STUDIO HUSH®

U S E R ' S M A N U A L

ROCKTRON CORPORATION

CE

Your Studio HUSH® noise reduction system has been tested and complies with the following Standards and Directives as set forth by the European Union:

Council Directive(s): 89/336/EEC Electromagnetic Compatibility

Standard(s): EN55013, EN50082-1

This means that this product has been designed to meet stringent guidelines on how much RF energy it can emit, and that it should be immune from other sources of interference when properly used. Improper use of this equipment could result in increased RF emissions, which may or may not interfere with other electronic products.

To insure against this possibility, always use good shielded cables for all audio input and output connections. Also, bundle audio cables separately from the AC power cables. These steps will help insure compliance with the Directive(s).

For more information about other Rocktron products, please see your local dealer or one of our importers closest to you (listed on the enclosed warranty sheet).

Contents

Introduction

Congratulations on your purchase of the Rocktron Studio HUSH®!

The Studio HUSH is a rackmount single-ended noise reduction unit featuring the latest in HUSH® noise reduction technology (including the SSM2000 IC, available from Analog Devices) combined with the latest Variable Integrated Release (V.I.R.) circuitry configured for expander enhancement. This powerful combination provides extremely effective noise reduction while playing and complete silence when not.

The Studio HUSH also features an adaptive threshold feature which automatically adjusts the HUSH threshold as a program is played, providing optimum results regardless of the program source. A stereo link switch is also included to allow the controls for Channel 1 to act as the master for both channels.

This manual will introduce you to the various features and functions of the Studio HUSH. Please keep it for future reference.

About the SSM2000...

The SSM2000 is an advanced audio noise reduction system based on patented HUSH® technology. The SSM2000 is commercially available from Analog Devices, produced under the license of the HUSH patents. HUSH® combines a dynamic filter and downward expander to provide a high level effectiveness without the sonic artifacts normally associated with noise reduction systems. In addition, an Adaptive Threshold circuit detects nominal signal levels and dynamically adjusts both thresholds, thereby providing optimal results regardless of program source. Since it is a single-ended system, HUSH can be used on virtually any audio source, including audio and video tapes, radio and television broadcasts, or any other source with objectionable noise. The SSM2000 can also be used with Dolby® encoded sources with excellent results.

FEATURES:

- Up to 25dB of noise reduction from virtually any audio source without sonic artifacts
- External port available for additional attenuation— providing in excess of 85dB of noise reduction
- "Single-ended" operation eliminates need for encode-decode process
- Adaptive threshold dynamically adjusts to changing nominal signal levels
- Effectively decodes Dolby® encoded sources
- Direct VCA control port access for additional level control functionality
- Logic-controllable bypass and muting
- Flexible on-chip voltage reference
- 100dB dynamic range (noise reduction OFF)
- 0.02% typical THD+N (@ 1kHz, noise reduction OFF)
- +7V to +20V operation
- No royalty requirements

OPERATING 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 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.

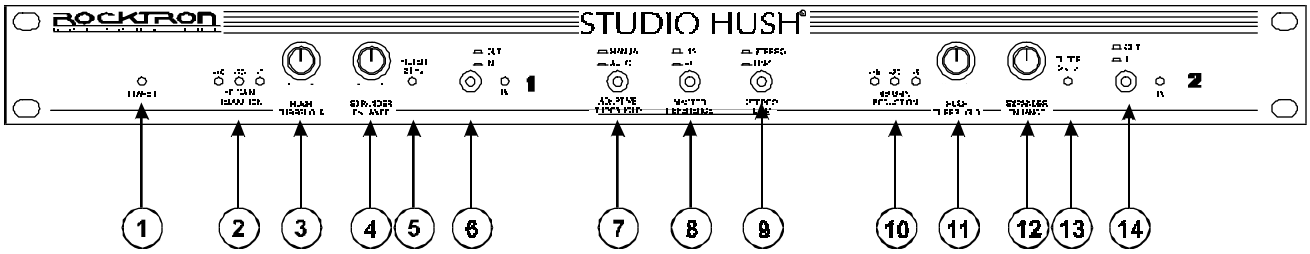
POWER REQUIREMENTS

This unit accepts power from the 9VAC/1500mA adaptor supplied with the unit. This 9 volt RMS AC voltage is internally processed by a voltage doubler which generates a bipolar ±15 volts 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.

Front Panel



1 ***POWER*** **LED**

When lit, this LED indicates that the Studio HUSH is powered and ready for operation.

2 ***GAIN REDUCTION*** **meter (Ch. 1)**

This L.E.D. array indicates the current amount of additional gain reduction generated by the *Expander Enhance* control.

3 ***HUSH THRESHOLD*** **control (Ch. 1)**

This control determines the level at which the downward expander and dynamic filter begin to operate for Channel 1. When the *Stereo Link* switch is set to *LINK*, this control acts as the master *Hush Threshold* for Channels 1 and 2.

4 ***EXPANDER ENHANCE*** **control (Ch. 1)**

This control determines the level at which expander enhancement will begin. As the input signal drops below this level, expander enhancement will activate and downward expansion will begin. The associated *Gain Reduction* meter (see #2) indicates the additional amount of downward expansion taking place.

5 ***FILTER 2kHz*** **L.E.D. (Ch. 1)**

When lit, indicates that the current bandwidth of the filter is below 2kHz.

6 ***IN/OUT*** **switch/L.E.D. (Ch. 1)**

This switch determines whether Channel 1 is currently active (*IN*) or bypassed (*OUT*).

7 ***ADAPTIVE THRESHOLD*** **switch**

This switch determines the adaptive threshold mode (*AUTO* or *MANUAL*) for both Channels 1 and 2.

When set to *MANUAL* mode, the *Hush Threshold* control for each channel is operable. In *AUTO* mode, the *Hush Threshold* controls are disabled and the adaptive threshold function is active. When active, the adaptive threshold circuit detects nominal signal levels and dynamically adjusts the threshold levels for Channels 1 and 2—providing optimal results regardless of the current program source.

The *Expander Enhance* controls may also be used when operating in *AUTO* mode to provide additional downward expansion.

8 ***MASTER REFERENCE*** **switch**

This switch determines the sensitivity of the Studio HUSH. When using the Studio HUSH with professional audio equipment providing a nominal output level of +4dB, it is recommended that the +4dB setting on the unit is used, as the threshold adjustment will allow you to optimize noise reduction for this reference level.

Reference selection is adjusted on both channels simultaneously.

9 ***STEREO LINK*** **switch**

When switched to *LINK*, the *Hush Threshold* and *Expander Enhance* controls of Channel 1 control both channels simultaneously. In this mode, Channel 2's controls are disabled, and any changes made to them will have no effect.

10 ***GAIN REDUCTION*** **meter (Ch. 2)**

This L.E.D. array indicates the current amount of additional gain reduction generated by the *Expander Enhance* control.

11 ***HUSH THRESHOLD*** **control (Ch. 2)**

This control determines the level at which the downward expander and dynamic filter begin to operate for Channel 2.

12 ***EXPANDER ENHANCE*** **control (Ch. 2)**

This control determines the level at which expander enhancement will begin. As the input signal drops below this level, expander enhancement will activate and downward expansion will begin. The associated *Gain Reduction* meter (see #10) indicates the additional amount of downward expansion taking place.

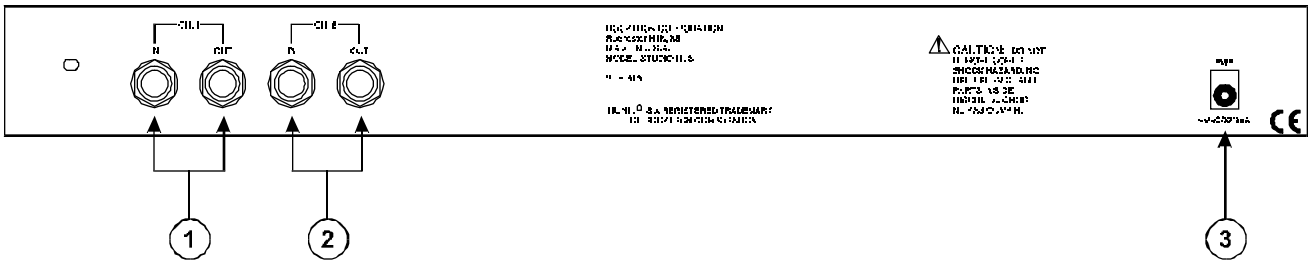
13 ***FILTER 2kHz*** **L.E.D. (Ch. 2)**

When lit, indicates that the current bandwidth of the filter is below 2kHz.

14 ***IN/OUT*** **switch/L.E.D. (Ch. 2)**

This switch determines whether Channel 2 is currently active (*IN*) or bypassed (*OUT*).

Rear Panel



1 ***INPUT / OUTPUT*** **jacks (Ch. 1)**

These ¼" phone jacks provide a mono balanced or unbalanced input and output for Channel 1.

```
T = "+",
R = "-",
S = "GND"
```

2 ***INPUT / OUTPUT*** **jacks (Ch. 2)**

These ¼" phone jacks provide a mono balanced or unbalanced input and output for Channel 2.

```
T = "+",
R = "-",
S = "GND"
```

3 ***POWER*** **jack**

This 2.5mm pin jack accepts power from the 9VAC adapter supplied with the Studio HUSH.

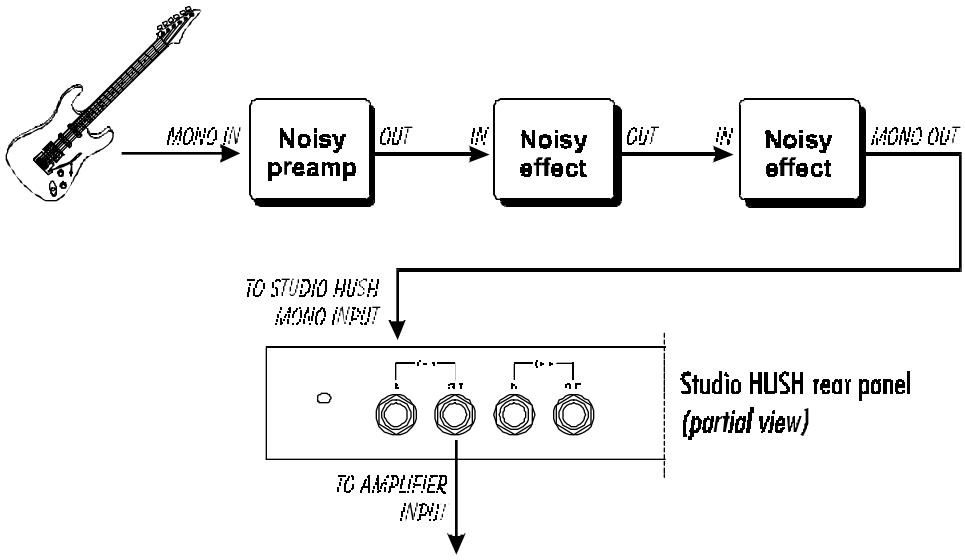
Connections and Applications

There are many possible connections for the Studio HUSH. The following pages illustrate the proper connections for many different applications.

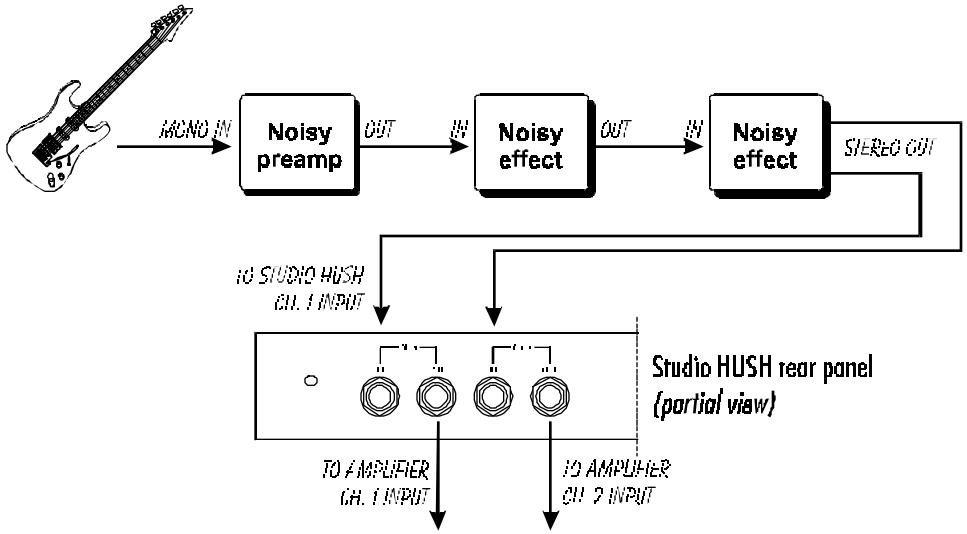
Guitar Applications

The following figures illustrate using the Studio HUSH with a guitar, effects and amplifiers. In these applications, the Studio HUSH quiets the noise generated from the guitar, preamp and effects.

Mono Example



Stereo Example

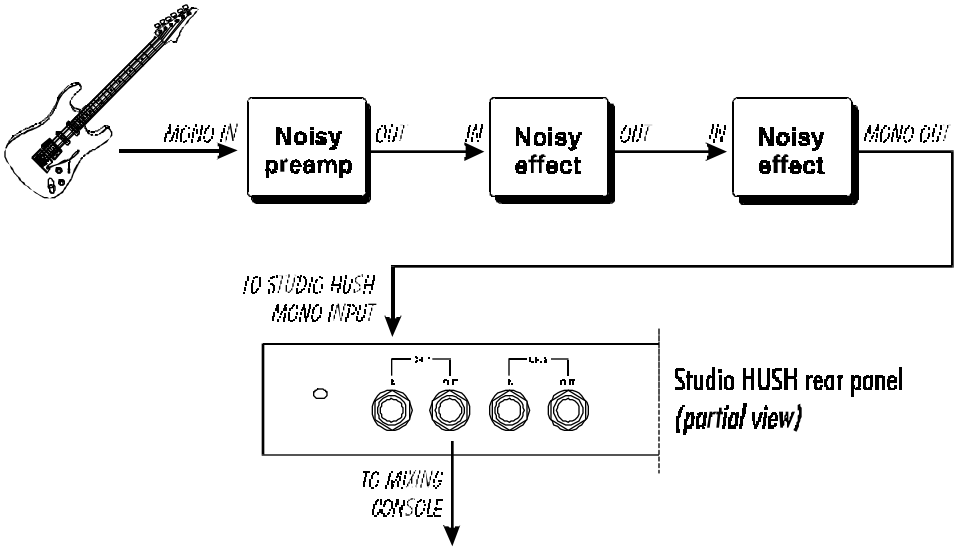


Note: It is also possible to connect from the effect outputs into the Studio HUSH when using the effects loop of an amplifier. This will quiet the preamp section of the amplifier.

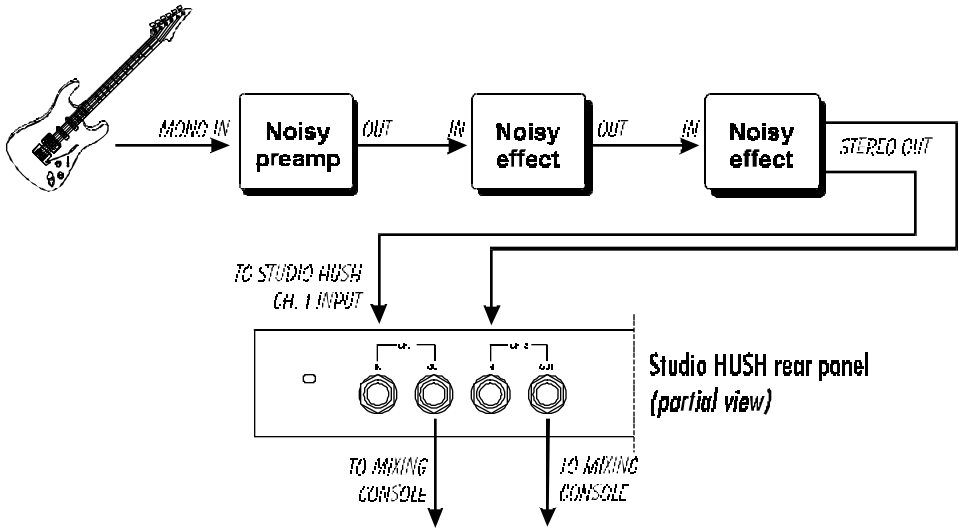
WARNING! **Never** connect the "Speaker Out" of any amplifier to the input of the Studio HUSH! This may result in severe damage to the Studio HUSH.

Recording Applications

Mono Example

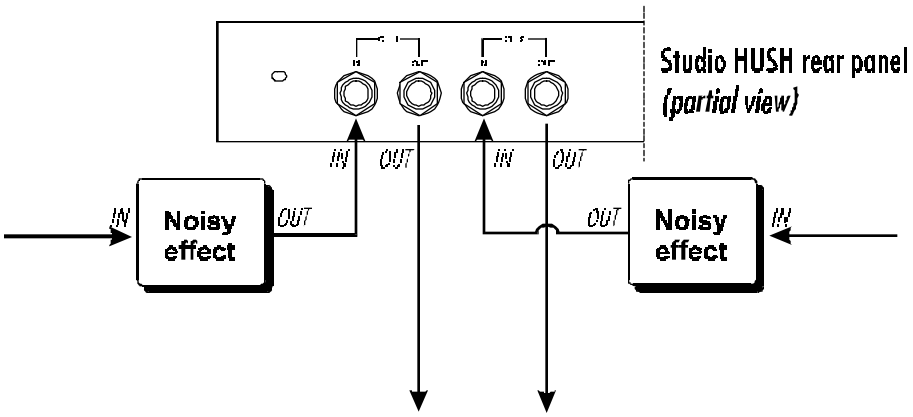


Stereo Example



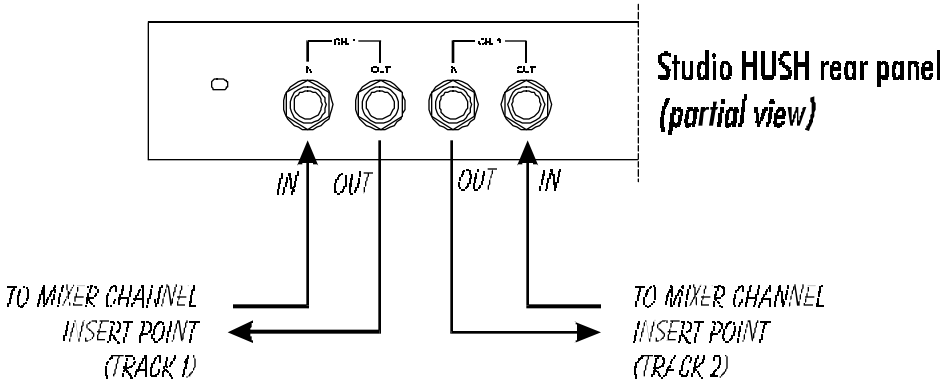
Studio Applications

The Studio HUSH has numerous applications for eliminating noise problems in the studio—from multichannel mixdown and two-channel mastering to reducing the noise in the recording of individual tracks. The Studio HUSH provides excellent results when copying previously recorded tapes, and can also be used to quiet outboard signal processing gear in the studio (such as digital delay lines, reverb units and drum machines).



Two-track Recording

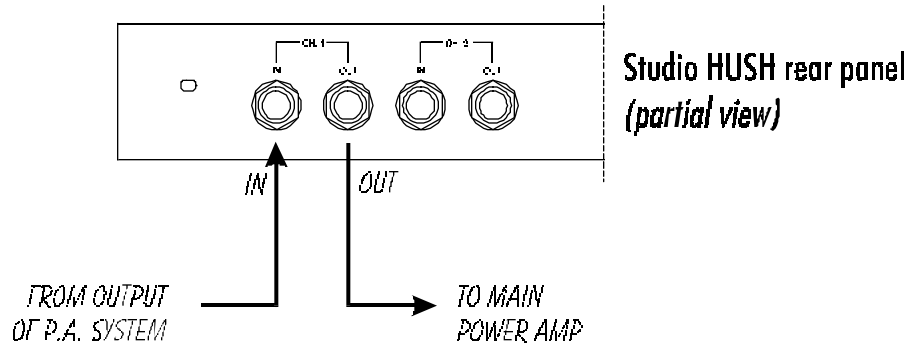
Below the Studio HUSH is shown patched in a channel of a mixing console for separate uses (vocals, guitar, etc.).



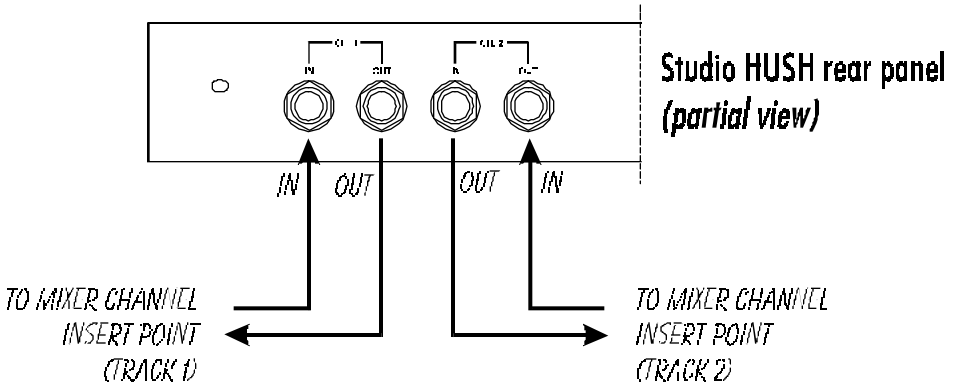
PA Applications

The Studio HUSH can be used on the output feed to the mains to quiet ambient stage noise and to reduce the noise of mixing consoles and any other signal processing devices used to inaudible levels.

Mono Example



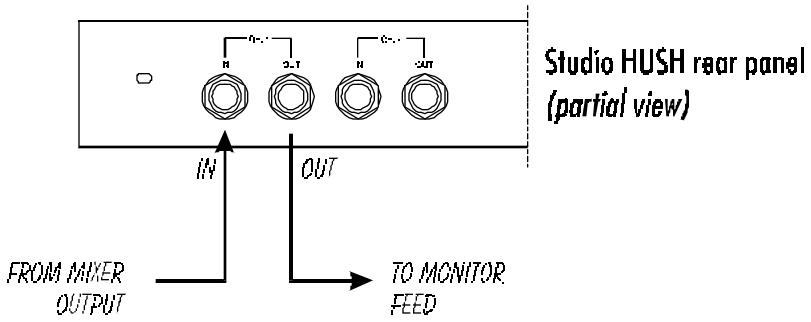
Stereo Example



Live Monitor Applications

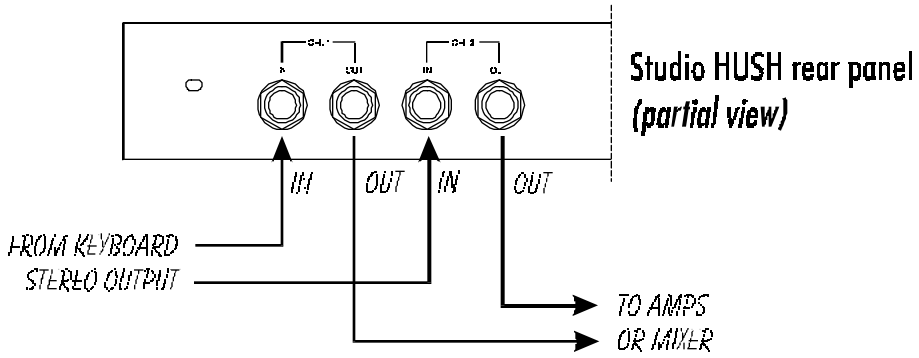
The Studio HUSH can be used to quiet monitor feed from the mixing console in a live application. This will help quiet the stage mix, and also greatly reduce the possibility of feedback from vocal microphones.

Mono Example



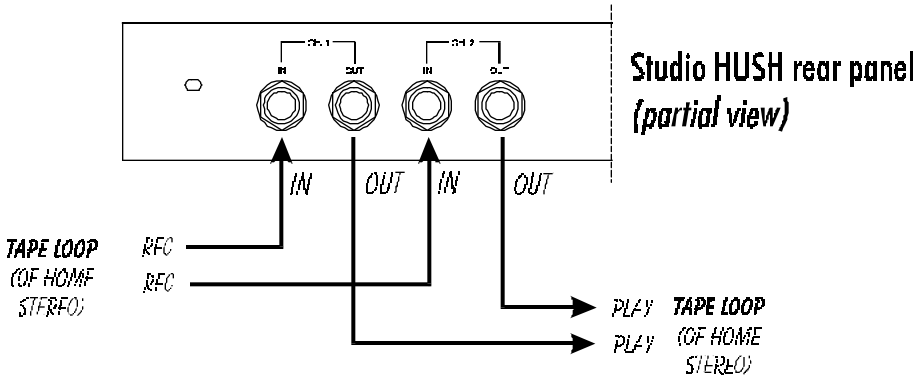
Keyboard Applications

The Studio HUSH can be used to quiet an entire keyboard mix before being fed to the power amplifier and speakers.



In the Home

By inserting the Studio HUSH into the tape loop of a home stereo system, the Studio HUSH can also be used to quiet tapes, compact discs, and FM broadcasts. The Studio HUSH can be used to reduce noise when making tapes (or copies) at home, and is also excellent for eliminating noise present in the home entertainment system when processing audio signals from VCRs.



Operation

When used properly, the Studio HUSH should be completely transparent (i.e., it should not affect the signal—only the noise). To maximize the performance of the Studio HUSH, it is necessary to understand its front panel controls and how they work together. By understanding how these controls work, it will be easier to correctly set up the Studio HUSH to suit any application.

The Studio HUSH front panel provides two controls per channel. The *HUSH Threshold* control sets the amount of noise reduction required for a given input signal, while the *Expander Enhance* control provides additional downward expansion when increased. (The *Expander Enhance* control may also be used by itself, allowing the unit to be used as strictly a downward expander.)

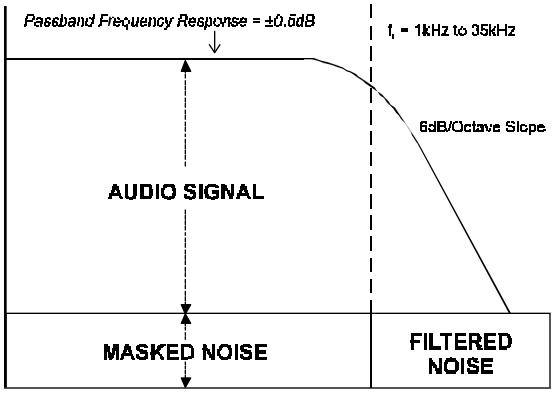
HUSH® Section

Rocktron's patented HUSH® noise reduction is a single-ended system that combines the principles of *dynamic filtering* and low-level *downward expansion*.

Dynamic Filtering

Dynamic filtering is achieved by dynamically-controlling a low pass filter which opens and closes the bandwidth of the output signal dependent upon the amount of mid and high band information present in the input signal. The filter bandwidth will only open far enough to pass the highest frequency information in the input signal, thus reducing the noise above it.

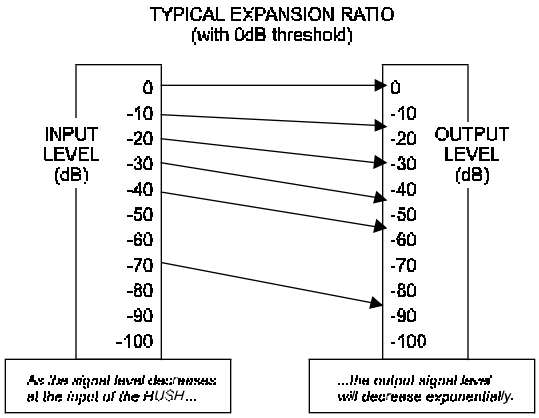
For example, if the highest frequency present in the input signal is 8kHz, the filter will open to pass up to 8kHz while the noise from 8kHz to 20kHz would be reduced. If a signal with frequency components up to 20kHz appears at the input, the dynamic filter will open to its full extreme (40kHz).



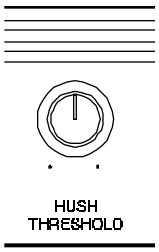
This means that if a signal is present at the input which consists of primarily bass components, the dynamic filter will reduce mid or high band noise. If no mid or high band information is present, the filter will close down to a pre-set cut-off point of 1kHz (allowing only frequencies of 1kHz and below to pass). However, if the input signal has high frequency components present, the dynamic filter will open fully to pass the signal and eliminate the possibility of a loss of high end frequency response.

Downward Expansion

The second half of the HUSH® process incorporates downward expansion. The low level expander of the HUSH® system operates like an electronic volume control. The HUSH® system utilizes a voltage-controlled amplifier (VCA) circuit which can control the gain between the input and the output from unity to 30, 40 or even 50dB of gain reduction. When the input signal is above the user preset threshold point, the VCA circuit remains at unity gain. (This means that the output signal level is equal to the input signal level.) As the input signal level drops below the user preset threshold point, downward expansion begins. It is at this point that the expander acts like an electronic volume control and gradually begins to decrease the output signal level relative to the input signal level.



As the input signal drops further below the threshold point, downward expansion increases. A drop in the input level by 20dB would cause the output level to drop approximately 40dB (i.e., 20dB of gain reduction). In the absence of any input signal, the expander will reduce the gain so that the noise floor becomes inaudible.

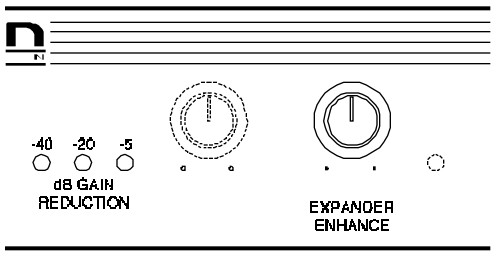


The front panel *HUSH Threshold* control determines the minimum input level at which the HUSH filter and downward expander will begin to operate. Setting this control too high will result in a loss of sustain, as notes will tend to die out much faster than they should. Conversely, when set too low, the expander will close too late (if at all) and the noise floor will remain audible.

Expander Enhance Section

The other control on the front panel is an *Expander Enhance* control. As described previously, the *Hush Threshold* control determines the minimum input level at which the HUSH filter and downward expander of the SSM2000 will operate. The expander section of the SSM2000 provides up to 25dB of downward expansion. The *Expander Enhance* control is an external circuit designed to provide additional downward expansion (the amount of which is indicated by the *Gain Reduction* LEDs).

This control should be set such that it doesn't cut notes off prematurely (i.e., set too high), yet doesn't activate long after a note ends (allowing the noise floor to remain audible).



This circuit is combined with the Variable Integrated Release (V.I.R.) circuit to provide an internal variable release to the downward expander. With the V.I.R. circuit, if the signal decays slowly, the downward expander will engage slowly. If the signal stops quickly, the downward expand will engage quickly.

When the Expander Enhance feature is activated, the additional downward expansion can be monitored on the *Gain Reduction* meter for the channel.

Setting the Controls

Manual Mode Operation

Set the *In/Out* switches for both channels to the IN position. With the *Hush Threshold* and *Expander Enhance* controls for each channel turned fully counterclockwise, listen to music information and set the *Hush Threshold* control just below where the loss of high-end information becomes audible.

After the proper *Hush Threshold* level has been determined, set the *Expander Enhance* control such that all three *Gain Reduction* L.E.D.s are lit when no music information is present (e.g., between music tracks). This control may be set slightly higher or lower, depending on the particular program source.

The Studio HUSH is now setup for the given application.

Auto Mode Operation

To select auto mode operation, set the *Adaptive Threshold* switch to the IN position. This will disable the *Hush Threshold* control for each channel and enable the Adaptive Threshold mode. When the Adaptive Threshold is active, the HUSH threshold will be adjusted dynamically by detecting the nominal signal level—thus providing the optimal setting for the given music source automatically.

Note that the Adaptive Threshold is intelligently determining the optimum threshold setting for the active filter and internal downward expander inside the SSM2000. The *Expander Enhance* control may also be used in this mode of operation to provide additional downward expansion (as this control is not controlled by the Adaptive Threshold function of the SSM2000) and may be set manually as described in the above *"Manual Mode Operation"* section. When operating the Studio HUSH in auto mode, the *Expander Enhance* controls can be used individually or in the link mode (where Channel 1's *Expander Enhance* control determines the setting for both channels).

Specifications

Maximum Input Level	*+18dBu (+4 ref.), +5dBu (-10dB ref.)*
Input Impedance	*42KΩ*
Input Jack	*¼" mono, balanced, T=(+), R=(-), S=(GND)*
Maximum Output Level	*+19dBu (+4 ref.), +6dBu (-10dB ref.)*
Output Impedance	*120Ω*
Output Jack	*¼" mono, balanced, T=(+), R=(-), S=(GND)*
Frequency Response	*±.5dB, 10Hz - 27kHz*
Dynamic Range	*105dB, peak signal to A-weighted noise floor*
Noise Floor	*-100dBu*
Effective Noise Reduction	*Greater than 70dB*
Filter	*Single pole, 6dB per octave slope* *1kHz Quiescent cut-off* *30kHz maximum bandwidth*
THD + Noise	*Less than 0.034% @ 0dBu, 1kHz*
Power Requirements	*9VAC RMS, 623mA*
Dimensions	*19" x 6" x 1¾"*

Note: 0dBv = 0.775V RMS
CE Approved

Rocktron Corporation
2870 Technology Drive
Rochester Hills, MI 48309
USA

Phone: *(248) 853-3055*
Fax: *(248) 853-5937*

World Wide Web: *http://www.rocktron.com*
E-mail: *rocktron@eaglequest.com*