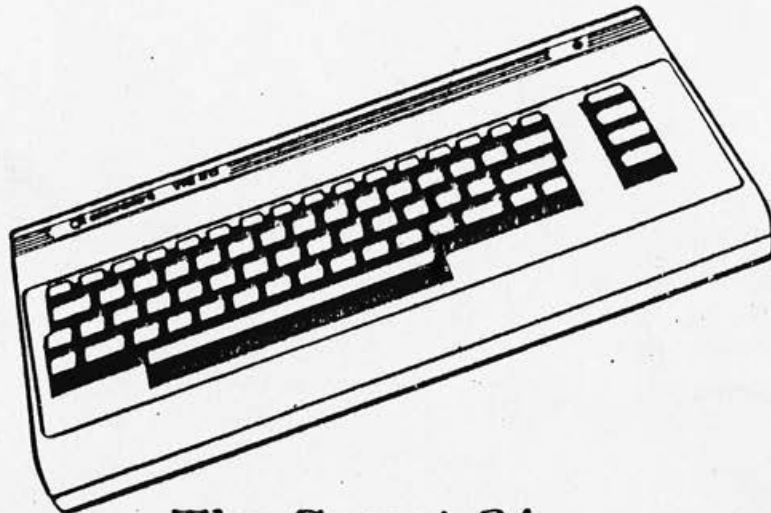


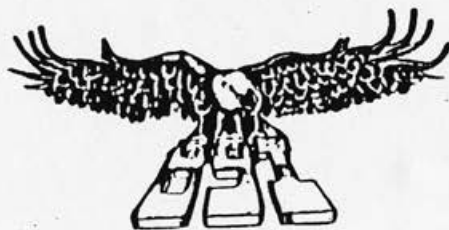
RTC

C64-LINK II

by David Foster



The Smart 64



Richvale Telecommunications

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Canada

C64-LINK II

**Expansion Cartridge for
The Commodore 64**

with

**BASIC 4.0
IEEE/Parallel I/O
Machine Language Monitor**

Designed by David Foster

Manual by Marc Swanson

**Copyright Richvale Telecommunications
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Richmond Hill, Ontario
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The C64-LINK II Cartridge was designed by David Foster

This manual was written by Marc Swanson

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SECTION 1 BASICS

1.1 C64-LINK II FEATURES

C64-LINK II is an expansion cartridge for the Commodore 64 that adds 16 disk commands and a machine language monitor to the Commodore 64. It also allows you to use the "parallel" and "IEEE" modes of data transmission, permitting the use of any parallel printer, IEEE printer or IEEE disk drive. The C64-LINK II cartridge takes up no memory and is completely transparent to commercial or home software.

1. Input/Output Commands

The Commodore 64 normally sends and receives data using the "serial" bus, through cables that plug into the back of the computer, disk drive and printer. The C64-LINK II adds IEEE and parallel data transmission to your computer. With the C64-LINK II, you can use any Commodore disk drive, such as dual drives or even hard disks. You can also use any parallel or IEEE printer.

2. BASIC 4.0

The Commodore 64 normally works with a version of the BASIC computing language called Commodore BASIC Version 2.0. The C64-LINK II cartridge upgrades your computer to use BASIC Version 4.0, adding 16 disk commands.

3. Machine Language Monitor

The C64-LINK II's Machine Language Monitor allows you to display the 64's memory and program in machine language.

4. Networking

With the appropriate cables, you can use a set of C64-LINKS to "daisychain" up to 8 Commodore 64's to the same IEEE disk drive or printer. The LINKS will act as a kind of traffic controller, allowing several computers to use the drive or printer at the same time.

1.2 INSTALLING THE C64-LINK II CARTRIDGE

1. Description

The C64-LINK II cartridge has two small wires hanging from one side. In the back of the cartridge is an IEEE port used to connect IEEE printers or drives. On the side of the cartridge is an edge connector for use with parallel printers.

2. Installation

Before you install the C64-LINK II cartridge, turn the computer off. Then open the computer up by removing the 3 screws holding the cover on. The two wires hanging from the side of the cartridge must be connected to chips inside the Commodore 64.

NOTE: Opening your computer or your drive to install the C64-LINK II could void the equipment warranty. You may want to contact your dealer for installation.

The wires are marked with the names of the chips they should be connected to. If you connect them wrongly or to the wrong chips, the C64-LINK II cartridge will not work. Both wires have a clip at one end. Inside this clip is a small hook that will emerge when you press the plunger down.

- 1) Use this hook to connect the clip marked "6510" to the 6510 chip, the large 40-pin chip which you will find marked "6510". On this chip, locate pin "28", the 8th pin up from the bottom on the right side of the chip. Clip the hook around this pin.
- 2) The hook at the end of the other wire goes to the chip labelled "U14". The characters "U14" appear in the actual board, not on the chip itself. (This chip will probably also be labelled "74LS258".) Connect this clip to pin 15, second pin from the top on the right side.
- 3) Make sure the hooks are touching only those pins. If they touch any other pins, it could cause a short.
- 4) Put the computer back together and insert the LINK cartridge onto the 64's cartridge port with the label side up. When you turn the computer on, the power-up message on the 64's screen has changed to show "COMMODORE BASIC V4".

1.3 INPUT/OUTPUT COMMANDS

1. Data Transmission Modes

There are several ways to transmit data between a computer and peripheral device such as a disk drive, modem or printer. The main modes of data transmission used with Commodore computers are:

- 1) SERIAL - The mode used for the Commodore 1541 disk drive, and the MPS 801 and 1526 printers. This is the only mode normally available to interface the 64 and peripherals.
- 2) IEEE - is the mode used between Commodore's PET/CBM computers and all other Commodore disk drives and printers.
- 3) RS-232 - similar to Commodore serial, often used with modems and some printers.
- 4) PARALLEL - describes a mode of data transmission in very common use between the computer and a printer, for example, Epson, Spinwriter and Gemini printers.

Without the LINK, your Commodore 64 is limited to sending and receiving data "serially". You can only work with the 1541 model disk drive and either the MPS 801 or the 1526 printer. But with the LINK, you may use any serial, IEEE or parallel peripheral device in any combination.

2. Input/Output Commands

Before you can use any command to address a printer or disk drive, you need to tell the LINK how the devices are connected to the computer. If you have a parallel printer or an IEEE disk drive, you need to use the LINK's Input/Output (often shortened to "I/O") commands. There are three I/O commands available with the LINK: "PARALLEL"; "IEEE"; and "SERIAL".

The LINK also provides several ways to vary these commands. For example, add a "D" to the SERIAL or IEEE command to specify a disk drive. Add "P" to the SERIAL or IEEE command to specify a printer. Add a "C" to the PARALLEL command if you want the LINK to handle conversions from PET ASCII to true ASCII.

Follow the instructions in the rest of this section to connect and use peripheral devices with your 64 and the C64-LINK II.

1.4 IEEE PERIPHERALS

The C64-LINK II allows you to use any Commodore disk drive or Commodore printer. With a LINK, you can connect your 64 to the single disk drive Model 2031, the dual drive Models 4040, 8050 and 8250, and even the hard disk drives. You may use any Commodore printer, such as the Models 4022, 8023, 6400 and 8300. All of these devices send and receive data using the IEEE mode of data transmission.

When you power up your 64 with a C64-LINK II cartridge, the computer "defaults" to IEEE data transmission, that is, the LINK causes the 64 to assume it is in IEEE mode as soon as you turn it on. When you address any peripheral device using commands such as "LOAD" or "OPEN", the computer will assume you are addressing an IEEE device.

On the back of the C64-LINK II cartridge, there is an IEEE port. Use a "PET-to-IEEE" cable to connect this port to either an IEEE printer or disk drive. If you have both an IEEE printer and drive, connect the drive to the cartridge. Then use an "IEEE-to-IEEE" cable to connect the drive to an IEEE printer.

1.5 SERIAL PERIPHERALS

To use the Commodore 1541 model disk drive, or the Commodore 1526/MPS 801 printers with your 64, you do not need to buy or use any extra cables. Data is sent and received from these devices through the 64's built-in mode of data transmission, the Commodore "serial" bus.

The C64-LINK II cartridge powers your computer up into IEEE mode, not serial mode. If you are trying to load a program from a serial disk drive, your computer may display the error message, "DEVICE NOT PRESENT".

To use serial drives or printers, use the LINK's "SERIAL" I/O command. Type the word **SERIAL** and press the <RETURN> key. The

64 is then ready to send and receive data through the serial bus. To return to IEEE mode, type **IEEE** and press <RETURN>.

NOTE: To power up with serial as the default mode instead of IEEE, hold down the <C=> key as you turn the computer on.

1.6 PARALLEL PRINTERS

Many non-Commodore printers are "parallel" printers, for example, most Epson, NEC, Gemini and Centronics printers. Parallel data transmission is similar to IEEE but requires a different cable. Connect your cable from the printer to the parallel port on the actual LINK cartridge itself.

If you have a parallel printer, use the LINK's "PARALLEL" I/O command. Type **PARALLEL** and press <RETURN>, and the 64 will send data to any parallel printer.

NOTE: With some parallel printer interfaces, such as the CARD? interface, you do not use the PARALLEL command. Such interfaces treat the printer as if it were serial. Use the "SERIAL" command to work with those printer interfaces.

1.7 COMBINATIONS OF EQUIPMENT

When you enter "SERIAL", the computer is set up to send and receive data only to and from serial devices. If your peripherals are all serial, or all IEEE, you can address all of them by typing in "SERIAL" or "IEEE". However, if you have mixed equipment, such as serial and parallel, or serial and IEEE, you will need to alter the I/O commands.

Add a "D" to the end of an I/O command to specify the "Disk drive". Add a "P" to specify a "Printer".

For example, if you have an IEEE drive and a serial printer, you would enter:

IEEED <RETURN> and

SERIALP <RETURN>

You can enter the I/O commands in any order.

NOTE: If you have both a serial and an IEEE drive, the LINK allows you to work with both of them connected. Unit 8 will be determined by the I/O command you enter with a "D" at the end. The other drive will be treated as Unit 15. For example, if you enter IEEEED, then the IEEE drive will be Unit 8 and any disk commands you enter will be sent to the IEEE drive. However, the serial drive will be Unit 15. You can send disk commands to the serial drive by adding ",U15" to the command.

1.8 PET ASCII AND TRUE ASCII

Printers understand characters as a series of numbers. All of the symbols, characters and letters your computer will display have been assigned a standardized set of numbers in the "ASCII" code. However, because of the extra graphics characters available on the Commodore 64, Commodore computers do not work with true ASCII. Instead, they work with a modified version of the ASCII code usually called "PET ASCII".

Most non-Commodore printers are set up to understand true ASCII. When the 64 sends PET ASCII codes to the printer, you may not get the output you wanted because of the difference between true and PET ASCII. Most often, the difference occurs when you try to print in lower case, and the output appears on the page in upper case.

The C64-LINK II cartridge will handle ASCII conversions for you. When you enter the I/O command for the type of printer you have, put a "C" (for "conversion") at the end. For example:

PARALLELC <RETURN>

tells the LINK you have a parallel printer, and you want to convert the 64's PET ASCII to true ASCII when you print.

1.9 CLEANING YOUR LINK CARTRIDGE

As you use the C64-LINK II cartridge, the gold-plated edge connectors will tend to get dirty. This can cause operation problems. Clean the edge connectors periodically by buffing them lightly with a soft rubber pencil eraser. Do not use an abrasive pen eraser.

SECTION 2 BASIC 4.0

2.1 BASIC 4.0 VS BASIC 2.0

BASIC ("Beginner's All-purpose Symbolic Instruction Code") is a computer programming language that was designed to be simple and close to English. The version of the BASIC language normally available with the Commodore 64 is Commodore BASIC Version 2.0. The C64-LINK II cartridge upgrades the computer to work with Commodore BASIC Version 4.0.

The biggest difference between the two versions of BASIC is in their disk commands. Many single commands available in BASIC 4.0 take the place of several lines of programming in BASIC 2.0. The LINK's BASIC 4.0 adds 16 disk commands to the Commodore 64.

2.2 USING BASIC

This section of the manual briefly describes the BASIC 4.0 disk commands available through the LINK cartridge. For more on the BASIC language and for fuller discussions of the commands covered in this section, consult Commodore disk drive manuals and BASIC manuals.

1. Syntax In This Manual

In this section, the function of each command is given, followed by the SYNTAX and one or two examples. To help you use the commands and the Syntax lines of each command correctly, keep these points in mind:

- 1) The Commodore 64's BASIC allows you to enter commands in two ways: program mode and immediate mode. In immediate mode, a command is executed as soon as you press <RETURN>. In program mode, commands are assigned line numbers and execution is delayed until you enter the "RUN" command. Most BASIC 4.0 commands can be used in either mode.
- 2) The Commodore 64 has two character sets: upper/lower case, and upper/graphics case. To toggle between the two character sets, hold down the <SHIFT> key and press <C=>. In this manual, the syntax for BASIC 4.0 commands is given in capitals, as if the

computer were always in upper/graphics case. Do not hold down <SHIFT> to type in these capital letters.

- 3) Enter capital letters shown in the Syntax lines exactly as they are shown. Punctuation symbols, such as commas and quotation marks, should also be entered exactly as shown.
- 4) Any words printed in lower case in the Syntax lines for each command should be replaced by variable names or numbers. The meaning of each expression is given under the Syntax line.
- 5) Expressions shown in brackets - "(" and ")" - are optional. The command works differently with or without the expression.
- 6) BASIC 4.0 commands can be abbreviated, just as BASIC keywords can, by shifting certain letters. BASIC 4.0 treats abbreviations in alphabetical order. For example, if you enter "cA", this will be understood as the "catalog" command.
- 7) Most BASIC 4.0 commands default to using drive 0, that is, if you do not specify a drive number, the command will be sent to drive 0. If you have a single disk drive, you do not need to specify a drive number with most commands.
- 8) Unit or Device numbers, which are options in BASIC 4.0, are not shown in the Syntax. All BASIC 4.0 disk commands default to Unit (Device) 8, the disk drive. If you have two disk drives, use the change unit address program provided with your drive to make one drive Unit 8 and the other drive Unit 9. To send commands to Unit 9, enter ",U9" after the command.

2. Pattern Matching

Commodore's Disk Operating System allows you to use two special characters in file handling commands: the "*" and the "?". These two characters allow you to use one disk command to specify more than one file. Use the "*" to indicate that the rest of the string is insignificant. Use the "?" to indicate that the character in that position is insignificant. The asterisks and question marks you use to identify several files using the same command is called the "pattern".

For example, a series of files on a disk called, "FILE1", FILE2", "FILE3" and so on could all be represented by the one string, "FILE*". The "*" shows that whatever comes after the first four characters,

"FILE" is not important. If you had another series of files on the disk called, "AFILE", "BFILE", "CFILE" and so on, they could all be represented by "?FILE". In this case, the character in the first position does not matter. However, "*FILE?" would not make sense, because the characters after the "*" are not significant.

2.3 BASIC 4.0 COMMANDS

The new commands provided by the C64-LINK II cartridge can be broken into two groups:

1. Disk Maintenance Commands

A. At the Disk Level

HEADER
DIRECTORY/CATALOG
BACKUP
COLLECT

B. At the File Level

COPY
CONCAT
RENAME
SCRATCH

2. Data Handling Commands

APPEND
DOPEN
DCLOSE
DLOAD
DSAVE
RECORD

The LINK also adds the variables "DS" and "DS\$".

2.4 DISK MAINTENANCE COMMANDS

2.4.1 At the Disk Level

1. HEADER

The HEADER command prepares a disk for use with a disk drive. Use HEADER to format a disk, dividing a disk into tracks and sectors where data will be stored and read back into memory. The HEADER command also lays down a directory track where the name of the disk, the individual file names and information about the type and length of files is stored.

Syntax: **HEADER "dn", Dx, (lxx)**

dn = disk name

x = drive number (0 or 1)

l = a 2-character, alphanumeric Identifier

Example: **HEADER "TEST DISK", D0, I64**

would format the disk in drive 0, giving it the name "TEST DISK" and an Identifier of "64".

Before the drive will start to HEADER a disk, the question "ARE YOU SURE?" will appear on the screen. To stop the procedure, enter "N" and press <RETURN>. To continue with the header, enter "Y" and press <RETURN>. Formatting the disk will take between 2 and 13 minutes, depending on the type of disk drive you have.

NOTE: Headering a disk erases any data that you have previously saved to the disk. If you have a disk that has already been headered, and you want to erase the programs on it quickly, use the HEADER command without including an Identifier. Be careful you don't HEADER a disk with wanted information when you use the command this way.

2. DIRECTORY and CATALOG

Use either DIRECTORY or the CATALOG command to display the contents of a disk to the screen. CATALOG and DIRECTORY are identical commands in their effect. However, many users prefer CATALOG because its abbreviation - "cA" - is only 2 characters,

while the abbreviation for DIRECTORY - "diR" - has 3.

Syntax: CATALOG (Dx) or DIRECTORY (Dx)

x = Drive number (0 or 1)

Example: CATALOG D0

would list the contents of the disk in drive 0.

With a dual drive, if you do not specify a drive number, CATALOG will display the contents of disks in both drives. With a single drive, you do not need to specify a drive number.

Explanation of the Directory

When the disk directory appears on the screen, the top line (called the "header") is printed in reverse field. This line shows the number of the disk drive, the name of the disk and the disk identifier. Below that line appear the names of the files on this disk, shown inside quotation marks. To the left of each file name appears the number of blocks that a file occupies on the disk. To the right of each filename is an abbreviation showing the type of file: sequential, relative, user or program. The last line of a disk directory shows the number of blocks on the disk that have not yet been assigned to a file.

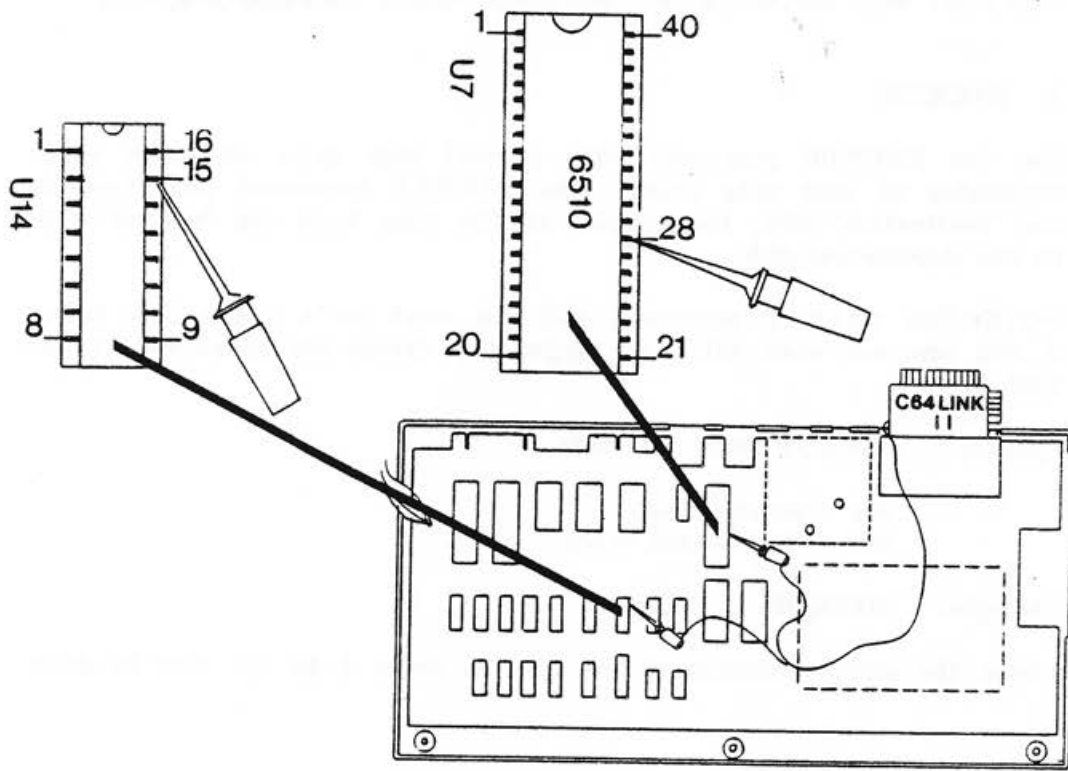
Loading from the Directory

In the space to the left of the file type, the C64-LINK II puts a colon (":"). When the directory appears on the screen, you can quickly load a program from the disk. Position the cursor on the first space of the line where the desired file name appears. Type "DLOAD" (or its abbreviation, "dL") and press <RETURN>. ("DLOAD", discussed later, is one of the BASIC commands added by the LINK.) The colon that the LINK puts on each line allows you to load a program without moving the cursor over to erase the letters "PRG".

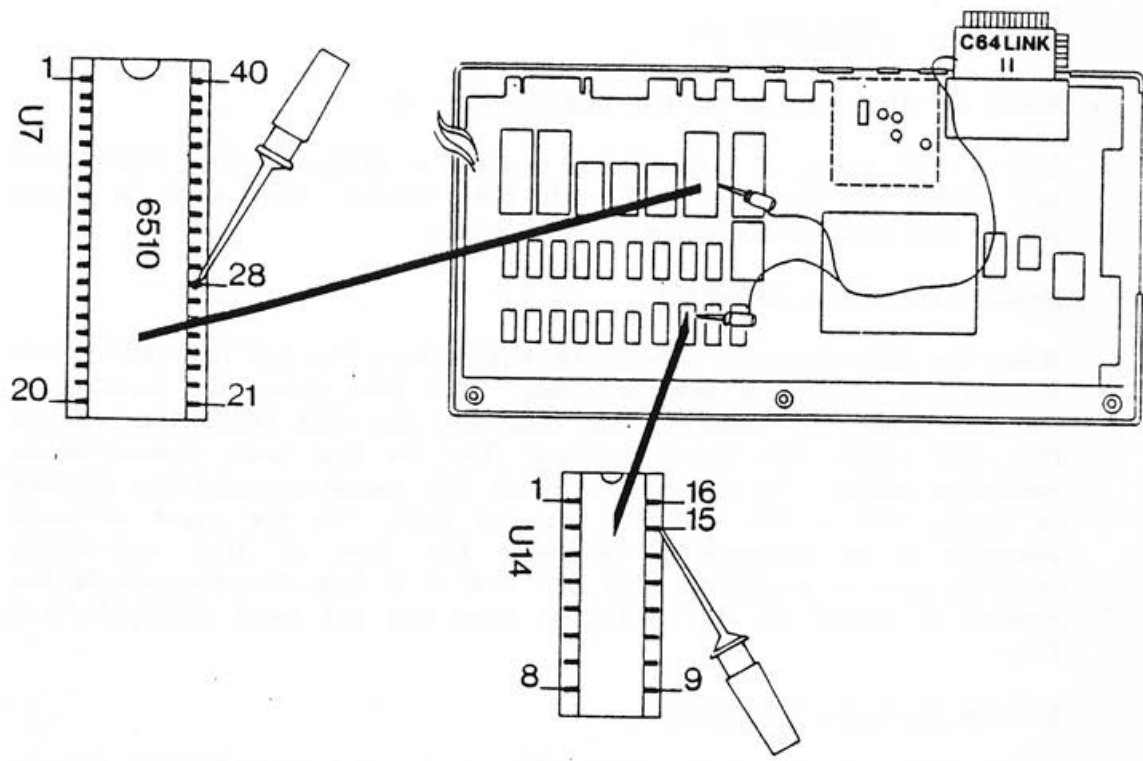
Pattern Matching and CATALOG

You may use pattern matching (see Section 1.5) in the CATALOG command in two ways: to find specific types of files, or specific file names.

To find all the program files on a particular disk in drive 0, you



EARLY C64 BOARD



NEW C64 BOARD

would enter: **CATALOGD0,"*=PRG"**. To find all the sequential files, enter: **CATALOGD0,"*=SEQ"**. Use "REL" for relative files and "USR" for user files.

Similarly, you can use pattern matching to display a list of particular file names on a disk. For example, to list of all the files on a disk that start with the letter "P", you could enter: **CATALOGD0,"P*"**.

3. BACKUP

Use the **BACKUP** command with a dual disk drive to make exact duplicates of your data disks. The **BACKUP** command first formats the "destination" disk, then copies all the files from the "source" disk to the destination disk.

NOTE: The **BACKUP** command will not work on a single disk drive. It will also not work with two single disk drives set up as Unit 8 and Unit 9.

Syntax: BACKUP Dsdr TO Dddr

 sdr = source drive
 ddr = destination drive

Example: BACKUP D1 TO D0

copies the entire contents of the disk in drive 1 to the disk in drive 0.

NOTE: For single drive backups, Richvale Telecommunications has produced a set of disk utility programs for Commodore single drives called "SuperCopy". The SuperCopy program allows you to make disk backups on a single drive in less than 7 minutes. It also performs a number of other single drive disk operations quickly and easily. For more information about this and other Richvale programs for the Commodore 64, phone or write to Richvale Telecommunications at the address given in the front of this manual.

4. COLLECT

The "directory" track is created with the **HEADER** command. In this

track, the drive stores information about each of the files on a disk: the type of file, the number of blocks it occupies and its location on the disk. If a file is opened but never closed, or if a block has been allocated by not used, the directory track will not record this information accurately. The number of blocks free on the disk that appears at the end of a CATALOG may not be the actual number of free blocks. Use the COLLECT command to rewrite the directory and bring it up to date. This command can sometimes free up an extra block or two on a disk.

Syntax: **COLLECT (Dx)**

x = Drive number (0 or 1)

Example: **COLLECT D0**

will collect the disk in drive 0. If you do not specify a drive number with this command, it will default to the last drive accessed.

2.4.2 File Level Commands

1. CONCAT

Use the CONCAT ("concatenate") command to combine two files into one file containing all the information from both files.

Syntax: **CONCAT Dsdr, "sfn" TO Dddr, "dfn"**

sdr = source drive number
sfn = source file name
ddr = destination drive number
dfn = destination file name

Example: **CONCAT D0, "THIS FILE" TO D1, "THAT FILE"**

adds "THIS FILE" from drive 0 to the end of "THAT FILE" from drive 1. The resulting file on drive 1 is called "THAT FILE".

NOTE: The CONCAT command will not work with relative files.

2. COPY

Use the COPY command to transfer selected files from one disk to

another, or to recopy a file on the same disk. If you have a dual disk drive, you can use the COPY command to copy the entire contents of one disk to another headered disk.

Syntax: **COPY Dsdr, "sfn" TO Dddr, "dfn"**

sdr = source drive number
sfn = source file name
ddr = destination drive number
dfn = destination file name

Example: **COPY D1, "ADDRESSES" TO D0, "MY ADDRESSES"**

would copy the file called "ADDRESSES" from the disk in drive 1 to the disk in drive 0, giving it the new name "MY ADDRESSES" in the process. If you are recopying a file on the same disk, you must give it a different destination file name. If you are copying a file to a different disk, you can either use the same file name or change it.

Example: **COPY D0 TO D1**

would copy the entire contents of the disk in drive 0 to the disk in drive 1, without affecting the existing files on the disk in drive 1.

You may use pattern matching in the COPY command to copy several files at once. For example, to copy all of the files from drive 0 starting with the letter "F" to drive 1, you could enter:

COPY D0,"F*" TO D1, "*"

The "*" at the end of the above example copies all the files to drive 1 with the same names they had on drive 0.

NOTE: In any COPY command, the destination disk must be already headered.

3. RENAME

Use the RENAME command to change the name of any file on a disk.

Syntax: RENAME Dx, "ofn" TO "nfn"

 x = Drive number (0 or 1)
 ofn = old file name
 nfn = new file name

Example: RENAME D0, "WRONG" TO "RIGHT"

changes the name of the file on drive 0 from "WRONG" to "RIGHT".

4. SCRATCH

Use "SCRATCH" to delete or erase unwanted files from a disk.

Syntax: SCRATCH Dx, "fn"

 x = drive number (0 or 1)
 fn = file name

Example: SCRATCH D1, "UNWANTED FILE"

will delete the file "UNWANTED FILE" from the disk in drive 1.

Before the drive scratches a file a file, the question "ARE YOU SURE?" appears on the screen. To continue, enter "Y" and press <RETURN>. The disk drive activity light will come on while the file is being scratched.

Use pattern matching in the SCRATCH command to delete several files at once. For example, to scratch the series of files called "AFILE", "BFILE", "CFILE" and so on, you could enter:

SCRATCH D0, "?FILE"

Make sure you do not erase the wrong file when you use pattern matching with the SCRATCH command.

NOTE: Print the disk status after using SCRATCH to make sure the file has actually been deleted (see Section 2.6 for more on printing the disk status). The status message should read, "01,FILES SCRATCHED", followed by the number of files scratched. If any other message appears, or if the number of files scratched is "0", the file has not been deleted from the disk.

2.5 DATA HANDLING COMMANDS

1. APPEND

Use the APPEND command to reopen a closed sequential file. You may then expand the file by writing information to the end of it.

Syntax: **APPEND#lfn, "fn", Dx**

lfn = logical file number
fn = file name
x = drive number (0 or 1)

Example: **APPEND#3, "MASTERFILE", D0**

opens file number 3 to the sequential file "MASTERFILE" in drive 0.

2. DOPEN

The DOPEN command opens a channel to the disk drive to read or create a relative or sequential file of a fixed length. Any file may be opened for reading, but only sequential and relative files may be opened for writing.

Use the DCLOSE command to close the channel opened with DOPEN.

command to close the channel opened with DOPEN.

the channel opened with DOPEN.

command to close the channel opened with DOPEN.

Syntax: **DOPEN#lfn, "fn" (, Dx) (, Lrl) (, W)**

lfn = logical file number
x = drive number (0 or 1)
rl = record length (relative files only)
W = write (not used with relative files)

Example: **DOPEN#2, "SUBFILE", W**

opens logical file number 2 for writing to the file called "SUBFILE".

Example: **DOPEN#2,"SUBFILE"**

opens logical file number 2 to the disk for reading the file called "SUBFILE".

3. DCLOSE

Use "DCLOSE" to close a specified file. If no file is specified, DCLOSE closes all files currently open to unit 8.

Syntax: **DCLOSE (#lfn)**

lfn = logical file number

Example: **DCLOSE#2**

closes logical file number 2.

Example: **DCLOSE**

closes all files currently open to Unit 8.

4. DLOAD

The DLOAD command loads a specified program from the disk into computer memory.

Syntax: **DLOAD "fn" (,Dx)**

fn = file name

x = drive number (0 or 1)

Example: **DLOAD "SCRIPT 64"**

loads the program called "SCRIPT 64" into memory from the disk in drive 0. If no drive number is specified, the DLOAD command defaults to drive 0.

NOTE 1: When you use DLOAD on the program names in a directory, you do not need to put a colon after the file name, or erase the file

type. The LINK has already placed a colon after each file name on a disk directory.

NOTE 2: If you hold down the <SHIFT> key and press the <RUN/STOP> key, the LINK will load the first program from the disk in drive 0. These keystrokes are the equivalent of **DLOAD**** and **RUN**.

5. DSAVE

Use the DSAVE command to save the program in memory to the disk.

Syntax: **DSAVE "fn" (,Dx)**

fn = program name
x = drive number (0 or 1)

Example: **DSAVE "PROGR", D1**

saves the program in memory to the disk in drive 1 under the name "PROGR". If you do not specify a drive number, the DSAVE command defaults to drive 0.

Example: **DSAVE "@PROGR"**

resaves the program called "PROGR" over an existing program with the same name. If you try to save a program using a file name that already exists on this disk, the disk drive will prevent the save. If you print the disk status (see Section 2.6), the message "FILE EXISTS ERROR" will appear on the screen. To resave a program under the same file name, put an "@" sign before the file name.

NOTE: You can use the DLOAD and DSAVE commands to "backup" on a single disk drive. Use DLOAD to load the first program from one disk into the computer's memory. Then use DSAVE to write that program to another, headered disk. Continue loading programs from the first disk and saving them to the second disk until you have copied all the programs on the first disk.

6. RECORD#

The RECORD# command positions the file counter to a specific

record (and byte) in a relative file. Use RECORD# before other commands, such as GET#, INPUT# and PRINT# to select the desired record.

Syntax: **RECORD#lfn,r (,b)**

lfn = logical file number
r = desired record
b = desired byte position within record

The desired record ("r") can be either a variable name or a value between 0 and 65535. If "r" is a name, it must appear in brackets - "(" and ")". The byte position ("b"), which is optional, has a value between 1 and 254.

Example: **RECORD#3,200**

positions file #3 to record #200.

Example: **RECORD#3,200,6**

positions file #3 to record #200 at byte number 6.

Example: **RECORD#3,(J)**

positions file #3 to record J.

2.6 DISK STATUS

If the disk drive detects a problem, either with the drive itself or with the data disk you are using, then the error light will begin to flash (on the 1541 disk drive) or turn red (on other Commodore drives). The problem can be as simple as not having inserted the disk in the drive, or it can be a more complex problem, such as a scratch on the surface of the disk.

Use the variables DS and DS\$ to check the Disk Status. DS and DS\$ are not commands, they are variables. To view the disk status, you will have to print DS or DS\$.

Syntax: **PRINT DS**

PRINT DS\$

You may use the BASIC abbreviation for "PRINT" - "?".

When you print DS, a number appears on the screen. When you print DS\$, the same number appears, but with a short error message and additional numbers.

For example, if your disk drive error light begins flashing, enter **PRINT DS**, and the computer screen will return a number. "21" for example. If then enter **PRINT DS\$**, the message would "21,READ ERROR",XX,YY".

This message contains a "DOS (Disk Operating System) Error". The first number, 21, is the number of the error. An error with a number of "19" or less is not significant. Next comes a short description of the nature of the error. In this case, it is a "read" error, indicating the drive was unable to read the requested information from the disk. The last two numbers, separated by commas, show the track and sector numbers where the error occurred.

Check your Commodore drive manuals for more on DOS errors and how to recover from them.

2.7 ADDITIONAL FEATURES

This subsection describes certain additional features of the C64-LINK II cartridge. Some of them are already documented in the rest of the manual, but they are assembled here for convenient reference.

1. Loading the First Program on Disk

If you hold down the <SHIFT> key and press the <RUN/STOP> key, the LINK will load the first program from the disk in drive 0. These keystrokes are the equivalent of **DLOAD**** and **RUN**.

2. Using Two Different Drives

If you have both a serial and an IEEE drive, the LINK allows you to work with both of them connected. Unit 8 will be determined by the I/O command you enter with a "D" at the end. The other drive will be treated as Unit 15. For example, if you enter **IEEED**, then the

IEEE drive will be Unit 8 and any disk commands you enter will be sent to the IEEE drive. However, the serial drive will be Unit 15. You can send disk commands to the serial drive by adding ",U15" to the command.

3. Printing a Directory

To get a hard copy of a disk directory, you will not be able to use the CMD command followed by the CATALOG command. Instead, use the BASIC 2.0 syntax:

LOAD "\$0",8 <RETURN>

to read the directory from the disk. Then type:

OPEN 4,4:CMD4:LIST <RETURN>

to list the directory to the printer.

4. Disabling Time Outs

A "time out" occurs when the drive fails to locate requested data. If the data is not located within a certain period of time, the drive stops looking for it and the computer displays a "FILE NOT FOUND" error. To disable the time out feature, enter:

POKE 645,255 <RETURN>

To return to normal operations, hold down the <RUN/STOP> key and press <RESTORE>.

SECTION 3 THE C64-LINK II MONITOR

3.1 MACHINE LANGUAGE MONITOR

The C64-LINK II cartridge has a built-in machine language monitor that allows you to view and alter the memory of the computer.

To access the monitor, type:

MONITOR <RETURN>

The computer will display the state of the registers approximately at memory location \$FE6F. This is a call to the monitor, not a break.

The numbers that appear on the screen when in the Monitor are shown in "hexadecimal", or simply "hex". Hexadecimal numbers operate with a base of 16 instead of the more usual base of 10 ("decimal"). The characters in hex numbering system run from "0" through to "9", then from "A" to "F". Hexadecimal numbers are usually shown with a "\$" in front of them to distinguish them from decimal numbers, for example: "\$045E". You do not need to type the "\$" while in the Monitor.

You may also break to the Monitor by typing:

SYS # <RETURN>

where "#" is the address of a break instruction, for example: **SYS8**.
Enter:

SYS 64738

to reset the machine, clearing memory and returning the computer to its power-up condition.

3.2 MONITOR COMMANDS

The C64-LINK II provides 6 commands for machine language programming. For more on using these commands and programming in machine language, consult 6510 programming manuals.

The Monitor commands available with the LINK are:

COMMAND PURPOSE

M	display Memory
R	display Registers
G	execute code ("Go")
L	Load file to memory
S	Save memory
X	eXit to BASIC

1. Display Memory

To display memory in the 64, enter:

M sa ea <RETURN>

sa = starting address
ea = end address

Use the "M" command to display specified addresses. The first number, the "start address", stands for the beginning address to be displayed. The second number, the "end address", stands for the last address to be displayed.

Example: **M F000 F010**

will display memory locations starting at \$F000 through up to \$F017. On screen, this would appear something like this:

```
.:F000 DD 09 02 8D 01 DD 2C 81  
.:F008 DD 70 07 30 F9 A9 40 8D  
.:F010 97 02 18 60 20 28 F0 AC
```

Each screen line displays 8 memory addresses.

To alter memory, type the new values directly over the appropriate addresses and press <RETURN>. If you enter an unacceptable value, for example, by trying to write to ROM, the computer will place a question mark on the line with the error.

2. Display Registers

Enter: **R** <RETURN>

to display these memory registers:

PC = Program Counter
IRQ = Interrupt Request Vector
AC = Accumulator
XR = X Register
YR = Y Register
SP = Stack Pointer

To change the registers, type new values over the old ones.

3. Execute Code

Use the "G" command to run a program in memory.

Enter: **G (sa)** <RETURN>

sa = start address

If you do not specify a start address, execution defaults to the program counter.

4. Load File to Memory

Enter: **L "#:fn", dn**

= drive number (0 or 1)
fn = file name
dn = device number

Example: **L "0:FILE",08**

would load the program called "FILE" from drive 0 of device 8, the disk drive.

5. Save Code

Enter: S "#:fn", dn, sa, ea

= drive number (0 or 1)

fn = file name

dn = device number

sa = start address

ea = end address

Example: S "1:FILE",08, B000, C000

would save the program called "FILE" starting at memory location \$B000 and ending at \$C000. This program will be saved under the name "FILE" on drive 1 of device number 8. To replace an existing program, put an "at" sign before the file name.

SECTION 4 DAISYCHAINING 64'S

4.1 NETWORKING WITH THE C64-LINK II

One of the LINK's built-in features allows you to "network" up to 8 computers to the same disk drive or printer or both. Any computer in the chain can send a command to the printer or disk drive at any time. The commands can even be sent at the same time.

If the printer is busy and one of the computers in the chain sends a command to the printer, the LINK will hold onto the second command up until the printer is free, when it will send the second command through. Commands are transmitted one at a time in the order they were sent.

4.2 SETTING UP A CHAIN

To set up a chain of 64's, you will require one "VL-16" cable (available from Richvale Telecommunications) for each computer in the chain, plus one VL-16-to-IEEE cable for the last computer in the chain.

Connect the computers together using the VL-16 cables. Connect the last computer in the network to the disk drive and printer using the VL-16-to-IEEE cable.

Each computer in the network that OPENS a file for writing or reading to the disk should use a different secondary address. Use the BASIC 2.0 OPEN command instead of the BASIC 4.0 DOPEN command. DOPEN selects its own channel; if you use the BASIC 2.0 OPEN command, you can ensure that unique secondary addresses are chosen.

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