Description: **Body-Pack UHF Transmitter**	DRWG. **UC1-7** **94-8379-7, 94-8392-7**
Refer To Drawing NOS. **6A250, 94-8379-3, 90-8762-11, 90-8762-3, 34A8577, 900G000, 94-8392-3, 90-8789-11, 90-8789-3**	Page 1 of 20

Shure Model UC1B
UHF Body-Pack Transmitter Specification

Outline

General Product Description

The Shure Model UC1 is a UHF, µP (microprocessor) controlled, transmitter operating over the frequency range of 692-716 MHz (With four different models). The transmitter features a minimum of 8hrs battery life using a 9-volt alkaline battery, switchable group/channel, with a battery status indicator, a plastic enclosure, and utilizes an external 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 agile, microprocessor controlled. Model number determines frequency band of operation as well as size of minimum step of synthesizer (center frequency). User capable of selecting 10 Groups of 16 compatible channels. For example:UC1-UA operates between 692-716 MHz on 125 kHz centers for a total of 160 frequencies.
2. A minimum of 12 compatible systems (country dependent).
3. Tone-key squelch.
4. 9 Volt battery operation with electrical reverse battery protection.
5. Switchcraft “Tini Q-G” type input connector (4 pin, mates with switchcraft TA4F or equivalent). Supports WL83A, WL84A, WL93, WM98, WCM16, WH10TQG, and WA302 mics, headsets, and cables. (A Lemo connector version also available)

ISS	RECORD OF CHANGES MADE		
1	Production Release		EXP. DWG. NO. 16914 ORIG USED IN
			SHURE BROTHERS INC. **222 HARTREY AVENUE** **EVANSTON, IL 60202** **PHONE 847-866-2200** *Microphones-Electronic Components*
			TYPED J. Astroski, D. Cerra, I. Singh
			CHECKED
			APPROVED K. Mikes 8/13/98
			APPROVED

6. When using a new alkaline battery (Duracell MN16044 is recommended) the battery life will be a minimum of 8 hours.
7. Rugged, plastic construction.
8. The power On/Off two position miniature toggle switch located on top of unit.
9. The Group/Channel rotary switches, audio gain adjustment and Mic/Instrument switches are located under the battery door.
10. LED's for low battery condition.
11. The audio gain is adjustable using a screwdriver (Xcelite R3322 "greenie" is recommended) via a rotary potentiometer.
12. A 3.5 mm input connector is provided for external audio muting capability using digital logic.

II **Circuit Description**

Audio Section

The audio signal enters through the micjack board to the audio board at J204. The signal then enters a switchable 20dB pad made up of SW201, R203,R204, C204 and C206. The back to back diodes, D206, are used to keep the op amp from snapping to the rail and reverse phasing when maximum input voltage is exceeded.

The signal is ac coupled through C205 into a 40dB (30dB Japan) user adjustable gain stage around amplifier U204A. This gain stage is externally accessible to the user. This is a unique stage in that it is non-inverting, and allows for a gain less than unity. R205 and R207 set up a half-supply bias and R206 sets the input impedance.

The amplified audio signal then passes through a premphasis network before entering the compression stage. R221, R222, and C216 set up two corners for the premphasis network. The premphasis network feeds the NE575 compandor, U203, which utilizes an external amplifier U201D. The compandor performs 2:1 logarithmic compression of the audio signal.

Transistor's Q201 and Q202 with crystal Y201 form the tone-key oscillator circuit which provides a stable continuous 32.768 kHz sine wave. Transistor Q204 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 in the transmitted signal. Therefore, if the tone key or the transmitter is turned off, the receiver will be muted. Q211 acts as a switch for toggling the tone key ON/OFF. It is controlled from the µProcessor, via the TONEMUTE0 signal. The tone key signal along with the processed audio signal is then fed to a summing amplifier U201A. After passing through the ac coupling capacitor, (C240), the signal is then fed to the RF module.

The battery meter circuit is made up of comparator U208, LED's D201, D202, D203, and various resistors. The meter works by comparing a divided down version of the battery voltage (R255, R256) to two thresholds (set by R274, R275, and R276), and lighting the appropriate LED. When the battery voltage is less than 6.5 V, the output of U208 at pin13 changes low which turns the red LED on. Through Q222 and U201B the voltage applied to the tone key oscillator circuit switches high; thus, when the red LED goes on the tone key level increases. The tone key amplitude change is utilized by the receiver to indicate the transmitter battery level. When the on/off switch, SW202, is turned off the PWRDN0 signal goes low. The microprocessor will then change the RFOFF0 signal to a high level which shuts down the sytem.

Power to the audio pcb comes from a 9V battery, via switch SW202. FET Q217 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. 9V then enters U205, 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. Q213, Q215, Q216, Q218, and their respective resistors, are used for power management and timing.

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" group, 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.

RF section

Processed audio enters R149, an internal potentiometer which is adjusted for 45kHz deviation (100% modulation for UA, MA, MB) with a -7.2 dbV (0.355 Vrms) 1kHz tone at the output of the front audio stage (pin 1 of U201). (For KK: R243 is adjusted for 40 kHz deviation)(For JB: R149 is adjusted for 5 kHz deviation with -63.2 dBV, 1 kHz tone at the input to the transmitter). The audio is then fed to the tuning voltage pin 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 is provided to ensure frequency stability with changes in battery voltage.

The VCO is capable of tuning from 782 to 810 MHz with a 1 to 4 volt tuning voltage range. (Different VCO's are required for MB and KK models). At the output of the VCO, the RF signal splits into two paths. The output of the VCO is coupled by C134 to the frequency control pin of the synthesizer U104 pin 8. The synthesizers internal circuitry divides the signal as necessary to the desired reference frequency of 125kHz. The synthesizer contains a reference oscillator circuit operating from a 4.0 MHz quartz crystal Y101 which is adjusted by means of trimmer C123. The transmitter output frequency is user selectable in 125kHz increments from 782 to 806 MHz. (Frequency range and increment size are different for each model. See section VII and Appendix A for details.) Frequency selection is made via microprocessor U101 which interfaces with the user by means of the mode/select switches. The output of the synthesizer is a series of pulses which are integrated by a passive loop filter R121, C130, R122, C129, C130, R123, and C132 to produce a control voltage signal. The control voltage signal is then connected to the VCO through amplifier U106A which is used to isolate the PLL filter from the audio modulation signals.

The VCO output is also coupled to an RF power amplifier through a resistive pad consisting of R127, R128, R129, and R130. The signal is then low pass filtered through U107. The signal is coupled through C144. Transistor Q102 acts as a RF preamplifier stage with typically 8 dB of gain. R131, R132, and R133 provide dc bias to Q102. C145, C146, C147, C149, C150 and L111 are used to decouple the RF off the emitter of Q102, VCC, and +9VDC supply voltages. C152 couples the output of Q102 to low pass filter U108. The signal is then low pass filtered through U108. The signal is coupled through C157. Transistor Q104 acts as a RF amplifier stage with typically 16 dB of gain. L110, R136, R137, and R138 provide dc bias to Q102. C160, C161, C162, C163, C164, C165 and L114 are used to decouple the RF off the emitter of Q104, VCC, and +9VDC supply voltages. L115 and C167 match the output of Q104 to low pass filter U109. The signal is coupled through C173 to the output antennae W101.

The transmitter is capable of delivering +17dbm (50 milliwatts), maximum to the 50 ohm antenna. During transmitter power up and frequency selection the RF power is muted by bringing the gate of Q103 and Q105 high (RFUNMUTE signal is 5 volts). This provides approximately 45dB RF attenuation until the PLL has locked. The transmitter RF power is then unmuted by bringing the gate low (RFUNMUTE). During transmitter power off conditions, the RF power is first muted by bringing the base of Q103 and Q105 high. When the RF is turned off in this manner the carrier signal of the transmitter is not allowed to drift off frequency during power on or power off conditions.

When the external mute switch is closed, the ring and sleeve on the jack are connected or the tip and sleeve can be connected depending on how the switch is wired. If the tip is connected to the sleeve this grounds the IRQ signal line that is connected to the microprocessor. Then, the 33kHz tone key signal is muted (TONEMUTE1). The transmitter RF power is muted by bringing the gate of Q103 and Q104 high (RFUNMUTE1). RF power is turned off via the RFOFF1 signal by muting the VCO and the last RF stage. If the ring is connected to the sleeve this grounds the TKMUTE1. The TKMUTE1 grounds Q4 at the output of the tone key oscillator circuit. This mutes the audio signal immediately.

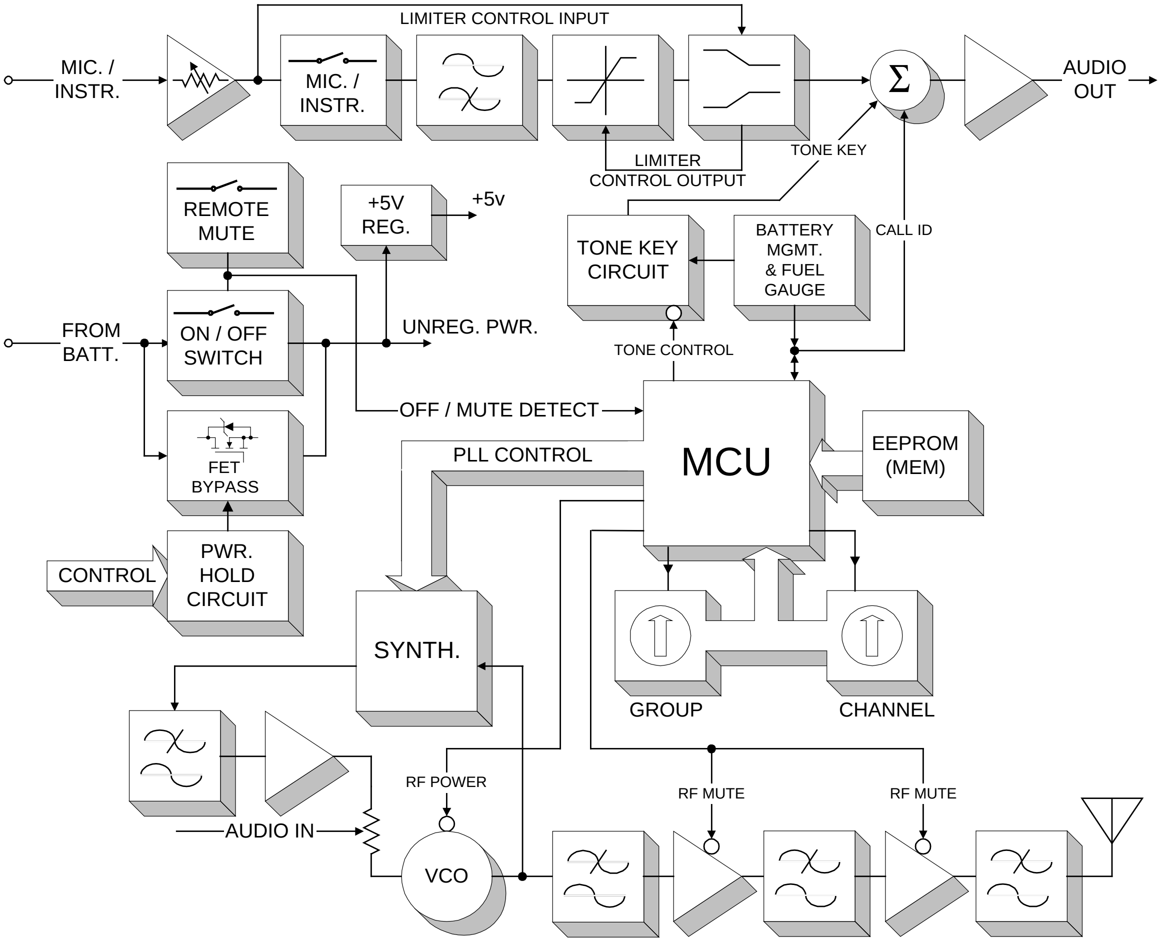

Figure 1
Block Diagram of the UC1B Body Pack Transmitter

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1	Production Release

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Digital Section

1.0 General Description

The Digital Section consists of following circuitry blocks:

1.0.0 Microcontroller Section

It consists of U101 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 C117, C118, and Y102. U103, R106, and C120 form the reset circuit. U103 is the reset IC that resets U101 microcontroller if the 5 V normal operating voltage falls below 4.3 V. R115 and C119 form the power supply filter circuit.

1.0.1 Memory section

It consists of U102, 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. 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. R103 and R108 resistors allow the clock and data lines to be driven independent of the microcontroller port pin states during in-circuit programming of 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 U101 microcontroller must shut down the transmitter. Resistors R104 and R105 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, mutes the RF output, and power downs the RF output amplifier section. The current drawn from the 9 V battery in this state shall be less than 45 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 (S101) and a 16 position Channel switch (S102) select the transmitter frequency. Both rotary switches share the same U101 microcontroller port pins (3 through 6) for a multiplexed switch read operation. The individual switches are selected by pins 7 and 8 of U101 microcontroller. Resistors R109 through R112 are the pullups for switch position read. Diode packs D101 through D104 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 cannot be filtered 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 position settings the contact on pin 1 is open from the switch common pin and the pull down resistors R114 and R115 force logic low to the U101 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 U101 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 PWRDN1 signal goes to logic low on U101 pin 19. The same signal is also forced low when a remote mute switch closes the ring contact to the sleeve ground. The microcontroller treats both of these events in a similar manner. It 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. If it is the power off condition then the transmitter is shut off. Otherwise, it is the remote mute condition and the transmitter waits here for unmute to occur. PWRDN1 is pulled up back to logic high level when unmute occurs. The RF section repowers and unmuted followed by tone key enable to completely recover from the remote mute condition. When a remote mute switch closes the tip contact to the sleeve ground. The TKMUTE1 signal goes to a logic low which immediately mutes the audio.

1.1 Programmed microcontroller (U101)

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 188D238A and 84A0014A on its label.

1.2 Programming the EEPROM (U102)

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 U102 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. Do not send this header to the EEPROM.

FILENAME	COUNTRY
ucxua1_0	USA
ucxja1_0	Japan (JA)
ucxjb1_0	Japan (JB)
ucxma1_0	Europe
ucxka1_0	U.K.

Table 1

Following is an example how a ucxua1_0.txt, software release 1.0, may look like:

```
ucxua1_0 1.0
080F170817171615151414100D0A0A0909090A0B0C0C0D0D0E0F1111121314140909 0A0B
```

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:

$F_{VCO} = (P*N+A)*F_{OSC}/R$ equation 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 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 and is 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 U102 EEPROM corresponding to an above example of ucxua1_0.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 with respect to (w.r.t.) TP109 (GND1) unless specified otherwise.

1.3.3 Logic high shall imply 5 Vdc ± 5 %. Logic low shall imply 0.0 Vdc ± 20 mVdc.

1.3.5 Apply +9 Vdc ± 1 % to TP7 (+ TERMINAL) w.r.t. TP8 (- TERMINAL). The power supply current drain must be less than 0.500 µA dc.

1.4 <u>Operational description and troubleshooting guide</u>

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

1.4.1 Turn on S202 power switch by flipping it away from W101 antenna connectors.

1.4.2 Immediately after turn on the signal RFOFF1 (U101 pin 15, I111) shall be a logic low. This powers up the RF section of the transmitter. The VCO comes up at its natural frequency. However, the RF amplifier section is still muted. For specifications please refer to the RF section description.

1.4.3 After the RFOFF1 signal changes to a low state. Then the microcontroller sends the frequency data to the PLL synthesizer U104. This serial communication takes place on signal lines CK (serial clock, U104 pin 13 TP155), D (serial data, U104 pin 12 TP156), and LE (load enable, U104 pin 11 TP157) respectively.

1.4.4 After sending data to U204 PLL the muted carrier must lock to the desired frequency. Then the signal RFUNMUTE (U101 pin 16, TP153) changes to a logic high state. This unmutes the RF power amplifier section and transmits at full carrier power. Then the signal TONEMUTE1 (U101 pin 14, TP104) will change to a logic low state. This enables the tone key oscillator in the audio section. A 32.768 KHz audio tone is now modulated on the carrier and the transmitter is completely on.

III **Test Equipment**

1.0	Required test equipment (or approved equivalent).	
1.1	Spectrum analyzer	HP8590L
1.2	Digital multimeter	Fluke 87
1.3	Audio Oscillator	HP8903B
1.4	AC Meter	HP8903B or HP400GL or Tektronix AA501
1.5	Distortion Analyzer	HP8903B or Tektronix AA501
1.6	Frequency Counter	Phillips PM6666 or HP53131A
1.7	Receiver	Shure UC4
1.8	Board Interconnect 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.

Initial Setup

1.0 The rf-digital board and audio board should be connected through the 11 pin board interconnects J101 and J201.
1.1 Apply +9V across the battery terminals, J202 and J203.
1.2 Set the audio gain pot, R7, to minimum.
1.3 Connect audio generator to TPMIC1. For bench testing, the audio generator can be directly connected to the micjack input.
1.4 Turn on the UC1 through SW202.
1.5 Set the Group and Channel switches, S101 and S102, according to the group designators on the board and the following table.

Table 2

Group	Group Code	Group Switch (S101)	Channel Switch (S102)	Carrier Frequency	Tuning Voltage TP130 (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	851.125	2.9	15
MC	F	--	--	--	--	--
--	G	--	--	--	--	--
--	H	--	--	--	--	--

Tuning Voltage / Frequency Alignment

2.1 Turn on the UC1 via SW202.
2.2 Adjust Group and Channel switches for the UC1 based on *Table 2*. Make sure the receiver and spectrum analyzer are also set to the appropriate frequency from *Table 2*.
2.3 Measure the dc voltage at TP130 (tuning voltage line). Adjust the VCO trimmer C510 until the voltmeter reading equals that shown in *Table 2*, ± 0.125 V.
2.4 Adjust the variable capacitor C123 until the frequency counter measurement matches the desired frequency in *Table 2,* ± 1 kHz.

Deviation Adjustment

The following procedure requires a U4S, U4D, 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 Turn off the UC1 and 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 2*.

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 Turn on the UC1 and input a 1kHz tone.

3.2 **Domestic (UA):** Adjust audio input level to give -6.8 dBu ± 0.02 dB (354mV ± 1mV) at TP3 (U201.7).

Japan (JA & JB): Adjust audio input level to give -23.47dBu (52mV ± 1mV) at TP3.

Europe (MB): Adjust audio input level to give -16.3 dBu (118mV ± 1mV) at TP3.

England (KK): Adjust audio input level to give -15.3 dBu (133mV ± 1mV)at TP3.

3.3 Transmit from the UC1 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 R149 until the audio voltmeter at the receiver output 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 TP7 (+ TERMINAL) and the (-) terminal of the power supply to TP8 (- TERMINAL). Connect a DC Voltmeter across the power supply. Connect the audio generator to the mic input.

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 +5 Volt Regulator Test

With the unit turned on and +9V applied to the battery terminals, measure the DC voltage at TP+5. The voltage should be 5V ± 0.2V DC.

4.0 Current Consumption Test

With +9V to the battery terminals, measure the current drain using a DC milliammeter. It should be less than 70mA.

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 TP3 - this is your *1kHz reference level*. Change the audio generator frequency to 100Hz and measure the level at TP3 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 TP3 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. Activate the 30kHz LPF on the audio generator. Set the audio generator output to 1kHz with an amplitude of -5.0 dBu ± 0.1 dB (436mV ± 5mV). The sum of the total harmonic distortion and noise (THD+N) should be less than 0.7%.

7.0 RF Output Power Test

Disconnect the antenna and connect a 50Ω coaxial cable between W101 and ground. Connect the other end to a spectrum analyzer. Set the analyzer center frequency to the transmitter frequency. Set the span to 1 MHz. The unmuted carrier power should be +15dBm ± 2dB and +13dBm ± 2dB for KK models. **JA & JB models should be 8.8dBm ± 1dB.**

8.0 Occupied Bandwidth Test **(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 **(JB models only)**
- Set the transmitter 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 60dBc.

10.0 Tone key Level Test
- View transmitting carrier on the spectrum analyzer with a span of 200kHz.
- Measure the 32.768kHz tone key level to be 22dBc ± 2dB

VI **Agency Approvals**

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

VII **Additional Product Specifications**

SPECIFICATION	
Operating Frequency	782.125 to 805.875 MHz
Number of User Selectable Channels	191 (125 kHz Spacing)
Type of Emission	120KF3E
Oscillator	PLL Controlled Synthesizer
RF Conductive Power Output	15dBm ±2dBm
Frequency Stability	± 50 PPM
Antenna	50 ohm 1/4 wave
Pre-emphasis	470 µsec.
Audio Processing	2:1 Companding
Tone Key Signal	32.786 kHz
Maximum FM Deviation (UA)	45 kHz
Dynamic Range (UA)	> 100dB
Total Harmonic Distortion	< 0.7% (45kHz deviation, 1kHz)
Audio Adjustment Range	-6dB to +40dB of input level
Operating Voltage	6.0 to 9.0 Vdc
Power Consumption	60mA ± 10mA @ 9V
Battery Life	> 8 hrs (Alkaline Battery)

MB Model (Changes from US 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 US model)

Operating Frequency	774.000 to 782.000 MHz (approx)
Number of User Selectable Channels	(25 kHz Spacing) no info yet

JA Model (Changes from US model)

Operating Frequency	797.125 to 805.875 MHz
Number of User Selectable Channels	85 (25 kHz Spacing)
Dynamic Range	> 80dB
Frequency Stability	±20 ppm
Reference FM Deviation 1kHz audio level	5 kHz -23.47dBu (52mV) at TP3
Output Power	+8.8 dBm ±1 dB

JB Model (Changes from US model)

Operating Frequency	806.125 to 809.750 MHz
Number of User Selectable Channels	30 (25 kHz Spacing)
Dynamic Range	> 80dB
Frequency Stability	±20 ppm
Reference FM Deviation 1kHz audio level	5 kHz -23.47dBu (52mV) at TP3
Output Power	+8.8 dBm ±1 dB

KK Model (Changes from US model)

Operating Frequency	838.625 to 861.875 MHz
Dynamic Range	> 80dB
Number of User Selectable Channels	140 (25 kHz Spacing)

VIII Mechanical Specification

1. Overall Dimensions
   3-7/8 inches (98 mm)long x 2-1/2 inches (63 mm)wide x 7/8 inches (23 mm) thick, excluding antenna and belt clip.

2. Weight
   3 oz (142 grams), without battery

3. Housing
   Black ABS Plastic

4. Antenna
   1/4 wavelength, flexible insulated lead wire, 3-3/4 inches (95 mm) long. Conductor construction consists of 6 strand, silver plated cadmium copper alloy. Insulation consists of 0.03 inch wall flexible polyvinyl chloride.

5. Battery
   9 Volt (NEDA 1604A), Alkaline (Duracell MN1604) recommended.

6. Belt Clip
   Stainless steel wire construction, removable.

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 the specification found in Table VII.

Temperature Cycling
5 cycles from -20F (-29C) degrees, to +165F (+74C) degrees, allow 24 hours for stabilization before testing. Units must operate within the specifications found in Table VII and VIII.

Operational Temperature
Operate units within the specifications found in Table VII at +20F (-7C) and +120F (+49C) degrees. Allow three hours for stabilization of each temperature before testing. Units must operate per the specification found in Table VII.

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 the specifications found in Table VII.

Operational Humidity
Operate units as described in the specification found in Table VII 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. The product must meet the specification found in Table VII.

Mechanical Shock (modified Drop Test)
Drop product from a height of 40” onto a hardwood floor. Two units onto each corner, two units onto each edge, and two units on each face. The units must not fracture or battery pop out and pass the specifications found in Table VII.

Electrostatic Discharge
Product will be subjected up to a ± 15 kV air discharge and ± 4 kV contact discharge. Units must operate per the specifications found in Table VII.

X Service Evaluation

1.0 DC Problems - No Power

1.1 Verify battery voltage at U205 pin 6 (TP+9). If it is not there, the supply voltage is not being applied properly or the trace between the battery and U205 has a discontinuity, most likely at the power switch, SW202.

1.2 Verify +5Vdc at TP+5. If it is not +5Vdc, there is either a short from U205 pint 4 to ground, or U205 is bad. Check integrity of capacitors across the +5Vdc line and look for solder shorts. As a last resort, replace U205.

1.3 Vds of Q217 should be -.025Vdc ± .02V. If it is not, make sure battery voltage is getting to the Q217 pin 1. If the battery voltage is being properly applied, replace Q217.

2.0 Unit still ON when power switch is OFF

2.1 Verify integrity of Q218 and replace if necessary.

2.2 Make sure SW202 is connecting and disconnecting its terminals properly during ON/OFF cycles.

3.0 Rf Frequency Problems

3.1 If the carrier is out of specification by less then 40kHz and can’t be corrected by adjusting C123, check the values of C123, C124 & Y101. If these values are correct replace Y101. As a last resort replace the synthesizer U104.

3.2 If the carrier frequency is not between 782 and 810 MHz, or is unstable, the loop is unlocked. Check solder connections at the, VCO, µP (traces LE, D, & CK) and synthesizer U104. Check for 4MHz oscillation at pins 1&2 of U104. If not replace the crystal Y104. Check the values and polarity of the loop filter:R121, R122 R123, C129, C130, C131, C132. Check the bias voltage of U104 pins 3 & 4 and U106 pin 8. As a last resort replace the synthesizer U104. The tuning voltage of the VCO at U104 pin 5 should be approximately 3 volts DC when the transmitter is programmed for 800 MHz operation.

4.0 Low Rf Output Power

4.1 Check the polarity of the lowpass filters U107, U108, and U109 (pin 1 is marked with a dash).
4.2 Under normal operating conditions, the RFOFF1 signal on the RF board changes from +5Vdc at power up and power down to 0v during normal operation. Trace signal to µP. Q101 should be saturated during normal operation.
4.3 Check for missing ground connections.
4.4 Verify the VCO output power at R128 and U104 pin 8
4.5 Check the DC level at the VCO Vcc pin.
4.6 Isolate the VCO from the rest of the circuit by removing R127, R128 and C134. The Carrier frequency will no longer be locked, but the output power from the VCO should be approximately 0 dBm.
4.6 If the power out of the VCO is still low replace the VCO.
4.7 Verify DC bias of Q102 and Q104. Verify RF Mute signal changes from +5v at power up and power down, to 0v during normal operation. If Q103 and Q105 are not saturated during normal operation the RF power at the antenna port will be attenuated by about 45dB.
4.8 Isolate components starting from the antenna port and working back to the RF power amp.
4.9 Remove the lowpass filter and check the power out of the amplifier.
4.10 Check the values of the output matching network for Q102 and Q104, C258, L206, C256. Look for open coils.
4.11 Check the values of bypass capacitors.
4.12 As a last resort replace the transistors.

5.0 Excessive Current Drain

5.1 Verify that supply voltages, +9Vdc and +5Vdc, are correct. If not, follow instructions for “DC Problems - No Power”.
5.2 Isolating different sections of circuit: RF, Audio, and Digital. Look for reversed polarity capacitors or wrong resistor values.

6.0 Deviation Problems

6.1 If R149 can’t be adjusted to obtain 45 kHz deviation, apply a 1kHz signal at 0dBu to the audio input. Verify ac voltages at each gain stage match schematic. At stages that don’t match the schematic, check for bias and gain structure problems in that stage.
6.2 Verify the correct value for R149.
6.3 To check the RF section, set the transmitter frequency to 800 MHz and verify the tuning voltage of the VCO U104 pin 5 is approximately 3V DC.

ISS	RECORD OF CHANGES MADE
1	Production Release

EXP. DWG. NO. 16914
ORIG USED IN

SHURE BROTHERS INC.
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EVANSTON, IL 60202
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CHECKED
APPROVED K. Mikes 8/13/98
APPROVED