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Bulletin 1011

Development Overview

The Spectral SDR-4000SL Reference CD Processor System

The SDR-4000SL Reference CD Processor is a limited edition reference instrument crafted in the Spectral engineering department and individually programmed and calibrated by its designer Keith Johnson. Relatively unlimited time and resources have been utilized to achieve our ultimate objective: Engineer the most sophisticated and sonically accurate CD player in the audio industry. Those that are familiar with Keith Johnson's credentials and previous achievements in digital design know this objective is not taken casually or an idle boast.

As with previous editions of our SDR components from the 1980s and 1990s, such as the SDR-1000 and SDR-2000 reference digital components, it takes our engineers multiple design generations to arrive at the final and ultimate model. The SDR-4000 has been previously produced in two highly regarded versions, the original SDR-4000 and the revised SDR-4000 Pro which incorporates the exclusive HDCD "Long Filter" technology. It has taken Spectral engineers four years more to develop the final and most uncompromising generation, the SDR-4000SL. In the SDR-4000SL, Keith Johnson and the design team address their remaining performance objectives to create the ultimate SDR-4000 and redefine the possibilities of the redbook CD medium in the finest music systems.

The Spectral UltraDrive High Performance Optical Drive Redefines Data Precision

Keith Johnson's experience in evaluating and testing optical disc drives for video and audio use has few equals. In the 1970s Keith Johnson and Paul Greg joined development work which resulted in optical tracking servo systems used in the original laser disc systems, the forerunner to the compact disc drive. Later Keith worked intensively with Philips and Teac/Esoteric to develop the modified premium CD drives used in Spectral SDR components built in the 1980s and 1990s. Keith's extensive experience with optical drives and servos continued as he evaluated CD drive performance in HDCD licensees throughout the audio industry. Finally, Keith has spent the better part of a decade evaluating manufacturer prototypes for a custom, high-performance drive exclusively for Spectral. Now, after years of development by Keith and our manufacturing partner, the new Spectral UltraDrive is finally here.

A Fundamentally Superior Compact Disc Drive

The Spectral UltraDrive is based on an unusual CD ROM computer drive designed for critical avionics and commercial applications. This high-rel drive stands out from the countless number of drives we evaluated for its superior performance and build quality and is rated at over twice the cycle life of any other premium drive built today. As most remaining optical drives are decontented mass-market models, destined to be phased out in the immediate future, our drive is contracted to be built for avionics and critical military use for many years to come with component parts support extending further still. In all probability this drive will be one of the few fully supported optical drives many years from now.

By starting with the most robust and overbuilt CD ROM drive on the market we can assure our customer reliable and extended service life. To minimize the service requirements our drive is a beltless design to eliminate the inevitable need for belt replacement found in most CD drives, including our own earlier SDR components. Our drive also features an extended life laser readhead with full glass optics to further reduce service needs.

Perhaps the most unusual aspect of the new Spectral UltraDrive is something that it does not have. The UltraDrive has been engineered and tested to be clocked by an external oscillator, it has no clock reference of its own. Spectral engineers then clock directly from the DAC master clock for the highest possible timing accuracy. Slaving the optical drive directly from the DAC clock is acknowledged as the most precise method possible to control data output, but in the real world this ideal approach is never actually implemented in production, the optical drive manufacturers are unwilling to produce drives without clock systems they can test. Spectral UltraDrive is different. We have co-developed the drive electronics to be run exclusively by our own external clock reference. The result is the first optical drive designed and optimized for external clocking.

Modular Approach Addresses Service Concerns

Having built reference CD playback components for over twenty-five years, we are interested in more than high performance alone. In the final edition of the SDR-4000 we wanted to address the challenge of mechanical service on a more fundamental basis. In the past the finest available CD drives have also been the largest and most complex, with elaborate loading, damping and suspension systems. Servicing for the replacement of wear items like laser readheads and drive belts could require extensive disassembly and re-alignment. Our goal in the SDR-4000SL was to eliminate as much of the time and expense as possible. We have designed the UltraDrive as an easily replaceable, self-contained modular system. The UltraDrive is plugged directly into the master clock reference and firmly mounted to a critically damped foundation.

The fully modular UltraDrive optical transport makes practical dealer and field-serviceability a reality for our SDR-4000 for the first time.

The Spectralock Master Clock Architecture

The pursuit of ever improving clocking accuracy and lower timing error and jitter have been a fundamental priority in every Spectral SDR component since the original. Although generations of high-end audio digital components have previously proclaimed the “banishment” of jitter, careful listening evaluation of even the best of these reveals the clear sonic effects of these insidious distortions. We are under no casual illusion regarding this difficult technical issue: audible consequences of insufficiently precise data timing and noise-induced jitter are still the foremost reason that digital audio fails to deliver on its musical promise. Our new Spectralock Master Clock architecture is Keith Johnson’s most ambitious assault yet on jitter and its sonic consequences.

The Spectralock data management system is fully integrated to the UltraDrive optical disc transport. It is completely enclosed and shielded and like other parts of the SDR-4000SL, its powering floats as if from batteries. Signal transmissions are balanced to self-cancel digital activity and data outputs are slaved from the ultra-precision crystal that directly clocks the conversion to analog signals at the DAC. These design features hide the optical transport and its servo activity to assure always accurate filter processing and prevent any intrusion of the drive to our silent conversion environment.

The carefully shielded and interfaced UltraDrive transport contains a fast loading - quick to play data buffer. The Spectralock system grabs the information bursts from the CD and outputs a continuous time invariant stream of data. Twin synchronization loops slave both operations to the DAC master clock so that motors, tracking servos and other activity that would damage timing accuracy are sequestered to create a time stable stealth platform. The Spectralock system is considerably more precise than even the best master clock box systems which have noise induced jitter

problems as a result of the long clock cables. Spectral's fast lock synchronization loops, quick loading buffer and effective isolation strategy all combine to make an ideal platform for pristine timing for processing and conversion. We achieve an industry leading 120 dB signal-to-noise with better than one-part-per-million data accuracy. There is absolutely no presence of any other activities such as ripples, noises, stray fields or any intrusions to the digital waveforms. Our new Spectralock/Ultradrive system produces signals that are an exact replica of those making the recording—nothing added, nothing subtracted or changed.

The Ultimate Reproduction of Compact Discs

Is the SDR-4000SL our last reference CD player? In the Spectral design language, SL models are usually the final versions in an SDR series, and this is the case with the SDR-4000SL. In the here and now, we are confident that there is little possible regardless of cost that could improve the performance of the Spectral SDR-4000SL in any significant way. We believe this is one way to define a true reference instrument. It is also why the SDR-4000SL is worth listening to and owning.