TECHNICAL MANUAL

(890-0009-000)

RP SERIES RECORDER/REPRODUCERS

Monophonic, Single Cue	829-0001-000
Stereophonic, Single Cue	829-0002-000
Monophonic, Triple Cue	829-0003-000
Stereophonic, Triple Cue	829-0004-000
Monophonic, Hi-Speed Cue	829-0005-000
Stereophonic, Hi-Speed Cue	829-0006-000

The INTERNATIONAL TAPETRONICS RP Series Recorder/Reproducers consist of a WP Series Reproducer and a RA Series Recording Amplifier. These units are supplied with a common front panel in a single case designed for table mounting. An optional rack mounting kit is available.

This manual is presented in two sections. The section nearest to the front pertains to the WP Reproducer section and its associated adjustments, descriptions, and schematics. Similar information pertaining to the RA Recording Amplifier section is found from approximately the middle of the book. The Table of Contents may be found immediately in front of the pertinent section.

TECHNICAL MANUAL

(890-0001-000)

REPRODUCERS

SP SERIES

MONO, SINGLE CUE	826-0001-000
STEREO, SINGLE CUE	826-0002-000
MONO, THREE CUE	826-0003-000
STEREO, THREE CUE	826-0004-000
MONO, HI-SPEED CUE	826-0005-000
STEREO, HI-SPEED CUE	826-0006-000

WP SERIES

MONO, SINGLE CUE	826-0011-000
STEREO, SINGLE CUE	826-0012-000
MONO, THREE CUE	826-0013-000
STEREO, THREE CUE	826-0014-000
MONO, HI-SPEED CUE	826-0015-000
STEREO, HI-SPEED CUE	826-0016-000

SECTION I

INTRODUCTION — SP & WP SERIES REPRODUCERS

A. GENERAL DESCRIPTION

International Tapetronics Corporation's magnetic cartridge tape Reproducers are designed to meet or exceed the NAB standards for cartridge tape recording and reproducing. The SP & WP series Reproducers are available in either monophonic or stereophonic configurations. All reproducers are furnished with primary (1 kHz) cue capabilities while the secondary (150 Hz) and tertiary (8 kHz) cue detectors are optional. Also optional is the Hi-Speed Cue feature which permits the rapid advance of the tape to the next cue tone.

The SP series is designed to function exclusively as a reproducer and accepts both the NAB type A and NAB type B cartridges. The WP series accepts the NAB types A, B and C cartridges and can be used alone as a Reproducer or with a RA series Recording Amplifier. The RP series combines these two units on a single front panel.

The printed circuit electronics include the latest silicon solid-state diodes, transistors, and integrated circuits. The regulated power supply is an integrated circuit in a plug-in TO-3 case. The program amplifiers have NAB equalization and transformer coupled outputs.

The cue tone detectors utilize reliable L-C networks and provide relay contact output information. Upon the conclusion of the audio, the Reproducer continues to advance the tape until a 1 kHz primary cue tone is detected, whereupon the 1 kHz cue detector stops the tape drive mechanism.

The Secondary Cue Tone (150 Hz) Detector, when the machine is so equipped, can be used for such functions as the indication of the "end-of-message." This is necessary in automated systems to start the next machine and can be useful in live operations to keep the operator "on cue" for inserts, tags, or the beginning of the next material. The presence of the secondary cue tone is indicated by the brightening of the front panel and remote "Run" (Start) Lamp.

In machines with the Hi-Speed Cue option, detection of the 150 Hz cue tone automatically places the Reproducer in the "fast run" mode and advances the tape to the next cue tone at four times the normal speed.

The Tertiary Cue Tone (8 kHz) Detector, also optional, can be used to supply information in automated systems or for auxiliary switching such as the control of slide projectors in television. Presence of the tertiary cue tone is indicated by the illumination of the front panel and remote "Ready" (Stop) Lamps.

A full-swing pressure roller is connected to the actuating solenoid by a mechanically simple chain linkage with a screw adjustment for pressure roller/capstan pressure. Air damping of the solenoid is adjustable with a needle valve. The direct-capstan, 450 RPM (375 RPM in 50 Hz models), hysteresis synchronous drive motor with an electrolyzed shaft provides optimum tape drive. A 450/1800 RPM (375/1500 in 50 Hz models) is used in units with the Hi-Speed Cue feature.

The precision head assembly consists of three independent tape guides and micro-adjust head mounting blocks with screw adjustments for height, zenith, and azimuth.

Several other features improve the ease and reliability of operation and serviceability. The ITC Reproducer is fully operative when partially or fully removed from its slide-out case to facilitate cleaning, maintenance and adjustment. Locking connectors are supplied for audio output and remote control. Socket connectors for head cables provide plug-in connection at the head and at the cue tone and audio amplifiers.

The head and track configuration of ITC Reproducers is in accordance with the NAB Standards. The magnetic tape head nearest the capstan shaft is head A, the reproducing head. Head B is a "dummy" which is installed to maintain constant tension on the tape, minimize wow and flutter and tape skew. On the WP series head B is a recording head when the Reproducer is connected to a RA series recording Amplifier.

On mono machines, the upper track is the program channel and the lower track is the cue channel. On stereo units, the upper track is the left program channel, the center track is the right program channel, and the lower track is the cue channel. A graphic comparison of the mono and stereo track configuration is shown in Figure 5-6.

B. SPECIFICATIONS

Power:	117 volts AC, 60 Hz, 70 watts; other voltage and frequency variations are available on special order.
Tape Speed:	7½ inches per second; direct drive, hysteresis-synchronous, capstan motor with electrolyzed shaft and instrument-type, permanently lubricated ball bearings.

Wow and Flutter:		0.2% or less, NAB Un-weighted.
Timing Accuracy:		0.1% or better
Audio Output:		+12 dBm before clipping; normally +4 dBm: 600 ohms balanced. May be strapped for 150 ohms.
Distortion:		2% or less, record to playback at O VU 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. Adjustable to compensate for head wear.
Cue Signals:		NAB primary cue, 1 kHz, standard. Secondary cue, 150 Hz, and tertiary cue, 8 kHz, optional. External information when tone is sensed furnished as relay contact closure.
Playback Time:	SP Series:	2 seconds to 16 minutes, NAB size A and B cartridges.
	WP Series:	2 seconds to 31 minutes, NAB size A, B, and C cartridges.
Start Time:		0.1 second, at minimum solenoid damping.
Stop Time:		0.1 second, at minimum solenoid damping.
Ambient Temperature:		55 degrees C, 131 degrees F, maximum
Remote Control:		All controls and indicators
Mounting:		Table top mounting with rack mounting adapters optional
Dimensions:	SP Series:	8½" width, 5¼" height (add 3/8" for feet), 11" depth.
	WP Series:	17¼" width, 5¼" height (add 3/8" for feet), 11" depth.
Weight:	SP Series:	23 pounds
	WP Series:	28 pounds
Head Configuration:		NAB (provided with reproduce and dummy head only; except WP Series supplied with recording head when purchased with an RA Series Recording Amplifier)

A. UNPACKING

Remove the reproducer 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, therefore, should be kept on hand until installation has been completed in case concealed damage is discovered. If shipping damage is found, contact ITC for assistance in the filing of claims.

B. INSTALLATION

The ITC Reproducers 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 Reproducers and other equipment should be from 1¾" to 3½" depending on the temperature inside the closed rack.

C. EXTERNAL CONNECTIONS—AUDIO

Audio output connections are made on the six pin socket J2. The mating plug is supplied. Terminal information is provided below.

CONNECTOR J-2

Terminal	Function
1	Monophonic Shield (Ground) (left channel stereo)
3	Monophonic Audio Output (left channel stereo +)
5	Monophonic Audio Output (left channel stereo −)
2	Right Channel Stereo Shield (Ground)
4	Right Channel Stereo Audio Output (+)
6	Right Channel Stereo Audio Output (−)

Socket and terminal locations are shown in Section V, Figure 5-3.

The impedance of the audio output is normally 600 ohms. A 150 ohm output can be achieved by changing the transformer wires on connector J2 as noted on the schematic diagram.

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

D. EXTERNAL CONNECTIONS—CONTROL

Remote Control connections are provided on the fifteen pin socket J1. A mating plug is supplied for this purpose and terminal information is provided as follows:

CONNECTOR J-1

Terminal	Function
1	Ground
2	Remote Start (Run Ground)—Normally Open Switch
3	Remote Start (Ready Ground)—Normally Open Switch
4	Remote Stop (Ready Ground)—Normally Open Switch
5	Remote Stop (Stop Ground)—Normally Open Switch
6	Remote Run Lamp Ground Circuit
7	Remote Ready Lamp Ground Circuit
8	+24 Volts
9-10	Sec. Cue Relay (Normally Closed)
10-11	Secondary Cue Relay Contact (Normally Open)
12-13	Tertiary Cue Relay Contacts (Normally Open)
14-15	Cue Audio—Unbalanced Audio Output from Cue Preamplifier; High Impedance (Terminate with 10K ohms or greater)

Socket and terminal locations are shown in Section V, Figure 5-3.

Ground switching is employed for all remote control functions. Normally open, momentary action switches are utilized for both the remote START and STOP functions. A sample remote control schematic is shown in Figure 10-1.

If necessary, the normally open stop circuit can be replaced with a normally closed circuit by removing the jumper installed inside the machine between pins 3 and 4 on J1 and installing a remote, normally closed switch in its place.

E. CONTROLS AND INDICATORS

Each of the Reproducers (SP/WP) have the following associated control switches and indicators:

POWER LAMP	The Power Indicator Lamp shows that the Reproducer is connected to an AC power source. (Should a power switch be required, the Power Indicator Lamp may be replaced with a switch as shown on the schematic diagram.)
CARTRIDGE SWITCH	Two cartridge-sensing Micro Switches are installed on all single deck cartridge machines. These switches are designated as S1 in Figure 5-1. The switch located nearest the deck may be used as an on/off switch for the capstan motor. As supplied from the

factory, a strap across the switch places the motor in the "Run" mode when source voltage is applied to the Reproducer. The removal of the strap will place the motor in the "Run" mode only when a cartridge is placed in the Reproducer.

The Micro Switch located furthest from the deck provides a "Ready" indication to the Reproducer's control circuit and illuminates the indicator lamp located in the Stop Switch (on front panel) when a cartridge is placed in the Reproducer. The "Ready" cartridge switch must be operated in order for the tape transport to be started.

START SWITCH — The Start Switch (green) is used to energize the transport's pressure roller solenoid and put the tape in motion. The indicator lamp in the Start Switch shows that the machine is in a "Run" condition. Location is shown in Figure 5-2.

STOP SWITCH — The Stop Switch (yellow) can be pressed to stop the tape drive system. (Remember that unless a cartridge stops automatically, it will not be properly cued for the next play.) The indicator lamp in the Stop Switch shows that a cartridge has been properly loaded and the machine is "Ready" to be started.

F. MOTOR ON-OFF CONTROL SWITCH

Two cartridge-sensing micro switches are installed on all machines. The switch located nearest the deck, when utilized, will serve as an on/off switch for the capstan motor.

It is the customer's option as to whether this switch is actually used. As supplied from the factory, a strap across the switch negates the action of the switch and causes the motor to run continuously (as long as AC is applied to the machine). This mode of operation would be recommended for most installations. The motor is designed for continuous duty operation, and the instrumentation-type bearings in the motor will last longer if they are not subjected to the stresses of frequent expansion and contraction caused by starting and stopping the motor. Having the motor run continuously offers a second advantage in that a cartridge can be started instantly after being placed in the machine without having to wait the few seconds it takes for the motor to come up to speed.

In those installations where the cartridge machine is not frequently used, or where the machine builds up substantial heat because of poor ventilation or high ambient temperature, it may be desirable to allow the motor to remain off when a cartridge is not in place. This may be accomplished by removing the strap that is across the terminals of the motor control micro switch. (Refer to the schematic.)

NOTE: It is normal for a frequently used machine to feel quite warm to touch. Both the motor and the solenoid will generate heat when frequently or continuously used. This is normal and represents a problem only if the machine receives little or no ventilation or the ambient temperature is quite high.

G. OPERATING PROCEDURES

To play a tape cartridge:

1. Insert a properly recorded tape cartridge into the right-hand side of the cartridge slot.
2. Check to see that the Ready Lamp (Stop Switch) is illuminated, indicating that the cartridge has been properly inserted and that the Reproducer is "Ready" for operation.
3. Press the Start Switch momentarily. The tape drive system will be started, and the tape motion will continue until the primary (1 kHz) cue tone automatically stops the machine or until the Stop Switch is pressed.

A. HEAD ASSEMBLY

The micro-adjust head assembly used on SP and WP Reproducers includes three tape guides constructed of non-magnetic material. The positioning of these tape guides is pre-set at the factory, but may be field adjusted if required. The head mounting bracket is of very sturdy contruction with the azimuth pivot point located directly behind the center of the heads in both a vertical and horizontal plane. This feature permits azimuth adjustment without disturbing the zenith adjustment. The head assembly includes the provision for locking each head in position after adjustment, and the head mounting arrangement permits rapid head replacement when required.

Reliability, maintenance and performance is improved through the use of heads with a metal face and a hyperbolic front contour. The shape and material reduce the need for cleaning and relieve the problems sometimes caused by pressure pads.

B. CAPSTAN DRIVE

The proper drive of tape in a cartridge is much more difficult than in reel and other types of tape equipment. SP and WP Reproducers are designed and constructed to overcome the difficulties of cartridge tape drive. In a cartridge, the tape pulls from the center and winds back on the outside of an endless loop of tape. Therefore, the tape must slip upon itself as the cartridge plays. This slipping action does not occur at an even rate, and the tape tends to jerk as it pulls from the center of the hub. In addition, the tape is coated with a lubricant which reduces drive friction. One means of improving the drive would be to use a larger diameter pressure roller, but this is not possible since there is insufficient clearance in the bottom of the cartridge for a larger roller. Another approach—the one used in ITC equipment—is to use a capstan shaft with the largest diameter possible. This results in the use of a 450 RPM (375 RPM in 50 Hz models) direct-drive capstan motor with an electrolyzed shaft. The hysteresis-synchronous, direct-drive motor has a constant speed since there are no belts or pulleys to introduce speed variables.

With a large capstan, directly driven, constant tape drive can be achieved if the tape is not permitted to slip between the pressure roller and the capstan. This problem is counteracted by machining the capstan shaft to a very high polish and then blasting it with aluminum oxide particles. The result is a finish with a random-rough pattern which provides the positive tape drive demanded of professional cartridge machines. An electrolyzing process hardens the roughened pattern and prevents the finish from wearing. The life of the shaft finish should be approximately five years.

C. PRESSURE ROLLER LINKAGE

A chain and sprocket converts the reciprocating action of a powerful solenoid into the rotating action required to bring the pressure roller into contact with the capstan. This design is both reliable and efficient and provides more than adequate torque. Greater turning torque must be exerted as the pressure roller comes into contact with the capstan, and the required torque curve is achieved through proper shaping of the solenoid plunger. Correct pressure roller/capstan pressure is achieved by adjusting the screw which attaches the chain assembly to the solenoid plunger. This mechanical assembly has a design life in excess of a million operations.

Extremely quiet mechanical operation is achieved through the use of an air-damped solenoid. The speed and the resultant noise of the assembly is controlled by a needle valve at the rear of the solenoid.

The design of the SP and WP Series Reproducers results in long life, dependable operation, and a minimum of maintenance.

A. GENERAL MECHANICAL INFORMATION

ITC Tape Cartridge Reproducers have been designed to provide reliable, rugged mechanics which require a minimum of simplified adjustments.

The sequence in which mechanical adjustments are completed, however, is important. Therefore, if a complete check of all mechanical adjustments is required, start at the beginning of this section and check and/or adjust the deck as instructed—from Capstan Shaft (Motor) Position to Head Azimuth Adjustment.

Head Adjustments, outlined last in this section, may be made without having completed the deck adjustments covered first in this section.

The alignment gauges mentioned in this section are optionally available from ITC.

B. CAPSTAN SHAFT (MOTOR) POSITION

While the adjustment procedure outlined below will normally be required only if the motor has been removed, a check for proper positioning of the capstan should be part of the regular maintenance schedule.

1. Remove the rubber pressure roller and place the round steel Capstan Shaft Locator Gauge on the pressure roller shaft of the deck as shown in Figure 5-7.
2. Loosen the motor mounting screws and manually press the steel Capstan Shaft Locator Gauge against the capstan shaft.
3. While squeezing the steel gauge and the capstan shaft together, position the capstan shaft as shown in Figure 5-8. The steel tool must lie flat against the capstan shaft to make the pressure roller shaft parallel with the capstan shaft.

   The slight offset between the two shafts allows the tape to come into contact with the capstan shaft before the pressure roller to minimize wow and flutter and to slightly "wrap" around the capstan shaft for better pull.
4. Tighten the motor mounting screws and re-check the adjustment.
5. Replace the rubber pressure roller on its shaft. The steel washer goes on the bottom and the nylon washer goes on the top just under the retainer clip.

C. PRESSURE ROLLER/CAPSTAN PRESSURE —COARSE SOLENOID ADJUSTMENT

This adjustment is made at the factory and should not normally have to be repeated unless a parts replacement (solenoid, solenoid plunger, linkage chain, clevis, or cross-shaft clamp) has been made in the solenoid linkage assembly. If there is no specific reason for making this adjustment, skip ahead to part "D" of Section IV.

1. Check to see that the steel roll pin protruding from the cross-shaft clamp is inserted between the eleventh and twelfth (counting from the clevis) connector pins in the linkage chain as shown in Figure 5-9.
2. Loosen the clevis locknut and rotate the solenoid plunger and the locknut until the Pressure Roller Compression Tool will fit snugly between the shoulder of the clevis and the locknut as shown in Figure 5-10. The locknut must be finger tight against the plunger. If the tool is not available, the space between the clevis and the locknut should be .2812 (9/32) inch.
3. Remove the capstan motor plug from the socket and actuate the cartridge sensing micro switch by pushing a piece of folded cardboard or other material between the switch's actuator arm and plunger (Figure 5-1).
4. Press the front panel START switch to energize the solenoid; loosen the screws in the cross-shaft clamp (Figure 5-1). Adjust the clamp screws so that the clamp is snug on the shaft but can be moved with a small amount of force.
5. Remove the rubber pressure roller and adjust the pressure roller shaft so that the Pressure Roller Compression Gauge fits snugly between the left side of the slot in the deck and the pressure roller shaft as shown in Figure 5-11.
6. Place the steel Capstan Shaft Locator Gauge on the pressure roller shaft, press it tight against the capstan shaft (see Figure 5-7), and tighten the screws in the cross-shaft clamp. If the Capstan Locator Gauge is not available, place a rubber pressure roller on the shaft, press it against the capstan until the rubber is depressed approximately 1/32 of an inch where it makes contact with the capstan shaft, and tighten the screws in the cross-shaft clamp. Pressure is applied by pushing plunger into solenoid, this will keep this linkage taut.
7. Remove the Capstan Shaft Locator Gauge and check the adjustment made in Step 5 above.
8. Replace the rubber pressure roller on its

shaft. The steel washer goes on the bottom and the nylon washer goes on the top just under the retainer clip.

9. Replace the capstan motor plug in the socket.

D. PRESSURE ROLLER/CAPSTAN PRESSURE – FINE SOLENOID ADJUSTMENT

This adjustment will normally be required only after parts replacement; but for best results, a check of the pressure roller/capstan pressure should be on the routine maintenance schedule.

1. Using the Pressure Roller Compression Gauge, check the distance between the capstan shaft and the pressure roller shaft. The tool should advance to the first "step" and stop as shown in Figure 5-12.
2. If adjustment is required, loosen the clevis locknut and rotate the solenoid plunger as follows (Figure 5-1):
   a. To increase the pressure, rotate the solenoid plunger so that it penetrates deeper into the solenoid (clockwise as viewed from the front panel). This will increase the pull of the solenoid on the plunger and, therefore, the pressure roller/capstan pressure will be increased. The plunger must not "bottom out" to the seat of the solenoid.
   b. To decrease the pressure, rotate the plunger counterclockwise as viewed from the front panel.
3. Tighten the clevis locknut when the proper pressure has been achieved. (If proper adjustment cannot be attained, complete the coarse adjustment outlined in part "C" of Section IV before repeating the fine adjustment.)

E. SOLENOID DAMPING

The air damping of the solenoid is controlled by the adjustment of the set screw at the rear end of the solenoid seat. The speed of the solenoid operation is proportional to the speed at which air is allowed to move through the small hole on the underside of the solenoid seat. The noise of the solenoid operation shares the same relationship.

The adjustment procedure outlined below in no way affects pressure roller/capstan pressure as in some machines of older design. See Figure 5-1 for parts location.

1. Loosen the locknut on the Solenoid Damping Set Screw.
2. Turn the Damping Screw clockwise to reduce, or counterclockwise to increase, the speed of the solenoid operation. The average length of time for the solenoid to retract is 0.1 sec.
3. Check the adjustment by inserting a cartridge and starting the Reproducer. Repeat the adjustment as required.
4. Tighten the locknut.

F. RIGHT CARTRIDGE GUIDE

The right cartridge guide controls the cartridge positioning in relation to the heads, capstan shaft, and pressure roller shaft. Proper location of this cartridge guide is essential to proper operation of the machine. The right cartridge guide is properly positioned at the factory and should not normally require adjustment.

The adjustment procedure is outlined below:

1. Loosen the right cartridge guide mounting screws and insert a cartridge into the deck.
2. Adjust the cartridge so that the pressure roller shaft is centered in the "keyhole" in the cartridge.
3. Position the cartridge guide 1/64 of an inch from the cartridge and at a right angle with the front edge of the deck.
4. Tighten the cartridge guide mounting screws.
5. Press the start switch and, with the cartridge playing, check to see that the cartridge is free to move approximately 1/64 of an inch in and out and from left to right. If the cartridge is tight in the machine, re-check all mechanical adjustments.

G. LEFT CARTRIDGE GUIDE

The left cartridge guide is intended to help guide the cartridge into the machine and prevent damage to a head due to improper loading. When NAB type B (or C in the WP Series) cartridges are used, the left cartridge guide must be removed.

The adjustment procedure is outlined below:

1. With a cartridge in the machine, position the end of the left cartridge guide nearest the front panel approximately 1/8 of an inch from the cartridge and snug down the mounting screw nearest the front panel.
2. Position the end of the left cartridge guide nearest the head assembly approximately 1/32 of an inch from the cartridge.
3. Tighten both mounting screws.

The left cartridge guide should not come into contact with the cartridge when the cartridge has been properly inserted into the machine. Its purpose is to simply guide the cartridge into place — not to hold it there.

H. TAPE GUIDE ADJUSTMENT

The Reproducer has three independent tape guides to provide the maximum of tape guidance outside of the cartridge. The left tape guide has been specially formed to provide clearance for the corner post in the cartridge.

For optimum performance, not only should a check for proper tape guide positioning be made, as outlined below; but, also the positioning of the corner post in the cartridges should be checked and adjusted as shown in Figure 5-16.

The adjustment procedure is outlined below:

1. Check the positioning of each tape guide by advancing the Tape Height Gauge into the tape guide as shown in Figure 5-13. The gauge should advance fully into the tape guide, without friction, while resting flat on the deck—not tilted as shown by the dashed line (or its opposite) in Figure 5-13. The tape height gauge should be demagnetized so that it will not effect the "heads."
2. If adjustment is required, loosen the two tape guide mounting screws.
3. Keeping the Tape Height Gauge flat on the deck, position the tape guide as shown in Figure 5-13.
   a. Keep the tape guides as close to the head as possible without coming into contact with the head mounting blocks or any parts mounted on these blocks.
   b. Keep the tape guides vertical. Normally, the bottom edge of the tape guide's mounting surface should rest on or very near the surface of the deck plate.
4. Tighten the tape guide mounting screws and re-check the adjustment.
5. Check and adjust as required the other tape guides.

The slot in the tape guide is .249 inch wide. (Actual tape width is .246± .002 inch.) The width of this slot can also be properly gauged with the Tape Height Gauge. The arm on the gauge should advance fully into the slot without friction, but there should be no room for noticeable movement of the tool in the slot.

Adjustments obtained with the Tape Height Gauge should be accurate to less than .001 of an inch—much better than that obtained with most inexpensive optical devices.

I. HEAD HEIGHT ADJUSTMENT

The magnetic tape head nearest the capstan shaft is head A, the reproducing head. Head B in the SP series and independent WP series is a "dummy" which is installed to maintain constant tension on the tape and minimize wow and flutter. On the WP series, head B is a recording head when the Reproducer is connected to a RA series Recording Amplifier.

The adjustment procedure outlined below should be followed in positioning both the reproducing and recording heads. Only coarse height and zenith adjustments are required for a "dummy" head when used in position B. See Figure 5-1 for the location of the adjustment screws.

1. Loosen the Lock Screw L by turning it counterclockwise approximately four complete turns.
2. Course Height: Adjust the Front Height Screw FH until the top of the upper head track (pole piece) is 9/16 of an inch above the deck surface.
3. Course Zenith: Adjust the Rear Height Screw RH until the face of the head is perpendicular with the surface of the deck. Position the Tape Height Gauge (or any gauge known to be square) on the deck surface and move it against the face of the head as shown in Figure 5-14. The gauge used should be demagnetized before using for adjustment. Be careful to avoid scratching the face of the head. When the head is perpendicular, the face of the head and the "square" will be flush.
4. Fine Height and Zenith: This adjustment is made by using a strip of white "leader" tape or a piece of recording tape from which the oxide has been removed. (Shellac thinner, flux remover or a similar solvent will loosen the oxide which can then be wiped off the transparent base.) A test cartridge may also be used for this adjustment (refer to Section IX).
   a. Position the transparent tape across the face of the heads as the tape would be positioned if a cartridge was being played. See Figure 5-15. Check to see that the tape is not being distorted (wrinkled) where it makes contact with the tape guides and attach it to one of the tape guide support blocks with adhesive tape to free one hand for adjustments.

b. Alternately adjust Height Screws FH and RH to position the top of the upper head track (pole piece) so that it is even with the upper edge of the tape, and to position the bottom of the lower head track (pole piece) so that it is even with the lower edge of the tape. Screws FH and RH should be adjusted by equal amounts in the same direction.
c. Re-check the zenith of the head as instructed in Step 3 above.
d. Remove the transparent tape.

J. CARTRIDGE CORNER POST ADJUSTMENT

The ITC head assembly includes three tape guides — the maximum number of tape guides which can be used with NAB type A cartridges. Even with carefully adjusted tape guides, the tracking of the tape as it passes across the recording and reproducing heads can be adversely affected by improper positioning of the corner post in most cartridges. See Figure 5-16.

After the tape has been pulled up out of the center of the endless loop, the cartridge corner post must bring the tape down to the proper height to pass across the heads. If the corner post is too high, the tape will be traveling "downhill" as it encounters the first tape guide and recording head. By the time the tape reaches the reproducing head, it will normally be brought into the proper position; but, in the worse case, tracking across the reproducing head can also be adversely affected by an improperly positioned cartridge corner post.

For optimum results, the tape must travel in a perfect horizontal path through the tape guides and across the heads. When the tape travels "downhill," as in the example cited above, the azimuth positioning of the recording head would be different from that of the reproducing head. In fact, the azimuth positioning of the recording head would vary from cartridge to cartridge if positioning of the cartridge corner posts is not properly maintained.

Several cartridge manufacturers now offer cartridges with vernier adjustments for vertical positioning of the corner post. In older cartridges, proper position can be achieved by using the ITC Tape Height Gauge as shown in Figure 5-16.

1. Place the cartridge and the Tape Height Gauge on a flat surface and advance the gauge between the upper and lower flanges as shown in Figure 5-16. The gauge should advance between the flanges without friction while resting flat on the surface, but there should be no room for noticeable vertical movement of the gauge between the flanges.
2. If adjustment is required, remove the top from the cartridge and raise the upper portion of the corner post from the cartridge base.
3. Sparingly apply a small amount of a general purpose cement to the inside of the corner post mounting hole in the cartridge base.
4. Keeping the Tape Height Gauge flat on the surface, press the corner post into the base until the gauge fits snugly between the two flanges as shown in Figure 5-16.
5. Remove the excess cement and re-check the corner post positioning before replacing the top cover.

K. MONOPHONIC HEAD AZIMUTH ADJUSTMENT

Before attempting these adjustments, insure that the mechanical adjustments of the tape guides as outlined in Section 4-H, and the adjustment of height and zenith of both the Record and Reproduce heads (or Reproduce and "dummy" in Reproduce only machines) as outlined in Section 4—I are correct.

1. Reproduce Head Azimuth Adjustment:
   a. Connect a 600 ohm load to the output terminals. Connect a VTVM across this load.
   b. Insert a 15 kHz Standard Azimuth Alignment Tape and start the machine.
   c. Adjust the azimuth screw A (refer to Figure 5-1 for location) of the reproduce head to produce maximum output level.
   d. Carefully tighten lock screw L, observing the VTVM to insure that no change in output level occurs.
2. Record Head Azimuth Adjustment: It is reminded that changes in azimuth to the Master Record head can result in azimuth errors in all the Reproduce machines within a system unless the resultant azimuth is carefully checked against each of these Reproducers. Any change of azimuth of the record head should be attempted

ONLY AFTER all mechanical adjustments are carefully checked and the Master Reproduce head is aligned to the 15 kHz Standard Azimuth Alignment Tape as above.

a. Select an erased 3½ minute cartridge which has had the corner post properly adjusted (Refer to Section 4-J) and is known to have consistently good operating characteristics.
b. Connect a 600 ohm load to the Reproducer output terminals. Connect a VTVM across this load.
c. Connect an audio generator to the Recorder input terminals. Set the input and Record Level to -10 dbm.
d. Start the Recorder and adjust the azimuth screw A on the record head to produce maximum output level.
e. Carefully tighten lock screw L, observing the VTVM to insure that no change in output level occurs.

L. STEREO SYSTEM HEAD AZIMUTH ADJUSTMENT

Two track stereo recording-reproducing results are subject to several contributing mechanical inaccuracies which can cause phase shift in simultaneously monitored reproducer outputs. In stereo systems these phase shifts are generally not perceptable in the final reproduction; however, in cases where monophonic "dubbing" or channel summing is desired, phase shifts can result in serious amplitude variations or drop-out at the higher frequencies. Most common causes of these problems are:

1. Lateral displacement of the heads with respect to each other within the head case.
2. Improper azimuth of the heads with respect to each other (record head to play head on any reproducer in a system).
3. Improper tape guidance (skew) either within the cartridge or through the tape guide system.

International Tapetronics has attempted to provide the best features possible to assist in the proper guidance of tape outside of the cartridge. Three adjustable tape guides, heavy-duty adjustable head mounts, and the use of "dummy" heads in Reproduce only machines, lend to consistent guidance of the tape through the head assembly. Adjustment procedures for cartridge corner posts in Section IV—J and gauges made available for this purpose are other measures taken by ITC to assist the discriminate in maintaining the best possible stereo performance from this equipment. The following test and adjustments do not preclude the many possible techniques for measuring phase shift, but provide the basis for satisfactory results using a minimum of equipment and skill.

1. Master Reproduce Head Azimuth:
   a. Connect 600 ohm loads to both left and right channel outputs. Connect a VTVM to the left channel output. Insert a FULL TRACK 400 Hz reference "0" level tape and start the machine. Set left gain control R111 for 0 DBM output. Now connect the VTVM to the right channel output and adjust right gain control R 130 for 0 DBM output.
   b. Insert a 15 kHz FULL TRACK azimuth alignment tape and carefully adjust playhead azimuth screw A for a maximum reading on the VTVM. Observe the mechanical position of the azimuth screw.
   c. Move the VTVM to the left channel output. Now move azimuth screw A a small amount in either direction and observe the VTVM reading as an increasing or decreasing output. Continue moving the screw in the direction that produces increasing output until a maximum reading is obtained.
   d. Observe direction and amount that the screw was turned to obtain maximum reading on the left output with respect to the previous setting for maximum on the other channel. Set screw A to the midpoint between these settings to obtain AVERAGE azimuth for the two channels.
   e. Connect the horizontal input of any scope so equipped to the right channel output. Insert a FULL TRACK FREQUENCY ALIGNMENT TAPE and start the machine. Adjust the horizontal gain, if provided on the scope to a suitable amplitude. Remove the horizontal input.

f. Connect the vertical input to the same right channel output and adjust the vertical gain to provide a deflection equal to that of the horizontal above.

g. Now connect the horizontal input to the left channel output. Run the tape to the 400 Hz section. A pattern such as Figure 1 should now appear. If not, reverse the two leads of the horizontal input. This pattern represents the "0" or near "0" phase shift pattern of the system.

h. Allow the tape to run to the 5 kHz section and observe if phase shift has occurred. (Refer to Figures 2 through 4.) If phase shift has occurred, adjust the azimuth screw A to correct this phase shift in the exact reverse rotation to which it has occurred. (This means that if the pattern was increasing clockwise from 0 shift as frequency increased, screw A should be turned in such a way to cause scope display to rotate CCW back to the "0" position.)

i. Now allow the tape to continue through the various frequencies observing the scope display to insure that no 180° reversals occur. At 15 kHz final adjustment of screw A can be made to provide best average phase shift. It is normal for shift "jitters" of several degrees to occur at the highest frequencies, so setting should be based on best results. It is desirable to run the tape several times, observing that phase reversals do not occur at any frequency. Tighten lock screw L and observe that no change occurs.

0 PHASE SHIFT

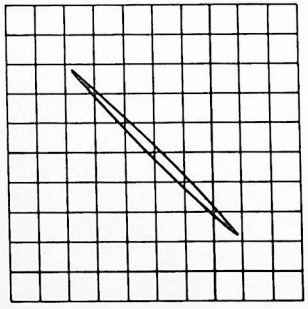


FIG. 1

45° PHASE SHIFT

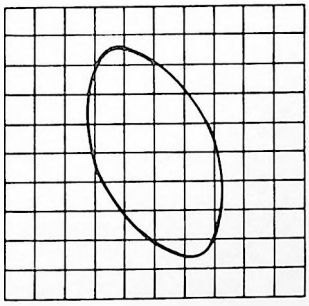


FIG. 2

90° OR 270° SHIFT

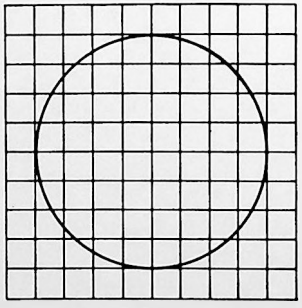


FIG. 3

180° PHASE SHIFT

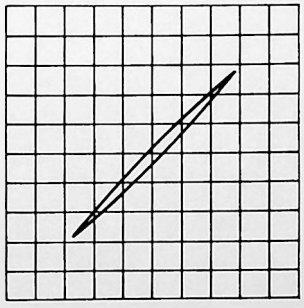


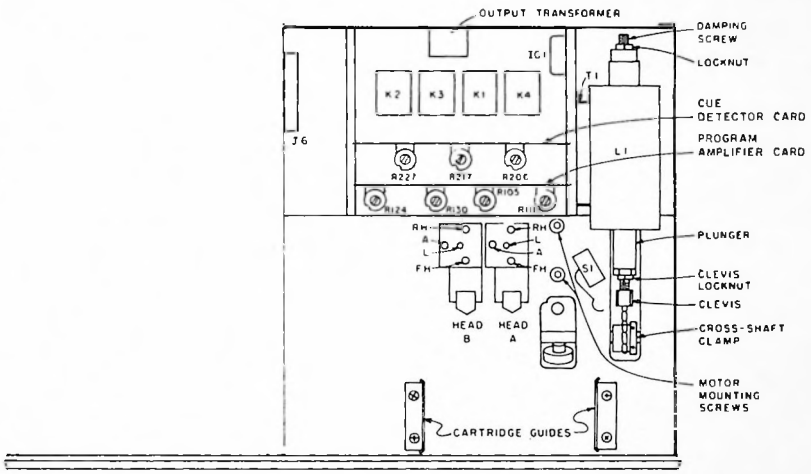
FIG. 4

2. Master Record Head Azimuth:
   a. Select a 3½ minute cartridge that is known to have consistently good operating characteristics and proper adjustment of the corner post.
   b. Connect a 15 kHz tone to both channel inputs on the recorder. (Observe phase relationship of these inputs.) Set the input and Record levels to -10 dbm.
   c. Start the recorder and adjust the azimuth screw A on the record head for maximum amplitude of the display on the scope. (The scope gains may be adjusted in equal amounts to increase amplitude of the display if necessary.)
   d. Sweep the dial on the tone source slowly to 400 Hz and observe phase rotation on the scope display. If 180° reversals occur, adjust screw A (of the record head only) at 5 kHz to produce "0" phase shift. Repeat the 400 Hz to 15 kHz sweep and adjust as necessary to remove phase reversals and provide best average phase shifts at 15 kHz. Tighten lock screw L and observe that no change occurs.
3. Other Reproduce Head Azimuth: It is important to realize that all reproducers within a system must be azimuth aligned to the master recorder. To implement this it is necessary to prepare a test cartridge recorded on the master recorder each time any adjustment to this recorder is performed. This cartridge is in turn used to align EACH reproducer in the system, using the technique outlined in paragraph one above.

M. HEAD REPLACEMENT

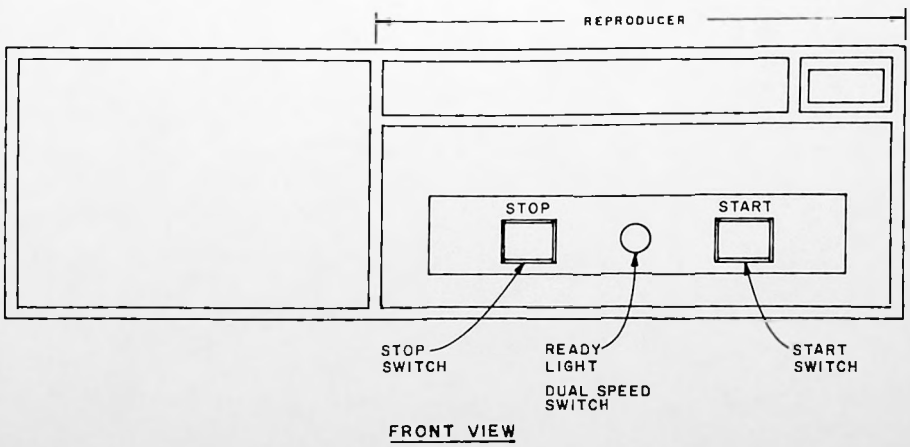
The ITC Reproducers utilize the no-mount type heads to provide quick and easy installation.

1. Loosen the two screws in the head mounting strap.
2. Remove the old head and insert a new one. (The side of the head with the printing on it should be positioned up.)
3. Align the rear edge of the head case so that it is flush with the rear edge of the head mounting strap.
4. Tighten the screws in the head mounting strap.
5. Reconnect the head cable. The locator slot in the head socket of mono units must be on the top side to prevent a reversal of the program and cue channels. See the schematic diagram for the color code of the head lead arrangement used on stereo units.



TOP VIEW

FIGURE 5-1



FRONT VIEW

FIGURE 5-2

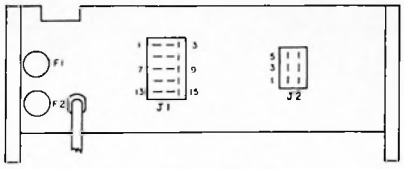


FIGURE 5-3

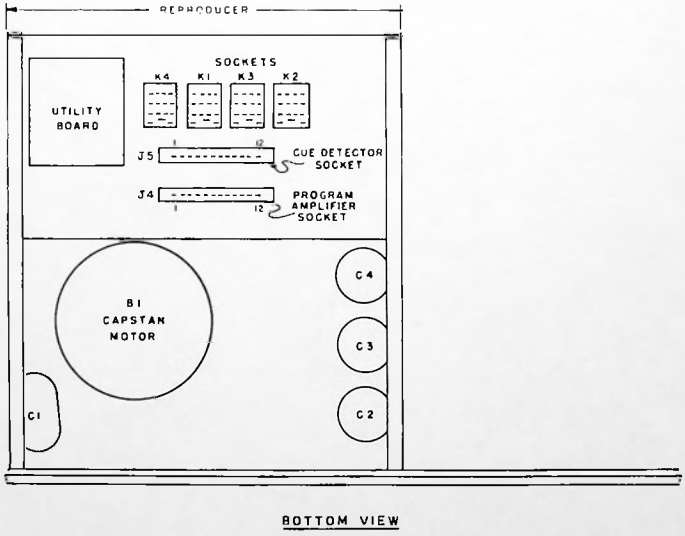


FIGURE 5-4

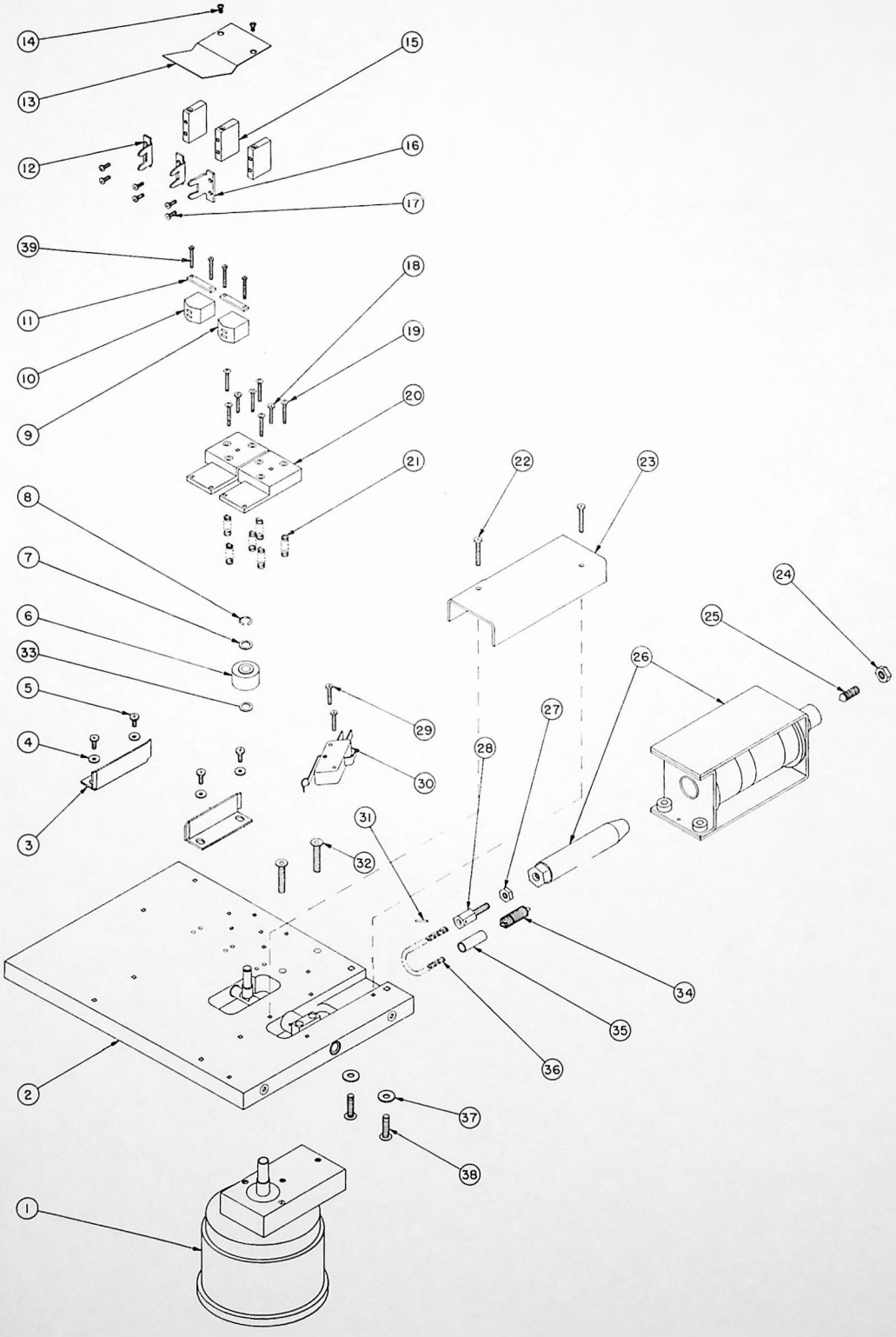

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FIGURE 5-5

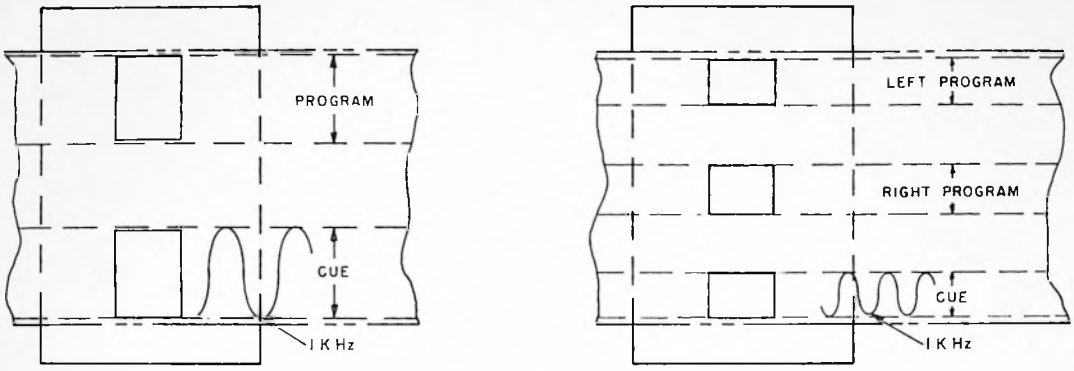


FIGURE 5-6

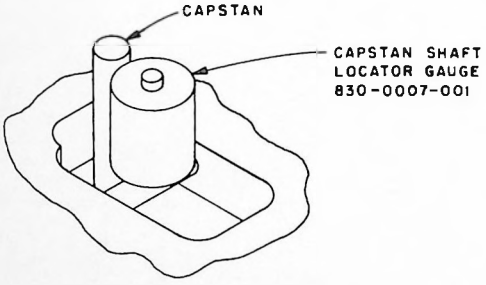


FIGURE 5-7

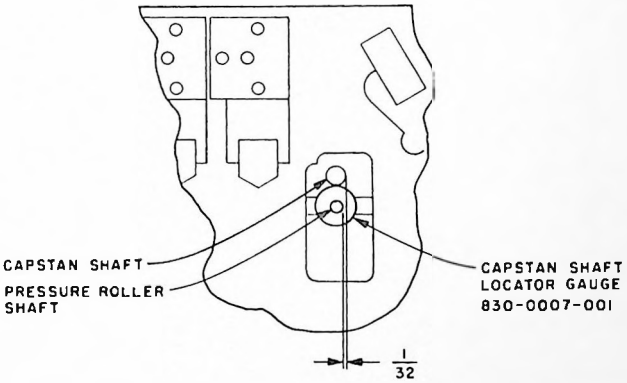


FIGURE 5-8

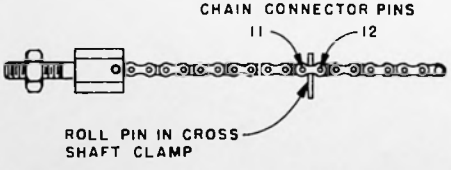


FIGURE 5-9

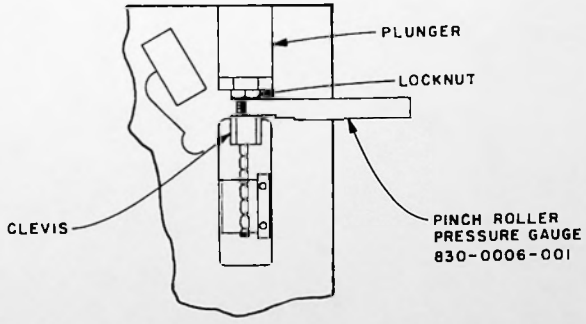


FIGURE 5-10

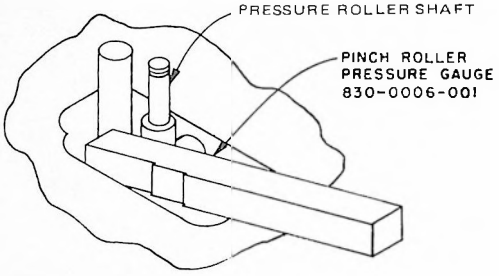


FIGURE 5-11

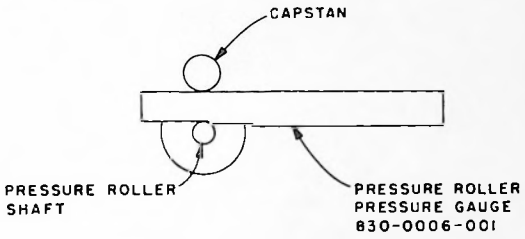


FIGURE 5-12

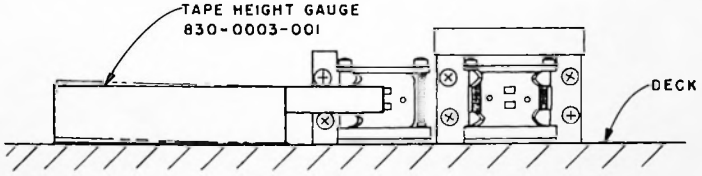


FIGURE 5-13

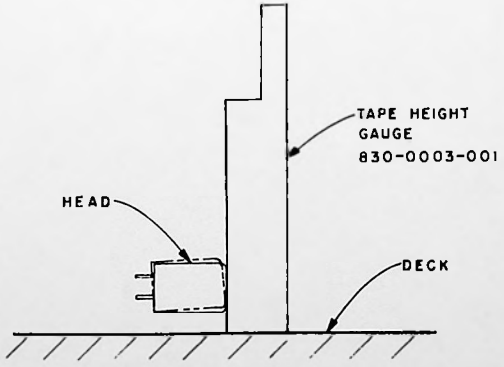


FIGURE 5-14

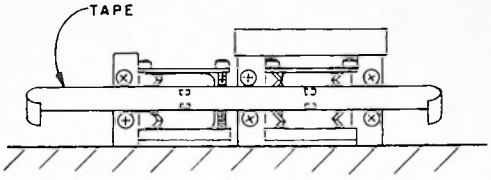


FIGURE 5-15

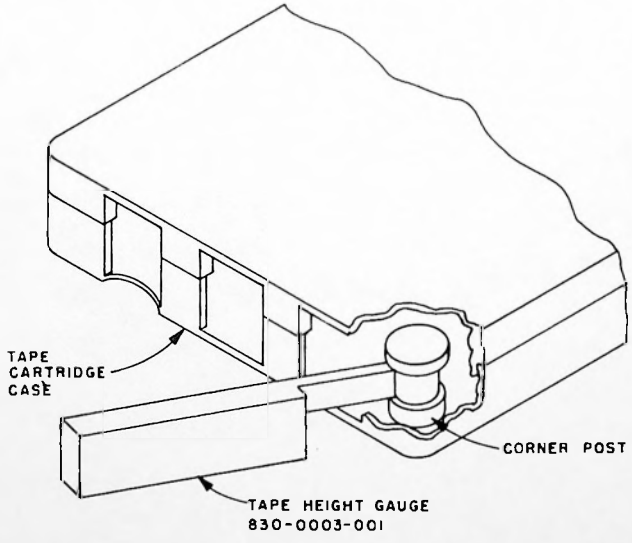


FIGURE 5-16

SECTION VI

MECHANICAL PARTS LIST — SP & WP SERIES REPRODUCERS

(See Figure 5-5)

Item	Part Number	Description
1	451-0001-010	Motor, Capstan, 450 RPM, 117V, 60 Hz
	451-0005-010	Motor, Capstan, 450/1800 RPM, 60 Hz Hi-Speed Cue
	451-0006-010	Motor, Capstan, 375 RPM, 115V, 50 Hz
	451-0007-010	Motor, Capstan 375/1500 RPM, 117V, 50 Hz, Hi-Speed Cue
2	267-0001-014	Deck, SP Series
	267-0001-034	Deck, WP Series
3	272-0001-001	Guides, Cartridge (two)
4	360-0601-000	Washers (four)
5	350-0604-000	Screws, Cartridge Guide Mtg. (four)
6	291-0003-001	Pressure Roller
7	359-0006-000	Washer, mylar
8	289-0002-000	Clip, retainer
9	504-0002-000	Head, Mono Reproduce, Nortronics, PB2H7KNO
	504-0004-000	Head, Stereo Reproduce, Nortronics, PB3Q7KNO
10	504-0001-000	Head, Dummy
	504-0003-000	Head, Mono Record, Nortronics, PB2H4RNO (on WP Series only when used with recording amp)
	504-0005-000	Head, Stereo Record, Nortronics, PB3Q4RNO (on WP Series only when used with recording amp)
11	303-0001-001	Straps, Head Mounting (two)
12	272-0003-001	Guide, Tape, Left (one)
13	301-0001-011	Spring, Cartridge Hold-Down
14	350-0402-000	Screws, Cartridge Spring Mtg. (two)
15	304-0001-001	Supports, Tape Guide (three)
16	272-0002-002	Guides, Tape, Center and Right (two)
17	350-0403-000	Screws, Tape Guide Mtg. (six)
18	350-0415-000	Screws, Head Block Locking (two)
19	353-0001-000	Screws, Head Block Azimuth and Height (six)
20	253-0035-002	Blocks, Head Mounting (two)
21	301-0003-001	Springs, Compression, Head Block Support (six)
22	350-0422-000	Screws, Solenoid Plunger Cover Mtg. (two)
23	265-0011-011	Cover, Solenoid Plunger
26	477-0006-002	Solenoid Coil and Plunger
27	370-1001-000	Nut, Lock, Clevis Screw
28	264-0001-001	Clevis, Screw (Solenoid Linkage)
29	350-0420-000	Screws, Micro Switch Mtg., (two)
30	392-0001-000	Switch, Micro (two)
31	282-0001-001	Pin, Roll
32	353-0004-000	Screws, Motor Mounting
33	360-1005-000	Washer, steel
34	301-0005-000	Spring, Expansion, Solenoid Linkage Return
35	441-0004-010	Tubing
36	277-0001-001	Chain, Solenoid Linkage
37	360-1003-000	Washers (two)
38	353-0003-000	Screws, Solenoid Mounting (two)
39	350-0307-000	Screws, Head Mtg. (four)

MISCELLANEOUS MECHANICAL PARTS

311-0009-000	Foot, plastic
830-0003-001	Gauge, Tape Height
830-0006-001	Gauge, Pressure Roller Pressure
830-0007-001	Gauge, Capstan Shaft Locator

A. GENERAL INFORMATION

This section of the manual describes the electronic circuitry and the way in which it works. The symbol designations referred to are used on the schematic diagram for the SP/WP Reproducers. The WP Reproducer is designed so that it may be used in conjunction with a recording amplifier. The SP Reproducer is designed as a play only device with no recorder interconnect circuitry supplied.

B. SOLENOID POWER SUPPLY

Diodes CR1, CR2, CR3, and CR4 are a full wave bridge rectifier which furnishes 110 volts DC to the solenoid power supply filter. The dual section filter consists of R1, R9, and the two sections of C2. The diodes and resistors are located on the Utility Power Supply board (see Figure 5-4 for the board location) while the filter capacitors are mounted on the under side of the deck (see Figure 5-4). The output of 110 volts DC (under load) is switched by the parallel contacts 7 and 11 / 8 and 12 of control relay K1. A network consisting of C13 and R17 is across the coil of solenoid L1 for transient protection when power is removed.

C. LOW VOLTAGE POWER SUPPLY

Transformer T1 provides low voltage AC (with the center tap grounded) to diodes CR6 and CR7, a full wave rectifier that supplies the input to the regulated power supply. Capacitor C3 acts as an input filter. The diodes and resistors of this power supply are mounted on the Utility Power Supply board (see Figure 5-4 for the board location) while the filter capacitors are located on the under side of the deck (see Figure 5-4).

IC1 is the regulated power supply. (See Figure 5-1 for location.) The output of this power supply is +24 volts. The regulated power supply is protected by F1, a fast acting ½ ampere fuse. The output of the regulated power supply is represented on the schematic diagram by a triangle which is common to all other points on the schematic shown with a like symbol. R3 and C4 provide decoupling and additional filtering for the program amplifier card.

The case of IC1 is insulated from the chassis by a mica washer to prevent hum loops. To provide maximum heat dissipation, the mica washer is coated on both sides with thermal conductive agent and IC1 is held firmly in place with two mounting screws.

D. CONTROL CIRCUITRY

The chassis control circuitry is furnished with power by the low voltage DC power supply and utilizes ground switching. At all times other than when a primary (1 kHz) cue tone is being detected, positive voltage is routed from the low voltage DC power supply through R215 and CR205 on the cue card to control relay, K1. When a cartridge has been properly inserted in the deck, the cartridge sensing micro switch S1 closes furnishing ground information through contacts 2 and 10 on relay K1 and pin 2 on J5 to the stop cue tone protection circuit on the cue card, the action of which is described under Cue Circuitry. This same "ready" ground is furnished through CR8 and R4 to illuminate I3, the "ready" lamp, and through R5 to a remote "ready" lamp. See Figure 5-4 for the location of the control relays and the Utility Power Supply Board.

The ground furnished through S1 is routed to S3, the Stop Switch, through pin 4 on J1 to a remote stop switch, through the jumper installed between pins 3 and 4 on J1 to S2, the Start Switch, and through pin 3 on J1 to a remote start switch. On the WP Series the ground arriving at the Start Switch is also made available to a recording amplifier through pin 18 on J6 and through contacts 9 and 1 on K1 and pin 15 on J6.

With conditions described above, pressing the Start Switch presents a ground to pin 13, the coil of K1, the control relay, which energizes and holds itself energized by closing contacts 5 and 9. Contacts 1 and 9 open removing the "ready" ground from the recording amplifier. Contacts 2 and 10 open removing the "ready" ground from the stop tone cue protection circuit and the Ready lamps. Contacts 6 and 10 close providing a ground through R6 to a remote run lamp and to the audio squelch to turn on the audio. Parallel contacts 7 and 11 / 8 and 12 close completing the circuit to energize the solenoid.

When a primary (1 kHz) cue tone is detected, transistor Q203 turns on and takes the junction of R215 and CR205 to ground, removing the positive holding voltage from K1.

Pressing S3, the Stop Switch, accomplishes the same thing with a normally open, momentary action switch which eliminates the disadvantages of a series stop circuit. If for any reason a series remote stop circuit is required, the normally open stop circuit can be replaced with a normally closed circuit by removing the jumper installed inside the machine between pins 3 and 4 on J1

and installing a remote, normally closed switch in its place.

When a secondary (150 Hz) cue tone is sensed, relay K2 is energized. A contact closure is then provided on pins 10 and 11 of J1 by parallel contacts 5 and 9 / 6 and 10. The closure of contacts 8 and 12 shorts out dropping resistor R7 providing a brighter illumination of the Run Lamp as an indication of 150 Hz cue tone detection. Contacts 7 and 11 short out R6 in the remote run lamp circuit.

Relay K3 is energized when a 8 kHz tone is detected. A contact closure is provided on pins 12 and 13 of J1 by parallel contacts 5 and 9 / 6 and 10. The closure of contacts 8 and 12 provides an indication of the 8 kHz cue tone detection by returning the ground to the Ready Lamp circuit. Diode CR8 functions as a blocking diode and prevents this ground from being presented to the stop cue tone protection circuit.

E. CUE CIRCUITRY

The plug-in Cue Detector card is located in the second position at the rear of the deck assembly. The 1 kHz Primary Cue detector and the optional 150 Hz and 8 kHz detectors when so equipped are designed to operate from tones as specified in the NAB Standards.

Transistors Q210 and Q211 are the equalized preamplifier stages which provide essentially equal voltage for each of the normal level cue tones to the common signal bus of the three detectors (when so equipped).

Diodes CR201 and CR202 act as a signal limiter to prevent the signal bus from exceeding the detector input maximum level of approximately .5 volts. This bus is also supplied to the remote socket J1 (Pin 15) and to the recorder meter circuits via J6 (Pin 2) of WP Series Reproducers.

The 1 kHz Primary Cue section contains a stop cue tone protection circuit which prevents the machine from being stopped by a 1 kHz tone for approximately two seconds after the unit is started. While the reproducer is sitting idle with a cartridge inserted (cartridge sensing micro switch S1 closed), capacitor C206 is discharged through R204, CR203, contacts 2 and 10 of relay K1, and S1 to ground. When the reproducer is started, the discharge path is opened by relay K1; and C206 begins to be charged by the 24 volt DC power supply through resistor R203. While C206 is charging, the base of Q201 is clamped sufficiently close to ground to prevent operation of the 1 kHz detector. When C206 is charged to approximately 11 volts, diode CR204 is reverse biased and the clamp is removed.

In the 1 kHz Primary Cue Section, a series resonant circuit consisting of L201, C208 and C209 provides a low impedance regenerative circuit for Q201 at 1 kHz, while attenuating frequencies more than a few percent above or below 1 kHz. Transistor Q202 is a zero bias signal rectifier which amplifies positive current pulses present at its base. R212, R213 and C210 act as the rectifier load and coupling network to switching transistor Q203. This configuration also acts to filter out any transients that may be present on incoming signals. Q203 diverts current flow from relay coil K1 during the cue tone and causes it to de-energize and stop the tape drive.

The operation of the 150 Hz Secondary and 8 kHz Tertiary Cue sections is, in principle, the same – except that the tuned circuit is designed for the respective frequency. Since no tone protection is provided in these circuits, the 150 Hz and 8 kHz detectors are free to operate at any time. Switching transistors Q209 and Q206, when conducting, operate relays K2 and K3 respectively.

NOTE: The NAB standards specify that the Primary Cue tone oscillator generate a tone of 925 Hz to 1075 Hz. Many older cartridge recorders produce a stop cue tone that is well outside these tolerances.

A broad-band cue detector is supplied in ITC single cue tone machines. This broad-band cue detector will pass a wide range of frequencies which permits proper cueing of cartridges recorded on older machines. The broad-band characteristics will cause no problem as long as only single cue tone operation is used. Components C220 and C221 provide the broad-band operation.

The broad-band detector can be changed to the narrow band mode (1 kHz ± 75 Hz) by removing the white wire strap that is on top of the detector PC card. In addition, it may be necessary to increase the gain of the detector by turning the sensitivity control clockwise. (The detector has about 10 dB less gain in the narrow band mode.)

F. PROGRAM PLAY CIRCUITRY

The program play amplifier is located on the plug-in PC Card immediately to the rear of the deck assembly. Single monophonic or dual stereophonic amplifiers of identical design are on the same card, depending upon machine design.

Transistors Q101 and Q102 are the high stability equalized pre-amplifier stages. Adjustable AC feedback equalization is employed to improve input impedance. These components are C104, R104 and R105 in the L. Channel amplifier. Out-

put from these stages is coupled through the electronic attenuator IC101 to the gain control R111. Audio is muted by IC101 in all but the run mode. Transistors Q103 and Q104 are conventional voltage amplifiers, each with local AC feedback employed. The output is connected via edge pin 1 to the balanced output transformer T2. Output impedance is normally 600 ohms but may be changed to 150 ohms by re-connection of the secondary wires. Refer to the schematic notes.

G. HIGH SPEED CUE CIRCUITRY (WHEN SO EQUIPPED)

The function of the Hi-Speed option on the Reproducer is to automatically produce a high speed run mode of the capstan motor when an end of message tone (150 Hz) is detected or when the dual speed switch (Figure 5-2) is pressed. The Reproducer will remain in the "fast" run mode until a stop tone (1 kHz) is detected or the stop switch (Figure 5-2) is pressed. While the Reproducer is in the "fast" run mode, the 1 kHz tone becomes approximately 4 kHz and the 150 Hz tone becomes approximately 600 Hz. The Reproducer can only be placed in high speed operation during the "run" mode because contacts (6 / 10) of K1 are closed only during this mode. During the high speed operation of the Reproducer the power indicator light is "OFF," indicating this state of operation.

During the normal run mode capacitor C9 is charged to +24 volts and remains at this steady state until an end of message tone (150 Hz) energizes relay K2. Relay K2 then places one side of C9 at ground potential and discharges the capacitor. When the end of message tone terminates, the relay K2 returns to the normal run position and the capacitor C9 charges through the coil of the relay K4. This energizes K4 which switches the capstan motor into the fast mode. By changing the windings then poles 1 and 2 and paralleling the run capacitor C1 with C16 the charge time of C9, R13 allows K2 to return to the normal run position creating a hold circuit for K4 through pins (7 / 11) of K4, pins (4 / 12) of K2, and pins (6 / 10) of K1. The fast run mode remains until a cue tone (1 kHz) is detected and stops the tape drive.

Two transistors Q101 and Q102 and their associated components are added to the utility card (figure 10-5). Q101 is the lamp inverter to turn off I4 during the fast mode. Q102 is on during the fast mode and operates as the 1 kHz broadbanding switch, and to inhibit the Secondary and Tertiary tone detectors.

The Hi-Speed Cue Card is substituted in the same card location and connector wiring for the standard cue card. The pre-amplifier and limiter components and those associated with the optional 150 Hz and 8 kHz detectors are similar to the description of the standard circuit described in Paragraph E of this section. The 1 kHz Primary Cue detector is entirely of different design and operates as follows:

The 1 kHz cue gain control R206 adjusts the operation of the detector from full off to approximately -10 dB lower than normal recorded tone level.

Transistor Q201 is a dual purpose tuned amplifier. During the normal mode L201 provides a tuned circuit for the emitter at 1 kHz and attenuates all frequencies more than a few percent above or below this frequency. During the fast mode the emitter of Q201 is re-generated to ground thru C230, edge connector pin 8 and transistor Q102. This causes the amplifier to be broadbanded to frequencies above 1 kHz. Capacitor C221 provides a roll off above 4 kHz to reduce the response to the 8 kHz tone when used.

Transistor Q202 operates as a zero bias rectifier and current amplifier. C210 acts as the ripple filter. When DC voltage rises to +12 volts or higher CR208 conducts to the base of Q203 which turns on and diverts current from relay K1 and causes the tape drive to stop.

L204 and C228 form a series resonant circuit tuned to approximately 600 Hz. The capacitive reactance of C228 causes an increasing E drop at all frequencies 600 Hz and lower and is coupled thru R245 to the base of Q212, which is connected across C210. This causes frequencies 600 Hz and lower to be inhibited from operation of the 1 kHz cue detector.

A. CONTROLS

The various electrical controls listed below are adjusted at the factory to provide optimum operation of the ITC Reproducer. At the time of installation, the only control which may require adjustment is Program Level.

A good maintenance schedule will include periodic checks (weekly or monthly, depending upon the operational requirements) of the machine's electronics. Remember to demagnetize the heads and check their mechanical adjustments first. Minor adjustment of the electronic controls may be required to compensate for normal head wear, but the need for large adjustments may indicate need for head replacement, or failure which requires further testing. See Figure 5-1 for the location of the electronic controls.

1. **Program Level:** The output level of the program amplifier(s) is factory adjusted to produce 0 dBm when reproducing a NAB standard reference level tape, 400 Hz. R111 is the control for mono reproducers, and the left channel of stereo units. R130 is the right channel control on stereo units. When outputs below -10 DBM are required, the addition of an external pad should be considered to maintain optimum signal to noise ratio.
2. **Program Equalization:** The equalization of the program amplifier(s) is factory adjusted to meet the NAB specifications when reproducing a Standard Frequency Response tape. The control(s) may be adjusted to compensate for normal head wear and for variations in heads when replacement is required. R105 is the control for mono units, and the left channel of stereo units. R124 is the right channel control for stereo units. Adjustment of the equalization controls should not be attempted until the reproduce head has been properly azimuth aligned using the procedure outlined in Section 4-K (Section 4-L for stereo) of this manual. Following this procedure, the equalization control should be adjusted to provide the flattest response to the Standard Frequency Response Tape.
3. **Primary (1 kHz) Cue Sensitivity:** The sensitivity of the 1 kHz Primary Cue Detector is increased by turning R206 in the clockwise direction. This control should be adjusted to the point of just responding to the 1 kHz tones recorded on a test tape at 8 dB lower than NAB Cue Level.
4. **Secondary (150 Hz) Cue Sensitivity:** The sensitivity of the 150 Hz Secondary Cue Detector is increased by turning R227 in the clockwise direction. This control should be adjusted to the point of just responding to the 150 Hz tones recorded on a test tape at 8 dB lower than NAB Secondary Cue Level.
5. **Tertiary (8 kHz) Cue Sensitivity:** The sensitivity of the 8 kHz Tertiary Cue Detector is increased by turning R217 in the clockwise direction. This control should be adjusted to the point of just responding to the 8 kHz tones recorded on a test tape at 8 dB lower than NAB Tertiary Cue Level.

A. PREVENTIVE MAINTENANCE

Preventive maintenance of the electrical adjustments should be done on monthly schedule. Each installation should be equipped with a primary test cartridge such as the NAB Standard Test Tape.

Should a primary test cartridge be used to test several tape transports on a monthly basis, the short wave length sensitivity will be degraded by repeated playing. The proper handling and storing of the Primary Test Cartridge, and proper cleaning of heads and tape guides will minimize signal loss. The best method to preserve a primary test cartridge is to record your own test cartridges as outlined below and compare them with the primary test cartridge every six months. It is important that all test cartridges contain the same type of tape that is used for normal recording.

B. TEST CARTRIDGES

1. **Test Cartridge No. 1:** Carefully align the reproducer to the Primary Test Cartridge for azimuth and level. Verify the proper adjustment of the recorder electronics and the recording head azimuth. Select a properly erased cartridge of known good guidance. Record a 15 kHz azimuth tone at -10 dB level for 30 seconds. Follow this tone with 400 Hz, 10 kHz, 5 kHz, 2500 Hz, 1 kHz, 250 Hz, 100 Hz and 50 Hz tones at -10 dB level and 5 seconds duration. The last tone should be 400 Hz at 0 dB level of 20 seconds duration. This tape can now be used for day to day response tests as a second generation standard.
2. **Test Cartridge No. 2:** (Refer to the recorder instructions for adjusting the level of the tone oscillators.) Temporarily connect the cue head to the properly calibrated program amplifier input. With an erased tape, adjust these tone oscillator levels to 8 dB below normal. The program amplifier will play at -7.6 dB for 1 kHz, -1.9 dB for 150 Hz and -17.4 dB for 8 kHz. Record each tone at an interval of approximately 5 seconds at this level. Set this tape aside. With another tape, return the tone oscillators to their proper settings (+0.4 dB for 1 kHz, +6.1 dB for 150 Hz, and -9.4 dB for 8 kHz). The -8 dB tone tape may now be used as required to adjust the tone detector levels to just reliably operate at the -8 dB from normal tone level setting.
3. **Test Cartridge No. 3:** Using a long cartridge, record a single 1 kHz cue tone on the cue track. Accurately time this cartridge in several machines. Average the playing time and mark the exact time on the rear of this cartridge.

   If a frequency counter is available, record a 12 kHz tone on the program track at -10 dB. Play this cartridge in two or more tape transports and measure the frequency of the tone. Average the measurements and mark the frequency on the rear of the cartridge.
4. **Test Cartridge No. 4:** This cartridge is to be used for the height adjustment of the heads during the run mode. The cartridge has the pressure pads removed and the top section is cut out to allow observation of the tape travel across the heads. Since the pressure pads are removed, the tape travel across the cartridge face must be checked to be sure it is parallel with the base of the case.

C. USE OF TEST CARTRIDGES

1. **Mechanical Head Adjustment:** Place test cartridge No. 4 in the tape transport and check the tape travel across the tape heads. (Refer to Figure 5-15.) If the tape travel is incorrect, perform adjustment in accordance with Section 4-F, G, H, and I.
2. **Program Playback Level:** The output level of the program amplifier is factory adjusted for 0 DBM when reproducing the NAB Standard Reference Level Tape, 400 Hz. Test cartridge No. 1 may be used to adjust this level as required. Refer to Section 8-1 for these adjustments.
3. **Program Playback Equalization:** Equalization of the program amplifier(s) is adjusted for flattest response. Test cartridge No. 1 may be used to adjust this response when necessary. It is cautioned not to attempt this adjustment until reproduce head azimuth adjustment of Section 4-K or L is performed.
4. **Cue Detector(s) Sensitivity:** Test cartridge No. 2 is used to make adjustments as required. Refer to Section 8-3, 4, and 5 for these adjustments.
5. **Machine Speed Tests:** Test cartridge No. 3 is used for the periodic speed test. Insert this cartridge in the machine and measure the running time. If the running time is outside the 0.1% specification, refer to the mechanical adjustments in Section 4 and perform these as necessary to restore proper timing.

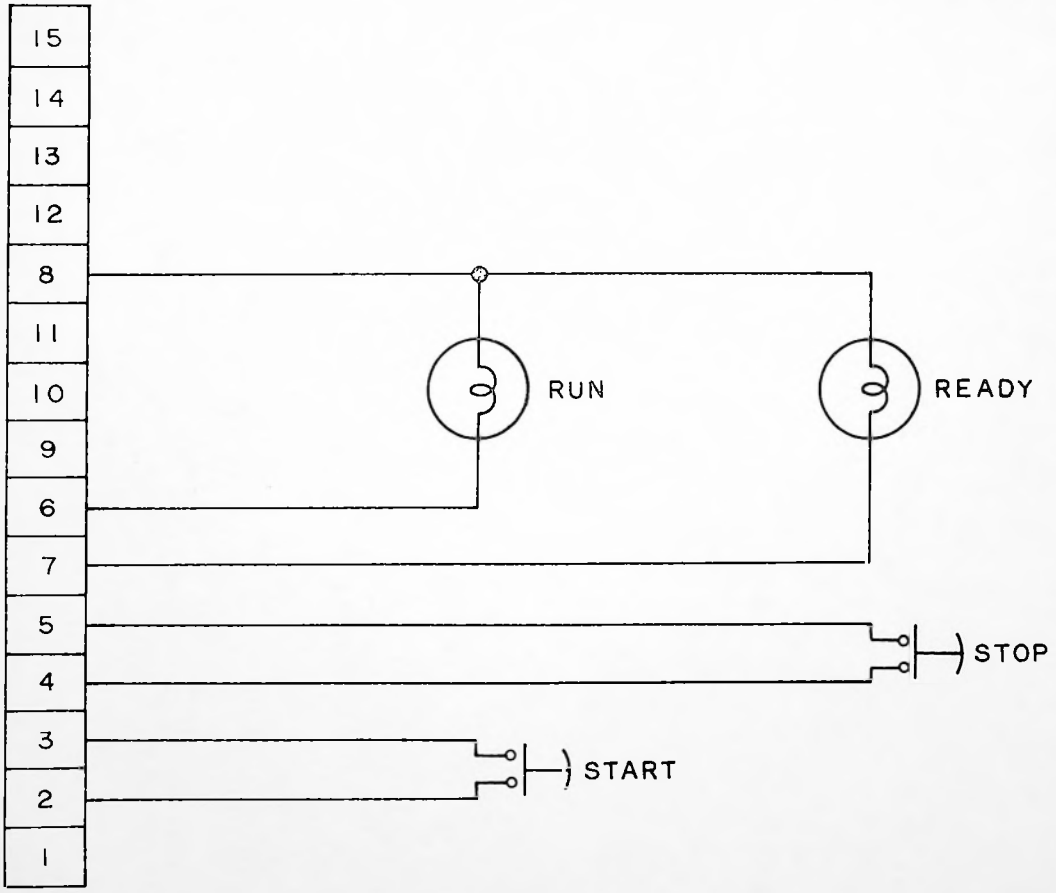
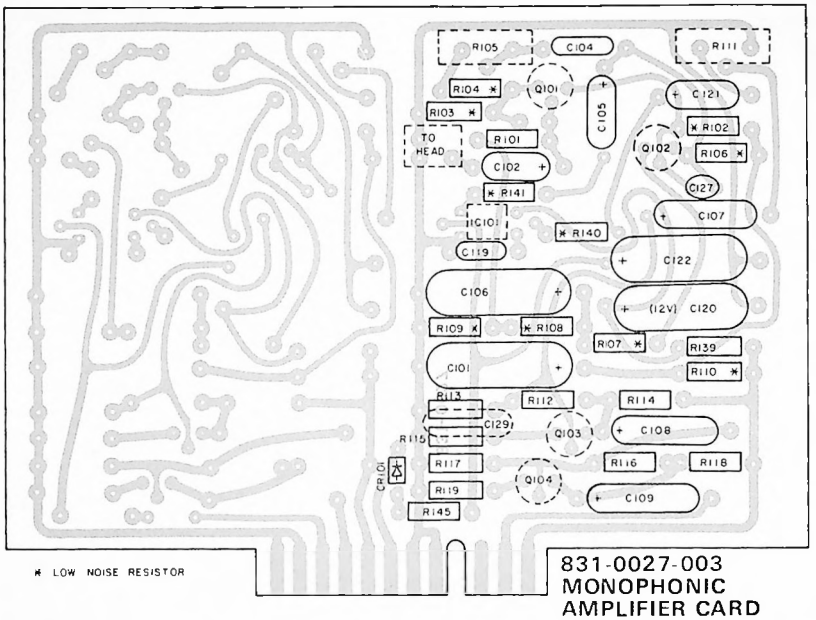


FIGURE 10-1

SAMPLE REMOTE CONTROL SCHEMATIC

PROGRAM AMPLIFIER CARD



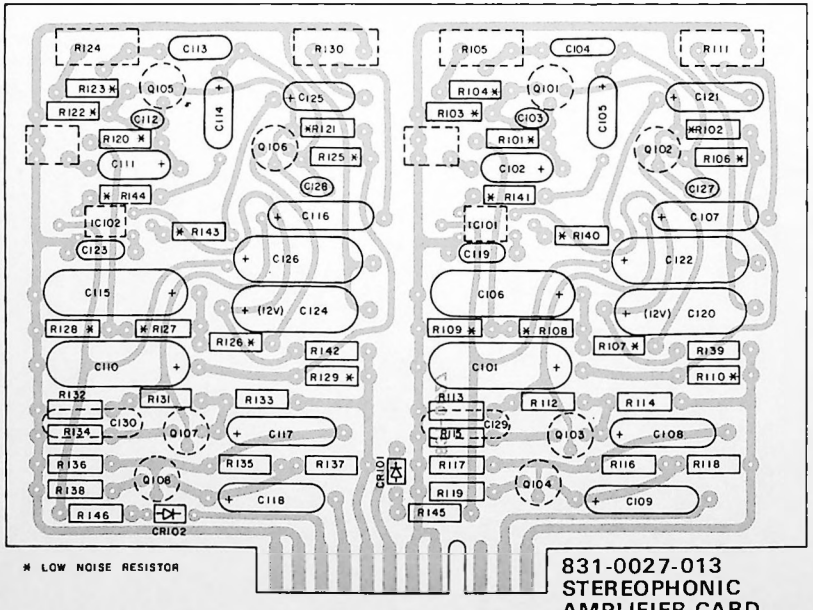
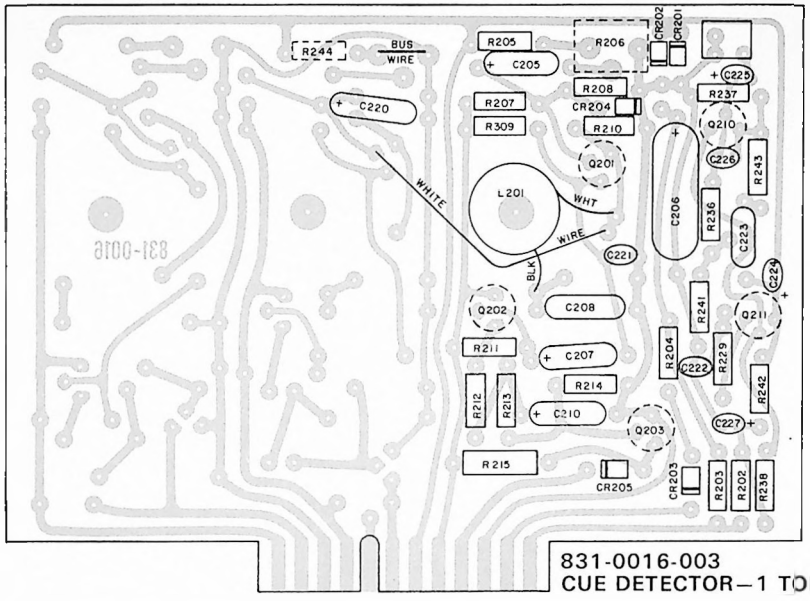


FIGURE 10-2

CUE DETECTOR CARD



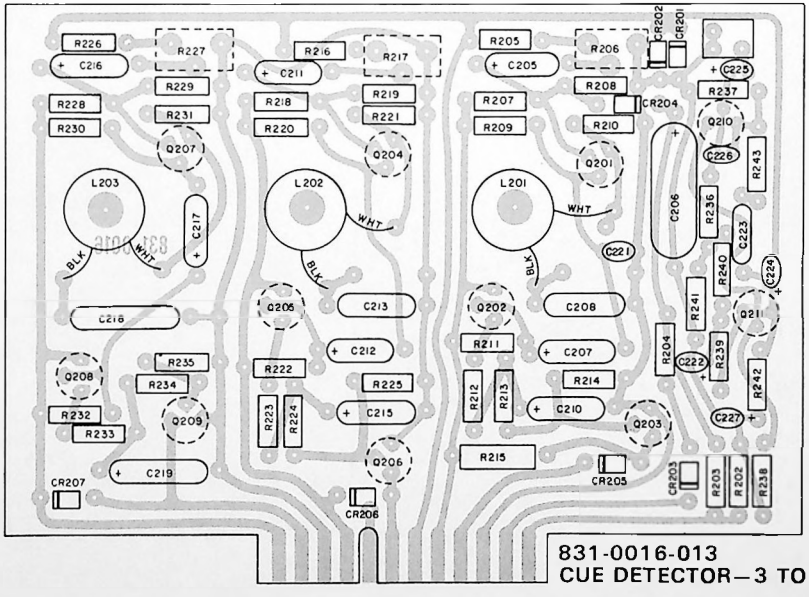
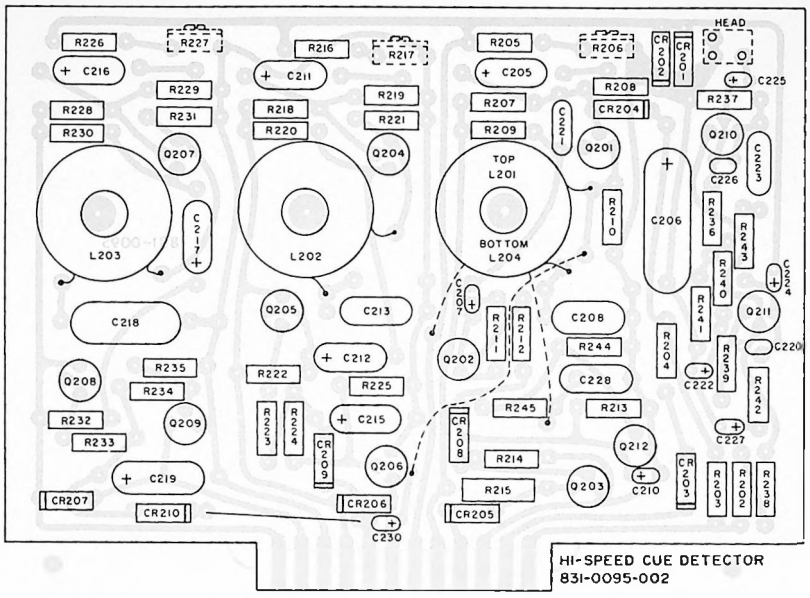
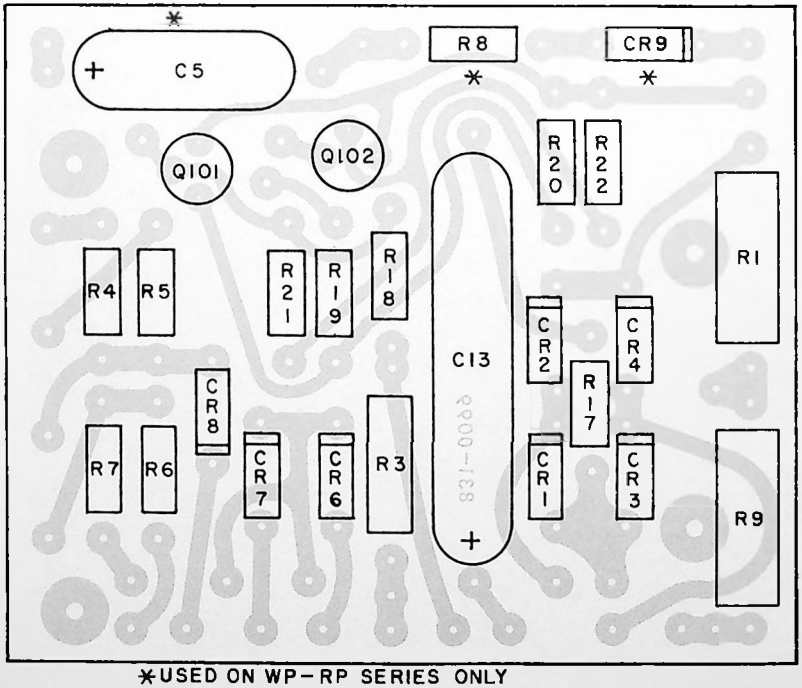


FIGURE 10-3



HI-SPEED CUE DETECTOR
FIGURE 10-4



*USED ON WP-RP SERIES ONLY

UTILITY BOARD
831-0099
FIGURE 10-5

SECTION XI

ELECTRICAL PARTS LIST — SP & WP SERIES REPRODUCERS

A. CHASSIS

Symbol	Part Number	Description
		MOTORS
B1	451-0001-010	Capstan, 450 RPM, 110 V., 60 Hz
	451-0005-010	Capstan, 450/1800 RPM, 110 V., 60 Hz (Hi-Speed Cue)
	451-0006-010	Capstan, 500 RPM, 110 V., 50 Hz
	451-0007-010	Capstan, 375/1500 RPM, 110 V., 50 Hz (Hi-Speed Cue)
		CAPACITORS
C1	683-0001-000	1.5 mfd, 370 VAC (for 60 Hz motor)
	683-0004-000	3.0 mfd, 370 VAC (for Hi-Speed Cue, 60 Hz motor)
	683-0003-000	2.0 mfd, 370 VAC (for 50 Hz motors)
C2	698-0003-000	100/100 mfd, 250 V.
C3	698-0001-000	1000 mfd, 50 V.
C4	698-0001-000	1000 mfd, 50 V.
C5	696-0078-000	100 mfd, 12 V. (WP Series)
C6	686-0001-000	.1 mfd, 500 V. (Hi-Speed Cue)
C7	686-0001-000	.1 mfd, 500 V. (Hi-Speed Cue)
C9	696-0122-000	50 mfd, 25 V. (Hi-Speed Cue)
C10	686-0001-000	.1 mfd, 500 V. (Hi-Speed Cue)
C11	686-0001-000	.1 mfd, 500 V. (Hi-Speed Cue)
C12	686-0001-000	.1 mfd, 500 V. (Hi-Speed Cue)
		DIODE
CR10	575-0007-000	1N4005
		FUSES
F1	417-0001-000	½ ampere, 3AG
F2	417-0002-000	1 ampere, slow-blow, 3AG
		LAMPS
I1	415-0002-000	Power Indicator, 110 V. (Not used in Hi-Speed Cue models)
I2	415-0001-000	No. 327, 28 V. (Run)
I3	415-0001-000	No. 327, 28 V. (Ready)
I4	415-0001-000	No. 327, 28 V. (Hi-Speed Cue)
		INTEGRATED CIRCUIT
IC1	605-0007-000	Regulated Power Supply, 24 VDC, 1 ampere, 7824KC, TO3
		SOCKETS
J1	380-0004-000	15 Pin (Control)
J2	380-0003-000	6 Pin (Audio)
J3	380-0001-000	3 Pin (Motor)
	380-0007-000	6 Pin (Motor—Hi-Speed Cue)
J4	380-0002-000	12 Pin Card Edge (Program)
J5	380-0002-000	12 Pin Card Edge (Cue)
J6	380-0008-000	18 Pin (WP Series—Interconnect)
		RELAYS
K1	480-0001-000	4 PDT, 24 V. (1 kHz)
K2	480-0001-000	4 PDT, 24 V. (150 Hz)
K3	480-0001-000	4 PDT, 24 V. (8 kHz)
K4	480-0001-000	4 PDT, 24 V. (Hi-Speed Cue)

Symbol	Part Number	Description
		INDUCTIVE DEVICES
L1	477-0006-002	Solenoid, 110 VDC
L2	504-0002-000	Head, Mono Reproduce, Nortronics, PB2H7KNO (2001)
	504-0004-000	Head, Stereo Reproduce, Nortronics, PB3Q7KNO (5701)
L3	504-0001-000	Head, Dummy, Nortronics
	504-0003-000	Head, Mono Record, Nortronics, PB2H4RNO (2003) (When used with a Recording Amplifier)
	504-0005-000	Head, Stereo Record, Nortronics, PB3Q4RNO (5703) (When used with a Recording Amplifier)
		RESISTORS
R11	626-0215-000	10 ohms, ½ watt, 5% (Hi-Speed Cue)
R12	626-0215-000	10 ohms, ½ watt, 5% (Hi-Speed Cue)
R13	626-0231-000	47 ohms, ½ watt, 5% (Hi-Speed Cue)
R14	626-0215-000	10 ohms, ½ watt, 5%
R15	626-0215-000	10 ohms, ½ watt, 5% (Hi-Speed Cue)
R16	626-0215-000	10 ohms, ½ watt, 5% (Hi-Speed Cue)
		SWITCHES
S1	392-0001-000	Micro (Cartridge Sensing)
S2	391-0002-000	Push-Button (Start)
S3	391-0002-000	Push-Button (Stop)
S4	391-0006-000	Push-Button (Hi-Speed Cue)
S5	392-0001-000	Micro (Cartridge Sensing—Motor)
		TRANSFORMERS
T1	526-0001-000	Power, SP Series
	526-0002-000	Power, WP Series
T2	532-0001-000	Audio, +14 dBm
T3	532-0001-000	Audio, +14 dBm (Stereo)
		MISCELLANEOUS
	311-0003-000	Strain Relief, AC Power Cord
	433-0001-000	Cord, AC Power
	418-0001-000	Holder, Fuse
	507-0001-010	Head Lead Assembly, Mono Play
	507-0002-010	Head Lead Assembly, Stereo Play Left
	507-0003-010	Head Lead Assembly, Stereo Play Cue
	507-0004-010	Head Lead Assembly, Stereo Play Right
	507-0001-000	Head Lead Assembly, Mono Record (WP Series)
	507-0002-000	Head Lead Assembly, Stereo Record Left (WP Series)
	507-0003-000	Head Lead Assembly, Stereo Record Cue (WP Series)
	507-0004-000	Head Lead Assembly, Stereo Record Right (WP Series)
	487-0001-000	Sockets, Relay
	613-0002-000	Socket, TO-3 Transistor (For IC1)
	378-0003-000	Plug, 15 Pin (Control)
	378-0002-000	Plug, 6 Pin (Audio)
	378-0001-000	Plug, 3 Pin (Motor)
	378-0007-000	Plug, 6 Pin (Motor—Hi-Speed Cue)

B. SP — UTILITY BOARD (831-0029-003) (w/Hi-Speed Cue—831-0029-023)

Symbol	Part Number	Description
		CAPACITORS
C13	696-0164-000	20 MF, 150 V.
	696-0155-000	2 MF, 150 V. (Hi Speed Cue)
		DIODES
CR1	575-0007-000	1N4005
CR2	575-0007-000	1N4005
CR3	575-0007-000	1N4005
CR4	575-0007-000	1N4005
CR6	575-0007-000	1N4005
CR7	575-0007-000	1N4005
CR8	575-0007-000	1N4005
		RESISTORS
R1	628-0116-000	75 ohms, 5 watt, 5%
R3	626-0439-000	100 ohms, 1 watt, 10%
R4	626-0239-000	100 ohms, ½ watt, 5%
R5	626-0239-000	100 ohms, ½ watt, 5%
R6	626-0239-000	100 ohms, ½ watt, 5%
R7	626-0239-000	100 ohms, ½ watt, 5%
R9	628-0116-000	75 ohms, 5 watt, 5%
R17	626-0231-000	47 ohms, ½ watt, 5%

C. WP — UTILITY BOARD (831-0029-013) (w/Hi-Speed Cue—831-0029-033)

		CAPACITORS
C13	696-0164-000	20 MF, 150 V.
	696-0155-000	2 MF, 150 V. (Hi-Speed Cue)
		DIODES
CR1	575-0007-000	1N4005
CR2	575-0007-000	1N4005
CR3	575-0007-000	1N4005
CR4	575-0007-000	1N4005
CR6	575-0007-000	1N4005
CR7	575-0007-000	1N4005
CR8	575-0007-000	1N4005
CR9	575-0007-000	1N4005
		RESISTORS
R1	628-0116-000	75 ohms, 5 watt, 5%
R3	626-0439-000	100 ohms, 1 watt, 10%
R4	626-0239-000	100 ohms, ½ watt, 5%
R5	626-0239-000	100 ohms, ½ watt, 5%
R6	626-0239-000	100 ohms, ½ watt, 5%
R7	626-0239-000	100 ohms, ½ watt, 5%
R8	626-0231-000	47 ohms, ½ watt, 5% (WP Series)
R9	628-0116-000	75 ohms, 5 watt, 5%
R17	626-0231-000	47 ohms, ½ watt, 5%

D. PROGRAM REPRODUCE AMPLIFIER CARD

MONO 831-0027-003
STEREO 831-0027-013

		CAPACITORS
C101	696-0124-000	100 mfd, 25 V.
C102	696-0114-000	5 mfd, 25 V.
C103	677-0001-000	100 pfd, 300 V.
C104	681-0046-000	.01 mfd, 200 V.
C105	696-0114-000	5 mfd, 25 V.
C106	696-0124-000	100 mfd, 25 V.
C107	696-0117-000	10 mfd, 25 V.
C108	696-0117-000	10 mfd, 25 V.
C109	696-0117-000	10 mfd, 25 V.
C119	681-0032-000	.00068 mfd, 200 V.
C120	696-0202-000	450 mfd, 12 V.
C121	696-0114-000	5 mfd, 25 V.
C122	696-0122-000	50 mfd, 25 V.
C127	677-0001-000	100 pfd, 300 V.
C129	681-0050-000	.022 mfd, 200 V.
		CAPACITORS (STEREO ONLY)
C110	696-0124-000	100 mfd, 25 V.
C111	696-0114-000	5 mfd, 25 V.
C112	677-0001-000	100 pfd, 300 V.
C113	681-0046-000	.01 mfd, 200 V.
C114	696-0114-000	5 mfd, 25 V.
C115	696-0124-000	100 mfd, 25 V.
C116	696-0117-000	10 mfd, 25 V.
C117	696-0117-000	10 mfd, 25 V.
C118	696-0117-000	10 mfd, 25 V.
C123	681-0032-000	.00068 mfd, 200 V.
C124	696-0202-000	450 mfd, 12 V.
C125	696-0114-000	5 mfd, 25 V.
C126	696-0122-000	50 mfd, 25 V.
C128	677-0001-000	100 pfd, 300 V.
C130	681-0050-000	.022 mfd, 200 V.
		TRANSISTORS
Q101	590-0013-000	2N5089
Q102	590-0013-000	2N5089
Q103	590-0017-000	2N5816
Q104	590-0017-000	2N5816
		TRANSISTORS (STEREO ONLY)
Q105	590-0013-000	2N5089
Q106	590-0013-000	2N5089
Q107	590-0017-000	2N5816
Q108	590-0017-000	2N5816
		RESISTORS
R101	626-0311-000	100 K ohms, ½ watt, 5%
R102	630-0311-000	100 K ohms, ½ watt, 5%, Lo Noise
R103	630-0249-000	100 ohms, ½ watt, 5%, Lo Noise
R104	626-0275-000	3.3 K ohms, ½ watt, 5%
R105	636-0002-000	Variable, 10 K ohms, ¼ watt, (L. Equalization)
R106	630-0287-000	10 K ohms, ½ watt, 5%, Lo Noise
R107	630-0259-000	680 ohms, ½ watt, 5%, Lo Noise
R108	630-0283-000	6800 ohms, ½ watt, 5%, Lo Noise
R109	630-0267-000	1500 ohms, ½ watt, 5%, Lo Noise
R110	630-0295-000	22 K ohms, ½ watt, 5%, Lo Noise
	630-0293-000	18 K ohms, ½ watt, 5%, Lo Noise (STEREO ONLY)
R111	636-0002-000	Variable, 10 K ohms, ¼ watt, (L. Level)
R112	626-0307-000	68 K ohms, ½ watt, 5%
R113	626-0287-000	10 K ohms, ½ watt, 5%
R114	626-0271-000	2.2 K ohms, ½ watt, 5%
R115	626-0251-000	330 ohms, ½ watt, 5%
R116	626-0295-000	22 K ohms, ½ watt, 5%
R117	626-0279-000	4700 ohms, ½ watt, 5%
R118	626-0259-000	680 ohms, ½ watt, 5%
R119	626-0231-000	47 ohms, ½ watt, 5%
R139	626-0263-000	1 K ohms, ½ watt, 5%
R140	626-0271-000	2.2 K ohms, ½ watt, 5%
R141	626-0303-000	47 K ohms, ½ watt, 5%
R145	626-0267-000	1500 ohms, ½ watt, 5%

Symbol	Part Number	Description
		RESISTORS (STEREO ONLY)
R120	626-0311-000	100 K ohms, ½ watt, 5%
R121	630-0311-000	100 K ohms, ½ watt, 5%, Lo Noise
R122	630-0249-000	100 ohms, ½ watt, 5%, Lo Noise
R123	626-0275-000	3.3 K ohms, ½ watt, 5%
R124	636-0002-000	Variable, 10 K ohms, ¼ watt, (Right Equal)
R125	630-0287-000	10 K ohms, ½ watt, 5%, Lo Noise
R126	630-0259-000	680 ohms, ½ watt, 5%, Lo Noise
R127	630-0283-000	6800 ohms, ½ watt, 5%, Lo Noise
R128	630-0269-000	1800 ohms, ½ watt, 5%, Lo Noise
R129	630-0293-000	18 K ohms, ½ watt, 5%, Lo Noise
R130	636-0002-000	Variable, 10 K ohms, ¼ watt, (Right Level)
R131	626-0307-000	68 K ohms, ½ watt, 5%
R132	626-0287-000	10 K ohms, ½ watt, 5%
R133	626-0271-000	2.2 K ohms, ½ watt, 5%
R134	626-0251-000	330 ohms, ½ watt, 5%
R135	626-0295-000	22 K ohms, ½ watt, 5%
R136	626-0279-000	4700 ohms, ½ watt, 5%
R137	626-0259-000	680 ohms, ½ watt, 5%
R138	626-0231-000	47 ohms, ½ watt, 5%
R142	626-0231-000	1 K ohms, ½ watt, 5%
R143	626-0271-000	2.2 K ohms, ½ watt, 5%
R144	626-0303-000	47 K ohms, ½ watt, 5%
R146	626-0267-000	1500 ohms, ½ watt, 5%
		MISCELLANEOUS
IC101	606-0003-000	MFC 6040
IC102	606-0003-000	MFC 6040 (Stereo Only)
CR101	575-0007-000	IN4005
CR102	575-0007-000	IN4005 (Stereo Only)

E. CUE TONE DETECTOR CARD
1 TONE 831-0016-003
3 TONE 831-0016-013

		CAPACITORS
C205	696-0114-000	5 mfd, 25 V.
C206	696-0124-000	100 mfd, 25 V.
C207	696-0114-000	5 mfd, 25 V.
C208	681-0054-000	.047 mfd, 200 V
C209		Selected to tune the detector to 1 kHz.
C210	696-0114-000	5 mfd, 25 V.
	681-0058-000	.1 mfd, 200 V. (Hi-Speed Cue)
C211	696-0114-000	5 mfd, 25 V. (8 kHz)
C212	696-0114-000	5 mfd, 25 V. (8 kHz)
C213	681-0081-000	.015 mfd, 200 V. (8 kHz)
C214		Selected to tune the detector to 8 kHz.
C215	696-0110-000	1 mfd, 25 V. (8 kHz)
C216	696-0114-000	5 mfd, 25 V. (150 Hz)
C217	696-0114-000	5 mfd, 25 V. (150 Hz)
C218	685-0003-000	2.2 mfd, 250 V. (150 Hz)
C219	696-0117-000	10 mfd, 25 V. (150 Hz)
C220	696-0114-000	5 mfd, 25 V. (1 kHz only) Single Tone
C221	686-0002-000	.025 mfd, 100 V.
C222	694-0002-000	10 mfd, 20 V.
C223	681-0046-000	.01 mfd, 200 V.
C224	694-0003-000	4.7 mfd, 35 V.
C225	694-0004-000	.47 mfd, 35 V.
C226	677-0001-000	100 pfd, 300 V.
C227	694-0002-000	10 mfd, 20 V.
		DIODES
CR201	575-0002-000	IN462
CR202	575-0002-000	IN462
CR203	575-0007-000	IN4005
CR204	575-0007-000	IN4005
CR205	575-0007-000	IN4005
CR206	575-0007-000	IN4005 (Three Tone Only)
CR207	575-0007-000	IN4005 (Three Tone Only)

Symbol	Part Number	Description
		INDUCTORS
L201	511-0002-000	Toroid, 500 mh
L202	511-0005-000	Toroid, 20 mh (8 kHz)
L203	511-0002-000	Toroid, 500 mh (150 Hz)
		TRANSISTORS
Q201	590-0001-000	2N3053
Q202	590-0014-000	2N2905
Q203	590-0001-000	2N3053
Q204	590-0001-000	2N3053 (8 kHz)
Q205	590-0014-000	2N2905
Q206	590-0001-000	2N3053 (8 kHz)
Q207	590-0001-000	2N3053 (150 Hz)
Q208	590-0014-000	2N2905 (150 Hz)
Q209	590-0001-000	2N3053 (150 Hz)
Q210	590-0011-000	2N930
Q211	590-0011-000	2N930
		RESISTORS
R202	626-0255-000	470 ohms, ½ watt, 5%
R203	626-0283-000	68 K ohms, ½ watt, 5%
R204	626-0239-000	100 ohms, ½ watt, 5%
R205	626-0263-000	1 K ohms, ½ watt, 5%
R206	636-0002-000	Variable, 10 K ohms, ¼ watt (1 kHz sensitivity)
R207	626-0291-000	15 K ohms, ½ watt, 5%
R208	626-0291-000	15 K ohms, ½ watt, 5%
R209	626-0275-000	3.3 K ohms, ½ watt, 5%
R210	626-0279-000	4.7 K ohms, ½ watt, 5%
R211	626-0271-000	2.2 K ohms, ½ watt, 5%
R212	626-0263-000	1 K ohms, ½ watt, 5%
R213	626-0279-000	4.7 K ohms, ½ watt, 5%
R214	626-0279-000	4.7 K ohms, ½ watt, 5%
R215	626-0448-000	240 ohms, 1 watt, 10%
R216	626-0291-000	15 K ohms, ½ watt, 5%
R217	636-0002-000	Variable, 10 K ohms, ¼ watt (8 kHz sensitivity)
R218	626-0291-000	15 K ohms, ½ watt, 5% (8 kHz)
R219	626-0291-000	15 K ohms, ½ watt, 5% (8 kHz)
R220	626-0275-000	3.3 K ohms, ½ watt, 5% (8 kHz)
R221	626-0279-000	4.7 K ohms, ½ watt, 5% (8 kHz)
R222	626-0271-000	2.2 K ohms, ½ watt, 5% (8 kHz)
R223	626-0263-000	1 K ohms, ½ watt, 5% (8 kHz)
R224	626-0279-000	4.7 ohms, ½ watt, 5% (8 kHz)
R225	626-0279-000	4.7 K ohms, ½ watt, 5% (8 kHz)
R226	626-0239-000	100 ohms, ½ watt, 5% (150 Hz)
R227	636-0002-000	Variable, 10 K ohms, ¼ watt (150 Hz sensitivity)
R228	626-0291-000	15 K ohms, ½ watt, 5% (150 Hz)
R229	626-0291-000	15 K ohms, ½ watt, 5% (150 Hz)
R230	626-0275-000	3.3 K ohms, ½ watt, 5% (150 Hz)
R231	626-0279-000	4.7 K ohms, ½ watt, 5% (150 Hz)
R232	626-0271-000	2.2 K ohms, ½ watt, 5% (150 Hz)
R233	626-0263-000	1 K ohms, ½ watt, 5% (150 Hz)
R234	626-0279-000	4.7 K ohms, ½ watt, 5% (150 Hz)
R235	626-0279-000	4.7 K ohms, ½ watt, 5% (150 Hz)
R236	626-0311-000	100 K ohms, ½ watt, 5%
R237	626-0235-000	68 ohms, ½ watt, 5%
R238	626-0287-000	10 K ohms, ½ watt, 5%
R239	626-0239-000	100 ohms, ½ watt, 5%
R240	626-0271-000	2.2 K ohms, ½ watt, 5%
R241	626-0259-000	680 ohms, ½ watt, 5%
R242	626-0271-000	2.2 K ohms, ½ watt, 5%
R243	626-0303-000	47 K ohms, ½ watt, 5%
R244	626-0287-000	10 K ohms, ½ watt, 5% (single tone only)

F. HIGH SPEED CUE DETECTOR CARD 831-0095-002

The parts listed in this section are used exclusively in the Hi-Speed Cue Detector Cards. Other parts are common to the Standard Cue Tone Detector Card and are listed in Section E.

CAPACITORS

C205	696-0110-000	1 MF, 25 V., Electrolytic
C207	694-0005-000	1 MF, 35 V., Tantalum
C210	694-0002-000	10 MF, 20 V., Tantalum
C220	677-0003-000	300 pf, 100 V., Mica
C221	681-0040-000	.0033 MF, 200 V., Mylar

RESISTORS

R205	626-0279-000	4.7 K ohms, ½ watt, 5%
R213	626-0303-000	47 K ohms, ½ watt, 5%
R236	626-0319-000	220 K ohms, ½ watt, 5%
R237	626-0233-000	56 ohms, ½ watt, 5%
R239	626-0235-000	68 ohms, ½ watt, 5%
R240	626-0261-000	820 ohms, ½ watt, 5%
R241	626-0251-000	330 ohms, ½ watt, 5%

TRANSISTORS

Q212	590-0017-000	2N5816

DIODES

CR208	577-0001-000	1N4742, 12 V., Zener
CR209	575-0007-000	1N4005
CR210	575-0007-000	1N4005

A. GENERAL

International Tapetronics has designed the reproducers and recorders with excellent reliability and minimum maintenance as primary design goals. Simplicity and mechanical strength are important factors in reducing mechanical maintenance. Electronic dependability is assured through the use of negative feedback and other techniques which stabilize circuits which are subjected to widely varying ambient conditions.

B. MECHANICAL MAINTENANCE— REPRODUCERS

1. Weekly Maintenance
   a. Clean the capstan and pressure roller with a cloth dipped in alcohol. Remove all traces of lubricant and oxide from both the capstan and pressure roller.
   b. Clean the head with a cotton swab dipped in a head cleaning solution.
2. Monthly Maintenance
   a. Check speed of unit. Since the capstan motor is a 450 RPM, direct drive, hysteresis synchronous device, there are no belts, pulleys, or flywheel assembly to cause speed variables. The bearings in this motor are permanently sealed ball bearings which need no lubrication. Any effort to lubricate the motor bearings will result in oil seeping into the motor windings.

      To check the speed of the unit, play test cartridge number 4 (see Section IX). the playing time should not vary more than .4 seconds in 3½ minutes. If a frequency counter is available, the 12 kHz tone should not vary more than 24 Hz (0.2%).

   b. Check the pressure roller using an ITC pressure roller gauge 830-0006-001 (see Section IV-D).
   c. Check head alignment (see Section IV-J).

C. MECHANICAL MAINTENANCE— RECORDERS

1. Clean the record head as described for the reproduce head.
2. Check head alignment as described for the reproduce head.

D. ELECTRICAL MAINTENANCE— REPRODUCERS

The electrical maintenance is to be conducted monthly and takes the form of measuring electrical parameters and making corrective adjustments if required.

Using the test cartridges and procedures outlined in Section VIII, check the reproducer cue sensitivity, program play level and equalization.

E. ELECTRICAL MAINTENANCE— RECORDERS

1. Head zenith adjustment should be conducted monthly for optimum performance of the recorder. This adjustment is described in Section IV-J.
2. The bias trap (L401) on the program amplifier printed circuit board should be checked monthly to obtain the overall response capabilities of the recorder. The adjustment is described in Section VII-2.
3. Record equalization as described in Section VII-3 should be checked monthly to assure the optimum response from the recorder.

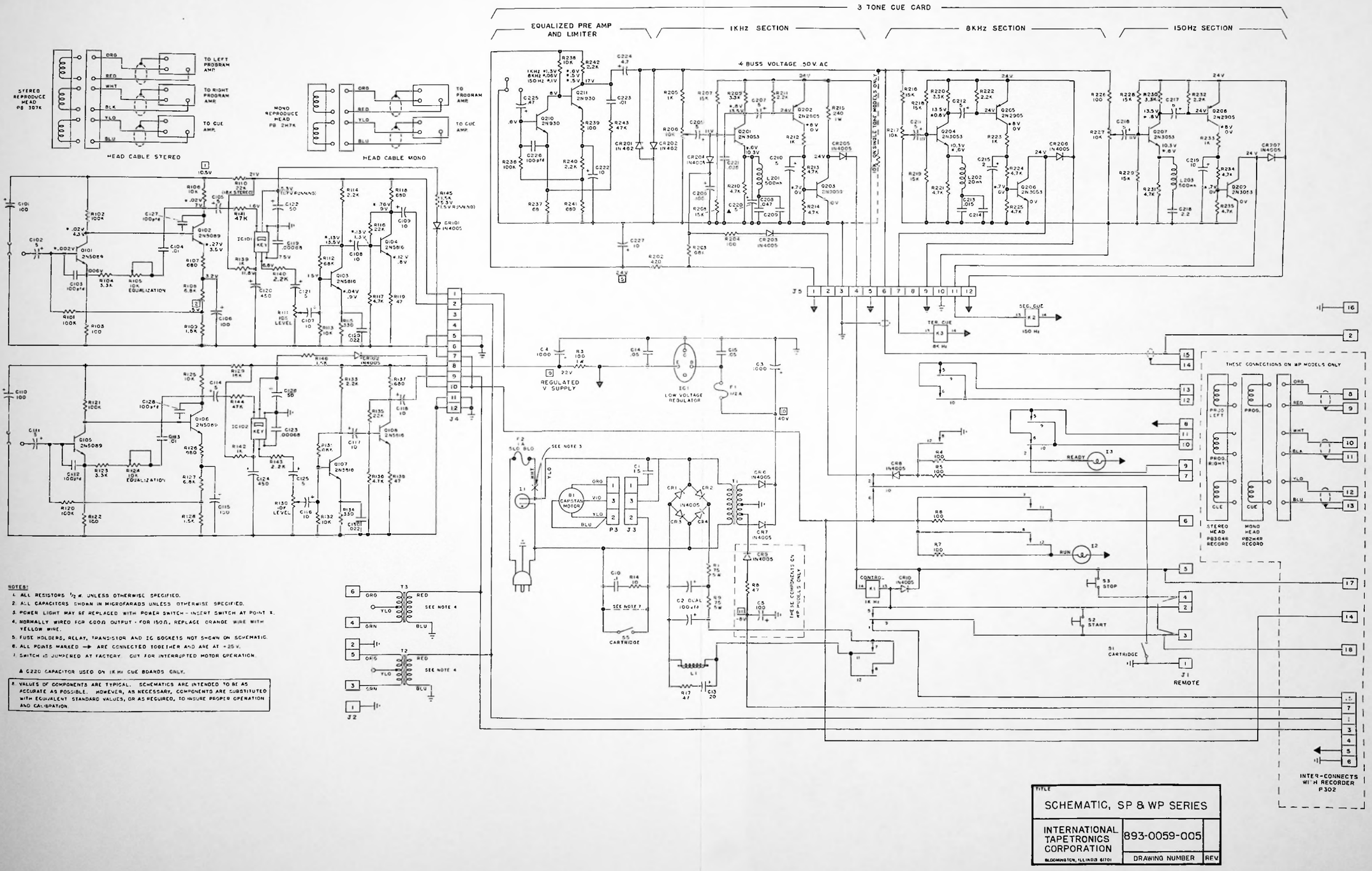
SECTION XIII

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.



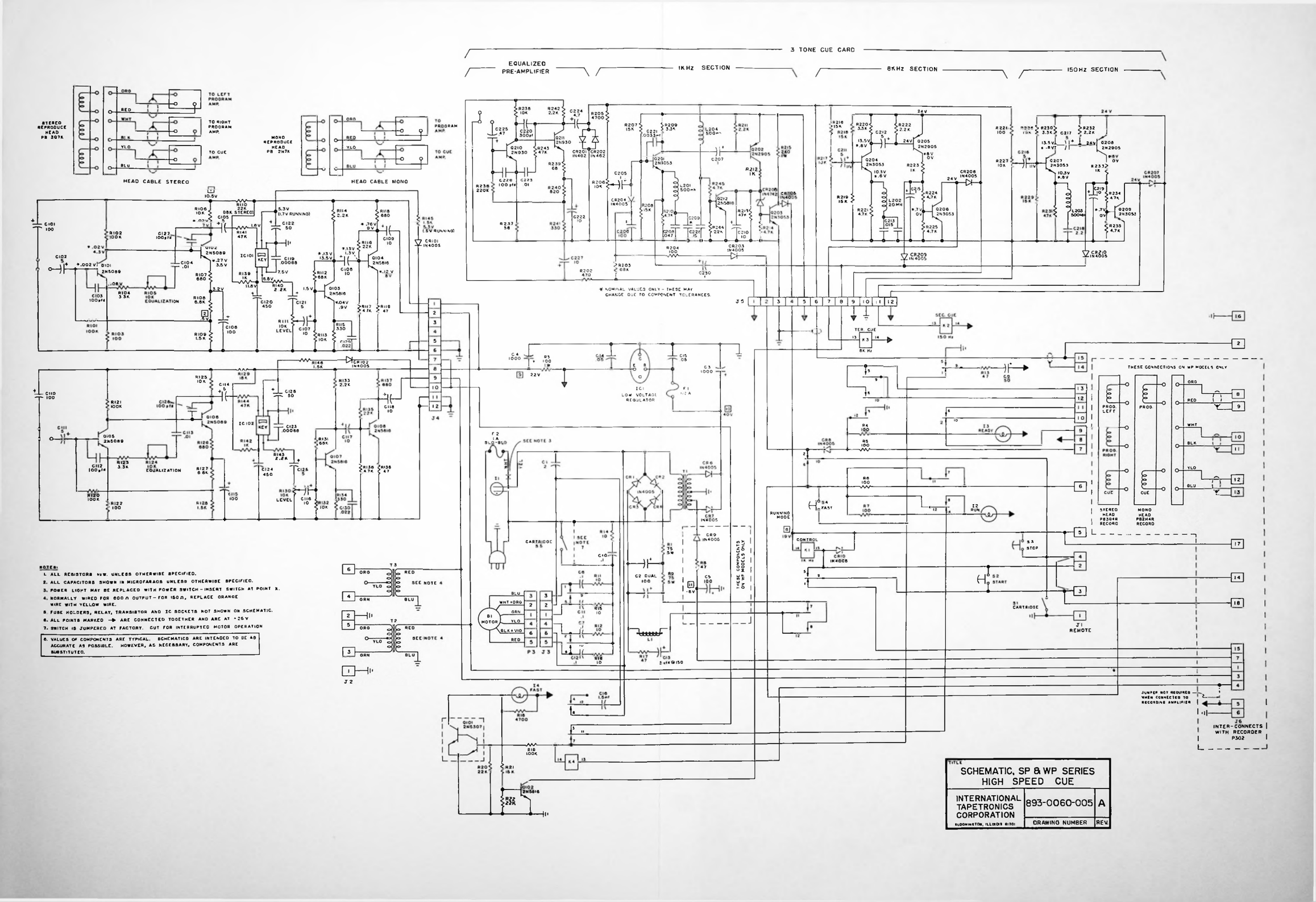
NOTES:

1. ALL RESISTORS ½ W. UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS SHOWN IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
3. POWER LIGHT MAY BE REPLACED WITH POWER SWITCH - INSERT SWITCH AT POINT X.
4. NORMALLY WIRED FOR 600Ω OUTPUT - FOR 150Ω, REPLACE ORANGE WIRE WITH YELLOW WIRE.
5. FUSE HOLDERS, RELAY, TRANSISTOR AND IC SOCKETS NOT SHOWN ON SCHEMATIC.
6. ALL POINTS MARKED → ARE CONNECTED TOGETHER AND ARE AT +25 V.
7. SWITCH IS JUMPERED AT FACTORY. CUT FOR INTERRUPTED MOTOR OPERATION.

▲ C220 CAPACITOR USED ON 1K Hz CUE BOARDS ONLY.

8. 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.

TITLE		
SCHEMATIC, SP & WP SERIES		
INTERNATIONAL TAPETRONICS CORPORATION BLOOMINGTON, ILLINOIS 61701	893-0059-005	
	DRAWING NUMBER	REV.



NOTES:

1. ALL RESISTORS ¼W. UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS SHOWN IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
3. POWER LIGHT MAY BE REPLACED WITH POWER SWITCH - INSERT SWITCH AT POINT X.
4. NORMALLY WIRED FOR 600 Ω OUTPUT - FOR 150 Ω, REPLACE ORANGE WIRE WITH YELLOW WIRE.
5. FUSE HOLDERS, RELAY, TRANSISTOR AND IC SOCKETS NOT SHOWN ON SCHEMATIC.
6. ALL POINTS MARKED → ARE CONNECTED TOGETHER AND ARE AT +26 V
7. SWITCH IS JUMPERED AT FACTORY. CUT FOR INTERRUPTED MOTOR OPERATION
8. VALUES OF COMPONENTS ARE TYPICAL. SCHEMATICS ARE INTENDED TO BE AS ACCURATE AS POSSIBLE. HOWEVER, AS NECESSARY, COMPONENTS ARE SUBSTITUTED.

TITLE		
SCHEMATIC, SP & WP SERIES HIGH SPEED CUE		
INTERNATIONAL TAPETRONICS CORPORATION BLOOMINGTON, ILLINOIS 61701	893-0060-005	A
	DRAWING NUMBER	REV.

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

TABLE OF CONTENTS

RA & WRA SERIES RECORDING AMPLIFIERS

SECTION VI PARTS LISTS

SECTION VII SCHEMATICS

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 (stereo) — 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 (stereo) — The right channel stereo potentiometer 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 "O" 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.

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 703 latches on and the Record Set pushbutton may be released. SCR703 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 oscillator card and through diode CR702 and resistor R718 to SCR Q706 and the unijunction transistor Q705.

When +24 is first supplied, SCR706 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 ¾ 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.

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) PROG 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 O dBm. If necessary, adjust R111 on the reproduce program amplifier to obtain this reading.
4. Adjust R314, the left channel (or mono) PROG 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 O dBm. If necessary, adjust R130 on the reproduce program amplifier to obtain this reading.
6. Adjust R320, the right channel PROG 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) PROG BIAS trim-pot R311 for O (100%) on the left meter.
4. Stereo units – adjust the right channel PROG 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

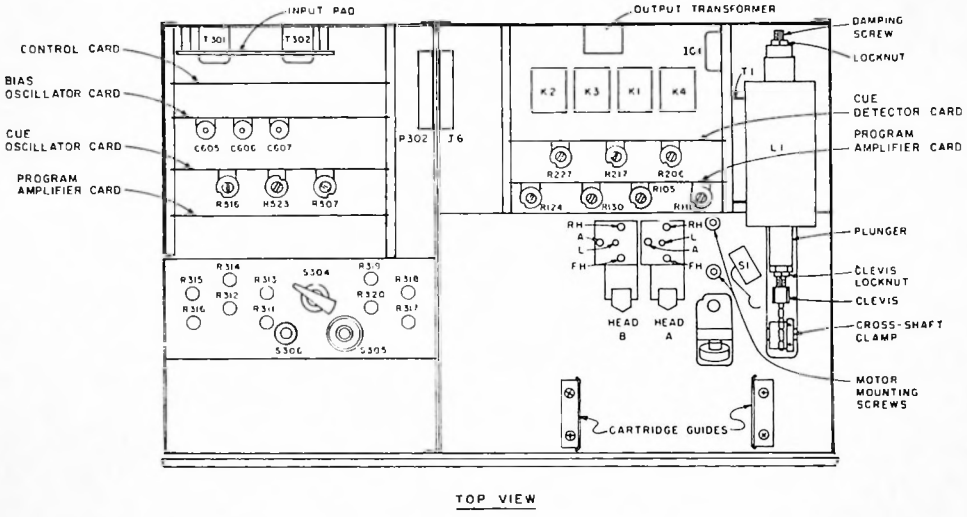
1. Disable the reproducer 1 kHz primary cue detector by turning its sensitivity control R206 full counter-clockwise. (Observe the initial setting so that the control may be easily returned to this setting.)
2. With a short erased cartridge, start and stop the recorder and reproducer several times to 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.



TOP VIEW

FIGURE 5-1

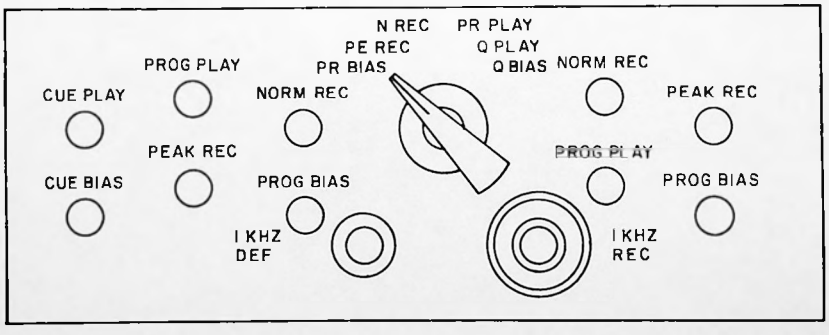
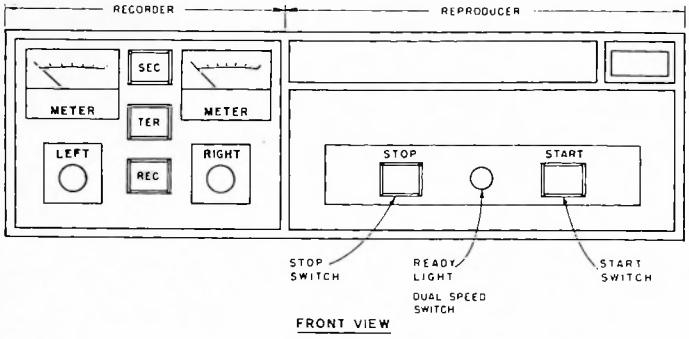
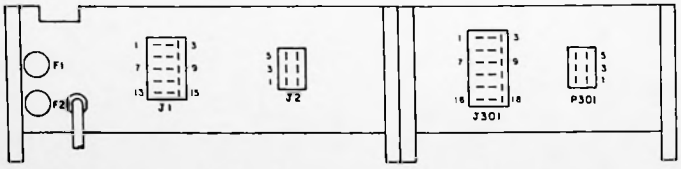


FIGURE 5-2



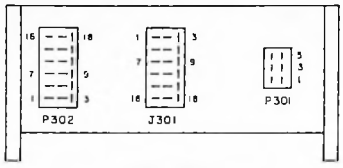
FRONT VIEW

FIGURE 5-3



REAR VIEW

RP SERIES
FIGURE 5-4



WRA SERIES
FIGURE 5-5

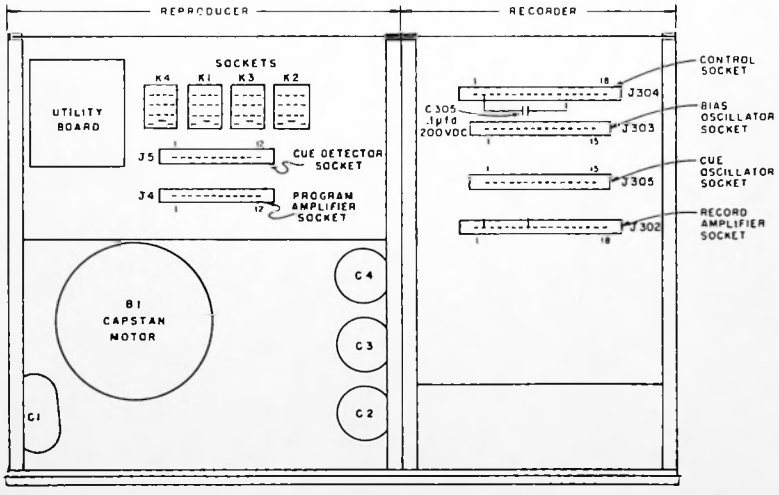
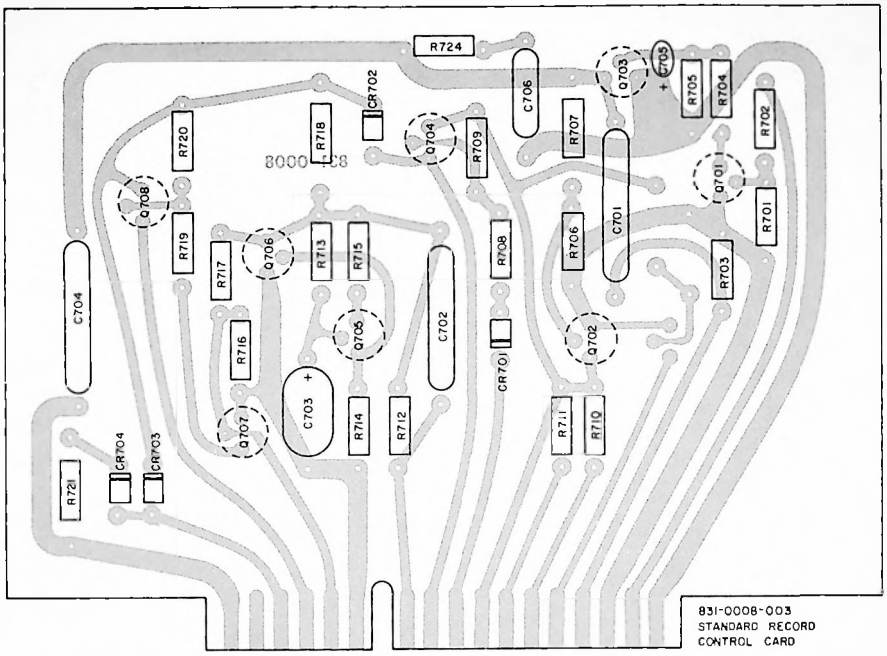


FIGURE 5-6


R724
CR702
C706
Q703
+ C705
R705
R704
R702
R720
R718
Q704
R709
R707
Q701
Q708
R719
R717
Q706
R713
R715
C701
R706
R701
C704
R716
Q705
C702
R708
R703
Q702
C703 +
CR701
Q707
R714
R712
R711
R710
R721
CR704
CR703
831-0008-003
STANDARD RECORD
CONTROL CARD

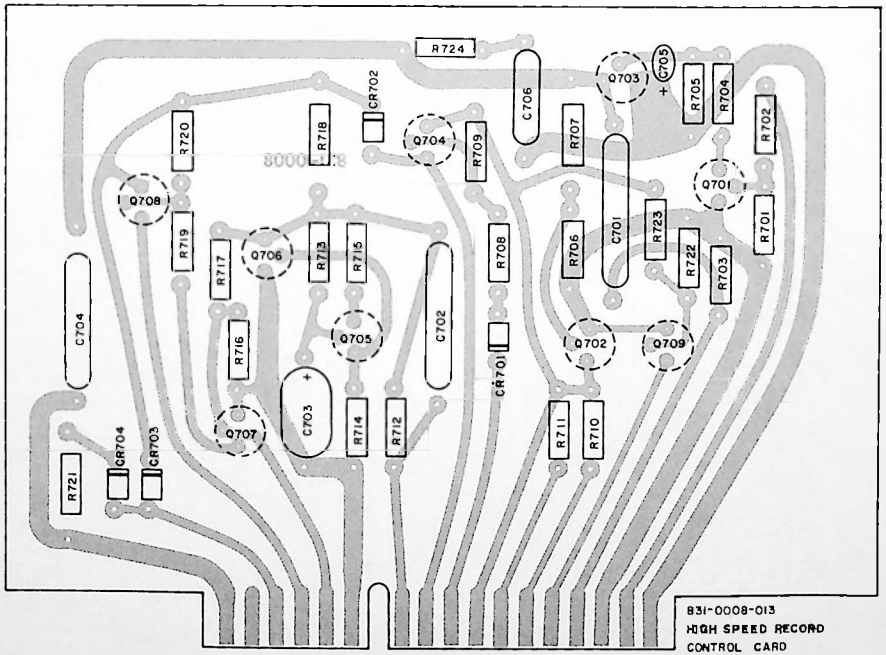
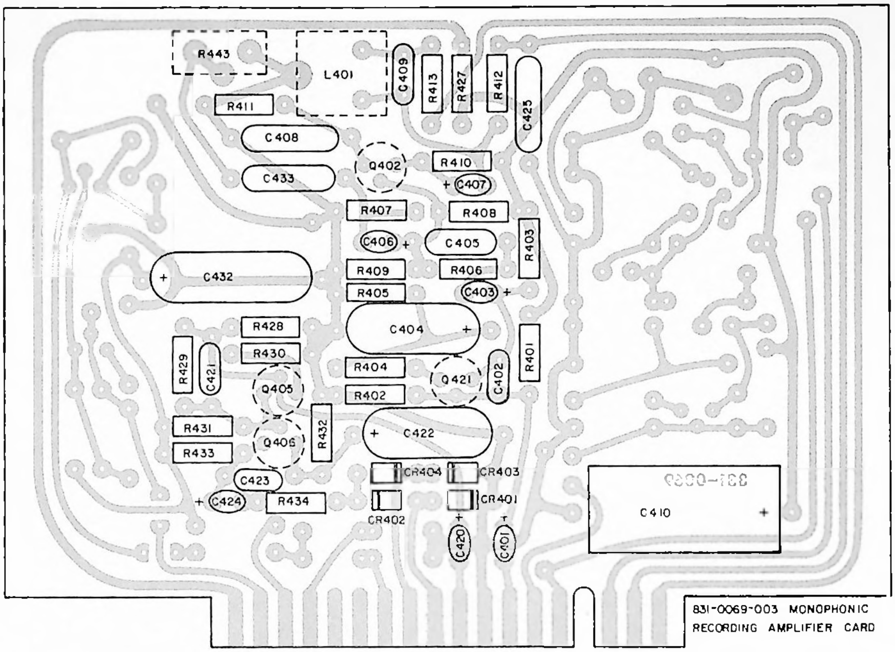
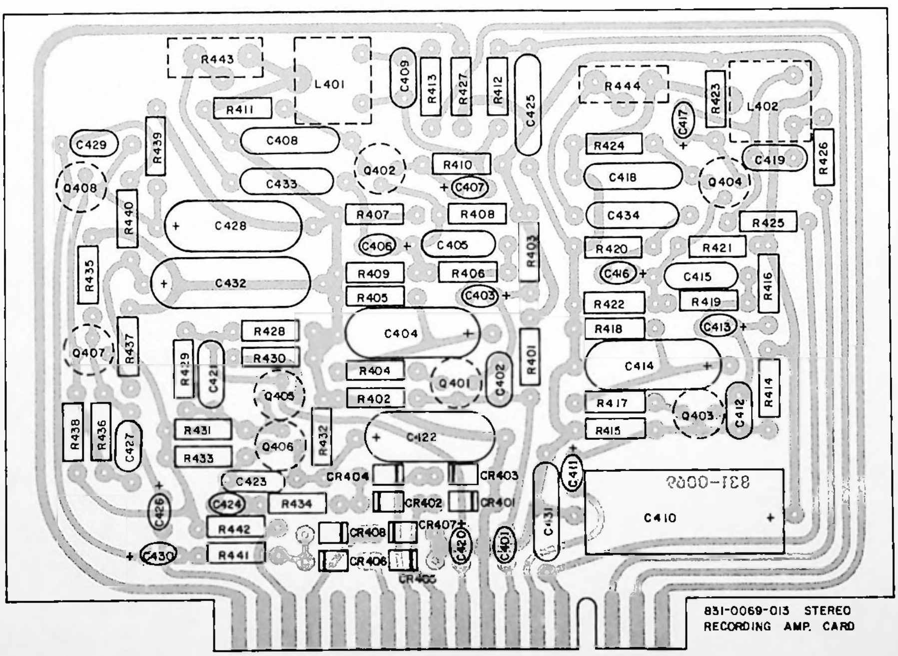

R724
CR702
C706
Q703
+ C705
R705
R704
R702
R720
R718
Q704
R709
R707
Q701
Q708
R719
R717
Q706
R713
R715
C701
R723
R706
R722
R701
C704
R716
Q705
C702
R708
R703
Q702
Q709
C703 +
CR701
Q707
R714
R712
R711
R710
R721
CR704
CR703
831-0008-013
HIGH SPEED RECORD
CONTROL CARD

FIGURE 5-7



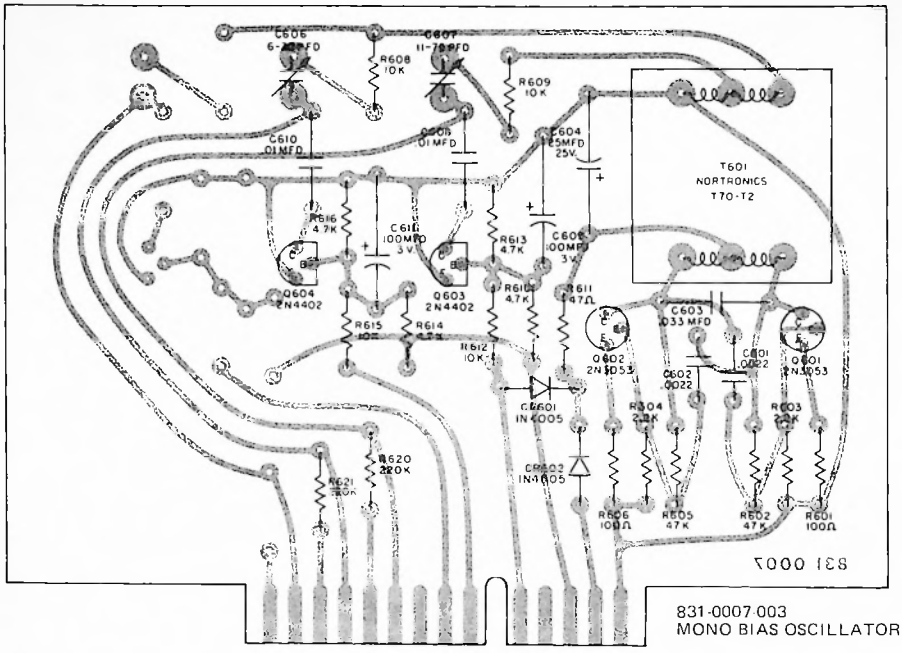
831-0069-003 MONOPHONIC RECORDING AMPLIFIER CARD



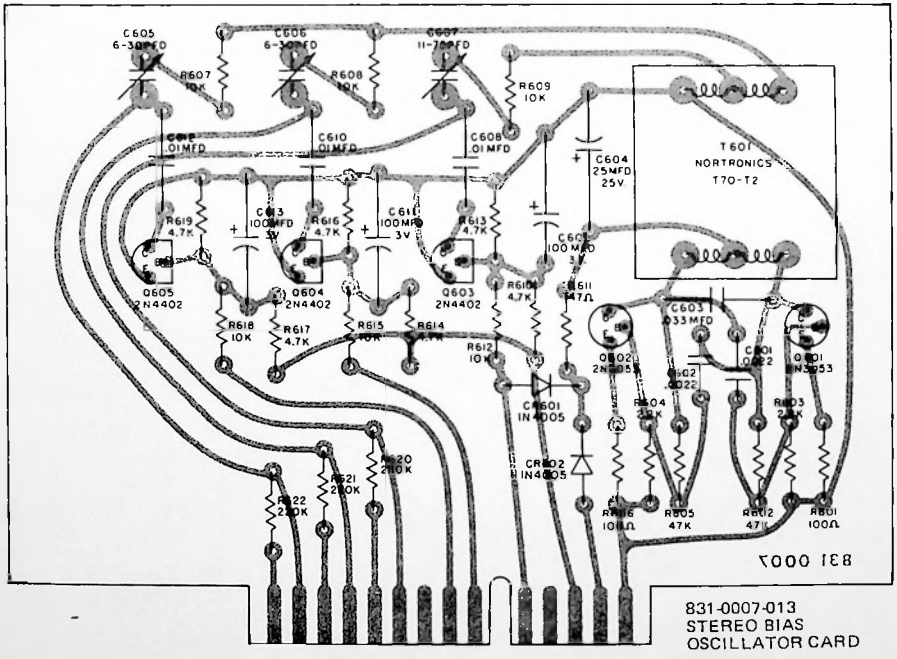
831-0069-013 STEREO RECORDING AMP. CARD

FIGURE 5-8

BIAS OSCILLATOR CARD

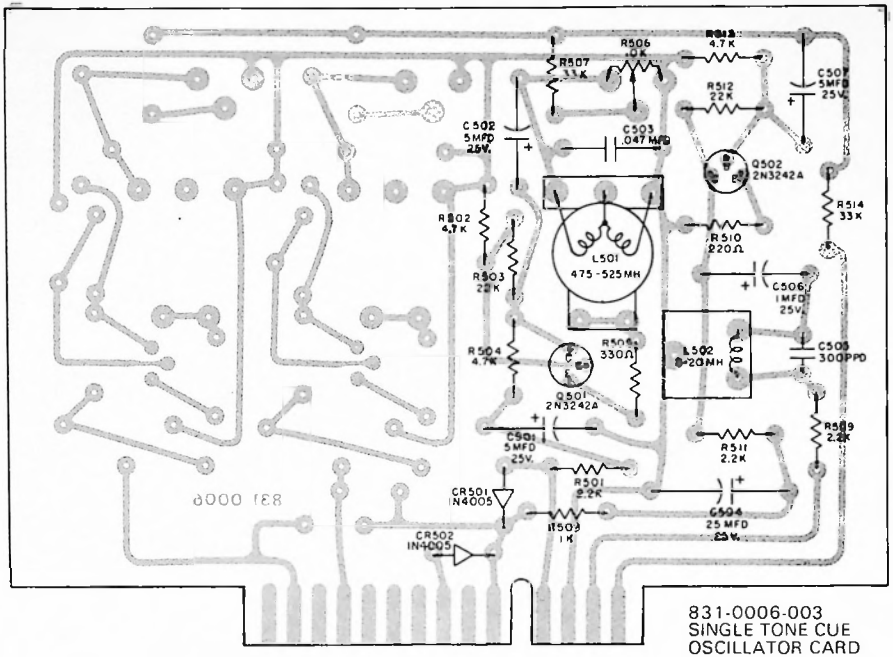


831-0007-003
MONO BIAS OSCILLATOR CARD

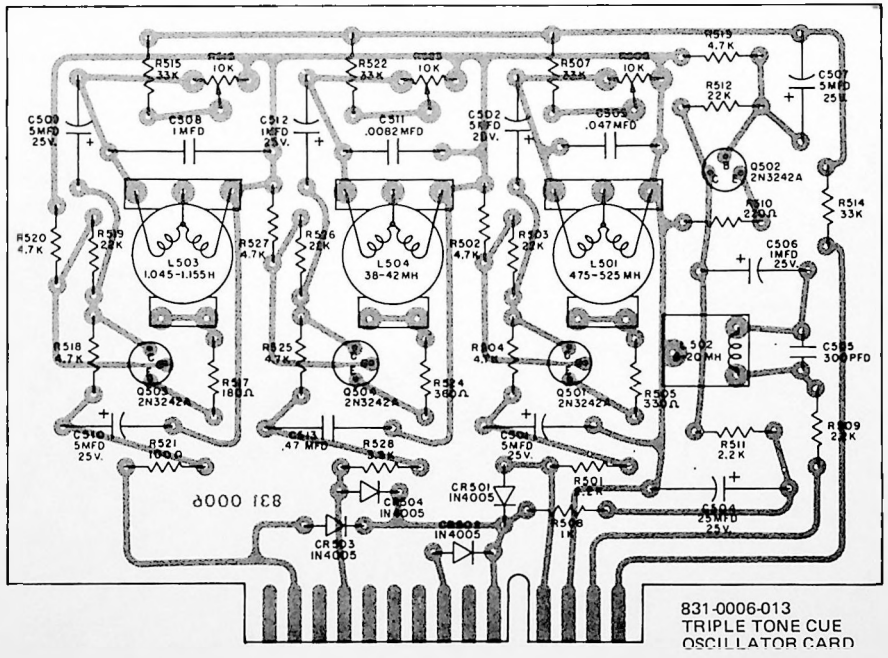


831-0007-013
STEREO BIAS
OSCILLATOR CARD

FIGURE 5-9

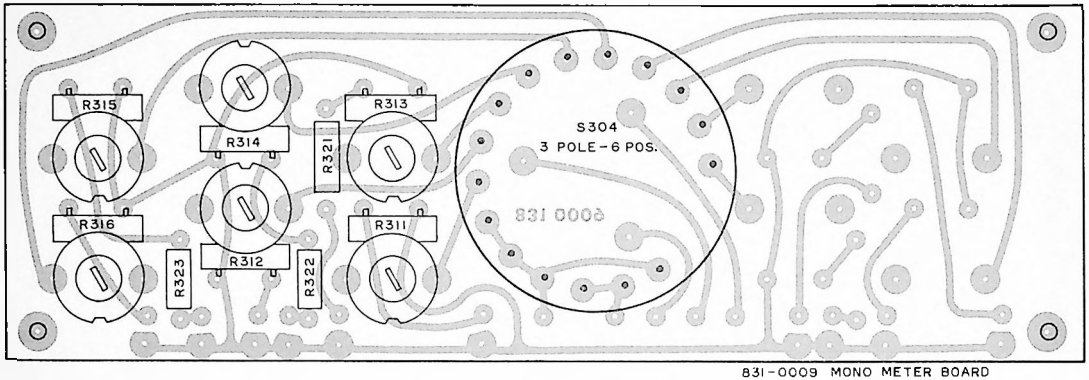


831-0006-003
SINGLE TONE CUE
OSCILLATOR CARD

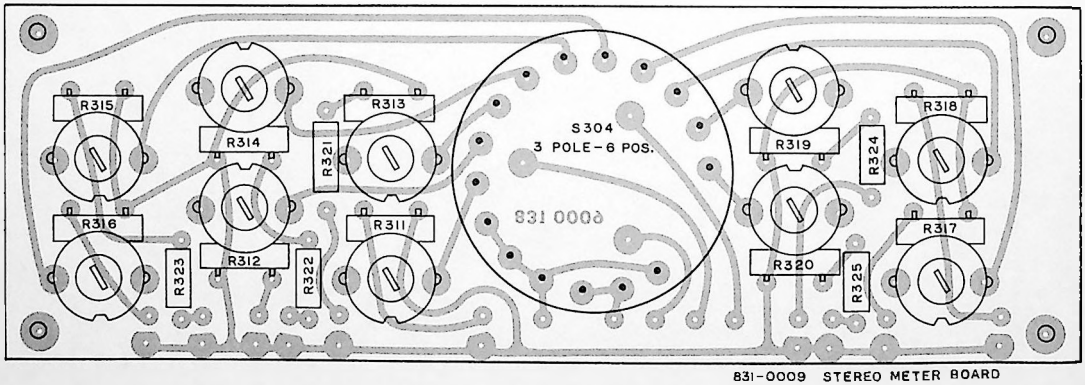


831-0006-013
TRIPLE TONE CUE
OSCILLATOR CARD

FIGURE 5-10



831-0009 MONO METER BOARD



831-0009 STEREO METER BOARD

FIGURE 5-11

AUDIO INPUT PAD CARD

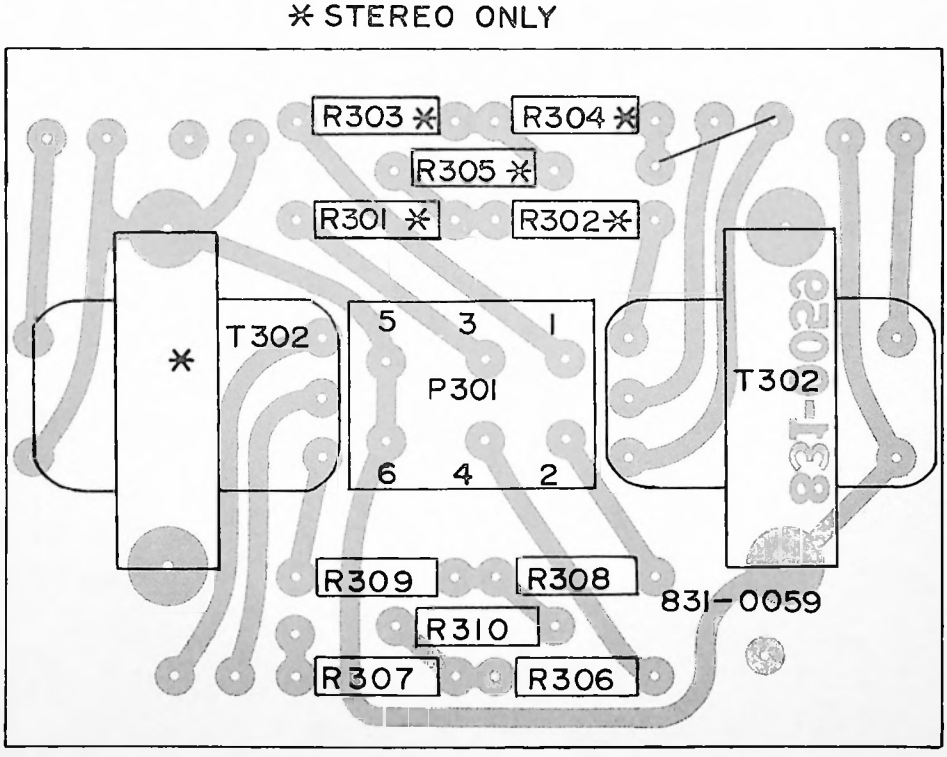
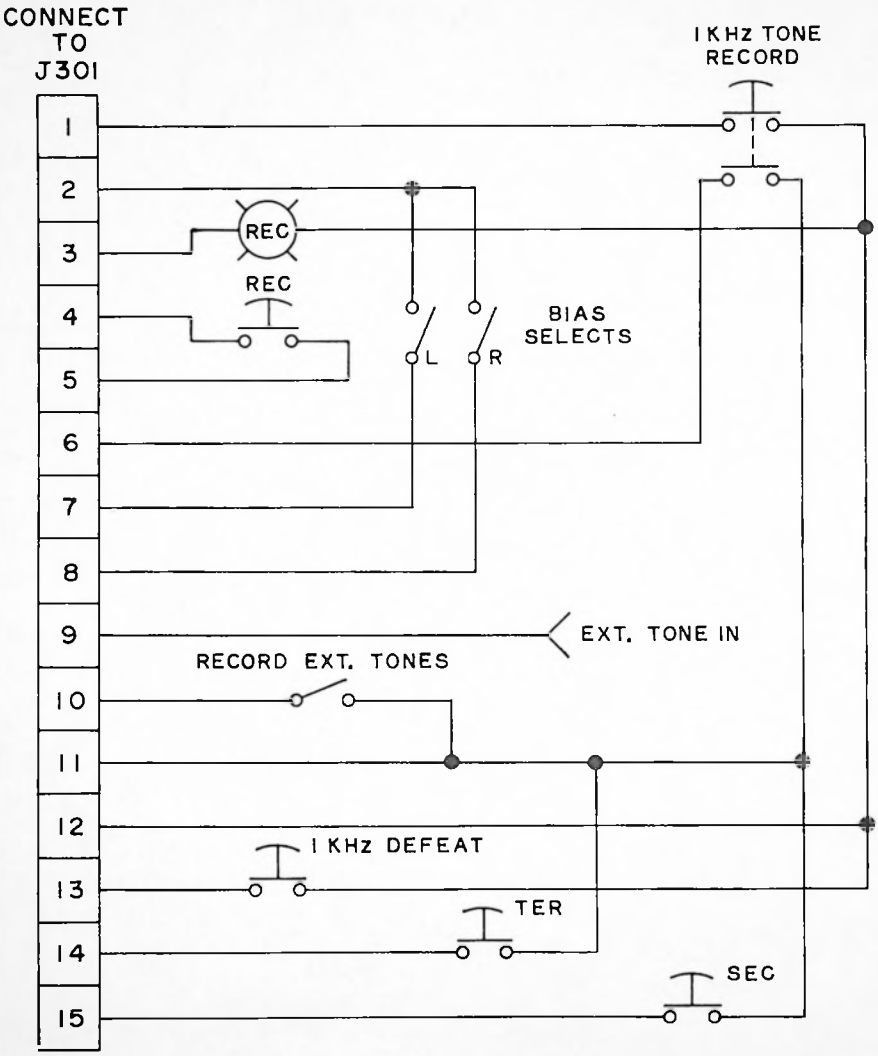


FIGURE 5-12



SAMPLE REMOTE CONTROL SCHEMATIC
RA, WRA & RP RECORDERS

FIGURE 5-13

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, ½ 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)

Symbol	Part Number	Description
		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
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, ½ watt, 5%
R702	626-0287-000	10 K ohms, ½ watt, 5%
R703	626-0327-000	470 K ohms, ½ watt, 5%
R704	626-0271-000	2.2 K ohms, ½ watt, 5%
R705	626-0239-000	100 ohms, ½ watt, 5%
R706	626-0271-000	2.2 K ohms, ½ watt, 5%
R707	626-0658-000	620 ohms, 2 watt, 5%
R708	626-0271-000	2.2 K ohms, ½ watt, 5%
R709	626-0271-000	2.2 K ohms, ½ watt, 5%
R710	626-0239-000	100 ohms, ½ watt, 5%
R711	626-0239-000	100 ohms, ½ watt, 5%
R712	626-0299-000	33 K ohms, ½ watt, 5%
R713	626-0307-000	68 K ohms, ½ watt, 5%
R714	626-0227-000	33 ohms, ½ watt, 5%
R715	626-0247-000	220 ohms, ½ watt, 5%
R716	626-0271-000	2.2 K ohms, ½ watt, 5%
R717	626-0271-000	2.2 K ohms, ½ watt, 5%
R718	626-0265-000	1.2 K ohms, ½ watt, 5%
R719	626-0271-000	2.2 K ohms, ½ watt, 5%
R720	626-0271-000	2.2 K ohms, ½ watt, 5%
R721	626-0449-000	270 ohms, 1 watt, 5%
R722	626-0279-000	4.7 K ohms, ½ watt, 5% (Hi-Speed Cue Only)
R723	626-0287-000	10 K ohms, ½ watt, 5% (Hi-Speed Cue only)

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

Symbol	Part Number	Description
		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, ½ watt, 5%
R402	626-0287-000	10 K ohms, ½ watt, 5%
R403	626-0287-000	10 K ohms, ½ watt, 5%
R404	626-0239-000	100 ohms, ½ watt, 5%
R405	626-0263-000	1 K ohms, ½ watt, 5%
R406	626-0287-000	10 K ohms, ½ watt, 5%
R407	626-0273-000	2.7 K ohms, ½ watt, 5%
R408	626-0309-000	82 K ohms, ½ watt, 5%
R409	626-0287-000	10 K ohms, ½ watt, 5%
R410	626-0283-000	6.8 K ohms, ½ watt, 5%
R411	626-0263-000	1 K ohms, ½ watt, 5%
R412	626-0287-000	10 K ohms, ½ watt, 5%
R413	626-0271-000	2.2 K ohms, ½ watt, 5%

Symbol	Part Number	Description
R427	626-0263-000	1 K ohms, ½ watt, 5%
R427	626-0255-000	470 ohms, ½ watt, 5% (STEREO ONLY)
R428	626-0287-000	10 K ohms, ½ watt, 5%
R429	626-0307-000	68 K ohms, ½ watt, 5%
R430	626-0259-000	680 ohms, ½ watt, 5%
R431	626-0287-000	10 K ohms, ½ watt, 5%
R432	626-0285-000	8.2 K ohms, ½ watt, 5%
R433	626-0279-000	4.7 K ohms, ½ watt, 5%
R434	626-0277-000	3.9 K ohms, ½ watt, 5%
R443	636-0004-000	10 K ohms, Variable, ¼ watt
		RESISTORS (STEREO ONLY)
R414	626-0311-000	100 K ohms, ½ watt, 5%
R415	626-0287-000	10 K ohms, ½ watt, 5%
R416	626-0287-000	10 K ohms, ½ watt, 5%
R417	626-0239-000	100 ohms, ½ watt, 5%
R418	626-0263-000	1 K ohms, ½ watt, 5%
R419	626-0287-000	10 K ohms, ½ watt, 5%
R420	626-0273-000	2.7 K ohms, ½ watt, 5%
R421	626-0309-000	82 K ohms, ½ watt, 5%
R422	626-0287-000	10 K ohms, ½ watt, 5%
R423	626-0283-000	6.8 K ohms, ½ watt, 5%
R424	626-0263-000	1 K ohms, ½ watt, 5%
R425	626-0287-000	10 K ohms, ½ watt, 5%
R426	626-0271-000	2.2 K ohms, ½ watt, 5%
R435	626-0287-000	10 K ohms, ½ watt, 5%
R436	626-0307-000	68 K ohms, ½ watt, 5%
R437	626-0259-000	680 ohms, ½ watt, 5%
R438	626-0287-000	10 K ohms, ½ watt, 5 %
R439	626-0285-000	8.2 K ohms, ½ watt, 5%
R440	626-0279-000	4.7 K ohms, ½ watt, 5%
R441	626-0277-000	3.9 K ohms, ½ watt, 5%
R442	626-0263-000	1 K ohms, ½ watt, 5%
R444	636-0004-000	10 K ohms, Variable, ¼ 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, ½ watt, 5%
R602	626-0303-000	47 K ohms, ½ watt, 5%
R603	626-0271-000	2.2 K ohms, ½ watt, 5%
R604	626-0271-000	2.2 K ohms, ½ watt, 5%
R605	626-0303-000	47 K ohms, ½ watt, 5%
R606	626-0239-000	100 ohms, ½ watt, 5%
R607	626-0287-000	10 K ohms, ½ watt, 5% (Stereo Only)
R608	626-0287-000	10 K ohms, ½ watt, 5%
R609	626-0287-000	10 K ohms, ½ watt, 5%
R610	626-0279-000	4.7 K ohms, ½ watt, 5%
R611	626-0231-000	47 ohms, ½ watt, 5%
R612	626-0287-000	10 K ohms, ½ watt, 5%
R613	626-0279-000	4.7 K ohms, ½ watt, 5%
R614	626-0279-000	4.7 K ohms, ½ watt, 5%
R615	626-0287-000	10 K ohms, ½ watt, 5%
R616	626-0279-000	4.7 K ohms, ½ watt, 5%
R617	626-0279-000	4.7 K ohms, ½ watt, 5% (Stereo Only)
R618	626-0287-000	10 K ohms, ½ watt, 5% (Stereo Only)
R619	626-0279-000	4.7 K ohms, ½ watt, 5% (Stereo Only)
R620	626-0319-000	220 K ohms, ½ watt, 5%
R621	626-0319-000	220 K ohms, ½ watt, 5%
R622	626-0319-000	220 K ohms, ½ 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, ½ watt, 5%
R502	626-0279-000	4.7 K ohms, ½ watt, 5%
R503	626-0295-000	22 K ohms, ½ watt, 5%
R504	626-0279-000	4.7 K ohms, ½ watt, 5%
R505	626-0251-000	330 ohms, ½ watt, 5%
R506	636-0002-000	Variable, 10 K ohms, ¼ watt (1 kHz Level)
R507	626-0299-000	33 K ohms, ½ watt, 5%
R508	626-0263-000	1 K ohms, ½ watt, 5%
R509	626-0271-000	2.2 K ohms, ½ watt, 5%
R510	626-0247-000	220 ohms, ½ watt, 5%
R511	626-0271-000	2.2 K ohms, ½ watt, 5%
R512	626-0295-000	22 K ohms, ½ watt, 5%
R513	626-0279-000	4.7 K ohms, ½ watt, 5%
R514	626-0299-000	33 K ohms, ½ watt, 5%
R515	626-0299-000	33 K ohms, ½ watt, 5%
R516	636-0002-000	Variable, 10 K ohms, ¼ watt (150 Hz Level)
R517	626-0245-000	180 ohms, ½ watt, 5% (150 Hz)
R518	626-0279-000	4.7 K ohms, ½ watt, 5%
R519	626-0295-000	22K ohms, ½ watt, 5%
R520	626-0279-000	4.7 K ohms, ½ watt, 5%
R521	626-0239-000	100 ohms, ½ watt, 5%
R522	626-0299-000	33 K ohms, ½ watt, 5% (8 kHz)
R523	636-0002-000	Variable, 10 K ohms, ¼ watt. (8 kHz Level)
R524	626-0252-000	360 ohms, ½ watt, 5% (8 kHz)
R525	626-0279-000	4.7 ohms, ½ watt, 5% (8 kHz)
R526	626-0295-000	22 K ohms, ½ watt, 5% (8 kHz)
R527	626-0279-000	4.7 K ohms, ½ watt, 5% (8 kHz)
R528	626-0275-000	3.3 K ohms, ½ watt, 5% (8 kHz)

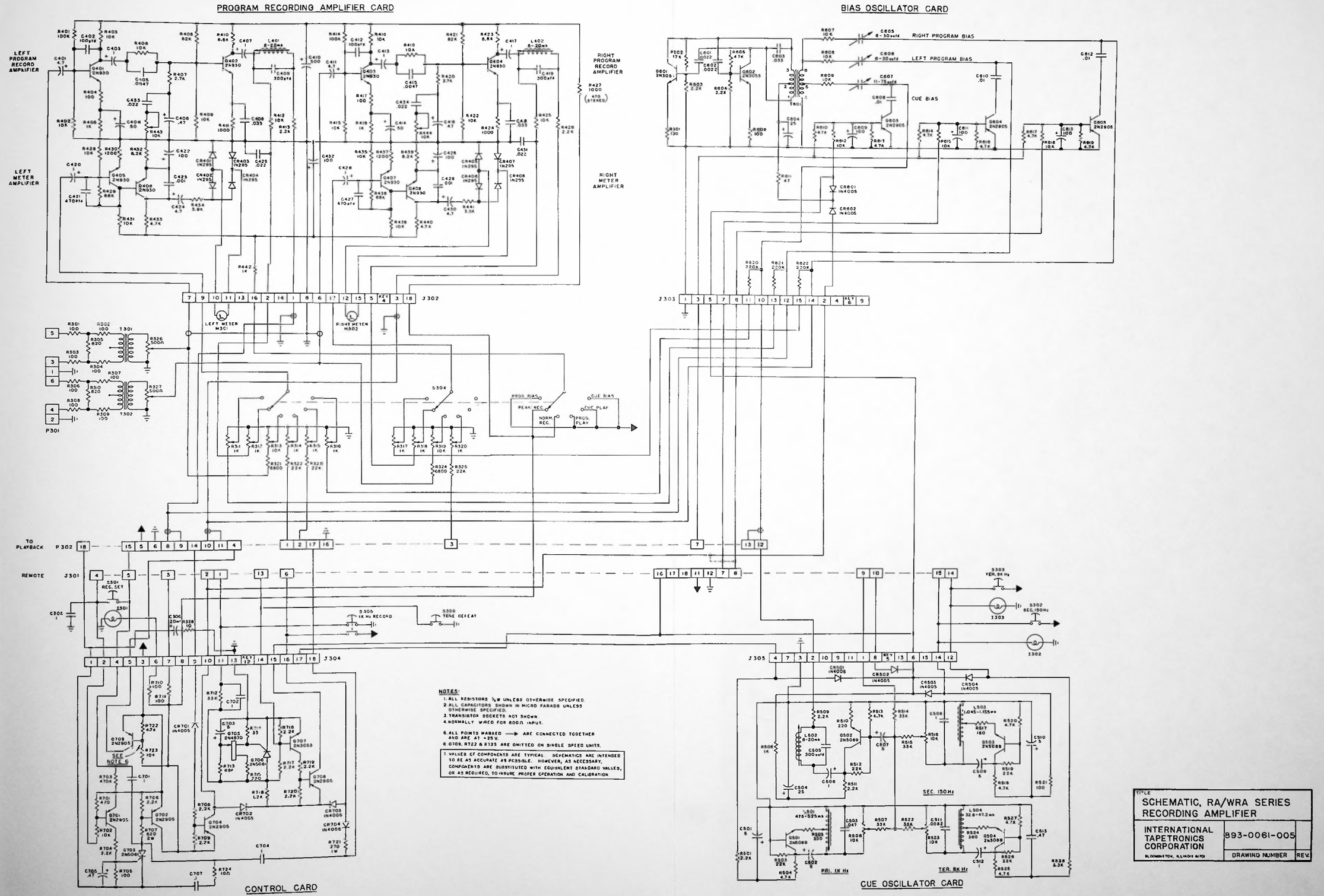
F. METER CIRCUITS CARD
831-0009-003 MONO
831-0009-013 STEREO

		RESISTORS
R311	636-0001-000	Variable, 1 K ohms, ¼ watt
R312	636-0001-000	Variable, 1 K ohms, ¼ watt
R313	636-0004-000	Variable, 10 K ohms, ¼ watt
R314	636-0001-000	Variable, 1 K ohms, ¼ watt
R315	636-0001-000	Variable, 1 K ohms, ¼ watt
R316	636-0001-000	Variable, 1 K ohms, ¼ watt
R321	626-0283-000	6.8 K ohms, ½ watt, 5%
R322	626-0295-000	22 K ohms, ½ watt, 5%
R323	626-0295-000	22 K ohms, ½ watt, 5%
		RESISTORS (STEREO ONLY)
R317	636-0001-000	Variable, 1 K ohms, ¼ watt
R318	636-0001-000	Variable, 1 K ohms, ¼ watt
R319	636-0004-000	Variable, 10 K ohms, ¼ watt
R320	636-0001-000	Variable, 1 K ohms, ¼ watt
R324	626-0283-000	6.8 K ohms, ½ watt, 5%
R325	626-0295-000	22 K ohms, ½ 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, ½ watt, 5%
R302	626-0239-000	100 ohms, ½ watt, 5%
R303	626-0239-000	100 ohms, ½ watt, 5%
R304	626-0239-000	100 ohms, ½ watt, 5%
R305	626-0261-000	820 ohms, ½ watt, 5%
R306	626-0239-000	100 ohms, ½ watt, 5%
R307	626-0239-000	100 ohms, ½ watt, 5%
R308	626-0239-000	100 ohms, ½ watt, 5%
R309	626-0239-000	100 ohms, ½ watt, 5%
R310	626-0261-000	820 ohms, ½ 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)


PROGRAM RECORDING AMPLIFIER CARD
BIAS OSCILLATOR CARD
LEFT PROGRAM RECORD AMPLIFIER
LEFT METER AMPLIFIER
RIGHT PROGRAM RECORD AMPLIFIER
RIGHT METER AMPLIFIER
RIGHT PROGRAM BIAS
LEFT PROGRAM BIAS
CUE BIAS
J302
J303
J304
J305
P301
P302
J301
TO PLAYBACK
REMOTE
LEFT METER M301
RIGHT METER M302
S304
PROG. BIAS
CUE BIAS
PEAK REC.
NORM. REC.
CONT. PLAY
PROG. PLAY
S301 REC. SET
S305 1K Hz RECORD
S306 TONE DEFEAT
S303 TER. 8K Hz
S302 SEC. 150Hz
I301
I303
I302
SEE NOTE 6
CONTROL CARD
CUE OSCILLATOR CARD
SEC. 150 Hz
PRI. 1K Hz
TER. 8K Hz
NOTES:
1. ALL RESISTORS ½W UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS SHOWN IN MICRO FARADS UNLESS OTHERWISE SPECIFIED.
3. TRANSISTOR SOCKETS NOT SHOWN.
4. NORMALLY WIRED FOR 600Ω INPUT.
6. ALL POINTS MARKED → ARE CONNECTED TOGETHER AND ARE AT +25 V.
6. Q709, R722 & R723 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.
TITLE
SCHEMATIC, RA/WRA SERIES RECORDING AMPLIFIER
INTERNATIONAL TAPETRONICS CORPORATION
BLOOMINGTON, ILLINOIS 61701
893-0061-005
DRAWING NUMBER
REV.