PARTS LIST / TUNE UP INFORMATION

This exhibit contains a list of the semiconductor devices used in the transceiver and the test equipment and tuning procedures for maintaining the transceiver.

EXHIBIT 11A Function of RF Semiconductors and Other Active Devices

EXHIBIT 11B List of Recommended Test Equipment for Servicing

EXHIBIT 11C Tune Up Information

Exhibit 11A - Function of RF Semiconductors & Other Active Devices

REF NO.	PART NUMBER	CIRCUIT APPLICATION	OPERATING FREQUENCY	INDUSTRY EQUIVALENT
CR1201	4802245J22	REF OSC FREQ CONTROL	16.8 MHz	1T363
CR1202	4813825A05	VOLTAGE MULTIPLIER	1.05 MHz	MMBD301
CR1302	4805649Q14	RX VCO FREQ CONTROL	52.7-60.7 MHz	HN1V02H
CR1306	4880154K03	RX VCO AGC RECTIFIER	52.7-60.7 MHz	MMBD353
CR1310	4805649Q14	TX VCO FREQ CONTROL	42-50 MHz	HN1V02H
CR1314	4880154K03	TX VCO AGC RECTIFIER	42-50 MHz	MMBD353
D0101	4880236E05	DATA SWITCH	230 kHz	MMBD301
D0151	4813833C02	DC SWITCH	DC	MMBD6100
D0179	4813833C02	CLAMP	DC	MMBD6100
D0301	4802245J47	DC SWITCH	DC	RB471E
D0621	4813833C02	DC SWITCH	DC	MMBD6100
D0651	4813833C02	DC SWITCH	DC	MMBD6100
D0660	4813833C02	DC SWITCH	DC	MMBD6100
D0661	4813833C02	DC SWITCH	DC	MMBD6100
D1001	4880154K03	CLIPPER	42-50 MHz	MMBD353
D1101	4880154K03	CLIPPER	10.7 MHz	MMBD353
D1401	4808379X02	RF PIN SWITCH	42-50 MHz	MA4P1450
D1402	4808379X02	RF PIN SWITCH	42-50 MHz	MA4P1450
D1501	4880236E05	DC SWITCH	DC	MMBD301
D1601	4880236E05	CLIPPER	100 kHz	MMBD301
Q0110	4880048M01	DC SWITCH	DC	DTC144EKA
Q0151	4880048M01	DC SWITCH	DC	DTC144EKA
Q0171	4880048M01	DC SWITCH	DC	DTC144EKA
Q0173	4880052M01	DC SWITCH	DC	RXT-A28
Q0177	4880048M01	DC SWITCH	DC	DTC144EKA
Q0181	4880048M01	DC SWITCH	DC	DTC144EKA
Q0183	4880048M01	DC SWITCH	DC	DTC144EKA
Q0185	4880048M01	DC SWITCH	DC	DTC144EKA
Q0271	4813824A10	DC SWITCH	DC	MMBT3904
Q0331	4805921T02	DATA SWITCH	1 MHz	FMC2A
Q0641	4880048M01	DC SWITCH	DC	DTC144EKA
Q0661	4805921T02	DC SWITCH	DC	FMC2A
Q0662	4813824A10	DC SWITCH	DC	MMBT3904
Q0663	4880048M01	DC SWITCH	DC	DTC144EKA
Q0681	4880052M01	DC VOLTAGE SOURCE	DC	RXT-A28
Q1001	4880173R01	RF AMPLIFIER	42-50 MHz	MMBR951
Q1002	4813824A17	RF AMPLIFIER BIAS CONTROL	DC	MMBT3906
Q1003	4813824A17	DC SWITCH	DC	MMBT3906

REF NO.	PART NUMBER	CIRCUIT APPLICATION	OPERATING FREQUENCY	INDUSTRY EQUIVALENT
Q1101	4813827A07	FIRST I-F AMPLIFIER	10.7 MHz	MMBR941
Q1102	4813823A05	I-F NOISE BLANKER SWITCH	10.7 MHz	MMBFU310L
Q1103	4813823A05	I-F NOISE BLANKER SWITCH	10.7 MHz	MMBFU310L
Q1104	4813823A05	I-F ISOLATION BUFFER	10.7 MHz	MMBFU310L
Q1106	4813827A07	SECOND I-F AMPLIFIER	10.7 MHz	MMBR941
Q1201	4813824A17	SUPER FILTER PASS DEVICE	DC	MMBT3906
Q1202	4880173R01	FEEDBACK BUFFER AMPLIFIER	42-60.7 MHz	MMBR951
Q1303	4880141L06	RX VCO	52.7-60.7 MHz	MMBFU310
Q1304	4880173R01	RX VCO FIRST BUFFER AMP	52.7-60.7 MHz	MMBR951
Q1305	4880173R01	RX VCO SECOND BUFFER AMP	52.7-60.7 MHz	MMBR951
Q1306	4880141L06	TX VCO	42-50 MHz	MMBFU310
Q1307	4880173R01	TX VCO FIRST BUFFER AMP	42-50 MHz	MMBR951
Q1308	4880173R01	TX VCO SECOND BUFFER AMP	42-50 MHz	MMBR951
Q1401	5105385Y70	TX DRIVER STAGE	42-50 MHz	85Y70
Q1402	4886136B01	TX FINAL POWER AMPLIFIER	42-50 MHz	36B01
Q1403	4886136B01	TX FINAL POWER AMPLIFIER	42-50 MHz	36B01
Q1501	4880141L03	DC SWITCH	DC	BCW68G
Q1502	4813824A10	DC SWITCH	DC	MMBT3904
Q1503	4813824A10	ERROR AMPLIFIER	DC	MMBT3904
Q1504	4813824A10	DC AMP/LEVEL SHIFTER	DC	MMBT3904
Q1505	4813824A17	DC AMP/LEVEL SHIFTER	DC	MMBT3906
Q1506	5180159R01	VOLTAGE REGULATOR	DC	IMX1
Q1601	4813824A17	DC SWITCH	DC	MMBT3906
Q1602	4880048M01	DC SWITCH	DC	DTC144EKA
Q1603	4813824A10	IMPULSE NOISE DETECTOR	100 kHz	MMBT3904
Q1604	4813824A10	PULSE AMPLIFIER	100 kHz	MMBT3904
Q1605	4813824A10	PULSE SHAPER	100 kHz	MMBT3904
Q1606	4813824A17	PULSE AMPLIFIER	100 kHz	MMBT3906
Q1607	4813824A10	PULSE RATE AMPLIFIER	100 kHz	MMBT3904
Q1608	4813824A10	PULSE RATE AMPLIFIER	100 kHz	MMBT3904
Q1609	4813824A17	PULSE RATE DETECTOR	100 kHz	MMBT3906
Q1610	4805585Q17	NOISE BLANKER I-F AMPLIFIER	10.7 MHz	NE25139
U0101	5102226J56	MICROPROCESSOR	38.4 kHz-7.4 MHz	MC68HC11FL0
U0111	5102463J64	EEPROM	1 MHz	X25128_2.7
U0121	5186137B01	FLASH ROM	1.85 MHz	AT49F040
U0122	5185963A21	SRAM	1.85 MHz	63A21
U0141	5113805A30	DECODER/DEMUX	5 kHz	MC74HC138A
U0211	5183222M49	AUDIO AMPLIFIER	AUDIO	MC3403
U0221	5185963A53	AUDIO FILTER	16.8 MHz	63A53
U0251	5113806A20	AUDIO GATE	AUDIO	MC14053B
U0271	5109699X01	AUDIO POWER AMPLIFIER	AUDIO	TDA1519C

REF NO.	PART NUMBER	CIRCUIT APPLICATION	OPERATING FREQUENCY	INDUSTRY EQUIVALENT
U0301	5102463J53	VOICE STORAGE	1 MHz	ISD33000
U0341	5180932W01	AUDIO AMPLIFIER	AUDIO	LM2904
U0342	5105750U28	AUDIO GATE	AUDIO	TC4S66F
U0351	5102463J40	VOLTAGE REGULATOR	DC	LP2951ACMM-3.3
U0611	5183308X01	VOLTAGE REGULATOR	DC	LM2941
U0641	5183308X01	VOLTAGE REGULATOR	DC	LM2941
U0651	5113816A07	VOLTAGE REGULATOR	DC	MC78M05
U0652	5113815A02	RESET MONITOR	DC	MC33064
U1001	4802245J50	DC SWITCH	DC	UMC5N
U1051	5108278X01	DOUBLE BALANCED MIXER	10.7-60.7 MHz	78X01
U1103	5186144B01	RECEIVER SYSTEM	455 kHz-10.7 MHz	SA616
U1201	5185963A27	FREQUENCY SYNTHESIZER	1.05-60.7 MHz	63A27
U1250	5185963A33	VOLTAGE REGULATOR	DC	LP2951
U1377	4802245J50	DC SWITCH	DC	UMC5N
U1378	4802245J50	DC SWITCH	DC	UMC5N
U1401	5105109Z67	GAIN CONTROLLED AMPLIFIER	42-50 MHz	09Z67
U1402	5113818A03	DC AMPLIFIER	DC	MC33072
U1501	5185963A15	TEMPERATURE SENSOR	DC	LM50
U1502	5180932W01	DIFFERENTIAL AMPLIFIER	DC	LM2904
U1503	5185765B01	TX POWER CONTROL	1 MHz	H99S-4
U1601	5180929W01	GAIN CONTROLLED AMPLIFIER	10.7 MHz	MC1350
VR0151	4813830A15	DC LEVEL-SENSING SWITCH	DC	MMBZ5232B
VR0501	4805656W09	ESD PROTECTION	DC	MMQA20VT1
VR0503	4805656W09	ESD PROTECTION	DC	MMQA20VT1
VR0504	4813830A40	ESD PROTECTION	DC	MMBZ5257B
VR0505	4805656W09	ESD PROTECTION	DC	MMQA20VT1
VR0509	4813830A40	ESD PROTECTION	DC	MMBZ5257B
VR0510	4813830A40	ESD PROTECTION	DC	MMBZ5257B
VR0537	4813830A15	ESD PROTECTION	DC	MMBZ5232B
VR0541	4813830A27	ESD PROTECTION	DC	MMBZ5244B
VR0601	4813832C77	TRANSIENT SUPPRESSOR	DC	MR2835S
VR0621	4813830A14	VOLTAGE REGULATOR	DC	MMBZ5231B
VR1501	4813830A27	VOLTAGE REGULATOR	DC	MMBZ5244B

COMMENTS: The Motorola designators are special code numbers for active devices used in Motorola radios. These devices are either identical or derived from the device family listed under Industry Equivalent, by the manufacturer or are proprietary to Motorola. Service people do not have access to any cross-references or given any information on proprietary devices and are prevented from making unauthorized substitution.

Exhibit 11B - List of Recommended Test Equipment for Servicing

Instrument	Recommended Type	Application
RF Signal Generator *	HP 8656B or equivalent	Receiver Measurements
Modulation Analyzer *	HP 8901B or equivalent	Frequency and Deviation Measurements
Audio Analyzer *	HP 8903A or equivalent	Receiver Measurements
Power Meter *	HP 438A or equivalent	Transmitter Power Output
Power Sensor *	HP 8482A or equivalent	Transmitter Power Output
DC Power Supply	0-20 volts at 15 amps	
Attenuator Pad *	50 □, 75 Watts, 30 dB	Transmitter Measurements
DC Ammeter	30 mA to 20 A	Current Drain Measurements
Computer	IBM PC, PC/XT or PC/AT	Radio Alignment
Radio Interface Box	HLN9214	Computer Interface to Radio
Cable	HKN9215 or HKN9216	From RIB to Computer
Cable	HKN9217	From RIB to Radio
Software	HVN9015	Radio Alignment

* These items can be replaced by a Motorola 2000 Series Communications System Analyzer or equivalent piece of integrated communications test equipment.

Exhibit 11C - Tune Up Information

All transmitter adjustments are performed by electronic means. The transmitter contains no electromechanical components for the purpose of transmitter tuning or adjustment.

The tuning elements that are used for transmitter adjustment are:

Location	Type of Element	Function
U0101	Microcomputer	Supplies data to Audio Filter IC, Fractional-N Synthesizer, Temperature Compensated Crystal Oscillator, and Power Control IC for Transmitter Modulation, Frequency and Power Adjustment
U3201	Programmable Attenuator	VCO Modulation Sensitivity
U3201	Programmable Attenuator	Reference Modulation Sensitivity
U0221	Programmable Attenuator	Deviation Adjustment
U3201	Temperature Compensated Crystal Oscillator	Transmitter Frequency Adjustment
U3501	Digital to Analog Converter	Transmitter Power Adjustment

The value of a particular tuning element is determined by data sent to that tuning element by microcomputer U0101. This data is generated by the microcomputer based on tuning information that is stored in the microcomputer's EEPROM (Electrically Erasable Programmable Read Only Memory).

Tuning information is stored in the EEPROM during factory adjustment or by qualified field service facilities, using the attached procedure and recommended test equipment.

TUNING PROCEDURE

This procedure was written in the sequence the radio is to be tuned. The following points should be noted:

1) Table 1 shows the frequencies to be used for tuning receive, transmit and synthesizer circuits. To reduce tuning times, not all the frequencies are used for tuning each parameter. Table 19 shows which frequencies to use.
2) Radio controller refers to the microprocessor in the radio.
3) Tester/test controller refers to external test system (hardware as well as software).
4) Values in tables may change to improve yield.
5) Radios may not support all combinations of signalling modulation. Deviation should only be adjusted on the modulation types actually available in the radio.
6) The mobile radio tuning and testing must be performed at a supply voltage of 13.2V unless otherwise specified.

1. REFERENCE OSCILLATOR WARPING

Adjustment of the reference oscillator is critical for proper radio operation. Improper adjustment will not only result in poor operation, but also a misaligned radio that will interfere with other users operating on adjacent channels. For this reason, the reference oscillator should be checked every time the radio is serviced. The frequency counter used for this procedure must have a stability of 0.1 ppm (or better).

General Tuning Procedure

(1) Set the power supply to 13.2V and power up the radio.

(2) Set the radio to the **Carrier Squelch Environment**.

(3) Disable modulation **(Environment Override)** and remove any audio input signals to minimize frequency inaccuracy

(4) Set the radio to the transmit frequency indicated in table 19.

(5) Key up the radio.

(6) Measure the transmit frequency and compare it with the specification limits shown in table 10.

(7) If the measured frequency is within the specification limits.

  (A) Dekey the radio.

  (B) **Reference Oscillator Tuning** done.

(8) If the measured frequency is outside the specification limits.

  (A) Read the codeplug value for the **Oscillator Warp**. While the transmit frequency is outside the specification limits.

    (i) Update the IC value of the **Oscillator Warp** without codeplug update.

    (ii) Re-measure the transmit frequency and compare it with the specification limits.

    (iii) Repeat steps (i) (ii) until the transmit frequency is within the specification limits.

  (B) Write the value of the tuned **Oscillator Warp** to the codeplug.

  (C) Dekey the radio.

  (D) **Reference Oscillator Tuning** done.

2. PA BIAS TUNING

This procedure must be done before the transmitter is keyed the first time. To avoid FET device damage care must be taken not to exceed the drain current and dissipation limits of the devices by setting a too high bias voltage during tuning. The use of a power supply with an appropriate current limitation setting is recommended. The tune procedure should be done as fast as possible to keep the device temperature low and to achieve the required quiescent current accuracy.

The following tuning procedure does not simply determine the settings for the PA Bias Voltage DACs, it also provides a gain balancing between the device, used to control the RF output power, and the PA FET devices. If the hardware has the control voltage DAC and the PA bias voltage DAC connected via a resistive network, the bias voltages will be modified along with the control voltage for any selected power level. This will maintain gain and power dissipation balanced over a wide RF output power range. For these radios the value **Control Voltage Limit** in table 8 is set to 0. Radios which have the control voltage and the bias voltages connected via diodes will require to preset the

control voltage DAC. For these radios the value **Control Voltage Limit** in table 8 is set to a value higher than 0. Tuning of the **PA Voltage Limit** is then skipped in the procedure below.
List of variables used in the tuning procedure:

- **VL0_B0_CURRENT**: DC current with **Control Voltage** and all **PA Bias Voltages** set to zero.
- **VL_B0_CURRENT:** DC current with **Control Voltage** set for a specified PA current and all **PA Bias Voltages** set to zero.
- **PA Voltage Bias [n]:** DC current with **Control Voltage** set for a specified PA current, **PA Voltage Bias [n]** set for a specified quiescent current of **FET[n]** and all remaining **PA Bias Voltages** set to zero.

General Tuning Procedure

(1) Set the power supply to 13.2V and power up the radio.

(2) Set the radio to **PA Bias Voltage Test Environment**. The IC values for **PA Voltage Limit** and **PA Voltage Bias 1...3** are set to zero and for **Transmit Power** to maximum.

(3) If the value of **Control Voltage Limit** in table 8 for the radio model is greater than 0

(A) Set the IC value of the **PA Voltage Limit** without codeplug update to the value of **Control Voltage Limit**.

(B) Measure the DC current the radio draws from the power supply. Note the measured current as **VL_B0_CURRENT**. This is the DC current with all PA Bias Voltages switched off and is used as reference for the following steps.

(4) If the value of **Control Voltage Limit** in table 8 for the radio model is 0

(A) Measure the DC current the radio draws from the power supply. Note the measured current as **VL0_B0_CURRENT**. This is the DC current with all PA devices switched off and is used as reference for the following steps.

(B) If the measured current is outside the limits specified for **VL_B0_CURRENT** in table 8:

(i) While the measured DC current is outside the limits specified for **VL_B0_CURRENT**:

(a) Modify the IC value of the **PA Voltage Limit** without codeplug update.

(b) Re-measure the DC current the radio draws from the power supply. Note the measured current as **VL_B0_CURRENT** and compare the value with the specified limit.

(c) Repeat steps (i)(ii) until the measured DC current **VL_B0_CURRENT** is within the specified limits.

NOTE: If the current did not increase although the IC value of the **PA Voltage Limit** has reached the maximum value $7F, the radio hardware has a failure. Tuning should then be terminated without updating the codeplug.

(C) The quiescent current of the device, which controls the output power, is now set to a defined value. The current **VL_B0_CURRENT** is used as reference for the following steps.

(5) This procedure is to be performed for all supported **PA Voltage Bias Softpots**. Radios can have up to 3 PA FET devices which require tuning. Tuning must be done in the sequence **Bias 1, 2, 3 (n=1, 2, 3)**. If less than 3 PA FET devices are used, the radio will respond with an unsupported opcode message when trying to read the softpot. This is the indication that no further bias softpots require tuning and the tuning procedure is done.

(A) Read the codeplug value for the **PA Voltage Bias [n]**.

(B) If the radio does not support the requested **PA Voltage Bias [n]** Softpot and responds with an unsupported opcode message

(i) Set the radio to **Carrier Squelch Test Environment** and the lowest power level.

(ii) **PA Bias Tuning** done.

3. TRANSMITTER POWER TUNING

Overview: The softpots used for PA power setting do not contain the DAC values directly like they do in the portable radio. Instead they store the parameters (Mcp, Kcp) for approximation of the dependency between power and DAC setting. This procedure allows to set any power within the range of the PA without retuning. The PA output power (Pcp) levels are stored in the softpots for HIGH and LOW POWER. The following equations are used to calculate the DAC value for the desired power.

$$DAC\ PWR\ SET = 100 \cdot \frac{Pcp \cdot Kcp \cdot 128}{Mcp} \qquad \textbf{Equ. 1}$$

$$Pcp = 25 \cdot \sqrt{desired\ power} \qquad \textbf{Equ. 2}$$

The power is not stored directly in the softpots to avoid square root calculation by the radio software.

General Tuning Procedure

The **PA Bias** must already be tuned for this procedure to be valid.

(1) Set the power supply to 13.2V and power up the radio.

(2) Read the tuning parameters from the radio and determine the values for **DAC1** and **DAC2**.

(3) Set the radio to the **Carrier Squelch Environment** and **highest Transmit Power Level**.

(4) Disable modulation **(Environment Override)** and remove any audio input signals to minimize frequency inaccuracy.

(5) This procedure is to be performed for all **Power Tuning Channels** indicated in table 19.

(A) Set the radio to the appropriate transmit frequency.

(B) Key up the radio.

(C) Set the IC value of the **PA Control Voltage Limit** to maximum ($3F) without codeplug update.

(D) Set the IC value of the **Transmit Power** to the value **DAC1**.

(E) Measure the transmit power and note the value as **P1**.

(F) Set the IC value of the **Transmit Power** to the value **DAC2**.

(G) Measure the transmit power and note the value as **P2**.

(H) Dekey the radio.

(I) Calculate Mcp and Kcp with the following equations:

$$M = \frac{\sqrt{P2} - \sqrt{P1}}{DAC2 - DAC1} \quad \textbf{Equ. 3}$$

$$Mcp = 2500 \times M \quad \textbf{Equ. 4}$$

$$Kcp = 128 \times 25 \times \sqrt{P1} \times M \times DAC1 \quad \textbf{Equ. 5}$$

(J) Write the values Kcp and Mcp the codeplug.

(K) Repeat steps (A) to (J) for all the channels that require actual tuning. Values for the untuned channels are to be interpolated by the test controller and programmed into the codeplug.

(6) **Transmit Power Tuning** done.

4. MODULATION BALANCE TUNING

"Modulation Balance" balances the modulation sensitivity of the VCO and reference modulation (synthesizer low frequency port) lines. Balance algorithm is critical to the operation of signalling schemes that have very low frequency components (e.g. PL) and could result in distorted waveforms if improperly adjusted. The radio stores only one set of tuning data for all supported channel spacings (12.5, 20 and 25 kHz). Therefore, tuning should only be performed for 25 kHz channel spacing.

General Tuning Procedure

(1) Set the power supply to 13.2V and power up the radio.

(2) Set the radio to the **External Signal Modulation Balance Environment**, to **25kHz Channel Spacing** and to the lowest transmit power level to reduce current drain during tuning.

(3) This procedure is to be performed for all **Modulation Balance Attenuator Tuning Channels** indicated in table 19.

(A) Set the radio to the appropriate Modulation Balance Attenuator Tuning Channel.

(B) Remove any audio signals applied to any audio inputs to avoid a transmit frequency offset.

(C) Key up the radio.

(D) Update the IC value of the **VCO Attenuator** to its maximum setting ($255) without codeplug update.

(E) Apply an **80Hz tone @ 100mV RMS** to the **Auxiliary Transmit Audio Path.**

(F) Measure the transmit deviation, note the value as **D1**.

(G) Apply an **3kHz tone @ 100mV RMS** to the **Auxiliary Transmit Audio Path.**

(H) Measure the transmit deviation, note the value as **D2**.

(I) Find the ratio of the measured transmit deviation values in dBs using equation **20*log(D1/D2)**.

(J) If the ratio of the measured transmit deviations is within **0.15 dB**

(i) Dekey the radio.

(ii) **Modulation Balance Tuning** for the set **Tuning Channel** done. Continue with step (A) for the next **Modulation Balance Attenuator Tuning Channel**

(K) If the ratio of the measured transmit deviations is **NOT** within **0.15 dB**

(i) Read the codeplug value for the **Modulation Balance Attenuator**.

(ii) While the ratio of the measured transmit deviations is outside the specification limits.

(a) Disable modulation **(Environment Override)** to minimize frequency offset.

(b) Update the IC value of the **Modulation Balance Attenuator** without codeplug update.

(c) Enable modulation **(Environment Override)**.

(d) Repeat steps (E) to (I).

(e) Repeat steps (a) to (d) until the ratio of the measured transmit deviations is inside the specification limits

NOTE 1: Modulation must be removed from the Fractional–N Synthesizer while it is being programmed.

(iii) Dekey the radio.

(iv) Write the value of the tuned **Modulation Balance Attenuator** to the codeplug.

(v) **Modulation Balance Tuning** done.

5. MODULATION LIMIT TUNING

Modulation limit tuning sets the maximum deviation of the carrier. The radio stores only one set (7 values across the frequency band) of tuning data for 25kHz channel spacing. Therefore, tuning across the frequency band must only be performed for 25 kHz channel spacing. For 12.5 and 20kHz channel spacings an offset value in the codeplug is used to reduce the deviation. The offset value should be tuned at one frequency only.

General Tuning Procedure

The **Modulation Balance Tuning** must already be done for this procedure to be valid.

(1) Set the power supply to 13.2V and power up the radio.

(2) Set the radio to the **Carrier Squelch Environment**, to **25kHz Channel Spacing** and to the lowest transmit power level to reduce current drain during tuning.

(3) Enable the microphone path **(Environment Override)**.

(4) This procedure is to be performed for all **Modulation Limit Tuning Channels** indicated in table 19.

(A) Set the radio to the appropriate **Modulation Limit Tuning Channel**.

(B) Remove any audio signals applied to any audio inputs to avoid a transmit frequency offset.

(C) Key up the radio.

(D) Apply an **1kHz tone @ 800mV RMS** to the **External Microphone Audio Path.**

(E) Measure the transmit deviation and compare it with the specification limits in table 18a.

(F) If the measured transmit deviation is within the specification limits

(i) Dekey the radio.

(ii) **Modulation Limit Tuning** for the set **Tuning Channel** done. Continue with step (A) for the next **Modulation Limit Tuning Channel**

(G) If the measured transmit deviation is outside the specification limits

(i) Read the codeplug value for the **VCO Attenuator**.

(ii) While the measured transmit deviation is outside the specification limits.

(a) Update the IC value of the **VCO Attenuator** without codeplug update.

(b) Re-measure the transmit deviation and compare it with the specification limits.

(c) Repeat steps (a) (b) until the measured transmit deviation is inside the specification limits

(iii) Dekey the radio.

(iv) Write the value of the tuned **VCO Attenuator** to the codeplug.

(v) VCO Attenuator Tuning for the set **Tuning Channel** done. Continue with step (A) for the next **Modulation Limit Tuning Channel**

(5) This procedure is to be performed for all remaining **Modulation Limit Tuning Channel Spacings (20kHz)** and the **Modulation Limit Tuning Channel** indicated in table 19.

(A) Enable the microphone path **(Environment Override)** and set the appropriate **Modulation Limit Tuning Channel Spacing**.

(B) Set the radio to the appropriate VCO Attenuator Tuning Channel for the set channel spacing.

(C) Remove any audio signals applied to any audio inputs to avoid a transmit frequency offset.

(D) Key up the radio.

(E) Apply a **1kHz tone @ 800mV RMS** to the **External Microphone Audio Path**.

(F) Measure the transmit deviation and compare it with the specification limits in table 18a.

(G) If the measured transmit deviation is within the specification limits

(i) Dekey the radio.

(ii) VCO Attenuator Tuning for the set **Channel Spacing** done. Continue with step (A) for the next **Modulation Limit Tuning Channel Spacing**

(H) If the measured transmit deviation is outside the specification limits

(i) Read the codeplug value for the **VCO Attenuator**.

(ii) While the measured transmit deviation is outside the specification limits.

(a) Update the IC value of the **VCO Attenuator** without codeplug update.

(b) Re-measure the transmit deviation and compare it with the specification limits.

(c) Repeat steps (a) (b) until the measured transmit deviation is inside the specification limits

(iii) Dekey the radio.

(iv) Write the value of the tuned **VCO Attenuator** to the codeplug.

(v) **Modulation Limit Tuning** for the set **Tuning Channel** done. Continue with step (A) for the next **Modulation Limit Tuning Channel.**

(vi) **Modulation Limit Tuning** done.

6. Tables FOR TUNING

Table 1 **Default Tune and Test Frequencies**

Freq	Low Band R3 RX	Low Band R3 TX
F1	42.025	42.125
F2	43.125	43.225
F3	44.425	44.525
F4	46.025	46.125
F5	47.425	47.525
F6	48.025	48.125
F7	49.625	49.725

Table 8 **PA FET Bias Tuning Parameter Values**

RF Band	PA Control Voltage Limit	VL_B0 Current / mA	VL_B1 Current / mA	VL_B2 Current / mA	VL_B3 Current / mA	Freq.
Low Band R3	95 dec		10 □ 15%	100 □ 15%	100 □ 15%	F7

Table 10 **Warping Target (25 C setting)**

RF Band	Frequency Error at F7
Low Band	+/- 50 Hz

Table 2 **PA Output Power Test Windows**

RF Band	PA Type	Low Power Level	High Power Level
Low Band	40 – 60 W	41 – 44 W	61 – 68 W

Table 18a **Reference Voice Deviation Tuning Limits**

Channel Spacing	Deviation
20 kHz	4.40 – 4.60 kHz

Table 19 Tuning Profile

	F1	F2	F3	F4	F5	F6	F7
Ref Osc Warp	□	□	□	□	□	□	Tune
TX Power	Tune	Calc.	Calc.	Tune	Calc.	Calc.	Tune
Modulation Balance	Tune	Tune	Tune	Tune	Tune	Tune	Tune
Deviation Limit (Voice)	Tune	Calc.	Calc.	Tune	Calc.	Calc.	Tune

NOTES: □ = No tuning required
Calc. = Linear interpolation using adjacent tune values
CFx = Use value obtained for Fx
OFx = Use offset calculated for Fx
Fixed = Use a fixed value (see appropriate table)