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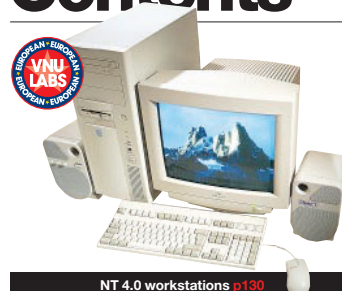


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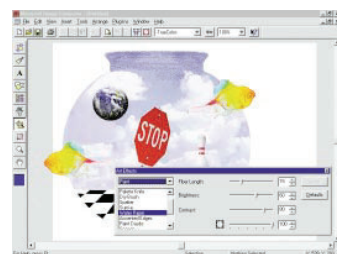
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- NEW SECTION **p314**

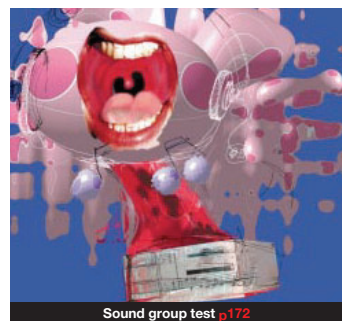
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Gordon Laing and Lynley Oram tune in to a dozen sound cards and tackle editing, sequencing and sampling.

Sound for the PC has come of age. What was once restricted to emitting the occasional beep or click, now produces convincing music, enhances games and encyclopedias with speech and sound effects, and can even be used as a complete, professional quality, recording studio. Sound is now a standard feature in almost every new business or home PC. Modern motherboards typically feature on-board E-IDE hard disk controllers and general I/O (input/output). Additionally, some even boast on-board sound facilities and on-board graphics, too. On-board sound offers basic facilities, allowing you to record sounds and replay the effects found in most games and day-to-day application or operating system events. Some of the better motherboards even feature built-in wavetable support for superior music reproduction. But what if you are dissatisfied with your basic on-board sound and want to upgrade it? Perhaps you want more sophisticated tools to make your own music or professionally record and edit sound? Or maybe you just want the ultimate system for playing games? It could be that you have no sound at all and want to see what all the fuss is about? We have reviewed a dozen sound cards for those who want to upgrade or start from scratch. We have listened to on-board sound to test whether it cuts the mustard or is just a cheap bonus. We have rounded up all the best musical sequencing, sound-editing, and fun music software. We have looked at the future, with noises created via software only, the influence of MMX Pentium processors and where the Universal Serial Bus (USB) fits into the equation. You can check out our explanations of how it all works, from FM synthesisers to sampling to wavetable to General MIDI. We look at whether plug-and-play really makes installing a sound card any easier. Whatever your interest, just you listen here!

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- ★★★★★ Buy while stocks last
- ★★★★ Great buy
- ★★★ Good buy
- ★★ Shop around
- ★ Buy it and weep

Illustration: DANIEL MACKIE

Sound beginnings

Sound hardware may exist on an upgrade card or be integrated directly onto your motherboard. Although sound cards tend to be more sophisticated, there's no reason why on-board chips can't offer the same capabilities. For simplicity here, we'll refer to all flavours of sound hardware as sound cards. The end result of a sound card may be music or noises coming from your PC, but there is more versatility there than first meets the ear. There are two main ways to generate sound using hardware: you can either attempt to synthesise it artificially, or actually record the sounds you want and play them back on demand. Both have their pros and cons.

FM synthesis is performed by cheap chips, usually Yamaha's OPL2 and OPL3 technologies or some kind of emulation. This basic FM synthesis is what all sound cards have in common and it is cheap and easy to implement.

Trying to get as close as you can to that nifty guitar sound using FM synthesis is all very well, but why not record the guitar and play back the sound as and when you need it? This is the premise for wavetable synthesis, where short snippets of numerous instruments are recorded digitally and stored in the sound card's memory, ready for playback when required.

Wavetable synthesis, conforming to General MIDI (see below), is standard on many sound cards today while upgrades are possible for those who don't have it at all or want something better.

The number of voices offered by a sound card (a.k.a. polyphony) is the number of notes it can play simultaneously: multi-timbral refers to the ability to play more than one instrument at a time. The combination of multiple voices, existing wavetable samples and the increasingly common ability to record and download your own, makes a sound card with its built-in MIDI interface an extremely flexible musical instrument.

So how do you record your own samples and sounds? Well, a sound card is also capable of digitising analogue sound, copying it into memory or onto a hard disk, then reading it off and converting it back to analogue for listening. Yes, you can use your sound card as a tapeless digital recorder (see page 175); that's what those line in and line out plugs on the back are for.

Thinking of plugs on the back, look at the joystick interface. This not only allows you to connect a joystick for games use, but also doubles as a MIDI interface.

MIDI is a standard (see below) which allows you to connect various musical instruments together and control them all from one point, say, a master keyboard and/or a software sequencer (see also, "Sequencing software", page 183).

Although largely unnecessary these days, most sound cards also feature IDE CD-ROM drive interfaces and, more importantly, a CD audio connector. This allows a sound card to take your CD audio, mix it with the FM and wavetable synthesis and any additional recorded sounds, and feed the whole lot out of one socket at the back. Sometimes you'll have the option of adding real-time digital effects such as echo, reverb or 3D simulations. All in all, sound cards are pretty clever things.

Gordon Laing

MIDI and wavetable synthesis

The Musical Instrument Digital Interface, or MIDI, is a communication protocol designed to enable two or more musical instruments to talk to each other. MIDI does not transmit sound, but note instructions: a typical MIDI instruction might hit middle C quite hard, twice, wait a couple of seconds and then hit it again, only a bit softer.

In practice you could have several sound modules, samplers and synthesisers, all linked with MIDI cables and controlled by a single keyboard. Sequencers can be used to record MIDI instructions for playback later, or to play along while you add additional melodies.

All sound cards offer a MIDI interface via the joystick port: one suitable cable later and you are ready to connect up to various electronic musical instruments. Install some sequencing software and you are ready to make music. If you have not got any external MIDI instruments, you can knock around with the sound card's FM synthesiser, or better still, use the built-in wavetable samples.

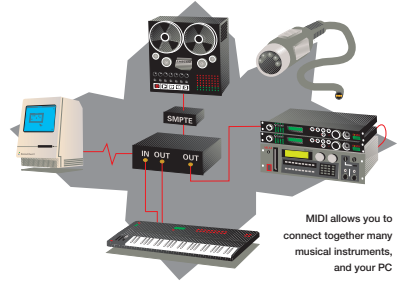
The advantage of wavetable synthesis over FM synthesis is realistic sound, so long as the original samples are OK. The downside is memory. Sampling at high quality requires plenty of memory even for short periods of time. A reasonable set of sampled wavetable instruments may require up to four or 6Mb of dedicated ROM memory on a sound card. It is possible to compress your wavetable samples to two or even 1Mb, but at risk of losing quality.

Then there's the problem of incompatibility. Let us say that wavetable sound cards have ten recorded instruments, and that a third party has written some music featuring those ten instruments. Everything is hunky-dory as long as the musician knows which instruments are which. The musical track contains only the MIDI notes, directed towards a specifically numbered instrument and if the musician believes instrument number four to be a guitar when the sound card knows it is a trumpet, you are going to get a strange-sounding tune. Clearly, everybody has to agree on which instrument number refers to what instrument sample: enter General MIDI (GM) which specifies 128 named instruments in a known order. When a musician, using GM, writes a tune for a piano that is what you will hear with GM hardware. Both Roland's GS, and Yamaha's XG standards have extended the number of sampled instruments on offer beyond GM.

Wavetable samples are usually stored in ROM, which cannot be modified. If your sound card has RAM or provision for RAM, it is possible to store your own samples for playback. Make your own or take them from professionally recorded sampling CDs. Download them into your card's RAM and play them back using a MIDI instrument or sequencer. Some sound cards also offer an improved set of less compressed General MIDI samples to download if you have expanded your sample RAM.

Wavetable software is starting to arrive, offering additional voices with which to work and the possibility of less hardware dependence, but at the cost of a substantial processor hit. The AWE 64 doubles its number of voices using software, which may be a boon to those using underminding sequencing software on a powerful PC. Do bear in mind that processors are getting faster all the time.

Gordon Laing



Compatibility

Running hardware is no good without software compatibility which can make or break a sound card. It is no good if your software is making requests for sounds your hardware can neither interpret nor produce; hence the adoption of audio standards.

Without doubt, the most famous is SoundBlaster compatibility, developed by Creative Labs. It assumes a basic digital audio capability offering sound and voice effects, as well as FM Synthesis for simple music reproduction. It may be basic, but SoundBlaster is supported by virtually every game, and consequently one of the most important standards with which a sound card should comply.

For superior musical reproduction, look for a wavetable card that is compatible with general MIDI (see p174). In games or Windows, just select General MIDI as your choice of playback, sit back and enjoy. However, in recent times most games music was played directly off the CD, rendering wavetable and General MIDI capabilities more or less redundant unless you were a musician or a fan of older games.

DirectSound, one of the latest sound standards being implemented today, comes from Microsoft. As part of the DirectX application programming interface (API), currently available in version 3.0, DirectSound is completely hardware-independent. All the user needs to make use of DirectSound is Windows 95.

DirectX removes the necessity of software to be written directly for specific hardware, like a sound card. Today, with the presence of DirectX and the DirectSound component, a sound card no longer needs to be SoundBlaster compatible or have software developed with that card in mind. As long as the card manufacturer provides DirectX drivers, the card can run any programme or game using that API.

DirectSound has two main features. The first consists of two buffers. The secondary buffer handles low-level sounds, such as background sound effects, music, or voices and mixes them together. Theoretically, the secondary buffer can handle an infinite number of sound samples (also called channels) but in reality the number of sounds used is limited by the CPU's capability. Once all the sounds are combined they are output to the primary buffer which sends the sound to the speakers.

The second feature of DirectSound involves 3D sound. It is based on a 3D positional audio concept which places a sound in a certain mathematical position relative to the listener's position. In real life, human hearing has "pick-up" cues which relate to sound frequency, intensity and distance. 3D sound applies the same concept with its "sound emitters" (or sound sources) such as a monster in a game. As the monster close in to attack, say from behind, its sound becomes more intense and provides the listener with a sense of something approaching them from behind.

Gordon Laing and Dylan Armbrust

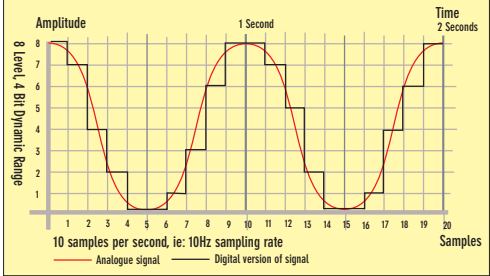
Sampling and direct to disk recording

When a sound card records analogue audio, it is converting the sound waveform into digital information and then copying this in real time onto your hard disk. It is using your hard disk as a digital tapeless recorder. To hear what you have recorded, the sound card takes the digital information off the hard disk, converts it back into analogue, and then feeds it to loudspeakers, headphones or a conventional tape recorder.

The process of converting analogue to digital is known as digitising or sampling. With audio, the analogue waveform is chopped into a number of slices per second. At each slice, the amplitude is measured and rounded to the nearest available value. Clearly the more chops per second (sampling rate) and the finer the values assignable to the amplitude (dynamic range), the better the representation of the original.

CD digital audio employs a sampling rate of 44,100 Hz and a 16-bit dynamic range. That is 44,100 chops every second, each one describing the waveform amplitude at that moment in time with a 16-bit number; 16-bit itself offering 65,536 steps from which to choose. Remember, CD is a stereo system so that's two 16-bit words every 44,100th of a second. It works out at around 160Kb/sec, 10.5Mb/min, or 630Mb/hour. The most common file format used to store digital audio on PCs is WAV.

All sound cards should offer up to 16-bit resolution and sampling rates of 44,100 Hz or 48KHz, although they will also operate at



The finer the steps, the better the digital approximation of the original analogue sound

lower quality settings for less demanding circumstances. Superior sound cards boast lower noise levels and higher-quality analogue to digital and digital to analogue converters (ADC and DACs respectively).

If you are into recording and editing audio, you will need as much hard disk space as possible, with ten minutes' CD quality requiring over 100Mb. The faster the disk and I/O sub-system the better when you are working with such large files. Today's hard disks and PCI controllers should be able to sustain a transfer of at least 4Mb/sec.

If you are serious, you will want to ensure that there are no interruptions in the audio stream. Many hard disks pause, to thermally recalibrate, which can result in a short but undesirable pause. Some AV drives are specifically designed not to thermally recalibrate, thus eliminating this effect. Micropolis produces a range of high-performance SCSI AV hard disks up to 9Gb in capacity with sustained data transfer rates of around 7Mb/s.

Windows 95 dynamically re-sizes its cache and virtual memory as required. This may be all very well for normal applications but suddenly hammering the disk to change the cache size will interrupt audio recording and playback. Try manually setting your virtual memory so that the minimum and maximum sizes are the same, typically 2.5 times the amount of system RAM. This will prevent Windows re-sizing the virtual memory when you least want it to.

Gordon Laing

Aztech Sound Galaxy Waverider Pro 32 3D

This is much the same card as the one reviewed in last year's (April issue) group test, but with one major difference. Aztech has slashed the price of this half-sized card by 50 percent, which represents a huge saving for those on a budget.

Compatible with General MIDI, Direct Sound and SoundBlaster, this card gave us great-sounding grunts in Doom2. The 3D function worked a treat, giving the opening video in Diablo a particularly spine-chilling chuckle.

This card is not plug and play, and if you have no autoexec.bat file on your PC (like many Windows 95 setups), the software installer will not bother putting in the raw DOS support. Installation of this card required much manual configuration.

There is no wavetable daughterboard connector but the card does have 2Mb of wavetable samples compressed into a 1Mb ROM, containing 128 instruments and 69 drum sounds, with Yamaha's OPL3 FM chipset producing 20 voices.

For running high-end audio applications, give this one a miss, as the signal-to-noise ratio is not great. For games and other things, like taking voice notes, this card will do the job, but there are better around.

Aztech has included a set of headphones and is bundling this card with a suite of multimedia applications, including Audiostation for accessing the sound mixer, and MIDI functions.



PCW Details

Price £49.95 (£42.51 ex VAT)

Contact Aztech 01734 820840

Good Points Cheap.

Bad Points Difficult installation.

Conclusion A good option for those on a budget.

★★★

Creative Labs SB16

This is the baby of the Creative Labs SoundBlaster family. There is no on-board memory or wavetable but the card does have an upgrade connector for installing a daughterboard.

Compared with the other FM-only card we tested (the Schubert 3D) the SoundBlaster 16-bit had easily the best sounds. Installation was very simple: Windows did all the hard work for us; it correctly identified the card, pulled the appropriate drivers off the Win95 CD and worked first time without a restart.

If you are looking for some sound support on the internet, this card has full duplex and comes with software, enabling simultaneous record and playback. It also comes with a selection of Creative's audio applications, including the easy-to-use WaveStudio software and WebPhonelite, plus a free trial from CompuServe. However, if you want to do more than talk over the internet (and there is a world of music waiting for you out there) then you had better either get a wavetable upgrade or opt for a wavetable card. Sample rates ranged from 8 - 44.1kHz, and the card has a standard IDE CD-ROM connector, and two audio CD connectors. The card proved compatible with DirectSound, and while there was no need to test for SoundBlaster compatibility, we did anyway. Well, any excuse to play Doom.



PCW Details

Price £85 (£72.34 ex VAT)

Contact Creative Labs
01734 344322

Good Points Easy to install.

Bad Points FM and SoundBlaster only.

Conclusion Good, basic card.

★★★

Creative Labs SB Awe 64

Installing a SoundBlaster card is usually a piece of cake, and this one was no exception: you do not even need to restart your PC.

Overall, the Awe 64 sounds excellent but it is not going to trash the opposition in the same way as its predecessor, the AWE 32, did. We were more impressed with the samples from the Maestro 32/96 and the Ubi Maxi 64: both had 4Mb of on-board ROM, compared to the AWE 64's 1Mb, and it showed. Neither of the AWE 64s feature a daughterboard interface.

The card has 64-voice polyphony, provided half-and-half via a mix of hardware and software wavetable. One drawback is the extra load that wavetable synthesis puts on the CPU, so only use this card with a Pentium-class system.

There is 512Kb of on-board RAM, in addition to a proprietary daughterboard connector for adding up to 8Mb of RAM via Creative's own memory cards. Unsurprisingly, the card was SoundBlaster and DirectSound compatible. The sample rate ranges from 5kHz up to 44.1kHz.

The card comes supplied with the usual Creative Labs software packages, INTERNETed Audio Tools and a music library containing E-mu's 2Mb and 4Mb GM banks (if you install extra RAM), SoundFonts files, MIDI and audio files.



PCW Details

Price £149 (£126.81 ex VAT)

Contact Creative Labs
01734 344322

Good Points Extremely easy installation.

Bad Points Wavetable ROM could be better.

Conclusion Sufficient for amateur musicians.

★★★★

Creative Labs SB Awe 64 Gold

As you would expect from a card with the epithet "Gold", this has all the features of the AWE 64 and then some. But do not be fooled into thinking that this is the same card with bells on, plus an extra £50 on the price.

This card has a smart, gold-lettered top side and distinctive reverse side sporting gold-plated RCA jacks, while the other cards we saw had only 3.5mm Walkman-style jacks. Creative has thoughtfully included an RCA audio cable in the box, along with an external MIDI cable and a microphone.

The AWE 64 lacked a Sony-Philips Digital Interface, whereas the Gold not only features a S/PDIF connector on the board, it also comes with a cable and its own blanking plate with socket: connect this to an external DAC or DAT recorder for pure digital output from the sample bank.

While the AWE 64 suffered from a paltry 512Kb of on-board RAM, the Gold offers 4Mb, and 2Mb and 4Mb GM banks are included in its software package. Up to 28Mb RAM can be added using the card's proprietary memory upgrade connectors. This is considerably more than the AWE 64's 8Mb, as Creative is aiming the Gold at serious musicians and high-end gamers.



PCW Details

Price £199 (£169.36 ex VAT)

Contact Creative Labs
01734 344 322

Good Points S/PDIF connection. RCA jacks. 4Mb on-board RAM.

Bad Points Restricted to using Creative Labs' memory upgrade boards.

Conclusion Good feature-to-price ratio.

★★★★★

Gravis UltraSound Plug and Play Pro

If this were a beauty competition, this card would win hands down. It feels sturdy and has a red PCB. But looks aren't everything, and our delight with this card faded as we tried to plug it in.

Do not be too put off by our experience though, as the Version 1 drivers originally shipped with the card were riddled with bugs. Now, updated drivers can be downloaded from the company's website at www.gravis.com. Gravis will supply existing customers with Version 2 drivers on request.

Once up and running, this card has a passable sound. The samples sound good but not great. We tested its mettle on Doom2 and Diablo and found no SoundBlaster or DirectSound compatibility problems. The card has 32 wavetable voices and 1Mb of on-board ROM. More importantly, it has 512Kb of RAM for storing user samples, although ironically you will need to upgrade to 4Mb to support the ageing but excellent Gravis compatibility for old DOS games. Up to 8Mb of RAM can be added via two 30-pin SIMM slots on the card.

Gravis is making the most of the full duplex capability of this card, including a microphone with stand, plus an internet Phone demo, Real Audio for tuning into internet radio, and a CompuServe internet starter kit.



PCW Details

Price £179 (£152.34 ex VAT)

Contact Koch Media
01420 541 880

Good Points Room to upgrade RAM.

Bad Points Not fantastic sound quality.

Conclusion Not as good as it should be, given its price point.

★★★

Pine Megawave Gold

Using plug and play, the installation of this 16-bit card was a breeze. Unfortunately, the DOS drivers were not installed as standard but this is a minor quibble even though it required a bit of mucking about with the settings to put it right.

Otherwise, the card was unpretentious and a nice little producer of solid sounds.

There are two versions of the Megawave Gold: one with software wavetable, another with hardware wavetable provided by Yamaha's OPL4 chip. The same drivers are used for both, so you will get the software wavetable with the hardware version. But if you want more than the 24 hardware wavetable voices to play with, you will need to configure each instrument singly for either software or hardware wavetable; a laborious undertaking. Software wavetable taxes the processor's performance, so with this in mind, Yamaha's OPL Soft Synth has two reverb effects and four levels of variable quality from which to choose. If you want your processor to devote some quality time to your games, you can opt for the lowest setting.

The card comes with the Willowpond sound utility and games. It has full duplex for simultaneous recording and playback, plus the Microsoft software packages NetMeeting and Internet Explorer.



PCW Details

Price Hardware version £52.88 (£45 ex VAT); software version £43.48 (£37 ex VAT)

Contact Dabs Direct 0800 558866

Good Points Can utilise both hardware and software wavetable.

Bad Points Did not automatically install DOS drivers.

Conclusion Not bad for the price.

★★★★

Pine Schubert 3D Plus

This is an inexpensive card, the cheapest Pine has to offer, so we cannot judge it too harshly. It nevertheless managed a decent performance for a 16-bit FM card, although the sound was not quite as good as the 16-bit SoundBlaster. There is a daughterboard connector if you want to upgrade to wavetable at a later date.

According to the box, this card should be plug and play but we had to resort to using the Add New Hardware wizard to get installation to proceed smoothly. To be fair, though, plug and play did work when our sister publication, *What PC?*, reviewed the card.

There are only three sockets at the back of this half-sized card, with one shared for speaker and line out, plus a game/midi port. Sampling range goes from 4kHz to 44.1kHz.

Once we had got the DOS drivers correctly installed the Schubert 3D Plus worked fine when we played Doom2, so no SoundBlaster compatibility problems there. Likewise, the card worked well with DirectSound and it is also MPU401 and General MIDI compatible. For gamers, the 3D effect is a definite plus.

There are two CD audio-in connectors, for Sony and Panasonic drives. For playing about with your sound system, Pine has bundled some audio utilities in the form of Willowpond, which includes various recording facilities.



PCW Details

Price £34.08 (£29 ex VAT)

Contact Dabs Direct 0800 558866

Good Points Okay sounds for an FM-only card.

Bad Points Manual installation of DOS drivers.

Conclusion A cheap and cheerful way to put sound on your PC.

★★★★

Terratec Maestro 32/96

The Maestro features 4Mb of wavetable samples on a Dream ROM, with 393 sounds, eight drum kits, multi-effects processing and 32-voice polyphony. There is no sample RAM as standard, nor allowance for fitting it at a later date, but there is a wavetable daughterboard interface and the provision to address 32 MIDI channels.

Impressively, the Maestro features compatibility with Roland's General Synthesiser (GS) standard (under DOS and Windows), along with the usual array of General MIDI, SoundBlaster and Windows Sound System. It supports full duplex for simultaneous recording and playback, and there is a MIDI cable thrown in.

The software bundle is impressive: Steinberg's Cubasis Audio Lite, and Circle Elements for budding dance-music makers. Installation was a breeze, with the card requesting drivers from the supplied CD at startup, then restarting the machine before installing the sound applications. Most cards come with a fairly average array of sound recording and playback utilities, some of the more imaginative resembling home hi-fi systems. Terratec's utilities and control panels are tastefully designed, easy to use and extremely comprehensive. They look like a cross between higher-end home hi-fi and quite serious professional audio gear.

Overall sound quality on input and output was excellent.



PCW Details

Price £139 (£118.30 ex VAT)

Contact Multimedia Direct
01635 294394

Good Points Great sound, software and utilities.

Bad Points No sample RAM.

Conclusion One for the shortlist.

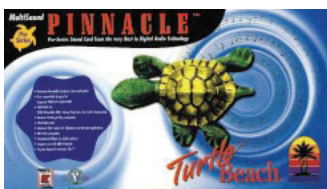
★★★★

Turtle Beach MultiSound Pinnacle

This is the top of Turtle Beach's range; the kind of sound card you buy if you are serious about music. The optional SPDIF digital I/O daughterboard enables you to send digital audio directly backwards and forwards from the card to, say, a DAT, an outboard DAC, or a CD player, by-passing the on-board converters and effectively eliminating generation-loss. However, the Pinnacle's high-quality 20-bit DAC and ADC, claim an impressive signal to noise ratio above 97db.

Wavetable samples from Kurzweil are stored on a 2Mb ROM, and while there's no sample RAM as standard, the Pinnacle can be expanded to an enormous 48Mb RAM via two 72-pin SIMM slots; a musician's dream. A 4Mb General MIDI patch set is included for when you invest in some RAM. Despite offering great wavetable sound out of the box, Turtle Beach has done the right thing and fitted a daughterboard interface: 48 MIDI channels are supported and there is full duplex for simultaneous recording and playback; but no SoundBlaster compatibility.

We have heard the Pinnacle in action, but could not get it to work under Win95 on our test machines; if you buy, you should get some sort of guarantee. Also consider Terratec's forthcoming EWS-64 card, offering similar capabilities.



PCW Details

Price £479 (£407.66 ex VAT); £579 (£492.77 ex VAT) with Digital IO

Contact Etc Distribution
01706 219999

Good Points Excellent sound, facilities and expansion.

Bad Points Expensive. No SB. Install problems.

Conclusion A musician's dream — if they get it to work.

★★★★

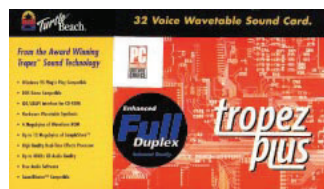
Turtle Beach Tropez Plus

This 16-bit, 32-voice card is the successor to the Tropez sound card. The memory available for samples has been doubled to 4Mb of on-board wavetable ROM, containing 128 instruments. Three 30-pin SIMM sockets allow up to 12Mb RAM for user samples at a future date.

Installation should be plug-and-play but there were a few snags: the BIOS on motherboards with on-board sound will need to be upgraded before installing this card and we also had to skip a missing DOC file during installation.

There are some good-quality samples which, coupled with the reverb effects available, produced some impressive sounds. It is SoundBlaster and DirectSound compatible, and has an on-board MIDI interface for the connection of up to two MPU-401 compatible external interfaces. There is no daughterboard connector, just an IDE ATAPI interface for CD-ROM and a couple of CD audio connectors.

A Yamaha OPL3 chip provided the FM synth. The sampling rate ranges from 4kHz to 48kHz. Bundled audio software includes recording and editing suites, plus Samplestore, enabling users to replace any General MIDI instrument with their own sample, as long as they have fitted some RAM.



PCW Details

Price £269 (£228.94 ex VAT)

Contact Etc Distribution
01706 219999

Good Points Quality samples.

Bad Points Tricky to install. No on-board RAM.

Conclusion Fairly pricey, but produces good-quality sounds.

★★★

Ubi Maxi Sound Home Studio

Setting this card up wasn't so much of a chore as it had been with some of the others we looked at, but it still took Windows 95 a few goes to get things right. To make up for it, the card produced some excellent sounds, on a par with the other 64-voice cards we reviewed. It had no problem meeting the SoundBlaster demands of Doom2, or the DirectSound requirements of Diablo.

The 4Mb Dream wavetable ROM, features a total of 425 sounds, 128 instruments and 200 percussion sounds divided up into 16 drum sets. If that's not enough for you, the card also has a wavetable daughterboard connector and a 72-pin SIMM slot, for adding 16Mb of RAM.

Ubi has also put a dial on the rear of this card, to control the volume of the on-board amplifier. There's an E-IDE CD-ROM connector, and three CD audio connectors for Sony, Panasonic, and Mitsumi drives.

Ubi has included a whole bunch of software in the box, along with an external MIDI cable, and there is Internet Phone software to make use of the full duplex feature. Best of all, the card has been bundled with a copy of Cakewalk, and a suite of 8-track recording software, in the form of Quartz Audio Master SE, for recording direct to disk.



PCW Details

Price £189 (£160.85 ex VAT)

Contact UbiSoft 0181 944 9000

Good Points Good software. Lots of memory.

Bad Points No standard RAM.

Conclusion Great value for money

★★★★

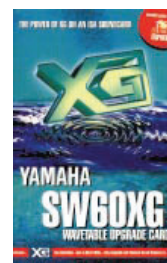
Yamaha SW60XG

High-quality wavetable daughterboards have been available for ages, but at a high price. Then along came Yamaha with its DB50XG, arguably the best-sounding wavetable daughterboard which, amazingly, cost only £129. The only downside was that to install it you required an existing sound card with a daughterboard interface. Unfortunately, plenty of sound cards and all motherboards with sound facilities do not have wavetable daughterboard interfaces, leaving the DB50XG infuriatingly out of reach for many.

Happily, Yamaha has fitted the same sonic capabilities of the DB50XG onto a standard 16-bit ISA card, which will slot into almost any PC; and this the SW60XG. But remember, there is no physical joystick or MIDI port facility to record audio or emulate a SoundBlaster: the SW60XG is nothing more than a wavetable MIDI tone generator, albeit an extremely good one.

Installation is easy, requiring no IRQs or DMAs. Most people will complement existing SoundBlaster-compatible hardware with the SW60XG; in which case you will need to pass the output of one to the input of the other.

Once powered up, you will have General MIDI and Yamaha XG compatibility from a 4Mb ROM, offering 676 wavetable voices, 32-note polyphony, 47 different effects from three independent DSPs, and played back using decent 18-bit DACs. Sound quality is brilliant, and it's great that now every user can experience the XG format.



PCW Details

Price £152 (£129.36 ex VAT)

Contact Yamaha 01908 366700

Good Points The best-sounding wavetable...

Bad Points ...but that's all it does.

Conclusion The perfect wavetable upgrade.

★★★★

Digital audio-editing software

Why would you want to edit sound recorded on your PC? You may just want to edit short clips for use at various Windows events in amateur quality (up to 22KHz) or at high-quality 44KHz for use in a music sampler as MIDI instruments, or for converting to lower

instance, which comes with SoundBlaster sound cards, or Wave SE which comes with Turtle Beach cards.

WaveStudio's goodies include the ability to edit left and right channels of a stereo sound independently and to save files in compressed formats (such as ADPCM). It also has zoom

the two top stereo editors.

But processing time isn't everything. Many editing processes require complex algorithms and programs which use simple calculations for speed or memory reasons and may introduce unwanted artefacts which can make the result unpleasant to listen to. What's more, programs like SoundForge and WaveLab offer additional parameters to fine-tune processes and ensure quality. So, in SoundForge, when converting sounds from 16-bit to 8-bit, you have the option to either the sound; a process similar to that of image dithering when displaying photorealistic pictures with few colours.

SoundForge has more features than WaveLab, including the ability to read AVI files and edit their audio. WaveLab has fewer sound processing effects and fewer parameters to set for each process, so it is easier to use. One of WaveLab's strong features is its batch mode, where a list of processes can be applied to a list of files. But a batch converter is available with SoundForge as a plug-in. Another of the company's plug-ins removes noise from analogue recordings, although if you are heavily into sound restoration, Dart Pro from Tracer Technologies is a good bet; it removes clicks, pops and noise, as well as offering basic sound-editing features. Plug-ins are now available for WaveLab, too.

Editing of digital audio may require the mixing of multiple tracks to make up a soundtrack for a film or video from music, sound effects and voices, or mixing recordings of various instruments for a music production. Many MIDI sequencers (like Cubasis, CakeWalk and Digital Orchestrator) offer this facility as standard, but others, like Master Tracks Pro Audio, work in sync with dedicated multi-track sound editors to mix music with audio.

Master Tracks Pro Audio offers a cut-down (4-track) version of SAW (Software Audio Workshop), a program which lets you place sound files on a time line on different tracks and play them together or process them into a single file. SAW includes real-time effects, even equalisation, panning and volume changes if your machine and hard disk are fast enough to cope with them. The top version of the program, SAW Plus, can handle 16 tracks.

PCW Details

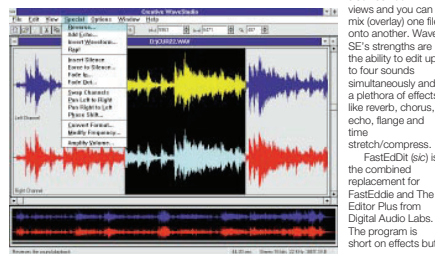
Creative WaveStudio (bundled with sound cards), Creative Labs 01734 344322.
MasterTracks Pro Audio £199.95 (£170.17 ex VAT), Arturia 0181 202 1199.

Saw Plus £599 (£509.79 ex VAT), **SoundForge 4.0** £299 (£254.47 ex VAT) and plug-ins. MCMACX Distribution 0171 723 72211.

Steinberg WaveLab £399 (£339.57 ex VAT), Harman Audio 0181 207 5050.

Wave SE (bundled with sound cards), **Dart Pro** £299 (£254.47 ex VAT), **FastEditDI** £189 (£160.85 ex VAT), ECI/Eterna Distribution 01706 219999.

its strong points lie in its non-destructive editing, using Edit Lists, and in its speed. It is the fastest program around when it comes to basic editing jobs. In tests we carried out, it took only 40 seconds to time-stretch a three minute file, as opposed to 70 seconds taken by WaveLab and five minutes by SoundForge,



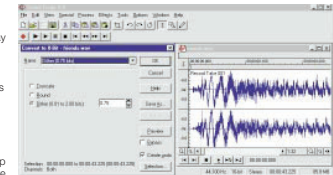
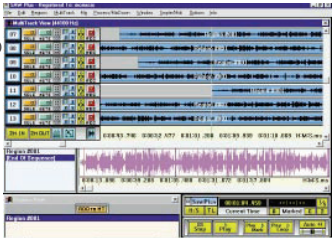
Top Creative Wave Studio (comes with SoundBlaster cards)

Above SAW Plus multitrack sound mixer/editor

Right SoundForge 4.0 has more features than WaveLab but is not as easy to use

rates for use in multimedia applications. You may require longer stereo clips for voice-overs or music recordings, or multiple sound files which need to be synchronised and mixed into a stereo track. Or you may want to do special things like cleaning up a recording to remove tape hiss, scratches, clips and pops. There is software available to do all this, and to suit most people's pockets.

At the lowest level, most sound cards come with simple audio-editing software which provides little more than what you get with the Windows Sound Recorder. Some are nevertheless quite good. WaveStudio, for



Sequencing software

A sequencer is essentially a tapeless multi-track recorder that enables you to record, edit and play back MIDI information. Over the past year or so, more sequencers have become audio-equipped, which means that additional tracks can be used for recording "live" instruments or simply for playing wave files. This feature is not just offered in high-end applications, though. Cubasis Audio (supplied with Creative's AWE 64 Gold and Terratec's Maestro 32/96) offers up to eight audio tracks in addition to basic audio editing.

Although sequencers have somehow evolved from uncomplicated hardware devices into elaborate and complex applications, their basic operation remains simple, and similar to that of a multi-track tape recorder. By first selecting an instrument and a track on which to record, all you then have to do is enable the record button and continue to play, sing, or whatever. Additional instruments can be recorded to new tracks in exactly the same way to gradually build a complete arrangement.

What you need
Assuming you already have a PC fitted with a sound card, all that remains is to add a MIDI device and possibly a microphone. MIDI keyboards start at around £70 and, with a £20 MIDI adaptor kit, simply connect to the joystick/MIDI interface of the sound card (many sound cards come with a suitable MIDI cable). This will enable you to record whatever notes you play on the keyboard, using the instruments stored on your sound card's wavetable chip.

Other worthwhile investments include sampling CDs, which provide professionally-recorded instruments and sound bites, from techno drum loops through to complete orchestral passages. If your sound card has RAM, you can download these samples and play them back. Time + Space has 30 titles in its Creative Essentials library, each offering over 200 samples in both audio and Wave format. At just £20 apiece, they can work miracles in the smallest of MIDI set-ups.

Whereas tape is restricted to a finite number of tracks, sequencers are limited only by the processing power of your PC. MIDI data consists of simple note instructions so you are never likely to run out of tracks. Audio tracks, however, require hefty resources. In addition to a fast processor and huge quantities of RAM, a fast hard disk must come high on your priority list.

Because audio files are too large to fit into RAM (up to 10Mb/min) they are recorded direct to disk. To play eight stereo tracks recorded at 16-bit 44.1KHz without glitches, the disk must sustain above 3Mb/sec.

The software

The most intuitive sequencing package around is Steinberg's Cubase (Figs 1 & 2). Currently in version 3.0, it offers extensive MIDI and audio editing facilities and is happy to work with any Windows-compatible sound card. In the "arrange" window, shown in Fig 1, audio tracks can be identified by a wave

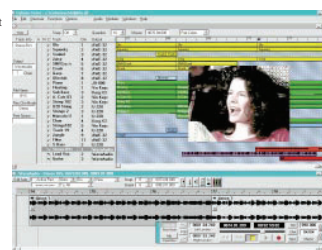


Fig 1 (left) Cubase 3.0 and **(Fig 2, below)** Cubasis Audio; a cut-down version of Cubase. It is supplied with Creative's AWE 64 Gold and provides all you are ever likely to need to get started with sequencing

symbol in the track info column. Other than the way audio tracks are recorded (which first requires you to give it a filename) audio parts can be treated in pretty much the same way as MIDI counterparts.

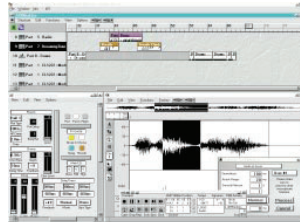
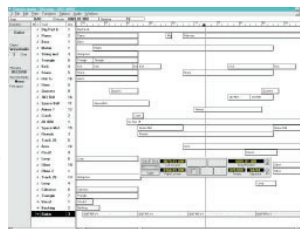
For example, parts can be moved around, copied, dragged to other sections in a song and even merged. The coloured blocks shown to the right of the screen in Fig 1 represent recorded MIDI parts, while audio tracks are shown as waveforms.

All editing in Cubase is non-destructive, which means any edits you perform will not change the original sound file. Instead, a new image is created based on the original take. Once you have your audio tracks laid down and positioned correctly, you can then use the audio mixer to get the best mix. This is a basic 8-channel mixer with sliders for output level and pan position.

MIDI data can be displayed graphically in any one of four editors, making it easy to correct wrongly played notes and generally tidy-up your performances.

Logic Audio

Logic Audio (Fig 3) is geared towards the demanding user and offers stacks of professional features, but there is a steep learning curve. In addition to unlimited MIDI tracks, Logic can record and play back up to eight tracks of digital audio at 44.1KHz and 48KHz sampling rates. The integration of MIDI and audio is flawless, both appear in the "arrange" window as objects, or parts. All the standard tools are available in Logic for editing audio, including fades, normalising,



reverse, etc. Logic is not for the faint-hearted, but is the most powerful package around.

PCW Details

Creative Essentials
Time + Space 01442 870681
Cubase £329 (£280 ex VAT)
Harman Audio 0181 207 5050
Logic Audio £399 (£339.57 ex VAT)
Sound Technology 01462 480000

Fun music software

Once upon a time there was Band in a Box: you selected a musical style and input the chords of your song in spreadsheet-like cells. The program then generated and played the accompaniment for you — drums, base line, chords and so on. It was cheap, easy to use and bags of fun. Fun? Well, you didn't need to do a great deal of work, you derived a lot of pleasure from it, and you could produce something colourful without spending extra money. All the software mentioned here has at least one of these "fun" qualities.

Band in a Box is still around now, at version 7, and offers a lot more than the original program, including the ability to create your own styles and customise in many different ways. Visual Arranger, from Yamaha, is the closest relative of Band in a Box. You still need to know the chords of your composition, but it is easier to use with its drag-and-drop icons. It does not give you the ability to create your own styles but the built-in styles offer a great many variations and are quite good. Not surprising, really, as Yamaha has been providing auto-accompaniment features in its home keyboards for years.

Moving from auto-accompaniment to composition, Microsoft's Music Producer is the easiest, but least flexible. Select a style (Amadeus, blue grass, rave), a mood (righteous, sad, happy), the type of band, the tempo and duration, then sit back and enjoy it. By dragging icons of the instruments left, right, up and down, you change their position in the stereo field, and their loudness.

KoanX Platinum is similar but has a different set of parameters. It offers a plug-in for web browsers to play its files so you can have continuous background music played from your site without having to stream MIDI or audio data; an ingenious solution.

KoanX's big brother is Koan Pro, a more complex program offering a sequencer-type interface with tracks. Each track is a separate instrument for which you set parameters for the computer to use in generating the music. This program is very sophisticated and has been endorsed by professional musicians, Brian Eno amongst them.

The Jammer Pro has a similar interface but with different settings which produce a different style of music. Although both programs can in theory produce anything, the demos reflect their origins: Koan has a



Left & below
Virtual bands: create your own number one hit with Yamaha's Visual Arranger

European ambient feel, while Jammer has a more jazzy feel. Both allow you to record your own material on a track instead of having the computer generate everything. Koan Pro lets you import MIDI files and analyses their style so you can use it to generate other music.

There are a few programs around which enable you to create music by stringing along sound recordings (a bit like creating mosaics instead of paintings). Three of these are Techno Maker, Making Waves and Music Maker. What type of music do they produce? Well, if you fancy yourself as a contemporary dance music producer, you might even get on Top of the Pops with one of these. They all come on CD-ROM and provide lots of WAV files. Making Waves and Music Maker can pitch them as well as mix them, and Music Maker, the most advanced of the three, also has real-time effects.

Music Painter is a program which, among other things, can convert bitmap graphics or drawings created on-screen, into music. So if you want to know what your face sounds like, scan it, and import it into Music Painter!

If you can sing, but cannot play an instrument, sing into your sound card and Sound2MIDI (reputedly commissioned by Phil Collins) can convert your voice into MIDI files which you can record into a sequencer and then play, using any instrument. If you fancy that old analogue synthesiser sound (Mini Moogs, Oberheims and stuff like that) you can now create them with software like Audio Architect using a theoretically unlimited number of oscillators. The results can be saved as WAV files and imported into

Left The Band in a Box arranger

PCW Details

Band in a Box £39.95 (£76.55 ex VAT).
Artsoft 0181 202 1199

Microsoft Music Producer (price tba).
Microsoft 03450 002000

Visual Arranger £39 (£33.19 ex VAT).
Yamaha 01505 366 700

Koan X Gold £15.99 (£13.61 ex VAT);
KoanX Platinum £39.99 (£34.03 ex VAT);
Koan Pro £164.44 (£139.95 ex VAT).
SSEYO 01628 28828

Jammer Pro £149 (£126.81 ex VAT).
EJCeters 01706 228039

Techno Maker £24.95 (£21.23 ex VAT).
Data Becker Software 01420 22707

Making Waves £49.95 (£42.51 ex VAT).
Perceptive Solutions 01773 821120

Music Maker £29.90 (£25.45 ex VAT);
Music Painter £27.90 (£23.75 ex VAT).
Telstar Distribution 0181 805 8005

Sound2MIDI £99 (£84.26 ex VAT).
AudioWorks 0181 445 4331

Audio Architect (prices on application).
Karnataka Group 0171 721 7021

Mixman CDs £39.95 (incl VAT).
Time+Space 01442 870681

Editor's Choice

We tested the sound cards in three main areas: ease of installation, compatibility and sound quality. We played back a MIDI file and recorded it from the sound card's line output. We also recorded a CD track through the external line inputs. Sound quality was judged subjectively by a panel of listeners and revealed noise levels on input and output, along with the quality of the wavetable samples. For compatibility we ran Doom2 in pure DOS mode, Diablo under Windows 95, and played back numerous WAV and MIDI files from Windows 95. In almost every case, installation proved troublesome in some respect. The problem is that there are typically three drivers to be loaded for every sound device: the audio chipset itself, the MPU-401 MIDI interface, and the Gameport Joystick Interface. Consequently, most installations will prompt you three times for suitable driver disks, which may be on supplied disks, or the Windows 95 CD, or a combination of both. Sometimes you won't be prompted at all and will have to resort to a supplied Setup program or Windows 95's Add New Hardware wizard.

Plug-and-play does not necessarily help, and in some instances may set interrupts and ports to unsuitable, albeit available, values. Remember, for SoundBlaster compatibility without messing around with settings in games, you will want your main audio chipset running on IRQ 5, Port 220 and DMA 1. Most General MIDI software expects your GM hardware to be set on Port 330, so if you have no conflicts, along with no sound, these settings are a good place to start looking. Many cards also feature IDE interfaces for a CD-ROM drive, which should be disabled if not in use, to avoid additional conflicts.

Another problem is support under DOS alone, without the Windows drivers operating in the background. Here you will need a line to initialise the sound hardware either in your autoexec.bat or dosstart.bat files, depending on whether you are starting up with the command prompt only, or are shutting down and restarting in MS-DOS mode. On many occasions we had to install these lines manually after the software installers had claimed the job was finished.

On-board sound chips can cause a few problems, too, for those upgrading. You should be able to disable on-board sound from the BIOS settings as you start your PC, allowing you to install a standalone sound card. But we still discovered some conflicts even after the PC had assured us the on-board chips were disabled. BIOS upgrades may solve your problems but those serious about any sound may want to use a motherboard without any on-board audio chips.

Which sound solution is best for me?
Almost every computer user wants sound capability to some extent, but solutions vary widely. Maybe you just want the occasional

sound as you perform various Windows tasks, or to enhance a presentation? Perhaps you want the best all-round games setup? You might even want to create your own musical masterpieces.

Remember that however good General MIDI and wavetable synthesis sound, today's games and multimedia titles feature music too. Users requiring top performance, particularly from games, will want to remove as much work from the main processor as possible, rendering software audio out of the question — for now.

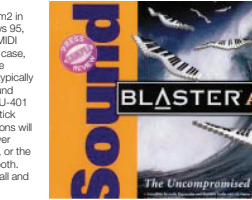
If you are merely after basic sound capabilities for general business and home use, buying a PC with on-board audio hardware is a cheap and neat solution. Quality is improving all the time and the integration saves money and slots; Yamaha's very respectable 24-voice OPL4 hardware wavetable chip is also finding its way onto many motherboards. Those users requiring a wavetable upgrade or GM compatibility should look no further than

Yamaha's superb SW60XG card (essentially its award-winning DB50XG wavetable daughterboard on an ISA card). This recommendation also goes to anyone using a sound card without a daughterboard connector, although the daughterboard itself is a great choice for those with a suitable connector.

Our recommendation for a good all-rounder fell between TerraTec's Maestro 32/96 and Ubi's MaxSound 64 Home Studio, both employing the excellent 4Mb Dream wavetable ROM. There is little to choose between the two, apart from a saving of £50 in favour of the Maestro. But the Maestro features neither built-in memory nor the facility to expand, making it a no-go for serious musicians. Neither does MaxSound 64 feature a built-in memory, but it does boast a single 72-pin SIMM slot, so there is possibility for expansion there. But a £50 premium for this facility is a bit steep, so TerraTec's Maestro 32/96 with its excellent utilities receives our Highly Commended award. At entry-level, we were impressed by Pine's MegaWave Gold, which offered respectable wavetable and 16-bit SoundBlaster capabilities for around £50.

Our Editor's Choice is Creative Labs' AWE 64 Gold. Having struggled to install so many of the cards in this test, it was a relief to slot in a Creative Labs SoundBlaster PNP, watch Windows 95 sort itself out, and hear sound without even having to restart the PC. The plain 64 is £50 less, but comes across as a bit dull by comparison. Both 64s have the same average 1Mb wavetable ROM, but the 64 Gold boasts 4Mb sample RAM as standard and a downloadable General MIDI patch to improve things. The Gold also features a clean SPDIF digital output from the RAM bank. Sadly, Creative has replaced the standard SIM slots of the AWE 32 with proprietary memory connections but the AWE 64 Gold remains a clear winner from all points of view, from the games player to the music enthusiast.

Gordon Laing



MAESTRO 32

MAXI Sound 64 Home studio



Table of Features

Manufacturer	Aztech	Creative Labs	Creative Labs	Creative Labs	Gravis	Pine
Product	Waverider Pro 32-3D	SB AWE 64	SB AWE 64 Gold	SoundBlaster 16	UltraSound PnP Pro	Megawave Gold
Supplier	Aztech	Creative Labs	Creative Labs	Creative Labs	Koch Media	Dabs Direct
Tel	01734 820840	01734 344322	01734 344322	01734 344322	01420 541880	0800 558866
Price inc VAT	£49.95 (£42.51 ex)	£149 (£126.81 ex)	£199 (£169.36 ex)	£85 (£72.34 ex)	£179 (£152.34 ex)	£52.88 (£45 ex)
Plug-and-play	○	●	●	●	●	●
Wavetable synthesis	●	●	●	○	●	●
Wavetable ROM	1Mb	1Mb	1Mb	n/a	1Mb	1Mb
Standard RAM	n/a	512Kb	4Mb	n/a	512Kb	n/a
Max sample RAM	n/a	8Mb	28Mb	n/a	8Mb	n/a
RAM slots	n/a	proprietary	proprietary	n/a	2 x 30-pin	n/a
Hw voices	32	32	32	n/a	32	24
Sw voices	n/a	32	32	n/a	n/a	32
Max Sampling rate	48kHz	44.1kHz	44.1kHz	44.1kHz	48kHz	48kHz
Digital Effects / 3D	●	●	●	●	●	●
Full duplex	●	●	●	●	●	●
SoundBlaster	●	●	●	●	●	●
GM	●	●	●	○	●	●
GM patch supplied	n/a	4Mb	4Mb	n/a	5.6Mb	n/a
Roland GS	○	○	○	○	○	○
Yamaha XG	○	○	○	○	○	○
Win sound system	●	●	●	●	●	●
IDE interface	●	●	○	●	●	○
Dboard interface	○	○	○	●	○	○
SPDIF Digital out	○	○	●	○	○	○
Extras / cables	Headphones	MIDI / Audio / Mic	MIDI / Audio / Mic	Audio	Microphone	○



Table of Features

Manufacturer	Pine	TerraTec	Turtle Beach	Turtle Beach	Ubi	Yamaha
Product	Schubert 3D Plus	Maestro 32/96	MultiSound Pinnacle	Tropez Plus	Maxi Sound 64 Home Studio	SW60XG
Supplier	Dabs Direct	Multimedia Direct	Etc Distribution	Etc Distribution	Ubi Soft	Yamaha
Tel	0800 558866	01635 294394	01706 219999	01706 219999	0181 944 9000	01908 366700
Price inc VAT	£34.08 (£29 ex)	£139 (£118.30 ex)	£479 (£407.66 ex)	£269 (£228.94 ex)	£189 (£160.85 ex)	£152 (£129.36 ex)
Plug-and-play	●	●	●	●	●	●
Wavetable synthesis	○	●	●	●	●	●
Wavetable ROM	n/a	4Mb	2Mb	4Mb	4Mb	4Mb
Standard RAM	n/a	n/a	0	0	0	○
Max sample RAM	n/a	n/a	48Mb	12Mb	16Mb	n/a
Ram slots	n/a	n/a	2 x 72-pin	3 x 30-pin	1 x 72-pin	n/a
Hw voices	20	32	32	32	64	32
Sw voices	n/a	n/a	n/a	n/a	n/a	n/a
Max sampling rate	44.1kHz	48kHz	48kHz	48kHz	44.1kHz	n/a
Digital effects / 3D	●	●	●	●	●	●
Full duplex	○	●	●	●	●	n/a
SoundBlaster	●	●	○	●	●	n/a
GM	●	●	●	●	●	●
GM patch supplied	n/a	n/a	4Mb	○	○	n/a
Roland GS	○	●	○	○	●	○
Yamaha XG	○	○	○	○	○	●
Win sound system	●	●	●	●	●	n/a
IDE interface	●	●	●	●	●	n/a
Dboard interface	●	●	●	○	●	n/a
SPDIF Digital out	○	○	optional	○	○	○
Extras / cables	○	MIDI / Audio	○	○	MIDI	○

KEY: ● yes ○ no