technique reducing noise

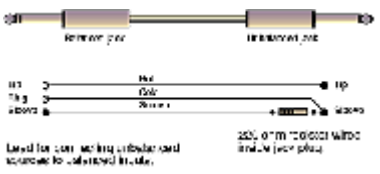
20 tips on... reducing noise

Hums, clicks, rustles, chirps, shuffles and creaks. Just a few of the sounds that your recordings could well do without. **Paul White** has a quiet word about the art of noise reduction.

Whatever the recording system, analogue or digital, tape or tapeless, there will always be some noise -- it's a basic physical law. The good news is that the minimum achievable noise level is very low indeed. The trick is to get as close to that theoretical limit as possible, and that means looking after your fragile signals on every step of their perilous journey from microphone to the final master.

If you're a regular *SOS* reader, at least some of the following tips should already be a part of your normal working methodology. However, even if you only learn one new trick, it will have made reading this article a worthwhile investment of your time.

1. Where possible, choose a minimum signal path. All electrical circuitry, no matter how well designed, adds a little more noise to your signal, so the less circuitry there is between source and destination, the better. Using a separate mic preamp or voice channel patched directly into a recorder input can make a huge improvement over inputting via a large mixing console. If you have to use a console, consider taking a feed from the mic channel's direct output or insert send and routing that directly to the recorder. External mic preamps are particularly useful with low-cost computer soundcards, as the mic inputs on cards (where provided) tend to be rather basic. However, you m ust be aware that no matter how careful you are, a cheap computer soundcard is likely to introduce a noticeable amount of noise by virtue of its proximity to other noisy circuitry inside the computer.



2. Setting the correct mic-amp gain is arguably the most important step in optimising your gain structure, because noise introduced here can't be removed later. If you're using a mixer, push the channel PFL button, then adjust the mic-gain trim to get a sensible reading on the meter (usually the main stereo meter). External mic preamps or voice channels should have their own metering system. As a rule, loud sounds should push the meter close to the maximum reading, but not so high as to cause the clip LED to light.

3. Use the right microphone for the job. A general-purpose dynamic mic is fine for close vocals, drums or instrument amplifiers, but is unlikely to be sufficiently sensitive to handle quiet acoustic instruments or more distant sounds. A good preamp will help, but ultimately, quiet or distant sounds need to be recorded using a sensitive capacitor or back-electret mic. As a rule, mics that operate only from phantom power tend to be more sensitive than mics that can run from batteries. For

very difficult jobs, you'll need to combine a sensitive mic with a very low-noise mic preamp.

4. Noise generally includes hum as well as hiss. So if your system is plagued by hums and buzzes, there's a strong possibility they might be caused by ground loops. Use balanced connections where possible, and if you're getting hum problems when connecting an unbalanced source to a balanced destination, try making up a special cable, as shown in Figure 1. Don't remove mains earths to try to solve ground loop hums: this can be very dangerous.

5. Mains cables and transformers can be another source of hum, so try to keep mains cables away from signal cables. Where they must cross, try to ensure they cross at right angles, as this minimises interference. Don't have mains cables lying alongside signal cables, especially mic-level signals or unbalanced lines. Also keep wall-wart power supplies away from audio cables, because some of these generate strong electromagnetic fields. In some cases, a poorly designed external power supply can even put interference back onto the mains, though that should be less likely with modern 'CE marked' supplies.

6. Gain structure applies to MIDI too, so before you come to mix a piece of sequenced music, make sure that the MIDI note levels are reasonably high and that the loudest MIDI track is set at, or close to, the maximum overall level. If all the MIDI notes are quiet and the parts turned down, the ratio of music to electronic background noise will be worse than if the music is as loud as possible. However, you must also listen for distortion, as some multitimbral modules run out of headroom if everything is running flat out. If this happens, try setting a maximum part level of around 100 instead of 128.

7. Another area often overlooked when setting gain structure is the external effects box. Ideally, the highest channel aux send control should be around three-quarters up, as should the master send level. This should leave you with the input gain on the effect unit set between halfway and three-quarters up to get the right meter reading. If the input gain control needs to be set much lower than this, check whether there's a +4/-10dBu switch on the back and try the +4 setting.

8. Recording levels are important in minimising noise, particularly if you're using analogue machines. As a rule, tape recorders using any form of Dolby noise reduction, or no noise reduction at all, can be driven 3 or 4dB 'into the red' on signal peaks. However, machines fitted with dbx noise reduction work better if the signals are allowed just to reach the red on peaks. Digital machines are more forgiving of low recording levels, as they have a much higher signal-to-noise ratio than analogue recorders. But it still pays to get as close to the peak level as you can without clipping, in order to improve the clarity of low-level passages and reverb tails. This is especially true when using low cost soundcards, because they tend to suffer more from noise than hardware recorders.

If you have a soundcard with a digital input and you also have a DAT recorder with digital I/O, you'll almost certainly get better results by using the DAT machine as your input stage and then connecting this digitally to the card. Most DAT machines will function happily as a preamp if you first insert a tape and then switch to input monitor, usually by pressing the record button on its own. Don't forget to set the card to external digital sync mode, though. Some older machines actually need to be recording to monitor the input, and if this is the case with yours, just stick in a blank tape

"Not all noise is electrical! When you're working with real musicians musicians playing acoustic

and put the machine into record, setting the record levels using the DAT machine's meters.

instruments, most noise problems tend to be acoustic."

9. I've already mentioned minimum signal paths, but there's another rule that might be described as 'no unnecessary signal paths'. In the context of a mixer, this means you should both mute and unroute (all routing buttons up) unwanted mixer channels. If they're just muted, they still make a contribution to mix buss noise. Similarly, any unused aux sends should be turned down, and if there's an option to route these to a different aux buss that isn't being used, that will also help. If you're adding an effect to one mixer channel only and you don't anticipate changing the fader level during the mix, you can use the channel's insert send to feed the effect instead of the aux buss -- it should be noticeably quieter.

10. Analogue tape machines, whether open reel or cassette, should be cleaned before every important recording session using cotton buds and isopropyl alcohol. Clean both the heads and the tape guides, but don't use alcohol on rubber parts, as it accelerates ageing. These may be cleaned with either a special fluid or water with a small amount of washing-up liquid added. Failure to clean heads will not only result in noisier recordings, it also means duller ones. Occasional demagnetising of analogue heads is also recommended, though you should always follow the instructions that come with the demagnetiser.

11. There are still people who don't understand what tape noise reduction does and as a consequence either they don't use it at all or they use it incorrectly. All the major tape noise reduction systems work on the encode/decode principle, which simply means that something happens to the signal during recording and then the opposite happens during playback to restore the original sound. The 'something' generally involves compression/expansion and equalisation, so if you record without noise reduction but play back with it, the recording will sound dull and odd. There's just one rule -- if you record with noise reduction on, you must play back with it on to get the correct sound.

12. Not all noise is electrical! When you're working with real musicians playing acoustic instruments, most noise problems tend to be acoustic. Here you need to pay attention to sound leaking in from outside (such as traffic noise), machinery or appliances elsewhere in the building, and, of course, noise from the players themselves. The main culprits are creaking chairs, people kicking mic-stand legs, rustling music sheets and general shuffling. Most of these can be solved by asking the players to remain perfectly silent for a few moments before and after takes. Fitting the mics with shockmounts can make a noticeable difference, especially if the room has a wooden floor.

13. Electric guitars can be difficult to record cleanly because of the amount of gain required to get a rock guitar sound. A high-gain amplifier is very susceptible to interference picked up by the guitar's electrics, which is why moving away from equipment containing transformers usually reduces the level of background hum and buzz. Rotating the playing position until a null point is located is the usual solution, though guitars with single-coil pickups may still produce more noise than you'd like. Computer monitors compound the problem further and single-coil guitars are affected very badly up to several feet from the monitor. Regular players may want to fit humbucking pickups, some of which sound very close to the original single coils (see *SOS* November '98) but if that

isn't possible, using a long lead to place the guitarist in a separate room where there is no other electrical equipment switched on is a good option.

14. Most pop vocals need compression to keep the sound even. However, for every dB of compression you apply, the noise during quiet passages is boosted by the same amount, so you really need to start off with the quietest signal you can. Even headphone spill can sound annoyingly loud after compression, especially if the singer has one phone off or is wearing acoustically open phones. Fortunately, it's usually possible to quieten the pauses using a gate or expander, and many compressors come with these built in.

15. Gates and expanders are useful for mopping up general noise during pauses, though if the noise level is too high, the sound of the noise switching on and off can be more annoying than a constant hiss. A longer gate release time will help to avoid noise pumping and it'll also help avoid chopping off the ends of wanted sounds. In the absence of automated mixing, gates are particularly useful for keeping tracks quiet where nothing is playing -- for example, to mute the guitar solo track before and after the solo. Even if the amount of background noise is reasonably low, 16 or more tracks of minor noise soon adds up, so if you can use gates to silence tracks when they aren't playing, the end result will be a lot cleaner.

16. If you don't have enough gates to go around, you can still clean up your mix by manually muting tracks when they are not needed. It helps if you have someone to assist you on the mix, and making a mute list referenced to time code or to the recorder's position counter will ensure you hit the mute buttons at the right times. This is one area where digital mixers score highly, as mutes can be programmed to operate automatically.

You can be even more precise with a computer-based hard disk system, since these invariably have waveform edit options that allow you to identify areas of silence with great precision. Noisy sections that are supposed to contain silence may then be highlighted and deleted, leaving absolute silence. When doing this, it's important to take into account the reverb tails of any sounds that have already been treated with effects. In most instances, though, it's best to work with dry sounds and add the effects at the mixing stage. Fades can be used instead of hard cuts to soften the transition from silence to music and vice versa.

"For every dB of compression you apply, the noise during quiet passages is boosted by the same amount, so you really need to start off with the quietest signal you can."

17. Adding high-frequency EQ will emphasise any high-frequency noise already present in the signal, so use it sparingly. If you're trying to lift a particular frequency out of a mix, try a band-pass (bell) filter rather than a wide shelving EQ, as this will boost a narrower part of the audio spectrum and hence add less noise. Trying to achieve the best sound at source, so that not much high-end EQ is needed, is the best approach. But if you do need more top and there doesn't seem to be much going on in that part of the spectrum for you to boost, consider using a harmonic enhancer instead.

18. Enhancers usually work by combining EQ with compression, controlled distortion and phase shift, and most are just as effective at enhancing noise as they are at enhancing the wanted signal. However, a harmonic enhancer can sharpen up a sound that has no significant top end for EQ to work on, so the noise penalty might well be acceptable, providing you use the effect sparingly. Enhancers that include some form of dynamic

expander combined with equalisation cause the least noise problems, as they don't actually boost the signal during quiet passages. In any event, as with compression, it helps if the source material is as clean as possible.

19. Ultimately, most recordings still end up containing more noise than the theoretical minimum, in which case it may be useful to employ a single-ended noise reduction system of some kind. However, these have their limitations, and if the noise contamination is severe the results can be disappointing. Unlike tape noise reduction systems, single-ended systems are used on playback only. Analogue systems work by combining dynamic filters with low-level expanders so that as the signal level decays, high frequencies are progressively filtered out. At very low levels, the expander acts as a soft gate to clean up pauses.

Computer-based digital systems are much more elaborate and deal with the audio spectrum as a large number of individual frequency bands, each with its own expander. Significant improvements can be made with either type, though both will introduce unwanted side-effects if used too heavily. The analogue dynamic filter will cause an obvious dulling of the sound and/or a dampening of natural reverb decays if applied too harshly, so it's essential to keep trying the bypass button while listening carefully for these side-effects. Digital systems, on the other hand, are much better from the point of view of keeping the top end of the sound intact, but unless they're used carefully, low-level signals take on an electronic, 'ringing' character, sometimes known as chirping. If the signal is very noisy, the noise floor itself starts to sound chirpy, which can be more annoying than the original noise. A typical digital noise reduction system should be able to reduce the overall background noise level by between 3 and 6dB before side-effects become audible, while the more esoteric systems can often double this figure. As with any noise reduction strategy, the better the original signal, the better the result after processing.

20. Finally, don't get too obsessed with noise -- most musical instruments or performances include a natural noise element of some kind. For example, a completely clean rock guitar track would sound quite unnatural, as would a vocal performance with all the breath noises gated out. By the same token, if you're recording acoustic instruments, the players' breathing is natural, though be careful when doing overdubs, as you also multitrack the breathing! SOS

SOUND ON SOUND

Europe's No1 Hi-Tech Music Recording Magazine

Sound On Sound
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

Go To SOS Website Homepage