TEST EQUIPMENT AND SERVICE TIPS

The following equipment is required to completely test and align modern high-fidelity amplifiers, tuners, and receivers.

- Line Voltage Auto-transformer or Voltage Regulator
- DC Vacuum Tube Volt-ohmmeter
- Accurately Calibrated AC Vacuum Tube Voltmeter
- Oscilloscope (Flat to 100 kHz Minimum)
- Low-Distortion Audio Sine-Wave Generator
- Intermodulation-Distortion Analyzer
- Harmonic Distortion Analyzer
- 2 - Load resistors, 8-Ohms, 100 Watt (Minimum Rating)
- AM/FM Signal Generator
- 10.7 MHz Sweep Generator
- Multiplex Generator (preferably with RF output)
- 485 kHz Sweep Generator
- Ferrite Test Loop Stick
- 2 - Full Range Speakers for Listening Tests
- Stereo Source — Turntable, Tape Recorder, etc.
- Soldering Iron with Small Tip, Fully Insulated from AC Line
- Suction Desoldering Tool

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

Many of these items are included only as a reminder — they are normal procedures for experienced technicians. Shortcuts may be taken, but these often cause additional damage to transistors, circuit components, or printed circuit boards.

SOLDERING: A well-trained, hot, clean soldering iron tip will make soldering easier, without causing damage to the printed circuit board or the components mounted on it. Regular use of a sponge cleaner will maintain a clean soldering surface. The heat available at the tip, not the wattage of the iron, is important. Some 50-watt irons reach temperatures of 1,000° F, while others will hardly melt solder. Small-diameter tips should be used for single solder connections, pyramid and chisel tips for large areas.

Always disconnect the AC power cord from the line when soldering. Turning the power switch OFF is not sufficient. Power-line leakage paths, through the heating element of the iron, may destroy transistors.

PARTS REMOVAL: If a part is not being returned for in-warranty factory replacement, it may be out in half (with diagonal cutting pliers) to make removal easier. Multiple terminal parts, such as IF transformers, or electrolytic capacitors, should be removed using special de-soldering tips made especially for this purpose. Removing solder from terminals, reduces the possibility of breaking the printed circuit board when the part is removed.

ACCIDENTAL SHORTS: A clean working area, free of metal particles, screws, etc., is an important preventive in avoiding servicing problems. Screws, removed from the chassis during servicing, should be stored in a box until needed. While a set is operating, it takes only an instant for a base-to-collector short to destroy a transistor (and others direct-coupled to it). In the time it takes for a dropped machine screw, washer, or screwdriver, to contact a pair of socket terminals (or terminal and chassis), a transistor can be ruined.

SOLID-STATE DEVICES: Integrated Circuits contain the equivalent of many circuit parts, including transistors, diodes, resistors, and capacitors. The preferred troubleshooting procedure requires isolating the trouble to one stage using AC signal tracing methods. Once the suspected stage is located, the DC voltages at the input and output leads are measured to determine an exact indication of the operating conditions of the IC. 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. Do not replace a defective IC until all external resistors, capacitors, and transformers are checked first, to prevent the replacement IC from failing immediately due to a defect in the connecting components. Solder and unsolder each lead separately, using a pliers or other heat sink on the lead to prevent damage from excessive heat. Check that the leads are connected to the correct locations on the printed circuit board before turning the set on.

Whenever possible, a transistor tester should be used to determine the condition of a transistor or diode. Ohmmeter checks do not provide conclusive data, and may even destroy the junctional within the device.

Never attempt to repair a transistor power amplifier module until the power supply filter capacitors are fully discharged.

If an output or driver transistor becomes defective I'm open or shorted, always check ALL direct-coupled transistors and diodes in that channel. In addition, check the bias pot, and other parts in the bias network, before installing replacement transistors. All output and driver transistors in one channel may be destroyed if the bias network is defective. After parts replacement, always check the bias adjustment for specified idling current.

In some applications, replacement of transistors must be made from the same beta group as the original type. The beta group is indicated by a colored marking on the transistor. Be sure to include this information when ordering replacement transistors.

When mounting a replacement power transistor, be sure the bottom of the flange, mica insulator, and the surface of the heat sink, are free of foreign matter. Dust and grit will prevent flat contact, reducing heat transfer to the heat sink. Metallic particles can puncture the insulator, cause a short, and destroy 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 transfer. Use Dow-Corning DC-3, or an equivalent compound made for power transistor heat conduction.

Use care when making connections to speakers and output terminals. To reduce the possibility of shorts, lugs should be used on the exposed ends, or stranded wire should be twisted to prevent frayed wire ends. Current in the speakers and output circuits is quite high — some contacts, or small stranded wire, can cause significant power losses in the system. For wire lengths greater than 30 feet, 18 AWG, or heavier, should be used.

VOLTAGE MEASUREMENTS: All voltages are measured with the low voltage applied to 120 volts. All measured voltages are ±10%. DC voltages are measured to ground with a VTFM, with no signal input unless otherwise noted. AC signal voltages are measured under the conditions specified on the schematic.

ALIGNMENT PROCEDURES: DO NOT attempt realignment until the proper test equipment is available, and the alignment procedure is thoroughly understood.

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REMOVING MOTORBOARD

To gain access to the chassis for servicing, remove the motorboard using the following procedure:
(1) Unplug AC power cord.
(2) Unscrew the two large shipping screws (near the left rear and right front corners of the turntable baseplate) fully out to lock the changer to the motorboard.
(3) Remove the four screws in the motorboard (two on each side) holding the board to the wood side panels. Lift the motorboard at the rear, and unplug audio cables and power plug from underside of changer.
(4) Remove the motorboard from top of chassis.
(5) To reinstall the motorboard, reverse procedure. Be sure to reconnect the audio cable with the red plug to the changer phone jack labeled Right.

REMOVING DRESS PANEL

(1) Unplug AC power cord.
(2) Gently pull the VOLUME, BASS, TREBLE, SELECTOR, and TUNING knobs from the control shafts. Remove the hex nuts from the shafts and remove panel by pulling forward over the shafts.
(3) Reverse procedure for reassembly.

REMOVING DIAL GLASS

(1) Remove dress panel. Refer to REMOVING DRESS PANEL procedure.
(2) Carefully remove the foam strips at the ends of the dial glass. Strips may be reused with the replacement glass.
(3) Slide the retaining clips from the flanges by gently twisting a flat-blade screwdriver in each slot.

REPLACING DIAL LAMPS

NOTE: Dial lamps are replaceable only as molded assemblies (IFR No. AS21410-3).
(1) Unplug AC power cord.
(2) Remove motorboard. Refer to REMOVING MOTORBOARD procedure.
(3) Remove dress panel. Refer to REMOVING DRESS PANEL procedure.
(4) Squeeze the sides of the assembly together at the back and press through the panel.

REPLACING STEREONEOBEACON AND METER LAMPS

NOTE: The compartmented lamp assembly (IFR No. LM21606-2), mounted on the rear of the meter, contains the meter lamp and the STEREONEOBEACON lamp, and must be replaced as a complete unit.
(1) Unplug AC power cord.
(2) Remove motorboard. Refer to REMOVING MOTORBOARD procedure.
(3) Gently pull the four wires off the terminal pins on the top rear of the meter. Label each wire with its associated pin location to make replacement easier later.
(4) Gently unsnap the lamp compartment from the top rear of the meter.
(5) Install the replacement lamp assembly between the plastic flanges and press firmly into place.
DIAL STRINGING

1. Unplug AC power cord.
2. Remove motorboard. Refer to REMOVING MOTORBOARD procedure.
3. Remove drop panel. Refer to REMOVING DRESS PANEL procedure.
4. Remove dial pointer from old dial cord.
5. Prep unit on left side. Remove right wood side panel by removing two slotted screws near feet on right side.
6. Rotate tuning capacitor fully CW. Loosen screws in the drum and remove old dial cord.
7. Tie cord to spring. Fasten spring to START screw.
8. Run cord through slot in rim and wrap it turn CW around drum. Guide cord around pulley “A”, and wrap 2 turns (CCW viewed from back) around tuning shaft.
10. Rotate gang CW, allowing cord to wind on drum.
11. Run cord over top of drum, around other side, into the rim slot. Tie a half-knot around FINISH screw.
12. Pull cord taut and tighten screw.
13. Rotate gang fully CW and CCW to distribute tensioning along cord. Repeat (12) and (13) to tension spring.
14. Place pointer on rail and slip cord over and under tabs.
15. Rotate gang fully CCW. Slide pointer to (3) mark on logging scale while holding tuning shaft fully CCW. Cement pointer to cord. Check dial calibration.

HARMONIC DISTORTION TEST

CAUTION:
(A) Measure the power of one channel at a time.
(B) Limit measurements to 10 minutes.
(C) Use a load resistor with a minimum rating of 50 watts.

Set BASS and TREBLE controls to NORMAL. Set SELECTOR switch to AUX. Depress MAIN SPKRS switch. Unplug AC power cord.
(1) Connect a low-distortion sine-wave generator to the LEFT AUX IN jack. Set generator frequency to 1,000 Hz, and output level to minimum.
(2) Connect an 8-ohm load resistor between the LEFT SPKRS MAIN and COMMON terminals. In parallel with the load resistor, connect the input leads of an HD analyzer and the input leads of an accurately calibrated AC VTM.
(3) Connect AC power cord and rotate VOLUME control to maximum.
(4) Increase generator level for 14 watts output (110.6 V RMS across 8-ohm load). HD meter should read 0.5% or less.
(5) Repeat preceding steps for right channel.
FM/AM TUNER 2083-4

(11) Set SELECTOR switch to AM. Turn VOLUME control to minimum.
(12) Connect 45kHz sweep generator through 0.1uF to P19. Connect scope through 220k to P18.
(13) Adjust cores of L14, L13, L11 and L10 for maximum gain and symmetry.
(15) Set generator frequency and dial pointer accurately to 600kHz. Modulate generator with 400Hz, 30% modulation.
(16) Connect a short jumper between P21 and chassis. Adjust oscillator coil L12 for maximum amplitude.
(17) Repeat steps (5) and (6) for accurate dial calibration and maximum gain.
(18) Disconnect jumper connection between P21 and chassis. Reconnect AM signal generator to AM ANTENNA A terminal.
(19) Tune receiver to generator frequency at 600kHz. Modulate generator with 400Hz, 30% modulation.
(20) Make sure holding the coil to the ferrite antenna. Shift the coil for maximum audio indication. To secure coil in position, remelt wax.
(21) Tune receiver to generator frequency at 1400kHz. Adjust antenna trimmer TC4 for maximum audio.

FM ALIGNMENT

(1) Set SELECTOR switch to FM. Turn VOLUME control to minimum.
(2) Connect 10.7kHz sweep generator through 1pF to Test Point 1. Connect scope through 220k to P24. Cut wire loop at P24.
(3) Adjust top and bottom cores of L8, L7, and L6, and bottom core of L9 for maximum gain and symmetry.
(5) Connect DC VTVM to P5. Readjust top core of L9 for 0 VDC. Disconnect sweep generator and DC VTVM. Connect FM RF generator through 120-ohm carbon resistors to P1 and P2.

AM ALIGNMENT

(1) Turn TUNING knob fully CCW. If pointer is not centered on dial, reposition and cement pointer. Except as noted, maintain generator levels as low as possible during alignment.

(2) Set generator frequency and dial pointer accurately to 90kHz. Modulate generator with 400Hz, ±75kHz deviation. Bend oscillator coil L3 for maximum amplitude at P5.
(3) Set generator frequency and dial pointer accurately to 108kHz. Adjust oscillator trimmer TC3 for maximum amplitude at P5.
(4) Repeat steps (1) and (7) for maximum sensitivity and accurate dial calibration.
(5) Reconnect DC VTVM to P5. Set generator level to 1 mV. Tune receiver to generator frequency (108kHz) for 0 VDC at P5.
(6) Disconnect MPX generator (output) to FM generator EXTERNAL MODULATION input. Modulate left and right channels with 40kHz, ±75kHz deviation) and 19kHz pilot (±5kHz deviation).
(7) Adjust top cores of L17 and L18 for maximum audio. Note audio level.
(8) Disconnect generator output to 20 mV, and modulate with 40kHz, ±75kHz deviation.
(9) Detune generator frequency for -0.5 VDC at P5. Disconnect jumper between P3 and P4 to turn AFC on. Disconnect generator output for -0.5 VDC at P5. Remove jumper. Measure should read between +0.5 and 0 VDC.
(10) Connect MPX generator. Set generator output to 20 mV, and modulate with 40kHz, ±75kHz deviation.
(11) Disconnect output to 20 mV, and modulate with 40kHz, ±75kHz deviation.
(12) Adjust generator output to 20 mV, and modulate with 40kHz, ±75kHz deviation.
(13) Reconnect jumper between P3 and P4 to turn AFC off. DC VTVM should read between +0.5 and 0 VDC.
(14) Connect MPX generator. Set generator output to 20 mV, and modulate with 40kHz, ±75kHz deviation.
(15) Disconnect output to 20 mV, and modulate with 40kHz, ±75kHz deviation.
CENTER VOLTAGE TEST

Turn VOLUME control to minimum. Depress MAIN SPKRS switch.

1. Connect an 8-Ohm load resistor across the LEFT SPKRS MAIN and COMMON terminals, and a second 8-Ohm load resistor across the RIGHT SPKRS MAIN and COMMON terminals.

2. Temporarily connect two 10K x 1% resistors in series between pins 201/202 and 225/222 on Power Supply board. Connect the common lead of a DC VTVM to the junction of the resistors.

3. Connect the probe of the DC VTVM to pin 85 on Power Amplifier Module. Meter should read between 0.50V and 1.50V.

4. Disconnect the two 10K resistors.

5. Disconnect the 8-Ohm load resistors from pins 201/202 and 225/222.

6. Turn VOLUME control to maximum.

IDLING CURRENT ADJUSTMENT

Turn off, and warm up thoroughly (approximately 10 minutes). Turn VOLUME control to minimum.

1. Connect the common lead of a DC VTVM to pin 85 on Power Amplifier Module. Connect the probe of the meter to pin 8A. BE CAREFUL TO AVOID SHORTING ADJACENT PINS. Meter should read between 10µA and 40µA.

2. If necessary, move BIAS ADJUST pot. R825 on Power Amplifier Module. Optimum amplifier performance will be achieved with 15µA setting.

3. Disconnect the common lead of the meter to pin 8A. Reconnect meter probe to pin 8B. BE CAREFUL TO AVOID SHORTING ADJACENT PINS. Meter should read between 10µA and 40µA.

4. If necessary, move BIAS ADJUST pot. R828.