# 100 SERIES
# RECORDER-REPRODUCER



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*Design Innovators - Quality Manufacturers*

# INDEX

# SECTION 1

## INTRODUCTION

Audi-Cord Corporation wishes to thank you for selecting Modu-Cart series tape cartridge equipment. This equipment has been designed for long and reliable service with a minimum of easy access maintenance.

Please take the time to study this instruction manual prior to installing the equipment. It contains specific information for installation, understanding the operating features, and recommendations for service of the equipment.

### GENERAL DESCRIPTION

The Modu-Cart 100 Series Reproducers are constructed of the latest in solid state technology such as CMOS digital, and linear intergrated circuits, combined with transistor load interface and amplifier circuits. Truly modular in design, the Modu-Cart series shares the use of a standardized transport assembly for NAB size A (*or* AA) and B (*or* BB) cartridges. These transports are fully interchangeable between units of similar channel capability, including the use of stereo transports in mono mainframes as required in emergency situations, and reproducer to record-reproducer (*with head changes*). All transports include the necessary recorder logic and contain head preamplifiers equalized for constant voltage output from the heads. Transports normally require no adjustment as a result of interchanging.

The Modu-Cart 100 Series is available in monophonic or stereophonic configuration in choice of single Primary Cue or three cue models. The 150 Hz Secondary Cue may be combined with the 8 kHz Tertiary Cue, or as an option, with 3500 Hz or 4 kHz logging cue output. The optional tones are provided with open collector logic output as standard. The card provides for addition of relays if required by the customer. The relays are readily available from local distributors or from Audi-Cord when required or as an option at time of order. An isolated logging output is provided on all reproducers as standard.

All Modu-Cart reproducers and recorders meet or exceed the 1975 NAB Cartridge Standard in all specifications except as waived and explained in the specifications or other pertinent sections of this manual, such as when a specific adjustment must be effected to meet the specification.

The Modu-Cart 100 Series contains all the controls and features common to cartridge reproducers and recorders on the market and several features which are exclusively new with this series, including the ability to "program" or select the use of these as required. To obtain the maximum benefit of these features, study Section 2, (*Operation Instructions*) of this manual carefully.

## SPECIFICATIONS: REPRODUCER

| | |
|---|---|
| Rated Audio Output | +8 dBm |
| Amplifier Overload Capability | +18 dBm min., +20 dBm clipping |
| Minimum Input Level | +8 dBm from 50 nWb/m *(10 dB reserve)* |
| Rated Output Impedance | 600 ohms or 150 ohms Balanced Selectable |
| Amplifier Output Impedance | *300 ohms on 600 ohms tap<br>*90 ohms on 150 ohms tap |
| Amplifier Distortion | 0.5% max. total harmonic @ +18 dBm |
| Hum and Noise | -50 dB re 160 nWb/m @ 1 kHz |
| Signal to Noise *(Typical Tape)* | -47 dB re 160 nWb/m @ 1 kHz |
| Equalization | Per NAB Cartridge Standard, 1975 |
| Equalization Adj. Range *(To NAB Median Adjustment)* | 10 dB @ 15 kHz, High Freq.<br>4 dB @ 50 Hz, Low Freq. |
| Frequency Response | ±2 dB to NAB Standard Tape |
| Phase Stability | ±90 degrees, Long Term @ 12 kHz |
| Phase Differential | ±90 degrees @ 12 kHz<br>*Transport is long-term phase stable for selected cartridge under controlled measurements. It is appreciated that phase differential over a group of cartridges and long term use is difficult to achieve unless stringent maintenance and operator techniques are applied. This specification, therefore, represents a best case intent and cannot be guaranteed in the user's application under present typical operations.* |
| Cue Tones | 1 kHz Primary Cue Std., Optional 2 Tone card with combination of 150 Hz Secondary Cue and 8 kHz Tertiary, 3500 Hz logging or 4 kHz logging. |
| Cue Inhibit Time | 1.75 sec ± .25 sec. Electronic Timed |
| Optional Cue Switching | Sinking *(Open Collector)* Logic |
| Cue Switching Loads | 100 ma. max., +40 VDC open circuit max. |
| Logging Output Isolation | 40 dB min., from 10 K ohm source |

*Does not fully meet the 1975 NAB Standards*

| | |
|---|---|
| Cue Sensor Bandwidth | ±10% min @ 3 dB points |
| Cue Sensor Gain | 10 dB minimum Reserve @ NAB Std. Level |
| Start Time | 0.12 Sec. Max @ Min. solenoid damping |
| Stop Time | 0.08 Sec. Max @ Min. solenoid damping |
| Crosstalk, Cue to Program | 50 dB or better |
| Crosstalk, Program to Program | 50 dB or better |
| Tape Speed | 7.5 IPS, Hysteresis Synchronous Direct Drive |
| Timing Accuracy | .2%, 250 Sec. Tape |
| Effective Speed Accuracy | .2%, NAB method |
| Flutter | 0.15% weighted peak, Max. |
| Remote Control *(all inputs are ground signalled)* | 15 Pins, permanently wired for:<br>Start<br>Stop<br>Run Lamp<br>Ready Lamp<br>Secondary Cue Out<br>Tertiary Cue Out<br>Gnd *(Chassis)*<br>+24 DC<br>Logging Cue Output<br><br>5 Pins, Internally programmed by Solderless Strap:<br>Sec and Ter Sensor Inhibit<br>Audio Mute<br>Start Pulse Out<br>Played Indicator Lamp<br>Secondary Cue Relay *(w/optional relay card)*<br>Tertiary Cue Relay *(w/optional relay card)* |
| Universal Interface Circuits | 1 Input logic circuit, buffer or inverter, Std.<br>1 Output logic circuit, source or sink, Std. |
| Cartridge Capability | NAB A or AA and B or BB Std. *(C or CC on special order)* |
| Max. Temp. Rise | 20° C max, above 25° C ambient |
| Recommended max. Ambient | 40° C max. |
| Power Requirements | 117 volts, 60 Hz, 50 VA max.<br>*(117 volts, 50 Hz, on special orders)* |
| Dimensions | 8 5/8" W x 5 1/4" H x 15" L |

# SECTION II

## OPERATION INSTRUCTIONS

### INTERFACE METHODS

The Modu-Cart 100 Series Reproducers and Record-Reproducers are ideal for operation in total solid state systems with the ultimate of control reliability. The control logic uses the latest CMOS integrated logic packages operating at 12 volts DC for maximum noise immunity. Audi-Cord recognizes that standards have not existed to allow for predictable connections to a system. For this reason the Modu-Cart reproducers contain two universal interface circuits and the recorders contain one input inverter. With these circuits the user can connect the remote control to satisfy the system needs in most cases without the need to construct "black box" circuits.

In the reproducers, a row of spring receptacles lettered A through Z are located at the lower rear of the mother board in the mainframe section. These are accessible by removing the lower cabinet section. A length of 24 gauge solid wire is used in connecting the interface circuits, *(or optional signals which will be discussed in later paragraphs)*, to the unwired pins of the remote socket J1. Figures 1 and 2 show the electrical schematics of these two circuits.

In the recorders, an inverter identical to Figure 2 is wired to the remote connector J11. The base input is connected to Pin 6 and the collector to Pin 5.

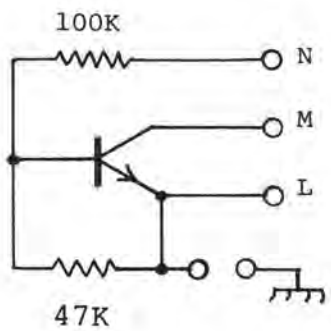



Figure 1

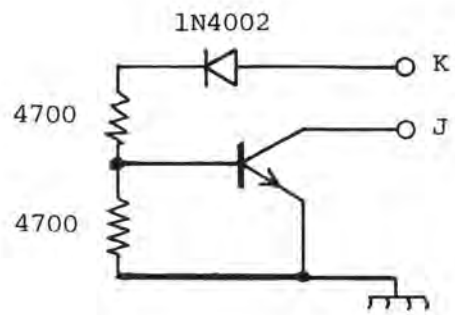



Figure 2

The transistor of Figure 1 is a darlington buffer requiring 120 microamperes from the 12 volt CMOS logic for a sink current of 100 milliamperes. The inverters of Figure 2 require approximately 1 ma from a 5 volt TTL logic circuit for 40 ma sinking load. These inputs are suitable for typical 24 volt (*positive only*) control circuits, requiring 5 ma of drive current.

The typical Modu-Cart signal input circuit and connecting customer control is shown in Figure 3 below. The pushbutton or control signal may be connected via an internal impedance to a positive (*+ volts to common chassis*) source in the case of the remote Start or Stop circuit *only*, since a diode is provided in these input circuits. *Negative voltage* with respect to common ground *cannot be connected* to a Modu-Cart input without an isolating circuit such as an opto-isolator or relay contact.

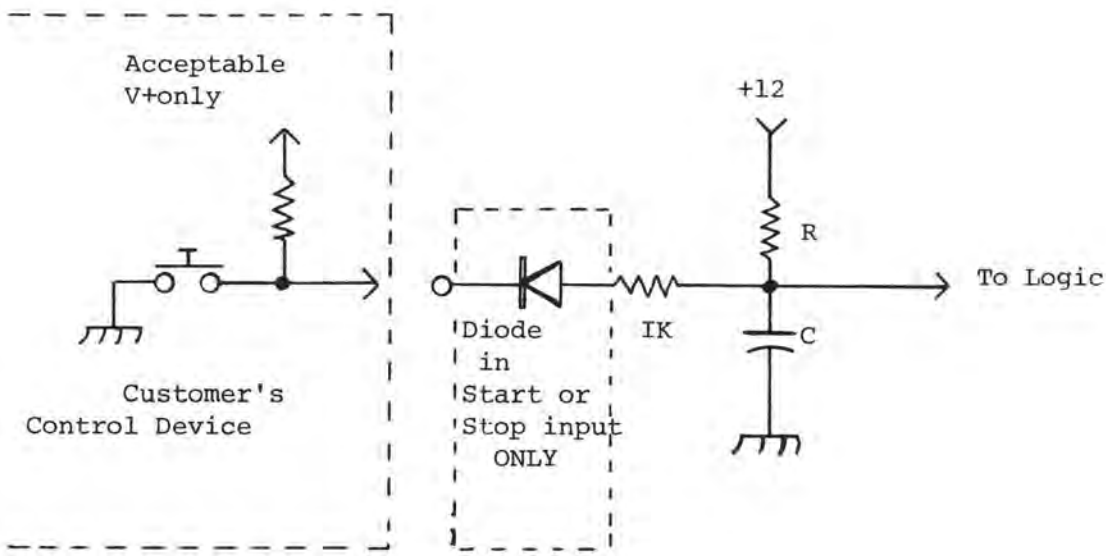
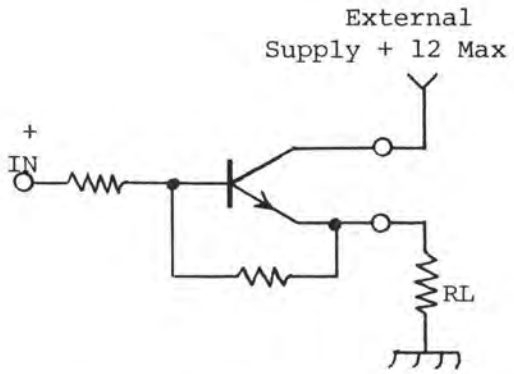



Figure 3

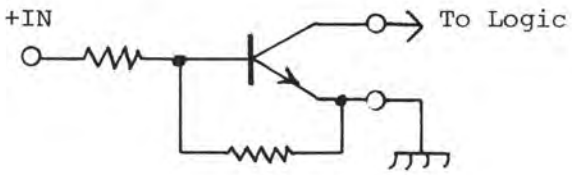
Figure 4 shows a typical use of the circuit of Figure 1 as an interface buffer from an internal 12 volt CMOS logic signal to a (*12 volt max.*) circuit such as TTL logic. Figure 5 shows the use of this same circuit as an inverter buffer.

Figure 6 shows the typical use of the inverters to convert a Hi (*sourcing*) current to the ground (*sinking*) signal required by the Modu-Cart series. The source current required for these circuits is approximately 200 microamperes per volt (*1 ma @ 5 volts*). These circuits are reverse voltage protected by the series diodes.



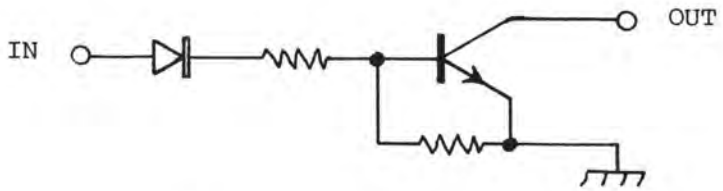

(HI) IN = (HI) OUT

Figure 4




(HI) IN = (LO) OUT

Figure 5




(HI) IN = (LO) OUT

Figure 6

# AVOIDING ERRORS IN AUDIO CONNECTION AND CALIBRATION

All Audi-Cord Cartridge equipments are designed in accordance with the intent of the 1975 NAB Standard for Cartridge Recording. To meet this standard, the audio output is higher than usual (+8dBm), with an improved source impedance. The recorder input impedance is higher than usual (5K ohms) and suitable for bridging a 600 ohm line. These improvements, although desirable in most cases; can cause for serious application errors in the field and degradation of operation if improperly connected.

## WHY THE HIGH OUTPUT LEVEL?

The purpose of higher output is largely to allow higher levels on the shielded lines and offer a higher immunity to line induced noises and RF encountered in many broadcast installations. The lower source impedance provides the capability of driving longer shielded lines (with their larger shunt capacatances) without loss of high frequency performance.

## WHY THE HIGHER INPUT IMPEDANCE?

The purpose of higher input impedance essentially guarantees the ability to "bridge" a 600 ohm line without burden to the line and consequent level shifts when a unit is connected or removed.

## WHERE DO THE ERRORS ENTER?

In general, no serious error occurs from connecting a recorder with 5K (bridging) input impedance in place of a 600 ohm terminated machine. Although a rise of level may be experienced on the line, this is usually easy to adjust gain or if desirable, simply install a 600 ohm terminating resistor to stabalize the source line.

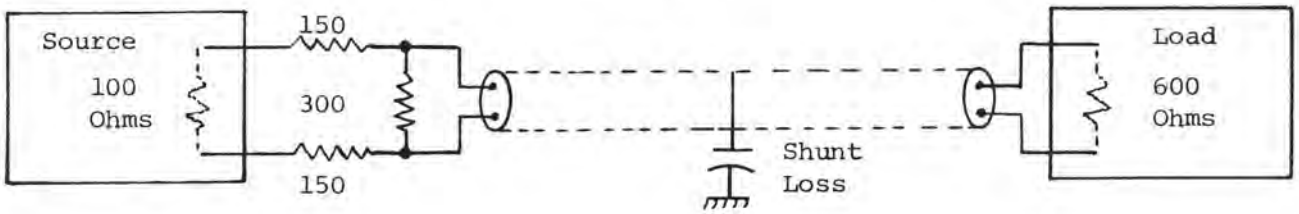
## HANDLING THE HIGHER OUTPUT LEVEL.

The first and obvious mistake can occur by simply turning down the Level controls to accomodate the system. If the adjustment is of a minor nature this may well be satisfactory but most amplifiers have a fixed noise "bench" which relates to current noises generated within the amplifier. The higher the output design, the higher is the noise bench. Amplifiers designed for an optimum +8dBm output are noiser than those designed for 0dBm. This is a fact of design which cannot be avoided. To provide a good dynamic overload (headroom), the gain control must be located interstage in such a manner that the pre-amplifier sections do not overload. This frequently allows for foil and coupling lines to cross-talk (internal transmission line noise) at a fixed level. To turn down an amplifier such as those in Audi-Cord equipment by 8dB will simply degrade signal to noise, bias and cue tone cross-talk and other noises. These amplifiers are designed to operate at +8dBm with a minimum of 10dB dynamic overload (+20dBm nominal clipping point) and should be operated in this manner. These amplifiers will deliver +2dBm and may be satisfactorily adjusted for 0dBm thru +4dBm by use of the 150 ohm connection. Refer to the instruction book for method of change over. This method will result in a lower output impedance and improved performance.

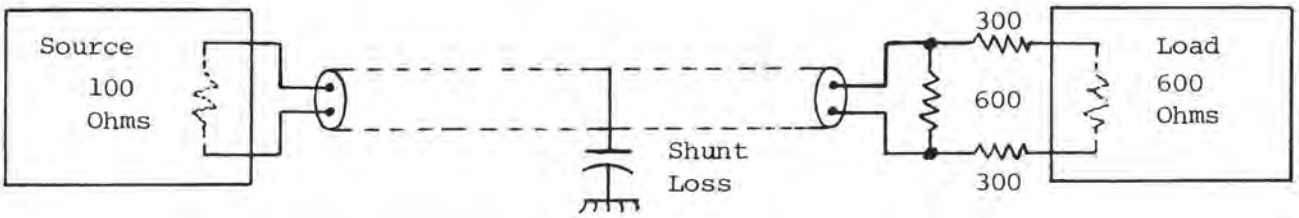
INSTALLING TERMINATING PADS.

Many users may option for constructing and installing a loss pad to reduce the output. Here again, although a good method; mistakes in judgement can prevail. Is it best to install the pad at the source (*cart, machine*) or the load (*console*)? Obviously if a pad is installed at the source, the driving source impedance may be destroyed if 600 ohm design is used. If long lines are used, the pad should be installed at the load. This can be shown as follows:

SOURCE PAD DESIGN
6dB Loss - 6X Loss in
Source Z




Load Pad Design - 6dB loss
No loss of source Z



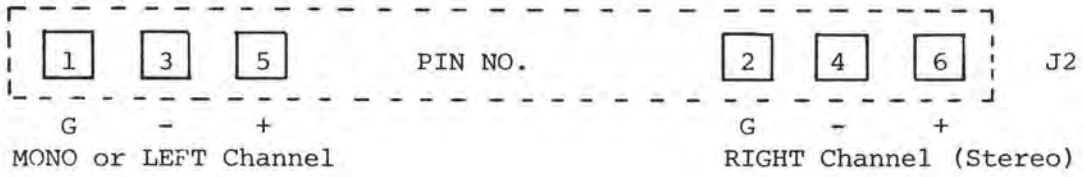

Obviously the pad design can be determined for matching at the source without degrading the source impedance if and only if the source impedance is measured or known and the rated load impedance is ignored.

ALTERNATE METHODS

The Audi-Cord output may be reduced from the nominal +8dBm to lower levels by using the 150 ohm output tap as earlier mentioned, construction of a satisfactory loss pad usually at the load end to take advantage of the higher level transmission line capability or by altering the gain of the Program Output amplifier if desired. Audi-Cord will be happy to provide information and components free of charge for almost any level of output voltage. Please call our Customer Service if help is required.

## CONNECTING TO THE PLAYBACK

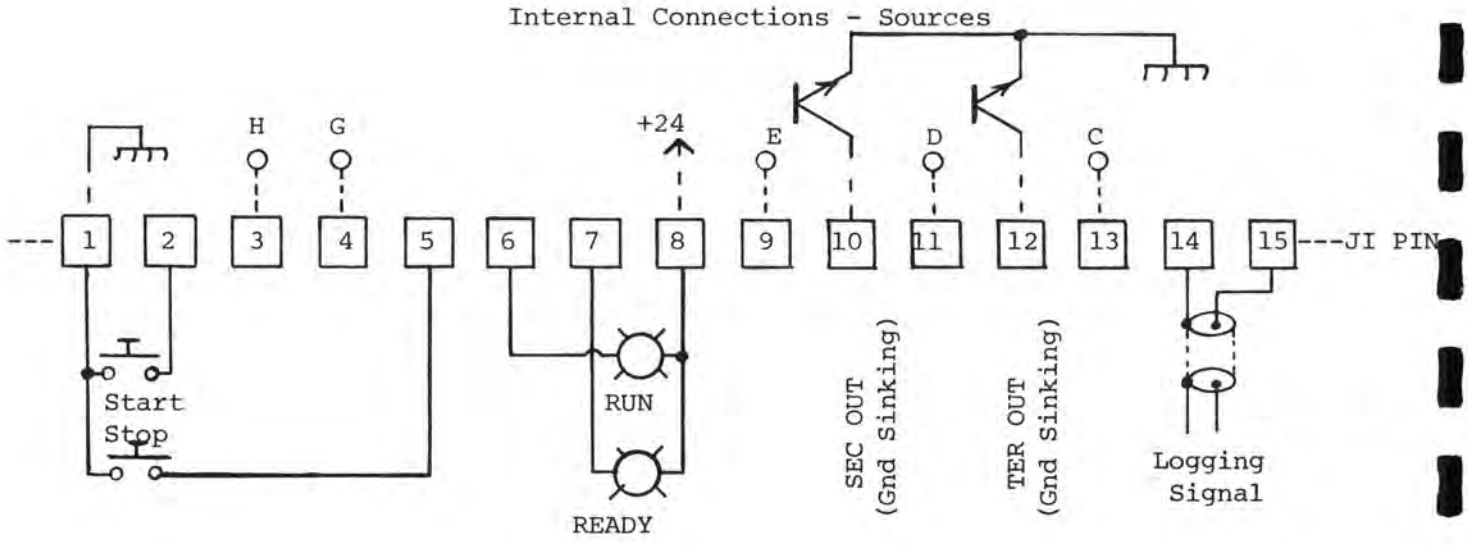
The program audio output is connected to J2 located on the rear mainframe cover. The connections are as follows:




The audio output is factory connected for balanced 600 ohms rated load impedance. If the output level required is 0 dB (*0.775 volts*) or less or a load impedance of 150 ohms is required, the balanced 150 ohms rated output should be used. This is selected by removing the rear card cover and moving the output cable from the left connector to the right connector located adjacent to the output transformer(s).

The 15 pin remote control connector J1 is factory wired for the 10 normally used outputs. The remaining 5 pins are connected to the programming receptacles as indicated. These may be connected for interface needs as previously described or to the desired optional outputs available. These will be explained in subsequent chapters.

The typical remote connections are as indicated in the diagram below.



## OPTIONAL CONNECTIONS

The optional programming receptacles are lettered A through Z as previously described along with several of their uses. The remainder of these provide useful signal outputs for special functions. Many of these are at 12 volt CMOS logic level and require the use of the buffer/driver in series with any load exceeding approximately 120 micro-amperes or must feed directly to comparable external logic. The signals and their purposes are as follows:

| RECEPTACLE | SIGNAL OR CONNECTION | TYPICAL PURPOSE |
|---|---|---|
| A | Tertiary Cue Relay Common | Active only when relay is installed on the switching card. See circuit card description for instructions. |
| B | Secondary Cue Relay Common | |
| C | Connects to Remote, J1 | Connected to Pin 13 |
| D | Connects to Remote, J1 | Connected to Pin 11 |
| E | Connects to Remote, J1 | Connected to Pin 9 |
| F | Not Used | |
| G | Output to Remote, J1 | Connected to Pin 4 |
| H | Output to Remote, J1 | Connected to Pin 3 |
| J | Inverter Transistor (Coll.) | Refer to interface methods |
| K | Inverter Transistor (Base) | Refer to interface methods |
| L | Universal Transistor (Emitter) | Refer to interface methods |
| M | Universal Transistor (Coll.) | Refer to interface methods |
| N | Universal Transistor (Base) | Refer to interface methods |
| P | Secondary Cue = HI (1) | |
| R | End of Sec. Cue = HI (1) *(Latches until Primary Cue Tone)* | |
| S | Record/Ext. Timer Stop Signal *(The user may select the recording timer or external accessory timer to stop from the beginning* (S to P connection) *or the end* (S to R connection) *of the Secondary Cue signal. The recording timer then displays actual playing time of the cartridge in overlap or non-overlap switching systems.)* | |
| T | Ext. Sec. and Ter. Cue Inhibit, LO = Enable, HI = Inhibit. *(Change jumper on logic card prior to use)* | |
| U | Not used | |
| V | Restart Transistor (Emitter) | Pulse, for length of Pri. Cue Inhibit Timer on each start. |
| W | Restart Transistor (Collector) | Pulse, for length of Pri. Cue Inhibit Timer on each start. |

| RECEPTACLE | SIGNAL OR CONNECTION | TYPICAL PURPOSE |
|---|---|---|
| X | Remote "Played" Light | Return other side of light to +24 |
| X | Remote Audio Mute | This circuit allows external audio muting. A ground at Pin Y activates audio. The open circuit voltage is +12 and load current is 20 ma. |
| Z | (Jumper to Y at factory) | |

## OPERATING CONTROLS

The Modu-Cart series playbacks are equipped with the Replay Lock and Reminder which is incorporated within the transport logic system. A four-element miniature switch S1, located at the top of the logic card allows selection of the kind of replay reminder desired as shown in the table below.

| SWITCH S1- | | | | OPERATING CONDITIONS |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | |
| ON | ON | OFF | OFF | Replay only by removing & reinstalling a cartridge |
| ON | ON | ON | OFF | Replay by removing cart. or press "Stop" pushbutton |
| ON | OFF | *ON | OFF* | Replay not prevented. "Played" light indicates status |
| OFF | OFF | OFF | ON | Feature totally disabled. "Played" light inoperative |

*If stop P.B. reset is desired. If not, set 3 off, 4 on.

| | |
|---|---|
| READY LIGHT | Indicates that the cartridge is in place and the machine is ready to play. |
| START PUSHBUTTON | Places the machine in the run mode. |
| RUN LIGHT | Indicates that the transport is in the run mode. |
| STOP PUSHBUTTON | Stops the transport and/or resets the logic when replay lock is chosen to provide this option. |
| CARTRIDGE SENSOR | Signals the logic when a cartridge is in place and turns the motor "on". |
| SEC LIGHT | Signals when a Secondary Cue tone is received |
| TER LIGHT | Signals when a Tertiary Cue tone *(or logging decoded tone in the case of this optional card)* is received. |

# SECTION III

## CIRCUIT DESCRIPTIONS

### TRANSPORT CIRCUITS

#### CONTROL LOGIC CARD

The control logic for both playback and recorder (*when connected*) consists of 7 CMOS digital intergrated circuits and 5 transistors. These circuits are located on a vertical plug-in card at the rear of the transport section.

Integrated circuit U2 is a quad NOR latch with "Set" input predominant. This circuit provides the latching storage for Start, Stop, Record, and the Replay reminder as well as deriving the end of Secondary Cue signal when this circuit is used.

Integrated circuit U4 is a dual 1 shot multivibrator which provides precision timing for the Primary Cue inhibit circuit and the Primary Cue tone burst when a recorder is attached.

The remaining I.C.'s provide for utility gating and steering of the input and output signals. Transistors Q1 through Q4 are high gain darlington interface drivers for the required outputs. These may be either "sourcing" or "sinking" outputs as required by the external circuits. All customer input connections such as Start, Stop, and the recorder inputs are "ground sinking" inputs and are equipped with "bounce" and RF filters to insure outside noise immunity. Transistor Q5 is the squaring amplifier for the accessory tape timer pulses.

To assist in troubleshooting, the various signal lines are indicated in the "true" (*signal present*) logic statement. For instance the signal statement Start = 0 refers to the "0" ground required to effect this action. At other times, the inverse statement is assumed. In this case Start (*not "Start"*) would be equal to "1" or approximately + 12 volts.

#### HEAD PREAMPLIFIERS CARD

This card is located at the lower left side of the transport assembly. The controls are accessible through the front panel door provided. The circuits contained on this card provide amplification and equalization for the Cue head and one or two program heads as required for mono or stereo operation. The output voltage is approximately 0.2 volts RMS constant (*flat*) for normal recording levels at all frequencies. These signals are coupled via the interconnect circuit card to output amplifiers or switching circuits located in the mainframe assembly.

Linear integrated circuit U1 *(and the optional stereo Right Channel duplicate circuit)* provide the program head amplification. Two equalizer controls for each channel are provided. R7 is the Lo Frequency control for the Left Channel or monophonic pre-amp, affecting those frequencies from approximately 1 kHz and lower. The range is approximately 6 dB at 50 Hz centered over the nominal response. R11 is the Hi Frequency control for this channel, affecting frequencies from 1 kHz upward. The range at 15 kHz is approximately -4 and +8 dB centered over the nominal response. These same controls for Right Channel stereo are R21 and R25 respectively. R2 and the equivalent R16 for Right Channel stereo are the output gain controls.

U3 is the cue head preamplifier. Fixed equalization of complex nature is provided by R32, R33, C22, and C23. These components along with the gain stability of U3 will maintain close tolerances permanently and insure proper output level for metering circuits and logging outputs derived ahead of the Cue level control, R29. A single control is used primarily to allow "turn off" of the sensor(s) for maintenance needs. The sensor designs are of wide latitude and equal in gain sensitivity, making the single gain control setting adequate for all sensors.

## INTERCONNECT CIRCUITS CARD

This card is located at the lower rear of the transport assembly,terminating at the edge to mate with the 50 pin receptacle in the mainframe. A vertical circuit card holder accommodates the Logic Circuit Card, and another card holder accepts the Head Preamplifiers Card. This card provides connection foils for these circuits.

Transistor Q3, the isolating LDR, SCR Q1, and diodes D2 through D5 operates as a motionless control switch for the capstan motor, signalled by the presence of the cartridge.

Transistor Q2 operates as a saturated DC switch for the pressure roller solenoid. Capacitor C1 and resistor R1 form a ramped energy circuit for the solenoid which is accelerated by application of a momentary over voltage.

## DECK AND PANEL CIRCUITS

The panel controls, motor and deck circuits are plugged in to the Interconnect Circuits Card by pin and post connectors. The deck contains two optoelectronic sensors, one which indicates the presence of a cartridge, and one which operates as a time pulse generator from the rotation of the capstan motor. Since the motor operates at 600 RPM, this output is a pulse at each 0.1 second interval.

# MAINFRAME CIRCUITS

## POWER SUPPLIES CARD

This plug-in card is located in the mainframe, accessible by removing the rear card cover. The card contains two separate regulated power systems for 12 and 24 volts and supplies unregulated DC for the solenoid.

Diodes D2, D3 and package regulator U1 in conjunction with capacitors C1 and C3 are the 24 volt power supply. D4 is the couple to the solenoid and D1 serves as reverse voltage protection for the regulator.

Diodes D6, D7 and regulator U2 in conjunction with capacitors C2 and C4 are the 12 volt power supply. D5 provides reverse voltage protection for this regulator.

## PROGRAM AMPLIFIERS CARD

This plug-in card, located in the mainframe, contains one or two amplifiers as required for mono or stereo models. The input audio is furnished at approximately 0.2 volts RMS from the Head Preamplifiers Card via the gain controls. This input for the mono or Left Channel is switched to the phase inverter Q3 by the LDR. Transistors Q1 and Q2 are the complementary push-pull amplifiers. C1 couples audio output to the associated transformer T1 which is located on the mother board. The Right Channel when used is identical except for the change of component part numbers.

## 1 kHz CUE SWITCHING CIRCUITS - LOGGING ISOLATOR

This card is also located in the mainframe section. The Cue Tone signal input is from the Head Preamplifiers Card at approximately 0.3 volts RMS for normal tone levels via the Cue Gain control.

Integrated circuit U1 is configured in a low gain, high stability passband active filter circuit. Two sections of filter with slight "stagger" frequencies are compounded to add to the Q and provide adequate band width. The passive characteristics are fix-tuned at the factory by two resistors identified as "R tune" in the schematic. These should require no further attention. The output is coupled via C2 to the two stage signal rectifier and current amplifiers Q1 and Q2. The output is logic 1 for tone on state. The output is returned to the Logic card for further switching actions.

The Cue tone and logging signals taken ahead of the Cue Gain Control (*on the Head Preamplifiers Card*) is provided to the Logging output isolation transistor Q3. The emitter coupled output stage provides adequately low output impedance and excellent output isolation. No gain control is provided in this output.

## SEC AND TER TONE SWITCHING CIRCUITS

The optional Secondary and Tertiary Cue switching card is located in the mainframe section. This card is also optional with the 8 kHz Tertiary circuits altered for 3500 or 4000 Hz logging (*Logic decoded*) output.

These circuits are identical except for the center frequency of the design. Each circuit consists of a 2 section I.C. (*U1 for SEC, U2 for TER or Logging*), comprising a 2 pole active passband amplifier of low gain and high stability. These are factory tuned and should require no further attention. Signal input is from the Head Preamplifiers Card via the Cue Gain control. Each circuit has two open collector load drivers (*Q3 and Q4 for Secondary Cue and Q7 and Q8 for Tertiary Cue or Logging option*). One of these is connected to the front panel signal lights, the other is connected to the remote connector J1. An optional relay location is provided on the circuit card as a customer option. To install the relay, it is necessary to remove the link which provides the open collector logic output. The relay coil is then substituted as the transistor load and the desired normally open or normally closed contact is selected by a link installed at the card edge. It is also necessary to connect the relay common from the "programming terminal options" to the remote connector J1 to complete the contact circuit. (*Refer to the circuit card pictorial for link locations.*)

## MOTHER BOARD CIRCUITS

The mother board contains card receptacles and printed wiring to accept the transport card edge and the mainframe plug-in circuits. Additional wiring includes the EMI filter composed of L1, L2, C1, and C2, connections for the incoming AC line, the power transformer, audio Transformer(s), and connections to the rear panel. When part of the record-reproducer, the connections to the companion recorder are provided for interconnection.

Two transistor circuits are located between the power supplies and the program amplifier(s) cards. These are the universal output transistor Q12 and its associated parts and the input inverter Q11 and associated parts. These circuits are connected to the row of programmed output receptacles and are available to the remote connector J1 as explained in the Interface Methods section.

# SECTION IV

## TRANSPORT DESCRIPTION

### DECK AND DRIVE SYSTEM

The Modu-Cart transport system utilizes a cast aluminum deck overlayed with a stainless steel wear plate. The solenoid is of air damped design, connected to the pressure roller via a cross-shaft suspended on two ball bearing pivots to remove undesirable end lash. The solenoid linkage consists of a tensilized mylar drive band and a unique split roller regulator. One of these rollers is directly pinned to the cross-shaft. The other roller is an idler to which is connected the solenoid. Located internally of the two rollers is a silicone rubber part and a pin. This rubber is of such design to absorb approximately 30 percent of the solenoid pull and to maintain the pressure at the roller essentially constant. Since the solenoid is designed not to bottom and has excess pull, this pull which is stored in the rubber part is returned to the pressure roller when required. This combination of parts offers other advantages in as much as no adjustment of the solenoid or its linkage is required. The pressure roller can readily displace when thickness of tape varies and the motor bearing load can be maintained at a lower value to extend its life.

### HEAD MOUNTINGS AND GUIDES

The Modu-Cart head mountings are of the inverted design, allowing for top adjustment of the heads and easy removal from the deck for adjustment on external flat surfaces such as a precision surface plate. The tape guides are of two piece design of stainless steel. This arrangement allows individual top and bottom surface adjustment for additional guiding precision as required. The two parts are designed to interchange the wearing surfaces as such wear occurs in later use, resulting in twice the wear life.

### CARTRIDGE SENSOR

This assembly is a moving plunger located directly in front of the cartridge center between the head locations. The moving plunger interrupts an optical sensor beam when engaged and develops the logic signal for the electronics.

# SECTION V

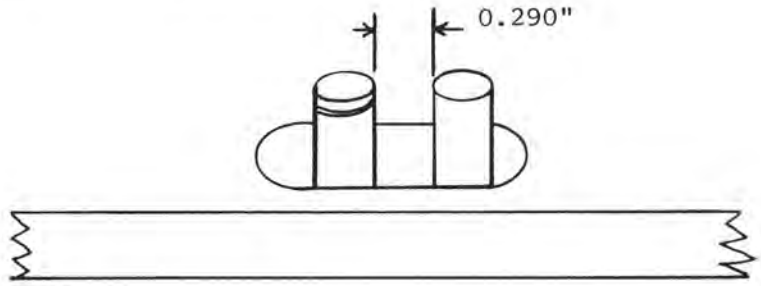
## TRANSPORT MAINTENANCE

### CROSS-SHAFT ADJUSTMENT

The cross-shaft will normally require no further adjustment. The proper adjustment if required is the point of zero end lash, consistent with full freedom of rotation on the pivots. The pressure roller shaft is located directly on center over the motor shaft.

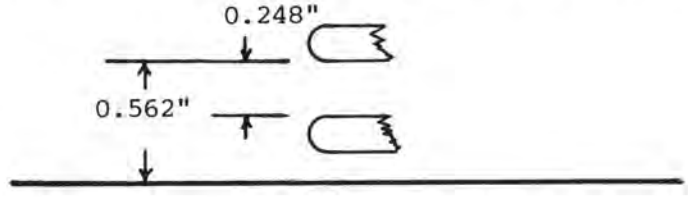
### MOTOR SHAFT ADJUSTMENT

The motor shaft is located exactly 0.290 inches to the rear of the pressure roller shaft when it is in the vertical position. Use a parallel precision gauge for this adjustment.




### TAPE GUIDE HEIGHT ADJUSTMENT

The lower guiding surface of the upper guides is located 0.562 inches above a precision flat surface. The upper guiding surface of the lower guides is set typically 0.248 inches lower. This may be done by precision measurement to the surface plate or by using a penetrating gauge such as a Johannsen block.




### HEAD PENETRATION AND ZENITH

The proper head penetration is 0.285 $\pm$ .010. A convenient means of measurement is to scratch a line on the front edge of a typical clear cartridge cover.

The head zenith is carefully aligned for vertical perpendicularity of the head face to the deck surface. A small square or machined block may be used. Do not touch the face of the head with metallic objects as scratches and magnetizm may be instilled in the head, especially with steel objects.

## HEAD HEIGHT, TRACK ADJUSTMENT

Adjust the head center line to 0."438" (7/16) above the deck surface. Typically the upper and lower extremes of the pole pieces will be at the edge of the tape. A piece of clear leader strung carefully through the tape guides will serve as a practical means of adjustment.

## CARTRIDGE HOLD DOWN SPRING ADJUSTMENT

Adjust this spring as necessary to apply moderate holding force to the cartridge. Do not over apply force as warping of the center area of older cartridges will result in poor tape guidance.

# SECTION VI

## ELECTRONIC MAINTENANCE

### HEAD AZIMUTH - MONOPHONIC

Verify that the head height, penetration, and zenith are as recommended in the Transport Maintenance Section before attempting the following adjustments.

1. Connect a 600 ohm resistor to the audio output connector J2. Connect a VTVM across this load.

2. Play a known standard 15 kHz azimuth tape.

3. Adjust the play head azimuth for maximum output as read on the VTVM.

4. Tighten the head lock screw, observing that the output reading remains at maximum.

### PHASE ADJUSTMENT - STEREOPHONIC

1. Connect 600 ohm loads to both L and R outputs of connector J2.

2. Connect a VTVM across the Left Channel load. Adjust the Play head azimuth for maximum output reading from a 15 kHz full track azimuth tape.

3. Connect the vertical input of an oscilloscope across this channel. Connect the horizontal input *(or channel 2 of a two trace scope triggered from Channel 1 zero crossing)* to the Right Channel output. Adjust the Play head azimuth for in-phase display of the two channels. Refer to Figure 1 below for typical phase displays. *(Phase jitter is normal during these tests.)*

4. Play a full track tape with frequencies from about 1 kHz through 15 kHz in several non-harmonically related frequencies. Observe that the phase display remains in phase for all frequencies.

5. Tighten the head lock screw, observing that phase shift does not occur.

### FREQUENCY RESPONSE AND EQUALIZATION ADJUSTMENT

1. Install a known accurate frequency response tape such as the NAB Standard Tape or one prepared on a calibrated Audi-Cord record-play machine.

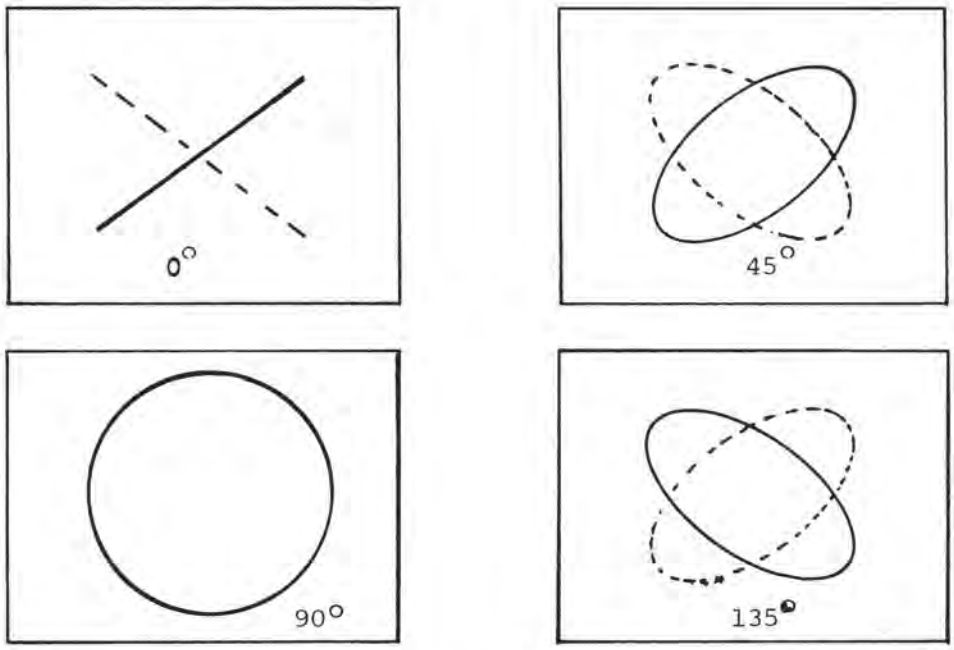



Figure A

2. Play the tape and observe the results for frequencies above 1 kHz. Adjust the Hi frequency equalization control R29 (and the companion R7 for Right Channel of stereo units) for flattest response of frequencies from 1 kHz through 15 kHz.

3. Observe frequencies from 1 kHz down to 50 Hz. Write down each output level and apply fringing corrections if a full track tape is used.

4. Adjust the Lo frequency equalization control R35 (*and the companion R13 for Right Channel of stereo units*) for flattest response from 50 Hz through 1 kHz.

5. Play the entire tape and make minor corrections as required for flattest response from 50 Hz through 15 kHz.

## PROGRAM PLAY LEVEL ADJUSTMENTS

1. Play a standard level tape of the operating flux level choice. Adjust the program Play Level Control R2 (*and the companion R16 for Right Channel of stereo units*) for the desired output. Do not exceed +8 dBm.

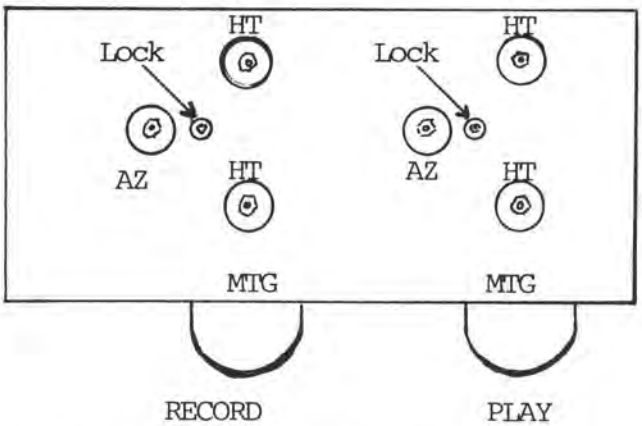
   NOTE: *Audi-Cord playbacks are factory adjusted for +8 dBm from a reference fluxivity of 160 nWb/m at 1 kHz in accordance with the 1975 NAB Cartridge standards.*

## CUE LEVEL ADJUSTMENT

1. Record a tape with each tone at 6 dB below normal recorded level. Refer to "Cue Tone Level" of the recorder instructions for method of adjusting a recorder oscillator.

2. Play this tape and adjust R29 for reliable operation of each sensor.

NOTE: *Audi-Cord playback sensors utilize a specially equalized pre-amplifier and closely designed switching electronics. There should be only a very minor difference in the single cue gain setting for any tone at proper recorded level. A single control in combination with wide rejection latitude of the sensors will tolerate considerable difference in recorded level as required.*




HEAD ADJUSTMENTS LOCATION

# SECTION VII

## ELECTRONIC TROUBLESHOOTING

The Audi-Cord Corporation Engineering and Customer Service Departments are available to assist in any electronic troubleshooting procedure which may be of complex nature. Frequently this service can result in savings of down time should failure occur. Remember to *remove power from the unit* during all times possible when out of the cabinet. *Hazardous voltages are present* on some circuit cards and terminals.

### VOLTAGE MEASUREMENTS

The +24 DC bus may be measured at the rear plug connector J1, Pin 8. The panel lamps and meter indications can also assist in isolating the probable area of fault and difficulties.

### LOGIC LEVELS AND TERMS

The Modu-Cart logic system is of CMOS digital design operating at +12 volts with respect to chassis. The term logic 1 (*or Hi*) refers to a voltage at or near +12 volts and logic 0 (*or Lo*) refers to near gound, typically less than 1 volt. Measurements of logic voltages as indicated on the logic diagram should be done with great care, not too short to adjacent pins or ground. A 20K ohm per volt DC meter is satisfactory for most measurements. Some signals are of short duration and may require the use of an oscilloscope with DC input to be seen accurately.

### ISOLATING THE DIFFICULTY TO A CARD SECTION

Since the Modu-Cart consists of a transport with the pre-amplifier sections and a mainframe with sensors and line amplifier(s), it is desirable to determine which card is in fault. It is convenient to "*listen*" or monitor the cue signals on the remote connector J1 at Pin 15. These signals are essentially equal in level with approximately 0.25 volts RMS from stereo and 0.50 volts RMS from mono systems. If not present, the pre-amp is likely to be at fault.

In a similiar manner, remove the back card cover and "*listen*" to the program pre-amplifier on C2 for mono and C4 for right channel of stereo of the program amplifier. The signals will be approx. 0.1 volts RMS if the pre-amp is operating properly.

### VALUES OF SCHEMATIC COMPONENTS

To effect the best calibration and performance it is some times necessary for Audi-Cord to change critical components by an increment of value. Please assume that these changes are not errors but are intended to improve performance of your Modu-Cart machine.

# SECTION VIII

## CIRCUIT CARD PARTS LOCATION

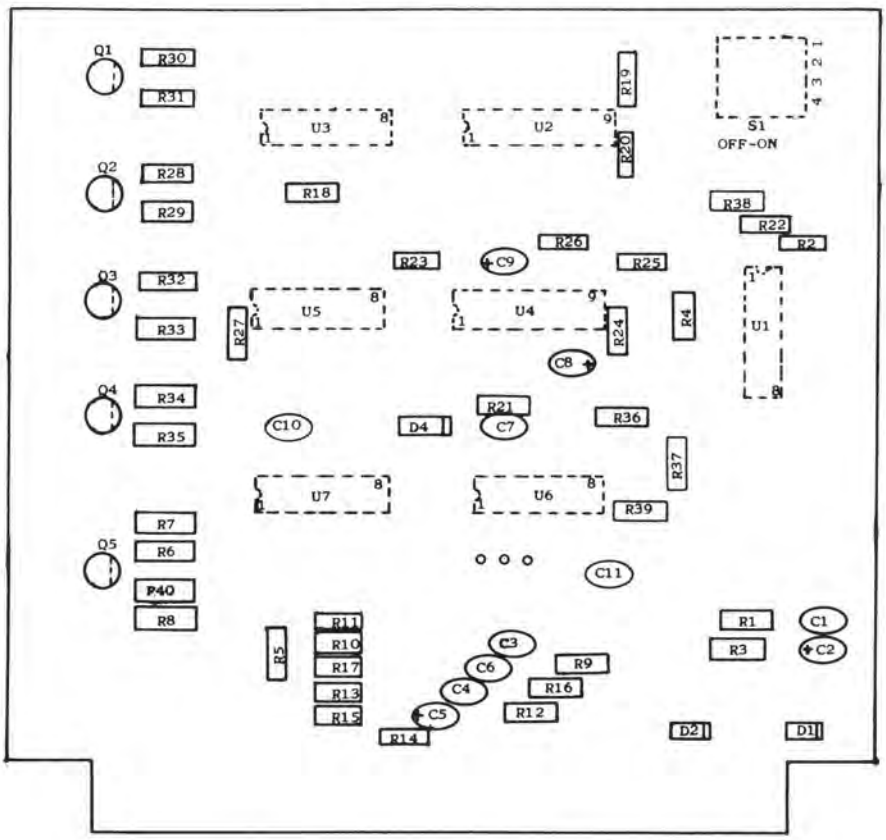



Figure 1 CONTROL LOGIC CARD 151-1

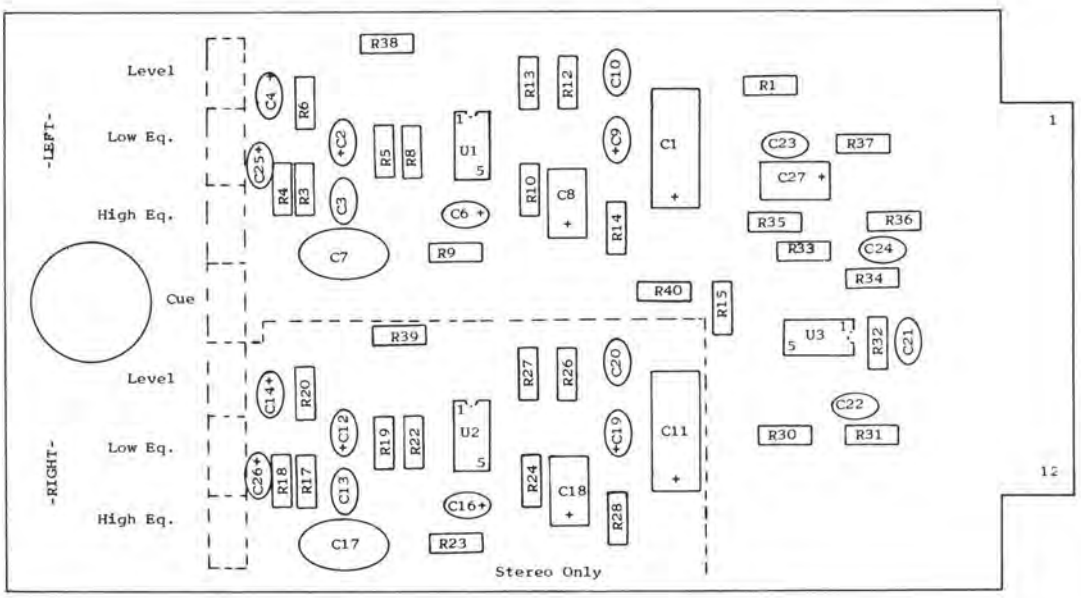
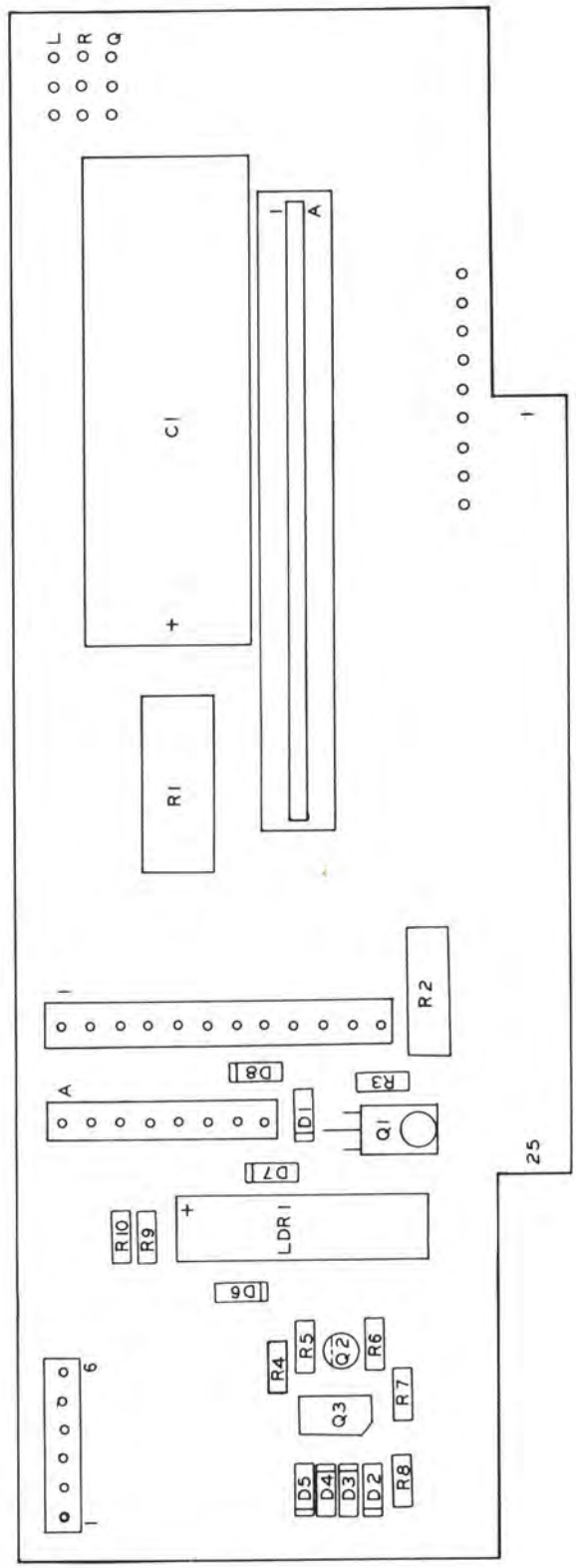



Figure 2 HEAD PREAMPLIFIERS CARD 151-3




INTERCONNECT CIRCUITS CARD 151-2

Figure 3

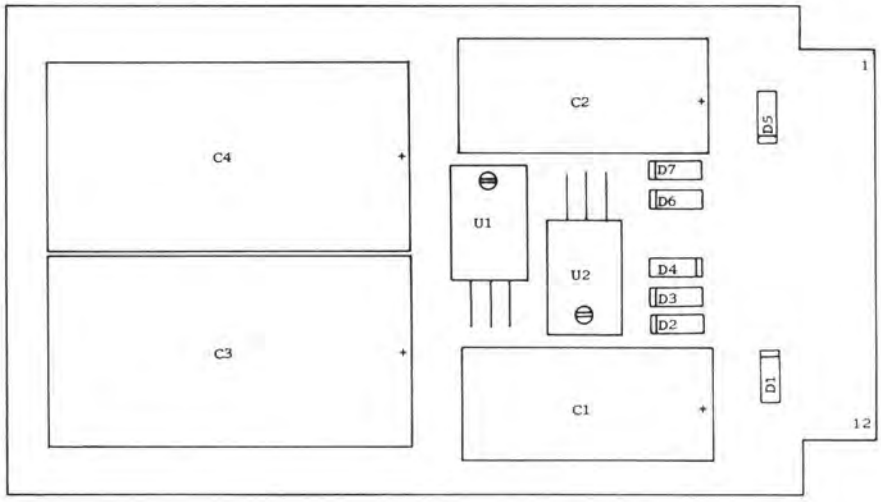



Figure 4 POWER SUPPLIES CARD 151-4

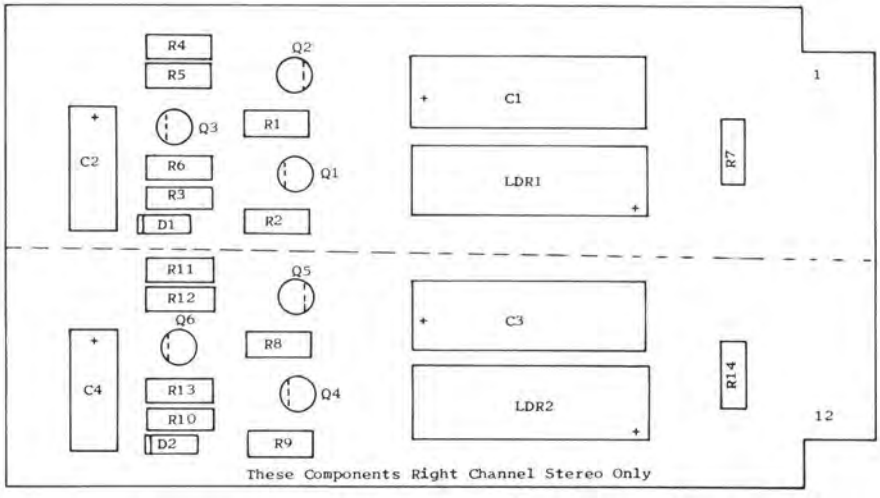



Figure 5 PROGRAM AMPLIFIERS CARD 151-5

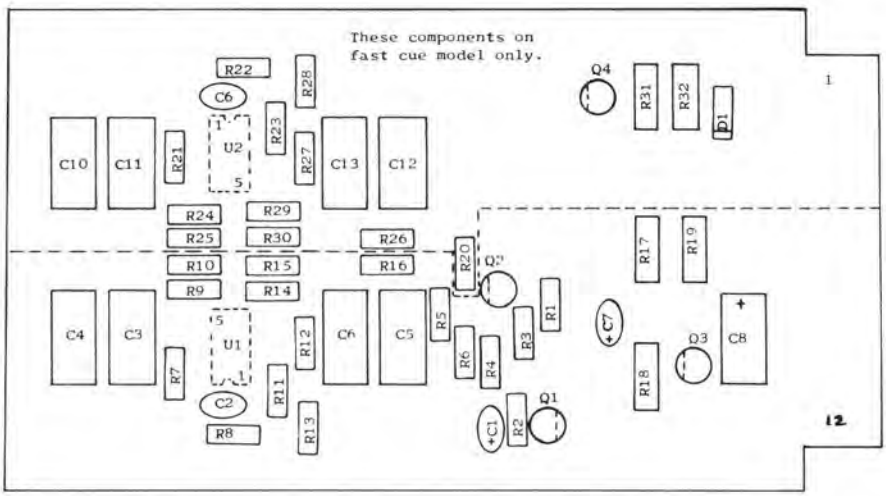



Figure 6 1 kHz CUE SWITCHING CIRCUITS - LOGGING ISOLATOR 151-6

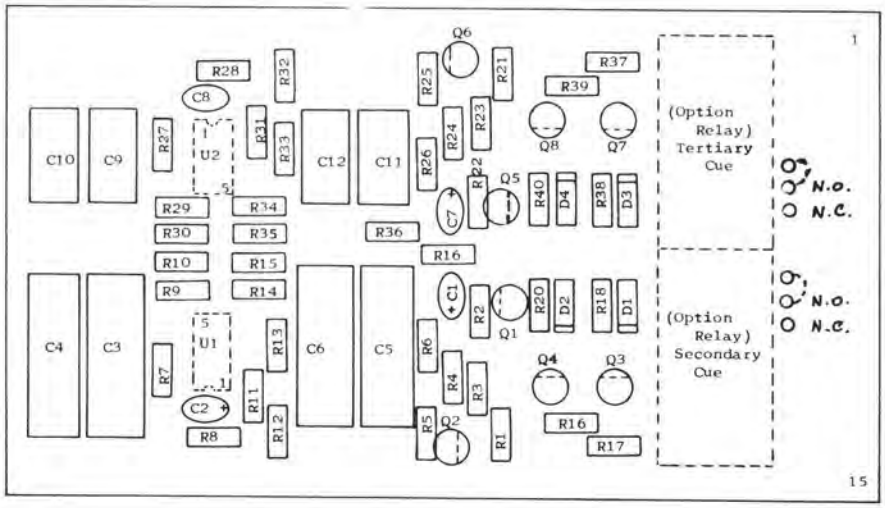



Figure 7 SEC AND TER TONE SWITCHING CIRCUITS 151-7

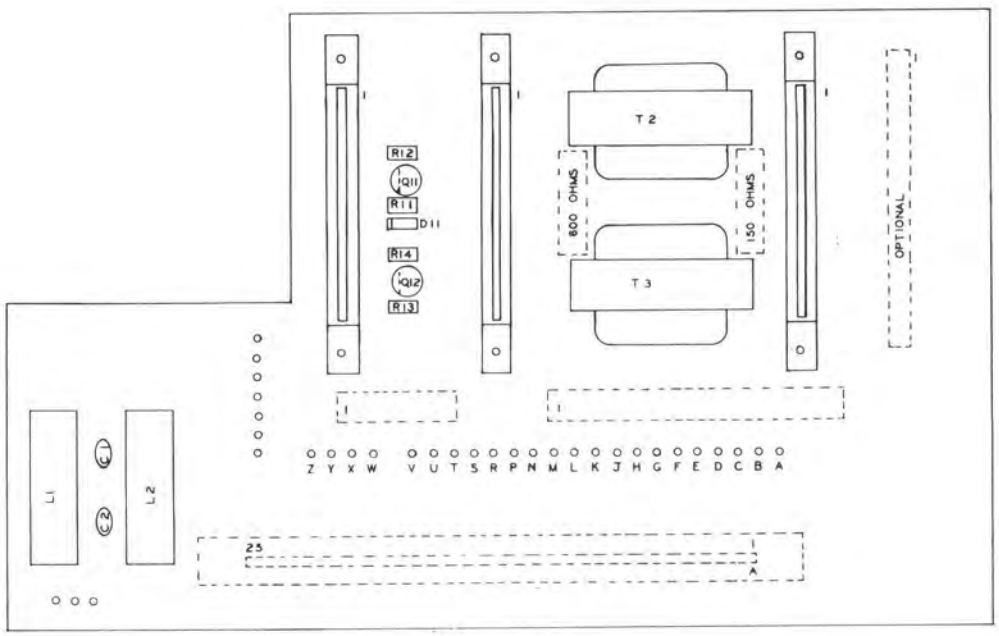
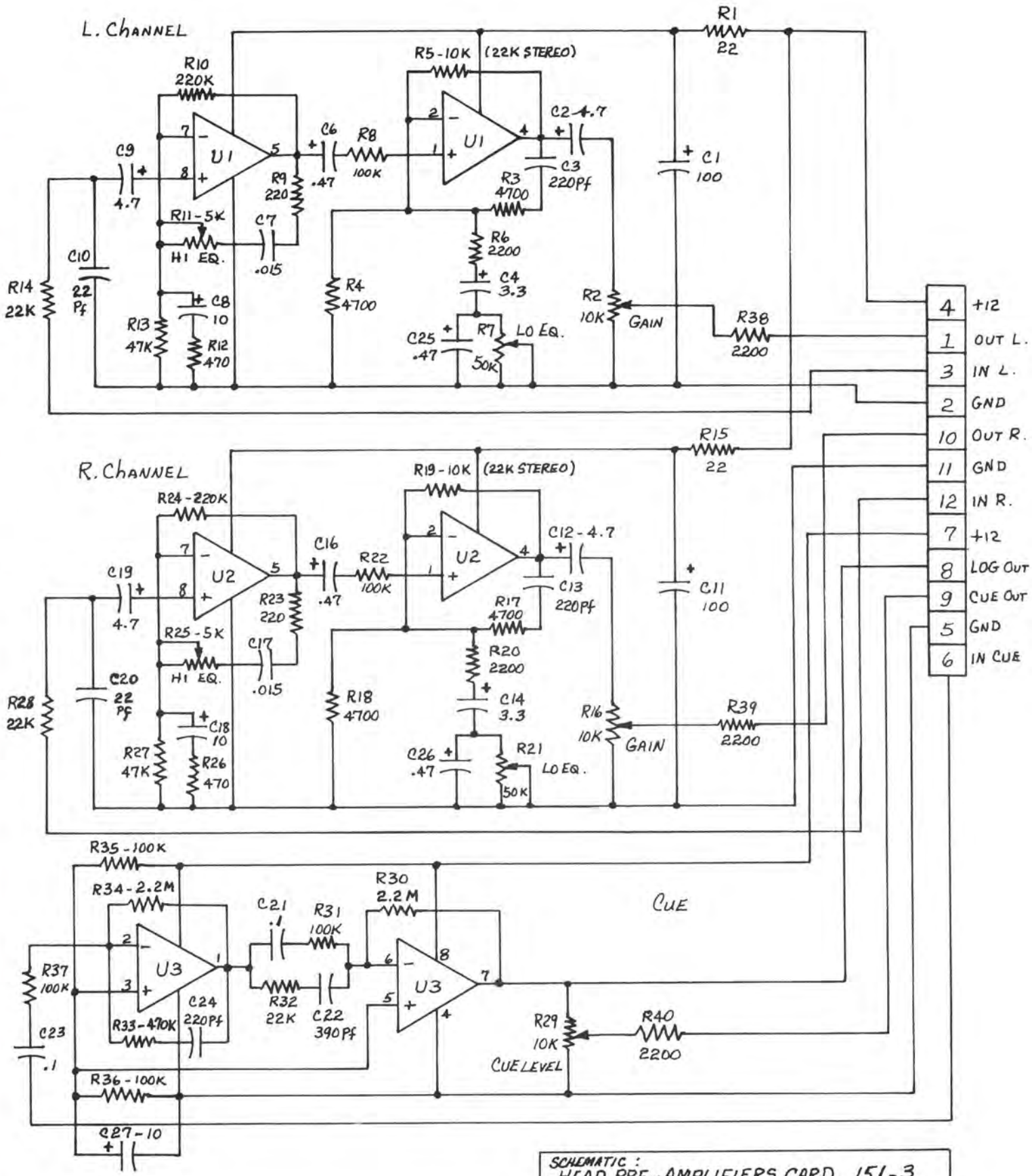
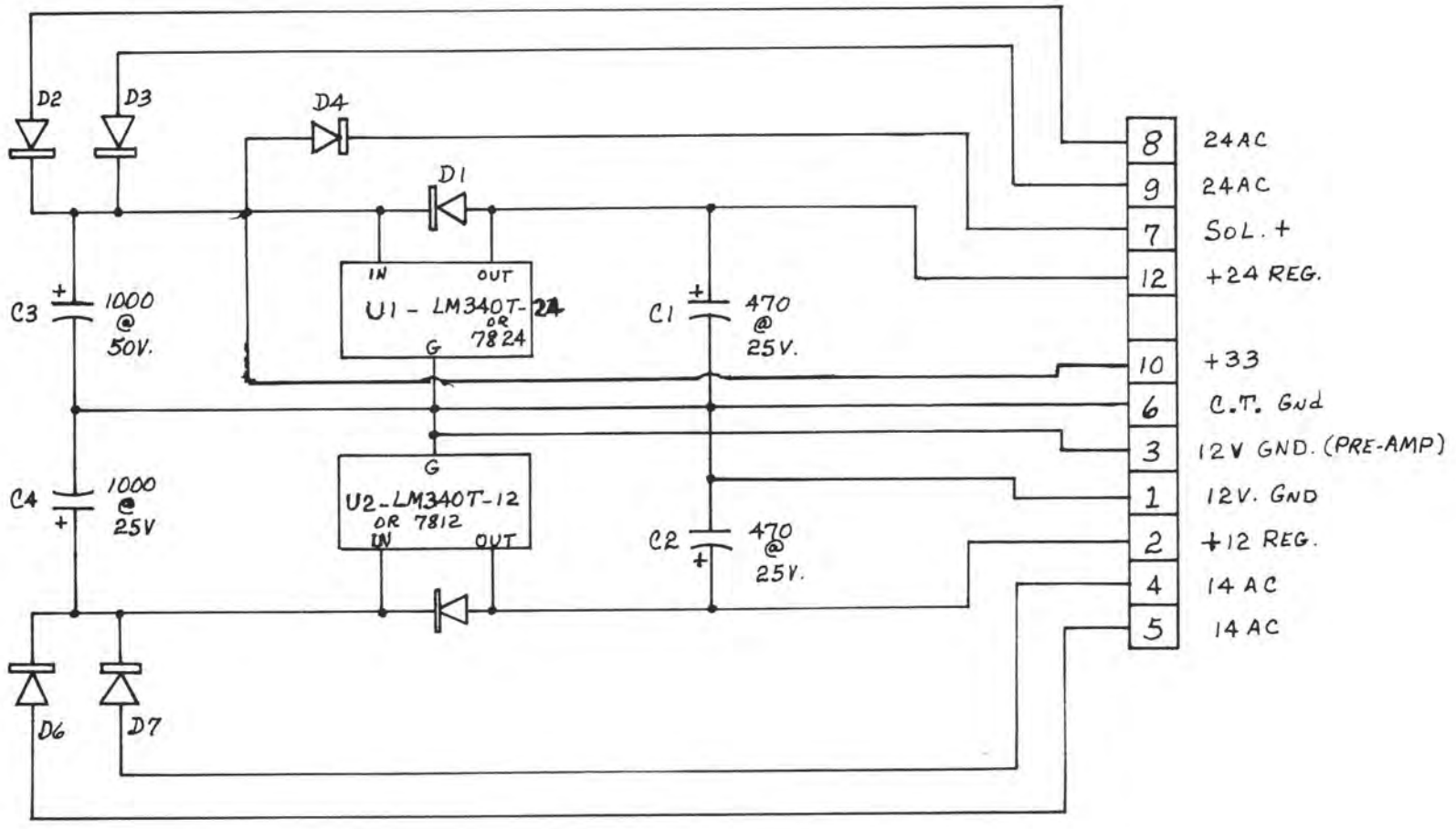



Figure 8 MOTHER BOARD CIRCUIT 151-8

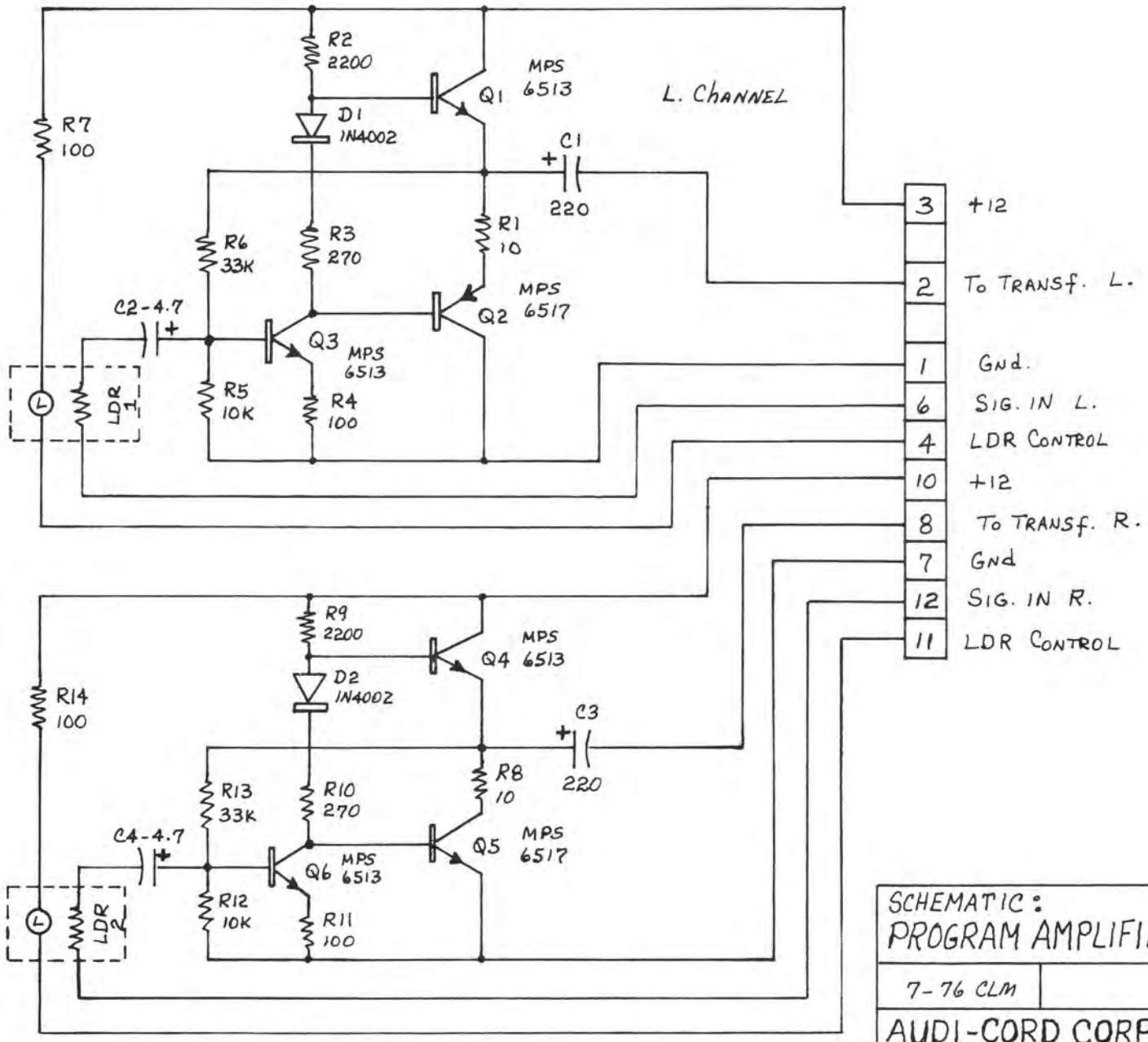



| | | |
|---|---|---|
| SCHEMATIC: HEAD PRE-AMPLIFIERS CARD 151-3 | | |
| 12-75 CLM | | |
| AUDI-CORD CORP. NORMAL, ILL 61761 | | 1-900-3 |



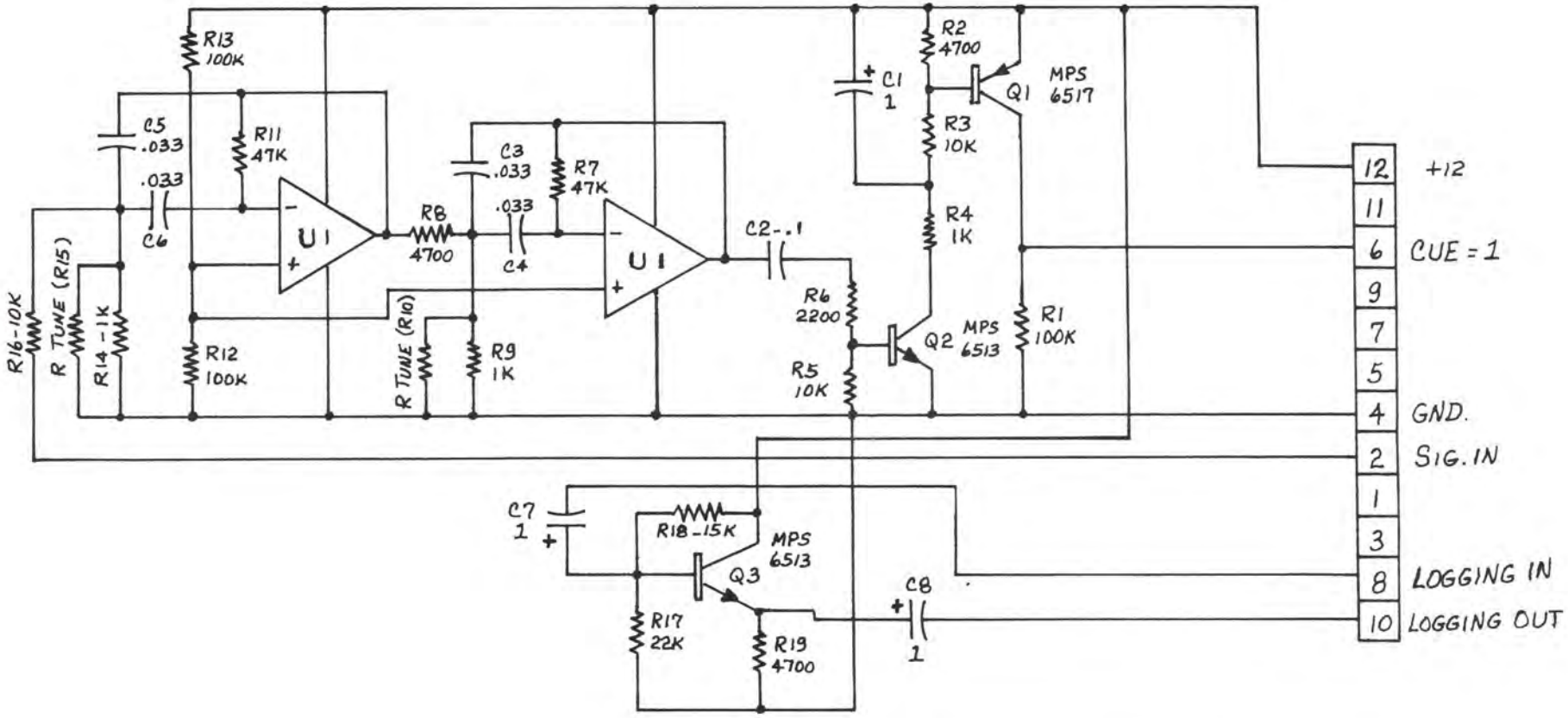

All Diodes = 1N4002

| | | |
|---|---|---|
| SCHEMATIC: POWER SUPPLIES CARD 151-4 | | |
| 12-75 CLM | | |
| AUDI-CORD CORP. NORMAL, ILL 61761 | | 1-900-4 |

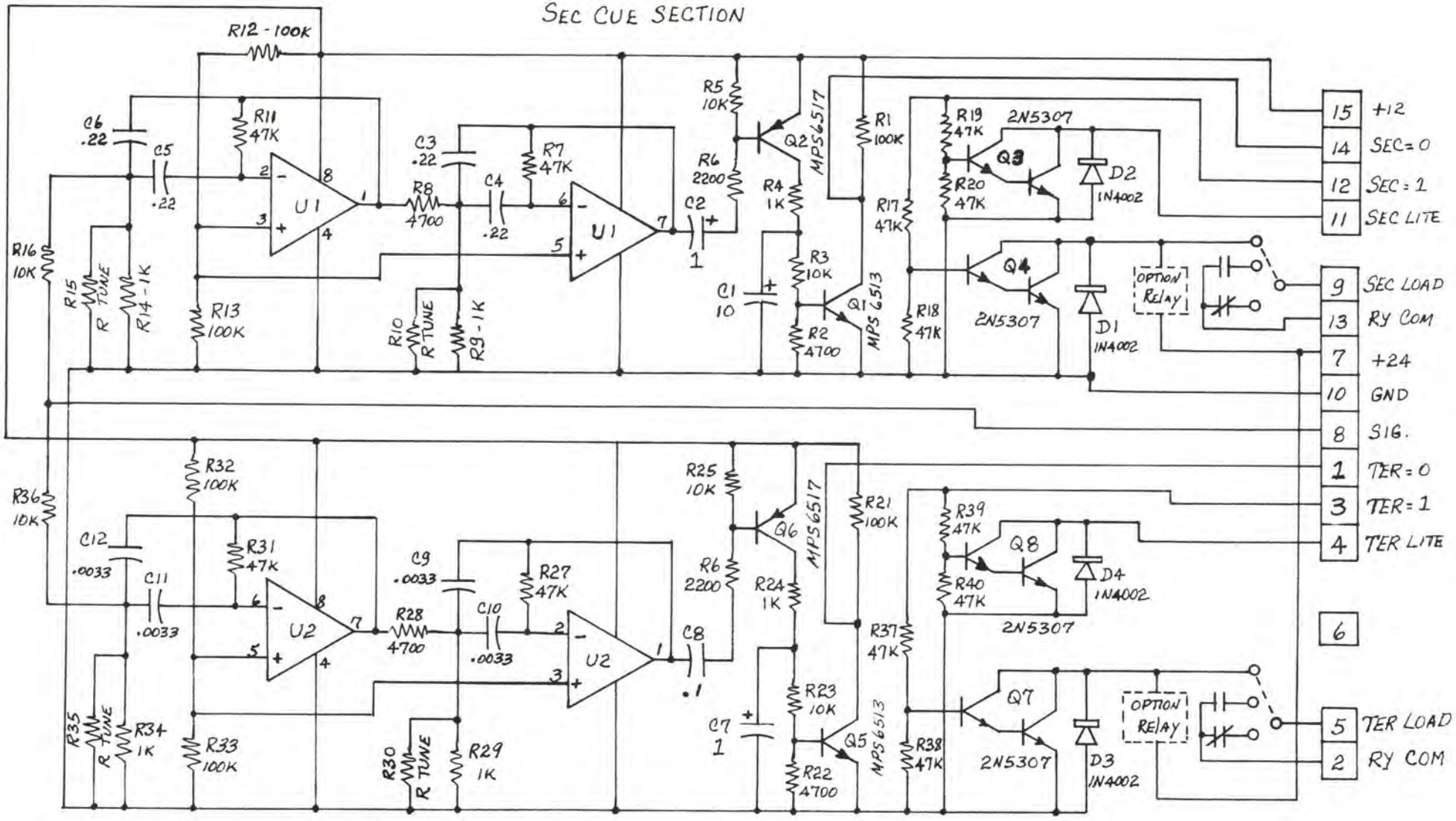



SCHEMATIC:
PROGRAM AMPLIFIERS CARD 151-5

| | | |
|---|---|---|
| 7-76 CLM | | |
| AUDI-CORD CORP.<br>NORMAL, ILL 61761 | | 1-900-5 |



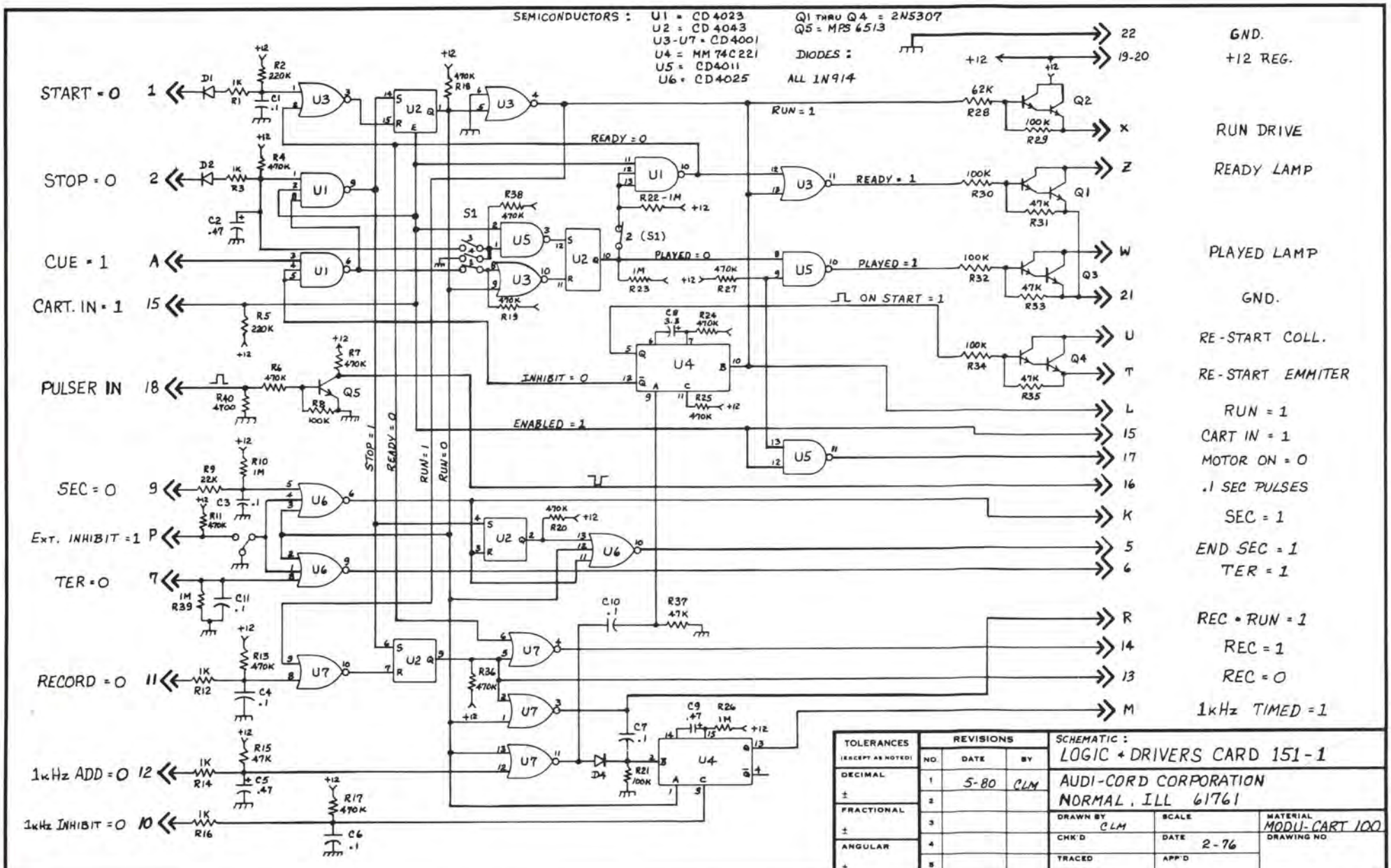

| SCHEMATIC: 1kHz CUE SWITCHING CARD 151-6 | | |
|---|---|---|
| 12-75 CLM | | |
| AUDI-CORD CORP. NORMAL, ILL 61761 | | 1-900-6 |




U1 , U2 = LM358 - MC1458

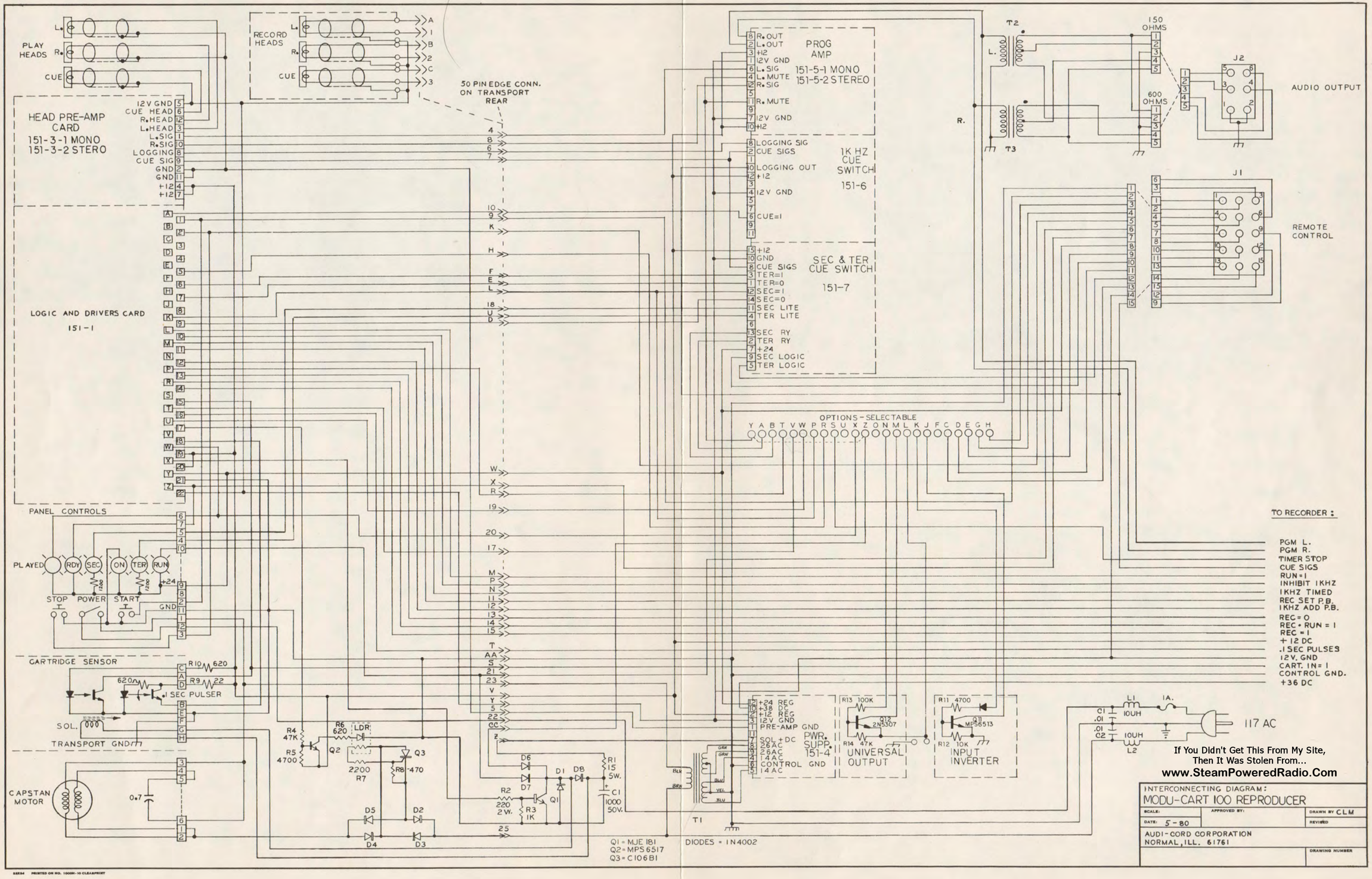
RELAY NOT SUPPLIED STD. = P+B R50-E2-Y1-24DC

| | | |
|---|---|---|
| SCHEMATIC: SEC AND TER CUE SWITCHING CARD 151-7 | | |
| 12-75 CLM | | |
| AUDI-CORD CORP. NORMAL, ILL 61761 | | 1-900-7 |




| TOLERANCES (EXCEPT AS NOTED) | REVISIONS | | | SCHEMATIC : LOGIC + DRIVERS CARD 151-1 | |
|---|---|---|---|---|---|
| DECIMAL ± | NO. | DATE | BY | AUDI-CORD CORPORATION NORMAL, ILL 61761 | |
| FRACTIONAL ± | 1 | 5-80 | CLM | DRAWN BY CLM | SCALE |
| ANGULAR ± | 2 | | | CHK'D | DATE 2-76 |
| | 3 | | | TRACED | APP'D |
| | 4 | | | | |
| | 5 | | | | |

MATERIAL MODU-CART 100
DRAWING NO.






INTERCONNECTING DIAGRAM:
MODU-CART 100 REPRODUCER

| SCALE: | APPROVED BY: | DRAWN BY CLM |
|---|---|---|
| DATE: 5-80 | | REVISED |

AUDI-CORD CORPORATION
NORMAL, ILL. 61761

DRAWING NUMBER

33E94 PRINTED ON NO. 1000R-10 CLEARPRINT

# SECTION X

## WARRANTY AND SERVICE POLICY

### WARRANTY

Audi-Cord Corporation warrants all Modu-Cart equipment to be free of defects in workmanship and material for one year. Exception is applied to fuses, lamps, heads, etc. which are considered replacement items of useful life and are guaranteed for 90 days. Audi-Cord will replace or repair all such material subject to the warranty periods.

Audi-Cord further guarantees satisfaction of the product for its useful life. If any part or portion fails that in the user's opinion was not satisfactory in performance or useful life, contact Audi-Cord for replacement or repair.

Audi-Cord reserves the right to request that any material subject to warranty repair or replacement be returned to our manufacturing location for inspection or repair.

### SERVICE POLICY

Audi-Cord will provide the necessary service parts to insure useful life of our product at a fair and equitable price as possible. Some materials used are subject to vendor availability and substitution, and may not be within our control. Therefore, we reserve the right to provide acceptable substitutes or redesign when necessary. Any unit or assembly may be returned for factory service upon prior notification or explanation of such service required.

Our Engineering and Customer Service Departments will provide advice for customer needs in service or operational requirements as needed without charge or obligation.

# I N D E X

# SECTION 1

## INTRODUCTION

### GENERAL DESCRIPTION

All Modu-Cart recorders are equipped with 1 kHz Primary Cue, 150 Hz Secondary Cue, and 8 kHz Tertiary Cue oscillators as standard. These three tones are precision divided in level and used as internal mini-frequency oscillators for day-to-day record-play response tests. Logging tone input and bias control system for automation encoders are standard in the recorders.

### SPECIFICATIONS: RECORDER

| | |
|---|---|
| Rated Audio Input (for 160 nWb/M) | *-24 dBm, 600 ohms, (50 mv.rms) min. |
| Input Impedance | 5100 ohms, Balanced |
| Max. Input Level | 2.5 V RMS (Higher inputs by change of bridging resistor values) |
| Amplifier Distortion | 0.5% total harmonic, 18 dB above 160 nWb/m, 1 kHz |
| System Distortion | 1% typical at 160 nWb/m, 1 kHz |
| Equalization | Per NAB Cartridge Standards, 1975 (Old Standard by Special Request) |
| Equalization Range | 10 dB @ 15 kHz, High Frequency<br>4 dB @ 50 Hz, Low Frequency |
| Response Accuracy (Recorded) | ±1 dB to NAB Standard Tape, Max. |
| Recorded Noise | _48 dB min. re 160 nWb/m, 1 kHz |
| Crosstalk, Cue to PGM | 50 dB or better |
| Crosstalk, PGM to PGM | 50 dB or better |
| Tone Oscillators | 1 kHz, 150 Hz, and 8 kHz, Standard |
| Tone Freq. Accuracy | ±5% Long Term, Adjustable |

*Does not fully meet the 1975 NAB Standards.

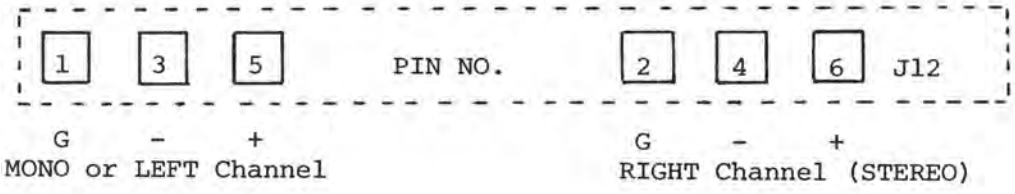
| | |
|---|---|
| Tone Oscillator Distortion | 5% max, Total Harmonic |
| 1 kHz Cue Tone Duration | 0.5 sec. ± 0.25 sec, Electronic Timed |
| Bias Oscillator Frequency | 100 kHz, nominal |
| Remote Control | 12 Pins permanently wired for:<br>Record Set<br>Record Set Indicator<br>1 kHz cue add<br>150 Hz cue apply<br>8 kHz cue apply<br>Logging bias control<br>Logging signal input<br>GND<br>+24<br>Universal input logic in (*inverter buffer*)<br>Universal input logic out |
| Internal Metering Modes | Record Line<br>Record Current<br>Program Bias<br>Tone Bias<br>Tone Recording Level (*OSCS*)<br>Replay Level (*As selected below*) |
| Replay Monitor Modes | Program or Cue Tones |
| Meter Accuracy | ±1 dB max, 50 Hz thru 15 kHz |
| Calibration Adjustments | All meter inputs |
| Frequency Response Test | 3 Frequencies, 150 Hz, 1 kHz, and 8 kHz |
| Response Test Accuracy | ±0.5 dB, verified by metering internal |
| Optional Record Timer | 4 Digit, Seconds and Tenths |
| Record Timer Stop Mode | Front or End of Sec. Cue, Selectable |
| Record Timer Accuracy | ± .2 second (*plus transport timing accuracy*) |
| Power Requirements | From play system |
| Dimensions (*R/P Models*) | 16" W x 15" L x 5 1/4" H |

# SECTION I

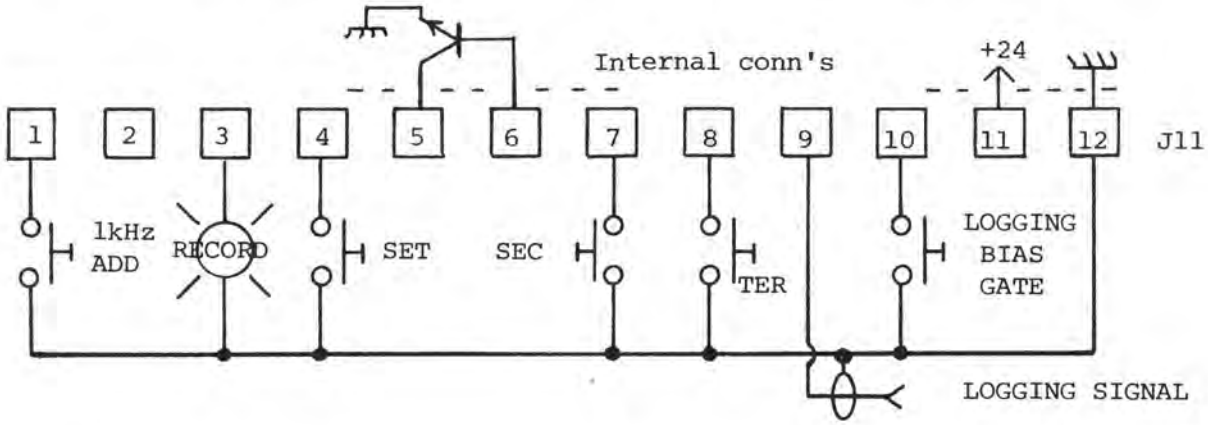
## OPERATING INSTRUCTIONS

### CONNECTING TO THE RECORDER

The program audio input is connected to J12 located on the recorder rear panel. The input impedance is 5100 ohms balanced and is rated for 600 ohms source impedance. However, this input impedance is acceptably high for most bridging requirements. Connect the input audio as indicated below:




The 12 pin remote control connector J11 is located on the recorder rear panel. The typical remote connections are as indicated below. The input inverter connected to pins 5 and 6 allows for special connection requirements. Refer to "Interface Methods" for typical connection methods.




### OPERATING CONTROLS

SET PUSHBUTTON — Places the recorder in the "record" mode anytime the playback is in the ready mode. Pressing "Start" starts the recording process.

| | |
|---|---|
| RECORD LIGHT | Indicates when the recorder is in the "record" mode. |
| SEC PUSHBUTTON | Causes the Secondary Cue to be recorded for the duration that the button is held down. The Secondary Cue may be recorded at any time the transport is in motion, either in record or replay modes. |
| TER PUSHBUTTON | Causes the Tertiary Cue to be recorded for the duration that the button is held down. The Tertiary Cue may be recorded at any time the transport is in motion, either in record or replay modes. |
| TONE LIGHT | Indicates that a tone is being recorded and its duration. This light indicates for any of the three tones. |
| BIAS LIGHT | Indicates that the bias oscillator is on. In normal recording this light will turn on synchronously with the "Start" of the transport. It also will turn on with the recording of any tone including the Logging tone. |
| RECORDED TIME *(Optional)* | This 4 digit readout indicates the recorded time of the program material. The time is reset to zero upon insertion of a cartridge or pressing the "Start" pushbutton. The time can be selected to be from the "Start" of recording to the front or end of the Secondary Cue. *(Refer to "Optional Connections".)* If no Secondary Cue is used or the playback is not so equipped, the time will be from "Start" to "Stop" of the recording process. |
| LEVEL CONTROL(S) | Adjusts the recording level of the individual channels. |

The following controls are located on the meter switch panel inside the recorder front panel. They are accessible by lifting the front panel outward at the bottom.

| | |
|---|---|
| 1 kHz TONE INHIBIT | Prevents the 1 kHz Primary Cue from being recorded. Press and hold the button down prior to "Start" of the recording process. Continue to hold this button for 1 full second minimum after the start. |
| 1 kHz TONE ADD | Allows the 1 kHz Primary Cue to be recorded at any time *(in addition to the automatic tone at the "Start" of the recorder)*. A momentary push of this button applies a timed cue burst. Continuing to hold the button will extend the 1 kHz Cue tone indefinitely and cause the transport to stop after the inhibit timer duration. *(This operation allows valuable measurements to be made in "Electronic Maintenance".)* |

| | |
|---|---|
| METER MODE | Allows selection of the mode of measurement during the recording process. Six positions are provided and will be explained below. An automatic electronic switching system transfers the metering amplifier(s) from the recording mode to the replay mode as each is in operation. |
| RECORD "LINE" POSITION | Monitors the level recorded from the incoming audio lines. The meter response is "flat" for a constant voltage vs frequency. |
| RECORD CURR. | Electronically tracks the current in the recording head. The response follows the pre-emphasis curve at high frequencies. Indicates presence of proper current in the head to prevent tape distortion. |
| OSC'S | Monitors the tone oscillators for proper recording level. All three tones are precision divided to indicate "0" for proper level. |
| REPLAY | Diverts the meter amplifier to read the playback signals during the record mode. Monitors the program or Cue tone replay as selected on the "Replay Mode" switch. These signals are calibrated to read "0" at proper replay level. |
| PROGRAM BIAS | Monitors the bias level to the program head(s) on the associated meter for each channel. Calibrated for "0" reading at proper bias. |
| CUE BIAS | Monitors the bias level to the cue head. Calibrated to read "0" on the Left Channel meter at proper bias. |
| REPLAY MODE SWITCH | This 2-position switch selects the program or cue channel replay to be monitored in the play mode or when the Record Meter Mode switch is in the "Replay" position. These inputs are calibrated to read "0" for either mode at proper level. A stable cue pre-amplifier with equalized output insures the accuracy of each tone, including Logging tones. The metered output is not affected by the cue gain control. |

# SECTION III

## CIRCUIT DESCRIPTIONS

### BIAS OSCILLATOR AND GATES CARD

This card is the top card of the right hand pair in the lower section. It is accessible for adjustment or removal by lifting the recorder front panel.

Transistor Q1, Q2, and Q3 are gates which control the bias oscillator and select the output LDR's for application of bias to the heads. Transistor Q1 allows program bias to be applied, while Q2 turns on bias to the cue head only. Either signal turns on the push-pull bias oscillator, Q4 and Q5. The bias level is front adjusted to each head as required by trimmer capacitors C5, C6, or C7. Trimpots R24, R25, and R26 located near the plug-in end are for calibration of the meter circuits.

Located also on this card is a second voltage regulator U1. Its purpose is to provide isolation of the recorder control loads and prevent overload of the regulator on the main power supplies card located in the playback.

### INPUT AUDIO CIRCUITS

The input audio circuits are composed of the input transformers, the primary series resistors located adjacent to each transformer, and the front level control potentiometer(s). The input impedance is 5100 ohms balanced as shipped. This impedance is usually suitable for bridging a 600 ohm source as low as 50 millivolts RMS (*-24 dBm @ 600 ohms*). If 10 K ohm bridging is required, substitute the two 1800 ohm resistors for 4300 ohms. The input sensitivity for this change will degrade to -18 dBm @ 600 ohms.

### PROGRAM RECORDING AMPLIFIER CARD

This card is the top card of the lower left pair, accessible by lifting the recorder front panel. The integrated circuit U1 serves both circuits of the stereo card when required while individual transistors Q1 and Q4 act as isolating amplifiers in each channel to provide maximum dynamic swing of voltage (*head room*) for the head.

Each channel is provided with Hi and Lo frequency equalization adjustment. The Lo frequency control (*R37 for the Left Channel or mono*) provides approximately +2 and -4 dB range at 50 Hz, centered over normal equalization. The Hi frequency control (*R29 for the same channel*) provides approximately +2 and -6 dB at 15 kHz, centered over normal.

R 25 and R3 of stereo units are calibrated potentiometers for the recording "Current" meter. The combination of R24 and C15 are selected to closely parallel the actual current in the recording head (*Left Channel*).

Transistors Q2 and Q3 are current amplifiers and gates for the logic signal which activates the amplifier. L2 and C13 are a high Q bias trap with C13 adjusted for minimum bias at the amplifier output.

Switch S1 disconnects the inputs from the audio sources and connects them to an accurately calibrated source of tone voltage from the three tone oscillators for day to day response tests. Under conditions of proper bias, these frequencies will record flat at NAB level ±1 dB. Refer to the Electronic Maintenance Section for these tests.

## TONE OSCILLATORS CARD

This is the lower plug-in card at the right side and is accessible by lifting the front panel. A single four section I.C. operates as three independent oscillators and mixing amplifier. These are stable bridged T oscillators in a controlled feedback configuration. Three trimpots are provided for each oscillator. These are output level, limited range frequency adjustment, and waveform adjustment to insure low distortion tones.

Two mixed outputs are taken from each level control. One of these feeds the mixing amplifier and the head via the bias trap, L1, and C1. The second mixed output feeds through selected resistors to a calibrated control located on the mother board and to both the meter circuit, for level verification and the "Response Test" switch on the Program Recording Amplifier Card. This system allows for accurate use of the three tone oscillators for day to day response tests.

Each oscillator is gated on or off by a transistor. Two transistors Q1 and Q2 provide current gain for the 1 kHz logic signal; Q3 is the 150 Hz gate; Q5 is the 8 kHz gate; and Q4 is the external logging signal gate. These gates also provide a matrix output to activate bias and the TONE recording lamp.

## METER MULTIPLEXER AND AMPLIFIER CARD

This card is the lower plug-in card of the left group and is accessible by lifting the front panel. Integrated circuit U1 is a quad analog switch with logic inputs for "record" or "play" modes and switches the input to the meter amplifier(s), Q1 and Q2 (*Q3 and Q4 for right channel of stereo units*) automatically to read the recording signal or replay signal as selected on the meter switches located on the inner front panel. The output of each amplifier is bridge rectified and fed to the associated meter(s). All inputs to the meter system come from calibrating potentiometers located elsewhere to provide "O" meter reading on all monitored signals.

# SECTION IV

## ELECTRONIC MAINTENANCE

The following adjustments and calibrations require that the companion reproducer is preadjusted as in Section 6 for the following:

a. Set the reproducer play level for +8 dBm in 600 ohms *(or to the operating "0" level required)* from a Standard Level Tape.

b. Adjust the reproduce head azimuth or phase to the standard of azimuth tape used.

c. Verify the reproduce equalization against a known accurate standard such as the NAB Standard Response and Level Test Tape.

d. Temporarily turn the Cue Level control "off" to prevent nuisance cueing during these tests.

### BIAS TRAP ADJUSTMENTS

1. Connect a high impedance VTVM or scope to the collector of Q4 located on the Recording Amplifier Card. "Set" and "Start" the recorder. Tune trimmer capacitor C13 for minimum indication of bias. On stereo models, in a similar manner connect to the collector of Q1 and tune trimmer C1.

2. The cue bias trap should normally require no further tuning. The procedure requires removal of the lower cabinet shell to gain adjustment access. Temporarily remove U1 from the socket. Connect the VTVM or scope to the trimmer capacitor C1 at the end furthest from the card edge connections. Turn the 150 Hz oscillator level control "off". Depress the SEC pushbutton and tune C1 for minimum bias indication. Return U1 to its socket.

### RECORD HEAD AZIMUTH

1. Connect a 15 kHz signal source to the recorder input(s). Connect a VTVM across the reproducer audio output. Use a 600 ohm load.

2. Install an erased cartridge and start the recorder. Maintain the recorder input level to produce -10 dB level from normal reproduce output.

3. Adjust the record head azimuth for maximum reproduce output. *(Stereo models should be adjusted to in phase outputs for all frequencies. This may require a minor loss of 15 kHz output from each channel.)*

## PROGRAM BIAS ADJUSTMENT

1. With the signal source and outputs connected as in Paragraph 1 above, set the frequency to 1 kHz and adjust bias trimmer C5 for maximum reproduce output. In a similar manner adjust C5 for maximum output of stereo Right Channel.

   *NOTE: Some users prefer to set bias for 1 dB over bias erasure at 10 khz and -10 dB output. This method frequently results in a more uniform adjustment.*

## CUE FREQUENCIES AND WAVEFORM ADJUSTMENTS

1. Connect a high impedance VTVM and a frequency counter *(or scope with "zero beat" connections)* to the Hi side of the 1 kHz tone level control.

2. Depress the 1 kHz Add pushbutton. Set the 1 kHz frequency control for 1 kHz.

3. Observe the voltage on the VTVM. Adjust the 1 kHz waveform control R12 for exactly 1.5 volts RMS.

4. Recheck the frequency output. These controls produce some interaction which may require more than 1 adjustment for proper results.

5. Connect the VTVM and counter to the Hi side of the 150 Hz tone level control. In a similar manner adjust the frequency to 150 Hz and waveform control R49 for exactly 1.5 volts RMS.

6. Connect the VTVM and counter to the Hi side of the 8 kHz tone level control. In a similar manner adjust the frequency to 8 kHz and waveform control R36 for exactly 1.5 volts RMS.

## CUE BIAS ADJUSTMENT

1. Place an erased cartridge of known good quality in the reproducer.

2. Set the Meter Mode switch to "Replay" and the Replay switch to "Cue". Start the reproducer.

3. Press and hold the 1 kHz Add pushbutton.

4. Adjust the Cue Bias Trimmer C7 for maximum output as read on the left panel meter.

## CUE TONES LEVEL ADJUSTMENTS

These level adjustments are critical to the performance of the Internal Response Test system and must refer to the 160 nWb/m of the NAB Standard Response Tape. These levels are established accurately by Audi-Cord and the metering circuit dividers are of fixed value to insure that these remain constant.

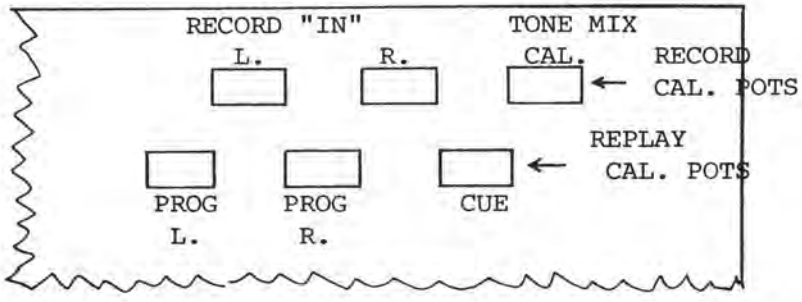
1. Connect a high impedance VTVM to pin 15 of the reproducer Remote socket. Connect the Ground to pin 14. *(This is the Logging output connection).*

2. Reproduce the 160 nWb/m 1 kHz Primary Cue signal "O" level section of the NAB Standard Tape or its equivalent. Note the output exactly.

3. Place an erased tape in the reproducer. "Set" and "Start" the recorder.

4. Depress and hold the 1 kHz ADD pushbutton. Adjust the 1 kHz oscillator Level control to record the exact same level as read in paragraph 2 above.

5. Place the Meter Mode switch in OSCS position. While recording the 1 kHz tone as above adjust the Tone Mix Cal control located on the recorder mother board for exactly "O" reading on the left panel meter. Seal this adjustment to prevent accidental adjustment.




6. Depress the SEC pushbutton. Adjust the 150 Hz Oscillator Level control to read exactly "O" on the left panel meter.

7. Depress the TER pushbutton. Adjust the 8 kHz oscillator Level control to read exactly "O" on the left panel meter.

## PROGRAM FREQUENCY RESPONSE, EQUALIZATION

1. Connect a signal generator to the recorder input and a VTVM and 600 ohm load to the reproducer output.

2. Place an erased cartridge of known good quality in the reproducer. Set and Start the recorder.

3. Adjust the input frequency and level to produce a 1 kHz recording at - 10 dB below "O" output. Observe the oscillator output level and maintain at this level for all other test.

4. Set the frequency to 100 Hz. Adjust the Lo frequency equalization control R35 for Left Channel *(R13 for Right Channel of stereo)* to obtain the same output as 1 kHz in paragraph 3 above.

5. Set the frequency to 10 kHz. Adjust the Hi frequency equalization control R29 for Left Channel *(R7 for Right Channel of Stereo)* to obtain the same output as 1 kHz in paragraph 3 above.

6. Performance may now be evaluated at all frequencies from 50 Hz thru 15 kHz and the equalization adjusted for best results.

7. If any question concerning the reproducer equalization or quality of the test tape exists, refer to the use of the Internal Response Tests paragraph below.

## METER SYSTEM CALIBRATION

The tone oscillators calibration has been previously performed under Cue Tone Level Adjustments. It is advisable to perform the following meter calibrations in a single routine.

### PROGRAM PLAY LEVEL

1. Install and play a "O" Level tape at 400 Hz or 1 kHz as desired. Set the reproducer Level controls for +8 dBm in 600 ohms *(or to the required operating "O" level)*.

2. Set the Replay switch to PGM.

3. Adjust the Left and Right Play Cal. Controls located on the recorder mother board (*see sketch in Cue Tone Level Adjust paragraph*) for "O" reading on their respective panel meters.

CUE PLAY LEVEL

1. Install an erased cartridge in the reproducer.

2. Set the Replay switch to CUE.

3. Start the reproducer and depress the 1 kHz Cue Add pushbutton.

4. Adjust the Cue Play Cal. control located on the recorder mother board for "O" reading on the left panel meter.

5. Depress the TER pushbutton. The meter should read "O", $\pm$ 2 dB from this signal . Do not adjust the controls. This reading is dependent on head error.

6. Depress the SEC pushbutton. The meter should read "O", $\pm$ 2 dB from this signal. Do not adjust the controls. This reading is dependent on head error.

RECORD INPUT CAL.

1. Connect a 1 kHz signal to the recorder input(s). Set the Meter Switch to IN.

2. Install an erased cartridge in the reproducer. "Set" and "Start" the recorder.

3. Increase the input level to produce +8 dBm in 600 ohms (*or the required "O" play level*) from the reproducer output.

4. Adjust the Left and Right Record Line Cal. controls located on the recorder mother board for "O" reading on their respective panel meters.

RECORD CURR. CAL.

1. Move the Meter Switch to CURR. while recording 1 kHz at "O" play level as above.

2. Adjust R25 located on the Recording Amplifier Card at the left rear side, for "O" reading on the left panel meter.

3. In a similar manner adjust R7 located on the right rear side of this card, for "O" reading on the right panel meter.

4. While recording, sweep the input frequency upward toward 10 kHz. The meter readings should deflect to full scale, indicating the increase of head current and approach of saturation. This indication can be useful in recordings where high frequency distortion is of concern and is used for verifying recorded response in later discussion.

PROGRAM BIAS CAL.

1. Verify the proper bias setting as in Program Bias Adjustment.
2. "Set" and "Start" the recorder.
3. Set the Meter Switch to PGM Bias position.
4. Adjust the Left Bias Cal. control R27, located on the right side of the Bias Oscillator card, for "O" reading on the left panel meter.
5. In a similar manner adjust the center control, Right Bias Cal. R26 on Stereo units, for "O" reading on the right panel meter.

CUE BIAS CAL.

1. Verify the proper bias setting as in Cue Bias Adjustment.
2. "Set" and "Start" the recorder.
3. Set the Meter Switch to Q Bias position. Depress the 1 kHz ADD pushbutton.
4. Adjust the Cue Bias Cal. control R25 located on the left side of the Bias Oscillator card, for "O" reading on the left panel meter.

## USING THE INTERNAL RESPONSE TEST AND METERING

1. Place an erased cartridge of known good quality in the reproducer.
2. Place the Meter Switch in OSCS position. "Set" and "Start" the recorder.
3. Depress and hold the 1 kHz ADD pushbutton and verify that the left panel meter reads "O".
4. Depress the 150 Hz SEC and 8 kHz TER pushbuttons and verify that these read "O".
5. Place the RESPONSE TEST switch located on the Recording Amplifier card in the "up" position.

6. Place the Meter Switch in REPLAY position and the Replay switch in the PGM position to monitor play output during recording.

7. Terminate the play output with 600 ohms. If desired, a VTVM may be used across the resistor.

8. "Set" and "Start" the recorder.

9. Depress and hold the 1 kHz ADD pushbutton. The output from the playback and the panel meter(s) should read "O".

10. Depress the 150 Hz SEC and 8 kHz TER pushbuttons and observe the output. These should read "O" on the panel meters, with a tolerance of 1 dB.

The three tone oscillators are factory fixed resistor divided to produce "O" level flux on the recorded tape when the OSCS level are "O" in reading. These readings can be altered only by replacement of the fixed dividers.

If for any reason the response from the reproducer indicates other than in tolerance record-play response, it can be assumed that either of two errors have occurred. These are: the reproducer response has been erroneously equalized to a defective or partially erased Standard Test Tape; or the recording amplifier equalization at Hi frequencies is incorrect. To assist in verifying or in decision, the Modu-Cart recorder is provided with a recording CURR measuring system. Proceed as follows:

1. Connect a signal generator with constant voltage to the recorder input.

2. Place the RESPONSE TEST switch on the Recording Amplifier card in the "down" (*normal*) position.

3. Adjust the frequency input to 1 kHz.

4. Place the Meter Switch in CURR position. "Set" and "Start" the recorder.

5. Adjust the input level to -6 VU on the panel meter at 1 kHz.

6. Move the signal generator to 8 kHz. The panel meter should now read approximately +2 VU or 8 dB higher in recording current.

7. If the above is approximately correct, it may be assumed that the recorded flux from the recorder is correct and the response of playback amplifier, test tape wear or other fault exist unless the recording head is extremely worn or grooved to prevent tape contact. It is at best a dangerous policy to seriously alter the response of a recorder to enhance the reproduce head characteristics

or match the characteristic of a worn test tape since the result may be *poor quality recording for all the tapes produced on the recorder.*

CUE REPLAY LEVEL

The cue pre-amplifier is of fixed equalization to reproduce all 4 NAB cue signals at equal level within 2 dB. These differences are primarily the result of contour inaccuracy of the heads. To verify the proper cue signal level, place the Replay Switch in the CUE position and observe each signal as required.

Other uses and the results of the metering system may be determined by reading the section on Meter Calibration.

# SECTION V

## CIRCUIT CARD PARTS LOCATIONS

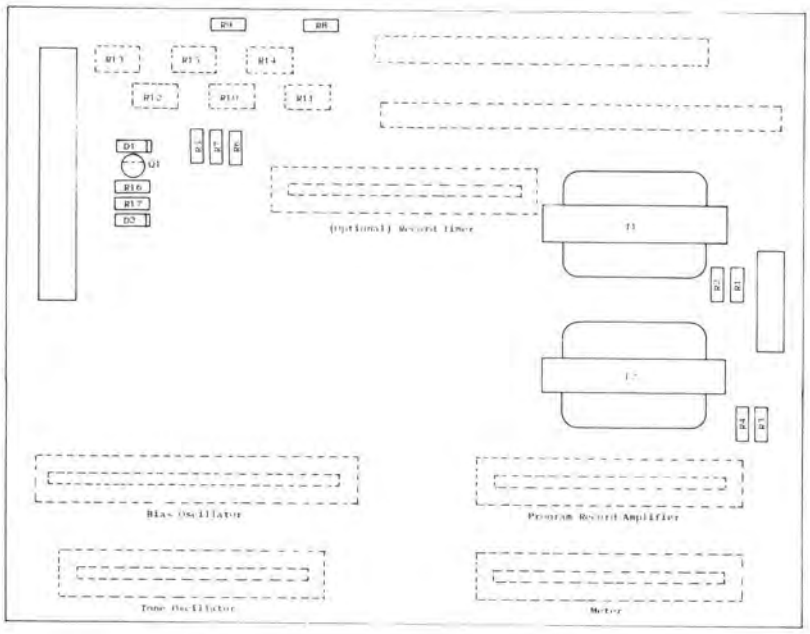



Figure 9 Mother Board 151-9

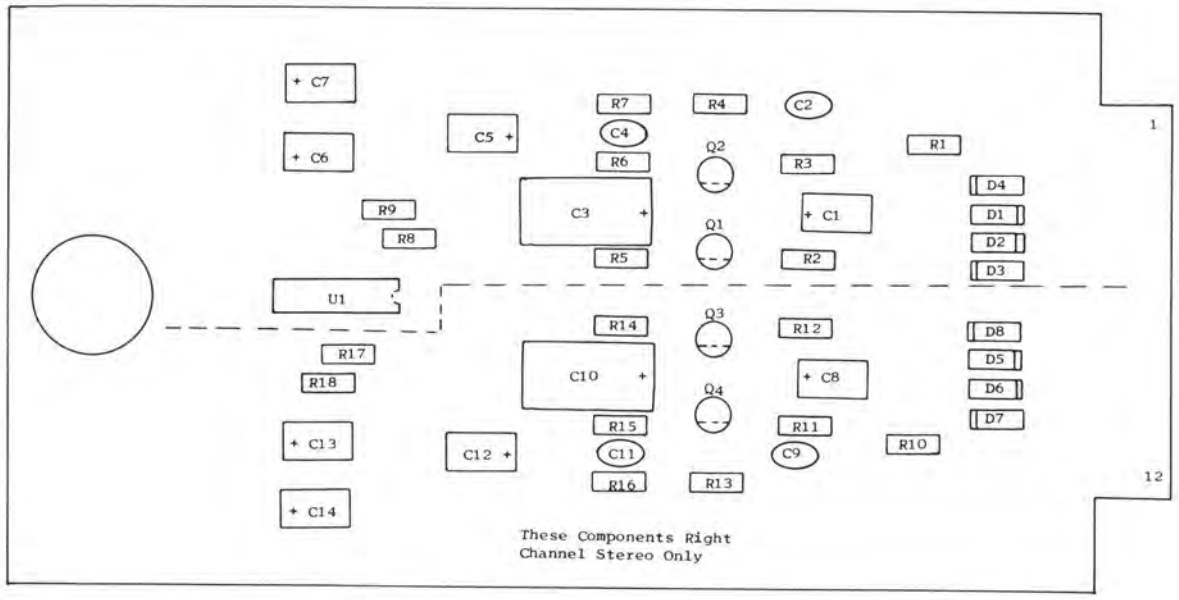



Figure 10 Meter Multiplexer and Amplifier Card 151-10

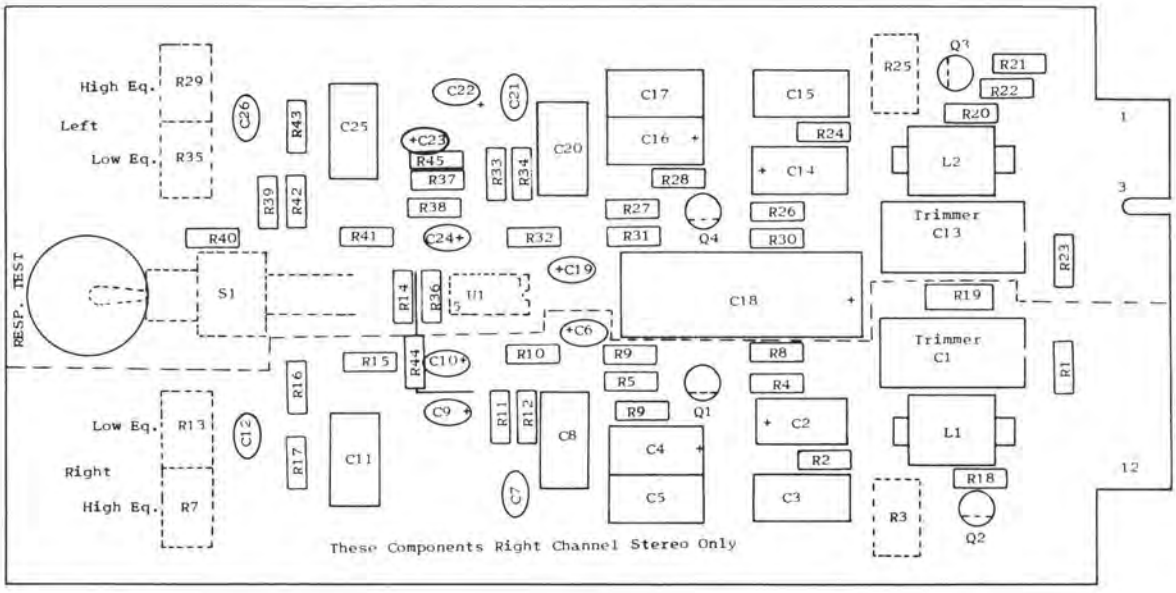



Figure 11 PROGRAM RECORDING AMPLIFIER CARD 151-11

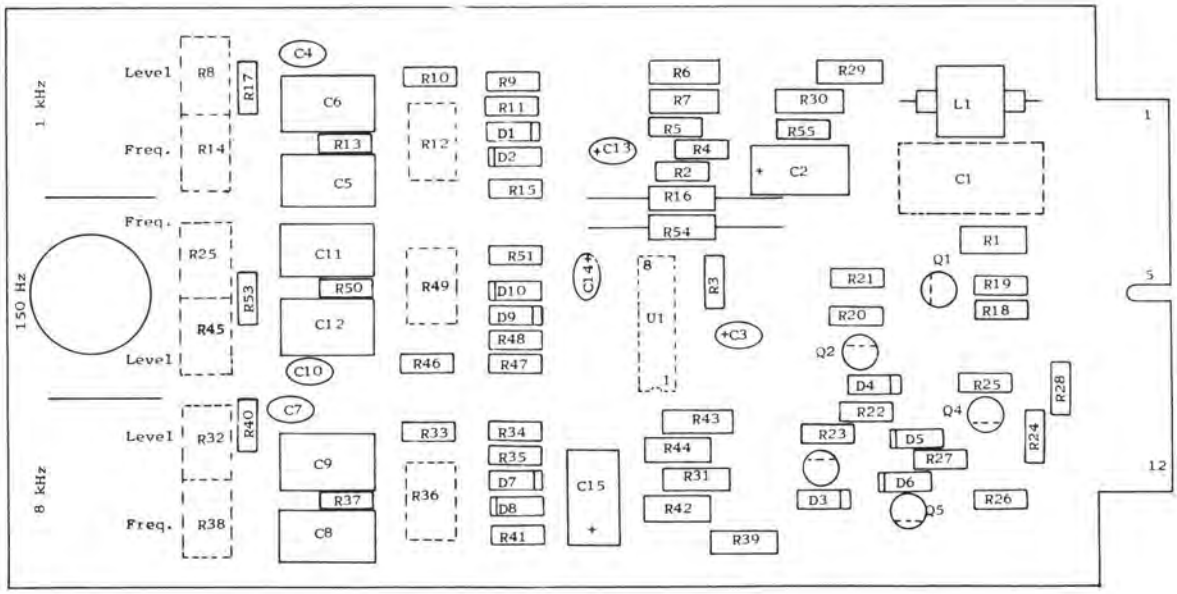



Figure 12 TONE OSCILLATORS CARD 151-12

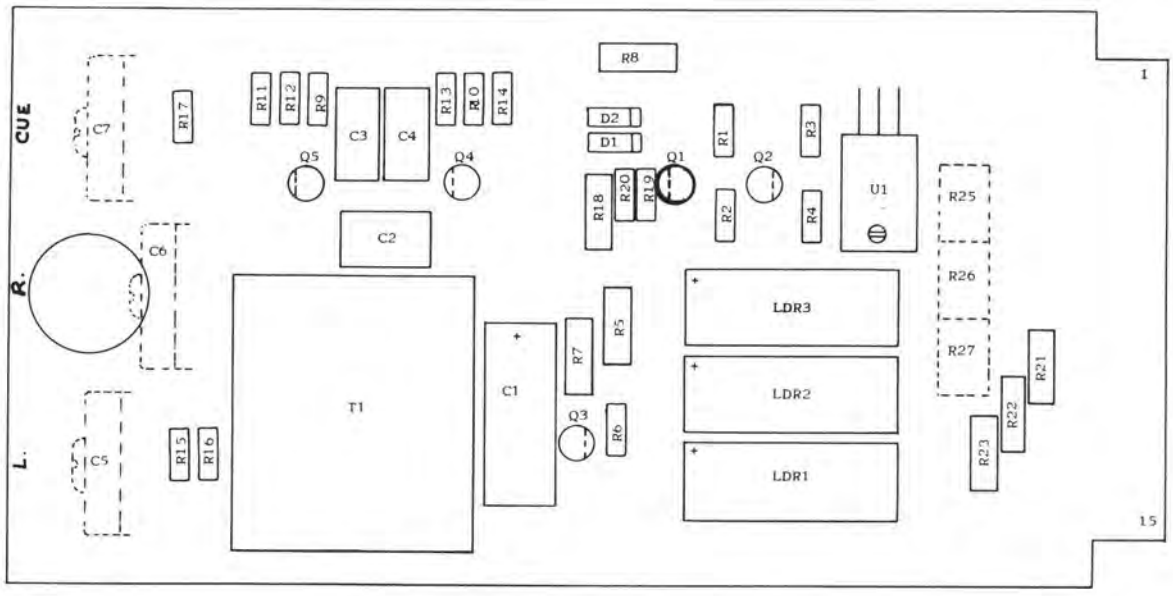



Figure 13 BIAS OSCILLATOR AND GATES CARD 151-13

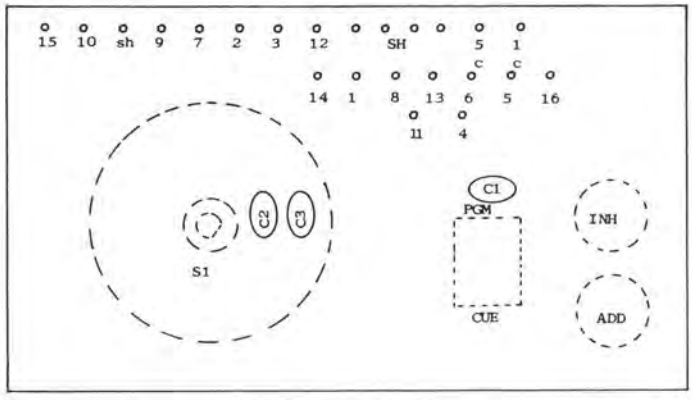
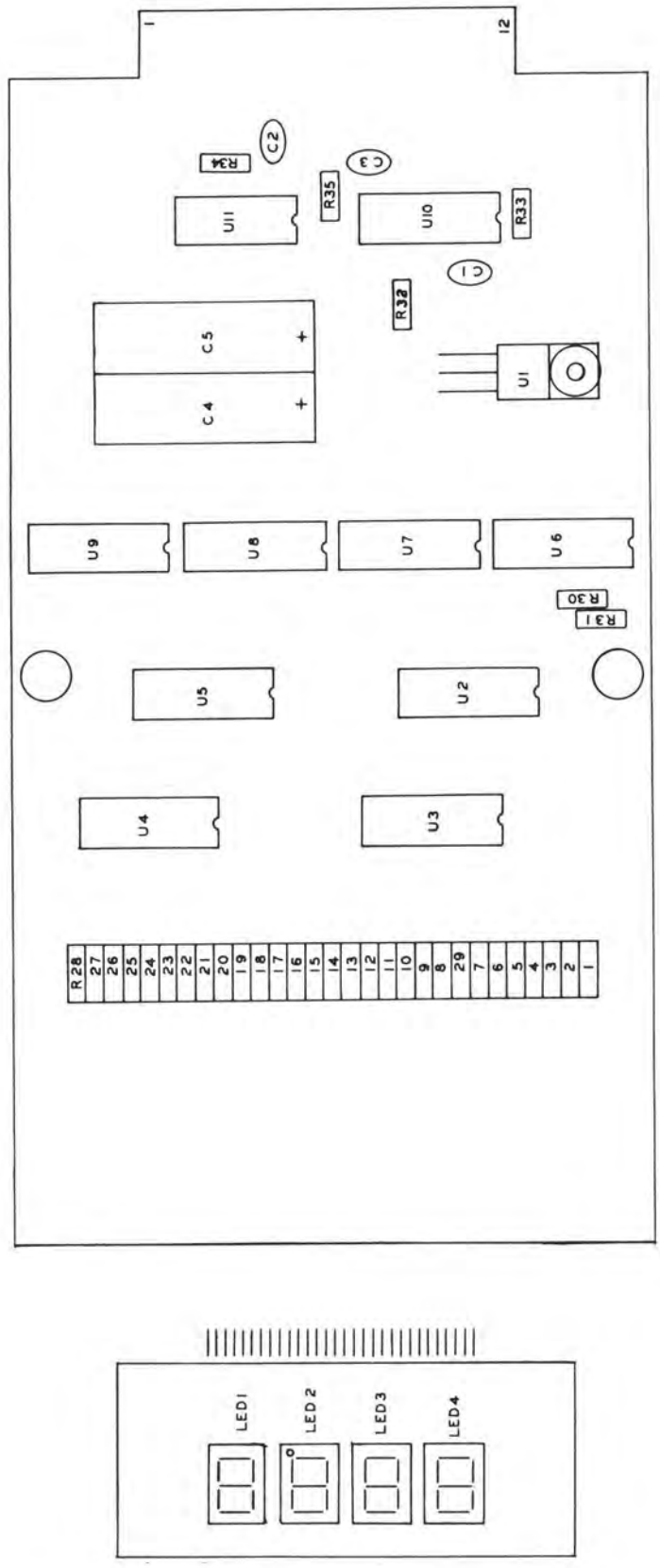
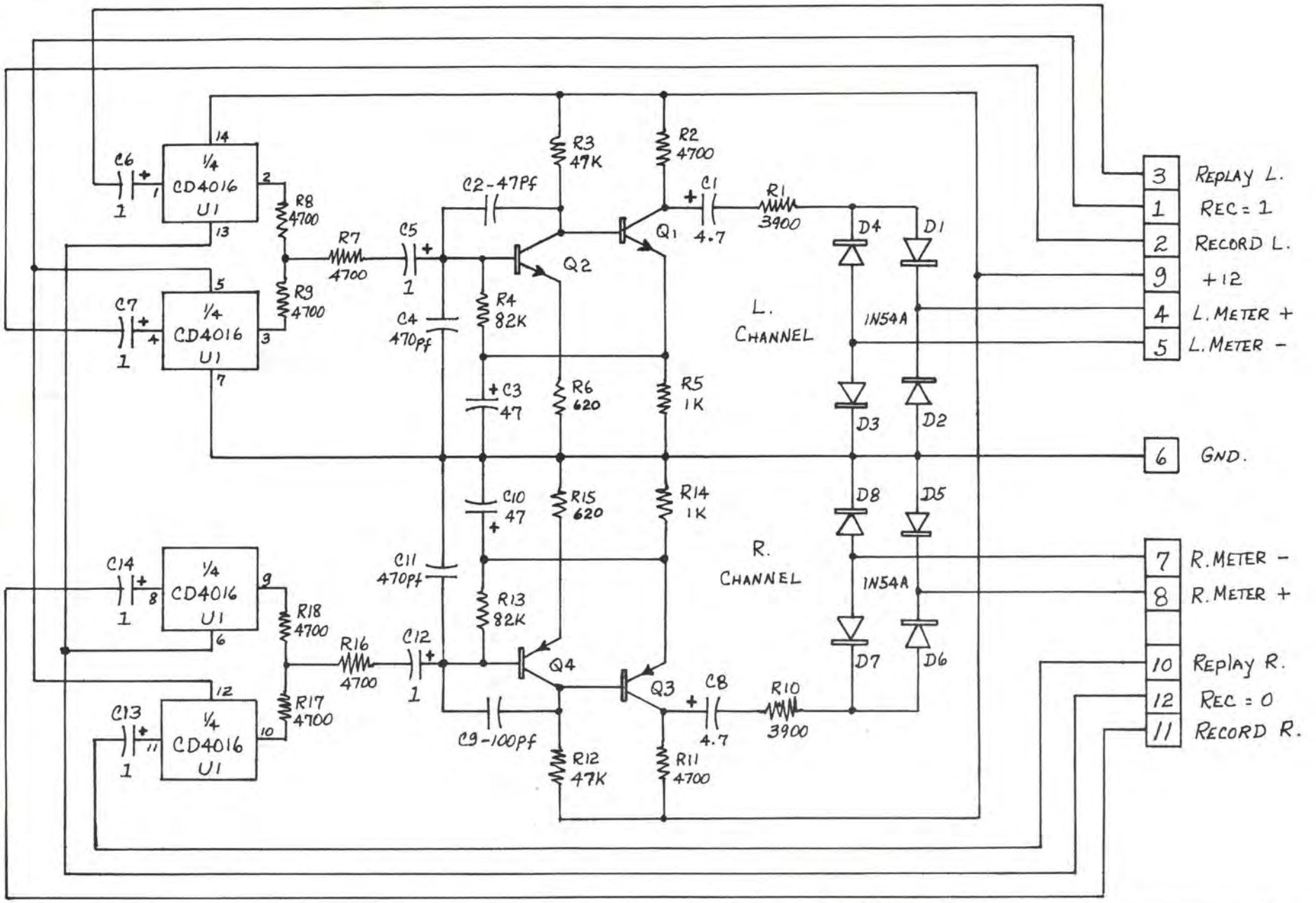



Figure 14 METER SWITCH CARD 151-14



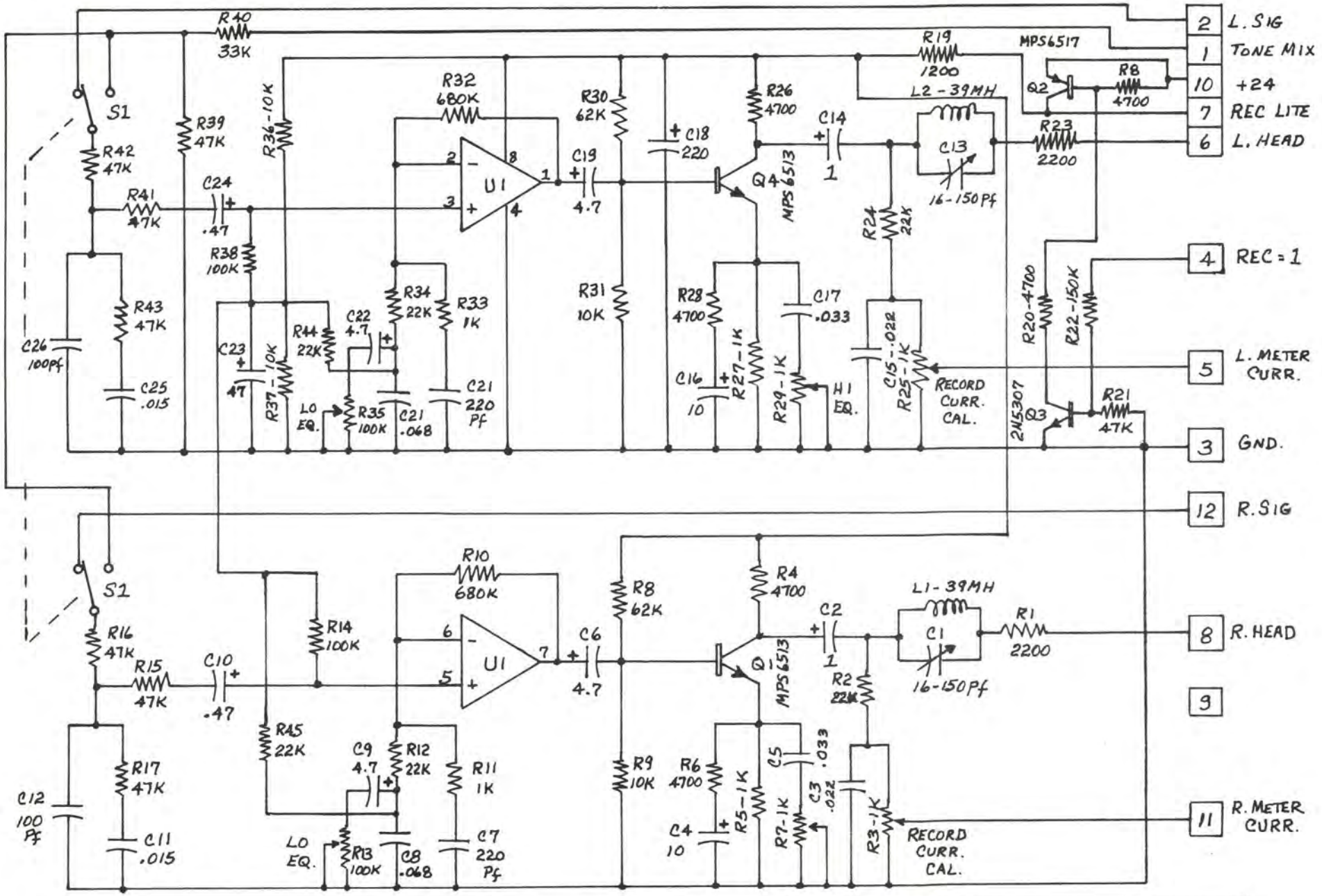

OPTIONAL RECORDING TIMER CARD 151-15

Figure 15



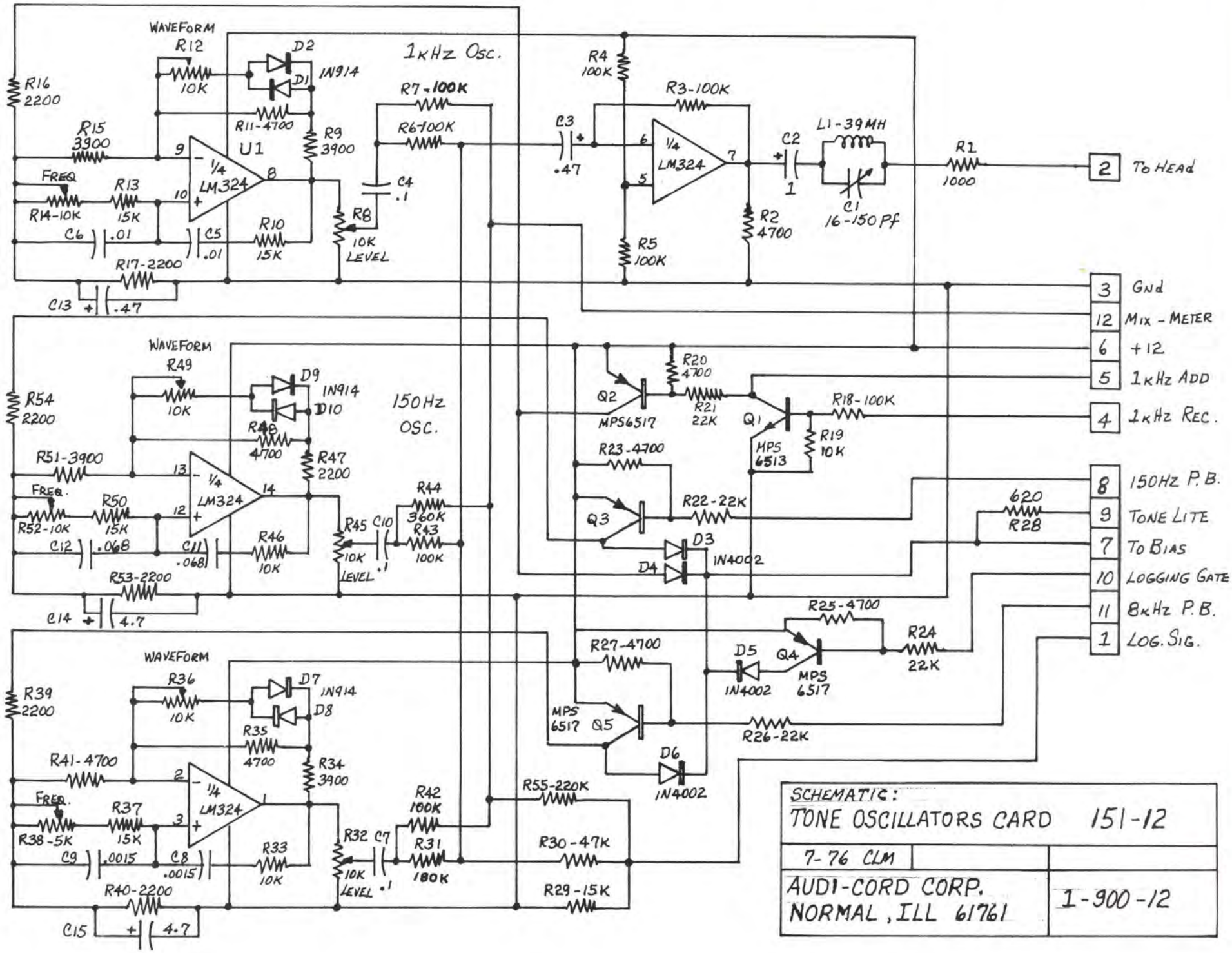

TRANSISTORS = MPS 6513

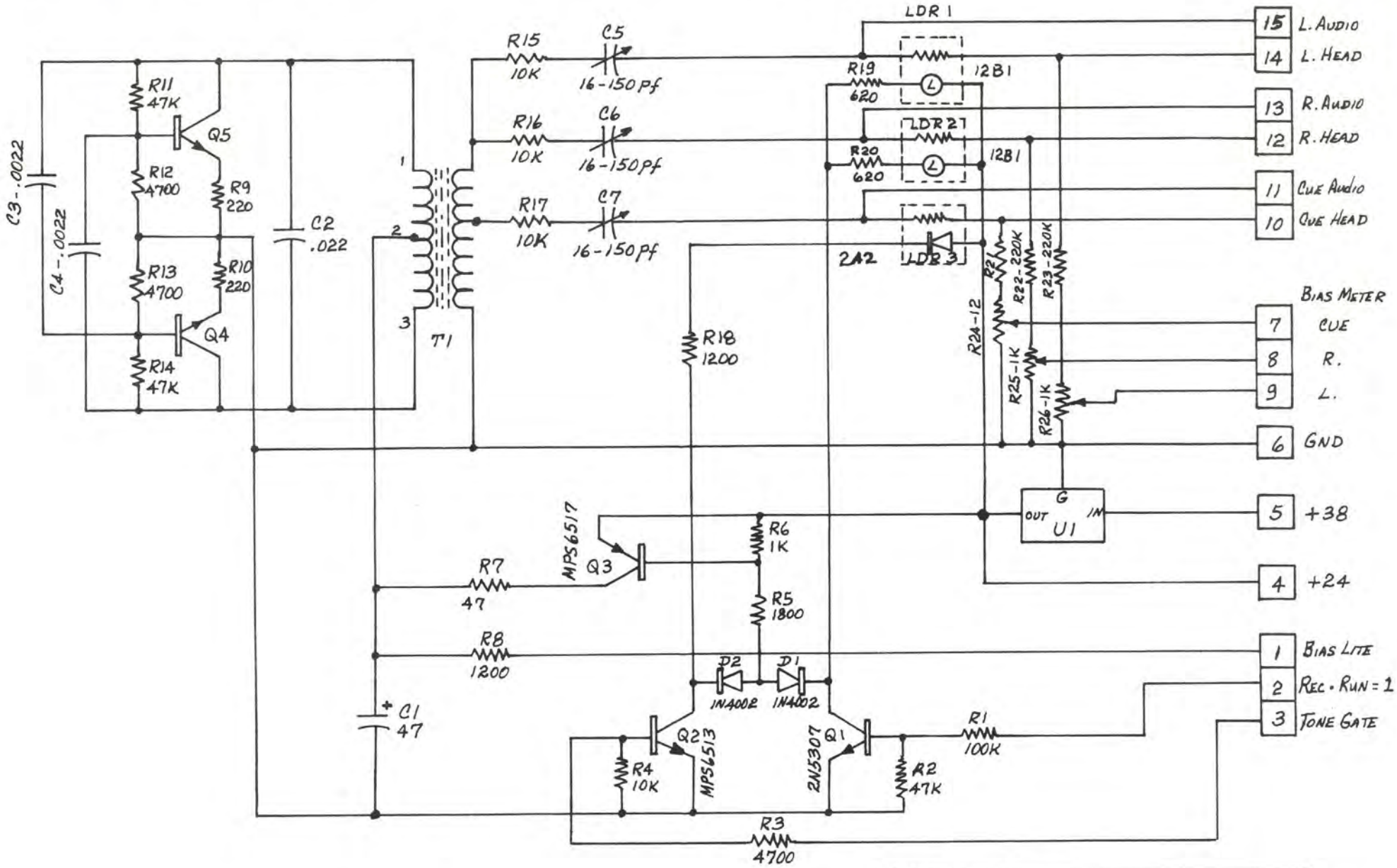
| | | |
|---|---|---|
| SCHEMATIC: METER AMP. AND MULTIPLEXER 151-10 | | |
| 7-76 CLM | | |
| AUDI-CORD CORP. NORMAL, ILL 61761 | | 1-900-10 |




U1 = LM358 or MC1458

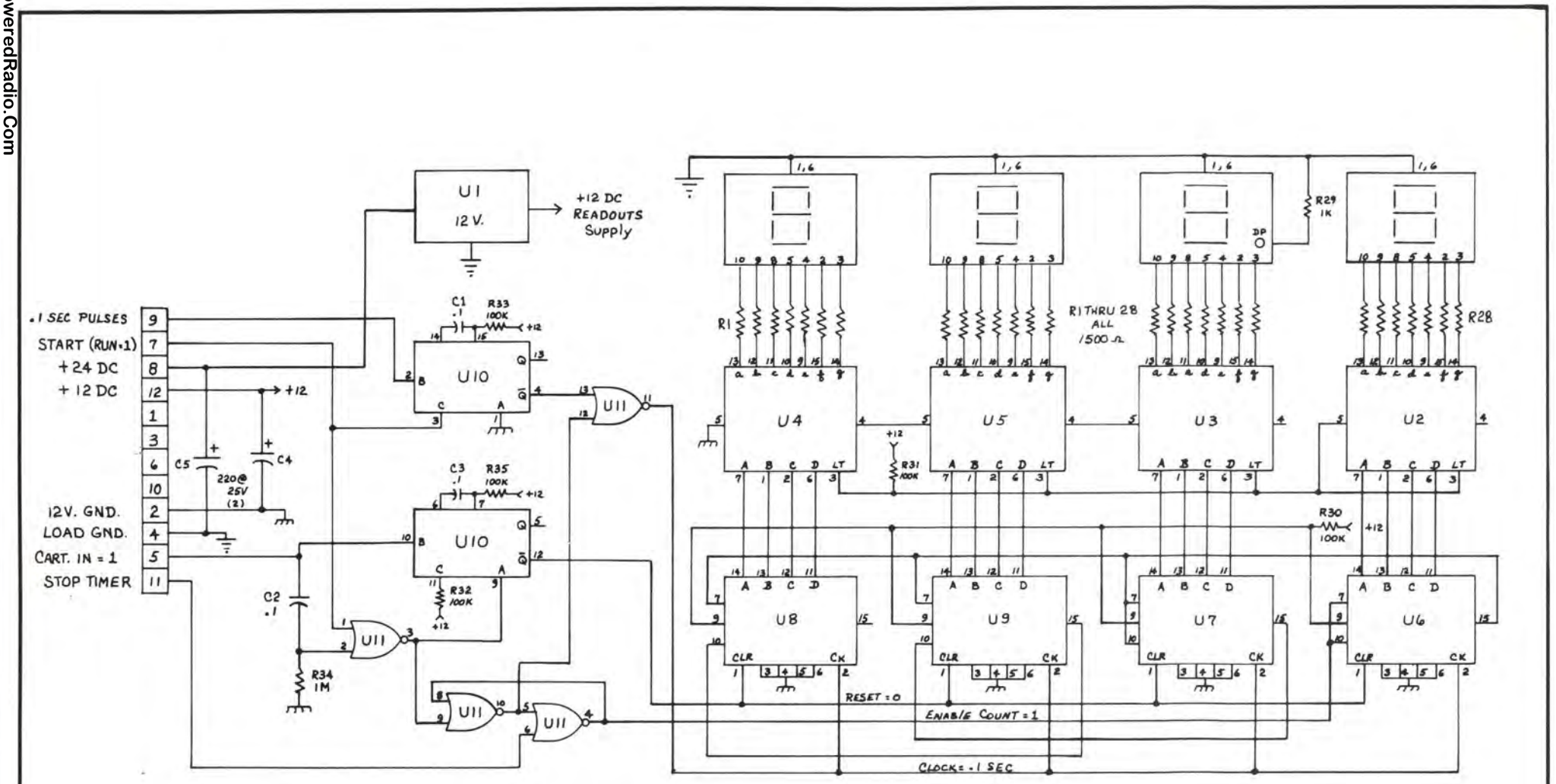
| | |
|---|---|
| SCHEMATIC: PROGRAM RECORDING AMP. 151-11 | |
| 12-75 CLM | |
| AUDI-CORD CORP. NORMAL, ILL 61761 | 1-900-11 |






U1 = LM340T-24 OR 7824

| | | |
|---|---|---|
| SCHEMATIC: BIAS OSCILLATOR CARD 151-13 | | |
| 12-75 CLM | | |
| AUDI-CORD CORP. NORMAL, ILL 61761 | | 1-900-13 |




I.C.'S : U1 = LM340T-12 OR 7812
U2 THRU U5 = MM74C48
U6 THRU U9 = 74C160 OR 14160
U10 = 74C221
U11 = CD4001 OR 14001

READOUTS = TIL 313

| TOLERANCES (EXCEPT AS NOTED) | REVISIONS | | | SCHEMATIC : OPTIONAL RECORDING TIMER CARD | | |
|---|---|---|---|---|---|---|
| DECIMAL ± | NO | DATE | BY | AUDI-CORD CORPORATION NORMAL, ILL 61761 | | |
| | 1 | 5-80 | CLM | | | |
| FRACTIONAL ± | 2 | | | | | |
| | 3 | | | DRAWN BY CLM | SCALE | MATERIAL |
| ANGULAR ± | 4 | | | CHK'D | DATE 2-76 | DRAWING NO. 151-15 |
| | 5 | | | TRACED | APP'D | |

OPTIONAL TIMER CARD 151-15

START
CONTROL GND
STOP
RESET
0.1 SEC PULSES
+24
+12 REG
GND

50 10 W

BIAS OSC. & GATES
151-13-1 MONO
151-13-2 STEREO

+36
CUE HEAD
TONES IN
R. HEAD
R. AUDIO
L. HEAD
L. AUDIO
REC=RUN=1
CUE BIAS MTR
L. BIAS MTR
R. BIAS MTR
+24
TONE GATE
BIAS LIGHT
GND

METER AMP CARD
151-10-1 MONO
151-10-2 STEREO

+12
IN L
IN R
REC=0
REC=1
R. METER-
R. METER+
R. PLAY
L. METER+
L. METER-
L. PLAY
GND

3 TONE OSC CARD
151-12

OUTPUT
TONE LIGHT
1K TONE TIMED
+12
1K HZ REC
LOG BIAS
LOG SIG
TONE ON
SEC P.B.
TER P.B.
METER TONE
GND

PROGRAM RECORDING AMP
151-11-1 MONO
151-11-2 STEREO

R. OUT
+24
L. OUT
METER CURR L.
METER CURR R.
REC=1
REC LIGHT
TONE MIX IN
R. INPUT
L. INPUT
GND

RECORD INPUT J12

R3 1800
R4 1800
R1 1800
R2 1800
T2
T1

REPLAY
REC CURR
REC IN
OSCS
PGM BIAS
Q BIAS

16 PIN CONN

REPLAY MODE
PGM
CUE
.01
L
R

PLAY CAL
R5 100K R10 10K R
R6 100K R11 10K L
R7 100K R12 10K CUE
RECORD CAL
R13 10K OSCS
R8 2200 R14 10K L
R9 2200 R15 10K R

START TIMER
STOP TIMER
RESET TIMER
PULSES @ SEC
+12 DC
12V GND
+36 DC
REC=0
REC=1
REC•RUN=1
1K TONE TIMED
CUE SIGNALS
CUE REC HEAD
R. PGM REC
L. PGM REC
L. PGM PLAY
R. PGM PLAY
CONTROL GND
1 KHZ REC
1 KHZ INHIBIT
REC P.B.

REMOTE J11

12 PIN CONN

D1
D2
R17 4700
R16 10K
Q1 MPS 6513

20 PIN CONN

LEFT LEVEL
L.
1KHZ ADD
1KHZ INHIBIT
TONE
BIAS
REC
SEC
SET
TER
RIGHT LEVEL
R.

RECORD CAL



SCHEMATIC
MODU-CART RECORDER INTER-CONNECTION

| SCALE: | APPROVED BY: | DRAWN BY R.P.S. |
|---|---|---|
| DATE: 12-75 | | REVISED |

AUDI-CORD CORP
NORMAL IL 61761

MODEL 110/120 SERIES — DRAWING NUMBER

11X84 PRINTED ON NO. 1000M-10 CLEARPRINT

# SECTION X

## WARRANTY AND SERVICE POLICY

### WARRANTY

Audi-Cord Corporation warrants all Modu-Cart equipment to be free of defects in workmanship and material for one year. Exception is applied to fuses, lamps, heads, etc. which are considered replacement items of useful life and are guaranteed for 90 days. Audi-Cord will replace or repair all such material subject to the warranty periods.

Audi-Cord further guarantees satisfaction of the product for its useful life. If any part or portion fails that in the user's opinion was not satisfactory in performance or useful life, contact Audi-Cord for replacement or repair.

Audi-Cord reserves the right to request that any material subject to warranty repair or replacement be returned to our manufacturing location for inspection or repair.

### SERVICE POLICY

Audi-Cord will provide the necessary service parts to insure useful life of our product at a fair and equitable price as possible. Some materials used are subject to vendor availability and substitution, and may not be within our control. Therefore, we reserve the right to provide acceptable substitutes or redesign when necessary. Any unit or assembly may be returned for factory service upon prior notification or explanation of such service required.

Our Engineering and Customer Service Departments will provide advice for customer needs in service or operational requirements as needed without charge or obligation.