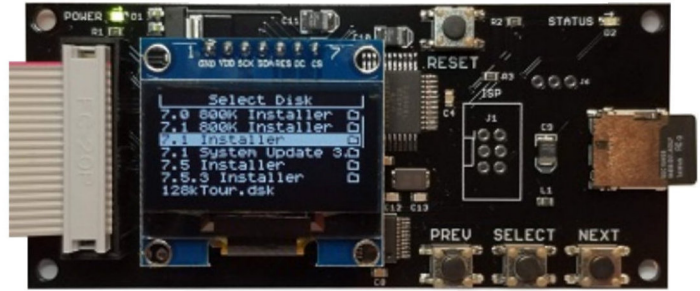


FEMU

Floppy disk EMUlator

User Manual



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1. INTRODUCTION

Thank you for purchasing a Floppy Emu disk emulator! Floppy Emu is a specialized floppy and hard disk emulator for classic Apple computers. It uses a removable SD memory card and custom hardware to mimic an Apple floppy disk and drive, or an Apple hard drive. The Emu behaves exactly like a real disk drive, requiring no special software or drivers on the computer. It's perfect for booting your favorite games, moving files between modern and vintage machines, and troubleshooting a computer without a working OS. Just plug in the Emu board, and you'll be up and running in seconds.

Floppy Emu is designed to work with *disk images* – special files that store the contents of an entire floppy disk or hard disk. Each disk image is stored on the SD card as a separate file. Using the menu interface on the Floppy Emu, you can select which of those disks to insert or mount in the emulated disk drive.

Disk images can be downloaded from archives on the internet, or created using 3rd-party tools. With the right software for Windows or Mac OSX computers, it's also possible to peek inside a disk image, and view the actual Apple II or classic Mac files it contains. See the **DISK IMAGES** section for further details.

Compatibility

Floppy Emu Model C is compatible with the entire Apple II line. It's also compatible with vintage Macintosh computers from the original Mac 128K through the Mac II series and Power Mac, as well as the Lisa 2/5 and 2/10. The supported disk emulations are:

COMPUTER	DISK EMULATION MODES
Macintosh	
Macintosh 128K	✓ 3.5 inch 400K floppy
Macintosh 512K	✓ 3.5 inch 400K floppy, HD20 hard disk[1]
Macintosh 512Ke, Plus, SE	✓ 3.5 inch 400K/800K floppy, HD20 hard disk
SE FDHD, Classic, Classic II, Portable, IIfx, IIsi	✓ 3.5 inch 400K/800K/1.4MB floppy, HD20 hard disk
SE/30, IICx	✓ 3.5 inch 400K/800K/1.4MB floppy
LC	✓ 3.5 inch 400K/800K/1.4MB floppy, HD20 hard disk[2]
IIfx, IIVx, IIVI, LC-II, LC-III, LC 5xx, Color Classic, Color Classic II, TV, Performa, Quadra, Centris, Power Mac	✓ 3.5 inch 400K/800K/1.4MB floppy[2]
Lisa	
Lisa 2/5 and 2/10	✓ 3.5 inch 400K/800K floppy
Apple II	
Apple II, II+, IIE with standard disk controller	✓ 5.25 inch floppy
Apple II, II+, IIE with Liron disk controller	✓ Smartport hard disk
Apple IIc	✓ 5.25 inch floppy[3], Smartport hard disk[4]
Apple IIgs, IIC+	✓ 5.25 inch floppy, 3.5 inch floppy, Smartport hard disk

[1] Mac 512K also requires boot floppy with HD20 Init

[2] uses internal disk connector

[3] requires IIC internal connection for booting 5.25 inch disks, see manual for details

[4] requires IIC with ROM revision 0 or newer for Smartport mode

2. CONNECTING THE FLOPPY EMU



The Floppy Emu board can be connected to the computer's external 19-pin disk port, or internal 20-pin port, as described further below.



Always plug the Floppy Emu board into your computer *before* turning it on. "Hot plugging" the Floppy Emu (plugging and unplugging when the computer is already on) may damage it.

2.1 External Connection and Daisy Chaining

Connect the Floppy Emu to the 19-pin disk port on the rear of the computer. Most early Macintosh computers have this external 19-pin disk port, as well as the Apple IIGS, IIc, and IIc+. The Apple 5.25 Drive controller card commonly used in the Apple II, II+, and IIe also has the same 19-pin port.

Daisy Chaining

For Apple II computers, the Floppy Emu can also be connected to the end of a daisy chain of multiple disk drives, at the 19-pin daisy chain output port on the rear of an Apple disk drive. The Apple II requires daisy chained drives to be connected in a **specific order**: 3.5 inch drives must go first in the chain, then Smartport/Unidisk drives, and finally 5.25 inch drives. The Emu board must be placed at the proper position in the chain, given the type of drive it's currently emulating. Because it does not have a daisy chain output, it's not possible to chain more drives behind the Floppy Emu board. This may prevent connecting additional 5.25 inch or Smartport drives, when the Emu is emulating a Smartport or 3.5 inch drive.

The Lisa does not support daisy chaining, and Floppy Emu must be connected directly to the computer on this system.

The Macintosh generally does not support daisy chaining, and the Floppy Emu must normally be connected directly to the Mac. The only exception is when using a real Apple HD20 drive. In this case, Floppy Emu may optionally be attached to the disk connector on the back of the HD20.

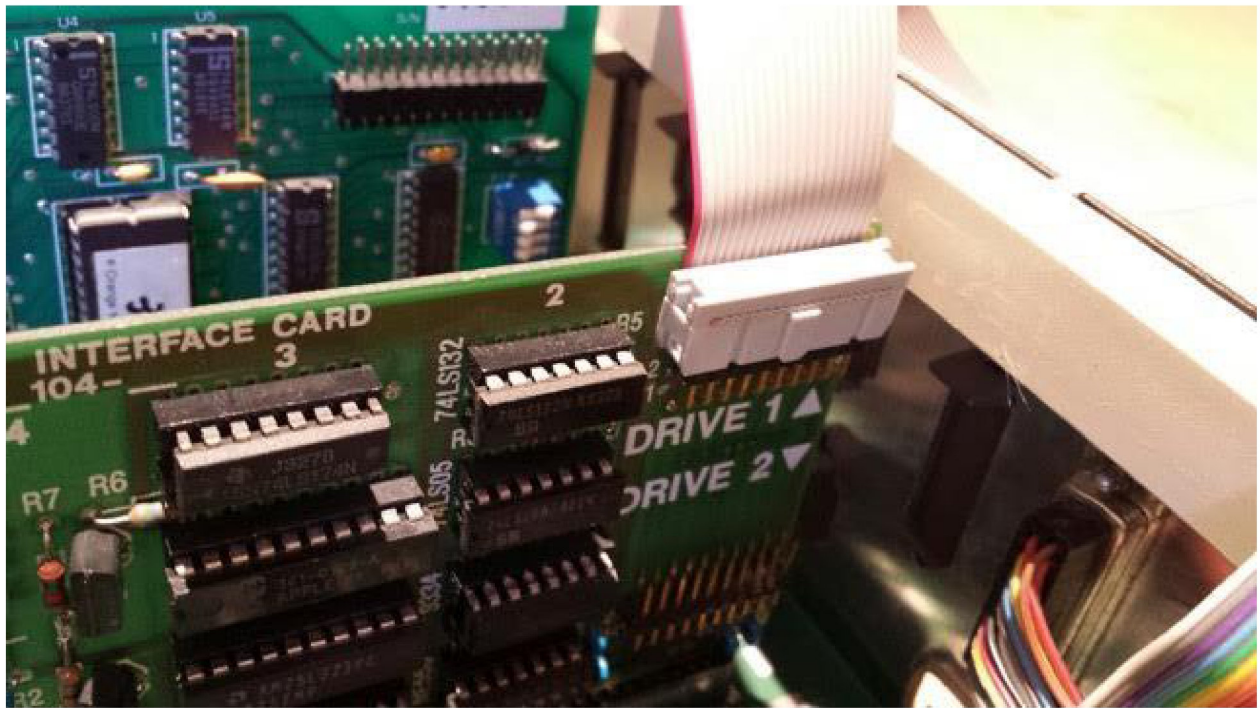
2.2 Internal Connection

The Lisa and some early Macintosh computers do not have an external 19-pin disk port, nor does an Apple II, II+, or IIe when equipped with an Apple Disk II controller card. For these computers, the Floppy Emu's 20-pin flat ribbon cable should be disconnected from the DB-19 adapter, and connected to a 20-pin internal disk port on the computer's logic board or disk controller card. It may be necessary to disconnect the internal floppy drive that's normally connected to this port.

2.2.1 Special Note for Apple II Disk II Controller Card



When connecting Floppy Emu to a Disk II Controller Card, be very careful to orient the cable correctly. The red stripe on the cable should be at the left, near the pins marked “1” and “2” on the Disk II Controller Card. An incorrectly oriented cable will damage the Floppy Emu.



Pay careful attention to the cable orientation when connecting to a Disk II Controller Card in an Apple II computer. The Disk II connector lacks a polarity key, so it's easy to connect the cable backwards accidentally. This can result in damage to the Emu board or your computer. In the correct orientation, the red stripe on the cable will go to the pins marked “1” and “2” on the Disk II card, as shown in the photo. The cable will be sandwiched between the connector and the board.

2.3 Special Note for Apple IIc

The Apple IIc computer has an external 19-pin disk port, but when using Floppy Emu to emulate a 5.25 inch floppy drive, it's normally better to connect the Emu internally to the 20-pin disk port on the computer's logic board instead. This will make the Emu appear as 5.25 inch drive 1, and enable the IIc to boot from it. If connected to the external 19-pin disk port, a Floppy Emu in 5.25 inch emulation mode will appear as 5.25 inch drive 2: a secondary non-bootable drive.

For instructions on how to remove the Apple IIc top cover and access the logic board, please visit <https://www.ifixit.com/Guide/Disassembling+Apple+IIc+Cover/6772>

This quirk of the Apple IIc only applies to *5.25 inch floppy emulation mode*. When using Floppy Emu in Smartport or Unidisk mode with the Apple IIc, use the external 19-pin disk port.



3. INITIAL CONFIGURATION AND SETUP

3.1 Installing the Desired Firmware

It may be necessary to install different firmware on the Floppy Emu device, depending on the type of Apple computer being used. **The Emu ships with Apple II compatible firmware pre-installed.** For Macintosh and Lisa disk emulation, an alternate firmware must be used instead. Download and install the appropriate firmware from www.bigmessowires.com/floppy-emu

Firmware updates require copying two special files to the SD card, and then inserting the SD card into the Emu board and pushing a few buttons while the power is turned on. Full instructions for installing firmware updates can be found in the *readme.txt* file that's included with the firmware download.

Please note that firmware updates consist of two separate parts that must be installed one after the other. If you see a warning message about "wrong CPLD", it means you're not finished yet, and haven't installed both parts of the firmware.

3.2 Choosing the Disk Emulation Mode

Each version of the Floppy Emu firmware can emulate many different types of disk drives. These are called *emulation modes*. Only one mode can be enabled at a time.

For example, the Apple II firmware has separate emulation modes that can emulate a 5.25 inch drive, standard 3.5 inch drive, Unidisk 3.5 drive, or Smartport hard drive. The Mac/Lisa firmware has emulation modes for a Macintosh 3.5 inch drive, Lisa 3.5 inch drive, or HD20-type Macintosh hard drive. The current emulation mode is briefly displayed on the Floppy Emu's title screen on the display, whenever the device is powered-on or reset.

To change the emulation mode, press the Floppy Emu's reset button, and wait for the title screen to appear on the display. While the title screen is visible, press the SELECT button. The Floppy Emu will display a menu of available emulation modes, from which you can select a new mode. The selected mode is stored in non-volatile memory, and will remain in effect permanently until changed.

After changing the emulation mode, you may need to turn the computer off, then on again in order for it to correctly recognize the new type of disk drive.



4. SD MEMORY CARDS

Floppy Emu supports standard SD and SDHC memory cards with sizes up to 32 GB. Cards should be formatted with the FAT32 filesystem. Nearly all SD cards sold from retail stores are already formatted this way.

Do not insert or remove the SD card while the power is on. The card should only be inserted or removed from the Floppy Emu socket when the computer is turned off and the Floppy Emu board is not powered.



5. APPLE II USAGE

The Floppy Emu ships with Apple II compatible firmware pre-installed. You may wish to visit www.bigmessowires.com/floppy-emu to see if a newer firmware version is available.

Before use, the Floppy Emu must be set to the desired emulation mode. Use the mode selection menu to choose between 5.25 inch floppy, 3.5 inch floppy, Smartport hard disk, or Unidisk emulation mode. See the **INITIAL CONFIGURATION AND SETUP** section for details.

The Apple II firmware supports the following disk emulation modes:

- 5.25 inch floppy
- 3.5 inch floppy
- Smartport hard disk
- Smartport unit 2
- Unidisk 3.5



5.25 Inch Floppy Disk Emulation

Apple II 5.25 inch floppy disk emulation mode supports 140K floppy disks, and is compatible with all models of Apple II computers. Use the PREV and NEXT buttons to navigate through the menu listing of disk image files on the SD card. Press the SELECT button to choose an image to insert into the drive. After inserting a disk image, press NEXT to eject it and select a different one.

Floppy Emu supports 5.25 inch Apple II floppy disk images in .DSK, .DO, .PO, .NIB, .WOZ, or .2MG formats. The DSK, DO, and PO formats will provide somewhat better performance than .2MG, and their use is preferred. NIB and WOZ image files are typically used for copy-protected software, and will be treated as read-only disks. See the **DISK IMAGES** section for more details about Apple II disk image formats.



3.5 Inch Floppy Disk Emulation

Apple II 3.5 inch floppy emulation mode supports 800K floppy disks. It emulates a “dumb” 3.5 inch floppy drive similar to the A9M0106 AppleDisk 3.5, and is compatible with the Apple IIgs and Apple IIc+. Use the PREV and NEXT buttons to navigate through the menu listing of disk image files on the SD card. Press the SELECT button to choose an image to insert into the drive. After inserting a disk image, press NEXT to eject it and select a different one.

Floppy Emu supports 3.5 inch Apple II floppy disk images in .DSK, .DO, .PO, or .2MG formats. DSK, DO, and PO will provide somewhat better performance than .2MG, and their use is preferred.

The Apple IIgs and IIc+ may not respond immediately when you insert a 3.5 inch floppy disk. If the computer displays some kind of “check disk” error and halts, you’ll need to force it to re-scan for a boot disk. Hold down CTRL + Apple + RESET to reset the computer and force a re-scan.



Unidisk 3.5 Emulation

Apple II Unidisk 3.5 emulation mode supports 800K floppy disks. It emulates a “smart” 3.5 inch floppy drive similar to the A2M2053 Unidisk 3.5, and is compatible with the Apple IIgs, Apple IIc+, and Apple IIc. This emulation mode is effectively the same as Smartport hard disk emulation mode, except the disk can be ejected and its size is fixed at 800K. Unidisk 3.5 emulation mode is slower than 3.5 inch floppy emulation mode, so the former mode is normally preferred.

Use the PREV and NEXT buttons to navigate through the menu listing of disk image files on the SD card. Press the SELECT button to choose an image to insert into the drive. After inserting a disk image, press NEXT to eject it and select a different one.

Floppy Emu supports Unidisk 3.5 floppy disk images in .DSK, .DO, .PO, or .2MG formats. DSK, DO, and PO will provide somewhat better performance than .2MG, and their use is preferred.



Smartport Hard Disk Emulation

Smartport hard disk emulation mode for Apple II can emulate up to four simultaneous Smartport hard disks, where each disk is up to 32 MB in size. This mode is compatible with the Apple IIgs and Apple IIc+, as well as the Apple IIc if it has an updated ROM version. Smartport emulation mode is also compatible with the Apple Liron disk controller card on the Apple II+ and IIe.

Floppy Emu supports Smartport disk images in .PO, .HDV, or .2MG formats. Unlike the other emulation modes, there is no menu for selecting the desired Smartport disk. Floppy Emu automatically uses the disk images named SMART0.*, SMART1.*, SMART2.*, and SMART3.*, where * can be either PO, HDV, or 2MG. If you have fewer than four Smartport disk images, number them beginning with SMART0 and don't use SMART3.

The original Apple IIc ROM version 255 does not support Smartport, but all later Apple IIc ROM versions do. To find your IIc's ROM version, type `PRINT PEEK(64447)` at the BASIC prompt. The number that's returned is the version number of your IIc ROM.

Although the Smartport protocol supports drive sizes up to 8 GB, the maximum size of a ProDOS volume is 32 MB, which means Apple II hard disk images normally can't be any larger than this. On the Apple IIgs under GS/OS 6.0.1, however, it's possible to boot from a 32 MB ProDOS volume, and then mount additional HFS volumes. HFS supports volume sizes up to 2 GB, and is the filesystem normally used on vintage Macintosh computers. Apple2Online has some [blank HFS disk images of various sizes](#) in their CFFA3000 area, which are perfect for Apple II usage.



Smartport Unit 2

Smartport Unit 2 emulation mode may be useful for some Apple IIgs owners, when the Floppy Emu is emulating a Smartport hard disk as “unit 2” daisy-chained behind an Apple 3.5 inch floppy drive. In all other cases, use the normal Smartport hard disk emulation mode instead.

Smartport Unit 2 mode addresses a limitation of the Apple IIgs design: the IIgs can normally only boot from unit 1 on slot 5. When an Apple 3.5 inch floppy drive is connected, it becomes unit 1, and the IIgs will only attempt to boot from the 3.5 inch drive, ignoring the Floppy Emu at unit 2.

This mode performs a complex sleight of hand to accomplish booting from the Floppy Emu’s Smartport hard disk in combination with an Apple 3.5 inch floppy drive:

1. At power-on, the Floppy Emu initially configures itself as a 5.25 inch floppy drive on slot 6
2. Apple IIgs boots from this 5.25 inch drive
3. Floppy Emu provides a hard-coded disk image containing a bootstrap program
4. The bootstrap program displays a splash screen and modifies the Smartport boot priority table in RAM
5. Floppy Emu reconfigures itself as a Smartport HD on slot 5
6. Bootstrap program performs a restart of the IIgs
7. IIgs boots from the Floppy Emu’s Smartport HD

For more details, please see <https://www.bigmessowires.com/2019/05/03/floppy-emu-firmware-update-smartport-unit-2-mode/>

5.1 Understanding Boot Disks

Because of the way the Apple II is designed, only some of the computer’s attached drives can function as boot disks. The other drives can function as secondary disks after the computer has already booted, but can’t be used to start up the computer. Depending on how Floppy Emu is connected and what other drives are present, **it may be prevented from functioning as a boot disk.**

Apple II computers organize their disks into *slots* (numbered 1 through 7) and *drives* (2 drives per slot). If a disk is in drive 1 of a slot, then the Apple II can boot from it. But if the disk is in drive 2, the Apple II can *not* boot from it, and can only use it as a secondary disk.

It may not always be obvious whether Floppy Emu is drive 1 or 2 of a slot. The earliest Apple II models had separate connectors for drive 1 and drive 2, so the choice was obvious. But later models introduced daisy chains of many drives, where the slot and drive number is auto-assigned. Floppy Emu’s slot and drive number can also change when the current emulation mode is altered, because different types of drives are auto-assigned to different slots.

Built-in internal disk drives also complicate drive numbering. The Apple IIc's internal 5.25 inch drive is always drive 1, so any externally-connected 5.25 inch floppy drive will be assigned to drive 2. Similarly the IIc+'s internal 3.5 inch drive is always drive 1, and any externally-connected 3.5 inch floppy drive will be assigned to drive 2.

If Floppy Emu is not assigned to drive 1 of its slot, you can:

- remove one or more drives ahead of Floppy Emu in the daisy chain
- connect Floppy Emu internally on the computer's motherboard, in place of the original internal drive
- change the emulation mode, so Floppy Emu will be assigned to a different slot

5.2 Copying 5.25 Inch Disks

To copy from the Floppy Emu to a real 5.25 inch floppy disk, perform the copy like you would for any other disk. You can use standard disk copy programs such as Copy II+ or Locksmith or ProDOS disk utilities.

To copy from a real 5.25 inch floppy disk to the Floppy Emu, special attention is needed. Most disk copy programs perform a simultaneous format-and-write of the destination disk, which creates problems for Floppy Emu, because it doesn't handle formatting the same way as a real disk drive. If possible, configure your disk copy program to disable formatting of the destination and to copy sectors one at a time.

An alternative method is to use the simple COPYA program on the DOS3.3 system master disk, after modifying one line of the program to disable formatting of the destination. Boot from DOS3.3 system master, then type:

```
LOAD COPYA  
250 FT=1  
RUN
```

You can then remove the DOS3.3 system master disk, and then follow the program's prompts for disk copying. Use a blank 5.25 inch floppy disk image on the Floppy Emu as the destination disk.

6. MACINTOSH USAGE



For Macintosh disk emulation, an alternate firmware version must first be installed on the Floppy Emu device (the Emu ships pre-configured with Apple II compatible firmware). Download the Macintosh-compatible firmware from www.bigmessowires.com/floppy-emu, and follow the installation procedure described in the *readme.txt* file that accompanies the download.

This firmware is compatible with all Macintosh models, but some models may not support every type of emulated disk.

Floppy Disk Emulation

Macintosh 3.5 inch floppy disk emulation mode supports 400K, 800K, and 1.4 MB floppy disks. The type of disk is automatically determined by the size of the disk image you select. Use the PREV and NEXT buttons to navigate through the menu listing of disk image files on the SD card. Press the SELECT button to choose an image to insert into the drive.

The Macintosh controls disk ejection. To eject a floppy disk, select “Eject” from the Macintosh Finder’s menu.

Avoid pressing the Emu’s reset button while in floppy emulation mode. The Macintosh won’t recognize that the emulated floppy disk has been removed, causing it to become confused and behave incorrectly.

Floppy Emu supports Macintosh floppy disk images in one of two common formats: raw disk images (.DSK files) and Disk Copy 4.2 disk images (.IMG or .IMAGE files). The less common Disk Copy 6.3 format is not directly supported, but DC63 images can be converted to raw images. See the **DISK IMAGES** section for more details about Macintosh disk image formats.

The very oldest Macintosh models were introduced before some of the larger floppy disk sizes had been developed. As a result, the Macintosh 512Ke, Plus, and SE don’t support 1.4MB disks. The Macintosh 128K and 512K don’t support 800K or 1.4MB disks, and are limited to using 400K disk images only.

Hard Disk Emulation

In hard disk emulation mode, the Floppy Emu emulates an HD20-compatible external hard drive – an Apple-brand hard drive from 1985 that predated SCSI. HD20-type hard disks are compatible with the Mac 512K (requires the HD20 Init), Mac 512Ke, Plus, SE (not SE/30), Classic, Classic II, Portable, IIci, IIsi, LC-I. **Other Macintosh models are not compatible with hard disk emulation mode.**

When using this emulation mode, the Floppy Emu requires a raw disk image (.DSK file). Hard disk images up to 2 GB are supported. For a suitable raw disk image, use an existing hard disk image file from a software-based Mac emulator like Mini vMac, or download a prebuilt blank disk image from Gryphel, which includes various size blanks up to 224 MB. You can also

use a command line tool such as `dd` to create a blank disk image, by generating a file containing nothing but zeroes (the size of the file must be a multiple of 512).

The Mac 512K cannot boot directly from an HD20-compatible hard disk. Instead, you must first insert a bootable floppy disk with a System folder that contains Apple's [HD20 INIT](#). The computer will load the HD20 INIT, then switch over to the Floppy Emu hard drive and continue booting from there. The Mac 512Ke, Plus, SE, Classic, Classic II, Portable, Ilci, IIsi, and LC-I have HD20 support built into ROM and do not require the HD20 INIT.

Accelerator add-ons for compact Macs like the Plus and SE appear to be incompatible with HD20 disks. Some users have found success by disabling the instruction cache in their accelerator's control panel. For best results, it's recommended to disable or remove any accelerator from your compact Mac if you plan to use Floppy Emu's HD20 hard disk mode.



7. LISA USAGE

For Lisa floppy disk emulation, an alternate firmware version must first be installed on the Floppy Emu device (the Emu ships pre-configured with Apple II compatible firmware). Download the Lisa-compatible firmware from www.bigmessowires.com/floppy-emu, and follow the installation procedure described in the *readme.txt* file that accompanies the download.

After installing the new firmware, the Floppy Emu must be set to Lisa 3.5 inch floppy emulation mode. See the **INITIAL CONFIGURATION AND SETUP** section for details.

Lisa floppy emulation mode works with the Lisa 2/5 and 2/10 for emulation of 400K and 800K floppy disks. The type of disk is automatically determined by the size of the disk image you select. Use the PREV and NEXT buttons to navigate through the menu listing of disk image files on the SD card. Press the SELECT button to choose an image to insert into the drive.

Avoid pressing the Emu's reset button while in floppy emulation mode. The Lisa won't recognize that the emulated floppy disk has been removed, causing it to become confused and behave incorrectly.

Native Lisa floppy disk images must be in Disk Copy 4.2 format (.IMG or .IMAGE files), in order to preserve the sector tag bytes needed by the Lisa.

When the Lisa is running the MacWorks environment, Floppy Emu can also emulate Macintosh disks for the Lisa. The Macintosh disks can be raw disk images (.DSK files) or Disk Copy 4.2 disk images (.IMG or .IMAGE files). Keep the Floppy Emu set to Lisa 3.5 inch floppy emulation mode, even when running MacWorks.



8. DISK IMAGES

Disk images are special files that store the contents of an entire floppy disk or hard disk. Each of your disk images will be stored on the SD card as a separate file. For example, a disk image of a Macintosh System 6.0.8 startup floppy might be stored on the SD card as the file *SYSTEM-608.DSK*, while side 1 of the Apple II game Oregon Trail might be stored on the card as the file *OREGON TRAIL 1.DO*.

When you select a disk image from the Floppy Emu's menu listing, the computer behaves as if you had inserted a real disk with the same contents as the disk image. It can read the disk, or boot from it. If you write to the emulated disk, the contents of the disk image file on the SD card will be modified too.

On a modern Mac or Windows computer, the vintage Mac and Apple II disk images appear as generic files of unknown type. You can see them and copy them, although the computer won't know what they are. But using 3rd-party tools, it's possible to peek inside a disk image, and view the actual Apple II or classic Mac files it contains.

If a padlock icon appears next to a disk image's name, it means that disk image is read-only. This may be because the disk image file itself is read-only on the SD card (check the file properties in Windows or OSX), or because that type of disk image is inherently read-only (.NIB and .WOZ images are two examples), or because it's a sparse disk image where empty sectors have been omitted.

Compressed file archives such as Stuffit (.SIT files) and Zip (.ZIP files) are *not* disk images, and can't be used directly with Floppy Emu. Instead, 3rd-party tools can create a new disk image containing the contents of the archive.

8.1 Technical Info for Disk Image Formats

Floppy Emu can work with the following disk image formats:

Macintosh raw disk images – These typically have a filename that ends with the letters .DSK. A raw disk image is just the actual data from the original disk, with no extra headers or metadata. For example, a raw disk image of an 800K floppy disk will be exactly 800K in size, or 819,200 bytes. Raw disk images provide somewhat better I/O performance than the alternative Mac formats, and their use is preferred.

Disk Copy 4.2 images – These are used for Macintosh and Lisa disk images, and also less commonly for Apple II disk images of 3.5 inch floppies. They typically have a filename that ends with the letters .IMG or .IMAGE. Disk Copy 4.2 images contain extra header information describing the original disk, and are therefore normally larger than the original. For example, a Disk Copy 4.2 image of an 800K floppy disk will be at least 819,284 bytes in size. Occasionally a Disk Copy 4.2 image may be smaller than the original disk, if empty sectors from the original are omitted in the disk image.

Disk Copy 4.2 images contain an embedded checksum value, used to help detect if the file is corrupted. When using Floppy Emu to write to an emulated disk using a DC42 disk image file, the contents of the image file on the SD card will be updated but the checksum will not be recalculated. Instead, the checksum value will be set to 0 to indicate that it was not calculated. This may cause other disk utility programs to report incorrectly that the disk image is corrupt.

[dc42cksm](#) is a Windows command line program that can view the checksums in a Disk Copy 4.2 image, and optionally update the checksums if they're not correct.

Disk Copy 6.3 images – These Macintosh disk images typically have a filename that ends with the letters .IMG or .IMAGE, making them difficult to distinguish from Disk Copy 4.2 images. DC63 images are uncommon, and are most often encountered in collections of Apple’s own operating system disk images for System 7.5 and later. If you’re not sure whether a disk image is in Disk Copy 6.3 format, the OSX command line program `hdiutil` can tell you its type:

```
hdiutil imageinfo myUnknownDisk.img
```

Floppy Emu does not directly support Disk Copy 6.3 format, because DC63 disk images have separate data and resource forks that have no equivalent in the FAT32 filesystem used by the SD card. However, DC63 images can be converted to Macintosh raw disk images using the OSX command line programs `hdiutil` and `dd`. Type these two commands:

```
hdiutil convert myDC63disk.img -format DC42 -o myDC42disk.img
```

```
dd ibs=1 skip=84 if=myDC42disk.img of=myrawdisk.dsk
```

The first command uses `hdiutil` to convert the DC63 disk image into DC42 format. However, there is a bug in `hdiutil`'s DC42 implementation, and some of the values in the DC42 header are written in the wrong byte order. This causes the error message "convert failed - corrupt image", but don’t worry. The second command strips off the entire 84-byte DC42 header, resulting in a finished Macintosh raw disk image.

DOS 3.3 disk images – This Apple II disk image format is used for floppy disk images. The files typically have a name that ends with the letters .DO or .DSK. These are raw disk images, containing only the actual data from the original disk, with no extra headers or metadata. A DOS 3.3 image of a 140K floppy will be exactly 143360 bytes in size. The “DOS 3.3” name refers only to the order in which the sectors are interleaved, and these disk images aren’t specific to DOS 3.3 software.

ProDOS disk images – These Apple II disk images are used for floppy disks of any size, or for hard disk images. The “ProDOS” name refers to the order in which the sectors are interleaved, not the contents of the disk. ProDOS disk images typically have a name that ends with the letters .PO or .HDV (for hard disks). Like DOS 3.3 images, these are raw disk images with no extra headers or metadata.

2MG disk images – These are used for Apple II floppy disk images of various sizes, and have a filename that ends with the letters .2MG. The 2MG disk images contain extra header information describing the original disk, and are therefore normally larger than the original. On the Floppy Emu, 2MG disk images exhibit slightly slower I/O performance than DOS 3.3 and ProDOS disk images.

NIB disk images – This Apple II disk image format is used almost exclusively for 140K 5.25 inch floppy disk images, and has a filename ending with the letters .NIB. Unlike the other disk image formats described above, NIB disk images store data in a very low-level format that includes all the original sector headers, footers, checksums, and inter-sector bytes. The other formats omit this information, and regenerate it dynamically when needed. The low-level nature of NIB disk images make it possible to encode non-standard sectoring schemes, such as those found on some lightly copy-protected Apple II floppy disks. NIB disk images are read-only when used with the Floppy Emu.

WOZ disk images – Conceptually similar to NIB, WOZ is another low-level disk image format for Apple II disks, and has a filename ending with the letters .WOZ. Floppy Emu supports WOZ images of 140K 5.25 inch floppy disks. WOZ disk images are well-suited for copy-protected Apple II games and other protected Apple II software, thanks to this image type’s ability to store non-standard and invalid disk data. These disk images are read-only when used with the Floppy Emu.

8.2 Creating and Editing Disk Images

On a modern Mac or Windows computer, vintage Macintosh and Apple II disk images appear as generic files. Windows and OSX can show you the disk image file, and let you copy it to/from the SD card, but won't be able to view the disk image's contents. That's not a problem if you're simply retrieving pre-made disk images from a web site, but sometimes it's helpful to edit disk images or to create your own.

To create or edit disk images with a modern computer, you'll need some 3rd-party software tools. The choice of software depends on what type of disk images you want to edit, and what modern computer you're using.

Stand-alone disk image editors are similar to word processors or paint programs: they open a document (the disk image), and provide a way to view and modify its contents. This is the easiest way to edit disk images. Examples are CiderPress and HFVExplorer.

Software emulators replicate an entire vintage Mac/Lisa/Apple II running on your modern computer. They use disk images in the same way that the emulated computer uses real disks. Any modifications made to the disk through the emulated computer environment will result in corresponding changes to the disk image. Software emulators are more difficult to set up and use, but they provide more flexibility than stand-alone disk image editors. Examples are Virtual][, Mini vMac, and IDLE.

Apple II Disk Images

[CiderPress](#) is a stand-alone disk image editor for all types of Apple II disk images. It makes it easy to open Apple II disk images, view their contents, and transfer files between the disk image and the modern computer. CiderPress only runs on Windows, but it's such a valuable tool, OSX users are strongly encouraged to install Parallels or another Windows virtualization tool so they can run CiderPress on their Mac. If you do lots of Apple II work, CiderPress is essential.

[Virtual \]\[](#) is a Mac OSX-hosted Apple II emulator.

[AppleWin](#) is a Windows-hosted Apple II emulator.

Vintage Macintosh Disk Images

[OSX](#) version 10.13 High Sierra can directly open and view Macintosh raw disk images, if they're renamed. Vintage Mac disk images are mounted as read-only disks under OSX. You'll need to change the filename extension of the disk image. Rename the disk image file from myDiskImage.DSK to myDiskImage.IMG, then simply double-click the renamed file to open it. If you prefer the command line, you can also use hdiutil to mount the disk image without renaming it:

```
hdiutil attach -imagekey diskimage-class=CRawDiskImage myDiskImage.dsk
```

[HFVExplorer](#) is a stand-alone disk image editor for Macintosh raw disk images. It's a similar concept to CiderPress, and makes it easy to transfer files between Mac disk images and the modern computer. HFVExplorer only runs on Windows, but it's such a valuable tool, OSX users are strongly encouraged to install Parallels or another Windows virtualization tool so they can run HFVExplorer on their Mac.

[Mini vMac](#) is a cross-platform Macintosh emulator that mimics a Mac Plus. It can open and use disk images in Macintosh raw or Disk Copy 4.2 formats. It's particularly useful for running Stuffit Expander on the emulated Mac Plus, for those times when you encounter software that's distributed as a .SIT file rather than as a disk image. A setup guide is [here](#), and you'll also need a vMac.ROM file (search Google). In order to transfer individual files between Mini vMac and the modern computer, you'll also need the [ImportFI and ExportFI extras](#).

[Basilisk II](#) is a cross-platform Macintosh emulator that mimics a 680x0 Macintosh II computer. It's primarily useful for those times when you encounter software that's distributed as a newer version of .SIT file, where the required version of Stuffit Expander is incompatible with Mini vMac's emulated Mac Plus.

Lisa Disk Images

[IDLE](#) and [LisaEm](#) are cross-platform Lisa emulators.

9. Transferring Files from Modern to Vintage Computer

Floppy Emu makes it easy to share data with your vintage computer. In most cases, all that's needed is to download a disk image from a collection on a web site, and copy it to the SD card. When the SD card is placed in the Floppy Emu, the new disk image will appear in the menu listing of available disks.

9.1 Vintage Software from the Web

Disk images of classic Apple II, Macintosh, and Lisa software can be found at many sites on the internet.

Macintosh

macintoshgarden.org

macintoshrepository.org

www.macfixer.com/vintage-software

[Apple public FTP mirror](#)

Apple II

[ASIMOV](#)

macgui.com/downloads/ (see the Apple II and IIgs categories)

Lisa

[The Mothership](#)

[TOSEC: Apple Lisa](#)

[Binary Dinosaurs](#)

9.2 Stuffit (.SIT) and Other Compressed File Archives

Occasionally you may find some vintage software that's distributed as a Stuffit (.SIT) file or other compressed file archive, rather than as a disk image. Because these are not disk images, they can't be used directly with Floppy Emu.

It's not recommended to UnStuff the .SIT file directly on your Modern Mac or Windows computer. Although you may find UnStuff utility programs that appear to work, the result will likely be unsatisfactory. Vintage Macintosh files have separate

data and resource forks with no equivalent in the FAT32 or NTFS filesystems used by the SD card and Windows computers. If UnStuffed in this environment, the forks and their associated metadata will be separated, and the file may become unusable. Instead, you should UnStuff the .SIT file on a real vintage Macintosh, or on a software emulator of a vintage Macintosh.

Two options for dealing with Stuffit files are:

1. Create a new disk image, and add the Stuffit file to it. Copy the disk image to the SD card, and open the disk image on your vintage Mac. Then run Stuffit Expander on the vintage Mac to decompress the .SIT archive.
2. Run the Mini vMac emulator on a modern computer. Run Stuffit Expander from inside the emulated Mac environment to decompress the .SIT archive. Then copy the decompressed files to a new disk image.

See the **CREATING AND EDITING DISK IMAGES** section for more information about Mini vMac and HFVExplorer.

You can find a disk image containing version 4.0 of Stuffit Expander at the [Gryphel Project](#).

Option 1 is the easiest solution, but it requires you to already have Stuffit Expander available on your vintage Mac.

1. Use HFVExplorer to create a new blank disk image, or download a pre-made blank from [here](#).
2. Use HFVExplorer's "Open Volume" menu option to open the disk image, and copy the .SIT file into it.
3. Quit HFVExplorer.
4. Copy the disk image to your SD card.
5. Connect the Floppy Emu to your vintage Mac, and insert the SD card into the Floppy Emu.
6. Select the new disk image from the menu listing on the Floppy Emu screen.
7. The .SIT file will now be visible in the disk you selected. Run Stuffit Expander to decompress it. If your .SIT file isn't listed as an option, try holding down the command key before selecting "Expand" from the "File" menu.

Option 2 is a more flexible but cumbersome approach. It doesn't require anything special on your vintage Mac.

1. Use HFVExplorer to create two new blank disk images, or download pre-made blanks from [here](#).
2. Use HFVExplorer's "Open Volume" menu option to open the first disk image, and copy the .SIT file into it.
3. Quit HFVExplorer.
4. Launch Mini vMac on your modern Mac or Windows computer.
5. Drag your disk image with the .SIT file into the Mini vMac window to mount the disk.
6. Drag your other blank disk image into the Mini vMac window to mount the disk.
7. Drag the Stuffit Expander disk image into the Mini vMac window to mount the disk.
8. Inside Mini vMac, run Stuffit Expander to decompress the .SIT file. If your .SIT file isn't listed as an option, try holding down the command key before selecting "Expand" from the "File" menu.
9. Save the uncompressed files to the blank disk.
10. Quit Mini vMac.
11. Copy the disk image containing the uncompressed files to your SD card.
12. Connect the Floppy Emu to your vintage Mac, and insert the SD card into the Floppy Emu.
13. Select the new disk image from the menu listing on the Floppy Emu screen.
14. The uncompressed files will now be visible in the disk you selected.

Incompatible Stuffit Versions

There are many different versions of Stuffit and corresponding versions of Stuffit Expander. Newer versions are normally able to UnStuff files created by older versions, but older versions may not even recognize files created by newer versions. If you have a .SIT file that Stuffit Expander complains is not a valid .SIT file, you may need to try a newer version of Stuffit Expander.

Versions 4.5 and later of Stuffit Expander work poorly on a Mac Plus, or don't work at all. Because Mini vMac emulates a Mac Plus, this means the newest versions of Stuffit Expander can't be used with Mini vMac. You'll need to use a 680x0 Macintosh II emulator such as Basilisk II, in order to run Stuffit Expander versions 4.5, 5.0, 5.5, or later. The rest of the process is the same as with Mini vMac.

10. Transferring Files from Vintage to Modern Computer

Floppy Emu can be used to backup old files or entire disks from your vintage computer, and copy them to a modern computer for safekeeping. You will need a disk image utility program like CiderPress or HFVExplorer - see the **CREATING AND EDITING DISK IMAGES** section for more information about these.

1. Use CiderPress or HFVExplorer to create one or more blank disk images. These can be floppy-sized disk images, or if your vintage computer supports HD20 or Smartport hard disks, you may prefer a single large disk image.
2. Copy the blank disk images to your SD card.
3. Connect the Floppy Emu to your vintage computer, and insert the SD card into the Floppy Emu.
4. Select the blank disk image from the menu listing on the Floppy Emu screen.
5. Copy the desired files onto the blank disk, using normal file copying methods on your vintage computer. This might be a simple drag and drop (Lisa and Macintosh), or a disk copy program like ProDOS Utilities or Copy II+ (Apple II).
6. Remove the SD card from the Floppy Emu, and insert it into your modern computer.
7. Use CiderPress "Open" or HFVExplorer "Open Volume" menu options to open the disk image on the SD card.
8. Use CiderPress or HFVExplorer to copy the desired files from the disk image to your modern computer's disk.

When using disk copy programs like Copy II+ to copy entire disks to the Floppy Emu, some extra attention is needed, due to the way many disk copy programs handle formatting of the destination disk. For Macintosh disk copying with Copy II Mac, use the program's "Sector Copy No Format" option. For Apple IIc disk copying, see the section **COPYING 5.25 INCH DISKS**.

Appendix A. - ERROR MESSAGES

Disk image type is not supported in the current Emu mode

A variety of disk image types can be used with Floppy Emu, depending on which firmware is installed and what emulation mode is currently selected. You'll see the "image type is not supported" error if you choose a disk image that the Floppy Emu can't use with the present firmware and emulation mode. Often this is because you need to change the firmware or emulation mode to the ones appropriate for that type of disk image. This error may also appear if you chose a type of disk image that Floppy Emu doesn't know how to read. Some examples:

- You selected a Macintosh disk image, but the Emu has the Apple II firmware installed, or vice versa. See **INSTALLING THE DESIRED FIRMWARE** for instructions for installing the appropriate firmware.
- You selected a floppy disk image, but the Emu is set to hard disk emulation mode, or vice versa. See **CHOOSING THE DISK EMULATION MODE** for instructions for changing the emulation mode.
- You selected a 5.25 inch Apple II disk image, but the Emu is set to 3.5 inch disk emulation mode, or vice versa. See **CHOOSING THE DISK EMULATION MODE** for instructions for changing the emulation mode.
- You selected a DiskCopy 6.3 disk image. See **TECHNICAL INFO FOR DISK IMAGE FORMATS** for instructions to convert the image.
- You selected something that isn't a disk image, such as an archive or an individual file. See **STUFFIT (.SIT) AND OTHER COMPRESSED FILE ARCHIVES** for instructions for working with archives.
- The Emu is set to hard disk emulation mode, but the selected disk image is smaller than 2 MB.
- The Emu is set to Macintosh hard disk emulation mode, but the selected disk image isn't in raw format with a .disk filename extension. Use a disk image utility program to convert it.
- The Emu is set to Macintosh or Lisa floppy emulation mode, but the selected disk image is not a raw image precisely 400K, 800K, or 1440K, nor is it a DiskCopy 4.2 image of a disk less than or equal to 1440K size. Verify that the disk image is actually a floppy-sized image. If necessary, use a disk image utility program to convert it.
- The Emu is set to Apple II 5.25 inch emulation mode, but the selected disk image is not precisely 140K (for .po and .do images), nor is it 227.5K (232960 bytes, for .nib images), nor is it a .2mg or .woz image of a 140K disk. Verify that the disk image is actually a floppy-sized image. If necessary, use a disk image utility program to convert it.
- The Emu is set to Apple II 3.5 inch emulation mode, but the selected disk image is not a raw image precisely 800K, nor is it a .2mg image of an 800K disk, nor is it a DiskCopy 4.2 image of an 800K disk. Verify that the disk image is actually a floppy-sized image. If necessary, use a disk image utility program to convert it.

File not contiguous

For optimal performance with Floppy Emu, disk images must be stored on the SD card in a contiguous span of sectors. Normally this happens automatically, but if the SD card becomes fragmented, you may see this error message, and will need to defragment the SD card.

The easiest way to defragment the SD card is to insert it into a modern computer, copy everything from the SD card into a temp directory, delete all the files on the SD card (including any hidden files that may exist), and then copy everything back to the SD card. An alternative method is to reformat the SD card, or use a disk defragmenting utility program.

SD read error***SD write error******SD writestop fail***

These errors indicate a problem transferring data between the SD card and the Floppy Emu's on-board microcontroller. Typically they appear intermittently, and if you simply try again, it will succeed.

The error may be caused by a flakey SD card, although this is rare. You can try substituting a different SD card to rule out this possibility.

Most often this error is caused by out-of-spec voltages, or electrical noise of some kind. Typically this is due to a degraded power supply or failing capacitors in a 20+ year old computer. It can also be caused by bad cables or connectors. On certain Macintosh models, the Bourns filters on the logic board can become degraded and cause trouble. To help find the cause, try using the Floppy Emu on a different computer and see if the error persists. Then try substituting parts one at a time to isolate the problematic hardware.

Appendix B. - FAQ

Does this require a special driver or INIT?

No software is required for floppy emulation on any system. For Macintosh HD20 hard disk emulation, most supported Mac models require no software, though the Mac 512K requires Apple's HD20 Init.

Can I format the emulated disk?

Yes for hard disk emulation, no for floppy emulation. Floppy Emu emulates standard sector-by-sector floppy writing, as occurs with normal I/O operations such as copying files or saving data from within a program. Instead of formatting a blank disk, use one of the provided blank disk images.

Can I back-up old floppies using tools like Disk Copy 4.2 or Copy II Plus?

Yes, with some conditions. Many disk copy programs perform a simultaneous format-and-write of the destination floppy, which creates problems (see previous answer about formatting). For the Mac, direct floppy-to-floppy copies are possible using Copy II Mac with its "Sector Copy no Format" option. For Apple II, see the section titled Copying 5.25 Inch Disks.

Can the Emu work with copy-protected disks?

The hardware is designed to work with unprotected disks using standard sector and disk formats. Some copy-protection schemes may work, including some Apple II WOZ and NIB disk images, but this isn't a hardcore cracking tool.

Can I emulate multiple floppies at once?

Floppy Emu can store as many disk image files as your SD card will hold, but only one can be "inserted" in the drive at any given time.

Can I connect two Floppy Emus to the same computer?

Yes, if they are connected to separate disk ports. For the Apple II, a Floppy Emu board can also be placed at the end of a daisy chain of other disk drives. The Emu doesn't have a daisy-chain output port, and can't be daisy-chained on the Lisa or Macintosh.