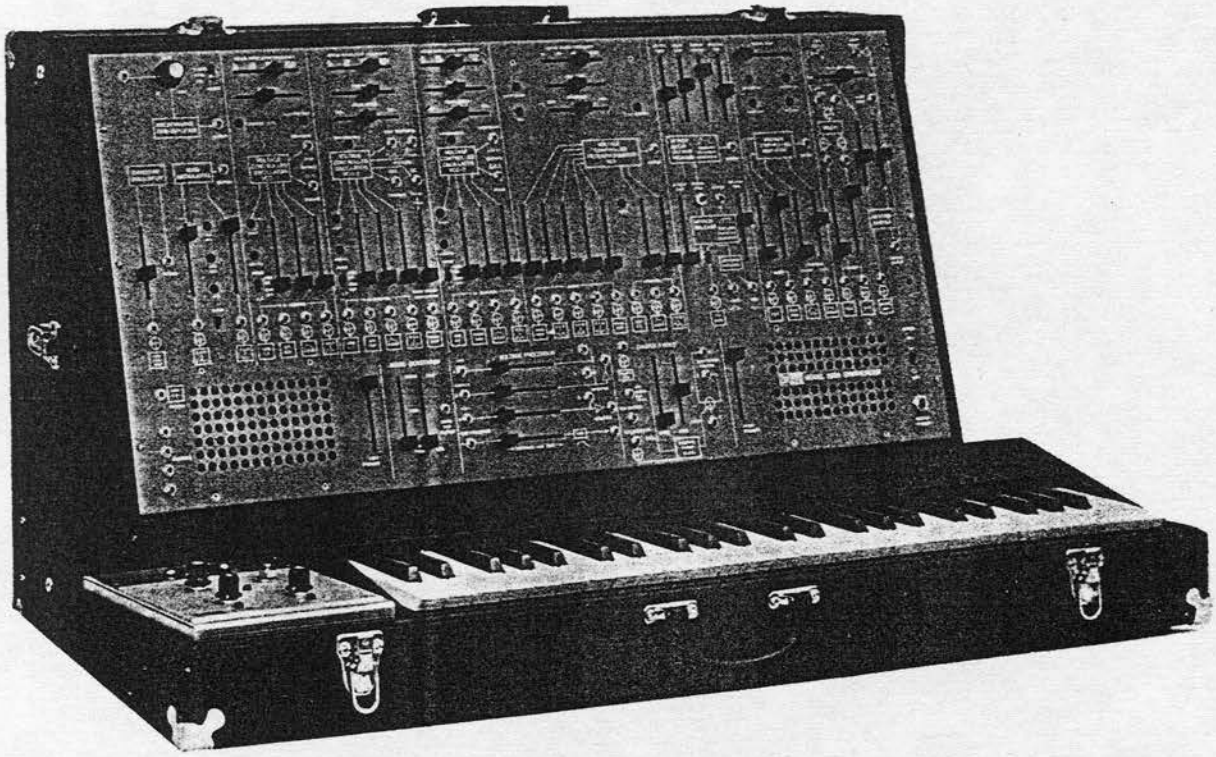
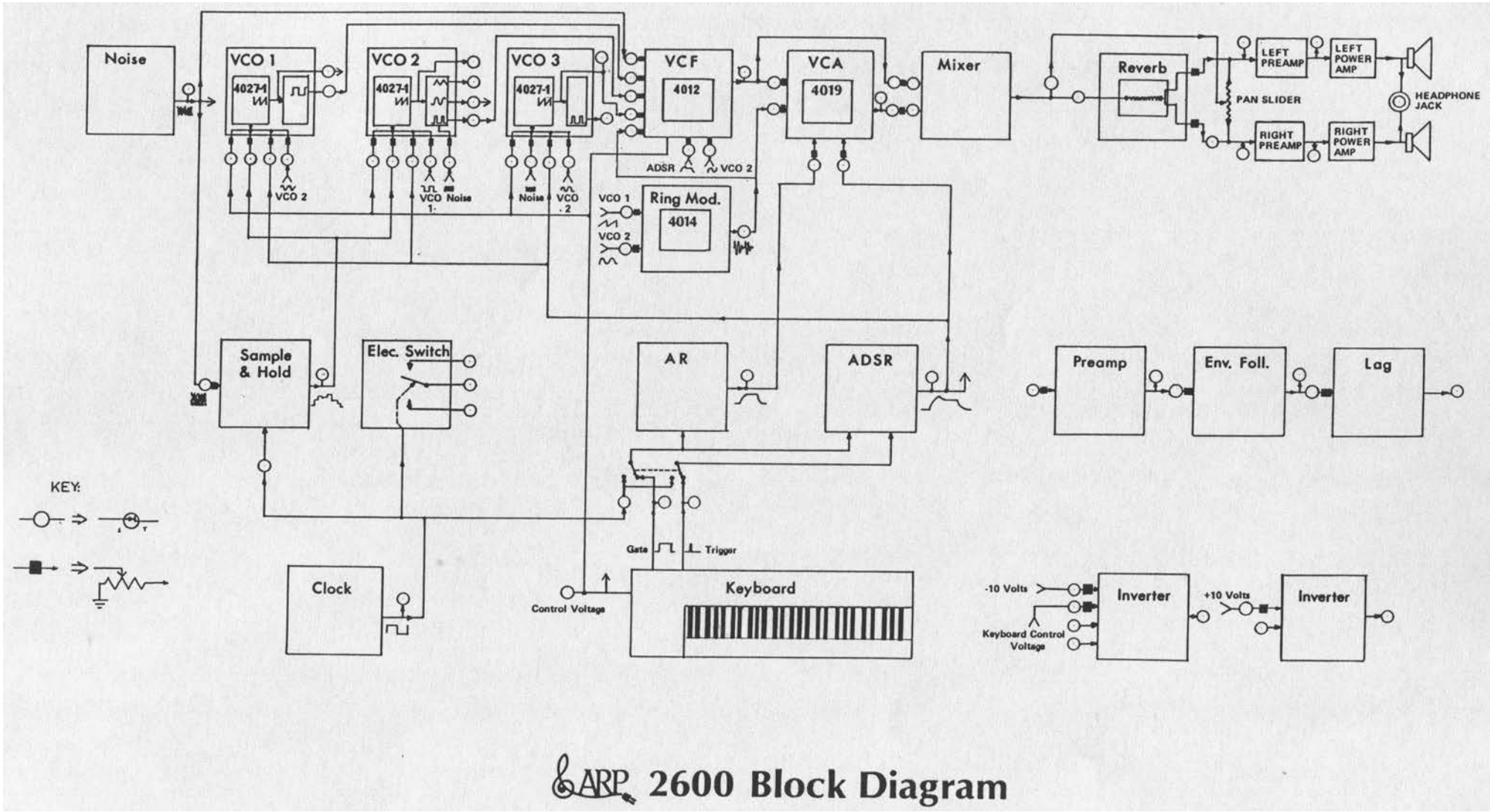
ARP MODEL 2600
SERVICE MANUAL



ARP Instruments, Inc.
320 Needham Street,
Newton, Mass. 02164
617-965-9700



ARP 2600 Block Diagram

2600 SIGNAL FLOW

1.1 INTRODUCTION

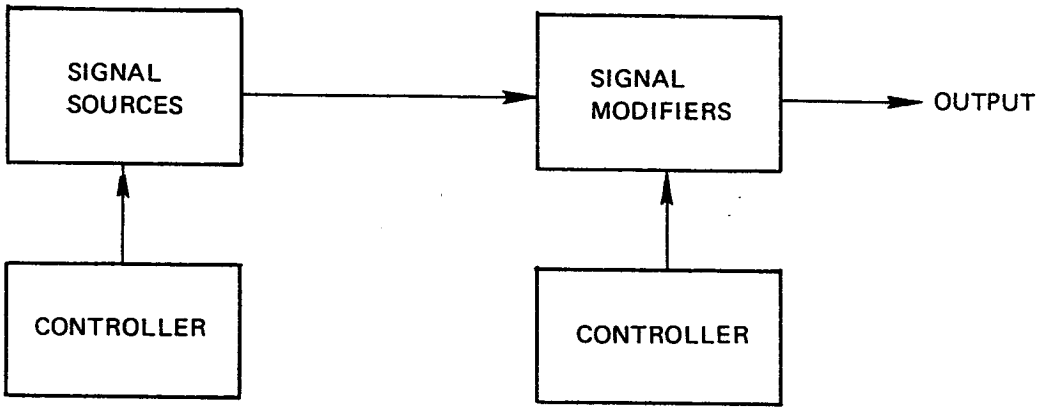
This section discusses the prewired signal flow through the 2600. See Sections 2.3 through 2.24 for details of individual functions.

1.2 PREWIRED PATCHES

The 2600's prewired patches provide most popular synthesizer effects without the use of patch cords by using the closed circuit tip and shunt of mini jacks. This internally 'prewired' patch may be overridden however, by inserting a patch cord into the appropriate panel jack. Note that a circle in the block diagram indicates a mini jack.

1.3 SYNTHESIZERS IN GENERAL

Synthesizers include three types of circuits: 1) signal sources, 2) signal modifiers, and 3) controllers. In general, sounds are produced by a synthesizer in the following manner:



A 'raw' signal is produced by a signal source, such as an oscillator or noise generator. The tone or color of the raw signal is then shaped as the signal passes through the modifier which in the 2600 could be the ring modulator, VCF or VCA. Controllers are used to give automatic variations in the pitch of the signal source and/or the operating characteristics of the modifier.

Although many functions on the 2600 can be used as both controllers or signal sources, the following table suggests the most common use of each function on the 2600:

SOURCES	MODIFIERS	CONTROLLERS
VCO 1	VCF	ADSR
VCO 2	VCA	AR
VCO 3	RING MODULATOR	KEYBOARD
NOISE GENERATOR	ELECTRONIC SWITCH	ENVELOPE FOLLOWER
	REVERB	SAMPLE AND HOLD
	INVERTERS	VCO's IN LF RANGE
	LAG PROCESSOR •	INTERNAL CLOCK
	MICROPHONE PREAMP	

ARP 2600 SERVICE MANUAL

TABLE OF CONTENTS

SECTION 2

CHECKOUT, CALIBRATION & REPAIRS

2.1 INTRODUCTION

Part 2.2 contains the board and trim location diagrams which are used in conjuction with the check-out procedures. Section 2.3 through 2.24 detail the individual functions in the 2600. Each section contains the following information:

1. A function description which describes what each device is designed to do.
2. A circuit description accompanied by schematic segments to assist you in understanding the circuit. (Full board schematics and component layouts are located in section 7.)
3. A checkout and trim* section which covers the electrical performance specifications and formal checkout procedures

Do not make any trims or adjustments until you have completed the entire checkout procedure to properly identify the nature of the failure. Note any defects and repeat the checkout procedure making trims or repairs where needed. (Note: There are time saving troubleshooting hints included in most sections.)

* Tuning the VCO's and VCF is covered separately in Section 3

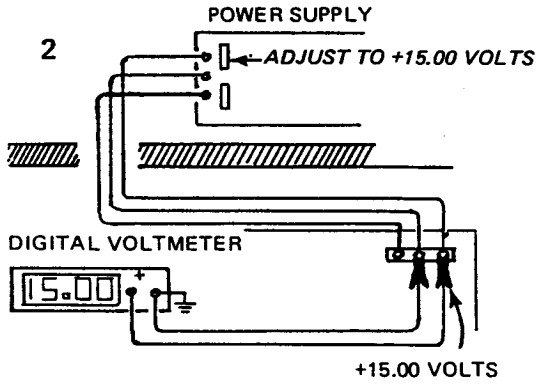
2.1.1 EQUIPMENT NEEDED FOR CHECKING THE 2600

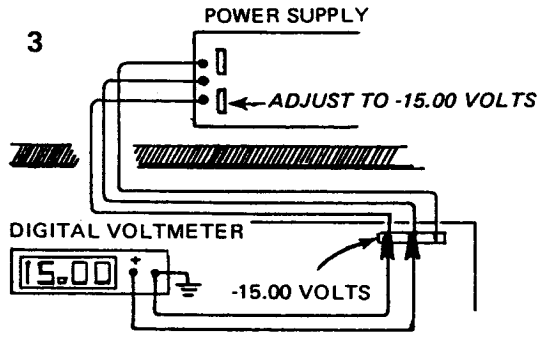
A DC coupled oscilloscope and a digital voltmeter with at least three digit accuracy are required to check the functions of the 2600 properly. While a frequency counter is helpful, (especially in tuning) it is not necessary for any of the testing procedures.

2.1.2 ADJUSTING THE POWER SUPPLY

Before any trims or adjustments are made on the 2600, check that the power supply is properly calibrated:

1. Allow fifteen minutes warm-up time.
2. Adjust the positive power supply to +15.00 volts with a digital voltmeter.
3. Adjust the negative power supply to -15.00 volts by connecting the meter's positive lead to the power supply's ground terminal so that the meter always reads positive voltage.





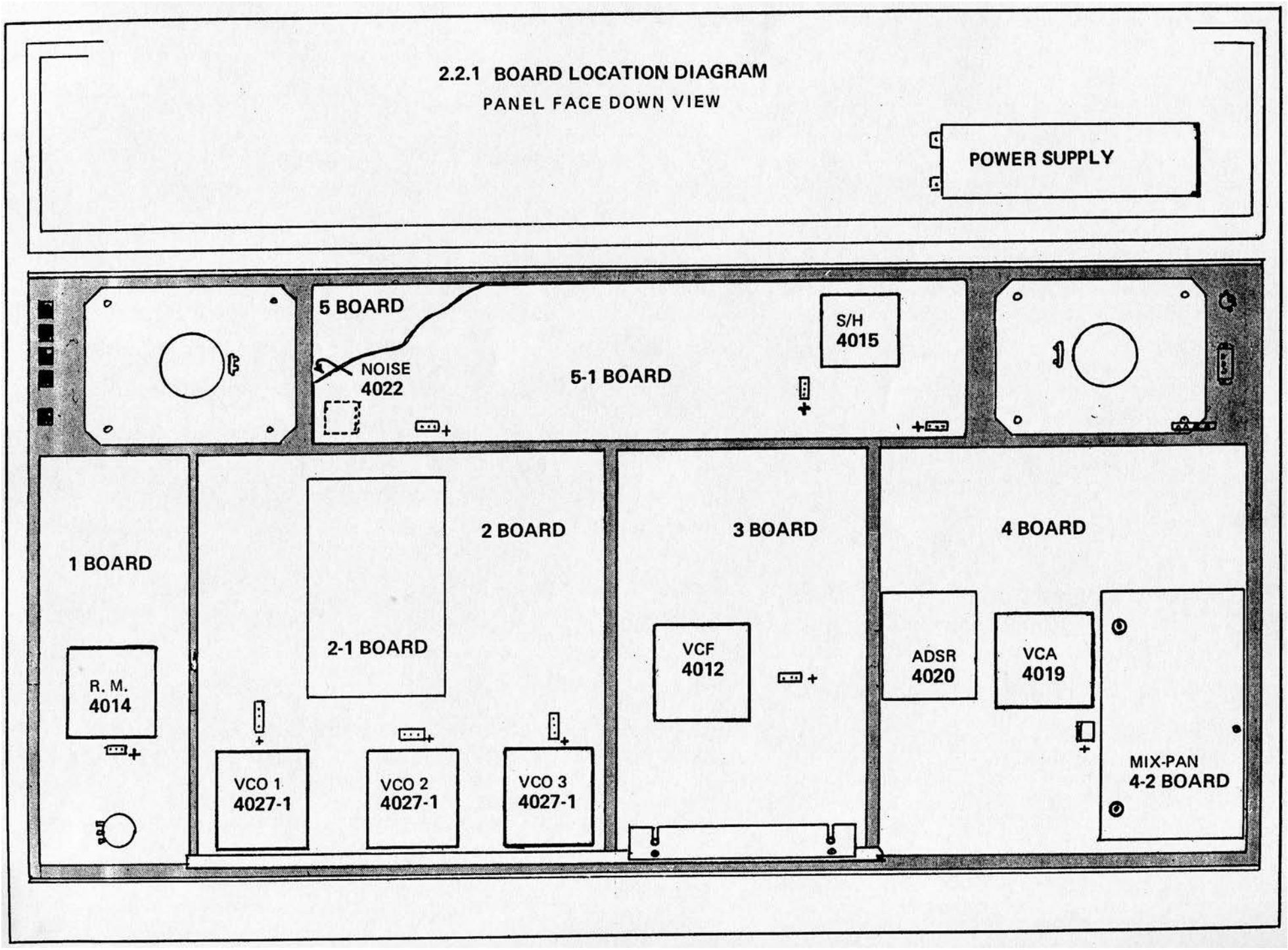
2.1.3 MODULE REPLACEMENT

If it should become necessary to replace an encapsulated 4000 series module, desolder each pin using a solder sucker or solder wick. DO NOT CUT THE PINS. ARP will not issue credit for modules with cut pins.† When inserting the new module, care should be taken not to insert the module too far into the board where it could short against other components.

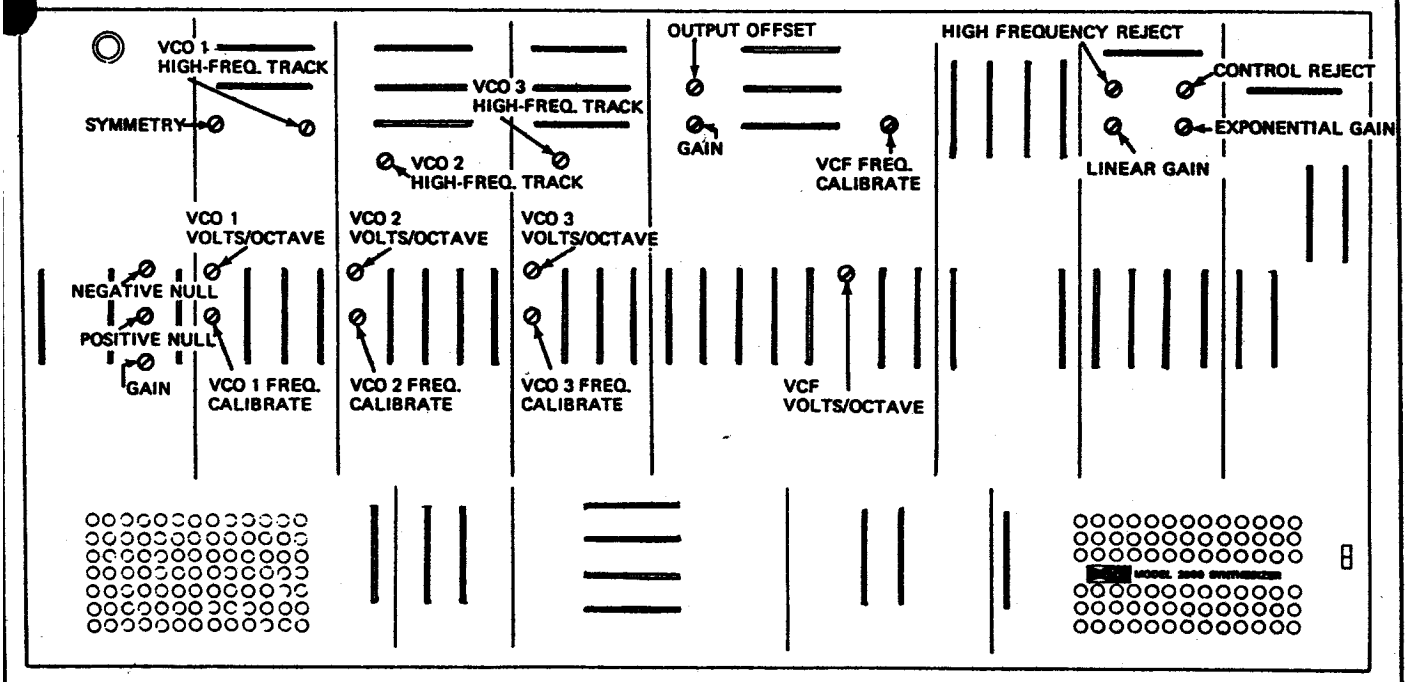
† The factory will accept modules that have pin 15 cut for the high frequency track trim. (See section 3.3.1) This is the only exception.

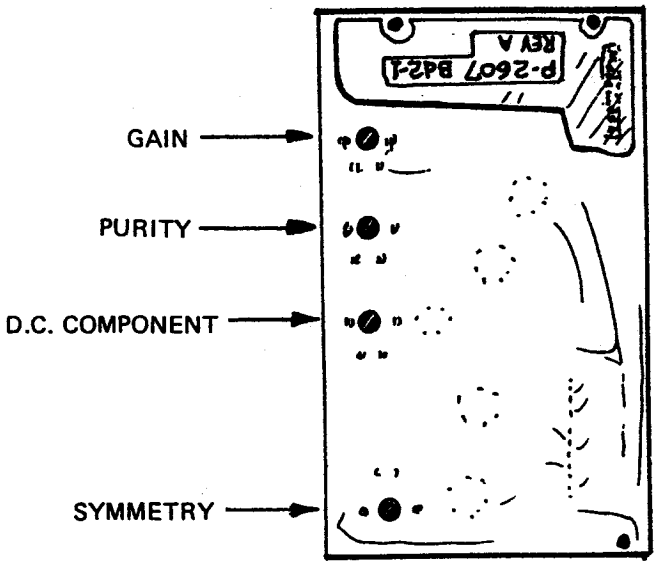
2.2.1 BOARD LOCATION DIAGRAM

PANEL FACE DOWN VIEW

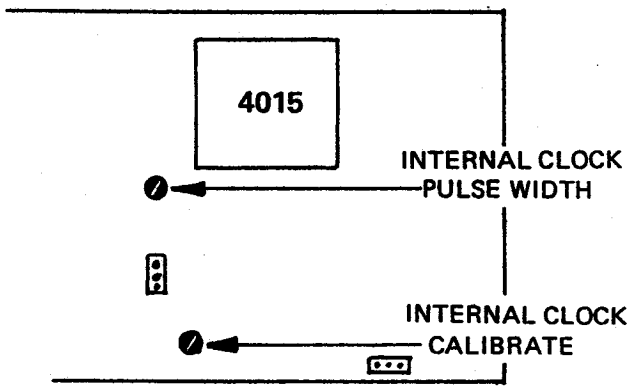


2.2.2 TRIM LOCATIONS





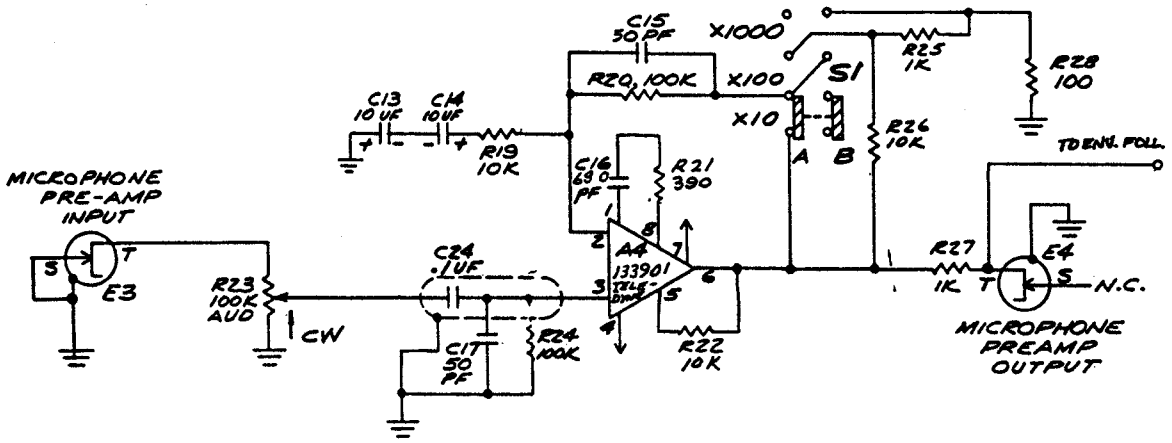
2-1 BOARD



5-1 BOARD

2.3.1 PREAMPLIFIER FUNCTION DESCRIPTION

The microphone preamplifier accepts any low to medium level external input. A rotary control serves as an input attenuator and a three position slide switch selects one of three gain ranges: X10 (20db), X100 (40db) and X1000 (60db). The preamplifier is useful with microphones, electronic musical instruments, and any other signals which do not have adequate signal level to drive the 2600 circuits directly.

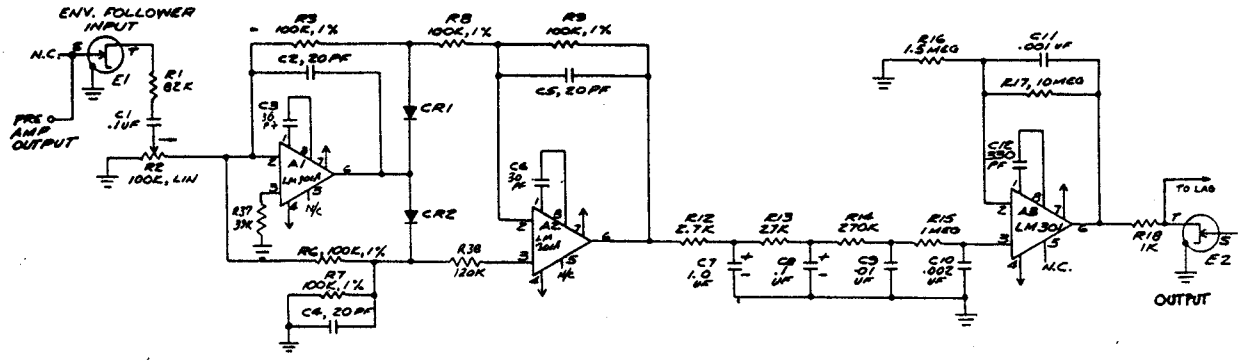


2.3.2 PREAMPLIFIER CIRCUIT DESCRIPTION

The signal to be amplified enters the preamplifier circuit through R23, the gain control, and is coupled through C24 to the noninverting input (pin 3) of A4. The range switch, S1, selects the feedback path for A4 through either R20 for X10, R20 and R26 for X100 or R20, R25 and R28 to ground for X1000. The amplified signal then passes from pin 6 of A4 through R27 to the output jack.

2.4.1 ENVELOPE FOLLOWER FUNCTION DESCRIPTION

The envelope follower generates a positive D.C. voltage output which is directly proportional to the amplitude of the audio input signal. The envelope follower's sensitivity is such that a 2 volt peak to peak signal will produce about 5 volts D.C. on the output with the input slider fully up. The preamplifier is prewired to the envelope follower input.



2.4.2 ENVELOPE FOLLOWER CIRCUIT DESCRIPTION

The signal enters the envelope follower circuitry through R1, C1 and attenuator, R2. A1, CR2, CR1, and A2 comprise a full wave rectifier for the audio signal. The positive portion of the wave on pin 6 of A1 goes through CR2 and into the noninverting input of A2 (pin 3). The negative portion of the wave passes through CR1 to the inverting input (pin 2) of A2 so that the output of A2 is always positive. The rectified signal on pin 6 of A2 is then filtered by R12-15 and C7-10 and then amplified and buffered by A3.

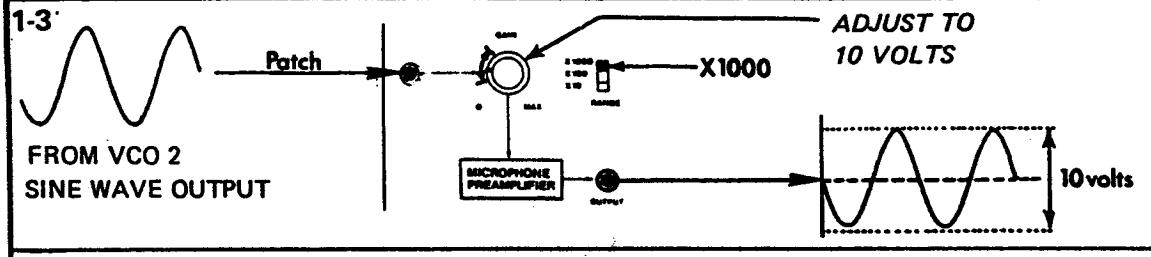
2.3.3 PREAMPLIFIER — CHECKOUT PROCEDURE

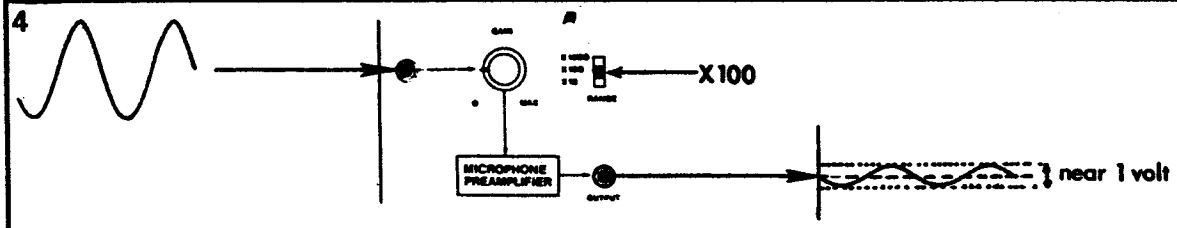
SET UP:	CHECK:
1. Preamplifier range switch: X1000 2. Patch: from VCO 2 sine wave output to the pre-amplifier's input. 3. Gain Control: Adjust the gain control so that the output is 10 volts, peak to peak.	
4. Preamplifier Gain Switch: X100	4.1 The output of the preamplifier should drop to near 1 volt, peak to peak.
5. Gain Control: Adjust the gain control so that the output fo the preamplifier is 10 volts, peak to peak.	
6. Preamplifier Gain Switch: X10	6.1 The output of the preamplifier should drop to near 1 volt, peak to peak.

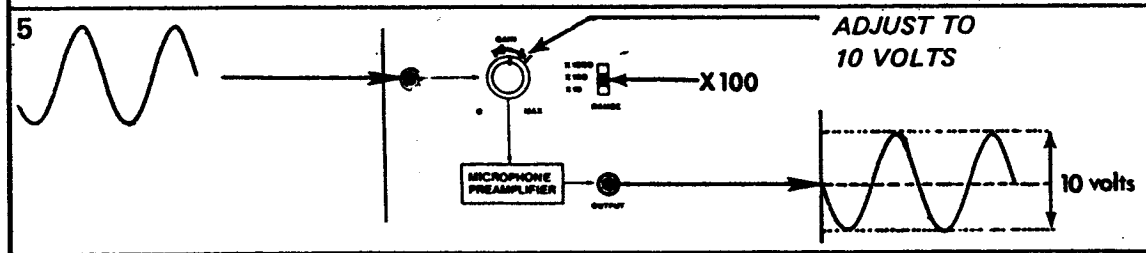
2.4.3 ENVELOPE FOLLOWER

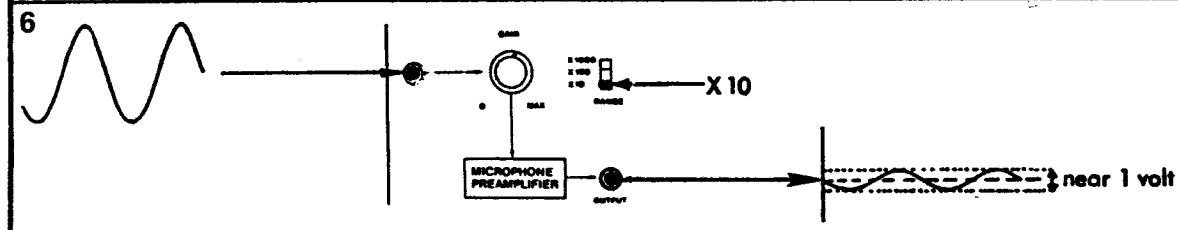
1. Patch: from VCO 1 sawtooth output to the envelope follower input. 2. Envelope Follower Input Slider: 2/3 up. 3. VCO 1 Initial Frequency Slider: Fully left (Put VCO 1 in audio mode)	3.1 The output of the envelope follower should be between 9 and 11 volts with large ripple.
4. VCO 1 Initial Frequency Slider: about ¾. 5. Envelope Follower Input Slider: Fully down	4.1 The output of the envelope follower should be about 10 volts D.C. 5.1 The output of the envelope follower should be zero.

PREAMPLIFIER 2.3.3

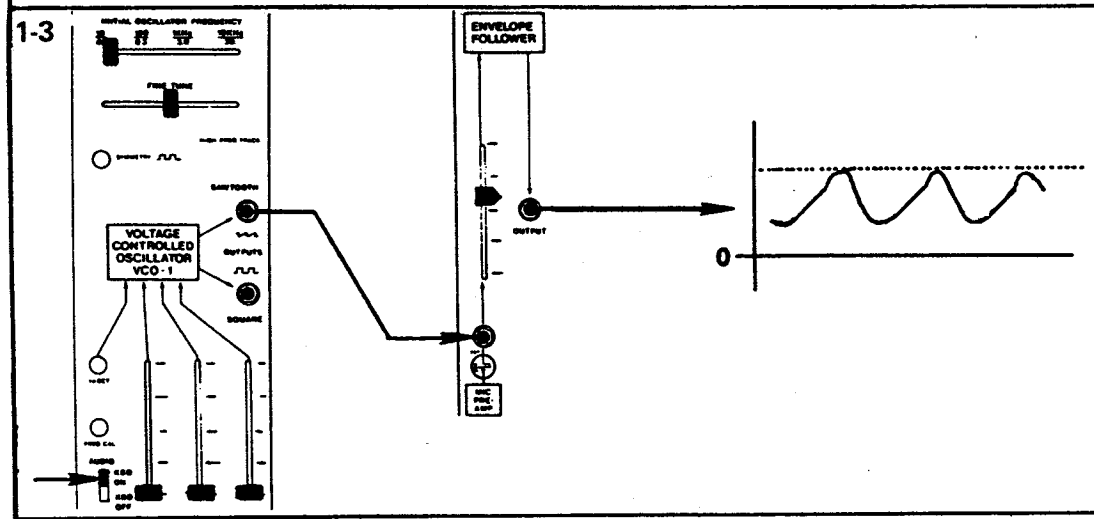


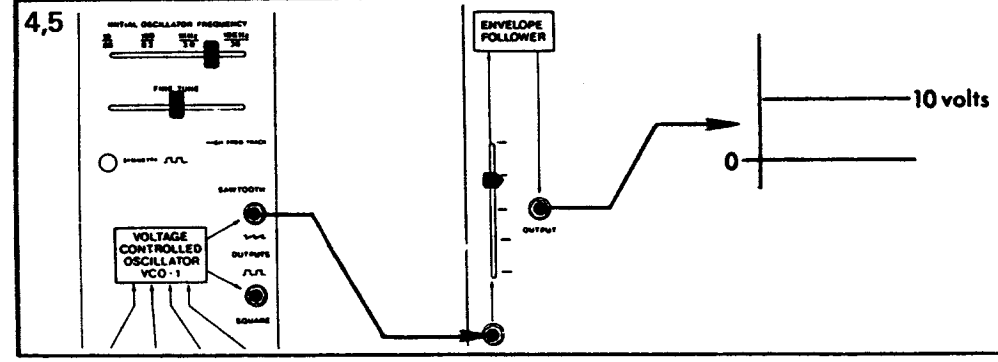






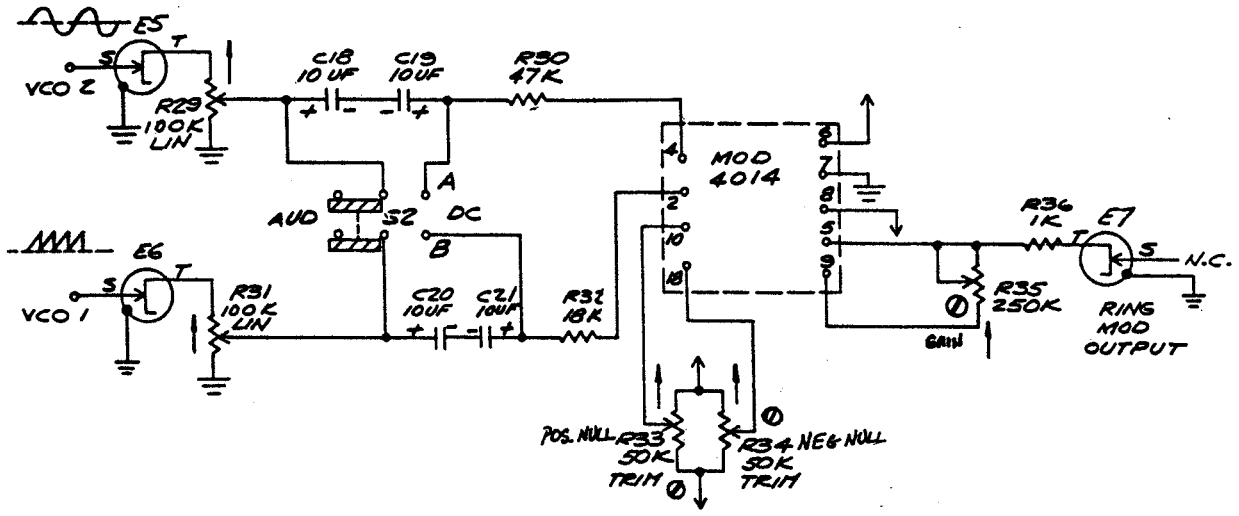
ENVELOPE FOLLOWER 2.4.3





2.5.1 RING MODULATOR FUNCTION DESCRIPTION

The Ring Modulator is an analog multiplier which accepts two different signals and multiplies them to form a single complex wave. In the 'audio' mode, the DC component of each of the input signals is cancelled before it reaches the modulator. In the DC mode, the output voltage of the ring modulator will be the product of the two input voltages divided by 5. The Ring Modulator is useful for producing bell or gong sounds. In the DC mode, it can also be useful as a second voltage controlled amplifier by applying a control voltage to one input and an audio signal to the other input. The Ring Modulator will pass the audio signal with an amplitude proportioned to the control voltage. VCO 1's sawtooth output is prewired to the left input and VCO 2's sine wave output is prewired to the right input.



2.5.2 RING MODULATOR CIRCUIT DESCRIPTION

The two signals that are to modulate one another enter the Ring Modulator through R29 and R31 When S2 is in the 'audio' position, the signals are AC coupled through C18-19 and C20-21. When the switch is in the DC mode, these capacitors are bypassed and the signals are DC coupled to the inputs of the 4014 Modulator. R33 and R34 are the null trimmers. R35, the gain trimmer, sets the amplitude of the modulator's output signal on pin 5 of the 4014.

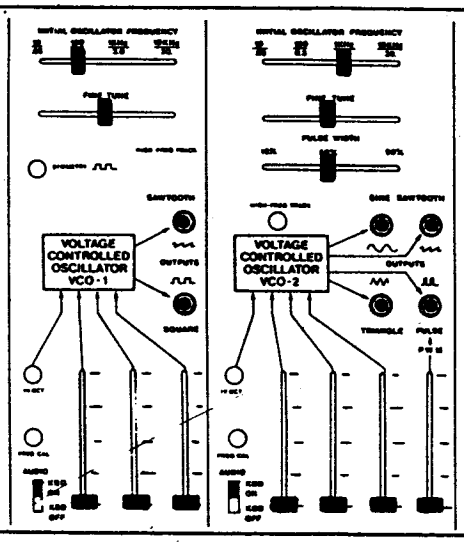
TROUBLESHOOTING HINTS

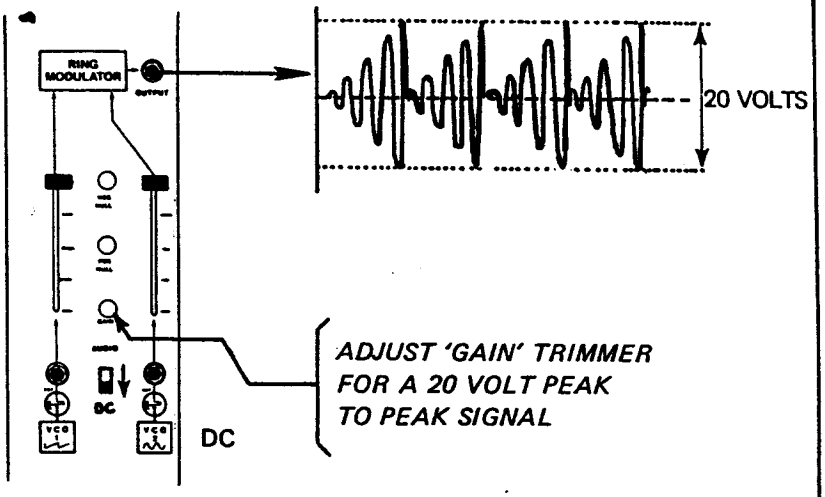
SYMPTOM	PROBLEM	REPAIR	LOCATION
PITCH BLEEDS THROUGH TO THE RING MODULATOR OUTPUT WHEN ONLY ONE SLIDER IS UP	'NULL' TRIMMER IS SET INCORRECTLY	SEE STEPS 5 AND 8 OF THE CHECKOUT PROCEDURE	BOARD 1

2.5.3 RING MODULATOR — CHECKOUT PROCEDURE

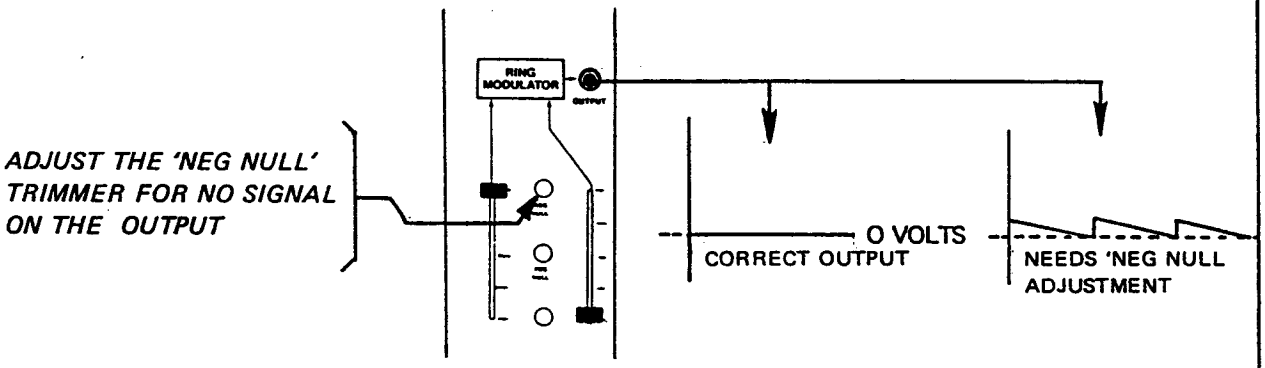
SET UP:	CHECK:
1. Ring Modulator Input Sliders: both fully up. 2. Ring Modulator 'Mode' switch: 'D.C.' (down) 3. VCO 1 Initial Frequency Slider: Set to about 100 HZ. 4. VCO 2 Initial Frequency Slider: Set to about 1000 HZ.	4.1 Observe a waveform similar to the illustration on the right on the output of the ring modulator.
5. Right Ring Modulator Input Slider: Fully down	5.1 The output of the ring modulator should be zero. None of the input signal should be present on the output.
6. Right Ring Modulator Input Slider: Fully up. 7. Ring Modulator 'Mode' Switch: 'Audio' (up)	7.1 Observe a waveform similar to the illustration on the right on the ring modulator output.
8. Right Ring Modulator Input Slider: Fully down	8.1 The output of the ring modulator should be zero. None of the input signal should be present on the output.

1-4

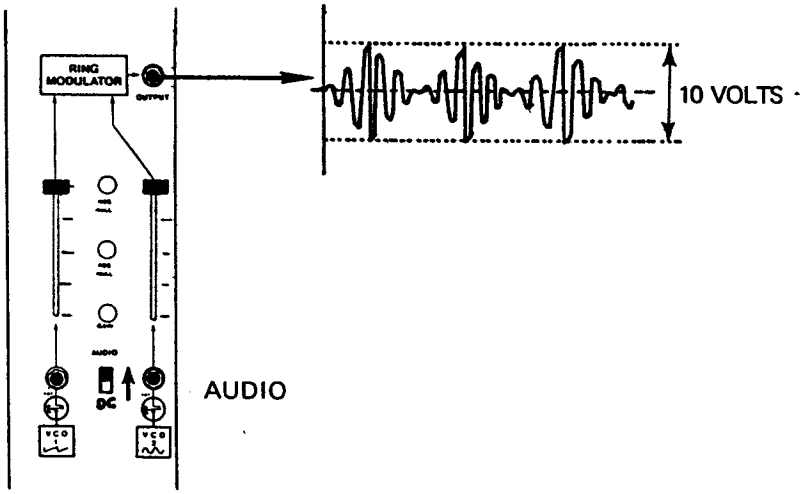

VOLTAGE CONTROLLED OSCILLATOR VCO-1
VOLTAGE CONTROLLED OSCILLATOR VCO-2


RING MODULATOR
OUTPUT
20 VOLTS
DC
ADJUST 'GAIN' TRIMMER FOR A 20 VOLT PEAK TO PEAK SIGNAL

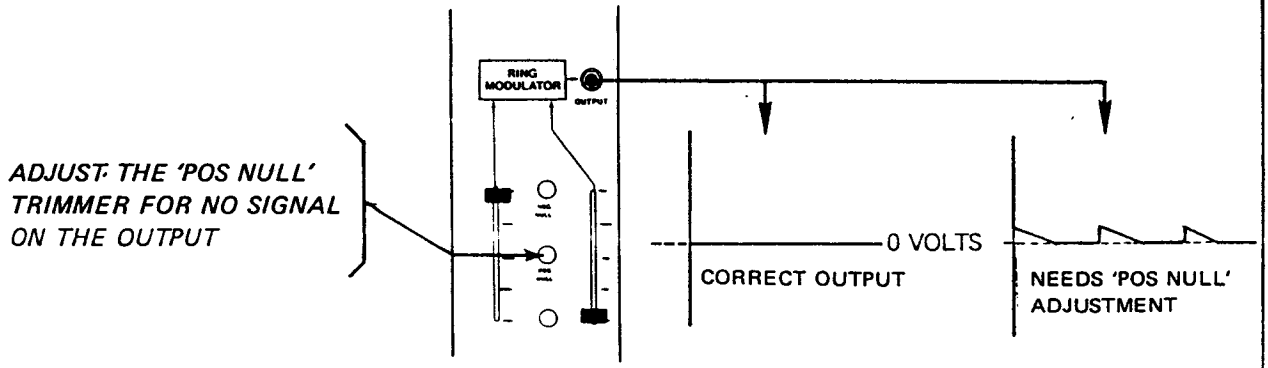
5


RING MODULATOR
OUTPUT
ADJUST THE 'NEG NULL' TRIMMER FOR NO SIGNAL ON THE OUTPUT
0 VOLTS
CORRECT OUTPUT
NEEDS 'NEG NULL ADJUSTMENT

6,7


RING MODULATOR
OUTPUT
10 VOLTS
DC
AUDIO

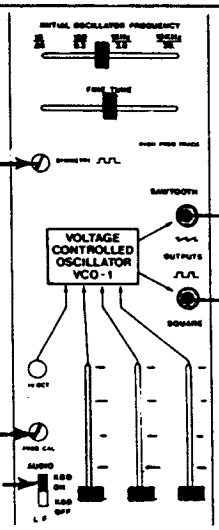
8

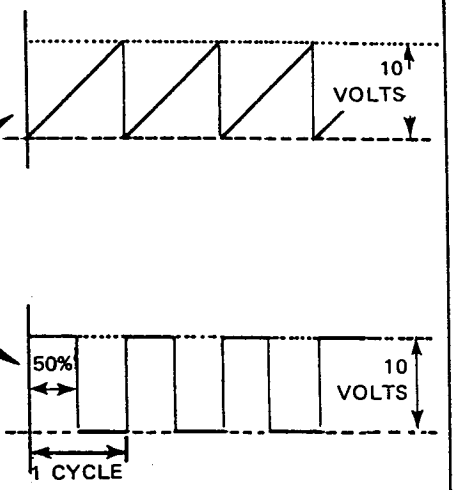

RING MODULATOR
OUTPUT
ADJUST THE 'POS NULL' TRIMMER FOR NO SIGNAL ON THE OUTPUT
0 VOLTS
CORRECT OUTPUT
NEEDS 'POS NULL' ADJUSTMENT

1-4

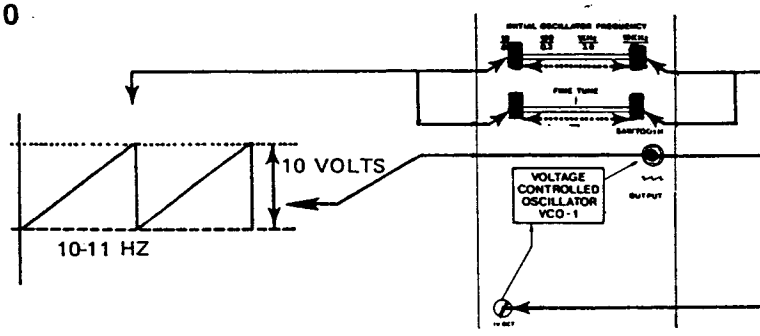
ADJUST THE 'SYMMETRY' TRIMMER FOR EXACTLY 50% DUTY CYCLE ON THE SQUARE WAVE. (THE SOUND IS PUREST WHEN IT IS EXACTLY SQUARE.

ADJUST THE 'FREQ CAL' TRIMMER TO 10-11 HZ. WHEN THE INITIAL FREQUENCY AND FINE TUNE SLIDERS ARE IN THE FULLY LEFT POSITION



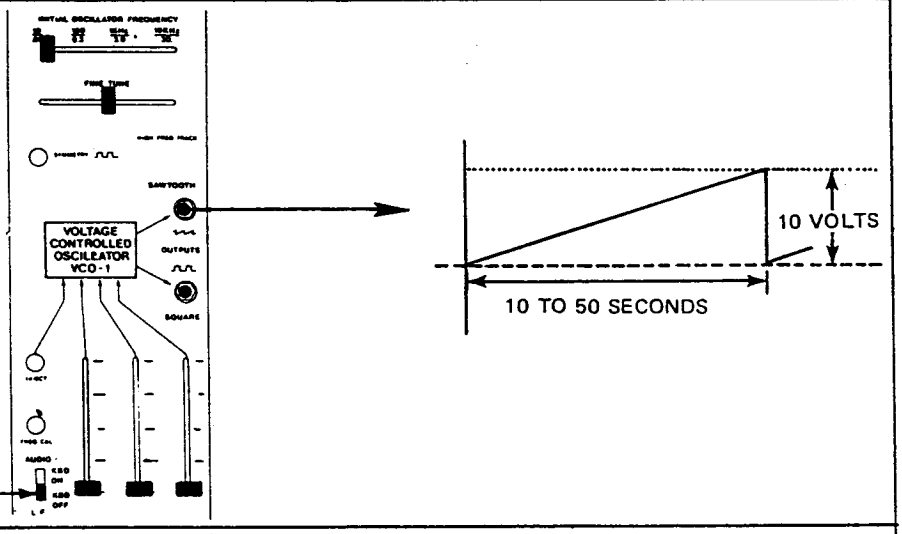


5-10

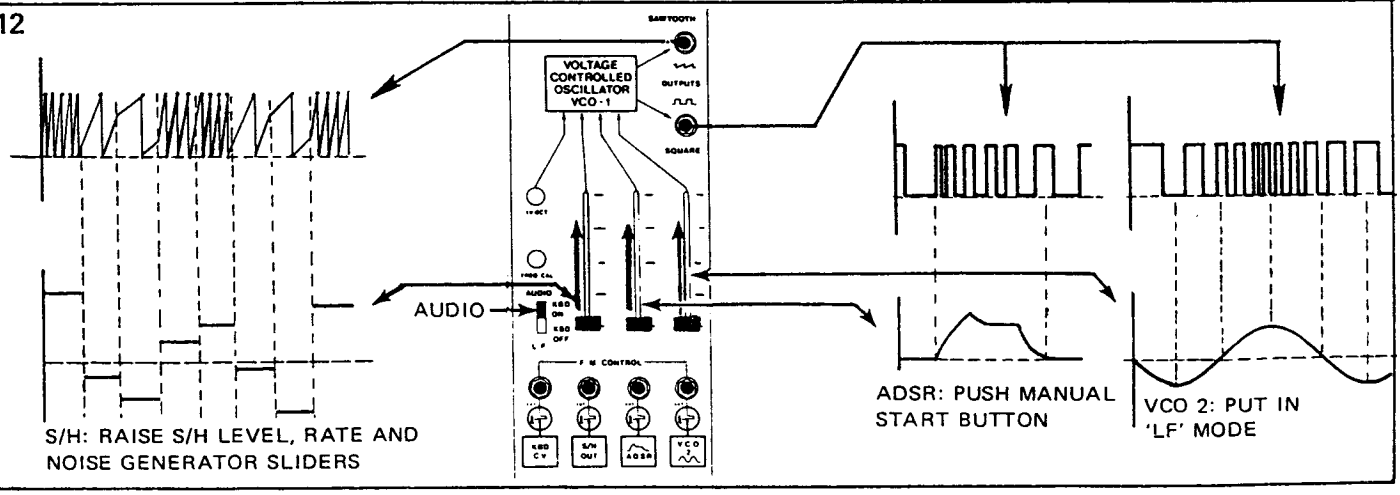


'VOLTS PER OCTAVE' TRIMMER: SEE SECTION 3 IF VCO 1 FAILS STEP 10.

11

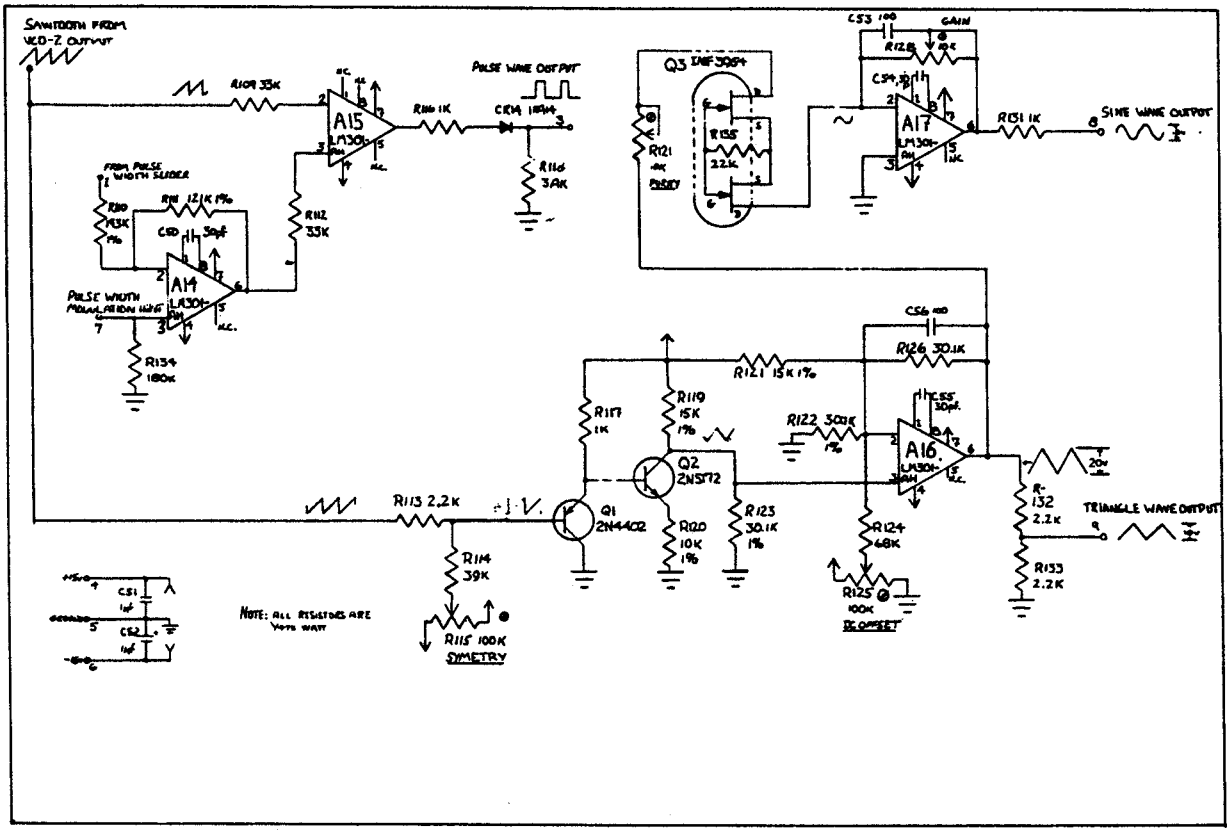


12



2.7.1 VCO 2 FUNCTION DESCRIPTION

VCO 2 generates sawtooth, pulse, triangle and sine waveforms. The width of the pulse wave can be controlled either by the pulse width slider or by a control voltage applied to the pulse width modulation input. This input is normally prewired to the Noise Generator output. The Keyboard Control Voltage, Sample and Hold, ADSR, and VCO 1 square wave outputs are prewired to the frequency control inputs of VCO 2.



2.7.2 VCO 2 CIRCUIT DESCRIPTION

The 4027-1* oscillator is exactly the same as the 4027-1 module in VCO 1. The difference between the two oscillators is in the waveform converters.

Pulse Converter: The pulse converter on VCO 2 is similiar to the square wave converter on VCO 1. The sawtooth wave from the 4027-1 module enters board 2-1 (the waveform converter board) on connector pin 2 and enters the inverting input of A15 through R109. A15 is a comparator which compares the sawtooth wave against the output of A14. A14 sums the voltage from the pulse width control (R20) and the pulse width modulation signal entering through slide pot R82. CR14 rectifies the output of A15 so that the pulse wave is positive going only. R116 and R118 reduce the amplitude of the pulse wave to about 10 volts.,peak to peak.

Triangle Converter: Q1, Q2, and A16 convert the sawtooth to a triangle wave. The sawtooth wave passes through R113 to Q1, an emmiter follower. R115, the symmetry trimmer, sets the DC offset of the sawtooth at the emmiter of Q1. As the voltage at the base of Q2 rises from OV to about +5, Q2's collector voltage drops from +10V to +5V. As the voltage at Q2's base rises from +5V to +10V, the base-collector junction of Q2 becomes forward biased and the voltage at Q2's collector, heads back toward +10V. A16 amplifies the resulting 5VP.P triangle wave to about 20 volts peak to peak and cancels the DC component. R132 and R133 attenuate the output to 10 volts peak to peak.

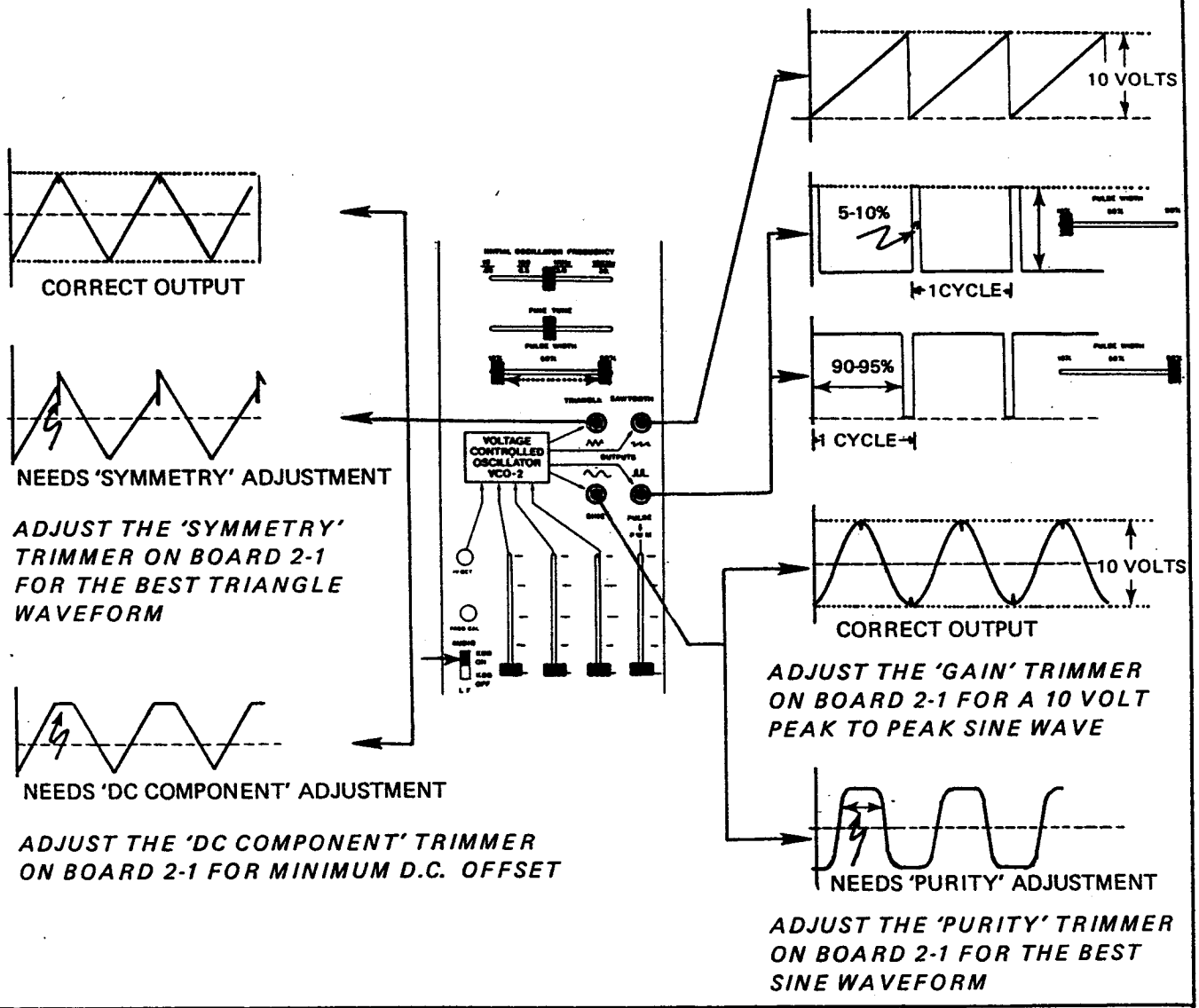
Sine Converter: The triangle wave at the output of A16 is applied to the sine wave converters, Q3 and A17, through attentuator R121 (purity trimmer). Q3's nonlinearity rounds the peaks of the triangle to approximate a sine wave. A17 amplifies the signal from Q3 to ten volts peak to peak.

* 4027-1 supercedes modules 4027 and 4017. See Section 3.3

2.7.3 VOLTAGE CONTROLLED OSCILLATOR 2 — CHECKOUT PROCEDURE

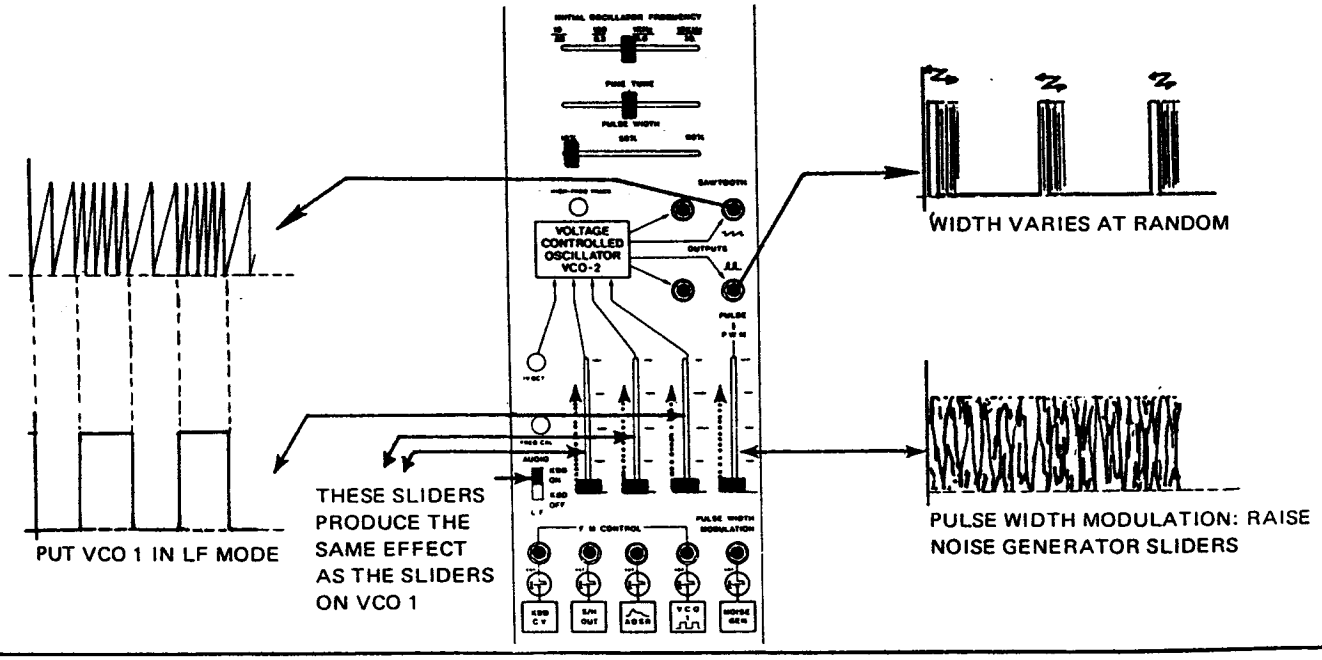
SET UP:	CHECK:
1. Turn off the power to the 2600 and disconnect the keyboard from the console.	
2. VCO 2 Frequency Mode Switch: 'Audio' position	
3. VCO 2 Initial Frequency and Fine Tune Sliders: Midposition	
4. All VCO 2 F.M. (vertical) Sliders: Fully down	4.1 VCO 2's sawtooth output should be a 10 volt peak to peak, positive going sawtooth waveform. 4.2 VCO 2's pulse wave output should be a 10 volt peak to peak pulse wave with a 5-10% duty cycle when the pulse width slider is fully left, and 90-95% when the pulse width slider is fully right. 4.3 VCO 2's triangle output should be a 10 volt peak to peak triangle wave with no D.C. offset. 4.4 VCO 2's sine wave output should be a 10 volt peak to peak sine wave.
5. VCO 2 Initial Frequency and Fine Tune Sliders: Fully left	5.1 The frequency of the sawtooth should be between 10 and 11 HZ.. The amplitude should be 10 volts.
6. VCO 2 Initial Frequency and Fine Tune Sliders: Fully right	6.1 The frequency of the sawtooth should be between 9 and 12 KHZ.. The amplitude should be between 9 and 10 volts with no D.C. offset.
7. Turn off the power to the 2600 and reconnect the keyboard to the console.	
8. Pin low 'C' (C1)	
9. VCO 2 Initial Frequency and Fine Tune Sliders: Adjust for a 100 HZ. signal on the output of VCO 2.	
10. Pin: C2, C3, C4, and C5 one at a time	10.1 The frequency of VCO 2 should exactly double: C1 should produce 100HZ., C2-200 HZ., C3-400 HZ., C4-800 HZ. and C5-1600 HZ..
11. VCO 2 Frequency Mode Switch: 'LF' position	11.1 The keyboard should no longer control the frequency of VCO 2. The period of the sawtooth should be between 10 and 50 seconds with the initial frequency slider in the fully left position.
12. Raise each of the VCO 2 F.M. (vertical) sliders one at a time.	12.1 The frequency change of VCO 2 should correspond to the input voltage or waveform (see pictured examples).

1-4



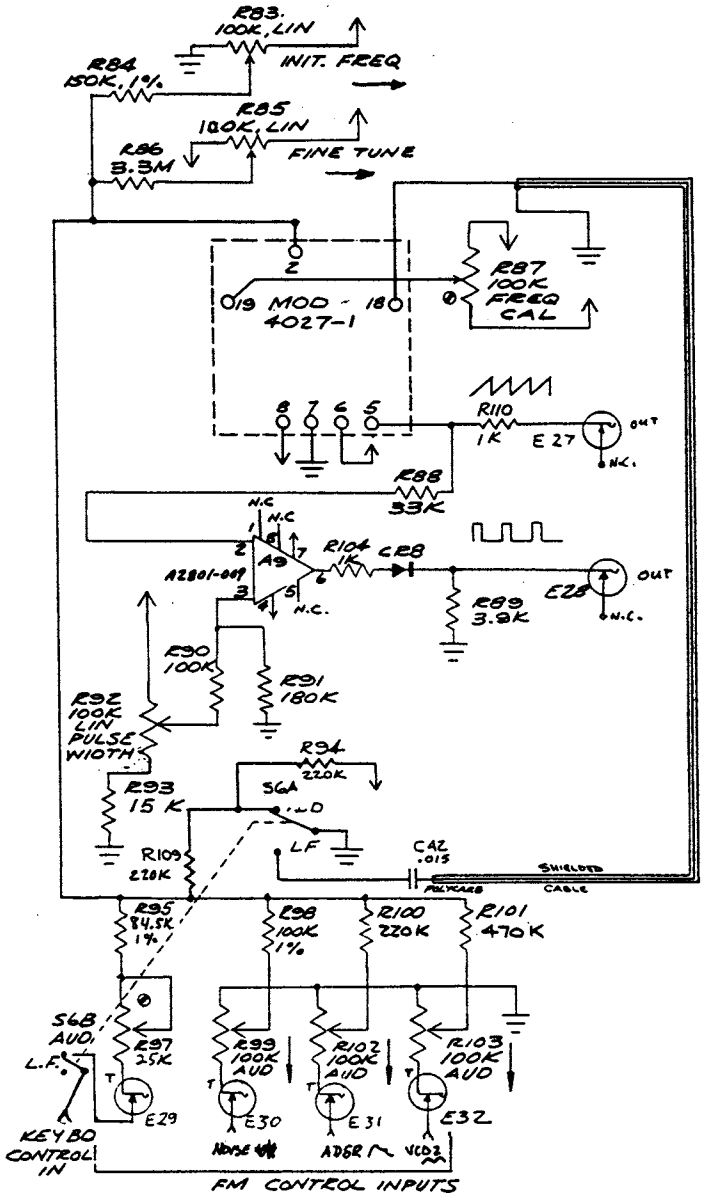
5-11 STEPS 5 THROUGH 11 ARE THE SAME AS VCO 1

12



2.8.1 VCO 3 FUNCTION DESCRIPTION

VCO 3 generates a sawtooth and a pulse wave. The width of the pulse wave is controlled by the pulse width slider only. The Keyboard Control Voltage, Noise Generator, ADSR. and VCO 2 sine wave are prewired to the VCO 3 frequency control inputs.



2.8.2 VCO 3 CIRCUIT DESCRIPTION

The 4027-1* oscillator module is exactly the same as the module in VCO 1. The pulse wave converter of VCO 3 is exactly like the square wave converter of VCO 1 except that the symmetry trimmer is replaced by a slider on the front panel for manually variable pulse width control.

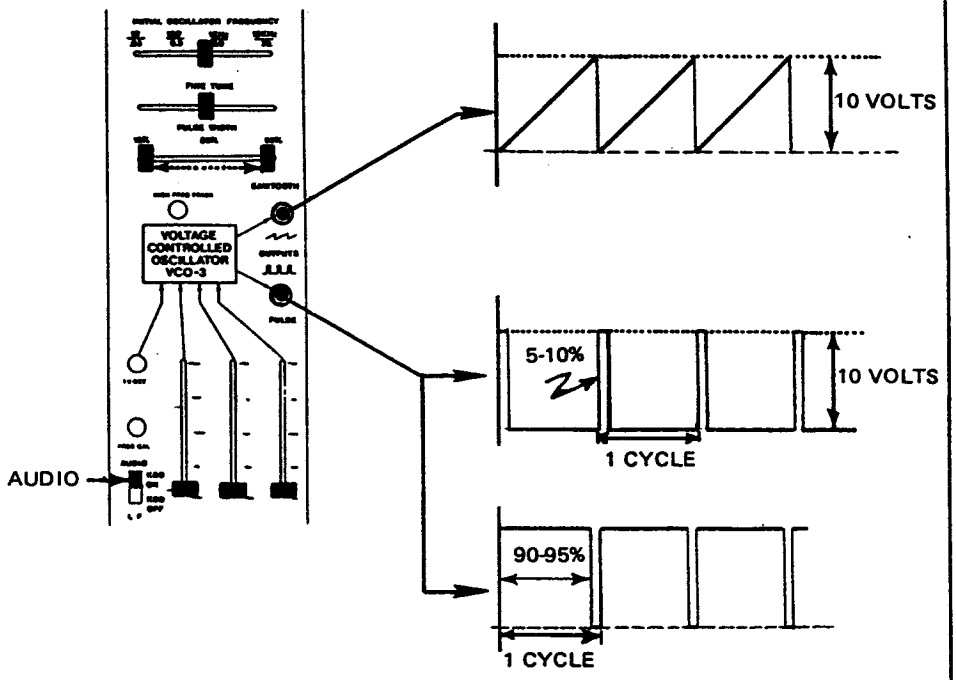
R92, the pulse width slider, sets the exact level of the voltage on the noninverting input of A9 and is used to set the duty cycle of the pulse wave on the output of A9. CR8 rectifies the output of A9 so that the pulse wave is positive going only. R104 and R89 reduce the amplitude of the pulse wave to about 10 volts, peak to peak.

* 4027-1 supercedes 4027 and 4017. See Section 3.3

2.8.3 VOLTAGE CONTROLLED OSCILLATOR 3

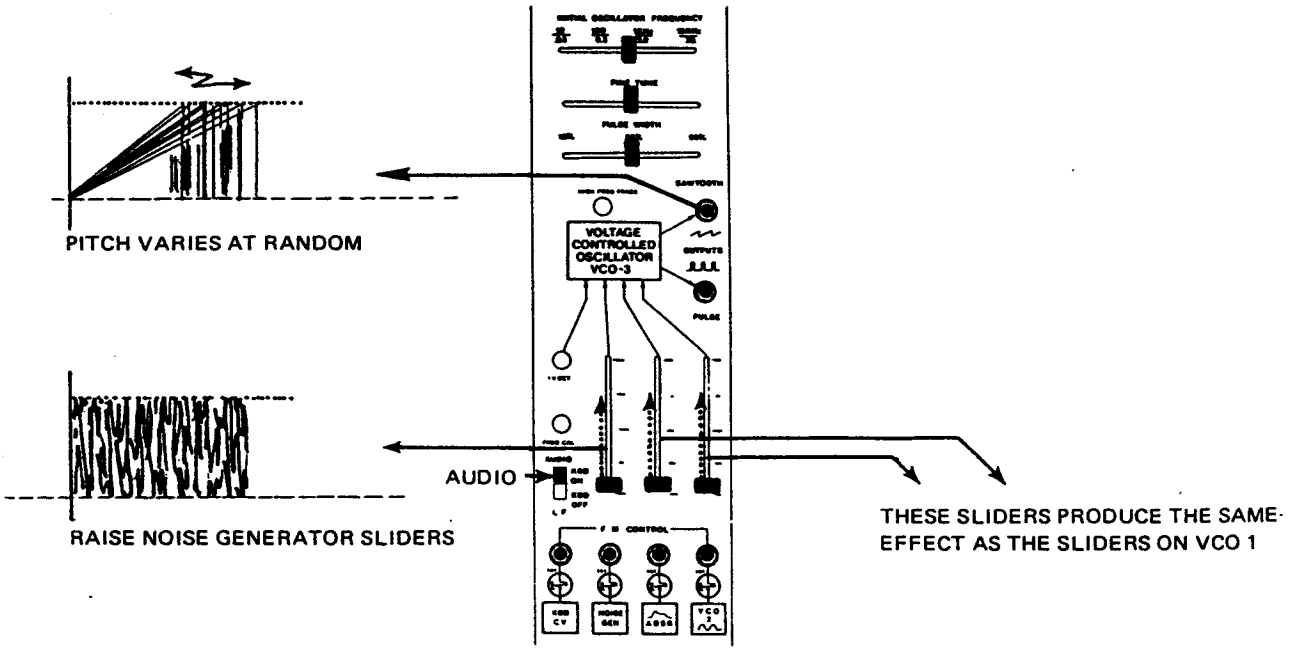
SET UP:	CHECKOUT PROCEDURE CHECK:
1. Turn off the power to the 2600 and disconnect the keyboard from the console.	
2. VCO 3 Frequency Mode Switch: 'Audio' position	
3. VCO 3 Initial Frequency and Fine Tune Sliders: Midposition	
4. All VCO 3 F.M. (vertical) Sliders: Fully down	4.1 VCO 3's sawtooth output should be a 10 volt peak to peak, positive going sawtooth waveform. 4.2 VCO 3's pulse wave output should be 10 volts peak to peak with 5-10% duty cycle when the pulse width slider is fully left, and 90-95% duty cycle when the pulse width slider is fully right.
5. VCO 3 Initial Frequency and Fine Tune Sliders: Fully left	5.1 The frequency of the sawtooth wave should be between 10 and 11 HZ. and the amplitude should be 10 volts, peak to peak.
6. VCO 3 Initial Frequency and Fine Tune Sliders: Fully right	6.1 The frequency of the sawtooth wave should be between 9 and 12 KHZ. and the amplitude should be between 9 and 10 volts with no D.C. offset.
7. Turn off the power to the 2600 and reconnect the keyboard to the console.	
8. Pin low 'C' (C1)	
9. VCO 3 Initial Frequency and Fine Tune Sliders: Adjust for a 100 HZ. signal on the output of VCO 3.	
10. Pin: C2, C3, C4, and C5 one at a time.	10.1 The frequency of VCO 3 should exactly double: C1 should produce 100 HZ., C2-200 HZ., C3-400 HZ., C4-800 HZ., and C5-1600 HZ..
11. VCO 3 Frequency Mode Switch: 'LF' position	11.1 The keyboard should no longer control the frequency of VCO 3. The period of the sawtooth should be between 10 and 50 seconds with the initial frequency slider in the fully left position.
12. Raise each of the VCO 3 F.M. (vertical) sliders one at a time.	12.1 The frequency change should correspond to the input voltage or waveform (see pictured examples).

1-4



5-11 STEPS 5 THROUGH 11 ARE THE SAME AS VCO 1

12



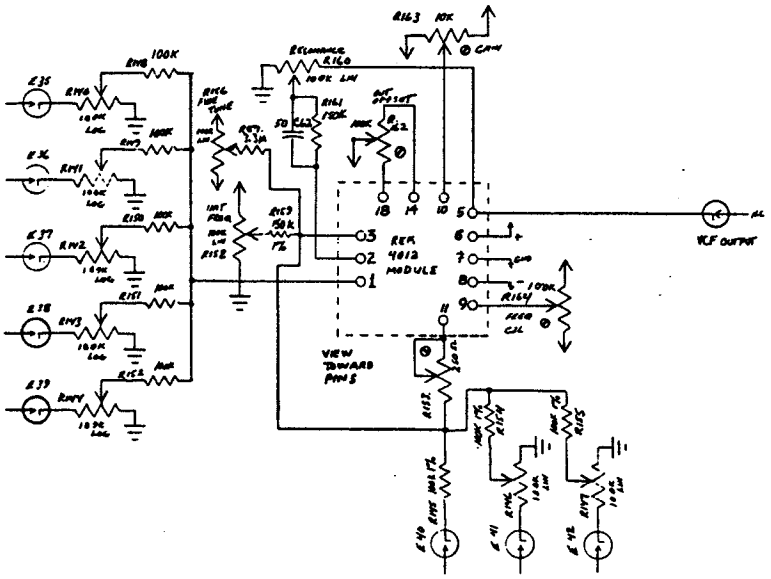
2.9.1 THE VOLTAGE CONTROLLED FILTER

The VCF is a 24db/octave low pass filter with a variable cutoff frequency (f_c) and resonance (Q). As the f_c is decreased, the higher harmonics of a signal are attenuated until only the fundemental frequency is audible. The f_c of the filter is variable from approximately 10Hz to 10KHz. When the f_c is set as high as possible the filter is said to be 'open' and will pass all audio and DC signals applied to its input. When the f_c is set to the lowest frequency, the filter is said to be 'closed' and it will completely attenuate all audio frequencies.

The f_c can be controlled manually by the Initial Frequency Slider and the Fine Tune Slider as well as by control voltage signals applied to the control inputs. The f_c range is adjustable from 10Hz to 10KHz without external inputs and can be made as low as 1Hz or as high as 20KHz with additional negative or positive control voltages. The keyboard is prewired to the VCF control input through the 1V/OCT trimmer which is tuned so that the f_c of the filter tracks the frequency of the oscillators.

The 'Q' (resonance) is controlled manually by the resonance slider. The resonance accentuates a narrow band of frequencies which produces a 'wow' effect when the f_c is varied. When the Q is at maximum, the VCF will oscillate, producing a sine wave, and can be used like the other voltage controlled oscillators.

The filter's five audio inputs are prewired to the Ring Modulator, VCO 1 square wave, VCO 2 pulse wave, VCO 3 sawtooth wave, and the noise generator.



2.9.2 THE VOLTAGE CONTROLLED FILTER CIRCUIT DESCRIPTION

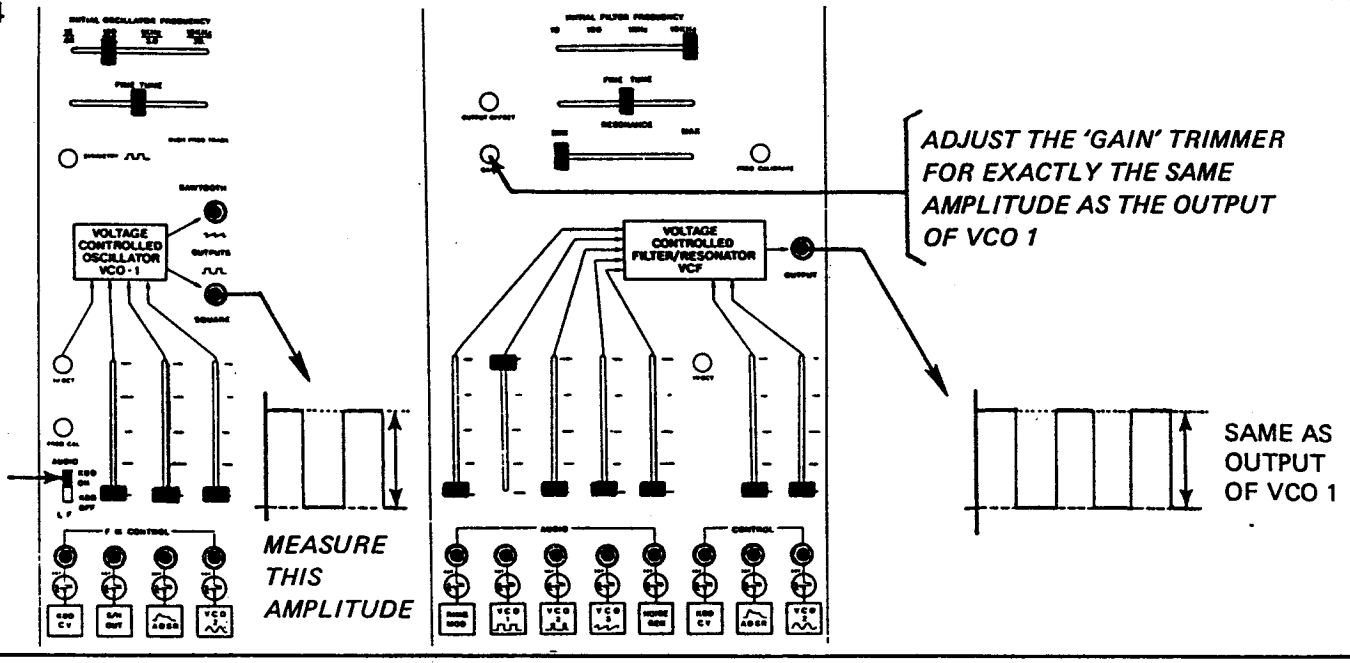
Audio signals enter the VCF Circuitry through the five audio attentuators. R140 through R144. Pin I of the 4012 module is the audio input summing junction. The output of the module is pin 5. The Resonance Slider, R160, allows some of the output signal to feed back into the input through pin 2. R163 CONTROLS THE GAIN OF THE VCF and R162 eliminates the DC from the output. The control voltages (or signals) enter the circuitry through the sliders R145 - R147. Pin 3 and 11 are the control inputs. R156 and R158, the Initial Frequency and Fine Tune Sliders, add voltage to the control inputs to increase the f_c. R164 sets the f_c when there are no external control signals. R153 (volts per octave) sets the sensitivity of the VCF so that it will track with the other oscillators.

TROUBLESHOOTING HINTS

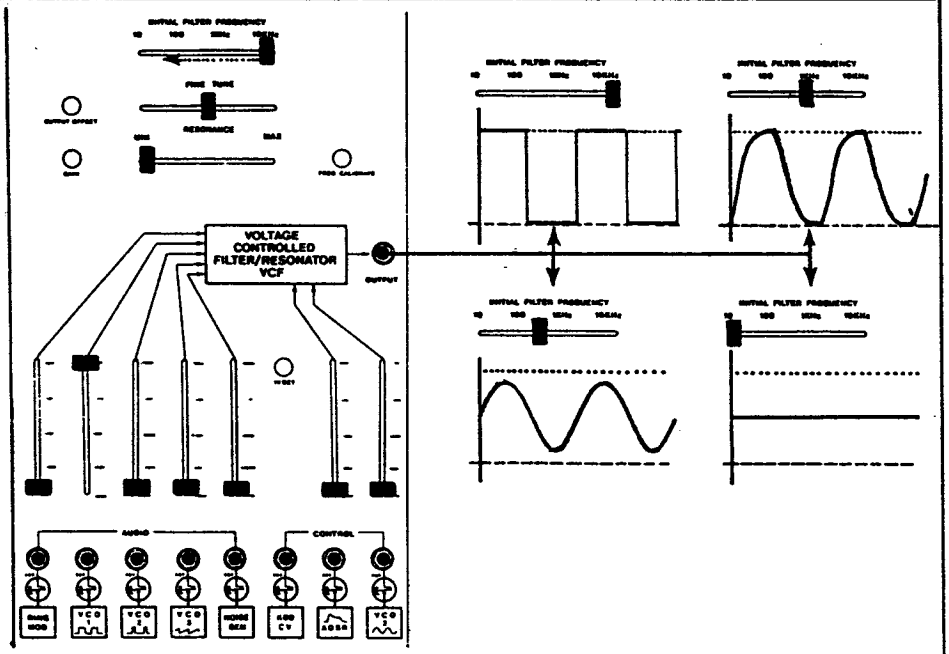
SYMPTOM	PROBLEM	REPAIR	LOCATION
OUTPUT OF VCF AT +15 VOLTS	VCF OUTPUT OFFSET' INCORRECTLY SET	SEE STEPS 7 THROUGH 9 IN CHECKOUT PROCEDURE	BOARD 3
SIGNALS DISTORT WHEN ALL THREE OSCILLATORS ARE USED TOGETHER	NO PROBLEM: VCF OVERDRIVEN	LOWER AUDIO INPUT SLIDERS TO ¾ UP	BOARD 3

2.9.3 VOLTAGE CONTROLLED FILTER	CHECKOUT PROCEDURE
SET UP: 1. Measure the exact amplitude of VCO 1's square wave output. (Set VCO 1 to about 100 HZ.) 2. VCF 'VCO 1' Audio input Slider: Raise fully. 3. VCF Initial Filter Frequency Slider: Fully right. 4. VCF Resonance Slider: Fully left.	CHECK: 4.1 The square wave should pass through the VCF with unity gain.
5. Turn the power off to the 2600 and disconnect the keyboard from the console. 6. VCF Initial Filter Frequency: Slowly move the slider from right to left.	6.1 The square wave should become rounded as the higher harmonics are filtered out. When the initial filter frequency slider setting falls below the frequency of the square wave, there should be 5 volts D.C. with no A.C. signal on the output of the VCF.
7. All VCF F.M. and Audio sliders (vertical sliders): Fully down 8. VCF Initial Filter Frequency: Midposition 9. VCF Resonance: Fully left *CONTINUED*	9.1 The output of the VCF should have no more than ½ volt D.C.

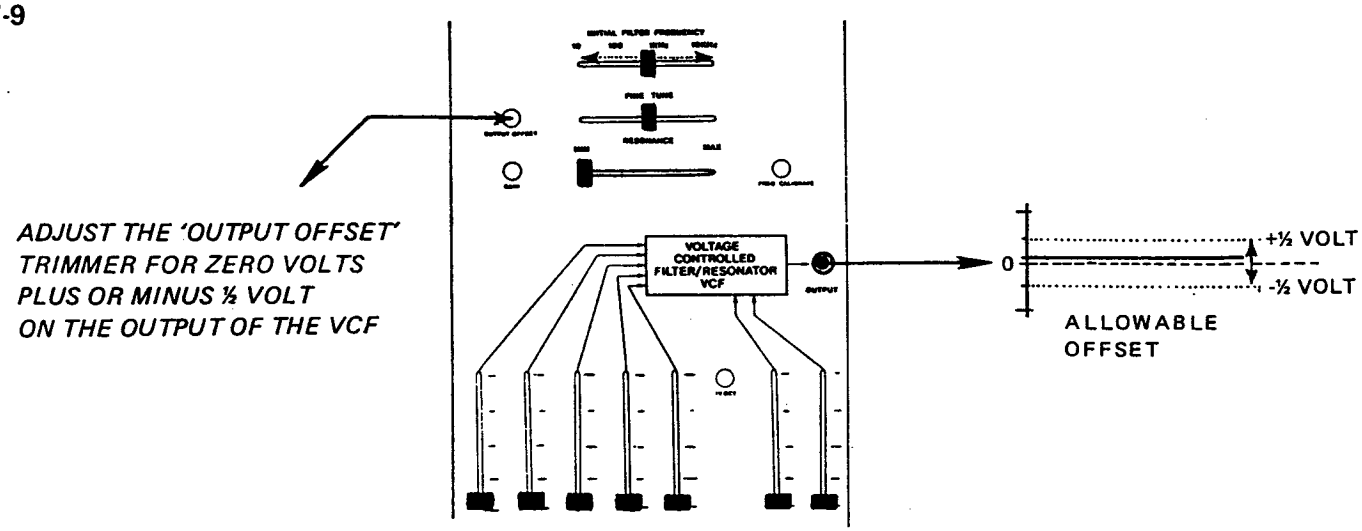
1-4


VOLTAGE CONTROLLED OSCILLATOR VCO-1
VOLTAGE CONTROLLED FILTER/RESONATOR VCF
MEASURE THIS AMPLITUDE
ADJUST THE 'GAIN' TRIMMER FOR EXACTLY THE SAME AMPLITUDE AS THE OUTPUT OF VCO 1
SAME AS OUTPUT OF VCO 1

5,6


VOLTAGE CONTROLLED FILTER/RESONATOR VCF

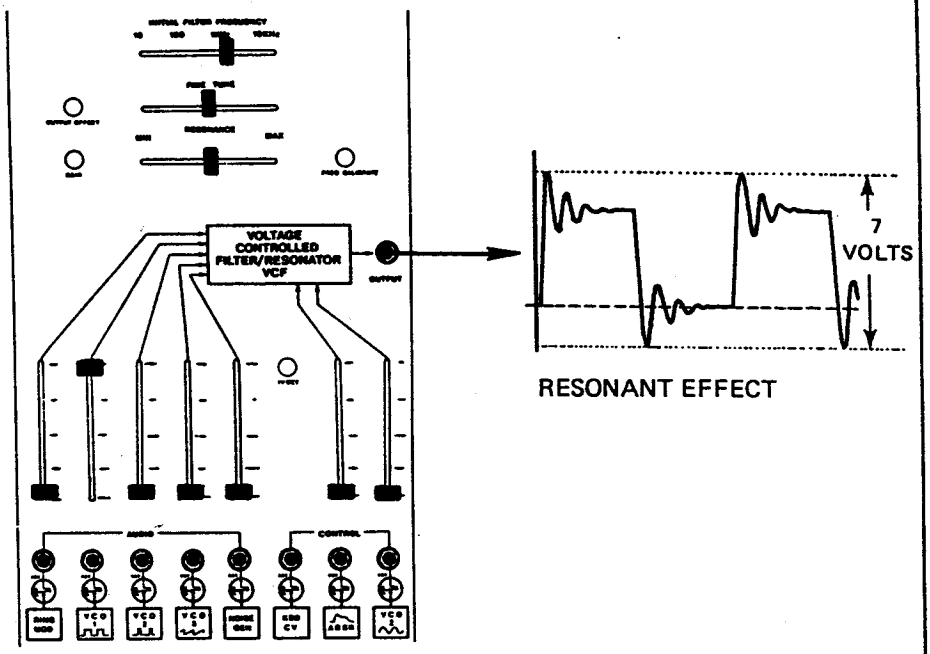
7-9


ADJUST THE 'OUTPUT OFFSET' TRIMMER FOR ZERO VOLTS PLUS OR MINUS ½ VOLT ON THE OUTPUT OF THE VCF
VOLTAGE CONTROLLED FILTER/RESONATOR VCF
0
+½ VOLT
-½ VOLT
ALLOWABLE OFFSET

2.9.3 VOLTAGE CONTROLLED FILTER (CONTINUED) CHECKOUT PROCEDURE

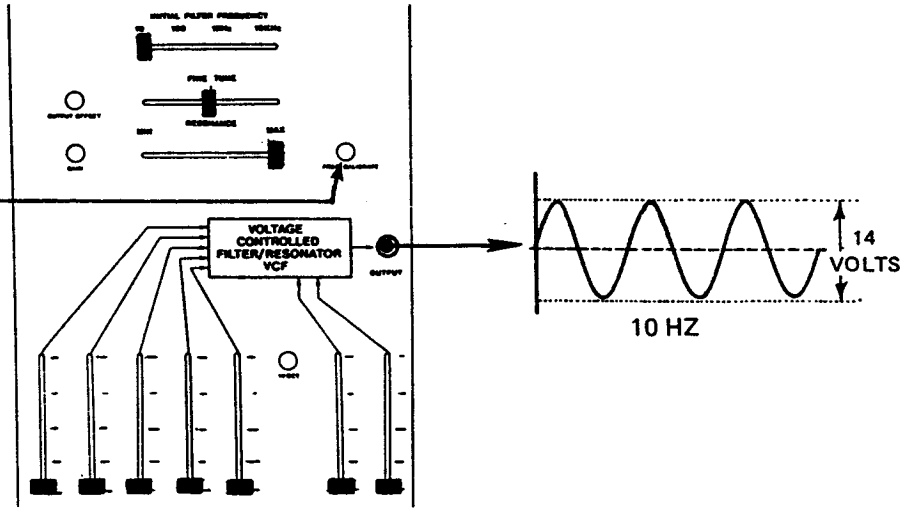
SET UP:	CHECK:
10. VCF 'VCO 1' Audio Input Slider: Raise Fully 11. VCF Initial Frequency Slider: Set to about 1KHZ., Resonance Slider: Midposition	11.1 The VCF should accent the harmonics of the square wave passing through it. When the initial filter frequency is moved to the left or right, the harmonic frequency should change accordingly.
12. VCF Initial Filter Frequency Slider: Fully left 13. VCF Resonance Slider: Fully right 14. VCF Fine Tune Slider: Midposition 15. All Other VCF Sliders: Fully down	15.1 The output of the VCF should be a 13-14 volt peak to peak sine wave with a frequency of about 10 HZ.
16. Turn off the power to the 2600 and reconnect the keyboard to the console. 17. Pin low 'C' on the keyboard (C1). 18.VCF Initial Filter Frequency and Fine Tune Sliders: Adjust for a 100 HZ. signal on the output of the VCF. 19. Pin: C2, C3, C4 one at a time. 20 Pin low 'C' on the keyboard. 21. VCF 'ADSR' Control Input slider: ¾ up. 22. Put the gate select slide switch in the upper position and push the manual start button.	19.1 The frequency of the sine wave on the output of the VCF should exactly double: C2 should produce 200 HZ., C3-400 HZ., and C4-800 HZ. 22.1 The frequency of the sine wave on the output of the VCF should sharply increase and then taper back to the original frequency.

10-11



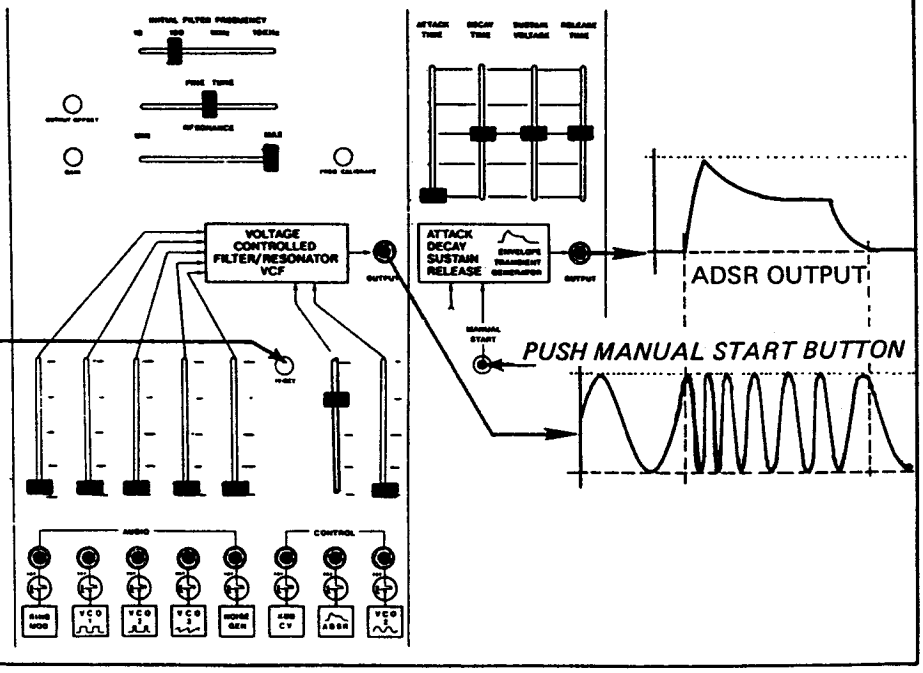
12-15

ADJUST THE 'VCF CAL' TRIMMER SO THE OUTPUT OF THE VCF IS A 10 HZ. SINE WAVE



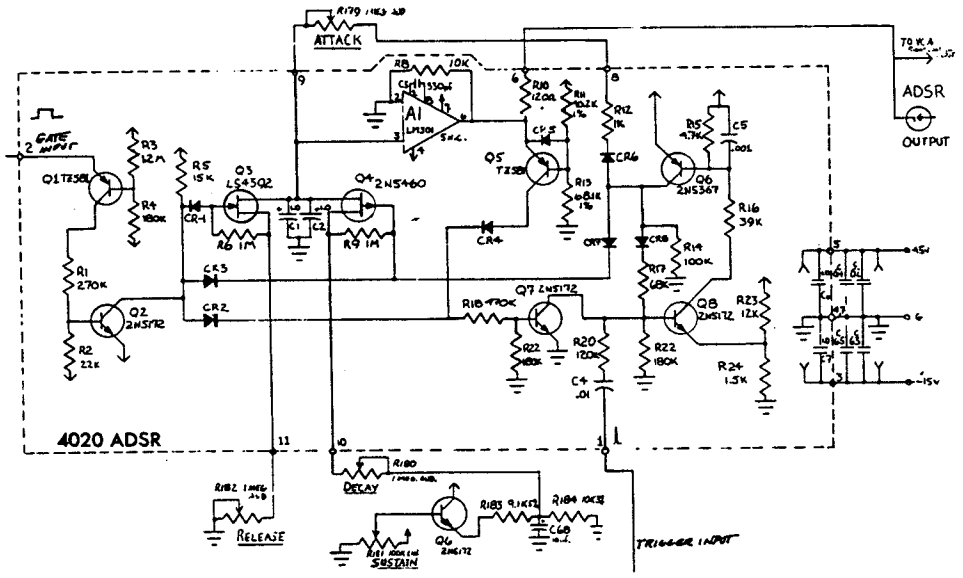
16-22

'VOLTS PER OCTAVE' TRIMMER: IF THE VCF FAILS STEP 19, SEE SECTION 3.5 FOR TUNING INSTRUCTIONS



2.10.1 ADSR FUNCTION DESCRIPTION

The Attack-Decay-Sustain-Release (ADSR) envelope generator produces control voltages with variable rise and fall times. It is used primarily to control the VCA and the VCF. When the ADSR is supplied with a gate and a trigger (from either the keyboard, internal clock, or the manual start button), the voltage first rises to ten volts (Attack) and then decreases to a predetermined level (Decay) and remains there (Sustain) while the gate signal is present. Finally, the voltage decreases to zero (Release) when the gate is removed. The attack time, initial decay, sustain level and the final release are each controlled by the four sliders on the front panel.



2.10.2 ADSR CIRCUIT DESCRIPTION

Q2 (4020 board) is turned off unless there is a gate signal present on pin 2 of the 4020 board. In this off state, Q2's collector voltage is high, which holds on Q7, the trigger enable. As long as Q7 is on, all trigger signals entering on pin 1 of the 4020 board are grounded out which prevents the ADSR from initiating an attack when no gate is present. When a key (or the manual start button) is depressed, the gate signal turns on Q2 through Q1. The voltage on the collector of Q2 drops to -15 volts, Q3 turns off, and Q7 turns off which allows the trigger signal to enter through C4 and R20. The keyboard trigger, which is delayed by the keyboard electronics, arrives on the base of Q8 (4020 board) 15 milliseconds after the rise of the gate voltage. The trigger turns on Q8 which turns on Q6. The collector of Q6 rises and latches Q8 and Q6 on through CR8. The voltage on the collector of Q6 also travels through CR6, R12 and R179 (attack slider) and begins to charge up C1 and C2. A1 buffers and follows the voltage level on C1 and C2; when the voltage reaches +10 volts, Q5 turns on which turns on Q7 through CR4 and R18. Q7 then grounds out the voltage on the base of Q8 thus unlatching Q8 and Q6. When Q6 turns off, CR7 is reversed biased which allows Q4 to turn on. The +10 volts on C1 and C2 discharges through the decay slider, R180, to the voltage level present on C68 (on board 4). Q6 (on board 4) holds C68 to a voltage level determined by the position of the sustain slider, R181. When the gate voltage is removed, Q2 turns off and the voltage on the collector of Q2 rises which turns off Q4 through CR3 and turns on Q3 through CR1. The remaining voltage on C1 and C2 discharges to ground through the release slider, R182.

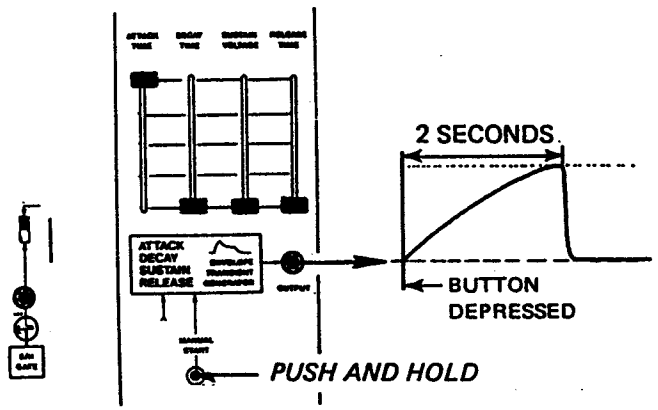
TROUBLESHOOTING HINTS

SYMPTOM	PROBLEM	REPAIR	LOCATION
SUSTAIN AT MAXIMUM REGARDLESS OF SLIDER POSITIONS	Q6, BOARD 4, SHORTED	REPLACE Q6	BOARD 4, UNDER 4020 BOARD
OUTPUT OF ADSR LOCKED UP AT +15 VOLTS	FOIL SHORT CAUSED BY RETAINING STRIP ALONG THE TOP OF THE 1,2,3 & 4 BOARDS	CLEAN FOIL	BOARD 4, UPPER LEFT CORNER (AS VIEWED FROM THE OUTSIDE)
ADSR NOT GETTING TRIGGER INTERNALLY	Q7 SHORTED	REPLACE Q7	4020 BOARD

2.10.3 ADSR ENVELOPE GENERATOR — CHECKOUT PROCEDURE

SET UP:	CHECK:
1. ADSR Slider Positions: Attack up, Decay down, Sustain down, Release down	
2. Gate Select Switch: Up	
3. Depress the manual start button.	3.1 The output of the ADSR should slowly rise to +10 volts (about 2 seconds) and then drop immediately to zero.
4. ADSR Slider Positions: Attack down, Decay up, Sustain down, release down.	
5. Depress the manual start button.	5.1 The output of the ADSR should immediately rise to +10 volts and fall slowly to zero (about 4 seconds).
6. ADSR Slider Positions: Attack down, Decay down, Sustain up, Release down	
7. Depress the manual start button.	7.1 The output of the ADSR should immediately rise to +10 volts and stay there until the button is released. The voltage should then drop immediately to zero.
8. ADSR Slider Positions: Attack down, Decay down, Sustain up, Release up	
9. Depress the manual Start button.	9.1 The output of the ADSR should immediately rise to +10 volts and stay there until the manual start button is released. The voltage should then slowly decrease to zero (about 4 seconds).
10. Gate Select Switch: Down	
11. All ADSR Sliders: Fully down	
12. Clock Rate Slider: Adjust for about a 50 millisecond period on the clock output.	12.1 The output of the ADSR should have a waveform similar to the illustration on the right.

1-3



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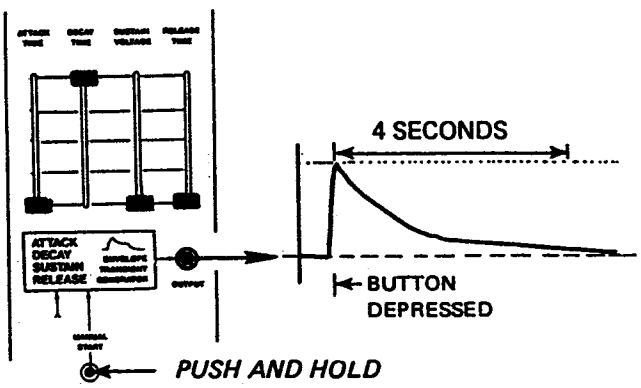

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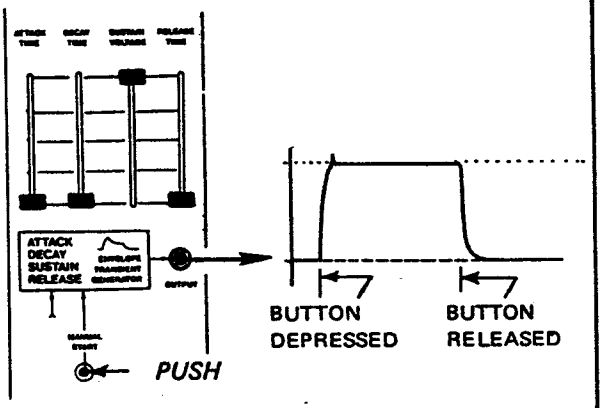

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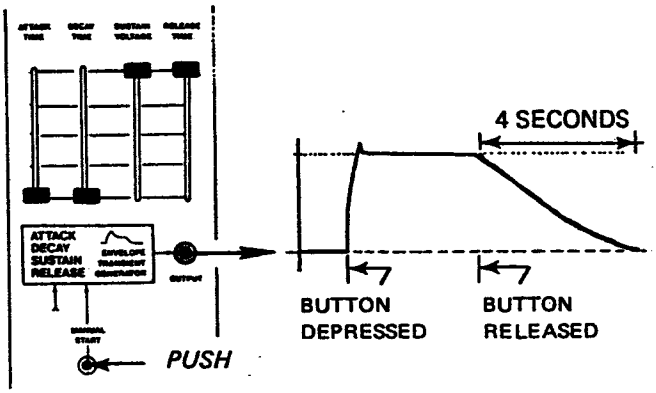
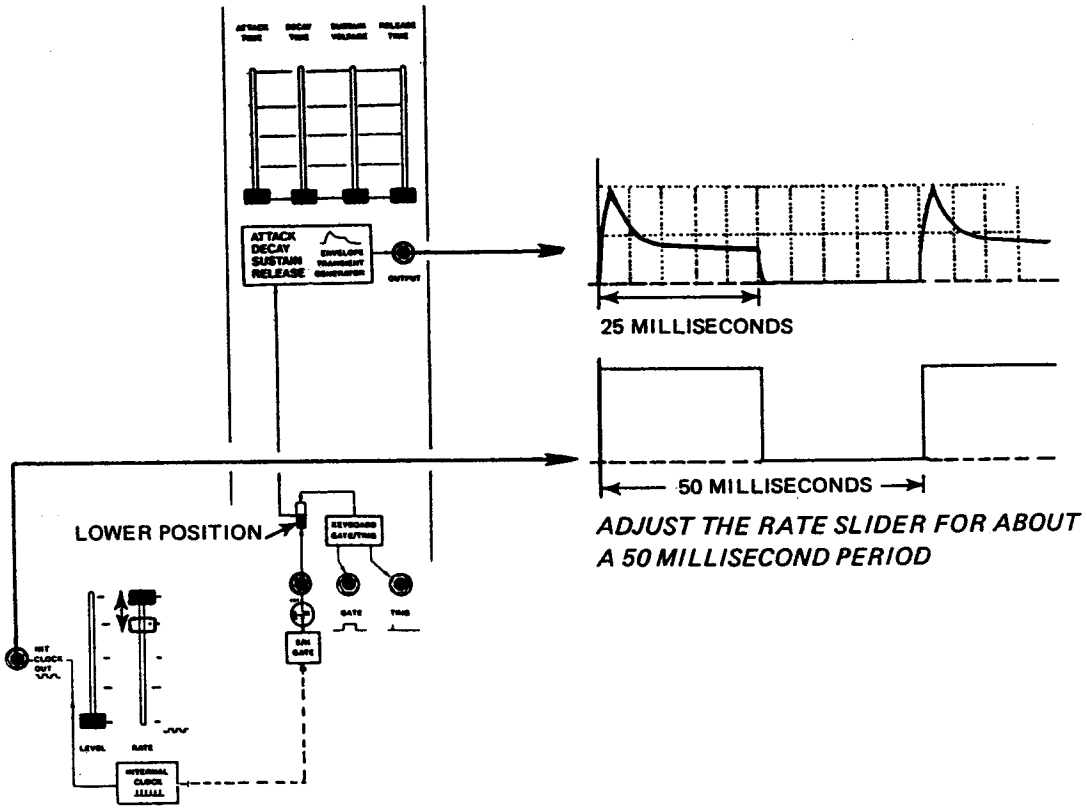
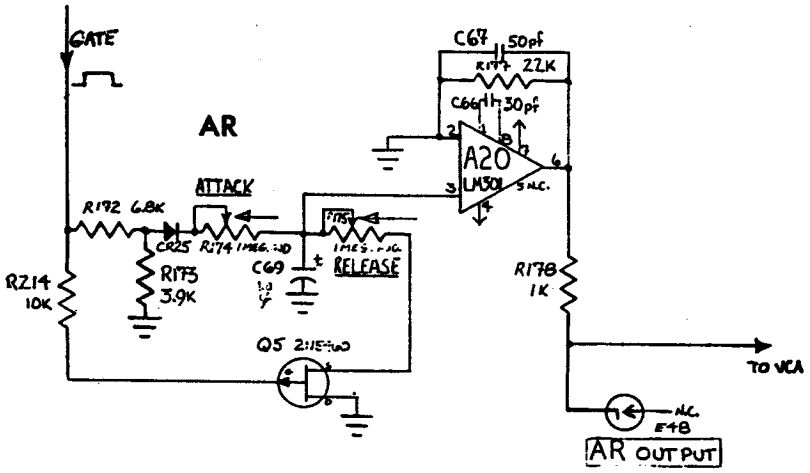


10-12



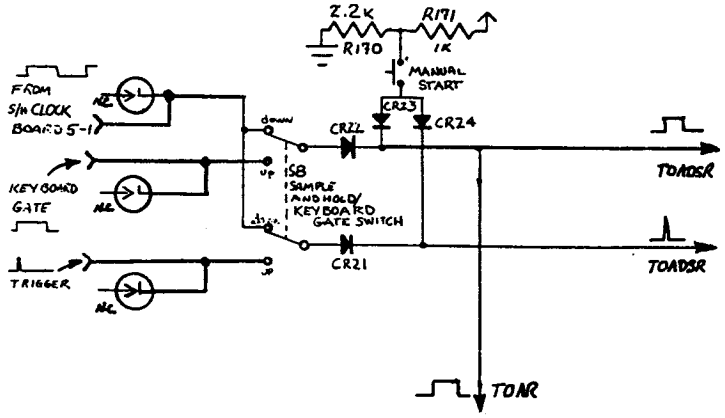
2.11.1 AR ENVELOPE GENERATOR FUNCTION DESCRIPTION

The Attack-Release (AR) envelope generator produces control voltages with variable rise and fall times. It is used primarily to control the VCA. When the AR is supplied with a Gate signal from the manual start button, keyboard or internal clock, the output rises to 10 volts and stays at that level for the duration of the gate signal. When the gate is no longer present, the voltage decreases to zero. The attack time and the release time are manually controllable by the sliders on the front panel.



2.11.2 AR ENVELOPE GENERATOR CIRCUIT DESCRIPTION

The gate voltage passes through R172, CR25 and the attack slider (R174) and charges C69 to 10 volts. The charge time is determined by the position of the Attack Slider, R174. At the same time, the gate signal turns off Q5 through R214 so that C69 cannot discharge through it while the gate is present. When the gate is no longer present, Q5 turns on and C69 discharges through Q5 and the Release Slider, R175. A20 follows the voltage level on C69 and buffers it from the output.

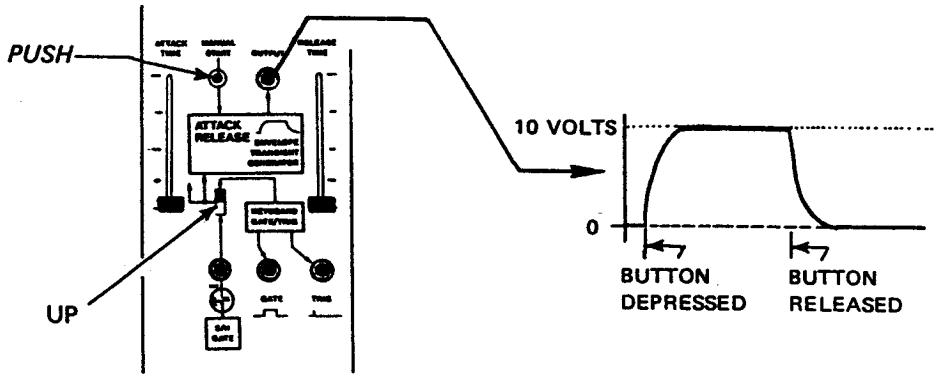


The Gate Select slide switch (located under the AR envelope generator) selects the gate and trigger signal source for the two envelope generators. In the upper position, the switch selects the keyboard gate and trigger; in the lower position, the switch selects the gate from the input jack., which is prewired to the internal clock squarewave output. A third gate/trigger source is the manual start button; when depressed, it produces a 10 volt gate signal at the junction of CR22 and CR23. A trigger is derived from the rising edge of the gate signal by C4 (on the 4020 board). The keyboard supplies the trigger separately so the ADSR can be re-initiated even while the key is held down.

2.11.3 AR ENVELOPE GENERATOR — CHECKOUT PROCEDURE

SET UP:	CHECK
1. AR Slider Positions: Both down 2. Gate Select Switch: Up 3. Depress the manual start button.	3.1 The output of the AR should immediately rise to +10 volts and stay there until the manual start button is released. The voltage should then immediately fall to zero.
4. AR Slider Positions: Attack up, Release down 5. Depress the manual start button.	5.1 The output of the AR should slowly rise to +10 volts (about 4 seconds) and stay there until the manual start button is released. The voltage should then immediately fall to zero.
6. AR Slider Positions: Attack down, Release up 7. Depress the manual start button.	7.1 The output of the AR should immediately rise to +10 volts and stay there until the manual start button is released. The voltage should then slowly decrease to zero (about 2.5 seconds).
8. AR Slider Positions: Both down 9. Gate Select Switch: Down 10. Clock Rate Slider: Adjust for about a 50 millisecond period on the clock output.	10.1 The output of the AR should be similar to the illustration on the right.

1-3



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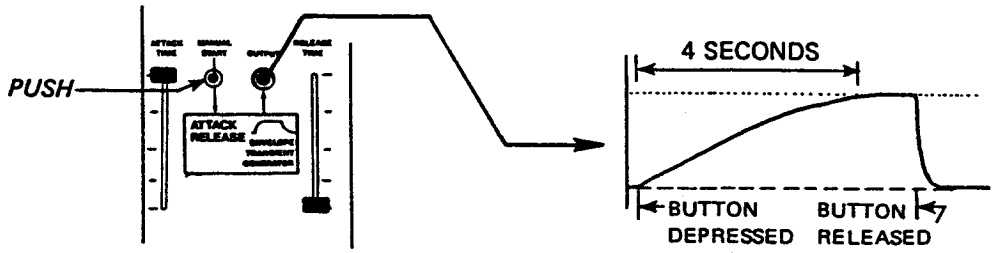

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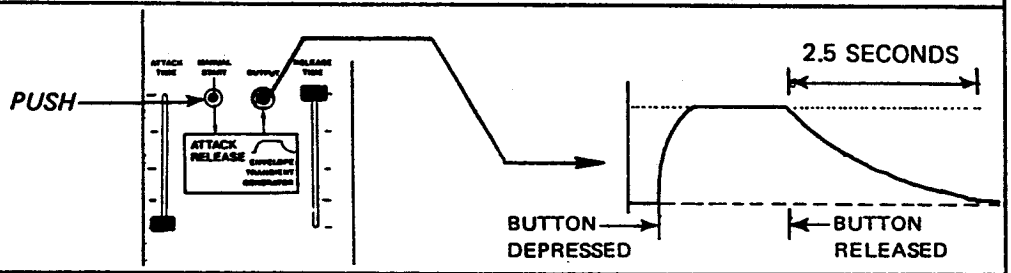
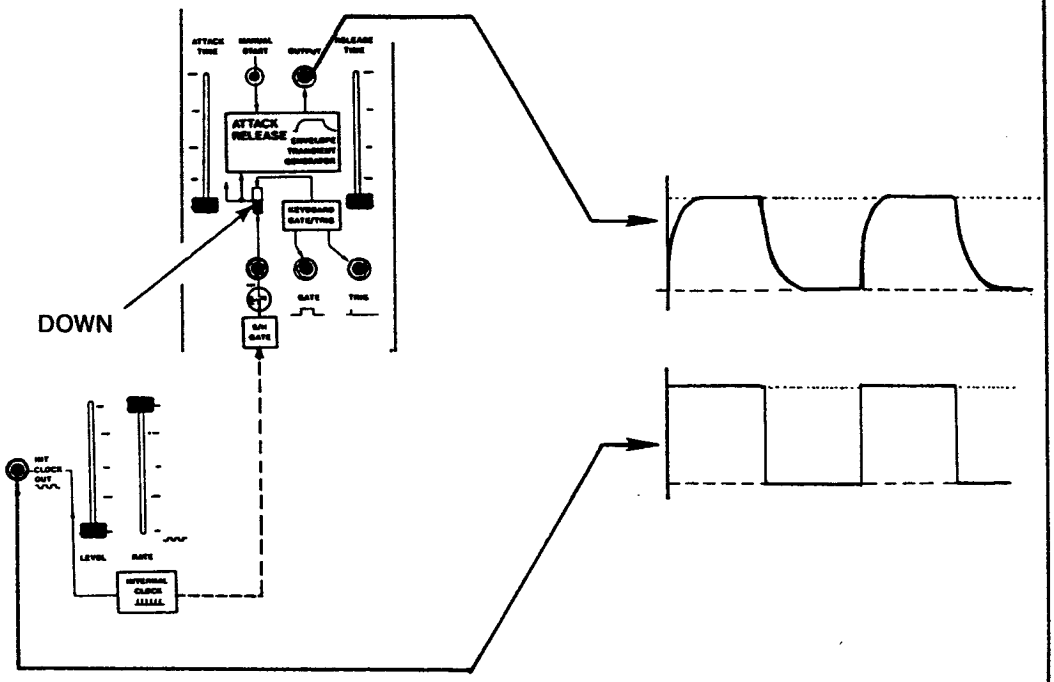


8-10

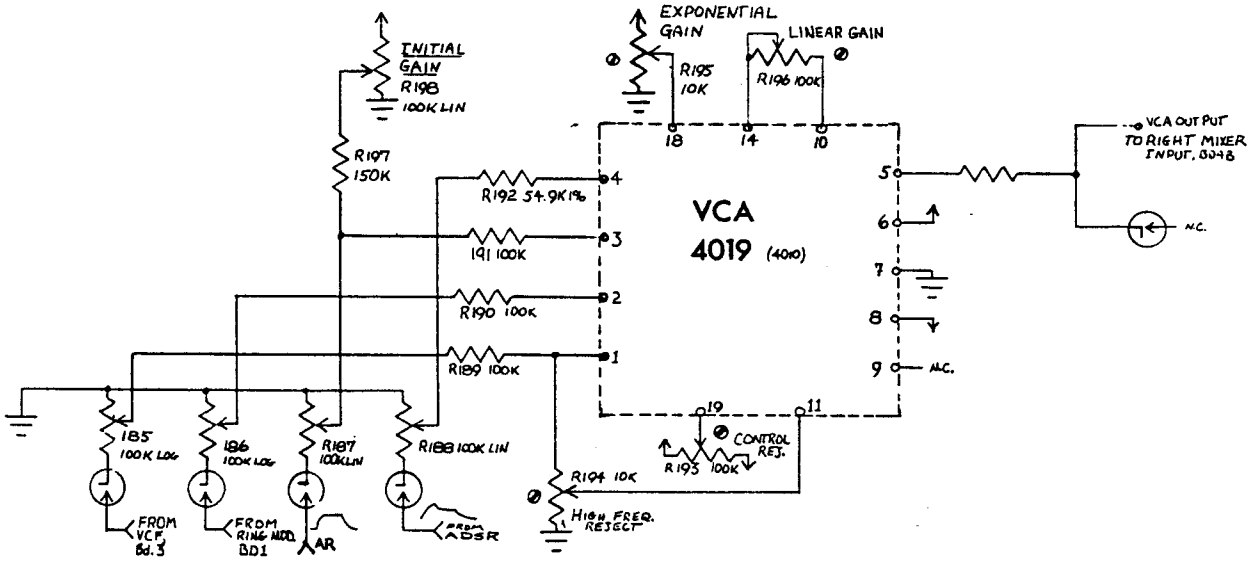


ADJUST THE RATE SLIDER FOR ABOUT A 50 MILLISECOND PERIOD

2.12.1 VOLTAGE CONTROLLED AMPLIFIER FUNCTION DESCRIPTION

The VCA controls the amplitude of a signal passing through it. When the initial gain slider on the front panel is at maximum, the signal will pass through the VCA with no change in amplitude (unity gain). If the gain slider is at a minimum, no signal will pass through the VCA unless a positive control voltage is applied to either of the two control inputs. The sensitivity of the left control input is linear but the response of the right control input is exponential. The left control input is prewired to the AR and the right control input is prewired to the ADSR output.

There are two audio inputs to the VCA; the left input is noninverting and the right audio input is inverting. Thus, a positive going sawtooth wave applied to the right audio input produces a negative going sawtooth wave on the output of the VCA. The left audio input is prewired to the VCF output and the right audio input is prewired to the Ring Modulator output.



2.12.2 VCA CIRCUIT DESCRIPTION

Pin 1 is the noninverting audio input and pin 2 is the inverting audio input of the 4019 module. Pin 3 is the linear control input and pin 4 is the exponential control input. R196, the linear gain trimmer, sets the sensitivity of the linear input and R195, the exponential gain trimmer, sets the sensitivity of the exponential control input (this trimmer is always set in the fully clockwise position). R198, the initial gain slider, adds voltage to the linear control input to allow signals to pass through the VCA without external control voltages. The control reject trimmer, R193, eliminates any leakage of the control voltage into the output of the VCA. The high frequency reject trimmer, R194, is designed to minimise unwanted high frequency noise from the output of the VCA. Often there is too little high frequency noise to warrent adjustment of this trimmer. Pin 5 of the 4019 module is the audio output of the VCA.

TROUBLESHOOTING HINTS:

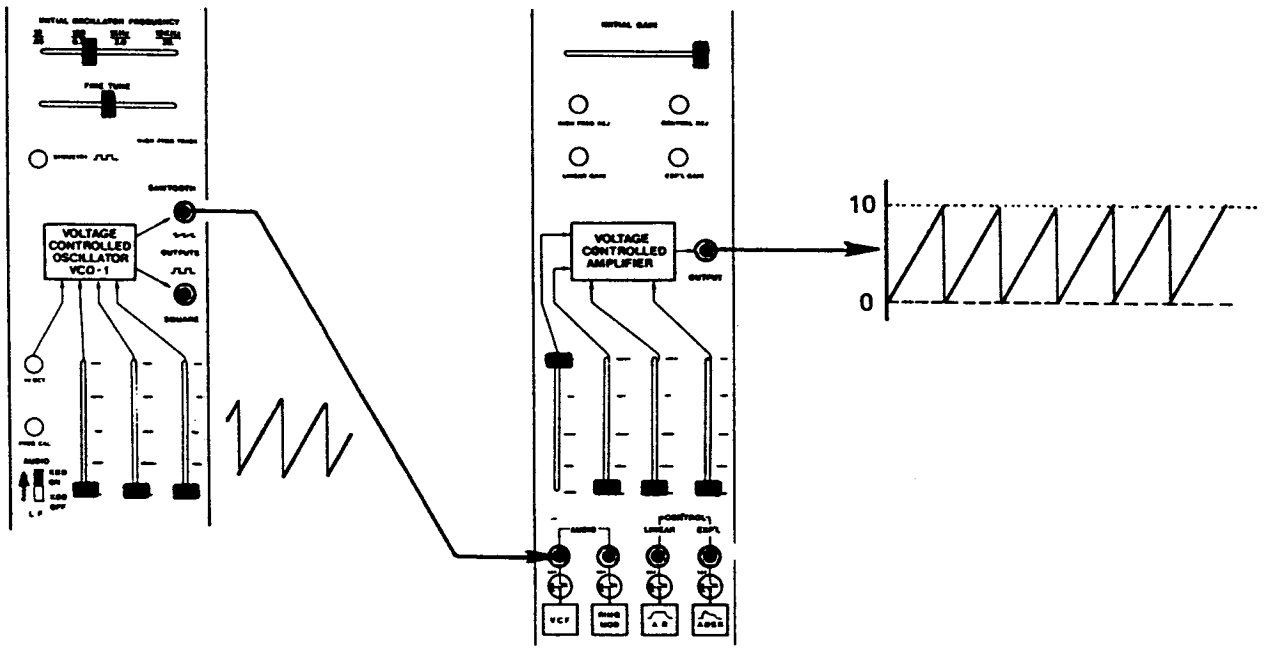
SYMPTOM	PROBLEM	REPAIR	LOCATION
VCA LOCKED UP AT +15 VOLTS	4019 MODULE SHORTED INTERNALLY	REPLACE THE 4019 MODULE	BOARD 4
VCA CLIPS (DISTORTS) WHEN ADSR IS USED	NO PROBLEM: EXPONENTIAL INPUT SLIDER UP TOO FAR	LOWER RIGHT CONTROL SLIDER TO ¾ UP	BOARD 4 (PANEL)

2.12.3 VOLTAGE CONTROLLED AMPLIFIER — CHECKOUT PROCEDURE

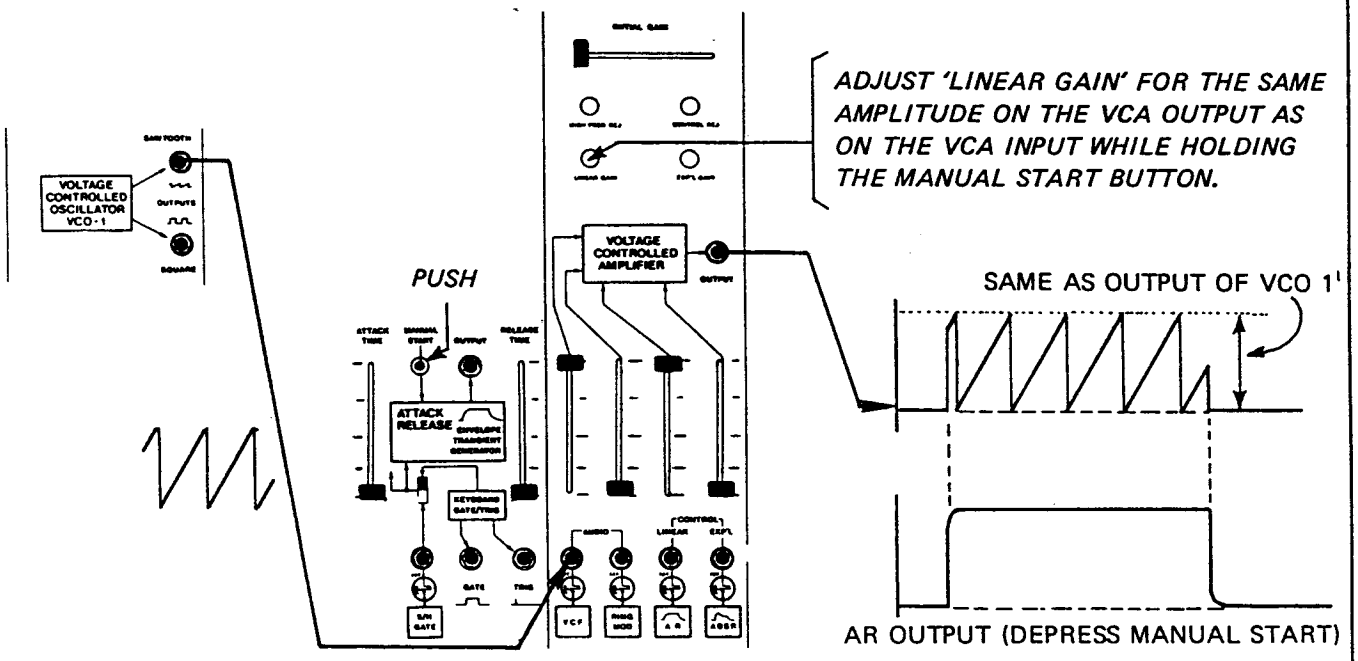
SET UP:	CHECK:
1. Patch: From VCO 1 sawtooth output to the left VCA audio input.slider 2. Left Audio Input Slider: Up fully 3. VCA Initial Gain Slider: Fully right 4. All other VCA sliders: Down	4.1 The output of the VCA should be the same as the signal on the input of the VCA.
5. VCA Initial Gain Slider: Fully left 6. AR Envelope Generator Sliders: Both fully down 7. Left VCA Control Input Slider: Up fully.	7.1 The signal from VCO 1 should pass through the VCA only while the manual start button is depressed. The amplitude of the signal on the output of the VCA should be the same as the amplitude of the input signal.
8. VCA Audio Input Sliders: Lower the left audo input slider, raise the right input slider. 9. Patch: From VCO 1 sawtooth output to the right audio VCA audio input. 10. Depress and hold the manual start button.	10.1 The output of the VCA should be an inverted sawtooth, 10 volts peak to peak.

CONTINUED

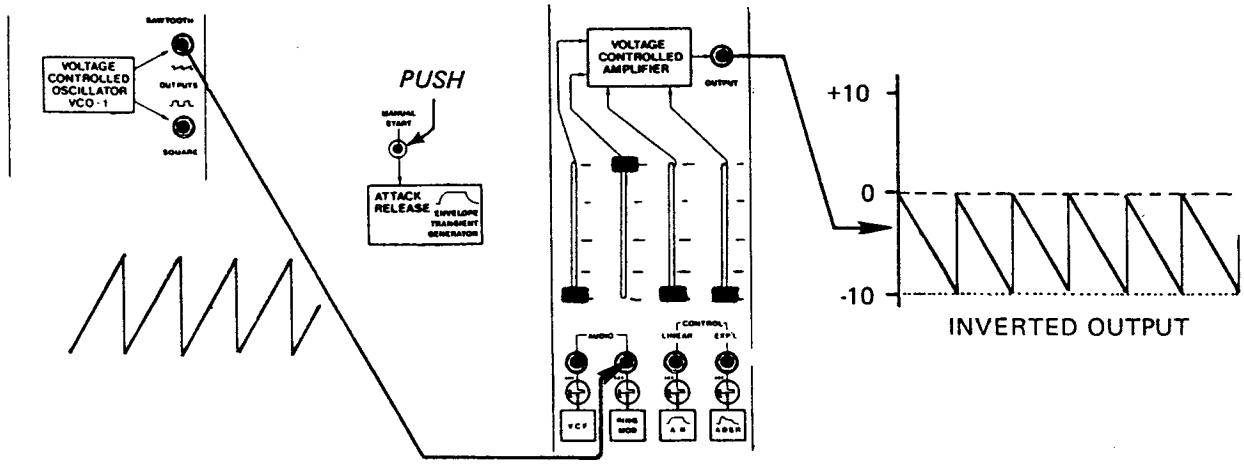
1-4


VOLTAGE CONTROLLED OSCILLATOR VCO-1
VOLTAGE CONTROLLED AMPLIFIER
10
0

5-7


VOLTAGE CONTROLLED OSCILLATOR VCO-1
VOLTAGE CONTROLLED AMPLIFIER
PUSH
ATTACK RELEASE
ADJUST 'LINEAR GAIN' FOR THE SAME AMPLITUDE ON THE VCA OUTPUT AS ON THE VCA INPUT WHILE HOLDING THE MANUAL START BUTTON.
SAME AS OUTPUT OF VCO 1
AR OUTPUT (DEPRESS MANUAL START)

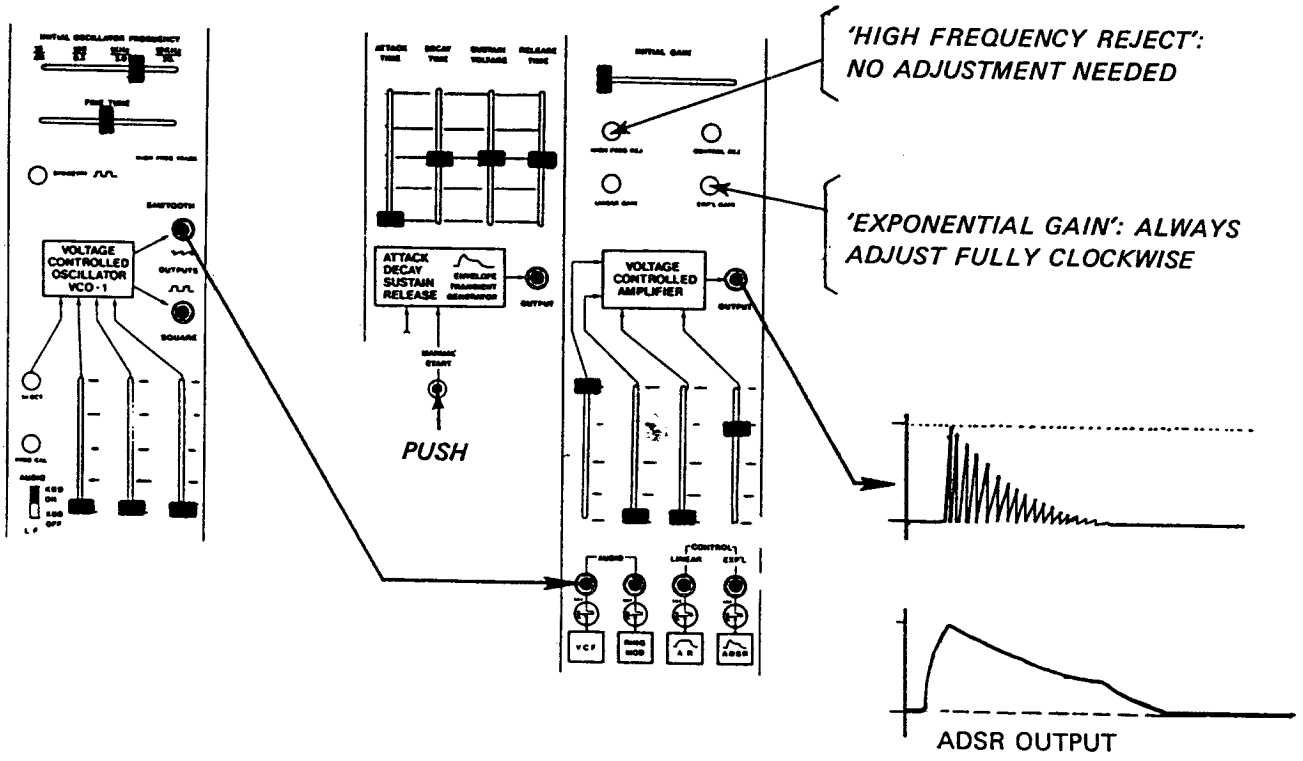
8-10


VOLTAGE CONTROLLED OSCILLATOR VCO-1
PUSH
ATTACK RELEASE
VOLTAGE CONTROLLED AMPLIFIER
+10
0
-10
INVERTED OUTPUT

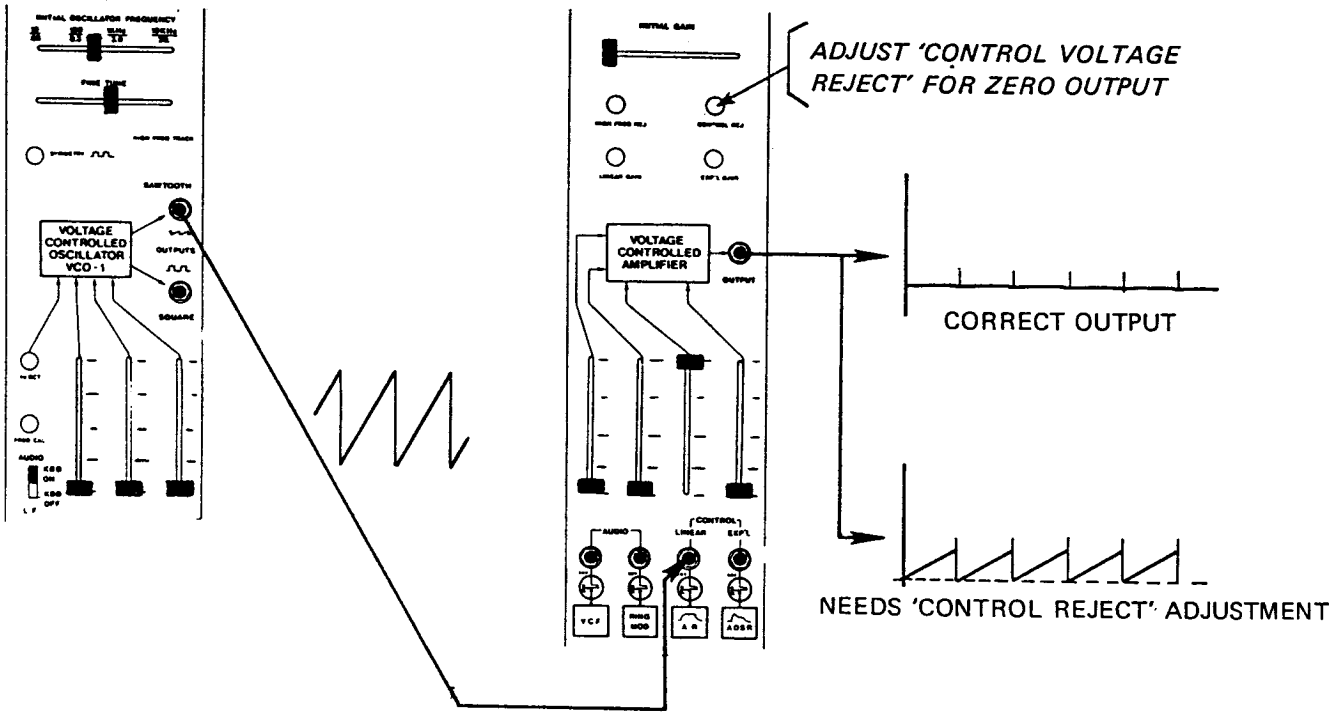
2.12.3 VOLTAGE CONTROLLED AMPLIFIER (CONTINUED)

SET UP:	CHECK:
11. ADSR Slider Positions: Attack down, Decay ½, Sustain ½, Release ½ 12. Left VCA Control Input Slider: Down 13. Right VCA Control Input Slider: Up 14. Patch: From VCO 1 sawtooth output to the left VCA audio input. 15. Left VCA Audio Input Slider: Up 16. Right Audio Input Slider: Down	16.1 The output of the VCA should be a pulse of the signal from VCO 1 when the manual start button is first depressed. If the signal clips when the button is depressed, lower the right control slider slightly.
17. Patch: From VCO 1 sawtooth output to the left VCA control input. 18. All other VCA sliders: Fully down.	18.1 The output of the VCA should be zero. (Check with a sensitive range on an oscilloscope.)

11-16

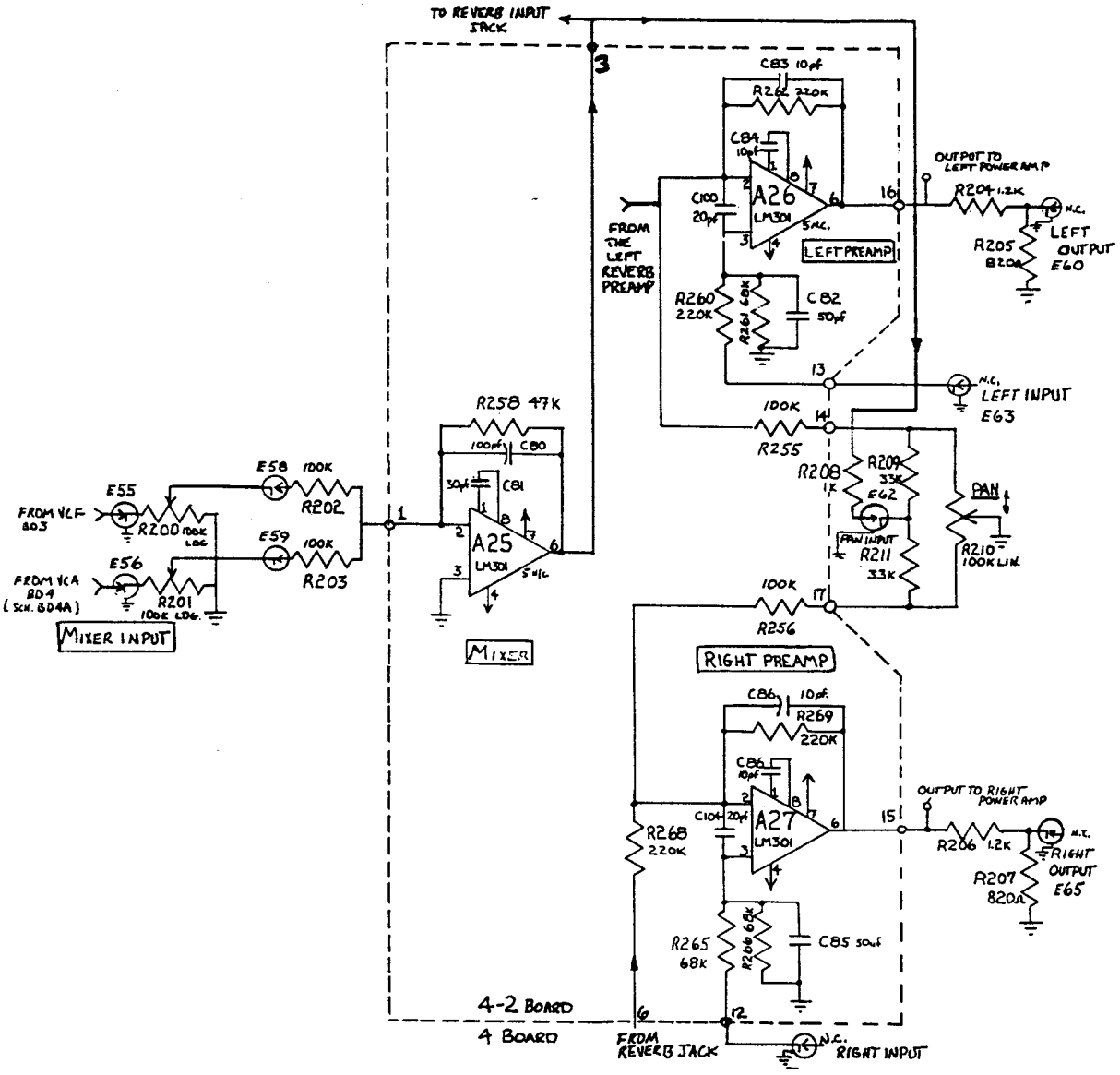

'HIGH FREQUENCY REJECT': NO ADJUSTMENT NEEDED
'EXPONENTIAL GAIN': ALWAYS ADJUST FULLY CLOCKWISE
VOLTAGE CONTROLLED OSCILLATOR VCO-1
ATTACK DECAY SUSTAIN RELEASE
VOLTAGE CONTROLLED AMPLIFIER
PUSH
ADSR OUTPUT

17-18


ADJUST 'CONTROL VOLTAGE REJECT' FOR ZERO OUTPUT
VOLTAGE CONTROLLED OSCILLATOR VCO-1
VOLTAGE CONTROLLED AMPLIFIER
CORRECT OUTPUT
NEEDS 'CONTROL REJECT' ADJUSTMENT

2.13.1 MIXER AND PAN FUNCTION DESCRIPTION

The Mixer is a general purpose mixer useful for audio or DC signals. Its ouput goes directly to the Pan Slider through the Pan output jack and to the reverberator input. The two inputs of the mixer are prewired to the VCF and the VCA. The jacks above the mixer input sliders will disconnect the slider from the mixer input when a patch cord is inserted so that the slider can be used as general purpose attenuators in other functions of the 2600. The outputs of the pan slider go to the left and right preamplifiers.



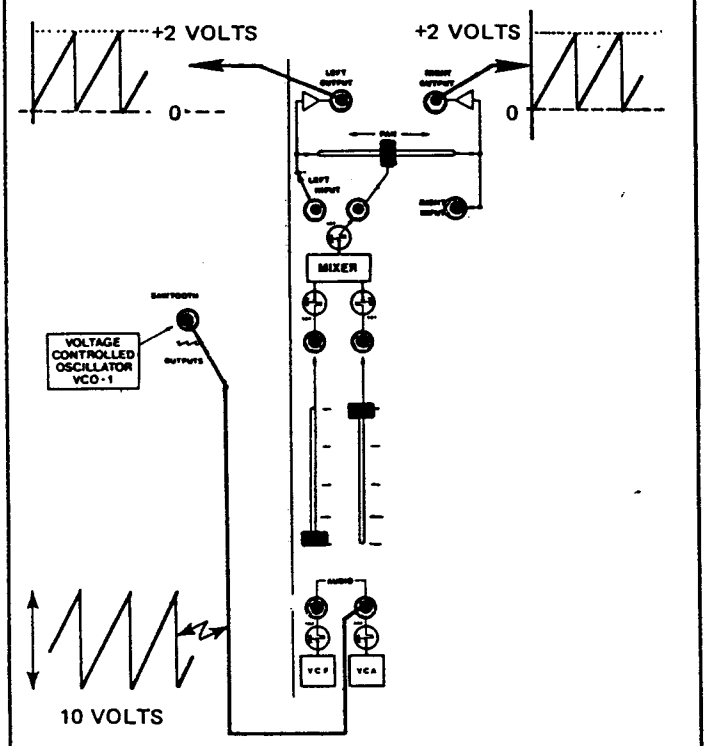
2.13.2 MIXER AND PAN CIRCUIT DESCRIPTION

Signals enter the mixer circuitry through either slider R200 or R201. The signals then pass through R202 and R203 into the inverting input (pin 2) of A25 on the 4-2 board. The signal then goes to the Pan slider and to the Reverberator input jack. At the Pan Slider, the signal splits into two channels; left and right. When the Pan Slider is moved from left to right the arm of the slider grounds our right channel and then the left thus producing a pan effect. The right signal passes through R256 into the inverting input (pin 2) of A27. A27 buffers and amplifies the signal and delivers it to the right output jack and also to the right power amplifier for the right internal speaker. In the same manner, the left channel signal leaves the Pan Slider through R255 and enters the inverting input jack and to the left power amplifier for the left internal speaker.

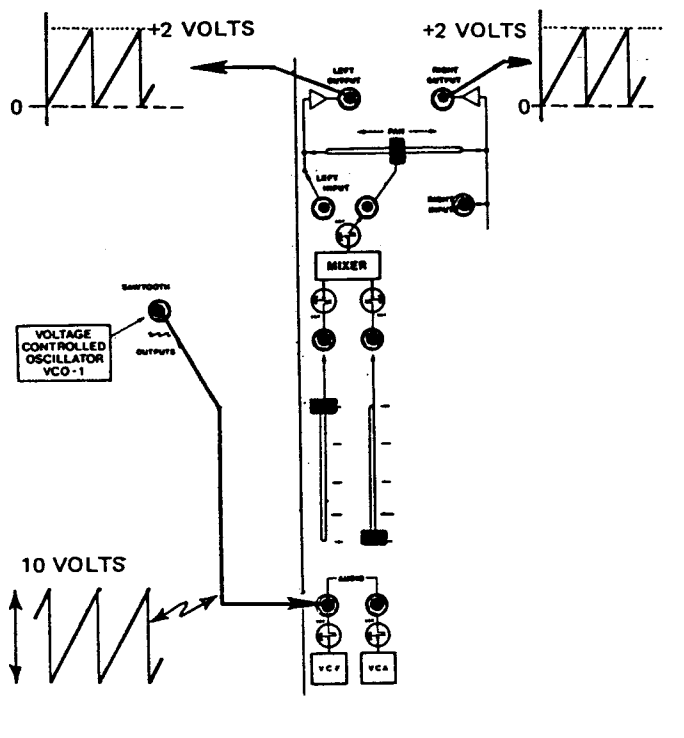
2.13.3 MIXER & PAN

SET UP:	CHECK:
1. Patch: From VCO 1 sawtooth output to the right mixer input	
2. Mixer Slider Positions: Right slider up, left slider down	
3. Pan slider: Midposition	3.1 Both the left and right output jacks should be a 2 volt peak to peak sawtooth wave.
4. Patch: From VCO 1 sawtooth output to the left mixer input.	
5. Mixer Slider Positions: Right slider down, left slider up	5.1 Both the left and right output jacks should be a 2 volt peak to peak sawtooth wave.
6. Patch: From VCO 1 sawtooth output to the pan input jack	
7. Pan Slider: Fully left	7.1 The right output jack should be zero volts and the left output jack should be a 5 volt peak to peak inverted sawtooth wave.
8. Pan Slider: Fully right	8.1 The left output jack should be zero volts and the right output jack should be a 5 volt peak to peak inverted sawtooth wave.
9. Patch: From VCO 1 sawtooth output to the left input jack.	9.1 The left output jack should be a 4 volt peak to peaksawtooth wave.
10. Patch: From VCO 1 sawtooth output to the right input jack	10.1 The right output jack should be a 4 volt peak to peak sawtooth wave.

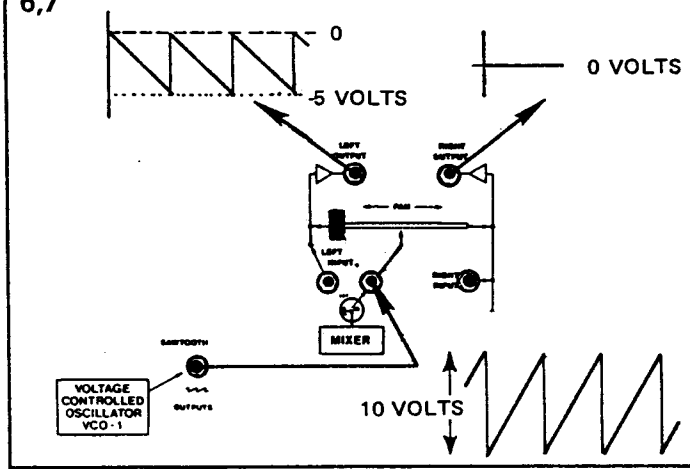
1-3


+2 VOLTS
+2 VOLTS
0
0
MIXER
VOLTAGE CONTROLLED OSCILLATOR VCO-1
10 VOLTS

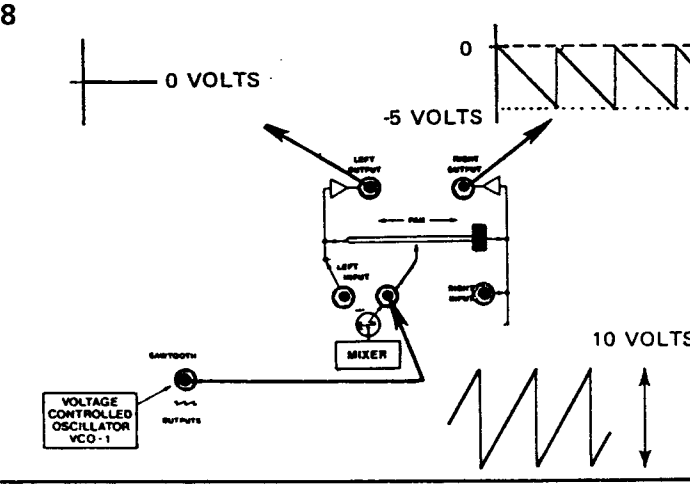
4,5


+2 VOLTS
+2 VOLTS
0
0
MIXER
VOLTAGE CONTROLLED OSCILLATOR VCO-1
10 VOLTS

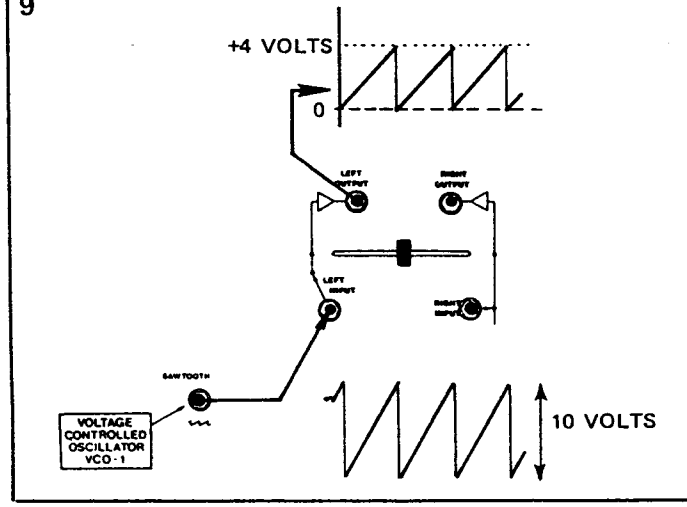
6,7


0
0 VOLTS
-5 VOLTS
MIXER
VOLTAGE CONTROLLED OSCILLATOR VCO-1
10 VOLTS

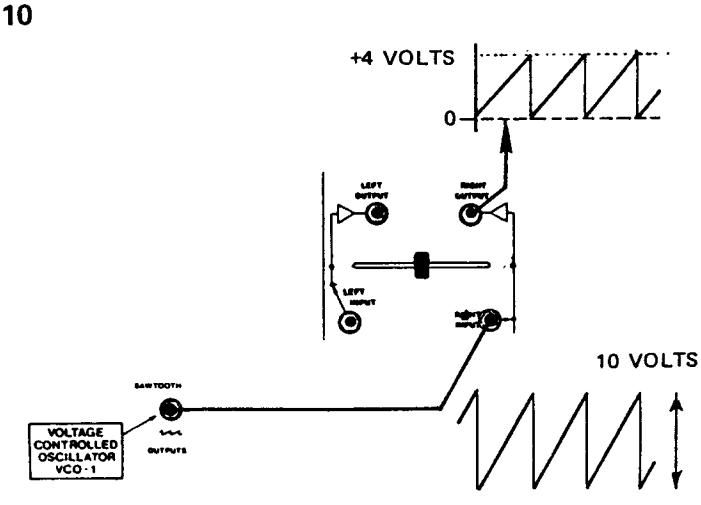
8


0 VOLTS
0
-5 VOLTS
MIXER
VOLTAGE CONTROLLED OSCILLATOR VCO-1
10 VOLTS

9

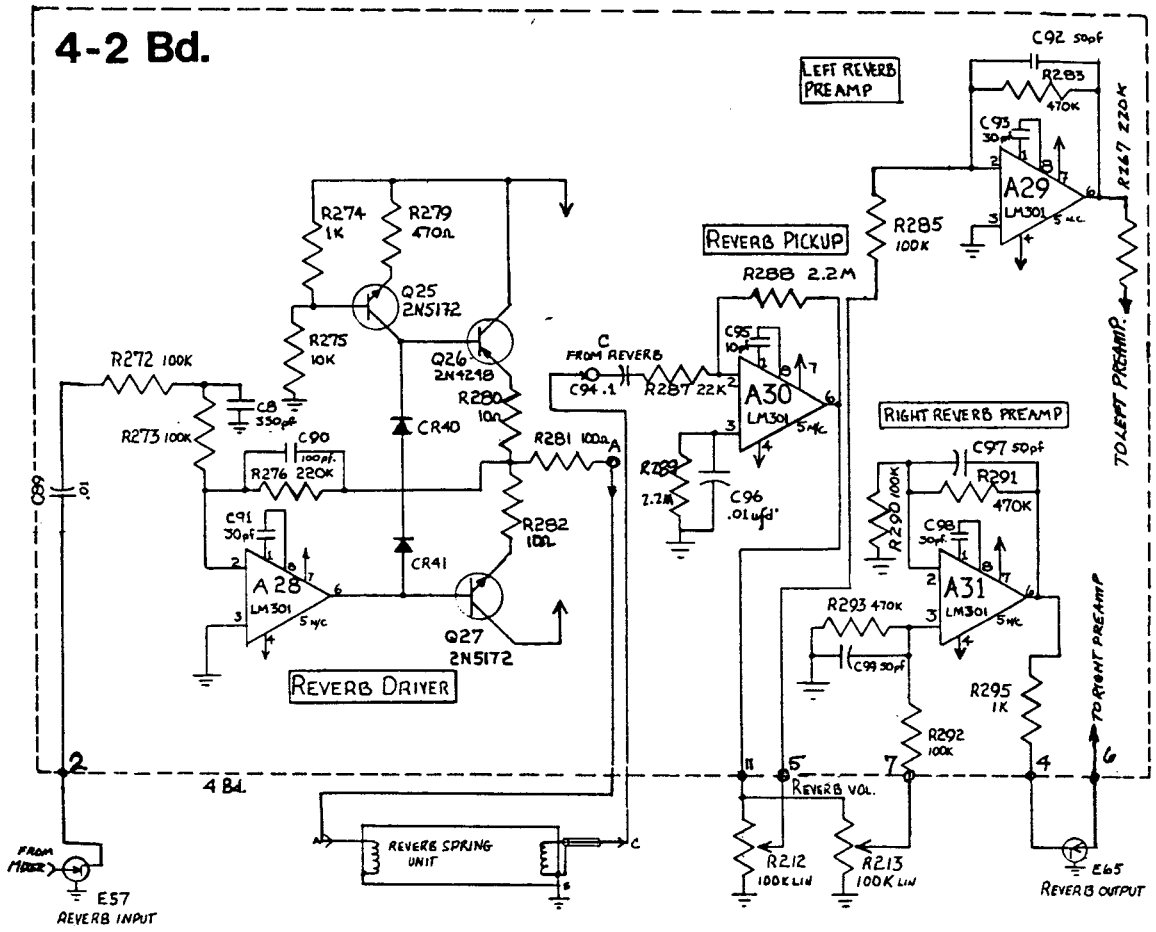

+4 VOLTS
0
VOLTAGE CONTROLLED OSCILLATOR VCO-1
10 VOLTS

10


+4 VOLTS
0
VOLTAGE CONTROLLED OSCILLATOR VCO-1
10 VOLTS

2.14.1 THE REVERBERATOR FUNCTION DESCRIPTION

The Reverberator has one input that is prewired to the Mixer output and has two outputs; the left is wired directly to the left preamplifier and the right output is wired through the reverb output jack to the right preamplifier.



2.14.2 THE REVERBERATOR CIRCUIT DESCRIPTION

A signal entering the reverb circuit through the reverb input jack is AC coupled by C89 and enters the inverting input, pin 2 of A28 (on board 4-2) through R272 and R273. From the output of A28 (pin 6) the positive portion of the signal passes through CR41 and CR40 and is amplified and inverted by Q36. The negative portion of the signal is amplified and inverted by Q27. The complete amplified wave then passes through R281 to the reverb spring driver (located on the back of the console case) to give the reverb effect. The other end of the reverb springs (the pick up) is AC coupled through C94 to pin 2 of A30 which amplifies the signal and sends it to the two reverb sliders. There the two signals are split into the different channels; left and right. The left channel signal goes directly from the reverb slider to A29 where it is amplified and mixed with the left mixer signal. The right reverb signal goes directly to the noninverting input (pin 3) of A31 where it is amplified and sent to the reverb output jack. The shunt of the reverb output jack is wired to the input of A27 so that the right reverb signal can normally be mixed with the right mixer signal.

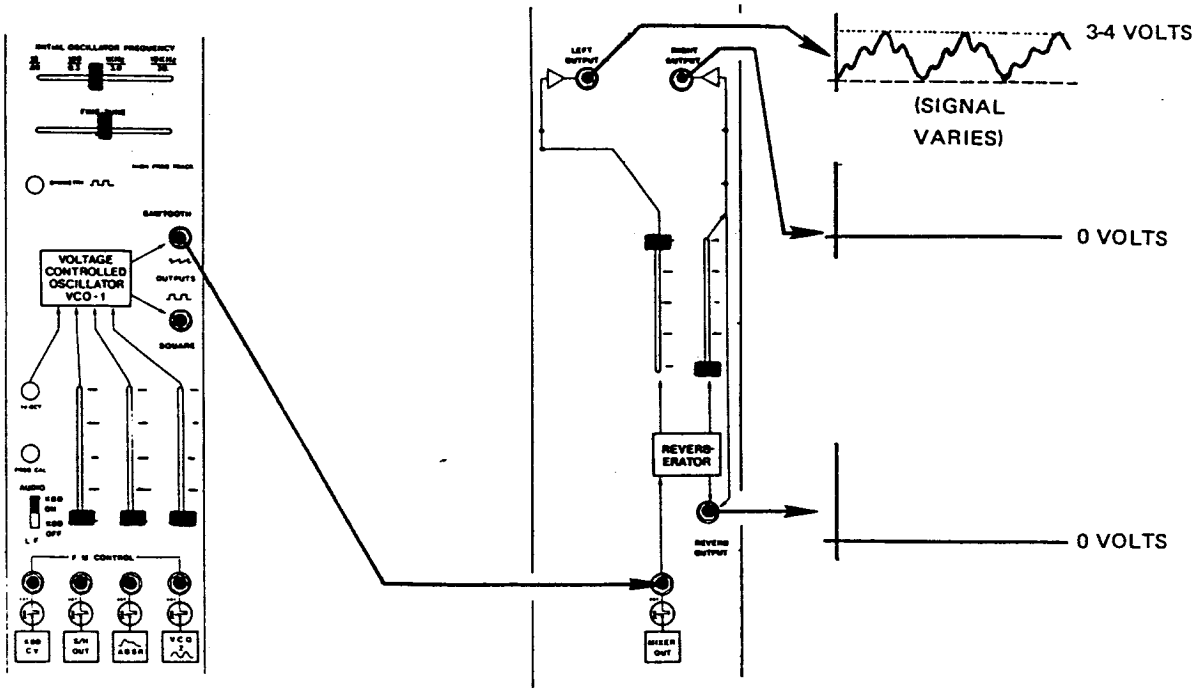
TROUBLESHOOTING HINTS

SYMPTOM	PROBLEM	REPAIR	LOCATION
REVERB DEAD BUT SPRINGS ARE AUDIBLE WHEN CASE IS SHAKEN	A28 LOCKED UP OR DOWN	REPLACE A28	4-2 BOARD
REVERB DEAD, NO SOUND WHEN SHAKEN	WIRE BROKEN IN REVERB UNIT	LOCATE AND RECONNECT LOOSE WIRE	REVERB UNIT MOUNTED IN 2600 CASE

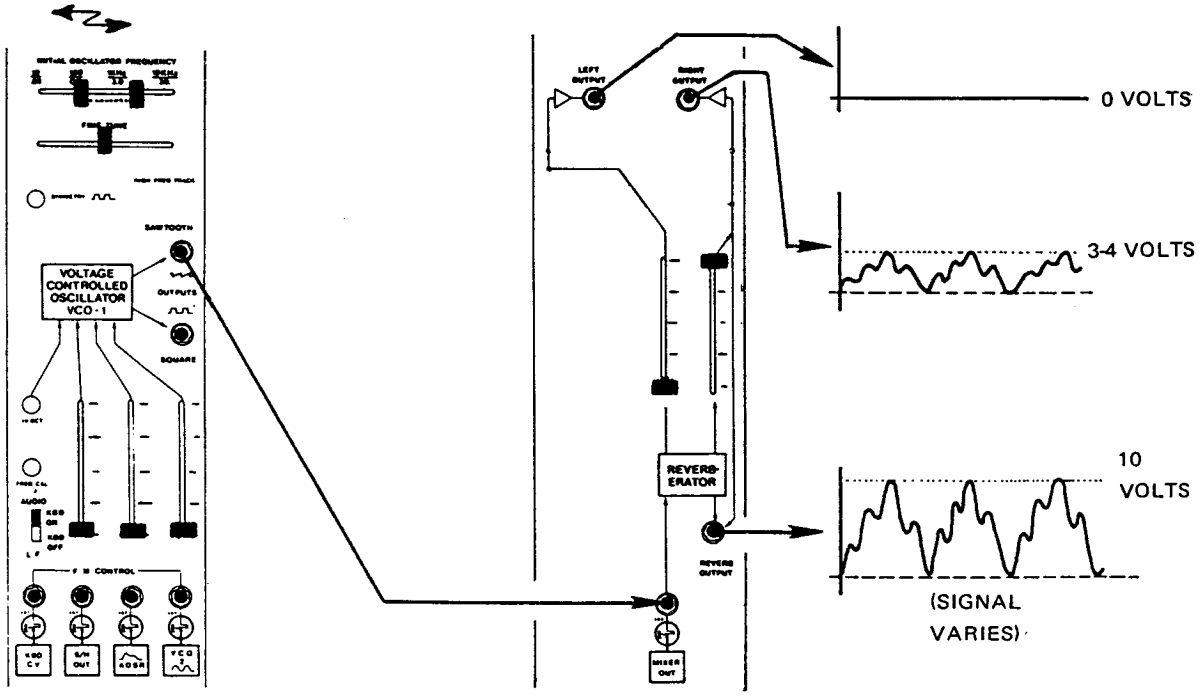
2.14.3 REVERBERATOR CHECKOUT PROCEDURE

SET UP:	CHECK:
1. Patch: From VCO 1 sawtooth output to the reverb input jack 2. Reverb Slider Positions: Left reverb slider up, right reverb slider down.	2.1 A 3 to 4 volt reverb signal should be present on the left output jack only. (Move the initial frequency slider on VCO 1 back and forth to verify the reverb effect.)
3. Reverb Slider Positions: Right reverb slider up, left reverb slider down.	3.1 A 3 to 4 volt reverb signal should be present on the right output jack and there should be a 10 volt reverb signal on the reverb output jack. (Move the initial frequency slider on VCO 1 back and forth to verify the reverb effect.)

1,2

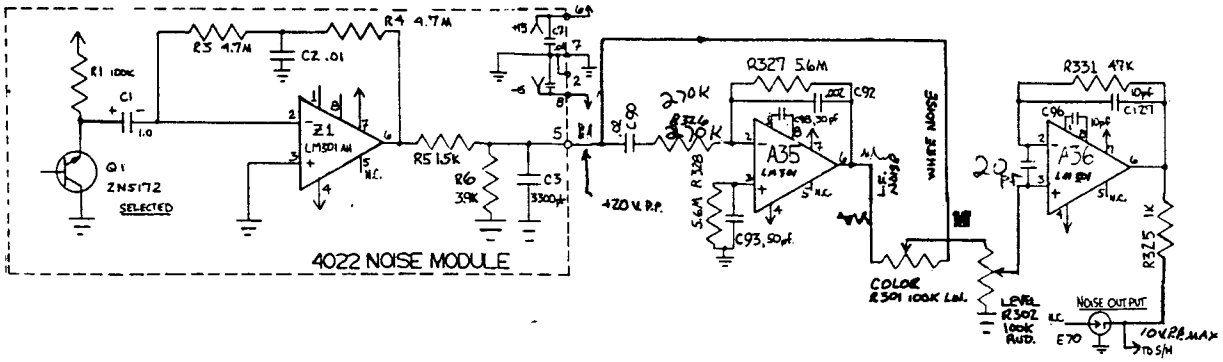

VOLTAGE CONTROLLED OSCILLATOR VCO-1
SAWTOOTH
OUTPUTS
SQUARE
REVERB-ERATOR
3-4 VOLTS
(SIGNAL VARIES)
0 VOLTS
0 VOLTS

3


VOLTAGE CONTROLLED OSCILLATOR VCO-1
SAWTOOTH
OUTPUTS
SQUARE
REVERB-ERATOR
0 VOLTS
3-4 VOLTS
10 VOLTS
(SIGNAL VARIES)

2.15.1 NOISE GENERATOR FUNCTION DESCRIPTION

The Noise Generator provides a +10 volt peak to peak noise signal of about 10 octaves bandwith. The right Noise Generator slider controls the amplitude of the noise and the left slider controls the noise color. As the color slider is lowered from top to bottom, the higher frequencies in the noise are attenuated. The output from the Noise Generator is prewired to the VCF, VCO 2, VCO 3, and the Sample and Hold.



2.15.2 NOISE GENERATOR CIRCUT DESCRIPTION

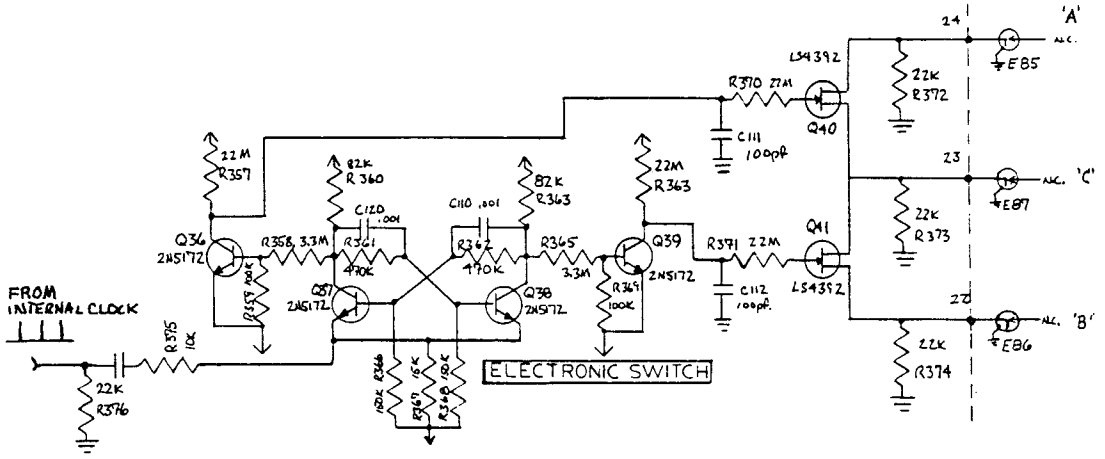
The source of the noise is an amplified, reversed junction of a selected transitor (Q1 on the 4022 module). Z1 amplifies and clips the noise to ten volts peak to peak. A35 (on board 5-1) filters out the higher frequencies of the noise signal leaving only a low frequency noise signal. The noise color slider pans from the output of the low frequency noise filter (A35) to the output of the 4022 (pin 5). A36 amplifies and buffers the final noise signal.

TROUBLESHOOTING HINTS

SYMPTOM	PROBLEM	REPAIR	LOCATION
NOISE BROKEN UP; SOUNDS 'DIRTY'	Q1 NO GOOD	REPLACE Q1	4022 MODULE

2.16.1 ELECTRONIC SWITCH FUNCTION DESCRIPTION

The electronic switch is bi-directional; it will alternately switch two signals or voltages on the inputs 'A' and 'B' to the single output 'C' or switch a single signal or voltage on the 'C' input alternately to the outputs 'A' and 'B'. The rate of the switching is only controllable by the rate of the internal clock.



2.16.2 ELECTRONIC SWITCH CIRCUIT DESCRIPTION

Q36-Q39 comprise a bistable multivibrator which is triggered by the pulse output of the clock. The pulse from the internal clock flips the multivibrator which turns on one or the other of the FETs (Q40 and Q41) so that a signal or voltage can pass from 'C' to 'A' and 'B' alternately or from 'A' or 'B' alternately to 'C'.

2.15.3 NOISE GENERATOR — CHECKOUT PROCEDURE

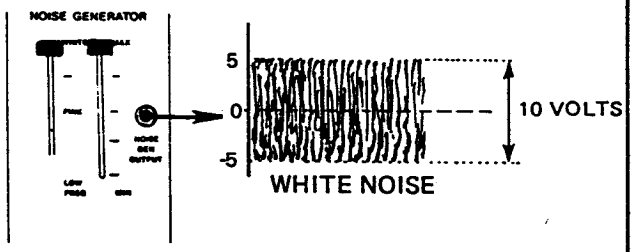
SET UP:	CHECK:
1. Noise Generator Sliders: Both up	1.1 The output of the noise generator should be a 10 volt peak to peak, white noise signal with no break up.
2. Noise Generator Sliders: Color slider ½, level slider up fully.	2.1 The output of the noise generator should be a 10 volt peak to peak, pink noise signal with no break up (less high frequency noise).
3. Noise Generator Sliders: Color slider down, level slider up fully.	3.1 The output of the noise generator should be a 10 volt peak to peak, low frequency noise signal with no break up.
4. Noise Generator Sliders: Both fully down	4.1 The output of the noise generator should be zero volts.

2.16.3 ELECTRONIC SWITCH — CHECKOUT PROCEDURE

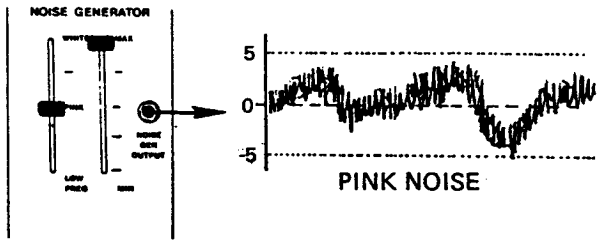
1. Clock Rate Slider: ½ 2. Patch: From VCO 2 sawtooth output to the 'C' input of the electronic switch.	2.1 The electronic switch outputs 'A' and 'B' should alternately contain the sawtooth wave at a rate determined by the clock rate slider.
3. Patch: From VCO 1 square wave output to the 'B' input of the electronic switch and from VCO 2 sawtooth output to the 'A' input of the electronic switch	3.1 The 'C' output of the electronic switch should alternate between the sawtooth wave from VCO 2 and the square wave from VCO 1 at a rate controlled by the clock rate slider.

NOISE GENERATOR 2.15.3

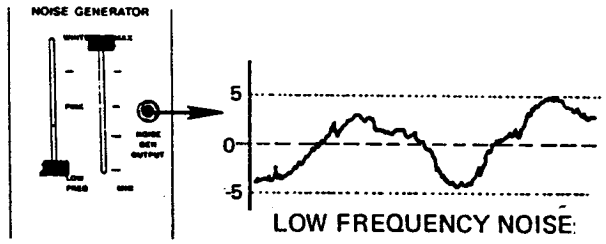
1



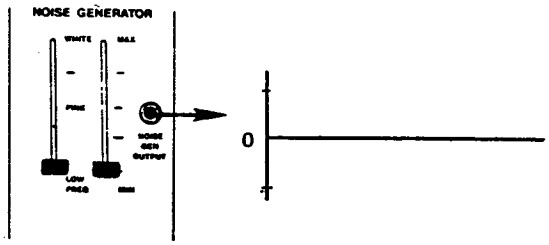
2



3

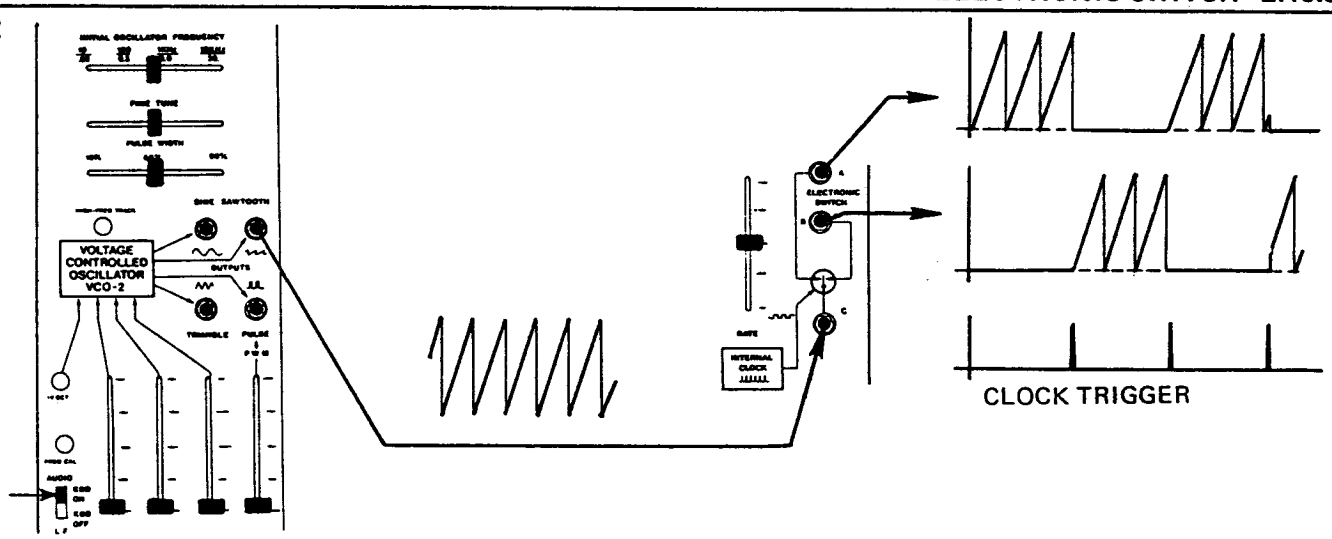


4

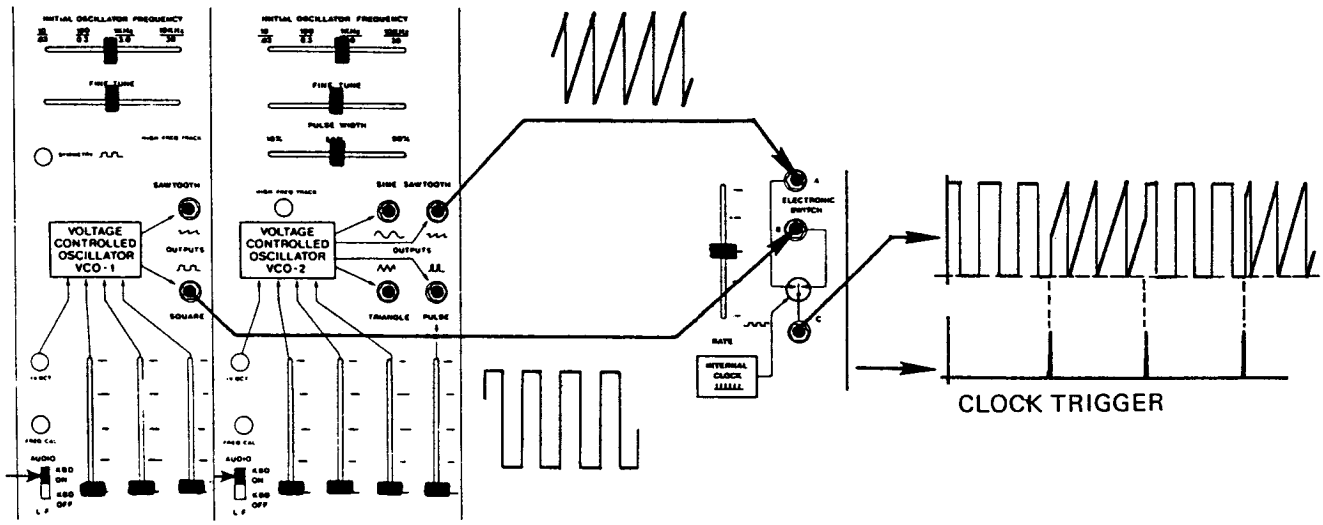


ELECTRONIC SWITCH 2.16.3

1,2

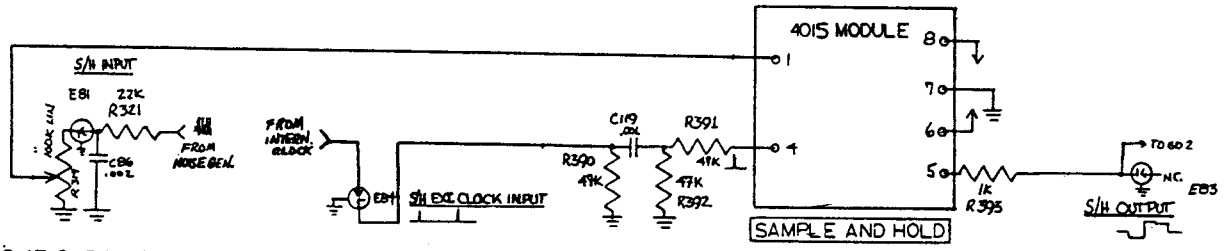


3



2.17.1 SAMPLE AND HOLD FUNCTION DESCRIPTION

The S/H provides a stepped output voltage by sampling and storing the insantaneous voltage level of the input signal each time it receives a trigger pulse. This stored voltage is held until the next trigger pulse occurs. The S/H trigger input is prewired to the Internal Clock but the S/H can be triggered from any sharply rising waveform. The S/H input is prewired to the Noise Generator output. The left S/H slider (level) attentuates the input signal before it is sampled, thus lowering the average voltage level on the S/H output. The right slider (rate) does not actually belong to the S/H, but it controls the rate of the Internal Clock which may be used to supply a trigger and therefore controls the sample rate.



2.17.2 SAMPLE AND HOLD CIRCUIT DESCRIPTION

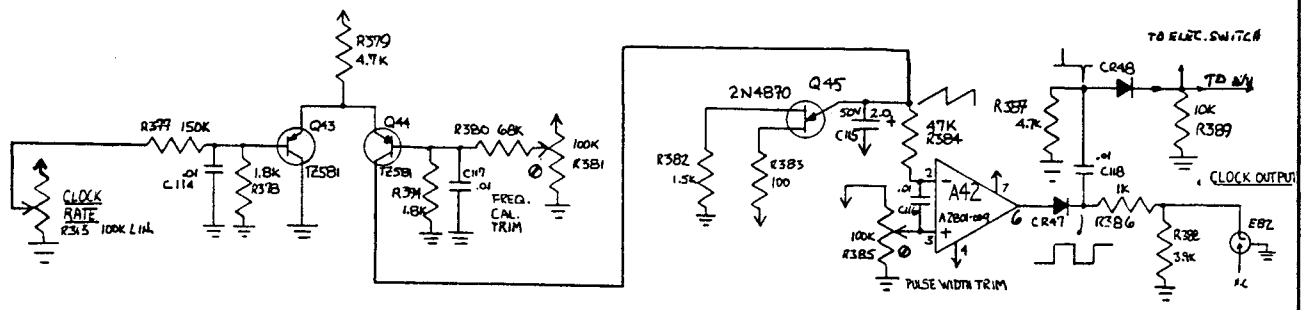
The signal that is to be sampled enters pin 1 of the 4015 module through the level slider on the 5 board. The pulse that instructs the module to sample the voltage of the signal on pin 1 enters the module on pin 4. C119 and R392 differentiate any sharply rising waveform to produce a suitable trigger pulse shape. Pin 5 of the 4015 module is the sample and hold output.

TROUBLESHOOTING HINTS:

SYMPTOM	PROBLEM	REPAIR	LOCATION
S/H DEAD	MODULE BROKEN LOOSE	RESOLDER	5-1 BOARD
S/H PASSING NOISE ONLY	FAULTY MODULE	REPLACE 4015	5-1 BOARD

2.18.1 INTERNAL CLOCK FUNCTION DESCIRPTION DESCRIPTION

The clock is a low frequency square wave oscillator whose frequency is determined by the position of the rate slider. The clock trigger output is hardwired to the S/H and the Electronic Switch and has a separate square wave output which is also wired to the clock output jack , and the shunt of the external gate input jack (under the gate select switch).



2.18.1 INTERNAL CLOCK CIRCUIT DESCRIPTION

Q45 and C115 comprise a relaxation oscillator; when C115 has charged up to about -5 volts through Q44 to the threshold of the unijunction transistor, Q45 discharges the capacitor to -15 volts through R382. The result is a positive going sawtooth wave on C115. The frequency calibrate trimmer, R381, sets the amount of current through Q44. The clock rate slider is connected to point 25 and to Q43 through R377. When the voltage from the rate slider is increased, Q43 turns on which causes Q44 to conduct less current and lowers the frequency of the clock by decreasing the current to C115. A42 converts the sawtooth into a square wave. The voltage on pin 3 of A42 is set by the pulse width trimmer so that the voltage is half way between the maximum and minimum voltage of the sawtooth. If the pulse width trimmer is set correctly, the output of A42 will be a square wave. CR47 clips the resulting square wave so that the signal is positive only. R386 and R388, a voltage divider, sets the amplitude at 10 volts. C118 and R387 convert the square wave into trigger pulses. CR48 clips the negative pulse so that the output is a positive trigger pulse used for triggering the electronic switch and the sample and hold.

2.17.3 SAMPLE & HOLD — CHECKOUT PROCEDURE

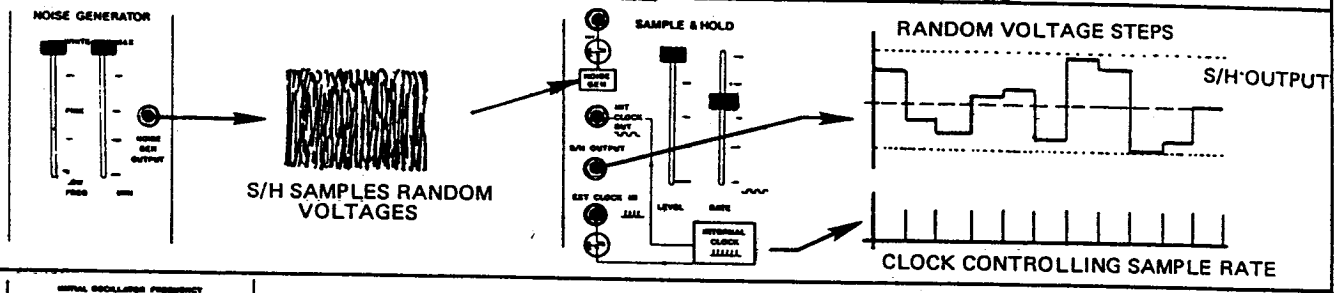
SET UP:	CHECK:
1. Noise Generator Sliders: Both up 2. Sample & Hold Level Slider: Fully up 3. Clock Rate Slider: 2/3 up	3.1 The Sample & Hold output should be a random stepped voltage
4. VCO 2 Initial Frequency and Fine Tune Sliders: Mid-position 5. VCO 2 Frequency Mode Switch: 'Low Frequency' (down) 6. Patch: From VCO 2 sawtooth output to the sample and hold input.	6.1 The output of the sample and hold should be an increasing 'staircase' voltage. The length of the 'steps' should be controlled by the clock rate slider.
7. Patch: From VCO 1 Square wave output to the external clock input. 8. VCO 1 Frequency Mode Switch: 'Low Frequency' (down)	8.1 The rate that the sample and hold samples should be controlled by the initial frequency slider of VCO 1.

2.18.3 INTERNAL CLOCK

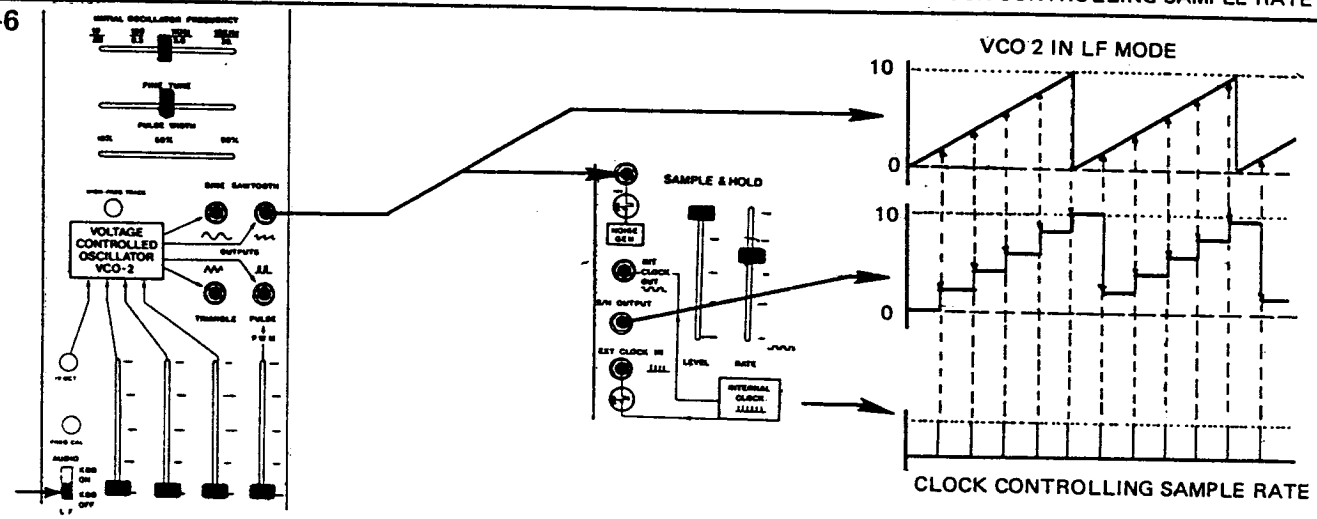
1. Clock Rate Slider: ½	1.1. The pulse width of the square wave on the clock output should have a 50% duty cycle.
2. Clock Rate Slider: Fully down.	2.1 The square wave on the clock output should have a period of 5 to 15 seconds.

SAMPLE & HOLD 2.17.3

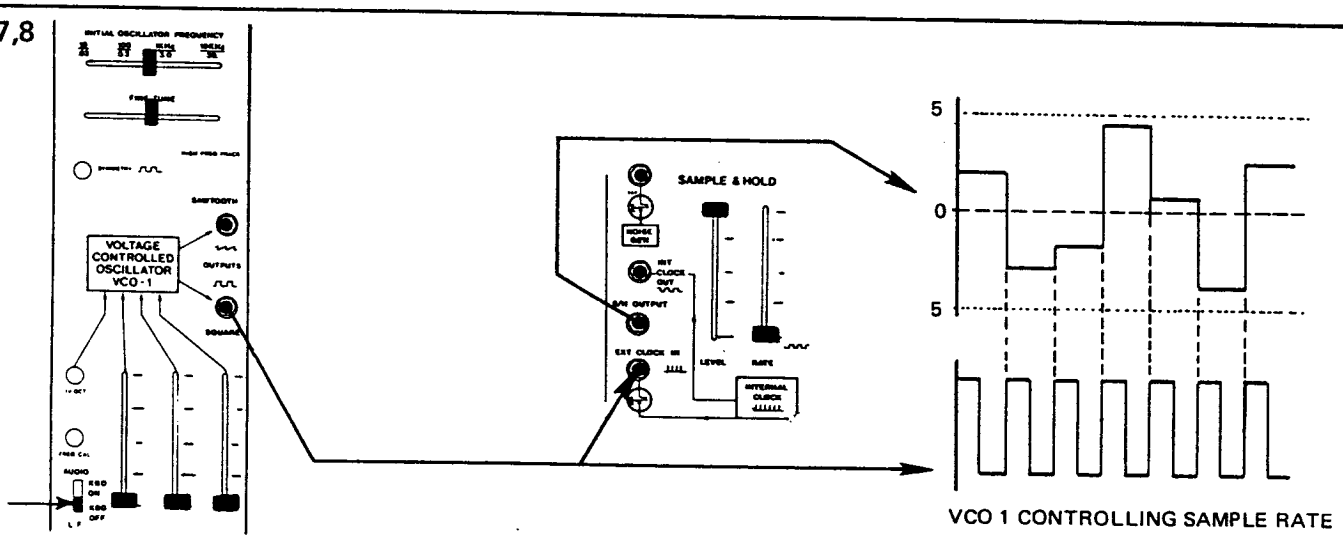
1-3



4-6

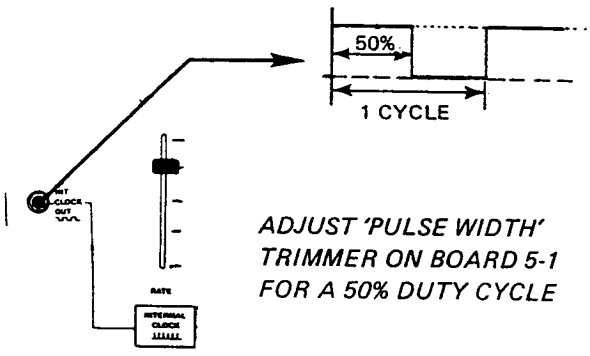


7,8



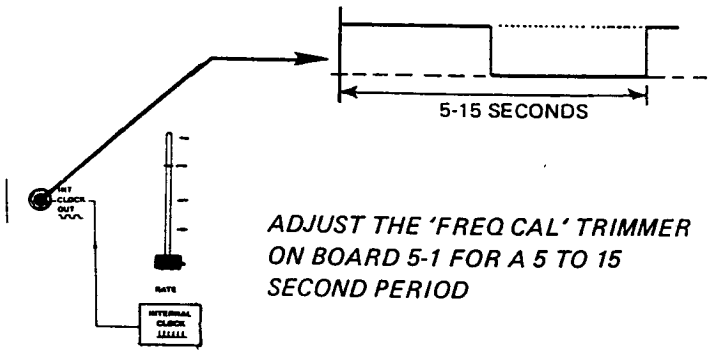
INTERNAL CLOCK 2.18.3

1



ADJUST 'PULSE WIDTH' TRIMMER ON BOARD 5-1 FOR A 50% DUTY CYCLE

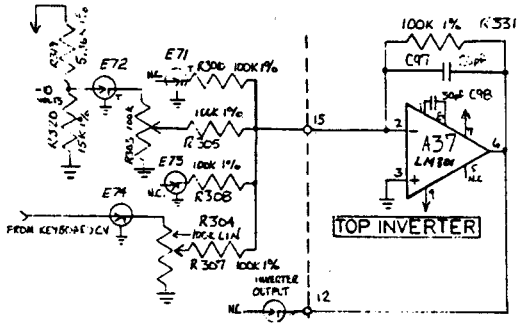
2



ADJUST THE 'FREQ CAL' TRIMMER ON BOARD 5-1 FOR A 5 TO 15 SECOND PERIOD

2.19.1 TOP INVERTER FUNCTION DESCRIPTION

The top inverter has two attenuated inputs and two fixed inputs which are useful for mixing voltages or signals. The gain from either of the attenuated inputs is adjustable from 0 to -1. The fixed inputs are calibrated for a gain of -1 exactly. The upper attenuated inputs of the inverter is prewired to -10 volts and will produce a +10 volts on the output when the slider is fully right. The lower attenuated input is prewired to the Keyboard Control Voltage and will produce a negative compliment of the Keyboard Control Voltage output when the slider is fully right.

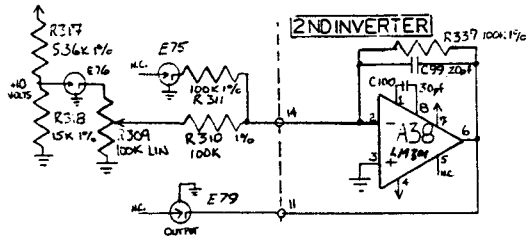


2.19.2 TOP INVERTER CIRCUIT DESCRIPTION

The four inputs of the top inverter are connected to the inverting input (pin 2) of A37 which inverts the signal with unity gain. The output of the top inverter is pin 6 of A37.

2.20.1 SECOND INVERTER FUNCTION DESCRIPTION

The second inverter is the same as the upper inverter except that it has one attenuated input and one fixed input. The attenuated input is prewired to +10 volts and will produce -10 volts on the inverter output when the slider is fully right.

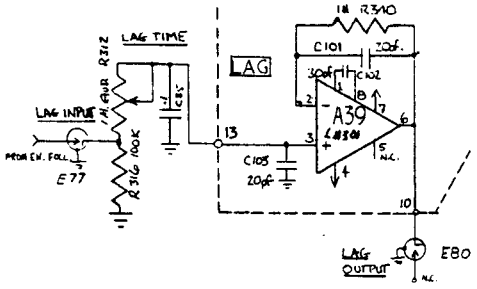


2.20.2 SECOND INVERTER CIRCUIT DESCRIPTION

The two inputs of the second inverter are connected to the inverting input (pin 2) of A38 which inverts the signal with unity gain. The output of the second inverter is pin 6 of A38.

2.21.1 LAG PROCESSOR FUNCTION DESCRIPTION

The lag processor acts to smooth out sharp rising and falling voltages. When the slider is fully left, lag time constant is about .05 milliseconds. When the slider is fully right, the delay is about .5 seconds. The lag processor is used whenever a low frequency signal needs to be filtered or rounded out. The input is prewired to the output fo the Envelope Generator.



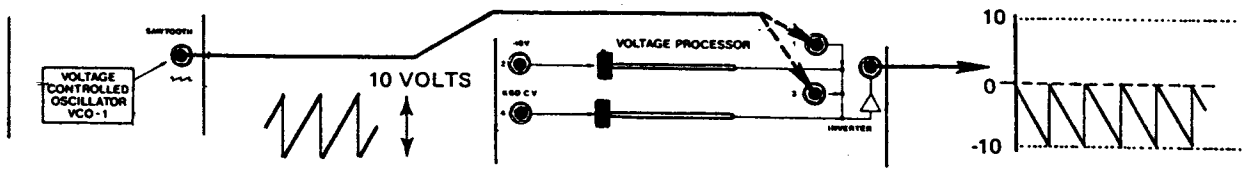
2.21.2 LAG PROCESSOR CIRCUIT DESCRIPTION

The input of the lag processor is conected to the noninverting input (pin 3) of A39 (on board 5-1) through the lag time slider. The time constant of the lag processor is determined by C85 (board 5-1) and R312 (lag slider, board 5-1).

2.19.3 - 2.21.3 VOLTAGE PROCESSORS CHECKOUT PROCEDURE

SET UP:	CHECK:
2.19.3 TOP INVERTER CHECKOUT PROCEDURE 1. Top Inverter Input Sliders: Both fully left 2. Patch: From VCO 1 sawtooth output to the '1' input of the top inverter, and then to the '3' input.	2.1 The output of the top inverter should be a 0 to -10 volt, negative going sawtooth wave.
3. Remove all patch cords. 4. Top Inverter Slider positions: Upper slider fully right, lower slider fully left.	4.1 The output of the top inverter should be +10 volts D.C.
5. Top Inverter Slider Positions: Upper slider fully left, lower slider fully right.	5.1 The output of the top inverter should follow the keyboard control voltage but go negative instead of positive (inverted).
2.20.3 SECOND INVERTER CHECKOUT PROCEDURE 1. Lower Inverter Slider Position: Fully left 2. Patch: From VCO 1 sawtooth output to the '5' input of the second inverter.	2.1 The output of the second inverter should be a 0 to -10, negative going sawtooth wave.
3. Remove all patch cords. 4. Second Inverter Slider Position: Fully right	4.1 The output of the second inverter should be -10 volts, D.C.
2.21.3 LAG PROCESSOR CHECKOUT PROCEDURE 1. VCO 1 Frequency Mode Switch: Low frequency 2. VCO 1 Initial Frequency and Fine Tune Sliders: Adjust to about 15 HZ. 3. Patch: From VCO 1 square wave output to the lag processor input. 4. Lag Processor Slider Position: Fully left	4.1 The lag processor should pass the square wave with only slight rounding.
5. Lag Processor Slider Position: Fully right	5.1 The lag processor should filter the square wave to almost +5 volts D.C. but with a triangular shaped wave.

1,2



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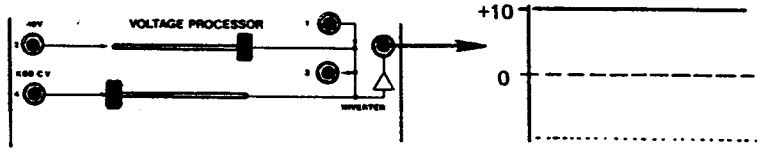

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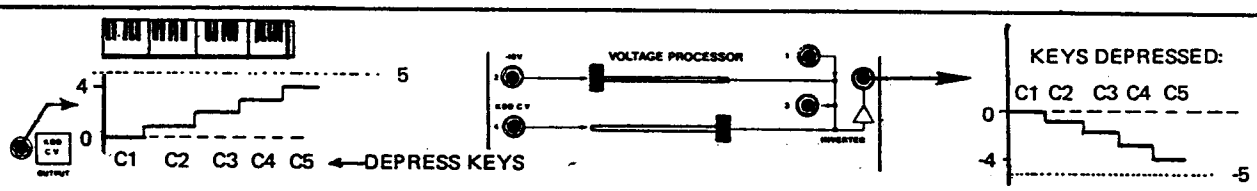
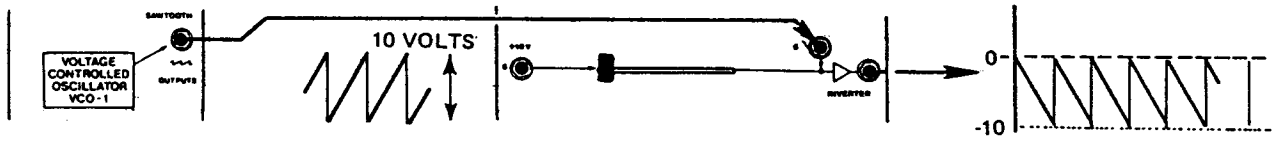


1,2



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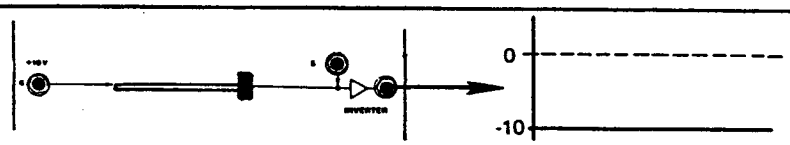
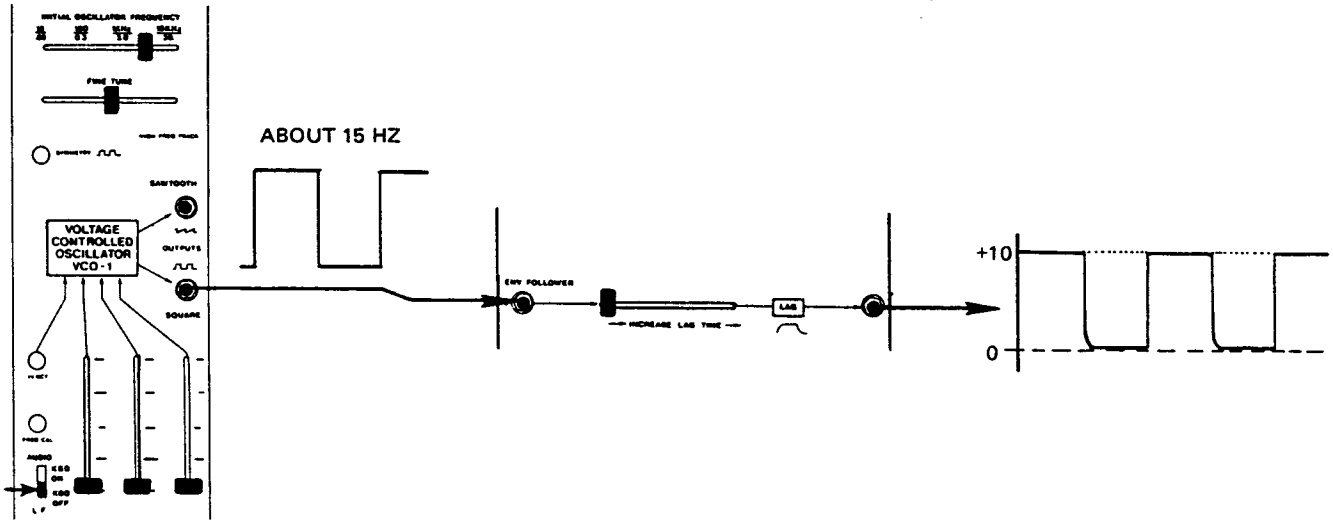
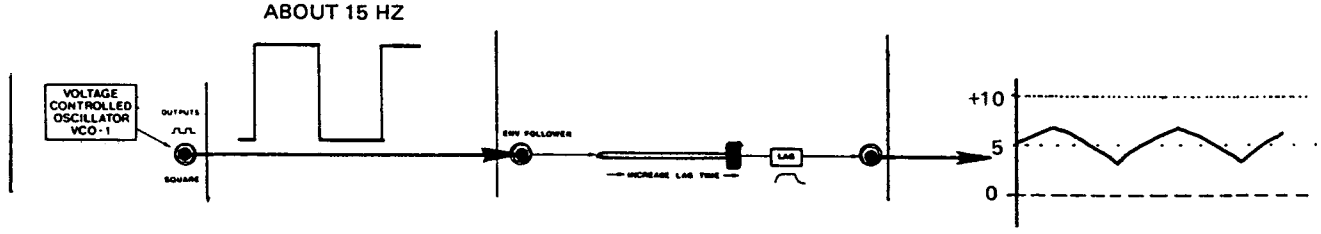


1-4



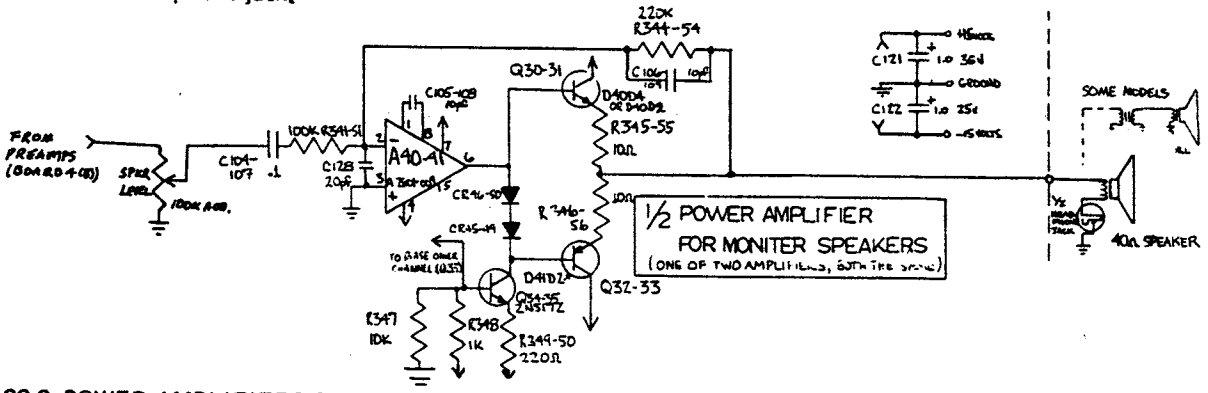
5



2.22 POWER AMPLIFIERS

2.22.1 POWER AMPLIFIERS FUNCTION DESCRIPTION

Two power amplifiers are included in the 2600 to drive the left and right monitor speakers. The power amplifier driven directly from the left and right output jacks and has no available output on the front panel, other than the speakers and headphone jack.

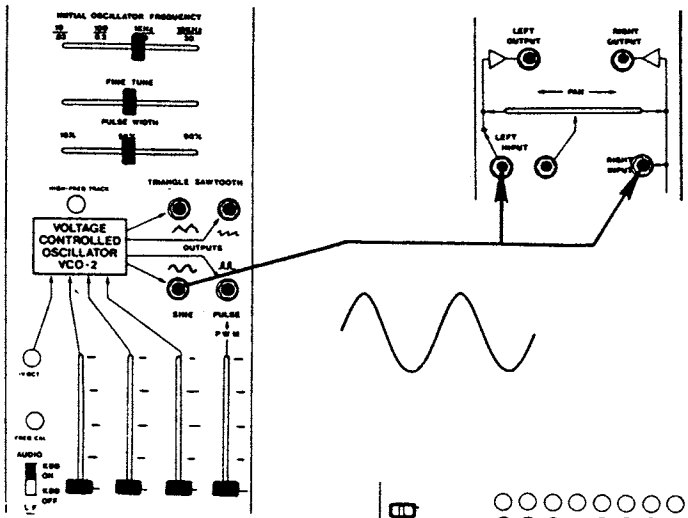


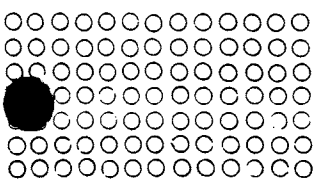
2.22.2 POWER AMPLIFIERS CIRCUIT DESCRIPTION

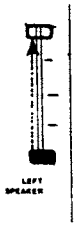
The two power amps that drive the speakers in the 2600 are exactly the same so only one schematic is provided for the both of them. The signal from the preamps (connected through the speaker level sliders) enter the power amp circuitry through C104 and R341 to the inverting input of A40. The feedback for the op amp is from the power amp output through R344. The positive portion of the wave on the output of A40 controls the current through Q30 and the negative portion of the signal passes through CR46 and CR45 to control the current through Q32. The complete amplified signal is at the junction of R346 and R345. Q34 limits the current through the negative portion of the power amp. Outputs 'A' and 'B' go directly to the 40 ohm speakers.

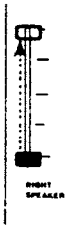
2.22.3 POWER AMPLIFIERS CHECKOUT PROCEDURE

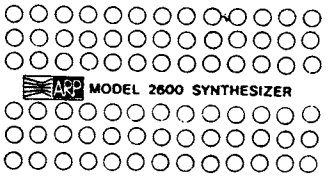
SET UP:	CHECK:
1. Patch: From VCO 2 sine wave output to the left and right input jacks.	
2. Raise the left moniter speaker level slider and lower the right moniter speaker level slider.	2.1 The sound from the left moniter speaker should be pure with no distortion.
3. Lower the left moniter speaker level slider and raise the right moniter speaker level slider.	3.1 The sound from the right moniter speaker should be pure with no distortion.











2.23.1 THE KEYBOARD FUNCTION DESCRIPTION

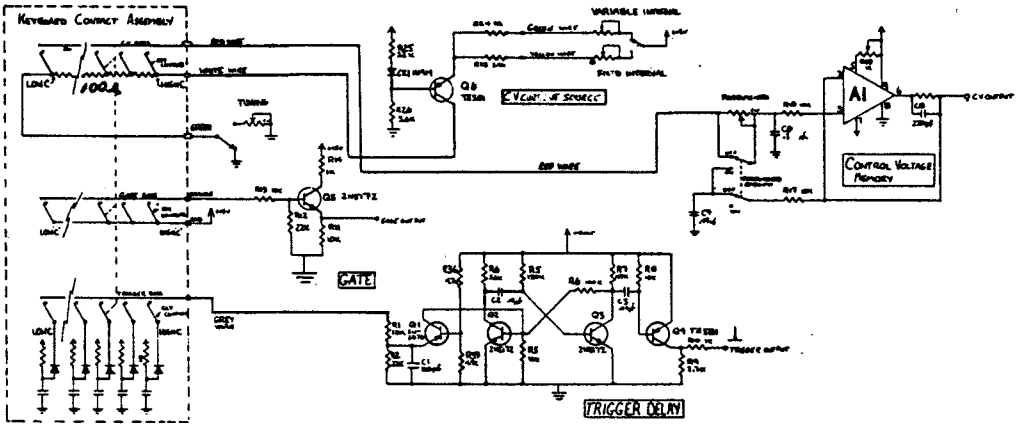
When a key is depressed, the keyboard produces a gate, trigger, and a control voltage (CV). The gate and trigger are used only to control the two envelope generators. The keyboard CV is used to control the frequency of the oscillators and the cutoff of the filter.

Gate: The function of the gate is to indicate that a key is being depressed by supplying voltage to the envelope generator.

Trigger: The function of the trigger is to indicate when a key is first depressed by supplying a pulse to the ADSR envelope generator. (Note: The trigger occurs at the instant any key is depressed, regardless of how many keys are held down).

Control Voltage: The function of the control voltage is to supply specific voltages to the oscillators and the filter which results in specific changes in frequency. The CV output will 'hold' until another key is depressed, even after the first key is released: a 'memory' circuit in the keyboard holds the voltage until it is changed by depressing a different key. If more than one key is depressed, the control voltage will be determined by the lowest or leftmost, key.

The 2600 Keyboard produces one volt for each octave, so there is a four volt difference between the highest and the lowest key. The voltage difference between adjacent keys is 1/12 of a volt (when the interval switch is in the 'preset' position).



2.23.2 KEYBOARD (3604P) CIRCUIT DESCRIPTION

Gate: When a key is depressed on the keyboard, the gate bus receives +15 volts. Q5 is an emitter follower which sets the gate output voltage at +10 volts while the key is held.

Trigger: Each key on the keyboard has its own capacitor-resistor-diode network. The capacitors are normally charged to +15 volts until a key is depressed at which time the capacitor discarges through the diode creating a trigger pulse on the trigger buss. Q1 through Q4 comprise a monostable multivibrator which delays the trigger 15 milliseconds to allow the gate and control voltages to stabilize.

Control Voltage: The variable and fixed interval potentiometers and Q6 make up the current source for the CV resistor chain, which is a series of resistors used as a voltage divider. Contacts between each resistor supply the CV memory with specific voltages . There is a total of four volts drop (when the fixed interval is used) across the resistor chain and 1/12th of a volt per key across each resistor. The bottom of the resistor chain is connected to the tuning control to raise the voltage levels of the entire keyboard. When a key is depressed, the contact associated with that particular key meets the buss and delivers its particular voltage to the CV memory circuitry (red wire). When the portamento switch is in the off position, the CV is shunted around the portamento potentiometer and charges up C6, the memory capacitor. A1 buffers the voltage on the memory capacitor. The CV output appears on pin 6 of A1. The voltage on the output of A1 is connected to the portamento capacitor (C7) through the portamento switch so that the capacitor is always charged to the CV level. When the portamento switch is turned on, C7 is disconnected from the output of the op amp and connected in parallel with the memory capacitor (C6). As the portamento potentiometer is advanced clockwise, the time constant of the RC network is increased and the time it takes for the voltage to change from one level to another is increased thus producing a sliding effect.

TROUBLESHOOTING HINTS:

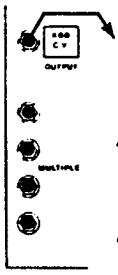
SYMPTOM	PROBLEM	REPAIR	LOCATION
CV DRIFTS UP	A1 LEAKING	REPLACE A1	KEYBOARD ELECTRONICS
CV DRIFTS DOWN	CV LEAKING THROUGH PORTAMENTO POT.	ISOLATE PORTAMENTO POT. FROM PANEL	KEYBOARD CONTROL PANEL
CV LOCKED DOWN	A1 SHORTED	REPLACE A1	KEYBOARD ELECTRONICS

2.23.3 3604P KEYBOARD CHECKOUT PROCEDURE

SET UP:	CHECK:
1. Put all slide switches on the keyboard control panel in the right hand position.	
2. Pin low 'C'.	2.1 The keyboard control voltage should be 0.00 volts (moniter the 'CV OUTPUT' on the main console).
3. Release the low 'C'.	3.1 After one minute, the keyboard control voltage should be 0.00 plus or minus .025 volts.
4. Pin high 'C'.	4.1 The keyboard control voltage should be 4.00 volts.
5. Release high 'C'.	5.1 After one minute, the keyboard control voltage should be between 3.97 and 4.03 volts.
6. Pin high 'C'. 7. Variable Tone Interval Control: Fully counter clockwise.	
8. Tone Interval Slide Switch: Left.	8.1 The keyboard control voltage should be less than 2 volts.
9. Variable Tone Interval Control: Fully clockwise	9.1 The keyboard control voltage should be more than 5 volts.
10. Tone Interval Slide Switch: Right 11. Tuning Slide Switch: Left 12. Tuning Control: Fully clockwise	12.1 The keyboard control voltage should be between +4.7 and +5.0 volts.
13. Portamento Slide Switch: Left 14. Portamento Control: Fully clockwise 15. Release high 'C'. 16. Depress low 'C' and hold it for about 5 seconds and then pin high 'C'.	16.1 The keyboard control voltage should take from 1 to 2.5 seconds to change from 0 volts to 4.0 volts (low 'C' to high 'C').
17. Portamento Control: Fully counterclockwise. 18. Depress low 'C' then high 'C'.	18.1 The keyboard control voltage should change immediately from 0 volts (low 'C') to 4 volts (high 'C').

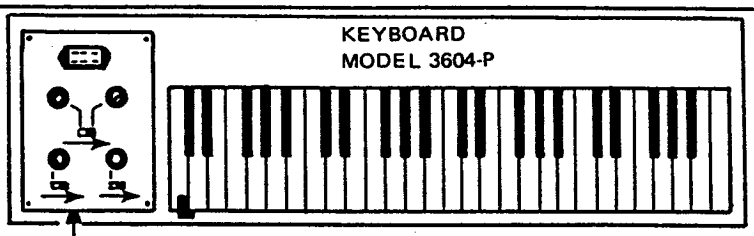
SEE SECTION 5 FOR CONTACT ADJUSTMENTS

1-3



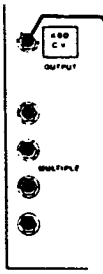
0.00 VOLTS

'ZERO SET' TRIMMER: ADJUST TO 0.00 VOLTS WITH A DIGITAL VOLTMETER (REMOVE PANEL, TRIMMER IS ON THE P. C. BOARD)



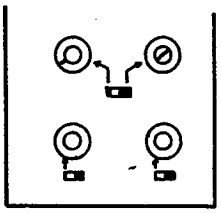
PIN LOW 'C' THEN RELEASE AND CHECK FOR DRIFT

4,5



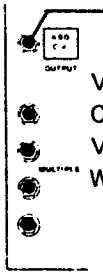
+4.00 VOLTS

USE A LARGE SCREWDRIVER TO ADJUST THE FIXED INTERVAL. DO NOT LOOSEN THE LOCKING NUT!

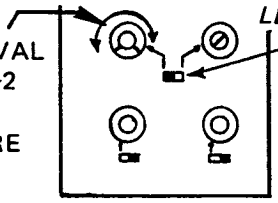


PIN HIGH 'C' THEN RELEASE AND CHECK FOR DRIFT

6-9



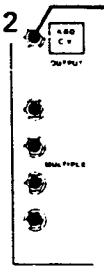
VARIABLE TONE INTERVAL COUNTER CLOCKWISE: +2 VOLTS OR LESS; CLOCK-WISE: +5 VOLTS OR MORE



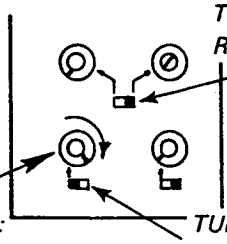
TONE INTERVAL SLIDE SWITCH: LEFT POSITION

PIN HIGH 'C'

10-12



BETWEEN +4.7 VOLTS AND +5.0 VOLTS



TONE INTERVAL SLIDE SWITCH: RIGHT POSITION

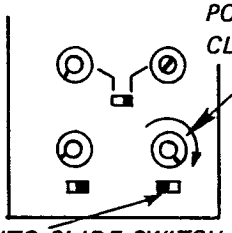
PIN HIGH 'C'

TUNING CONTROL: CLOCKWISE

TUNING SLIDE SWITCH: LEFT POSITION

13-16

1 TO 2.5 SECONDS TO REACH 4 VOLTS

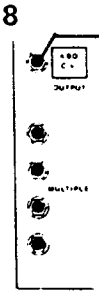


PORTAMENTO CONTROL: CLOCKWISE

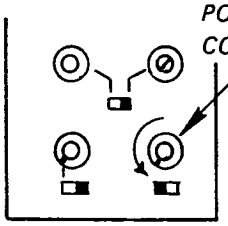
DEPRESS LOW 'C' AND HOLD IT FOR 5 SECONDS THEN PIN HIGH 'C'

PORTAMENTO SLIDE SWITCH: LEFT POSITION

17,18



SHARP CHANGE TO 4 VOLTS



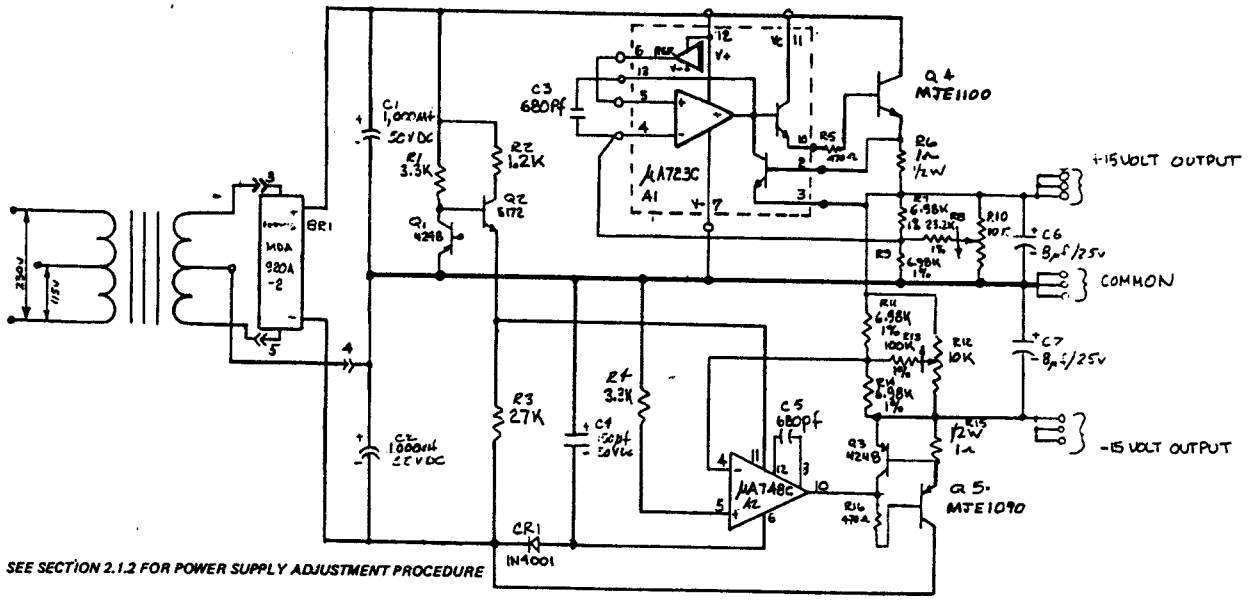
PORTAMENTO CONTROL: COUNTER-CLOCKWISE

DEPRESS LOW 'C' AND THEN HIGH 'C'

2.24 POWER SUPPLY

2.24.1 POWER SUPPLY FUNCTION DESCRIPTION

The 2600 power supply delivers plus and minus 15.00 volts, regulated, to each of the boards in the instrument. The -15.00 derives its reference from the +15.00 volts. Should the current drawn from either the +15.00 or -15.00 supply become too large, the power supply will begin current limiting automatically.



2.24.2 POWER SUPPLY CIRCUIT DESCRIPTION

Voltage Source: BR1 is a full wave bridge rectifier supplying about plus and minus 28.5 volts to the regulating circuitry. C1 and C2 filter out ripple on the supply lines.

+15 Volt Supply: A1 contains a voltage reference which supplies about 7.5 volts to pin 6 of A1. This fixed voltage is connected through pin 5 to the noninverting input of a comparator. The output of the comparator is connected to an emitter follower, also located inside A1, which controls Q4, the current amplifier. The power supply normally delivers +15 volts to the output; if the voltage should change, the voltage at the junction of R7 and R9 will also change. The resistor junction is connected to the inverting input of the comparator through pin 4 of A1. If the voltage at this point should drop, the output of the camparator will rise, turning on the emitter follower and the current amplifier, thus raising the output voltage. Similarly, if the voltage at the resistor junction should increase, the voltage on the output of the comparator will decrease which limits the current through the current amplifier and lowers the output voltage. R10, the +15 volt trimmer, sets the voltage level on the inverting input of the comparator and thus sets the output voltage of the supply.

+15 Volt Current Limiting: When enough current flows out of the positive power supply to cause a .7 volt drop across R6, the transistor conected to pins 2 and 3 of A1 turns on, effectively shorting the base of the emitter follower to the output voltage of the +15 supply. Q4 in turn supplies less current to the output.

-15 Volt Supply: Q1, Q2 and CR1 are the voltage regulators for A1. The -15 volt supply derives its regulation from the +15 volt supply through R11 to the inverting input of A2, the -15 volt comparator. The output of A1 controls Q5, the -15 volt current amplifier. Deviations in the output voltage are reflected through R14 back to the inverting input of A2. The noninverting input of A2 is referenced to ground through R4.

-15 Volt Current Limiting: When enough current flows out of the negative supply to cause .7 volts drop across R15, Q3 turns on effectively shorting the base of Q5 to the output voltage of the -15 volt supply. Q5 in turn supplies less current to the output.

Note: See section 6.2 for 110 to 220 volt conversion procedures.

TROUBLESHOOTING HINTS:

SYMPTOM	PROBLEM	REPAIR	LOCATION
+15 VOLT SUPPLY UNSTABLE: RIPPLE ON A1 PINS 5 & 6	REGULATOR IN A1 BAD	REPLACE A1	POWER SUPPLY
-15 VOLT TOO LOW	A2 NOT WORKING	SPRAY WITH CIRCUIT COOLER TO CHECK AND THEN REPLACE A2	POWER SUPPLY

TUNING THE 2600

3.1 INTRODUCTION

The following sections deal with the MUSICAL adjustments of the 2600. (ELECTRICAL trims and adjustments are covered in Section 2: Checkout, Calibration and Repairs.) Section 3.2.1 and 3.2.2 are a general tuning description. Sections 3.3.1 through 3.3.6 cover the types of oscillators and their tuning procedures. Section 3.7 covers the tuning procedure for the VCF (which is the same for all units).

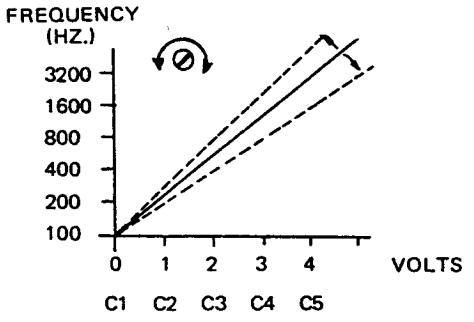
3.2.1 VOLTS PER OCTAVE DEFINITION

Tuning the 2600 requires the frequency of the oscillator to exactly double for each volt applied to the control input. The 'Volts per Octave' trimmer, located above the calibrate trimmer, adjusts the input of the oscillator for this response. For example, when an oscillator is tuned initially to 100Hz, with low 'C' depressed, (zero volts supplied to the oscillator), the highest 'C' would produce 1600Hz (four volts supplied to the oscillator).

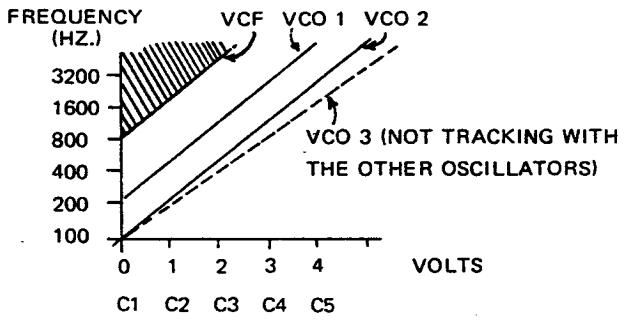
3.2.2 TRACKING DEFINITION

Oscillators which are tracking together will maintain the same relative frequency difference regardless of which key is depressed. If they are not tracking properly, oscillators in tune with each other on the lowest note will not be in tune with each other on the highest note.

VOLTS PER OCTAVE ADJUSTMENT

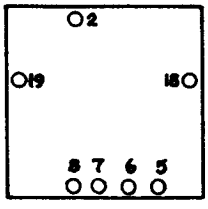


TRACKING



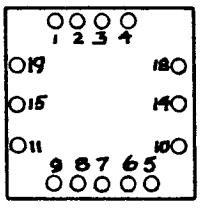
3.3.1 TYPES OF OSCILLATOR MODULES

Several types of oscillator modules have been used in the 2600: the 4017, 4027, and most recently, 4027-1. They are equivalent except that the 4017 and 4027 modules require an external high frequency compensating trimmer to prevent the pitch from going flat at higher frequencies. The 4027-1 is internally compensated and this trim is unnecessary.



4027-1

TOP VIEW



4027 & 4017

3.3.2 HOW TO TELL THE DIFFERENCE

The 4017 and 4027 have from 15 to 18 pins, the 4027-1 has only 7. (Some units containing the 4027-1 may still have the high frequency track timmer on the board, but it is not connected to the module.)

3.3.3 REPLACEMENT

The 4027-1 replaces all other oscillator modules. If only one module is to be replaced in a unit containing the 4017 or 4027 modules, follow the 4027-1 tuning procedure for the new module and use the 4017/4027 tuning procedure for the remaining oscillators (use the new oscillator as the tuning standard once it has been tuned).

3.3.4 4027-1 OSCILLATOR TUNING PROCEDURE

NOTE: *Follow the procedures in section 2.1.2 and 2.21.3 before tuning the oscillators.*

1. Connect the sawtooth output of VCO 1 to a frequency counter or strobe tuner.

2. Pin low 'C' on the keyboard (C1).

3. Using the VCO 1 *Initial Frequency* and *Fine Tune* sliders on the front panel, tune VCO 1 to 100 Hz. on the frequency counter or a low 'C' on the strobe tuner. (100 Hz. is used for convenience with the frequency counter; any frequency in that range will work as long as the frequency is doubled for each octave.)

4. Pin high 'C' on the keyboard (C5).

5. Using the VCO 1 *Volts per Octave* trimmer, tune VCO 1 exactly to 1600.0 Hz. or 'C' four octaves higher on the strobe tuner.

6. Repeat steps 2 through 5 until the pitch is stable and in tune on low 'C' and high 'C'. Tune VCO 1 exactly; it will be used as the tuning standard for the other oscillators.

7. Moniter the output of the VCF with a D.C. oscilloscope and set the VCF sliders as follows:

    1. VCF Initial Filter Frequency: fully right
    2. VCF Fine Tune: midposition
    3. VCF Resonance: fully left
    4. 'VCO 1' Audio input to the VCF: fully up
    5. 'VCO 2' Audio input to the VCF: fully up
    6. All other VCF vertical sliders: fully down

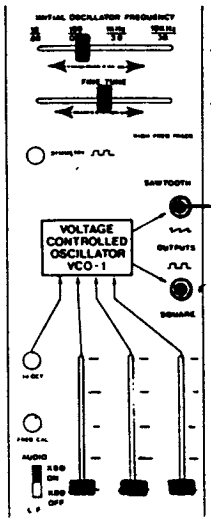
Raise the 'VCF' slider into the mixer and raise the speaker level sliders on the front panel to a comfortable listening level.

8. Pin low 'C' on the keyboard (C1).

9. Using the VCO 2 *Initial Frequency* and *Fine Tune* sliders on the front panel, tune VCO 2 to VCO 1 by zero beating the two frequencies. The oscilloscope will facilitate the tuning by giving a visual representation of the beating of the frequencies

CONTINUED

1-3



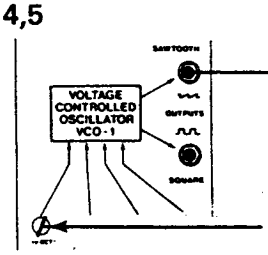
ADJUST TO 100 HZ. OR LOW 'C' ON THE STROBE TUNER

FREQUENCY COUNTER

STROBE TUNER

PIN LOW 'C'

4,5

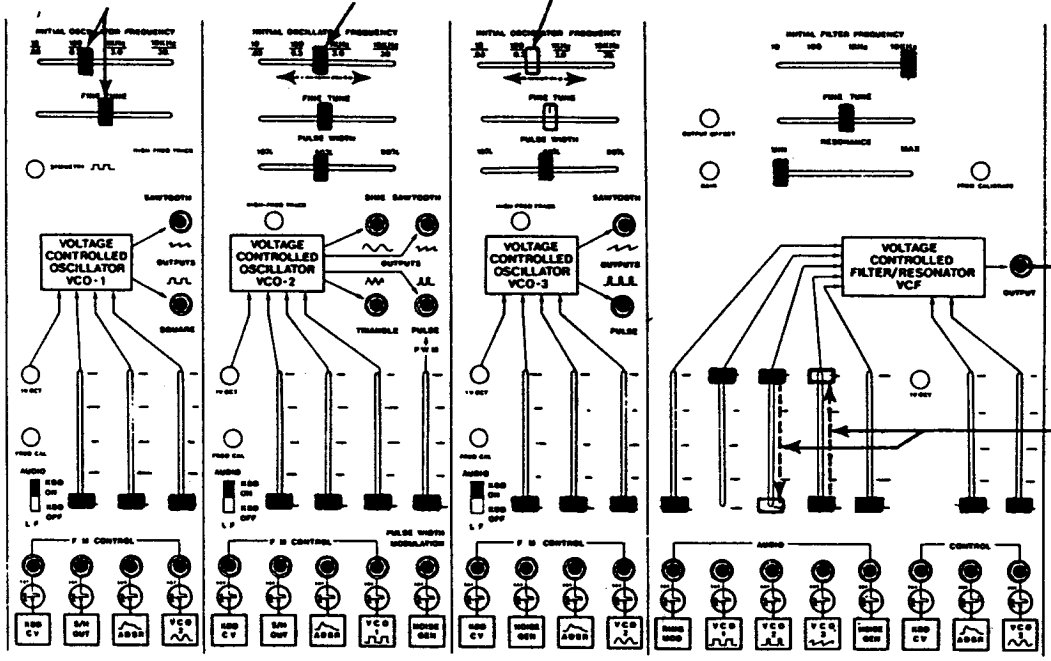


VCO 1 VOLTS PER OCTAVE:
ADJUST TO 1600 HZ. OR 'C' FOUR OCTAVES HIGHER ON THE STROBE TUNER

PIN HIGH 'C'

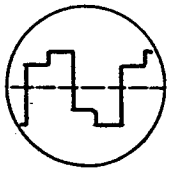
6 REPEAT STEPS 2 THROUGH 5

7-9 *DO NOT CHANGE* *TUNE TO VCO 1* *TUNE TO VCO 1 AFTER VCO 2 IS TUNED*



VCO 1 & 2 OSCILLOSCOPE DISPLAY

ZERO BEAT (NO MOVEMENT)



AFTER STEP 13, RAISE VCO 3 SLIDER, LOWER VCO 1 SLIDER AND REPEAT STEPS 7 THROUGH 13

TUNING REFERENCE

TUNE VCO 2 USING STEPS 7 THROUGH 13

TUNE VCO 3 AFTER STEP 13

PIN LOW 'C'

3.3.4 4027-1 OSCILLATOR TUNING PROCEDURE (CONTINUED)

10. Pin high 'C' on the keyboard (C1).

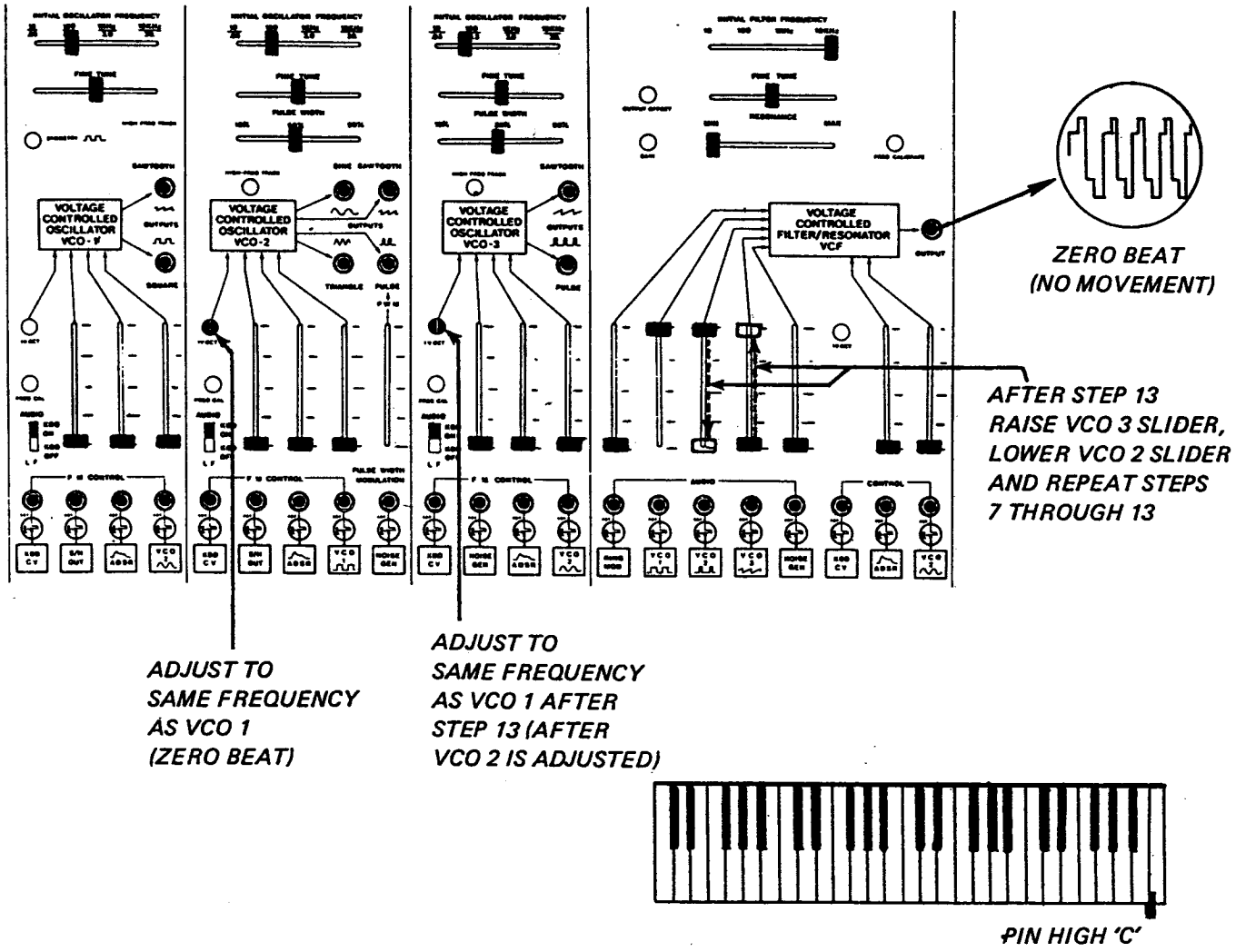
11. Using the VCO 2 *Volts per Octave* trimmer, tune VCO 2 exactly to VCO 1 by zero beating the two frequencies.

12. Repeat steps 7 through 11 until the two pitches are stable and in tune on high 'C' and low 'C'.

13. Depress the second, third and fourth 'C' on the keyboard and check that they remain in tune with each other. (See section 2.6 through 2.8 if incorrect,)

14. Once VCO 1 and VCO 2 have been tuned, repeat steps 6 through 13 with VCO 3 in place of VCO 2.

10,11



12 REPEAT STEPS 7 THROUGH 13

13 DEPRESS THE SECOND, THIRD AND FOURTH 'C'. CHECK THAT THE PITCHES ZERO BEAT

14 REPEAT STEPS 7 THROUGH 11 USING VCO 3 IN PLACE OF VCO 2

3.3.5 4017/4027 OSCILLATOR TUNING PROCEDURE

NOTE: *Follow the procedures in section 2.1.2 and 2.23.3 before tuning the oscillators.*

1. Connect the VCO 1 sawtooth output to a frequency counter or a strobe tuner.

2. Pin low 'C' on the keyboard (C1).

3. Using the VCO 1 *Initial Frequency* and *Fine Tune* sliders on the front panel, tune VCO 1 to 100 Hz. on the frequency counter or low 'C' on the strobe tuner. (100 Hz. is used for convenience with the frequency counter; any frequency in that range will work as long as the frequency is doubled for each octave.)

4. Pin the fourth 'C' (C4) on the keyboard.

5. Using the VCO 1 *Volts per Octave* trimmer, tune VCO 1 to exactly 800 Hz. on a frequency counter or 'C' three octaves higher on the strobe tuner.

6. Repeat steps 2 through 5 until the pitches are stable and in tune on the fourth 'C' and the low 'C'.

7. Pin low 'C' on the keyboard (C1).

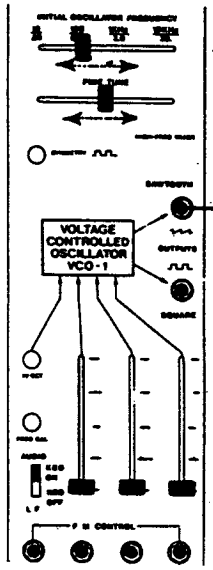
8. Using the VCO 1 *Initial Frequency* and *Fine Tune* sliders on the front panel, tune VCO 1 to 400.0 Hz. on the frequency counter or 'C' two octaves higher on the strobe tuner.

9. Pin the fourth 'C' on the keyboard (C4).

10. Using the VCO 1 *High Frequency Track* trimmer, tune VCO 1 to 3200. Hz. or 'C' five octaves higher than step 2 on the strobe tuner. (See note at the end of this section if the high frequency track trimmer will not tune the oscillator properly.)

11. Repeat steps 7 through 10 until the pitches are stable and in tune on the low 'C' and the fourth 'C'.

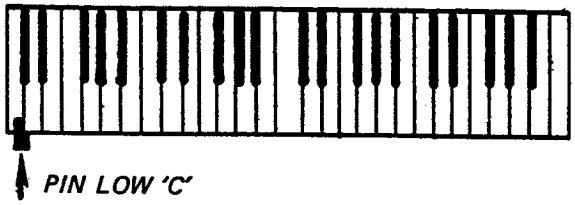
1-3



ADJUST TO 100 HZ. OR LOW 'C' ON THE STROBE TUNER

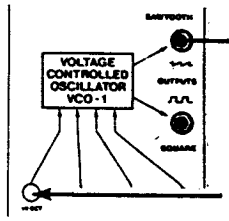
FREQUENCY COUNTER

STROBE TUNER



PIN LOW 'C'

4,5

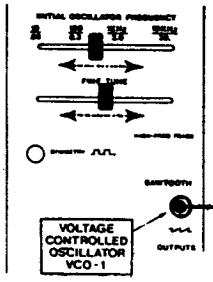


VCO 1 VOLTS PER OCTAVE:
ADJUST TO 800 HZ. OR 'C' THREE OCTAVES HIGHER ON THE STROBE TUNER

PIN THE FOURTH 'C'

6 REPEAT STEPS 2 THROUGH 5

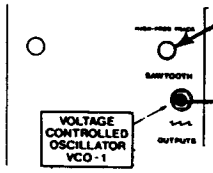
7,8



ADJUST TO 400 HZ. OR 'C' TWO OCTAVES HIGHER ON THE STROBE TUNER

PIN LOW 'C'

9,10



VCO 1 HIGH FREQUENCY TRACK:
ADJUST TO 3200 HZ. OR 'C' FIVE OCTAVES HIGHER ON THE STROBE TUNER

PIN THE FOURTH 'C'

11 REPEAT STEPS 7 THROUGH 10 OVER AGAIN

3.3.5 4017/4027 OSCILLATOR TUNING PROCEDURE (CONTINUED)

12. Repeat steps 1 through 11 using VCO 2 in place of VCO 1.

13. Repeat steps 1 through 11 using VCO 3 in place of VCO 1.

14. Pin low 'C' on the keyboard (C1)..

15. Using the VCO 1 *Initial Frequency* and *Fine Tune* sliders on the front panel, tune VCO 1 to 100 Hz. or low 'C' on the strobe tuner.

16. Raise the 'VCO1' and 'VCO 2' sliders on the audio input of the VCF.

17. Using the VCO 2 *Initial Frequency* and *Fine Tune* sliders on the front panel, tune VCO 2 to VCO 1 by zero beating the two frequencies.

18. Raise the'VCO 3'slider on the audio input of the VCF and lower the 'VCO 2' slider.

19. Using the'VCO 3'*Initial Frequency* and *Fine Tune* sliders on the front panel, tune VCO 3 to VCO 1 by zero beating the two frequencies.

20. Raise the'VCO 2'slider on the audio input of the VCF and check that all three oscillators are tuned together exactly. (Note: When all three oscillator sliders on the input of the VCF are used, lower them to ¾ up to prevent distortion.)

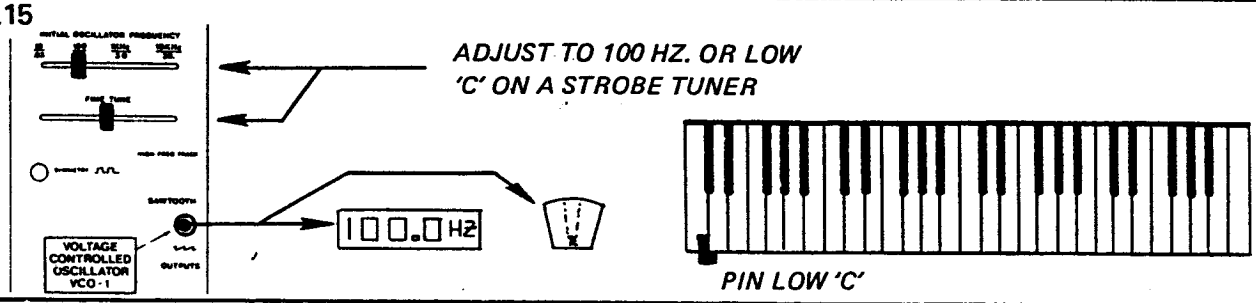
21. Depress high 'C' (C5).

22. All the oscillators should be exactly in tune with each other. If one of the VCOs is out of tune, repeat steps 1 through 11 for that oscillator.

12 REPEAT STEPS 1 THROUGH 11 USING VCO 2 IN PLACE OF VCO 1

13 REPEAT STEPS 1 THROUGH 11 USING VCO 3 IN PLACE OF VCO 1

14,15

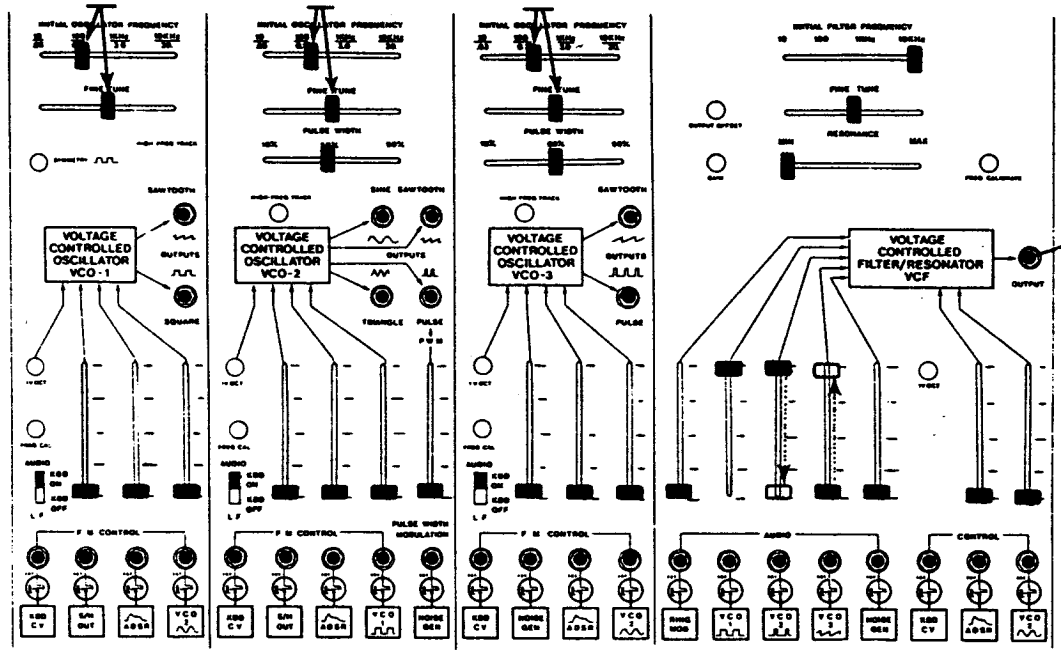


ADJUST TO 100 HZ. OR LOW 'C' ON A STROBE TUNER

PIN LOW 'C'

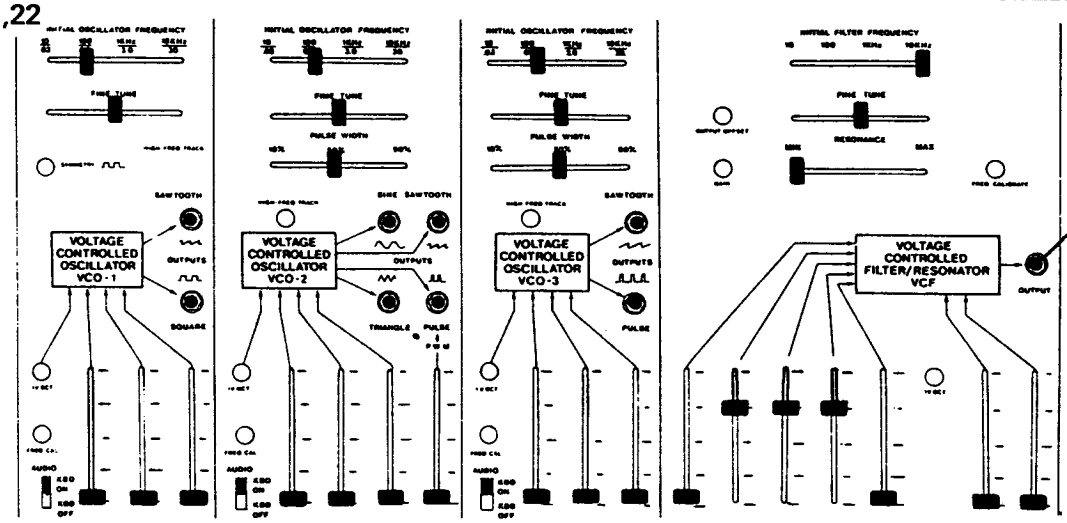
16-20

DO NOT CHANGE *TUNE TO VCO 1* *TUNE TO VCO 1 AFTER TUNING VCO 2*



ZERO BEAT VCO 2 TO VCO 1 THEN LOWER VCO 2 SLIDER, RAISE VCO 3 SLIDER AND ZERO BEAT VCO 3 TO VCO 1 ON LOW 'C' THEN CHECK THAT THEY ALL ZERO BEAT ON HIGH 'C'

21,22



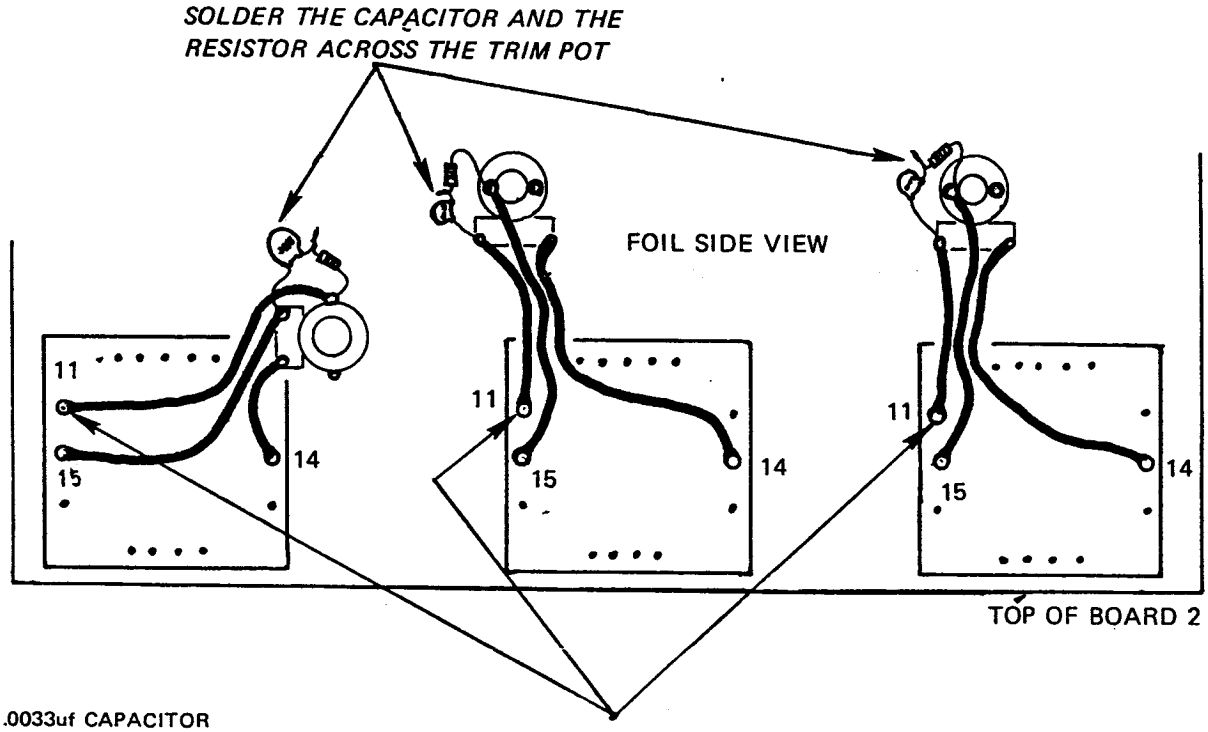
MONITER ALL THREE OSCILLATORS AND CHECK THAT THEY ALL ZERO BEAT

REPEAT STEPS 1 THROUGH 11 ON OSCILLATORS STILL NOT IN TUNE

PIN LOW 'C', CHECK TUNING THEN PIN HIGH 'C' AND CHECK TUNING

3.3.6 4017/4027 HIGH FREQUENCY TRACK TRIM

Should the 'High Frequency Track' trimmer not bring the oscillator in tune on step 10, an additional trim may be necessary: If the pitch of the oscillator is sharp (too high) and the 'High Frequency Track' trimmer will not bring the frequency down to 3200 Hz., cut pin 11 on the oscillator module near the P.C. board and bend it out of the way. Solder a .0033uf. disc capacitor (50 volt) and a 10K resistor (1%) in series across the arm of the trimmer and the leg of the trimmer which was connected to pin 11. This should bring the oscillator to the proper frequency.



.0033uf CAPACITOR
10K 1% RESISTOR

CUT PIN 11 NEAR THE P. C. BOARD AND BEND IT OUT OF THE WAY

3.3.7 VCF TUNING PROCEDURE

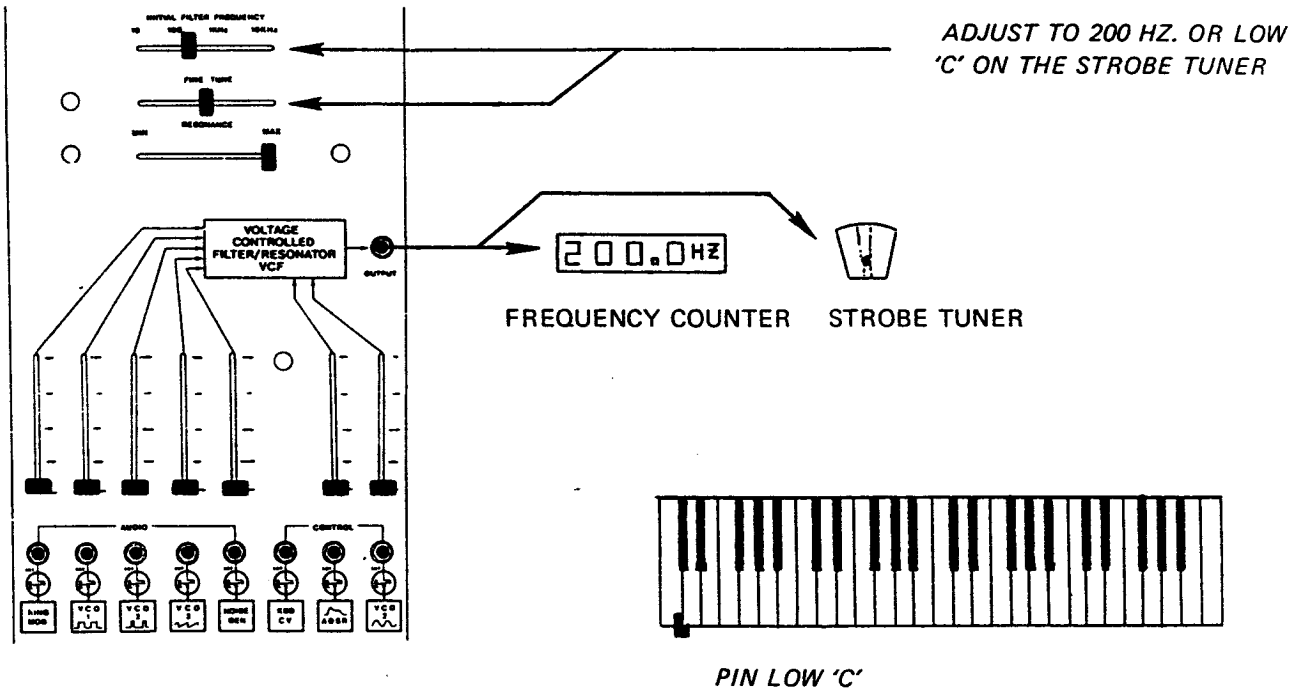
NOTE: *Follow the procedures in section 2.1.2 and 2.21.3 before tuning the VCF.*

1. Connect a frequency counter or strobe tuner to the VCF output.
2. Pin low 'C' on the keyboard (C1).
3. Set the VCF sliders as follows:
    1. VCF Initial Filter Frequency: ¼
    2. Fine Tune: midposition
    3. Resonance: fully right
    4. All other VCF vertical sliders: fully down
4. Using the VCF *Initial Filter Frequency* and *Fine Tune* sliders on the front panel, tune the sine wave on the output of the VCF to exactly 200.0 HZ. on the frequency counter or low'C' on the strobe tuner. (200 HZ. is used for convenience with the frequency counter; any frequency in that range will work as long as the frequency is doubled for each octave.)

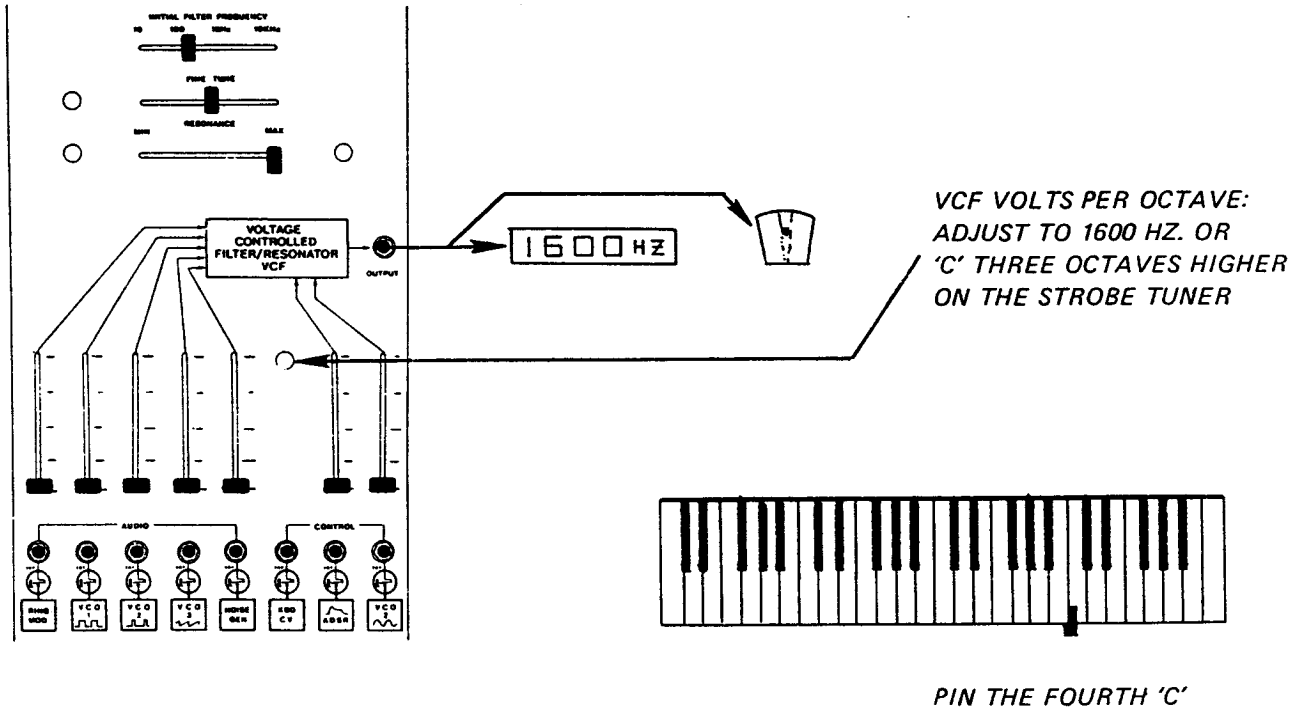
5. Pin the fourth 'C' (C4).
6. Using the VCF *Volts per Octave* trimmer, tune the VCF to exactly 1600 HZ. on the frequency counter or 'C' three octaves higher on the strobe tuner. (If the VCF 'Volts Per Octave' trimmer fails to bring the VCF down to 1600 HZ., add a 4.7K in series with R145 on board 3. This should bring the frequency of the VCF down to the normal range.)

7. Repeat steps 2 through 6 until the VCF is stable and in tune on the low 'C' and the fourth 'C'

1,4



5,6



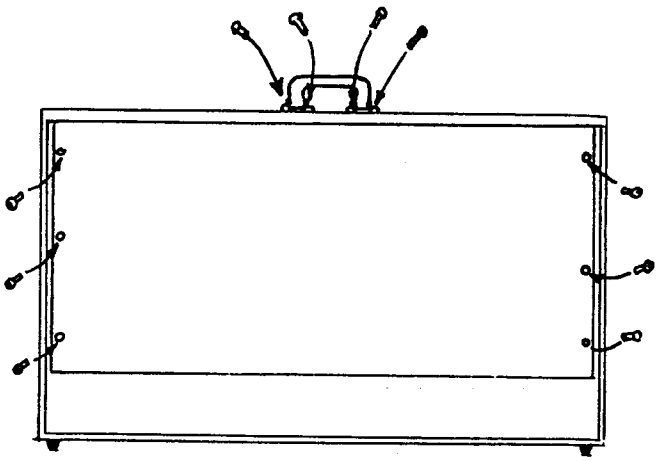
7 REPEAT STEPS 2 THROUGH 6

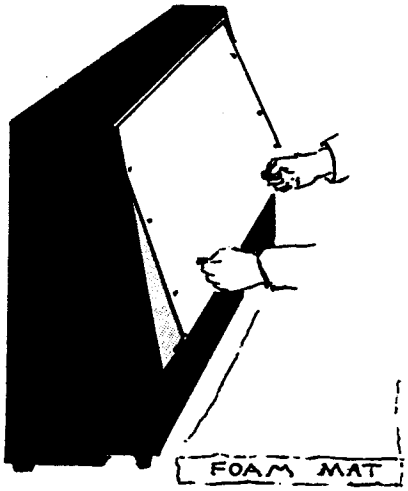
SECTION 4

ASSEMBLY & DISASSEMBLY

4.1 INTRODUCTION

Section 4.2 describes the disassembly of the 2600 console and the 3604P keyboard. Access to the components on each of the boards in the 2600 is covered in sections 4.3.1 through 4.3.11.



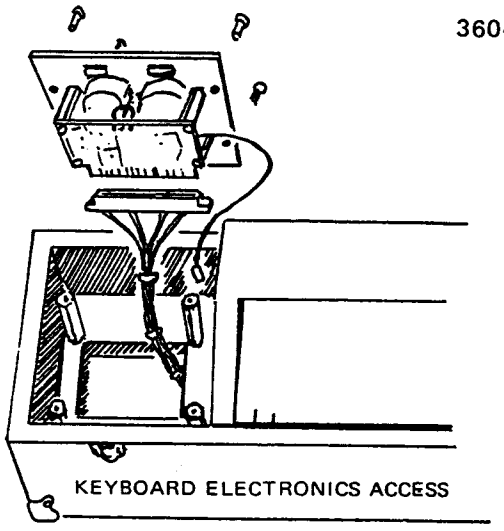


4.2.1 OPENING THE 2600 CONSOLE

1. Remove the three screws on each side of the front panel.
2. Remove the four screws that hold the handle on top in place.
3. Using two dummy plugs in jacks as handles on the lower portion of the panel, lift the panel up and then out from the bottom. Take care not to damage any of the components as you lift the panel out.
4. Lay the panel on something soft such as foam rubber or a blanket to prevent damage to the panel.

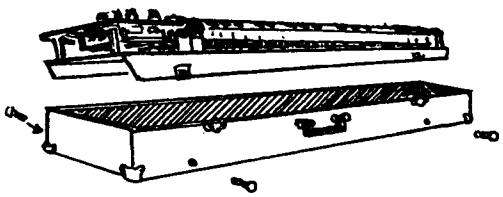
NOTE: When reassembling the unit, install the top of the panel first, then the bottom. Lay the unit on its back to reinstall the screws. (Be careful when putting in the panel screws that the 'T' nuts in the console are not crossthreaded.)

3604P KEYBOARD



KEYBOARD ELECTRONICS ACCESS

KEYBOARD CONTACTS ACCESS

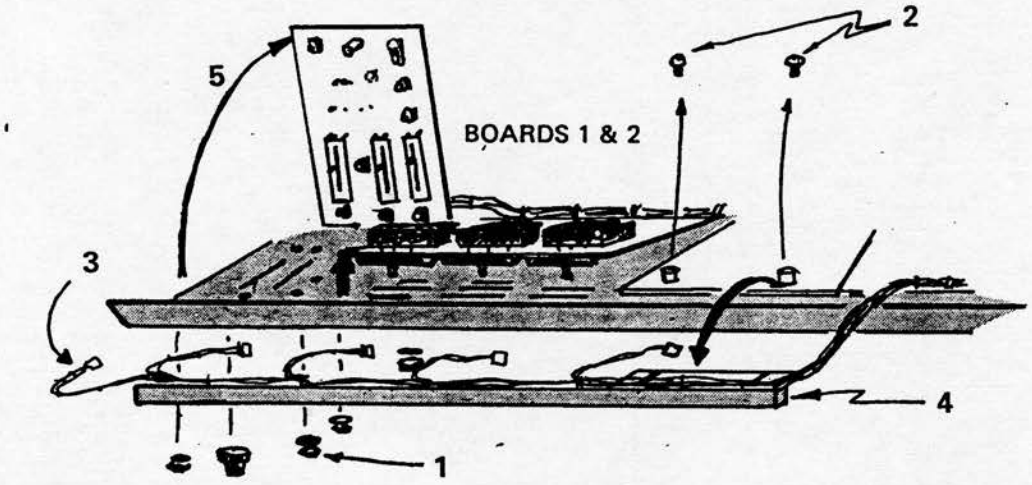


4.2.2 OPENING THE 3604 KEYBOARD

TURN THE UNIT OFF BEFORE DISCONNECTING THE KEYBOARD CONNECTING CABLE.

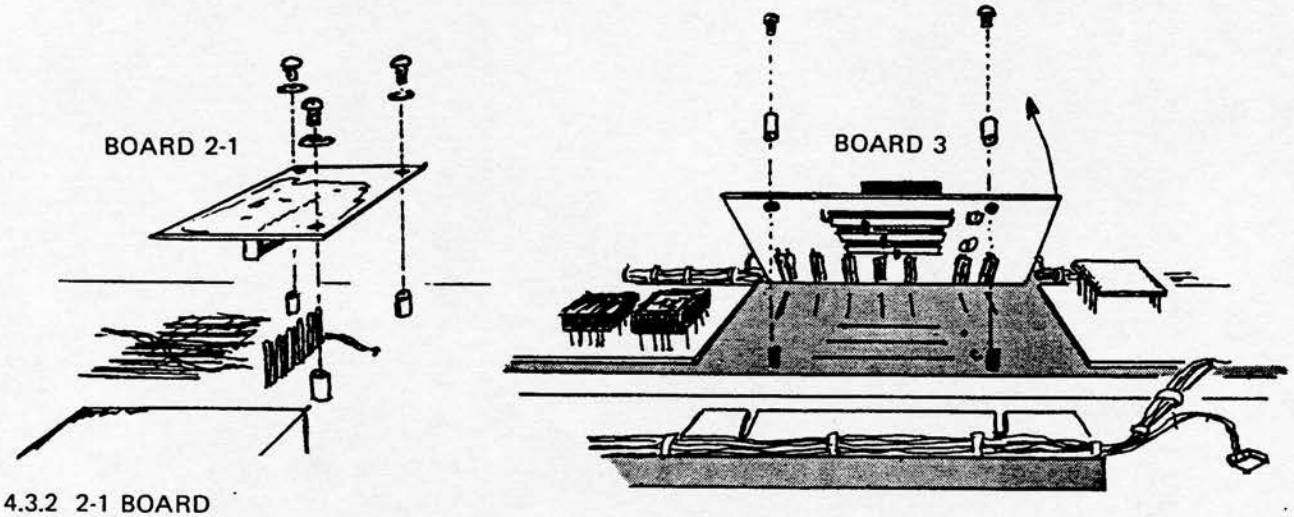
1. If repairs involve only the keyboard electronics, remove the grey metal panel. (see illustration) For proper operation of the keyboard, be sure that this panel does not become grounded since it is at the Keyboard Control Voltage potential.
2. If the keyboard contacts must be serviced, remove the four screws on the keyboard case and remove the entire assembly.

CAUTION: DO NOT REMOVE ANY SOLDERED WIRES TO GAIN ACCESS TO THE BOARDS.



4.3.1 BOARDS 1 AND 2

1. Remove the slider knobs and jack nuts from the front panel that hold Board 1 or Board 2 in place. (Take care not to damage the front panel).
2. Remove the two screws that hold the retaining strip in place on the top of the 3 Board (see illustration).
3. Remove the power connections to the Board(s). (The power connections are the twisted red-black-violet wires that go to a plug on each board.)
4. Remove the retaining strip along the top of Board 3, Board 2, and Board 1, and place it out of the way. Cut the cable tie that holds the strip to the VCO I module. Note: Later units may have metal bracket holding the retaining strip in place instead of a cable tie. Slide strip to the right and out after removing the two screws on Board 3 that hold it in place.
5. Raise the board from its top to gain access to the components.



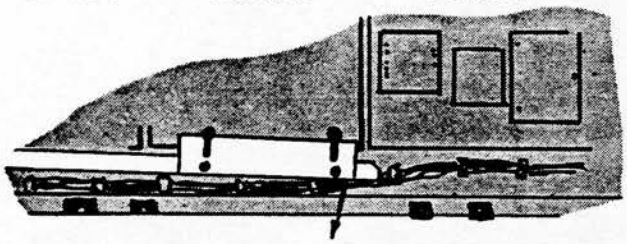
4.3.2 2-1 BOARD

1. To gain access to the components, remove the three screws on the top of the 2-1 Board. Lift the board straight up from the 2 Board.

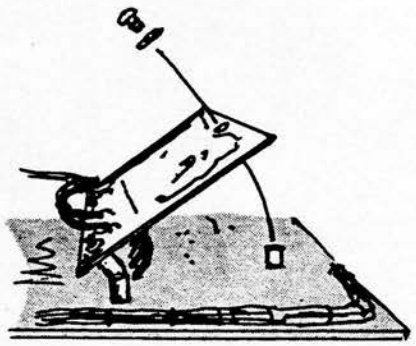
4.3.3 BOARD 3

1. Disconnect the power connections to Boards 1, 2, and 3.
2. Remove the retaining strip along the top of these boards after removing the two screws on the 3 Board that hold it in place. Note: Later units may have a metal bracket holding the retaining strip in place instead of a cable tie in Board 2. Slide the strip to the right and out after removing the two screws on Board 3 that hold it in place.
3. Remove the two spacers which held the two screws on the top of Board 3.
4. Remove the slider knobs and the jack nuts in the area of Board 3.
5. Lift the top of Board 3 up and back to gain access to the components.

BOARD 4



BOARD 4-2



4.3.4 BOARD 4

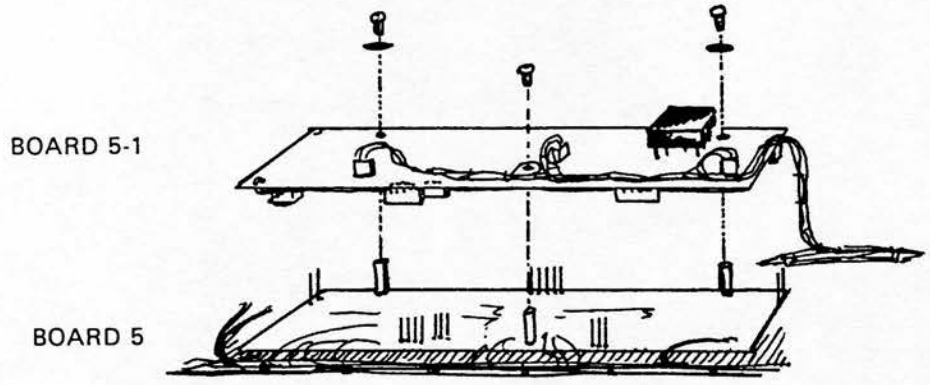
1. Loosen the two screws that hold the retaining strip along the top of Boards, 1, 2, and 3, and pull it just clear of the 4 Board. (See illustration)
2. Remove the power connections on the board.
3. Remove the slider knobs and the jack nuts (including the manual start button) in the area of the board.
4. Lift the top of Board 4 up and back to gain access to the components.

4.3.5 BOARD 4-2

1. Remove the single screw on the top of the board and carefully hinge back the board to gain access to the components. Do not disconnect any wires.

4.3.6 4020 BOARD (ADSR)

1. Desolder the pins that connect the 4020 board to the 4 board. Remove the board entirely to gain access to the components. DO NOT CUT THE PINS.

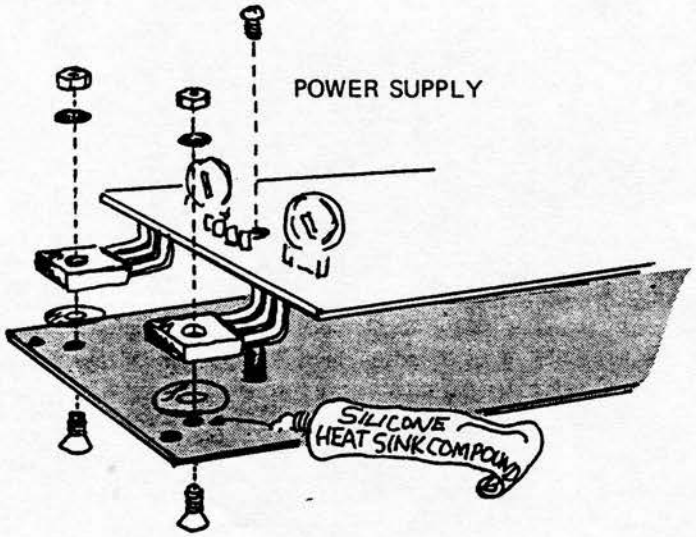


4.3.7 BOARD 5-1

1. Remove the three retaining screws on the top of the 5-1 board (see illustration).
2. Lift the 5-1 Board up from the 5 Board and lay it back out of the way.
   Do not disconnect any other wires; there is plenty of room to get to the components.

4.3.8 BOARD 5

1. Remove the slider knobs and jack nuts from the front panel area that holds the 5 Board in place.
2. Remove the 5-1 board (see above) and lay it out of the way.
3. Lift the board out of the panel as far as the connecting wires will permit to gain access to the components.



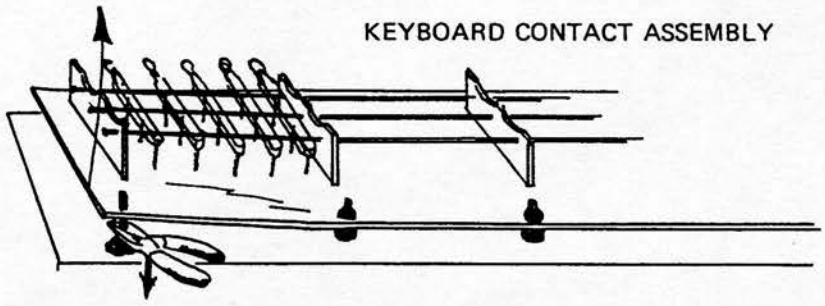
4.3.9 POWER SUPPLY

1. Remove the four screws that hold the power supply assembly in place on the case.
2. Remove the three screws that hold the P.C. Board to the metal mounting plate and the two screws that hold the two power transistors in place (see illustration).
3.

Note: When reassembling the power supply, be sure to use silicone heat compound between the power transistors, mica washers and the metal mounting plate.

4.3.10 KEYBOARD (ELECTRONICS)

1. Remove the four screws on the grey panel of the keyboard.
2. Carefully lift the panel assembly out of the keyboard. Remove the red wire from the keyboard control voltage buss.
3. Remove the edge connector from the P.C. Board and lift the entire assembly out of the unit.
4. Remove the four screws holding the P.C. Board in place to gain access to the components.



4.3.11 KEYBOARD CONTACT ASSEMBLY

1. Remove the entire keyboard assembly from the wooden case (see 4.2.2, step 2).
2. To service the underside of the key contact assembly, remove the four screws that hold the wooden cover across the top of the keys. Then, remove the six screws that hold the keyboard assembly to the keyboard.
3. Using needle nose plyers to hold the rubber hold-down in place under the P.C. Board, pull gently but firmly until the board pops loose. Grip the hold-downs tightly as they are difficult to reinstall into the keybed. Repeat this procedure on each of the hold-downs. (see illustration)

SECTION 5

KEYBOARD ADJUSTMENTS

5.1 INTRODUCTION

Section 5.2 describes the proper timing of the keyboard contacts and the effect it has on other functions in the 2600. Section 5.3 covers the checkout procedure for the contacts and the musical effects of improperly adjusted contacts. Adjustment of the contacts is covered in Section 5.4.

5.2 CONTACT TIMING

Ideally, all three contacts should meet the buss exactly at the same time for the proper effect. The control voltage change should occur at the same time as the leading edge of the gate so that the pitch changes at the same time as the ADSR is initiated (which allows the signal to be passed by the VCA or VCF). The trigger is delayed electronically 15 milliseconds to allow the noise on the leading part of the gate signal and the control voltage to subside. If the trigger is delayed much more than 15 milliseconds, the delay may become audible. If some keys do not give the proper response or do not trigger the ADSR at all, cleaning or adjustment may be needed.

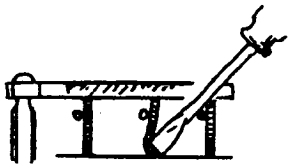
5.3 TIMING CHECKOUT PROCEDURE

If any of the contacts fail to meet the buss rods at the proper time, thefollowingeffects may result:

EFFECT	CAUSE
SOUND BECOMES AUDIBLE BEFORE ADSR IS INITIATED	GATE TOO SOON OR TRIGGER TOO LATE
NO SOUND AT ALL: ADSR IS NOT INITIATED	GATE TOO LATE OR TRIGGER TOO SOON
PITCH CHANGES BEFORE PREVIOUS ENVELOPE HAS COMPLETED	CONTROL VOLTAGE TOO SOON
PREVIOUS NOTE IS HEARD BEFORE CORRECT NOTE	CONTROL VOLTAGE TOO LATE

1. Put VCO 1 in the audio range and put all (vertical) control sliders fully down. With the lowest key on on the keyboard depressed, adjust the frequency of the VCO 1 to about 300Hz (audible range over the entire keyboard) using the Initial Frequency slider on VCO 1.
2. Put the VCF resonance, fine tune and Initial Filter Frequency Sliders at fully left. Raise the VCO 1 audio input slider to the VCF and the ADSR control input slider to the VCF. Lower all other VCF vertical sliders.
3. Set the ADSR sliders: attack-down, decay-1/2, sustain-down, release-1/2.
4. Raise the VCF input slider to the mixer and raise the speaker sliders. Lower both of the reverb sliders.
5. Make sure the gate select slide switch (located below the AR envelope generator) is in the upper position (Keyboard controlled).
6. Depress each key lightly and at a moderate speed in the following order: C5, C1, B4, C1, A#4, C1, A4, C1, G#4. C1, G4. etc. until all of the keys are played. The sound produced by every key depression should be a well defined sharp pulse of sound. If any of the keys produce a sluggish or delayed sound, clean the contacts and buss thoroughly. If the problem persists, consult the above chart and locate the particular problem, then make the necessary contact adjustments. (Be sure to depress the keys that are being tested at least four(4) times.)
7. To be sure that the control voltage contact has not been over adjusted, set the ADSR to : attack-down, decay-1/2, sustain-up, release-up. Repeat step 6 and check that the pitch changes exactly at the same time the key is depressed.
8. Pin the Highest C and press C1, C#1, D1, D#1, etc. The pitch should change smoothly. If any of the notes are not stable, clean the CV buss.

CLEAN THE CONTACTS WITH DENATURED ALCOHOL BEFORE ADJUSTING THEM



CONTACT SPRING ADJUSTMENTS

5.4 CONTACT ADJUSTMENTS

To adjust the contacts, use a small screwdriver at the base of the spring contact. Pivot the screwdriver against the base of the spring by anchoring one edge of the screwdriver on the P.C. Board. This will give you the control you need to adjust the contacts without bending them too far.

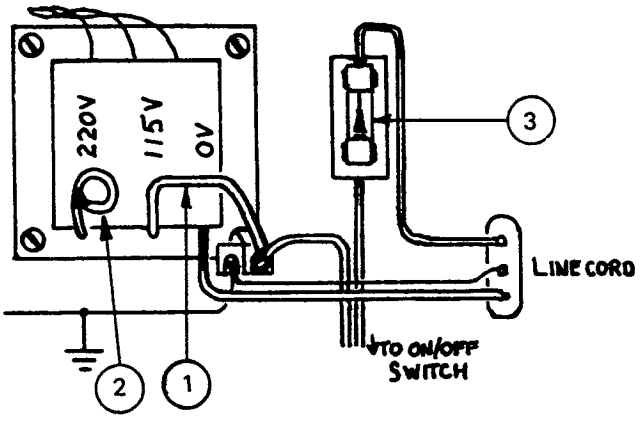
6.1 INTRODUCTION

Section 6.2 covers the conversion from 115 volt service to 220 volts for units which are to be taken to foreign countries. Section 6.3 describes what to do if a mini jack fails to conduct from the tip to the shunt. Section 6.4 covers the conversion procedure for older 2600 units which may contain different operational amplifiers from the ones presently used.

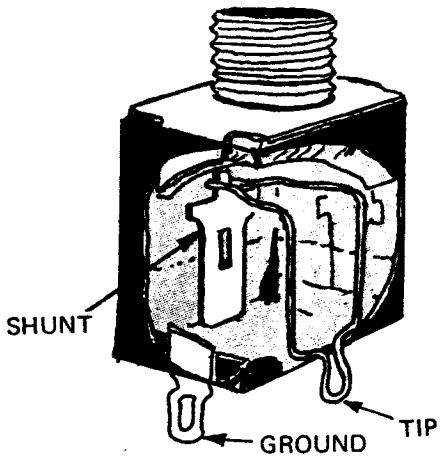
6.2 2600 115 to 220 VOLT CONVERSION

1. Remove the 115 volt wire from the terminal strip and tie it back out of the way.
2. Solder the 220 volt wire from the transformer to the terminal strip where the 115 volt wire was.
3. Change the fuse to 1/4 amp, slow blow. The 2600 will operate on 50 cycles with no other changes.

115 TO 220 VOLT CONVERSION

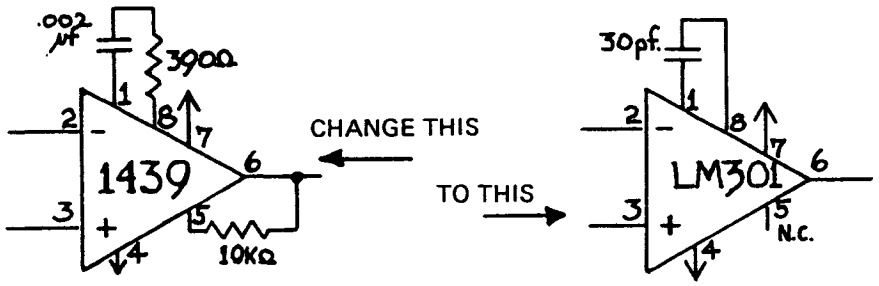


MINI JACK



6.3 MINI JACK REPAIRS

When a mini jack fails to conduct a signal from the tip to the shunt, sometimes the jack can be fixed without replacement. Pick the tip spring with a scribe, then spray the insides of the jack with some tuner cleaner or other volatol cleaning fluid that will leave no residue and will not damage either the paint of plastic. Prick the spring against the jack with a small pick to remove any rosin that may be present on the interior of the jack. Spray the jack again and put a plug in and out of the jack rapidly. If that doesn't work, take the unit apart and desolder the tip of the jack and wiggle it back and forth to clean the insides of the jack. If none of these repairs are of any help, replace the jack with a new one. In an emergency, the jacks in the multiple group in the lower left hand corner of the front panel can be swapped with the faulty jack since these jacks do not use the tip to shunt feature and they are easy to reach.

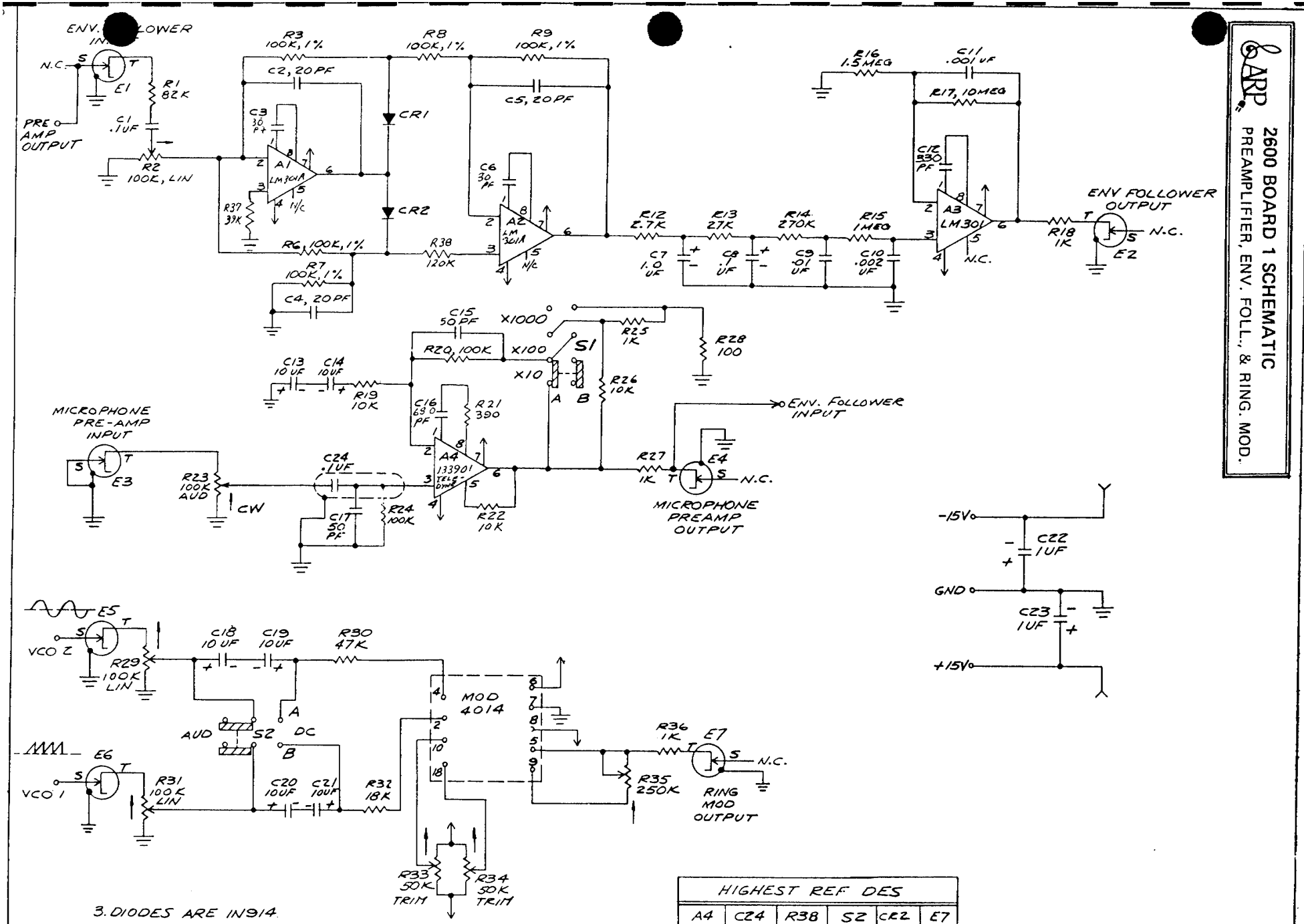


6.4 -1439TO LM301 OPERATIONAL AMPLIFIER REPLACEMENT

If it should become necessary to change a 1439 op amp. always replace it with the LM301AH. The following changes should be made:

1. Remove the resistor between pins 5 and 6.
2. Remove the resistor and capacitor between pins 1 and 8.
3. Install a 30pf capacitor between pins 1 and 8.
4. Install the new LM301AH op amp.

Note: If the problem is intermittent lock up or down and the op amp is a1439, the op amp is most likely to be at fault. When in doubt, it is a good idea to change the op amp and make the conversion to LM301AH.



HIGHEST REF DES					
A4	C24	R38	S2	CR2	E7

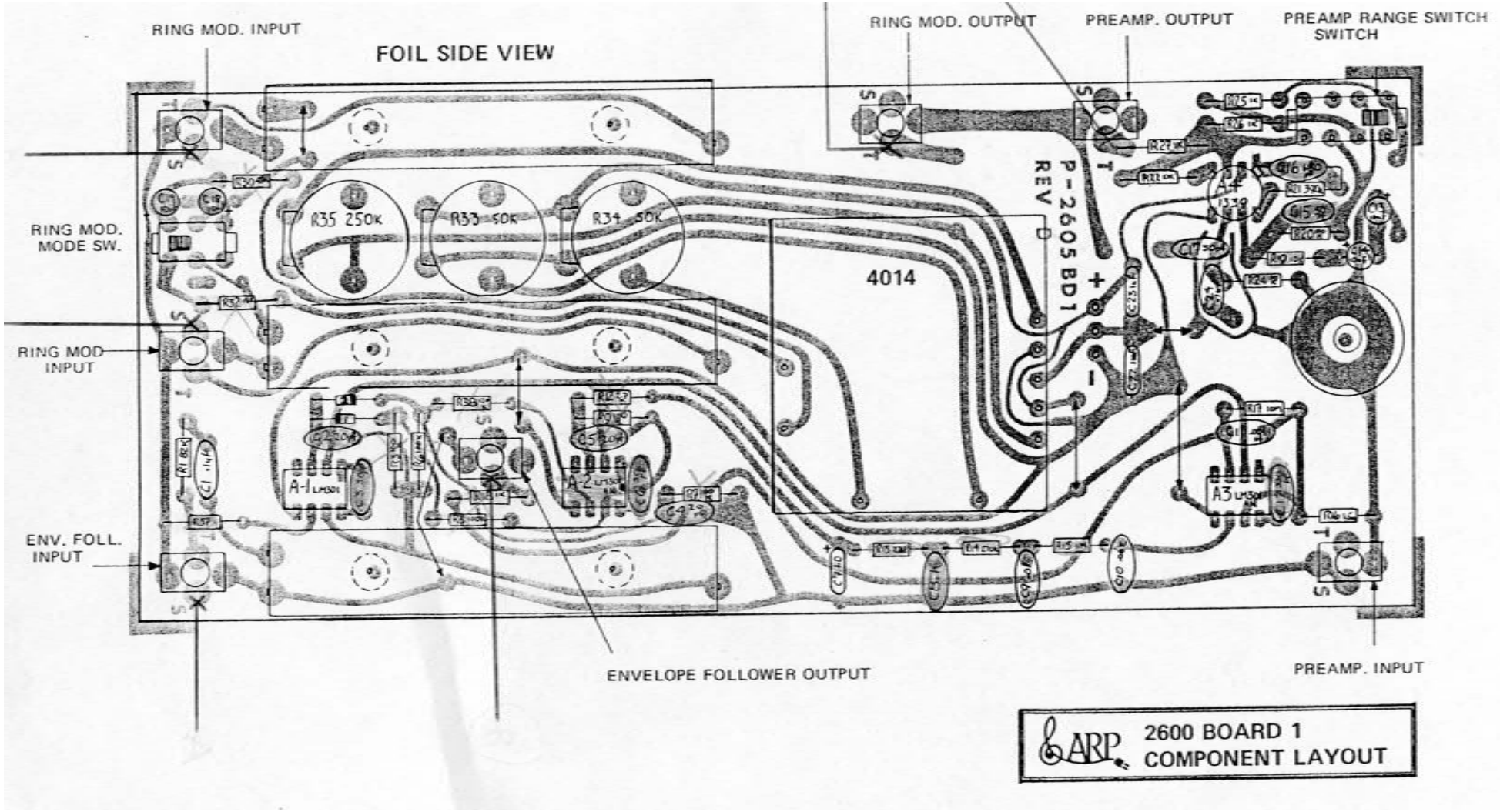
3. DIODES ARE IN914
2. RESISTORS R3, R6-R9 ARE RN55D M.F. TYPE
1. UNLESS OTHERWISE SPECIFIED ALL

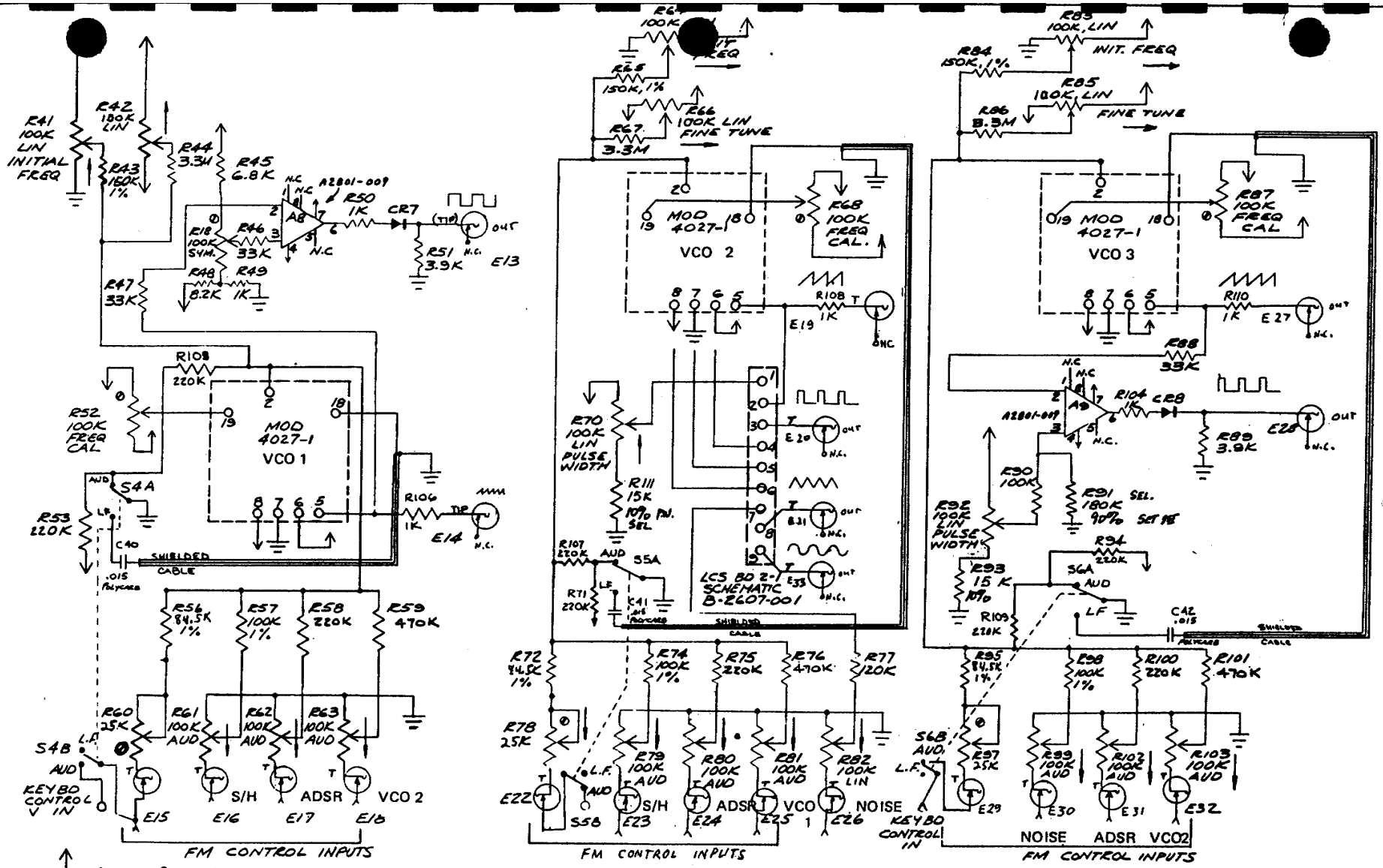
NOTES: RESISTORS ARE 1/4W ± 10%.

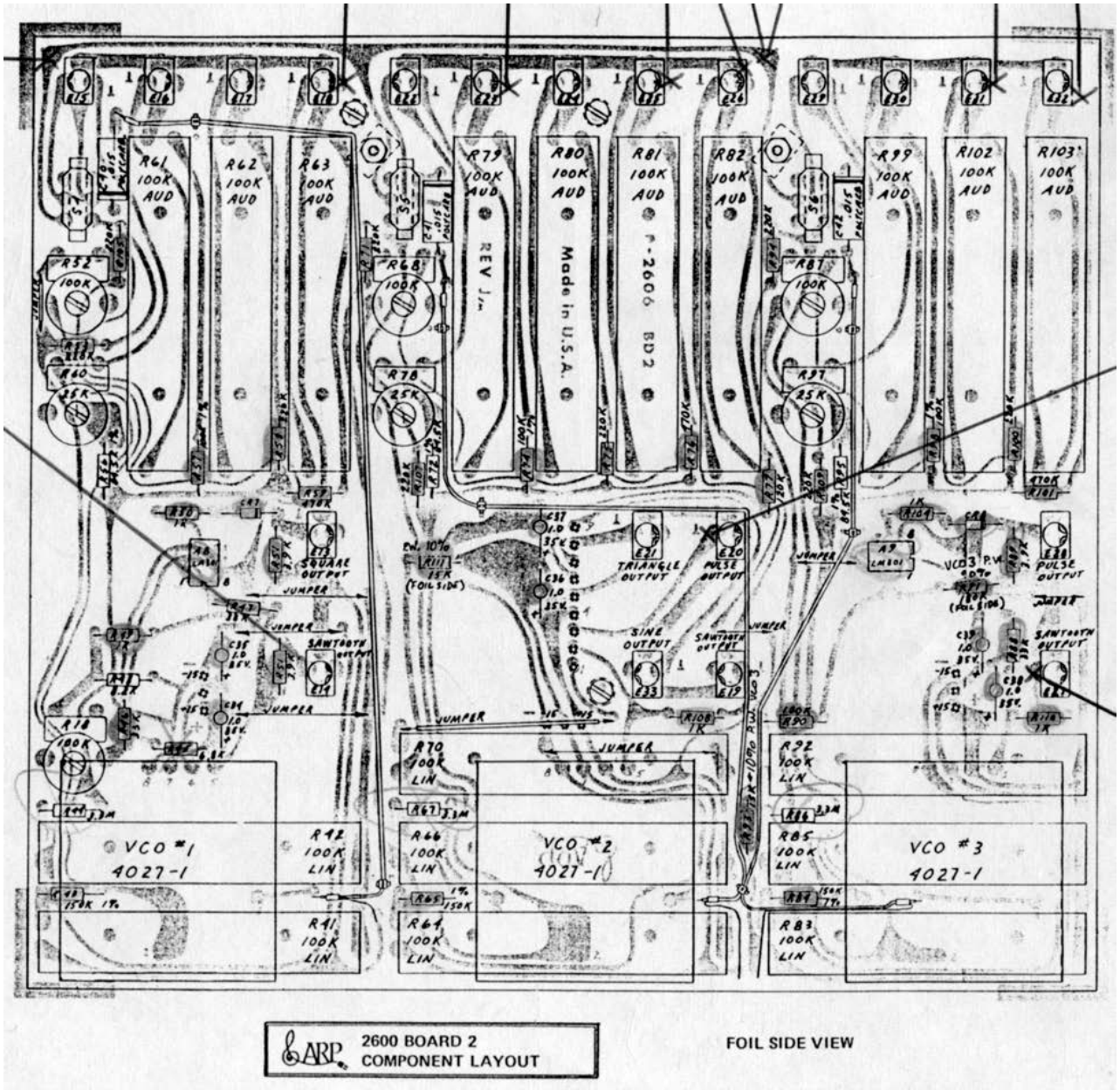
ARP

2600 BOARD 1 SCHEMATIC

PREAMPLIFIER, ENV. FOLL., & RING. MOD.


RING MOD. INPUT
FOIL SIDE VIEW
RING MOD. OUTPUT
PREAMP. OUTPUT
PREAMP RANGE SWITCH
SWITCH
RING MOD. MODE SW.
RING MOD INPUT
ENV. FOLL. INPUT
R35 250K
R33 50K
R34 50K
4014
P-2605 BD1 REV D
A-1
A-2
A3
ENVELOPE FOLLOWER OUTPUT
PREAMP. INPUT
ARP
2600 BOARD 1
COMPONENT LAYOUT

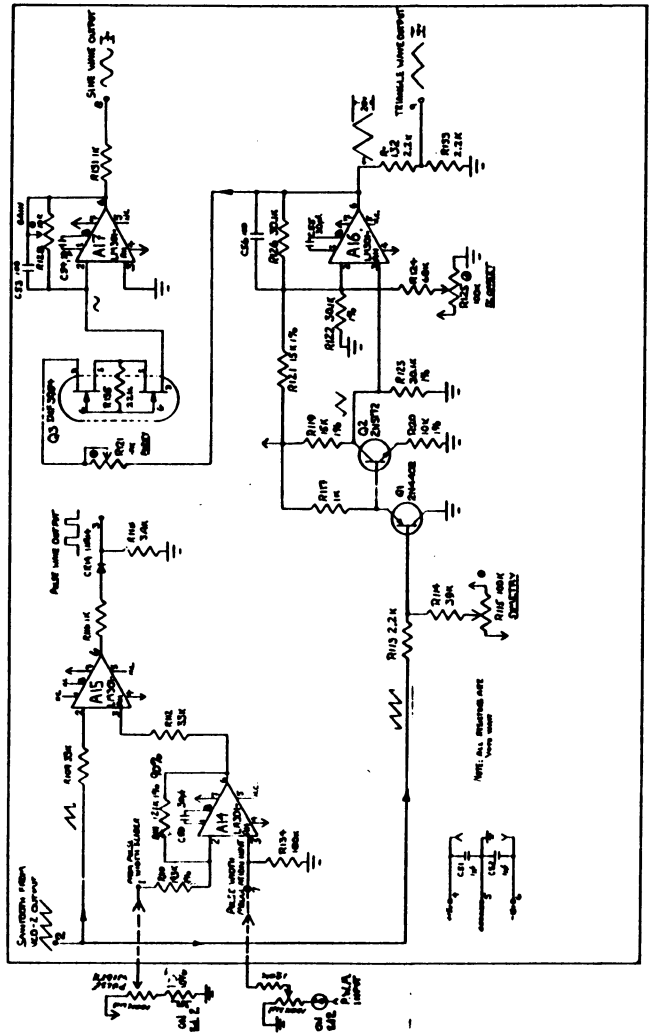

R41 100K LIN INITIAL FREQ
R42 180K LIN
R43 150K 1%
R44 3.3M
R45 6.8K
R46 33K
R47 33K
R48 8.2K
R49 1K
R50 1K
CR7
E13
R51 3.9K
A2801-009
MOD 4027-1 VCO 1
R52 100K FREQ CAL
R53 220K
R108 220K
S4A
S4B
C40 .015 Polycarb
SHIELDED CABLE
R106 1K
E14
R56 84.5K 1%
R57 100K 1%
R58 220K
R59 470K
R60 25K
R61 100K AUD
R62 100K AUD
R63 100K AUD
KEYBD CONTROL V IN
E15
S/H
E16
ADSR
E17
VCO 2
E18
FM CONTROL INPUTS
+15V
C34 1. 35V
GND
C35 1. 35V
-15
NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE 1/4 W ± 10%.
2. DIODES ARE IN914.
3. DELETED R55, 73, 96.
4. UNLESS OTHERWISE STATED ALL RESISTOR VALUES IN OHMS. ALL CAPACITOR VALUES IN µf.
R64 100K
R65 150K, 1%
R66 100K LIN FINE TUNE
R67 3.3M
MOD 4027-1 VCO 2
R68 100K FREQ CAL.
R108 1K
E19
R70 100K LIN PULSE WIDTH
R111 15K 10% PW SEL
R107 220K
S5A
S5B
RT1 220K
K41 .015 POLYCARB
LCS BD 2-1 SCHEMATIC B-2607-001
E20
E21
E33
R72 84.5K 1%
R74 100K 1%
R75 220K
R76 470K
R77 120K
R78 25K
R79 100K AUD
R80 100K AUD
R81 100K AUD
R82 100K LIN
E22
S5B
E23
E24
E25
VCO 1
E26
NOISE
KEYBD CONTROL IN
FM CONTROL INPUTS
+15V
C36 1. 35V
GND
C37 1. 35V
-15V
R83 100K, LIN INIT. FREQ
R84 150K, 1%
R85 100K LIN FINE TUNE
R86 3.3M
MOD 4027-1 VCO 3
R87 100K FREQ CAL
R110 1K
E27
R88 33K
A2801-009
R104 1K
CR8
E28
R89 3.9K
E30 100K
E31 180K SEL.
E32 100K LIN PULSE WIDTH
90% SET PW
R94 220K
E33 15K 10%
S6A
S6B
C42 .015 POLYCARB
SHIELDED CABLE
R109 220K
R95 84.5K 1%
R98 100K 1%
R100 220K
R101 470K
E29
E30
E31
E32
NOISE
ADSR
VCO2
FM CONTROL INPUTS
+15V
C38 1. 35V
GND
C39 1. 35V
-15V
HIGHEST REF DES
A9 C39 R104 S6 CR8 E33
ARP
2600 BOARD 2 SCHEMATIC
VCO 1, 2 & 3



ARP 2600 BOARD 2
COMPONENT LAYOUT

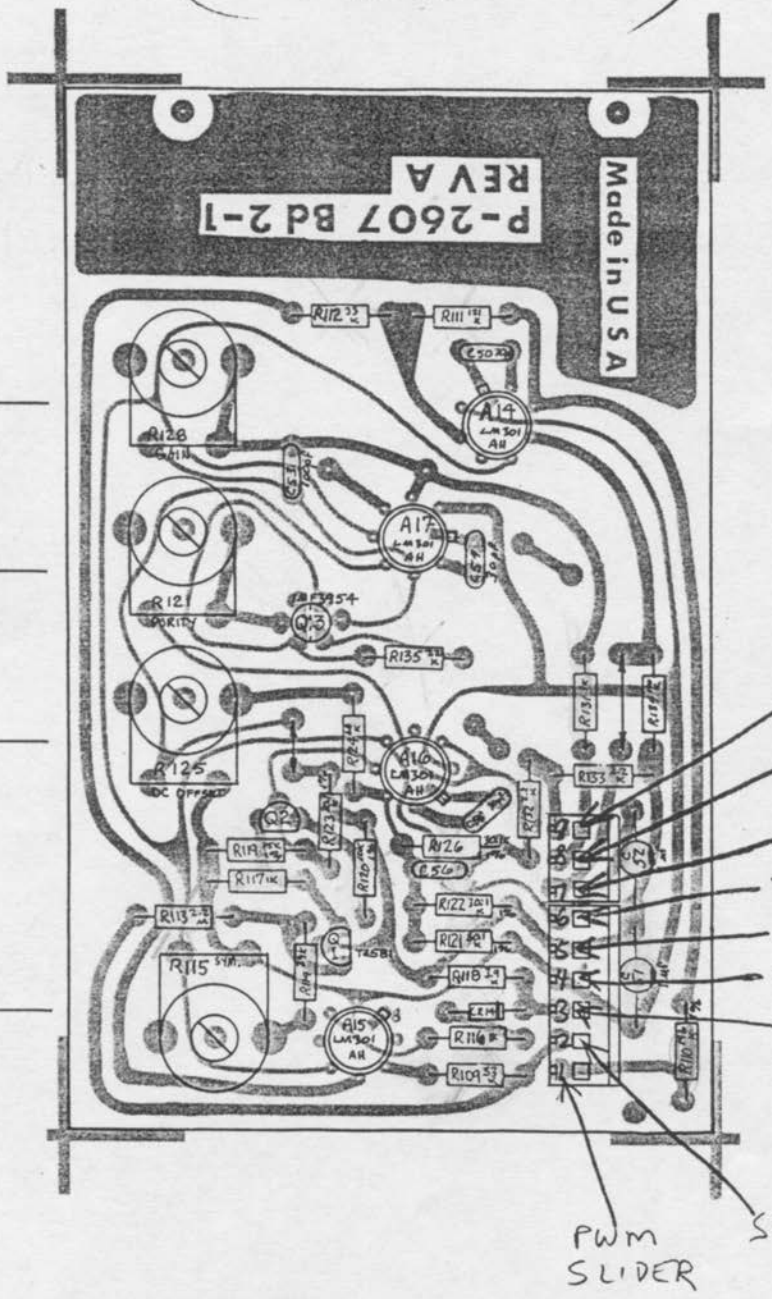
FOIL SIDE VIEW

2600 BOARD 2-1 SCHEMATIC
VCO 2 WAVEFORM CONVERTER

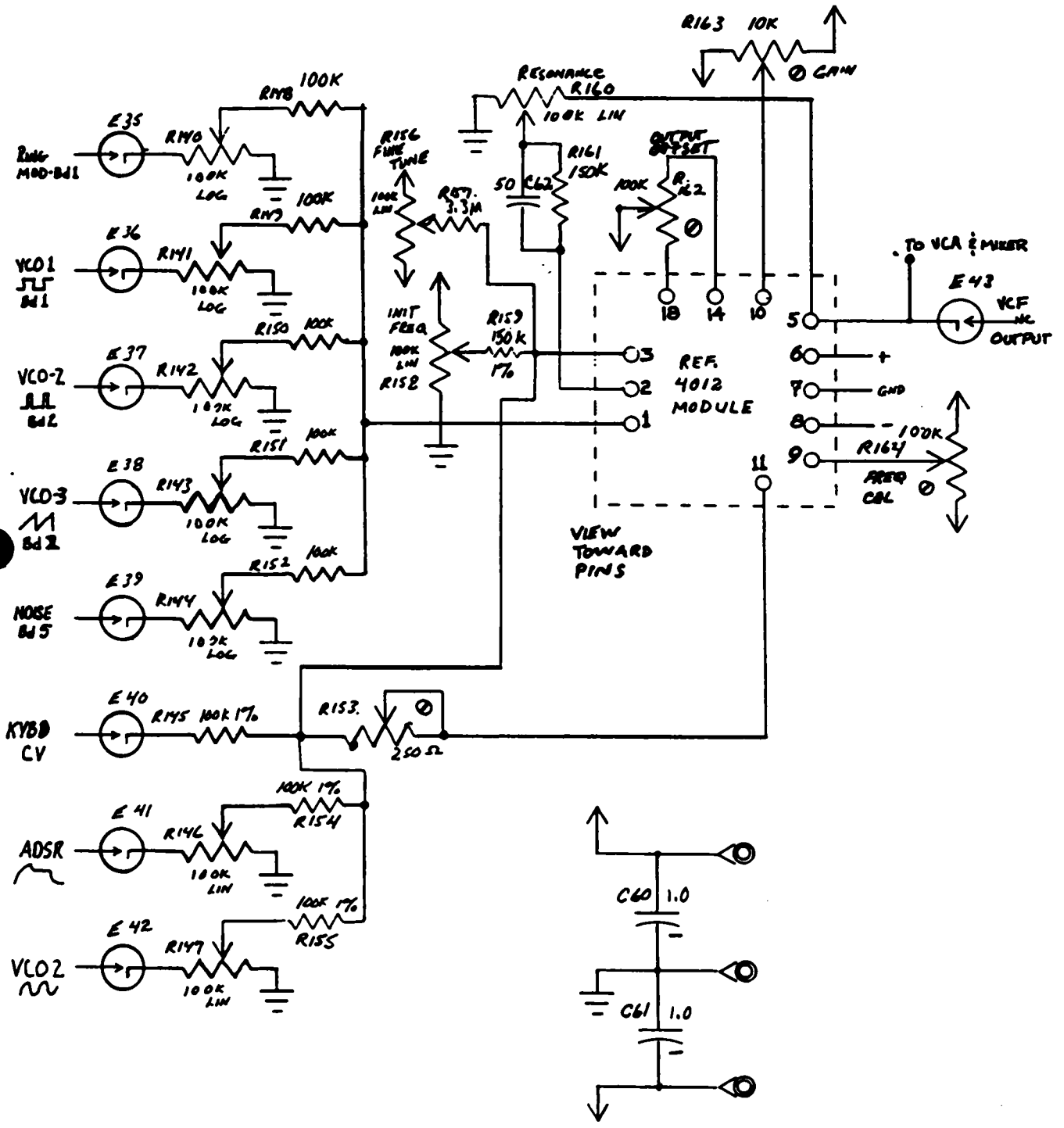


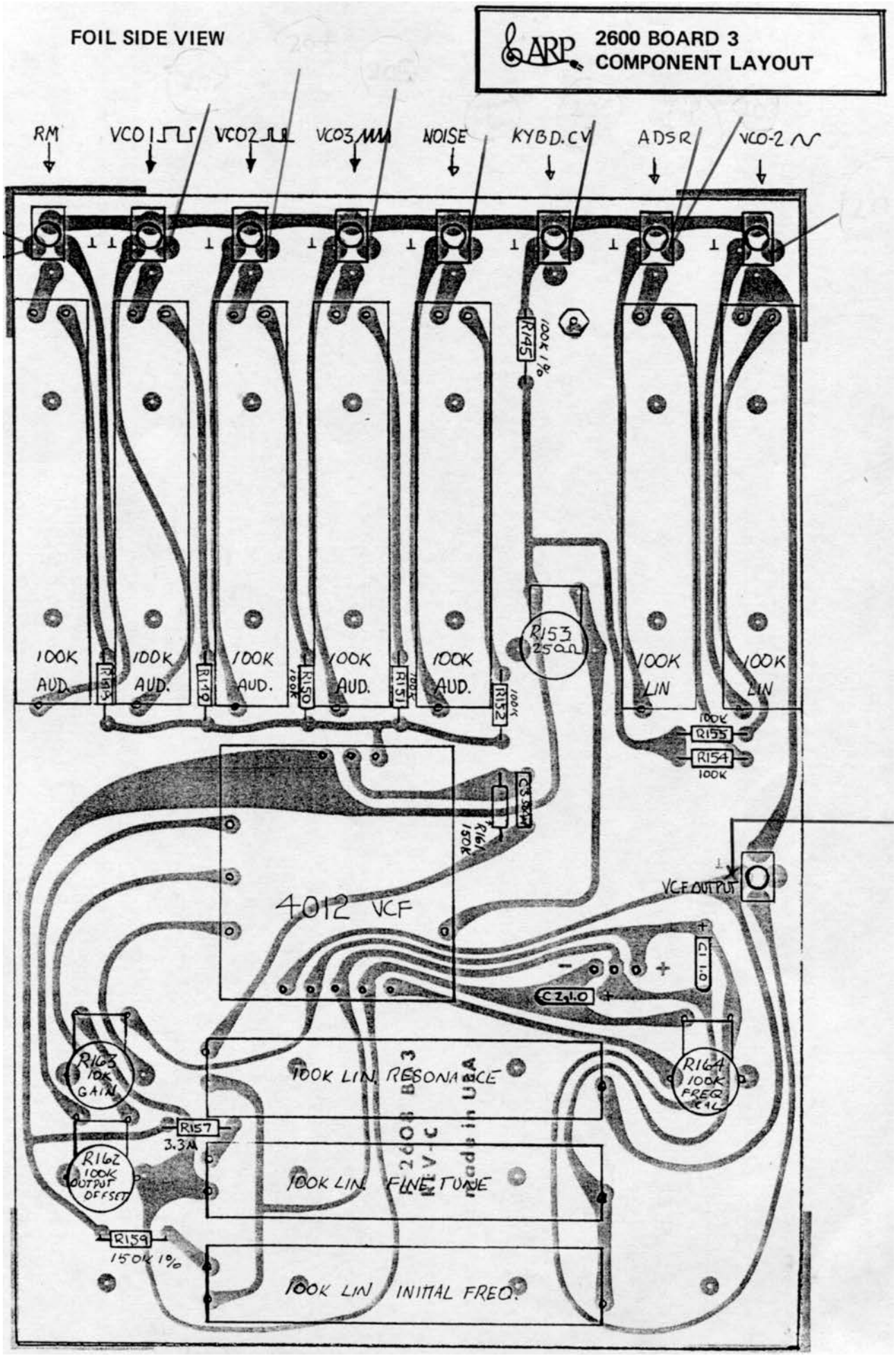
ARP 2600 BOARD 2-1
COMPONENT LAYOUT

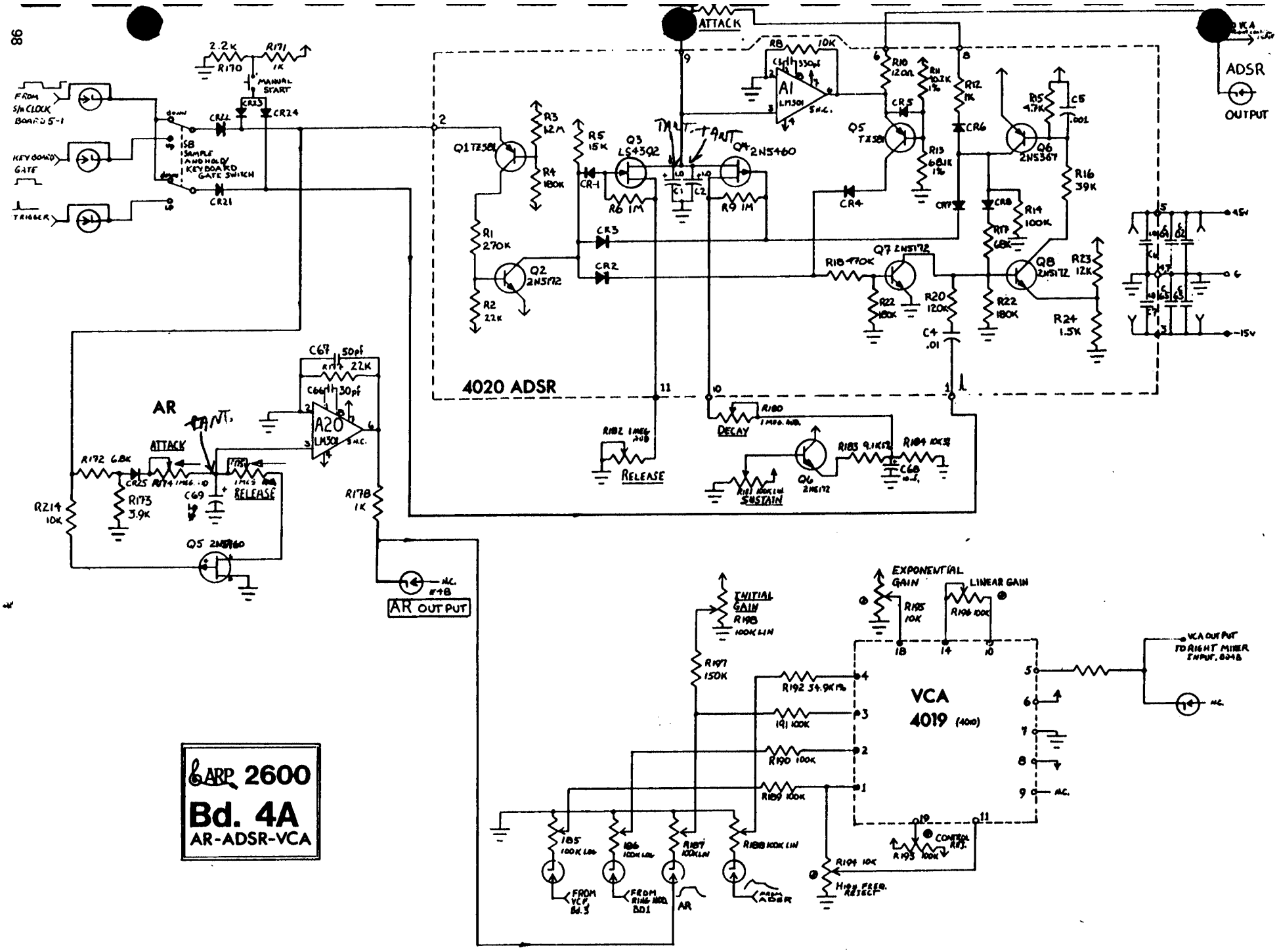
WAVEFORM CONVERTER



2600 BOARD 3 SCHEMATIC
VCF

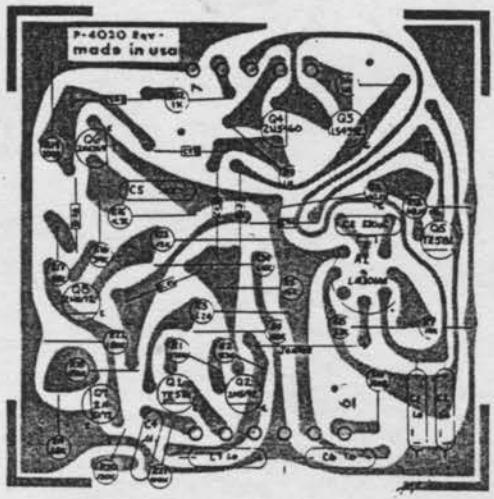



FOIL SIDE VIEW
ARP 2600 BOARD 3 COMPONENT LAYOUT
RM
VCO 1
VCO2
VCO3
NOISE
KYBD.CV
ADSR
VCO-2
100K AUD.
100K AUD.
100K AUD.
100K AUD.
100K AUD.
100K LIN
100K LIN
R145 100K 1%
R153 250Ω
R155 100K
R154 100K
R152 100K
R150 100K
R151 100K
R149
R143
C3 .33M
R161 150K
4012 VCF
VCF OUTPUT
C1 1.0
C2 1.0
R163 10K GAIN
R164 100K FREQ
100K LIN RESONANCE
R157 3.3M
R162 100K OUTPUT OFFSET
100K LIN FINE TUNE
R159 150K 1%
100K LIN INITIAL FREQ.
2600 BD 3 REV C
made in USA

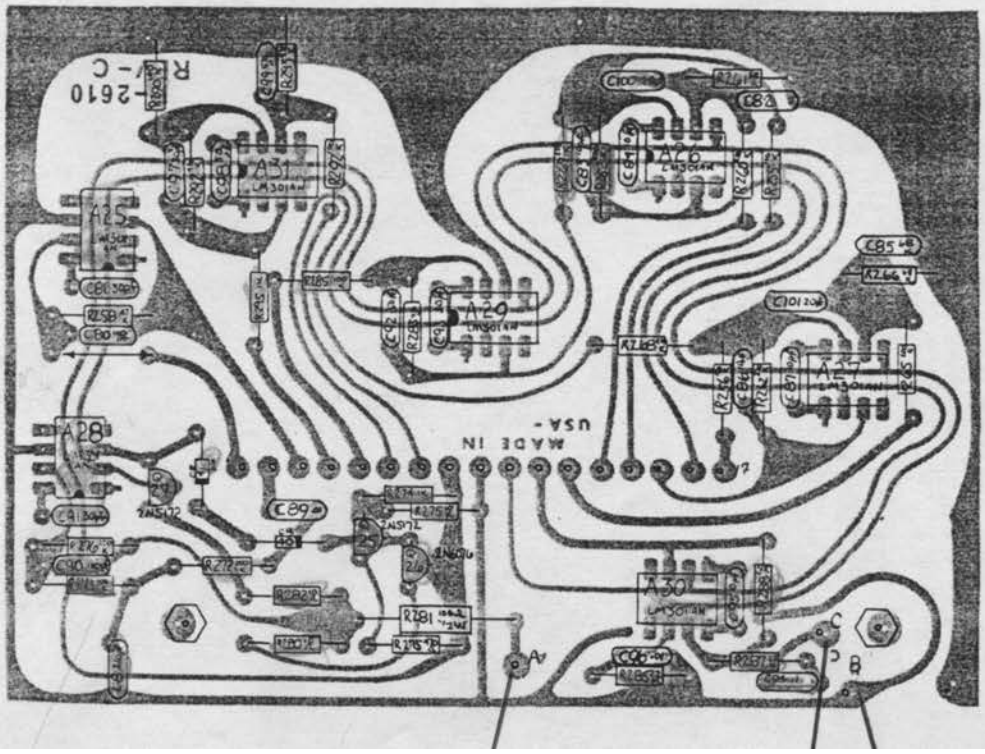


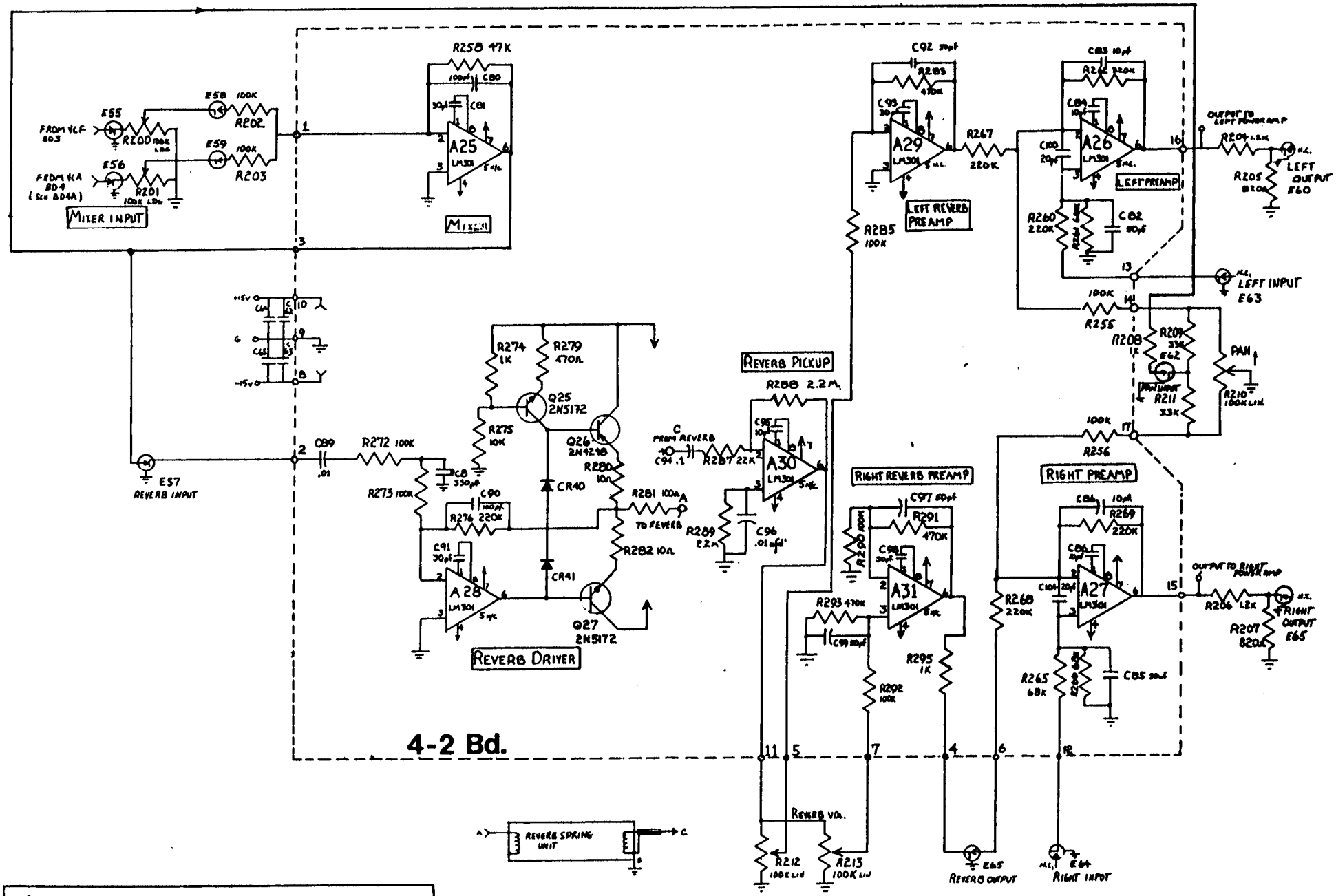
ARP 2600
Bd. 4A
AR-ADSR-VCA

2600 BOARD 4020 (ADSR)
COMPONENT LAYOUT

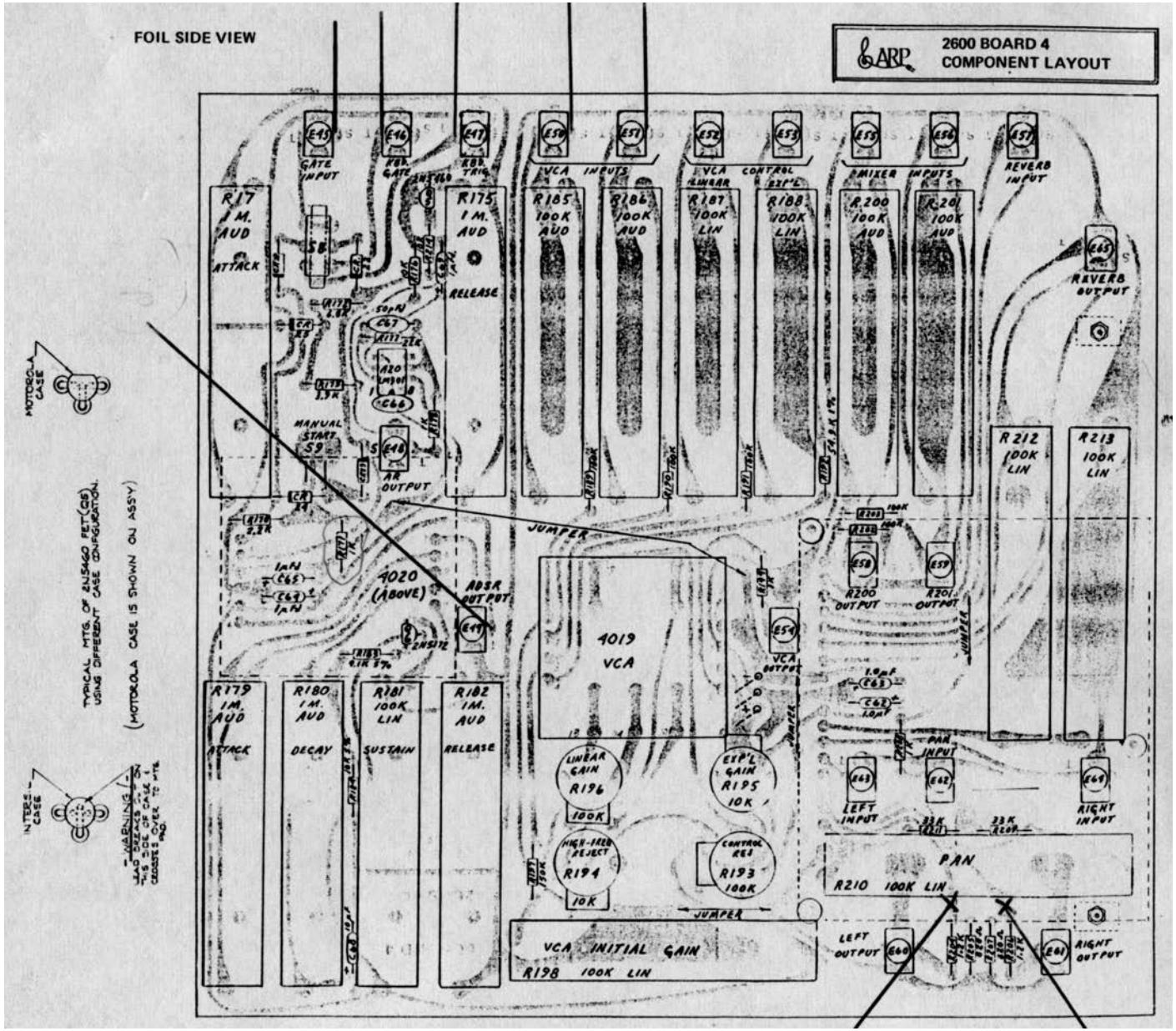


2600 BOARD 4-2
COMPONENT LAYOUT



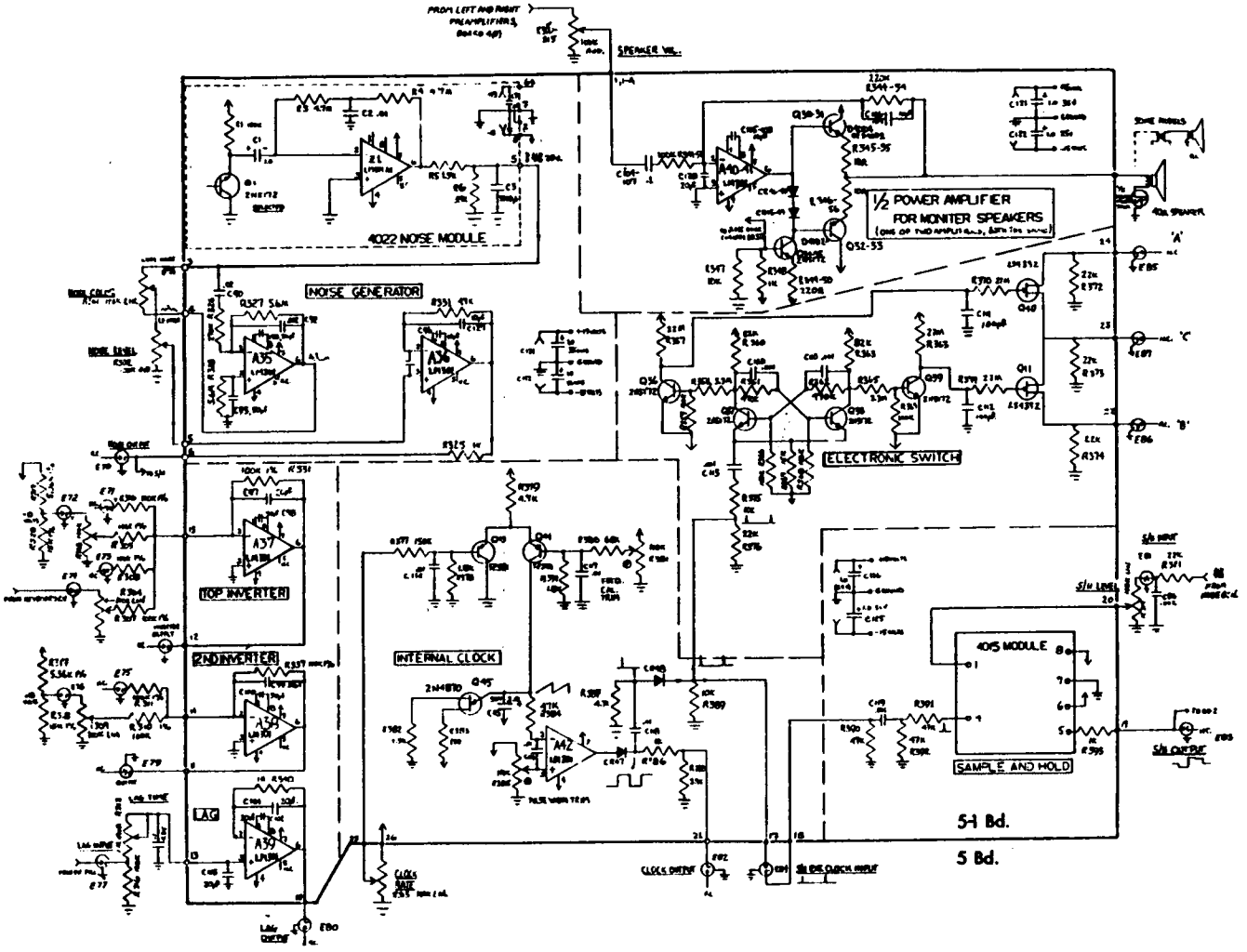


ARP 2600 4B & 4-2 Bd.


FOIL SIDE VIEW
ARP
2600 BOARD 4
COMPONENT LAYOUT
GATE INPUT
R17 1 M. AUD ATTACK
R175 1 M. AUD RELEASE
VCA INPUTS
R185 100K AUD
R186 100K AUD
VCA LINEAR CONTROL
R187 100K LIN
R188 100K LIN
MIXER INPUTS
R200 100K AUD
R201 100K AUD
REVERB INPUT
REVERB OUTPUT
R212 100K LIN
R213 100K LIN
MANUAL START S9
AR OUTPUT
JUMPER
4020 (ABOVE)
ADSR OUT PUT
4019 VCA
R200 OUTPUT
R201 OUTPUT
VCA OUTPUT
R179 1M. AUD ATTACK
R180 1M. AUD DECAY
R181 100K LIN SUSTAIN
R182 1M. AUD RELEASE
LINEAR GAIN R196 100K
EXP'L GAIN R195 10K
HIGH-FREQ REJECT R194 10K
CONTROL REJ R193 100K
PAN INPUT
LEFT INPUT
RIGHT INPUT
PAN R210 100K LIN
VCA INITIAL GAIN R198 100K LIN
LEFT OUTPUT
RIGHT OUTPUT
TYPICAL MTG. OF 2N5460 FET (G&S) USING DIFFERENT CASE CONFIGURATION.
(MOTOROLA CASE IS SHOWN ON ASSY)
MOTOROLA CASE
INTERSIL CASE
WARNING! LEAD BREAKS OFF ON THIS SIDE OF CASE. DO NOT CROSS OVER TO THIS PAD.

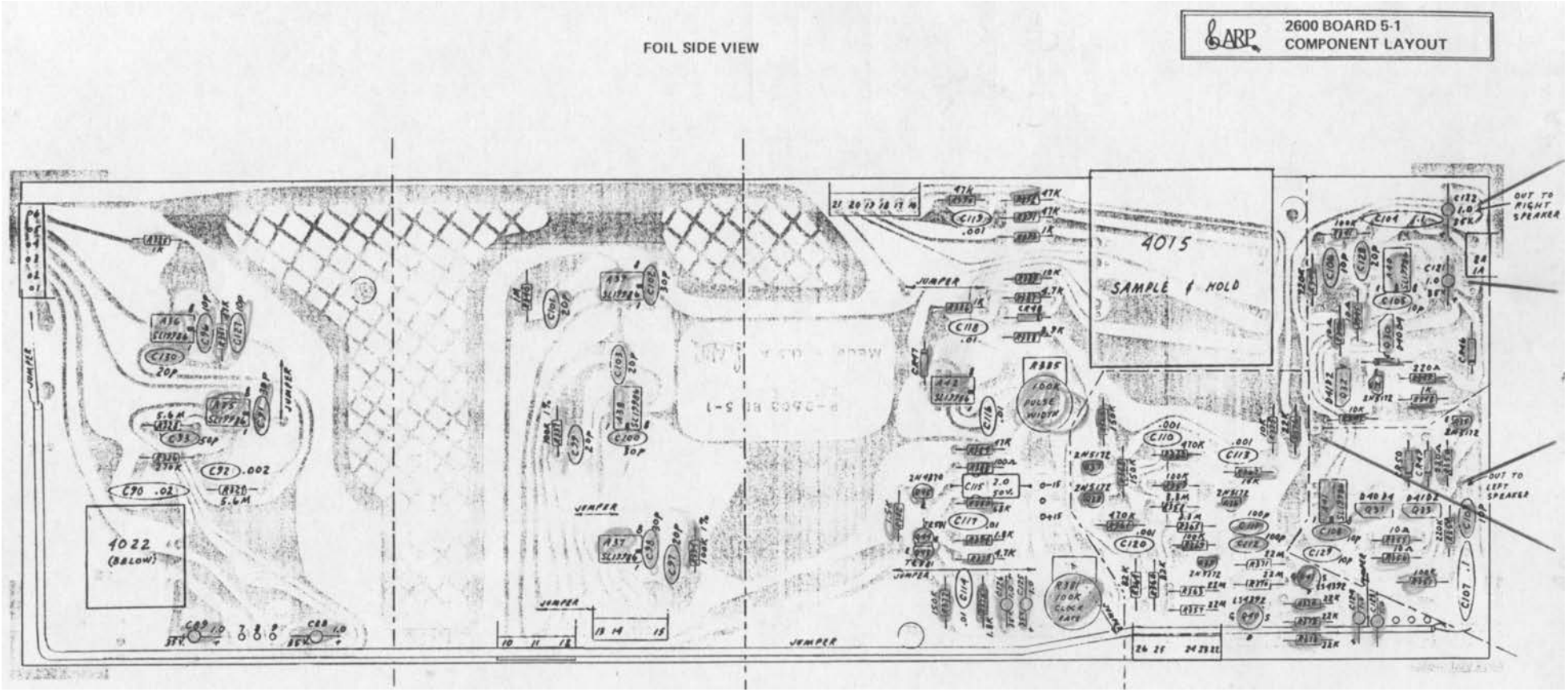
ARP 2600 Board 5, 5-1 & 4022

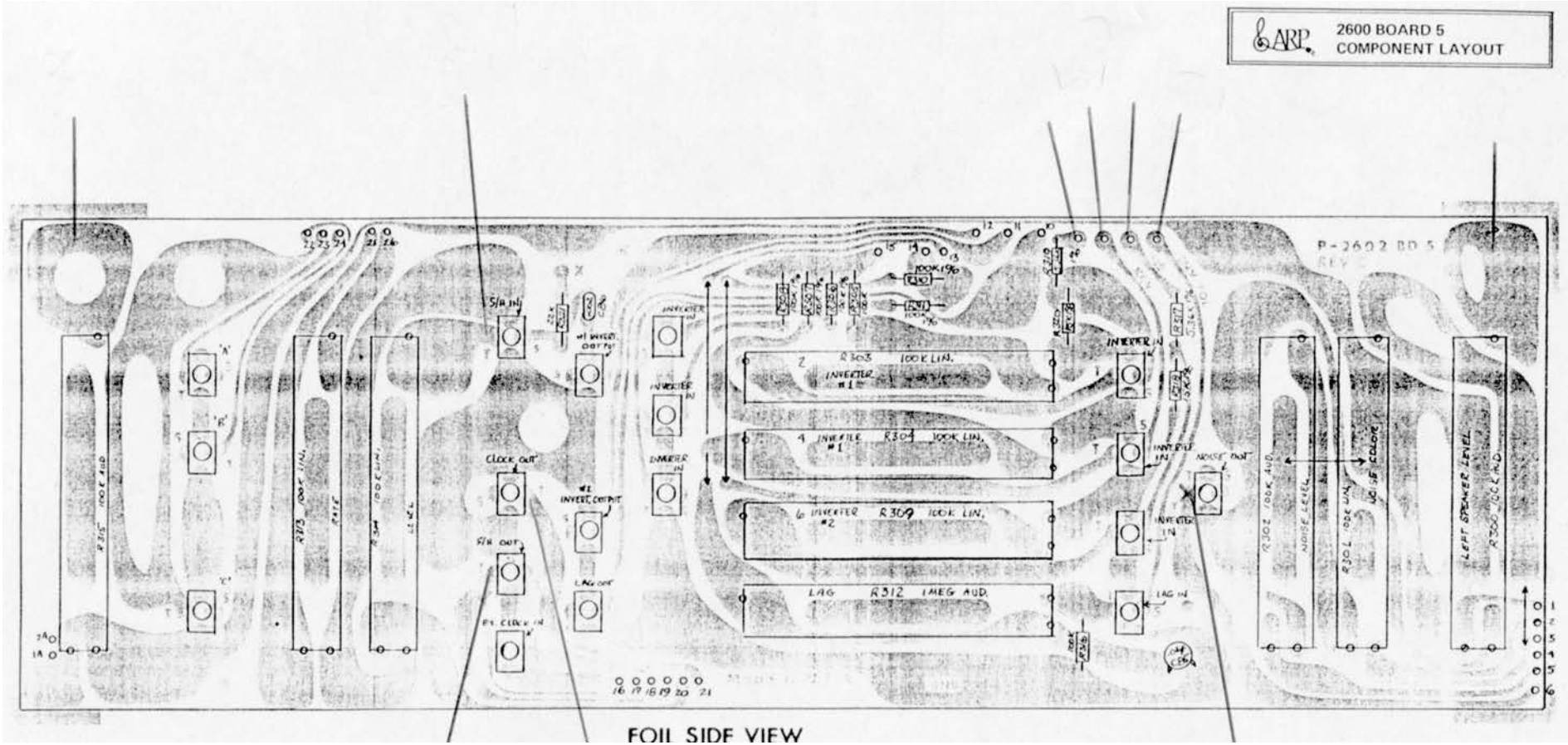
NOISE, VOLTAGE PROCESSORS, INTERNAL CLOCK, ELECTRONIC SWITCH, SAMPLE & HOLD AND POWER AMPS



FOIL SIDE VIEW

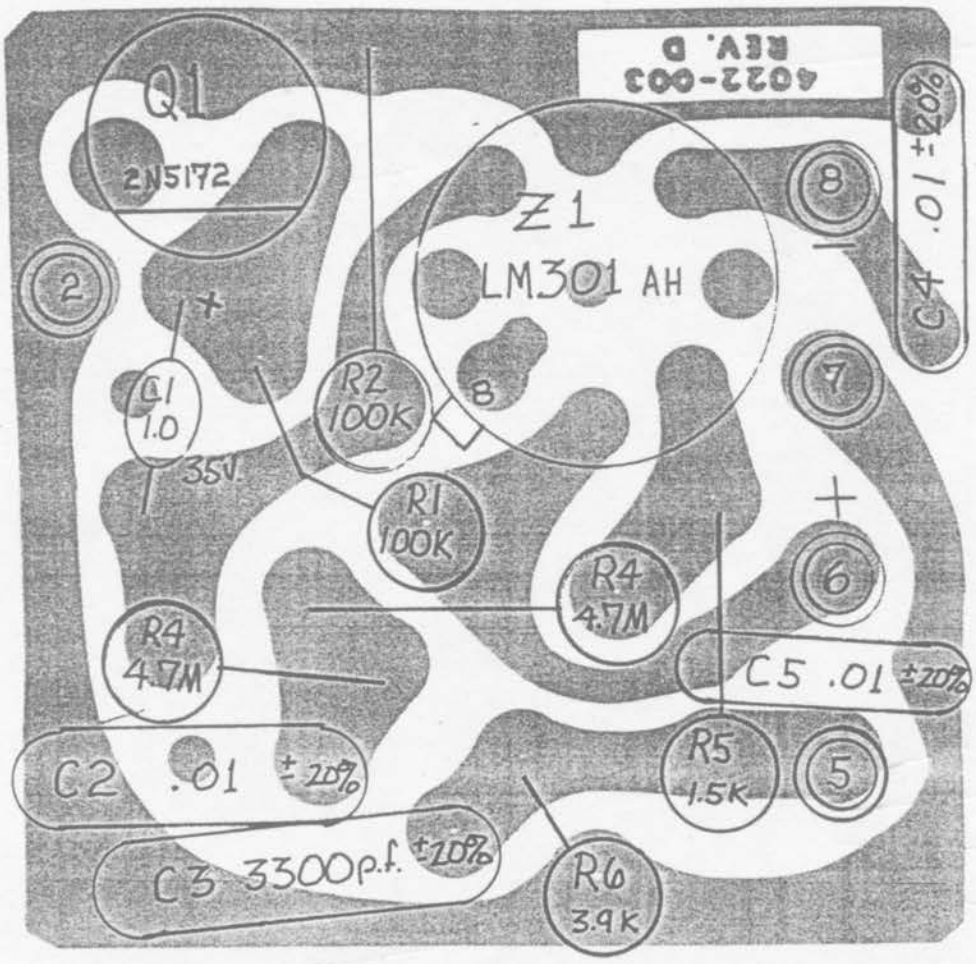
ARP 2600 BOARD 5-1
COMPONENT LAYOUT

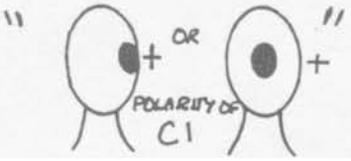



ARP
2600 BOARD 5
COMPONENT LAYOUT
P-2602 BD 5
REV
R303 100K LIN.
INVERTER #1
R304 100K LIN.
INVERTER #1
R309 100K LIN.
INVERTER #2
LAG R312 1MEG AUD.
R301 100K AUD.
NOISE LEVEL
R302 100K LIN.
OSC SYNC LEVEL
R300 100K AUD.
LEFT SPEAKER LEVEL
S/H IN
S/H OUT
CLOCK OUT
EXT. CLOCK IN
LAG OUT
LAG IN
INVERTER IN
NOISE OUT
FOIL SIDE VIEW

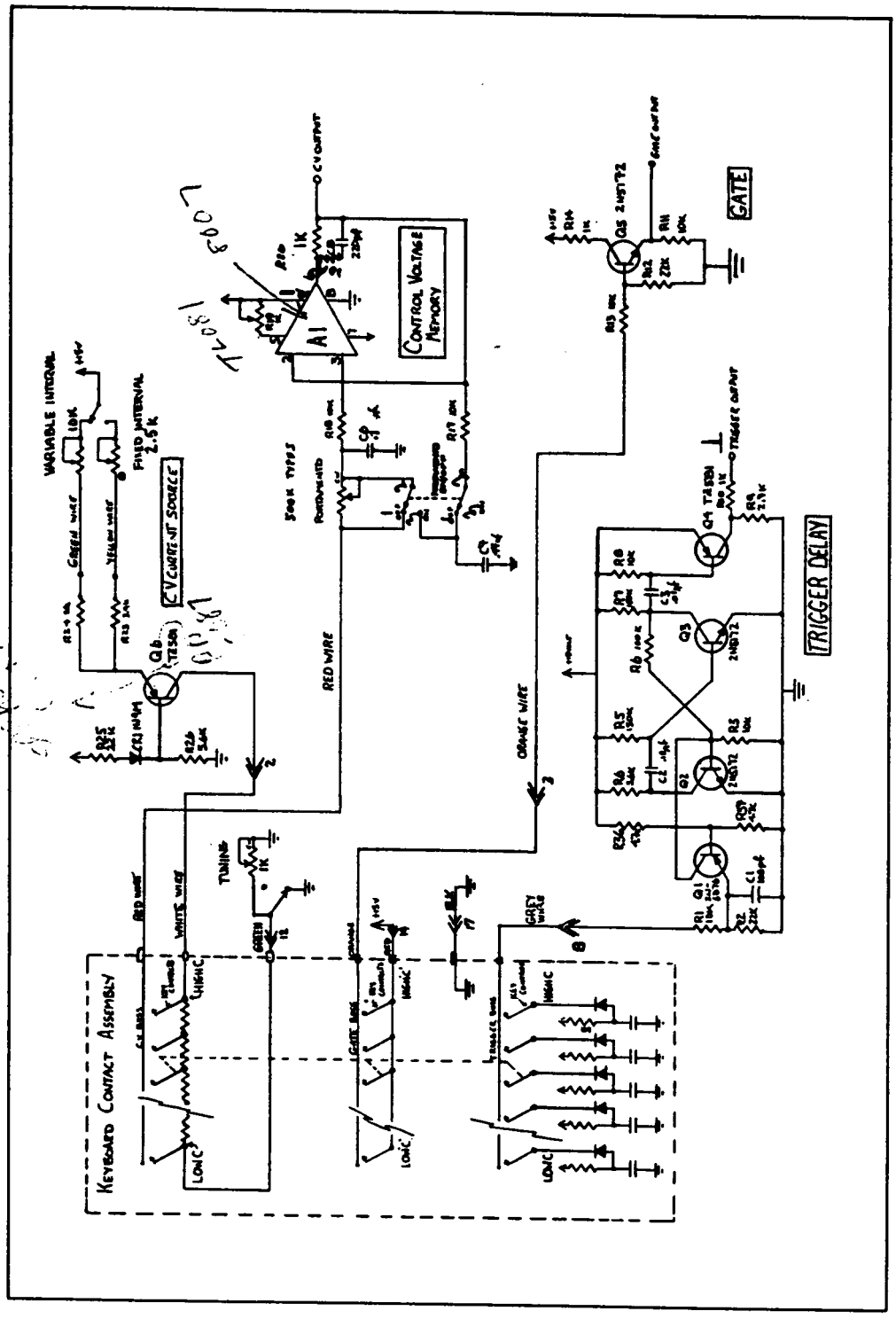
ARP

2600 BOARD 4022 (NOISE) COMPONENT LAYOUT

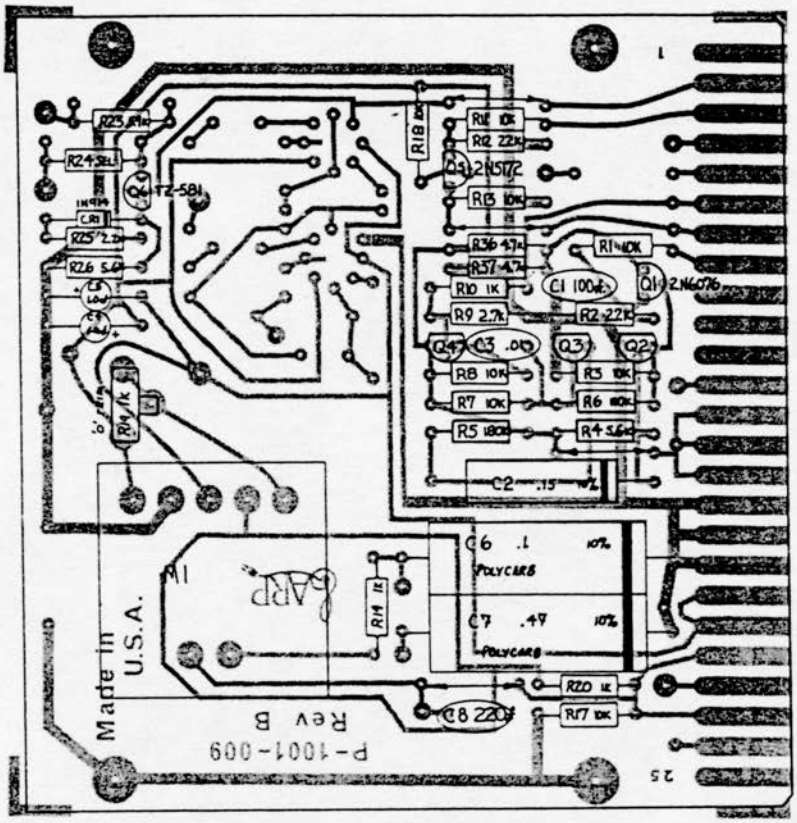




3604P KEYBOARD ELECTRONICS SCHEMATIC

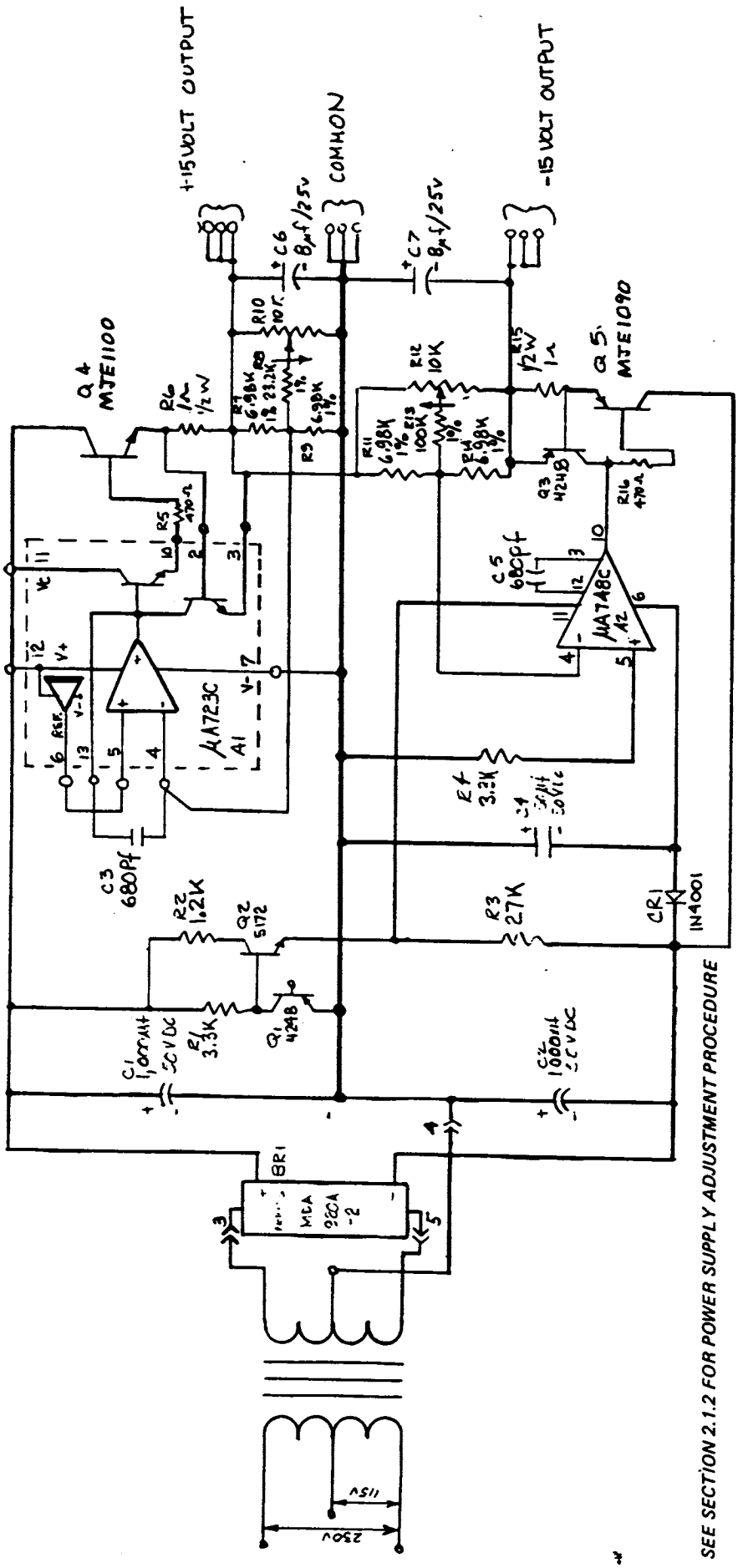


3604P KEYBOARD ELECTRONICS COMPONENT LAYOUT



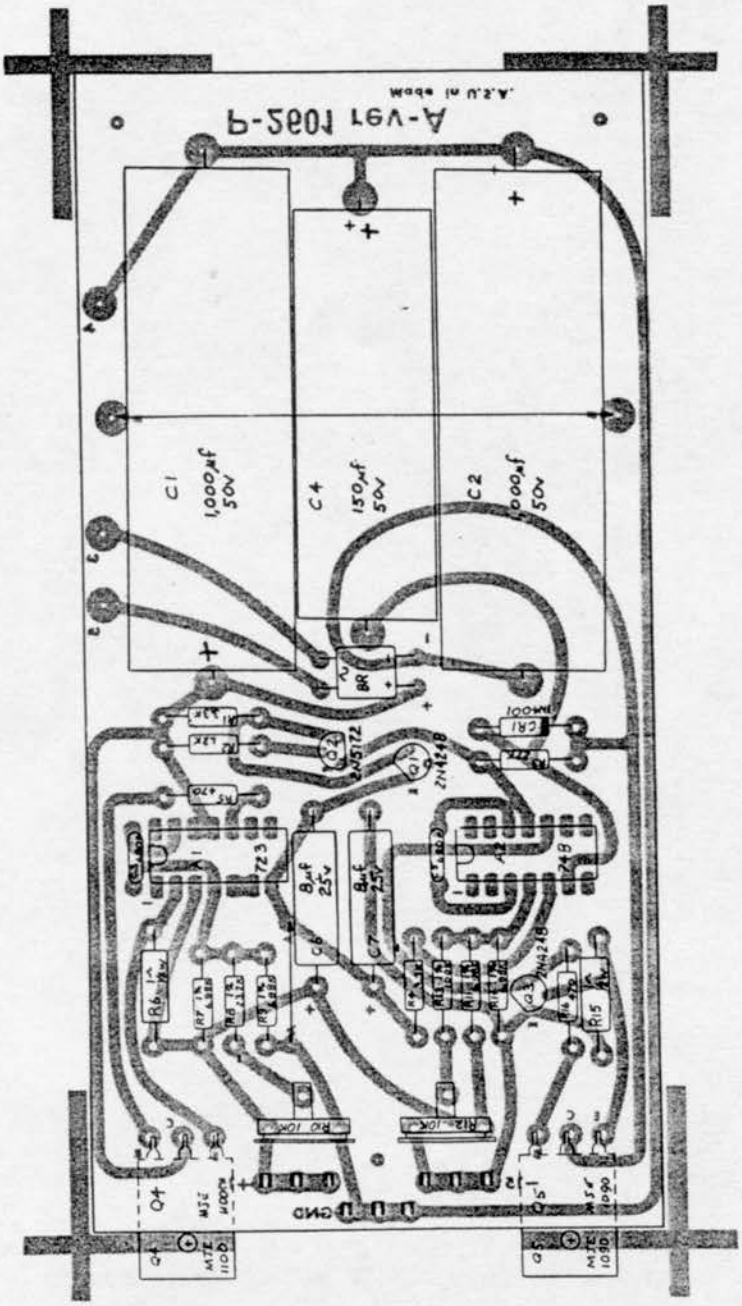
FOIL SIDE VIEW

2600 POWER SUPPLY SCHEMATIC



SEE SECTION 2.1.2 FOR POWER SUPPLY ADJUSTMENT PROCEDURE

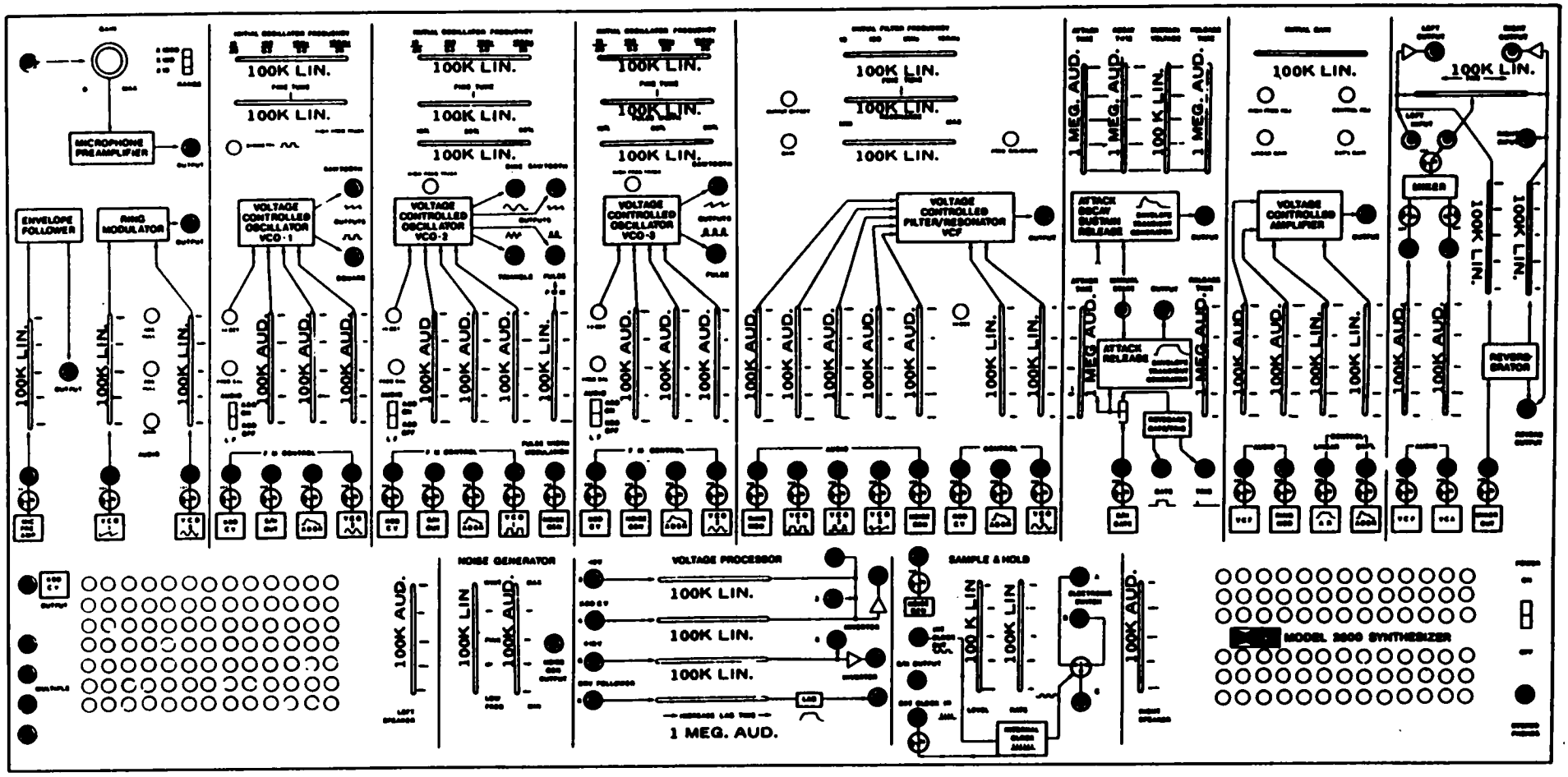
2600 POWER SUPPLY
COMPONENT LAYOUT



COMPONENT SIDE VIEW

2600 SLIDE POT VALUE LOCATIONS

AMOUNT	DESCRIPTION	PART NUMBER
30	100K LINEAR	WH 3259
21	100K AUD.	WH 3260
6	1 MEG. AUD.	WH 3261



2600 PARTS LIST

PREAMP/RING MODULATOR

BOARD 1

REFERENCE	PART NUMBER	DESCRIPTION
A1,A2,A3	LM301AN	OP AMP
A4 ✓	133901	OP AMP
C1,C8,C24	5815-000-Y5U0104Z	.1 uf CAP DISC +80 -20% 50V
C2,C4,C5	AC-1	20PF CAP DISC 20% 50V
C3,C6	AC-1	30PF CAP DISC 20% 50V
C7,C22,C23	TAG-00	I uf CAP TANTALUM 10% 35V
C9	AC-2	.01 uf CAP DISC 20% 50V
C10	AC-1	.002 uf CAP DISC 20% 50V
C11	AC-1	.001 uf CAP DISC 20% 50V
C12	AC-1	330PF CAP DISC 10% 50V
C13,C14,C18,C19,C20,C21	TAG-00	10 uf CAP TANTALUM +10% -20% 20V
C15	AC-1	50PF CAP DISC 20% 50V
C16	AC-1	680PF CAP DISC 20% 50V
C17	AC-1	50PF CAP DISC 20% 50V
CR1,CR2	IN4148	DIODE
E1,-E7	142A	TINI-D-JACK
R1	CB8231	82K RESISTOR CARB. ¼w 10%
R2,R29,R31	WH3259	100K SLIDE POT LIN
R3	RN55D1003F	100K METAL FILM 1%
R6 — R9	RN55D1003F	100K METAL FILM 1%
R12	CB2721	2.7K RESISTOR CARB ¼w 10%
R13	CB2731	27K RESISTOR CARB ¼w 10%
R14	CB2741	270K RESISTOR CARB ¼w 10%
R15	CB1051	1 MEG RESISTOR CARB ¼w 10%
R16	CB1551	1.5 MEG RESISTOR CARB ¼w 10%
R17	CB1061	10 MEG RESISTOR CARB ¼w 10%
R18,R25,R27,R36	CB1021	1K RESISTOR CARB ¼w 10%
R19,R22,R26	CB1031	10K RESISTOR CARB ¼w 10%
R20,R24	CB1041	100K RESISTOR CARB ¼w 10%
R21	CB3911	390 OHM RESISTOR CARB ¼w 10%
R23	JAIN064P—104RA	100K ROTARY POT
R28	CB1011	100 OHM RESISTOR CARB ¼w 10%
R30	CB4731	47K RESISTOR CARB ¼w 10%
R32	CB1831	18K RESISTOR CARB ¼w 10%
R33,R34	U201R503B	50K TRIMPOT
R35	U201R254B	250K TRIMPOT
R37	CB3931	39K RESISTOR CARB ¼w 10%
R38	CB1241	120K RESISTOR CARB ¼w 10%
S1 ✓	G128L	SLIDE SWITCH DP3T
S2	G126	SLIDE SWITCH DPDT
	4014	BALANCED MODULATOR MODULE

BOARD 2 VCO 1,2,3

REFERENCE	PART NUMBER	DESCRIPTION
A8, A9	2801-009	SL19986 SELECT OP AMP LM301AN
C34 — C39	TAG-00	1 uf CAP TANTALUM 20% 35V
C40 — C42	463uw	.015 uf CAP POLYCARB 10% 50V
CR7,CR8	IN4148	DIODE
E13 — E33	142A	TINI-D- JACK
R18,R52,R68,R87	U201R104B	100K TRIMPOT
R41,R 64,R70,R83,R85,R92	WH3259	100K SLIDEPOT LIN
R43,R66,R84	RN55D1503F	150K RESISTOR METAL FILM 1%
R44,R67,R86	CB3351	3.3M RESISTOR CARB ¼w 10%

REFERENCE	PART NUMBER	DESCRIPTION
R45	CB6821	6.8K RESISTOR CARB ¼w 10%
R46,R47,R88	CB3331	33K RESISTOR CARB ¼w 10%
[redacted]	CB8221	8.2K RESISTOR CARB ¼w 10%
[redacted]R89	CB3921	3.9K RESISTOR CARB ¼w 10%
R53,R58,R71,R75,R94,R105,R107,R109	CB2241	220K RESISTOR CARB ¼w 10%
R56,R72,R95	RN55D8452F	84.5K RESISTOR METAL FILM 1%
R57,R74,R98	RN55D1003F	100K RESISTOR CARB ¼w 10%
R59,R76,R101	CB4741	470K RESISTOR CARB ¼w 10%
R60,R78,R97	U201R253B	25K TRIMPOT
R61,R63,R79,R81,R97,R102,R103	WH3260	100K SLIDEPOT AUDIO
R77	CB1241	120K RESISTOR CARB ¼w 10%
R90	CB1031	100K RESISTOR CARB ¼w 10%
R91	CB1841	180K RESISTOR CARB ¼w 10%
R93,R111	CB1531	15K RESISTOR CARB ¼w 10%

BOARD 2-1 WAVEFORM CONVERTER

REFERENCE	PART NUMBER	DESCRIPTION
A14 – A17	LM301AH	HIGH POWER OP AMP
C50,C54,C55	AC-1	30PF CAP CER 50V 10%
C51,C52	TAG-00	1 uf CAP TANTALUM 35V 10%
C53,C56	AC-1	100PF CAP CER 50V 10%
CR14	IN4148	DIODE
Q1	TZ581	PNP TRANSISTOR LOW NOISE HI GAIN
Q2	2N5172	NPN SMALL SIGNAL
Q3	IMF3954	DUAL N CHANNEL FET
R109,R112	CB3331	33K RESISTOR CARB ¼w 10%
R110	RN55D1963F	196K RESISTOR METAL FILM 1%
R111	RN55D1231F	121K RESISTOR METAL FILM 1%
[redacted],R132,R133	CB2221	2.2K RESISTOR CARB ¼w 10%
[redacted]4	CB3931	39K RESISTOR CARB ¼w 10%
R115,R125	U201R104B	100K TRIMPOT
R116,R117,R131	CB1021	1K RESISTOR CARB ¼w 10%
R118	CB3921	3.9K RESISTOR CARB ¼w 10%
R119,R121	RN55D1502F	15K RESISTOR METAL FILM 1%
R120	RN55D1002F	10K RESISTOR METAL FILM 1%
R122,R123,R126	RN55D3012F	30.1K RESISTOR METAL FILM 1%
R124	CB6831	68K RESISTOR CARB ¼w 10%
R128	U201R103B	10K TRIMPOT
R134	CB1841	180K RESISTOR CARB ¼w 10%
R135	CB2231	22K RESISTOR CARB ¼w 10%

BOARD 3 VCF

REFERENCE	PART NUMBER	DESCRIPTION
C1,C2,C3	TAG-00	1 uf CAP TANTALUM 35V 10%
E35 – E43	142A	TINI-D-JACK
R140 – R144	WH3260	100K SLIDEPOT AUDIO
R145,R154,R155	RN55D1003F	100K RESISTOR METAL FILM 1%
R146,R147,R156,R158,R160	WH3259	100K SLIDEPOT LIN
R148 – R152	CB1041	100K RESISTOR CARB ¼w 10%
R153	U201R251B	250 OHM TRIMPOT
R157	CB3351	3.3M RESISTOR CARB ¼w 10%
R159	RN55D150+F	150K RESISTOR METAL FILM 1%
[redacted]1	CB1541	150K RESISTOR CARB ¼w 10%
[redacted]2,R164,	U201R104B	100K TRIMPOT
R163	U201R103B	10K TRIMPOT

BOARD 4 VCA

REFERENCE	PART NUMBER	DESCRIPTION
A20	LM301AN	OP AMP
C62 – C65,C69	TAG-00	1 uf CAP TANTALUM 35V 10%
C66	AC-1	30PF CAP CER 50V 10%
C67	AC-1	50PF CAP CER 50V 10%
C68	196D106X0020FB	10 uf CAP TANTALUM 35V 10%
CR21 – CR25	IN4148	DIODE
E45 – E65	142A	TINI-D-JACK
Q5	2N5460	GEN PURPOSE FET
Q6	2N5172	NPN SMALL SIGNAL
R170	CB2221	2.2K RESISTOR CARB ¼w 10%
R171,R178,R199,R208	CB1021	1K RESISTOR CARB ¼w 10%
R172	CB6821	6.8K RESISTOR CARB ¼w 10%
R173	CB3921	3.9K RESISTOR CARB ¼w 10%
R174,R175,R179,R182,R180	WH3261	1 MEG SLIDEPOT AUDIO
R176,R214	CB1031	10K RESISTOR CARB ¼w 10%
R177	CB2231	22K RESISTOR CARB ¼w 10%
R181,R187,R188,R198,R210,R212,R213	WH3259	100K SLIDEPOT AUDIO

BOARD 5

REFERENCE	PART NUMBER	DESCRIPTION
C85	5815-000-Y5UD-104Z	.1 uf CAP CER +80 -20% 25V
C86	AC-2	.002 uf CAP CER 50V 10%
E70-E87	142A	TINI-D-JACK
R300,R302,R315	WH3260	100K SLIDEPOT AUD
R301,R303,R304,R309,R313,R314	WH3259	100K SLIDEPOT LIN
R305,R308,R310,R311	RN55D1003F	100K RESISTOR METAL FILM 1%
R312	WH3261	1 MEG SLIDEPOT AUD
R316	CB1041	100K RESISTOR CARB ¼w 10%
R317,R319	RN55D5361F	5.36K RESISTOR METAL FILM 1%
R318,R321	RN55D1502F	15K RESISTOR METAL FILM 1%
R321	CB2231	22K RESISTOR CARB ¼w 10%

BOARD 5-1

REFERENCE	PART NUMBER	DESCRIPTION
A35-A42	A-2801-009	OP AMP SL19986
B92	AC-3	.002 uf CAP CER 50V 10%
C82,C87,C101,C103,C128,C129,C130	AC-1	20PF CAP CER 50V 10%
C88,C89,C121-C126	TAG-00	1.0 uf CAP TANTALUM 35V 10%
C90	AC-4	.02 uf CAP CER 50V 20%
C91,C98,C99,C100,C102	AC-1	30PF CAP CER 50V 10%
C93	AC-1	50PF CAP CER 50V 10%
C96,C105,C106,C108,C109	AC-1	10PF CAP CER 50V 10%
C104,C107	5815-000-Y5UD-104Z	.1 uf CAP CER +80 -20 25V 10%
C110,C113,C119,C110	AC-3	.001 uf CAP CER 50V 10%
C111,C112	AC-2	100PF CAP CER 50V 10%
C116,C117,C118	AC-3	.01 uf CAP CER 50V 20%
CR45-CR50	A-2801-009	OP AMP SL19986

BOARD 5-1 (CONTINUED)

REFERENCE	PART NUMBER	DESCRIPTION
CR45-CR50	IN4148	DIODE
Q30,Q31	2N904	TRANSISTOR NPN PLASTIC
Q32,Q33	2N4402	TRANSISTOR PNP
Q34-Q39	2N5172	TRANSISTOR NPN
Q40,Q41	LS4392 KE4392	FET TRANSISTOR
Q43,Q44	TZ581	TRANSISTOR PNP
Q45	2N4870	TRANSISTOR UNIJUNCTION
R325,R348,R386,R393	CB1021	1K RESISTOR CARB ¼w 10%
R326	CB2741	270K RESISTOR CARB ¼w 10%
R327,R328	CB5661	5.6 MEG RESISTOR CARB ¼w 10%
R331,R384,R390,R391,R392	CB4731	47K RESISTOR CARB ¼w 10%
R334,R337	RN55D1003F	100K RESISTOR METAL FILM 1%
R340	CB1051	1 MEG RESISTOR CARB ¼w 10%
R341,R351,R352,R369	CB1041	100K RESISTOR CARB ¼w 10%
R344,R354	CB2241	220K RESISTOR CARB ¼w 10%
R345,R346,R355,R356	CB1001	10 OHM RESISTOR CARB ¼w 10%
R347,R375,R389	CB1031	10K RESISTOR CARB ¼w 10%
R349,R350	CB2211	220 OHM RESISTOR CARB ¼w 10%
R357,R363,R370,R371	CB2261	2.2 MEG RESISTOR CARB ¼w 10%
R358,R365	CB3351	3.3. MEG RESISTOR CARB ¼w 10%
R360,R364	CB8231	82K RESISTOR CARB ¼w 10%
R361,R362	CB4741	470K RESISTOR CARB ¼w 10%
R366,R368,R377	CB1541	150K RESISTOR CARB ¼w 10%
R367	CB1531	15K RESISTOR CARB ¼w 10%
R372,R373,R374,R376	CB2231	22K RESISTOR CARB ¼w 10%
R378,R394	CB1821	1.8K RESISTOR CARB ¼w 10%
R379,R387	CB4721	4.7K RESISTOR CARB ¼w 10%
R380	CB6831	68K RESISTOR CARB ¼w 10%
R381,R385	U201R104B	100K TRIMPOT
R382	CB1521	1.5K RESISTOR CARB ¼w 10%
R383	CB1011	100 OHM RESISTOR CARB 10%
R388	CB3921	3.9K RESISTOR CARB ¼w 10%
P2603	P2603-BD 5-1-G	P'C' BOARD
4015		SAMPLE AND HOLD
4022		NOISE GENERATOR

KEYBOARD

REFERENCE	PART NUMBER	DESCRIPTION
A1	8000-007-A	OP AMP MODULE
C1	AC-1	100pf CAP DISC 20% 50V
C2	463UW	.15uf POLY CARB 10% 50V
C3	AC-3	.01uf CAP DISC 20% 50V
C4,C5	TAG-00	1.0uf CAP TANTALUM 20% 35V
C6	463UW	.1uf POLY CARB 10% 50V
C7	463UW	.47uf POLY CARB 10% 50V
C8	AC-1	220pf CAP CER 20% 50V
CR1	IN4148	DIODE
Q1	2N6076	TRANSISTOR PNP PLASTIC
Q2,Q3,Q5	2N5172	TRANSISTOR NPN PLASTIC
Q4,Q6	TZ581	TRANSISTOR PNP PLASTIC
R1,R3,R7,R8,R11,R13,R17,R18	CB1031	10K RESISTOR CARB 10%¼w
R2,R12	CB2231	22K RESISTOR CARB ¼w 10%
R4,R26	CB5621	5.6k RESISTOR CARB ¼w 10%

KEYBOARD (CONTINUED)

REFERENCE	PART NUMBER	DESCRIPTION
R5	CB1841	180K RESISTOR CARB ¼w 10%
R6	CB1041	100K RESISTOR CARB ¼w 10%
R9	CB2721	2.7K RESISTOR CARB ¼w 10%
R10,R14,R20	CB1021	1K RESISTOR CARB ¼w 10%
R19	X201R102B	1K TRIMPOT
R23	CB3721	3.9K RESISTOR CARB ¼w 10%
R25	CB2221	2.2K RESISTOR CARB ¼w 10%
R36,R37	CB4721	4.7K RESISTOR CARB ¼w 10%

POWER SUPPLY

REFERENCE	PART NUMBER	DESCRIPTION
A1	U6E7723393C	OP AMP
A2	U6E7748393C	OP AMP
BR1	MDA 920A-2	BRIDGE
C1,C2	43D102G050JNI	1000 uf CAP ELEC +/- 10% 50VDC
C3,C5	AC-1	680PF CAP CER +/-10% 50VDC
C4	43D151G050RG1	150 uf CAP ELEC -40% 50VDC
C6,C7	TE-1203.5	8 uf CAP ELEC +/- 10% 25 VDC
CR1	IN4001	DIODE
Q1,Q3	2N4248	TRANSISTOR
Q2	2N5172	TRANSISTOR NPN
Q4	MJE1100	POWER TRANSISTOR
Q5	MJE1090	POWER TRANSISTOR
R1,R4	CB3321	3.3K RESISTOR CARB ¼w 10%
R2	CB1221	1.2K RESISTOR CARB ¼w 10%
R3	CB2731	27K RESISTOR CARB ¼w 10%
R5,R16	CB4711	470 OHM RESISTOR CARB ¼w 10%
R6,R15		1.0 OHM RESISTOR CARB ½w 5%
R7,R9,R11,R14	RN55D6981F	6.98K RESISTOR METAL FILM 1%
R8	RN55D2322F	100K RESISTOR METAL FILM 1%
R10,R12	X201UR7321	10K TRIMPOT
R13	RN55D1003F	100K RESISTOR METAL FILM 1%
	8000-007	KYBD OP AMP

NOTES

TOP VIEW

LM301AN

LM301AH

2N5172
2N6076

CAPACITORS

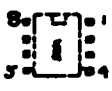
↑ =+15 VOLTS ↓ =-15 VOLTS

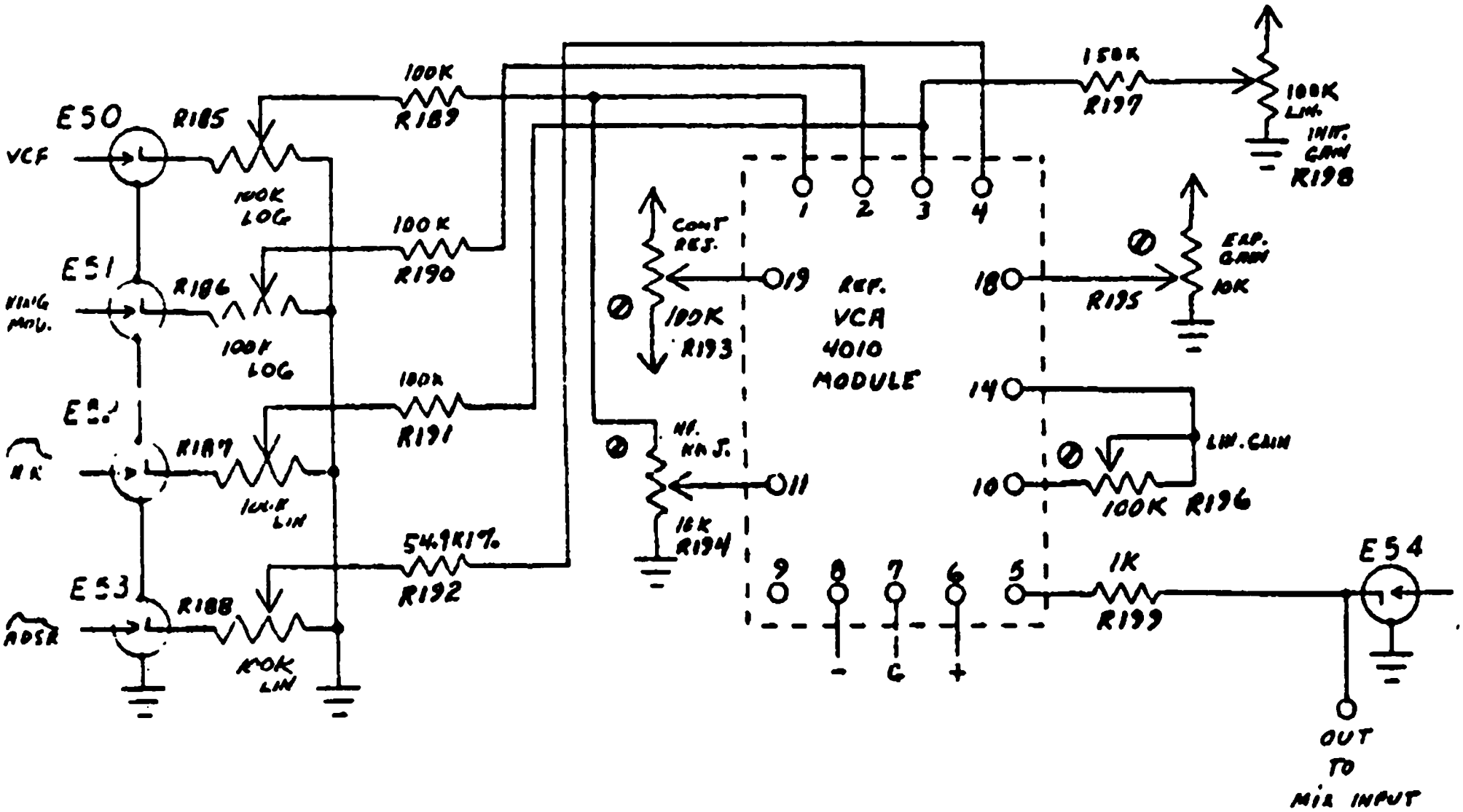
BOTTOM VIEW

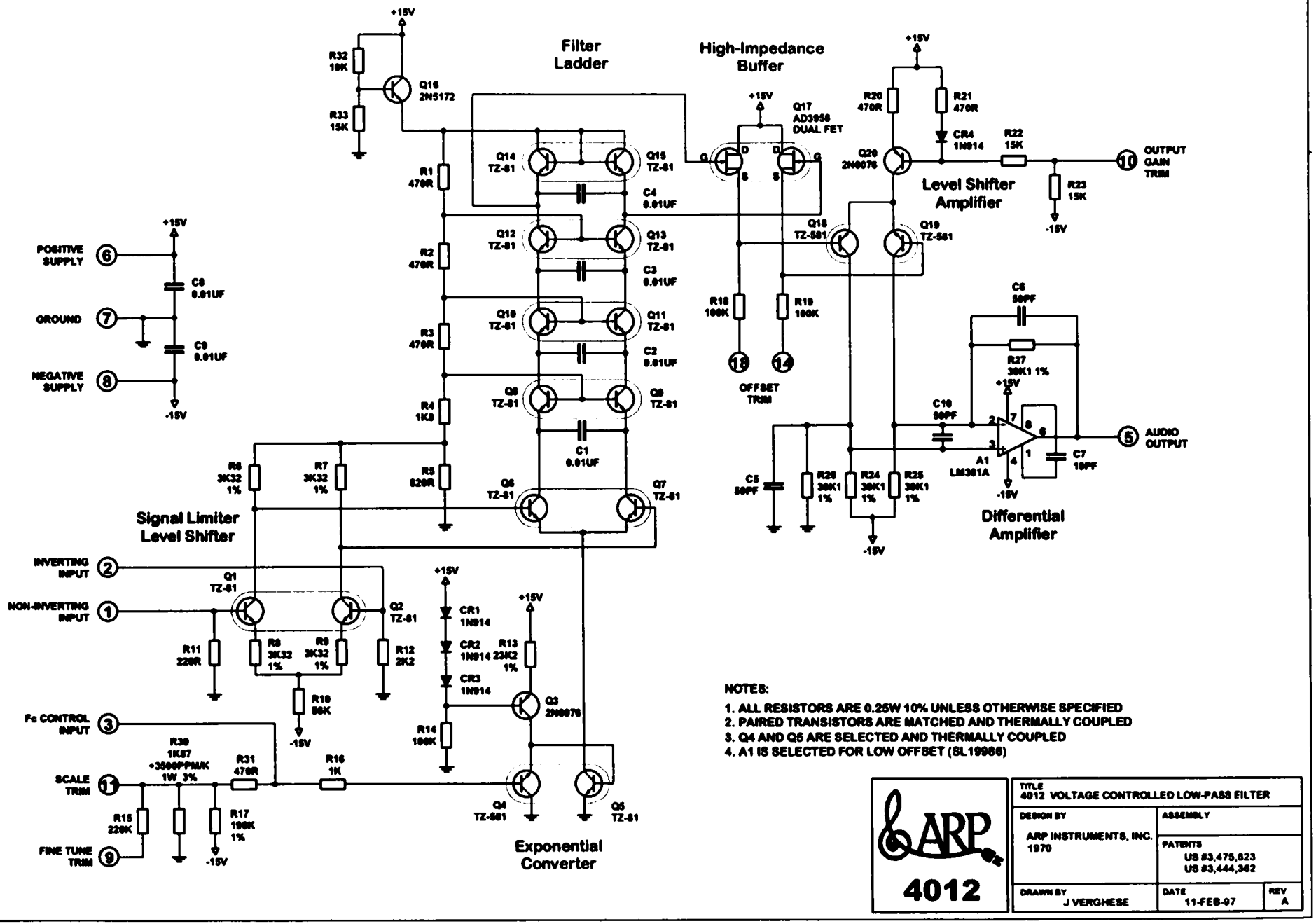
2N5172
2N6076

LM301AH

LM301AN




E50
R185
100K
R189
150K
R197
100K LIN.
INIT. GAIN
R198
VCF
100K LOG
100K
R190
E51
R186
RING MOD.
100K LOG
100K
R191
E52
R187
MIX
100K LIN
549K 1%
R192
E53
R188
NOISE
100K LIN
CONT. RES.
100K
R193
19
REF. VCA 4010 MODULE
1
2
3
4
EXP. GAIN
10K
18
R195
14
LIN. GAIN
10
100K R196
HI. RES.
16K
R194
11
9
8
7
6
5
1K
R199
E54
-
G
+
OUT TO MIX INPUT

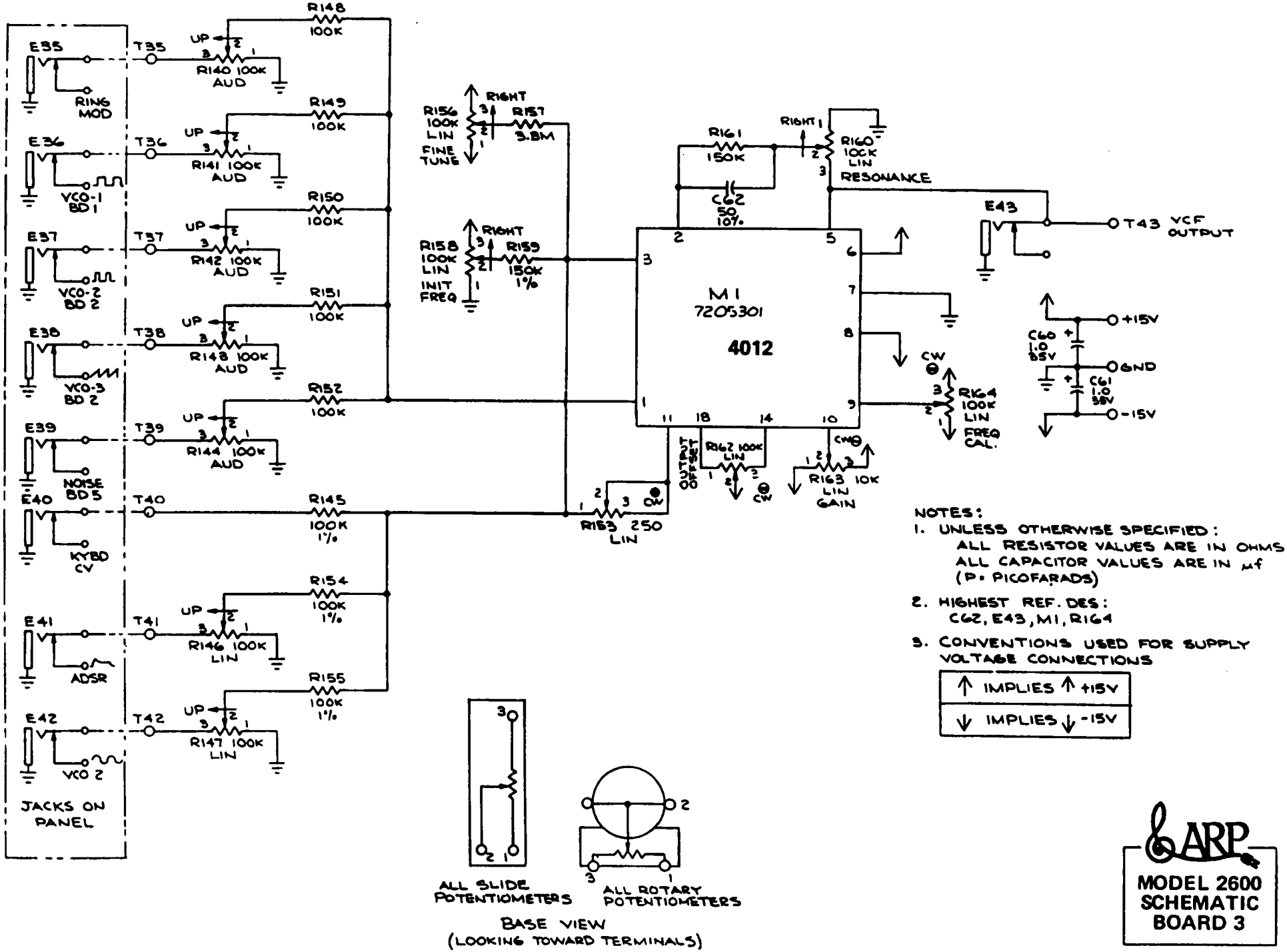


NOTES:

1. ALL RESISTORS ARE 0.25W 10% UNLESS OTHERWISE SPECIFIED
2. PAIRED TRANSISTORS ARE MATCHED AND THERMALLY COUPLED
3. Q4 AND Q5 ARE SELECTED AND THERMALLY COUPLED
4. A1 IS SELECTED FOR LOW OFFSET (SL19966)

ARP 4012

TITLE: 4012 VOLTAGE CONTROLLED LOW-PASS FILTER	
DESIGN BY: ARP INSTRUMENTS, INC. 1970	ASSEMBLY:
	PATENTS: US #3,475,623 US #3,444,362
DRAWN BY: J VERGHESE	DATE: 11-FEB-97 / REV: A



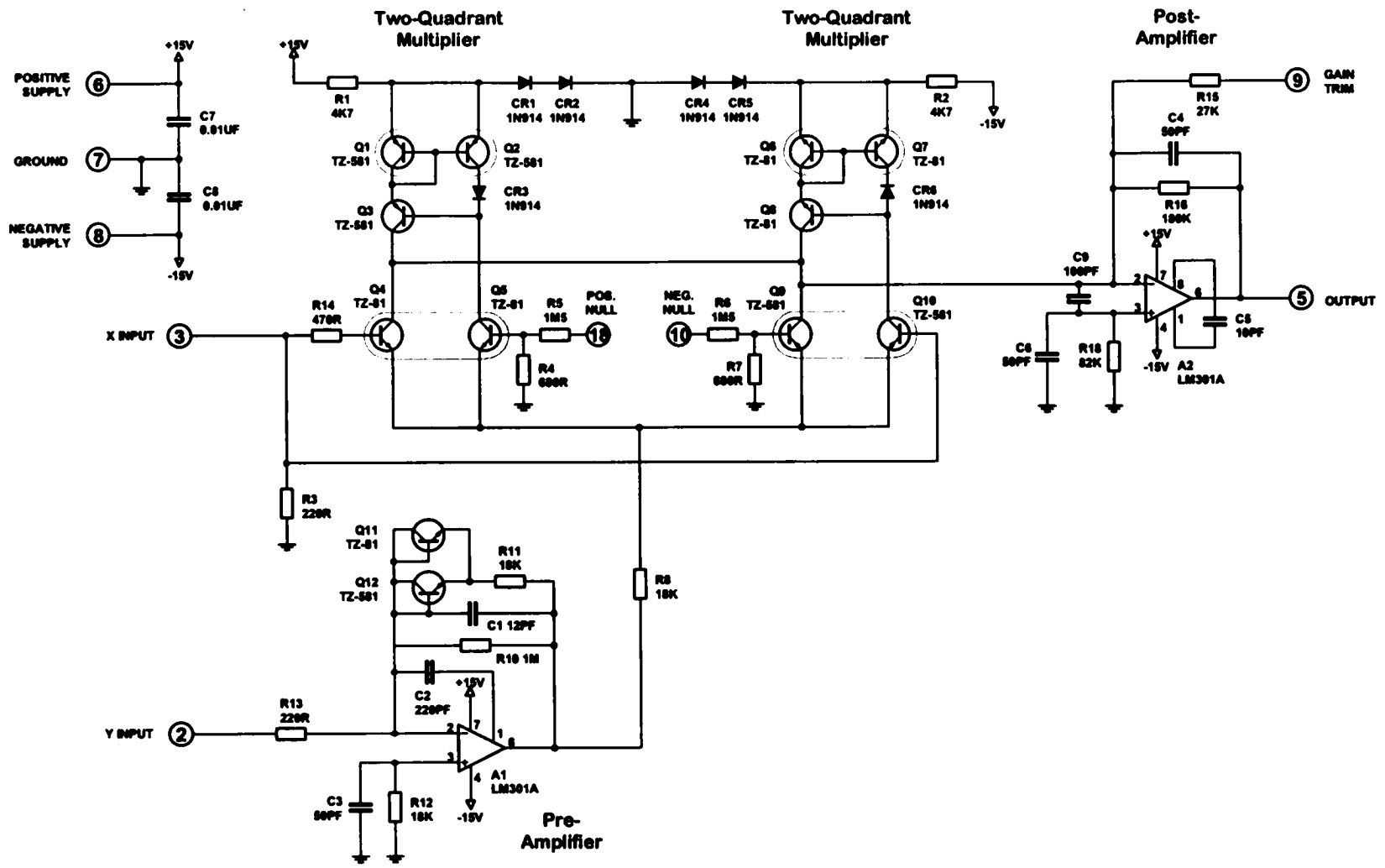
NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS
   ALL CAPACITOR VALUES ARE IN μf
   (P. PICOFARADS)
2. HIGHEST REF. DES:
   C62, E43, M1, R164
3. CONVENTIONS USED FOR SUPPLY VOLTAGE CONNECTIONS

↑ IMPLIES ↑ +15V
↓ IMPLIES ↓ -15V

ARP

MODEL 2600 SCHEMATIC BOARD 3

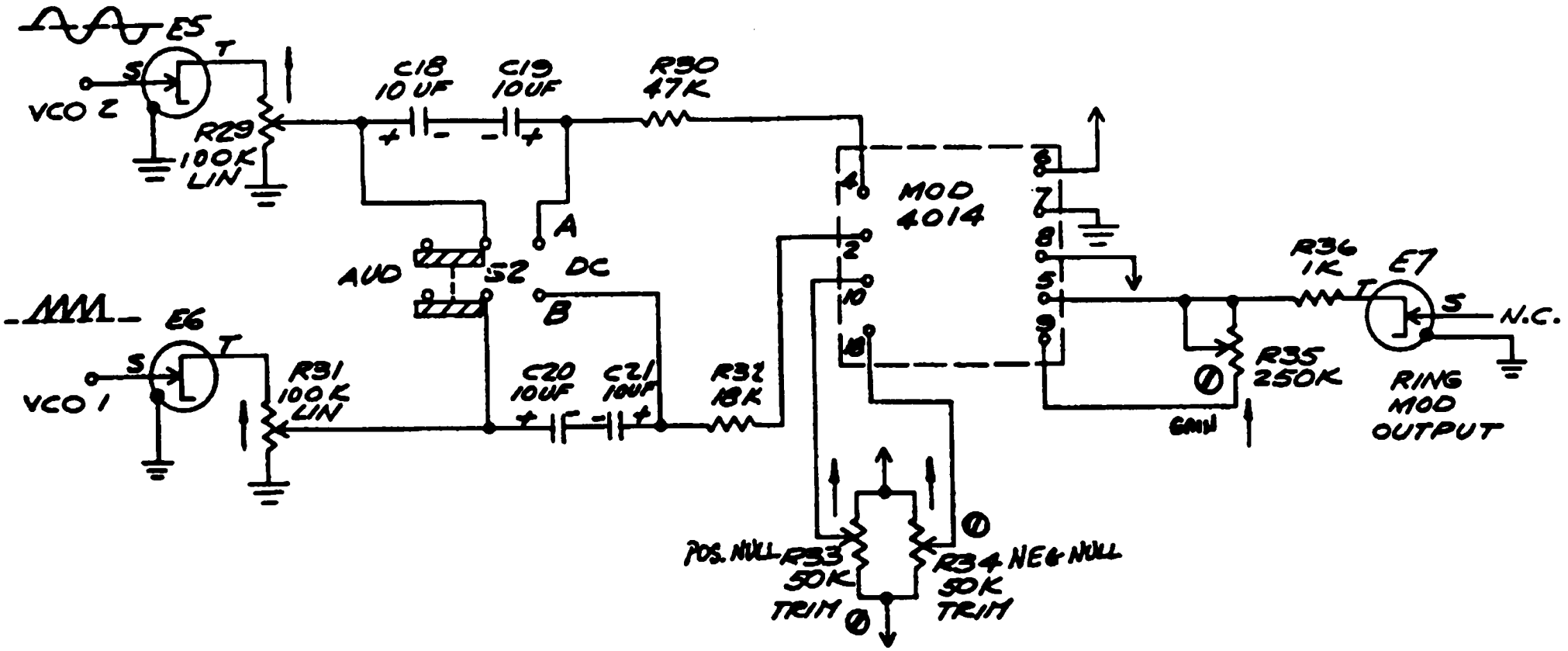


NOTES:

1. ALL RESISTORS ARE 0.25W 10% UNLESS OTHERWISE SPECIFIED
2. PAIRED TRANSISTORS ARE MATCHED AND THERMALLY COUPLED

ARP 4014

TITLE: 4014 BALANCED MODULATOR		
DESIGN BY: ARP INSTRUMENTS, INC. 1970	ASSEMBLY	
	PATENTS	
DRAWN BY: J VERGHESE	DATE: 19-MAR-97	REV: A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S
T
VCO 2
R29
100K
LIN
C18
10 UF
C19
10UF
R30
47K
MOD
4014
A
AUD
S2
DC
B
E6
VCO 1
R31
100K
LIN
C20
10UF
C21
10UF
R32
18K
R36
1K
E7
N.C.
R35
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GAIN
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MOD
OUTPUT
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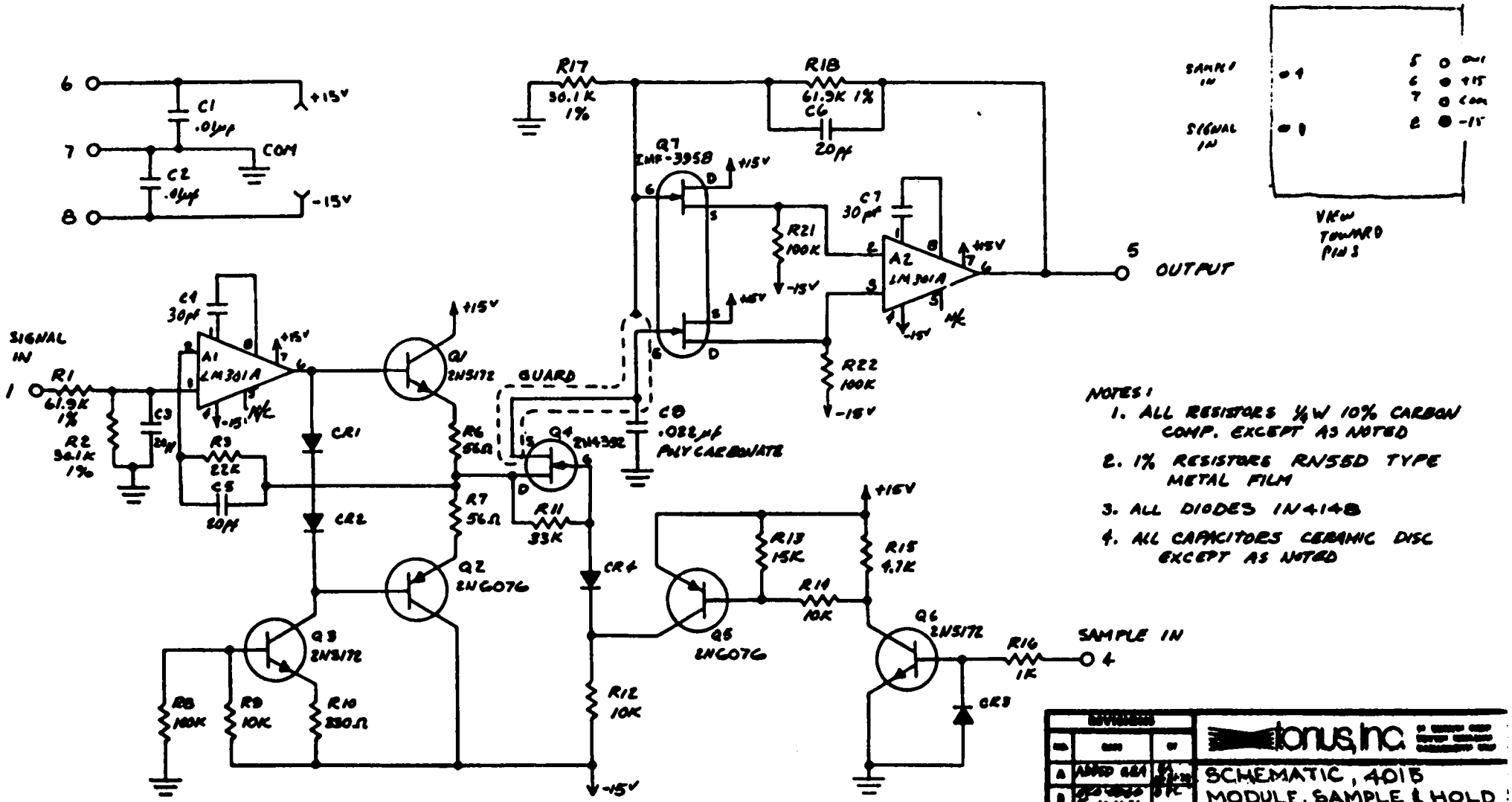
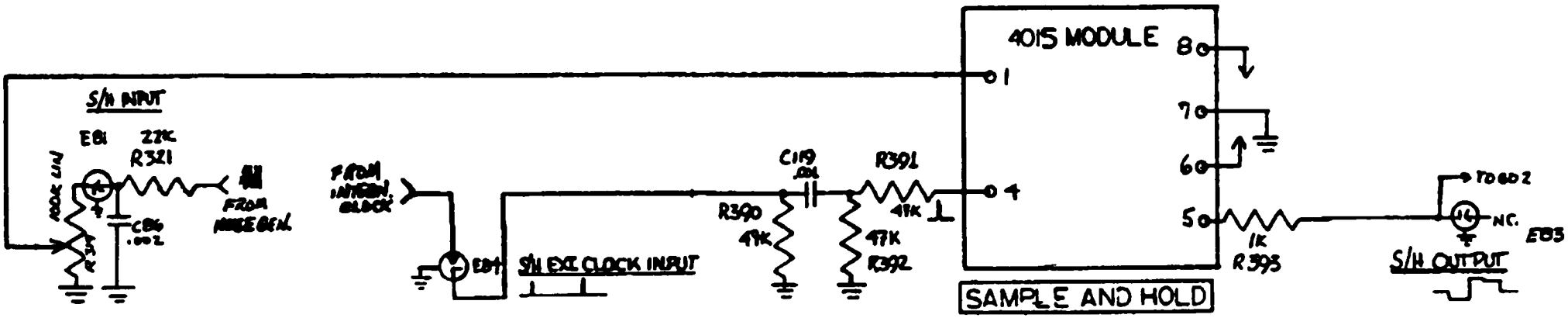
R33
50K
TRIM
R34 NEG NULL
50K
TRIM

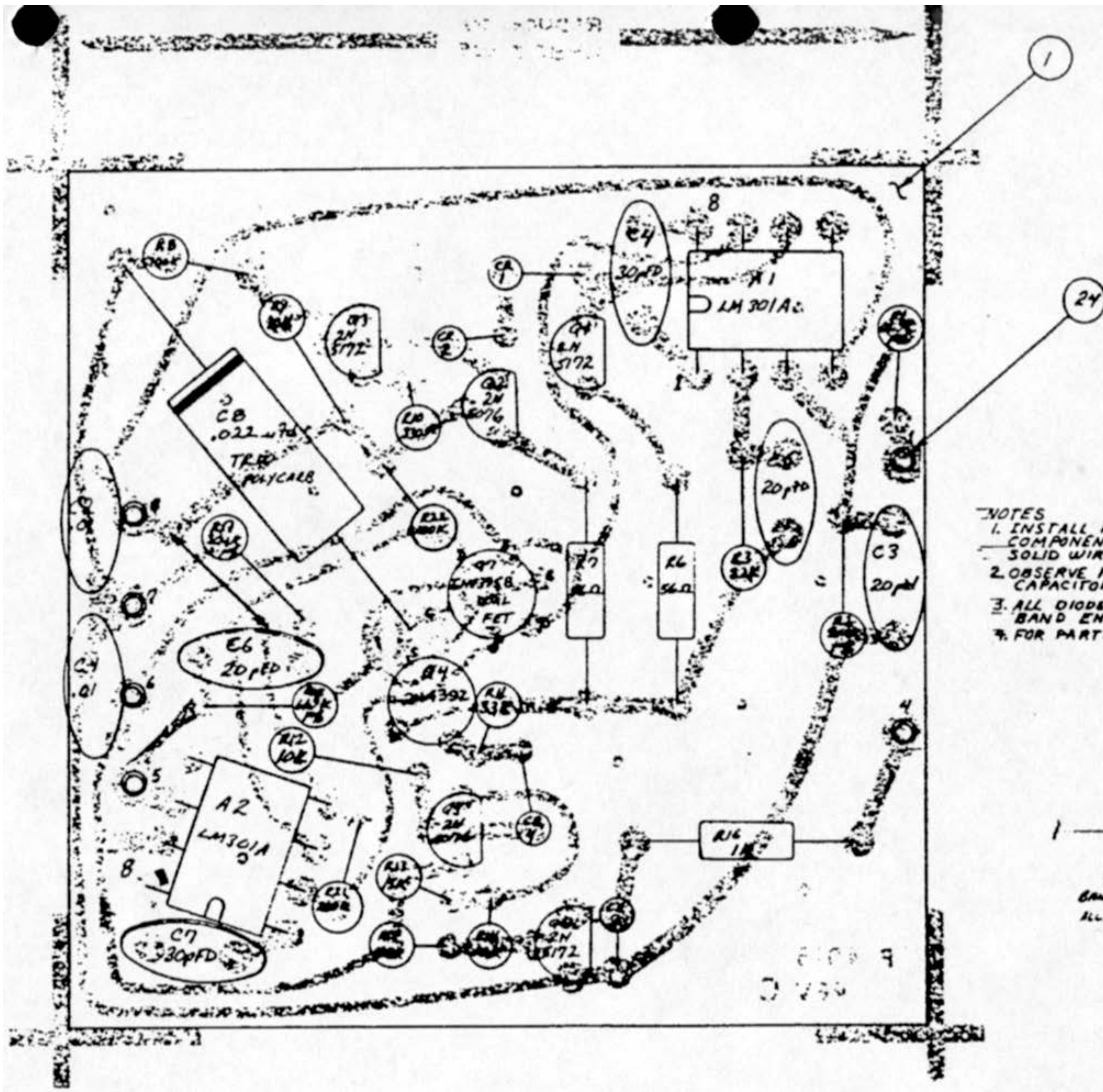


NOTES:

1. ALL RESISTORS ¼W 10% CARBON COMP. EXCEPT AS NOTED
2. 1% RESISTORS RN55D TYPE METAL FILM
3. ALL DIODES IN4148
4. ALL CAPACITORS CERAMIC DISC EXCEPT AS NOTED

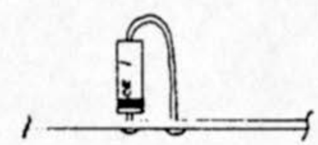
REVISIONS			
LTR	DESCRIPTION	BY	
A	ADDED C61		tonus, inc.
B			SCHEMATIC, 4015 MODULE, SAMPLE & HOLD
C			12-21-70
D			
E			
F			
			DATE 10-7-71
			X
			8-4015-00A1C


4015 MODULE
S/H INPUT
E81
22K
R321
FROM MIXER BAL.
C119
.001
R391
49K
R390
49K
47K
R392
FROM INTERN. CLOCK
E84
S/H EXT CLOCK INPUT
1
4
8
7
6
5
1K
R395
TO E82
NC.
E83
S/H OUTPUT
SAMPLE AND HOLD



PIN NO.S FOR REF. ONLY

NOTES
1. INSTALL 1 JUMPER PRIOR TO MOUNTING COMPONENTS AS SHOWN (⟷) USE 24 GA SOLID WIRE
2. OBSERVE POLARITY OF OP-AMPS, AND CAPACITOR C8
3. ALL DIODES IN4148 OR EQUIV. MOUNT WITH BAND END DOWN (SEE DETAIL 1)
4. FOR PARTS LIST SEE APL 4015-005

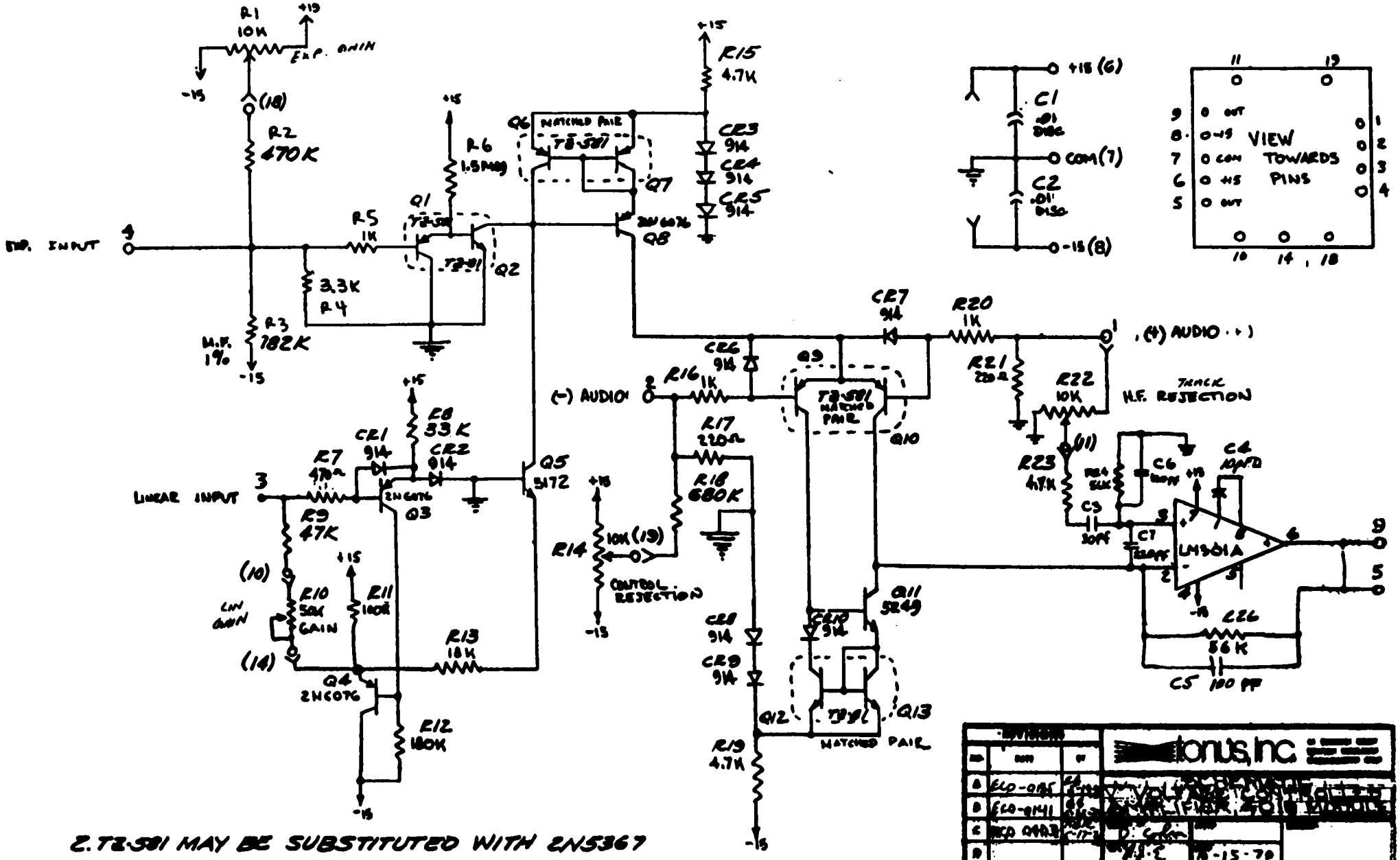


DETAIL 1 (Typical)
BAND END ON BOARD
ALL DIODES

tonus, inc.

P.C. ASSEMBLY
SAMPLE & HOLD
4015 MODULE

4015.



2. TB-381 MAY BE SUBSTITUTED WITH 2N5367

1. TB-81 MAY BE SUBSTITUTED WITH 2N5249

NOTES:

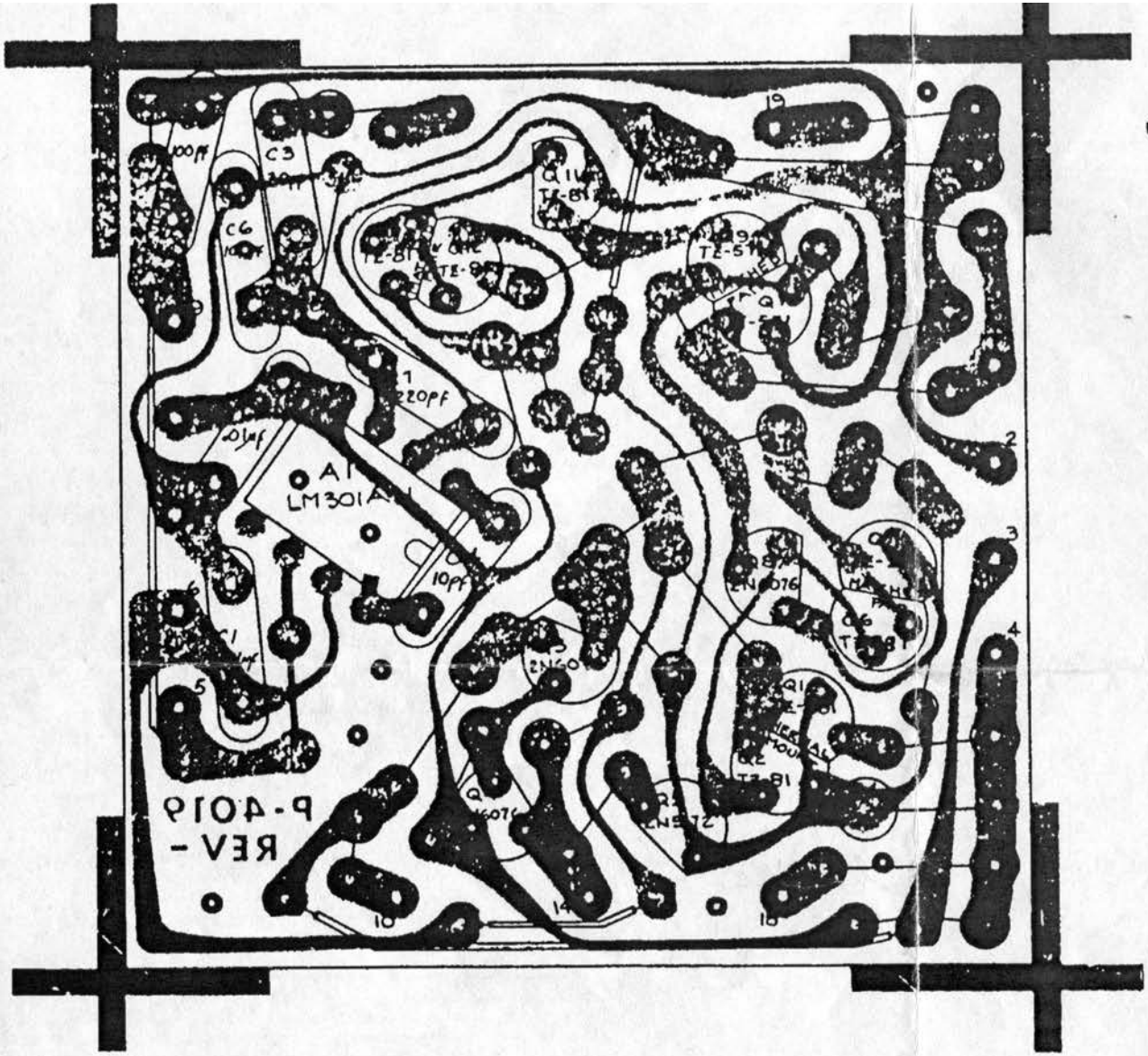
REVISIONS			
	DESCRIPTION	BY	
A	ECO-0185		
B	ECO-0141		
C	ECO 0183		
D			
E			
F			

tonus, inc

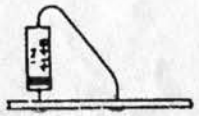
D. Colon 8-15-70

D. Colon 4-6-71

D. Colon 4-6-71

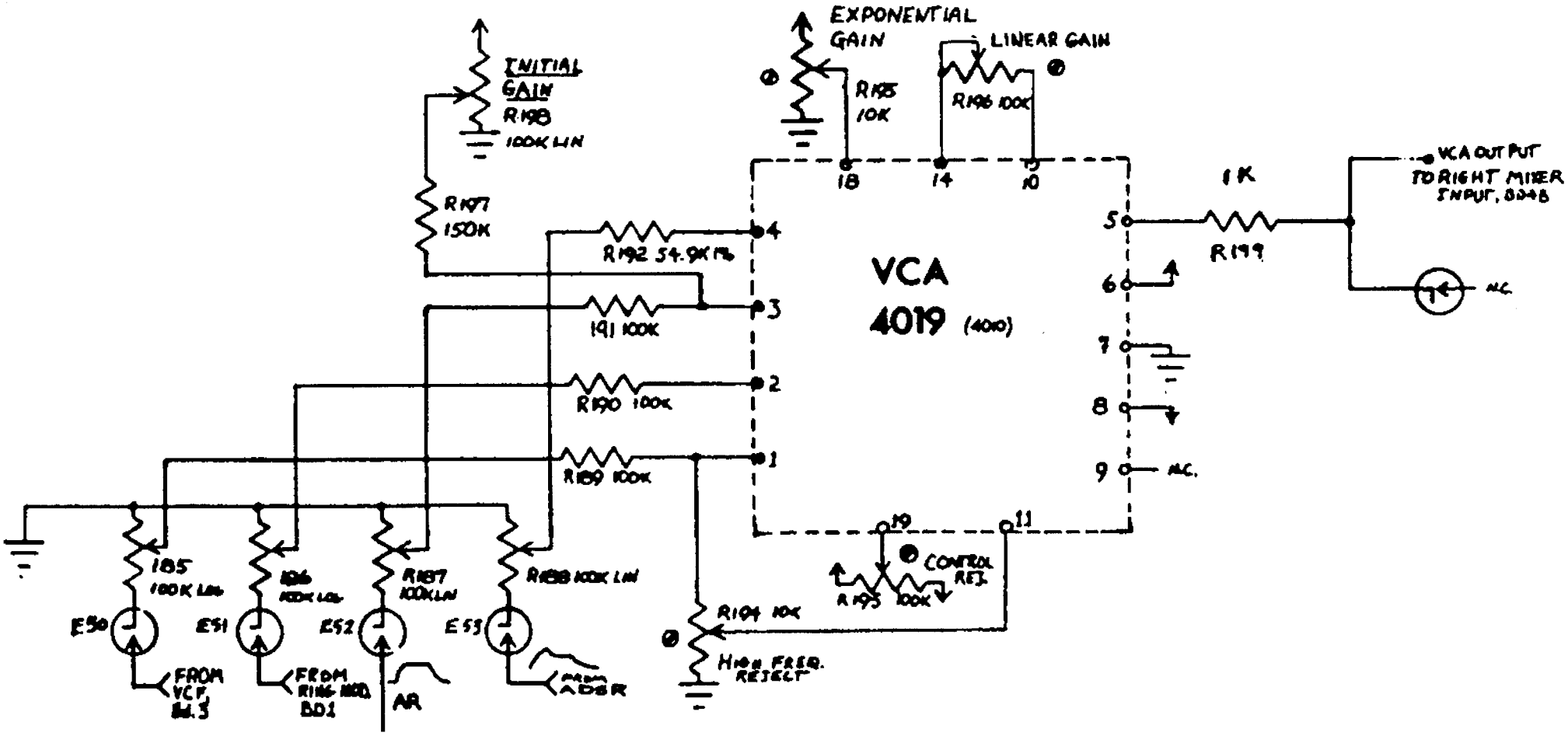


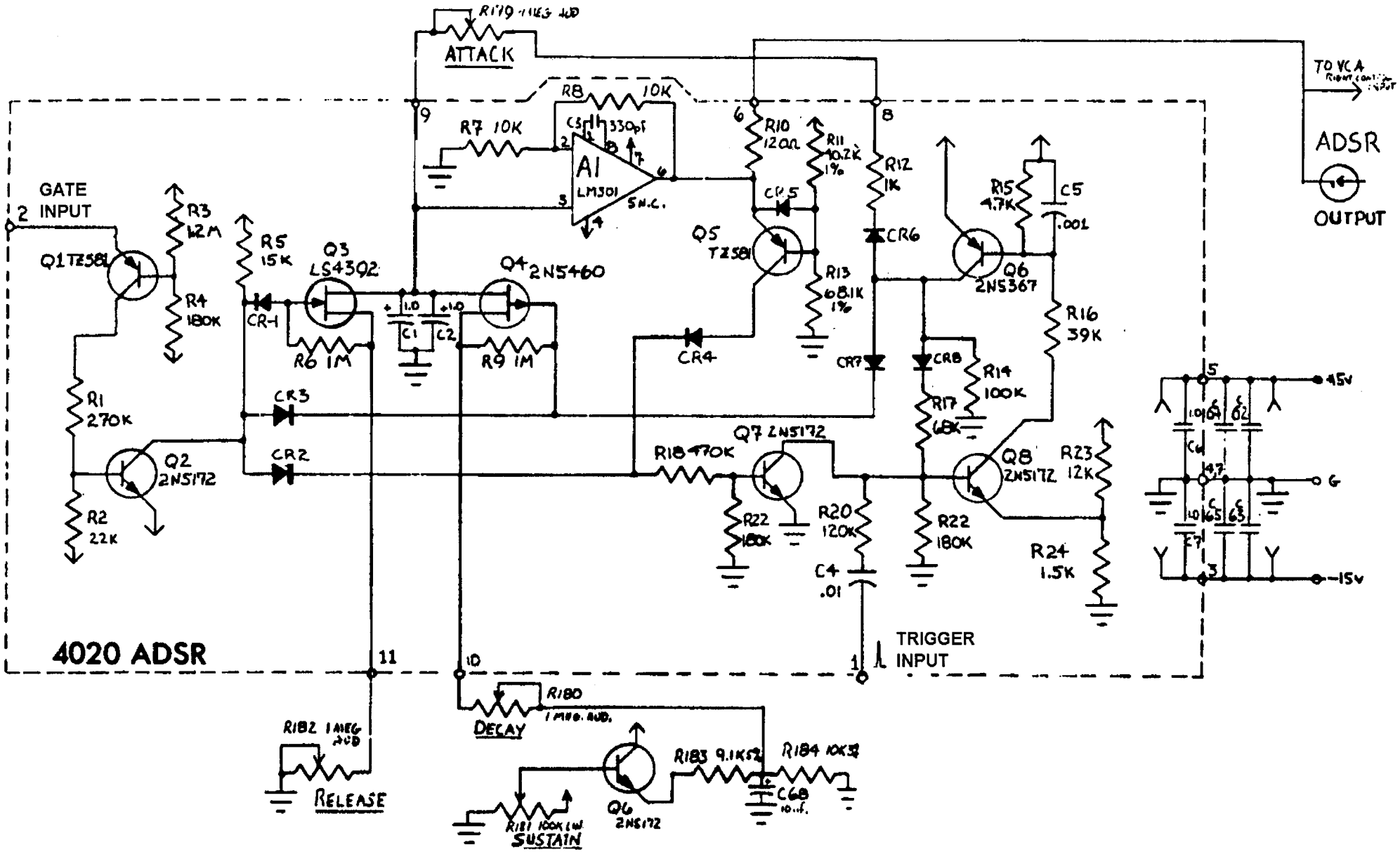
NOTES:
1. INSTALL 5(FIVE) JUMPERS AS SHOWN (⟷) USING AWG# 24 SOLID WIRE AND BIRNBACH T-500-22 SLEEVING
2. OBSERVE POSITION OF OPAMP A-1
3. ALL DIODES IN914 OR IN4148 INSTALL BAND END TOWARDS BOARD (SEE EXAMPLE BELOW)
4. DO NOT SCALE PRINT
5. REF. DWGS - B 4019-001 SCHEMATIC
   C 4019-003 FABRICATION
   APL 4019-004 SHEETS 2-3-4 PARTS LIST

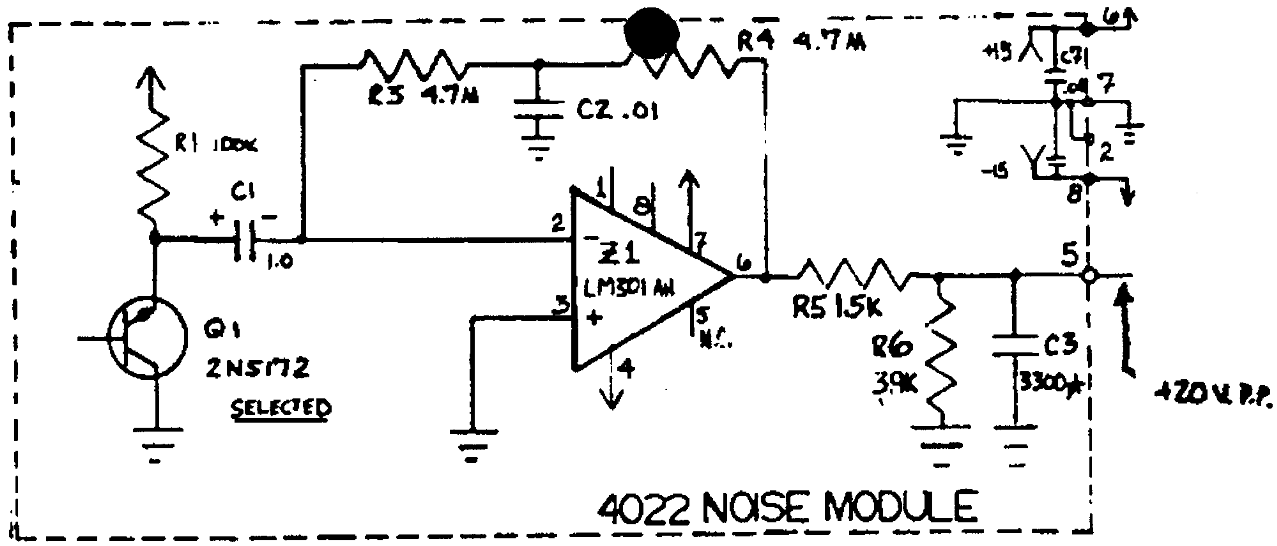


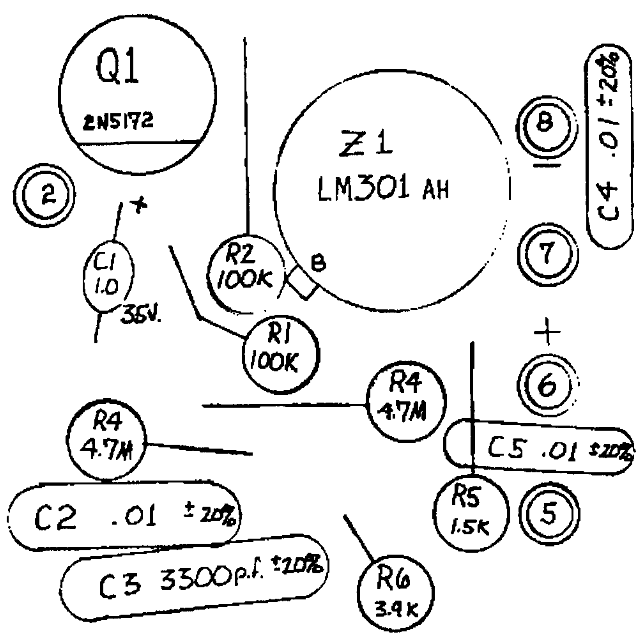
BAND END DOWN
ALL DIODES

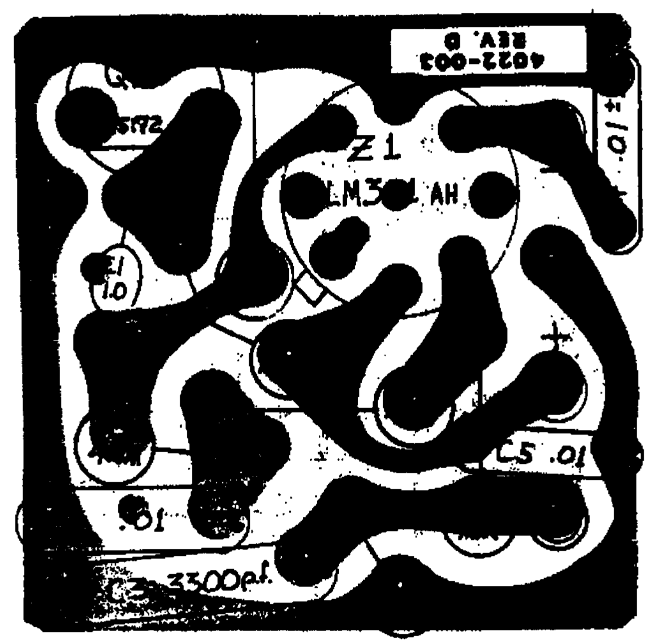
REVISIONS			tonus, Inc.
REV.	DATE	BY	
A	ECO-0115 9/9/72	LB 10/11/72	P.C. ASSEMBLY VOLTAGE CONTROLLED AMPLIFIER 4019 MODULE
B	ECO 0403	RBR 5-17-73	
C			DRAWN BY BA 10-21-71 — SCALE 5:1 — SHEETS 2,3,4 ARE 'A' SIZE
D			CHK'D AE — DATE
E			APP'D FOR RELEASE O. Gelbart 10-21-71 — SHEET 1 of 4
F			APP'D FOR MFG — DRAWING NO. C-4019-004 — REV B

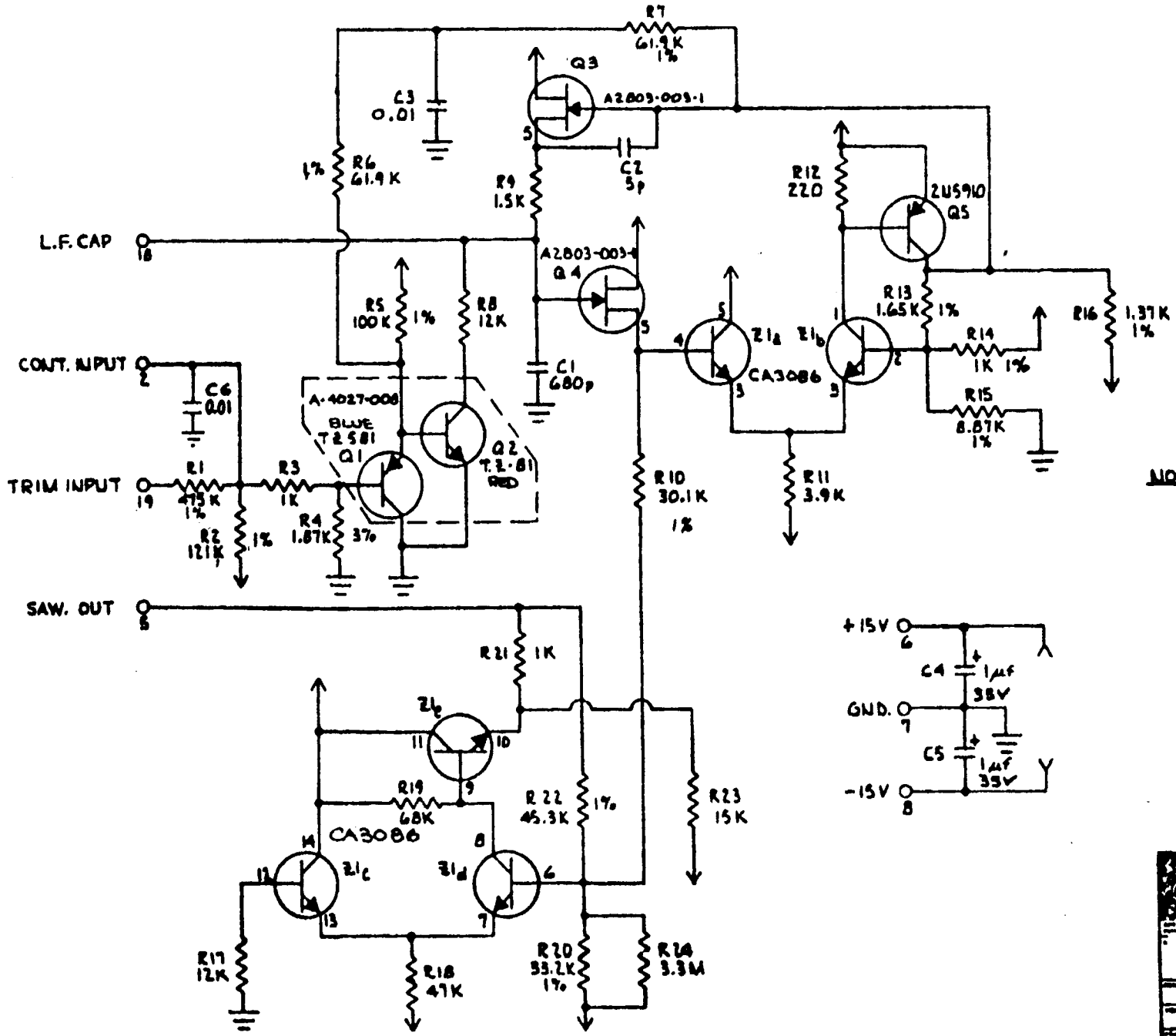

INITIAL GAIN R198 100K LIN
R197 150K
EXPONENTIAL GAIN
R195 10K
LINEAR GAIN
R196 100K
18
14
10
1K
VCA OUT PUT TO RIGHT MIXER INPUT, 8048
R199
AC.
R192 54.9K 1%
191 100K
R190 100K
R189 100K
VCA
4019 (400)
4
3
2
1
5
6
7
8
9
19
11
CONTROL REJ.
R193 100K
R194 10K
HIGH FREQ. REJECT
185 100K LIN
186 100K LIN
R187 100K LIN
R188 100K LIN
E50
E51
E52
E53
FROM VCF, PIN 3
FROM R186 100K, PIN 1
AR
FROM ADSR


4020 ADSR
GATE
2 INPUT
ATTACK
DECAY
SUSTAIN
RELEASE
TRIGGER
INPUT
ADSR
OUTPUT
TO VCA
A1
LM301
Q1 TZ581
Q2 2N5172
Q3 LS4392
Q4 2N5460
Q5 TZ581
Q6 2N5367
Q7 2N5172
Q8 2N5172
Q9 2N5172
R1 270K
R2 22K
R3 1.2M
R4 180K
R5 15K
R6 1M
R7 10K
R8 10K
R9 1M
R10 120Ω
R11 10.2K 1%
R12 1K
R13 68.1K 1%
R14 100K
R15 4.7K
R16 39K
R17 68K
R18 470K
R20 120K
R22 180K
R23 12K
R24 1.5K
C1
C2
C3 330pf
C4 .01
C5 .001
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
+15v
-15v
G


R1 100K
C1
1.0
Q1
2N5172
SELECTED
R3 4.7M
C2 .01
R4 4.7M
Z1
LM301 AH
N.C.
R5 1.5K
R6
3.9K
C3
3300pf
+20V P.P.
4022 NOISE MODULE


Q1
2N5172
Z1
LM301 AH
C4 .01 ±20%
C1
1.0
35V.
R2
100K
R1
100K
R4
4.7M
C5 .01 ±20%
C2 .01 ±20%
C3 3300p.f. ±20%
R5
1.5K
R6
3.9K


4022-003
REV. B
Z1
C5 .01
3300p.f.



NOTES:

1. UNLESS OTHERWISE STATED:
   ALL RESISTOR VALUES IN OHMS.
   ALL CAPACITOR VALUES IN μf
2. HIGHEST REF. DES:
   Z1, Q5, C6, R24

C	AA		0331	
B	R.C.		0331	
A	RAP		0111	

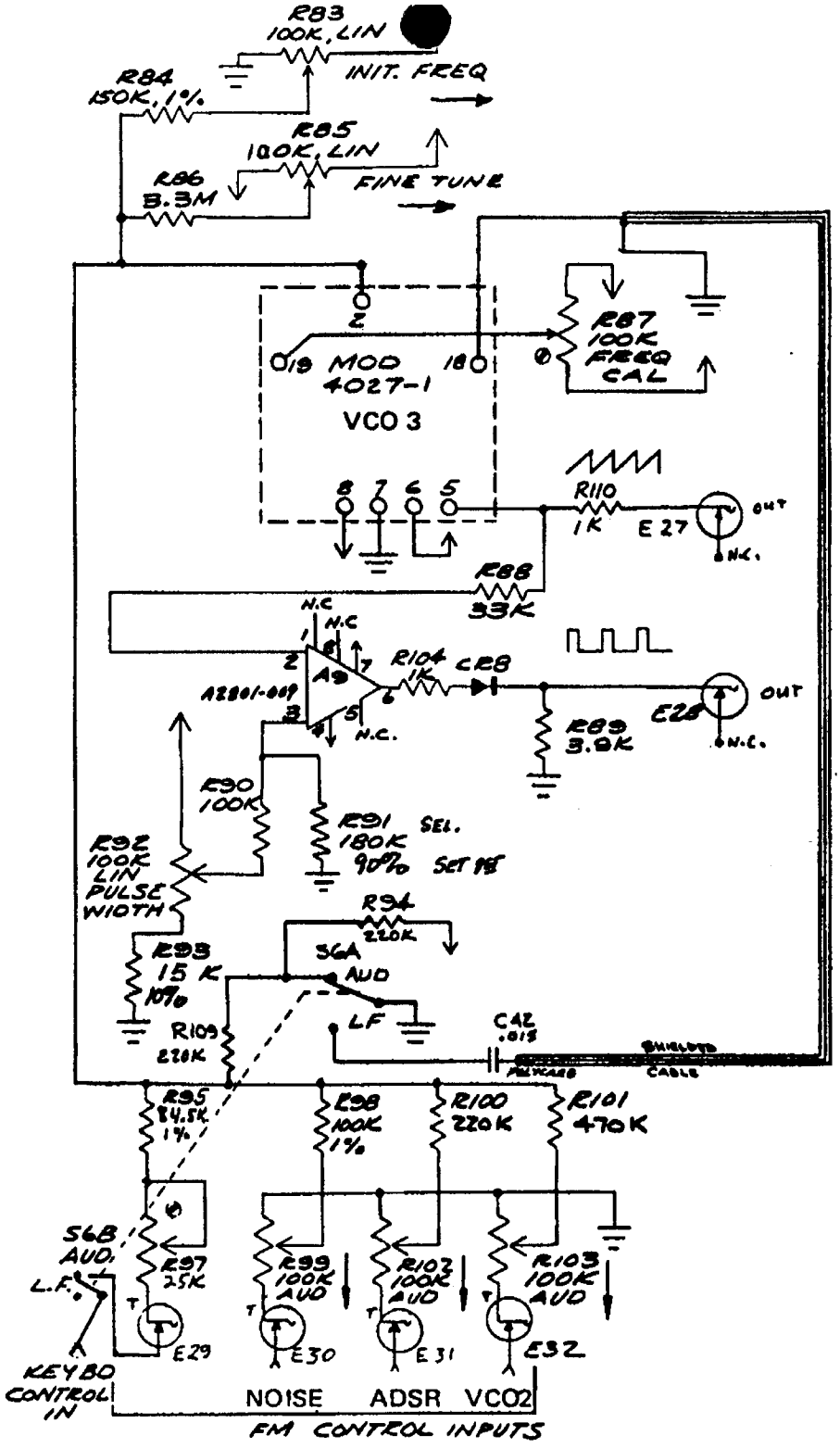
APL 4027-01E

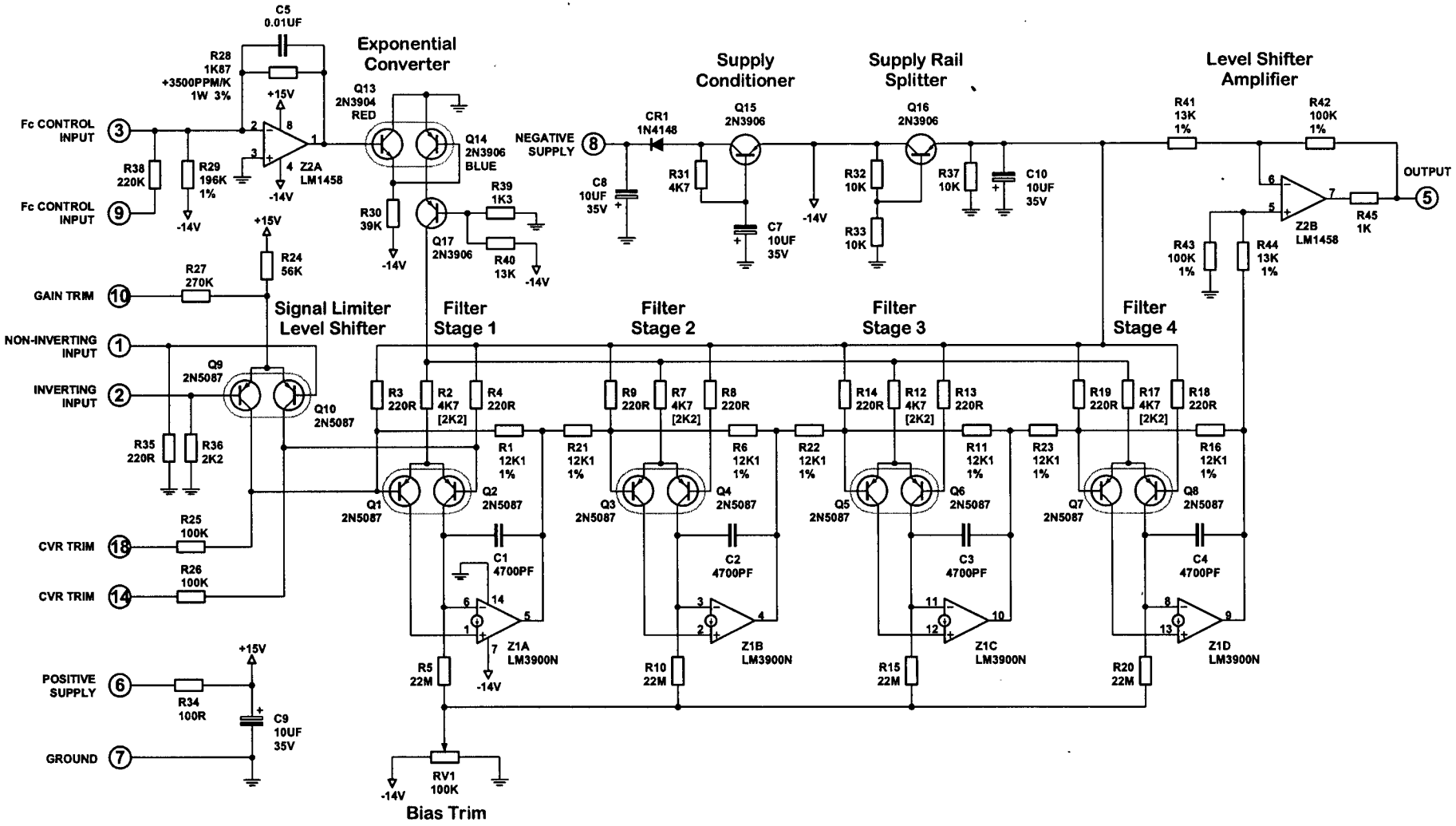
SCHEMATIC

4027-1 OSCILLAT

RAP 4-8-73

A-4027


R83
100K, LIN
INIT. FREQ
R84
150K, 1%
R85
100K, LIN
FINE TUNE
R86
8.3M
R87
100K
FREQ
CAL
MOD
4027-1
VCO 3
R110
1K
E27
OUT
N.C.
R88
33K
N.C
R104
1K
CR8
A2801-009
A9
E28
OUT
N.C.
R89
3.9K
E90
100K
R91
180K
90%
SET PW
E92
100K
LIN
PULSE
WIDTH
R94
220K
E93
15 K
1%
SGA
AUD
LF
R109
220K
CAL
.01
SHIELDED
CABLE
R95
84.5K
1%
E98
100K
1%
R100
220K
R101
470K
SGB
AUD
L.F.
E97
25K
E29
E30
E31
E32
R99
100K
AUD
R102
100K
AUD
R103
100K
AUD
KEYBD
CONTROL
IN
NOISE
ADSR
VCO2
FM CONTROL INPUTS



NOTES:

1. ALL RESISTORS ARE 0.25W 10% UNLESS OTHERWISE SPECIFIED
2. ALL 10UF CAPS ARE TANTALUM
3. PAIRED PNP TRANSISTORS ARE MATCHED AND THERMALLY COUPLED
4. Q13/Q14 ARE SELECTED AND THERMALLY COUPLED

MODIFICATIONS (DESIGN BY TIMOTHY SMITH):

5. R2, R7, R12, R17 SHOULD BE CHANGED TO 2K2 FOR IMPROVED CUT-OFF RANGE

ARP 4072

TITLE	4072 VOLTAGE CONTROLLED LOW-PASS FILTER
DESIGN BY	TIMOTHY C. GILLETTE ALAN R. PEARLMAN ARP INSTRUMENTS, INC. 1975
ASSEMBLY	
PATENTS	US #4,011,466 US #3,924,199 US #3,444,362
DRAWN BY	J VERGHESE
DATE	16-APR-96
REV	D

5.1 Types of Voltage Controlled Filter Modules: 4012, 4072

The later model 2601's use a 4072 filter module. This module is physically larger than the 4012 and is not encapsulated. In order to use the newer style filter in an older unit, modifications are required to the control input as shown on the circuit below. The newer 4072 module is identical in operation to the 4012.