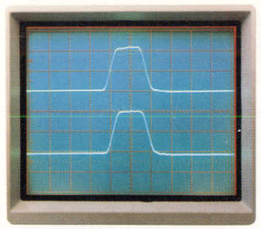
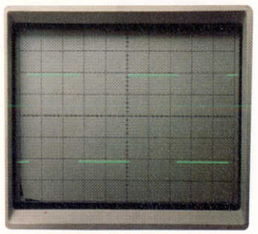
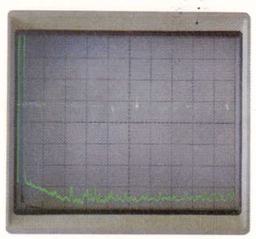


The extraordinary speed of the SL10 basic circuit is revealed in the input vs output pulse burst display above. Shown is the SL10 basic circuit responding to a 200 nanosecond pulse burst. The upper trace is the input pulse of a 100 millivolt peak burst. The lower trace is the output of the SL10 basic circuit, driven from a 50 ohm source, reproducing the burst at a 2 volt peak output. The display is calibrated to 100 nanoseconds per division (1 microsecond across the screen). Note the extreme similarity of the two traces at this extended performance level.



The superiority of DC response capability is clearly illustrated in the oscilloscope display above. Shown is the performance of the SL10 basic circuit reproducing a one-half Hertz square wave. Note the total absence of sag and, thereby, the capability for unencumbered low frequency performance.



The spectral noise density for the SL10 preliminary phono gain stage is shown above and indicates the extremely low, broadband, stochastic noise levels that can be obtained with an advanced, feedback-free design. The less than 50 nanovolts per √Hz noise density establishes a midband noise floor greater than 125dB below the 100 millivolt rated output. The spectrum display is calibrated to 50 nanovolts per vertical division. Frequencies shown are 20 Hz through 20,000 Hz with a filter bandwidth of 10 Hz. The input to the SL10 is shorted.

Threshold model SL10
technical data

description

Two channel, low-level signal processing unit having switch selected capacitance or impedance load characteristics for matching all velocity characteristic cartridges. Built-in, preliminary gain phono stage, operated without feedback, for moving coil or ribbon cartridges. Three high level amplitude characteristic (flat) inputs. Record/monitor facilities for a single tape recorder. Front panel control functions consist of program selection, instantaneous source or recorder monitoring, channel balance, and audio level. Audio processing circuits are powered from a separate power supply module and operate with a total of 20,000 microfarads capacitive regulation throughout the supply circuitry.

Audio circuits incorporate ultra-fast, cascode/class A, direct coupled operation. High gain, wide bandwidth (200,000,000 Hz) semiconductors are selected through noise and curve-trace linearity analysis. Auto-null assures dc offset of no more than ± 10 mv maximum at the output, even when injected at the input by associated equipment, without affecting audio response. Superior power supply rejection through quadruple decoupling.

active circuit data

performance of basic gain stages. (measured to IHF standards A202 for distortion specifications).

preliminary phono gain stage:

(all measurements made at highest input impedance)
FREQUENCY RESPONSE: .3 Hz through 500,000 Hz, +0, −3dB.
SQUARE WAVE RISE TIME: .5 microseconds.
TOTAL HARMONIC DISTORTION: .015% second harmonic @ 50 millivolts out. .03% second harmonic @ 100 millivolts out.
NOISE: (preliminary phono gain stage + RIAA gain stage): −80dB A weighted referenced to 1 volt out. −72dB unweighted referenced to 1 volt out.
CROSSTALK: (left minus right) > −70dB @ 1,000 Hz.
INPUT OVERLOAD: 70 millivolts peak for any frequency.
INPUT IMPEDANCE: selectable 1 through 15 ohms, 15 through 30 ohms, 30 through 50 ohms.

RIAA phono gain stage:

RIAA EQUALIZATION: no greater than .5dB deviation at frequency extremes.
TOTAL HARMONIC DISTORTION: .012%, 20 Hz through 20,000 Hz @ 2 volts out. typically: .008% @ 1,000 Hz.
SMPTE INTERMODULATION DISTORTION: .006% @ 1 volt out.
NOISE: −90dB A weighted referenced to 1 volt out. −75 dB unweighted referenced to 1 volt out.
CROSSTALK: (left minus right) −70 dB @ 1,000 Hz.
INPUT IMPEDANCE: 47,000 ohm and selectable 100 pf, 200 pf, or 400 pf.
INPUT OVERLOAD: 320 millivolt peak @ 1,000 Hz.
OUTPUT IMPEDANCE (tape out): 1,000 ohms.
GAIN FACTOR: +33dB @ 1,000 Hz.

high level gain stage

(performance of the basic gain stage outside the system)
FREQUENCY RESPONSE: dc through 500,000 Hz, +0, −3dB.
SQUARE WAVE RISE TIME: <.6 microseconds.
PROPAGATION DELAY: input to output transit time: <.02 microseconds.
PHASE SHIFT: <10° at 1,000,000 Hz.
SLEW RATE: 150 volts/microsecond.
TOTAL HARMONIC DISTORTION: .003%, 20 Hz through 5,000 Hz. .006%, 5,000 Hz through 20,000 Hz @ 5 volts out into 10,000 ohm, 1,000 pf load.
SMPTE INTERMODULATION DISTORTION: .008%, 10,000 Hz @ 5 volts out into 10,000 ohm, 1,000 pf load.
CROSSTALK: left channel to right channel; −60dB @ 1,000 Hz. tuner to auxiliary; −65dB @ 1,000 Hz.
GAIN FACTOR: +20dB.
MAXIMUM OUTPUT BEFORE CLIPPING: ±12 volts peak.

dimensions:

Faceplate: 19 inches wide, 2.62 inches high.
Chassis: 17 inches wide, 2.215 inches high, 8 inches deep.
Power supply: 8 inches wide, 3.375 inches high, 5 inches deep.

available accessories

Rack mount kit for S1 power supply consisting of 19 inch wide faceplate matching that of the SL10 audio module, hardware, and instructions.

Because Threshold is constantly researching new technology and materials the option is reserved to incorporate design refinements and/or modifications into existing product lines without notice or obligation.

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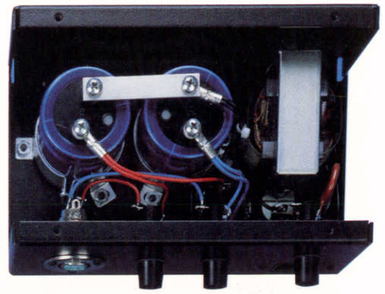
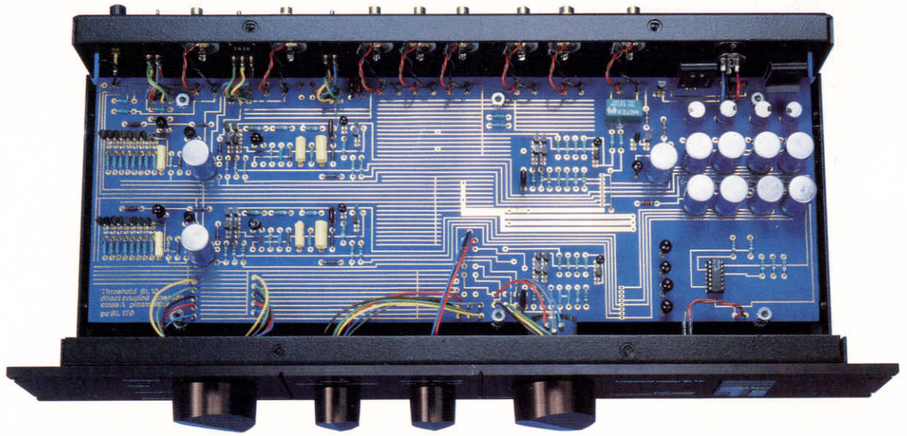
Threshold
model SL10
direct-coupled cascode/class A preamplifier

Threshold
model SL10



The interior of the Threshold SL10 reveals its premium components. The basic circuit board is military grade, double sided, gold plated, plated-through construction. All connectors and switch contacts are gold plated. Rotating controls are environmentally sealed. The separate power supply employs Mallory computer grade capacitors and carries an immense reserve capability with quadruple decoupling from the audio circuits.



The Threshold model SL10 preamplifier is the vanguard for a new generation of low-level signal processing units whose performance margins lie substantially beyond those required by the emerging, high technology, recording systems. As an exercise in highly advanced engineering, the Threshold SL10 represents fresh design concepts and empirical performance that establish new accuracy domains in the transfer of signal from source to amplifier. Several unique operating configurations are employed in the comprehensive SL10 system, allowing it to process at extremely high levels of information integrity.

Input transistors of the phono and high level circuits are operated in the cascode mode, which increases bandwidth through a reduction of "Miller" capacitances and provides additional isolation between the source, the power supply, and the gain circuitry. In addition, the active input devices are biased to current levels an order of magnitude beyond those normally applied to solid-state preamplifiers, particularly those reaching for the lowest possible "noise" figures.

These very large bias currents substantially reduce the distortions in the gain transistors, yielding a "super class A" operating mode where the idling currents are many times larger than the current called for in actual operation. Not only does the high bias assure extreme linearity but also increases the phono input transistor overload to approximately *2 volts,* measured at 20,000 Hz, for the high level magnetic cartridge input, and greater than *70 millivolts peak,* at any frequency, for the low level, "moving coil," cartridge input.

Biasing preamplifier transistors to the range realized in the SL10, however, creates undesirable voltage offset characteristics which impede the application of such levels in a dc coupled system. In the conventional approach to dc coupled design, input circuitry is optimized to the overriding requirement of low offset voltage. This avoids the cascading dc amplification of voltage and bias currents which result in severe driver offset or even damaged woofer assemblies. Unfortunately, to optimize for this single parameter in the high speed circuitry of the SL10 would have compromised the system's performance as an audio processor of maximum resolution. In order to realize the wideband phase integrity of a dc coupled design with the linearity of ultra-high bias levels, it was necessary to develop a unique offset nulling circiut that would assure absolutely stable dc performance under all conditions. This peripheral control system, completely outside the signal processing path, watches for the presence of dc offset through the signal carrying circuits and nulls it to "0" at the SL10 output over a time span far outside the region of subsonic information. The action of this null circuit even includes effective cancellation of offset originating in associated equipment connected to an input of the SL10. As a result, the SL10 exhibits the dc stability of a capacitively coupled feedback loop but with the *only* capacitors appearing in the signal path being the individually calibrated polystyrene and tantalum devices used to obtain RIAA equalization.

The phono stage circuitry of the SL 10 employs an advanced approach to the handling of RIAA equalization in the feedback loop. Threshold's investigations into transient distortion phenomena have shown the desirability of maintaining a constant amount of feedback across the audio band. Most commonly this is achieved, in power amplifiers, through very low, and thus constant, open loop gain. The governing parameter is consistency and greater open loop feedback is permissible as long as the level of feedback remains constant versus frequency. Unfortunately, in an RIAA phono stage, a flat open loop characteristic results in a feedback variation of 100 to 1 across the audio band resulting in high feedback at high frequencies and low feedback at low frequencies. This causes lack of control for bass information and stability problems at high frequencies.

One solution that has found recent favor has been to split the phono stage into two flat gain stages which are separated by passive RIAA equalization. This allows constant feedback for each stage. The technique has two disadvantages however: the additional degradation caused by two circuits in series, instead of one, and greater susceptibility to high frequency input overload from the pre-emphasized disc.

Threshold uses an original approach to the problem whereby the open loop curve of the phono stage is shaped to compliment the RIAA characteristic, resulting in a virtually constant amount of feedback across the audio band. The SL10 exhibits high open loop gain when 60 dB of closed loop gain is required at low frequencies and low open loop gain at high frequencies where only 20 dB of closed loop gain is called for. This technique allows constant feedback to be achieved without the use of two circuits, and with a phono overload point which increases with frequency to accommodate disc pre-emphasis.

The Threshold SL10 is designed to accept all velocity characteristic phono cartridges, providing equalization to the exact reverse of the RIAA recording characteristic, and includes a highly advanced pre-preamp section. Not a transformer, this preliminary phono gain circuitry circumvents the performance limitations inherent in these devices to attain very low noise, extraordinary definition, and high rejection of rf interference. Consisting of eight transistors per channel, *directly coupled to the input and operated without feedback,* the SL10 circuit forms the active synthesis of a transformer while avoiding the reactance effects that compromise transformer performance. The circuit is a system of such accuracy that it does not require frequency compensation or corrective feedback and therefore maintains extremely high levels of speed and phase integrity.

Designed as a "modular" system, the Threshold SL10 consists of two interconnected components. In order to eliminate any possibility for the noise pickup that occurs when audio circuits are in proximity to ac power components, the SL10 utilizes an independent power supply module that may be located at a distance from the audio module. The reserve capability of the supply lies far beyond the demands of the audio module. Its construction features computer grade Mallory capacitors and there is a total of *20,000 microfarads* regulation exhibited within the supply circuitry. Quadruple decoupling, consisting of 14 electrolytics and monolythics in parallel, provides isolation equivalent to a separate power supply for each preamplifier gain stage. Absolutely no interaction between stages or channels is allowed to occur through this elaborate power source system.

The Threshold SL10 is a discrete design employing components of the highest grade. Dale and Corning metal film resistors are used throughout. All connectors, circuit paths, and switch contacts are gold plated. Audio level is controlled through a Waters, conductive plastic, dual potentiometer which is environmentally sealed, as are all rotating switches. For maximum noise shielding, the chassis and cover of the SL10 and its power supply are fabricated of sheet steel. *All* transistors used in the SL10 are individually curve traced on Tektronix equipment to determine gain and linearity characteristics, while those transistors actually in the signal path are further selected for an ultra-low noise component.

As a component evolving from the most advanced engineering concepts, the Threshold SL10 will provide uncompromised performance when coupled with associated equipment of the highest calibre. The audio path is so simple, so distortion free, and so extraordinarily fast that within the broadest definition of "audio range" transient and phase anomalies simply do not exist. No expense has been spared in engineering or construction to assure that the SL10 fully justifies the Threshold claim to design concepts that constitute the leading edge of audio technology.