Shure Model UC2B (58, 87, B58, B87)
UHF Handheld Transmitter Specification

Outline

General Product Description

The Shure Model UC2 is a UHF, µP (microprocessor) controlled, transmitter operating over the Domestic frequency range of 692 to 716 MHz (With four different models). The transmitter features adjustable groups/channels, a battery status indicator, a plastic enclosure, and utilizes an internal antenna to provide optimum range. This product is intended for use in installed sound, music instrument,audio/video, audio rental, and touring sound markets.

I Special Features

1. Frequency agility, microprocessor controlled. User capable of selecting 10 groups of 16 compatible channels each, within the 782-806 MHz frequency band. This allows for a maximum of 160 selectable frequencies. There are 6 different models available from 692-716 MHz.
2. A minimum of 12 compatible systems (Country dependent).
3. Tone-key squelch.
4. Electrical reverse battery protection.
5. Supports SM58, SM87, BETA58A, and BETA87 cartridges.
6. 8 hour minimum battery life for a new 9V alkaline battery.
7. Rugged, plastic construction.
8. Power On/Off two position miniature switch located on the handle bezel.
9. Group/Channel rotary switches located on handle under the cup.
10. Three LED battery fuel gauge.

ISS	RECORD OF CHANGES MADE
1.	Production Release
2	ECO 81440: Revised thru-out for typos. No spec changes
3	ECO 81498: Added MC and MD specifications

EXP. DWG. NO. 16914

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11. “Greenie” screwdriver adjustable audio gain.

II **Circuit Description**

Audio Section

Audio enters L200, an inductor used as an RF choke. The signal is ac coupled through C200 into a user adjustable gain stage. 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 32dB adjustable gain stage is built around U200A. The gain of this stage is externally controlled by the user. C206, C207, and C208 protect the amplifier and bias circuits from RF interference. This is a unique stage in that it is non-inverting, and allows for a gain less than unity.

Audio then enters a buffer to the premphasis network and the compression stage. R213, R214, and C211 set up two corners for the premphasis network. The purpose of pre-emphasis is to boost the high frequencies before transmission. This network feeds an NE575 compandor, U202, which utilizes an external amplifier U201B. The compandor performs 2:1 logarithmic compression of the audio signal. Additionally, the pre-emphasis network plays a role in setting the hinge point (0dB gain) of the compandor. From the compressor, the processed audio enters a summing amplifier U201C. Here, tone key (and the call ID signal for the JB Group) is added to the processed audio signal.

Transistors Q208 and Q209 with crystal Y200 form the tone key oscillator circuit which provides 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; therefore, if the tone key or the transmitter is turned off, the receiver will be muted. The tone key squelch will eliminate receiver noise associated with loss of a carrier. Q211 acts as a switch for toggling the tone key MUTE/UNMUTE and is controlled by the μP. 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, is used to help prevent spurious oscillations from the opamp. After passing the ac coupling capacitor, C243, the signal is then fed to the RF module through an RF choke, L207.

The battery meter circuit is made up of comparator U205, LED’s 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.

Power to the audio pcb comes from a 9V battery, via switch S200. FET Q203 is used for 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 9v then enters U203, a low dropout 5V regulator, which gives a clean regulated 5V 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, are used for power management and timing.

RF section

Processed audio enters R320, an internal potentiometer which is adjusted to set the appropriate deviation for the country in which the system is sold. The audio is then fed to the tuning voltage line of the voltage controlled oscillator (VCO), and modulates the carrier directly. The use of a phase locked loop (PLL) frequency synthesized system eliminates the need for multiplier stages, resulting in a much higher degree of spectral purity. The VCO is shielded to prevent external RF fields from affecting its operation. Regulated 5vdc power from the low dropout regulator U311 is provided to ensure frequency stability with changes in battery voltage.

The VCO is capable of tuning from 782 to 806 MHz(domestic) with a 1 to 4 volt tuning voltage range. At the output of the VCO, C504, C505, the RF signal splits into two paths. 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, which is adjusted by means of trimmer C314. The transmitter output frequency is user selectable in groups of compatible channels from 782 to 806 MHz. 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 which are integrated by a passive loop filter R316, C319, R317, C353, R318, and 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 consisting of R322, R324, R325, and a matching network containing C328, C329, and C330. The pre-driver stage, Q302, provides roughly 6-8 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, and C337 provide filtering / matching for the stage. The collector of Q302 feeds into the power amplifier stage via a pi matching network made up of C339, L305, and C340.

The RF power amplifier Q304 is a dual emitter BJT from HP, namely the HP AT41486. It is a high-gain, high-frequency, low noise device, capable of providing +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. For Japanese systems only, the output power is trimmed via R42. L306 acts as a filter / partial choke, and C349, C350, C355, and C356 provide a good emitter bypass to ground. The amplifier output is matched to low pass filter U310 via L307. The low pass filter output couples to the antenna via C347 and L308. Since the battery is somewhat shorter than it should be, L308 helps to make it look electrically longer, closer to .25 wave lengths.

The transmitter is capable of delivering +17dbm (50 milliwatts) maximum to the antenna (Domestic). During transmitter power up and frequency selection the RF power is muted by bringing the gates of Q303/Q305 low. This provides approximately 45dB RF attenuation until the PLL has locked. The transmitter RF is then unmuted by bringing the gates Q303/Q305 of high. During transmitter power off conditions, voltage is first removed from the VCO by bringing the base of Q301 high. In this manner the carrier signal of the transmitter is not allowed to drift off frequency during power on / power off conditions.

ETSI Audio Section

An ETSI-approved transmitter uses the same board as the non-ETSI system, except it requires a different circuit topology and different parts. All board groups, except the “A” & “D” groups, require an ETSI approved audio section.* A limiter is inserted between the premphasis and the compressor to limit the occupied bandwidth. The buffer after the gain stage, U201A, is now an inverter with premphasis and 20dB of attenuation. Previously bypassed, the expander side of the NE575 (U202) is now activated and is used as a limiter. A sample of the audio is taken from the limiter output (U202.6) and sent to a control circuit which detects signals above a limiting threshold. The comparator then sends a control signal to U202.5 which clamps the signal.

*** For the “C” group (JA), a modified limiter circuit is used which has less attenuation.**

UHF Hand Held Transmitter Digital Section

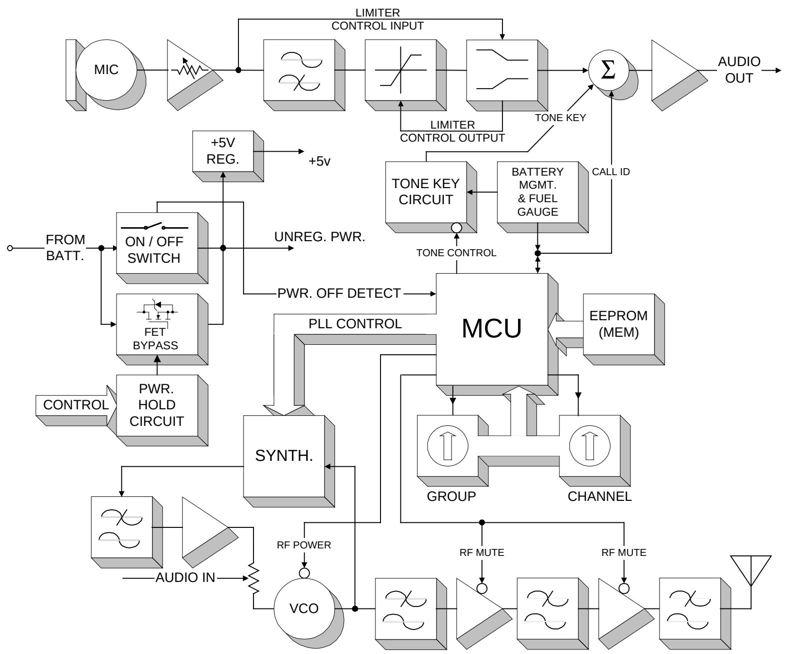

Fig. 1
Block Diagram of the Hand Held Transmitter

1.0 General Description

The Digital Section consists of following circuitry blocks:

1.0.0 Microcontroller Section

It consists of U303 microcontroller. The rotary switches indicate the UHF frequency Group and Channel as indicated in appendix A. 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 U303 microcontroller if the 5 V normal operating voltage falls below 4.3 V. C302 and C303 form the power supply bypass filter circuit.

1.0.1 Memory section

It consists of U302, non volatile Electrically Erasable / Programmable Read Only Memory (EEPROM), that stores the mapping of the compatible groups and channels.

The microcontroller serially communictes with this part via data and clock lines to read the frequency corresponding to the Group and Channel position. Write to the memory occurs during factory programming only. During normal usage this memory is used as a look-up table only. Additional detail about the contents of EEPROM is covered in one of the following sections.

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

1.0.2 Battery management section
The microcontroller is responsible for low battery shut down. The shut down threshold is 1.88 Vdc ± 10%. A voltage lower than the shut down threshold on pin 17 of U303 microcontroller must shut down the transmitter. Resistors R308 and R309 divide down the battery voltage for the microcontroller. Therefore, a battery voltage of less than 5.65 Vdc must shut down the transmitter.

This auto shut down disables the audio tone key mix, mutes the RF output, and power downs the RF output amplifier section. The current draw from a 9 V battery in this state shall be 14 mA ± 2.0 mA and the battery fuel gauge shall be functional. Turning off the power switch must completely shut off the transmitter.

Please refer to the audio section for battery fuel gauge circuit description.

1.0.3 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 pins 7 and 8 of U303 microcontroller. Resistors R4, R300, R302, and R303 are the pullups for switch position read. Diode packs D301 through D304 isolate the switches during multiplexed read operation.

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

In a steady state, the switch selector common pins are inputs to the microcontroller pins 7 and 8. While pins 3 through 6 of the microcontroller 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 postion settings the contact on pin 1 is open from the switch common pin and the internal pull down resitors force logic low to the U303 pins 7 and 8.

Any switch change comprises of state toggle from odd to even or vice versa. Only this change is detected to be followed by multiplexed switch read. In which case U303 pins 7 and 8 selectively become 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 quiet change to another frequency.

1.0.4 Power switch and remote mute switch 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. Followed by 500 msec. of delay the RF is muted and also turned off. The power hold circuit is also disabled at this point. The transmitter then shuts off.

1.1 Programmed microcontroller (U303)

1.1.0 The microcontroller must already be programmed with the correct code for this product before placing in the circuit board. The programmed microcontroller must display 188D238- and 84A0xxA on its label.

1.2 Programming the EEPROM (U302)

1.2.0 The EEPROM must be programmed before any functional tests can be conducted. The EEPROM is placed blank in the board and must be programmed in circuit. The EEPROM shall be programmed with the help of 34A8593A Interface Board. This interface board is required because the EEPROM communicates in I^2C protocol while the programmer uses RS-232.
The format of the file to be programmed into an EEPROM shall conform to the Shure standard for this product. A hexadecimal text file can be made to conform the Shure format as described below.

1.2.1 U302 is organized as 512 x 8 bit memory. Thus each data byte can be represented as two hexadecimal characters.

1.2.2 The text file length shall be 1024 hexadecimal characters (0-9, A-F), where alphabets shall be capitals only.

1.2.3 All data shall sequentially appears in the file, i.e., starting from the data contents of address 000_{16} and ending at $1FF_{16}$. For example if address 000_{16} has data 01_{16} and there is AF_{16} in location 001_{16} then the file would begin as "01AF..."

1.2.4 All data bytes shall appear in a single line and unspaced text without any line feeds.

1.2.5 Append the single line data text to "filename<space>revision<LF>" header. Revision can be variable length numeric revision indicator with a decimal point and a single decimal digit after it (e.g. 1.0 or 1.1). Where filename shall be 8 characters max. and may have only valid names as tabulated below. Revision may or may not match the microcontroller revision level. This file must have ".txt" extension. The header in the file, as described above, is for version control by Automated Test Equipment (ATE) only. The programmer must not send this header to the EEPROM.

FILENAME	COUNTRY
ucuafram	USA
ucjbfram	Japan
ucmafram uckafram	Europe-I U.K.

Table 2

Following is an example how a ucuafram.txt, software release 1.0, may look like:

```
ucuafram 1.0
080F170817171615151414100D0A0A0909090A0B0C0C0D0D0E0F1111121314140909 0A0B0B0C0D0D
0E0F1112131314140909090B0C0D0D0E0F0F1011111213140C0D0D0E0F0F1112131314151516 1616
090A0A0B0B101112121314151516161709090A0A0B0C0D0D0E0F141415161617080909 0A0B0C0C0D
0D0D0F10111112130909090B0C0D0D0E0F0F1011111213140C0D0D0E0F0F1112131314151516 1616
35002B303008203810280038302800180E272D10022A0330130A0220210E0A1E1D3619062425033A
1823342B09360F37091D3B011B0D2B1D23373307253A3137340835130A2834300E36140B240C2A3E
090A2D1F3D15020321220F1F3311390D1D361E3C333E263F312D1428060C2508351831230B022F08
2B3F2315112F3518091D3B011B0D2B1D23373307253A3137340835130A2834300E36140B240C2A3E
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
```

1.2.6 General description of EEPROM contents

There are several parameters that describe the transmitter and two of them are stored in the EEPROM, namely, N offset and A. The Group and Channel setting is simply an address of N offset. The address of A values stored in the EEPROM is simply = [160 + N offset address]. Being a frequency agile system it tunes to an EEPROM defined frequency by sending appropriate variables to the Phase Locked Loop (PLL) frequency synthesizer, U104. The mathematical relationship between these variables and the synthesized frequency is as below:

$$F_{VCO} = (P*N+A)*F_{OSC}/R \qquad \text{eqn. 1}$$

1.2.6.0 Where F_{VCO} in equation 1 above is the output frequency of external Voltage Controlled Oscillator (VCO). This is the carrier frequency upon which

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the audio signal is FM modulated.

1.2.6.1 F_{OSC} in equation 1 above is the output frequency of an external reference oscillator. It is 4 Mhz, Y101, for this system and is reference frequency for the Phase Lock Loop synthesizer.

1.2.6.2 P, or preset modulus of external dual modulus prescaler, can be 64 or 128 but has been defined as a constant in the microcontroller software as 64.

1.2.6.3 N, or preset divide ratio of binary 11-bit counter, can have values from 16 to 2047. The lowest N value is a constant, equal to 480, and is defined in the microcontroller program. Thus the minimum tuneable frequency limited by the current microcontroller software is 768.000 Mhz. All mapped frequencies, according to a compatible table, have their N offsets stored from address 000 up to $09F_{16}$. Therefore, the highest tunable frequency limited by the microcntroller software and 8 bit EEPROM data is 1177.600 Mhz. The maximum number of frequencies can not exceed 160 (up to address 159_{16}) due to hardware limitations.

1.2.6.4 A, or preset divide ratio of binary 7-bit swallow counter, can have values from 0 up to and including 127. However, value of A can not exceed the value of N in general. For this system the highest value of A is 63. All frequencies have their respective A values stored from address $0A0_{16}$ up to address $13F_{16}$. The maximum number of mapped frequencies is limited to 160 due to hardware limitations.

1.2.6.5 R, or the preset divide ratio of binary 14-bit programmable reference counter. It can have any value from 6 to 16383, however, given a fixed frequency step size of 0.025 Khz (or multiples thereof) and F_{OSC} of 4 MHz for the value of R is also a constant defined in the software. R is simply a ratio of F_{OSC} (4 MHz) to the frequency step size (0.025 Khz) and thus equal to 160 for this system.

1.2.6.6 Following is the memory map of U302 EEPROM corresponding to an above example of u1uafram.txt:

$ADDRESS_{16}$	$DATA_{16}$	COMMENTS	FREQ.	GROUP	CHAN
000	08	N offset	782.125	0	0
001	0F	N offset	792.000	0	1
...	...	N offset	...	0	...
010	09	N offset	782.750	1	0
...	...	N offset	...	...	...
020	09	N offset	783.125	2	0
...	...	N offset	...	...	...
09F	16	N offset	804.750	9	15
0A0	35	A	782.125	0	0
0A1	00	A	792.000	0	1

...	...	A	...	0	...
0B0	0E	A	782.750	1	0
...	...	A	...	...	...
0C0	1D	A	783.125	2	0
...	...	A	...	...	...
13F	3E	A	804.750	9	15
140	FF	Not used			
...	...	Not used			
1FF	FF	Not used			

1.3 After the EEPROM is programmed the system is capable of all designed functions and the system level functional tests can be conducted. Following are the initial conditions for system functional tests:

1.3.0 Power switch must be in off position.

1.3.1 Audio and RF / Digital boards must be electrically connected.

1.3.2 All voltage measurements are w.r.t. TPGND1 (RF ground) unless specified otherwise.

1.3.3 Logic high shall imply 5 Vdc ± 5 %.

1.3.4 Logic low shall imply 0.0 Vdc ± 20 mVdc.

1.3.5 Apply +9 Vdc ± 1 % to TP102 (DVBATT+) w.r.t. TP104 (DVBATT-). The power supply current drain must be less than 0.500 µA dc.

1.4 Operational description and troubleshooting guide

1.4.0 All of the above initial conditions must be established unless stated otherwise.

III **Test Equipment or Equivalent**

1.0	Spectrum analyzer	HP8591E
1.1	Digital multimeter	Fluke 87
1.2	Distortion Analyzer/ac-dc meter/audio osc.	HP 8903B
1.3	Frequency Counter	HP 5385A
1.4	Receiver	Shure U4S/D or UC4
1.5	50 ohm, RG-174 BNC to open (stripped) coaxial cable	
1.6	For JA/JB, 50 ohm, “Rocket Launch” to BNC cable.	

IV **Alignment Procedure**

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

dB Conversion Chart

0dBV = 2.2 dBu

0dBu = 0dBm assuming the load = 600 ohms

Be aware that dBu is a measure of *voltage* and dBm is a measure of *power*. The HP8903, for example, should be labeled dBu instead of dBm since it is a voltage measurement. These two terms are often used interchangeably even though they have different meanings.

The alignment procedure is sequential and does not change unless specified. Use RG58 or any other low loss, 50 ohms cables for all RF connections. Keep test cables as short as possible. Include the insertion loss of the cables and the connectors for all RF measurements. DC voltages are present at most RF test points. Use DC blocks to protect the test equipment, if necessary. All audio analyzer filters should be OFF unless otherwise specified.

Initial Setup

1.0 Connect the audio board to rf board through interconnects J200 and J300.
1.1 Apply +9V across the battery terminals, J201 and J202.
1.2 Set audio gain pot, R207, to minimum.
1.3 For bench testing, remove, C347 and connect a 50Ω cable between TPRF1/ground and a frequency counter. **For JA/JB, connect the "Rocket Launch" cable from J2 to the frequency counter.**
1.4 Connect audio generator to TPA1. For bench testing, the audio generator can be directly connected to the headboard gold contacts with clip leads.
1.5 Turn on UC2 by toggling the power switch, S200.
1.6 Set the UC2 Group and Channel switches, S301 and S302, according to the group designators on the board and the following table.

Table 1

Group	Group Code	Group Switch (S302)	Channel Switch (S301)	Carrier Frequency (MHz)	Tuning Voltage TP30 (Vdc)	Deviation (kHz)
UA	A	4	0	805.500	3.7	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	857.125	2.9	15
MC	B	1	1	774.125	1.3 ± .25	15
MD	B	3	7	805.500	2.2	15
UB	F	not defined	not defined	--	--	45

*** For JA only, the “Group” switch has 16 positions, and the “Channel” switch has 10 positions.**

Tuning Voltage / Frequency Alignment

2.0 Put a dc voltmeter across TP30 (tuning voltage line) and RFGND.
2.1 Adjust the VCO trimmer C510 until the voltmeter reading matches the appropriate entry in *Table 1*, +/- 0.125 V.
2.2 Adjust the variable capacitor C314 until the frequency counter measurement matches the appropriate entry in table 1, ± 1kHz.

Deviation Adjustment

The following procedure requires a U4S or D, or a UC4 receiver and is designed to tune the UC 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.

3.0 Receiver Setup
- 3.0.1 Connect the RF signal generator to one of the receiver antenna ports.
- 3.0.2 Set the receiver frequency to match the transmitter.
- 3.0.3 Set the rf signal generator frequency to match the transmitter.
- 3.0.4 Set the deviation according to *Table 1*.
- 3.0.5 Modulate the rf signal with a 1kHz audio tone.
- 3.0.6 Turn the receiver on and set the tone key switch (S501 for UC4, S201 for U4S) to the OFF position.
- 3.0.7 Connect the ac voltmeter to the unbalanced output of the receiver.
- 3.0.8 Note the voltage obtained. This is *the **deviation reference voltage***.
- 3.0.9 Disconnect the RF generator from the receiver and return the tone

key switch to the ON position.

3.1 Connect the audio generator to the mic input of the transmitter and set the generator frequency to 1kHz.

3.2 **Domestic (UA,UB):** Adjust audio input level to give -6.8 dBu ± 0.02 dB (354mV ± 1mV) at TPA4 (U201.7).

Japan (JA & JB): Adjust audio input level to give -23.47dBu (52mV ± 1mV) at TPA4.

Europe(MB,MC,MD): Adjust audio input level to give -16.3 dBu (118mV ± 1mV) at TPA4.

England (KK): Adjust audio input level to give -15.3 dBu (133mV ± 1mV)at TPA4.

3.3 Transmit from the UC2 transmitter to the receiver. If transmission is conductive instead of radiative, insert a 20-60 dB pad between the transmitter rf output and the receiver rf input. Turn the transmitter ON and adjust R320 until the ac voltmeter on the receiver reads the ***deviation reference voltage*** ± 0.1 dB, as measured in 3.0.7.

3.4 Disconnect the audio generator.

V **Test for Product Acceptance**

1.0 Initial Setup

Connect the (+) terminal of the power supply through a milliammeter to the positive battery terminal and the (-) terminal to the negative battery terminal. Connect a DC Voltmeter across the power supply. Connect the audio generator to the center spring contact on the headboard and ground. Connect the RMS audio voltmeter across pin-8 U201D and GND. Connect the audio distortion analyzer between “AUD_OUT” (input to RF section) and GND.

2.0 Reverse Battery Protection Test

Turn on the power supply and adjust to -9.0V ± 0.1V as indicated on the DC voltmeter. Measure the current drain on the milliammeter. The current should be less than 0.5 mA.

3.0 Voltage Regulation Check

With power applied properly, and the unit switched on, measure the dc voltage at C308 pin 1 (RF board) and at TP5 (C227 pin 1 on the audio board). They should be 5 ± 0.2 Volts.

4.0 Current Consumption Test

With +9V to the battery terminals, measure the current drain using a DC milliameter. It should be 60 +/- 10 mA.

5.0 Frequency Response Test

Set the audio generator output frequency to 1kHz with an amplitude of -34.26 dBu (15mV). Record the 1kHz ac level at TPA4 - this is your *1kHz reference level*. Change the generator's frequency to 100Hz and measure the level at TPA4 to be -4.0 dB ± 1 dB relative to the 1kHz reference level. Next, change the generator's frequency to 10kHz and measure the level at TPA4 to be +9.0 dB ± 1 dB relative to the 1kHz reference level.

6.0 Distortion Test
Set the gain control to be fully CCW. Set the audio generator frequency to 1kHz with an amplitude of -5.0 dBu ± 0.1 dB (436mV ± 5mV). Set the 30kHz LPF on the audio generator. Measure the total harmonic distortion and noise (THD+N) to be less than 0.7%.

7.0 RF Mute and Output Power.
Connect the RF output TPRF1 to the Spectrum analyzer. Set the analyzer center frequency to the transmitter frequency. Set the span to 1 MHz. Turn on the transmitter. Quickly measure the difference between the muted and unmuted carrier power. This difference should be greater than 40dB. The unmuted output power should be 16dBm +1dBm /-2dBm. **For JA & JB models: The output power should be adjusted via R40 to obtain 8.8 dBm +/-.5 dB. This should be verified on an HP Power Meter.**

8.0 Occupied Bandwidth Test **(JA & JB models only)**
- Set transmitter gain to maximum.
- Set up the HP-8591E spectrum analyzer to measure *Occupied Bandwidth* with the following settings:
  Percentage Power = 99.5%
  Channel Spacing = 250kHz
  Bandwidth = 110kHz
- Connect the audio generator to the mic input with a 1kHz tone and a level which gives -23.47dBu (52mV) at TPA4.
- Increase the audio level by 36dB.
- Measure *Occupied Bandwidth* to be less than 110kHz.

9.0 Adjacent Channel Power Test **(JA & JB models only)**
- Set the trasnmitter gain, HP-8591E spectrum analyzer, and audio input level to the same settings as stated in 8.0.
- Measure *Extended Adjacent Channel Power* to be less than -60dB.

10.0 Tone key Level Test
- View transmitting carrier on the spectrum analyzer with a span of 200kHz. Use the "Peak Search, Marker Delta, Next Peak" softkeys on the analyzer.

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- Measure the 32.768kHz tone key level to be 22dBc ± 2dB.
- **For JA/JB, measure the tone key level to be -25 dBc +/- 2 dB.**

VI **Agency Approvals**

1.0 FCC (UA,UB)
2.0 IC (UA)
3.0 ETS (MB,MC,MD,KK)
4.0 MKK (JA,JB)

VII **Additional Product Specifications**

UA Model

SPECIFICATION	
Operating Frequency	782.125 to 805.875 MHz
Number of User Selectable Channels	160 (25 kHz Spacing)
Type of Emission	120KF3E
Oscillator	PLL Controlled Synthesizer
RF Conductive Power Output	16dBm +1 /-2dBm
Tone Key Signal	32.786 kHz
Maximum FM Deviation	45 kHz
Dynamic Range	> 100dB
Total Harmonic Distortion	< 0.7% (45kHz deviation, 1kHz)
Audio Adjustment Range	-6 to 26dB, user adjustment
Operating Voltage	9V (Alkaline recommended)
Power Consumption	60mA ± 10mA @ 9V
Battery Life	8 hrs (Alkaline Batteries)

MB Model (Changes from UA model)

Operating Frequency	800.100 to 829.700 MHz
Number of User Selectable Channels	160 (25 kHz Spacing)
Dynamic Range	> 80dB

MC Model (Changes from UA model)

Operating Frequency	774.000 to 782.000 MHz
Number of User Selectable Channels	160(25 kHz Spacing)
Dynamic Range	> 80dB

MD Model (Changes from UA model)

Operating Frequency	800.000 to 820.000 MHz
Number of User Selectable Channels	160(25 kHz Spacing)
Dynamic Range	> 80dB

JA Model (Changes from UA model)

Operating Frequency	797.125 to 805.875 MHz
Number of User Selectable Channels	85 (125 kHz Spacing)
Dynamic Range	> 80dB
Frequency Stability	±20 ppm
Reference FM Deviation 1kHz audio level	5 kHz -23.47dBu (52mV) at TPA4
Output Power	+ 8.8 dBm +/- .5 dB **(power meter verification required)**

JB Model (Changes from UA model)

Operating Frequency	806.125 to 809.750 MHz
Number of User Selectable Channels	30 (125 kHz Spacing)
Dynamic Range	> 100dB
Frequency Stability	±20 ppm
Reference FM Deviation 1kHz audio level	5 kHz -23.47dBu (52mV) at TPA4
Output Power	+ 8.8 dBm +/- .5 dB **(power meter verification required)**

KK Model (Changes from UA model)

Operating Frequency	838.625 to 861.875 Mhz
Output power	+14 dBm +1/-2 dB
Dynamic Range	> 80dB
Number of User Selectable Channels	140 (25 kHz Spacing)

See Drawing #900G000 for the detailed frequency maps for each country.

VIII Mechanical Specification

1. Overall Dimensions
   254mm x 51mm DIA. (10 x 2 IN) including SM58 cartridge.
2. Weight
   375.6 grams(13.25 oz), without battery
3. Housing
   Molded ABS Handle and battery cup
5. Battery
   9V battery type MN1604, Alkiline recommended

IX Environmental Specification

Temperature Storage
7 days at +165F (+74C) degrees, unpackaged.
7 days at -20F (-29C) degrees, packaged.
After each 7 day storage, the units must be allowed to stabilize for 24 hours before testing. Units must operate per Section V.

Temperature Cycling
5 cycles from -20F (-29C) degrees, to +165 (+74C) degrees, allow 24 hours for stabilization before testing. Units must operate per Section V specifications Mechanically and Electrically.

Operational Temperature
Operate units as described in Section V at +20F (-7C) and +120F (+49C) degrees. Allow three hours for stabilization of each temperature before testing. Units must operate per Section V specifications.

Steady State Humidity
Perform a 10 day test at 90% RH at room temperature. Evaluate units for visual and mechanical defects after 1, 3, 5, 7, and 10 days. At the end of the 10 day period allow the units to recover for 24 hours. Units must pass Section V specifications.

Operational Humidity
Operate units as described in Section V at 90% RH at room temperature. Allow two days for stabilization.

Moisture Resistance
Perform a 7 day test at 90% to 98% RH with temperature cycled between +14F (-10C) and +150F (+65C) degrees. Allow the units to recover for 24 hours. Product must meet Section V specifications.

Mechanical Shock
Hand Held Drop Test: Drop product from a height of 6′ onto a hardwood floor for a total of 10 drops. The unit must pass Section V specifications.
Stand Drop Test: Place product on a stand with the appropriate size swivel adapter. Drop unit from a height of 5′ onto a hardwood floor for total of 10 drops. The product must meet Section V specifications.

Electrostatic Discharge
Product will be subjected up to a ± 15 kV air discharge and ± 4 kV contact discharge. Units must operate per Section V specifications.

X **Service Evaluation**

1.0 DC PROBLEMS (RF Section)

1.1 Verify the battery voltage is between 6 and 9v. Check for proper Vcc and +5v RF at Q301 (make all DC measurements with respect to RF Ground unless otherwise specified). If incorrect voltage is present check the biasing resistors values. Trace the DC back to the voltage regulator. Check the power switch. Look for open coils, cracked parts, reversed polarity capacitors, solder shorts. If you have a short to ground from 5 volts try to isolate different parts of the circuit.

1.2 Verify :

- RF OFF signal changes from +5v at power up and power down to 0v during normal operation. Trace signal to uP. Q301 should be saturated during normal operation.

- Battery voltage appears at U311 pin 6. Check for reversed polarity capacitors C308 and C309. Check for open coil L300. Make sure J300 is soldered correctly.

2.0 RF FREQUENCY PROBLEMS

2.1 If the carrier is out of spec. by less then 40kHz and can't be corrected by adjusting C314, check the values of C314, C313 & Y302. If these values are correct replace C314. As a last resort replace the synthesizer U304.

2.2 If the carrier frequency is not between 782 and 810 MHz, or is unstable, the loop is unlocked. Check the solder connections at the, head board, VCO , µP (traces LE, D, & CK) and synthesizer U304. Check for 4MHz oscillation at pins 1&2 of U304. If not replace the crystal Y302. Check the values and polarity of the loop filter: R316, C319, R317, C353, R318, C320, C354, U306B, R319, R320, R321. Check the bias voltage of U304 pins 3 & 4 and U306B pin 8. As a last resort replace the synthesizer U304. The tuning voltage of the VCO should be about 2.9 volts DC when the transmitter is set for 796 MHz operation (1,C for UA).

3.0 LOW RF OUTPUT POWER

3.1 Check the polarity of the low pass filter U1 (RF IN is marked with a dot).
3.3 Check the polarity of Q304.
3.4 Check for missing ground connections.
3.5 Verify VCO output power.
3.5.1 Check DC level at VCO Vcc pin (L302).
3.5.2 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 dBm into a 50 Ohm load, at some frequency. If you don't see any carrier, try adjusting C510.

3.5.3 If the power out of the VCO is still low the problem is in the VCO.

3.6.1 Check the values of R322, R323, R324, R325, and C329.

3.7 Verify DC bias of Q302 and Q304. Verify that the RF Mute signal changes from 0v at power up and power down to +5v during normal operation. If Q303 & Q305 are not in a low impedance state during normal operation the RF power at the antenna port will be attenuated by about 45dB.

3.8 Isolate components starting from the antenna and working back to the RF power amp.

3.8.3 Remove the lowpass filter and check the power out of the amplifier at C345.

3.8.4 Check the values of the input and out put matching networks for Q302, Q304 (C329, L304, C338, L305, C339, C340, L306, and L307). Also, look for open coils.

3.8.5 Check the values of bypass capacitors C357, C2, C332, C333, C334, C335, C360, C341, C342, C349, C350, C355, C356.

3.8.6 As a last resort replace Q302 or Q304.

4.0 EXCESSIVE CURRENT DRAIN

Try isolating different sections of the circuit, RF, Audio, Digital, etc. Look for reversed polarity capacitors, wrong resistor values, or solder shorts to ground.

5.0 DEVIATION PROBLEMS

If R320 can't be adjusted to obtain 45 kHz deviation, try to isolate the problem to the Audio or RF section. Check the value of R319 and R320. To check the RF section, set the transmitter frequency to 796 MHz (1,C for UA) and verify the tuning voltage of the VCO is approximately 2.9 V DC. To check audio section, apply -5 dBu at 1 kHz to mic input. Set the gain to minimum. Check for audio with a scope at "AUDIO_OUT" (L207). The level should be approximately -9.9 dBu. If there is no audio, or the level is wrong, the problem is probably in the audio section. Trace backwards through the audio stages until you find the problem.

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