# FCC Certification Test Report (Revision 1)
# For

## MB Martin & Company
## FCC ID: TDOAVICOM1

**August 2005**
**Rev. 1: September 2005**

Prepared for:

**MB Martin & Company**
**965 Leigh Mill Road**
**Great Falls, VA 22066**

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

# FCC Certification Test Report (Revision 1)
# For the
# MB Martin & Company
# AVIACOM1 VHF Transceiver

WLL JOB# **8843**
**August 2005**

**Rev. 1: September 2005**

Prepared by:

Christina M. Karlhoff
Technical Liaison

Reviewed by:

Gregory M. Snyder
Chief EMC Engineer

 

# Abstract

This report has been prepared on behalf of MB Martin & Company to support the attached Application for Equipment Authorization. The test report and application are submitted for a transceiver under Part 87 part of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a MB Martin & Company AVIACOM1 VHF Transceiver.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The MB Martin & Company AVIACOM1 VHF Transceiver complies with the limits for a transmitter device under Part 87 part of the FCC Rules and Regulations.

# Table of Contents

**Abstract** ........ **ii**
**1 Introduction** ........ **1**
1.1 Compliance Statement ........ 1
1.2 Test Scope ........ 1
1.3 Contract Information ........ 1
1.4 Test Dates ........ 1
1.5 Test and Support Personnel ........ 1
1.6 Abbreviations ........ 2
**2 Equipment Under Test** ........ **3**
2.1 EUT Identification & Description ........ 3
2.2 Test Configuration ........ 3
2.3 Testing Algorithm ........ 4
2.4 Test Location ........ 4
2.5 Measurements ........ 5
2.5.1 References ........ 5
2.6 Measurement Uncertainty ........ 5
**3 Test Results** ........ **6**
3.1 RF Power Output: (§2.1046(a)/§87.131) ........ 6
3.2 Modulation Characteristics: (FCC Part 87 §2.1047(a)/§87.141); Audio Filter Response and Modulation Limiting ........ 7
3.3 Emission Mask and Occupied Bandwidth: (FCC Part §2.1049/§87.139(a)) ........ 10
3.4 Spurious Emissions at Antenna Terminals (FCC §87.139(a) and §2.1051) ........ 15
3.5 Radiated Spurious Emissions: (FCC Part 87 and §2.1053) ........ 25
**3.5.1 Test Procedure** ........ 25
3.6 Frequency Stability: (FCC Part §2.1055/§87.133) ........ 29

 

# List of Tables

Table 1. Device Summary.......... 3
Table 2. RF Power Output .......... 6
Table 3. Occupied Bandwidth Results.......... 14
Table 4:  Radiated Emission Test Data.......... 26
Table 5. Frequency Deviation as a Function of Temperature.......... 29
Table 6. Frequency Deviation as a Function of Voltage .......... 30

# List of Figures

Figure 1. Test Configuration.......... 4
Figure 2. Audio Frequency Response.......... 7
Figure 3. Modulation Deviation with Varying Input Amplitude.......... 8
Figure 4. Occupied Bandwidth, Low Channel Emission Mask.......... 11
Figure 5. Occupied Bandwidth, Mid Channel Emission Mask .......... 12
Figure 6. Occupied Bandwidth, High Channel Emission Mask .......... 13
Figure 7. Conducted Spurious Emissions, Low Channel Plot 1 .......... 16
Figure 8. Conducted Spurious Emissions, Low Channel Plot 2 .......... 17
Figure 9. Conducted Spurious Emissions, Low Channel Plot 3 .......... 18
Figure 10. Conducted Spurious Emissions, Mid Channel Plot 1.......... 19
Figure 11. Conducted Spurious Emissions, Mid Channel Plot 2.......... 20
Figure 12. Conducted Spurious Emissions, Mid Channel Plot 3.......... 21
Figure 13. Conducted Spurious Emissions, High Channel Plot 1 .......... 22
Figure 14. Conducted Spurious Emissions, High Channel Plot 2 .......... 23
Figure 15. Conducted Spurious Emissions, High Channel Plot 3 .......... 24

# 1 Introduction

## 1.1 Compliance Statement

The MB Martin & Company AVIACOM1 VHF Transceiver complies with the limits for a transmitter device under Part 87 part of the FCC Rules and Regulations.

## 1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed according to the ANSI/TIA-603-B. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

## 1.3 Contract Information

| | |
|---|---|
| Customer: | MB Martin & Company<br>965 Leigh Mill Road<br>Great Falls, VA 22066 |
| Purchase Order Number: | N/A |
| Quotation Number: | 62475 |

## 1.4 Test Dates

Testing was performed on the following date(s): 07/21/2005 to 08/02/2005

## 1.5 Test and Support Personnel

| | |
|---|---|
| Washington Laboratories, Ltd. | Greg Snyder; James Ritter |
| Client Representative | Jim Mastropole |

 

## 1.6 Abbreviations

| | |
|---|---|
| **A** | **A**mpere |
| **ac** | **a**lternating **c**urrent |
| **AM** | **A**mplitude **M**odulation |
| **Amps** | **Amp**eres |
| **b/s** | **b**its per **s**econd |
| **BW** | **B**and**w**idth |
| **CE** | **C**onducted **E**mission |
| **cm** | **c**enti**m**eter |
| **CW** | **C**ontinuous **W**ave |
| **dB** | **d**eci**b**el |
| **dc** | **d**irect **c**urrent |
| **EMI** | **E**lectro**m**agnetic **I**nterference |
| **EUT** | **E**quipment **U**nder **T**est |
| **FM** | **F**requency **M**odulation |
| **G** | giga - prefix for $10^9$ multiplier |
| **Hz** | **H**ertz |
| **IF** | **I**ntermediate **F**requency |
| **k** | kilo - prefix for $10^3$ multiplier |
| **M** | Mega - prefix for $10^6$ multiplier |
| **m** | **m**eter |
| **µ** | micro - prefix for $10^{-6}$ multiplier |
| **NB** | **N**arrow**b**and |
| **LISN** | **L**ine **I**mpedance **S**tabilization **N**etwork |
| **RE** | **R**adiated **E**missions |
| **RF** | **R**adio **F**requency |
| **rms** | **r**oot-**m**ean-**s**quare |
| **SN** | **S**erial **N**umber |
| **S/A** | **S**pectrum **A**nalyzer |
| **V** | **V**olt |

# 2 Equipment Under Test

## 2.1 EUT Identification & Description

The MB Martin & Company AVIACOM1 VHF Transceiver is an aviation VHF transceiver "building block" intended for ground-based applications. The frequency range of operation is from 118-137 MHz.

**Table 1. Device Summary**

| ITEM | DESCRIPTION |
|---|---|
| Manufacturer: | MB Martin & Company |
| FCC ID Number | TDOAVICOM1 |
| EUT Name: | Aviation VHF Transceiver |
| Model: | AVIACOM1 |
| FCC Rule Parts: | Part 2 and Part 87 |
| Frequency Range: | 118 MHz – 136.975 MHz |
| Maximum Output Power: | 0.4198 W |
| Modulation: | AM |
| Necessary Bandwidth: | 5.6kHz |
| Keying: | Manual |
| Type of Information: | Voice |
| Power Output Level | Fixed |
| Antenna Type | Connector |
| Frequency Tolerance: | <20 ppm |
| Emission Type(s): | A3E |
| Interface Cables: | RS-232 Comm Port,<br>SMA Antenna Port<br>Custom connector for Audio I/O |
| Power Source & Voltage: | +12Vdc |

## 2.2 Test Configuration

The AVIACOM1 VHF Transceiver was powered from an external AC to DC regulated supply into a custom connector. The custom connector also has 2 RCA type connections for transmit audio input and for receive. The transmit audio port was attached to a function generator providing 2500Hz 1 Vp-p input to EUT. The receive port was terminated in 50 Ohms. A support Laptop with HyperTerminal was connected to the EUT's RS232 port (DB9 connector) for controlling the radio during testing.

 

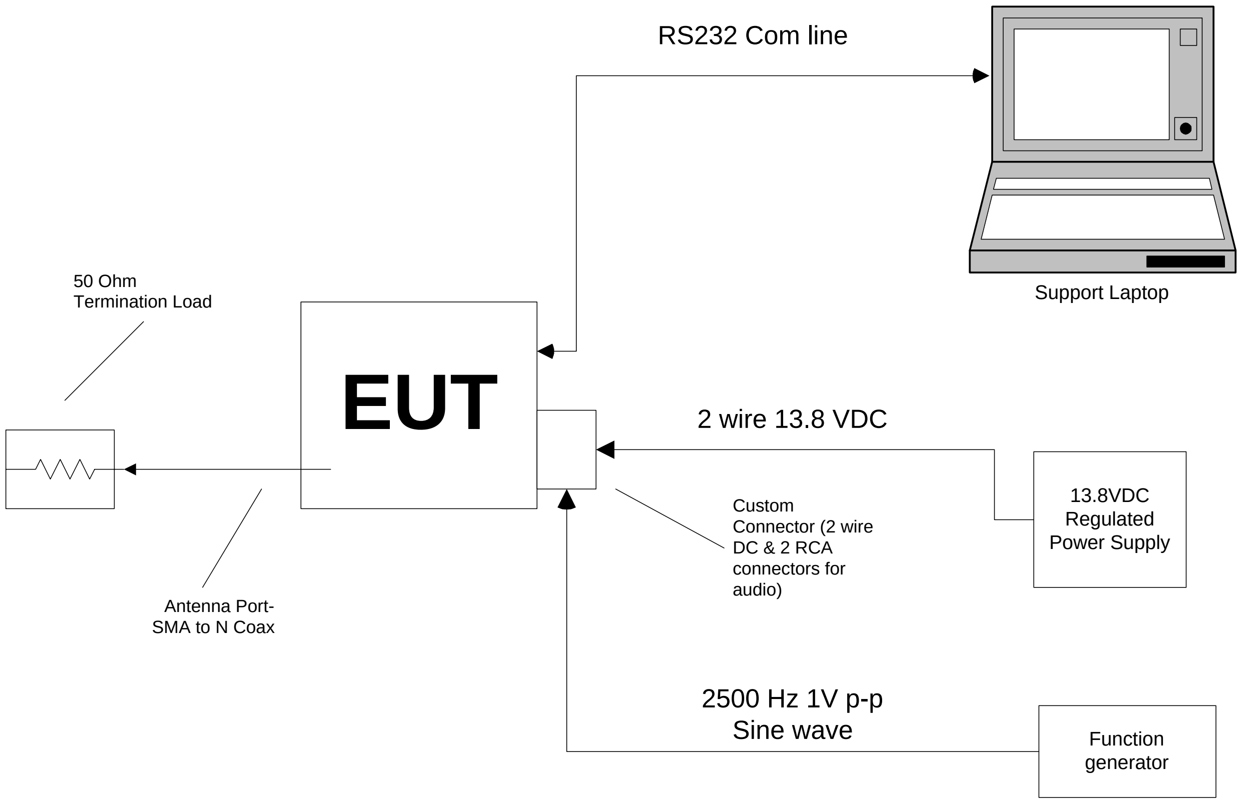


**Figure 1. Test Configuration**

## 2.3 Testing Algorithm

The AVIACOM1 VHF Transceiver was operated for continuous transmission as follows:

The Unit was set to transmit @ 127.5MHz via a RS232 link to HyperTerminal on the support laptop. The command: *$F127.5000* set the transmit frequency to 127.5 MHz, and *$T* started the transmit pulses. A function generator supplied 2500 Hz sine wave at the audio input port to modulate the transmission as necessary. Additional frequencies were similarly programmed.

Worst case emission levels are provided in the test results data.

## 2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

 

## 2.5 Measurements

### 2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-93)

## 2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

 

# 3 Test Results

## 3.1 RF Power Output: (§2.1046(a)/§87.131)

The test setup was in accordance with TIA/EIA 603. The unmodulated output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system. The spectrum analyzer bandwidth settings were: RBW = 1MHz, VBW = 1MHz.

**Table 2. RF Power Output**

| Channel and/or Frequency | Measured Level (dBm) | Measured Level (mWatts) | Rated (mWatts) | Limit (Watts) |
|---|---|---|---|---|
| 118 MHz | 26.23 | 419.8 | 350 | 55 |
| 127.5 MHz | 26.02 | 400 | 350 | 55 |
| 136.975 MHz | 25.13 | 325.8 | 350 | 55 |

Notes: The unit has a linear Class A amplifier. The voltage is 8Vdc and the current is 300mA.

**Equipment Used:**

| Manufacturer | Description/Model | Asset Number | Cal. Due |
|---|---|---|---|
| Agilent | E4446A | 00528 | 6/2/06 |
| Hewlett-Packard | 8714C RF Network Analyzer | 00420 | 5/9/2006 |
| MCL | Attenuator 3dB | None | Cal-in-use |
| Mini-Circuits | Attenuator 6dB | None | Cal-in-use |

## 3.2 Modulation Characteristics: (FCC Part 87 §2.1047(a)/§87.141); Audio Filter Response and Modulation Limiting

### Audio Filter Response:

The audio Frequency Response was measured and recorded. The test setup was in accordance with EIA/EIA 603 2.2.6.2.2 Constant Input Method. A plot of the response of the audio filter is shown in the following figure.

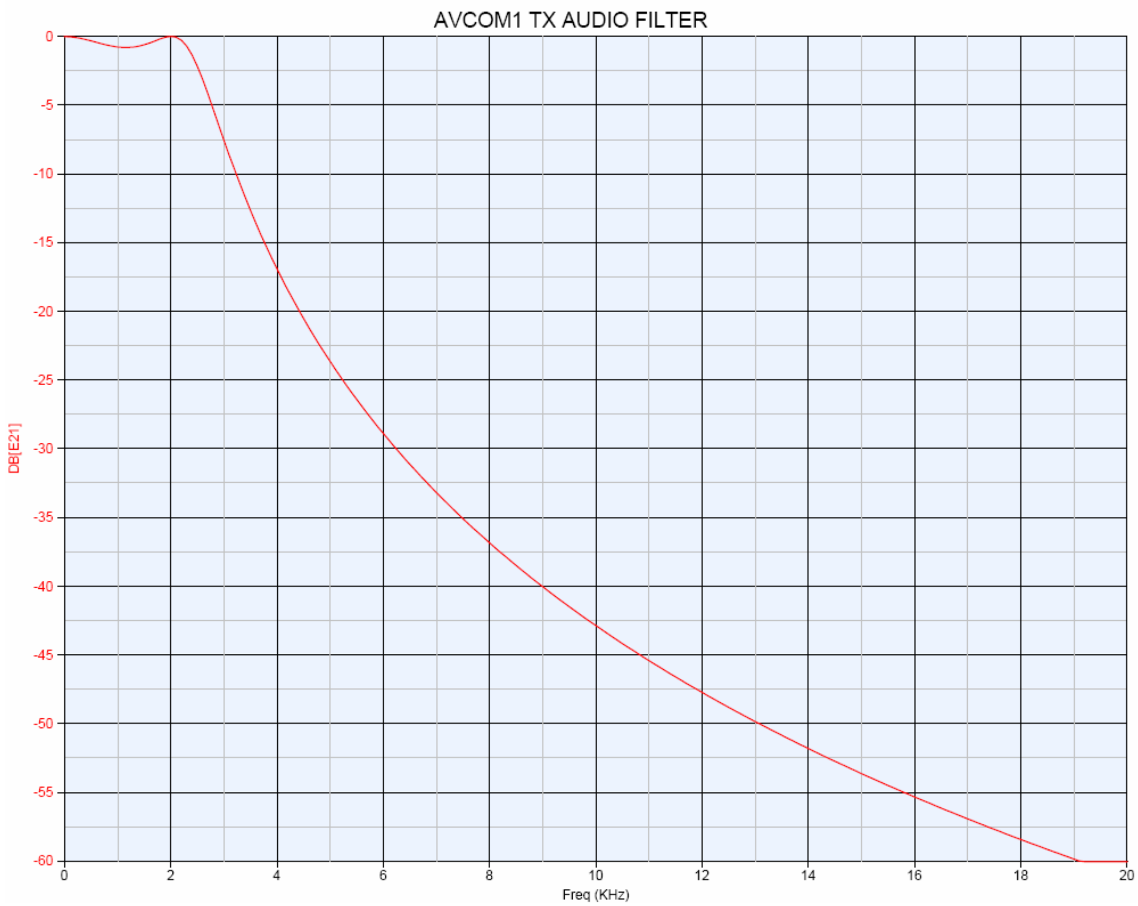


**Figure 2. Audio Frequency Response**

## Modulation Limiting:

The test setup is in accordance with TIA/EIA 603. The EUT is functioning normally on the indicated frequency. EUT is powered by an external 12VDC power source. A family of curves is plotted as a function of modulation percentage over a varying input level. The input voltage level was varied from 0 to 2V. Modulation frequencies of 100, 300, 1500, 2500, and 5000 Hz were used.

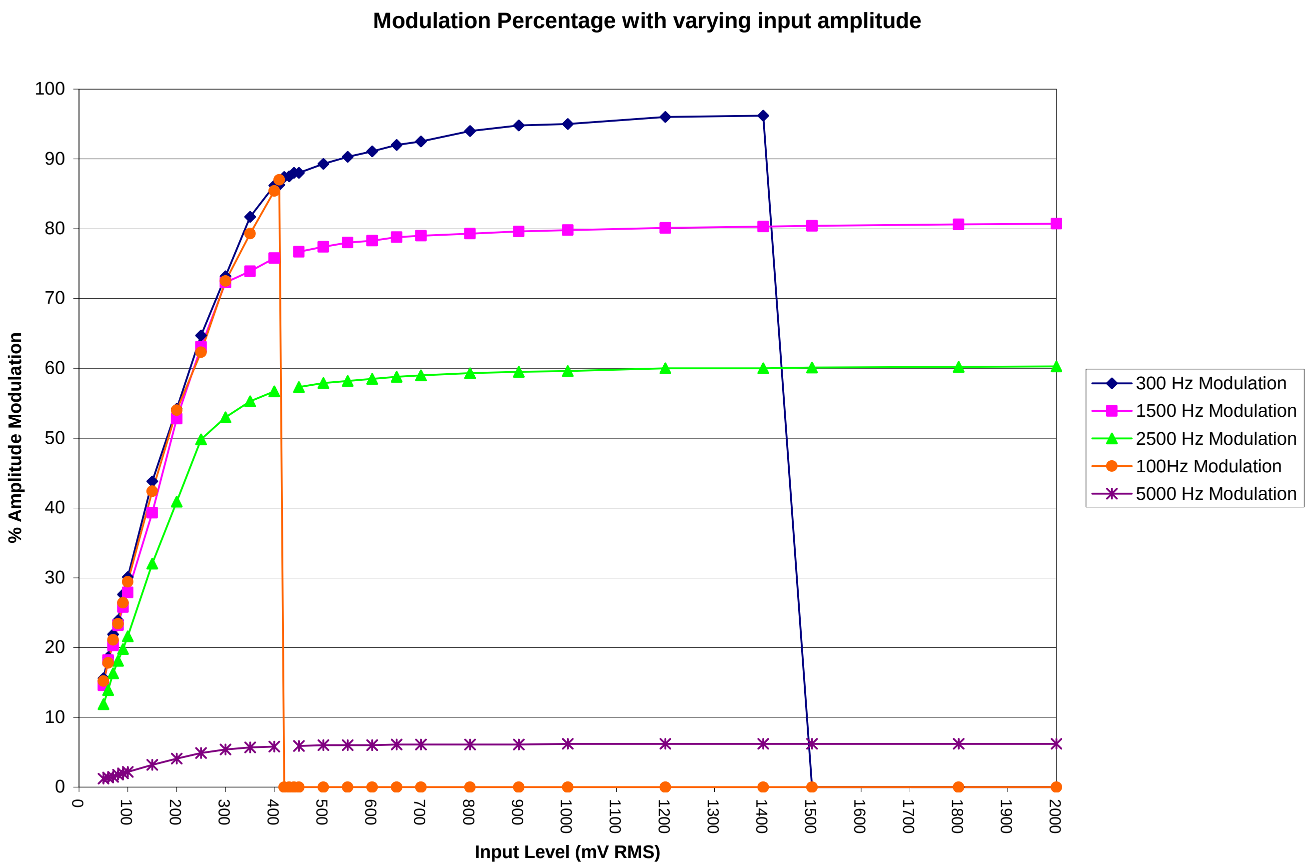


**Figure 3. Modulation Deviation with Varying Input Amplitude**

## Equipment Used:

| Manufacturer | Description/Model | Asset Number | Cal. Due |
|---|---|---|---|
| Tektronix | TDS-222 | 00333 | 8/26/05 |
| Boonton | 82AD/01A/S10/S13 Modulation Analyzer | 00012 | 5/2/06 |
| B&K Precision | 4040A Function/Signal Generator | 00406 | Cal-in-use |
| Hewlett-Packard | 8714C RF Network Analyzer | 00420 | 5/9/2006 |
| MCL | Attenuator 3dB | None | Cal-in-use |
| Mini-Circuits | Attenuator 6dB | None | Cal-in-use |

## 3.3 Emission Mask and Occupied Bandwidth: (FCC Part §2.1049/§87.139(a))

The EUT was setup in accordance with the method described in EIA/TIA 603 for sideband spectrum measurements. A 2500Hz audio signal was provided to the audio input of the EUT. The spurious emissions were then measured for the low, middle, and high channels and compared to the appropriate emission mask.

The following figures are plots of the emissions within the emission mask.

 

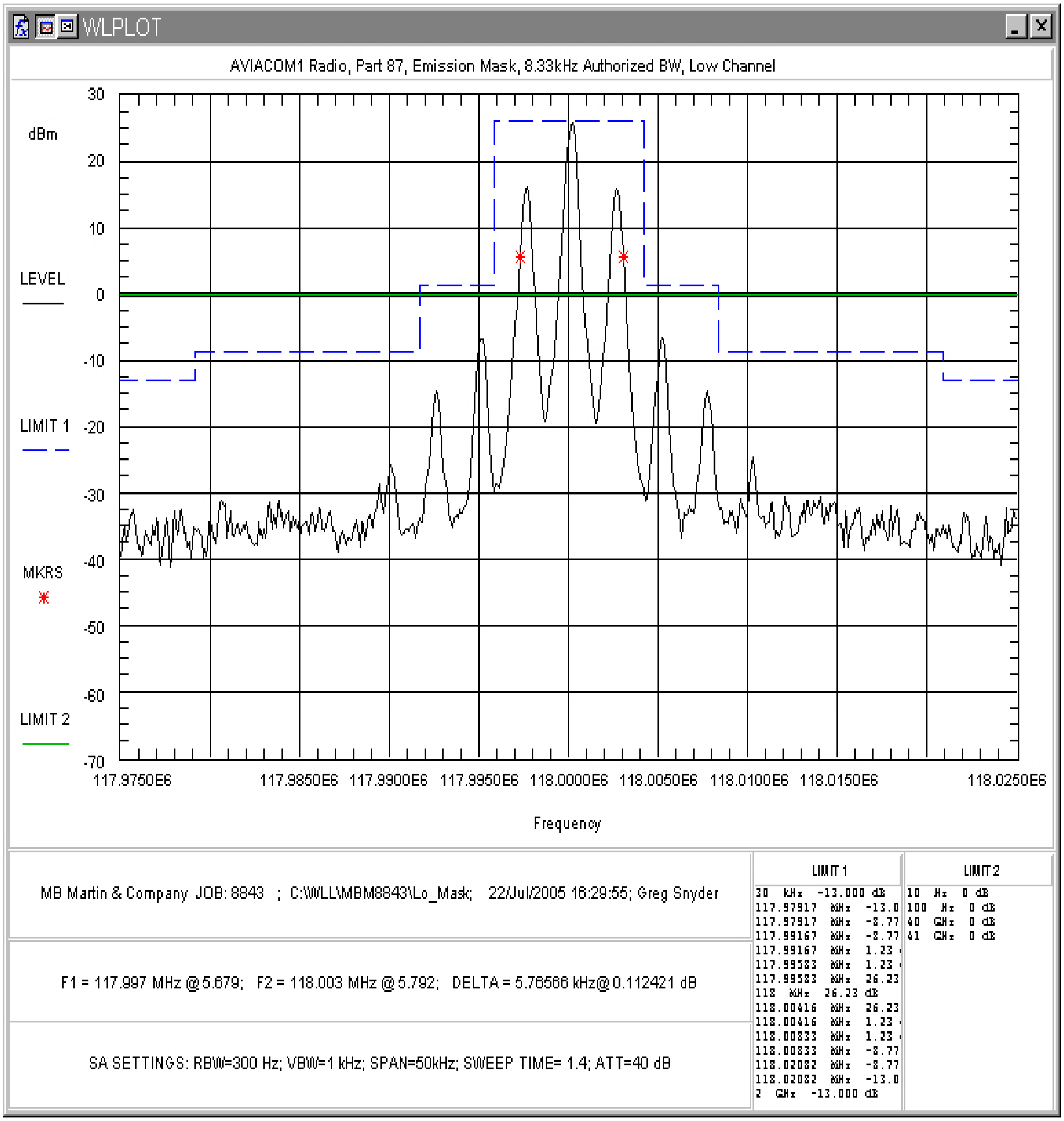


**Figure 4. Occupied Bandwidth, Low Channel Emission Mask**

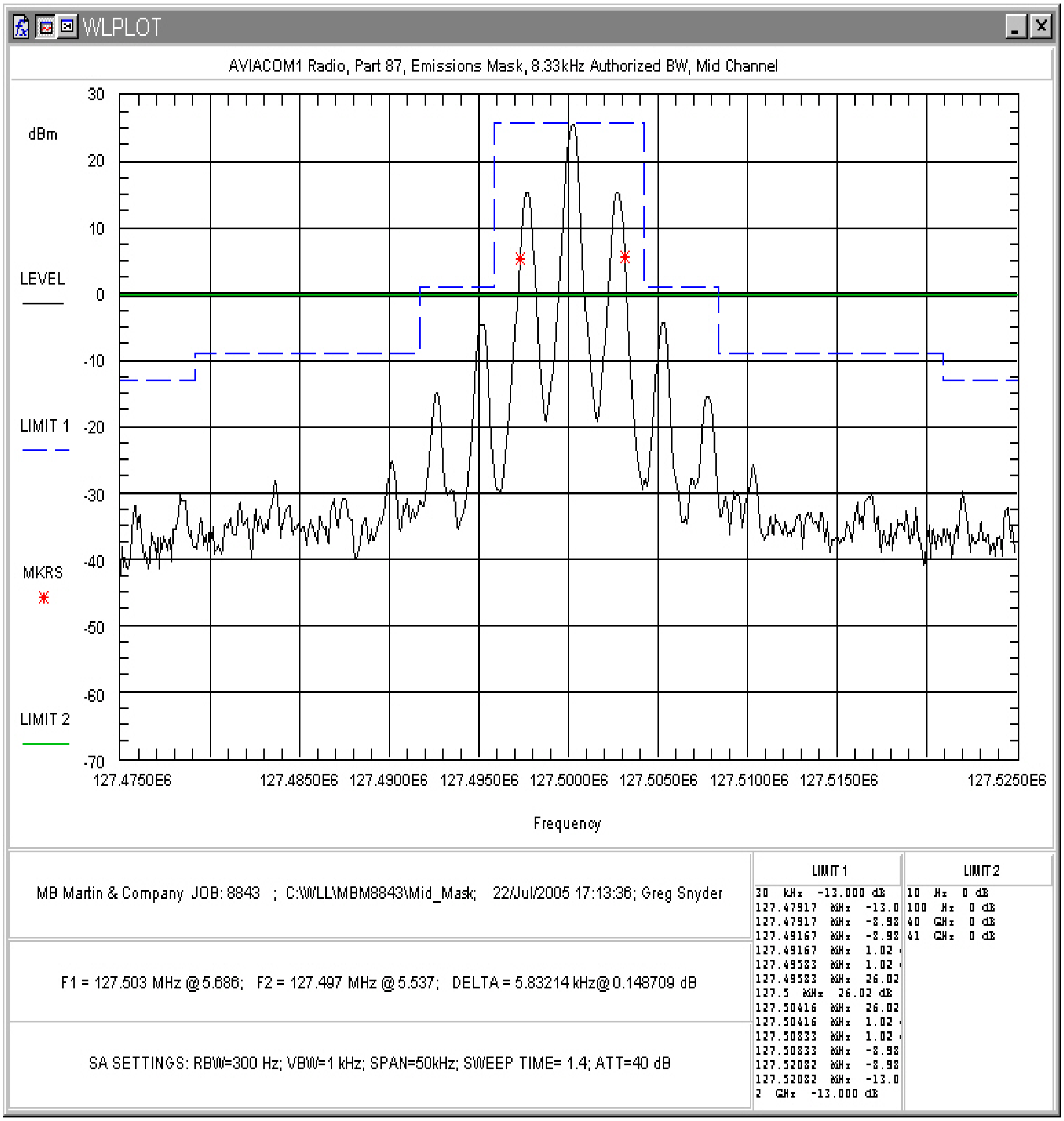


**Figure 5. Occupied Bandwidth, Mid Channel Emission Mask**

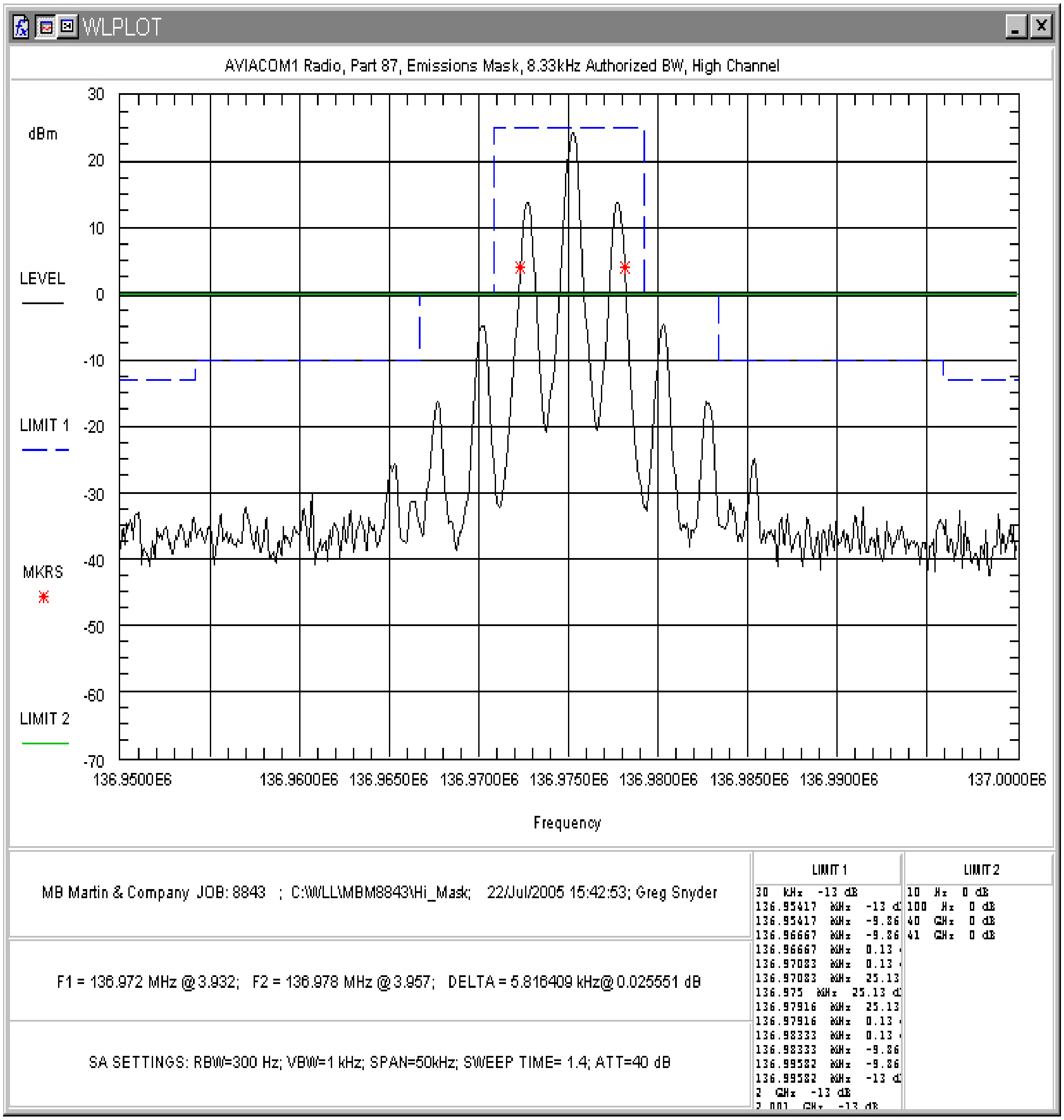


**Figure 6. Occupied Bandwidth, High Channel Emission Mask**

Table 3 provides a summary of the Occupied Bandwidth Results.

**Table 3. Occupied Bandwidth Results**

| Frequency | Bandwidth | Pass/Fail |
|---|---|---|
| Low Channel: 118 MHz | 5.766 kHz | Pass |
| Mid Channel: 127.5 MHz | 5.832 kHz | Pass |
| High Channel: 136.975 MHz | 5.816 kHz | Pass |

**Emissions Designator**:

Per §87.137 for a transmitter with an emission class of A3E operating above 50MHz with an authorized bandwidth of 8.33kHz, the emission designator will be:

5K6A3E

**Equipment Used:**

| Manufacturer | Description/Model | Asset Number | Cal. Due |
|---|---|---|---|
| Tektronix | TDS-222 | 00333 | 8/26/05 |
| Hewlett Packard | 8564E Spectrum Analyzer | 00012 | 7/16/06 |
| B&K Precision | 4040A Function/Signal Generator | 00406 | Cal-in-use |
| Hewlett-Packard | 8714C RF Network Analyzer | 00420 | 5/9/2006 |
| MCL | Attenuator 3dB | None | Cal-in-use |
| Mini-Circuits | Attenuator 6dB | None | Cal-in-use |

### 3.4 Spurious Emissions at Antenna Terminals (FCC §87.139(a) and §2.1051)

The EUT must comply with requirements for spurious emissions at antenna terminals. The limits, from §87.139(a), are as follows:

(1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;

(2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.

(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least 43 + 10 $\log_{10}$ pY dB.

Results of the conducted spurious emissions are shown in the following plots.

**Equipment Used:**

| Manufacturer | Description/Model | Asset Number | Cal. Due |
|---|---|---|---|
| Tektronix | TDS-222 | 00333 | 8/26/05 |
| Hewlett Packard | 8564E Spectrum Analyzer | 00012 | 7/16/06 |
| B&K Precision | 4040A Function/Signal Generator | 00406 | Cal-in-use |
| Hewlett-Packard | 8714C RF Network Analyzer | 00420 | 5/9/2006 |
| MCL | Attenuator 3dB | None | Cal-in-use |
| Mini-Circuits | Attenuator 6dB | None | Cal-in-use |

 

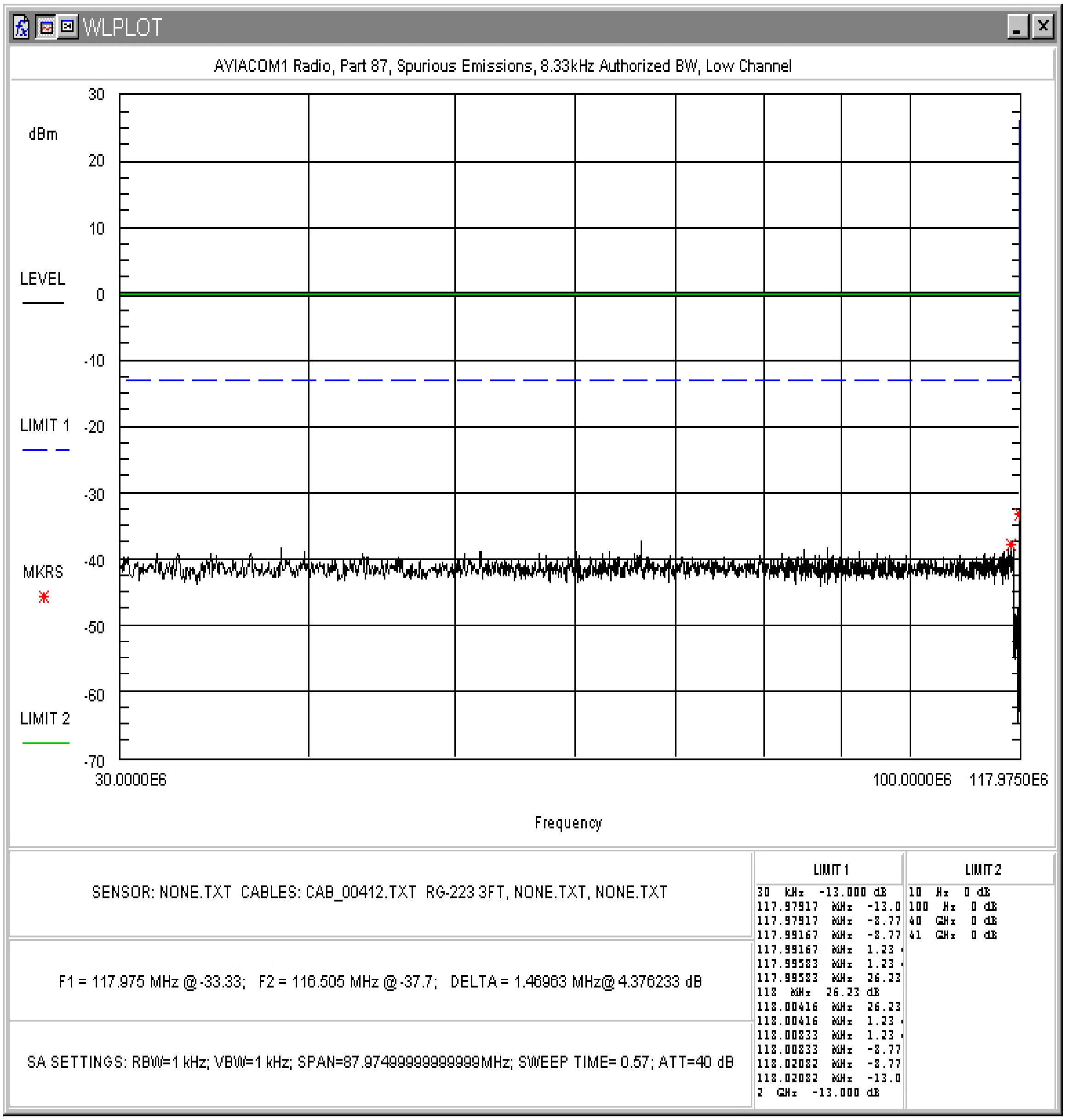


**Figure 7. Conducted Spurious Emissions, Low Channel Plot 1**

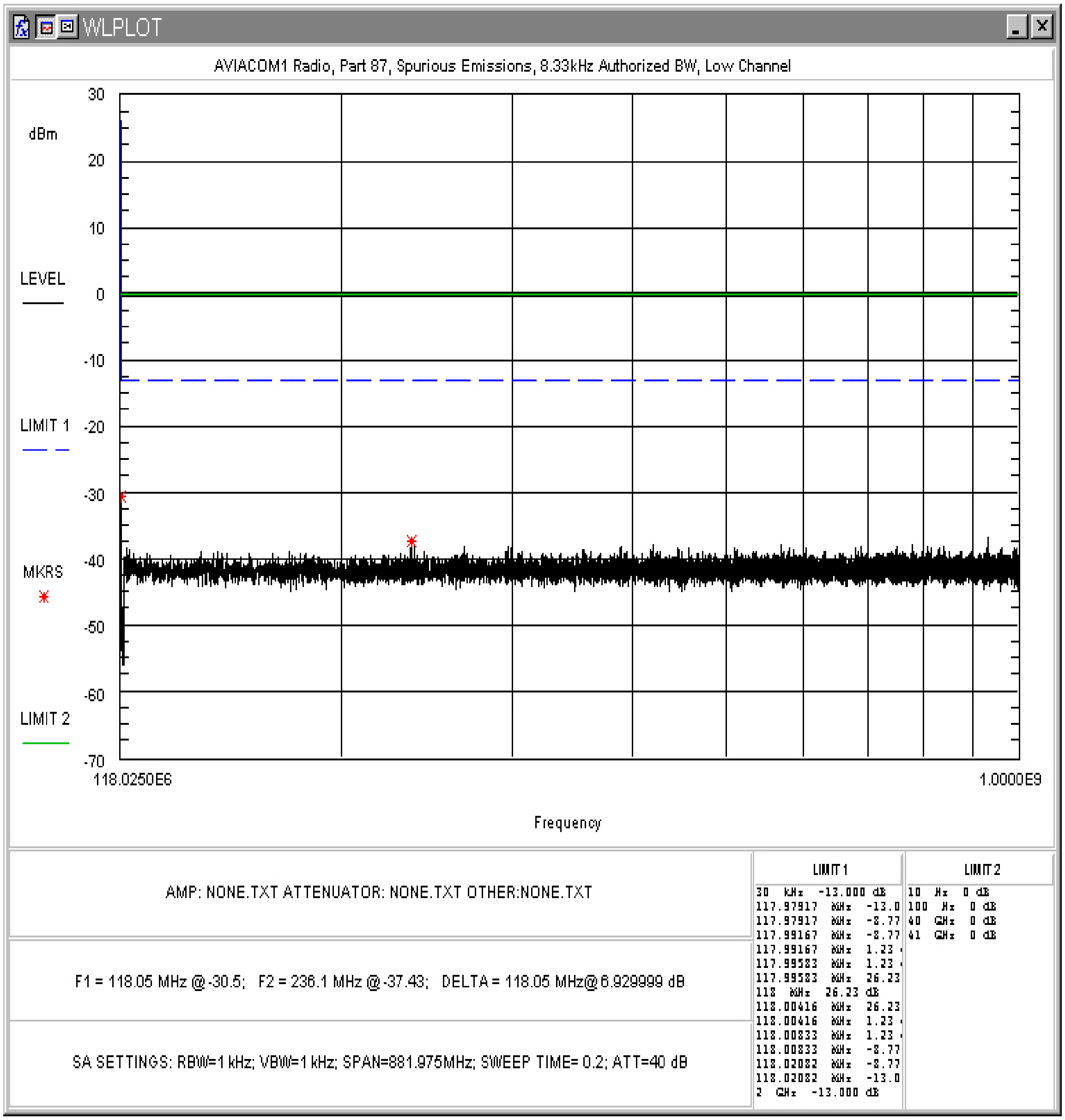


**Figure 8. Conducted Spurious Emissions, Low Channel Plot 2**

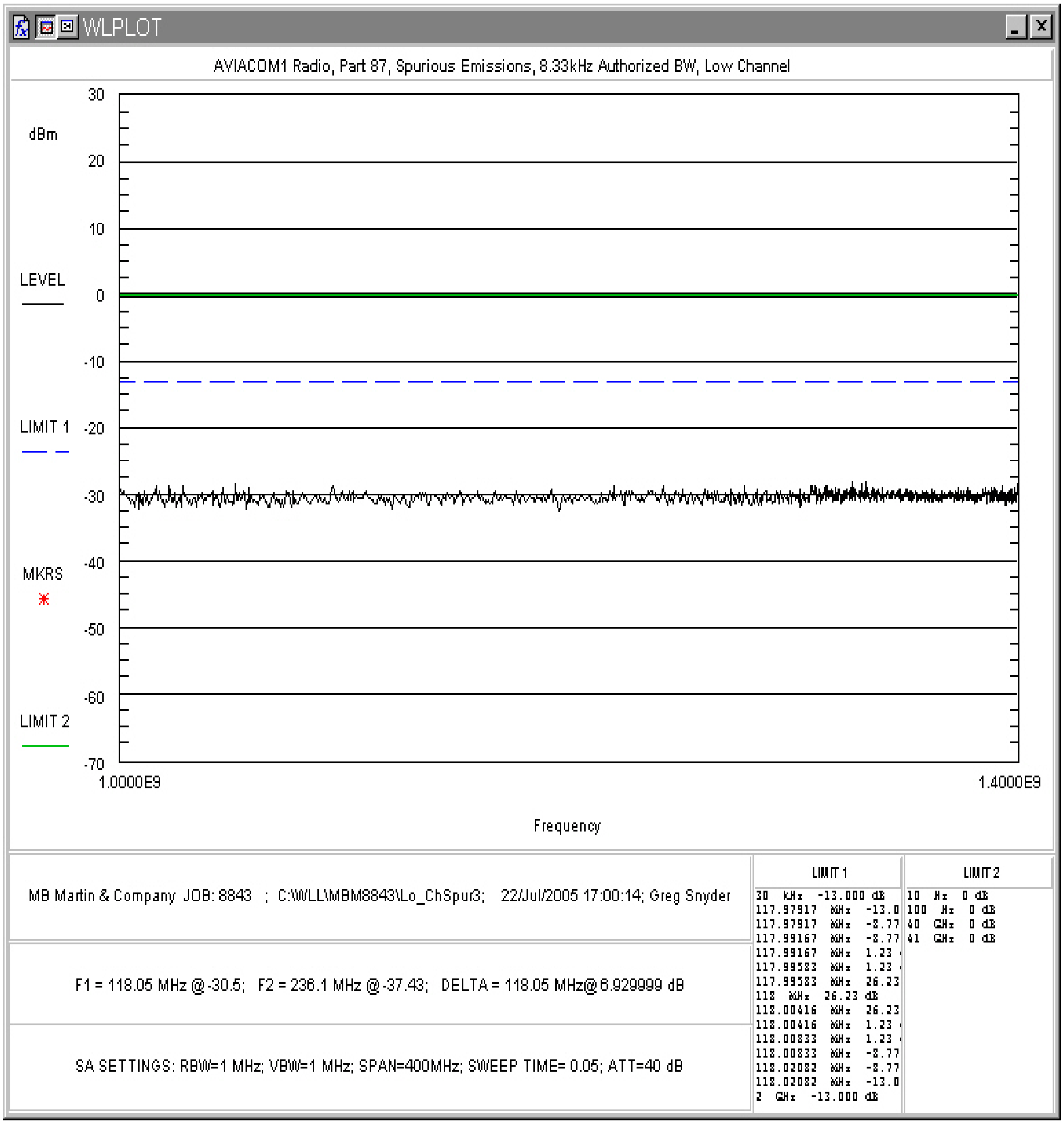


**Figure 9. Conducted Spurious Emissions, Low Channel Plot 3**

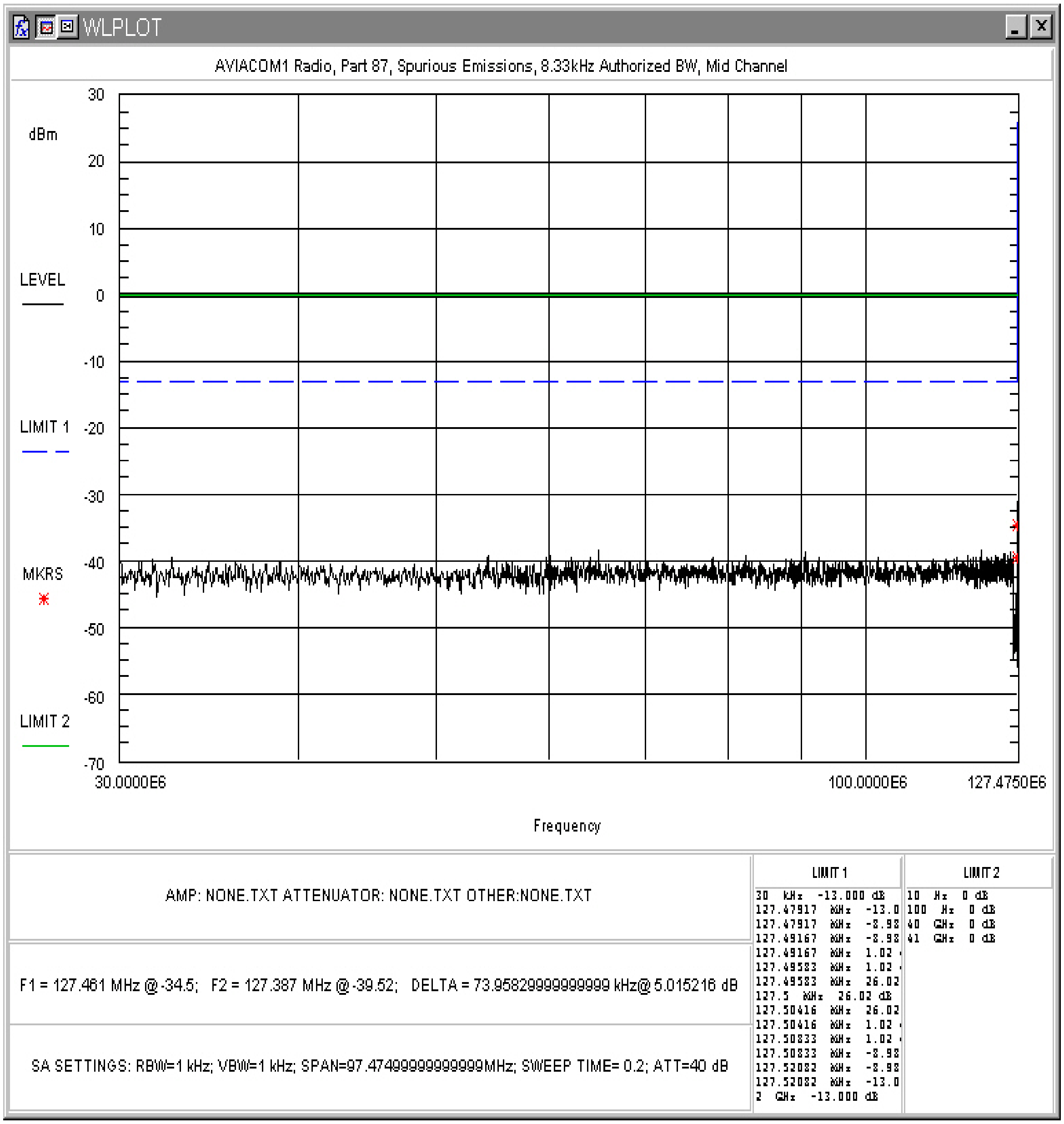


**Figure 10. Conducted Spurious Emissions, Mid Channel Plot 1**

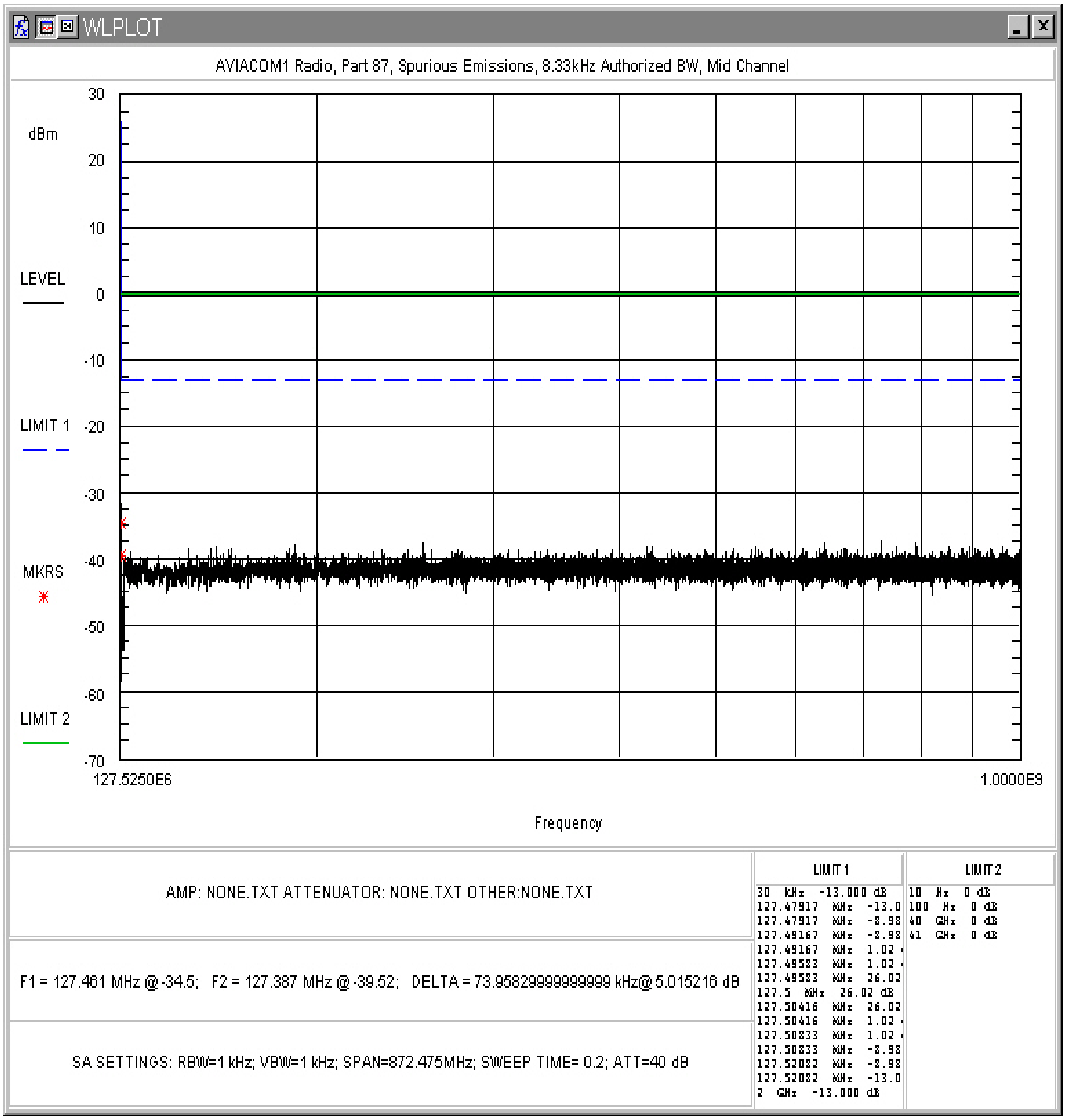


**Figure 11. Conducted Spurious Emissions, Mid Channel Plot 2**

 

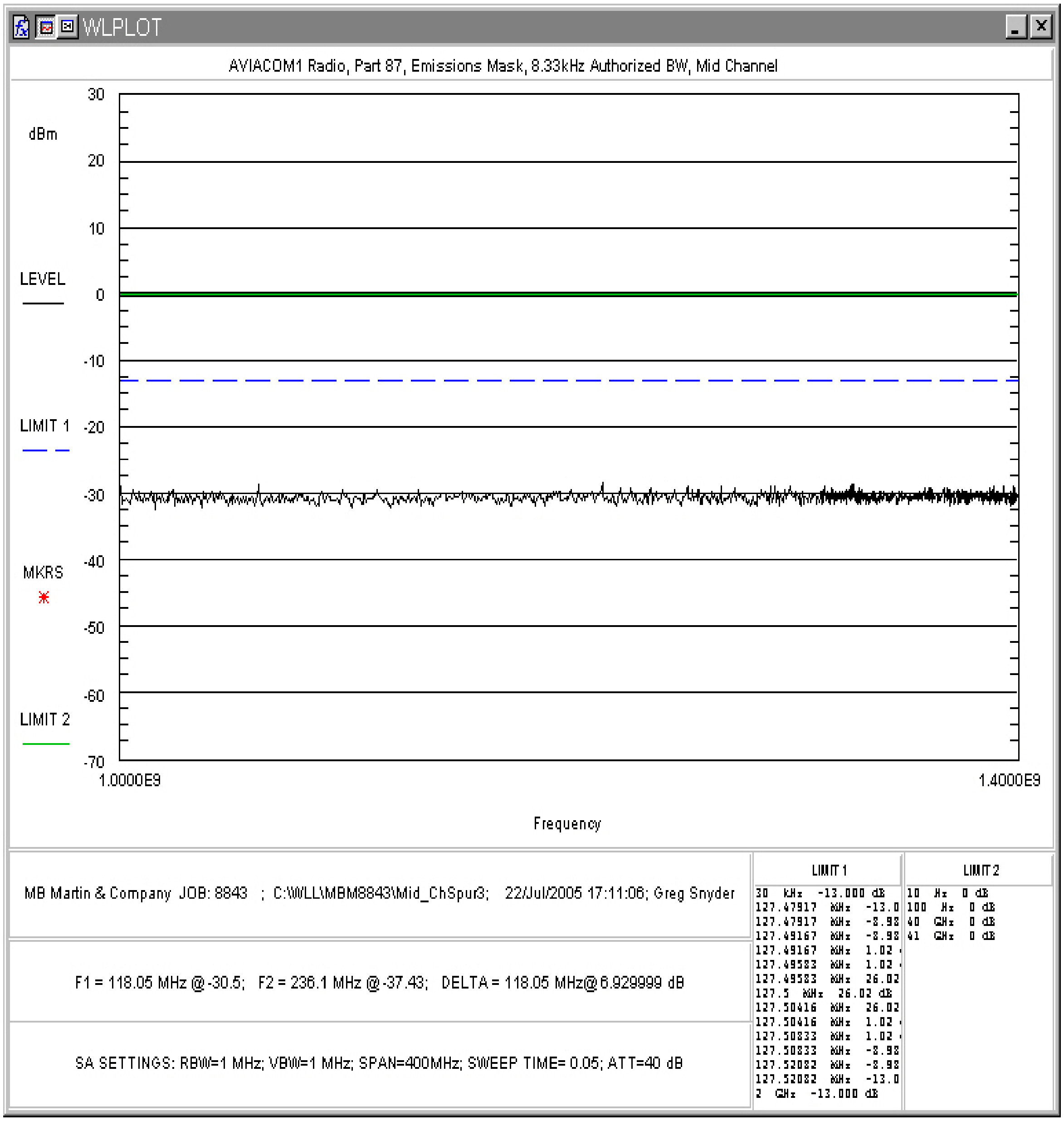


**Figure 12. Conducted Spurious Emissions, Mid Channel Plot 3**

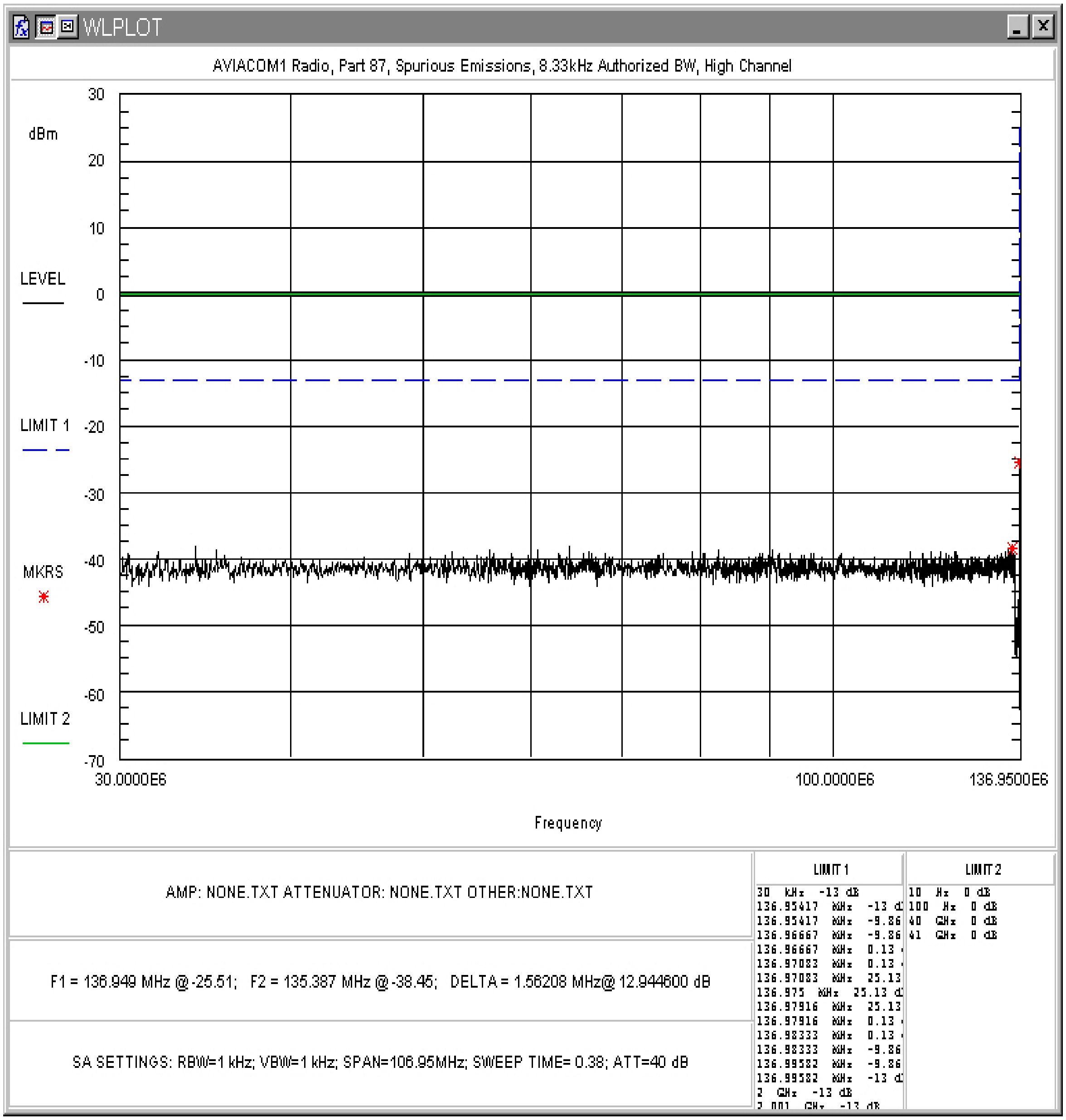


**Figure 13. Conducted Spurious Emissions, High Channel Plot 1**

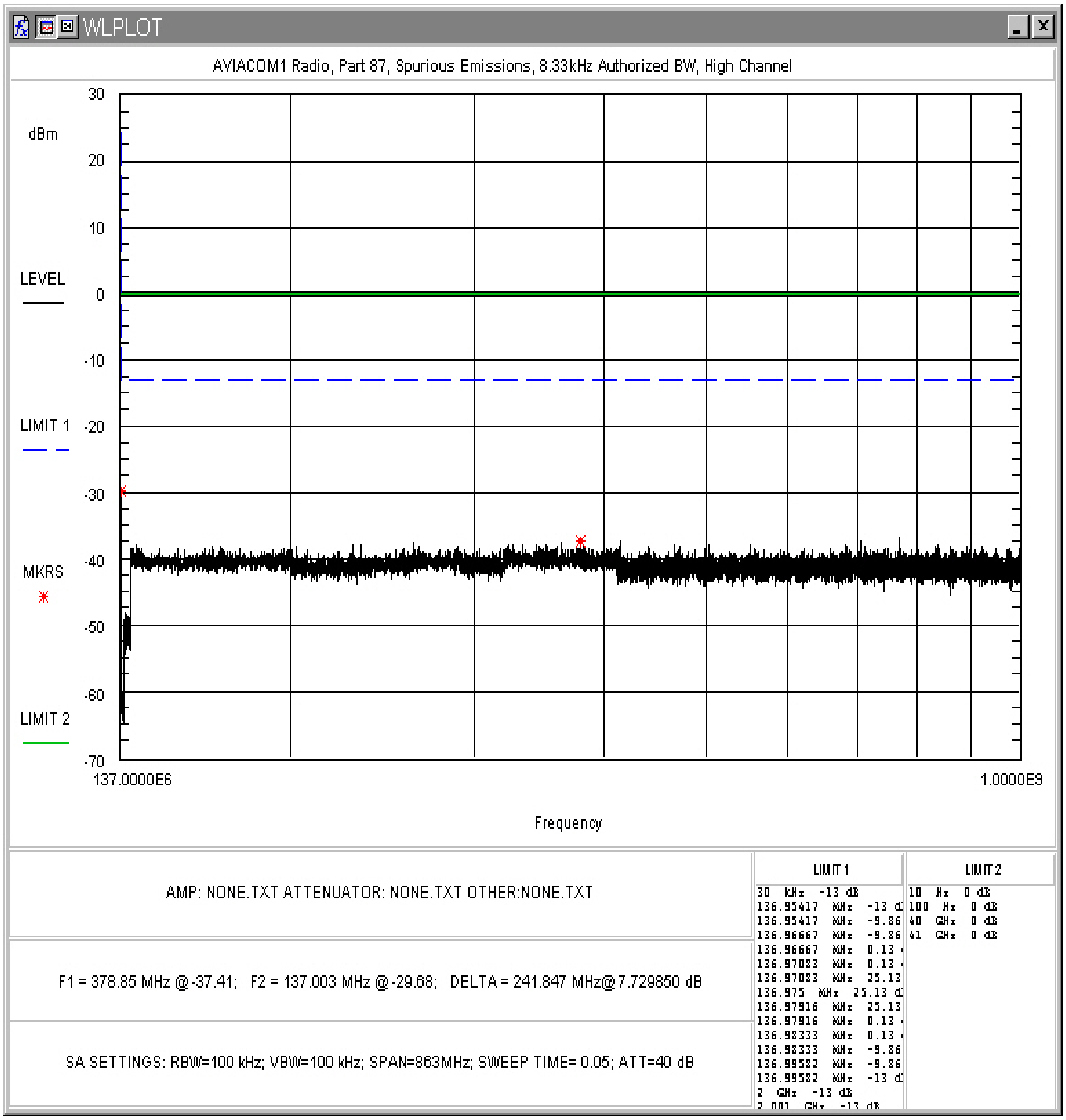


**Figure 14. Conducted Spurious Emissions, High Channel Plot 2**

 

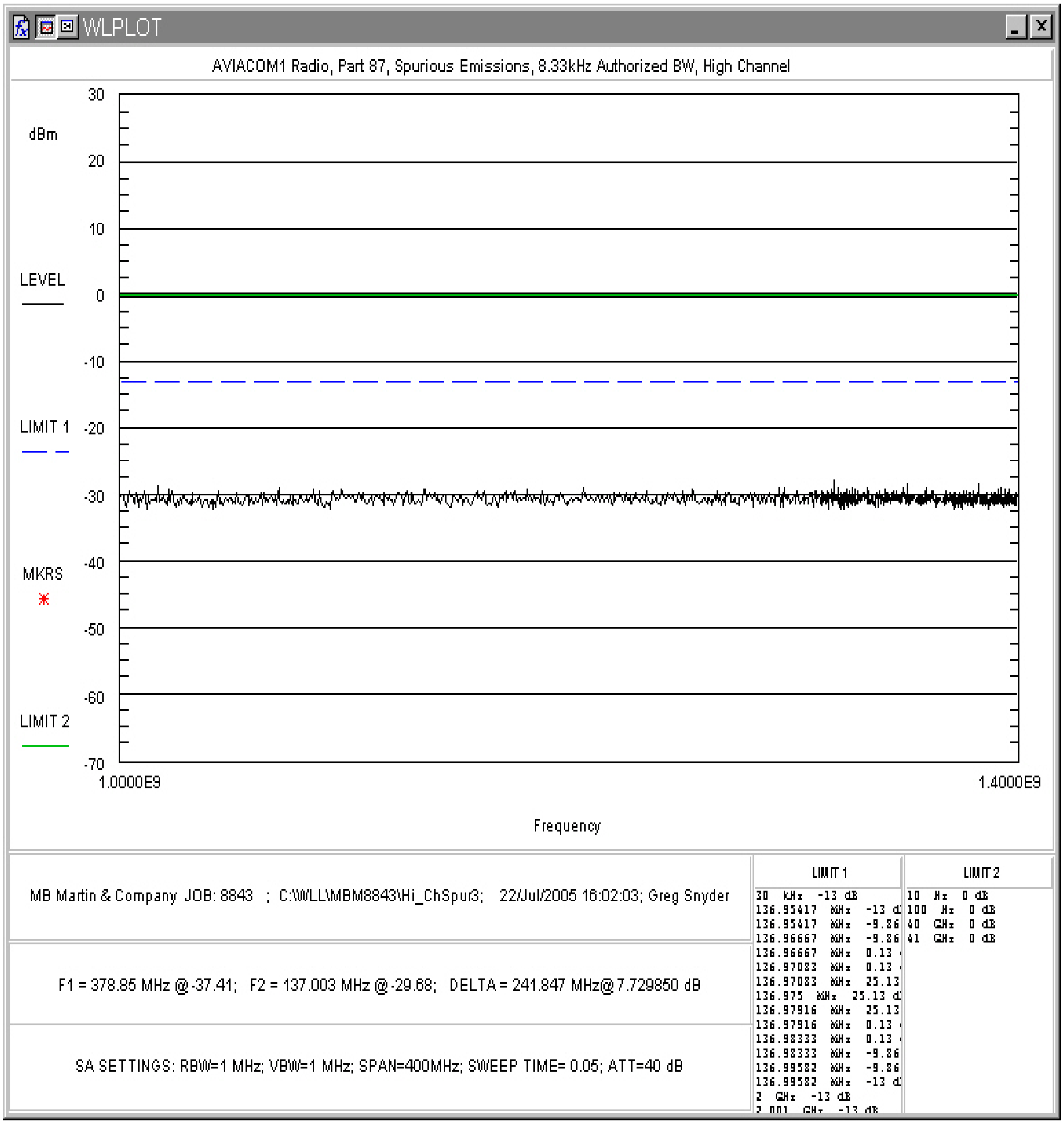


**Figure 15. Conducted Spurious Emissions, High Channel Plot 3**

## 3.5 Radiated Spurious Emissions: (FCC Part 87 and §2.1053)

The EUT must comply with requirements for radiated spurious emissions. The limit for the spurious radiated emissions is calculated from §87.139(a) as all spurious emissions must be attenuated below the carrier by $43 + 10 \log_{10} pY$.

### 3.5.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters.

The Effective Isotropic Radiated Power (EIRP) levels were measured and compared with the limit of §87.139(a). The limit of -13dB is derived from the formula of $43 + 10 \log_{10} pY$ dB per §87.139(a)(3).

Emissions were scanned up to the $10^{th}$ harmonic of the fundamental. Worst case measurements are reported. The signal substitution method procedure as given in TIA-603 was used to obtain EIRP levels.

Sample Calculation:

EIRP Level (dBm) = Sub. Power Level (dBm) + Sub. Ant. Gain (dBi)

**Test Equipment:**

| Manufacturer | Description/Model | Asset Number | Cal. Due |
|---|---|---|---|
| Tektronix | TDS-222 | 00333 | 8/26/05 |
| Hewlett-Packard | 8568B Spectrum Analyzer | 00073 | 6/30/06 |
| Hewlett-Packard | 85650A Quasi-Peak Adapter | 00074 | 6/30/06 |
| Hewlett-Packard | 85685A RF Preselector | 00071 | 6/30/06 |
| Hewlett Packard | 8564E Spectrum Analyzer | 00012 | 7/16/06 |
| Hewlett Packard | 8449B Pre-amplifier | 00066 | 6/14/06 |
| Hewlett Packard | 8648A Signal Generator | 00159 | 8/12/06 |
| Electro Metrics | BIA-30 Biconical Antenna | 00034 | 6/14/06 |
| EMCO | 3146A Log Periodic Antenna | 00029 | 6/28/06 |
| Sunol | JB1 Antenna | 00382 | 1/6/06 |
| ARA | DRG-118 Horn Antenna | 00004 | 2/17/06 |
| B&K Precision | 4040A Function/Signal Generator | 00406 | Cal-in-use |
| Hewlett-Packard | 8714C RF Network Analyzer | 00420 | 5/9/2006 |
| MCL | Attenuator 3dB | None | Cal-in-use |
| Mini-Circuits | Attenuator 6dB | None | Cal-in-use |

 

## Table 4: Radiated Emission Test Data

| Frequency (MHz) | Polarity H/V | Azimuth Degree | Ant. Height (m) | Spurious Level dBµV | Sub. Sig. Gen. Level dBm | Sub. Power Level dBm | Sub. Ant. Factor dB/m | Sub. Ant. Gain dBi | EIRP Level dBm | Limit dBm | Margin dB |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Configuration: 2500 Hz 1VP/P input<br>Tx Frequency: 127.5 MHz (*Tx into Dummy load)* | | | | | | | | | | | |
| **Unit Flat** | | | | | | | | | | | |
| 38.22 | V | 100.0 | 1.0 | 2.9 | -70.0 | -71.0 | 10.8 | -9.0 | -80.0 | -13.0 | -67.0 |
| 42.22 | V | 270.0 | 1.0 | 4.9 | -71.2 | -72.2 | 10.8 | -8.1 | -80.3 | -13.0 | -67.3 |
| 45.46 | V | 90.0 | 1.0 | 3.2 | -73.1 | -74.1 | 10.9 | -7.6 | -81.7 | -13.0 | -68.7 |
| 56.80 | V | 0.0 | 1.2 | 6.5 | -74.7 | -75.7 | 11.2 | -5.9 | -81.6 | -13.0 | -68.6 |
| 111.13 | V | 180.0 | 1.0 | 7.3 | -64.1 | -65.1 | 14.3 | -3.2 | -68.3 | -13.0 | -55.3 |
| 122.88 | V | 90.0 | 1.0 | 3.2 | -66.9 | -67.9 | 13.4 | -1.4 | -69.3 | -13.0 | -56.3 |
| 181.89 | V | 45.0 | 1.5 | 4.6 | -70.9 | -71.9 | 16.9 | -1.5 | -73.4 | -13.0 | -60.4 |
| 307.18 | V | 180.0 | 1.6 | 2.5 | -71.9 | -73.9 | 14.1 | 5.9 | -68.0 | -13.0 | -55.0 |
| 127.50 | V | 90.0 | 1.0 | 57.5 | -11.0 | -12.0 | 13.3 | -1.0 | -13.0 | 26.0 | -39.0 |
| 255.00 | V | 90.0 | 1.2 | 14.9 | -54.5 | -55.5 | 16.9 | 1.4 | -54.1 | -13.0 | -41.1 |
| 382.50 | V | 270.0 | 1.2 | 4.8 | -75.4 | -77.4 | 15.7 | 6.2 | -71.2 | -13.0 | -58.2 |
| 510.00 | V | 190.0 | 1.5 | 2.2 | -71.7 | -74.7 | 17.1 | 7.3 | -67.4 | -13.0 | -54.4 |
| 637.50 | V | 180.0 | 2.0 | -0.4 | No signal detected | | | | | | |
| 765.00 | V | 180.0 | 2.0 | -2.0 | No signal detected | | | | | | |
| 892.50 | V | 180.0 | 1.2 | 5.9 | No signal detected | | | | | | |
| 1020.00 | V | 180.0 | 2.0 | 0.6 | No signal detected | | | | | | |
| 1147.50 | V | 180.0 | 2.0 | -0.2 | No signal detected | | | | | | |
| 1275.00 | V | 180.0 | 2.0 | -1.1 | No signal detected | | | | | | |
| | | | | | | | | | | | |
| 38.22 | H | 190.0 | 4.0 | 1.5 | -65.0 | -66.0 | 10.8 | -9.0 | -75.0 | -13.0 | -62.0 |
| 42.22 | H | 90.0 | 4.0 | 1.6 | -63.6 | -64.6 | 10.8 | -8.1 | -72.7 | -13.0 | -59.7 |
| 111.13 | H | 290.0 | 3.6 | 8.2 | -65.6 | -66.6 | 14.3 | -3.2 | -69.8 | -13.0 | -56.8 |
| 122.88 | H | 190.0 | 3.4 | 2.8 | -75.1 | -76.1 | 13.4 | -1.4 | -77.5 | -13.0 | -64.5 |
| 181.89 | H | 100.0 | 3.2 | 4.9 | -67.1 | -68.1 | 16.9 | -1.5 | -69.6 | -13.0 | -56.6 |
| 127.50 | H | 0.0 | 2.7 | 54.9 | -23.6 | -24.6 | 13.3 | -1.0 | -25.6 | 26.0 | -51.6 |
| 255.00 | H | 90.0 | 1.7 | 26.3 | -42.4 | -43.4 | 16.9 | 1.4 | -42.0 | -13.0 | -29.0 |
| 382.50 | H | 270.0 | 3.0 | 6.4 | -64.9 | -66.9 | 15.7 | 6.2 | -60.7 | -13.0 | -47.7 |
| 510.00 | H | 180.0 | 2.7 | 2.4 | -74.3 | -77.3 | 17.1 | 7.3 | -70.0 | -13.0 | -57.0 |
| 637.50 | H | 180.0 | 1.5 | -0.4 | No signal detected | | | | | | |
| 765.00 | H | 180.0 | 2.0 | -0.7 | No signal detected | | | | | | |
| 892.50 | H | 180.0 | 2.0 | 0.5 | No signal detected | | | | | | |
| 1020.00 | H | 180.0 | 1.0 | 0.3 | No signal detected | | | | | | |
| 1147.50 | H | 180.0 | 1.0 | -1.0 | No signal detected | | | | | | |
| 1275.00 | H | 180.0 | 1.0 | -0.3 | No signal detected | | | | | | |

 

| Frequency (MHz) | Polarity H/V | Azimuth Degree | Ant. Height (m) | Spurious Level dBμV | Sub. Sig. Gen. Level dBm | Sub. Power Level dBm | Sub. Ant. Factor dB/m | Sub. Ant. Gain dBi | EIRP Level dBm | Limit dBm | Margin dB |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| **Unit On side** | | | | | | | | | | | |
| 38.22 | V | 190.0 | 2.1 | 3.0 | -67.3 | -68.3 | 10.8 | -9.0 | -77.3 | -13.0 | -64.3 |
| 45.46 | V | 180.0 | 1.4 | 3.0 | -71.2 | -72.2 | 10.9 | -7.6 | -79.8 | -13.0 | -66.8 |
| 56.80 | V | 220.0 | 2.0 | 6.0 | -74.0 | -75.0 | 11.2 | -5.9 | -80.9 | -13.0 | -67.9 |
| 111.13 | V | 180.0 | 1.4 | 5.5 | -60.7 | -61.7 | 14.3 | -3.2 | -64.9 | -13.0 | -51.9 |
| 122.88 | V | 190.0 | 1.3 | 3.4 | -62.7 | -63.7 | 13.4 | -1.4 | -65.1 | -13.0 | -52.1 |
| 181.89 | V | 180.0 | 1.3 | 4.3 | -72.5 | -73.5 | 16.9 | -1.5 | -75.0 | -13.0 | -62.0 |
| 307.18 | V | 180.0 | 1.7 | 2.4 | -79.1 | -81.1 | 14.1 | 5.9 | -75.2 | -13.0 | -62.2 |
| 127.50 | V | 0.0 | 1.0 | 61.2 | -6.2 | -7.2 | 13.3 | -1.0 | -8.2 | 26.0 | -34.2 |
| 255.00 | V | 190.0 | 1.0 | 22.6 | -48.8 | -49.8 | 16.9 | 1.4 | -48.4 | -13.0 | -35.4 |
| 382.50 | V | 0.0 | 2.4 | 8.5 | -68.7 | -70.7 | 15.7 | 6.2 | -64.5 | -13.0 | -51.5 |
| 510.00 | V | 180.0 | 2.0 | 2.9 | -71.0 | -74.0 | 17.1 | 7.3 | -66.7 | -13.0 | -53.7 |
| 637.50 | V | 10.0 | 1.6 | 1.6 | -71.7 | -75.7 | 19.2 | 7.1 | -68.6 | -13.0 | -55.6 |
| 765.00 | V | 180.0 | 2.0 | -1.1 | No signal detected | | | | | | |
| 892.50 | V | 180.0 | 2.0 | -1.6 | No signal detected | | | | | | |
| 1020.00 | V | 180.0 | 2.0 | 0.5 | No signal detected | | | | | | |
| 1147.50 | V | 180.0 | 2.0 | 0.1 | No signal detected | | | | | | |
| 1275.00 | V | 180.0 | 1.3 | -0.2 | No signal detected | | | | | | |
| | | | | | | | | | | | |
| 38.22 | H | 100.0 | 3.4 | 2.7 | -63.8 | -64.8 | 10.8 | -9.0 | -73.8 | -13.0 | -60.8 |
| 111.13 | H | 190.0 | 3.6 | 9.0 | -64.6 | -65.6 | 14.3 | -3.2 | -68.8 | -13.0 | -55.8 |
| 122.88 | H | 180.0 | 3.4 | 2.1 | -75.6 | -76.6 | 13.4 | -1.4 | -78.0 | -13.0 | -65.0 |
| 181.89 | H | 200.0 | 3.0 | 5.7 | -65.7 | -66.7 | 16.9 | -1.5 | -68.2 | -13.0 | -55.2 |
| | | | | | | | | | | | |
| 127.50 | H | 170.0 | 2.6 | 61.8 | -17.8 | -18.8 | 13.3 | -1.0 | -19.8 | 26.0 | -45.8 |
| 255.00 | H | 170.0 | 1.3 | 25.2 | -45.8 | -46.8 | 16.9 | 1.4 | -45.4 | -13.0 | -32.4 |
| 382.50 | H | 160.0 | 1.7 | 4.3 | -71.9 | -73.9 | 15.7 | 6.2 | -67.7 | -13.0 | -54.7 |
| 510.00 | H | 180.0 | 2.0 | 3.6 | -70.7 | -73.7 | 17.1 | 7.3 | -66.4 | -13.0 | -53.4 |
| 637.50 | H | 180.0 | 2.0 | -0.2 | No signal detected | | | | | | |
| 765.00 | H | 190.0 | 1.6 | -2.0 | No signal detected | | | | | | |
| 892.50 | H | 190.0 | 2.0 | -0.5 | No signal detected | | | | | | |
| 1020.00 | H | 180.0 | 1.0 | 0.2 | No signal detected | | | | | | |
| 1147.50 | H | 180.0 | 1.0 | -0.4 | No signal detected | | | | | | |
| 1275.00 | H | 180.0 | 1.0 | -1.3 | No signal detected | | | | | | |
| | | | | | | | | | | | |
| **Unit upright** | | | | | | | | | | | |
| 38.22 | V | 200.0 | 1.0 | 1.3 | -72.1 | -73.1 | 10.8 | -9.0 | -82.1 | -13.0 | -69.1 |

| Frequency (MHz) | Polarity H/V | Azimuth Degree | Ant. Height (m) | Spurious Level dBμV | Sub. Sig. Gen. Level dBm | Sub. Power Level dBm | Sub. Ant. Factor dB/m | Sub. Ant. Gain dBi | EIRP Level dBm | Limit dBm | Margin dB |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45.46 | V | 180.0 | 1.0 | 3.0 | -72.7 | -73.7 | 10.9 | -7.6 | -81.3 | -13.0 | -68.3 |
| 56.80 | V | 200.0 | 1.0 | 5.0 | -76.8 | -77.8 | 11.2 | -5.9 | -83.7 | -13.0 | -70.7 |
| 111.13 | V | 180.0 | 1.0 | 4.8 | -67.5 | -68.5 | 14.3 | -3.2 | -71.7 | -13.0 | -58.7 |
| 122.88 | V | 0.0 | 1.0 | 2.2 | -66.3 | -67.3 | 13.4 | -1.4 | -68.7 | -13.0 | -55.7 |
| 181.89 | V | 190.0 | 1.2 | 2.3 | -74.9 | -75.9 | 16.9 | -1.5 | -77.4 | -13.0 | -64.4 |
| 307.18 | V | 45.0 | 1.3 | 1.5 | -80.2 | -82.1 | 14.1 | 5.9 | -76.2 | -13.0 | -63.2 |
| | | | | | | | | | | | |
| 127.50 | V | 0.0 | 1.0 | 53.5 | -13.2 | -14.2 | 13.3 | -1.0 | -15.2 | 26.0 | -41.2 |
| 255.00 | V | 270.0 | 2.5 | 26.7 | -49.4 | -50.4 | 16.9 | 1.4 | -49.0 | -13.0 | -36.0 |
| 382.50 | V | 180.0 | 1.0 | 7.2 | -73.1 | -75.1 | 15.7 | 6.2 | -68.9 | -13.0 | -55.9 |
| 510.00 | V | 180.0 | 1.5 | 7.0 | -67.1 | -80.1 | 17.1 | 7.3 | -72.8 | -13.0 | -59.8 |
| 637.50 | V | 180.0 | 1.0 | 5.2 | -67.8 | -71.8 | 19.2 | 7.1 | -64.7 | -13.0 | -51.7 |
| 765.00 | V | 180.0 | 1.7 | 0.2 | No signal detected | | | | | | |
| 892.50 | V | 180.0 | 1.0 | 0.4 | No signal detected | | | | | | |
| 1020.00 | V | 180.0 | 2.0 | 0.4 | No signal detected | | | | | | |
| 1147.50 | V | 180.0 | 2.0 | 0.2 | No signal detected | | | | | | |
| 1275.00 | V | 180.0 | 2.0 | -1.1 | No signal detected | | | | | | |
| | | | | | | | | | | | |
| 111.13 | H | 0.0 | 3.0 | 5.1 | -69.8 | -70.8 | 14.3 | -3.2 | -74.0 | -13.0 | -61.0 |
| 181.89 | H | 180.0 | 3.2 | 3.7 | -68.6 | -69.6 | 16.9 | -1.5 | -71.1 | -13.0 | -58.1 |
| | | | | | | | | | | | |
| 127.50 | H | 220.0 | 2.5 | 50.3 | -28.0 | -29.0 | 13.3 | -1.0 | -30.0 | 26.0 | -56.0 |
| 255.00 | H | 90.0 | 1.8 | 22.1 | -48.6 | -49.6 | 16.9 | 1.4 | -48.2 | -13.0 | -35.2 |
| 382.50 | H | 180.0 | 3.0 | 3.2 | -73.0 | -75.0 | 15.7 | 6.2 | -68.8 | -13.0 | -55.8 |
| 510.00 | H | 180.0 | 3.0 | 4.3 | No signal detected | | | | | | |
| 637.50 | H | 200.0 | 2.4 | 3.2 | -70.6 | -74.6 | 19.2 | 7.1 | -67.5 | -13.0 | -54.5 |
| 765.00 | H | 230.0 | 2.0 | -1.7 | No signal detected | | | | | | |
| 892.50 | H | 190.0 | 1.7 | 1.6 | No signal detected | | | | | | |
| 1020.00 | H | 180.0 | 1.0 | 36.0 | No signal detected | | | | | | |
| 1147.50 | H | 180.0 | 1.0 | 34.2 | No signal detected | | | | | | |
| 1275.00 | H | 180.0 | 1.0 | 33.2 | No signal detected | | | | | | |

### 3.6 Frequency Stability: (FCC Part §2.1055/§87.133)

Frequency as a function of temperature and voltage variation shall be maintained within the FCC-prescribed tolerances. The frequency stability requirement for this radio is 20 ppm.

The temperature stability was measured with the unit in an environmental chamber used to vary the temperature of the sample. The sample was held at each temperature step to allow the temperature of the sample to stabilize.

The EUT is powered by DC voltage supplied externally. The manufacturer's power requirements for the EUT include the following:

Low DC Voltage of 9 VDC (manufacturer's specification)

High DC Voltage of 16 VDC (manufacturer's specifications)

The frequency stability of the transmitter was examined at the voltage extremes and for the temperature range of -30°C to +50°C. The carrier frequency was measured while the EUT was in the temperature chamber. The reference frequency of the EUT was measured at the ambient room temperature with the frequency counter. The following are the reference frequencies at ambient for the Middle channel.

Mid Channel: 127.5 MHz

**Table 5. Frequency Deviation as a Function of Temperature**

| Temperature (Celsius) | Frequency (MHz) | Deviation (Hz) | Limit (Hz) | Result |
|---|---|---|---|---|
| Ambient | 127.499987 | 0.0 | - | - |
| -30 | 127.500069 | 82.0 | 2550 | Pass |
| -20 | 127.499984 | -3.0 | 2550 | Pass |
| -10 | 127.499954 | -33.0 | 2550 | Pass |
| 0 | 127.499967 | -20.0 | 2550 | Pass |
| 10 | 127.499988 | 1.0 | 2550 | Pass |
| 20 | 127.499987 | 0.0 | 2550 | Pass |
| 30 | 127.499963 | -24.0 | 2550 | Pass |
| 40 | 127.499941 | -46.0 | 2550 | Pass |
| 50 | 127.499940 | -47.0 | 2550 | Pass |

**Table 6. Frequency Deviation as a Function of Voltage**

| Channel | Voltage (Volts DC) | Frequency (MHz) | Deviation (Hz) | Volts (Rated 10-18 VDC) |
|---|---|---|---|---|
| Mid Channel 127.5 MHz | at rated | 127.499984 | 0 | 13.5 VDC |
| | At 85% of 10 VDC | 127.499983 | 1 | 8.5VDC |
| | At 115% of 18VDC | 127.499984 | 0 | 20.7VDC |

**Test Equipment:**

| Manufacturer | Description/Model | Asset Number | Cal. Due |
|---|---|---|---|
| Racal-Dana | 1992 Frequency Counter | 00117 | 5/16/06 |
| Global Specialties | 1337 Adjustable Power Supply | 00361 | Cal-in-use |
| Fluke | 73 Multimeter | 00045 | 5/9/06 |
| Tenney Engineering | TR64 Environmental Chamber | 00254 | 9/7/05 |