INSTRUCTION MANUAL

# MODEL 355

DUAL CHANNEL TAPE RECORDING ELECTRONICS

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INOVONICS INCORPORATED 503-B Vandell Way CAMPBELL, CA 95008

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## SECTION 1.0 GENERAL INFORMATION

The Inovonics 355 is a remarkably compact two-channel magnetic recording and reproducing electronics assembly incorporating a number of performance and convenience features not previously found in one unit. Among these are:

3-speed equalization to accommodate any combination of NAB and IEC characteristics. Low frequency pre-emphasis can be strapped out of any or all positions.

Full remote control of all monitor modes as well as Ready-Safe function; solid state switching of these functions eliminates the contact noise problem associated with signal-handling wafer switches.

Recorded distortion minimized through use of complementary distortion, and biasing signal with very low even-order distortion.

Transients reproduced faithfully due to phase compensation in reproduce and sync amplifiers.

Separate amplifiers for reproduce and sync functions permit optimal alignment of each function.

Hybrid circuitry utilizes both IC's and discrete semiconductors as appropriate to maximize performance of each function.

## 1.1 SPECIFICATIONS

NOTE: Performance of a tape recording system will depend on the heads and tape used. The specifications below are based on a system utilizing a head complement of Nortronics 9227 erase, 9203 record, and 9213 reproduce, with 3M 206 tape used at an operating level of 200 nW/m, with 70-80 mil tracks, typical of 2-, 4-, 8-, and 16-track formats.

Frequency Response:

| | | OVERALL | SYNC |
|---|---|---|---|
| 30 ips | ±2dB | 60-20k | 60-15k |
| 15 ips | ±2dB | 35-20k | 40-15K |
| 7½ ips | ±2dB | 30-15k | 40-7.5k |

Signal-to-Noise Ratio (referred to 6dB above 200 nW/m) see 1.1.1

| | OVERALL | | SYNC | | STANDBY | |
|---|---|---|---|---|---|---|
| | unwtd | wtd | unwtd | wtd | unwtd | wtd |
| 30 ips | -62 | -71 | -62 | -72 | -72 | -83 |
| 7½-15 ips | -61 | -67 | -61 | -70 | -69 | -78 |

Erase/Bias Frequency

**250 kHz (100 kHz optional)**

Erasure

>75dB reduction in 500 Hz signal recorded 3dB below saturation

Recorded Distortion

(LIN and NOISE BAL controls optimized, 3M 206 tape)
<.1% THD at operating level
<1% THD 6dB above operating level

Amplifier Distortion and Headroom

Record (15 ips pre-emphasis)

<.1% THD 50-10k Hz at operating level
<.2% THD 50-10k Hz 25 dB above operating level
Clipping level >28dB above operating level

Reproduce

<.1% THD 50-10k Hz at operating level
<.2% THD 50-10kHz 15dB above operating level
Clipping level +24dBm

Inputs

Sensitivity: -20 to +8dBm
Impedance: 10k, unbalanced (transformer optional)

Outputs

Line Output: feeds 600 ohm unbalanced line, terminated or unterminated, at +4 or +8dBm for zero VU.
Headphones: Rear panel jack

Power Requirements

±20V dc, 400mA: 250kHz, 1V rms

Dimensions

3½" x 19" x 9"

Weight

12 pounds

1.1.1 This level is approximately that "peak record level" to which recorder specifications are generally referred. S/N Ratio with respect to 3% 3rd harmonic point of unlinearized 3M 206 tape is approximately 2dB better than these figures.

## SECTION 2.0 INSTALLATION

2.1 Upon receipt of the equipment, inspect it for shipping damage. If any is found, notify the carrier at once; if not, proceed as follows.

2.2 The 355 Recording Electronics is packaged to mount in a standard 19 inch rack, requiring only 3½ inches of rack space per pair of channels. It may be powered by either the Model 900 Power Supply (also in a 3½-inch rack mount chassis), or by the Model 910 Power Supply of higher capacity (8-24 channels) designed for remote mounting - such as under the tape transport. Because of the modest space requirements of this system, there will generally be excess rack or console space for mounting it; when this is true, it is advantageous to space the Power Supply away from the transport and Recording Electronics to minimize the possibility of hum pickup.

2.3 As not all tape transports incorporate a master power switch, record button, and equalization switch, the Model 900 is supplied with various options to provide these facilities as necessary. Either Power Supply comes with suitable cabling for interconnecting it with the tape transport and 355(s).

2.4 As delivered, unless supplied otherwise to special order, this equipment is properly aligned for use with 3M 206 tape at an operating level of 200 nW/m, and a head complement consisting of Nortronics 9227 Erase (½mHy), 9204 Record (4 mHy), and 9213 Reproduce (400 mHy). If heads of considerably different characteristics are to be used, make the following alterations before final adjustment:

2.4.1 Low Impedance Reproduce Head - If reproduce heads to be used are of low inductance (3-5 mHy), rearrange input jumpers on the Reproduce cards to match those on the Sync cards as delivered, and remove R1 on each Reproduce card.

2.4.2 Erase Head - If erase head inductance is less than ½ mHy, move jumper connecting terminal H to 1 so that it bridges H and 2. If using any head but a Nortronics 9227 or equivalent, select a value for C 13 such as to resonate the erase head at 250 kHz, as outlined in paragraph 4.1.4.1.

2.5 Remote control of transport functions is effected according to the transport manufacturer's instructions. If it is desired to control remotely any or all of the recording and monitor functions of the 355, this may be done through the 24-pin Micro-ribbon connector on the rear apron, using as much of Remote Control Schematic as needed for the functions desired.

2.6 If it is desired to operate into a +8 dBm line, remove the jumper across R 18 on each Line Amplifier card and recalibrate as described in paragraph 4.1.2.7.

2.7 No line termination switch is provided or necessary. Transformer resistance will result in a slight drop in level when the line is terminated in 600 ohms; the equipment should be connected to its normal load before final calibration.

## SECTION 3.0 OPERATION AND FUNCTIONAL DESCRIPTION

### 3.1 Operation

3.1.1 The operating controls and mode indicating lamps for each channel are grouped together with the corresponding level meter: A to the left. Similarly, the left four cards behind the cover panel are those of Channel A.

3.1.2 The controls labeled RECORD and REPRO are the record level and reproduce level controls. They are provided with sufficient range to record from a -20 dBm line, and to produce normal line output from a tape which was under-recorded by 10 dB. Both are provided with CAL positions, consisting of a switch at extreme counterclockwise rotation, so that the convenience of these controls is not compromised by having their use upset machine calibration.

3.1.3 The MODE switch determines whether the line OUTPUT connector will derive its signal from the Sync (Record) Head, the Reproduce Head, or the incoming signal, and whether that channel can be placed in record mode; or whether all these functions are transferred to remote control.

3.1.4 Power Supply interconnections are made so that power and equalization switching and record mode selection are accomplished by the corresponding controls on the tape transport. Where the transport lacks any of these controls, they are provided on the Model 900 Power Supply panel.

## 3.2 Circuit Descriptions

### 3.2.1. Erase-Bias Amplifier

In the Model 355 Recording Electronics, the source of erase/bias signal for all channels of a system is an oscillator circuit on the Power Supply Regulator card. Each channel has an amplifier to raise the 1-volt "pilot" signal to the power level required to drive the erase and record heads.

The oscillator signal is applied to the base of Q1, which, with Q2 forms an emitter-coupled phase inverter. Signals at the collectors of Q1 and Q2, therefore, are out of phase as applied to the bases of Q3 and Q4, the push-pull output drivers. The primary of transformer T1 forms a tuned collector load for Q3 and Q4, in conjuction with capacitor C5. ERASE control, R8, a common emitter resistor for the output driver transistors, determines the operating current of Q3 and Q4, and provides an adjustment of erase drive.

The secondary of T1 is tapped to accommodate the drive requirements of erase heads of various inductances. The proper tap is selected by straps on the circuit board. C12 and L1 comprise a series resonant circuit to reduce harmonic components in the bias waveform. Also, the erase head itself is resonated at the operating frequency with C13.

Slow buildup and decay of the erase/bias waveform, essential to noise-free "punch-in's" is effected by the Miller integrator formed by Q5, Q6, and C9. The action of this circuit is to apply and remove DC power to the amplifier output stages with a buildup and decay of approximately 0.1 second.

A bias trap, consisting of L2-C15, C11, and L3-C16, is included to keep bias voltage from overloading the Record Amplifier in the RECORD mode, or the Sync Amplifier in SYNC playback. An additional trap section, using L4, is included in cards for use with 100 kHz bias frequency.

### 3.2.2 Record Amplifier

An input signal to the Record Amplifier card first passes through the REC GAIN control and into a 30 kHz active low-pass filter. This filter, consisting of R2-C2, R3-C3, and IC 1, removes RF and other spurious signals outside the audio band which otherwise could cause high-frequency overloading

during recording. The signal then passes through the high frequency equalizer consisting of R8 and C5, C6, or C7, depending upon the operating speed. The signal is routed to the appropriate variable capacitor by the application of +20 volts on the control lead of the associated FET switch, Q1, Q2, or Q3.

Integrated circuit IC2 performs three functions. First it provides voltage gain to the now attenuated and equalized input signal. Secondly, it provides the NAB low frequency pre-emphasis (defeatable by a fourth FET switch, Q4). Finally, IC2 has incorporated within its feedback loop, a non-linear network consisting of diodes CR1 and CR2. In conjuction with the LIN control, R23, a non-linear characteristic may be imparted to the signal which will cancel a major portion of the third harmonic generated by the tape.

The signal is then fed to IC3, a constant-current-source output stage. A switching circuit consisting of Q5 and relay K1 connects the record head either to the output of IC3, in the RECORD mode, or the Sync Amplifier in the SYNC playback mode. The NOISE BAL control, R34, permits introduction of a small DC offset to the record head for the purpose of nulling any second harmonic distortion which may appear in the recorded signal as result of magnetic fields near the record head.

3.2.3 Reproduce/Sync Amplifier

The Inovonics 355 utilizes two separate but identical amplifiers for normal reproduce and sync playback.

Transformer T1 is always used in SYNC playback and is used in normal reproduce when low impedance heads are employed. A series of straps on the board permits T1 to be bypassed for high impedance reproduce heads. Resistor R1, directly across the amplifier input, may be used to damp the LC resonance of the cable and head when high impedance heads are connected.

Transistors Q1 and Q2 with their associated components constitute a low-noise input amplifier. An emitter follower, Q3, isolates the low-current input stages from their load. FET'S Q4, Q5, and Q6 switch the proper equalization network into the input amplifier feedback loop for the selected speed. When an equalization control lead is connected to +20 Volts, the associated equalization components are connected into the circuit.

Integrated circuit IC1, capacitor C11, and PHASE COMP control R29 form a phase compensation circuit which may be used to correct for phase shift during the recording process by introducing a complementary shift in phase between high and low frequency components of the reproduced signal.

3.2.4 Line Amplifier

The line amplifier receives signals from the Reproduce Amplifier (TAPE monitor), the Sync Amplifier (SYNC monitor), and the Record Amplifier (INPUT monitor). FET switches Q1, Q2, and Q3 direct the selected signal to the line amplifier input when the proper control lead is grounded, either by the front panel MODE switch or through the Remote Control connector.

Integrated circuit IC1 performs the voltage gain function of the line amplifier. Transistors Q4, Q5 and their associated components provide the output current required for driving low impedance loads and long cables. Protection from output short circuits is afforded by diodes CR2 and CR3.

Transformers T1 and T2 (chassis-mounted) provide output isolation. These units have a near-unity ratio, and can be removed from the circuit, if desired, with no loss in performance.

3.2.5 Bias Oscillator and Power Supply Regulator

This card contains two separate sections; the bias oscillator which feeds the system Erase/Bias Amplifiers, and the +20 and -20 volt power supplies.

Transistors Q1 and Q3 provide the voltage amplification required to sustain oscillation of the Bias Oscillator circuit. Q4 and Q5 supply current for driving as many as 24 individual channel amplifiers. The resonant circuit L1-C1 determines the operation frequency. Transistor Q6 and associated components constitute a gated current source to supply the proper amount of positive feedback to the amplifier input and provide and AGC function to maintain constant output amplitude.

Transistor Q2 limits current to the amplifier and protects the output stages in the event of an output short circuit.

Type 723 integrated circuits are employed as both positive and negative voltage regulators. Aside from precision voltage dividers which determine the supply voltage, positive regulator IC1 requires only Q7 and a chassis-mounted power device to form a high-current series regulator.

The negative supply includes Q8 for output short circuit protection; otherwise, it is an inverted version of the positive regulator. Q9 and a chassis-mounted power device complete the high-current negative supply.

## SECTION 4.0 ALIGNMENT AND CALIBRATION

### 4.1 ROUTINE CALIBRATION

#### 4.1.1 EQUIPMENT REQUIRED:

Head demagnetizer
Appropriate Reproducer Alignment Tapes
Audio Oscillator
AC Voltmeter

#### 4.1.2 REPRODUCE

4.1.2.1 Place MODE switch in INPUT position. Clean and demagnetize all heads, moving very slowly while demagnetizer is near heads and withdrawing it about a yard from head assembly before unplugging it.

4.1.2.2 Place MODE switches in SAFE-TAPE position and thread appropriate Alignment Tape.

4.1.2.3 While reproducing the high frequency on the tape, adjust reproduce head azimuth for maximum output.

In the event that reproduce gaps in multitrack heads are not perfectly co-linear, the peaks for the various channels will not quite coincide. More than ½ dB of such error is cause for rejection of the head, but the following technique may be used to set azimuth where some gap alignment problem exists, or where a particularly critical adjustment is desired:

> Connect the two edge tracks to the vertical and horizontal inputs of an oscilloscope and adjust azimuth for minimum phase shift (closest to a straight diagonal line) at a moderately short wavelength (5-10 kHz at 15 ips).

In the case of fixed base heads, accuracy of azimuth can be checked roughly by reproducing the highest frequency tone and skewing the tape slightly just before it crosses the reproduce head. If head contact and tape tension are correct, an increase in output indicates azimuth error.

4.1.2.4 If the resonance of the reproduce head and its cable is near the top of the passband (as is usually the case for best signal-to-noise performance), a peak in response will be observed at the

highest frequencies. RI on the Reproduce Amplifier cards is provided to damp the resonance. To determine whether its value is correct for the head used, set High Speed H.F. control so that 5 kHz playback is flat with respect to the reference frequency tone on the Alignment Tape. Note response at the highest frequencies, and raise the value of RI to increase, or lower to decrease this output. If a low impedance reproduce head is used, the RI supplied should be removed when the input jumpers are restrapped (as described in paragraph 2.4.1.), and replaced with a new value, determined as above, if necessary.

4.1.2.5 Now set H.F. control for smoothest response from reference frequency to highest frequency. The L.F. control should not be disturbed; it will be trimmed if necessary as described in paragraph 4.1.5.4.

4.1.2.6 Repeat step 4.1.2.5 for remaining speeds to be used. It is advisable to recheck azimuth at the lowest speed in use unless the phase coincidence method was used initially.

4.1.2.7 Turn REPRO level control fully ccw to CAL position, and adjust R34 PB GAIN control for an indication of zero VU when reproducing a reference tone recorded to the desired operating level. If it is wished to operate into a +8dBm line, cut the jumper nearest Q4 on each Line Amplifier before making this adjustment.

4.1.2.8 The PHASE COMP control, R29, should not be disturbed except in accordance with the instructions in paragraph 4.2.4.

4.1.3 SYNC

4.1.3.1 Place MODE switches in SYNC position and perform steps 4.1.2.3 - 4.1.2.7 as above, with record head and Sync card.

4.1.4 ERASE/BIAS

4.1.4.1 The value of C13 on the Erase/Bias cards must match the inductance of the erase head used. This is checked as follows:

> Put the system in record mode (it is not necessary to pull tape, however). Connect an AC voltmeter across the Erase (red) and Ground (black) terminals on the rear apron. It should be possible to observe a peak in the meter reading as C5 TUNE is adjusted through its range. If C5 cannot be loosened sufficiently to

achieve a peak in output, decrease C13, and vice versa. If erase head inductance is known to be less than 1/2 mHy, move 1-H strap on all Erase/Bias cards to 2-H. See table at the end of this section for C13 values to match commonly used heads.

NOTE: C5 control is omitted on units supplied for 100 kHz Erase/Bias operation. In this case, the proper choice of C13 provides optimum amplifier tuning.

4.1.4.2 Set R8 ERASE drive so that the voltage measured at the ERASE terminal is in accordance with the table at the end of this section. Consult Inovonics for proper figure to be used with non-standard heads.

4.1.4.3 Place MODE switches in READY-TAPE position and thread transport with a good sample of the type of tape to be used subsequently. Connect an audio oscillator to one or both INPUT connectors and proceed as follows:

A conventional way to set bias is to record a signal of 1 kHz at 15 ips at or just below operating level, and set R13 BIAS control for maximum reproduced signal.

A more precise and repeatable method is to set and bias for a certain amount of reduction in output at a short wavelength: however, the particular amount of reduction will depend on the tape used.

4.1.5 RECORD

4.1.5.1 With conditions as for 4.1.4.3 above, place recorder in Record mode at 15 ips and set the input signal to 700 Hz at +4 dBm (+8 dBm if reproduce was calibrated for this level).

4.1.5.2 Raise the frequency to 20 kHz and adjust record head azimuth for maximum output (if Sync adjustment has been performed, it should already be correctly set).

4.1.5.3 Set record pre-emphasis by adjusting appropriate EQ capacitor (C6 or C7) for smoothest response from reference frequency (500 to 1000 Hz) up.

4.1.5.4 At this point, the corresponding L.F. control on the Reproduce cards may be set for flattest overall response.

4.1.5.5 Set equalization for the remaining speeds to be used. For speeds below 15 ips, set REPRO level control fully cw, and readjust input level or RECORD level control for convenient reading on the meters.

4.1.5.6 If suitable distortion measuring equipment is available, and it is desired to optimize the linearization control, proceed to paragraph 4.2.2.

4.1.5.7 Switch RECORD level control fully ccw to CAL position. With input of same frequency as the reference tone on the Reproducer Alignment Tape and at normal line level, set RI REC GAIN controls for an indication of zero VU in each channel.

4.1.5.8 Place MODE switches in READY-INPUT position and adjust R7 REC CAL controls for an indication of zero VU in each channel.

4.1.5.9 (See also 4.2.3) Remove input signal, place MODE switches in READY-TAPE position, and go into record mode. Monitoring each channel OUTPUT in turn at high, adjust R34 NOISE BAL control for minimum noise in the corresponding channel.

4.2 Specialized Ajustments

The following adjustments require specialized test equipment, and once made for a given combination of heads and tape should not require further attention until a change is made in one or both. They should be made at the primary tape speed, i.e., the one at which it is most important to optimize performance.

Should the required test equipment not be available, do not attempt to make those adjustments, except as described by 4.1.5.9.

4.2.1 Equipment Required:

Wave Analyzer (Quantec 303)
Square Wave Generator
Audio Oscillator

4.2.2 Linearization Adjustment

Place the MODE switches in READY-TAPE position. Feed INPUT connectors with a clean sine-wave signal of 1 kHz at a level such as to generate a recording at operating level. Set Wave Analyzer to 3 kHz, with sufficient bandwidth to obtain a steady reading. Adjust R23 LIN control of each channel for minimum reading on Analyzer.

4.2.3 Second Harmonic Null

The Wave Analyzer provides a means of adjusting the NOISE BAL controls far more accurately than subjective noise does. Set controls as above. Set Analyzer at 2 kHz and adjust NOISE BAL control to null indication on Analyzer. (Heads must be completely demagnetized if this adjustment is to be made correctly.)

4.2.4 Phase Compensation

Feed INPUTs with square wave generator set to 3 kHz at approximately normal operating level. Observing output on the oscilloscope, adjust R29 PHASE COMP controls on Reproduce cards for best approximation of input signal shape. Rewind this section of tape, place MODE switches in SYNC position, and repeat for PHASE COMP control on each SYNC card.

## SECTION 5.0 SERVICE NOTES

5.1 P.C. Card Removal - The Reproduce/Sync, Record, and Erase/Bias Amplifier Cards are provided with a dummy terminal post near the lower edge of the card. A small screwdriver or nut driver may be used to pry the card free of its connector by these terminals. The line amplifier cards are retained by the same 10-32 studs which make connection to the meters.

5.2 Meter Lamps - The meters are illuminated by #388 lamps, which are operated well below their design voltage. In the event it becomes necessary to replace one, remove the top cover and the Line Amplifier card. The 3/16" threaded spacers which serves as nuts for the lamp sockets may then be removed with a nut driver.

> NOTE: The meter lamps for Channel A are driven from the -20v supply, and those for Channel B from the +20v supply, providing a front panel indication in case of power supply failure.

| SCHEMATIC REF. NO. | PART NUMBER | DESCRIPTION | MFG. | MANUFACTURER PART NUMBER |
|---|---|---|---|---|
| | 105400D | Erase & Bias Amplifier PCB Assembly, 250 kHz | | |
| C 1 | 0806 | Capacitor, 47 pF, mica | Elmenco | DM15-470J |
| C 2,3 | 0862 | " 0.01 uF, 100V | Sprague | 225P10391 |
| C 4,7,8,9 | 0867 | " 0.1 uF, 100V | Sprague | 225P10491 |
| C 5 | 1012 | " , Variable, 390-1400 pF | Elmenco | 4615 |
| C 6 | 0821 | " 820 pF, mica | Elmenco | DM19-821J |
| C 10 | 0870 | " 0.47 uF, 200V | Sprague | 225P47492 |
| C 11 | 0818 | " 470 pF, mica | Elmenco | DM19-471J |
| C 12,15,16 | 0828 | " 750 pF, mica | Elmenco | DM19-751J |
| C 13 | | " Selected Value | | |
| C 14 | 0827 | " 300 pF, mica | Elmenco | DM15-301J |
| CR 1-4 | 1100 | Diode, Silicon, 1N4009 | Fairchild | |
| L 1 | 1400 | Inductor, 560 uH | Delevan | 2500-16 |
| L 2,3 | 1401 | " , Sheilded, 560 uH | Nytronics | SWD 560 |
| Q 1,2 | 1204 | Transistor, 2N3567 | National | |
| Q 3,4 | 1200 | " 2N2102 | RCA | |
| Q 5 | 1205 | " 2N3645 | National | |
| Q 6 | 1212 | " 40319 | RCA | |
| R 1, 4,10 | 0161 | Resistor, ¼W, 10%, 1k | | |
| R 3 | 0153 | " " " 220 ohms | | |
| R 5,2 | 0059 | " " 5%, 910 ohms | | |
| R 6 | 0083 | " " " 10k | | |
| R 7 | 0089 | " " " 20k | | |
| R 8 | 0504 | " , Variable, 100 ohms | Helipot | 89PR100 |

| SCHEMATIC REF. NO. | PART NUMBER | DESCRIPTION | MFG. | MANUFACTURER PART NUMBER |
|---|---|---|---|---|
| R 9 | 0360 | Resistor, ½W, 10%, 10 ohms | | |
| R 11 | 0178 | " " " 27k | | |
| R 12 | 0080 | " " 5% 7.5k | | |
| R 13 | 0511 | " Variable, 50k | Helipot | 89PR50K |
| T 1 | 105600B | Transformer, Bias | | |
| | 105401 C | Erase & Bias Amplifier PCB Assembly, 100 kHz<br>SAME AS ABOVE EXCEPT: | | |
| C 5 | | Omitted | | |
| C 6 | 0862 | Capacitor, 0.01 uF, 100V | Sprague | 225P10391 |
| C 11 | 0837 | " 1100 pF mica | Elmenco | DM19-112J |
| C 12,15,16 | 0834 | " 2700 pF, mica | Elmenco | DM19-272J |
| L 1 | 1403 | Inductor, 1 mHy | Delevan | 2500-28 |
| L 2,3 | 1404 | " 1 mHy, shielded | Nytronics | SWD-1000 |
| L 4 | 1406 | " 2.4 mHy | Delevan | 2500-46 |
| | 105200 D | Record Amplifier PCB Assembly 7 1/2-15-30ips | | |
| C 1 | 0904 | Capacitor, 25 uF, 25 V | Sprague | TE 1207 |
| C 2 | 0827 | " 300 pF, mica | Elmenco | DM15-301J |
| C 3 | 0812 | " 150 pF, mica | Elmenco | DM15-151J |
| C 4,12,18 | 0801 | " 10 pF, mica | Elmenco | DM15-100J |
| C 5,6 | 1004 | " , Variable, 37-250 pF | Elmenco | 426 |
| C 7 | 1007 | " , Variable, 170-600 pF | Elmenco | 4213 |
| C 8-10,14,19 | 0867 | " 0.1 uF, 100 V | Sprague | 225P10491 |
| C 11 | 0810 | " 100 pF, mica | Elmenco | DM15-101J |
| C 13 | 0871 | " 0.056 uF, 100 V | Sprague | 225P56391 |

| SCHEMATIC REF. NO. | PART NUMBER | DESCRIPTION | MFG. | MANUFACTURER PART NUMBER |
|---|---|---|---|---|
| C 15 | 0831 | Capacitor, 510 pF, mica | Elmenco | DM19-511J |
| C 16 | 0905 | " 50 uF, 3 V | Sprague | TE 1058 |
| C 17,20 | 0901 | " 5 uF, 25 V | Sprague | TE 1202 |
| CR 1-4 | 1100 | Diode, Silicon, 1N4009 | Fairchild | |
| CR 5 | 1102 | " , Zener, 15 V, 20% | Motorola | 1N5245 |
| IC 1,2,3 | 1300 | Integrated Circuit, Type 748 | Signetics | 5748V |
| K 1 | 1904 | Relay, SPDT, 12V DIP | Sigma | 191TE1C1-12G |
| Q 1-5 | 1211 | Transistor, F.E.T., MPF 111 | Motorola | |
| Q 6 | 1205 | " 2N3645 | National | |
| R 1,7,34 | 0510 | Resistor, Variable, 10k | Helipot | 89PR10K |
| R 2,3,5 | 0175 | " , ¼W, 10%, 15k | | |
| R 4,27 | 0070 | " " 5%, 3k | | |
| R 6,28 | 0173 | " " 10% 10k | | |
| R 8,14-19,21, 26 | 0185 | " " " 100k | | |
| R 9 | 0167 | " " " 3.3k | | |
| R 10-12,20,41 | 0189 | " " " 220k | | |
| R 13 | 0080 | " " 5% 7.5k | | |
| R 22 | 0105 | " " " 91k | | |
| R 23 | 0508 | " , Variable, 2k | Helipot | 89PR2K |
| R 24 | 0186 | " , ¼W, 10%, 56k | | |

| SCHEMATIC REF. NO. | PART NUMBER | DESCRIPTION | MFG. | MANUFACTURER PART NUMBER |
|---|---|---|---|---|
| R 25 | 0101 | Resistor, ¼W, 5%, 62K | | |
| R 29,30,32 | 0083 | " " " 10K | | |
| R 31 | 0082 | " " " 9.1K | | |
| R 33,40 | 0161 | " " 10% 1K | | |
| R 35 | 0191 | " " " 330K | | |
| R 36 | 0197 | " " " 1 meg | | |
| R 37 | 0379 | " ½W, 10%, 390 ohms (not used with 24V K1) | | |
| R 38 | 0171 | " ¼W, 10%, 6.8K | | |
| R 39 | 0177 | " " " 22K | | |
| | 105201D | Record Amplifier PCB Assembly 3 3/4-7 ½-15 ips | | |
| | | SAME AS ABOVE EXCEPT: | | |
| C 6 | 1007 | Capacitor, Variable, 170-600pF | Elmenco | 4213 |
| C 21 | 0816 | " 330 pF, mica | Elmenco | DM15-331J |
| | 105300D | Reproduce/Sync Amplifier PCB Assembly | | |
| C 1 | 0904 | Capacitor, 25 uF, 25V | Sprague | TE 1207 |
| C 2 | 0810 | " 100 pF, mica | Elmenco | DM15-101J |
| C 3 | 0906 | " 100 uF, 3 V | Sprague | TE 1059,5 |
| C 4,5,6 | 0862 | " 0.01 uF, 100 V | Sprague | 225P10391 |
| C 7,8,9 | 0867 | " 0.1 uF, 100 V | Sprague | 225P10491 |
| C 10,12 | 0801 | " 10 pF, mica | Elmenco | DM15-100J |
| C 11 | 0820 | " 680 pF, mica | Elmenco | DM19-681J |
| C 13 | 0901 | " 5 uF, 25 V | Sprague | TE 1202 |
| CR 1 | 1100 | Diode, Silicon, 1N4009 | Fairchild | |
| IC 1,2 | 1300 | Integrated Circuit, Type 748 | Signetics | 5748V |

| SCHEMATIC REF. NO. | PART NUMBER | DESCRIPTION | MFG. | MANUFACTURER PART NUMBER |
|---|---|---|---|---|
| Q 1,3 | 1210 | Transistor, SE 4010 | National | |
| Q 2 | 1205 | " 2N3645 | National | |
| Q 4,5,6 | 1211 | " F.E.T., MPF 111 | Motorola | |
| R 1 | | Resistor, ¼W, 10% (Selected Value) | | |
| R 2 | 0151 | " " " 150 ohms | | |
| R 3 | 0192 | " " " 390k | | |
| R 4 | 0161 | " " " 1k | | |
| R 5 | 0153 | " " " 220 ohms | | |
| R 6,7, 34 | 0510 | " , Variable, 10K | Helipot | 89PR10K |
| R 8 | 0511 | " " 20K | Helipot | 89PR20K |
| R 9,20,21,35 | 0173 | " ¼W, 10%, 10K | | |
| R 10,15 | 0169 | " " " 4.7K | | |
| R 11 | 0112 | " " 5% 200K | | |
| R 12,13,14 | 0519 | " , Variable, 2 meg | Helipot | 89PR2meg |
| R 16 | 0196 | " ¼W, 10%, 820K | | |
| R 17,18,19 | 0189 | " " " 220K | | |
| R 22-24,26-28 | 0185 | " " " 100K | | |
| R 25 | 0055 | " " 5%, 620 ohms | | |
| R 29 | 0514 | " , Variable, 100K | Helipot | 89PR100K |
| R 30 | 0149 | " ¼W, 10%, 100 ohms | | |
| R 31 | 0073 | " " 5%, 3.9K | | |
| R 32 | 0070 | " " " 3K | | |
| R 33 | 0076 | " " " 5.1K | | |
| T 1 | 1500 | Transformer, Head matching | | |

| SCHEMATIC REF. NO. | PART NUMBER | DESCRIPTION | MFG. | MANUFACTURER PART NUMBER |
|---|---|---|---|---|
| | 105100D | Line Amplifier PCB Assembly | | |
| C 1,2,3 | 0867 | Capacitor, 0.1 uF, 100 V | Sprague | 225P10491 |
| C 4 | 0901 | " 5 uF, 25 V | Sprague | TE 1202 |
| C 5,6 | 0801 | " 10 pF, mica | Elmenco | DM15-100J |
| CR 1-4 | 1100 | Diode, Silicon, 1N4009 | Fairchild | |
| IC 1 | 1300 | Integrated Circuit, Type 748 | Signetics | 5748V |
| Q 1,2,3 | 1211 | Transistor, F.E.T., MPF 111 | Motorola | |
| Q 4 | 1204 | " 2N3567 | National | |
| Q 5 | 1205 | " 2N3645 | National | |
| R 1,2,3 | 0189 | Resistor, ¼W, 10%, 220k | | |
| R 4-10 | 0185 | " " " 100k | | |
| R 11 | 0173 | " " " 10k | | |
| R 12 | 0187 | " " " 150k | | |
| R 13,14 | 0168 | " " " 3.9k | | |
| R 15,16 | 0137 | " " " 10 ohms | | |
| R 17 | 0068 | " " 5% 2.4K | | |
| R 18 | 0072 | " " " 3.6K | | |
| R 19 | 0157 | " " 10% 470 ohms | | |
| R 20,21,22 | 0169 | " " " 4.7K | | |

| SCHEMATIC REF. NO. | PART NUMBER | DESCRIPTION | MFG. | MANUFACTURER PART NUMBER |
|---|---|---|---|---|
| | | Chassis | | |
| I 1,3 | 2001 | Indicator Lamp, "Record" | Dialco | 507-3917-1431-60C |
| I 2,4 | 2002 | " " "Ready" | Dialco | 507-3917-1433-60C |
| | 1711 | Socket for above | Eldema | Q-082-2K |
| I 5,6,7,8 | 2000 | Lamp, Meter illuminating | Chicago Min | #388 |
| M 1,2 | 2800 | Meter, VU | Modutec | 2BA-AVU-00-AB-KW/BA1 |
| R 1,2,9,10 | 0137 | Resistor, ¼W, 10%, 10 ohms | | |
| R 3,5,11,13 | 0600 | " , Variable, 100k | A-B | JA1N200P-104-AA |
| R 4,8,12,16 | 0177 | " ¼W, 10%, 22k | | |
| R6,14 | 0181 | " " " 47k | | |
| R 7,15 | 0185 | " " " 100k | | |
| S 5,6 | 1800 | Switch, Rotary, "MODE" | Centralab | PSA-208 |

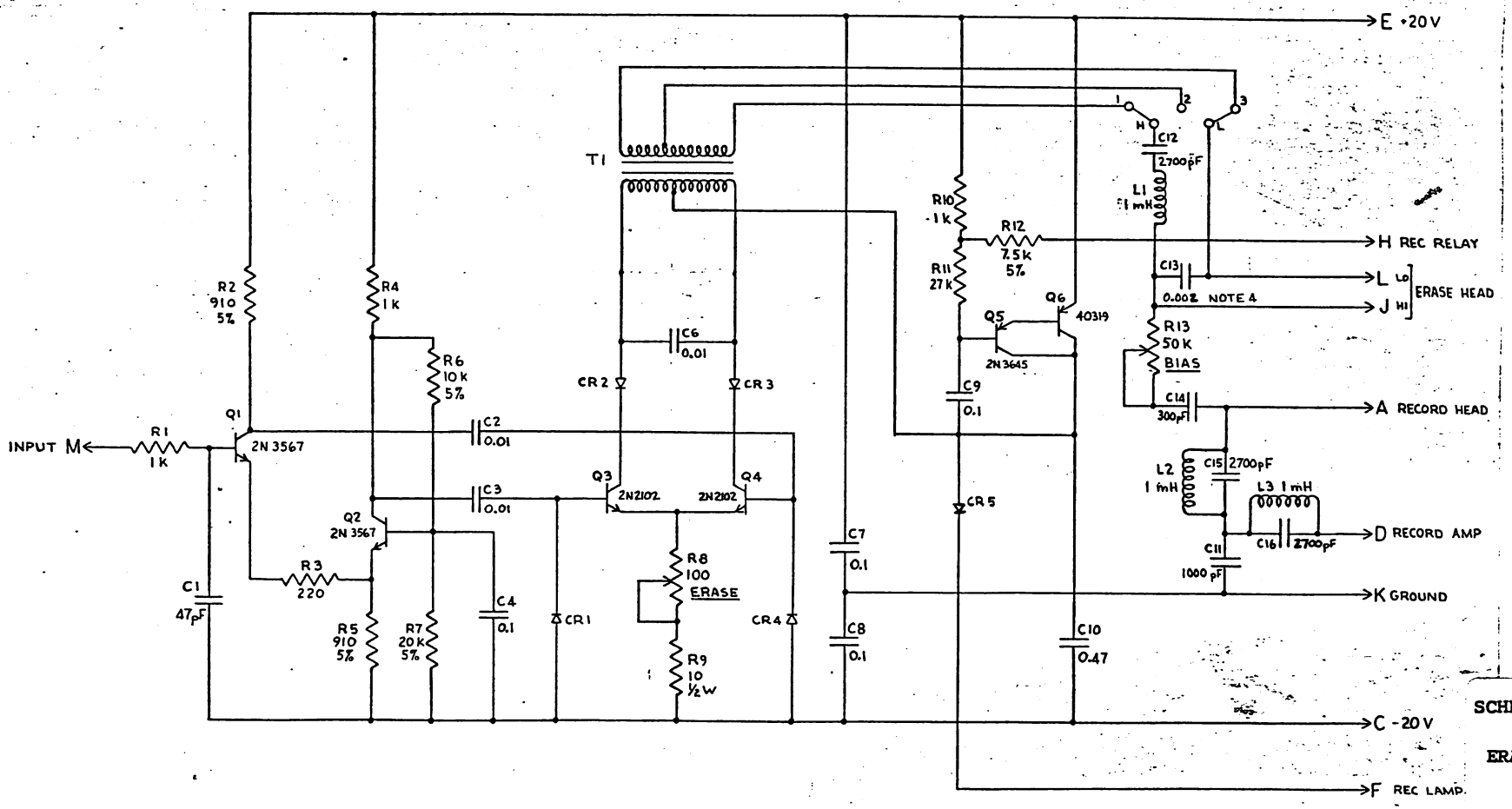
| SCHEMATIC REF. NO. | PART NUMBER | DESCRIPTION | MFG. | MANUFACTURER PART NUMBER |
|---|---|---|---|---|
| | 105000C | Oscillator and Regulator PCB Assembly, 250kHz | | |
| C 1 | 0822 | Capacitor, 1000 pF, mica | Elmenco | DM19-102J |
| C 2 | 0827 | " 300 pF, mica | Elmenco | DM15-301J |
| C 3,6,7 | 0867 | " 0.1 uF, 100V | Sprague | 225P10491 |
| C 4 | 0810 | " 100 pF, mica | Elmenco | DM15-101J |
| C 5,8,9,10 | 0850 | " 0.001 uF, 100V | Sprague | 225P10291 |
| C 11,12 | 1050 | " , Tantalum, 4.7 uF, 35V | Kemet | T310B475K035 |
| CR 1,2,3 | 1100 | Diode, Silicon, 1N4009 | Fairchild | |
| CR 4,5 | 1125 | " , " 1N4005 | Motorola | |
| IC 1,2 | 1301 | Integrated Circuit, Type 723-C | National | |
| L 1 | 1406 | Inductor, Adjustable, 350-430 uH | J.W. Miller | 46A394CPC |
| Q 1 | 1210 | Transistor, SE 4010 | National | |
| Q 2,3,6,8 | 1205 | " 2N3645 | National | |
| Q 4,7 | 1201 | " 2N3053 | Fairchild | |
| Q 5,9 | 1212 | " 40319 | RCA | |
| R 1 | 0179 | Resistor, ¼W, 10%, 33k | | |
| R 2 | 0188 | " " " 180k | | |
| R 3,4 | 0155 | " " " 330 ohms | | |
| R 5 | 0070 | " " 5% 3k | | |
| R 6 | 0133 | " " 10% 4.7 ohms | | |
| R 7,14,15 | 0161 | " " " 1k | | |
| R 8,9 | 0137 | " " " 10 ohms | | |
| R 10 | 0173 | " " " 10k | | |

| SCHEMATIC REF. NO. | PART NUMBER | DESCRIPTION | MFG. | MANUFACTURER PART NUMBER |
|---|---|---|---|---|
| R 11 | 0149 | Resistor, ¼W, 10%, 100 ohms | | |
| R 12 | 0510 | " , Variable, 10k | Helipot | 89PR10K |
| R 13 | 0180 | " ¼W, 10%, 39k | | |
| R 16 | 0454 | " , Metal Film, ½W, 1%, 16.2k T-1 | | |
| R 17 | 0451 | " " " " " 3.57k T-1 | | |
| R 18 | 0074 | " , ¼W, 5%, 4.3k | | |
| R 19,20 | 0450 | " , Metal Film, ½W, 1%, 3.01k T-1 | | |
| R 21 | 0452 | " " " " " 7.15k T-1 | | |
| R 22 | 0386 | " , ½W, 10%, 1.5k | | |
| R 23 | 0453 | " , Metal Film, ½W, 1%, 12.7k | | |
| R 24 | 0053 | " , ¼W, 5%, 510 ohms | | |
| | 105001 | Oscillator and Regulator PCB Assembly 100kHz | | |
| C 1 | 0834 | Capacitor, 0.0068, 100V | Sprague | 225P68291 |

NOTES:
UNLESS OTHERWISE SPECIFIED
1. FIXED RESISTORS ¼ WATT 10%, VALUE IN OHMS
2. CAPACITANCE VALUES IN μF
3. DIODES ARE 1N4009
4. C13 SELECTED TO MATCH ERASE HEAD

| LAST USED REF DESIG |
|---|
| C 16 |
| CR 5 |
| L 3 |
| Q 6 |
| R 13 |
| T 1 |

| REF DESIG. NOT USED |
|---|
| C 5 |



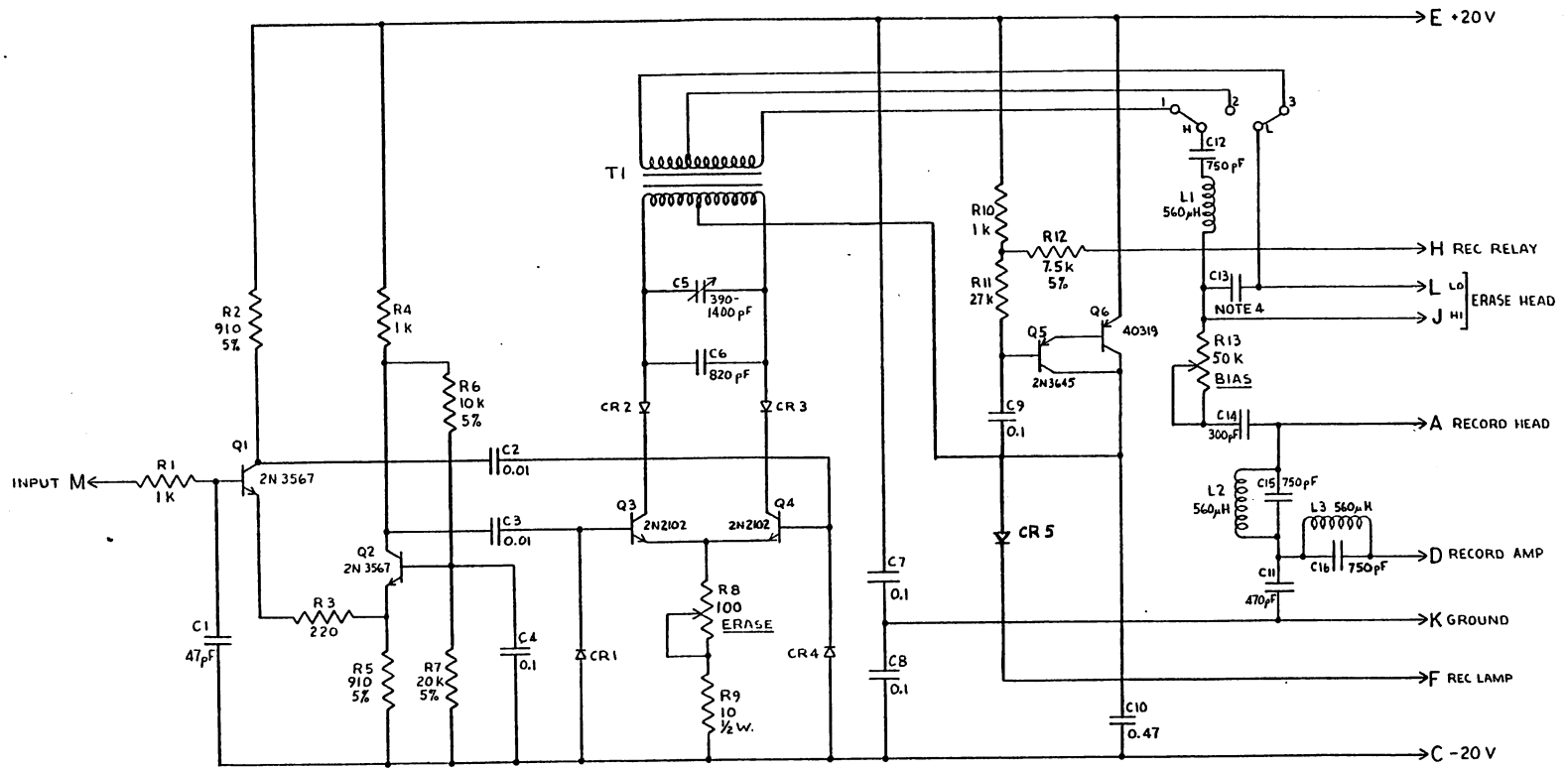

SCHEMATIC, A/N 105402B

ERASE/BIAS AMPLIFIER

Fig. 5-3

NOTES:
UNLESS OTHERWISE SPECIFIED
1. FIXED RESISTORS ¼ WATT 10%, VALUE IN OHMS
2. CAPACITANCE VALUES IN μF
3. DIODES ARE IN4009
4. C13 SELECTED TO MATCH ERASE HEAD

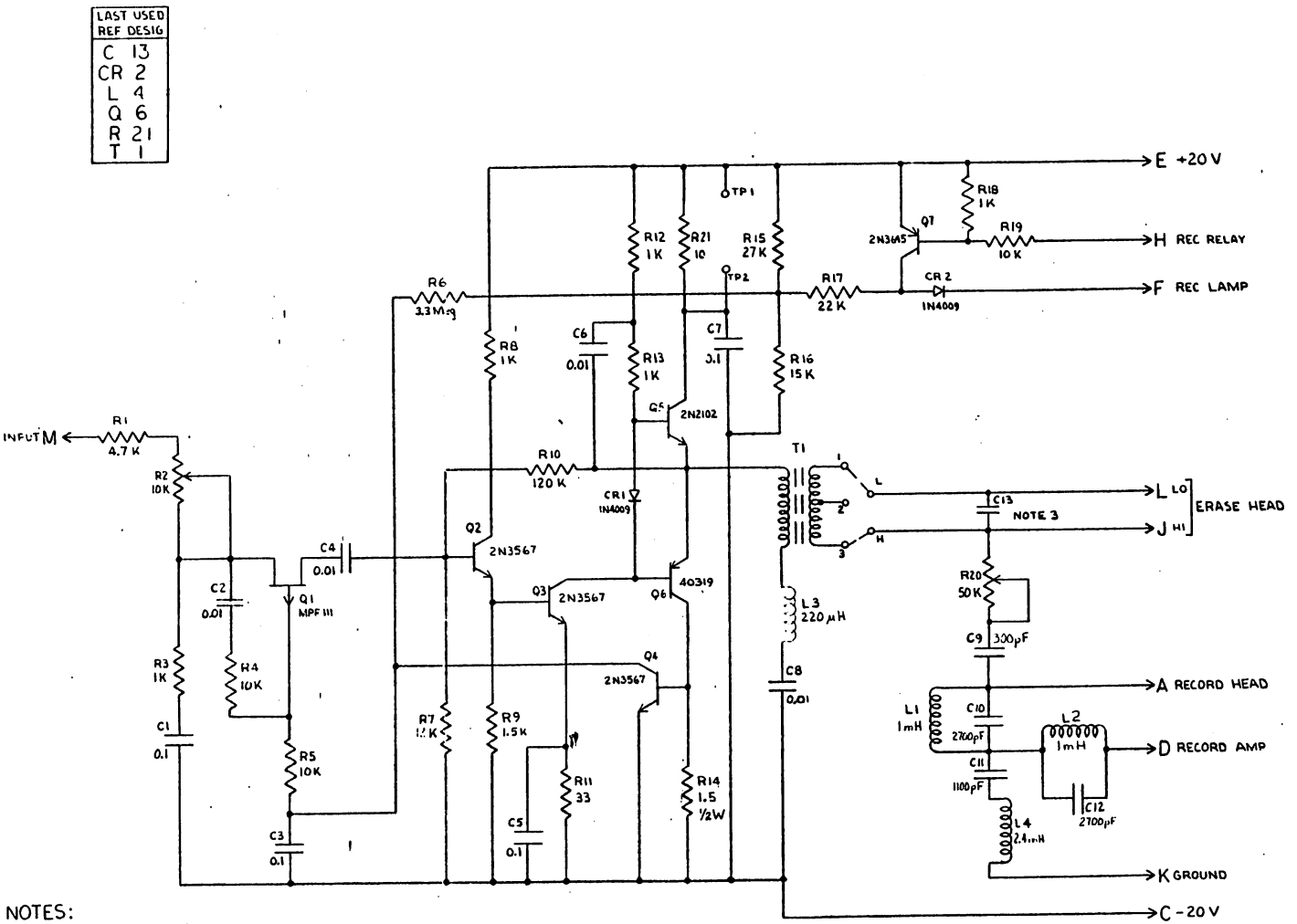
| LAST USED REF DESIG | |
|---|---|
| C | 16 |
| CR | 4 |
| L | 3 |
| Q | 6 |
| R | 13 |
| T | 1 |




SCHEMATIC, A/N 105400F

ERASE/BIAS AMPLIFIER
250kHz

Fig. 6-1-1




NOTES:
UNLESS OTHERWISE SPECIFIED
1. FIXED RESISTORS, ¼ W, 10%, VALUE IN OHMS
2. CAPACITANCE VALUES IN µF.
3. C13 SELECTED TO MATCH ERASE HEAD

SCHEMATIC, A/N 119201A

ERASE/BIAS AMPLIFIER
100kHz

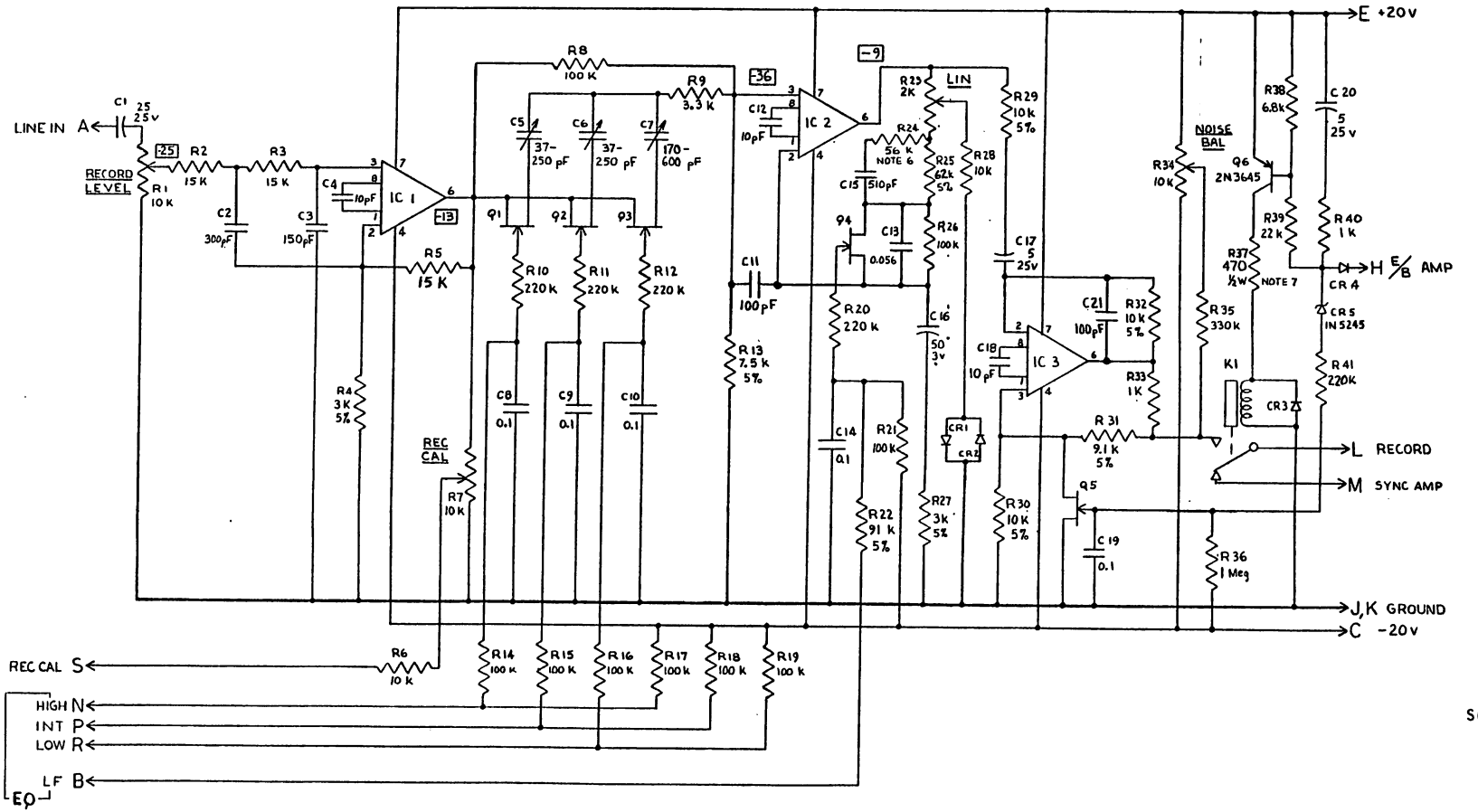
Fig. 6-1-2

NOTES:

UNLESS OTHERWISE SPECIFIED

1. ALL FIXED RESISTORS ¼ WATT 10%, VALUE IN OHMS
2. ALL CAPACITANCE VALUES IN μF
3. ALL DIODES TYPE IN4009
4. ALL IC's TYPE 748
5. ALL FETS TYPE MPF 111
6. R24 MAY BE DELETED FOR SMOOTHEST RESPONSE WITH OLDER HEADS
7. R37 USED ONLY WITH 12 V K1

| LAST USED REF DESIG |
|---|
| C 20 |
| CR 5 |
| IC 3 |
| K 1 |
| Q 6 |
| R 41 |




SCHEMATIC, A/N 105200F

RECORD AMPLIFIER
7-1/2 - 15 - 30ips.

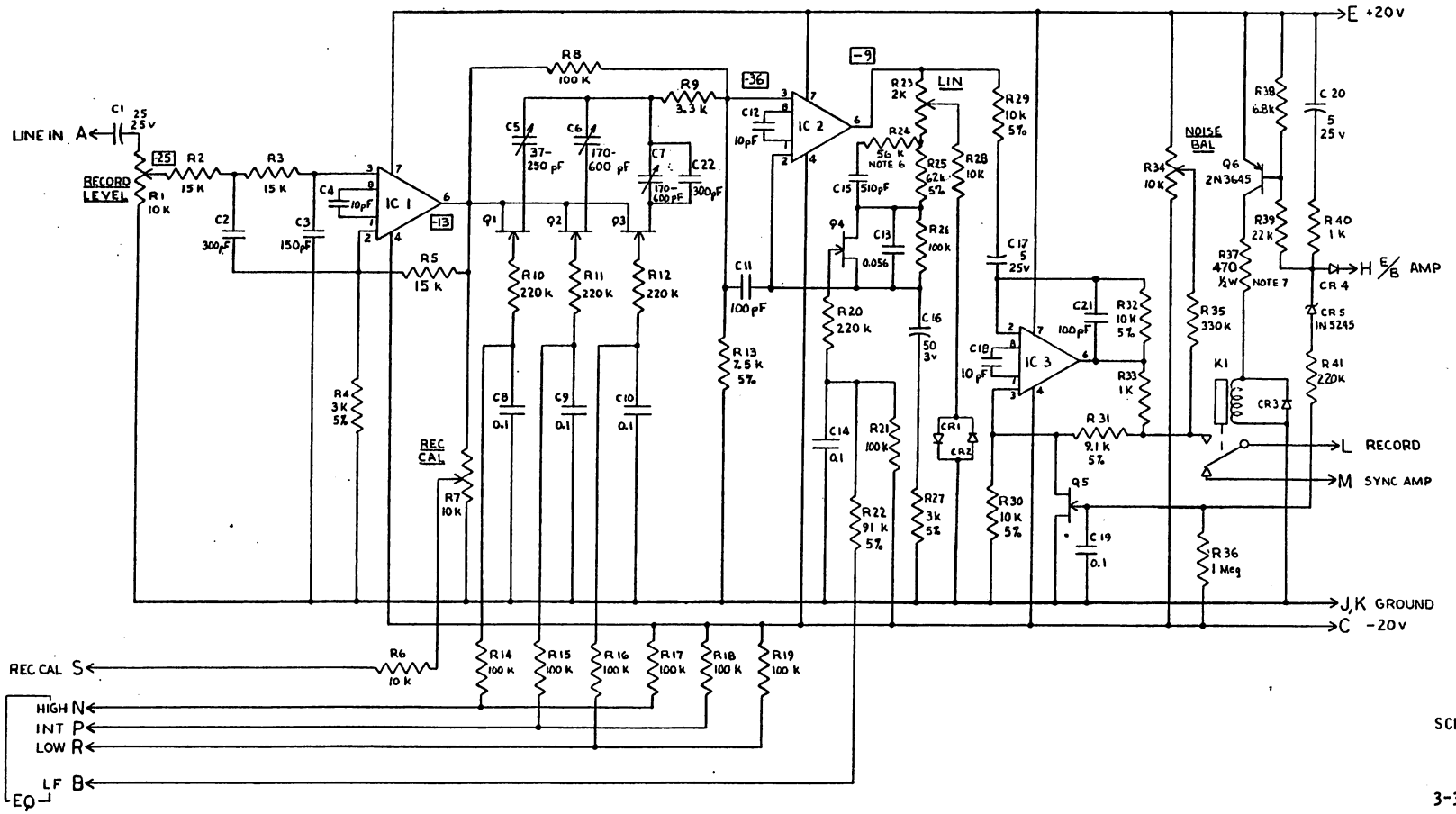
Fig. 6-2-1

NOTES:

UNLESS OTHERWISE SPECIFIED

1. ALL FIXED RESISTORS ¼ WATT 10%, VALUE IN OHMS
2. ALL CAPACITANCE VALUES IN μF
3. ALL DIODES TYPE IN4009
4. ALL IC's TYPE 748
5. ALL FET's TYPE MPF 111
6. R24 MAY BE DELETED FOR SMOOTHEST RESPONSE WITH OLDER HEADS
7. R37 USED ONLY WITH 12 V K1

| LAST USED REF DESIG |
|---|
| C 21 |
| CR 5 |
| IC 3 |
| K 1 |
| Q 6 |
| R 41 |




SCHEMATIC, A/N 105201F

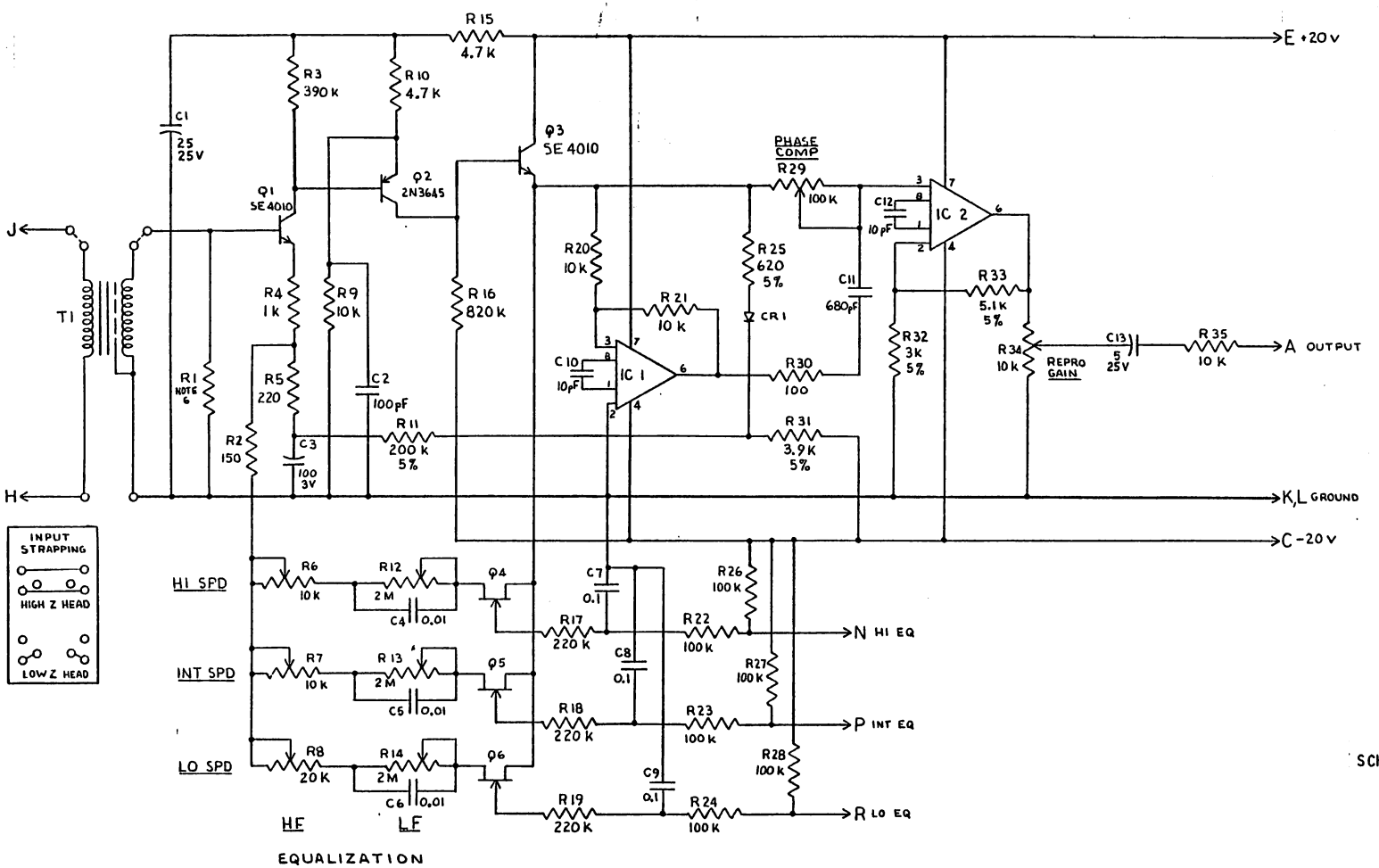
RECORD AMPLIFIER — 3-3/4 - 7-1/2 - 15ips.

Fig. 6-2-2

NOTES:
UNLESS OTHERWISE SPECIFIED

1. ALL FIXED RESISTORS 1/4 WATT 10%, VALUE IN OHMS
2. ALL CAPACITANCE VALUES IN μF
3. ALL DIODES TYPE IN4009
4. ALL IC's TYPE 748
5. ALL FET's TYPE MPF 111
6. SELECTED FOR BEST H.F. RESPONSE - NOT USED WITH LOW Z HEAD

| LAST USED REF DESIG |
|---|
| C 13 |
| CR 1 |
| IC 2 |
| Q 6 |
| R 35 |
| T 1 |




SCHEMATIC, A/N 105300F

REPRODUCE/SYNC AMPLIFIER

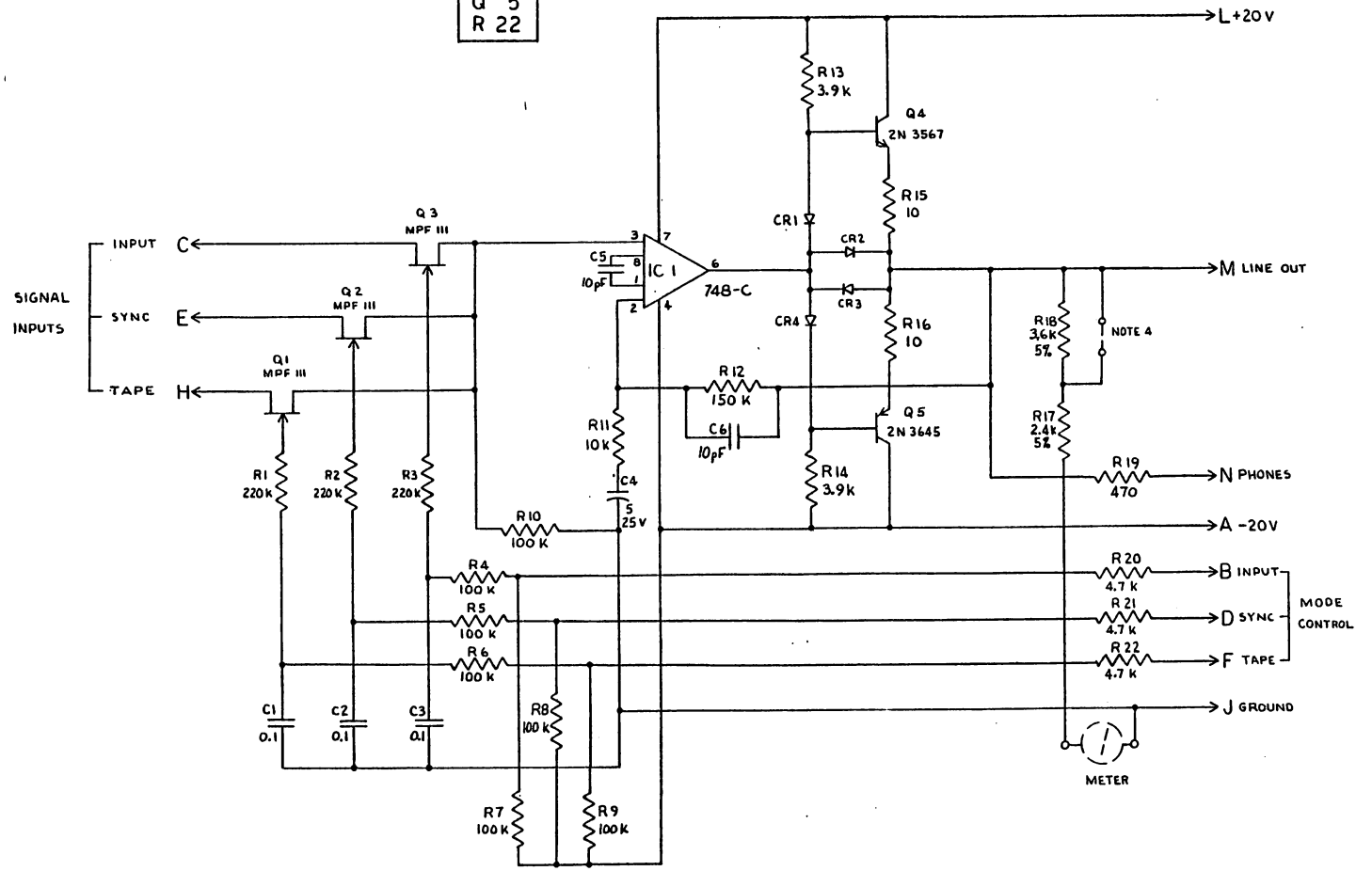
Fig. 6-3

NOTES:

UNLESS OTHERWISE SPECIFIED

1. RESISTORS ARE 1/4 WATT 10%, VALUE IN OHMS
2. CAPACITANCE VALUES IN μF
3. DIODES ARE IN4009
4. REMOVE JUMPER FOR +8dBm LINE

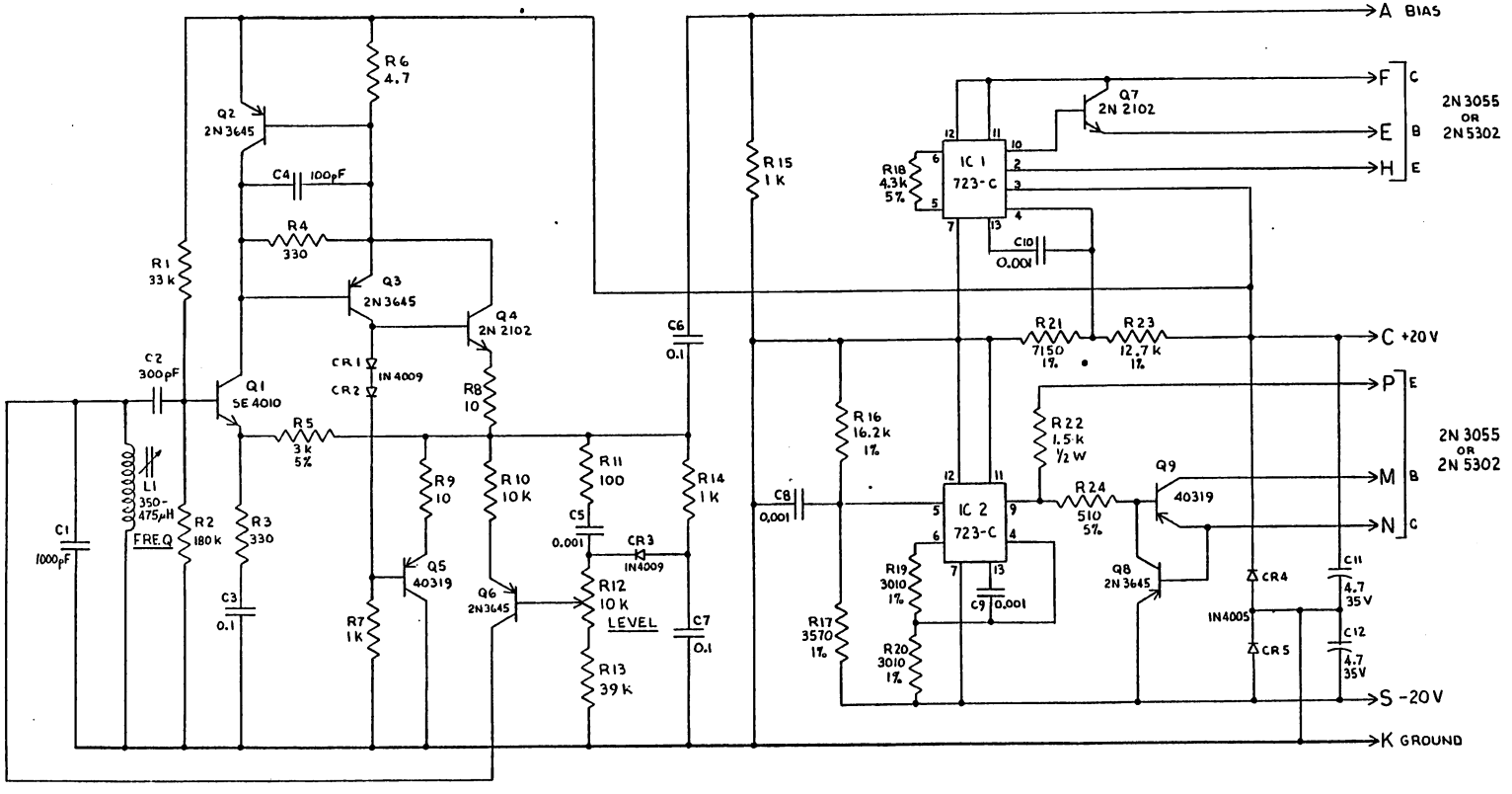
| LAST USED REF DESIG |
|---|
| C 6 |
| CR 4 |
| IC 1 |
| Q 5 |
| R 22 |




SCHEMATIC, A/N 105100D

LINE AMPLIFIER

Fig. 6-4



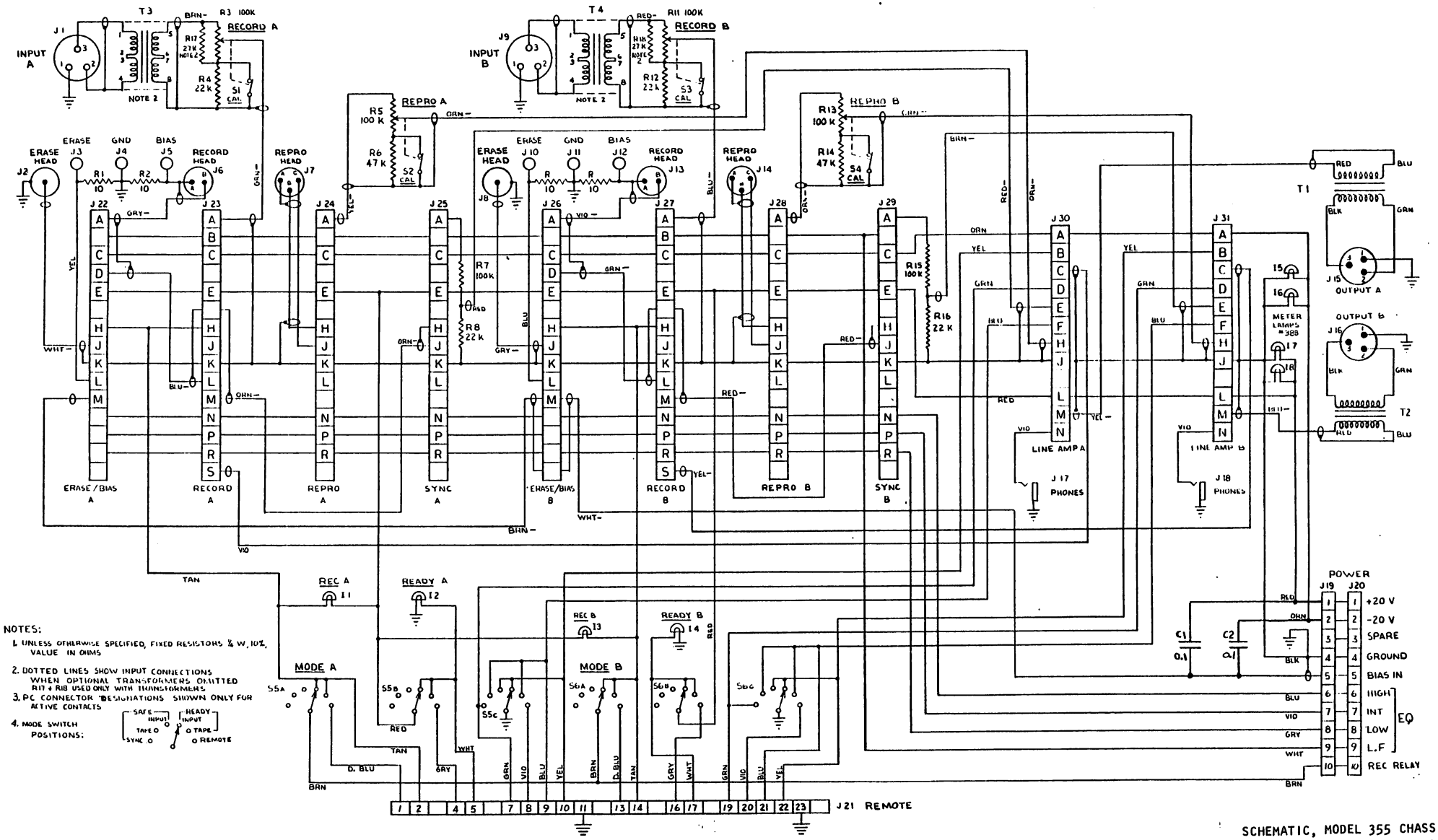

NOTES:
UNLESS OTHERWISE SPECIFIED
1. FIXED RESISTORS 1/4 WATT 10%, VALUE IN OHMS
2. CAPACITANCE VALUES IN μF
3. USE HEAT DISSIPATORS ON Q7, Q9

| LAST USED REF DESIG | |
|---|---|
| C | 12 |
| CR | 5 |
| IC | 2 |
| L | 1 |
| Q | 9 |
| R | 24 |

SCHEMATIC, A/N 105000B

OSCILLATOR/REGULATOR
250kHz

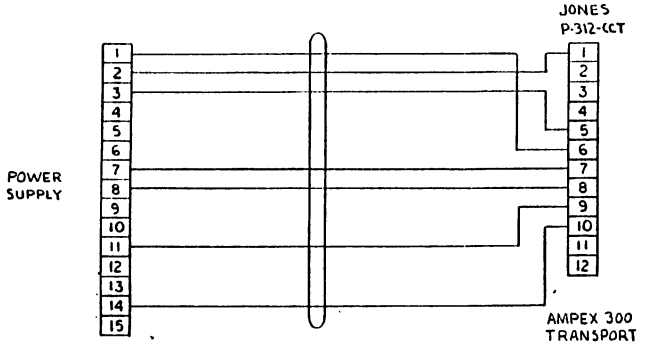
Fig. 6-6-1

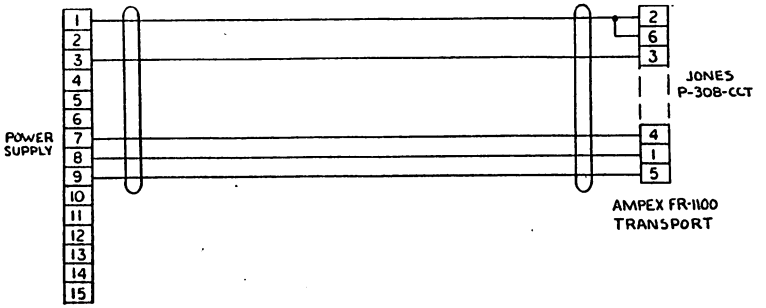


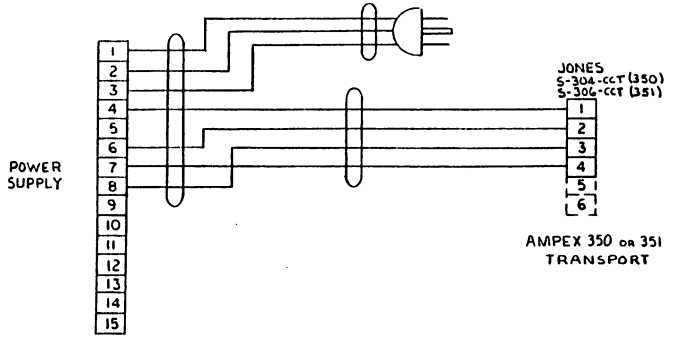

NOTES:

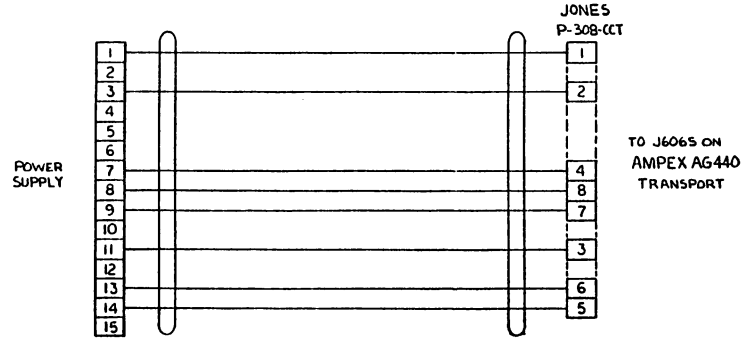
1. UNLESS OTHERWISE SPECIFIED, FIXED RESISTORS ¼ W, 10%, VALUE IN OHMS
2. DOTTED LINES SHOW INPUT CONNECTIONS WHEN OPTIONAL TRANSFORMERS OMITTED R17 & R18 USED ONLY WITH TRANSFORMERS
3. PC CONNECTOR DESIGNATIONS SHOWN ONLY FOR ACTIVE CONTACTS
4. MODE SWITCH POSITIONS:

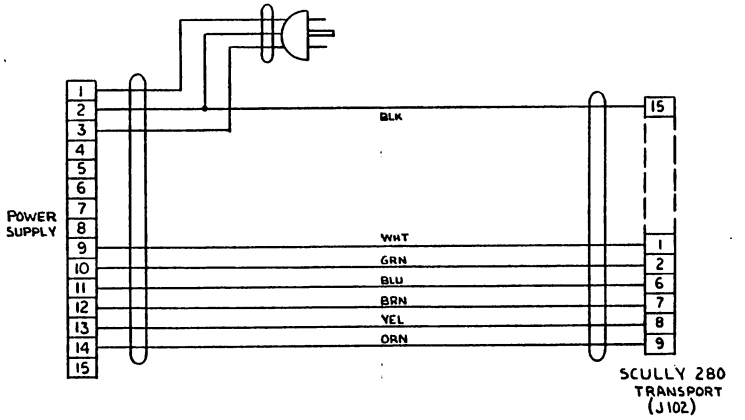
SCHEMATIC, MODEL 355 CHASSIS
Fig. 6-5



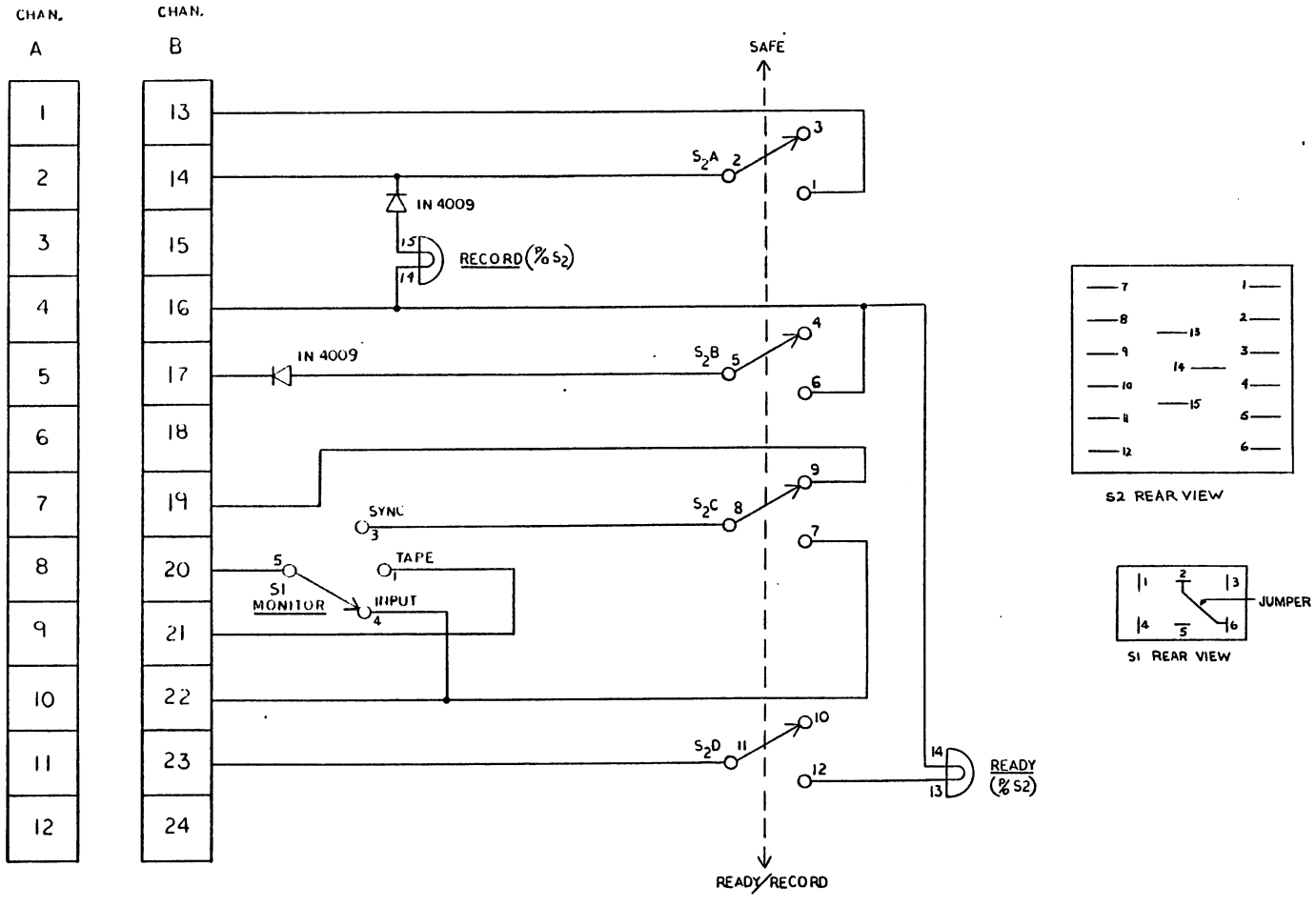




SCHEMATIC,

INTERCONNECTING CABLES

Fig. 6-8









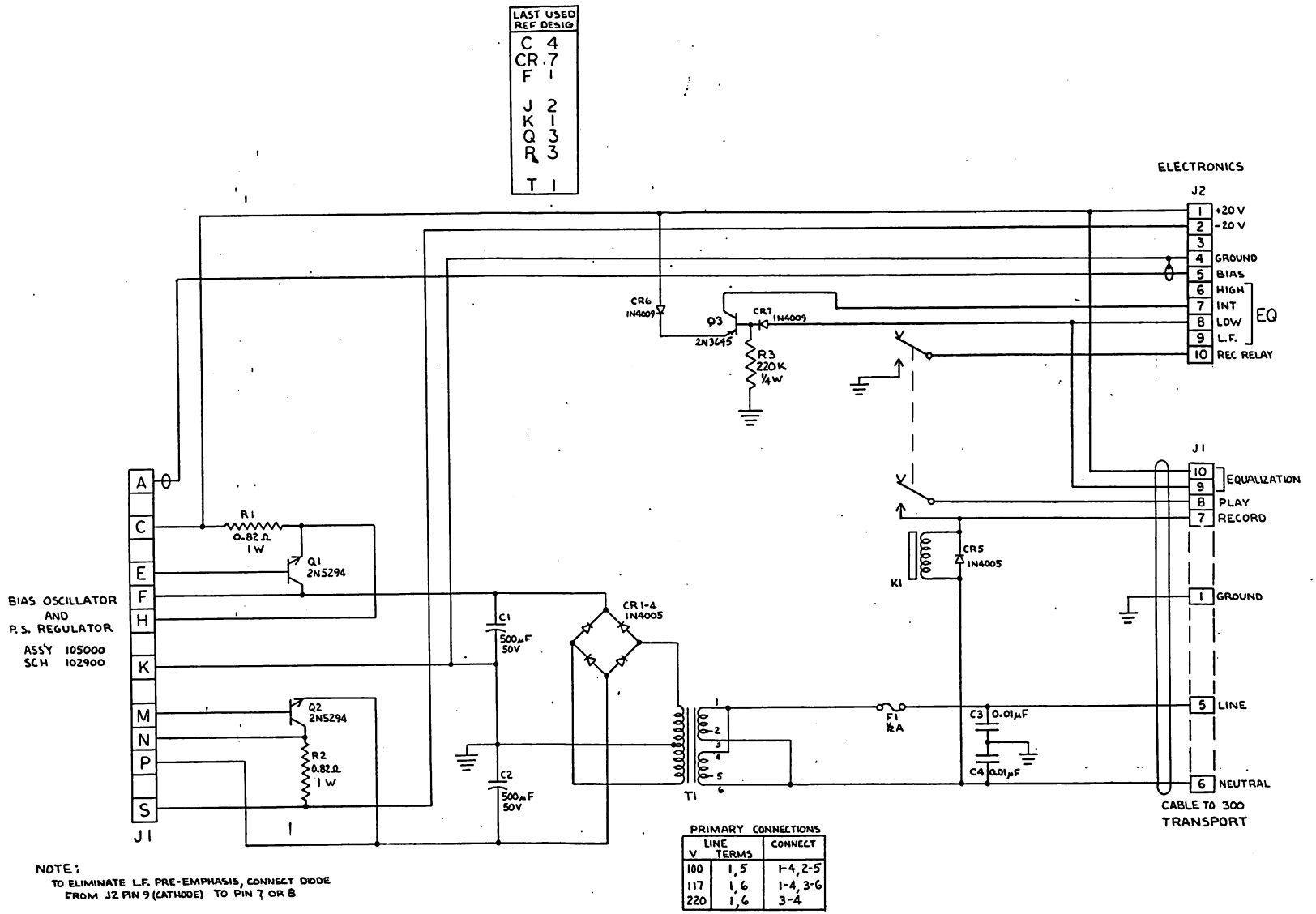

NOTES:

1. CH B SHOWN - CHA IDENTICAL
2. S1 IS ALCOSWITCH MST 205 PA
3. S2 IS SWITCHCRAFT PL-2127-05
   USE 1 EA. PL 301 & PL 308 FILTERS
   USE 2 EA. TYPE 387 LAMP

SCHEMATIC,

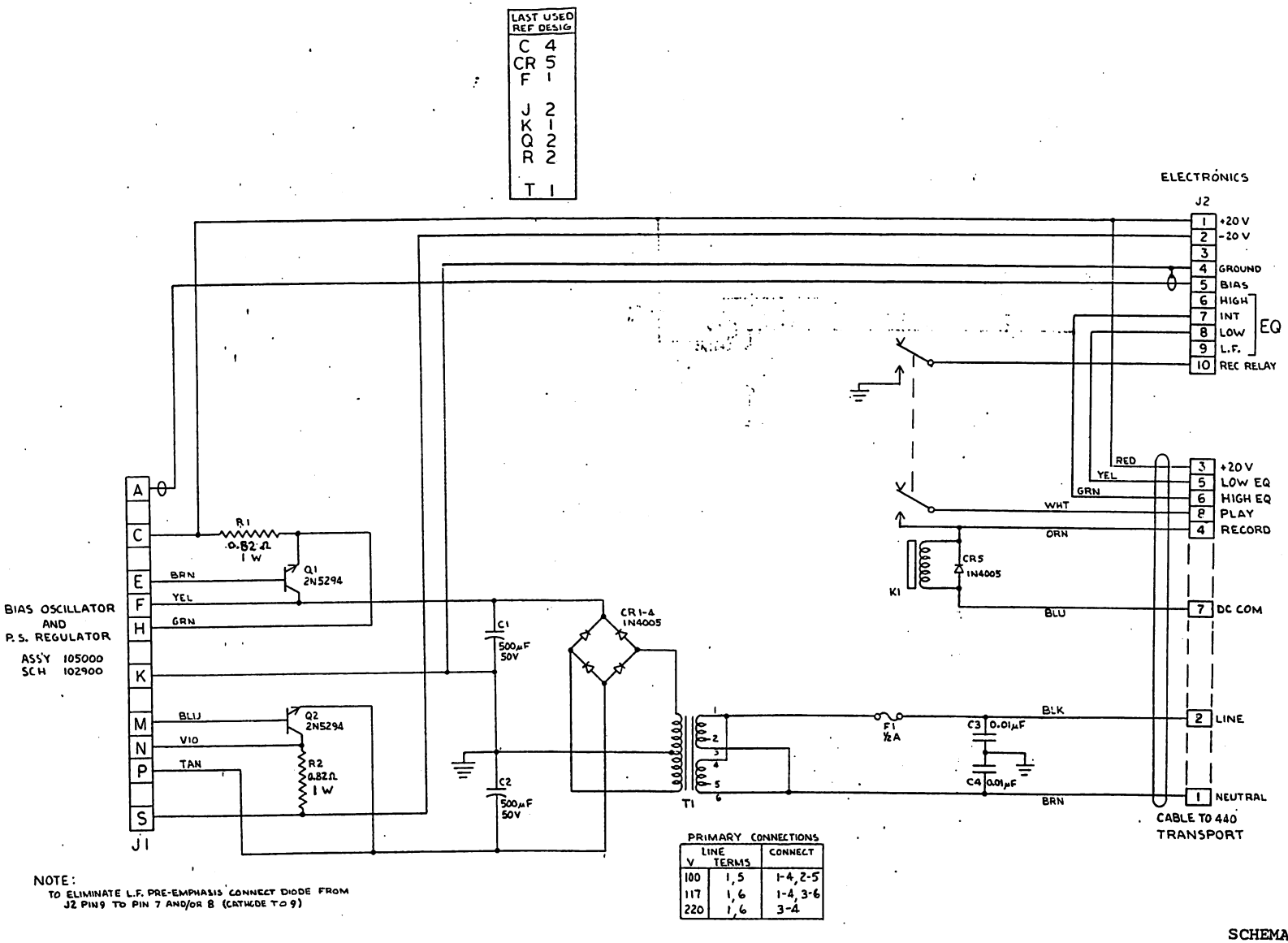
REMOTE CONTROL

Fig. 6-9




SCHEMATIC,

MODEL 902-00 POWER SUPPLY
(Ampex 300)



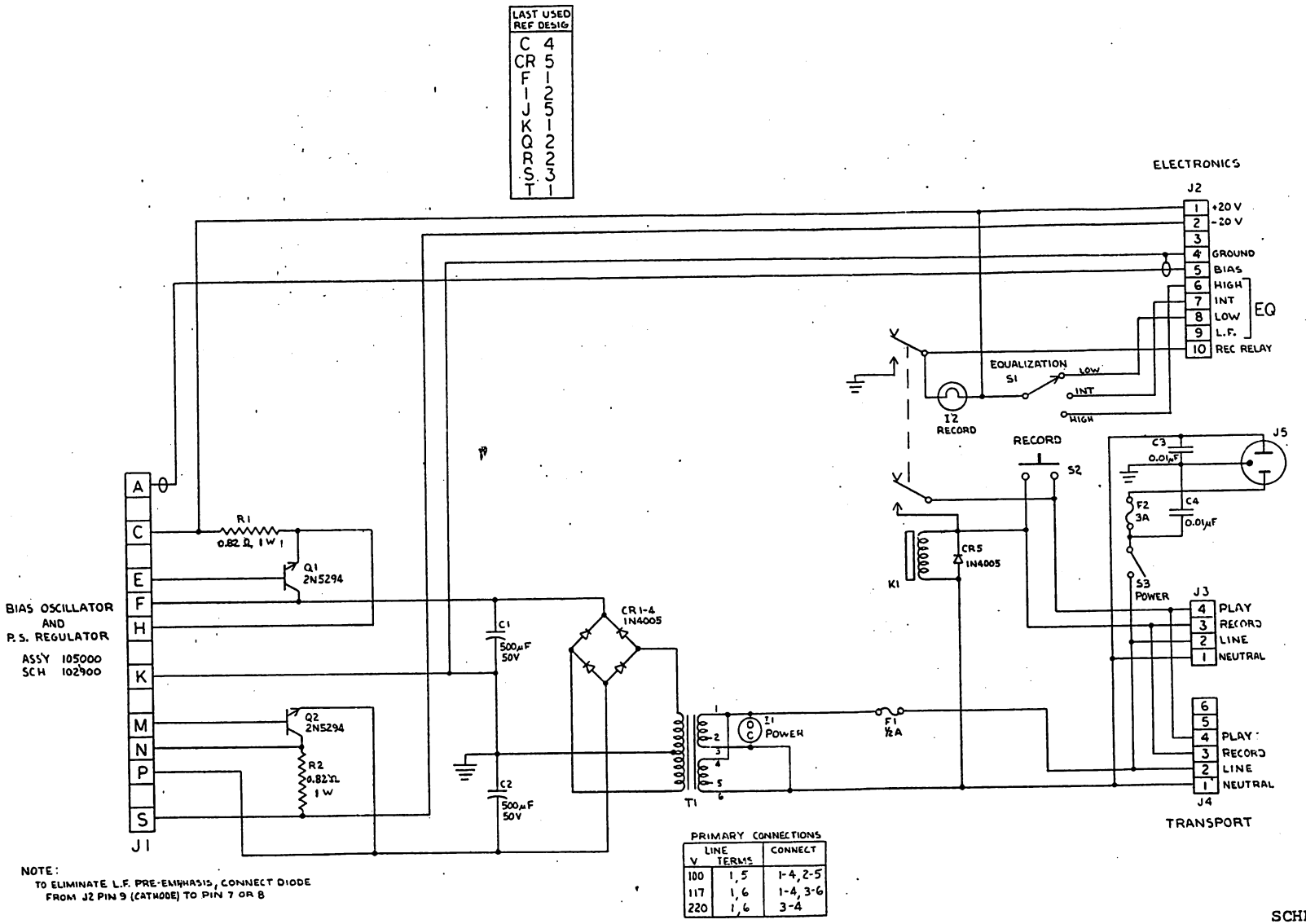

NOTE:
TO ELIMINATE L.F. PRE-EMPHASIS CONNECT DIODE FROM J2 PIN 9 TO PIN 7 AND/OR 8 (CATHODE TO 9)

PRIMARY CONNECTIONS

| V | LINE TERMS | CONNECT |
|---|---|---|
| 100 | 1, 5 | 1-4, 2-5 |
| 117 | 1, 6 | 1-4, 3-6 |
| 220 | 1, 6 | 3-4 |

SCHEMATIC,

MODEL 902-01 POWER SUPPLY
(Ampex AG 440)



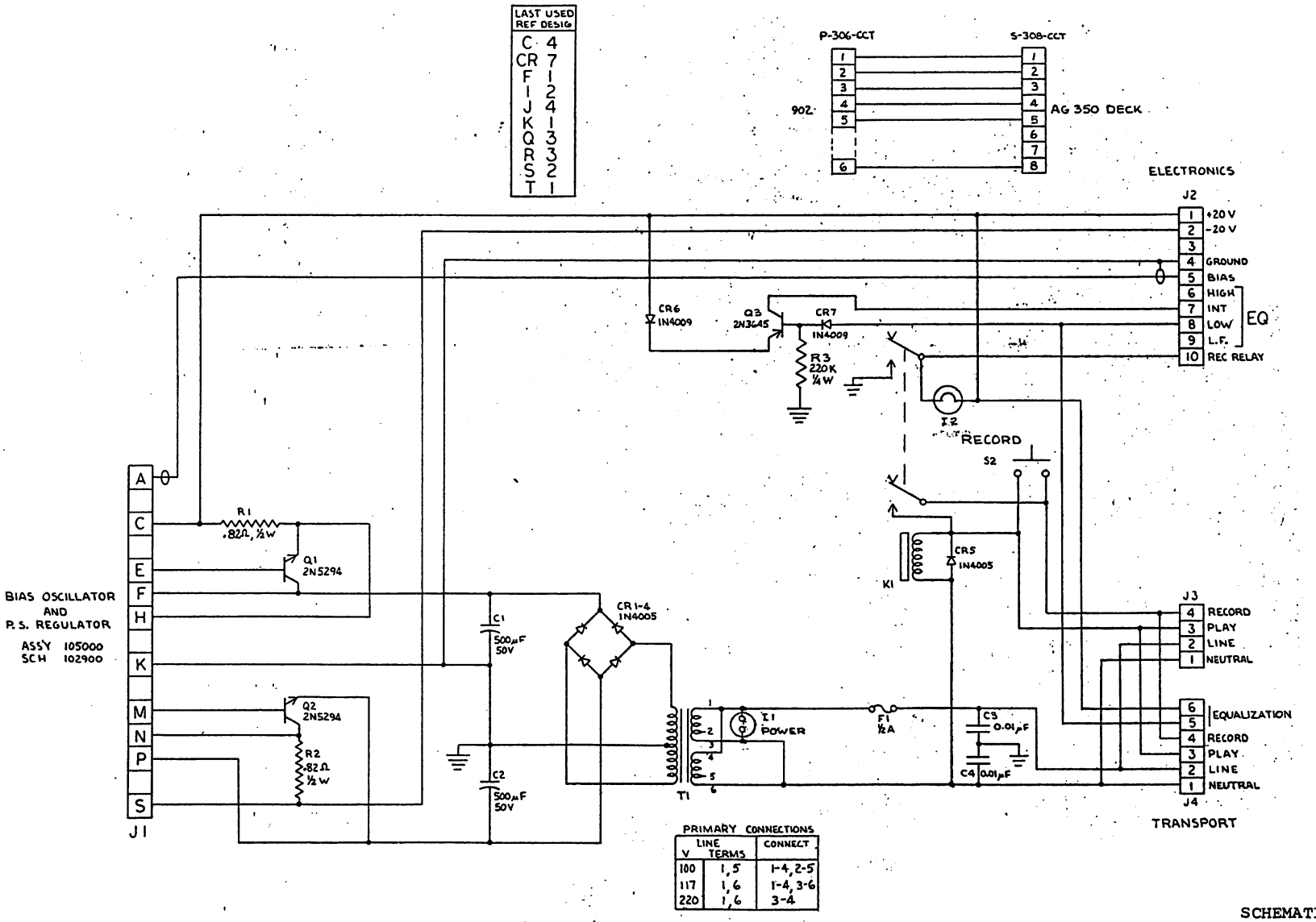

NOTE:
TO ELIMINATE L.F. PRE-EMPHASIS, CONNECT DIODE FROM J2 PIN 9 (CATHODE) TO PIN 7 OR 8

PRIMARY CONNECTIONS

| LINE V | TERMS | CONNECT |
|---|---|---|
| 100 | 1, 5 | 1-4, 2-5 |
| 117 | 1, 6 | 1-4, 3-6 |
| 220 | 1, 6 | 3-4 |

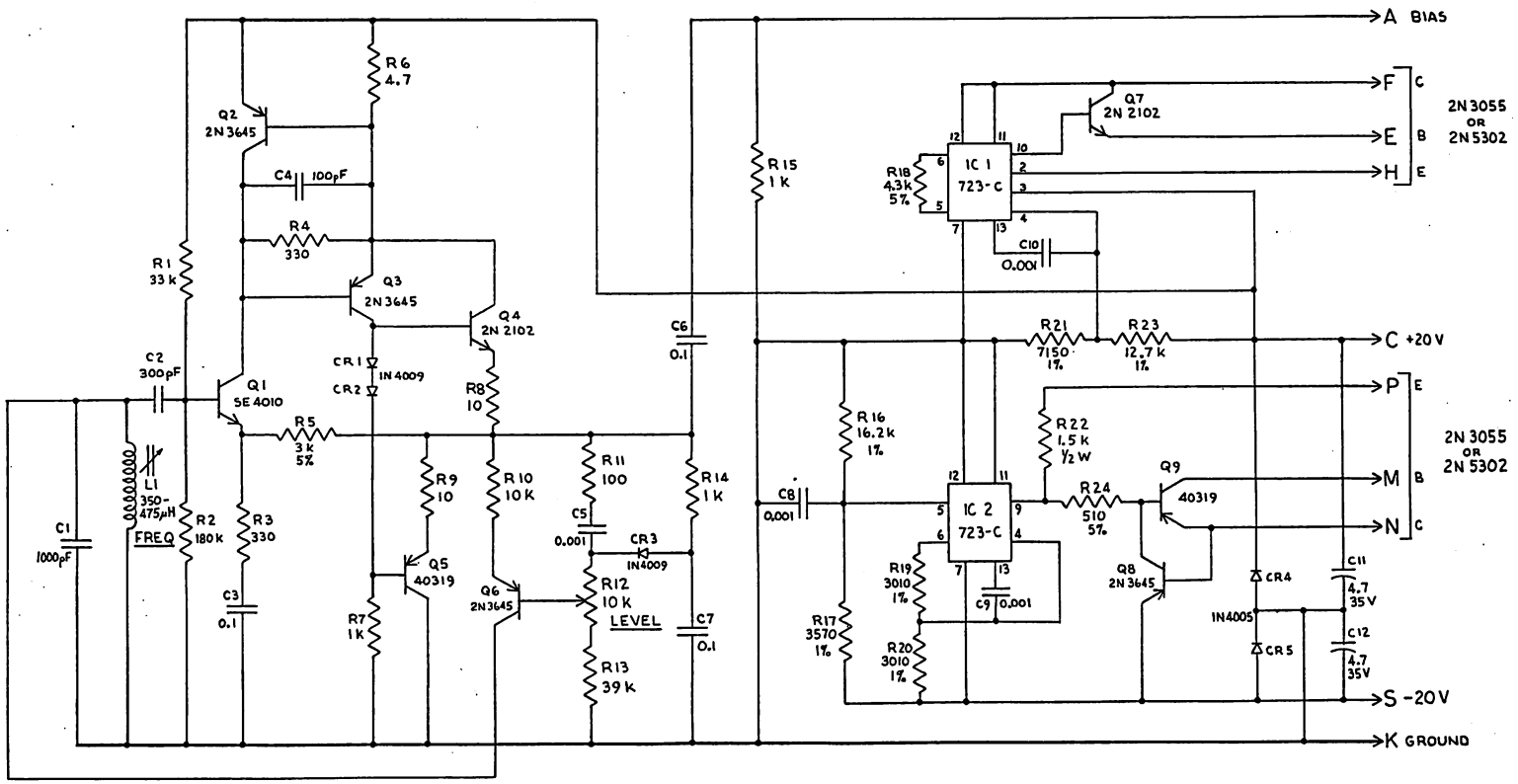
SCHEMATIC,

MODEL 902-11 POWER SUPPLY
(Ampex 350, 351, 354)




SCHEMATIC,

MODEL 902-12 POWER SUPPLY
(Ampex AG 350)




NOTES:

UNLESS OTHERWISE SPECIFIED

1. FIXED RESISTORS ¼ WATT 10%, VALUE IN OHMS
2. CAPACITANCE VALUES IN μF
3. USE HEAT DISSIPATORS ON Q7, Q9

| LAST USED REF DESIG | |
|---|---|
| C | 12 |
| CR | 5 |
| IC | 2 |
| L | 1 |
| Q | 9 |
| R | 24 |

SCHEMATIC, A/N 105000B

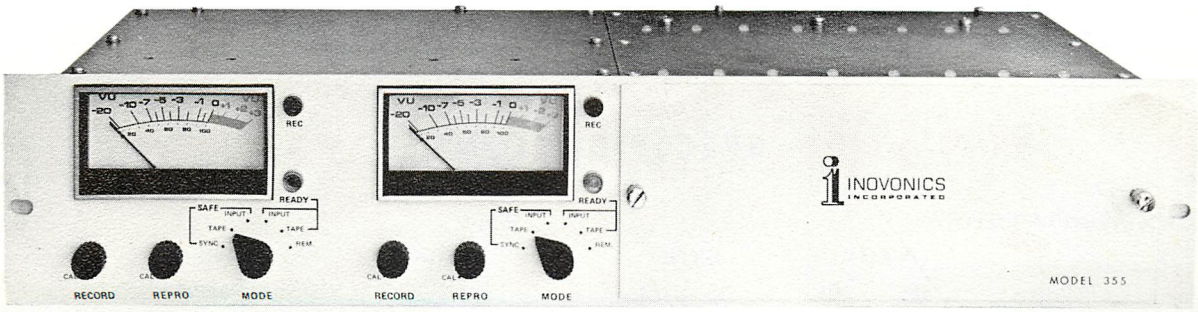
OSCILLATOR/REGULATOR
250kHz

Fig. 6-6-1

INOVONICS
INCORPORATED

# MODEL 355

# TAPE RECORDING ELECTRONICS




*A multi-featured, professional magnetic recording electronics package equally suited to original installations or for upgrading existing systems in the studio recording, broadcast, or motion picture fields.*

## FEATURES

**Compact** — two fully independent channels in a single 3½ inch rack mount chassis.

**3–Speed Equalization** accommodates any combination of NAB or IEC curves. LF equalization easily defeated at any speed.

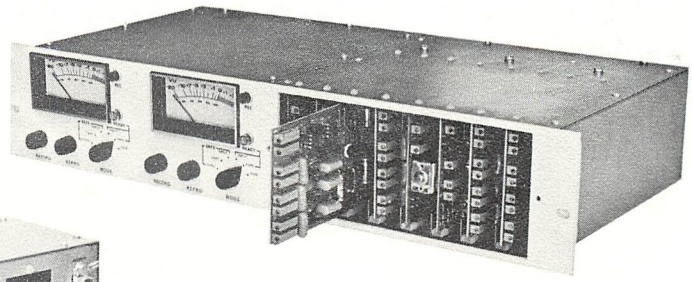
**Full Remote Control** of all modes: READY/RECORD; INPUT, TAPE and SYNC monitor. Solid-State switching eliminates contact noise.

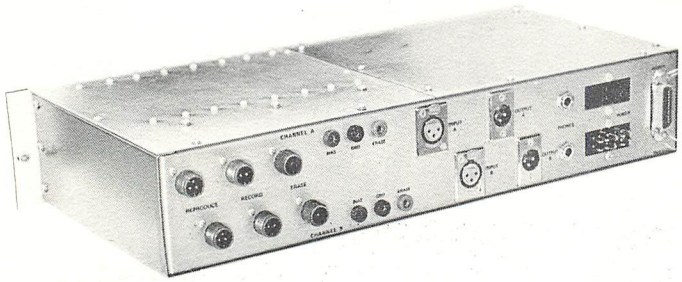
**Distortion Reduced** through the use of "linearized" Recording Amplifiers and phase corrected Reproduce and Sync Amplifiers.

**Separate Reproduce and Sync Amplifiers** permit optimum adjustment of equalization in both playback modes.

**Plug-In Circuit Cards** combine advantages of both IC and discrete circuitry for unexcelled performance and trouble-free operation.

# MODEL 355





## SPECIFICATIONS

**Frequency Response** (in Hz) (1)

| | | OVERALL | SYNC |
|---|---|---|---|
| 30ips | ±2dB | 60 – 20k | 60 – 15k |
| 15ips | ±2dB | 35 – 20k | 40 – 15k |
| 7½ips | ±2dB | 30 – 15k | 40 – 7.5k |

**Signal–to–Noise Ratio** (in dB) (1) (2)

| | OVERALL | | SYNC | | STANDBY | |
|---|---|---|---|---|---|---|
| | u'wtd | wtd | u'wtd | wtd | u'wtd | wtd |
| 30ips | –62 | –71 | –62 | –72 | –72 | –83 |
| 7½ – 15ips | –61 | –67 | –61 | –70 | –69 | –78 |

**Equalization**

3 speeds with solid-state switching. Adjusts for any combination of NAB and IEC characteristics.

**Erase/Bias Frequency**

250kHz standard. 100kHz available on special order.

**Erasure** (1)

> 75dB erasure of 500Hz signal recorded 3dB below tape saturation.

**Recorded Distortion** (LIN and NOISE BAL controls optimized –3M 206 tape)

< .15% THD at 200nW/m
< 1% THD at 6dB above 200nW/m

**Amplifier Distortion**

Record: < .1% THD at Operating Level
< .2% THD 25dB above Operating Level

Reproduce: < .1% THD at Operating Level

**Input**

Sensitivity: –20 to +8dBm
Impedance: 10K, unbalanced (transformer optional)

**Outputs**

Line Output – feeds 600 ohm line or bridging input at +4 or +8dBm. Clipping level +24dBm.

Rear Panel headphone jack

**Panel Controls**

RECORD: Gain (with preset CAL position)
REPRO: Gain (with preset CAL position)
MODE: Selects SAFE/READY and INPUT, TAPE, or SYNC monitor, or activates REMOTE control of all functions.

**Power Requirement**

±20 VDC, 400mA; 250 kHz, 1V rms

**Size and Weight**

3½" x 19" x 9"; 12 lbs.

**Accessories**

Power Supplies:

Model 900 (8 tracks max.)
Model 910 (24 tracks max.)

**Price**

(1) Overall performance will obviously depend on heads and tape used. These specifications are representative of a system using a head complement of Nortronics 9227 erase, 9204 record, and 9213 reproduce; 3M 206 tape and an operating level of 200nW/m.

(2) Referred to 6dB above a flux level of 200nW/m, or approximately 3dB below the 3% THD point of 3M 206 tape. Spec. applies to 70 - 80 mil tracks, as in 2-, 4-, 8-, or 16-track formats.

NOTE:
Operating Level refers to a flux level of 200nW/m at 1kHz. This is approximately 1dB above the "Operating Level" tone on current Ampex Standard Tapes.

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