SX ELECTRONICS

ILLUSTRATIONS

7.1 DESCRIPTION AND SPECIFICATIONS

7.1.1 General Characteristics

The SX electronics is a dual Solid State record/reproduce amplifier. Its purpose is to accept and condition input signals to properly drive magnetic tape recording heads and to provide tape reproduce facilities with proper equalization.

The SX record/reproduce amplifier uses all silicon planar transistors and the highest quality construction throughout, (see fig. 7-4).

7.1.2 General Specifications (See also Section 7-4)

Audio Inputs	Two per channel. Either input will accommodate high impedance mic or line level.
Preamplifier Response	Flat from 10Hz to over 50KHz exclusive of required equalization.
Audio Output	Low impedance high level output, +4 dbm; 2.45 into HI-Z with "0" level on VU
Metering	Two 5" lighted VU's read input-output signals or bias.
Power Supplies	Electronically regulated positive and negative supplies.
Bias Frequency	100KHz ± 5%.
Power Source	66 VCT. This supply is normally derived from the associated transport.
Power Drain	Approximately 10 watts.

7.1.3 Input — Output Specifications

			*Recommended Input Levels	
Inputs	Notes	Input 2	Min. db	Max. db
Line	1, 2, 3	100k	-24	+25
Mic	4, 5	350k	-64 or -44	-26 or -6

Outputs	Notes	Maximum Output Z	Minimum Load Z	Output Level
Line Out	6	600 ohms	note 6	+10db to Hi-Z +4dbm
Front Panel Monitor Jack	6, 7	600 ohms	note 6	+10db to Hi-Z +4dbm

*Odb is same voltage as 1mw into 600 (Odbm)

NOTES:

1. Maximum input level limited only because gain setting becomes difficult at extremely high levels due to the very small amount of rotation required. If levels over +25dB are encountered, an external divider is recommended.

2. Plugging into Line disconnects Mic input.

3. Input Z becomes 50K at maximum CW position of input control.

4. In general, low quality microphones such as most crystal, ceramic and low cost dynamic units are not recommended for professional sound recording. For professional results use a professional microphone.

5. Mic gain may be semipermanently altered by means of jumpers on the main boards (see fig. 7-1). Removal of the jumpers lowers the gain by 20dB and increases the maximum input level. If overload is a problem remove the jumpers.

6. The output may be shorted, however, it is not recommended practice to simultaneously short both outputs Line and Monitor jacks as this doubles the loading on the output amplifier.

7. High or Low Z headphones may be used.

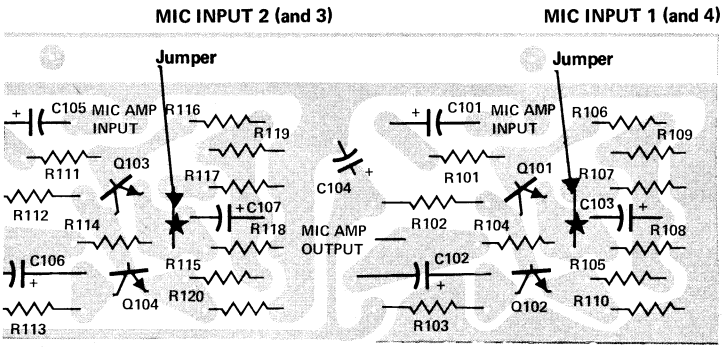


FIG. 7-1 MIC STAGE JUMPERS

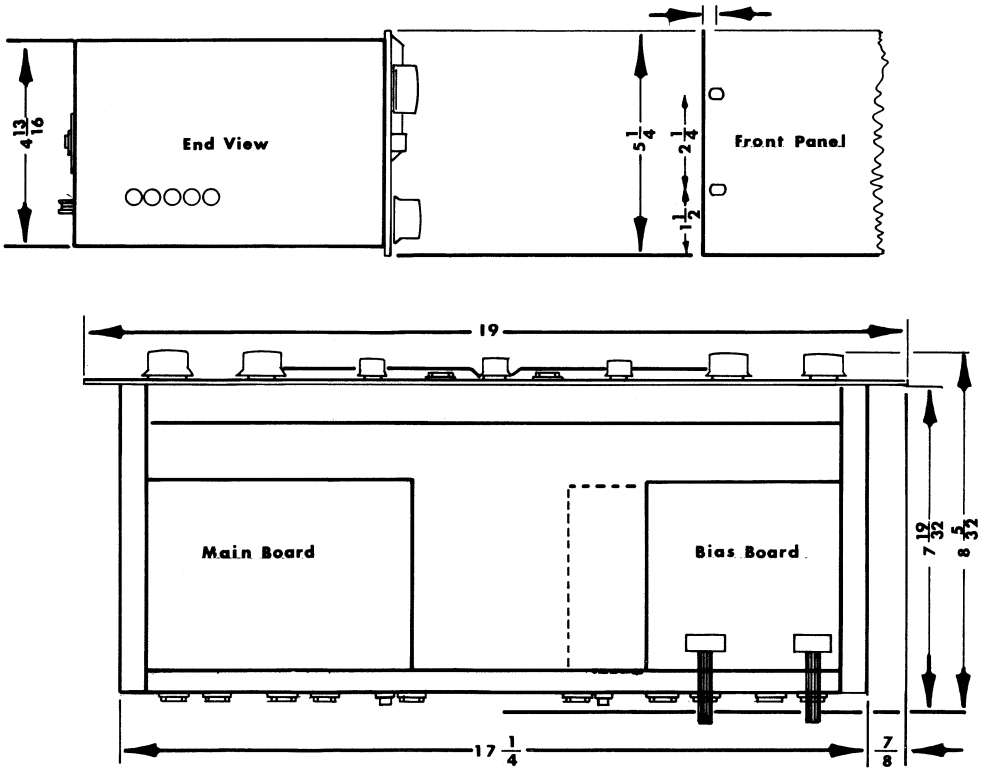


FIG. 7-2 MOUNTING

7.1.4 Mechanical Specifications

Record Interlock	Interlocked mechanically, electrically and visually.
Circuit Boards	Translucent glass epoxy.
Chassis	Anodized aluminum.
Front Panel	1/8" anodized aluminum with silk-screened markings.
Weight	7 Lbs.
Dimensions	5-1/4" H x 19" W x 7-19/32" D behind panel (see fig. 7-2).

7.2 INSTALLATION

7.2.1 Mounting

The SX electronics is designed on a 19" rack mounting format, however it may be placed in custom mountings. Very little ventilation is needed for the electronics, however access should be allowed for input and output cables. (Refer to fig. 7-2 and section 2.2).

7.2.2 Connecting Cables

Each reproduce head has a numbered cable which terminates in a pin plug. Under the electronics covers on the main circuit boards are located the input connectors. The channel number corresponds to the head cable number. (See fig. 7-3).

The record/erase head cables terminate in 4-way Amplock connectors. The connectors on the sub front, under the covers, near the Record Switch. Once again each cable is numbered as to the channel to which it belongs. (See fig. 7-3).

The power cable plugs into the 9-way Amplock connector on the back of the transport chassis.

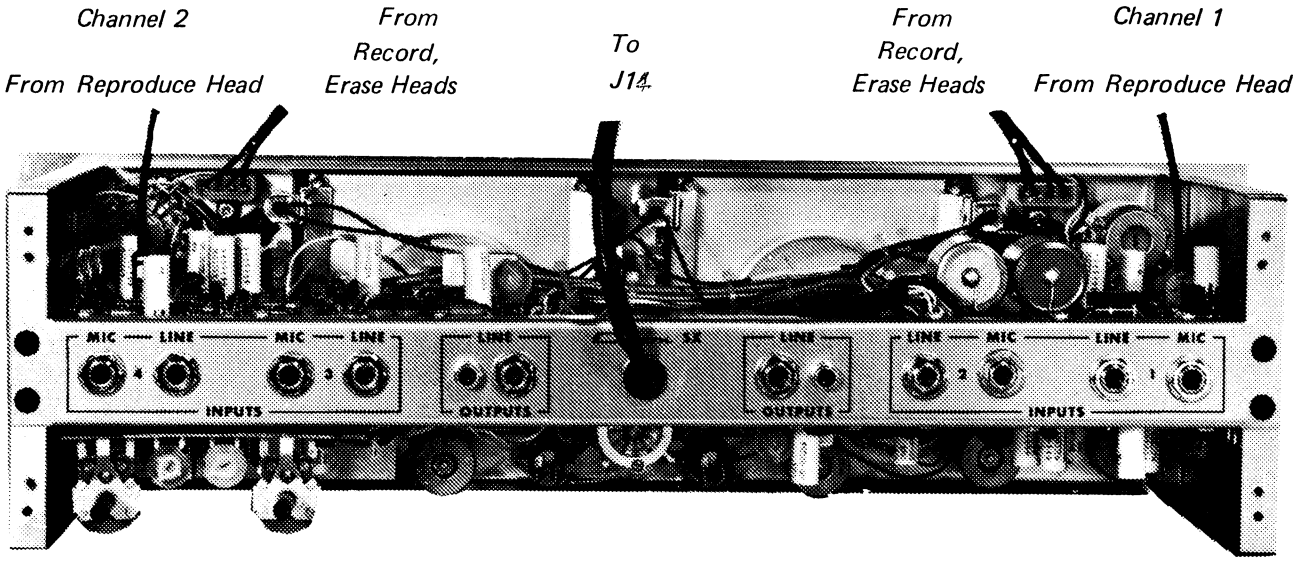


FIG. 7-3 SX BACK

7.2.3 Connecting Inputs

The controls on the SX electronics are symetrical on each side of the center line. Controls on the left, control the left channel (channel 1) while controls on the right control the right channel (channel 2). The only exception is the equalization control which is common to both channels. The following instructions apply to one channel only. It should be understood that inputs, outputs, and controls for the other channel are identical. (See fig. 7-3 and 7-4).

Input #1

Either a high-impedance unbalanced microphone or a high-level, line-type signal may be plugged into Input #1. When a plug is plugged into the line input for Input #1, it will automatically disconnect Mic 1 input.

Input #2

The inputs for #2 are identical to those for Input #1.

Note: Low impedance balanced microphones may be used by employing the matching input transformer available as an accessory. (See Section 8).

7.2.4 Connecting Outputs

Two jacks are provided for the Line Output of each channel of the SX electronics. One jack is the standard ¼" phone type and the other is the RCA pin jack type. (See specifications section 7.1.3 for output levels and impedance).

7.3 OPERATING INSTRUCTIONS (See Fig. 7-4)

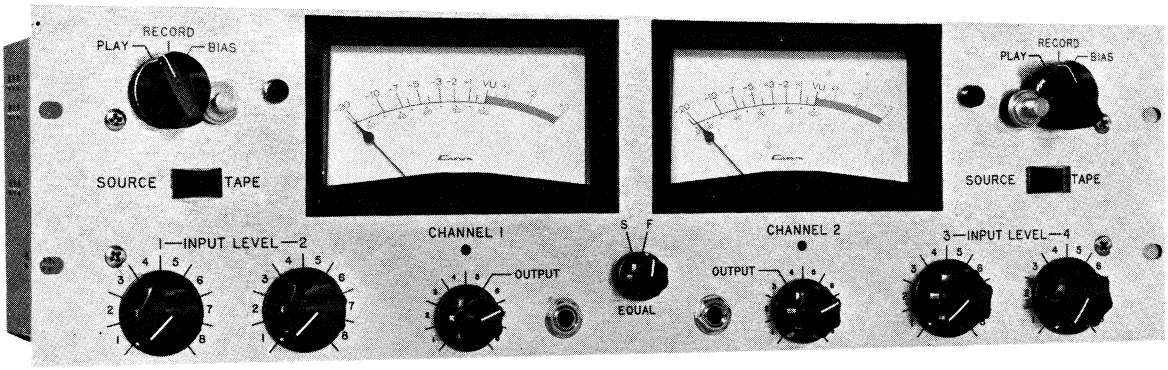


FIG. 7-4 SX FRONT

7.3.1 Setting the Controls for Recording

Source-Tape	Place the switch in the Source position.
Input #1 and Input #2	Adjust Inputs #1 and #2 for the proper recording level as indicated on the meter. With proper setting, the meter will read "O" VU and go into the red only occassionally on the very loudest peaks.
Monitor Jack	If you desire to monitor the signal to be recorded, headphones may be plugged into one of the front panel phone jacks. The tip on the jacks are connected to Channel 2 and the ring to Channel 1.
Output Level	This control should be set for convenient listening level and/or proper output to auxiliary equipment.
Equalization	This switch should be set according to the speed being used "S" refers to the slower of the two recording speeds and "F" to the faster.
Record Switch	Depress the record lockbutton and rotate the record switch all the way to the bias position.

The bias is adjustable on the rear of the machine. Two small knurled shafts at the left of the machine (when viewed from the back) allow approximately +3, -5dB of bias adjustment range. Bias should be adjusted to the settings recommended for the tape and speed being used. A general rule to use is to adjust for the highest possible setting that does not noticeably attenuate the highest frequency. This will normally result in the least amount of distortion and the widest dynamic range. Critical adjustment may be made for flatest response if proper test equipment is available. After setting the bias, the record switch should be rotated to the Record position. This allows the incoming signal to be monitored. Note that recording will still take place with the switch in the "Bias" position. The only difference being in the signal fed to the meter.

Normally, with a machine equalized for 7-½ and 3-¾ ips, the BIAS setting is "O" for 7-½ ips and "-2" for 3-¾ ips. (See P. P. sheets).

To begin recording momentarily press the Play button on the transport.

To check the recording process (A-B Test), the Source-Tape switch may be switched from Source to Tape. When this switch is in the Tape position, the actual recording will be reproduced (delayed slightly due to the spacing between record and play heads). Normally no noticeable change in volume or quality should occur when switched from the Source to Tape position except at very low tape speeds. Note that the Output Level control has no effect on the meter reading or the recording level in either of the switch positions. Its only effect will be to adjust the level at the monitor and output jacks.

7.3.2 Setting the Controls for Reproducing

Equalization	Set according to the speed being used.
Record Switch	Place in the "Play" position. Be sure that both record switches are in the Play position to prevent possible damage to a valuable recording. Note: It will be impossible to engage the fast forward or rewind if either channel is in the record mode.
Source-Tape Switch	Place the switch in the "Tape" position. The meter will monitor the level of the tape. To start the tape in motion, press the "Play" button on the transport.
Output Level	Adjust the volume to desired level at the headphones or to the auxiliary equipment.

7.5 CIRCUIT DESCRIPTION

7.5.1 General

The circuitry of the SX electronics is most easily described if it is broken up into functional units. These functional units are indicated on the block diagram in Fig. 7-5. The schematics and parts list are placed in section 12.

Many of the units are contained on a common board referred to as the main electronics board. The main board consists of two mic amps, the buffer amp, the output amp, the record amp, the meter amp and the playback amp. The bias oscillator is on a board by itself and the power supply is on a board by itself.

7.5.2 Mic Stages

Mic input stages consist of a direct coupled pair of very high gain low noise epitaxial planar silicon transistors. This pair employs heavy negative feedback for linearity and control along with a bootstrapped input for high input impedance. The output impedance is very low and capable of driving to a clipping level in excess of +14dB. The outputs are fed by way of the line input jack to the top of the input level controls.

The microphone inputs stages are designed to accommodate a wide range of input levels. A dual gain feature is employed so that the operator may select the amount of gain to suit his particular needs. (See fig. 7-1 and Note 5 in section 7.1.3).

7.5.3 Buffer Amp

The buffer amp is employed to isolate and mix inputs and provide approximately 14db of gain for the line inputs. It consists of three direct coupled silicon transistors with DC feedback for gain stability and linearity. The output of this amplifier is fed to both the record amplifier and the Source-Tape switch.

7.5.4 Output Amp

The output amp employs five direct coupled silicon transistors in a high feedback circuit with complementary output transistors. The circuit provides high level, distortion free, transformerless output. This unit will drive a 600 ohm line to a level of +20dbm before clipping. Normal output is +4dbm for "O" VU. A bias trap is located in the line output to remove any bias "Bleed thru".

7.5.5 Record Amp

The record amplifier is a three-stage amplifier providing necessary gain, impedance match and pre-emphasis equalization for the recording process. High frequency pre-emphasis is provided by an RLC network in the emitter circuit of Q105. Low frequency equalization is provided by an RC network in the feedback loop from Q107 to the emitter of Q105. The record level is adjusted by means of a constant current resistor in the output of the amp. Voltage drive is provided and then converted to current drive. At no time will the amplifier be current limited within the dynamic range of any known recording tape.

7.5.6 Reproduce Amp

The reproduce amplifier consists of a proven circuit of three high gain low noise silicon planar transistors. Feedback equalization is employed around the three direct coupled stages with a degenerative gain control. Circuitry is such that the equalization gain, and distortion performance are almost entirely independent of transistor characteristics. NAB equalization is provided by the RC network in the feedback loop to the emitter of Q128. The bass responses are adjustable by means of R201 or R202. L106 and C141 provides a notch filter at the bias frequency. The output of the reproduce amp is fed directly to the Source-Tape switch.

7.5.7 Bias Oscillator

The bias oscillator consists of a pair of push-pull connected power transistors operating into a highly efficient ferrite cup core assembly. The circuit produces a very clean low distortion 100KHz signal for bias and erase. This results in the lowest possible erase noise. Bias is coupled to the heads by means of the internal bias adjust and the rear panel bias adjust and mixed with the audio signal at the output of the bias trap consisting of L103 and C115. Erase voltage is coupled to the erase head by way of C119 which is an adjustable trimmer.

7.5.8 Power Supply

A regulated power supply is employed to make the SX electronics independent of line voltage variations and to ensure stable operation in all modes. The power supply board contains all the components to rectify and control the necessary supply voltages to the rest of the circuitry. The +30 supply is adjustable by means of R182. The output of the +30 supply is highly regulated and very well filtered. The negative supply is referenced to the positive and is adjusted with it. Additional filtering and decoupling of the power supply lines are employed within the various circuits where needed.

7.5.9 Meter Amp

The meter amplifier is a direct coupled complementary pair whose gain is feedback stabilized. R163 is the meter gain adjust. The meter is in a full wave diode bridge which is overload protected by diodes CR112-114.

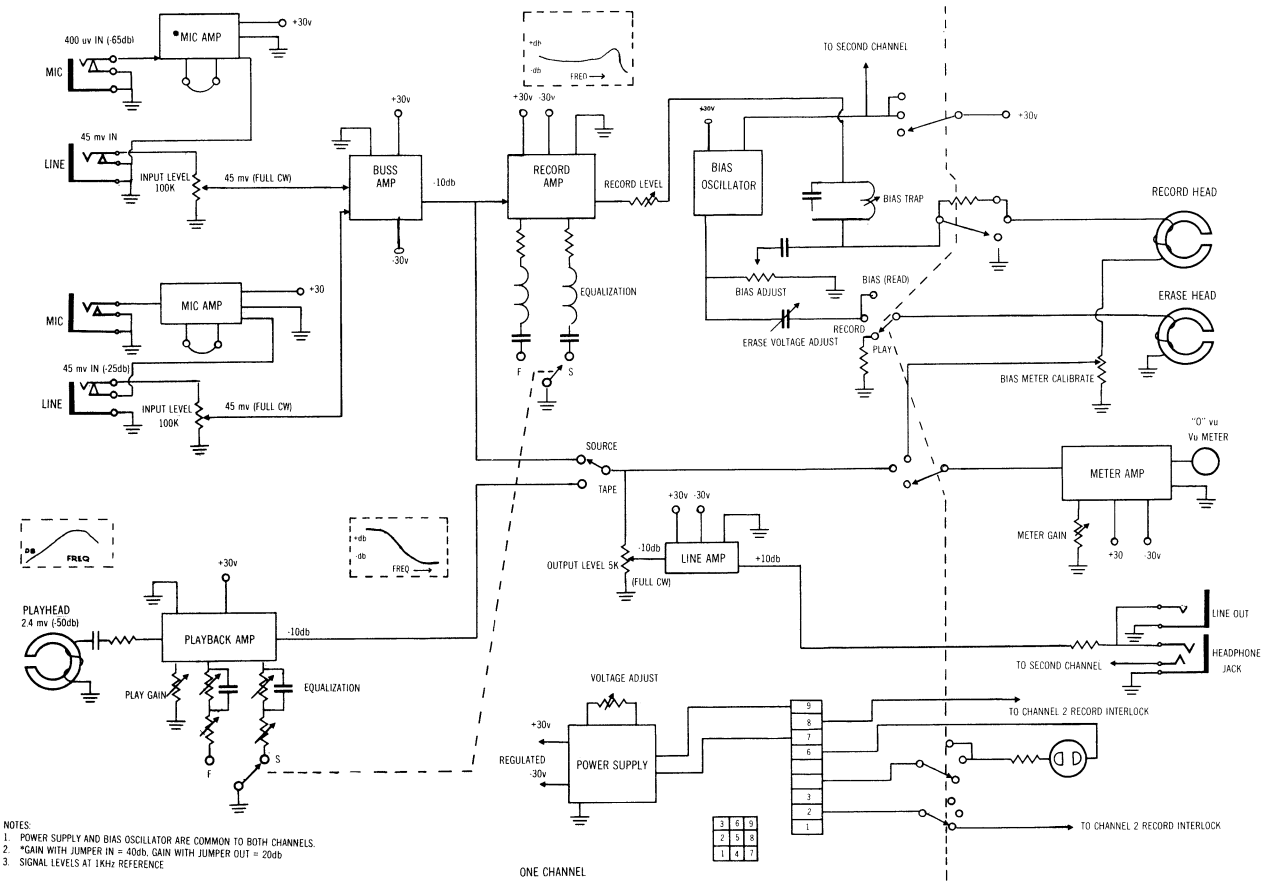


FIG. 7-5 BLOCK DIAGRAM

ACCESSORIES

ILLUSTRATIONS

8.1 Casing

There are a variety of sizes of carrying cases available for CROWN recorders ranging from 14 to 28 inches of panel space. In addition a console and an oiled-walnut enclosure are available. (See accessory sheet).

This section will give some tips for inserting the recorder into one of these cases. If you observe these tips you should be able to avoid smashed fingers and frayed nerves.

If you buy a case as an accessory it will come with side rails mounted. This makes installation relatively easy. Keep the recorder mounted on its rails in one piece, flip the case on its back, carefully lift the recorder over the case and lower it into the opening, onto the rails. Now it is a simple matter of removing the front panel screws, sliding the rails out, and fastening the unit to the new rails. One note of caution - if the case is a 19-C enclosure, extreme care must be taken when lowering the recorder into the case. The plastic covering of the sides overhangs the rails a bit and means less clearance. The plastic is soft and easily damaged. Never attempt to ship the recorder in a 19-C, it is **not** a shipping case. (See fig. 8-1).

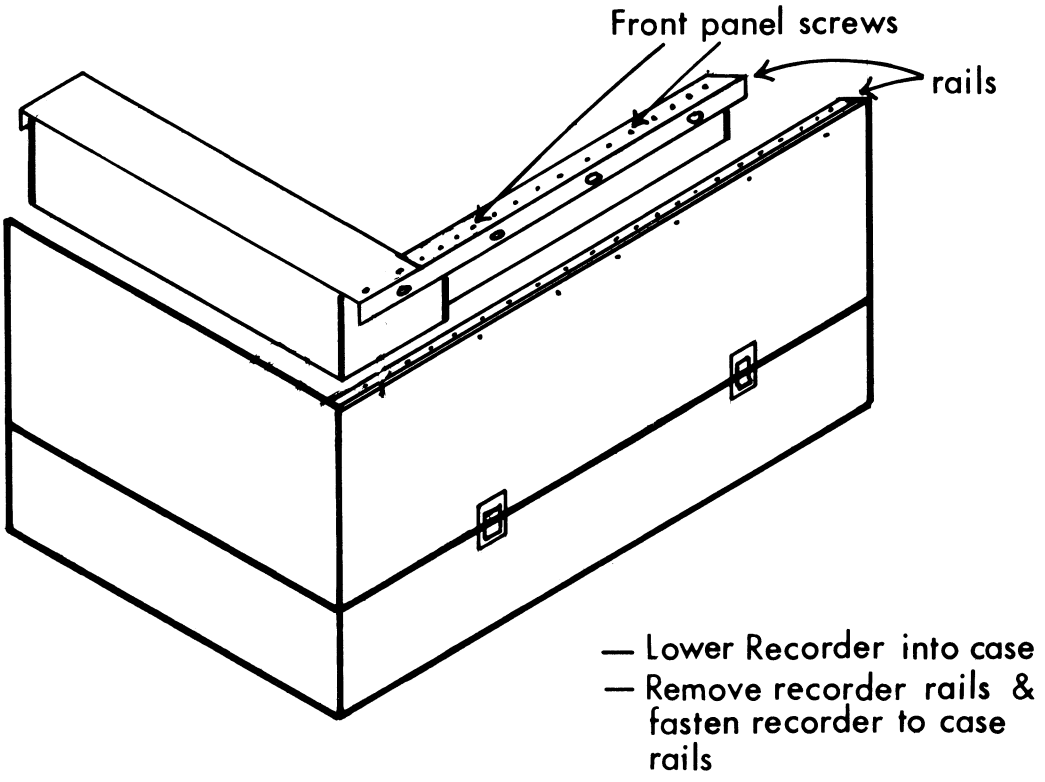


FIG. 8-1 CASING

If you purchased the recorder in a carrying case you will only have one set of rails. The casing procedure is a bit different. Always keep the recorder on the rails, (in one piece) otherwise head cables are subject to stress and liable to break. The best procedure is to place the case upright and remove the screws from the **sides** of the case. The recorder can be "walked" out of the case. Getting it back in again may be more difficult. It may be necessary to "lift" the recorder with a thin screw driver or an awl, through the side holes, to line up the case holes and the holes on the rails. This is a bit tricky and may require a "third hand." (See fig. 8-2).

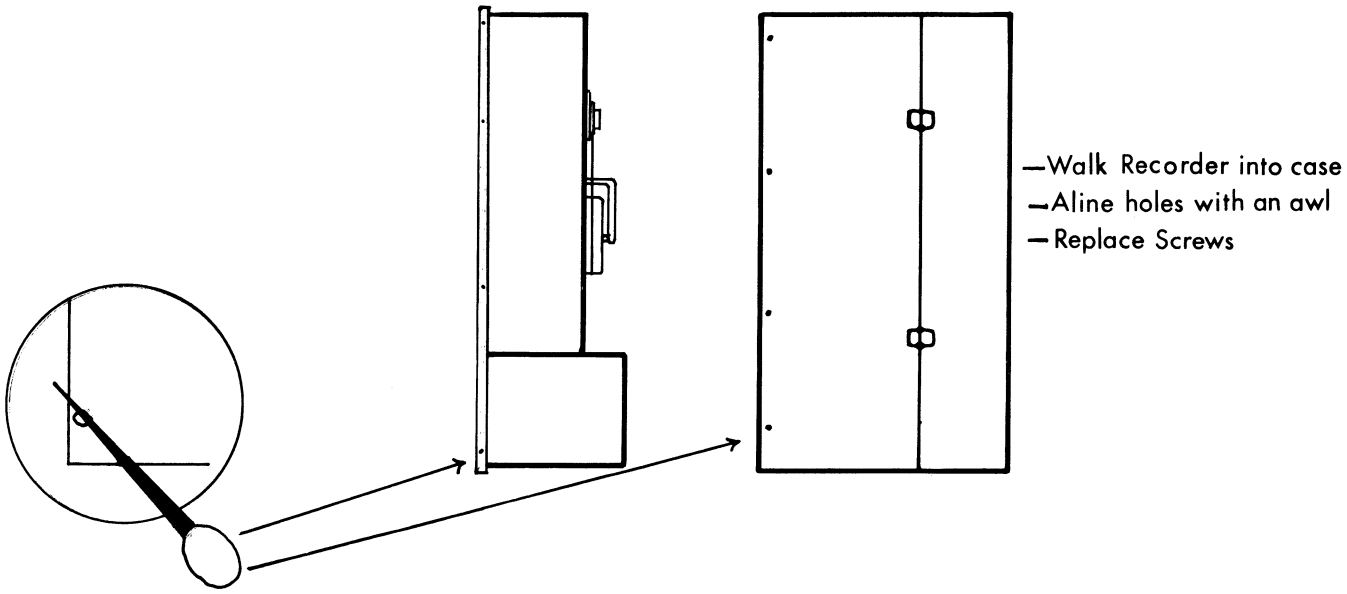


FIG. 8-2 CASING

The choice of case size depends on which accessories you wish to install with the recorder. For example you might want a tape counter and a D-60 monitor amp. This would require an additional 3-½ inches of panel space. Also, additional space may be filled with blank panels. (See accessory sheet.)

8.2 Remote Control

8.2.1 SX 800-RC-40

For the PRO 800 deck the RC-40 remote control unit is available. This operates in conjunction with the logic circuit of the 800 deck and provides all functions (except record) from a remote command point. The RC-40 is supplied with a 20' cable.

8.2.2 SX 700-RC-7A

For the PRO 700 deck the RC-7A is available as an accessory. This can be installed on the field by a competent technician, and is available from the factory. It is a minor modification of the transport which provides the stop and start commands from a remote point. The RC-7A kit available from CROWN is a complete kit of parts and instructions, for the modification of the transport only. The customer needs to provide a control box and cable.

8.3 Matching Transformers

There are three transformers available for the SX electronics which increase the versatility of the electronics. The transformers serve to match different types of program lines to the electronics.

8.3.1 SMIT

The SMIT is designed to match a Lo-z balanced line microphone (studio quality) to the unbalanced Mic inputs of the SX. It is connected right into the mic line. (See fig. 8-3).

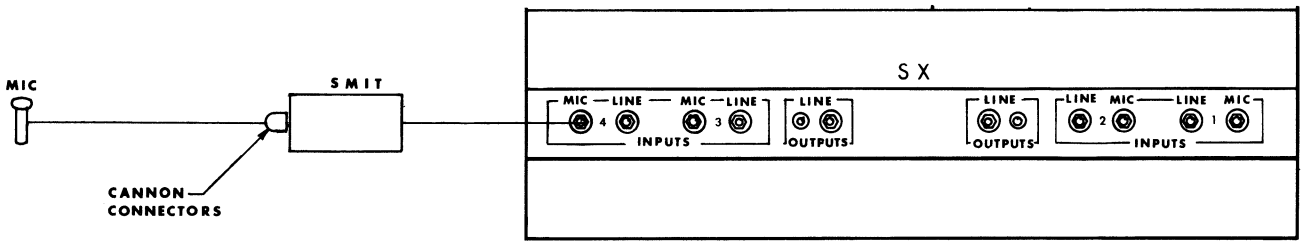


FIG. 8-3 SMIT

8.3.2 SBIT

The SBIT is designed to match a 600 ohm balanced line (relatively high level, -20db to +4db) to the unbalanced input of the SX. It can be plugged into either the MIC or LINE input depending on the level of the signal and how much gain you want from the SX. Since this is a bridging function (20,000 ohm to 600 ohm) there is some loss through the transformer. (See fig. 8-4).

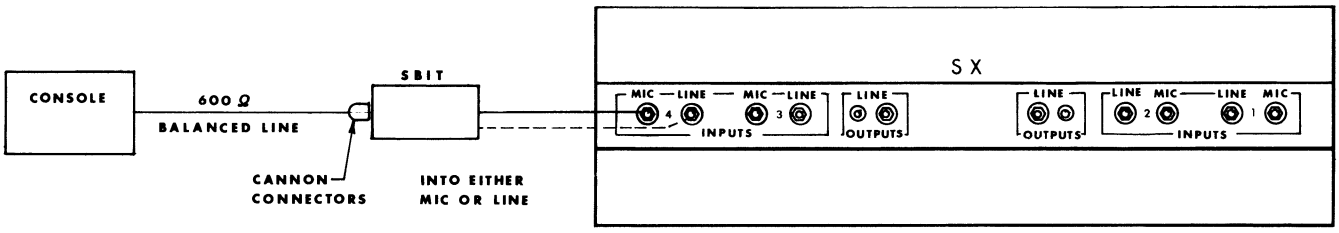


FIG. 8-4 SBIT

8.3.3 SLOT

The slot has two uses. It can be used to match the unbalanced 600 ohm output from the SX to a balanced 600 ohm line. It can also function as a loading input transformer to match a 600 ohm balanced line to the unbalanced SX input. (1: 1) See fig. 8-5.

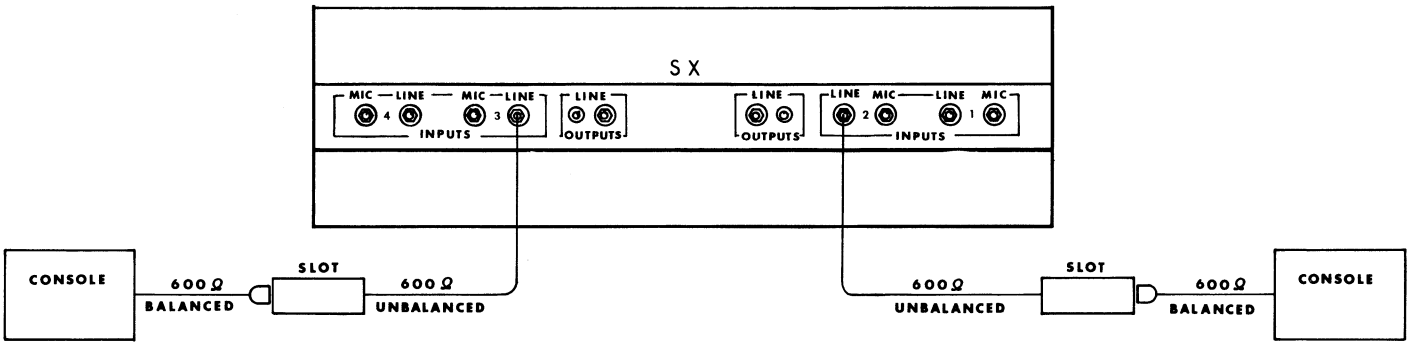


FIG. 8-5 SLOT

SPECIAL APPLICATIONS

ILLUSTRATIONS

9.1 Introduction

This section deals with the actual hook-up of the SX recorder and how to use it with external equipment. Simple block diagrams illustrate typical hook-ups with a variety of different systems. The preamp (or combination pre-amp amp, or receiver) is the heart of the hi-fi system, and exact hook-up procedures for associated equipment will depend somewhat on the specific facilities and functions of the pre-amp. The tape recorder is part of the "associated equipment", therefore our illustrations will be of the general or most frequently encountered hook-ups. (For the specific details of your system, see the manuals for the pre-amp.) We will start with the simplest functions of the SX and work up to some of the more complex functions.

9.2. SX as Tape Player

9.2.1 With Head Phones

This is the simplest function for any recorder, that of a tape player. The only additional equipment needed to play a tape on the SX is a set of head phones, which can be plugged into either front panel jack. High or low impedance phones can be used. (Electrostatic head phones cannot be used as they are very low impedance and require power amplification). See fig. 9-1.

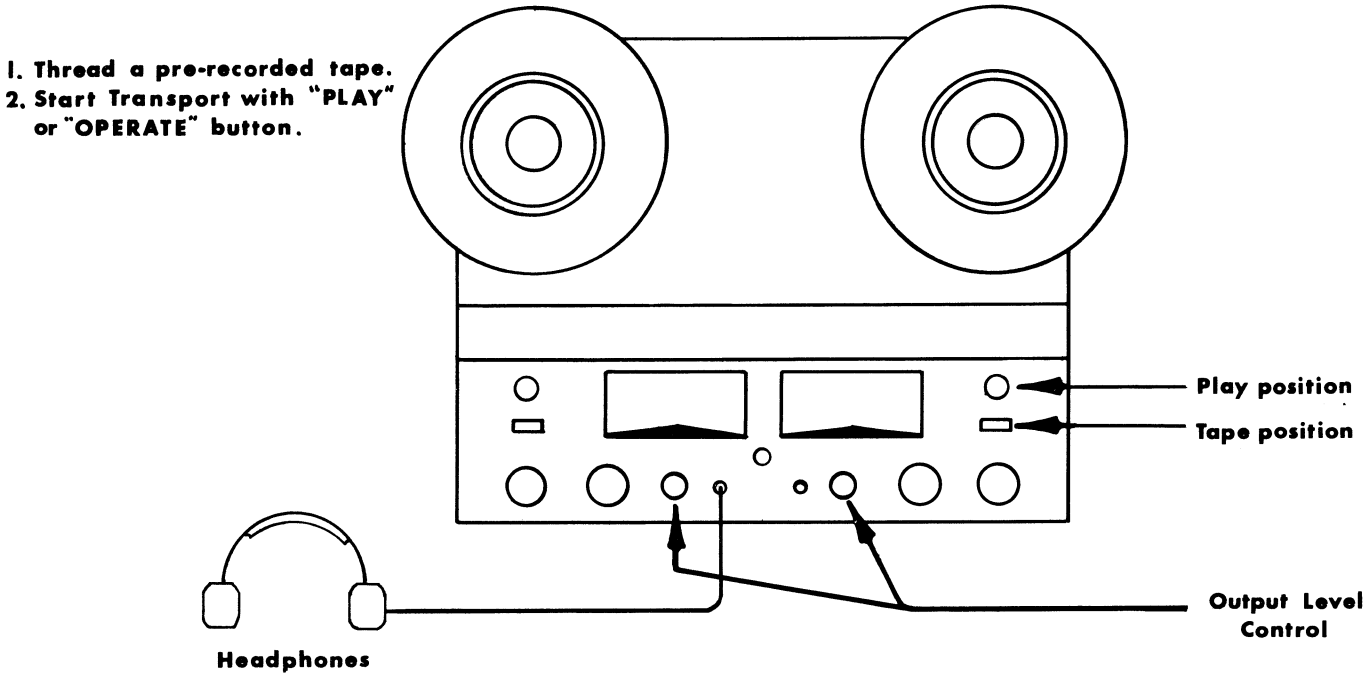


FIG. 9-1 SX WITH HEAD PHONE

9.2.2 With Amp

The next step would be to substitute a power amp and speakers for the head phones. See fig. 9-2. All adjustments remain the same.

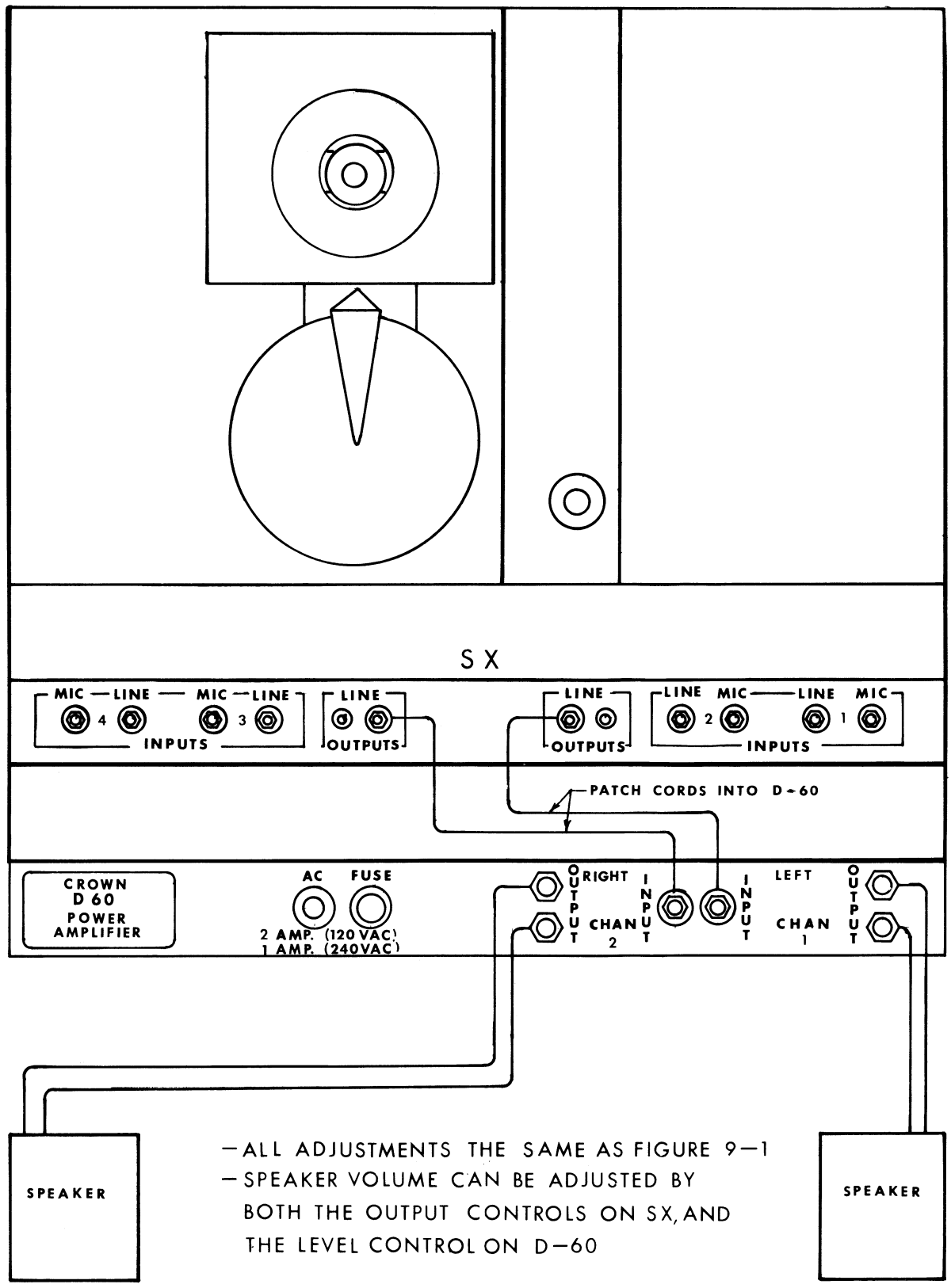


FIG. 9-2 SX WITH MONITOR AMP

9.2.3 With a Hi-Fi System

The function of the SX into a pre-amp is the same as the preceeding hook-up. There are several additional

considerations; the pre-amp now offers tone controls, loudness control, balance, filters, etc. The normal method of volume control would be to adjust the output level controls on the SX to full CW, then adjust the volume control on the pre-amp for proper listening level. If the signal from the SX is too loud in relation to signals coming from other equipment (tuners, etc.) the SX output levels may be turned CCW until the proper balance is achieved. See fig. 9-3.

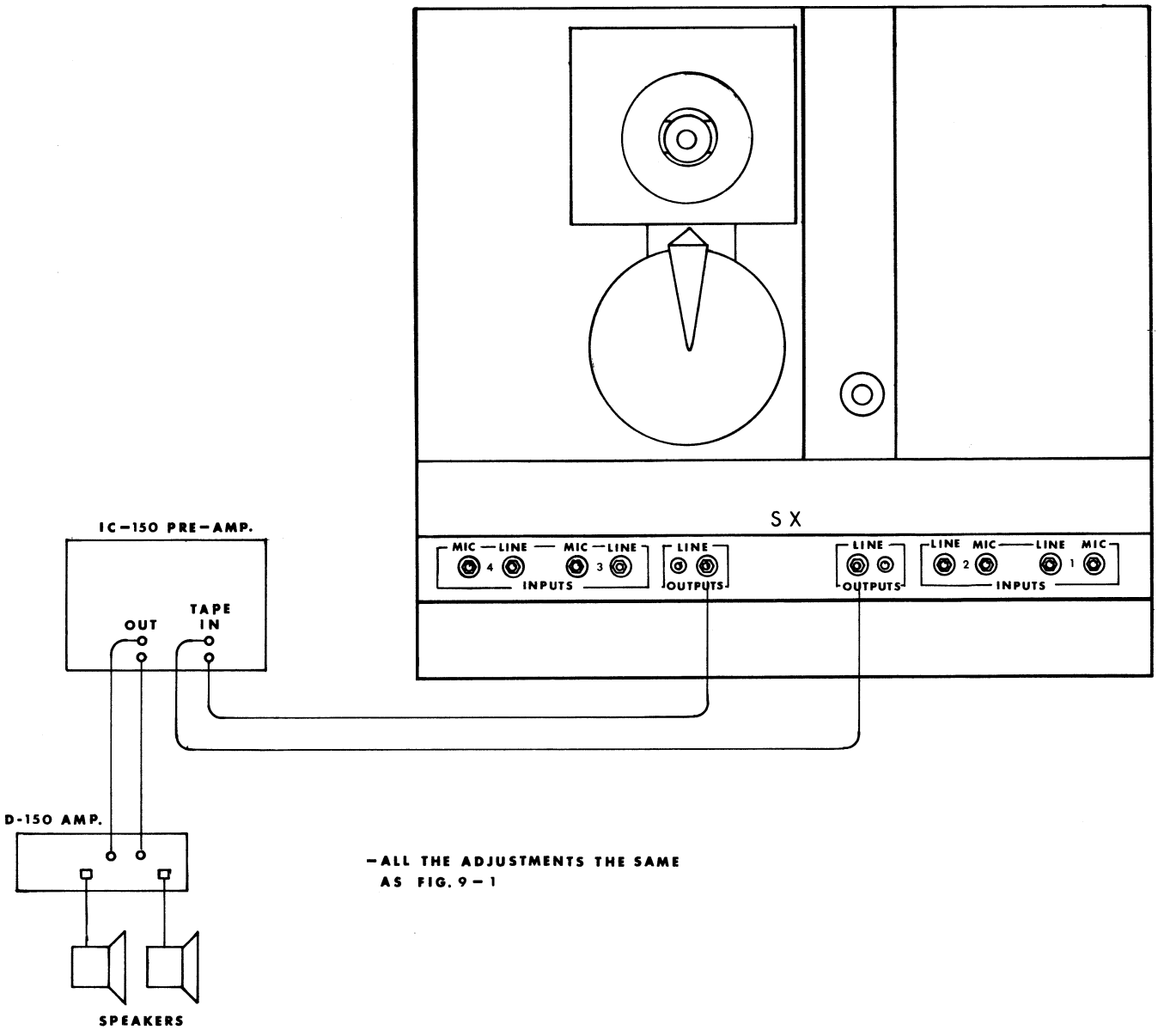


FIG. 9-3 SX WITH A HI-FI SYSTEM

9.3 The SX in the Record Mode

9.3.1 Simple Recording and Monitoring

The SX can function by itself as a recorder with the addition of head phones for monitoring. Simple monitoring can be used, either the hook-up in figure 9-1, or 9-2. The only difference between recording and playback with the SX is that in recording there are two signals to control instead of just one. In recording the incoming signal level must be adjusted to a proper level (usually less than "O" VU on the meter) with the input level controls. This is the most important function as it determines the over-all quality of the recording. The out-going signal (the one coming off the tape just recorded) is adjusted the same as in hook-up 9-1. When the recording process has started you may select either the incoming signal (SOURCE) or the playback of the recorder signal (TAPE) for monitoring. The SOURCE-TAPE switch performs this switching; either will be heard in the monitor system. The "tape" signal will be slightly delayed from the "source" signal. See fig. 9-4.

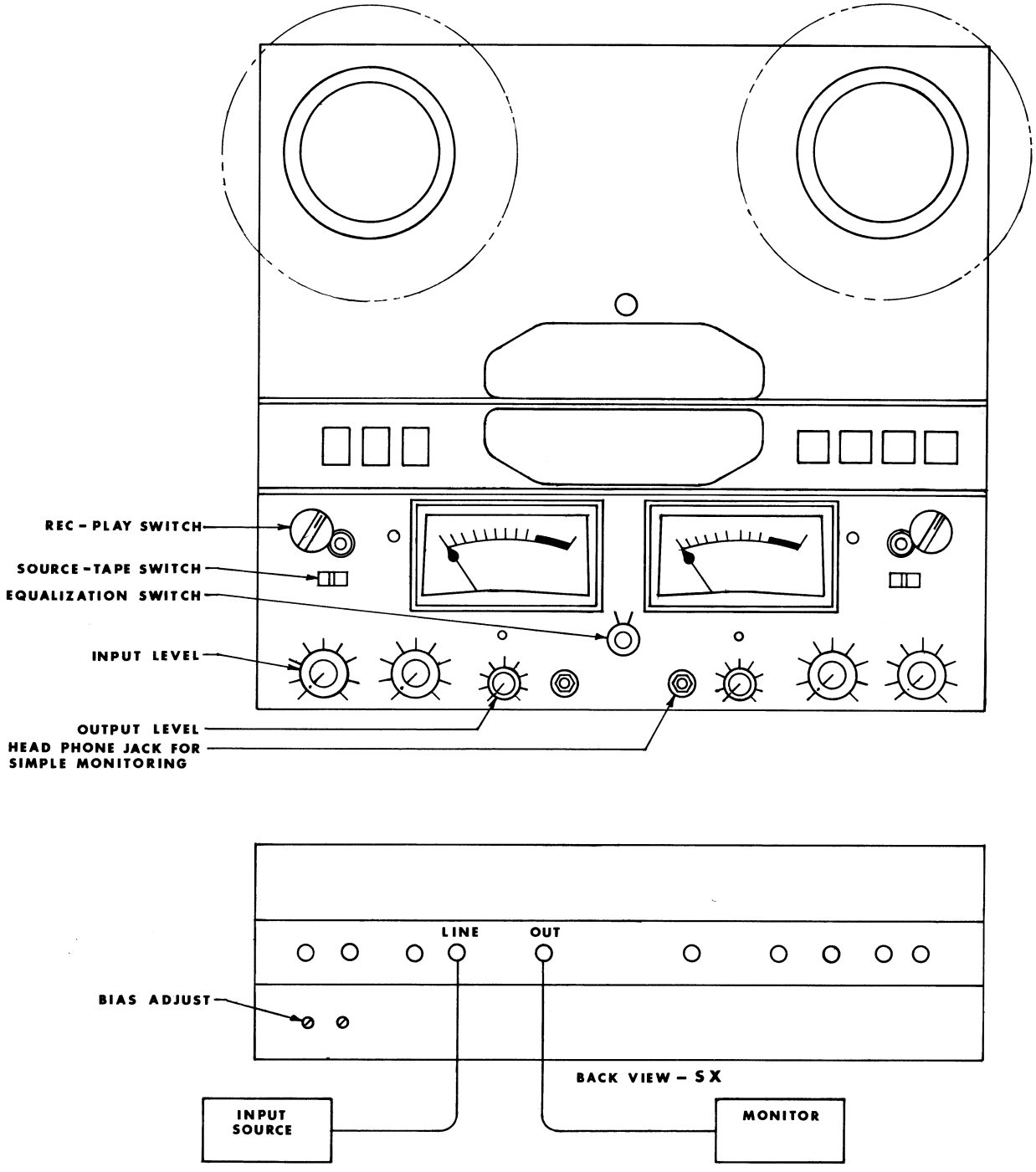


FIG. 9-4 SX IN SIMPLE RECORDING HOOK-UP

9.3.2 Recording in a Hi-Fi System

One function that most pre-amps offer is that of tape monitoring. Basically this is a system for being able to listen either to the signal going **to** the recorder or the signal coming back **from** the recorder. This selection is done at the pre-amp with the "tape" or "tape monitor" button. It can only be utilized with a recorder that has three heads. The three heads enable the operator to listen to the playback while he is recording. The following example will illustrate a situation of making a recording from a record. (All the record steps from 9.3.1 are preliminary.)

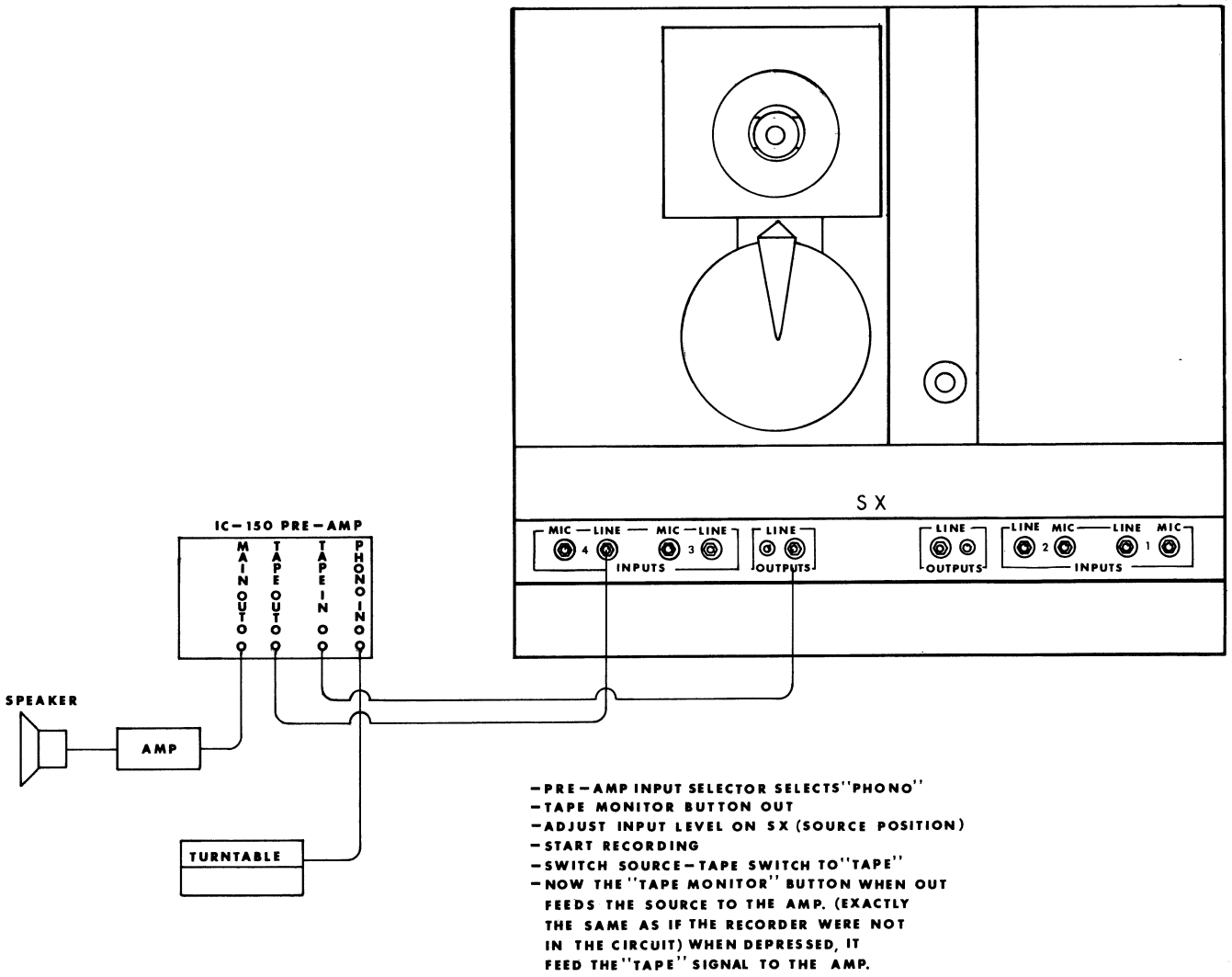


FIG. 9-5 RECORDING WITH SX IN A HI-FI SYSTEM

9.4 ADDITIONAL FUNCTIONS

9.4.1 Mixer

With the input sources as described under the section on recording, the SX electronics may be used as a mixer. The Line Output may then be fed to public address systems, broadcast consoles, etc. Program material fed to the line output will then depend upon the position of the Source-Tape switch. One channel could act as a program source being set to tape with its Line Output patched into the line input of the remaining channel which would be used as a mixer set on "source". See fig. 9-6.

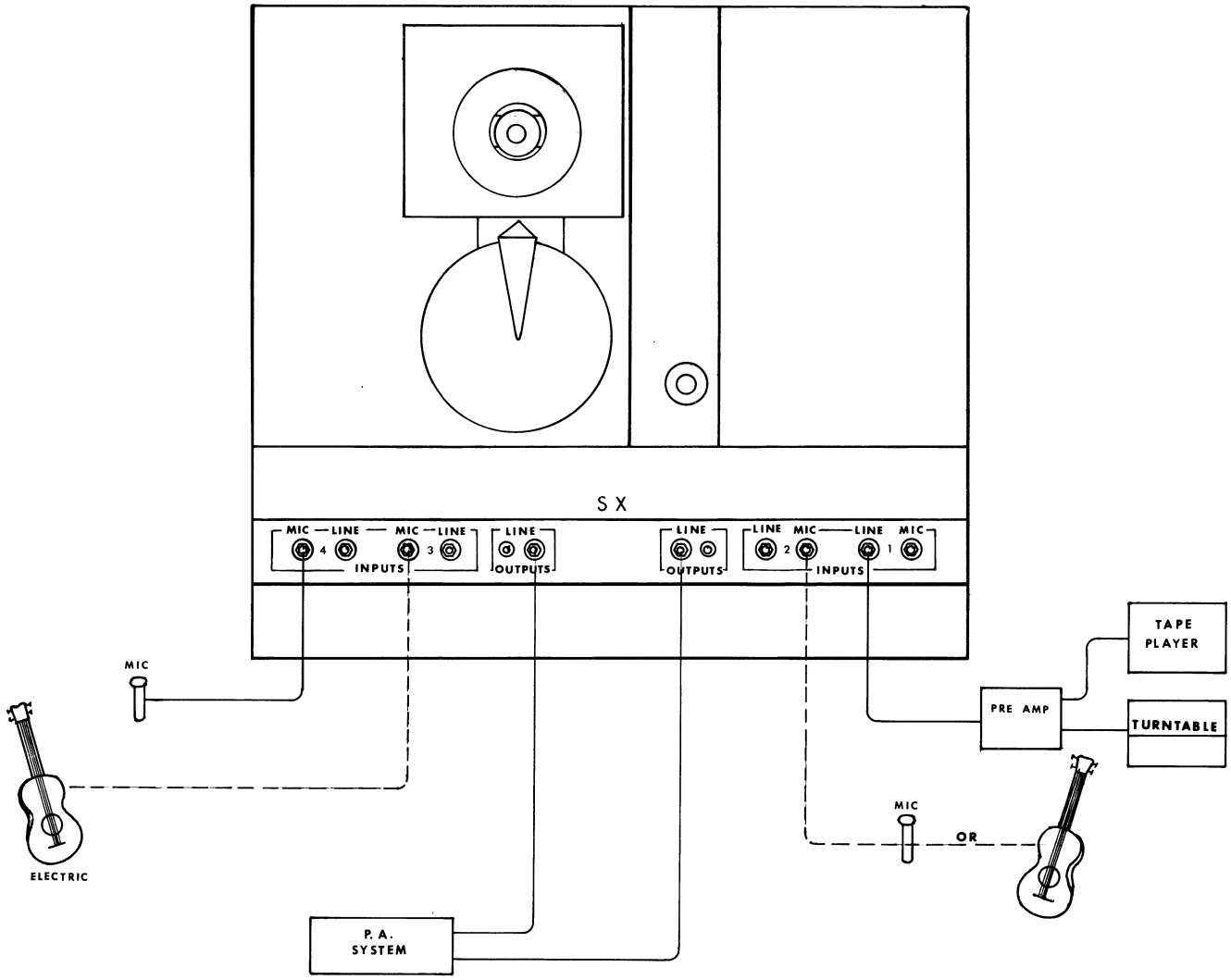


FIG. 9-6 TYPICAL MIXER HOOK-UP

9.4.2 Modes of Recording Using Reproducing Delay

a. Simple Delay — A simple delay is readily obtained by reproducing the tape while recording. The delay is equal to the distance between the record and the reproduce heads divided by the tape speed.
b. Double Delay — A double delay is achieved by patching the simple delay of a single channel into the second unused channel where it is re-recorded and again reproduced. This second reproduction is doubly delayed.
c. Source + Simple Delay — In this instance a simple delay is formed by one channel and the other is used to mix it with the original source which must be parallel patched into both channels. The second channel is then set to Source.
d. Simple Delay + Double Delay — Set second channel of Source plus Simple Delay set-up to reproduce the tape.
e. Multiple Delay — Set recording channel to tape and using a "Y" connector patch its Line Output back to one of the Inputs. The amount of "echo" will then be adjustable by both the output level control and the input control. CAUTION: Too much echo produces undesirable feedback effects.
f. Crosscoupled Multiple Delays — By crosscoupling (Patching) the reproduce outputs of each channel into the input of the other recording amplifier a sound can be made to bounce back and forth between the two channels. The remaining inputs may then be used for either a single or a stereo source.

9.4.3 Sound-on-Sound Recording

With multiple recordings great care must be taken to keep the distortion as low as possible. If the record level is allowed to go too high, the distortion will become progressively worse at each stage, until it becomes quite noticeable. On the other hand, if the record level is too low, the gain controls will be needed to be advanced too far during the reproduction and tape hiss will be heard. It is suggested that the record level be monitored very carefully and kept slightly below normal. It is also suggested that multiple recordings be done in the least number of stages possible.

The first stage of multiple recording may consist of recording on the left channel only. One or both inputs to the left channel may be used and the recording monitored normally.

For a second stage, the tape must first be rewound. A new input may be combined with the signal originally recorded as it is transferred from the left channel to the right where it is recorded again. It is usually desirable to monitor the left channel as it is being reproduced to facilitate syncronization.

The functions of the left and right may then be reversed for a third stage, if desired. See fig. 9-7.

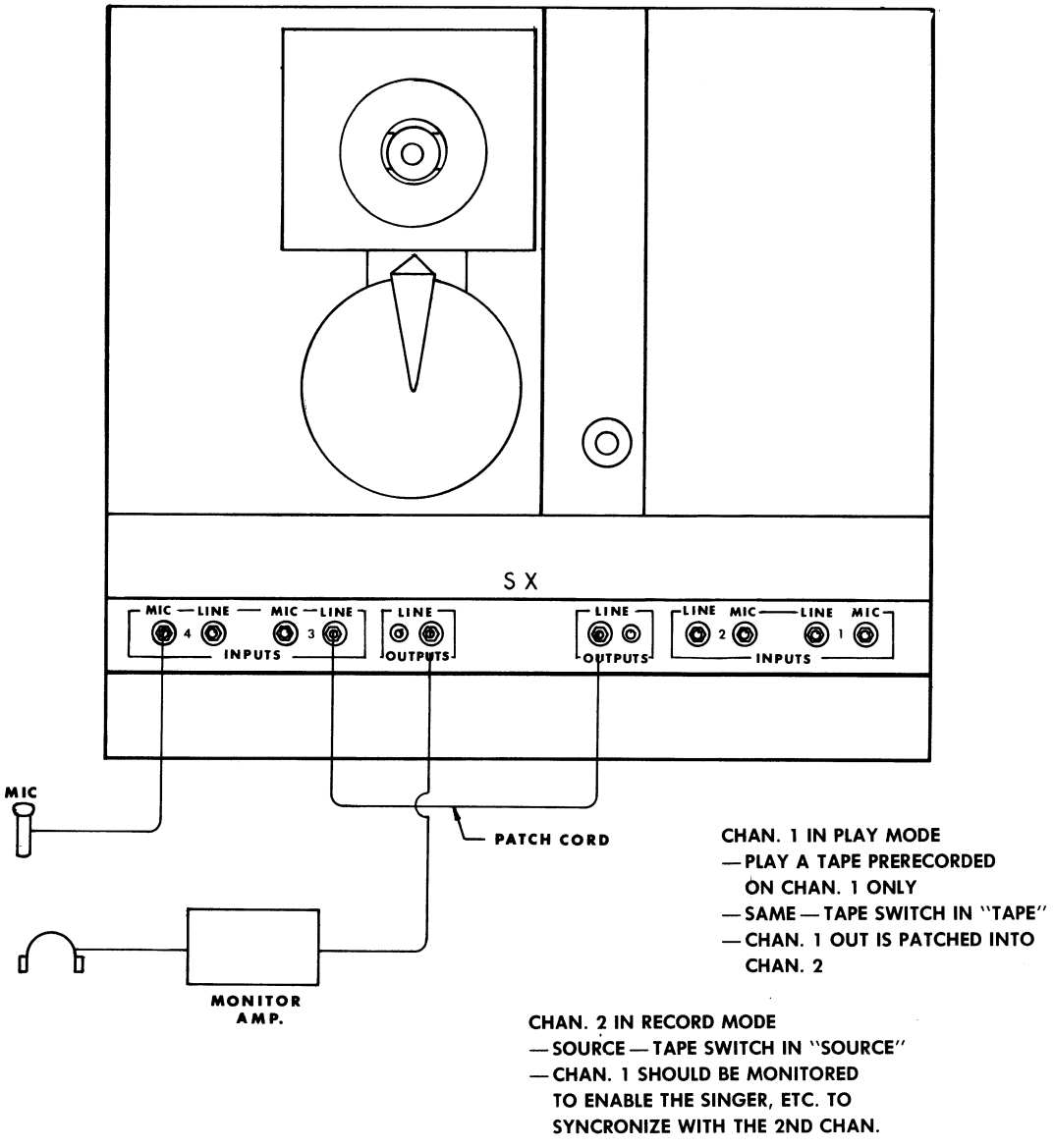


FIG. 9-7 SOUND-ON-SOUND HOOK-UP

PERFORMANCE AND TESTING

ILLUSTRATIONS

10.1 General Theory

10.1.1 Introduction

The CROWN tape recorder has three main units

1. Transport
2. Head Assembly
3. Electronics

The transport contains main power supplies, take-up motor, pay-off motor, drive motor, capstan assembly, tape lifter housing, and the head assembly.

Head Assembly: Is made up of the head mounting plate, tape guides, and three heads — Play, Record and Erase - with facilities for adjusting the heads.

The Electronics: Contains the circuitry for electronic operation of the tape recorder in the Play and Record modes.

This discussion will involve the Electronics unit and the Head Assembly in their relationship physically and electronically with each other and the tape.

Part one of this manual will give a brief technical summary of important aspects of Magnetic Tape Recording.

Part two will give a series of performance tests to check the overall operations of the recorder.

10.1.2 Reproduce Equalization and the Reproduce Head

In an ideal situation, the signal picked up by the play head will double in amplitude if the frequency is doubled. (An increase of 6db per octave will occur). This is assuming that the record level has been held constant.

This happens because the voltage generated is proportional to the rate-of-change of flux. If the frequency is doubled, the flux changes twice as fast, and the voltage has doubled.

In order to compensate for this 6db per octave rise, the preamp must include a 6db per octave drop. The resultant output would then be flat.

However, other factors affect the curve, and must be taken into account. Such factors as gap losses and spacing losses tend to decrease the high frequency response. The final curve will, then, follow a 6db drop at the low frequency end, and then begin to level off in the area where high frequency losses begin to become effective. (Some modification to the curve is required at the extreme low end of the response also).

CROWN "SX" recorders are equalized for speeds of 7-½ and 3-¾. (15 or 1-⅞ available on special order).

The electronics unit, whether stereo or mono, is equipped with playback equalization controls for electronically setting a prescribed play curve (or response) in the electronics to compensate for the characteristics of the head (deviations from ideal) conditions. The following curves show the steps of playback equalization:

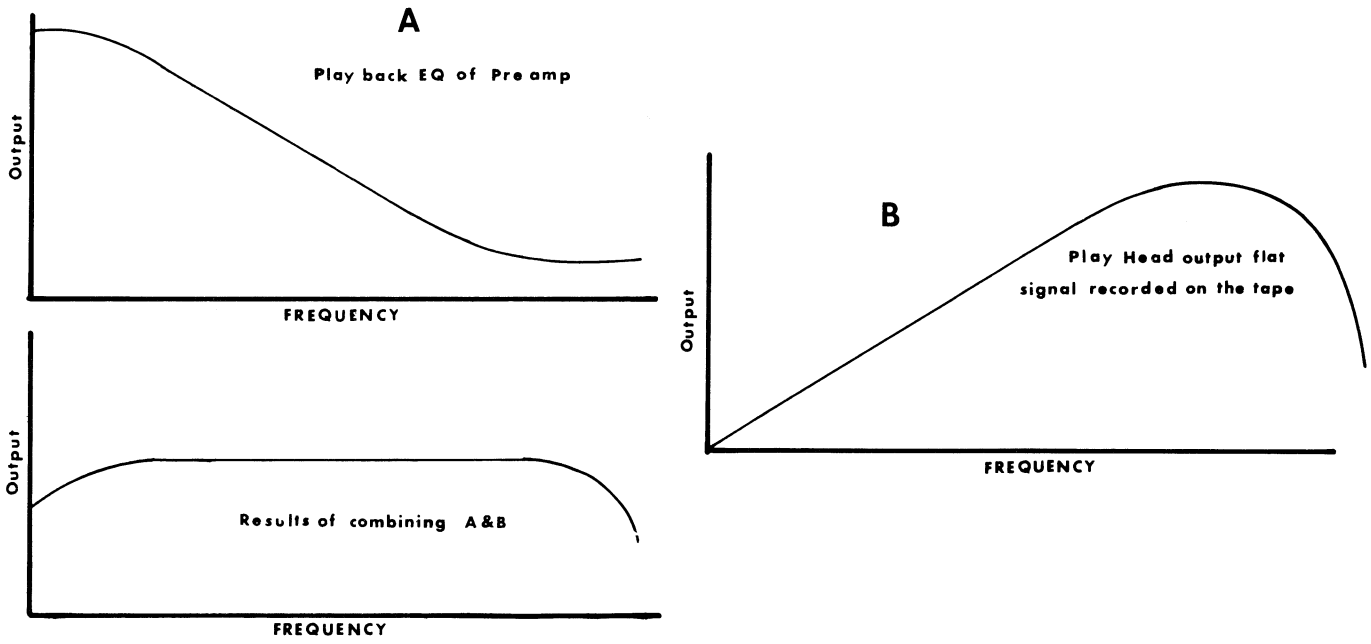


FIG. 10-1 REPRODUCE EQUALIZATION CURVES

10.1.3 Record Equalization

In order to realize the best possible high frequency response, equalization must be used in the record circuit to offset certain losses. Losses might include the erasing effect of bias, penetration losses due to the thickness of the oxide coating, self-demagnetization losses due to the magnetic nature of the medium, head losses through the gap, and eddy current losses.

Record equalization in CROWN recordings is accomplished by providing additional gain in the frequencies subject to recording losses.

In order to obtain the desired composite curve, two separate correction curves are considered. The mid equalization provides a gradual rise beginning at a point slightly beyond 1khz. The peak equalization provides a sharp rise at the upper response limit.

Sometimes the peak frequency can be adjusted slightly higher thus giving a slightly better frequency response. If the peak is adjusted too far out, serious roll-off will occur at the high frequency end. If the peak frequency is set too low, there will be an unusually high boost somewhere below the maximum frequency and serious roll-off following this peak. We have chosen the specification on our recorders so that the highest frequency we specify as flat is very nearly the proper setting for the peak frequency adjustment. IT MUST BE REMEMBERED, HOWEVER, THAT IN RUNNING A FREQUENCY RESPONSE CURVE, THE LEVEL SHOULD BE KEPT 15 to 30db BELOW THE ZERO LEVEL AT 1KHz. If this is not done, tape saturation will be experienced at the frequencies where high frequency boost has been used. This will result in distortion and erroneous results.

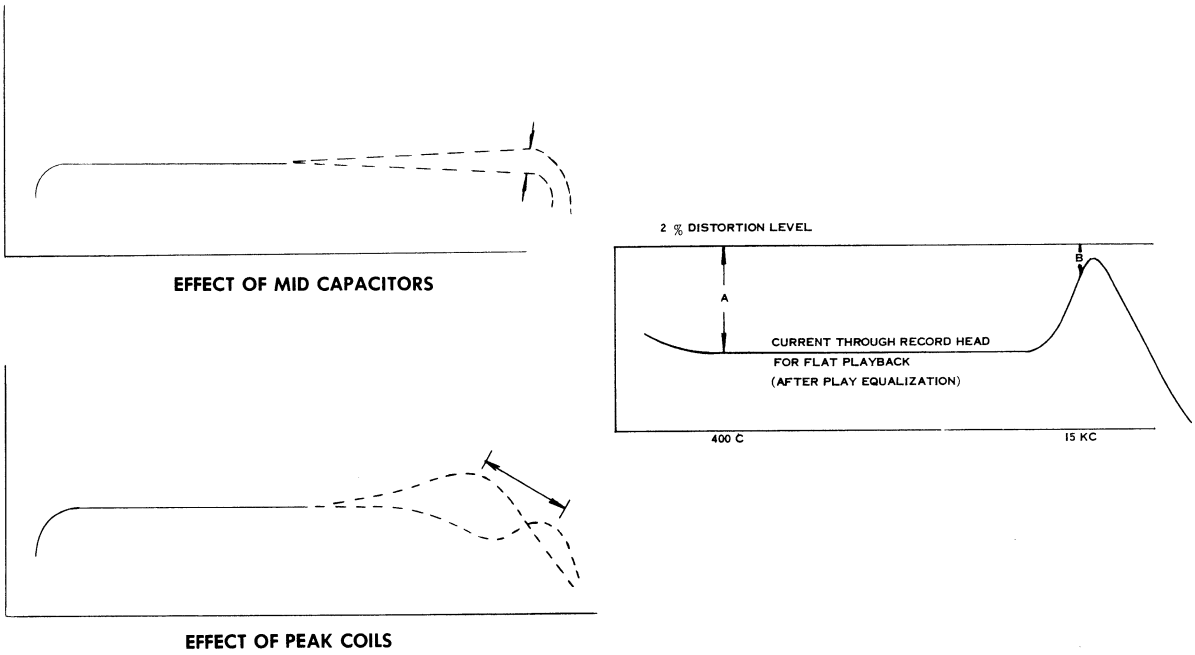


FIG. 10-2 RECORD EQUALIZATION CURVES

10.1.4 The Need for Bias in the Magnetic Recording Process

Magnetic tape is basically a non-linear medium; that is, the magnetism left on the tape is not always proportional to the current in the recording head. This non-linearity (or distortion) appears mainly as the signal passes through the zero axis. The appearance is much the same as that which occurs in an overbiased class "B" amplifier.

One simple method of biasing is to add enough direct current to the signal current to prevent it from ever reaching zero. Of course, the maximum signal level used will be less than half since the signal may not be allowed to reach saturation, or zero.

This may be accomplished a second way by previously saturating the tape in one direction. A direct current is then made to flow through the recording head as before. This direct current is then adjusted so that with no signal present, this DC will just overcome the original magnetism and leave the tape demagnetized. A signal current superimposed upon this will then magnetize the tape in a fairly symmetrical manner about the zero point. This will be true because in this process the tape is being recorded by **demagnetizing** varying amounts rather than by magnetizing it by varying amounts, and the **demagnetizing** curve is relatively free of distortion. With this type of bias, signal-to-noise ratios up to 30db may be realized. However, through the use of ultrasonic bias, signal-to-noise ratios will be obtained which can be made to exceed 60db.

Ultrasonic bias (which is the type used in all CROWN recorders) uses an alternating bias current which is relatively high in amplitude, and several times the frequency of the signal. The signal is then superimposed upon the bias. The ultrasonic bias allows the tape to be saturated in each direction as it moves past the record head gap. As it leaves the gap, it is demagnetized to a level which is dependent upon the signal, therefore utilizing the more linear demagnetizing curve BC rather than the non-linear curve AB. (See fig. 10-3).

The main effect of changing bias levels will be changes in distortion. As the bias level is increased, distortion will be decreased. As the bias is increased however, output will be reduced, especially at the higher frequencies. For optimum performance, therefore, the bias should be adjusted carefully. As the bias is increased (starting from zero), distortion will at first decrease rapidly. As the usable bias range is entered, the distortion will decrease more slowly. If this bias is increased much beyond this point, serious losses in high frequency response will result. It will be desirable to keep the bias as high as possible without causing the high frequency response to drop outside of the specified limits.

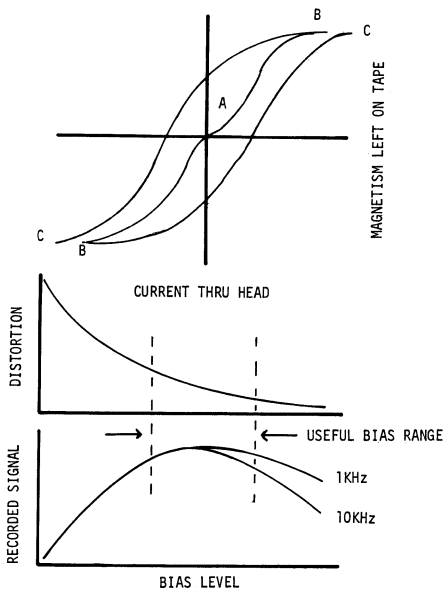


FIG. 10-3 BIAS CURVES

10.2 Performance Tests

10.2.1 General

The performance of your recorder can be checked quickly by making some general tests. For example, deterioration of playback and/or record can be determined by playing a pre-recorded tape, or making a simple A-B listening test while recording. By stopping the recorder and turning up the amp gain, excessive hum and noise will be apparent. Meter calibration can be checked by playing a pre-recorded tape and comparing meter readings. In addition, much can be learned by checking headwear and listening for mechanical problems.

Following is a complete step-by-step set-up procedure, in the event that your SX needs servicing. It should be emphasized that only proper test equipment and knowledgable personnel can achieve reliable results. If the results of the adjustments aren't understood, serious degradation of performance is likely to occur.

Before any electronic adjustments are made it is imperative that all mechanical functions of the recorder are normal. This would include pressure roller adjustment, tape lifter and pressure pad alignment, head alignment and any other function which directly affects the tape transporting process. In addition, the wow and timing should be checked. Please refer to the transport section which deals with these adjustments.

Following is a list of recommended equipment with some typical model numbers included.

- Demagnetizing Tool - Robins ME-66
- DC Voltmeter - Simpson Model 260
- Precision AC Voltmeter (capable of accurately measuring 100KHz) - Hewlett-Packard Model 400 E
- Audio Oscillator (low distortion) - General Radio Model 1309 A
- Distortion Analyzer - Hewlett-Packard Model 331 A
- Standard Alignment Tape - Ampex 01-31321-01 or Standard Tape Laboratory Cat. #2
- Resonate Probe - See figure 10-4
- Noise Filter (20Hz-20KHz bandpass) See figure 10-5
- 100KHz Bias Trap - See figure 10-6
- Frequency Meter - Hewlett-Packard 5210A

Optional:

- Flutter Meter - Micom 8100
- Oscilloscope - Telequipment Model S 54 A
- Monitor System

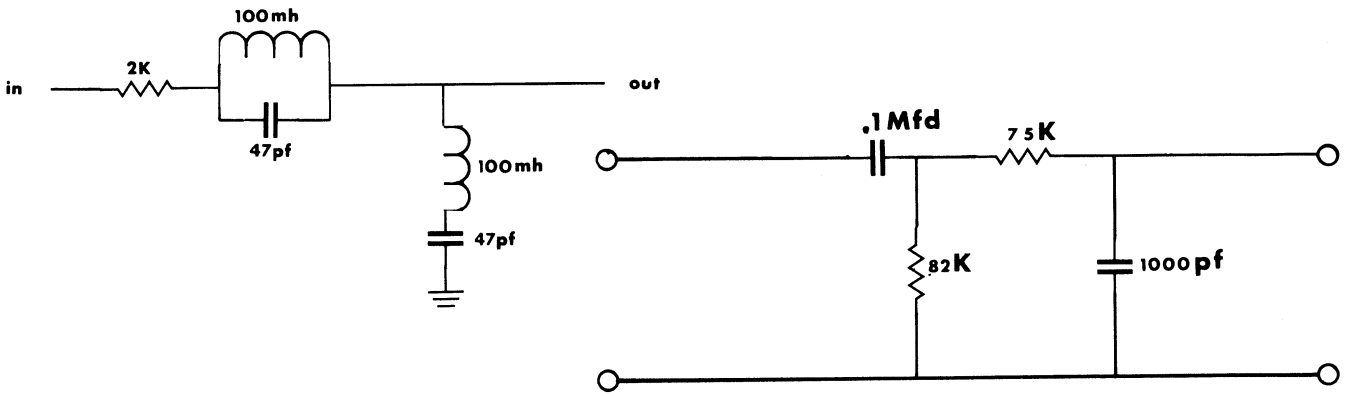


FIG. 10-5 20Hz-20KHz BANDPASS FILTER

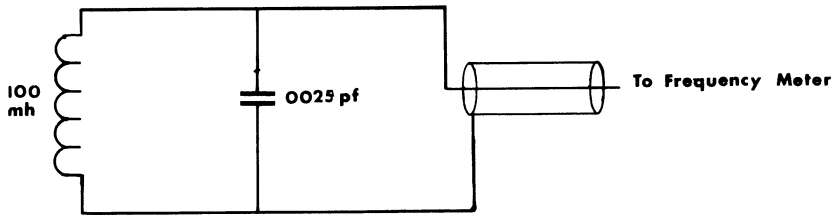


FIG. 10-4 RESONATE PROBE

PRECAUTIONS TO OBSERVE BEFORE MAKING ANY ADJUSTMENTS

1. Make sure heads are free of dirt and oxide.
2. Demagnetize heads **and** all tools that will come into contact with head assembly.
3. Make sure a new tape (of proper type) is being used for record checks.
4. Adjustments **must** be made in the specified order.
5. If a discrepancy occurs in any step, stop and remedy that problem before proceeding to next step.

10.2.2 Test Set-up

Following is a block diagram of a typical test set-up using the recommended equipment.

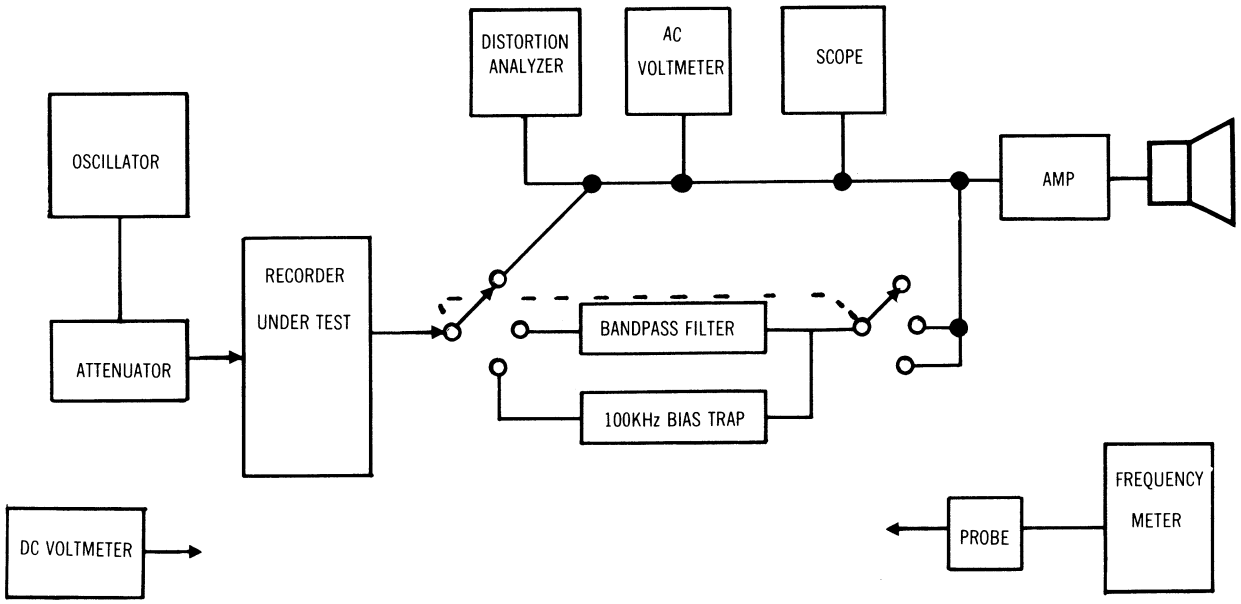


FIG. 10-7 TYPICAL TEST SET-UP

10.3 Set-up Procedure

10.3.1 Check Power Supply Voltages and Output Balance

A. Power Supply
   1. Set to + 30 volts, using R182, located on Power Supply Board.
   2. Check regulation — should be less than 2 mv ripple.

B. Output Balance
   1. Output DC balance is fixed; check with voltmeter. Typical reading would be very low + a few millivolts.

10.3.2 Meter Calibration

A. Buss Amp Gain
   1. Gain is fixed, should be approximately 14db from input to output.

B. Line Amp Gain
   1. Gain is fixed, +10db output, Hi-Z, +4dbm output into 600Ω.

C. Meter Amp Gain
   1. Set output level controls full clockwise.
   2. Feed in 1KHz signal, monitor output from SX on an External audio voltmeter.
   3. Increase input level control until output from SX is +10db into HI-Z.
   4. Adjust meter gain control (R163 Main Board) for "O" VU reading on front panel meters.

10.3.3 Check Electronic Performance

1. Feed in 1KHz "O" level signal. Check frequency response, distortion, signal-to-noise through the electronics (slide switch in "Source" position).
2. Feed 1KHz -60db signal into mic pre-amp. Check frequency response, distortion, signal-to-noise.

10.3.4 Reproduce Amp Gain and Equalization

A. Set play head tracking, tilt, height and tape wrap, zenith, and approximate azimuth.

B. **DEMAGNETIZE** Heads

C. Play Level — Play a standard "O" level 700Hz tape, adjust play level control (R199 on Main Board) for "O" VU reading on front panel meters.

D. Azimuth adjust — Play standard 15KHz Azimuth adjust tape, adjust azimuth screw for maximum output, both channels. Watch for split azimuth, an indication of a defective head. Split azimuth is apparent when the channels don't reach peak output together. Only 1.5dB between peaks can be tolerated for proper results.

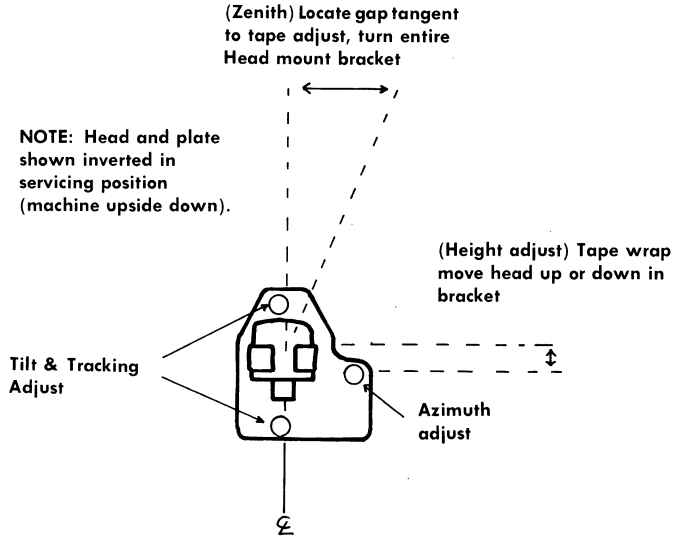


FIG. 10-8 HEAD ALIGNMENT

E. Play Equalization

1. Play a 700Hz (equalization reference) section of standard alignment tape, set a suitable reference on external audio voltmeter.
2. Switch tape to 10KHz section (equalization adjust).
3. a. **(Service method:)**

   Use appropriate equalization control (R203 or R204 on Main Board) to set output as follows: (All adjustments are made with a 7-½ ips standard alignment tape playing at 7-½ ips, switching only the equalization switch):

   — For 15 ips, set 10KHz -1db from 700Hz reference.
   — For 7-½ ips, set 10KHz Odb from 700Hz reference.
   — For 3-¾ ips, set 10KHz +6db from 700Hz reference.
   — For 1-⅞ ips, set 10KHz +12 db from 700Hz reference (only approximate.)

   b. **(Direct method:)**

   Using standard alignment tapes for the appropriate speeds, set 10KHz for flat playback using appropriate controls (R203 or R204 on Main Board). Since there are no standard response curves for 1-7/8, satisfactory alignment can be achieved by disconnecting the playback and feeding a -50db signal directly into the electronics, and adjusting for a response according to the curves below. (See fig. 10-9).

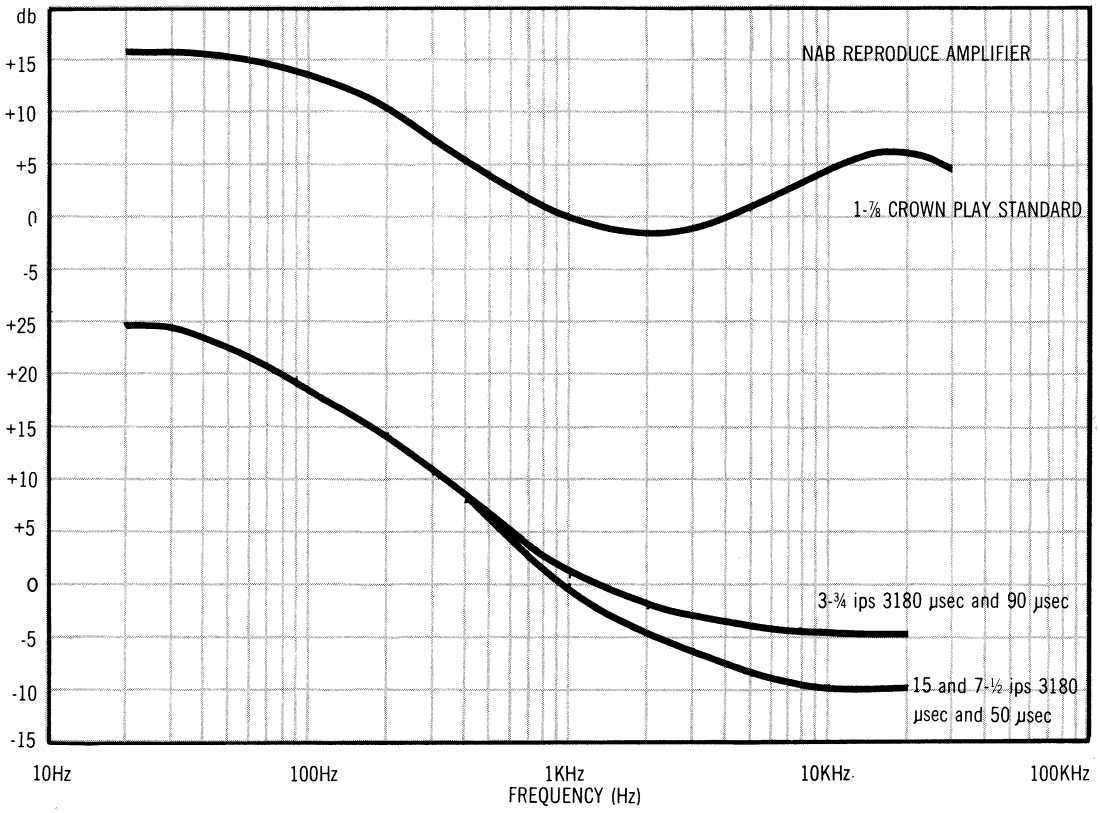


FIG. 10-9 REPRODUCE EQUALIZATION CURVES

NOTE: When using a full-track alignment tape on multi-track machines, a high output (+2 to +4db) may be noted at the low frequencies. This is due to a "fringing" effect and may be disregarded. Output will be normal when using a multi-track tape. Also, bear in mind that standard tapes frequently are slightly boosted at the highest test frequencies, in an attempt to compensate for self-erasure effects that occur gradually with aging. The relative age of the tape should be taken into consideration when attempting to adjust equalization.

F. Bass End adjust — Play 50Hz (bass end adjust) section, using bass and adjust control (R202 or R201 on Main Board), set output +.5db to +1db above 700Hz reference. Set bass end for both speeds.

G. Play standard "O" level tape again. Re-check play level as there is some interaction between level and equalization controls.

H. You can verify flat playback and proper equalization by playing standard play tape and noting the response curve. Response should be ±2db from 50Hz to 15KHz. If results are out of tolerance, the following possibilities should be considered:
   1. Worn or defective playhead which would require placement.
   2. Defective playamp. This may be checked by feeding a -50db signal into the playhead input and comparing output to standard play curves. Also check signal for distortion. (See fig. 10-9)
   3. Defective component in equalization circuit.
   4. Bass end out of tolerance — adjust R201 or R202.

10.3.5 Set Bias Oscillator, Pre-set Erase Voltage

A. Set oscillator to 100KHz ± 5K-O, (slug of T-1 on OSC board) (See fig. 10-10).

B. Pre-set erase voltage (setting only approximate).
   — full-track - 100V to 175V
   — half-track - 50V to 100V
   — quarter-track - 40V to 90V

   Refer to Proof of Performance sheets with machine or on permanent file in CROWN Factory Service Dept.

C. Adjust bias traps for a null at 100KHz.
   1. This can be done by connecting the audio voltmeter to the Q107 side of the record level control (R151 on Main Board) and adjusting the bias traps L103 (See fig. 10-10, and 10-11).

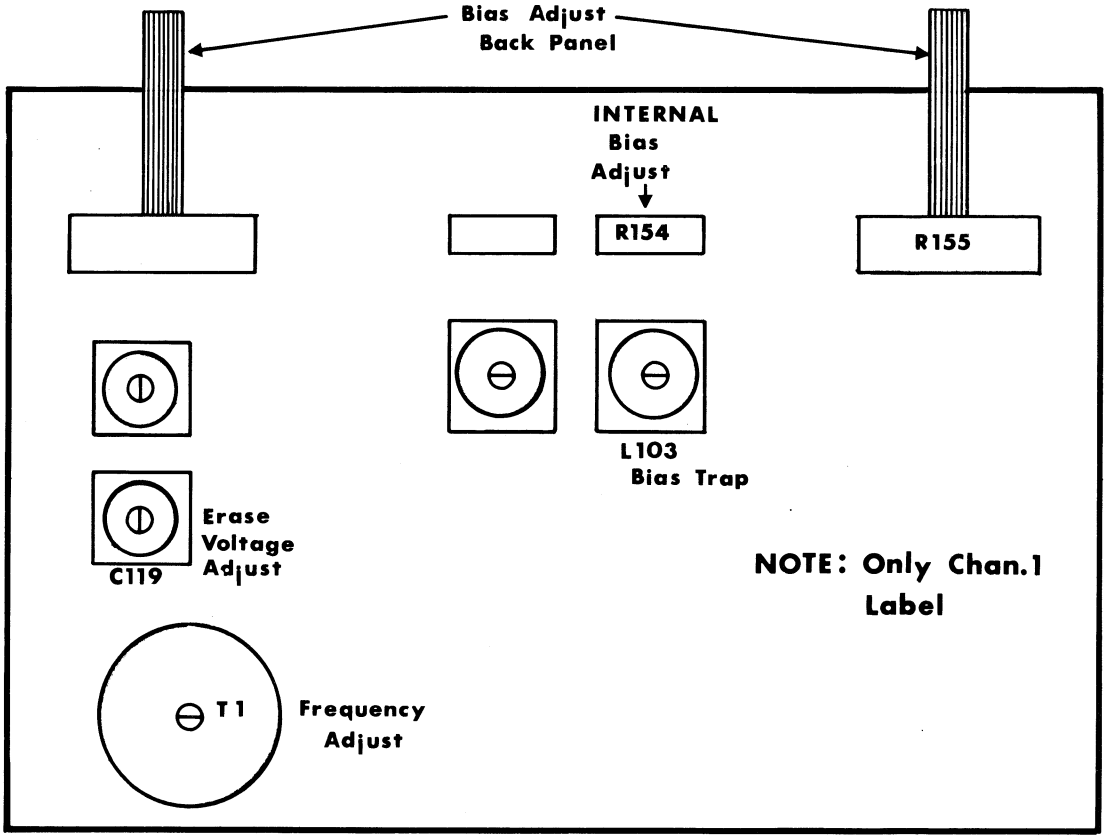


FIG. 10-10 OSCILLATOR BOARD OUTLINE

10.3.6 Check Erasure and Signal-to-Noise

A. Set tracking, tilt, height and tape wrap and zenith of erase head.

B. Insert bandpass filter (20Hz to 20KHz) between recorder and audio voltmeter. (See fig. 10-5)

C. Play pre-recorded erase tape (3% THD, 400Hz*) set reference on audio voltmeter.

D. Switch to record mode (no signal input) and measure output. Should be in the vicinity of -55db below 3% reference.

E. Maximum erase can be achieved by adjusting erase head tracking and erase voltage. Best procedure is to adjust erase voltage just to the point where clean erasure results. This prevents overloading the oscillator.

G. Using same set-up (reference to 3% THD tape *) put on a roll of virgin tape, start recording (inputs full counter-clockwise). Output can be measured as signal-to-noise in db below 3% THD, should be in the vicinity of -60db.

* 3% THD occurs with Scotch 202 at approximately +8db, with Scotch 207 at +11db.

10.3.7 Record Response and Level, Bias Meter Calibrate

A. Insert 100KHz bias trap ahead of audio voltmeter. (See fig. 10-6)

B. Use correct type of tape (Scotch 202 or 207).

C. Adjust record head tracking, height and tape wrap, tilt zenith and approximate azimuth.

D. Start recording at 700Hz "O" level signal, switch to "tape".
   1. Adjust the back panel bias control (R155) to produce peak in audio output off tape. Set bias right on peak in output.
   2. If clear peak cannot be obtained, adjust the internal bias control (R154) in the same direction through and slightly past the peak in audio. Then the back panel control can be adjusted for a peak in audio.

E. Set the bias meter calibrate control (R153) to read "O" VU with switch in "Bias" position. This is only a preliminary setting. Control R153 is mounted behind the Rec-Play switch and can be reached with a long small shaft screwdriver.

F. Adjust record level control (R151 on Main Board) so that 700Hz "O" level in, reads "O" VU in "tape" position.

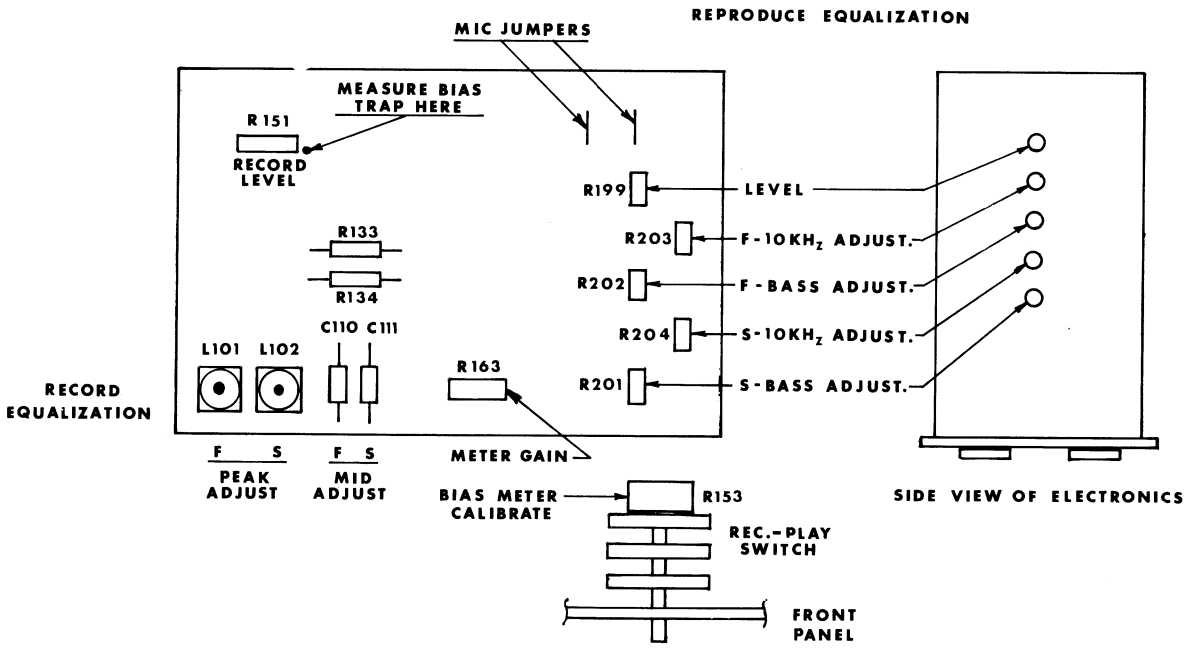


FIG. 10-11 MAIN BOARD OUTLINE

G. Record a 1KHz "O" level signal and check distortion. THD should be below 1% typically.

H. Reduce signal level 20db with attenuator and record a 15KHz signal. Adjust record head azimuth for peak output. Again be alert for split azimuth problems.

I. At proper record level (see chart below), set 1KHz reference on external audio voltmeter.
   1. Sweep frequency to confirm only if machine had potential to meet specs at high frequencies.
   2. Switch to slowest speed, set bias to proper setting (see chart below) and check response.
   3. At this point, response can be corrected or adjusted using back panel bias adjust and record equalization.

NOTE: The RLC record equalization network works as follows:
   — the capacitor changes the overall amount of boost in the upper mid-range frequencies (2KHz to 10KHz depending on speed). An increase in capacitance increases boost and conversely.
   — The coil is adjustable and changes the frequency of the highest frequency to be boosted.
   — The resistor changes the amount of the high frequency boost. Increasing the resistance, decreases the boost and conversely.

   4. When all channels are nearly the same and response is within specs, use bias meter calibrate control to set bias meter to proper setting (see chart below).
   5. Now switch to highest speed, change to proper bias setting (back panel control) and equalization position. Correct or adjust response using **only** equalization. It should be pointed out that the correcting setting for the bias is a compromise and not exactly optimum for both speeds.

Set-up Information Chart

Speed	Record Level	Bias Set Full; Half-Track	Bias Set Quarter, 4 Channel
15	-10	O VU	O VU
7-1/2	-20	O VU	O VU
3-3/4	-20	O VU	-2 VU
1-7/8	-20	O VU	-3 VU

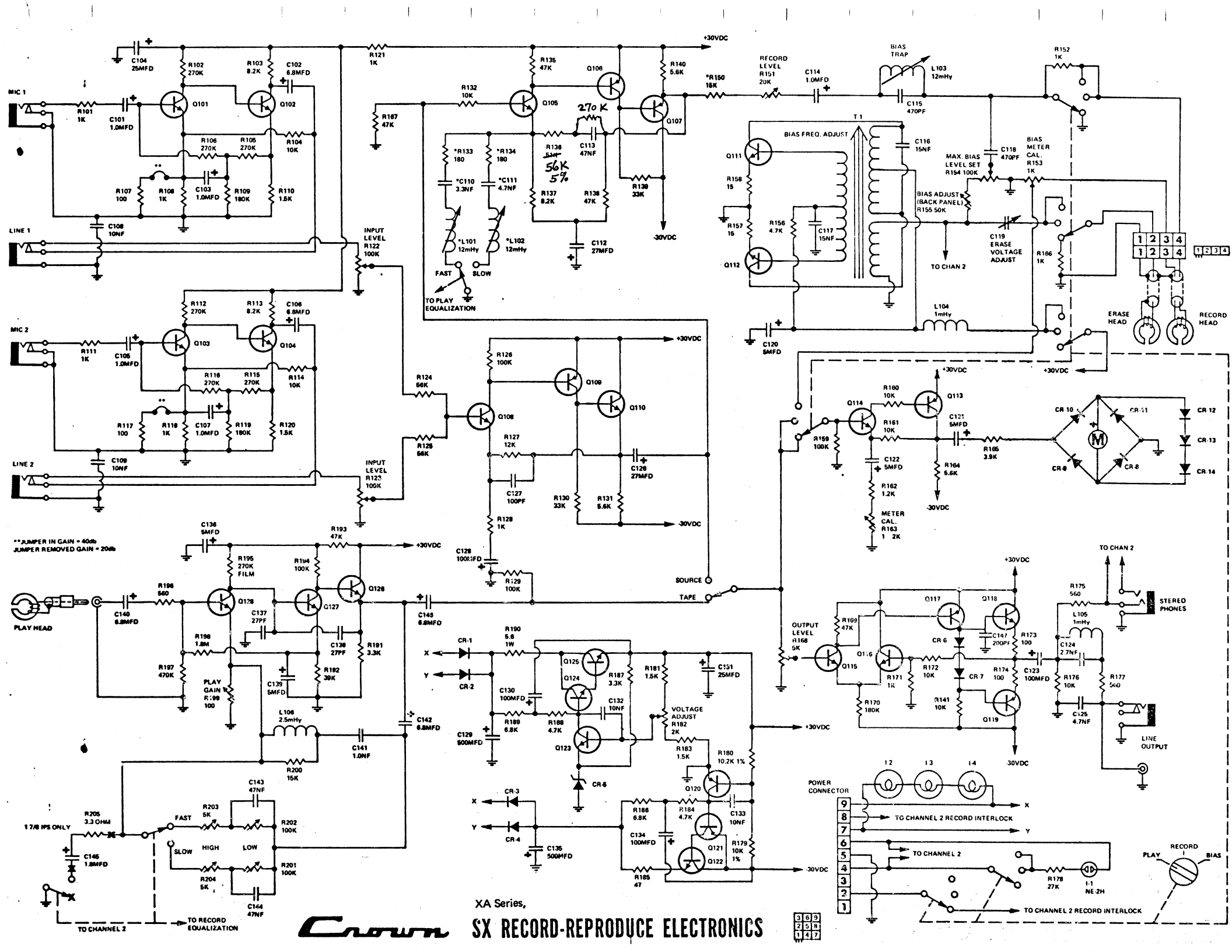
J. Bias swing — Only after proper bias calibration is obtained should bias swing be set.
   1. Use the internal bias control (R154) to set the range of the back panel bias adjust (R155). Final swing should be at least +2db to -3.5db.

K. Final Record Level.
   1. Record at "O" level 700Hz signal, set record level pot (R151) to read "O" VU in "tape" position.

10.3.8 Distortion Check

A. Insert bandpass filter between recorder and audio voltmeter. (See fig. 10-5)

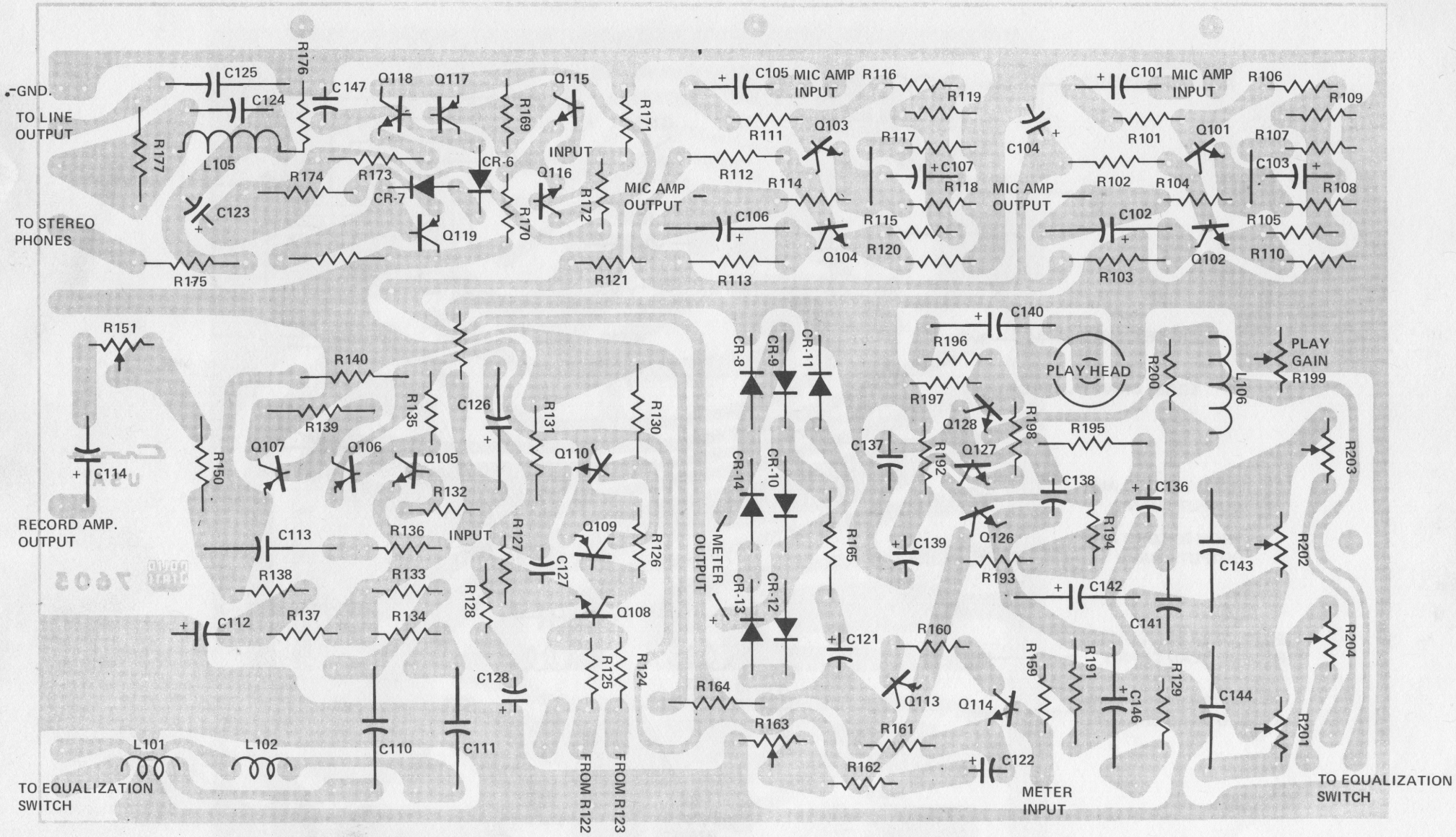
B. Record a "O" level, 1KHz signal, check distortion. Total Harmonic Distortion should be 1% or less.



XA Series,

SX RECORD-REPRODUCE ELECTRONICS

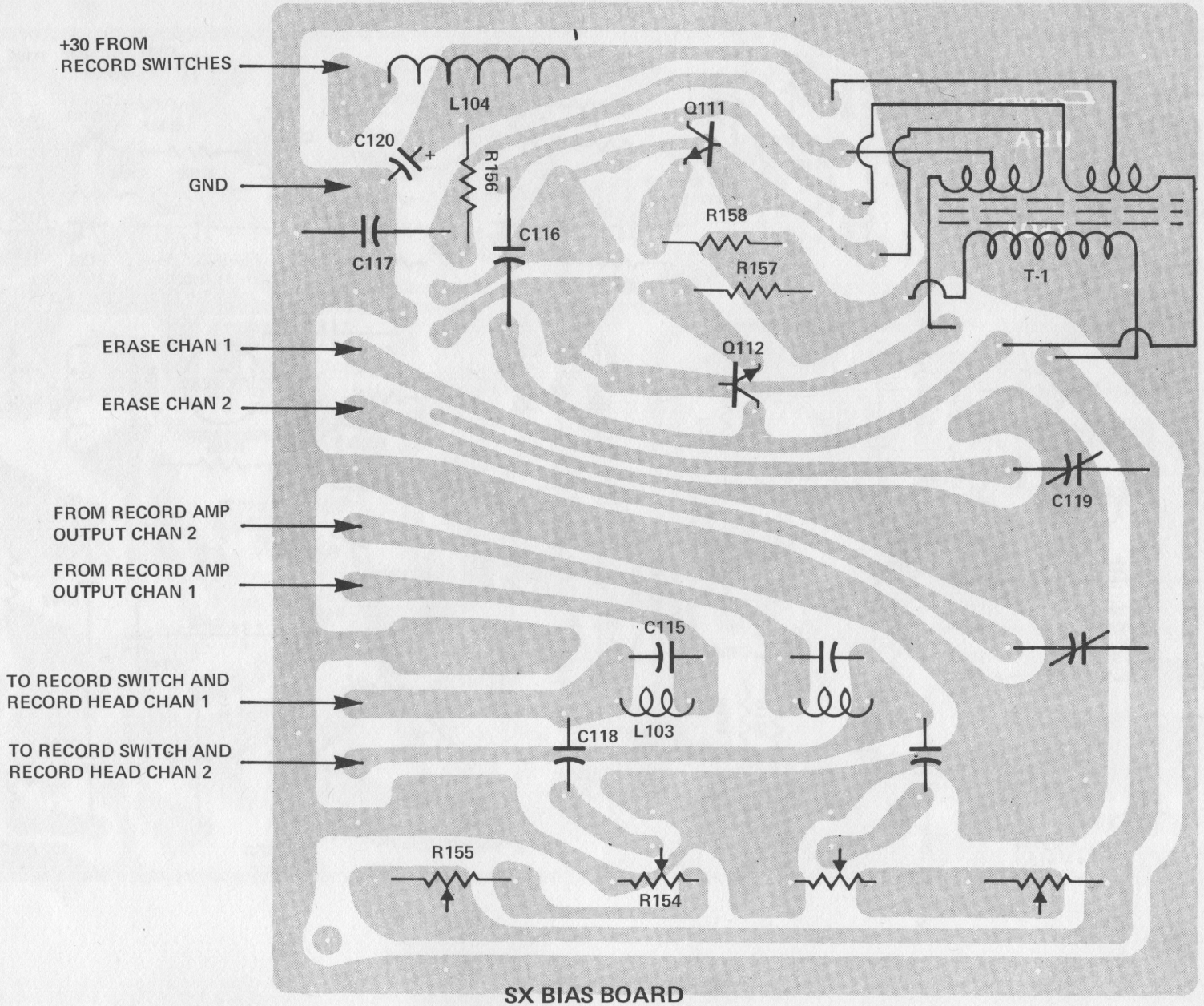
Crown



SX MAIN BOARD

(TOP SIDE)

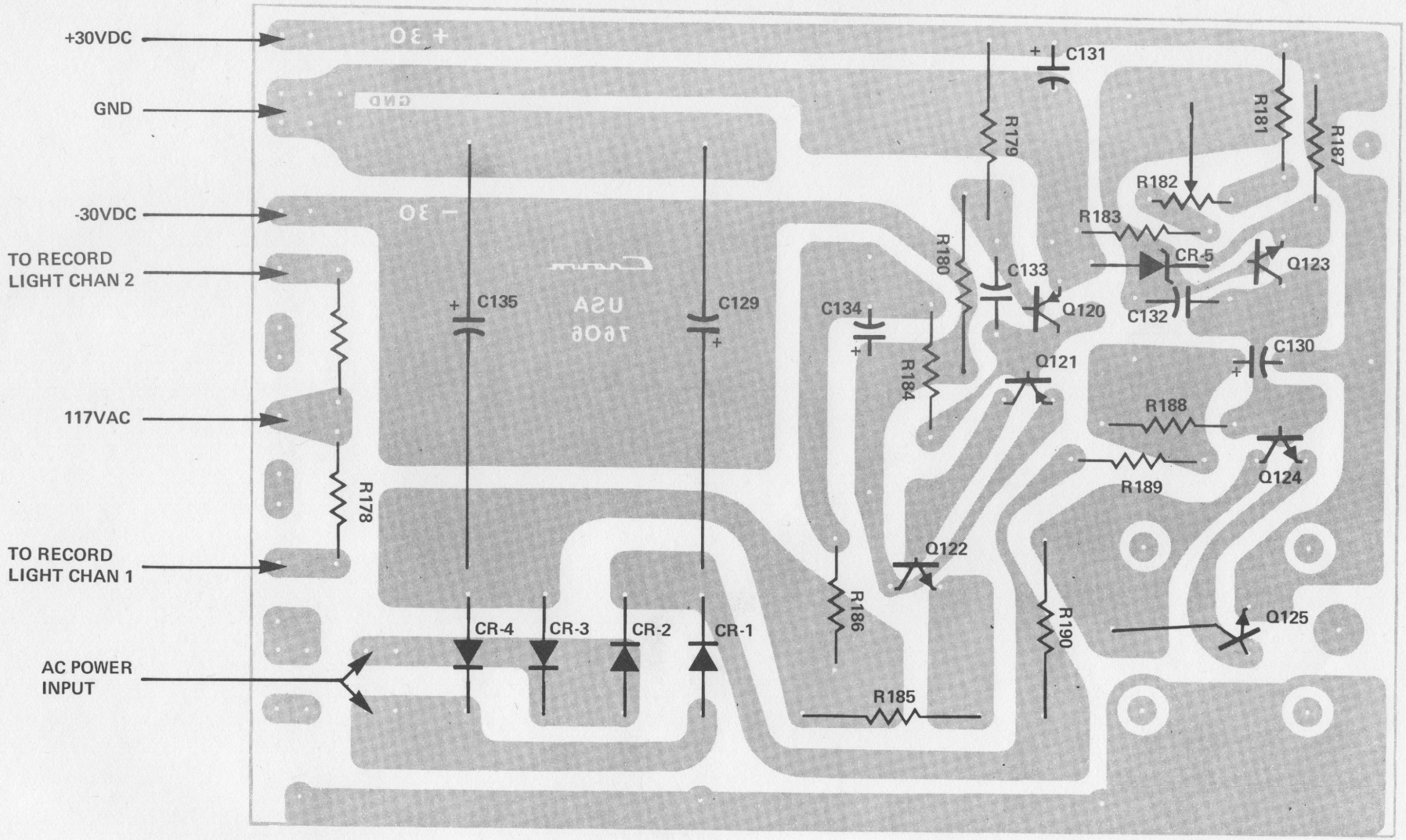
MI-218A



SX BIAS BOARD

(TOP SIDE)

MI-219A

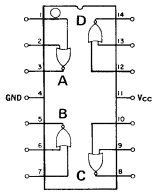


SX POWER SUPPLY BOARD

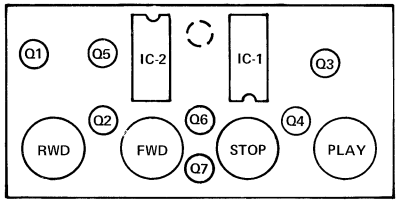
(TOP SIDE)

MI-220A

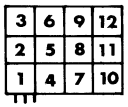
NOTE: R179 & R180 ARE SHOWN IN REVERSE LOCATION

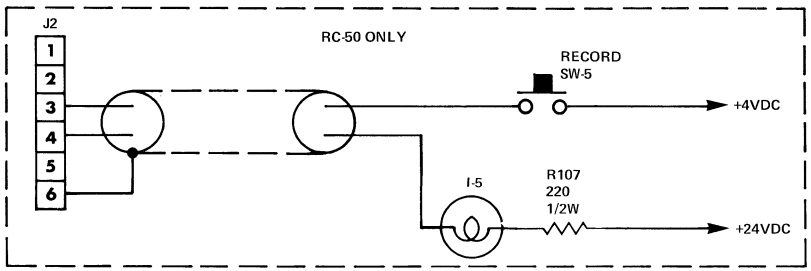


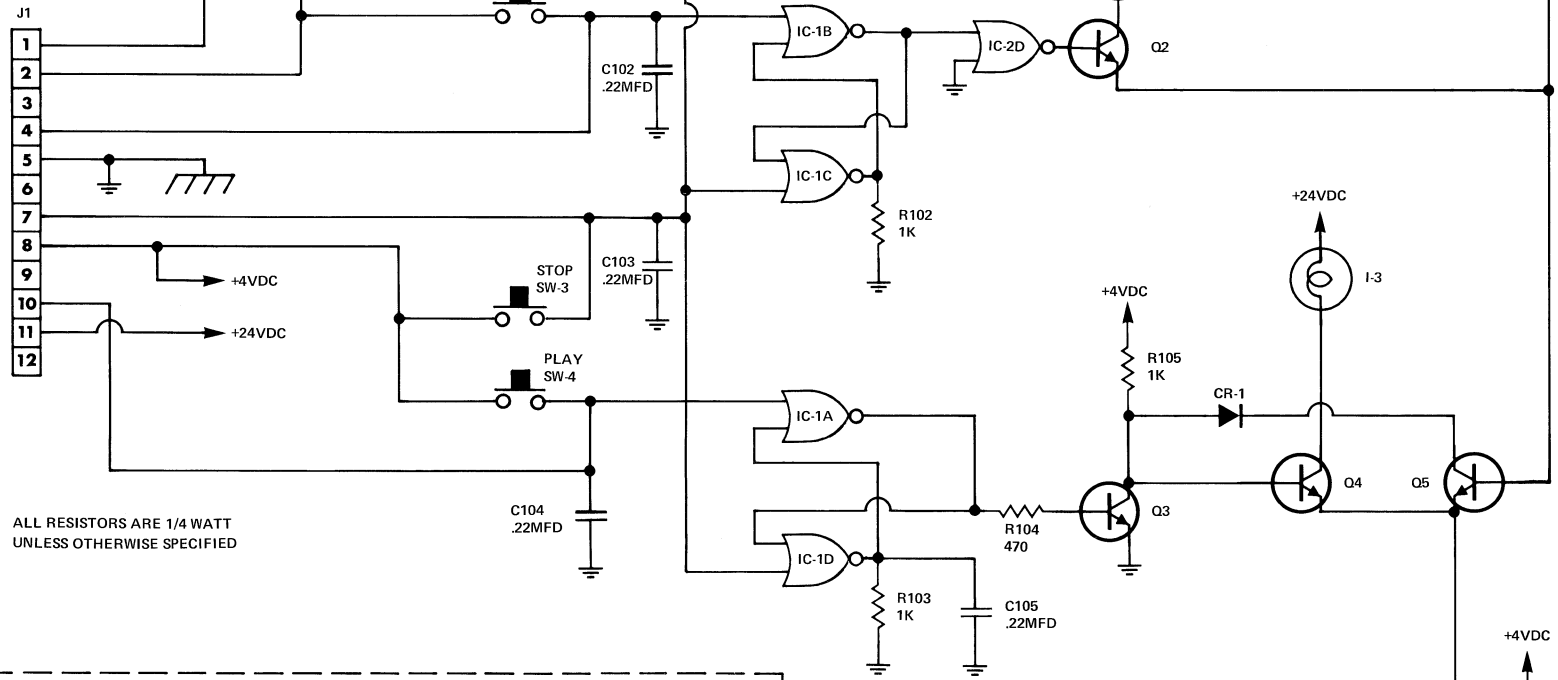
MC724P — Quad 2-Input Gate

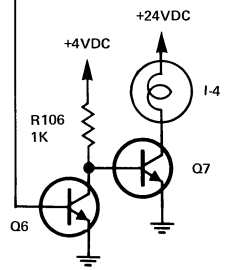


TOP VIEW









ALL RESISTORS ARE 1/4 WATT
UNLESS OTHERWISE SPECIFIED

Crown

MI-232

RC-40 AND RC-50 REMOTE CONTROL

RC40, 50 PARTS LIST

Schematic Ref.	CROWN Part No.	Description
Capacitors		
C101, 2, 3, 4 and 5	2625	.22/12V disc
Connectors		
J1	7811	17 way Amp Cap
J2 (RC50 only)	2149	6 way Amp Cap
	2444	contacts for J1
Camps		
I1, 2, 3, 4	2639	No. 327 lamp
Resistors		
R101, 2, 3 and R1-5, 6	2627	1K ohm, ¼ W.
R104	2626	470 ohm, ¼ W.
R107		220 ohm, ½ W.
Semiconductors		
IC1, IC2	2622	MC724P I.C.
CR1	3447	1N270 diode
Q1, 2, 3, 4, 5, 6, 7	2961	2N3859A
Switches		
SW-1, 2, 3, 4	2614	DIALCO P-Button
	2636	WHITE Lens Cap
	2637	GREEN Lens Cap
	2638	RED Lens Cap
SW-5, I5 (RC-50)	2845	Record P-Button
Mechanical Parts		
RC50	7706	Control Panel
	7826	Circuit Board
	7747	Cast Housing
RC40	7710	Control Panel
	7707	Sub Chassis
	7708	Bottom Cover
	2945	Rubber Foot
	1566	3/8 Grommet
	2271	8-32x¼ T.H.P. Scr.
	1309	3/32 Nylon washer
	1823	No. 6 Int. Lockwasher
	1889	No. 6-32 Hex Nut
	2554	3/8 Fiber Spacer
	2708	No. 8x3/8 Sht. Mtl. Scr.
	2858	No. 6-32x¾ O.H.M. Scr.
	3163	No. 505 Solder Lug

Section 8.3

MODEL T C TAPE COUNTER

8.3.1 DESCRIPTION

The model TC Tape Counter accessory serves as a convenient tape-location reference device. A 4-digit, push-to-reset, indicator counts the number of revolutions of the Take-up Motor, and is there by linked to the tape in all modes of transport operation (see fig. 8-3-1). Rapid return to "0" reference is possible with the push-to-reset button.

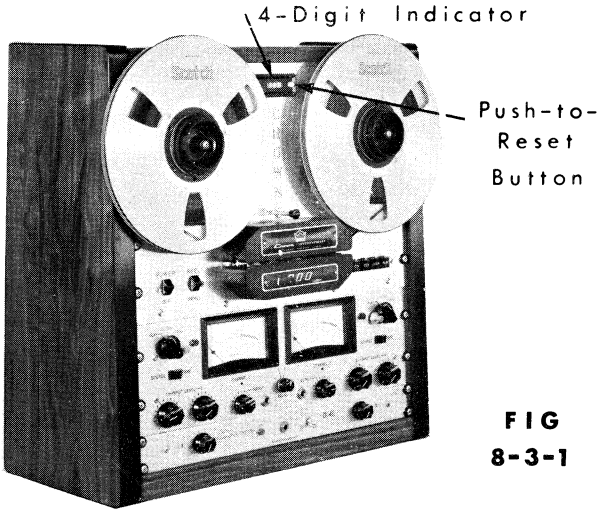


FIG 8-3-1

8.3.2 INSTALLATION

Normally, the TC will be installed at the factory, with no user-installation required.
Since the counter mechanism occupies a separate rack-mounted chasses, the height of a typical machine increases by 1 3/4".
Field-installation of the TC may be effected on all PRO Transports, and many older units having 3/8" of T.U. Motor Shaft (at the rear).

8.3.2.1 All PRO700 and PRO800

The T.U. Motor Shaft will accept the threaded end of the small drive-pulley supplied with the TC kit.

Although a clearance hole is normally provided for this pulley, earlier transports may require modification of the corner cover (see fig. 8-3-2).

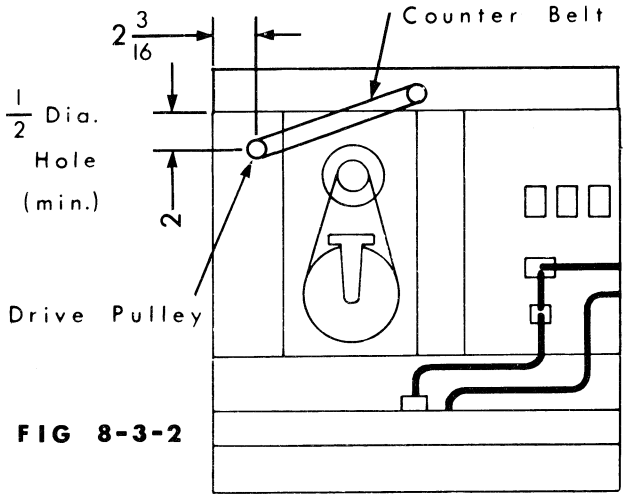


FIG 8-3-2

The drive pulley is then carefully threaded into the rear-end thread shaft of the motor -- tightening by holding reel flange. Stringing the drive belt between pulleys completes the TC installation.

8.3.3.3 T-series 700, G-series 800

A special drive-pulley with 5/16 bore must be supplied with the kit -- specified when ordered by model and S/N of your machine. A modification of motor cover may be necessary on some transports as well.

8.3.3 OPERATION

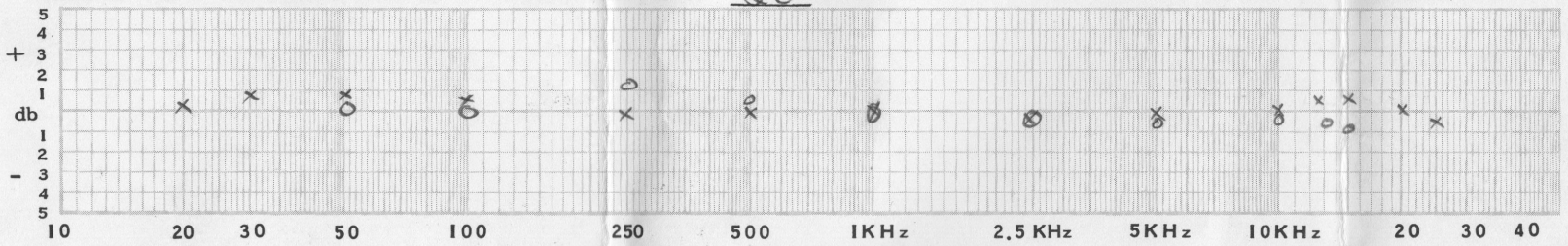
Usually, the white reset-button is depressed at the beginning of a given tape -- establishing a "0" reference. Thereafter, desired locations on the tape must be noted as a convenient means of returning to a taped selection.

MARKING CODE:

"0" INDICATES PLAYBACK RESPONSE USING A REPRODUCE ALIGNMENT TAPE
"X" INDICATES RECORD–PLAYBACK RESPONSE

crown

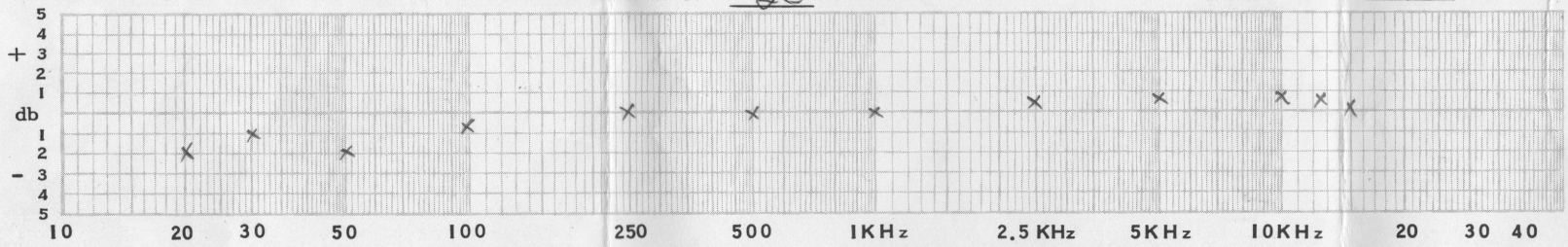
RECORD–PLAY RESPONSE RUN AT A RECORD LEVEL OF - 20 db BIAS SET ____ VU



7½ IPS
PLAY: ± 1.2 db
50 Hz TO 15 KHz

RECORD: ± 0.6 db
20 Hz TO 25 KHz

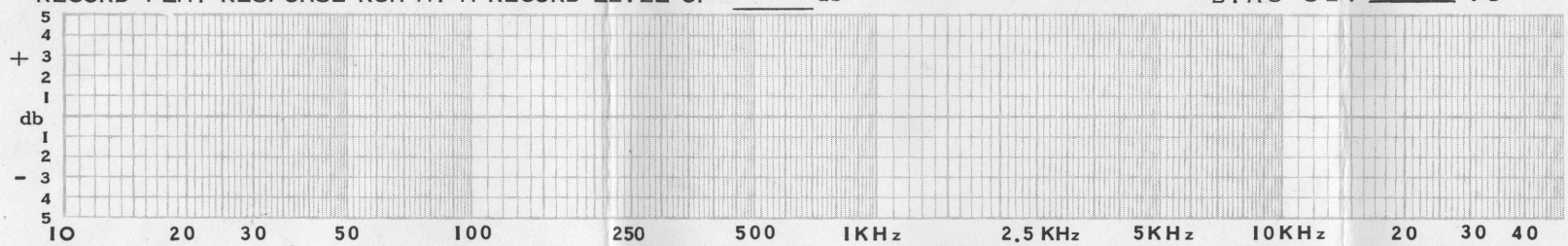
RECORD–PLAY RESPONSE RUN AT A RECORD LEVEL OF - 20 db BIAS SET -2 VU



3¾ IPS
PLAY: ± — db
— Hz TO — KHz

RECORD: ± 1.6 db
20 Hz TO 15 KHz

RECORD–PLAY RESPONSE RUN AT A RECORD LEVEL OF - ____ db BIAS SET ____ VU



____ IPS
PLAY: ± ____ db
____ Hz TO ____ KHz

RECORD: ± ____ db
____ Hz TO ____ KHz

SET–UP DATA:

FULL LEVEL MA .058
ERASE VOLTAGE 51
BIAS MA .78

ERASE LEVEL db- 65
TAPE DISTORTION .18 %
PLAY SIGNAL TO NOISE db- 66

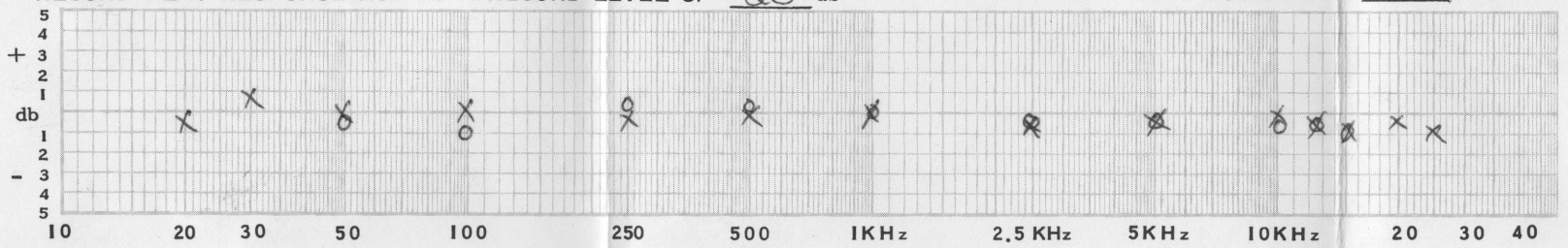
TECHNICIAN DLS
TAPE SCOTCH 207
MODEL SX 824
SERIAL No. K 5236
CHANNEL TWO

MARKING CODE:

"0" INDICATES PLAYBACK RESPONSE USING A REPRODUCE ALIGNMENT TAPE
"X" INDICATES RECORD–PLAYBACK RESPONSE

crown

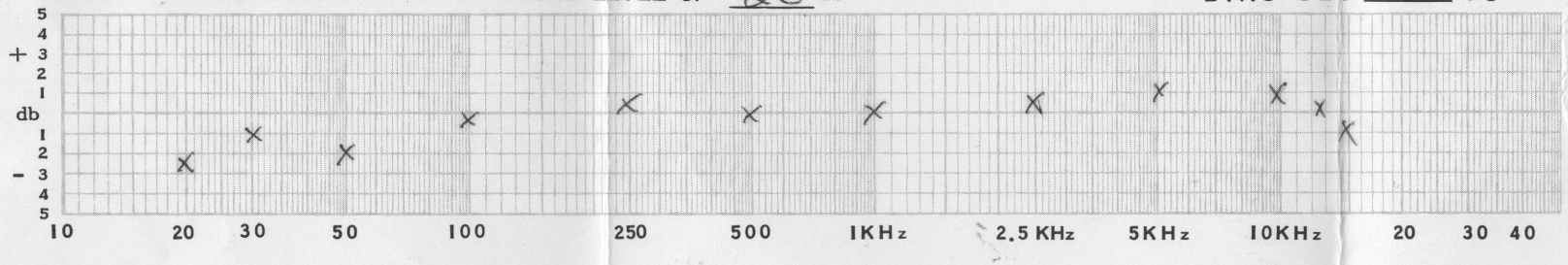
RECORD–PLAY RESPONSE RUN AT A RECORD LEVEL OF - 20 db BIAS SET 0 VU



7½ IPS
PLAY: ± 1.0 db
50 Hz TO 15 KHz

RECORD: ± 1.0 db
20 Hz TO 25 KHz

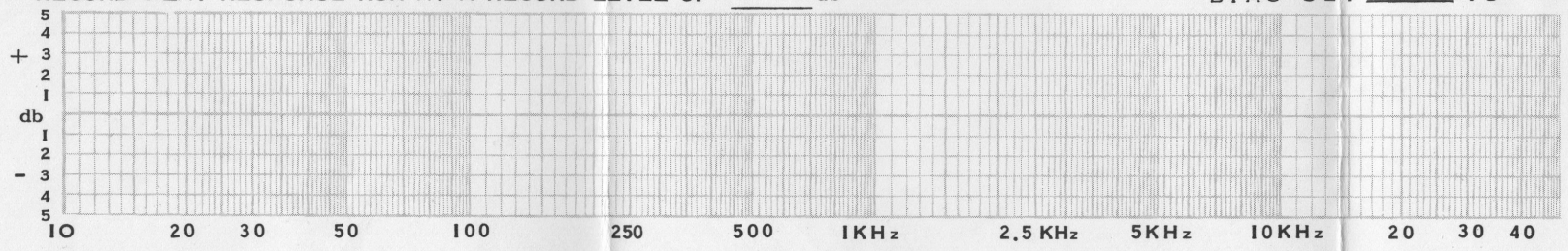
RECORD–PLAY RESPONSE RUN AT A RECORD LEVEL OF - 20 db BIAS SET -2 VU



3¾ IPS
PLAY: ± — db
— Hz TO — KHz

RECORD: ± 2.0 db
20 Hz TO 15 KHz

RECORD–PLAY RESPONSE RUN AT A RECORD LEVEL OF - ____ db BIAS SET ____ VU



____ IPS
PLAY: ± ____ db
____ Hz TO ____ KHz

RECORD: ± ____ db
____ Hz TO ____ KHz

SET–UP DATA:

FULL LEVEL MA .064
ERASE VOLTAGE 51
BIAS MA .90

ERASE LEVEL db- 63
TAPE DISTORTION .14 %
PLAY SIGNAL TO NOISE db- 64

TECHNICIAN DLS
TAPE Scotch 207
MODEL SX824
SERIAL No. K5236
CHANNEL ONE