Service Manual

THE FISHER

600-T

CHASSIS SERIAL NUMBERS
BEGINNING 37000

$2.00

FISHER RADIO • LONG ISLAND CITY • NEW YORK 11101
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.

EQUIPMENT AND TOOLS NEEDED

The following are needed to completely test and align modern high-fidelity instruments such as amplifiers, tuners and receivers.

Test Instruments

- Vacuum-Tube Voltohmmeter DC VTVM
- Audio (AC) Vacuum-Tube Voltmeter (AC VTVM)
- Oscilloscope (Flat to 100 kc minimum)
- Audio (Sine-wave) Generator
- Intermodulation Analyzer
- Sweep (FM) Generator (88 to 108 mc)
- Marker Generator
- Multiplex Generator (preferably with RF output — FISHER Model 300 or equal).

Miscellaneous

- Adjustable-Line/Voltage Transformer or line-voltage regulator
- Load Resistors (2) — 8-ohm, 50-watt (or higher)
- Stereo source (Turntable with stereo cartridge or Tape Deck)
- Speakers (2) Full-range, for listening tests
- Soldering iron (with small-diameter tip).
- Fully insulated from power line.

PRECAUTIONS

Many of the items below are included just as a reminder. The 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 many circuit components mounted on it. It is not the wattage of the iron that counts — it is the heat available at the tip. Low-wattage soldering irons will often take too long to heat a connection — pigtail leads will get too hot and damage the part. Too much heat, applied too long, will damage the printed-circuit board. 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 pyramidal 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 through the heating element, can destroy transistors.

Transistors — Never attempt to do any work on the transistor amplifiers without first disconnecting the AC-power linecord — wait until the power supply filter capacitors have discharged.

- Guard against shorts — it takes only an instant for a base-to-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 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 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 heat range 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 mica insulator and the surface of the heat sink are free of foreign matter. Dust and grit can prevent proper 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 mica insulator and between the mica and the heat sink for best heat conduction. Heat is the greatest enemy of electronic equipment. It can shorten the life of transistors, capacitors and resistors. (Use Dow-Corning DC-3 or C20194 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. There is no output transformer — nothing to limit current through the transistors except the fuses. To reduce the possibility of shorts at the speakers, lugs should be used on the exposed ends — at least the ends of the stranded wires should be tinned to prevent frayed wire exposed current in the speakers and output circuitry is quite high. Any poor contact or small-size wire, can cause power losses in the speaker system. Use 14 or 16 AWG for long runs of speaker-Connecting wiring.

DC-Voltage Measurements — These basic tests of the transistor circuitry are made without the signal generator. Without any signal input measure the circuit voltages — as indicated on the schematic. The voltage difference between the base and the emitter should be in the millivolt range — a sensitive DC meter is needed for these readings. A low-voltage range of 1 volt, full scale — or lower — is needed.

Audio-Voltage (gain) Measurements — The schematic and printed-circuit board layout diagrams are used. Input signals are injected at the proper points — found most quickly by using layout of the printed-circuit board instead of the schematic. An AUDIO (AC) VTVM connected to the test points should indicate voltages close to those values shown in the boxes on the schematic. Many of the signal levels in the input stages are only a few millivolts. Therefore, the AC ranges should be used with caution. The voltmeter should be the same AC ranges 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.
POWER OUTPUT MEASUREMENT

The power-output stage of this unit is designed to deliver its full-rated power with program material (voice or music) into 4-to-16-ohm loads for indefinite periods.

When a constant audio tone is used as a signal to measure the **continuous RMS power output** certain 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 16 ohms).

Should it ever be necessary to measure the power output of both channels simultaneously, use a load of 4 or 8 ohms (per channel), limit measurement to a period not longer than 1 minute for a 4-ohm load or to 5 minutes for an 8-ohm load.
PREAMPLIFIER - PRINTED CIRCUIT LAYOUT

QRS01
A1380
+4.8V
C
+4.8V
B
+4.8V
E
+4.6V
C
+10V
B
+4.6V
E
25V
C
+10V
B
+4.6V
E

LEFT CHANNEL

RIGHT CHANNEL

PARTS DESCRIPTION LIST

Symbol | Description | Part No. | Symbol | Description | Part No.
--- | --- | --- | --- | --- | ---
R101 | Resistor, 220K | R12DC24J | C101 | Capacitor, 22UF/160V | CS0857S-3
R102 | Resistor, 220K | R12DC24J | C102 | Capacitor, 22UF/160V | CS0857S-3
R103 | Resistor, 2.7K | R12DC272J | C103 | Capacitor, 100µF/10V | CS08568-3
R104 | Resistor, 2.7K | R12DC272J | C104 | Capacitor, 100µF/10V | CS08568-3
R105 | Resistor, 3.3 | R12DC333J | C105 | Capacitor, 100µF/10V | CS08568-3
R106 | Resistor, 3.3 | R12DC333J | C106 | Capacitor, 100µF/10V | CS08568-3
R107 | Resistor, 1800K | R12DC180J | C107 | Capacitor, 4.7UF/160V | CS0483-1
R108 | Resistor, 1800K | R12DC180J | C108 | Capacitor, 4.7UF/160V | CS0483-1
R109 | Resistor, 1800K | R12DC180J | C109 | Capacitor, 22UF/160V | CS0575-3
R110 | Resistor, 1800K | R12DC180J | C110 | Capacitor, 22UF/160V | CS0575-3
R111 | Resistor, 220 | R12DC221J | C111 | Capacitor, 100µF/15V | CS0483-5
R112 | Resistor, 220 | R12DC221J | C112 | Capacitor, 100µF/15V | CS0483-5
R113 | Resistor, 1.2M | R3DC125J | Q101 | Transistor | A1380
R114 | Resistor, 1.2M | R3DC125J | Q102 | Transistor | A1380
R115 | Resistor, 8.2K | R12DC822J | Q103 | Transistor | 2N2934
R116 | Resistor, 8.2K | R12DC822J | Q104 | Transistor | 2N2934
R117 | Resistor, 3.3K | R12DC332J | Q105 | Transistor | 2N2934
R118 | Resistor, 3.3K | R12DC332J | --- | Printed Circuit Board | PB1340

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INS252

120 µA

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283

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120 µA

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INS 283

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283
1249 MULTIPLEX MODIFICATION
(for early production runs).

In some reception areas the possibility of an audible interference exists when a stereophonic station simultaneously transmitting an SCA (background music) signal is received.

To fully eliminate this possibility in the aforementioned models, a change in the existing SCA filter circuits on the Multiplex-Decoder Printed Circuit Board (P-1249) should be made, as outlined below.

Fisher Radio has prepared a package (Part No. SCA) of the few small parts required for this change, which can be performed easily by a service station or a dealer. Alignment is not required.

Refer to the photograph of the MPX adaptor board. The parts to be changed are indicated. Please note that some previous parts differ in value

- **Radd** 22k
  This is an addition

- **R405** was 39k or 56k
  Must be 39k

- **R412** was 6.8k or 8.2k
  Must be 15k paralleled with 120pf (Cadd)

- **C406** was 56pf or 82pf
  Must be 15pf

- **C410** was 820pf
  Must be 220 pf

- **Cadd** 120pf parallel with 15k (R412)
  120 pf is an addition

- **L401** was 5.3mh
  Must be 20mh
Reducing hum in the FM AUTOMATIC position of the SELECTOR switch

The SCA-filter coil on the 1249 Multiplex Decoder board may pick up hum from the power transformer. The position of the coil on the printed-circuit board is critical and the coil might be displaced during shipping. To eliminate the need for critical positioning the following change has been made:

- Mount a 3-terminal strip (FISHER part number E-100T3N) on the chassis, parallel to the short side of the front-end assembly, using the existing hexhead screw.
- Remove the SCA-filter coil from the MPX printed-circuit board. (Just clip the pig-tail leads of the SCA-filter coil 3/16 inch from the MPX board.)
- Connect a twisted pair of insulated wires from the original coil terminals on the MPX printed-circuit board to the two insulated terminals of the added terminal strip. (Dress the wires as shown in the photograph.)
- Solder the pig-tail leads of the SCA-filter coil to the two insulated terminals of the added terminal strip along with the ends of the twisted pair of wires connecting it to the MPX printed-circuit board.
- Solder the twisted pair of insulated wires to the 3/16-inch long leads left when the SCA-filter coil was clipped off of the MPX printed-circuit board.
- Set the SELECTOR switch to FM AUTOMATIC; tune to a point between FM-broadcast stations; push MUTING switch ON and position the SCA-filter coil for minimum hum with VOLUME turned up.

1249 Multiplex Decoder Board

ORIGINAL SCA-FILTER COIL TERMINALS
E-100T3N
SCA-FILTER COIL
CAPACITORS
10% tolerance for all fixed capacitors, unless otherwise noted or marked GMW (guaranteed minimum value).
All capacitors not marked uF are pF (uuf).

Symbol | Description | Part No.
--- | --- | ---
C751 | Ceramic, 8, 5%, NPO, 1000V | C50070-45
C752 | Ceramic, 21, 5%, N750, 1000V | C50070-32
C753 | Trimmer | C662-123
C754A,B,C | Variable, Tuning | C966C117-1
C755, 756 | Ceramic, 1000, GMV, 500V | C50089-2
C757 | Trimmer | C662-123
C758 | Ceramic, 8, 5%, NPO, 1000V | C50070-45
C759 | Ceramic, 68, 5%, N750, 1000V | C50070-35
C760 | Ceramic, 24, 5%, N150, 1000V | C50070-8
C761 | Ceramic, 100, 5%, N1500, 1000V | C50070-19
C762, 763 | Ceramic, 100, N1500, 1000V | C50070-6
C764 | Trimmer | C662-123
C765 | Ceramic, 10, ±0.5pF, P100, 500V | CC20A110005
C766 | Cera, 1k, 1000, 1000V | C50072-3
C767, 768 | Ceramic, 0.02uF, ±20%, 100V | C50095-1
C769 | Ceramic, 120, N1500, 1000V | C50070-9
C770, 771, 772, 773, 774 | Ceramic, Feedthru, 1000, GMV | C592-187

RESISTORS
Deposited Carbon, in ohms, 5% tolerance, 1/4 watt.
K = Kilohms, M = Megohms.

Symbol | Description | Part No.
--- | --- | ---
R751 | 22K | R12DC22023J
R752 | 390 | R12DC2391J
R753 | 220K | R12DC2224J
R754 | 1.2K | R12DC1222J
R755 | 18K | R12DC183J
R756 | 1K | R12DC102J

MISCELLANEOUS

Symbol | Description | Part No.
--- | --- | ---
L751 | Coil, Antenna | L966-113
L752 | Coil, RF | L1034-113
L753 | Coil, Mixer | L966-115
L754 | Coil, Oscillator | AS966-107
L755 | Choke, 0.6 Microhenry | LS006-1
L756 | Choke, 1.2 Microhenry | LS006-3
L757 | Choke, 1 Microhenry | LS006-2
L758 | Choke, 1.2 Microhenry | LS006-3
V751 | Tube, EC900/6HA5 | V-EC900
V752, 753 | Tetrode, 6CW4 | V-EC904
Z751 | Transformer, IF | ZZ0210-45

* To prevent oscillator drift, under unusual or extreme conditions, replace temperature-compensating capacitor C765 with FISHER part number CC20CG100DS (Ceramic, 10pF, ±0.5pF, NPO, 500V).
TROUBLESHOOTING GUIDE

Does not go on – (meter and dial lamps do not light). – In any position of SELECTOR

Check:
- Fuse F1
- AC-interlock switch S3 (chassis will not operate with cover removed).
- Power cord, plug and wall outlet (use test lamp in rear chassis outlets).
- AC ON-OFF switch S4 (part of VOLUME control).

Hum – (both channels) – In any position of SELECTOR

Check:
- DC power supply – CR1, CR2, CR3, CR4; C25, C26; C24, C27, Q11.

Hum – In FM positions of SELECTOR only.

Check:
- Multiplex decoder production changes in this manual.

Test:
- V1, V2, V3 for filament leakage.

Distorted, weak or No audio output.

Check:
- Set speaker selector to MAIN + REMOTE position
- Set MONITOR switch to OFF (out) position.
- Speaker connections.
- Jumper between REV IN and REV OUT jacks.
- Speaker IMPEDANCE SELECTOR switch.

Test:
- Voltages at: CR1, CR3, C25, R45; CR2, CR4, CR26, R51, R53; C23, R44, R45; C22, R44; C27, R30, R51, Q11; Q12, R17, C10.

Distorted, Weak or No audio output

Check:
- Set BALANCE control to center or "0" (zero) position.
- Speaker connections.
- Jumper between LEFT REV IN and REV OUT jacks.
- Speaker IMPEDANCE SELECTOR switch.
- Fuses F2, F3.
- Q5, Q6, Q7, Q8, Q9.
- Setting of bias adjustments P1 (R81), P2 (R91).
- 1096 Audio Control Amplifier section and PC3.
- R31 and C17.

Distorted, Weak or No audio output

Check:
- Set BALANCE control to center of "0" position.
- Speaker connections.
- Jumper between RIGHT REV IN and REV OUT jacks.
- Speaker IMPEDANCE SELECTOR switch.
- Fuses F4, F5.
- Q1, Q2, Q3, Q4, Q10.
- Setting of bias adjustments (P3 (R92), P4 (R92).
- 1096 Audio Control Amplifier section and PC4.
- R32 and C16.

Distorted, Weak or – (either channel) – PHONO and TAPE HEAD positions of SELECTOR only.

Check:
- Interchange input cables in rear-chassis PHONO and TAPE HEAD jacks temporarily.
- 1240 Preamplifier section.
## Capacitors

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C10, 21</td>
<td>Ceramic, 100, N1300, 100V</td>
<td>C00704-07</td>
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<tr>
<td>C12</td>
<td>Ceramic, 220pF, 50V</td>
<td>C00804-07</td>
</tr>
<tr>
<td>C14</td>
<td>Ceramic, 5.6pF, 50V</td>
<td>C00805-07</td>
</tr>
<tr>
<td>C16</td>
<td>Ceramic, 0.1pF, 50V</td>
<td>C00806-07</td>
</tr>
<tr>
<td>C18</td>
<td>Ceramic, 0.01pF, 100V</td>
<td>C00807-07</td>
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</table>

## Resistors and Potentiometers

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<tr>
<th>Symbol</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>Composition, 270, 10%, 1W</td>
<td>RC20B371X</td>
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<tr>
<td>R2</td>
<td>Wirewound, 540, 1%, 1W</td>
<td>RC20C371X</td>
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<tr>
<td>R3</td>
<td>Composition, 1X, 4%, 1W</td>
<td>RC20B372X</td>
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<tr>
<td>R4</td>
<td>Composition, 560, 1%, 1W</td>
<td>RC20C372X</td>
</tr>
<tr>
<td>R5</td>
<td>Composition, 2X, 4%, 1W</td>
<td>RC20B373X</td>
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<tr>
<td>R6</td>
<td>Composition, 600, 1%, 1W</td>
<td>RC20C373X</td>
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<td>R7</td>
<td>1kX</td>
<td>R21C1053</td>
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<td>R8</td>
<td>Composition, 15k, 0.1%, 1W</td>
<td>R20S1040</td>
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<td>R9</td>
<td>Pot, 500k, Metering Level</td>
<td>R21C2061</td>
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<td>R10</td>
<td>5kX</td>
<td>R21C2062</td>
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<td>R11</td>
<td>Composition, 560, 10%, 1W</td>
<td>RC20B471X</td>
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<td>R12</td>
<td>Composition, 47k, 1%, 1W</td>
<td>RC20B472X</td>
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<td>R13</td>
<td>Composition, 12k, 1%, 1W</td>
<td>RC20B473X</td>
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<td>Composition, 15k, 0.1%, 1W</td>
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<td>R15</td>
<td>330</td>
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<td>R16</td>
<td>Composition, 390, 10%, 1W</td>
<td>R20S1043</td>
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<td>R17</td>
<td>Composition, 560, 0.1%, 1W</td>
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<td>R18</td>
<td>100k</td>
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<td>320k</td>
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<td>R22</td>
<td>470k</td>
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<td>R23</td>
<td>1M</td>
<td>R21C2085</td>
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<td>R24</td>
<td>Composition, 0.02, 10%, 1W</td>
<td>RC20B502X</td>
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<td>R25</td>
<td>Composition, 1k, 10%, 1W</td>
<td>R21C2091</td>
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<td>R26</td>
<td>Composition, 1k, 0.1%, 1W</td>
<td>R20S1045</td>
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<td>R27</td>
<td>2kX</td>
<td>R21C2092</td>
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<td>R28</td>
<td>5kX</td>
<td>R21C2093</td>
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<td>R29</td>
<td>10k, Wirewound</td>
<td>R21C2094</td>
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<td>R30</td>
<td>22k2</td>
<td>R21C2095</td>
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<td>R31</td>
<td>33k2</td>
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<td>10k, Wirewound</td>
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<td>R35</td>
<td>22k2</td>
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<td>R36</td>
<td>33k2</td>
<td>R21C2101</td>
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<td>R37</td>
<td>47k</td>
<td>R21C2102</td>
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<td>R38</td>
<td>100k</td>
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<td>R39</td>
<td>10k</td>
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<td>R40</td>
<td>22k</td>
<td>R21C2105</td>
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<td>R41</td>
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<td>R42</td>
<td>47k</td>
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<tr>
<td>R43</td>
<td>100k</td>
<td>R21C2108</td>
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<tr>
<td>R44</td>
<td>Composition, 1k, 1%</td>
<td>R21C2109</td>
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<tr>
<td>R45</td>
<td>Wirewound, 59, 5%</td>
<td>R20W3090</td>
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## Controls

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<th>Symbol</th>
<th>Description</th>
<th>Part No.</th>
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<tbody>
<tr>
<td>S1</td>
<td>Switch, Selector, Input</td>
<td>594-235</td>
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<tr>
<td>S2</td>
<td>Switch, Speaker</td>
<td>594-236</td>
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<td>S3</td>
<td>Switch, Interlock</td>
<td>594-316</td>
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<tr>
<td>S4</td>
<td>Switch, Push-to-Turn, Volume Control</td>
<td>594-178</td>
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<tr>
<td>S5A, B</td>
<td>Switch, Impedance Selector</td>
<td>595-000-5</td>
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<td>P5S</td>
<td>Switch, P.B. Low</td>
<td>594-276</td>
</tr>
<tr>
<td>S6</td>
<td>Filter, Monitor, Volume</td>
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## Miscellaneous

<table>
<thead>
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<th>Symbol</th>
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<tr>
<td>C1, 2</td>
<td>Diode, Silicon Rectifier</td>
<td>SR10157</td>
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<td>C15</td>
<td>Diode, Silicon Rectifier</td>
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<td>F1</td>
<td>2.5 Air, 500, 5V</td>
<td>F101-122</td>
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<td>F2</td>
<td>5V</td>
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<td>F3</td>
<td>Lamp, Stereo Beep</td>
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<td>L1</td>
<td>Lamp, Power, Panel of Assembly</td>
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<td>Lamp, 2 Microphone</td>
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<td>Printed Circuit, Illuminated</td>
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<tr>
<td>L6</td>
<td>Printed Circuit, Tone</td>
<td>PC00439-10</td>
</tr>
<tr>
<td>L7</td>
<td>Transformer, 115V, 25VA</td>
<td>TR20404</td>
</tr>
<tr>
<td>L8</td>
<td>Transformer, 115V, 25VA</td>
<td>TR20405</td>
</tr>
<tr>
<td>L9</td>
<td>Transformer, 220V, 25VA</td>
<td>TR20294</td>
</tr>
<tr>
<td>L10</td>
<td>Transformer, 220V, 25VA</td>
<td>TR20957</td>
</tr>
<tr>
<td>L11</td>
<td>Transformer, Driver, Left Channel</td>
<td>TY6-218-3</td>
</tr>
<tr>
<td>L12</td>
<td>Transformer, Driver, Right Channel</td>
<td>TY6-218-2</td>
</tr>
<tr>
<td>L13</td>
<td>Insert, Dress Panel, Speaker</td>
<td>AS946-201</td>
</tr>
<tr>
<td>L14</td>
<td>Insert, Dress Panel, Speaker (Lower)</td>
<td>AS946-202</td>
</tr>
</tbody>
</table>

If replacement parts are out of stock, locally, they may be obtained directly from the Parts Department of FISHER Radio Corporation. They will be shipped “best way”, either prepaid or C.O.D. unless otherwise specified.

For instrument-operation information and technical assistance write Richard Hamilton, Customer Service Department, FISHER Radio Corporation, Long Island City, New York 11101.
TUNING METER CALIBRATION
- Connect FM generator output leads to antenna terminals.
- Generator output to 100 mV, ±2.25 kc deviation at 400 cpm.
- Adjust meter control (on IF printed-circuit board) for tuning meter indication of 4.

MUTING CONTROL ADJUSTMENT
- Connect signal generator to the NORM antenna terminals through two 120-ohm resistors.
- Connect AC (audio) VTVM to right or left RCRD OUT jacks.
- Set generator and tuner to 96 kHz (mc).
- Modulate generator with 400 Hz (cps) to ±22.5 kHz (kc) deviation, at 10 v output.
- Rotate muting-level control (R337) to maximum clockwise position.
- With MUTING on, make a note of the AC (audio) VTVM reading at RCRD jack.
- Set MUTING selector to position 3 and adjust the muting-level control (R337) on the IF printed-circuit board for an AC (audio) VTVM reading 1 to 5 db lower than that noted previously.
- With MUTING selector to position 2 and slowly reduce generator output to less than 30 v, reading on AC (audio) VTVM should drop to approximately the same reading as that obtained in position 3. DO NOT readjust muting-level control (R337).
- Set MUTING selector to position 1 and slowly reduce generator output to less than 15 v, reading on AC (audio) VTVM should drop to approximately the same reading as that obtained in position 3. DO NOT readjust muting-level control (R337).

FRONT PANEL MAINTENANCE
1. CLEANING THE DIAL GLASS
   (1) Remove the front panel. Disconnect the set from AC power as a precaution. Remove all knobs, but not the pushbuttons. Remove the three hex nuts located at the points occupied by the Volume control, the Selector switch and the Speakers switch. Then lift off the front panel.
   (2) Loosen the screws that retain the clips to the dial glass. (When you replace the dial glass, make certain to rest it on the bezel frame by placing it firmly against the lower left-hand corner.) Swing the clips aside, and then lift off the glass.
   (3) Dust with a dry rag. If you wish to clean more thoroughly, use a soap and water solution only if you use any stronger cleaning agent, you may damage the markings on the glass.

2. REPLACING DIAL LAMPS
   First, disconnect the AC power cord as a precaution. Remove the front panel as described above. The lamp is set in place by springs and clips and can be removed with the fingers. Replace with a new lamp from your FISHER朝化(Par. Number 150441-1).

3. REPLACING THE DIAL POINTER LIGHT
   (1) Remove the top of the metal cabinet, after loosening the screws which fasten it in place.
   (2) Remove the front panel and dial glass as described in the paragraph above. The two wires from the dial pointer light are connected to two clips on the top chassis, behind the front panel. Remove the wires from the small hook clip on the rear of the pointer base. (See Figure 2.)
   (3) Remove the dial pointer (bulb plus metal guard), by sliding it directly downward, as shown in Figure 2. (4) Slide the new dial pointer (Part No. AS 20451) upward, while pressing downward on the pointer base, until the pointer reaches its lower limit. The tab on the pointer should mate with the slot on the pointer base.
   (5) Twist the two wires together and slip them through the hook clip on the rear of the pointer base. Be sure to avoid leaving any slack in the wire above the pointer. (See Figure 2.)
   (6) Secure the ends of the two wires to the clips by pressing the tip of the wires into the pointer base.
   (7) Replace the dial glass, front panel, and cabinet top.

4. REPLACING THE STEREO BEACON LIGHT
   (1) Remove the top of the metal cabinet, after loosening the screws which hold it in place.
   (2) Remove the two wires of the STEREO BEACON lamp from the two clips located atop the chassis, behind the front panel.
   (3) Remove the bulb (Part No. 155594-1) from the cylinder which houses the STEREO BEACON lamp, and replace it with a new bulb.
   (4) Fit the ends of the two wires from the lamp over the clips.
   (5) Replace the cabinet top.

DIAL STRINGING
- Turn tension-adjust screw A to maximum clockwise position. With screw A set to its maximum clockwise position, the dial cord can be pulled as tightly as possible. (Before securing the loose end without stretching the tension spring. This is not an adjustment screw. It is used only for easier dial-cord stringing.)
- Rotate tuning-capacitor-drive drum B to its maximum clockwise position, as shown.
- Adjust dial cord to cover C (in capacitor-drive drum) as shown. The cord goes through slot in drum, and is set in the inner groove.
- Thread dial cord around pulleys (as shown) to point D.
- While holding dial cord taut, with left hand, rotate the tuning-capacitor-drive drum to its maximum clockwise position with the right hand.
- Wrap the end of the dial cord around the body of the machine screw (E) in the hub of the drive drum and tighten. The cord goes under the flat washer.

CAUTION—When securing the end of the dial cord the adjusting screw (A) must be in contact with the screw stop.
- Machine screw A is now backed out and turned counterclockwise to let the spring hold the dial cord under proper tension. The screw must clamp the screw stop to allow free movement of the pulleys while providing non-slip drive.

DIAL STRINGING
- Dialigsage of dial cord wrapped around drive shaft rod for slack cord, and then turned back to a higher locating holes.
- Dial stringing is completed when does not rattle freely and smoothly, in a low spring to a lower adjusting hole.
- Pulleys E: Nylon pulleys generally do not need lubrication. However, if excessive noise or rattle occurs during turning, silicones or lighter motor oil may be applied to moving parts. Accumulations of dust should be removed biweekly any lubricant is applied. Often cleaning will need to clean the need for lubrication.
**IMPROVED ALIGNMENT INSTRUCTIONS**

**ALTERNATE ALIGNMENT INSTRUCTIONS (For multiplex generators without an RF output)**

Disconnect the radio detector from the multiplexer unit before using this procedure. A low-pass filter (Figure 1) is used between the multiplexer output and the input to the multiplexer section. It has about the same loading effect as the output of the radio detector in the tuner.

### OF MULTIPLEX GENERATOR CONNECTED TO INPUT OF MPX DECODER THROUGH LOW-PASS FILTER

<table>
<thead>
<tr>
<th>RAT OR LEVEL</th>
<th>INDICATOR TYPE AND CONNECTION</th>
<th>ALIGNMENT</th>
<th>INDICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>100mV</td>
<td>Audio (AC) VTM input to TP400 with a 10pf capacitor in series with lead.</td>
<td>—</td>
<td>Read minimum AC voltage between 70 and 70 kc.</td>
</tr>
<tr>
<td>only</td>
<td>AC VTM to TP401</td>
<td>201, 420, 404</td>
<td>Maximum AC voltage (38 kc).</td>
</tr>
<tr>
<td>PX signal channel only</td>
<td>Audio (AC) VTM and oscilloscope vertical input to left channel output terminal. Leave the VTM and scope probes connected to this point and complete alignment procedure. If it is necessary to adjust 2402 more than a half turn repeat alignment steps above.</td>
<td>2402</td>
<td>Maximum AC voltage with claim 1 kc sine wave on oscilloscope.</td>
</tr>
<tr>
<td>300mV</td>
<td>Same as Step 3</td>
<td>MPX Separation Control</td>
<td>Minimum reading in Audio (AC) VTM—should be at least 3366 below reading obtained in Step 3.</td>
</tr>
<tr>
<td>300mV</td>
<td>Audio (AC) VTM and oscilloscope vertical input to right channel output terminal</td>
<td>—</td>
<td>Same Audio (AC) VTM reading as obtained in Step 3 (3366), claim 1 kc sine wave on scope.</td>
</tr>
<tr>
<td>3</td>
<td>Same as Step 5</td>
<td>—</td>
<td>Minimum reading in Audio (AC) VTM should be at least 3366 below reading obtained in Step 3.</td>
</tr>
<tr>
<td>4</td>
<td>Same as Step 5</td>
<td>—</td>
<td>Check signal at output or recorder (jacks and reverse leads going to terminals 4H and 4K for correct channel/signal output.</td>
</tr>
</tbody>
</table>
**MULTIPLEX DECODER TESTS**

- Use external modulation, if necessary.
- Connect the FM generator output to the antenna terminals of the unit under test.
- With the FM generator set at an output of 25 mV at the antenna terminals, the stereo indicator should light up. If the generator output is reduced to 5 mV, or the stereo indicator, the indicator light should remain ON.
- Reduce FM generator output to zero and the indicator light should go OFF.
- If the stereo indicator does not respond properly to the tests above, reset the indicator control (R403) until the stereo indicator lamp will remain lit with a 4 mV signal applied to the antenna terminals.

**PREFERRED ALIGNMENT INSTRUCTIONS**

(Using multiplexer with RF and 19 kc outputs and with 1 kc modulation)

In Table 1, below, a multiplexer with an RF output is used. This is the better method of alignment since the multiplexer circuitry is connected to the tuner circuitry. Table 2 is used to check the alignment of the IF stages before making multiplexer adjustments. Poor RF alignment can make proper multiplexer operation impossible.

This table is based on the FISHER Model 300 multiplexer generator. Another alignment procedure, for MPX generators without an RF output, is shown in Table 2.

**TEST EQUIPMENT:** Multiplexer Generator, Audio and Video Tone Generator, RF Generator, Vacuum Tube Voltmeter, Oscilloscope (100 kc minimum) with external sweep input.

**WARNING:** Use only the proper alignment tool to prevent core breakage.

### MULTIPLEX-GENERATOR RF OUTPUT CONNECTED TO ANTENNA TERMINALS

<table>
<thead>
<tr>
<th>STEP</th>
<th>GENERATOR MODULATION</th>
<th>RF DEV.</th>
<th>INDICATOR TYPE AND CONNECTION</th>
<th>ALIGNMENT</th>
<th>ADJUST INDICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>70 to 76 kc (contact external audio generator to SCA input of multiplexer generator)</td>
<td>172 kc</td>
<td>Audio (AC) VTVM input to TP401 with a 10 pf capacitor in series with load</td>
<td>———</td>
<td>Read minimum AC voltage between 70 and 76 kc.</td>
</tr>
<tr>
<td>2</td>
<td>19 kc pilot only</td>
<td>16.5</td>
<td>AC VTVM to TP401</td>
<td>2401, 402, 403</td>
<td>Maximum AC voltage (18 kc)</td>
</tr>
<tr>
<td>3</td>
<td>Composite MPX signal</td>
<td>275 kc</td>
<td>CAUTION: Some 1 kc signal will be present on both the 70 and 40 kc output terminals. The terminal with the highest output signal is not the proper L/P-Tuner output terminal. Leave the VTVM and scope lines connected up to this point and complete alignment procedure. If it is necessary to adjust 2402 more than a half turn repeat alignment steps above.</td>
<td>———</td>
<td>———</td>
</tr>
<tr>
<td>4</td>
<td>Composite MPX signal</td>
<td>275 kc</td>
<td>Same as Step 3</td>
<td>MPX Separation Control</td>
<td>Minimum reading on Audio (AC) VTVM should be at least 35 db below reading obtained in Step 3.</td>
</tr>
<tr>
<td>5</td>
<td>Same as Step 4</td>
<td>275 kc</td>
<td>Audio (AC) VTVM and oscilloscope vertical input to left channel output log</td>
<td>———</td>
<td>Same Audio (AC) VTVM reading as obtained in Step 3 (126 db), clear 1 kc sine wave on scope.</td>
</tr>
<tr>
<td>6</td>
<td>Same as Step 3</td>
<td>275 kc</td>
<td>Same as Step 3</td>
<td>Minimum reading on Audio (AC) VTVM should be at least 25 db below reading obtained in Step 3.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Same as Step 4</td>
<td>275 kc</td>
<td>Same as Step 3</td>
<td>Check signal at output or recorder jack and reverse leads going to terminals D1 and D4 for correct channel signal output.</td>
<td></td>
</tr>
</tbody>
</table>
AUDIO AMPLIFIER TESTS

Control Positions for Tests

1. Unplug unit from AC-power line.
2. Set Balance, Bass and Treble controls to their center positions.
3. Press Monitor pushbutton in. Set Speaker selector point to 1. Hi-Filer and Low-Filler switches out. Select switch to AUX. Mono switch in the output position. Mono position of channel is to be set on the 8-16 ohms position.

Output Stage Balancing and
IM Distortion Measurements

1. Connect an 8K ohm, 50-watt resistor across the left output terminals. In parallel to the load resistor con- neet the output leads of an IM (inter-Modulation) distor- tion analyzer and the leads of a DC VVM capable of reading 0.1 volt with accuracy.
2. Connect IM analyzer generator output to the left Monitor input.
3. Apply AC power and rotate Volume control to its maximum clockwise position—full volume.
4. Increase signal input to amplifier for 40-watts output. (1.47 VAC across 8K ohm load resistor). After one full minute of warm-up time proceed to next step. The warm-up time is very important (to get proper IM measurements) since the transistors change slightly as their internal temperature rises. A 15-watt warm-up should be sufficient. Once they are warm the tests and adjust- ments should be completed without delay—before they can cool off.
5. Reduce IM analyzer generator output for 5 watts output from amplifier (0.16 VAC across load).
6. Adjust P1 and P2 (P3 and P4 for right channel) for minimum IM distortion and zero DC voltage across the load. IM distortion should be less than 0.01% and DC voltage less than 0.01 volts across the 8-ohm load. Use the two trimmers to adjust the control—its faster than shifting from one control to the other.
7. Increase signal input for 40 watts output from amplifier. IM reading should be less than 1%—DC across load should be less than 0.03 volt.
REPEAT steps 1 through 7 above for right-channel tests.

NOTE: If any of the above instructions are different from those supplied with the IM analyzer instruction manual, it is best to follow those in the manual. If a load resistor of 8K ohms is bridged into the IM analyzer, a separate load resistor is not required for the channel under test—single should be wired across the other channel as a precaution. For best results the IM range switch should be set to give a reading in the center to full-scale portion of the meter scale—this gives greater accuracy.

Harmonic Distortion Test

1. Set amplifier controls to positions indicated above (control positions).
2. Connect an audio (tone-wave) generator to the left AUX input. Connect the harmonic-distortion analyzer to the left speaker and a 1 meters across an 8K ohm, 50-watt resistor load.
3. Apply AC power—rotate Volume control to its maximum clockwise position.
4. Set the frequency control of the audio generator to 20 cycles. Increase the output level of the audio gen- erator until the sine waves, as viewed on the scope, start to distort—these are clipped from overdriv- ing the amplifier. Check waveforms on scope for insta- bility—changes in both shape or oscillation (thinner line at a portion of the waveform).
5. Repeat the above steps using 0.1 of a microfarad load as a load. Remove the 8-ohm resistor.
REPEAT steps 1 through 5 above, for the right stereo channel.

Transistor Testing

If a power transistor is not available the circuit in Figure 1 can be used to determine the DC data for the transistors. This is a complete test of the trans-istor.

OPERATION: Connect the transistor to the test circuit. Adjust R22 and R23 for max amplification. This is then calculated by measuring the collector current. The DC beta should be between 50 and 250.

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 base of the transistor. Be sure to include this information when ordering replacement transistors.
ALIGNMENT INSTRUCTIONS

IF ALIGNMENT (General Maintenance)
Set selector switch to FM MONO. MUTE pushbutton depressed. HIGH FILTER, LOW FILTER and MUTING switches "OFF" (out position). VOLUME to lowest output (maximum CCW) position.
1. Connect IF-amp output to the insulation of wire connected to front-end TP-751. Connect scope input and DC VTVM (through diode probe—Fig. 1) to lead to collector of Q303, and ground. NOTE: The connection between the lead of the IF transformer and the diode probe must be as short as possible.
2. Adjust front-end 2751 (top and bottom) for maximum gain and a symmetrical curve (Fig. 2). Keep generator output as low as possible.
3. Connect scope input to the left or right RCDR output jack. Ratio detector curve should be like that in Fig. 3.

IF ALIGNMENT (After part replacement)
Use same switch positions as above.
1. Connect 10V/7 mA output lead to the collector of Q303. DO NOT use AM or FM modulation.
2. Connect DC VTVM across C324 (ratio-detector filter). Use 100K ohm amplifier board and adjust the top core of Z303 for maximum gain and a symmetrical curve that in Figure 5.
3. Connect DC VTVM to point M1 on the IF-amp board and adjust the top core of Z303 for maximum gain and curve like that in Figure 5.

FM FRONT-END ALIGNMENT
NOTE: This step is not necessary unless the circuitry has been disturbed or components replaced.
1. Connect DC VTVM to point M1 on the IF board FM generator (with two 120-ohm composition resistors in series with the leads) to the 300-ohm antenna terminals.
2. Connect generator and tuner dial to 90 mc. Adjust the RF trimmers (G764, L752) for maximum DC VTVM reading.
3. Set generator and tuner dial to 106 mc. First adjust the oscillator trimmer (C764) and then the RF trimmers (C757, C753).
4. Repeat steps 2 and 3 several times until calibrations are correct when VTVM reading is maximum. Use as little generator output as possible.
5. Connect generator and tuner dial to 98 mc. Adjust antenna coil (L751) for maximum DC VTVM reading.