

# **BMOW FLOPPY EMU DISK EMULATOR**

**For vintage Apple II, Macintosh, and Lisa computers**

## **Instruction Manual for Floppy Emu Model C**

### **0. Five Minute Quick Start**

### **1. Introduction**

### **2. Connecting the Floppy Emu**

#### 2.1 External Connection Options

#### 2.2 Internal Connection Options

##### 2.2.1 Special Note for Connecting to the Apple II Disk II Controller Card

#### 2.3 Special Note for Connecting to the Apple IIc

### **3. Initial Configuration and Setup**

#### 3.1 Installing or Updating the Firmware

#### 3.2 Choosing the Disk Emulation Mode

#### 3.3 Selecting a Disk Image

#### 3.4 The Settings Menu

### **4. SD Memory Cards**

### **5. Apple II Usage**

#### 5.1 Understanding Apple II Boot Disks

#### 5.2 Formatting and Copying Apple II Floppy Disks

### **6. Macintosh Usage**

#### 6.1 Formatting and Copying Macintosh Floppy Disks

### **7. Lisa Usage**

### **8. Disk Images**

#### 8.1 Technical Info for Disk Image Formats

#### 8.2 Creating and Editing Disk Images

### **9. Transferring Files from Modern to Vintage Computer**

#### 9.1 Vintage Software from the Web

#### 9.2 Stuffit (.SIT) and Other Compressed File Archives

### **10. Transferring Files from Vintage to Modern Computer**

### **Appendix A. - Error Messages**

### **Appendix B. - Notes for Visually Impaired Users**

### **Appendix C. - FAQ**

## 0. FIVE MINUTE QUICK START

Don't have time to read a long instruction manual? Start here.

### Install the desired Floppy Emu firmware version

The BMOW Floppy Emu board ships with Apple II-compatible firmware pre-installed. For Macintosh and Lisa-compatible disk emulation, alternate firmware can be downloaded from [www.bigmessowires.com/floppy-emu/#firmware](http://www.bigmessowires.com/floppy-emu/#firmware) Copy the firmware file to your SD card, and follow the instructions included with the firmware to update the Floppy Emu board.

### Insert your SD memory card into the Floppy Emu

The SD card stores all of the disk images that you'll use with the Floppy Emu. It may be an SD card purchased from BMOW, or your own SD card filled with disk images that you downloaded from the internet.

### Connect the Floppy Emu to your computer and turn it on

Using the included cable and DB-19 adapter, the Floppy Emu can be connected to any 19-pin or 20-pin floppy disk port, inside or outside the computer. Detach the DB-19 adapter from the cable if you don't need it, and save it for future use. If connecting to a 20-pin Apple Disk II Controller Card, see section 2.2.1 for the correct cable orientation.

### Choose a disk emulation mode

Directly after the computer is turned on, press and hold the Floppy Emu's SELECT button to open the settings menu. From the settings menu, select the option for Disk Emulation Mode. Here you can choose what type of disk drive the Floppy Emu will emulate: a 3.5 inch drive, 5.25 inch drive, dual drive system, hard disk, or other type. Your computer and disk controller may not support all of the disk drive types offered by the Floppy Emu.

The chosen disk emulation mode is stored in non-volatile memory, and will remain in effect permanently until changed. After choosing a new emulation mode, restart the computer. This will ensure it correctly recognizes the new drive type.

### Select a disk image

The Floppy Emu will display a directory listing, showing the contents of your SD card. If you're using the BMOW-provided card, you'll see three top-level directories named *Apple II Stuff*, *Macintosh Stuff*, and *Lisa Stuff*. Within these directories, you'll find a collection of disk images for each computer family. Use the PREV, NEXT, and SELECT buttons to navigate the directory listing and choose one of the disk images from the SD card. The computer will behave as if a new disk was inserted or mounted. You may need to reset or restart the computer in order to boot from the new disk.

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# 1. INTRODUCTION

Thank you for purchasing a BMOW 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 disk images to insert or mount in the emulated disk drive. Disk images can be downloaded from archives on the internet, or created using 3<sup>rd</sup>-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, classic Mac, or Lisa files the disk image contains.

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

COMPUTER	DISK EMULATION MODES
<b>Apple II</b>	
Apple II, II+, IIe with <a href="#">Yellowstone</a> disk controller	✔ 5.25 inch floppy, Dual 5.25 inch floppy, 3.5 inch floppy, Smartport hard disk, Unidisk 3.5
Apple II, II+, IIe with standard disk controller	✔ 5.25 inch floppy, Dual 5.25 inch floppy[1]
Apple II, II+, IIe with Liron disk controller	✔ Smartport hard disk, Unidisk 3.5
Apple IIc	✔ 5.25 inch floppy[2], Dual 5.25 inch floppy[3], Smartport hard disk[4], Unidisk 3.5[4]
Apple IIgs, IIc+	✔ 5.25 inch floppy, Dual 5.25 inch floppy, 3.5 inch floppy, Smartport hard disk, Unidisk 3.5
<b>Macintosh</b>	
Macintosh 128K	✔ 3.5 inch 400K floppy
Macintosh 512K	✔ 3.5 inch 400K floppy, HD20 hard disk[5]
Macintosh 512Ke, Plus, SE	✔ 3.5 inch 400K/800K floppy, HD20 hard disk
SE FDHD, Classic, Classic II, Portable, IIci, IIxi	✔ 3.5 inch 400K/800K/1.4MB floppy, HD20 hard disk
LC [6]	✔ 3.5 inch 400K/800K/1.4MB floppy, HD20 hard disk
SE/30, IIcx	✔ 3.5 inch 400K/800K/1.4MB floppy, HD20 hard disk[7]
IIx [6]	✔ 3.5 inch 400K/800K/1.4MB floppy, HD20 hard disk[3]
IIfx, IIvx, IIvi, LC-II, LC-III, LC 4xx, LC 5xx, Color Classic, Color Classic II, TV, Performa, Quadra, Centris, Power Mac [6]	✔ 3.5 inch 400K/800K/1.4MB floppy
<b>Lisa</b>	
Lisa 2/5 and 2/10	✔ 3.5 inch 400K/800K floppy

[1] *Disk II Controller Card with 20-pin connector requires [Dual 5.25 Adapter](#) for dual drives*

[2] *requires internal motherboard connection or [Internal/External Switcher](#) for booting 5.25 inch disks, see instructions*

[3] *requires [Internal/External Switcher](#)*

[4] *requires IIc with ROM revision 0 or newer for Smartport and Unidisk 3.5 modes, see instructions for details*

[5] *Mac 512K also requires a boot floppy with HD20 Init for HD20 hard disk mode*

[6] *uses internal disk connector on the computer's motherboard*

[7] *requires [Mac ROM-inator II](#) for HD20 hard disk 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 Options

Connect the Floppy Emu to the DB-19 disk port (19-pin D-shaped) 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+. Some Apple II disk controller cards also include a DB-19 connector, including the Apple 5.25 Drive controller card and Apple Duo Disk controller card. Floppy Emu is not a SCSI device and can not be connected to the 25-pin SCSI port found on some Macintosh computers.

#### Daisy Chaining

For Apple II computers, the Floppy Emu can also be connected to the DB-19 port on the rear of another Apple disk drive. This is called Daisy Chaining, and several drives can be connected in series using this technique. The Apple II requires daisy chained drives to be connected in a **specific order**: standard 3.5 inch drives must go first in the chain, then Smartport hard disks and Unidisk 3.5 drives, and finally 5.25 inch drives. The Floppy Emu must be placed at the proper position in the daisy chain, based on its chosen emulation mode, or else it won't work correctly.

Because the Floppy Emu does not have a daisy chain output port, it's usually not possible to add more drives in the daisy chain after the Emu. The optional BMOW Daisy Chainer accessory enables the attachment of more drives after the Floppy Emu, providing more flexibility in daisy chain arrangements.

When the Floppy Emu is configured to emulate a Smartport hard disk or Unidisk 3.5, and is daisy-chained to the rear connector of another Unidisk 3.5 or to the BMOW Daisy Chainer, the **Smartport daisy chain** version of the Floppy Emu firmware is required for correct operation. See <https://www.bigmessowires.com/2021/04/22/floppy-emu-update-smartport-daisy-chain-support/>

The Lisa does not support daisy chaining, so Floppy Emu must be connected directly to the computer.

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 rear of the HD20.

### 2.2 Internal Connection Options

The Lisa and some early Macintosh computers don't have an external 19-pin disk port, nor does an Apple II, II+, or IIe when equipped with a standard Apple Disk II controller card. For these computers, the Floppy Emu's DB-19 adapter should be

disconnected from the 20-pin flat ribbon cable, so the cable can be connected to a 20-pin disk port on the disk controller card or computer's motherboard.

If connecting the cable internally to the computer's motherboard, it may be necessary to disconnect the internal floppy drive that's normally attached to this 20-pin port. The Floppy Emu will replace the built-in floppy drive. The cable can then be routed outside the computer's case through an existing opening, or a new opening can be cut if needed.

### 2.2.1 Special Note for Connecting to the 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 notch, 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 Connecting to the Apple IIc

The Apple IIc computer has an external 19-pin disk port that's compatible with the Floppy Emu, but which has some limitations that make it inconvenient for certain uses. A standard Apple IIc is unable to boot from an externally connected 5.25 inch floppy drive. If a Floppy Emu in 5.25 inch emulation mode is connected to the external 19-pin disk port, it will appear as 5.25 inch drive number 2: a secondary non-bootable drive. This Apple IIc quirk only applies to *5.25 inch floppy drives*. When using Floppy Emu in Smartport hard disk or Unidisk 3.5 emulation modes, there's no issue with the Apple IIc's external 19-pin disk port.

Due to this behavior of the Apple IIc, when using a Floppy Emu to emulate a 5.25 inch floppy drive, it may be preferable to connect the Emu internally to the 20-pin disk port on the computer's motherboard. This will make the Emu appear as 5.25 inch drive number 1, and enable the IIc to boot from it. Smartport hard disk and Unidisk 3.5 emulation aren't supported in this configuration, however. 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>

A more robust solution is the optional BMOW Internal/External Drive Switcher. With this extra hardware, the Floppy Emu can behave as an internal drive while connected externally, with a switch that swaps the drive number assignment. This makes it easy to boot from an emulated 5.25 inch disk on the Apple IIc, while retaining support for Smartport hard disk or Unidisk 3.5 emulation and full use of the Apple IIc's built-in 5.25 inch floppy drive.



### 3. INITIAL CONFIGURATION AND SETUP

#### 3.1 Installing or Updating Firmware

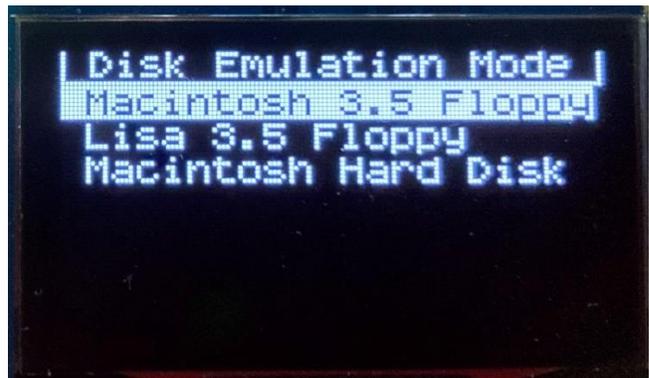
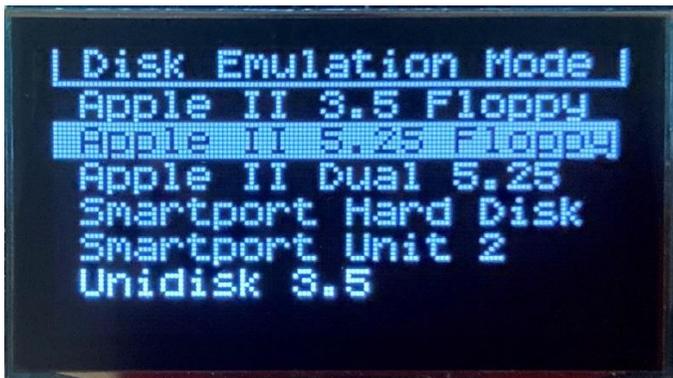
It may be necessary to install different firmware on the Floppy Emu device, depending on the type of Apple computer being used. **The Emu ships with Apple II compatible firmware pre-installed.** For Macintosh and Lisa disk emulation, an alternate firmware must be used instead. Download and install the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

Firmware updates require copying a special file to the SD card, and then inserting the SD card into the Emu board and pushing a few buttons. Full instructions for installing firmware updates can be found in the *readme.txt* file that's included with the firmware download. A [demo video](#) of the firmware update process is also available.

The Floppy Emu firmware is also updated from time to time, to add new features or fix bugs. Watch the BMOW blog or the Floppy Emu web site for announcements.

#### 3.2 Choosing the Disk Emulation Mode

Each version of the Floppy Emu firmware can emulate many different types of disk drives, such as 3.5 inch drives, 5.25 inch drives, and dual drive setups. These are called *emulation modes*. Floppy Emu can only emulate one type of disk drive at any given time. 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. When prompted, press the SELECT button to open the settings menu. From the menu, choose the option for *Disk Emulation Mode...* 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.

### 3.3 Selecting a Disk Image

The Floppy Emu will display a File Explorer directory listing, showing the contents of your SD card. If you're using the BMOW-provided card, you'll see three top-level directories named *Apple II Stuff*, *Macintosh Stuff*, and *Lisa Stuff*. Within these directories, you'll find a collection of disk images for each computer family. Use the PREV, NEXT, and SELECT buttons to navigate the directory listing and choose one of the disk images from the SD card.

If your SD card contains hundreds of disk images or many deeply-nested subdirectories, navigating through the contents of the card can become tedious and slow. In this case, an optional Favorites menu can be configured. At startup, the Favorites menu will be shown instead of the standard File Explorer menu. If needed, you can exit the Favorites menu at any time in order to choose non-favorite disk images.

The Favorites menu is configured using a file named *favdisks.txt*. This is a plain text file, placed in the top-level root directory of your SD card. In this file, list the full path to each favorite disk image, one per line. An example file is included with the Floppy Emu's firmware update package, which can be downloaded from the BMOW web site.

For Apple II computers, the floppy automount behavior can also be configured using an optional automount directive on the first line of the *favdisks.txt* file. This is just the word "automount" followed by a space and a single digit:

- 0 – Never automount. The Floppy Emu will always power up to display your Favorites menu.
- 1 – Always automount the first disk image listed in *favdisks.txt*
- 2 – Automount the most recently used disk, if there was a disk inserted when the power was turned off last time.

Automounting is only supported for the Apple II floppy disk emulation modes. The automount directive has no effect in other emulation modes, or for Macintosh / Lisa disk emulation.

### 3.4 The Settings Menu

Directly after the Floppy Emu is turned on or reset, a prompt is displayed to press SELECT to open the settings menu. If the SELECT button is pressed during this start-up time (about three seconds), the Floppy Emu will pause its disk emulation behavior and display a menu for configuring the device settings. Many aspects of the device can be customized here, including the disk emulation mode and the built-in display options.

The display brightness can be adjusted in the Floppy Emu settings menu as needed for the ambient light level. Floppy Emu Model C features a high-contrast 128x64 pixel OLED display. The firmware implements automatic screen-dimming during periods of inactivity, to help prevent OLED screen burn-in.

The settings menu also offers a choice between OLED display types. The normal 1.3 inch OLED is standard equipment for the Floppy Emu. Some users prefer to replace the standard OLED with an aftermarket 2.4 inch jumbo OLED. There's no harm in selecting the wrong display type, but the display image may look incorrect.



## 4. SD MEMORY CARDS

Floppy Emu supports standard Micro-SD sized 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. High capacity SDXC cards are not currently supported.

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 <https://www.bigmessowires.com/floppy-emu/#firmware> to see if a newer firmware version is available.

Before first use, the Floppy Emu must be set to the desired disk emulation mode, to choose the type of disk drive the Floppy Emu will emulate. See the **INITIAL CONFIGURATION AND SETUP** section for details.

The Apple II firmware supports the following disk emulation modes:

- 5.25 inch floppy
- Dual 5.25 inch floppies
- 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 disk images of copy-protected software. See the **DISK IMAGES** section for more details about Apple II disk image formats.

Apple II computers may not respond immediately when you insert a 5.25 inch floppy disk. If the computer displays some kind of “check disk” error and halts, or shows a blank screen with nothing but the words “Apple II”, then 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.



### Dual 5.25 Inch Floppy Disk Emulation

Dual 5.25 inch disk emulation mode is available on the Floppy Emu Model C. This emulation mode is directly compatible with most Apple II computers. The Apple IIc requires the optional BMOW Internal/External Drive Switcher to make use of this emulation mode. Apple II+ and Apple IIe computers with a 20-pin Disk II Interface Card require the optional BMOW Dual 5.25 Adapter to make use of this emulation mode. Other Apple II computers and disk controllers including Yellowstone can support Dual 5.25 emulation mode without the need for additional hardware.

When using dual 5.25 mode, the Floppy Emu will appear to the computer as two daisy-chained 5.25 inch disk drives. This may be convenient for games and other software that are distributed on two disks. You can choose different disk images for drive 1 and drive 2, and eject the disks independently. Note that a maximum of two 5.25 inch drives is possible in a daisy chain, so if a real 5.25 inch drive is “upstream” from the Floppy Emu in a daisy chain configuration, Floppy Emu’s drive 2 will be ignored by the computer.

Dual 5.25 mode supports the same disk image types as single 5.25 inch emulation mode, and aside from the dual-drive UI, the behavior is the same.



**Never use Dual 5.25 mode in combination with the optional BMOW Daisy Chainer or A/B Switch. It will cause disk errors and may damage the Floppy Emu or your daisy-chained 5.25 inch drive.**

The optional BMOW Daisy Chainer makes it possible to add more disk drives “downstream” from the Floppy Emu. The BMOW A/B Switch enables run-time switching between two different drives attached to the same disk connector. If using a Daisy Chainer or A/B Switch, do not select dual 5.25 emulation mode – use single 5.25 mode instead. Combining dual 5.25 mode with a Daisy Chainer and another downstream 5.25 inch drive or with an A/B Switch can create a problem. Both the Floppy Emu and the other drive will try to function as Drive 2, fighting with each other and possibly damaging both devices.



### 3.5 Inch Floppy Disk Emulation

Apple II 3.5 inch floppy emulation mode supports 800K floppy disks. It emulates a standard “dumb” 3.5 inch floppy drive similar to the A9M0106 AppleDisk 3.5, and is compatible with the Apple IIgs and Apple IIc+, as well as with Apple II+ and Apple IIe computers using a Yellowstone disk controller or other disk controller with 3.5 inch drive capability. 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.

Apple II computers 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 through a different method than the standard 3.5 inch floppy emulation. This mode emulates a “smart” 3.5 inch floppy drive similar to the A2M2053 Unidisk 3.5, and is compatible with the Apple IIGS and Apple IIc+, as well as the Apple IIc if it has an updated ROM version. It’s also compatible with Apple II+ and Apple IIe computers using a Yellowstone disk controller or Apple Liron disk controller. This emulation mode is effectively the same as Smartport hard disk emulation mode, except the disk size is fixed at 800K and it can also be ejected. Unidisk 3.5 emulation mode is slower than standard 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.

Apple II computers 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.



### 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. It’s also compatible with Apple II+ and Apple IIe computers using a BMOW Yellowstone disk controller, or an Apple Liron disk controller. Disk images in .PO, .HDV, or .2MG formats are supported.

The original Apple IIc ROM version 255 does not support Smartport, but all later Apple IIc ROM versions do, beginning with version 0. 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. ROM upgrade kits are available on eBay, and can update a version 255 Apple IIc to version 0 or later.

When more than one Smartport hard disk is configured for simultaneous use, the first disk will behave as the boot disk. The other hard disks (up to three additional) will behave as secondary non-bootable disks, usable for programs or data.

For Floppy Emu firmware versions 221122A and later, the Smartport hard disk images can be selected directly through the menu UI, similar to the 5.25 inch and 3.5 inch floppy emulation modes. For older firmware versions, there's no menu UI for choosing the desired Smartport disk images, and the Floppy Emu automatically uses disk images from the SD card according to a fixed naming scheme. The Emu looks for files in the top-level directory of the SD card named SMART0.\*, SMART1.\*, SMART2.\*, and SMART3.\*, where \* is the filename extension and can be either PO, HDV, or 2MG. If you have fewer than four Smartport disk images, number them consecutively beginning with SMART0 and leave SMART3 unused.

Although the low-level 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 and later, however, it's possible to boot from a 32 MB ProDOS volume, and then mount additional jumbo-sized HFS volumes as secondary hard disks. 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](#) which are perfect for Apple II usage.



**Smartport Unit 2**

Smartport Unit 2 emulation mode is a variant of the standard Smartport Hard Disk mode that may be helpful for some Apple IIgs owners. Use this mode only when the Floppy Emu is emulating a Smartport hard disk as "unit 2", meaning that it's daisy-chained behind an Apple 3.5 inch floppy drive or other Smartport 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 to slot 5, it becomes unit 1, and the IIgs will only attempt to boot from that 3.5 inch drive. If a Floppy Emu in Smartport hard disk mode is daisy-chained to the 3.5 inch drive, it will become unit 2, and the IIgs will ignore it when booting.

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 IIgs RAM
5. Floppy Emu reconfigures itself as a Smartport HD on slot 5
6. Bootstrap program performs a restart of the IIgs
7. The IIgs uses the modified boot priority table to boot from the Floppy Emu's Smartport HD at unit 2

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

## 5.1 Understanding Apple II 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 the 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 were 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 Formatting and Copying Apple II Floppy Disks

### Formatting

In-system formatting of disk images on the Floppy Emu may require extra care. If a blank disk is needed, it's normally preferable to use a pre-existing blank disk image on the SD card instead of formatting a previously-used disk image. The SD card that's sold by BMOW includes a number of blank disk images for this purpose, or blanks can be created with tools like Ciderpress. If additional blanks are needed, the blank disk image on the SD card can be duplicated using a modern PC, as many times as desired.

When the Floppy Emu is emulating a 5.25 inch drive, formatting the disk is possible, but requires special care. A NIB or WOZ disk image should be used as the target disk when formatting, with WOZ being the preferred option. Successful formatting is dependent on the write cache behavior of the SD card, and on the specific disk image used.

For 5.25 inch disk formatting, it's recommended to use the specific **Blank.WOZ** disk image that's included with the Floppy Emu firmware files, in the Examples subdirectory. This disk image has been specifically optimized to provide the best performance when being formatted. If the format fails, try it again.

When the Floppy Emu is emulating a normal 3.5 inch drive, the disk can not be formatted.

When the Floppy Emu is emulating "smart" disk drives like the Smartport hard disk and Unidisk 3.5, there are no limitations on formatting. These disks can be formatted by normal Apple II tools, or used as the destination for format-and-copy tools.

## Copying

Copying individual files between disks with the Floppy Emu is easy. Copying whole disks can lead to similar challenges as formatting, however. Most disk copy utilities perform a simultaneous format-and-write of the destination disk. If the destination is a disk image on the Floppy Emu, this may lead to the same formatting challenges described in the previous section.

To copy a whole disk from a real 5.25 inch disk to a Floppy Emu disk image, if possible, configure the disk copy program to disable formatting of the destination, and to copy sectors one at a time.

If it's not possible to disable formatting of the destination disk, a NIB or WOZ 5.25 inch disk image can be used as the destination disk. It's recommended to use the BMOW-provided **Blank.WOZ** disk image as the destination. This disk image is included with the Floppy Emu firmware files, in the Examples subdirectory, and can be formatted in the Floppy Emu using DOS 3.3's COPYA or ProDOS disk utilities, and used as a destination disk for standard disk copying. If the copy fails, try it again. Other WOZ disk images or .DSK, .PO, .DO, .NIB, and .2MG disk images may not always work correctly as a destination disk for copies. Cracking tools and bit copiers like Copy II+ may not work correctly with Floppy Emu as the destination disk, regardless of the disk image used. DOS 3.3's COPYA or ProDOS disk utilities are the best tools for copying regular unprotected 5.25 inch disks.

When the Floppy Emu is emulating a normal 3.5 inch drive, the copy program must disable formatting of the destination, since format-and-write is not possible.

When the Floppy Emu is emulating "smart" disk drives like the Smartport hard disk and Unidisk 3.5, there are no limitations on disk copying.



## 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/#firmware](http://www.bigmessowires.com/floppy-emu/#firmware), 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 Mac models may not support every type of drive that Floppy Emu can emulate.



### 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 three common formats: raw disk images (typically .DSK files), Disk Copy 4.2 disk images (typically .IMG or .IMAGE files), or MOOF – a newer type of disk image that’s often used for copy-protected disk images. The less common Disk Copy 6.3 format is not directly supported, but DC63 images can be converted to raw images.

The filename extension on a Macintosh disk image is not always a reliable way of determining the disk image type, and some sources using .dsk or .img extensions generically. 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.

Compressed archive files like Stuffit SIT, BinHex HQX, MacBinary BIN, Compact Pro CPT, and text TXT are not disk images, but are recognized by Floppy Emu. If you select one of these archive files, Floppy Emu will automatically create a temporary 400K, 800K, or 1440K disk image “box” to contain the archive file.



### Hard Disk Emulation and CD-ROM Emulation

Macintosh hard disk and CD-ROM emulation can be enabled in Floppy Emu’s disk emulation mode menu, as an alternative to 3.5 inch floppy emulation. In hard disk / CD-ROM emulation mode, the Floppy Emu emulates an HD20-compatible external drive. HD20 was an Apple-brand hard drive from 1985 that predated SCSI, with a size of 20 MB, but Floppy Emu hard disks and CD-ROMs can be any size up to 2GB. The Mac 512Ke, Plus, SE, Classic, Classic II, Portable, IIfx, IIsi, and LC-I are all compatible with HD20-type disks. The Mac 512K is also compatible, but requires first booting from a floppy containing Apple’s HD20 Init. With the addition of a BMOW ROM-inator II replacement ROM, the Macintosh SE/30, IIfx, and IIfx can also be made compatible with HD20-type disks. **Other Macintosh models are not compatible with Floppy Emu’s hard disk or CD-ROM emulation mode.**

When using hard disk or CD-ROM emulation mode, the Floppy Emu requires a raw disk image (.DSK file), an Apple Partition Map SCSI device image (HDA or IMG file), or a CD-ROM image (ISO, CDR, or TOAST file). Disk images up to 2 GB are supported.

To obtain a suitable raw disk image for hard disk emulation, 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.

A new unformatted hard disk image can also be created with a command line tool such as `dd`, by generating a DSK file containing nothing but zeroes. The size of the file must be a multiple of 512 bytes. If the Macintosh is first booted from another disk, it will see this unformatted hard disk on the Floppy Emu and offer to format it. After a System file is written to the blank disk, it can then be used directly as a boot disk.

If using a SCSI device hard disk image that contains an Apple Partition Map, such as the HDA image files used by Zulu SCSI and Blue SCSI, Floppy Emu will search the partition map and mount the first HFS volume in the partition list. Driver partitions and other non-HFS partitions will be ignored.

CD-ROM images are handled as a special case of hard disk. Floppy Emu will mount the HFS volume from the CD-ROM image as if it were a read-only hard disk, rather than as removable media. The speed is comparable to a 1x CD-ROM drive so it won't replace a dedicated CD drive, but it's great for installing software. To obtain a CD-ROM image, visit a software library web site such as Macintosh Garden (see section 9).

The Mac 512K cannot boot directly from an HD20-compatible disk. Instead, you must first insert a 400K [HD20 Startup floppy disk](#) with System 3.2 and Apple's HD20 INIT. The computer will load the HD20 INIT, then switch over to the Floppy Emu HD20-type disk and continue booting from there. The other compatible Macintosh models have HD20 support built into ROM and do not require the HD20 INIT.

Many accelerator add-ons for compact Macs like the Mac Plus and SE appear to be incompatible with HD20-type 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-type disk mode.

## 6.1 Formatting and Copying Macintosh Floppy Disks

### Formatting

In-system formatting of disk images on the Floppy Emu may require extra care. If a blank disk is needed, it's normally preferable to use a pre-existing blank disk image on the SD card instead of formatting a previously-used disk image. The SD card that's sold by BMOW includes a number of blank disk images for this purpose, or blanks can be created with tools like Ciderpress. If additional blanks are needed, the blank disk image on the SD card can be duplicated using a modern PC, as many times as desired.

When the Floppy Emu is emulating a 3.5 inch Macintosh drive, formatting the disk is possible, but requires special care. Any type of disk image may be used as the target disk when formatting, but a MOOF disk image will produce the best results. Successful formatting is dependent on the write cache behavior of the SD card, and on the specific disk image used.

For 3.5 inch Macintosh disk formatting, it's recommended to use the specific **Blank.MOOF** disk image that's included with the Floppy Emu firmware files, in the Examples subdirectory. This disk image has been specifically optimized to provide the best performance when being formatted. If the format fails, try it again.

When the Floppy Emu is emulating an HD20-type hard disk, there are no limitations on formatting. These disks can be formatted by normal Macintosh utility software.

### Copying

Copying individual files between disks with the Floppy Emu is easy. Copying whole disks can lead to similar challenges as formatting, however. Most disk copy utilities perform a simultaneous format-and-write of the destination disk. If the destination is a disk image on the Floppy Emu, this may lead to the same formatting challenges described in the previous section.

To copy from a real 3.5 inch disk to a Floppy Emu disk image, if possible, configure the disk copy program to disable formatting of the destination, and to copy sectors one at a time.

If it's not possible to disable formatting of the destination disk, any type of disk image may be used as the destination, but it's recommended to use the BMOW-provided **Blank.MOOF** disk image as the destination. This disk image is included with the Floppy Emu firmware files, in the Examples subdirectory, and can be formatted in the Floppy Emu using the Macintosh Finder, used as a destination disk for standard disk copying in tools like Disk Copy 4.2. If the copy fails, try it again. Other disk images may not always work correctly as a destination disk for copies. Cracking tools and bit copiers like Copy II Mac may not work correctly with Floppy Emu as the destination disk, regardless of the disk image used.



## 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/#firmware](http://www.bigmessowires.com/floppy-emu/#firmware), 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 (typically .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 is 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.

If a padlock icon appears next to a disk image's name on the Floppy Emu display, 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.

Compressed file archives such as Stuffit (.SIT files) and Zip (.ZIP files) are *not* disk images. However, 3<sup>rd</sup>-party tools can create a new disk image that contains the archive file. The latest version of the Floppy Emu firmware will also automatically create a temporary floppy disk image when you select a Stuffit file or other Macintosh archive file from the Floppy Emu's menu listing.

## 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. A raw disk image can be identified by checking that its size is precisely 400KB, 800KB, or 1440KB. 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.

A raw Macintosh disk image that's been formatted as a typical HFS volume will have the values 0x42 and 0x44 (ASCII 'BD') stored at location 0x400 (location 1024 decimal).

**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.

A Disk Copy 4.2 image will have the values 0x01 and 0x00 stored at locations 0x52 and 0x53 (locations 82 and 83 decimal).

**MOOF disk images** – The MOOF format is used only for Macintosh disk images, and will always have a .moof filename extension. Unlike raw Macintosh and Disk Copy 4.2 images, MOOF disk images store data in a very low-level format that includes all the original sector headers, footers, checksums, and inter-sector bytes. MOOF is normally used only for Macintosh disk images containing media-based copy-protection. Floppy Emu supports 400K and 800K MOOFs.

**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 or Disk Copy 4.2 format, use a hex editor to examine the values at locations 0x52 and 0x53 in the image. A Disk Copy 4.2 image will have the values 0x01 and 0x00 stored in those locations, and Disk Copy 6.3 will have something else stored there.

DC63 images contain separate *forks* for data and resources, which have no equivalent in the FAT32 filesystem used by the SD card. This means that *Floppy Emu can not directly support Disk Copy 6.3 format*. However, DC63 images can be converted to Macintosh raw disk images using some versions of OSX, with the 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=myrawdsk.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.

**Macintosh SCSI device and CD-ROM images** – These are disk images containing multiple partitions in Apple Partition Map format, and may have a filename that ends with the letters HDA, IMG, DSK, ISO, CDR, or TOAST. These images are typically used to burn CD-ROM discs or for emulation with SCSI device emulator hardware. Floppy Emu's Macintosh HD20-type Hard Disk emulation mode supports disk images with an Apple Partition Map where one of the partitions is a Macintosh-standard HFS volume.

Partitioned disk images will have the values 0x45 and 0x52 (ASCII 'ER') as the first two bytes, and the values 0x50 and 0x4D (ASCII 'PM') at one or more 512-byte boundaries near the beginning of the image file.

**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.

**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.

## 8.2 Creating and Editing Disk Images

On a modern Mac or Windows computer, vintage Apple 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, to insert or delete files from a disk image, or to create your own image.

To create or edit disk images with a modern computer, you'll need some 3<sup>rd</sup>-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

[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.

[HFSEExplorer](#) is another stand-alone disk image editor, written in Java, so it can run on Windows, OSX, or Linux. It requires a separate installation of the Java Runtime Environment, and is more difficult to install and run than HFSEExplorer.

[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](http://macintoshgarden.org)

[macintoshrepository.org](http://macintoshrepository.org)

[www.macfixer.com/vintage-software](http://www.macfixer.com/vintage-software)

[Apple public FTP mirror](#)

[Archive.org MOOF-a-Day collection](#)

#### **Apple II**

[ASIMOV](#)

[Archive.org WOZ-a-Day collection](#)

[macgui.com/downloads/](http://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 are more difficult to use with Floppy Emu.

## Automatic Support via Boxing

With the latest Floppy Emu firmware for Macintosh, archive files including Stuffit SIT, BinHex HQX, MacBinary BIN, Compact Pro CPT, and text TXT can be directly used as if they were disk images, as long as the archive file is smaller than 1.4MB. Floppy Emu will automatically create a temporary read-only “box” floppy disk image that contains the file archive. Once the box disk is mounted on your Mac, you can use Stuffit Expander on your Mac to decompress the archive directly to your Mac’s hard disk. This can be a major time-saver when you’re downloading software from web libraries and using Floppy Emu to transfer it to your Mac.

Floppy Emu generates a box disk that’s the smallest possible size to contain the archive file: 400K, 800K, or 1440K. Your Mac will need to have support for the larger floppy disk sizes in order to transfer larger archive files. 400K box disks are HFS volumes, not the older MFS 400K format, and your Mac with 400K drives will need to be running System Software 2.0 or later.

## Incompatible Stuffit Versions

There are many different versions of Stuffit and corresponding versions of Stuffit Expander. Newer versions can UnStuff files created by older versions, but older versions may not even recognize files created by newer. 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. Unfortunately the newer versions may require a 68020+ Mac, System 7, or both.

Version 4.0 of Stuffit Expander will run on a 68000 Mac Plus with System 6. 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 either. You’ll need to use a newer Mac model with System 7, or a 68020/030/040 Macintosh II emulator such as Basilisk II, in order to run Stuffit Expander versions 4.5, 5.0, 5.5, or later.

## Manual Boxing or Offline Decompression

It’s not recommended to UnStuff a .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 manual options for dealing with Stuffit archive 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.

These suggested instructions involve using the 3<sup>rd</sup>-party tools Mini vMac and HFVExplorer. See the **CREATING AND EDITING DISK IMAGES** section for more information about these tools.

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. On your Mac, 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 for decompression, try holding down the command key before selecting "Expand" from Stuffit Expander's "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 for decompression, try holding down the command key before selecting "Expand" from Stuffit Expander's "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. On your Mac, the uncompressed files will now be visible in the disk you selected.

## 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 II disk copying, see the section **FORMATTING AND COPYING APPLE II FLOPPY 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. – Notes for Visually Impaired Users

With some preparation, Floppy Emu can be used successfully by computer collectors who have limited or no vision. A Favorites menu can be configured to show a list of commonly-used disk images – see section 3.3 of this manual for details. The first disk image on this list can also optionally be configured to automount at startup. This might be a speech disk or other disk with special OS support that must be loaded before any other disks. Choosing a disk image requires knowing its position on the Favorites list, repeatedly pressing the NEXT button the right number of times to select it, and then pressing the SELECT button to insert the desired disk. A smartphone app like Seeing AI can also be used to read any messages or errors on the Floppy Emu’s display, but in normal usage this shouldn’t be necessary.

### *Physical Description*

The Floppy Emu is a rectangular board, 100 mm wide and 45 mm tall. At the left side is a keyed 10x2 connector, where the disk ribbon cable should be attached. The 1.3 inch display is at center-left of the board. It’s a monochromatic display that shows white text on a black background. At the board’s right edge is a micro SD card socket. Your SD card full of disk images goes here.

The RESET button is located on the top edge of the board, just to the right of the display. When it’s pressed, the Floppy Emu will go through a self-test for about three seconds, and then return to the main menu. This will have the side-effect of ejecting any disk that might have already been inserted.

The PREV, SELECT, and NEXT buttons are located along the bottom-right edge of the board. These are used to navigate the menus and select various options.

Floppy Emu does not have any audio feedback or sound-making capability.

### *Favorites Menu Usage*

When you turn on the power, after about three seconds the Floppy Emu will show the main menu. If you’ve previously set up a Favorites list (see section 3.3), then this will show your Favorites menu. The first item in the menu is “File Explorer”, which if chosen will exit the Favorites menu and show the standard file explorer interface described in the next section. The rest of the menu items are the entries from your Favorites list, in the order you listed them. Initially, the first item from your favorites list will be highlighted. This is the second item overall in the menu, after “File Explorer”.

The highlighted menu item is drawn with black text on a white background. You can change the highlight by pressing the PREV and NEXT buttons. If you reach the end of the list, the highlight stops there – it does not wrap-around. You can choose the highlighted item by pressing the SELECT button.

When you choose a disk image from the menu, the Floppy Emu will “insert” that disk. The display will show the name of the disk image, some status information about its type and size, and whether the disk is currently reading, writing, or idle.

For Apple II computers, the name of the selected disk is stored in the Floppy Emu’s non-volatile memory, so it will be automounted when you turn the computer off and on again. So the next time you turn on the computer and the Floppy Emu, the display will show the disk status info rather than the main menu. This behavior can be changed to instead always automount the first disk on the favorites list, or to never automount anything. See section 3.3 for details about automount setup.

For Apple II computers, the currently inserted floppy disk can be ejected by pressing PREV or NEXT. This also has the side-effect of moving the menu highlight to the previous or next item in the menu, reducing the number of button presses required to switch between disks in the same menu. You can insert a new disk by pressing PREV or NEXT to reach the desired menu item, then SELECT.

For Macintosh and Lisa computers, the disk must be ejected through the computer's OS. You can't initiate a disk ejection from the Floppy Emu. Once the disk is ejected from a Mac or Lisa, the Floppy Emu will return to the menu, with the just-ejected disk still highlighted. From there you can use PREV, NEXT, and SELECT to choose another disk.

### *File Explorer Usage*

If there is no Favorites list, then the main menu shows the standard file explorer interface. This is an alphabetical list of the subdirectories and disk images at the top-level root directory of your SD card. All the subdirectories are listed before all the files, similar to the behavior of Windows' File Explorer.

When you choose a subdirectory from the menu, you'll see a new menu showing the alphabetized contents of that subdirectory. When viewing a subdirectory's contents, the first menu item listed is .. (two periods), which will take you back to the parent directory if you select it.

The other behavior of the File Explorer is the same as the Favorites menu.

Example: If you want the third disk image (alphabetically) that's in the second subdirectory (alphabetically) of the root directory, you would do this: wait 3 seconds after power-on, then press NEXT once, press SELECT, press NEXT three times (one extra time to skip the .. two periods entry), then press SELECT. The disk will then be inserted. If this done immediately after power-on, your computer will probably have already given up looking for a boot disk. For Apple II computers, you can do a soft-reset by pressing control-apple-reset on the computer keyboard, to make it look again for a boot disk.

### *Updating the Floppy Emu Firmware*

You may occasionally need to update the Floppy Emu firmware, either to get a newer version or to switch between the Apple II and the Mac/Lisa firmware versions. Detailed instructions are included with the Floppy Emu's firmware update package, which can be downloaded from the BMOW web site.

## Appendix C. - FAQ

Does this require a special driver, ROM, or INIT?

*No software is required for standard floppy disk emulation on any system. Apple IIc requires ROM version 0 or later for Smartport hard drives and Unidisk 3.5 drives – ROM version 255 lacks support for these. 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 most drive types and disk image types. However, instead of formatting the emulated disk, it's normally preferable to use a pre-existing blank disk image. In-system formatting of the emulated disk is supported for all Macintosh disk image types, as well as Apple II Smartport hard disks, Unidisk 3.5, WOZ disk images, and NIB disk images. Formatting performance of floppy disk images may vary depending on your SD card's write cache behavior. For best performance, use the Blank.WOZ or Blank.MOOF sample disk images that are included with the Floppy Emu firmware. See the manual sections on formatting and disk copying.*

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 may create problems (see previous answer about formatting). For best results, use a destination disk image type that supports in-system formatting. See the manual sections on formatting and disk copying.*

Can the Emu work with copy-protected disks?

*Most copy-protected disks in WOZ or MOOF format will work with the Floppy Emu, but there are some rare exceptions. The hardware is primarily designed to work with unprotected disks using standard sector and disk formats.*

Can I emulate multiple floppies at once?

*Floppy Emu can store as many disk image files as your SD card will hold. For compatible Apple II models, the hardware supports dual 5.25 inch floppy drive emulation. For Apple II Smartport hard disk emulation, up to four hard disks may be active at the same time. For other computer models and disk types, only one disk can be "inserted" in the emulated drive at any given time.*

Can I connect two Floppy Emus to the same computer?

*Yes, if they're attached to separate disk ports, or to separate connectors of a dual-connector disk controller. For compatible Apple II computers, a Floppy Emu board can also be placed in a daisy chain along with other disk drives. The Emu doesn't have a daisy-chain output port, but the optional Daisy Chainer adds one. Daisy-chaining is not supported by the Lisa or Macintosh.*

How can I copy documents from an old Apple II or Mac disk to a modern PC?

*Use Floppy Emu to copy the documents from the original disk onto a blank disk image residing on the SD card, then put the SD card in your PC and use a disk image utility program like CiderPress or HFVExplorer to open the disk image and extract the files. See section 10 for details.*