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 Voltmeter (100-mV DC scale)
- Audio Vacuum-Tube Voltmeter (10-mV AC scale)
- Oscilloscope (Flat to 100 kHz Minimum)
- Audio (Line-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 — Low Range Speakers for Listening Tests
- Stereo Source — Turntable or Tape Recorder for Listening Tests
- Soldering Iron with Small Tip
- Fully Insulated from Power Line
- Soldering Desoldering Tool

PRECAUTIONS

Many of these items are included just as a reminder—they are normal procedures for experienced technicians. Shortcuts can be taken but often they cause additional damage—to transistors, circuit components of 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 iron tips can reach temperatures of 1,000° F — others will hardly melt solder. Small-diameter tips should be used for single solder connections—larger pyramidal and chisel tips are needed for larger areas.

- When removing defective resistors, capacitors, etc., the leads should be cut 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-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 a 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 short), 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 range, the mixer 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—raining the transistor.

- Silicone grease must be used between the transistor and the mixer insulator and between the mixer and the heat sink for best heat conduction. (Use Dow-Corning DC-3 or C30194 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 clipped 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 ±5%. 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 phone 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.

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**SERVICE PROCEDURES**

**DIAL STRINGING**
- Turn the tension screw to its maximum clockwise in position.
- Rotate the tuning capacitor drive drum to its maximum clockwise position. Tie the end of the dial cord to the arm inside the top of the drive drum (detent view).
- Run the dial cord through the slot in the drive drum. Position the dial cord in the undersurface of the inner groove of the drive drum.
- Place the dial cord on pulleys A and B.
- Wrap two full turns of the dial cord around the tuning shaft.
- Position dial cord on other pulleys and over the top of the tuning capacitor drive drum.
- Pull the dial cord straight and wrap 2 1/2 turns around the outer groove of the drive drum. Run the dial cord through the slot in the drive drum and under the banded washer (detent view). Tighten the machine screw to hold the dial cord, making certain that the tension screw is in contact with the screw stop.
- Turn the tension screw counterclockwise to hold the dial cord under tension so that the flywheel revolves freely but the dial cord does not slip on the tuning shaft.
- Place the dial cord over and under the tabs on the rear of the dial pointer. Place the dial pointer on the top of the chassis front panel.

**REPLACING METER LAMP**
- Disconnect AC power cord.
- Remove the screws which hold the top cover to the chassis and lift off the top cover.
- Gently push in on the lamp and turn it counterclockwise to remove. Remove the metal lamp shade and place it on the new lamp in the same position. Place the new lamp in the socket, push it gently and turn it clockwise to lock it in place.
- Replace the top cover on the chassis and secure with the screws removed previously.

**REPLACING STEREO BEACON LAMP**
- Disconnect AC power cord.
- Remove the screws which hold the top cover to the chassis and lift off the top cover.
- Gently push in on the lamp and turn it counterclockwise to remove. Remove the metal lamp shade and place it on the new lamp holder in the socket.
- Replace the top cover on the chassis and secure with the screws removed previously.

**CLEANING FRONT PANEL**
*WARNING:* Use only plain lukewarm water and a freshly laundered, soft lint-free cloth to clean the front control panel.

**REPLACING DIAL LAMPS**
- Disconnect AC power cord.
- Gently pull all knobs off the front panel control shafts. Remove hex nuts from the control shafts and lift off the front panel.
- Snap the defective lamp from the spring clip. Place the new lamp in the socket making certain that the unpointed side of the lamp faces the edge of the dial glass.
- Replace the front panel and secure with the hexnuts removed previously. Replace the knobs on the control shafts.

**CLEANING DIAL GLASS**
- Disconnect AC power cord.
- Gently pull all knobs off the front panel control shafts. Remove the hex nuts from the control shafts and lift off the front panel.
- If there are foam-cushion strips located at the ends of the dial glass, remove them.
- Loosen the screws that hold the retaining clips to the dial glass. Swing the clips aside and lift off the dial glass.
- Remove dust with a dry cloth. If you wish to clean more thoroughly, use only plain lukewarm water; any stronger agent may damage the markings on the glass.
- Replace the dial glass and position it down and towards the left of the chassis front. Swing the retaining clips back into place and tighten the retaining clip screws. Replace the foam-cushion strips, if removed previously.
- Replace the front panel and secure with the hexnuts removed previously. Replace the knobs on the control shafts.

**POWER AMPLIFIER CENTER VOLTAGE ADJUSTMENT**
- Connect two 10K, 1/4" resistors in series across capacitor C19(250v25). Connect the common lead of a DC VTM to the junction of the two resistors.
- Connect DC VTM to the junction of resistors R37 and R39. Adjust Center Voltage Adjust Pot, R837 on left channel driver board for meter reading of 0.505 VDC.
- Connect DC VTM to the junction of resistors R38 and R40. Adjust Center Voltage Adjust Pot, R837 on right channel driver board for meter reading of 0.505 VDC.
- Disconnect 10K resistors.

**POWER AMPLIFIER IDLING CURRENT ADJUSTMENT**
*NOTE:* This adjustment is to be performed only after completing Center Voltage Adjustment.
- Connect DC VTM across resistor R33. Adjust Output Bias Adjust Pot, R950 on left channel driver board for meter reading of 40 ± 5 mA DC.
- Connect DC VTM across resistor R38. Adjust Output Bias Adjust Pot, R956 on right channel drive board for meter reading of 40 ± 5 mA DC.
NOTE: Alignment must be performed while starting this procedure.

- Set TUNING dial pointer to zero (0) calibration mark on the scaling log. If the dial pointer does not coincide with the 0 at the extreme end of the tuning range, reposition the pointer assembly on the dial card and center the pointer in place to prevent slippage.
- Connect DC VTM to Test Point 301 on the IF board.
- Connect RF generator to the NORM antenna terminals. Use a 50-ohm coaxial cable. Connect resistor in series with the generator—see Figure 1—so resistors in series with the antenna terminals and TUNING dial pointer to 50 MHz (blk). DO NOT USE MODULATION (AM or FM) and keep the generator output low as possible during the alignment procedure.
- Align generator output to the max. of the oscillator (L734, L735, L736) for maximum reading on DC VTM.
- Set RF generator frequency and TUNING dial pointer to 106 MHz (blk).

Set RF generator output to zero. Turn on TUNING switch (L734, L735, L736) for maximum reading on DC VTM.

- Repeat alignment several times until required calibration accuracy and maximum gain are obtained. Keep the generator output as low as possible during all adjustments.
- Adjust RF generator for output of 200 mV, with no modulation, at NORM antenna terminals. Use speakers or headphones to monitor the output.
- Turn up VOLUME control until noise is heard in the output. Adjust RF generator for output of 1 mV, gradually increase generator output to 200 mV. There should be no audible increase in the noise level. If necessary, readjust slightly AGC Adjust Pot. (756) for no increase in noise as the generator is varied from 1 mV to 200 mV.

**FM TUNING METER CALIBRATION**

- Connect a 10-kHz (blk) sweep generator to Test Point 751 on the IF board. Connect scope to Test Point 301. NOTE: Connect ground lead of generator to ground near Test Point 751 and ground of scope closest to scope input.

- Adjust generator output voltage and frequency to observe 1 Hz frequency. Use 1 Hz generator output as possible. Measure voltage at Test Point 301 with DC VTM during alignment and readjust generator output to keep meter reading from 1.6 to 2.0 VDC, maximum.
- Define top band of 2300 MHz: top and bottom bars of 2302, 2300 and 2301 MHz for maximum gain and symmetry—see Figure 2.
- Repeat step 6 above.

- Connect RF generator frequency and TUNING dial pointer to 90 kHz (blk). Note maximum gain output in each position—see Figure 3.
- Disconnect scope and connect sweep generator to Test Point 301. Connect DC VTM to Test Point 301.
- Set generator output to 10.7 kHz (blk) with no sweeves. Verify generator frequency from minimum to maximum, reading in DC VTM should increase in increments.
- Adjust DC VTM across resistor R4. Verify generator voltage from maximum to minimum, reading in DC VTM should decrease in increments.
- Set generator voltage to 200 mV. Adjust Meter Adjust Pot. (R14) for reading tuning meter at 200 mV.
- Connect sweep vertical input through 220R resistor to terminal 5 (L731) for scope signal at 200 mV.
- Set generator for sweep and adjust generator output voltage to observe into detector response. Use as a detector output as possible.
- Adjust top and bottom bars of 2304 MHz for maximum gain, top band for best linearity—see Figure 4.

**FM MUTING ADJUSTMENT**

- Set MUTING switch to OFF.
- Connect RF generator to the NORM antenna terminals using a 2900 MHz transmission line resistor across each feed point of the front and rear antenna terminals. Use an AC VTM resistor across each NORM antenna terminals.
- Connect RF generator frequency and TUNING dial pointer to 90 kHz (blk). Adjust generator output for 120.5 kHz (blk) detector output shortfall of 90 kHz (blk). Note maximum gain output in each position.
- Increase generator output voltage for reading. Increase generator output of 2.5 V generator frequency to ensure that peak meter reading is at peak. Generator output voltage should be between 8 and 25 VAC. Note reading on AC VTM.
- Set MUTING switch to ON. Adjust Mutting Adjust Pot. (R16) for reading on AC VTM to 1±2 dB below that previously noted.
- Reduce generator voltage to zero signal (400 Hz modulation). Note reading in AC VTM or RCVR.
- Make a note of reading for later reference.

**HARMONIC DISTORTION TEST**

- Set BALANCE, BASS and TREBLE controls to center position. Set NODE-TAPE MONITOR switch to STEREO. SELECTOR switch to AUX and SPEAKERS switch to ON. Set LOUDNESS COUNTER and HIGH FILTER switches to OFF. Unplug AC power cord.
- Connect a dummy, 50-ohm resistor across the LEAF SPKRS MAIN terminals. In parallel with the load resistor, connect the input leads of a harmonic distortion analyzer and the leads of an AC VTM across reading for 0.1 watts.
- Increase generator input to set 35 watts output (11.8 VAC across dummy load resistor). Harmonic distortion meter should read less than 0.08%.
- Repeat preceding steps for right channel.

**INTERMODULATION DISTORTION TEST**

- Set BALANCE, BASS and TREBLE controls to center position. Set NODE-TAPE MONITOR switch to STEREO. SELECTOR switch to AUX and SPEAKERS switch to ON. Set LOUDNESS COUNTER and HIGH FILTER switches to OFF. Unplug AC power cord.
- Connect a dummy, 50-ohm resistor across the LEAF SPKRS MAIN terminals. In parallel with the load resistor, connect the input leads of a harmonic distortion analyzer and the leads of an AC VTM across reading for 0.1 watts.
- Increase generator input to set 35 watts output (11.8 VAC across dummy load resistor). INTERMODULATION DISTORTION TEST PROCEED TO NEXT STEP.

**POWER OUTPUT MEASUREMENT**

The output amplifier of this unit is designed to deliver its full-rated power with program material (voice or music) into loads of 4 to 8 ohms for indefinite periods. When a constant audio tone is used as a signal to measure the continuous RMS power output, the following precautions must be taken:

- Measure the power output of one channel at a time.
- Limit the measurement period to 10 minutes with a load resistance between 4 and 8 ohms.
- If the power output of both channels must be measured simultaneously, use a load of 4 to 8 ohms per channel and limit measurements to a period not longer than 1 minute for 4 ohm load and not longer than 3 minutes for an 8-ohm load.
MULTIPLEX ALIGNMENT

Two methods of aligning the multiplex decoder are given. The preferred procedure uses a multiplex generator with RF and 19 kHz output and with 1 kHz modulation, such as the Fisher Model 250 Multiplex Generator. This is the better method of alignment since the front end and IF stages are also checked through this procedure. An alternate procedure for use with multiplex generators not having an RF output is also given.

PREFERRED ALIGNMENT PROCEDURE

Set MUTING switch to OFF and SELECTOR switch to FM AUTO.
- Connect multiplex generator to the LOC antenna terminals. Use the 1200Ω composition resistors in the generator leads.
- Follow procedures given in Table 1 below.

If alignment condition 5 is not obtained, nominally 1.2 kHz multiplex generator and resistance lead coming from connection 3K on the IF board to connection 4K on the multiplex board.

FIGURE 1. LISSAJOUS PATTERN FOR MPH ALIGNMENT.

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>MULTIPLEX ALIGNMENT USING RF MULTIPLEX SIGNAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STEP</strong></td>
<td><strong>GENERATOR MODULATIONS</strong></td>
</tr>
<tr>
<td>1</td>
<td>19KHz (Ac) pilot only.</td>
</tr>
<tr>
<td>2</td>
<td>Short connection 4F to ground</td>
</tr>
<tr>
<td>3</td>
<td>Connect portion of 101kHz (Ac) generator output to scope horizontal input.</td>
</tr>
<tr>
<td>4</td>
<td>Same as Step 3.</td>
</tr>
<tr>
<td>5</td>
<td>Disconnect connection 4F from ground.</td>
</tr>
<tr>
<td>6</td>
<td>Composite MPH signal 1kHz (Ac) on left channel only.</td>
</tr>
<tr>
<td>7</td>
<td>Composite MPH signal 1kHz (Ac) on right channel only.</td>
</tr>
<tr>
<td>8</td>
<td>Same as Step 7.</td>
</tr>
<tr>
<td>9</td>
<td>Same as Step 6.</td>
</tr>
<tr>
<td>10</td>
<td>1kHz (Ac) pilot only.</td>
</tr>
</tbody>
</table>

*NOTE: Separation Control is located on preamplifier board.

TABLE 2 | MULTIPLEX ALIGNMENT USING COMPOSITE MULTIPLEX SIGNAL |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STEP</strong></td>
<td><strong>GENERATOR MODULATIONS</strong></td>
</tr>
<tr>
<td>1</td>
<td>1kHz (Ac) pilot only.</td>
</tr>
<tr>
<td>2</td>
<td>Short connection 4F to ground</td>
</tr>
<tr>
<td>3</td>
<td>Connect portion of 101kHz (Ac) generator output to scope horizontal input.</td>
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<tr>
<td>4</td>
<td>Same as Step 3.</td>
</tr>
<tr>
<td>5</td>
<td>Disconnect connection 4F from ground.</td>
</tr>
<tr>
<td>6</td>
<td>Composite MPH signal 1kHz (Ac) on left channel only.</td>
</tr>
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<td>7</td>
<td>Composite MPH signal 1kHz (Ac) on right channel only.</td>
</tr>
<tr>
<td>8</td>
<td>Same as Step 7.</td>
</tr>
<tr>
<td>9</td>
<td>Same as Step 6.</td>
</tr>
<tr>
<td>10</td>
<td>1kHz (Ac) pilot only.</td>
</tr>
</tbody>
</table>

*NOTE: Separation Control is located on preamplifier board.