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 (10 kHz 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-cleaned, 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, in any 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 warranty factory replacement, it may be cut in half with a 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 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 pencil 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.

Whenver 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 (leaks or shorts), 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, leads should be used on the exposed ends, or stranded wire should be bonded 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 losses 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 low voltage adjusted to 120 volts. All measured voltages are ±10%. DC voltages are measured to ground with a VTM, with no signal input unless otherwise noted. AC signal voltages are measured under the conditions specified on the schematic.

ALIGNMENT PROCEDURE: 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 RESERVES THE RIGHT TO MODIFY ANY DESIGN OR SPECIFICATION WITHOUT PRIOR NOTICE.
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REMOVING DRESS PANEL
(1) Unplug AC power cord.
(2) Gently pull SELECTOR, BASS, TREBLE, BALANCE, VOLUME, and TUNING knobs from control shafts. Remove hex nuts from shafts and remove panel by pulling forward over shafts.
(3) Reverse procedure for reassembly.

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.
To remove any of the three boards containing the front panel controls and switches, use the following procedure:
(1) Remove dress panel. Refer to REMOVING DRESS PANEL procedure.
(2) a. Remove CONTROL AMPLIFIER board by removing hex nuts from BASS, TREBLE, BALANCE, and VOLUME controls.
   b. Remove pushbutton mounting boards by removing the appropriate pushbutton knob and the two screws holding the switch to the chassis.

REPLACING METER
(1) Unplug AC power cord. Remove top cover.
(2) Gently unsnap the lamp compartment from the top of the meter. It is unnecessary to remove the leads.
(3) Gently pry the meter off the panel, and scrape off the residual adhesive.
(4) Un solder 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.
WARNING: Damage to the meter may result from excessive heating of the meter terminals. Use a pair of pliers (or a heat sink) to hold each terminal when soldering or unsoldering leads.
(5) Peel the backing from one side of the replacement adhesive mounting pad (FR No. CST1485), and affix it to the replacement meter (FR No. MC21600-1). Peel the backing from the remaining side of the adhesive pad, align the meter over the cutout, and firmly press the meter to the back of the panel.
(6) Center the lamp compartment between the flanges and press firmly into place.

REPLACING DIAL LAMPS
NOTE: Dial lamps are replaceable only as molded assemblies (FR No. A0214410-0).
(1) Unplug AC power cord. Remove top cover.
(2) Remove dress panel. Refer to REMOVING DRESS PANEL procedure.
(3) Source the sides of the assembly together at the back and press through the panel.

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. Slight 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.
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(1) Unplug AC power cord. Remove top cover.
(2) Remove pointer from old dial cord. Rotate tuning capacitor fully CCW. Loosen screw in center of drum and remove old cord.
(3) Tie end of new cord to one end of dial spring. Hook spring around drum shaft (see illustration).
(4) Run cord through rim slot and wrap ½ turn CCW around drum inside groove. Guide cord around pulley “A,” underpass pulley “B,” and wrap 2 full turns CCW around tuning shaft.
(5) Guide cord around pulley “C,” and around pulley “D.” Rotate drum fully CW, allowing cord to wind on drum, keeping cord tight. Run cord over top of drum inside groove S to other side into rim slot.
(6) Pull cord twice under washer and tighten screw.
(7) Turn tuning shaft to rotate gang fully CCW and fully CW to distribute tensioning along cord.
(8) Place pointer on rail and slip cord over and under tab on pointer. Repeat steps (6) and (7) until spring is properly tensioned.
(9) Turn tuning shaft fully CCW. Slide pointer to (8) on logging scales while holding tuning shaft CCW. Cook cement to cord to prevent slippage. Allow cement to thoroughly dry. Check dial calibration.

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 SECTOR switch to AUX 1. Depress MAIN SPKR switch. Unplug AC power cord.
(1) Connect a low-distortion sine-wave generator to the LEFT AUX 1 IN jack. Set generator frequency to 1,000 Hz, and output level to minimum.
(2) Connect an 8-ohm load resistor between the LEFT SPKR 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 32 watts output (115.9V RMS across 8-ohm load). HD Meter should read 0.5% or less.
(5) Repeat preceding steps for right channel.
LEFT RCVR 1 OUT jack.
88 Set generator frequency and dial pointer accurately to 900kHz. Modulate generator with 400Hz, 75kHz deviation. Adjust oscillator coil L505 for center-of-scale reading on receiver's tuning meter, and maximum audio on AC VTM.
88 Set generator frequency and dial pointer accurately to 100kHz. Adjust oscillator trimmer CS51 for center-of-scale and maximum audio meter readings.
(10) Repeat steps 89 and 90 for accurate dial calibration and maximum audio.
89 Set generator frequency and dial pointer to 900kHz. Reduce generator output until noise interference is visible on sine wave. Adjust generator frequency to center noise interference on positive and negative half-cycles. See SYMMETRICAL TUNING illustration. Adjust mixer coil L504 and RF coil L503 for maximum audio.
90 Set generator frequency and dial pointer to 100kHz. If necessary, readjust generator output until noise interference is visible on sine wave (see SYMMETRICAL TUNING illustration). Adjust mixer trimmer CS51 and RF trimmer CS52 for maximum audio.
(13) Repeat steps 89 and 90 for maximum audio. Increase generator level to 10mV.
(14) Connect MPX generator composite output to FM signal generator EXTERNAL MODULATION input. Modulate composite signal with 1kHz, ±7kHz deviation (50% audio) and 1kHz carrier, ±3kHz deviation (45% pilot). Modulate right channel only.
(15) Tune receiver accurately to generator frequency.
Connect DC VTM to pin 4K. Connect vertical input of scope to pin 4L.
(16) Adjust 2401 and 2402 for maximum DC voltage at pin 4L. Note meter reading. Adjust 2402 for maximum AC voltage (on scope) at pin 4L. Reconnect vertical input of scope to LEFT RCVR 1 OUT jack.
(17) Detune 2401 locate core CDWI until DC voltage at pin 4C decreases 10%. Increase 1kHz carrier deviation to ±7kHz (10% pilot). STEERED BEACON lamp should be fully on. Readjust 2402 for maximum amplitude on scope (maximum separation).

FM ALIGNMENT

(1) Set SELECTOR switch to FM. Turn VOLUME control to minimum. Depress FM LOCAL and MONO MODE pushbuttons.
(2) Connect 10.7kHz swept generator to pin 5F, cable ground to pin 50. Connect DC (vertical) input of scope to pin 3L, cable ground to pin 3E.
(3) Adjust bottom core of 2302, then top and bottom cores of 2303, 2301, and L606 for maximum gain and symmetry. See FM IF Illustration.
(4) Reconnect scope input to pin 4N. Connect DC VTM to pin 4N. Temporarily connect a jumper between pin 3H and chassis ground. Adjust top core of 2303 for maximum symmetrical amplitude. See FM DETECTOR Illustration.
(5) Reduce generator sweep to zero. SWEEP OFF. Set DC VTM to lowest (most sensitive) range. Readjust top core of 2305 for 0VDC. Disconnect test equipment and jumper.
(6) Tune receiver to point of non-interference (noise only). Adjust pos. R105 for exact center-of-scale reading on receiver's tuning meter.
(7) Connect an FM signal generator to the FM ANTENNA terminals through 120kHz composition resistors, one in each lead from the generator. Release FM LOCAL pushbutton switch. Connect scope and AC VTM to the

AM ALIGNMENT

(1) Set SELECTOR switch to AM. Turn VOLUME control to minimum.
(2) Connect 45kHz swept generator to pin 2C, and 275Hz to pin 7C. Connect scope input to pin 3G, cable grounds to chassis.
(3) Adjust top and bottom cores of 2303, 2302, and 2751 for maximum gain and symmetry. See AM IF Illustration.
(5) Set generator frequency and dial pointer accurately to 600kHz. Modulate generator with 400Hz, 30% modulation. Adjust oscillator coil L762 for maximum audio.
(6) Adjust generator frequency and dial pointer accurately to 1400kHz. Adjust oscillator trimmer CS75 for maximum audio.
(7) Repeat steps 5 and 6 for accurate dial calibration and maximum gain.
(8) Set dial pointer accurately to generator frequency at 600kHz. Adjust antenna coil L761 for maximum audio.
(9) Adjust dial pointer accurately to generator frequency at 1400kHz. Adjust antenna trimmer CS75 for maximum audio.
(10) Repeat steps 8 and 9 for maximum gain.
CENTER VOLTAGE TEST

Turn VOLUME control to minimum. Depress MAIN Speaker switch.
1) Connect DC VTM across LEFT MAIN Speaker terminals.
   Meter should read OVDC (+100 mV).
2) Connect DC VTM across RIGHT MAIN Speaker terminals.
   Meter should read OVDC (+100 mV).

IDLING CURRENT ADJUSTMENT

Turn VOLUME control to minimum.
1) Connect ground of DC VTM to pin 8C and probe to pin
   8D. BE CAREFUL TO AVOID SHORTING ADJACENT
   PINS. Set BIAS ADJUST pot. R515 for 15 mVDC.
2) Connect ground lead of DC VTM to pin 8A and probe to
   pin 8B. BE CAREFUL TO AVOID SHORTING ADJACENT
   PINS. Set BIAS ADJUST pot. R616 for 15 mVDC.

NOTE: Letting current will increase and stabilize as amplifier
   temperature normalizes.

(3) Allow unit to warm up 15 minutes. Repeat steps (1) and
(2), resetting BIAS ADJUST pots, for 15 mVDC.