SCSI hard disk replacement options



This article covers classic Macs (Nubus and older architectures) only. Options for more recent machines are covered in PCI and Cardbus drive controllers



Always have a working backup of your important data before working on your storage!

Most classic Macs use a hard disk drive (HDD or HD) as their boot device and main mass storage medium. The majority use SCSI drives of a kind no longer in production; either 50 pin 3.5“ desktop drives, or the exceptionally rare 2.5” laptop SCSI drives.

There are several replacement options for defective SCSI drives. Even with a working SCSI boot drive, a second drive for extra storage is often desirable.

The choice depends on the expected use of the device, and the performance required. Note that the throughput of a faster, more modern drive is usually throttled by the slow SCSI speed on the Mac itself. Unless you are using a high-performance drive controller, it will still be limited to the host Mac's speed.

Options

Choices may be classified by

- Storage medium
- Adapter(s) required
- Use, or
- Performance

SCSI

50 Pin SCSI

The simplest solution of course is another 50 pin SCSI drive. Typically these are older drives now, and limited to around 4.5GB to 9GB in capacity. They may also be loud and hot server drives. However they have the advantage of plugging straight in to all 68k Macs except the Powerbooks, space permitting.

Note that there are two versions of the 50 pin connector, large and small. Macs use the larger of the two. A simple socket adapter is all that is required.

Newer SCSI drives (internal)

3.5“ SCSI drives are still available, but rarely with the native 50 pin interface of older Macs. An adapter from 68 or 80 pin to 50 pin, or a SCSI card, is required. These are usually server drives: they can be noisy, but offer relatively large capacities, high performance and reliability.

It is essential to confirm that the drive supports single-ended SCSI / SCSI-1, usually by checking the manufacturer's support page for the exact model number of drive. One will also usually need to terminate the top 8 bits of the 16 bit SCSI channel: converters with termination resistors are available, or they may be added by the user.

While 2.5” 68 pin SCSI server drives, such as the Seagate Savvio, exist, they will usually not fit in a Powerbook drivebay along with the necessary pin adapter.

Note that SAS (Serial Attached SCSI) is **not** compatible.

External SCSI enclosure

These are available for single drives, pairs, and multiples of 7, 14 and so on. With a long enough cable, the enclosure can be hidden in a place where noise can be contained. An external drive can still be used as a boot drive, and the enclosure can easily be unplugged and connected to different Macs, including Powerbooks.

Some host 68 or 80 pin drives internally, yet interface to the host with a 50 pin cable. Even if not, a single reliable and properly terminated and powered 50 pin adapter to a multi-bay enclosure could be more economic than buying adapters for individual drives.

Some even host IDE drives, and thus function as multi-drive IDE to SCSI converters (see below)

Drives too small for practical single use can be combined, making a cheap, high speed storage unit. This especially applies to people with access to server farms, where SCSI drives are regularly swapped out for new ones.

For many classic Macs, including all 68k Powerbooks, an external enclosure is the only simple way of connecting a CD-ROM drive.

SCSI RAID

RAID arrays of SCSI drives can be built internally in, or externally attached to, larger Macs, such as the tower Quadras, with the use of a Nubus SCSI card. Different cards will allow use of 50, 68 or 80 pin SCSI drives.

RAID arrays can be configured either by dedicated hardware on the card (hardware RAID), or by RAID software running on the Mac (software RAID).

In general, a RAID is tied to the host card or application that created it. To use the same array on different machines requires that each machine have the same card or software installed.

Note that a RAID configured by one card or software utility is unlikely to be recognised by a different

card or utility, with the possible exception of newer versions of the same series. If in doubt, check available documentation, and if none is available, assume incompatibility.

A dedicated external RAID array is a box with an intelligent RAID controller onboard, and a single cable to the host computer. Typically used with servers, or in audio or video production, this is a flexible, high performance, and relatively expensive solution. Other advantages are as per SCSI external boxes, and the overall speed limit is as described in the introduction.

Other drive types adapted to SCSI (see below) can also be used in SCSI RAIDs. However it is advisable that all drives in an array be identical.

IDE and Flash

SCSI to IDE converter



Details in SCSI-IDE converter.

Readily available, but somewhat expensive converters. However, IDE drives are the cheapest option in very large capacities, and may offset the cost of the converter. For frequent use with heavy writing load, where write speed is important. Modern IDE disks can be near silent, and have low heat output. Ideal where a single, large boot disk is desired.

2.5“ SCSI-IDE converters for Powerbooks are much harder to find, and expensive. One known source is inside Powerbooks; any SCSI drive larger than approximately 750MB is possibly a converted IDE drive. These converters can mount up to a 6GB IDE drive.

Artmix sells converters to IDE, SATA, and CF, for both 3.5” desktop and 2.5“ Powerbook SCSI.

SCSI to SATA converter



Details in SCSI-SATA converter.

Readily available, but somewhat expensive converters. However, SATA drives are the most recent option in very large capacities. For frequent use with heavy writing load, where write speed is important. Modern SATA disks can be near silent, and have low heat output. Ideal where a single, large boot disk is desired.

A SCSI to IDE/ATA converter can be used with a PATA to SATA converter, but adding a second layer of conversion may introduce reliability and compatibility issues. Please note that the second converter must be one which mounts a SATA drive to a PATA/ATA/IDE computer, not the other way round.

Artmix sells SCSI to SATA converters.

SCSI to SD Converter

A Working and completed project, the SCSI2SD, is available at scsi2sd.com

They can be purchased via:

- Inertial Computing
- AmigaKit (UK/Europe)
- The project creator Michael McMaster (Australia)
- ITEAD Studio (China) (require firmware update from project homepage)

This project is a working, mature, design based on a Cypress PSoC 5LP MCU. The firmware and source code is open-source, along with the design of the PCB. All the details can be found at the project homepage.

If you decide to roll your own PCB and purchase your own parts to build the system, keep in mind you will need a miniprog3 to program the microprocessor, and that some parts require fine pitch surface-mount soldering.

This is the best solution at this time to replace dying SCSI HDD units in 68K macs. This provides an open source - and somewhat cheaper - alternative to the Artmix IDE and CF adapters.

Solid State Disk

Solid-state drive (SSD) or industrial-grade Compact Flash (CF). Available as, or adapted for, IDE and SCSI, these are small, silent, have no moving parts, are shock resistant, and produce little heat. Expensive, but with top performance and guaranteed reliability, and ideal where silence or low heat are a priority.[1)]

At much lower cost, a recent consumer CF card in an appropriate adapter should do well in a vintage machine, and give many of the same advantages. (Long term reliability, write speeds, and use for virtual memory, are debated.

While CF to SCSI adapters can be found, more commonly two adapters will be required; one CF to IDE and one IDE to SCSI, or CF-PCMCIA and PCMCIA-SCSI (See below)

Artmix sells converters to IDE, SATA, and direct to CF, for both 3.5” desktop and 2.5“ Powerbook SCSI.

Microdrive

A MicroDrive is a tiny (1.8”) hard disk in Compact Flash format.

It has a small footprint, low power consumption, noise and heat, and fast write speeds. While not as physically robust (ie has moving parts), it has none of the write-cycle limitations of consumer-grade Flash. They are also much cheaper than industrial CF or SSD.

Adaption to SCSI is as per Compact Flash.

Other

Network Attached Storage (NAS) devices: IDE / ATA / SATA / USB 2

Network Attached Storage (NAS) devices provide a LAN interface to a hard disk, typically IDE/ATA or SATA. If your Mac has Ethernet and a working boot disk (even a Network Tools floppy) this is an option for extra storage. In some cases, this may be as fast or faster than a local SCSI disk. Used IDE NAS devices as well as new network storage adapters for USB flash drives can be picked up fairly cheaply.

If a second, more modern computer, or embedded device, running Linux, is being used to bridge old Macs to the internet (such as a Raspberry Pi running macipgw), adding netatalk to the system will allow the Macs to browse files via the Chooser.

It may also be possible to add netatalk to various commercial NAS devices and routers which can have their existing Linux firmware hacked, such as the NSLUG project, OpenWRT, Tomato, and DD-WRT.

Card Readers

Powerbooks with native PCMCIA slots have successfully used Compact Flash, Microdrives and other solid state drives in PCMCIA adapters (“card readers”).

Unfortunately, the only 68k Powerbooks this applies to are the 190 series, which use IDE drives anyway, and 5x0 series with the rare PCMCIA module.

All later Powerbooks use IDE/ATA drives.

SCSI-hosted PCMCIA (PC Card) readers for desktop computers, both internal and external, were once relatively common, and can still be found new; second-hand readers are somewhat rare but available. Using these on Macs with CF or other storage devices is under investigation, with some successes reported.

Note that many ebay sellers may mislabel as “SCSI” a common type of front-panel PCMCIA card reader, which connects via two ribbon cables to a matching ISA or PCI controller card. These devices are not SCSI, and are useless without the matching controller.

Experimental / Theoretical

A home-made SCSI to PCMCIA converter, based on an AVR microcontroller, is documented here. A PCMCIA flash card adapter as above should work. This project is based on SCSI-3 and may not be compatible with the Macintosh.

Now Defunct: This project is currently being miniturized and converted to the Powerbook series by techknight in the forum. The progress can be watched here.

It has been suggested that a Powerbook could be used as a SCSI to IDE converter. It would requires a Powerbook (or at least partially functioning logic board) that supports internal IDE drives and SCSI

Disk Mode

Another possibility is a serial port (RS-232) flash card reader. These were available in the early days of digital cameras, to transfer pictures to a PC. Such a device would require a newly-written storage driver, and thus would not be bootable. Alternatively, new hardware could be designed around a microcontroller. An RS-422 (Mac serial) compatible solution would allow higher transfer speeds than RS-232.

And, a more hypothetical case, if the price should not matter at all, have a battery backed RAM-disk and mirror the data to a NAS.

See Also

- Using flash memory
- SCSI-IDE converter
- Flash Drive Test Results

[1)]
Some CF adapters mount two cards; it remains to be seen if both will be recognised in a SCSI Mac. Usually both cards will be combined to one volume in striping mode; the dual slot adapters use only one SCSI ID number.

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