



FLOPPY EMU DISK EMULATOR

For vintage Macintosh, Apple II, and Lisa computers

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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.

2. HARDWARE VERSIONS

| Emulation Type | Model A with Standard Adapter | Model A with Universal Adapter | Model B |
|------------------------|----------------------------------|-----------------------------------|---------|
| Macintosh | | | |
| 3 1/2 inch floppy disk | ✓ | ✓ | ✓ |
| HD20 hard disk [1] | ✓ | ✓ | ✓ |
| Lisa | | | |
| 3 1/2 inch floppy disk | ✓ | ✓ | ✓ |
| Apple II, II+, IIe | | | |
| 5 1/4 inch floppy disk | ✗ [2] | ✓ | ✓ |
| Apple IIc | | | |
| 5 1/4 inch floppy disk | ✓ | ✓ | ✓ |
| Smartport hard disk | ✓ | ✓ | ✓ |
| Apple IIc+ | | | |
| 5 1/4 inch floppy disk | ✓ | ✓ | ✓ |
| 3 1/2 inch floppy disk | ✗ | ✗ | ✗ |
| Smartport hard disk | ✓ | ✓ | ✓ |
| Apple IIgs | | | |
| 5 1/4 inch floppy disk | ✓ | ✓ | ✓ |
| 3 1/2 inch floppy disk | ✗ [3] | ✓ | ✓ |
| Smartport hard disk | ✓ | ✓ | ✓ |

[1] Requires Macintosh 512K, 512Ke, Plus, SE, Classic, Classic II, Portable, IIfx, IIsi, or LC-I

[2] Reading the disk works, but writing does not

[3] Apple IIgs with ROM 01 can boot from a 3 1/2 inch disk

The current hardware version is Floppy Emu Model B. Except as noted below, the disk emulation functionality of Model A and B is identical. Key differences between Model A and B are:

- **Built-in Apple II Compatibility** – Model B is directly compatible with the entire Apple II line. Model A requires a separate Universal Adapter for best Apple II compatibility, which is described further below.
- **SD Card Type** – Model A uses full-size SD cards, while Model B uses smaller microSD cards like those typically used with mobile phones.
- **SD Card Hot-Swap** – With Model B, the SD card can be removed and re-inserted while the Floppy Emu is powered on.
- **Improved Protection Circuitry** – Model B features improved protection circuitry on the disk drive interface connector. This circuitry will help protect the Floppy Emu from electrical damage caused by voltage spikes and surges. It also eliminates the risk of potential damage if an Emu board running the Apple II firmware is inadvertently connected to a Mac or Lisa computer.

Model B hardware is labeled "Model B" on the underside of the board, and will have a serial number of #0800 or higher. If a Floppy Emu board does not say "Model B" on the bottom, or has a serial number below #0800, then it's Model A.



3. SD CARD

You will need an SD memory card for use with Floppy Emu. Both standard SD and SDHC cards are supported. Smaller capacity cards typically provide better performance – use a 4GB or smaller card if possible. The card should be formatted as FAT32. Most new cards are already pre-formatted as FAT32, so you probably don't need to do anything.

Floppy Emu Model A uses full-size SD cards. Model B uses the smaller microSD size card.



4. FIRMWARE

Floppy Emu can be used with a Macintosh, Apple II, or Lisa computer. It may be necessary to install new firmware on the Floppy Emu device, depending on the type of Apple computer being used. The Emu ships with Macintosh floppy emulation firmware pre-installed. For Macintosh hard disk emulation, Lisa disk emulation, or Apple II disk emulation, download and install the appropriate firmware from www.bigmessowires.com/floppy-emu



For Model A: Use the Apple II firmware only when connected to an Apple II computer. If a Model A Emu board running the Apple II firmware is connected to a Mac or Lisa, it may cause damage.

The Apple II firmware modifies one interface pin from an input to an output. If a Model A Emu board running the Apple II firmware is inadvertently connected to a Mac or Lisa, then both the Emu and the computer will try to output on this same pin, which may cause damage. If you wish to move your Emu board from an Apple II to a Mac/Lisa, install the Mac/Lisa firmware first while the board is still connected to the Apple II, and then move the board to the new computer after the firmware update is complete. Floppy Emu Model B has updated circuitry on the interface pin to eliminate this risk.

Firmware updates consists of two separate parts. **You must install both parts!** If you see a warning message about "wrong CPLD", it means you haven't installed both parts of the firmware. Full instructions for installing firmware updates can be found in the *readme.txt* file included with the firmware.



5. EMULATION MODES

Some firmware versions support multiple emulation modes. For example, the Apple II firmware supports three separate emulation modes for 5.25 inch disks, 3.5 inch disks, and Smartport disks. The current mode is briefly displayed on the Emu's LCD screen, whenever the device is powered-on or reset. To change the emulation mode, press the SELECT button while the Emu's version info is displayed on the LCD screen. This will display a menu, 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 installing new firmware or changing the emulation mode, you may need to turn the computer off, then on again in order for it to correctly recognize the Floppy Emu as a disk drive.



6. DISK IMAGES

The emulated Apple disks are stored as disk image files on the SD card. For example, an image of a Macintosh System 6.0.8 startup disk might be stored on the SD card as the file *SYSTEM-608.DSK*. An SD card may contain many hundreds of disk image files, up to the capacity of the card. For floppy disk emulation, the desired disk image file is selected through the Floppy Emu's menu interface. For hard disk emulation, the names of the disk image files are preset – see details below.

When you select a disk image file, 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.

6.1 Working with Disk Images

If you insert the SD card into a modern OS X or Windows computer, you will see all the disk image files stored on the card. You can download new disk images from the internet, and copy them to the SD card, where they will then be available for emulation for your vintage Apple computer.

Disk images for many old Macintosh software titles can be found at <http://macintoshgarden.org>. Apple no longer offers legacy Mac system software disk images on their web site, but you can access a mirror of their old site at asa.max1zzz.co.uk/English-North_American/Macintosh/System. For disk images of Apple II software, two good sources are the ASIMOV Apple II collection at <http://mirrors.apple2.org.za/ftp.apple.asimov.net/> and the Apple II and IIGS categories at <http://macgui.com/downloads/>. Lisa disk images are harder to find – Google is your friend.

To a modern computer, these disk image files have no particular meaning – they're just files of seemingly-random data with filenames like SYSTEM-608.DSK. OS X and Windows don't know how to look inside the disk image files, to see the individual Macintosh, Apple II, or Lisa files contained therein. However, with appropriate software it is possible to open those disk image files and peer inside them. For Macintosh disk images, use [HFVExplorer](#) (Windows) or [Fuse HFS](#) (Mac OS X) to copy files between the local filesystem and the disk image. Or mount the disk image in a Macintosh emulator program like [Mini vMac](#) or [Basilisk II](#). For Apple II disk images, use [CiderPress](#).

If a disk image file on the SD card is marked "read only" in its Windows properties or its OS X file info, then the emulated disk will appear locked when it's used on the Macintosh, Apple II, or Lisa. If the write-protect tab on the SD card is set to the "lock" position, then all the emulated disks will appear locked when they are used.



6.2 DiskCopy 4.2 Image Files

Disk image files in Disk Copy 4.2 format contain an embedded checksum value, used to help determine if the file is corrupted. When using Floppy Emu to write to an emulated disk with a DC42 image file, the image file on the SD card will be modified 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 that the disk image file is corrupt.

[dc42cksm](#) is a Windows command line program that can view the checksums in a DC42 disk image file, and optionally update the checksums if they're not correct.



7. CONNECTION METHOD

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.

7.1 Hot-Plugging



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.

7.2 External Connection

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 do 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.

Some Floppy Emu boards have a built-in DB-19 connector soldered to the board. These can be plugged directly into the external 19-pin port, like a dongle. Other Floppy Emu boards have a 20-pin ribbon cable, with a detachable 20-to-19 pin adapter on one end. The cable makes it possible to place the Floppy Emu board somewhere on your desk where it's more convenient to access.

For Apple II computers, the Floppy Emu can also be connected to the end of a daisy chain of other disk drives, at the 19-pin disk port on the rear of an Apple 3.5 Drive, Apple 5.25 Drive, or other similar drive. The Floppy Emu board does not have a daisy chain output, and so it will always be the last drive in the chain. The Emu board must be placed at the correct position in the chain, given what type of drive it is emulating. 3.5 inch drives (if any) go first, then Smartport drives (if any), and finally 5.25 inch drives (if any).

The Macintosh and Lisa do not support daisy chaining, and Floppy Emu must be connected directly to the computer on those systems.

7.3 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. In these cases, the Floppy Emu must be connected to a 20-pin internal disk port on the computer's logic board or disk controller card, using a 20-pin flat ribbon cable. This may necessitate disconnecting the internal floppy drive that's normally connected to this port.



When connecting to a Disk II Controller Card, be very careful to orient the cable correctly. The red stripe on the cable should go to the pin marked "1" on the Disk II Controller Card. An incorrectly oriented cable may cause damage.



8. LCD SCREEN ADJUSTMENT

If the LCD screen is difficult to read, you can adjust the contrast setting. Hold down the SELECT and NEXT buttons while Floppy Emu is initializing. After a few seconds you'll see the contrast adjustment screen. Use the PREV and NEXT buttons to change the contrast, and SELECT to save it.

If the LCD image flickers or disappears, press down firmly on the corners of the metal LCD frame. If necessary, use pliers to bend the four lock tabs on the back of the LCD, to help keep it mounted firmly.



9. MACINTOSH USAGE

Macintosh computers are compatible with two different firmware versions:

- floppy-emu-1.0Q-F13: Ships pre-installed, supports floppy disk emulation only.
- hd20-0.7C-F14.5: Supports floppy disk and HD20-compatible hard disk emulation.

If necessary, install one of these two firmware versions, following the procedure described above.



9.1 Floppy Disk Emulation for Macintosh

Floppy disk emulation supports 400K, 800K, and 1.4 MB floppy disks. The type of disk is automatically determined by the size of the disk image file that's selected. The disk image files can be in "raw" format, which typically has a .DSK filename extension, or DiskCopy 4.2 format, which typically has a .IMG or .IMAGE filename extension. Raw .DSK format images will provide somewhat better performance, and their use is preferred.

Use the PREV and NEXT buttons to navigate through the list of image files on the SD card. Press the SELECT button to choose an image to insert into the drive. The Macintosh OS handles disk ejection. To eject a disk, drag its Finder icon into the trash can, or select "Eject" from the Finder's menu.

Macintosh floppy mode works with any classic Macintosh from the original Mac 128K to the Mac II and Power Macintosh series. The very oldest Mac models aren't designed to use 800K and 1.4MB disks, and will be limited to using 800K or 400K disk images.



9.2 Hard Disk Emulation for Macintosh

Hard disk emulation mode is compatible with the Mac 512K (requires HD20 Init), Mac 512Ke, Plus, SE, Classic, Classic II, Portable, IIfx, IIsi, LC-I. The Mac 128K is also compatible if it has a 512K RAM expansion. Other Macintosh models are not compatible with this mode. In hard disk mode, the Floppy Emu emulates an HD20-compatible external hard drive – an Apple-brand hard drive from 1985 that predated SCSI and connected to the external floppy disk port.

Before using hard disk emulation mode for the Macintosh, you'll first need to install the *hd20-0.7C-F14.5* firmware, which you can download from the Floppy Emu web site. To choose between 3.5 inch floppy and HD20 hard disk emulation modes, press the SELECT button while the Emu's version info is displayed on the LCD screen. See the previous sections on Firmware and Emulation Modes for details.

Hard disk emulation supports Macintosh disk image files up to 2 GB. In hard disk mode, the Floppy Emu automatically loads a disk image file named *HD20.dsk* from the SD card. For a suitable HD20.dsk file, rename an existing hard disk image file from a software-based Mac emulator, or create an empty disk image by using a tool like *dd* to generate a large file full of zeroes.

The Mac 512K cannot boot directly from an HD20-compatible hard disk. Instead, you must first insert a floppy disk containing a System folder with 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, IIfx, IIsi, and LC-I have HD20 support built into ROM and do not require the HD20 INIT.



10. APPLE II USAGE

Apple II floppy disk and Smartport hard disk emulation is provided by the firmware version *apple-II-0.1E-F6* or *apple-II-0.1E-F7*. Download and install this firmware, following the procedure described above. This firmware is compatible with all Apple II models, but not all emulation modes are supported on every model.

The Floppy Emu must be set to the desired emulation mode. To choose between 5.25 inch, 3.5 inch, and Smartport hard disk emulation, press the SELECT button while the Emu's version info is displayed on the LCD screen.



10.1 Universal Adapter for Floppy Emu Model A

The [Universal Adapter for Floppy Emu Model A](#) improves Apple II emulation behavior with some Apple II system configurations, when using a Floppy Emu Model A. The Universal Adapter is not required with Floppy Emu Model B, because equivalent functionality is built-in.

The Floppy Emu is available in three versions:

- Model A with Standard Adapter extension cable (a small DB-19 to 20-pin ribbon adapter)
- Model A with Universal Adapter extension cable (a larger DB-19 to 20-pin ribbon adapter with a slide switch)
- Model B with Model B Adapter extension cable (a small DB-19 to 20-pin ribbon adapter)

For Apple II users, check the table in section 2, Hardware Versions, to see if your intended usage would benefit from the Universal Adapter.

The Universal Adapter also contains a protection resistor to guard against accidental damage to Model A when switching between the Floppy Emu firmware for Apple II and the firmware for Mac/Lisa. With the Standard Adapter, if a Floppy Emu Model A board running the Apple II firmware is accidentally plugged in to a Mac or Lisa, it could damage the Emu or the computer.

To use the Universal Adapter, set its slide switch to the appropriate position, depending on the selected emulation mode of the Floppy Emu. If the Emu is set to 3 1/2 inch floppy disk mode, then set the switch to the “3.5” position. If the Emu is set to any another mode (5 1/4 inch floppy, Smartport hard disk), then set the switch to the “other” position. Setting the switch to the wrong position won’t harm anything, but it may cause disk-related errors.



10.2 5.25 Inch Disk Emulation for Apple II

5.25 inch disk mode supports 140K Apple II floppy disks, and is compatible with all models of Apple II computers. The disk image files can be in .DSK, .DO, .PO, .NIB, or .2MG formats. DSK, DO, and PO will provide somewhat better performance than .2MG, and their use is preferred. NIB image files will appear as locked read-only disks to the computer.

Use the PREV and NEXT buttons to navigate through the list of 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 remove it and select a different one.

Apple IIc Note: The IIc cannot normally boot from an external floppy drive, because its internal drive is configured as slot 6, drive 1, making the external drive slot 6, drive 2. The Apple II hardware only supports booting from drive 1 on any given slot. This means that Floppy Emu in 5.25 inch disk mode can be used as a second 5.25 inch drive on the IIc, but not as a primary boot disk under most circumstances. The best solution is to open the IIc's case, and connect the Floppy Emu internally on the logic board, in place of the original internal drive. An alternative method is possible on the Apple IIc with ROM version 255, using an external floppy connection: the IIc with ROM 255 can be booted from slot 6, drive 2 by typing PR#7 at the BASIC prompt. However, most software is hard-coded to expect loading from drive 1, and won't run correctly using this method, so the PR#7 trick has limited usefulness.



10.3 3.5 Inch Disk Emulation for Apple II

3.5 inch disk mode supports 800K Apple II floppy disks, and is compatible with the Apple II GS and other Apple II systems with the Liron disk controller card. The Apple IIc+ is not compatible with 3.5 inch disk mode. Disk image files can be in .DSK, .DO, .PO, or .2MG formats. DSK, DO, and PO will provide somewhat better performance than .2MG, and their use is preferred.

Use the PREV and NEXT buttons to navigate through the list of image files on the SD card. Press the SELECT button to choose an image to insert into the drive.

The Apple II GS will not wait for you to insert a 3.5 inch disk at startup. It will check only once for a suitable boot disk, and if none is found, it will display an error message and halt. Because it takes some seconds to select the desired disk image file from the Floppy Emu's menus, at startup the II GS will give up and display an error message before you can select and insert a virtual disk. If this happens, reset the computer by pressing CTRL + Apple + RESET to force it to re-scan for a startup disk.



10.4 Smartport Hard Disk Emulation for Apple II

Smartport hard disk mode for Apple II can emulate up to four simultaneous Smartport hard drives. It is compatible with the Apple II GS, the Apple IIc+, and the Apple IIc with ROM version 0 or later (anything other than ROM version 255). Check the IIc ROM revision by typing PRINT PEEK(64447) at the BASIC prompt.

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 II GS under GS/OS 6.0.1, however, it's possible to boot from a 32 MB ProDOS volume, and then mount other HFS volumes. HFS is the filesystem normally used on vintage Macintosh computers, and it supports volume sizes up to 2 GB. Apple2Online has some [blank HFS disk images of various sizes](#) in their CFFA3000 area, which are perfect for Apple II usage.

The hard disk image files can be in .PO, .HDV, or .2MG formats. The four disk image files should be named SMART0.*, SMART1.*, SMART2.*, and SMART3.*, where * is either PO, HDV, or 2MG. If you have fewer than four disk images, number them beginning with 0 and don't use SMART3.



11. LISA USAGE

Lisa floppy disk emulation is provided by the firmware version *hd20-0.7C-F14.5*. Download and install this firmware, following the procedure described above. Lisa floppy mode works with the Lisa 2/5 and 2/10 for emulation of 400K and 800K floppy disks.

The Floppy Emu must be set to Lisa Floppy mode. To set the emulation mode, press the SELECT button while the Emu's version info is displayed on the LCD screen.

Native Lisa floppy disk images should be stored on the SD card in Disk Copy 4.2 format, in order to preserve the sector tag bytes needed by the Lisa. Floppy Emu can also emulate Macintosh disks while the Lisa is running the MacWorks environment, using either DC42 disk images or raw disk images. Keep the Emu in "Lisa floppy" mode, even when operating under MacWorks.

Use the PREV and NEXT buttons to navigate through the list of image files on the SD card. Press the SELECT button to choose an image to insert into the drive. The Lisa OS handles disk ejection.