INTRODUCTION

The Westrex RA-1712A is an integrated photographic sound recording electronics package for use with Westrex light valve recorders. The system accepts balanced or unbalanced inputs. It provides a front panel input level adjustment range of 20 dB. High and low pass filters are front panel selectable for 16mm, 35mm or 8mm sound track recording. High frequency pre-emphasis to compensate for printer or other loss is also front panel selectable. Percent track modulation and average light value current are monitored on a front panel meter. The system uses a CCD solid state delay line to delay the audio signal in an anticipatory noise reduction system. The noise reduction and drive signals are internally combined and their relative levels set for a 3dB margin. The margin is independent of external control setting and is factory set. The output level to the light valve is controlled by a single front panel ten-turn drive control. The system is capable of driving any Westrex light valve used for recording positive or negative photographic sound track.

INSTALLATION AND OPERATION

The RA-1712A accepts either single sided or balance line level high impedance input. It is important to follow good grounding practice in the installation of the RA-1712A. If balanced line input is available (i.e. transformer input), the center terminal of the input to the RA-1712A should be connected to the “water pipe” ground with the balanced input applied between the + (high side) and - (low side) input terminals. This terminal is the transmission ground point. Chassis ground is accessible via the ground lead on the power plug - or via one of the 4 screws attaching the back panel to the RA-1712A.

For operation of the RA-1712A without the RA-1713A auxiliary electronics package, terminals A and B on the other three terminal Jones connector on the back panel should be shorted together with a 2" length of wire. (These terminals are used by the RA-1713A to access the filtered and level set signal of the RA-1712A and as a signal injection point for signals from the RA-1713A. The short loops the signal though).

The modulator output on the two terminal Jones strip of the back of the RA-1712A is connected directly to the two input terminals of the light valve using 14 GA wire. **Warning! Neither of these terminals should ever be connected to ground!**

Before turning the RA-1712A on the first time, the drive control should be reduced to 0 and the polarity switch set to the standby middle position. IMPORTANT! Always have the polarity switch in the standby position when turning the RA-1712A on or off to protect the light valve from turn-on and turn-off transients. An input signal source capable of supplying an audio input of at least -2 dBm should be connected to the input of the RA-1712A. The program switch should be turned off.

Turn on the RA-1712A and toggle the polarity switch to the PLUS position. Observe the modulator opening while the DRIVE control is advanced. If the ribbons of the

light valve begin to move apart as the drive is increased, return the POLARITY switch to the standby position and reverse the modulator leads on the back of the RA-1712A. Return the POLARITY switch to the PLUS position and continue to increase the DRIVE control until normal, .002" bias line(s) are achieved.

It is desirable during the setup of the RA-1712A to have a photocell or visual monitor of the actual modulation of the light valve

Turn on the program switch with a 400 Hz signal applied; increase its level until the meter on the RA-1712A in the IN mode reads 100% modulation. Increasing the level beyond that point should result in perceptible distortion being noted from the photocell monitor. The distortion is the clipping the signal at 100% modulation. If clipping is not noted, make sure the DRIVE control has been advanced to the point necessary to achieve the desired bias line size and that the program switch is on. If some clipping is observed within 1 dB over 100% modulation, the RA-1712A calibration should be checked. (See section on Calibration.)

Having verified performance at 400 Hz, the next step is to adjust the light valve equalization of the RA-172G. These adjustments are made inside the unit after removing the top plate. A nominal adjustment of the light valve equalization circuit has been set at the factory. However, because of the age and use of various light valves, a readjustment may be necessary. Apply a signal to the input at 8.0 kHz and listen to the modulated output on the modulator of the photocell monitor and/or watch it on the modulator display screen of your recorder. Increase the input level until the RA-1712A meter reads 100% in the IN mode. Now adjust trimpots R-154 and R-155 until exactly 100% modulation deflection of the light valve is noted either visually or audibly at the onset of clipping which in this instance will sound like a faint screeching sound. R-154 and R-155 should be adjusted together; that is, so that the small arrows on them point parallel to each other when the adjustment is completed.

Next, the input signal frequency is increased to 10.5 kHz and its input level adjusted to 100%. Trimpot R-180 is adjusted to achieve 100% modulation as noted either visually or audibly. NOTE: The RA-1712A low pass filter should be set to the 12.5 kHz position in the above alignment procedures. The above procedure should be iterated (since R-180also affects the setting of R-154 and R-155 and vice versa) until both criteria are met.

RECOMMENDED USE

The RA-1712A may be used to record 35-mm, 16-mm and 8-mm positive and negative sound tracks with Westrex modulators. For recording 35-mm sound tracks, we recommend setting the HIGH PASS filter to 45Hz and the LOW PASS filter to either 12.5 or 10.5 kHz. The Equalization switch should be set to either position 1 or 2. This setting will be determined by your experience with the amount of high frequency lost in development and printing at the lab processing the sound track. For 16-mm recording, the HIGH PASS filter should be set to 65 Hz and the LOW PASS to 8.5 kHz or alternatively the HIGH PASS may be set to 85 Hz and the low

pass to 6.5 kHz. The EQUALIZATION switch may be set to position 3 or 4, again depending on the laboratory which will be developing and printing the film. Finally for 8-mm recording, the 85 Hz - 6.5 kHz filter selections should be used with maximum film loss equalization.

For all sound track recording, we recommend a .002 to .003 inch bias line size. Because of the use of anticipatory noise reduction in the RA-1712A, the larger bias lines and greater margin are not necessary. The result of the smaller margin and bias lines is a quieter sound track with no transient distortion.

CIRCUIT DESCRIPTION

INPUT AMPLIFIER AND FILM LOSS EQUALIZER

The signal enters the RA-1712A via a three terminal, Jones type, back panel connector. The balanced differential input amplifier U-9 amplifies the input. The output of the amplifier passes through the front panel 20-dB step-pot attenuator and to the equalization amplifier comprising the other half of the input amplifier chip U-9. The front panel equalization switch associated with the amplifier switches capacitors C82 - C86 to provide from 0dB to 10-dB high frequency boost at 10 kHz.

LOW PASS AND HIGH PASS FILTERS

The signal is applied simultaneously to the 4 low pass filters comprising amplifiers U5 - U8. These filters use a 5-pole design breaking at 6.5 kHz, 8.5 kHz, 10.5 kHz and 12.5 kHz. The LOW PASS front panel select switch selects the desired low pass filters output. The output of the selected low pass filter is applied to the three high pass filters comprising U2 - U4. The filters use a 4-pole design breaking at 45 Hz, 64 Hz and 85 Hz. The front panel HIGH PASS switch selects the output of one of these filters. In the MIN position the high pass filters are bypassed and the resultant system low frequency cutoff is approximately 5 Hz.

RA-1713A INTERFACE

After passing through the high and low pass filters, the signal is routed to the other three terminal back panel Jones connector labeled A - GND - B. This is the insertion point for interfacing the RA-1712A with the RA-1713A Auxiliary Electronics package. For use without the RA-1713A, terminals A and B are shorted together, thus looping the signal back into the RA-1712A.

LIMITER

The signal returned from the back panel connector strip is hard limited by the current control clipper made up of amplifier U11 and IC U10. This circuit provides a symmetrical clipping of the signal if it exceeds 100% modulation level by more that 2 dB. The amount over 100% modulation at which clipping occurs is set by pot R84.

This circuit prevents serious overdriving of the light valve modulator, which results in spurious ringing distortion on the recorded optical sound track. After passing through the clipper, the signal branches. One branch goes to signal delay; the other branch goes to the noise reduction circuit.

ANTI-ALIASING FILTERS

Amplifiers U23 and U22 act as anti-aliasing filters for CCD delay. The delay uses a 2000 element CCD delay device, RS101. Its clock input comes from the free running multivibrator U19 and the 2:1 divider flip-flop U20. The clock operates at 150 kHz at test point 10; the clock input point to the CCD chip. Amplifiers U23 and U24 are the post amplifiers and filters. U25 is a distortion correction circuit whose output provides a delayed signal to the noise reduction circuit to assure that under no circumstances will the noise reduction close below the amount necessary to provide clearance for the current signal. The main delay signal output appears at test point 7. Trimpot R151 adjusts the amount of audio signal summed into the final composite signal and thus sets the margin.

NOISE REDUCTION CIRCUIT

The noise reduction circuit comprises a dual input resettable peak follow-and-hold circuit made up of amplifiers U12, U13 and U14. This circuit stores the highest peak positive signal received in the preceding 25 ms and buffers that value out to test point 8 (TP8). U15 and U17 are timing circuits that reset the peak follow circuit after 25 ms if its stored value is not exceeded by the incoming signal during that period. U17 adds a DC offset to the held peak value set by pot R99 and simultaneously hard limits at ground. U18 is a two-pole low pass filter that removes all audio frequency components from the noise reduction signal.

LIGHT VALVE HIGH FREQUENCY RESPONSE CIRCUIT

The audio signal, which has been delayed by 25 ms by the delay circuit, is passed to the two-pole low pass filter circuit a U26 and the four pole high pass filter at U31. Trimpots R155 and R154 adjust the low pass filters cutoff frequency; pot R180 adjusts the amount of high frequency added by the high pass filter. The outputs of these filters are summed together along with the noise reduction signal at amplifier U30. The high and low pass filters are adjusted to compensate for high frequency response variations of the light valve. These circuits comprise the light valve high frequency resonance equalization circuit. Trimpot R174 is a DC offset pot, which allows electronically changing the zero deflection setting of the light valve. It is factory set for no offset.

DRIVE AMPLIFIERS

U29, U32 and transistors Q1 through Q4 form the output amplifier (Drive Amplifier) of the RA-1712A. The two complementary drivers for a bridge output amplified capable of 85 volts peak-to-peak swing using a moderate supply voltage of ± 24

volts. The output level of the system is set by the front panel 5K ten-turn potentiometer called DRIVE control. The output amplifier is a current regulated design. The amount of current passing through the light valve being driven is measured as a voltage across the precision resistor R156 and used as negative feedback to the driver amplifier U29. The output is connected to the light valve through the front panel 3-pole toggle switch labeled POLARITY. One pole of the switch is used together with one pole of the program switch to light the RECORD light when the light valve is connected in the forward bias record direction and the program switch is on. Capacitor C76 provides high frequency compensation for the increased inductive reactance of the light valve at high frequencies. For some light valve applications its value may be changes or it may be eliminated altogether

METER CIRCUIT

Dual Amplifier U1 is a buffered slow decay, peak follow-and-hold meter circuit. A peak follow-and-hold circuit is used so fast transient overloads of significant duration (a duration long enough to be heard on the recorded track) will be indicated on the meter.

POWER

Power for the system is provided by a bipolar regulated 15-volt supply. This voltage is delivered directly to the output amplifier section of the RA-1712A. Power for the rest of the systems circuitry is regulated down to bipolar 12 volts by on-board IC regulation.

CALIBRATION

The following equipment is required to calibrate the RA-1712A:

Low distortion Audio signal source whose distortion is less than .05% across the audio spectrum

Digital voltmeter

Distortion analyzer

Oscilloscope

Frequency counter

INPUT SIGNAL LEVEL CALIBRATION

Connect the signal source to the input of the RA-1712A. Connect a short piece of wire from the terminal marked "A" on the back panel to the terminal marked "B". Connect another short piece of wire from the modulator "+" terminal to the modulator

"-" terminal. Set the HIGH PASS switch to the MIN position and the LOW PASS switch to the 12.5 position. Set the POLARITY SWITCH TO THE STBY position. Adjust the input level to achieve -2 dBm at Test point 1 (TP1). Turn the PROGRAM switch on and the EQUALIZATION switch off. Set the step pot attenuator to the 0 position (the 12 o'clock position) and adjust trimpot R31 so that the signal level at TP2 is 0 dBm.

NOTE: All measurements made during the calibration of the RA-1712A are made between the stated test point (TP) and the RA-1712A ground. A convenient ground is provided as a loop of bare wire near the center of the printed circuit board.

CLIPPER LEVEL CALIBRATION

In this calibration step the level at which the RA-1712A clips the audio signal after 100% modulation is achieved is set. We recommend that the clipper be set to 2 dB over 100% modulation to provide maximum safety and long term stability of the light valve modulator. The input signal is increased 2 dB over 100% modulation by advancing the front panel step pot two steps. Observing the signal at TP4 with a scope, adjust trimpot R84 until the onset of clipping is just noted. This sets the clipping level of the unit.

INPUT METER CALIBRATION

In this step the RA-1712A meter is set to read 100% in the IN meter mode when the modulation level is 100%. Return the step pot to the 0 position, turn the meter switch to the IN position and adjust trimpot R5 so that the meter reads 100%. Verify that the signal level at TP3 is 0 dBm. If it is not, set it for 0 dBm by adjusting the input level and repeat the above procedure.

NOISE REDUCTION OFFSET CALIBRATION

This step adjusts the off set of amplifiers U12 and U14. It is unlikely that the adjustment of the offsets discussed in this paragraph will ever need to be done in the field. Their effect on the operation of the system is very subtle and is not critical. Adjust trimpot R72 so that the voltage observed at TP9 just switches to approximately -12 volts with no input signal in to the RA-1712A (i.e., with the PROGRAM switch in the OFF position. Do not rotate the trimpot to its limits; it should be near midrange. Lift one end of diode D6 from the circuit board. Adjust trimpot R90 for 0 millivolts of offset voltage at TP8 with the PROGRAM switch OFF. Next lift one end of the diode D5 and reinsert diode D6. Adjust trimpot R95 for 0 millivolts offset at TP8, again with the program switch off. After completing this procedure ensure the lifted ends of both diodes have been returned to their proper location and are soldered in position. Readjust trimpot R72 so that the voltage observed at TP9 just switches to -12V and remains there with the PROGRAM switch OFF.

DELAY CALIBRATION

Connect a frequency counter or sweep time calibrated oscilloscope to TP10 and adjust trimpot R106 to yield a 150 kHz square wave. This results in a 25-msec delay in the CCD delay. With a 100% signal at 1 kHz applied as noted on the RA-1712A meter in the IN meter mode, trimpot R119 is adjusted to give -2 dBm signal at TP5. With a scope probe attached to TP6, adjust trimpot R144 so that the two sampled 1 kHz waveforms are positioned directly on top of one another and appear as a single waveform. With a 100% signal applied at 1 kHz adjust trimpot R135 to yield minimum distortion as measured at TP7. This completes the delay calibration.

NOISE REDUCTION CALIBRATION

With a 100% signal applied, adjust trimpot R68 so that the voltage at TP8 just begins to increase. For best results, trimpot R68 should be set just before this increase occurs. Adjust R168 so that the voltage at TP11 is 0 mV. With PROGRAM switch OFF, set trimpot R99 so that the voltage at TP11 is -.790 volts.

NOISE REDUCTION MARGIN ADJUSTMENT

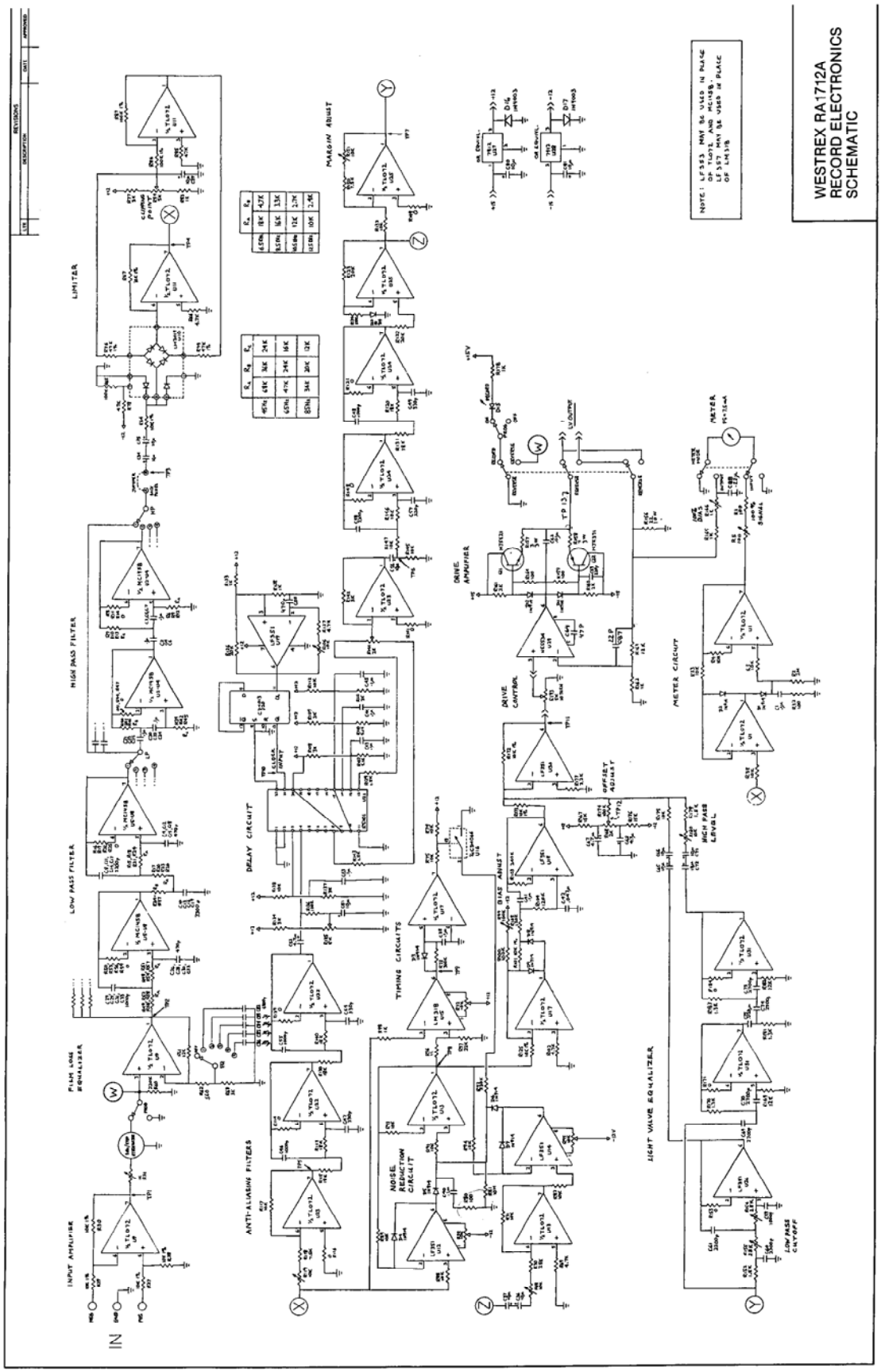
This step adjusts the relative level of the audio and noise reduction signals by adjusting the amount of audio signal summed into the pre-driver amplifier, U30. Connect the scope probe to TP13. Set the scope on DC and have the trace in the center. Turn the PROGRAM switch to OFF and set the POLARITY switch to PLUS. Increase the DRIVE control to achieve a -3.4 VDC deflection. (Be sure zero is the center line.) Now turn the PROGRAM switch to ON and apply a 100% signal at 1 kHz to the RA-1712A. Adjust R168 so that the positive and negative peaks are equal. (DC average voltage is zero.) Now turn the PROGRAM switch OFF and readjust the DRIVE control for a -3.4 VDC deflection. Turn the PROGRAM switch ON again and adjust R151 so that the peak signal levels at TP11 are ±3.8 volts

OUTPUT METER ADJUSTMENT

Turn the PROGRAM switch OFF and turn the DRIVE control to maximum. Set the POLARITY switch to PLUS and set the METER switch to OUT. Adjust trimpot R166 so that the meter reads 100%.

Note: The adjustment of the high frequency resonance circuits comprising amplifiers U26 and U31 are discussed in the manual section on

SCHEMATICS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