

HUSH Elite™

Professional Noise Reduction System

OWNER'S MANUAL

May be covered by one or more of the following:
U.S. Patents #4538297, 4647876, 4696044,
4745309, 4881047, 4893099 and 5124657.
Other patents pending.
Foreign patents pending.

HUSH
SYSTEMS

Contents

1. Introduction	Pg 1
2. Front Panel	Pg 2
3. Rear Panel	Pg 3
4. Connections	Pg 4
5. Operation	Pg 5
A. How the HUSH Elite™ operates.....	Pg 5
B. HUSH Elite™ controls	Pg 8
6. Specifications	Pg 10

1. Introduction

The HUSH Elite™ noise reduction system redefines the standard for excellence in the field of noise reduction. The approach in designing the HUSH Elite™ was to provide the maximum performance that could be obtained utilizing the latest technology available, yet maintaining a user interface as simple as possible. The Elite™ is the first commercially-available HUSH product that incorporates both high and low pass sliding filters to provide independent high and low band noise reduction.

The new patent-pending adaptive release circuit tracks the audio envelope and provides the proper release time based on the audio. The addition of this circuit eliminates the need for any user adjustment of the release time.

In addition, the Elite™ incorporates an intelligent "AUTO" mode for automatic continual adjustment for noise elimination. In this mode, the HUSH Elite™ detects the noise floor level present in the audio source and automatically adjusts the threshold for the dynamic filter and downward expander for optimal results.

For a thorough explanation of the HUSH Elite™ and its functions, please read this manual carefully and keep it for future reference.

After removing the HUSH Elite™ from the box, save all packing materials in case it becomes necessary to ship the unit.

PRECAUTIONS

NOTE: IT IS VERY IMPORTANT THAT YOU READ THIS SECTION TO PROVIDE YEARS OF TROUBLE FREE USE. THIS UNIT REQUIRES CAREFUL HANDLING.

All warnings on this equipment and in the operating instructions should be adhered to and all operating instructions should be followed.

Do not use this equipment near water. Care should be taken so that objects do not fall and liquids are not spilled into the unit through any openings.

The power cord should be unplugged from the outlet when left unused for a long period of time.

DO NOT ATTEMPT TO SERVICE THIS EQUIPMENT. THIS EQUIPMENT SHOULD BE SERVICED BY QUALIFIED SERVICE PERSONNEL ONLY. DO NOT MAKE ANY INTERNAL ADJUSTMENTS OR ADDITIONS TO THIS EQUIPMENT AT ANY TIME. DO NOT TAMPER WITH INTERNAL ELECTRONIC COMPONENTS AT ANY TIME. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY VOID THE WARRANTY OF THIS EQUIPMENT, AS WELL AS CAUSING SHOCK HAZARD.

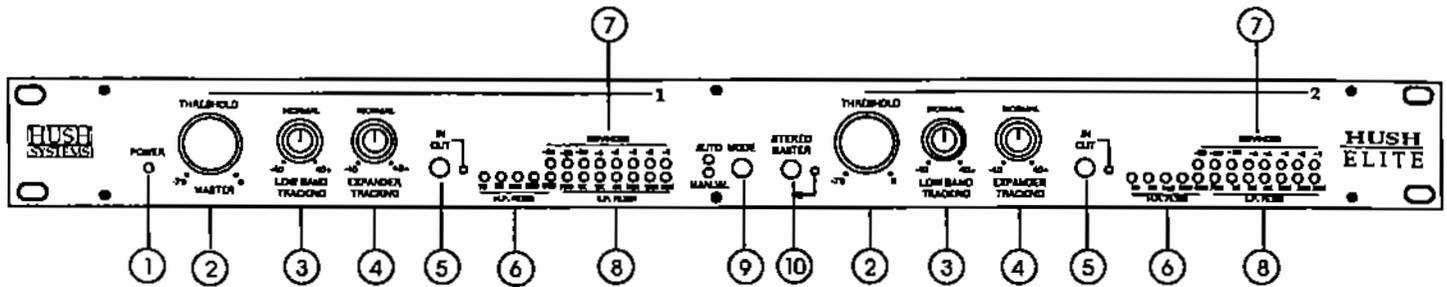
POWER REQUIREMENTS

This unit accepts power from the 9V AC/1500mA adaptor supplied with the unit. This 9V RMS AC voltage is internally processed by a voltage doubler, thus generating a bi-polar + & - 15V to maintain the headroom and sound quality of professional, studio quality equipment. Using an external power source such as this minimizes excessive noise and hum problems often associated with internal transformers, providing optimal performance for the user.

OPERATING TEMPERATURE

Do not expose this unit to excessive heat. This unit is designed to operate between 32 F and 104 F (0 C and 40 C). This unit may not function properly under extreme temperatures.

2. Front Panel



1. POWER led

When lit, indicates that the HUSH Elite™ is powered and ready for operation.

2. MASTER THRESHOLD control (Channels 1 and 2)

This control is used to adjust the threshold for the high band dynamic filter, the low band dynamic filter and the downward expander simultaneously for each channel.

3. LOW BAND TRACKING control (Channels 1 and 2)

This control is used to adjust the sensitivity of the low band portion of the noise reduction relative to the high band noise reduction for each channel.

4. EXPANDER TRACKING control (Channels 1 and 2)

This control is used to adjust the sensitivity of the downward expander for each channel.

5. Channel IN/OUT switch and led

This switch is used to switch each individual channel in or out of the circuit path. When the led is lit, the channel is active.

6. HIGH PASS FILTER led meter (Channels 1 and 2)

This led meter indicates the current bandwidth (in KHz) of the high pass filter for each channel.

7. EXPANDER meter (Channels 1 and 2)

This led meter indicates the current amount of gain reduction (in dB) taking place in each channel.

8. LOW PASS FILTER meter (Channels 1 and 2)

This led meter indicates the current bandwidth of the low pass filter for each channel.

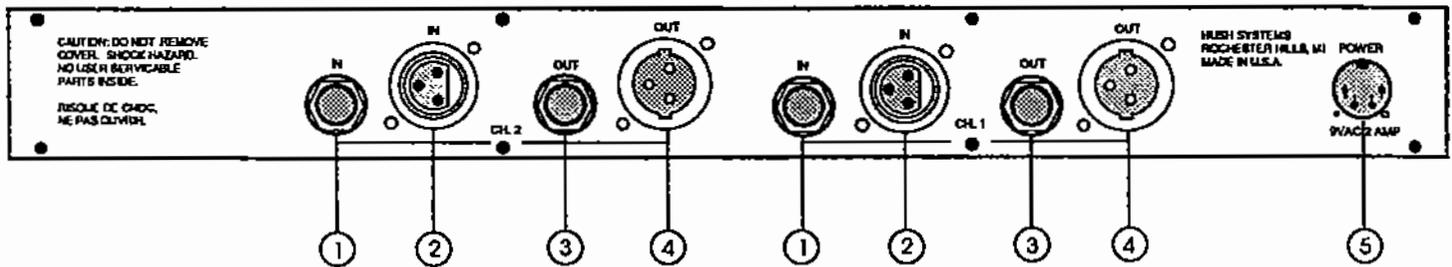
9. AUTO/MANUAL MODE switch

This switch allows the user to select manual or automatic operation (when switched in "AUTO" mode, the front panel controls are inoperable). The lit led indicates the current mode that the Elite™ is operating in.

10. STEREO MASTER switch

When switched in (led lit), channel 1's controls manipulate both channel 1 and 2 (channel 2's controls become inoperable).

3. Rear Panel



1. 1/4" INPUT jacks (Channels 1 and 2)

These 1/4" mono jacks provide an unbalanced input to each channel of the HUSH Elite™. These jacks are provided for applications which require -10dB reference operation.

2. XLR INPUT jacks (Channels 1 and 2)

These XLR jacks provide a balanced input to each channel of the HUSH Elite™. These jacks are provided for applications which require +4dB reference operation.

3. 1/4" OUTPUT jacks (Channels 1 and 2)

These 1/4" mono jacks provide an unbalanced output from each channel of the HUSH Elite™. These jacks are provided for applications which require -10dB reference operation.

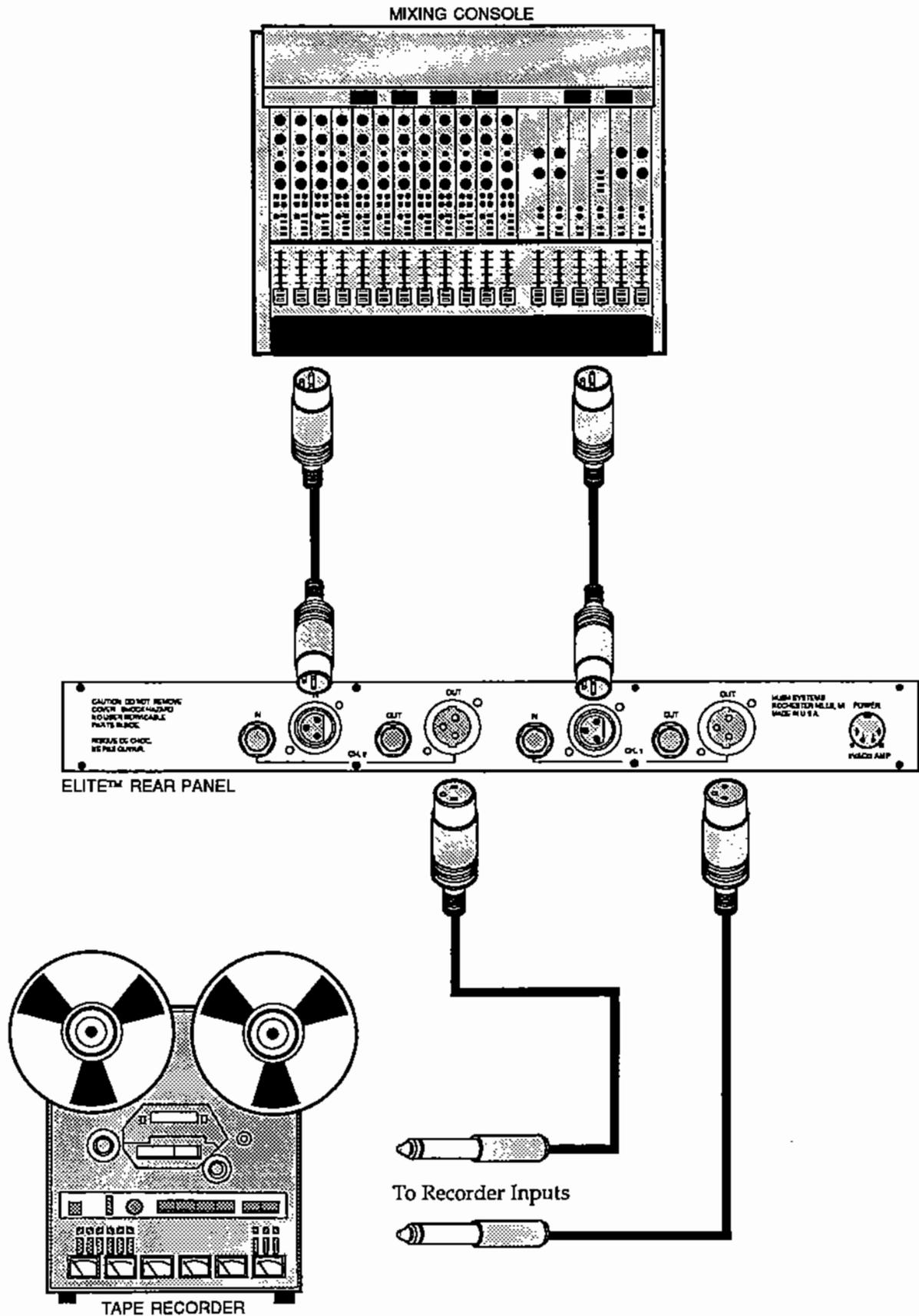
4. XLR OUTPUT jacks (Channels 1 and 2)

These XLR jacks provide a balanced output from each channel of the HUSH Elite™. These jacks are provided for applications which require -10dB reference operation.

5. POWER jack

This 4 pin DIN connector accepts power from the 9VAC adaptor supplied with the unit.

4. Connections



5. Operation

When properly used, the HUSH Elite™ should be completely transparent (i.e. it should have no effect on the audio signal). To maximize the performance of the HUSH Elite™, it is necessary to understand both the purpose of each of the controls and also how they perform together. By understanding how these controls work, it will be easier to set up the HUSH Elite™ to suit any application.

A. Principles of HUSH Elite™ operation:

The HUSH Elite™ achieves noise reduction by employing three individual processes which work cohesively to attain superior results. These processes are:

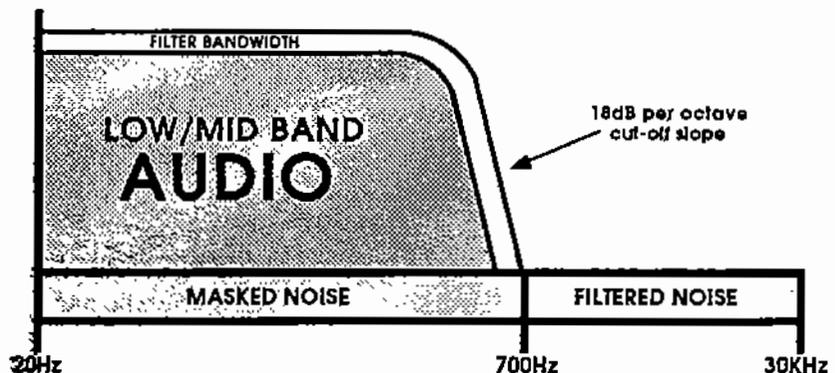
1. High Band Dynamic Filtering
2. Low Band Dynamic Filtering
3. Low Level Downward Expansion

The High Band Dynamic filter is actually a low-pass filter which passes low frequency information while filtering (or reducing) high frequency information. Likewise, the Low band Dynamic filter is actually a high-pass filter which passes high frequency information while filtering (or reducing) low frequency information.

The HUSH Elite™ is the first HUSH™ product to utilize both low and high band dynamic filtering simultaneously. The inclusion of the low band (or high pass) filter allows for the processing of high band audio (such as a cymbal crash) while still maintaining low band noise reduction.

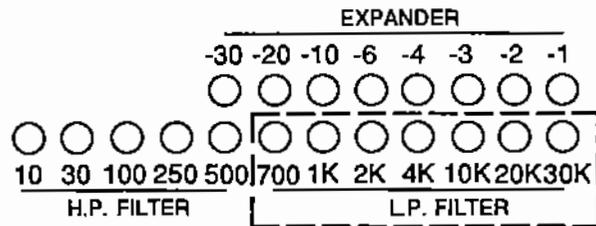
High Band Dynamic Filtering involves opening and closing the bandwidth of a low-pass dynamic filter dependant upon the amount of mid and high frequency information present in the input audio signal. The filter bandwidth will open to pass the high frequency information in the input signal while reducing the high frequency noise above the highest input signal frequency. For example, if the highest input frequency is 8KHz, the filter will open to pass up to 8KHz while the noise from 8KHz to 20KHz would be reduced.

Graphic Representaion
of the
High Band Filter



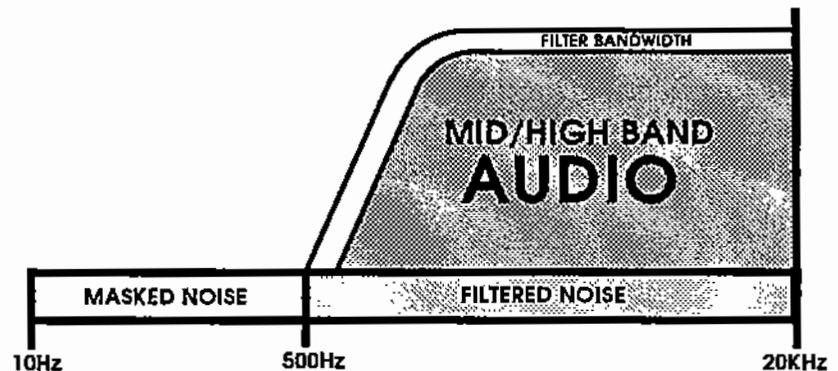
The Low Pass Filter meter indicates (in KHz) the current bandwidth of the high band filter. This bandwidth is dependant upon the highest frequency currently in the audio signal. As the highest frequency decreases, the bandwidth of the low pass filter decreases - thus removing the high frequency noise above the highest frequency of the audio signal.

Front panel LED meter



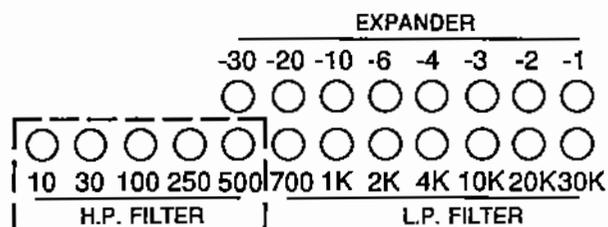
Low Band Dynamic Filtering opens and closes the bandwidth of a high-pass dynamic filter based on the amount of low frequency information present in the input audio signal. The filter bandwidth will open to pass the low frequency information in the input signal while reducing the low and mid frequency noise below the lowest input signal frequency. For example, if the lowest input frequency is 500Hz, the filter will open to pass down to 500Hz while the noise from 10Hz to 500Hz would be reduced.

Graphic Representaion of the Low Band Filter

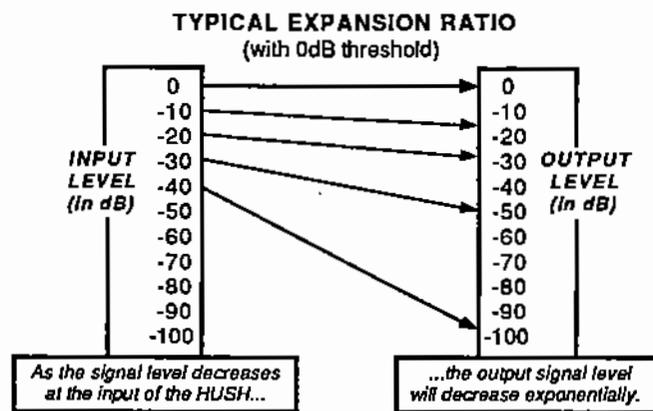


The High Pass Filter meter indicates (in KHz) the current bandwidth of the low band filter. This bandwidth is dependant upon the lowest frequency currently in the audio signal. As the lowest frequency increases, the bandwidth of the high pass filter decreases - thus removing the low frequency noise below the lowest frequency of the audio signal.

Front panel LED meter

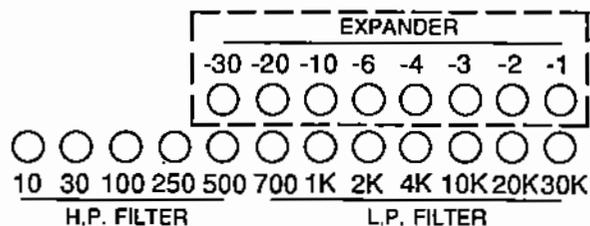


Low Level Downward Expansion senses the volume of the signal at the input of the HUSH Elite™. When the level of the input signal is above the selected threshold, the expander is not engaged and therefore has no effect on the signal. When the input signal level falls below this threshold, downward expansion takes place and the output signal is attenuated relative to the input signal. This attenuation rises exponentially as the input signal falls further below the threshold point (for example, a drop of 20dB below the threshold at the input will result in a 30dB drop at the output). When no signal is present at the input of the HUSH Elite™, the expander circuit will reduce the output level so that the noise floor is inaudible.



The Expander meter indicates (in dB) the amount of expansion gain reduction currently taking place. For example, if the "-1", "-2", "-3" and "-4" LEDs are lit, at least 4dB of gain reduction is taking place.

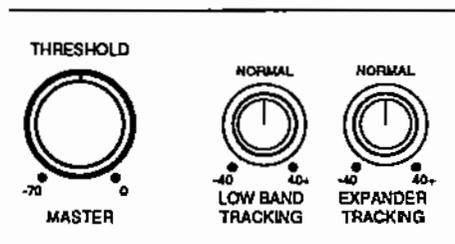
Front panel LED meter



B. Setting the HUSH Elite™ controls:

Each channel of the HUSH Elite™ consists of three controls - MASTER THRESHOLD, LOW BAND TRACKING and EXPANDER TRACKING, as well as three led meters. When operating the HUSH Elite™ in the "auto" mode, these controls are inoperable and no user adjustments are required.

When setting up the HUSH Elite™ for a specific application utilizing the "manual" mode of operation, begin with the MASTER THRESHOLD control fully counter-clockwise, and the LOW BAND TRACKING and EXPANDER TRACKING controls set at the center "normal" position.



Step 1: The Master Threshold control



The first control which needs to be set is the Master Threshold control. This control determines the level at which the high band dynamic filter, the low band dynamic filter and the downward expander will engage.

This control should be set based on the performance of the high band filter - i.e. as this control is increased, high frequency noise will be reduced dependant on the dynamic content of the audio signal. When this control is set too low, the noise floor of the audio source will hold the high band dynamic filter open when a signal is not present - thus allowing all high frequency noise to pass and causing undesirable "breathing" effects with any subtle changes in signal level. When set too high, the high band dynamic filter will remain closed when a signal is present and an audible loss of high frequency content will result.

Step 2: The Low Band Tracking control



After properly setting the Master Threshold control, the sensitivity of the low band dynamic filter (i.e. the high-pass filter) can be further adjusted (independent of the high band dynamic filter) via the Low Band Tracking control. Should there be an audible loss of low frequency information, the Low Band Tracking control should be turned counter-clockwise to open the filter bandwidth far enough to pass the low frequency information in the input audio signal.

Step 3: The Expander Tracking control



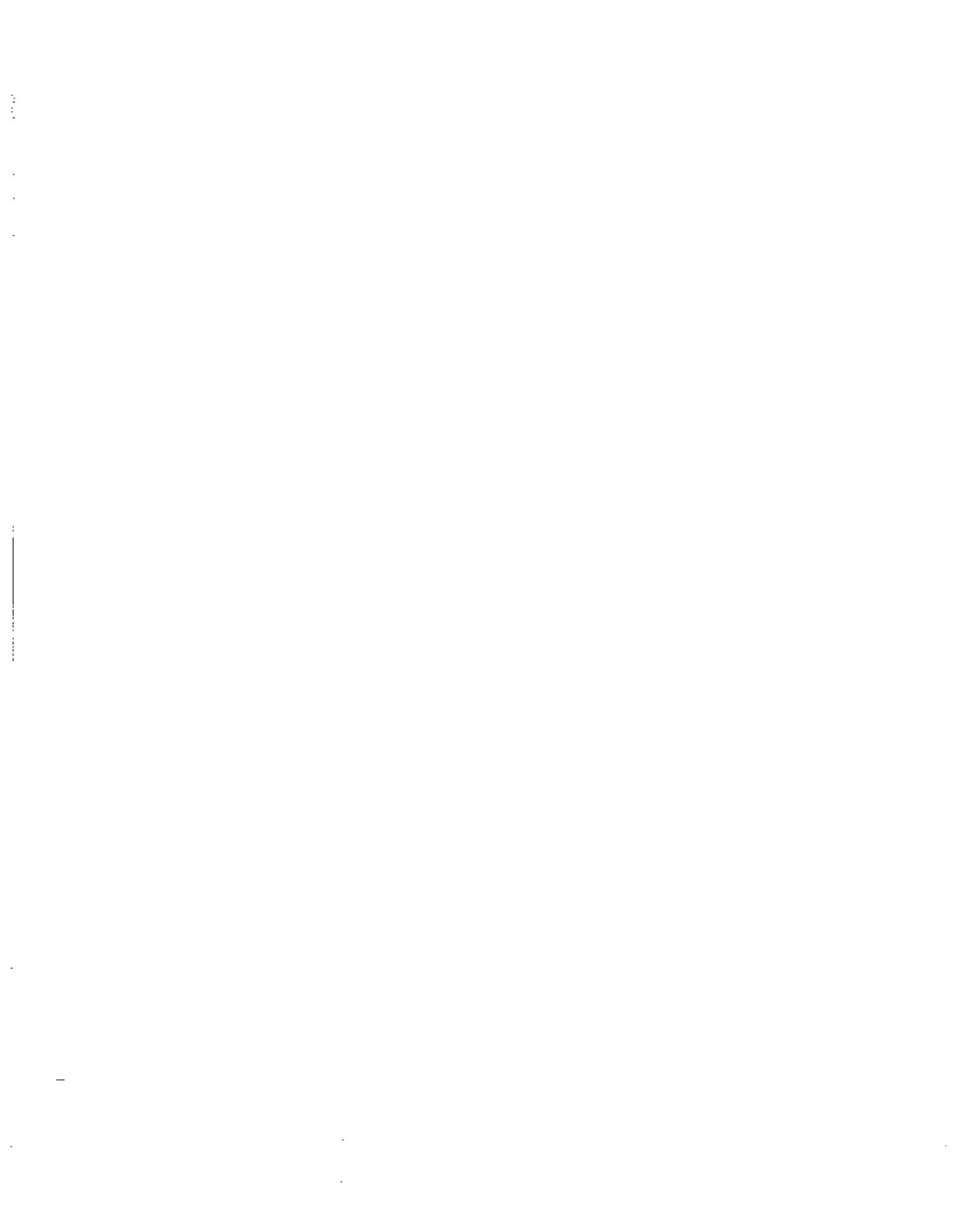
The sensitivity of the downward expander can also be fine tuned via the Expander Tracking control. If, after setting the Master Threshold control properly, the expander is coming in too soon and cutting off the audio signal, this control needs to be turned down (counter-clockwise) until the expander is no longer affecting the audio. Conversely, if the expander isn't coming in soon enough, noise will not be reduced during pauses in the audio and the Expander Threshold control should be turned up (clockwise) until the expander reduces noise during passages which do not contain audio.

6. Specifications

INPUT	
Input Impedance	24K Ω (+4 ref), 20K Ω (-10 ref)
Maximum Input Level	+18dBu (+4 ref), +7dBu (-10 ref)
Input Jack	Balanced XLR (+4 ref), Unbalanced 1/4" (-10 ref)
FREQUENCY RESPONSE	+1, -.5dB, 10Hz to 30KHz
TOTAL HARMONIC DISTORTION	Less than 0.018% at -10dBu, 1KHz (-10 ref) Less than 0.022% at +4dBu, 1KHz (+4 ref)
DYNAMIC RANGE	111dB, Peak signal to A-weighted noise floor (-10 ref) 107dB, Peak signal to A-weighted noise floor (+4 ref)
EFFECTIVE NOISE REDUCTION	Greater than 60dB
NOISE FLOOR	-104dBu (-10 ref) -88dBu (+4 ref)
FILTERS	
Low Band	Single pole Class A, 6dB per octave slope, Quiescent cut-off: 700Hz Maximum bandwidth: 50KHz
High Band	Triple pole Class A, 18dB per octave slope, Quiescent cut-off: 700Hz Maximum bandwidth: 50KHz
EXPANDER VCA	Class A
OUTPUT	
Maximum +4 Ref Output Level	+13dBu (+4 ref), +7dBu (-10 ref)
Output Impedance	Less than 100 Ω
Output Jack	Balanced XLR (+4 ref), Unbalanced 1/4" (-10 ref)
POWER REQUIREMENTS	9VAC RMS, 1374mA
DIMENSIONS	19" x 6" x 1 ³ / ₄ "

Note: 0dBu = 0.775V RMS

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