



User Manual

(Volume One)

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Also for:
VIC20,
Plus4, C16,
C128

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Alpha & Beta versions of this software before version 1.0 are freeware.

The Professional version of 64HDD is available for purchase from the 64HDD website or authorised dealers.

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Volume One – User Manual	Page
At a Glance	3
Quick Start Guide	8
Table of Contents	13
User Manual	16

Volume Two – Command Reference Manual

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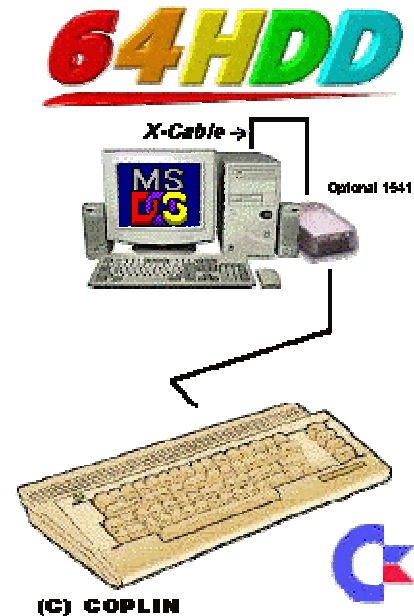
64HDD at a Glance

What is 64HDD and how does it 64HDD work?

64HDD is a software program that is run on a PC to provide highly compatible disk and hard drive functionality for Commodore 8-Bit computers. A simple cable is needed to connect the PC port to the Commodore.

64HDD emulates the serial protocol used by the Commodore computers to communicate to the disk drives such as the 1541. This protocol requires very precise control of the timing of the signals and so 64HDD must usually take full control of the computer it is running on.

In addition to emulating the communications protocol, 64HDD emulates the functionality of the 1541 and many other Commodore and CMD drives, making operations seem transparent to most games and other software. The emulation allows disk and tape images (D64, T64, PRG, etc) to be directly used.



PC Requirements:

Almost any PC capable of operating a version of MSDOS, equipped with a conventional LPT port and CPU speed of at least 33MHz is suitable. Some slower PCs have been known to work, whilst some portable PCs with speed-stepping technologies have been found to be incompatible. Version 6.xx MSDOS is recommended, however other versions of DOS will largely work including version 7.xx (Win9x DOS) and FreeDOS (some LFN limitations).



Commodore Requirements:

Any Commodore computer equipped with an IEC serial device bus. This includes the popular C64, C128, C16/+4 and Vic20. Note that some aftermarket kernel ROM upgrades and cartridges are incompatible. Please use a stock system when first installing and testing 64HDD.



Cabling:

The basic setup requires an X1541 or XE1541 cable to connect the PC's LPT to the Commodore computer. For the fastest possible data transfer speeds a parallel PwrLoad compatible data cable is recommended.

Additional drives may be connected by daisy chaining in the normal way.

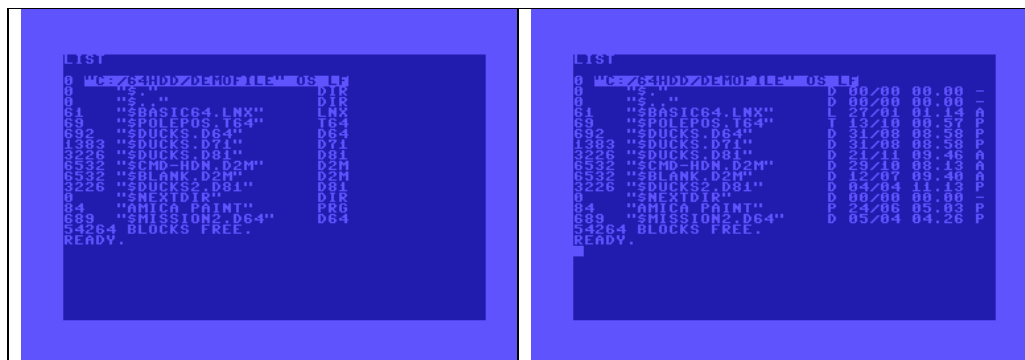


64HDD Compared to the original 1541:

Feature / Function	Original 1541	64HDD
Type	Hardware	PC Software
C= support:		
C64	Yes	Yes
C128	Yes	Yes
C16/P4	Yes	Yes
VIC20	Yes	Yes
Serial Cable (for compatibility)	Yes	Yes – X/XE
Disk Image Support	No	D64, D71, D81, D2M, T64, etc
File support:		
Read	Yes	Yes
Write	Yes	Yes
PRG, SEQ	Yes	Yes
REL	Yes	Not yet
Direct Access	Yes	Yes
Directory:		
Standard	Yes	Yes
Advanced	Yes	Yes
Command Channel	Yes	Yes
Compatibility:		
Fastloaders	Yes	No CPU
GEOS	Yes	Yes^
Cartridge	Yes	Mostly
JiffyDOS	Yes	Tolerant
Max Capacity	166kb	Unlimited#
CDROM/DVD Drive Support	No	Yes
User Subdirs	No	Yes
User Partitions	nil	990

^ Disk driver required

Only limited by PC used



Differences between 64HDD Versions:

Feature / Function	Freeware	Decade	Professional
C= support: C64, C16/+4, VIC20 C128	Yes Standard	Yes Standard	Yes Comprehensive
Serial Cable Supports Turbo/XE Supports X-Loader (C64) Supports Z-Loader (C128)	Yes - -	Yes - -	Yes Yes Yes
Parallel Cable Pwr/Cart and Pwr/Link Pwr/Load (C64) Pwr/Load (C128, VIC20)	Yes Yes -	Yes Yes -	Yes Yes Yes
Device Numbers	8 08-15	8 08-15	8 08-15, 16-30
Device Swap	-	-	Yes, 8 or 9
Disk-Flip Support	Flip button/[F11] - -	Flip button/[F11] Flip Lists -	Flip button/[F11] Flip Lists AutoDisk Hot Keys
Graphical User Interface Runtime Disk Management File Management Print Management	- - - -	Standard Yes - -	Comprehensive Yes Yes Yes
GEOS^ Support Slow Mode Fast Mode Pwr/XE or Pwr/Link* D81 and XP Kernal# C128 Mode	Yes Yes - - -	Yes Yes - - -	Yes Yes Yes Yes Yes
Printer Emulation	-	-	Yes
Disk Image Support	D64 D71 D81 D2M T64	D64 D71 D81 D2M T64	D64 D71 D81 D2M T64
Archive Support	- -	- -	ZIP LNX
Time/Date Stamping (disks)	-	-	Yes
Directory and File support: Standard Filetype masking AutoLoad EZ-Load and EZvic T18 emulation	Yes Standard - - -	Yes Standard Yes Yes -	Yes Comprehensive Yes Yes Yes
Command Channel Std Commands CMD Commands CMD Software	Yes Subset Limited	Yes Subset Limited	Yes Comprehensive Comprehensive
Compatibility: GEOS Cartridge JiffyDOS	Yes^ Mostly Tolerant	Yes^ Mostly Tolerant	Yes^ Mostly Tolerant
Disk Transfer	1581 only	1581 only	1541 and 1581

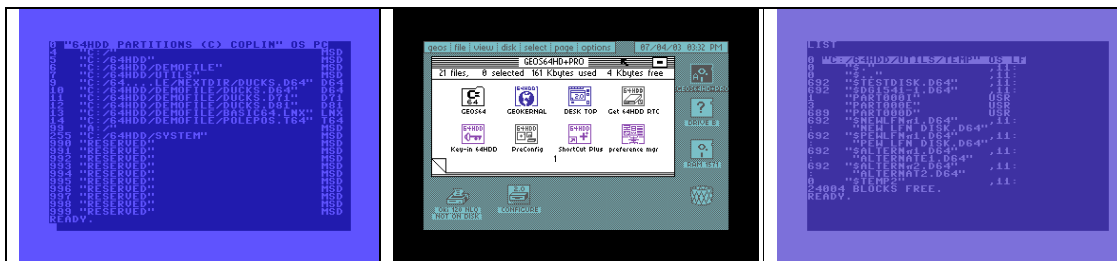
^ Disk driver required

* Pwr/Link is read only speed-up

800kb disk support , drivers and shortcut tools

64HDD Compared to the Cartridge Alternatives:

Feature / Function	IDE64	MMC64	64HDD
Type	Cartridge	Cartridge	PC Software
C= support:			
C64	Yes	Menu Only	Yes
C128	No	No	Yes
C16/+4	No	No	Yes
VIC20	No	No	Yes
Serial Cable (for compatibility)	No	No	Yes – X/XE
Disk Image Support	Extracted D64	Transfer D64 to real 1541	D64, D71, D81, D2M, T64, etc
File support:			
Read	Yes	Menu Only	Yes
Write	Yes	No	Yes
PRG, SEQ	Yes	Menu Only	Yes
REL	Yes – v0.9	No	Not yet
Direct Access	No	No	Yes
Directory:			
Standard	Yes	No	Yes
Advanced	???	No	Yes
Command Channel	Yes	No	Yes
Compatibility:			
Fastloaders	No	No	No CPU
GEOS	Yes [%]	No	Yes [^]
Cartridge	No	No	Mostly
JiffyDOS	Tolerant	Tolerant	Tolerant
Max Capacity	2GB, two drives (??)	MMC/SD Limit	Only limited by PC used
CDROM/DVD Drive Support	Yes	No	Yes
User Sub-dirs	Yes	Yes	Yes
User Partitions	16 on v0.9	nil	990

[^] GEOS disk driver required[%] Drive / CF card must be dedicated to GEOS only and GEOS requires a disk driver.

64HDD Compared to the SD-Drive Alternatives:

Feature / Function	1541-III	SD2IEC	64HDD
Type	SD-Drive	SD-Drive	PC Software
C= support: C64 C128 C16/+4 VIC20	Yes Yes Yes Yes	Yes Yes Yes Yes	Yes Yes Yes Yes
Serial Cable (for compatibility)	Yes	Yes	Yes – X/XE1541
Parallel Cable	-	-	Pwr/XE 30-50x faster
Device Numbers	1 8-9	1 8-11	8 8-15, 16-30
Device Swap	-	-	Yes, 8 or 9
Disk Image Support	D64 - - - T64	D64 D71 D81 - -	D64 D71 D81 D2M T64
Archive Support	- -	- -	ZIP LNX
Disk-Flip Support	LCD GUI	Fwd/Back Btns	Flip button AutoDisk Hot Keys
Time/Date Stamping	-	RTC h/w req.	Yes
File support: Read Write PRG, SEQ REL Direct Access	Yes Yes Yes - -	Yes Yes Yes Partial Yes	Yes Yes Yes Not yet Yes
Directory: Standard Advanced Filetype masking	Yes ??? -	Yes ??? Yes	Yes Yes Yes
Command Channel	Yes - limited	Yes	Yes
CMD Command Support	-	Subset	Comprehensive
Compatibility: Drive CPU Fastloaders GEOS Cartridge JiffyDOS	- - - Some No – beta ver?	- Some* - Mostly Yes	- No CPU Yes^ Mostly Tolerant
Max Capacity	MMC/SD	MMC/SD	Unlimited#
CDROM/DVD Drive Support	-	-	Yes
DOS Sub-directories Command Channel LOAD Commands	- Yes	Yes -	Yes Yes
User Partitions	No	Physical	990 Short-cuts and paths
Printer Emulation	-	-	Yes

^ GEOS disk driver required

* via emulation/simulation

Only limited by PC used

Quick Start Guide

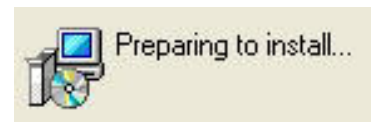
Please read the INSTALL.TXT file included with your distribution of 64HDD for more detailed information. 64HDD is intended to run from MSDOS, so you will need to boot to DOS (or shutdown from Windows to the DOS prompt). Some of the installation can however be accomplished whilst within Windows.

If you are new to the world of MSDOS, or even just a little rusty don't forget to download a copy of "MSDOS for Commies" from the 64HDD website.



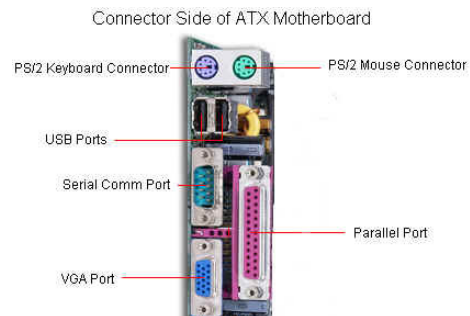
Cable Installation and PC Setup

The details below generally apply to both the freeware and Professional versions. In some cases 64HDD Professional has slightly higher system requirements, and some optional requirements are needed to make use of the advanced features. Remember that other important information may be found in the readme.txt and FAQ supplied with the installation files.



64HDD will work just as well with your regular MSDOS compatible PC or laptop, or a custom built box. Basic requirements are outlined below, and more extensive detail is given from pages 71 onwards of this manual. 64HDD can be tuned to the speed of different PCs using the method outlined in detail on page 80 of this manual. A trouble shooting guide is given on page 83.

- 386/486 PC controller (or motherboard with CPU). Minimum speed is believed to be a 386SX25 (for basic LOAD type operations), whilst PCs faster than 2.5GHz can also work. A faster 486 or Pentium machine may be required to take full advantage of the *FastLoader* and *X-Loader* options available in the *Professional* package.
- 1x LPT (parallel) port mapped to a standard location (LPT1, LPT2, LPT3). The LPT port needs to be an old SPP type if an X1541 cable/adaptor is used. A PS2 type bi-directional port might work. On-board LPT ports on Pentium and newer machines may not operate as SPP correctly even if set to do so. For these systems you will need to install an "old" 8- or 16-bit I/O card or alternatively use a XE1541 cable/adaptor.
- X1541 or XE1541 cable (refer to LPT port requirements). Alternatively, an X1541 or XE1541 adaptor can be used in conjunction with a standard CBM serial cable (my preference for shielding reasons).



Software Installation

64HDD *Professional* users should refer to the Quick Start installation leaflet provided with their software disks.

64HDD CD-Edition users should refer to the CD-Edition user guide available for download from the 64HDD website. The CD-Edition comes on a bootable CDROM configured to start you PC into MSDOS mode and start the installation.

For freeware users, and those who prefer to manually install the software, the easiest way to use 64HDD is to install it with a default setup. From the c:\ prompt, and using the DOS version of PKUNZIP:

```
PKUNZIP -d 64HDD.ZIP
```

The -d is important as it will create the correct file system structure:

```
c:\64hdd
c:\64hdd\system
...and so on...
```

If using the Windows version of an UNZIP tool, such as WinZip, then check that the option to extract with “sub-folders” is enabled.

You will need to add C:\64HDD to your MSDOS path by modifying your autoexec.bat file.

The GO64HDD batch file is the ideal way to run 64HDD. It will accept addition parameters after the "code", and you can permanently modify the batch file to suit your configuration. It is advisable to start off with the most standard configuration and tailor it only when you know it works.

If you run "64HDD.EXE -h" you get the help screen that lists all valid command-line options. These command line options will allow you to tailor the runtime configuration. Command-line options will change depending upon the version of 64HDD you are using. The general usage of the command is as shown below:

```
usage: 64HDD.EXE [option1] [option2] [...]
```

```
usage: 64HDD.EXE [-{h|8|9|10|11}] [+{8|9|10|11} filename] [+lpt {1|2|3}]
```

Example commands/options available in all versions:

-RegNo	replace 'RegNo' with real 'code'
-8..-15	activate device 8..15 (default location is used)
+8..+15 d:\path[filename]	activate device 8..15 and attach to 'filename'
+p mhz	use Pentium TSC, with CPU at (1-9999)MHz
+lpt x	use printer port 'x' (default is '1')
+pwr xxx	set default PwrLoader (default is '990' or C64)

-lfn	support Win95 LongFileNames in MSDOS (v1.55 req.)
-noreset	do not respond to signal on IEC RESET line
-sl	enable Scroll-Lock LED (default is 'off')
-tune	output signals to IEC port for 64HDD calibration

A complete listing of command-line options is given on pages 75 onwards of this manual.

You *must* enable at least one device with '-X' or '+X filename' (with X equal 8, 9,...) or the emulator will not be that useful.

NOTE: filename given must include an absolute path to its location

The "Scroll-Lock LED" if enabled will function as an activity indicator, but will slow down transmissions (particular from the command channel) considerably (and may even be incompatible with some PCs). *Professional* users also have a virtual on-screen indicator for each activated device number.

Pentium PC may need to have "Pentium TSC" support enabled and this requires that EMM386 is not installed (QEMM386 is however compatible). The CPU speed should be given as an integer (in MHz), but if omitted and +p is the last command line parameter 64HDD will *attempt* to compute it. Some Pentium systems will work with the standard "PIT" timing method; really depends on how *compatible* your "compatible" is! The -tune command in combination with the TUNE64HD utility can also be used to fine tune the timing of the 64HDD system.

LongFileName (LFN) support needs a special module installed. See the INSTALL.TXT file for information and the relevant chapter (pg. 41) in this User Manual for specifics. Special attention should be given to ensure adequate FILES, BUFFERS, and FCBS are allocated - the LFN tools can stretch these requirements.

As the emulator may reset when the RESET signal on the serial line is reset (eg when the Commodore computer is switched "on" or reset), it is recommended that the 64HDD program be controlled via the example batch file provided (GO64HDD.BAT). This batch file is also configured for working with the "EXIT" command. This batch file may be modified by the experienced user. The "-noreset" command line option may also be used.

The GO64HDD.BAT file has been configured to accept command-line parameters so that (as in the registration example below) additional information can be given (note: -xyz will need to be replaced with your actual registration code):

GO64HDD -xyz

The number of parameter passed to the batch file and the length of the final command-line is limited by MSDOS rules and this can vary between DOS versions. You might need to be mindful of the number of items listed and the size of paths specified. Extra drives can be activated via the command channel once 64HDD is running.

To run the 64HDD drive emulator, either start the GO64HDD from within the installed directory or have the batch and EXE programs on the MSDOS PATH. As noted above, you should add the 64HDD directory to your MSDOS PATH.

Professional users should use PRO64HDD if they would like to take advantage of the functions made available by 64GUI and 64CONFIG.

Accessing emulated disk drives

If you have the emulator running on PC (e.g. with device 8 activated) you can load the directory as usual with:

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

This gives the directory of the device which may be a directory on the harddisk, a disk-image (.D64, .D71, .D81, .D2M), a tape-image (.T64) or an archive created by the LYNX archiver (.LNX).

Loading works as usual too:

```
LOAD"filename",8
```

To change the directories on the PC, the directory loading command is slightly changed. Wildcards will show files matching this pattern, and will not work to change directories:

LOAD"\$..",8	goes to the higher level PC directory
LOAD"\$dir1/dir2",8	change to absolute PC directory
LOAD"\$d:",8	change PC drives
LOAD"\$d:/dir1/dir2",8	change PC drive and directory
LOAD"\$directory",8	changes the current PC directory
LOAD"\$diskimage.D64",8	attaches a diskimage in the current PC directory
LOAD"\$diskimage.D71",8	attaches a diskimage in the current PC directory
LOAD"\$diskimage.D81",8	attaches a diskimage in the current PC directory
LOAD"\$tapeimage.T64",8	attaches a tapeimage
LOAD"\$lynxarchive.LNX",8	attaches a LYNX archive

Wildcards '*' can be used to load the first file in a disk /tape image, or MSDOS file system.

Also, filetype specifiers are allowed when reading directories (see the 64HDD reference manual for complete listing).

In addition to the LOAD command, you can attach disk images or navigate paths using the CD: (change directory) command. This is easiest using a DOS wedge, for example, JiffyDOS:

```
@CD:directoryname
```

A navigation tool can also be used. Examples include 64XPLOr, 64NAV and SD2BROWSE, MENUETTE64, etc.

Unit numbers are also supported and have the special function in that they can be predefined as "shortcuts" to either directories or images. These are effectively "partitions" as defined by CMD products, and the full range of CMD DOS commands is supported. Up to 990 such short-cuts can be defined making navigation to these locations as easy as using the @CP command.

The remainder of this manual provides a detailed insight into the setup and operation of 64HDD. Additional information about 64HDD command syntax and error information is given in the second manual, the *64HDD Command Reference Guide*.

Table of Contents

*{The same manual describes both the standard and Professional capabilities of 64HDD. Commands and functions available only to the Professional versions are identified by **yellow highlighting**. From time-to-time some Professional features may be released in other “special” versions of 64HDD}*

64HDD at a Glance	3
Quick Start Guide	8
Table of Contents	13
64HDD – The CBM Drive Emulator	16
Overview	16
Introduction.....	16
Features	18
Connectivity	18
Disk Functions	19
Cross-Platform Functions	19
External Functions	19
Graphical User Interface Functions (<i>Professional version only</i>)	19
Print Spooling and Emulation Functions (<i>Professional version only</i>)	20
Background	20
Compatibility	21
CBM Computer Compatibility.....	21
PC Compatibility	22
Protocol Speed	23
Cartridge / DOS Wedge Compatibility	24
64HDD – User Interface (<i>Professional only</i>)	25
64GUI – Disk / Partition Tool (<i>Professional only</i>)	27
Basic Operations.....	29
Summary of 64HDD / CBM / CMD Commands	29
Directory and Disk Image Access /Loading	29
Standard Commodore Drive Commands	30
Device Dependent Commands	30
Device Independent Commands.....	31
Partitions and Unit Support (Short-cuts)	32
CMD Compatible Time and Date Commands.....	32
Extended CMD Compatible Drive Commands	32
1541COPY and Transfer Commands	33
1581COPY Commands	33
Print Spooling and PrintEngines	33
Summary of 64HDD / CBM DOS Error Messages	34
Accelerating Data Transfer	35
Overview	35
Serial vs Parallel Cables	35
PWRLOAD ROM Upgrade	36
64HDD Speed-Up Cartridges	36
Disk Acceleration for 64HDD <i>Professional Users</i>	36

FastLoader and X-Loader Disk Accelerators for the C64	37
Z-Loader Disk Accelerator for the C128	39
64HDD System Plug-ins.....	41
Overview	41
LongFileName Support	41
CD-Audio Extensions	41
Power-Loader Extensions	42
PSID for DOS	42
Networking with 64HDD	42
USB Drives with 64HDD.....	42
1541 Disk Transfers (read/write)	42
CMD Function/Command Support	42
EZ-Load Functions.....	43
Device Management.....	44
Activating/De-activating Drives	44
Device Number Swapping	44
Device Swapping Command Summary	45
Multi-Disk Program Compatibility	46
Flipping disks with “Disk-Flip”	46
Automating “Disk-Flip”	47
Manually Setting the Disk-Flip List	47
Copy Protection Support.....	49
Introduction.....	49
TRACK18 Emulation	52
MSD TRACK&SECTOR Copy Protection	52
T&S Command Summary.....	53
Native C128 Mode Support.....	54
Boot Sector Support for Disk Images	54
Boot Sector Support for MSD/LFN File Systems.....	54
CP/M Support.....	54
GEOS 2.0 Support	55
Introduction.....	55
What will your 64HDD-GEOS configuration look like?	55
What will not work with 64HDD-GEOS?	56
Choice of Different GEOS-KERNELS	57
XP GEOS-Kernels for GEOS64 and GEOS128: (Professional version only).....	57
Re-Compiled GEOS-Kernels for GEOS64:.....	57
First-time Installation Procedure (serial number keying)	57
Bootting GEOS from 64HDD	58
XP-GEOS (XP Kernels)	58
Re-Compiled 64HDD-GEOS Kernels	59
Using CONFIGURE (Re-Compiled Kernels).....	61
Using 64HDD-GEOS Supplied Utilities	63
Using Other GEOS Utilities	65
64HDD-GEOS Disk and Utilities (Screenshots)	65
Print Spooling and PrintEngines.....	68
Print Jobs	68
Print Engines.....	69
64GUI – PrintManager	69

Print Command Summary	70
Setup and Configuration.....	71
Basic Requirements	71
Optional Requirements.....	72
Building the PC.....	72
Configuring 64HDD	73
64CONFIG – Setup Tool	73
Manually Configuring 64HDD	74
Configuring 64HDD for Use with a Boot Floppy or Boot CD.....	75
64HDD Command-line Parameters.....	75
Using TUNE64HD to adjust 64HDD's Timing.....	80
Using a RAMDISK to speed things up (especially for LFN and Power-Loader Operation)	82
Trouble Shooting 64HDD	83
Specifications Guide.....	85
Dependent Devices	85
Independent Devices.....	86
64HDD File Systems Modes	87
CBM Disk Images (D64, D71, D81)	87
CMD Disk Images (D2M, etc)	87
CBM Tape Images (T64)	87
Archive (LNx)	87
Zips (ZIP) (<i>Professional version only</i>)	87
MSDOS File System.....	88
MSDOS LongFileName Support.....	88
Setting up the LFN Utilities.....	89
Notes, Tips and Suggestions	90
PC-to-CBM Cable Specification	92
X1541 Cable Specification.....	92
XE1541 Cable Specification	92

64HDD – The CBM Drive Emulator

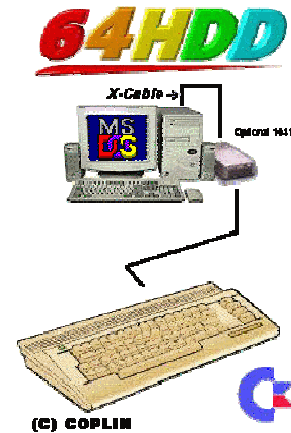
{This manual is being developed in conjunction with the program. The general sections of the manual will discuss items as if the functions and capabilities have been verified and proven, however the “general” section may get ahead of the current technical capability of the software. For what the program actually does in its present form please refer to the Configuration, Command Reference and Specification sections.}

Overview

64HDD is PC software that provides many of the 8-bit Commodore computer range with drive emulation without the need of special drivers or kernal patches. In very simple terms, it makes the PC think, and act, like it is an enhanced 1541, 1571 or 1581 or CMD disk drive system.

Connection this through a X1541 or XE1541 cable joining the LPT port of a PC system and the CBM computer. Real CBM drives can still be daisy chained into the system. A parallel transfer cable can also be added to dramatically reduce program load times. 64HDD supports all MSDOS based mass storage hardware and various CBM-emulator disk images. It also emulates most CBM drive commands, omitting only those that require the 65xx hardware (for example M-E, memory execute).

When you become fully familiar with all its features, you will see that 64HDD can be a lot whole more than a disk drive.



Introduction

64HDD was the first Commodore compatible drive emulation system to offer users a comprehensive and robust alternative to rare and expensive Commodore and CMD hardware. Ten years on, 64HDD continues to be a popular choice providing support for more file types, operating modes, command modes, printing support and GEOS compatibility than any other system.

Being software, 64HDD is able to harness the power of the PC for use by your Commodore computers. All that is required is a cable to connect the two. Primarily, the vision for 64HDD is to allow a PC based controller to be built up and to serve the Commodore computers as a mass storage device. However, many users will simply configure 64HDD to run off their main home PC when they are not using it for regular applications. Virtually every PC can be booted to run 64HDD, with the right boot tools.

Though there have been several hard disk drives developed over time for the Commodore 8-bit machines, most have been expensive, rare and... expensive (I intentionally said that twice). The mass storage products by CMD (Creative Micro Designs) were the standard of the day and even today are still highly sought after. All versions of 64HDD support the basic functionality of the CMD hard drive range, with the *professional version* emulating near all the advanced features that these drives were capable plus a range of new and unique features.

The older Commodore 1541, 1571, 1581 devices were based around micro-systems using the 65xx CPU hardware. 64HDD uses the PC as its hardware, along with all the storage connected to it. There is a wealth of applications which have proven the use of X1541 and XE1541 cables as a way of controlling, reading and writing to a CBM drive. The 64HDD emulator does the reverse and acts as a server (intelligent drive controller) for the Commodore computer (any CBM computer which uses the standard CBM serial bus protocol: VIC20, C64, C128, Plus/4, C16 etc).

Additionally, the 64HDD program can support any media device that can be supported by the PC, providing that an MSDOS compatible driver is available. These include: FDD, HDD, CDROM, RamDrive etc. In addition to supporting the hardware, various CBM image formats can be supported including disk (D64, D71, D81), Tape (T64) and archive (LNK). Raw binary and text files saved in the MSDOS filing system can also be “loaded”. The MSDOS file system can be configured in a way which allows 16character filenames to be used (these use the Windows95 LongFileName ‘LFN’ format). Also, 1581 emulation with a 1.44Mb 3.5” floppy drive is possible with the appropriate program add-ins.

Emulation of the standard CBM drive command set has been extended with a number of new commands added to provide Real-Time-Clock information (from the PC controller’s RTC) and to manage the new hardware and devices. Mouse support for the Commodore computer is provided by command channel functions when a PC mouse is attached and configured to the 64HDD host.

Only a very few standard commands, namely those requiring the specific 65xx hardware such as memory execute, are not supported by 64HDD. However reads and writes to drive RAM /ROM are generally supported whilst accessing CBM disk images (and for all file systems when using the professional version).

The hardware specification level of the PC controller is reasonably minimal, and the design of 64HDD is for user-free operation once configured (as such a keyboard and /or video card is not required and can be flagged “off” in the PC BIOS). Because of this, the basic freeware version has no “pretty” user screen, but special commands are provided to manage the PC hardware via the Commodore computer. If the user wants a functional and informative graphical user interface then the purchase of 64HDD *Professional* should be considered.

Features

64HDD supports an extensive range of both CBM DOS standard and non-standard functions. To help provide the user with an overview of the functions, not necessarily the syntax, a summary of these features is outlined below:

Connectivity

- Standard CBM serial mode support with no need to have special “drivers” loaded on the CBM computer
- Compatible with the C64, C128, VIC20, C16 and Plus4 computers
- Compatible with both NTSC and PAL systems
- Both X1541 and XE1541 cables are supported
- 64HDD Serial *FastLoader* support with the standard X-Cable
 - Turbo/XE cartridge required; or
 - ROM-less version for simple LOAD *(Professional version Only)*
- Parallel cable support for high transfer rates
 - Pwr/Cart or Pwr/Link cartridge required; or
 - ROM-less version for simple LOAD
 - GEOS support *(Professional version Only)*
- ROM-less versions of the serial or parallel modes do not interfere with the cartridge port, so you are free to use 64HDD in conjunction with an REU or cartridge
- JiffyDOS tolerant and compatible with various disk and cartridge DOS wedge systems (turbo functions should generally be switched off)
- EZ-Loader feature allows automatic listing of device number at the end of the line for users who do not have a built-in DOS-wedge. *FastLoader* prefix can be automatically enabled also *(Professional version Only)*
- GEOS Compatible with the appropriate 64HDD-GEOS disk driver installed/configured, includes RTC support. *FastSaver* and large 800kb disk support is also available *(Professional version Only)*
- Can be configured to various drive numbers (and multiple drives simultaneously #8 through #15). Professional users can assign up to 8 devices simultaneously using any device number from #0 though #30 (devices #0 through #3 require a modified Kernal ROM) *(Professional version Only)*
- PC specification is minimal (386SX25 or higher), MSDOS (or equivalent). To tolerate JiffyDOS reliably a slightly higher spec 386DX33 machine may be needed. To gain the full benefit of *FastLoader*, GEOS *FastSaver* and *X-Loader* a faster PC may be required (486DX33 or P100 respectively) *(Professional version Only)*
- Graphical User Interface for configuration, device and partition / ShortCut management. The GUI also provides detailed run-time information *(Professional version Only)*

Disk Functions

- Support for standard image types such as T64, D64, D71, D81 and LNX, and also raw PRG, SEQ, USR files
- Supports other emulator formats such as P00 and N64, as well as built-in functions to decompress ZIP files *(Professional version Only)*
- Support for native mode providing unlimited file sizes and structures
- Native mode files can support 16.3 character names without special headers (format is Win95 compatible)
- Directory listing and filtering using wildcards. Extended directory information such as file count and block count can be requested *(Professional version Only)*
- Changing between directories via the command channel or LOAD
- Assigning of “partitions” or short-cuts to disk images or directories including the use of easy to remember names instead of path details *(Professional version Only)*
- Changing between partitions and other management functions
- File time and date stamping, including files on D64, D71 and D81 disk image formats *(Professional version Only)*
- Block Read /Error handling to support many low-level disk copy protection schemes, with special T18 and T&S error modes for providing this emulation in the MSD/LFN file system *(Professional version Only)*
- “Disk-Flipping” for compatibility with applications spanning several disks.
- Commands to assign new drives “on-the-fly”
- Simple “ON” and “OFF” commands to control which device numbers are activated/deactivated *(Professional version Only)*
- Supplied with a large selection of demonstration programs and utilities
- Special CMD drive “compatibility mode” to improve operation with tools designed for CMD products *(Professional version Only)*
- Device Number Swapping *(Professional version Only)*



Cross-Platform Functions

- Copying of files between MSDOS drives with a single command (great for transferring images or files from PC floppy to your file system)
- “On-the-Fly” ASCII translation between standard and PETASCII

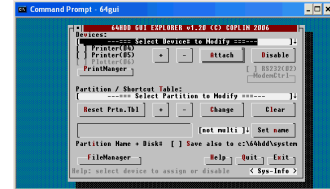
External Functions

- Reading and writing of disk images using 1541 *(Professional version only)*
- Reading and writing of 1581 and FD2000 compatible disks
- Co-processing on the PC’s CPU possible (for example PKZIP, cross-compilers, etc can do the job in seconds compared to minutes)
- PC Mouse support for custom CBM applications via the command channel
- Control of CD-Audio Playback
- Reading and setting of Real Time Clock /Calendar

Graphical User Interface Functions *(Professional version only)*

- Various functions can be co-ordinated from the PC keyboard and mouse

- 64HDD supports hot-keys for shelling to MSDOS, resetting 64HDD or the C64 (doesn't work with all cables/CBM computer types), and for changing certain operational modes (toggle LFN and CMD modes).
- 64HDD's GUI provides details about the Track and Sector being accessed, the filename and path, progress during the data transfer and error information.
- 64GUI can be spawned from the 64HDD screen at the press of a key. 64GUI allows attachment of new files/paths to devices, the activation/deactivation of devices and maintenance of the partition and short-cut tables.
- 64CONFIG allows many of the steps needed as part of the installation and configuration to be automated, and it can make recommendations about changes needed to your MSDOS system files.
- FileManager built-in for copying, renaming, moving and deleting files, with "Favorites list"



Print Spooling and Emulation Functions (*Professional version only*)

- Jobs to devices 4 and 5 can be spooled to the PrintSpooler
- New commands to control jobs on the "PrintQueue"
- 64GUI includes a PrintManager
- "PrintEngines" allow conversion or redirection of print jobs (eg TXT, HTML)

Background

64HDD was born in 1999. The concept of 64HDD was inspired by the number of PC based Commodore emulators being released and the relative drop in the price of PC hardware comparative to that of specialist CBM compatible hardware.

My initial thoughts were that someone "out there" must have a "product" which would do what emulators do, especially as there were programs readily available to create disk images from a LPT port controlled 1541 (my recommendation is Trans64 or Star Commander).

An extensive search on the Internet identified many programs that provided PC-to-C64 communication, but required either software drivers or kernal patches thereby reducing compatibility with most C64 programs. These also often necessitated specialist cables and did not support "standard" commands and direct disk access. Only two programs were identified at the time that attempted what I was hoping was possible; VC1541 and SERVER64 – however both had significant limitations. Since then other programs have been identified that attempt to do PC based drive emulation, including PC-DISK 3.0 and 1541EMU; the later requiring very precise timing for both PC's CPU and IO cards, and a specialised cable.

Consequently, the 64HDD project was born with the purpose of implementing some of the features the above two programs did, plus a range of other functions orientated to cater for disk management. Ultimately, the aim is to make this a viable

option for those not able to get their hands on a CMD hard disk, and further more, allow those with many emulator disk images to use them easily with their original CBM equipment.

There were various sources of information regarding the protocol documented on the Internet, and even some code in various programming languages. The implementation of the protocol supported by the aforementioned programs was unfortunately not adequate for detailed emulation, the reason being that they employed “streaming” of data rather than true control of data transmission with ATN signal acknowledgment. Basically, what this meant was that the simple streaming techniques worked fine for streaming a PRG file, but could not be used to control SEQ data or byte-by-byte transmissions as required for command control. This was new ground for the 64HDD project, and implementation was made all the more difficult because of the PC CPU constraint imposed.

In recent times there have been several “card” based systems using a microchip and SD/MMC/CF card based storage device. These devices work well, however 64HDD proudly remains the benchmark with regard to completeness, compatibility and capability, particular for power users.

Compatibility

CBM Computer Compatibility

Since 64HDD emulates Commodore’s serial bus protocol it is expected to be compatible with all CBM models that had a CBM serial port and could connect to drives such as the 1541. This serial port is technically referred to as an IEC serial port. CBM models using this port include:

C64, C64c, SX64, C128, C128D, and C128DCR C16, Plus/4 (and presumably also C116, etc) and VIC20 (and VC20)

Of course, not every software release will be fully tested with all of these machines. Some of these machines ran at slightly different speeds to the C64, but in general all had their kernals developed to be compatible with the 1541. The 64HDD emulator is primarily being developed with a C128DCR and is tested in both C64 and C128 modes.

Please note, as the 64HDD emulator does not support cycle emulation and CPU execution, schemes that are NTSC /PAL sensitive cannot be expected to work.

64HDD has been tested with standard CBM Kernals and the JiffyDOS Kernal for the C64. It is not intended to support alternate turbo Kernals that do not attempt to identify the device before initiating turbo transactions.

Special Note for troublesome communications: for the IEC communications to work reliably with some installations of 64HDD you may need to have a real CBM disk drive (eg 1541) connected as part of the daisy chain, and it must be switched “on”. This is generally observed to be needed if the PC’s timing

is not accurate or reliable or fast enough and the use of a real drive may reduce the likelihood of hang-ups in these installations.

The only two characters which may give rise to unexpected results when used in a filename, these being the “/” and “\$” characters which now are used to control directory access. It is also worth noting that some CBM characters displayed are not true ASCII as the PETASCII map contains several duplications. For example “~” is CHR\$(126), and not CHR\$(255) as would be sent if contained in filename quotes. Remember though that JiffyDOS and other DOS wedges do not accept constructed filenames, eg /“abc”+chr\$(126)+“xyz” will not work with JD which will issue /“abc” only. Such commands will unfortunately need to be sent the long-hand way with OPEN, unless you are using the professional version of 64HDD.

64HDD can be used for GEOS using specialised drivers. Refer to the GEOS section (pg. 55) of this manual for detailed information.

64HDD will work with the Handic “Vic-Switch” and will presumably work with other IEC multiplexing /networking devices. For the Handic configuration a real CBM drive was found to be definitely required in the daisy-chain.

If a particular disk drive command is not supported then one of the following errors will be reported:

31,SYNTAX ERROR

This means commands is not understood or syntax is incorrectly given.

8x,COMMAND NOT SUPPORTED (xxxxx)

This means that the command is understood, but that its function has not been implemented yet or is unavailable with the selected file system. Error 89 means that 64HDD does not yet support the function and a series of “beeps” will be sounded each time such a command is given (for example with M-E). In C128 mode, 64HDD will also beep as the burst load command is tested for, but loading will continue as normal after this.

Some additional error codes have also been added such as error 78 for when an MSDOS device is “Not Ready”

PC Compatibility

The development PC hosting the emulator is a 486SX33, but a range of PCs up to 2.4GHz have been tested at one time or other. Mobile PC processors (Centrino and M type for example) may be incompatible because they do not necessarily run at a fixed clock speed since they are optimised for low power applications.

64HDD is a DOS program. This is necessitated by the Commodore serial bus protocol being intolerant of errors in timing and therefore necessitating the 64HDD program to very accurately monitor and control the timing of its communications. Although some users have reported getting 64HDD to work from a MS Windows

DOS-Box, the use of 64HDD in such an environment can not be guaranteed since interruptions may cause the communications with a Commodore to hang or error.

Protocol Speed

The transfer rate for 64HDD can be configured by the user using command-line switches. The default setting uses timings that are essentially to Commodore specifications so any improvement in transfer rate is in the reduction of “seek” and decode times.

However, for older PCs optimisation of the timings is possible via the use of the `-faster` and the `-fastest` command line switches. These switches should only be used on older PCs as they reduce the duration of the high and low CLOCK transitions to the minimum levels to account for the software execution latency. These options however might not work with your particular PC hardware configuration as they are dependent on the speed of the PC running 64HDD. Higher clock rate 486 PC controllers (>40MHz) should use the `-faster` setting, slower clock rate PCs (<33MHz) should use the `-fastest` setting. An optimised system should be capable of attaining LOAD and SAVE performance at least comparable to a 1581 drive, and generally similar to the CMD HDD with the best settings. If you are using with a VIC20 the `-vic` option will set timings to the 1540 standard.

64HDD supports an accelerated serial mode (see page 35) in its GEOS driver and via the use of selected 64HDD Professional features and/or the Turbo/XE cartridge.

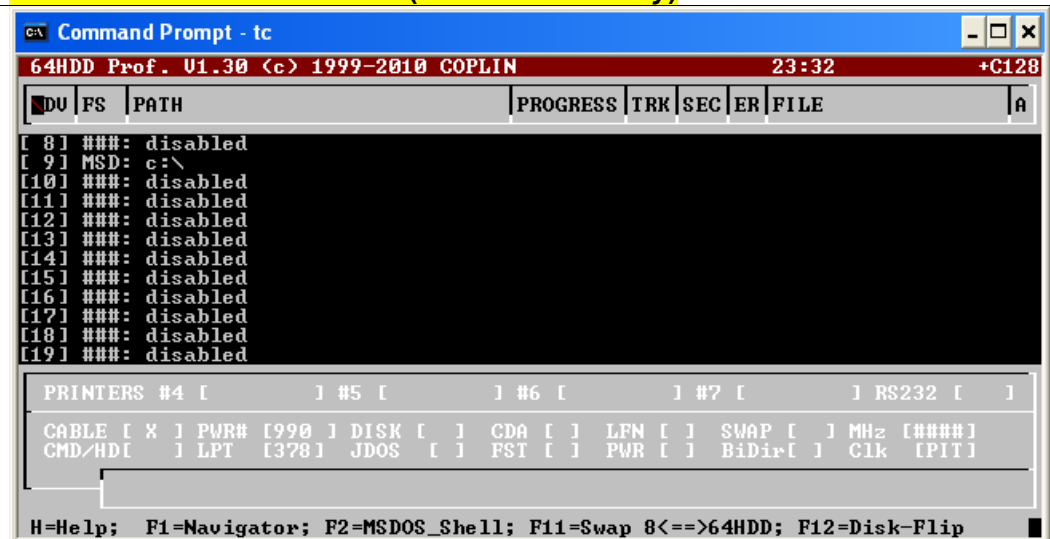
A parallel cable connection is also available for use with 64HDD. This cable, in combination with the PwrLoaders should speed communications up by 30-50 times over a standard CBM1541. See separate documentation on page 35 or the documentation that is supplied with PwrLoad plug-in package.

Cartridge / DOS Wedge Compatibility

Since default configuration of 64HDD uses the serial bus only, users are generally free to use their favourite cartridge in the expansion port. The 64HDD emulator has been tested with a number of Cartridge and DOS Wedge utilities and an assessment of compatibility is outlined in the table below. Incompatibility is normally a result of using non-standard communications or unimplemented functions, for example trying to read the native directory using M-R (not supported by the freeware version of 64HDD) or trying to install and execute fast-loader routines. The latter may be outside the scope of 64HDD as the fast-loader usually tries to run its own drive code, and CPU emulation is not yet supported by 64HDD.

Cartridge /DOS Aid	Works (directory /status)	Freezer /BackUp	Remarks or Workaround
DOS Wedge 5.1 (C64)	Yes/Yes		
BASIC 7.0 (C128)	Yes/Yes		DIRECTORY, DS\$ is valid, DLOAD works.
JiffyDOS 6.01 Wedge	Yes/Yes		@ and @\$, on slow PC set-ups, use a real 1541 in the drive daisy-chain
Final Cart III	Yes/Yes		Works from both command-line and GUI. To avoid the built in FC3 fast-loader either use the KILL command or POKE816,165:POKE817,244
KCS Power Cart	Yes/Yes	Yes, BACKUP only to #8	Use QUIT 1 or #48 or #49 for LOADs
Cockroach TurboROM	Yes/Yes		To avoid the built in fast-loader either use: POKE816,165:POKE817,244
MACH5	Yes/Yes		Seems to work only for device #8. Use ← D to disable MACH-DOS, but keep extra commands active.
Freeze Machine	No/No	Neither	\$ works. @ command hangs. Loader can also hang C64 / PC
Warp Speed (64/128)	Yes/Yes		^K to disable fast-loader
Epyx FASTLOAD	Yes/Yes		\$ and /\$ works use POKE186,drive to swap. @ works also. /filename <i>does not</i> work!!
Action Replay V6.0	Yes/Yes	YES, use "Standard" #8 or #9	Use OFF to turn turbo load off. Or use the AR6 command-line switch if using the <i>professional</i> version of 64HDD.
SureData 30-in-1	Yes/Yes		Seems to work only for device #8.
SnapShot v3.0 (LMS)	Yes/Yes		TurboLOAD/SAVE must be switched off from menu

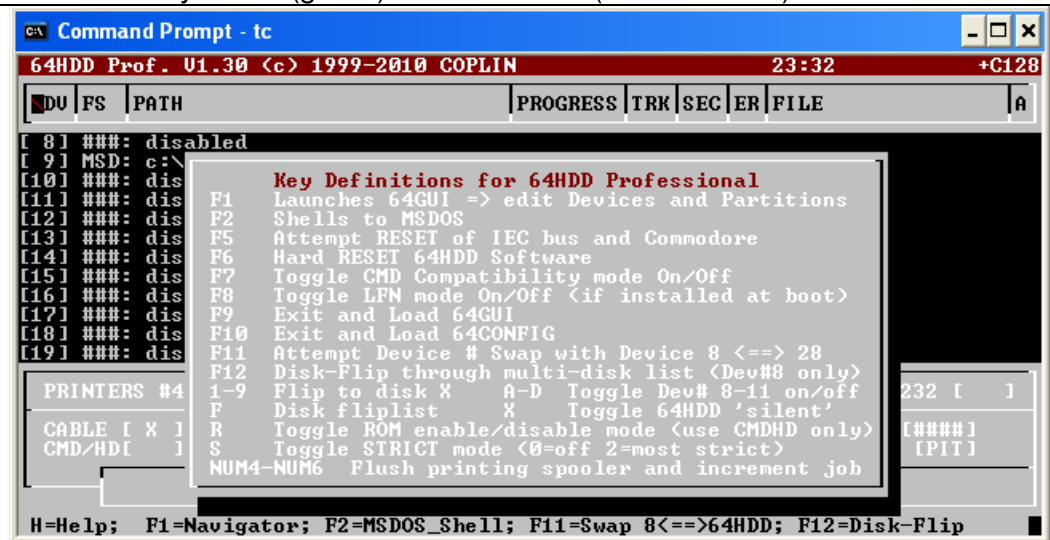
64HDD – User Interface (*Professional only*)



64HDD *Professional* features a GUI for displaying runtime information. The display lists details about the setup used at boot time (parameters in black), the status of various other modes detectable during runtime (parameters in red) and information about every device. Note, some runtime parameters are indicated as present until detected otherwise.

The information displayed for each device includes:

- Path of directory or disk image attached
- The file system mode being used
- Name of file being transferred, or command being processed
- Progress status shown as block count
- Track, Sector and Error status of block being transferred
- Activity “LED” (green) or Error “LED” (red with code)



An online help screen is available to remind *professional* users of special hot-keys. Just press [H] to activate the display, any other key to clear. Esc as always exits 64HDD. Always consult for the help screen for the most up to date information. For laptop users, some of cursor keys replace the NUM keys. Most are self-explanatory, for those that are not:

- [F] displays the current disk-flip listing, see below
- [1]-[9],[0] selects partition 1-10, representing the corresponding disk-flip
- [A]-[D] toggles the activation state of drives 8 through 11, respectively
- [F7],[R],[S] in combination control the 64HDD mode of compatibility by enabling or disabling new features. The status of these parameters mirrors those actioned through the corresponding command channel and are shown on the GUI against the CMD/HD indicator.
- [F7] CMD mode on (X) or off
- [R] Drive ROM = CMD mode on (X) or off (with this enabled navigation from within CMD compatible programs is possible)
- [S] Strict Mode; 0=off, 1=mild, 2=very CBM strict
- [X] toggles 64HDD into and out of silent mode. In silent mode, 64HDD will not respond to any requests allowing you to use other devices with the same number or special fast load applications.
- [NUM4]-[NUM6] activates/flushes the corresponding print emulation device. This can be used when access to the command channel is not possible from the C64 keyboard because an application is running.

```

c:\ Command Prompt - tc
64HDD Prof. V1.30 (c) 1999-2010 COPLIN 23:33 +C128
DU FS PATH PROGRESS TRK SEC ER FILE
[ 8] ###: disabled
[ 9] MSD: c:\
[10] ###: dis
[11] ###: dis
[12] ###: dis
[13] ###: dis
[14] ###: dis
[15] ###: dis
[16] ###: dis
[17] ###: dis
[18] ###: dis
[19] ###: dis
[001]
[002]
[003]
[004] C:\
[005] C:\64HDD
[006] C:\64HDD\DEMOFILE
[007] C:\64HDD\UTILS
[008]
[009]
[010] C:\64HDD\DEMOFILE\DUCKS.D64
F12 Disk-Flip through multi-disk list (Dev#8 only)
1-9 Flip to disk X A-D Toggle Dev# 8-11 on/off
Remember: DFL only works for Device #8
PRINTERS #4
CABLE [ X ]
CMD/HD [ 0 ]
H=Help; F1=Navigator; F2=MSDOS_Shell; F11=Swap 8<=>64HDD; F12=Disk-Flip
  
```

Partitions (short-cuts) [001] through [010] act as the Disk Flip List. The definitions for the DFL can be easily seen by pressing the [F] key. 64HDD *Professional* supports a number of commands and methods for easily (and automatically) defining the DFL for your applications.

64GUI – Disk / Partition Tool (Professional only)

64GUI is a new tool which allows users who operate 64HDD from the PC (rather than the Commodore) to easily navigate their way through their disk collections and selected which devices are active/disabled.

This tool also allows easy and accurate management of partitions and shortcuts.

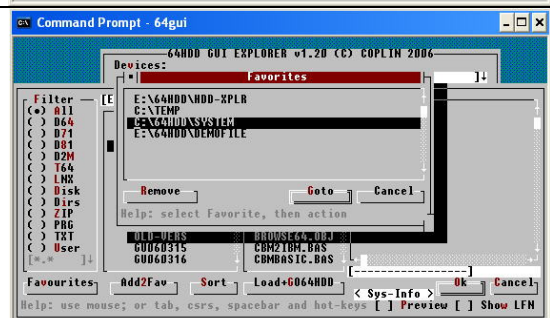
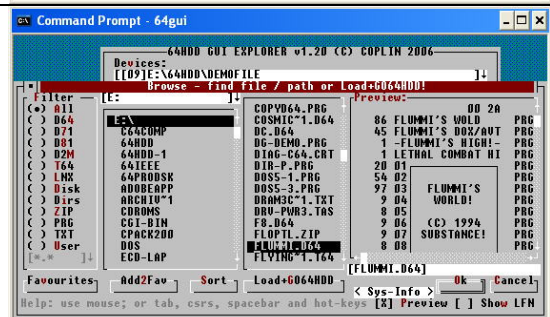
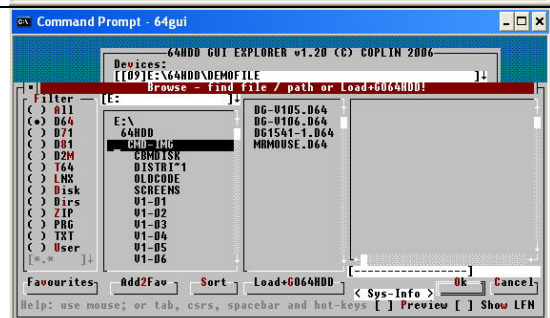
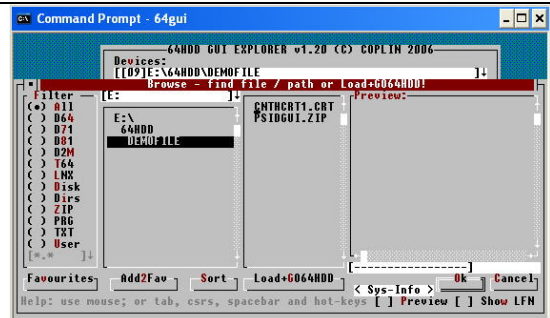
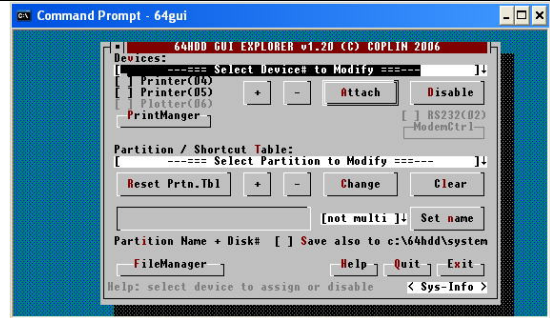
After either a device or partition number is selected, pressing “Attach” or “Change” respectively will open a file browser allowing you to navigate your way to the desired disk image or directory. Filtering is possible to provide a clearer view of files being searched for.

Filetype filtering is supported for standard Commodore types, common text format files and for user defined.

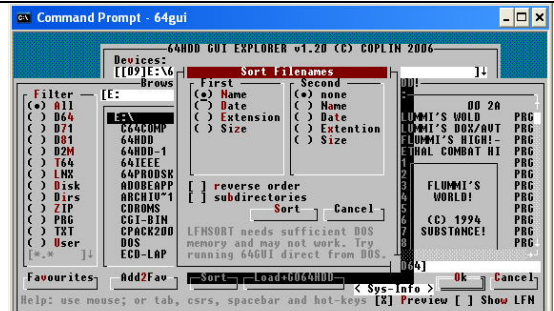
The GUI can also optionally display the Long File Name of the currently selected file or disk image.

The preview screen can be set to automatically be displayed. This will list the contents of supported disk images so that you can verify the contents are what you are looking for. The contents of standard text types used as indexes on many popular C64 CDROM compilations are also viewable.

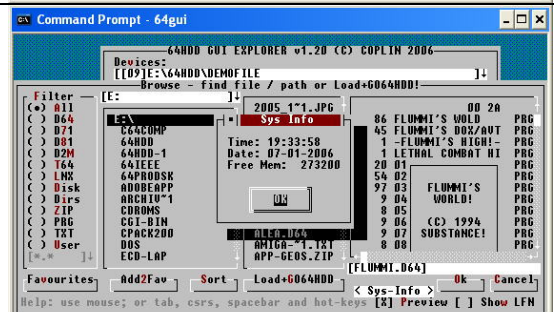
Commonly used file locations can be added to you “favourites” list allowing you to jump straight to these locations...



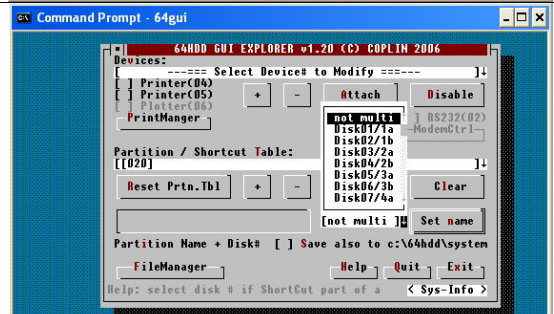
Directory contents can be sorted with the appropriate MSDOS plug-in tools. This helps make files easier to find. Note however that this option requires lots of DOS memory and so may only be available in some modes of starting 64GUI.



System Info is available from most screens so that you can keep track of details such as date, time and free DOS memory.



The partition assistant will allow you to configure the partition table, including specification of multiple disk sets.

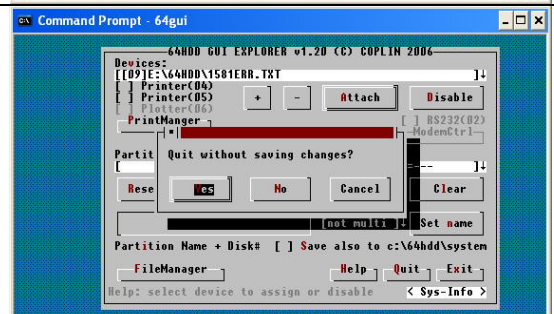


A built-in FileManager allows you to copy, move, rename and delete files. The FileManager works using the “source” and “destination” format, and includes Preview support.

Operations are carried out using both DOS and LFN names.



If changes are made you should “Exit” 64GUI. If you try to “Quit” after changes have been made, 64GUI will verify if this is what you want to do. Note: Changes are saved to the directory sysdir 64HDD is currently using. If you want to save changes to the c:\64hdd\system then “check the box” before exit.



Basic Operations

The 64HDD Command Reference Manual gives complete details about the commands which 64HDD supports. Listed below are the most common functions supported by 64HDD and the basic syntax

LOAD / SAVE / OPEN commands will work with 64HDD as they would on any other Commodore compatible disk device. Some of these commands will also have additional options to control new functionality made available by 64HDD, yet will remain compatible. These commands all support unit numbers (also known as partition numbers) and the extensions provided by the CMD product range.

Regular CMD mode commands are supported by all versions of 64HDD. A summary of the most popular commands is given below:

CD/RD/MD for change, remove and make directories
 CP/G-P for changing partitions or getting partition information
 LOAD"\$=P",device for listing the partition table
 LOAD"\$=T",device for listing time stamp info
 T-RA, etc for reading / writing the real time clock

Extended CMD mode commands are supported by the professional version of 64HDD. These improve the functionality and compatibility of 64HDD with applications designed for the CMD drives.

Custom 64HDD commands are used to control and configure the operation of 64HDD. Custom commands include everything from reading the available drive path, configuring the emulation mode, or locking and unlocking files. Some of the custom commands are exclusive to 64HDD professional, but most are compatible with all versions of 64HDD.

Summary of 64HDD / CBM / CMD Commands

Directory and Disk Image Access /Loading

LOAD"\$drive:/path=type",device LOAD"\$drive:/path=type[,options]",device OPEN fileno,device,15,"\$drive:/path=type":CLOSE	Select and/or view 64HDD directory
LOAD"\$!EZ:drive:/path=type",device LOAD"\$drive:/path=type,EZ",device	Request EZ-Load format for 64HDD directory
OPEN fileno,device,3,"\$drive:/path"	Fast 64HDD Directory Reading
OPEN fileno,device,sa,"filename,type,mode" LOAD "filename,type,mode",device,sa	Open File for LOAD/SAVE/Read/Write

Standard Commodore Drive Commands

"S:filename[;M]"	Scratch file(s) from current device /directory
"R:newfilename=oldname[;M]"	Rename file on /in current device /directory
"C:backup=original[;M]"	Copy file on /in current device /directory to new name Merge multiple sequential files to one combined file
"I"	Initialize device
"V"	Validate device /dis
"UI" "UJ" "U9"	Warm boot / Cold boot
"/" "/:" "/0:"	1581 Partition Selection
"/name,"+CHR\$(starting track)+CHR\$(starting sector)+CHR\$(<# of sectors)+CHR\$(># of sectors)+",C"	1581 Partition Creation
U1 B-R BLOCK-READ	Block Read
U2 B-W BLOCK-WRITE	Block Write
B-A BLOCK-ALLOCATE	Block Allocate
B-F BLOCK-FREE	Block Free
B-P BLOCK-POINTER	Block Pointer
M-R	Memory Read
M-W	Memory Write

Device Dependent Commands

"K:backup#=original" "KOPY:backup#=original"	Copy (Kopy) files between 64HDD virtual devices
"MD:new_dirname" "MD0:new_dirname"	Make MSDOS directory
"CD:dirname" "CD0:dirname"	Change MSDOS directory
"RD: dirname" "RD0: dirname"	Remove MSDOS directory
"XS:" "XS:listfile.DFL"	Activate a Disk-Flip List
"F-L:filename[;M]" "F-L0:filename[;M]" "F-U:filename[;M]" "F-U0:filename[;M]"	Locking and Unlocking file(s) from a directory
N:diskname.typ[,id] N0:diskname.typ[,id]	Create and Name Blank Disk Image

Device Independent Commands

T:hhmmss T0:hhmmss TIME:hhmmss TIME0:hhmmss	Get /Set 64HDD Time
D:dd/mm/yyyy D0:dd/mm/yyyy DATE:dd/mm/yyyy DATE0:dd/mm/yyyy	Get /Set 64HDD Date
DAY: DAY0:	Get 64HDD Day
F:drive_letter F0:drive_letter FREE:drive_letter FREE0:drive_letter	Get 64HDD Device Space Information
E:error_level E0:error_level EXIT:error_level EXIT0:error_level	Exit 64HDD and set error_level upon exit
M: M0: MOUSE: MOUSE0:	Read PC Mouse Position and button status (ASCII)
M1: MOUSE1:	Read PC Mouse Position and button status (Binary)
MSD:application_name MSD0:application_name	Run an external MSDOS application
SPEED: SPEED0:	Report protocol speed mode and Pentium CPU speed
SFN: SFN0:	Switch to ShortFileName Mode
LFN: LFN0:	Switch to LongFileName Mode
U0>+chr\$(device_number)	Activate another 64HDD Device
STR:n STR0:n STRICT:n STRICT0:n	Set /reset "strict" directory mode in MSDOS
CMD:n CMD0:n	Set /reset "CMD" mode for 64HDD operation
"CWD"	Identify what is the current path
"ON:x"	Activate a new 64HDD Device
"OFF:x"	De-activate a 64HDD Device
"SORT:x"	Sort MSDOS directory filename order

Partitions and Unit Support (Short-cuts)

LOAD"\$=P",device LOAD"\$=P:=type[>pn] [<pn]",device	Load partition table
LOAD"\$=N",device LOAD"\$=N:=type[>pn] [<pn]",device	Load "common name" partition table
LOAD"pn:\$dirspec",device LOAD"pn:filename",device LOAD"pn//dir1/dir2:filename",device SAVE"xpnfilename",device OPEN lfn,dev,sec,"x:filename,type,mode"	Load /save /open from /to unit path
"CPx" "cPn"	Change partition to path defined by unit number
"APx" "aPn"	Add current path /image to partition table
"DPx" "dPn"	Delete current partition table definition
"IPx" "iPn"	Information about partition
"NPx"	Assign common name to a partition definition
"INx"	Get "common name" assigned to a partition

CMD Compatible Time and Date Commands

"T-RA" "T-WAdow. mo/da/yr/ hr:mi:se xM"	Read /set RTC in CMD ASCII format
"T-RD" "T-WD"+9bytes	Read /set RTC in CMD decimal format
"T-RB" "T-WB"+9bytes	Read /set RTC in CMD BCD format
LOAD"\$=T:dirspec,type",device	Load Directory with TimeStamp

Extended CMD Compatible Drive Commands

"W-0" "W-1"	Set / Clear Write Protection Mode
"S-C"	SCSI Command
"G-Pn" "G-D"	G-P Get-Partition information
"R-H:diskname[,id]"	R-H Rename Disk Header
"S-8" "S-9" "S-D"	Device number Swapping

1541COPY and Transfer Commands

"T1541:filename.D64[,F]"	Transfer D64 image to 1541FDD connected as Device #8
"F1541:filename.D64"	Create D64 from 1541FDD connected as Device #8
"I1541:"	Interrogate 1541FDD connected as Device #8

1581COPY Commands

"T1581:filename.D81" "I1581:"	Transfer D81 image to 1.44FDD using 1581COPY
"F1581:filename.D81"	Transfer 1581 disk in 1.44FDD to D81 with 1581COPY

Print Spooling and PrintEngines

"PNEXT:dev"	Increment to next JobNumber
"PPAUSE" LOAD"\$",pdev	Viewing the PrintQueue
"PPRINT:dev:jobnumber:PrintEngine"	Printing a specific JobNumber
"PDEL:dev:jobnumber"	Delete a specific JobNumber
"PFLUSH:dev"	Flush the print queue for a device

Summary of 64HDD / CBM DOS Error Messages

0	OK, no error exists
1	Files scratched response. Not an error condition
2	Partition selected. Not an error condition
3	Files locked response. Not an error condition
4	Files unlocked response. Not an error condition
5-19	Unused error messages: should be ignored
20	Block header not found on disk
21	Sync character not found
22	Data block not present
23	Checksum error in data
24	Byte decoding error
25	Write-verify error
26	Attempt to write with write protect on
27	Checksum error in header
28	Data extends into next block
29	Disk id mismatch
30	General syntax error
31	Invalid command
32	Long line
33	Invalid filename
34	No file given
39	Command file not found
43	Status Error (pseudo SCSI error)
44-48	Controller Error (pseudo SCSI error)
50	Record not present
51	Overflow in record
52	File too large
60	File open for write
61	File not open
62	File not found
63	File exists
64	File type mismatch
65	No block
66	Illegal track or sector
67	Illegal system track or sector
70	No channels available
71	Directory error
72	Disk full or directory full
73	Power up message, or write attempt with DOS Mismatch
74	Drive not ready
75	Format error
76	Controller error
77	Selected partition illegal
78	Selected path not available
79	SYSDIR error
80-89	Command not supported (actual code depends on mode)
92	Pwr-Load driver missing
94	Fast-Load driver missing
160	LFN mode not available
180	D81 TO 1.44FDD transfer error
181	1.44FDD TO D81 transfer error
182	D64 TO 1541 transfer error
183	1541 TO D64 transfer error
200	CD-AUDIO error

Accelerating Data Transfer

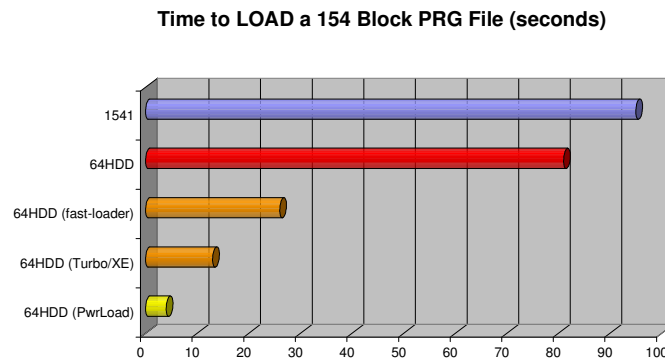
Overview

64HDD emulates the standard serial protocol used to communicate for example with the 1541 disk drive. Because this protocol is emulated so well, 64HDD's number #1 strength is its "out of the box" compatibility with a huge range software written for these computers. Unlike many other cartridge based storage devices, programs run without the need to be patched.

However, compatibility with Commodore's IEC protocol comes at the price of the traditional slow 1541 transfer speed that we all have grown to hate.

The bottleneck to fast loading is in the serial transfer of data from the disk drive controller to the computer. The C64/C128 is even slower than the VIC20 it replaced because of the DMA characteristics of the VIC-II graphics chip.

There are several things however that you can do to enhance your basic 64HDD system and reduce your loading times. All 64HDD users can take advantage of a range of cable, ROM and cartridge upgrades. 64HDD *Professional* users also have a range of plug-ins which can be installed on their system to enhance the performance of their 64HDD system using only their standard X1541 or XE1541 cables.



Serial vs Parallel Cables

To get started all 64HDD requires is your basic X1541 or XE1541 cable. This cable is a serial cable, meaning data is sent as a stream of bits rather than as a single byte.

64HDD also supports an 8bit parallel cable, the PwrLoad cable, that connects the PC's LPT port to both the Commodore's userport and IEC serial port. Commands travel down the serial link, but data is LOADED through the userport connection. This instantly equates to at least an 8x improvement, but because of the optimisation of the clocking between the computers data rates are actually 30-50times faster when loading.

In order to use the PwrLoad cable software plug-ins have to be installed to your basic 64HDD system. Some of these plug-ins are available for all users in the download from the 64HDD website, whilst others are included with 64HDD *Professional*. The GEOS drivers supplied the 64HDD *Professional* and the DriveGhost program can take advantage of the PwrLoad cable for both read and write operations.

PwrLoad Plug-in	Availability
C64	All users
DriveGhost	All users
GEOS64	64HDD Professional
C128	64HDD Professional 128
GEOS128	64HDD Professional 128
Plus4/C16	Not yet developed
VIC20	64HDD Professional

PWRLOAD ROM Upgrade

One way to guarantee that the PwrLoad cable is used as often as it can be is to upgrade the KERNAL ROM chip within your C64 or C128. The image for a very basic version of the PwrLoad ROM is included in the plug-in download from the 64HDD website. The online 64HDD Shop sells a range of enhanced upgrade ROMs. The upgrade ROMs are compatible with all versions of 64HDD.

64HDD Speed-Up Cartridges

For those who do not want to tinker inside their beloved Commodore, there is a range of 64HDD Speed-up cartridges available to accelerate both serial and parallel systems. The Turbo/XE range allows for an 8x increase in loading speeds using the standard XE1541 cable. The Pwr/Cart and Pwr/Link range provides a 30-50x increase with a parallel data transfer. Complete information is available on the 64HDD website, including the cartridge user manual and FAQ. The upgrade cartridges are compatible with freeware, CD and *Professional* versions of 64HDD.



Disk Acceleration for 64HDD *Professional* Users

Many software developers have created their own disk fast-loaders to overcome the slow “performance” of the 1541, but unfortunately, there is no standardised “fast” method. GEOS, Epyx, ActionReplay, etc, all developed their own methods. Some provide a speed up of 2-3times, others like JiffyDOS, claim up to a 10-12times improvement (with sector interleave optimally set).

Often these transfer methods are reliant on the fact that both the 1541 and the Commodore 64 run at 1MHz, hence there is no problem in synchronising the activities of each machine.

On the other hand, CPUs in PCs run at a variety of speeds and they cannot be relied up on to be synchronised to the 1MHz Commodore computer. Because of this, the chances of 64HDD synchronising itself with every PC and disk fast-loading method are pretty small.

To overcome this, 64HDD uses its own serial disk acceleration method. The method used simply sends the requested file as a bit stream, the rate of which is controlled by the slowest computer in the partnership; the C64! Presently only the C64 and C128 are support, but with time it is hoped to adopt the method to the other Commodore computers used with 64HDD.

FastLoader and X-Loader Disk Accelerators for the C64 (Professional version only)

Since the C64 is now the boss, the PC must be fast enough to respond to the requests. For this reason XMS (extended memory) is used to buffer the file for transfer directly from RAM – it would not be possible to keep up with the Commodore if the file were to be read straight from the disk during the transmission. Also, different speed PCs respond at different rates, and as such, even the humble C64 can be too fast for some low-specification PCs!

So, how does the C64 know about the new transfer method? A small 1-block auto-run file is sent when a special load request is made. This auto-run file is specific to the Commodore model, and so different files will be needed for each member of the Commodore family. Two types of fast-loaders can be requested. The first works even on many i386 models, however the maximum load rate comes with the second *FastLoader* designed for faster 64HDD systems.

The new load commands are compatible with older CBM type disk units as the prefix is ignored by them and translated to the equivalent of `0:filename`

Loader Name	Command examples	Remarks
<i>FastLoader</i>	LOAD"!F:filename",9,1 or %!F:filename	Faster 386, eg 386DX40 x4 improvement
<i>X-Loader</i>	LOAD"!X:filename",9,1 or %!X:filename	Faster 486, eg 486DX33 x6 – x8 improvement

The *FastLoad* prefix can be extended to include path or partition details, for example
%!X:7:filename

When 64HDD receives the command it first sends the loader then buffers the requested file to 64HDD's XMS cache (this is done so that it can subsequently send the file independently of the type of disk it was read from). If your system does not have enough XMS to support the creation of this cache, the file will not be transferred and an error will be indicated. Once buffered to cache, the file will then be transferred using the loader previously downloaded to the Commodore. Whilst the transfer takes place the 64HDD screen will look unchanged (the PC doesn't have much free time...) but the borders on the Commodore screen will scroll indicating that the transfer is taking place. The rate of the boarder scroll will depend upon the type of loader you have selected.

There are several variants of the *X-Loader*, each offering progressively faster transfer times. During installation try the slowest first, then progressively experiment with the faster ones until you identify that loads become unreliable. The 64CONFIG program will allow you to set-up these.

Option (64CONFIG)	Remark
Default	Installs <i>FastLoader</i> also as the <i>X-Loader</i>
X0Ldr	Slowest of the <i>X-Loaders</i>
...	
X5Ldr	Fastest of the <i>X-Loaders</i>
X6Ldr	Faster still, but screen blanked
X7Ldr	May not work with many PCs as they only get 2us to do their stuff!

Most programs will be compatible with the auto-run file, however some no doubt will not be.

- Files programmed or saved on a C128 or non-C64 machine.
Note: These will contain an incorrect "load address" header can be "repaired" by first slow loading then in C64 mode, and then saving them to disk again. The header will now point to the C64's load address.
- Files which themselves auto-run and hence over-write 64HDD's loader
- Files which load over the C64's datasette buffer
- Files longer than approximately 202blocks as these will over-write the IO memory map and scramble the C64's hardware.

The ROM resident version of the fast-loader will probably overcome many of these limitations. As with the advanced PwrLoad ROM it should be able to load "under" the IO area, but with a small penalty in transfer speed.

Multi-part programs will only be subsequently *FastLoaded* if the filenames are prefixed with the appropriate code, or if the ROM resident version automatically does it. It should be easy to “fix” some multi-part games by using this technique:

- a) Open the disk image in a binary editor
- a) Find where the filename is stored and usually appears in PETACSII, for example “filename”
- b) Modify the filename to include the prefix, for example “!X:file*”

Note: your modified name cannot contain more characters than the original, so you may need to use wildcards as in the example above (this is because the file is binary not text)

- c) Save the changes

The serial *FastLoader* will only work with LOAD operations and will not accelerate byte-by-byte disk accessing of data files.

Z-Loader Disk Accelerator for the C128

(Professional 128 version only)

C128 Professional users also have access to a powerful serial fast-loading system. *Z-Loader* can be considered as the C128 equivalent of the 64's *X-Loader*.

There are several variants of the *Z-Loader*, each offering progressively faster transfer times, though not all support RAM1 Bank loading. During installation try the slowest first, then progressively experiment with the faster ones until you identify that loads become unreliable. The 64CONFIG program will allow you to set-up these.

Option (64CONFIG)	RAM Banking	Remark
Default	Yes	Installs the slowest <i>Z-Loader</i>
Z0Ldr	Yes	Slowest of the <i>Z-Loaders</i>
...	Yes	
Z5Ldr	No	Fastest of the <i>Z-Loaders</i>
Z6Ldr	No	Faster still, but screen blanked
Z7Ldr	No	May not work with many PCs as they only get 2us to do their stuff!

Programs which LOAD/RUN can use any of the above fast loaders. Rather than using an auto-run scheme the *Z-Loader* can be operated by one of two ways.

Firstly, using the BOOT command (see note below):

```
BOOT"!Z:filename" [, Ud [, Dn]]
```

The default value used for “d” (the device number) is 8, but other devices can be specified for example U9 for device #9.

The default partition number is “0”, but again other numbers can be specified.

The !Z: prefix requests the *Z-Loader*.

Note: due to a bug in early versions of the C128 Kernal ROM this method will not work on all C128 computers. If you do not have the latest ROM (version -04) then you may be forced into the MONITOR when you execute this command. There are several other bugs in the early C128 ROM including the lower case “q” when caps-lock is used. Commodore’s latest -04 Kernal ROM can be obtained from the author.

Secondly, using the LOAD /SYS commands:

```
LOAD"!Z:filename", dv, 1  
SYS 11*256
```

Where “dv” is the device number. These steps can be automated by using a loader and the dynamic keyboard technique.

Unlike the C64, the C128 has two RAM banks. Whilst most programs load into the default RAM0 bank, some programs like the GEOS system needs to be loaded into the RAM1 bank. This is where the second load method is useful. Location 198 stores a flag to indicate which RAM bank should be loaded. A simple `POKE198, 1` will cause the load to be into RAM1. For example:

```
LOAD"!Z:ram1-file", dv, 1  
POKE198, 1  
SYS 11*256
```

Omitting the poke will default to loading the file into RAM0. If you are intending to take advantage of GEOS128 support, do not install a driver higher than Z4Ldr.

Note:

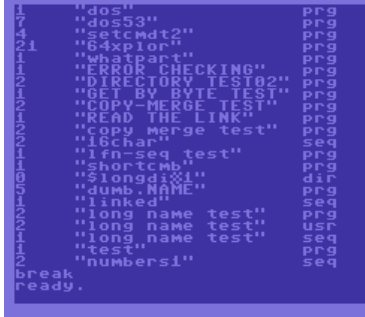

PC processors come in all sort of “flavours” and from various manufacturers. Likewise the same processor can be installed in differing main-boards, with differing amounts of cache, etc. Some, like laptops have processors that feature power-saving features such as Speed-Step. These variations can lead to variability in the timing of the precise control signals that must pass between the PC and the Commodore during data transfer. It is possible that some PCs that cope with the standard slow CBM serial transfer method may be incompatible with the *FastLoad* methods employed in 64HDD. To avoid disappointment, users are encouraged to test compatibility using the GEOS fast-serial disk driver that is distributed from the 64HDD website.



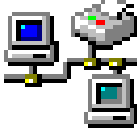



64HDD System Plug-ins

Overview

64HDD's capabilities can be expanded by the use of plug-ins. Plug-ins are executable programs and drivers which can be called by 64HDD to do new things, such as play audio CDs, networking or enhance the loading of files. Officially supported 64HDD plug-ins usually get their own commands which can be issued from the Commodore's keyboard. Alternately users can execute other PC programs via the MSD command. This, for example, could be done to run a cross-compiler or other tool.

Below are listed a number of plug-ins supported by 64HDD and downloadable from the 64HDD webpage.

	LongFileName Support This plug-in allows 64HDD to support 16-character filenames in MSDOS using the Win95 LongFileName format. This means most Commodore filenames can be transferred as PRG files and have their names preserved rather than being truncated to DOS's 8.3 format. Upper and lower case, spaces and most other characters... Full setup details are given elsewhere in this manual (pg. 88).
	CD-Audio Extensions By adding this software to your 64HDD system you can control the playback of audio CDs from your Commodore. To listen to the playback all you need is a set of headphones or speakers connected to your CD-ROMs front panel socket or with the special audio-lead connected you can mix the CD sound using the C64's SID chip. Use the CD sound for your latest programming project or just sit back and listening to music whilst you work on your Commodore. You can used the Commodore CD-Player available from the 64HDD website, or write your own. Full setup details are given CD-Audio User Manual included in the plug-in download.

	<p>Power-Loader Extensions</p> <p>By adding these loaders and a parallel cable to your 64HDD system you can reduce loading times to a minimum. The Pwr-Load plug-ins speed-up access to single file programs by 30-50times compared to standard 1541 loads. The speed up is available to standard Commodores, however with a replacement Kernal ROM or 64HDD Cartridge you can use Pwr-Load transparently with almost every application. Wiring instructions for the Pwr-Load cable are included in the plug-in download. Alternately, the Pwr/XE cable can be ordered from 64HDD Shop.</p> <p>Full setup details are given PwrLoad User Manual included in the plug-in download.</p>
	<p>PSID for DOS</p> <p>64HDD user Nils Andreas came up with this idea to interface Roland Hermans' SID file converter to 64HDD. Roland obliged by porting his software to DOS, whilst Nils put together a simple utility to control it directly from the C64 keyboard. Now you can sample all those SID tunes with ease!</p>
	<p>Networking with 64HDD</p> <p>64HDD user Peter Simmonds worked out how to network 64HDD systems running in DOS with other PC which are running either DOS or Windows. The NETWORK.TXT file included with 64HDD has the details, but you may need to download the MS networking client package.</p>
	<p>USB Drives with 64HDD</p> <p>This MSDOS device driver allows many USB "mass storage class" devices to be identified and made available to DOS programs. Mass storage class devices include "thumb drives" (Flash memory sticks), card readers (for CompactFlash, SD, MMC, etc) and even many new Digital cameras. By using the driver, the USB devices identified when DOS boots will be accessible by your Commodore through 64HDD.</p> <p>Full setup details are given in the plug-in download.</p>
 <p>http://sta.c64.org/</p>	<p>1541 Disk Transfers (read/write)</p> <p>Transfer support is available to 64HDD Professional via the F1541, T1541 and I1541 commands. The usage of these is detailed in the 64HDD reference guide. The default as of Prof v1.30 is to the Star Commander utility in command mode for F1541 and T1541 functions – this provides full customisation and superior transfer speeds.</p>
	<p>CMD Function/Command Support</p> <p>All versions of 64HDD include basic CMD command functionality whilst the <i>Professional</i> version includes extensive command, partition and timestamp support.</p>

EZ-Load Functions

(Professional version only)

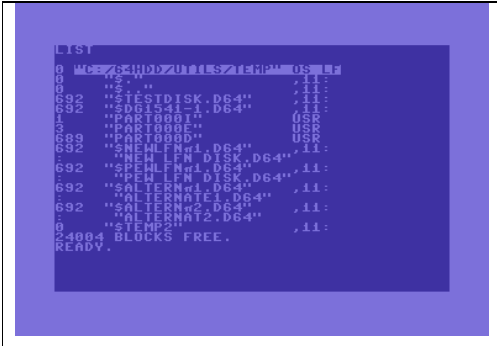
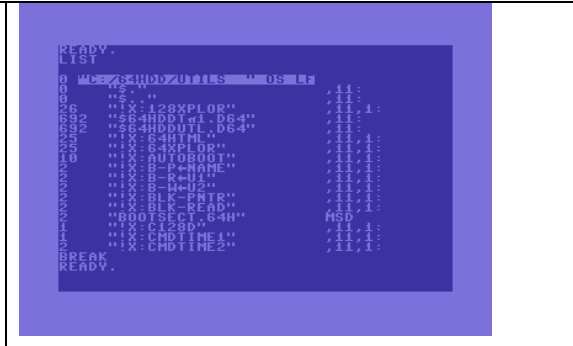
Users who do not have a DOS wedge system, such as that written into the JiffyDOS ROM, now have an easy way to load files and directories without the hassle of having to cursor to the end of the line to add the device number or delete the filetype.

EZ-Load is activated by one of three ways:

- Prefix the directory request with !EZ:
`LOAD"$!EZ:*",9`
- Suffix the directory request with ,EZ
`LOAD"$!* ,EZ",9`
- Make it default with the `-ez` command-line option

EZ-Load adds three features to the standard directory format:

- The filetype is changed to display the current device number (for example PRG is replaced with ", 9 :". This is done automatically for all PRG files, in all file modes. LOADING a file or changing directories requires only the word LOAD to be typed at the start of the line.
- If LFN support has been installed, all files with short names will have their Long File Name displayed on the following line.
- (Optionally) The X-Loader or PwrLoad prefix is added for Professional users, and the absolute LOAD suffix is added after the device number. This functionality can only be set from the command-line, but can be toggled on and off by using the LOAD version of EZ-Loader.

	
EZ-Load basic functions	EZ-Load with X-Loader Prefix enabled

EZ-VIC is activated by the `-vzvic` command-line option. This will set the directory format to suit the VIC20 screen which has fewer columns than the C64's. The narrower format hides the file type fields and limits some of the additional spaces.

Device Management

Activating/De-activating Drives

(Professional version only)

Professional users can use command channel commands ON and OFF to activate and de-activate drives. It is also possible to toggle the status of devices 8 through 11 using the [A] through [D] keys, for example [A] toggles Dev#8.

Remember, only one device of each number can be activated at any given time otherwise the IEC bus will stall.

64HDD can also be “removed” from the serial daisy-chain by pressing the [X] key. This puts 64HDD into a ‘silent mode’ where it listens to the bus, but doesn’t respond. This is sometimes required for compatibility with programs designed for only one device on the serial bus (especially those using the ATN line in a very special way as part of a customised fast-loader scheme). Pressing [X] again re-activates 64HDD. Holding the [64HDD reset] signal low on the Pwr/XE interface cable for longer than 1 second has a similar function.

Device Number Swapping

Many C64 programs were written expecting there would only be one disk drive and that it would be numbered as device #8. Most users have a 1541 in addition to 64HDD. As each device on the Commodore serial bus must have a unique number it is not possible to have both 64HDD and another drive enabled as #8.

The easiest way to avoid the conflict is to switch-off the other device if not required.

Alternatively the other device can be “re-numbered” either by hardware (modifying jumpers and installing switches if needed) or by software (for example by using the one of the demo programs supplied with 64HDD). For 64HDD *Professional* users, there is a third way – device number swapping.

(Professional version only)

Device number swapping is a procedure introduced by CMD devices to cater for occasions where software must be booted from a real disk due to copy protection or fastloader, but once booted, can be run from a compatible device. The error-extended disk image formats used by 64HDD overcome many of these limitations, but the same technique can be used with software that uses fast-loaders or GCR type copy protection or won’t work from the larger D81 image type. The other situation that may require swapping is for programs which were written with only drive #8 in mind.

Two types of device-swapping are catered for:

- When swapping to device #8, the last accessed 64HDD device number and path is exchanged.
- When swapping to device #9, 64HDD device #29 is used

To use in combination with a program that requires booting from a real floppy disk, first activate and assign an image of the program to the appropriate 64HDD device. Then boot the original in #8, swapping once the boot process is complete.

The device-swap function can also be invoked directly from the PC keyboard or by push buttons connected to the LPT port.

- Pressing the F11 key on the PC keyboard is the equivalent of S-8. Pressing it a second time will cancel the “swap”.
- Pressing the RESET64HDD and DISK-FLIP switches can also be used to invoke a swapping operation. Firstly, press and hold DISK-FLIP, momentarily press and release RESET64HDD, then release DISK-FLIP. The action is equivalent to S-8 the first time it is done. The second time the sequence is done the “swap” will be cancelled.

Note: The initial swap may not occur if the C64 has just been started and no serial bus commands have been issued. This can occur with JiffyDOS which does not release all signal lines on start-up (it doesn't expect another device to want to have control). Simply issue a disk command, and the bus will be freed.

Device Swapping Command Summary

(Professional version only)

Command	Syntax
Swap Device number 8	S-8
Swap Device number 9	S-9
Swap Device number back to default	S-D

For complete command and syntax information, refer to the *64HDD Command Reference Manual*.

Multi-Disk Program Compatibility

Flipping disks with “Disk-Flip”

Some C64 programs were distributed on multiple 1541 disks. With some of these programs it is possible to copy the contents to a 1581 image and use all levels of a game for example without “flipping” the disk. However, many programs will not transfer to formats other than that of the original disk. Nor, do some programs allow you to enter disk commands so that you can re-assign which disk image is attached to the current disk. The problem also occurs when you have “program” and “data” disks, for example with a compiler, word-processor and GEOS.

To help in these situations, 64HDD supports disk “flipping” at the push of a button. There are several ways to use this feature:

- You can add a switch to you X1541 or XE1514 connection. This suits users who do have a standalone 64HDD system. The modification involves connecting a switch to pin15 of the LPT plug and to ground (pins18-25). The X1541 cable may already use pin15 for the “detection” loop, but this link can be removed and the cable will still work. The XE1541 cable has no such link in place. This switch is the “disk-flip” button.
- You use the [F12] key on systems that have a keyboard to toggle through a list.
- You use the [1]-[9] and [0] keys on the top row of systems that have a keyboard. This will instantly flip to disk 01 through 10.

In order to use the “multiple-disk” feature, disk images or directories need to be assigned as partitions, or short-cuts. The “disk-flip” function is only available when device #8 is activated on 64HDD.

Partition/short-cut [001] through [010] take on a special meaning when the “disk-flip” button is pressed. The ten partitions are enough to accommodate five double-sided diskettes (ten D64 images). Each press of the button causes 64HDD to search for the next valid definition. This definition is then attached to device #8 and becomes the default for subsequent accesses. If a partition/short-cut in the [001]-[010] range is undefined, 64HDD skips to the next. After partition/short-cut [010], 64HDD jumps loops back to [001].

Partitions [001] though [010] can be assigned automatically or manually (see below for description of both methods).

Notes:

- Each press of the “disk swap” button when 64HDD is “idling” (that is twirling bar is rotating), will increment the “disk number” between 1 and 10. If a valid partition is assigned to this number, the partition is assigned to device #8. The partition can be a disk /tape /LNX image or native MSDOS partition

- Blank definitions are skipped. Therefore if a 2-disk game is used only partitions 1 and 2 should be defined. If 3 double-sided disks make up the game only partitions 1,2,3,4,5,6 should be defined. Hence a maximum “game” size is 5 double-sided 1541 disks or ten 1581 disks.
- When a valid partition (that is, “disk”) is changed to, the corresponding number of beeps is given, for example 1 for disk1, 2 for disk2, etc. The current disk number should also be shown on the PC display (top line).
- The button should have no effect during loads, but may upset SEQ transmissions because 64HDD may idle between blocks. 64HDD does put the C64 into hold-off mode though during the swap, and so may not be a problem (except for transmission is now from another source)

Automating “Disk-Flip”

(Professional version only)

Auto-Disk-Flip (ADF) can also be used to support multi-disk programs. Using ADF, all you need to do is have your files name similarly, and 64HDD will do the rest.

If ADF is activated by the `-adf` command then partitions/short-cuts [001]-[010] are preloaded with the first 10 files in the directory matching the disk image selected. The number of letters used in the filename matching maybe set on the command line by using the `+adf` command, else the default is the first 5.

Using the GUI, another special way exists to automate the Disk-Flip partition table by using extended “common name” partition tables. The method is fully described in the section on Partition and Unit Definitions (ShortCuts).

In addition to using the Disk-Flip button to cycle through the list, professional users can jump to any given disk in the table using hot keys [1]-[9] and [0] (top row of the PC keyboard). Simply press the key and 64HDD will attach the new disk.

Note: the [1]-[9] and [0] hot keys also act as a quick way to access partitions definitions 1-10 even if setup by other programs and not Auto Disk-Flip.

Manually Setting the Disk-Flip List

Partitions [001] though [010] can be assigned manually. Several options are available:

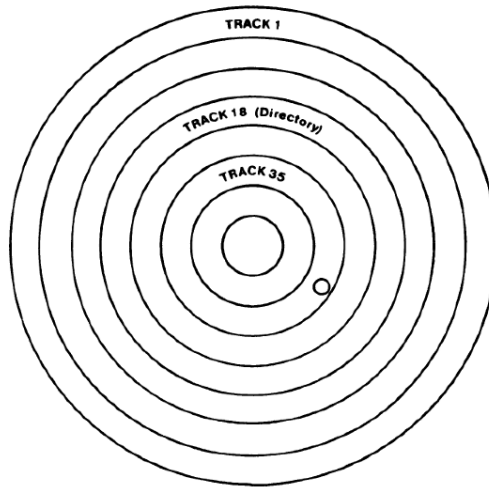
- The partition table (CMDPRTN.TBL) can be manually edited using the DOS EDIT program.
- The partition table (CMDPRTN.TBL) can be updated using a C64 program. The 64HDD distribution includes a sample program (MULTIDSK.PRG) to demonstrate clearing and assigning partition definitions. This could be modified to suit the particular program, and you could create one per game and include the drive number swap code.

- The XS: command can be used to read in a text file containing the names of the disk in a disk set. See the 64HDD Reference Guide for details on this command.
- 64GUI can be used to specify which disk images are part of a disk set (*professional only*)

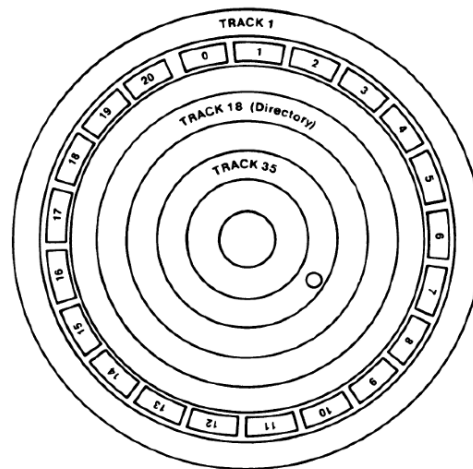
Copy Protection Support

Introduction

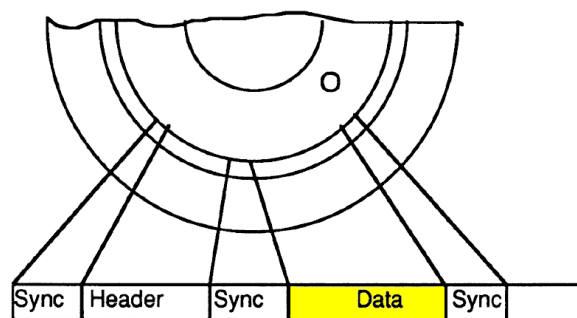
Many commercial programs written for the C64 were distributed on copy-protected disks. The schemes employed by these programs were many and varied and even to this day, not all can be transferred to emulator disk image format. The information below provides an overview of how disks work and how the emulator formats capture the information that is on them.



The above describes the structure of a typical 1541 disk. The standard disk has 35 tracks (or concentric rings), with the directory on track 18. Each track is divided into a number of segments called sectors. These sectors are shown pictorially below. Some Commodore disks can vary the number of sectors stored on a track on a track-by-track basis. The actual 1541 drive was physically capable of formatting more than 35 tracks, in fact it could easily be made to format 40 tracks. Even more extreme, some schemes used the fact that “half-tracks” and tracks up to 42.5 could be accessed and so made use of these as part of their copy-protection.



Commodore used a disk recording method called GCR. The method means that the sectors are recorded on the disk in a special way, different to that used by the IBM format that has become widespread. Commodore was not alone in its choice of disk recording method, notably Apple also used this method. The pictorial below shows a simplified pictorial of all the information stored in one sector.



The diskette structure

In most cases, only the information in the “data” section is important and this can be considered as the “block”. One block is 256bytes. However, the information store on the disk before and after the block can be manipulated to provide copy protection. The copy protection information can result in errors when the disk sector or track read. These errors are detected by the program and the absence of which is taken to mean the disk has been tampered with.

The disk image formats used by Commodore emulators try to capture the information on these disks by creating a linear file containing the data blocks, errors and /or GRC code. The D64 or similar format image is simply a sequence of data blocks as shown in the pictorial below. If T&S error information is also captured at the time the disk is transferred, the format becomes known as an “error extended” disk image.

Disk data	Image Type
Track 1, Sector 0	D64 or similar 256bytes per block
Track 1, Sector 1	
...	
Track n, Sector m-1	
Track n, Sector m	Error Extended 1byte per block
Error T ₁ , S ₀	
Error T ₁ , S ₁	
...	
Error T _n , S _{m-1}	
Error T _n , S _m	

The original D64 image format knows nothing about the “half-tracks” and so in its standard form, only 35track disks are stored. A 40track version of the disk also now exists and is supported by 64HDD.

For 64HDD, or indeed any other emulator, to work with a copy-protected disk enough information needs to be captured from the disk when it originally transferred to disk image.

The table below outlines some the schemes employed and how compatible they are with the disk images supported by 64HDD.

Copy Protection	Disk Image Type	64HDD Support?
none	D64 or similar	Yes, disk image or MSD/LFN modes
Hidden files	D64 or similar	Yes, disk image only
T&S error	D64 (error extended)	Yes, disk image or transfer to MSD/LFN with T&S emulation
40Track Disks	D64 or similar	Yes, disk image or MSD/LFN modes, Read-only on disk image though.
Half-Tracks	D64 or similar	Depending upon the method, some ½ track schemes block physical backups, but not D64 backups as for example T20.5 will be saved as T20 upon the second read attempt
Half-Tracks	G64	File format not supported by 64HDD
GCR errors	G64	Not supported, no X1541 cable tools exist to create image from real disks

Fortunately, many programs can be archived without any copy-protection being present and these will often be the easiest to use with 64HDD. Parameter tools such as Maverick can de-protect many programs, or alternatively back-up cartridges such

as ActionReplay can make single file back-ups of most games, and AR for example can save backups directly to 64HDD (when active as device #9).

D71, D81 and other disk image formats work in a similar way, but it is less likely that these will contain copy-protection information. However, the extended error information is a useful check on whether the disk contains physical errors due to aging or surface damage.

TRACK18 Emulation

(Professional version only)

Many commercial programs written for the C64 directly access the directory located in Track 18. They do this for reasons of speed, but the technique only works if the disk drive is a 1541. Many of these programs will fail to work if transferred to D81 format as the 1581's directory is located in an entirely different disk track. This would be a serious modern day limitation as it prevents programs being transferred to the 64HDD native file system where they can be more efficiently run without the 1541's drive space constraints. However, 64HDD Professional can overcome all this.

The 64HDD MSD file system uses the native file system of MSDOS or the LFN extension of it. The MSD file system doesn't have a CBM compatible directory structure and so cannot be normally accessed with block-read commands. TRACK18 emulation corrects for this by intercepting the block-read command, and either creating or responding with the equivalent directory block information.

This enhancement, combined with the mapping of the 1541's ROM, allows programs such as GoDot to use the unrestricted space of the MSD/LFN file system, whilst keeping the program "thinking" it is working with a 1541 drive.

This emulation scheme alone however, will not overcome all incompatibilities as some programs, most notably GEOS and programs with copy-protection, will access data blocks not on the disk directory's track (see next sub-section).

MSD TRACK&SECTOR Copy Protection

(Professional version only)

Many commercial programs use disk errors as part of their copy protection schemes. Early copy protection schemes used errors located in a particular track-sector location. These errors can be transferred to a disk image by using the error-extended disk format when the disk is first transferred to D64, D71 or D81 format. 64HDD copes with these "errors" and sends the appropriate response when the copy protection scheme tries to detect a copy.

However, when the disk's contents are transferred to the MSD file system, not all commercial programs will work as the track and sector error information is not present. The T&S error information can be transferred to the MSD directory by using the disk interrogate command (`I1541`), or by manually creating a file called 64HD-T&S.ERR containing the track-sector-error table for the original disk.

Despite this enhanced mode, there are still many other copy protection schemes which 64HDD cannot cope with. The newer G64 format was hoped to overcome these limitations. However, many of these error schemes cannot as yet be transferred to a disk image by the CBM-PC copy software. There are however tools available to convert the data in G64 images to D64 files. This conversion will lose the copy protection information in most cases, preventing the program from booting – but will still allow other data to be accessed by 64HDD.

T&S Command Summary

(Professional version only)

Command	Syntax
Interrogate 1541 Disk and transfer error information	I1541:

For complete command and syntax information, refer to the *64HDD Command Reference Manual*.

Native C128 Mode Support

Boot Sector Support for Disk Images

Disk image booting is supported by all versions of 64HDD greater than v0.7a0. It should be noted that although the C128 kernal will allow the boot sector from any device number to be requested, subsequent operations default to device #8. If you wish the boot process to be completed, ensure 64HDD is configured as device #8.

Boot Sector Support for MSD/LFN File Systems

(Professional 128 Only)

BOOTing from the native MSD/LFN file system is only supported by 64HDD Professional for the 128. Using a boot sector creation tool (such as AUTOBOOT supplied in the distribution zip), pseudo boot sectors can be created. The boot sector information is stored as a special file identified as BOOTSECT.64H

The same disk image rules apply to booting from the MSD/LFN file system.

CP/M Support

Although 64HDD is intended primarily to support native Commodore modes of operation, some limited CP/M compatibility is possible. Support presently is limited to the use of the disk images file system, namely D64 types because the operation of CP/M is via direct track /sector accesses. Only disk images compatible with the GCR system are usable with 64HDD. This means that MFM disks cannot be utilised.

Multiple device numbers can be utilised, each number being associated with the appropriate device letter, for example A: instead of #8, D: instead of #11

It has been reported that some CP/M utilities such as SPORT.COM can be used to send disk commands to 64HDD for the purpose of changing disk images etc. It should also be remembered that Disk-Flipping **and 64GUI** (Professional 128 Only) can also be used to change disks.

Presently there is only minimal demand for a better CP/M support, and so there is no intention of spending time to develop these capabilities further. If you require better CP/M support, please discuss this requirement with the author.

Note: There is presently no Z-Loader or PwrLoader support for the CP/M operating system.

GEOS 2.0 Support

Introduction

GEOS support is available to 64HDD and you have three options:



1. Download the pre-keyed D64 images from the CMDRKEY website. These are essentially “load and go” images, but you will only be able to use the basic GEOS applications. You may skip most of the information in this section of the 64HDD manual if you take this option.
2. Download the freeware driver disks from the 64HDD website and follow the instructions in this section of the manual on how to key these kernel drivers to match your personal GEOS disks
3. Use the XP GEOS-Kernels distributed with 64HDD Professional. To use your existing applications, the keying procedure will need to be followed.

64HDD provides support for GEOS via the use of a specialised GEOS-kernel. The kernel is the code that is always available to applications running under GEOS. The kernel routines that talk to the disk drives have been modified to talk to 64HDD in a special way, and 64HDD knows how to talk back. This communication method is not the same as that used by real 1541/81 disk drives, but that doesn't not matter to 99% of the applications written for GEOS.

If you go for methods 2 or 3, your GEOS system needs to be configured before it will work. Like the original GEOS, your 64HDD copy needs to be “keyed” with the serial number on your original boot disk, but once done you need not use your original floppies again.

What will your 64HDD-GEOS configuration look like?

When 64HDD you will no longer need to have a stack of 5.25” GEOS disks. All these disks will be accessible as images available from your 64HDD-GEOS drive.

Your new configuration can include one or two 64HDD drives and a REU, or one 64HDD drive and a real disk (should you need to transfer data to real disks). The configuration details will be discussed in detail below.

The other benefits of having GEOS run from 64HDD (other than eliminating your stack of disks) is that

- You'll be able to launch applications located on different disk images by using simple to configure disk ShortCuts and thus avoid the disk shuffling
- You'll have an accurate clock as the driver included will set the time from the 64HDD system when you boot

- You will be able to spool print jobs to files, using 64HDD Professional
- You'll have access to lots more features yet to be finalised (why not help by coding some)

The basic D64 driver set is available to all versions of 64HDD. The professional version also includes support for the D81 image format and for Pwr-Loader support.

In the future, additional support may be developed to make use of the features provided by 64HDD (eg PC-Mouse driver). However, there is no intention for me to develop a new GEOS. Wheels and MegaPatch3 seem like fine products and should you wish for 64HDD to be usable with these products, discuss it with their respective authors. I am willing to assist the authors with coding the necessary disk-drivers.

If you wish to use replacement desk-tops such as Dual-Top and Mini-Desk, you can try them. These desk-top replacements are merely file management applications that lie over the kernal and providing they use the standard kernal jump-table calls, should work. Not all at present work with the Re-Compiled kernals, but most work with the *XP* version.

All official GeoWorks products have been tested and these do work. This includes:

GEOS,
geoPAINT
geoWRITE
geoCALC
geoCHART
geoPUBLISH
geoPROGRAMMER
geoBASIC
and various utilities supplied on the disks.

What will not work with 64HDD-GEOS?

In addition to Wheels and MP3, Gateway is not expected to work with the 64HDD-GEOS kernal. Maurice Randall has released the driver code for the 1581 Wheels disk drivers, so it should be possible to modify this to work with 64HDD. Anyone interested in helping should contact me for information.

It is also expected that some programs that apply patches to the GEOS kernal will not work with the reverse-engineered kernals. This is because the actual code within the kernal is differently organised to the original GEOS. This may include patches for the SCPU and TurboMaster accelerators. If you have the need for such devices, send me some details and I'll investigate what can be done.

Additionally, drivers for other non-standard drive types may conflict with 64HDD. Though it has not been verified, it is not expected for example to use the CMD HD, 64HDD and an REU concurrently. Only one drive type other than 64HDD is expected to work, so you may be able to only get some combinations working.

Choice of Different GEOS-KERNELS

There are several new GEOS-kernels to choose from depending upon the disk hardware configuration and disk format you are using. The recommended drivers are those that include a fast-loader disk routine as they will dramatically improve performance.

There are two families of GEOS-Kernels available for 64HDD Users:

XP GEOS-Kernels for GEOS64 and GEOS128:

(Professional version only)

These are the next generation of Xtra-Performance (XP) kernels available exclusively to 64HDD *Professional* users. These kernels work on the principle of loadable disk-drivers and offer a higher degree of overall compatibility with non-standard GEOS applications (such as those that patch the system).

Re-Compiled GEOS-Kernels for GEOS64:

These are back-bone of the kernels available to freeware users of 64HDD.

Extended functionality based on these kernels is also available to Professional users.

These 64HDD-Disk Drivers have been built by studying the information in the GEOS Programmer's Reference Guide and examining the reverse-engineered source code for GEOS 2.0 made available by Maciej/YTM. Many thanks go to Maciej for the work to reverse engineer the GEOS Kernal. Those wanting to program for GEOS using should check out these sources, and other examples of his applications (usable with TASS and ACME PC-cross-assemblers). Maciej is also responsible for the GEOS library included with CC65, which can be used to write GEOS applications in C.

First-time Installation Procedure (serial number keying)

The disk keying and setup process can be avoided by using the pre-keyed disk images available directly from the CMDRKEY website. 64HDD Professional users who opt for the XP-GEOS kernels can also avoid some of these installation requirements.

For certain GEOS applications to work they require the GEOS kernal to report a serial number that matches that "keyed" to the application you own. The installation procedure described below will take care of that, ensuring your GEOS applications continue to work.

Also, GEOS is still available as a commercial program. In order to respect the rights of those who own the rights to it, you need to perform the initial boot from a real disk to validate that you are entitle to the 64HDD upgrading. Other files such as Desk-Top etc must be provided from your original disks. Before following the steps below, read through the rest of this section on GEOS support so that you are familiar with all the options you have.

Before proceeding with the first-time installation process, you will have to make some decisions about which disk protocol and which disk image format you will be using.

- Step 1) Copy all your GEOS disks to D64 format
If you haven't done this before, do so using TRANS64 or StarCommander. There is also a large range of Public Domain GEOS software available on the internet.
- Step 2) If required, copy the DESK-TOP and other utilities to the 64HDD-GEOS boot disk image you hope to use
This should be done using Trans64, StarCommander or another disk-management utility that works with disk images and understands the GEOS file format. CONFIGURE should be placed after at least one auto-exec driver, eg after the 64HDD clock driver or renamed to CONFIGUREx so that it is not automatically started by the DESK-TOP.
- The boot disk image to use depends upon which disk-driver version you will be using (slow, fast, pwr-load). You should try the fast drivers first and only if not compatible should you revert to the slow driver (see notes below)
- Step 3) Copy the 64HDD-GEOS boot D64 to a real 5.25" floppy
This physical copy of the 64HDD boot disk will contain the application that will be used to "key" your 64HDD D64 boot disk image. The keying application must be run from a real disk drive after booting your original disk.
- Step 4) Start up 64HDD with your 64HDD-GEOS boot disk image attached as drive #15, and no other 64HDD drives active
Only the image in drive #15 will be keyed by the registration program. The EXIT:15 command can be sent to restart the GO64HDD batch file, or you can set this path manually.
- Step 5) Boot GEOS 2.0 using your original disk in #8, swap to the copy of the 64HDD disk and launch the keying program
This GEOS application will "key" your 64HDD D64 boot disk image and transfer your serial number.

Booting GEOS from 64HDD

XP-GEOS (XP Kernals)

(Professional version only)

The XP kernals greatly simplify the boot process, though some of the general rules discussed for the recompiled kernals also apply to this system. XP is available for both GEOS64 and GEOS128. Each GEOS master disk contains a boot-menu program that allows runtime selection of the disk driver to load.

There are currently six disk drivers to select from. The default is to configure only the boot drive as type “real”. The PreConfig utility is used to change the 64HDD drive to type “RAM” if you wish to use GEOS with a real 1541 disk drive. In general, the same rules as above apply to mixing real, 64HDD and REU drives. The table below outlines the disk driver protocols that are support. If you do not use any of the disk drivers, they can be deleted to recover further disk space. By re-ordering the location of the files on the desktop, the first driver file will become the default type.

	Disk Driver Names	Reads	Writes	Remarks
1	DRV1541FF or DRV1581FF	Fast	Fast	Faster PCs, X-Cable
2	DRV1541PF or DRV1581PF	PwrLoad	Fast	Faster PCs, PwrCable
3	DRV1541SS or DRV1581SS	IEC	IEC	All systems
4	DRV1541FS or DRV1581FS	Fast	IEC	Slower PCs, X-Cable
5	DRV1541PS or DRV1581PS	PwrLoad	IEC	Slower PCs, PwrCable
6	DRV1541PP or DRV1581PP	PwrLoad	PwrLd	Bi-dir LPT, PwrCable

With GEOS XP, CONFIGURE will appear as a file in the border of your boot disk. The CONFIGURE file should be left there to prevent it from executing automatically on boot-up. You will only need to use CONFIGURE (instead of, or in addition to PreConfig) if you wish to use a REU device.

To activate your REU, 1) start CONFIGURE after booting has finished, 2) enable the option “DMA for MOVEDATA”, 3) enable RAM1541 or RAM1571 drive type. Following this sequence is necessary for correct operation of the REU driver.

Re-Compiled 64HDD-GEOS Kernals

Before proceeding with the first-time installation process, you will have had to make some decisions about which disk protocol and which disk image format you will be using. The freeware release is limited to D64 and a choice of “slow” or “fast” serial routines. The “slow” format uses the standard CBM way of talking to drives, it will work, but it is slow. The “fast” serial routines use a custom disk speeder. The “fast” routines may not be compatible with very slow PC processors; you will have to try it for yourself. You may also run into problems on very fast PCs which use a variable clock speed (especially some modern notebooks).

For each disk image type (D64, D81, etc) there are three disk protocols and two modes to choose from. This may seem complicated, but there are good reasons for this. For each of these combinations you will have a choice of kernal to use. The initial release is limited to D64. Refer to the table below:

Re-Compiled 64HDD-GEOS Kernals		
Protocol	D64 images	D81 images
Slow IEC routines	GEO1541S GEO1541S.REU	GEO1581S
Fast IEC routines	GEO1541F GEO1541F.REU	GEO1581F
Pwr-Load routines (Professional version only)	GEO1541P GEO1541P.REU	GEO1581P

It is good practice to leave both drivers on your boot disk:

- one for working with a real disk drive, and
- one for working with an REU.

Professional version only

A new Pre-Configure tool means that you only need to keep a minimum of one Kernal type that can be modified by the auto-exec PreConfig application to support a second disk of type real, 64HDD, or RAM. See information later in this chapter. The professional version also has a simple BASIC boot program to allow selection of multiple options.

If you like you could order these two files such that the most often used is first in the directory, so that `LOAD"*"` gets your most popular configuration loaded. Note: that these files may be compressed and may take some time to de-compress after you type `RUN`

GEOS has the limitation built-in that it can only work with two drives – A and/or B; with drives C and/or D needing to be swapped for usage (to/from the REU). 64HDD-GEOS will also only work with only two drives shown, A and/or B.

- One or both of these drives has to be a 64HDD
- At least one drive (64HDD or real) has to be of non-RAM type (either 1541/71/81) in order for CONFIGURE to allow you to save/exit.

The table below shows which drivers you need to use depending up your drive set-up.

Configuration	Real Drive 1541/71/81	RAM Drive "inside REU"	64HDD Drive "disk image"	64HDD Driver
Real Disk Drives only	X			N/A
Real Disk Drives + REU	X	X		N/A
64HDD + Real Disks	X		X	RAM-type GEOxxxxx
64HDD + REU		X	X	Non-RAM GEOxxxxx.REU
Two 64HDD Drives			X2	Non-RAM GEOxxxxx.REU

The “xxxxx” will depend on the disk format and protocol (slow, fast, pwr) being used, as noted above. There may not be any 1581 “REU” versions of the kernal as these are only supplied with the professional version which also has the PreConfig application.

Using CONFIGURE (Re-Compiled Kernals)

Most of the time you will be able to work from one 64HDD “drive”. This will be clear later when the utilities supplied with 64HDD-GEOS are explained in detail. Should you need to use other devices such as a real disk drive, a REU or another 64HDD-drive, you will need to run CONFIGURE.

Currently some precautions apply to the use of the CONFIGURE program. Normally CONFIGURE auto-runs on boot-up and detects the drives that are attached to the system. The problem is, CONFIGURE has a default way of checking drives which will cause GEOS to hang when it talks to a 64HDD drive. Until a patched version of CONFIGURE is developed the following work-around has to be used.

- Place CONFIGURE after the auto-exec programs. The D64 supplied with 64HDD includes a clock driver “Get 64HDD RTC”, place CONFIGURE after this file.
- Manually start CONFIGURE after the desktop is first booted. From here, select the additional device to be used.
- For CONFIGURE to let you save or exit, at least one of the attached device needs to be of non-RAM type
- Do not have CONFIGURE on your non-boot disks. Logging these disks will activate the program and cause the system to hang. A simple work-around is to rename the file to CONFIGUREx
- Do not run applications from a real disk in Drive A. This will result in Drive B (your 64HDD drive) disappearing. When you next try C= B, CONFIGURE on that disk will be automatically run and will attempt to detect the 64HDD drive causing the system hang. A real drive should be used for transferring files into and out of your system, not usually for running applications.
- Do not use directory shadowing.

Example #1

- 64HDD drive is #9, D64 boot image, fast-load disk driver
- 1) Start 64HDD on #9, attach the GEOS disk image
 - 2) Load and run `GE01541F`
 - 3) When Desk-Top finishes loading, you are ready to use GEOS. No further operations are needed. Drive A will report an error if you try to access it with C=A, but the error is not fatal.
 - 4) Within programs the “DRIVE” button should be not visible.

Example #2

- 64HDD drive is #9, D64 boot image, fast-load disk driver
 - real 1541 is #8
- 1) Start 64HDD on #9, attach the GEOS disk image
 - 2) Load and run `GEO1541F`
 - 3) When Desk-Top finishes loading, start CONFIGURE.
 - 4) The 64HDD drive #9 will be of type `RAM-1541`. Select drive #8 as `1541`. “Save Configuration”. “Quit”.
 - 5) Use `C= A` to activate drive #8. Use `C= B` to activate drive #9. Alternatively, click the disk A/B icons.
 - 6) Within programs the “DRIVE” button should be visible.
 - 7) Note: to copy files between Drives A and Drive B using the Desk-Top, the disk names should be different (this is a GEOS rule).

Example #3

- 64HDD drive is #9, D64 boot image, fast-load disk driver
 - you want to have your REU available
- 2) Start 64HDD on #9, attach the GEOS disk image
 - 3) Switch off your real #8 if possible
 - 4) Load and run `GEO1541F.REU`
 - 5) When Desk-Top finishes loading, start CONFIGURE.
 - 6) The 64HDD drive #9 (B) will be of type `1541`. Select #10 (C) to be the same. Then select drive #8 (A) as `RAM-1541` or `RAM-1571` or `RAM-1581` depending upon the size of your REU. Then select the DMA option if you wish to use that access method. “Save Configuration”. “Quit”.
 - 7) Use `C= A` to activate drive #8. Use `C= B` to activate drive #9. Alternatively, click the disk A/B icons. A Ghosted C drive may exist, ignore this.
 - 8) Within programs the “DRIVE” button should be visible.
 - 9) You REU can be used to store the Desk-Top and other files regularly accessed.

Example #4

- 64HDD drive is #9, D64 boot image, fast-load disk driver
 - 64HDD drive as #8 also
- 1) Switch-off #8 or renumber it to either 10 or 11
 - 2) Start 64HDD with #8 and #9 active.
 - 3) Attach the GEOS disk image to drive # you wish to boot from. Attach another D64 to the other drive #
 - 4) Load and run `GEO1541F.REU`
 - 5) When Desk-Top finishes loading, start CONFIGURE.
 - 6) The 64HDD boot drive # will be of type `1541`. Set the other drive # also to `1541`. “Save Configuration”. “Quit”.
 - 7) Use `C= A` to activate drive #8. Use `C= B` to activate drive #9. Alternatively, click the disk A/B icons.
 - 8) Within programs the “DRIVE” button should be visible.

- 9) Note: to copy files between Drives A and Drive B using the Desk-Top, the disk names should be different (this is a GEOS rule).
- 10) You may additionally have an REU also active for caching, etc but this may not work for swapping. In fact, you may need to activate it before selecting the disk for #8.

Using 64HDD-GEOS Supplied Utilities

There are a number of utilities supplied with the 64HDD-GEOS system and more will be added in the future. The purpose of most of these utilities will be to assist with disk image navigation and/or to take advantage of other 64HDD features.

Disk-Flip: With 64HDD-GEOS configured for Drive A as either the boot or as a second 64HDD drive, the disk-flip function can be used to swap through a list of D64 disk images. Care should be taken to only swap the “disk” when GEOS would normally consider it to be safe to do so.

64GUI: The GUI interface built into 64HDD Professional can be used to navigate and set GEOS disks. It is recommended to first “close” or “disk” before attaching a new one image to the assigned device number. Note: you can only exchange to a disk of the same type.

ShortCuts: Supplied with 64HDD is a small application called ShortCut. This application should be copied to all your disks. This application allows you to attach a new disk image by simply running it. In addition to attaching a new disk, the name of an application to launch can be specified.

This application can be remained to suit your needs. The information in the InfoBox (C=Q) identifies where the short-cut goes to. For example, say you want a short-cut to your GEO-Publish disk.

- Copy ShortCut to a new name, eg `geoPublish`
- Change the text in the info box to point to the name and location of the disk image, eg `d:/geos/geopub.d64`
- If you also want to start the application, add the name of the application to the path after a * character, eg `d:/geos/geopub.d64*GEOPUBLISH`
- Note: GEOS is case sensitive when it comes to application names.
- A special use of the ShortCut feature is to replace the “DESK TOP” file that is 120blocks in size with a 2block short-cut called “DESK TOP” pointing back to your boot disk. This will give your applications more room to save data. For example, `d:/geos/geosboot.d64`

Whenever applications finish, they will return to your first boot disk where you can have all your short-cuts.

The InfoBox can also be used as a convenient way of sending commands to 64HDD to do house keeping functions such as checking on drive space with FREE: or setting the date with DATE: The reply from 64HDD will appear in a dialog box.

ShortCut+: Supplied with 64HDD Professional is an enhanced version of ShortCut, called ShortCut Plus. This application has additional capabilities compared to the standard ShortCut tool. By modifying the parameters in the info-box these functions can be activated. The new features allow you to:

- 1) Spawn a copy of the ShortCut utility on the target disk. By adding a # at the end of the path, the new disk image will firstly be attached, but before returning to the desktop, ShortCut+ will create a new “blank” ShortCut on the disk so that it can be redefined and/or copy. Eg: `$d: /geos/geopub.d64#` will attach the geopub.d64 disk image, then create a new ShortCut on that disk image.
- 2) Attach a new disk image to a particular device number (not just the current device). For example, appending , 8 will apply the request to device 8 regardless of whether ShortCut+ was launched from device 8, 9 or 10 (A, B or C in GEOS speak). Eg `$d: /geos/geopub.d64, 8`

The latest version of this utility works with both GEOS64 and GEOS128.

RTC Clock: Supplied with 64HDD is a small application called “Get 64HDD RTC”. This is an auto-exec application and will on boot-up set the GEOS time to that set on your 64HDD-PC. The latest version of this utility works with both GEOS64 and GEOS128.

PreConfig: Supplied with 64HDD Professional is new auto-exec tool which allows the Pre-Configuration of the 64HDD GEO-Kernal at start up. The tool also performs the functions done by the RTC driver thereby reducing the number of auto-execs that need to be run at boot-up. PreConfig lets each drive be set as either “real” or “RAM” type. The setting is changed by editing the InfoBox data.

If you want to use a real RAM expansion device such as a C1750, then the 64HDD device should be set as “real”. If you want to use a real disk drive such as a 1541 with 64HDD, then you should identify the 64HDD disk as “RAM” type. PreConfig will run before the desktop is loaded, or can be re-run manually by double-clicking the icon. If you are using a Commodore Disk or RAM Device, you will need to manually start CONFIGUREx to ensure the driver code is installed for them. The latest version of this utility works with both GEOS64 and GEOS128.

Using Other GEOS Utilities

Other GEOS tools can be used to control 64HDD during your GEOS session. These utilities include CMD_MOVE (for copying or changing between disk images attached as “partitions” (CMD compatibility mode with 64HDD Professional must be activated). “DOS wedge” by Jim Collette is another utility that can be used to enhance your GEOS session by allowing you to send commands to your 64HDD system. Others to try include geoShell.

Command: Clear/Set Master-Disk-Protection flag

Applicability:

☐ All ☐ MSDOS ☒ D64 ☐ D71 ☐ D81 ☐ D2M ☐ T64 ☐ LNX

Syntax: “GMP : 0”
“GMP : 1”

Examples:

Clear protection flag on current diskimage

OPEN 1,11,15,“GMP:0”

CLOSE 1

Errors:

-

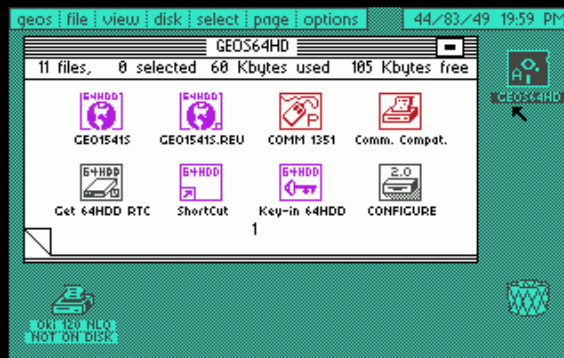
Notes:

- When bit is set, files cannot be directly deleted from the desktop, but only via dragging to the border.
- Booting from a diskimage will re-activate the protection flag, and so the only way to clear flag from a boot disk is temporarily by using a utility running under GEOS

64HDD-GEOS Disk and Utilities (Screenshots)

64HDD-GEOS Disk

This disk contains you're the start-up kernels and some utilities. DeskTop needs to be added and the D64 keyed with your GEOS serial number before it will work as a boot disk image.



Key-in 64HDD

This is the application that will perform the keying operation. You must have the D64 transferred to a real disk and run from there after booting the original and 64HDD.

**Non-Keyed Error**

If your 64HDD-GEOS boot disk image has not been keyed you will get this error screen – pretty obvious.

Try keying the disk image again.

**Desk Top Error**

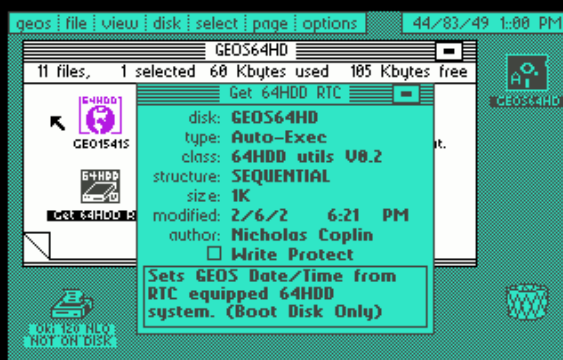
This will result if you successfully key your 64HDD boot disk, but either you forgot to put desk-top on the D64 (you need to do this as it is not supplied) or the driver has experienced an error whilst trying to load desk-top (might mean your PC is not fast enough to use the fast drivers)



64HDD Clock Driver

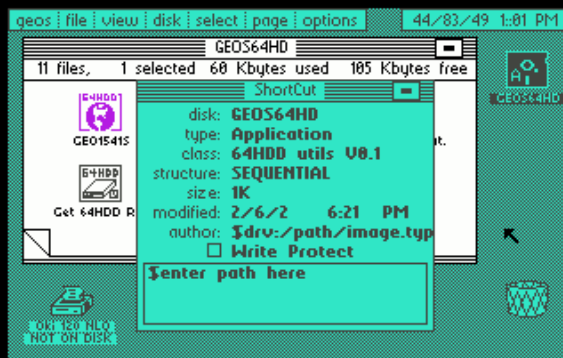
This is an auto-exec that will run each time your 64HDD-GEOS boots to set the date and time automatically.

It will only work if your boot /current drive is a 64HDD drive.

**ShortCut Utility**

This is small application can be used to connect and run applications not on the currently attached D64 disk image.

It's one of the ways of moving between your various without physically swapping disks.



Print Spooling and PrintEngines

(Professional version only)

Commodore serial printer devices normally are assigned device numbers 4, 5 or 6. 64HDD Professional had the ability to trap the information being sent to these device numbers and re-direct this information to disk. Each job started and trapped is assigned a "JOB" number. These jobs can then be processed by custom Print Engines to either translate the data for a different printer or provide some type of emulation.

For 64HDD to trap devices 4, 5, and 6:

- Switch off any device with the same number as the one trapped by 64HDD
- Activate device spooling from either 64GUI or by adding the appropriate device switch on the command line, eg -4 for activating device #4

The 64HDD screen will indicate that the `SPOOLER` is active.

Refer also to the *64HDD command reference manual* for detail on command channel control of printing features.

Print Jobs

Communication to serial printers essentially follows the same protocol as disk drives do. The devices listen as data is sent to them, whilst in the background the actually "print" the information to paper. Communication to a printer begins with the `OPEN` command. If the `OPEN` command includes a secondary address (eg `OPEN4,4,7`) then 64HDD knows this to be the start of a new "job" and so closes off the current "job", assigns it a new number and starts the next spool file. However, there are several instances that may cause some variation to this.

- Print jobs which do not specify a secondary address: eg `OPEN4,4` When this happens 64HDD will continue to spool the information to the current job. To overcome this and initiate a new job, 64HDD includes a special command that can be sent over the command channel.
- Some programs that continually open and close the printer device, even though they are only printing a single job. The most notable software of this type is that written for C1520 plotter that is designed to use the secondary channels to define special actions. Fortunately the C1520 is reserved as device #6, but if you come across other such software then you may need to have a specialised PrintEngine written.

Fortunately, most programs including listing of source code and GEOS are well behaved and so should not cause to many problems. When listing BASIC source using the `CMDx` redirection command, just remember to include a secondary address when opening the printer device and the rest will take care of itself.

The print job can also be manually closed and incremented using the [Num4][Num5][Num6] keys on the PC's numeric key pad (not the top row of the keyboard).

For each print job, two files are created. The first is an `APPSPPOOL.USR` file, that for now contains the secondary address used to open the file, but will in future contain additional information about the print job. The second is the `JOBSPPOOL.USR` file, which contains the stream of data the Commodore application was sending to the printer device.

Print Engines

Print Engines are standalone programs that read in a Print Job and process it.

Print Engines can be written to perform a number of purposes:

- Translation: from Commodore format to another format, for example PC Text or HTML.
- Redirection: this involves taking the data that was destined for a Commodore printer and streaming it to another devices connected to a PC (eg another LPT port) or to another Commodore device (for example connected as #5). It should be noted that the latter can also easily be written as a Commodore program.

Print Engines are written as separate pieces of software. They can be written in any language that compiles to a MSDOS EXE. A number of PrintEngines are included with 64HDD Professional and these may be supplemented by others still to be coded. PrintEngines should be stored in a location that is on the MSDOS Path, and the naming convention is: `64PE-xxx.EXE` where `xxx` is the file extension created by the PrintEngine.

64GUI – PrintManager

(Professional version only)

64GUI includes a PrintManager to help you manage jobs on your print queues. For some, this is easiest way to delete or “print” jobs. The use of the PrintManager is fairly straight forward; select the device, select the job and click on the option. There are a number of Print Engine options, or you can use a custom Print Engine by clicking “other” and typing in its name.

All the functions of the PrintManager can also be invoked through the 64HDD command channel directly from your Commodore keyboard if you prefer to work it that way.

Unlike the rest of 64HDD which can be installed in alternate drives, the printing functions need to be installed on the C: drive. The following directory structure is created when the installation zip is correctly expanded:

```
C:\64hddpro\device02
C:\64hddpro\device04
C:\64hddpro\device05
C:\64hddpro\device06
```

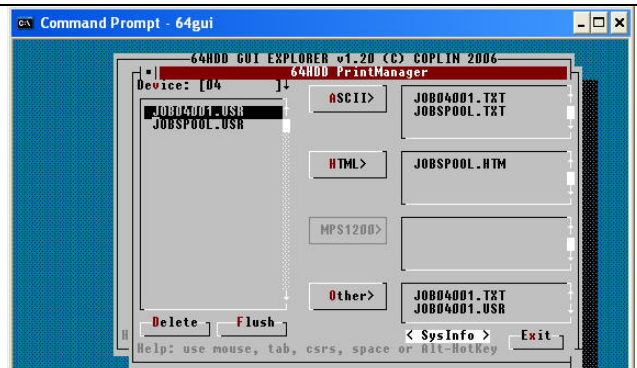
C:\64hddpro\fonts

C:\64hddpro\temp

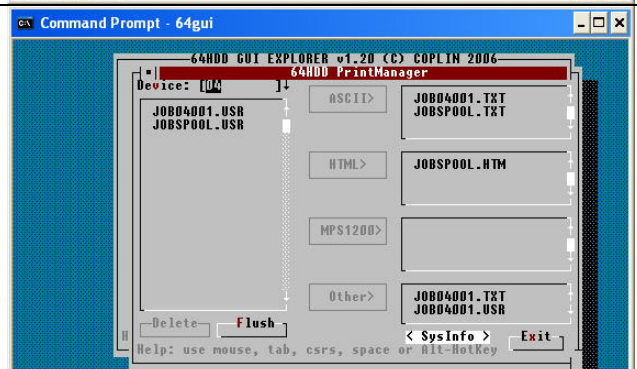
Each of the “deviceXX” directories is where the respective spool files are created.

The “fonts” directory contains TrueType™ fonts that may be used by the HTML based print engines. The fonts need to be installed into your appropriate MS Windows folder (see Windows Help on how to do this). The “fonts” allow representation of Commodore’s special characters on your Windows PC and thus allow you to print these to documents to modern day printers supported by the Windows platform.

The built-in PrintManager provides a convenient interface with which to re-direct spooled print jobs.



The PrintManager uses context sensitive action buttons.



Print Command Summary

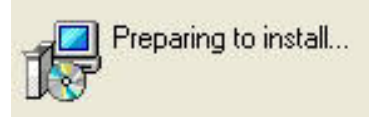
(Professional version only)

Command	Syntax
Increment to next JobNumber	PNEXT :dev
Viewing the PrintQueue	PPAUSE LOAD"\$", pdev
Printing a specific JobNumber	PPRINT:dev:jobnumber:PrintEngine
Delete a specific JobNumber	PDEL:dev:jobnumber
Flush the print queue for a device	PFLUSH:dev

For complete command and syntax information, refer to the *64HDD Command Reference Manual*.

Setup and Configuration

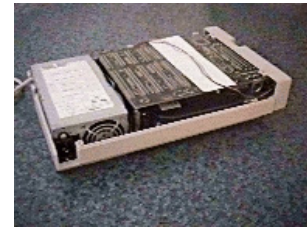
The details below generally apply to both the freeware and Professional versions. In some cases 64HDD Professional has a slightly higher system requirements, and some optional requirements are needed to make use of the advanced features. Remember that other important information may be found in the readme.txt and FAQ supplied with the installation files.



64HDD will work just as well with your regular MSDOS compatible PC or laptop, or a custom built box. If you are not building your PC from scratch, you can skip the first few sub-sections.

The 386/486/Pentium hardware platform chosen can be a stand-alone PC device in a standard PC case, or can be integrated in one of the following ways:

- 1) Small (Baby-AT form factor) all-in-one 486 board fitted within the case of a C128DCR; or
- 2) Small (Sub-Baby-AT form factor) all-in-one 486 board fitted in the case of a 1571 or 1541 drive (for transportability).

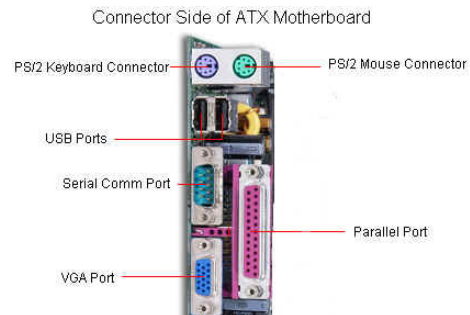


If you are new to the world of MSDOS, or even just a little rusty don't forget to download a copy of "MSDOS for Commies" from the 64HDD website.



Basic Requirements

- 386/486 PC controller (or motherboard with CPU). Minimum speed is believed to be a 386SX25 (for basic LOAD type operations). You can also use a Pentium or higher system, but you may need to use the additional `+p` command-line setting. **A faster 486 or Pentium machine may be required to take full advantage of the FastLoader and X-Loader options available in the Professional package.**
- 1x LPT (parallel) port mapped to a standard location (LPT1, LPT2, LPT3). The LPT port needs to be an old SPP type if an X1541 cable/adaptor is used. A PS2 type bi-directional port might work. On-board LPT ports on Pentium and newer machines may not operate as SPP correctly even if set to do so. For these systems you will need to install an "old" 8- or 16-bit I/O card or alternatively use a XE1541 cable/adaptor.
- X1541 or XE1541 cable (refer to LPT port requirements). Alternatively, an X1541 or XE1541 adaptor can be used in conjunction with a standard CBM serial cable (my preference for shielding reasons).
- 1x mass storage device capable of booting (FDD or HDD)



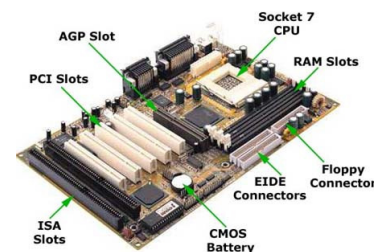
- 512kB RAM (generally the minimum for this spec of machine, rather than a 64HDD requirement). 64HDD professional has additional memory requirements for spawning to 64GUI and as such 640kB of conventional RAM is needed (with at least 550kB free). XMS memory is needed for caching during *FastLoad* and for activated device memory maps. If you need to use the +p option and do not have enough DOS memory free, you should consider using a non-MS XMS manager such as QEMM386 (QEMM is compatible with the +p option).
- MSDOS 6.xx (or compatible) is considered the minimum supported specification. MSDOS 7.x (Win9x) appears to be compatible if you have a faster PC type, but differences in the MS kernel may necessitate tweaking of the +p speed parameter. FreeDOS has also been found to mostly work, with some limitations being reported regarding LFN tools support.

Optional Requirements

- 1.44MB 3.5" Floppy Disk Drive for file transfer to the machine and for 1581 support. For 64HDD Professional a floppy drive is also a requirement for keying the 64HDD program upon first installation.
- PC Speaker for "start-up" beep, and "clicking" to signal activity after each block is transferred.
- keyboard (for maintenance), not scroll-lock light will flicker to represent 64HDD "disk activity"
- display card /monitor (for maintenance, personally during program development I use a CGA card as its output drives a 1901 or 1084 Commodore monitor, so at a "flick of a switch" you can see either the PC or CBM screen – of course you have to change cables to view the C128 80column screen)
- 2MB of memory configured as Extended Memory and HIMEM.SYS driver (for XMS support allowing better emulation of drive memory maps). At a minimum 64k for each drive supported is needed, so at least 512k of XMS is needed for 8 devices, with surplus XMS used for caching and other performance enhancements. XMS is dynamically allocated by 64HDD.
- CDROM drive and DOS driver (for mega mass storage)
- PC Mouse and DOS driver (for MOUSE: command channel support)
- A real CBM disk drive such as a 1541, 1571, or 1581 may be required as part of the daisy-chain if you find that your PC's timing is sensitive

Building the PC

Information on constructing a PC from boards, etc is readily available, so rather than dwell on the detail only the highlights will be given. Construction of a PC in a CBM case is trickier, and an example is shown on 64HDD website.



- Mount main board (often a mother board to the case)
- Add "cards" for video, etc and RAM SIMMs
- Change any jumpers on the main board necessary to disable functions duplicated by the add-on cards. For example, if you add a CGA card and the main board has "on-board" video, you will need to disable it. You may also need

to set a jumper for selecting video mode (normally determine whether bios uses colour or not)

- Install your mass storage device. If you will not be installing a floppy drive make sure the HDD has been pre-formatted and an operating system installed, otherwise install also a floppy drive. Install any other “drives” at this point.
- Connect power cables to the main board and drives; connect keyboard and monitor.
- Start machine, enter BIOS set up (usually hold DEL-key) configure options to make your system run (do not ask me what these are!). If you will ultimately be using the PC without keyboard or display either set these options as “not installed” or disable “halt on errors”.
- Re-boot machine, if starting with an unformatted mass media device format this and install the MSDOS system, as well as any device drivers and the HIMEM.SYS XMS driver.
- Check that the machine works reliably as a PC before going further...

Configuring 64HDD

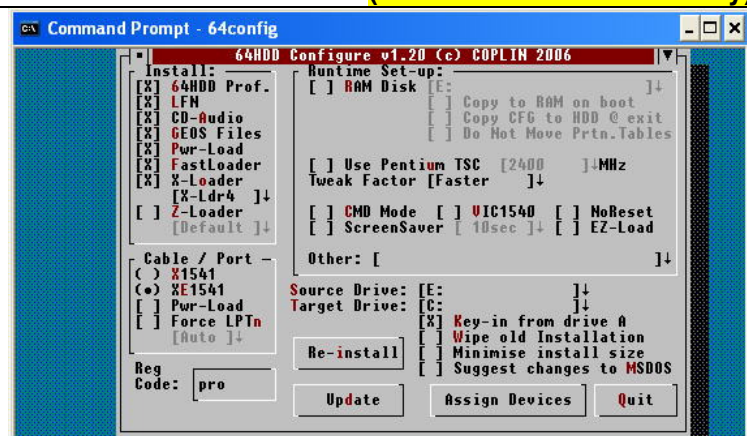
- 64HDD freeware users will need to manually configure 64HDD – see page 74.
- 64HDD Professional Users should also consult the information supplied with their package. The 64CONFIG or SETUP file will perform many of the installation and configuration duties. Additional functions may require command-line parameters to be manually added to the starting batch file.

64CONFIG – Setup Tool

(Professional version only)

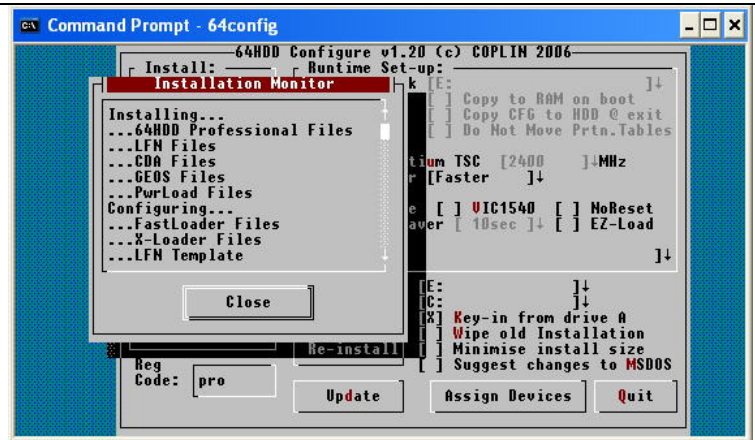
This tool is both the setup and maintenance program for 64HDD. Power users can make changes using the command-line functions options also.

Elsewhere in the manual or readme.txt file, details about the options is given.



During installation a dialog box provides details to the user about what is being done.

64GONFIG will not make changes to AUTOEXEC.BAT or CONFIG.SYS but rather will create files with a .64H extension which will list recommendations only.



Installation and upgrades to 64HDD Professional require keying with the original distribution disk. Once keyed to a system, no further keying is needed until the software is upgraded or transferred to another machine. If you are using a RAMDISK, note that the c: drive copy will need to be keyed so that changes are saved when you switch off your PC.

Note: Changes made to the configuration will only take effect when the changes are “installed”. To speed up the process, uncheck any options that have been previously successfully installed.

Manually Configuring 64HDD

- 64HDD is distributed in either a ZIP or EXE compressed file. Expand the file (typically using the `-d` option) and follow included installation instructions in the README.TXT file. The documentation below is comparatively too general.
- Know beforehand the LPT number to which the X1541 or XE1541 cable is connected. You might need to manually set the LPT number should auto detection not work. You will need to specify `-xe` if you are using the XE1541 cable, refer to README.TXT.
- Decide which “paths” you want, and how you wish to configure your device numbers. Real CBM peripherals and the 64HDD emulator cannot have the same device number (they will clash and lock the system up). You can set the device /path for each number used on the command line calling 64HDD (or in the batch file). You may need to modify /install one of the example batch files to do what you want. See README.TXT for more information. Remember that the MSDOS command-line is limited in length and that these limits should not be exceeded. Connect to default paths if you want to start many devices simultaneously.
- Connect the PC to the CBM computer using the cable. You can daisy chain other CBM peripherals as normal. Obviously, you’ll need either a double X1541 adaptor or an external disk drive (which has double ports) if you want several external devices attached.
- Generally speaking, a PC LPT port will pull lines “low” when not “running”. This has the effect of pulling the ATN line low which holds all real CBM products at “attention” – ie waiting for a command. It also conflicts with some CBM computers (eg the C128) which have an auto-booting mode (hence, the machine will not get to the cursor until the PC has released the ATN line).

- Note: This has not been found to be dangerous to the CBM hardware, but the practice of booting the PC before switching on CBM equipment may be recommended if you are worried.
- Modify the PATH statement to include the 64HDD EXE file location

Note: This can be done with the following command to append the existing path to the 64HDD directory with:

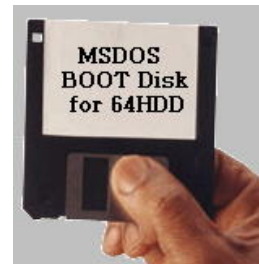
```
PATH=c:\64hdd;%PATH%
```
 - Start the GO64HDD batch file controlling 64HDD. As 64HDD boots check to see that the devices and paths are as you require and that the X1541 LPT port is found.
 - When 64HDD is up and running (signalled by a long “beep” if your PC has a speaker) switch “on” the CBM machine.

Note: If your X1541 cable connects the RESET line from the IEC serial port, the 64HDD emulator will reset when the CBM computer resets. This occurs when you switch on the CBM computer, but by using the batch file supplied with 64HDD, the emulator will restart. 64HDD can be reset by resetting the CBM computer. The 64HDD emulator will not be reset by pressing the “drive reset” on a C128D or DCR.
 - After the emulator has started issue the `LOAD"$",device` command. If a PC directory is listed then you are in business. If not, see trouble shooting.
 - Attach one of the disk images supplied with 64HDD utilities and work through the examples to test function and capability.
 - If you wish to have LongFileName support in the MSDOS environment refer to details in that section of the manual and follow the instructions carefully.

Configuring 64HDD for Use with a Boot Floppy or Boot CD

For those 64HDD users who must use a boot floppy since their PC system does not have the option to reboot to MSDOS (eg WinNT, Win2000 or WinXP) here are some tips which may be useful:

- Use a RAMDISK to store key MSDOS components; this will improve system performance
- Use the MSDOS COMSPEC variable to point the search for COMMAND.COM to either a hard drive or RAM drive location
- USE the NTFSDOS.EXE utility to read your NTFS disks.
The freeware version downloadable from the internet allows read-only access to your NTFS drives (so you can still store your Commodore archives on disk)
- If configuring a DOS boot disk seems too hard, an auto-configuring boot CDROM can be purchased from the 64HDD website.



64HDD Command-line Parameters

There are many command-line parameters that can be used to change the way 64HDD operates. Most users will only use a couple of these. Further, not all the command-line options are available to all users as some control 64HDD

Professional functionality. The list below details the most important parameters. The README.TXT file has the most up to date details. The inbuilt 64HDD help list can

also be invoked by starting 64HDD with the `-h` option – this will list the command-line options specifically available to the version of 64HDD that you are using.

usage: 64HDD.EXE [-{h|8|9|10|11}] [{8|9|10|11} filename] [+lpt {1|2|3}]

<code>-h</code>	this help screen
<code>-RegNo</code>	replace 'RegNo' with real 'code'
<code>-8..-15</code>	activate device 8..15 (default location is used)
<code>+8..+15 d:\path\filename</code>	activate device 8..15 and attach to 'filename'
<code>@dev</code>	activate devices listed in DEVICES.TBL
<code>+sysdir d:\path</code>	set user defined 'system' location
<code>+prtnldr d:\path</code>	set user defined 'cmdprtn.tbl' location
<code>-xe</code>	use XE1541 protocol (default is 'X1541')
<code>+p mhz</code>	use Pentium TSC, with CPU at (1-9999)MHz
<code>-tune</code>	output signals to IEC port for 64HDD calibration
<code>+lpt x</code>	use printer port 'x' (default is '1')
<code>+pwr xxx</code>	set default PwrLoader (default is '990' or C64)
<code>-lfn</code>	support Win95 LongFileNames in MSDOS (v1.55 req.)
<code>-nocredits</code>	do not pause on start up for credits
<code>-noreset</code>	do not respond to signal on IEC RESET line
<code>-sl</code>	enable Scroll-Lock LED (default is 'off')
<code>-faster</code>	speed up load transmissions ≥ 40 MHz 386/486CPU
<code>-fastest</code>	speed up load transmissions ≤ 33 MHz 386/486CPU
<code>-vic</code>	enable 1540 /VIC20 timings
<code>-ezvic</code>	optimise directory listing for the VIC20
<code>-ls</code>	LoadStar \$ style
<code>-ps2</code>	extra PS2 mouse bump protection
<code>-nup</code>	limit video updates (for slow PCs)
<code>-AR6</code>	prevent Action Replay v6 fast loader error
<code>-adf</code>	enable Auto-Disk-Flipping on Dev#8
<code>+adf x</code>	enable ADF on Dev#8 (match first x letters, 1-7)
<code>-auto</code>	activates the Auto-Load function (when "*" used)
<code>-cmd</code>	enable CMD ROMs and Partition Format
<code>+snd x</code>	tweak sound output (x=0 'off', -1 'only errors')
<code>+ss x</code>	Screen Saver after x seconds (0=disable)
<code>-mse</code>	use left+right mouse click to shell 64GUI
<code>-vga</code>	use VGA hi-res text mode for GUI
<code>-ez</code>	set EZ-LOAD dir format
<code>-pl</code>	include !: to EZ-LOAD
<code>-xl</code>	include !X: to EZ-LOAD
<code>-zl</code>	include !Z: to EZ-LOAD

64HDD Configuration/Setup	
-h	Provides a list of command-line parameters available and their basic syntax
-RegNo	To activate 64HDD, a registration code needs to be provided. Replace 'RegNo' with real 'code' obtained with your version
-8..-15	Activate device 8..15, assigning the path to the default location (usually c:\). At least one device needs to be defined for 64HDD to be useful. Up to 8 devices can be assigned.
+8..+15 d:\path[filename]	Activate device 8..15 and attach a specified path and/or 'filename'
@dev	Activate devices listed in DEVICES.TBL (used primarily by 64HDD <i>professional</i>)
+sysdir d:\path	64HDD uses the 'system directory' for special functions and operations. This option sets a user defined 'system' location. For most efficient operation this location should be a fast drive or ramdrive. Default is c:\64hdd\system
+prtndir d:\path	64HDD uses the 'partition directory' for special partition related functions. This option sets a user defined location for 'cmdprtn.tbl', etc.
-xe	use XE1541 cable transfer protocol (default is 'X1541')
+p mhz	use Pentium Time Stamp Counter (TSC), with CPU at (1-9999) MHz. If MHz is not specified, then +p should be the last command on the command-line and 64HDD will attempt to auto-calibrate.
-tune	This feature can help you tune the +p parameter or let you know to give up if your PC has an <i>erratic or inconsistent</i> timing clock. Full details are given on page 80.
+lpt x	Use interface cable connected to the PC printer port (lpt) 'x' (default is '1')
+pwr xxx	Set default PwrLoader to be used (default is '990' or C64). See the PwrLoad plug-in documentation for codes for respective machines.
-lfn	Provide support for Windows95 compatible LongFileNames in MSDOS (v1.55 of LFN-Tools is required – other versions and tools may not be compatible).
-nocredits	Do not pause on start up for credits to be displayed – allows for faster 64HDD booting.
-noreset	Do not respond to signal on IEC RESET line – this prevents 64HDD from resetting when the C64 or a Commodore peripheral is switched on/off.
-sl	64HDD can simulate the drive's activity LED using the PC keyboard's Scroll-Lock LED. This command-line

	option enables the Scroll-Lock LED simulation (default is 'off')
-faster	To be used only with 386/486CPU PCs of speed greater than 40MHz. The command reduces the assumed software latency to speed up load transmissions. Not recommended for use with other CPUs.
-fastest	As above, but to be used only with 386/486CPU PC of speed slower than 40MHz.
-vic	Enables 1540 timings which are optimised for VIC20 operation. These timings will not work with the C64 and so should not be used with this machine.
-ezvic	Optimise the directory listing for the VIC20. Since the VIC20 has a narrower screen, the display format of the directory is reduced to prevent line wrapping. This mode works well for interactive viewing, but may be in compatible with directory listings within applications.
-ls	By default, when changing directories only a short listing is given showing only the header and free space. This is done to reduce the data sent, particularly when wanting to quickly change through intermediate directories. The <i>LoadStar</i> \$ style format sends all directory info with each directory change – this mode suits menu programs such as that supplied with LoadStar.
-AR6	This command fools the Action Replay cartridge into using its “normal” loading mode preventing fast loader errors. Tested with AR v6.
-adf	Enable Auto-Disk-Flipping on Dev#8. By default the first 5 letters of the diskimage filename being attached is used to match other diskimages to the flipping list. For example, attaching GAME01A.D64 would pattern match GAME0*. * and add the first 10 files found to the ADF listing.
+adf x	Enable ADF on Dev#8, however use only the first x letters, x=1 to 7.
-al	Activates the Auto-Load function when “*” used. When LOAD “*” is used AUTOLOAD.PRG (located in the 64hdd\system folder).
-cmd	Enable CMD ROMs and Partition Format to improve compatibility with the various CMD compatible programs such as FCOPY, etc...

64HDD Mode/Control	
-ps2	The PS2 port is used for both keyboards and mice. When mice are connected, bumping them may send codes to 64HDD which get confused and interpreted as key strokes. This option provides extra PS2 mouse bump protection.
-nup	On slow PCs video updates may significantly slow data transfers. This option limits video updates.
+snd x	Sounds output by 64HDD are tweaked. x=0 turns all sounds 'off', whilst -1 limits sounds to 'only errors'.
+ss x	Enables the Screen Saver after x seconds. By default, the screen saver is disabled (0=disable).
-mse	Activates mouse support for accessing 64GUI from the runtime module. Pressing both left+right mouse buttons at the same time will shell 64GUI.
-vga	Use VGA hi-res text mode for the runtime modules and GUI. The hi-res text mode increases line resolution to 50lines (instead of the standard 25) allowing all device numbers to be listed.

EZ-Load Options	
-ez	Activate EZ-LOAD directory format
-pl	include !: to EZ-LOAD
-xl	include !X: to EZ-LOAD
-zl	include !Z: to EZ-LOAD

Using TUNE64HD to adjust 64HDD's Timing

TUNE64HD is program which is run on the C64 to monitor the calibration of the 64HDD PC. This manual "tuning" is only required if 64HDD cannot correctly or reliably identify the speed of your CPU.

Using the `-tune` command line parameter will make 64HDD output calibration signals to IEC port (CLK and DATA lines). The signals are active for 20us and 100us, respectively, and the TUNE64HD program will sample these and report on whether the PC's timing is satisfactory (accurate and constant) or not. TUNE64HD will need to be transferred to your C64 before it can be used.

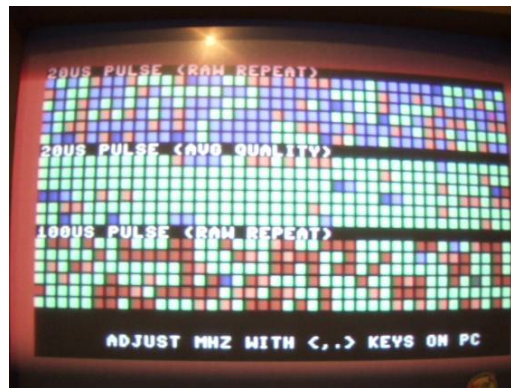
This feature can help you tune the `+p` parameter or let you know to give up if your PC has an *erratic or inconsistent* timing clock. Typically the `-tune` must be the last parameter given on the command line and used with all the other parameters that define clocking, LPT port and cables details, for example:

```
GO64HDD -xe + lpt 1 +p 500 -tune
```

On the C64 load and run the TUNE64HD program. The display will update and turn **green** when the signals are better tuned. For a quality link the signals needs to be consistently **green** for both pulse durations. Signals which are out of tolerance are shown as either **red** or **blue**. Whilst TUNE64HD is running the screen will intermittently blank to take new measurements – this is normal.

The mhz parameter can be adjusted realtime using the [`<`],[`.`],[`>`] keys on the PC to decrement and increment the MHz value. TUNE64HD will update to show the effect.

Example screenshots:







No hope of 64HDD working reliably. PC timing is too variable: sometimes fast, sometimes slow (random mix of **RED**, **GREEN**, **BLUE**).

This can sometimes be resolved by:

- Disabling "USB for DOS" functions in BIOS
- Disabling power management functions in BIOS (eg those that modulate CPU speed for reducing power)
- Removing the laptop's battery (or ensuring it is fully charged and/or powering the laptop from mains supply)

Typically, whilst tuning your 64HDD system the TUNE64HD display will change from non-green to mostly (if not completely) green, confirming that the optimal MHz value has been found.

Screenshot	Description
	MHz parameter is set to high for the PC (screen shows too much BLUE)
	MHz parameter is close, and link likely to work as both 20us and 100us pulses are mostly in the GREEN .
	MHz parameter close to perfect!!!
	MHz parameter set too low (screen shows too much RED)

Using a RAMDISK to speed things up (especially for LFN and Power-Loader Operation)

The use of a RAMDISK can improve the performance of 64HDD in several ways. Firstly, each time 64HDD is subsequently loaded, it is done so from RAM which is faster. Secondly, the DOS ROM images which are stored in the system directory will also be faster to access. Thirdly, the directory scratch files will be created faster. And fourthly, there will be significant improvements to the speed of LFN and Pwr-Load support functions as these also will be available in RAM and any temporary files can be created in RAM also.

- Install RAMDRIVE.SYS (or RAMDISK.SYS) as per the instructions that come with your version of MSDOS. Depending upon your system is it recommended to use extended memory, and as much of it as is available since 64HDD make no other use of it.
- Replicate the 64HDD directory structure on the RAMDRIVE. COPY or LCOPY all EXE and BAT files to their corresponding locations and also all files in the 64HDD\SYSTEM directory
- Modify the PATH statement to include the EXE location on the RAMDRIVE as the first item
- If you wish to always use the RAMDISK configuration, make the above changes part of your CONFIG.SYS and AUTOEXEC.BAT files.
- Modify GO64HDD.BAT such that it starts the copy of 64HDD.EXE residing on the RAMDRIVE. This is important as it will force the LFN tools to also be loaded from the RAMDRIVE.
- Modify the GO64HDD.BAT file so that it copies back the CMDPRTN.TBL file to a permanent location (otherwise the updates will be lost when power is switched off)
- Modify the GO64HDD.BAT file such that calls to 64HDD include the +sysdir option to set the system directory as the RAMDRIVE location. The path to the system directory is limited to 32characters.
- You may also modify the GO64HDD.BAT file such that calls to 64HDD include the +prtndir option to set the CMDPRTN.TBL save directory to a location that is not the same as +sysdir (such as the HDD). This change will ensure that all changes to the partition table are saved to non-volatile memory, but will slow down operation. The path to the partition directory is limited to 32characters, and the option must be set after the +sysdir option.

Notes:

- A “SmartDrive” style disk cache system may give similar benefits in disk operating speed.
- The MSDOS command prompt is limited in size (limited by Microsoft, not 64HDD) and so be mindful about the number of options used. Remember, you can enable drives to the default path with -9, -10, etc.
- To conserve RAMDISK space, it should be pointed out that not all 64HDD files need to be on the RAMDISK. It is possible to leave files not critical for 64HDD data transfers on a real disk, and the path for both locations included in the PATH statement, eg: PATH = e:\64hdd;c:\64hdd;%PATH%
- The RAMDISK drive provided in some versions of FreeDOS does not support the LongFileName tools.

Trouble Shooting 64HDD

- PC System issues: Certain PC types may not instantly be compatible with the timing requirements of 64HDD. These issues often relate to the PC not having a consistent and stable clock timing. Things to consider:
 - Disable speed switching or power management
 - For laptops, leave connected into mains to avoid CPU power management when operating on batteries or remove battery to avoid charging modes
 - Do not use 64HDD under a “Windows” type operating environment
 - Disable USB “for DOS” or “legacy” modes in BIOS which can cause random interrupts. This means you may need a PS2 keyboard rather than a USB keyboard (should not affect use of USB drives)
 - Set LPT port to SPP, and enable “bidirectional” if you wish to use the Pwr/Load cable in write mode.
- X1541 LPT port not known: use MSD (Microsoft Diagnostics) or another PC utility to identify the printer ports you have available and their addresses.
- X1541 connection not working:
 - Have you used a X1541 cable before (eg with TRANS64, etc)?
 - Have you got the X1541 cable attached to the correct LPT port?
 - Is the LPT port you are using the correct type?
 - Is the connector securely fastened (I often find this is the problem – a bumped cable)?
- Intermittent operation: check that idle indicator (twirling bar) works when 64HDD started and after loading
- Suspended operation: if data transmission is lost soon after the transfer begins it is likely that the PC controller is not running the emulator fast enough. Keep in mind the program’s minimum specification, and avoid unnecessary TSRs which take away from processing performance (eg if you do not need a mouse driver, do not install it).
- Trouble with Pentiums: if your Pentium hangs after a long load, but normally works, then it is possible the +p mhz setting is not 100% accurate. Try the auto-calibrated value or try something a little higher or lower than the actual processor speed (or even leave out the +p). The TUNE64HD program can also be used.
- Searching for....: If you are using the XE1541 cable, chances are that you have not specified -xe option when starting 64HDD.
- Can save and send commands, but not load: more than likely an XE1541 cable is used, but -xe not specified on the command line.
- Device Not Present Error: check that device is activated when 64HDD is initialised. If you get this message during serial and /or GET# data transfers it may be a serial bus timing error – this could indicate that the emulator is not running fast enough or is installed on a PC controller which is not able to run the program fast enough. Solutions are to use a faster PC or to run a real CBM drive in the daisy chain.
- Load Error: this may be the same problem as above, and can be resolved by adding a real CBM drive to the daisy chain.
- 64HDD beep-beep-beep: the emulator has been given a command that is not currently support. For example the M-E command is not processed. Some “fast” loader schemes rely on drive programming and will probably not work with

64HDD. Note: when using 64HDD with a C128, there will be three beeps, but the load operation proceeds. These beeps are because the C128 checks whether 64HDD is capable of burst mode before reverting to normal load routines.

- HDD is not there when I boot from a floppy disk: are you using Win98 or higher with an incompatible FAT system? You will need a DOS7.x disk to read FAT32. To read an NTFS formatted disk you will need a third party NTFS driver. Earlier versions MSDOS do not have access to these disks formats.
- Trans64 Compatibility: Note TR64 will not work when the X1541 cable is connected to a CBM Computer instead of, or in addition to, CBM disk drives (even if the CBM computer is “off”). The following fix was provided by Jochen Adler:

After a reset the C64 sets clock to active (0V) and thus TRANS64 cannot use this line. The `POKE56576,7` sets all serial lines to inactive (5V) and TRANS64 then works.

Specifications Guide

Dependent Devices

File system devices are termed dependent devices. The behaviour of the emulator depends upon the mode the file system is in.

For example, when a D64 image is logged the emulator will respond and emulate a 1541 drive (unless 1571 mode is specified by the appropriate CBM command). Because the mode is dependent, only applicable commands will be available and ROM/RAM maps will reflect the mode specified. A D64 image can of course be “seen” with both a 1541 and 1571 as in real life. A D81 image can only be accessed via a 1581 emulated interface.

Files within the MSDOS file structure are treated in a mode which is neither 1541/1571/1581. Here the file extension defines the type of file with the following conventions used:

PRG	Default /program file
SEQ	Sequential file
USR	User file (only PRG /SEQ format though)

Logging of a file with a disk, tape or archive image extension will switch modes to the appropriate device interface.

Files in the MSDOS structure other than the above types are treated as binary and can also be loaded. In the CBM directory listing they are identified as type “MSD” (abbreviation for MSDOS, though they may really be CBM binary and text files). For these to load the complete name (including file extension) must be used. The full name will be shown in the CBM directory listing.

64HDD has up to 8 dependent devices (devices 8, 9, 10, 11, 12, 13, 14 and 15) and not all need to be activated. Optionally a “boot floppy” in drive A: can be used to re-configure the system as required, or preferably 64HDD is set up to work in conjunction with batch file which respond to error_level commands sent by the emulator’s EXIT command. The numbering of these devices cannot however conflict with real devices on the CBM serial bus. This conflict can easily occur if you have a SX64 or a C128D with internal drive(s). You will have to soft/hard change the number in these drives before starting (or restarting) the emulated drive. Each “initialised” dependent device needs to have a path assigned at 64HDD start-up, else a default “c:\” location is assumed. More than one device can be logged to a given path, but only one device should be logged to disk image (this is because a disk image may get corrupted if one device modifies the image whilst the other is not watching).

Independent Devices

These devices are not file system devices. They are for example devices that receive and send data, but are not used for storing file data. A good example is the Real-Time-Clock (RTC) in the PC controller. The time /date for this device can be set via the command channel regardless of whether in 1541 /1571 /1581 /etc mode (none of which support RTC commands). The concept of “independent” devices is used also for interrogating the functioning of the controller and emulator without having to work from a keyboard and monitor attached to the PC controller.

A PC compatible mouse may be attached to a 64HDD serial or PS2 port. With the appropriate MSDOS mouse driver installed, the position of the mouse and button status can be read by the CBM computer and the information used in the program you write.

Other device independent functions will be added as concepts are defined.

64HDD File Systems Modes

CBM Disk Images (D64, D71, D81)

- PRG, SEQ, USR, GEOS (SEQ and VLIR, with 64HDD-GEOS)
 - 35 track D64 format images
 - 70 track D71 format images
 - 80 track D81 format images
- Error setting for T&S error encoded disk images
- Read / Write
- Direct Access Support
- Command Channel support
- REL not yet supported
- Refer to project specification sheet for intended capabilities.

CMD Disk Images (D2M, etc)

- PRG, SEQ, USR
 - 80 track D2M format images
- Error setting for T&S error encoded disk images
- Read only at present
- Direct Access Support
- Command Channel support
- REL not yet supported
- Partitions and native directories not yet supported
- CMD Native Partitions not yet supported
- Refer to project specification sheet for intended capabilities

CBM Tape Images (T64)

- Read only of directory “track” and PRG files for T64 format images
- No command channel support is planned (Error 8x will always be returned)

Archive (LNX)

- Read only of directory track and PRG files for LNX format images
- No command channel support is planned (Error 8x will always be returned)

Zips (ZIP) *(Professional version only)*

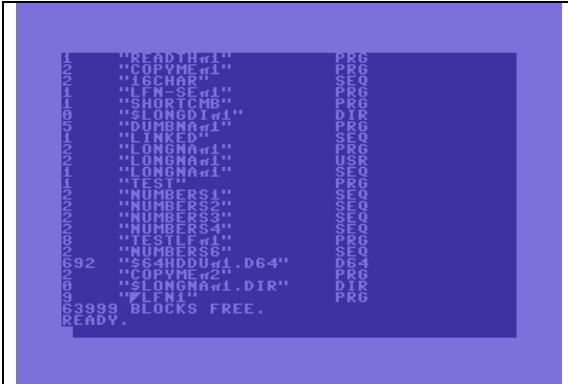
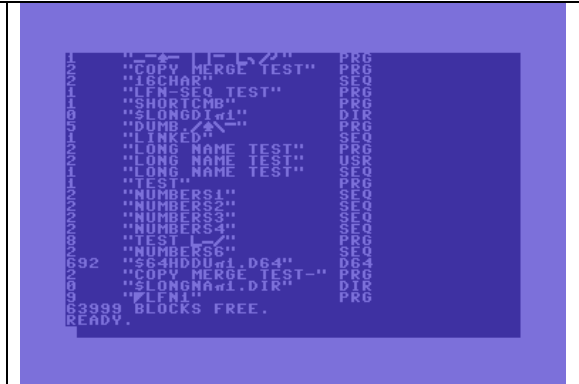
- Built-in decompression of ZIP archive to the MSDOS file system
- C:\64HDDPRO\TEMP is used at the destination path
- An external MSDOS batch file is used to perform the decompression. This can be adjusted by the user to suit their particular ZIP program, or even an alternative decompressor. By default, the 64UNZIP.BAT file will delete all files in the decompression directory using DELTREE and then use PKUNZIP to perform the actual decompression.
- Note: if you chose to use a LFN based decompression tool, be sure to use a LFN compatible DELetion tool.

MSDOS File System

- Read and write of PRG, SEQ and USR files (OPEN 1,11,2,"filename,type" where type is "P", "S" or "U")
- Name is searched as requested, but if not found an attempt will be made to append the appropriate extension (default is PRG)
- P00, P01, S00, S01 type files created by the old PC64 emulator are treated as a special case of the PRG format. 64HDD will skip the header information and continue as if the file was of PRG type *(Professional version only)*
- N64 type files created by the old 64NET emulator are treated as a special case of the PRG format. 64HDD will skip the header information and continue as if the file was of PRG type *(Professional version only)*
- All other non-disk files are streamed from start to finish as if SEQ
- Command channel support for working with directories, scratching, copying and modifying files.
- Refer to project specification sheet for intended capabilities.
- By default, 64HDD will only create files with valid 8.3 names, and will substitute legal file extensions where not provided. Generally upon reads (files or directories) will be as requested, and only upon failure will substitution be tried. For example, if a file "TEST FOR ERROR" is saved, 64HDD will save it as "TESTFORE.PRG" in order to obey MSDOS rules. An attempt to load it by the name "TEST FOR ERROR" file be attempted, but as this will fail a retry with the name "TESTFORE.PRG" will be made without an error being flagged to the CBM user. For file or directory deletion or copying the complete MSDOS filename (with extension) or a wildcard is required.
- If the LongFileName (LFN) system has been correctly installed, 64HDD will allow the creation of valid 16.3 filenames. The LFN system uses a naming /file format which is Windows95 compatible and as such, files can be transferred to /from a Windows95 system.

MSDOS LongFileName Support

64HDD can support most CBM 16character filenames in the MSDOS file system providing Odi's LongFileName (LFN) utilities are installed. Use of LFNs improves CBM software compatibility. Version 1.55 of the LFN tools is required along with an installation of 64HDD v0.6a3 and higher. This version of the LFN tools allows some support long names to be read on ISO9660 format CD-ROMs.

	
MSDOS FileNames in 8.3 format	LongFileNames in 16.3 format

In LFN mode, 64HDD uses 16.3 format names instead of the 8.3 format dictated by MSDOS. The 16.3 format is subset of the LFN format introduced by Windows95. However, Windows95 or MSDOS7x did not provide tools that allow the LFN files to be created or copied in any environment except for when Windows95 is actually running in its Graphical Mode.

There are several tools available for free which allow the Windows95 LFN format to be used in MSDOS, each having advantages and disadvantages. 64HDD has chosen to use Odi's LFN Utilities. The LFN utilities included in the Zip distributed with 64HDD are the only LFN utilities that have been verified for correct operation with 64HDD.

MSDOS LFN support has many benefits and so it is likely to be important to the 64HDD user, but before it will work correctly the LFN utilities need to be installed correctly. If the utilities are not correctly installed, then there is the risk that 64HDD or the tools will corrupt the directory structure. Before you proceed it is recommended to read the LFN.TXT file distributed in the LFNFILES Zip.

There are three important steps to follow:

- 1) Install the LFN utilities into the correct directory
- 2) Unzip and/or LCOPY and/or LFN-FIX the `LFN$$$16CHAR$LFN. $$$` file to the correct directory
- 3) Check that the CONFIG.SYS file has sufficient BUFFERS and FILES available
- 4) Modify the PATH statement to include 64HDD directory containing EXE files

64HDD performs several tests before it will allow LFN mode to be selected. These tests should catch 95% of possible installation errors, and should errors be found a double "beep" and prompt will be displayed.

LFN mode is selected only when the `-lfn` command line switch is used when starting 64HDD, and should be added to the relevant line in the GO64HDD.BAT file.

Setting up the LFN Utilities

Step 1: The LFN utilities are distributed in a Zip file called LFNFILES.ZIP. This Zip contains one LongFileName file that is used by 64HDD as the name template for creating all new LFNs. To create this LFN file you can use one of the following methods:

- 1) Unzip the LFN files using a DOS based de-compressor (don't forget to use the `-d` option), and then from the 64HDD directory run the LFN-FIX.BAT utility.
- 2) Use a Windows95 version of WinZip (ie versions 6+). The LFN template file is called `LFN$$$16CHAR$LFN. $$$` and is the only file which must be created under the Windows95 LFN system. The rest of the Zip can be expanded with DOS "PKUNZIP -d" for example.

Only a subset of Odi's LFN utilities are included and these must be located in the directory from which 64HDD.EXE is executed. Additionally, the directory must be on the MSDOS PATH as 64HDD will need to find them. The ****must have**** utilities are: LDIR.EXE, LREN.EXE, LCOPY.EXE and LDEL.EXE

64HDD checks to see if these files are correctly located.

Step 2: If you are using the non-default location for the 64HDD system directory you will need to move the LFN template file.

The LFN template file `LFN$$$16CHAR$LFN. $$$` must be moved to the 64HDD system directory as defined by `+sysdir` or the default `c:\64hdd\system` location if not specified. The file can only be correctly copied using the LCOPY utility or Windows95. If necessary you will LCOPY it to a floppy disk, and then LCOPY it to the location. If you are using a RAMDISK for the 64HDD system directory, you will also need to LCOPY the file to the RAMDISK. You can use LDIR to see that the LFN is as shown above. The MSDOS name should be `LFN$$$~1. $$$`

If you used an MSDOS unzip tool it is likely that there will be a `LFN$$$16. $$$` file in the 64HDD system directory. This must be deleted or fixed using LFN-FIX.BAT. Use LDEL in preference to DEL as it will correctly delete any LFN files. You may need to use DEL if LDEL says the file was not found (that is no LFNs were found).

Step 3: Check the setting of the BUFFERS and FILES in the CONFIG.SYS file. LFNs need lots of channels open for assembling the filename. Be generous and set FILES=50 and BUFFERS=17,0 and FCBS=8,0

You will need to re-boot the PC for these new settings to take effect.

Step 4: The 64HDD directory can be added to the PATH using this modifier command, but only from within a batch file:

`PATH=c:\64hdd;%PATH%`

Notes, Tips and Suggestions

- You can create LFNs in the root directory of a disk, however should errors result the disk structure may be damaged. It is perhaps best to limit these files to floppy disks that can easily be re-formatted.
- If you've decided to use LFNs with 64HDD use LCOPY, LREN and LDEL in preference to DEL, REN and COPY when doing your disk house-keeping. This will ensure directory entries do not get corrupted.
- A corrupted directory entry can only be cleared by using ScanDisk for Windows95 or by removing the entire directory. For this reason it may be recommended practice that LFNs be created in subdirectories and not the root directory of your Hard Disk.

- The LFN tools only work on drives which use the FAT system or ISO9660 CD file system (LFN tools v1.55). This generally includes Floppy and Hard Disks, and some CD-ROMs. Only CD-ROMs written using the ISO9660 standard will work. {note: directory names need to follow the 8.3 format as per the following note}
- 64HDD only implements LFNs for filenames. Directories are limited to 8character names and LFN named directories are only accessible by their shortname. Activating EZ-Load will provide additional LFN support for directory names.
- Disk /tape /LNX image names are also assume to be in 8.3 format. If not the name may be truncated and the extension incorrectly displayed. The image may still be attached to, but only if you know the complete name.
- Automatic recognition of files by their extension type is only possible if the three character extension is capitalised in the LFN format when viewed with LDIR (ie “test file.PRG” is recognised as a PRG, “test file.prg” is identified as a MSD file). 64HDD creates capitalised PRG, SEQ and USR extensions. Files with non-capitalised extensions must have their whole name specified or a wildcard used. Capitalisation refers to how the names appear when viewed with LDIR and not how they appear on the CBM machine.
- Some characters are still invalid in the Windows95 LFN system and 64HDD checks and removes these. This includes / and \ which are directory specifiers and other punctuation used for redirection. However, spaces and periods are allowed as part of the 16.3 name. Upper and lower characters are accepted and used in the name. 64HDD, when LFN is enabled, does some translation for PETASCII characters such that they are mapped to the true ASCII. Also, you may find that some illegal characters are translated to graphic equivalents, for example \ will be substituted for a CBM graphic that looks similar.
- When LFN mode is used, directories may take a little longer to generate before they are sent to the CBM computer. This is normal and can be improved by the use of a RAMDISK or SMARTDRIVE cache.

PC-to-CBM Cable Specification

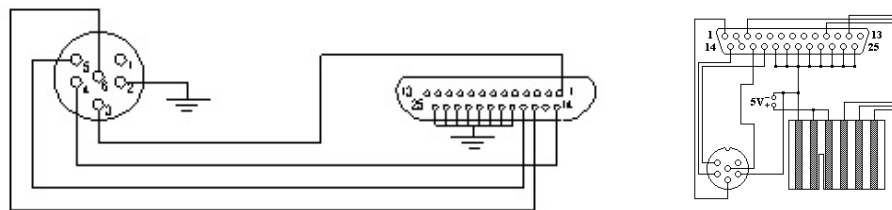
The 64HDD program requires one of the following adaptor cables to be connected between your parallel printer port (LPT1/LPT2/LPT3) and your Commodore computer or disk drive. By connecting it to your disk drive you will be able to chain together other hardware to you system.

This cable is also known as X1541 cable because it was used the first time by a program with this name. Nowadays, it is used by many programs. At present only the original X1541 and the XE1541 cable schemes are supported. If you have a newer machine with on-the-mainboard LPT ports chances, are it will not work with the X1541. To overcome this limitation you need an older LPT card installed in a slot as a secondary LPT port or an XE1541 interface.

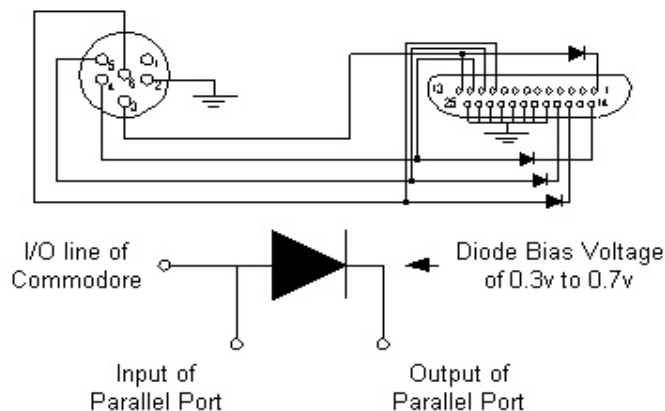


Optionally a parallel PwrLoad cable can be used to increase the speed of data transfers during load and read operations.

X1541 Cable Specification



XE1541 Cable Specification



(One of the X1541 schematics above also shows optional tape connector for use on the C64S emulator. Alternate details are in the README.TXT file. X1541 and XE1541 schematics can also be found in the Star Commander documentation or on their website. The diode specification is BAT85 or 1N5819 types, but for some LPT interfaces 1N4148 or 1N4005 diodes will work equally well.)

Note: the XM and XA1541 cables are not as yet supported. Until support is available you can modify your XE cable by swapping two wires on the Commodore plug (DATA and RESET). Some people have modified their cable with a switch to allow it to operate as both types. If you are thinking that you need to buy an XA cable to protect your modern PC, but already have an XE cable; then try the XE first as it will not do any damage (according to the designers), and it may work anyway!