LP to CD conversion: Music to your ears

By Matthew Moore

Own up, who hasn't got any vinyl in their music collection? Most of you will probably have a pile of old LPs and singles that haven't graced your eardrums for a long time and are gathering dust in the attic.

When CDs came along in 1982 it was something of a mixed blessing. They're more convenient than vinyl and less prone to those annoying pops and clicks that either made you grimace as they ruined your latest Genesis LP or shrug your shoulders at the idiosyncrasy of the medium.

But there's something unsatisfying about the smaller format, something missing about pulling out that 12in vinyl disc from its cover and flicking through the liner notes as you enjoy the music.

But you can have the best of both worlds. We're going to take you through every step of recording and digitising your vinyl and committing the music to CD. You'll find it easier to manage and store, and in many cases you can make your recording sound better than the original.

Don't worry about spending a lot of money on new hi-fi equipment, PC hardware and software. You probably already have everything you need.

However, if you want to get better sound quality, we've included some advice on a few equipment upgrades and technical tricks that will improve matters.

So get out your record brush (you're going to need it) and prepare to give your vinyl collection a new lease of life.

Equipment you need

The turntable is probably the most important part of your stereo set-up, and therefore the most important part to get right. An old turntable will work fine provided it's a good-quality model, but make sure it's clean, and that includes dusting the motors.

You may have an all-in-one midi system or collection of hi-fi separates that reproduces music to your satisfaction. Fitted to your good-quality turntable should be a correctly adjusted tonearm.

If you change your pick-up cartridge, you need to make sure that its compliance matches the tonearm. A low-compliance cartridge on a high-compliance arm won't track properly, while a high-compliance cartridge on a low-compliance arm will result in mis-tracking over any uneven areas of the record, as well as generating a large sub-audio signal.

The best way is to ask your hi-fi supplier for advice on whether your tonearm matches your cartridge.

We achieved good results with a Stanton 500AL Cartridge (£24.95 from www.richersounds.com) on a Technics 1210MkIII turntable (£349.95 from the same company).

If you have not used your turntable for some time, it's a good idea to make sure your cartridge is correctly seated and that tracking is at a suitable weight for your cartridge.

If your turntable doesn't have a tracking control, buy a new one. You can get very good models from Technics and Pioneer, or you can go upmarket with a Linn product. Try to make your tracking weight between 1g and 1.5g to minimise distortion.

We're sure none of you are mad enough to try this, but on no account use a coin to weigh down your cartridge; you risk gouging out swathes of vinyl from your discs.

Amplifier answers

Provided your amplifier contains both a pre-amp and a power amp, or if there's a pre-amp on your turntable, you won't have to fork out for a separate pre-amp. However, a pre-amp does offer more control over the analogue audio signal.

For example, the Terratec Phono Preamp (£139) or the Terratec Phono Preamp Studio (£199) are both shielded PC components that offer three-step selection of input capacities and output levels.

You should check that your amp applies Recording Industry Association of America (RIAA) equalisation to the phono signal for correct bass response.

All records produced after about 1960 use this equalisation standard, which comes with amplifiers that have a phono input. This means you can't connect your turntable directly to a PC sound card as the RIAA equalisation standard must be applied first.

RIAA equalisation contributes to the 'richness' of vinyl sound so beloved by audiophiles. It's not physically possible to cut grooves into vinyl deep enough or wide enough to use an unbiased equalisation curve, so the RIAA circuitry exaggerates the bass to reproduce it with greater tonal accuracy.

Try playing a record without turning on your hi-fi, and you'll see what we mean when you hear the quiet but unmistakably tinny version of the music.

PC specification
Audio recording isn't a demanding task, so any PC bought within the past four years should manage easily.

Make sure you have at least a 150MHz processor, 64MB of memory, and enough hard disk space to hold uncompressed wav audio files occupying about 10Mbytes/min, although this will vary depending on the complexity of your music.

A more powerful PC will come into its own when you edit and manipulate sounds, though. Even with a 450MHz Celeron system with 192MB of Ram, it took over 90 seconds to save a 419MB wav file.

You don't need a professional sound card; the PC just needs to be capable of recording 44.1KHz, 16bit stereo, as the CD specification requires sound recorded at this frequency.

Picking a model with a breakout box stops you having to rummage around at the back of your PC if you need to connect and disconnect your cable frequently.

Cleaning stylus and vinyl
To get the best results in your final recording, you need to make sure your stylus and vinyl are as clean as possible. If you're planning on a marathon project, buy a new stylus.

The goal of cleaning vinyl and stylus is to end up with media that will leave as few clicks, pops and hisses as possible on the final recording.

On very dirty records use a fine camel hair brush soaked in isopropyl alcohol to clean the stylus, blowing it dry softly before use.

For slightly less dirty LPs and singles, a carbon fibre record brush extracts dust from deep inside the grooves. Earthing yourself by touching the turntable with the hand that's holding the brush can reduce the amount of static on your discs.

In order to avoid damaging the stylus when cleaning it, you should only move the brush in the same direction as a record moves against it.

When the side has finished playing, check the stylus for dust and hair, and play again if there's significant contamination. Above all, check your stylus regularly for wear and tear, as a damaged stylus will abrade your records' grooves.

To clean records that haven't seen a stylus for some years, play at least once before recording to remove remaining dirt. If dirt continues to emerge on the stylus after repeated plays, you should take your records to your local hi-fi shop or record specialist for deep cleaning.

Connecting your equipment
Now you've got clean vinyl, an undamaged stylus, and all the equipment required, you need to connect your hi-fi to your PC. There are a number of ways to do this, but here are the most practical ones that won't damage your PC and will deliver the best sound.

The best method is via the twin RCA phono Tape-out connectors on your amplifier. Female phono jacks measure 8mm, and accept a male connector which has a central post and an outer sheath. You'll recognise them as the most common kind of analogue hi-fi connector.

The Tape-out connector is useful because it delivers a line-level signal. This is a 1v peak-to-peak voltage which the Line-in input on your sound card is designed to accept.

If you don't have Tape-out connectors, you can use the Headphone-out connector, but the signal will suffer from greater electrical noise and can exceed the line-level values, so make sure you monitor the volume carefully during recording.

The cable fable
Spend about £5 on a suitable cable with 3.5mm minijacks (the smaller type of headphone plug) at either end for headphone connection - and you'll need an adaptor for the larger headphone output on your amplifier, or a twin RCA phono plug stereo cable to minijack for Tape-out.

A stereo cable is essential, indicated by two small rings on the minijack connector. By contrast, a microphone connector is mono and has only one ring.

It may seem like a minor point, but a little care with cabling can increase the quality of your sound recording. Although you don't need specialist hi-fi cabling to get a good signal between stereo and hi-fi, you should try to keep length to under a meter to reduce signal noise.

The cable shouldn't be placed close to unshielded electrical equipment such as telephones, PCs and speakers.

For monitoring your recording, use another phono-to-minijack cable, this time to connect the Line-out connector to the video/aux RCA connectors on your amp.

Sounding out your sound card
Connect the minijack part to the Line-in input on your sound card. It's marked by a small set of concentric circles with an arrow pointing into the centre. On more modern PCs, it's also marked red.

Inputting too high a signal into your PC's sound card will result in clipping distortion, which can ruin the finished recording. Don't worry if you don't have a pre-amp with selectable output levels - you can use the gain control in the Windows mixer applet to set the input level.

If you're using a pre-amp by itself, make sure it inputs a signal of 1v to the Line-in input on your sound card.

Don't connect it to the microphone input, as it has a different specification for input and you won't get the correct signal size to record on your PC. On many PCs, the microphone input is mono, and won't give you sound quality matching your Line-in.

Making the first recording
Now you're all connected, it's time to start recording. Defragment your hard drive, and then bring up the Windows Sound Recorder, which is designed to record audio snippets via a microphone.

Although it's not suitable for any demanding recording jobs, use it to ensure that you're getting a signal.

If you're not getting a signal at all, make sure that Line-in is enabled in Windows. Go to Sounds and Multimedia in the Control Panel and select the Audio tab. Under the Sound Recording Tab, there's a Volume button.

Pressing this brings up the Recording Control, which is a simple mixer. Ensure that Line-in recording is enabled by ticking the Select box. Set the input level so that the bottom of the slider touches the second marker from the top.

If your first attempt at recording results in a seriously distorted sample, reduce the Line-in recording level on your PC. Dropping the bass and volume on your amplifier won't have any effect.

If you're going to output to CD, you should also make sure that you're recording at 44.1KHz, 16bit stereo in PCM (Pulse Code Modulation - wav is the Windows implementation of PCM) format, parameters you'll find under Sound Recorder/Properties/Format Conversion. If not, you can choose a sound quality to suit your requirements and available hard disk space.

Choosing an audio editor
For any kind of committed recording, you'll need a specialist recording package. Many are available - we tried Goldwave at $40 (£28) which won't break the bank and will cope with undemanding work.

However, the full version of Cool Edit 2000 is well worth the $69 download fee and wins our recommendation hands down. Unlike the Lite version ($39 download), it supports the invaluable Audio Cleanup Plug-In ($49).

Although you don't need anything like the full mixing and effects capabilities from these packages, it's worth learning your way around the noise reduction and basic editing features.

If you're using Easy CD Creator 5 Platinum, it comes with Sound Editor built in for capture and CD Spin Doctor for removing audio blemishes. Easy CD Creator costs £36.42 inc VAT from www.dabs.com.

Whichever package you choose, make sure it has a good VU (volume unit) meter so you can set the level to avoid distortion.

If your VU meter displays in decibels, set it to about -6dB for the volume peaks on the loudest music on your album, as this allows you some leeway when it comes to manipulating the file digitally.

Calibrating software
Packages such as Cool Edit will simplify set-up by giving you the correct sample rates and bit level for common tasks such as CD recording, radio and voice at the touch of a button.

Quality aficionados can go for 32bit recording initially, although it'll take more time when you have to throttle back down to 16bit value for output to CD.

Another useful feature is noise threshold, which starts recording only when you get above a user-defined input level, and saves you having to put on a record and dash back to your PC to hit Record in time.

Making the recording
With all levels set correctly, it's time to start recording. Close down all non-essential applications on your PC, start up your recording software, put the needle in the groove and begin recording (you can always edit out any silence or other audio that appears at the start of the recording at a later stage).

It's easiest to record the whole album as one long wav. You can monitor recording via your amp, and perhaps note parts of the disc that will need special attention at the clean-up stage.

Removing hiss, pops and cracks
When listening to the wav you've recorded, there will still be pops, clicks and hisses from your vinyl, as well as some inevitable buzz or hum caused by electromagnetic interference somewhere in your set-up.

The good news is that there are ways to reduce this in software, either manually in Goldwave or automatically in Cool Edit 2000.

Run your wav through the pop and click eliminator to get rid of sounds caused by damaged vinyl. You'll need to experiment with the correct settings for this, and it'll depend on the frequency and seriousness of the faults.

It's worth treating any particularly problematic areas separately by highlighting them in software and running the click detector over just that section.

For really troublesome records, you can remove single big clicks, and then run click removal in multiple passes over the track. We've found that any more than three passes is not worth while.

Removing pops and clicks can leave audible gaps in your recording, but Cool Edit 2000 includes an expand function to fill out lost information.

Again, you'll need to experiment to get the most out of this, as the correct settings will depend on individual recordings.

Reducing clipping
Clipping is one of the worst things that can blight your recording, sounding a little like static interference. It occurs when input levels exceed 0dB.

The clipping indicators in Cool Edit 2000 are to the right of the sound meters and light up when a clipped signal is present. Clicking on them will reset the levels and prevent further clipping unless that level is also exceeded.

Cool Edit's Clip Restoration feature goes some way towards fixing clipped audio, but it's often better just to launch the Windows Recording mixer (easily done from Cool Edit's Options menu) and rerecord from scratch. In some instances you can't get rid of clipping.

Improving your wav further
Cool Edit 2000 and some other packages allow you to expand the dynamic range of your music, so you capture the loudest and quietest parts without exceeding the upper decibel boundaries.

The default setting of about 3:1 is too high for most music, so you should try something between 1.2:1 and 1.4:1 in Cool Edit.

Finally, normalise your track, which sets the volume to the maximum possible without distortion. For best results, set the normalisation separately for the left and right stereo channels, and save your clean audio file.

Splitting a large wav file into tracks
Under special circumstances, for example a classical work or a dance music mix CD, you'll want to record the entire disc at once.

But for pop music, you'll want to split the long wav into tracks when recording to CD. In Cool Edit you need to go to the Edit/Cue List option, and bring up the Cue List window.

It floats above the Wave Editor window, and shows you the cues set throughout the wav of the whole side of the album. Then use the batch mode, with the start cues of all the tracks you want to include highlighted, and Cool Edit will create the tracks for you.

Tracks are output as track1, track2, track3 and so on by default, so you'll want to rename them. Putting a leading zero before tracks one to nine will ensure that they are sorted properly.

If you never intend to play the final CD in your computer, there's little point naming the tracks as long as you're organised and have a written or printed jewel case ready with you to take your media.

Quality review
Irksome it may be, but you'll need to listen to all the tracks again to make sure they're recorded to your satisfaction. If they don't pass muster, check your cables and connections, fine-tune your levels and noise reduction settings, and you should end up with a better result.

Ultimately, you only have to satisfy yourself with the quality of your recordings and the more time and effort you invest, the better the quality of your recordings should be.

Creating CDs
You'll need to spend a lot less time playing with software settings, so committing your recordings to CD should be easy.

You can use any up-to-date recording software such as Nero 5.5, Roxio Easy CD Creator 5, or try Cosmi Software's CD Maker Deluxe. Just add the tracks in the order you want and select Burn. It is possible to fit two albums onto one CD, although given the low price of CD-R discs, it's a negligible benefit.

It's possible to revisit a CD-R with music already recorded if you've managed the initial recording process cleverly. Any full-featured recording package will enable you to record in either disc-at-once or track-at-once modes.

Disc-at-once writes a whole CD without turning off the laser between tracks. After recording, the disc is closed, and cannot be used for multi-session recording, though it's readable in an audio CD player.

Like disc-at-once recording, track-at-once is supported by most modern CD burners and software, but turns off the laser between each track. If you have already recorded an album, choose the 'Finalise this session' option when recording your disc.

You can then return to it later if you decide to put more music on it. Most modern recorders will read the first finalised session of a multi-session disc, but no subsequent ones until the whole disc is finalised.

The right CD burner
If you've got money to burn, go for the hottest CD burner you can afford. But for those with more limited finances, our advice is to stick with what you've got. Burning a music CD is no more of a challenge for your system than burning any other CD, so if what you've got ain't broke, don't fix it.

If you are looking for an excuse to get a new burner, then SCSI remains the choice for power users. It doesn't burden the CPU as much as an IDE drive, and will probably have higher throughput, depending on the version of SCSI used.

If you use an IDE drive, you should connect it to a different controller on your motherboard to the one used by your hard drive. If you've a USB2 or Firewire burner, it can be used very effectively for fast burns without burdening your system.

Whichever internal drive you choose, get a Burnproof model to ensure that you minimise the chance of buffer underruns.

Selecting CD media
Although it can be tempting to buy the least expensive CD-R discs, it pays to invest a little more in the long term.

If you want your collection to last a while, buy branded discs from a reputable manufacturer with some pledge on the disc's lifetime.

The dyes used on various media have different properties. Pale green or aqua discs use a dye that offers better resistance to deterioration under sunlight or external artificial light sources.

However, blue or emerald green discs have a greater tolerance in the range of laser power that can be used to burn them.

However, this matters very little. What's important is good CD-R that works well in your recorder and players. The darker material used in CD-Rs means players find them more difficult to read than commercially produced silver CDs.

Labelling CD-Rs
Although you won't be able to recapture the 12in format of your album liner notes inside your jewel case, there are ways to make sure that the more fastidious members of your household don't turn their noses up at a CD collection that simply has album titles scrawled up the spines of the cases.

The first step is to get your hands on a CD labelling package. There's a perfectly serviceable one in Roxio's Easy CD Creator 5 Platinum. Make sure you get software that will produce both jewel case inserts and sticky labels.

You just need to select the image and resize it to fit, then print it onto the stock you've chosen. A range of shareware packages is also available.

Storage of CDs
Amenable conditions for storing CDs are largely a matter of common sense. Leaving them out in direct sunlight will wreck many brands of CD, although Kodak claims that its CD-R Digital Audio Gold will withstand direct sunlight in a hot car, but obviously we don't advise this.

It's best to keep them in a cool, dry place without exposure to direct light.

Digitising 78rpm records
Although it's a lot less likely that you'll have any 78rpm records, digitising them can preserve some far rarer music.

It's not an easy process, and we don't have space to explore this complex issue in detail here, but there are some guidelines you should follow.

Obviously, most modern tables don't operate at the correct speed to play these discs. Electronics buffs can modify their turntables, but this is only for experts. You can buy specialist 78rpm turntables over the web. Try www.78rpm.com.

Using a diamond stylus on a 78 disc will damage both the vinyl and the stylus. You should use a sapphire stylus as found on the Shure M75EJ Type 2. The cartridge is specifically designed for use with the faster discs.

78rpm records don't use the RIAA equalisation curve of post-1960 discs, so it's not possible to plug the discs directly into the phono connector on your amplifier to get the correct equalisation.

The best way to equalise is in software - again you can use any audio package with a graphic equaliser to get more convincing frequency response. And seek expert advice before risking irreplaceable recordings.

Recording from tape to CD
Recording from tape to your PC is slightly easier than transferring vinyl. A tape deck gives a Line-out signal, so you can connect it directly to a sound card's Line-in. You can use the same phono-to-miniplug connector to connect.

Select the input as Line-in and find an appropriate input volume, then just press Play on your tape deck and record on your chosen software. Just as with vinyl, you'll need to set the sample frequency and bit level to the CD specification.

Like vinyl, tape comes with its own noise gremlin: tape hiss, an unavoidable result of the way cassette tape recording works. But there's a way round it. Using Cool Edit's hiss eliminator, you can rid music of this annoyance.

Hiss is easy to screen out because it's constant. You can set a threshold below which all noise is excluded, or copy a part of the digitised recording and instruct Cool Edit to eliminate sound with this profile.

Run this process over your tape recording, and your digitised cassette recordings will sound as good as your vinyl.

KEY POINTS TO REMEMBER
If you've set up your equipment as we've explained, you should be having no trouble recording onto your hard disk. However, if you're not managing to get a signal, there could be a problem with your PC. Here are five things to check:

- Make sure you're not using a compressed hard disk.
- Check your graphics card isn't using Windows acceleration
- Background tasks like Findfast, screensavers, and any spyware or peer-to-peer should be switched off.
- Ensure File System Read-Ahead is disabled
- Change your Windows cache settings by editing the system.ini file.

Are you sitting comfortably?
Now comes the fun part. Sit back and enjoy music you haven't heard for years which sounds as good as when you first bought it. We can't take responsibility for the Showaddywaddy albums, though ...