8.6 PROGRAMMING

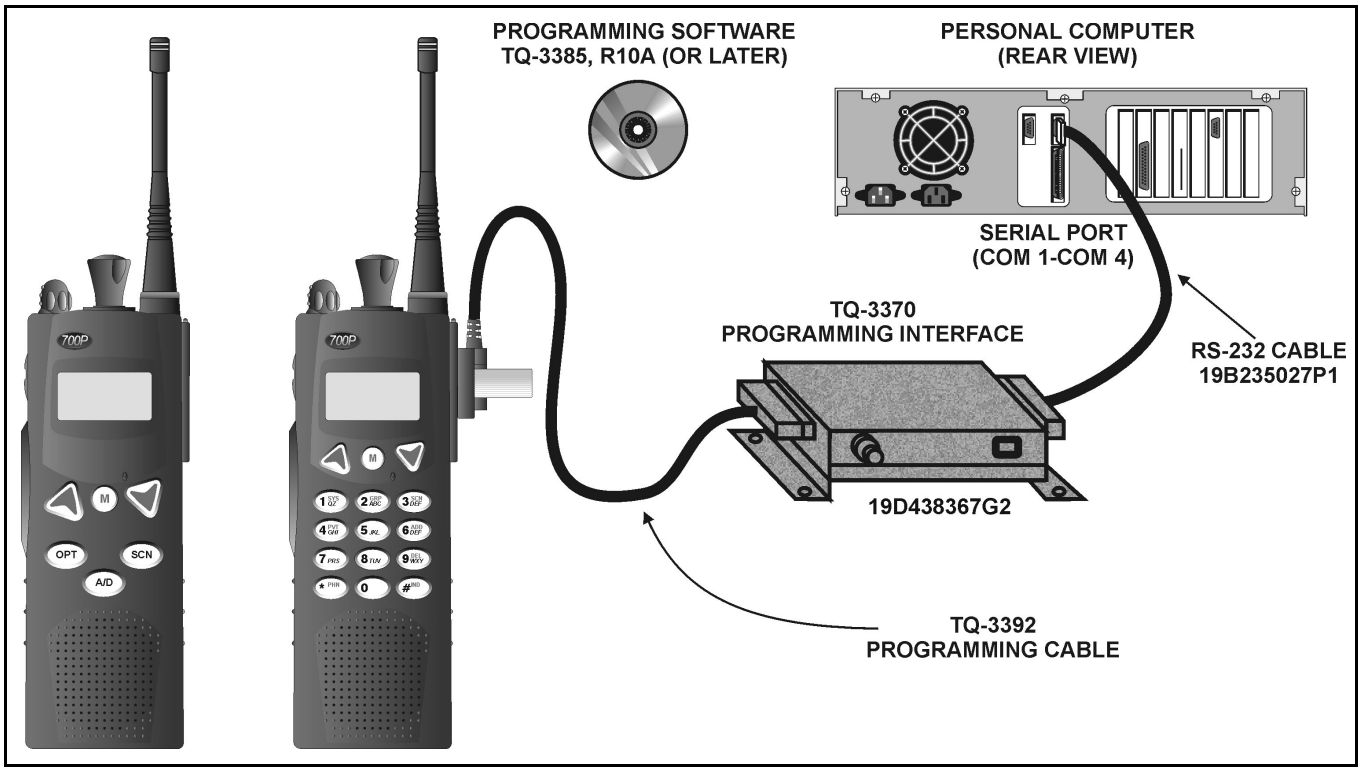

Figure 8-2: JAGUAR Programming Setup

8.6.1 Personality Programming

M/A-COM's ProGrammer **TQ-3385** *(R10A or later)* is used to edit, read, or write the personality to the radio. A *personality* is a computer file created by the user of the program. The file contains the data that directs certain operating characteristics and frequencies of the radio unit. The personality is then downloaded and stored in the radio.

ProGrammer software communicates with the radio through the TQ-3370 programming interface module. Figure 8-2 shows a diagram of the Programming Setup required to program the radio. Refer to ProGrammer On-Line Help "Programming the Radio" section for detailed programming instructions.

8.6.2 Flash Programming

The "Flash" software is the current version of the JAGUAR 700P/Pi radio operating software. When changes and enhancements are made to the operating code, the new operating code can be "flashed" to the radio, upgrading the operating code without any hardware changes to the radio. Flash software is a computer file read from a disk and downloaded to the radio using ProGrammer. Figure 8-2 shows an equipment setup diagram to program new flash to the radio and is the same as the Personality Programming setup.

8.6.3 Programming Mode

ProGrammer cannot communicate with the radio unless the radio is in the programming mode. Perform the following steps to place the radio in the programming mode:

1. Ensure the radio is powered OFF.

2. Press and hold the **PTT** and **Clear/Monitor** and **Option** buttons.
3. Power the radio ON. Release the buttons.
4. All pixels on the display should be lit until files are transferred.

8.7 RADIO CALIBRATION

Tracking and Feature Encryption Data

The JAGUAR 700P/Pi portable radios depend upon tracking and feature encryption data specific to each individual radio for its proper and legal performance. ***Before this radio is used, programmed, or serviced in any manner, perform the procedure in Section 8.7.7.***

Should anything happen to the radio resulting in the corruption or loss of tracking or feature encryption data, the data can be restored using the "Radio Maintenance" application of ProGrammer and previously copied and stored tracking and feature encryption data files.

8.7.1 General

Replacement of major components in the transmitter or receiver circuits may require adjustment of some Tracking Data values for optimum performance. The adjustment procedure is described in this section. Acceptable limits for each parameter are also given.

The radio software contains certain information bytes known as Tracking Data that allow the radio computer to control transmitter power, modulation characteristics, RSSI level, squelch opening threshold, and reference oscillator frequency. Normally, no adjustments to the tracking data are necessary to maintain specified limits for all related functions, since the radio computer makes the necessary adjustments using the Tracking Data established at the factory. However, should hardware that stores, uses or is affected by Tracking Data levels (major transmit or receive circuit components) be replaced, it may be necessary to establish new Tracking Data to restore calibrated performance. Additionally, if the Tracking Data is lost or corrupted, specialized procedures are required to load new Tracking Data (see Section 8.7.7).

8.7.2 Situation Requiring New Tracking Data

Tracking Data is set at the factory and normally need not be reloaded. However, some component replacements can corrupt Tracking Data and may result in the need for Tracking Data adjustment. The following examples of repair situations require reloading (restoring) factory Tracking Data or establishing new Tracking Data.

SITUATION	NEW TRACKING DATA REQUIREMENTS
New PA Module	All RF Power settings
New Reference Oscillator	Reference Oscillator setting
New Main Board	All Tracking Data plus Feature Encryption Data and Operating Software
New Flash Memory	All Tracking Data and Operating Software

8.7.3 Setup for Radio Test

The initial test equipment setup should be modified as follows for "Radio Tests" (as specified in the alignment procedures):

1. Attach the TQ-0609A audio test box to the JAGUAR 700P/Pi UDC using the audio test cable.
2. Attach the RF adapter to the JAGUAR 700P/Pi antenna port.
3. Attach the RF coaxial cable between the RF adapter and the radio test set RF IN, or RF OUT port, as required.
4. Attach the RF coaxial cable from the AUDIO OUT port of the radio test set to the TX AUDIO port of the TQ-0609A audio test box.
5. Attach the RF coaxial cable from the AUDIO IN port of the radio test set to the RX AUDIO port of the TQ-0609A audio test box.

8.7.4 Setup for Tracking Data Editing

The initial test equipment setup should be modified as follows for "Tracking Data" (as specified in the alignment procedures):

1. Attach the TQ-3370 programmer interface box to the JAGUAR 700P/Pi UDC using the programming cable.
2. Attach the RS-232 serial cable between the programmer interface box and personal computer serial port.
3. Set the JAGUAR 700P/Pi radio to programming mode, refer to Section 8.6.3.
4. Start the Radio Maintenance software on the personal computer.

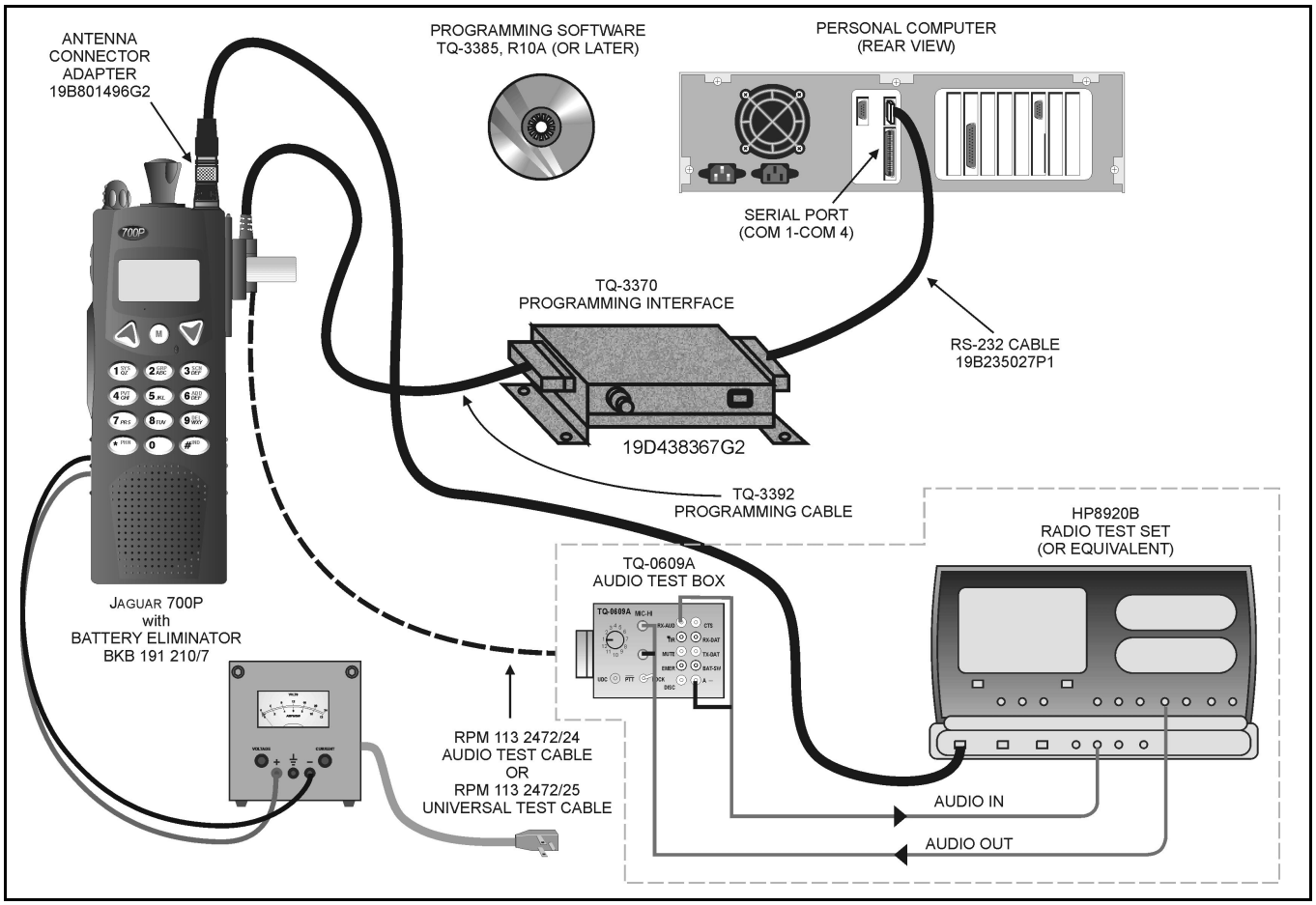

Figure 8-3: Test and Calibration Equipment Setup

NOTE

Consult the On-Line Help utility in ProGrammer “Radio Maintenance” for instructions and explanation of Tracking Data Controls.

NOTE

It is the responsibility of anyone entering new Tracking Data to ensure that the resultant performance is within operational limits governing the service in which the radio will operate.

Table 8-1: Parameters and Number of Corresponding Data Points

TAB	PARAMETER	NUMBER OF DATA POINTS
Tracking Data Edit		
General	Reference Oscillator	1
	TX Modulator I Balance	*Not user-adjustable*
	TX Modulator Q Balance	*Not user-adjustable*
	Hardware I & Q Balance	*Not user-adjustable*
Squelch/RSSI	Squelch Open Levels	5 – Wideband; 5 – NPSPAC
	Squelch Close Levels	5 – Wideband; 5 – NPSPAC
	RSSI	5 – Strong; 5 – Mid; 5 – Weak
Deviation Settings	Deviation Settings	20 – Wideband Deviation 20 – NPSPAC Deviation
• Data/CG Deviation	TX Data Dev Scalar	1 – Wideband 1 – NPSPAC 1 – C4FM
	Digital CG Scalar	1 – Digital CG Scalar
	Analog Channel Guard Deviation	4 – Wideband 4 – NPSPAC
TX Power Control	TX Power Control	20 – Low Power 20 – High Power

8.7.5 Typical Tracking Data Values and Calibration Channels

Typical tracking data values and the corresponding calibration frequencies are shown in tables in the following sections (associated with each parameter being adjusted). These values are suggested as starting values for calibration if the factory set values are lost or corrupt. Each Calibration Channel has the appropriate frequency and Channel Guard tone (if applicable) for the specific adjustment being performed.

8.7.6 Step 1 – Create a Wideband (Non-NPSPAC) Calibration Personality

A Wideband Calibration Personality corresponding to the required calibration parameters must be created and written to the JAGUAR 700P/Pi. (Refer to Section 8.6 for programming descriptions.)

1. Hook-up the equipment. Refer to Figure 8-2.
2. Put the radio in programming mode. Refer to Section 8.6.3.
3. Click the Start button the select Programs > MA-COM Software Tools > ProGrammer.
4. Select the  button to read the personality from the radio.
5. In the New Radio Type control, select “Jag 700P Scan RU101219” for Scan Models or “Jag 700P Sys RU101219” for System Models.
6. Select the Tools menu > Options and Directory Settings... menu item to open the Options and Directory Settings dialog box.

7. Disable (no check in) the NPSPAC control, in the Options and Directory Settings dialog box.
8. Select the OK push button.
9. Select the Options tab in the personality editor and double-click on the General Options menu item to open the General Options dialog box.
10. Disable (no check in) the Override Default NPSPAC Channel Assignments control, in the General Options dialog box.
11. Select the OK push button.
12. In the Options tab, double-click on the Programmable Menus item to open the Programmable Menus dialog box.
13. Highlight a menu number (this parameter is user defined) in the Conventional Menus list box and select FCC MENU in the Menu control.

NOTE

The FCC Menu and the appropriate frequencies in the frequency sets, which are defined in Step 15, must be programmed in the personality to calibrate RSSI or TX Data Scalar.

14. Select the OK push button.
15. Select the SETS tab, double-click the Conventional Frequency Set item to open the Conventional Frequency Sets dialog box to create calibration frequency sets:
    a. Name each calibration frequency set according to the parameter being adjusted (e.g., SQ_RSSI, REF_OSC, TX_VOICE, etc.). The set name is limited to eight alphanumeric characters. (Refer to Table 8-3 for SQ_RSSI examples.)
    b. Name each frequency within the calibration frequency set. It is recommended that the names correspond to the cell within the table listing the tracking data values. Each frequency name within the set is also limited to eight alphanumeric characters. (Within the SQ_RSSI calibration frequency set example, channel number 1 would be named FREQ_01.)
    c. Enter the frequency value from the table corresponding to the parameter being adjusted. (In the SQ_RSSI example, FREQ_01 would have the TX frequency of 806.000 entered.) The RX frequency will be automatically entered after the TX frequency is entered.
16. Highlight one of the conventional frequency sets created for the Wideband Calibration Personality in the Conventional Set list box, disable (no check in) the NPSPAC control.
17. Repeat Step 16 until all of the conventional frequency sets created for the Wideband Calibration Personality have the NPSPAC control disabled.
18. Select the OK push button after entering the appropriate calibration frequency sets.
19. Select the File menu > Save As... menu item to open the Save As dialog box.
20. Name the new personality in a convention that cross-references the radio and indicates it is a Wideband Calibration Personality. Select a directory location to store the personality and select the Save push button.
21. Select the  button to write the personality to the radio.
22. Select the OK push button in the Program Radio Setup dialog box.
23. The radio will cycle to operational mode after the personality has been successfully written to the radio.

24. Exit ProGrammer.

8.7.7 Step 2 – Save Existing Tracking Data/Feature Encryption Files

The JAGUAR 700P/Pi portable radios depend upon tracking and feature encryption data specific to each individual radio for its proper and legal performance. Should anything happen to the radio resulting in the corruption or loss of tracking or feature encryption data, the data can be restored using the data copied and stored in this procedure.

1. Hook-up the equipment. Refer to Figure 8-2.
2. Put the radio in programming mode. Refer to Section 8.6.3.
3. Click the Start button the select Programs > MA-COM Software Tools > RadioMaint.
4. Select the Radio menu > Read > Tracking Data from Radio menu item. The Read Tracking Data Complete dialog box will appear when the read is complete.
5. Select the OK push button in the Read Tracking Data Complete dialog box.
6. Select the Radio menu > Write > Tracking Data to Disk menu item to open the Save As dialog box.
7. Name the Tracking Data file in a convention that cross-references the serial number of the radio. Select a directory location to store the personality and select the Save push button.
8. Select the Radio menu > Read > Feature Data from Radio menu item. The Read Feature Data Complete dialog box will appear when the read is complete.
9. Select the OK push button in the Read Feature Data Complete dialog box.
10. Select the Radio menu > Write > Feature Data to Disk menu item to open the Save As dialog box.
11. Name the Feature Data file in a convention that cross-references the serial number of the radio. Select a directory location to store the personality and select the Save push button.

8.7.8 Step 3 – Setup for Radio Test

Hook-up the equipment according Section 8.7.3 also illustrated in the dotted line section of Figure 8-3.

8.7.9 Step 4 – Test the Radio with a Wideband Calibration Personality

Perform the necessary tests detailed in Sections 8.7.9.1 through 8.7.9.5. Be sure to record all values, highlighting values that are not within the specified ranges.

8.7.9.1 Reference Oscillator

The Reference Oscillator tracking data value controls the frequency of the frequency oscillator from which the transmit and receive frequencies are computed.

NOTE

The factory standard calibration frequency is 851 MHz. For the highest accuracy radio performance, use a Calibration Channel Frequency closest to the radios original RX operating frequency.

Ensure the frequency counter (HP8920B test set or equivalent) has a high stability time-base so its PPM error is <0.1 PPM.

Table 8-2: Reference Oscillator Tracking Data

CHANNEL NAME OR #	TX FREQUENCY (MHZ)	RX FREQUENCY (MHZ)	TYPICAL TRACKING DATA VALUE
FREQ REF	851.000	851.000	581

1. Connect the radio antenna output to the HP8920B Test Set (or equivalent) configured to measure the transmit frequency at the RF frequency of the Calibration Channel (851.000 MHz).
2. Power the radio ON.
3. After the power-up self-test functions have completed, select the Calibration Channel and press the PTT button to transmit.
4. Record the RF frequency displayed on the HP8920. If the transmit carrier frequency is more than 1 PPM (800 Hz) different from the nominal frequency this value will need to be adjusted in Step 15. The transmit carrier frequency should never be more than 1.5 PPM different from the assigned frequency.
5. Power the radio OFF.
6. Un-hook the radio from the HP8920B Test Set.
7. Hook-up the equipment. Refer to Figure 8-2.
8. Put the radio in programming mode. Refer to Section 8.6.3.
9. Click the Start button the select Programs > MA-COM Software Tools > RadioMaint.
10. Select the MRK/LPE/EDACS500M/Jaguar tab.
11. Select the Radio Information push button to open the Radio Status Information dialog box.
12. Select the Close push button in the Radio Status Information dialog box.
13. Select the Tracking Data Edit… push button to open the Edit Tracking Data JAGUAR dialog box.
14. Select the General tab in the Edit Tracking Data JAGUAR dialog box.
15. Adjust the value in the Reference Oscillator control. Increasing the value Reference Oscillator control will increase the transmit carrier frequency.
16. Select the OK push button.
17. Select the Radio menu > Write > Tracking Data to Radio menu item. The Write Tracking Data Complete dialog box will appear when the write is complete.
18. Select the OK push button in the Write Tracking Data Complete dialog box.
19. Repeat Steps 1 through 5 to test the new values. If the RF frequency is within ±200 Hz of the nominal Calibration Frequency proceed to a different test. If the RF frequency is **not** within ±200 Hz of the nominal Calibration Frequency repeat Steps 6 through 19.

8.7.9.2 Squelch and RSSI

Prior to leaving the factory, appropriate Squelch and RSSI values are calibrated and entered into each radio. Factory entries assure Squelch and RSSI responses in the radio are based upon the band, type, and service. New entries should not be made unless the original entries are lost, corrupted, or associated hardware is replaced (e.g., RF and Audio Processing assemblies).

Table 8-3: Squelch Opening/Closing and RSSI Tracking Data

CHAN #	TX FREQ. (MHz)	RX FREQ. (MHz)	TYPICAL TRACKING DATA VALUES						
			SQUELCH OPENING		SQUELCH CLOSING		RSSI (dBm)		
			WIDE	NPSPAC	WIDE	NPSPAC	STRONG –60	MID –85	WEAK -110
1	851.000	851.000	53	26	105	55	115	85	52
2	855.750	855.750	50	23	100	65	115	85	52
3	860.500	860.500	53	20	105	60	114	85	51
4	865.250	865.250	35	23	110	65	113	85	51
5	870.000	870.000	41	26	105	65	115	85	50

8.7.9.2.1 Squelch Open/Close Levels

Squelch Open Level values control the RX RF signal level at which the RX audio "unsquelches" (becomes audible). Squelch Close Level values control the RX RF signal level at which the RX audio "squelches" (becomes inaudible).

Squelch Open/Close Level Tracking Data values range from 1 (maximum "tight" squelch, high RF level) to 255 (minimum "loose" squelch, low RF level). A hysteresis of 1.5 to 3.0 dBm between opening and closing is incorporated to prevent squelch "bubbling." Squelch opening and closing tracking data values are inversely proportional to the RF level needed to open or close squelch. To increase the RF level for squelch opening (tighter squelch, higher SINAD at opening), decrease the Squelch Open Level Tracking Data value. To increase the RF level for squelch closing, decrease the Squelch Close Level Tracking Data value. Increasing the value lowers the necessary RF level for squelch closing.

The standard factory setting yields a squelch opening at receiver audio SINAD = 8 dB ±2 dB (with increasing RF level input).

NPSPAC channels require a "tighter" (lower Tracking Data value) squelch setting than the "Wideband" entry, since a narrower IF bandwidth is used (less noise power detected).

1. Connect the HP8920B to the radio antenna connector with the generator frequency set to that of the Calibration Channel, at an RF output level of <-125 dBm, modulated with 1000 Hz at 3 kHz deviation.
2. Power the radio ON and set the volume knob to mid-range.

3. After power-up, self-test functions are completed, select the Calibration Channel. (The radio should be squelched. If not, a lower Tracking Data value may be required.)
4. Increase the generator signal level and note the RF level at which the tone becomes audible. This is the Squelch Open Level.
5. Record the Squelch Open Level. If the squelch opens at level higher or lower then –122 ±0.5 dBm then this value will need to be adjusted in Step 18. The standard factory setting yields a squelch opening level receiver audio SINAD = 8 dB ±2 dB.
6. Now lower the generator signal level and note the RF level at which the tone mutes (becomes inaudible). This is the Squelch Close Level.
7. Record the Squelch Close value. The Squelch Close value should be 1.5 to 3.0 dBm lower than the level that it opened. If this value is not 1.5 to 3.0 dBm lower than the level that it opened this value will need to be adjusted in Step 18.
8. Power the radio OFF.
9. Un-hook the radio from the HP8920B Test Set.
10. Hook-up the equipment. Refer to Figure 8-2.
11. Put the radio in programming mode. Refer to Section 8.6.3.
12. Click the Start button the select Programs > MA-COM Software Tools > RadioMaint.
13. Select the MRK/LPE/EDACS500M/Jaguar tab.
14. Select the Radio Information push button to open the Radio Status Information dialog box.
15. Select the Close push button in the Radio Status Information dialog box.
16. Select the Tracking Data Edit… push button to open the Edit Tracking Data JAGUAR dialog box.
17. Select the Squelch/RSSI tab in the Edit Tracking Data JAGUAR dialog box.
18. Adjust the value in the Wide Squelch Open Levels controls and Wide Squelch Close Levels controls.
19. Select the OK push button.
20. Select the Radio menu > Write > Tracking Data to Radio menu item. The Write Tracking Data Complete dialog box will appear when the write is complete.
21. Select the OK push button in the Write Tracking Data Complete dialog box.
22. Repeat Steps 1 through 8 to test the new values. If the Wide Squelch Open Levels and Wide Squelch Close Levels are within limitations proceed to a different test. If the Wide Squelch Open Levels and Wide Squelch Close Levels are **not** within limitations repeat Steps 9 through 22.

8.7.9.2.2 RSSI Level

RSSI is utilized in certain scanning functions and field signal level measurements. Calibration of this function requires the use of the "FCC Menu" operation in the radio.

Perform the following procedure to calibrate the RSSI function.

1. Power the radio ON.
2. Select the first calibration channel in Table 8-3.
3. Access the FCC MENU in the radio by pressing the menu (M) button.

4. Use the ◄ or ▼ buttons to scroll through the menu until "RSSI" appears in the display. Press the ● button to activate the selection.
5. Connect the signal generator to the radio antenna connector with the generator frequency set to that of the Calibration Channel, at an output of –60 dBm. Record the RSSI value displayed.
6. Reduce the generator signal level to –85 dBm and record the RSSI value displayed.
7. Reduce the generator signal level to –110 dBm and record the RSSI value displayed.
8. Power cycle the radio to get the radio out of the "FCC Menu" mode.
9. Select the next calibration channel from the table and repeat Steps 3 through 8 until all calibration channels have been measured.
10. Record the RSSI values.
11. Power the radio OFF.
12. Hook-up the equipment. Refer to Figure 8-2.
13. Put the radio in programming mode. Refer to Section 8.6.3.
14. Click the Start button the select Programs > MA-COM Software Tools > RadioMaint.
15. Select the MRK/LPE/EDACS500M/Jaguar tab.
16. Select the Radio Information push button to open the Radio Status Information dialog box.
17. Select the Close push button in the Radio Status Information dialog box.
18. Select the Tracking Data Edit… push button to open the Edit Tracking Data JAGUAR dialog box.
19. Select the Squelch/RSSI tab in the Edit Tracking Data JAGUAR dialog box.
20. Adjust the value in the appropriate controls of the RSSI section.
21. Select the OK push button.
22. Select the Radio menu > Write > Tracking Data to Radio menu item. The Write Tracking Data Complete dialog box will appear when the write is complete.
23. Select the OK push button in the Write Tracking Data Complete dialog box.
24. Repeat Steps 1 through 11 to test the new values. If the RSSI levels are within limitations proceed to a different test. If the RSSI levels are **not** within limitations repeat Steps 12 through 24.

8.7.9.3 TX Voice, DATA, and Channel Guard Deviation

Modulated deviation for all TX outputs is set by Tracking Data values. Increasing the number increases the deviation for each parameter.

Prior to leaving the factory, appropriate values are calibrated and entered into each radio. The factory entries establish the proper operating levels within the maximum, legal deviation levels for the radio based upon its frequency band, type, and service. New entries should not be made unless the original entries are lost, corrupted, or associated hardware is replaced (e.g., the main control board).

NOTE

Adjust the TX Voice Deviation level before adjusting TX Data Deviation levels since the TX Data Deviation level is a proportionality factor applied to TX Voice Deviation.

Table 8-4: TX Power, TX Voice Deviation, and TX Data Tracking Data

CHANNEL #	TX FREQUENCY (MHz)	RX FREQUENCY (MHz)	TYPICAL TRACKING DATA VALUES					
			TX POWER		TX VOICE DEVIATION		TX DATA	
			LOW	HIGH	WIDE 4.5 kHz	NPSPAC 3.6 kHz	WIDE	NPSPAC
1	806.000	851.000	116	209	7800	6020	-	-
2	808.100	853.100	116	210	7800	6240	-	-
3	810.225	855.225	116	210	7850	6040	-	-
4	812.325	857.325	116	210	7800	6240	-	-
5	814.450	859.450	116	211	7800	6060	-	-
6	816.550	861.550	117	211	7800	6080	-	-
7	818.675	863.675	118	211	7775	3240	-	-
8	820.775	865.775	118	212	7800	5940	-	-
9	822.900	867.900	119	212	7450	5950	-	66
10	825.000	870.000	119	212	7775	5960	-	-
11	851.000	851.000	122	217	7750	6020	87	-
12	853.100	853.100	123	216	7685	6240	-	-
13	855.225	855.225	123	217	7800	6040	-	-
14	857.325	857.325	124	217	7800	6240	-	-
15	859.450	859.450	124	218	7775	6060	-	-
16	861.550	861.550	125	219	7765	6040	-	-
17	863.675	863.675	125	219	7725	6240	-	-
18	865.775	865.775	125	219	7775	6060	-	-
19	867.900	867.900	126	220	7588	6070	-	-
20	870.000	870.000	126	220	7800	6080	-	-

8.7.9.3.1 TX Voice Deviation

The TX Voice Deviation values control the TX modulation amplitude of spoken (microphone) audio in the "Wide" (non-NPSPAC) RF band. Increasing the value increases deviation.

1. Connect the radio antenna output to the HP8920B Test Set (or equivalent) configured to measure the TX Voice Deviation at the RF frequency of the calibration channel.
2. Connect the UDC Test Cable and Test Box to the HP8920B and apply a 1000 Hz tone at 90 mVrms.
3. Power the radio ON.

4. After the power-up self-test functions have been completed, select the Calibration Channel and press the PTT to transmit.
5. Record the deviation amplitude displayed on the HP8920B.
6. Power the radio OFF.
7. Un-hook the radio from the HP8920B Test Set and UDC Test Cable.
8. Hook-up the equipment. Refer to Figure 8-2.
9. Put the radio in programming mode. Refer to Section 8.6.3.
10. Click the Start button the select Programs > MA-COM Software Tools > RadioMaint.
11. Select the MRK/LPE/EDACS500M/Jaguar tab.
12. Select the Radio Information push button to open the Radio Status Information dialog box.
13. Select the Close push button in the Radio Status Information dialog box.
14. Select the Tracking Data Edit… push button to open the Edit Tracking Data JAGUAR dialog box.
15. Select the Deviation Settings tab in the Edit Tracking Data JAGUAR dialog box.
16. Adjust the values in the Wide Band Deviation controls so that the deviation amplitude (+ or -) is 4.5 ±0.2kHz when tested.
17. Select the OK push button.
18. Select the Radio menu > Write > Tracking Data to Radio menu item. The Write Tracking Data Complete dialog box will appear when the write is complete.
19. Select the OK push button in the Write Tracking Data Complete dialog box.
20. Repeat Steps 1 through 6 to test the new values. If the Wideband Deviation levels are within limitations proceed to a different test. If the Wideband Deviation levels are **not** within limitations repeat Steps 7 through 20.

Under no circumstances should an entry be retained which results in deviation in excess of the above limits. Deviation in excess of the above limits may violate FCC requirements.

8.7.9.3.2 TX Data Deviation Scalar

Adjust the TX Voice Deviation level (Wide or NPSPAC) before adjusting TX Data Deviation Scalar levels since the TX Data Deviation level is a proportionality factor applied to TX Voice Deviation.

A NPSPAC Calibration Personality is not required to test and align the NPSPAC TX Data Deviation Scalar value.

The TX Data Deviation Scalar value controls the level of high-speed data deviation and is a factor applied to TX Voice Deviation (Wide, NPSPAC, and C4FM). Adjust this value only after completing the TX Voice Deviation calibration. A higher value gives a higher data deviation.

Use the following procedure to calibrate the TX Data Deviation Scalar for Wide, NPSPAC, and C4FM. Calibration of this function requires the use of the “FCC Menu” operation in the radio.

1. Connect the radio antenna output to the HP8920B Test Set (or equivalent) configured to measure TX Deviation in "scope mode," set to 1 kHz per vertical division, ≥1 msec per horizontal division, at the RF frequency of the Calibration Channel.
2. Power the radio ON.
3. After the power-up self-test functions have completed, select the Calibration Channel and press the Ⓜ Menu button.
4. Scroll through the menu using the ◮ or ◭ buttons and select "FCC MENU." Press Ⓜ again to activate the menu selection.
5. Scroll through the FCC Menu to "TX 9600W" for Wide, "TX9600NP" for NPSPAC or "P25 High" for C4FM. Press Ⓜ to activate the selection. After one second the radio will indicate "Test Mode" and will transmit random data on the chosen channel: 9600 baud for Wide and the standard transmitter symbol rate pattern for C4FM.
6. Record the deviation amplitude displayed on the HP8920B.
7. Power the radio OFF to end the "TestMode" data transmission.
8. Un-hook the radio from the HP8920B Test Set.
9. Hook-up the equipment. Refer to Figure 8-2.
10. Put the radio in programming mode. Refer to Section 8.6.3.
11. Click the Start button the select Programs > MA-COM Software Tools > RadioMaint.
12. Select the MRK/LPE/EDACS500M/Jaguar tab.
13. Select the Radio Information push button to open the Radio Status Information dialog box.
14. Select the Close push button in the Radio Status Information dialog box.
15. Select the Tracking Data Edit… push button to open the Edit Tracking Data JAGUAR dialog box.
16. Select the Deviation Settings tab in the Edit Tracking Data JAGUAR dialog box.
17. Select the Data/CG Deviation push button to open the Data/CG Deviation dialog box.
18. Adjust the values in the Wide TX Data Dev Scaler control, NPSPAC TX Data Dev Scaler control and C4FM TX Data Dev Scaler control so that the deviation amplitude (+ or -) is 3.0 ±0.2kHz for Wide, 2.4 ±0.2kHz for NPSPAC and 2.8 ±0.2kHz for C4FM.
19. Select the OK push button.
20. Select the Radio menu > Write > Tracking Data to Radio menu item. The Write Tracking Data Complete dialog box will appear when the write is complete.
21. Select the OK push button in the Write Tracking Data Complete dialog box.
22. Repeat Steps 1 through 7 to test the new values. If the Wide TX Data Dev Scaler levels, NPSPAC TX Data Dev Scaler levels and C4FM TX Data Dev Scaler levels are within limitations proceed to a different test. If the Wide TX Data Dev Scaler levels, NPSPAC TX Data Dev Scaler levels and C4FM TX Data Dev Scaler levels are **not** within limitations repeat Steps 8 through 22.

8.7.9.3.3 Analog Channel Guard (CG) Deviation

The Analog Channel Guard Deviation value controls the level of Channel Guard deviation.

1. Program the frequency sets for Calibration Personality from Table 8-5.
2. Connect the radio antenna output to the HP8920B Test Set (or equivalent) configured to measure TX Deviation at the RF frequency of the Calibration Channel.
3. Connect the UDC Test Cable, but do not add external audio.
4. Power the radio ON.
5. After the power-up, self-test functions have completed, select the Calibration Channel (Channels 1 - 4) and press the PTT button to transmit.
6. Record the deviation amplitude displayed on the HP8920B.
7. Select the next calibration channel and repeat steps 4 and 5 until all calibration channels have been tested and results recorded.
8. Power the radio OFF.
9. Un-hook the radio from the HP8920B Test Set and UDC Test Cable.
10. Hook-up the equipment. Refer to Figure 8-2.
11. Put the radio in programming mode. Refer to Section 8.6.3.
12. Click the Start button the select Programs > MA-COM Software Tools > RadioMaint.
13. Select the MRK/LPE/EDACS500M/Jaguar tab.
14. Select the Radio Information push button to open the Radio Status Information dialog box.
15. Select the Close push button in the Radio Status Information dialog box.
16. Select the Tracking Data Edit… push button to open the Edit Tracking Data JAGUAR dialog box.
17. Select the Deviation Settings tab in the Edit Tracking Data JAGUAR dialog box.
18. Select the Data/CG Deviation push button to open the Data/CG Deviation dialog box.
19. Adjust the values in the Wide Analog Channel Guard Deviation controls (controls 1-4 correspond to the Calibration Channels) so that the deviation amplitude (+ or -) is 750 ±100 Hz when tested. Higher values result in higher CG deviation.
20. Select the OK push button.
21. Select the Radio menu > Write > Tracking Data to Radio menu item. The Write Tracking Data Complete dialog box will appear when the write is complete.
22. Select the OK push button in the Write Tracking Data Complete dialog box.
23. Repeat Steps 1 through 8 to test the new values. If the Wideband Analog Channel Guard Deviation levels are within limitations proceed to a different test. If the Wideband Analog Channel Guard Deviation levels are **not** within limitations repeat Steps 9 through 23.

NOTE

Voice deviation levels are automatically reduced by the amount of Channel Guard deviation so that the combined deviation is the same as that of voice without the Channel Guard.

Table 8-5: Channel Guard Deviation Tracking Data

CHANNEL #	TX FREQUENCY (MHZ)	RX FREQUENCY (MHZ)	TX ENCODE (HZ)	RX DECODE (HZ)	TYPICAL TRACKING DATA VALUES	
					WIDEBAND ANALOG	NPSPAC ANALOG
1	806.000	851.000	156.7	156.7	149	119
2	825.000	870.000	156.7	156.7	144	115
3	851.000	851.000	156.7	156.7	119	95
4	870.000	870.000	156.7	156.7	123	98
5	815.000	860.000	123	123	75	N/A

8.7.9.3.4 Digital CG Scalar

NOTE

Adjust the Analog Channel Guard Deviation level (Wide or NPSPAC) before adjusting Digital CG Scalar levels since the Digital CG Scalar level is a proportionality factor applied to Analog Channel Guard Deviation.

The Digital Channel Guard Scalar value scales the Digital Channel Guard levels.

1. Program the frequency sets for Calibration Personality from Table 8-5.
2. Connect the radio antenna output to the HP8920B Test Set (or equivalent) configured to measure TX Deviation at the RF frequency of the Calibration Channel.
3. Connect the UDC Test Cable, but do not add external audio.
4. Power the radio ON.
5. After the power-up, self-test functions have completed, select the Calibration Channel (Channel 5) and press the PTT button to transmit.
6. Record the deviation amplitude displayed on the HP8920B.
7. Power the radio OFF.
8. Un-hook the radio from the HP8920B Test Set and UDC Test Cable.
9. Hook-up the equipment. Refer to Figure 8-2.
10. Put the radio in programming mode. Refer to Section 8.6.3.
11. Click the Start button the select Programs > MA-COM Software Tools > RadioMaint.
12. Select the MRK/LPE/EDACS500M/Jaguar tab.
13. Select the Radio Information push button to open the Radio Status Information dialog box.
14. Select the Close push button in the Radio Status Information dialog box.
15. Select the Tracking Data Edit… push button to open the Edit Tracking Data JAGUAR dialog box.
16. Select the Deviation Settings tab in the Edit Tracking Data JAGUAR dialog box.
17. Select the Data/CG Deviation push button to open the Data/CG Deviation dialog box.
18. Adjust the value in the Digital CG Scalar control to 750 ±100 Hz when tested. Higher values result in higher CG deviation.

19. Select the OK push button.
20. Select the Radio menu > Write > Tracking Data to Radio menu item. The Write Tracking Data Complete dialog box will appear when the write is complete.
21. Select the OK push button in the Write Tracking Data Complete dialog box.
22. Repeat Steps 1 through 7 to test the new values. If the Digital CG Scalar levels are within limitations proceed to a different test. If the Digital CG Scalar levels are **not** within limitations repeat Steps 8 through 22.

8.7.9.4 TX Power

Please note that cables used to connect the radio to the test set will affect RF Power by adding losses (the longer the cable the greater the loss). For optimum results, connect the radio directly to the test set using a female-to-female BNC connector. If a cable must be used, use the shortest cable possible and factor the losses of the cable into the test results.

The TX Power values control the transmitter RF output power level over the entire frequency range of the transmitter. Increasing the Tracking Data value increases the power output.

At any given TX power control voltage, the output power varies with RF frequency. The TX power output isn't a linear function of control voltage either. To compensate for this, the radio software applies a compensation factor to TX power control voltage at each operating frequency of the radio. The compensation factor is determined by Tracking Data in two rows of twenty entries (see Table 8-4). One row of entries is for low power and one for high power. Each entry corresponds to a specific Calibration Frequency used by the software to calculate the compensation factor for channels on and between the Calibration Frequencies. Refer to Table 8-4 for calibration frequencies. Each calibration frequency is shown in the corresponding Tracking Data position.

The TX power control is divided into two sections corresponding to TX Power = 1 Watt (Low), represented by "10," and TX Power = 3 Watts (High), represented by "30." Each section is divided into two rows by ten columns containing Tracking Data values corresponding to twenty (20) calibration frequencies covering the entire frequency split. Each power level section has the same frequency set.

Appropriate values are calibrated and entered into each radio before leaving the factory. Factory entries establish the appropriate, legal transmit power levels for the radio based on its band, type, and service. New values should not be entered unless original values are lost, corrupted, or associated hardware is replaced (e.g., TX Power Amplifier).

To measure the results of TX Power Tracking Data entries, transmit on the appropriate radio channel frequency and power level corresponding to the Tracking Data value position in "Radio Maintenance." Increasing the TX Power Level Tracking Data value will increase the TX power output. ***For optimum performance, sufficient battery life, TX power amplifier protection,* AND TO ASSURE COMPLIANCE WITH FCC REQUIREMENTS*, DO NOT exceed nominal settings by more than 20% (1.2 watts for Low power and 3.6 watts for High power).***

For optimum performance, sufficient battery life, TX power amplifier protection, AND TO ASSURE COMPLIANCE WITH FCC REQUIREMENTS,* DO NOT *exceed nominal settings by more than 20% (1.2 watts for Low power and 3.6 watts for High power).

1. Connect the radio antenna output to the HP8920B Test Set (or equivalent) configured to measure TX RF power at the RF frequency of the Calibration Channel.
2. Power the radio ON.
3. After the power-up self-test functions have completed, select the Calibration Channel and press the PTT button to transmit.
4. Record the RF power displayed on the HP8920B. Power the radio OFF.
5. Repeat the RF power measurement (Steps 2 through 4 of this procedure) for each Calibration Channel for which Tracking Data is to be adjusted.
6. Power the radio OFF.
7. Un-hook the radio from the HP8920B Test Set.
8. Hook-up the equipment. Refer to Figure 8-2.
9. Put the radio in programming mode. Refer to Section 8.6.3.
10. Click the Start button the select Programs > MA-COM Software Tools > RadioMaint.
11. Select the MRK/LPE/EDACS500M/Jaguar tab.
12. Select the Radio Information push button to open the Radio Status Information dialog box.
13. Select the Close push button in the Radio Status Information dialog box.
14. Select the Tracking Data Edit… push button to open the Edit Tracking Data JAGUAR dialog box.
15. Select the TX Power Control tab in the Edit Tracking Data JAGUAR dialog box.
16. Adjust the values in the TX Low Power controls and TX High Power controls so the power level is appropriate for the Calibration Channel (i.e., 1 watt for the low power section and 3 watts for the high power section).
17. Select the OK push button.
18. Select the Radio menu > Write > Tracking Data to Radio menu item. The Write Tracking Data Complete dialog box will appear when the write is complete.
19. Select the OK push button in the Write Tracking Data Complete dialog box.
20. Repeat Steps 1 through 6 to test the new values. If the TX Power levels are within limitations proceed to a different test. If the TX Power levels are **not** within limitations repeat Steps 7 through 20.

NOTE

Factory calibrated power levels are 5% above the nominal settings to assure compliance with regulatory requirements. The factory “actual” calibration power level for 1 watt is 1.05 watts and for 3 watts is 3.15 watts.

8.7.9.5 I Balance, Q Balance, Hardware I and Q Balance

The values for I Balance, Q Balance, and Hardware I and Q Balance cannot be calibrated using “Radio Maintenance.” If the original Tracking Data values cannot be recovered or if hardware changes (such as Main Board replacement) require new, calibrated values, contact M/A-COM’s Technical Assistance Center.

8.7.10 Step 5 – Create a NPSPAC Calibration Personality

A NPSPAC Calibration Personality corresponding to the required calibration parameters must be created and written to the JAGUAR 700P/Pi. (Refer to Section 8.6 for programming descriptions.)

1. Hook-up the equipment. Refer to Figure 8-2.
2. Put the radio in programming mode. Refer to Section 8.6.3.
3. Click the Start button the select Programs > MA-COM Software Tools > ProGrammer.
4. Select the  button to read the personality from the radio.
5. In the New Radio Type control, select "Jag 700P Scan RU101219" for Scan Models or "Jag 700P Sys RU101219" for System Models.
6. Select the Tools menu > Options and Directory Settings... menu item to open the Options and Directory Settings dialog box.
7. Enable (put a check in) the NPSPAC control, in the Options and Directory Settings dialog box.
8. Select the OK push button.
9. Select the Options tab in the personality editor and double-click on the General Options menu item to open the General Options dialog box.
10. Enable (put a check in) the Override Default NPSPAC Channel Assignments control, in the General Options dialog box.
11. Select the OK push button.
12. In the Options tab, double-click on the Programmable Menus item to open the Programmable Menus dialog box.
13. Highlight a menu number (this parameter is user defined) in the Conventional Menus list box and select FCC MENU in the Menu control.


NOTE

The FCC Menu and the appropriate frequencies in the frequency sets, which are defined in Step 15, must be programmed in the personality to calibrate RSSI or TX Data Scalar.

14. Select the OK push button.
15. Select the SETS tab, double-click the Conventional Frequency Set item to open the Conventional Frequency Sets dialog box to create calibration frequency sets:
    a. Name each calibration frequency set according to the parameter being adjusted (e.g., SQ_RSSI, REF_OSC, TX_VOICE, etc.). The set name is limited to eight alphanumeric characters. (Refer to Table 8-3 for SQ_RSSI examples.)
    b. Name each frequency within the calibration frequency set. It is recommended that the names correspond to the cell within the table listing the tracking data values. Each frequency name within the set is also limited to eight alphanumeric characters. (Within the SQ_RSSI calibration frequency set example, channel number 1 would be named FREQ_01.)
    c. Enter the frequency value from the table corresponding to the parameter being adjusted. (In the SQ_RSSI example, FREQ_01 would have the TX frequency of 806.000 entered.) The RX frequency will be automatically entered after the TX frequency is entered.

16. Highlight one of the conventional frequency sets created for the NPSPAC Calibration Personality in the Conventional Set list box, enable (put a check in) the NPSPAC control.
17. Repeat Step 16 until all of the conventional frequency sets created for the NPSPAC Calibration Personality have the NPSPAC control enabled.
18. Select the OK push button after entering the appropriate calibration frequency sets.
19. Select the File menu > Save As... menu item to open the Save As dialog box.
20. Name the new personality in a convention that cross-references the radio and indicates it is a NPSPAC Calibration Personality. Select a directory location to store the personality and select the Save push button.
21. Select the  button to write the personality to the radio.
22. Select the OK push button in the Program Radio Setup dialog box.
23. The radio will cycle to operational mode after the personality has been successfully written to the radio.
24. Exit ProGrammer.

8.7.11 Step 6 – Setup for Radio Test

Hook-up the equipment according Section 8.7.3 also illustrated in the dotted line section of Figure 8-3.

8.7.12 Step 7 – Test Radio with a NPSPAC Calibration Personality

Perform the necessary tests detailed in Sections 8.7.12.1 through 8.7.12.2.2. Be sure to record all values, highlighting values that are not within the specified ranges.

8.7.12.1 Squelch Levels

Prior to leaving the factory, appropriate Squelch and RSSI values are calibrated and entered into each radio. Factory entries assure Squelch and RSSI responses in the radio are based upon the band, type, and service. New entries should not be made unless the original entries are lost, corrupted, or associated hardware is replaced (e.g., RF and Audio Processing assemblies).

8.7.12.1.1 Squelch Open/Close Levels

Squelch Open Level values control the RX RF signal level at which the RX audio “unsquelches” (becomes audible). Squelch Close Level values control the RX RF signal level at which the RX audio “squelches” (becomes inaudible).

Squelch Open/Close Level Tracking Data values range from 1 (maximum “tight” squelch, high RF level) to 255 (minimum “loose” squelch, low RF level). A hysteresis of 1.5 to 3.0 dBm between opening and closing is incorporated to prevent squelch “bubbling.” Squelch opening and closing tracking data values are inversely proportional to the RF level needed to open or close squelch. To increase the RF level for squelch opening (tighter squelch, higher SINAD at opening), decrease the Squelch Open Level Tracking Data value. To increase the RF level for squelch closing, decrease the Squelch Close Level Tracking Data value. Increasing the value lowers the necessary RF level for squelch closing.

The standard factory setting yields a squelch opening at receiver audio SINAD = 8 dB ±2 dB (with increasing RF level input).

NOTE

NPSPAC channels require a "tighter" (lower Tracking Data value) squelch setting than the "Wideband" entry, since a narrower IF bandwidth is used (less noise power detected).

1. Connect the HP8920B to the radio antenna connector with the generator frequency set to that of the Calibration Channel, at an RF output level of <-125 dBm, modulated with 1000Hz at 1.5 kHz deviation.
2. Power the radio ON and set the volume knob to mid-range.
3. After power-up, self-test functions are completed, select the Calibration Channel. (The radio should be squelched. If not, a lower Tracking Data value may be required.)
4. Increase the generator signal level and note the RF level at which the tone becomes audible. This is the Squelch Open Level.
5. Record the Squelch Open Level. If the squelch opens at level higher or lower then –122 ±0.5 dBm then this value will need to be adjusted in Step 17. The standard factory setting yields a squelch opening level receiver audio SINAD = 8 dB ±2 dB.
6. Now lower the generator signal level and note the RF level at which the tone mutes (becomes inaudible). This is the Squelch Close Level.
7. Record the Squelch Close value. The Squelch Close value should be 1.5 to 3.0 dBm lower than the level that it opened. If this value is not 1.5 to 3.0 dBm lower than the level that it opened this value will need to be adjusted in Step 17.
8. Power the radio OFF.
9. Un-hook the radio from the HP8920B Test Set.
10. Hook-up the equipment. Refer to Figure 8-2.
11. Put the radio in programming mode. Refer to Section 8.6.3.
12. Click the Start button the select Programs > MA-COM Software Tools > RadioMaint.
13. Select the MRK/LPE/EDACS500M/Jaguar tab.
14. Select the Radio Information push button to open the Radio Status Information dialog box.
15. Select the Close push button in the Radio Status Information dialog box.
16. Select the Tracking Data Edit… push button to open the Edit Tracking Data JAGUAR dialog box.
17. Select the Squelch/RSSI tab in the Edit Tracking Data JAGUAR dialog box.
18. Adjust the value in the NPSPAC Squelch Open Levels controls and NPSPAC Squelch Close Levels controls.
19. Select the OK push button.
20. Select the Radio menu > Write > Tracking Data to Radio menu item. The Write Tracking Data Complete dialog box will appear when the write is complete.
21. Select the OK push button in the Write Tracking Data Complete dialog box.
22. Repeat Steps 1 through 8 to test the new values. If the NPSPAC Squelch Open Levels and NPSPAC Squelch Close Levels are within limitations proceed to a different test. If the NPSPAC Squelch Open Levels and NPSPAC Squelch Close Levels are **not** within limitations repeat Steps 9 through 22.

8.7.12.2 TX Voice and Channel Guard Deviation

Modulated deviation for all TX outputs is set by Tracking Data values. Increasing the number increases the deviation for each parameter.

Prior to leaving the factory, appropriate values are calibrated and entered into each radio. The factory entries establish the proper operating levels within the maximum, legal deviation levels for the radio based upon its frequency band, type, and service. New entries should not be made unless the original entries are lost, corrupted, or associated hardware is replaced (e.g., the main control board).

Adjust the TX Voice Deviation level before adjusting TX Data Deviation levels since the TX Data Deviation level is a proportionality factor applied to TX Voice Deviation.

8.7.12.2.1 TX Voice Deviation

The TX Voice Deviation – NPSPAC entry controls the TX modulation amplitude of spoken (microphone) audio in the "NPSPAC" RF band. Increasing the value increases the deviation.

1. Connect the radio antenna output to the HP8920B Test Set (or equivalent) configured to measure the TX deviation at the RF frequency of the Calibration Channel.
2. Connect the UDC Test Cable and Test Box to the HP8920B and apply a 1000 Hz tone at 90 mVrms.
3. Power the radio ON.
4. After the power-up self-test functions have completed, select the Calibration Channel and press the PTT button to transmit.
5. Record the deviation amplitude displayed on the HP8920B.
6. Power the radio OFF.
7. Un-hook the radio from the HP8920B Test Set and UDC Test Cable.
8. Hook-up the equipment. Refer to Figure 8-2.
9. Put the radio in programming mode. Refer to Section 8.6.3.
10. Click the Start button the select Programs > MA-COM Software Tools > RadioMaint.
11. Select the MRK/LPE/EDACS500M/Jaguar tab.
12. Select the Radio Information push button to open the Radio Status Information dialog box.
13. Select the Close push button in the Radio Status Information dialog box.
14. Select the Tracking Data Edit… push button to open the Edit Tracking Data JAGUAR dialog box.
15. Select the Deviation Settings tab in the Edit Tracking Data JAGUAR dialog box.
16. Adjust the values in the NPSPAC Deviation controls so that the deviation amplitude (+ or -) is 3.6 ±0.2kHz for NPSPAC band (821 – 824, 866 – 869 MHz) when tested.
17. Select the OK push button.

18. Select the Radio menu > Write > Tracking Data to Radio menu item. The Write Tracking Data Complete dialog box will appear when the write is complete.
19. Select the OK push button in the Write Tracking Data Complete dialog box.
20. Repeat Steps 1 through 6 to test the new values. If the NPSPAC Deviation levels are within limitations proceed to a different test. If the NPSPAC Deviation levels are **not** within limitations repeat Steps 7 through 20.

Under no circumstances should an entry be retained which results in deviation in excess of the above limits. Deviation in excess of the above limits may violate FCC requirements.

8.7.12.2.2 Analog Channel Guard (CG) Deviation

The Analog Channel Guard Deviation value controls the level of Channel Guard deviation.

1. Program the frequency sets for Calibration Personality from Table 8-5.
2. Connect the radio antenna output to the HP8920B Test Set (or equivalent) configured to measure TX Deviation at the RF frequency of the Calibration Channel.
3. Connect the UDC Test Cable, but do not add external audio.
4. Power the radio ON.
5. After the power-up, self-test functions have completed, select the Calibration Channel (Channels 1 - 4) and press the PTT button to transmit.
6. Record the deviation amplitude displayed on the HP8920B.
7. Select the next calibration channel and repeat steps 4 and 5 until all calibration channels have been tested and results recorded.
8. Power the radio OFF.
9. Un-hook the radio from the HP8920B Test Set and UDC Test Cable.
10. Hook-up the equipment. Refer to Figure 8-2.
11. Put the radio in programming mode. Refer to Section 8.6.3.
12. Click the Start button the select Programs > MA-COM Software Tools > RadioMaint.
13. Select the MRK/LPE/EDACS500M/Jaguar tab.
14. Select the Radio Information push button to open the Radio Status Information dialog box.
15. Select the Close push button in the Radio Status Information dialog box.
16. Select the Tracking Data Edit… push button to open the Edit Tracking Data JAGUAR dialog box.
17. Select the Deviation Settings tab in the Edit Tracking Data JAGUAR dialog box.
18. Select the Data/CG Deviation push button to open the Data/CG Deviation dialog box.
19. Adjust the values in the NPSPAC Analog Channel Guard Deviation controls (controls 1-4 correspond to the Calibration Channels) so that the deviation amplitude (+ or -) is 600 ±80 Hz when tested. Higher values result in higher CG deviation.

20. Select the OK push button.
21. Select the Radio menu > Write > Tracking Data to Radio menu item. The Write Tracking Data Complete dialog box will appear when the write is complete.
22. Select the OK push button in the Write Tracking Data Complete dialog box.
23. Repeat Steps 1 through 8 to test the new values. If the NPSPAC Analog Channel Guard Deviation levels are within limitations proceed to a different test. If the NPSPAC Analog Channel Guard Deviation levels are **not** within limitations repeat Steps 9 through 23.

NOTE

Voice deviation levels are automatically reduced by the amount of Channel Guard deviation so that the combined deviation is the same as that of voice without the Channel Guard.

8.8 TROUBLESHOOTING

The objective of this section is to guide in quickly isolating a problem to either hardware or software. Software errors and problems can usually be corrected in the field. Hardware failures are difficult to isolate and sometimes very tedious to repair without specialized tools. Hardware repair to this radio is very limited at best and not recommended. Service Parts has set up a Repair and Return policy. Service Parts has also made provisions for Circuit Board and Module replacement, as required.

This section includes a General Troubleshooting Table and Test Point Diagram for checking nominal Transmit/Receive Levels (not recommended). Start by referring Table 8-6 and then use the reference material in the back of this manual, as needed.