Shure Brothers Incorporated
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UHF Wireless System

SERVICE MANUAL CHANGE NOTICE

UHF WIRELESS RECEIVER MODEL U4D

Changes and corrections have been made to the Service Manual for the U4D UHF Wireless Receiver. These changes will make it easier to properly align the receivers. To update your Service Manual, remove the pages identified in the tables below and replace them with the pages attached to this Change Notice. Note that there are no changes to pages not specifically identified in the tables below.

U4D SERVICE MANUAL REVISION HISTORY

Release	Part Number	Date Code
Original	25A1062	QE
Revision 1	25B1062	QK
Revision 2	25C1062	SB
Revision 3	25D1062	TD
Revision 4	25D1062	TL
Revision 5	25D1062	AG

CHANGES EFFECTIVE JULY, 2001

REMOVE these pages from the U4D Service Manual	INSERT these Revisionpages into the U4D Service Manual
35–40	35–40

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SHURE®

Service Manual

25D1062 (AG)

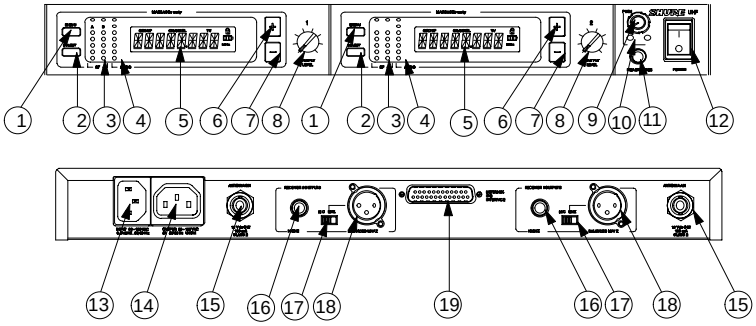
U4D Dual Diversity UHF Receiver

General

Characteristics

The Shure Model U4D Dual Diversity UHF Receiver is a microprocessor controlled dual diversity receiver operating in the UHF frequency range. This product is intended for use in high-end installed sound, rental, and concert sound markets. Different frequency variations are available in various countries.

Controls and Connectors



1. MENU Button
2. SELECT Button
3. RF Level Indicators
4. AUDIO Level Indicators
5. Programmable Display
6. + Button
7. – Button
8. Volume Control
9. Headphone Monitor Volume Control
10. Headphone Monitor Status
11. Headphone Input Connector
12. POWER On/Off Switch
13. Power Input Connector
14. Power Output Connector
15. Antenna Input Connectors
16. HIGH Z (Unbalanced) Output Connector
17. Mic/Line Slide Switch
18. **L**OW Z (Balanced) Output Connector
19. Networking Interface

Figure 1. U4D Receiver Controls and Connectors

Service Note: Shure recommends that all service procedures be performed by a Factory-Authorized Service Center or that the product be returned directly to Shure Brothers Inc.

Licensing: Operation may require a user license. Frequency or power-output modifications may violate this product's approvals. Contact your country's communications authorities.

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25D1062 (AG)

Circuit Description

Power Section

The receiver accepts power line voltage ranging from 85 Vac to 264 Vac. The receiver hardware uses the +5 Vdc, +12 Vdc and 12 Vdc voltages from the switching power supply. The switching power supply has 40 W overall output power capability, with maximum current capabilities of 4A at 5V, 2A at +12V, and .5A at –12V. It also includes a fast–acting 2.5A fuse.

Up to four in-line rf amplifiers may be connected to the receiver, depending on system setup. The receiver provides dc power to the in-line amplifiers via the BNC antenna ports and RG58 cables. Maximum dc power supplied to each antenna port is limited by self–resettable fuse.

Rf Section

The rf circuit description is limited to one rf strip (channel A) in receiver 1. The other rf strip (channel B) is virtually identical. The local oscillator (LO) section is common for both channels and is described separately. Receiver 2 is identical to receiver 1.

The rf input signals are sent from the antenna ports to the receiver via cables with BNC and rf mini–plug connectors. Antenna port A is connected to J302 of receiver 1. Antenna port B is connected to J302 of receiver 2. Connectors J302 on each receiver are the input of the rf power dividers.

Each of these splits the rf power from the antenna between two receivers. The outputs of the power dividers are connected to the inputs of the opposite rf strips of the other receiver: J303 of receiver 1 to J304 of receiver 2; and J303 of receiver 2 to J304 of receiver 1. In addition, J306 on receiver 1 and J306 on receiver 2 have to be solder jumpered to provide connection from the outputs of the rf power dividers to channel A rf strips of both receivers.

Rf Channel

The rf signal is preselected to the appropriate frequency range with two dielectric filters. The first dielectric filter is located between the antenna port and the low noise amplifier (LNA). The second filter is located between the LNA block and mixer input. The front end down–converter integrated circuit contains the LNA block and the first mixer.

The first conversion produces the first intermediate frequency (IF) signal at 50 MHz. The first if signal is amplified with the MMIC, band-limited with a SAW filter, then down-converted to the second IF frequency (10.7 MHz) with a second down-converter.

The second down-converter has an internal second local oscillator (LO) that oscillates at 60.7 MHz, using an external crystal. The second LO buffered output also provides the LO drive to channel B of the sec-

ond mixer. The second down–converter also incorporates an internal IF amplifier that is used with external 10.7 MHz ceramic filters. The 10.7 MHz signal goes to the second IF gain block with detector. The audio output is buffered with an operational amplifier, then processed as described in the Audio section. The noise output is also amplified by the operational amplifier, providing a signal for the noise squelch circuitry. The received signal strength indication (RSSI) output of LM1865 is used to drive the LEDs on the receiver front panel.

Local Oscillator

The first local oscillator (LO) is common for channel A and channel B rf strips. The LO is a phase locked-loop (PLL) system. The PLL consists of a prescaler/synthesizer, voltage-controlled oscillator (VCO), loop filter, rf power divider, and band-pass filter, band limiting the LO signal before injection to the first down converter. The prescaler receives the rf signal from the VCO via the coupling capacitor, C116. The output from the phase detector is connected to the external loop filter, which controls the tuning voltage input to the VCO.

The prescaler/synthesizer integrated circuit (IC) is a serial programmable input IC. It receives the programming data from the front panel/ digital board. The digital board includes a user-controlled microprocessor that allows users to change the frequency and other settings.

Audio Section

The audio for channel A comes from the channel A detector output of the rf section. Each channel's audio then enters its own factory-adjustable gain amplifier stage. These adjustable gain stages are used to exactly match the audio levels coming from each rf channel, as well as to set the proper level necessary for the compandor.

From the gain stages, each channel enters an analog switch. Noise outputs also come from the channel A and channel B detector outputs. Each noise output enters a bandpass noise filter that is used to measure the 60 kHz noise present in the audio signal. The noise level is proportional to the signal-to-noise ratio of the channel.

The noise from a channel, after being rectified and low-pass filtered (changed from an ac to dc signal), enters a bank of comparators. A version of the channel's noise that is 6 dB less also enters the comparator bank. The noise levels from the two channels are then compared. If they are within 6 dB of each other, the comparators send a logic high signal to the control of each channel's analog switch, and audio is allowed to pass through the switches.

If the noise levels are *not* within 6 dB of each other, the channel with the noise level greater than 6 dB of the other channel is not allowed to pass through the analog switch; the comparator puts a logic low signal on the control line for the analog switch. Also, each channel's noise is

compared to an adjustable squelch level (a dc level). If either channel's noise is greater than the squelch threshold, its switch is shut off.

The outputs from the analog switches are connected at the audio combining stage. This is a unity gain buffer stage where the audio from channel A is combined with the audio from channel B. The output from this stage splits into three paths.

The first path goes to a high Q tone key detection circuit. This circuit is a crystal filter in which the tone key level is converted to dc and compared to a fixed dc voltage. If the tone key is not present, the comparator sends a logic high signal to an audio mute IC and mutes the receiver output. If the tone key is present, a logic low signal is sent, and the audio is allowed to pass.

The second path goes to a low Q bandpass filter centered around 32 kHz. This filter provides low battery detection in the receiver. The lower Q allows for small frequency variation of tone key from various transmitters, without large amplitude variations that the crystal filter would have.

The filtered signal is then rectified and averaged. The resulting dc signal is amplified and then enters the digital section of an analog to digital (A/D) converter. The A/D converter and the microcontroller control the battery icon on the LCD display.

The third path goes into the compandor, via a 17 kHz low-pass filter. Here the audio is expanded and de-emphasized. The compandor output then goes off the audio board to a volume potentiometer on the front panel board. Then the wiper is brought back to the audio board.

At this point, the audio signal takes two paths. The first path is through the mute IC and into the output stage. The output stage consists of an inverting amplifier stage, the output of which goes directly to one pin of an XLR connector. A 180° phase-shifted version of the same signal is obtained by tapping off of this point and entering another inverting stage. This phase-shifted version then goes to another pin on the XLR connector.

Taking the output across the two XLR pins provides an electrically balanced output signal. The unbalanced output is obtained by taking one of the output stage amplifier's outputs with respect to ground. Each side of the balanced output goes through a pad that is switched in or out by the user. This switch changes the balanced output level by approximately 30 dB.

The second path is through the headphone amplifier circuit. The audio signal goes into a fixed gain amplifier, then off the board to the monitor board. The monitor board can select between receiver 1 and receiver 2. It also has a user-adjustable gain control, and a 1/4 inch jack for headphones.

For the audio level meter, audio is tapped off from the 17 kHz filter output and goes through a full wave precision rectifier and averaging circuit. This dc signal then enters a dc amplifier stage to adjust levels for

the LEDs. The output from this stage drives the audio level meter on the front panel board.

A dc voltage from the detector chip RSSI drives the bar graph integrated circuit on the front board for the rf level meters.

Display Board / Digital Section

Microcontroller Section

The microcontroller section consists of microcontroller U103 and the liquid crystal display (LCD). The microcontroller has an on-board LCD driver. R104, R116, and R118 supply the microcontroller with LCD drive voltage for a four-plex drive. The LCD is a transmissive type that uses a backlight for optimum readability. J104 supplies current, limited through 5 Ω (paralleled R119 and R120), +5V for the LCD diffused backlight LED array.

The LCD indicates frequency in MHz, a user-programmable name up to 8 characters long, and the UHF frequency group, channel, and television channel.

The LCD also has a battery fuel gauge that indicates the state of the transmitter battery. A padlock icon on indicates whether the user-accessible menus are locked or unlocked. A 4.000 MHz oscillator (Y101) provides the operating frequency to the microcontroller.

The oscillator circuit includes C107, C108, R111, R112, and Y101. R105 and C103 form the reset circuit. R121 is the pull-up resistor for the U103 programming voltage pin.

Memory Section

The memory consists of non-volatile ferroelectric RAM or EEPROM U106, which stores current receiver settings and maps of compatible groups and channels. R108 and R109 allow in-circuit programming of U106 FRAM.

Analog to Digital Converter Section

The analog to digital converter section consists of A/D converter U101. Signal DLOW_BATT (P102.2, U101.2, I138) from the audio section is an analog signal representing the transmitter's battery level. This is converted to an 8-bit digital signal for the microcontroller and is displayed on the LCD as the battery fuel gauge. Microcontroller U103 communicates serially with A/D converter U101.

User Interface Section

The user interface section consists of switches SW101 MENU, SW103 SELECT, SW102 UP (+), and SW104 DOWN (–). These switches provide access to various user-programmable menus on the front panel display. The LCD provides the user with feedback for all switch actions performed.

Audio Output Level Control R110

The audio output level control potentiometer has no associated circuitry in this section. Refer to the Audio Section.

RSSI Bar Graph Section

Channel A

Bar graph driver U104 gets the DRSSI_CH_A analog signal (U104.5, P102.6, I155) from the rf-audio board and indicates its strength on the 5-LED bar graph formed by D117, D115, D110, D109, and D105.

Channel B

Bar graph driver U102 gets the DRSSI_CH_B analog signal (U102.5, P102.11, I170) from the rf-audio board and indicates its strength on the 5-LED bar graph formed by D116, D114, D111, D108, and D106.

Audiometer Bar Graph Section

Bar graph driver U105 gets the DAUDMTR audio metering (averaging only, no peak) signal (U105.5, P102.13, I156) from the rf-audio board and indicates its strength on the 7-LED bar graph formed by D119, D118, D113, D112, D107, D104, and D103.

Diversity LEDs D101 and D102

Diversity LEDs A and B have no associated circuitry in this section. Refer to the Audio Section.

Digital to Analog Converter Section

The microcontroller communicates with 8-bit serial D/A converter U215 over two signal wires, DSQUELCH (P102.3, U103.10, TP113) and DSCL (P102.15, U103.9, T114), to set up the audio squelch threshold.

Display Board Interconnect with Rf-Audio Board

Integrated ribbon cable connector P102 interfaces with the rf-audio board and the networking Interface board through the display board. Pin assignments for the P102 connector are presented in the table below.

Table 1
P102 Interconnect Pin Assignments

PIN NO.	SIGNAL NAME	DESCRIPTION
1	D+5V	+5V power supply to the Digital Board
2	DLOW_BATT	Analog voltage representing TX battery level
3	DSQUELCH	Data signal to U215 squelch D/A
4	GND	Input power ground to the Digital Board
5	DLE	Data Load Enable to U309 PLL Synthesizer
6	DRSSI_CH_A	Chan. A rf Received Signal Strength Indicator
7	DD	Data signal to U309 PLL Synthesizer
8	DLEDA	Diversity LED A drive signal input
9	DCK	Clock signal to U309 PLL Synthesizer
10	DLEDRET	Diversity LED A and B common return
11	DRSSI_CH_B	Chan. B rf Received Signal Strength Indicator
12	DLEdB	Diversity LED B drive signal input
13	DAUDMTR	Audio metering analog signal input
14	N141	Audio potentiometer return to the Audio Board
15	DSCL	Clock signal to U215 squelch D/A
16	N142	Audio potentiometer wiper to the Audio Board
17	DLONE_W_OUT	Interrupt output to the Networking Interface
18	N143	Audio potentiometer input from the Audio Board
19	DSDO	Networking Serial Data Output
20	DLONE_W_INT	Interrupt input from the Networking Interface

Notes

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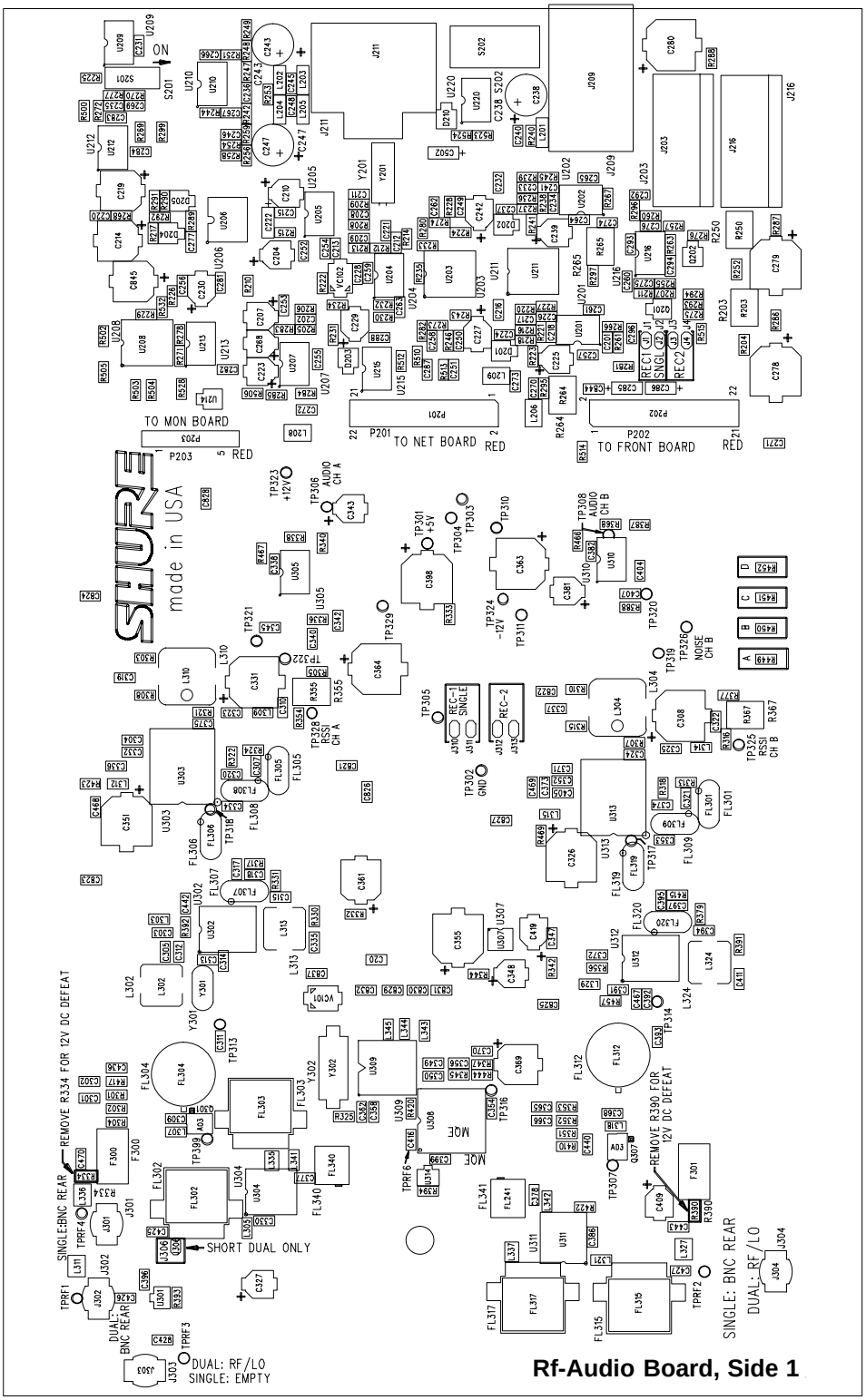
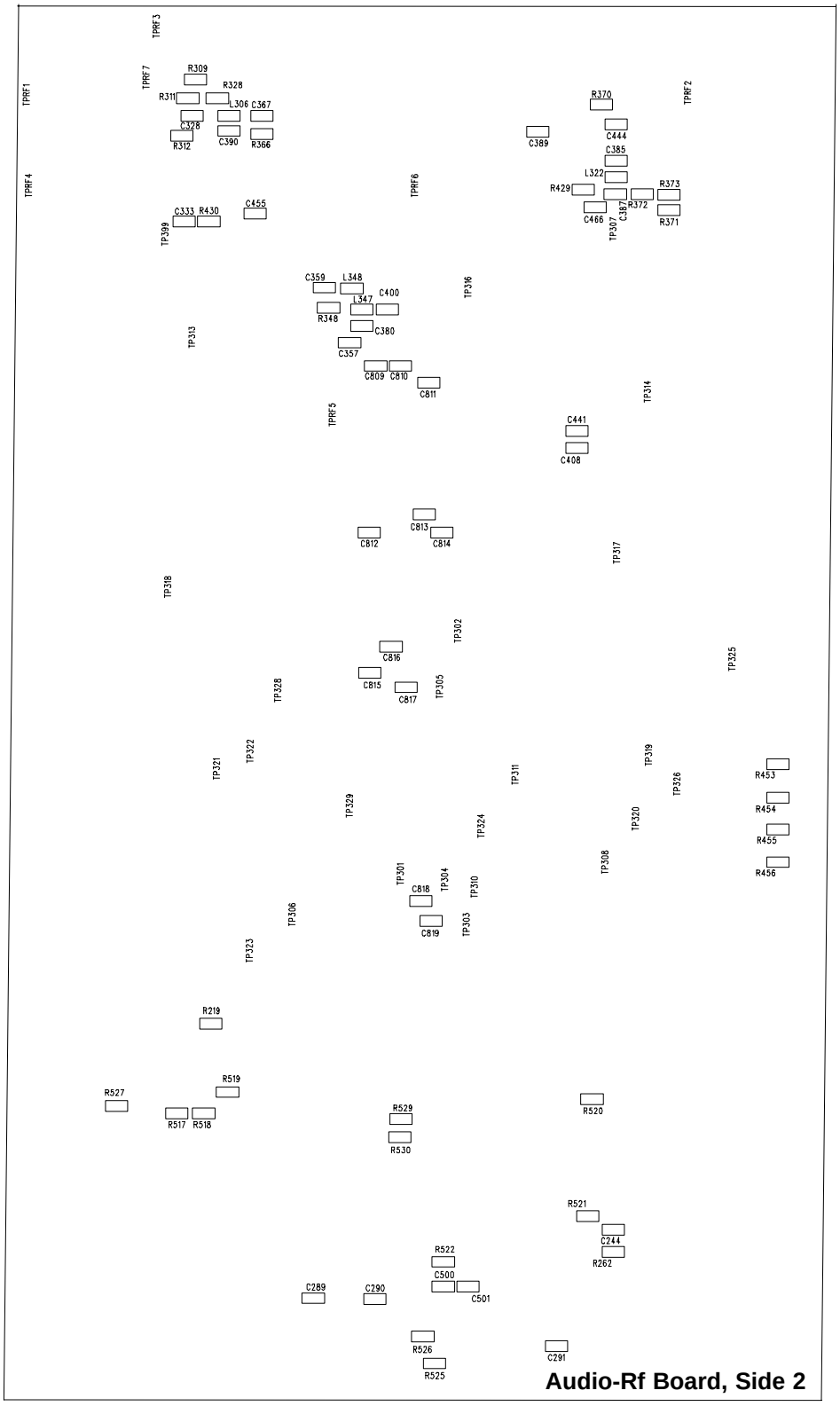
Preliminary Tests

Test Component Locations



Rf-Audio Board, Side 1



Audio-Rf Board, Side 2

Listening Test

Before completely disassembling the receiver, operate it to determine whether it is functioning normally and try duplicating the reported malfunction. Refer to the *User Guide* for operating instructions, troubleshooting suggestions, and specifications.

Review any customer complaint or request, and focus the listening test on any reported problem. The following, more extensive, functional tests require partial disassembly.

Functional Tests

Refer to the *Disassembly* section to partially disassemble the receiver for the following functional tests.

Use dc blocks at all rf output to protect test equipment.

To reduce the risk of electrical shock, do not touch or short any components in the power supply partition of the receiver. The heat sink of the switching power supply and all ac wiring contain hazardous voltages.

1. Remove five screws and washers from the top of the receiver and two screws and washers from the left and right sides of the receiver. Lift off the top cover.
2. Program the receiver squelch through the SET SQCH menu to –10.0.
3. Program the receiver frequency through the SET FREQ menu to any clean frequency in your area. To do this, select an inactive television channel and then scan for a frequency at which the yellow LEDs (RF A/RF B) are not lit. Note this frequency as *Fo* .
4. Connect a dc voltmeter to the center conductor (+) and the ground (–) of BNC antenna channel A input, marked ANTENNA A IN. The measured voltage should be to be ± 12.0 0.5 Vdc.
5. Set the rf signal generator frequency to *Fo*. Set the Level to –90 dBm and set the deviation as follows:

   UA, UB, MA, MB, MC, MD: 45 kHz deviation at 1 kHz modulation
   KK: 40 kHz deviation at 1 kHz modulation
   II: 28 kHz deviation at 1 kHz modulation
6. Connect the rf signal generator to the BNC antenna channel A input, marked ANTENNA A IN. Be sure to use a dc block to protect the test equipment.
7. Rotate the receiver Output Level control to a fully clockwise position.

8. Make sure the tone key switch (S201) on the receiver rf-audio board is in the ON position.The receiver should be muted. No audio output should be present at the balanced and unbalanced outputs.

9. Slide the tone key switch to the OFF position. J211 can be accessed from the outside of the receiver and is marked BALANCED LOW Z. With the audio analyzer in the Float position, the audio voltage at balanced audio output J211 with the switch at the LINE position (pin 2 and 3, unloaded) should be as follows:

   UA, UB MA, MB, MC, MD: 2.5 ± 0.5 Vrms

   KK: Not available at this time; measurements will be available later.

   II: 1.7 ± 0.5 Vrms

10. J209 can be accessed from the outside of the receiver and is marked HIGH Z. With the audio analyzer NOT in the Float position, the audio voltage at unbalanced audio output J209 (pin 1 and 2, unloaded) should be as follows:

    UA, UB,MA, MB, MC, MD: 1.25 ± 0.25 Vrms

    KK: Not available at this time; measurements will be available later.

    II: 0.837 ± 0.25 Vrms

11. Set the rf signal generator Level to –105 dBm. The receiver should be muted. No audio output should be present.

12. Connect a dc voltmeter to the center conductor (+) and the ground (–) of receiver BNC antenna channel B input, marked ANTENNA B IN. The measured voltage should be 12.0 ± 0.5 Vdc.

13. Set the rf signal generator Level to –90 dBm, and connect it to the receiver BNC antenna channel B input, marked ANTENNA B IN. Be sure to use a dc block to protect the test equipment.

14. Repeat steps 7 through 11.

15. Return the tone key switch (S201) to the ON position.

16. Repeat the procedure on the second receiver.

Disassembly and Assembly

! IMPORTANT SAFETY INSTRUCTIONS !

1.. READ these instructions.
2.. KEEP these instructions.
3.. HEED all warnings.
4.. FOLLOW all instructions.
5.. DO NOT use this apparatus near water.
6.. CLEAN ONLY with a damp cloth.
7.. DO NOT block any of the ventilation openings. Install in accordance with the manufacturer's instructions.
8.. DO NOT defeat the safety purpose of the grounding-type plug. The third prong is provided for your safety. When the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
9.. PROTECT the power cord from being walked on or pinched, particularly at plugs, convenience receptacles, and the point of exit from the apparatus.
10.. USE only attachments/accessories specified by the manufacturer.
11.. USE only with a cart, stand, tripod, bracket, or table specified by the manufacturer or sold with the apparatus. When a cart is used, use caution when moving the cart-apparatus combination to avoid injury from tip-over.
12.. UNPLUG this apparatus during lightning storms or when unused for long periods of time.
13.. REFER all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as when the power-supply cord or plug has been damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.

! CAUTION !

Observe precautions when handling this static-sensitive device.

! WARNING !

Voltages in this equipment are hazardous to life. No user-serviceable parts are inside. Refer all servicing to qualified service personnel. The safety certifications of the U4D Dual Diversity Receiver do not apply when the operating voltage is changed from the factory setting.

To reduce the risk of electrical shock, do not touch or short any components in the power supply partition of the receiver. The heat sink of the switching power supply and all ac wiring contain hazardous voltages.

Top Cover Removal

1. Remove five screws and washers from the top of the receiver.
2. Remove two screws and washers from the left and right sides of the receiver.
3. Slide the top cover off of the receiver to expose the circuit boards.

Front Panel Removal

1. Remove the three screws securing the brace and the rf shielding gaskets to the chassis, then remove the brace.
2. Remove the hexnuts and star washers securing the front panel to the inside of the front chassis.
3. Tag and disconnect the power on/off switch from the power supply wires.
4. Remove the rubber monitor volume control knob and the master volume control knob by pulling them away from the front panel.
5. Carefully pull the front panel away from the chassis.

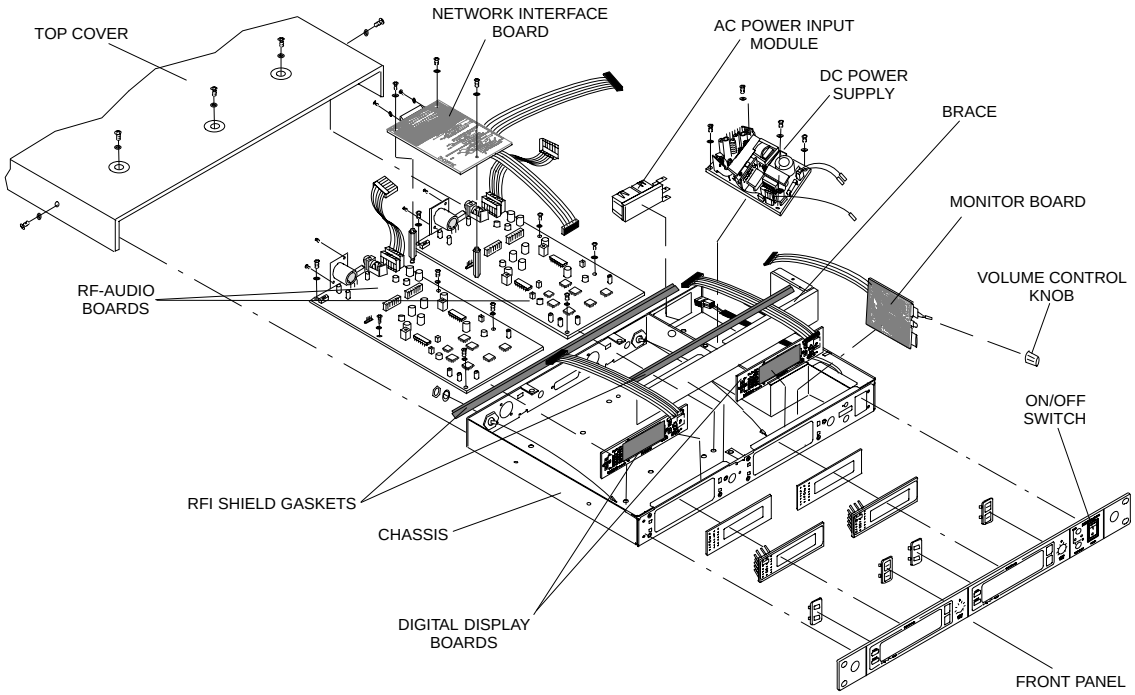


Figure 2. U4D Disassembly and Assembly

Printed Circuit Board (PCB) Removal

Rf-Audio Board Removal

1. Tag and disconnect the cables attached to the pcbs. Standard cable connections are shown in Figure 3.
2. Remove the screws and washers that secure the rf-audio pcb to the receiver chassis, then lift the board out.

Display Board Removal

1. Remove the rf shield brace inside the receiver by removing the three screws and washers securing it to the bottom of the chassis.
2. Remove each display pcb by removing the two screws securing the board to the back of the front chassis. Then pull the board away from the chassis and lift the board out.

Monitor Board Removal

1. Perform the following steps after removing the front panel.
2. Remove the hexnuts that secure the stem of the monitor volume control and the monitor output connector to the front chassis.
3. Pull the monitor board away from the chassis.

Power Supply Removal

1. Tag and disconnect the cables attached to the power supply.
2. Remove the screws and washers that secure the power supply to the receiver chassis, then lift the power supply out.

U4D Assembly

1. Reinstall the rf–audio circuit boards and secure them with the previously removed screws and washers.
2. Reinstall the power supply and secure it with the previously removed screws and washers.
3. Reinstall the display pcbs and secure them with the previously removed hexnuts and washers.
4. Reinstall the monitor circuit board and secure it to the chassis by reinstalling the previously removed hexnuts and washers over the volume control pot and output connector.
5. Reinstall the front panel and secure it to the front chassis with the previously removed hexnuts and washers.
6. Reinstall the steel brace and secure it with the previously removed screws and washers.
7. Reconnect all tagged wires and cables. Standard cable connections are shown in Figure 3.
8. Reinstall the top cover, and secure it with the previously removed screws and washers.

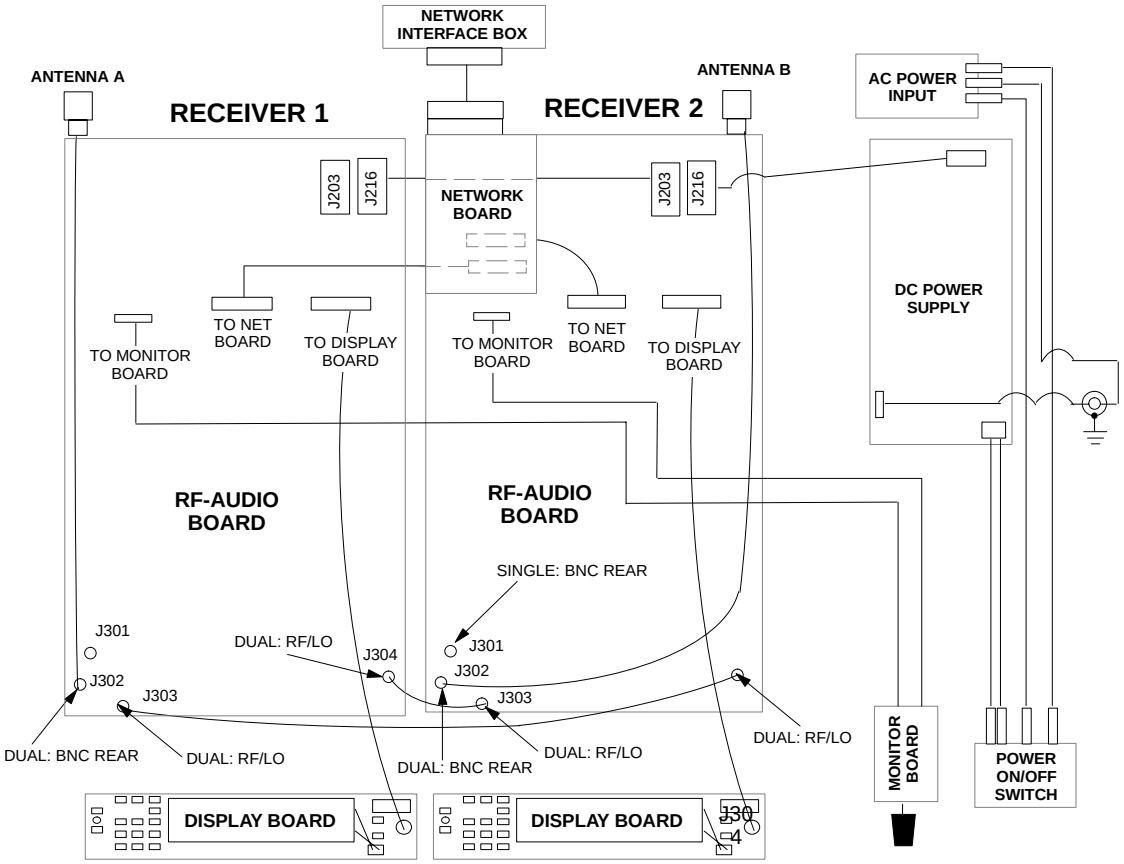


Figure 3. Final Cable Configuration

Service Procedures

Product Changes

The following changes have been made to the U4D receiver.

New Volume Control Knobs and Potentiometers

The new potentiometers ***cannot*** be used on old boards, and the new knob assembly cannot be used with old potentiometers.

PRINTED CIRCUIT BOARD REVISION	R110 VOLUME CONTROL POTENTIOMETER PART NO.	VOLUME CONTROL KNOB ASSEMBLY PART NO.
“G” or earlier	46A8048	90A8652
“H” or later	46A8069	90A8747

New Digital Display Board Pushbutton Actuators

The old actuators ***cannot*** be used on newer display boards. If for any reason the display board is replaced, the actuators must also be updated. However, any revision display board can be mixed with any revision rf–audio board. On newer boards, the switches will be surface mount components; on older boards the switches are thru-hole components.

PRINTED CIRCUIT BOARD REVISION	RUBBER ACTUATOR PART NO.	PUSHBUTTON SWITCH PART NO.
“J” or earlier	66A8039	55A187 (thru-hole)
“K” or later	66A8044, 66A8045	155A03 (SMT)

New PCB layout, component changes and designations

The U4 receiver PCB layout (34A8507K and earlier) has been revised due to discontinued status to part number 188A190 (FM IF/Quad detector). The new replacement component 188A129 (FM IF/Quad detector) is not pin for pin compatible so, associated support circuitry was added which results in the new PCB layout (34A8703). Also a new choice of RF front end filters were chosen which contributed to the new PCB layout change

PRINTED CIRCUIT BOARD REVISION	FM IF / QUAD DETECTOR	QUADRATURE COIL
34A8507K or earlier	U303 and U313	L304 and L310
34A8703	U315 and U316	FL311 and FL313

Test Equipment

Most test equipment needed is described in the Shure *Wireless Service Equipment Manual*. The following test equipment (or approved equivalent) is also needed.

Table 2
Test Equipment

Equipment Type	Model
Audio analyzer	*Hewlett-Packard 8903B
Digital multimeter	Fluke 87
Rf signal generator	HP 8656B or E440B
Frequency counter	Hewlett-Packard 53181A
Spectrum analyzer	HP 8590L or E4403B
Shure U4D receiver	Shure U4D

*Audio levels in dBu are marked as dBm on the HP8903B.

LCD Back Light Brightness Adjustment

Adjust R531 on the display board to achieve desired brightness level.

This adjustment is only possible on G and later versions of the printed circuit board.

Alignment

Align Receivers 1 and 2 separately. Receiver 1 is on the left and Receiver 2 is on the right when looking at the front panel.

Equipment setup for the alignment procedure is sequential.

Test Setup

1. Remove the top cover from the U4D receiver.
2. To reduce the risk of electrical shock, do not touch or short any components in the receiver switching power supply. The heat sink on the power supply and all ac wiring contains hazardous voltages.
3. Dc voltages are present at most rf test points. Use dc blocks on the rf signal generator to protect the test equipment.
4. Use RG58 or any other low loss 50 Ω cables for all rf connections. Keep test cables as short as possible. Include insertion loss of cables and connectors when making rf measurements.
5. Remove the network board.

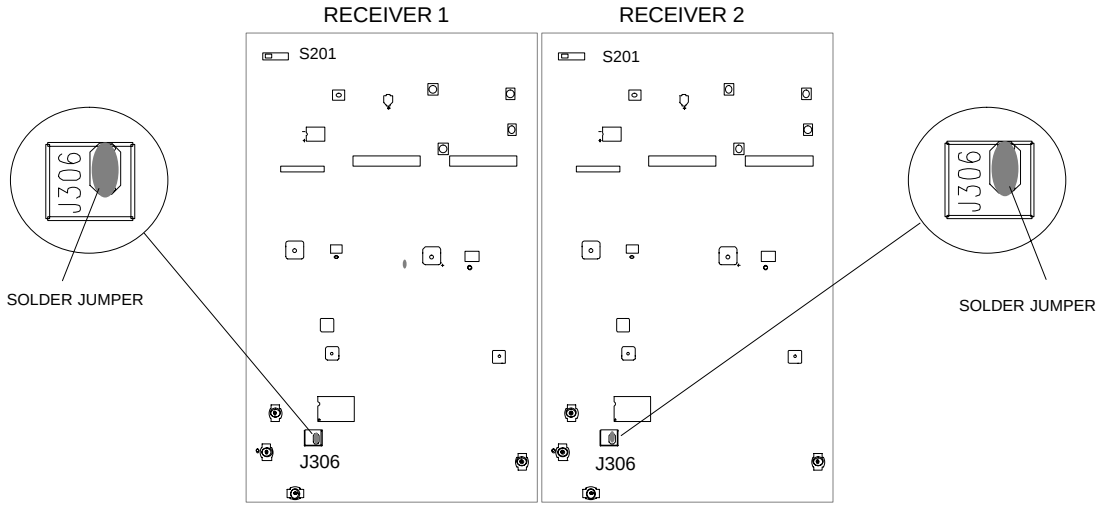


Figure 4. U4D Receiver Solder Jumper Locations

Alignment

1. Turn the U4D receiver power ON.
2. Connect the U4D receiver antennas.
3. Program the U4D receiver to any clean frequency in the area, using the SET FREQ menu on the display. To do this, select a television channel that is inactive in the area, and then scan for a frequency at which the yellow rf LEDs are not lit. Note this frequency as *Fo*.
4. Remove the U4D receiver antennas.
5. Connect the audio analyzer output to the external (EXT) modulation input of the rf signal generator.
6. Set the audio analyzer output for 1 kHz and 1.4 V (5.2 dBu).
7. Adjust the audio analyzer output amplitude until both the HI EXT and LO EXT lights on the rf generator turn off (use amplitude increments of 10 to 100 mV).
8. Make sure all internal tone generators on the rf signal generator are turned off. Set the rf signal generator deviation as follows:

UA, UB,MA, MB, MC, MD:	45 kHz deviation at 1 kHz modulation
KK:	40 kHz deviation at 1 kHz modulation
II:	28 kHz deviation at 1 kHz modulation

9. Turn ON the 400 Hz high-pass and 30 kHz low-pass filters on the audio analyzer.
10. Verify that solder jumpers J306 are closed.
11. Set the receiver squelch control to the mid-level (0) position.
12. Slide tone key switch (S201) on the rf–audio board to the OFF position.

Rf Tuning, Channel A

Dc Voltage Verification

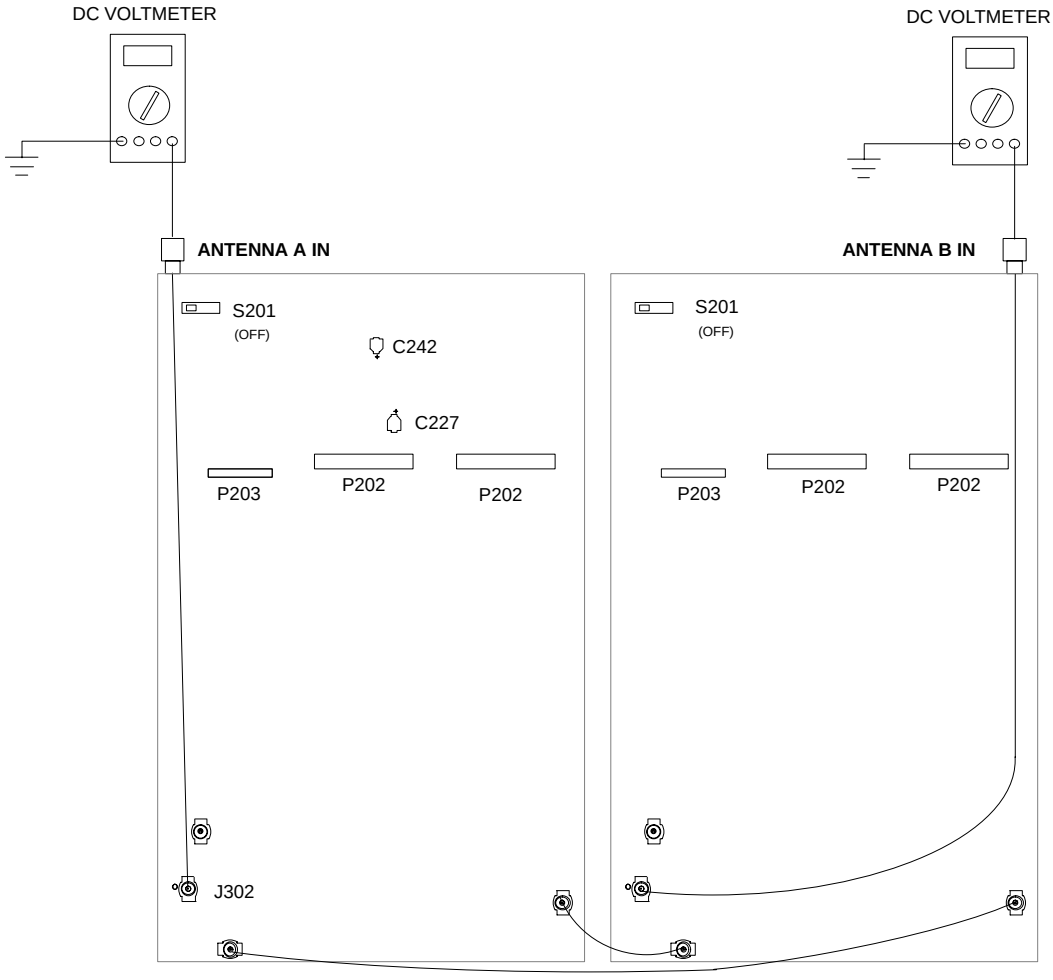


Figure 5. Dc Voltage Level Verification

1. Measure the dc voltage between the center pin of BNC connector ANTENNA A IN, located on the receiver rear panel, and ground. The voltage should measure 12.0 ± 0.5 Vdc.
2. Measure the dc voltage between the center pin of BNC connector ANTENNA B IN, located on the receiver rear panel and ground. The voltage should measure 12.0 ± 0.5 Vdc.

Local Oscillator Frequency Alignment (Channel A)

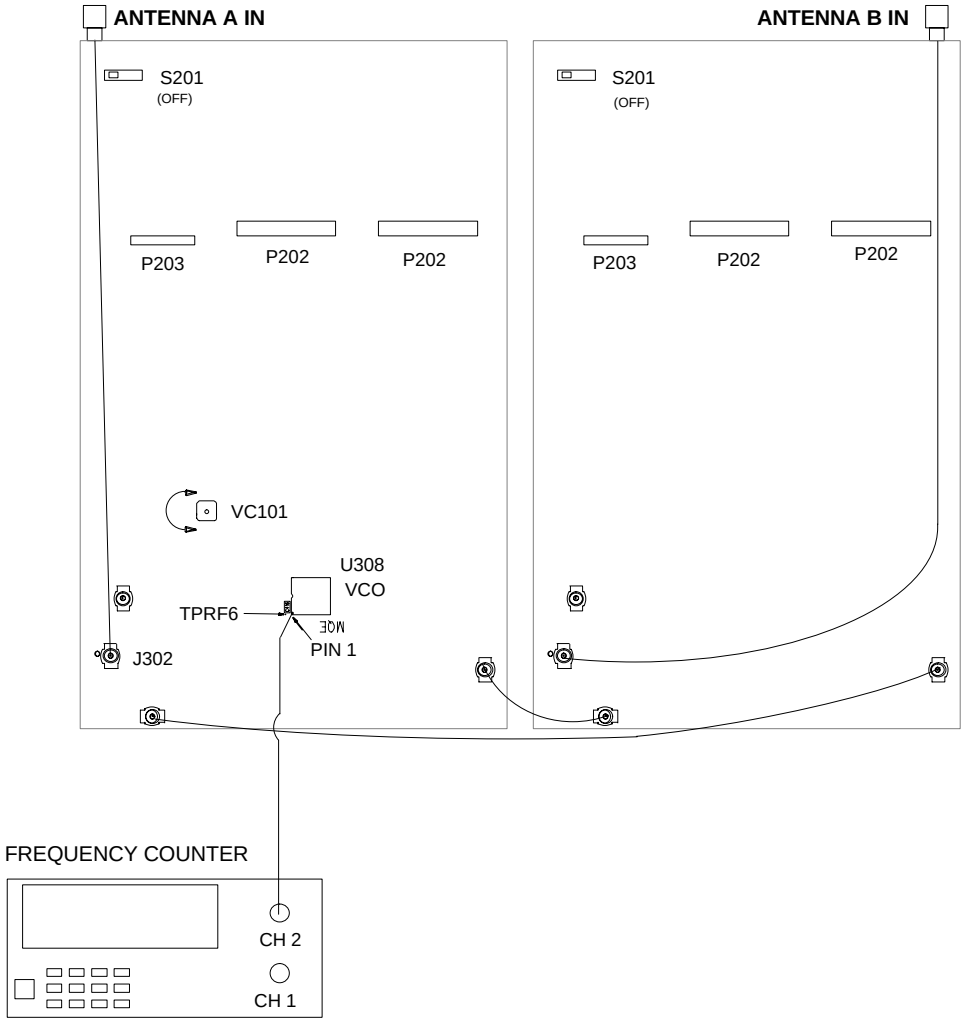


Figure 6. Local Oscillator Frequency Alignment

If using a spectrum analyzer, adjust the span so that the frequency accuracy measurement is better than1 kHz.

1. Attach a spectrum analyzer or frequency counter to TPRF6 (pin 1 of the U308 VCO).
2. Adjust VC101 for (*Fo* + 50 MHz) ± 5.0 kHz.
3. Disconnect the spectrum analyzer or the frequency counter from TPRF6.

FM Detector Quadrature Coil Alignment (Channel A)

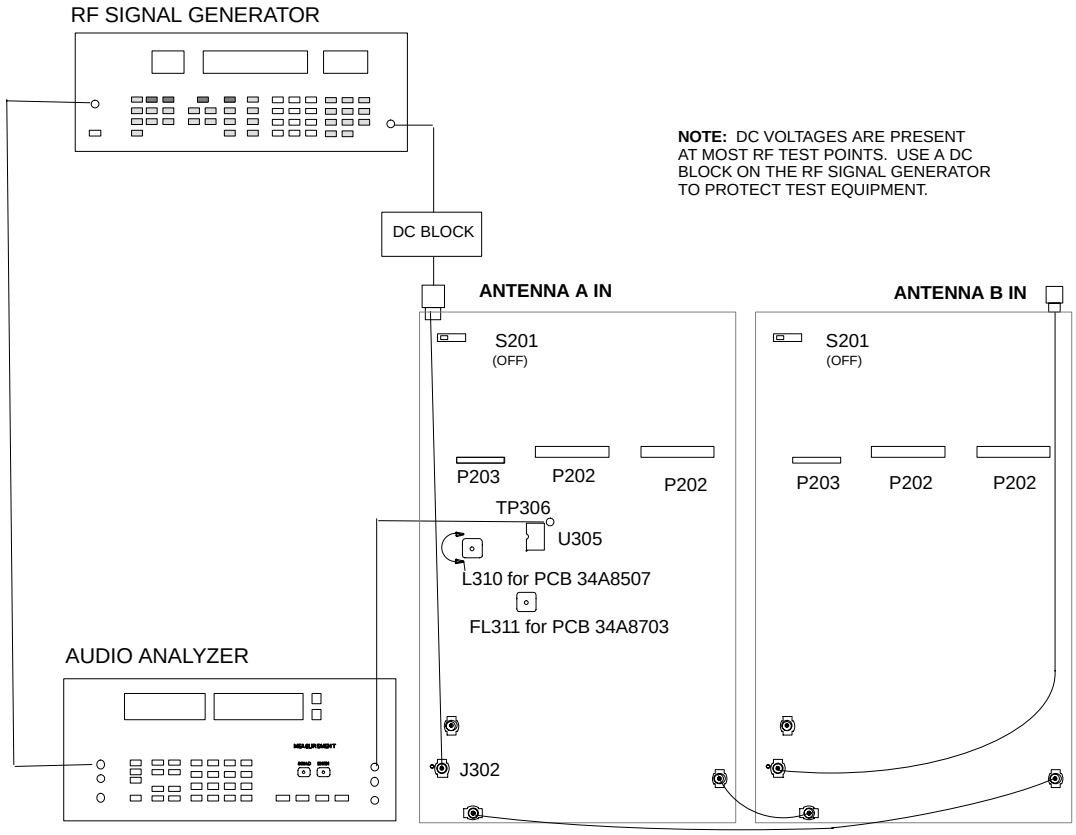


Figure 7. FM Detector Quadrature Coil Alignment Connections

1. Set the rf signal generator Frequency to *Fo*. Set the Level to –86 dBm and verify the Deviation as follows:

   UA, UB,MA, MB, MC, MD: 45 kHz deviation at 1 kHz modulation
   KK: 40 kHz deviation at 1 kHz modulation
   II: 28 kHz deviation at 1 kHz modulation

2. Connect the rf signal generator to the ANTENNA A input.
3. Connect the audio analyzer to U305, pin 7 (TP306).
4. Make sure that audio analyzer 400 Hz high-pass filter and the 30 kHz low-pass filter are activated.
5. For PCB version 34A8507 tune L310 for maximum audio output at TP306. For PCB version 34A8703 tune FL311 for maximum audio output at TP306. The low limit is 250 mVrms. There is no high limit.

Second Mixer Coil Alignment (Channel A)

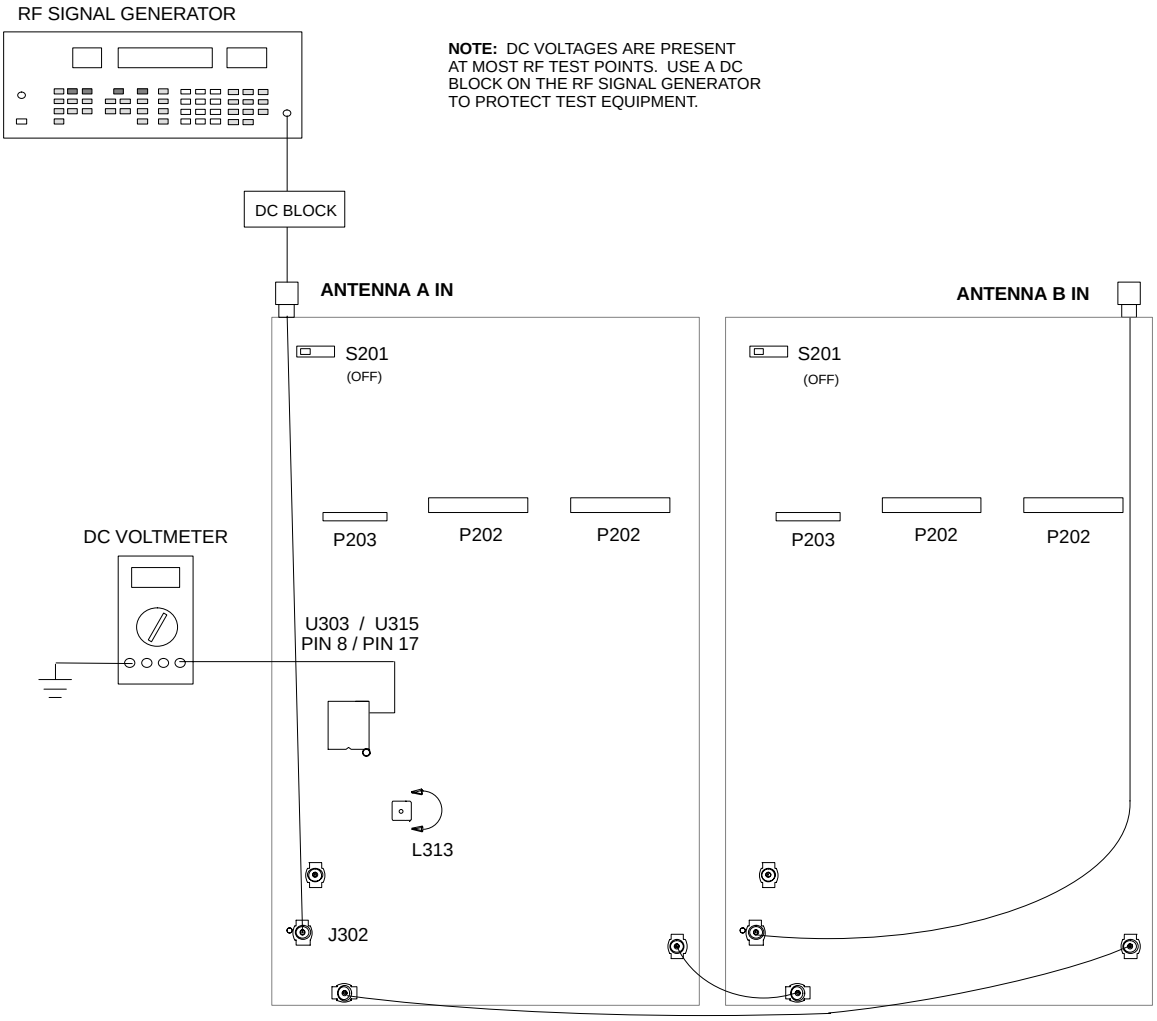


Figure 8. Channel A Second Mixer Coil Alignment

1. Change the rf input level to –105 dBm.
2. Adjust L313 for maximum dc voltage at U303 pin 8 for PCB version 34A8507 or at U315 pin 17 for PCB version 34A8703.

THD Verification and RSSI Adjustment (Channel A)

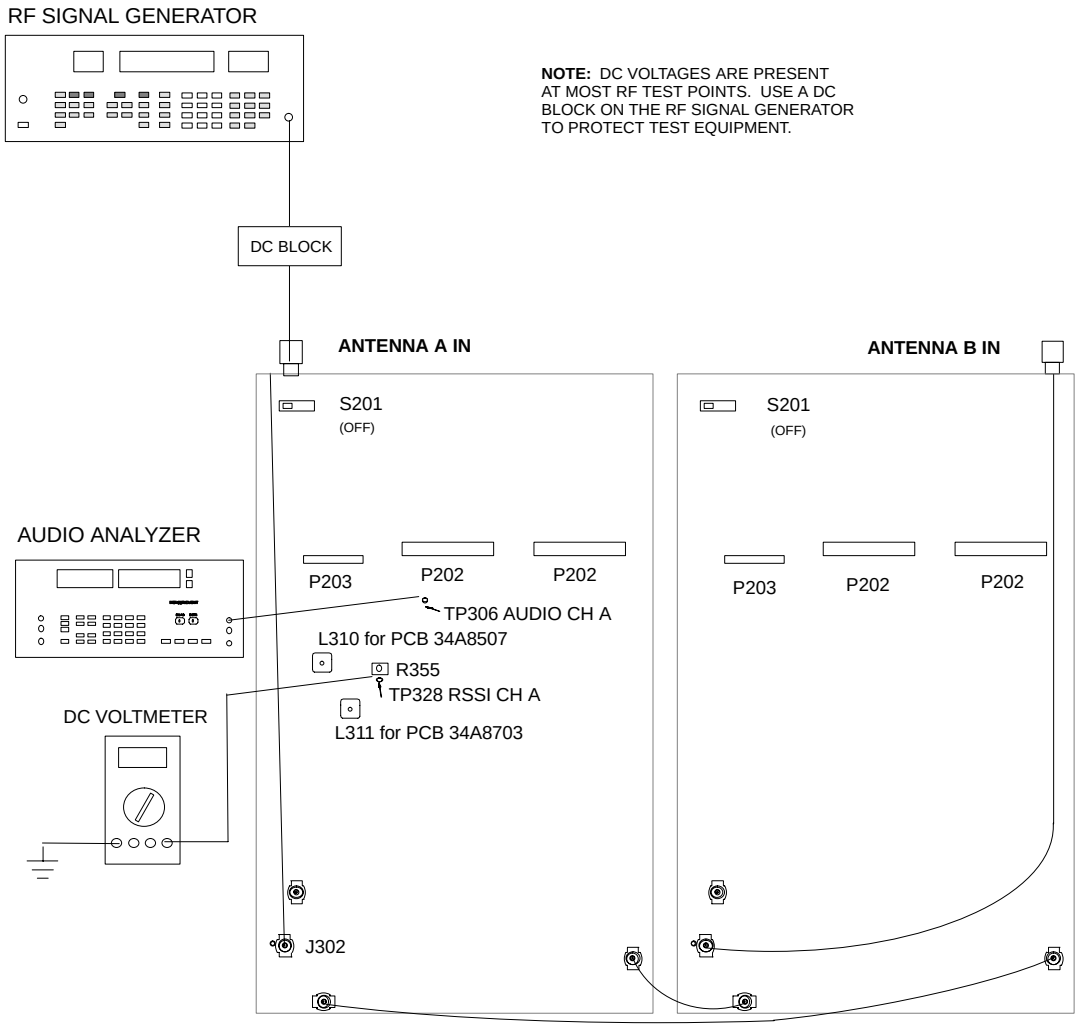


Figure 9. Channel A RSSI Alignment

1. Change the rf signal generator Level to –50 dBm.
2. Measure the total harmonic distortion (THD) at TP306 (U305 pin 7). It should be less than 0.5%. If not adjust L310 for PCB version 34A8507 or adjust FL311 for PCB version 34A8703 to minimize the distortion.
3. Adjust R355 for Vrssi at the wiper (TP328). The Vrssi should be 2.75 ± 0.1 Vdc for 34A8507F and earlier PCB versions.The Vrssi should be 2.3 ± 0.1 Vdc for 34A8507G and later versions of the board and the 34A8703 PCB version.

Noise Set-Up (Channel A)

The Noise Setup procedure aligns each channel so that for a given signal-to-noise ratio, the respective dc levels match.

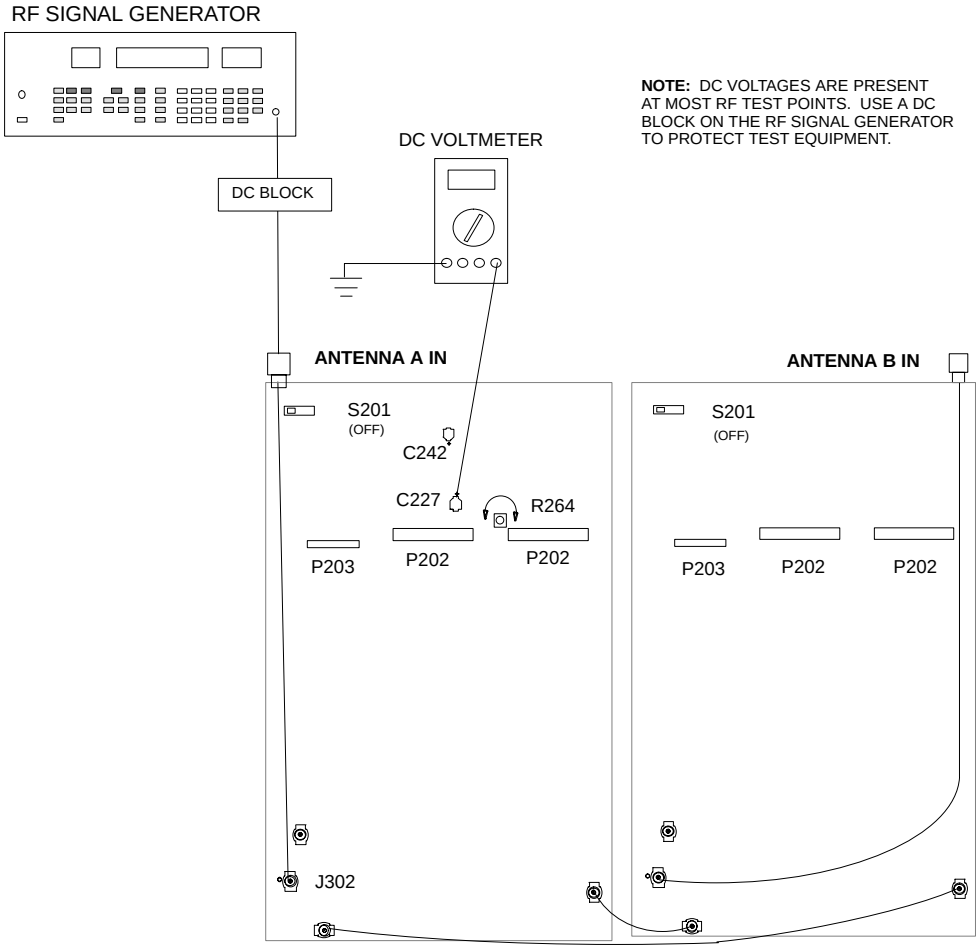


Figure 10. Channel A Noise Setup Connections

1. Set the modulating frequency from the audio analyzer to 60 kHz and, if necessary, readjust the amplitude so HI EXT and LO EXT lights turn off. Use amplitude increments of 10 to 100 mV.
2. Verify that the rf signal generator power is –61 dBm.
3. Place the (+) terminal of a dc voltmeter on the (+) side of C227 and connect the (–) terminal to ground.
4. For 34A8507F or earlier PCB versions, adjust R337 (not shown above) until the voltmeter reads 8.00 ± 0.03 Vdc. For 34A8507G or later PCB versions and PCB 34A8703, adjust R264 to 4.00 ± 0.03 Vdc.

FM Detector Quadrature Coil Alignment (Channel B)

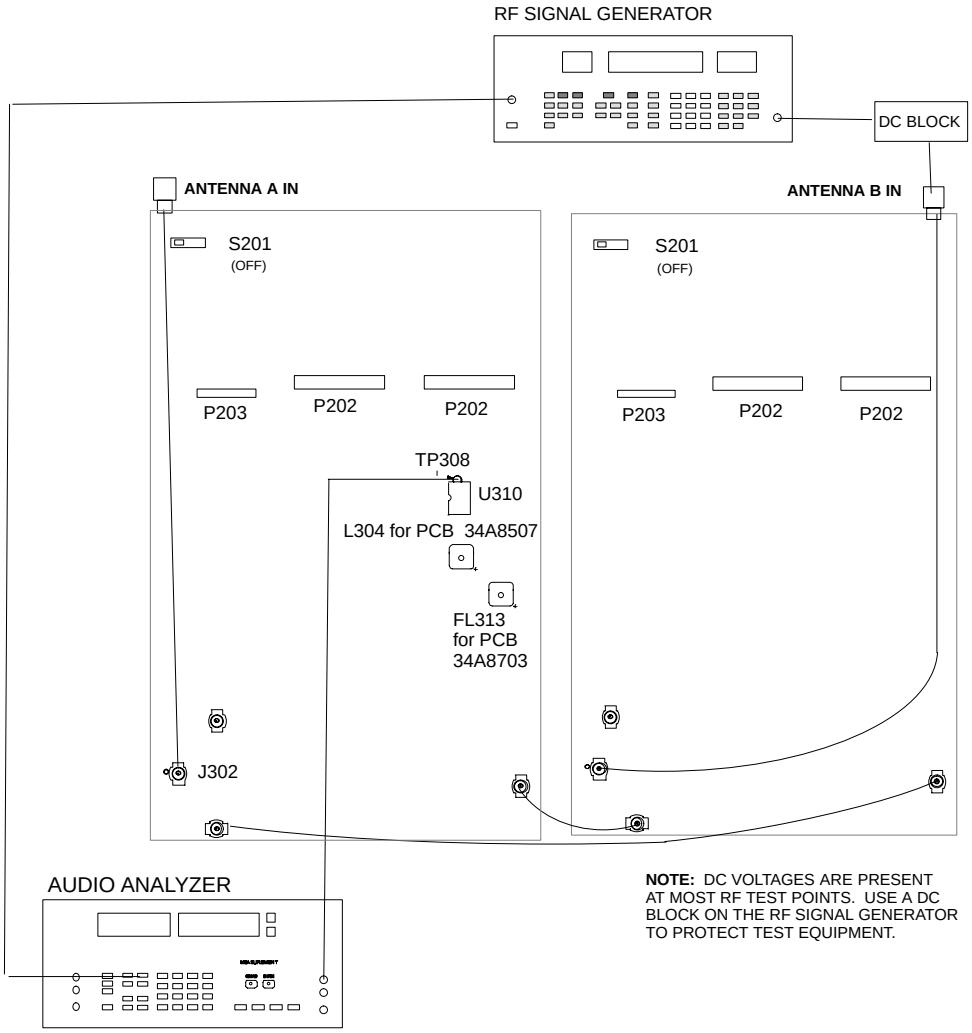


Figure 11. Channel B FM Detector Quadrature Coil Alignment

1. Set the rf signal generator Level to –86 dBm and the Deviation as follows. If necessary, readjust the amplitude so HI EXT and LO EXT lights turn off.

   UA, UB,MA, MB, MC, MD: 45 kHz deviation at 1 kHz modulation

   KK: 40 kHz deviation at 1 kHz modulation

   II: 28 kHz deviation at 1 kHz modulation

2. Connect the rf signal generator to the ANTENNA B input.
3. Connect the audio analyzer to U310, pin 7 (TP308).
4. For PCB version 34A8507 tune L304 for maximum audio output at TP308.For PCB version 34A8703 tune FL313 for maximum audio output at TP308. The low limit is 250 mVrms. There is no high limit.

Second Mixer Coil Adjustment (Channel B)

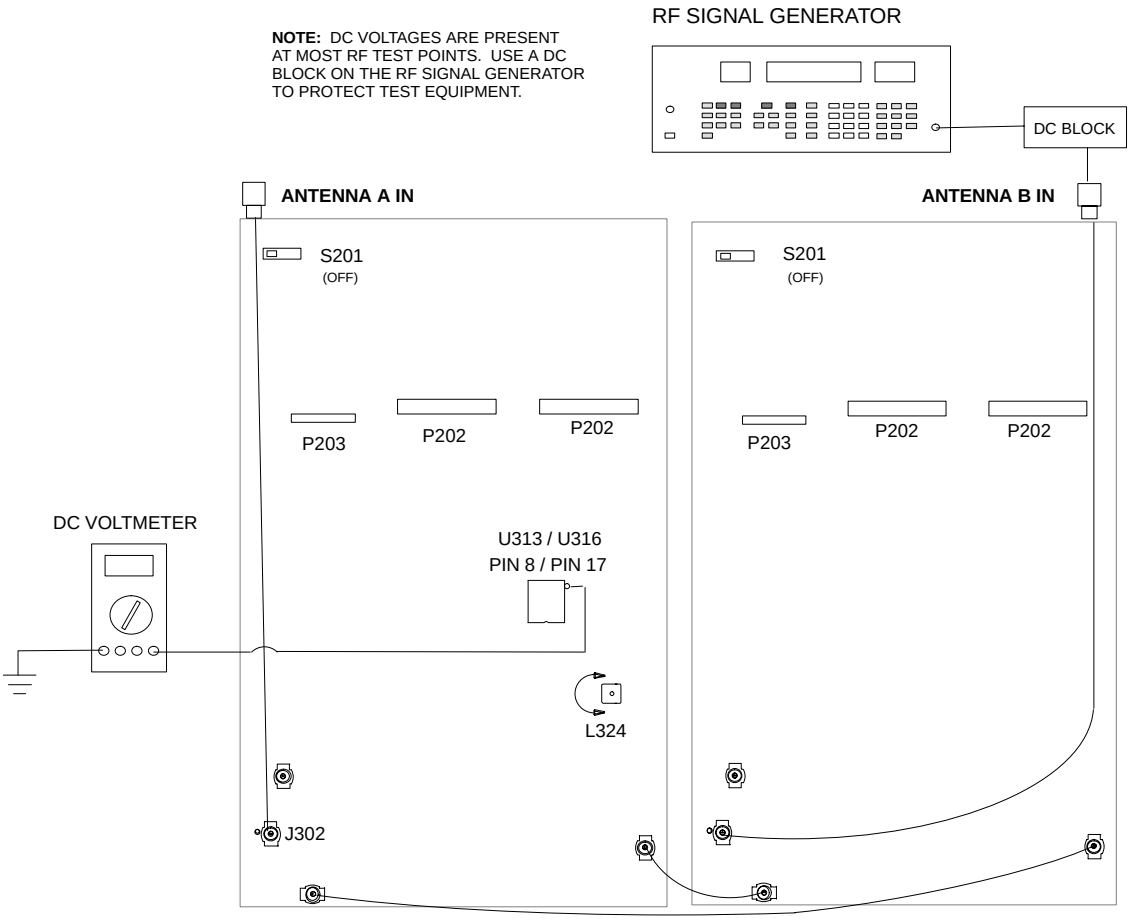


Figure 12. Channel B Second Mixer Coil Adjustment Connections

1. Change the rf input level to –105 dBm.
2. Adjust L324 for maximum dc voltage at U313 pin 8 for PCB version 34A8507 or at U316 pin 17 for PCB version 34A8703.

THD Verification and RSSI Adjustment (Channel B)

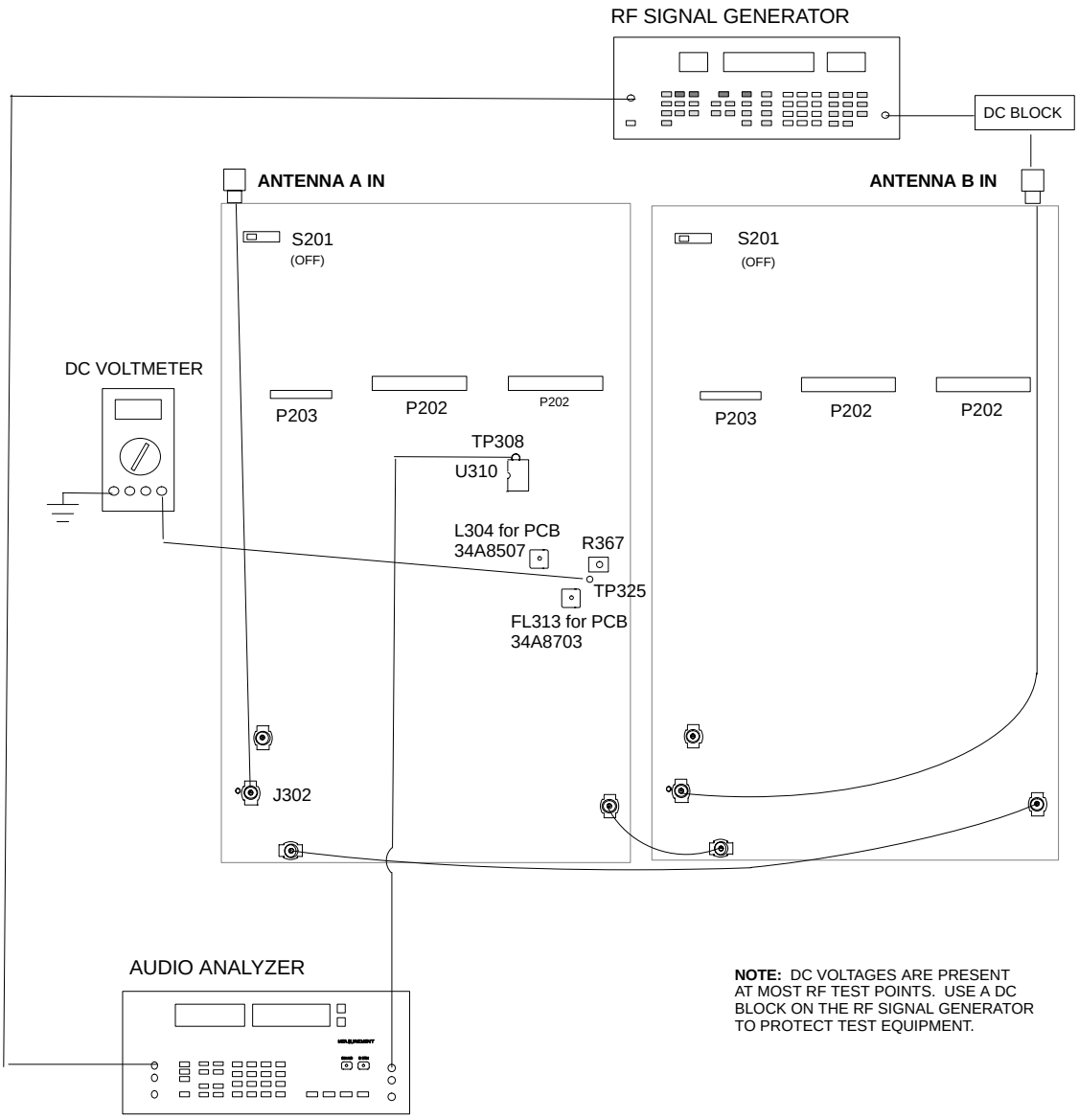


Figure 13. Channel B RSSI Alignment Connections

1. Change the rf signal generator level to –50 dBm.
2. Measure the total harmonic distortion (THD) at TP308 (U310 pin 7) should be less than 0.5%. If not adjust L304 for PCB version 34A8507 or adjust FL313 for PCB version 34A8703 to minimize the distortion.
3. Adjust R367 for Vrssi at the wiper (TP325). The Vrssi should be 2.75 ± 0.1 Vdc for 34A8507F and earlier PCB versions.The Vrssi should be 2.3 ± 0.1 Vdc for 34A8507G and later versions of the board and the 34A8703 PCB version.

Noise Setup (Channel B)

The Noise Setup procedure aligns each Channel so that for a given signal-to-noise ratio, the respective dc levels match.

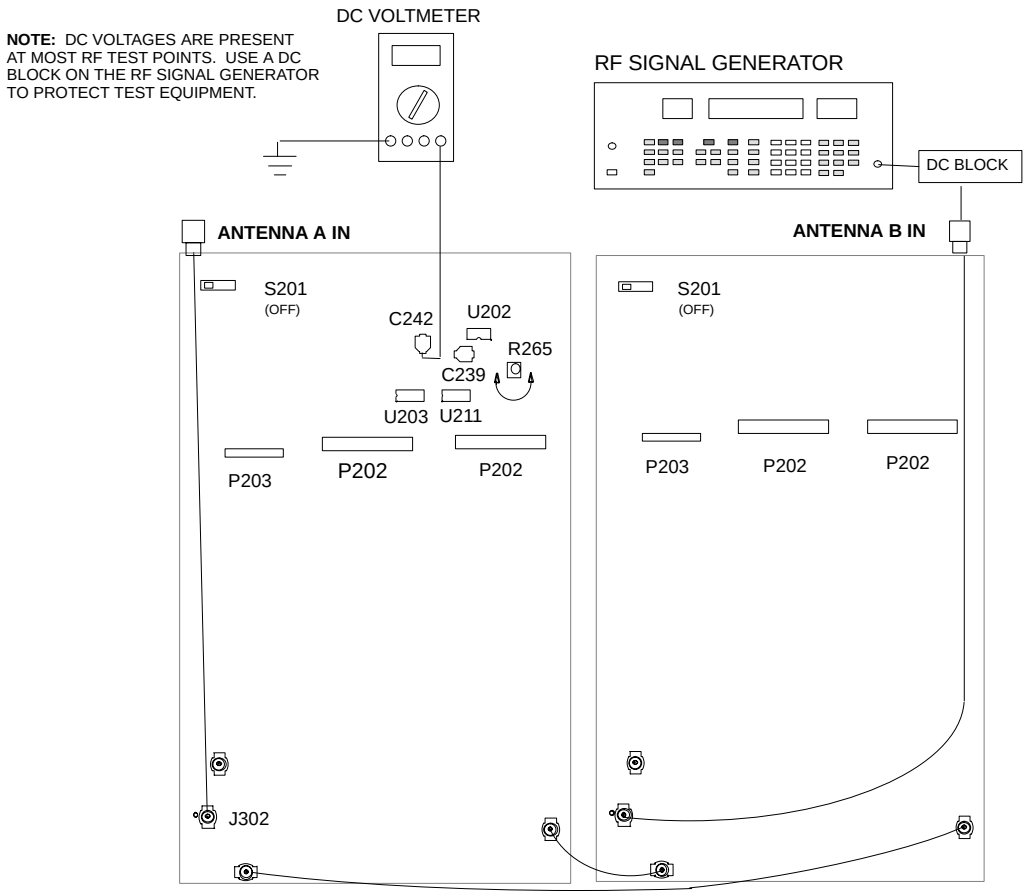


Figure 14. Channel B, Noise Setup Connections

1. Set the modulating frequency from the audio analyzer to 60 kHz and, if necessary, readjust the amplitude so HI EXT and LO EXT lights turn off.
2. Verify that the rf signal generator output power is –61 dBm.
3. Place the (+) terminal of a dc voltmeter on the (+) side of C242 and connect the (–) terminal to ground.
4. For 34A8507F or earlier PCB versions, adjust R389 (not shown above) until the voltmeter reads 8.00 ± 0.03 Vdc. For 34A8507G or later PCB versions and PCB 34A8703, adjust R265 to 4.00 ± 0.03 Vdc.

Audio Level Setup, Channel B

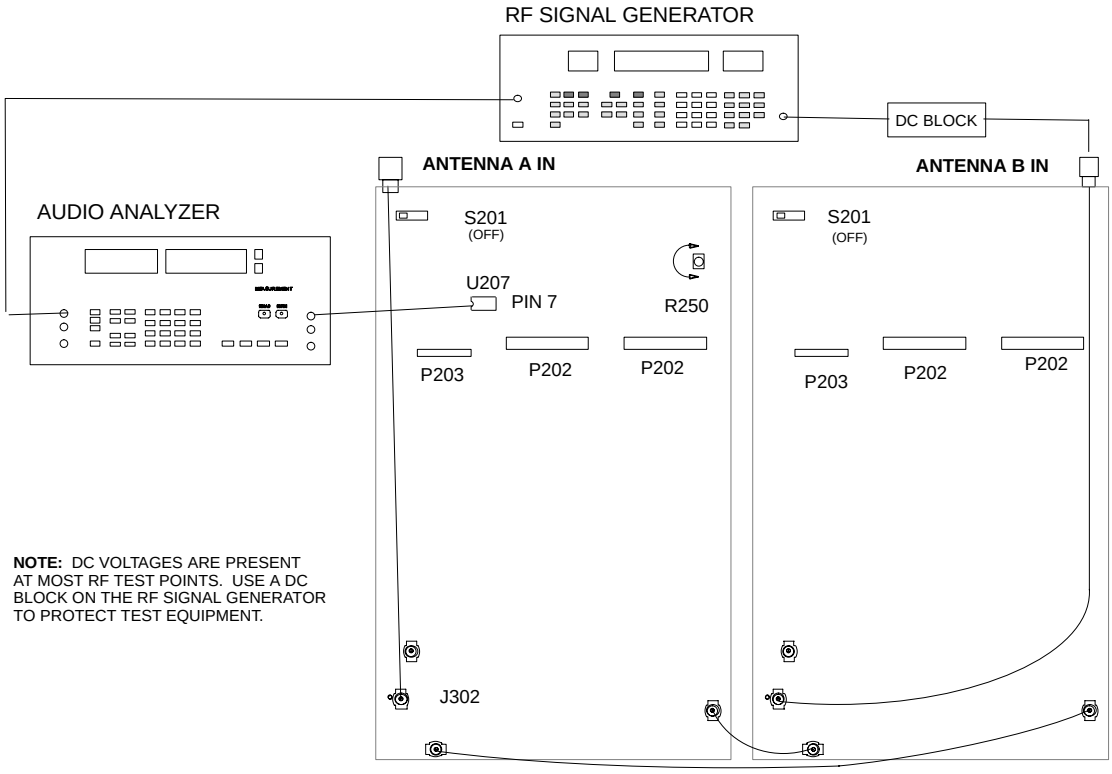


Figure 15. Channel B Audio Level Setup Connections

For the following test, make sure the tone key switch (S201) is OFF.

All Models (Except II and KK Models)

1. Change the modulating frequency out of the audio analyzer to 1 kHz with deviation set to 45 kHz. If necessary, readjust the amplitude so that the HI EXT and LO EXT lights turn off.
2. Place the (+) terminal of the audio analyzer on U207, pin 7, and connect the (–) terminal to ground.
3. Adjust R250 until the audio analyzer reads 0.436 ± 0.005 Vrms.

II Models (Japan)

1. Set the rf signal generator's deviation to 28.0 kHz and the modulating frequency to 1 kHz.
2. Place the (+) terminal of the audio analyzer on U207, pin 7, and connect the (–) terminal to ground.
3. Adjust R250 until the audio analyzer reads 0.282 ±. 003 Vrms.

KK Models (United Kingdom)

1. Set the rf signal generator's deviation to 40.0 kHz and the modulating frequency to 1 kHz.
2. Place the (+) terminal of the audio analyzer on U207, pin 7, and connect the (–) terminal to ground.
3. Adjust R250 until the audio analyzer reads 0.436 ±. 003 Vrms.

Audio Level Setup, Channel A

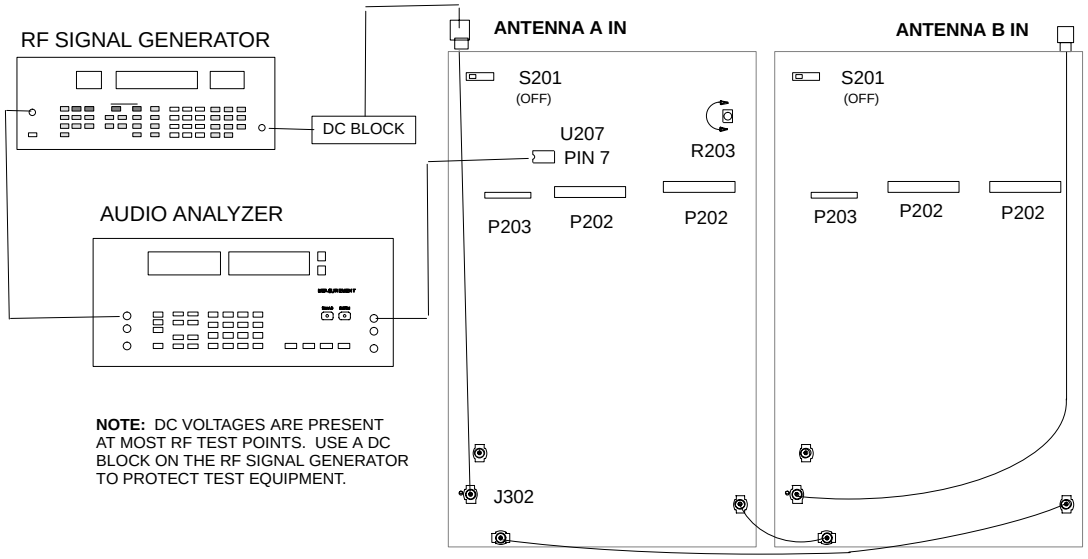


Figure 16. Channel A Audio Level Setup Connections

For the following test, make sure the tone key switch (S201) is OFF.

All Models (Except II and KK Models)

1. Set the rf signal generator deviation to 45 kHz and modulating frequency to 1 kHz.
2. Connect the rf signal generator to BNC connector ANTENNA A IN on the receiver back panel.
3. Place the (+) terminal of the audio analyzer on U207, pin 7, and connect the (–) terminal to ground.
4. Adjust R203 until the audio analyzer reads 0.436 ± 0.005 Vrms.
5. Disconnect the rf signal generator from the BNC connector ANTENNA A IN on the receiver back panel.

II Models (Japan)

1. Set the rf signal generator deviation to 28 kHz and modulating frequency to 1 kHz.
2. Connect the rf signal generator to BNC connector ANTENNA A IN on the receiver back panel.
3. Place the (+) terminal of the audio analyzer on U207, pin 7, and connect the (–) terminal to ground.
4. Adjust R203 until the audio analyzer reads 0.282 ±. 003 V.
5. Disconnect the rf signal generator from the BNC connector ANTENNA A IN on the receiver back panel.

KK Models (United Kingdom)

1. Set the rf signal generator's deviation to 40.0 kHz and modulating frequency to 1 kHz.
2. Connect the rf signal generator to BNC connector ANTENNA A IN on the receiver back panel.
3. Place the (+) terminal of the audio analyzer on U207, pin 7, and connect the (–) terminal to ground.
4. Adjust R203 until the audio analyzer reads 0.436 ±. 003 V.
5. Disconnect the rf signal generator from the BNC connector ANTENNA A IN on the receiver back panel.

Tone Key Filter Alignment

Reinstall the antennas for the Tone Key Filter Alignment procedure.

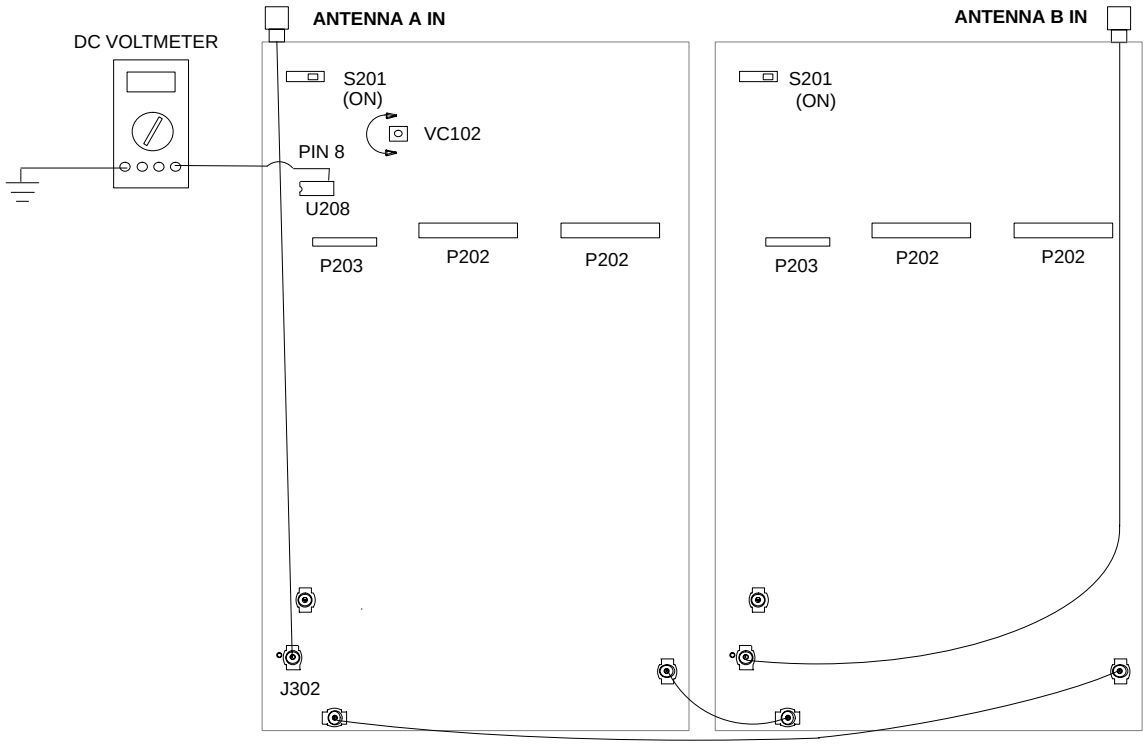


Figure 17. Tone Key Filter Alignment Connections

For the following test, make sure the tone key switch (S201) is ON.

1. Turn the tone key switch (S201) to the ON position.
2. Turn the rf signal generator output OFF.
3. Be sure to reinstall the antennas.
4. Program a UHF transmitter (U1 or U2) to the same Group and Channel as the receiver.
5. Place the transmitter within 1.75 – 3.25 m (5 – 10 ft.) of the receiver.
6. Adjust VC102 for the maximum dc voltage at U208, pin 8.

Receiver 1 Alignment is now completed.

U4D Receiver 2 Alignment

The Receiver 2 alignment procedure is identical to the Receiver 1 alignment procedure.

However, for the Receiver 2 alignment procedure refer to Antenna B alignment procedures each time Antenna A is called out and refer to Antenna A procedures each time Antenna B is called out.

Replacement Parts and Drawings

U4D Model Variations

Different frequency versions of the U4D receiver are currently available for use in various countries. Each version is identified in the table below by country code, frequency range, and printed circuit board version.

Table 3
U4D Model Variations

COUNTRY CODE	FREQUENCY RANGE	COUNTRY DESIGNATION	RF-AUDIO PC BOARD NUMBER
UA	782–806 MHz	U.S.A. and Canada	90UA8902
UB	692–716 MHz	U.S.A.	90UB8902
MA	782–810 MHz	Germany	90MA8902
MB	800–830 MHz	Europe	90MB8902
M3	692–716 MHz	Europe	90M38902
R7	782–810 MHz	Europe	90R78902
R2	800–830 MHz	Europe	90R28902
MC	774–782 MHz	Netherlands	90MC8902
R3	774–782 MHz	Netherlands	90R38902
MD	To create an MD board, order the 90MB8902 PCB and install the MD EEPROM (188R131MD).		
II	806–810 MHz	Japan	90II8902
JB	806–810 MHz	Japan	90JB8902
KK	854–862 MHz	United Kingdom	90KK8902
R6	800–820 MHz	Scandanavia	90R68902
S2	838–862 MHz	England	90S28902

Note: The PC board number is a family panel part number which includes the main PCB and the front panel digital PCB.

Parts Designations

The following comments apply to the parts list and the schematic:

Resistors: Unless otherwise noted, all resistors are surface-mount with $^{1}/_{10}$ W rating and 1% tolerance.

Capacitors: Unless otherwise noted, non-polarized capacitors are surface-mount NPO dielectric types with a 100 V capacity and a 5% tolerance, and polarized capacitors are tantalum types.

Table 4
U4D Receiver Replacement Parts

Reference Designation	Description	Shure Part Number
A1	Ac ground wire assembly	90A8677
A2	Ac wire assembly (brown)	90A8678
A3	Ac wire assembly (blue)	90B8678
A4	BNC cable assembly (13–inch)	95C8418
A5	BNC cable assembly, mini pin (17 3/4–inch)	95D8418
A6	Cable assembly, mini pin jumper (11 3/4 inch)	95B8277
A7	Cable assembly, mini pin jumper (3 inch)	95F8277
A8	Cable assembly, ribbon cable (12 inch, 5 pin)	95A8661
A9	Cable assembly, ribbon cable (18 inch, 5 pin)	95B8661
A10	Cable assembly, ribbon cable (7 inch, 22 pin), 2	95A8662
A11	Cable assembly	90B8850
A12	Knob assembly, master (J or earlier version boards)	90A8652
A13	Knob assembly, master (K or later version boards), 2	90A8747
A14	LED backlight display panel assembly, 2	90A8651
A15	Printed circuit board assembly, rf-audio/digital display	90_8901
A16	Printed circuit board assembly, monitor	90A8635G
A17	Printed circuit board assembly, network	90A8629C
A18	Wire assembly	90A8682
MP1	Actuator, pair (J or earlier board versions)	66A8039
MP2	Actuator, pair (K or later board versions)	66B8045
MP3	Actuator, pair, up/down (J or earlier board versions)	66B8042 (no longer available)
MP4	Actuator, pair, up/down (K or later board versions)	66B8044
MP5	Bezel, transparent	65A8404
MP6	Bezel insert, printed, 2	65B8253
MP7	BNC female bulkhead chassis mount connector	95A8647
MP8	Bracket, 2	53A8440
MP9	Connector housing	65E1235
MP10	Conductive gasket, 11.75 in. (29.8 cm)	80D8198
MP11	Conductive gasket, 15.2 in. (36.8 cm)	80E8198
MP12	Front panel (For UA, UB, MA, & II Bands)	48A8027
MP13	Front panel (For M3, R2, R3, R6, R7, & S2)	48B8027
MP14	Knob, headphone	95A8638
MP15	Liquid crystal display	95B8571
MP16	Phone and power board interconnect cable	90B8848
MP17	Power entry module	95A8577
MP18	Power supply, switching	95A8603
MP19	Rocker switch	55B8100
MP20	Screwlock, #4 – 40	95W8655
MP21	Shield	53A8460
MP22	Hardware Kit	90VL1371
MP23	508 mm (20 in.) BNC cable	95A2035
MP24	Power cord	95A8380

U4D Receiver Replacement Parts (Continued)

Reference Designation	Description	Shure Part Number
MP25	Daisy chain power cord	95A8576
MP26	AC ground wire	90A8677
MP27	Standoff	80A8094
MP28	Cover	53B8433
MP29	Antenna	UA820A

Table 5
Digital Display Printed Circuit Board Replacement Parts, Non-SMT Components, Side 1

Reference Designation	Description	Shure Part Number
J101, 103	Receptacle assembly, 25 position	95A8583
J104	Shrouded header, 2 position	95A8272
P102	Cable assembly, plug/socket	95B8663
R110	Potentiometer, 10k	46A8069
U105	Dot/Bar display driver	86A8941

Table 6
Digital Display Printed Circuit Board Replacement Parts, SMT Components, Side 1

Reference Designation	Description	Shure Part Number
D101, 102, 112, 113, 118, 119	SMD LED, green	184D18
D103	SMD LED, red	184A18
D104, 105, 106, 107, 108, 109, 110, 111, 114, 115, 116, 117	SMD LED, yellow	184F18
R110	Potentiometer (G and earlier board versions)	46A8048
R110	Potentiometer (H and later board versions)	46A8069
SW101, 102, 103, 104	Switch, pushbutton, SPST	155A03
U101	Analog–digital converter, 8 bit	188A183
U102, 104	Dot /bar display driver	188A86
Y101	Crystal, SMT, 4 MHz	140A005

Table 7
U106 EPROM Table

Country Code	Shure Part Number
UA	188R131UA
UB	188R131UB
MA	188R131MA
MB	188R131MB
MC	188R131MC
MD	188R131MD
II	188R131II
KK	188R131KK

Table 8
Network Interface Printed Circuit Board Replacement Parts, Non-SMT Components, Side 1

Reference Designation	Description	Shure Part Number
P201, 202	Header, dual row	95A8660
P203	Header, single row, 5 position	95A8659

Table 9
Monitor Printed Circuit Board Replacement Parts, SMT Components, Side 1

Reference Designation	Description	Shure Part Number
U201, 202, 204, 205, 207	Dual Op Amp	188A18

Table 10
RF–Audio Printed Circuit Board Replacement Parts, Non–SMT Components, Side 1

Reference Designation	Description	Shure Part Number
C238	Electrolytic capacitor, 10 µF x 80 V	86AS629
C243, 247	Electrolytic capacitor, 47 µF x 63 V	86BE629
FL301, 305, 306, 307, 308, 309, 319, 320	Ceramic filter	86A8971
FL304, 312	Saw filter	80A8195
J203, 216	Header, 6 pin	95A8363
J209	Phone jack, 1/4–inch	95Z8322
J211	XLR connector, male	95A8400
J301, 302, 303, 304	Jack, mini pin	95A8278
L302	Coil, tunable	82A8026
L304, 310	Coil, quadrature (For PCB versions 34A8507)	82A8004
FL311, FL313	Coil, quadrature (For PCB versions 34A8703)	82A8004
L313, 324	Coil, tunable	82A8025
P201, 202	Header, dual row	95A8660
P203	Header, single row, 5 position	95A8659
R203, 250, 265, 531	SMD trim potentiometer, 1k	146B02
R355, 367	SMD trim potentiometer, 5k	146D02
S201	Switch, slide	55A8087
S202	Switch, slide, DPDT, right angle	55A8061
Y201	Crystal, tone key, 32.76 kHz	40A8010
Y301	Crystal, leaded, 60.7 MHz	40A8013

Table 11
RF–Audio Printed Circuit Board Replacement Parts, SMT Components, Side 1

Reference Designation	Description	Shure Part Number
D201,202, 203, 204, 205, 210	SMD, switching diode	184A08
F300, 301	Polyswitch, SMD fuse	187A05
FL340, 341	Filter, SMD, low-pass	162A17
L201, 202, 203, 204, 205	Ferrite bead, SMD	162A03
L206, 311, 327, 336	Inductor, SMD, 82 nH	162F06
L208, 209	Inductor, SMD, 180 nH	162D06
L300, 301	Inductor, SMD, 22nH	162C06
L301–303, 306, 307, 309, 312, 314, 315, 318, 322, 329, 343, 344, 345, 347, 348	Ferrite bead, SMD	162A12
L335, 337	Inductor, SMD, 15 nH	162B10
Q201, 202	SMD transistor	183A38
Q301, 307	Monolithic microwave IC amplifier	183A37
Q308	SMD transistor	183A24
R202	Potentiometer	46A8059
R203, 250, 264, 265, 531	Potentiometer, SMD, Trim	146B02
R355, 367	Potentiometer, SMD, Trim	146D02
U201, 202, 204, 205, 207, 210, 212, 213, 216, 220, 305, 310	Dual Op Amp	188A18
U203, 208	Comparator, SMD, quad	188A123
U206	Compander, low voltage	188A126
U209	IC, muting	188A105
U211	Switch, quad, analog	188A19
U214	SMD transistor	183A30
U215	Digital–analog converter	188A201
U301, 314	Power spllitter	161A02
U302, 312	IC, monolithic linear	188A128R
U303, 313	detector, FM IF (For PCB versions 34A8507)	188A190
U315, U316	detector, FM IF (For PCB versions 34A8703)	188A129
U304, 311	Low current LNA/Mixer	188A127
U307	Voltage regulator, 5V	188A115
U309	PLL Frequency Synthesizer	188A134
VC101,102	Trim capacitor, SMT	152D02
Y302	Crystal, SMT, 24 MHz (G and earlier versions)	140A12
Y302	Crystal, leaded, 24 MHz (H and later versions)	40A8016

Table 12
RF–Audio Printed Circuit Board Replacement Parts, SMT Components, Side 2

Reference Designation	Description	Shure Part Number
L301–303, 306, 307, 309, 312, 314, 315, 318, 322, 329, 343, 344, 345, 347, 348	Ferrite bead, SMD	162A12

Table 13
VCO Selection

Country Code	UA205 VCO Range	Shure Part Number
UA MA MC	824–849 MHz	187A04
KK S2	837–863 MHz	187B04
MB MD R2	800–830 MHz	187C04
UB M3 R6	692–716 MHz	187D04
II R3 R7 JB	824–849 MHz	187A04

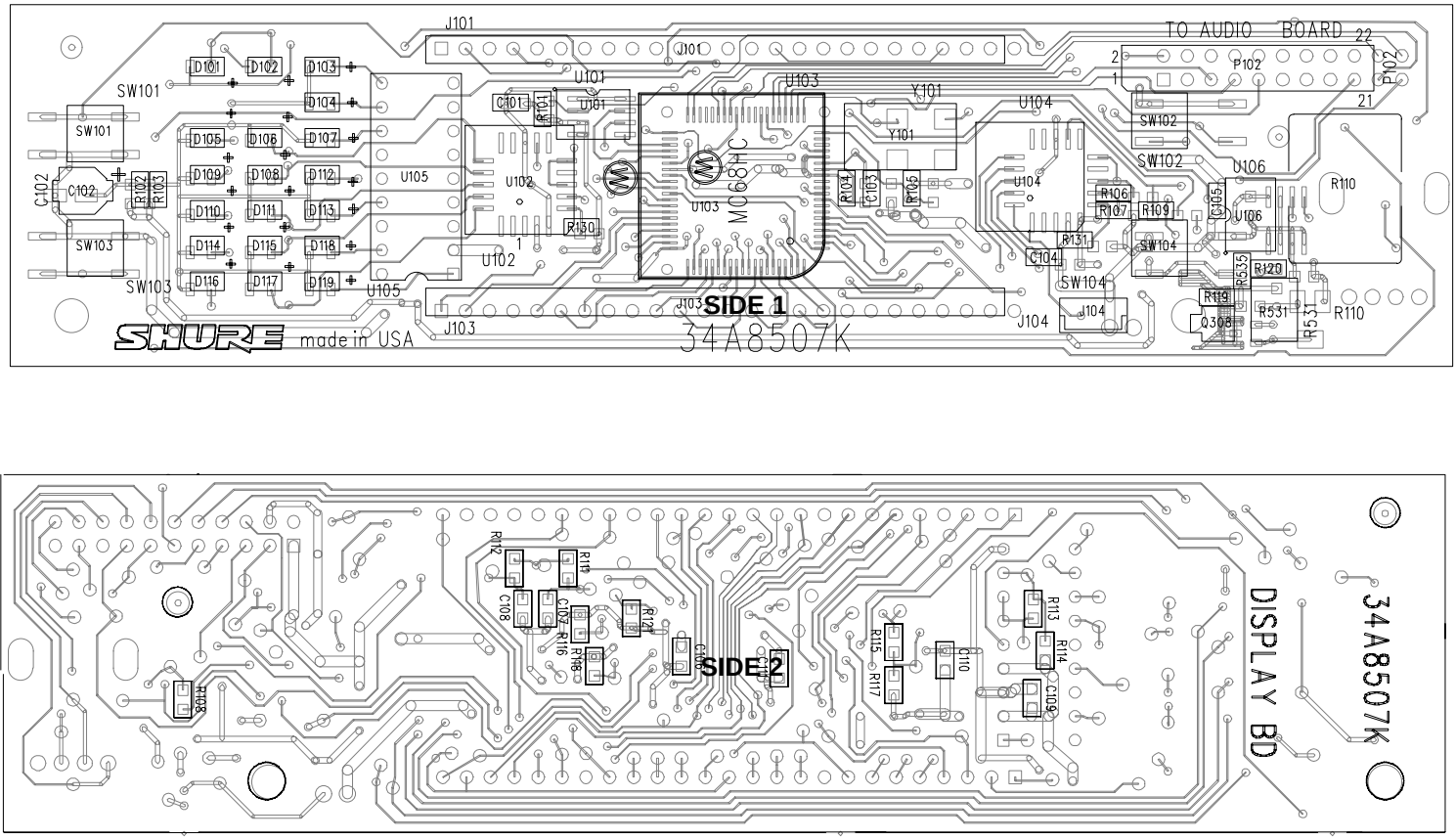


Figure 18. Digital Display Printed Circuit Board Legend

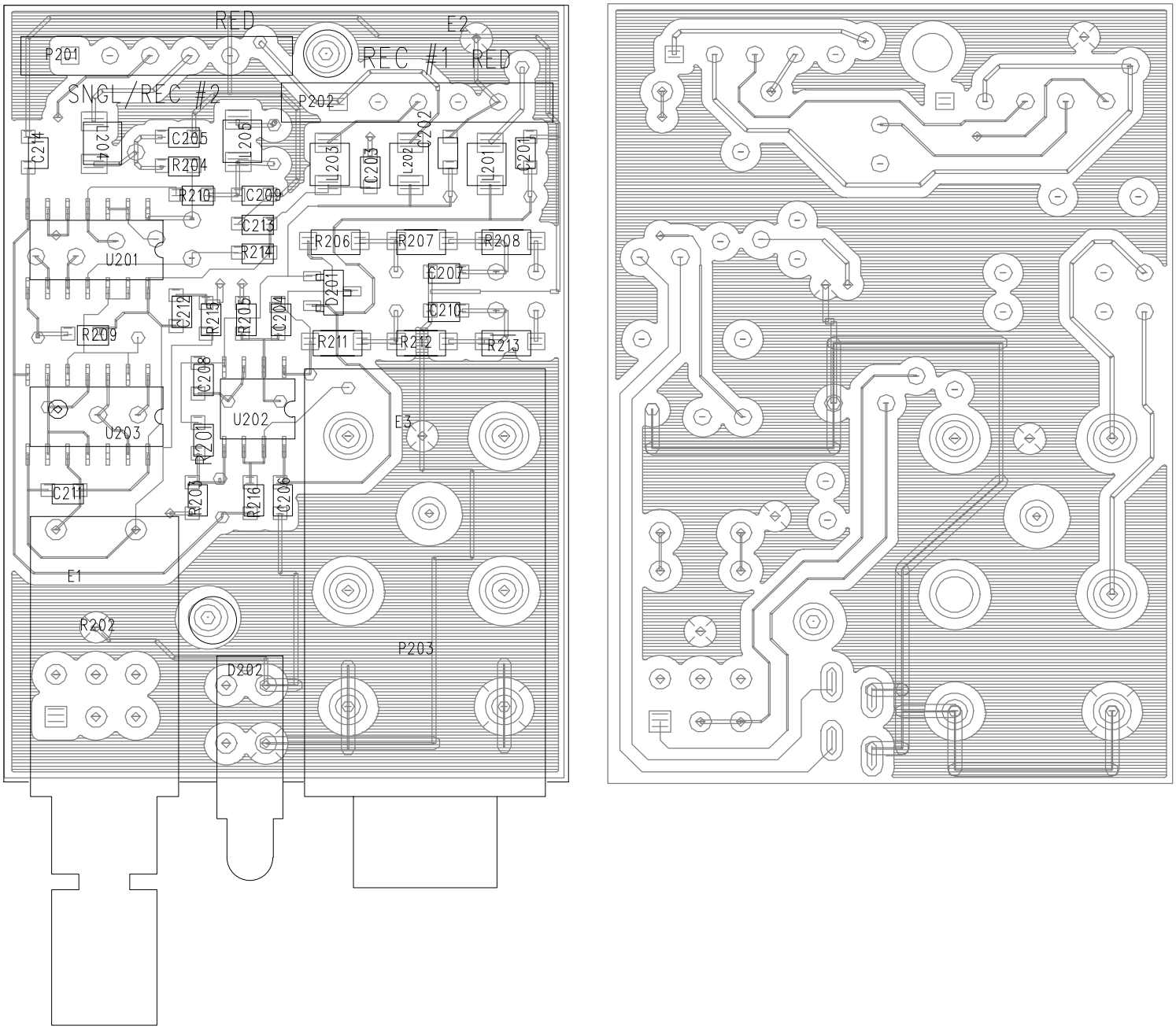
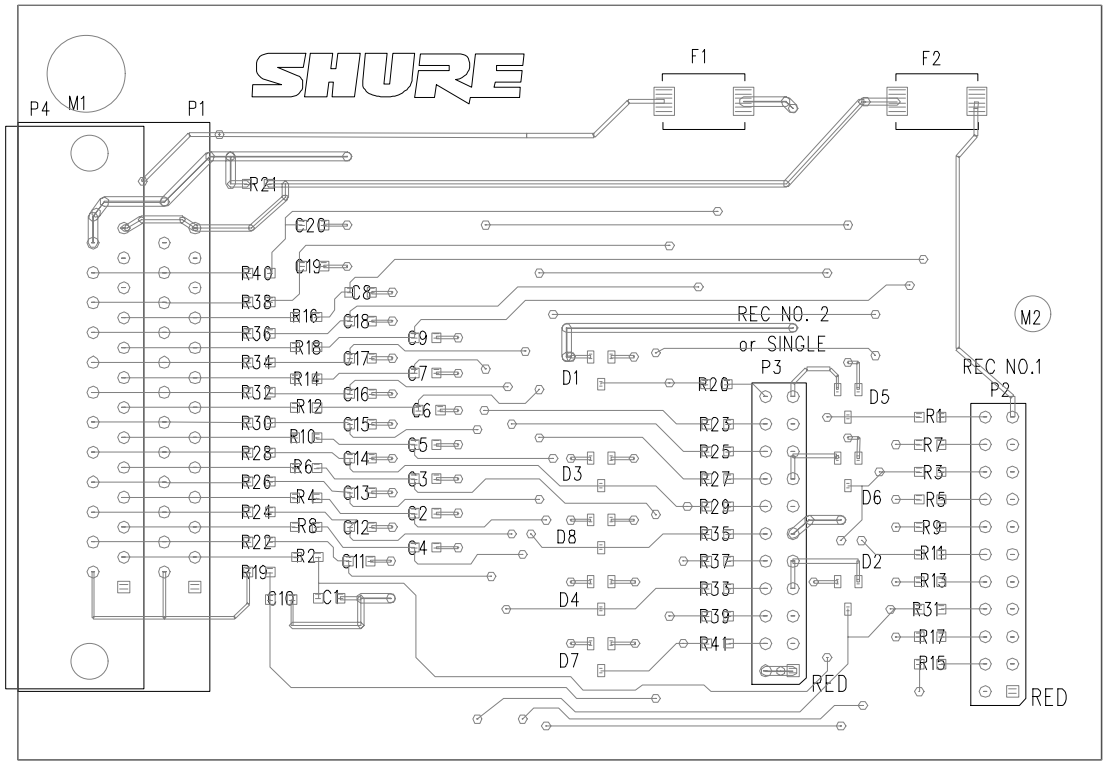
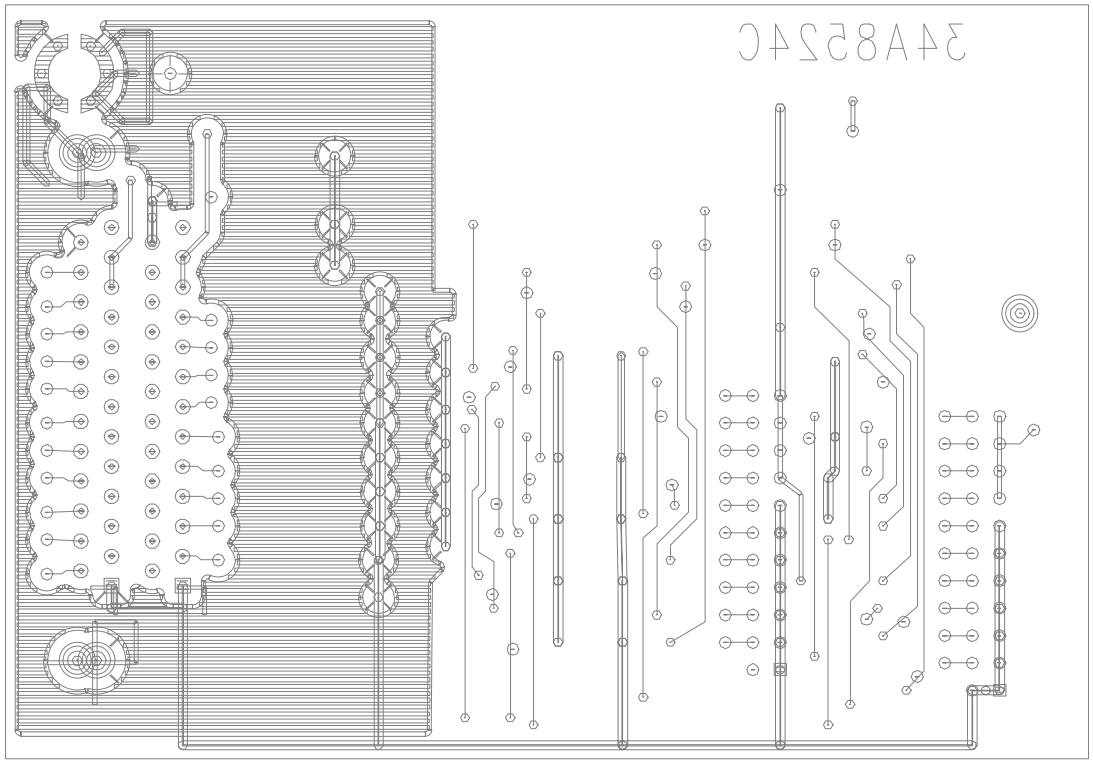


Figure 19. Headphone Monitor Printed Circuit Board Legend



SIDE 1



SIDE 2

Figure 20. Network Interface Printed Circuit Board Legend

Notes

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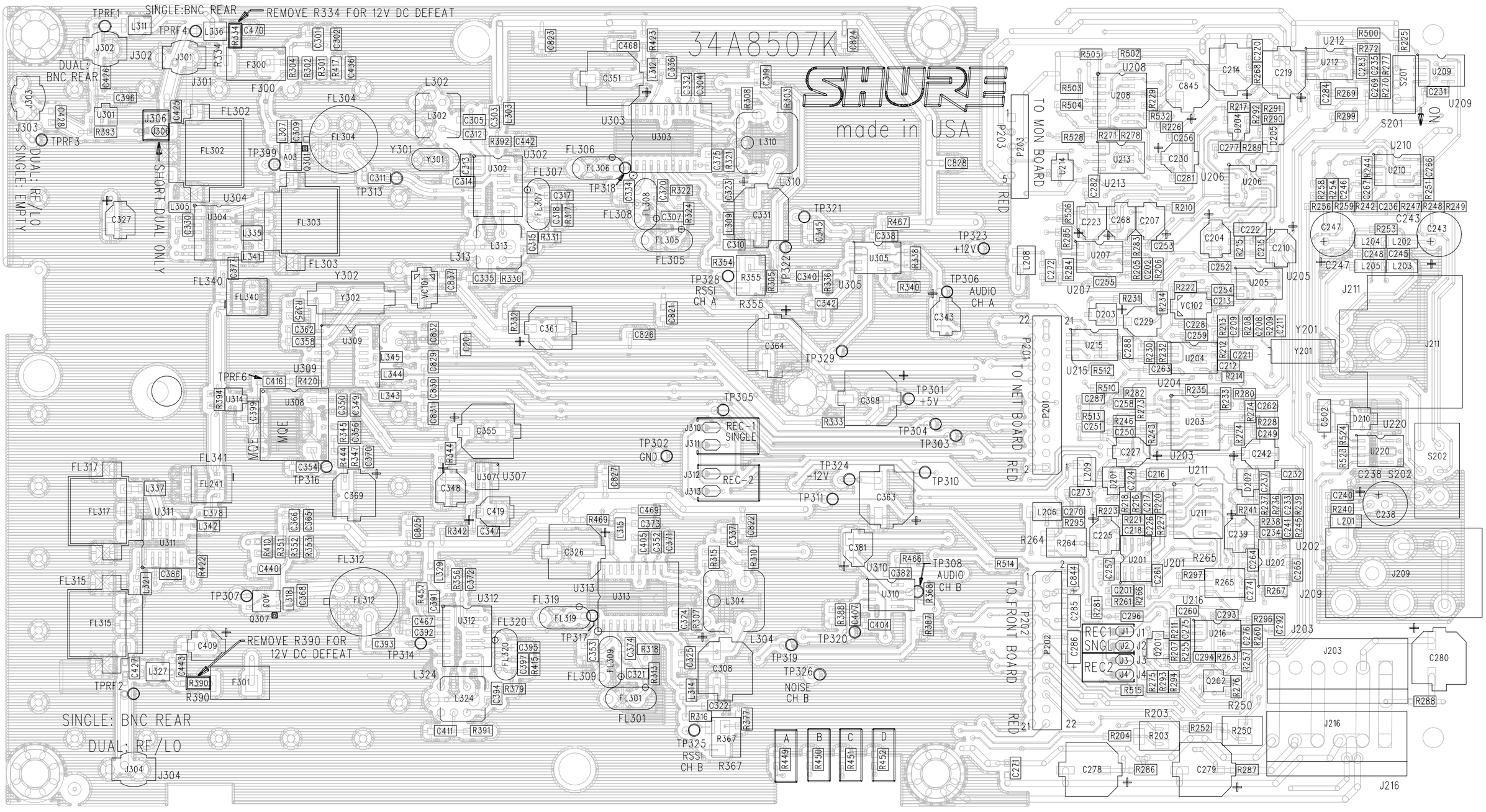
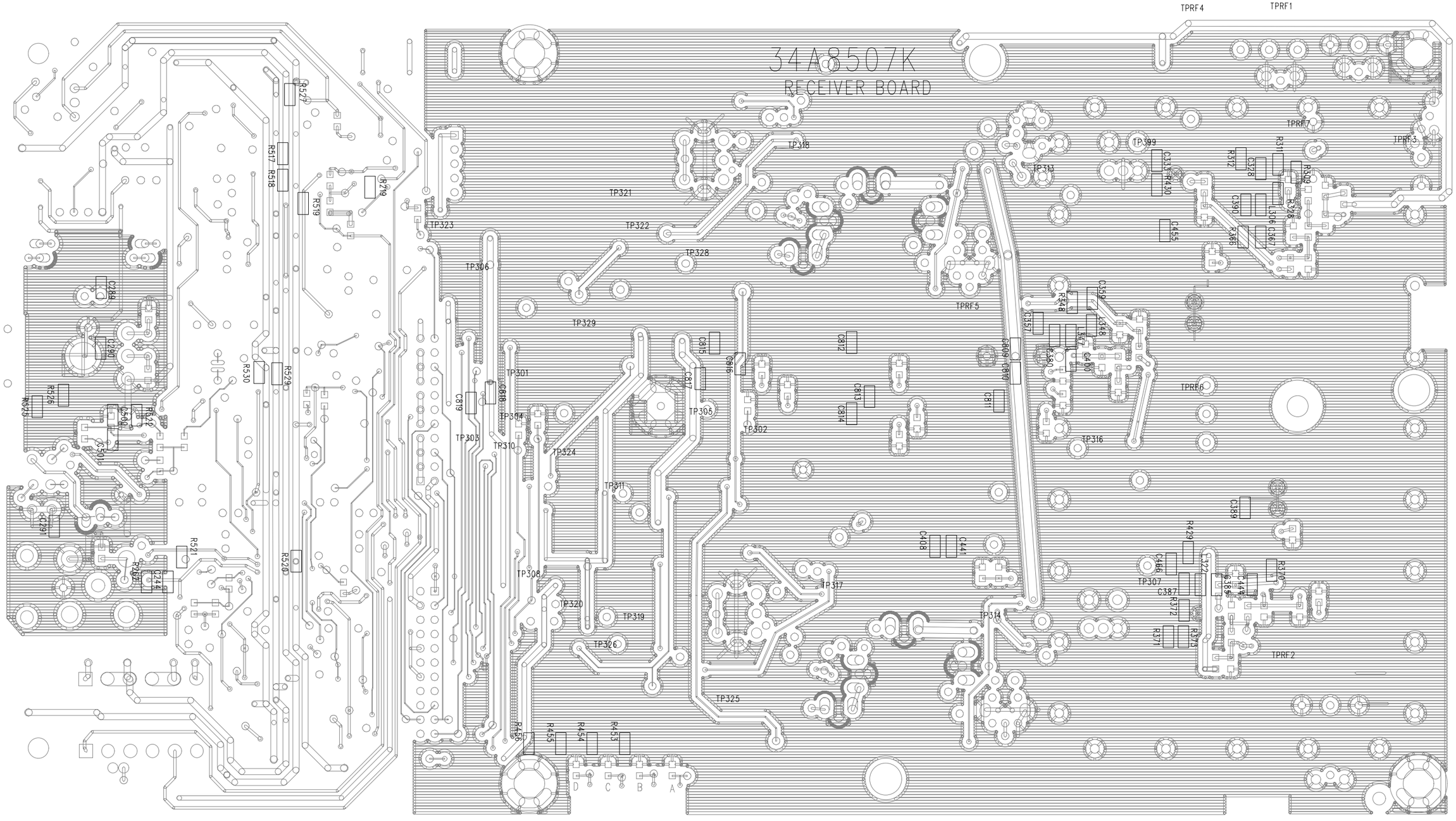


U4 Rf-Audio Printed Circuit Board Legend (Side 1)



U4 Rf-Audio Printed Circuit Board Legend (Side 2)