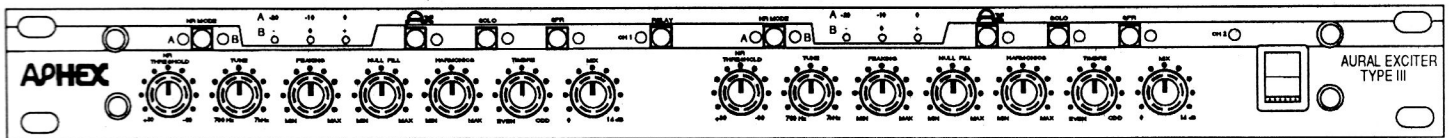

AURAL EXCITER® TYPE III

MODEL 250



OPERATING GUIDE

&

SERVICE MANUAL

Scanned and Prepared
by Dale H. Cook

WARNING

**TO REDUCE THE RISKS OF FIRE OR ELECTRIC
SHOCK, DO NOT EXPOSE THIS APPLIANCE TO
RAIN OR MOISTURE**

TABLE OF CONTENTS

1.0	INTRODUCTION	1-1
2.0	OPERATIONAL CHARACTERISTICS	2-1
2.1	New Features	2-1
2.2	Typical Applications	2-3
2.3	Specifications	2-4
2.4	Warranty and Service Information	2-6
3.0	INSTALLATION	3-1
3.1	Unpacking	3-1
3.2	Setting Input Sensitivity	3-1
3.3	Audio I/O (Input/Output) Connectors	3-1
3.4	I/O Connection Considerations	3-2
3.5	AC Line Connection	3-2
3.6	Remote Control Connection	3-4
3.7	Installing the Type III in an Equipment Rack	3-4
3.8	Applying Power and Initial Checkout	3-5
4.0	FRONT PANEL CONTROLS	4-1
4.1	NR MODE Switch	4-2
4.2	NR THRESHOLD Switch	4-4
4.3	TUNE Control	4-5
4.4	PEAKING Control	4-4
4.5	NULL FILL Control	4-5
4.6	HARMONICS Control	4-6
4.7	TIMBRE Control	4-8
4.8	MIX Control	4-8
4.9	Ax Switch	4-8
4.10	SOLO Switch	4-9
4.11	SPR Switch	4-9
4.12	RELAY Switch	4-10
4.13	POWER Switch	4-10
5.0	APPLICATIONS	5-1
5.1	Initial Settings	5-1
5.2	Exciting a Recorded Tom or Kick Drum	5-3
5.3	Recording a Snare Drum with Excitement	5-4

TABLE OF CONTENTS

5.0 APPLICATIONS (continued)

- 5.4 Exciting FM Audio for Television and Radio 5-5
- 5.5 Exciting AM Broadcast Audio 5-6
- 5.6 User Templates 5-7

6.0 CIRCUIT DESCRIPTION

- 6.1 Main Audio Path 6-2
- 6.2 Ax Sidechain Path 6-5
- 6.3 Power Supply 6-7

7.0 TEST AND NULLING PROCEDURES

- 7.1 Main Audio Board 7-1
- 7.2 Control Boards 7-2

8.0 PARTS LIST

- 8.1 Main Audio Board 8-1
- 8.2 Control Board 8-5
- 8.3 Power Supply 8-8

9.0 SCHEMATICS

1.0 INTRODUCTION

A little history...

It all started back in 1956 when Curt Knoppel, an inventor and entrepreneur who was tinkering with a Heathkit amplifier, accidentally stumbled across the principles behind a new audio processor that could effectively restore the essential high-frequency musical harmonics that are lost in the recording and playback process. Nineteen years later, after moving to the United States from Sweden, Knoppel met Marvin Caesar, then an accountant and land developer. An audiophile himself, Caesar marvelled at Knoppel's invention, and the two became partners in 1975, forming Aphex Systems in Framingham, Massachusetts.

After moving to Hollywood, California in 1976, the company began to establish itself by leasing its provocatively-named "Aphex Aural Exciter" to record companies for \$30 per minute of finished product. The original Model 402 was tube-powered and was subsequently updated to a solid state version, the Model 602. This two-channel unit provided controls for input sensitivity, output level, Aphex mix, de-esser, and signal phase reversal. The unique combination of circuitry made this psychoacoustic processor an essential ingredient in producing the "California" sound on numerous projects, including albums by Fleetwood Mac, Linda Ronstadt, James Taylor, and Jackson Brown. As the hit list grew, so did criticism from detractors, and, more importantly, competition from manufacturers with knock-off products.

In 1982, in an effort to stay innovative and also keep ahead of the field, Aphex introduced the second generation Model 201, the Aphex Aural Exciter II. This version provided additional features for tuning the high pass filter, as well as controlling the range and type of harmonics generated within the patented Aphex process. Also, the VU meters were replaced with electronic bar graph indicators having selectable ballistics and reference level settings. This new design was a great advancement over the aging Model 602, yet the biggest change was the dropping the policy of lease only in favor of outright purchase. Popularity soared as numerous engineers and producers found out that they could now buy the famous Aphex Aural Exciter. The increased sales volume propelled the Model 201 into every conceivable sound application. It seemed as though every sound specialist was using the Aural Exciter II in recording studios, concert venues, film dubbing theaters, broadcast, and video post-production houses throughout the world.

The new Aural Exciter III

The beginning of 1989 marks the introduction of the latest generation Aphex Aural Exciter III. The slimmer and more powerful Model 250 is the latest successor to the premium product in the field of Aural Excitement. As you read the following sections you will find information on Operational Characteristics, Installation, Front Panel Controls, Applications, Circuit Theory, and Maintenance Procedures. Technicians and other interested users will find complete schematics located at the end of the manual.

2.0 OPERATIONAL CHARACTERISTICS

Special features...

The Aphex Aural Exciter Type III, Model 250, is the latest generation, fully professional Aural Exciter, loaded with powerful new processing features and improved circuitry. The dual-channel Type III adds thrilling new dimensions to Aural Excitement. Noise and distortion are virtually eliminated in the Type III circuitry, with new special features that make enhancement possible and actually erase noise from noisy sources. The Model 250 is the third successor to the original Aphex Aural Exciter that started an audio revolution back in 1975.

2.1 New Features in the Model 250

The Aphex Type III Aural Exciter utilizes a patented audio process that will recreate and restore missing harmonics. These harmonics are musically and dynamically related to the original sound. When added, they restore natural brightness, clarity and presence, and can actually extend audio bandwidth. These harmonics are so low in level, however, they add little power to the signal. Unlike an equalizer or other "brightness enhancers," which can only boost high frequencies, the Type III Aural Exciter extends the high frequencies. It is a single-ended process that can be applied at any point in an audio chain, and needs no decoding.

2.1.1 Two Audio Paths

Main and Sidechain audio paths

The Type III Aural Exciter process consists of two audio paths, the main path and the process side-chain path. The main path transparently conveys the audio signal directly from the input stage to the output stage, maintaining unity gain with wide dynamic range. The side-chain path contains all of the Aural Exciter processing circuits and receives audio from the input stage. A mixing circuit in the main path allows the sidechain output signal to be mixed with the main signal. You adjust the amount of MIX to set the strength of the effect.

2.1.2 Two Noise Reduction Modes

A and B noise reduction

Additional new design features include two modes of noise reduction, Mode A and Mode B, for sound enhancement without adding to the noise floor of reasonably noise free sources. It can also enhance the brightness, detail and clarity of seriously noisy audio sources while, at the same time, erasing much of the original noise.

Mode A operates as a linear sidechain expander with variable threshold. The expansion ratio of 2.5-to-1 permits the sidechain MIX to follow the signal level below threshold. When the higher frequencies of the input signal drop below threshold, the MIX will drop at a proportional 2.5 to-1 ratio. In this way, the original signal-to-noise is not affected even with a great deal of enhancement.

Mode B is a revolutionary new noise reduction technique which operates to actually "erase" source audio noise while the Type III enhances the signal. This feature allows you to restore brightness and intelligibility to noisy recorded tracks or other noisy sources and improve the signal-to-noise ratio! Both modes are fast and easy to use, and effective in any application from live sound to broadcasting and recording.

2.1.3 Spectral Phase Refractor (SPR)

Correct bass delay

The SPR, or Spectral Phase Refractor, function of the Type III is a totally new concept in psychoacoustic enhancement which can produce some amazing results. Through the many steps of recording, duplicating, distributing and reproducing sound, the phase of the low frequency audio spectrum becomes delayed compared to mid and high frequencies. This is a natural and unavoidable effect which becomes worse with each generation.

When the bass frequencies become delayed in time compared to other sounds, the bass loses fullness and definition and seems to become less powerful, even though there may be no actual loss of bass frequency response. The high end also loses definition, seeming to get duller.

Amplitude equalization at this point will not fully restore the clarity and bass power. In fact, it may worsen the condition causing clipping or overload distortion. SPR corrects the bass delay anomaly to restore clarity and openness and significantly increases the apparent bass energy level without adding any amplitude equalization or "bass boost." The SPR function works harmoniously with the new Aural Exciter circuitry to give the Type III Aural Exciter amazing new capabilities.

2.1.4 Adjustable Harmonics Level and Timbre Mixing

The DRIVE Control of previous Aural Exciters has been eliminated. In its place are two new controls that provide adjustable mixing of the exact amount of desired harmonics level and timbre. These features make the Type III more flexible and even easier to use.

2.1.5 Servo Balanced Inputs and Outputs

Short-circuit proof

Although more costly than conventional designs, servo-balancing offers many advantages. Servo-balanced input circuits absorb high common-mode voltages found in long cable runs without sacrificing headroom. Servo-balanced outputs are not only short-circuit proof, but can be used single-ended at any time without the usual 6 dB loss of conventional circuits.

To use input or output in a single-ended (unbalanced) mode, you need only to ground the unused pin. In addition, both inputs and outputs are fully RF protected. The unity gain I/O structure is normalized for both +4 dBu (professional) and -10 dBv (IHF) operating levels by switch selection from the rear panel.

2.1.6 Null Fill

Phase Nulling...

NULL FILL is a new and useful tuning adjustment introduced for the first time with the Aural Exciter Type III. The addition of NULL FILL to the PEAKING and TUNE controls gives the Type III more power and flexibility to enhance all types of audio sources. To understand how it works, it is necessary to understand a physical phenomenon called "Phase Nulling" which occurs with all Aural Exciters when the MIX control is adjusted to obtain high frequency enhancement.

There is a time delay associated with the sidechain signal which is an important part of the operating theory of the Aural Exciter. This time delay causes transient waveforms to be slightly "stretched" as the sidechain signal is added to the main audio path. The "stretched" transients are then perceived by the ear as more pronounced or "louder". The side effect of the time delay is a "dip" or "null" in the output equalization curve. The null can be a desirable characteristic because it compensates for the slight additional power added to the signal by the high frequency shelving boost. The null de-emphasizes the frequency range around the TUNE control setting, thus giving even greater emphasis to the higher frequencies.

There are times, however, when the Phase Null is unwanted. The NULL FILL control allows the user to "fill-in" the phase null to any desired amount, thus further improving presence.

2.2 Typical Applications

The Aural Exciter may be used in many ways for audio enhancement. Depending upon the requirements, either pre- or post-processing may be selected. Either source or system optimization, or a combination of both, is possible.

2.2.1 Sound Reinforcement

Increase intelligibility

For example, a P.A. system may be greatly enhanced by using the Aural Exciter to increase the intelligibility of the loudspeakers, thus improving penetration of the sound around corners and in areas usually difficult to fill. In another case, the source may sound dull and hard to understand. The Aural Exciter will compensate for this deficiency by adding brightness and clarity to the sound more effectively than use of equalization alone.

2.2.2 Tape Duplication

Pre-process recordings

The Aural Exciter may be used to "pre-process" recordings to anticipate the audio degradation in the medium or during subsequent reproduction. Much of the detail added by the Aural Exciter will survive filtering and distortion of the reproduction equipment and provide a better quality audio playback. Audio and Video Cassette duplication are examples of this application. Broadcasting is another good example.

2.2.3 Sound Recording

In the recording studio, post production suite or similar environment, post-processing of previously recorded sound tracks can restore lost vibrance and realism, even to the extent of saving dialogue or sound effects which were thought to be unusable. Instruments and vocals can be made to stand out in the mix without substantially increasing the mix levels or using equalization.

2.2.4 Electronic Music

Extend bandwidth

Many electronic instruments are limited by their sampling rate (bandwidth) and word length (resolution); they can sound lifeless. The Aural Exciter actually extends bandwidth and adds details making synthesizers, samplers and drum machines come alive.

2.2.5 Broadcasting

Broadcast audio is constrained in dynamics and frequency response to fit the parameters of AM and FM transmission. AM and FM radio, as well as television audio, all have unique, critical bandwidth and signal level transmission limits. The Type III is especially useful in creating the perception of higher frequencies and greater dynamics without pre-emphasis distortion or overmodulation. As a result, the final audio product has more presence and clarity, with no apparent increase in noise.

2.3 Specifications

VCA:	Aphex 1001
Frequency Response:	+0,-1dB from 1Hz to 190 kHz
THD:	.01% Max @ +27dBu
IMD:	.01% Max @ + 27 dBu
Max Input/Output Level:	+27 dBu
Nominal Gain:	0 dBu

Input Impedance:	19.5 k Ohms/600 Ohms (switch selectable from rear panel)
Load Impedance:	600 Ohms or greater
Output Impedance:	65 Ohms
Unweighted Output Noise (20 Hz-20 kHz BANDWIDTH):	-86 dBu
Unweighted SNR (for +4dBu operating level):	-90 dB
Dynamic Range:	114dB
Crosstalk:	Better than 85 dB up to 20 kHz
Output Circuits:	Servo Balanced Transformerless
Input Circuits:	Servo Balanced Transformerless
Input CMRR:	Better than 50 dB 20 Hz to 10 kHz
Input RF Rejection:	Better than 40 dB at 800 kHz, better than 60 dB above 2 MHz
Power Requirements:	100/120/220/240V AC (+/- 10%), 50/60 Hz 16 W.
Size:	1 3/4" (44.5 mm) h x 19" (482.6 mm) w x 9" (228.6 mm) d
Weight:	8 lbs (s.63 kg)
Accessories:	Model 51 Plexiglass Security Cover

Aphex Aural Exciter covered by U.S. Patent Number 4,150,253. Additional Patents Pending. Foreign Patents granted and pending.

Aphex Systems is constantly striving to maintain the highest professional standards. As a result of these efforts, modifications may be made from time to time to existing products without prior notice. Specifications and appearance may differ from those listed or shown. Aphex and Aural Exciter are registered trademarks of Aphex Systems, Ltd.

2.4 Warranty and Service Information

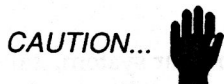
Aphex Systems, Ltd. warrants parts and labor for the Aural Exciter Type III for a period of one year from the date of purchase.

If it becomes necessary to return a unit for repair, repack it in the original carton and packing material, if possible. For warranty repair, enclose a copy of proof of purchase and send package to:

APHEX SYSTEMS, LTD.
11068 RANDALL ST.
SUN VALLEY, CA 91352-2621
PH: (818) 767-2929 FAX: (818) 767-2641

3.0 INSTALLATION

To install the Aphex Aural Exciter Type III for use with your system, perform the instructions described in the following sections.



Thoroughly read Section 3.5 before you apply power to the unit. An incorrect line voltage setting can damage the unit.

3.1 Unpacking

Your Aural Exciter Type III was carefully packed at the factory, and the container was designed to protect the unit from rough handling. Nevertheless, we recommend careful examination of the shipping carton and its contents for any sign of physical damage which could have occurred in transit. If damage is evident, do not destroy the container or packing material. Immediately notify the carrier of a possible claim for damage. Shipping claims must be made by the consignee.

3.2 Setting Input Sensitivity

Before using the Aural Exciter Type III, you need to set the unit for the correct operating level (OVU). Choose either -10 or +4 dBu by pressing the OPERATING LEVEL button IN or OUT for each channel located on the back panel, as shown in Figure 3-1.

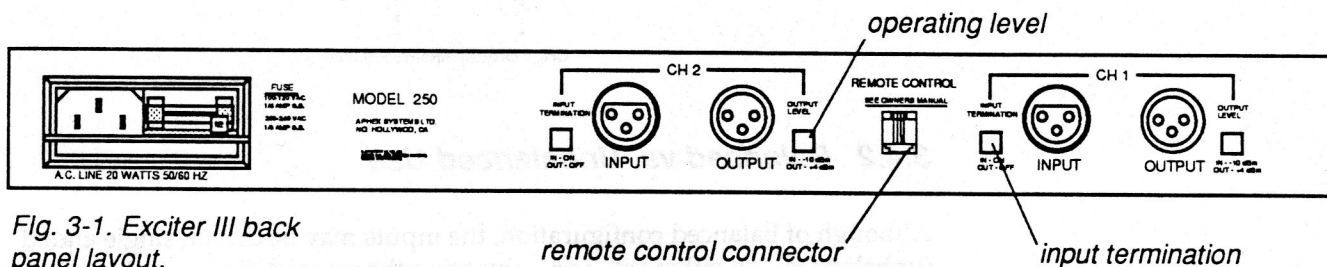


Fig. 3-1. Exciter III back panel layout.

The IN position engages a -10 dB Operating Level, while the OUT position is suitable for Operating Levels from 0 to +10 dB.

3.3 Audio I/O (Input/Output) Connectors

The audio inputs and outputs are made with standard XLR type 3-pin connectors on the rear panel. Equal polarity is maintained from input to output, so that you may elect to use either pin 2 or pin 3 as high to match your balanced system. Also be sure to use proper shielding techniques (i.e. lifting the shield wire to the output connection and connecting the shield wire to the input connection).

3.4 I/O Connection Considerations

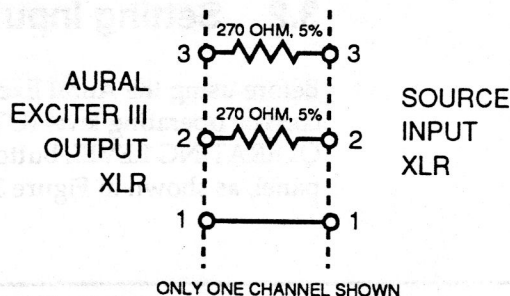
Prior to installing the Aural Exciter Type III into your system, take note of the following considerations for I/O impedance matching and system wiring.

3.4.1 Impedances

The input is of high (19.5 kOhms) impedance and may be easily driven by any output source. If your source needs to see a 600 Ohm load, press the 600 OHM INPUT TERMINATION button located next to each audio input (Fig.3-1.). Pressing the switch IN connects an internal 602 Ohm (1%) resistor across pins 2 and 3 of the input XLR connector.

The output is of an active, transformerless type, with an output impedance of 65 Ohms between pins 2 and 3. When driving certain transformer coupled loads, the unit may need 270 Ohm 5% resistors installed in a series bridge with pins 2 and 3 to create a 600 Ohm source impedance, as shown Fig. 3-2.

Fig. 3-2. Circuit for creating a 600 Ohm source impedance at output of Aural Exciter III.



3.4.2 Balanced vs. Unbalanced Use

Although of balanced configuration, the inputs may be driven single ended (unbalanced), on either pin 2 or 3, by tying the unused pin to pin 1 ground.

3.5 AC Line Connection

A.C. line power is supplied to the unit via an integral receptacle/fuse holder on the rear panel which meets all of the international safety certification requirements and also doubles as a radio frequency line filter.

Verify that the unit is configured to match your A.C. line voltage by inspecting the voltage programming tag located with the fuse holder, as shown in Fig. 3-3. If you need to change the voltage setting, follow the procedure outlined in the following two sub-sections.

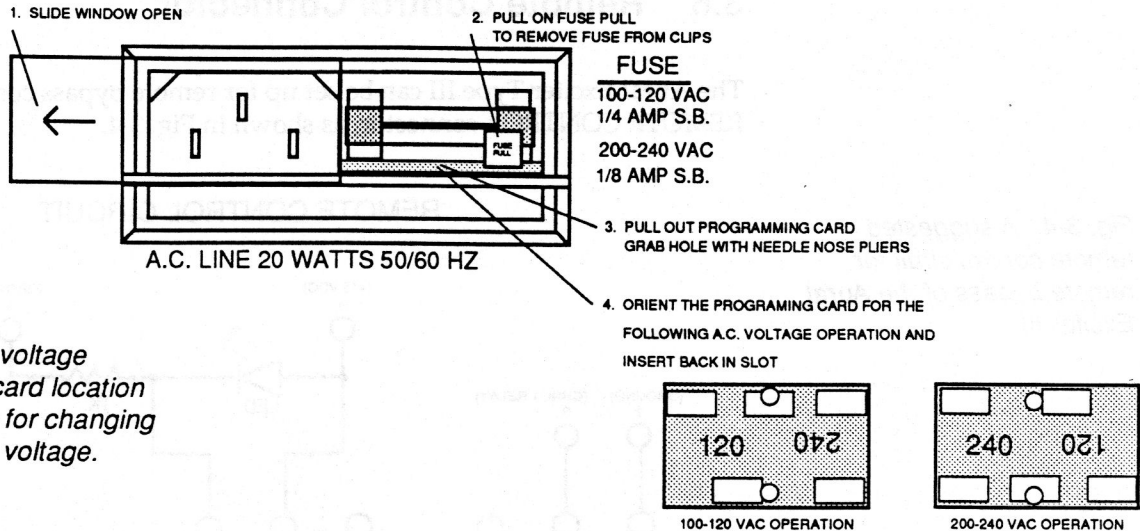


Fig. 3-3. A.C. voltage programming card location and procedure for changing operating A.C. voltage.

3.5.1 AC Voltage Selection

As shipped, the Aural Exciter Type III is set for 120 VAC operation, but you can change your unit to match any standard AC line voltage simply by reprogramming the voltage programming card in the fuse holder in the following way:

1. Remove the power cord from the chassis receptacle.
2. Slide the clear plastic cover to the left to uncover the fuse compartment.
3. Remove the fuse by prying out the "fuse pull" lever.
4. Pull out the small printed circuit programming tag.

The tag has four voltages printed on it which are labelled 100/220 on one side and 120/240 on the other side, as shown in Fig. 3-3. Orient the tag so the required voltage is readable on the top left side of the tag, and reinsert the tag in the fuse holder. You should now be able to read your correct line voltage through the window of the fuse holder.

3.5.2 Fuse Selection

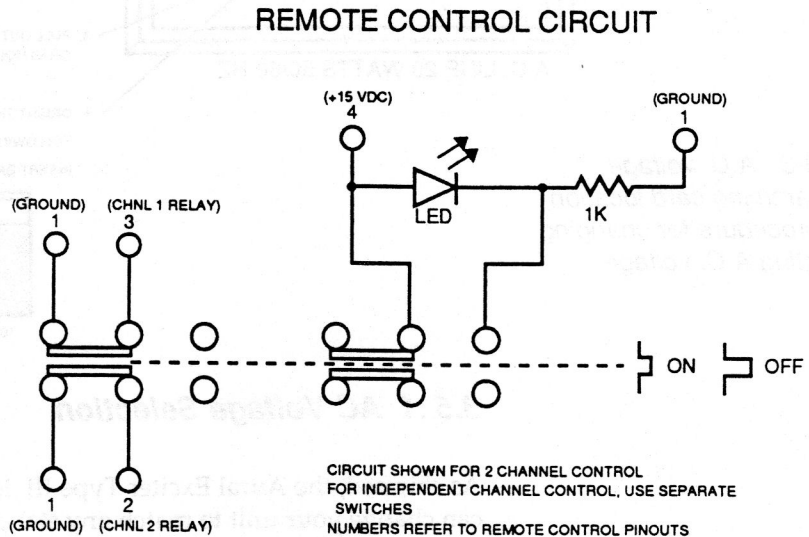
After reprogramming the AC line voltage, be sure one of the following rated fuses is inserted into the fuse holder before you apply power to the unit:

- 0.25A Slo-Blo for 100-120 ACV operation
- 0.125A Slo-Blo for 220-240 ACV operation

3.6 Remote Control Connector

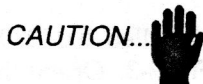
The Aural Exciter Type III can be set up for remote bypass control use via the REMOTE CONTROL connector, as shown in Fig. 3-4.

Fig. 3-4. A suggested remote control circuit for remote bypass of the Aural Exciter III.



This four-pin, modular telephone-type jack (Fig. 3-1) provides the following control signals:

- Pin 1 - Logic Ground
- Pin 2 - Channel 2 Relay Control
- Pin 3 - Channel 3 Relay Control
- Pin 4 - +15 VDC (for remote indicator lamp use)



Shorting pin 4 to ground will temporarily disable the Type III and eventually cause damage.

You may want to construct the suggested circuit (Fig. 3-4) for remote on-line control of the Aural Exciter Type III in an automated broadcast system, production studio, or audio duplication chain.

3.7 Installing the Type III in an Equipment Rack

The Aural Exciter Type III occupies one standard rack unit of space (1 3/4") at a width of 19" and a depth of 9". Allow at least an additional 3" of depth for connectors and at least 1/2" of air space around the unit for cooling.

Mount the unit in the desired space by using the cushioned rack screws provided with the package.

3.8 Applying Power and Initial Checkout

After you have completed the previous instructions, apply power to the unit by depressing the POWER switch (located on the front panel). If none of the indicator LED's light, check fuse and power cord installation before proceeding with the remaining checks.

Position all rotary knobs at 12 o'clock, send a test signal of your choice to each channel input, and verify that the signal is passing through the unit by auditioning or measuring the signal at each output.

After you are satisfied that signal is passing through the unit, proceed to the next section for an explanation of the Front Panel Controls.

4.0 FRONT PANEL CONTROLS

The front panel layout of the Aphex Aural Exciter III provides identical sets of controls for two independent channels of Aural Excitement, as shown in Fig. 4-1.

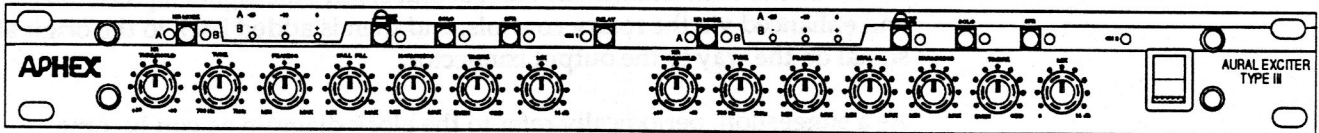


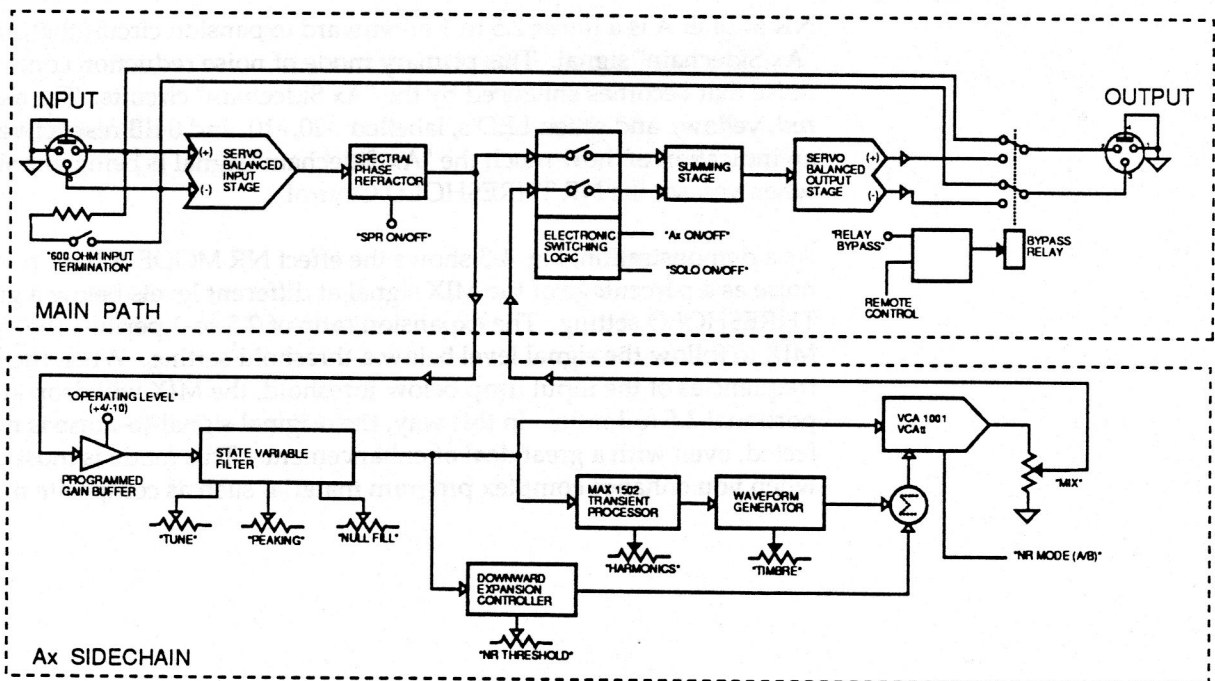
Fig. 4-1. Aural Exciter III front panel layout.

Each channel contains six rotary controls (located left to right), for setting NR THRESHOLD, TUNE, PEAKING, NULL FILL, HARMONICS, TIMBRE, and MIX parameters. In addition, each channel also has an identical set of four in/out pushbutton switches (located left to right), for selection of NR MODE, Ax, SOLO, and SPR. Besides these controls and switches, the Model 250 also includes a single two-channel RELAY bypass pushbutton and a unit POWER on/off switch.

The following sections contain details on the function and use of each control and switch. Furthermore, a block diagram, as shown in Fig. 4-2, shows a simplified signal path to help you understand the effect of each adjustment or selection.

Fig. 4-2. Aural Exciter III block diagram.

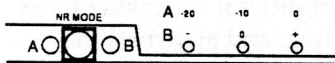
BLOCK DIAGRAM APHEX TYPE III AURAL EXCITER



NAMES ENCLOSED IN QUOTES ARE OPERATOR CONTROLS
ONE CHANNEL OF TWO IDENTICAL CHANNELS IS SHOWN
▶ = SIGNAL PATH
▽ = AUDIO GROUND

Notice that the signal coming from the input is divided into two paths, known as the "Main Path" and "Ax Sidechain". The "Main Path" contains very little processing and basically serves as a signal tap and summing point for the Excitement circuits. In the "Ax Sidechain", the signal tap is altered and enhanced via the rotary controls, and then is added back to the original signal on the way to the output connector.

As a suggestion, periodically refer to the block diagram as you become familiar with the controls and switches described below. When you have completed this section, move on to APPLICATIONS for details on typical settings.



4.1 NR MODE Switch

The NR MODE is a new feature which reduces noise that becomes enhanced by the Exciter circuits. This NR MODE switch, located above each accompanying NR THRESHOLD control (described in section 4.2), gives you a choice of either A or B noise reduction. Two LED's, labelled A and B, show which mode is active, depending on the position of the switch. In addition, each mode also has three associated LED's that indicate the present threshold status for a chosen noise reduction mode.

4.1.1 NR MODE A

NR MODE A is a linear 2.5 to 1 downward expansion circuit that controls the "Ax Sidechain" signal. This primary mode of noise reduction controls the noise that becomes enhanced by the "Ax Sidechain" circuits. The associated red, yellow, and green LED's, labelled -20, -10, and 0 dB respectively, give an indication of how much the "Ax Sidechain" signal is being attenuated when you set the NR THRESHOLD Control.

As a demonstration, Fig. 4-3 shows the effect NR MODE A has on reducing noise as a percentage of the MIX signal at different levels below a given THRESHOLD setting. The expansion ratio of 2.5-to-1 permits the sidechain MIX to follow the signal level below a threshold setting. When the higher frequencies of the input drop below threshold, the MIX will drop at a proportional 2.5 to-1 ratio. In this way, the original signal-to-noise is not affected, even with a great deal of enhancement. This mode is most useful when you enhance complex program material such as composite mixes.

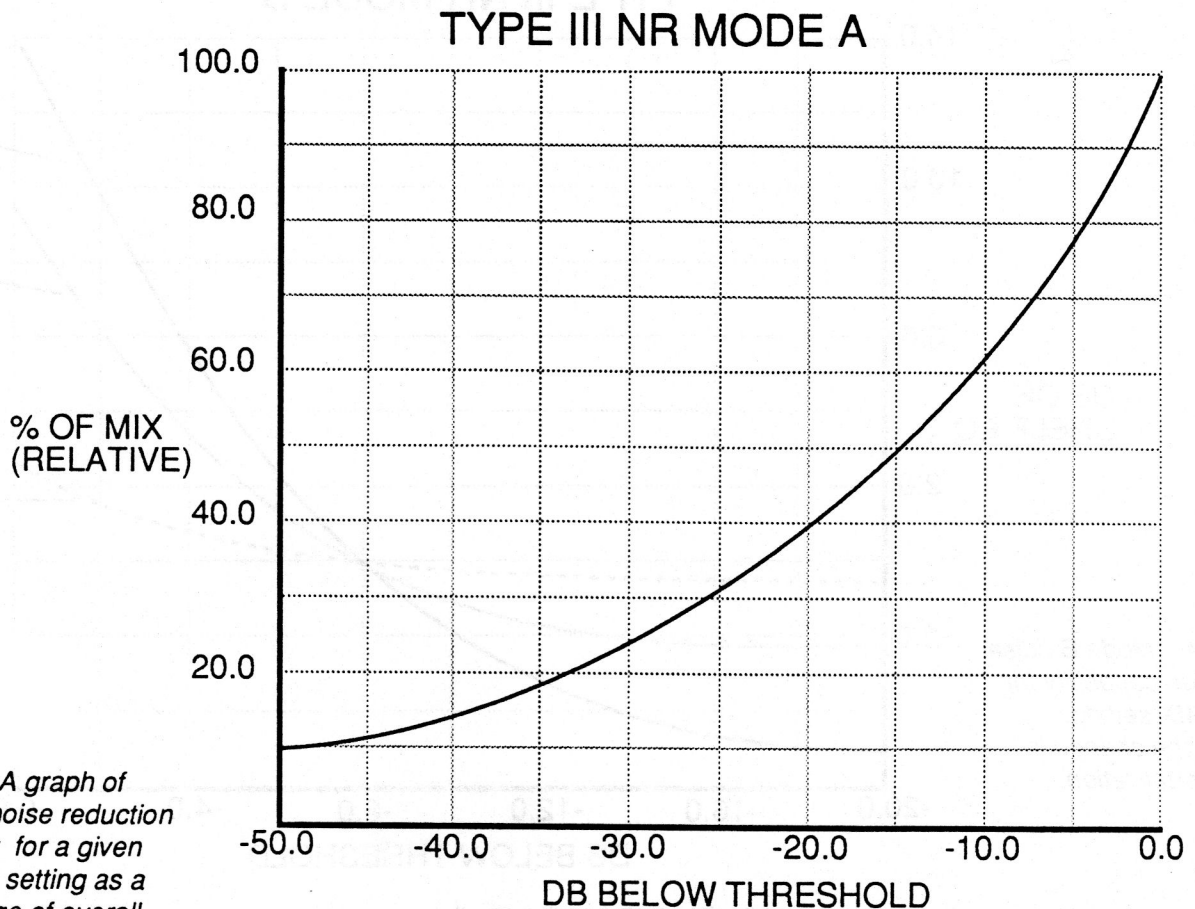


Fig. 4-3. A graph of Mode A noise reduction capability for a given threshold setting as a percentage of overall mix signal.

4.1.2 NR MODE B

When selected, the NR MODE B is a variable shelving equalization circuit that also controls the "Ax Sidechain" signal. The associated red, yellow, and green LED's correspond directly to a -, 0, or + change in a variable high pass shelving circuit when you set the NR THRESHOLD Control. The yellow (0) LED indicates no shelving equalization, while the red (-) and green (+) LED's signify a shelving cut or boost of the high frequencies, respectively.

Fig. 4-4 shows the action of NR MODE B (variable shelving equalization) for three different MIX Control settings (refer to Section 4.8) at different levels below a given THRESHOLD setting. Notice that a maximum MIX Control setting produces the greatest shelving drop as sidechain signal falls below a set threshold. When NR MODE B is active, the Model 250 will actually "erase" audio (broadband) noise while, at the same time, restore brightness and intelligibility to a seriously noisy audio track or source.

TYPE III NR MODE B

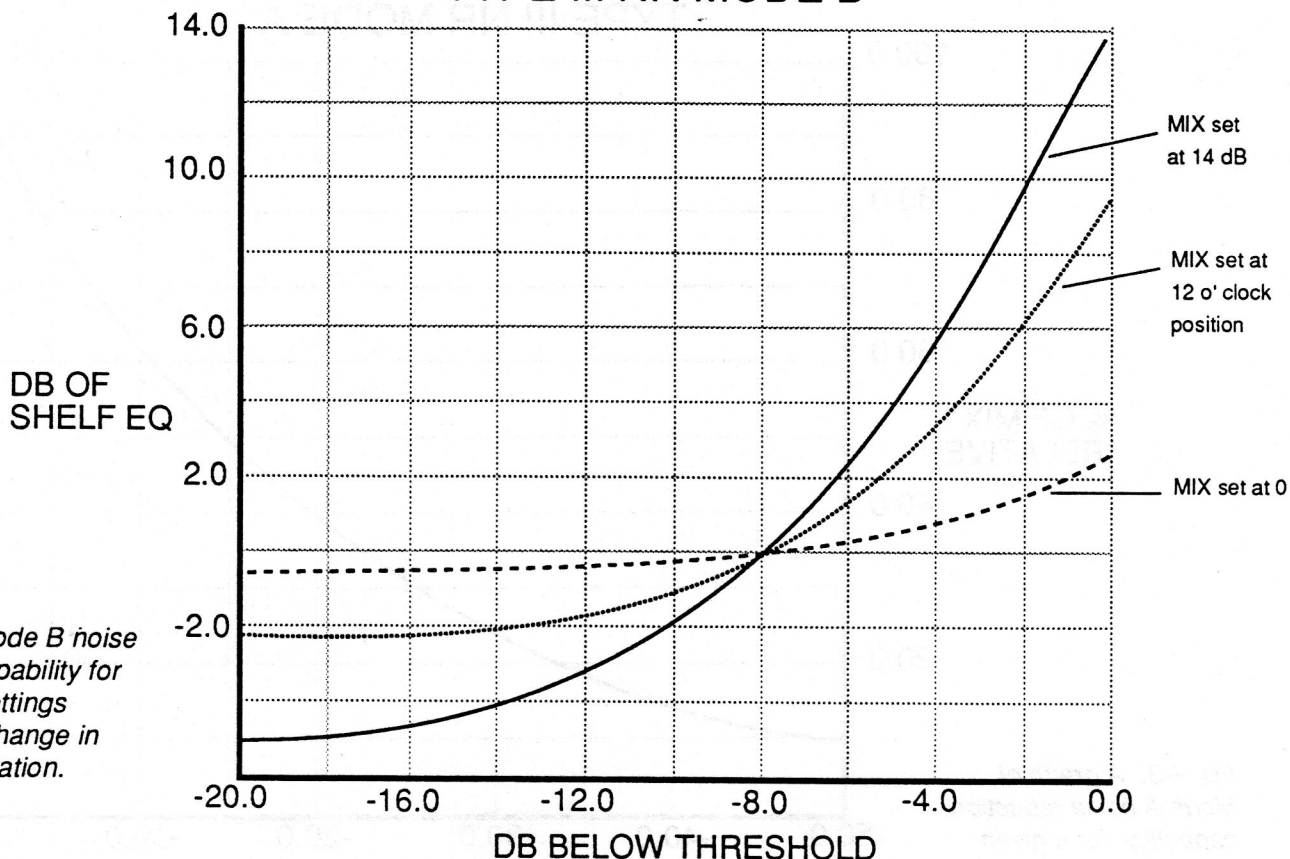


Fig. 4-4. Mode B noise reduction capability for three MIX settings versus the change in shelf equalization.



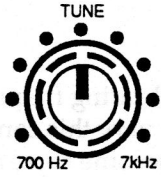
4.2 NR THRESHOLD Control

This rotary control provides a threshold setting range from +30 dB to -60 dB for a chosen NR MODE (described in section 4.1). When audio program is present at the channel input, the NR MODE LED's provide an indication of noise reduction action for a given threshold setting. The actual position of this control will vary with program content (i.e. dynamics, composition, etc).

For NR MODE A, an optimum noise reduction setting is achieved when the yellow (-10) LED and green (0) LED flashes alternately with each audio program peak and pause. At this point, the noise reduction circuits provide the greatest downward expansion of the "Ax Sidechain" signal, as the program signal drops below the NR THRESHOLD setting (refer to Fig. 4-3).

For NR MODE B, a proper noise reduction setting is achieved when the red (-) and yellow (0) LED's alternately flash between audio program pauses or breaks. At this point, the shelving circuit will cut the high frequencies, as the program signal drops below the NR THRESHOLD setting (refer to Fig. 4-4).

As you adjust the other parameters (i.e. TUNE, PEAKING, etc), you will need to trim the NR THRESHOLD control to achieve the optimum setting. Refer to Section 5, entitled APPLICATIONS, for some example settings.



4.3 TUNE Control

The TUNE Control sets the frequency of the second-order high pass filter in "Ax Sidechain" that establishes the frequency domain for the Aural Excitement effect. The control range extends from 700 Hz to 7 kHz and is similar to all other TUNE Controls found on other Aural Exciter models.

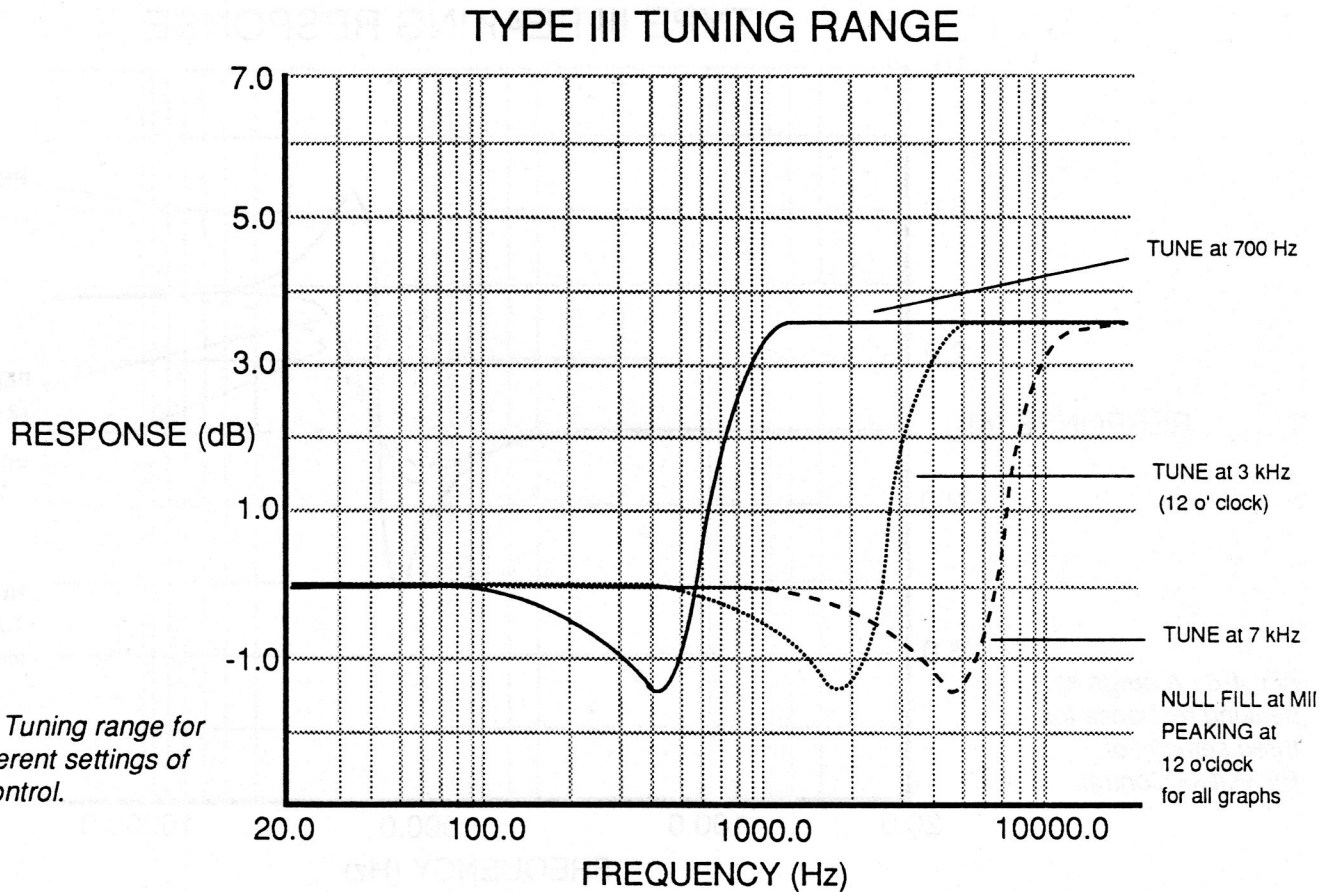
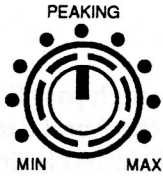


Fig. 4-5. Tuning range for three different settings of TUNE Control.

Fig. 4-5 demonstrates the range of the TUNE Control from 700 Hz to 7 kHz with minimum NULL FILL (see Section 4.5) and PEAKING Control (see Section 4.4) set at a 12 o'clock position. As you read the following sections on PEAKING and NULL FILL, notice the interaction these controls have on TUNE, as well as on each other.



4.4 PEAKING Control

The PEAKING control provides a damping effect on the leading frequency edge of the high pass filter controlled by TUNE. As you vary this control from minimum to maximum, the TUNE frequency will become more accentuated, as demonstrated in Fig. 4-6.

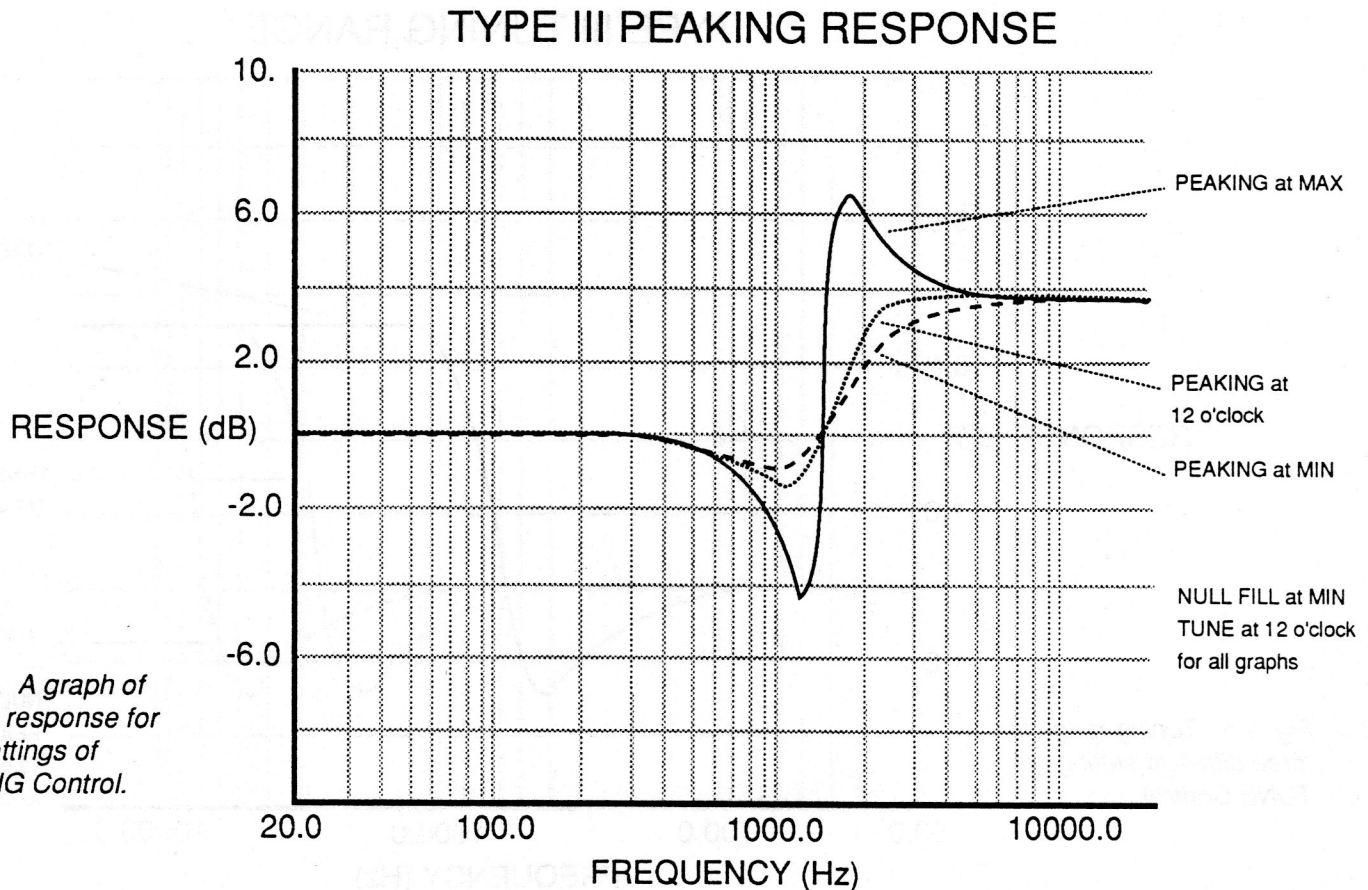


Fig. 4-6. A graph of peaking response for three settings of PEAKING Control.

However, at that same time, a dip is created just before the accentuated TUNE frequency. This dip or null becomes larger as PEAKING Control is increased.



4.5 NULL FILL Control

The NULL FILL Control adjusts a bandpass signal that is added to the high pass signal in the sidechain to compensate for "phase nulling". "Phase nulling" occurs as a side effect of the time delay present in the sidechain signal, an important part of the Aural Exciter operating theory. As the time delay "stretches" transient waveforms to create a perception of louder sound,

TYPE III NULL FILL RANGE

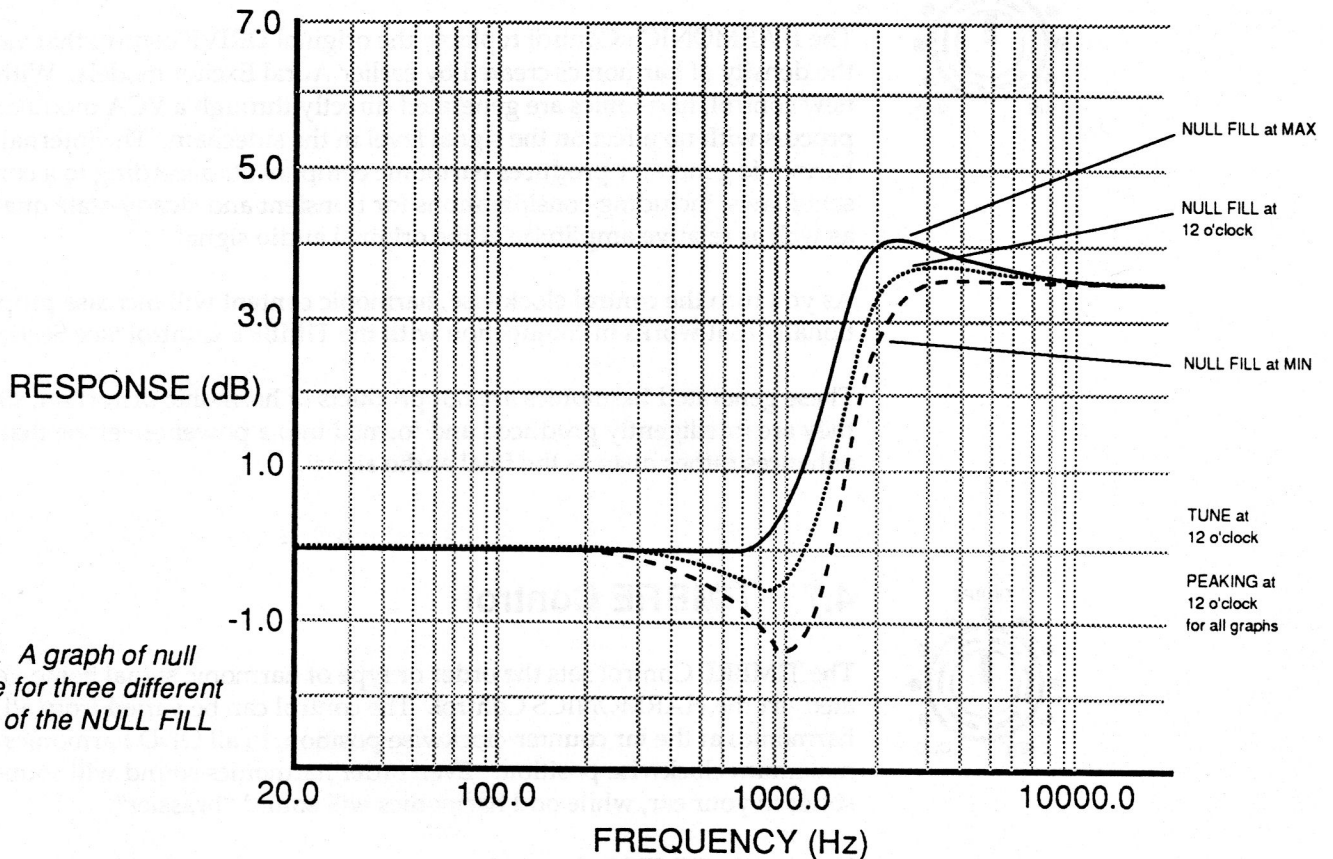


Fig. 4-7. A graph of null fill range for three different settings of the NULL FILL Control.

a "dip" or "null" also occurs in the output equalization curve at the TUNE frequency. As a result, the "null" frequencies are de-emphasized, thus giving even more emphasis to the higher frequencies. Although this often is a desirable effect, the NULL FILL Control was created to allow the user to "fill-in" the "null" by a selectable amount for any applications requiring less emphasis, as shown in Fig. 4-7.

The graph shows three different NULL FILL settings with TUNE set at the 12 o'clock position. With the NULL FILL Control set at minimum, there is a noticeable drop in the frequency response just before the start of the high pass shelf boost. At this setting, program material under enhancement would lose some presence. When the NULL FILL Control is set at maximum, the frequency dip is filled, but the frequencies associated with the shelf top become accentuated. Also notice the shift in the TUNE frequency (0 dB axis) for the range of NULL FILL settings.



4.6 HARMONICS Control

The HARMONICS Control replaces the original DRIVE control that varied the density of harmonics created by earlier Aural Exciter models. With this new control, harmonics are generated directly through a VCA modulation process with no effect on the signal level in the sidechain. The internal harmonic generator produces harmonic components according to a complex set of laws, including considerations for transient and steady-state qualities, as well as relative amplitude of the original audio signal.

As you turn the control clockwise, harmonic content will increase proportionally as it works in conjunction with the TIMBRE Control (see Section 4.7).

These generated harmonics are not products of harmonic distortion, since they are intelligently produced and formed into a power envelope that enhances rather than distorts the final audio signal.



4.7 TIMBRE Control

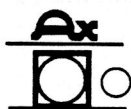
The TIMBRE Control sets the order or type of harmonic signal being generated via the HARMONICS Control. The control can be varied from all EVEN harmonics at the far counter-clockwise position, to all ODD harmonics at the maximum clockwise position. Even order harmonics sound will sound softer to your ear, while odd harmonics will sound "brassier".

Varying the TIMBRE Control between these two extremes will provide you with a mix of both EVEN and ODD harmonics in proportion to the control knob position.



4.8 MIX Control

The MIX Control introduces the amount of Aural Exciter enhancement into the original signal. The control ranges from 0 dB, or no enhancement, up to +14 dB, which represents a 14 dB boost in the tuning shelf when the NR THRESHOLD is well below the signal level.



4.9 Ax Switch

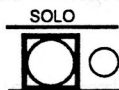
The Ax Switch gives you the choice of turning the Aural Excitement process On or Off by pressing the switch In or Out. An adjacent LED becomes lit when the Ax Switch is pressed In, confirming that the Effect is On.

Unlike the BYPASS Mode, the audio signal from the input does travel through active circuits on the way to the output whenever Ax is Off.

NOTE...



When Ax is Off, SPR (section 4.11) is still operational.



4.10 SOLO Switch

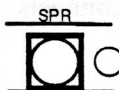
The SOLO Switch gives you a choice of auditioning the Aural Excitement signal alone without the main audio, whenever you press the button in. An adjacent LED becomes lit whenever SOLO is active.

As an application for the SOLO switch, press SOLO to return the pure effect back to an automated mixing console for precise memory control of the Aural Excitement signal only.

NOTE...



Be sure to turn off the SPR effect (see section 4.11) to avoid possible phase problems when mixing raw audio.



4.11 SPR Switch

The SPR Switch controls the Spectral Phase Refractor effect which is a new feature on the Model 250. This effect is independent of all other controls or switches except the RELAY Bypass Switch (see Section 4.12). An adjacent LED becomes lit when the SPR Switch is pressed in, confirming that SPR is On. SPR processes the main audio signal in such a way that bass frequencies (up to 150 Hz) lead phase in relation to the rest of the spectrum.

Through the many steps of recording, duplicating, distributing and reproducing sound, the phase of the low frequency audio spectrum becomes delayed compared to mid and high frequencies. SPR corrects the bass delay anomaly to restore clarity and openness and significantly increases the apparent bass energy level without adding any amplitude equalization or bass boost.

To audition the effect of SPR on the audio signal, press the Ax Switch Out. Next, press the SPR Switch In. Then alternately press the RELAY Bypass Switch In and Out to hear the SPR effect on incoming audio.

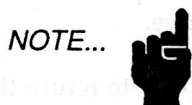


4.12 RELAY Switch

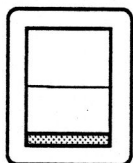
The RELAY switch, located in the center of the front panel, provides an internal, two-channel (hard-wire) bypass of the Aural Exciter III circuitry.

In the normal mode of operation, the RELAY Bypass is "Off" (button Out), and the CH1 and CH2 indicators, located to the right of each individual channel MIX Control, are "On".

To activate bypass, press the RELAY button In. Immediately the two lit indicator LED's, CH1 and CH2, **extinguish** to confirm your action.



This is an active Bypass "Off" condition that allows the audio signal to continue through the Type III during any unforeseen power outages to the unit. If power is lost, the relay is deactivated, and the Bypass mode goes "On".



4.13 POWER Switch

The POWER on/off switch routes incoming AC power to the internal power supply circuits. Pushing the top of the switch inward applies power to the unit, while pushing the bottom of the switch disconnects power.

5.0 APPLICATIONS

In this section, we will first review setting the Aphex Aural Exciter Type III for initial operation (as mentioned in Section 3.8 - Initial Checks). Then, a series of illustrated applications will provide you a look at some typical settings for the Model 250. At the end of the section, you will find a page of identical front panel drawings without control knob markings, for noting your own custom settings. Feel free to reproduce the templates so that you can include a copy of your settings with your project documentation.

5.1 Initial Settings

The Aural Exciter Type III can be used as either an in-line or sidechain processor, as shown in Fig. 5-1.

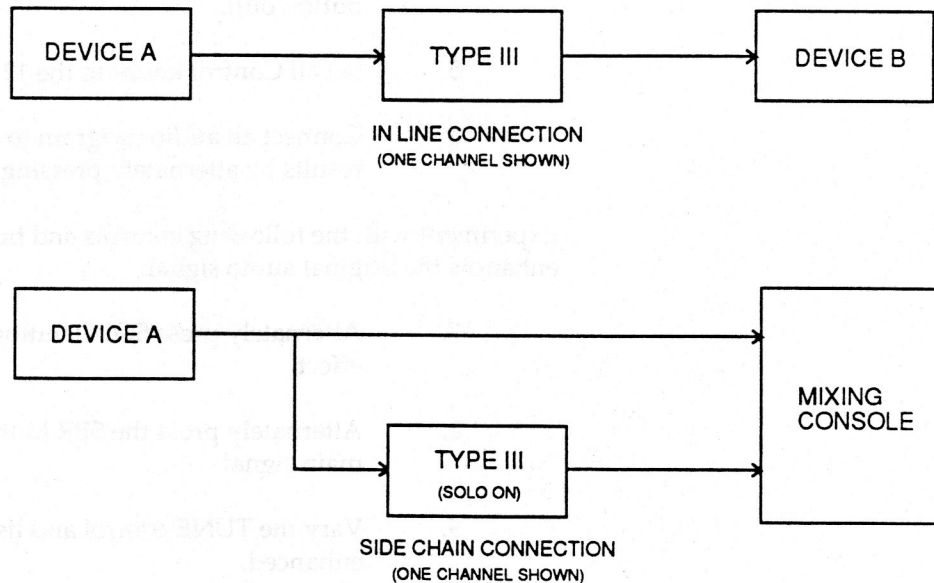


Fig. 5-1. A block diagram showing Aural Exciter III routing connections for in line or side chain operation.

For most applications, you will use the unit as an in-line enhancement device by connecting it between other electronic devices, or by inserting the unit at appropriate console I/O patch points. To use the device as a sidechain processor, press the SOLO button (light on) to defeat the main (original) audio signal. This action will route only the pure effect back to your console return. Remember that the SPR effect (see section 4.11) should be turned Off for this mode.

Once the Type III has been properly installed (see Section 3.0), perform the following steps for an initial operation setting, as shown in Fig. 5-2:

1. Press the POWER switch on.
2. Press NR MODE to indicate A, Ax to indicate in (LED on), and SOLO to indicate off (LED off).

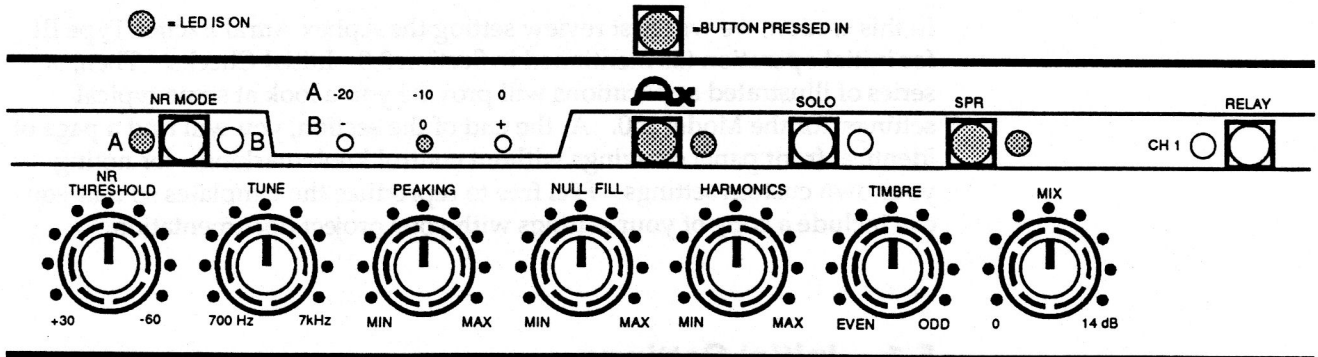


Fig. 5-2. Initial Settings (one channel shown).

3. Press SPR to indicate in (LED on).
4. Make sure that RELAY is not active (no indicator - button out).
5. Set all Control knobs to the 12 o'clock position.
6. Connect an audio program to one channel and monitor the results by alternately pressing the RELAY button.

Experiment with the following controls and buttons to hear how each feature enhances the original audio signal:

7. Alternately press SOLO button to hear the pure excitement effect.
8. Alternately press the SPR button to hear its effect on the main signal.
9. Vary the TUNE control and listen to the frequency being enhanced.
10. Vary the PEAKING and NULL FILL controls and listen to the change in the attack and presence for a given TUNE setting.
11. Vary the HARMONIC and TIMBRE controls and listen to the amount and type of "sound" color added to the original audio signal.
12. Vary the MIX Control and listen to the change in original audio as Aural Excitement (combination of all the above settings) is added or subtracted.

5.2 Exciting a Recorded Tom or Kick Drum

After you have set the console gain structure and applied equalization, try the following settings, as shown in Fig. 5-3, to Excite the tom or kick drum sound:

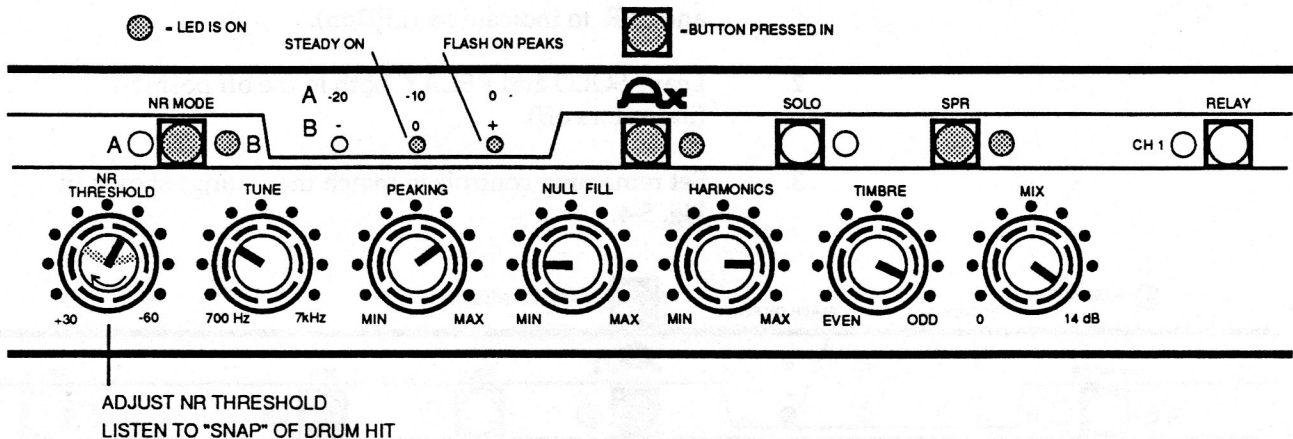
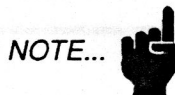


Fig. 5-3. Settings for exciting a recorded tom or kick drum.

1. Press NR MODE to indicate B, and Ax to indicate in (LED on).

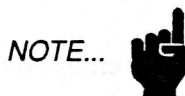


Notice that B noise reduction is used to control tape hiss.

2. Press SOLO to indicate off (LED off).

If you want to use the Aural Exciter as a sidechain processor in an automated mixdown, press SOLO to indicate on (light on).

3. Press SPR to indicate in (LED on).
4. Make sure that RELAY is not active (no indicator - button out).
5. Set all Control knobs to match those shown in Fig. 5-3.



Notice that the MIX control is set for maximum Aural Excitement. The critical control setting in this application is the NR THRESHOLD.

6. Slowly turn the NR THRESHOLD clockwise until you hear enhancement in the "snap" of drum hit.

5.3 Recording a Snare Drum with Excitement

To add Aural Excitement to the sound of a snare drum, perform the following steps after you are satisfied with the audio balance of level and equalization:

1. Press NR MODE to indicate A, Ax to indicate on (LED on), and SPR to indicate on (LED on).
2. Leave SOLO and RELAY both in the off position (indicators off).
3. Set remaining controls to match the settings shown in Fig. 5-4.

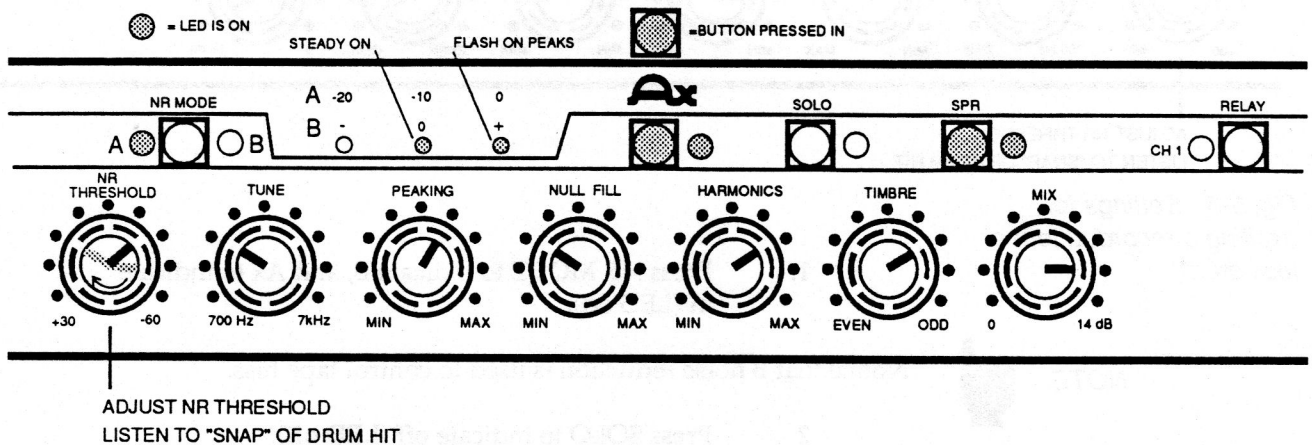


Fig. 5-4. Settings for recording a snare drum with excitement.

4. Press SOLO (indicator becomes lit) and listen to the "snap" (attack) of the snare drum.
5. Adjust TUNE, PEAKING, and NULL until you hear the best blend of "snap" and other frequency accents.
6. Adjust THRESHOLD so that "-10" and "0" LED's flash on audio peaks.
7. Release SOLO (indicator off) to hear entire sound and adjust the MIX control to your sonic taste.
8. Alternately press SPR on and off to hear the SPR effect on the low frequency sound of the excited snare drum.

5.4 Exciting FM Audio for Television and Radio

To improve the sound of television and FM radio broadcast audio, place the Aural Exciter Type III in-line between the studio feed and the transmitter limiter, as shown in Fig. 5-5. Set the controls as follows:

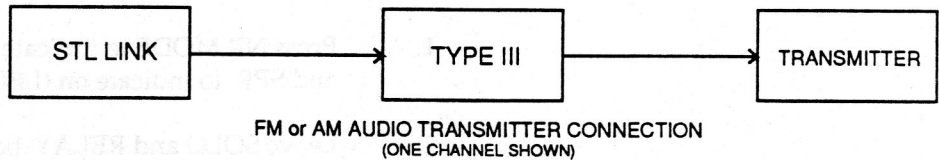
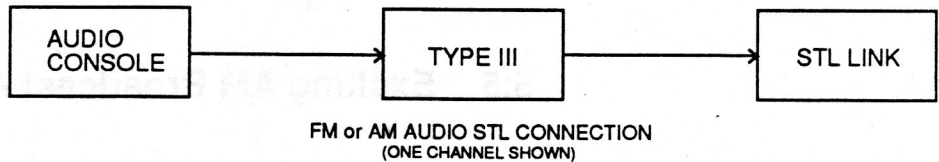


Fig. 5-5. Block diagram showing connection of Aural Exciter III in FM or AM broadcast chain.

1. MODE to indicate A, Ax to indicate on (LED on), and SPR to indicate on (LED on).
2. Leave SOLO and RELAY both in the off position (indicators off).
3. Set remaining controls to match the settings shown in Fig. 5-6.

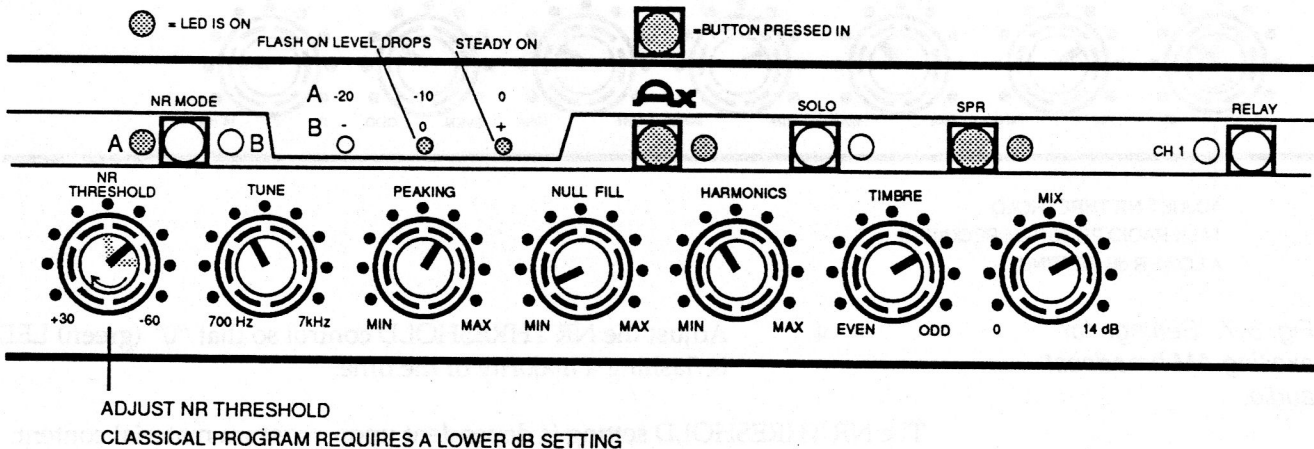


Fig. 5-6. Settings for exciting FM audio (television or radio) broadcast.

- Adjust the NR THRESHOLD control so that the "0" (green) LED is flashing a majority of the time.

The NR THRESHOLD setting is dependent upon program material content. For example, classical music programming would require a lower dB setting to accommodate the wider dynamic excursions in the music.

5.5 Exciting AM Broadcast Audio

To improve the broadcast sound of AM radio, place the Aural Exciter Type III in-line between the studio feed and the transmitter limiter. Set the controls as follows:

- Press NR MODE to indicate A, Ax to indicate on(LED on), and SPR to indicate on (LED on).
- Leave SOLO and RELAY both in the off position (indicators off).
- Set remaining controls to match the settings shown in Fig. 5-7.

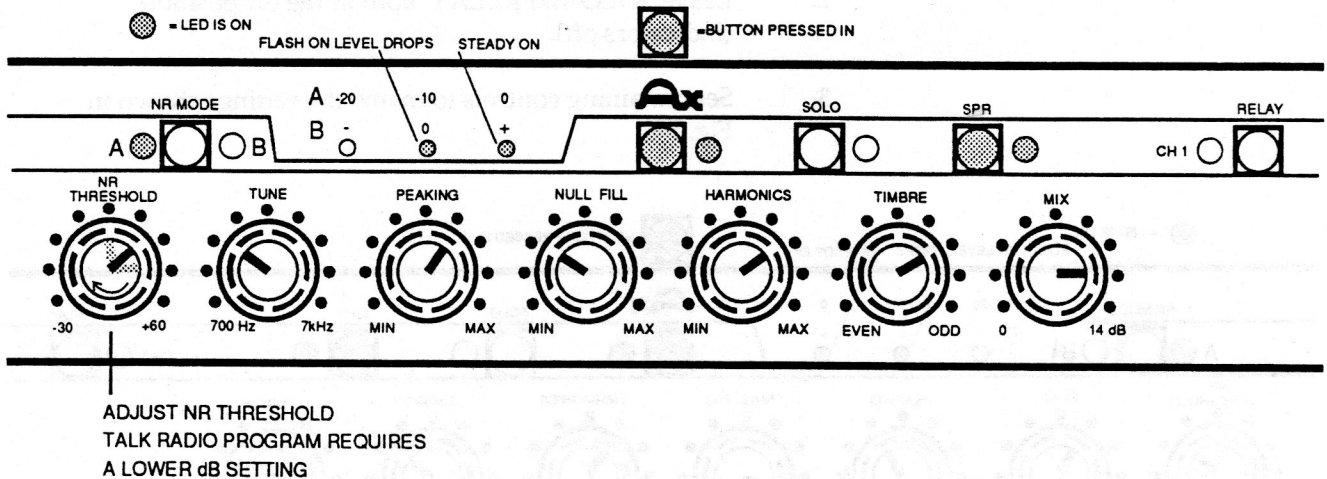


Fig. 5-7. Settings for exciting AM broadcast audio.

- Adjust the NR THRESHOLD control so that "0" (green) LED is flashing a majority of the time.

The NR THRESHOLD setting is dependent upon program material content. For example, talk radio programming would require a lower dB setting to accommodate the smaller dynamic excursions than a Top 40 format.

5.6 User Templates

A set of Front Panel drawings without knob indicators are provided for your use in Fig. 5-8. Feel free to reproduce the page so you can mark and include custom settings with your project documentation.

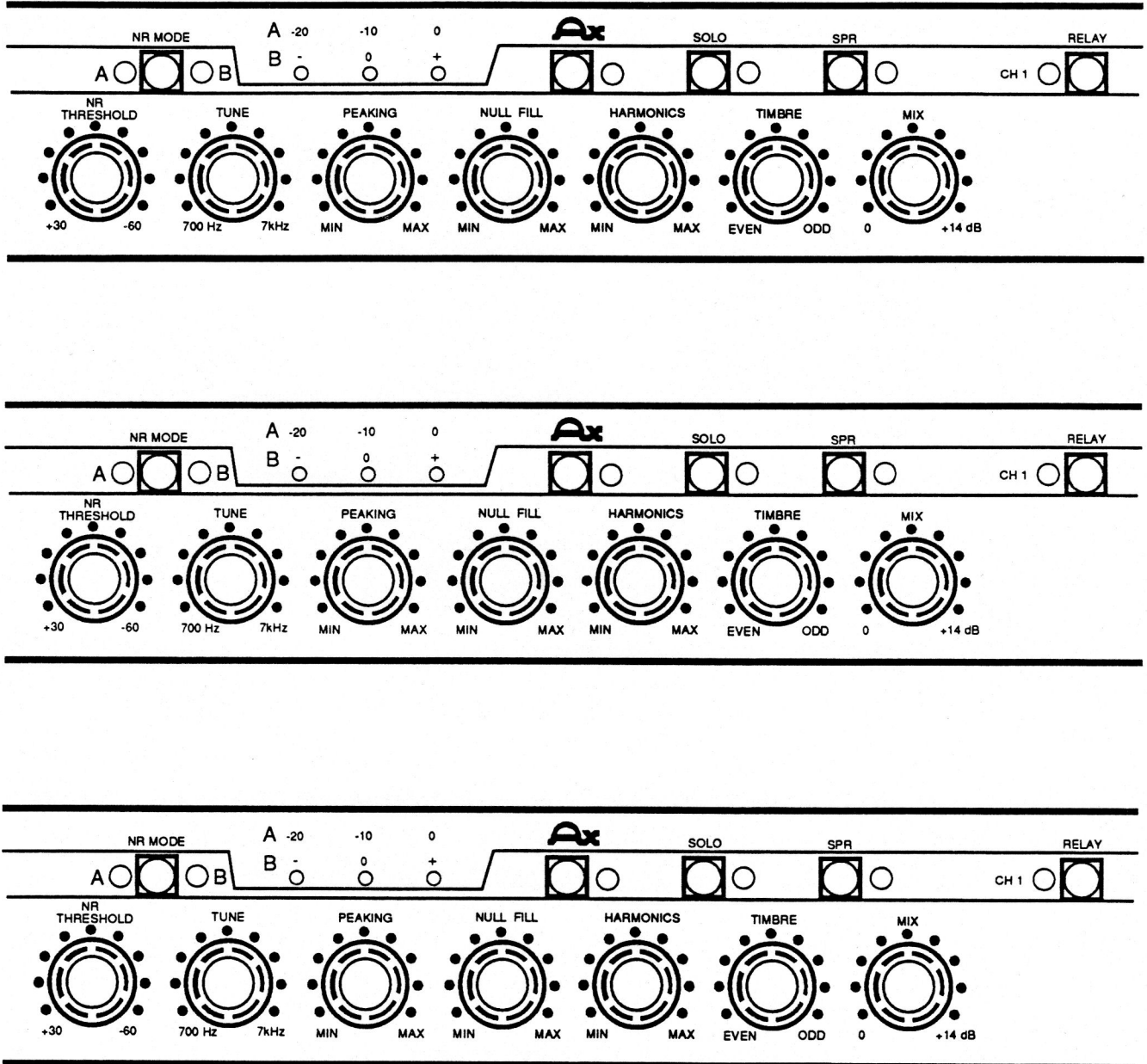


Fig. 5-8. User templates.

6.0 CIRCUIT DESCRIPTION

The circuits that make up the Apex Aural Exciter Type III are grouped onto several boards, including: one Main Audio Board (two channels), two Control Boards (one for each channel), and a Power Supply Board for AC to DC voltage conversion via the separate AC line transformer. A block diagram, shown in Fig. 6-1, discloses the circuit elements and connections in a simplified form. Refer to this diagram, as well as the circuit schematics (located at the end of the manual), throughout the following text.

BLOCK DIAGRAM APEX TYPE III AURAL EXCITER

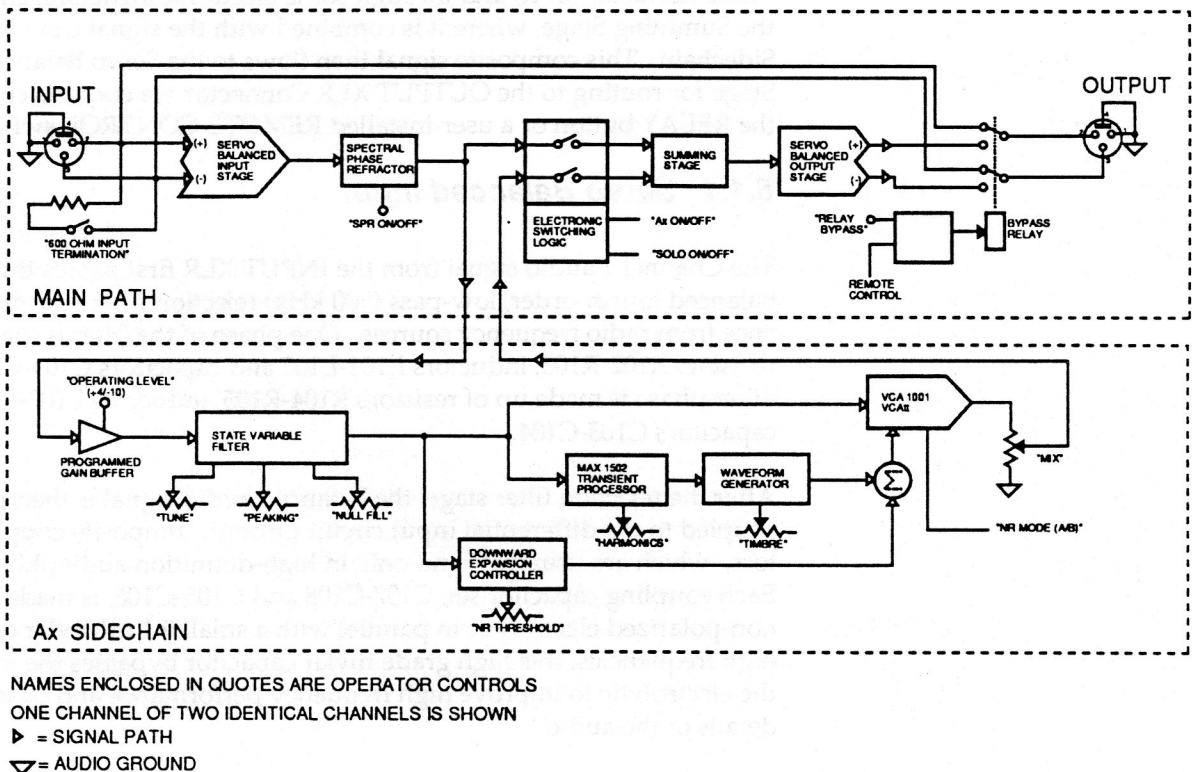


Fig. 6-1. Block diagram of Aural Exciter III circuits.

The component part numbers mentioned in the circuit descriptions can be located on a schematic diagram according to the following scheme:

100 series components (i.e. C101, U102B, R125, etc.) designate channel 1 electronics and are found on the Main Audio Board.

200 series components (i.e. C201, U202B, R225, etc.) designate channel 2 electronics and are also found on the Main Audio Board.

400 series components (i.e. C401, U402B, R425, etc.) can designate either channel 1 or 2 electronics and are found on either channel 1 or channel 2 Control Boards. Since the two boards are identical, only the physical location and interconnection of the boards within the Model 250 assembly determines the channel routing.

NOTE...



For the sake of brevity, only channel 1 components are mentioned in the following discussion.

6.1 Main Audio Path

Channel 1 audio enters the Model 250 through the INPUT XLR connector to a Servo Balanced Input Stage. Then the audio signal is routed to the Spectral Phase Refractor (SPR) and through some electronic switching circuits on to the Summing Stage, where it is combined with the signal from the Ax Sidechain. This composite signal then flows to the Servo Balanced Output Stage for routing to the OUTPUT XLR Connector via contacts controlled by the RELAY button or a user-installed REMOTE CONTROL switch.

6.1.1 Servo Balanced Input

The Channel 1 audio signal from the INPUT XLR first passes through a balanced fourth-order, low-pass (500 kHz) rejection filter to reduce interference from radio frequency sources. One phase of the filter is made up of resistors R102-R103, inductors L101-L102 and capacitors C101-C102. The other phase is made up of resistors R104-R105, inductors L103-L104 and capacitors C103-C104.

After the rejection filter stage, the balanced audio signal is then phase coupled to the differential input circuit through composite coupling capacitors, which are usually found only in high-definition audiophile circuits. Each coupling capacitor set, C107-C108 and C105-C106, is made up of a 22 μ F non-polarized electrolytic in parallel with a small 0.1 μ F mylar capacitor. At high frequencies, this high grade mylar capacitor bypasses the inductance of the electrolytic to improve high frequency performance and pass the fine details of the audio.

The balanced audio signal is then transformed via RN101, VR101, and U101B into a single-ended current that feeds differential input amplifier, U101A. The single-ended output of U101A feeds the SPR circuit via R110. U101B acts as a common-mode servo that modulates a correction current into U101A's input nodes via RN101 (pin 5 & 6 and pin 3 & 4). U101B creates the error signal through the signals it receives from the output of U101A via R106 and its own output through RN101 (pin 3 & 4). As a result, none of the common-mode signal appears at the inputs of either amplifier stage. This circuit greatly improves the linearity of the entire input stage under high common-mode conditions such as AC hum, RF interference, and DC offsets. VR101 is a fine trim for nulling CMR and is set according to the Input CMR test procedure discussed in Section 7.1.2.

An internal termination resistor, R101, can be placed across INPUT XLR pins 3 and 2, whenever the INPUT TERMINATION Switch, SW101, is pressed IN. This resistor presents a 602 ohm load to the outside world at the Model 250 Channel 1 input.

6.1.2 Spectral Phase Refractor (SPR)

The SPR circuit, U102A and U102B, is designed as two identical all-pass filters that act as delay circuits on the overall audio signal. A greater time delay occurs for signals above 150 Hz according to the time constant product of C110 and R109.

Q101 and Q102 are FET switches that turn the SPR circuit on or off, depending on the selection status of the SPR switch found on the front panel. When SPR is off, the FET switches are biased on (R146 goes to ground) and C110/C112 are shorted to ground. As a result, U102A and U102B essentially become serial inverting amplifiers that maintain proper signal polarity to the output stage.

6.1.3 Operating Level

The output signal from U102B splits into two paths. The main audio path goes to the SUMMING STAGE consisting of U104A and U104B and their associated electronic switches, U103A-D. The sidechain path goes through the OPERATING LEVEL (Gain Normalizing) Switch, SW102, located on the back panel.

The Ax Sidechain circuit needs to see an incoming signal at a -10 dB operating level. Therefore, when the audio signal is at a +4 dBu level (OPERATING LEVEL Switch is out), resistor R145 is grounded through one pole of SW102 and the main audio signal is appropriately dropped to present a -10 dB operating level for sidechain processing. When the audio signal is at -10 dB (OPERATING LEVEL is IN), R145 is unconnected and there is no signal drop.

The return from the Ax Sidechain circuit is routed to the Electronic Switching stage through R118. This resistor adjusts the gain structure according to the chosen OPERATING LEVEL. For +4 dBm operation, R118 is in-line (along with R119) to drop the returning signal. For -10 dB operation, R118 is shorted and the returning signal is unaltered.

6.1.4 Electronic Switching for SOLO and Ax Modes

CMOS switches U103A and U103D, working in tandem, shut off the main audio signal whenever the SOLO button is pressed to indicate on. Logic ground is routed via SW407 (see Control Board schematic) to H101 pin 5 causing U103D's switch to open and U103A's switch to close to audio ground via R143, through the use of logic inverter U301F. In addition, D104, acting like an OR circuit, turns on the Ax Sidechain signal (described below). When SOLO is released to indicate off, H101 pin 5 is pulled up to +15 VDC through RN301. This causes U103D's switch to close, U103A's switch to open, and D104 to bias off. This dual switch action always presents a zero potential across any switch to prevent distortion.

CMOS switches U103B and U103C, also working in tandem, route the Ax Sidechain signal to Summing Stage whenever the Ax IN/OUT button is pressed IN. Logic ground is routed via SW402 (see Control Board schematic) to H101 pin 6 causing U103C's switch to open and U103B's switch to close through the use of logic inverter U301A. When Ax IN/OUT is OUT, the above logic states flip and the Ax Sidechain signal is disconnected from U104A.

6.1.5 Summing Stage

U104A is a summing amplifier, while U104B is a unity-gain inverting amplifier to provide differential output for the servo balanced output stage. The audio signal is coupled to this last stage via capacitors C116 and C117.

6.1.6 Servo Balanced Output Stage

The Servo Balanced Output Stage has two servos, a Cross-Coupling Servo and a DC Servo, within the output circuitry. U106A and U106B are balanced high pass output amplifiers, having a time constant (R129/C120 or R137/C123) that defines a pass frequency of less than 1 Hz.

The differential signal from the switching stage is routed as two equal, opposite-polarity, signals to respective minus and plus input terminals of U106A and U106B. This configuration creates two equal, opposite-polarity signals as the final balanced output signal. In addition, the outputs from the differential amplifiers are cross-coupled back to each others' open input terminals, to provide AC servo protection for shorted or unbalanced connections present at an output XLR. VR102 is a trimming resistor used to adjust the AC voltage leaving the differential output stage. TP101 is provided as a test point for this balancing procedure (see Section 7.0).

U105A and U105B are output monitors that provide a DC servo error signal back to U106A and U106B inputs, to correct for any DC offset from the output amplifiers. This circuit keeps the balanced output signal at 0 VDC without the use of any output coupling capacitors.

6.1.7 Relay Bypass

Relay K101 is a 5 VDC relay that switches in a hard wire bypass between the input and output XLR's whenever the relay coil is not powered. When the RELAY Button, SW405 (shown on the Control Board schematic), is pressed to indicate off (button out), a ground path through H101-7 and D103 activates the relay coil, causing its switches to connect the differential output stage to the output XLR connector. When a properly designed remote RELAY switch is connected to pin 3 of the J301 REMOTE CONTROL port (located on back panel), a ground path through D102 provides a similar action. Q103 controls the LED indicator (Control Board) to provide visual confirmation of the BYPASS mode. D301 and D302 provide voltage regulation for proper shutoff of Q103 whenever a remote RELAY switch is used.

6.2 Ax Sidechain Path

After leaving the OPERATING LEVEL gain normalizing circuit (Section 6.1.3), a split of the main audio signal feeds a state variable filter that provides control of TUNE, PEAKING, and NULL FILL. The filter output signal splits into three paths to feed a Downward Expansion circuit for NR THRESHOLD Control, a Harmonic Generator with control of HARMONICS and TIMBRE, and a VCAtt (voltage controlled attenuator) where all the Excitement components are summed together. The output from the VCAtt is routed through the MIX Control and is then sent back as the Ax signal to the Electronic Switching Stage (Section 6.1.4)

6.2.1 State Variable Filter for TUNE, PEAKING, and NULL FILL

U402A-C is a state variable filter configured as a high-pass filter at the output of U402. The damping or "Q" of the filter is adjusted with the PEAKING Control, VR103. VR 402A and B provides TUNE Control for selecting the starting frequency of the high pass filter. VR404 is the NULL FILL Control, with a taper correction resistor R430 in parallel, which introduces a band-pass signal from U402B to the input of U402D. The high-pass and band-pass signals are together in inverting amplifier U402D which provides proper signal polarity to the remaining circuits. The output signal from U402D splits to the VCAtt, Harmonics Generator, and the Noise Reduction circuits.

6.2.2 Harmonics Generator

One signal from the state variable filter reaches VR405, a variable HARMONICS Control. The potentiometer wiper feeds a chosen amount of signal to an Aphex MAX 1502 integrated circuit for transient processing of fast attack signals. Transient processing helps produce more harmonics in the attack, rather than the sustain, portion of the incoming signal.

The output signal at pin 10 of the MAX 1502 is routed to a waveform generator circuit, composed of U406C and U406D. U406C is a half-wave rectifier and U406D is a summing amplifier. The TIMBRE Control provides an adjustable mix of the rectified signal and the compressed signal to produce the desired balance of odd and even harmonics. The output of the summing amplifier U406D is tied to VC of the VCAtt circuit (see Section 6.2.5).

6.2.3 Noise Reduction (NR) MODE A

NR MODE A is based on a downward expansion circuit that can provide up to 30 dB of noise reduction through the use of a voltage controlled attenuator (VCAtt). A signal from the output of U402D feeds a cascaded logarithmic amplifier made up of U406A and 406B. The combination of these two op amps provides a greater open loop gain than a single integrated circuit. Back-to-back precision diodes contained within the VCAtt (pins 10 and 12)

are used in the feedback loop to define the logarithmic function. The output from the logarithmic amplifier stage feeds a full wave rectifier circuit made up of U401B and U401C, which produces a positive-going signal at pin 8 of U401C. The THRESHOLD Control imparts a DC bias voltage onto this rectified signal prior to feeding a peak-hold filter made up of U401A circuitry. The THRESHOLD Control provides a DC bias that sets the point where the signal from the logarithmic circuit triggers D403 on. This action charges capacitor C401 up as it acquires the peak value of the incoming signal. R405 and R418 help to determine the fast attack and slow release times of the peak-hold circuit.

U401A is a difference amplifier that outputs a negative DC voltage in the absence of an input signal. For this condition, the output of U401A pulls the VC bias voltage lower, resulting in another 20 dB of attenuation. When a signal exceeds the THRESHOLD setting and reaches U401A's input, the voltage at U401A's output rises and VCAtt attenuation decreases. U401D, a voltage comparator, also senses the output signal from U401A to turn on a fast release mode for any signal that is decaying towards silence. The fast release occurs through Q402 which switches R417 in parallel with R418 into the peak-hold circuit. The result is a quicker discharge of C401 and a faster attenuation of VCAtt for elimination of noise tail.

U405A inverts the control voltage from the expander and then feeds U408, a ten segment bar driver circuit, to activate the green, yellow, and red threshold indicators located on the front panel.

The front panel NR MODE button, SW401, selects A or B noise reduction modes. A mode is always active, and selecting B mode adds an opposite polarity feed-forward signal to the final MIX stage. A and B LED's indicate the chosen mode through closure of remaining switch contacts on SW401.

6.2.4 Noise Reduction (NR) MODE B

When NR MODE B is selected via SW401, a balanced signal from U403A and U403B is summed with the VCAtt output signals at the input terminals of U405B through capacitors C414 and C415. This feed-forward signal is opposite polarity to VCAtt outputs, resulting in a complete cancellation of signals when the VCAtt signal is attenuated 8 dB. Above this point, the VCAtt output signals predominate to provide normal Exciter enhancement. Below the 8 dB attenuation threshold, the feed-forward signal predominates with its opposite polarity condition. Mixing this signal back with the original audio through the MIX control produces a high frequency cancellation effect within the final composite signal. The net result of NR MODE B is that source noise can be reduced by 5 dB below the attenuation threshold through the use of the described high frequency shelving.

6.2.5 Voltage Controlled Attenuator (VCAtt)

The signal leaving the state variable filter is transformed into a differential signal by U403A and U403B. The differential output feeds IN1 and IN2 of

the VCAtt integrated circuit. OUT 1 and OUT 2 (from VCAtt) feed U405B where they are combined into single-ended signal feeding the MIX Control VR407 through capacitor C417.

The VCAtt output is controlled by the type and amount of voltage present on the VC terminal. When VC is 0 VDC, VCAtt output exhibits no attenuation. Resistors R450, R404, and R468 set up a negative bias voltage on VC that pre-attenuates VCAtt approximately 10 dB. This action allows for the integration of modulation signals from the Harmonics Generator (Section 6.2.2) and Downward Expander circuit (6.2.3).

VR408 and VR409 are used to null any residue signal from VC before it reaches the OUT1 and OUT2. Refer to the Nulling and Test Procedures in Section 7.0 for further information.

6.2.6 Series Connected LED's

RELAY BYPASS, SPR, SOLO and Ax switches contain dry contact closures to ground to activate individual modes. However, an individual LED indicator, associated with a chosen mode, is activated by removing a short circuit bridge from the LED terminals. A constant current source, Q401, provides 15 mA of current to a series connection of LD401-402 and LD406-409. All mentioned LEDs, except LD409, are extinguished by sorting the LED terminals. LD409 is controlled by Q403 which follows the REMOTE BYPASS logic. The benefit of the constant current design is a reduction in the power supply requirements and a constant illumination brightness for any LED in the series chain.

6.3 Power Supply

The Power Supply circuit consists of a combination Corcom Fuse/RF Filter/Voltage Selector assembly, a toroid AC transformer, and a AC/DC power convertor board. The circuit board contains a full wave rectifier, rectifier filter capacitors, and conventional +15 and -15 VDC regulators with overvoltage/short circuit protection diodes. Regulated +15 VDC, ground, and -15 VDC is routed to separate sets of wired connectors for individual connection to the Main Audio and Control boards.

7.0 TEST AND NULLING PROCEDURES

The listed test procedures require the use of the following test equipment:

1. Audio Analyzer (Sound Technology 1710 or equivalent)
2. Spectrum Analyzer (Tektronics 5L4N or equivalent)
3. Sweep Function generator (B&K 3025 or equivalent)
4. Multimeter (Fluke 77 or equivalent)
5. Oscilloscope (minimum 10MHz bandwidth)

7.1 MAIN AUDIO BOARD

7.1.1 Beginning Setup

1. Make sure all boards are connected.
2. Verify Ax, SOLO, and SPR are all "OFF".
3. Verify RELAY (Bypass) is "OFF".

7.1.2 Input CMRR

1. Set input signal equal to 100Hz at +20dBu, COMMON MODE.
2. Null the output using VR201 and 101. CMRR should be better than 60 dB.

7.1.3 Output CMRR

1. Set input signal equal to 100Hz at +20dBu, NORMAL MODE.
2. Terminate output with 600 ohms.
3. Adjust VR 102 (202) for null at TP101 (201).

7.1.4 Gain Test

1. Set input signal equal to 100Hz at +20dBu, NORMAL MODE.
2. Check that output level equals +20dBu with 600 ohm load.
3. Raise input until output chips; level should equal +25dBu.

7.1.5 Distortion

1. Set input signal equal to 1kHz at +10dBu, NORMAL MODE.
2. Verify output distortion less than .006 %.
3. There should be no crossover distortion.
4. Increase input to +20dBu.

5. Verify output distortion less than .01%.

7.1.6 Noise

1. Short the inputs.
2. Output should be better than -86dBu.

7.1.7 Input Loads

1. Turn loads off.
2. Set input signal equal to 1kHz at +20dBu, **NORMAL MODE**.
3. Turn on one load at a time.
4. The generator output should drop 6dB for either load on.

7.1.8 SPR Test

1. Place oscilloscope x-y inputs on R116 and R216 (ends nearest the power supply)
2. Set the generator for 27Hz.
3. Observe a straight line (in phase).
4. Turn on the left SPR.
5. Observe a circle (90 deg. phase).
6. Set the generator for 170Hz.
7. Observe a circle (90 deg. phase).
8. Turn on the right SPR.
9. Observe a straight line (in phase).

7.1.9 RF Input Filter

1. Feed in an unbalanced linear sweep out to 500KHz to pin 2.
2. Observe output at pin 1 of U101 (201) on the oscilloscope.
3. The envelope should look like Example 1.
4. Repeat 1, 2, and 3 for input to pin 3.

7.2 CONTROL BOARDS

Perform all tests for both channels.

7.2.1 Beginning Setup

1. Make sure all boards are connected.
2. Verify Ax, SOLO, and SPR are all "OFF".
3. Verify RELAY (Bypass) is "OFF".
4. Set NR THRESHOLD to -60.

7.2.2 Tune Check

1. Set input signal to audio sweep.
2. Set SOLO to "ON".
3. Set PEAKING to 12 o'clock.
4. Set NULL FILL to minimum.
5. Place a spectrum analyzer on output.
6. Verify -3dB point tunes from 700Hz to 7KHz (approx).

7.2.3 Peaking Check

1. Set input and output to equal those in section 7.2.2.
2. Set TUNE Control to 12 o'clock position.
3. Set NULL FILL to minimum.
4. Verify nominal peaking characteristics (Max peak = +6dB).

7.2.4 Null Fill Check

1. Set input and output to equal those in section 7.2.2.
2. Set SOLO to "OFF".
3. Set Ax to "ON".
4. Set MIX to maximum position.
5. Set PEAKING to 12 o'clock position.
6. Verify NULL FILL the null at maximum setting.

7.2.5 Shift Null

1. Inject a +2V to -2V ramp at TP402.
2. Observe the shift at TP403.
3. Adjust VR408 and VR409 for minimum shift.

7.2.6 NR Mode A

7.2.6.1 Threshold Check

1. Set input signal equal to 1kHz at +26dBu.
2. Set NR MODE switch to A.
3. Set NR THRESHOLD to +30.
4. Place an oscilloscope probe on D409's anode.
5. Observe waveform and adjust the threshold so the voltage goes negative. This should occur near the +30 end of the pot.
6. Set input signal to -40dBu.
7. Adjust NR THRESHOLD to -40.
8. Adjust the NR Threshold knob until the voltage goes negative. This should occur near the -40 end of the range.

7.2.6.2 Ratio Check

1. Set input signal to 5KHz at +10dBu.
2. Set SOLO to "ON".
3. Set TUNE to 700 Hz.
4. Set PEAKING to 12 o'clock position.
5. Set NULL FILL to minimum.
6. Set NR THRESHOLD to -40.
7. Set MIX for +10 output.
8. Set NR THRESHOLD 0.5dB past the verge of attenuation.
9. Drop the input to 0dBu.
10. The output should drop to -4dBu.

7.2.7 NR Mode B

1. Set input signal to 5 kHz at 0dBu.
2. Set NR MODE Switch to B.
3. Set SOLO to "ON".
4. Set MIX to maximum.
5. Set NR THRESHOLD to -40.
6. Verify output level equals +8dBu.
7. Set NR THRESHOLD for output null.
8. Yellow indicator light should be "ON".
9. Set NR THRESHOLD to +30.
10. Verify output level equals -3dBu.

7.2.8 Transient Processor

1. Set input signal to 5 kHz at 0dBu.
2. Set TUNE to 700Hz.
3. Set PEAKING and NULL FILL to 12 o'clock positions.
4. Place an oscilloscope probe on pin 16 of U407.
5. Vary HARMONICS control end to end.
6. Observe that DC Voltage goes approximately from .85 to 1.2 volts.

7.2.9 Waveform Generator

1. Set input as above (section 7.2.8).
2. Set HARMONICS to maximum.
3. Place an oscilloscope probe on pin 7 of U406.
4. Vary TIMBRE Control end to end.
5. Observe that sinewave changes from full wave rectified to halfwave at about 60% of rotation range.

7.2.10 VCA Gain

1. Set input as above (section 7.2.8)
2. Set NR THRESHOLD at -40.
3. Set NR MODE to A.
4. Set TUNE to 700 Hz.
5. Set PEAKING to 12 o'clock position.
6. Set NULL FILL to minimum.
7. Set HARMONICS to minimum.
8. Place an oscilloscope probe on TP403.
9. Observe that TP403 level = 2.2V p-p.
10. Set OPERATING LEVEL to -10.
11. Observe that TP403 level = 7V p-p.

7.2.11 Harmonics Multiplier

1. Repeat steps 1-8 listed in section 7.2.10
2. Set HARMONICS Control to maximum.
3. Set SOLO to "ON".
4. Set MIX for output = 0dBu.
5. Set TIMBRE to even.
6. Verify that THD equals 35 percent.
7. Set TIMBRE to odd.
8. Verify that THD equals 12 percent.

8.0 PARTS LIST

The following items are sub-assemblies and assorted parts that make up a complete Model 250 Aural Exciter III.

<u>QUANTITY</u>	<u>DESCRIPTION</u>	<u>PART #</u>
(1)	CORCOM PWR CONN	42-013
(1)	(7) PIN MOLEX	43-059
(7)	MOLEX PINS	49-016
(1)	US POWER CORD	54-013
(1)	GROUND LUG	60-028
(1)	8-32 X 5/8"	60-040
(1)	STANDOFF, TORIOD	62-041
(1)	POLY BAG (UNIT) 12 X 24	66-052
(1)	POLY ZIP BAG (MOUNTING SCREWS)	66-090
(1)	"GROUND LUG" STICKER	66-110
(1)	CHASSIS COVER	66-185-001
(1)	CHASSIS	66-204
(1)	BEZEL (FRONT)	69-068
(4)	6-32 X 3/8" BLK OVAL PHIL SCREWS	60-033
(4)	4-40 X 1/4" BLK PAN PHIL SELF TAP	60-042
(1)	SHIPPING CARTON	66-201
(1)	SET SHIPPING FOAM	66-120-113
(1)	OWNERS MANUAL	N/A
(1)	POWER SUPPLY	68-143-B-SA
(1)	AUDIO CARD	68-157-SA
(2)	CONTROL CARDS	68-160-SA
(1)	TOROID PWR XFRMR	70-012
(1)	POLY BAG (LIT) 9 X 12	66-036

8.1 MAIN AUDIO BOARD PARTS

8.1.1 Resistors

<u>PART#</u>	<u>VALUE</u>	<u>TOLERANCE</u>	<u>STYLE</u>	<u>STOCK#</u>
R101	604 OHM	1% (1/2 WATT)	FILM	94-6040
R102	100K	1%	FILM	32-1003
R103	1K0	1%	FILM	92-1001
R104	100K	1%	FILM	92-1003
R105	1K0	1%	FILM	92-1001
R106	6K98	1%	FILM	92-6981
R107	6K98	1%	FILM	92-6981
R108	5.6 MEG	1%	FILM	92-5604
R109	47K5	1%	FILM	92-4752
R110	10K0	1%	FILM	92-1002
R111	10K0	1%	FILM	92-1002
R112	47K5	1%	FILM	92-4752
R113	10K0	1%	FILM	92-1002
R114	10K0	1%	FILM	92-1002
R115	10K0	1%	FILM	92-1002
R116	9K31	1%	FILM	92-9311
R117	2K0	1%	FILM	92-2001
R118	10K0	1%	FILM	92-1002
R119	2K49	1%	FILM	92-2491
R120	8K25	1%	FILM	92-8251
R121	10K0	1%	FILM	92-1002
R122	10K0	1%	FILM	92-1002
R123	10K0	1%	FILM	92-1002
R124	10K0	1%	FILM	92-1002
R125	10K0	1%	FILM	92-1002
R126	10K0	1%	FILM	92-1002
R127	332K	1%	FILM	92-3323
R128	56 OHM	1%	FILM	92-0560
R129	10 MEG	1%	FILM	92-1005
R130	10K0	1%	FILM	92-1002
R131	499K	1%	FILM	92-4993
R132	10K0	1%	FILM	92-1002

<u>PART#</u>	<u>VALUE</u>	<u>TOLERANCE</u>	<u>STYLE</u>	<u>STOCK#</u>
R133	10K0	1%	FILM	92-1002
R134	10K0	1%	FILM	92-1002
R135	332K	1%	FILM	92-3323
R136	56 OHM	1%	FILM	92-0560
R137	10 MEG	1%	FILM	92-1005
R138	150 OHM	1%	FILM	92-1500
R139	150 OHM	1%	FILM	92-1500
R140	20K0	1%	FILM	92-2002
R141	20K0	1%	FILM	92-2002
R142	249 OHM	1%	FILM	92-2490
R143	150 OHM	1%	FILM	32-1500
R144	4K99	1%	FILM	92-4991
R145	887 OHM	1%	FILM	92-8870
R146	10K0	1%	FILM	92-1002
R201	604 OHM	1% (1/2WATT)	FILM	94-6040
R202	100K	1%	FILM	92-1003
R203	1K0	1%	FILM	92-1001
R204	100K	1%	FILM	92-1003
R205	1K0	1%	FILM	92-1001
R206	6K98	1%	FILM	92-6981
R207	6K98	1%	FILM	92-6981
R208	5.6 MEG	1%	FILM	92-5604
R209	47K5	1%	FILM	92-4752
R210	10K0	1%	FILM	92-1002
R211	10K0	1%	FILM	92-1002
R212	47K5	1%	FILM	92-4752
R213	10K0	1%	FILM	92-1002
R214	10K0	1%	FILM	92-1002
R215	10K0	1%	FILM	92-1002
R216	9K31	1%	FILM	92-9311
R217	2K0	1%	FILM	92-2001
R218	10K0	1%	FILM	92-1002
R219	2K49	1%	FILM	92-2491
R220	8K25	1%	FILM	92-8251
R221	10K0	1%	FILM	92-1002
R222	10K0	1%	FILM	92-1002
R223	10K0	1%	FILM	92-1002
R224	10K0	1%	FILM	92-1002
R225	10K0	1%	FILM	92-1002
R226	10K0	1%	FILM	92-1002
R227	332K	1%	FILM	92-3323
R228	56 OHM	1%	FILM	92-0560
R229	10 MEG	1%	FILM	92-1005
R230	10K0	1%	FILM	92-1002
R231	499K	1%	FILM	92-4993
R232	10K0	1%	FILM	92-1002
R233	10K0	1%	FILM	92-1002
R234	10K0	1%	FILM	92-1002
R235	332K	1%	FILM	92-3323
R236	56 OHM	1%	FILM	92-0560
R237	10 MEG	1%	FILM	92-1005
R238	150 OHM	1%	FILM	92-1500
R239	150 OHM	1%	FILM	92-1500
R240	20K0	1%	FILM	92-2002
R241	20K0	1%	FILM	92-2002
R242	249 OHM	1%	FILM	92-2490
R243	150 OHM	1%	FILM	92-1500
R244	4K99	1%	FILM	92-4991
R245	8-7 OHM	1%	FILM	92-8870
R246	10K0	1%	FILM	92-1002
R301	10K0	1%	FILM	92-1002
RN101	10K	8 PIN	ISOLATED	97-0041
RN201	10K	8 PIN	ISOLATED	97-0041
RN301	10K	8 PIN	ISOLATED	97-0041

8.1.2 Variable Resistors

<u>PART#</u>	<u>VALUE</u>	<u>STYLE</u>	<u>STOCK#</u>
VR101	50K	PIHER LAYDOWN TRIMMER	22-008
VR102	10K	PIHER LAYDOWN TRIMMER	22-003
VR201	50K	PIHER LAYDOWN TRIMMER	22-008
VR202	10K	PIHER LAYDOWN TRIMMER	22-003

8.1.3 Capacitors

<u>PART#</u>	<u>VALUE</u>	<u>STYLE</u>	<u>STOCK#</u>
C101	470 PF	CERAMIC DISC	80-015
C102	470 PF	CERAMIC DISC	80-015
C103	470 PF	CERAMIC DISC	80-015
C104	470 PF	CERAMIC DISC	80-015
C105	22/50V	ELECT/NP RADIAL	89-001
C106	.1/100V	POLY RADIAL	84-025
C107	22/50V	ELECT/NP RADIAL	89-001
C108	.1/100V	POLY RADIAL	84-025
C109	10 PF	MICA DIP RADIAL	85-001
C110	.047/100V	POLY RADIAL	84-018
C111	10 PF	MICA DIP RADIAL	85-001
C112	.047/100V	POLY RADIAL	84-018
C113	.01/100V	POLY RADIAL	84-041
C114	10 PF	MICA DIP RADIAL	85-001
C115	10 PF	MICA DIP RADIAL	85-001
C116	100/25V	ELECT RADIAL	82-014
C117	100/25V	ELECT RADIAL	82-014
C118	20 PF	MICA DIP RADIAL	85-003
C119	20 PF	MICA DIP RADIAL	85-003
C121	20 PF	MICA DIP RADIAL	85-003
C120	.33/100V	POLY RADIAL	84-039
C122	20 PF	MICA DIP RADIAL	85-003
C123	.33/100V	POLY RADIAL	84-039
C124	.1/50V	MONO RADIAL	88-001
C125	.1/50V	MONO RADIAL	88-001
C126	.1/50V	MONO RADIAL	88-001
C127	.1/50V	MONO RADIAL	88-001
C201	470 PF	CERAMIC DISC	80-015
C202	470 PF	CERAMIC DISC	80-015
C203	470 PF	CERAMIC DISC	30-015
C204	470 PF	CERAMIC DISC	80-015
C205	22/50V	ELECT/NP RADIAL	89-001
C206	.1/100V	POLY RADIAL	84-025
C207	22/50V	ELECT/NP RADIAL	89-001
C208	1/100V	POLY RADIAL	84-025
C209	10 PF	MICA DIP RADIAL	85-001
C210	.047/100V	POLY RADIAL	84-018
C211	10 PF	MICA DIP RADIAL	85-001
C212	.047/100V	POLY RADIAL	84-018
C213	.01/100V	POLY RADIAL	84-041
C214	10 PF	MICA DIP RADIAL	85-001
C215	10 PF	MICA DIP RADIAL	85-001
C216	100/25V	ELECT RADIAL	82-014
C217	100/25V	ELECT RADIAL	82-014
C218	20 PF	MICA DIP RADIAL	85-003
C219	20 PF	MICA DIP RADIAL	85-003
C220	.33/100V	POLY RADIAL	84-039
C221	20 PF	MICA DIP RADIAL	85-003
C222	20 PF	MICA DIP RADIAL	85-003
C223	.33/100V	POLY RADIAL	84-039
C224	.1/50V	MONO RADIAL	88-001
C225	.1/50V	MONO RADIAL	88-001
C226	.1/50V	MONO RADIAL	88-001
C227	.1/50V	MONO RADIAL	88-001

8.1.4 Semiconductors

<u>PART#</u>	<u>DESCRIPTION</u>	<u>FUNCTION</u>	<u>STOCK#</u>
U101	LF353N	DUAL OP AMP	32-007
U102	LF353N	DUAL OP AMP	32-007
U103	CD4016BE	QUAD ANALOG SWITCH	38-003
U104	LF353N	DUAL OP AMP	32-007
U105	LF353N	DUAL OP AMP	32-007
U106	NE5532N	DUAL OP AMP LOW NOISE	32-028
U201	LF353N	DUAL OP AMP	32-007
U202	LF353N	DUAL OP AMP	32-007
U203	CD4016BE	QUAD ANALOG SWITCH	33-003
U204	LF353N	DUAL OP AMP	32-007
U205	LF353N	DUAL OP AMP	32-007
U206	NE5532N	DUAL OP AMP LOW NOISE	32-028
U301	HEF4069UBP	HEX INVERTER	38-006
D101	1N4003	POWER DIODE	30-009
D102	1N4003	POWER DIODE	30-009
D103	1N4003	POWER DIODE	30-009
D104	1N914B	LOW SIGNAL DIODE	30-002
D201	1N4003	POWER DIODE	30-009
D202	1N4003	POWER DIODE	30-009
D203	1N4003	POWER DIODE	30-009
D204	1N914B	LOW SIGNAL DIODE	30-002
Q101	J113	FET	31-010
Q102	J113	FET	31-010
Q103	2N3904	NPN SMALL TRANS	31-015
Q201	J113	FET	31-010
Q202	J113	FET	31-010
Q203	2N3904	NPN SMALL TRANS	31-015
D301	1N4003	POWER DIODE	30-009
D302	1N4003	POWER DIODE	30-009

8.1.5 Inductors

<u>PART#</u>	<u>DESCRIPTION</u>	<u>FUNCTION</u>	<u>STOCK#</u>
L101	220uh	INDUCTOR AXIAL	72-016
L102	1000uh	INDUCTOR AXIAL	72-013
L103	220uh	INDUCTOR AXIAL	72-016
L105	47uh	INDUCTOR AXIAL	72-018
L106	47uh	INDUCTOR AXIAL	72-018
L201	220uh	INDUCTOR AXIAL	72-016
L202	1000uh	INDUCTOR AXIAL	72-013
L203	220uh	INDUCTOR AXIAL	72-016
L204	1000uh	INDUCTOR AXIAL	72-013
L205	47uh	INDUCTOR AXIAL	72-018
L206	47uh	INDUCTOR AXIAL	72-018

8.1.6 Hardware

<u>PART#</u>	<u>DESCRIPTION/FUNCTION</u>	<u>STOCK#</u>
(4)	ALPS BUTTON CAPS	11-009
SW101	2PDT SW 600 OHM IN MTK2UEE	20-031
SW102	2PDT SW -10/+4 MTK2UEE	20-031
SW201	2PDT SW 600 OHM IN MTK2UEE	20-031
SW202	2PDT SW -10/+4 MTK2UEE	20-031
(10)	8 PIN IC SOCKETS	43-003
(3)	14 PIN IC SOCKETS	43-004
J101	XLR FEMALE PCB MOUNT RIGHT ANGLE	43-074
J102	XLR MALE PCB MOUNT RIGHT ANGLE	43-073
J201	XLR FEMALE PCB MOUNT RIGHT ANGLE	43-074
J202	XLR MALE PCB MOUNT RIGHT ANGLE	43-073
J301	RJ11 (4) COND P.C.MOUNT CONNECTOR	43-NEW
H101	(9) PIN STRAIT MOLEX CONNECTOR	43-087
H201	(9) PIN STRAIT MOLEX CONNECTOR	43-087
H301	(3) PIN STRAIT MOLEX CONNECTOR	43-093
(2)	8-32 X 1/4" SIMS	60-035
(3)	8-32 X 5/8" M/F STANDOFFS	62-041
(16)	4-40 X 1/4" SELF TAP SCREWS	60-042
(24)	.25 BIVAR SPACERS	62-029
(8)	.1 BIVAR SPACERS	62-040
(3)	TESTPOINTS	67-046
(1)	PRINTED CIRCUIT CARD	68-157
K101	5VDC GAS FILLED RELAY	73-006
K201	5VDC GAS FILLED RELAY	73-006

8.2 CONTROL BOARD PARTS

8.2.1 Resistors

<u>PART#</u>	<u>VALUE</u>	<u>TOLERANCE</u>	<u>STYLE</u>	<u>STOCK#</u>
R401	4K99	1%	FILM	92-4991
R402	10K0	1%	FILM	92-1002
R403	10K0	1%	FILM	92-1002
R404	12K7	1%	FILM	92-1272
R405	100 OHM	1%	FILM	92-1000
R406	5K62	1%	FILM	92-5621
R407	10K0	1%	FILM	92-1002
R408	15K0	1%	FILM	92-1502
R409	332K	1%	FILM	92-3323
R410	10K0	1%	FILM	92-1002
R411	2K0	1%	FILM	92-2001
R412	249 OHM	1%	FILM	92-2490
R413	1K0	1%	FILM	92-1001
R414	100K	1%	FILM	92-1003
R415	150K	1%	FILM	92-1503
R416	249 OHM	1%	FILM	92-2490
R417	1 MEG	1%	FILM	92-1004
R418	10 MEG	1%	FILM	92-1005
R419	15K0	1%	FILM	92-1502
R420	13K7	1%	FILM	92-1372
R421	100K	1%	FILM	92-1003
R422	10K0	1%	FILM	92-1002

<u>PART#</u>	<u>VALUE</u>	<u>TOLERANCE</u>	<u>STYLE</u>	<u>STOCK#</u>
R423	11K0	1%	FILM	92-1102
R424	11K0	1%	FILM	92-1102
R425	10K0	1%	FILM	92-1002
R426	10K0	1%	FILM	92-1002
R427	2K49	1%	FILM	92-2491
R428	24K3	1%	FILM	92-2432
R429	20K0	1%	FILM	92-2002
R430	2K40	1%	FILM	92-2491
R431	10K0	1%	FILM	92-1002
R432	10K0	1%	FILM	92-1002
R433	10K0	1%	FILM	92-1002
R434	100K	1%	FILM	92-1003
R435	30K1	1%	FILM	92-3012
R436	15K0	1%	FILM	92-1502
R437	68K1	1%	FILM	92-6812
R438	1K0	1%	FILM	92-1001
R439	10K0	1%	FILM	92-1002
R440	10K0	1%	FILM	92-1002
R441	10K0	1%	FILM	92-1002
R442	200K	1%	FILM	92-2003
R443	33K2	1%	FILM	92-3322
R444	33K2	1%	FILM	92-3322
R445	100K	1%	FILM	92-1003
R446	100K	1%	FILM	92-1003
R447	100K	1%	FILM	92-1003
R448	4K 9	1%	FILM	92-4991
R449	21.5 OHM	1%	FILM	92-0215
R450	40.2 OHM	1%	FILM	92-0402
R451	21.5 OHM	1%	FILM	92-0215
R452	100K	1%	FILM	92-1003
R453	100K	1%	FILM	92-1003
R454	20K0	1%	FILM	92-2002
R455	100 OHM	1%	FILM	92-1000
R456	1 MEG	1%	FILM	92-1004
R457	4K99	1%	FILM	92-4991
R458	4K99	1%	FILM	92-4991
R459	1 MEG	1%	FILM	92-1004
R460	10K0	1%	FILM	92-1002
R461	21.5 OHM	1%	FILM	92-0215
R462	1.5 OHM	1%	FILM	92-0215
R463	2K0	1%	FILM	92-2001
R464	15K0	1%	FILM	92-1502
R465	1K0	1%	FILM	92-1001
R466	301 OHM	1%	FILM	92-3010
R467	100K	1%	FILM	92-1003
R468	604 OHM	1%	FILM	92-6040
R469	1 MEG	1%	FILM	92-1004

8.2.2 Variable Resistors

<u>PART#</u>	<u>VALUE</u>	<u>STYLE</u>	<u>STOCK#</u>
VR401	B10K	18 TH NOBLE	23-038
VR402	15C100KX2	18 TH NOBLE "TUNE"	23-058
VR403	10C50K	18 TH NOBLE	23-021
VR404	B10K	18 TH NONLE	23-038
VR405	15A10K	18 TH NOBLE	23-055
VR406	B10K	18 TH NOBLE	23-038
VR407	B10K	18 TH NOBLE "MIX"	23-038
VR408	100 OHM	PIHER LAY DOWN	22-009
VR409	1K	PIHER LAY DOWN	22-011

8.2.3 Capacitors

<u>PART#</u>	<u>VALUE</u>	<u>STYLE</u>	<u>STOCK#</u>
C401	.1/25V	CERAMIC DISC	80-008
C402	270 PF	MICA DIP RADIAL	85-020
C403	.022/100V	POLY RADIAL	84-014
C404	.0022/100V	POLY RADIAL	84-048
C405	.0022/100V	POLY RADIAL	84-048
C406	.1/35V	TANT RADIAL	83-001
C407	22/25V	ELECT RADIAL	82-003
C408	22/25V	ELECT RADIAL	82-003
C409	10 PF	MICA DIP RADIAL	85-001
C410	10 PF	MICA DIP RADIAL	85-001
C411	10 PF	MICA DIP RADIAL	85-001
C412	1/35V	TANT RADIAL	83-001
C413	1/35V	TANT RADIAL	83-001
C414	.01/100V	POLY RADIAL	84-041
C415	.01/100V	POLY RADIAL	84-041
C415	.1/25V	CERAMIC DISC	80-008
C417	.33/100V	POLY RADIAL	84-039
C418	.1/25V	CERAMIC DISC	80-008
C419	100/25V	ELECT RADIAL	82-014
C420	100/25V	ELECT RADIAL	82-014
C421	.1/25V	CERAMIC DISC	80-008
C422	.1/25V	CERAMIC DISC	80-008
C423	.1/25V	CERAMIC DISC	80-008
C424	.1/25V	CERAMIC DISC	80-008
C425	1/35V	TANT RADIAL	83-001
C426	20 PF	MICA DIP RADIAL	85-003

8.2.4 Semiconductors

<u>PART#</u>	<u>DESCRIPTION/ FUNCTION</u>	<u>STOCK#</u>
U401	LF347 QUAD OP AMP	32-048
U402	LE347 QUAD OP AMP	32-048
U403	LE353N DUAL OP AMP	32-007
U404	VCA1001 APHEX	33-052
U405	NE5532N DUAL OP AMP LOW NOISE	32-028
U406	LF347 QUAD OP AMP	32-048
U407	MAX 1502 ENHANCEMENT GEN.	33-051
U408	LM3914 DISPLAY DRIVER	33-023
Q401	2N3904 NPN SMALL TRANS	31-015
Q402	2N3904 NPN SMALL TRANS	31-015
Q403	2N3906 PNP SMALL TRANS	31-011
D401	1N914B LOW SIGNAL DIODE	30-002
D402	1N914B LOW SIGNAL DIODE	30-002
D403	1N914B LOW SIGNAL DIODE	30-002
D404	1N914B LOW SIGNAL DIODE	30-002
D405	1N914B LOW SIGNAL DIODE	30-002
D406	1N914B LOW SIGNAL DIODE	30-002
D407	1N914B LOW SIGNAL DIODE	30-002
D408	1N914B LOW SIGNAL DIODE	30-002
D409	1N914B LOW SIGNAL DIODE	30-002
D410	1N914B LOW SIGNAL DIODE	30-002
D411	1N914B LOW SIGNAL DIODE	30-002
D412	1N914B LOW SIGNAL DIODE	30-002
LD401	RED LED, ROHM #SLC-26VR	27-028
LD402	RED LED, ROHM #SLC-26VR	27-028
LD403	RED LED, ROHM #SLC-26VR	27-028
LD404	YELLOW LED, ROHM #SLC-26YY	27-030
LD405	GREEN LED, ROHM #SLC-26GG	27-029
LD406	RED LED, ROHM #SLC-26VR	27-028
LD407	RED LED, ROHM #SLC-26VR	27-028
LD408	RED LED, ROHM #SLC-26VR	27-028
LD409	RED LED, ROHM #SLC-26VR	27-028

8.2.5 Hardware

<u>PART#</u>	<u>DESCRIPTION/ FUNCTION</u>	<u>STOCK#</u>
(5)	ALPS BUTTON CAPS (9 PER UNIT)	11-009
(7)	KNOBS	12-004
(7)	KNOBS CAPS	14-003
SW401	4PDT SW MTK4UEE	20-030
SW402	2PDT SW MTK2UEE	20-031
SW403	4PDT SW MTK4UEE	20-030
SW404	2PDT SW MTK2UEE	20-031
SW405	2PDT SW MTK2UEE	20-031
H401	(4) PIN RT ANGL MOLEX CONNECTOR	43-NEW
H402	(9) PIN RT ANGL MOLEX CONNECTOR	43-090
(2)	3 PIN IC SOCKETS	43-003
(3)	14 PIN IC SOCKETS	43-004
(1)	16 PIN IC SOCKET	43-007
(2)	18 PIN IC SOCKETS	43-008
(2)	8-32 X 1/4" SIMS	60-035
(11)	.25 BIVAR SPACERS	62-029
(4)	.1 BIVAR SPACERS	62-040
(9)	BIVAR SPACERS FOR LEDS	62-050
(2)	TESTPOINTS	67-046
(1)	PRINTED CIRCUIT CARD	68-160

8.3 POWER SUPPLY PARTS

8.3.1 Diodes, Semiconductors

<u>PART#</u>	<u>DESCRIPTION</u>	<u>STOCK#</u>
D501	1N4003 POWER DIODE	30-009
D502	1N4003 POWER DIODE	30-009
D503	1N4003 POWER DIODE	30-009
D504	1N4003 POWER DIODE	30-009
BR501	BRIDGE POWER DIODE #BR81D	30-004
U501	7915 REG NEG 15V	36-010
U502	7315 REG POS 15V	36-009

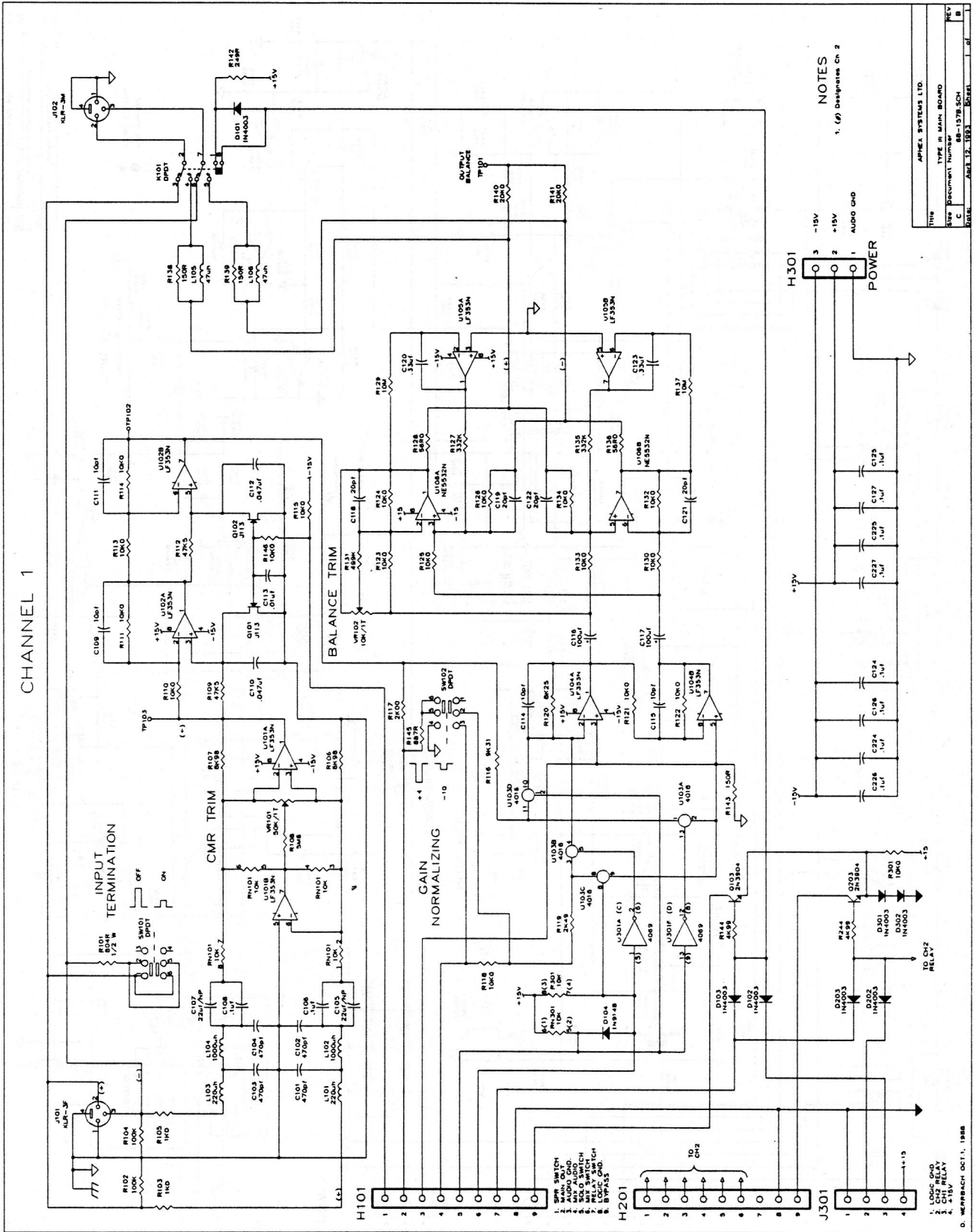
8.3.2 Capacitors

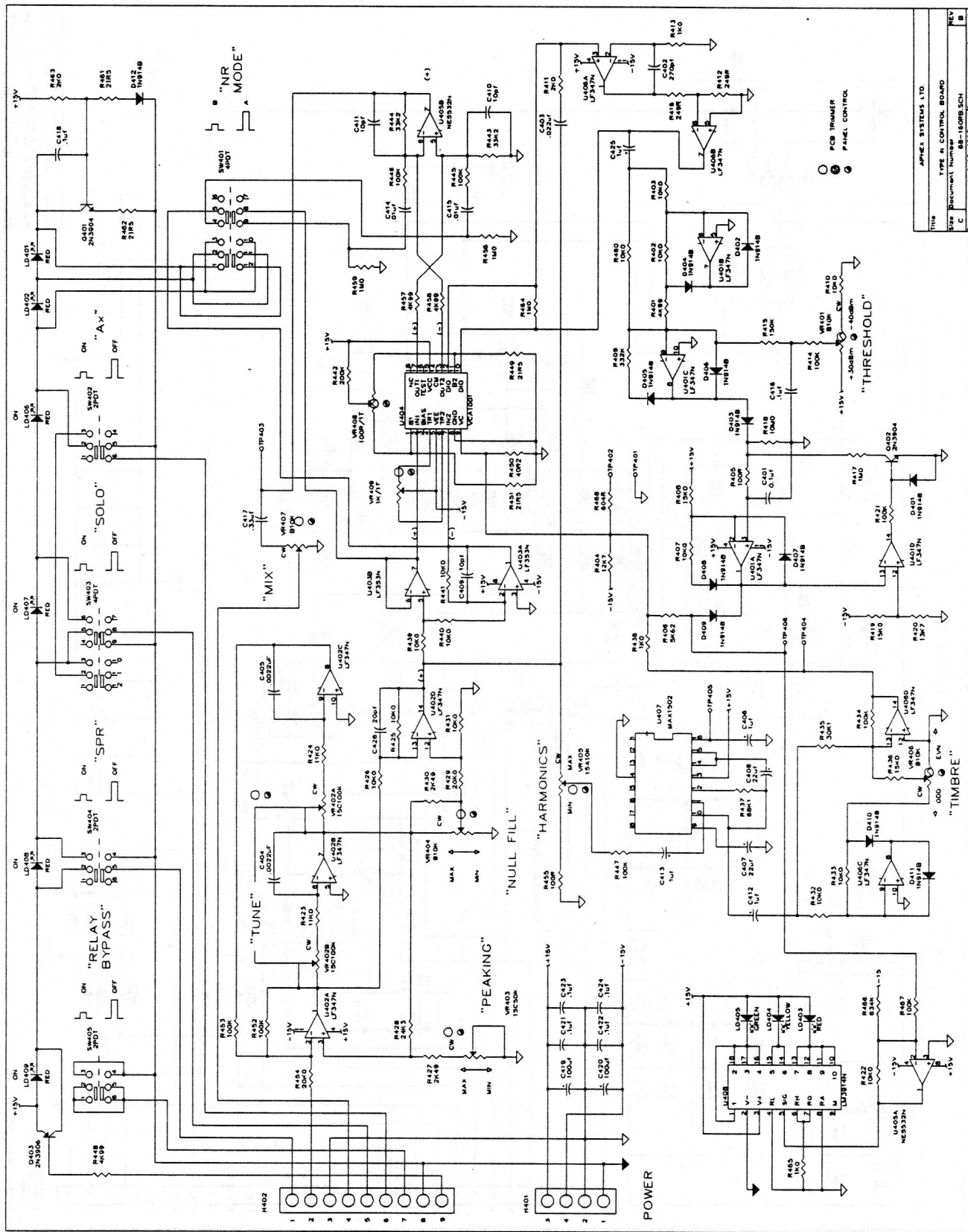
<u>PART#</u>	<u>DESCRIPTION</u>	<u>STOCK#</u>
C501	2200/35V ELECT RADIAL	82-040
C502	2200/35V ELECT RADIAL	32-040
C503	1/35V TANT RADIAL	83-001
C504	1/35V TANT RADIAL	83-001

8.3.3 Hardware

<u>PART#</u>	<u>DESCRIPTION</u>	<u>STOCK#</u>
H501	(7) COND LOCKING MOLEX HEADER	43-062
H502	(3) COND LOCKING MOLEX HEADER	43-093
H503	(4) COND LOCKING MOLEX HEADER	43-113
H504	(4) COND LOCKING MOLEX HEADER	43-113
H505	(4) COND LOCKING MOLEX HEADER	43-113
(2)	#4-40 X 1/4" PAN PHIL (HEAT SINKS)	60-001
(4)	#8-32 X 1/4" SIMS BOLTS	60-035
(2)	#4-40 KEP NUTS (HEAT SINKS)	63-005
(2)	HEAT SINKS (TERC #7-190T)	65-007
(1)	POWER SUPPLY PCB.	63-143-B

9.0 SCHEMATICS





REV	2
B	
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Docu	Document Number
68-1608B SCH	
DATE	APR 15, 1961
	Model

APPEC SYSTEMS LTD
 TYPE B CONTROL BOARD
 PCB TRIMMER
 PANEL CONTROL