feature pc musician

PC Soundcards
A Practical Guide

Newcomers to PC recording face a steep learning curve. How do you get sound in and out of a computer, what makes a soundcard suitable for music, and what pitfalls do you face if you buy the wrong one?

Martin Walker

With all the hi-tech PC Musician features I write, it can be easy to forget that some of our readers, while perhaps seasoned musicians, may still be new to the PC. For instance, there are plenty of guitarists and keyboard players who have been recording on hardware multitrackers for years, without ever getting involved in computer-assisted recording, editing, or mastering.

To these musicians, buying a PC may seem like the ideal step forward, and let's face it, powerful PCs have never been so inexpensive. However, once you've opened the boxes, fathomed out what plugs in where, and had your first couple of sessions using the new machine, it's easy to get totally lost knowing what to do next. Is the consumer soundcard that came ready-installed with the PC up to making good-quality audio recordings of your music? Will you need to buy any more hardware to plumb in your MIDI keyboards, and if so what options are available?

Although some of the topics I'm about to cover have been presented in more depth on previous occasions (see 'Further Reading' box), the last thing a newcomer wants is to have to wade through page after page of highly detailed information. So, this month I'll be gathering together in one place all the relevant information the PC musician needs to get started.

Sound Chips Or Soundcards

'Which soundcard should I buy?' is probably the most popular question on the *SOS* web forums, and one of the most confusing topics for the newcomer, since there are now so many models competing for attention. The forum includes all my on-line FAQs on the subject, but for the newcomer even some of the terms used may be unfamiliar, so here I'm going to go right back to basics.

Nearly all modern PCs include some sort of sound-making apparatus, which will either be a sound chip built into the motherboard, or a separate soundcard that plugs into one of its

expansion slots. The cheap est solution for the manufacturer is to use a motherboard with an integrated sound chip, and although in the past these have often produced pretty poor results, customer expectations have now risen to the point where you should get audio performance good enough for some quick demos. However, one limitation is that many onboard sound chips are playback-only: you may not get an audio input to enable you to record your own performances, or a MIDI port for attaching external keyboards and synths. Happily, it's easy to check whether your PC's built-in sound source is a motherboard soundchip. Just look on your PC's back panel and see where the audio sockets are. If they are mounted on the main case, next to the parallel port and twin serial ports (where you can plug in a printer, external modem, or old-style mouse) then you have a sound chip, and you can check by the labels on the sockets what facilities you have.

If instead the sockets are mounted on a separate panel in one of the typically four to six expansion slots placed in a row, alongside other panels which feature sockets that you plug in to your telephone socket (an internal modem card) and your computer monitor (a graphics card), then you have a proper soundcard, with more features on offer. By the way, don't despair if you discover you have a limited integral soundchip, since you can nearly always disable these by altering an on-screen setting such that they become invisible to the PC system, and add a proper soundcard.

Unless you've bought a PC specifically for music purposes from a specialist music retailer, any supplied soundcard will almost certainly be a low-cost consumer model, such as one of Creative Labs' extremely popular Soundblaster series. These provide a lot of features, and are capable of some good results, but it's important for the musician to realise that the feature set is primarily intended for applications such as gaming and DVD viewing, although they do include multiple MIDI ports and a built-in synthesizer or sampler.

This sort of soundcard provides incredible value for money, and creditable performance when recording and playing back audio tracks: their audio quality exceeds that of many cassette multitrackers, and matches that of some DAT recorders. However, even the most up-to-date models won't have audio performance on a par with entry-level soundcards designed specifically for use by musicians. Soundblaster cards also have a fixed internal sampling rate of 48kHz: this is a pain if you want to create audio CDs, since these have to be recorded at 44.1kHz.

Another major limitation of most consumer soundcards concerns drivers -- the low-level software components that allow computer programs to 'talk to' the card. Most music applications work much better with specialist drivers that are different from the driver types used by consumer applications (the different formats available are explained in the Soundcard Driver Types box), and as we'll see, this is an important factor in favour of buying a more professional soundcard. Apart from Creative Labs' new Audigy card, few consumer soundcards support specialist driver formats such as ASIO.

It should also be pointed out that although having a huge array of features can be incredibly useful, it does make using a consumer soundcard considerably more confusing. Moreover, the huge number of software drivers, utilities, and demos that come with consumer soundcards can often cause more problems than the simple, clean, conflict-free approach of most music soundcards, which typically install under a dozen small files.

Soundcard Driver Types

Most musicians' soundcards now support between two and six possible driver formats, while consumer ones may offer two or three, and working out the best ones to use with your particular music software can often result in a lot of wasted time and frustration. Here are some basic guidelines and explanations:

- **MME** (MultiMedia Extensions) are the lowest common denominator. First introduced in Windows 3.1, these drivers have in the past given high latency figures (see main text), and in general they are to be avoided with sequencer software like *Cubase VST* and *Logic Audio* unless you have no alternative. However, Cakewalk seem to have used them to provide excellent performance in their *Sonar* package, and they can also give good performance with some stand-alone soft synths.

- **DirectSound** drivers generally provide much lower latency than MME, and are a good choice for many soft synths in the absence of other dedicated drivers, especially as they can be accessed from multiple applications simultaneously. To do this they hook into Windows at a lower level, and utilise various onboard acceleration features on the soundcard, but must have properly written drivers. If your soundcard doesn't have properly written DirectSound drivers then Windows will still let you choose them as an option, but will use an emulation mode, which degrades performance often to a point worse than MME drivers. The main limitation is that they can only be used for playback -- if you want to record you need to choose a different driver format.

- **ASIO** (Audio Stream Input Output) drivers were introduced by Steinberg in their popular *Cubase VST* MIDI + Audio sequencer, and were the first driver type to offer truly low latencies of 10 milliseconds or less. ASIO 2.0 also supports sample-accurate positioning across multiple ports (handy for ADAT transfers), as well as the provision of 'zero'-latency monitoring (see main text). Always use them if your sequencer and soundcard both support them.

- **EASI** (Enhanced Audio Streaming Interface) drivers are only available for a few soundcards, and essentially offer an improvement over ASIO drivers when running in Emagic's *Logic Audio* range since version 4.0. CPU overhead is generally lower than when running ASIO drivers, so *Logic Audio* users should always use this format if available, though *Logic* will also happily run using ASIO drivers.

- **GSIF** (*GigaSampler* InterFace) drivers only work with the Tascam/Nemesys *Gigasampler* and *GigaStudio* range of soft samplers. These are highly regarded due to their excellent sound libraries and fixed low-latency performance (6 to 9mS). If you want to run these applications then having GSIF support is almost obligatory: although DirectSound drivers do work in a more limited fashion, they give higher latency, and don't offer multi-output support. Always use GSIF drivers with *Giga* products if they're available for your soundcard.

- **WDM** (Win32 Driver Model) is the latest driver type from Microsoft, first introduced in Windows 98 SE as an option (although there are some problems with this combination, and few soundcard manufacturers have released suitable drivers). They can run successfully under Windows ME, but are far more important to Windows 2000 and XP users. They offer much lower latency than either MME or DirectSound drivers (in some cases down to an amazing 1.5mS), but have been slow to be released, although this looks likely to change with the recent launch of Windows XP. Use when running Windows 2000 or XP, and especially if running *Sonar*.

Onboard Synths & Samplers

Although they can be complicated to use, the additional features on consumer soundcards usually include such welcome goodies as onboard synths and samplers. Again, though, if this is what you want from a soundcard, specialist music soundcards can offer more powerful facilities, albeit at a higher price. These days, software instruments also provide a real alternative.

Up until a couple of years ago, if you wanted quality synthesizer sounds in your songs, you had to use external MIDI synths. Consumer soundcards have included onboard synths for a long time, but the first ones used two-operator FM sound chips and sounded pretty tacky. Creative Labs' Soundblaster cards provided a big improvement at the budget end of the

market, with their collection of 16-bit SoundFont-format samples. Although the default 1Mb, 2Mb, and 8Mb General MIDI collections in SoundFont format were still mostly uninspiring, the user could add up to 32Mb of proprietary RAM to the Soundblaster AWE64 Gold to hold a smaller number of higher-quality instruments. The subsequent Soundblaster Live! card made this technology even cheaper by using up to 32Mb of your PC system RAM to store its SoundFont data, while Creative's latest Audigy series are claimed to be able to use up to 1Gb of system RAM!

Libraries in SoundFont format are now a well established standard supported by various developers. Even where they use exactly the same samples as collections in other formats, however, these libraries have never been taken very seriously by 'real' musicians, and two things have conspired to make having an onboard SoundFont synthesizer less desirable today: Yamaha's SW1000XG soundcard, and software synths.

The SW1000XG was a turning point in soundcard design, as it was essentially a Yamaha professional hardware synth -- the MU100R module -- transplanted onto a card. Capable of 64 voices and 32-part multitimbral, the SW1000XG provided a built-in 20Mb ROM set whose voices were in a different league to the majority of SoundFonts. It also included a daughterboard socket that could hold any one of six PLG (PLuG-in) cards, each one a synth on a small circuit board that added a different synthesis type and more polyphony. Its five-buss 24-bit digital effects engine, plus the ability to add these effects to the six additional stereo audio playback channels, set new standards for soundcard sound quality, and it's still selling well three years later.

Other designs have since followed this trend of providing professional sounds on a soundcard. Terratec's EWS64/Microwave PC combination, for instance, is a Waldorf Microwave XT synth on a circuit board, while the various models in Creamware's versatile range, including the Luna, Powersampler and Pulsar, are essentially a clutch of DSP (Digital Signal Processing) chips on a card to which you download software code that runs synths, samplers, and effects, all without using up the native processing power of your PC.

Software Synths

However, with processor clock speeds doubling every year, the PC is now powerful enough to run several software synth engines in real time without the need of assistance from a soundcard DSP chip, and still have enough power left over to run a sequencer application and some real-time audio effects. Software synths take a MIDI input signal and generate an audio output signal, just like any hardware synth, but while many new PC users take to them like ducks to water, some musicians are still sceptical of their sound quality and practicality.

Early software synths did cause more than their fair share of problems because they were stand-alone applications: you launched them directly from Windows, had to provide them with their own dedicated MIDI input to pla y them from an external MIDI keyboard and a dedicated soundcard audio output to hear them, and then either had to rerecord their audio output into a sequencer application as you would a hardware synth, or 'capture' it during playback as an audio file on your hard drive, and then import this into your MIDI + Audio sequencer. The biggest cause of premature hair loss was attempting to use

Further Reading

Over the last few years I have written many PC Musician features that go into particular topics in much greater depth. Here are some of the most appropriate for the newcomer:

- April 1999: Latency explained.
- July 2000: Getting started with Windows 95/98 music applications.
- Nov 2000: The practicability of software-only studios.
- Jan 2001: Making music with laptop PCs.

them alongside a MIDI + Audio sequencer package using just one soundcard, as two or more applications can share a soundcard only if that card has so-called 'multi-client' drivers.

- Feb 2001: Windows 2000 and the PC musician.
- July 2001: Basic principles of PC audio recording.
- August 2001: Choosing and Installing today's PC soundcards.

These and other useful articles are available on the SOS web site; go to: www.sound-on-sound.com/search/search.asp

Thankfully, quite a few soundcards now have these, but many soft instruments are now being developed in formats that don't require direct access to a soundcard independent of a sequencer. Plug-in instruments were first introduced by Steinberg in *Cubase VST*, and are now supported in slightly different forms by all of the major sequencing packages, including Emagic's *Logic Audio* and Cakewalk's *Sonar*. Plug-in VST, *Logic* and DX Instruments are soft synths that can be launched from within the sequencer package, whereupon their audio output appears within the sequencer in just the same way as recorded audio streamed from hard disk. It is mixed within the sequencer and sent, along with the recorded audio, to whatever soundcard output is being used by the sequencer.

Today's twin availability of multi-client soundcard drivers and integral software synths means that getting started is no longer a problem, and personally I don't think sound quality is an issue either. Recreations of vintage instruments should fool most people unless they have the original alongside for an A/B comparison, and there are loads of new sounds now available that have never existed in the world of hardware synths.

One remaining problem may be not having enough processing power available to run all the soft synths you desire. While some musicians manage to create complete songs using software synthesis, this still demands a cutting-edge PC with the fastest processor available. If you're writing dance music that uses lots of drums and percussion, but monophonic lead synths and bass lines, and limited chord work, your total polyphony will still probably leave you with some spare CPU power to add software plug-in effects. However, judging by my own recent tests, a Pentium III 1GHz PC will be pretty well fully occupied if you attempt both to run effects and achieve the 64-voice polyphony provided by many of today's hardware synths, so you still can't expect to create the equivalent of a full commercial track inside a PC quite yet.

The Problem Of Latency

Latency is by now a pretty well-known problem, but it's often not until you experience it for yourself that you realise the nuisance it can be. Owing to interruptions such as opening new windows, responding to user key presses and incoming MIDI data, soundcards cannot simply output data as soon as it is received, because they cannot guarantee that the stream of data will not be broken. Instead, they need to 'buffer' the sound that is being both recorded and played back, effectively introducing a delay. As long as its buffers are large enough to survive these interruptions, the soundcard can carry on delivering audio smoothly, without any clicks and pops. However, if any interruption is long enough to result in the buffer outputting all its data before there's enough time to feed some more in at the input end, you'll hear a gap in the audio.

So, depending on the size of the soundcard audio buffers, there will always be some sort of delay between initiating a sound and hearing it. This isn't a problem during playback of existing recordings, since the music software can prepare the sounds in advance, but there's no way to do this with sounds being recorded, since they occur in real time. The result is that if, like most vocalists and electric guitarists for instance, you want to listen to your performance with a little reverb or other effects, what you hear from the output of your soundcard will lag behind what you play, exactly as it does when monitoring off-head from a

tape deck.

There are several possible solutions. For recording with effects, you could monitor using an external rackmount effect unit, but still record a dry signal so you can add software effects later on. If the soundcard has built-in DSP effects, you could use these in exactly the same way. A third way, with suitable ASIO drivers (see Soundcard Driver Types box) is to use a soundcard with 'zero'-latency monitoring. Effectively, this bypasses all the software, by passing the soundcard input signal direct to the soundcard output socket so that you can hear it immediately. You can then use this signal as a headphone feed, or patch it into a rackmount effect unit as before.

The other area where latency can cause problems is when playing a soft synth in real time. Here, only the audio playback buffers are involved, so the time delay is usually less than that involved in recording, and most modern music soundcards with ASIO, EASI, WDM, and in particular GSIF drivers will provide soft-synth latencies of 12mS or less, which are unnoticeable for most musicians. In the longer term, bold claims are being made for WDM soundcard drivers that should offer latencies of under 6mS with suitable soundcards, effectively making even audio monitoring latency problems disappear, although we'll have to wait and see whether or not this is achieved in practice.

Glossary Of Terms

- 24-bit: Now offered by most entry-level soundcards designed for musicians, 24-bit recording typically offers between 6dB and 16dB more dynamic range than 16-bit recording on the same soundcard. This makes it useful for capturing subtle details, as well as letting you leave more headroom for unexpected peaks (particularly handy if recording live).

- 96kHz: As well as recording at higher bit depths, some sequencers and soundcards give you the option of recording audio at a higher sample rate than the 44.1kHz used by CD audio. This can make high frequencies sound slightly more natural, but plug-ins will take double the amount of processing power, and 24-bit/96kHz audio files are three times the size of those recorded at 16-bit/44.1kHz.

- DSP (Digital Signal Processing) chips: additional computer components dedicated to audio functions such as synthesis or audio effects, which take some of the load from your PC's own processor.

- Gameport adaptor: a cheap way to add MIDI sockets to an existing consumer soundcard. Bear in mind, though, that some older and cheaper cards may not cope with heavy MIDI traffic such as large SysEx dumps, leading to hanging notes.

- Latency: the delay between generating a sound and hearing it from your soundcard's audio output, which is largely dependant on the soundcard and PC setup. Most modern soundcards designed for musicians are capable of being adjusted to run at 20mS latency or less with suitable drivers (see Soundcard Driver Types box), which is sufficient to prevent playing a soft synth in real time from a keyboard feeling like wading through treacle. However, latency needs to drop to under 10mS to make monitoring incoming audio with plug-in effects very practical.

- Plug-ins: real-time software audio effects that can be added to a suitable MIDI + Audio sequencer such as *Cubase VST*, *Logic Audio*, and *Sonar*. Many freeware ones are available for download, while shareware and commercial ones continue to amaze with their audio quality and possibilities.

- Soft synth: a synthesizer created entirely in software, and running on the native processing power provided by your computer. These have come on in leaps and bounds over the last couple of years, and now offer believable recreations of various old analogue synths, as well as totally new designs. Many are now available as plug-ins (see above) in either the VST Instrument format compatible with *Cubase VST*, *Logic Audio*, and others, or the DX Instrument format compatible with *Sonar*. Latency can be a problem with some consumer soundcards, but partnered with a decent musician's soundcard they are only held back by how much processing power your PC has.

- SoundFont: a format used originally by Creative Labs soundcards to store a set of samples to use as a playback-only sampler, but now capable of being loaded into many soft synths as well.

- Sound chip: essentially a computer chip that reproduces some of the functions of a soundcard, but which is built in to the PC's motherboard. Can be useful on a laptop, but seriously outranked by any soundcard as far as audio quality is concerned, and can sometimes cause conflicts with consumer soundcards if not disabled.

- Soundcard: an expansion card installed in a PC providing inputs and outputs that can be used to record and play back audio data, and often a single MIDI port as well. Some also include onboard hardware synths, samplers, or effects.

- USB (Universal Serial Buss): quite possibly the easiest way to add audio or MIDI peripherals to your computer, USB ports are to be found on all PCs sold during the last couple of years. Beware of attempting to run both MIDI and audio on USB at the same time unless using a specially designed product designed for the task, or you may run into timing problems.

- WAV: the majority of Windows audio files will have this suffix automatically appended to their filenames, although you may also find some AIFF (Audio Interchange File Format) files that have escaped from a Mac. Although other audio formats exist, these are two you are most likely to come across.

Attaching MIDI Hardware

If your PC already contains some sort of soundcard, you'll probably already have a MIDI interface. Most consumer soundcards, as well as some motherboard soundchips, have a 15-pin socket that doubles as a joystick port (for playing games), and a MIDI In and Out. All you need to complete the picture is a suitable adaptor lead. These are often called Gameport adaptors, only cost about £10, are available from most mail-order suppliers, as well as from both high-street PC and music shops, and provide a standard five-pin DIN MIDI In and Out lead. There are also plenty of entry-level musician's soundcards that provide a single MIDI In and Out, including the M Audio Audiophile 2496 and Terratec EWX 24/96 (both reviewed in *SOS* April 2001).

If you've got two or three external MIDI synths and keyboards, you'll probably scrape by with a single MIDI In and Out, but buying a dedicated MIDI interface and allocating a separate MIDI port to each synth will make your life a lot easier, and this is where many people get totally lost in the huge number of available options. MIDI interfaces are available in a huge variety of forms, ranging from one-in/one-out devices that plug into serial, parallel, or USB ports, to eight-in/eight-out rackmount units with built-in SMPTE, patchbays, and cable testing.

If you're thinking of buying a more comprehensive soundcard, there are a few that come with integral multiple MIDI ports. Models to look at include the Marian Marc 4 MIDI (reviewed in *SOS* March 2001), which provides two MIDI Ins and Outs along with four-channel analogue audio I/O for the very reasonable price of £225, and the SEKD Siena, which has eight analogue ins and outs as well as two MIDI Ins and Outs for around £399.

If you're convinced that you only need to record single mono or stereo instruments to build up your songs one track at a time, the Lynx One from Lynx Studio Technology has a hefty £499 street price, but is probably the best-sounding soundcard I've reviewed to date, as well as having two MIDI Ins and Outs. Finally, if you want even more MIDI ports on your soundcard, one of the few options is the EgoSys WaMi Rack24, which has four analogue audio inputs and eight analogue outputs, along with four MIDI Ins and Outs -- quite a combination, and very reasonably priced once again at about £500.

If you're already happy with the audio facilities of your soundcard, but want to add one or more MIDI ports, there are far more possibilities. For between one and four extra Ins and Outs, USB is probably the easiest solution, and despite reports of MIDI timing problems with older PCs, the majority of teething troubles now seem to have been resolved. Ranges to consider include those from Edirol, Emagic, Midiman, and Steinberg among others, while if you are particularly concerned about tight timing and use *Cubase* or *Logic*, then it makes sense to buy one of the 'intelligent' interfaces made by Steinberg and Emagic respectively. These send MIDI data early and then clock it out exactly on time regardless of any USB delays.

Up And Running

There's a steep learning curve involved in recording with PCs. This is partly because there are so many possibilities open to you, and partly because of the sheer number of ways in which you can achieve them. When you've chosen a soundcard that works well with your software of choice and a MIDI interface that is sufficiently well-endowed to connect all your MIDI instruments, however, you'll be in a good position to explore these possibilities and find a way of working that suits you. Good luck... SOS

Glossary
http://www.sospubs.co.uk/sos/regular_htm/glossary.htm

SOUND ON SOUND
Europe's No1 Hi-Tech Music Recording Magazine Sound On Sound

Go To SOS Website Homepage

Media House, Trafalgar Way, Bar Hill, Cambridge CB3 8SQ, UK.
Telephone: +44 (0)1954 789888 Fax: +44 (0)1954 789895
Email: info@sospubs.co.uk Website: www.sospubs.co.uk