# EXPRESSOR MODEL 9651

# OPERATING GUIDE

## 1.0 INTRODUCTION

The Aphex EXPRESSOR is the "sound" you've been looking for but, until now, could not find in any other compressor/limiter devices. Now you can get it fast and get it clean with fully adjustable controls and unparalleled audio performance.

In addition to the standard controls (i.e., INPUT, THRESHOLD, RATIO, ATTACK, RELEASE, and OUTPUT) you'd expect to find on a professional device like this, we've included several unique features that give you more value for your money.

With our exclusive High Frequency Expander (patent pending), you can use higher compression ratios, even up to 50 to 1, without worrying about "dullness" artifacts, typically found in other wide-band devices. Sidechain Controls let you choose whether you want to cut low frequencies, employ a soft-knee threshold, or link two EXPRESSORs for stereo or master/slave operation.

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Your EXPRESSOR 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.

## 1.1 Limited Warranty

Aphex Systems, Ltd. warrants to the original owner that the EXPRESSOR will be free from defects in parts and labor for a period of one (1) year from the date of purchase.

**THE ABOVE WARRANTY IS IN LIEU OF ANY OTHER WARRANTY, WHETHER EXPRESSED, IMPLIED OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY WARRANTY ARISING OUT OF ANY PROPOSAL, SPECIFICATION, OR SAMPLE. APHEX SYSTEMS SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES. APHEX SYSTEMS NEITHER ASSUMES NOR AUTHORIZES ANY PERSON TO ASSUME FOR IT ANY OTHER LIABILITY**

## 1.2 Service Information

If it becomes necessary to return a unit for repair, contact Aphex for a return authorization number, repack it in the original carton and packing material, and insure the shipment. If a warranty repair, enclose a copy of proof of purchase and send package to:

APHEX SYSTEMS, LTD.
11068 Randall Street
Sun Valley, CA 91352
PH: (818) 767-2929 FAX: (818) 767-2641

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



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9651

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## 2.0 PRINCIPLES OF GAIN REDUCTION

In order to fully understand the features found in your EXPRESSOR, we need to first explain several Gain Reduction principles that are basic to the design of the Aphex family of Gain Reduction devices.

Gain Reduction is the process of proportionally reducing the dynamic range of audio signal into a smaller, more compact range so it "fits" the recording or transmission medium at hand. Ideally, the output signal should be a scaled replica of the original signal, without any undesired artifacts created by the Gain Reduction system.

How well this procedure is executed is subject to a number of factors including: audio path, understanding Gain Reduction applications, and correctly setting the controls.

### 2.1 Audio Path

All our Gain Reduction devices (EXPRESSOR, COMPELLOR, and DOMINATOR) use the latest circuit techniques, incorporating our own Aphex VCA 1001, to produce the industry's HIGHEST performance.

We include transformerless servo-balanced instrumentation input stages on all these products to provide high headroom, superb common-mode rejection, transparent audio interface, and high input impedance.

The output stages also use a transformerless servo-balanced design to drive balanced or unbalanced lines without loss of level or increase in distortion. The outputs can actually sense short circuits to ground on either leg . When this occurs, they immediately throw full audio to the other (ungrounded) pin, while turning off the grounded amplifier.

### 2.2 Gain Reduction Parameters

The level at which Gain Reduction starts is the Threshold setting. Above Threshold, Gain Reduction takes place as the audio level rises above the setting. When the audio level falls below the Threshold setting, Gain Reduction ceases. Knowing this, we may choose to gain-reduce all or only the highest peaks of the audio signal.

Ratio is the mathematical relationship that provides a convenient measurement of how much an increase in Input signal level will be reduced. For example, a Ratio of 5:1 means an increase of 5dB in input level would result in only a 1dB increase in output signal.

Attack Time is defined as the time it takes the Gain Reduction circuit, set at its highest Ratio, to attenuate by 10dB an increase in the Input signal above Threshold. With a fast Attack Time (e.g., 50microseconds), the Gain Reduction circuit would react almost immediately to any signal increase above Threshold, whereas a slow Attack Time (e.g., 60 ms) would create a slower reaction time. A lower Ratio setting also influences the Attack Time by proportionally slowing the reaction time.

Overshoot is defined as the signal above the Output signal eventually achieved through Gain Reduction. The slower the Attack Time, the greater the Overshoot. This relationship may be used to create greater "slap","punch", or "bite", depending upon the particular Input signal.

Release Time is defined as the time it takes to "undo" or un- attenuate the Gain Reduction by 10dB when the Input level drops (based on the highest Ratio setting). A very fast Release Time (e.g., 0.4 seconds) quickly "brings up" the Output level as the Input decreases. A slow Release Time (e.g., 2 seconds or longer) creates a gradual release of Gain Reduction.

A faster Release Time will generally keep the Ouput level more constant and make low level signals louder. A slower Release Time will allow the Output dynamics to more closely resemble the Input dynamics, resulting in a more natural sound.

Make-Up Gain is the amount of additional gain needed to bring the gain-reduced signal up to a

desired Output level.

## 2.3 Types of Gain Reduction and Applications

There are five different types of Gain Reduction: Leveling, Compression, Program Limiting, Peak Limiting, and Clipping. Depending on the application, you must choose which type or which combination of types of Gain Reduction are appropriate to achieve a desired effect.

Leveling maintains a consistent output level over the long term, without affecting the short-term dynamics. The Ratio is set for a high value, while Attack and Release Times are adjusted for slow response.

Compression is a low Ratio setting, typically less than 8:1, with faster Attack and Release times. It is used to "fit" a wide dynamic range signal into a smaller range. Compression is typically used to bring low level signals "up."

Program Limiting is a high Ratio setting with fast Attack and Release times. It is used to set a maximum level for an"average" (i.e., VU) Output.

Peak Limiting is high Ratio setting with extremely fast Attack and Release times. It is used to set a maximum level for peak Output. Most peak limiters will produce Overshoot even though the Attack Time is very fast.

Clipping is an infinite Ratio setting with nearly instantaneous Attack and Release times. It provides an absolute, zero overshoot, "brick wall" at which peak levels will be capped. The EXPRESSOR is not capable of this type of gain reduction.

Typically, higher Ratio settings and faster Attack/Release times produce greater Gain Reduction effects. The EXPRESSOR allows you to use these effects for creative purposes. If these effects are not desired, then use more sophisticated gain control devices like the COMPELLOR on average levels and the DOMINATOR on peak levels.

# 3.0 EXPRESSOR INSTALLATION

## 3.1. Physical Considerations

The 9651 Expressor is designed to fit into one slot of an Aphex 9000 frame and dbx® 900 series frames. The thumbscrews (#6-32) secure the module to the frame.

## 3.2 Electrical Considerations

### *3.2.1 Power*

The 9651 is powered by +/-15V. The power is bussed to the unit on the backplane of both the Aphex and the dbx® racks. The +/-24V which appears on the dbx® rack will not affect the 9651 in any way.

NOTE: The 9651 consumes 171mA worst case. Compute the total power consumption of all modules in the rack to determine if sufficient power is available from the power supply.

On the Aphex rack model 9000R the audio ground and chassis ground come out the the power screw terminal connector seperately (see figure 1). The terminal ⏚ marked may be jumpered to the terminal ⏚ marked to electrically connect the audio and chassis grounds together.

### 3.2.2 Edge Connector Pin-out (see schematics)

Pin #

| | Description |
|---|---|
| 1 | No connection |
| 2 | No connection |
| 3 | Ground (Chassis) |
| 4 | Ground (Audio) |
| 5 | +15V |
| 6 | -15V |
| 7 | Sidechain in |
| 8 | Sidechain out |
| 9 | no connection |
| 10 | Link |
| 11 | Ground |
| 12 | Input + |
| 13 | Input - |
| 14 | Output + |
| 15 | Output - |

### 3.2.3 Rear Panel Connections (screw terminals on rear of racks)

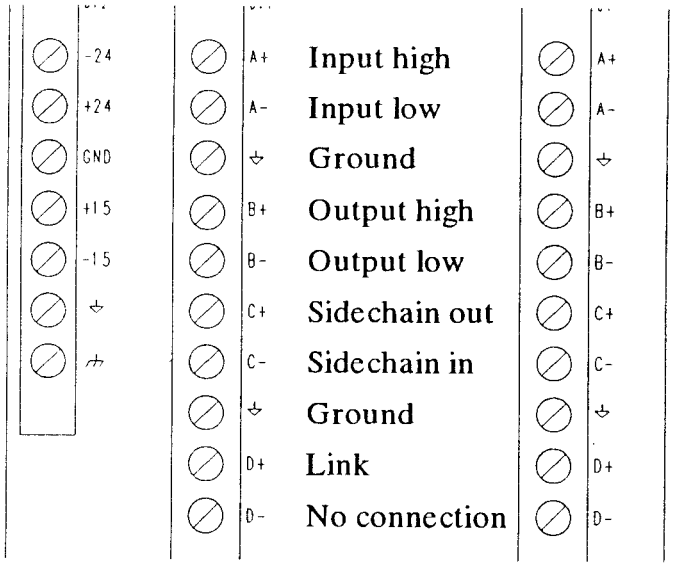



*Fig: 1 Rear Panel Connections*

### 3.2.4 Audio Input and Output Connections

The 9651 may be driven balanced or unbalanced. If balanced, "high" should be connected to A+, "low" connected to A- and shield connected to Ground. If unbalanced, connect "high" to A+, "low" to A- and connect a jumper from A- to Ground.

The output can drive either balanced or unbalanced loads. Connect B+ for output "high" and B- for output "low". Do not connect shield. If driving a known unbalanced load, connect a jumper between B- and Ground.

The reference level of the meter of the EXPRESSOR may be set for -10dBV or +4dBu via a shunt (jumper) JP2 located in the upper middle area of the main PCB. -10dBV is with the shunt in, +4dBu is with the shunt removed.

### 3.2.5 *Impedances*

The EXPRESSOR features a high input impedance (22kΩ balanced), allowing it to be easily driven by any other piece of audio equipment, including consumer gear. However, a piece of equipment designed to work into a 600Ω load may show unusually low output meter readings, even though the unit is driving the EXPRESSOR properly. Or the unit may considerably overdrive the EXPRESSOR's input, while still indicating 0VU.

In either case, you will observe a large disparity between indicated drive levels, with the EXPRESSOR's meter reading a much higher level than the output meter of the driving unit. If this occurs, install a 600Ω resistor across each EXPRESSOR input to lower the input impedance to 600Ω.

### 3.2.6 *Sidechain Access Wiring Considerations*

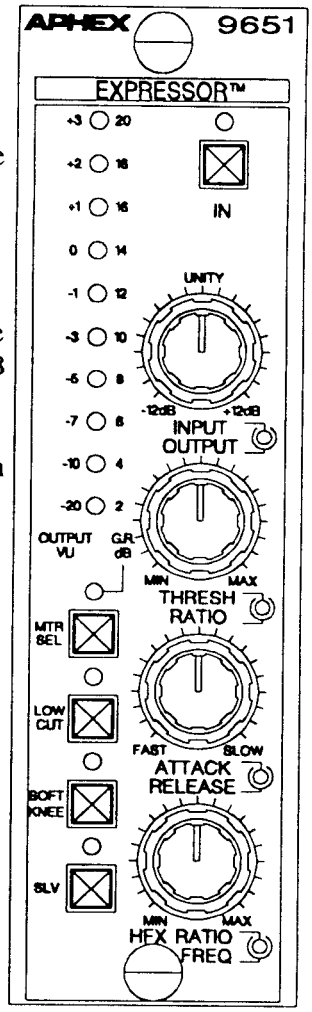
Sidechain Access is provided via unbalanced connections at the rear panel. Sidechain "out" (the audio input) appears at **C+**. Sidechain "in" connects to **C-**. Connect the "high" to the respective terminals and the "low" to Ground. IN ORDER TO USE SIDECHAIN ACCESS YOU MUST REMOVE THE SHUNT (JUMPER) JP1 AT REAR OF THE MAIN PCB. IF YOU DO NOT USE SIDECHAIN ACCESS, REPLACE THE SHUNT OR CONNECT A JUMPER BETWEEN **C+** AND **C-**.

Use the Sidechain to send the EXPRESSOR's audio signal to an outside device for modification and return it or a completely different signal to achieve creative processing.

NOTE: The Low Cut Filter is inserted after the sidechain access point.

You can use the LINK terminal **D+** to either link two EXPRESSORs for Stereo operation (SLAVE OFF/ON Switch is OFF) or Master/Slave operation (SLAVE OFF/ON Switch is ON on the "slave" unit and OFF on the "master" unit).

# 4.0 FRONT PANEL




## 4.1 "IN" Switch

When the "IN" Switch is IN, the LED lights and the audio is routed through the EXPRESSOR. In the OUT position, this switch provides a hardwire audio bypass.

## 4.2 INPUT Control

The INPUT Control provides a variable audio input gain control that drives the EXPRESSOR circuits. You can adjust this control from -20 to +17dB with 0dB representing unity gain, at your system's nominal operating level (e.g.;-+4dBu,-10dBV). The servo balanced input stage uses a transformerless circuit that accepts balanced or unbalanced audio signals (see Installation). This design also provides a high degree of common-mode signal rejection, to get rid of unwanted signals generated in long cable runs.

## 4.3 THRESHOLD Control

The THRESHOLD Control allows you to set the threshold level where gain reduction begins, regardless of INPUT Control position. This control is adjustable from -20 to +20dBu.

If the SOFT KNEE Switch is ON, the threshold level is automatically lowered by 10dB to accommodate the lower "soft" compression ratio and keep the same Ouput level.

## 4.4 RATIO Control

The RATIO Control allows you to compress the incoming audio signal according to the ratio of input versus output signal. The control can be varied from a ratio of 1.1 (to 1) to 50 (to 1). For example, a Ratio of 5:1 means an increase of 5dB in input level would result in only a 1dB increase in output signal.

## 4.5 ATTACK Control

The ATTACK Control allows you to control how fast an audio signal is going to be compressed. The control can be varied from .05 to 100 ms, with attack time being defined as the time it takes to fully attenuate a signal by 10dB with the highest Ratio setting.

## 4.6 RELEASE Control

The RELEASE Control allows you to control how long an audio signal is going to be compressed. The control can be varied from .04 to 4s, with release time being defined as the time it takes to "undo" or un-attenuate a signal by 10dB with the highest Ratio setting.

## 4.7 HFX RATIO Control

Fixed equalization is the traditional method of retrieving brightness lost due to high Ratio compression/limiting. The problem with this technique occurs when equalization is no longer needed because the signal is out of limiting and creates an undesirable audible increase in background noise. The EXPRESSOR provides a unique feature that automatically adds equalization only when necessary. The HFX Control allows you to set the amount of equalization (6dB per octave shelving) for the amount of Gain Reduction. At a minimum ratio of 0:1, there is no HFX effect. At 1.0:1, there is 1dB of High Frequency Expansion (or boost) for every 1dB of Gain Reduction. The maximum amount of High Frequency Expansion is 6dB, regardless of the amount of Gain Reduction. With this unique High Frequency Expander, you can add "life" or "air" to a compressed signal, without fear of hearing "background noise pumping" that usually results from standard attempts at post-equalization

of a compressed signal.

## 4.8 FREQUENCY Control

The FREQUENCY Control lets you set the high pass corner frequency of the HFX expander. The control can be varied from 2kHz to 20kHz.

## 4.9 OUTPUT Control

The OUTPUT Control provides a variable audio "make-up" gain control that feeds the EXPRESSOR servo balanced output circuits. You can adjust this control from -9 to +17dB, with 0dB representing unity gain at your system's nominal operating level. The servo balanced output stage uses a transformerless circuit that is virtually short-circuit proof and can drive either balanced or unbalanced audio systems.The EXPRESSOR is designed to output a maximum audio signal of +27dBu.

## 4.10 SIDECHAIN Control

The EXPRESSOR has three SIDECHAIN CONTROLS to provide you with several unique functions to enhance the overall signal. The controls are: LOW CUT OFF/ON Switch, SOFT KNEE OFF/ON Switch, and SLAVE OFF/ON Switch.

## 4.11 LOW CUT Switch

When the LOW CUT OFF/ON Switch is ON, a low cut filter (6dB per octave) is inserted into the sidechain signal to attenuate all frequencies below 80 Hz. With this feature, you can remove unwanted low frequencies (e.g., proximity effect) that can produce unnatural Gain Reduction.

## 4.12 SOFT KNEE Switch

When the SOFT KNEE OFF/ON Switch is ON, the THRESHOLD setting is lowered 10dB, and Gain Reduction becomes more gradual, to produce a less perceived sound change at Threshold. When the RATIO Control is set for a high value, the EXPRESSOR becomes a compressor/limiter.

When SOFT KNEE is OFF, Gain Reduction begins at the RATIO setting. This may produce a noticeable change in signal quality at the Threshold level.

## 4.13 SLV (SLAVE) Switch

When the SLAVE OFF/ON Switch is ON, a control signal from another EXPRESSOR is used to control your EXPRESSOR through respective LINK connections. There are two modes of operation: Stereo Link and Slave Link.

### *4.13.1 Stereo Link*

Normally, two EXPRESSORs can be linked for stereo operation by connecting the two Link terminals leaving the SLAVE OFF/ON Switch in the OFF position. The EXPRESSOR exhibiting the greatest GAIN REDUCTION will control the pair.

Set all other controls on both EXPRESSOR units to the same respective positions.

### *4.13.2 Slave Link*

When you set SLAVE OFF/ON to ON on one EXPRESSOR, then it will be controlled by the other (master) EXPRESSOR's setting, regardless of the GAIN REDUCTION setting.

Up to three EXPRESSORs (one master/two slaves) can be linked for master/slave operation. To achieve the same Output from the Slave Units, make sure the INPUT, OUTPUT, and HFX Controls match the Master's settings.

## 4.14 MTR SEL (METER SELECT) Switch

With the MTR SEL switch IN, the LED meter will display gain reduction. When the MTR SEL

switch is OUT, the LED meter displays output level.

### *4.14.1 OUTPUT LEVEL (VU) Meter*

This VU meter lets you monitor the output level of the EXPRESSOR over a range from -20 to +3dB VU (referenced to either -10dBV or +4dBu as set on the main PCB). The meter shows Output level, regardless of whether the "IN" Switch is IN or OUT.

### *4.14.2 GAIN REDUCTION (dB) Meter*

The GAIN REDUCTION meter shows you how much the audio signal is being compressed at any moment for a given THRESHOLD setting. The meter is calibrated in 2dB steps over a 20dB range. The meter shows the amount of Gain Reduction generated as if the "IN" Switch is IN, whether the "IN" Switch is IN or OUT.

## 5.0 Setting the EXPRESSOR Controls

When using any Gain Reduction device, you need to know your system's nominal operating level. Even if your console operates at +4dBu, the patch insert points may be 0dBu or -10dBv. The next step is to use a consistent set-up method like the one discussed below.

A suggested Set-up Method for the EXPRESSOR:

On the EXPRESSOR, initially set the RATIO Control to its minimum setting (i.e., 1.1:1) and adjust THRESHOLD for a maximum value (e.g., +20dBu). These settings effectively make the EXPRESSOR inactive on most audio programs.

Next, adjust the INPUT and OUTPUT Controls for unity gain, so that average levels at the Input match the Output. Use the OUTPUT VU Meter to set the Output Level at your system's reference level (also refer to section 4 - Front Panel Controls).

Make sure PROCESS is ON and the LOW CUT, SOFT KNEE, and SLAVE are all OFF. Also adjust the HFX RATIO to 0 and (HFX) FREQUENCY to 20 kHz.

Adjust the ATTACK and RELEASE Controls for average values (approximately 12 o'clock position).

While listening to the audio program, increase the RATIO Control to an average value (approximately 12 o'clock position) and then start lowering the THRESHOLD Control. Observe the GAIN REDUCTION Meter to see how much Gain Reduction is taking place for the sound you're hearing.

Once you've set an approximate THRESHOLD, adjust the RATIO, ATTACK and RELEASE Controls and judge the effect of each adjustment.

After you've set the controls in step 5, adjust the OUTPUT Control to make up any desired gain.

At this point, you've correctly adjusted the EXPRESSOR for its basic Compression application. The remaining controls add additional refinements to the sound you've created. Until you become more proficient in the use, follow this set-up each time you use the EXPRESSOR on an audio date.

## 6.0 SPECIFICATIONS

INPUT

| | |
|---|---|
| Type: | Transformerless, RF-filtered, true-instrumentation, differential servo-balanced |
| Impedance: | 22kΩ |
| Maximum Input Level: | +27dBu |

OUTPUT

| | |
|---|---|
| Type: | Transformerless, RF-filtered, true-instrumentation, differential servo-balanced |
| Output Impedance: | 65Ω |
| Maximum Output Level (600Ω): | +27dBu |
| Dynamic Range: | 112dB |
| Bandwidth: | 5 Hz to 100kHz; +0, -0.2dB |
| Signal/Noise @ Unity Gain: | -85dBu |
| THD @ +4dBu | 0.006% |
| IMD (SMPTE) @ +10dBu: | 0.006% |

CONTROLS

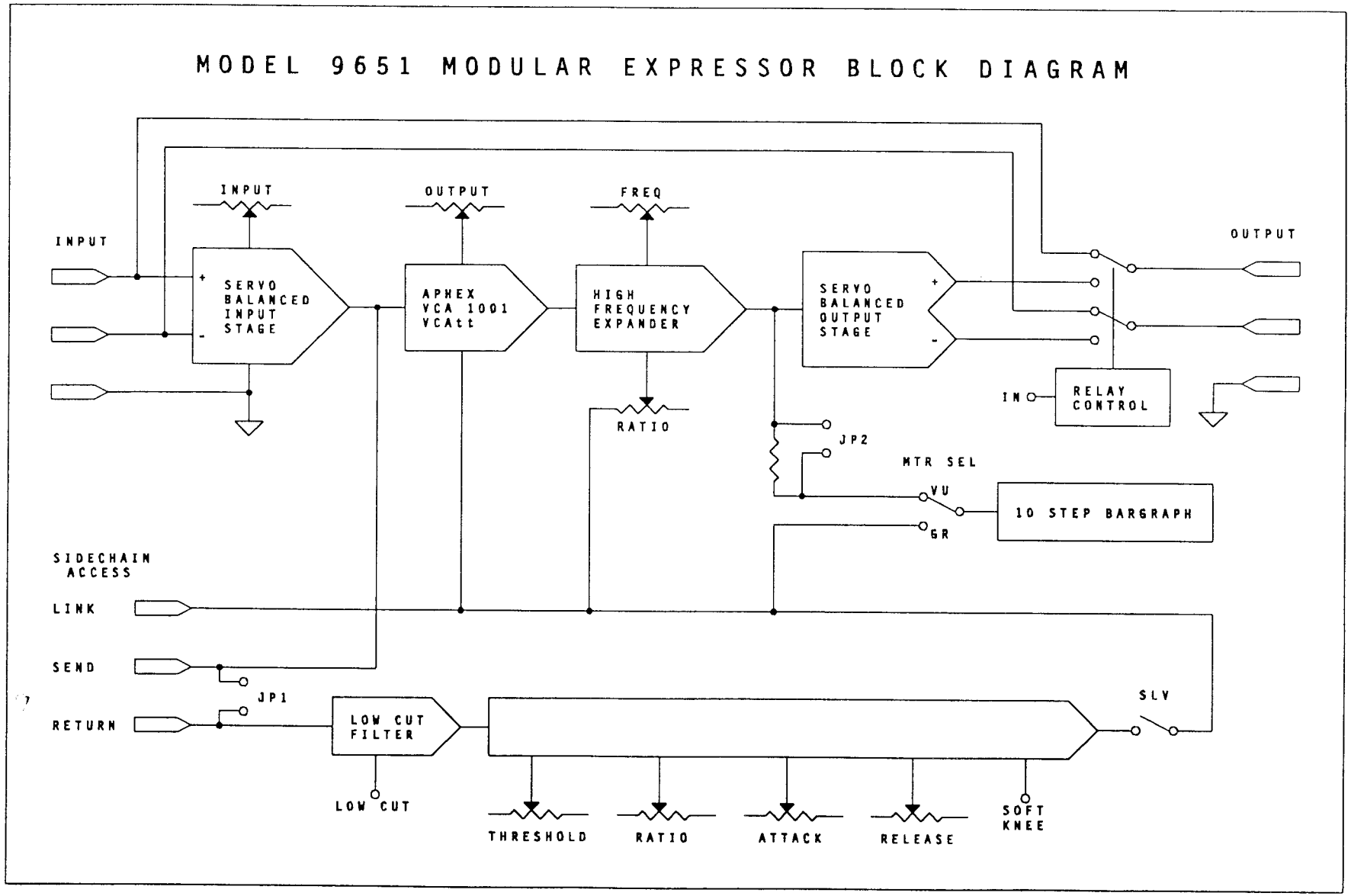
| | |
|---|---|
| Input range: | -20 to +17dB |
| Output range: | - 9 to +17dB |
| Threshold: | -20 to +20dB |
| Attack Time: | 0.5 to 100ms |
| Release: | 0.4 to 4s |
| Ratio: | 1.1:1 to 50:1 |

HF EXPANDER

| | |
|---|---|
| Ratio: | 0:1 to 1:1 |
| Frequency: | 2kHz to 20kHz |

OTHER SPECIFICATIONS

| | |
|---|---|
| Gain Reduction Element | VCA1001 |
| Power Requirements: | +/-15 Volts DC, 171mA |
| Dimensions: | Board: 4.5" H x 9.5" D; Front Panel: 5.25" H x 1.5" W |


MODEL 9651 MODULAR EXPRESSOR BLOCK DIAGRAM
INPUT
INPUT
OUTPUT
FREQ
OUTPUT
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APHEX VCA 1001 VCAtt
HIGH FREQUENCY EXPANDER
SERVO BALANCED OUTPUT STAGE
IN
RELAY CONTROL
RATIO
JP2
MTR SEL
VU
GR
10 STEP BARGRAPH
SIDECHAIN ACCESS
LINK
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RETURN
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SLV
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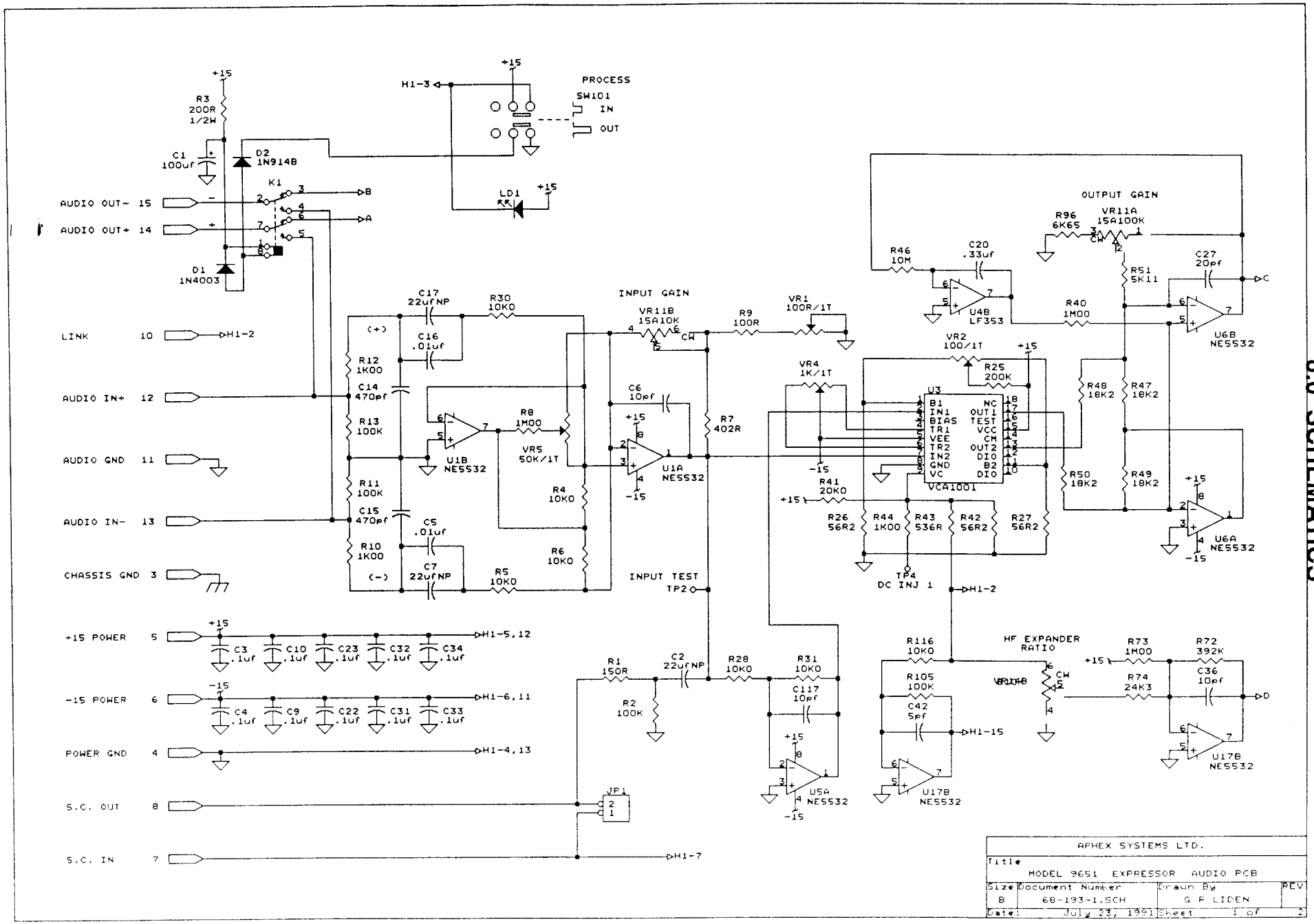
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AUDIO OUT+ 14
LINK 10
AUDIO IN+ 12
AUDIO GND 11
AUDIO IN- 13
CHASSIS GND 3
+15 POWER 5
-15 POWER 6
POWER GND 4
S.C. OUT 8
S.C. IN 7
H1-2
H1-5,12
H1-6,11
H1-4,13
H1-7
H1-3
H1-15
PROCESS
SW101
IN
OUT
LD1
D1 1N4003
D2 1N914B
K1
R3 200R 1/2W
C1 100uf
INPUT GAIN
VR11B 15A10K
VR11A 15A100K
OUTPUT GAIN
INPUT TEST
TP2
TP4 DC INJ 1
HF EXPANDER RATIO
VR116
VR1 100R/1T
VR2 100/1T
VR4 1K/1T
VR5 50K/1T
U1A NE5532
U1B NE5532
U3 VCA1001
U4B LF353
U5A NE5532
U6A NE5532
U6B NE5532
U17B NE5532
JP1
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Size B
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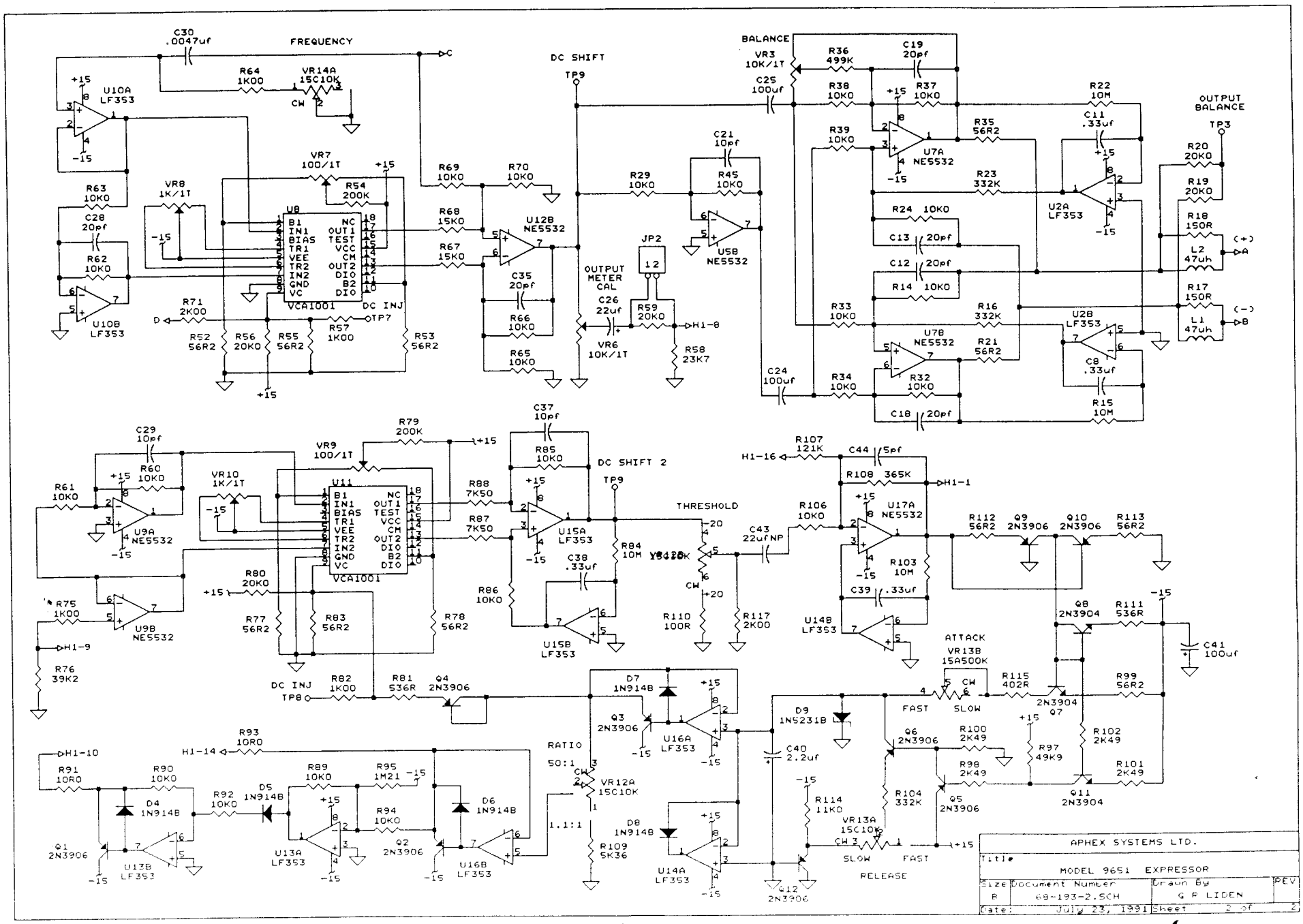
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July 23, 1991