WESTREX RA-1712
PHOTOGRAPHIC SOUND RECORD ELECTRONICS

INTRODUCTION

The RA-1712 solid state Record Electronics is an integrated system for recording photographic sound tracks on a Westrex photographic sound recorder. It accepts a 600Ω input signal level from -10 to +10 dBm bus level, and outputs a drive directly connected to the light valve. No audio transformers are used; instead, a solid state drive is used. The system incorporates a solid state analog signal delay as part of its unique anticipatory noise reduction system which configures the optimum noise reduction envelope to assure no valve clash on transients and minimum valve opening for optimum signal-to-noise performance. The RA-1712 also incorporates front panel switchable electronic film loss equalization and high and low-pass electronic filters for recording 35mm, 16mm, or even 8mm sound tracks using the same electronics. The system is 100% solid state to assure maximum reliability, stability and long life.

The RA-1712 utilizes a simple, single control adjustment setup for recording. The system also provides positive valve overload protection and meter monitoring of the recording process. The system is designed to drive a conventional Westrex light valve out to 12.5 kHz. This provides a remarkable improvement in the transient and high frequency response of optical sound tracks.

If the RA-1713 is used in conjunction with the RA-1712, a total electronics package is available for photographic sound recording.

CIRCUIT DESCRIPTION

Signal Input to the RA-1712 feeds a balanced differential amplifier A1. The output of the amplifier passes through a 20 dB step attenuator to the PROGRAM switch that controls the audio fed to the electronics. From the switch, the signal is fed to the film loss equalization amplifier A2. The front panel EQUALIZATION switch selects the amount of equalization. The input level may be trimmed internally by a trimpot in the feedback loop of the equalization amplifier. The output of the equalization amplifier is switched through one of three two-stage output high-pass active filters, A3, A4 and A5. The front panel switch labeled HIGH PASS Hz selects the high-pass filter. The high pass roll-off begins at 45, 65 or 85 Hz. In the MIN position the frequency extends to below 10 Hz. After the high pass filter, the signal is switched through one of four two-stage active low pass filters, also selected by a front panel switch labeled LOW PASS kHz. The low pass roll-off begins at 6.5 kHz, 8.5 kHz, 10.5 kHz or 12.5 kHz. The high pass filters provide a 24-dB/octave roll-off; the low pass filters provide a 36-dB/octave roll-off. The filter output/limiter input is the breakpoint for interconnecting the RA-1713.

The band limited signal passes through the signal level limiter A10 to the noise reduction circuit, consisting of A11, A12, A13, IC1 and IC2, and the signal delay circuit. The noise reduction circuit includes a resettable peak follower circuit, then a summing electronic diode and a low pass filter. The reset delay time matches the signal delay, and together with the low pass filter maintains noise reduction action below audio frequencies.

The signal delay is a solid state CCD type. It is clocked at an effective 75 kHz sample rate and provides a 12.5 kHz bandwidth, 26 millisecond delay. (See Delay Board schematic.)

The delayed signal drives the light valve resonance equalization circuit which contains two paths. The low frequency path is a low pass 18 dB/octave active filter A16 whose edge is frequency adjustable by means of an internally adjustable dual potentiometer R34. The high pass system comprises a 30 dB/octave high pass active filter A17 whose output level is adjusted by another internally adjustable dual potentiometer. The high and low pass signals are summed by A16 and added to the noise reduction signal by summing amplifier A18.

The output of the summing amplifier is attenuated by the front panel drive potentiometer before being applied to the power drive amplifier A19. This drives a complimentary pair of transistors, Q1 and Q2, which provide up to .6 amps of direct current drive to the light valve. The output drive to the light valve is fused by a back panel 3AG/1amp fuse. A front panel switch controls polarity and signal. The light valve is part of the drive amplifier negative feedback loop to reduce distortion and increase the signal quality.

The system power supply is bi-polar with current limiting protection. This is used to directly power the drive amplifier. The supply is further regulated to ±12V to provide power for all other electronics.

The system provides metering of three functions. The front panel switch in the IN position the meter reads modulation percentage of the light valve. The input meter level is adjustable by trimpot R75. With the front panel switch in the NR position the meter reads the noise reduction component of the output signal, and is adjustable by trimpot R74. With the front panel switch in the OUT position the meter reads the average DC current through the light valve, and is adjustable by trimpot R76.

INSTALLATION

The RA-1712 will accept unbalanced and balanced line inputs. For unbalanced operation, the –input is connected to GND, which is the low side of the input. The +input is the high side. If the audio bus requires termination, a resistor equal

to the desired impedance is to be connected from GND to +input. The RA-1712 normal input impedance is 10 kΩ.

For balanced operation, the –input is the low side and the +input is the high side. GND is then the shield connection. If the audio bus requires termination, two resistors, which together equal the desired impedance, are to be used. If a 600Ω input impedance is desired, two 300Ω 1% resistors should be used. Note that the resistors are 1% tolerance. If this tolerance in unavailable, two resistors should be matched in value. Connect one resistor from +input to GND, and the other resistor from –input to GND. For an input signal level of 0 dBm, the meter reads 100 with the front panel ATTN DB at 0. This may vary depending on the setup of the RA-1712 used and the bias line width used. However, the above numbers may be used as a guideline in the desired bus level.

A 10 μF non-polarized tantalum capacitor is used to jumper the signal when the Ra-1712 is used without the RA-1713. The capacitor will be seen on the center terminal block. Do not remove the capacitor unless the RA-1713 is interconnected with the RA-1712.

The modulator terminals are connected by two 14 GA, or larger, wires directly to the light valve connector terminal inside the recorder. ALL OTHER LEADS AND THE TRANSFORMER TO THE LIGHT VALVE MUST BE DISCONNECTED AND REMOVED.

OPERATION

Before turning the RA-1712 on for the first time, reduce the front panel DRIVE control to 0 and turn the POLARITY switch off. Turn the POWER switch on and turn the PROGRAM switch off. Turn the POLARITY switch to the plus position. Turn the DRIVE in a clockwise direction while observing the light valve ribbons; they should begin to close. If they begin to open, reverse the leads on the modulator terminals and repeat the above procedure. The reverse polarity position is used to make density end tests in the usual manner. With the POLARITY switch in the standby position, the light valve is disconnected completely from the RA-1712. (Note: that DRIVE simultaneously varies the noise reduction signal and the audio signal to maintain the internally set margin.)

Increase the DRIVE until the ribbons of the light valve are drawn down to the bias line size desired (typically 1.5 to 1.5 mills on the film); the proper margin is internally set/ Set the lock on the DRIVE control. (Note: The light valve should be allowed to reach thermal equilibrium before final adjustment of the bias lines. This required approximately 15 minutes of exposure to the exposing lamp at exposure intensity.)

Feed a 1 kHz signal from the transfer system at normal of "zero" bus level to the RA-1712. Set the METER switch to the IN position, and turn the ATTN DB fully ccw. Listen to the PEC monitor. Turn the PROGRAM switch on, and gradually increase the level with the ATTN DB control until clash is heard. Note the setting of the ATTN DB control - this provides the reference point. The meter should be reading 100 or close to it. If it does not indicate 100, Adjust trimpot R75 inside the unit until the meter reads 100.

For recording 35mm tracks, the LOW PASS KHZ switch should be set to either 12.5 kHz or 10.5 kHz , and the HIGH PASS HZ switch should be set to position 2 or 3. Each step of the equalization switch provides approximately 1 dB of boost at 8.5 kHz.

For recording 16mm tracks, the LOW PASS KHZ switch should be set to either 6.5 to 8.5 kHz, and the HIGH PASS HZ switch set to 45 Hz or 65 Hz. The EQ switch should be set to position 3 or 4, depending on the amount of high frequency equalization desired.

In the IN mode, the meter reads modulation percentage. In the OUT mode, the meter reads the average DC current through the valve. In the N.R. mode, the meter reads the noise reduction signal component of the composite signal. During recording the meter should be used in the IN position to monitor modulation level.

POWERING

The RA-1712 may be operated on either 115 VAC at 50/60 Hz or on 230 VAC at 50/60Hz. For 115-volt operation, connect power supply transformer pin 1 to pin 3, and pin 2 to pin 4 on the AC input side of the power transformer. For 230-volt operation, connect pin 2 to pin 3 only. In both cases, the AC wires are left connected to pins 1 and 4.

The fuse size is 3AG, 1A for either voltage.

LIGHT VALVE TUNING

The RA-1712 is designed to drive a Westrex light valve mechanically tuned to 8.5 kHz. The RA-1712 was factory adjusted with this light valve tuning in mind. If a light valve with a very different tuning is used, the internal light valve equalization on the RA-1712 should be adjusted. If the light valve is grossly mistuned, the best performance cannot be obtained without having the light valve mechanically retuned. If it is retuned, specify that it is to be tuned to 8.5 kHz. This will provide the best performance when used with the RA-1712.

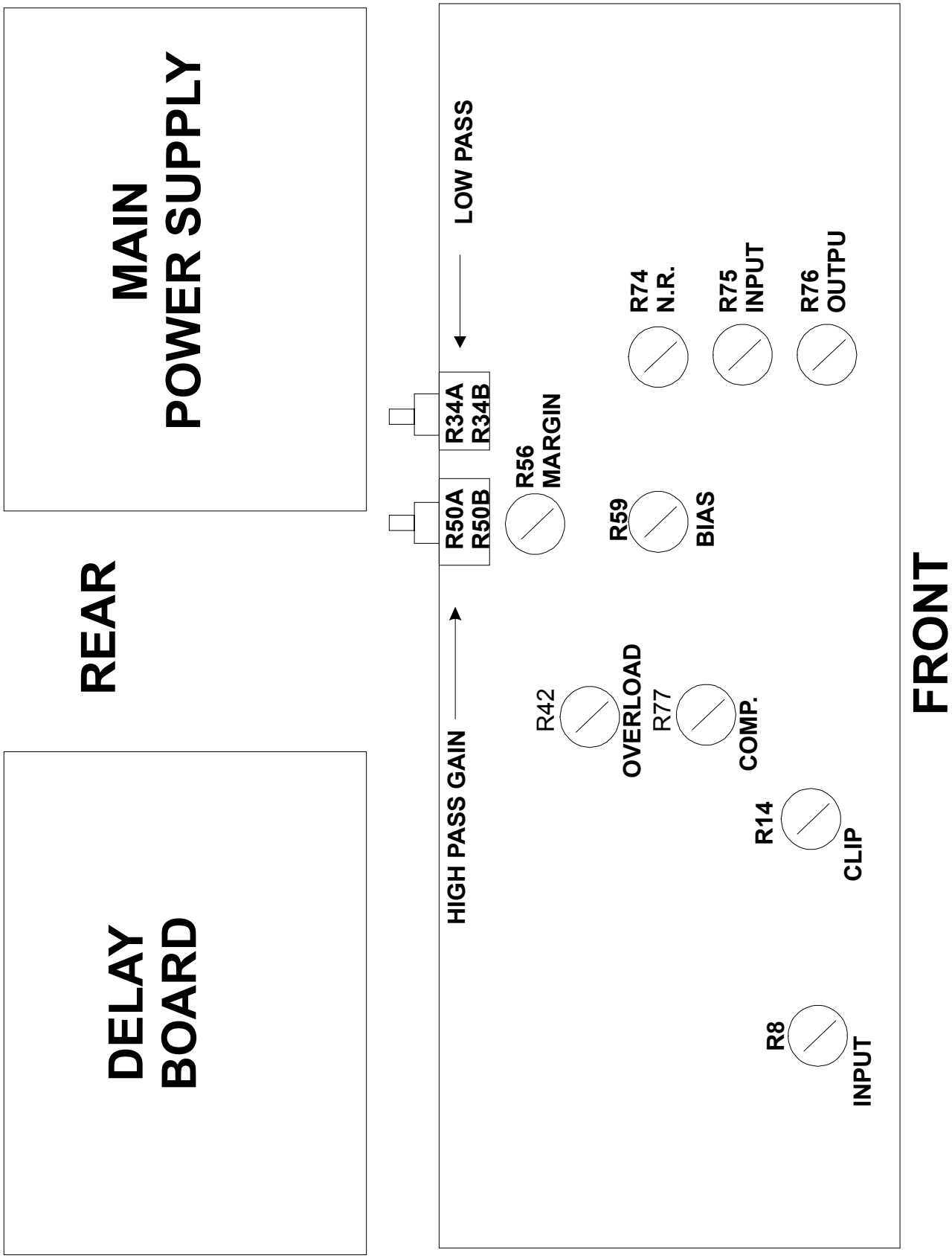

FIGURE 1. WESTREX RA-1712 Adjustment Control Layout

MAINTENANCE AND ADJUSTMENTS

The following procedures are provided to check adjustments or vary parameters. The location of the various trimpots can be found by referring to the parts location diagram in Figure 1, Westrex RA-1712 Adjustment Control Layout. For alignment, the RA-1712 should be connected to the light valve. It must be remembered that varying the factory adjustments can cause damage to the light valve. For this reason, only competent technical personnel should perform the following procedures.

Equipment required:

A sine wave signal source variable from 100 Hz to 13 kHz.

A photoelectric monitoring system for monitoring the light valve response.

A suitable oscilloscope

BIAS: R59

The bias trimpot R59 adjusts the DC current through the light valve when the noise reduction is driven completely off. Turn the RA-1712 on and connect a 1 kHz signal to the input. Put the POLARITY switch in the standby position and turn the program switch on. Turn the DRIVE control to 5.00 and put the METER switch in the N.R. (noise reduction) position. Increase the input signal until the meter reaches 0, then increase the input signal 2 dB more. Switch the METER switch to output and adjust R59 to 0 output current as read on the meter. This assures the average current through the light valve is 0 when high signal levels have turned off the noise reduction.

N.R. METER: R74

R74 adjusts the meter when it is reading N.R. The meter should read 100 when no signal is applied and the noise reduction signal is maximum. Switch the METER switch to N.R. Turn the PROGRAM switch off and adjust R74 so that the meter reads 100.

MARGIN: R56

R56 adjusts the gain of the signal before it is added to the noise reduction signal. Varying R56, therefore, varies the relative gain of the two and controls the noise reduction to signal margin. It is factory set to 3 dB.

Switch the POLARITY switch to plus. With the PROGRAM switch off, adjust the front DRIVE control to achieve the desired bias line width. Switch the METER switch to N.R. and turn the PROGRAM switch on. Increase the 1000 Hz signal level at the oscillator until the N.R. meter reads 0. Increase the signal at the ATTN level the number of dB margin desired and adjust trimpot R56 until the light valve is just audibly clashing on the PEC monitor. 3 dB of margin is recommended.

INPUT METER: R75

R75 adjusts the meter when it is reading the audio input, IN. The meter should read 100 just at the onset of valve clash.

With no signal input, adjust the Drive control to provide the desired bias lines. Apply a 1 kHz (approximate) sine wave and adjust the level until clash is just heard or viewed on an oscilloscope reading the PEC monitor. R75 should then adjusted so that the meter reads 100.

As different light valves are used, a given DRIVE setting will provide slightly different bias lines and variations in clash level as read on the meter. These variations will not cause problems in normal use.

INPUT LEVEL: R8

R8 is a fine trim on the input attenuator step pot, and is used to adjust the input signal level so the either 100% of 50% modulation occurs exactly as a given step on the input attenuator pot. R8 provides about 3 dB of level trim.

CLIP LEVEL: R14

This pot sets the clip level and the input level to the delay board. The delay board is sensitive to overload; hence, the clip level should not be changed unless it is known to be out of adjustment.

At 100% modulation, or onset of valve clash, the signal measured at the output of A10 (the input to the delay board) must be 1.8 volts peak-to-peak. At onset of clipping (which is accomplished through the diode bridge at the input of A10), the signal measured at the output of A10 must be 2.20 volts peak-to-peak.

The level at onset of clipping should be measured first, then verified by measurement at onset of valve clash, or 100% modulation.

If any IC's are changed, this level may be checked, but because of extensive use of FB around the various IC's, there should be little cause to change the setting of R14.

OUTPUT LEVEL: R76

R76 adjusts the meter when the METER switch is in the OUT position. The meter then reads the average DC current through the light valve. R76 is adjusted as follows:

Turn the PROGRAM switch OFF and place the POLARITY switch in the STANDBY position, thus disconnecting the light valve from the RA-1712. Advance the DRIVE control to its maximum at 10.00; adjust R76 so that the meter reads 100. Return the DRIVE control to the required drive level for the light valve before moving the POLARITY switch from STANDBY!

OVERLOAD: R42

This trimpot adjusts how much past clash the RA1712 will drive the light valve before limiting. It does this by varying a DC bias added to the noise reduction signal when no input signal is present. To change the nominal 3 dB over clash, the procedure is as follows: Place the POLARITY switch in the STANDBY position, the PROGRAM switch OFF, and the METER switch in the OUT position. Adjust the DRIVE control until the meter indicates 40%. To increase the amount the RA-1712 will drive past clash, R42 is adjusted so as to reduce the output current. A 4% reduction of 36% output results in a 1-dB increase capacity. Increasing the output current decreases the output overdrive capacity. If R42 is adjusted, all other adjustments should be rechecked as this control interacts with several others.

LIGHT VALVE EQUALIZATION: R34 & R50

The two larger screwdriver adjust dual potentiometers are used to adjust to a particular light valve equalization. They provide adjustable attenuation around the resonance point of the light valve. Their function is described in the description section of this manual. The adjustment procedure is given below.

Once the RA-1712 has been adjusted for proper operation at 1 kHz, the light valve equalization may be done. With the RA-1712 connected to a light valve and adjusted for recording, place the LOW PASS FILTER switch in the 12.5 kHz position and apply a 50% 1 kHz tone to the input with the meter in the input mode, verifying normal operation at 1 kHz. Apply a 10.5 kHz tone and adjust the input level to read 50% on the meter and adjust R50 (high pass gain, see figure 1). There may be a grating or screeching sound. Reduce R50 to just below this point. Next, apply an 8 kHz tone at 50% on the input meter and adjust R34 to read 50% on the meter.

MAINTENANCE

The RA-1712 is totally solid state and, therefore, little or no maintenance should be required. A periodic check of the alignment as described in the previous section is desirable. However, on an annual basis, all rotary switches may be sprayed with a switch cleaner lubricant safe for plastics, such as General Electric Silicone TV Tuner Cleaner/Lubricant to assure a good switch contact. Any cleaner containing sulfur or carbon-tet should not be used, as this will produce greater corrosion on the contacts.

APPENDIX A

FACTORY ALIGNMENT PROCEDURE

Test Equipment Required:
Oscilloscope calibrated to read both AC and DC with ungrounded power cord.
Low distortion audio signal generator.

A
1. Connect signal generator to INPUT terminals with "-" and GND strapped.
2. Connect oscilloscope to TP8 (input to delay board) and common loop on main board.
3. Turn POLARITY switch to STBY and PROGRAM switch to ON.
4. Set ATTEN to +3 dB.
5. Set R14 (clip level) fully CCW.
6. Increase input at 400 Hz until clipping just begins as observed on the oscilloscope.
7. Decrease ATTEN to 0.
8. Set R14 for a reading of 1.8 volts (100%) peak-to-peak at TP6.
9. Turn METER switch to IN.
10. Set R75 so input meter reads 100.

B
1. Connect oscilloscope to TP7 and COM.
2. Turn PROGRAM switch to Off.
3. Adjust R77 to point that voltage at TP7 just switches to GND.

C
1. Connect oscilloscope to TP9.
2. Turn PROGRAM switch ON and see that 400 Hz still reads 100 on METER.
3. Decrease ATTEN to -3 dB.
4. Adjust R42 so DC scope trace just increases in positive direction very slightly.
5. Return ATTEN to 0.

D
1. Connect oscilloscope to pin 6, A18 (input to drive control, erroneously labeled pin 7 on some schematics).
2. See that 400 Hz input still reads 100 in meter.
3. Adjust R59 so average signal on oscilloscope is 0 (symmetrical about 0 line, if scope input were grounded).

E
1. Leave oscilloscope connected to pin 6, A18.
2. Turn PROGRAM switch OFF.
3. Turn oscilloscope vertical vernier control until trace is down 17 divisions from 0 position.

4. Turn PROGRAM switch ON.
5. Adjust R56 for an amplitude of ±19 divisions symmetrical on oscilloscope. (400Hz, 100 on meter)
6. Return vernier control to calibrate position

F 1. Turn PROGRAM switch to OFF.
2. Turn METER switch to N.R.
3. Set R74 so that the meter reads 100.

G 1. Leave PROGRAM switch OFF.
2. Leave POLARITY switch in STBY.
3. Turn METER switch to OUT.
4. Turn DRIVE control fully CW to 10.00.
5. Adjust R76 so that the meter reads 100.
6. Return DRIVE control to original drive level for light valve before moving POLARITY switch from STBY.
7. Return METER switch to IN.

H. See setup procedure for alignment with light valve.

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PHOTOGRAPHIC SOUND RECORD ELECTRONICS

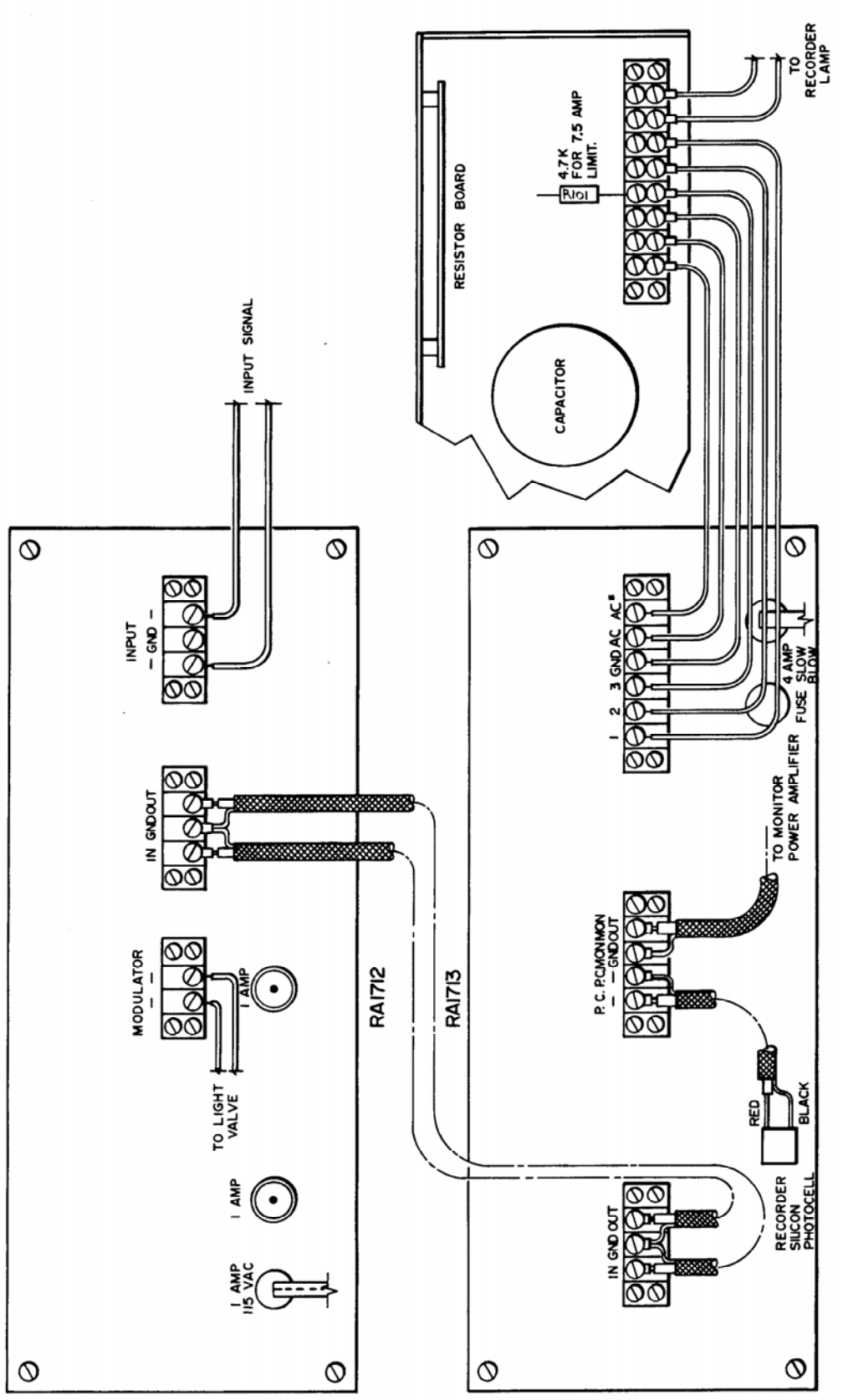
APPENDIX B

LIGHT VALVE ALIGNMENT

A 1. Turn PROGRAM switch ON.
2. Turn METER switch to IN.
3. Set the input ATTEN to 0.
4. Adjust the 400 Hz input to read 100 on the meter.
5. Move the POLARITY switch to PLUS.
6. Adjust DRIVE control (increase from 0) so that clash just occurs. You will have an approximately .002 bias line now.

B 1. Follow steps 1 through 3 in Part A above.
2. Set HIGH PASS Hz switch to MIN.
3. Set LOW PASS Hz switch to 12.5.
4. Adjust a 1 kHz input to read 50% on the input meter and note the level at the output of the PEC monitor. (This input level will be retained for the rest of this alignment.)
5. Change input frequency to 10.5 kHz. Adjust R50 so that PEC output level is the same as noted for 1 kHz.
6. Change input frequency to 8 kHz. Adjust R34 for same output level.
7. R34 adjusts the cutoff frequency to a low pass filter and R50 adjusts the amplitude of the band pass of a 10 kHz high pass filter. This adjustment allows the adjustment of a notch filter to match the resonant peak of the light valve resonance and extend the frequency response of the system beyond this resonant point. By sweeping the band between 6 kHz and 10.5 kHz and adjusting these two potentiometers alternately several times, the response of the system can be made to match that of the light valve and the overall result will be extremely flat.

WESTREX RA-1712
PHOTOGRAPHIC SOUND RECORD ELECTRONICS



WESTREX 9000 SYSTEM
ELECTRONICS INTERCONNECTION DIAGRAM

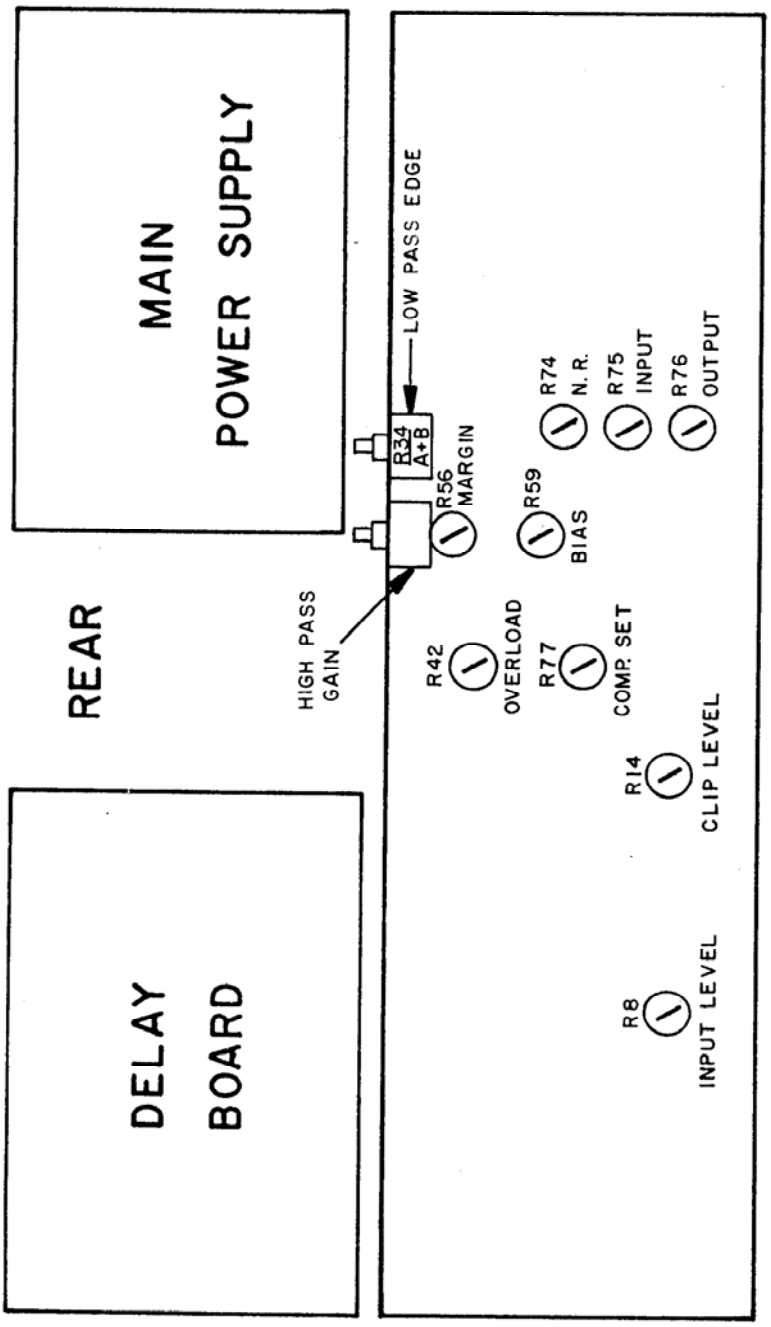
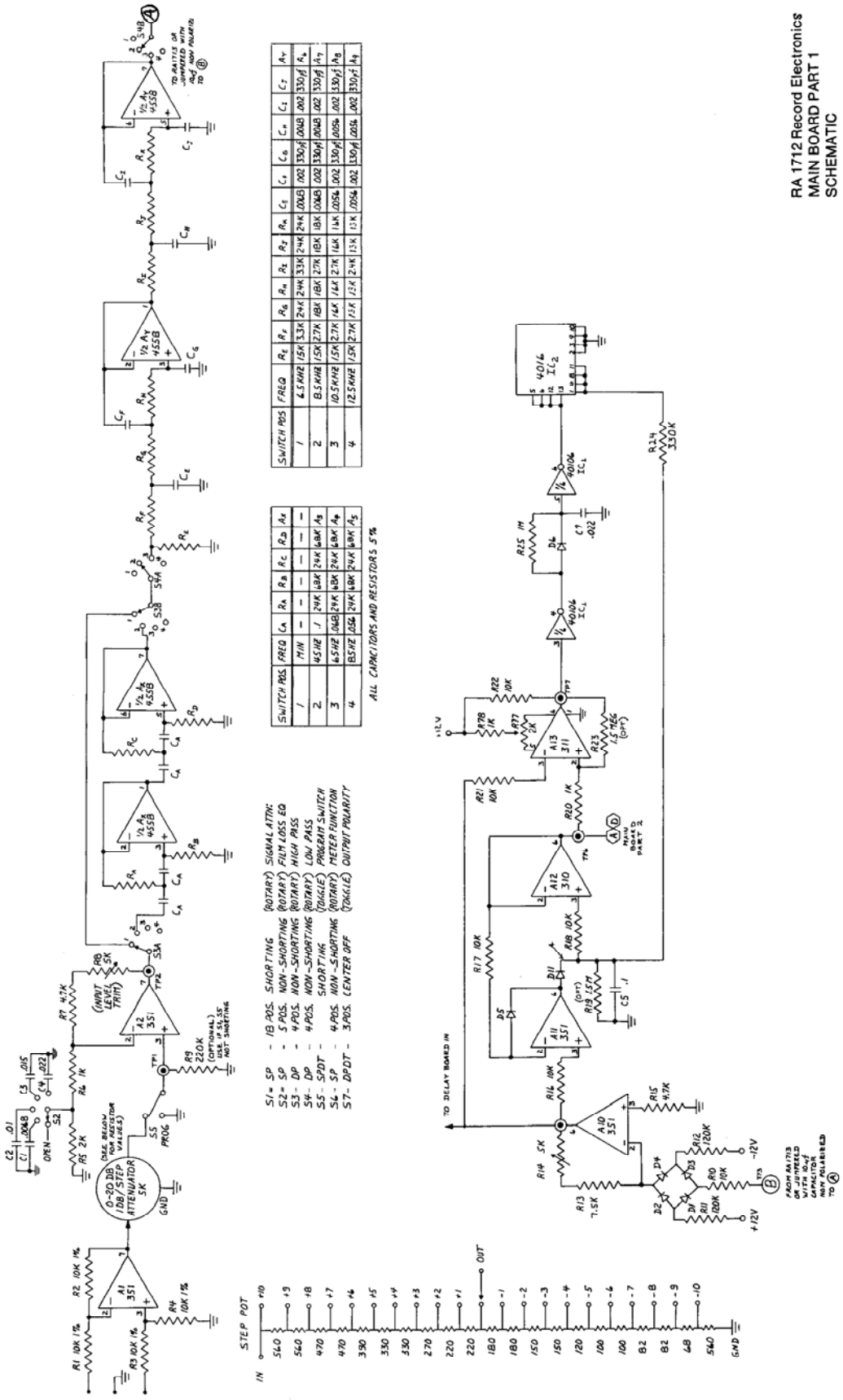


FIGURE 2: WESTREX RA1712 ADJUSTMENT CONTROL LAYOUT.

WESTREX RA-1712
PHOTOGRAPHIC SOUND RECORD ELECTRONICS



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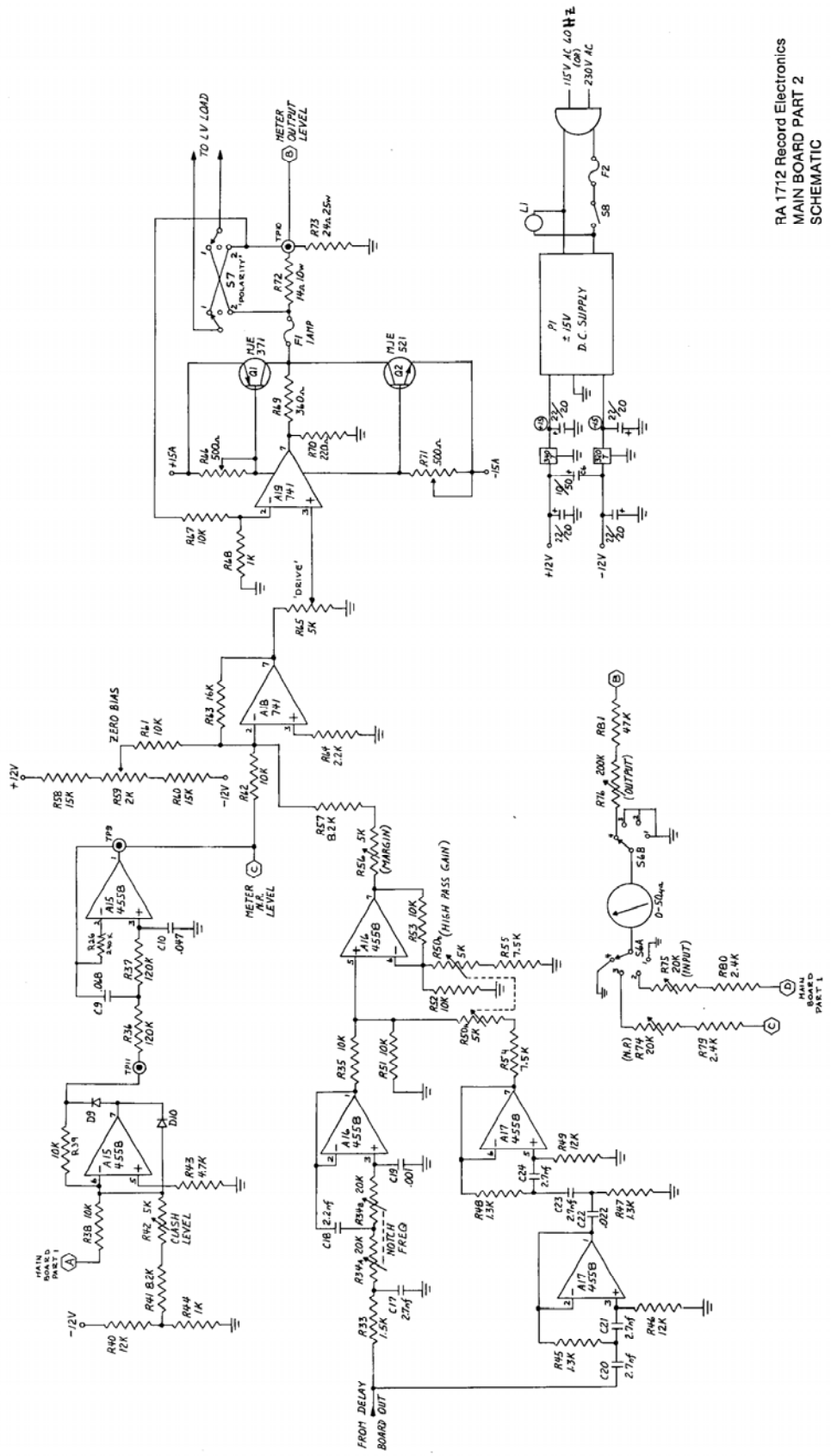
PHOTOGRAPHIC SOUND RECORD ELECTRONICS



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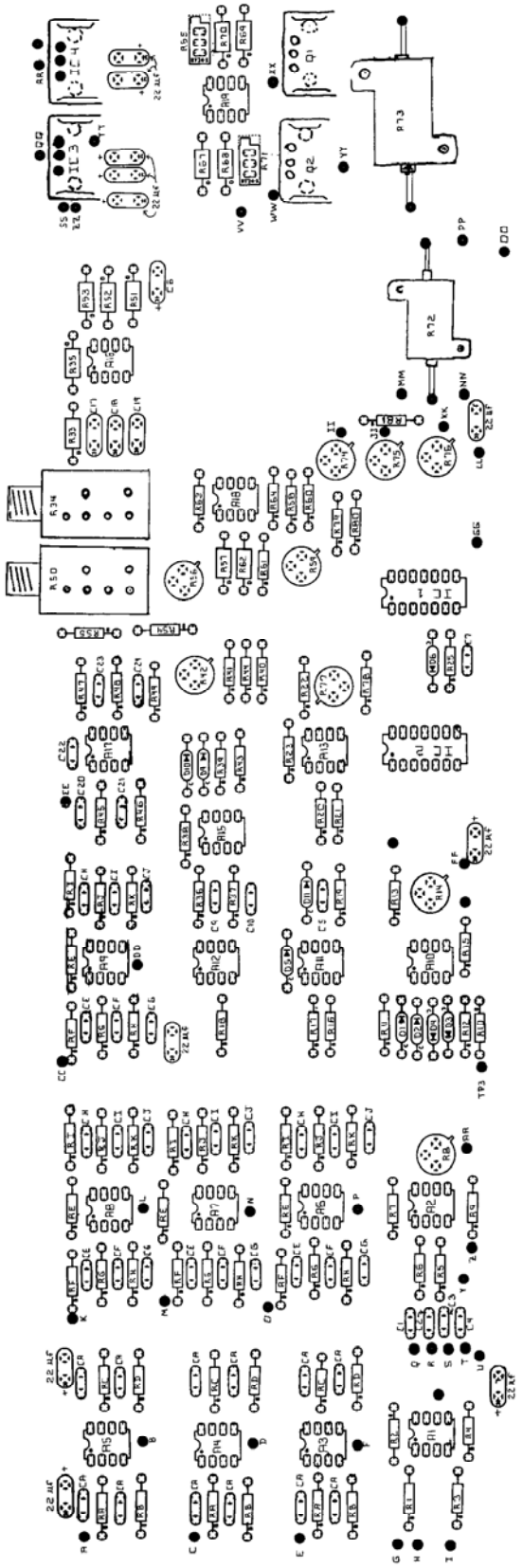
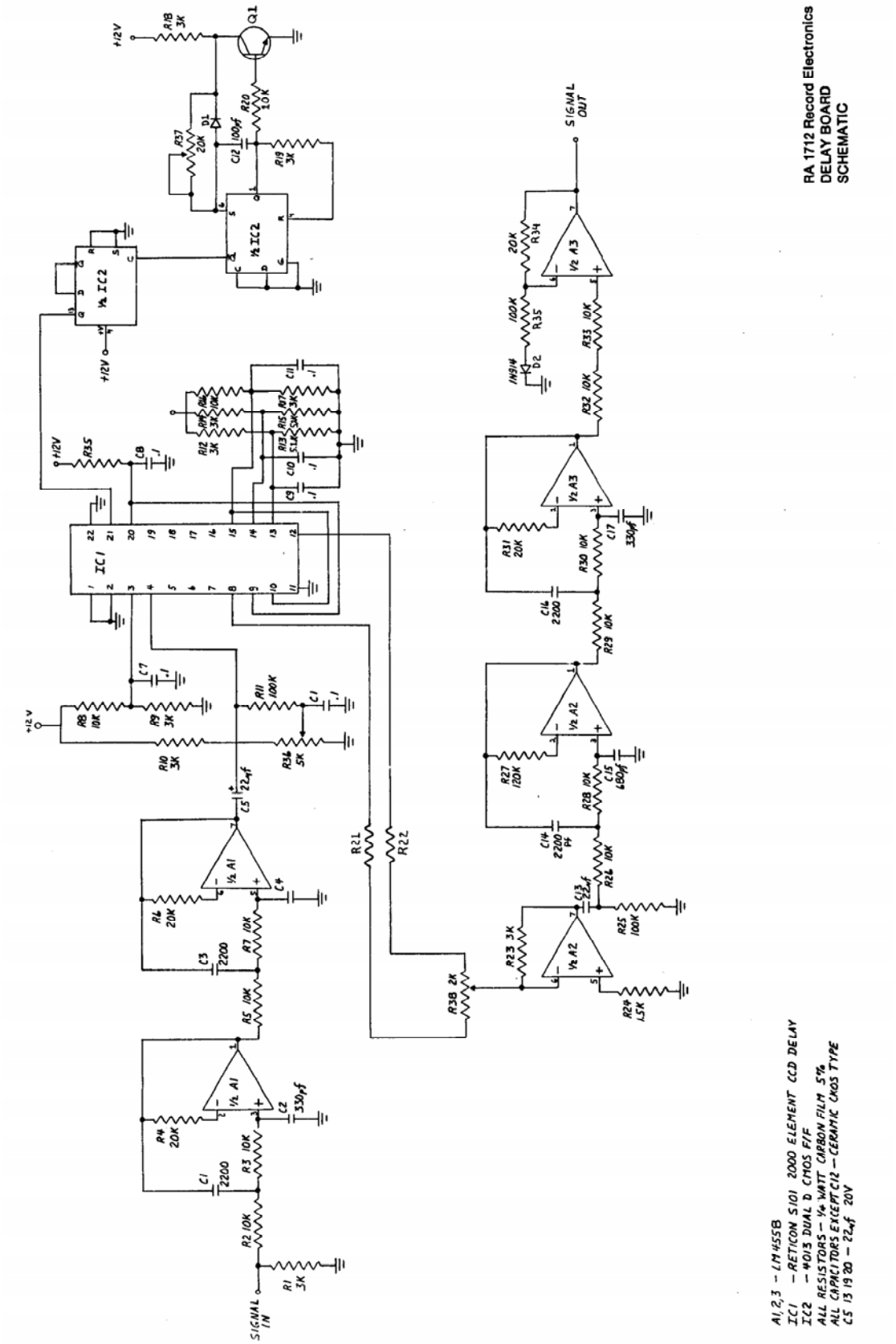
PHOTOGRAPHIC SOUND RECORD ELECTRONICS

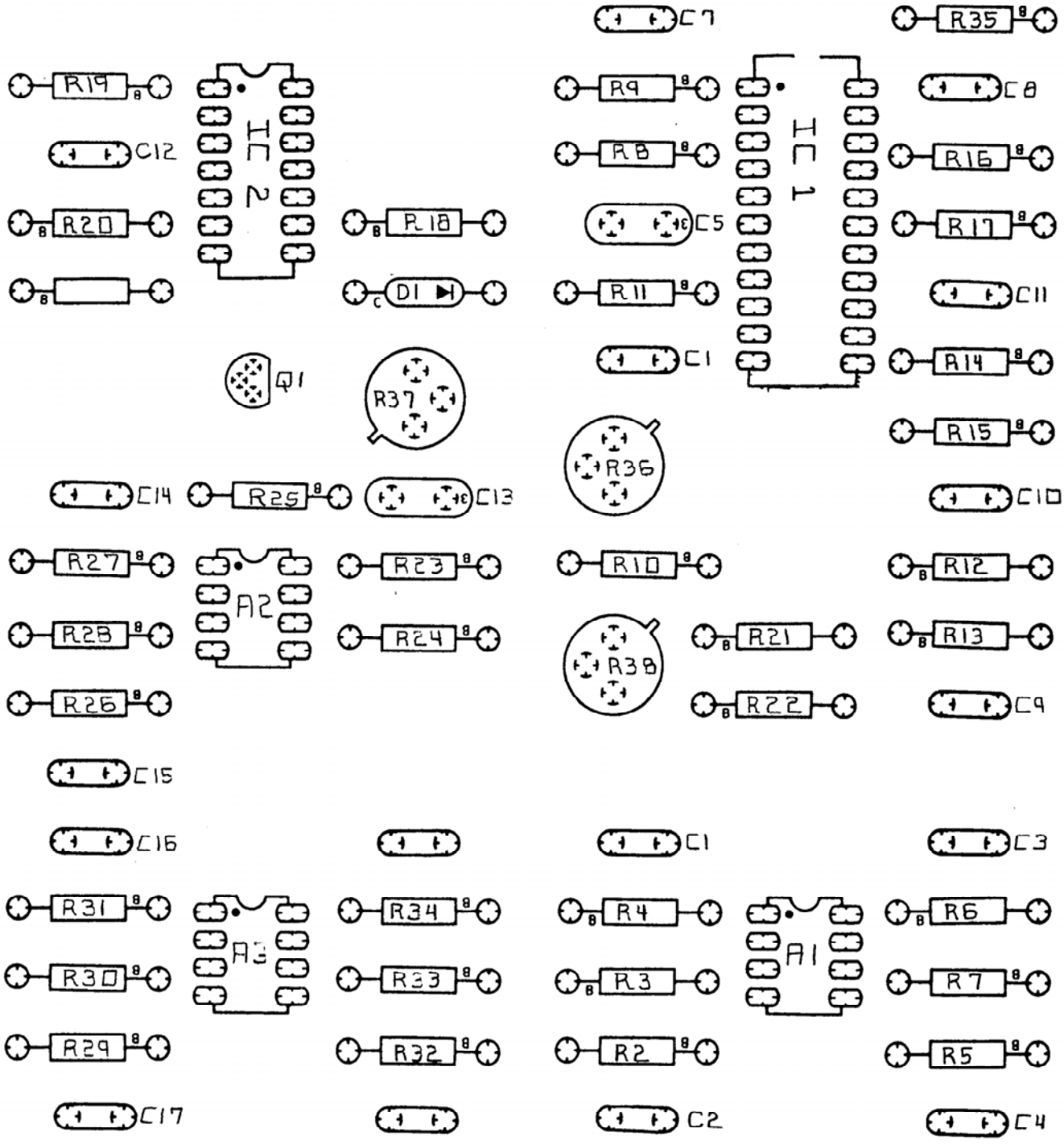


RA 1712 Record Electronics
MAIN BOARD
PARTS LOCATION DIAGRAM

WESTREX RA-1712
PHOTOGRAPHIC SOUND RECORD ELECTRONICS

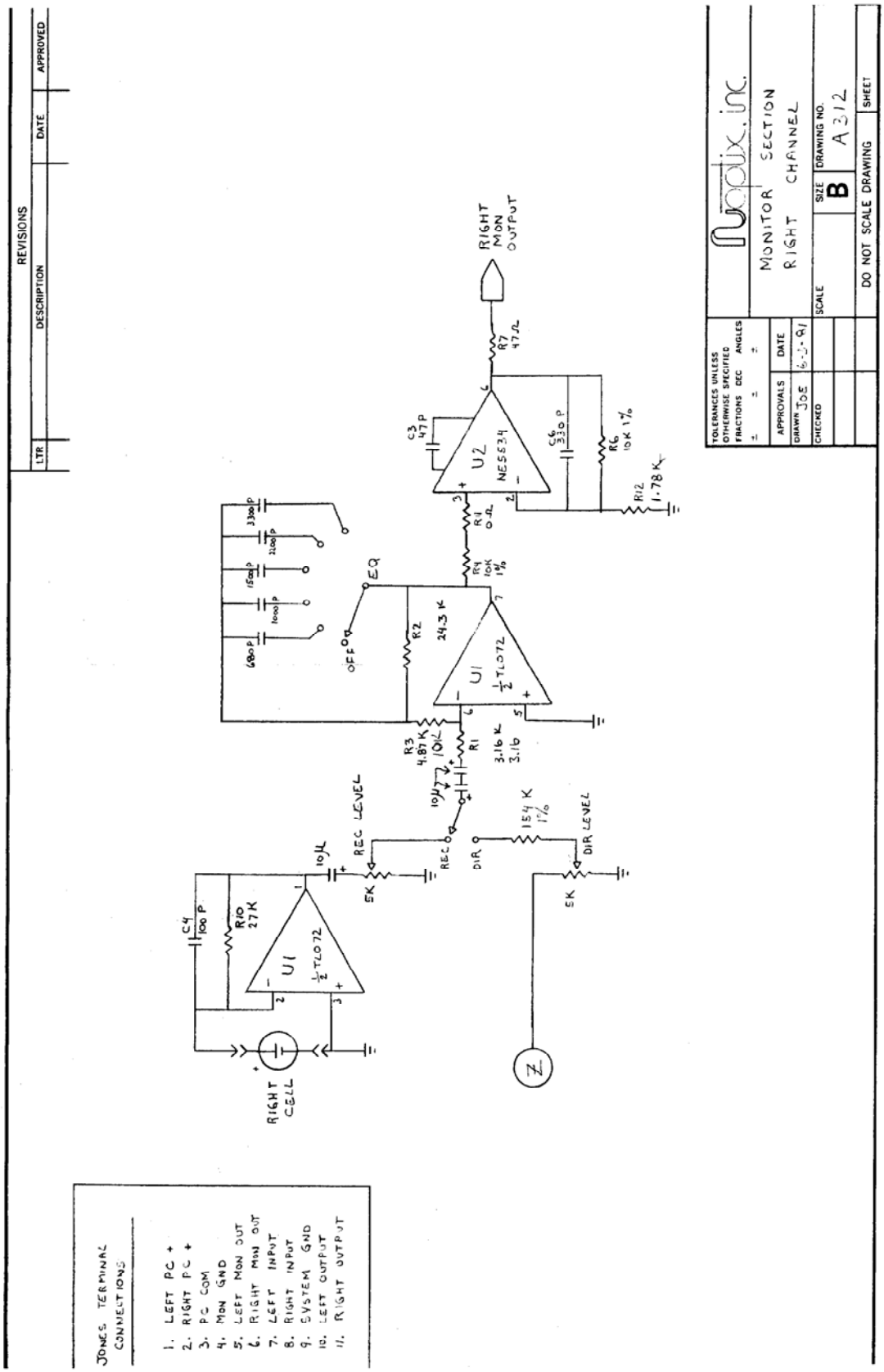


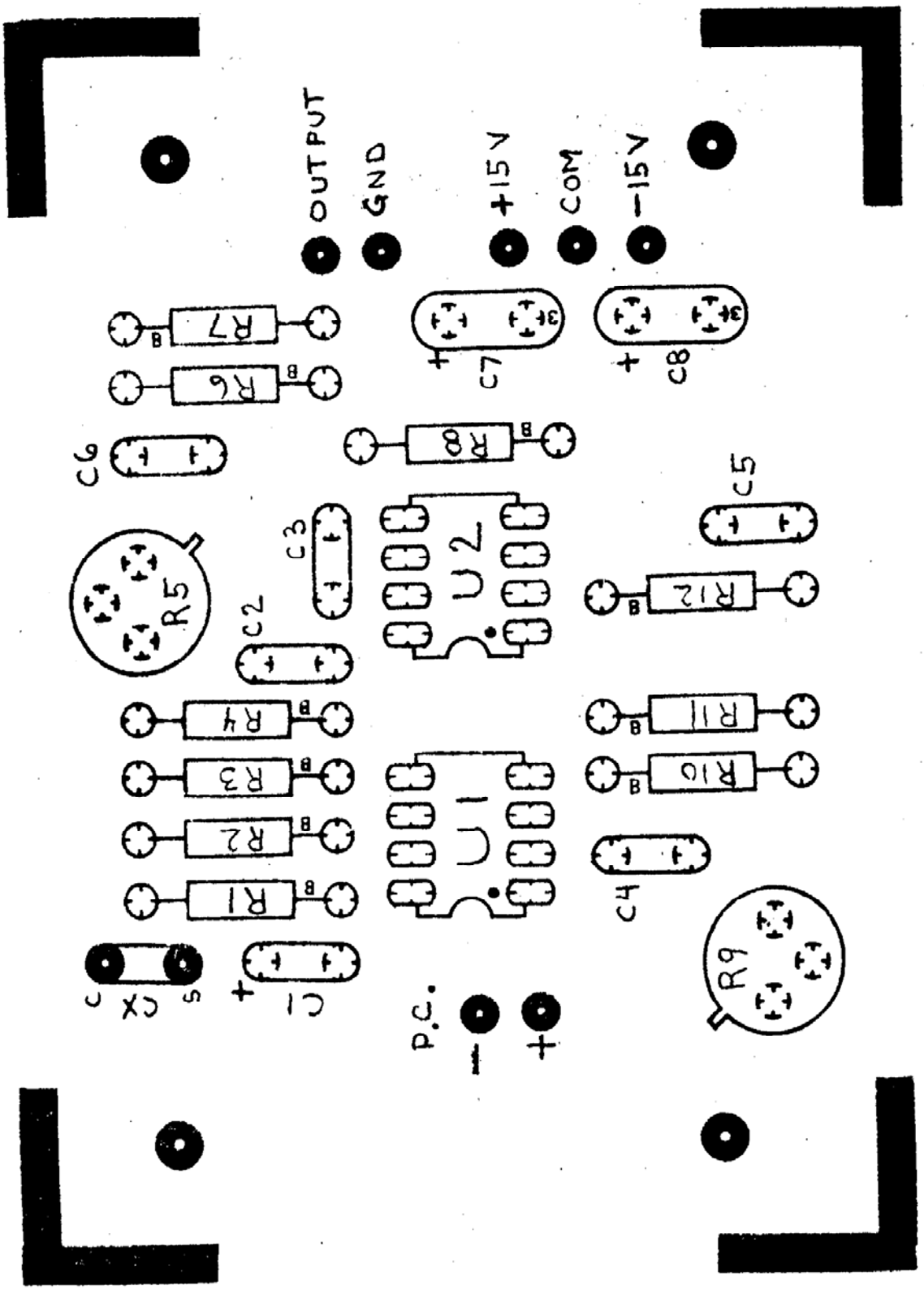
WESTREX RA-1712
PHOTOGRAPHIC SOUND RECORD ELECTRONICS



RA 1712 Record Electronics
DELAY BOARD
PARTS LOCATION DIAGRAM

WESTREX RA-1712
PHOTOGRAPHIC SOUND RECORD ELECTRONICS




DRAWING
B202
OUTPUT
GND
+15V
COM
-15V
C7
C8
R7
R6
R8
C6
C5
C3
C2
R5
U2
R12
R4
R11
R3
R10
R2
R1
U1
C4
R9
CX
C1
P.C.