MADRIGAL

Nº 30.5 Reference Digital Processor

To bear the Mark Levinson name, an audio product must offer the finest technology, unmatched craftsmanship, and genuinely advance the state of the art for products of its type. In addition, Mark Levinson "Reference" products are designed in a modular fashion to allow the incorporation of new technology, and have a well-earned reputation for the greatest updatability and market longevity of any audio products.

True to its definition as a "Reference" product, the original Mark Levinson Nº 30 held sway as the standard against which other digital processors were measured for almost three years. During the design of its successor, the Nº 30.5, all major subassemblies in the Nº 30 were reevaluated. Interestingly, neither the power supply nor the analog sections (including the digital to analog converters) warranted changes-powerful testimony to the strength of the original design. All of the improvements offered in the Nº 30.5 reside in the digital section, as described below.

The long-term value of the Nº 30.5 is assured not only due to its updatable design, but also because its performance is so advanced and musically satisfying that it will remain a benchmark for many years.

INDUSTRIAL DESIGN

The striking appearance of the Nº 30.5 springs from both æsthetic and technical considerations. The industrial design of the Nº 30.5 combines form and function while maintaining the traditional character of Mark Levinson products.

For ideal performance, analog and digital sections of the processor must be thoroughly isolated; unfortunately, locating them in completely separate chassis degrades signal quality by unnecessarily lengthening the signal path. The two vertical towers of the Nº 30.5 contain the right and left analog audio circuitry respectively, thus providing thermal, electrical, electromagnetic, and mechanical isolation from the digital circuitry contained in the central section. Yet this innovative design maintains intimate physical proximity for optimal communication between sections.

The asymmetric contours of the center section visually balance the large display, and add a fresh element to the design of audio equipment. The fine texture of hand-brushed aluminum, beautifully black-anodized, and the lacquer-filled engraved lettering (for durability as well as elegance) typify the handcrafted excellence for which Mark Levinson products have become so well known.

INPUTS AND OUTPUTS

One of the advantages of a separate digital audio processor is that the redundant investment that otherwise might have been made in several built-in D/A converters can be put it into one superior processor. This processor, in turn, should enhance the performance of all the transports with which it is used. Ironically, many outboard processors fail to live up to this potential due to interference between their various digital inputs.

The Nº 30.5 provides outstanding isolation between its inputs, realizing the full potential of the various digital transports with which it is used. In fact, all unselected digital inputs are capacitively shunted to ground upon entering the Nº 30.5 to prevent their interaction with any portion of the circuitry inside the processor. As a result, the selected input effectively has the Nº 30.5 "all to itself." This extraordinary isolation holds true even when as many as eight inputs are connected to active digital sources-a real possibility in this increasingly digital world.

Three electrical inputs are provided via top-quality XLR connectors, implementing the balanced 110 ohm AES/EBU professional digital standard. Two additional electrical inputs provide compatibility with the common 75 ohm S/PDIF digital standard, and employ custom-made Madrigal RCA connectors.

Optical inputs are supported in both the ST and EIAJ formats. The Nº 30.5 offers a Hewlett-Packard implementation of the ST optical standard that delivers the highest performance of existing optical packages. In addition, two EIAJ-standard Hewlett-Packard optical inputs deliver unsurpassed EIAJ performance. Fortunately, although EIAJ normally delivers relatively poor performance, the Nº 30.5's Intelligent FIFO largely overcomes the limitations of this widely-used optical interconnection standard.

Top-quality analog outputs are provided in a balanced configuration via Swiss-made gold-plated XLR-type connectors. For compatibility with equipment lacking balanced capability, single-ended outputs also are provided via custom-designed Madrigal RCA-type connectors.

The Nº 30.5's extensive input/output capability makes it the uniquely capable centerpiece of a digital audio reproduction system.

OPERATION

The Nº 30.5 uses a large, easy-to-read LED dot-matrix display that provides useful operational information to the listener even from across the room. For æsthetic considerations and to accommodate varying ambient light, its brightness is adjustable to

four levels including fully off.

Each input may be assigned one of more than a dozen names, such as: CD, LD (laserdisc), DBS, DAT, DCC, or AUX. When selected, the display shows both the type of the input and its number (for example: CD1, DAT2, LD7, etc.). In the case of "linked" Mark Levinson transports, the actual model designation is shown: Nº 31 or Nº 37. This level of customization makes even complex systems involving many digital sources easy to use, particularly for those in the home who may listen to the system only occasionally.

Additional intelligence is built into the Nº 30.5 for interaction with other Mark Levinson products, allowing for special features and exceptional ease of use. For example, turning on the CD transport will bring the "linked" digital processor, preamplifier and power amplifier(s) out of standby, automatically selecting the appropriate inputs on each to allow a CD to be heard. This proprietary hardware and software Communications Link bus, designed by Madrigal's engineers, provides "one-touch" simplicity of operation even in extremely sophisticated systems.

POWER SUPPLY

One of the most critical elements of any audio product is its power supply. Digital-to-analog converters must accurately deal with truly minuscule electrical signals (approximately as tenuous as those on the surface of your skin as a result of brain wave activity). To achieve the level of performance required of the Nº 30.5, it was necessary to develop an even more exceptional power supply than those for which the Mark Levinson line was already legendary.

For isolation, as well as for decentralization of sheer physical bulk, the basic power supply for the Nº 30.5 is located in the separate PLS-330 chassis. The PLS-330 actually contains three completely separate power supplies: one for the digital section of the Nº 30.5, and one each for the right and left audio channels. Three separate DC cables connect these supplies to the Nº 30.5 chassis.

The purity and stability of the DC power provided by the PLS-330 are superior to any previous Mark Levinson power supply, yet power supply refinement does not stop there. Additional local power supply regulation is provided for each of the analog channels inside the vertical towers of the main chassis, and also within the digital center section. This redundant regulation provides further filtering and stabilization, and also eliminates any degradation of the power quality due to cables and connectors. Only through this "distributed" regulation can we achieve the isolation and purity of power that are the foundation of the Nº 30.5's reference-quality performance.

DIGITAL FILTERING

Like all Mark Levinson products, the Nº 30.5 is a thorough design, innovative in every respect. Innovations, however, must be seen within the context of a complete system. Experience has shown that it is all too easy to overemphasize the importance of only one or two design elements. This approach either wastes resources on insignificant refinements or actually *degrades* performance through unforeseen interactions with other aspects of the design.

For example, although extremely high oversampling (16x, 32x, even 64x and higher) has some theoretical technical advantages and undeniable marketing appeal, it makes the entire digital processor more susceptible to the unwanted effects of data "jitter" (inconsistencies in the timing of the digital audio signal). As a consequence, extremely high oversampling actually results in lost musical resolution rather than sonic improvement.

Similarly, it is tempting to use digital signal processing (DSP) chips to implement proprietary filtering algorithms. Unfortunately, the general-purpose, programmable DSPs that can be used for these proprietary filters provide flexibility at the expense of speed. As a consequence, their use allows a wide range of filtering algorithms, all of which are severely limited in their sophistication.

A far better approach is to develop a richly sophisticated filtering algorithm and to then "commit it to silicon" in the form of an application-specific integrated circuit, or ASIC. Because the digital process is "hardwired" into the chip itself, an ASIC can execute a given filter algorithm many times faster than a general-purpose DSP. In the context of digital audio, where the amount of time between one digital audio sample and the next is predetermined, this additional speed allows the implementation of far more sophisticated, more powerful algorithms within the available time.

The ASIC chosen for use in the Nº 30.5 is the Pacific Microsonics® PMD-100. During extensive objective evaluations and subjective listening tests, the algorithm used in this digital filter was found consistently to offer the finest performance with a wide range of program material. All digital filtering and processing maintains a true 24-bit throughput capability, providing greater digital resolution than any existing source component, and full compatibility with professional standards.

In addition, the digital filter also incorporates High Definition Compatible Digital® (HDCD®) decoding to take full advantage of the increased resolution available from HDCD encoded 16-bit CDs. The High Definition Compatible Digital format retains much of the resolution inherent in professional twenty bit recordings by encoding this information more efficiently within the sixteen bit space available in most digital formats.

While our primary interest in the Pacific Microsonics digital filter was in its ability to outperform alternative designs with conventional recordings, the fact that it offers HDCD decoding makes the Nº 30.5 fully compatible with those recordings employing this new technology. Although it is up to the software companies to decide how many HDCD-encoded recordings will be offered for sale, people who invest in the Nº 30.5 will be able to make the most of *every* recording in their collection.

AN INTELLIGENT FIFO™

The Nº 30.5 introduces a new technology that dramatically improves the quality of the incoming digital signal, profoundly enhancing the sound of your CD transport, laserdisc player, DAT machine or any other digital source used with the Nº 30.5.

"FIFO" stands for "First In, First Out." It describes a simple buffer in which the digital information is stored temporarily on its way to being converted to analog. Just as a large water tower can provide a steady source of water to a small town, despite hour-to-hour variations in the supply of water from the well, a FIFO can provide a steady, consistent source of digital data to the internal converters that are responsible for changing that data into music. Even if there is significant "jitter" (inconsistencies

in timing) in the incoming digital information, the output of the FIFO is controlled by a special clock with tremendous accuracy. The result virtually eliminates the jitter and allows the musical information to be reproduced cleanly, without jitter-induced distortions.

The trouble with most FIFOs lies in their behavior when the incoming signal is poor enough to cause the "water tank" either to overflow or to be emptied. Normally, a FIFO would then have to "invent" false data to fill the gap, throw away excess data, or revert to non-FIFO operation. None of these approaches is desirable.

The simplistic response to such a problem would be to use an *extremely* large buffer, one which would never overflow or run empty. Unfortunately, this solution also is a poor one.

A larger buffer implies a longer delay between when information goes in and when it starts coming back out. With laserdiscs, for example, you must keep the in/out delay small so as to keep the soundtrack synchronized with the picture on the screen. An oversized buffer would cause actors' voices to *follow* the motion of their lips-an unacceptable situation. (Of course, one *could* bypass such a FIFO for movies, at the cost of all of its audible benefits.)

Madrigal engineers have developed a proprietary buffer management scheme which limits reproduced jitter to unprecedented low levels while maintaining the synchronization of sound and picture in movies. It employs a buffer large enough to absorb the jitter found in transports of reasonable quality, yet small enough to have imperceptible delay. The rate at which data is released from the FIFO buffer is controlled by software to track the *long-term* data rate of the incoming signal, allowing the buffer to absorb all the short-term variations which cause sonic degradation. This approach yields an intelligent FIFO buffering scheme which rejects virtually all incoming jitter without requiring an enormous buffer and the consequent audible delay. It also avoids the sonic penalties associated with the usual strategies used when a buffer overflows or empties.

The "intelligent" FIFO operates at both 44.1 kHz and 48 kHz sampling rates. The Nº 30.5 reverts to non-FIFO (recovered clock) operation for 32 kHz sampling rates (a proposed but rarely used standard for digital satellite transmission), or when the long-term data rate from the transport is extremely inaccurate.

Notice that the "reclocking" of the digital audio signal is done at the last moment before the data are sent to the DACs for conversion. This approach minimizes *all* sources of jitter: not only jitter stemming from the transport, but also that from subsequent digital transmission, digital receiving circuitry, digital filtering and all other digital circuitry. After the FIFO, the reclocked, jitter-reduced digital audio signal is driven directly (in dual differential mode) to the two towers for conversion to analog.

DUAL DIFFERENTIAL DIGITAL CONVERSION

The 20-bit DAC used in the Nº 30.5 has been manufactured according to Madrigal specifications and is made exclusively for Mark Levinson products. There are two digital to analog converters in each DAC module, working in opposite polarity in a differential, or "balanced," configuration. In this way, common-mode distortions or glitches that typify even the finest DACs are largely cancelled before they can be heard.

This DAC achieves precise 20-bit resolution benefiting conventional Compact Discs, HDCD recordings, and professional AES/EBU recordings. We are confident that its performance will not be significantly surpassed in the foreseeable future.

ANALOG FILTERING AND OUTPUT

The final analog filter and the output buffer of any digital processor are critical to its overall performance. The accolades showered on the Nº 30 validate the attention paid to this portion of Mark Levinson digital processor design.

The Bessel-tuned (for phase linearity) active filter in the output stage of the Nº 30.5 benefits from the use of current-mode amplifiers. The discrete component output buffer, implemented with a DC servo rather than coupling capacitors, sets a new standard for harmonic accuracy. In addition, the high current capability and low output impedance of this circuit ensure the best possible drive for interconnect cables and associated equipment.

With the introduction of the Nº 30.5, the Mark Levinson Reference Digital Processor once again leaps several years ahead of the widely-held "state of the art." The technology embodied in the Nº 30.5 qualifies it as a genuine Reference product, one which will stand the test of time and provide an invaluable touchstone for what is possible in digital audio reproduction. Its musical performance is destined both to satisfy the discriminating listener and to set a reference standard for years to come.

Nº 30.5 Specifications

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