



INSTRUCTION MANUAL
 MODEL SP-3A-1
 PREAMPLIFIER
 (INCLUDES ALL VERSIONS)

audio research
 HIGH DEFINITION®

3900 ANNAPOLIS LANE NORTH / PLYMOUTH, MINNESOTA 55447-5447
 PHONE: 763-577-9700 FAX 763-577 0323

TABLE OF CONTENTS

Section	Page
Introduction	1
Line Voltage Conversion	1
Equipment Packaging	2
Installation and Mounting	3
Rear Panel Functions	5
System Connection	7
Front Panel Functions	12
General Operation	16
System Diagnostics	17
Factory Service	18
Routine Maintenance	18
Technical Specifications	19
Circuit Description	21
Parts List	24
Equipment Servicing	27
Nominal Power Supply Filter Ripple Waveforms	28
Voltage/Resistance Table	29
Troubleshooting Table	30

LIST OF ILLUSTRATIONS

Title	Page
Equipment Packaging	2
Equipment Dimensions	4
Rear Panel Layout	5
Single Amplifier Connection (for dual output tape recorders)	8
Single Amplifier Connection (for single output tape recorders)	9
Bi-Amplified Connection	10
Tri-Amplified Connection	11
Front Panel Layout	12
Tone Control Response	14
Contour Control Response	14
Frequency Response	15
Phase Response	15
Simplified Schematic Diagram	20
Schematic Diagram	23
Chassis & Tube Layout	31
PCB-85C Component Layout	32
PCB-86 Layout (Resistors)	33
PCB-86 Layout (Capacitors)	34

INTRODUCTION

Congratulations on your purchase. The SP-3A-1 stereo preamplifier was conceived and designed for audio perfectionists. It will probably do more to enhance the quality of musical depth, detail, and subtlety than any other single component in your system. Its ability to perform under actual dynamic listening conditions is unequalled. Conservative design and extensive use of high quality industrial grade components insure many years of trouble-free performance.

LINE VOLTAGE CONVERSION

This equipment can be operated from either 120 Volts or 240 Volts A.C., 50/60 Hz. Check the position of the line voltage selector switch on the rear panel. If necessary, remove the switch safety cover and set the switch to the proper voltage as indicated above the switch. Secure the switch position with the safety cover and screws. Install the appropriate fuse as indicated below if the line voltage is different than that set for at the factory.

Voltage	Fuse
120	1/2 Amp. Type 3AG or MDL Slo-Blo
240	1/4 Amp. Type 3AG or MDL Slo-Blo

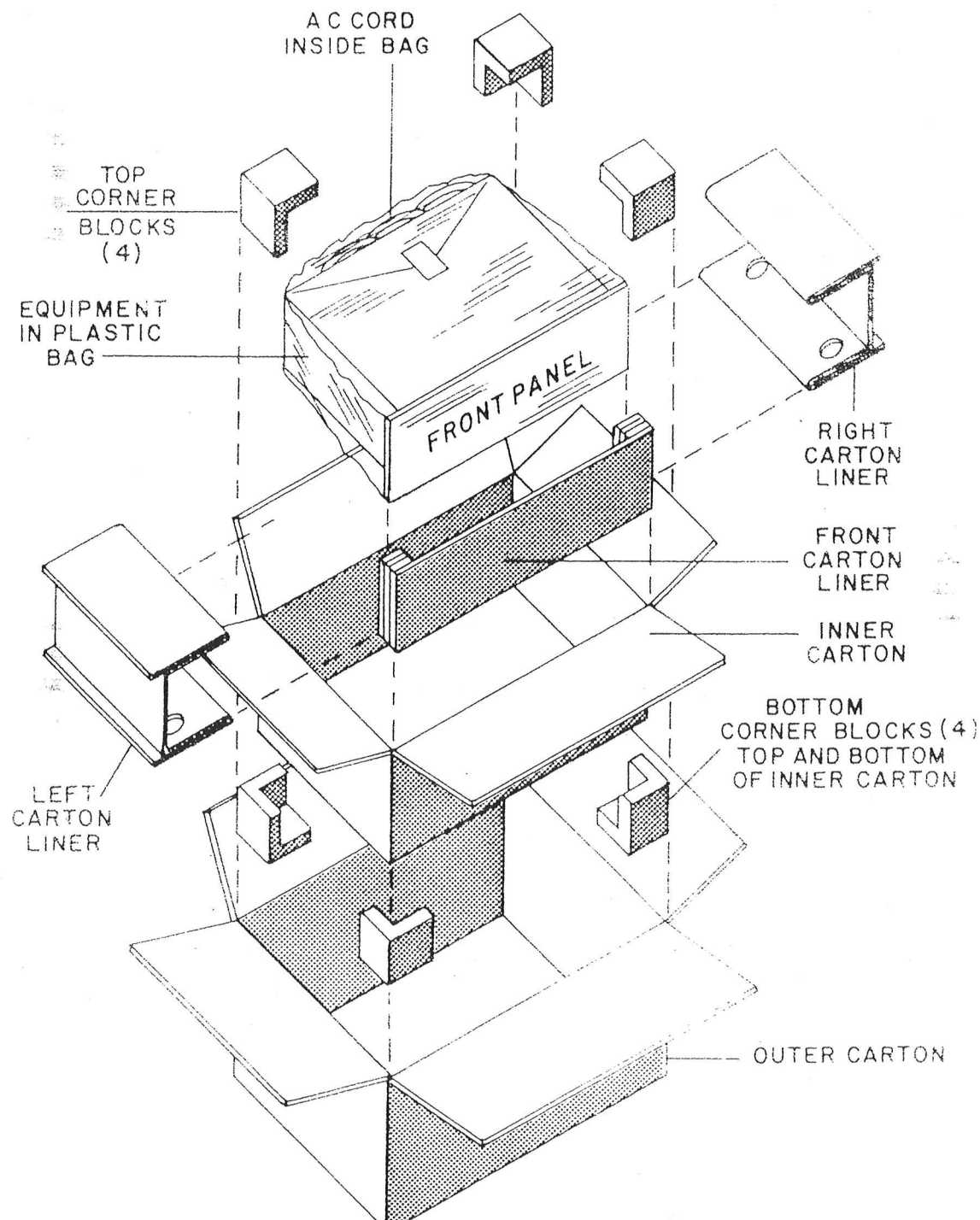
WARNING

To prevent fire or shock hazard, do not expose this equipment to rain or moisture.

This unit contains voltages which may be lethal. Do not operate this unit with covers removed. Refer servicing to qualified personnel.

EQUIPMENT PACKAGING

Save All The Packaging — Your Audio Research component is precision Electronic Equipment, and as such, deserves to be properly cartoned any time shipment is made. You may never have occasion to return it to the factory for service, but if such should be necessary, or other occasion to ship it occurs, the original packaging may save your investment from unnecessary damage or delay.



INSTALLATION & MOUNTING

To insure proper operation and normal component life, this equipment must receive proper ventilation. Never confine this device such as to inhibit proper cooling by natural convection through the ventilated enclosure. If this equipment is to be operated within a confined space, forced air cooling should be provided. It is recommended that the ambient operating temperature never exceed 120°F (49°C).

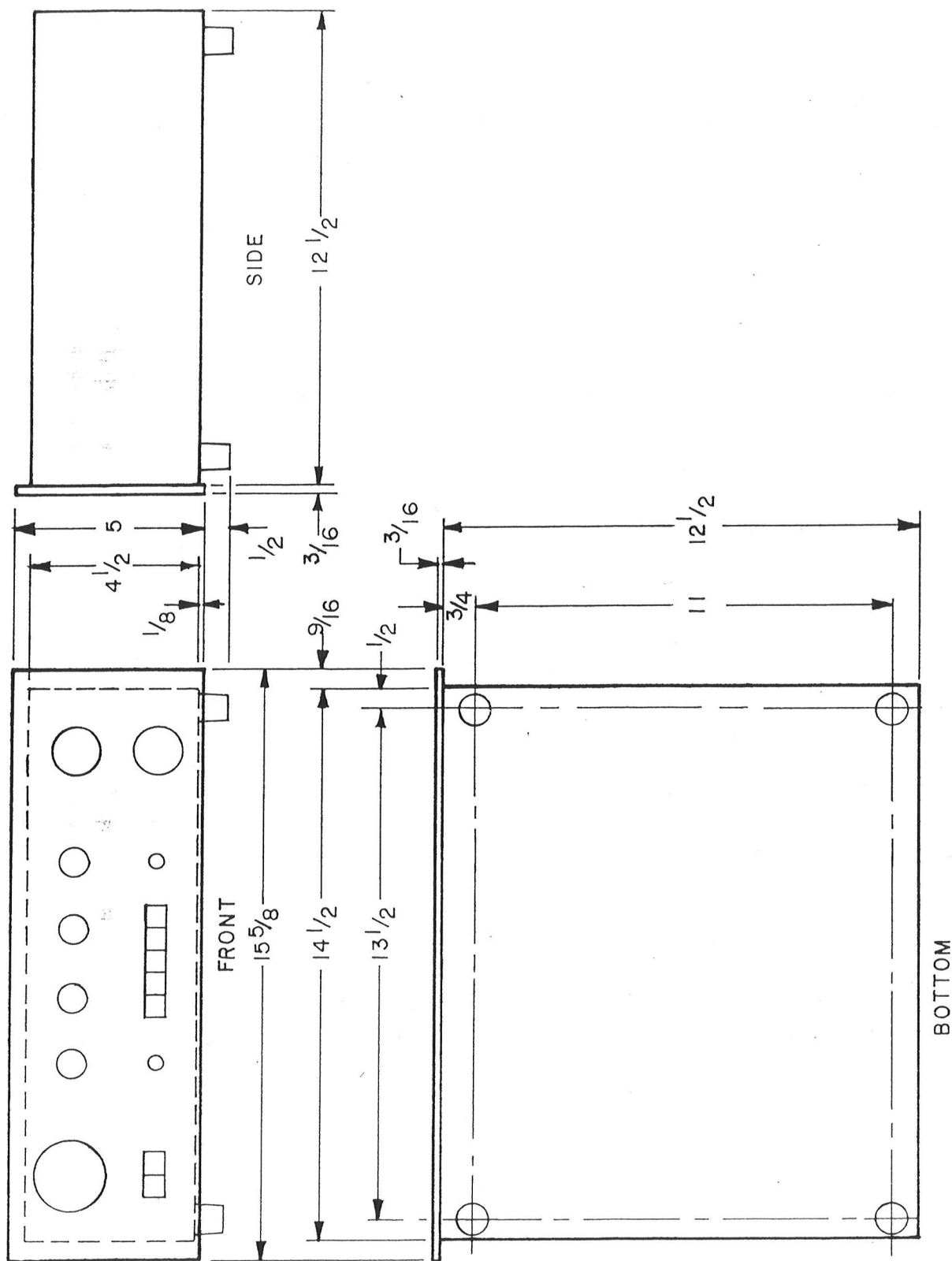
The mechanical configuration of the SP-3A-1 permits four convenient methods of mounting. The equipment drawing on page 4 and the mounting template at the back of this manual show the equipment dimensions necessary to assist in suitable mounting as outlined below:

Shelf Mount — The SP-3A-1 can rest directly upon a shelf or table. The four special elastomer feet prevent slipping on or marring of the mounting surface. For custom installations, the unit may be secured to a mounting shelf via the four holes used to fasten the feet to the bottom of the chassis. To accomplish this, remove the four 8-32 x 1/2" pan head screws holding the feet to the bottom of the chassis. Locate the mounting holes on the shelf using the template or dimensions given on page 4. Drill four 1/4" clearance holes for the # 8 mounting hardware. Insert the feet between the bottom of the chassis and the shelf — the feet serve as ventilation spacers. Secure the equipment to the shelf with four 8-32 screws and washers. The length of the mounting screws is determined by adding 3/4" to the thickness of the mounting shelf.

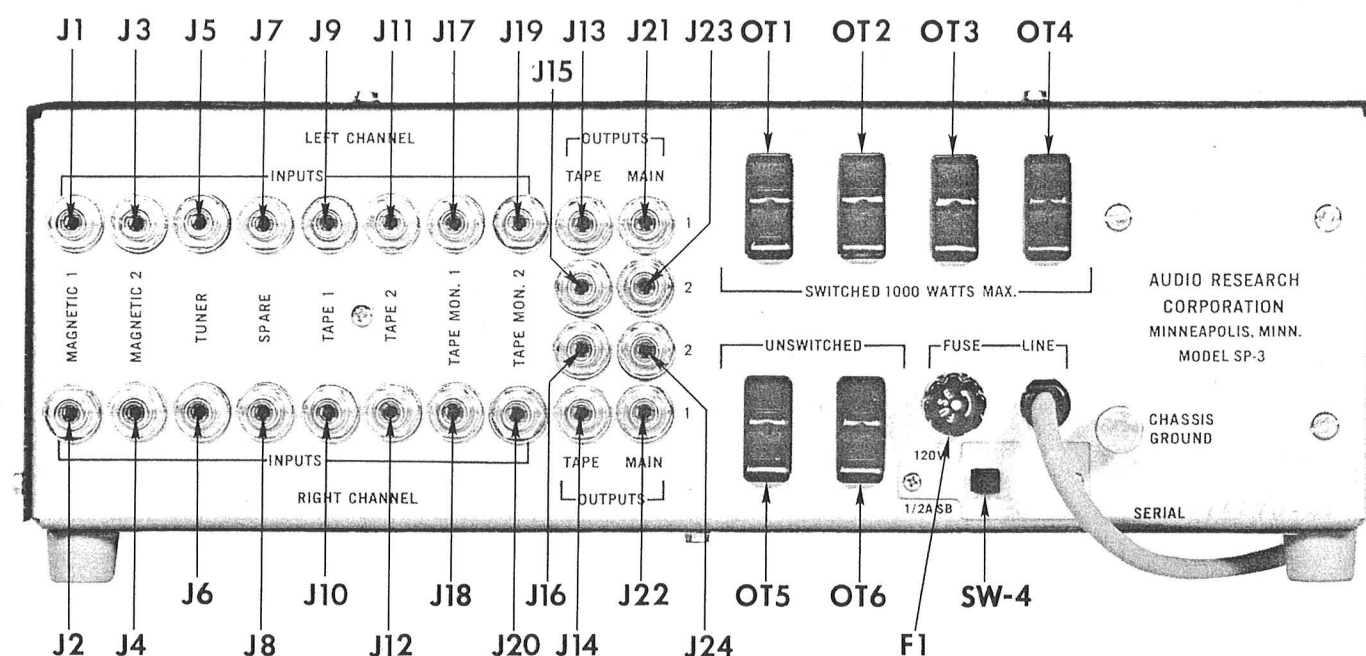
Panel Mount — The front panel of the SP-3A-1 may be flush mounted against the panel of any equipment cabinet or other custom installation. Using the template or dimensions given on page 4, locate and make a cut-out for the chassis. Make sure that the bottom edge of the cut-out is flush with the top surface of the mounting shelf or brackets. If a mounting shelf is used in place of side brackets, make the ventilation cut-out as shown on the template. Secure the unit **without the feet** via the four holes (normally used to fasten the feet) in the bottom of the chassis. The length of the mounting screws is determined by adding 3/8" to the thickness of the shelf or bracket.

Cabinet Mount — An optional solid walnut oiled finish accessory cabinet, Model WC-1, is available for the SP-3A-1. All necessary mounting hardware and instructions are supplied with the cabinet.

Rack Mount — An optional 19" width Rack Mount Panel (natural finish only) is available as Audio Research Corporation part number 10527. This panel enables rack mounting of the SP-3A-1 with other system components. The Rack Panel is attached to the chassis via the control mounting hardware. All necessary hardware and instructions are supplied with the Rack Panel.



EQUIPMENT DIMENSIONS



REAR PANEL LAYOUT

REAR PANEL FUNCTIONS

Refer to the "Rear Panel Layout" diagram above.

Audio Inputs:

- J1 — Magnetic 1, Left Channel
- J2 — Magnetic 1, Right Channel

Connect to record player, tone arm, or cartridge amplifier. Nominal input impedance is 50K (150 pf shunt). Use with magnetic type cartridges requiring RIAA playback compensation. Note: Normally connect grounding wire from record player to the "Chassis Ground" screw (located next to line cord). With certain systems this may add hum in which case no ground wire is required.

- J3 — Magnetic 2, Left Channel
- J4 — Magnetic 2, Right Channel

Same as above. Allows use of a second record player when selected from the front panel.

- J5 — Tuner, Left Channel
- J6 — Tuner, Right Channel

High level inputs. Connect to the output of an AM and/or FM tuner component.

- J7 — Spare, Left Channel
- J8 — Spare, Right Channel

Provides high level inputs for any auxiliary system component. Nominal input impedance is 100K when front panel source selector is in "spare" position. Inputs are shorted to ground when not in use.

- J9 — Tape 1, Left Channel
- J10 — Tape 1, Right Channel

High level inputs. Connect to tape recorder line outputs. Nominal input impedance is 100K.

- J11 — Tape 2, Left Channel
- J12 — Tape 2, Right Channel

Same as above. Allows use of a second tape recorder when selected from the front panel.

- J17 — Tape Monitor 1, Left Channel
- J18 — Tape Monitor 1, Right Channel

High level inputs. Connect to tape monitor outputs of tape recorder Number 1 when using tape recorders with separate monitor outputs. Permits tape monitoring from front panel. When using tape recorders with single outputs, refer to the "system Connection" section and the connection diagram for single output tape recorders on page 9. Nominal input impedance is 100K.

- J19 — Tape Monitor 2, Left Channel
- J20 — Tape Monitor 2, Right Channel

Same as above. Allows tape monitoring of a second tape recorder when selected from the front panel. Follow the same connection procedure as outlined above.

Audio Outputs:

- J13 — Tape 1, Left Channel
- J14 — Tape 1, Right Channel

Connect to tape record Number 1 line inputs. Provides a program source for tape recording. Output signal is independent of "level" control setting and equal to the source input level, i.e. "tuner", "spare", "tape 1", "tape 2", or magnetic phono preamplifier output. Nominal output impedance is 600 ohms. Load impedance must be equal to or greater than 20K.

- J15 — Tape 2, Left Channel
- J16 — Tape 2, Right Channel

Connect to tape recorder Number 2 line inputs. Function and characteristics are same as above.

- J21 — Main 1, Left Channel
- J22 — Main 1, Right Channel

Connect to power amplifier (or electronic crossover) inputs. Nominal output impedance is 600 ohms. Load impedance must be equal to or greater than 20K.

- J23 — Main 2, Left Channel
- J24 — Main 2, Right Channel

Same as (in parallel with) above. Used to drive a second power amplifier. Com-

bined load impedance of Main 1 and Main 2 must be equal to or greater than 20K.

Power Circuits:

- OT1 — Switched AC Convenience Outlet
- OT2 — Switched AC Convenience Outlet
- OT3 — Switched AC Convenience Outlet
- OT4 — Switched AC Convenience Outlet

Connect to system components (power amplifiers, tuners, electronic crossover, etc.) that are to be turned on by the front panel power switch (SW-4B). Will accept only 2 conductor line plugs. Capacity is 1000 watts total (not fused).

- OT5 — Unswitched AC Convenience Outlet
- OT6 — Unswitched AC Convenience Outlet

Connect to record players, turntables, or tape recorders where power should be controlled by the component on-off switch only. This insures proper "cycling" and mechanism disengagement.

- F1 — Preamplifier Line Fuse

Provides protection for preamplifier electronics only. Refer to page 1 for fuse replacement information.

- SW-4 — Line Voltage Selector Switch

Selects for 120 or 240 volt input power. Refer to page 1 for "Line Voltage Conversion" procedure.

SYSTEM CONNECTION

Before connecting the SP-3A-1 into your system, familiarize yourself with the rear panel functions by referring to the diagram and description of the rear panel in the previous section.

Use only high quality shielded phono cables when interconnecting the SP-3A-1 with any signal sources, power amplifiers, or electronic cross-overs. Avoid inexpensive cables which use "weak" or soft metal grounding shells as they may introduce hum and/or noise into the system.

Four different system wiring diagrams are shown on pages 8, 9, 10 and 11. Choose the diagram that applies to your system configuration. A brief description of each system is given below:

- a) Single Amplifier Connection (for dual output tape recorders) — page 8.

This basic diagram should be used for all single power amplifier systems incorporating tape recorders with separate tape monitor outputs. Also follow this diagram when tape recorders are not used by ignoring pertinent components and associated wiring.

- b) Single Amplifier Connection (for single output tape recorders) — page 9.

To permit "tape copying" or "cross-taping" with recorders having a single output connector per channel, phono cable "Y" adapters must be used as shown in this diagram. Make connections as follows:

1. Connect the single end of a shielded phono cable "Y" adapter to the "tape 1" right channel input on the rear panel of the SP-3A-1. Connect one of the two outputs of the "Y" adapter to the right channel "tape mon. 1" input with a short phono cable. Connect the remaining output of the "Y" adapter to the "right channel output" connector of tape recorder number 1.
2. Connect the single end of a shielded phono cable "Y" adapter to the "tape 1" left

SP-3A-1. Connect one of the two outputs of the "Y" adapter to the left channel "tape mon. 1" input with a short phono cable. Connect the remaining output of the "Y" adapter to the "left channel output" connector of tape recorder number 1.

3. Connect a phono cable from the right channel "tape output 1" of the SP-3A-1 to the right channel (high level) input of tape recorder number 1.
4. Connect a phono cable from the left channel "tape output 1" of the SP-3A-1 to the left channel (high level) input of tape recorder number 1. This completes the wiring of tape recorder number 1.
5. Repeat the above wiring procedure for tape recorder number 2 using the "tape 2 inputs" and "tape 2 outputs" of the SP-3A-1.
6. Connect the remaining system components as shown.

The wiring diagram shown and described above enable complete tape monitoring of a cross-taping or tape-copying procedure with the SP-3A-1 front panel pushbuttons. The SP-3A-1 and (tape-copy "Y" adapter modification) is also shown in the electrical schematic on page 23.

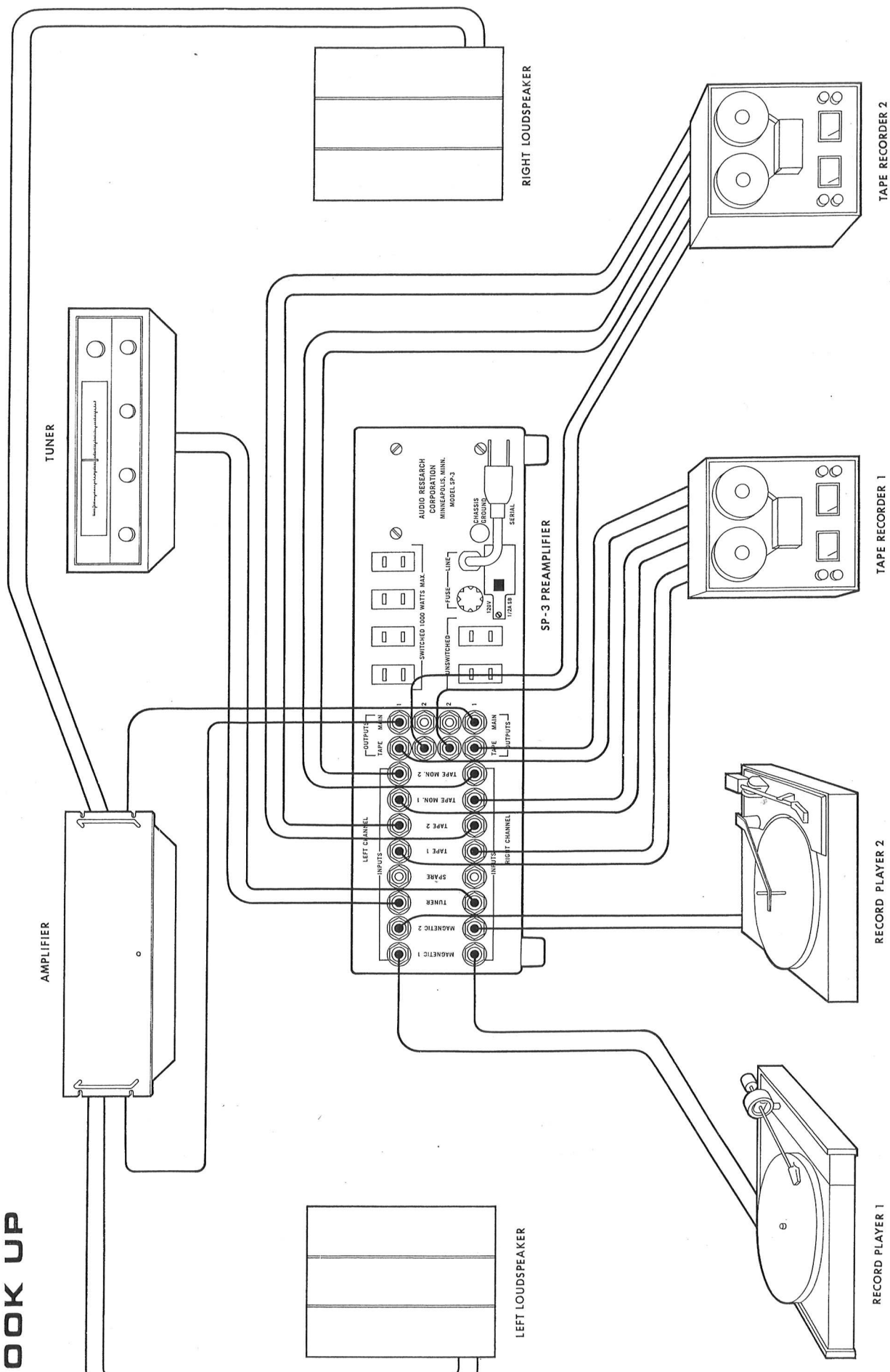
- c) Bi-Amplified Connection — page 10.

Using this wiring diagram for 2 way (bi-amplified) speaker systems which incorporate an Electronic Crossover such as the Audio Research EC-2. Connect other system components as described in (a) above.

- d) Tri-Amplified Connection — page 11.

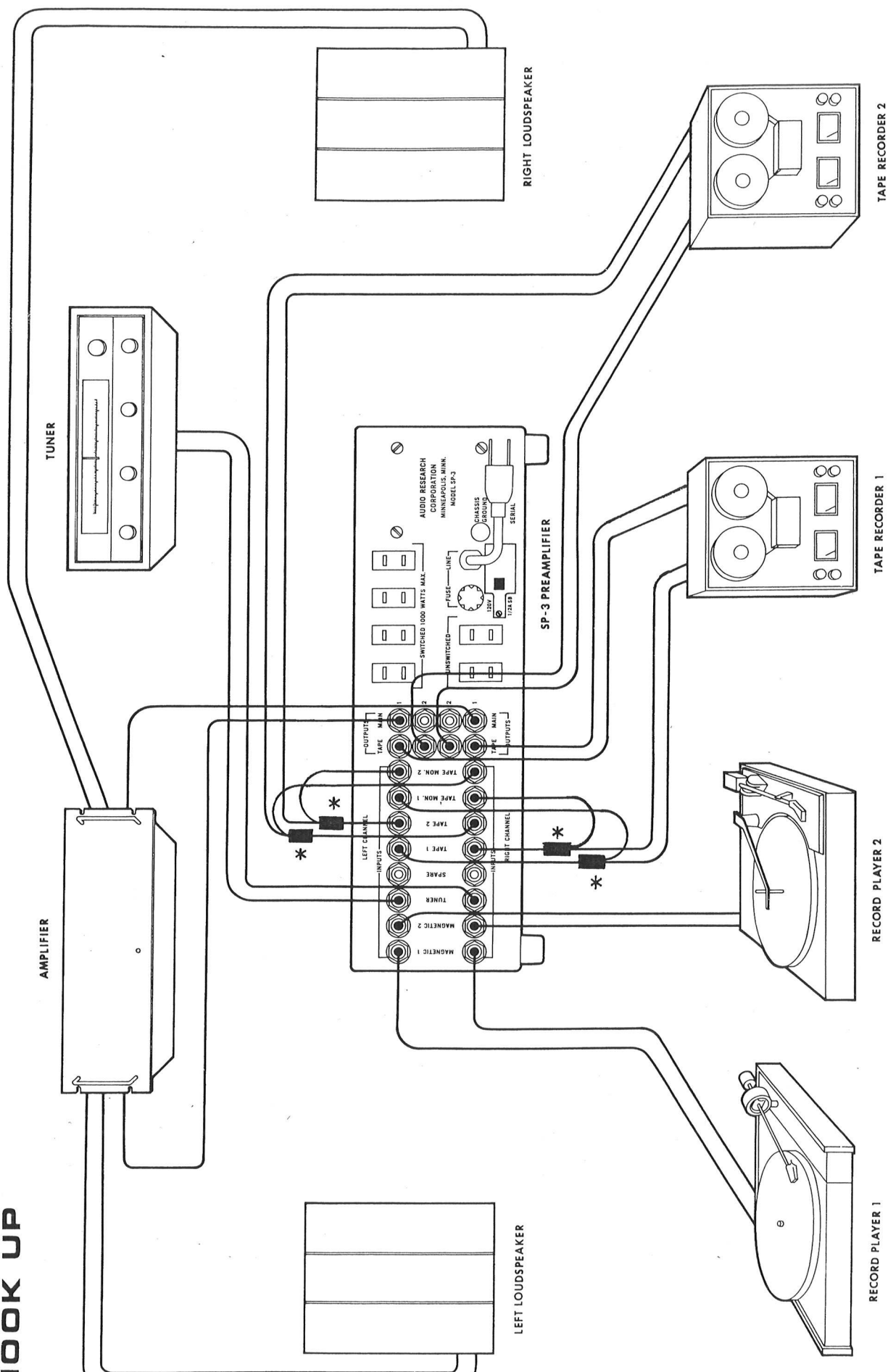
Use this wiring diagram for 3 way (tri-amplified) speaker systems which incorporate an Electronic Crossover such as the Audio Research EC-4. Connect other system components as described in (a) above.

YPICAL
OOK UP

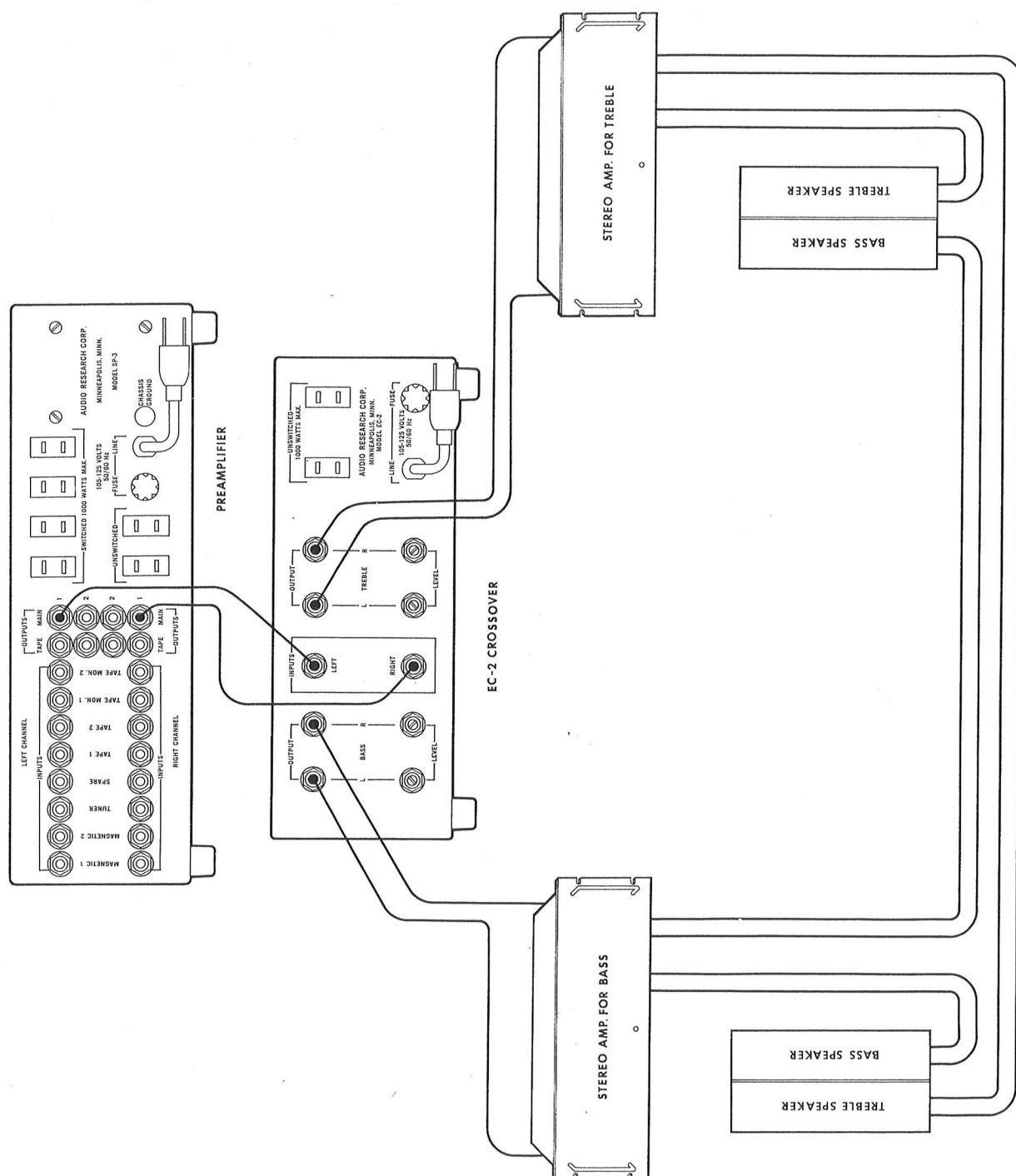


SINGLE AMPLIFIER CONNECTION (for dual output tape recorders)

TYPICAL
LOOK UP

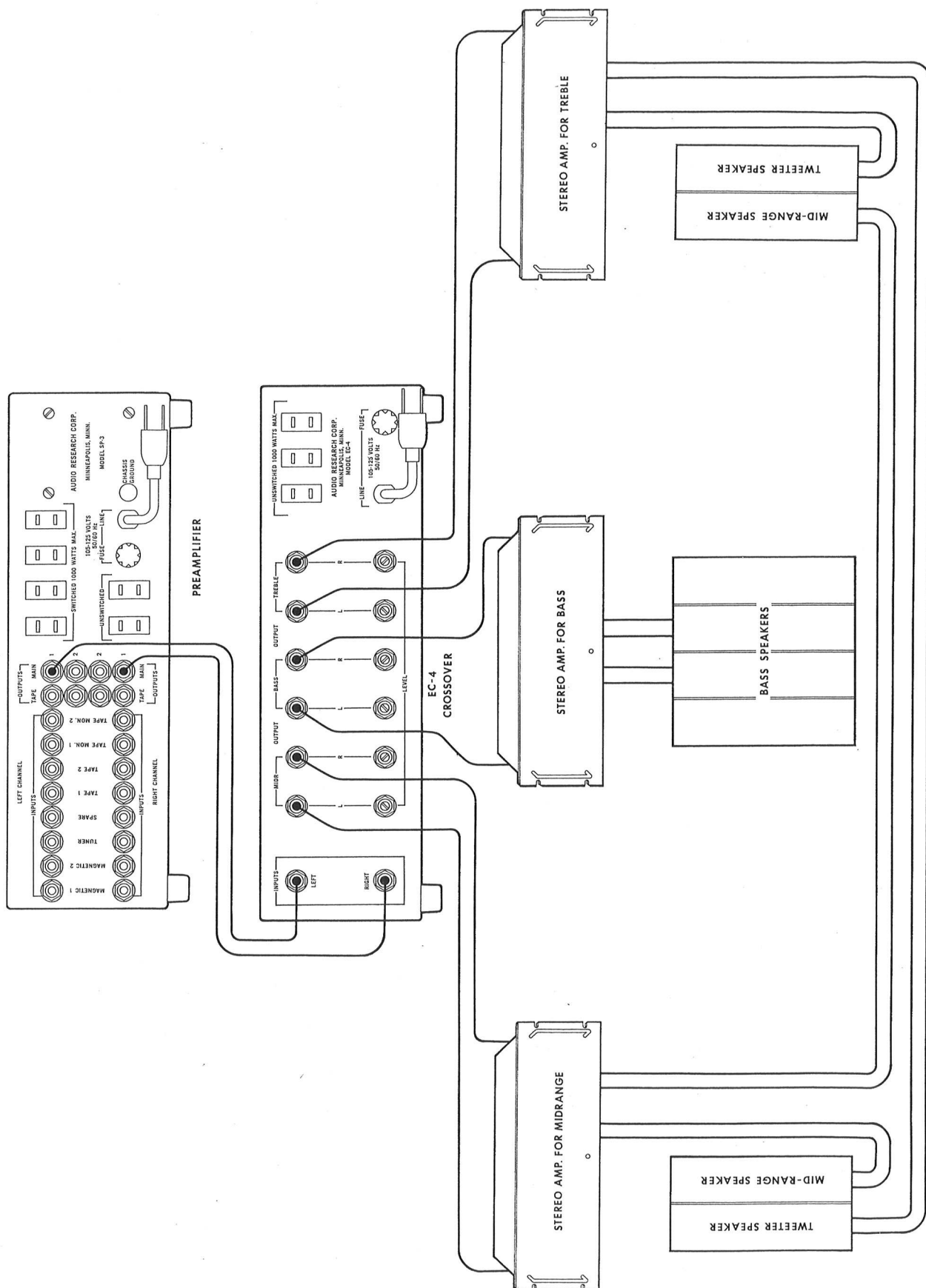


SINGLE AMPLIFIER CONNECTION (for single output tape recorders)



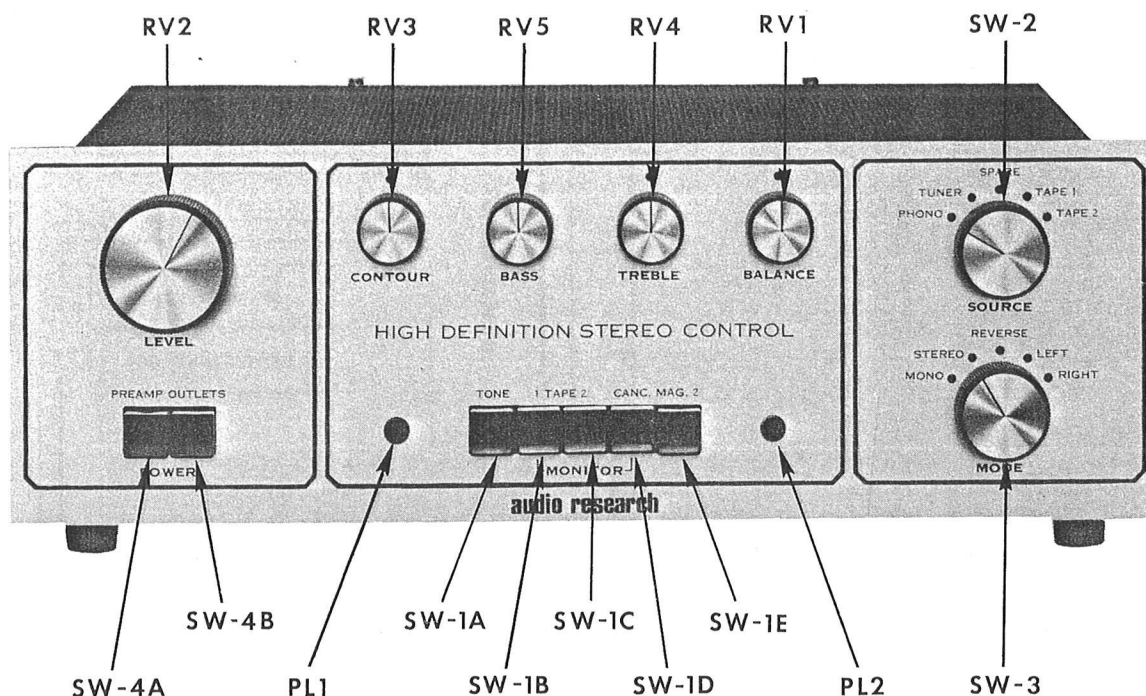
2 WAY SPEAKER SYSTEM

BI-AMPLIFIED CONNECTION



3 WAY SPEAKER SYSTEM

TRI-AMPLIFIED CONNECTION



FRONT PANEL LAYOUT

FRONT PANEL FUNCTIONS

Refer to the "Front Panel Layout" diagram above.

Push Buttons

Preamp
Power (SW-4A)

Description

Preamplifier on-off switch. Push button in for power "on". Also enables the "outlet power" switch, SW-4B. Push to release for power "off". Green indicator lamp, PL1, is illuminated when preamplifier is on.

Outlet
Power (SW-4B)

Switches rear panel outlets, OT1, OT2, OT3, OT4, "on". Allows separate or simultaneous turn-on of power amplifier(s). Push button to release for outlets "off". Pre-amp power switch, SW-4A, must be "on" before power is applied to the switched outlets. Leaving the "outlet power" switch on (pushed in) allows turn on and off of power amplifier(s) simultaneously with preamplifier. Red indicator lamp, PL2, is illuminated when switched outlets are on.

Push Buttons

Tone (SW-1A)

Description

Depressing switch activates "contour", "bass", and "treble" control circuitry. Unless needed, switch should be left off (out) for optimum performance and flat response.

Tape 1
(SW-1B)

Depressing switch allows instantaneous monitoring of tape recordings on tape channel 1. Push "canc." switch, SW-1D, to cancel (turn off) tape monitor function. Switch should be off (out) for normal listening.

Tape 2
(SW-1C)

Same as above except allows monitoring of tape channel 2.

Rotary Switches

Source (SW-2)

Switch selects one of five rear panel inputs (sound sources) as marked. "Phono" position selects "magnetic 1" input. "Magnetic 2" input is selected by the push button switch, SW-

1E, with the "source" switch left in the "phono" position. The selected source is also switched to the "tape outputs".

Mode (SW-3)

Switch selects one of five "main output" modes:

"Mono" — Combines the left and right input channels internally to provide a monaural output (common output for both left and right main outputs).

"Stereo" — Provides normal stereophonic operation without channel reversal, i.e. left input to left output, right input to right output.

"Reverse" — Provides stereophonic operation except channels are reversed, i.e. left input to right output, right input to left output.

"Left" — Left channel input sources are coupled to both the left and right "main outputs" simultaneously. The "balance" control functions as normal.

"Right" — Same as above except right channel input sources are coupled to both the left and right "main outputs" simultaneously.

Note: The "tape outputs" are unaffected by the position of the "mode" switch.

Rotary Controls

Level (RV2)

Controls preamplifier "main output" level (volume). Power amplifier or source gain controls should be set such that normal listening levels occur at approximately a 1 or 2 o'clock setting.

Balance (RV1)

Controls the relative volume of each channel. Equal channel volume occurs when the control is centered at the indicator mark. Clockwise rotation from center position increases right channel "main output" level

Contour (RV3)

while decreasing left channel output. Counter-clockwise rotation increases left channel output and decreases right channel output.

Activated when the tone switch, SW-1A, is depressed. Provides a bass and treble compensated output when listening at reduced or low volume levels. To use, set control full clockwise (12 o'clock), then advance "level" control, RV2, to a "full" listening volume. Turn "contour" control counter-clockwise to reduce volume to desired listening level. See response curves on page 14.

Treble (RV4)

Treble tone control circuitry is activated when tone switch, SW-1A, is depressed. Response is flat when control is centered at indicator mark. Clockwise rotation increases treble response while counter-clockwise rotation decreases response. See response curves on page 14.

Bass (RVS)

Bass tone control circuitry is activated when tone switch, SW-1A, is depressed. Response is flat when control is centered at indicator mark. Clockwise rotation increases bass response while counter-clockwise rotation decreases response. See response curves on page 14.

Indicators

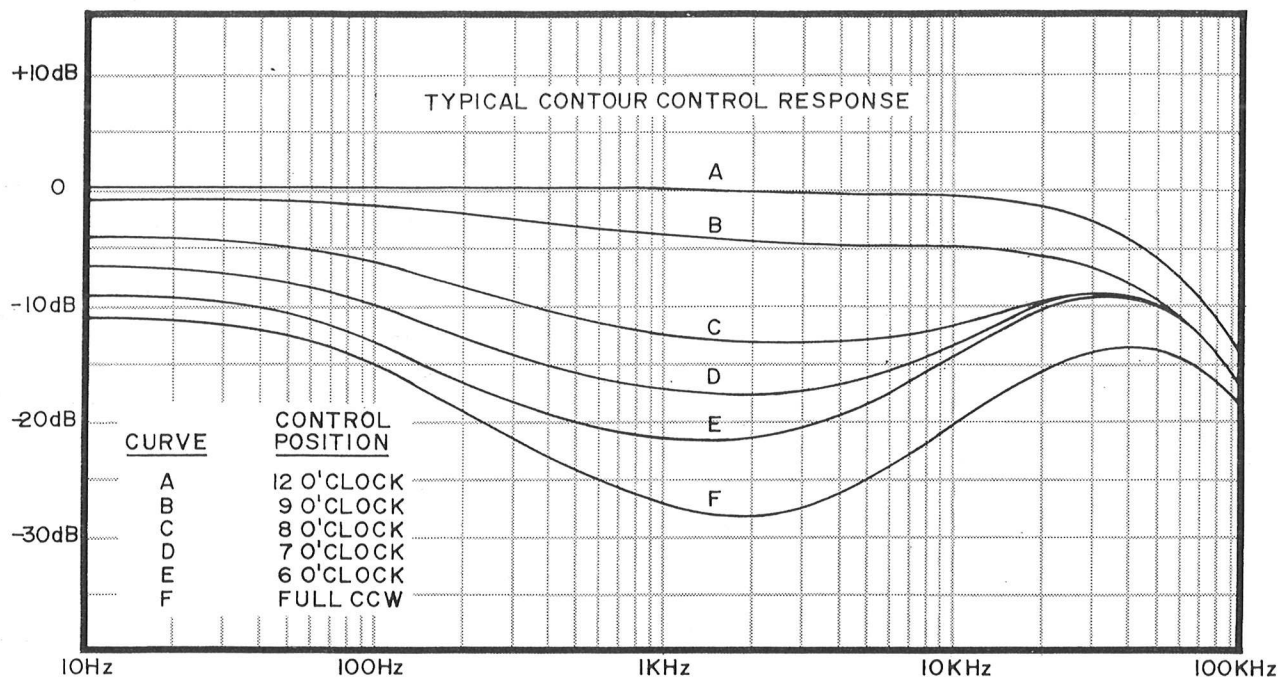
Green Lamp (PL1)

Illuminated when preamplifier power switch, SW-4A, is "on".

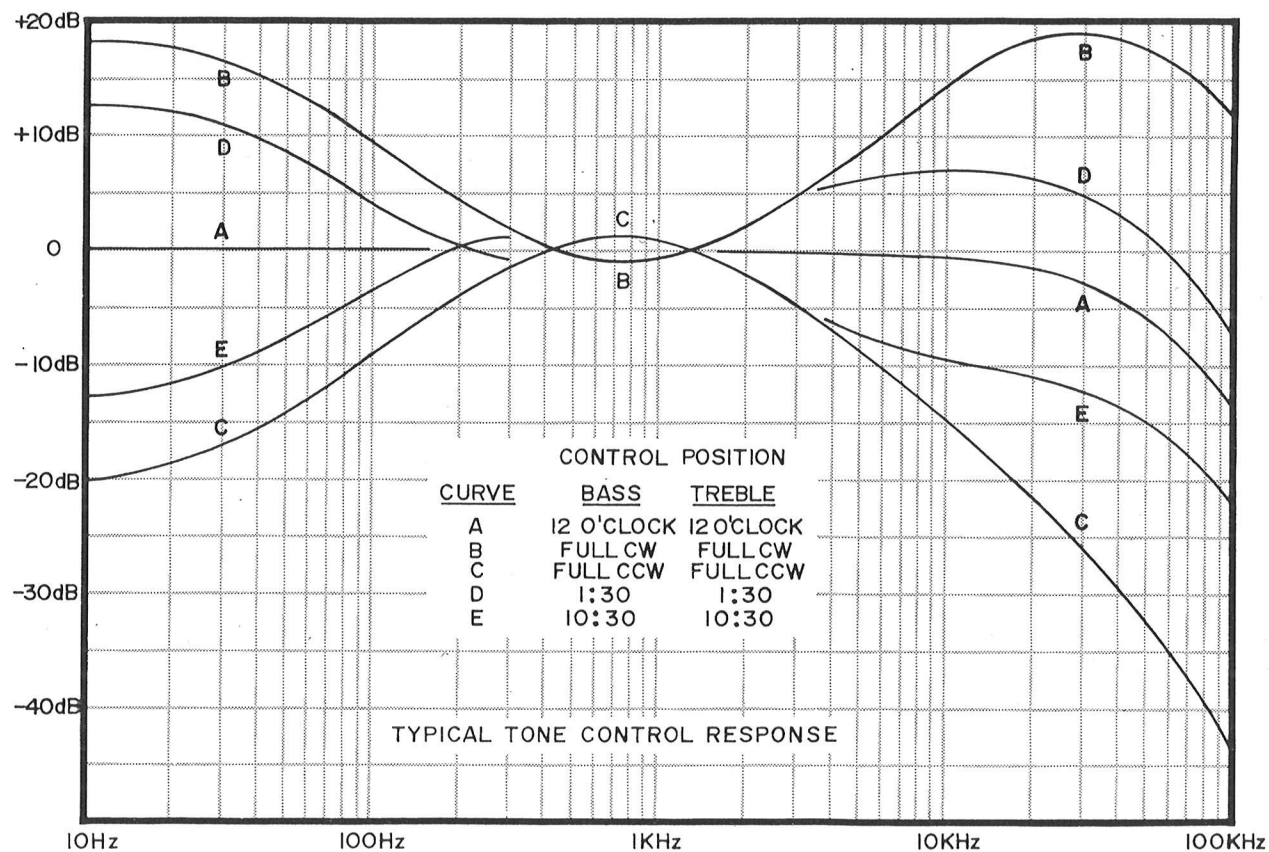
Red Lamp (PL2)

Illuminated when rear panel switched outlets, OT1, OT2, OT3, OT4, are "on".

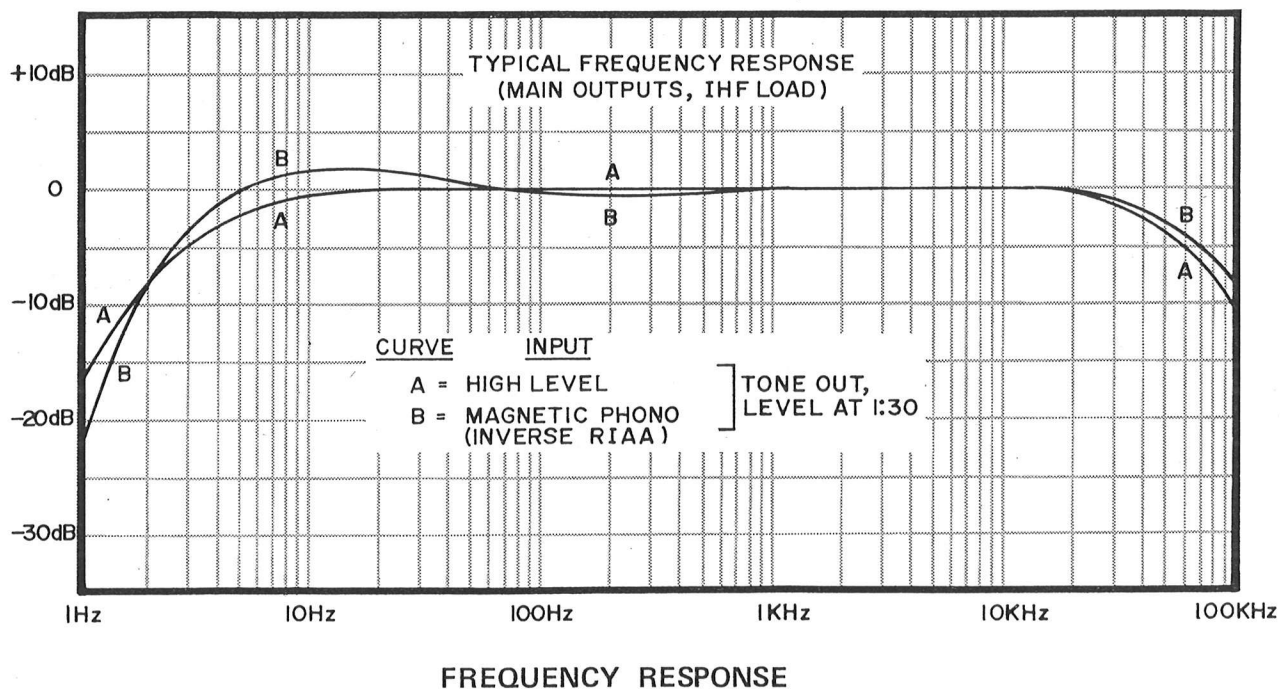
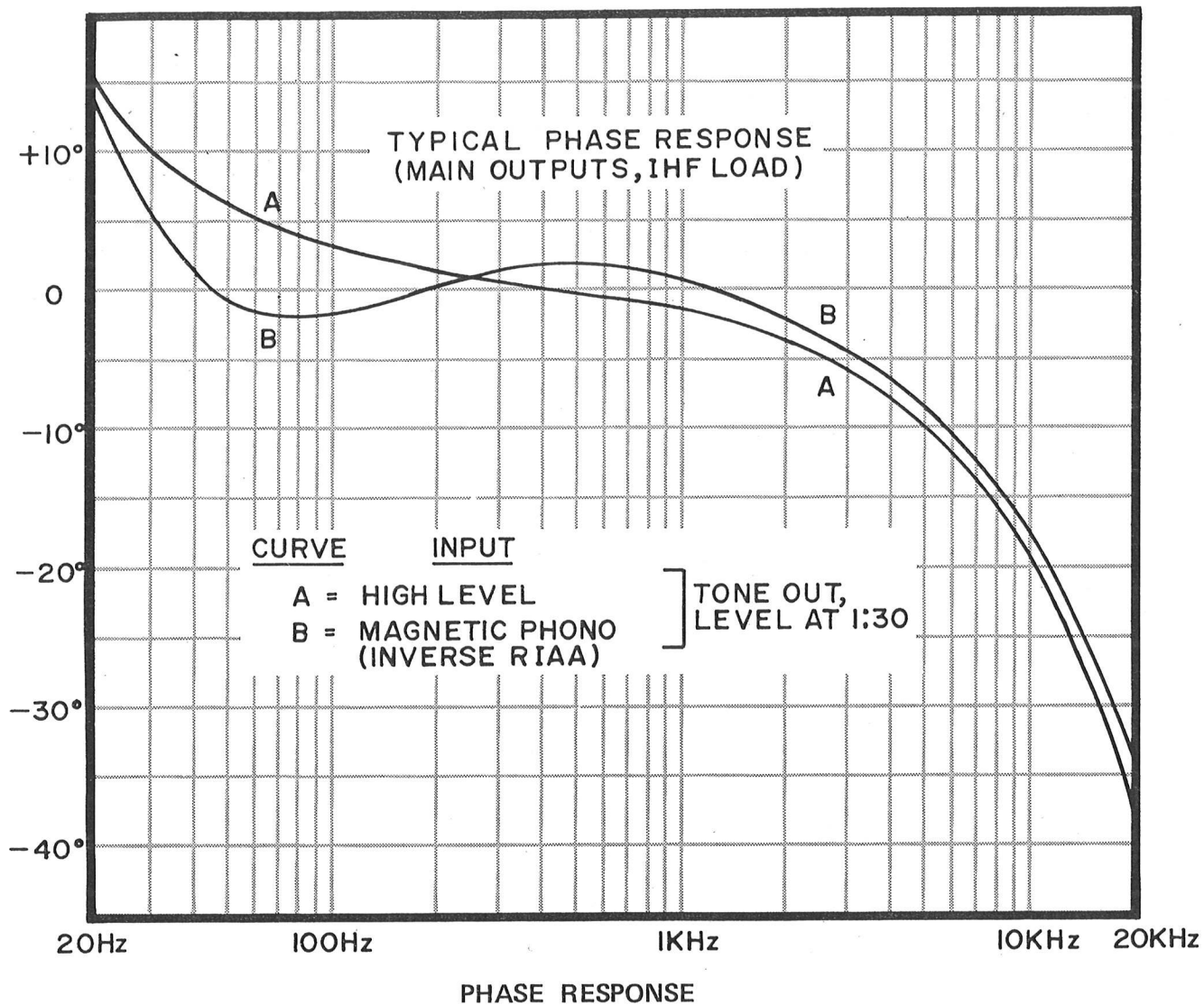
Note: Lamps are replaceable from the front panel by unscrewing (CCW) the "lens" and extracting the bulb from the lens base. Refer to the parts list or schematic diagram for type and number. PL1 and PL2 are not interchangeable.



CONTOUR CONTROL RESPONSE



TONE CONTROL RESPONSE



GENERAL OPERATION

Before operating, familiarize yourself with the front panel control functions by referring to the diagram and control description in the previous section. To operate your music system proceed as follows:

1. Set "level" control at minimum (full counter-clockwise).
2. Push "preamp" power switch "on" — green indicator panel light should illuminate.
3. Push "outlets" power switch "on" to turn on power amplifier(s) — red indicator panel light should illuminate.

Note: Since the SP-3A-1 is a vacuum tube device, it has "warm-up" characteristics which result in an output pulse within 20 seconds after power is first applied. This pulse occurs regardless of input and is due to "charging" of the output coupling capacitors.

It is recommended that when using solid state power amplifiers, which have fast warm-up characteristics, turn-on of the power amplifier be delayed by 20 to 30 seconds after pre-amplifier turn-on to avoid any subsequent "thump" through the speakers. The switch controlled AC convenience outlets are used for this purpose.

Turn-on of vacuum tube power amplifiers such as the Audio Research D-76 does not require any delay since it has warm-up characteristics similar to the SP-3A-1. Leaving the "outlet power" switch on (pushed in) allows turn on and off of power amplifier(s) simultaneously with the preamplifier.

4. Turn on desired source (record player, tuner, tape recorder, etc.)
5. While system is "warming up" (Approximately 30 seconds) set "source" switch to program source desired, "mode" switch to "stereo"; "contour", "bass", "treble", and "balance" controls to a 12 o'clock position, and all five button switches "out".
6. Turn "level" control up to desired listening volume.
7. Push "tone" button **in** to activate "contour", "bass", and "treble" controls. Leave "tone" button **out** for optimum performance and flattest response.

To use "contour" control, turn knob full clockwise (12 o'clock) with "tone" button pushed **in**. Advance the "level" control to full listening volume. Turn "contour" control counter-clockwise to reduce volume to desired listening level.

8. "Tape 1 and 2" buttons allow instantaneous monitoring of tape recordings. The "canc." button cancels tape monitors.
9. "Mag. 2" button disconnects "magnetic 1" input and connects "magnetic 2" input to allow use of second record player.
10. Refer to the previous section for a detailed description and operation of the front panel controls.

SYSTEM DIAGNOSTICS

In case of difficulty after connecting the SP-3A-1 into your system, a list of common system problems and possible causes is provided below to aid in troubleshooting:

Symptom	Possible Cause
Both channels dead	— Power amplifier off
	— Controls improperly set
	— Improper interconnect wiring
	— Defective signal source
	— Blown power amplifier fuse
	— Blown SP-3A-1 fuse
One channel dead	— Balance control not centered
	— Defective audio cable
	— Improper interconnect wiring
	— Defective signal source
Hum or noise	— System ground loop
	— Turntable not grounded
	— Poor interconnect wiring
	— Defective audio cable
	— Excessive lead length
	— Defective signal source
High distortion	— Low AC line voltage
	— Loudspeaker-Turntable mechanical feedback
	— Defective cartridge or source

FACTORY SERVICE

In the event that service other than routine tube or fuse replacement becomes necessary, this equipment should be returned to the factory or franchised dealer. Should return to the factory be required, a return authorization form must be obtained. Please write or call customer service at Audio Research to obtain this.

NOTE: WE CANNOT ACCEPT EQUIPMENT THAT DOES NOT HAVE THIS RETURN
AUTHORIZATION ATTACHED.

The original equipment packaging should be used any time shipment is made. Refer to page 2 for proper re-packaging of this equipment in the original carton.

All shipments to the factory must be prepaid and insured for full value. All factory-serviced equipment will be returned freight collect. In the event that chargeable repairs are required, you will be contacted prior to the return of your equipment.

Any service work performed on equipment that is not under warranty should be done by only competent electronic technicians equipped with the proper test equipment to insure performance to original specifications. All parts necessary for such service are available from the factory. When ordering any replacement part, include the part number and full description as found in the Parts List.

ROUTINE MAINTENANCE

Mechanical:

The model SP-3A-1 is of all-aluminum construction with a two-color anodized front panel and chassis finish for life-time service. Periodic dusting can be done with a soft paint brush or dusting cloth. Cleaning should be limited to the use of a moist cloth and mild detergent. Abrasive or strong chemical cleaners should be avoided as they might damage or attack the finish. If desired, the surface lustre of the chassis and front panel can be maintained by wiping the surfaces with a treated polishing cloth. This leaves a fine film of oil on the surface which enhances its lustre.

Electrical:

There is no routine electrical maintenance or adjustment required for the SP-3A-1. The small vacuum tubes used have a life expectancy of thousands of hours and therefore will not normally need any attention for many years under normal use. When replacement does become necessary, use only premium tubes of the type stated on the electrical schematic diagram or in the Parts List.

TECHNICAL SPECIFICATIONS

Frequency Response:	$\pm 1\text{dB}$ 10 Hz to 30 kHz, IHF load $\pm 1\text{dB}$ of RIAA from 30 Hz to 30 kHz
THD	
Distortion:	Less than .005% @ 5V RMS output, IHF load
IM	
Distortion:	Less than .005% @ 5V RMS output, IHF load, SMPTE method
Gain:	57dB, magnetic phono input, main outputs, IHF load 34dB, magnetic phono input, tape outputs, IHF load 23dB, high level inputs, main outputs, IHF load 0dB, high level input, tape outputs, IHF load
Tone Controls:	Bass and Treble variable $\pm 18\text{dB}$ @ 20 Hz and 15 kHz respectively
Input Impedance:	Magnetic Phono; 50K ohms typical (150 pf shunt) High Level; 100K ohms typical
Output Impedance:	Less than 600 ohms @ 1kHz (all outputs) Recommended load; 20K or greater
Maximum Output:	25V RMS @ 1kHz, all outputs, IHF load
Maximum Input:	300 mv RMS @ 1kHz (magnetic phono input) high level inputs overload proof
Noise:	High Level inputs (unweighted wideband): more than 90dB below rated output. Magnetic Phono inputs (below 10 mv input): 20 Hz to 20 kHz; more than 70dB below rated outputs. Power line components (hum); more than 66dB below rated output.
Channel Separation:	More than 30dB, 20 Hz to 20 kHz
Power Requirements:	120/240 V, 50/60 Hz, 60 Watts
Dimensions:	15 5/8" wide x 5 1/2" high x 12 1/2" deep
Weight:	14 lbs. net 20 lbs. shipping

CIRCUIT DESCRIPTION

This discussion will highlight the components shown in the simplified schematic diagram on page 20. A complete schematic diagram is shown on page 23 which will appendix the discussion if further technical insight is desired. Brief mention will be made, however, of the power supply components which are shown only in the complete schematic diagram.

The basic signal processing and switching functions of the SP-3A-1 are grouped as shown in the simplified schematic diagram. Signal flow through the SP-3A-1 is consistent with the listed order of these functions (and respective description of each) as given below:

a. Magnetic Phono (RIAA) Pre-amplifier

Low level magnetic cartridge or cartridge amplifier outputs are applied to inputs J1 and/or J3. The magnetic phono selector switch (SW-1E) connects one of the two inputs to the high impedance non-inverting input of the pre-amplifier (comprised of V1, V2, and V3). A low-pass radio frequency interference filter (R2, C2) attenuates undesired high frequency signals at the preamplifier input. A negative feedback network (R3, 7, 10, and C4, 5) around the overall pre-amplifier establishes the RIAA playback compensation with 35 dB of gain at 1 kHz. Input resistor R1 provides necessary damping for most magnetic cartridges requiring a nominal 47K ohm load.

b. Input Selector Switch

High level inputs (tuner, spare, tape 1, tape 2) and the magnetic phono pre-amplifier output (through AC coupling network C37, R11) are applied to the poles of a 5 position input selector switch (SW-2L). The output (wiper) of the switch is connected to the tape output/monitor circuits. Resistors R65, 66 prevent inhibit of the "tape 1" and "tape 2" monitor functions. All unused inputs to the switch are shorted to ground.

c. Tape Output/Monitor Circuits

Outputs from the input selector switch are applied through isolation resistors (R12, 15) to tape outputs 1 (J13) and 2 (J15) respectively and to the tape monitor circuit. The tape monitor switches (SW-1B and SW-1C) allow source selection of either the input selector switch

output or the tape monitor inputs 1 and 2 (J17, 19). The subsequent output is applied to the mode switch (SW-3). Either tape monitor switch is returned to the normal listening position by cancel switch SW-1D (mechanical return).

d. Mode Switch

The above selected source is applied to a 5 position mode switch (SW-3). It should be noted that right channel signals are also applied to the mode switch circuit. The mode switch allows selection of 5 different output combinations. They are outlined as follows:

Position	Mode	Description
1	Mono	Combines right and left channel inputs through R16 and 17 respectively and feeds them simultaneously to left and right outputs.
2	Stereo	Left channel input is connected to left output and right channel input is connected to right output.
3	Reverse	Left channel input is connected to the right output and the right channel input is connected to the left output.
4	Left	Left channel input drives both the left and right outputs.
5	Right	Right channel input drives both the right and left outputs.

e. Balance/Level Controls

Outputs from the mode switch are connected to the ganged left and right channel balance controls (RV1A and RV1B). These controls have a special taper which allows signal attenuation in one direction only when rotated from the normally centered position. Clockwise rotation attenuates the left channel output only while counter-clockwise rotation from center attenuates only the right channel output. There is no attenuation of either channel when the control is centered. Outputs from the wipers of the balance controls are fed directly to the ganged left and right gain controls RV2A and RV2B respectively. These controls have a logarithmic taper which allows apparent listening (loudness) levels to vary directly with the degree of control rotation. The controls "track" to-

gether such as to attenuate the left and right channels equally for counter-clockwise rotation. There is zero attenuation of outputs in a fully clockwise position. The outputs (wipers) of the gain controls are coupled to gain control amplifiers.

f. Gain Control Amplifier

Output of the gain control is AC coupled (C11, R18) to the high impedance non-inverting input of the wide-band gain control amplifier (comprised of V4, V5, and V6). Negative feedback (R21, 24, 28, C15) around the overall amplifier provides a fixed gain of 23 dB. The overall frequency and phase response of the SP-3A-1 is shown on page 15.

g. Contour Control Network

Output of the gain control amplifier is AC coupled (C39) to the contour control RV3A. The contour network also includes C19, 20 and R30, 31. This circuit attenuates midrange frequencies with counter-clockwise rotation of the contour control. The response curves are shown on page 14. Output of the contour network (wiper of RV3A) is connected to the tone control circuit.

h. Tone Control Amplifier

Feedback tone control circuits are employed in the SP-3A-1. The treble control (RV4A) and bass control (RV5A) are connected in the feedback network of an inverting tone control amplifier (comprised of V7 and V8). The feedback network also includes C22-26 and R33, 34, 37. The wipers of the tone controls are connected to the "summing" input of the amplifier. Clockwise rotation of the tone controls permits gain at high and low frequencies while counter-clockwise rotation results in attenuation. The "hinge" frequency of the circuit is 750 Hz. Overall response of the tone control circuit is shown on page 14. The tone control amplifier output is connected to the Tone/Contour Switch.

i. Tone/Contour Switch

The main outputs (J21, 23) of the SP-3A-1 can be switched with SW-1A to include the tone and contour control circuits ("in" position) or to bypass them in the "out" position. The "out" position connects the "main outputs" directly to the output of the gain control amp-

lifier (V4, 5, 6 and C39) through decoupling resistor R29. This position is used for optimally flat response and lowest distortion.

j. Power Supply Circuits

The vacuum tube amplifiers employed in the SP-3A-1 require two separate B+ voltages and two separate DC filament supplies.

Power transformer (T1) provides the voltages for these supplies. The dual primary windings of T1 are connected in parallel for 120 volt line operation or in series for 240 volt operation by switch SW5. The primary circuit also includes a half-wave rectifier and filter circuit (D13, C36, 58, 59, 65) for the switched AC outlet neon indicator PL-2.

Main B+ (500 VDC) is derived from a full-wave bridge rectifier and capacitive input filter (D9-12, C43, 44). This voltage is applied to the collector of a series regulator (Q1). A filtered "reference" voltage for the base of Q1 is developed by RC filters (R60, 61, C33, 46) and zener diodes (ZD1-9). The regulated output (440 VDC) of emitter follower Q1 is applied to tubes V2, 3, 5, 6, 7, and 8. Additional filtering (decoupling) for "front end" tubes V1 and V4 is provided by an RC filter (R62, C41, and 1/2 C45). Capacitors C40 and 1/2 C45 are across the output (emitter) of regulator Q1.

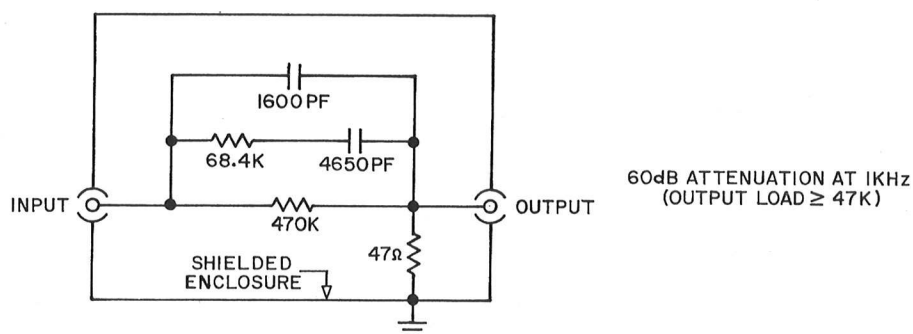
Two DC filament supplies are used in the SP-3A-1 for minimum hum and noise. One of the two is referenced to ground for tubes V1, 2, 4, 5, and 7. It consists of a full-wave bridge rectifier (D5-8) and a "pi" filter (C30, R42). The second filament supply is "elevated" above ground by R47, 48 for the direct coupled cathode follower output tubes V3, V6, and V8. This supply also consists of a full-wave bridge rectifier (D1-4) and a "pi" filter (C29, R41). Pilot light PL-1 is also driven by the elevated filament supply. Resistors R44 and R45 balance the current distribution in the series-parallel filament configuration of each supply.

EQUIPMENT SERVICING

This section contains service information and data for the Model SP-3A-1. It is intended for use by the knowledgeable and experienced technician only. Before attempting any servicing of this device, the previous sections of this instruction manual should be studied to gain a thorough understanding of its operation. Since the SP-3A-1 is inherently a very low distortion device, only high quality test equipment and carefully executed test procedures should be employed when evaluating its performance. Refer to page 19 for technical specifications.

Recommended Test Equipment

Item	Requirements	Use
Audio Oscillator	Less than .001% of distortion	Sine wave source for THD measurement, response measurements, and trouble-shooting
Harmonic Distortion Analyzer	Less than .001% residual	THD measurement
Oscilloscope	General purpose	Waveform analysis and troubleshooting
VTVM	General purpose	AC & DC voltage measurements
Variable Auto Transformer	0-140 V., 1 amp.	Adjust input line voltage for 120 VAC
Line Voltmeter	0-150 VAC	Monitors line voltage
Inverse RIAA Test Network	See circuit diagram below	Provides an attenuated RIAA test signal for magnetic inputs



INVERSE RIAA TEST NETWORK

SP-3A-1 VOLTAGE/RESISTANCE TABLE

TUBE NUMBER	PIN NUMBER	VOLTAGE	RESISTANCE	TUBE NUMBER	PIN NUMBER	VOLTAGE	RESISTANCE
V1	1	172	330K*	V5	1	206	301K*
V1	2	0	61K	V5	2	0	470K
V1	3	1.4	2.21K	V5	3	1.8	2.21K
V1	4	11	6Ω	V5	4	0	0Ω
V1	5	22	13Ω	V5	5	11	11Ω
V1	6	164	330K*	V5	6	208	301K*
V1	7	0	61K	V5	7	0	470K
V1	8	1.5	2.21K	V5	8	1.8	2.21K
V1	9	16.5	∞	V5	9	5.5	∞
V2	1	207	301K*	V6	1	450	0Ω*
V2	2	0	470K	V6	2	208	301K*
V2	3	1.8	2.21K	V6	3	211	105K
V2	4	0	0Ω	V6	4	198	80K**
V2	5	11	11Ω	V6	5	209	80K**
V2	6	209	301K*	V6	6	450	0Ω*
V2	7	0	470K	V6	7	206	301K*
V2	8	1.8	2.21K	V6	8	209	105K
V2	9	5.5	∞	V6	9	203.5	∞
V3	1	450	0Ω*	V7	1	210	301K*
V3	2	209	301K*	V7	2	0	900K#
V3	3	212	100K	V7	3	1.8	2.21K
V3	4	209	80K**	V7	4	22	13Ω
V3	5	220	80K**	V7	5	11	6Ω
V3	6	450	0Ω*	V7	6	209	301K*
V3	7	207	301K*	V7	7	0	900K#
V3	8	210	100K	V7	8	1.8	2.21K
V3	9	214.5	∞	V7	9	16.5	∞
V4	1	180	330K*	V8	1	450	0Ω*
V4	2	12	480K	V8	2	210	301K*
V4	3	14	7.2K	V8	3	213	100K
V4	4	11	6Ω	V8	4	220	80K**
V4	5	22	13Ω	V8	5	209	80K**
V4	6	180	330K*	V8	6	450	0Ω*
V4	7	12	480K	V8	7	209	301K*
V4	8	14	7.2K	V8	8	212	100K
V4	9	16.5	∞	V8	9	214.5	∞

NOTES:

1. Readings are typical — taken at 120 VAC line with a FLUKE 8000A DVM.
2. All measurements are with respect to ground unless noted.
3. Voltage readings taken with all tubes in place.
4. Resistance readings taken at socket with tube under test only removed.
5. * Approx. resistance reading with respect to B+1 (emitter of Q1).
6. ** Approx. initial reading, value will increase slowly as capacitors charge.
7. # Nominal resistance reading with tone controls centered.

SP-3A-1 TROUBLESHOOTING TABLE

Symptom	Possible Cause
Blows fuses or completely dead	<ul style="list-style-type: none"> — Wrong size and/or type fuse (F1) — Defective line cord or switch (SW4A) — Defective power transformer (T1) — Defective power supply (PCB-85C)
----- Defect in PCB-85C	<ul style="list-style-type: none"> — Defective bridge diode(s) (D1-12) — Defective electrolytic filter(s) (C29, 30, 43-46) — Defective transistor (Q1) <p>Note: After replacing a shorted transistor, check the voltage drop across each of the zener diodes (ZD1-9). The readings should be approximately 48 volts + 10%.</p>
Green pilot lamp doesn't come on	<ul style="list-style-type: none"> — Defective #387 bulb — No power at plug — Blown fuse — Defective switch (SW4A)
Red pilot lamp doesn't come on	<ul style="list-style-type: none"> — Defective NE-2J bulb — Defective DC supply component(s) (D13, C36, R58, 59) — Defective switch (SW4B)
Dead, noisy, or poor sound on phono inputs only	<ul style="list-style-type: none"> — Defective V1, V2, V3 or associated component(s)
Dead, noisy, or poor sound on all inputs (tone controls switched out)	<ul style="list-style-type: none"> — Defective V4, V5, V6 or associated component(s) — Defective C11 (leaky)
Dead, noisy, or poor sound on all inputs (tone controls switched in)	<ul style="list-style-type: none"> — Defective V7, V8 or associated component(s)
Noise — only while operating a specific control (level, contour, treble, bass)	<ul style="list-style-type: none"> — Dirty control <p>Note: Use a high quality spray cleaner (Channel Master "Contact Shield", model 9101, or equivalent) — exercise control after application.</p> <ul style="list-style-type: none"> — Defective C11 (leaky)
Hum	<ul style="list-style-type: none"> — Defective power supply (PCB-85C) — Pre-amplifier located near a strong AC field — RFI
Poor sound — all inputs, both channels	<ul style="list-style-type: none"> — Defective power supply (PCB-85C — see above), check for proper operating voltages.

