R8000 SERIES
COMMUNICATIONS SYSTEM ANALYZER

# AUTOTUNE USER GUIDE

Harris XG-75 Portable
Harris XG-75 Mobile

Freedom Communication Technologies
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FCT-1368A

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# 1. Introduction

The Freedom Communication Technologies R8000 Series Communications System Analyzer AutoTune™ (hereafter “AutoTune”) provides an automated test and alignment solution for supported two-way radios.

# 2. Scope

This document includes information regarding the tests and alignments performed for supported radios by AutoTune. This document is restricted to radio-specific information for Harris XG-75 Portable and XG-75 Mobile series radios.

Please refer to the R8000 Series Communications System Analyzer Owner’s Manual (FCT-1365) for an overview and basic operating instructions for AutoTune itself.

# 3. Conventions

## 3.1. PPM

“ppm” is “parts per million”. This specification is generally limited to frequency-related measurements. If the frequency units are in MHz, then the ppm specification is in Hz. For example, a 169.075 MHz frequency with a ±1.5 ppm specification is allowed to vary by 1.5 * 169.075 MHz, or about ±254 Hz.

## 3.2. Rated Audio

Rated audio voltage target is **2 $V_{RMS}$** for portable models and **7.745 $V_{RMS}$** for mobile models.

# 4. Important Notes

## 4.1. Required firmware

All Harris XG-75 series radios must be running **XGP** firmware for AutoTune to successfully service them. Older ECP firmware is not currently supported. Contact Harris Technical Assistance Center (TAC) for information on acquiring XGP firmware.

## 4.2. Conventional channel selection

The radio must have a conventional channel selected before AutoTune servicing begins. A trunked channel if selected is known to cause radio communication initialization failures.

## 4.3. Supported models

The following Harris XG-75 series models are supported by AutoTune:

- P7300
- XG-75
- XG-75P
- XG-75Pe
- M7300
- XG-75M

# 5. Harris XG-75 Portable Radio Test Setup

In order to perform the test and alignment procedures, the XG-75 Portable radio must be connected to the R8000 Communications System Analyzer as shown in the figure below.

CAUTION

Make certain that the radio under test is configured as described in the corresponding diagram **before** attempting to perform an alignment or test. Failure to do so may result in poor radio performance and/or damage to the analyzer or radio equipment under test.

## 5.1. XG-75 Portable Test Setup

Refer to the diagram below for the proper test setup. Note that the Test Box Device # knob should be set to position **7** as shown.

**Note**: Parts numbers shown in the diagram are available from Freedom Communication Technologies.

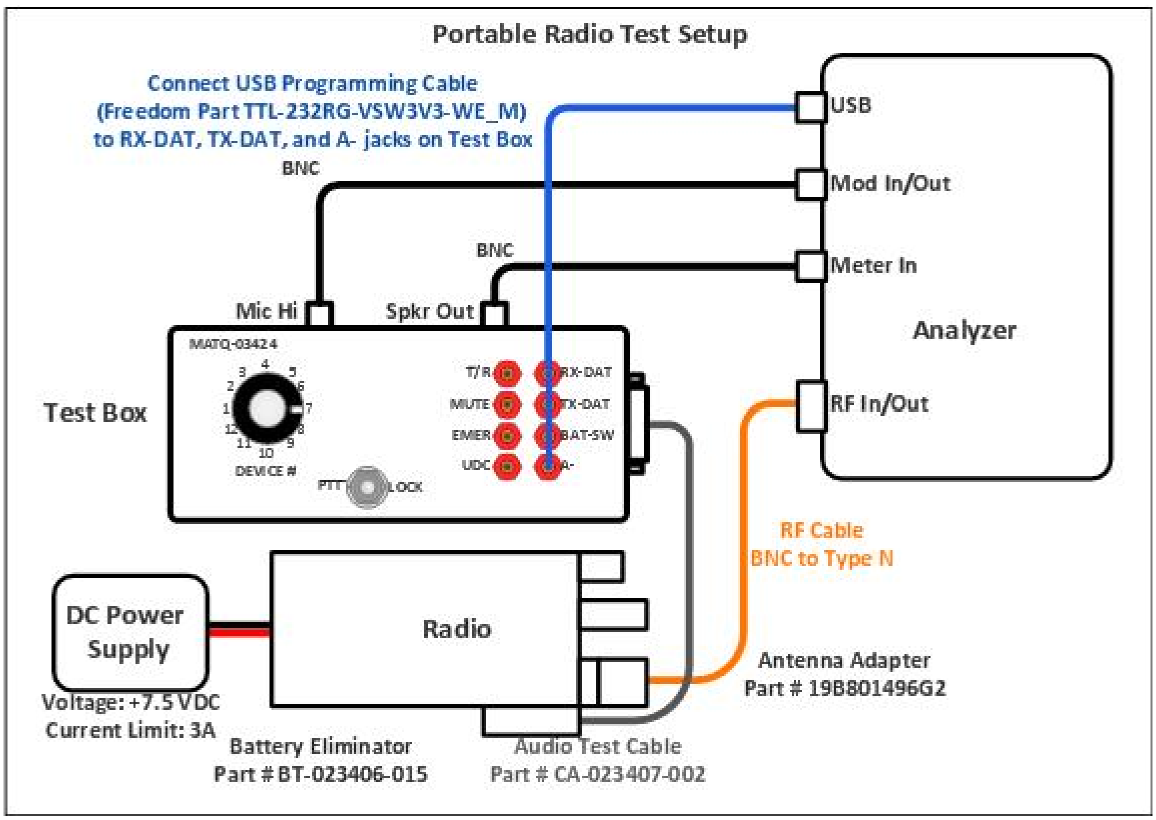


**Figure 5-1. XG-75 Portable Test Setup Diagram**

# 6. Harris XG-75 Portable Alignment and Test Descriptions

**Note**: Throughout this section are references to Test Frequency. Test Frequencies are band- and mode -specific. A table of the frequencies used by each band may be found in the respective Harris radio service manual.

**Note**: All analyzer Mode settings are Standard unless otherwise indicated.

## 6.1. Reference Oscillator

| RF Control | Port | Frequency | Modulation | Attenuation |
|---|---|---|---|---|
| Monitor | RF IN/OUT | Test Frequency | FM | 30 dB |

**Table 6-1. Analyzer Configuration for Reference Frequency**

### 6.1.1. Alignment

The radio is placed into Test Mode at a Tx Test Frequency and commanded to transmit. Using a best linear fit algorithm, two frequency error measurements are taken at two different radio softpot values. These frequency error measurements are used to calculate the softpot value which minimizes frequency error. After programming this new softpot value into the radio, the radio softpot is fine tuned until minimum frequency error is detected. The frequency error is compared against test limits and the final results written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Frequency Error within Max Limit, Min Limit. |
| Frequency | Test Frequency |
| Freq Error | Measured frequency error |
| Min Limit | Minimum Limit (inclusive) for frequency error alignment |
| Max Limit | Maximum Limit (inclusive) for frequency error alignment |
| Old Softpot | Radio softpot before alignment |
| New Softpot | Radio softpot after alignment |

**Table 6-2. Reference Frequency alignment results**

### 6.1.2. Test

The radio is placed into Test Mode at a Tx Test Frequency and commanded to transmit. The frequency error is measured by the analyzer and compared to test limits. The final results are written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Frequency Error within Max Limit, Min Limit. |
| Frequency | Test Frequency |
| Freq Error | Measured frequency error |
| Min Limit | Minimum Limit (inclusive) for frequency error |
| Max Limit | Maximum Limit (inclusive) for frequency error |
| Softpot | Radio softpot producing the Freq Error |

**Table 6-3. Reference Frequency test results**

## 6.2. TX Power

**Note**: For more information on Power Control and Power Sense softpots, see Harris radio maintenance manuals.

| RF Control | Port | Frequency | Modulation | Attenuation |
|---|---|---|---|---|
| Monitor | RF IN/OUT | Test Frequency | FM | 30 dB |

**Table 6-4. Analyzer Configuration for TX Power**

### 6.2.1. Alignment

The TX Power alignment aligns the power output level of the radio at Low, Mid, and High power levels. The radio is placed into Test Mode and commanded to transmit at the first Test Frequency and the Low, Mid, and High power settings in turn. For each test frequency, the output level is measured and then adjusted until near to a band-specific output level defined by the respective Harris XG-75 Portable radio service manuals. See APPENDIX A for test limits used.

| Name | Description |
|---|---|
| Result | Pass or Fail. Power Out within manufacturer limits |
| Power Level | Power setting under alignment (Low, Mid, High) |
| Power Out | Measured radio output level |
| Min Limit | Minimum Limit (inclusive) for Power Out |
| Max Limit | Maximum Limit (inclusive) for Power Out |
| Old Pwr Cntl | Original radio Power Control softpot setting before alignment. |
| New Pwr Cntl | Radio Power Control softpot setting after alignment. |
| Old Pwr Sens | Radio Power Sense softpot setting before alignment. |
| New Pwr Sens | Radio Power Sense softpot setting after alignment. |

Table 6-5. TX Power alignment results

### 6.2.2. Test

The radio is placed into Test Mode and commanded to transmit. Beginning at the first Tx Test Frequency, the output level is measured at each TX Test Frequency, for Low, Mid, and High Power, and compared against test limits. The final results are written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Power Out within Max Limit, Min Limit |
| Power Level | Power setting under test (Low, Mid, High) |
| Power Out | Measured radio output level |
| Min Limit | Minimum Limit (inclusive) for Power Out |
| Max Limit | Maximum Limit (inclusive) for Power Out |
| Power Control | Radio Power Control softpot setting which yields Power Out |
| Power Sense | Radio Power Sense softpot setting which yields Power Out |

**Table 6-6. TX Power test results**

## 6.3. FM Deviation

The FM Deviation test measures the “compensation factors used to maintain consistent modulation characteristics across the radio’s bandsplit.”

| RF Control | Port | Frequency | Modulation | Attenuation | Dev Avg |
|---|---|---|---|---|---|
| Monitor | RF IN/OUT | Test Frequency | FM | 30 dB | +/-Peak / 2 |

**Table 6-7. Analyzer Configuration for FM Deviation test**

### 6.3.1. FM Deviation Test

The radio is placed into Test Mode at low power at the first TX Test Frequency and commanded to transmit. The analyzer generates a modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. This test is performed for each bandwidth mode (Wideband, NPSPAC (if applicable), and Narrowband) and each Tx Test Frequency. The test results for each Tx Test Frequency are written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Deviation is less than or equal to Max Limit. |
| Frequency | Test Frequency |
| Deviation | Measured maximum deviation level |
| Min Limit | Minimum passable deviation level |
| Max Limit | Maximum passable deviation level |

**Table 6-8. FM Deviation test results**

## 6.4. Channel Guard Deviation and DCG Scalar Test

The Channel Guard Deviation and DCG Scalar test measures the "compensation factors used to maintain consistent modulation characteristics for Tone and Digital Channel Guard operation."

| RF Control | Port | Frequency | Modulation | Attenuation | Dev Avg |
|---|---|---|---|---|---|
| Monitor | RF IN/OUT | Test Frequency | FM | 30 dB | +/-Peak / 2 |

**Table 6-9. Analyzer Configuration for Channel Guard Deviation and DCG Scalar test**

### 6.4.1. Channel Guard Deviation and DCG Scalar Test

The radio is placed into Test Mode at low power at the first TX Test Frequency and commanded to transmit. The analyzer generates a modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. This test is performed for each bandwidth mode (Wideband TCG, NPSPAC TCG (if applicable), Narrowband TCG, and Wideband DCG) and each Tx Test Frequency. The test results for each Tx Test Frequency are written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Deviation is between Min Limit and Max Limit. |
| Frequency | Test Frequency |
| Deviation | Measured deviation level |
| Min Limit | Minimum passable deviation level |
| Max Limit | Maximum passable deviation level |

**Table 6-10. Channel Guard Deviation and DCG Scalar test results**

## 6.5. C4FM Deviation Test

The C4FM Deviation test measures the compensation factors used to maintain consistent modulation characteristics for C4FM digital operation.

| RF Control | Port | Frequency | Modulation | Attenuation | Dev Avg |
|---|---|---|---|---|---|
| Monitor | RF IN/OUT | Test Frequency | FM | 30 dB | Pwr-Weight |

**Table 6-11. Analyzer Configuration for C4FM Deviation test**

### 6.5.1. C4FM Deviation Test

The radio is placed into Test Mode at low power at the first TX Test Frequency and commanded to transmit. The analyzer generates a modulation tone and the Power-Weight-averaged deviation of this tone is measured with the analyzer. This test is performed for the C4FM bandwidth mode and each Tx Test Frequency. The test results for each Tx Test Frequency are written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Deviation is between Min Limit and Max Limit. |
| Frequency | Test Frequency |
| Deviation | Measured C4FM deviation level |
| Min Limit | Minimum passable deviation level |
| Max Limit | Maximum passable deviation level |

**Table 6-12. C4FM Deviation test results**

## 6.6. P25 Phase 1 Tx Modulation (C4FM) Test

The P25 Phase 1 Tx Modulation (C4FM) test measures the radio's P25 Phase 1 C4FM modulation level at a specific test frequency.

| RF Control | Port | Frequency | Modulation | Attenuation | Dev Avg |
|---|---|---|---|---|---|
| Monitor | RF IN/OUT | Test Frequency | FM | 30 dB | Peak Avg |

**Table 6-13. Analyzer Configuration for P25 Phase 1 Tx Modulation (C4FM) test**

### 6.6.1. P25 Phase 1 Tx Modulation (C4FM) Test

The radio is placed into Test Mode at low power at the last Tx Test Frequency and commanded to transmit. The analyzer generates a modulation tone and the Peak-averaged deviation of this tone is measured with the analyzer. This test is performed at a single Tx Test Frequency. The test results are written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Deviation is between Min Limit and Max Limit. |
| Frequency | Test Frequency |
| Measured Dev | Measured P25 Phase 1 C4FM deviation |
| Min Limit | Minimum passable deviation level |
| Max Limit | Maximum passable deviation level |

**Table 6-14. P25 Phase 1 Tx Modulation (C4FM) test results**

## 6.7. P25 Phase 2 Tx Modulation (TDMA) Test

The P25 Phase 2 Tx Modulation (TDMA) test measures the radio's P25 Phase 2 TDMA modulation level at a specific test frequency.

| RF Control | Port | Frequency | Modulation | Attenuation | Dev Avg |
|---|---|---|---|---|---|
| Monitor | RF IN/OUT | Test Frequency | FM | 30 dB | +/-Peak / 2 |

**Table 6-15. Analyzer Configuration for P25 Phase 2 Tx Modulation (TDMA) test**

### 6.7.1. P25 Phase 2 Tx Modulation (TDMA) Test

The radio is placed into Test Mode at low power at the last Tx Test Frequency and commanded to transmit. The analyzer generates a modulation tone and the +/-Peak / 2-averaged deviation of this tone is measured with the analyzer. This test is performed at a single Tx Test Frequency. The test results are written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Deviation is between Min Limit and Max Limit. |
| Frequency | Test Frequency |
| Measured Dev | Measured P25 Phase 2 TDMA deviation |
| Min Limit | Minimum passable deviation level |
| Max Limit | Maximum passable deviation level |

**Table 6-16. P25 Phase 2 Tx Modulation (TDMA) test results**

## 6.8. TX Audio Sensitivity and Distortion

Tx Audio Sensitivity and Distortion test verifies the transmitter audio distortion is at an appropriate level.

| RF Control | Port | Frequency | Modulation | Attenuation |
|---|---|---|---|---|
| Monitor | RF IN/OUT | Test Frequency | FM | 30 dB |

**Table 6-17. Analyzer Configuration for TX Audio Sensitivity and Distortion test**

### 6.8.1. TX Audio Sensitivity and Distortion Test

The radio is placed into Test Mode at Wide bandwidth and highest Tx Test Frequency and commanded to transmit. The analyzer generates a modulation tone and the audio distortion of the radio's modulated signal is measured with the analyzer. The distortion is compared against test limits and written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Distortion is less than or equal to Max Limit. |
| Frequency | Test Frequency |
| Audio Level | Audio tone voltage level generated by the analyzer |
| Distortion | Measured distortion percentage |
| Max Limit | Maximum passable deviation (inclusive) |

**Table 6-18. Tx Audio Sensitivity and Distortion test results**

## 6.9. Rx Audio Level and Distortion

Rx Audio Level and Distortion test verifies the receiver audio amplitude and distortion are at appropriate levels.

| RF Control | Port | Frequency | Modulation | Output |
|---|---|---|---|---|
| Generate | RF IN/OUT | Test Frequency | FM | -47 dBm |

**Table 6-19. Analyzer Configuration for Rx Audio Level and Distortion test**

### 6.9.1. RX Audio Level and Distortion Test

The radio is placed into Test Mode at Wide bandwidth and lowest Rx Test Frequency and commanded to transmit. The analyzer generates a modulation tone and the audio voltage and distortion of the radio's demodulated signal is measured with the analyzer. Both the audio level and the distortion are compared against test limits and written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Distortion is less than or equal to Max Limit. |
| Frequency | Test Frequency |
| Min Limit | Minimum audio voltage level required to pass the test |
| Max Volume | Audio volume level generated by the radio at max volume setting |
| Mid Vol Dist | Measured distortion percentage at mid volume setting |
| Max Limit | Maximum passable distortion (inclusive) |

**Table 6-20. Rx Audio Level and Distortion test results**

## 6.10. Squelch Open and Close

Squelch Open and Close alignment verifies and modifies as necessary the squelch hysteresis so stronger RF signals are correctly received and weaker RF signals are correctly blocked.

| RF Control | Port | Frequency | Modulation | Level |
|---|---|---|---|---|
| Generate | RF IN/OUT | Test Freq | Bandwidth- and frequency-specific | Model-specific |

**Table 6-21. Analyzer Configuration for Squelch Open and Close alignment, test**

### 6.10.1. Alignment

For each bandwidth mode (Narrowband, Wideband, NPSPAC, C4FM) and for each test frequency, the analyzer is setup to use the bandwidth- and test frequency-specific RF bandwidth and Fixed 1 kHz levels. The radio volume is then adjusted for Rated Audio. The radio is placed into Test Mode and the analyzer output level adjusted to -130 dBm. The analyzer output level is slowly increased until the radio unsquelches. The output level is then lowered until radio again squelches. SINAD is measured at the unsquelch point and the output levels between the unsquelch point and the squelch point are compared against test limits. If outside test limits, applicable softpots are updated and the alignment process is repeated. Once measurements are within test limits, the final results are written to the log file. This process is repeated for each bandwidth and each test frequency. Results are recorded to test log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Pass if alignment completes within valid softpot range. |
| Frequency | Test Frequency |
| Min Sql Open | Minimum SINAD level at which unsquelch should occur |
| Open SINAD | SINAD level at which squelch opens |
| Max Sql Open | Maximum SINAD level at which unsquelch should occur |
| Min Hyst | Minimum hysteresis between squelch open output level and squelch close output level |
| Hysteresis | Difference between squelch open output level and squelch close output level |
| Max Hyst | Maximum hysteresis between squelch open output level and squelch close output level |
| Open Softpot | Radio softpot governing Squelch Open level. |
| Close Softpot | Radio softpot governing Squelch Close level. |

**Table 6-22. Squelch Open and Close alignment results**

### 6.10.2. Test

For each bandwidth mode (Narrowband, Wideband, NPSPAC, C4FM) and for each test frequency, the analyzer is setup to use the bandwidth- and test frequency-specific RF bandwidth and Fixed 1 kHz levels. The radio volume is then adjusted for Rated Audio.

The radio is placed into Test Mode and the analyzer output level adjusted to -130 dBm. The analyzer output level is slowly increased until the radio unsquelches. The output level is then lowered until radio again squelches. SINAD is measured at the unsquelch point and the output levels between the unsquelch point and the squelch point are compared against test limits. If outside test limits, up to two measurement attempts are made to verify failure. Final results are written to the log file. This process is repeated for each bandwidth and each test frequency.

| Name | Description |
|---|---|
| Result | Pass or Fail. Pass if alignment completes within valid softpot range. |
| Frequency | Test Frequency |
| Min Hyst | Minimum hysteresis between squelch open output level and squelch close output level |
| Hysteresis | Difference between squelch open output level and squelch close output level |
| Max Hyst | Maximum hysteresis between squelch open output level and squelch close output level |
| Open Softpot | Radio softpot governing Squelch Open level. |
| Close Softpot | Radio softpot governing Squelch Close level. |

**Table 6-23. Squelch Open and Close test results**

## 6.11. RSSI

RSSI alignment and test verifies that varying levels of RF input power are accurately measured by the radio's receive signal strength indicator.

| RF Control | Port | Frequency | Modulation | Output Level |
|---|---|---|---|---|
| Generate | RF IN/OUT | Test Freq | None | Various |

**Table 6-24. Analyzer Configuration for RSSI alignment, test**

### 6.11.1. Alignment

The radio is placed into Test Mode at the first RX Test Frequency. The output level of the analyzer is then adjusted to match the current RSSI output level. The radio RSSI level is requested and then the corresponding softpot applied to the radio. The final results are written to the log file. This process is repeated for each Rx Test Frequency and each RSSI level (Weak, Medium, and High).

| Name | Description |
|---|---|
| Result | Pass or Fail. Pass if radio RSSI within target +/- tolerance |
| Frequency | Test Frequency |
| Weak Level +/-Tolerance | Measured Radio RSSI at weak input level |
| Weak Softpot | RSSI softpot associated with weak level |
| Medium Level +/- Tolerance | Measured Radio RSSI medium input level |
| Med Softpot | RSSI softpot associated with medium level |
| Strong Level +/-Tolerance | Measured Radio RSSI strong input level |
| Strong Softpot | RSSI softpot associated with strong level |

**Table 6-25. RSSI alignment results**

### 6.11.2. Test

The radio is placed into Test Mode at the first RX Test Frequency. The output level of the analyzer is then adjusted to match the current RSSI output level. The radio RSSI level is requested from the radio. The final results are written to the log file. This process is repeated for each Rx Test Frequency and each RSSI level (Weak, Medium, and High). Test report format is identical to RSSI alignment.

## 6.12. RX Sensitivity (SINAD)

Rx Sensitivity (SINAD) test verifies the receiver analog audio sensitivity is at an appropriate level.

| RF Control | Port | Frequency | Modulation | Output Level |
|---|---|---|---|---|
| Generate | RF IN/OUT | Test Freq | 1 kHz @ 3 kHz | -60 dBm |

**Table 6-26. Analyzer Configuration for RX Sensitivity test**

### 6.12.1. Test

The analyzer is setup by applying the Modulation signal in Table 6-26 to the radio and then adjusting radio volume for Rated Audio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The output level of the analyzer is then adjusted until the radio audio signal’s SINAD level measures about 12 dB. The current analyzer output level is then compared against test limits. The final results are written to the log file. This process is repeated for each bandwidth and each RX Test Frequency.

| Name | Description |
|---|---|
| Result | Pass or Fail. Sensitivity (SINAD) level within Max Limit |
| Frequency | Test Frequency |
| 12dB SINAD | Analyzer output level at which the radio SINAD level measures about 12 dB |
| Max Limit | Maximum Limit (inclusive) for RX Sensitivity to Pass |

**Table 6-27. RX Sensitivity test results**

## 6.13. P25 Phase 1 Rx Sensitivity (C4FM) Test

The P25 Phase 1 Rx Sensitivity (C4FM) test measures the radio's P25 Phase 1 C4FM sensitivity level at several Rx test frequencies.

| RF Control | Port | Frequency | Modulation | Output Level |
|---|---|---|---|---|
| Generate | RF IN/OUT | Test Frequency | C4FM | -116 dBm |

**Table 6-28. Analyzer Configuration for P25 Phase 1 Rx Sensitivity (C4FM) test**

### 6.13.1. Test

The analyzer is setup by applying the Modulation signal in Table 6-28 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The radio's reported BER level is measured and compared against test limits. The final results are written to the log file. This process is repeated for each Test Frequency.

| Name | Description |
|---|---|
| Result | Pass or Fail. BER level within Max Limit |
| Frequency | Test Frequency |
| BER | Radio Bit Error Rate (BER) level |
| Max Limit | Maximum Limit (inclusive) for Sensitivity (SINAD) to Pass |
| Min Limit | Minimum Limit (exclusive) for Sensitivity (SINAD) to Pass |

**Table 6-29. P25 Phase 1 Rx Sensitivity (C4FM) test results**

## 6.14. P25 Phase 2 Rx Sensitivity (TDMA) Test

The P25 Phase 2 Rx Sensitivity (TDMA) test measures the radio's P25 Phase 2 TDMA sensitivity level at several Rx test frequencies.

| RF Control | Port | Frequency | Modulation | Output Level |
|---|---|---|---|---|
| Generate | RF IN/OUT | Test Frequency | TDMA | -116 dBm |

**Table 6-30. Analyzer Configuration for P25 Phase 2 Rx Sensitivity (TDMA) test**

### 6.14.1. Test

The analyzer is setup by applying the Modulation signal in Table 6-30 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The radio's reported BER level is measured and compared against test limits. The final results are written to the log file. This process is repeated for each Test Frequency.

| Name | Description |
|---|---|
| Result | Pass or Fail. BER level within Max Limit |
| Frequency | Test Frequency |
| BER | Radio Bit Error Rate (BER) level |
| Max Limit | Maximum Limit (inclusive) for Sensitivity (SINAD) to Pass |
| Min Limit | Minimum Limit (exclusive) for Sensitivity (SINAD) to Pass |

**Table 6-31. P25 Phase 2 Rx Sensitivity (TDMA) test results**

## 6.15. Rx IF Bandwidth – Signal Displacement Bandwidth Test

The Rx IF Bandwidth – Signal Displacement Bandwidth test verifies the receiver adjacent channel selectivity is at an appropriate level.

| RF Control | Port | Frequency | Modulation | Output Level |
|---|---|---|---|---|
| Generate | RF IN/OUT | Test Frequency | 1 kHz @ 3 kHz | -60 dBm |

**Table 6-32. Analyzer Configuration for Rx IF Bandwidth – Signal Displacement Bandwidth test**

### 6.15.1. Test

The analyzer is setup by applying the Modulation signal in Table 6-32 to the radio. The radio is placed into Test Mode at the last RX Test Frequency. Radio volume control is set for mid-range. Adjust the output level until 12 dB SINAD is reached. Increase analyzer output level by 6 dBm. Slowly increase analyzer generate frequency until measured SINAD drops back to 12 dB. Starting from center frequency, slowly decrease analyzer generate frequency until measured SINAD drops back to 12 dB. Compare against test limits. The final results are written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. BER level within Max Limit |
| Frequency | Test Frequency |
| 12dB SINAD | Analyzer output level at which the radio SINAD level measures about 12 dB |
| Min Limit | Minimum Limit (inclusive) for Rx IF Bandwidth to Pass |
| Sig Disp BW | Measured signal displacement bandwidth |
| Min Limit | Minimum Limit (inclusive) for Rx IF Bandwidth to Pass |

**Table 6-33. Rx IF Bandwidth – Signal Displacement Bandwidth test results**

# 7. Harris XG-75 Mobile Radio Test Setup

In order to perform the test and alignment procedures, the XG-75 Mobile radio must be connected to the R8000 Communications System Analyzer as shown in the figures below.


Make certain that the radio under test is configured as described in the corresponding diagram **before** attempting to perform the indicated alignment or test. Failure to do so may result in poor radio performance and/or damage to the analyzer or radio equipment under test.

## 7.1. XG-75 Mobile Test Setup

Refer to the diagrams below for proper test setup.

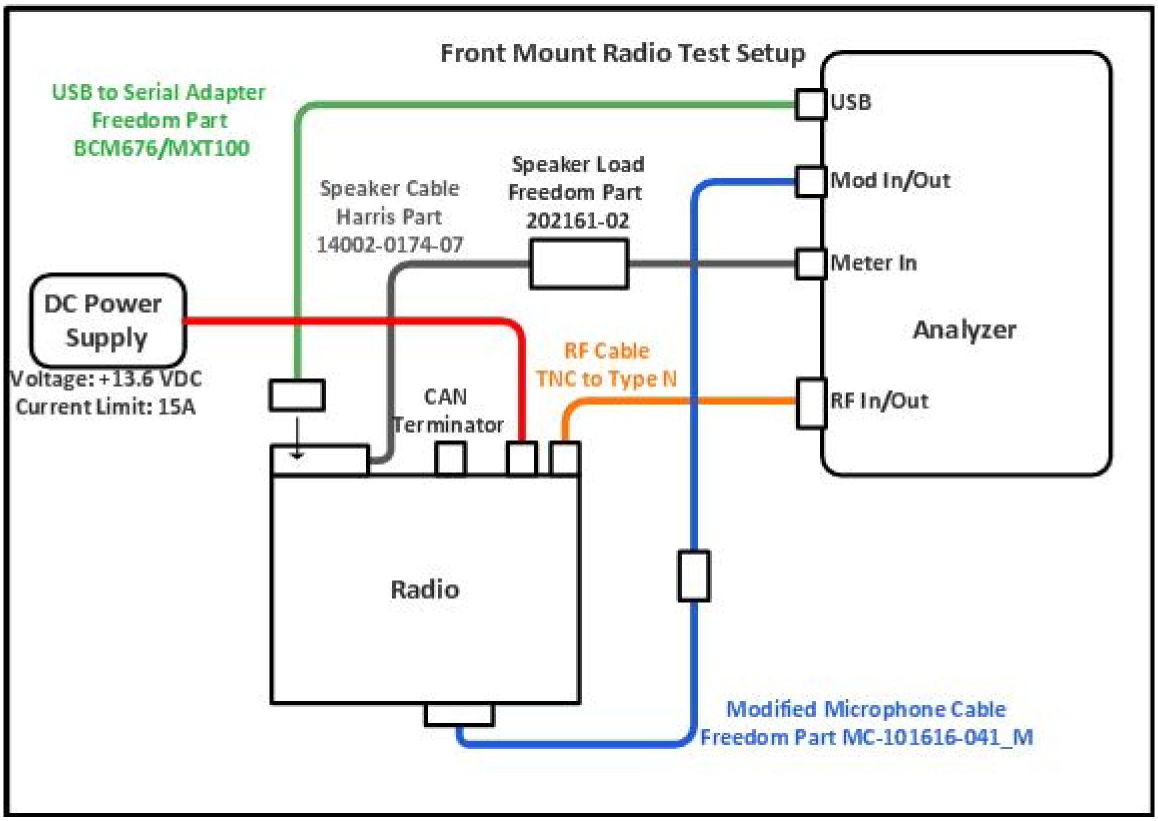


**Figure 7-1. XG-75 Mobile Front Mount Test Setup Diagram**

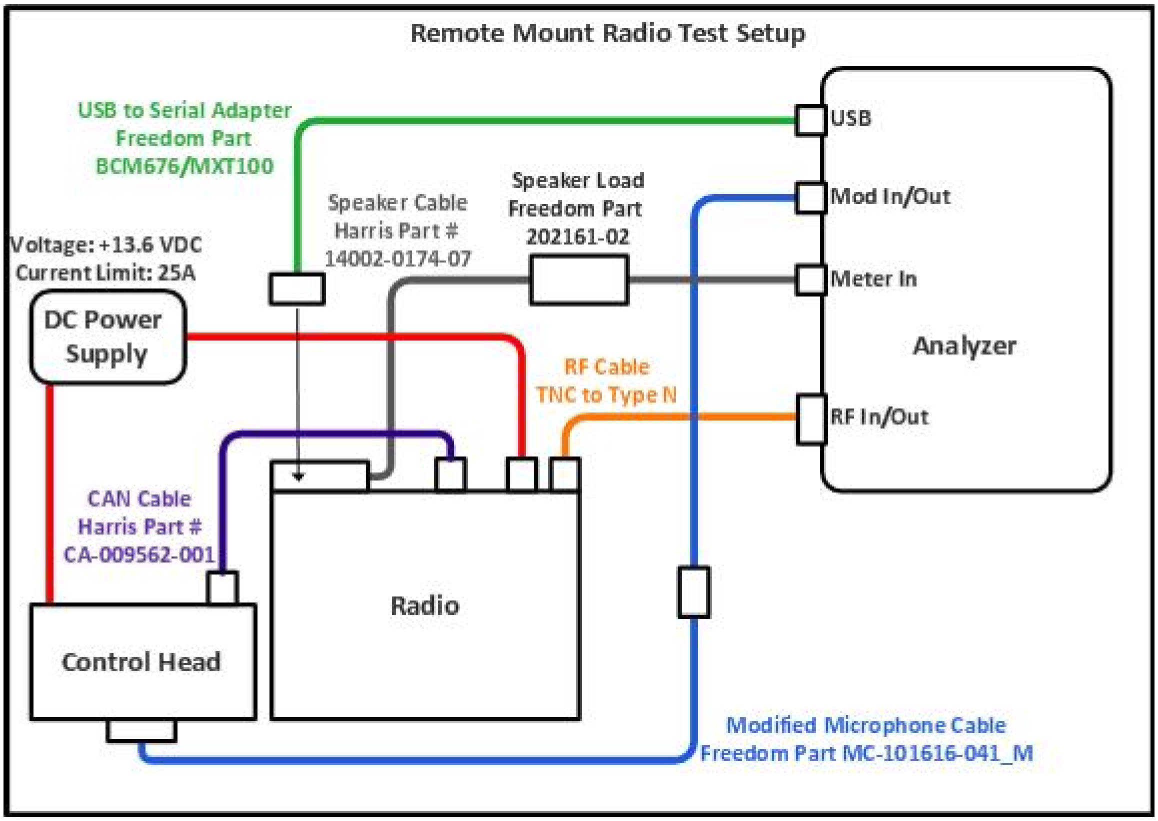


**Figure 7-2.  XG-75 Mobile Remote Mount Test Setup Diagram**

# 8. Harris XG-75 Mobile Alignment and Test Descriptions

**Note**: Throughout this section are references to Test Frequency that are band- and mode -specific. A table of the frequencies used by each band may be found in the respective radio service manual.

**Note**: All analyzer Mode settings are Standard unless otherwise indicated.

## 8.1. Reference Frequency

| RF Control | Port | Frequency | Modulation | Attenuation |
|---|---|---|---|---|
| Monitor | RF IN/OUT | Test Frequency | FM | 30 dB |

**Table 8-1. Analyzer Configuration for Reference Frequency**

### 8.1.1. Alignment

The radio is placed into Test Mode at a Tx Test Frequency and commanded to transmit. Using a best linear fit algorithm, two frequency error measurements are taken at two different radio softpot values. These frequency error measurements are used to calculate the softpot value which minimizes frequency error. After programming this new softpot value into the radio, the radio softpot is fine tuned until minimum frequency error is detected. The frequency error is compared against test limits and the final results written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Frequency Error within Max Limit, Min Limit. |
| Frequency | Test Frequency |
| Freq Error | Measured frequency error |
| Min Limit | Minimum Limit (inclusive) for frequency error alignment |
| Max Limit | Maximum Limit (inclusive) for frequency error alignment |
| Old Softpot | Radio softpot before alignment |
| New Softpot | Radio softpot after alignment |

**Table 8-2. Reference Frequency alignment results**

### 8.1.2. Test

The radio is placed into Test Mode at a Tx Test Frequency and commanded to transmit. The frequency error is measured by the analyzer and compared to test limits. The final results are written to the log file.

| Name | Description |
| --- | --- |
| Result | Pass or Fail. Frequency Error within Max Limit, Min Limit. |
| Frequency | Test Frequency |
| Freq Error | Measured frequency error |
| Min Limit | Minimum Limit (inclusive) for frequency error |
| Max Limit | Maximum Limit (inclusive) for frequency error |
| Softpot | Radio softpot producing the Freq Error |

**Table 8-3. Reference Frequency test results**

## 8.2. TX Power

**Note**: For more information on Power Control and Power Sense softpots, see Harris radio maintenance manuals.

| RF Control | Port | Frequency | Modulation | Attenuation |
|---|---|---|---|---|
| Monitor | RF IN/OUT | Test Frequency | FM | 40 dB |

**Table 8-4. Analyzer Configuration for TX Power**

### 8.2.1. Alignment

The TX Power alignment aligns the power output level of the radio at Low, Mid, and High power levels. The radio is placed into Test Mode and commanded to transmit at the first Test Frequency and the Low, Mid, and High power settings in turn. For each test frequency, the output level is measured and then adjusted until near to a band-specific output level defined by the respective Harris XG-75 Mobile radio service manuals. See APPENDIX A for test limits used.

| Name | Description |
|---|---|
| Result | Pass or Fail. Power Out within manufacturer limits |
| Power Level | Power setting under alignment (Low, Mid, High) |
| Power Out | Measured radio output level |
| Min Limit | Minimum Limit (inclusive) for Power Out |
| Max Limit | Maximum Limit (inclusive) for Power Out |
| Old Pwr Cntl | Original radio Power Control softpot setting before alignment. |
| New Pwr Cntl | Radio Power Control softpot setting after alignment. |
| Old Pwr Sens | Radio Power Sense softpot setting before alignment. |
| New Pwr Sens | Radio Power Sense softpot setting after alignment. |

Table 8-5. TX Power alignment results

### 8.2.2. Test

The radio is placed into Test Mode and commanded to transmit. Beginning at the first Tx Test Frequency, the output level is measured at each TX Test Frequency, for Low, Mid, and High Power, and compared against test limits. The final results are written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Power Out within Max Limit, Min Limit |
| Power Level | Power setting under test (Low, Mid, High) |
| Power Out | Measured radio output level |
| Min Limit | Minimum Limit (inclusive) for Power Out |
| Max Limit | Maximum Limit (inclusive) for Power Out |
| Power Control | Radio Power Control softpot setting which yields Power Out |
| Power Sense | Radio Power Sense softpot setting which yields Power Out |

**Table 8-6. TX Power test results**

## 8.3. Tx Modulation Limit

The Tx Modulation Limit test measures the radio's maximum modulation level at a specific test frequency.

| RF Control | Port | Frequency | Modulation | Attenuation | Dev Avg |
|---|---|---|---|---|---|
| Monitor | RF IN/OUT | Test Frequency | FM | 30 dB | +/-Peak / 2 |

**Table 8-7. Analyzer Configuration for Tx Modulation Limit test**

### 8.3.1. Tx Modulation Limit Test

The radio is placed into Test Mode at low power at the last TX Test Frequency and commanded to transmit. The analyzer generates a modulation tone and the ±Peak / 2-averaged deviation of this tone is measured with the analyzer. The test results are written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Deviation is less than or equal to Max Limit. |
| Frequency | Test Frequency |
| Deviation | Measured maximum deviation level |
| Min Limit | Minimum passable deviation level |
| Max Limit | Maximum passable deviation level |

**Table 8-8. Tx Modulation Limit test results**

## 8.4. P25 Phase 1 Tx Modulation (C4FM) Test

The P25 Phase 1 Tx Modulation (C4FM) test measures the radio's P25 Phase 1 C4FM modulation level at a specific test frequency.

| RF Control | Port | Frequency | Modulation | Attenuation | Dev Avg |
|---|---|---|---|---|---|
| Monitor | RF IN/OUT | Test Frequency | FM | 30 dB | Peak Avg |

**Table 8-9. Analyzer Configuration for P25 Phase 1 Tx Modulation (C4FM) test**

### 8.4.1. P25 Phase 1 Tx Modulation (C4FM) Test

The radio is placed into Test Mode at low power at the last Tx Test Frequency and commanded to transmit. The analyzer generates a modulation tone and the Peak-averaged deviation of this tone is measured with the analyzer. This test is performed at a single Tx Test Frequency. The test results are written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Deviation is between Min Limit and Max Limit. |
| Frequency | Test Frequency |
| Measured Dev | Measured P25 Phase 1 C4FM deviation |
| Min Limit | Minimum passable deviation level |
| Max Limit | Maximum passable deviation level |

**Table 8-10. P25 Phase 1 Tx Modulation (C4FM) test results**

## 8.5. P25 Phase 2 Tx Modulation (TDMA) Test

The P25 Phase 2 Tx Modulation (TDMA) test measures the radio's P25 Phase 2 TDMA modulation level at a specific test frequency.

| RF Control | Port | Frequency | Modulation | Attenuation | Dev Avg |
|---|---|---|---|---|---|
| Monitor | RF IN/OUT | Test Frequency | FM | 30 dB | +/-Peak / 2 |

**Table 8-11. Analyzer Configuration for P25 Phase 2 Tx Modulation (TDMA) test**

### 8.5.1. P25 Phase 2 Tx Modulation (TDMA) Test

The radio is placed into Test Mode at low power at the last Tx Test Frequency and commanded to transmit. The analyzer generates a modulation tone and the +/-Peak / 2-averaged deviation of this tone is measured with the analyzer. This test is performed at a single Tx Test Frequency. The test results are written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Deviation is between Min Limit and Max Limit. |
| Frequency | Test Frequency |
| Measured Dev | Measured P25 Phase 2 TDMA deviation |
| Min Limit | Minimum passable deviation level |
| Max Limit | Maximum passable deviation level |

**Table 8-12. P25 Phase 2 Tx Modulation (TDMA) test results**

## 8.6. Rx Audio Level and Distortion

Rx Audio Level and Distortion test verifies the receiver audio amplitude and distortion are at appropriate levels.

| RF Control | Port | Frequency | Modulation | Output |
|---|---|---|---|---|
| Generate | RF IN/OUT | Test Frequency | FM | -47 dBm |

**Table 8-13. Analyzer Configuration for Rx Audio Level and Distortion test**

### 8.6.1. RX Audio Level and Distortion Test

The radio is placed into Test Mode at Wide bandwidth and lowest Rx Test Frequency and commanded to transmit. The analyzer generates a modulation tone and the audio voltage and distortion of the radio's demodulated signal is measured with the analyzer. Both the audio level and the distortion are compared against test limits and written to the log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Distortion is less than or equal to Max Limit. |
| Frequency | Test Frequency |
| Min Limit | Minimum audio voltage level required to pass the test |
| Max Volume | Audio volume level generated by the radio at max volume setting |
| Mid Vol Dist | Measured distortion percentage at mid volume setting |
| Max Limit | Maximum passable distortion (inclusive) |

**Table 8-14. Rx Audio Level and Distortion test results**

## 8.7. RSSI

RSSI alignment and test verifies that varying levels of RF input power are accurately measured by the radio's receive signal strength indicator.

| RF Control | Port | Frequency | Modulation | Output Level |
|---|---|---|---|---|
| Generate | RF IN/OUT | Test Freq | None | Various |

**Table 8-15. Analyzer Configuration for RSSI alignment, test**

### 8.7.1. Alignment

The radio is placed into Test Mode at the first RX Test Frequency. The output level of the analyzer is then adjusted to match the current RSSI output level. The radio RSSI level is requested and then the corresponding softpot applied to the radio. The final results are written to the log file. This process is repeated for each Rx Test Frequency and each RSSI level (Weak, Medium, and High).

| Name | Description |
|---|---|
| Result | Pass or Fail. Pass if radio RSSI within target +/- tolerance |
| Frequency | Test Frequency |
| Weak Level +/-Tolerance | Measured Radio RSSI at weak input level |
| Weak Softpot | RSSI softpot associated with weak level |
| Medium Level +/- Tolerance | Measured Radio RSSI medium input level |
| Med Softpot | RSSI softpot associated with medium level |
| Strong Level +/-Tolerance | Measured Radio RSSI strong input level |
| Strong Softpot | RSSI softpot associated with strong level |

**Table 8-16. RSSI alignment results**

### 8.7.2. Test

The radio is placed into Test Mode at the first RX Test Frequency. The output level of the analyzer is then adjusted to match the current RSSI output level. The radio RSSI level is requested from the radio. The final results are written to the log file. This process is repeated for each Rx Test Frequency and each RSSI level (Weak, Medium, and High). Test report format is identical to RSSI alignment.

## 8.8. RX Sensitivity (SINAD)

Rx Sensitivity (SINAD) test verifies the receiver analog audio sensitivity is at an appropriate level.

| RF Control | Port | Frequency | Modulation | Output Level |
|---|---|---|---|---|
| Generate | RF IN/OUT | Test Freq | 1 kHz @ 3 kHz | -60 dBm |

**Table 8-17. Analyzer Configuration for RX Sensitivity test**

### 8.8.1. Test

The analyzer is setup by applying the Modulation signal in Table 6-26 to the radio and then adjusting radio volume for Rated Audio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The output level of the analyzer is then adjusted until the radio audio signal's SINAD level measures about 12 dB. The current analyzer output level is then compared against test limits. The final results are written to the log file. This process is repeated for each bandwidth and each RX Test Frequency.

| Name | Description |
|---|---|
| Result | Pass or Fail. Sensitivity (SINAD) level within Max Limit |
| Frequency | Test Frequency |
| 12dB SINAD | Analyzer output level at which the radio SINAD level measures about 12 dB |
| Max Limit | Maximum Limit (inclusive) for RX Sensitivity to Pass |

**Table 8-18. RX Sensitivity test results**

## 8.9. Squelch Open and Close

Squelch Open and Close alignment verifies and modifies as necessary the squelch hysteresis so stronger RF signals are correctly received and weaker RF signals are correctly blocked.

| RF Control | Port | Frequency | Modulation | Level |
|---|---|---|---|---|
| Generate | RF IN/OUT | Test Freq | Bandwidth- and frequency-specific | Model-specific |

**Table 8-19. Analyzer Configuration for Squelch Open and Close alignment, test**

### 8.9.1. Alignment

For each bandwidth mode (Narrowband, Wideband, NPSPAC, C4FM) and for each test frequency, the analyzer is setup to use the bandwidth- and test frequency-specific RF bandwidth and Fixed 1 kHz levels. The radio volume is then adjusted for Rated Audio. The radio is placed into Test Mode and the analyzer output level adjusted to -130 dBm. The analyzer output level is slowly increased until the radio unsquelches. The output level is then lowered until radio again squelches. SINAD is measured at the unsquelch point and the output levels between the unsquelch point and the squelch point are compared against test limits. If outside test limits, applicable softpots are updated and the alignment process is repeated. Once measurements are within test limits, the final results are written to the log file. This process is repeated for each bandwidth and each test frequency. Results are recorded to test log file.

| Name | Description |
|---|---|
| Result | Pass or Fail. Pass if alignment completes within valid softpot range. |
| Frequency | Test Frequency |
| Min Sql Open | Minimum SINAD level at which unsquelch should occur |
| Open SINAD | SINAD level at which squelch opens |
| Max Sql Open | Maximum SINAD level at which unsquelch should occur |
| Min Hyst | Minimum hysteresis between squelch open output level and squelch close output level |
| Hysteresis | Difference between squelch open output level and squelch close output level |
| Max Hyst | Maximum hysteresis between squelch open output level and squelch close output level |
| Open Softpot | Radio softpot governing Squelch Open level. |
| Close Softpot | Radio softpot governing Squelch Close level. |

**Table 8-20. Squelch Open and Close alignment results**

### 8.9.2. Test

For each bandwidth mode (Narrowband, Wideband, NPSPAC, C4FM) and for each test frequency, the analyzer is setup to use the bandwidth- and test frequency-specific RF bandwidth and Fixed 1 kHz levels. The radio volume is then adjusted for Rated Audio.

The radio is placed into Test Mode and the analyzer output level adjusted to -130 dBm. The analyzer output level is slowly increased until the radio unsquelches. The output level is then lowered until radio again squelches. SINAD is measured at the unsquelch point and the output levels between the unsquelch point and the squelch point are compared against test limits. If outside test limits, up to two measurement attempts are made to verify failure. Final results are written to the log file. This process is repeated for each bandwidth and each test frequency.

| Name | Description |
|---|---|
| Result | Pass or Fail. Pass if alignment completes within valid softpot range. |
| Frequency | Test Frequency |
| Min Hyst | Minimum hysteresis between squelch open output level and squelch close output level |
| Hysteresis | Difference between squelch open output level and squelch close output level |
| Max Hyst | Maximum hysteresis between squelch open output level and squelch close output level |
| Open Softpot | Radio softpot governing Squelch Open level. |
| Close Softpot | Radio softpot governing Squelch Close level. |

**Table 8-21. Squelch Open and Close test results**

## 8.10. P25 Phase 1 Rx Sensitivity (C4FM) Test

The P25 Phase 1 Rx Sensitivity (C4FM) test measures the radio's P25 Phase 1 C4FM sensitivity level at several Rx test frequencies.

| RF Control | Port | Frequency | Modulation | Output Level |
|---|---|---|---|---|
| Generate | RF IN/OUT | Test Frequency | C4FM | -116 dBm |

**Table 8-22. Analyzer Configuration for P25 Phase 1 Rx Sensitivity (C4FM) test**

### 8.10.1. Test

The analyzer is setup by applying the Modulation signal in Table 6-28 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The radio's reported BER level is measured and compared against test limits. The final results are written to the log file. This process is repeated for each Test Frequency.

| Name | Description |
|---|---|
| Result | Pass or Fail. BER level within Max Limit |
| Frequency | Test Frequency |
| BER | Radio Bit Error Rate (BER) level |
| Max Limit | Maximum Limit (inclusive) for Sensitivity (SINAD) to Pass |
| Min Limit | Minimum Limit (exclusive) for Sensitivity (SINAD) to Pass |

**Table 8-23. P25 Phase 1 Rx Sensitivity (C4FM) test results**

## 8.11. P25 Phase 2 Rx Sensitivity (TDMA) Test

The P25 Phase 2 Rx Sensitivity (TDMA) test measures the radio's P25 Phase 2 TDMA sensitivity level at several Rx test frequencies.

| RF Control | Port | Frequency | Modulation | Output Level |
|---|---|---|---|---|
| Generate | RF IN/OUT | Test Frequency | TDMA | -116 dBm |

**Table 8-24. Analyzer Configuration for P25 Phase 2 Rx Sensitivity (TDMA) test**

### 8.11.1. Test

The analyzer is setup by applying the Modulation signal in Table 6-30 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The radio's reported BER level is measured and compared against test limits. The final results are written to the log file. This process is repeated for each Test Frequency.

| Name | Description |
|---|---|
| Result | Pass or Fail. BER level within Max Limit |
| Frequency | Test Frequency |
| BER | Radio Bit Error Rate (BER) level |
| Max Limit | Maximum Limit (inclusive) for Sensitivity (SINAD) to Pass |
| Min Limit | Minimum Limit (exclusive) for Sensitivity (SINAD) to Pass |

**Table 8-25. P25 Phase 2 Rx Sensitivity (TDMA) test results**

## 8.12. Basic Troubleshooting

| Symptom | Possible Cause | Possible Solution |
|---|---|---|
| Analyzer consistently fails to communicate with radio | • Radio not running XGP firmware | • AutoTune only supports test and alignment on XG-75 series radios running XGP firmware. Older ECP firmware is not supported. |
| | • Unsupported USB to serial adapter (mobiles only) | • Approved USB to serial adapters for connecting the R8000 analyzer to the Harris XG-75 Mobile series radio under test include any adapters which utilize an FTDI FT232_USB to serial UART interface OR Prolific Technology Inc. PL-2303 USB to serial controller interface. See www.ftdichip.com or www.prolific.com.tw for more detail. |
| | • Radio on a trunking channel | • Change radio channel to a conventional channel. Trunking channel mode can prevent AutoTune from placing radio into test mode. |
| Analyzer occasionally fails to communicate with radio | • USB hub in use | • USB hubs are known to occasionally prevent or drop radio communication. Connect the radio programming cable directly to an analyzer USB port. |
| Tx Power aligns power output levels lower than expected. | • RF Level Offset not enabled | • Enable Settings > System Settings… > RF Level Offset. Change RF In/Out offset value to correspond with the RF cable in use and the radio's operating band. For example, if 0.5 dB of loss expected, enter "-0.5 dB" as the RF In/Out offset value. Cable losses are entered as negative values. |
| Squelch Open and Close test fails one or more points. Can occur even | • Squelch Open and Close sensitivity | • Repeat the Squelch Open and Close test. The variable nature of the unsquelch/squelch |

| | | |
|---|---|---|
| after Squelch Open and Close alignment has just been performed. | | process during the Squelch Open and Close test sometimes makes test consistency irregular. |

**Table 8-26. Harris XG-75 Series Troubleshooting Chart**

# 9. Support Information

## 9.1. Technical Support

Telephone/Fax: 844.903.7333
Email: service@freedomcte.com
Web: http://freedomcte.com/support/

## 9.2. Sales

Telephone/Fax: 844.903.7333
Email: sales@freedomcte.com
Web: http://freedomcte.com/sales/

## APPENDIX A. Test Limits

The factory limits contain the default limits as defined by the radio manufacturer and generally should not be modified. However, if extenuating circumstances cause a need to modify the limits this is accommodated by AutoTune. Refer to the R8000 Series Communications System Analyzer Owner's Manual (FCT-1365) for modification instructions.

The following tables list the default test limits for each Harris XG-75 Portable and XG-75 Mobile radio model supported by AutoTune.

| Section | Test Name | Limit | Default Value |
|---|---|---|---|
| 6.1 | Reference Oscillator | Reference Oscillator Align | Min= -0.15 ppm<br>Max= 0.15 ppm |
| | | Reference Oscillator Test | Min= -1.5 ppm<br>Max= 1.5 ppm |
| | | Reference Oscillator Test 700/800MHz Pe | Min= -0.6 ppm<br>Max= 0.6 ppm |
| 6.2.1 | TX Power (Align) | TX Power Align VHF Low | Min = 0.49 W<br>Max = 0.51 W |
| | | TX Power Align UHF-L(5W) Low | Min = 0.49 W<br>Max = 0.51 W |
| | | TX Power Align UHF-L(100mW) Low | Min = 0.02 W<br>Max = 0.02 W |
| | | TX Power Align UHF-H Low | Min = 0.49 W<br>Max = 0.51 W |
| | | TX Power Align 700/800MHz Low | Min = 0.49 W<br>Max = 0.51 W |
| | | TX Power Align VHF Mid | Min = 2.97 W<br>Max = 3.03 W |
| | | TX Power Align UHF-L(5W) Mid | Min= 1.98 W<br>Max= 2.02 W |
| | | TX Power Align UHF-H Mid | Min=1.98 W<br>Max=2.02 W |
| | | TX Power Align 700/800MHz Mid | Min=1.58 W<br>Max=1.62 W |
| | | TX Power Align VHF High | Min=5.93 W<br>Max=6.07 W |
| | | TX Power Align UHF-L(5W) High | Min=4.94 W<br>Max=5.06 W |
| | | TX Power Align UHF-L(100mW) High | Min=0.09 W<br>Max=0.10 W |
| | | TX Power Align UHF-H High | Min=4.94 W<br>Max=5.06 W |
| | | TX Power Align 700MHz High | Min=2.82 W<br>Max=2.88 W |
| | | TX Power Align 800MHz High | Min=3.16 W<br>Max=3.24 W |
| 6.2.2 | TX Power (Test) | TX Power Test VHF Low | Min= 0.44 W<br>Max= 0.56 W |
| | | TX Power Test UHF-L(5W) Low | Min= 0.44 W<br>Max= 0.56 W |
| | | TX Power Test UHF-L(100mW) Low | Min= 0.09 W<br>Max= 0.11 W |
| | | TX Power Test UHF-H Low | Min= 0.44 W<br>Max= 0.56 W |
| | | TX Power Test 700/800MHz Low | Min= 0.44 W<br>Max= 0.56 W |
| | | TX Power Test VHF Mid | Min= 2.7 W<br>Max= 3.3 W |
| | | TX Power Test UHF-L(5W) Mid | Min= 1.8 W<br>Max= 2.2 W |
| | | TX Power Test UHF-H Mid | Min= 1.8 W<br>Max= 2.2 W |
| | | TX Power Test 700/800MHz Mid | Min= 1.4 W |

| | | | |
|---|---|---|---|
| | | | Max= 1.8 W |
| | | TX Power Test VHF High | Min= 5.3 W<br>Max= 6.7 W |
| | | TX Power Test UHF-L(5W) High | Min= 4.4 W<br>Max= 5.6 W |
| | | TX Power Test UHF-L(100mW) High | Min= 0.09 W<br>Max= 0.11 W |
| | | TX Power Test UHF-H High | Min= 4.4 W<br>Max= 5.6 W |
| | | TX Power Test 700MHz High | Min= 2.5 W<br>Max= 3.2 W |
| | | TX Power Test 800MHz High | Min= 2.8 W<br>Max= 3.6 W |
| 6.3 | FM Deviation | FM Deviation Narrow | Min = 2.15 kHz<br>Max = 2.35 kHz |
| | | FM Deviation Wide | Min=4.1 kHz<br>Max=4.5 kHz |
| | | FM Deviation 700/800MHz NPSPAC | Min=3.5 kHz<br>Max=3.7 kHz |
| | | FM Deviation 700/800MHz Wide | Min=4.3 kHz<br>Max=4.7 kHz |
| | | FM Deviation 700/800MHz Narrow | Min=2.15 kHz<br>Max=2.35 kHz |
| 6.4 | Channel Guard Deviation and DCG Scalar Test | CG Deviation Wideband TCG | Min=500 Hz<br>Max=1000 Hz |
| | | CG Deviation NPSPAC | Min=400 Hz<br>Max=800 Hz |
| | | CG Deviation Narrowband TCG | Min=350 Hz<br>Max=500 Hz |
| | | CG Deviation Wideband DCG | Min=350 Hz<br>Max=500 Hz |
| 6.5 | C4FM Deviation Test | Data C4FM Deviation Wideband 9600 | Min=2.900 kHz<br>Max=3.100 kHz |
| | | Data C4FM Deviation C4FM | Min=2.626 kHz<br>Max=3.026 kHz |
| | | Data C4FM Deviation Narrowband 4800 | Min=2.300 kHz<br>Max=2.500 kHz |
| | | Data C4FM Deviation Narrowband 9600 | Min=2.300 kHz<br>Max=2.500 kHz |
| 6.6 | P25 Phase 1 Tx Modulation (C4FM) Test | P25 Phase1 Tx Modulation C4FM | Min=2.540 kHz<br>Max=3.120 kHz |
| 6.7 | P25 Phase 2 Tx Modulation (TDMA) Test | P25 Phase2 Tx Modulation TDMA | Min=2.995 kHz<br>Max=3.310 kHz |
| 6.8 | TX Audio Sensitivity and Distortion | Tx Audio Distortion | Max=3% |
| | | Tx Audio Level | Max=14 mV |
| 6.9 | Rx Audio Level and Distortion | Rx Audio Distortion | Max=3% |
| | | Rx Audio Voltage | Max=2 $V_{RMS}$ |
| 6.10 | Squelch Open and Close | Squelch Hysteresis | Max=5 dB<br>Min=2 dB |
| | | Squelch Open SINAD Align | Max=9.5 dB<br>Min=5.0 dB |
| | | Squelch Open SINAD Test | Max=9.5 dB |

| | | | |
|---|---|---|---|
| | | | Min=5.0 dB |
| | | Squelch Open Output Level | Min=-130 dBm |
| 6.11 | RSSI | XG RSSI Deviation Tolerance | Max=2 dBm |
| 6.12 | RX Sensitivity (SINAD) | SINAD | Max=-119 dBm |
| | | Audio Distortion | Max=0 % |
| 6.13 | P25 Phase 1 Rx Sensitivity (C4FM) Test | P25 Phase1 Rx Sensitivity C4FM | Min=0 %<br>Max=5 % |
| 6.14 | P25 Phase 2 Rx Sensitivity (TDMA) Test | P25 Phase2 Rx Sensitivity TDMA | Min=0 %<br>Max=5 % |
| 6.15 | Rx IF Bandwidth – Signal Displacement Bandwidth Test | Rx IF Selectivity | Max=7 kHz<br>Min=2 kHz |

**Table A-1. Default Harris XG-75 Portable Limits**

| Section | Test Name | Limit | Default Value |
|---|---|---|---|
| 8.1 | Reference Oscillator | Reference Oscillator Align VHF | Min= -10 Hz<br>Max= 10 Hz |
| | | Reference Oscillator Align 350MHz | Min= -10 Hz<br>Max= 10 Hz |
| | | Reference Oscillator Align UHF-L | Min= -10 Hz<br>Max= 10 Hz |
| | | Reference Oscillator Align UHF-H | Min= -10 Hz<br>Max= 10 Hz |
| | | Reference Oscillator Align 700/800MHz | Min= -10 Hz<br>Max= 10 Hz |
| | | Reference Oscillator Test | Min= -1.5 ppm<br>Max= 1.5 ppm |
| 8.2.1 | TX Power (Align) | TX Power Align VHF(50W) Low | Min = 9.4 W<br>Max = 10.6 W |
| | | TX Power Align VHF(100W) Low | Min = 47.2 W<br>Max = 53.0 W |
| | | TX Power Align 350MHz Low | Min = 7.5 W<br>Max = 8.5 W |
| | | TX Power Align UHF-L Low | Min = 8.2 W<br>Max = 9.2 W |
| | | TX Power Align UHF-H Low | Min = 8.2 W<br>Max = 9.2 W |
| | | TX Power Align 700MHz Low | Min = 1.55 W<br>Max = 1.75 W |
| | | TX Power Align 800MHz Low | Min= 5.2 W<br>Max= 5.6 W |
| | | TX Power Align VHF(50W) Mid | Min=18.9 W<br>Max=21.2 W |
| | | TX Power Align VHF(100W) Mid | Min=76.0 W<br>Max=85.0 W |
| | | TX Power Align 350MHz Mid | Min=18.9 W<br>Max=21.2 W |
| | | TX Power Align UHF-L Mid | Min=22.0 W<br>Max=22.8 W |
| | | TX Power Align UHF-H Mid | Min=22.0 W<br>Max=22.8 W |
| | | TX Power Align 700MHz Mid | Min=16.1 W<br>Max=16.9 W |
| | | TX Power Align 800MHz Mid | Min=16.1 W<br>Max=16.9 W |
| | | TX Power Align VHF(50W) High | Min=47.2 W<br>Max=53.0 W |
| | | TX Power Align VHF(100W) High | Min=103.8 W<br>Max=116.5 W |
| | | TX Power Align 350MHz High | Min=37.8 W<br>Max=42.4 W |
| | | TX Power Align UHF-L High | Min=53.0 W<br>Max=55.0 W |
| | | TX Power Align UHF-H High | Min=53.0 W<br>Max=55.0 W |
| | | TX Power Align 700MHz High | Min=36.6 W<br>Max=37.4 W |
| | | TX Power Align 800MHz High | Min=36.1 W |

| | | | |
|---|---|---|---|
| | | | Max=36.9 W |
| 8.2.2 | TX Power (Test) | TX Power Test VHF(50W) Low | Min = 8.9 W<br>Max = 11.2 W |
| | | TX Power Test VHF(100W) Low | Min = 44.5 W<br>Max = 56.1 W |
| | | TX Power Test 350MHz Low | Min = 7.1 W<br>Max = 9.0 W |
| | | TX Power Test UHF-L Low | Min = 7.8 W<br>Max = 9.8 W |
| | | TX Power Test UHF-H Low | Min = 7.8 W<br>Max = 9.8 W |
| | | TX Power Test 700MHz Low | Min = 1.47 W<br>Max = 1.85 W |
| | | TX Power Test 800MHz Low | Min= 4.8 W<br>Max= 6.1 W |
| | | TX Power Test VHF(50W) Mid | Min=18.9 W<br>Max=21.2 W |
| | | TX Power Test VHF(100W) Mid | Min=76.0 W<br>Max=85.0 W |
| | | TX Power Test 350MHz Mid | Min=18.9 W<br>Max=21.2 W |
| | | TX Power Test UHF-L Mid | Min=21.1 W<br>Max=23.7 W |
| | | TX Power Test UHF-H Mid | Min=21.1 W<br>Max=23.7 W |
| | | TX Power Test 700MHz Mid | Min=14.7 W<br>Max=18.5 W |
| | | TX Power Test 800MHz Mid | Min=14.7 W<br>Max=18.5 W |
| | | TX Power Test VHF(50W) High | Min=47.2 W<br>Max=53.0 W |
| | | TX Power Test VHF(100W) High | Min=103.8 W<br>Max=116.4 W |
| | | TX Power Test 350MHz High | Min=37.7 W<br>Max=42.4 W |
| | | TX Power Test UHF-L High | Min=51.0 W<br>Max=57.2 W |
| | | TX Power Test UHF-H High | Min=51.0 W<br>Max=57.2 W |
| | | TX Power Test 700MHz High | Min=34.9 W<br>Max=39.2 W |
| | | TX Power Test 800MHz High | Min=34.5 W<br>Max=38.7 W |
| 8.3 | Tx Modulation Limit | Tx Modulation Limit Narrowband | Min = 2.15 kHz<br>Max = 2.35 kHz |
| | | Tx Modulation Limit Wideband | Min=4.3 kHz<br>Max=4.7 kHz |
| | | Tx Modulation Limit 700/800MHz Wideband | Min=4.3 kHz<br>Max=5.0 kHz |
| 8.4 | P25 Phase 1 Tx Modulation (C4FM) Test | P25 Phase1 Tx Modulation C4FM | Min=2.540 kHz<br>Max=3.120 kHz |
| 8.5 | P25 Phase 2 Tx Modulation (TDMA) | P25 Phase2 Tx Modulation TDMA | Min=2.995 kHz<br>Max=3.310 kHz |

| | | | |
|---|---|---|---|
| | Test | | |
| 8.6 | Rx Audio Level and Distortion | Rx Audio Distortion | Max=5 % |
| | | Rx Audio Voltage | Max=7.745 $V_{RMS}$ |
| 8.9 | Squelch Open and Close | Squelch Hysteresis | Max=6 dB<br>Min=2 dB |
| | | Squelch Open SINAD Align | Max=12 dB<br>Min=8 dB |
| | | Squelch Open SINAD Test | Max=12 dB<br>Min=8 dB |
| | | Squelch Open Output Level | Min=-130 dBm |
| 8.7 | RSSI | XG RSSI Deviation Tolerance | Max=2 dBm |
| 8.8 | RX Sensitivity (SINAD) | SINAD VHF | Max=-119 dBm |
| | | SINAD 350MHz | Max=-119 dBm |
| | | SINAD UHF1 | Max=-119 dBm |
| | | SINAD UHF2 | Max=-119 dBm |
| | | SINAD 700MHz | Max=-119 dBm |
| | | SINAD 800MHz | Max=-118 dBm |
| | | Audio Distortion | Max=0 % |
| 8.10 | P25 Phase 1 Rx Sensitivity (C4FM) Test | P25 Phase1 Rx Sensitivity C4FM | Min=0 %<br>Max=5 % |
| 8.11 | P25 Phase 2 Rx Sensitivity (TDMA) Test | P25 Phase2 Rx Sensitivity TDMA | Min=0 %<br>Max=5 % |

**Table A-2. Default Harris XG-75 Mobile Limits**

# APPENDIX B. Sample Test Result Report

Note: Results shown below are representative of actual results. Actual results and report format may vary.

## Test Result Report

Model #: XG-75Pe:system    Date/Time: 7/27/2016 3:06 PM
Serial #: A40207000244    Operator ID: M

Info: FLASH Version: XGP R05C05

### Reference Oscillator Align

| Result | Frequency | Freq Error | Min Limit | Max Limit | Old Softpot | New Softpot |
|---|---|---|---|---|---|---|
| Pass | 860.987 MHz | 33 Hz | -129 Hz | 129 Hz | 187 | 188 |

### TX Power Align - 860.987500 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.49 W | 0.49 W | 0.51 W | 0 | 655 | 0 | 817 |
| Pass | Mid | 1.59 W | 1.58 W | 1.62 W | 0 | 943 | 0 | 1425 |
| Pass | High | 3.22 W | 3.16 W | 3.24 W | 0 | 1375 | 0 | 2027 |

### TX Power Align - 857.687500 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.49 W | 0.49 W | 0.51 W | 692 | 648 | 803 | 816 |
| Pass | Mid | 1.60 W | 1.58 W | 1.62 W | 1026 | 937 | 1409 | 1430 |
| Pass | High | 3.19 W | 3.16 W | 3.24 W | 1165 | 1349 | 1609 | 2011 |

### TX Power Align - 854.312500 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.51 W | 0.49 W | 0.51 W | 0 | 655 | 0 | 793 |
| Pass | Mid | 1.60 W | 1.58 W | 1.62 W | 0 | 943 | 0 | 1425 |
| Pass | High | 3.22 W | 3.16 W | 3.24 W | 0 | 1375 | 0 | 2015 |

### TX Power Align - 851.012500 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.51 W | 0.49 W | 0.51 W | 706 | 661 | 808 | 830 |
| Pass | Mid | 1.61 W | 1.58 W | 1.62 W | 1052 | 954 | 1413 | 1424 |
| Pass | High | 3.16 W | 3.16 W | 3.24 W | 1190 | 1371 | 1611 | 1990 |

### TX Power Align - 815.987500 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.50 W | 0.49 W | 0.51 W | 0 | 671 | 0 | 784 |
| Pass | Mid | 1.59 W | 1.58 W | 1.62 W | 0 | 983 | 0 | 1358 |
| Pass | High | 3.19 W | 3.16 W | 3.24 W | 0 | 1471 | 0 | 1923 |

### TX Power Align - 812.687500 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.50 W | 0.49 W | 0.51 W | 694 | 630 | 802 | 786 |
| Pass | Mid | 1.60 W | 1.58 W | 1.62 W | 1032 | 911 | 1401 | 1325 |
| Pass | High | 3.21 W | 3.16 W | 3.24 W | 1174 | 1335 | 1599 | 1913 |

### TX Power Align - 809.312500 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.50 W | 0.49 W | 0.51 W | 0 | 615 | 0 | 782 |
| Pass | Mid | 1.61 W | 1.58 W | 1.62 W | 0 | 887 | 0 | 1320 |
| Pass | High | 3.20 W | 3.16 W | 3.24 W | 0 | 1279 | 0 | 1902 |

### TX Power Align - 806.012500 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.50 W | 0.49 W | 0.51 W | 681 | 638 | 794 | 772 |
| Pass | Mid | 1.58 W | 1.58 W | 1.62 W | 1022 | 927 | 1408 | 1298 |
| Pass | High | 3.17 W | 3.16 W | 3.24 W | 1159 | 1342 | 1596 | 1883 |

### TX Power Align - 804.993750 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.50 W | 0.49 W | 0.51 W | 0 | 631 | 0 | 735 |
| Pass | Mid | 1.62 W | 1.58 W | 1.62 W | 0 | 927 | 0 | 1352 |
| Pass | High | 2.87 W | 2.82 W | 2.88 W | 0 | 1215 | 0 | 1752 |

### TX Power Align - 803.256250 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.51 W | 0.49 W | 0.51 W | 697 | 654 | 750 | 781 |
| Pass | Mid | 1.62 W | 1.58 W | 1.62 W | 1055 | 956 | 1328 | 1344 |
| Pass | High | 2.85 W | 2.82 W | 2.88 W | 1186 | 1253 | 1512 | 1775 |

### TX Power Align - 802.906250 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.50 W | 0.49 W | 0.51 W | 0 | 655 | 0 | 738 |
| Pass | Mid | 1.58 W | 1.58 W | 1.62 W | 0 | 959 | 0 | 1327 |
| Pass | High | 2.87 W | 2.82 W | 2.88 W | 0 | 1279 | 0 | 1784 |

### TX Power Align - 800.506250 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.50 W | 0.49 W | 0.51 W | 712 | 667 | 749 | 769 |
| Pass | Mid | 1.58 W | 1.58 W | 1.62 W | 1084 | 983 | 1326 | 1324 |
| Pass | High | 2.87 W | 2.82 W | 2.88 W | 1221 | 1311 | 1511 | 1774 |

### TX Power Align - 798.756250 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.50 W | 0.49 W | 0.51 W | 0 | 663 | 0 | 771 |
| Pass | Mid | 1.59 W | 1.58 W | 1.62 W | 0 | 975 | 0 | 1324 |
| Pass | High | 2.84 W | 2.82 W | 2.88 W | 0 | 1295 | 0 | 1733 |

TX Power Align - 798.006250 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.50 W | 0.49 W | 0.51 W | 722 | 654 | 749 | 733 |
| Pass | Mid | 1.60 W | 1.58 W | 1.62 W | 1111 | 968 | 1336 | 1295 |
| Pass | High | 2.82 W | 2.82 W | 2.88 W | 1249 | 1271 | 1522 | 1756 |

TX Power Align - 774.993750 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.51 W | 0.49 W | 0.51 W | 0 | 671 | 0 | 767 |
| Pass | Mid | 1.59 W | 1.58 W | 1.62 W | 0 | 991 | 0 | 1301 |
| Pass | High | 2.86 W | 2.82 W | 2.88 W | 0 | 1327 | 0 | 1743 |

TX Power Align - 774.006250 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.50 W | 0.49 W | 0.51 W | 760 | 677 | 761 | 758 |
| Pass | Mid | 1.60 W | 1.58 W | 1.62 W | 1158 | 1014 | 1323 | 1305 |
| Pass | High | 2.88 W | 2.82 W | 2.88 W | 1301 | 1368 | 1498 | 1749 |

TX Power Align - 773.406250 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.51 W | 0.49 W | 0.51 W | 0 | 687 | 0 | 725 |
| Pass | Mid | 1.62 W | 1.58 W | 1.62 W | 0 | 1039 | 0 | 1315 |
| Pass | High | 2.84 W | 2.82 W | 2.88 W | 0 | 1375 | 0 | 1698 |

TX Power Align - 771.006250 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.51 W | 0.49 W | 0.51 W | 759 | 712 | 748 | 758 |
| Pass | Mid | 1.62 W | 1.58 W | 1.62 W | 1180 | 1088 | 1329 | 1314 |
| Pass | High | 2.86 W | 2.82 W | 2.88 W | 1326 | 1456 | 1502 | 1739 |

TX Power Align - 769.993750 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.50 W | 0.49 W | 0.51 W | 0 | 719 | 0 | 757 |
| Pass | Mid | 1.62 W | 1.58 W | 1.62 W | 0 | 1103 | 0 | 1311 |
| Pass | High | 2.86 W | 2.82 W | 2.88 W | 0 | 1471 | 0 | 1733 |

TX Power Align - 768.006250 MHz

| Result | Power Level | Power Out | Min Limit | Max Limit | Old Pwr Cntl | New Pwr Cntl | Old Pwr Sens | New Pwr Sens |
|---|---|---|---|---|---|---|---|---|
| Pass | Low | 0.50 W | 0.49 W | 0.51 W | 765 | 718 | 753 | 716 |
| Pass | Mid | 1.62 W | 1.58 W | 1.62 W | 1187 | 1112 | 1327 | 1313 |
| Pass | High | 2.85 W | 2.82 W | 2.88 W | 1331 | 1482 | 1497 | 1708 |

FM Deviation Test Wide

| Result | Frequency | Deviation | Min Limit | Max Limit |
|---|---|---|---|---|
| Pass | 860.9875 MHz | 4.5 kHz | 4.3 kHz | 4.7 kHz |
| Pass | 857.6875 MHz | 4.5 kHz | 4.3 kHz | 4.7 kHz |
| Pass | 854.3125 MHz | 4.4 kHz | 4.3 kHz | 4.7 kHz |
| Pass | 851.0125 MHz | 4.5 kHz | 4.3 kHz | 4.7 kHz |
| Pass | 815.9875 MHz | 4.4 kHz | 4.3 kHz | 4.7 kHz |
| Pass | 812.6875 MHz | 4.5 kHz | 4.3 kHz | 4.7 kHz |
| Pass | 809.3125 MHz | 4.5 kHz | 4.3 kHz | 4.7 kHz |

FM Deviation Test NPSPAC

| Result | Frequency | Deviation | Min Limit | Max Limit |
|---|---|---|---|---|
| Pass | 806.0125 MHz | 3.6 kHz | 3.5 kHz | 3.7 kHz |

FM Deviation Test Narrow

| Result | Frequency | Deviation | Min Limit | Max Limit |
|---|---|---|---|---|
| Pass | 804.9937 MHz | 2.18 kHz | 2.15 kHz | 2.35 kHz |
| Pass | 803.2563 MHz | 2.23 kHz | 2.15 kHz | 2.35 kHz |
| Pass | 802.9062 MHz | 2.20 kHz | 2.15 kHz | 2.35 kHz |
| Pass | 800.5063 MHz | 2.21 kHz | 2.15 kHz | 2.35 kHz |
| Pass | 798.7563 MHz | 2.21 kHz | 2.15 kHz | 2.35 kHz |
| Pass | 798.0063 MHz | 2.21 kHz | 2.15 kHz | 2.35 kHz |
| Pass | 774.9937 MHz | 2.21 kHz | 2.15 kHz | 2.35 kHz |
| Pass | 774.0063 MHz | 2.21 kHz | 2.15 kHz | 2.35 kHz |
| Pass | 773.4062 MHz | 2.21 kHz | 2.15 kHz | 2.35 kHz |
| Pass | 771.0063 MHz | 2.19 kHz | 2.15 kHz | 2.35 kHz |
| Pass | 769.9937 MHz | 2.18 kHz | 2.15 kHz | 2.35 kHz |
| Pass | 768.0063 MHz | 2.21 kHz | 2.15 kHz | 2.35 kHz |

Channel Guard Deviation Test - Wideband TCG

| Result | Frequency | Deviation | Min Limit | Max Limit |
|---|---|---|---|---|
| Pass | 860.987500 MHz | 709 Hz | 500 Hz | 1000 Hz |
| Pass | 851.012500 MHz | 709 Hz | 500 Hz | 1000 Hz |
| Pass | 815.987500 MHz | 710 Hz | 500 Hz | 1000 Hz |

Channel Guard Deviation Test - NPSPAC

| Result | Frequency | Deviation | Min Limit | Max Limit |
|---|---|---|---|---|
| Pass | 806.012500 MHz | 569 Hz | 400 Hz | 800 Hz |

Channel Guard Deviation Test - Narrowband TCG

| Result | Frequency | Deviation | Min Limit | Max Limit |
|---|---|---|---|---|
| Pass | 804.993750 MHz | 357 Hz | 350 Hz | 500 Hz |
| Pass | 768.006250 MHz | 355 Hz | 350 Hz | 500 Hz |

Channel Guard Deviation Test - Wideband DCG

| Result | Frequency | Deviation | Min Limit | Max Limit |
|---|---|---|---|---|
| Pass | 860.987500 MHz | 676 Hz | 350 Hz | 850 Hz |

C4FM Deviation Test

| Result | Frequency | Deviation | Min Limit | Max Limit |
|---|---|---|---|---|
| Pass | 860.987500 MHz | 2.817 Hz | 2.626 Hz | 3.026 Hz |

P25 Phase 1 Tx Modulation C4FM

| Result | Test Frequency | Measured Dev | Min Limit | Max Limit |
|---|---|---|---|---|
| Pass | 860.9875 MHz | 2.805 kHz | 2.540 kHz | 3.120 kHz |

P25 Phase 2 Tx Modulation TDMA

| Result | Test Frequency | Measured Dev | Min Limit | Max Limit |
|---|---|---|---|---|
| Pass | 860.9875 MHz | 3.174 kHz | 2.995 kHz | 3.310 kHz |

Tx Audio Distortion

| Result | Frequency | Audio Level | Distortion | Max Limit |
|---|---|---|---|---|
| Pass | 860.9875 MHz | 10 mV | 2.8 % | 3.0 % |

Rx Audio Level and Distortion

| Result | Frequency | Min Limit | Max Volume | Mid Vol Dist | Max Limit |
|---|---|---|---|---|---|
| Pass | 768.006250 MHz | 2.0 Vrms | 3.3 Vrms | 1.1 % | 3.0 % |

RSSI Align

| Result | Frequency | -110 +/-2 dBm | Weak Softpot | -85 +/-2 dBm | Med Softpot | -60 +/-2 dBm | Strong Softpot |
|---|---|---|---|---|---|---|---|
| Pass | 860.9875 MHz | -108.5 dBm | 508 | -85.6 dBm | 1404 | -59.5 dBm | 2236 |
| Pass | 851.0125 MHz | -111.2 dBm | 584 | -85.0 dBm | 1404 | -60.0 dBm | 2238 |
| Pass | 774.9937 MHz | -109.1 dBm | 577 | -84.4 dBm | 1430 | -60.0 dBm | 2282 |
| Pass | 771.0063 MHz | -109.7 dBm | 574 | -85.0 dBm | 1434 | -59.5 dBm | 2256 |
| Pass | 768.0063 MHz | -110.2 dBm | 596 | -85.0 dBm | 1442 | -60.4 dBm | 2277 |

Rx Sensitivity (SINAD) Test

| Result | Frequency | 12dB SINAD | Max Limit |
|---|---|---|---|
| Pass | 768.006250 MHz | -120.2 dBm | -119.0 dBm |
| Pass | 771.006250 MHz | -120.2 dBm | -119.0 dBm |
| Pass | 774.993750 MHz | -120.8 dBm | -119.0 dBm |
| Pass | 851.012500 MHz | -119.8 dBm | -119.0 dBm |
| Pass | 860.987500 MHz | -120.1 dBm | -119.0 dBm |

Squelch Open and Close Align - Narrow

| Result | Frequency | Min Sql Open | Open SINAD | Max Sql Open | Min Hyst | Hysteresis | Max Hyst | Open Softpot | Close Softpot |
|---|---|---|---|---|---|---|---|---|---|
| Pass | 771.00625 MHz | 5 dB | 9 dB | 10 dB | 2 dB | 4 dB | 5 dB | 720 | 1500 |

Squelch Open and Close Align - Wide

| Result | Frequency | Min Sql Open | Open SINAD | Max Sql Open | Min Hyst | Hysteresis | Max Hyst | Open Softpot | Close Softpot |
|---|---|---|---|---|---|---|---|---|---|
| Pass | 860.98750 MHz | 5 dB | 8 dB | 10 dB | 2 dB | 2 dB | 5 dB | 1850 | 2550 |

Squelch Open and Close Align - NPSPAC

| Result | Frequency | Min Sql Open | Open SINAD | Max Sql Open | Min Hyst | Hysteresis | Max Hyst | Open Softpot | Close Softpot |
|---|---|---|---|---|---|---|---|---|---|
| Pass | 851.01250 MHz | 5 dB | 9 dB | 10 dB | 2 dB | 2 dB | 5 dB | 1400 | 2250 |

P25 Phase1 Rx Sensitivity C4FM

| Result | Frequency | BER | Max Limit | Min Limit |
|---|---|---|---|---|
| Pass | 768.0063 MHz | 1.366 % | 5.0 % | 0.000 % |
| Pass | 771.0063 MHz | 1.490 % | 5.0 % | 0.000 % |
| Pass | 774.9937 MHz | 1.146 % | 5.0 % | 0.000 % |
| Pass | 851.0125 MHz | 1.760 % | 5.0 % | 0.000 % |
| Pass | 860.9875 MHz | 1.609 % | 5.0 % | 0.000 % |

P25 Phase2 Rx Sensitivity TDMA

| Result | Frequency | BER | Max Limit | Min Limit |
|---|---|---|---|---|
| Pass | 768.0063 MHz | 0.308 % | 5.0 % | 0.000 % |
| Pass | 771.0063 MHz | 0.329 % | 5.0 % | 0.000 % |
| Pass | 774.9937 MHz | 0.275 % | 5.0 % | 0.000 % |
| Pass | 851.0125 MHz | 0.516 % | 5.0 % | 0.000 % |
| Pass | 860.9875 MHz | 0.587 % | 5.0 % | 0.000 % |

Rx IF Bandwidth

| Result | Frequency | 12 dB SINAD | Min Limit | Sig Disp BW | Max Limit |
|---|---|---|---|---|---|
| Pass | 860.9875 MHz | -120.1 dB | 2 kHz | 3.00 kHz | 7 kHz |

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APP Version 2.0.0.108

**Figure B-1. Sample Test Result Report**

# APPENDIX C. Revision History

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| A – Original Release | M. Mullins | W. Black | 11/11/2016 | 0089 |
| Revision – Change | Requested By | Approved By | Rel. Date | ECO# |