144

# SERVICE MANUAL

marantz

model 4400

*Stereo 2+Quadradial 4 Receiver*

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## TABLE OF CONTENTS



## LIST OF ILLUSTRATIONS

TABLE PAGE

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## INTRODUCTION

This service manual was prepared for use by Authorized Warranty Stations and contains service information for Marantz Model 4400 Stereo 2+Quadradial 4 Receiver.

Servicing information and voltage data included in this manual are intended for use by the knowledgeable and experienced technician only. All instruction should be read carefully. No attempt should be made to proceed without a good understanding of the operation in the receiver.

The parts list provides information by which replacement parts may be ordered from the Marantz Company. A simple description is included for parts which can be usually be obtained through local suppliers.

## 1. SERVICE NOTES

As can be seen from the circuit diagram, the chassis of Model 4400 consists of the following module units. Each unit mounted on a printed circuit board is described within the square enclosed by a bold dotted line on the circuit diagram.

1. FM Front End ..... mounted on P.W. Board, P100
2. AM Tuner ..... mounted on P.W. Board, P150
3. FM IF Amplifier ..... mounted on P.W. Board, P200
4. MPX Stereo Decoder, Noise and DC Amplifier ..... mounted on P.W. Board, P300
5. Phono Amplifier ..... mounted on P.W. Board, P400
6. Vari-Matrix ..... mounted on P.W. Board, P500
7. Dolby Unit ..... mounted on P.W. Board, P600
8. Power Amplifier ..... mounted on P.W. Board, P700
9. Power Supply ..... mounted on P.W. Board, P800
10. Scope Amplifier ..... mounted on P.W. Board, P900
11. FM CAL ..... mounted on P.W. Board, PC01
12. Tone Amplifier ..... mounted on P.W. Board, PD01
13. Buffer and Pre-Amplifier ..... mounted on P.W. Board, PE01
14. Tone Control and Diode Matrix Unit ..... mounted on P.W. Board, PF01
15. Balance Control Unit ..... mounted on P.W. Board, PG01
16. Filter Amplifier ..... mounted on P.W. Board, PH01
17. 400Hz Oscillator and Meter Driver ..... mounted on P.W. Board, PL01
18. Phase Convertor ..... mounted on P.W. Board, PM01
19. Speaker Protector ..... mounted on P.W. Board, PN01
20. Fuse Unit ..... mounted on P.W. Board, PP01
21. Switch Unit ..... mounted on P.W. Board, PS01
22. Switch Unit ..... mounted on P.W. Board, PT01
23. FM De-emphasis ..... mounted on P.W. Board, PU01
24. Dolby Terminal ..... mounted on P.W. Board, PV01
25. Head Phones ..... mounted on P.W. Board, PW01
26. Meter Lamp ..... mounted on P.W. Board, PX01
27. Selector Lamps ..... mounted on P.W. Board, PY01
28. Dial Lamps ..... mounted on P.W. Board, PZ01

## 2. AM TUNER

The AM TUNER portion of the 4400 is composed of one IC circuit (including RF amplifier, local oscillator, mixer, IF amplifier, detector, and a signal strength indicator amplifier) and one transistor amplifier to amplify the detected audio signals.

All components except the Tuning capacitor and ferrite bar antenna are mounted on printed circuit board P150.

The AM signals induced in a ferrite bar antenna are applied to the input of RF amplifier

(pin ① ) through a capacitor of C151 and amplified to the level required for overcoming the conversion noises, thus giving good S/N performance. The tuned circuits inserted in both output and input circuit of RF amplifier assure very high image and spurious rejection performance.

Thus amplified and selected AM signals are then applied to one input of Mixer section (pin ⑥ ) through a coupling capacitor C158, while the local oscillator voltage is injected to the other input of the section (pin ⑤ ) through a capacitor C157. Then both the AM signal and oscillator voltage are mixed and converted into 455KHz intermediate frequency. The resulting IF signal is applied to the first IF transformer L153 consisting of one ceramic filter and two tuned circuits.

The output of L153 is led to the IF amplifier's input (pin ⑦ ) through a coupling capacitor C169 and amplified to sufficient level to drive the detector. The output of IF amplifier (pin ⑧) is led to the detector's input (pin ⑫ ) through IF filter L154. The detected audio signal derived from pin ⑪ is filtered and amplified and final audio output is obtained from the collector of H152 and applied to the TAPE MONITOR OUT jacks through the function switch.

The DC component of the detected IF signal is used as a AGC voltage to control emitter current of RF and IF amplifiers through the resistors R154 and R155. A part of the DC component is also applied to the signal strength indication amplifier incorporated in the IC. The output appears at pin ⑭ and is level adjusted by R152, indicated on the display scope H011 through vertical scope amplifier.

### 2.1 Suggestion for AM Tuner trouble shooting

Check for broken AM bar antenna, next try to tune station by rotating fly-wheel tuning knob slowly and observe the spot on the oscilloscope whether it deflects up and down or not. If the spot moves up and down as you tune past each station, no failure may exist in the stages at least preceding final IF transformer L154. Next connect a oscilloscope to the test point Ⓑ or J157 and check for audio signals with the tuning meter deflected. If the signal strength does not deflect, check the local oscillator circuit. Normal oscillator voltage at the hot end of the oscillator tuning capacitor is about 1.5 or 3 volts, varying with tuning capacitor position. When measuring oscillator voltage use an RF VTVM; no circuit tester gives correct indication. If the local oscillator voltage is normal, check all voltage distribution in the AM circuits by using a DC VTVM and compare the measured values with those given in the schematic diagram.

## 3. FM TUNER

### 3.1 RF and IF Circuit

The FM Tuner section of the Model 4400 is divided into five functional blocks: FM Front End, IF Amplifier, Detector, Muting Control and MPX Stereo Decoding Circuit.

FM signals induced by a FM antenna are led to FM antenna coil L101 through a Balun coil. These signals are then applied to the FET RF amplifier which in turn applies its output to the next FET Mixer H102 through the triple tuned highly selective circuits. The FET Mixer converts its input signal into 10.7 MHz intermediate frequency and amplifies it at the same time. The H103 is a local oscillator and its output is injected into the source of the FET Mixer, the injection voltage is about 700 mV. The 10.7 MHz front end output is fed to the next IF amplifier unit through a coaxial cable.

The IF amplifier unit consists of seven IF amplifier stages and one AGC amplifier stage. Eight ceramic filters are also used to obtain high selectivity and four symmetrical diode limiter stages are employed for the best limiting characteristics, improved capture ratio and good AM suppression.

A part of FM Front End output is applied to the AGC amplifier H209 and its rectified output is fed back to the gate of FET RF amplifier to decrease the gain with increased signal strength.

The signals required for multipath indication are obtained from the five stages of IF amplifiers through coupling capacitors C252, C211, C214, C223 and C228 respectively and

rectified by five pair of full wave diode circuits. Thusly obtained AM components from the FM signal are appropriately mixed and applied to the vertical amplifier for multipath display.

The IF signal sufficiently amplified through each stage of IF amplifier is finally applied to the Detector Amplifier H208. The detected audio output is fed to the buffer amplifier H210 and its buffered output is fed to; (a) noise amplifier H310 through resistor R378 and capacitor C333, (b) QUADRADIAL OUTPUT Jack on the rear panel through resistor R379, (c) MPX stereo decoding IC (H321) through R301 and H301.

### 3.2 Audio Muting and Stereo Mode Auto-Selecting Circuit

The muting circuit consisting of all solid-state electrical switching has been incorporated in the Model 4400. Three inputs control the muting function. The first is related to signal strength, the second to the noise condition at the detector and the third is derived from the DC component of the detector output. These inputs are properly matrixed and gated to provide muting free from noise and transients.

The first input of DC voltage obtained by rectifying a part of IF output signal from the H205 and H206 is applied to the base of H308 and turns it on, if the IF output is greater than predetermined level (muting threshold level). When the H308 is turned on the H309 is turned off, allowing the emitter-collector resistance increasing and the collector voltage rises about 9V. The increased collector voltage increases the gate bias voltage and turns on the switching FET H301, decreasing the source-drain resistance to near zero ohm and allowing the audio signal applied to the source to flow to the pin ② of decoding IC through the source-drain path.

When the input signal is lower than predetermined level, the DC output obtained is small and can not turn on the H308, thus the H308 keeps its turn-off stage and this makes H309 turn on, decreasing the collector voltage and turning off H301. Thus no audio signals can pass through the FET. This is the fundamental principle of the muting operation but for more elaborate muting operation the second and the third inputs are necessary.

The second input is used to protect the muting operation and MPX stereo beacon lamps from misoperation due to undesirable noises. The high frequency noises included in the detected audio signals are separated by a small capacitor C333 and amplified by the noise amplifier transistor H310 and its output is rectified by the two diodes. The rectified DC output is proportional to the noise components in the audio signals.

When there are excessive noises in the audio signals such as obtained with a station incorrectly tuned in, the rectified DC output turns on the transistor H311, decreasing the emitter-collector resistance to zero. This means the collector of H309 is short-circuited to the ground, therefore the H301 is turned off and any audio signals having excessive high frequency noises can not go through the FET's source-drain path.

The transistor H317, also, turns off when transistor H309 or H311 turns on, and turns on the transistor H303 connected to pin ⑧ on the MPX decoding IC. Pin ⑧ is therefore grounded equivalently to set the IC in the monaural mode of operation. This prevent misoperation due to undesirable noises when the FM tuner is out of tuning.

The third input is obtained from the FM discriminator circuit. The DC output so called "S" curve is applied to the gate of H312 through a resistor R281 and dividing network (R361 & R362). The DC output is zero with a station correctly tuned in, but will vary from negative to positive values or vice versa when the tuning point is deviated toward either plus or minus frequency from the correct tuning frequency.

When the DC output is increased to a greater level than that of predetermined, the increased source potential of H312 makes the transistor H315 turn on (this means the collector of H309 is short-circuited to the ground), ... H301 turn off, ... H317 turn off, ... H303 turn on. This grounds pin ⑧ of the MPX stereo decoding IC, therefore the decoder is set in the monaural mode of operation and the stereo indicator lamp turns off. When the DC output is increased to the negative predetermined level, the decreased source potential turns off the H313 which in turn makes the H314 turn on (This means the collector of H309 is short-circuited to the ground).

The subsequenty changes are exactly the same as that just described above.

Thus when the tuning is shifted or deviated to the certain frequencies in which undesirable noisy side-audio signals are produced, both muting and monaural/stereo Switching Transistor H303 are operated automatically and open the circuits.

With the station correctly tuned in, the bias current of the FET H312 is adjusted so that both transistor H314 and H315 are not turned on, giving no effect on the transistor H309.

### 3.3 MPX Stereo Decoding Circuit

The stereo composite signal from the buffer amplifier undergoes a phase compensation by R301 and C301, is applied through the muting switching FET H301 to the input terminal pin ②, of the MPX stereo decoding IC H321 on a PLL (Phase Locked Loop) basis, and decoded into the left and right stereo signals, which become available at pins ④ and ⑤ respectively.

These decoded left and right stereo audio signals are introduced through a low pass filter composed of L301 to L304 and C311 to C320 for elimination of undesirable residual switching signal and through a de-emphasis network consisting of R325, R326, C321 and C322, into the npn-pnp direct coupled audio amplifier, where the signals are amplified to a required level for the output from J311 and J313. From these jacks, the audio signals are led to the TAPE MONITOR OUT jacks through the function switch. Figure 1 presents an internal block diagram showing the functions of the PLL basis MPX stereo decoding IC HA1156. The input stereo composite signal, amplified by the audio amplifier, is delivered to the phase detectors PD-1 and PD-2. A part of the stereo composite signal is also applied to the stereo decoder section.

The VCO (Voltage Control Oscillator) produces a free run oscillation in the neighborhood of 76KHz with the time constant determined by a capacitor C305 and resistors R311 and R312 set on the outside of pin ⑭. The VCO output has its frequency divided into 19KHz through the two stages of the frequency divider (DIV-1 & DIV-2), and is reverted to the phase detector PD-1, which contains two input terminals designed to produce an output in proportion to the product of the two input signals. The signal applied to one of the inputs of PD-1 is the 19KHz square wave formed through frequency division of the 76KHz VCO output signal by the two stages of the frequency divider DIV-1 and DIV-2, and the 19KHz pilot signal included in the stereo composite signal as a reference signal is applied to the other input. Therefore, the output of PD-1 which has passed through the low pass filter LPF-1 provides DC output voltage in proportion to the phase variance between the two inputs. This DC output voltage is amplified by

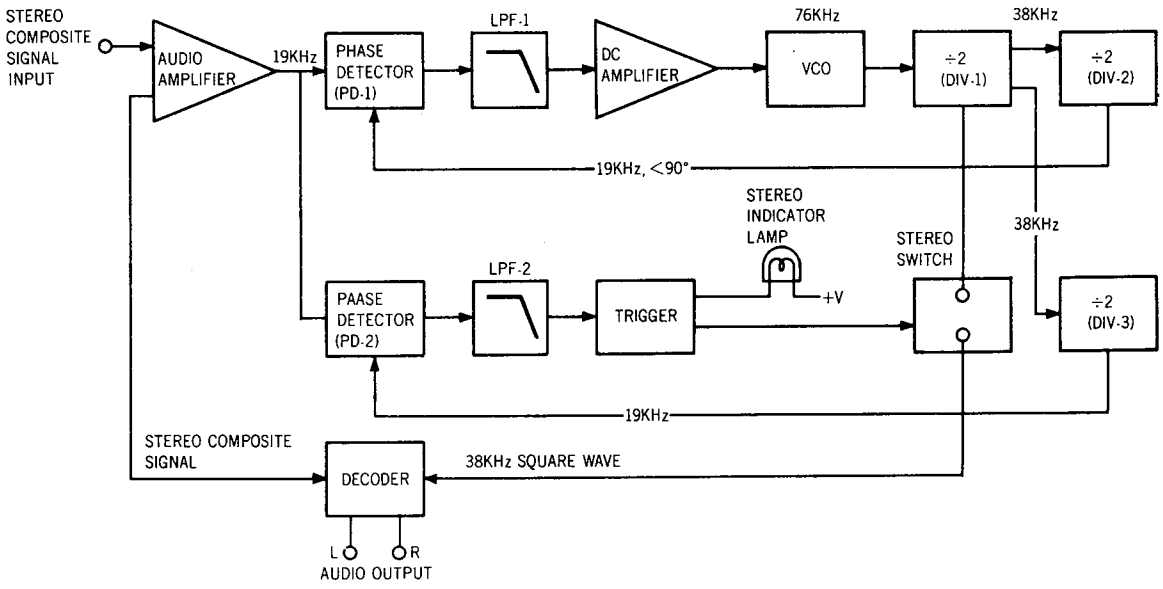


**Figure 1. Block Diagram of the HA1156**

the DC amplifier, and supplied to the 76KHz VCO as a control voltage. This means that the output frequency and phase of the VCO have been phase-locked to the input pilot signal. The 38KHz sub-carrier reproduced by PLL as stated above is delivered through the stereo switch to the stereo decoder section as a switching signal, thus driving the decoder section. One of the inputs of PD-2 is given the 19KHz resulting from the frequency division completed by DIV-1 and DIV-3, whereas the other input gets the 19KHz output contained in the composite signal, and the output is provided with a DC output in proportion to the amplitude of the pilot signal.

This DC output is furnished through LPF-2 to the trigger amplifier which drives the stereo indicator lamp and stereo switch. Therefore, insufficient supply of the pilot signal results in failure to light the stereo indicator and to turn on the stereo switch located in the path of the 38KHz switching signal, thereby avoiding a wrong stereo operation. H303 attached on the outside of pin ⑧ is a switching transistor for automatic monaural-stereo switchover. When the intensity of an incoming signal from an FM station is weaker than a predetermined level, this H303 is turned on and pin ⑧ is grounded, thereby developing a condition for monaural reception. For a forced monaural operation, switch the MODE switch to "MONO," and H303 comes into an "On" condition with the positive bias voltage applied to the base, and pin ⑧ is grounded, thereby establishing monaural operation. The transistor H302 connected externally to pin ⑭ is intended to stop the 76KHz oscillation of the VCO which interferes an AM signal during the reception of an AM station. When the function switch is set to "AM" position, a positive bias is charged on the base of H302, H302 is turned on, and pin ⑭ is grounded. Thus, the oscillation of the VCO is stopped, ending the interference with AM reception.

### 3.4 Suggestion for Trouble Shooting of FM Tuner

3.4.1 Symptom: No FM Reception

Turn on the POWER switch.

Turn on (depress) two SCOPE DISPLAY switches "ON" and "TUNING".

First try to tune to some FM stations. (Before this tuning, make sure that the spot on the scope display is centered by following the instructions of Step 22-1 to -5 in Section 22, the "SCOPE DISPLAY ALIGNMENT".)

Rotate the fly-wheel tuning knob slowly and observe the spot on the oscilloscope whether it follows an approximately rectangular path as you tune past each station or not. If it moves as described, the tuner circuits preceding the discriminator circuit may have no failure. If not, there would be some defects in the front end or IF amplifier stages, or oscilloscope circuits. To localize the defects in the former case, check FM local oscillator circuit, using RF VTVM. The normal local oscillator voltage is one or two volts (rms) at the tuning capacitor, depending on the tuning capacitor position. If the local oscillator voltage is normal, next check all voltage distribution in the front end and IF amplifier stages and compare them with those shown in the circuit diagram.

For localizing the defects in the latter case it is one of methods to apply an audio signal to the "CD-4/AUX" INPUTS jacks (FRONT L or R) on the rear panel with the "AUDIO" SCOPE DISPLAY switch, SELECTOR switch "CD-4/AUX".

The detected audio signals can also be checked by depressing the SCOPE DISPLAY switch "AUDIO" if scope circuit operate without any defects.

3.4.2 Symptom: No Stereo Separation

First check the "MODE" switch is in normal 2 CH position. Connect a FM RF signal generator output modulated by a stereo modulator to the rear FM antenna terminals, and check the stereo beacon is turned on or not. If not turned on, check for 19KHz VCO output signal (J310), using an oscilloscope and a frequency counter.

## 4. PHONO AND PRE-AMPLIFIER

Signals from the PHONO jacks are applied to the phono-amplifier mounted on P400. The amplified and RIAA equalized phono signals and signals from the tuner section, CD-4/AUX and