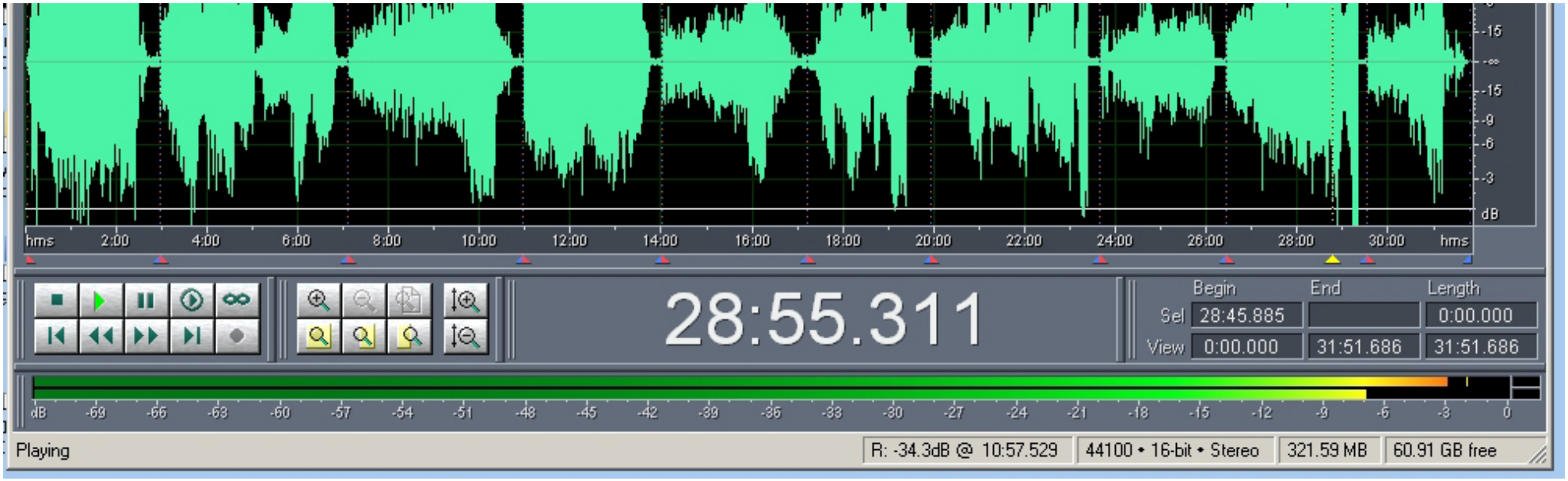
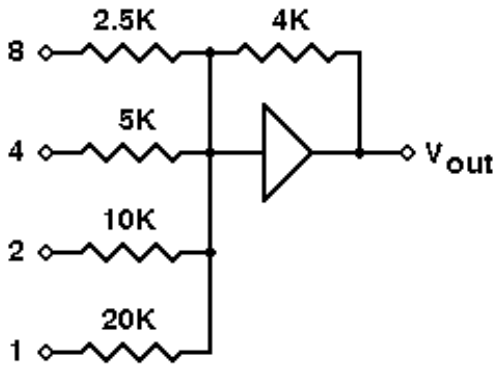
A vinyl-to-CD transfer is actually a genuine recording session. A lot can go wrong.

Above is a standard analog VU (Volume Units) meter. Probably from a TEAC open-reel tape recorder, it is used to monitor the loudness going on to, and coming off from, the tape. Notice the meter has a "Red" zone beginning at about 2/3 full scale and a peak alarm light. They are not there for pretty. Notice also that the whole center of the meter is consumed by 6 dB of energy. This 6 dB - an average of all the energies of all the frequencies that made up the instantaneous sound being recorded - is the magic that could produce the "Vinyl Sound" so cherished today. 6 dB is a small amount on a typical digital VU meter. Ignoring the significance of what that center 6 dB on an analog meter really means will keep anyone from transferring most of the "punch" a vinyl record has to a CD. Back in the olden days, a recording engineer who knew the best settings for an analog meter during a big-time classical recording session for a movie score could almost charge their weight in gold.



Above is a screenshot of the VU indication section of the author's Adobe Audition computer sound editor. Notice there are two different loudness scales: One digital, one analog. The digital is horizontal, has many 3 dB divisions, is brightly lit, multi-colored and moving enough to catch the attention of a Zombie. The analog is vertical, on the right, centered +/- on the signal, small, not very attention-getting and sometimes isn't even shown in some screen view preferences.

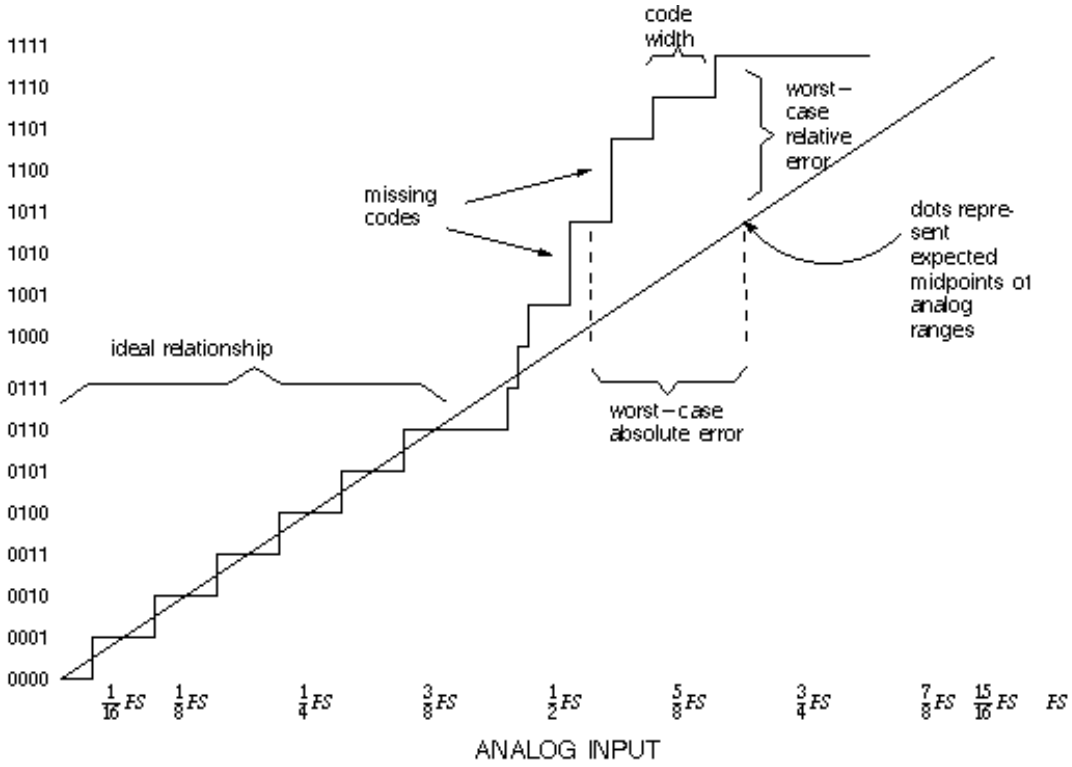
Notice the further into the top 6 dB the bar goes, the redder it gets?



Above is an electronic diagram that illustrates the basic principle of a "Digital-to-Analog" converter. The zig-zag lines are the symbol for resistors. This converter has only 4 instead of the standard 16 bits used in a CD. These four bits can be activated by 16 different combinations of digital "Ones and Zeros" coming from, perhaps, a

Compact Disc, or CD. The triangle is the symbol for an analog amplifier with the amplifier's analog output being the "V out." Digital recordings, such as a CD, are converted back into Analog by such a device. In the digital recording world, each digital bit is given a loudness energy value of 6 dB.

The resistors have resistances such that a digital "One" present on the "8" input will cause the output amplifier to produce 8 times the voltage a digital "One" on the "1" input will. This also means that the same error in the resistance of the "8" resistor will be 8 times as significant as the same error on the "One" resistor.



What can go wrong? Everything. And all in the same Digital-to-Analog Converter. And this diagram doesn't even show the inevitable additional analog errors.

Fortunately, real converters generally use timers, which offer both cheap and precision. But, to a some extent, there will always be residual errors. And they tend to multiply, rather than add up, sometimes producing horrific end results.

Guidelines

These remarks are confined to vinyl records recorded to the RIAA standard. Many early vinyls were recorded by hot-shot engineers who thought they "knew better."

1. Keeping It Clean Be mindful that the top 1/3 of the energy band is not nearly as distortion-free as the middle 1/3. The top 1/3 is the place for difficult-to-hear distortion sounds such as percussive transients and strong deep bass rather than the more revealing continuous melody sounds.

2. Signal processors for analog did different things to analog signals than today's digital processors do to digital signals. Signal processing is always a form of distortion, no matter how good it sounds. Co-mingling legacy processing from old vinyl signals with modern digital audio workstation signal processing causes a multiplication, not an addition of distortions - a situation almost certain to degrade the integrity of the sound.

3. Calibration Vinyl signals are in centimeters per second with gain equalized by the RIAA curve. The RIAA "0 dB" standard for loudness on a vinyl record is a stereo 5 centimeters per second at 1,000 Hz. This translates to -12 dB on a digital meter (or, 1 cm/sec @ 1 k Hz = -22 dB digital). This allows for percussive peaks of 15 centimeters per second and should produce a signal that will transfer with full vinyl "punch" but no distortion to a CD without any further processing. Only calibrated vinyl test records provide these signals. If you are using a mono (lateral only) test signal, the velocity will be 7 cm/second @ 1k Hz equals (minus) -12 dB digital.

4. Some vinyls were cut lower than RIAA. Normalizing these signals to -3 dB (minus 3 dB) keeps the dwell time in the top 1/3 of the energy range reasonable. This strategy also works well for recordings of FM broadcasts from high-quality FM stations, this level will cause a good energy aperture to be established for a broadcast-limited dynamic range.

5. Digital at sampling rates of 58 k samples/second or lower always make that digital filter "pre-ring" artifact audible - even to the author's 72 year old ears. The author "masters" and edits his vinyls at 88 k/24 bits and then dither downsamples the signal to 44/16 for the CD. Using the old, original, triangular dither will give you an effective bit-and-a-half of additional resolution - i.e., as much as an additional 9 dB of audibility down into the background surface scrape and hiss - much like what you get when listening to a half-track 15 ips tape recording. The author will usually re-listen to the archived vinyl from the 88/24 signal saved on a DVD-A rather than the CD. The master sample rate should be a multiple of the 44.1 CD sample rate to avoid the audio equivalent of Moiré harmonics. These are usually subsonic but why generate them if you don't have to?

6. The author prefers to use a well-installed "broadcast" cartridge rather than an "audiophile" cartridge that is gentler on the vinyl. Vinyls are intended to be worn out. Typically running about a gram heavier and working the vinyl harder seems to give that "intense vinyl sound." The Denon DL-103 is a low-cost broadcast classic in this category. The author prefers a moving-coil preamplifier that has a linear first stage, then passive RIAA equalization, and then a linear second stage with a 100 ohm output. These low-impedance output preamplifiers seem to be able to drive any analog-to-digital converter well. Preamplifiers that combine their RIAA equalization into their feedback loops never sound as clean and strong at the extremes of frequencies and levels since each function "eats" into the other to some extent.

7. http://www.clickrepair.net/ Makes a good, low cost, downloadable, click removal utility that uses wavelets to recognize clicks and thus does not impact the signal's frequency or dynamic domain. Has a "Percussion" setting to make the software look at both sides of a click to verify it really is a click before removing and interpolating it. Does each channel separately and includes a MONO preset to produce a true mono signal if desired. Good user trial policy and an extensive pdf user's manual.

8. Cleaning. Manual cleaning using the Stanton cleaning kit suffices for the author. Every now and then a record with unusual amounts of deep dust shows up. Knowing about it and being able to really put some real pressure on the cleaner is a big plus for manual cleaning.

Comments.

There are many differences between vinyl and digital.

One is that the sound a needle makes while tracing a groove excites the vinyl platter and, if you listen to a silent groove on the record at the same time using a second tone arm and cartridge - some turntables are so equipped - and turn off the sound of the playing cartridge - a very faint echo-like sound can be heard.

Second, some think the multiple trips the signal takes through the physical world - cutter head, then playback stylus - make life much easier for loudspeakers, having subjected the signal to a couple of inertia acceleration limiters that come into play both when starting and stopping the speaker cone. I suspect that's where the extra "punch" - overshoot - heavy moving coils give sharp percussive signals comes from. Different maximum velocities mid-slew give different amounts of overshoot at the end as the cantilever bends a bit. -- JH

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