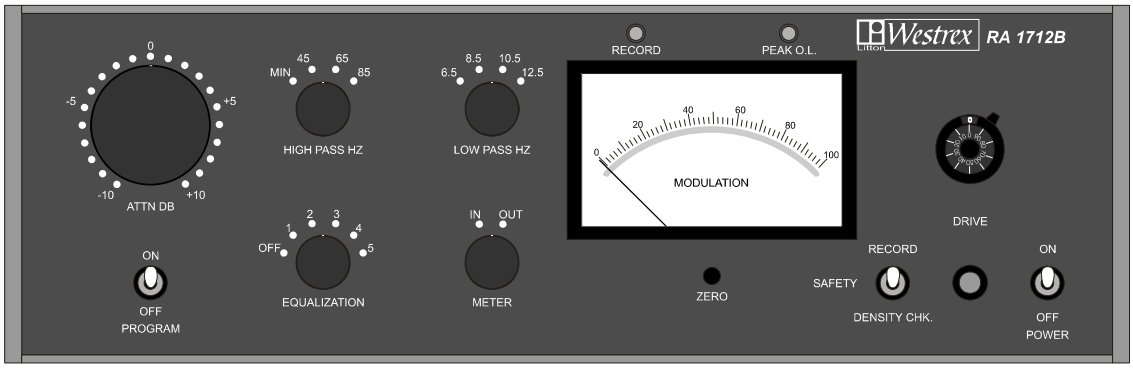
Westrex RA1712B
Optical Sound Track Record Electronics



INTRODUCTION

The Westrex RA-1712b 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 1dB step pot 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 audio 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-1712B 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-1712B. If balanced line input is available (i.e. transformer input), pin 1 of the INPUT connector should be connected to the “water pipe” ground with the balanced input applied between pin 2 (high side) and pin 3 (low side). Pin 3 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-1712B. For operation of the RA-1712B without the RA-1713B auxiliary electronics package, a short BNC cable should be connected between connectors “A” and “B”. (These connectors are used by the RA-1713B to access the filtered and level set signal of the RA-1712B and as a signal injection point for signals from the RA-1713B. The cable loops the signal though).

MODULATOR EQUALIZATION

The RA-1712B has a built in five band modulator graphic equalizer. To equalize the modulator a 50% sine wave signal should be applied to the RA-1712B. The output should be monitored on the optical viewer or by using a PEC monitor. The equalization controls should be adjusted to give a flat response when the input swept from 400Hz to 12.5 kHz. It should be noted that when the arrows on the 2kHz, 4kHz, 6kHz & 8kHz boost/cut trimpots (as labeled on the printed circuit board) are pointing toward the rear that is the zero boost/cut position. Rotating the controls counterclockwise provides cut and rotating the controls clockwise provides boost. The 10kHz trimpot is a boost only control. Counter clockwise is zero boost while rotating clockwise give boost. The f8 (as labeled) trimpot adjusts the center frequency of the 10 kHz filter.

CALIBRATION AND NECESSARY EQUIPMENT

The following equipment is required to calibrate the RA-1712B: A audio signal source whose distortion is less than .05%; a digital voltmeter; a distortion analyzer; an AC voltmeter; oscilloscope and frequency counter. The distortion analyzer must be band limited to 20Hz to 20kHz at its input to eliminate high frequency clock signal feed though. (Note: All measurements made during the calibration of the RA-1712B are made between the stated test point and the RA-1712B ground. A convenient ground is provided as a loop of bare wire labeled GND on the PC board.)

INPUT SIGNAL LEVEL CALIBRATION: Connect a short BNC cable between the connectors labeled “A” and “B” on the back panel. Set the HIGH PASS switch to the MIN position and the LOW PASS switch to the 12.5kHz position. Set the step pot attenuator to the 0 position (the 12 o’clock position) and the METER switch to the IN position. Toggle the PROGRAM switch ON and set the EQUALIZATION switch to the OFF position. Set the modulator switch to SAFETY and toggle POWER switch ON. Adjust R56 (labeled IN LEV on the PC board) to midrange. Apply a 400HZ sine wave signal to the input and adjust the output of the generator so that a +10dBm signal appears at TP2. Adjust R30 (labeled METER IN) for a 100% reading on the front panel meter. Adjust R2 so that the O.L. lamp just comes on.

DELAY & CLIPPER CALIBRATION: Connect a frequency counter or sweep time calibrated scope to TP8 and adjust R62 (labeled CL FREQ) to yield a 150 kHz square wave. This results in a 25-millisecond delay in the CCD delay. Turn R36 (labeled CLIP) fully clockwise. With the 100% signal at 400HZ still applied as noted on the RA-1712B meter in the IN meter mode, adjust R75 (labeled DEL IN) to give 0dBm signal at TP5. With a scope probe attached to TP6, adjust trimpot R98 (labeled BAL) so that the two sampled 400HZ waveforms lay directly on top of one another and appear as a single waveform. Now advance the step pot two steps (i.e. two dB.). The PEAK O.L. lamp should be lit. Adjust R93 to yield minimum distortion as measured at TP7. Return the step pot to the 12 o’clock position. Now with a DC voltmeter attached to TP3 readjust R36 (labeled CLIP) for 7.75 volts. This sets clipping to occur one dB over 100%. This completes the delay calibration and clipper adjustment.

NOISE REDUCTION CALIBRATION: TOGGLE the PROGRAM switch OFF. Adjust R82 (labeled CMP) so that the voltage at TP10 just switches from +15 volts to -15 volts. Toggle the PROGRAM switch ON to verify the 100% input level. Adjust R76 (labeled DEL NR) so that the voltage at TP9 just begins to increase. For best results, R76 should be set just before the increase occurs. Rotate the step pot counterclockwise two steps (i.e. -2dB) and adjust R163 (labeled NR LIM) for .1 volts DC at TP11. Return the step pot to the 12 o’clock position.

MARGIN CALIBRATION: 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, U-24. Set the oscilloscope for 1 volt/div. Connect the scope probe to TP12. Advance the drive control for a 6 volt peak-to-peak signal. Adjust the oscilloscope so that zero volts DC is at the oscilloscope center line. With the oscilloscope in the DC mode adjust R146 (labeled OUTPUT OFFSET) so that the waveform is symmetrical about the centerline (i.e. DC average is zero) for 100% input. Toggle the PROGRAM switch OFF and readjust the DRIVE control for a –3.4 VDC deflection. Toggle the PROGRAM switch back ON and adjust R109 (labeled AUD LEV) so that the peaks are 3.8 volts (7.6 volts peak-to-peak). Toggle the program switch OFF and turn the DRIVE control to maximum. Set the METER switch to the OUT position and adjust R181 (labeled METER OUT) so that the front panel meter reads 100%.

CIRCUIT DESCRIPTION

In the following sections the suffix “L” on U#s will denote pins 2 & 3 as inputs and pin 1 as the output on dual op amps. The “H” suffix will denote pins 5 & 6 as inputs and pin 7 as the output. For example U21H indicates U21 with pin 5 being the non-inverting input, pin 6 the inverting input and pin 7 as the output. The following section will give a description of the circuits used in each of the blocks of the block diagram.

THE INPUT CHAIN BLOCK

Input signals enter the RA-1712B via a three terminal XLR type connector on the back panel. The input is amplified by the balanced differential input amplifier U12H. The output of the amplifier passes through the front panel 20 dB step pot attenuator and to a buffer amplifier comprising the other half of the input amplifier chip U12L. The signal is applied simultaneously to the 4 low pass filters U8 - U11. These filter use a 5 pole design breaking at 6.5kHz, 8.5kHz, 10.5kHz and 12.5kHz. The desired low pass filter output is selected by the low pass front panel select switch. The output of the selected low pass filter is applied to the 3 high pass filters U5-U7. The filters use a 4 pole design breaking at 45, 65 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 5Hz. after passing though the high and low pass filter, the signal passes though equalization amplifier, U4H. The front panel equalization switch associated with the amplifier switches capacitors C92 - C96 to provide from 0 to 10dB high frequency boost at 10 kHz.

The signal is then routed to the BNC connector labeled “B” on the back panel. This is the insertion point for interfacing the RA-1712B with the RA-1713B Auxiliary Electronics package. For use without the RA-1713B, a short BNC cable is connected between connectors marked “A” and “B”, thus looping the signal back into the RA-1712B.

THE CLIPPER BLOCK

The signal returning from the auxiliary electronics loop is hard limited by the current control clipper made of amplifier U3 and IC U2. This circuit provides a symmetrical clipping of the signal if it exceeds the 100% modulation level more than 1dB. The amount over 100% modulation at which clipping occurs is set by pot R36. This circuit prevents serious overdriving of the optical modulator, which results in spurious ringing distortion on the recorded optical sound track. After passing though the clipper the signal branches. One branch goes to the noise reduction circuit and the other branch goes to the audio delay circuit.

THE DELAY BLOCK

Following this path, the signal goes to an adjustable attenuation amplifier, U19H. R75 is used to set the input level to the delay unit. The signal then passes though an anti-aliasing filter, U18H & U17H. The delay uses a 2000 element CCD delay device, U16. Its clock comes from the free running multivibrator, U14 and the 2:1 driver flip-flop, U15. The other half of U17 is used as a buffer amplifier. Its output is fed to the post filters, U18H and U19H. U20L is a distortion correction circuit.

THE NOISE REDUCTION BLOCK

The noise reduction section has two inputs. One is a real time audio input and the other a delayed audio input. The delayed input goes to a gain adjust stage, U20H then to an electronic diode, U21L. The real time input goes to a electronic diode stage, U21H. Both electronic diodes along with a buffer amplifier, U22L comprise a peak follow and hold circuit. The peak value and the current value are compared by comparator, U23. If the stored value is higher than the current value the output will go high. U22H is a part of a retriggerable one shot circuit. Negative edges on its input will trigger the one shot for approximately 25mSec. After the last negative going pulse from U23 the output of U22H goes high 25mS later. This voltage turns on the CMOS switch, U30, which in turn discharges C63 though R113 to the new current peak value. The output of the peak follow & hold circuit goes to a clamp circuit, U29H and a low pass filter U29L. The clamp circuit translates the zero to peak voltage to a new origin where zero volts represents a 100% signal and no input being a negative voltage. R136 sets the endpoint.

THE MODULATOR EQ BLOCK

Once the signal is delayed the signal is amplified by U28H. U28L is used as an unity gain inverter. Both the inverted and original signals are applied across trimpots R118, R119, R120 and R121. The wiper of these boost/cut trimpots feed the input of four bandpass filters; U25H is a 2kHz filter, U26H is a 4kHz filter, U26L is a 6kHz filter and U27H is a 8kHz filter. The outputs of these filters are summed together by U25L. These summed signals are added together with the original signal in amplifier U28L's feedback loop. Depending on the position of the trimpots either boost or cut in each band is effected. The output is then added to a boost only filter, U27L (10kHz band) by the summing amplifier U24H. This filter is not in the feedback loop. R158 is a frequency control for this band. R156 is a frequency control for the 8kHz band.

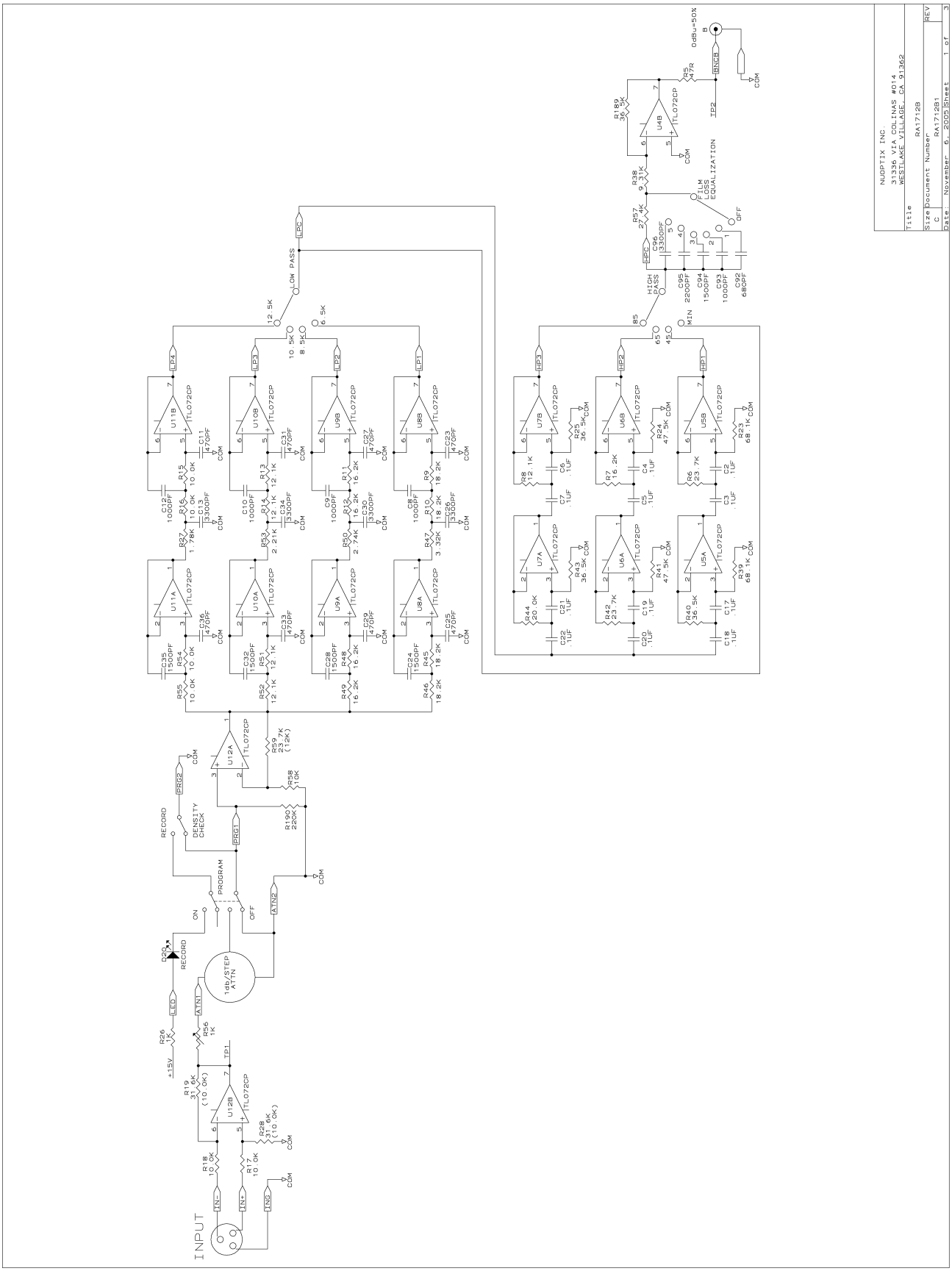
THE SUMMER & MODULATOR DRIVE BLOCK

U24L sums the delay audio signal with the noise reduction signal. It is the last stage before the drive amplifiers. DC current summed in at this point by R146 to compensate for any offset in the previous stages. The output of U24L goes to the front panel drive control pot and the wiper of this control goes to one of the two output amplifiers, U31. The RA-1712B has a differential output. The output of U31 drives one side of the modulator and U32 (a unity gain inverter amplifier) drives the other side of the modulator. The DENSITY CHK switch that precedes the output terminals is used to reverse the polarity of the modulator drive signals. In the DENSITY CHK position the audio signal is shorted to ground in the input chain block at U12L.

THE METER BLOCK

The signal returning from the auxiliary electronics loop goes to U13, a peak follow amplifier circuit. The peak value is stored on C50 which is slowly discharged though R88. The output of this peak follow amplifier goes though R29 and R30 (the 100% calibration trimpot) so that with the METER switch is in the IN the meter mode is connected to the resistors and therefore displays this peak input value. When the switch is set to the OUTPUT mode the meter reads the DC average voltage on the output of U32, the modulator drive amplifier. U1 is a comparator whose output illuminates the PEAK O.L. light emitting diode when the peak follow voltage of the output of U13L exceeds the 100% threshold voltage set at pin 6 of U1H by R2.

SCHEMATICS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10.5K
8.5K
6.5K
HIGH PASS
FILM EQUALIZATION
OFF
MIN
0dBu+50%
RECORD
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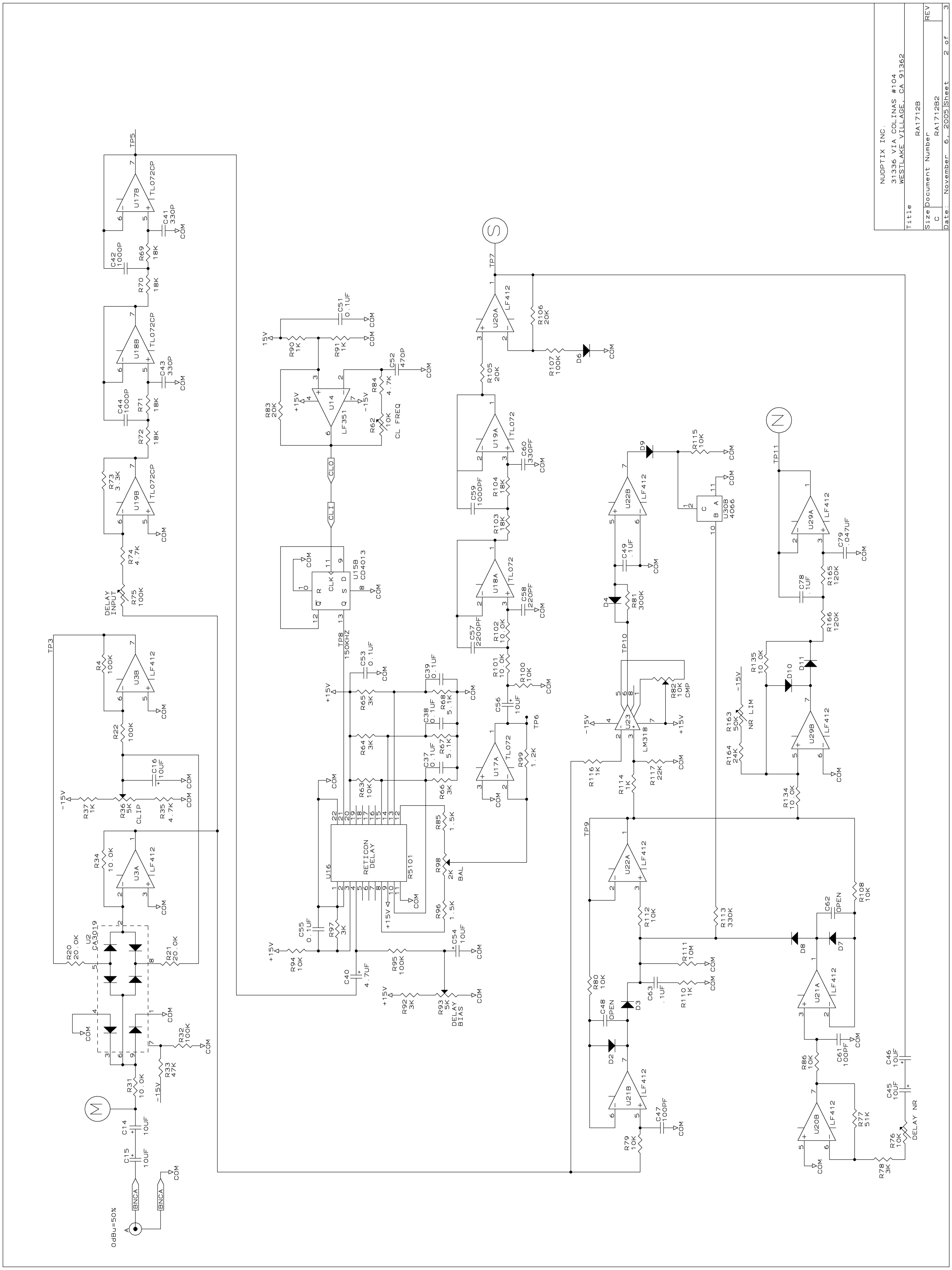
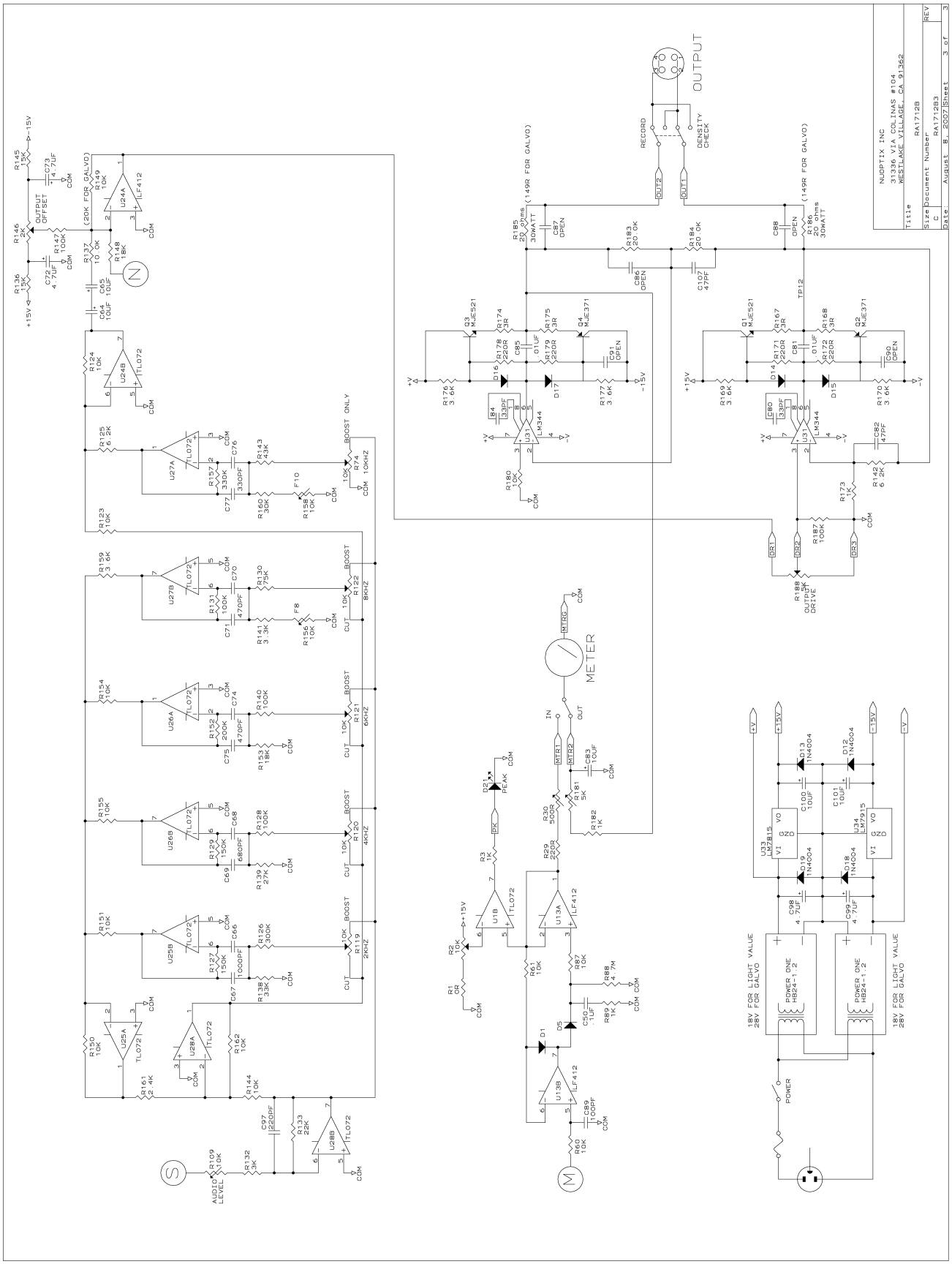
ON
OFF
14b/STEP ATTN
+15V
COM

WESTREX RA-1712B
OPTICAL SOUND TRACK RECORD ELECTRONICS

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POWER ONE HB24-1.2
POWER
AUDIO LEVEL
OUTPUT OFFSET
OUTPUT DRIVE
BOOST ONLY
18V FOR LIGHT VALVE
28V FOR GALVO