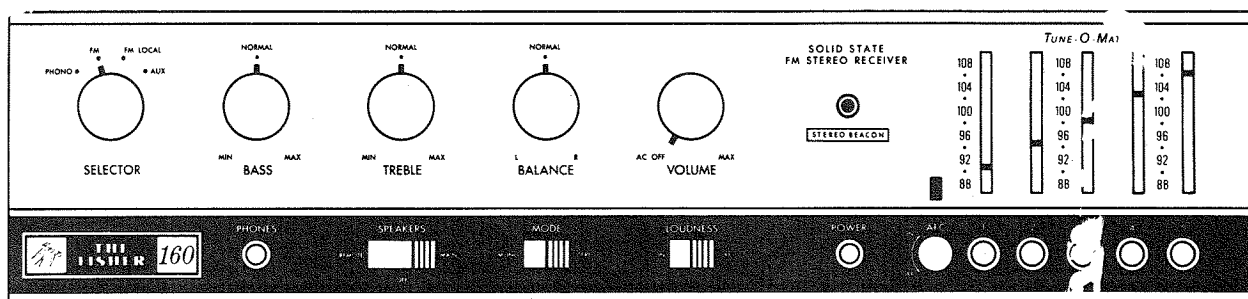


Service Manual

THE FISHER®



160-T™

CHASSIS SERIAL NUMBERS
BEGINNING 10001

PRICE \$1.00

FISHER RADIO • 11-40 45th ROAD • LONG ISLAND CITY, N.Y. 11101

CAUTION: This is a FISHER precision high-fidelity instrument. It should be serviced only by qualified personnel — trained in the repair of transistor equipment and printed circuitry.

TEST EQUIPMENT REQUIRED

The following are needed to completely test and align modern high-fidelity instruments such as amplifiers, tuners and receivers.

Vacuum-Tube Voltohmmeter
(100-mV DC scale)
Audio Vacuum-Tube Voltmeter
(10-mV AC scale)
Oscilloscope (Flat to 100 kHz Minimum)
Audio (Sine-Wave) Generator
Intermodulation Distortion Analyzer
Harmonic Distortion Analyzer
AM/FM Signal Generator
Multiplex Generator (preferably with RF
output — FISHER Model 300 or equal)

10.7-MHz Sweep Generator
455-kHz Sweep Generator
Line Voltage Autotransformer
or Voltage Regulator
2 — Load Resistors. 4 or 8 Ohm, 50 Watt
2 — Full Range Speakers for Listening Tests
Stereo Source — Turntable or Tape Recorder
for Listening Tests
Soldering Iron with Small Tip
Fully Insulated from Power Line
Suction Desoldering Tool

PRECAUTIONS

Many of these items are included just as a reminder—they are normal procedures for experienced technicians. Short-cuts can be taken but often they cause additional damage — to transistors, circuit components or the printed-circuit board.

Soldering—A well-tinned, hot, clean soldering iron tip will make it easier to solder without damage to the printed-circuit board or the many circuit components mounted on it. It is not the wattage of the iron that counts — it is the heat available at the tip. Some 50-watt irons reach temperatures of 1,000° F — others will hardly melt solder. Small-diameter tips should be used for single solder connections — larger pyramid and chisel tips are needed for larger areas.

- When removing defective resistors, capacitors, etc., the leads should be cut as close to the body of the circuit component as possible. (If the part is not being returned for in-warranty factory replacement it may be cut in half — with diagonal-cutting pliers — to make removal easier.)

- Special de-soldering tips are made for unsoldering multiple-terminal units like IF transformers and electrolytic capacitors. By unsoldering all terminals at the same time the part can be removed with little chance of breaking the printed-circuit board.

- Always disconnect the chassis from the power line when soldering. Turning the power switch OFF is not enough. Power-line leakage paths, through the heating element, can destroy transistors.

Transistors—Never attempt to do any work on the transistor amplifiers without first disconnecting the AC linecord and waiting until the power supply filter-capacitors have discharged.

- Guard against shorts — it takes only an instant for a base-to-collector short to destroy that transistor and possibly others direct-coupled to it. [In the time it takes for a dropped machine screw, washer or even the screwdriver, to glance off a pair of socket terminals (or between a terminal and the chassis) a transistor can be ruined.]

- DO NOT bias the base of any transistor to, or near, the same voltage applied to its collector.

- DO NOT use an ohmmeter for testing transistors. The voltage applied through the test probes may be higher than the base-emitter breakdown voltage of the transistor.

Output Stage and Driver — Replacements for output and

driver transistors, if necessary, must be made from the same beta group as the original type. The beta group is indicated by a colored dot on the mounting flange of the transistor. Be sure to include this information, when ordering replacement transistors.

- If one output transistor burns out (open or shorts), always remove ALL output transistors in that channel and check the bias adjustment, the control and other parts in the network with an ohmmeter before inserting a new transistor. All output transistors in one channel will be destroyed if the base-biasing circuit is open on the emitter end.

- When mounting a replacement power transistor be sure the bottom of the flange, the mica insulator and the surface of the heat sink are free of foreign matter. Dust and grit can prevent perfect contact reducing heat transfer to the heat sink. Metallic particles can puncture the insulator and cause shorts — ruining the transistor.

- Silicone grease must be used between the transistor and the mica insulator and between the mica and the heat sink for best heat conduction. (Use Dow-Corning DC-3 or C20194 or equivalent compounds made for power transistor heat conduction.)

- Use care when making connections to speakers and output terminals. Any frayed wire ends can cause shorts that may burn out the output transistors — they are direct-coupled to the speakers. To reduce the possibility of shorts at the speakers, lugs should be used on the exposed ends or at least the ends of the stranded wires should be tinned to prevent frayed wire ends. The current in the speakers and output circuitry is quite high. Poor contacts or small size wire can cause power losses in the speaker system. Use 14 or 16 AWG for long runs of speaker wiring.

Voltage Measurements—Voltage measurements are made with the line voltage adjusted to 117 volts and all readings are $\pm 10\%$. All voltages are DC, measured with a VTVM to ground, with no signal input unless otherwise noted. indicates 1-kHz audio voltages, measured with an audio AC VTVM to ground at various points from the phono input to the power amplifier output.

Alignment Procedures — Replacement of transistors and components in the front end, IF amplifier and multiplex decoder will normally not require realignment of these circuits. Realignment of these circuits, unless absolutely necessary, is not recommended. Do not attempt a realignment unless the required test equipment is available and the alignment procedure is thoroughly understood.

BECAUSE ITS PRODUCTS ARE SUBJECT TO CONTINUOUS IMPROVEMENT, FISHER RADIO CORPORATION RESERVES THE RIGHT TO MODIFY ANY DESIGN OR SPECIFICATION WITHOUT NOTICE AND WITHOUT INCURRING ANY OBLIGATION.

SERVICE PROCEDURES

REPLACING STEREO BEACON LAMP

The STEREO BEACON lamp is a long-life bulb which should not require replacement for many years. When replacement is necessary, follow these instructions:

- (1) Disconnect AC power cord.
- (2) Remove the screws which hold the top cover to the chassis and slide off the top cover.
- (3) Unsolder the lamp leads and remove the lamp sleeve together with the lamp.
- (4) Slide the lamp sleeve over the replacement lamp. Mount and cement the lamp to the chassis using Duco cement or an equivalent. Solder the leads to the terminals.
- (5) Replace the top cover on the chassis and secure with the screws removed previously.

REPLACING POWER INDICATOR LAMP

The POWER indicator lamp is an indefinite-life, neon cartridge assembly which normally never requires replacement. If replacement is ever necessary, follow these instructions:

- (1) Disconnect AC power cord.
- (2) Remove the top and bottom covers by removing the screws which hold them to the chassis.
- (3) Gently pull the six wires off the terminal pins behind the TUNE-O-MATIC dial assembly. These wires connect the dial assembly to the chassis circuitry. Label each wire with its associated pin location to make replacement easier later.
- (4) Gently pull the two leads of the POWER indicator lamp-cartridge off the terminal pins.
- (5) Gently pull all knobs off the front panel control shafts. Remove the hex nuts from the shafts and remove panel by pulling forward over the shafts.
- (6) Remove the clip which holds the cartridge to the panel and pull the cartridge assembly through the front of the panel.
- (7) Using the replacement cartridge, reverse the procedure to reassemble front panel, knobs, and covers. Do not forget to reconnect the wires removed previously before turning on.

CLEANING FRONT PANEL

WARNING: Use only plain lukewarm water for moistening a freshly laundered, soft lint-free cloth to clean the front control panel.

REMOVING P.C. BOARDS

To remove a board from its nylon mounts, squeeze the loop of each mounting clip (using pliers), and lift each corner of the board. To remount the board, align the mounting holes over the clips, and press firmly.

SERVICING INTEGRATED CIRCUITS

Integrated Circuits are used in this unit to approach the theoretical maximum of AM suppression and noise limiting. These IC's contain the equivalent of many circuit parts, including transistors, diodes, resistors, and capacitors. These integrated circuits are high-reliability devices, requiring minimum servicing. In the unlikely event that an IC requires servicing, it should be serviced in the same way as a transistor. The preferred troubleshooting procedure is to first isolate the trouble to one stage using AC signal tracing methods. Once the suspected stage is located, the integrated circuit can be checked by measuring the DC voltages at the input and output leads of the IC using a DC VTVM. These DC voltages are the most accurate indications of the operating conditions of the integrated circuit.

WARNING: Do not use an ohmmeter to check continuity with the IC mounted on the printed circuit board. Forward biasing the internal junctions within the IC may burn out the transistors.

When replacing an integrated circuit, the following precautions should be observed:

- (1) Do not replace a defective IC until the cause of the trouble is found. All external resistors, capacitors, and transformers should be checked first to prevent the replacement integrated circuit from failing immediately due to a trouble in the connecting components.
- (2) Solder and unsolder each lead separately using a pliers or other heat sink on the lead to prevent damage from excessive heat.
- (3) Check that the leads of the replacement IC are connected to the correct locations on the printed circuit board before turning the set on.

POWER AMPLIFIER CENTER VOLTAGE TEST

Turn VOLUME control to minimum. Set SPEAKERS switch to MAIN.

- (1) Connect an 8-ohm load resistor across the LEFT SPKRS MAIN terminals and an 8-ohm load resistor across the RIGHT SPKRS MAIN terminals.
- (2) Connect two 10k \pm 1% resistors in series across capacitor C5 (1500uF). Connect the common lead of a DC VTVM to the junction of the two resistors.
- (3) Connect the probe of the DC VTVM to Test Point 8S (junction of R835 and R837) on left channel of dual-channel power amplifier module. Meter should read 0 volt (\pm 2 volts).
- (4) Connect the probe of the DC VTVM to Test Point 8DD (junction of R836 and R838) on right channel of dual-channel power amplifier module. Meter should read 0 volt (\pm 2 volts).
- (5) Disconnect the two 10k resistors.

SERVICE PROCEDURES

POWER AMPLIFIER IDLING CURRENT ADJUSTMENT

NOTE: Power amplifier center voltage test should be performed before starting the following procedure.

Turn VOLUME control to minimum.

- (1) Connect DC VTVM across resistor R835 (0.56-ohm) on left channel of dual-channel power amplifier module.
- (2) Adjust R825 pot. (OUTPUT BIAS ADJUST) on left channel predriver/driver board for reading of 20mV on DC VTVM.
- (3) Connect DC VTVM across resistor R836 on right channel of dual-channel power amplifier module.
- (4) Adjust R826 pot. on right channel predriver/driver board for reading of 20mV on DC VTVM.

POWER OUTPUT MEASUREMENT

The output amplifier of this unit is designed to deliver its full-rated power with program material (voice or music) into 8-ohm loads for an indefinite period of time. When a constant audio tone is used as a signal to measure the continuous RMS power output, the following precautions must be taken:

- (1) Measure the power output of one channel at a time.
- (2) Limit the measurement period to 10 minutes with a load resistance of 8 ohms.

WARNING: If the power output of both channels is measured simultaneously, use a load of 8 ohms per channel and limit measurements to a period not longer than 5 minutes.

HARMONIC DISTORTION TEST

Set BALANCE, BASS, and TREBLE controls to their center positions. Set SELECTOR switch to AUX, SPEAKERS switch to MAIN, MODE switch to STEREO, and LOUDNESS switch to OFF. Unplug AC power cord.

- (1) Connect an 8-ohm, 50-watt resistor across the LEFT SPKRS MAIN terminals. In parallel with the load resistor, connect the input leads of a Harmonic Distortion analyzer and the input leads of an accurately calibrated AC VTVM.
- (2) Connect a low-distortion audio sine-wave generator,

- set for 1,000 Hz, to the Left channel AUX input.
- (3) Connect AC power cord and rotate VOLUME control to maximum.
- (4) Increase audio generator level for 14 watts output (10.6 V RMS across 8-ohm load). HD meter should read 0.8% or less.
- (5) Repeat preceding steps for right channel.

INTERMODULATION DISTORTION TEST

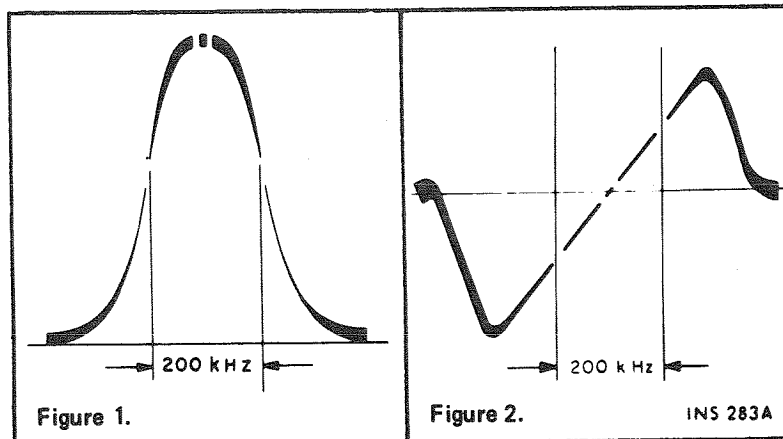
Set BALANCE, BASS, and TREBLE controls to their center positions. Set SELECTOR switch to AUX, SPEAKERS switch to MAIN, MODE switch to STEREO, and LOUDNESS switch to OFF. Unplug AC power cord.

- (1) Connect an 8-ohm, 50-watt resistor across the LEFT SPKRS MAIN terminals. In parallel with the load resistor, connect the input leads of an Inter-Modulation distortion analyzer and the input leads of an accurately calibrated AC VTVM.
- (2) Connect IM-analyzer generator output to the Left channel AUX input.
- (3) Connect AC power cord and rotate VOLUME control to maximum.
- (4) Increase IM-analyzer generator level for 12 watts output (7.95 V RMS across 8-ohm load). AFTER ONE FULL MINUTE OF WARM-UP TIME, PROCEED TO NEXT STEP.
- (5) IM meter reading should be 0.8% or less.
- (6) Repeat preceding steps for right channel.

NOTE: If any of the preceding instructions differ from those in the IM-analyzer instruction manual, it is best to follow those in the manual. If a load resistor of 50-watt rating is built into the IM analyzer, a separate load resistor is not required.

FM IF AND DETECTOR ALIGNMENT

- NOTE:** When all TUNE-O-MATIC pushbuttons are released to the out position, FM audio will be muted.
- Set SELECTOR switch to FM, MODE switch to MONO, and AFC switch to OFF. Turn VOLUME control to minimum. Release all TUNE-O-MATIC pushbuttons to out position.
- (1) Connect 10.7 MHz sweep generator to Test Point 501



SERVICE PROCEDURES

(on Front End). Connect vertical input of scope to Test Point 301 (on IF board).

- NOTE:** Connect ground lead of generator to ground near Test Point 501 and ground scope close to scope input.
- (2) Adjust generator level and sweep to observe IF response curve. Set generator output as low as possible.
 - (3) Adjust bottom and top cores of L505 (on Front End) for symmetry and maximum gain.
 - (4) Adjust top and bottom cores of Z301 and Z302 (on IF board) for symmetry and maximum gain (see Figure 1). Repeat alignment until maximum gain and symmetry are obtained.
 - (5) Connect vertical input of scope to Test Point 303 (on PC3). Press TUNE-O-MATIC pushbutton No. 1. Adjust top and bottom cores of Z303 (on IF board) for maximum gain and symmetry. See Figure-2 "S" curve.

FM FRONT END ALIGNMENT

NOTE: FM IF alignment must be performed before starting this procedure.

- Set SELECTOR switch to FM, MODE switch to MONO, and AFC switch to OFF. Turn VOLUME control to minimum.
- (1) Connect an FM generator to the FM ANTenna terminals. Use a 120-ohm composition resistor in series with each lead from the generator (see Figure 3). Connect a scope and an AC VTVM to either the Left or Right RCDR OUT jack.
 - (2) Set FM generator frequency to 88 MHz, modulated with 400 HZ, ± 75 kHz deviation. Press TUNE-O-MATIC pushbutton No. 1 and set the dial pointer to 88 MHz. Set generator output as low as possible.
 - (3) Align FM oscillator coil (L504) core first; then align mixer coil (L503) and RF coil (L502) for maximum gain and symmetry.
 - (4) Set FM generator frequency and dial pointer to 108 MHz.
 - (5) Adjust oscillator trimmer (C512) first; then adjust mixer trimmer (C511) and RF trimmer (C503) for maximum gain and symmetry.
 - (6) Repeat alignment several times until accurate dial calibration and maximum gain are obtained. Keep the generator output as low as possible during all adjustments.

AFC TEST

NOTE: IF, Detector, and Front End Alignment should be checked before starting this procedure.

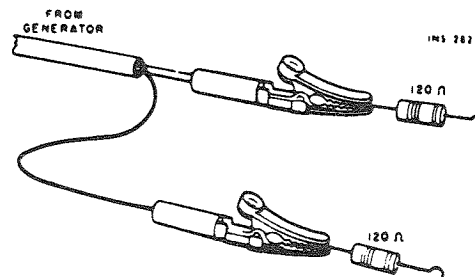


Figure 3. Connections To Provide 300-ohm Generator Output Impedance. Matching Resistors Reduce Generator Voltage By Half At The Antenna Terminals.

Set SELECTOR switch to FM, MODE switch to MONO, and AFC switch to OFF. Turn VOLUME control to minimum.

- (1) Connect AC VTVM and scope to either Left or Right RCDR OUT jack. Connect DC VTVM to Test Point 302 (on PC3).
- (2) Press TUNE-O-MATIC pushbutton No. 1 and tune to 98 MHz.
- (3) Connect FM signal generator to the FM ANTenna terminals. Use a 120-ohm composition resistor in series with each lead from the generator (see Figure 3).
- (4) Set FM generator output level to 2,000uV, and generator frequency to receiver frequency, modulated with 400 Hz, ± 75 kHz deviation. Adjust top core of Z303 (on IF board) for 0 V DC; AC VTVM should read 1.20 V (± 200 mV).
- (5) Detune FM generator until DC VTVM indicates +1 volt. Turn AFC switch ON. DC VTVM should read a lower value (between 0 volt and +1 volt).
- (6) Turn AFC switch OFF and detune FM generator until DC VTVM indicates -1 volt. Turn AFC switch ON. DC VTVM should read a lower value (between 0 volt and -1 volt).

MULTIPLEX ALIGNMENT

Two methods of aligning the multiplex decoder are given. The preferred procedure uses a multiplex generator with RF and 19 kHz outputs and with 1 kHz modulation, such as the FISHER 300 Multiplex Generator. This is the better method of alignment because the front end and IF stages are also checked through the use of this procedure. An alternate procedure for use with multiplex generators not having an RF output is also given.

PREFERRED ALIGNMENT PROCEDURE

NOTE: Check the alignment of the IF amplifier before aligning the multiplex decoder. Poor IF alignment can make proper MPX adjustment impossible.

- Set SELECTOR switch to FM, MODE switch to STEREO, and AFC switch to OFF.
- (1) Connect RF output of multiplex generator to the FM ANTenna terminals. Use a 120-ohm composition resistor in series with each lead from RF output (see Figure 3). Set MPX generator for external modulation with 19 kHz pilot carrier, ± 7.5 kHz deviation (10% pilot, no audio). Tune one of the TUNE-O-MATIC pushbuttons to the RF frequency of the MPX generator.
 - (2) Connect DC VTVM to Test Point 403 (on MPX board).
 - (3) Adjust cores of Z401 and Z402 (on MPX board) for maximum reading on DC VTVM.
 - (4) Connect output of audio generator, set for 1 kHz, to the external modulation input of MPX generator and to external sync input of an oscilloscope. Adjust audio generator level for composite signal ± 75 kHz deviation (10% pilot, 90% audio). Modulate right channel only.
 - (5) Connect AC VTVM to Left RCDR output jack. Connect scope through voltage divider probe (see Figure 5) to Test Point 402 (on MPX board).
 - (6) Adjust core of Z403 (on MPX board) for maximum gain and as straight as base-line as possible on scope (see Figure 6). AC VTVM should read minimum.
 - (7) With MPX generator modulated on right channel only, connect AC VTVM to Right RCDR jack. Record reading on AC VTVM.
 - (8) Set MPX generator to modulate left channel only. Adjust R107 SEPARATION CONTROL (on preamplifier board) for minimum reading on AC VTVM; at least 30dB below reading recorded in Step (7). Record reading.

- (9) Connect AC VTVM to Left RCDR jack. Same reading ± 2 dB as recorded in Step (7).
 - (10) Set MPX generator to modulate right channel only. Same reading ± 2 dB as recorded in Step (8).
- NOTE:** If equal readings cannot be obtained in Steps (8) and (10), readjust Z402 slightly (on MPX board) and repeat Steps (7) through (10).

- board) and connect the output of the multiplex generator through a 15k resistor to pin 4B.
- (2) Connect DC VTVM to Test Point 403 (on MPX board). Connect the vertical input of the scope to pin 4B (on MPX board).
 - (3) Set MPX generator for 19 kHz pilot carrier output only. Adjust pilot level for approximately 120mV peak-to-peak input at pin 4B.
 - (4) Adjust cores of Z401 and Z402 (on MPX board) for maximum reading on DC VTVM.
 - (5) Connect output of audio generator, set for 1 kHz, to the external modulation input of MPX generator and to external sync input of an oscilloscope. Adjust audio generator level for 1.2 volts peak-to-peak composite MPX input to MPX board (10% pilot, 90% audio). See Figure 4. Modulate right channel only. Proceed with Steps (5) through (10) of PREFERRED ALIGNMENT PROCEDURE.
 - (6) Reconnect the lead going to pin 4B (on MPX board).

ALTERNATE ALIGNMENT PROCEDURE

- Set SELECTOR switch to FM, MODE switch to STEREO, and AFC switch to OFF.
- (1) Disconnect the lead going to pin 4B (on multiplex

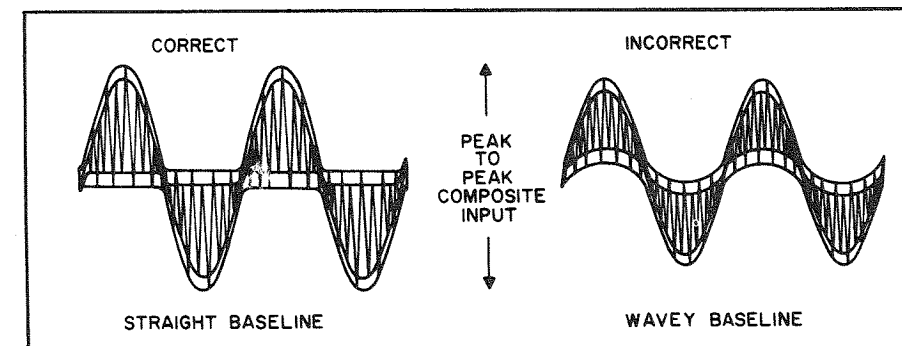


Figure 4. Composite Input To Multiplex Decoder.

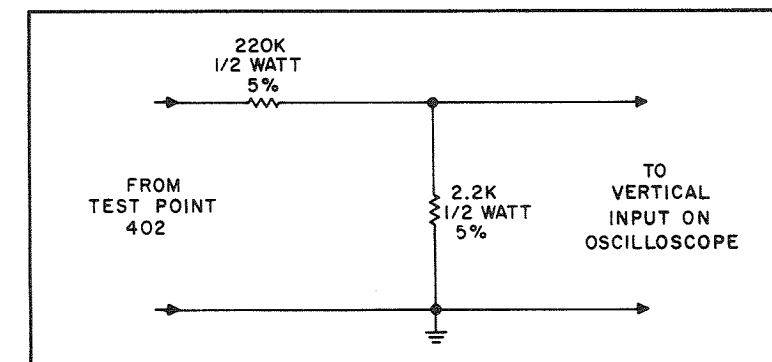


Figure 5. Voltage Divider Probe.

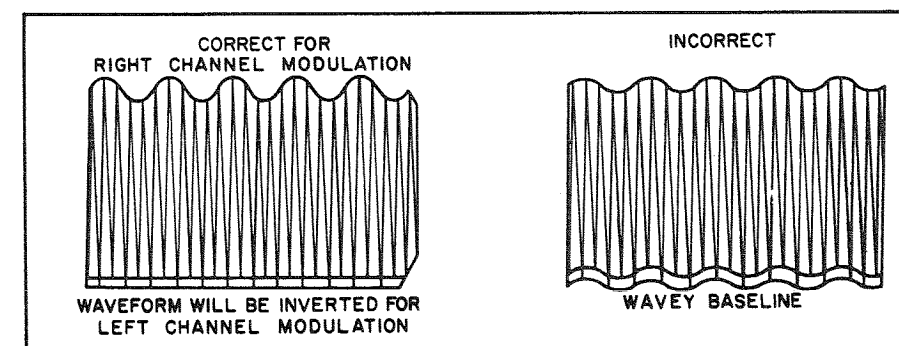
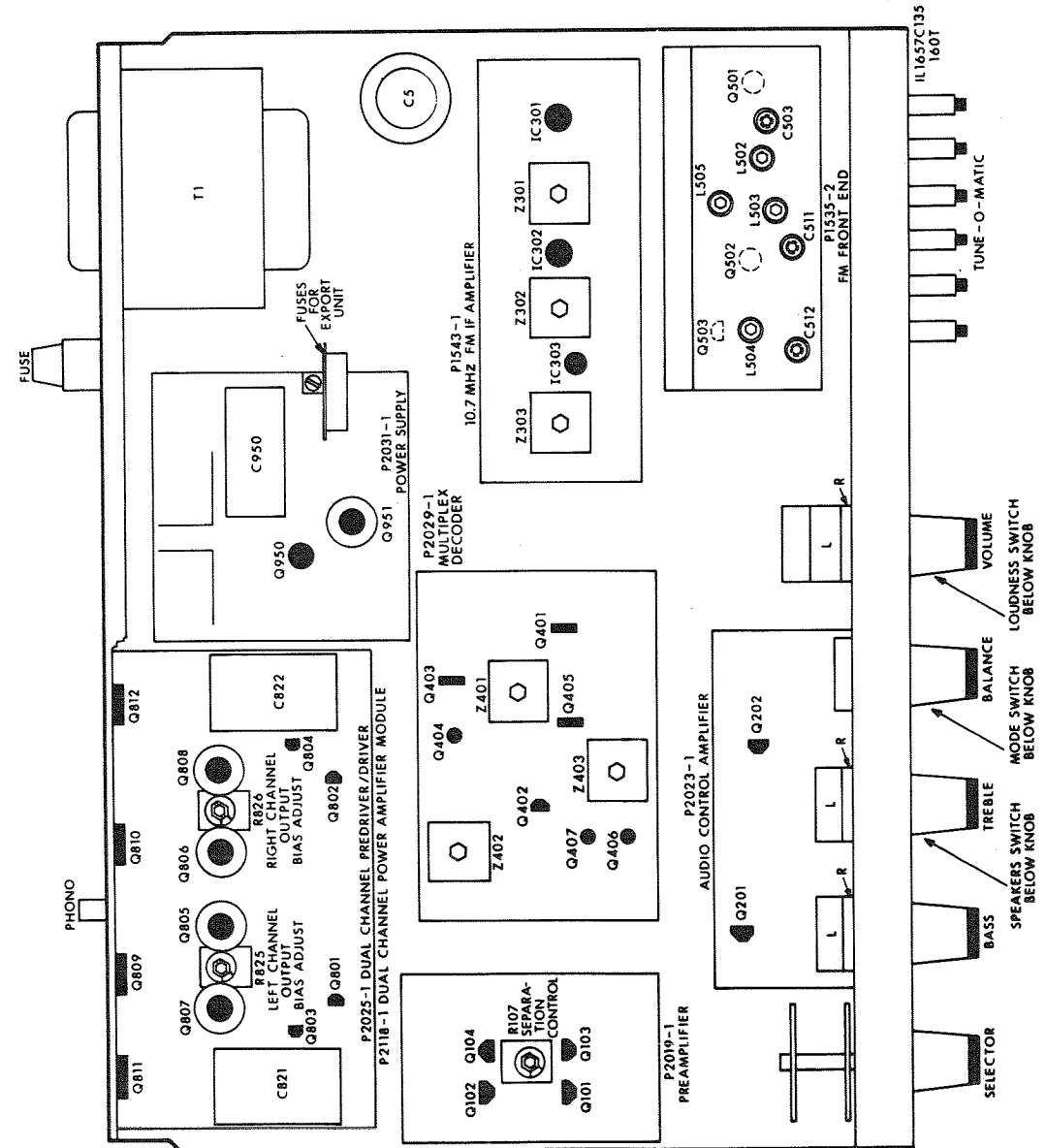
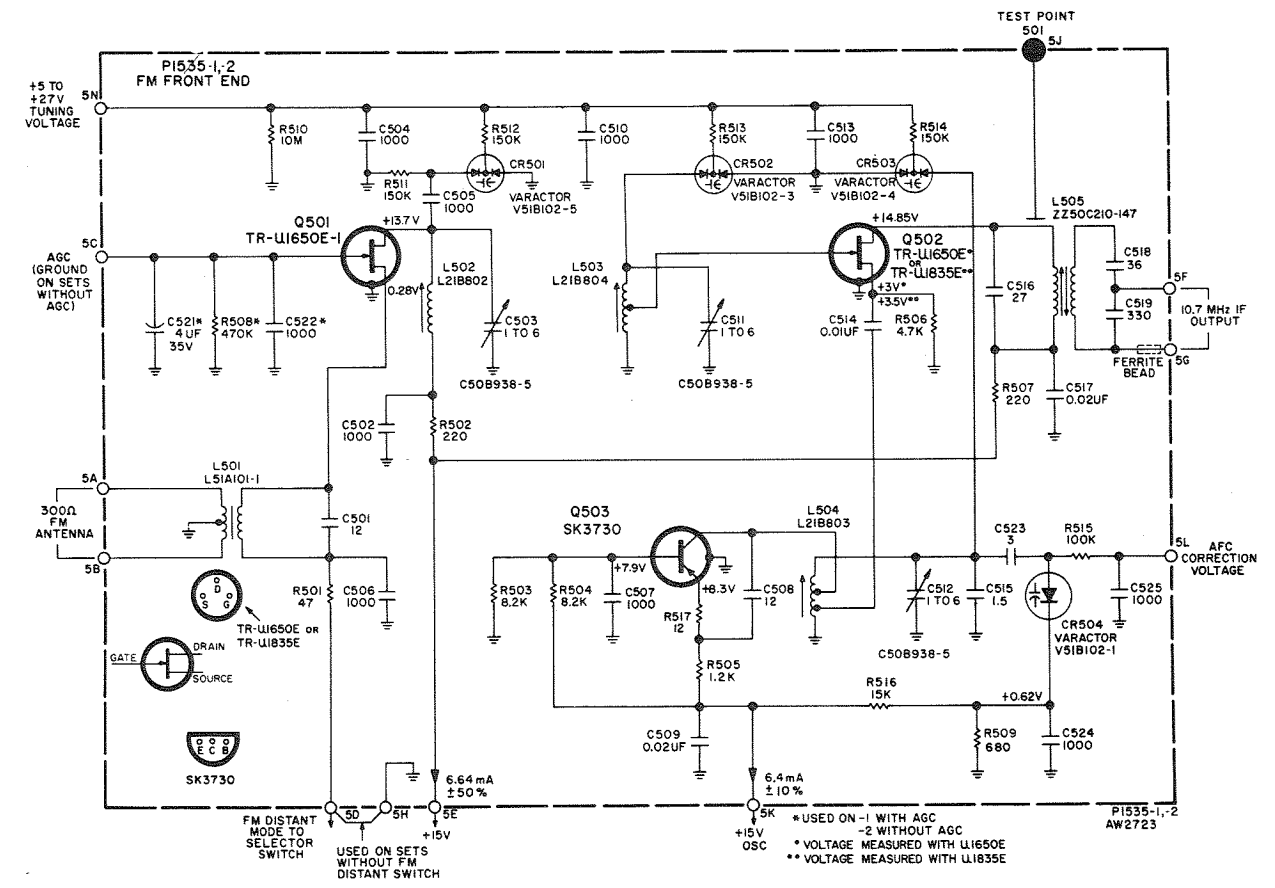


Figure 6. Waveform At Test Point 402.

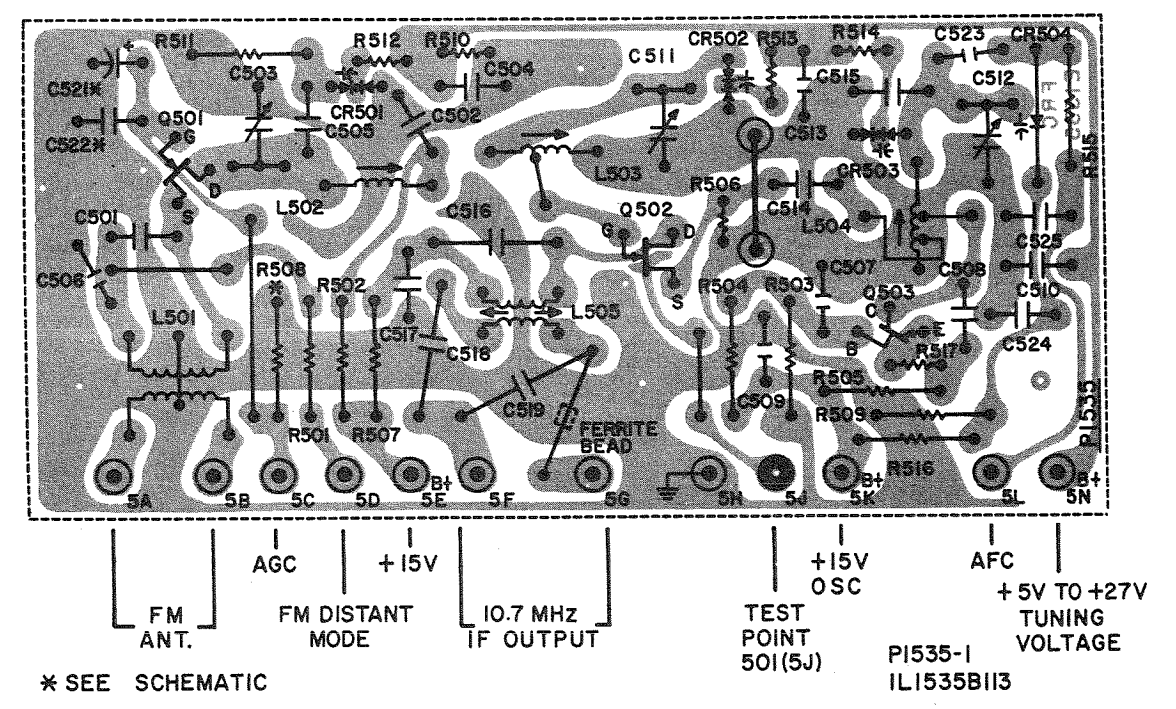
CHASSIS LAYOUT



1535-2 FM FRONT END



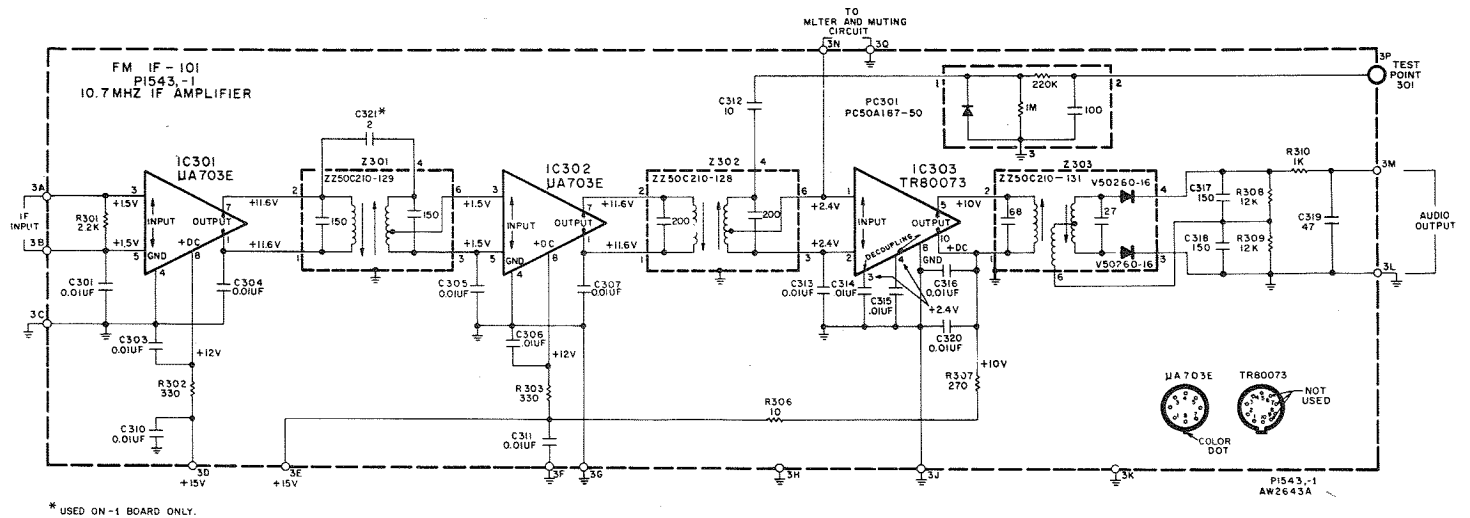
BOARD VIEWED FROM COMPONENT SIDE



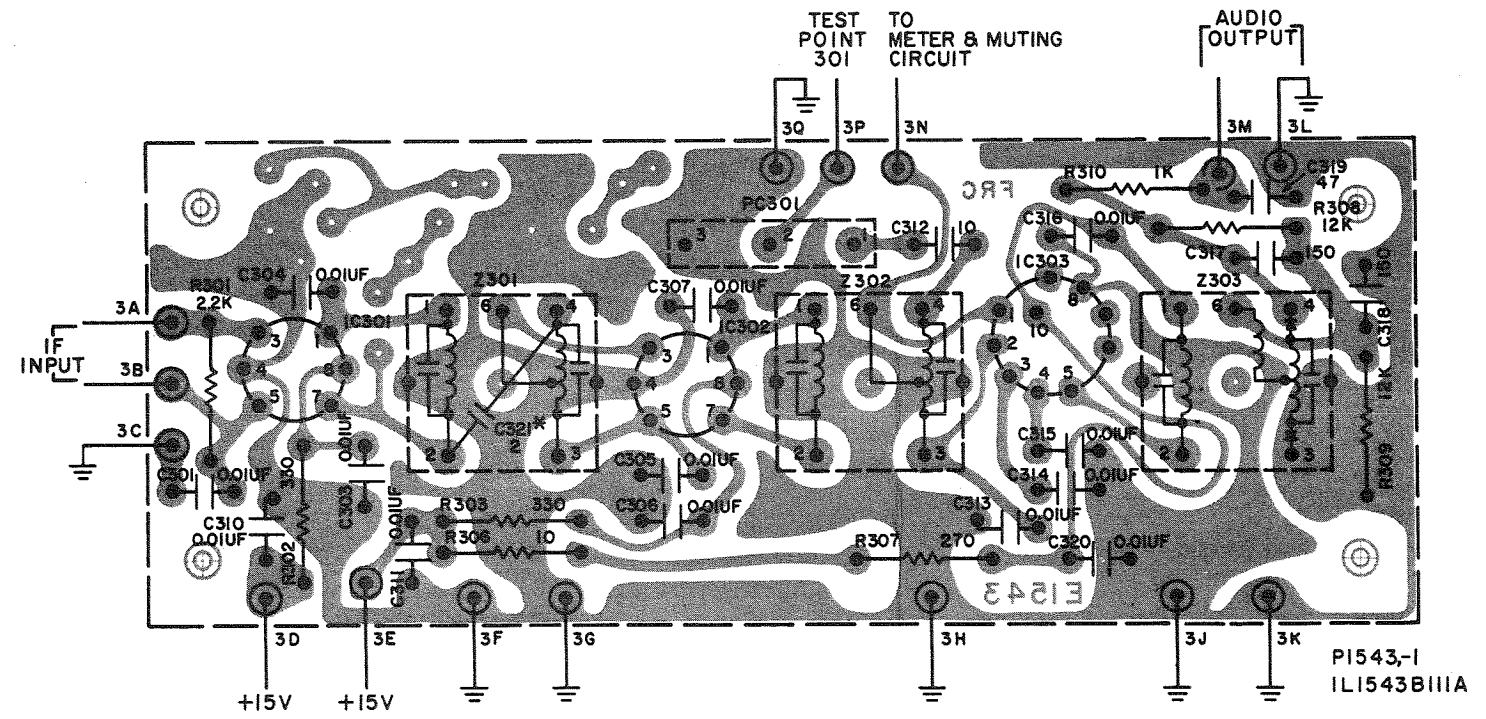
* SEE SCHEMATIC

PI535-1
IL1535B113

1543-1 10.7 MHz IF AMPLIFIER

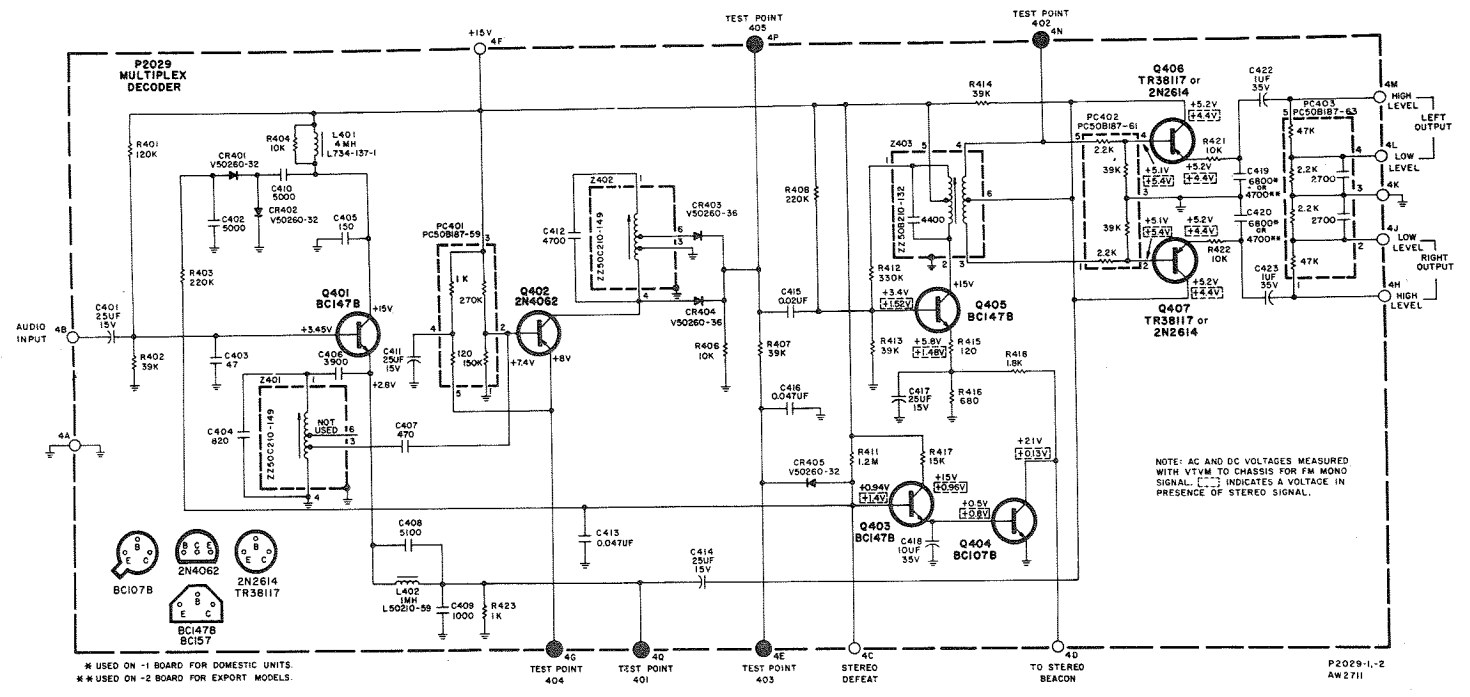


BOARD VIEWED FROM COMPONENT SIDE

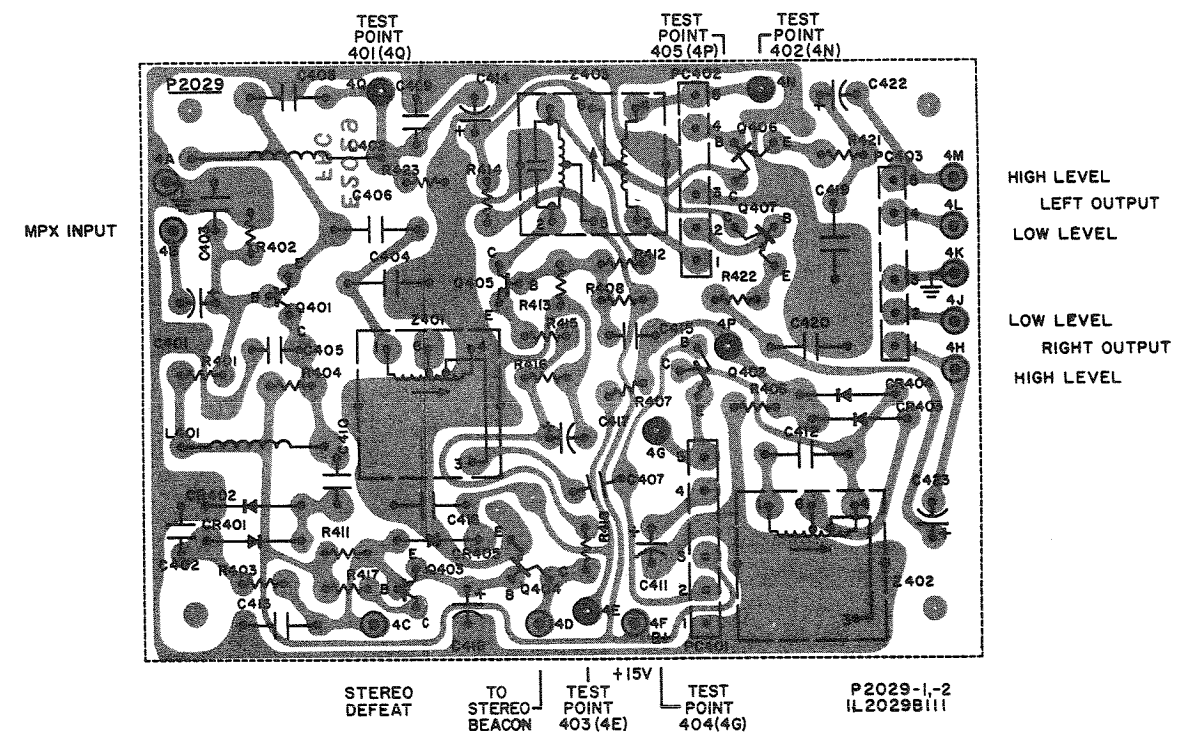


* USED ON -1 BOARD ONLY.

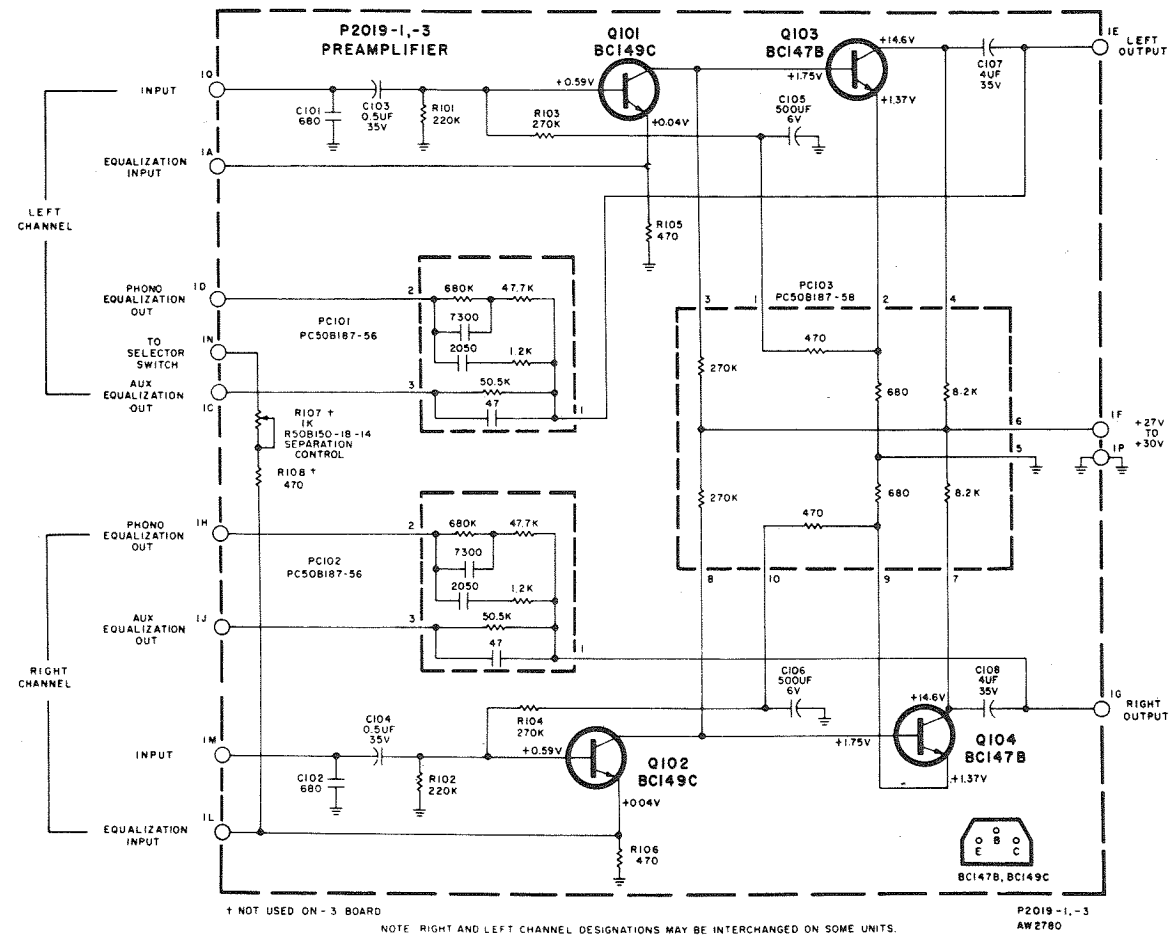
2029-1, -2 MULTIPLEX DECODER



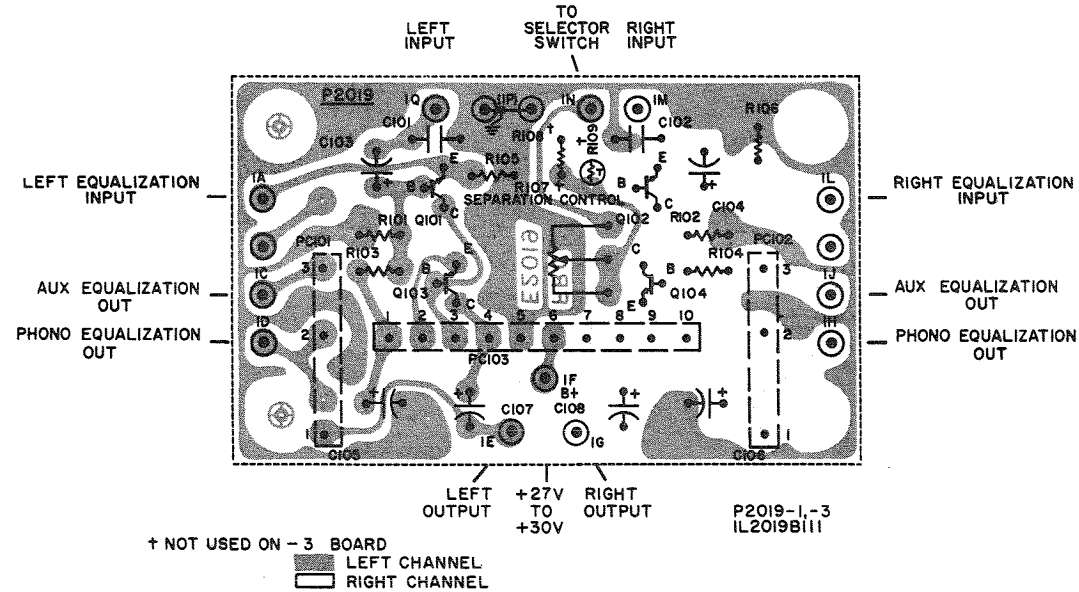
BOARD VIEWED FROM COMPONENT SIDE



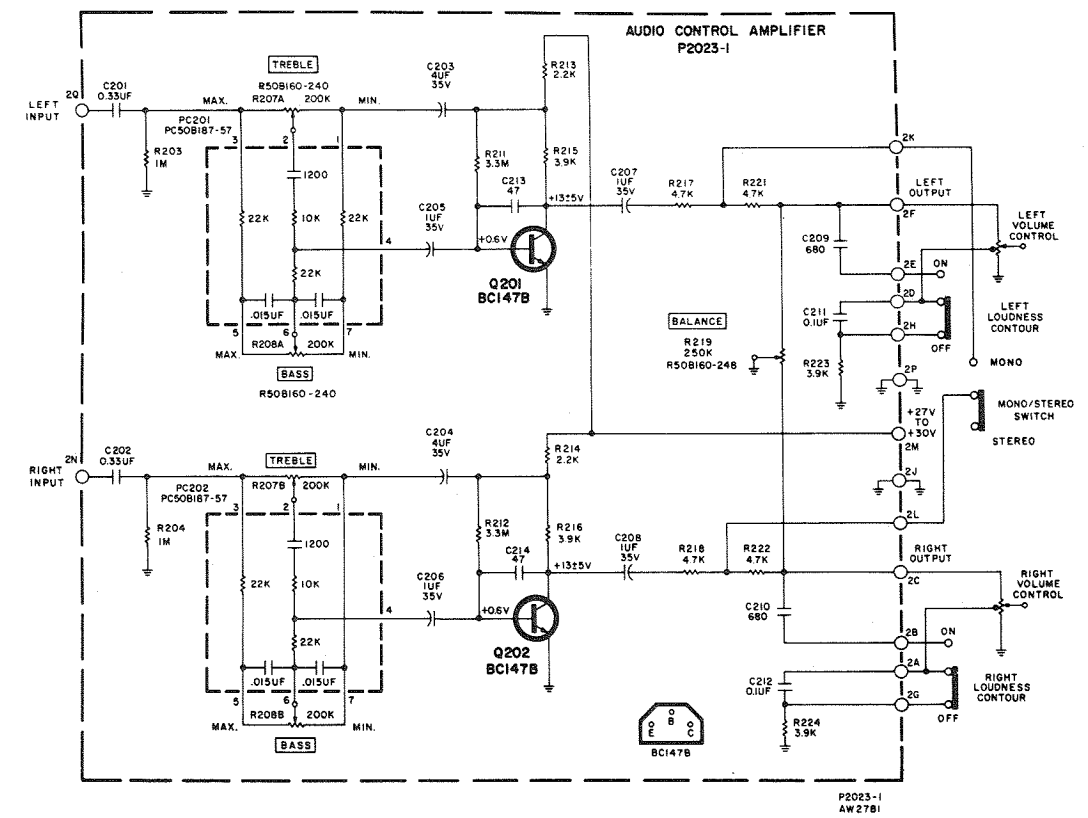
2019-1 PREAMPLIFIER



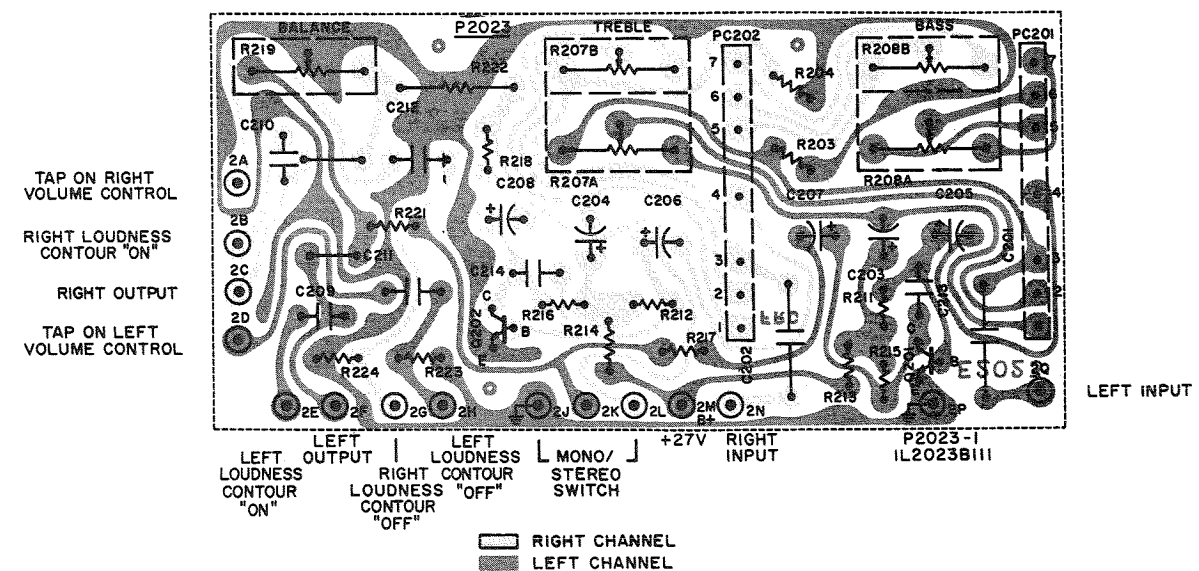
BOARD VIEWED FROM COMPONENT SIDE



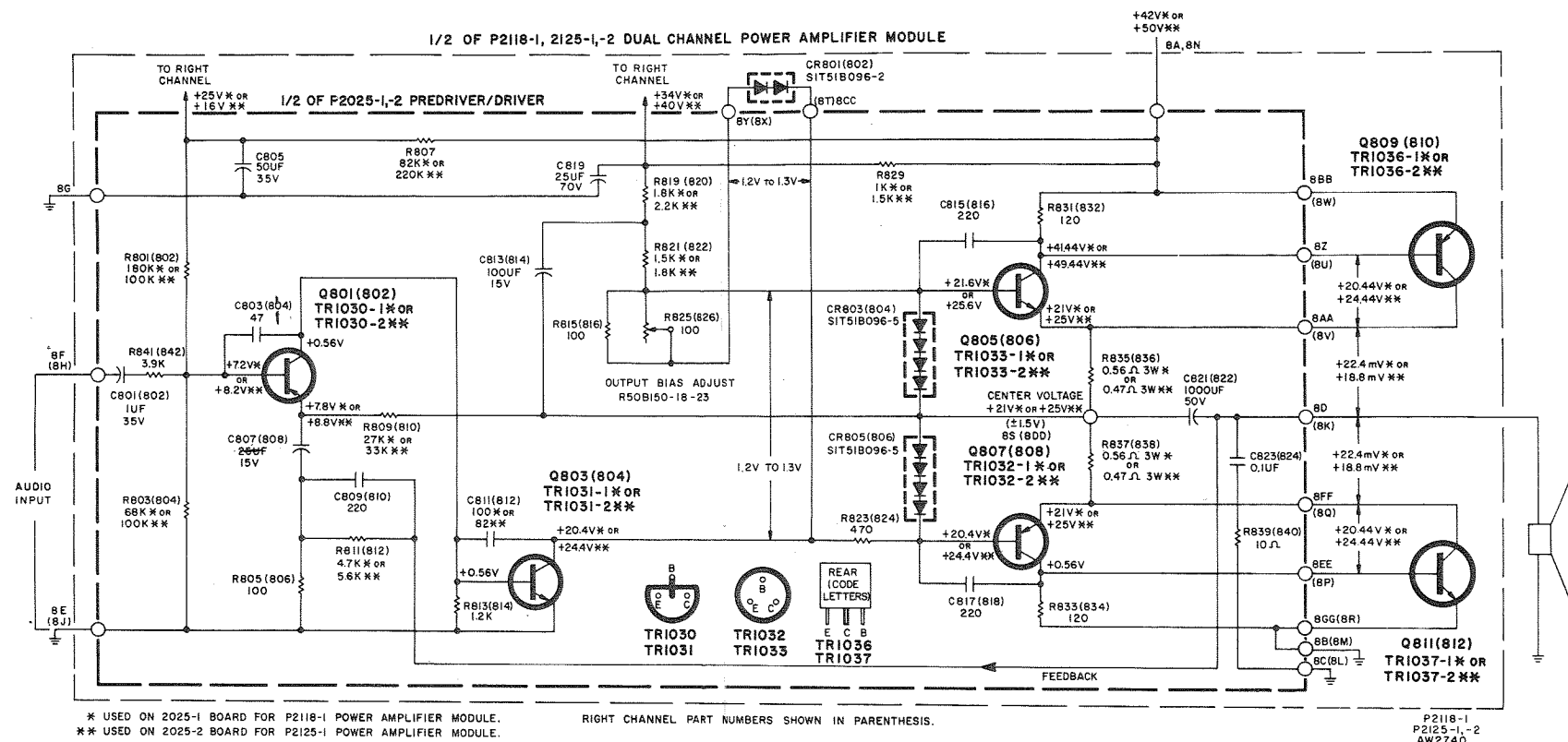
2023-1 AUDIO CONTROL AMPLIFIER



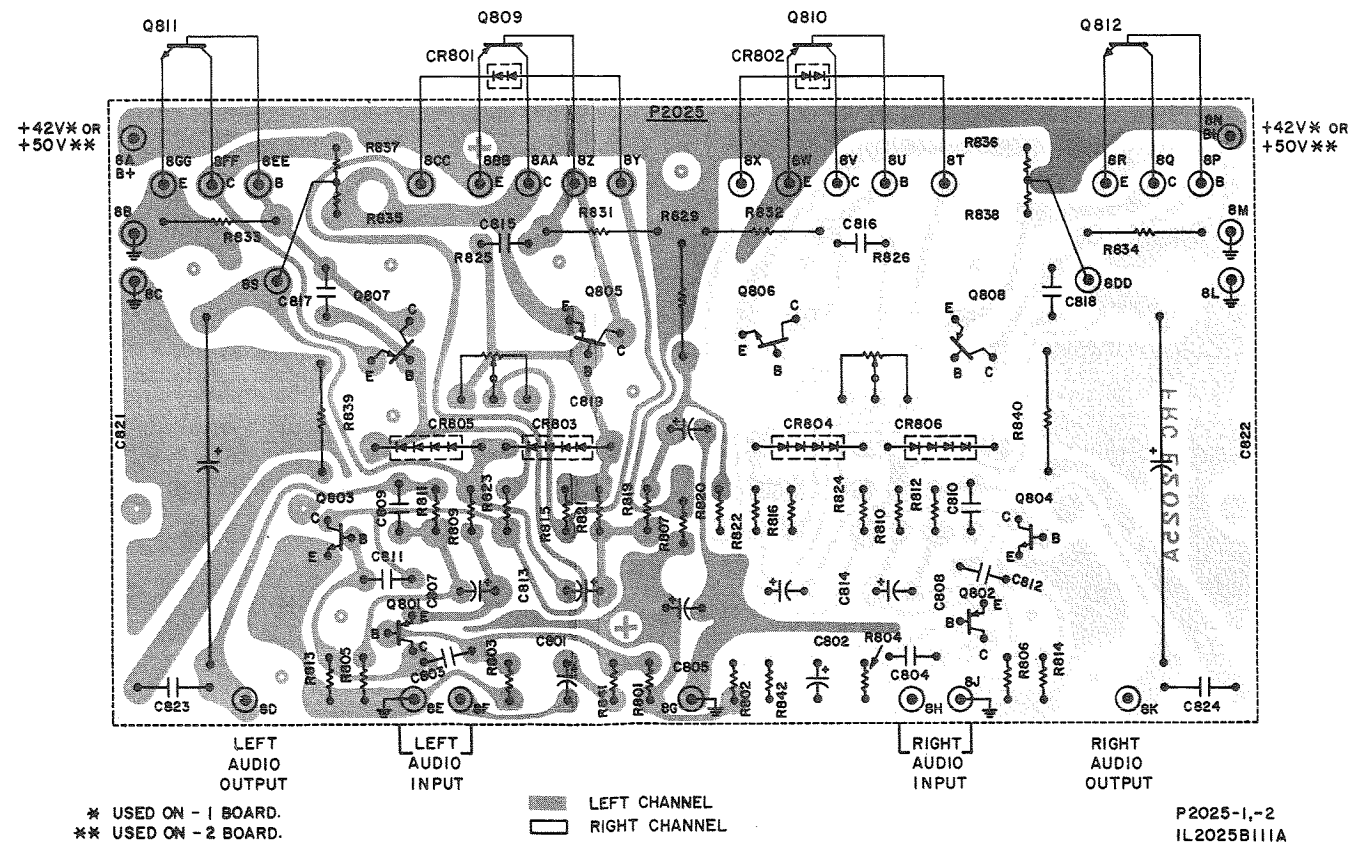
BOARD VIEWED FROM COMPONENT SIDE



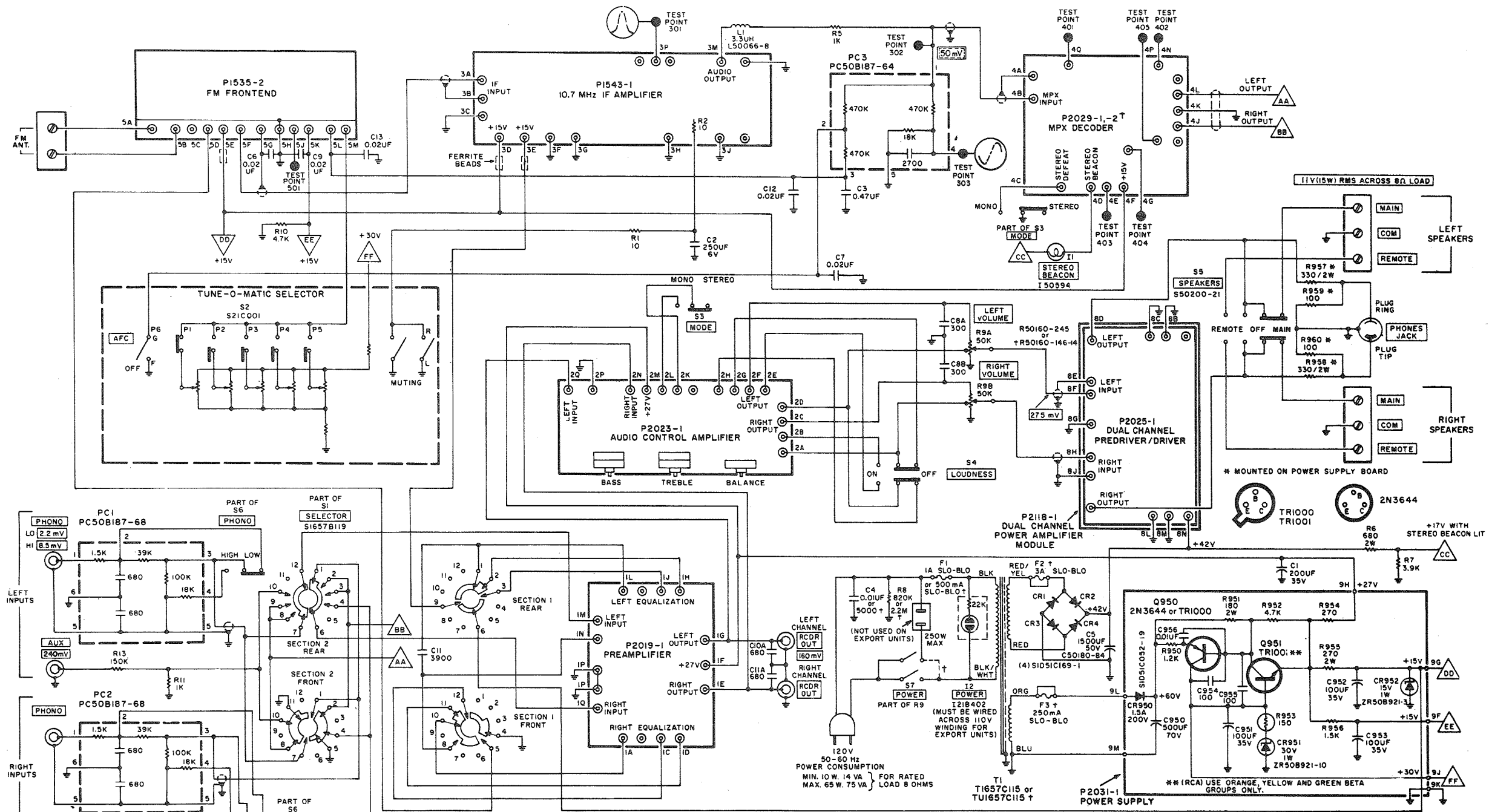
2118-1 DUAL CHANNEL POWER AMPLIFIER MODULE



BOARD VIEWED FROM COMPONENT SIDE

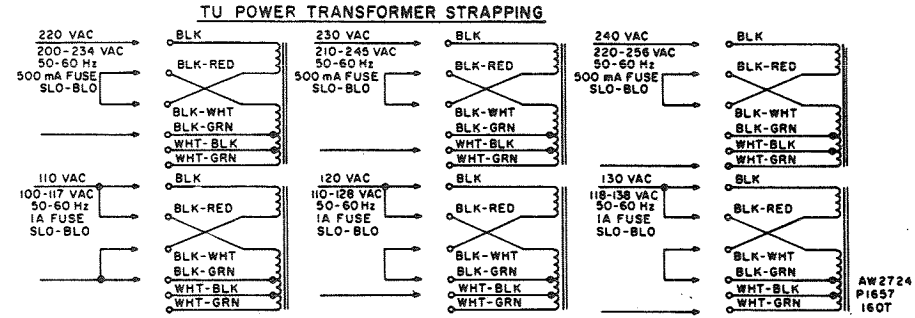


MAIN CHASSIS



SELECTOR SWITCH POSITIONS	
1	PHONO
2	FM
3	FM LOCAL
4	AUX

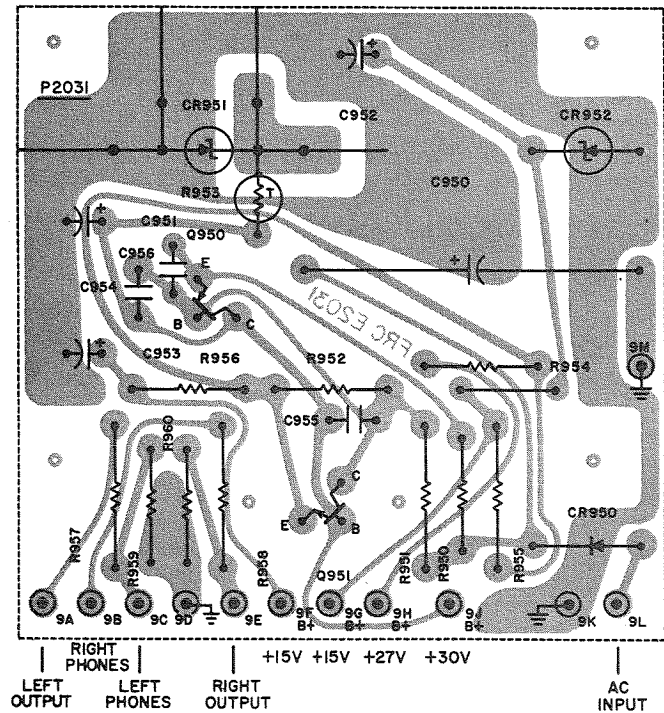
- NOTES:**
- FISHER PART NUMBER LISTED FOR PARTS SPECIALLY SELECTED FOR FISHER RADIO CORP.; 1/2 WATT, 5% COMPOSITION RESISTORS MAY BE USED FOR RESISTOR REPLACEMENTS, EXCEPT AS NOTED.
 - ALL ROTARY SWITCHES SHOWN IN MAXIMUM CCW POSITION NO. 1, ALL OTHER CONTROLS AND SWITCHES SHOWN IN NORMAL OPERATING POSITIONS.
 - FOR ALL VOLTAGE MEASUREMENTS, LINE VOLTAGE 120 VAC ALL DC VOLTAGES MEASURED WITH A DC VTVM TO CHASSIS WITH NO SIGNAL INPUT.
 - INDICATES 1KHz SIGNAL LEVELS FROM AUDIO INPUTS TO POWER AMPLIFIER OUTPUT **11V (15W) RMS ACROSS 8Ω LOAD** MEASURED WITH AC VTVM TO CHASSIS, VOLUME CONTROL MAXIMUM, ALL OTHER CONTROLS AND SWITCHES NORMAL.
 - INDICATES 1KHz SIGNAL LEVELS MEASURED IN FM MONO, WITH SIGNAL AT FM ANTENNA TERMINALS OF 10mV, 100MHZ, ±10 KHz DEVIATION WITH 1KHz AUDIO.
- † USED ONLY ON UNITS WIRED FOR EXPORT.



2031-1 POWER SUPPLY

SCHEMATIC SHOWN ON MAIN CHASSIS DIAGRAM

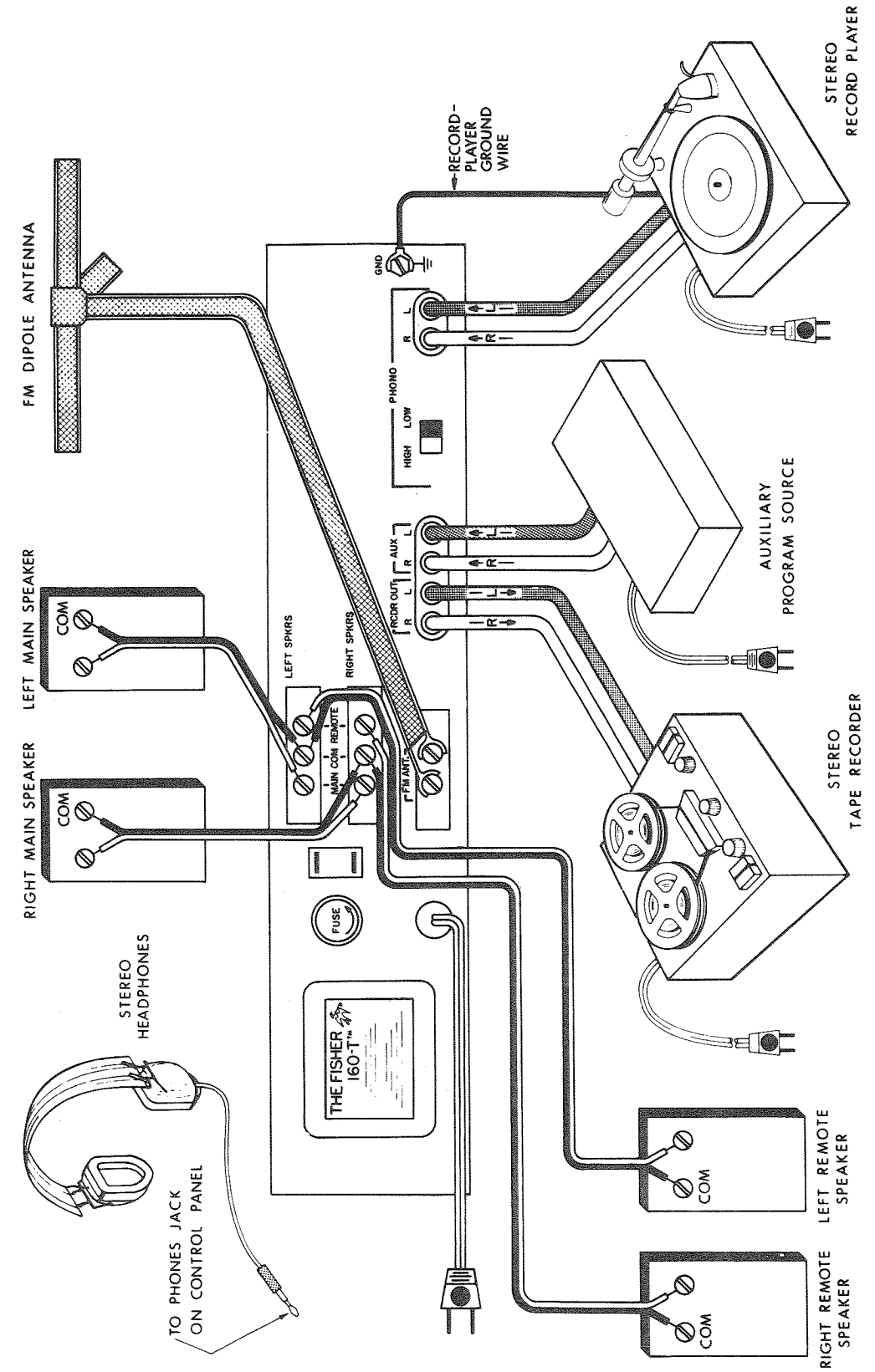
BOARD VIEWED FROM COMPONENT SIDE



AC INPUT
GROUND

P2031-1
IL2031B112

COMPONENT CONNECTIONS



IL 1657D127



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N1657-103

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