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UC UHF Wireless System

SERVICE MANUAL CHANGE NOTICE

UC2 UHF HAND-HELD TRANSMITTER

Changes or corrections have been made to this service manual. Update your service manual by replacing the pages listed in the table below with the ones attached to this change notice.

CHANGES EFFECTIVE [DATE]

REMOVE these pages from your current manual	INSERT the following revised pages attached to this notice
Revision 1 ALL	Revision 2 ALL
Revision 2 pages:14,15,17,20,22,27,29 and 30	Revision3 pages:14,15,17,20,22,27,29 and 30

SERVICE MANUAL REVISION HISTORY

Release	Part Number	Date Code
Original	25A1044	RI
Revision 1	25B1044	SB
Revision 2	25C1044	TB
Revision 3	25C1044	TK

SHURE®

Service Manual

UC2 Hand-Held UHF Transmitter

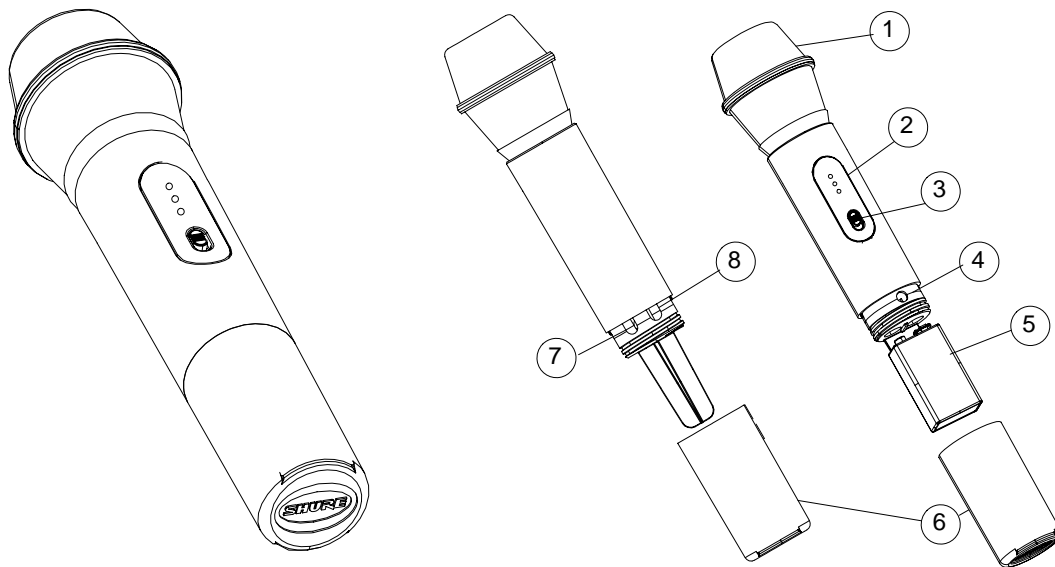
25C1044 (TK)

Characteristics

General

The Shure UC2 Hand-Held UHF Transmitter is a microprocessor-controlled microphone transmitter, operating in the 692 to 716 MHz and 774 to 862 MHz frequency range. The UC2 hand-held transmitter is used in mid-level installed sound, rental, and concert sound applications. Six frequency range variations are available.

Controls and Connectors



- | | |
|------------------------------------|------------------------------------|
| 1. Mic Cartridge Grille (87 shown) | 5. 9 V Battery |
| 2. Battery Fuel Gauge LEDs | 6. Battery Cup |
| 3. Power ON/OFF Switch | 7. Group Selection Rotary Switch |
| 4. Audio Gain Control | 8. Channel Selection Rotary Switch |

Figure 1. UC2 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.

Circuit Description

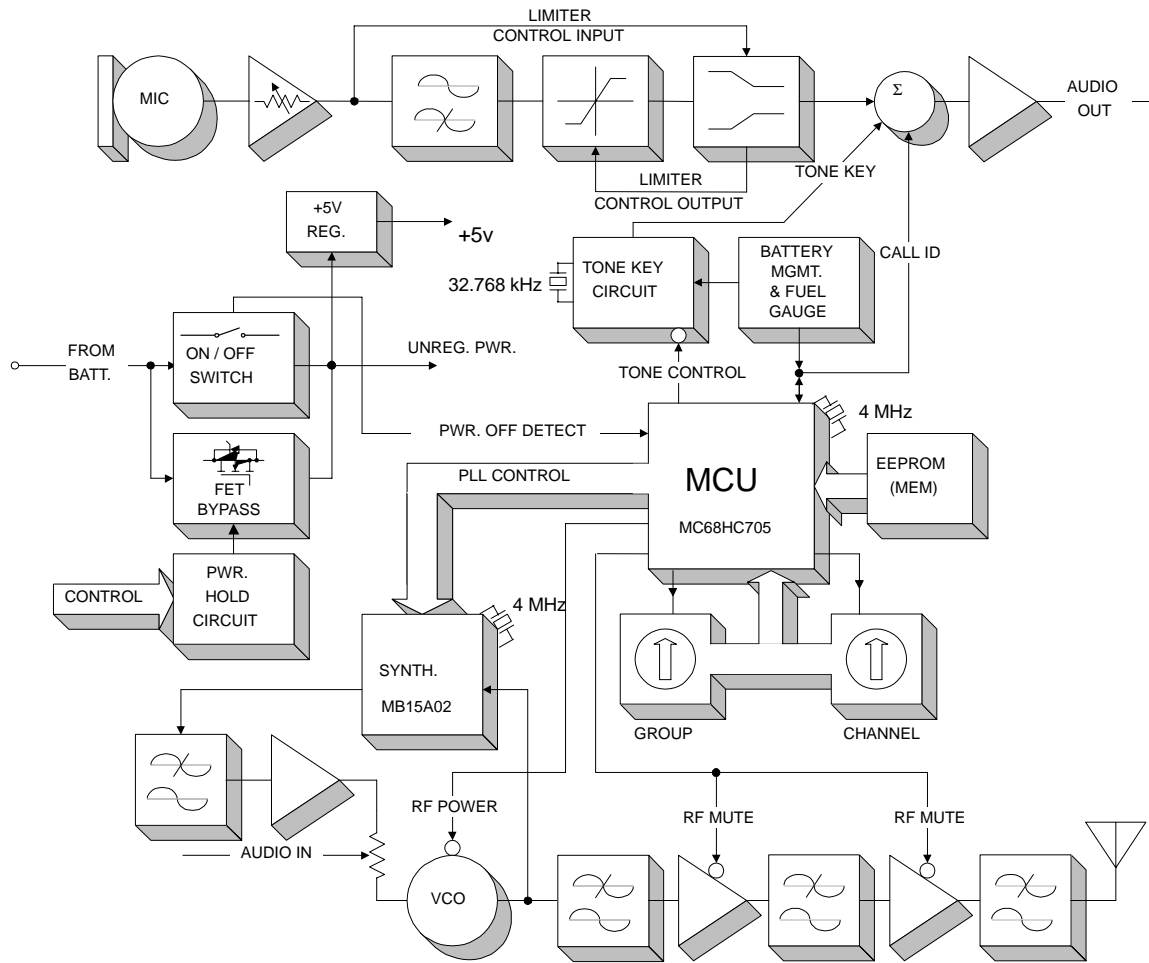


Figure 2. UC2 Hand-Held Transmitter Circuit Block Diagram

Audio Section

FCC-Approved

Audio enters L200, an inductor used as an rf choke. The signal is ac coupled through capacitor C200 into a user adjustable gain stage. Resistors R202 and R203 set up a half-supply bias, and R204 sets the input impedance for the stage.

The back-to-back diodes, D201, are used to keep the op-amp from snapping to the rail and reverse phasing when the maximum input voltage range is exceeded.

The 30 dB adjustable gain stage is built around U200A. The user externally controls the gain of this stage. C206, C207, and C208 protect

the amplifier and bias circuits from rf interference. Due to its topology, this stage is unique because it is non-inverting and allows for a gain less than unity.

Audio then enters a buffer to the pre-emphasis network and the compression stage. R213, R214, and C211 set up two corners for the pre-emphasis network. The pre-emphasis boosts the high frequencies before transmission.

This network feeds an NE575 compander, U202, that utilizes an external amplifier, U201B. The compander performs a 2:1 logarithmic compression of the audio signal. The pre-emphasis network also plays a role in setting the hinge point (0 dB gain) of the compander.

From the compressor, the processed audio enters a low-pass filter, U201D, and then a summing amplifier, U201C. The tone key (and for J frequencies, the call ID signal) is added here to the processed audio signal.

Transistors Q208 and Q209, with crystal Y200, form the tone key oscillator circuit to provide a stable, continuous 32.768 kHz sine wave. Transistor Q210 buffers the tone key signal before it is added to the audio signal.

The tone key signal is used in the receiver to provide audio output only when the tone key signal is present with the transmitted signal. If the tone key or the transmitter is turned off, the receiver will be muted.

The tone key squelch eliminates receiver noise associated with loss of a carrier. Q211 acts as a switch for toggling the tone key MUTE/UNMUTE; it is controlled via the microprocessor.

The tone key signal, along with the processed audio signal, is then fed to a summing amplifier, U201C. R244, at the output of the summing amplifier, helps prevent spurious oscillations from the op-amp. After passing the ac coupling capacitor, C243, the signal is fed to the rf module via the rf choke, L207.

The battery meter circuit is comprised of U205; LEDs D203, D204, D205; and various resistors. The meter works by comparing a divided down version of the battery voltage (R250, R251) to two thresholds (set by R252, R253, and R254), and lighting the appropriate LED.

A 9 Vdc battery provides power to the audio printed circuit board (pcb), via switch S200. FET Q203 provides electrical reverse battery protection by connecting the negative battery terminal to the pcb ground only when the battery is connected with the correct polarity.

The 9 Vdc then enters U203, a low dropout 5 V regulator, which gives a clean, regulated 5 V supply to run the audio circuitry. The regulator has appropriate bypass capacitors on its input and output. Q201, Q202, Q212, Q213, and their respective resistors, provide power management and timing.

ETSI-Approved

This transmitter uses the same pcb as the domestic system, but it requires a different topology and different parts.

A limiter is inserted between the pre-emphasis and the compressor to limit the occupied bandwidth.

The buffer after the gain stage, U201A, is now an inverter with pre-emphasis and 20 dB of attenuation. Previously bypassed, the expander side of the NE575 (U202) is now activated and used as a limiter. A sample of the audio is taken from the limiter output, U202, pin 6, and sent to a control circuit that detects signals above a limiting threshold. The comparator then sends a control signal to U202, pin 5, which clamps the signal.

Rf Section

Processed audio enters R320, an internal potentiometer that is adjusted for 45 kHz deviation (40 kHz for England), 100% modulation, with a 6.8 dBu 1 kHz tone at the output of the compressor. For J frequencies, R320 is adjusted for 5 kHz deviation with 1 kHz tone injected into the mic input, to give -23.47 dBu at U201, pin 7 (TPA4).

The audio is then fed to the tuning voltage pin of the voltage controlled oscillator (VCO), which modulates the carrier directly. A phase locked-loop (PLL) frequency-synthesized system eliminates the need for multiplier stages and results in a much higher degree of spectral purity.

The VCO is shielded to prevent external rf fields from affecting its operation. Regulated 5 Vdc power from the low drop-out regulator, U311, is provided to ensure frequency stability with changes in battery voltage.

The VCO is capable of tuning from 782 to 806 MHz (FCC-approved), with a 1 to 4 V tuning voltage range. At the output of the VCO, the rf signal splits into two paths. Frequency variations by country are given in a table in the *Service Procedures* section.

The output of the VCO is coupled by C323 to the frequency control pin of the synthesizer, U304. The synthesizer's internal circuitry divides the rf signal down, as necessary. The synthesizer contains a quartz-controlled reference oscillator circuit operating from a 4.0 MHz crystal, Y302, that is adjusted by trimmer C314.

The transmitter output frequency is user-selectable in groups of compatible channels from 782 to 806 MHz for domestic groups. Frequency selection is made via microprocessor U303, which interfaces with the user by means of the Group/Channel switches, S301 and S302.

The output of the synthesizer is a series of pulses integrated by a passive loop filter (R316, C319, R317, C353, R318, C320) to produce a control voltage signal. The control voltage signal is then connected to the VCO through buffer amplifier U306B, which is used to isolate the PLL filter from the audio modulation signals.

The VCO output is also coupled to the pre-driver and rf power amplifier through a resistive network (R322, R324, R325) and a coupling capacitor, C329.

The pre-driver stage, Q302, provides approximately 6 to 8 dB of gain, which makes up for the pad. R326 and R327 provide base bias for the transistor, while R328 sets its operating current.

L303 is an rf choke used to provide power to the stage, while L304, C332, C333, C357, and C2 provide filtering/matching for the stage. The collector of Q302 feeds into the power amplifier stage via coupling capacitor C338 and a pi-matching network made up of C339, L305, and C340.

The rf power amplifier, Q304, is a dual emitter BJT. This high-gain, high-frequency low-noise device can provide +18 dBm out at its 1 dB compression point. It is biased via base resistors R331 and R332. Its operating current is controlled via emitter resistor R333.

L306 acts as a choke, and C349, C350, C355, and C356 provide a good emitter bypass to ground. The amplifier output is matched to low-pass filter U1, via L307. The low-pass filter output couples to the printed circuit board (pcb) via C347 and L308.

The transmitter can deliver +17 dBm (50 mW) maximum to the antenna for domestic frequencies; JA and JB frequency transmitters can deliver +10 dBm maximum to the antenna. During transmitter power-up and frequency selection, the rf power is muted by bringing the gates of Q303/Q305 low. This provides approximately 45 dB rf attenuation until the PLL has locked.

The transmitter rf is then unmuted by bringing the gates Q303/Q305 high. During transmitter power off conditions, voltage is first removed from the VCO by bringing the base of Q301 high. Thus, the carrier signal of the transmitter is not allowed to drift off frequency during power on/off conditions.

Digital Section

The digital section contains several circuitry blocks.

Microcontroller Section

The microcontroller section consists of the U303 microcontroller. The rotary switches indicate the UHF frequency group and channel. A 4.000 MHz oscillator provides the operating frequency to the microcontroller. The oscillator circuit includes C300, C301, and Y301. U5, R306, and C305 form the reset circuit. U5 is the reset IC that resets the U303 microcontroller if the 5 Vdc normal operating voltage falls below 4.3 Vdc. C302 and C303 form the power supply bypass filter circuit.

Memory Section

The memory section consists of U302, a non-volatile, Electrically Erasable/Programmable Read Only Memory (EEPROM) that stores the

mapping of the compatible groups and channels. The microcontroller serially communicates with this part via data and clock lines to read the frequency corresponding to the Group and Channel position.

The ability to write to the memory occurs during factory programming only. During normal usage, this memory is used as a look-up table only.

R335 and R305 resistors allow the clock and data lines to be driven independently of the microcontroller port pin states during in-circuit programming of the EEPROM.

Battery Management Section

The U303 microcontroller provides low battery shutdown. The shutdown threshold is $1.88 \text{ Vdc} \pm 10\%$. A voltage lower than the shutdown threshold on U303, pin 17, shuts down the transmitter. Resistors R308 and R309 divide down the battery voltage for U303; a battery voltage less than 5.65 Vdc must shut down the transmitter.

This auto shutdown disables the audio tone key mix, mutes the rf output, and powers down the rf output amplifier section. The current draw from a 9 Vdc battery in this state is $14 \pm 2.0 \text{ mA}$, and the battery fuel gauge is not functional. Turning off the power switch completely shuts off the transmitter.

The audio circuit description section provides information for the battery fuel gauge circuit description.

Rotary Switches for Frequency Selection

A 10-position Group switch (S302) and a 16-position Channel switch (S301) select the transmitter frequency. Both rotary switches share the same U303 microcontroller port pins (3 through 6) for a multiplexed switch read operation. The individual switches are selected by U303, pins 7 and 8. Resistors R4, R300, R302, and R303 are the pull-ups for the switch position read. Diode packs D301 through D304 isolate the switches during the multiplexed read operation.

The multiplexed scheme to read switches does not allow incorporating switch change detection based on interrupts. Also, the switches cannot be constantly scanned to determine changes because the scanning frequency being in audio range is difficult to filter out.

In a steady state, the switch selector common pins are inputs to the U303, pins 7 and 8, while U303, pins 3 through 6, are outputs. In this state, pins 4, 5, and 6 are held low while pin 3 is held high. This forces logic high level on switch selector pins if the switches are set on odd positions. For even position settings, the contact on pin 1 is open from the switch common pin and the internal pull-down resistors force logic low to U303, pins 7 and 8.

Any switch change is comprised of state toggle from odd to even, and vice versa. Only this change is detected, and it is followed by a multiplexed switch read, in which U303, pins 7 and 8, become selectively grounded outputs to read the selected switch's state on pins 3 through 6.

A multiplexed switch read is preceded by tone key and rf mutes. This mutes the audio in the receiver to allow a quiet change to another frequency.

For JA frequencies, the Group switch has 16 positions, and the Channel switch has 10 positions.

Power Switch and Mute Interface

When a transmitter is turned off, the PWRDN signal goes to logic low on U303, pin 19. This immediately disables the tone key, and the power hold circuit automatically kicks in to bypass the power switch. This is followed by 500 mS of delay, and then the rf is muted and turned off. The power hold circuit is also disabled at this point, and the transmitter shuts off.

Notes

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Functional Test

Verify operation and reported malfunction, referring to the product User's Guide for a description of the unit as well as information on its operation, troubleshooting, and technical data.

Disassembly and Assembly



Disassembly

1. Remove the microphone cartridge from the UC2.
2. Use a pair of needlenosed pliers to remove the circuit board retaining ring from inside the handle.
3. Push the bezel tab-snap in the handle behind the contact pcb to remove the bezel and switch actuator.
4. Slide the circuit board out by pushing on the battery connectors.

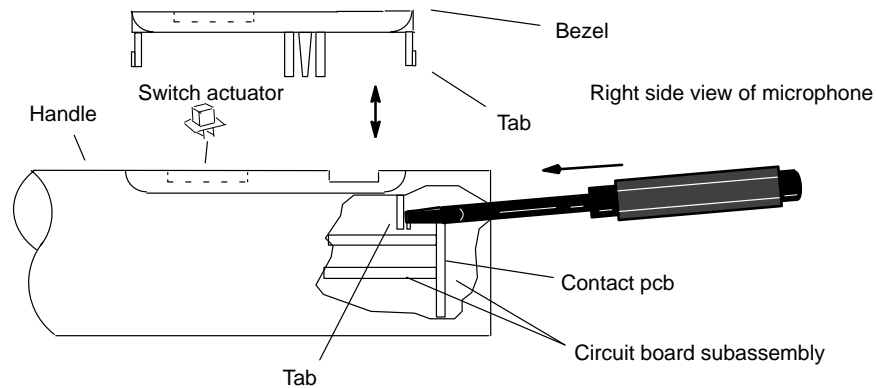


Figure 3. Bezel Removal

Shure UC2 Hand-Held UHF Transmitter

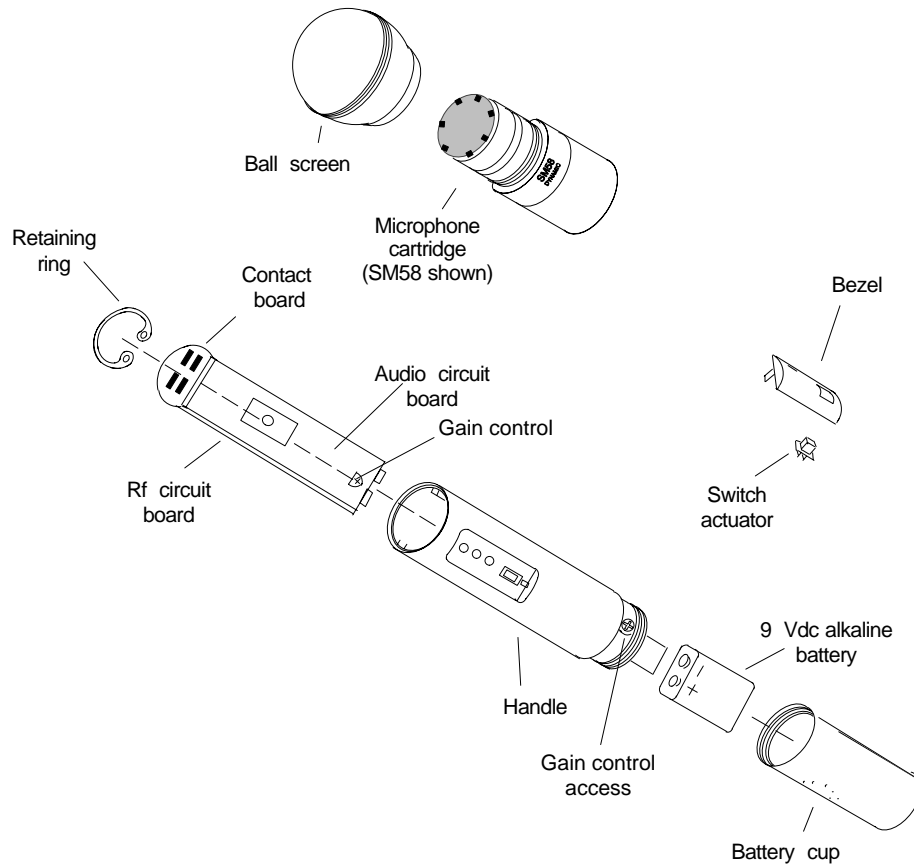


Figure 4. UC2 Hand-Held Transmitter, exploded view.

Reassembly

To reassemble the unit, reverse the disassembly steps given above:

1. Slide the circuit board back into the handle.
2. Reinstall the retaining ring, switch actuator, bezel, and the microphone cartridge.

Service Procedures

Measurement Reference

dBu is a measure of *voltage*, and dBm is a measure of *power*.

For example, the HP8903 should be labeled dBu instead of dBm because it is a voltage measurement. These two terms are often used interchangeably even though they have different meanings.

Audio levels in dBu are marked as dBm on the HP8903.

dB Conversion Chart	
0 dBV	= 2.2 dBu
0 dBu	= 0 dBm, assuming the load = 600 Ω

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 1
Test Equipment

Equipment Type	Model
Audio analyzer	*Hewlett-Packard 8903B
Digital multimeter	Fluke 87
Rf signal generator	Hewlett-Packard 8656B
Frequency counter	Hewlett-Packard 53181A
Spectrum analyzer (domestic)	Hewlett-Packard 8590L
Spectrum analyzer (JA, JB)	Hewlett-Packard 8591E
Shure UC4 receiver	Shure UC4
Test head	PT1840
Brass ring for use with test head	PT1838-Y
BNC to "rocket launch" cable. For use on Japan PCB versions "N" and earlier	95C8418
BNC(male) to unterminated 50Ω test cable	PT-1824

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

Test Equipment Set-Up

The alignment procedure is sequential and does not change, unless specified.

1. Use the following test cables for all RF test points: Use PT1824 cable for European and USA models. For the Japan models use the 95C8418 test cable for PCB versions "N" and earlier.
2. Keep the test cables as short as possible (less than 12 inches).
3. Include the insertion loss of the cables and connectors for all rf measurements.
4. Dc voltages may be present at rf test points. As a precaution, use dc blocks to protect the test equipment.

Test Set-Up

1. Desolder the printed circuit boards (pcbs) and pull them apart. When the pcbs are desoldered, leave the battery contacts soldered to the audio board for powering up the unit.
2. Remove C347 and connect the respective RF test cable between TPRF1 / RF GND and a frequency counter. For Japan models with PCB version "N" and earlier, do not remove C347. Connect a 95C8418 cable between J2 and the frequency counter.
3. Use the PT1843 cable to connect the audio board to the rf board through the 11-pin board interconnects (J200, J300, side 2).
4. Set the audio GAIN potentiometer (R207, side 1) to minimum, full counter-clockwise (CCW).
5. Apply + 9 Vdc across the battery terminals (J201, J202, side 2).
6. Toggle the power switch, S200, to turn on the UC2 transmitter.
7. Set the UC2 Group and Channel switches, S301 and S302, according to the group designators on the board and the settings given in Table 2.

Table 2
Group Carrier Frequencies and Tuning Voltages
(in order by carrier frequency)

Group	Group Code	Group Switch (S101)	Channel Switch (S102)	Carrier Frequency (MHz)	VCO Tuning Voltage (TP30)	Deviation (kHz)
UA	A	4	0	805.500	3.7	45
UB	F	1	A	703.750	2.6	45
MB	B	1	3	805.500	2.2	15
JA	C	0	2	805.500	3.7	5
JB	D	4	2	807.500	3.8	5
KK	E	5	5	851.125	2.9	15
MC	B	1	1	774.125	1.3 ±0.25	15
MD	B	3	7	805.500	2.2	15

Table 2 lists the group carrier frequencies, switch settings, and tuning voltages for all the alignment tests that follow.

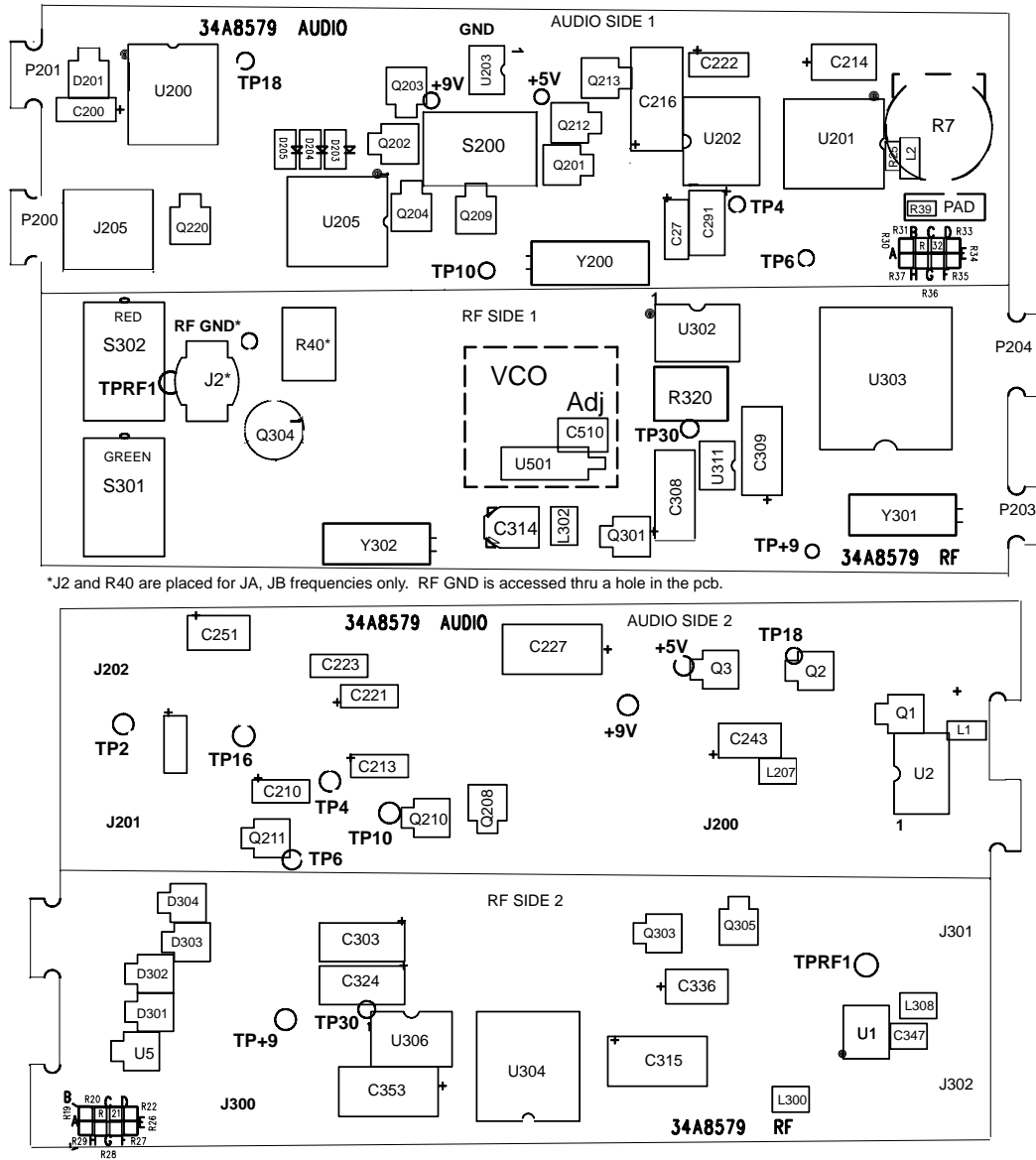


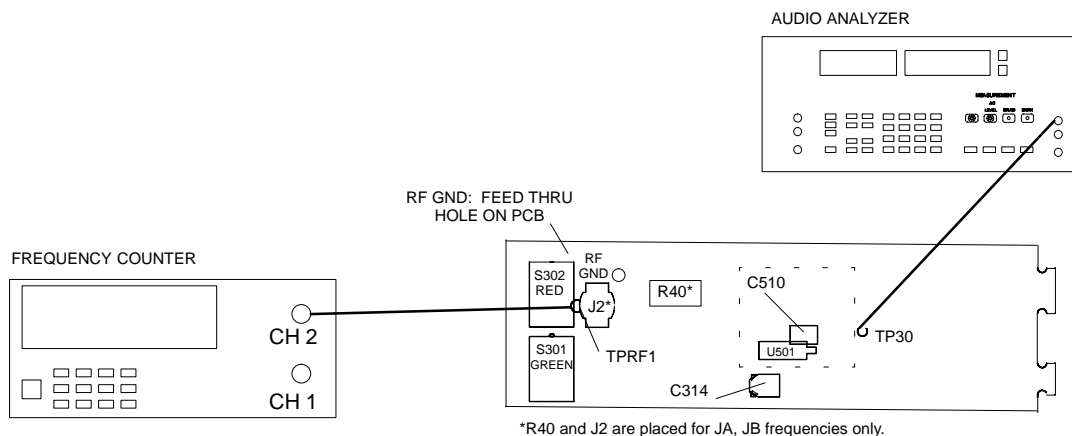
Figure 5. UC2 Major Test Component Locations

Alignment

Frequency

Use this service procedure to correctly align the transmitter's operating (output) frequency. C510 tunes the voltage-controlled oscillator (VCO) to the operating frequency selected, with a 1 – 4 Vdc tuning range.

C314 adjusts the reference oscillator on the synthesizer, U304.



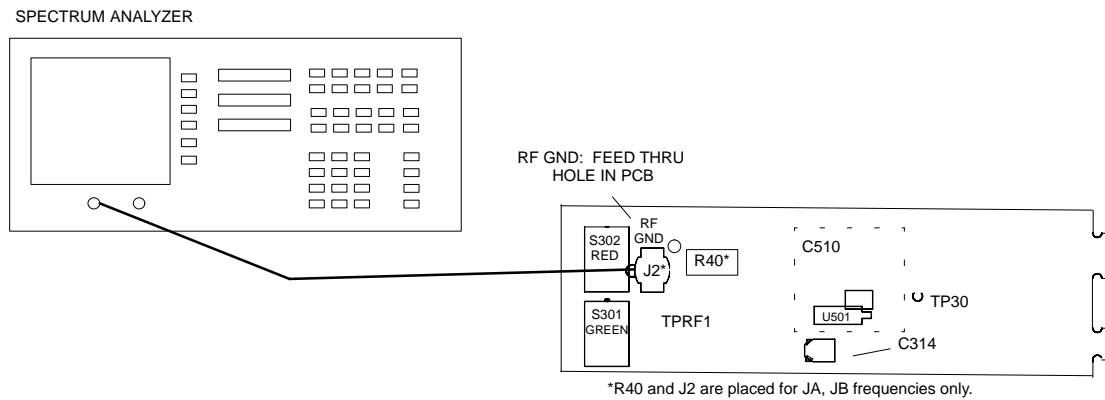
UC2 Transmitter		Frequency Counter		Audio Analyzer	
Power:	ON (+9 Vdc)	Operating freq:	See Table 2	Connect + :	TP30
Operating freq:	See Table 2	Connect CH 2:	TPRF1 and GND	Connect - :	RF GND
Channel switch:	See Table 2			Measurement:	DC level
Group switch:	See Table 2	For Japan models with PCB versions: "N" and earlier connect to J2 (pcb rf side 1)			

Figure 6. UC2 Frequency Test Set-Up

1. Put a dc voltmeter across TP30 (tuning voltage line) and RF GND.
2. Adjust the VCO trimmer, C510, until the voltmeter reading matches the appropriate entry in Table 2, ± 0.125 Vdc.
3. Adjust the variable capacitor, C314, until the frequency counter measurement matches the appropriate frequency in Table 2, ± 1 kHz.
4. Leave the test cable connected to the rf output.
5. The dc voltmeter can be removed from TP30.

Power Output Measurement

The output power measurement ensures that the output signal is strong enough for sufficient range when the system is in use. The output power measurement also verifies that the output power is not above the specified maximum level, to ensure compliance with regulatory agencies standards.



UC2 Transmitter		Spectrum Analyzer	
Power:	ON	Frequency:	See Table 2
Operating freq:	See Table 2	Span:	200 MHz
Group switch:	See Table 2	Reference voltage:	20 dBm
Channel switch:	See Table 2	Peak search:	ON
		Signal track:	ON
		Marker:	ON

Figure 7. UC2 Power Output Measurement Test Set-Up

1. Remove the BNC cable end from the frequency counter and connect it to the 50 Ω input of the spectrum analyzer.. Use the equipment settings shown in Figure 8.
2. Measure the output power. The output power should be:
 UA, UB, MB, MC, MD $16 + 1 / - 2$ dBm
 frequencies:
 KK frequencies: $14 + 1 / - 2$ dBm
 For J frequencies, with C347 in place,
 adjust R40 to obtain 8.8 ± 0.5 dBm.
3. Turn the UC2 power OFF.
4. Disconnect only the BNC end of the RF test cable from the spectrum analyzer.

Deviation

Deviation must be set to make sure the companding systems between the transmitter and receiver correctly track each other. The level coming out of the transmitter’s audio compressor must match the level going into the receiver’s audio expander. A fixed gain structure does not ensure an exact match, primarily because of variations in voltage-controlled oscillators (VCOs).

Option 1 – Using a UC4 or U4S Receiver

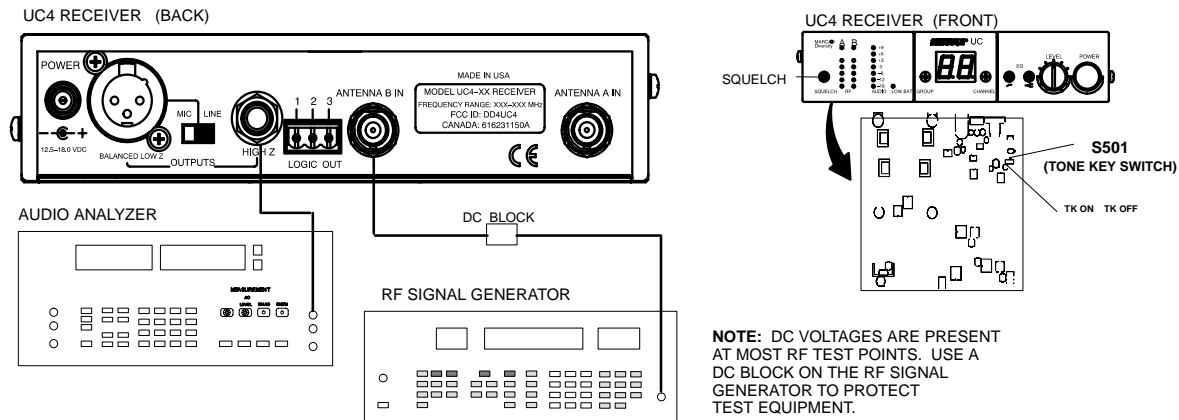
This test requires a UC4 or a U4S receiver and is designed to tune the transmitter regardless of the accuracy of the receiver’s tuning. It is, however, recommended that a properly-tuned receiver be used to perform the transmitter deviation adjustment.

Reference Voltage

1. Connect the rf signal generator to one of the receiver’s antenna ports.
2. Turn the UC4 or U4S receiver ON.
3. Set the receiver frequency to match the transmitter frequency.
4. Set the rf signal generator frequency to match the transmitter frequency.
5. Modulate the generator frequency with 1 kHz audio at a –60 dBm output level. See Table 2 for deviation.
6. Set the tone key switch (S501 for the UC4, S201 for the U4S) to the OFF position.
7. Connect the ac voltmeter to the unbalanced output of the receiver.
8. Read the ac voltage.

Record this voltage. This is the *deviation reference voltage*.

9. Turn off RF output.



UC4 Receiver		Audio Analyzer		Rf Signal Generator	
Output:	Unbalanced	Measurement:	AC level	INT:	FM
Gain:	Maximum	Filters:		INT:	1 kHz
Squelch:	Mid	Low-Pass (30 kHz):	ON	Output amplitude:	–60 dBm
Tone Key (S501):	OFF	High-Pass (400 Hz):	ON	Frequency:	See Table 2
Group switch:	See Table 2			Deviation:	See Table 2
Channel switch:	See Table 2				

Figure 8. Deviation Reference Voltage Test Set-Up, Using a UC4 or U4S Receiver

Adjustment Voltage

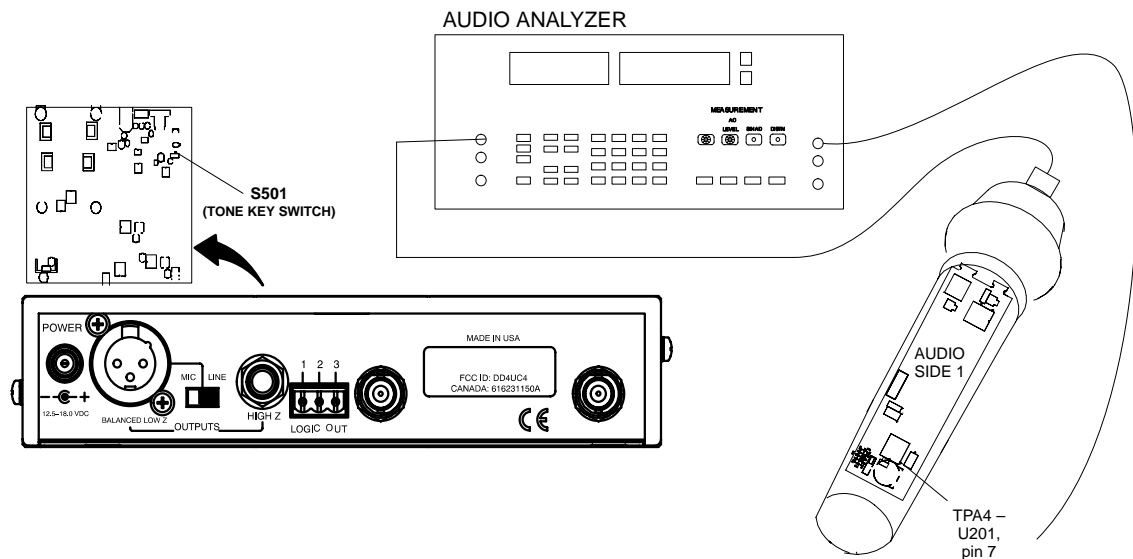
1. Remove the RF test cable from TPRF1 and GND, and replace C347. For Japan models PCB version “N” and earlier remove cable from J2.
2. Reassemble the printed circuit boards. Use a PT1840 test head and brass ring (PT1838-Y) to connect the audio analyzer to the UC2 audio input (J205). Turn ON the Low-Pass (30 kHz) and High-Pass (400 Hz) filters on the audio analyzer.

For bench testing, the audio analyzer can be directly connected to the contact board gold contacts with clip leads.

3. Disconnect the rf signal generator from the UC4 receiver and return the UC4 tone key switch to the ON position.
4. Adjust the audio analyzer output level (typically = -2.2 dBu) to measure the following at TPA4 (U201, pin 7) :

UA, UB	MB, MC, MD	JA	JB	KK
-6.8 dBu ± 0.2 dB (354 mV ± 1 mV)	- 16.3 dBu (118 mV ± 1 mV)	-26.5dBu (36.7mV± 1 mV)	- 23.47 dBu (52 mV ± 1 mV)	- 15.3 dBu (133 mV ± 1 mV)

See Figure 10 for equipment set-up and equipment settings for the rest of this test.



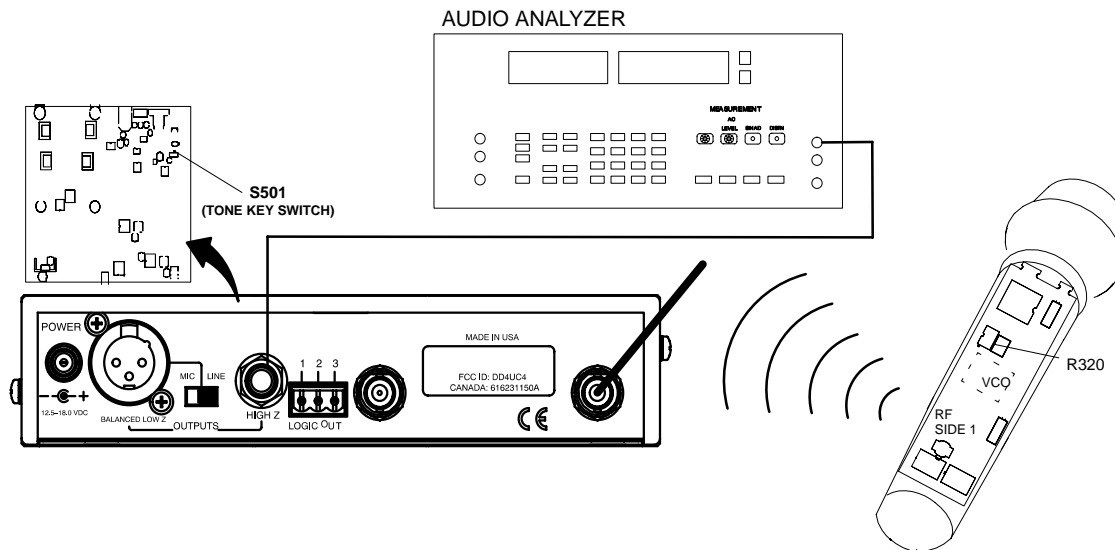
UC4 Receiver		UC2 Transmitter		Audio Analyzer	
Output:	Unbalanced	Power:	+ 9 Vdc	Measurement:	AC level
Gain:	Maximum	Gain:	Minimum	Frequency Output:	1 kHz
Squelch:	Mid	Group switch:	See Table 2	Filters:	

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Tone Key (S501):	ON	Channel switch:	See Table 2	Low-Pass (30 kHz):	ON
				High-Pass (400 Hz):	ON

Figure 9. Deviation Adjustment Voltage Test Set-Up, Using a UC4 or U4S Receiver

5. Connect the unbalanced output of the UC4 to the input of the audio analyzer (ac voltmeter).
6. Take a radiative measurement by holding the battery of the UC2 next to the receiver's antenna.
7. Turn the transmitter ON and adjust R320 until the ac voltmeter on the receiver reads the same as the *deviation reference voltage*, measured above, ± 0.1 dB; or ± 0.2 dB for JA, JB frequencies.



UC4 Receiver		UC2 Transmitter		Audio Analyzer	
Output:	Unbalanced	Power:	+ 9 Vdc	Measurement:	AC level
Gain:	Maximum	Gain:	Minimum	Frequency Output:	1 kHz
Squelch:	Mid	Group switch:	See Table 2	Filters:	
Tone key (S501):	ON	Channel switch:	See Table 2	Low-Pass (30 kHz):	ON
				High-Pass (400 Hz):	ON

Figure 10. Deviation Reference Voltage Test Set-Up, Using a UC4 or U4S Receiver

Option 2 – Using a Modified SC4 IF Receiver

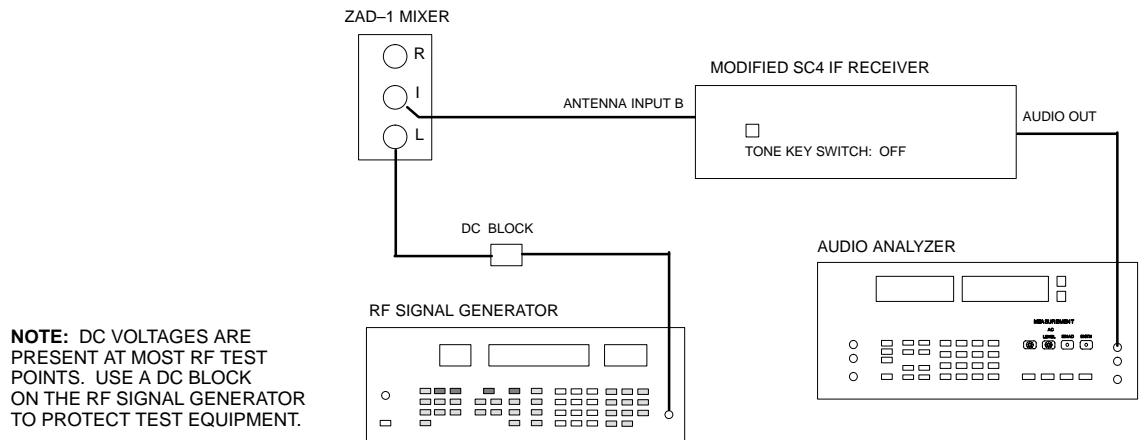
Deviation tests can also be performed using a modified SC4 IF receiver. For instructions on modifying an SC4 receiver, consult the *Shure Service Equipment* manual.

Reference Voltage

1. See Figure 12 for equipment test set-up and equipment settings.
2. Connect the rf signal generator output to the input port (L) of a Zad-1 mixer
3. Connect the output port I (intermediate frequency) of the Zad–1 mixer to antenna input B of the SC4 IF receiver.
4. Turn the SC4 IF receiver ON and set the tone key switch on the front panel of the SC4 IF receiver to OFF.
5. Connect the audio voltmeter to the receiver’s unbalanced output.
6. Measure the output voltage.

Record this voltage. This is the *deviation reference voltage*.

Use the same Zad-1 mixer connections for the next adjustment test.



SC4 IF Receiver		Audio Analyzer		Rf Signal Generator	
Output:	Unbalanced	Measurement:	AC level	INT:	FM
Gain:	Maximum	Filters:		INT:	1 kHz
Squelch:	Mid	Low-Pass (30 kHz):	ON	Output amplitude:	+ 7 dBm
Tone Key switch:	OFF	High-Pass (400 Hz):	ON	Frequency:	10.7 MHz
Operating freq:	See Table 2			Deviation:	See Table 2

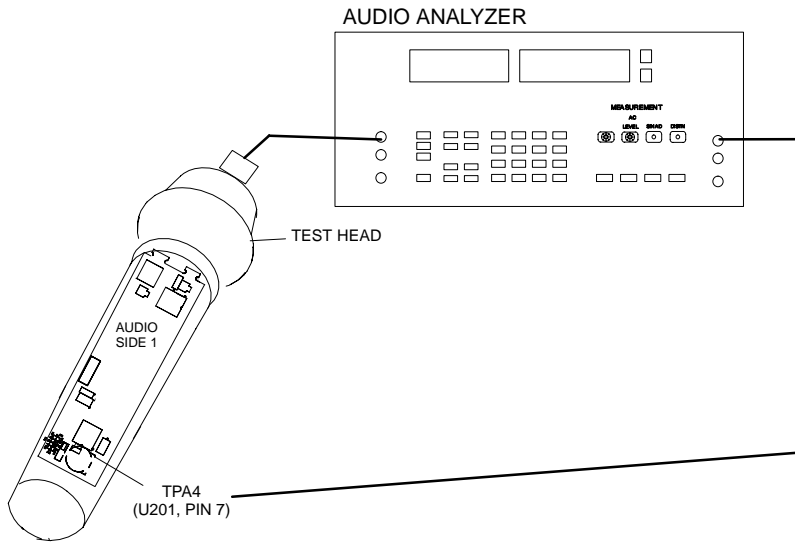
Figure 11. Deviation Reference Voltage Test Set-Up, Using a Modified SC4 IF Receiver

Adjustment Voltage

1. Disconnect the rf signal generator from the SC4 IF receiver.
2. Set the SC4 tone key switch on the SC4 front panel to ON.
3. Connect the audio analyzer output to the MIC input of the transmitter, using the test head or clip leads to the gold spring contacts.
4. Turn the UC2 power back ON.
5. Adjust the audio analyzer output level (typically = -2.2 dBu) to measure the following at TPA4 (U201, pin 7) :

UA, UB	MB, MC, MD	JA, JB	KK
-6.8 dBu ± 0.2 dB (354 mV ± 1 mV)	- 16.3 dBu (118 mV ± 1 mV)	- 23.47 dBu (52 mV ± 1 mV)	- 15.3 dBu (133 mV ± 1 mV)

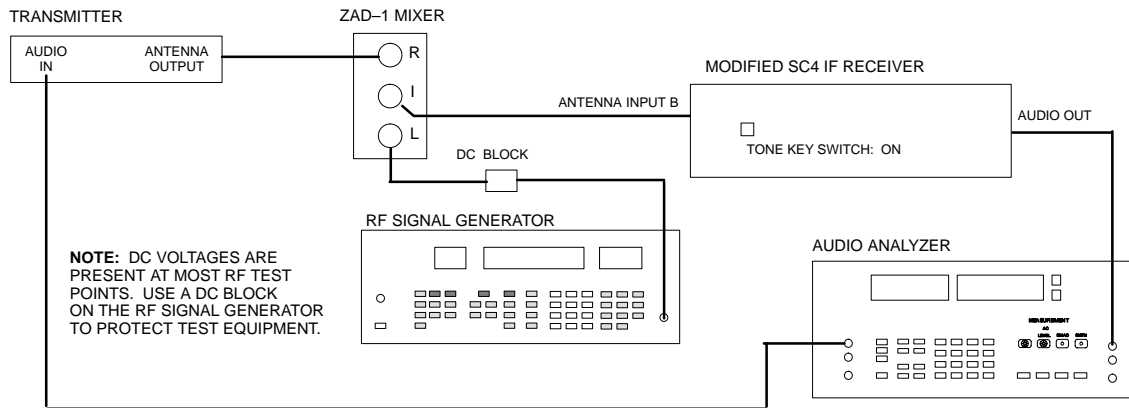
See Figure 14 for equipment set-up and equipment settings for the rest of this test.



UC2 Transmitter		Audio Analyzer	
Power:	+9 Vdc	Measurement:	AC level
Gain:	Minimum	Frequency Output:	1 kHz
Group switch:	See Table 2	Filters:	
Channel switch:	See Table 2	Low-Pass (30 kHz):	ON
		High-Pass (400 Hz):	ON

Figure 12. Deviation Adjustment Voltage Test Set-Up, Using a Modified SC4 IF Receiver

6. Connect the UC2 rf output test cable BNC end to the input port (R) of the Zad-1 mixer.
7. Connect the rf signal generator, and set the frequency to the operating frequency (from Table 2) minus 10.7 MHz.
8. Turn ON the UC2 and adjust R320 until the audio voltmeter connected to the unbalanced output of the UC4 reads the same as the *deviation reference voltage*, measured above, ± 0.1 dB, or ± 0.2 dB for JA, JB frequencies..



SC4 IF Receiver		UC2 Transmitter		Audio Analyzer		Rf Signal Generator	
Output:	Unbalanced	Power:	+ 9 Vdc	Measurement:	AC level	INT:	FM
Gain:	Maximum	Gain:	Minimum	Output:	1 kHz	INT:	1 kHz
Squelch:	Mid			Filters:		Output amplitude:	+ 7 dBm
Tone Key switch:	ON			Low-Pass (30 kHz):	ON	Deviation:	See Table 2
				High-Pass (400 Hz):	ON	Frequency:	Oper. Freq. minus 10.7 MHz

Figure 13. Deviation Adjustment Voltage Test Set-Up, Using a Modified SC4 IF Receiver

Product Specifications

After tuning, the unit should meet the following specifications.

Specification	Minimum	Typical	Maximum
Current drain	50 mA	60 mA	70 mA
Frequency	-1.0 kHz	See Table 2	+1.0 kHz
Audio freq response @ 100 Hz wrt 1 k	-5.0 dB	-4.0 dB	-3.0 dB
Audio freq response @ 10 KHz wrt 1 k	+8.0 dB	+9.0 dB	+10.0 dB
UA, UB:			
System S/N @ 45 kHz, A weighted	95.0 dB	100.0 dB	-
Output power, UA, without C347	14.0 dBm	16.0 dBm	17.0 dBm
MB, MC,MD			
System S/N @ 1% THD, A weighted	80.0 dB	85.0 dB	-
Output power, without C347	14.0 dBm	16.0 dBm	17.0 dBm
KK:			
System S/N @ 1% THD, A weighted	80.0 dB	85.0 dB	-
Output power, without C347	12.0 dBm	14.0 dBm	15.0 dBm
JA, JB:			
System S/N @ 1% THD, A weighted	85.0 dB	90.0 dB	-
Output power, at J2, with C347 in place	8.3 dBm	8.8 dBm	9.3 dBm

Bench Checks

Dc Problems

Make all dc measurements with respect to the rf ground unless otherwise specified. Connect the rf and audio printed circuit boards together via the 11 pin connector, the battery contacts, and the "D" board.

- ✓ Make sure the battery voltage is between 6 and 9 Vdc. Make sure TP+9 has this voltage. Check for the correct Vcc and +5 V rf at Q301.

If incorrect voltage is present:

- ✓ Trace the dc back to the voltage regulator.
- ✓ Check the biasing resistor values around Q301.
- ✓ Check the power switch.
- ✓ Look for open coils, cracked parts, reversed polarity capacitors, or solder shorts. If there is a short to ground from 5 V, try to isolate different parts of the circuit.

Make sure that:

- ✓ The rf OFF signal changes from +5 Vdc at power up and power down to 0 Vdc during normal operation. Trace the signal to the microprocessor. Q301 should be saturated during normal operation.
- ✓ Battery voltage appears at TP+9, U311, pin 6. Check for reversed polarity capacitors, C308 and C309. Check for open coil, L300.

Rf Problems

- ✓ If the carrier is out of specification by less than 40 kHz and cannot be corrected by adjusting C314, put the transmitter on the operating frequency (see Table 2). Measure and adjust the dc voltage at TP30. (See Table 2 for frequency variations.) If the carrier still cannot be trimmed properly, then check C314, C313, and Y302. If they are correct, replace the synthesizer.

If the carrier frequency is not in the correct frequency range shown in Table 2, or is unstable, the loop is unlocked.

- ✓ Check dc voltage at TP30. If it is 0 V or +5 V, look for a short.
- ✓ Check the solder connections at the contact board, VCO, micro processor (traces LE, D, and CK), and synthesizer U304. If the connections are good and there is no 4.0 MHz oscillation at U304, pins 1 and 2, replace the crystal, Y302.
- ✓ Check the values and polarity of the loop filter: R316, C319, R317, C353, R318, C320, C354, U306B, R319, R320, and R321. Check the bias voltage of U304, pins 3 and 4, and U306B, pin 8. As a last resort, replace the synthesizer, U304.

Low Rf Output Power

- ✔ Check the polarity/soldering of the output low-pass filter, U1. (Rf IN is marked with a dot.)
- ✔ Check for opens or shorts on output coil L308.
- ✔ Check the polarity of Q304.
- ✔ Verify the dc bias of Q302 and Q304. Check L303, L304, and L306, if no bias. Verify that the rf MUTE signal changes from 0 Vdc at power up and power down to +5 Vdc during normal operation. If Q303 and Q305 are not in a low impedance state during normal operation, the rf power at the antenna port will be attenuated by about 45 dB.
- ✔ Check for missing ground connections.
- ✔ Check the dc level at the VCO Vcc pin. If no dc power, check L302.
- ✔ Verify the VCO output power.
- ✔ Partially isolate the VCO from the rest of the circuit by removing C323. The carrier frequency will no longer be locked, but the output power from the VCO should be around -1 ± 2 dBm into a 50Ω load.
- ✔ If the power out of the VCO is still low, the problem is in the VCO.
- ✔ Check the values of R322, R323, R324, R325, and C329.
- ✔ Isolate components starting from the antenna and working back to the rf power amp.
- ✔ Check the values/continuity of the input and output matching networks for Q302, Q304 (C329, C338, L305, C339, C340, L307).
- ✔ Check the values of the bypass capacitors C357, C2, C332, C333, C334, C335, C360, C341, C342, C349, C350, C355, C356.
- ✔ As a last resort, replace Q302 or Q304.

Excessive Current Drain

- ✔ Try isolating different sections of the circuit: rf, audio, digital. Look for reversed polarity capacitors or wrong resistor values. Check the voltage regulators.

Deviation Problems

- ✔ If R320 cannot be adjusted to obtain the deviation reference voltage (see the *Service Procedures* section), try to isolate the problem to the audio or rf section. Check the value of R320. To check the rf section, set the transmitter frequency (see Table 2), and verify the tuning voltage of the VCO.
- ✔ Check the audio section by applying audio to the mic input. With an oscilloscope, make sure audio is present at TPA7. If not, work backwards towards the input.

Audio Problems

No Tone Key

No tone key means that the 32.768 kHz tone key sidebands are not visible when the carrier is viewed on a spectrum analyzer. If tone key levels are there but are too low, the deviation is off and needs to be recalibrated. They should be, roughly, $-23 \text{ dBc} \pm 3 \text{ dB}$.

- ✔ Apply a 1 kHz tone at a level of 0 dBu to the audio input with the audio gain pot at minimum.
- ✔ If the carrier on the spectrum analyzer does not show any deviation, check part integrity and audio path continuity between U201, pin 14, and the VCO.
- ✔ If the spectrum analyzer shows a deviated carrier, probe for a 32 kHz signal at TPA6 and I209 and continue to the next step.
- ✔ If there is a signal at I209 but not at TPA6, then the mute circuit through Q211 is being activated. Verify that the logic signal at Q211, pin 1, is logic low. If it is low, replace Q211. If it is not low, check the line for a short to +5 V. If there is no short, the microprocessor is defective and must be replaced.
- ✔ If there is a 32 kHz signal at both I209 and TPA6, replace R236.
- ✔ If there is not a 32 kHz signal at either I209 or TPA6, there is something wrong with the tone key circuit or the tone key supply voltage. If the tone key supply voltage (U200, pin 8) is less than 2 V, there is a problem with one or more of the following components: R261, R264, R265, R266, C238, Q220, C237, R232, or R260.
- ✔ If the voltage at U200, pin 8, is greater than 2 V, the problem is in the tone key circuit itself. Check for shorts and opens. Replace parts in this circuit beginning with the crystal until the 32 kHz oscillation returns.

No Audio

- ✔ View the carrier on the spectrum analyzer. If there are not 32 kHz tone key sidebands around the carrier, follow the steps above for “No Tone Key.”
- ✔ Verify +9 V, half-supply bias, and ground connections to U200.
- ✔ Verify +9 V, half-supply bias, and ground connections to U201.
- ✔ Follow the audio path from where audio is applied until the point of discontinuity is reached and replace the appropriate part.

Notes

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Replacement Parts and Drawings

Parts Designations

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

Resistors: Unless otherwise noted, all resistors are surface-mount 0603 size, with $\frac{1}{10}$ 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 3
UC2 Model Frequency Variations
Printed Circuit Boards
(in order by frequency)*

Country Code	Country Designation	Frequency Range	UC2 Printed Circuit Board #
UA	U.S.A. and Canada	782 – 806 MHz	90UA8792
UB	U.S.A.	692 – 716 MHz	90UB8792
MB	Europe	800 – 830 MHz	90MB8792
MC	Netherlands	774 – 782 MHz	90MC8792
MD	Scandinavia	800 – 820 MHz	90MD8792
JA	Japan	797 – 806 MHz	90JA8792
JB	Japan	806 – 810 MHz	90JB8792
KK	United Kingdom	838 – 862 MHz	90KK8792

*Table 4
Replacement Parts*

Reference Designation	Description	Shure Part Number
MP1	(1)Actuator/(3)Gold mic contact/(1)Retaining ring	RPW624
MP2	Battery snap (positive)	56A317
MP3	Battery snap (negative)	56A318
MP4	Bezel	65A8299
MP5	Compression disc (in battery cup)	38A180
MP7	Battery Cup	65A8300A
MP8	Handle	65A8301A
MP9	3–pin gold interconnect header for headboard	56D8074
MP9	Nameplate, bottom	39B8302
MP10	Headboard PCB	34A8597D

Table 5
Printed Circuit Board Replacement Parts

Reference Designation	Description	Shure Part Number
C314	Capacitor, trim, 5 – 40 pF	152F03
C510	Capacitor, trim, 1 – 3 pF	152A04
D201	Diode, signal / switching, SMD, SOT-23, 1.1 V	184A08
D203	LED, red	184A18
D204	LED, yellow	184B18
D205	LED, green	184C18
D301–304	Diode, dual switching, SOT-23, 1 V	184A07
D501	Diode, rf tuning	184A36
J200	Connector, receptacle, 11-pin header, female	170A08
J205	Socket, strip	170C15
J300	Connector, 11-pin header, male	170A07
L1	Bead, ferrite	162A12
L200,203,207, 300,32,303,306	Inductor, 180 nH	162R10
L304	Inductor, 8.2 nH	162W10
L305	Inductor, 3.3 nH	162T10
L307	Inductor, 22 nH	162D10
L308	Inductor, 6.8 nH	162V10
L501,503	Inductor, 100 nH	162A25
L502	Inductor, 10 nH	162N25
Q3,201,211,212, 213	Transistor, SMD, SOT–23, FET, TMOS	183A30
Q202	Transistor, chopper, PNP, SOT-23	183A07
Q203,303,305	Transistor, SMD, power MOSFET	183A46
Q204,208,209, 210,220	Transistor, SOT-23, NPN	183A02
Q301	Transistor	183A01
Q302,501,502	Transistor	183A48
R207	Potentiometer, Gain	46H8014
R320	Potentiometer, Trim, 1 k	146B02
S200	Switch, slide, DPDT	55A178
U5	Detector, SMD voltage	188C210
U107,108, 109	Filter, low-pass	162A28
U311	IC voltage regulator, 5V	188A115
U200,201	IC, quad op amp	188A49
U202	IC, compandor, low voltage	188A126
U203,311	IC voltage regulator, 5 V	188A115
U205	IC, comparator, quad, ultra-low power	188A123
U303	Microprocessor, programmed	188D238G
U304	PLL frequency synthesizer	188A265
U306	Amplifier, operational, dual, SMD	188A118
U501	Dielectric resonator	140A14
Y200	Tonekey Crystal, 32.768 kHz	40A8010
Y301,302	Crystal, 4.0 MHz	40A8012

Table 6
Group Designators
(in order by frequency)

Frequency Range (MHz)	Country Designation	Country Code	R19 kΩ	R20 kΩ	R21 kΩ	R22 kΩ	R26 kΩ	R27 kΩ
774–782	Netherlands	MC	–	1.0	–	–	–	–
782–806	U. S. & Canada	UA	1.0	–	–	–	–	–
692–716	U.S.	UB	–	–	–	–	–	1.0
797–806	Japan	JA	–	–	1.0	–	–	–
800–830	Europe	MB/MD	–	1.0	–	–	–	–
806–810	Japan	JB	–	–	–	1.0	–	–
838–862	England	KK	–	–	–	–	1.0	–

Country Code	R28 Ω	R29 Ω	R30 kΩ	R31 kΩ	R32 kΩ	R33 kΩ	R34 kΩ	R35 kΩ	R36 Ω	R37 Ω
MC	–	–	–	1.0	–	–	–	–	–	–
UA	–	–	1.0	–	–	–	–	–	–	–
UB	–	–	–	–	–	–	–	1.0	–	–
JA	–	–	–	–	1.0	–	–	–	–	–
MB/MD	–	–	–	1.0	–	–	–	–	–	–
JB	–	–	–	–	–	1.0	–	–	–	–
KK	–	–	–	–	–	–	1.0	–	–	–

Table 7
U302 EEPROM Programed
Part Numbers

Country Code	U102 Part Number
UA	188UCT131UA
UB	188UCT131UB
MB	188UCT131MB
MC	188UCT131MC
MD	188UCT131MD
JA	188UCT131JA
JB	188UCT131JB
KK	188UCT131KK

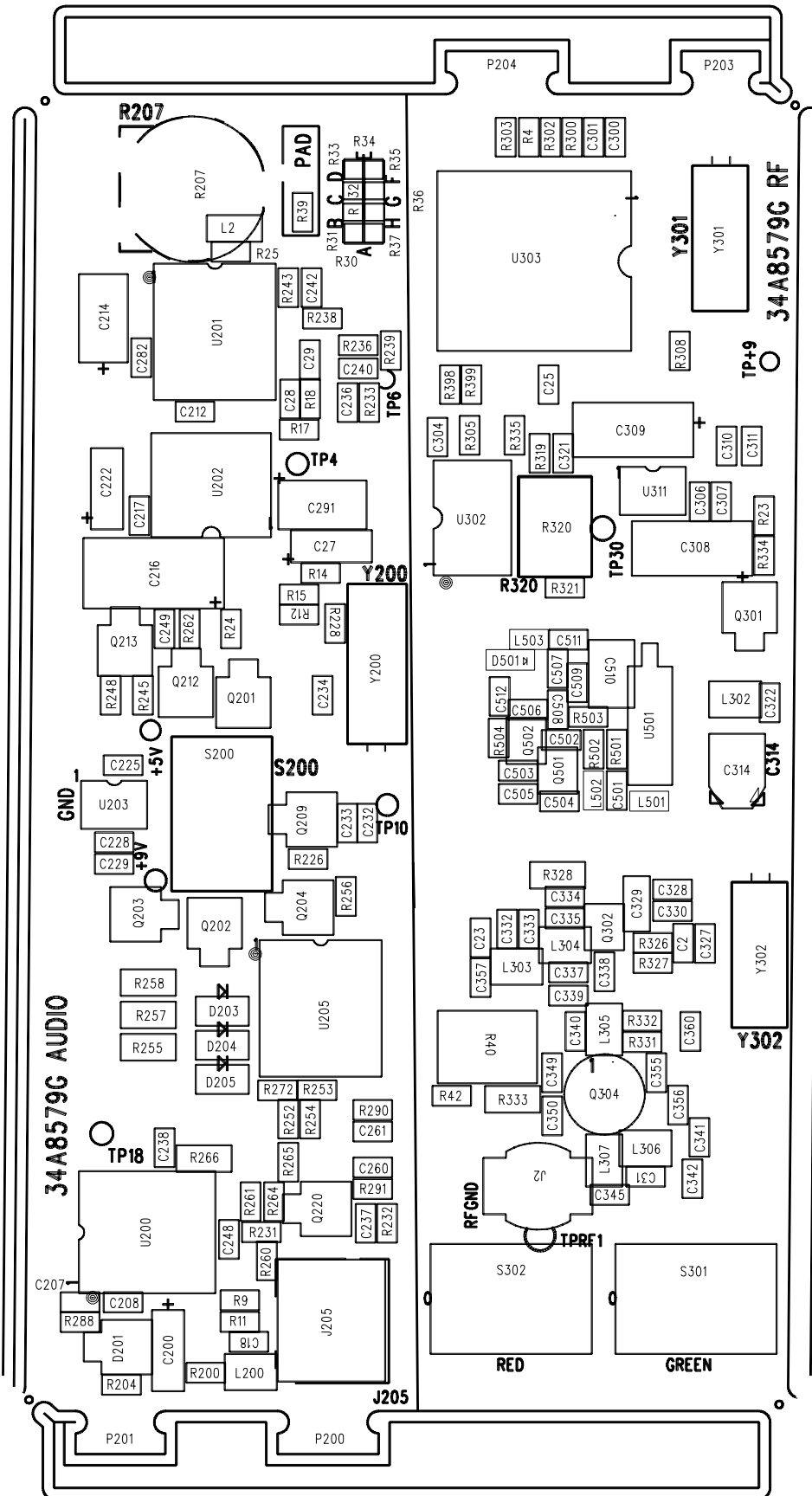
Table 7
Frequency Dependent Parts
(in order by frequency)

Frequency Range (MHz)	Country Designation	Country Code	C4 uF	C24 uF	C35 pF	C210 uF	C211 uF	C254 uF	C330 pF	C345 pF
774-782	Netherlands	MC	.047	0.1	220	2.2	-	-	-	27
782-806	U. S. & Canada	UA	-	-	-	-	.047	-	-	27
692-716	U. S.	UB	-	-	-	-	.047	-	n/a	n/a
797-806	Japan	JA	.047	0.1	220	2.2	-	-	10	4.7
800-830	Europe	MB/MD	.047	0.1	220	2.2	-	-	-	27
806-810	Japan	JB	-	-	-	-	.047	-	10	4.7
838-862	England	KK	.047	0.1	220	2.2	-	-	-	27

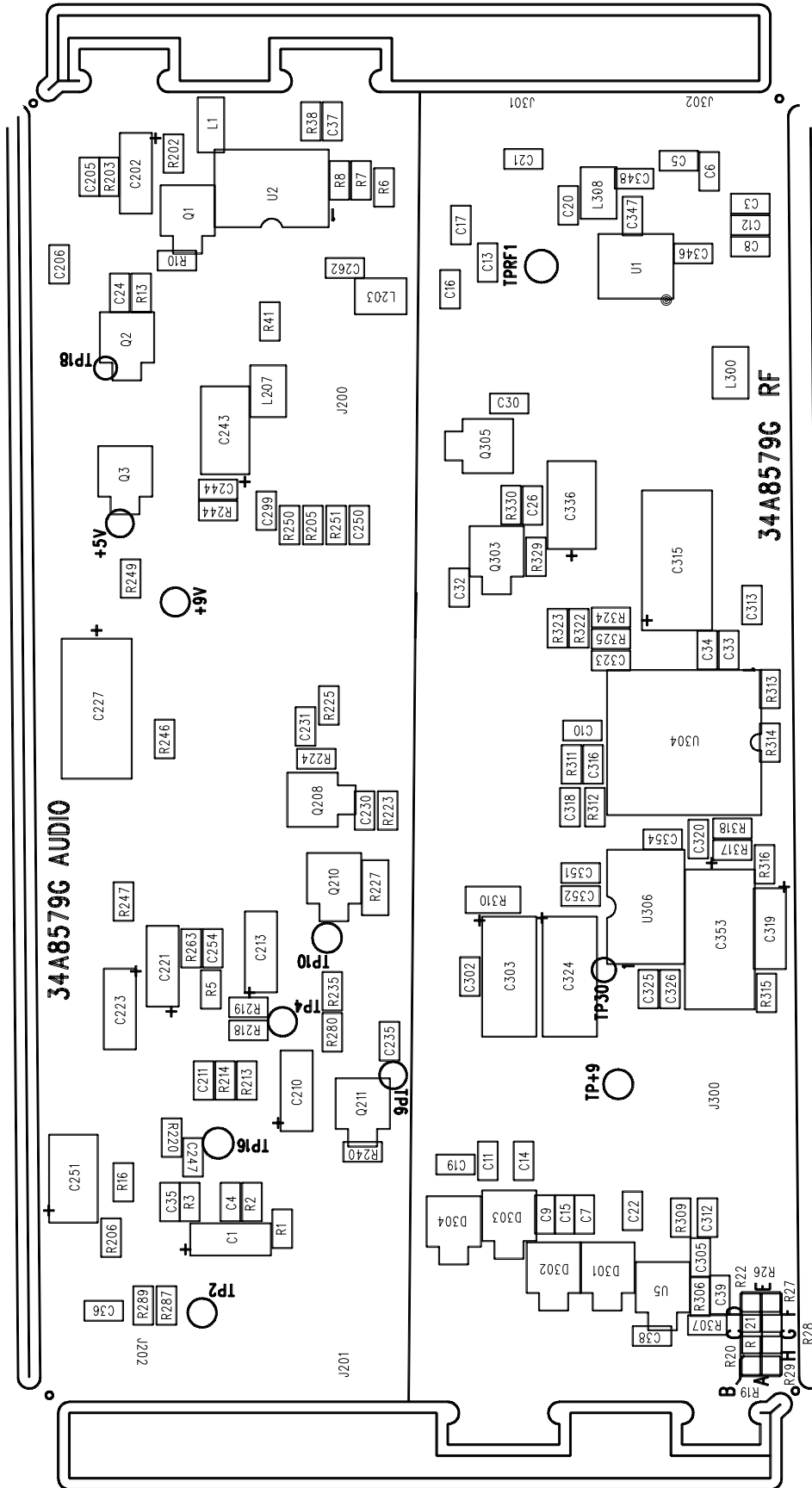
Country Code	C505 pF	C506 pF	C507 pF	C509 pF	J2	L2	Q1	Q2	R1 kΩ	R2 kΩ
MC	4.7	4.7	4.7	1.0	-	-	183A01	183A02	249	10.0
UA	4.7	4.7	4.7	1.0	-	162A12	-	-	-	-
UB	4.7	6.8	6.8	2.2	-	162A12	-	-	-	-
JA	4.7	4.7	4.7	1.0	95A8278	-	183A01	183A02	249	10.0
MB/MD	4.7	4.7	4.7	1.0	-	-	183A01	183A02	249	10.0
JB	4.7	4.7	4.7	1.0	95A8278	162A12	-	-	-	-
KK	3.9	2.2	3.9	-	-	-	183A01	183A02	249	10.0

Country Code	R3 kΩ	R6 kΩ	R7 kΩ	R8 kΩ	R9 kΩ	R10 MΩ	R11 kΩ	R12 kΩ	R13 MΩ	R16 kΩ	R40 kΩ
MC	1.5	10.0	4.02	10.0	100	1.0	10.0	22.1	1.0	-	-
UA	0	-	-	-	-	-	-	-	-	0	-
UB	0	-	-	-	-	-	-	-	-	0	-
JA	1.5	4.02	4.02	4.02	100	1.0	10.0	22.1	1.0	-	146B02
MB/MD	1.5	10.0	4.02	10.0	100	1.0	10.0	22.1	1.0	-	-
JB	0	10.0	-	-	-	-	-	-	-	0	146B02
KK	1.5	10.0	4.02	10.0	100	1.0	10.0	22.1	1.0	-	-

Country Code	R42 kΩ	R233 kΩ	R264 kΩ	R265 kΩ	R287 kΩ	R289 kΩ	R333 kΩ	S301 CH	S302 GRP	U2
MC	-	15	24.9	200	0	-	1.0	155A11	155B11	188A136
UA	-	15	24.9	200	10.0	4.02	1.0	155A11	155B11	-
UB	-	1.5	24.9	200	10.0	4.02	1.0	155A11	155B11	-
JA	100	20	-	24.9	0	-	2.49	155B11	155A11	188A136
MB/MD	-	15	24.9	200	0	-	1.0	155A11	155B11	188A136
JB	100	20	-	24.9	10.0	4.02	2.49	155A11	155B11	-
KK	-	15	24.9	200	0	-	1.0	155A11	155B11	188A136



UC2 Hand-Held UHF Transmitter
Printed Circuit Board, Side 1



UC2 Hand-Held UHF Transmitter
Printed Circuit Board, Side 2

