The Dino Club: "Hey! Drink Up" - **The Story of Your CD**

The original raw DAT mixes of the fourteen tracks were transferred digitally direct to the hard drive, three different ways from a Sony Pro DAT machine through a properly loaded 75-100 ohm digital cable. The first way was a "straight" transfer from 44.1kHz/16bit to the same on hard drive. The second way was at the same 44.1kHz sample rate but the word size was increased to 24bits without going through a sample rate converter. The third way was to use a GW Labs sample rate converter to "upsample" from 44.1/16 to 96kHz/24bit. This sample rate converter - de-jitter black box has a 4th generation (latest) sample rate converter and a state of the art clock with dual phase lock loop to reduce jitter to less than .02 picoseconds from a region of approximately 1000 picoseconds! The GW Labs is reviewed in March 2002 *Stereophile* magazine in Sam Tellig's column. The reviewer purchased it for himself. It is also praised to the hills in a technical description by Gary Galo in *Audio Express*-latest issue (3/2000).

The idea behind caring about oversampling and increasing word size is that when equalization (digital) or any DSP (digital signal processing- i.e. compression, limiting, reverb, delay, normalization, level changes, fades, editing, etc.) is used the less digital distortions that are introduced like Gibbs Phenomena, linear vs. non-linear phase, group delay, filter ringing, equi-ripple effects, etc. It is even better if the music is originally recorded at the highest sample rate and word size available but even if it is not; artificially increasing the word size and/or sample rate makes it possible to use the exact same "high resolution" EQ or DSP on music recorded at lower word sizes and lower sample rates with the same beneficial effects.

For The Dino Club CD I applied more than 300 different DSP parameters to the raw data on hard drive! Every parameter's value was chosen by listening. Most parameters were related so that changes to one necessitated changes to another and vice versa. Of course I would argue that none of the parameters could be changed without lessening my enjoyment of a particular track.

After all editing was finished (fades, crops, indexing, timing silences, splits and joins, etc.) I rendered all the DSP three different times to each of the three different ways the music had been transferred and listened to each version to pick the best sounding way. It was no surprise that the "straight" version was the harshest, brightest and less appealing of the "straight" vs. "larger word size" second version but it was a shock to prefer the "larger word size" second version to the upsampled third version. Increasing the word size to 24bit and keeping the sample rate at 44.1kHz sounded better than going through a state of the art sample rate converter to get 96kHz/24bit data! So the GW Labs was not used in the application of DSP but it's very superior clock was. (more on this later)

Sample rate converters in the path of a digital signal is a subject of much published controversy. I have read extreme pro and con and understand both but the changes I observed after copying and pasting all 300 some DSP parameters the three times for this listening experiment put me on the "con" side at least in this instance.

The sound quality of four or five tracks (No.'s 4,7,10,13,1?) suffered in a way that I decided that it would be worthwhile to look at the pulse shape and power spectrum of each to determine evidence of absolute phase inversion and the degree to which it effected the energy in the song. Absolute phase inversion can be easily heard sonically as the "Wood Effect" or as it is nicknamed, the Muffling Effect. It destroys the leading edge of transients as can be appreciated in the sound of a kick drum by converting a compression wave into a rarefacted wave (woofers move inward first instead of outward.) Voices are effected the most but the whole effect is disconcerting and by looking at the pulse shape and power spectrum of a track one can tell if particular microphones or pre-amps inverted. It is common that condenser mikes invert while dynamic ones don't; tubes invert and transistors don't; a single op amps inverts but two in a row don't, etc. An excellent book on just this subject is by Clark Johnson called The Wood Effect.

I noticed significant absolute phase confusion (ambiguity) in a couple cuts. Using software I digitally inverted those tracks w/DSP and listened to them to see if there would be a preference for an inverted one. While the cymbals that splash a bit too much as in tracks 7,10 & 13 splash much less when inverted; it sounded better to EQ them down and keep the leading edge. i.e.- mics on the cymbals did not invert. Ultimately the decision I made to not use any inverted tracks came down to the voice-whether it sounded better on the inverted version or not; none did.

The equalization and other DSP (excepting dither) was applied using the Alesis Masterlink ML-9600. (*Electronic Musician*-"Editor's Choice Product of the Year 2001", *Stereophile* Magazine June 2002 M. Fremer "State of the Art Digital") All timed operations like the burning of a CD or playback of an audio file on the hard drive are either clocked by the internal clocks of the Alesis or by a clock signal on the digital input allowing it to be used as a slave to an outboard clock. The GW Labs clock was very audibly superior sounding and could be auditioned by remote control. It was used then for all subsequent timed events.

While increasing the word size to 24bits and applying all DSP a' la Version 2 was obviously the best thing to do; less obvious was dividing the DSP applied between hardware and software execution. I compared hardware DSP on the Alesis to software DSP via Apple G4 and e-Magic Logic 5.0. Again this meant copying and pasting 300 some parameters and rendering it these two different ways. Neither sounded preferable with EQ but better EQ decisions could be made realtime on the Alesis while listening through 24bit DAC's. On the other hand e-Magic software offered a greater variety of limiters, compressors, exciters, reverbs, etc. and a comparison was made between all types of these. The "Adaptive Limiter on the Input" won hands down in this shootout and use for it was found in a couple of instances. So the "Adaptive Limiter on the Input" was used in software in 24bit and the EQ was applied by hardware in 24bit. Level changes were made some hardware, some software because the Alesis can deliver 24bit files to the computer but not the reverse. When no limiter was used levels were changed with hardware. So level changes after limiting were done in software.

Software based reverbs, hall sounds, echo and various delays were all considered. e-Magic's very special all digital "tape delay" enhanced track 2-She's Spinning to a significant degree and after a test CD was generated of that cut with 10 different versions of delay used for that cut a favorite was chosen.

Digital track split and joins (re-join) were used throughout. Most of them were to cure a loud kick-drum here or a bass note too loud there but in the case of track 4 (my favorite) even though the original sound quality was among the four hardest to treat (the others being 7,10,13) I was moved to split toward the end two different times. (Once to raise the volume and the second to jack-up the bass guitar.) Listen carefully and you can hear it and enjoy how it enhances the end of the song. This was rather more complicated than one might think because one frequency was chosen for the bass EQ for the whole song and a different one chosen for the track split for the bass.

All of the “Digital Domain” operations previously mentioned were executed in 24bit. To return the music to the Redbook Compact Disc standard all good work would be lost without excellent dither to reduce the data to 16bit. e-Magic boasts the world’s best dither in software or hardware and they offer three kinds. They each sound surprisingly different. Dither sound is so important that hardware (Apogee) based sells for as much as $3000.00 by itself! e-Magic software based is higher quality than even Apogee and certainly better than the Alesis’. So software based dither was chosen over hardware based. e-Magic’s dither is called Powr and is used by the mastering engineers for Madonna for example. I dithered The Dino Club all three Powr dithers and after comparing them chose Noise Shape N0.1. This effected the high frequencies tremendously and I had to go back and re-EQ most of the 14 tracks in the highs. Not being a real time process; many cycles of this occurred before I was satisfied. Noise Shape No.1 gives the best string sound, sweetness and overall clarity.

After the dithering I submitted a regular hard disc copy of the final CD that is called “disc-at-once” meaning that the laser never is turned off while burning the CD. This effects it’s ability to be compatible with a wide range of CD players including difficult portables, boom boxes, etc. I also produced a “CD 24” (not to be confused with 24bit) which has extensive integral error protection and is compatible with computers in that the AIFF files have already been generated and can be read instantly by a computer for mass production hopefully. This is better than copying a CD on a home computer from a regular Redbook CD and is the best way to ensure the mass produced disc will sound like the Master.

Finally, the CD-R blanks that were used for the Masters were Fujifilm. It was the winner of a listening comparison among twenty or so CD-R blank brands where it was chosen 100% of the time as the most like the sound of the hard drive heard direct. Hard as it may be to believe, many articles exist describing the effects of dyes (AZU), ink types, channel pitch, wow and construction on block bit data error rates and affected jitter levels.

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