

TECHNICAL MANUAL
(890-0002-000)

RECORDERS

RA SERIES

MONO, SINGLE CUE	828-0001-000
STEREO, SINGLE CUE	828-0002-000
MONO, THREE CUE	828-0003-000
STEREO, THREE CUE	828-0004-000
MONO, HI-SPEED CUE	828-0005-000
STEREO, HI-SPEED CUE	828-0006-000

WRA SERIES

MONO, SINGLE CUE	828-0011-000
STEREO, SINGLE CUE	828-0012-000
MONO, THREE CUE	828-0013-000
STEREO, THREE CUE	828-0014-000

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RA Series
WRA Series

SECTION I

INTRODUCTION

RA & WRA SERIES RECORDING AMPLIFIERS

A. GENERAL DESCRIPTION

The International Tapetronics RA Series Recording Amplifiers are designed for use with WP Series Reproducers, and the WRA Series Recording Amplifiers are designed for use with the 3D Reproducers.

The RP Series "Master Recorder/Reproducers" combine a WP Series Reproducer and a RA Series Recording Amplifier on a single unit front panel.

Models are available with the Hi-Speed Cue option where the reproducer automatically switches to this mode when the 150 Hz Secondary Cue Tone is detected. This feature is prevented, however, during the record mode of operation.

Each of these Recorders or Record/Reproducers meet or exceed the NAB standards for cartridge tape recording and reproducing and are available in monophonic or stereophonic configurations. All units provide the 1 kHz primary cue tone oscillator as standard equipment, with 150 Hz secondary and 8 kHz tertiary tone oscillators available as an option.

All circuits including amplifiers, oscillators, and the control system are solid-state. There are no relays used in the Recording Amplifiers.

The optional 150 Hz secondary cue tone functions as the "end of message" tone necessary in automated systems to start the next event, or can be used in live operations as the "on cue"

signal for live inserts or the beginning of the next event. This 150 Hz tone is also required for Hi-Speed Cue Reproducers where the sensing of the 150 Hz tone automatically places the Reproducer in the "Fast" run mode.

The optional 8 kHz tertiary cue tone can be used for such purposes as supplying digital information for logging in automated systems or for auxiliary switching such as the control of slide projectors in television.

The 150 Hz secondary or 8 kHz tertiary tones may be applied during either the recording, or the reproduce mode of operation.

An exclusive feature of ITC recording amplifiers allows the manual application of the 1 kHz cue tone whenever required in special production formats. Also a "Defeat" pushbutton is provided to manually prevent the automatic application of the cue tone when the recording is started.

Meter switching is included to provide monitoring and aid in the maintenance of the following:

1. Program bias level.
2. Peak recording level (where meter indicates possible high frequency tape saturation).
3. Normal recording level (VU)
4. Program Play Level.
5. Cue tone play level.
6. Cue bias level.

B. SPECIFICATIONS

Power:	From reproducer's regulated power supply (24 vdc)
Audio Input(s):	Line input impedance; 600 ohms balanced (two for stereo) -20 dBm to 0 dBm level; accepts higher level by changing input pad
Metering:	Taut-band movement with "A" scale. Internal meter switch allows selection for metering the following levels: recording input; playback; bias; cue playback; or peak recording
Distortion:	2% or less, record and playback at 0 dBm record level, 400 Hz
Noise:	55 dB or better below reference of 400 Hz at 3% THD, monophonic 50 dB or better below reference of 400 Hz at 3% THD, stereophonic
Cross Talk	
Between Channels:	Better than 50 dB at 1 kHz
Frequency Response:	± 2 dB from 50 to 15,000 Hz
Equalization:	NAB

Cue Signals: Standard 1 kHz primary cue, automatically recorded at start of recording (may be defeated and applied as required at user's option); 150 Hz and 8 kHz cues, optional (may be recorded during recording process or during playback); individual oscillators for each frequency with adjustable frequency and output level

Bias Oscillator: Push-pull, 82 kHz; individual gates and level controls for program (separate left and right in stereo units) and cue

Remote Control: All indicators and functions except meter switch

Dimensions: WRA Series — 5¼" High x 8¾" Wide x 12" Deep
RP Series — 5¼" High x 17¾" Wide x 12" Deep (includes RA Recorder and WP Reproducer on single panel)
(Add 3/8" for feet)

Weight: WRA Series — 13 pounds
RP Series — 38 pounds

A. UNPACKING

Remove the recorder from the shipping carton and inspect the unit for damage. All packing material must be retained if a claim for shipping damage is to be filed, and should be kept on hand until installation is completed in case concealed damage is discovered. If shipping damage occurs, contact ITC for assistance in the filing of claims.

B. INSTALLATION

The ITC RA and WRA cartridge recording amplifiers are normally supplied with an associated WP or 3D series reproducer. The units are supplied in cases prepared for table top mounting. Adapter angle brackets, hardware, and instructions for mounting in a 19 inch rack are supplied as an option.

To provide adequate ventilation in rack installations, vertical spacing between the recorders should be from 1¾" to 3½" depending on the temperature inside the closed rack.

RP series Record/Reproducers are fully tested and adjusted at the factory to provide optimum performance.

When RA or WRA series Recording Amplifiers are supplied separately for use with an existing reproducer, the recording amplifier has been fully tested and adjusted for optimum performance with the recording head supplied. Only the head installation and adjustment is required prior to placing the unit in service. Refer to Section IV of the reproducer instructions for head height, zenith and azimuth adjustments on this head. It is often advantageous to verify the proper operation of these equipments on the test bench prior to installing in the permanent location.

C. EXTERNAL CONNECTIONS—AUDIO

Audio input connections are made on the six pin plug P301. The mating socket is supplied. The input impedance as supplied is 600 ohms and may be changed by substituting values on the audio input pad.

In stereophonic systems, proper phasing of the audio connections must be observed.

CONNECTOR P301

Terminal	Function
1	Monophonic shield (ground) (left channel stereo).
3	Monophonic audio input (left channel stereo +).

5	Monophonic audio input (left channel stereo -).
2	Right channel stereo shield (ground).
4	Right channel stereo audio input (+).
6	Right channel stereo audio input (-).

Plug and terminal locations are shown in Section V, Fig. 5-4.

D. EXTERNAL CONNECTIONS—CONTROL

Remote control connections are made on the eighteen pin socket J301. A mating plug is supplied for this purpose and terminal information is provided below.

CONNECTOR J301

Terminal	Function
1	Primary (1 kHz) Cue Tone Record — requires momentary connection to ground (pin 12) simultaneous with circuit on pin 6.
2	Bias Control — remove the internal jumpers between pins 2, 7, and 8. Toggle switches may be installed to: CLOSE Pin 2 to 7 for left channel only. CLOSE Pin 2 to 8 for right channel only.
3	Record Set Lamp — connect other side to pin 12 (ground).
4	Record Set Pushbutton — normally open to pin 5
5	Record Set Pushbutton
6	Primary (1 kHz) Cue Tone Record — requires momentary connection to pin 11 (+24 VDC) simultaneous with Pin 1.
7	Bias Control — left channel (or mono).
8	Bias Control — right channel.
9	EXTERNAL CUE RECORD INPUT — (Unbalanced 33 k ohms).
10	Remote Cue Bias Control — requires connections to Pin 11 (+24 VDC) when external cue signals are being recorded.
11	+24 VDC (Regulated).
12	Ground
13	Primary (1 kHz) Cue Tone Defeat — requires connection to Pin 12 (ground) for at least two seconds after "Start" of recording.
14	Remote Tertiary (8 kHz) Cue Tone Record — requires connection to Pin 11 (+24) for desired length of the recorded tone.
15	Remote Secondary (150 Hz) Cue Tone Record — requires connection to Pin 11

(+24) for desired length of the recorded tone.

See Figure 5-13 for sample remote control schematic.

E. RECORDER TO REPRODUCER INTER-CONNECTION

The inter-connection between the RA Series Recorder and a WP Series Reproducer is made by the mating 18 pin side chassis plug P302 on the recorder and J6 on the reproducer (Refer to Fig. 5-1 of the reproducer instructions).

The inter-connection between a WRA Series Recorder and 3D Series Reproducer is made using the cable provided. This cable is connected to P302 on the recorder and J6 on the reproducer.

F. CONTROLS AND INDICATORS

REC This pushbutton is used to place the unit in the record mode and is active only when a cartridge is in place in the reproducer and "ready" mode exists. An integral lamp indicates when the unit is in the recording mode.

SEC This pushbutton is used to record the 150 Hz Secondary Cue Tone (when so equipped) and may be recorded when the unit is in either the recording or reproducing mode.

TER This pushbutton is used to record the 8 kHz Tertiary Cue Tone (when so equipped) and may be recorded when the unit is in either the recording or reproducing mode.

CAUTION:

It is suggested operators be cautioned against inadvertently actuating any control tone during playback.

LEVEL or L LEVEL The monophonic LEVEL (left channel stereo) potentiometer (Figure 5-3) provides an adjustment of the input level to the associated program recording amplifier. A visual indication of this level is provided by the meter above this potentiometer.

R LEVEL The right channel stereo potentiometer (stereo) provides an adjustment of the input level to the associated program recording amplifier. A visual indication is provided by the meter above this potentiometer.

METER The Meter Switch (Figure 5-2) is used to select the output to be monitored on the front panel meter(s). The switch is located on a support plate behind the front panel and is readily accessible to the operator when the Recorder

chassis is slid a few inches forward. The switch positions and their functions are as follows:

a. Program Bias — In this position, the front panel meter(s) indicate the presence of program bias. The reading is provided only when the unit is in the recording mode and the tape drive mechanism is running (solenoid energized and Start Switch illuminated). When properly adjusted and calibrated, the meter(s) should provide a "zero" (100%) indication.

b. Peak Recording Level—This switch position provides a meter indication of program recording level as related to tape saturation. (Tape saturation does not occur at the same level for all frequencies.) Meter deflections exceeding "zero" (100%) indicate that the point of tape saturation is being too closely approached and that distortion is occurring. The discriminating operator can create "clean" (undistorted) recordings by observing the Peak Recording.

c. Normal Recording Level—With the switch in this position, the meter(s) provide the VU-type indication normally used on tape recorders. The meter will provide an "average" level indication.

d. Program Play—This switch position provides an indication of the playback level at the output of the reproduce amplifier(s). A 100% level indicates "0" dBm output.

e. Cue Play—In this switch position, the meter shows the playback level of any information recorded on the cue track of a cartridge. This indication is derived from the output of the cue detector's preamplifier in the reproducer.

Note:

Diode limiting is employed at this point in the cue detector. Tones exceeding the NAB standard levels may, therefore, result in erroneous readings.

A stereo recording amplifier's right channel meter does not function in this position.

f. Cue Bias — This switch position provides an indication of the presence of bias at the output of the cue tone recording amplifier. This indication will

normally be present only when one of the three cue tone oscillators is keyed. When properly adjusted and calibrated, the meter should provide a "zero" (100%) indication. A stereo recording amplifier's right channel meter does not function in this position.

CUE
RECORD

The Cue Tone (1 kHz) Record Switch, located for safety on a support plate behind the front panel, enables the operator to record a 1 kHz "stop" tone whenever required. This tone can be applied when the unit is in the recording *or* reproducing mode of operation. Once depressed, this pushbutton *must* be held "down" for a full two seconds or longer. (Faster operation and release of this switch will cause the tape transport mechanism to stop.) The cue record switch may be remote controlled if easier operator access is desired.

CUE
DEFEAT

The Cue Tone (1 kHz) Defeat pushbutton is located behind the front panel to prevent accidental operation. To operate:

- a. Place the unit in the record mode by depressing the REC pushbutton.
- b. Depress and hold the Cue Tone Defeat pushbutton.

c. Start the reproducer.

d. Continue to hold the Cue Tone Defeat pushbutton for a full two seconds, or more, after the reproducer has been started.

G. OPERATING PROCEDURES

To record a tape cartridge

1. Review paragraph F (above) for operation of the optional features of the recorder.
2. Insert an erased tape cartridge into the right-hand side of the reproducer cartridge slot.
3. Observe that the Ready Lamp is lit, indicating the unit is "ready" for operation.
4. Press the REC pushbutton and observe that the lamp lights, indicating the recorder is in the "record" mode.
5. Press the "Start" pushbutton. The tape drive system will be started and should continue until either the machine "cues" the start of the tape or the "Stop" pushbutton is pressed.

It is cautioned that the practice of using the "Stop" pushbutton to terminate the recording process is a dangerous habit that may leave cartridges in the "un-cued" state. It is better, therefore, to always allow the machine to play to "cue" after it is once started.

PRINCIPLES OF ELECTRICAL OPERATION

RA & WRA RECORDING AMPLIFIERS

A. GENERAL

The ITC Recorders electronics are contained on four plug-in circuit cards and two fixed cards.

The plug-in cards contain the program recording amplifiers, bias oscillator and its control gates, cue tone oscillators, and a card for control electronics.

The two fixed cards contain meter switching and calibration controls, and an audio input pad.

The recorder derives its power and related control information from the associated reproducer through P302 and J6. On RA series, used with WP series Reproducers, these are mating side connectors. The WRA series, designed for use with 3D Reproducers, provides an inter-connecting cable for this purpose.

B. CONTROL CIRCUITS CARD

Circuits on this card take signals from the reproducer relays and determine the several recorder control functions including: record "Set" enable, power gating to the recording amplifier and bias oscillator and the automatic timing and control of the 1 kHz cue tone.

If a cartridge is properly installed in the reproducer, pin 18 of P302, pin 1 of J304 and the cathode return circuit of SCR Q703 is at ground. If the reproducer is in the stop "ready" mode, pin 15 of P302, pin 5 of J301 and one side of the "Rec Set" pushbutton S301 is at ground. Pressing the Record Set pushbutton turns on transistor Q701 which in turn energizes SCR Q703 with gate current supplied through R704. Once energized, SCR Q703 latches on and the Record Set pushbutton may be released. SCR Q703 supplies base current through R707 to turn on Q702.

Transistor Q702 is a series power gate which supplies +24 volts to the program record amplifier and its meter amplifier through switch S304, the panel record set lamp through R710, a remote set record lamp through R711 and pin 3 of J301 and to the emitter of transistor Q704.

If the Recorder and Reproducer are equipped with the Hi-Speed Cue option, an additional circuit, transistor Q709, R722 and R723 is included. This transistor is turned off when Q702 is on to prevent the Hi-Speed Cue operation during the record mode. These components are omitted on other units.

When the reproducer is started, ground is supplied to pin 14 of P302, pin 9 of J304, through diode CR701 and resistor R708, turning on series power gate Q704. With Q704 on, +24 volts is supplied through pin 10 of J304 to the bias oscil-

lator card and through diode CR702 and resistor R718 to SCR Q706 and the unijunction transistor Q705.

When +24 is first supplied, SCR Q706 is not on and current supplied through R718 and R717 turns on transistor Q707 which supplies current through R719 turning on Q708 which applies voltage to the 1 kHz Primary Cue oscillator through pin 15 of J304. After approximately $\frac{3}{4}$ second, current flow through R713 will charge C703 and fire the unijunction Q705, turning on SCR Q706 which latches and removes drive to Q707 and Q708, stopping the tone recording.

If the tone defeat switch S306 is pressed and held as the unit is started (while in the record mode), the base of Q707 is grounded and no 1 kHz tone will be recorded.

Pushbutton S305 causes a primary cue tone to be recorded during either the record or playback mode. If the switch is pressed during playback, +24 volts is supplied to the unijunction timer through diode CR703. The unijunction circuitry will function and cause a 1 kHz tone to be recorded. +24 volts is supplied to the reproducer through CR704, R721, and pin 17 of P302. This circuit inhibits the playback from stopping while the 1 kHz tone is being recorded. If switch S305 is pressed while the unit is in the record mode, a ground is supplied to pin 11 of J304 and to capacitor C702. Capacitor C702 is maintained in a discharge state by R712. When a ground is applied, C702 charges and drops the voltage which is present at the junction of R718 and SCR Q706. The drop in voltage commutates the SCR off which permits the unijunction circuitry to re-cycle and record a timed 1 kHz tone.

Once the Recorder has been set in the record mode (SCR Q703 is energized), it is necessary to de-energize Q703 under two different circumstances:

1. If the unit had been set to record, the reproducer started, and is running in the record mode.
2. The unit is set to record but the reproducer has not been started. Pressing the stop switch must de-energize the record set circuitry.

While the reproducer is in the run mode, there is no ground present at pin 15 of P302 and capacitor C701 is charged through R703, R707, and R706. When the reproducer unit cues or is stopped by pressing the stop switch, a ground is returned to pin 15 of P302 causing C701 to discharge which

drops the voltage at Q703 and commutates the SCR off. If the unit is set to record and the playback has not been started, pressing the stop switch will place a ground at pin 17 of P302 causing C704 to discharge which commutates SCR Q703 off.

C. PROGRAM RECORDING AMPLIFIER CARD

The program recording amplifier card is fed through Pin 7 (and Pin 6 for stereo models) from the arm of recording level control R326 which is provided signal from input transformer T301 secondary. The primary of T301 is in series with a 6 dB balanced H pad from P301, the input audio plug. R326 also is wired to R321 and R313 which provides a calibrated voltage input to the meter amplifier through Pin 9 (and Pin 17 for stereo models). The description of circuits to follow will pertain to the mono or left channel since the right channel of stereo systems is identical except for equivalent part numbers.

Transistor Q401 is a voltage amplifier and is connected through a high pass network R406 and C405 to Q402. Capacitor C406 and R407 is a high cut network of fixed loss to common ground. C433 and R433 is an additional high pass network to common ground, which allows for high frequency equalization adjustment as required for tape variations and head wear. Additional high frequency emphasis is provided in the emitter of Q402 by C408. L401 and C409 is a tuned resonant trap to prevent bias intermodulation of the output audio stage and to couple the audio signal through R413 to the recording head. Resistor R412 is used to feed the output audio to the metering circuit. C425 attenuates any leakage bias at this output. This particular output is contoured to the pre-emphasis curve of the recording amplifier and is used in conjunction with the PEAK REC position of the meter switch to indicate the presence of excessive high frequency content in the audio signal which may be approaching the saturation level of the tape.

The meter switch S304 provides a selection of six calibrated input signals from Program Bias, Peak Record, Normal Record, Program Play, Cue Play and Cue Bias. The selected signal is fed through Pin 9 and C420 to the input of Q405 and further amplified by Q406. The output of Q406 is coupled through C424 and the meter impedance matching resistor R434 to the full wave bridge rectifier and the meter.

The recording amplifier DC voltages are fed through Pin 18 and is on anytime the unit is "SET" to record. The meter amplifier DC voltage is fed through Pin 16 and S304 and may be on all

the time depending upon the meter switch position.

D. BIAS OSCILLATOR CARD

The bias oscillator is a conventional push-pull circuit with a transformer coupled output. There are three separate outputs from the oscillator each of which contains a transistor gate. Bias can be selectively controlled to the left channel only, right channel only, cue channel only, or any desired combination of all three.

Transistors Q601 and Q602 are connected as a push-pull oscillator circuit with power applied to the center tap of the primary winding of T601. The turn-on time of the oscillator is controlled by R611 and C604. The secondary is coupled to the cue head through R609 and variable capacitor C607. The bias supplied the cue head is normally clamped (shorted to ground) by Q603 and C608. Transistor Q603 is normally biased on with negative voltage supplied from the playback at pin 7 of P302. This negative voltage is connected to the base of Q603 through R610. When the unit is set to record and started, a pulse of plus voltage is supplied by the control card to pin 4 of J305, through CR501 on the cue oscillator card, to pin 6 of J305, pin 5 of J303, and through R612 to the base of Q603. This plus voltage overrides the negative voltage which is present at the base of Q603 and, thus, turns the transistor off. This removes the clamp and permits bias at the cue head.

The bias is supplied to the program tracks from the high side of T601 (pin 6) through fixed resistor R608 and variable capacitor C606 for the left channel (mono) and through R607 and C605 for the right channel. Individual gate circuits are connected to both of the program bias circuits. These gates are normally held on with negative voltage through R614 and R617. Overriding plus voltage is supplied through R615 and R618. The plus voltage is made available from the control card, pin 10 of J304, to remote connector J301, pins 7 and 8, and then to the resistors. If individual control of bias is required, cut the jumpers between pins 2, 7, and 8 of J301 and selectively supply a connection from pin 2 of J301 to pin 7 for the left channel, and from pin 2 to pin 8 for the right channel. Bias can be selectively applied to the cue channel by supplying a connection between pins 10 and 11 of J301. (A high impedance audio input to the cue channel is on pin 9 of J301.)

E. CUE OSCILLATOR CARD

The three tone cue oscillator circuit consists of three single transistor oscillator circuits and an output cue record amplifier. The frequency

and level of each oscillator is adjustable.

The frequency of the primary cue tone (1 kHz) is established by the parallel LC network L501 and C503. The inductance of L501 is variable over a range of 475 to 525 mHys. The 1 kHz oscillator is keyed when +24 volts is applied to pin 4 of J305 through R501 and R504 to the collector of Q501. The start and stop time of the oscillator is controlled by the charge and discharge of C501. The output of the oscillator is variable in level with control R506, the arm of which feeds a mixer bus, and is coupled to the input of the cue record amplifier through C507. There are four feeds to this bus: Primary cue 1 kHz through R507, Secondary cue 150 Hz through R515, Tertiary cue 8 kHz through R522, and a remote input from pin 9 of J301 through R514.

The secondary and tertiary oscillators function in the same manner as the 1 kHz oscillator and, therefore, will not be described. Diodes CR501, CR502, CR503, and CR504 combine from all the keying circuits a feed to the bias oscillator through pin 6 of J305 and pin 5 of J303. The bias control circuit keys the bias oscillator and releases the cue bias gate. Tone can, therefore, be recorded while the recorder/reproducer is in the playback or record mode.

Transistor Q502 is a single stage amplifier

with a bias trap L502 and C505 and a series resistor R509 which is connected to the cue record head through Pin 12 of P302.

F. METER CIRCUITS CARD

This card is mounted on the support plate behind the recorder front panel and contains the three-pole, six-position meter switch S304, its associated calibration controls and the series divider resistors. The purpose of these controls is to provide an adjustable input to the meter amplifier (part of the Recording Amplifier card) and when properly adjusted will yield a "O" (or 100%) reading on the meter(s) indicating proper operating levels for the various circuits.

G. AUDIO INPUT PAD CARD

This card is mounted on the inside of the recorder rear panel and contains resistors R301 through R305 (mono) and R306 through R310 (stereo only) which form a 6 db H pad for the input transformer primary. If the recorder is to be operated from inputs higher than approximately 0 dBm these resistors should be changed using typical H pad network design for 600 ohm constant impedance loss of the desired amount.

SECTION IV

ELECTRICAL ADJUSTMENTS

RA & WRA SERIES RECORDING AMPLIFIERS

A. GENERAL

All ITC Recording Amplifiers and Record/Reproducers are fully tested and adjusted at the factory for optimum performance and normally require no further adjustment prior to their installation.

When RA or WRA series Recording Amplifiers are delivered separately, it is only necessary to install the record head supplied and adjust this head for height, zenith and azimuth in accordance with Section IV of the reproducer instruction book.

Adjustments of the recording amplifier should not be undertaken unless a defined lack of performance exists and the reproducer has been carefully tested and found not to be contributing to the error.

The ITC Recording Amplifiers are equipped with internal meter switching which allows the panel meter to be used for the routine tests for proper operation of the various circuits, and is valuable in the adjustment of these circuits. For that reason, many of the following adjustments will refer to the use of the panel meter; however, it is necessary to provide a VTVM, Audio Signal Generator and Standard Tapes for program level.

This may be a test cartridge as outlined in Section IX of the reproducer instruction book. It is also useful to have 15 and 18 pin card extenders for access to the circuit adjustments.

Refer to the drawings in Section V for the location of the controls and adjustments referred to in the following procedures.

These adjustments should be followed in the sequence presented to result in a fully aligned recorder.

B. PROGRAM BIAS TRAP ADJUSTMENT

1. The reproducer cartridge sensing switch S1 must be turned "on." This may be done by use of a cardboard wedge between the lever arm and the switch body.
2. Place the meter switch S304 in the PR BIAS position.
3. Place the unit in the record/play mode by pressing REC on the recorder and START on the reproducer. A continuous bias reading should appear on the meter(s).
4. With a non-metallic screwdriver, adjust L401 for a maximum reading on the left channel (or mono) meter. Adjust L402 for a maximum reading on the right channel

meter of the stereo units only. (If the reading exceeds the meter, reduce this reading by adjusting R311 (left channel or mono) and R317 (right channel stereo) PROC BIAS trim-pots to reduce the reading.

C. CUE BIAS TRAP ADJUSTMENT

1. The reproducer cartridge sensing switch S1 must be turned "on." This may be done by use of a cardboard wedge between the lever arm and the switch body.
2. Place the meter switch S304 in the "Q" BIAS position.
3. Remove Q706 from its socket on the control board. This allows the 1 kHz cue oscillator and the cue bias to operate continuously.
4. Press REC and START pushbuttons.
5. With a non-metallic screwdriver, adjust L502 for a maximum reading on the panel meter. If necessary, reduce the meter reading with the CUE BIAS trim-pot R136.
6. Replace Q706 in its socket.

D. PROGRAM PLAY METER ADJUSTMENT

1. Place the meter switch S304 in the PR Play position.
2. Connect 600 ohm load(s) to J2 pins 3 and 5 (left channel or mono) and pins 4 and 6 (right channel stereo) on the reproducer. Connect an accurate VTVM across the load on pins 3 and 5.
3. Insert and play a NAB Standard Reference Level Tape (400 Hz) or its equivalent and observe that the VTVM reads 0 dBm. If necessary, adjust R111 on the reproduce program amplifier to obtain this reading.
4. Adjust R314, the left channel (or mono) PROC PLAY trim-pot for "OVU" reading on the left meter.
5. Stereo units — connect the VTVM across the load on pins 4 and 6 and observe that the VTVM reads 0 dBm. If necessary, adjust R130 on the reproduce program amplifier to obtain this reading.
6. Adjust R320, the right channel PROC PLAY trim-pot for "OVU" reading on the right meter.

E. PROGRAM BIAS ADJUSTMENT

1. Connect a 600 ohm load(s) to P301 pins 3 and 5 (left channel or mono) and pins 4

and 6 (right channel of stereo units) of the recorder.

2. Connect an audio signal generator across the load on pins 3 and 5. Set the output to approximately -10 dBm and the frequency to 1 kHz.
3. Connect the VTVM to the 600 ohm load on pins 3 and 5 of the reproducer output. Set the range to -10 dBm.
4. Insert an erased tape cartridge of several minutes time length and known good operating characteristics.
5. Press REC and START pushbuttons.
6. Advance the left record LEVEL control to provide approximately mid scale reading on the VTVM.
7. Adjust trimmer C606 on the bias oscillator card for maximum reading on the VTVM. (Note that a delay of .15 seconds between recording and play is present. Make these adjustments slowly.)
8. Stereo units — connect the VTVM to the 600 ohm load on pins 4 and 6 of the reproduce output (J2).
9. Advance the right record LEVEL control to provide approximately mid scale reading on the VTVM.
10. Adjust trimmer C605 on the bias oscillator card for maximum reading on the VTVM.
11. Leave the equipment set up and perform the record equalization adjustments in the next test.

F. PROGRAM RECORD EQUALIZATION

1. Connect the audio signal generator across the load on P301 pins 3 and 5. Set the frequency to 15 kHz and level to approximately -10 dBm.
2. Connect the VTVM to the load on pins 3 and 5 of the reproducer output J2. Set the range to -10 dBm.
3. Insert an erased tape of several minutes time length and known good operating characteristics.
4. Press REC and START pushbuttons.
5. Advance the left record LEVEL control to provide a mid-scale reading on the VTVM.
6. Carefully adjust the record head azimuth for maximum output as read on the VTVM. (Reduce record level as necessary to keep the VTVM on scale.)
7. Move the audio generator to 1 kHz and adjust the record LEVEL for -10 dBm on the VTVM.
8. Now move the audio generator to 10 kHz. Adjust the equalization trim-pot R443

located on the program record amplifier card to the same -10 dB reading as obtained at 1 kHz as in Step 7. Compare these outputs by switching back and forth.

9. Move the audio generator slowly upward in frequency to 15 kHz. Evaluate the response between 10 kHz and 15 kHz carefully. If an excessive loss of more than a dB or so occurs, it may be desirable to look at the bias adjustment again. Excessive bias can cause large losses in the upper frequencies. Adjust bias trimmer C606 carefully for the 1 kHz peak recording level.
10. The overall frequency response can now be compared and R443 adjusted slightly for the flattest response from 1 kHz up.
11. Stereo units — connect the input and output to the right channel and repeat steps 7 through 10 using C605 and R444 for the adjustments.

G. PROGRAM RECORD METER ADJUSTMENT

1. Connect the audio signal generator across the load on pins 3 and 5 of P301. Set the frequency to 1 kHz and level to approximately -10 dBm.
2. Set the meter switch S304 to PR Play.
3. Insert an erased tape and press REC and START.
4. Increase the left record LEVEL control to provide an "OVU" reading on the left (mono) meter.
5. Turn the meter switch to N REC (normal record).
6. Adjust the left NORM REC trim-pot R313 to produce "OVU" reading on the left meter.
7. Turn the meter switch to PE REC (peak record).
8. Adjust the left PEAK REC trim-pot R312 to produce "OVU" reading on the left meter.
9. Turn the audio generator frequency up toward approximately 7500 Hz and observe that the meter goes full scale in this mode. This indicates that tape saturation is approached at this level and frequency and is the desired result.
10. Stereo units — connect the audio generator across the load on pins 4 and 6 of P301. Set the frequency to 1 kHz.
11. Set the meter switch S304 to PR PLAY.
12. Increase the right record level control to

provide an "OVU" reading on the right channel meter.

13. Repeat steps 5 through 9 except using right channel trim-pots R319 and R318 and the right channel meter.

H. PROGRAM BIAS METER ADJUSTMENT

1. Turn the meter switch S304 to PR BIAS (program bias).
2. Insert an erased tape and press REC and START.
3. Adjust the left channel (mono) PROC BIAS trim-pot R311 for O (100%) on the left meter.
4. Stereo units — adjust the right channel PROC BIAS trim-pot R317 for O (100%) on the right meter.

I. CUE BIAS, METER AND TONE LEVEL ADJUSTMENT

1. Temporarily remove the left channel program play head lead from the amplifier card and connect the cue play head cable in its place.
2. Connect the VTVM to the load on pins 3 and 5 of the reproducer output J2. Set the range to O dBm.
3. Temporarily remove Q706 from its socket on the control card.
4. Insert an erased tape and press REC and START.
5. Turn up the 1 kHz oscillator gain control R506 for a mid scale reading.
6. Adjust the cue bias trimmer C607 for maximum output on the VTVM. (Note the delay in reaction because of the head spacing.)
7. Now adjust the 1 kHz oscillator gain control R506 for a reading of +0.4 dBm on the VTVM.
8. Turn the meter switch S304 to the Q BIAS position.
9. Adjust the CUE BIAS trim-pot R316 for "O" (100%) reading on the left meter. (Right meter is not used for cue bias measurement).
10. Replace Q706 in its socket.
11. Recorders with optional tones — with an erased tape, press REC and START.
12. Press the SEC pushbutton and adjust the 150 Hz oscillator gain control R516 for +6.1 dBm reading on the VTVM.
13. Press the TER pushbutton and adjust 8 kHz oscillator gain control R523 for -9.4 dBm reading on the VTVM.
14. Connect the head cables back to their

proper card inputs.

J. CUE TONE METER ADJUSTMENT

1. Disable the reproducer 1 kHz primary cue detector by turning its sensitivity control R206 full counter-clockwise. (Observe the initial setting so that the control may be easily returned to this setting.)
2. With a short erased cartridge, start and stop the recorder and reproducer several times to record a number of 1 kHz primary cue tones.
3. Set the meter switch S304 to the Q PLAY position.
4. Turn the CUE PLAY trim-pot R315 full counter-clockwise and play the tape just prepared in step 2 above.
5. Slowly advance the CUE PLAY trim-pot to provide a "O" (100%) reading of the tone bursts on the left meter. (Right meter is not used for tone measurements.)
6. Return the reproducer 1 kHz primary cue detector gain control R206 to the proper setting.
7. Three tone models — press the SEC pushbutton and observe the reading on the meter. This should be approximately -2VU on the meter.
8. Press the TER pushbutton and observe the reading on the meter. This should be approximately -2VU on the meter.

K. CUE TONE FREQUENCY ADJUSTMENT

1. Connect the vertical input of an oscilloscope to pin 9 of the recorder remote control jack J301.
2. Connect the horizontal input of the scope to an accurate audio signal generator. Set the frequency to exactly 1 kHz and the output level for a suitable display on the scope. (If a frequency counter is available, it may alternately be connected to pin 9 of J301 in place of the scope.)
3. Temporarily remove Q706 from its socket on the control circuit card.
4. Press the REC and START pushbuttons. (With no cartridge in place.)
5. Adjust the 1 kHz oscillator inductor L501 for "zero beat" on the scope display, or 1 kHz reading on the frequency counter.
6. Return Q706 to its socket on the control card.
7. Recorders with optional tones — set the audio signal generator to exactly 150 Hz.
8. Press the SEC pushbutton and adjust the 150 Hz oscillator inductor L503 for "zero

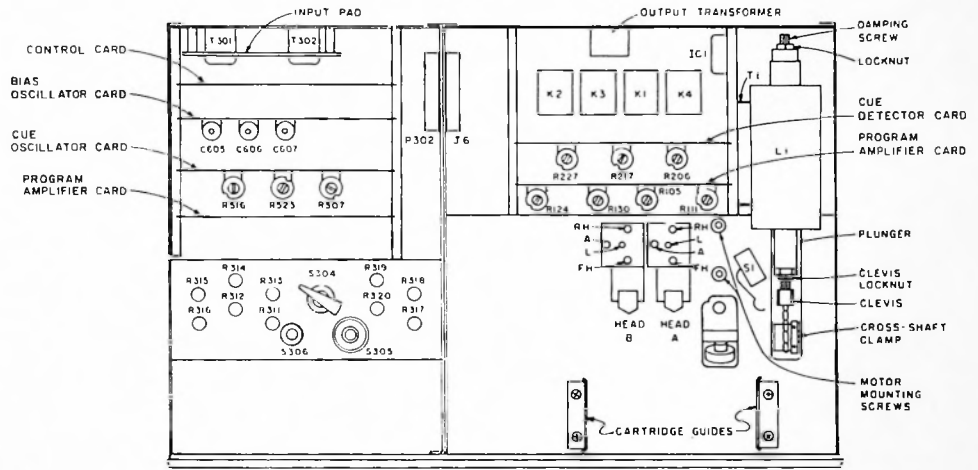
beat" on the scope display, or 150 Hz reading on the frequency counter.

9. Set the audio signal generator to exactly 8 kHz.
10. Press the TER pushbutton and adjust the 8 kHz oscillator inductor L504 for "zero beat" on the scope display, or 8 kHz reading on the frequency counter.

SECTION V

DRAWINGS

RA & WRA SERIES RECORDING AMPLIFIERS



TOP VIEW

FIGURE 5-1

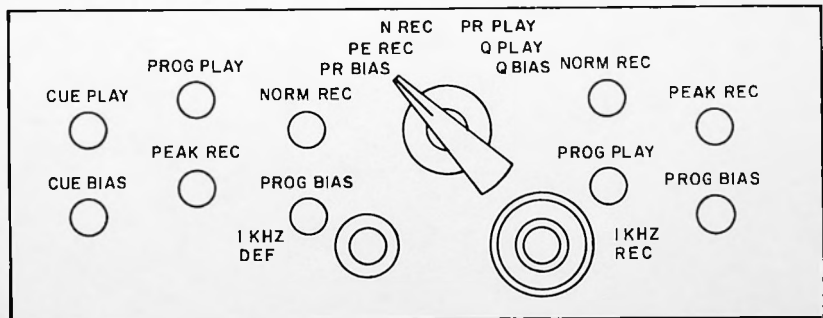


FIGURE 5-2

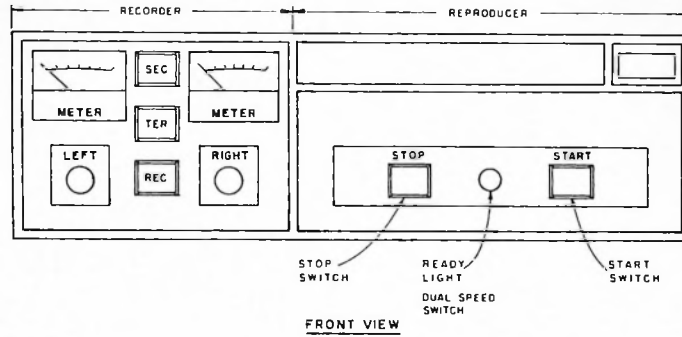
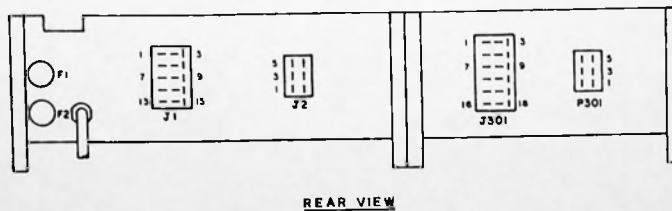
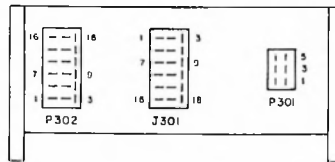


FIGURE 5-3

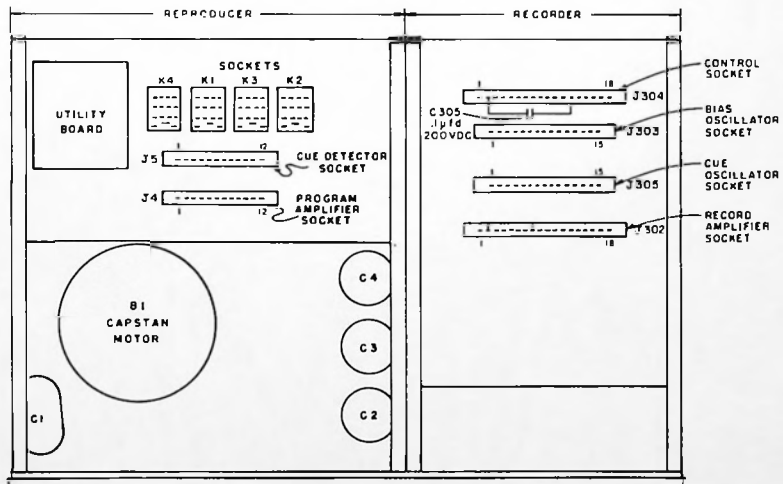


RP SERIES
FIGURE 5-4



REAR VIEW

WRA SERIES
FIGURE 5-5



BOTTOM VIEW

FIGURE 5-6

CONTROL CARD

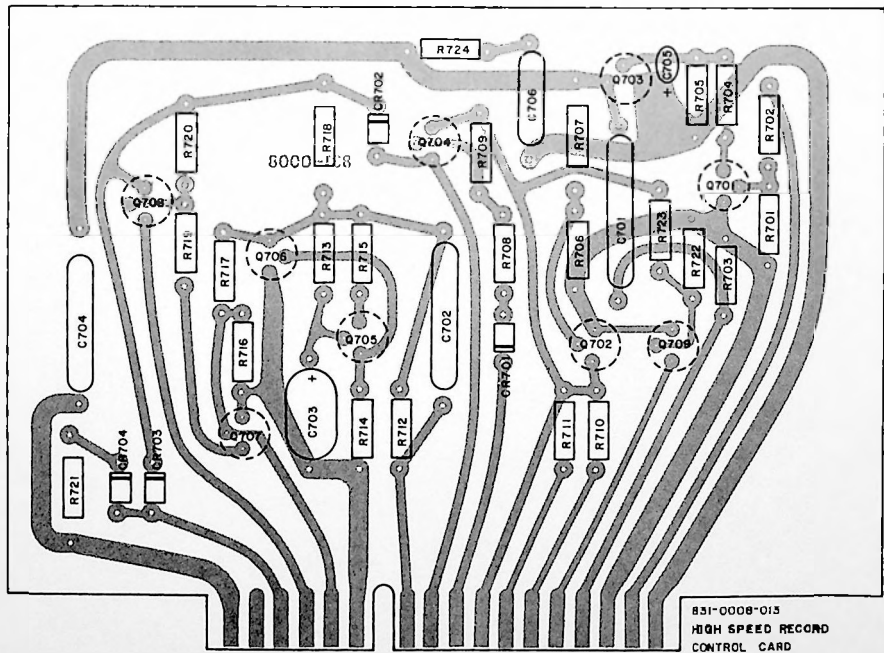
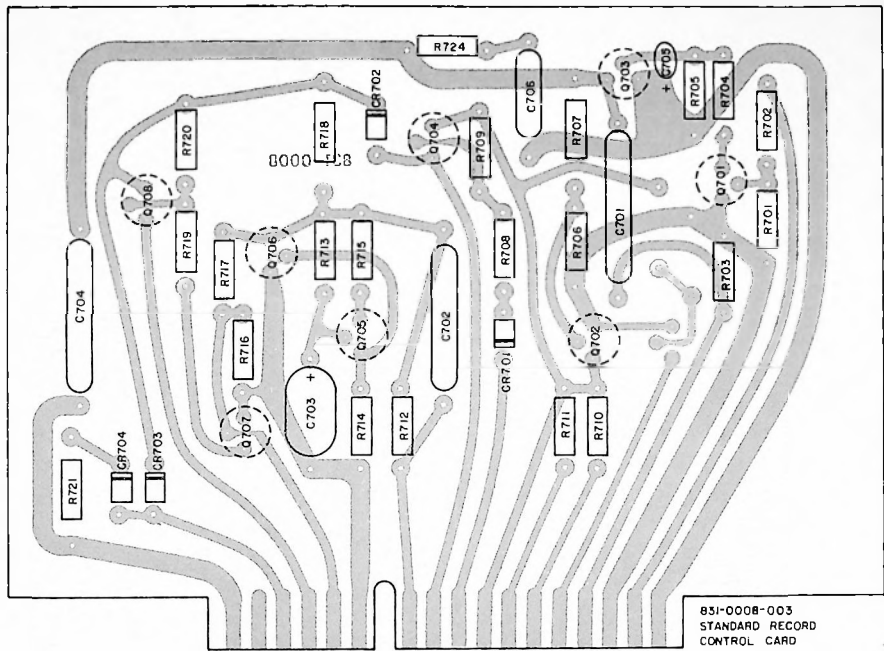


FIGURE 5-7

RECORD AMPLIFIER CARD

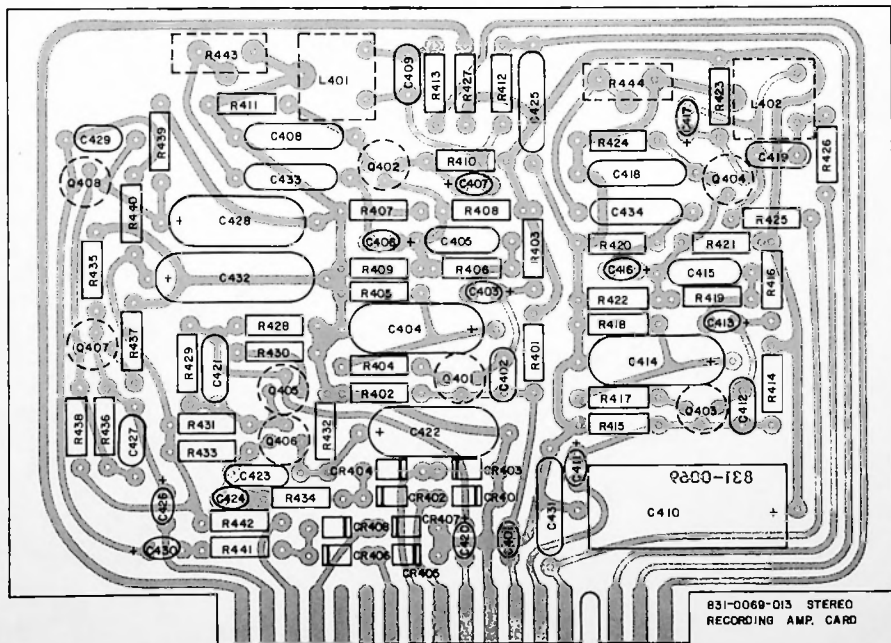
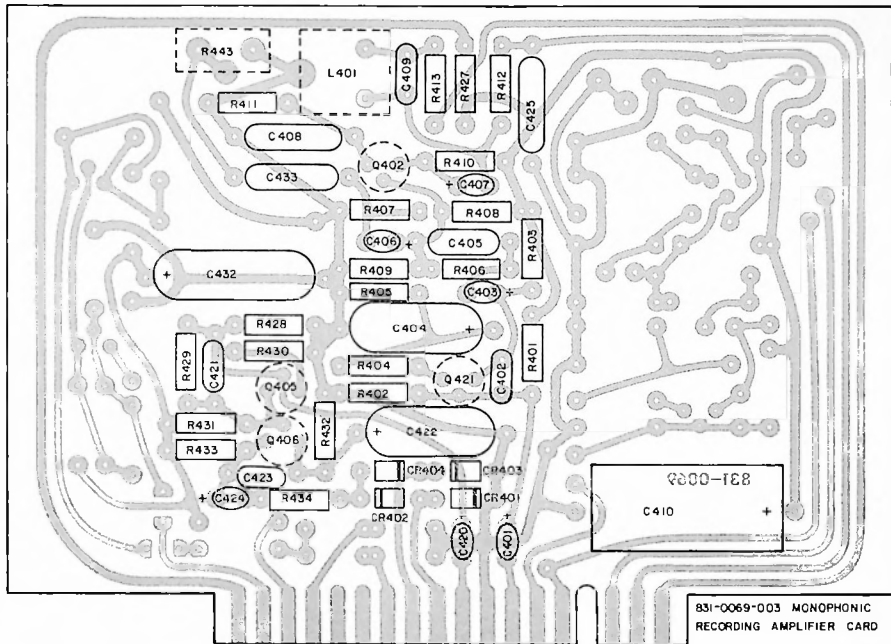


FIGURE 5-8

BIAS OSCILLATOR CARD

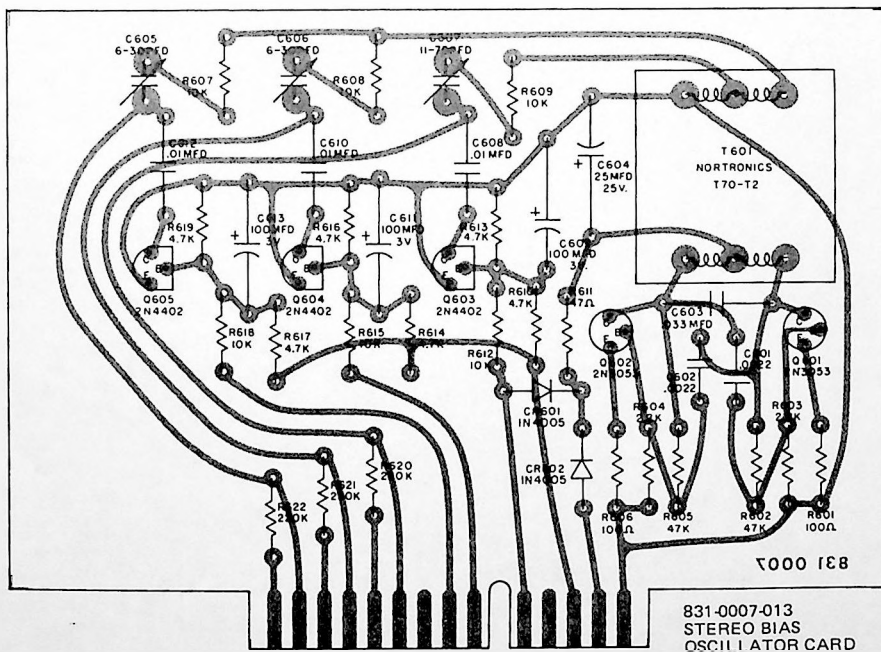
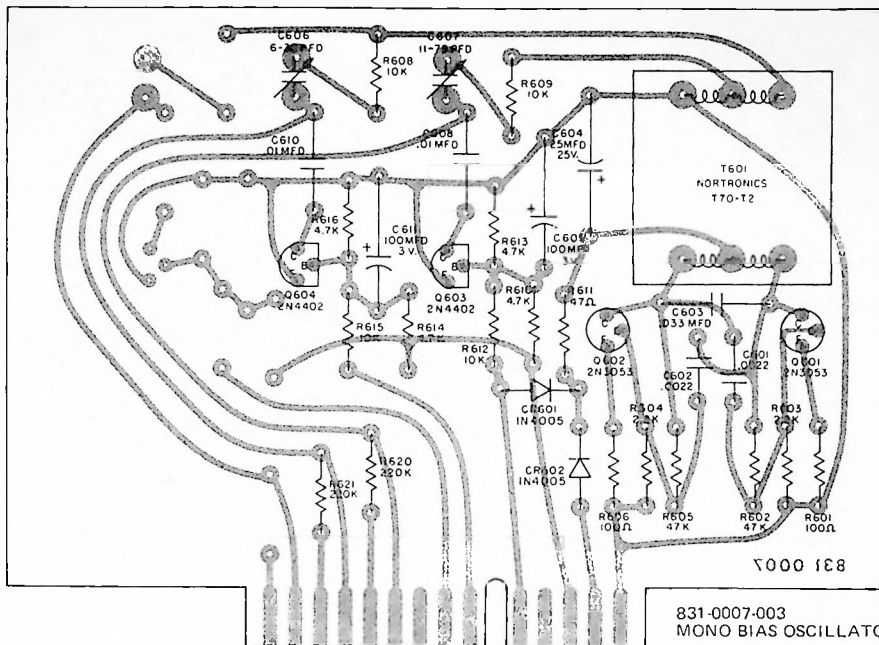


FIGURE 5-9

CUE OSCILLATOR CARD

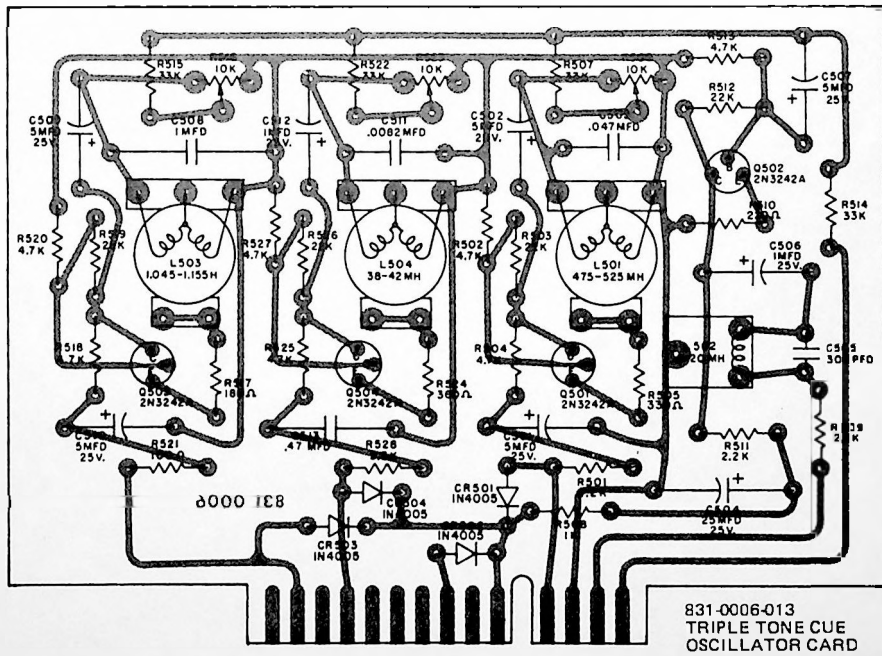
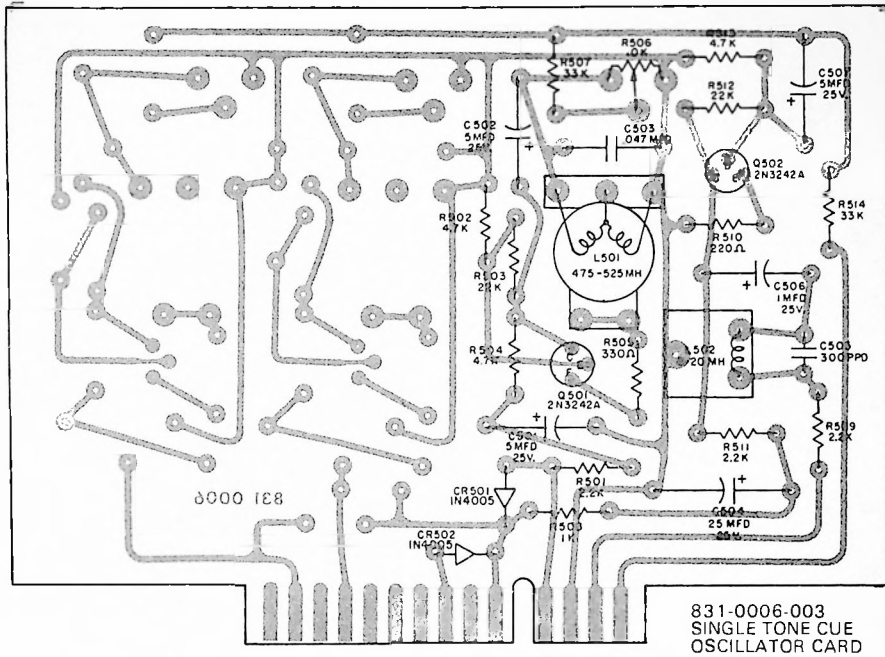


FIGURE 5-10

METER CIRCUITS CARD

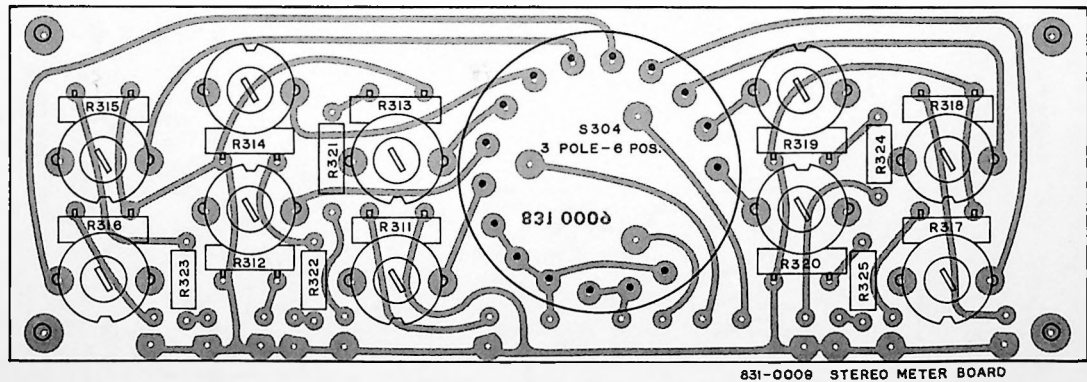
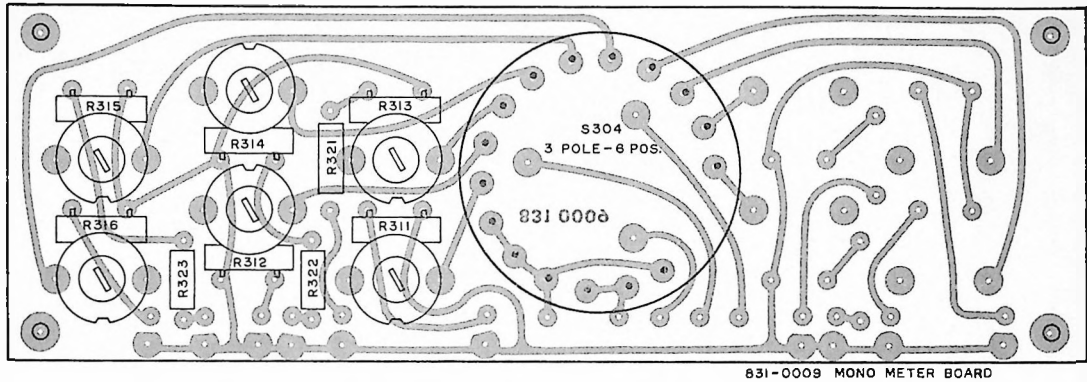


FIGURE 5-11

AUDIO INPUT PAD CARD

* STEREO ONLY

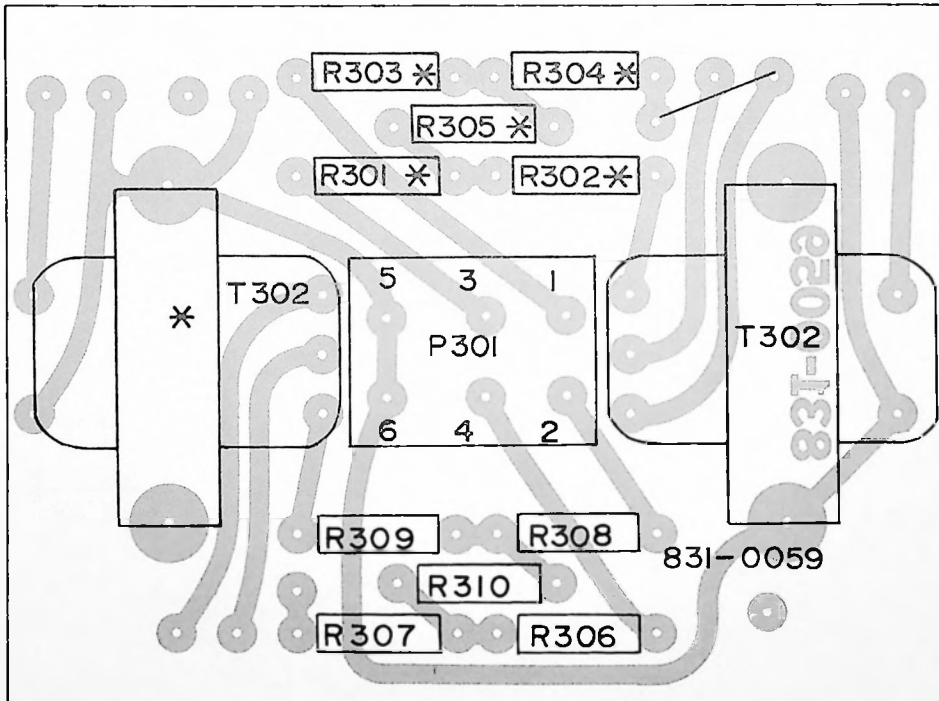
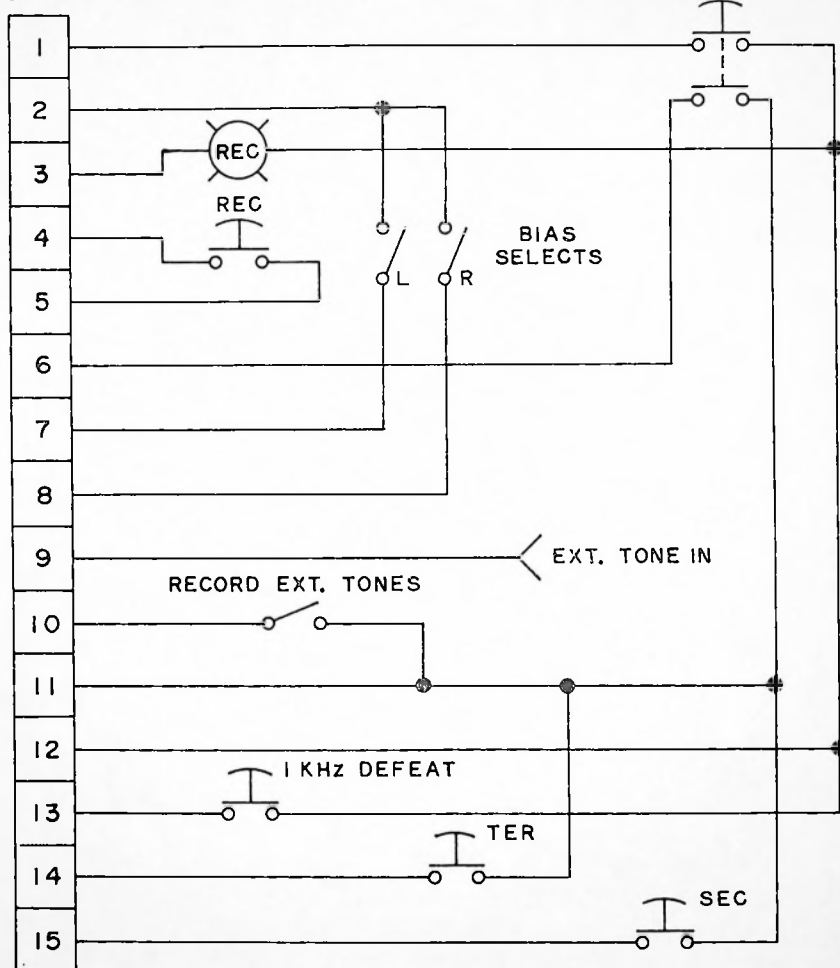


FIGURE 5-12

CONNECT
TO
J301



SAMPLE REMOTE CONTROL SCHEMATIC
RA, WRA & RP RECORDERS

FIGURE 5-13

SECTION VI

ELECTRICAL PARTS LISTS

RA & WRA SERIES RECORDING AMPLIFIERS

A. CHASSIS

Symbol	Part Number	Description
CAPACITORS		
C305	681-0058-000	1 mfd, 200 V.
C306	696-0019-000	25 mfd, 25 V.
LAMPS		
I301	415-0001-000	No. 327, 28 V.
I302	415-0001-000	No. 327, 38 V.
I303	415-0001-000	No. 327, 28 V.
SOCKETS		
J301	380-0005-000	18 pin, Remote
J302	380-0010-000	18 pin, card edge
J303	380-0006-000	15 pin, card edge
J304	380-0010-000	18 pin, card edge
J305	380-0006-000	15 pin, card edge
METERS		
M301	554-0002-000	Meter, VU scale
M302	554-0002-000	Meter, VU scale (STEREO ONLY)
PLUGS		
P302	378-0006-000	Plug, 18 pin, Gold Plated, Inter-Connect
POTENTIOMETERS		
R326	636-0003-000	500 ohms
R327	636-0003-000	500 ohms (STEREO ONLY)
RESISTORS		
R328	626-0215-000	10 ohms, 1/2 watt, 5%
SWITCHES		
S301	391-0002-000	Switch, Pushbutton
S302	391-0002-000	Switch, Pushbutton
S303	391-0002-000	Switch, Pushbutton
S305	391-0005-000	Switch, Pushbutton
S306	391-0004-000	Switch, Pushbutton
MISCELLANEOUS		
	380-0009-000	Socket, 6 Pin, Audio
	380-0014-000	Socket, 18 Pin, Remote

B. CONTROL CARD (831-0008-003) (Hi-Speed Cue 831-0008-013)

CAPACITORS		
C701	685-0002-000	1 mfd, 250 V.
C702	685-0002-000	1 mfd, 250 V.
C703	696-0114-000	5 mfd, 25 V.
C704	685-0002-000	1 mfd, 250 V.
C705	694-0004-000	.47 mfd, 35 V.
C706	681-0058-000	.1 mfd, 200 V.
DIODES		
CR701	575-0007-000	IN4005

Symbol	Part Number	Description
CR702	575-0007-000	IN4005
CR703	575-0007-000	IN4005
CR704	575-0007-000	IN4005
TRANSISTORS		
Q701	590-0014-000	2N2905
Q702	590-0014-000	2N2905
Q703	581-0001-000	Silicon Controlled Rectifier, 2N5061
Q704	590-0014-000	2N2905
Q705	601-0001-001	Unijunction Transistor 2N4870
Q706	581-0001-000	Silicon Controlled Rectifier, 2N5061
Q707	590-0001-001	2N3053
Q708	590-0014-000	2N2905
Q709	590-0014-000	2N2905 (Hi-Speed Cue Only)
RESISTORS		
R701	626-0255-000	470 ohms, 1/2 watt, 5%
R702	626-0287-000	10 K ohms, 1/2 watt, 5%
R703	626-0327-000	470 K ohms, 1/2 watt, 5%
R704	626-0271-000	2.2 K ohms, 1/2 watt, 5%
R705	626-0239-000	100 ohms, 1/2 watt, 5%
R706	626-0271-000	2.2 K ohms, 1/2 watt, 5%
R707	626-0658-000	620 ohms, 2 watt, 5%
R708	626-0271-000	2.2 K ohms, 1/2 watt, 5%
R709	626-0271-000	2.2 K ohms, 1/2 watt, 5%
R710	626-0239-000	100 ohms, 1/2 watt, 5%
R711	626-0239-000	100 ohms, 1/2 watt, 5%
R712	626-0299-000	33 K ohms, 1/2 watt, 5%
R713	626-0307-000	68 K ohms, 1/2 watt, 5%
R714	626-0227-000	33 ohms, 1/2 watt, 5%
R715	626-0247-000	220 ohms, 1/2 watt, 5%
R716	626-0271-000	2.2 K ohms, 1/2 watt, 5%
R717	626-0271-000	2.2 K ohms, 1/2 watt, 5%
R718	626-0265-000	1.2 K ohms, 1/2 watt, 5%
R719	626-0271-000	2.2 K ohms, 1/2 watt, 5%
R720	626-0271-000	2.2 K ohms, 1/2 watt, 5%
R721	626-0449-000	270 ohms, 1 watt, 5%
R722	626-0279-000	4.7 K ohms, 1/2 watt, 5% (Hi-Speed Cue Only)
R723	626-0287-000	10 K ohms, 1/2 watt, 5% (Hi-Speed Cue only)

C. PROGRAM RECORDING AMPLIFIER CARD 831-0069-003 831-0069-013 (STEREO)

CAPACITORS		
C401	694-0003-000	4.7 mfd, 35 V.
C402	677-0001-000	100 pfd, 300 V.
C403	694-0005-000	1 mfd, 35 V.
C404	696-0122-000	50 mfd, 25 V.
C405	681-0042-000	.0047 mfd, 200 V.
C406	694-0004-000	.47 mfd, 35 V.
C407	694-0005-000	1 mfd, 35 V.
C408	681-0052-000	.033 mfd, 200 V.
C409	677-0003-000	300 pfd, 500 V.
C410	696-0165-000	500 mfd, 25 V.
C420	694-0005-000	1 mfd, 35 V.
C421	681-0030-000	470 pfd, 200 V.
C422	696-0078-000	100 mfd, 12 V.

Symbol	Part Number	Description
C423	681-0034-000	.001 mfd, 200 V.
C424	694-0003-000	4.7 mfd, 35 V.
C425	681-0050-000	.022 mfd, 200 V.
C432	696-0078-000	100 mfd, 25 V.
C433	681-0050-000	.022 mfd, 200 V.

CAPACITORS (STEREO ONLY)

C411	694-0003-000	4.7 mfd, 35 V.
C412	677-0001-000	100 pfd, 300 V.
C413	694-0005-000	1 mfd, 35 V.
C414	696-0122-000	50 mfd, 25 V.
C415	681-0047-000	.0047 mfd, 200 V.
C416	694-0004-000	.47 mfd, 35 V.
C417	694-0005-000	1 mfd, 35 V.
C418	681-0052-000	.033 mfd, 200 V.
C419	677-0003-000	300 pfd, 300 V.
C426	694-0005-000	1 mfd, 35 V.
C427	681-0030-000	470 pfd, 200 V.
C428	696-0078-000	100 mfd, 12 V.
C429	681-0034-000	.001 mfd, 200 V.
C430	694-0003-000	4.7 mfd, 35 V.
C431	681-0050-000	.022 mfd, 200 V.
C434	681-0050-000	.022 mfd, 200 V.

INDUCTORS

L401	513-0004-000	8-20 mH, Variable
L402	513-0004-000	8-20 mH, Variable (STEREO ONLY)

DIODES

CR401	575-0001-000	IN295
CR402	575-0001-000	IN295
CR403	575-0001-000	IN295
CR404	575-0001-000	IN295

DIODES (STEREO ONLY)

CR405	575-0001-000	IN295
CR406	575-0001-000	IN295
CR407	575-0001-000	IN295
CR408	575-0001-000	IN295

TRANSISTORS

Q401	590-0011-000	2N930
Q402	590-0011-000	2N930
Q405	590-0011-000	2N930
Q406	590-0011-000	2N930

TRANSISTORS (STEREO ONLY)

Q403	590-0011-000	2N930
Q404	590-0011-000	2N930
Q407	590-0011-000	2N930
Q408	590-0011-000	2N930

RESISTORS

R401	626-0311-000	100 K ohms, 1/2 watt, 5%
R402	626-0287-000	10 K ohms, 1/2 watt, 5%
R403	626-0287-000	10 K ohms, 1/2 watt, 5%
R404	626-0239-000	100 ohms, 1/2 watt, 5%
R405	626-0263-000	1 K ohms, 1/2 watt, 5%
R406	626-0287-000	10 K ohms, 1/2 watt, 5%
R407	626-0273-000	2.7 K ohms, 1/2 watt, 5%
R408	626-0309-000	82 K ohms, 1/2 watt, 5%
R409	626-0287-000	10 K ohms, 1/2 watt, 5%
R410	626-0283-000	6.8 K ohms, 1/2 watt, 5%
R411	626-0263-000	1 K ohms, 1/2 watt, 5%
R412	626-0287-000	10 K ohms, 1/2 watt, 5%
R413	626-0271-000	2.2 K ohms, 1/2 watt, 5%

R427	626-0263-000	1 K ohms, 1/2 watt, 5%
R427	626-0255-000	470 ohms, 1/2 watt, 5% (STEREO ONLY)
R428	626-0287-000	10 K ohms, 1/2 watt, 5%
R429	626-0307-000	68 K ohms, 1/2 watt, 5%
R430	626-0259-000	680 ohms, 1/2 watt, 5%
R431	626-0287-000	10 K ohms, 1/2 watt, 5%
R432	626-0285-000	8.2 K ohms, 1/2 watt, 5%
R433	626-0279-000	4.7 K ohms, 1/2 watt, 5%
R434	626-0277-000	3.9 K ohms, 1/2 watt, 5%
R443	636-0004-000	10 K ohms, Variable, 1/4 watt

RESISTORS (STEREO ONLY)

R414	626-0311-000	100 K ohms, 1/2 watt, 5%
R415	626-0287-000	10 K ohms, 1/2 watt, 5%
R416	626-0287-000	10 K ohms, 1/2 watt, 5%
R417	626-0239-000	100 ohms, 1/2 watt, 5%
R418	626-0263-000	1 K ohms, 1/2 watt, 5%
R419	626-0287-000	10 K ohms, 1/2 watt, 5%
R420	626-0273-000	2.7 K ohms, 1/2 watt, 5%
R421	626-0309-000	82 K ohms, 1/2 watt, 5%
R422	626-0287-000	10 K ohms, 1/2 watt, 5%
R423	626-0283-000	6.8 K ohms, 1/2 watt, 5%
R424	626-0263-000	1 K ohms, 1/2 watt, 5%
R425	626-0287-000	10 K ohms, 1/2 watt, 5%
R426	626-0271-000	2.2 K ohms, 1/2 watt, 5%
R435	626-0287-000	10 K ohms, 1/2 watt, 5%
R436	626-0307-000	68 K ohms, 1/2 watt, 5%
R437	626-0259-000	680 ohms, 1/2 watt, 5%
R438	626-0287-000	10 K ohms, 1/2 watt, 5%
R439	626-0285-000	8.2 K ohms, 1/2 watt, 5%
R440	626-0279-000	4.7 K ohms, 1/2 watt, 5%
R441	626-0277-000	3.9 K ohms, 1/2 watt, 5%
R442	626-0263-000	1 K ohms, 1/2 watt, 5%
R444	636-0004-000	10 K ohms, Variable, 1/4 watt

D. BIAS OSCILLATOR CARD

831-0007-003 MONO

831-0007-013 STEREO

CAPACITORS

C601	681-0038-000	.0022 mfd, 200 V.
C602	681-0038-000	.0022 mfd, 200 V.
C603	681-0052-000	.033 mfd, 200 V.
C604	696-0119-000	25 mfd, 25 V.
C605	688-0001-000	Variable, 6-30 pfd, (Right Bias Adj.) (Stereo Only)
C606	688-0001-000	Variable, 6-30 pfd, (Left Bias Adj.)
C607	688-0002-000	Variable, 11-75 pfd (Cue Bias Adj.)
C608	681-0046-000	.01 mfd, 200 V.
C609	696-0018-000	100 mfd, 3 V.
C610	681-0046-000	.01 mfd, 200 V.
C611	696-0018-000	100 mfd, 3 V.
C612	681-0046-000	.01 mfd, 200 V. (Stereo Only)
C613	696-0018-000	100 mfd, 3 V. (Stereo Only)

DIODES

CR601	575-0007-000	IN4005
CR602	575-0007-000	IN4005

TRANSISTORS

Q601	590-0001-000	2N3053
Q602	590-0001-000	2N3053
Q603	590-0014-000	2N2905 or 2N4402
Q604	590-0014-000	2N2905 or 2N4402
Q605	590-0014-000	2N2905 or 2N4402 (Stereo Only)

Symbol	Part Number	Description
RESISTORS		
R601	626-0239-000	100 ohms, 1/2 watt, 5%
R602	626-0303-000	47 K ohms, 1/2 watt, 5%
R603	626-0271-000	2.2 K ohms, 1/2 watt, 5%
R604	626-0271-000	2.2 K ohms, 1/2 watt, 5%
R605	626-0303-000	47 K ohms, 1/2 watt, 5%
R606	626-0239-000	100 ohms, 1/2 watt, 5%
R607	626-0287-000	10 K ohms, 1/2 watt, 5% (Stereo Only)
R608	626-0287-000	10 K ohms, 1/2 watt, 5%
R609	626-0287-000	10 K ohms, 1/2 watt, 5%
R610	626-0279-000	4.7 K ohms, 1/2 watt, 5%
R611	626-0231-000	47 ohms, 1/2 watt, 5%
R612	626-0287-000	10 K ohms, 1/2 watt, 5%
R613	626-0279-000	4.7 K ohms, 1/2 watt, 5%
R614	626-0279-000	4.7 K ohms, 1/2 watt, 5%
R615	626-0287-000	10 K ohms, 1/2 watt, 5%
R616	626-0279-000	4.7 K ohms, 1/2 watt, 5%
R617	626-0279-000	4.7 K ohms, 1/2 watt, 5% (Stereo Only)
R618	626-0287-000	10 K ohms, 1/2 watt, 5% (Stereo Only)
R619	626-0279-000	4.7 K ohms, 1/2 watt, 5% (Stereo Only)
R620	626-0319-000	220 K ohms, 1/2 watt, 5%
R621	626-0319-000	220 K ohms, 1/2 watt, 5%
R622	626-0319-000	220 K ohms, 1/2 watt, 5% (Stereo Only)

E. CUE OSCILLATOR CARD 831-0006-003 MONO 831-0006-013 STEREO

CAPACITORS		
C501	696-0114-000	5 mfd, 25 V.
C502	696-0114-000	5 mfd, 25 V.
C503	681-0054-000	.047 mfd, 200 V.
C504	696-0119-000	25 mfd, 25 V.
C505	677-0003-000	300 pfd, 300 V.
C506	696-0110-000	1 mfd, 25 V.
C507	696-0114-000	5 mfd, 25 V.
C508	685-0002-000	1 mfd, 250 V. (150 Hz)
C509	696-0114-000	5 mfd, 25 V. (150 Hz)
C510	696-0114-000	5 mfd, 25 V. (150 Hz)
C511	681-0045-000	.0082 mfd, 200 V. (8 kHz)
C512	696-0110-000	1 mfd, 25 V (8 kHz)
C513	685-0001-000	47 mfd, 250 V. (8 kHz)

DIODES		
CR501	575-0007-000	IN4005
CR502	575-0007-000	IN4005
CR503	575-0007-000	IN4005 (150 Hz)
CR504	575-0007-000	IN4005 (8 kHz)

INDUCTORS		
L501	513-0002-000	Variable, 474-525 mH
L502	513-0004-000	Variable, 8-20 mH
L503	513-0003-000	Variable, 1.045-1.155 H (150 Hz)
L504	513-0005-000	Variable, 32.8-47.2 mH (8 kHz)

TRANSISTORS		
Q501	590-0013-000	2N5089 or 2N3242A
Q502	590-0013-000	2N5089 or 2N3242A
Q503	590-0013-000	2N5089 or 2N3242A (150 Hz)
Q504	590-0013-000	2N5089 or 2N3242A (8 kHz)

RESISTORS		
R501	626-0271-000	2.2 K ohms, 1/2 watt, 5%
R502	626-0279-000	4.7 K ohms, 1/2 watt, 5%
R503	626-0295-000	22 K ohms, 1/2 watt, 5%
R504	626-0279-000	4.7 K ohms, 1/2 watt, 5%
R505	626-0251-000	330 ohms, 1/2 watt, 5%

Symbol	Part Number	Description
R506	636-0002-000	Variable, 10 K ohms, 1/4 watt (1 kHz Level)
R507	626-0299-000	33 K ohms, 1/2 watt, 5%
R508	626-0263-000	1 K ohms, 1/2 watt, 5%
R509	626-0271-000	2.2 K ohms, 1/2 watt, 5%
R510	626-0247-000	220 ohms, 1/2 watt, 5%
R511	626-0271-000	2.2 K ohms, 1/2 watt, 5%
R512	626-0295-000	22 K ohms, 1/2 watt, 5%
R513	626-0279-000	4.7 K ohms, 1/2 watt, 5%
R514	626-0299-000	33 K ohms, 1/2 watt, 5%
R515	626-0299-000	33 K ohms, 1/2 watt, 5%
R516	636-0002-000	Variable, 10 K ohms, 1/4 watt (150 Hz Level)
R517	626-0245-000	180 ohms, 1/2 watt, 5% (150 Hz)
R518	626-0279-000	4.7 K ohms, 1/2 watt, 5%
R519	626-0295-000	22 K ohms, 1/2 watt, 5%
R520	626-0279-000	4.7 K ohms, 1/2 watt, 5%
R521	626-0239-000	100 ohms, 1/2 watt, 5%
R522	626-0299-000	33 K ohms, 1/2 watt, 5% (8 kHz)
R523	636-0002-000	Variable, 10 K ohms, 1/4 watt, (8 kHz Level)
R524	626-0252-000	360 ohms, 1/2 watt, 5% (8 kHz)
R525	626-0279-000	4.7 ohms, 1/2 watt, 5% (8 kHz)
R526	626-0295-000	22 K ohms, 1/2 watt, 5% (8 kHz)
R527	626-0279-000	4.7 K ohms, 1/2 watt, 5% (8 kHz)
R528	626-0275-000	3.3 K ohms, 1/2 watt, 5% (8 kHz)

F. METER CIRCUITS CARD 831-0009-003 MONO 831-0009-013 STEREO

RESISTORS		
R311	636-0001-000	Variable, 1 K ohms, 1/4 watt
R312	636-0001-000	Variable, 1 K ohms, 1/4 watt
R313	636-0004-000	Variable, 10 K ohms, 1/4 watt
R314	636-0001-000	Variable, 1 K ohms, 1/4 watt
R315	636-0001-000	Variable, 1 K ohms, 1/4 watt
R316	636-0001-000	Variable, 1 K ohms, 1/4 watt
R321	626-0283-000	6.8 K ohms, 1/2 watt, 5%
R322	626-0295-000	22 K ohms, 1/2 watt, 5%
R323	626-0295-000	22 K ohms, 1/2 watt, 5%

RESISTORS (STEREO ONLY)		
R317	636-0001-000	Variable, 1 K ohms, 1/4 watt
R318	636-0001-000	Variable, 1 K ohms, 1/4 watt
R319	636-0004-000	Variable, 10 K ohms, 1/4 watt
R320	636-0001-000	Variable, 1 K ohms, 1/4 watt
R324	626-0283-000	6.8 K ohms, 1/2 watt, 5%
R325	626-0295-000	22 K ohms, 1/2 watt, 5%

SWITCH		
S304	394-0001-000	3 pole, 6 position Rotary Switch

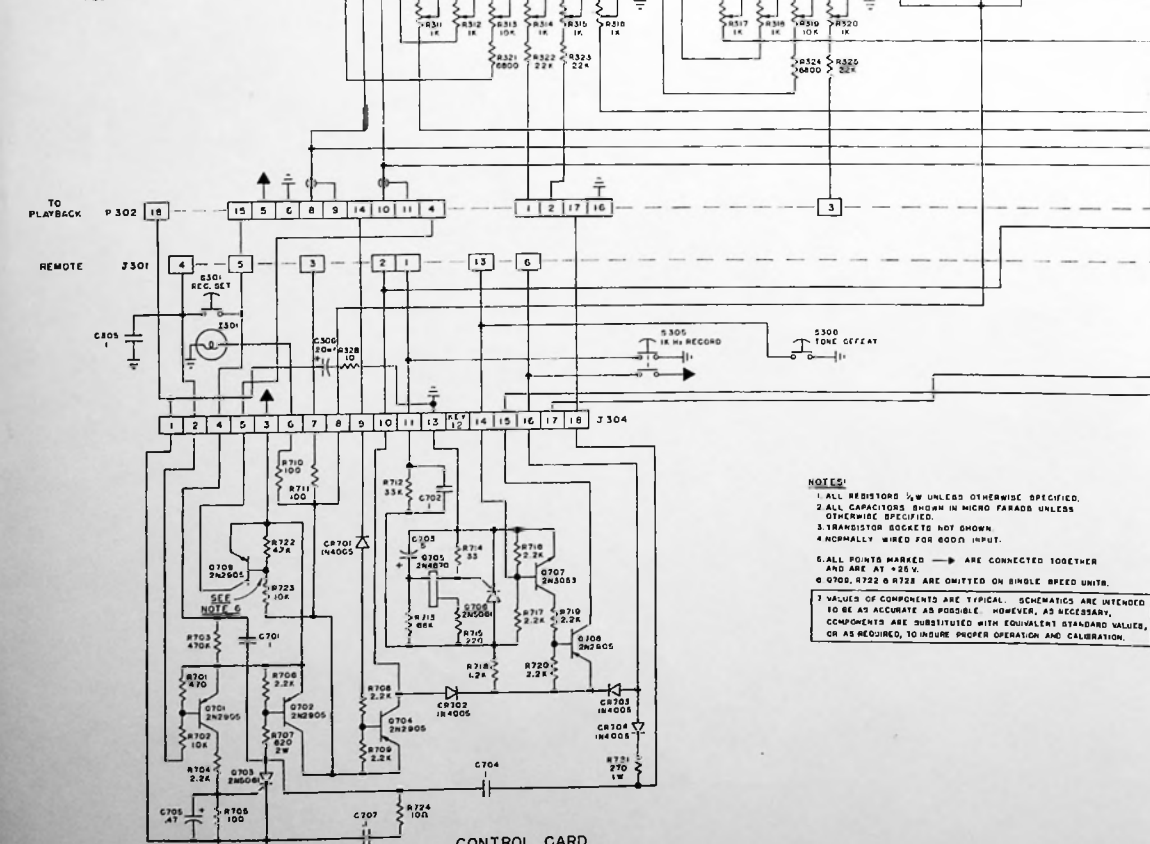
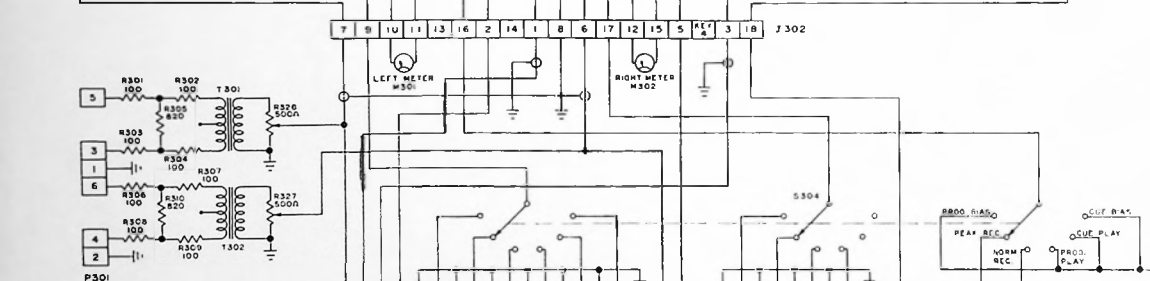
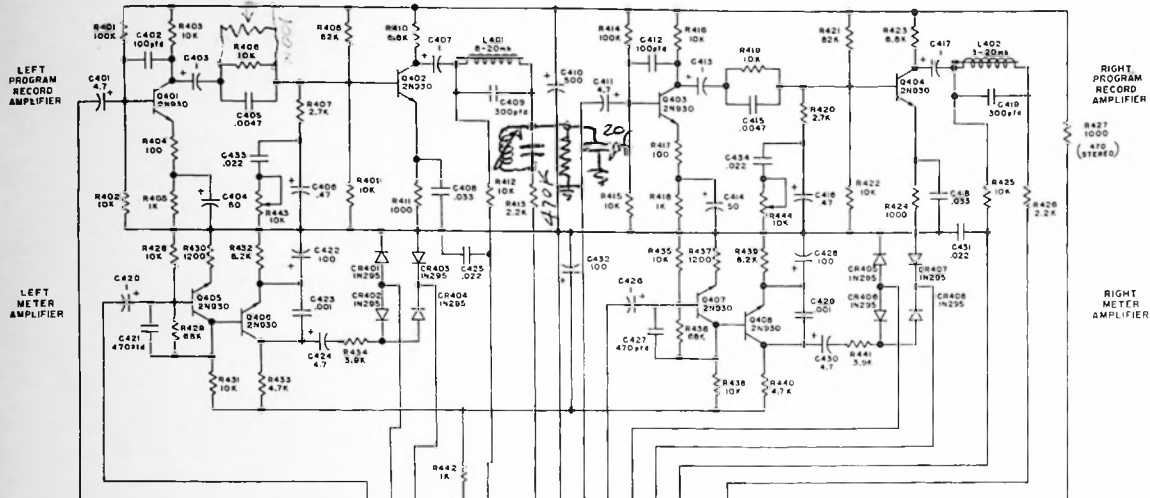
G. AUDIO INPUT PAD CARD 831-0059-003 MONO 831-0059-013 STEREO

RESISTORS		
R301	626-0239-000	100 ohms, 1/2 watt, 5%
R302	626-0239-000	100 ohms, 1/2 watt, 5%
R303	626-0239-000	100 ohms, 1/2 watt, 5%
R304	626-0239-000	100 ohms, 1/2 watt, 5%
R305	626-0261-000	820 ohms, 1/2 watt, 5%
R306	626-0239-000	100 ohms, 1/2 watt, 5%
R307	626-0239-000	100 ohms, 1/2 watt, 5%
R308	626-0239-000	100 ohms, 1/2 watt, 5%
R309	626-0239-000	100 ohms, 1/2 watt, 5%
R310	626-0261-000	820 ohms, 1/2 watt, 5%

Symbol	Part Number	Description
PLUGS		
P301	378-0015-000	Plug, 6 Pin
TRANSFORMERS		
T301	532-0001-020	Transformer, Audio
T302	532-0001-020	Transformer, Audio (Stereo Only)

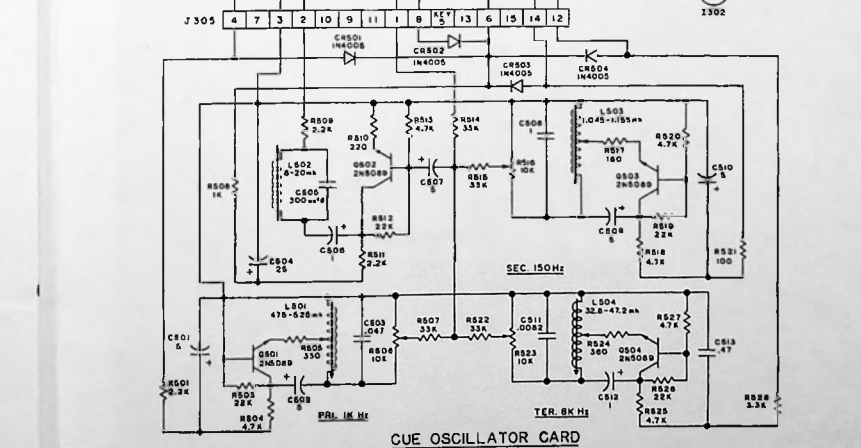
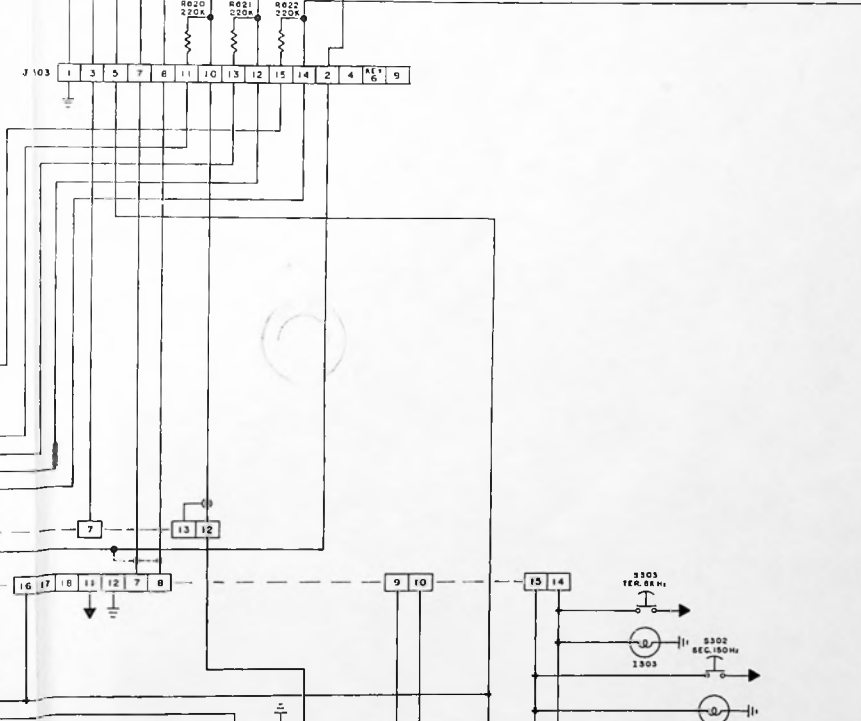
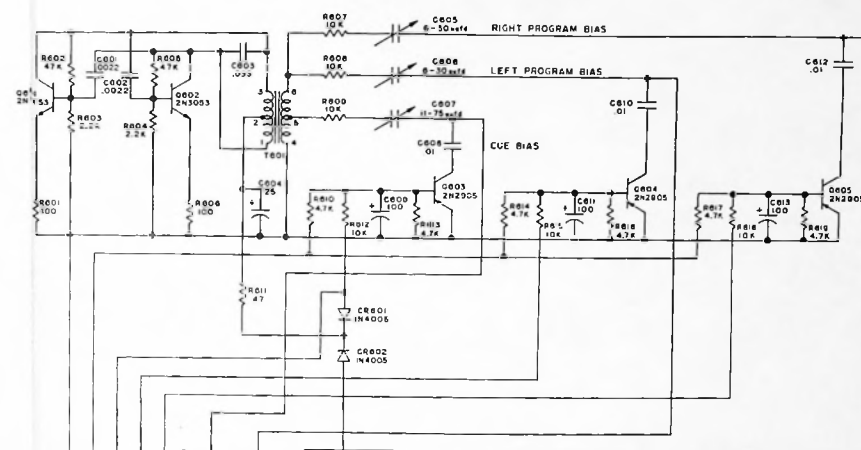
ADD EXTRA BIAS TRAP.

PROGRAM RECORDING AMPLIFIER CARD



- NOTES:
1. ALL RESISTORS 1/4W UNLESS OTHERWISE SPECIFIED.
 2. ALL CAPACITORS SHOWN IN MICRO FARADS UNLESS OTHERWISE SPECIFIED.
 3. TRANSISTOR SOCKETS NOT SHOWN.
 4. NORMALLY WIRED FOR 600Ω INPUT.
 5. ALL POINTS MARKED → ARE CONNECTED TOGETHER AND ARE AT +25V.
 6. Q700, R722 & R728 ARE OMITTED ON SINGLE SPEED UNITS.
 7. VALUES OF COMPONENTS ARE TYPICAL. SCHEMATICS ARE INTENDED TO BE AS ACCURATE AS POSSIBLE. HOWEVER, AS NECESSARY, COMPONENTS ARE SUBSTITUTED WITH EQUIVALENT STANDARD VALUES, OR AS REQUIRED, TO INSURE PROPER OPERATION AND CALIBRATION.

BIAS OSCILLATOR CARD



TITLE	
SCHEMATIC, RA/WRA SERIES RECORDING AMPLIFIER	
INTERNATIONAL TAPETRONICS CORPORATION	B93-0061-005
DRAWING NUMBER	REV

WARRANTY

International Tapetronics Corporation (ITC) warrants to Purchaser that the equipment sold is free of defects of workmanship or material and conforms to the specifications referred to or set out herein. This warranty, applying only to the original user, extends from date of shipment for a period of two years. No claim shall be maintained hereunder unless written notice is received by Seller within thirty days after the discovery of the facts giving rise to the claim. The sole or exclusive liability of Seller for breach of warranty shall be to refund the purchase price of the item sold, or at its option, to replace or repair the item or part concerned FOB its factory, or such other place as it may designate. ITC's liability shall arise only if Purchaser causes the defective part or item to be delivered to ITC for inspection upon ITC's request at Purchaser's expense. This warranty shall not be effective if the alleged defect is due to maltreatment, exposure, excessive moisture or any other use of the equipment other than the use for which the manufacturer prescribed.

No warranties expressed or implied shall be applicable to any equipment sold hereunder, and the foregoing shall constitute the Buyer's sole right and remedy under the agreements in this paragraph contained. In no event shall International Tapetronics Corporation have any liability for consequential damages, or for loss, damage, or expense directly or indirectly arising from the use of the products, or any inability to use them either separate or in combination with other equipment or materials, or from any other cause.

ITC's warranty is given solely to the original user and only to the extent above described. No dealer or agent is authorized to make any other or additional guaranty or warranty.