



HIGH RESOLUTION CDs – NO COMPROMISE

APOGEE SUPER CD ENCODING

# Experts Agree: "It's Amazing!"

Squeezing more performance from a standard CD is not a new idea. It began with adding white noise, called dither, to the digital audio. Plain dither was followed by different flavors of dither noise, then a process called 'noise shaping' and more recently various forms of so-called 'bit mapping'. Independent listening tests confirm these systems color the recordings we are trying to preserve or compromise the audible noise floor.

Five years in the making, *Apogee UV22 Super CD Encoding* is an entirely new process. UV22 does its job *without* sonic compromise, and *without* adding a sound of its own, preserving the sound stage and tonal balance of the original 20-bit source. The effects are even audible on original 16-bit recordings.

Apogee UV22 Encoding adds an inaudible, high frequency 'bias' to the digital bitstream, placing an algorithmically-generated 'clump' of energy around 22 kHz. Much as the bias on an analog tape recorder smooths out magnetic tape recording non-linearities, UV22 silently captures resolution up to and even beyond 20 bits on a standard, 16-bit CD.

In addition, this inaudible carrier smooths the rough edges of even the most inexpensive CD player or external converter. Apogee UV22 makes your recordings sound better on *all* lis-

tening systems. Running already-mastered 16 bit sources through a UV22 processor delivers sonic improvements that any user can realize on equipment they already own.

UV22 is a very special information carrier: it is *not* a new flavor of dither noise. The truly unique statistical properties of UV22 guarantee a constant white noise floor, very similar in character to analog tape noise, no matter what the input source. If you listen to the noise on a UV22 encoded recording, you can hear a stable, accurate sound stage and faithful

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## Impressive comments from critical listeners

"The reverb detail and stereo spread are amazing."

—Michael Bishop, *Telarc International, Cleveland*

"You can hear close to 20 bit resolution from a 16-bit CD without any special decoding hardware... it's amazing."

—Roger Nichols, *Engineer and Producer, Nashville*

"UV22 is the closest thing to the 20-bit source that I have heard."

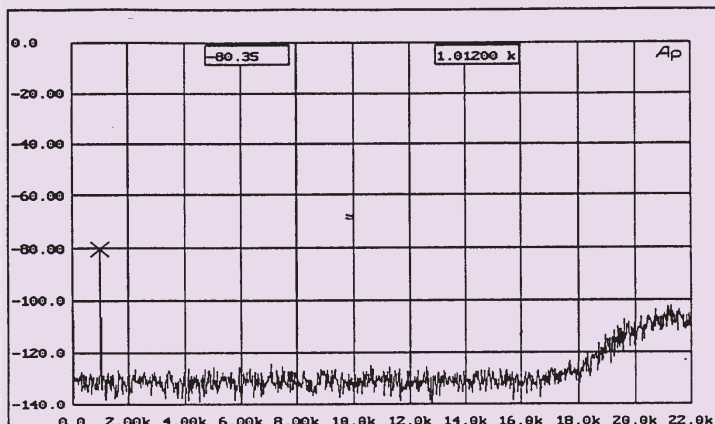
—Bob Ludwig, *Gateway Mastering, Portland*

"UV22 kept the 24 bit signal perfectly clean... all the way down to -120dB."

—Ted Jensen, *Sterling Sound, New York*

"UV22 rounds out the rough edges of digital"

—Stephen Marcussen, *Precision Mastering, Hollywood*



UV22 adds a unique, inaudible, algorithmically-generated 'clump' of energy around 22 kHz: the noise floor remains smooth and at the theoretical limit of 16-bit systems.



## WHAT THEY'RE SAYING ABOUT APOGEE UV22 SUPER CD ENCODING

We sent prototype UV22 Super CD Encoding systems to some of our Apogee Digital Converter customers. Here's what the industry has to say about it:

Telarc International, Cleveland

Engineers Michael Bishop, Scott Burgess and Elaine Martone tested a number of systems: Apogee UV22 Super CD Encoding; Sony Super Bit Mapping; Gambit; Harmonia Mundi; and Sonic Solutions Turbo Bit Mapping. They used a recording of the Atlanta Symphony Orchestra and Chorus, conducted by Yoel Levi, performing Ravel's *Daphnis and Chloe* (November 1993 release, Telarc catalogue number CD-80352). The source was 20-bit, recorded to a 20-bit Mitsubishi X-86 2-track.

*"Listening tests have shown the Apogee UV22's 16-bit output is the closest to what we hear on our 20-bit source. It's really like getting something for nothing."*

*"We chose the Ravel recording to test dithering schemes because of its wide dynamic range, distinct imaging and deep sound stage. The piece opens with very low level tympani, high woodwinds and light strings and slowly builds to a 250-voice and orchestra crescendo. Any change from the 20-bit source, especially in those opening bars, is immediately apparent."*

*"All other systems changed the sound stage and the tonal balance. The Apogee UV22 holds the detail, holds the sound-stage and holds the tonal balance across the spectrum. The UV22 was very open and very clean".*

Michael further used the UV 22 on a recent Brazilian project, *Paraíso*, featuring Gerry Mulligan and Jane Dubo (October 1993 release, Telarc catalog number CD-83361).

*"The UV 22 makes all the difference in the world in fades to digital black."*

*"The reverb detail and stereo spread are amazing; it makes an overall improvement in the final product"*

Ted Jensen, Sterling Sound, New York

*"In our system the UV22 kept the 24-bit signal perfectly clean with no step-type artifacts, all the way down to -120 dB on our digital fader. Also, unlike some...noise shaping/dithering systems we've listened to, the Apogee doesn't color the sound."*

*"Compared to other systems, or truncation, there is a solidity to the sound. Harmonics are in proper perspective with less 'sizzle', and the image is better preserved."*

*"Now, when can I get the thing back?"*

Roger Nichols, Engineer & Producer, Nashville

*"Warner Bros. Records called me and said that they were going to put out a 20-bit version of Donald Fagen's album, Kamakiriad, and would I please supervise the transfers. Our source was a 20-bit Mitsubishi X-86 tape of Donald's album."*

*"We played back the X-86 tape through the Sony Super Bit Map encoder and cut a CD and a CD master tape for Warner Bros."*

*"Afterwards, we compared the Super Bit Map CD with the original 16-bit CD. The noise level actually seemed to get louder on some cuts. The quality of the noise floor seemed to change with the signal content. The quality of the lead vocal seemed to get grainier. With our source material, the SBM version of the CD was not any better than the straight 16-bit CD. Maybe worse."*

*"We performed the same test with the Apogee UV22; we*

*made a CD master tape and a CD of the 20-bit X-86 tape through the UV22. We listened to all three discs, the 16-bit, the SBM, and the UV22. The UV22 version was by far the best. The voice was crystal clear, the noise floor was lower than that on the 16-bit CD, and there was no noise modulation by the program material. It was significantly better than the 16-bit CD, and the difference between the UV22 and the SBM version was like night and day."*

*"We sent the UV-22 tapes to Warner Bros. for the 20-bit version of Donald's album. If there is going to be an expensive gold-plated 20-bit version, it should sound better than the 16 bit CD, right?"*

*"The results are that [with UV22] you can hear close to 20-bit resolution from a 16-bit CD without any special decoding hardware. If you get a chance, listen to both of them and check out the difference. It is amazing."*

Bob Ludwig, Gateway Mastering, Portland, Maine

Bob had a chance to put our prototype UV22 through its paces with various program material he was working on. He had used several types of material in the ½-inch 2-track analog format, and had spent some time with our UV-22 on the song *Nobody's Hero* from the forthcoming Rush album *Counterparts* on Anthem Records. This is what he had to say about the UV 22:

*"The Apogee UV22 is very impressive... it's the last word in redithering."*

*"The Apogee UV22 is the closest thing to to the 20 bit source that I have heard. It even makes inexpensive D to A's sound twice as good."*

Stephen Marcussen, Precision Mastering

*"[The Apogee UV22] rounds out the rough edges of digital. I put material through the UV22 at below -60 dB and you could clearly hear the low-level information. It was much smoother and much more intact".*

*"The low-level stuff was really nice and smooth."*

*"The signal with the UV22 was a lot clearer than without."*

Scott Hull, Masterdisk Corporation, New York

*"The Apogee UV22 is an excellent way to utilize 20-bit A/D conversion and 20-bit signal processing. It allows you to capture the improvements of 20-bit even on 16-bit formats. Most importantly, it is very musical sounding; it doesn't change the tonal balance. With the UV22 the 16-bit output sounds very close to the 20-bit source."*

*"It's simple to use and sounds great. Bravo!"*

John Newton, Sound Mirror, Jamaica Plain, MA

*"When a 20-bit signal is processed by the UV22, the result is essentially the same as the 20-bit original, and cleaner than Turbo Bit Mapping".*

Joe Gaswirt, Ocean Digital, The Complex, Los Angeles

*"It's the closest thing to a 20-bit signal. Clearly the best of all the processors I've heard..."*

# SOMETHING FOR NOTHING AND YOUR BITS FOR FREE?



## About UV22 Super CD Encoding

With all the grandiose claims flying about, it would be easy to forget that well executed 16-bit digital audio for CD can already sound amazingly good, and enhancements must therefore be subtle at best.

## What are we comparing?

Sometimes a manufacturer will demonstrate a CD enhancement process using 2 CDs: one recorded using the enhancement process and the other without. What is not usually very clear is that the CD without was mastered several years ago using older A to D converter technology, and the CD with the process had the added benefit of the latest A to D conversion. In these comparisons, the converters have a much bigger bearing on the perceived sound quality than the difference between the enhancement processes. If you do your own listening evaluation, be sure to keep all the variables in mind and follow standard good engineering practices when making comparisons – such as accurate level matching.

## Something for nothing?

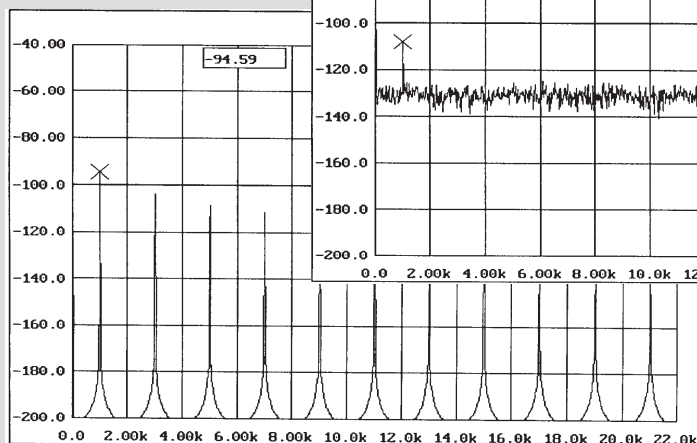
If we take a well recorded 16 bit digital audio source (from a DAT, for example) and we decide to add some digital EQ, compression, gain change, de-click, de-crackle or even the latest process to put the sound behind, above, or below us, we are digitally manipulating our 16-bit numbers. We don't get more audio information out than we put in, but we do get numbers with resolution greater than the 16 bit input signal. These extra 'detail' bits we pick up contain some of the results of whatever process we performed to our original 16-bit audio source – and ideally we should hang on to those bits. They show up in improved smoothness, detail, image and depth. The aim of the various encoding schemes is to hold on to the extra resolution after digital processing or A to D conversion, when transferring to a 16-bit CD quality output.

## Holding on to more bits in a 16-bit CD world

An ideal 'Super CD' system would take as much as 24-bit

## A tone at -108 dB, with and without UV22

*You are looking at 16-bit CD-quality digital audio with a pure 1 kHz tone hiding in the noise (above right). If you listen to it, the noise is 12 dB louder than the tone, yet the low-level, silent UV22 information carrier sitting around 22 kHz delivers the tone with no measurable distortion and is accompanied by a low, constant white noise floor. Turning the UV22 off and simply truncating the high-resolution digital input to 16 bits produces the nasty set of distortion products in the lower graph.*



resolution digital audio and capture the same detail and quality on to our 16-bit CD. We don't live in an ideal world, but it *is* possible to capture most of the added detail in 20-bit (and greater) systems into our world of 16-bit DATs and CDs.

## Dancing Bits on the Noise Floor

All 'super CD' encoding systems make the last digital bits dance so they capture extended resolution in the 16-bit CD format. A useful way to separate the different processes (dance steps?) is to look at how each handles the noise floor:

- Common dither methods compromise the 16-bit noise floor – they *add* noise
- Noise shaping and 'bit mapping' trade a reduced noise floor for a large boost at high frequencies
- UV22, Apogee's entirely new proprietary process, keeps the audible noise floor solid at the theoretical minimum for 16-bit systems

Although noise shaping and bit-mapping systems (questionably) focus on the noise floor, users often hear this 'improved' noise floor as changing with the music, making it watery and 'fluid-like'.

Traditional dither adds noise and raises the noise floor. UV22, on the other hand, presents a constant, smooth and stable noise floor, unobtrusively at the theoretical minimum level, but through which can be heard full 20-bit detail.

## It's all in the noise

The ideal noise floor of a digital system is about 6 dB per bit. Thus a 16-bit CD has a noise floor at about  $16 \times 6$  or -96 dB. A 20-bit system, -120 dB. Popular music CDs are seldom limited by a -96 dB noise floor.

20-bit sources mean two things: an ultra-low noise floor and very high resolution. In the real world, it's resolution that matters. And you get it from UV22 – in 16 bits.



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tonal balance more than 24dB into the noise – just as you do on analog tape. Yet the UV22's low audible noise floor sits at the theoretical limit for a 16-bit system. Nothing is lost – but a great deal is gained.

In listening test after listening test, mastering engineers unanimously choose UV22 over all other systems. Dozens of CDs have already been mastered using the UV22 prototypes.

This exclusive process, which has taken five years to perfect, is now available. The first UV22 encoding processor will satisfy the requirements of CD mastering. The UV22 Super CD Mastering System includes many features sure to bring a satisfied smile to any mastering engineer.

Beware of 'music shaping'! Noise-shaping and bit-mapping systems modify the noise floor by changing it from a familiar white noise to one that has been radically modified. Their proponents' theory says that the -96 dB CD noise floor is not low enough to avoid interfering with our listening pleasure, and that our ears would prefer a big dip (about 12 dB) in the noise floor in the 2-3 kHz area, with an accompanying HF boost of as much as 30 dB. What they forget is that few CD releases actually approach the -96 dB noise floor: the noise of almost all sources is significantly higher than this and swamps any of the claimed benefits. In addition, in the process of shaping the 'noise', these systems are also shaping audio information hiding in what they call noise, which results in noticeable shifts in image and colored tonality of the music.

At Apogee, we believe the dynamic range of CD to be fine for the majority of applications. As a result, we don't try to modify the noise floor. Instead, we make it transparent, allowing clear, clean audio information to be heard up to 30 dB into the noise – just like analog. This information is captured and encoded on to CD – and can be appreciated on any CD playback system.

You've worked hard on your project and you want the best product for the CD consumer. There are powerful reasons to master with UV22. Ask your mastering engineer to demonstrate Apogee UV22 for your next project. You'll agree with the experts that 'it's amazing.'

## Features & Benefits

- UV22: a unique algorithmic process
- Allows information beyond the 20-bit level to be encoded into a 16-bit medium such as CD
- Retains the 20-bit detail
- Retains the 20-bit sound stage
- Retains the 20-bit tonal balance
- No coloration of the 20-bit source
- Noise floor is constant, irrespective of input signal
- Hear clean audio detail up to 30 dB into the noise floor
- No special decoder required
- Improves any CD playback system
- Completely 'Red Book' CD compatible
- HF digital 'carrier' analogous to analog tape bias

## How does it compare to analog?

We all know one of the main reasons for going digital: low noise. So why do so many engineers still master to ½ inch analog?

Technically, analog recordings may appear to be limited by their noise 'floor'. On closer listening, however, the noise floor turns out not to be as solid as the name suggests. A better analogy would be to compare the 'floor' to the surface of a crystal clear lake, where you can see right into the depths. Analog noise is like that: smooth and constant – but you can hear through it.

This is where digital has differed in the past. The (albeit low) noise floor truly was a limit – more like a stirred muddy lake. *Dither* has been used (intentionally and unintentionally) for years to clarify the grunge usually lying on the bottom. The problem, however, was that dither is quite inefficient at capturing full fidelity musical detail, because it is very slow at its job – and it invariably increases the noise.

UV22 is the most efficient method of all in capturing extended resolution into the 16-bit format. This powerful information carrier sits inaudibly out of hearing, yet presents a smooth, white, unvarying noise floor through which can be heard undistorted detail up to 30dB lower in level – extending full-fidelity information beyond 20-bit resolution to your 16-bit CD.

A comprehensive discussion of the various considerations for UV22 encoding was first presented in a 76-page paper by Apogee mathematician Dr. Jerrold Goodwin, at the 89th AES Convention in Los Angeles (September 1990). Apogee formally introduced and demonstrated UV22 Encoding at the Berlin AES in March 1993.



The digital masters.