REQUIRED TEST EQUIPMENT

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

- Line Voltage Autotransformer or Voltage Regulator
- DC Vacuum Tube Voltmeter
- Accurately Calibrated AC Vacuum Tube Voltmeter
- Oscilloscope (IF flat to 100 kHz Minimum)
- Low-Distortion Audio Signal Generator
- Intermodulation 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 — FISHER 3001)
- 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-tinned, 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 90-watt irons reach temperatures of 1,900°F, while others will hardly melt solder. Small-diameter tip should be used for small 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 inventory factory replacement, it may be cut 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 loose connector to short out. Since most circuits are designed for direct-coupled to input circuits. In the time it takes for a dropped machine screw, washer, or screwdriver, to contact a pair of socket terminals (or small and cheater), a transistor can be ruined.

SOLID-STATE DEVICES: Integrated Circuits consist of the equivalent of many circuit parts, including transistors, diodes, resistors, and capacitors. The preferred troubleshooting procedure requires selecting 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 give an accurate 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 pilers 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 junctions 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 (open or short), 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 sitting 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-Coming 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 tinned to prevent frayed wire ends. Current in the speakers and output circuitry is quite high — poor contacts, or small sized wire, can cause significant power loss in the system. For wire lengths greater than 30 feet, 16 AWG, or heavier, should be used.

VOLTAGE MEASUREMENTS: All voltages are measured with the line voltage adjusted to 120 volts. All measured voltages are ±10%. DC voltages are measured to ground with a V'TVM, 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 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 INFRINGING ANY OBLIGATION.
To gain access to the chassis for servicing, remove the motorboard using the following procedure:
(1) Disconnect AC power cord.
(2) Unplug the two shipping screws (near the left front and right front corners of the turntable baseplate) fully out to lock the chasis to the motorboard.
(3) Remove the six screws in the motorboard and lift the motorboard at the front. Unplug the two audio cables and the power plug from the underlde of the changer. Remove the four audio plugs and the power plug from the back of the cassettes recenter. Label the recorde's audio cables with the appropriate INPUT or OUTPUT designation for easy replacement later.
(4) Remove the motorboard (with recorder and changer mounted) from the top of the chasis.
(5) To reinstall the motorboard, reverse the procedure. Be sure to reconnect the audio cables with the red plugs to the jacks labeled Rights.

REMOVING MOTORBOARD

REMOVING DRESS PANEL

(1) Disconnect AC power cord.
(2) Remove motorboard. Refer to REMOVING MOTORBOARD procedure.
(3) Remove dress panel. Refer to REMOVING DRESS PANEL procedure.
(4) Prop the unit on its back panel. Remove the two scated screws (near the feet) which hold the extention chassis to the main chassis.
(5) Set the unit on its feet. Lift the exention chassis and pull forward. Swing the extension chassis away from the main chassis at the front to provide access to the tuning drive motor. WARNING: Be careful to avoid breaking the wires interconnecting the main chassis and the extension chassis.
(6) Remove the dial pointer from the dial cord.
(7) Rotate the tuning capacitor drive drum to its maximum CW position. Loosen the machine screws in the center of the drum and remove the old dial cord.
(8) Tie end of new dial cord to one end of dial spring. Fasten to top right ear inside drive drum. See Figure 1.
(9) Run the dial cord through the slot in the rim of the drum and set in the bottom of the escutcheon guides. Guide the dial cord around pulley "A", across and underneath the tuning shaft. Wrap 2 full turns (1CW viewes from back) around the tuning shaft.
(10) Into the dial cord over pulley "B", across the front, around pulley "C", and back up around pulley "D". Keep the dial cord taut during this procedure.
(11) Rotate the drive drum to its maximum CCW position, allowing the cord to wind onto the drive drum. Keep the dial cord taut during this procedure.
(12) Run the dial cord over the top of the drive drum (in inside groove) and into the rim slot. Bring the cord around the drive drum and place the cord under the bezel washer.
(13) With the machine screws loosened, pull the dial cord and tighten the screw.
(14) Turn the tuning shaft to rotate the drive drum fully CW and fully CCW to distribute the tensioning along the dial cord. Repeat steps (13) and (14) until spring is tensioned.
(15) Place the dial cord over and under the tabs on the rear of the dial pointer, and place the pointer on the top of the rail.
(16) Turn the tuning shaft fully CCW. Slide the dial pointer to zero (0) calibration mark on the stepping scale while holding tuning shaft fully CCW. Cement dial pointer to dial cord to prevent slippage. Allow cement to thoroughly dry. Check dial calibration. Refer to FM FRONT END ALIGNMENT.
(17) Reconnect extension chassis. Dress audio cables away from tuning drive motor. WARNING. Use only plain lukewarm water for moistening a freshly laundered, soft lint-free cloth to clean the front dress panel.

REPLACING DIAL LAMPS

(1) Disconnect AC power cord.
(2) Remove dress panel. Refer to REMOVING DRESS PANEL procedure.
(3) Remove the defective lamp (with its metal shade) from its bayonet base by pressing the lamp in, and rotating 1/8 turn CCW. Slide the metal shade off the lamp. Install the replacement lamp by pressing in, and turning CW 1/8 turn. Slide the shade onto the lamp and adjust it to direct the light toward the edge of the dial glass.
(4) Reinstall the dress panel.

REPLACING STEREO BEACON LAMP

(1) Disconnect AC power cord.
(2) Remove motorboard. Refer to REMOVING MOTORBOARD procedure.
(3) Unsolder the two leads from the terminals on the rear of the STEREO BEACON lamp assembly.
(4) Remove the nylon lamp holder assembly may result from excessive heating of the terminals. Use a pair of pliers (at a heat sink) to hold each terminal when soldering or unsoldering leads.
(5) Gently pry off the nylon lamp holder assembly. Press the replacement assembly into the mount and resolder the leads removed previously.
(6) Reinstall the motorboard.

REPLACING METER LAMP

(1) Disconnect AC power cord.
(2) Remove motorboard. Refer to REMOVING MOTORBOARD procedure.
(3) Unsolder the two leads from the terminals on the rear of the METER LAMP assembly.
(4) Remove the frosted glass lamp holder assembly may result from excessive heating of the terminals. Use a pair of pliers (at a heat sink) to hold each terminal when soldering or unsoldering leads.
(5) Gently pull the meter retainer away from the rear of the tuning meter and lift out the meter.
(6) Slide the replacement meter behind the retainer and fit meter into panel cutout. Restorer the meter leads removed previously.
(7) Reinstall the motorboard.

REPLACING METER

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

CLEANING FRONT PANEL

POWER AMPLIFIER CENTER VOLTAGE TEST

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.

REMOVING P.C. BOARDS

(1) Disconnect AC power cord.
(2) Remove motorboard. Refer to REMOVING MOTORBOARD procedure.
(3) Remove the defective meter lamp (with its metal shade) from its bayonet base by pressing the lamp in, and rotating 1/8 turn CCW. Slide the shade off the lamp. Install the replacement lamp by pressing in, and turning CW 1/8 turn. Slide the shade onto the lamp and adjust it to direct the light toward the back of the tuning meter.
(4) Reinstall the motorboard.

(1) Remove motorboard. Refer to REMOVING MOTORBOARD procedure.
(2) Unsolder the two leads from the terminals on the rear of the meter and label each wire with its associated pin location for easy replacement later.
(3) Unsolder the two leads from the terminals on the rear of the STEREO BEACON lamp assembly.
(4) Gently pull the nylon lamp holder assembly. Press the replacement assembly into the mount and resolder the leads removed previously.
(5) Reinstall the motorboard.

Figure 1.
POWER AMPLIFIER IDLING CURRENT ACTUATION

NOTE: Power amplifier center voltage test should be performed before the following procedure.
Turn VOLUME control to minimum.
1. Connect DC VTVM across resistor R38 (10.5K ohms) on left channel of power amplifier module. Meter should read between 10 mV and 35 mV.
2. If necessary, adjust R25 (OUPUT BIAS ADJUST) pot. on predriver/driver board for reading between 10 mV and 35 mV on DC VTVM. Optimum amplifier performance will be achieved with 15 mV setting.
3. Connect DC VTVM across resistor R38 on right channel of power amplifier module. Meter should read between 10 mV and 35 mV. If necessary, adjust R26 pot. on predriver/driver board for reading between 10 mV and 35 mV on DC VTVM.

INTERMODULATION DISTORTION TEST

Set BALANCE, BASS and TREBLE controls to their center positions. Set SELECTOR switch to AUX, Depress MAIN SPKRS pushbutton switch. 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 IM distortion analyzer and the input leads of an accurately calibrated AC VTVM.
2. Connect IM-analyzer generator output to the LEFT AUX IN jack. Set level of IM-analyzer generator for 300 mV output.
3. Connect AC power cord and adjust VOLUME control for 12 watts output (17W RMS across 8-ohm load). AFTERCONE OF FULL MINIMUM OF WARM-UP, PROCEED TO NEXT STEP.
4. IM meter should read 0.8% or less.
5. Repeat preceding step for right channel.

NOTE: If this procedure differs from those in the IM analyzer manual, it is best to follow the instructions in the manual. If a load resistor of 50K ohms is used in the IM analyzer, a separate load resistor is not required.

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 at a nominal signal to measure the maximum continuous RMS power output, the following procedures 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.
3. Use a load resistor with a rating of at least 60 watts. 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 SELECTOR, BASS, and TREBLE controls to their center positions. Set SELECTOR switch to AUX, Depress MAIN SPKRS pushbutton switch. 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 IM analyzer and the input leads of an accurately calibrated AC VTVM.
2. Connect IM-analyzer generator output to the LEFT AUX IN jack. Set level of IM-analyzer generator for 300 mV output.
3. Connect AC power cord and adjust VOLUME control for 12 watts output (17W RMS across 8-ohm load). AFTER ONE FULL MINUTE OF WARM-UP, PROCEED TO NEXT STEP.
4. IM meter should read 0.8% or less.
5. Repeat preceding step for right channel.

NOTE: If this procedure differs from those in the IM analyzer manual, it is best to follow the instructions in the manual. If a load resistor of 50K ohms is used in the IM analyzer, a separate load resistor is not required.

FM FRONT-END ALIGNMENT

NOTE: FM alignment must be performed before starting this procedure.
Set SELECTOR switch to FM, Turn VOLUME control to minimum. Depress MONO MODE pushbutton switch.
1. Set TUNING dial pointer to zero (0) calibration mark on the logging scale. If the dial pointer is not centered on the zero line at the extreme end of knob rotation, reposition the pointer assembly on the dial and cement the pointer in place to prevent slippage. Allow output to settle for thoroughly.
2. Connect an FM generator to the FM ANTENNAS terminals. Use a 120-ohm component resistor in series with each lead from the generator (see Figure 5).
3. Connect an scope and AC VTVM to either Left or Right OUT TO EXT RCDR jack.

MULTIPLEX ALIGNMENT

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

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HARMONIC DISTORTION TEST

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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 IM analyzer and the input leads of an accurately calibrated AC VTVM.
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3. Connect AC power cord and adjust VOLUME control for 12 watts output (17W RMS across 8-ohm load). AFTER ONE FULL MINUTE OF WARM-UP, PROCEED TO NEXT STEP.
4. IM meter should read 0.8% or less.
5. Repeat preceding step for right channel.

NOTE: If this procedure differs from those in the IM analyzer manual, it is best to follow the instructions in the manual. If a load resistor of 50K ohms is used in the IM analyzer, a separate load resistor is not required.

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2. Connect an FM generator to the FM ANTENNAS terminals. Use a 120-ohm component resistor in series with each lead from the generator (see Figure 5).
3. Connect an scope and AC VTVM to either Left or Right OUT TO EXT RCDR jack.

MULTIPLEX ALIGNMENT

Two methods of aligning the multiplex decoder are given. The preferred procedure uses a multiplexer with RF and 19 kHz output and with 1 kHz modulation, such as the FISHER 300 Multiplexer. This is the better method of alignment procedure. In front-end and IF stages are also checked through the use of this procedure. An alternative procedure for use with multiplexer 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.

1. Connect RF output of multiplexer to the FM ANTenna terminals. Use a 120-ohm composition resistor in series with each lead from RF output (see Figure 5). Set MPX generator for external modulation with 19 kHz pilot carrier, ±7.5 kHz deviation (10% pilot, no audio). Tune receiver to RF frequency of MPX generator.

2. Connect DC VTM to Test Point 403 (pin 4G on FM IF, MPX, METER board).

3. Adjust cores of Z401 and Z402 (on FM IF, MPX, METER board) for maximum reading on DC VTM (1.5 to 4 VDC).

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 ±7.5 kHz deviation (10% pilot, 90% audio). Modulate right channel only.

5. Connect DC VTM to Left OUT TO EXT RCDR jack. Connect oscilloscope through voltage divider probe (see Figure 5) to Test Point 402 (pin 4K on FM IF, MPX, METER board).

6. Turn R 107 SEPARATION CONTROL (on FREQUENCY METER board) CW to maximum resistance setting. Adjust core of Z403 (on FM IF, MPX, METER board) for maximum gain and as straight a baseline as possible on scope (see Figure 7). AC VTM should read minimum.

7. With MPX generator modulated on right channel only, connect AC VTM to Right OUT TO EXT RCDR jack. Readout on AC VTM.

8. Set MPX generator to modulate left channel only. Adjust R 107 SEPARATION CONTROL (on FREQUENCY METER board) for minimum reading on AC VTM; at least 30 dB below reading recorded in step 7). Record reading.

9. Connect AC VTM to Left OUT TO EXT RCDR jack. Same reading ±2 dB as recorded in step 7).

10. Set MPX generator to modulate right channel only. Same reading ±3 dB as recorded in step 8).

NOTE: IF equal readings cannot be obtained in steps 8) and 10), readjust Z402 slightly (on FM IF, MPX, METER board) and repeat steps 7) through 10).

ALTERNATE ALIGNMENT PROCEDURE

Set SELECTOR switch to FM, and VOLUME control to minimum.

1. Disconnect the jumper lead going to pin 4A (on FM IF, MPX, METER board) and connect the output of the multiplexer generator through a 10k resistor to pin 4A.

2. Connect DC VTM to Test Point 403 (pin 4G on FM IF, MPX, METER board). Connect the vertical input of the scope to pin 4A.

3. Set MPX generator for 19 kHz pilot carrier output only. Adjust pilot level for approximately 120 mv peak-to-peak input at pin 4A.

4. Adjust cores of Z401 and Z402 (on FM IF, MPX, METER board) for maximum reading on DC VTM (1.5 to 4 VDC).

5. Connect output of audio generator, set for 1 kHz, to the external modulation input of MPX generator and to the external sync input of an oscilloscope. Adjust audio generator level for 1.2 volts peak-to-peak composite signal (10% pilot, 90% audio). See Figure 8. Modulate right channel only. Proceed with steps 8) through 10) of PREFERRED ALIGNMENT PROCEDURE.

6. Reconnect the jumper lead going to pin 4A (on FM IF, MPX, METER board) removed previously.