Slot in some sound

In the first of our new series, Roger Gann gives you a step by step guide to fitting a sound card.

To kick off with, I'm going to show you how to fit a sound card and then go on to examine the thorny problem of resolving hardware clashes — a common problem with sound cards but equally applicable to other peripherals, too.

PCW Step by step Photography by Graham *Pearson*

Step-by-Step

How to install a sound card

Just like fitting almost any kind of expansion card or peripheral to your PC, fitting a sound card consists of two distinct phases: fitting the card into the PC and then configuring it and it's software.

Although Plug and Play (or PnP) promises an end to configuration nightmares, it has yet to deliver these promises. So far, Plug and Play sound cards have been slow to appear but Creative Labs has released Plug and Play versions of its SoundBlaster 32 and AWE 32 cards. Orchid has done similarly. Nevertheless, the vast majority of sound cards remain a jumper-fest.

In this step by step guide, I'll assume that you'll be installing an old-style, non-PnP sound card — yes, we're going to do it the hard way!

Hardware Installation

Step 1

• *We don't want to lose you* — so take the usual safety precautions of unplugging your PC from the mains. It's not strictly necessary to disconnect peripherals, like printers or monitors, but it makes it easier if you want to move the system unit about.
• If you've never before removed your PC's lid, make a note of which cable goes where. Be sure to discharge any static you may be carrying; earth yourself by touching a metal pipe, or a tap, say. Static electricity is fatal for chips so try to minimise your handling of the card.

Step 2

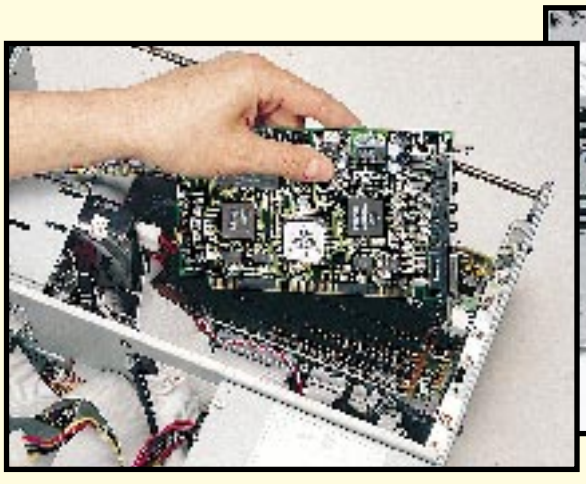
• Remove the cover from your PC — it's probably secured by four self-tapping Phillips screws at the rear.
• You can now see the innards of your PC: at the bottom of the system unit is the motherboard, which will have as many as eight expansion slots along it's rear edge.
• Unless you have got a highly-integrated motherboard, several of these slots will already be filled by cards such as your graphics accelerator.

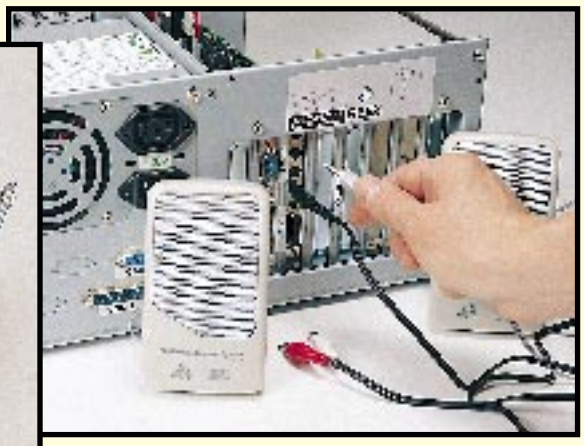
It might be wise at this point to determine exactly what hardware resources (IRQs, DMA channels and I/O ports) are free, so as to avoid a hardware clash.

For the time being, however, let's

What our new section has in store for you

Welcome to Hands On Hardware; a new, regular, slot which will deal with all matters relating to PC hardware. Over the next few months, Roger Gann will be showing you how to go about upgrading your PC hardware, step by step: from hard disks, to CD-ROMs; from motherboard upgrades, to fitting a SCSI card. Each month, Hardware will be split into two sections: one will show you an upgrade project, the other will look at a related hardware topic.





Left *Slotting a sound card into the expansion slot*

Right *Plugging in the bits: speakers, line connections and so on*

assume that the default settings of the card are OK and that no jumpers need setting.

Step 3

• Choose a slot — you can find four types of expansion slot in a PC: 8-bit ISA, 16-bit ISA, 32-bit VL-Bus and 32-bit PCI. I've not come across any sound cards that fit the latter two slots; the vast majority of sound cards are 16-bit ISA designs, although some cheap sound cards are 8-bit.

• Pick an appropriate expansion slot for your card: if you do have a 16-bit ISA sound card, try to put it in a 16-bit slot (although it will fit a VL-Bus slot it is a waste of a local bus slot).

If the sound card has an IDE interface for a CD-ROM drive, try to pick a slot close to where the drive is going to go. Sound cards can be susceptible to RF noise generated by other PC hardware and you may have to shuffle your cards around to rid yourself of any annoying buzzes or hums it's picking up.

Step 4

• Undo the bolt securing the blanking plate at the end of the slot and remove the plate.

• Hold the card firmly by it's top edge and press it's connector edge firmly into the expansion slot — it may be a tight fit and you may have to use a modicum of steady force. Tighten up the bolt to stop the card from flapping around.

• If you have a CD-ROM drive fitted, install the CD audio cable between the drive and the sound card: this will let you play audio CDs through your PC speakers.

Step 5

• Put the system unit cover back on, do up the screws and plug everything back in.

• Plug in any speakers to the sound card, plus any microphones or line connections. Some sound cards have a volume control next to the audio connectors, so make sure this is turned up!

• Power up the PC and make sure everything is working as it was before. Check that the sound card is not interfering with anything.

• If you do have a problem, see the section *Resolving Hardware Clashes* (p291).

Software configuration

• If all is well with your PC, the next step is to install the software for your card. If you have Windows 95 your first stop should be the "Add new hardware" wizard in Control Panel.

• You should let Windows 95 try to auto-identify your new sound card. When it does, you'll be prompted for the Windows 95 installation disks or the manufacturer's driver disks. You can then check its correct installation by clicking on the "System" in Control Panel, then on the "Device Manager" tab and selecting the "Sound, video and game controllers" entry on the device tree.

• Finally, click on your sound card and the "Properties" button (see *Fig 1*).

• If Windows 95 can't detect it, or mis-identifies it, you should then install the Windows 3.1x drivers supplied with the card; Windows 95 comes with a reasonable range of sound card drivers but lacks drivers for Turtle Beach, Orchid and Miro cards, for instance. Often these drivers or more up to date versions can either be pulled down from Internet dial-up services such as CIX, CompuServe or AOL, or direct from the manufacturer's Web site.

• If you're still running DOS+Windows 3.1x, install the drivers that come with the card. Often it will come with a simple diagnostic/confidence tester utility which will confirm that the sound card is working correctly (see *Fig 2*).

• Once you've confirmed that the sound card is working under DOS, the next step is to install drivers for Windows 3.1x.

Your sound card will probably have it's Windows own install program but it's not difficult to indulge in a spot of D-I-Y and install it manually.

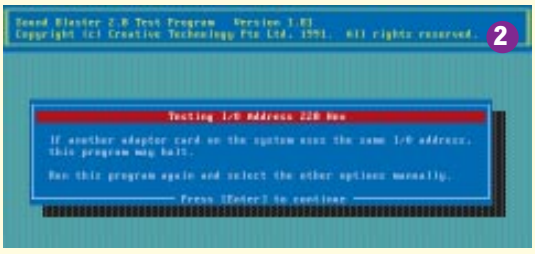
• Load the Control Panel and select Drivers, then Add… and you'll be prompted for the disk with the Windows drivers. Here, I've installed the drivers for an old SoundBlaster card (see *Figs 3 & 4*).

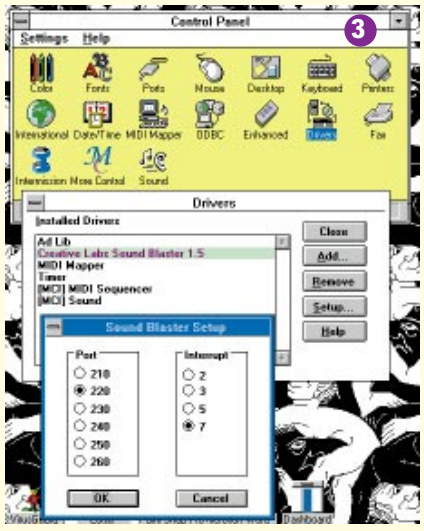
Fig1 *This tabbed dialogue reveals the Settings portion of the Microsoft Windows Sound System sound card properties*

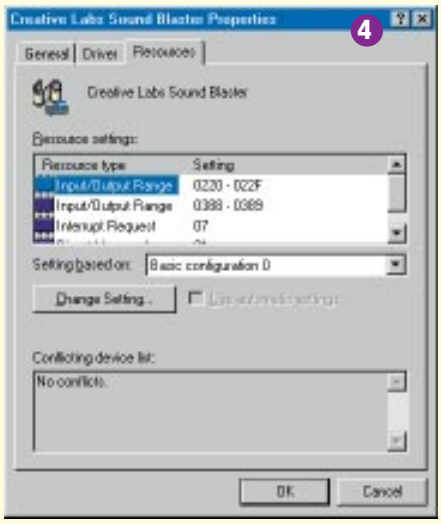
Fig2 *The SoundBlaster comes with a simple diagnostics program, TEST-SBC.EXE, which checks for hardware conflicts and plays some sample sounds to make sure that all is well*

Fig 3 *This Windows 3.1 installation of a SoundBlaster card reveals I'm using the default settings for the card*

Fig4 *Under Windows 95, the same information is kept in Device Manager Properties*







Resolving hardware clashes

Until Plug and Play heaven becomes a reality, we have to live with the ever-present problem of hardware clashes. These are caused when two hardware devices try to access the same hardware resource. The end result can be a non-functioning sound card or, at worst, a hung PC. These hardware resources in a PC are strictly limited and it can often take a bit of jockeying around to get all your cards and devices to co-exist peacefully with each other.

But just what are these hardware resources? They fall into four categories:

1. DMA, or Direct Memory Access

This is a method whereby a device can access memory by itself without using the CPU, thus cutting a corner and saving time.

There are only eight DMA channels on machines with 286 processors or better, but five of these will usually be free.

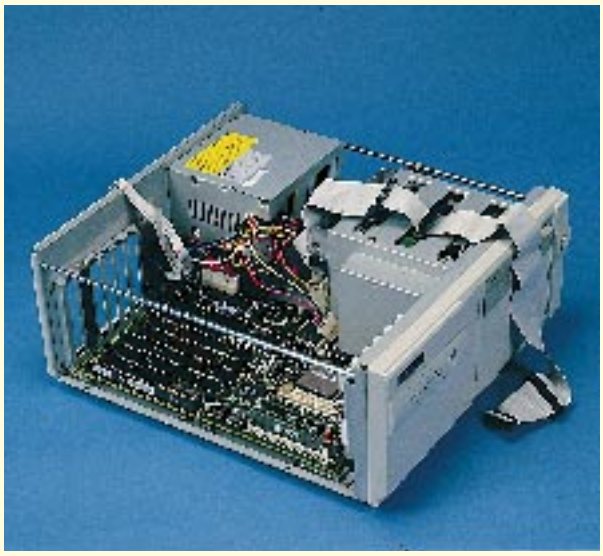
Normally, you'll be able to use DMA channels 1,3,5,6 or 7 for your expansion cards.

Standard DMA channel assignments

Channel	Used by	Width
DMA 0	System	16-bit
DMA 1	Free	8-bit
DMA 2	Floppy disk controller	8-bit
DMA 3	Free	8-bit
DMA 4	Slave DMA controller input into master	N/A
DMA 5	Free	16-bit
DMA 6	Free	16-bit
DMA 7	Free	16-bit

2. I/O port

This is an address in memory. It acts as a gateway, permitting a device to communicate with the processor. There are several hundred of these and are thus not in short supply unless your card can only use a few of them.



3. IRQ

IRQ is an "interrupt request" line — a hardware link between a device and the processor. PCs use the equivalent of two 8259 Programmable Interrupt Controller (PIC) chips and each controls eight IRQs. The second, or slave, PIC is co-ordinated via it's IRQ 9 and the master PICs, IRQ 2. As a result IRQs 2 and 9 become one and the same.

This is a list of IRQs and their owners:

Highest priority	Used by?
IRQ 9	Free
IRQ 10	Free
IRQ 11	Free
IRQ 12	Free
IRQ 13	Maths co-processor
IRQ 14	Hard disk
IRQ 15	Free
IRQ 0	Timer tick
IRQ 1	Keyboard
IRQ 2	Cascade to slave PIC
IRQ 3	COM 2
IRQ 4	COM 1
IRQ 5	LPT 2 (free)
IRQ 6	Floppy disk
IRQ 7	LPT1
IRQ 8	Clock
Lowest priority	

Because "high" IRQs receive greater priority than "low" IRQs; if you have a device that makes intensive use of interrupts, it makes sense to allocate it a high IRQ number rather than a low one.

You can't normally share IRQ lines (Windows NT3.51 forbids it) but it is common to share sound cards with the

very lowest priority, IRQ 7, which is normally assigned to the printer port. This is because the printer port is unlikely to be used all the time and is therefore "wasted" most of the time. It's also unlikely that you'll be playing sounds while you're printing, so it's relatively safe to mix both devices on this one IRQ.

For every IRQ line there's a corresponding I/O port address and here's a table showing you typical values:

Device decode	IRQ	I/O port	MEM
COM1	4	3F8 - 3FF	N/A
COM2	3	2F8 - 2FF	N/A
LPT1	7	378 - 37F	N/A
LPT2	5	278 - 27F	N/A
AT EIDE	14	1FO - 1F8	N/A
AT IDE	15	170 - 177	N/A
VGA 2/9	3	COh - 35Ah colour	A000 - BFF0
VGA	3	COh - 3BAh mono	C000 - C7FF

4. ROM address

Some expansion cards will incorporate a ROM, or ROM BIOS, and this has to sit in memory alongside other ROMs in the system: for instance, the boot ROMs and the Video BIOS.

• All ROMs must reside between 640Kb and 1,024Kb and must have a unique address. That is, it cannot share address ranges with anything else.

• All I/O cards will use all or a combination of these hardware resources. For example, a SoundBlaster's default settings are:

```
DMA Channel:     1
I/O port:      220
IRQ:             7
```

Troubleshooting

● You'll know when you've got a hardware clash because something will stop working.

A typical example of this is putting a modem on COM 3, which shares IRQ 4 with COM 1 (your mouse port). The mouse works just fine until you launch a comms program, when it will stop, only to magically reappear when you quit the comms program.

● We've seen that hardware resources are scarce and that it's possible for cards to try and utilise resources already in use. So how do you prevent these clashes occurring?

If you have DOS+Windows 3.1x there really is no substitute for conducting a hardware resource "audit" of your PC, noting which device uses which resources. Then, when it's time to add a new card you'll know exactly which hardware resources are free and which are spoken for, and thus be able to make the appropriate adjustments to the new card.

OK, it's a *schlepp* but it's nothing compared with making wild stabs in the dark when your PC isn't working properly — forewarned is forearmed! You might have to remove every card to find out its precise settings but sometimes you can use software to do this, such as MSD or WinCheckIt.

● Perhaps the best tool of all for resolving clashes is Windows 95, even if you're using non Plug and Play kit. The Device Manager will flag all hardware clashes and, here's the big advantage, tell you which device it's clashing with.

OK, so you probably won't be able to reconfigure the card via software but at least you will know precisely where the problem lies and that's half the battle.

Explanation of acronyms and terms used

● Low level

CPU	Central processing unit.
DMA	Direct memory access.
IRQ	Interrupt request lines.

● Hard drive and peripheral interface standards

IDE	Integrated drive electronics.
EIDE	Enhanced integrated drive electronics.
SCSI	Small computer system interface.

● Bus standards

ISA	Industry standard architecture.
PCI	Peripheral component interconnect (a local bus standard; now fairly universal).
VL-BUS	VESA location bus (VESA is the Video Electronics Standards Association; another local bus standard).

● Other terms

RF noise	Radio frequency noise (radio-like signals which are emitted from your PC and which can cause interference).

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