

BEFORE PROCEEDING WITH COMPLETE UNPACKING AND SETUP,
CONSULT UNPACKING AND INSPECTION INSTRUCTIONS ON PAGE 4

model 927
DIGITAL DELAY LINE



United Recording Electronics Industries

8460 SAN FERNANDO ROAD, SUN VALLEY, CALIFORNIA 91352

(213) 767-1000

Printed in U.S.A.

© Copyright 1978, UREI

TABLE OF CONTENTS

	PAGE
<u>SECTION I. INTRODUCTION</u>	
1.1 DESCRIPTION	1
1.2 ELECTRICAL SPECIFICATIONS	2
1.3 CONTROLS	3
1.4 PHYSICAL	3
1.5 CONNECTIONS	3
<u>SECTION II. INSPECTION AND INSTALLATION</u>	
2.1 UNPACKING AND INSPECTION	4
2.2 ENVIRONMENTAL CONSIDERATIONS	4
2.3 POWERING	4
2.4 LINE VOLTAGE SWITCH	5
2.5 EXTERNAL CONNECTIONS	5
2.6 IMPEDANCE AND TERMINATION	7
2.7 SIGNAL LEVEL AND OVERLOAD INDICATORS	8
<u>SECTION III. OPERATING INSTRUCTIONS</u>	
3.1 GENERAL	9
3.2 INPUT LEVEL	9
3.3 OUTPUT LEVEL	9
3.4 DELAY IN/OUT SWITCHES	9
3.5 DELAY TIME (THUMBWHEEL SWITCHES)	9
3.6 APPLICATIONS	10
3.6.1 DISTRIBUTED SPEAKER SYSTEMS	10
3.6.2 CALCULATING DELAY TIME	11
3.6.3 AUTOMATIC DOUBLE TRACKING	11
3.6.4 IMAGE BROADENING AND STEREO ENHANCEMENT	13
3.6.5 DELAYED ECHO SEND	15
3.6.6 SPECIAL FEEDBACK EFFECTS	16
<u>SECTION IV. THEORY OF OPERATION</u>	
4.1 INPUT CIRCUITS	17
4.2 INSTANTANEOUS FLOATING POINT A/D CONVERSION	17
4.3 MEMORY CIRCUITS	17
4.4 D/A (DIGITAL-TO-ANALOG) CONVERTER	18
4.5 ANALOG DE-MULTIPLEXER	18
4.6 OUTPUT RECONSTRUCTION FILTERS	18
<u>SECTION V. MAINTENANCE</u>	
5.1 GENERAL	19
5.2 REPAIRS AND WARRANTY	19
5.3 SERVICE ADJUSTMENTS	19
5.4 CLEANING	19

SECTION I
INTRODUCTON

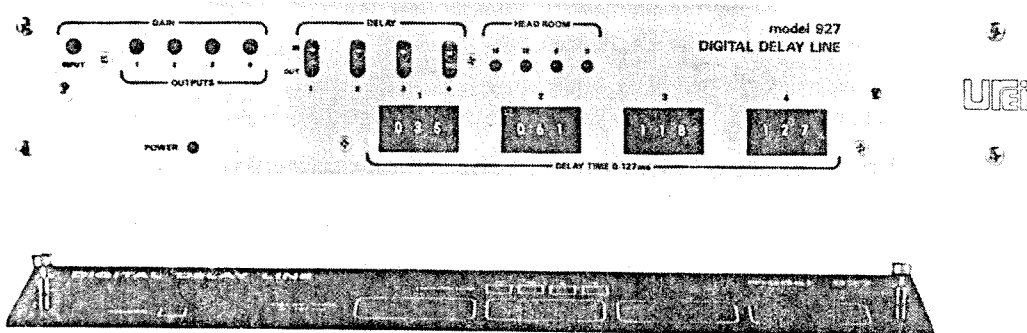


FIGURE 1. MODEL 927 FRONT PANEL.

1.1 DESCRIPTION

The UREI Model 927 Digital Delay Line is ideal for use in sophisticated sound reinforcement or playback systems where one or more delayed outputs are necessary. It permits proper acoustical synchronization of the direct sound and the sound from multiple source loudspeakers in large areas by eliminating or minimizing differences in arrival time at individual listener locations. This greatly improves intelligibility and naturalness of the system. Also it avoids annoying echoes and the shift of apparent sound localization away from the original sound source. In the recording studio, the 927 is the optimum choice for near-field generation, reverb delay and amplitude enhancement.

The Model 927 brings complete relief from the troublesome gain pumping, transient overload and band-edge "whistles" which plague many contemporary digital delay designs. This is achieved by unique proprietary circuitry, including our precision "instantaneous floating point" analog-to-digital and digital-to-analog converters. This, plus full 4k by 14 bit static memory provides over 90 dB dynamic range without resorting to analog signal processing. There is no high frequency pre-emphasis to rob the 927 of high-end headroom; there is no "companding" to cause "gain pumping" or dynamic wandering. We have also taken care of those annoying whistles and beats which usually accompany program frequencies near the band edge of competitive delay lines, with our super-effective 150 dB/octave Cauer filters at the input and each output. The result is clean, distortion-free, full-power bandwidth reproduction of the input signal at each of the four outputs, changed only with respect to time.

Setup and operation of the Digital Delay Line is simplicity itself. Each output is quickly set to any desired delay from zero to 127 milliseconds (in 1 millisecond steps) by direct-reading thumbwheel switches. Each output has its own level control. Four real-time amplitude-monitoring LED's indicate input level in 6 dB steps up to clipping to determine proper setting of the input gain control.

The security cover may be installed to protect all operating controls against inadvertent disturbance or tampering at fixed installations.

Due to the front panel's uncluttered and logical arrangement, operation is virtually self-explanatory. However, a thorough understanding of the Model 927 and its application can only benefit the user, so we recommend carefully reading this manual.

1.2 ELECTRICAL SPECIFICATIONS

Throughout this manual, where the expression "dB" is used to denote a signal level, it is referenced to 0 dB = 0.775 volts rms.

- INPUT: Balanced bridging differential amplifier.
- INPUT IMPEDANCE: 40 kohms, used as balanced input,
20 kohms, used as unbalanced (single-ended)
input.
- MAXIMUM INPUT LEVEL: +20 dB (Ref. 0.775 volt rms).
- DYNAMIC RANGE: Greater than 90 dB.
- SIGNAL-TO-NOISE: Better than 92 dB at full output,
15.7 kHz bandwidth.
- GAIN: Adjustable up to +12 dB.
- FREQUENCY RESPONSE: ± 0.5 dB, 30 Hz - 12 kHz.
- OUTPUTS: Floating, transformer isolated.
- OUTPUT LOAD: 600 ohms or greater.
- POWER OUTPUT: +18 dBm into 600 ohm load.
- DISTORTION: Less than 0.25% THD, 30 Hz to 12 kHz at
maximum rated output; (typically 0.07%).

NUMBER OF INPUTS: One.
NUMBER OF OUTPUTS: Four.
TIME DELAY: 0 to 127 milliseconds in 1 millisecond steps, each output independently selectable
DELAY ACCURACY: ± 0.03 millisecond.
PRE-EMPHASIS/
DE-EMPHASIS: None.
FILTERS: 8 pole, 6 zero Cauer at input and each output.
HEADROOM INDICATORS: 4 LED indicators showing 0, -6, -12, -18 dB relative to overload condition.

1.3 CONTROLS

Four groups of thumbwheel switches for independent delay selection in 1 ms increments; input level control; 4 output level controls; 4 delay in-out switches.
POWER REQUIREMENTS: 100 - 125 VAC, or 200 - 250 VAC, 50/60 Hz switch selectable, less than 50 watt.

1.4 PHYSICAL

ENVIRONMENT: Operating 0°C to +50°C; storage -20°C to +60°C.
DIMENSIONS: 483 x 89 mm rack panel, depth behind panel 371.5 mm (19" x 3-1/2" x 14-5/8").
FINISH: Panel is 4.76 mm (3/16") brushed anodized aluminum, 2 shades. Chassis is cadmium plated steel. Security cover is translucent plexiglass.
WEIGHT: 9.53 kg (21 pounds).
SHIPPING WEIGHT: 12.25 kg (27 pounds).

1.5 CONNECTIONS

All connections for input and output are made through barrier strips at the rear of the chassis (see Installation Instructions, Section 2.5, Figures 2 and 3).

SECTION II

INSPECTION AND INSTALLATION

2.1 UNPACKING AND INSPECTION

Your Model 927 was carefully packed at the factory, and the container was designed to protect the unit from rough handling. Nevertheless, we recommend careful examination of the shipping carton and its contents for any sign of physical damage which could have occurred in transit.

If damage is evident, do not destroy any of the packing material or the carton, and immediately notify the carrier of a possible claim for damage. Shipping claims must be made by the consignee.

The shipment should include:

Model 927 Digital Delay Line

UREI Instruction Manual (this book)

Two-part Warranty Card bearing the same serial number as the Model 927.

2.2 ENVIRONMENTAL CONSIDERATIONS

The system will operate satisfactorily over a range of ambient temperatures from 0°C to +50°C (+32°F to 122°F), and up to 80% relative humidity.

If the system is installed in an equipment rack with high heat producing equipment (such as power amplifiers), adequate ventilation should be provided in order to assure longest component life. Also, while circuitry susceptible to hum pick-up is sufficiently shielded from moderate electromagnetic fields, installation should be planned to avoid mounting the system immediately adjacent to large power transformers, motors, etc.

2.3 POWERING

The 927 may be operated from either 100-125 VAC or 200-250 VAC mains (50 or 60 Hz, single phase.) As indicated in section 2.4, the nominal line voltage may be selected with a rear panel switch. BE SURE TO VERIFY BOTH THE ACTUAL LINE VOLTAGE, AND THE SETTING OF THE VOLTAGE SELECTOR SWITCH BEFORE CONNECTING THE 927 TO THE MAINS.

To comply with most Electrical Codes, the 927 is supplied with a three-wire AC cord, the grounding pin of which is connected to the chassis. In some installations this may create ground-loop

problems. If ground problems are experienced, check for the possibility of ground loops by using a 3-prong to 2-prong AC adapter. This ungrounds the Model 927, and will sometimes cure the problem, but is not a substitute for proper grounding. Be aware that unless the Model 927 mainframe is properly grounded, a safety hazard can exist. UREI accepts no responsibility for legal actions or for direct, incidental or consequential damages that may result from violation of any electrical codes.

2.4 LINE VOLTAGE SWITCH

Unless a tag on the line cord specifies otherwise, the Model 927 was shipped ready for operation with nominal 115 VAC power mains. In order to change this for nominal 230 V (50 or 60 Hz), slide the VOLTAGE SELECTOR switch on the rear panel to the 230 position. The voltage is visible in a window next to the switch slot. Be sure to change the fuse to the correct value: 1/4-amp slo-blo when changing to 230 V operation or 1/2-amp slo-blo for 115 V operation. A small screwdriver may be used to move the recessed switch.

2.5 EXTERNAL CONNECTIONS

Permanent input and output signal wires should be shielded cable, and connected in accordance with standard wiring practice, as indicated on the rear panel barrier strip.

If the Model 927 output is connected to a high impedance circuit, we recommend shunting the "+" and "COM" output terminals with a 620 ohm, 1/2 watt resistor. This assures optimum loading of the output stage. (See section 2.6 regarding input termination).

(See Figures 2 & 3, next page)

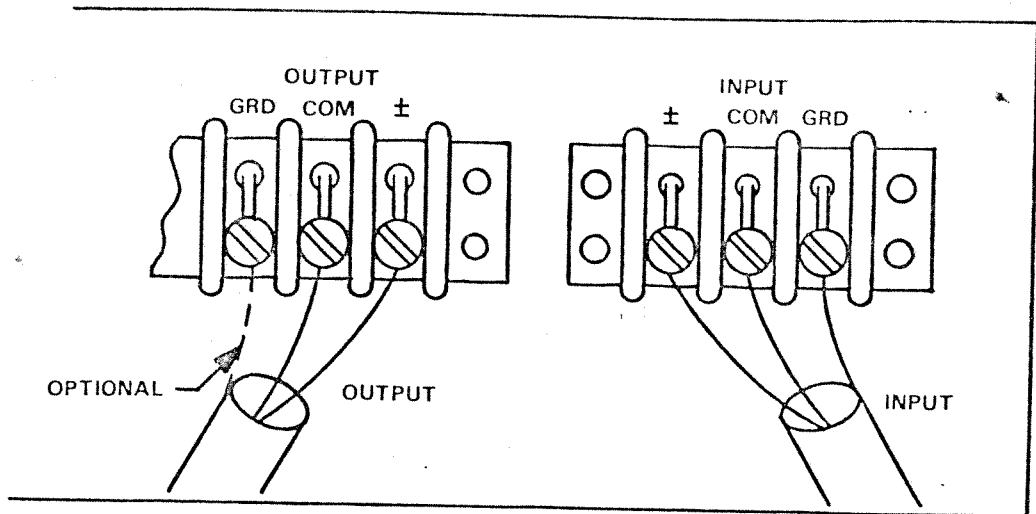


FIGURE 2. CONNECTING THE MODEL 927 WITH BALANCED INPUT AND BALANCED OUTPUT CIRCUITS.*

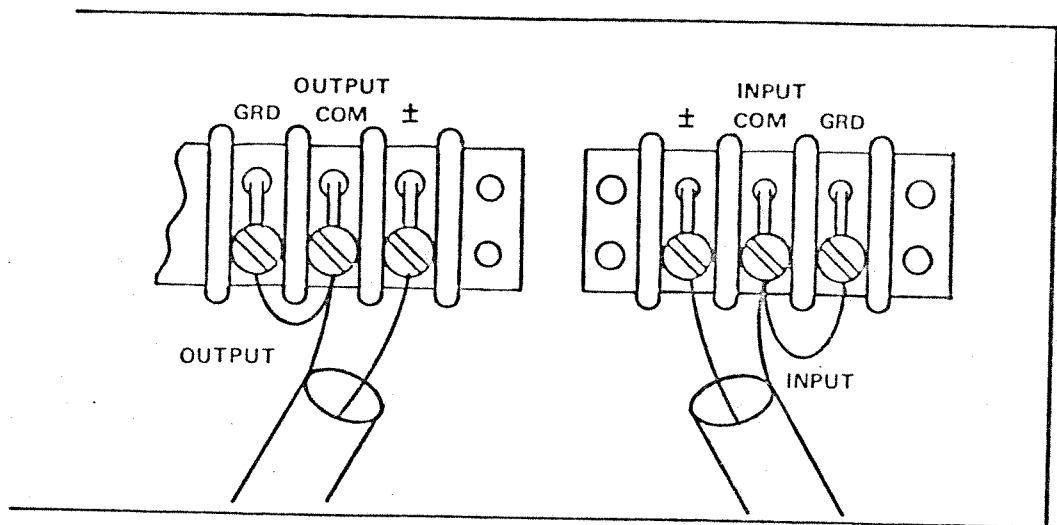


FIGURE 3. CONNECTING THE MODEL 927 WITH UNBALANCED INPUT AND UNBALANCED OUTPUT CIRCUITS.*

*With a balanced input and unbalanced output, or vice-versa, use the appropriate connections suggested by each of the above diagrams. No special switching or transformers are needed.

2.6 IMPEDANCE AND TERMINATION

Audio engineering had its roots in the telephone industry, and "600 ohm circuits" (together with their predecessors, "500 ohm circuits") are carry-overs from telephone transmission practices. Long audio transmission lines, like their video counterparts, must be properly sourced from and terminated in equipment which matches their characteristic impedance, if optimum frequency response and noise rejection are to be achieved.

However, transmission line theory and techniques are not only unnecessary but impractical within modern recording studios, broadcast studios and other local audio systems where transmission circuits are seldom more than several hundred feet in length. The advent of negative feedback circuitry and solid-state electronics has spawned modern audio amplifiers and other signal processing devices having source impedances of only a few ohms. They are essentially indifferent to load impedances and by varying their output current inversely to changes in load impedance, maintain the same output voltage into any load impedance above a rated minimum, with no change in frequency response. Most new designs (all at UREI) have high input impedance to allow use with various source impedances.

Most modern audio systems, therefore, utilize amplifiers and other active devices which have very low output impedances and high (10K to 50K) input impedances. These products may thus be cascaded (operated in tandem), or many inputs may be connected to a single output of a preceding device, without regard to impedance "matching". Switching, patching, etc. is simplified because "double loads" and "unterminated" bugaboos are essentially eliminated. "Floating" (ungrounded) transformer outputs minimize ground loop problems, and differential transformerless input circuitry (or input transformers) minimize common mode noise or interference which may be induced into the interconnecting wires or cables, or produced by different ground potentials.

Where audio must be transmitted through cables or wire pairs of more than several hundred feet in length, however, transmission line termination practices should still be observed.

The Model 927 has an input impedances of 40,000 ohms when used in a balanced, differential input configuration, and 20,000 ohms when used unbalanced (one side grounded). This makes the equalizer suitable for use with any normal source impedance, low or high. Only when it is used from a source which requires a low impedance termination (such as a 600-ohm transmission line or older vacuum-tube equipment) is a source termination resistor required at the 927 input.

2.7 SIGNAL LEVEL AND OVERLOAD INDICATORS

The Model 927's differential input amplifiers are capable of being driven by signals up to a level of +20 dB, above which clipping and distortion occurs.

Overload and headroom conditions are monitored at the output of the input amplifier and at the input gain control. The signal levels are displayed through 4 LED's. The LED's will turn ON when peak signals exceed the level as indicated on the front panel. They will remain ON long enough to be seen, even if the excess signal is only a brief transient.

The green LED's indicate "18 dB," "12 dB," and "6 dB" of remaining headroom before the signal reaches clipping level. The red "0 dB" LED flashes when actual overload conditions occur. To avoid audible distortion, when the "0 dB" LED turns ON more than occasionally, either lower the output level of the source feeding the digital delay line, or use an external attenuation pad.

The output amplifier is capable of delivering +18 dBm into a 600-ohm load.

SECTION III
OPERATING INSTRUCTIONS

3.1 GENERAL

After the Digital Delay Line has been installed and is connected to both the signal source and the succeeding equipment according to Section II, power may be switched ON at the rear of the chassis. Set all controls to a minimum and switch the delay channels to OUT.

3.2 INPUT LEVEL

Adjust the input gain control so that the red "0 dB" LED headroom indicator does not come ON at any time while the program material to be delayed is applied to the Model 927 (when the red LED flashes, clipping occurs in the D/A converter). However, for best signal-to-noise ratio, the input gain control should be as high as possible. The green LED's give a very good indication of the remaining headroom.

3.3 OUTPUT LEVEL

The 4 output controls can be adjusted independently to match the level to the following devices. This should be done after the best input signal level has been established according to the previous paragraph.

3.4 DELAY IN/OUT SWITCHES

Each of the delay switches controls its respective channel. The location in the circuit is such that neither the output level nor the bandwidth changes when the delay is switched IN or OUT, allowing instant A-B comparison.

3.5 DELAY TIME (THUMBWHEEL SWITCHES)

Each of the 4 output channels can be set independently for any delay time from 0 to 127 milliseconds in 1 millisecond steps.

IMPORTANT NOTE: The thumbwheel switches allow settings which read more than 127 ms. However, since such setting would exceed the maximum delay available, the internal logic returns this channel automatically to 0 ms delay time.

3.6 APPLICATIONS

- In this section two major application topics are discussed:
- A) The use of the Delay Line in sound reinforcement installations to optimize the arrival time of audio signals at different locations.
 - B) The use of the Delay Line in recording studios where creative processing of audio signals is performed.

3.6.1 DISTRIBUTED SPEAKER SYSTEMS FOR SOUND REINFORCEMENT

The ideal use of the 927 is in sound reinforcement systems that require remote speaker placement at a distance from the main speaker system on a stage. It is desirable to delay the program to the power amplifiers driving the remote speakers so that the wavefront from the remote speakers reaches the nearby audience at about the same time as the sound from the stage speakers.

Taking advantage of the Hass effect one would delay the signal to the remote speakers so that it actually arrives at the audience 5 to 20 ms later than the sound from the stage speakers. This ensures perceived localization of the sound from the stage. Thus, the sound does not appear to emanate from the remote speakers. However, the remote speakers reinforce the level of the sound which reaches the audience.

Without delay in this case, an echo could result and the wavefront would appear to originate from the remote speakers, not from the stage.

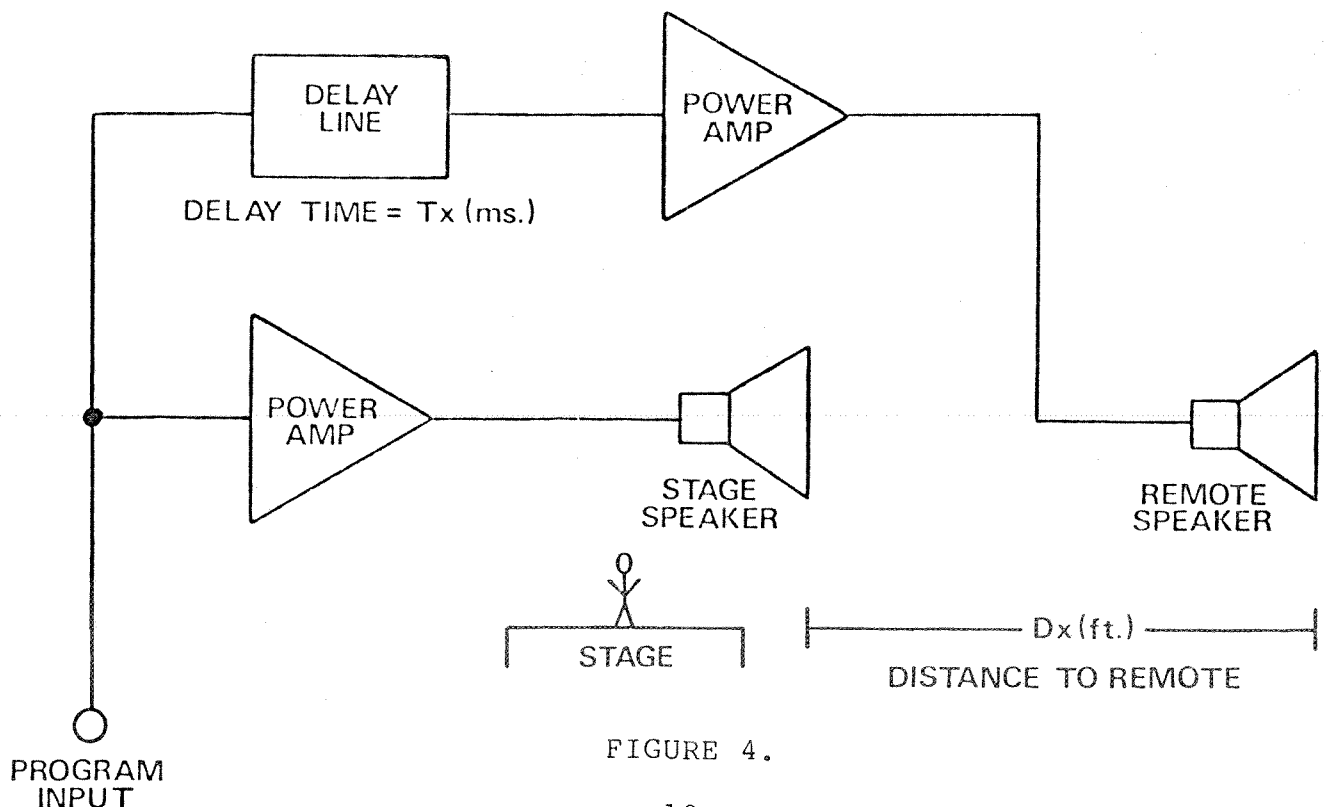


FIGURE 4.

3.6.2 CALCULATING DELAY TIME

Figure 4 illustrates a typical application of the Delay Line in a sound system. To achieve coincident wavefronts of the sound from the stage speaker and a remote speaker, it is necessary to remember that sound travels a distance of 1 foot in 0.885 ms at room temperature. This is equivalent to a velocity of 1130 feet per second. To find the delay time for a given distance, use the following formula:

$$T_x \text{ (ms)} = 0.885 D_x \text{ (ft)}$$

where T_x = delay time in milliseconds, and

D_x = differential distance between stage and remote speakers.

Then, to achieve apparent localization at the stage add 5 to 20 ms to the calculated delay time. This equation results in a close approximation of the ideal delay time, although differing remote speaker-to-audience distances may necessitate minor changes in the delay time. It is recommended that the system be set up as per calculations, then checked empirically at several audience seating positions and readjusted as required for optimum results.

The Model 927 features delay times up to 127 ms or, in terms of distance, delay compensation for remote speakers to a distance of nearly 150 feet. For 5 ms of Hass precedence effect, this maximum distance reduces to 140 feet, while for 20 ms of Hass effect, the maximum becomes 120 feet.

The multiple outputs are useful for reinforcement where irregular geometries exist, such as balconies or different seating levels. Overhead distributed reinforcement systems also can benefit by feeding different zones from Model 927 outputs adjusted for the appropriate delay times.

3.6.3 AUTOMATIC DOUBLE TRACKING

This is an attempt to simulate what happens when an artist duplicates his performance on a second track of a recorder. The slight but random differences in pitch and time which occur during the second performance will produce a sound with more richness and body when the original and "muled" tracks are mixed together. However, a delay line will produce a similar effect when hooked up as shown in Figure 5. A delay of 10 to 30 ms is generally used.

Less or greater delays will create unusual effects: for example a comb filter with broad notches as shown in Figure 6.

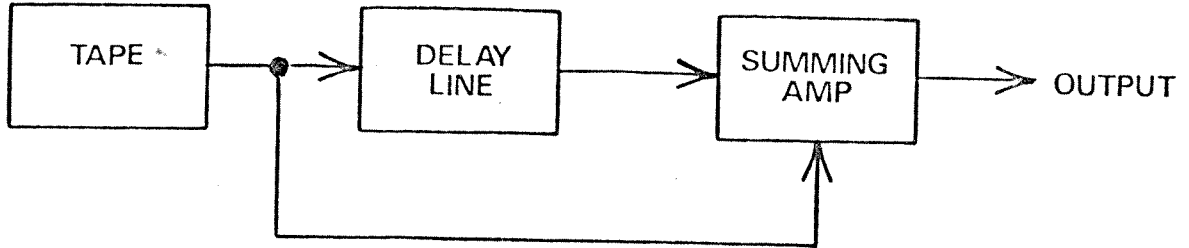


FIGURE 5.

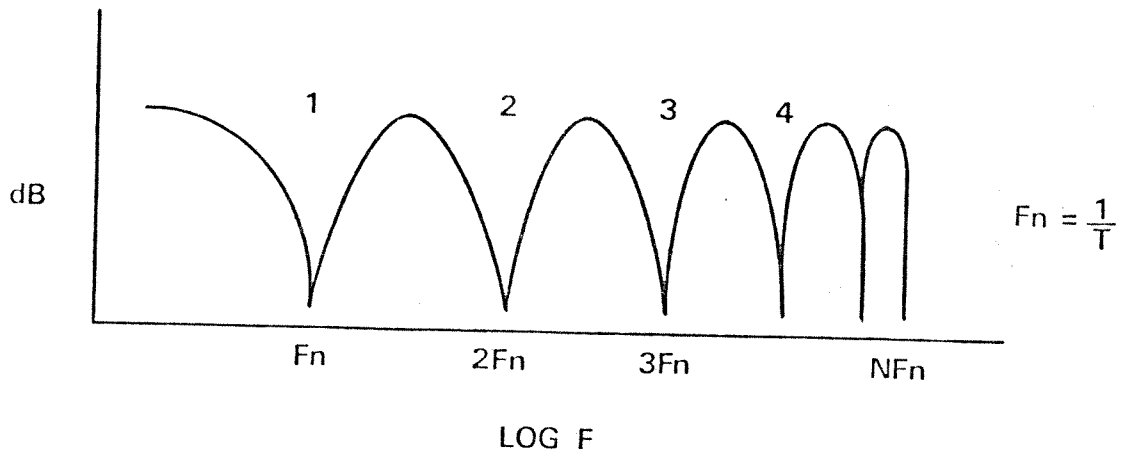


FIGURE 6.

A frequency response characteristic, as in Figure 6, obviously affects the sound. As longer delays are selected, these notches slide closer together and are thus less audible, but beyond 30 ms you begin to hear two sounds (an echo). With some experimentation, it is possible to create many sounds made familiar with popular records. A long delay will produce a "slap echo" effect, and feeding multiple taps at various delays from the 927 into the mixer will produce multiple "slaps".

3.6.4 IMAGE BROADENING AND STEREO ENHANCEMENT

Many times in the course of a mixdown, as well as on other occasions, it is necessary to take a mono source and simulate stereo. The usual method is to use a pan pot to place a mono image somewhere between two loudspeakers, but this is still mono.

One method of "spreading" the mono image is shown in Figure 7.

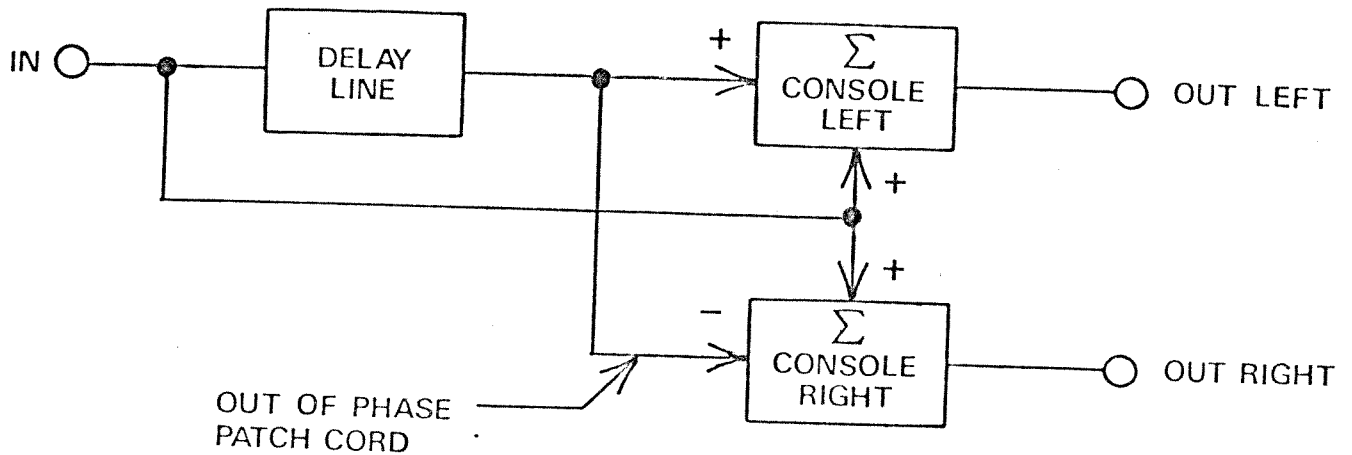


FIGURE 7.

Delays of 10 to 30 ms are useful. From the response of the two channels (Figure 8) one can see that the mono sum of this method will be almost the same as the input.

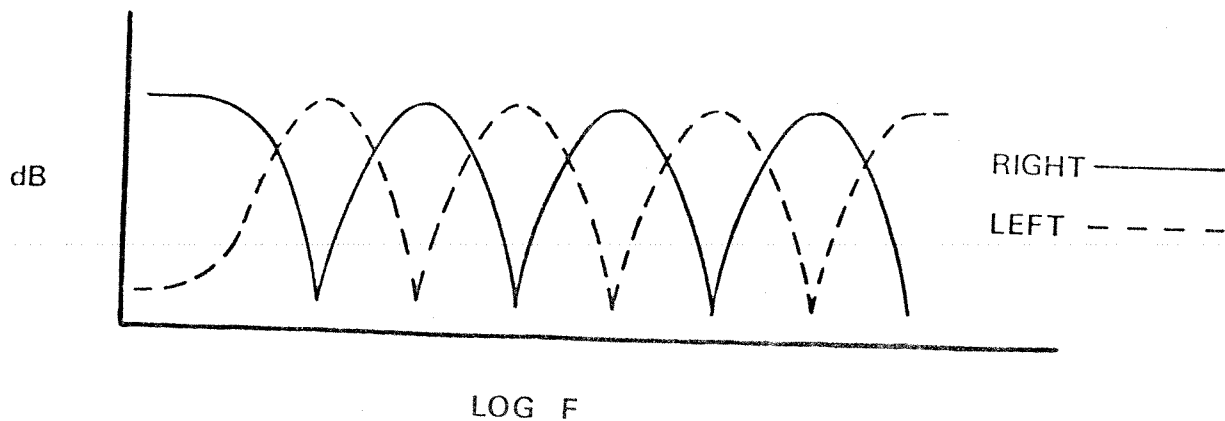


FIGURE 8.

Another technique of image broadening is shown in Figure 9. Unfortunately, it will not produce a good mono sum. As soon as a signal, delayed by 5 to 30 ms, is introduced into the left channel, all the sound seems to come from the right (this phenomenon is known as the Hass effect). The left channel will have to be increased in level in order to bring the image back to the center. If instead of raising the overall level only the mid or high frequencies are increased (with the help of an equalizer), the treble-heavy instruments will seem to come from the left. If in addition a little bass boost is added to the right, bass-heavy instruments will predominate in the right channel. Of course the same technique can be applied to increase the usefulness of a monaural echo chamber.

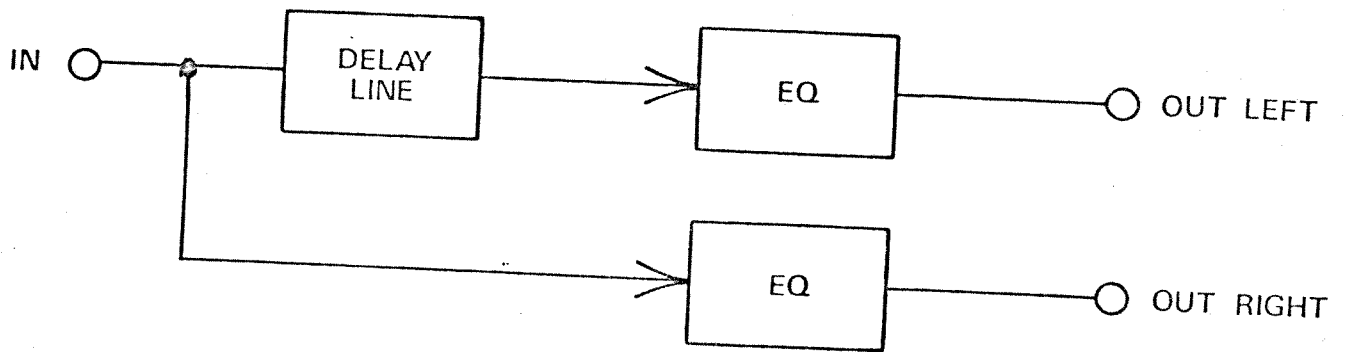


FIGURE 9.

Even in stereo recordings, the Delay Line may be used for additional enhancement. A typical setup is shown in Figure 10.

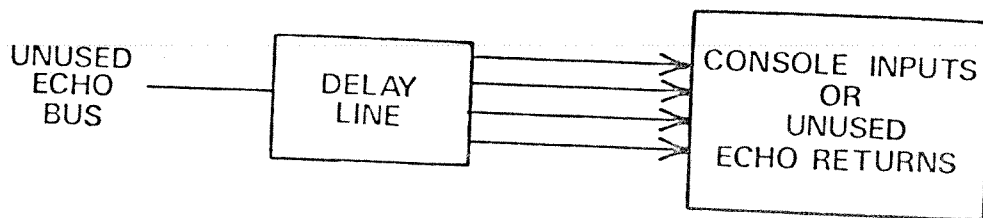


FIGURE 10.

An unused echo bus is connected to the delay unit and its 4 different outputs feed delayed inputs back into the console. These are then assigned or panned to the stereo channels. Delays up to 50 ms are useful with the return levels set for a degree of enhancement, as desired. This is especially useful on string instruments to add "room feel" or "liveness" to the usually rather dead studio sound, without the need of a long reverb decay.

3.6.5 DELAYED ECHO SEND

Echo chambers are by nature small, live rooms. The density of the reverberation produced by them is very high at the onset. Echo chambers are supposed to simulate large rooms in which a slow build-up of reflections occurs during the first 100 ms or so. The rapid echo density build-up in the echo chamber tends to cover or "mask" the direct sound to which it is being added. Delays of 30 to 100 ms are used most often. An even better simulation of an actual large room can be accomplished by using all 4 outputs of the Model 927, as shown in Figure 11. The signal with the longest delay is fed through the echo chamber before being added to the final mixdown. The 4 output taps can be "panned" anywhere in the stereo field. Care must be taken that any delay longer than 30 ms is mixed at a lower level to avoid "slap echo".

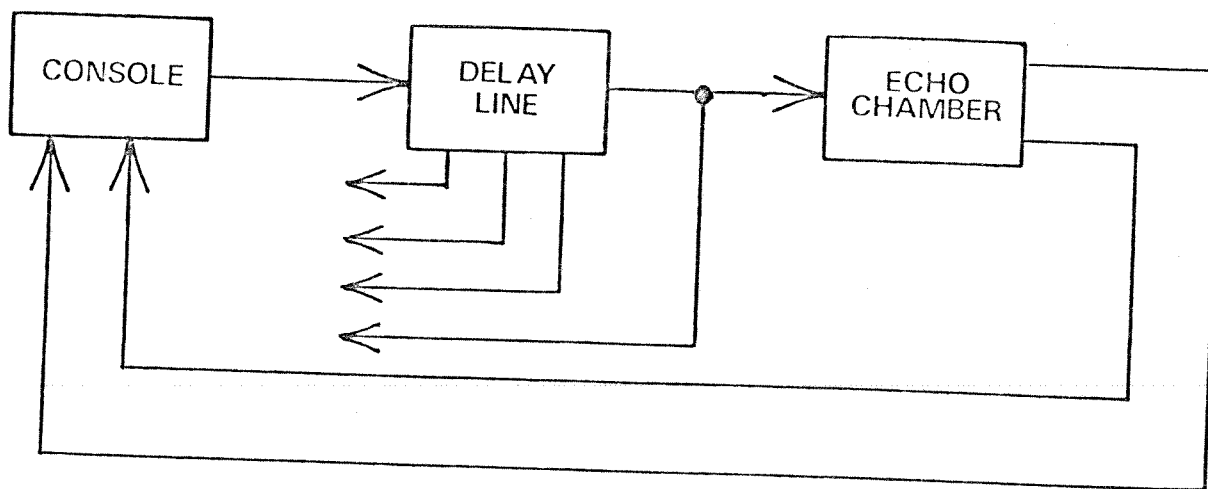


FIGURE 11.

3.6.6 SPECIAL FEEDBACK EFFECTS

To experiment with feedback effects, try the setup shown in Figure 12.

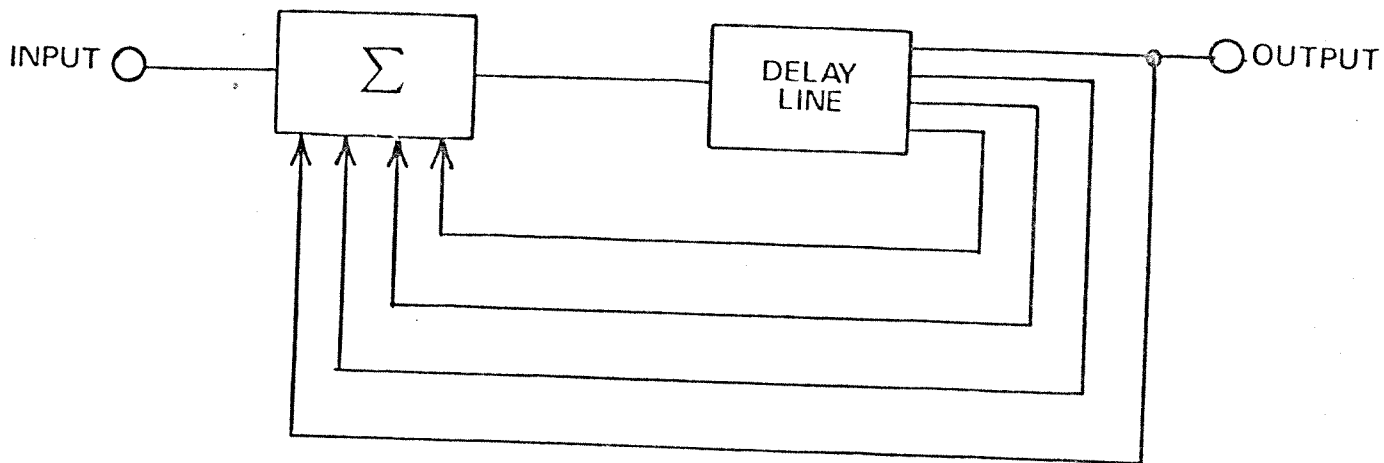


FIGURE 12.

This method also produces a comb filter characteristic. If the delay return into the mixer is raised too high, the system will oscillate. Just below this point, sounds can be made to repeat many times. With long delay times, a rhythm is "captured" and the performer can play new rhythms against it for many new and interesting effects. These effects multiply if more taps are connected back into the mixer.

SECTION IV

THEORY OF OPERATION

4.1 INPUT CIRCUITS

The signal is applied to a differential input amplifier. This input stage accepts either balanced or unbalanced sources. (See also Installation Instructions, Section 2.6.) The input stage drives a very sharp low pass filter which cuts off at 12 kHz. At 16 kHz the signal is attenuated more than 60 dB. This filter is necessary to condition the signal before the sampling process in order to avoid beats with the system's clock.

4.2 INSTANTANEOUS FLOATING POINT A/D CONVERSION

The most critical part of any digital delay system is the digitizing or data conversion element. The Model 927 contains a precisely and intricately timed group of circuits which allow an improvement in signal-to-noise ratio of more than 20 dB over conventional converters. As a result no pre-emphasis/de-emphasis or compression/expansion techniques are necessary, and the objectionable side-effects which often accompany their use are eliminated.

From the input circuits, the signal is fed to a sample-and-hold circuit and then drives an amplifier whose gain is instantaneously variable in 8 dB increments. Extended dynamic range is achieved by switching the gain at particular threshold points on the sampled program waveform.

A full-wave rectifier whose source is also the sample-and-hold output drives a group of 3 comparators with threshold levels 8 dB apart. Hence the instantaneous sampled signal is categorized sample-by-sample into four 8 dB amplitude bands.

In the following combinational logic, the comparator outputs develop a digital code which is used to switch the variable gain amplifier. The output of this amplifier drives a standard 12-bit, high-speed, successive approximation A/D converter. The digital code from the converter in addition to the floating point digital code completely defines the signal at any instant in time. The 14 bits of digitized data are strobed into a holding register to await its entry into memory.

4.3 MEMORY CIRCUITS

The memory unit contains 4096 data locations. Each is 14 bits wide (12 data, 2 floating points). Each 32 microseconds, a new location in the memory is addressed. Delayed data is retrieved

from various locations in the memory according to the delay settings on the front panel. There are 7 individual delayed locations read from memory between each writing time. Four of these are brought out and processed as delayed outputs for the user.

4.4 D/A (DIGITAL-TO-ANALOG) CONVERTER

The digital data which is retrieved from memory drives a storage register which in turn feeds the D/A converter. Its output yields a group of time-multiplexed, floating point analog waveforms. There are 7 of these waveforms corresponding to the 7 periods read from memory. The D/A output is processed by a variable gain amplifier whose source of control is the 2 floating point bits accompanying each data word. The resulting signal is a group of 7 multiplexed waveforms of various delays restored with extremely high accuracy.

4.5 ANALOG DE-MULTIPLEXER

The signal at the output of the variable gain amplifier drives a group of 4 analog-sampled de-multiplexers. These are controlled by 4 timing signals which are generated on the timing and control board. They each occur coincident with the corresponding delayed data word for the given channel.

4.6 OUTPUT RECONSTRUCTION FILTERS

The 4 de-multiplexer outputs drive individual reconstruction filters. These filters are similar to the input anti-aliasing filters; that is, they are flat to 12 kHz and then roll off quite rapidly. The purpose of these filters is to eliminate higher order frequencies (above 16 kHz) generated by the sampling process.

SECTION V

MAINTENANCE

5.1 GENERAL

The Model 927 is an all solid-state unit, ruggedly constructed of only the highest quality components, and as such, it should provide years of trouble free use with normal care. All parts used are conservatively rated for their application, and workmanship meets the rigid standards you have learned to expect in UREI products.

NO SPECIAL PREVENTIVE MAINTENANCE IS REQUIRED.

5.2 REPAIRS AND WARRANTY

The Model 927 is factory warranted to the original purchaser against defects in material and workmanship for one year after initial purchase. This limited warranty must be activated at the time of purchase by returning the registry portion of the Warranty Card to the factory. Should a malfunction occur, the dealer from whom the unit was purchased will be glad to handle return for factory repair; alternately, for even faster service, ship the unit prepaid directly to the factory. Be sure it is well packed in a sturdy carton, with shock-absorbing material such as foam rubber, styrofoam pellets or "bubble-pack" completely filling the remaining space. Include a note describing the malfunction, and instructions for return. We will pay one-way return shipping costs on any in-warranty repair.

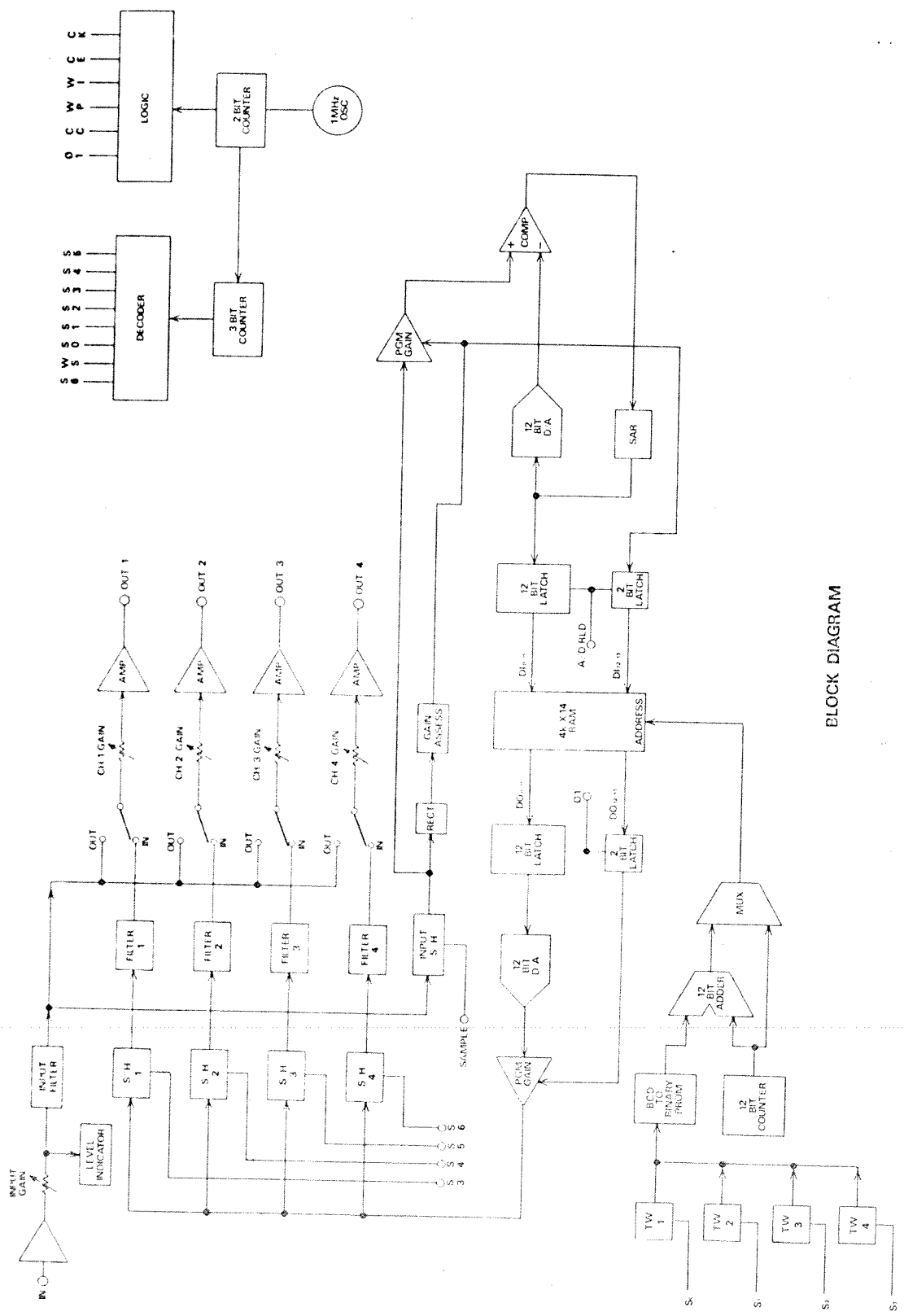
Field repairs are not normally authorized during the warranty period, and attempts to perform repairs may invalidate the warranty.

5.3 SERVICE ADJUSTMENTS

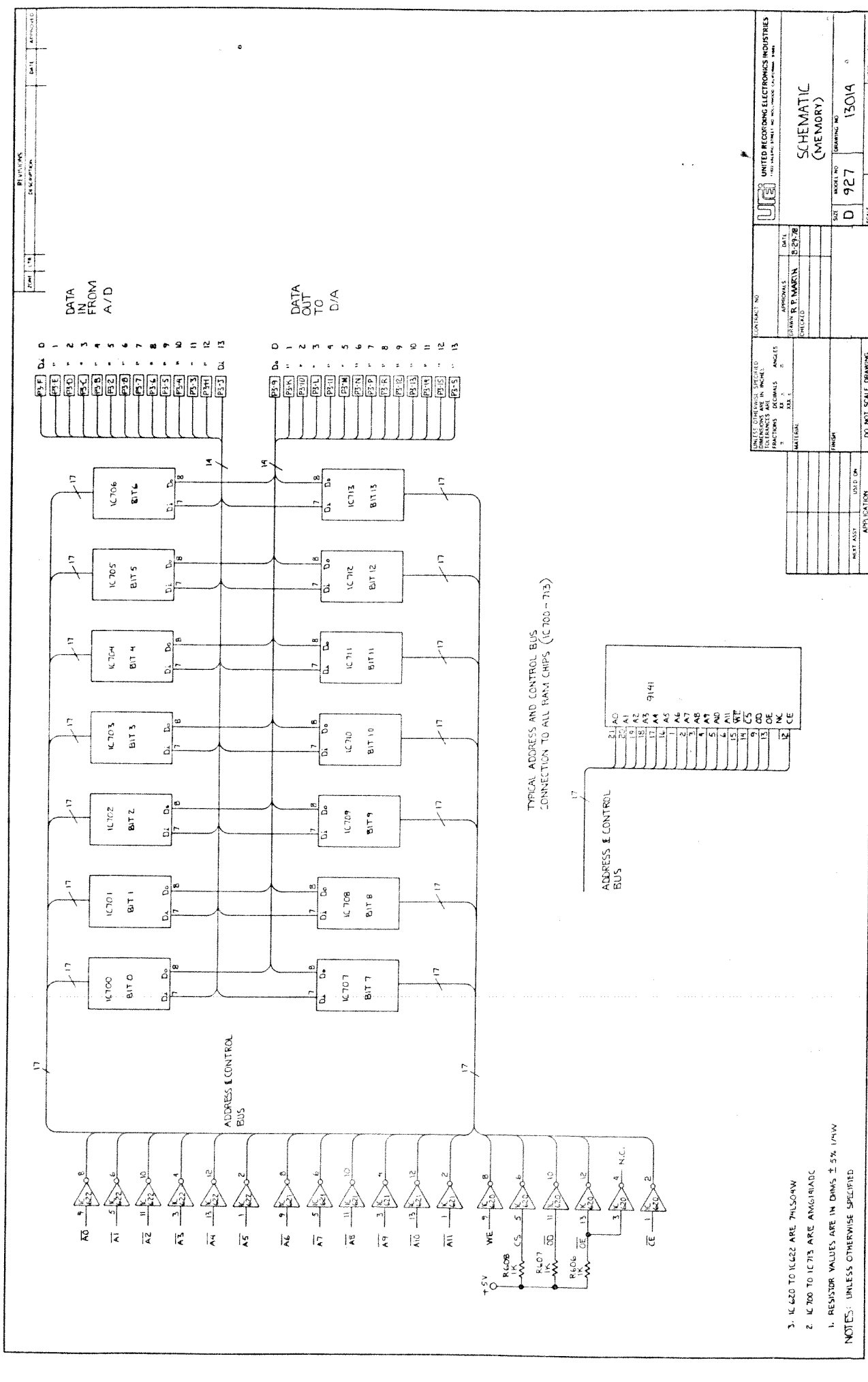
These controls have been carefully set at the factory and should not require adjustments except after service work.

5.4 CLEANING

The front panel of the 927 may be cleaned with a non-abrasive cleanser such as "Formula 409" or "Fantastic" applied with a soft clean cloth. Additional protection of the anodized panel can be afforded through a light application of a spray wax preparation such as "Pledge". Never spray the panel directly as the cleanser or wax may enter through the openings into the chassis.



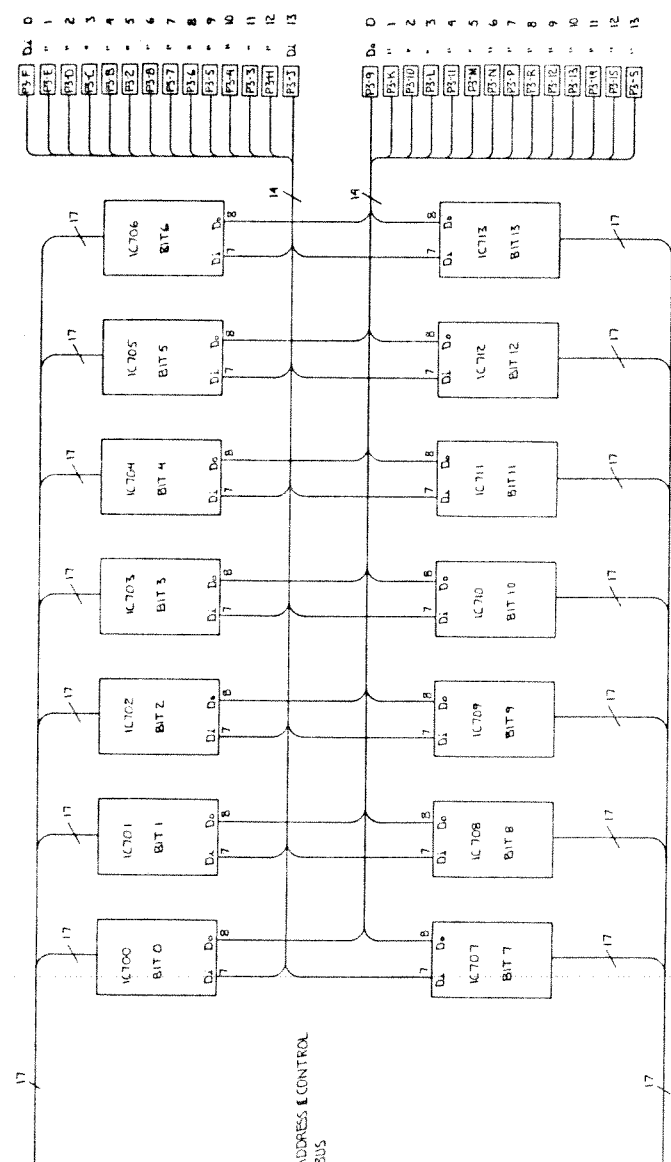
BLOCK DIAGRAM



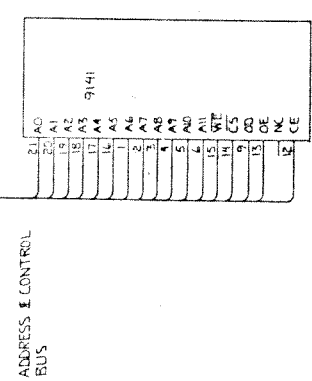
REV.	DESCRIPTION	DATE	APPROVED
1			

DATA IN FROM A/D

DATA OUT TO D/A



TYPICAL ADDRESS AND CONTROL BUS CONNECTION TO ALL RAM CHIPS (IC 700 - 713)



- 1C 620 TO 1C 622 ARE 7ALS0AW
- 1C 700 TO 1C 713 ARE AM6RIADC
- RESISTOR VALUES ARE IN OHMS ± 5% 1/4W

NOTES: UNLESS OTHERWISE SPECIFIED

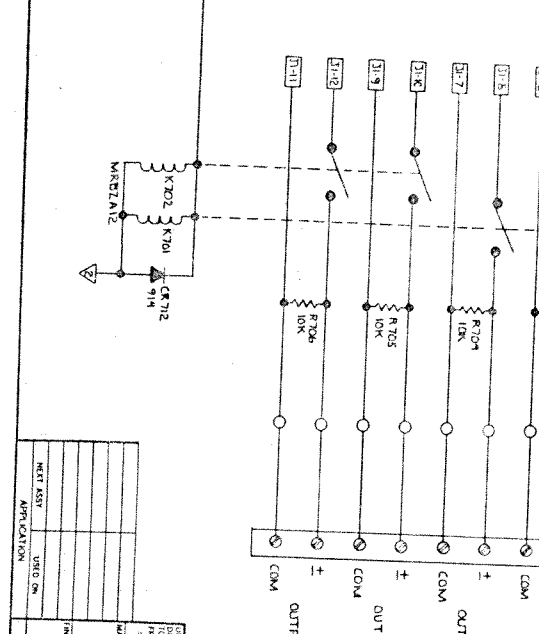
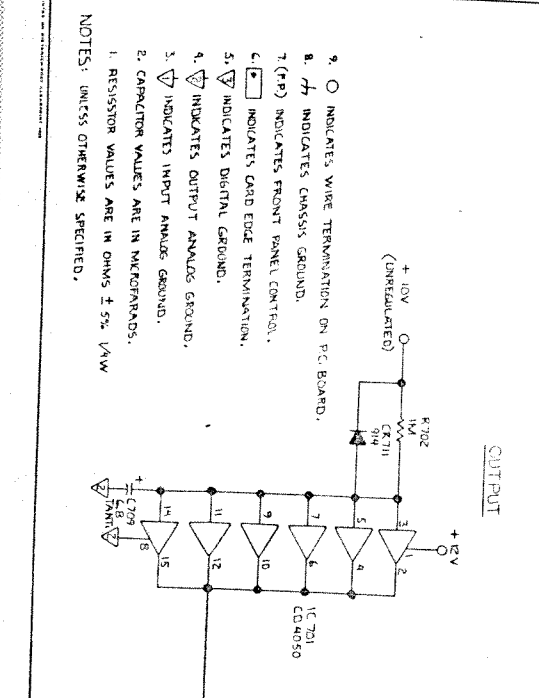
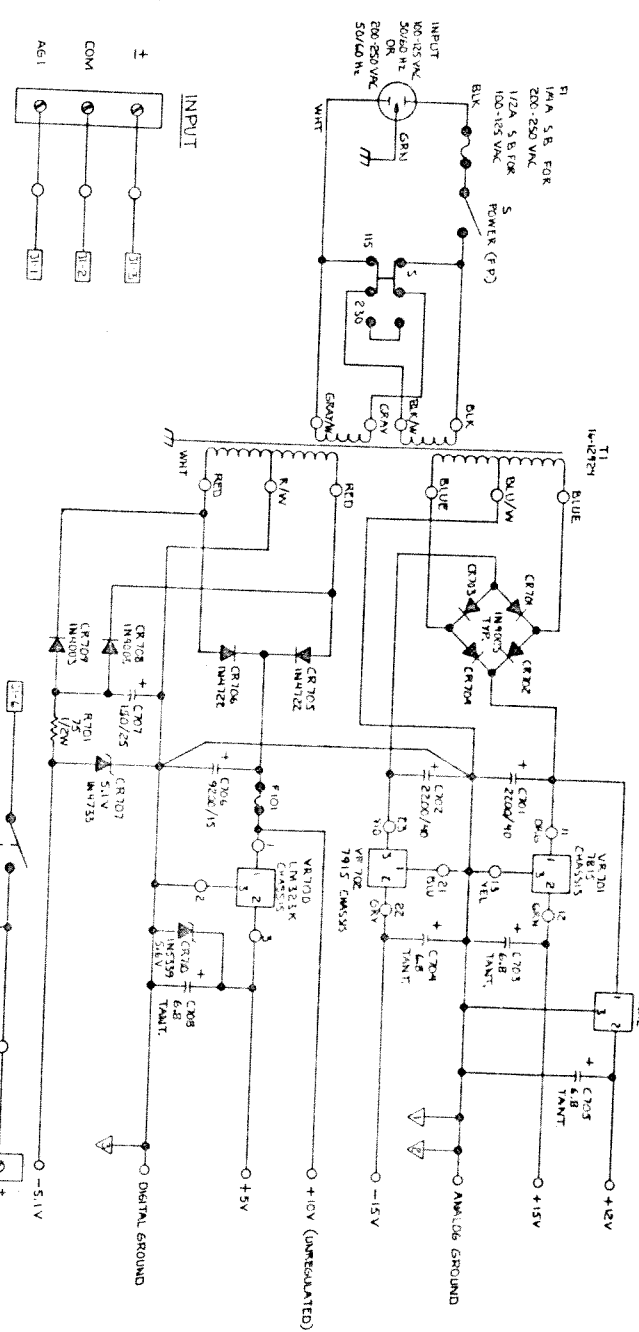
UNITED RECORDING ELECTRONICS INDUSTRIES
 1000 BAY STREET, SAN FRANCISCO, CALIF. 94133

CONTRACT NO. _____ DATE _____
 APPROVALS: _____ DATE _____
 DRAWN BY: P. MARIN (CHECKED) _____
 MATERIAL: _____
 FINISH: _____
 PART ASSY: _____ USED ON: _____
 APPLICATION: _____
 SCALE: _____
 SHEET: 04

UNLESS OTHERWISE SPECIFIED
 DIMENSIONS ARE IN INCHES
 FRACTIONS DECIMALS
 DECIMALS
 DIMENSIONS ARE IN INCHES
 FRACTIONS DECIMALS
 DECIMALS

UNITED RECORDING ELECTRONICS INDUSTRIES
 SCHEMATIC (MEMORY)
 MODEL NO. 927 (ORIGINAL NO. 15014)
 DATE: _____

POWER SUPPLY



1. ○ INDICATES WIRE TERMINATION ON P.C. BOARD.
2. h INDICATES CHASSIS GROUND.
3. (FP) INDICATES FRONT PANEL CONTROL.
4. □ INDICATES CARD EDGE TERMINATION.
5. ▽ INDICATES DIGITAL GROUND.
6. ▽ INDICATES OUTPUT ANALOG GROUND.
7. ▽ INDICATES INPUT ANALOG GROUND.
8. CAPACITOR VALUES ARE IN MICROFARADS.
9. RESISTOR VALUES ARE IN OHMS ± 5% 1/4W

<p>UNITED RECORDING ELECTRONICS INDUSTRIES</p> <p>SCHEMATIC</p> <p>MOTHER & POWER SUPPLY</p>		<p>DATE: 8-18-78</p> <p>DESIGNED BY: P. MANN</p> <p>APPROVED BY: [Signature]</p>
<p>CONTRACT NO.</p> <p>SCALE: D</p>	<p>MODEL NO. 927</p> <p>SHEET 13011</p>	<p>REVISIONS</p> <p>DATE</p> <p>DESCRIPTION</p>