SUPER PRIME TIME
programmable digital delay processor

Owner's Manual
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Unpacking & Inspection
Remove the Model 97 from its packing material, and SAVE ALL PACKING MATERIALS. In the event it becomes necessary to reship the unit, thoroughly inspect both the Model 97 and the packing material for indications of shipping damage, and report any damage found to the carrier.

[Diagram of Model 97]

BLANK PATCH DIAGRAMS for user convenience. [Recommended photocopying or instant printing a quantity of these pages if you plan to log many settings.]

[Diagram of Model 97]
SECTION ONE

Introduction

1.1 GENERAL

The Lexicon Model 97 "Super Prime Time" is a major advancement in digital audio equipment. With it you can create, store and recall an unlimited variety of effects which you have programmed, in any sequence you like. The standard unit offers a maximum delay time of 480 milliseconds, and memory expansion options let you increase that to either 960 milliseconds or 1.92 seconds — all at full 20 kHz bandwidth.

Because it is exceptionally flexible, as well as programmable, one Model 97 can do the job of a dozen conventional signal processing units. Two separate inputs provide versatile mixing and allow for the cross-connection of two delay lines for stereo — or for complex processing. Separate input mix, output mix, and delay only outputs are provided. To ensure feedback stability, virtually all professional equipment, there are standard phone jacks and balanced XLR connectors, plus a 20 dB input gain boost switch for low-level sources such as electronic guitars or -10 dBV to -20 dBV line level equipment.

The Model 97 is perfect for you if you're a performing musician who needs to work out a variety of special effects prior to the show or recording session, and then have the effects instantly available. That's because, at the touch of a button, you can store all the Model 97's front panel settings in internal memories, and later recall the settings as needed, in any sequence you like. The store/recall capability is equally useful to a busy recording engineer, since it allows changing the delay effects with split second timing and unparalleled precision. There are a total of 24 storage registers, 32 of which are user programmable and 8 of which are factory preset. The presets, built-in effects, are typical versions of flanging, reverse flanging, doubling, tripling, chorusing, delay echo, short echo and long echo. You can use them "raw" or, by modifying them, you can very quickly create and store your own customized effects.

With 32 memories "on line" several users can store their own effects. Built-in trickle charged Ni-Cad batteries keep the effects in memory after the power is shut off. However, in those instances where greater storage is required, all 32 user programmable registers (or individual banks of 8 registers) are easily transferred onto magnetic tape, either cassette or reel-to-reel. This makes it possible for you to build an effects library of unlimited size. Effects stored on tape can later be loaded back into your Model 97, or any Model 97, so you can carry the sound effects without carrying the machine.

The Model 97 is an irreplaceable tool in video and motion picture production, where the speed and accuracy of switching effects makes it possible to closely track the effects with the picture. To make the job even easier, the Model 97 can be made to automatically cycle through up to 32 stored effects in sync with the program by means of cue tones supplied to a slave track of the master audio tape.

We have included a number of popular, innovative features from other Lexicon delay processors, such as the ability to combine sine or square wave LFO modulation of the delay time with envelope follower modulation that tracks the input signal's amplitude, a technique which provides more realistic, less mechanical doubling and flanging effects. We have also included an infinite repeat function, selectable via the front panel or a foot switch, so performers can "capture" a phrase in the delay memory, castrate it to repeat indefinitely without signal degradation, and then play against the repeating phrase. Bypass of all processing is also selectable on the front panel or via a foot switch.

Additional foot control jacks enable a performer to sweep the Model 97's delay time over a 0 to 3,1 range, and to continuously vary the LFO modulation rate. In fact, because the rate and sweep functions are based on a 0 to 10 scale, symphonies, sonatas or solo improvisations can be directly interfaced to the Model 97 to control the effects, adding another dimension to the concept of delay processing.

Engineers can take advantage of the remote foot switch and foot control jacks by building suitable hand controls into the mixing console. They avoid the need to reach over to the outboard equipment bay when you wish to bypass the Model 97, and it for infinite repeat, step through the memory registers, sweep the delay time, or adjust the LFO rate.

The Model 97 is further equipped with features found in no other digital delay processor. Features like dynamic reconfiguration, which makes it possible to achieve long delay times (by using significant amounts of feedback without "cluttering" the sound, instead of having new sounds continuously overlap with the sounds that are being recorded), selecting the dynamic reconfiguration feature automatically reduces the amount of feedback to keep the new sounds are present at the Model 97 input. When the input signal ceases, the feedback is returned to the set amount to the decay time again increases. Now, without touching a control, the musician can play complex passages which retain their definition, yet enjoy a lingering effect after the last note.
1.2 ABOUT THIS MANUAL

Section 2 provides a very abbreviated description of the front panel controls and indicators, and rear panel features of the unit. It is OK for review. However, we recommend first reading the more detailed installation instructions in Section 3 and the operating instructions in Sections 4 and 5. Some applications and effects are covered in Section 6, while the balance of the manual covers specifications and what to do if something doesn’t work.

1.3 PRECAUTIONS

The Model 97 “Super Prime Time” is not particularly delicate or fragile, as compared to other audio equipment. However, the following common-sense precautions should be observed:

1. Never connect power sources or power amplifier outputs directly to any of the Model 97 XLR connectors or phone jacks (with the exception of 0 to 10 V DC power which may be applied to specified external control jacks). The Model 97’s inputs are designed for line level signals. If a guitar amplifier (or other power amplifier) is used as a signal input, then a suitable attenuation pad must be used to lower the level prior to feeding the Model 97 (about 30 to 50 dB of loss, depending upon the output voltage of the amp).

2. To prevent fire or shock hazards, never operate the Model 97 in the rain or exposed wet locations.

3. Please read the Installation instructions (Section 3) of this manual before operating the Model 97.

4. Be aware that feedback (howling) can occur when either or both of the RECIRCULATION controls is moved up (A-Fi and/or B-Fi). To avoid possible damage to your loudspeaker system, advance recirculation gradually. A safe practice when creating a new effect that relies heavily upon recirculation is to begin with monitor amplifier levels turned down until you are reasonably certain there is no tendency to oscillate.

8.7 DIAGNOSTIC SOFTWARE

There are several diagnostic routines permanently stored in the Model 97’s ROM. These are primarily of value to factory or factory authorized service personnel, but they can be accessed by the user to aid in identifying whether there is a problem. Should you telephone the factory for service assistance, the routine may be used to quickly identify the problem and to possibly arrange for more expedited field servicing.

The diagnostic routines are accessed by factory trained personnel in two steps: holding the BYP button, then pressing and also holding the VCA button, and then pressing one of the REGISTER buttons. DO NOT DO THIS UNLESS YOU FIRST TURN OFF THE AUDIO EQUIPMENT CONNECTED TO THE MODEL 97 OUTPUT. The diagnostic loops are intended for trouble shooting with an oscilloscope and/or signature analyzer, and possibly other specialized gear. They cause extreme disturbance in the audio output. The diagnostic routines are of little value to the user, and, at the very least, should not be used with monitor levels turned up. Caution: In case of abnormal or unusual behavior, the unit should be sent to factory service.

Here is a brief description of the diagnostics:

[Instructions on accessing and interpreting the diagnostic routines are provided, including how to enter and read the diagnostic results.]

8.8 RETURNING UNITS FOR REPAIR

If it becomes necessary to return your Model 97 for service, bear in mind that Lexicon assumes no responsibility for units in shipment from customer to factory, whether or not they are in warranty. It is important, therefore, that shipments be well packed, properly insured, and consigned to a reliable agent such as UPS or Federal Express. Be sure to include (inside the carton) a note explaining the nature of the problem, referencing any communication with Lexicon personnel you may have had. Also, include the preferred return shipping method, and indicate a date when the unit is again needed. Do not include accessories such as power cords, manuals, and remote switches. It is also important to provide Lexicon with the name and telephone number of a person we may contact should any questions arise.

8.9 REPLACEMENT PARTS

Replacement parts and the service manual may be ordered from:

Lexicon, Inc.
60 Turner Street
Waltham, MA 02154

U.S.A.
Attn: Customer Service
Phone: (617) 891-6790
TWX: 923 468

Subject to order approval by Lexicon, parts will be shipped F.O.B. Waltham. Charges will be that price in effect at the time the order is received. Lexicon may be consulted at any time, during business hours, for a parts quotation.

When ordering parts, refer to the appropriate parts list in the Model 97 Service Manual, or by complete description and give the following information:

A. Part ID number, if available.
B. Item description (e.g., RATE control knob, etc.)
C. Quantity desired.
D. The model and serial number of the unit.

8.10 LIMITED WARRANTY

Lexicon warrants each Model 97 to be free from defects in material and workmanship for one year, under normal use and service. This warranty begins on the date of delivery to the purchaser or his authorized agent or carrier. During the warranty period Lexicon will repair or, at its option, replace at no charge, components that prove to be defective, providing the equipment is returned, shipping prepaid, to Lexicon or designated service facility.

This warranty is null and void under any of the following conditions:

A. Abuse, neglect, alteration.
B. Damage caused by improper use, or operation from an incorrect power source.
C. Damage caused by accident, act of God, war, or civil insurrection. Lexicon shall not be responsible for any loss or damage, direct or consequential, resulting from Model 97 failure or the inability of this product to perform. Lexicon shall not be responsible for any damage or loss during shipment to or from the factory or its designated service facility.

This warranty is in lieu of all other warranties, expressed or implied, and of any other liabilities on Lexicon's part.
8.1 GENERAL
Before you attempt to verify whether there is a genuine problem with the unit, it is important that you understand the Model 97 output, and the installation information presented in this manual. The Model 97 does not work, jump up and down, yet, and see that the rest of the Section to read if you can pinpoint the problem.

WARNING
All servicing of the Model 97 should be performed by qualified service personnel. There are hazardous voltages located under both the top and bottom covers of the unit. To avoid electrical shock, remove the power cord prior to removing covers. Servicing procedures consistent with good safety practice should be used at all times. Additionally, due to the susceptibility of the CMOS-integrated circuit chips to static discharge, improper handling of circuitry even with power disconnected can cause expensive damage to the Model 97.

8.2 UNIT WILL NOT POWER UP
If the Model 97 will not power up first check the AC line cord to ensure it is secured to the rear panel and the service outlet. Then check the fuse and verify that the service outlet is "live" and that the voltage is correct for the Model 97 (use a voltmeter, neon test light, or a common lamp). If correct voltage is present, unplug the Model 97, and refer the problem to a Lexicon authorized service technician (who should also check to make sure the internal line voltage switches are properly set), or return the unit to Lexicon (see Section 8.4).

8.3 UNIT POWERS UP, BUT WILL NOT PASS AUDIO
8.3.1 Check Cables
Check all audio cables to ensure they are securely plugged into the proper jacks. If the connections are good, check the service outlet with a neon test light or a common lamp. If correct voltage is present, plug in the Model 97 and refer the problem to Lexicon. Look for continuity and shorts between conductors while flexing the cable to check for intermitter contacts.

8.3.2 Check Other Sound Equipment in System
If all cables are good, the next step is to check that the backpanel equipment in the sound system to ensure it is indeed operating properly. Unplug the Model 97 output cables(s) at both ends, and set aside. Then unplug the cable from the Model 97 input and reconnect it to the point which had been fed by the Model 97 output. This bypasses the Model 97 entirely. If the audio now passes through the sound system, the problem resides in the Model 97. If audio still does not pass, there is a problem elsewhere and probably not in the Model 97.

8.3.3 Check Model 97 Control and Switch Settings
Be sure the rear-panel MAIN INPUT GAIN switch is set properly, as well as the front panel input MIX and OUTPUT MIX controls. Also, be sure the unit is not in INFINITE REPEAT modes, so it may be "holding" no signal at all. Try using a preset effect rather than your own settings.

8.4 UNIT POWERS UP, AND THEN "DOES ITS OWN THING"
The Model 97 is a fully microprocessor controlled; nearly all front panel knobs, buttons, switches and indicators operate independently, relying upon the built-in computer to interpret the settings. If there is something amiss in the internal MPU interface or in the MPU itself, any number of odd symptoms could result. The chances are that a very strange malfunction is really a memory problem. Fortunately, we have built diagnostic software into the Model 97 to test the troubleshooting and test (see Section 8.7). You might suspect certain "typical" problems cause such as poor or intermittent grounding, excessive noise coming from the AC power line, or a loose circuit card.

8.5 UNIT CANNOT RECALL STORED PROGRAMS
When you store an effect in any of the 32 user-accessible memories, you are actually storing it in RAM (transient access memory). RAM is normally volatile, meaning it disappears when power is shut off, but the Model 97 contains a NiCad battery to provide continuous power to the memory registers. If you've not used the Model 97 for a long period, or if the unit is several years old, the NiCad battery may be dead, which explain the memory loss. If you suspect this, try leaving the Model 97 turned on for 24 hours; if the battery remains dead, it will have to be replaced. The loss of some memories but not others denotes a different problem, most likely in the circuitry. On the other hand, be sure the effect was actually stored. A pop time loss of one or more memories which cannot be restored may have been caused by a transient noise spike which "goes away" from the Model 97's extensive RFI and power supply filtering. In rare instances cosmic rays may have been known to "zap" IC memories.

8.6 UNIT WILL NOT STORE (OR RECALL) MEMORIES FROM FOLDER
If the Model 97 will not store its memory onto tape, check the cable to the recorder and make sure the recorder is in record mode with the input level set appropriately. With a cassette unit, be sure the "playback" tab is intact, and with reel-to-reel tape, the outside side of the head is against the holds. Still no recording? Check the signal at the TAPE STORE OUT jack: it should be a steady tone at line level until the actual "write" instruction is used in the front panel, at which time it should change to a multi-tone frequency if it modulated signal is used or a minute and a quarter (slightly less if only one track is being stored), if the input is not present, or is otherwise attenuated, there is a problem in the Model 97.

There are several reasons why, if the memory contents appear to be written on the tape, they may not read back into the Model 97. For one thing, if you try to recall a memory with a specific numerical tag (1 through 88), and the taped memory is not so numbered, then the Model 97 will ignore the read instruction. If you know the taped memory is numbered, but don't know the number, just instruct the Model 97 to read the tape without specifying a numerical tag. If that is not the problem, look into the speed accuracy and wow/flutter spec of the tape recorder by recording the steady tone present at the TAPE STORE OUT jack when the Model 97 is operating normally, and then upon playback, the tone sounds shaky, then the problem is probably in the tape player. Also, check the tape for possible defects. It is good without saying that the cable from the recorder's output to the Model 97 TAPE STORE IN jack is checked, the recorder output should be switched to monitor the tape (not output), and the output level should be turned up. After checking these items you still cannot get the channel to play, it probably lies in the Model 97's circuitry.
A. POWER switch
This switching pushbutton turns the AC power On and Off. When POWER is turned On, the front panel switch and delay settings, and the delay outputs are all "reset" to the same settings as the IC26 factory default settings.

NOTE: The Model 97 should be turned Off for at least 8 hours when first purchased so that the IC26 battery clears fully. To ensure the battery remains charged, the unit should be turned On for at least 8 hours a week.

B. HEADROOM display
The HEADROOM display monitors the audio levels of the MAIN INPUT MIX section. The display has 7 LEDs which indicate the following levels, relative to input voltage: 0.05 (0.1x headroom) to 360 dB (30 dB headroom remaining before clipping).

INPUT MIX Section
C. MAIN SOURCE control
This vertical slider adjusts the input sensitivity of the MAIN INPUT XLR and phone jack. Moving the slider up increases the level applied to the Model 97 delay processor (said to the INPUT MIX jack). This is the only front panel slider which is not memorized in any stored effect.

D. AUX SOURCE control
This vertical slider adjusts the input sensitivity of the AUX INPUT XLR and phone jack. Moving the slider up increases the level applied to the Model 97 delay processor, and the slider is to the MINIMUM.Wait interval for the desired signal gain level to be adjusted. Adjust the slider for the desired input level.

E. A-B control
This vertical slider adjusts the incoming level of all signals at the MASTER OUTPUT XLR and phone jack. The slider is to the MINIMUM.Wait interval for the desired signal gain level to be adjusted. The slider is the same as the "A" delay level control.

F. B-FD control
This vertical slider adjusts the incoming level of all signals at the MASTER OUTPUT XLR and phone jack. The slider is to the MINIMUM.Wait interval for the desired signal gain level to be adjusted.

G. Resonator low pass filter
This vertical slider adjusts the cutoff frequency of the low pass filter in series with the "A" and "B" resonator filter, which feedbacks the control to the inputs. All the way up, there is a 0.05pF capacitor, and below, the slider is brought down, the bandwidth decreases to 700 Hz. This high cut filter does not affect the delay or equalization, but it does affect the main or auxiliary signals fed to the delay processor.

H. MAIN SOURCE control
This vertical slider adjusts the amount of signal from the MAIN INPUT that is fed directly to the MASTER OUTPUT XLR and phone jack. This slider is independent of the MAIN SOURCE MIX slider and is at a programmable function. It controls the main output level and is at the MINIMUM.Wait interval for the desired signal gain level to be adjusted. Adjust the slider for the desired output level.

I. AUX SOURCE control
This vertical slider is similar to the MAIN SOURCE control, adjusting the amount of signal from the AUX INPUT that is fed directly to the MASTER OUTPUT XLR and phone jack.

J. A-DELAY control
This vertical slider adjusts the amount of delay time between the "A" delay level control and the MASTER OUTPUT XLR and phone jack.

K. B-DELAY control
This vertical slider is similar to the A-DELAY control, except it adjusts the "B" delay level control to the MASTER OUTPUT XLR and phone jack.

L. MASTER OUTPUT and OYDL indicator
This vertical slider adjusts the overall level of all inputs at the MASTER OUTPUT XLR and phone jack. The slider is to the MINIMUM.Wait interval for the desired signal gain level to be adjusted.

INVERT indicators
These indicators are located in the INPUT MIX section above the "A" and "B" delay slider, and in the OUTPUT MIX section above the "A" and "B" delay slider. When an LED is On, it indicates that the inverted signal has been inverted in polarity. Polarity reversal is controlled by the FIFTY button selection (paragraph VI), which also controls the inversion of the LEDs.

VCO section
M. MANUAL SWEEP control
This potentiometer, located in the OUTPUT MIX section, varies the range of 3.0-11.0 times the set delay to 1.5 times the set delay — with no change in signal bandwidth. The actual range is 3.0-11.0 times the set delay when the LED above the XTL button is on. The delay range is 1.5 times the set delay when the LED above the XTL button is off.

This control continuously varies the delay time, unlike the A-DELAY or B-DELAY pots, which bring about discrete temporal changes in the delay time.

*When set for maximum increase in delay time, certain loud and very high frequency signals may cause an adverse effect on the delay processor. Due to the Model 97's wide processor bandwidth, such distortion is rare, and would tend to occur only with unfiltered signals such as a very high level upper harmonic from a synthesizer.
Signal inputs and outputs

NOTE: All XLR connectors are wired according to AES/EBU pin 2 = signal high, pin 3 = signal low, pin 1 = ground. Phone jacks are wired tip high, ring low (wires balanced), sleeve ground.

A. MAIN INPUT connectors and GAIN switch (95 dB / 133 dB)

This is the main switch. Most often, the rear panel is used with the Model 97. The XLR connector on the main panel is an XLR connector of the same type as the front end, MAIN SOURCE. The XLR connector on the main panel is a 1/4" phone jack, separate channels are used in the INPUT MIX and OUTPUT MIX sections. The main panel has a GAIN switch, increasing the sensitivity by 20 dB so that -20 dB signals will drive the unit to "0" level with all channels at maximum positions.

B. AUX INPUT connectors

If two inputs are to be selected, one can be connected to the AUX INPUT, and the other to the EFFECTS RETURN INPUT. Like the MAIN INPUT, the AUX XLR connector and 1/4" phone jack have separate channel lines.

C. UNBALANCED OUTPUT connectors (INPUT MIX, DELAY A, DELAY B)

These unbalanced phone jacks are intended for output levels. The INPUT MIX output is the mixed MAIN and AUX signals at input levels as well as the "A" and "B" signals. The DELAY A and DELAY B outputs carry the delayed signal directly from the "A" and "B" signals, plus a "B" signal, also with no "direct" output. These outputs have an actual 800 ohm source impedance, which is adequate for driving 0.5 dB or higher impedance inputs, which drive to a maximum level of +5 dB.

D. MASTER OUTPUT connectors

This is the point where, most often, the audio output is derived from the Model 97. The XLR connector is electronically balanced, with the 1/4" phone jack in parallel. Both jacks carry the combined delay and direct signals from the OUTPUT MIX section. The outputs have an actual 800 ohm source impedance, and are intended for use with 600 ohm or higher impedance inputs. Maximum output level is +22 dB. To drive a single ended load, the XLR connector pin 6 or the phone jack may be used to ground. This connector is at the head end of the cable for minimum noise.

Remote Control connections

E. EXTERNAL DELAY SLEEP jack

This 1/4" phone jack is intended for use with a solid state or analog delay. This provides a means for remote control of the MANUAL SLEEP function. The MANUAL SLEEP control is turned to "OFF" when using this jack. The external delay is controlled by a switch. The Model 97 supplies its own +10 V DC to the jack so that the LINEAR source may be used as a delay controller. A switch may be used for any control that is 50 kohm or lower. As the tip is switched, the whine is heard to the left side of the unit.

F. MODULATION OUT jack

This 1/4" phone jack provides a DC voltage of 0 to 15 VDC, which correspond to the LED modulation signal at the output of the Model 97. The output may be connected to another Model 97's MODULATION IN jack, or to another delay line with similar modulation scaling so that one unit's offset signal is as a master for both units. Using this output does not affect the internal function of the Model 97, so long as it is connected to a high impedance circuit.

G. MODULATION IN jack

This 1/4" phone jack is intended to MODULATION OUT jack so that, when no plug is inserted, the Model 97's LFO signal is maintained as it can change the delay time. When a plug is inserted, the MODULATION IN jack, the model's LFO signal is sent to the oscillator. Instead, an external source of 0 to 15 V can be used for this purpose.
Specifications

7.1 GENERAL PERFORMANCE, CONTROLS AND INDICATORS

Frequency Response
20 Hz to 20 kHz ± 1 dB @ 1 kHz
Total Harmonic Distortion Plus Noise
0.008% at 1 kHz, 1% at 1 kHz
Dynamic Range
Better than 51 dB, 20 Hz – 20 kHz balanced
Delay Ranges
-Standard 0.4 to 600 ms @ ±1 kHz
-3/4/10/24/512 ms (Memory Expansion Option)
-0.4 ms to 1.36 seconds at ±1 kHz
-7.0/21.6/65.5/200.0/600.0 ms
-7.0/21.6/65.5/200.0/600.0 ms
Dynamic Range
Better than 51 dB, 20 Hz – 20 kHz balanced
Delay Modulation
Delay modulation is achieved from 0.1 to 3.1 times the delay time.
LFO Shape
Continuous 3-dimensional (isometric) draw-directible between sine wave, square wave, and triangle wave

7.2 INTERFACE INFORMATION

Input Connectors
Main inputs are XLR-3 female connectors in standard XLR-3 female plug. Tip=1 kHz, Ring=10 kHz, Shield=10 kHz
Input Impedance
200 ohm, when driven in parallel with 300 ohm for main input, 200 ohm, when driven in parallel with 300 ohm for shield (two inputs). Both inputs may be used by balanced or unbalanced
Input Levels
0 V to +19 dBV (20 V to 0 dBV) with Clarity switch in either position or +19 dBV to 0 dBV for Auxiliary input
Input Connectors
XLR-3 Male Connectors in parallel with Tip=1 kHz, Ring=10 kHz, Shield=10 kHz
Output Connectors
XLR-3 Male Connectors in parallel with Tip=1 kHz, Ring=10 kHz, Shield=10 kHz
Output Levels
+22 dBV for Master Output when driving balanced loads of 600 ohms or greater; +16 dBV for Master Output when driving unbalanced loads of 600 ohms or greater; +16 dBV for Input Mix, Delay A and Delay B outputs
Output Connectors
XLR-3 Male Connectors in parallel with Tip=1 kHz, Ring=10 kHz, Shield=10 kHz
Input/Output Power
Channels balanced electronic (Main)
Remote Control
1/4 inch XLR input on rear panel for remote control of modulation function. Modulation (1/4 inch input). Output (Tip=1 kHz, Ring=10 kHz, Shield=10 kHz)
Power
100/120/220/240 volts with worldwide input
Back Panel Power
NiCad 3.6 V automatic rechargeable pack (intended for continuous radio/charged)
Size
Standard 19" rack mount, 1.44 high by 1.5" deep (432 x 33 x 345 mm)
Weight
17.0 lbs (7.7 kilograms) net

7.3 H. RATE INJACK

This spring-loaded phone jack is intended for use with a foot pedal or rotary pot. It provides a means for remote control of the LFO RATE.

An external source of 8 to 10 VDC connected to the tip and sleeve will always change the LFO RATE from 0.00 ms to 5000 ms. The foot pedal will control the RATE in ms ranges. The foot pedal controls the RATE to an ms value, which increases from the RATE to 5000 ms range.

Output Connectors
XLR-3 Male Connectors in parallel with Tip=1 kHz, Ring=10 kHz, Shield=10 kHz
Input Connectors
XLR-3 Female Connectors in parallel with Tip=1 kHz, Ring=10 kHz, Shield=10 kHz
Output Levels
+22 dBV for Master Output when driving balanced loads of 600 ohms or greater; +16 dBV for Master Output when driving unbalanced loads of 600 ohms or greater; +16 dBV for Input Mix, Delay A and Delay B outputs

MAINTENANCE

8.0 A Maintenance Program is recommended in maintaining your LFO. Regularly check the components for wear and tear. Replace any worn out parts.

User Storage
50 effects programs can be stored in non-volatile solid state memory (IC card) battery protected RAM: unlimited storage via external audio tape reel, floppy disks or memory cards.

H. Backlight Indicator
7 level LED display shows input level (combined Main, Aux and Limiter) relative to maximum
8.5 Delay Feedback, as well as adjustable low cut filter for feedback, adjustable from 100 Hz to 20 kHz output
Input Selectors
Standard 19" rack mount, 1.44 high by 1.5" deep (432 x 33 x 345 mm)
Weight
17.0 lbs (7.7 kilograms) net

7.4 L. TAPE STORE INJACK

This spring-loaded phone jack is employed for monitoring the tape recorder’s memory bank and is used to control the tape recorder’s memory bank. It is used to control the tape recorder’s memory bank.

7.5 M. TAPE STORE OUTJACK

This spring-loaded phone jack is employed for monitoring the tape recorder’s memory bank and is used to control the tape recorder’s memory bank.

7.6 N. Power connector

The power connector accepts standard IEC (REMSA) power cords. Before plugging in the AC cord and applying power, check to ensure the AC cord is seated correctly.

FUSE holder

Warning: Do not use the unit in the USA or Canada, as the unit is designed as 115Vac x 1.15V input. The fuse holder is designed for 240Vac x 1.15V input. If the fuse holder is not designed for 240Vac x 1.15V input, it may cause a fire hazard.

7.7 M. HEADPHONES

The headphones are designed for monitoring the signal in a quiet environment.

7.8 N. Speaker Output

The speaker output is designed for monitoring the signal in a quiet environment.

7.9 O. Battery

The battery is designed for monitoring the signal in a quiet environment.

7.10 P. DC Power

The DC power is designed for monitoring the signal in a quiet environment.

7.11 Q. Remote Control

The remote control is designed for monitoring the signal in a quiet environment.

7.12 R. Back Panel Power

The back panel power is designed for monitoring the signal in a quiet environment.

7.13 S. Input/Output Power

The input/output power is designed for monitoring the signal in a quiet environment.

7.14 T. Output Power

The output power is designed for monitoring the signal in a quiet environment.

7.15 U. Power Indicator

The power indicator is designed for monitoring the signal in a quiet environment.
3.1 MOUNTING
The Model 97 is designed to be mounted in a standard 19 inch relay rack 5U (6.75 inch) high. The rack should be equipped with 5U of 19 inch relay rack, and mixed using the front panel con-

3.2 POWER REQUIREMENTS
The Model 97 requires 120VAC power. The unit can be powered from a standard 120VAC outlet. The power requirements are 500W (500 VA) for normal operation and 800W (800 VA) for maximum operation.

3.3 AUDIO SIGNAL CONNECTIONS
All unbalanced audio input and output jacks on the Model 97 accept 1/4" phone plugs. The input jacks are balanced differential amplifiers. Be sure you are using the proper plug and cable for the given connection. (Refer to the sections in Section 2.3, and Figure 3-27 below.) The Model 97 is intended for use with microphone or line-level signals, although certain high-impedance condenser mics and guitar pickups may provide adequate drive level for the MAIN INPUT when the GAIN button is engaged. Even if a guitar will drive the Model 97 directly, using a guitar preamp is a good idea.

3.4 REMOTELY CONTROLLED STAND-ALONE SYSTEMS
Three rear panel phone jacks permit remote switching of the BYPASS, INFINITE REPEAT and REGISTER STEP functions. Additional phone jacks permit remote control of the DUTY CYCLE, TRIGGER LEVEL, and MUTE橈 buttons on the front panel. (See Figure 3-3.)

3.5 SLEEP MODE
The Model 97 can be put into a sleep mode by pressing the SLEEP button on the front panel. In sleep mode, the unit consumes less power and is ready to be awakened by pressing the SLEEP button again.

3.6 TRANSIENT RESPONSE
The Model 97 has a fast transient response time, which is measured in milliseconds. This allows it to produce clean, distortion-free sound in a wide range of applications.

6.10 EVOLVING EFFECTS IN A CLASSIC DESIGN
The Model 97 is the most obvious example of effect evolution. The 97 effects provided in the Model 97's factory preset bank, effects which are permanently stored in read-only memory. As we've already said, these presets are merely starting points for you to derive your own effects. You can call up a preset, then move one or more front-panel controls past the "null" point and begin changing the effect. When you're satisfied with the modified effect, you can store it in one of the user-accessible memory banks and store the effect in its own bank. The preceding figure applies to recalling effects you've previously created, saving them in memory, and storing them in other memories. Storing them in the same bank makes it easier to "A-B" compare modified effects by alternatingly pressing different MEMORY buttons. Work out several different effect variations in this manner, storing them all. Then play typical program material and "A-B-C" the effects to select one that you prefer. You can then blank out or store other effects over the "looser."
indicate the nature of such setups. The Model 97 is used in the echo send/return loops of the mono-consoles (its separate Delay A and Delay B outputs also may be connected to additional echo return inputs). The setup uses a multi-track recorder (16, 24 or 32 tracks) for the post-production audio mixing. When working from a location film recording to a VCR audio track, these tracks can be transferred to the multi-track recorder or simply hooked-up to a suitable head-to-head or other recording. Dialogue looping, effects and music may then be dubbed onto the multi-track master. The Model 97's TAPES STORED jacks are connected to one track of the multi-track machine, which is dedicated to cue tones and effects memory storage; another track is reserved for the SMPTE time code.

In this simplified presentation, the Model 97 can be used during the recording of individual tracks on the multi-track machine that will be used later, during mixing to the final format, where it may process the entire dialogue mix or the entire effects mix. It is at this stage that the automatic "regenerative sweep" function is most useful. If more than one Model 97 is required for simultaneous processing of the different mixes (e.g., left, center, right, surround), then additional tracks may be required to handle discrete cue signals for each Model 97.

The use of the Model 97's foot or console-mounted switches and controls can be used to remotely control the Model 97. This can save time and distance of reaching for a distant equipment bay, and, in the case of foot controls, actually allows the engineer to do more things at once (if concentration and coordination permit).

### 6.7 LOCALIZATION AND IMAGE PLACEMENT

The provision is made for placing an image within a stereo or multi-track sound field is to use the signal level-to-right, varying approximately 1.0 dB per channel, between the two channels for proper positioning. Level differences in a normalized place can be used to create a sound source from an image in one ear and a sound source from the other ear to create a sound source from the center.

### 4.1 BYPASS

In Bypass mode, the INPUT MIX signal (including all polarity, not feedback) is rerouted to the output level control. All processing is bypassed by the output level control. The MAIN INPUT LEVEL, AUX INPUT LEVEL, and MASTER OUTPUT LEVEL settings are bypassed. The BYPASS jack accepts a standard 1/4" tip/sleeve phone plug or a tip/sleeve phone plug. Bypass is activated by a momentary push of the jack to the tip and sleeve. The jack is cancelled by a subsequent switch closure.

### 4.2 INFINITE REPEAT

The INFINITE REPEAT function allows the generation of any sound in the delay memory. The push and hold REPEAT key accepts a standard 1/4" tip/sleeve phone plug or a tip/sleeve phone plug. REPEAT is activated by a momentary remote switch closure which grounds the tip and sleeve. The internal switch is activated by a momentary remote switch closure after the tip and sleeve are connected to the switch closure circuit, which is cancelled by a subsequent switch closure.

### 4.3 REGISTER STEP

The REGISTER STEP function allows the operator to sequentially select steps of the register. The REGISTER STEP jack accepts a standard 1/4" tip/sleeve phone plug or a tip/sleeve phone plug. Each time a remote switch is closed the switches on the tip and sleeve of the jack are activated. The register memory register will index by one unless there is a "blank" memory point, and will then return to the register following the previous "blank". The absence of a "blank" memory point, following a switch closure will sequence to the next step, and will step through all 32 user-programmable registers.

### 4.4 EXTERNAL DELAY SWEEP

The EXTERNAL DELAY SWEEP JACK allows remote operation of the VCO, especially for those systems using the front-panel FLOPPY SWEEP function. The more depth for a given FLOPPY SWEEP is controlled by the knob, the less effect from this jack. The EXTERNAL DELAY SWEEP jack accepts a standard 1/4" tip/sleeve phone plug. Full sweep range is applied from 0 to 10 volts across the tip and sleeve of the jack. For those systems where an external delay sweep source is not used, the Model 97 provides a 0 to 10 volt output from the jack. When the 0 volt output is current limited for burn-out protection, tip/sleeve phone plug should be avoided since they will overload the internal 10 volt supply (100 mA max). Increasing the voltage across the tip and sleeve from 0 to 10 volts swells delay time for a given front-panel DELAY setting from minimum (equivalent to 0.5) to maximum (equivalent to 10). This is also true for both delay settings.

### 4.5 RATE IN

The RATE IN jack allows remote control of the model's modulation rate, essentially by duplicating the function of the front-panel RATE SKR. The RATE IN jack accepts a standard 1/4" tip/sleeve phone plug or a tip/sleeve phone plug. Full sweep range is 0 to 500 Hz (at 1 Hz for 5 Hz, or 500 Hz if the front-panel X100 is selected). This gives a 900 Hz range with the tip and sleeve inside the 10 volt source to the jack on the jack for use when an external 10 volt source is not available (e.g., for use with a foot controller rather than a synthesizer keyboard voltage or an automation system). For details see the RATE IN schematic on the following page.

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**Figure 3-3 (remote switch and controller schematic diagrams)**

Model 97's or panel-mounted switches, are used to remotely control the relevant parameters. For the system shown, the front-panel controls should be used. For any test controllers, cables should have to be shielded (coaxial) and stranded conductors, and a tough outer jacket. Avoid cable lengths exceeding...
3.5 TAPE STORE IN AND OUT

The TAPE STORE jacks have multiple functions. These tip/ring/sleeve phone jacks send data to a tape recorder (TAPE OUT), and receive it from a tape recorder (TAPE IN) for the purpose of permanently storing the Model 97’s memory registers and retrieving them later. Additionally, the TAPE STORE OUT of one Model 97 can be connected to the TAPE STORE IN of another Model 97 so that memory contents can be “dumped” directly from one unit to the other without using a tape recorder. There is one further use of these jacks: automatic register stepping. When the unit is placed in the appropriate operating mode (Section 5.9), the Model 97 TAPE OUT jack will carry a cue tone each time the front-panel TAPE button is pressed, and the unit will also step to the next memory register. Upon playing back the tape with the cue track output connected to the Model 97 TAPE IN jack, each occurrence of the cue tone will cause the unit to step to the next memory register. Once again, this automatic step function can be performed without tape by connecting TAPE OUT from one Model 97 to TAPE IN of the next unit, provided both are set to the proper modes; such operation is handy when using two units in tandem for stereo processing, since only one unit need be operated to sequence both of them.

The audio input and output at these jacks is unbalanced, applied to the tip and sleeve of any tip/ring/sleeve plug (tip/sleeve phone jacks may be used, too). The line-level signal present at TAPE OUT varies. There is frequency-shift keyed data when storing effects, a momentary frequency shift code for cue “register step automation” purposes, and a steady tone at all other times.

6.5.2 USING THE DELAY A OUT AND DELAY B OUT JACKS

While the Model 97’s OUTPUT MIX section allows the A and B delay taps to be mixed with the MAIN and AUX SOURCE signals, there are instances where the signals are best kept discrete. On the other hand, as explained in Section 8.1, certain effects are possible only when the delayed and direct sound are mixed within the Model 97. The hookup shown in Figure 6.6 allows for either situation without re-wiring anything (assuming the mixing console has at least three echo/effects return inputs). For those effects where the delayed and direct sound must be mixed inside the Model 97 (e.g., flanging), the unit’s OUTPUT MIX section is fully utilized, and the console’s return from MASTER OUT is used (echo return #2 in the illustration). The DELAY A and DELAY B output jacks are not affected by the respective OUTPUT MIX faders—they always carry the delayed signal (including any re-recording at full level) for simple echo or delay effects, the console’s corresponding echo return is used (#1 and #2 in the illustration).

6.6 USING THE MODEL 97 IN VIDEO AND FILM POST PRODUCTION STUDIO

In video or film work, the advantages of being able to instantly switch between one effect to the next are tremendous. You can have the audio follow the camera zoom with progressively longer or shorter delays, or change the entire reverberant field when the action moves to a different room or a different perspective. The Model 97’s ability to step through registers as dictated by recorded cue tones greatly simplifies the busy task of post-production audio mixing, especially when there are many fast-cut picture edits to track. The setup in Figure 6.10 is not necessarily a “real” post-production installation, but instead is meant to
sections are all the way down so that no display reaches the output.
5. Apply an input signal, and adjust the MAIN SOURCE sliders on both input sections at a level appropriate for the incoming signal (the READ/OUT display should track in both sections).
6. Tune in the polarity of unit #2's A-DELAY by pressing its IN and REGISTER 4 buttons.
7. Reset all unit #1 AUX SOURCE and A-DELAY slider in the output section until the maximum cancellation and reduction of level occurs.
8. With unit #1 HIPF control temporarily set at "off", adjust the MANUAL SWEEP control on unit #1 until the signal almost, but not quite, reaches absolute null (full cancellation).
9. Bring your LFO modulation sweep unit #1 in and out of phase with the unit #2 signal.
10. Try un-Inverting the unit #2 A-DELAY or Inverting the unit #1 A-DELAY, and experiment with different DFLAY times, different LFO RATE settings, and DEPTH settings.

6.5 TAKING FULL ADVANTAGE OF THE MODEL 97 IN THE WOODY

6.1 Synchronous register stepping from cues on a multi-track tape.
The concept of storing the Model 97's memories on tape, and the ability to automatically stop through memories based on taped cues, have been covered elsewhere in this '86 Basic. Hookup for a cassette or any reel-to-reel recorder is shown in Section 3, but we have yet to demonstrate how to hook up for synchronous tape cue induced memory stopping. The setup shown in Figure 69 would be useful in the recording studio, where a spare track on the multi-track recorder is used to store the cue tones. By loading the memory registers in an appropriate sequence, split-second timing for effects changes can be accomplished easily. If a cue is set in this right place, it can be erased, and another cue tone recorded over the correct instant. Remember that you can set up groups of effects within a BANK, delineated by blank (cleaned) memories on either end, such that the automatic stepping will cycle up to the highest numbered REGISTER before a blank, then return to the register after the lower-numbered blank. However, you'll have to manually select the first REGISTER in a given sequence so that the stepping begins with the proper effect. This is a "dumb" operation; the unit knows only to advance one register, not to a specific register.

Obviously, once a tape is set up with cue tones, the specific contents and order of the memory is important. It is easy to keep this information intact - just write the Model 97 memories onto the same track used for the cue tones. Do it at the head or tail of the tape, or between two program segments, if needed.

We recommend labeling tapes which have a data track not only to designate the cue/memory track, but also to indicate the initial memory register and bank which must be manually selected at different start times (or other discernable cue) on the tape. Once done, the tape can be used to recall memory banks.

4.1 GENERAL
This section describes how to "power up" the Model 97, how to immediately obtain useful effects, and how to store and recall your own effects - in the Model 97's 32 solid state storage registers and on tape for expanded register storage. After familiarizing yourself with these basic functions, be sure to consult Section 5, which covers more advanced features and functions, and Section 6, which describes approximate control settings.

4.2 TURNING ON THE MODEL 97
The Model 97 has no special "powering up" requirements, but should be treated with the same care given any audio signal processing device. When turning on or off, avoid power on/off transients in the audio path, and make sure you're using the correct power supply. Use of a power amplifier to drive the Model 97's speaker output will turn off the Model 97 and the amplifier volume should be immediately turned down. This precaution will avoid the chance of damaging a loudspeaker in the event of a Model 97 malfunction (or an improper setup); under normal operating conditions, there should be no "thump" when switching On The Model 97.

While the Model 97 may be used immediately, we suggest allowing 5 minutes for the VCO (voltage controlled oscillator) to warm up. This ensures the accuracy of recalled effects, and also provides stability so that newly programmed effects will remain constant.

4.3 "BUILT IN" EFFECTS
The Model 97 is equipped with eight "built-in" factory preset effects. These basic digital delay programs are combinations of front panel settings which are permanently programmed in the solid state memory. While the preset settings cannot be altered, these can be recalled, slightly or extensively modified, and then stored in other memory locations.

Notice that the BANK SELECT button has been labeled with them, labeled "A", "B", "C", and "D" corresponding to the four banks of 8 memory registers which you can use to store and recall your own programmed effects. Each of these 8 memory locations in the blank contains the 8 factory preset effects, and is accessible by pressing the BANK SELECT button. In this mode, you can then push any of the REGISTER buttons to recall an effect.

Once you have accessed the preset memory bank, you will see that all BANK SELECT LEDs are OFF (indicating you are working with the preset memory bank). You can now select any of the 8 factory preset effects by simply pressing the appropriate REGISTER button (1 to 8). You need not press BANK SELECT again.

4.4 CALIBRATING THE FRONT PANEL TO ANY RECALLED EFFECT
When you recall a programmed effect from one of the factory preset memories (or later, one of your own stored effects), most of the Model 97 front panel control and switch settings are galvanized so that the effect will "sound right" these controls internally. If the front panel feature is a switch with an associated LED, you can observe the recalled setting by observing that LED. However, you won't know the recalled settings when looking at the slide or rotary controls.

There is one simple method for you to determine the exact settings you've recalled. First, read out one of the preset effects (as described in Section 4.3), then try a rotary control, and slowly move it from its minimum or maximum setting while looking at the DELEY display. The control will have no effect until it reaches the setting equal to the stored setting. AT THIS "NULL" POINT THE DELEY TIME WILL FLICKER OR DREIVE FOR AN INSTANT. (If moving the control to one extreme did not cause the display to flash, move it all the way to the other extreme.)

One display, flashes, the control you're moving becomes active, and further adjustments will change the effect. If you move beyond this threshold change the effect, but you should suddenly notice the appropriate LED, with one control is labeled on the appropriate REGISTER button again; the initial effect will again be recalled, and you can perform this calibration process (it will not be necessary to re-calibrate any controls which are already at their null points).

This technique is particularly useful when you recall an effect that you don't remember how you achieved (or one that you don't want to alter). For reference, you can write down the settings using one of the blank front panel diagrams in the back of this manual. (Preset effects are shown in Section 7.1)

4.5 ABOUT THE DELAY TIME DISPLAY AND SETTINGS
The DELEY display consists of two sets of large 3-diglt, flickering decimal point LED readouts (for the "A" and "B" delay taps). Each readout is capable of displaying delay times ranging from 0.05 (zero milliseconds) up to 960 or 1,920 ms (1.92 seconds), depending on the memory location installed in the Model 97. Times above 999 ms, however, will be displayed in seconds, not milliseconds, to preserve greater resolution. The decimal point automatically moves, and an adjacent "sec" (seconds) LED lights to signal the resolution has changed from milliseconds to seconds.

The rotary controls on either side of the display adjust the "A" and "B" delay times, and are independent of one another. The response of these controls is tapered so that very fine resolution is available at the shorter delay times, with broader resolution at longer times. The delay time is adjusted in increments which provide greater resolution at shorter times. Also, except at the shortest and longest times, the "A" and "B" taps cannot be set to the identical delay time. Delay times are set by simply turning the "A" tap and then the "B" tap. This intentional effect is done to create modifying reverberant ambience by providing non-related delay times in the two outputs. (It also prevents "dithering" (a digital noise). The specific delay times available are determined by the way the Model 97 software was written.)
4.6 INPUT MIX CONTROLS

The Model 97 front panel has two sets of vertical sliding sliders, each in a blue box. One box is marked "INPUT MIX" and the other "OUTPUT MIX." Five Indicator lights adjust the Input signal supplied to the digital delay processor: MAIN and AUX SOURCE levels from input connectors and B-F8 and B-8F controls (RECIRCULATE), and a voltage 25 dB ocean pass filter which adjusts the recirculation signal bandwidth from 20 Hz down to 200 Hz.

The MAIN SOURCE control is the only front panel control on the Model 97 whose settings are neither stored nor recalled. This is so that different signal levels at the Model 97 MAIN INPUT can be accommodated without any need to alter the programmed effect. If you prefer to store the effect in the amp panel setting, use the AUX SOURCE control and connect the signal to the Model 97 AUX INPUT. (When two separate input signals are brought to the MAIN and AUX inputs, the MAIN and AUX SOURCE controls in the INPUT MIX section may be used to blend these signals in any desired proportion.) The preferred input, when only one is needed, is the MAIN INPUT.

The HEADROOM display should be observed when adjusting any of the INPUT MIX controls. Only on the loudest peaks should the red "0 dB" LED be allowed to turn ON. Any time the signal levels should be in the "0 dB" to "10 dB" range. Excessive levels will lead to distortion, and, at higher frequencies and longer delay times, may cause audible feedback. Very high input levels may cause unnecessary degradation of the signal-to-noise ratio of low levels (signal levels are needed), turn the Model 97 OUT- PUT level down. On the other hand, in the event low signal levels are used to drive the Model 97, remember that a rear panel-subpanel button can be engaged for an additional 20 dB of GAIN at the MAIN INPUT connector. (The 20 dB button, and the INPUT MIX controls affect all the levels to the 민TEX MIX OUTPUT jack, which will deliver about +10 dBV at 0.5 dBV on the headroom display, into 2 kohm or higher impedance loads.)

Feedback, or recirculation, is adjustable independently for the A and B delay taps. High levels of recirculation will lead to a loud, sustained howl that, in turn, could damage loudspeakers so go easy when bringing up the A-F8 and B-F8 sliders.

The low gain filter simultaneously adjusts the bandwidth of both the A and B recirculation. While 20 Hz is available, more natural effects will generally be obtained with a lower cut-off frequency. This because, in actual echoes, the longer the path of the sound, the more the air attenuates higher frequencies. (Lower frequencies are not attenuated as much.) Depending on the program meter, lowering the filter slider may allow you to raise the A-F8 and B-F8 sliders higher before howling occurs, thus effectively increasing the practical echo duration as a tradeoff against recirculation bandwidth.

4.7 OUTPUT MIX CONTROLS

The OUTPUT MIX controls adjust the relative amount of delayed (processed) and "direct" source signals that appear at the Model 97 MASTER OUTPUT. There are four independently adjustable level controls plus a master MAIN and AUX SOURCE levels (from input connectors), A and B DELAY controls (the processed signal), and MASTER OUT. The setting of all these controls are memorized when an effect is stored.

The relationship between the INPUT MIX and OUTPUT MIX controls is shown in Figure 4-1. Note the difference between the MAIN and AUX controls in the INPUT MIX section (to determine what signal is sent to the delay processor), and the MAIN and AUX controls in the OUTPUT MIX section (to determine what amount of those same input signals are sent unprocessed, directly to the MASTER OUTPUT connectors).

The HEADROOM display is not affected by the OUTPUT MIX controls. However, if the signal level becomes too high, it will cause clipping of the input stage, the red OVLVD (overload) LED above the MASTER OUTPUT control will turn ON. Even when OVLVD is not illuminated, it may be possible that a sweep range of only a few octaves. On the other hand, if two electronic delays are used, the rate to the same delay time, but one sweeping by means of LFO modulation and the other fixed, it is possible to get the signal offset between the two delay downs to "0," and hence the infinite sweep ratio is feasible. There is, however, a specific reason to use two identical delay lines, not just for two units. In true tape flanging/phasing setups, it is generally found that identical tape machines produce the best effects - drier and fuller flanges. This is because frequency and phase response of the signals being combined is consistent across the audio spectrum. Since any electronic signal processor, including delay lines, introduces some frequency response and phase alteration (as well as noise and distortion), it is impossible to get a precise cancellation or reinforcement of the processed (delayed) signal against the original input signal. Should two different delay lines be used, even though the delay time may sweep down "0" differences, total cancellation will not occur; the unequal noise and distortion products will continue to be audible as the signal level drops out.

Clearly, a pair of identical delay lines is the best way to simulate tape flanging/phasing effects. The Model 97 is an excellent choice because Londo Boys system of control standards ensure consistent performance. It can be stored on one unit, and the control delay bandwidth preserves the full harmonic content of the music. Precise level matching is important, and, when properly adjusted, the sweep will assume a depth and balance that surpasses any single delay line effect.

The two delay taps in a simple Model 97 may be used for obtaining zero offset because both taps are modulated by the unit's LFO. Thus, both will sweep up and down together - while the absolute delay values will be different, they won't cross at zero offset.

To set up in Figure 4-8, the same unprocessed input source feeds both units' INPUTS. Only one delay tap, on each unit is used (arbitrarily the A-DELAY), and both are set at the same time. However, one unit is subject to LFO modulation (a blend of ENY and sone wave), while the other delay is not modulated. The two A-DELAY outputs are mixed by routing unit #2's output through unit #1's AUX INPUT, keeping that signal out of unit #1's INPUT MIX section (so it isn't delayed twice), and bringing it up with the AUX SOURCE control in unit #1's OUTPUT MIX section.

To create the tape phasing effect, follow this procedure:
1. Set both unit's A-DELAY controls to the identical time, around 4 mS.
2. Set the A-DELAY A and B and MASTER OUT slider on both units' OUTPUT MIX sections to normal level.
3. Set the delay line #2's delay generator and MASTER OUT section at normal level so that the contribution from unit #2's delay can be mixed with that from unit #1.
4. Make sure the MAIN SOURCE sliders in both units' OUTPUT MIX
6.4.2 Series Connection of two Model 97's for composite effects or longer overall delays.

With a maximum of 1.92 seconds delay available from a single Model 97 (1.28 seconds with full memory option times 1.5X MANUAL SWEEP), it is seldom that any longer delay would be required. Still, if you already have two Model 97's available (or a Model 97 and another Lexicon delay unit), you can cascade the units in a series connection so the delay times add up. Another reason to connect two units in series is to combine effects, such as flanging or doubling with one unit and long echo or pitch twisting with the other unit. Refer to Figure 6-7 for the appropriate connections.

6.4.3 Parallel Connection of two Model 97's for deep tape phasing effects (the ultimate flange).

While this is but one of the many applications for a pair of identical delay lines, it has special consideration. Tape phasing is another term for flanging, so we use it here to refer to an effect that more closely resembles true re-flanging than any effect possible with a single delay line. As discussed in Section 6.2.1, flanging (tape phasing) was originally created by playing back the same recording from two tape machines, and relying on slight speed deviations between the two tapes to produce comb filters. By continually re-rolling the two tapes in and out of sync, very deep and unusual sounds could result – an effect loved by many producers, and hopefully by record buyers.

The precedence of modern electronic delays, phasers and flangers which have come to market in recent years simulate the original tape flanging/phasing effect, but they never quite capture the actual sound. In fact, to this day some artists and record producers will insist on rolling 2 extra tape decks into the studio for “effects.”

The reason electronic devices have been less than successful is that they generally operate by cancelling the original signal with a delayed version of that signal. In contrast, true tape flanging carves out two independently adjustable delayed signals, one of which is usually varied while the other “stays still.” The result is a varying delay interval between the two signals of from 0” to several milliseconds, effectively a sweep ratio of infinity.

Any given delay line will have a minimum delay time, even if it is a fraction of a millisecond, and hence cannot achieve a sweep down to zero difference with the input signal. This effectively limits the single delay to 3. Release the above buttons, or...

4. To invert another function, continue holding HI and press another REGIST button.

4.9 STORING, RECALLING, COPYING AND CLEARING VARIOUS EFFECTS IN MEMORY

**NOTE:** We have intentionally "skipped" a discussion of the controls labeled VCO (MANUAL SWEET, DEPTH, SHAPE, RATE, X100, sine/ square, and XTAL). These important functions, which are used to create many of the Model 97's special effects, are discussed in detail in Section 5. For now, let's explore how to store and then recall effects.

An effect, as defined here, is any combination of front panel control settings, with a few exceptions. As stated earlier, the Model 97 will not memorize the setting of the MAIN SOURCE control in the INPUT MIX section.

For reasons that should become obvious, neither will it store MAN, CLR, TAPE or STO button settings. MAN places the controls in manual mode, not subject to memory. CLR, TAPE and STO are used when "dumping" the solid state memories onto magnetic tape (or retrieving them); the buttons do not directly have anything to do with a particular effect.

To store an effect into memory:

1. Select the memory bank desired, A through D, by repeatedly pressing the corresponding button.

2. Press the STO button and hold it in.

3. Press any one of the 8 REGIST buttons corresponding to the #1 through #8 memories in the selected bank.

To recall an effect from memory:

1. Select the memory bank desired, A through D, by repeatedly pressing the corresponding button.

2. Press the REGIST button corresponding to one of the 8 memories in which the desired effect is stored.

3. Release the above buttons, or...

4. To invert another function, continue holding HI and press another REGIST button.

To copy an effect just recalled into another memory register:

1. Select the memory bank desired, A through D, by repeatedly pressing the corresponding button (if already in correct bank).

2. Press the STO button.

3. Press any of the 8 REGIST buttons to designate the memory into which you want to copy the effect.

You have now stored the effect in this second memory – it is still "in effect" in the processor, and also exists in its original memory location.

For reasons that should become obvious, neither will it store MAN, CLR, TAPE or STO button settings. MAN places the controls in manual mode, not subject to memory. CLR, TAPE and STO are used when "dumping" the solid state memories onto magnetic tape (or retrieving them); the buttons do not directly have anything to do with a particular effect.

To select the desired memory bank, as described above.

2. Press the CLR button and hold it in.

3. Press the REGIST button(s) corresponding to any of the memories you wish to clear.

4. Release the above buttons, or...

5. To invert another function, continue holding HI and press another REGIST button.

4.10 WRITING THE MEMORIES ON MAGNETIC TAPE (CREATING A FILE)

When you store effects in any of 32 locations (i.e., banks A through D times 8 registers 1 through 8), you are actually placing digital information in solid state memories. Because the Model 97 includes a re-writable backup battery, its memories can be considered non-volatile. Still, there are reasons to store the contents of the memories in other permanent, non-volatile location – on magnetic tape.

Off-loading digital information onto tape ("writing a file" onto tape) makes it possible to have an unlimited repository of stored effects. When storing the contents of the memories on tape, digital data is output as two frequency-shifted modulated tones, requiring a 3 to 7 kHz bandwidth, so the demands on the tape recorder's frequency response are not severe.

However, the recorder should have reasonably good record/playback speed stability (as well as low wow & flutter). You can choose to write all 32 effects on tape, or only one of the banks. You also have a choice of labeling the stored bank or banks with one or two digit memory location.

It is not necessary to store a new effect if you want to store a new effect. However, clearing is necessary when you intentionally want a "blank" memory, or you may need when using a REGISTER STEP footswitch or when using tape recorded cues tones to step through memories as described in Section 5.

To clear a memory register:

1. Select the desired memory bank, as described above.

2. Press the CLR button and hold it in.

3. Press the REGIST button(s) corresponding to any of the memories you wish to clear.

4. Release the above buttons, or...

5. To invert another function, continue holding HI and press another REGIST button.

NOTE: It is generally faster to log the tape at which a particular file is located, and wind directly to that point, or just before it. The numerical ID then assures the proper file will be read into the Model 97. We also recommend labeling a vocal label on the tape just ahead of the digital effects file to help you identify it.

NOTE: It is assumed the TAPE STORE CLR jack is connected to the front input of a suitable tape machine for this procedure.

Figure 6-7 – Series Connection of Two Model 97's

[Diagram of a stereo setup with various connections and labels, indicating how to connect two Model 97's in series for longer delays or to combine effects.]
4. Press \text{TAPE} once more to initiate the write process.

4.11 VERIFICATION THAT MEMORIES ARE ACCURATELY STORED ON TAPE

A steady pilot tone is present at the Model 97 TAPE STORE OUT jack except when actually writing memories onto tape. If this tone is recorded and, upon playback sound "shaky" (i.e., if there is an audible waver), then the tape machine performance is probably inadequate for reliable memory storage. However, there a more precise way to check any given memory "jump" to any tape dropout, noise, level deviation or "glitch" which might have interfered with the writing onto tape can be discovered before any Model 97 memories are cleared or changed.

Immediately after writing memories onto tape, perform the following verification procedure, which compares the tape recorded memory with the original tape memory. A visual indication is provided if the Model 97 memory contents are not identical to the tape recorded data. Therefore, it is best not to change any Model 97 front panel settings (and certainly do not store any modified or new entries into memory) until after performing this procedure.

1. Press the \text{TAPE} button and hold it in.

2. Press the \text{STO} once, then while still holding in \text{TAPE} release \text{STO} and press the number you designate \text{NN} or \text{NN} \text{N} refers to any of the 8 REGISTER buttons you use to enter a one or two digit (0 number, from \#1 to \#88).

3. Place the tape machine in record mode, and roll tape.

4. Press \text{TAPE} once more to initiate the write process.

6.4 USING TWO MODEL 97'S (OR THE MODEL 97 WITH ANOTHER LEGION DELAY PROCESSOR) FOR ADDITIONAL SPECIAL EFFECTS PROCESSING

The Model 97 alone is a phenomenal flexible unit. There, however, certain jobs that require two units, such as processing a discrete stereo program signal. That concept is so simple it does not really require a separate discussion, but the Model 97 does permit some interesting cross-controlling to be done. Additionally, there are some effects that can be enhanced by using two processors.

6.4.1 Stereo Processing with coupled LFO modulation as well as coupled memory

Suppose you're processing a stereo program. You want to keep each channel's audio discrete, yet you basically want each to be subject to the same, exact delay processing.

The setup shown in Figure 6-6 illustrates how this can be done. The LFO controls of the "master" unit simultaneously control the "slave" unit by the MODULATION INPUT (DEPTH, SHAPE, the sine/square button, RATE and the \text{X100} button). It is easy to ensure that any effects set up on the "master" are duplicated on the slave. Once you create the effects on the master, ready it for writing its memories onto tape and also ready the slave for reading memories from tape, as explained in Section 4. Then press the TAPE button on the master to commence the writing operation; instead of writing onto tape, the patch cord lets you write from master to slave. After about 15 seconds, both units' memories are identical.

A further benefit is that both units can be stepped through their memory registers by pressing just one button. This is done by preparing both units for tape cue activated register stepping, as explained in Section 5. When the master's TAPE button is pressed, it and the slave simultaneously step to the next register. Instead, if desired, a single foot switch can be "Y" connected to both REGISTER STEP jacks, or, for that matter, to the BYPASS or \text{REPEAT} jacks. DO NOT "Y" CONNECT FOOT CONTROLS FOR EXTERNAL DELAY SWEEP OR RATE IN.

We have shown with dotted lines the possible cross-feed of one delay only output from each channel with the auxiliary input of the other channel. This can make stereo echo/revverb effects more natural, simulating the blending that occurs acoustically as sound bounce back and forth in an environment.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig6-6.png}
\caption{Figure 6-6 — Processing a Stereo Program with Cross-Coupling between Two Model 97's}
\end{figure}
6.3 CHROMATIC TUNED RESONANCES

Thanks to its programmable nature, the Model 97 makes it possible to create a series of resonant effects, tuned in half-octaves. Tuning on the chromatic scale by means of differing delay times. Then, by directly accessing specific tunings (e.g., different memory REGISTERS), it is possible to create melodies from such non-melodic sound sources as a single drum. You may wish to store two octave worth of chromatic resonances in 24 of the memory banks (e.g., in 3 banks). And, naturally, you'll want to permanently store this memory full of chromatic resonances on tape.

For a given performance sequence, you can recall the needed “notes,” one at a time in the sequence they will be used, and store them in the fourth memory bank. This will allow you to use the REGISTER STEP foot switch to move from note to nice while performing. If one sequence of notes is insufficient, store that bank on tape. Then create the next bank of

8 tuned resonances and store it on tape, and, if needed, continue doing so until you have up to four sequenced memory banks on tape. Then you can read the tape, one segment at a time, into the four memory banks, replacing the chromatic scale with the actual musical sequence.

The basic front panel setup for a chromatic tuned resonance is shown in Figure 6.5. Specific delay times for different notes are listed in the chart accompanying this front-panel illustration. More RECIRCULATION will produce a longer decay time for the resonance.

<table>
<thead>
<tr>
<th>NOTE</th>
<th>DELAY</th>
<th>NOTE</th>
<th>DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>30.6</td>
<td>E2</td>
<td>12.3</td>
</tr>
<tr>
<td>C#1</td>
<td>25.9</td>
<td>F2</td>
<td>11.6</td>
</tr>
<tr>
<td>D1</td>
<td>27.2</td>
<td>F#2</td>
<td>10.6</td>
</tr>
<tr>
<td>E1</td>
<td>25.7</td>
<td>G2</td>
<td>10.2</td>
</tr>
<tr>
<td>E#1</td>
<td>24.3</td>
<td>G#2</td>
<td>9.6</td>
</tr>
<tr>
<td>F1</td>
<td>22.7</td>
<td>A2</td>
<td>9.1</td>
</tr>
<tr>
<td>F#1</td>
<td>21.6</td>
<td>A#2</td>
<td>8.6</td>
</tr>
<tr>
<td>G1</td>
<td>20.4</td>
<td>B2</td>
<td>8.1</td>
</tr>
<tr>
<td>G#1</td>
<td>19.3</td>
<td>B#2</td>
<td>7.6</td>
</tr>
<tr>
<td>A1</td>
<td>18.2</td>
<td>C3</td>
<td>7.2</td>
</tr>
<tr>
<td>A#1</td>
<td>17.2</td>
<td>C#3</td>
<td>6.8</td>
</tr>
<tr>
<td>B1</td>
<td>16.2</td>
<td>D3</td>
<td>6.4</td>
</tr>
<tr>
<td>C2</td>
<td>15.3</td>
<td>E3</td>
<td>6.1</td>
</tr>
<tr>
<td>C#2</td>
<td>14.4</td>
<td>F3</td>
<td>5.7</td>
</tr>
<tr>
<td>D2</td>
<td>13.8</td>
<td>F#3</td>
<td>5.4</td>
</tr>
<tr>
<td>D#2</td>
<td>12.9</td>
<td>G3</td>
<td>5.1</td>
</tr>
</tbody>
</table>

NOTE: Volumes given in millivolts are accurate to the limits of the display. Fine tuning may be done by direct adjustment of “Manual Swing” controls.

but will not place the taped data into its memories. If all data on the tape agrees with the solid state memories, the unit returns to normal display and normal operation at the end of the process.

6. IF ERRORS ARE FOUND, THE MODEL 97 DISPLAY WILL SHOW A MESSAGE “EC...”. The two-digit code displayed after “EC” depicts the quantity of discrepancies found. (Obviously, if you changed a memory prior to checking the tape, there will be a lot of errors.)

7. If there were errors, press MAN twice to return to normal operation. Check the tape and the tape machine to discover and remedy the source of the errors. Look for dirty heads, slippage, level problems, and speed or frequency response anomalies. Then try rewriting the memories on tape and again verify the accuracy.

4.12 READING A FILE FROM THE TAPE

If a numerical flag is entered as part of the read operation, the Model 97 will read the first file it is fed, whether numbered or not. If a numbered file is specified, then the unit will ignore all files on tape until it sees the designated word or two-digit label at the front of the tape recorded file. Since it does take over a minute for each tape file to play back, asking the Model 97 to search through a tape for a given file may take a while. It is faster to note the approximate tape location where a given file is located, fast wind to that point, and then read the file into the Model 97 as indicated below.

NOTE: It is assumed the TAPE SOURCE IN jack is connected to the line output of the tape machine for this procedure.

To read a file of 32 effects from tape:

1. Rewind the tape to a point a few seconds ahead of the stored effects memories.

2. Play the tape.

3. If you wish the 97 to read the first file that comes along, press TAPE twice.

4. If you wish the 97 to read only a designated file, hold in TAPE .

5. Then press the file number N or N using the appropriate REGISTER button(s). Then release TAPE and press it once more.

6. While the tape file is being “read” into memory, the Model 97 display will show the letter “EC”.

NOTE: If you want to abort the tape reading operation at any point while it is in progress, press MAN .
5.1 GENERAL
This section assumes you are familiar with Section 4 (Basic Features). We use the term "advocated" advisedly because all the Model 97 features are technically advanced. Like most things in life, the features described here are found either less often, in less sophistication, or not at all in other delay processors.

5.2 THE VCO VOLTAGE CONTROLLED OSCILLATOR AND ITS MODULATION FUNCTIONS (MANUAL SWEEP, XTL MODE, and the LFO SECTION)

The VCO has one basic function: it serves as the master clock for the audio processor. If the clock frequency (the VCO output) changes, so will the delay times you have set with the "A" and "B" DELAY controls. (Setting the Model 97 to XTL mode crystal controls the VCO frequency so the delay times are unalterable.) Many effects depend upon changing the delay time, and for this reason the VCO can be modulated by one of two primary methods: either by MANUAL SWEEP or automatically by the LFO (Low Frequency Oscillator). Refer to Figure 5-1. Turning MANUAL SWEEP is not quite the same as simultaneously turning the VCO times up and down. Whereas adjusting the DELAY time controls alters the location in memory of the audio signal from which the digitally stored audio is read, adjusting MANUAL SWEEP simply changes the rate at which data moves through the memory. The maximum sweep available covers a 3:1 range, from 0.5 to 1.5 times the set DELAY.

Once you purchase the Model 97 with option #2 (full memory extension) having a maximum of 3.5 seconds DELAY. That 1.28 seconds is present only when the VCO is in XTAL mode, or when MANUAL SWEEP is centered at "X1," moving MANUAL SWEEP to "X1.5" will result in a 1.5X delayed delay (1.5X 1.28 seconds = 1.92 seconds).

MANUAL SWEEP can be used for "time" delay times, or to manually alter flanging, echo or pitch distortion effects. The available range for MANUAL SWEEP is not always the 3:1 range indicated on the control, because it depends on the LFO DEPTH setting. At a DEPTH setting of "10," there is no MANUAL SWEEP at all (because the LFO is providing all the VCO modulation). At a "0" DEPTH setting, the full 3:1 MANUAL SWEEP is possible.

To obtain automatic delay time modulation, the LFO is provided. It changes the delay time over the same range as the MANUAL SWEEP, only you don't have to keep moving a knob for the change to occur. The LFO consists of two basic rotary controls (SHAPE and RATE), and along with two jumper controls, determine the shape of the time delay. Pressing the XTAL button defines the entire VCO section (LFO and MANUAL SWEEP) and fixes the delay time scaling at 1 times the DELAY display setting. This is accomplished by controlling the oscillator frequency with a quartz crystal.

More, once you'll probably want to modulate the delay times: LFO modulation is essential for many effects (flanging, phasing, doubling, chorus, etc.). If the unit is in XTAL mode, just press the XTAL button again to the LED above that button turns off. Then you can use the VCO as desired.

6.2.9 VIBRATO
Vibrato is the effect produced by small, regular variations in a sound's pitch. Vibrato can be created by alternating the pitch, and the resulting sound is similar to vibrato. Vibrato is generally used to create a smooth, flowing sound.

The Model 97 can create automatic, regular vibrato for any single instrument, or mix of sounds, by means of sine wave modulation from the LFO section. Manual vibrato effects can be created using the MANUAL SWEEP control or a variable control connected to the EXTERNAL DELAY SWEEP jack.

6.2.11 Resonant Effects
Singing in the shower is one way to obtain a natural, somewhat moderating, resonant effect. Stereoscopic resonances are possible by using the Model 97 at short delay times with a lot of RECURCULATION. This creates a build-up of fundamental tones and harmonics which, when added to the delay system cycle, is equal to the set delay time. Those emphasized pitches and "resonate." The effect can be characterized as adding a ringing, metallic quality to the sound. Extreme resonant effects create the "Cydon" voice of TV fame. A special class of resonant effects, chromatic tuned resonances, is discussed in Section 6.4.

6.2.10 Pitch Twisting Effects
Pulling a string toward the edge of the fretboard will cause pitch twisting (pitch bending or shifting a guitar's pitch). The Model 97 can twist the pitch of any Instrument or vocal. Slow sine wave modulation of the VCO by the LFO produces upward and downward sweeps in frequency similar to vibrato, but the rate is slower. Square wave modulation produces a sequence of (1) the original pitch, (2) a raised pitch, and (3) a lowered pitch; this is often referred to as an "up-down-up" effect.

The Model 97’s envelope modulation is another dimension to the pitch twisting effects normally available with a delay line. Setting the SHAPE control to FULL (LOW) causes the delay time to increase and decrease in proportion to the envelope of the audio input, "envelope" refers to the moment to moment changes in the overall amplitude level of the program.) The result is an articulated pitch sweep, or "envelope(opt)"

If the pitch shifted output is fed back to the input (using the LFB, and/or BFB sliders in the INPUT MIX section), it will "envelope" the input. Then a single note at the input may result in many different output pitches as the original note is delayed, altered in pitch, and recirculated.

Since it is impossible to see the full range of pitch twisting effects, visual experimentation is encouraged. The main parameters involved are DEPTH, SHAPE, DELAY TIME, and RECIRCULATION. (Manual pitch shifting is possible by means of the MANUAL SWEEP control or a variable control connected to the EXTERNAL DELAY SWEEP jack.)

6.2.12 Infinite Repeat Effects
The ultimate in sound-source sound capability can be obtained by using the front-panel A/B button or selecting the monaural footswitch into the rear panel of REPEAT jack. With the full memory option, the "one-shot" sound can be "repeated" in the delay line, then repeatedly fed to the output with no fading or degradation in quality. When ready, the performer can play the front panel button or foot switch or select the INFINITE REPEAT LED light. During the performance, the player can control the duration of the repeated segment.

Multi-tracking is possible by bringing up the A/B or B/F sliders; this has no effect so long as the B/FLED is off. INFINITE REPEAT is on, but the moment duration of the repeating phrase is not altered. The phrase will fade out rather than stop abruptly. With a slow enough fade (i.e., enough RECIRCULATION), a new phrase can be entered without waiting for the previous one to fade out completely.

The two phrases are thus "layered" on top of each other, a pretty neat trick. The "layering" can be achieved indepently. INFINITE REPEAT mode offers still more possibilities. The pitch and duration of a "captured" segment can be altered. This is done by changing the clock frequency on the front panel INFINITE REPEAT mode (see note below). The pitch/duration change can be coupled to a delay delay on the SIGNAL CONTROL or a controller connected to the EXTERNAL DELAY SWEEP jack. Automatic pitch/duration changes can be achieved by providing a VCO modulation.

If the MANUAL SWEEP control was centered (X1) when the INFINITE REPEAT was initiated, then the pitch can be doubled & duration halved or pitch can be cut to 1/3 its value & duration extended to 1/3 times its value (X1.5). If MANUAL SWEEP was at X1.5 to begin with, then pitch can be raised 1/3rd octave & duration cut to 3/4 the third time.

NOTE: The length of the repeated segment is dependent only upon the setting of the MANUAL SWEEP control and the size of the memory option (indicated on the D.LEYS). The delay controls and display times are irrelevant to the length of the repeated segment, although they do affect the relative offset in time of the segments. The memory memory is always equal to the maximum delay memory installed (usually up to 1.28 seconds) times the DELAY MULTIPY factor. It is suggested that the DELAY LED be set at maximum when playing with INFINITE REPEAT so that the player has an accurate preview of the duration of the repeated segment.

Figure 5-1 – Model 97 VCO Section Block Diagram
varied, causing the null frequencies to sweep. As these nulls (notches in response) sweep across the various components of the signal, the different harmonics and fundamentals are boosted or cut in relation to each other, thus creating a new null pattern that can cause the pitch of the signal to change constantly.

Since the original pitch of the signal appears to be changing, even if you record the audio tracks on a VCR using the bandwidth reduction feature it is possible that the pitch of the signal may change. This could cause problems with the pitch of the audio output and may cause the audio output to be out of sync with the video output.

5.3 USING THE LFO

The LFO is a 20Hz, 25Hz, 30Hz, 50Hz, 75Hz, 100Hz, 150Hz, 200Hz, or 300Hz oscillation that can be used to control various parameters in the mixer. The LFO can be used to control the input sensitivity, output level, and the center frequency of the bandpass filter.

5.4 DYNAMIC RECIRCULATION (AND THE VCA BUTTON)

Press the VCA button to control the audio level. The VCA button controls the amount of gain applied to the audio signal before it is sent to the next stage. This allows you to control the level of the audio signal without changing the audio frequency response.

When the VCA button is pressed, the amount of gain applied to the audio signal is increased. This allows you to control the level of the audio signal without changing the audio frequency response. The VCA button is useful for controlling the level of the audio signal in a variety of situations, such as when you want to match the audio level of different audio sources or when you want to control the level of the audio signal in a particular part of the audio signal.

5.5 CROSS FADING BETWEEN EFFECTS (AND THE VCA BUTTON)

This feature is useful for smoothly transitioning between different audio sources. When you want to smoothly transition between different audio sources, you can use the cross fading feature to control the level of the cross fading between the two audio sources.

When you want to smoothly transition between different audio sources, you can use the cross fading feature to control the level of the cross fading between the two audio sources. This allows you to transition between different audio sources in a smooth and natural way. The cross fading feature is useful for creating smooth transitions between different audio sources, which can be useful in a variety of situations, such as when you want to transition between different parts of a song or when you want to create smooth transitions between different audio sources in a broadcast.

6.0 INFINITE REPEAT

It is possible to create an infinite loop or repeat effect by using the infinite repeat feature. This feature allows you to create an infinite loop or repeat effect by using the infinite repeat feature which allows you to create an infinite loop or repeat effect by using the infinite repeat feature.

When you want to create an infinite loop or repeat effect, you can use the infinite repeat feature to control the amount of time that the audio signal is repeated. This allows you to create a smooth and natural transition between different audio sources, which can be useful in a variety of situations, such as when you want to transition between different parts of a song or when you want to create smooth transitions between different audio sources in a broadcast.
plug a momentary foot switch into the rear panel of the REGIST ER jacks, and actuate the switch to start and cancel the repeat. This momentary remote switch closure will initiate the infinite repeat, and the second closure will restore normal Model 97 operation.

The signal held in memory is equal to the maximum delay time available at the time that INFINITE REPEAT is initiated. That is, the maximum delay available with a given memory option times the MANUAL SWEEP setting. The DELAY controls adjacent to the time display do not affect the length of the infinite repeat. They do, however, determine where in the memory cycle the repeat is initiated. The entire memory contents will repeat indefinitely, with the difference between the A and B DELAY settings determining the offset of the two outputs. If you want both the A and B outputs to be exactly synchronized, set them to either the maximum or minimum delay (the only points at which both can be set for the same time).

When the on/off switch or foot switch is first actuated, the program to be repeated is already in memory. At first, it may be helpful for the performer to get a "feel" for the program before the delay is set, so that the repeat can be actuated at the appropriate moment. To practice or obtain the feel prior to actually using infinite repeat, one can set the DELAY time at maximum, bring up some recitation, and play the notes to be repeated. If the delay is then insufficient to accommodate the notes, increase MANUAL SWEEP. If there is a "gap," increase MANUAL SWEEP.

5.7 USING A REMOTE SWITCH TO ADVANCE THROUGH THE MEMORY REGISTERS

By plugging a momentary contact foot switch into the rear panel REGISTER STEP jack, a performer can advance from one memory register to the next without having to press the Model 97 REGIST ER or BANK SELECT buttons. Assuming all memories are used, each time the remote switch contacts touch, the Model 97 will look to the next memory; after it reaches REGISTER 99, it will advance to the next memory. (Switch design is discussed in Section 3.)

It is possible, however, to restrict the automatic register step function to only a portion of the registers. For example, if you have a single voice that occupies registers 1 through 50, and use a foot switch to advance through these at a rate of 40 per second, the foot switch can cause the Model 97 to step through all the registers up to the 50th, and then return to the 1st, and continue the loop.

To provide further control over the delay, you can store a blank register just before the first memory you wish to access with the REGISTER STEP function. For example, storing a blank at #0 and at #7 will allow you to rapidly step through #0, #5 and #6. However, you must first manually press one of the register buttons in that "window" (e.g., #4 or #9 in this example).

For different songs, etc., you can set up several groups of memories, bordered by cleared (blank) registers in five banks. (You can always step through the entire bank and into the next, but the unit will return only as far as the beginning of the bank in which it finds the first cleared register.) Just manually select the particular bank and register you wish to access for a given song, and use the foot switch from there.

During a busy mixing session, an engineer may prefer to use the remote REGISTER STEP switching feature rather than to physically reach over and operate the Model 97. A foot switch need not be used here—any similar momentary contact type switch is usable. If the application comes up regularly, consider mounting a switch in the mixing console.

5.8 USING RECORDED CURVES TO ADVANCE THROUGH THE MEMORY REGISTERS

A form of quasi-automation is possible, using tape recorded cue tones to automatically step through the memory registers. The same triggering technique described in the foot switch discussion in Section 5.8 above applies here, i.e., when the register after the last one you wish to access, and optionally, the one before the first register. The cue tones are output from the Model 97's TAPRE STORE OUT jack when stepping through the registers. Follow the special button press sequence described below.

NOTE: It is assumed the Model 97 TAPRE STORE OUT jack is connected to a tape recorder or mixer output, and that the track is in record mode. Generally this will be done with an analog tape recorder or mixer.

To prepare the Model 97 to work with step cue tones:

1. Press the TAPE button and hold it in.
2. Press the MAN button: then release both.

All displays now flicker to indicate the machine is in tape cue mode. The Model 97 is now ready to be switched from one register to the next in a special way that simultaneously applies a specific cue tone at the TAPE STORE OUT jack. For example, turn off this special register stepping while listening to the program or a track of the same tape (or on a tape which is sync-locked to the tape on which the cue tones are being recorded).

3. Now press the TAPE button once each time you wish to step to the next register.

4. To escape this mode, press the MAN button. (It is not necessary to escape this mode if you are going to playback the tape immediately.)

To have the Model 97 automatically step through the memories upon playback of a cue tone coded tape, prepared as above, play the track's line output into the Model 97 TAPE STORE.

This setup is viable in the recording studio or in a live or recorded sound reinforcement situation. The machine's echo or effect send (output) is connected to the MAIN INPUT. Program signal from the MASTER OUTPUT is coupled to the machine's echo or effect return (input). In this type of installation, the Model 97's MAIN SOURCE control in the OUTPUT mix section usually will be at the very top, since input source signals can be blended with the delayed program. Both the echo and the send are connected to the machine's line output, so that when the actual effect would change as the return level is adjusted, not just the amount of effect.

6.2 GENERAL APPLICATIONS FOR DELAY LINES

Before considering the details of how to create specific delay processing effects, it will be useful to review what each effect is, and to thus establish a set of definitions. For readers who would like to know more about time delay applications than is presented here, Application Note A9 is available from Lexicon. Contact us if you would like a copy. A delay line is nothing more than a recording channel where the tape machines need not be kept in close proximity. In effect, no tape mechanics is necessary—flanging can be done as a live event. A short delay is output with the original signal, causing cancellation (nulling) at a frequency whose positive (the time for one cycle) corresponds to twice the delay time. Cancellation also occurs on odd harmonics of that frequency. The depth of cancellation depends on the level balance of direct and delayed sounds when the SOURCE and DELAY controls in the OUTPUT mix section are set at the same level, the deepest cancellation, and hence the maximum effect, occurs. The delay time is continuously variable when the delay time is continuously variable.
IN jack. If the Model 97 is no longer in cue tone mode, again follow the preceding steps 1 and 2 (these steps also prepare the unit to read the tone curve). Each time a cue tone appears at the Model 97 TONE STORE IN jack, the unit will step to the next memory register. Remember, though, that initially the unit must be manually placed in the first memory you wish to use so that the cue tones advance the unit through the proper registers.

5.9 REMOTE BYPASSING SWITCHING
The rear panel BYPASS jack can be connected to a foot switch or other remote switch. When this switch contacts are momentarily closed, the Model 97 will be bypassed, just as though the front panel BYP button were pressed; in fact, the LED above the front panel BYP button will be ON. When the remote switch contacts are closed again, the Model 97 will again process the signal and the BYP LED will turn OFF. (Switch design is covered in Section 3.)

5.10 REMOTE CONTROL OF THE LFO RATE OR THE VCO MANUAL SWEEP
It is possible to remotely duplicate the functions of the front panel RATE and MANUAL SWEEP controls (see Figure 5-1). A zero through 10 V DC signal applied to the rear panel RATE IN jack will sweep the rate through the full 100.1 range available on the front panel (providing the front panel RATE control is set fully clockwise). Similarly, a zero through 10 V signal applied to the EXTERNAL DELAY SWEEP jack will sweep the delay through the full 3.1 range available on the front panel (providing the DEPTH control is set at "0" and the MANUAL SWEEP control is set at "XO.5").

The connections for the EXTERNAL DELAY SWEEP and RATE IN jacks are covered in Section 3. Additional applications information can be found in Section 6. We do wish to emphasize here that the range of control available with these remote controls will depend upon the setting of related front panel controls. In the case of DELAY SWEEP, 0 volts will give the lowest frequency (the longest delay time). For RATE, 0 volts will give the lowest frequency (the slowest sawtooth).

5.11 REMOTE CONTROL (OR LINKAGE) OF THE LFO'S MODULATION
The modulation of the LFO refers to the waveform output by the SHAPE control — from a sine or square wave LFO component (low frequency oscillator) to the ENV (input envelope follower). It is possible to use an external source of 0 to +10 V to replace the front panel SHAPE control function. Simply plug that source into the rear panel MODULATION IN jack. It may be a control voltage from a synthesizer or sequencer, or the audio output of an oscillator or electronic musical instrument (in which case a positive DC offset may be added to keep the voltag e positive). The Model 97 also has a MODULATION OUT jack; it may be patched to the MODULATION IN jack of another Model 97. This allows two channels of audio to be processed simultaneously, yet with synchronized modulation which is keyed by one of the units. The connections to these jacks are covered in Section 3, and further applications in Section 6.

Figure 6-2 — Pseudo Stereo Setup for Electronic Keyboard Player
Note: Gated foot switches are shown for the bypass, infinite repeat and register step functions. The second instrument connected to the AUX INPUT is optional.
6.1 WHERE TO USE THE MODEL 97 - BASIC SETUPS

Within a given sound system, there are a number of different locations where the Model 97 can be inserted. The examples shown below are representative of typical live performance and studio setups. Front panel settings to achieve a few exemplary effects are given in subsequent pages of this section, but we have not tried to be comprehensive. That's because you can quickly derive the front panel settings for the 8 factory preset effects (or any effects you may have "read" from a tape recorded by another Model 97 user); remember to just set each knob at its "null" position where the DELAY display momentarily blinks, as described in Section 4.4.

In general, when using the Model 97 MAIN INPUT, it is a good idea to initially set its GAIN switch to "0 dB" position. Then, if the input level is too low to light up the headroom display at "18" or "21" with the MAIN SOURCE slider of the INPUT section all the way up, press in the GAIN switch to "-20 dB" position.

If an electric guitar is plugged directly into the Model 97, the GAIN switch will have to be set to "-90 dB" (unless the guitar has a built-in battery-powered preamp, as a few do). The amp's "guitar input" could then be fed from the Model 97 MASTER OUT jack; a 20 dB to 40 dB pad will probably be required at the guitar amp input to prevent clipping by attenuating the Model 97's line level output.

This setup processes a single signal to feed a single channel of amplification (See Figure 6.3 for creating a pseudo-stereo feed from one or two mono signals.) When using several keyboards and mixing them locally, the Model 97 can be connected in the echo send/return loop of the mixing board as shown in Figure 6.4.

Figure 6.2 - Basic Mono Setup for Electronic Keyboard Player

Note: An optional foot pedal is shown for sweeping the delay time. Optional foot switches are shown for the bypass, infinite repeat, and pattern step functions.

Figure 6.1 - Basic Setup for an Electric Guitar Player

Note: Optional foot pedals are shown for sweeping the delay time and controlling the LFO rate. Optional foot switches are shown for bypass, infinite repeat and register step functions.
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In general, when using the Model 97 MAIN INPUT, it is a good idea to initially set its GAIN switch to "0 dB" position. Then, if the input level is too low to light up the headroom display at "18" or "26" with the MAIN SOURCE slider of the INPUT section all the way up, press in the GAIN switch to "+20 dB" position.

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Figure 6.2 - Basic Mono Setup for Electronic Keyboard Player

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Figure 6.1 - Basic Setup for an Electric Guitar Player

Note: Optional foot pedals are shown for sweeping the delay time and controlling the LFO rate. Optional foot switches are shown for bypass, infinite repeat and register step functions.
This setup produces two different keyboards, mixing them together with the MAIN SOURCE and AUX SOURCE controls in the Model 97 INPUT MIX section. (The second keyboard, shown connected to the AUX INPUT, is optional.) A pseudo-stereo effect is achieved by feeding the "straight" (non-delayed) signal from the INPUT MIX OUT jack to one amplifier and speaker, and feeding a delayed signal from the MASTER OUT jack to the other amplifier and speaker. A stereo effect is obtained by using a moderate delay time (about 20 milliseconds) from one amp (A, for example), and perhaps a small amount of envelope modulation for "interest.

5.9 REMOTE BYPASSING SWITCHING
The rear panel BYPASS jack can be connected to a foot switch or other remote switch. When the switch contacts are momentarily closed, the Model 97 will be bypassed, just as though the front panel BYP button were pressed: in fact, the LED above the front panel BYP button will be On. When the remote switch contacts are opened again, the Model 97 will again process the signal and the BYP LED will turn OFF. (Switch design is covered in Section 3.)

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The Model 97 also has a MODULATION OUT jack, it may be patched to the MODULATION IN jack of another Model 97. This allows two channels of audio to be processed simultaneously, yet with synchronous modulation which is keyed by one of the units. The connections to these jacks are covered in Section 3, and further applications in Section 6.
7.8 USING A REMOTE SWITCH TO ADVANCE THROUGH THE MEMORY REGISTERS

By plugging a momentary contact foot switch into the near side REGISTER STEP jack, a performer can advance from one memory register to the next without having to press the Model 97 REGISTER or BANK SELECT buttons. Assuming all memories are used, each time the remote switch contacts touch, the Model 97 will advance to the next memory; after it reaches REGISTER #9, it will advance to the next MEMORY BANK. (Switch design is discussed in Section 3.)

It is possible, however, to restrict the automatic register step function to any group of registers within a given memory bank. Simply clear the register that comes after the last register you want to use (see Section 4 for clearing instructions). Then the remote switch will cause the Model 97 to step through all the registers up to the blank, return to the #1 register, and continue the loop.

To provide a further degree of control, you can store a blank register just before the first memory you wish to access with the REGISTER STEP function. For example storing a blank at #8 and at #7 will allow you to repeatedly step through #4, #5 and #6. However, you must first manually press one of the register buttons in that "window" (i.e., #4, #5 or #6 in this example).

For different songs, etc., you can set up several groups of memory banks bordered by cleared (blank) registers in the four banks. (You can step through the end of one bank and into the next, but the unit will return only as far as the beginning of the bank in which it finds the first cleared register.) Just manually select the particular bank and register you wish to access for a given song, and use the foot switch from there.

During a busy mixing session, an engineer may prefer to use the remote REGISTER STEP switching feature rather than to physically reach over and operate the Model 97. A foot switch need not be used here - any similar momentary contact type switch is usable. If the application comes up regularly, consider mounting a switch in the mixing console.

8. GENERAL APPLICATIONS FOR DELAY LINES

Before considering the details of how to create specific delay processing effects, it will be useful to review what each effect is, and to thus establish a set of definitions. For readers who would like to learn more about time delay applications than is presented here, Application Note AN3 is available from Lexicon. Contact us if you would like a copy. In any case, a delay line or a space reverberation system is a device that can be used to simulate the effects of a room having a certain shape, size, and material characteristics.

A delay line is a device that can be used to simulate the effects of a room having a certain shape, size, and material characteristics. The basic delay line consists of a series of delay times that can be set independently, allowing for the creation of complex delay patterns. The delay times can be set to simulate the reflections and reverberations that occur in a real room, or to create original effects.

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varied, causing the null frequencies to sweep. As these nulls (notches in response) sweep across the various components of the piano, different harmonics and fundamentals are boosted or cut in relation to each other, thus changing the overall sound caused to constantly change.

As flanging relies on precise phase cancellations, it must be done electrically, either by mixing the input signal (the input) with itself inverted with respect to the input signal (using the INV button and the #4 or #5 REGISTER buttons). This is similar to a 180° phase shift, the comb filter pattern is shifted. The effect is known as “negative flange.”

6.2.2 Resonant Flanging
(Preset BANK, REGISTER #2)

The flanging effect can be further altered by recirculating the delay with the appropriate DEPTH control. Larger amounts of recirculation cause exaggerated “dust” or resonant flanges (echoes that are more pronounced with greater depth). Inverting the polarity of the feedback (with the INV button and the #4 or #5 REGISTER buttons) gives a “hollow” characteristic to the sound.

Use of the LFO’s envelope (ENV position on the SHAPE control) produces an interesting “transient flanging”: sweep is produced for each note change, and the effect is particularly noticeable in a single note. When a note is played, the sweep is constant at its maximum value. From a single note to another, the sweep can be mixed for a complex sweep which is fully quite pleasing. Square wave, triangle wave, or even random is also sensen, may be useful to create an unusual effect.

6.2.3 Double-Track Flanging
(Preset BANK, REGISTER #3)

Double-tracking, or stereo doubling, is very similar to doubling, except that two different delays are mixed with this direct sound to make a second performer sound like three. The advantage of this doubling is that you can still hear the original sound on top of the chorus, a great deal of distance, and a gradual narrowing of bandwidth. The #4 and #5 registers of the Model 79 only simultaneously reverberate with its “Echo with Recirculation” effects, with the LFO’s envelope running through the SHAPE envelope and the LFO’s envelope running through the SHAPE envelope.

6.2.6 Echo (LFO, BANK, REGISTERS #6 & #7)

True echo occurs when the direct sound output from a source bounces off an object and returns back to the location of the source (LFO of delay time). Bandwidth effect is so that it is heard as a distinct repetition of the direct sound, even if it is at different levels. A LFO of delay time per second. The initial delay time can be set by the distance between the sound source, the image of the reflecting surface, and the receiving point. Delay times of 60 ms to 150 ms create an effect that is commonly called “slip echo.” But when you set delay times over 150 ms, you get a very distinct repetition of the source, or “moderate echo.” If both the A and B DELEY taps are used, there can be a double reverb or a two repeated signal.

6.2.7 Echo with Recirculation
(Preset BANK, REGISTER #8)

Recirculation of the delayed sound (feedback) provides multiple reiterations, and now two or more reiterations are combined. The DEPTH control is used to make the sound less clear. In this case, the delay time is modulated by the LFO, and the LFO’s envelope running through the SHAPE envelope is applied to the delay time. In addition, the LFO’s envelope running through the SHAPE envelope is applied to the delay time. In this case, the feedback signal is always present, even when the delay time is zero. The LFO’s envelope running through the SHAPE envelope is applied to the delay time. In this case, the feedback signal is always present, even when the delay time is zero.

6.2.8 Rhythmic Effects

True synchronizations and elaborations of rhythmic patterns can be achieved when two rhythm patterns are layered or sing in a close, interacting manner, which can be helpful to achieve similar results during a slow performance. In this case, the LFO’s envelope running through the SHAPE envelope is applied to the delay time. In this case, the feedback signal is always present, even when the delay time is zero.
SECTION FIVE
Advanced features of the Model 97

5.1 GENERAL
This section assumes you are familiar with Section 4 (Basic Features). We use the term “advanced” advisedly because all the Model 97 features are technically advanced. Like some of the effects, the features described here are found either less often, or with less sophistication, or not at all in other delay processors.

5.2 THE VCO VOLTAGE CONTROLLED ORCHESTRATION AND ITS MODULATED FUNCTIONS (MANUAL SWEEP, XTL MOD, and the LFO SECTION)

The VCO has one basic function; it serves as the master clock for the audio processor. If the clock frequency (the VCO output) changes, so too will the delay times you have set with the “A” and “B” DELAY controls. (Setting the Model 97 to XTAL mode crystal controls the VCO frequency so the delay times are untamable.) Many effects depend upon changing the delay time, and for this reason the VCO can be modulated by one of two primary means, either by MANUAL SWEEP or automatically by the LFO (Low Frequency Oscillator). Refer to Figure 5-1. Turning MANUAL SWEEP is not done by simultaneously turning the knobs up and down, whereas adjusting the DELAY time controls alters the location in memory from which the digitally stored audio is read, adjusting MANUAL SWEEP simply changes the rate at which data moves through the memory. The minimum sweep available covers a 3:1 range, from 0.16 to 1.5 times the set DELAY time. (Note that MANUAL SWEEP causes the LFO time to change smoothly and continuously rather than in discrete steps, as occurs when you adjust the individual DELAY controls.) Since the clock frequency itself is altered, the maximum available delay time can be increased beyond the nominal “memory option” indicated in the unit. For example, if you purchase the Model 97 with option #2 (Full memory extension) having a maximum of 1.25 seconds delay, that 1.25 seconds is present only when the VCO is in XTAL mode, or when MANUAL SWEEP is centered at “X1.” Moving MANUAL SWEEP to “X1” will result in a 1.25 second delay (1.25 x 1.25 = 1.2192 seconds).

MANUAL SWEEP can be used to “fine tune” delay times, or to manually adjust flanging, echo, or pitch shifting effects. The available range for MANUAL SWEEP is not always the 3:1 range indicated on the control; it depends on the LFO DEPTH setting. At a DEPTH setting of “19,” there is no MANUAL SWEEP at all (because the LFO is providing all the audio modulation). At a “0” DEPTH setting, the full 3:1 MANUAL SWEEP is possible. To obtain automatic delay time modulation, the LFO is provided. It changes the delay time over the same range as the MANUAL SWEEP, only you don’t have to keep moving a knob for the change to continue. The LFO consists of two basic rotary controls (SHAPE and RATE), along with two jacks for the left and right stereo inputs. Pressing the XTAL button defeats the entire VCO section (LFO and MANUAL SWEEP) and fixes the delay time (scaling at 1 times the DELAY display setting). This is accomplished by controlling the oscillator frequency with a quartz crystal. More often, you’ll want to modulate the delay times: LFO modulation is essential for many effects (flanging, phasing, dubbing, mixing, etc.). If the unit is in XTAL mode, just press the XTAL button again to the LED above that button turns off. Then you can use the VCO as desired.

6.2.9 Vibrato
Vibrato is the effect produced by small, regular variations in a sound’s pitch. Pitch variations can be created by alternately stretching and relaxing the strings with a special tool. The Model 97 can create automatic, regular vibrato for any single instrument or mix of sounds, by means of sine wave modulation from the LFO section. Manual inflections can be created using the MANUAL SWEEP control. For a vibrato effect, the controller connected to the EXTERNAL DELAY SWEEP can be used. Short delays should be used with no feedback and 100% delayed sound fed to the output. Modulator modulation DEPTH is more natural sounding, especially with realistic RATE settings (both depend on the instrument and the music). To obtain automatic delay time modulation, the LFO is provided. It changes the delay time over the same range as the MANUAL SWEEP, only you don’t have to keep moving a knob for the change to continue. The LFO consists of two basic rotary controls (SHAPE and RATE), along with two jacks for the left and right stereo inputs. Pressing the XTAL button defeats the entire VCO section (LFO and MANUAL SWEEP) and fixes the delay time (scaling at 1 times the DELAY display setting). This is accomplished by controlling the oscillator frequency with a quartz crystal. More often, you’ll want to modulate the delay times: LFO modulation is essential for many effects (flanging, phasing, dubbing, mixing, etc.). If the unit is in XTAL mode, just press the XTAL button again to the LED above that button turns off. Then you can use the VCO as desired.

6.2.10 Pitch Twisting Effects
Pulling a string toward the edge of the fretboard will create pitch twisting (pitch bending or shifting) on a guitar or bass. The Model 97 can twist the pitch of any instrument or vocal. Slow or wave modulation of the VCO by the LFO produces upward and downward twists in similar fashion to vibrato, but the rate is slow (low). Square wave modulation produces a sequence of pitch jumps (like the top of the scale, a 2nd raised pitch, and a 3rd lowered pitch; this is often referred to as an “aphroditan” effect). The Model 97’s envelope modulation adds another dimension to the pitch twisting effects normally available with a delay line. Setting the SHAPE control to the fully CW position (fully CCW) causes the delay time to increase and decrease in proportion to the envelope of the audio input. (“Envelope” refers to the moment to moment changes in the overall level of a signal, such as one played on a piano.) The result is an articulated pitch sweep (like the "wah" effect on a new range of musical and special effects.

If the switched output is fed back to the input (using the AF/B and/or BFB sliders in the INPUT MIX section), the LFO is "looped" (shifted). Thus a single note at the input may result in many different output pitches produced by the original note (i.e., played, altered in pitch, and recirculated). Since it is impossible to see the full range of pitch twisting effects, liberal experimentation is encouraged. The main parameters to control are DEPTH, SHAPE, DELAY TIME, and RECIRCULATION. (Manual pitch shifting is possible by means of the MANUAL SWEEP control or a foot controller connected to the EXTERNAL DELAY SWEEP jack.)

6.2.11 Resonant Effects
Singing in the shower is one way to obtain a natural, though moderate, resonant effect. Stereophonic resonance is possible by using the Model 97 at short delay times with a lot of RECIRCULATION. This causes a build-up of fundamental notes and harmonics which form a quasi-resonant "sound cycle" equidistant to the delay time. These emphasized pitches and the “resonance.” The effect can be characterized as adding a ringing, metallic quality to the sound. Extreme resonant effects create the “Cyton” -- voice of TV fame. Special cases of resonant effects, chromatic tuned resonances, is discussed in Section 6.4.

The pitch and tone of the resonance is affected by the DELAY SWEEP phase (INV), the amount of RECIRCULATION, and the OUTPUT MIX. (Like the flanging effects, resonance is necessarily a mono effect.) Care must be exercised to keep feedback below the point where the unit will spontaneously oscillate (run away or howl). Use of the low pass filter before greater amounts of RECIRCULATION, in many cases, before howling occurs.

6.2.12 Infinite Repeat Effects
The ultimate in sound-sound capability can be obtained by using the front panel A/B button or switch and a monaural microphone input to the rear panel of the INFINITELY REPEAT jack. With the full memory extended to the maximum delay memory, the delay line is locked (the sound may be "cut and paste" in the delay line, then repeatedly fed to the output with no fading or degradation in quality. With a delay exceedingly above the normal amount. The INFINITELY REPEAT buffer will hold the signal in a "loop" until a destructive event occurs (such as an overload) or the INFINITELY REPEAT button is released.)
6.3 CHROMATIC TUNED RESONANCES

Thanks to its programmable nature, the Model 97 makes it possible to create a series of resonant effects, tuned in half-step increments on the chromatic scale by means of differing delay times. Then, by directly accessing specific tunings (e.g., different memory REGISTERS), it is possible to create melody lines from such non-melodic sound sources as a single drum. You may wish to store two octaves worth of chromatic resonances in 24 of the memory banks (e.g., 3 banks). And, naturally, you'll want to permanently store this memory full of chromatic resonances on tape.

For a given performance sequence, you can recall the needed "notes," one at a time in the sequence they will be used, and store them in the fourth memory bank. This will allow you to use the REGISTER STEP foot switch to move from note to note while performing. If a one-byte sequence of notes is insufficient, store that bank on tape. Then create the next bank of

8 tuned resonances and store it on tape, and, if needed, continue doing so until you have up to four sequenced memory banks stored on tape. Then you can recall the tape, one segment at a time, into the four memory banks, replacing the chromatic scale with the actual musical sequence.

The basic front panel setup for a chromatic tuned resonance is shown in Figure 6-5. Specific delay times for different notes are listed in the chart accompanying the front-panel illustration. More RECIRCULATION will produce a longer decay time for the resonance.

<table>
<thead>
<tr>
<th>NOTE</th>
<th>DELAY</th>
<th>NOTE</th>
<th>DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>30.6</td>
<td>F2</td>
<td>12.3</td>
</tr>
<tr>
<td>C#1</td>
<td>28.9</td>
<td>F#2</td>
<td>11.5</td>
</tr>
<tr>
<td>D1</td>
<td>27.7</td>
<td>G2</td>
<td>10.6</td>
</tr>
<tr>
<td>D#1</td>
<td>25.7</td>
<td>G#2</td>
<td>10.2</td>
</tr>
<tr>
<td>E1</td>
<td>24.3</td>
<td>A2</td>
<td>9.1</td>
</tr>
<tr>
<td>F1</td>
<td>22.9</td>
<td>A#2</td>
<td>8.6</td>
</tr>
<tr>
<td>F#1</td>
<td>21.8</td>
<td>B2</td>
<td>8.1</td>
</tr>
<tr>
<td>G1</td>
<td>20.4</td>
<td>B#2</td>
<td>7.6</td>
</tr>
<tr>
<td>G#1</td>
<td>19.3</td>
<td>C3</td>
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<td>A1</td>
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<td>C#3</td>
<td>6.8</td>
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<td>D3</td>
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<td>13.6</td>
<td>F#3</td>
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</tr>
<tr>
<td>D#2</td>
<td>12.9</td>
<td>G3</td>
<td>5.1</td>
</tr>
</tbody>
</table>

**NOTE:** Values given in milliseconds are accurate to the limits of the display. Fine tuning may be done by different adjustment of "Manual Tune" controls.

but will not place the taped data into its memories. If all data on the tape agrees with the solid state memories, the unit returns to normal display and normal operation at the end of the process.

6. IF ERRORS ARE FOUND, THE MODEL 97 DISPLAY WILL SHOW A MESSAGE "EC...". The two-digit code displayed after "EC" depicts the quantity of discrepancies found. (Obviously, if you changed a memory prior to checking the tape, there will be a lot of errors.)

7. If there were errors, press **MAN** twice to return to normal operation. Check the tape and the tape machine to discover the source of the errors. Look for dirty heads, dropouts, level problems, and speed or frequency response anomalies. Then try re-writing the memories on tape and again verify the accuracy.

4.12 READING A FILE FROM THE TAPE

If no numerical flag is entered as part of the read command, the Model 97 will read the first file it is fed, whether numbered or not. If a numbered file is specified, then the unit ignores all files on tape until it sees the designated one or two digit label at the front of the tape recorded file. Since it may take over a minute for each tape file to play back, asking the Model 97 to search through a tape for a given file may take a while. It is faster to note the approximate tape location where a given file is located, fast wind to that point, and then read the file into the Model 97 as indicated below.

**NOTE:** It is assumed the TAPE SOURCE IN jack is connected to the line output of the tape machine for this procedure.

To read a file of 32 effects from tape:

1. Rewind the tape to a point a few seconds ahead of the stored effects memories.

2. Press the tape.

3. If you wish the 97 to read the first file that comes along.

4. If you wish the 97 to read only a designated file, hold in **TAPE**.

5. Then press the file number **N** or **N** using the appropriate REGISTER button(s). Then release **TAPE** and press it once more.

6. While the tape is being "read" into memory, the Model 97 display will show the letter "EC".

**NOTE:** If you want to abort the tape reading operation at any point while it is in progress, press **MAN**.
4.11 VERIFICATION THAT MEMORIES ARE ACCURATELY STORED ON TAPE

A steady pilot tone is present at the Model 97 TAPE STORE OUT jack except when actually writing memories onto tape. If this tone is recorded and, upon playback sounds "shaky" (i.e., if there is an audible waver), then the tape machine's performance is probably inadequate for reliable memory storage. However, there is no precise way to check any given memory "dump," so that any tape dropouts, noise, level deviation or "glitch" which might have interfered with the writing onto tape can be discovered before any Model 97 memories are cleared or changed.

Immediately after writing memories onto tape, perform the following verification procedure, which compares the tape recorded memory with the solid state memory. A visual indication is provided if the Model 97 memory contents are not identical to the tape recorded data. Therefore, it is best not to change any Model 97 front panel settings (and certainly do not store any modified or new effects into memory) until after performing this procedure.

To verify the accuracy and readability of "memory" tape:
1. Rewind the tape to a point just before the stored effects memories.
2. Press and, while holding the TAPE button.
3. If the memories were identified by a numerical flag, also press the corresponding REGISTER button(s) while still holding in the TAPE button.
4. Release the TAPE button.
5. Place the tape machine in play mode, and then press the Model 97 TAPE button again to initiate the comparison process. The Model 97 will read the tape in the normal fashion, as explained in Section 5. When the master's TAPE button is pressed, it and the slave simultaneously step to the next register. Instead, if desired, a single foot switch can be connected to both REGISTER step jacks, or, for that matter, to the BYPASS or REPEAT jacks. DO NOT "V" CONNECT FOOT CONTROLS FOR EXTERNAL DELAY SWEEP OR RATE IN.

We have shown with dotted lines the possible cross-feeding of one delay only output from each channel with the auxiliary input of the other channel. This can make stereo echo/mix effects more natural, simulating the blending that occurs acoustically as sound bounces back and forth in an environment.

Figure 6-6 — Processing a Stereo Program with Cross-Coupling between Two Model 97's
6.4.2 Series Connection of two Model 97's for common effects or longer overall delays.

With a maximum of 1.92 seconds delay available from a single Model 97 (1.28 seconds with full memory option times 1.5X MANUAL SWEEP), it is seldom that any longer delay would be required. Still, if you already have two Model 97's available (or a Model 97 and another Lexicon delay unit), you can cascade the units in a series connection so the delay times add up. Another reason to connect two units in series is to combine effects, such as flanging or doubling with one unit and long echo or pitch twisting with the other unit. Refer to Figure 6-7 for the appropriate connections.

6.4.3 Parallel Connection of two Model 97's for deep tape phasing effects (the alliumg flange)

While this is but one of the many applications for a pair of identical delay lines, it bears special consideration. Tape phasing is another term for flanging; we use it here to refer to an effect that more closely resembles true tape flanging than any effect possible with a single delay line. As discussed in Section 6.2.1, flanging (tape phasing) was originally created by playing back the same recording from two tape machines, and relying on slight speed deviations between the reels of tape to produce comb filters. By continuously moving the two tapes in and out of sync, very deep scooping sounds would result—an effect loved by many producers, and hopefully by record buyers.

The predominance of electronic delays, phasers and flangers which have come to market in recent years simulate the original tape flanging/phasing effect, but they never quite capture the actual sound. In fact, to this day some artists and record producers will insist on rolling 2 extra tape decks into the studio for "effects."

The reason electronic devices have been less than successful is that they generally operate by cancelling the original signal with a delayed version of that signal. In contrast, true tape flanging carves out independently adjustable delayed signals, one of which is usually varied while the other "stays still." The result is a varying delay interval between the two signals of form "D" to several milliseconds effectively a sweep ratio of infinity.

Any given delay line will have a minimum delay time, even if it is a fraction of a millisecond, and hence it cannot achieve a sweep down to zero difference with the input signal. This effectively limits the single delay to

3. Release the above buttons, or...
4. To invert another function, continue holding [ ] and press another [ ] button.

2. Press the [ ] button corresponding to one of the 8 memories in which the desired effect is stored

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
</table>

To copy an effect just recalled into another memory register:
1. Select the memory bank desired, A through D, by repeatedly pressing [ ]
2. Press the [ ] button.
3. Press any of the 8 [ ] buttons to designate the memory into which you wish to copy the effect.

4.10 WRITING THE MEMORIES ON MAGNETIC TAPE (CREATING A FILE)

When you store effects in any of 32 locations (i.e., banks A through D times 8 through 16), you are actually placing digital information in solid state memories. Because the Model 97 includes a relocatable back-up battery, its memories can be considered non-volatile. Still, there are reasons to store the contents of the memories in other permanent, non-volatile location—on magnetic tape.

"Writing" memories onto tape ("writing a file") onto tape makes it possible to have an unlimited repertoire of stored effects. When storing the contents of the memories on tape, digital data is output as two frequency-shifted modulated tones requiring very little bandwidth, so the demands on the tape recorder's frequency response are not severe. However, the recorder should have reasonably good record/playback stability (as well as low wow & flutter). You can choose to write all 32 effects on tape, or only one of the banks. You also have a choice of labeling the stored bank or banks with a one or two digit number, sequentially setting different groups of memories onto tape, such numeric flag become useful. That's because the Model 97 can later be instructed to "ignore" all but the one numbered file you are seeking as you play a tape described with several different files.

NOTE: It is generally faster to log the tape time at which a particular file is located, and wind directly to that point, or just before it. The numerical ID then assures the proper file will be read into the Model 97. We also recommend slating a vocal label on the tape just ahead of the digital effects file to help you identify it.

NOTE: It is assumed the TAPE STORED CLIR pack is connected to the line input of a suitable tape machine for this procedure.

Figure 6-7 — Series Connection of Two Model 97's
4.6 INPUT MIX CONTROLS

The Model 97 front panel has two sets of vertical slide faders, each in a blue box. One box is marked "INPUT MIX" and the other "OUTPUT MIX." Five input mix controls adjust the input signal supplied to the digital delay processor. MAIN A and AUX SOURCE levels. (From input connectors, A/B and B/C controls [RECIPIRULATE], and a vertical filter slider to adjust the .recirculation signal bandwidth from 20 kHz down to 700 kHz.

The MAIN SOURCE control is the only front panel control on the Model 97 whose settings are neither stored nor recalled. This is so that different signal levels at the Model 97 MAIN INPUT can be accommodated without any need to alter the programmable effect. If you prefer to store the input level setting, use the AUX SOURCE control and connect the signal to one of the AUX INPUT. (Where two separate input signals are brought to the MAIN and AUX inputs, the MAIN and AUX SOURCE controls in the INPUT MIX section may be used to blend these signals in any desired proportion.)

The preferred input for only one signal is needed, is the MAIN INPUT.

The HEADROOM display should be observed when adjusting any of the INPUT MIX controls. Only on the loudest peaks should the red "00" LED be allowed to turn ON. Average signal levels should be in the "6 dB" to "18 dB" range. Extreme levels will lead to distortion, and, at higher frequencies and longer delay times, may cause audible noise when reproduced on a stereo system. Because of the presence of the 10 kHz to 20kHz band, which is the audio band, the necessary degradation of the signal-tone ratio. If low effect levels are needed, turn the Model 97 OUTPUT level down. On the other hand, if the effect level is too high, a "blank." Not only does the effect level change the effectiveness of the effect, but it also changes the frequency response of the system. The frequency response of the system is determined by the frequency response of the input signal. The frequency response of the input signal is determined by the time delay of the signal.

Model 97 out of the box. The output controls are adjustable independently for both A and B delay taps. High level leakage will lead to a loud, sustained noise that, in turn, could damage loudspeakers if it is not controlled. Low-level leakage with A/B delay taps greater than 10-20 dB in B delay taps may be desirable, depending on the size and power of the delay taps, and the power and size of the delay taps.

4.7 OUTPUT MIX CONTROLS

The OUTPUT MIX controls adjust the relative amount of delayed (processed) and direct (source) signals that appear at the Model 97 MASTER OUTPUT. There are four independently adjustable level controls per main MAIN A and AUX SOURCE levels. (From input connectors, A/B and B/C delay taps, and MASTER OUT. The settings of all these controls are memorized when an effect is stored.

The relationship between the INPUT MIX and OUTPUT MIX controls is illustrated in Figure 4.4. Note the relationship between the MAIN A and AUX controls in the INPUT MIX section (determine what signal is sent to the delay process), and the MAIN A and AUX controls in the OUTPUT MIX section (determine what amount of those same input signals are sent unprocessed, directly to the MASTER OUTPUT connectors). The HEADROOM display is not affected by the OUTPUT MIX controls. However, the input signal level is an important parameter when tuning the output stage, the red LED above the MASTER OUTPUT control will turn ON. Even when the red LED is unlit, it may be possible that the sweep range of only a few octaves.

On the other hand, if two electronic delays are used, both set to the same delay time, but one being delayed more than the other, it is possible to get the signal overlap between the two delay taps to "O," and hence the infinite sweep ratio is fixed. There is, however, a specific reason to use two identical delay lines. This is, each of the two units: In true tape delay systems, it is generally found that one tape machine produces the best effects—deeper and fuller than others. This is because frequency and phase response of the signal being combined is consistent across the audio spectrum. Since any electronic signal processor, including delay lines, introduces some frequency response and phase alteration as well as noise and distortion, it is important to maintain a consistent cancellation or reinforcement of the processed (delayed) signal against the original input signal. Should two different delay lines be used, even though the time delay may sweep down "O" differences, total cancellation will not occur; the unequal noise and distortion products will continue to be audible as the signal itself drops out.

Clearly, a pair of identical delay lines is the best way to simulate tape flanging/blurring effects. The Model 97 is an excellent choice because Lexicon's strict quality control standards ensure consistent performance. Moreover, the input delay bandwidth preserves the full harmonic content of the music. Further, level matching is important, and, when properly adjusted, the sweep will assume a shape and range of effects that surpasses any single delay line effect.

The two delay taps in a single Model 97S are not used for obtaining zero effect because both taps are matched by the unit's LFO. Thus, both will sweep up and down together — while the absolute delay values will change, they won't cross at zero offset.

In the setup in Figure 6-8, the same unprocessed input source feeds both unit's INPUTS. Only one delay tap on each unit is used (rather than the A/Delay). and both are set at the same time. However, each unit is subject to LFO modulation (a blend of FNV and sine wave), while the other delay is not. The two A/Delay outputs are mixed by routing unit #1's output through unit #1's AUX INPUT, keeping that signal out of unit #1's INPUT MIX section (for delay line balance), and bringing it up with the AUX SOURCE control in unit #1's OUTPUT MIX section.

To create the tape phasing effect, follow this procedure:

1. Set both unit's A/Delay controls to the identical time, around 4 m.

2. Set the DELAY A and the MASTER OUT slider on both unit's OUTPUT MIX sections to nominal level.

3. Set the MAIN SOURCE and both unit's OUTPUT MIX sections at nominal level so that the contribution from unit #2's delay can be mixed with that from unit #1.

4. Make sure the MAIN SOURCE slides in both unit's OUTPUT MIX.
6.5 TAKING FULL ADVANTAGE OF THE MODEL 97 IN ROOD 6
6.5.1 Synchronous register stepping from cues on a multi-track tape.

The concept of storing the Model 97's memories on tape, and the ability to automatically step through memories based on taped cues, have been covered elsewhere in this manual. Basic hookup for a cassette or any reel-to-reel recorder is shown in Section 3, but we have yet to demonstrate how to set up for synchronous tape cue induced memory stepping. The setup shown in Figure 6-9 would be useful in the recording studio, where a spare track on the multi-track recorder is used to store the cue tones. By loading the memory register in an appropriate sequence, you can record cue tones that are always recorded at the same instant. This technique is particularly useful when timing is critical, because it simplifies cue recording and playback.

4.1 GENERAL
This chart describes how to "power up" the Model 97, how to immediately obtain useful effects, and how to store and recall your own effects. In the Model 97's 32 solid state storage registers and on tape for expanded storage. Using the "step" function familiarizes you with these basic functions, be sure to consult Section 8, which covers more advanced features and functions, and Section 6, which describes advanced operations.

4.2 TURNING ON THE MODEL 97
The Model 97 has a special "powering up" requirements, but should be treated with the same care given any audio signal processing device. When using power amplifiers, make sure that the speaker system, the power amp should be turned on before the Model 97, and turned off before turning off the Model 97, and the amplifier volume should be turned down. This precaution will avoid the risk of damaging a loudspeaker in the event of a Model 97 malfunction or an improper set-up. For this reason, you can write down the settings using one of the blank front panel displays in the back of this manual. The initial effect will again be recalled, and your system calibrated for precision performance (it will not be necessary to re-calibrate any controls which are already at their null points).

5.4.5 ABOUT THE DELAY TIME DISPLAY AND SETTINGS
The DELAY displays consist of two sets of large 3-digit, 10-division delay setpoints (for the "A" and "B" delay taps). Each display is capable of displaying delay times ranging from 0 ms (non-zero millisecond) up to 960 or 1,920 ms (1.92 seconds, depending on the memory location installed in the Model 97. Times above 960 ms, however, will be displayed in seconds, not milliseconds, to preserve accuracy and precision. The delay time automatically adjusts and an adjacent "sec" (seconds) LED lights to signal the readout. The readout changes from milliseconds to seconds.

The rotary controls on either side of the display adjust the "A" and "B" delay taps, and are independent of one another. The response of these controls is tapered so that very fine resolution is available at the shortest delay times, with broader resolution at longer times. The delay time is adjusted in increments which provide greater resolution at shorter times. Also, except at the shortest and longest times, the "A" and "B" taps cannot be set to the identical delay time. The delay times are set by the "A" tap and then by the "B" tap. This intentional offset is done to create satisfying reverberation by providing non-related delay times in the two outputs. It also prevents "dithering" (a digital noise). The specific delay times available are determined by the way the Model 97 software was written.
3.5 TAPE STORE IN AND OUT

The TAPE STORE jacks have multiple functions. These tip/sleeve phone jacks send data to a tape recorder (TAPE OUT), and receive it from a tape recorder (TAPE IN) for the purpose of temporarily storing the Model 97's memory registers and retrieving them later. Additionally, the TAPE STORE OUT of one Model 97 can be connected to the TAPE STORE IN of another Model 97 so that memory contents can be "dumped" directly from one unit to the other without using a tape recorder. There is one further use of these jacks; automatic register stepping. When the unit is placed in the appropriate operating mode (Section 5.9), the Model 97's TAPE STORE OUT jack will carry a cue tone each time the front-panel TAPE button is pressed, and the unit will also step to the next memory register. Upon playing back the tape with the cue track output connected to the Model 97 TAPE IN jack, each occurrence of the cue tone will cause the unit to step to the next memory register. Once again, this automatic step function can be performed without tape by connecting TAPE OUT from one Model 97 to TAPE IN of the next, provided both are set to the proper modes; such operation is handy when using two units in tandem for stereo processing, since only one unit need be operated to sequence both of them.

The audio input and output at these jacks is unbalanced, applied to the tip and sleeve of any tip/sleeve phone plug (tip/sleeve phone plugs may be used, too). The line-level signal present at TAPE OUT varies. There is frequency-shift keyed data when storing effects, a momentary frequency-shift codes for cue register step automation purposes, and a steady tone at all other times.

with any Model 97, not just the one initially used.

If more than one track at a time is being "processed" with Model 97's, it may be necessary to dedicate more than one track for cue tone data. On the other hand, if two Model 97's are being used for the stereo mixdown signal, one data track on the multitrack master can be used for the cue tones. Initially, when recording the cue tones during a rough mix, use a Y-connection to feed one Model 97's TAPE STORE IN jack and the multitrack's data track with cue tones from the second Model 97's TAPE STORE OUT jack. In subsequent "passes" during the reming, re-connect the "Y" so that the multitrack's data track output feeds both Model 97's TAPE STORE IN jacks. Both units will be processing the mixed signal being recorded on the 2-track machine, but will be made to step through the memory registers only on the multitrack machine.

NOTE: Use of cue tones for synchronous processing with several tape machines, as in video and film post production, is discussed in Section 6.6.

6.5.2 Using the DELAY A OUT and DELAY B OUT jacks

While the Model 97's OUTPUT MIX section allows the A and B delay tape to be mixed with the MAIN and AUX source signals, there are instances when the signals are best kept discrete. On the other hand, as explained in Section 8.2, certain effects are possible only when the delayed and direct sound are mixed within the Model 97. The hookup shown in Figure 6.6 allows for either situation without re-wiring anything (assuming the mixing console has at least three echo/effects return inputs).

For those effects where the delayed and direct sound must be mixed inside the Model 97 (e.g., flanging), the unit's OUTPUT MIX section is fully utilized, and the console's return from MASTER OUT is used (echo return #3 in the illustration). The DELAY A and DELAY B output jacks are not affected by the respective OUTPUT MIX sliders – they always carry the delayed signal (including any recombination at full level). However, a simple "straight" delay, or two different "straight" delays are needed (for simple echo or step effects), the console's corresponding echo returns are used (#1 and #2 in the illustration).

6.6 USING THE MODEL 97 IN VIDEO AND FILM POST PRODUCTION STUDIO

In video or film work, the advantages of being able to instantly switch from one effect to the next are tremendous. You can have the audio follow the camera zoom with progressively longer or shorter delays . . . or change the entire reverberant field when the action moves to a different room or a different perspective. The Model 97's ability to step through registers as dictated by recorded cue tones greatly simplifies the busy task of post-production audio mixing, especially when there are many fast-cut pictures to track. The setup in Figure 6.10 is not necessarily a "real" post-production installation, but instead is meant to...
indicate the nature of such setups. The Model 97 is used in the echo send/receive loop of the mixing console. Its separate Delay A and Delay B outputs also may be connected to additional echo return inputs. This setup shows a multi-track recorder (8, 16, or 24 tracks) for the post-production audio mixing. It working from a location with a recording or a VCR audio track, these tracks can be transferred to the multi-track recorder or simply locked-down with a suitable synchronizer or resolver. Dialogue or individual tracks may then be dubbed onto the multi-track master. The Model 97's TAPÉ STORE function can be connected to one track of the multi-track machine, which is declued to cue tones and effects memory storage, another track is required for the SMpte time code.

In this simple, straight presentation, the Model 97 can be used during the recording of individual tracks for the multi-track master. It can also be used later, during mixing to the final format, where it may process the entire dialogue mix or the entire effects mix. It is at this stage that the automatic "register step on cue" function is likely to be most useful. If more than one Model 97 is required for simultaneous processing of the different mixes (e.g., left, center, right, surround), then additional tracks may be required to handle discrete cue signals for each Model 97.

The foot or control-mounted switches and controls can be used to remotely control the Model 97. This can save time and distraction of reaching to a distance equal bay, and, in the case of foot controls, actually allows the engineer to do more things at once (it concentrates and coordination permit).

6.2 LOCALIZATION AND IMAGE PLACEMENT

The prevalent technique for placing an image within a stereo or multi-track sound field is to pan the signal left-to-right, relying on aminitude differences between channels for perception of position. Delay is an alternative place-technique that offers some different advantages over conventional panning.

A panned image is located strictly by amplitude differences so the sound source is perceived as coming from the loudspeaker. The technique offers good results for a listener in the center (the "ideal" stereo seat), but as the listener moves farther to one speaker, the image moves with him to that speaker. This shift is due to a psychoacoustic principle known as the Haas effect.

Haas has shown that we tend to localize a sound source to the position from which the first arriving sound originated. When the sound originates at the same time from both speakers, we will perceive the sound as coming from the center to which we are nearest. This perception persists even if the closest speaker has a weaker signal than the farthest one (unless the farthest speaker is many, many dB louder).

Armed with a knowledge of the Haas effect, it is easy to see how a time delay processor can be used for panning. To pan to the right, delay the signal feeding the left speaker, and vice-versa. The advantages of using delay for panning, rather than level differences, is that the listener can readily locate a sound source even when not listening from the center seat. Delay times of 0.1 ms to 30 ms are most useful for this effect. With delays over 30 ms, we begin to hear two distinct sounds (an echo) rather than a psychoacoustic pairing of the early and late arrivals into one sound.

Figure 6-3 shows how to position keyboard voltage (directly or via a sequencer) or a mixing automation system.

One further remotely controlled function is the talkback. This is achieved through triggers registered by cue tones on track A. This is accomplished using the TAPÉ STORE function, and is discussed in Section 5.5.

BYPASS

In bypass mode, the INPUT MUX signal (on track A, minus talkback) is routed to the main output via the MASTER OUTPUT level control, along with the normal input to the MAIN INPUT LEVEL, AUX INPUT LEVEL and MASTER OUTPUT LEVEL settings. The bypass jack accepts a standard 1/4" tip/ring/sleeve phone plug or a 1/4" tip/sleeve phone plug. Bypass is activated by a momentary remote control switch. The center pin grounds the tip to the sleeve, and is controlled by a subsequent switch closure.

INFINITE REPEAT

The INFINITE REPEAT function allows permanent replication of any sound in the delay memory. The PRESET REPEAT jack accepts a standard 1/4" tip/ring/sleeve phone plug. REPEAT is activated by a momentary remote control switch which grounds the tips to the sleeve. The program segment is repeated in memory as many times as the setting in which was in the memory prior to the switch closure. REPEAT is cancelled by a subsequent switch closure.

REGISTER STEP

The REGISTER STEP function allows the operator to sequentially select stored effects. The REGISTER STEP also accepts a standard 1/4" tip/ring/sleeve phone plug. Each time a remote switch closes, momentarily grounds the tip to the sleeve, the selected memory replay is indexed by one less than the "blank" memory. Then the unit will return to the first memory register in that memory bank, or, if there is another "blank" memory stored in the bank, the unit will return to the register following the previous "blank".

The "blanks" memories, continuous switch closures will sequentially pass through the next bank, and will stop through all 32 user-programmable registers.

EXTERNAL DELAY SWEEP

The EXTERNAL DELAY SWEEP jack allows remote operation of the VCO, essentially duplicating the front-panel MANUAL SWEEP function. The more DEPTH selects the appropriate LFO modulation rate, the less effect available from this jack. The EXTERNAL DELAY SWEEP jack accepts a standard 1/4" tip/ring/sleeve phone plug. Full sweep range is achieved by applying from 0 to 10 volts across the tip and sleeve of the jack. For conventional instances where an external 10 volt source is not available, the Model 97 provides its own 10 volt source on the tip of the jack. While the 10 volt output is limited for bum-out protection, tip/ring/sleeve phone plugs should be avoided since they will overload the internal 10 volt supply. Increasing the voltage across the tip and sleeve from 0 to 10 volts will sweep delay time for a given front-panel L.E.F. setting from minimum (equivalent to X0.5) to maximum (equivalent to X5). If the user activates the 

rate indicator that the input is not in XTLATE mode, (b) VCO DEPTH is turned to "0", and (c) the MANUAL SWEEP control is turned to "X0.5".

RADIO IN

The RADIO IN jack allows remote control of the LFO modulation rate, essentially duplicating the function of the front-panel RADIO control. The RADIO IN jack accepts a standard 1/4" tip/ring/sleeve phone plug. Full sweep range of 0.0 Hz to 10 Hz (or from 0 Hz to 500 Hz if the front-panel X100 scale is selected) occurs as the voltage across the tip and sleeve is increased from 0 to 10 volts assuming that (a) the front panel RADIO control is at maximum, (b) the unit is not in XTLATE mode, and (c) VCO DEPTH is turned to "10". Like the EXTERNAL DELAY SWEEP, the RADIO IN provides its own 10 volt source on the tip of the jack for use when an external 10 volt source is not available, (e.g., with use for a foot controller or other than a synaptic keyboard modulation or an automatic system).

MODULATION OUT and IN jacks

MODULATION OUT is a tip/ring/sleeve phone jack with a DC voltage of 0 to 10V across the tip and sleeve, corresponding to the LFO modulation rate generated by the Model 97's sine wave oscillator and envelope follower. Tip/ring/sleeve phone plugs may be used. MANUAL SWEEP or EXTERNAL SWEEP modulation that might also affect the Model 97 VCO is not part of this modulation output. In fact, even if XTLATE mode is selected and the Model 97 is not affected by the VCO, the MODULATION OUT jack still carries a signal that corresponds to the setting of the front-panel LFO controls. This output can be used without affecting the internal operation of the Model 97 (so long as it is connected to a 2k ohm or higher input).

MODULATION IN, also a tip/ring/sleeve phone jack, a normally configured externally MODULATION IN jack can reach its VCO. When a tip/ring/sleeve phone plug is inserted in the MODULATION IN jack, the internal signal path is broken and whatever voltage is present across the tip and sleeve of the plug will be applied to the Model 97's VCO.

Typically, MODULATION OUT of one Model 97 is patched to MODULATION IN of another. When stereo signals are being processed and the stereo LFO modulation is desired for both channels. In such cases the audio itself is discrete, but the delay time changes track each other. The Model 97 whose MODULATION IN jack is used becomes known as the master, its LFO controls having no effect, and the Model 97 whose MODULATION OUT jack is used becomes known as the slave, its LFO controls setting both units.
3.1 MOUNTING

The Model 97 is designed to be mounted in a standard 19 inch relay rack. It occupies a panel footprint of 5 units (5-1/4"), and extends 13" behind the front panel. If the unit is to be shipped in a rack, we suggest supporting the rear of the chassis to protect the unit from vibration and mechanical shock.

The Model 97 is fitted with rubber feet, and may therefore be rested on any flat surface. Whether in a rack or not, be sure to provide adequate ventilation around the top and bottom covers of the unit. In general, electronic equipment operates with greater stability and reliability when kept cool.

Since the Model 97 processes low level audio signals, it is essential to isolate it from strong electromagnetic fields such as those generated by power transformers, fluorescent ballasts, etc.

3.2 POWER REQUIREMENTS

The Model 97 is set at the factory to operate from either 100, 120, 230 or 240 volt, 50 or 60 Hz, the factory set voltage is indicated on the rear panel. The unit draws a maximum of 50 watts. Units set for 100 or 120 volts are fixed at 1/2 ampere, while 230 and 240 volts are fixed at 1/4 amperes.

The nominal line voltage can be changed from whatever value is factory preset. However, NO CHANGE SHOULD BE MADE EXCEPT BY A QUALIFIED SERVICE TECHNICIAN. The line voltage is directly connected to a pair of changeover switches located at the left rear of the chassis, behind the power transformer. Make sure the AC power cord is first unplugged, the cover is removed and the power is off before you can operate these switches. They are set for the desired voltage, as shown in Figure 3-1. Then the cover is replaced, and if necessary the line cord is changed and the primary fuse is changed to an appropriate value.

3.3 AUDIO SIGNAL CONNECTIONS

All unbalanced audio input and output jacks on the Model 97 accept 1/4" jacks/leads or 1/4" mini-plugs. The ring is automatically grounded. All XLR connectors and parallel phone jacks are electronically balanced by means of differential amplifiers. Be sure you are using the proper plug and cable for a given connection. (Refer to the sections in Questions 2.3, and to Figure 2.3a below.)

The Model 97 is not intended for use with microphone-level signals, although certain high-output condenser microphones and quality pickups may provide adequate drive level for the MAIN INPUT when the GAIN button is engaged. (Even if a guitar will drive the Model 97 directly, using a guitar preamp is a good idea.)

3.4 REMOTELY CONTROLLED MUTE SWITCH

Three rear panel phone jacks permit remote switching of the BYPASS, INFINITE REPEAT and REGISTER STEP functions. Additional phone jacks permit remote control of the SELECT function.

Sweep and LFO RATE. For performing musicians, foot switches and foot controllers are available from Lexicon. A small number of auxiliary output jacks are available for use in conjunction with the Model 97's AES/EBU outputs. MAIN and AUX INPUT connections are provided so that two source signals can be connected to the Model 97, and mixed using the front panel controls. Bears in mind that the input level from the MAIN INPUT is not "memorized" when a front panel control is changed. The AUX INPUT level is memorized. Therefore, if you want the input settings to be "remembered", use the AUX INPUT.

WARNING

Never connect the Model 97 MAIN or AUX inputs directly to power sources, improperly isolated AC/DC power supplies, or improperly isolated DC power supplies. Disregarding these precautions can lead to electrical shock and may damage both the Model 97 and the AC source. Power supply requirements are covered in Section 2.2.

6.8 AVOIDING ECHOES IN DIGITAL SOUND REINFORCEMENT SYSTEMS

Most people think of a delay processor as a device created to used to create echoes. An important application, however, is the exact opposite — avoiding echoes. In large sound reinforcement systems, both the direct and the reflected sound can be placed in widely separated locations. The listener can often times of sound the listener's ear to either directly or reflectively through a sound source. For the last time you are in need of a delay, a train station or air terminal.)

Time delay cannot do much about reflections from walls and ceilings, but it can be used to avoid the confusion that results when a listener first hears the sound from a nearby speaker which is a distance from the place where the performer is located, and later hears the sound from the area in which the performer is performing. The "temporal confusion" not only destroys intelligibility, it is very fatiguing and tends to shorten attention spans.

6.10 EVOLVING LAYERED STORED ECHOES INTO NEW ONES

The most obvious examples of effect evolution involves the 8 effects provided in the Model 97's factory preset bank, effects which are permanently stored in read-only memory. As we've already said, these effects are merely starting points for you to derive your own effects. You can call up a preset, then move one or more front-panel controls past the "null" point and begin changing the effect. When you're satisfied with the modulated effect, you can select one of the four user-accessible memory banks and store the effect in one of its 8 registers. The same technique applies to recalling effects you've previously stored, modifying them, and storing them in other memories. Storing them in the same bank makes it easier to "A-B" compare modified effects by alternately pressing different REGISTER buttons. Work out several different effect variations in this manner, storing them all. Then play typical program material and "A-B-C" compare the effects to better select your favorite. You can then blank-out or store other effects over the "loosers."

Figure 3-1 — Setting the Voltage Changeover Switches
7.1 GENERAL PERFORMANCE, CONTROLS AND INDICATORS

Frequency Response
20 Hz to 20 kHz ± 2 dB @ 1 kHz

Total Harmonic Distortion Plus Noise
0.08% at 1 kHz (max), 0.1% at 10 kHz (max)

Dynamic Range
Better than 85 dB, 20 Hz – 20 kHz

Delay Ranges
Standard: 0.2 to 600 ms ± 1 kHz
Special (Memory Expansion Option): 0.2 to 1.28 seconds ± 1 kHz

Delay Selection
Rotary control for Delay Times ‘A’ and ‘B’, with large 1-inch ‘progress’ digits.

Delay Synchronization
Digital DC offset correction and Delay Synchronization for accurate 3-dig delay resolution of over 5000 delay times.

Register Storage
Futuristic control of store and recall

7.2 INTERFACE INFORMATION

Input Connectors
Main Input: from front, XLR-3 female connectors installed with 75 Ohm, Tip-Ring-Sleeve ‘A’ phone jack.

Input Impedance
100 Ohms input (nominal) with 100 Ohms, tip-rung-sleeve input, or 100 Ohms input, tip-rung-sleeve input, or 100 Ohms input, tip-rung-sleeve input.

Input Levels
0 dBv (+18 v) to +15 dBv (+27 v) with CR, switch on rear panel for main input.

Output Connectors
75 Ohm balanced or unbalanced for tip-1, 600 Volt unbalanced for tip-2, 600 Volt balanced for tip-3.

Output Levels
460 Ohms load or balanced for tip-1, 600 Volt unbalanced for tip-2, 600 Volt balanced for tip-3.

H. RATE IN JK

This 8-pin DIP socket plug-in card is available for use with a wide variety of rotary and standard phone jacks. It provides a means for remote control of the LFO RATE using the following controls:

- Rate Control: 0.02 to 50 Hz connected across the J1 and J2 leads will change the LFO RATE from 000 Hz to 5000 Hz (0 to 5000 Hz in 0.1 Hz steps). The rate control is not adjustable when the effect is external.

- Rate IN JK is used as the motor control for the RATE IN JK. So that the controls should be used for continuous control using a 0-10 volt signal and the following phone jacks may be used to externally control the RATE IN JK. The phone jacks may be used to provide a 0-10 volt signal to the RATE IN JK. The phone jacks may be used to provide a 0-10 volt signal to the RATE IN JK.

NOTE: The following three jacks are used with the continually changing phone jacks. Continuous ratings in this range of 0 to 5 VDC are involved.

I. BYPASS JACK

This 8-pin DIP socket plug-in card is available for use with a wide variety of rotary and standard phone jacks. It provides a means for remote control of the LFO RATE using the following controls:

- Rate Control: 0.02 to 50 Hz connected across the J1 and J2 leads will change the LFO RATE from 000 Hz to 5000 Hz (0 to 5000 Hz in 0.1 Hz steps).

- Rate IN JK is used as the motor control for the RATE IN JK. So that the controls should be used for continuous control using a 0-10 volt signal and the following phone jacks may be used to externally control the RATE IN JK. The phone jacks may be used to provide a 0-10 volt signal to the RATE IN JK. The phone jacks may be used to provide a 0-10 volt signal to the RATE IN JK.

NOTE: The following three jacks are used with the continually changing phone jacks. Continuous ratings in this range of 0 to 5 VDC are involved.

J. STEPPED RATE JK

This 8-pin DIP socket plug-in card is available for use with a wide variety of rotary and standard phone jacks. It provides a means for remote control of the LFO RATE using the following controls:

- Rate Control: 0.02 to 50 Hz connected across the J1 and J2 leads will change the LFO RATE from 000 Hz to 5000 Hz (0 to 5000 Hz in 0.1 Hz steps).

- Rate IN JK is used as the motor control for the RATE IN JK. So that the controls should be used for continuous control using a 0-10 volt signal and the following phone jacks may be used to externally control the RATE IN JK. The phone jacks may be used to provide a 0-10 volt signal to the RATE IN JK. The phone jacks may be used to provide a 0-10 volt signal to the RATE IN JK.

NOTE: The following three jacks are used with the continually changing phone jacks. Continuous ratings in this range of 0 to 5 VDC are involved.

L. TAPE STORE IN JK

This 8-pin DIP socket plug-in card is available for use with a wide variety of rotary and standard phone jacks. It provides a means for remote control of the LFO RATE using the following controls:

- Rate Control: 0.02 to 50 Hz connected across the J1 and J2 leads will change the LFO RATE from 000 Hz to 5000 Hz (0 to 5000 Hz in 0.1 Hz steps).

- Rate IN JK is used as the motor control for the RATE IN JK. So that the controls should be used for continuous control using a 0-10 volt signal and the following phone jacks may be used to externally control the RATE IN JK. The phone jacks may be used to provide a 0-10 volt signal to the RATE IN JK. The phone jacks may be used to provide a 0-10 volt signal to the RATE IN JK.

NOTE: The following three jacks are used with the continually changing phone jacks. Continuous ratings in this range of 0 to 5 VDC are involved.

M. TAPE STORE OUT JK

This 8-pin DIP socket plug-in card is available for use with a wide variety of rotary and standard phone jacks. It provides a means for remote control of the LFO RATE using the following controls:

- Rate Control: 0.02 to 50 Hz connected across the J1 and J2 leads will change the LFO RATE from 000 Hz to 5000 Hz (0 to 5000 Hz in 0.1 Hz steps).

- Rate IN JK is used as the motor control for the RATE IN JK. So that the controls should be used for continuous control using a 0-10 volt signal and the following phone jacks may be used to externally control the RATE IN JK. The phone jacks may be used to provide a 0-10 volt signal to the RATE IN JK. The phone jacks may be used to provide a 0-10 volt signal to the RATE IN JK.
Signal inputs and outputs

C. UNBALANCED OUTPUT

Remote Control connections

These unbalanced phone jacks are inter-
connected line-level outputs. The INPUT MIX
OUTPUT carries the mixed MAIN and AUX
inputs, while the OUTPUT MIX sections
are controlled by the controls on the rear
panel. Both jacks carry line-level signals
to the external MAIN SOURCES, and are

G. MODULATION IN jack

The unbalanced phone jack is connected
to the MODULATION IN jack so that
when a plug is inserted, the
Model 97's LFO signal is routed to
it can change the delay time. When a plug
is inserted in the MODULATION IN jack,
the internal LFO is no longer used.

NOTE: The MAIN INPUT has slightly
better common-mode rejection and lower
noise than the AUX INPUT. A line-level
input from a guitar and/or similar source
should be applied to the MAIN INPUT.

D. MASTER OUTPUT

This is the point where, most often, the
audio output is derived from the Model 97.
The XLR connector is electrically balanced,
with the tip/sleeve phone jack for
problems. The MASTER OUTPUTS have
a typical XLR nominal amplitude.

Automatic gain control can be used
in the MODEL 97's monitoring section.
The incoming signal is amplified to

AUX INPUT connectors (INPUT MIX, DELAY-A,
and DELAY-B).

NOTE: The MAIN INPUT has slightly
better common-mode rejection and lower
noise than the AUX INPUT. A line-level
input from a guitar and/or similar source
should be applied to the MAIN INPUT.
GO. DEPTH control

This button allows you to adjust the amount of LFO modulation affecting the delay line. When DEPTH is set to 0%, the LFO is bypassed. When DEPTH is set to 100%, the LFO is fully engaged.

H. RATE control, X100 button and indicator

The RATE control adjusts the rate of the pitch modulation. When RATE is set to 100%, the pitch modulation is set at a rate of 100 Hz. Pressing the X100 button sets the rate to 1000 Hz. The RATE control can also be adjusted by turning the encoder.

Additional Signal Processing Functions

5. VCA function button and indicator

This button allows you to select the VCA function. When the button is pressed, the VCA function is engaged, affecting the gain of the input signal. When the button is released, the VCA function is disengaged.

6. FILTER button

This button allows you to select the filter type. When the button is pressed, the filter is engaged, affecting the frequency response of the input signal. When the button is released, the filter is disengaged.

7. LFO button

This button allows you to select the LFO type. When the button is pressed, the LFO is engaged, affecting the modulation of the delay line. When the button is released, the LFO is disengaged.

8. ADJUST button

This button allows you to adjust the delay time. When the button is pressed, the delay time is increased. When the button is released, the delay time is decreased.

9. MEMORY button

This button allows you to save the current settings to memory. When the button is pressed, the settings are saved to memory. When the button is released, the settings are restored from memory.
2.2 FRONT PANEL

A. POWER switch
This switch pull pin turns the AC power on and off. When the power is turned on, the front panel switch and delay settings, and the transient indicators are all "on" and "on". When the power is turned off, the unit should be turned on for at least 5 minutes before operation.

B. HEADING display
The HEADING display monitors the audio level of the input signal. The display has 7 LEDs which indicate signal levels. The LEDs light up sequentially, from 1 to 7, indicating increasing signal levels.

C. MAIN source control
This vertical slider adjusts the level of the MAIN input signal and the output of the MIX section. It sets the level of the MAIN INPUT to XLR and phone jack. Moving the slider up increases the level, and moving it down decreases the level.

D. AUX source control
This vertical slider adjusts the level of the AUX input signal and the output of the MIX section. It sets the level of the AUX INPUT to XLR and phone jack. Moving the slider up increases the level, and moving it down decreases the level.

E. A-DELAY control
This vertical slider adjusts the amount of delay (in seconds) of the A-DELAY slider. Moving the slider up increases the delay, and moving it down decreases the delay.

F. B-DELAY control
This vertical slider adjusts the amount of delay (in seconds) of the B-DELAY slider. Moving the slider up increases the delay, and moving it down decreases the delay.

G. Recirculation low-pass filter (500 Hz - 20 kHz)
This vertical slider adjusts the cutoff frequency of the low-pass filter in series with the "A" and "B" recirculation feedback. Moving the slider up increases the cutoff frequency, and moving it down decreases it.

H. MAIN source control
This vertical slider adjusts the level of the MAIN input signal and the output of the MIX section. It sets the level of the MAIN INPUT to XLR and phone jack. Moving the slider up increases the level, and moving it down decreases the level.

I. AUX source control
This vertical slider adjusts the level of the AUX input signal and the output of the MIX section. It sets the level of the AUX INPUT to XLR and phone jack. Moving the slider up increases the level, and moving it down decreases it.

J. A-DELAY control
This vertical slider adjusts the amount of delay (in seconds) of the A-DELAY slider. Moving the slider up increases the delay, and moving it down decreases the delay.

K. B-DELAY control
This vertical slider adjusts the amount of delay (in seconds) of the B-DELAY slider. Moving the slider up increases the delay, and moving it down decreases it.

L. MASTER output control
This vertical slider adjusts the level of the MASTER output signal and the output of the MIX section. It sets the level of the MASTER OUTPUT to XLR and phone jack. Moving the slider up increases the level, and moving it down decreases it.

M. INVERT indicators
These indicators show whether the signal is inverted or not. When the indicator is on, the signal is inverted, and when it is off, the signal is not inverted.

N. MANUAL SWEEP control
This potentiometer controls the sweep rate of the delay time. Moving the potentiometer up increases the sweep rate, and moving it down decreases it.

O. MAXIMUM delay control
This potentiometer controls the maximum delay time of the delay line. Moving the potentiometer up increases the maximum delay time, and moving it down decreases it.

P. MAXIMUM delay control
This potentiometer controls the maximum delay time of the delay line. Moving the potentiometer up increases the maximum delay time, and moving it down decreases it.

Q. MAXIMUM delay control
This potentiometer controls the maximum delay time of the delay line. Moving the potentiometer up increases the maximum delay time, and moving it down decreases it.

R. MAXIMUM delay control
This potentiometer controls the maximum delay time of the delay line. Moving the potentiometer up increases the maximum delay time, and moving it down decreases it.

S. MAXIMUM delay control
This potentiometer controls the maximum delay time of the delay line. Moving the potentiometer up increases the maximum delay time, and moving it down decreases it.

T. MAXIMUM delay control
This potentiometer controls the maximum delay time of the delay line. Moving the potentiometer up increases the maximum delay time, and moving it down decreases it.

U. MAXIMUM delay control
This potentiometer controls the maximum delay time of the delay line. Moving the potentiometer up increases the maximum delay time, and moving it down decreases it.

V. MAXIMUM delay control
This potentiometer controls the maximum delay time of the delay line. Moving the potentiometer up increases the maximum delay time, and moving it down decreases it.

W. MAXIMUM delay control
This potentiometer controls the maximum delay time of the delay line. Moving the potentiometer up increases the maximum delay time, and moving it down decreases it.

X. MAXIMUM delay control
This potentiometer controls the maximum delay time of the delay line. Moving the potentiometer up increases the maximum delay time, and moving it down decreases it.

Y. MAXIMUM delay control
This potentiometer controls the maximum delay time of the delay line. Moving the potentiometer up increases the maximum delay time, and moving it down decreases it.

Z. MAXIMUM delay control
This potentiometer controls the maximum delay time of the delay line. Moving the potentiometer up increases the maximum delay time, and moving it down decreases it.
8.1 GENERAL
Before you attempt to verify whether there is a genuine problem with the unit, it is important that you understand the nature of the symptoms presented and the installation information presented in this manual. Please test the unit in your own installation, with the same accessories used in the test installation. Always use the correct test procedure, if any, that has been provided by the manufacturer.

WARNING
All servicing of the Model 97 should be performed by qualified service personnel. There are hazardous voltages located under both the top and bottom covers of the unit. To avoid electrical shock, remove the power cord prior to removing covers. Servicing procedures consistent with good safety practices should be used at all times. Additionally, due to the susceptibility of the CMOS integrated circuit chips to static discharge, improper handling of circuitry even with power disconnected can cause expensive damage to the Model 97.

8.2 UNIT WILL NOT POWER UP
If the Model 97 will not power up, first check the AC line cord to ensure it is properly connected to the power outlet and the service outlet. Then check the fuses and verify that the service outlet is “live” and that the voltage is correct for the Model 97 (see a voltmeter, neon test light, or a common lamp). If correct voltage is present, unplug the Model 97, and refer the problem to a Lexicon authorized service technician (who should also check to make sure the internal line voltage switches are properly set), or return the unit to Lexicon (see Section 8.4).

8.3 UNIT POWERS UP, BUT WILL NOT PASS AUDIO
8.3.1 Check Cables
Check all audio cables to be sure they are securely plugged into the proper jacks. If the connections are good, check the service outlet for proper voltage. Look for continuity and shorts between conductors while flexing the cable to check for intermittent contacts.

8.3.2 Check Other Sound Equipment in System
If all cables are good, the next step is to check the sound equipment in the sound system to ensure it is indeed operating properly. Unplug the Model 97 output cables (at both ends, and set aside). Then unplug the cable from the Model 97 input and connect it to the point which had been fed by the Model 97 output. This bypasses the Model 97 entirely. If the audio now passes through the sound system, the problem resides in the Model 97. If audio still does not pass, there is a problem elsewhere and probably not in the Model 97.

8.3.3 Check Model 97 Control and Switch Settings
Be sure the rear panel MAIN INPUT GAIN switch (O/100/200) is set properly, as well as the front panel INPUT MIX and OUTPUT MIX controls. Also, be sure the unit is not in INFINITE REPEAT modes, since it may be “holding” no signal at all. Try using a preset effect rather than your own setups.

8.4 UNIT POWERS UP, AND THEN “DOES ITS OWN THING”
The Model 97 is fully microprocessor controlled; nearly all front panel knobs, buttons, switches and indicators operate indirectly, relying upon the built-in computer to interpret the settings. If there is something amiss in the internal software or in the CPU itself, a number of odd symptoms could result. The chances are that a very strange malfunction is a memory failure. Fortunately, we have built diagnostic software into the Model 97 to expedite troubleshooting and repair (see Section 8.7). You might suspect certain “typical” problems cause such as poor or intermittent grounding, excessive noise riding on the AC power line, or a loose circuit card.

8.5 UNIT CANNOT RECALL STORED PROGRAMS
When you store an effect in any of the 32 user-accessible memory registers, you are actually storing it in RAM (random access memory). RAM is normally volatile, meaning it disappears when power is shut off, but the Model 97 contains a NiCad battery to provide continuous power to the memory registers. If you’ve not used the Model 97 for a long period, or if the unit is several years old, the NiCad battery may be dead, which may explain the memory loss. If you suspect this, try leaving the Model 97 turned On for 24 hours; if the battery remains dead, it will have to be replaced. The loss of some memories but not others denotes a different problem, most likely in the circuitry. On the other hand, be sure the effect was actually stored. A possible time lapse of one or more memories which cannot be recalled may have been caused by a transient noise spike which "goes beyond" the Model 97’s extensive RFI and power supply filtering. In rare instances, cosmic radiation may have been known to "zap" IC memories.

8.6 UNIT WILL NOT STORE (OR RECALL) MEMORIES FROM TAPE
If the Model 97 will not store its memory onto tape, check the cable to the recorder and make sure the recorder is in record mode with the input level set appropriately. With a cassette unit, be sure the "playback" tab is intact, and with reel-to-reel tape, be sure the oxide side is against the holds. Still no recording? Check the signal at the TAPE STORE OUT jack; it should be a steady tone at line level until the actual "write" instruction is punched in on the front panel, at which time it should change to a multi-tone frequency shift modulated signal (or pause) for a minute and a half (slightly less if only one bank is being stored). If it is not present, or is severely attenuated, there is a problem in the Model 97.

There are several reasons why, if the memory contents appear to be written on the tape, they may not read back into the Model 97. For one thing, if you try to recall a memory with a specific numerical file (1 through 88), and the taped memory is not so numbered, then the Model 97 will ignore the read instruction. If you know the taped memory is numbered, but you don’t know the number, just instruct the Model 97 to read the tape without specifying a numerical file. If that is not the problem, look into the speed accuracy and wow/flutter specs of the tape recorder by playing the steady tone present at the TAPE STORE OUT jack when the Model 97 is operating normally. If full playback, the tone sounds shaky, then the Transport/Timebase may be the culprit. Also, check the tape for possible damage. If it is possible, switc

2.1 GENERAL
The front panel control of the Model 97 is divided conceptually into two parts, the Decoder/Controller, and the Computer controller. While these two sections are closely related to one another, they may be considered as separate, independent areas. The computer controller serves to "read" the front panel control settings, and to "command" the audio processing circuitry to follow those control settings. There are two primary operating modes, Manual and Memory. In Manual mode, the panel controls are all active, and the computer becomes "transparent," passing the control settings directly to the delay processor. Even in manual mode, however, it is thecomputer, not the delay processor, which operates the delay time displays and the control status LEDs. Manual mode is the equivalent of operation of a traditional, hard-wired processing device such as the Model 93 "Prime-Time." In fact, those who are familiar with the Model 93 will notice that many of the controls on the left side of the Model 97 front panel serve similar functions to controls on the Model 93, though some are operated in a slightly different manner.

While in Manual mode, the operator can change, at any time, to store the setup of the front panel controls into memory. In Memory mode, stored setups (including 32 user addressable registers and 8 factory preset setups) can be selected from a memory register, you actually cause the computer to command the delay processor to duplicate the original setup that was stored into memory; the front panel controls do not physically move, but the internal computer behaves as though the controls were moved. Incidentally, the factory preset effects are set up as fairly general versions of common delay usages. Once any of the stored setups has been recalled, the user can still operate the front panel controls as though the unit were in Manual mode, with a few minor differences. Pushbuttons will work normally. The rotary and slidebar controls, however, will be ignored until they pass through the "null" position, the position which existed at the time the setup was stored. Once the rotary or slidebar control passes the null position, it becomes active and is able to change the audible effect. This allows for the "sliding" of a recalled effect. Setups edited in this way can be stored back into the same memory from which they were taken or into a different memory. (The present can be edited, but then must be stored in a different memory because you cannot alter the preset memory registers themselves.)

While the Model 97 is a "delay line," it actually has two separately adjustable delay times which may be mixed, but which also may be output independently. There are called the "A" and "B" delay taps.
1.3 PRECAUTIONS
The Model 977 "Super Prime Time" is not particularly delicate or fragile, as compared to other audio equipment. However, the following common-sense precautions should be observed:
1. Never connect power sources or power amplifier outputs directly to any of the Model 977 XLR connectors or phone jacks (with the exception of 0 to 10 V DC power which may be applied to specified external control jacks). The Model 977's inputs are designed for line level signals. If a guitar high-level (i.e., power amplifier) signal is used as a signal input, then a suitable attenuation pad must be used to lower the level prior to feeding the Model 977 (about 30 to 50 dB of loss, depending upon the output voltage of the amp).
2. To prevent fire or shock hazards, never operate the Model 977 in the rain or exposed wet locations.
3. Please read the installation instructions (Section 3) of this manual before operating the Model 977.
4. Be aware that feedback (howling) can occur when either or both of the RECIRCULATION controls is moved up (A-FB and/or B-FB). To avoid possible damage to your loudspeaker system, advance recirculation gradually. A safe practice when creating a new effect that relies heavily upon recirculation is to begin with monitor amplifier levels turned down until you are reasonably certain there is no tendency to oscillate.

8.7 DIAGNOSTIC SOFTWARE
There is several diagnostic routines permanently stored in the Model 977's memory. These are primarily of value to factory or factory authorized service personnel, but they can be accessed by the user (or other to aid in identifying whether there is a problem. Should you telephone the factory for service assistance, the diagnostic routines would then be available to identify the problem and to possibly arrange for more expedient field service.

The diagnostic routines are accessed by factory trained persons in the testing of the Model 977's built-in diagnostic test area. It is not recommended that the user try to identify the problem by the procedure described above, for the diagnostic test area is not available to the user. The test area is accessed through the MODE button, and the test area is not accessible to the user without assistance from an authorized technician.

When ordering parts, refer to the appropriate parts list in the Model 977 Service Manual, or by complete description and give the following information:
1. Part # and/or description (e.g., RATE control knob, etc.)
2. Quantity desired.
3. The model and serial number of the unit.

8.8 RETURNING UNITS FOR REPAIR
If it becomes necessary to return your Model 977 for service, bear in mind that Lexicon assumes no responsibility for units in shipment from customer to factory, whether or not they are in warranty. It is important, therefore, that shipments be well packed, properly insured, and consigned to a reliable agent (i.e., UPS or Federal Express). Be sure to include (inside the carton) a note explaining the nature of the problem, referencing any conversation with Lexicon personnel you may have had. Also, detail the preferred return shipping method, and indicate a date when the unit is again needed. Do not include accessories such as power cords, manuals, and remote switches. It is also important to provide Lexicon with the name and telephone number of a person we may contact should any questions arise.

When any control is rotated to its maximum clockwise position, the digital display will show a code "000 00 00", on the left and "0 n x 0" on the right, where x is the hexadecimal number unique to the pot, and n is the value being read off the pot, also in hexadecimal. The display will hold the same pot until another is activated by turning it to maximum clockwise position. (User Man to escape.)

BYP + VCA + REGISTER 8

This tests the switch reading capability of the CPU, similar to the above pot interpretation test. The display is "000 00 00", where x is the code unique to each key. (User Man to escape.)

BYP + VCA + REGISTER 8

This is a test of the CPU's Random Access Memory (RAM) area (not the delay memory). If RAM is OK, the display will blink brightly for an instant and then return to normal. If the RAM is bad, the display is "--". Call the factory on this one.

8.9 REPLACEMENT PARTS
Replacement parts and the service manual may be obtained from:
Lexicon, Inc.
60 Turner Street
Watsonville, CA 95076

U.S.A.

Attn: Customer Service
Telephone: (408) 819-6790
TWX 923 468

Subject to order approval by Lexicon, parts will be shipped F.O.B. Watsonville. Charge will be at price in effect at the time the order is received. Lexicon may be consulted at any time, during business hours, for a parts quotation.

When ordering parts, refer to the appropriate parts list in the Model 977 Service Manual, or by complete description and give the following information:
1. Part #, if available.
2. Item description (e.g., RATE control knob, etc.)
3. Quantity desired.
4. The model and serial number of the unit.

8.10 LIMITED WARRANTY
Lexicon warrants each Model 977 to be free from defects in material and workmanship for one year, under normal usage as defined herein. This warranty begins on the date of delivery to the purchaser by an authorized agent or dealer. During the warranty period Lexicon will repair or, at its option, replace at no charge, components that prove to be defective, providing the equipment is returned, shipping prepaid, to Lexicon or designated service facility.

This warranty is null and void under any of the following conditions: A. Abuse, neglect, alteration, tampering, or repair by an unauthorized person.
B. Damage caused by improper use, or operation from an incorrect power source.
C. Damage caused by accident, act of God, war, or civil insurrection. Lexicon shall not be responsible for any loss of damage, direct or consequential, resulting from Model 977 failure or the inability of the product to perform as intended. Lexicon shall not be responsible for any damage or loss during shipment to or from the factory or its designated service facility. This warranty is in lieu of all other warranties, express or implied, and of any other liabilities on Lexicon's part.
and Lexicon does not assume or authorize anyone to make any warranty or assume any liability not strictly in accordance with the above. Lexicon reserves the right to make changes or improvements in the design and construction of the Model 97 without prior obligation to make such changes in equipment purchased units.

No equipment may be returned under this warranty without prior authorization from Lexicon. Authorized return shipments must be prepaid and should be insured. System repair/ exchange should be wrapped or packed in soft padding material and shipped in an appropriate, small protective box. In the case of returning the entire Model 97, it should be carefully packed in the original carton and packing material. If this is not available, new packing may be procured from Lexicon.

## SECTION ONE

### Introduction

1.1 GENERAL

The Lexicon Model 97 "Super Prime Time" is a major advancement in digital audio equipment. With it you can create, store and recall an unlimited variety of effects which you have programmed, in any sequence you like. The standard unit offers a maximum delay time of 480 milliseconds, and memory expansion options let you increase it to either 960 milliseconds or 1.92 seconds— all at full 20 kHz bandwidth.

Because it is exceptionally flexible, as well as programmable, one Model 97 can do the job of a dozen conventional signal processing units. Two separate inputs provide versatility mixing and allow for cross-connection of delay lines for stereo—or for complex processing. Separate input mix, output mix, and delay only outputs are provided. To ensure uniformity of performance, virtually all professional equipment, there are standard phone jacks and balanced XLR connectors, plus a 20 dB input gain boost switch for low-level sources such as electric guitars or -10 dBV to -20 dBV line level equipment. Because the Model 97 is perfect for you if you’re a performing musician who needs to work out a variety of special effects prior to the show and recording, and then have the effects instantly available. That’s because, at the touch of a button, you can store all the Model 97’s front panel settings in internal memories, and later recall the settings as needed, in any sequence you like. The store/recall capability is equally useful to a busy recording engineer, since it allows changing the delay effects with split second timing and unparalleled precision. There are a total of 40 storage registers, 32 of which are user programmable and 8 of which are factory preset. The preset, built-in effects, are typical versions of flanging, resonant flanging, doubling, tripling, chorusing, delay echo, short echo and long echo. You can use them "raw" or, by modifying them, you can very quickly create and store your own customized effects.

With 32 memories "on line" several users can store their own effects. Built-in triggers in like channels for remote CD drives keep the effects, in memory after the power is shut off. However, in these instances where greater storage is required, all 32 user-programmable registers (or individual banks of 8 registers) are easily transferred onto magnetic tape, either cassette or reel-to-reel. This makes it possible for you to build an effects library of unlimited size. Effects stored on tape can later be loaded back into your Model 97, or any Model 97, so you can carry the sound effects without carrying the machine. The Model 97 is an invaluable tool in video and motion picture production, where the speed and accuracy of switching effects makes it possible to display the effects with the pictures. To make the job even easier, the Model 97 can be made to automatically cycle through up to 32 stored effects in sync with the picture by means of cue tones applied to a spare track of the master audio tape.

We have included a number of popular, innovative features from other Lexicon delay processors, such as the ability to combine sine or square wave LFO modulation of the delay time with envelope follower modulation that tracks the input signal’s amplitude—a technique which provides more realistic, less mechanical doubling and flanging effects. We have also included an infinite repeat function, selectable via the front panel or a foot switch, so performers can "capture" a phrase in the delay memory, cause it to repeat indefinitely without signal degradation, and then play along the repeating phrase. Bypass of all processing is also selectable on the front panel or via a foot switch.

Additional foot control jacks enable a performer to swipe the Model 97’s delay time over a 3:1 range, and to continuously vary the LFO modulation rate. In fact, because the rate and swing functions are based on 0 to 10 volt scaling, synthesizers, sequencers or automation systems can be directly interfaced to the Model 97 to control the effects, adding another dimension to the concept of delay processing.

Engineers can take advantage of the remote foot switch and foot control jacks by building suitable hand controls into the mixing console. This avoids the need to reach over to the outboard equipment bay when you wish to bypass the Model 97, and it for infinite repeat, step through the memory registers, swap the delay time, or adjust the LFO rate.

The Model 97 is further equipped with features found in no other digital delay processor. Features like dynamic recirculation, which makes it possible to achieve long delay times (by using significant amounts of feedback) without "cluttering" the sound, instead of having new sounds continuously overlap with the sounds that are being recirculated, selecting the dynamic recirculation feature automatically reduces the amount of feedback so long as new sounds are present at the Model 97 input. When the input signal ceases, the feedback is returned to the set amount to the decay time again increases. Now, without touching a control, the musician can play complex passages which retain their definition, yet enjoy a lingering effect after the last note.
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**Unpacking & Inspection**

Remove the Model 97 from its packing material, and SAVE ALL PACKING MATERIALS in the event it becomes necessary to reship the unit. Thoroughly inspect both the Model 97 and the packing material for indications of shipping damage, and report any damage found to the carrier.

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**BLANK PATCH DIAGRAMS for user convenience.**

[Diagram of Patch Diagrams]
SUPER PRIME TIME
programmable digital delay processor

Owner's Manual