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 circuit.

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 (Sine-Wave) Generator
- Intermodulation Distortion Analyzer
- Harmonic Distortion Analyzer
- AM/FM Signal Generator
- Multiplex Generator (preferably with RF output — FISHER Model 500 or equal)
- 16.7-MHz Sweep Generator
- 455-kHz Sweep Generator
- Line Voltage Autotransformer or Voltage Regulator
- 2 — Lead 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. Shortcuts 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 pyramids 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, though 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.

- Girded against shorts — it takes only an instant for a base-to-collector short to destroy the 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 checking 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 mike 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 mike insulator and between the mike and the heat sink for best heat conduction. (Use Dow-Corning DC-3 or C219/4 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 the speakers, leads should be used on the exposed ends or at least the ends of the stranded wires should be twisted 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 ±10%. All voltages are DC, measured with a VTVM to ground, with no signal input unless otherwise noted. Indicated 1-Amps audio voltages, measured with an audio AC VTVM in ground at various points from the phono input to the power amplifier output.

Alignment Procedure — 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

DIAL STRINGING

- Remove dial pointer.
- Lift out left dial glass lamp and remove screw holding left side of dial glass panel.
- Remove two screws holding right side of dial glass panel.
- Pull dial glass panel towards left and lift up the panel down so as to the leads allow.
- Rotate the tuning capacitor drive drum to its maximum counterclockwise position.
- Tie end of dial card to the end of small spring A. Fasten spring to ear inside the drive drum (Figure 1).
- Run the dial card through the slot in the rim of the drive drum and place in the underside of groove 1 (side view).
- Pull dial card thru and wrap 1/2 turns around the flywheel shaft.
- Rotate the tuning capacitor drive drum to its maximum clockwise position, allowing the dial card to follow the grooves in the drive drum (Figure 2). Keep the dial card out during this procedure.
- Guide the dial card over the top of the drive drum and place it in groove 2 (top view).
- Run the dial card through the slot in the drive drum and bring it under and around the bracket to allow the flywheel to turn without the dial card.
- Return dial card up through the slot in the drive drum and place it in groove 3 (Figure 3). Guide the dial card through pulley A and B of the dial card.
- Rotate the tuning capacitor drive drum to its maximum clockwise position. Keep the dial card out during this procedure.
- Guide the dial card under the drum into groove 4 (Figure 4). Bring the dial card up and around groove 6 and into the slot in the drive drum.
- Rotate the tuning capacitor drive drum to its maximum clockwise position. Guide the dial card out during this procedure.
- Lower the bracket to the bottom of the drum.
- Release the machine screw. Pull the dial card out until it is fully extended and place the bracket back on the screw. The dial card is now ready for replacement.

REPLACING STEREO BEACON LAMP

- Disconnect AC power cord.
- Remove the screws which hold top cover to the chassis and lift off the top cover.
- Pry out lamp holder from the lamp mount. Unscrew the leads from the lamp holder. solder leads to rear terminals on the new lamp holder. Place new lamp holder in the mount.
- Replace the top cover and secure with the screws removed previously.

REPLACING DIAL LAMPS

- 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.
- Snap out the defective lamp from the spring clip. Place the new lamp inside the spring clip. Place the new lamp inside the spring clip.
- Replace the knob panel and secure with the hex nuts 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 rubber strips located at the ends of the dial glass, remove these.
- Loosen the screws that hold the retainer 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 a computer-mounted solution only, dry stronger cleaning agent may damage the markings on the glass.
- Slide the dial glass to the left off the chassis front. Swing the retainer clips back into place and tighten the retainer screws.
- Replace the foam-rubber strips, if removed previously.
- Replace the front panel and secure with the hex nuts removed previously. Replace the knobs on the control shafts.

CLEANING FRONT PANEL

WARNING: Use only plain lukewarm water and a really laundered, soft lint-free cloth to clean the front control panel.
MULTIPLEX ALIGNMENT

Two methods of aligning the multiplexer decoder are given. The preferred procedure uses a multiplexer generator with RF and IF signals through a 1 kHz modulation, such as the Fisker Model 200 Generator. The other procedure uses a multiplexer generator with a 1 kHz modulation, such as the conner model 300 Generator. This is the better method of alignment since the 1 kHz 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

Set SELECTOR switch to FM AUTO, MONO/STEREO switch to STEREO, and MUTING switch to OFF.
- Connect multiplexer generator to the RF input terminals. Use a 100-kHz composite resistor in series with each lead from the generator.
- Proceed as given in Table 1 below.

NOTE: Careful alignment of the RF amplifier is required for proper multiplex adjustment.

ALTERNATE ALIGNMENT PROCEDURE

Set SELECTOR switch to FM AUTO, MONO/STEREO switch to STEREO, and MUTING switch to OFF.
- Disconnect lead going to connection 4P on the multiplexer board. Connect a 100-kHz resistor in series with each lead from the generator.
- Proceed as given in Table 2 below.

NOTE: After alignment, disconnect generator and lowpass filter and reconnect lead going from connection 3K on the IF board to connection 4P on the multiplexer board.

STEREO BEACON TEST

Set SELECTOR switch to FM AUTO, MONO/STEREO switch to STEREO, and MUTING switch to OFF.
- Connect FM inputs to the RF input terminals. Use a 120-kHz composite resistor in series with each lead from the generator.
- Connect a 10-kHz input and TUNING dial pointer to 0 kHz (if). Set generator output to 2 mV; STEREO BEACON lamp should light.
- Reduce generator output to 16 V. Adjust Stereo Trigger Control Pot (RA4) on multiplexer board until STEREO BEACON lamp just lights. Generator output voltage should be 10 and 20 V.
- Reduce generator output to zero; STEREO BEACON lamp should go out.
- Increase generator output until STEREO BEACON lamp lights. Generator output voltage should be 10 and 20 V.

FIGURE 1. LOW-PASS FILTER CIRCUIT.

INTERMODULATION DISTORTION TEST

Set BALANCE, BASS and TREBLE controls to their center positions. Set MONO/STEREO switch to STEREO, SPEAKERS switch to MAIN and SELECTOR switch to AUX. Unplug AC power cord.
- Connect a dummy, 300-ohm resistor across MAIN SPEAKER terminals. In parallel with the lead resistor, connect the input leads of an IM (Inter-Modulation) distortion analyzer and the leads of a dummy 300 ohm resistor to reading 6 VDC with accuracy.
- Connect the analyzer generator output to the L AUX jack. NOTE: Speaker common terminals are not on ground potential.
- IM distortion analyzer ground should be connected to AUX input ground only.
- Connect AC power cord and rotate VOLUME control to its maximum clockwise position-full volume.
- Invert level of one generator input as for 7 watts output. After output has stabilized, after one FULL-MIINUTE OF WARMUP TIME, PROCEED TO NEXT STEP.
- Immer reading should be 0.8% or less.
- Measure power output of one channel at a time.
- Limit the measurement period to 10 minutes with a load resistor of 100 ohms. If the power output of both channels must be measured simultaneously, use a load resistor of 100 ohms per channel and limit measurements to a period not less than 3 minutes for 100 ohms load and not longer than 3 minutes for 4x4 loads.

HARMONIC DISTORTION TEST

Set BALANCE, BASS and TREBLE controls to their center positions. Set MONO/STEREO switch to STEREO, SPEAKERS switch to MAIN and SELECTOR switch to AUX. Unplug AC power cord.
- Connect a dummy, 300-ohm resistor across MAIN SPEAKER terminals. In parallel with the lead resistor, connect the input leads of a harmonic distortion analyzer and the leads of an AC VTIME capable of reading 0.1 volts with accuracy. Set the harmonic distortion analyzer to a known level of 60%. Connect AC power cord and rotate VOLUME control to its maximum clockwise position-full volume.
- Connect AC power cord and rotate VOLUME control to its maximum clockwise position-full volume.
- Increase generator output as for 7 watts output, after full stabilization. After one FULL-MIINUTE OF WARMUP TIME, PROCEED TO NEXT STEP.
- IM reading of one channel should be 0.8% or less.
- Repeat preceding steps for right channel.

POWER OUTPUT MEASUREMENT

The output amplifier of this unit is designed to deliver its maximum rated power, with program material (voice or music) input in a balanced capacitive mode. 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 resistor of 100 ohms. If the power output of both channels must be measured simultaneously, use a load resistor of 100 ohms per channel and limit measurements to a period not less than 3 minutes for 100 ohms load and not longer than 3 minutes for 4x4 loads.
NOTE: FM IF alignment must be performed before starting this procedure.

Set SELECTOR switch to FM AUTO, MONO/STEREO switch to STEREO and MUTING switch to OFF.
(1) Set TUNING dial pointer to zero US calibration mark on the logging scale. If the dial pointer does not coincide with the 0 at the extreme end of the knob rotation, reposition the pointer assembly on the dial cord and cement the pointer in place to prevent slippage.

NOTE: Moving dial pointer will make realignment of FM front end necessary.
(2) Connect DC VTM to Test Point 301 on the IF board. 
(3) Connect an RF generator to the NORM antenna terminals. Use a 120-ohm composition resistor in series with each lead from the generator—see Figure 1.
(4) Set RF generator frequency and TUNING dial pointer to 90 MHz (Mc). DO NOT USE MODULATION (AM or FM) and keep the generator output as low as possible during the alignment procedure.
(5) Align FM oscillator coil (LS01) core first—then align the FM RF coil (LS02) and the FM antenna coil (LS03) cores for maximum reading on DC VTM.
(6) Set generator frequency and TUNING dial pointer to 106 MHz (Mc).
(7) Adjust FM oscillator trimmer (C518) first—then adjust the FM RF trimmer (C511) and the FM antenna trimmer (C9011) for maximum reading on DC VTM.
(8) Repeat alignment several times until accurate dial calibration and maximum gains are obtained. Keep the generator output as low as possible during all adjustments.

FIGURE 1. CONNECTIONS TO PROVIDE 300-OHM GENERATOR OUTPUT IMPEDANCE. MATCHING RESISTORS REDUCE GENERATOR VOLTAGE BY HALF AT THE ANTENNA TERMINALS.

FM TUNING METER CALIBRATION

Set SELECTOR switch to FM AUTO, MONO/STEREO switch to STEREO and MUTING switch to OFF.
(1) Connect an FM generator to the NORM antenna terminals. Use a 120-ohm composition resistor in series with each lead from the generator—see Figure 1.
(2) Connect scope to L or R RCDR jack.
(3) Connect a 4.4-ohm 250-watt resistor to the generator for 4.4 ohms 250 watts.
(4) Connect RF generator frequency and TUNING dial pointer to 100 kHz (Mc). 
(5) Connect a 4.4-ohm 250-watt resistor to the generator for 4.4 ohms 250 watts.
(6) Set RF generator frequency and TUNING dial pointer to 1400 kHz (Mc). 
(7) Adjust FM oscillator core (C212) for maximum audio indication on oscilloscope and AC VTM.
(8) Set RF generator frequency and TUNING dial pointer to 6000 kHz (Mc). 

NOTE: Move IF generator output as low as possible during the alignment procedure.

FM MUTING ADJUSTMENT

Set SELECTOR switch to FM AUTO, MONO/STEREO switch to STEREO and MUTING switch to OFF.
(1) Connect an FM generator to the NORM antenna terminals. Use a 120-ohm composition resistor in series with each lead from the generator.
(2) Connect AC VTM to LEFT or RIGHT RCDR jack.
(3) Set RF generator frequency and TUNING dial pointer to 80 MHz (Mc). 
(4) Adjust TUNING knob for maximum reading on tuning meter. Note reading on AC VTM.
(5) Set SELECTOR switch to ON, Adjust Muting Adjust Pot. R42 for reading on AC VTM to 5 dB lower than that previously noted.
(6) Reduce generator voltage to zero—no 400 Hz (vpp) signal should be indicated on AC VTM at RCDR output jack.

AM MUTING ADJUSTMENT

Set SELECTOR switch to AM.
(1) Connect 90-volt AC source to Test Point 1 (output of wire at pin 1 of Z21). Connect scope vertical input through 220-k resistor to Test Point 2.
(3) Adjust generator output voltage and frequency to observe IF response curve. Use low generator output as possible during the alignment procedure.
(4) Align bottom and core of C23 and core of L3 for maximum amplitude and symmetry—see Figure 3. 
(5) Repeat alignment.

AM IF ALIGNMENT

Set SELECTOR switch to AM.
(1) Connect short jumper wire between AM RF trimmer IC6 and chassis ground.
(2) Connect 800-kHz IF sweep generator to Test Point 1 (output of wire at pin 1 of Z21). Connect scope vertical input through 220-k resistor to Test Point 2.
(3) Adjust generator output voltage and frequency to observe IF response curve. Use low generator output as possible during the alignment procedure.
(4) Align bottom and core of C23 and core of L3 for maximum amplitude and symmetry—see Figure 3.
(5) Repeat alignment.
(6) Disconnect jumper between AM RF trimmer IC6 and chassis ground.

PREDIVER/DRIVER OUTPUT ADJUSTMENT

Set BALANCE, BASS and TREBLE controls to their center positions. Set MONO/STEREO switch to STEREO, SPEAKERS switch to AUX. Connect a Select switch to AUX. Unplug AC power cord.
(2) Connect 220 volt AC power source across L MAIN SPKR terminals. In parallel with the load resistor, connect the vertical input leads of an oscilloscope.
(3) Connect an audio sine wave generator, set for 1000 Hz (Mc), to the L MAIN jack.
(4) Adjust AC power cord and rotate VOLUME control to its maximum clockwise position—full volume.
(5) Increase generator output until sine wave on scope just starts to clip. Adjust DC Bias Adjust Pot. R302 on the left channel grid leak/drive board for equal clipping on the positive and negative half cycles of the signal.
(6) Repeat preceding steps for right channel.