The perfect **host**

If you want to add peripherals to your PC, SCSI is the ideal choice of interface. Roger Gann shows you how to install a SCSI host adaptor.

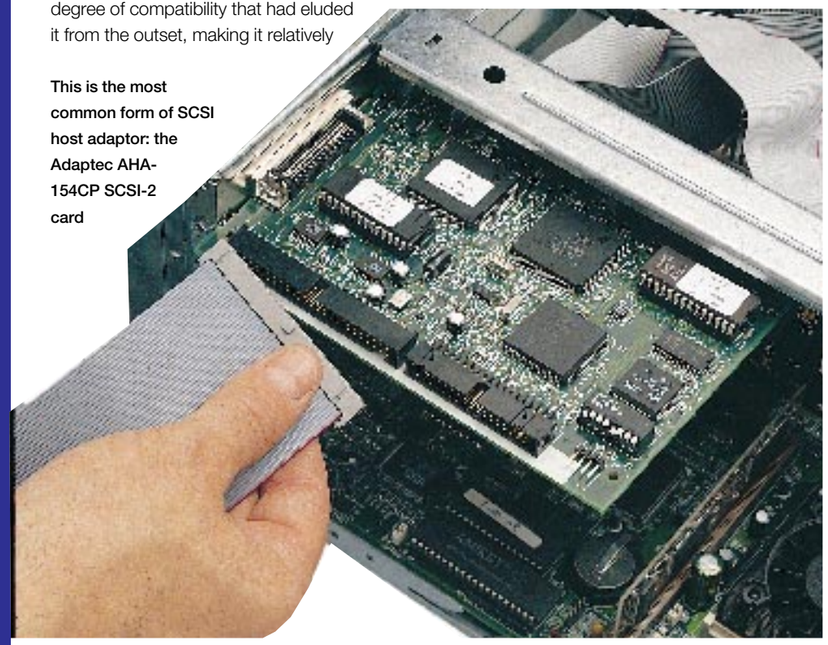
Although much of SCSI's thunder has, in recent years, been stolen by Enhanced IDE which offers great performance, ease of installation and value for money that's hard to beat, the basic strengths of the Small Computer System Interface (SCSI — pronounced *scuzzy*) remain undiminished.

SCSI remains the interface of choice for advanced PC peripherals such as very large, hard AV drives, magneto-optical drives, writable CD-ROMs, DAT tape drives and scanners. It offers the ultimate in data throughput, good flexibility, and lately a degree of compatibility that had eluded it from the outset, making it relatively painless to add a multiplicity of diverse peripherals to your PC.

For serious multimedia work, SCSI is essential, guaranteeing the very high data throughputs required when handing video and audio streams. While it's true that Mode 4 PIO EIDE hard disks can deliver 16.6Mb/sec and that the latest eight-speed IDE CD-ROMs can deliver 1.2Mb/sec, this method of transferring data requires such a high degree of CPU intervention that it affects the CPU's ability to further process the data it's transferring, such as video or MPEG data streams. This problem doesn't occur with SCSI because data transfers are controlled by the host adaptor and hence steal few, if any, CPU cycles.

As its name implies, SCSI is a system interface rather than a device interface, which is designed to operate with specific devices such as disk or tape drives. System-level interfaces on the other hand are more general purpose, designed like expansion buses to match virtually any kind of device to a computer system. What makes SCSI so special is that it's "smart", and has some of the advanced arbitration features of the EISA and Micro Channel buses used in PCs.

The original SCSI specification featured an 8-bit data path at a maximum speed of 5MHz, providing a maximum possible data transfer rate of 5Mb/sec. "Wide SCSI" doubles the width of the data path to 16 bits (and allows for further widening to 32 bits) with transfer rates from 10Mb/sec to 20Mb/sec. "Fast SCSI", meanwhile, doubles the data rate across the SCSI connection by doubling the speed to 10MHz. A system that takes advantage of all SCSI-2 possibilities (i.e. Fast *and* Wide) can achieve a data transfer rate as high as 40Mb/sec, though these are fairly rare. A final benefit of SCSI is its ability to extend the "reach" of a single expansion slot: each SCSI host adaptor can support up to seven devices, and you can have more than one SCSI host adaptor.



This is the most common form of SCSI host adaptor: the Adaptec AHA-154CP SCSI-2 card

Installing the card

As is often the case, this is a two-part job: installing hardware first, followed by the software. If you're not running Windows 95 then you'll need to know just what hardware resources (i.e. IRQs, DMA channels, I/O ports and ROM addresses) are already spoken for in your PC. This is so that you can identify any potential hardware clashes in advance and adjust the settings on the SCSI card before you fit it.

I thought I'd mastered the arcane mysteries of SCSI a long time ago, but only last week, when I was fitting an external Zip drive, my system was brought to its knees for an afternoon by a common or garden SCSI card — and this was a PC running Windows 95! Time spent gathering hardware resource information is time well spent and can prevent much frustration.

The most common brand of SCSI host adaptor is Adaptec and that's what I'll be fitting: an Adaptec AHA-154CP SCSI-2 card. The default resource settings of this card are IRQ 11 and I/O port 330h and usually these settings are, generally speaking, "free". So all things being equal, they shouldn't clash with anything. However, if problems do arise, this card has a set of easy-to-get-at DIP switches which configure the I/O ports, address space of the SCSI ROM BIOS, and other factors. Other SCSI minutiae are configured by hitting CTRL+A during the boot sequence, which pops up the SCSISelect menu. By contrast, the PCI version, the AHA-2940 PCI Fast SCSI-2 card, is a DIP switch and jumper-free zone and is completely software configurable — perfect for Windows 95.

Hardware installation

Step 1

- Take the usual safety precautions: power down and unplug the PC from the mains and disconnect all other leads, such as printers and mice. If you're unsure which bit goes where, mark where each lead goes when you unplug it.
- Remove any static electricity you might be carrying by earthing yourself before handling any electrical components: touch a metal pipe, for instance; or If you've got one, wear an earthing wrist-strap.

Step 2

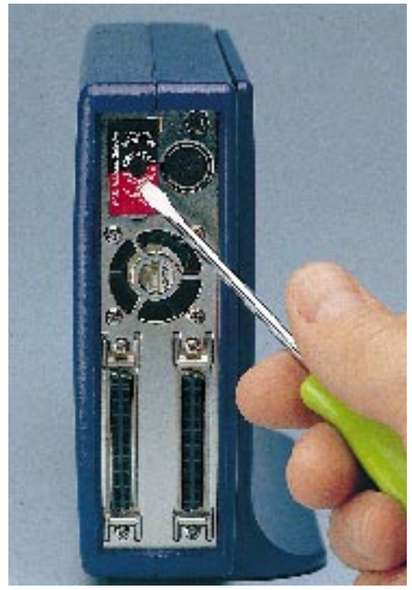
- Take the lid off of the PC. It'll be held on by four or five self-tapping screws and you'll most likely need a Phillips screwdriver to undo them — don't lose the screws!
- OK, you can now see the inside of your PC. If you're going to do detective work to discover the hardware resources used by the existing cards, do it now. Choose a free 16-bit ISA expansion slot. Undo the bolt securing the blanking plate at the end of the slot and remove the blanking plate.

Step 3

- Hold the card firmly by its top edge and press its gold edge connector firmly into the expansion slot. Watch the clips on the external SCSI connector: they often get in the way, or get trapped.
- Do up the bolt to secure the card. If you already have a floppy interface, flick DIP switch 5 to disable the floppy interface of the Adaptec card.

Step 4

- If you're installing any internal SCSI devices, set their ID and termination before fitting them in their drive bays.
- Plug in the power leads and make sure your internal SCSI ribbon cable has enough connectors for all your devices.
- Hook up the ribbon cables to the internal SCSI devices and, as always, note the coloured edge of the ribbon cable — this has to be aligned with the same side as Pin 1 of the sockets at each end.



Every SCSI device must be assigned a unique SCSI ID, from 0 to 7

SCSI Troubleshooting

It's often at this point in the procedure that you'll come across problems. If it's an IRQ clash, this is easily changed by hitting CTRL+A and using SCSISelect. If it's an I/O or ROM BIOS address overlap you'll have to flip some DIPs, but as the switch block is on the top edge of the card there's no need to yank it out to get at them. If the problem isn't a blatant hardware resource clash, look for the obvious errors: two SCSI devices with the same ID number, a loose connector or termination plug, or a SCSI device that's not turned on. Once you've excluded the obvious, you can look for the subtle.

Double-check your work

Verify that your SCSI devices are compatible with your host adaptor. With ASPI systems, make sure that you've installed both host and peripheral drivers. Watch for driver error messages by using the F8 interactive boot option.

Juggle with the cabling

Sometimes the cable lengths between external peripherals are critical so try swapping a short cable for a longer one (or vice versa), or moving to a different connector on the ribbon cable. Make sure you snap in place the retaining clips or wires on each SCSI connector. This is particularly important with SCSI connections because they work like old-fashioned Christmas lights: if one goes out, they all go out.

Juggle with the SCSI IDs and device order

Although it shouldn't make any difference which ID is used or where on the cabling "chain" a device is plugged in, changing these is worth a try.

Check termination

Try moving the terminator from the end device, or even adding one in the middle. For example, instead of terminating the last device, try terminating the second-last. Work your way back. Or leave it off entirely.

Divide and conquer

If all else fails, break the SCSI chain in two and try each half separately.

Use the resource kit

Finally, check out the Windows 95 Resource Kit Help file on the Windows 95 CD-ROM. It's a gold-mine of useful troubleshooting advice and information.

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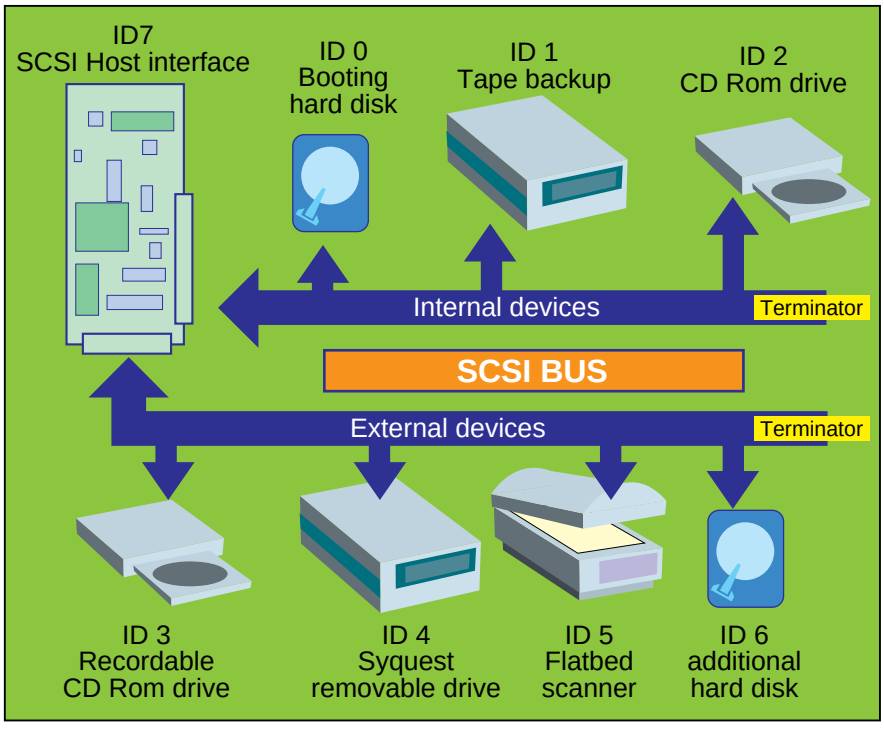

■ If you are installing a bootable SCSI hard disk as well, don't forget to alter your CMOS setup to "No hard disk installed" as the BIOS on the SCSI card takes care of the hard disk from now on. If you're not, disable the SCSI BIOS, otherwise it'll hunt for a drive to boot from, won't find it, and the "timeout" will delay booting up for a minute or so.

Step 5

■ Put the lid back on, do up the screws and plug everything back in, including any external SCSI devices such as scanners or Jaz drives.

Power up the PC and make sure everything is working — i.e. that it will boot up correctly. One new thing you'll notice at boot time is the SCSI BIOS "signing on" after the video BIOS, listing all the SCSI devices it's found.

Step 6

■ If you've installed a new SCSI hard disk as well, now's the time to partition it using AFDISK (Adaptec's version of FDISK) and high-level format it with FORMAT. If you need to low-level format the drive first, this can be done via SCSISelect.

Installing the software

■ Apart from bootable hard disks, all other SCSI devices require some sort of software support so we now need to install some software. This used to be a fraught affair but Adaptec has gone some way, with it's EX-SCSI package, to making the software installation and configuration virtually automatic.

■ If you're running DOS+Windows 3.11, depending on your devices and hardware it'll add these device drivers:

```
DEVICE=C:\SCSI\ASPI4DOS.SYS /D
DEVICE=C:\SCSI\ASPIDISK.SYS /D
DEVICE=C:\SCSI\ASPICD.SYS /D:
 ASPICD0
```

The ASPI4DOS line loads the ASPI driver for the card while ASPIDISK adds support for removable disks such as SyQuest, Zip or Jaz. The third line installs support for a SCSI CD-ROM drive.

■ Windows 95 doesn't need these Real Mode drivers and instead has its own

Hardware terms

AV	Audio Visual
ROM	Read Only memory
DAT	Digital Audio Tape
EISA	Extended Industry Standard Architecture
IDE	Integrated Drive Electronics
EIDE	Enhanced Integrated Drive Electronics
SCSI	Small Computer Systems Interface
PIO	Programmed Input/Output
IRQ	Interrupt Request
DMA	Direct Memory Access
CMOS	Complementary Metal-Oxide Semiconductor
BIOS	Basic Input/Output System

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SCSI Basics

SCSI ID

Just as multiple IDE drive installations require a master and a slave, so every SCSI device (and that includes the host adaptor) must be assigned a unique SCSI ID number.

There are eight SCSI IDs (0 to 7) and typically the host adaptor will take ID 7. Generally speaking, so long as the IDs are unique you can use any ID, the only difference between them being that higher numbers get higher priority during arbitration, so ID 6 will be serviced before ID 5. However, bootable devices normally have to be either 0 or 1. Note that If you already have an IDE drive in your PC then you must boot from this drive — you have no choice.

Most external SCSI devices use a pushbutton or rotary switch on the rear panel to set the ID, while internal SCSI devices will probably use jumpers or DIP switches. The very latest Plug and Play SCSI devices feature SCAM (Self-configuring Auto Magically) and these automatically allocate SCSI IDs without user intervention.

Termination

Just as thin Ethernet network requires termination at each end of the network chain, so does SCSI. A terminator is a bank of resistors that absorbs the excess signals on the SCSI line and prevents them from reflecting back across the cable and causing problems. They can take the form of a plug or a resistor pack that plugs in to the device's circuit board, or DIP switches.

So, if you have no external SCSI devices: the host adaptor will be at one end of the SCSI "chain", with an internal SCSI device (a hard disk, say) at the other. Both devices will need to be terminated and if you fit a CD-ROM in the middle of the chain, between the hard disk and the SCSI card, then it won't need to be terminated because it's not at the end. However, if you fit it after the hard disk, then it will. Similarly, if you plug in an external device this will have to be terminated and the host adaptor un-terminated. Sorting out termination is important as it can prevent your SCSI devices from working properly. Luckily, modern SCSI devices often feature "auto-termination" which can automatically work out which devices require termination.

Cabling

You have to pay special attention to SCSI cables. For a start, external cables must be a minimum of 0.3m long, while the total SCSI chain must be no longer than about 6m. Internal SCSI devices (i.e. those inside the system unit) all attach to one 50-pin ribbon cable that typically has connectors for two devices and the SCSI card. If you plan on adding a third internal device you'll need a ribbon cable with more connectors. If you're re-attaching a third internal drive (a CD-ROM, say), you'll need a new ribbon cable with connectors for as many drives as you plan to install — an 8-way internal cable should cost no more than £25.

Sadly, external connectors are less standardised: there are no less than three types of connector; the 25-pin plug, as featured on Macs and Zip drives, the 50-pin Centronics-style connector, and the newer SCSI-2 50-pin high-density connector. External cables tend to be dear, so expect to pay up to £30.

internal 32-bit Protected Mode SCSI drivers. However, the drivers supplied with the card are likely to be newer than the ones on the Windows 95 CD-ROM, so you should use these in preference. EZ-SCSI 4.0 includes a useful Windows 95 SCSI utility, SCSI Explorer, which lets you change some esoteric SCSI settings, things like automatic drive power down and write cacheing.

•PCW Contacts

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