№ 36
№ 37

MADRIGAL AUDIO LABORATORIES

Nº36 Digital Processor
Nº37 CD Transport

For years, Madrigal's Mark Levinson brand has been synonymous with the finest in digital audio. Used by manufacturers, recording professionals, equipment reviewers and music lovers around the world, Mark Levinson components consistently are held up as the standard against which others are measured.

The Nº36 Digital Audio Processor and the Nº37 Compact Disc Transport bring unparalleled performance, flexibility, and design sophistication to an audience for whom a Mark Levinson digital front end has been unattainable. Individually, each represents a significant advancement, yielding benefits to all associated components; together, they establish a new standard of value in digital audio, one that will stand the test of time.

The Nº36 Digital Audio Processor

A digital audio processor's role can be likened to that of the conductor of a symphony orchestra. The processor must coordinate the efforts of the many players in the orchestra (the various bits of the digital to analog conversion process) to create music that accurately reflects the instructions contained within the musical "score" (the digital audio signal). Unlike analog sources, the processor must make a musical signal from something which bears no resemblance to the original event, in a sense *creating* music rather than *reproducing* it. Small wonder, then, that digital processors sound as different as they do.

As with CD transports, describing the task of a perfect digital processor is simple; approaching perfection, however, is extremely challenging. An ideal digital processor would receive the digital information flawlessly from various digital sources, and convert each of the received numbers into its precise analog equivalent at *exactly* the right time. It would do so without introducing any extraneous noise or errors that either add to or subtract from the music signal being created. Successfully attaining these goals is expensive and demands careful attention to detail.

AN INTELLIGENT FIFO™

Unlike other processors which are highly dependent on the quality of the digital signal they are fed, the Nº36 Digital Audio Processor delivers outstanding performance with a wide range of digital sources, thanks to its Intelligent FIFO™. This technology, first developed for the Nº30.5 Reference Digital Processor, is a clear example of how extended research and development projects benefit a variety of Madrigal products.

"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 to the tower itself), a FIFO can provide a steady, consistent source of digital data to the converters which are responsible for changing that data into music. Even if there is significant "jitter" (timing inconsistencies) in the incoming digital information, the output of the FIFO is stable since it is controlled by a special reference clock with tremendous accuracy. The result largely eliminates the jitter and allows the musical information to be reproduced cleanly, without jitter-induced distortions.

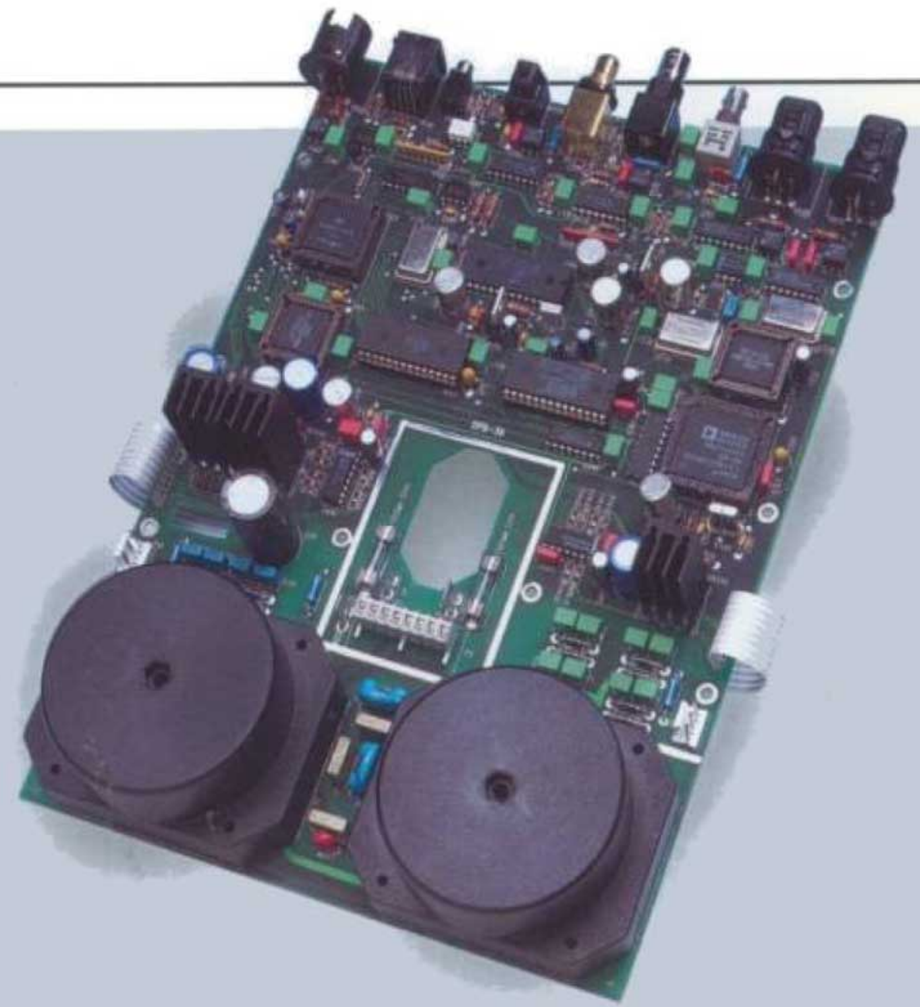
However, not all FIFOs are created equal. The trouble with most FIFOs lies in their behavior when the incoming signal is poor enough to cause the "water tank" to overflow or to be emptied. Normally, a FIFO would then have to "invent" false data to fill the gap, throw away excess data, or revert to non-FIFO operation. None of these approaches is desirable, as they all represent serious performance compromises.

Of course, one could simply use an extremely *large* buffer to minimize the chance of running empty or overflowing. Unfortunately, this solution is also a poor one.

A larger buffer implies a longer delay between when information goes in and when it starts coming back out again. With laserdiscs, for example, you must keep this transit delay small so as to keep the soundtrack synchronized with the picture on the screen. An oversized buffer would make every movie's sound out of step with its picture, an unacceptable situation. (In principle, of course, one could bypass the FIFO for movies—at the cost of losing all of its distortion-reducing benefits.)

Madrigal engineers have developed a proprietary buffer management scheme which reduces reproduced jitter to unprecedented 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 that cause sonic degradation. This approach yields a "smart" FIFO buffering scheme which rejects virtually all incoming jitter *without* requiring an enormous buffer, nor suffering the consequent audible delay. What little jitter that remains is "white" jitter, the least audible type in that it is totally uncorrelated to the music being reproduced. The Intelligent FIFO™ successfully avoids the sonic penalties associated with the strategies that would otherwise have to be used when a buffer overflows or empties.

The Intelligent FIFO™ operates at both 44.1 kHz and 48 kHz sampling rates. The Nº36 reverts to non-FIFO (recovered clock) operation for 32 kHz sampling rates (a proposed but rarely used standard for digital satellite transmission). It also reverts to the recovered clock when the long-term data rate from the transport is *extremely* inaccurate. *(Sorry, but the digital output of your CD portable will not sound as good as a fine CD transport such as the Mark Levinson Nº37.)*



The Nº36 Digital Board with Intelligent FIFO™ and independent power supplies.

24 BIT DIGITAL FILTER WITH HDCD® COMPATIBILITY

All digital filtering and processing in the Nº36 maintains a true 24-bit throughput capability (rounded to 20 bits prior to conversion), providing greater digital resolution than any commercial source component. Even the most stringent requirements of professionals can easily be met with the Nº36.

The digital filter used in the Nº36 is the Pacific Microsonics® PMD-100. During extensive objective evaluations and subjective listening tests, this digital filter (when fully optimized) consistently

The N°36 operates in a balanced configuration in both the analog and digital domains. Even single-ended digital inputs (anything other than the balanced AES/EBU standard) are immediately converted to balanced signals before any further routing or processing of the signal. Conversion to analog is also accomplished in two opposing polarity 20-bit converters per channel. This approach maintains the integrity of the signal, reducing the opportunities for music-destroying noise and digital artifacts to enter the signal path.

Top-quality analog outputs are provided in a balanced configuration via 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 TRANSPORT CHALLENGE

The characteristics of an outstanding CD transport are simple to define: while suppressing the noise inherent in digital processing, it must recover the correct data from the disc and deliver it to the digital processor without any timing errors. As simple as this sounds, achieving it in reality has been extremely difficult—as evidenced by the significant sonic differences between various CD transports.

Recovering the correct data, by itself, is not difficult. The error detection and error correction schemes used by all modern CD players are quite powerful. Since the technology used for compact discs borrows heavily from computer technology (where even a single error can cause a system "crash"), you might imagine that uncorrectable errors would be quite rare. If so, you would be right. Even badly scratched discs can often be played without difficulty.

Significant sonic differences between quality CD transports are frequently the result of differences in their *timing accuracy*: unlike a computer, digital audio depends on the signal being reconstructed by the digital to analog converters *at precisely the right time*. Timing errors in digital audio have come to be known as "jitter," which can be thought of as the digital version of "wow & flutter." These inconsistencies in the transmission rate of digital information distort the sound, causing it to sound harsh and unnatural.

Since compact discs operate with a 44.1 kHz sampling rate, there should be exactly 44,100 samples passed on to the digital processor each second. Moreover, each sample should consistently follow the previous one at precise intervals; that is, each sample of musical information should last for exactly 1/44,100th of a second before being replaced by the next one. One of the big challenges

in digital audio is "clocking" these samples out with a high level of precision—without it, the system falls short of its potential.

Traditional transport designs seek to retrieve the digital audio information from the disc itself at exactly the correct rate. An oscillator mounted on the laser pickup mechanism provides a "reference" frequency that is used to control the rate at which digital information is being extracted from the disc. You might think of it as being like the transport's "metronome," determining the "tempo" at which the musical information is recovered. Any discrepancy between the "tempo" of this oscillator and the transport causes the latter's motor to adjust its speed accordingly. Thus, in conventional CD transport design, the regularity with which information is obtained from the disc depends on the quality of the oscillator as well as on many associated components (such as the motor, its bearing, control servos, power supplies, etc.).

Unfortunately, this important oscillator exists in an extremely noisy electrical environment, close to the motor that spins the disc and to related circuits that interfere with the oscillator's consistency. The resultant electrical noises introduce timing errors in the critical reference frequency produced by the oscillator. In addition, mechanical problems such as friction, vibration, and inertia prevent the laser/disc mechanism from attaining even the imperfect level of accuracy called for by the oscillator. All of the resultant timing errors, regardless of their source, carry over into the delivery of the digital signal and have come to be known collectively as "jitter."

Subsequent handling of the digital audio signal in traditional transport designs cannot improve upon this "jittery" signal, lacking a better reference. To the contrary, the various stages of signal processing between the laser pickup and the final output can only contribute additional jitter of their own.

Until now.

A NEW GENERATION

The Mark Levinson Nº37 Compact Disc Transport leaps beyond conventional digital audio playback technology by employing a proprietary, closed-loop jitter-reduction system in conjunction with an industrial-quality CD-ROM drive. Simply put, the Nº37 separates the recovery of the actual digital data from the task of maintaining a consistent, jitter-free output. This separation of labor allows each task to be performed with greater accuracy than is otherwise possible: both accurate data recovery and jitter-free performance are optimized.

The Nº37 derives its reference frequency from a part custom-made for the task: a temperature-compensated crystal oscillator that acts as a "clock" with better than five part-per-million accuracy. This oscillator is isolated from the noisy environment of the laser mechanism and placed on a quiet, independent digital output board. Bene-

fiting from its own dedicated power supply and electrically isolated signal feeds, this "clock" provides a far more stable reference frequency than in any previous design. In addition, its very proximity to the digital output minimizes the opportunity for corruption of the reference frequency (by minimizing the distance between the oscillator itself and the digital output circuitry).

Prior to the digital output, each bit of the digital audio signal is momentarily stored in a small memory buffer, and then released according to the accuracy of the reference "clock." This process virtually eliminates transport-related jitter from the digital audio signal, whether it be of mechanical or electrical origin. Since another bit must be ready to be loaded into the buffer when the current bit exits (on its way to the processor), this same crystal oscillator controls the all-digital servo used to control the rate at which the disc spins.

In effect, the design of the N°37 turns the accepted *status quo* on its head. By placing the all-important reference clock in the *final* stage of the transport's output section, and slaving the mechanical subassemblies to the requirements of the output rather than the other way around, the signal presented to the outputs of the N°37 is uncontaminated by electrically- or mechanically-induced jitter. The sonic advantages of this design are immediately apparent in the clarity, warmth and stunning dynamic contrasts exhibited by the N°37.

DIGITAL SERVO CONTROL

The laser mechanism used in the N°37 uses all digital servo control of its operations. Critical functions such as focus and tracking are handled completely in the digital domain with mathematical precision. A digital servo performs more consistently and predictably than an analog servo, and remains stable over time. Under normal conditions, the servo in the N°37 should never need adjustment or servicing.

OUTPUT VERSATILITY

All high quality digital output configurations are supported in the N°37. Each of these digital interfaces has been carefully optimized to deliver the finest performance its standard allows. As a direct result, the N°37 performs optimally with any digital processor without having to resort to techniques which would limit its compatibility to other Mark Levinson products.

For example, some digital processors yield their best performance using their ST-optical inputs, since an ST digital input is far simpler to optimize than the electrical inputs (even though the latter have greater *potential* performance). The N°37 uses a high-bandwidth Hewlett Packard® ST interface that outperforms more common, less costly parts.

The N°37 also supports both AES/EBU and S/PDIF electrical interfaces. A new complementary driver for the balanced AES/EBU electrical output delivers outstanding performance to the high quality XLR

connector. Single-ended S/PDIF electrical outputs are provided *via* both BNC and RCA connectors for complete compatibility with a wide variety of products. Special care has been taken with all the electrical outputs to maintain excellent symmetry between the rising and falling edges of the digital waveform (which looks like a series of square waves) to maximize high performance compatibility with the widest possible range of digital processors.

INDUSTRIAL DESIGN

The №37 shares the handsome industrial design of other Mark Levinson components such as the №36 digital audio processor. The combination of the hand-brushed, black-anodized aluminum faceplate and bead-blasted custom-machined buttons make operating the №37 a tactile as well as a sonic pleasure.

A large, easily read display provides information as to the operational status of the №37 from across the room, enhancing the value and usability of the supplied remote control.

In keeping with its sophisticated design, the №37 also incorporates a Madrigal-designed loading mechanism. Contrasting strongly with the bulky, plastic drawers commonly used, the slim ⅛-inch drawer is machined from a solid piece of aluminum and rides on highly polished steel and Teflon™ bearings. Its variable-speed design opens and closes quickly, without jarring the disc contained within. Optical sensors ensure that the drawer cannot close on an improperly-placed disc—something off-the-shelf drawer mechanisms cannot offer.

Unwanted mechanical energy is removed from the system using newly developed, exotic shock and vibration mounting materials that outperform the more commonly-used Sorbothane™ or Neoprene™. This high degree of mechanical isolation combined with the digital servo described above yield a fast tracking, error-free transport system.

CONVENIENCE FEATURES

Too often, high performance CD transports have eschewed convenience in the hopes of achieving greater performance. While there were good arguments for such a "minimalist" design in the days of analog turntables, modern digital formats (implemented with good engineering practices) no longer force the audiophile to give up operational convenience for the sake of musical performance. After all, convenience features in a digital product are largely a matter of writing appropriate software, and have no affect on the quality of the digital data itself.

As an example, the №37 supports custom programs, including "delete programming" wherein selected tracks are omitted from

One of two channels of digital to analog conversion within the N°36.

was found to offer the finest performance with a wide range of program material.

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 was designed to retain 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 lay in its ability to outperform alternative designs with conventional recordings, the fact that it offers HDCD decoding makes the N°36 fully compatible with 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 N°36 will be able to make the most of *every* recording in their collection.

The HDCD standard calls for internal gain-matching to eliminate the 6 dB difference in output level between conventionally-mastered CDs and most HDCD recordings. This gain-matching feature may be manually disabled in the N°36, allowing it to perform optimally at all times (and placing the burden of volume control on you, the listener). If the N°36 is used in conjunction with a Mark Levinson N°38 or N°38S preamplifier, the requisite gain-matching may be accomplished properly and automatically in the preamplifier rather than in the digital processor.

Changing the volume control on the preamplifier is by far the best way of compensating for disc-to-disc changes in volume, as it avoids potentially performance-degrading methods for gain matching. It avoids introducing any additional circuitry into the signal path, using the single high quality volume control of the N°38 instead. Neither analog "padding down" nor performing digital attenuation of strong signals, nor engaging an extraneous gain stage for the weak ones is required when the preamplifier can automatically adjust its volume setting as required by the digital processor.

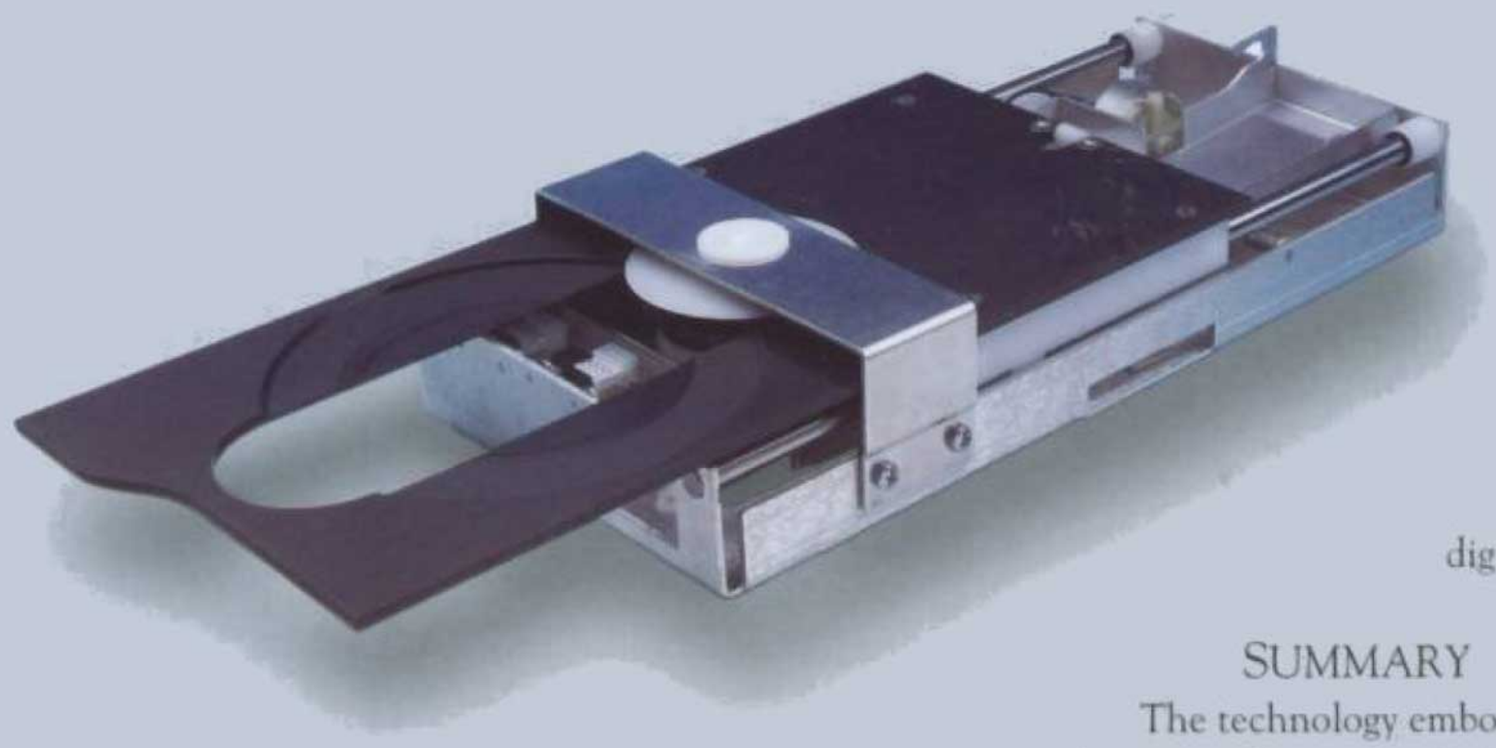
OTHER PERFORMANCE FEATURES

One of the advantages of a separate digital audio processor is that the redundant investment that otherwise might have been made in several sources with 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 N°36 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 N°36 to prevent their interaction with any portion of the circuitry inside the processor. As a result, the selected input effectively has the N°36 "all to itself." This extraordinary isolation holds true even when as many as six inputs are connected to active digital sources—a real possibility in this increasingly digital world.

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

Optical inputs are supported in both the ST and EIAJ formats. The N°36 offers a Hewlett-Packard implementation of the ST optical standard that delivers the highest performance of existing optical packages. Thanks in large part to the action of the Intelligent FIFO, the EIAJ-standard optical input (sometime called "Toslink™") delivers unsurpassed EIAJ performance.



the playlist. This allows the user to skip the one or two songs on an otherwise good disc that have been overplayed on the radio (for example). The N°37 will remember such programs for thousands of discs, should you want to save that many programs.

The remote control included with the N°37 provides for all normal operations. It even allows you to create a custom program from the comfort of your favorite chair. But it does more. When used in the context of a "Linked" Mark Levinson system (see below), the N°37 remote control even allows you to control the volume setting on your preamplifier, the digital input on your processor, and several other day to day functions—*without* having to juggle multiple remote controls.

COMMUNICATIONS LINKS

As with all Mark Levinson 30-series components, the N°37 incorporates a sophisticated inter-component communications bus. Unique among high performance audio systems, Mark Levinson 30-series components offer a degree of system integration that makes even complex systems easy to use.

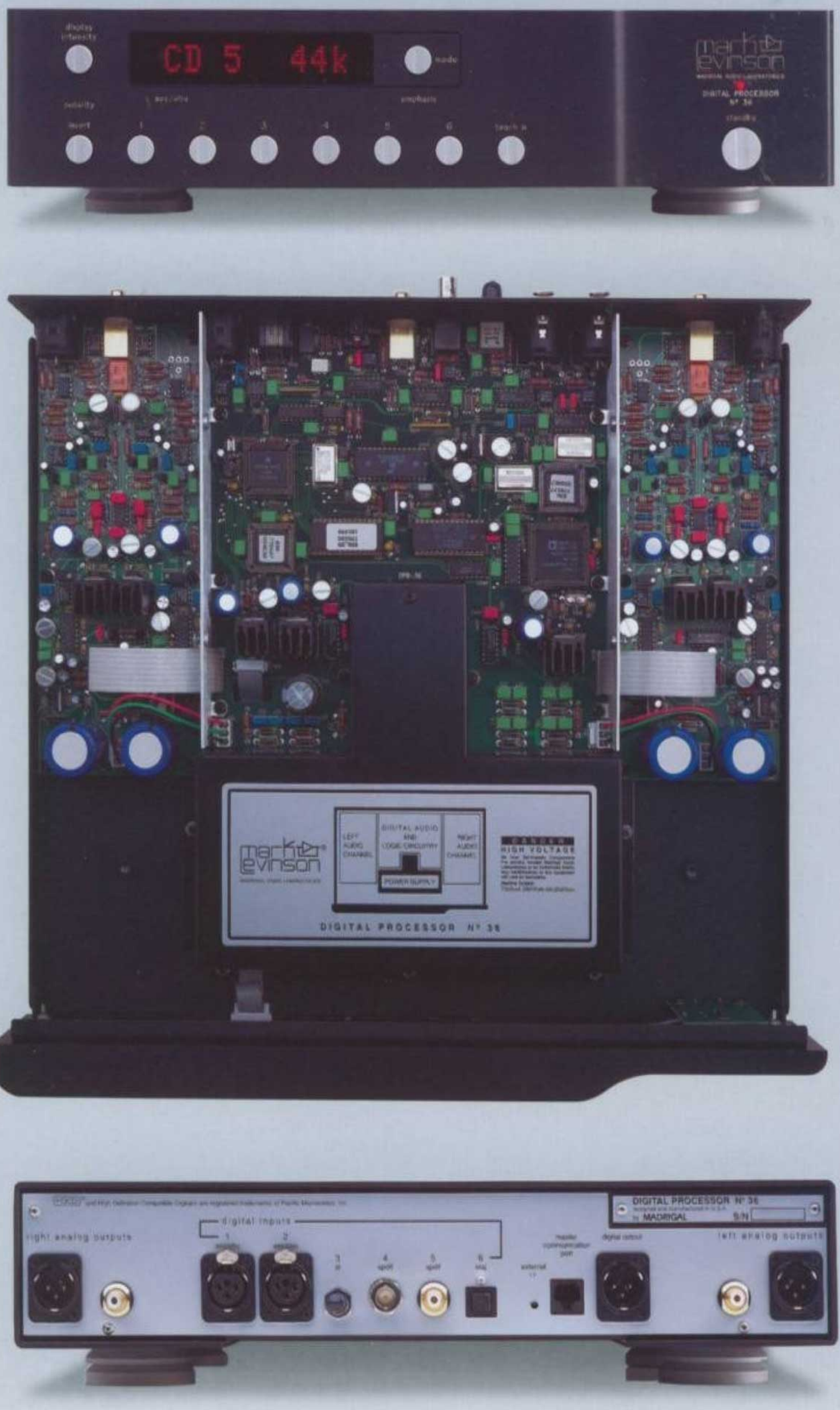
For example, pressing Play on the N°37 CD transport will bring it out of Standby and "wake up" the Linked digital audio processor, preamplifier and power amplifier(s). Next, both the digital processor and the preamplifier will automatically select the appropriate inputs so that a CD can be enjoyed. Even a sophisticated system with many components can thus offer one-button simplicity of operation.

In short, the Mark Levinson N°37 establishes a new standard for performance and value among high end CD transports and should be auditioned by anyone who desires the finest in digital audio.

SUMMARY

The technology embodied in the N°36 and the N°37 sets them apart from other high end products. Used separately, each establishes a new standard of performance and value. Together, the N°36 and N°37 form the heart of a digital playback system that offers uncompromising performance, outstanding flexibility, unsurpassed convenience and ease of operation.

No mere piece of printed literature can convey the pleasure derived from simply using these fine instruments. Please visit your nearest Mark Levinson dealer at your earliest convenience to evaluate the N°36 and N°37 for yourself, preferably as part of a complete, linked Mark Levinson system.



The adjustable-intensity LED display indicates the name, number and sampling frequency of the selected input.

When a new input is selected, the previous input's volume is gently muted and the display indicates "locking" until the new signal is fully stabilized.

All unselected digital inputs are capacitively shunted to ground to preclude any possibility of interference.

"Intelligent FIFO™" technology makes the N°36 largely independent of time-domain errors ("jitter") in the incoming digital audio signal.

The N°36 serves as the master control unit in the Mark Levinson Communications Linking system, providing exceptional ease of use and flexibility in system operation.

Extensive internal shielding (including some not shown here) minimizes electromagnetic interference and reduces noise, allowing the music to take on a live quality rarely heard in reproduced audio.

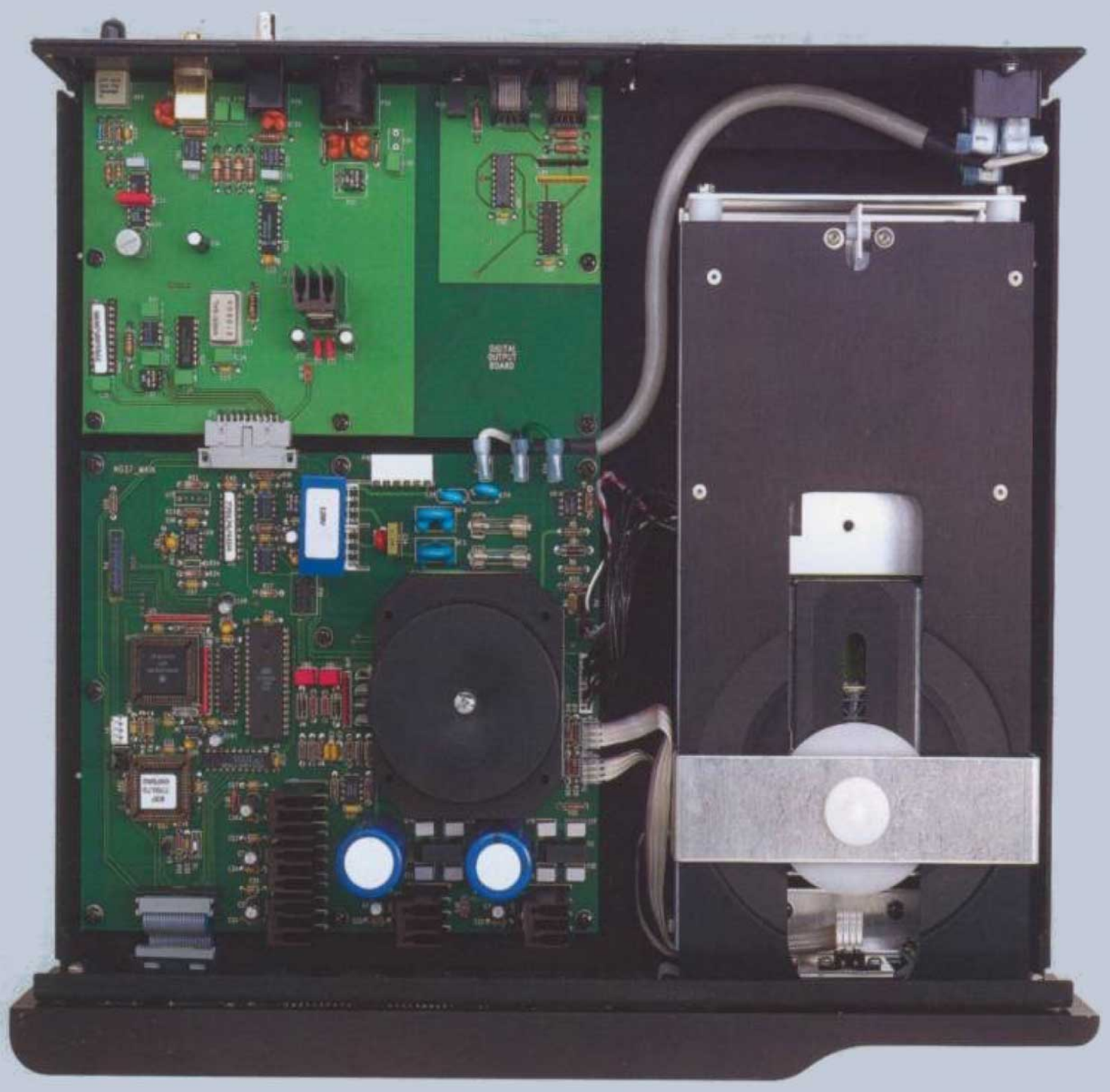
For top quality digital interconnection, two XLR electrical inputs employing the AES/EBU standard are provided. The popular S/PDIF electrical standard is supported also, with two inputs that use BNC and RCA connectors, respectively.

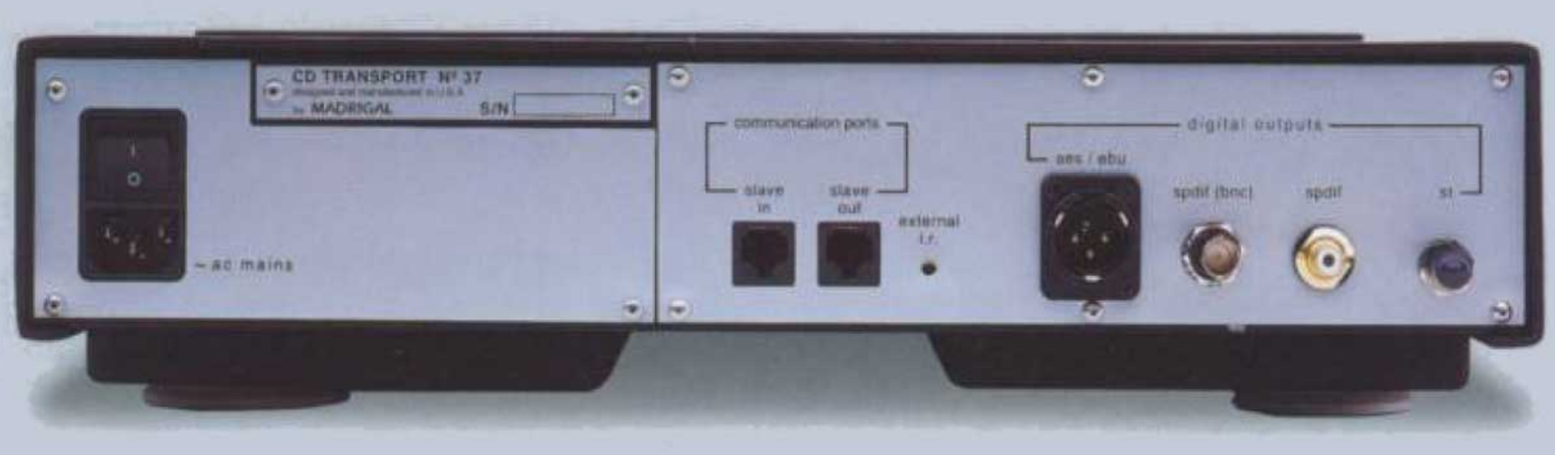
For compatibility with digital sources having optical outputs, the N°36 features optical inputs in both ST and EIAJ configurations.

The N°36's digital record path provides digital output via an AES/EBU (XLR) electrical connection.

Balanced analog outputs are provided via gold-plated XLR connectors. For components lacking balanced capability, single-ended analog outputs are available via Madrigal-designed RCA connectors.

A hard-wired infrared input makes custom installations simple, even when the components are hidden within cabinets.





The adjustable-intensity LED display normally indicates the track number and current time of the disc being played.

Both the N°37 and the N°36 receive and send infrared commands, allowing them to "teach" special commands to learning remote controls, giving them unsurpassed custom installation versatility.

Custom playlists for thousands of discs may be entered and stored for future use.

An all-digital servo controls the action of the laser with utter precision and consistency, eliminating any need for subsequent realignment or adjustment.

A temperature-compensated crystal oscillator with better than 0.0005% accuracy supplies the critical master clock for the Closed-Loop Jitter-Reduction™ circuitry.

An industrial 2x CD-ROM mechanism retrieves the data from the disc, and is isolated from vibration using an advanced polymer suspension that outperforms even other "exotic" materials such as Sorbothane™.

Madrigal Communications Linking technology provides for intelligent interaction between various Madrigal products, allowing (for example) one-touch operation: pressing Play will turn on all needed components and automatically select the appropriate inputs on the processor and preamplifier so that a CD may be heard.

A complement of fully optimized digital interfaces is provided to ensure the best possible results with a wide range of processors.

Rubber ribs along the length of the N°37's remote control enhance the user's grip and protect valuable furniture from scratches.

All Mark Levinson products are hand built in limited quantities to exacting standards. The thoughtful, multi-disciplined design and engineering expertise contained in a Mark Levinson component can be appreciated fully only by personally examining the product thoroughly, both inside and out, in conjunction with a careful audition.

The unique performance and extraordinary build quality of Mark Levinson products are realized only when integrated into a properly designed system. Our worldwide network of authorized dealers and distributors has been trained in the details and operation of our products and others which together reproduce music in its finest expression. We recommend that you contact the representative in your area to evaluate and purchase these fine instruments.

ADDITIONAL DATA: Nº36 DIGITAL AUDIO PROCESSOR

Frequency response:	10Hz - 20kHz +0dB, –0.2dB
Total harmonic distortion (THD):	0.001% @ 1 kHz, 0dB, A-weighted
Dynamic range:	greater than 98dB
Signal-to-noise ratio:	greater than 105dB
Channel separation:	greater than 110 dB
Digital-to-analog conversion:	dual differential 20-bit DACs
Digital filter:	24 bit, 8x oversampling, HDCD® compatible
Analog filter:	Bessel-tuned, linear phase to 40kHz
Output impedance:	Less than 6Ω
Mains voltage:	100V, 120V, 200V, 220V, 240V *
Mains frequency:	50 or 60 Hz *
Mains consumption:	50 watts
Overall dimensions:	15.75" W by 3.84" H by 14.3" D 40.0 cm W by 9.75 cm H by 36.3 cm D
Shipping weight:	35 lbs. (16 kg)

ADDITIONAL DATA: Nº37 COMPACT DISC TRANSPORT

Digital Outputs:	AES/EBU 110Ω, 3.5V (via XLR) S/PDIF 75Ω, .5V (via both RCA and BNC) ST optical
Mains voltage:	100V, 120V, 200V, 220V, 240V *
Mains frequency:	50 or 60 Hz *
Mains consumption:	50 watts
Overall dimensions:	15.75" W by 3.84" H by 14.3" D 40.0 cm W by 9.75 cm H by 36.3 cm D
Shipping weight:	34 lbs. (15.5 kg)

** factory set for destination country only*

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