



Engineering and Testing for EMC and Safety Compliance

## CERTIFICATION APPLICATION REPORT FCC PART 90 & INDUSTRY CANADA RSS-119

|                                                                                                                                                                                                                                                    |                                                                                           |                                                                                                                                                                                           |                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
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| <b>FCC ID / IC:</b>                                                                                                                                                                                                                                | ATH2425131 / 933B-2425131                                                                 | <b>FRN NUMBER:</b>                                                                                                                                                                        | 0005-8136-88               |
| <b>MODEL:</b>                                                                                                                                                                                                                                      | 242-513x                                                                                  | <b>RTL WORK ORDER NUMBER:</b>                                                                                                                                                             | 2004134                    |
| <b>EQUIPMENT TYPE:</b>                                                                                                                                                                                                                             | PTT 400 MHz                                                                               | <b>RTL QUOTE NUMBER:</b>                                                                                                                                                                  | QRTL04-279                 |
| <b>DATE OF TEST REPORT:</b>                                                                                                                                                                                                                        | August 23, 2004                                                                           |                                                                                                                                                                                           |                            |
| <b>FCC Classification:</b>                                                                                                                                                                                                                         | <input checked="" type="checkbox"/> TNF – Licensed Non-Broadcast Transmitter Held to Face |                                                                                                                                                                                           |                            |
| <b>FCC Rule Part(s):</b>                                                                                                                                                                                                                           | Part 90: Private Land Mobile Radio Services                                               |                                                                                                                                                                                           |                            |
| <b>Industry Canada Standard:</b>                                                                                                                                                                                                                   | RSS-119: Land Mobile and Fixed Radio Transmitters and Receivers, 27.41MHz to 960MHz       |                                                                                                                                                                                           |                            |
| <b>Frequency Range (MHz) *</b>                                                                                                                                                                                                                     | <b>Output Power (W)</b>                                                                   | <b>Frequency Tolerance (ppm)</b>                                                                                                                                                          | <b>Emission Designator</b> |
| 380-470                                                                                                                                                                                                                                            | 5.2                                                                                       | 0.9                                                                                                                                                                                       | 11K0F3E                    |
| 380-470                                                                                                                                                                                                                                            | 5.2                                                                                       | 0.9                                                                                                                                                                                       | 16K0F3E                    |
| 380-470                                                                                                                                                                                                                                            | 5.2                                                                                       | 0.9                                                                                                                                                                                       | 11K8F1E                    |
| 380-470                                                                                                                                                                                                                                            | 5.2                                                                                       | 0.9                                                                                                                                                                                       | 11K8F1D                    |

\* Industry Canada permits a frequency range of 406.1-430 MHz only.

We, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards.

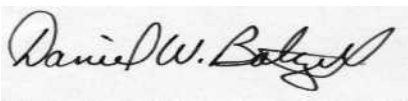
Furthermore, there was no deviation from, additions to, or exclusions from FCC Part 2, FCC Part 90, Industry Canada RSS-119, ANSI C61.1; 4.5, ANSI/TIA/EIA603 and ANSI/TIA/EIA 603-1.

Signature: 

Date: August 23, 2004

Typed/Printed Name: Desmond A. Fraser

Position: President

Signature: 

Date: August 23, 2004

Typed/Printed Name: Daniel Baltzell

Position: Test Engineer

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## **1 GENERAL INFORMATION**

### **1.1 SCOPE**

FCC Rules Part 90 (Subpart K): This subpart sets forth special requirements applicable to the use of certain frequencies or frequency bands.

Industry Canada RSS-119: This document sets out standards for radio transmitters and receivers for the land mobile and fixed services in bands allocated within the 27.41 MHz to 960 MHz range.

All measurements contained in this application were conducted in accordance with the FCC Rules and Regulations CFR47 Part 90, Industry Canada RSS-119, and ANSI/TIA/EIA603-2002 Land Mobile FM or PM Communications Equipment Measurement and Performance Standards. The measurement instrumentation conforms to the ANSI C63.2; standard for EMI and Field Strength Instrumentation. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

### **1.2 TEST FACILITY**

The open area test site and conducted measurement facility used to collect the radiated data is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.7; 1992).

### **1.3 RELATED SUBMITTAL(S)/GRANT(S)**

This is an original application for certification. The IF, LO and up to the 2<sup>nd</sup> LO were investigated.

## 2 EQUIPMENT INFORMATION

### 2.1 TEST SYSTEM DETAILS

The FCC Identifiers for all equipment, plus descriptions of all cables used in the tested system are shown in the tables below. There were no deviations from the test standard(s) and/or methods. The test results relate only to the item that was tested.

**TABLE 2-1: EQUIPMENT UNDER TEST (EUT)**

| Part               | Manufacturer | Model        | Serial Number       | FCC ID     | Cable Description | Date Sample Received | RTL Bar Code |
|--------------------|--------------|--------------|---------------------|------------|-------------------|----------------------|--------------|
| UHF Portable Radio | E.F. Johnson | 242-513x     | N/A                 | ATH2425131 | N/A               | 8/19/04              | 016130       |
| UHF Portable Radio | E.F. Johnson | 023-5170-042 | 51720E344A<br>36148 | ATH2425131 | N/A               | 8/19/04              | 016141       |

**TABLE 2-2: EXTERNAL COMPONENTS IN TEST CONFIGURATION**

| Part                        | Manufacturer | Model           | Serial Number | FCC ID | Cable Description | Date Sample Received | RTL Bar Code |
|-----------------------------|--------------|-----------------|---------------|--------|-------------------|----------------------|--------------|
| Cable                       | E.F. Johnson | N/A             | N/A           | N/A    | N/A               | 4/7/04               | 015827       |
| Charger                     | E.F. Johnson | AA16740         | 1123327073    | N/A    | N/A               | 4/7/04               | 015826       |
| Adapter                     | E.F. Johnson | Audio Accessory | N/A           | N/A    | N/A               | 4/7/04               | 015825       |
| Headset                     | E.F. Johnson | 5890015059      | N/A           | N/A    | N/A               | 4/7/04               | 015824       |
| 1/4 wave antenna            | E.F. Johnson | 501 0105 012    | N/A           | N/A    | N/A               | 8/19/04              | 016131       |
| 1/2 Wave Antenna            | E.F. Johnson | 501 0103 013    | N/A           | N/A    | N/A               | 4/7/04               | 015822       |
| Microphone                  | E.F. Johnson | N/A             | N/A           | N/A    | N/A               | 4/7/04               | 015821       |
| 3600 MAH Battery            | E.F. Johnson | 587-5100-360    | N/A           | N/A    | N/A               | 4/7/04               | 015820       |
| 3600 MAH Battery            | E.F. Johnson | 587-5100-360    | N/A           | N/A    | N/A               | 4/7/04               | 015819       |
| 3600 MAH Battery            | E.F. Johnson | 587-5100-360    | N/A           | N/A    | N/A               | 4/7/04               | 015818       |
| 3600 MAH Battery            | E.F. Johnson | 587-5100-360    | N/A           | N/A    | N/A               | 4/7/04               | 015817       |
| Alkaline Cell Pack          | E.F. Johnson | N/A             | 100803-433ATH | N/A    | N/A               | 4/7/04               | 015816       |
| Cable for accessory adaptor | E.F. Johnson | N/A             | N/A           | N/A    | N/A               | 4/7/04               | 015814       |
| Accessory Adapter           | E.F. Johnson | SYS1097-3015    | 0311214811    | N/A    | N/A               | 4/7/04               | 015813       |
| Charger Kit                 | E.F. Johnson | 585-5100-210    | 55-65575      | N/A    | N/A               | 4/7/04               | 015812       |

## 2.2 WORST CASE CONFIGURATION OF TESTED SYSTEM

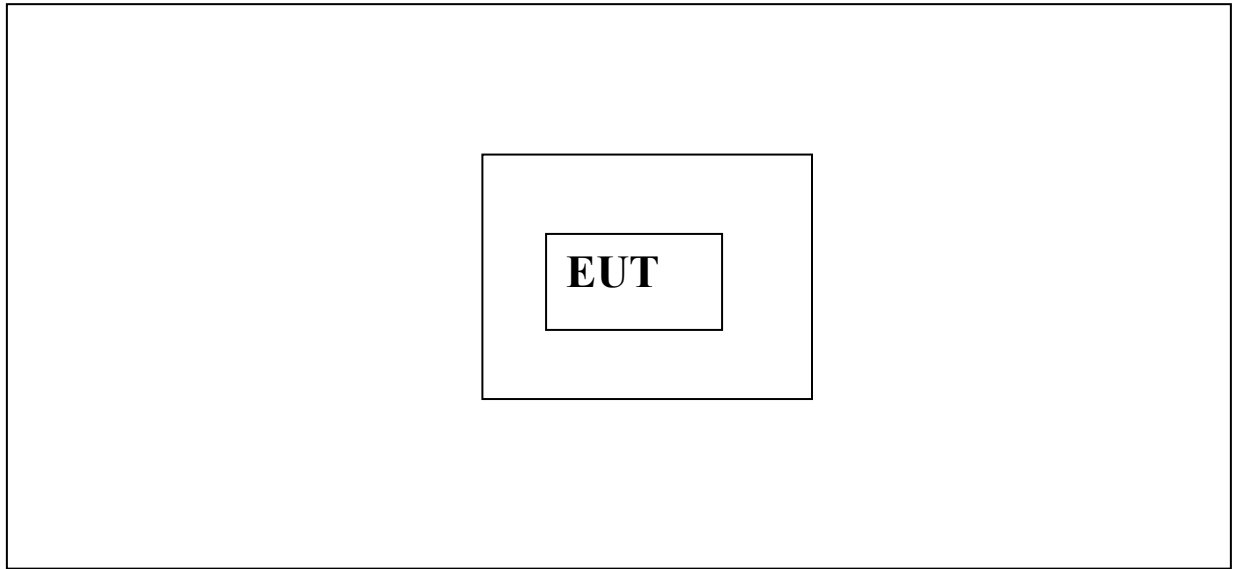


FIGURE 2-1: WORST CASE CONFIGURATION OF SYSTEM UNDER TEST

### 3 FCC PART 2.1033(C)(8); DC VOLTAGES AND CURRENTS

The dc voltages applied to, and dc currents into, the several elements of the final radio frequency amplifying device for normal operation over the power range where:

7.5 volts @ 3.6A

### 4 RF POWER OUTPUT - §2.1046; RSS-119 §6.2

#### 4.1 ANSI/TIA/EIA-603-1992, SECTION 2.2.1 TEST PROCEDURE

Connect the equipment as illustrated below. Measure the transmitter output power during the defined duty cycle. The EUT was connected to a coaxial attenuator having a 50  $\Omega$  load impedance.

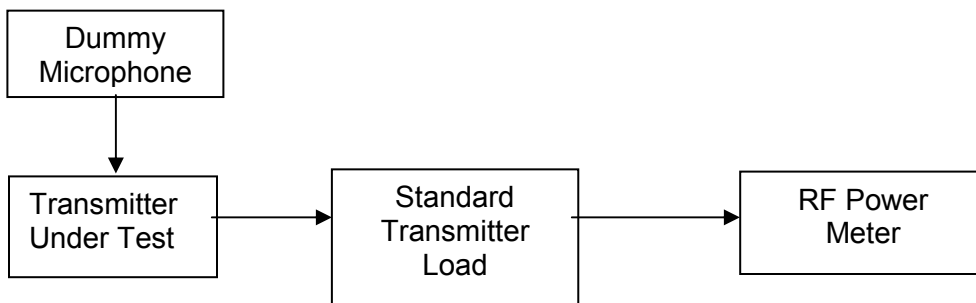


FIGURE 4-1: ILLUSTRATION OF HOW EQUIPMENT IS CONNECTED FOR TEST



## 4.2 RF POWER OUTPUT TEST EQUIPMENT

TABLE 4-1: RF POWER OUTPUT TEST EQUIPMENT

| RTL Asset # | Manufacturer         | Model                      | Part Type                         | Serial Number | Cal Due Date |
|-------------|----------------------|----------------------------|-----------------------------------|---------------|--------------|
| 901184      | Agilent Technologies | E4416A                     | EPM-P Power Meter, single channel | GB41050573    | 8/2/05       |
| 901186      | Agilent Technologies | E9323A<br>(50 MHz – 6 GHz) | Peak & Average Power Sensor       | US40410380    | 8/2/05       |

## 4.3 RF POWER OUTPUT TEST DATA

TABLE 4-2: RF POWER OUTPUT TEST DATA

| Frequency (MHz) | Channel | Power Measured (dBm) | Power (Watt) |
|-----------------|---------|----------------------|--------------|
| 380             | 1       | 36.68                | 4.7          |
| 425             | 2       | 37.14                | 5.2          |
| 470             | 3       | 36.73                | 4.7          |

## TEST PERSONNEL:

|                                  |                                                                                                   |                                 |
|----------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------|
| DANIEL BALTZELL<br>TEST ENGINEER | <br>SIGNATURE | AUGUST 21, 2004<br>DATE OF TEST |
|----------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------|

## 5 MODULATION CHARACTERISTICS - §2.1047; RSS-119 §6.6 TEST PROCEDURE

The modulation characteristic tests apply to analog modulation and do not apply to digital modulation.

### 5.1 MODULATION CHARACTERISTICS TEST EQUIPMENT

TABLE 5-1: MODULATION CHARACTERISTICS TEST EQUIPMENT

| RTL Asset # | Manufacturer    | Model    | Part Type                   | Serial Number | Cal Due Date |
|-------------|-----------------|----------|-----------------------------|---------------|--------------|
| 901118      | Hewlett Packard | HP8901B  | Modulation Analyzer         | 2406A00178    | 7/07/05      |
| 901057      | Hewlett Packard | 3336B    | Synthesizer/Level Generator | 2514A02585    | 9/08/05      |
| 901054      | Hewlett Packard | HP 3586B | Selective Level Meter       | 1928A01892    | 9/08/05      |

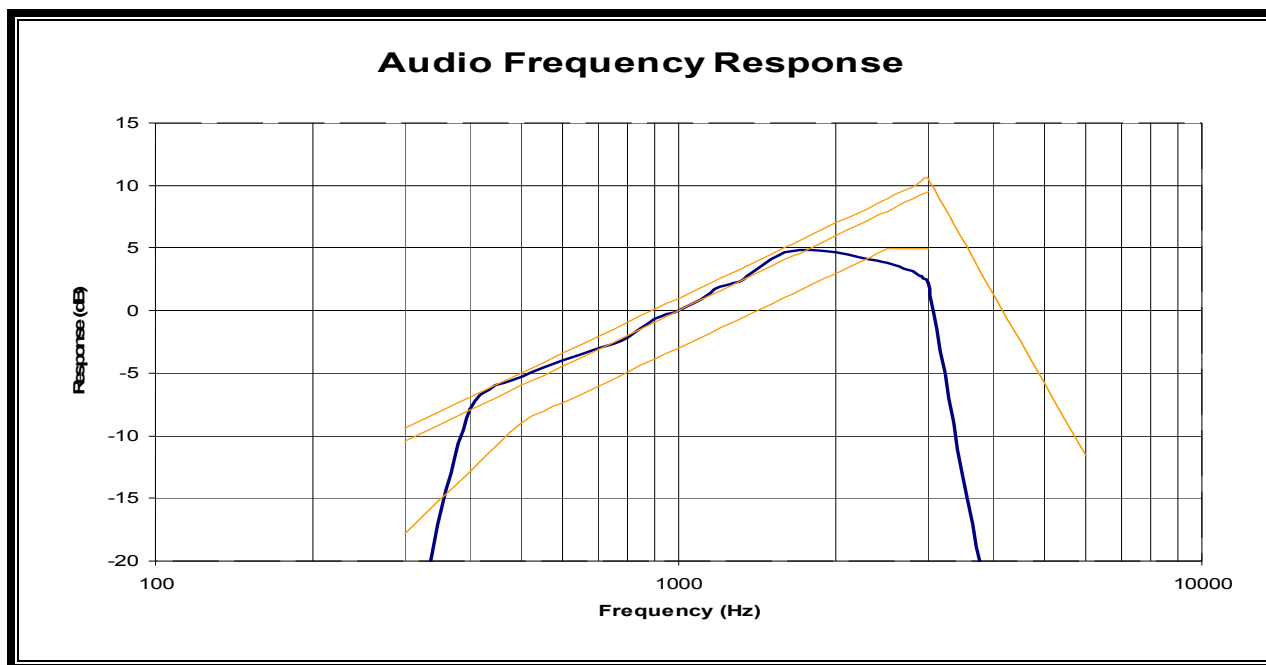
## 6 FCC PART 2 §2.1047 (A): MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE

### 6.1 TEST PROCEDURE

ANSI/TIA/EIA-603-2002, section 2.2.6. The audio frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic. The input audio level at 1000 Hz is set to produce 20% of the rated system deviation. This point is shown as the 0 dB reference level, noted DEVref. The audio signal generator was varied from 300 Hz to 5 kHz with the input level held constant. The deviation in kHz was recorded using a modulation analyzer as DEVfreq. The response in dB relative to 1 kHz was calculated as follows: Audio Frequency Response =  $20 \text{ LOG} (\text{DEVfreq}/\text{DEVref})$

### 6.2 TEST DATA

PLOT 6-1: AUDIO FREQUENCY RESPONSE CHANNEL 2 AT 425 MHZ



### TEST PERSONNEL:

DANIEL BALTZELL  
TEST ENGINEER

SIGNATURE

SEPTEMBER 11, 2004  
DATE OF TEST

## 7 FCC PART 2 §2.1047 (A): MODULATION CHARACTERISTICS - AUDIO LOW PASS FILTER RESPONSE

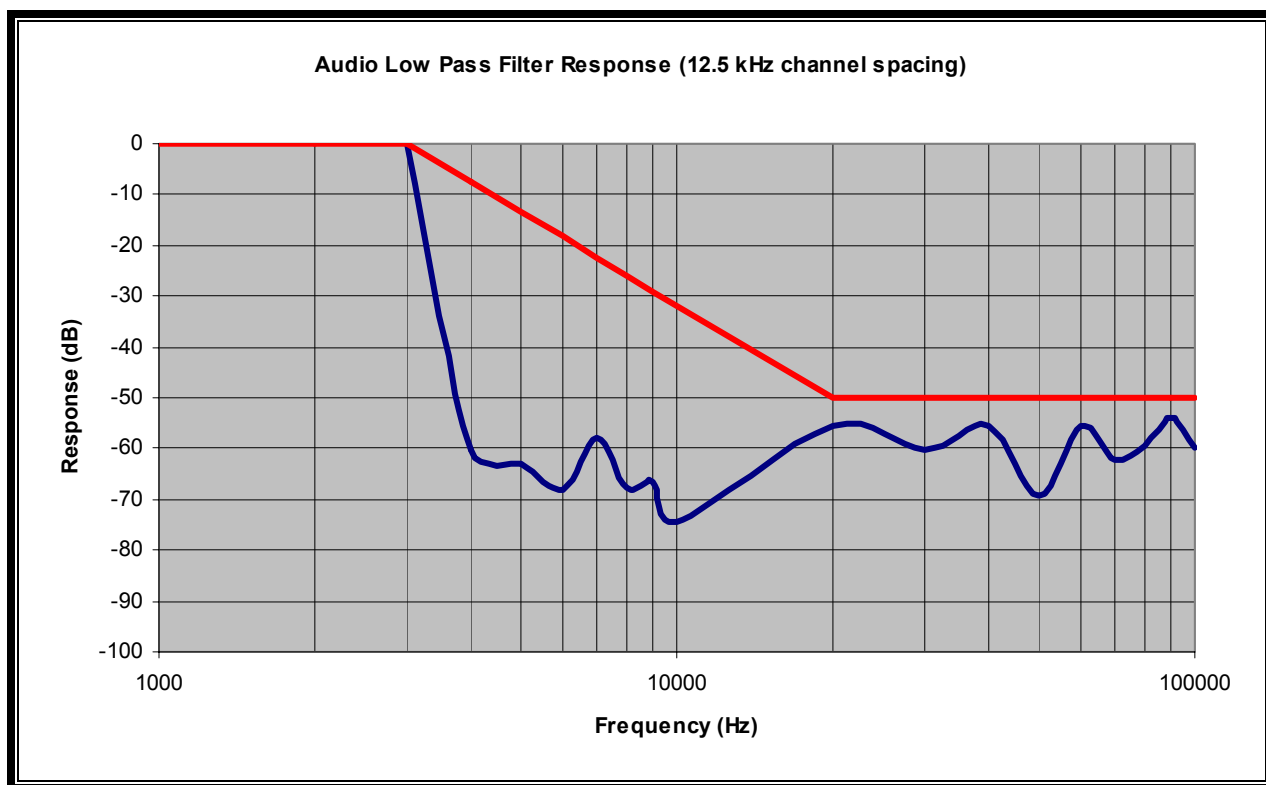
### 7.1 TEST PROCEDURE

ANSI/TIA/EIA-603-2002, 2.2.15

The Audio Low Pass Filter Response is the frequency response of the post limiter low pass filter circuit above 3000 Hz.

### 7.2 TEST DATA

PLOT 7-1: AUDIO LOW PASS FILTER RESPONSE (CHANNEL 2)



### TEST PERSONNEL:

DANIEL BALTZELL  
TEST ENGINEER

SIGNATURE

AUGUST 22, 2004  
DATE OF TEST

## 8 FCC PART 2 §2.1047 (B): MODULATION CHARACTERISTICS - MODULATION LIMITING

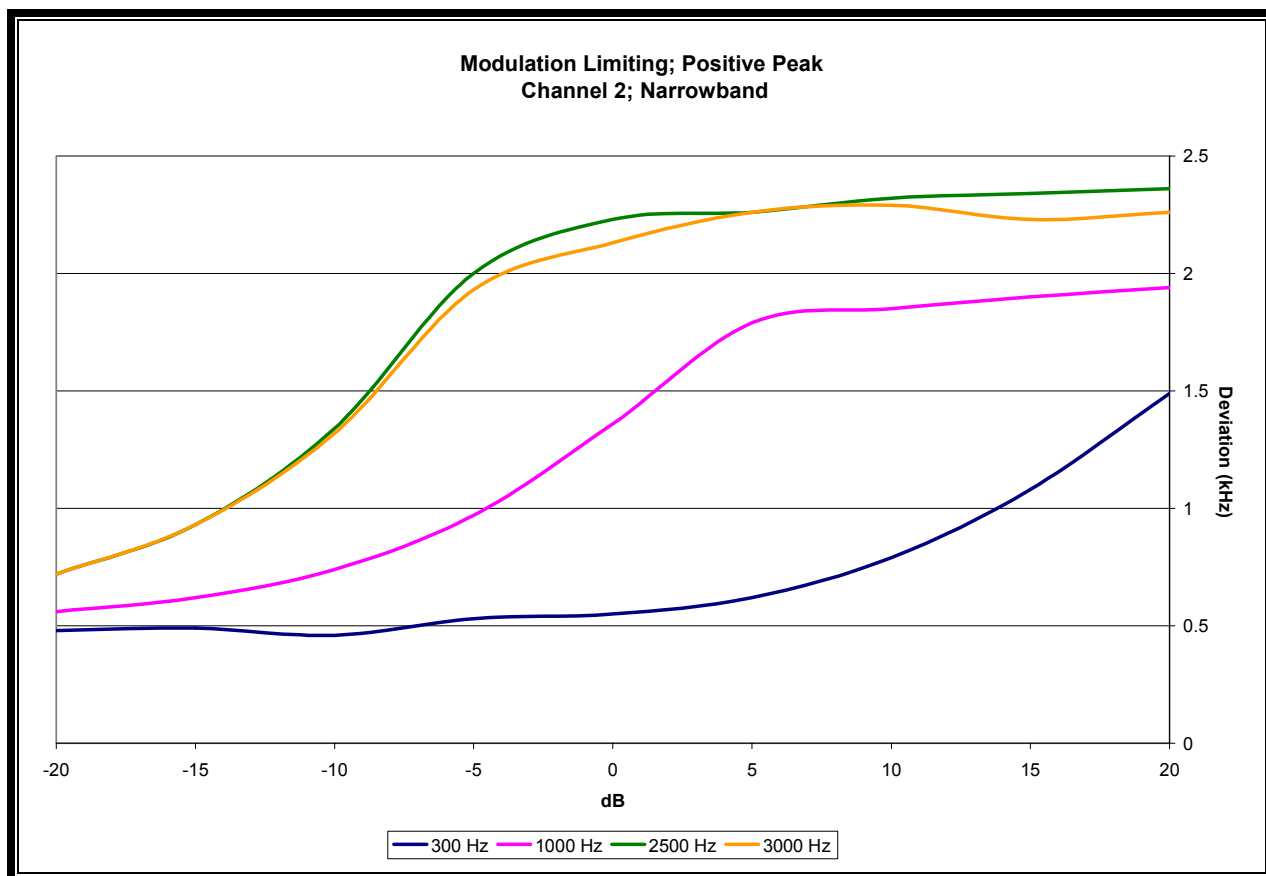
### 8.1 TEST PROCEDURE

ANSI/TIA/EIA-603-2002, section 2.2.3

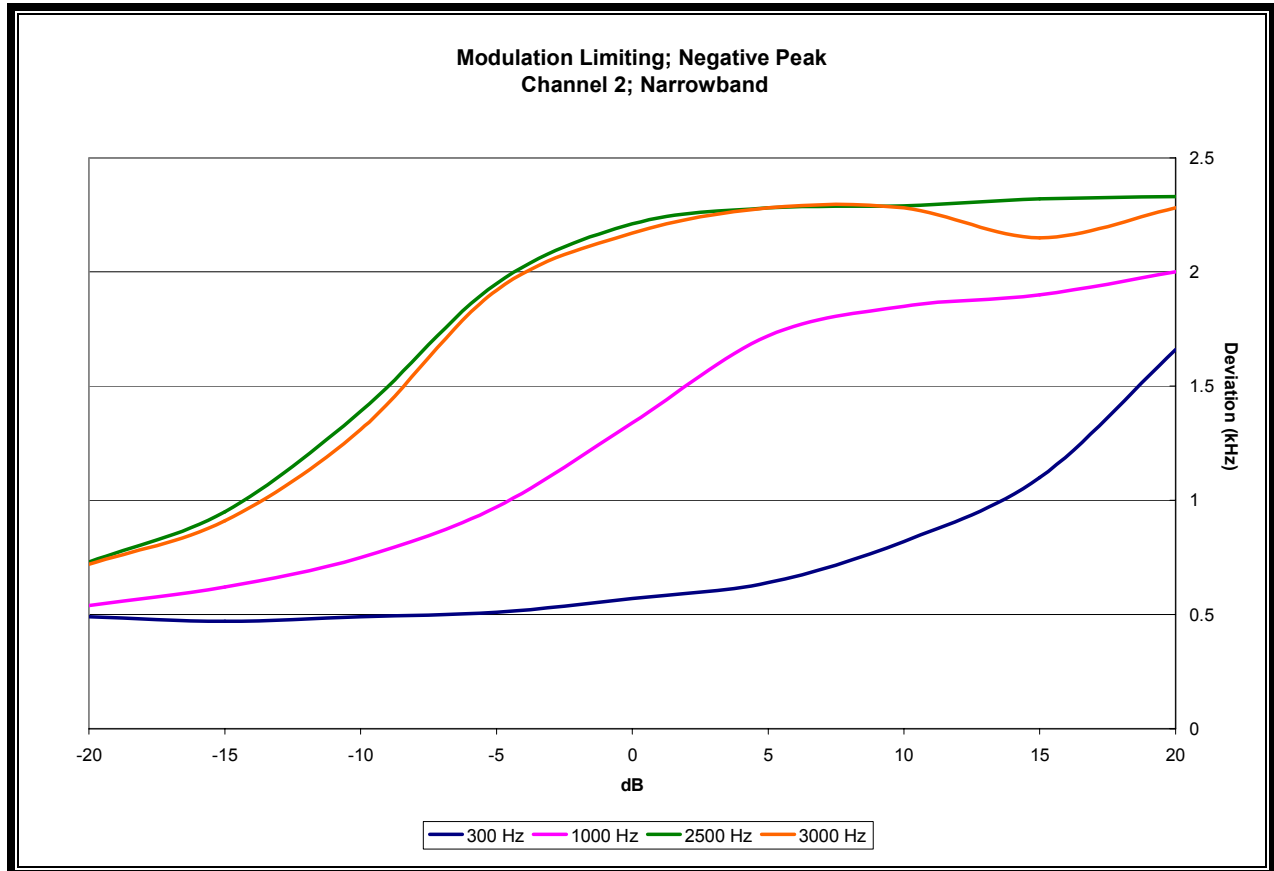
The transmitter is adjusted for full rated system deviation. The audio input level is adjusted for 60% of rated system deviation at 1000 Hz. Using this level as a reference (0 dB), the audio input level is varied from the reference to a level +20 dB above it and -20 dB under it, for modulation frequencies of 300 Hz, 1,000 Hz, and 2,500 Hz. The system deviation obtained as a function of the input level is recorded. Both Positive and Negative Peak deviations were recorded.

### 8.2 TEST DATA

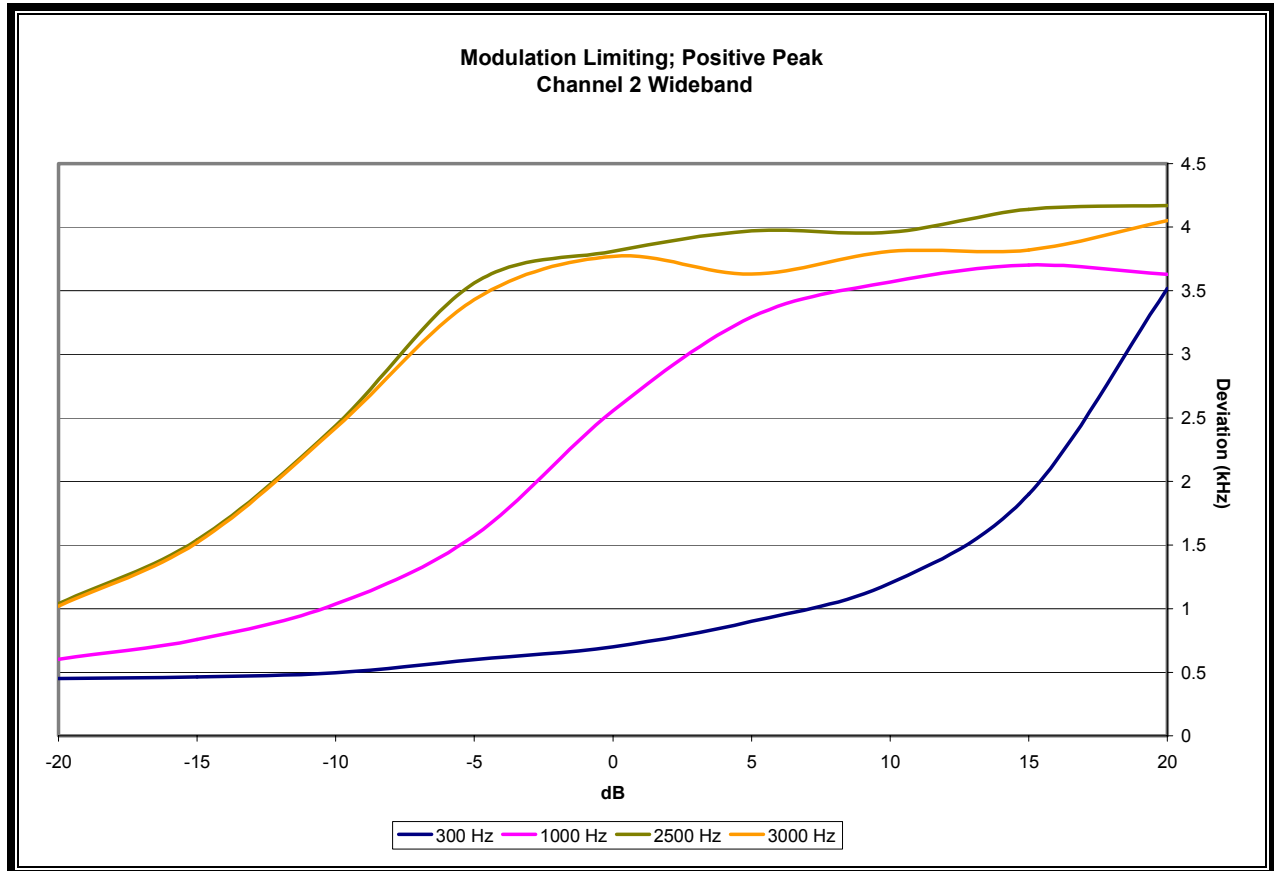
**PLOT 8-1: MODULATION LIMITING RESPONSE (POSITIVE PEAK) CHANNEL 2, 425 MHZ NARROWBAND**



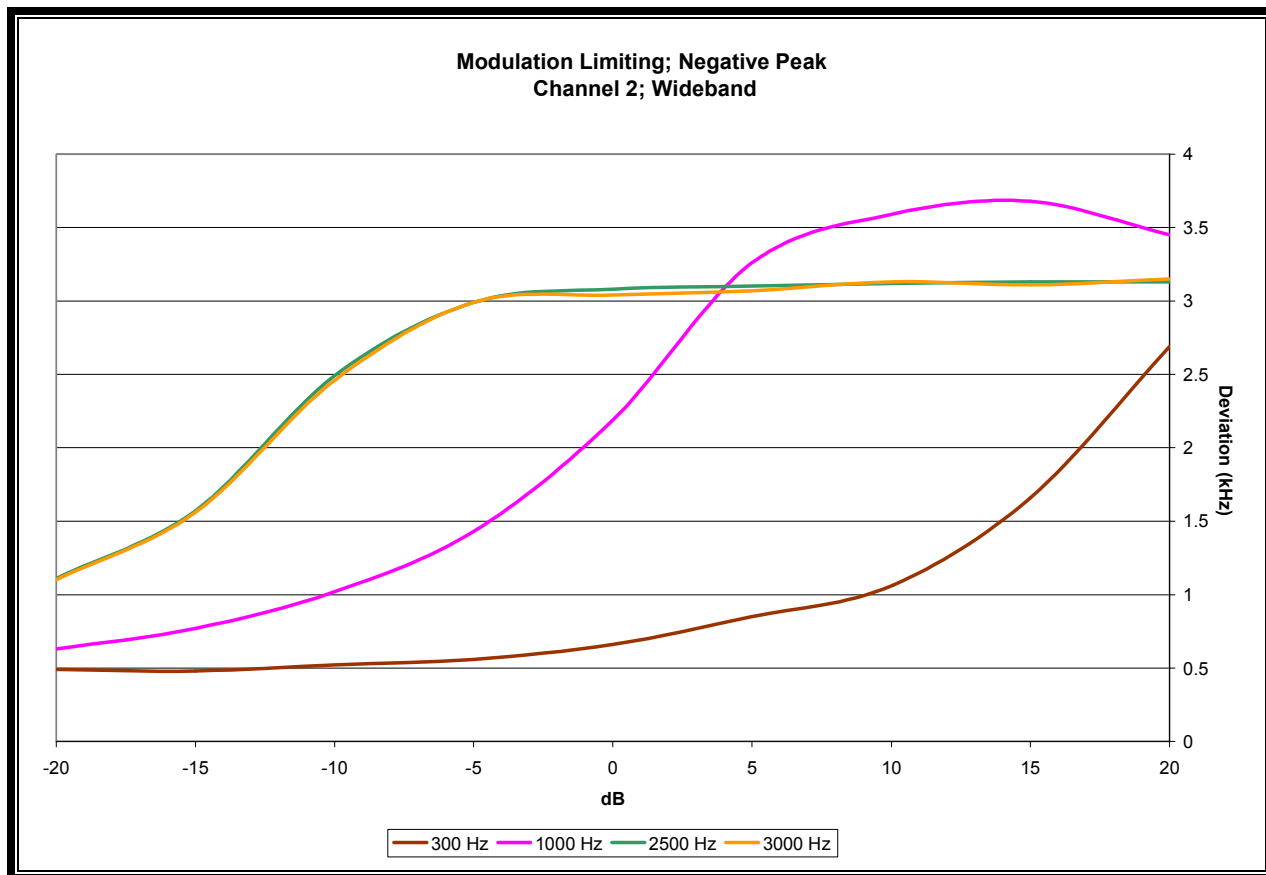
**PLOT 8-2: MODULATION LIMITING RESPONSE (NEGATIVE PEAK) CHANNEL 2; 425 MHZ;  
NARROWBAND**



**PLOT 8-3: MODULATION LIMITING RESPONSE (POSITIVE PEAK) CHANNEL 2; 425 MHZ;  
WIDEBAND**



**PLOT 8-4: MODULATION LIMITING RESPONSE (NEGATIVE PEAK) CHANNEL 2; 425 MHZ;  
WIDEBAND**



**TEST PERSONNEL:**

DANIEL BALTZELL  
TEST ENGINEER

SIGNATURE

SEPTEMBER 11, 2004  
DATE OF TEST



## 9 OCCUPIED BANDWIDTH - §2.1049; RSS-119 §6.4

### 9.1 OCCUPIED BANDWIDTH - §2.1049 TEST PROCEDURE

The antenna output terminal of the EUT was connected to the input of a 50W spectrum analyzer through a matched 10 dB attenuator. The radio transmitter was operating at maximum output power with and without internal data modulation. One hundred percent of the in-band modulation was below the specified mask. Specified Limits:

- A. On any frequency removed from the assigned carrier frequency by more than 20 kHz, up to and including 45 kHz, the sideband was at least 26 dB below the carrier.
- B. On any frequency removed from the assigned carrier frequency by more than 45 kHz, up to and including 90 kHz, the sideband was at least 45 dB below the carrier.
- C. On any frequency removed from the assigned carrier frequency by more than 90 kHz, up to the first multiple of the carrier frequency, the sideband was at least 60 dB below the carrier of  $40 + \log_{10}$  (mean power output in Watts) dB, whichever was the smaller attenuation.

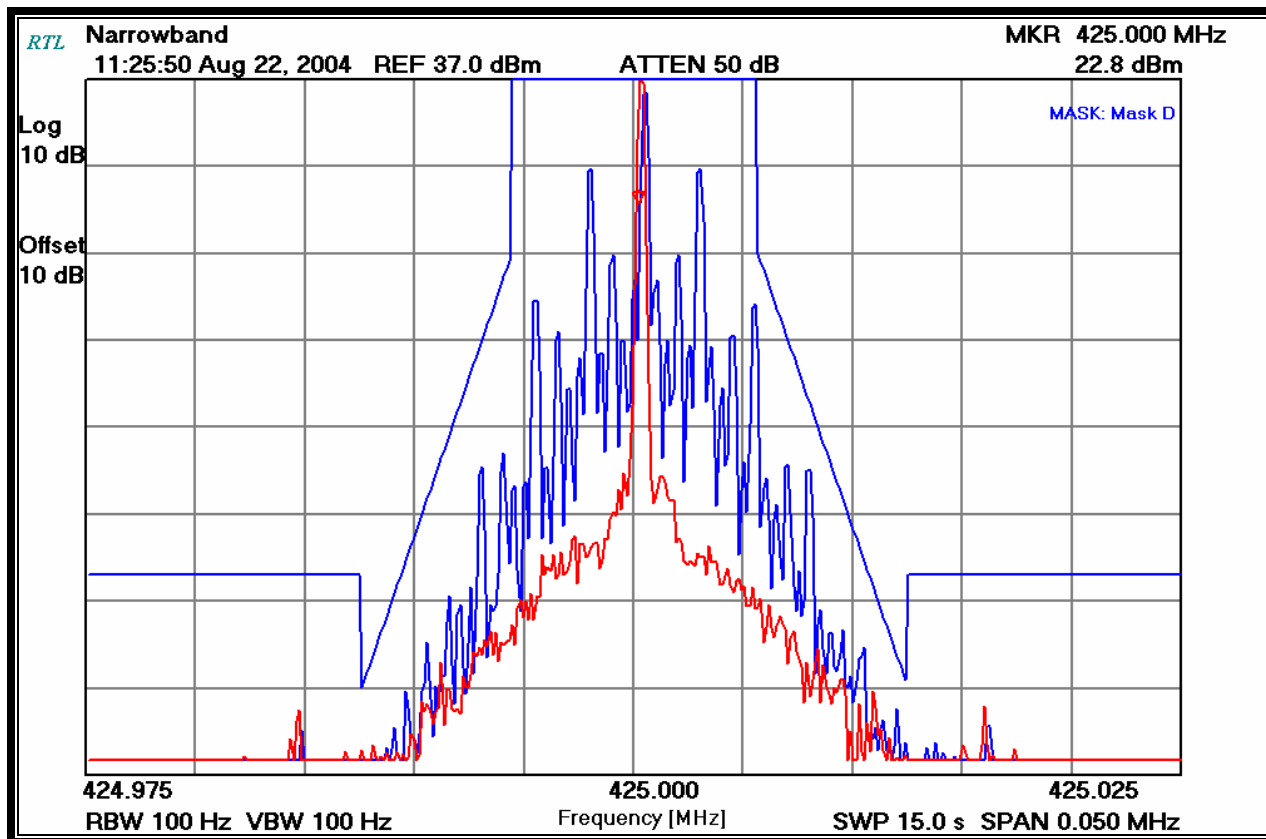
### 9.2 OCCUPIED BANDWIDTH TEST EQUIPMENT

TABLE 9-1: OCCUPIED BANDWIDTH TEST EQUIPMENT

| RTL Asset # | Manufacturer    | Model                        | Part Type    | Serial Number | Cal Due Date |
|-------------|-----------------|------------------------------|--------------|---------------|--------------|
| 901215      | Hewlett Packard | 8596EM<br>(9 kHz - 12.8 GHz) | EMC Analyzer | 3826A00144    | 8/27/04      |

### 9.3 OCCUPIED BANDWIDTH TEST DATA

PLOT 9-1: MASK D (425 MHz; CH 2; NARROWBAND)



#### TEST PERSONNEL:

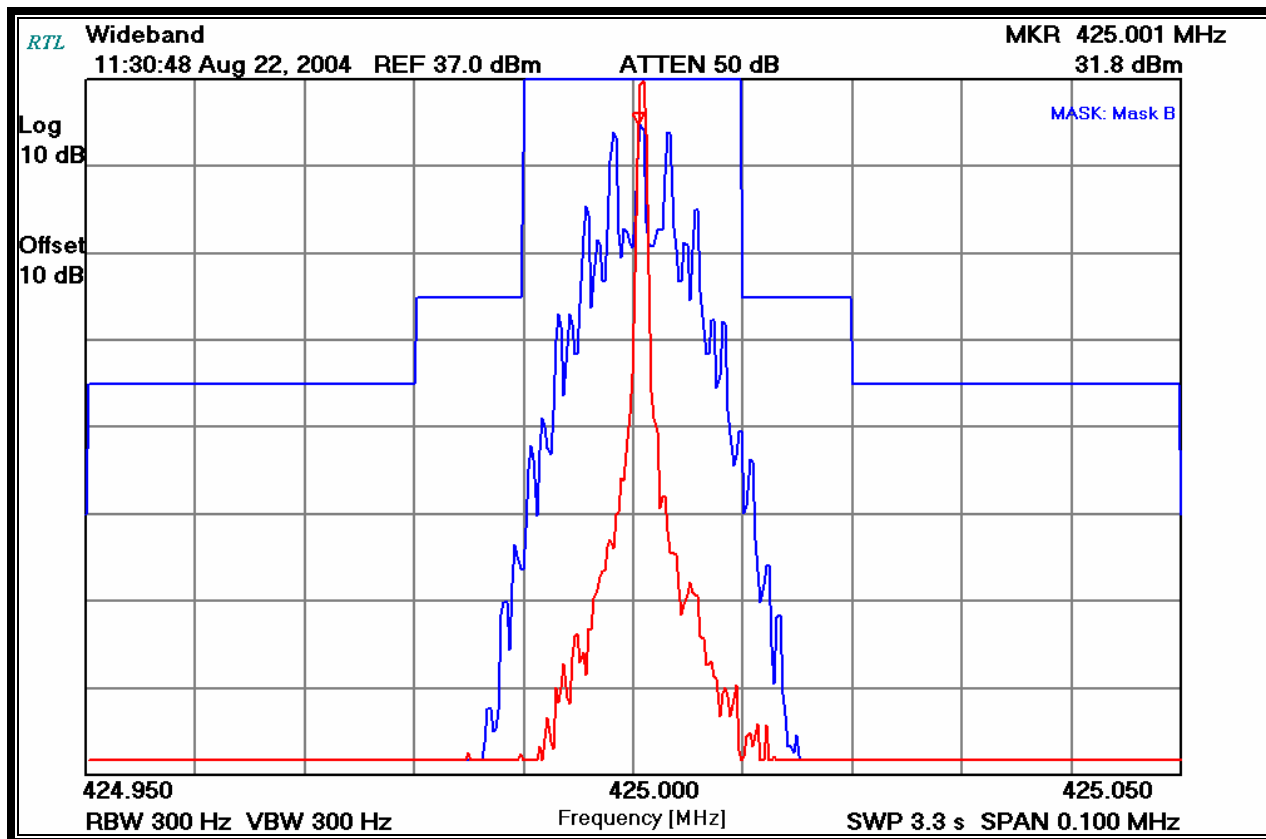
DANIEL BALTZELL  
TEST ENGINEER

SIGNATURE

AUGUST 22, 2004  
DATE OF TEST

#### 9.4 OCCUPIED BANDWIDTH TEST DATA

PLOT 9-2: MASK B (425 MHz; CH 2; WIDEBAND)



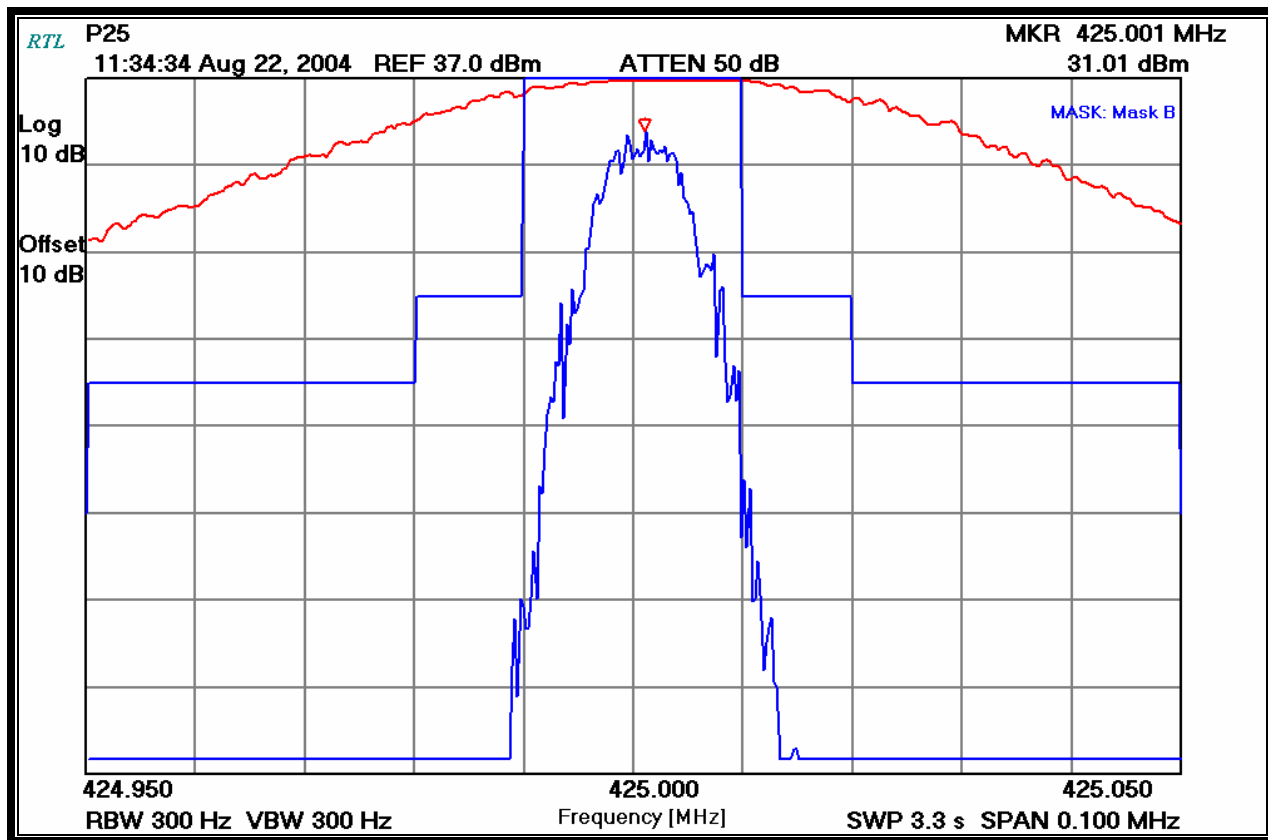
#### TEST PERSONNEL:

DANIEL BALTZELL  
TEST ENGINEER

SIGNATURE

AUGUST 22, 2004  
DATE OF TEST

PLOT 9-3: MASK B (425 MHZ; P25 DIGITAL)



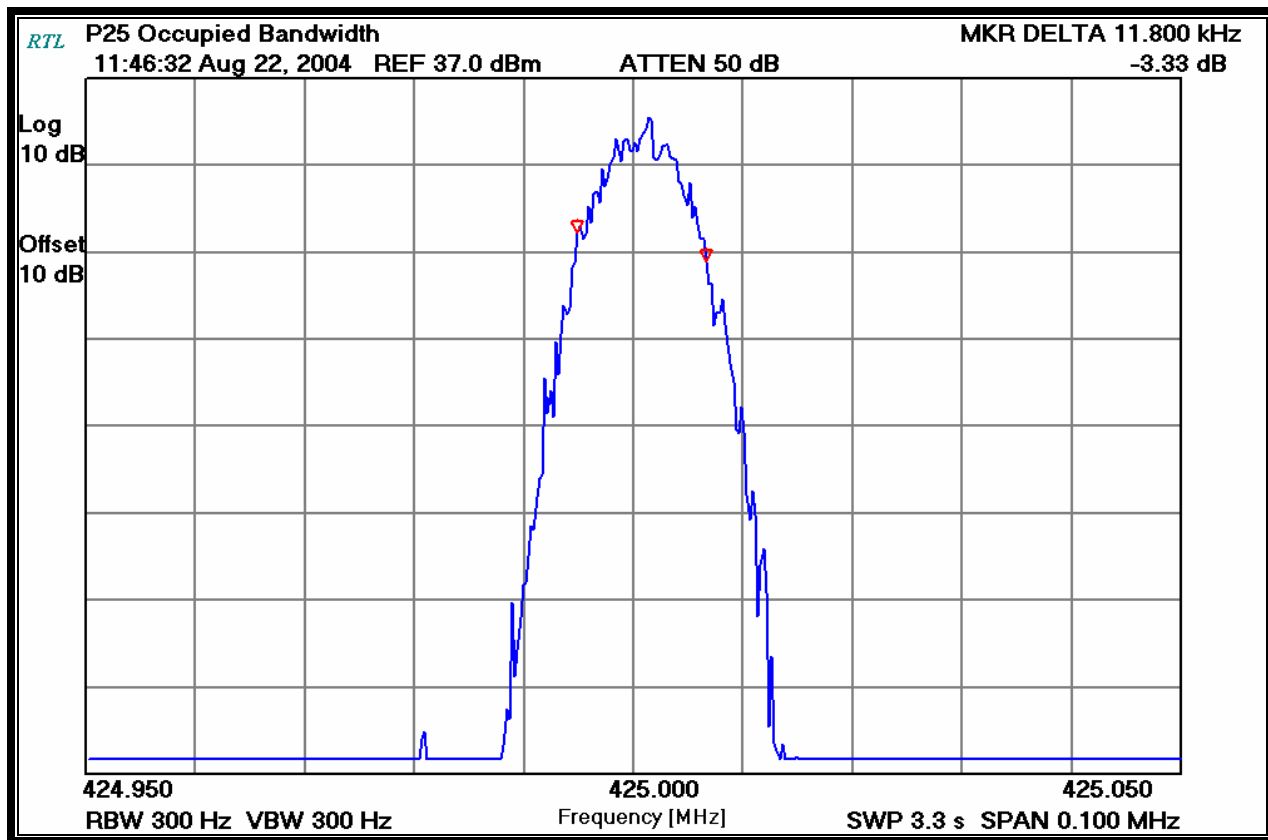
TEST PERSONNEL:

DANIEL BALTZELL  
TEST ENGINEER

SIGNATURE

AUGUST 22, 2004  
DATE OF TEST

**PLOT 9-4: OCCUPIED BANDWIDTH: (425 MHz, P25 DIGITAL): 11.8 KHZ**



**TEST PERSONNEL:**

DANIEL BALTZELL  
TEST ENGINEER

SIGNATURE

AUGUST 22, 2004  
DATE OF TEST

## 10 SPURIOUS EMISSIONS AT ANTENNA TERMINAL - §2.1051; RSS-119 §6.3

### 10.1 SPURIOUS EMISSIONS AT ANTENNA TERMINAL - §2.1051 TEST PROCEDURE

The level of the various conducted spurious frequencies was measured by means of a calibrated spectrum analyzer. The antenna output terminal of the EUT was connected to the input of a 50  $\Omega$  spectrum analyzer through a matched 3dB attenuator and notch filter. The transmitter was operating at maximum power.

### 10.2 SPURIOUS EMISSIONS AT ANTENNA TERMINAL TEST EQUIPMENT

TABLE 10-1: SPURIOUS EMISSIONS AT ANTENNA TERMINAL TEST EQUIPMENT

| RTL Asset # | Manufacturer    | Model                        | Part Type        | Serial Number | Cal Due Date |
|-------------|-----------------|------------------------------|------------------|---------------|--------------|
| 901215      | Hewlett Packard | 8596EM<br>(9 kHz - 12.8 GHz) | EMC Analyzer     | 3826A00144    | 8/27/04      |
| 901132      | Par Electronics | 806-902 (25W)                | UHF Notch Filter | N/A           | 5/13/05      |

### 10.3 CONDUCTED SPURIOUS EMISSIONS TEST DATA

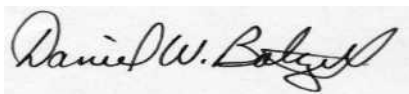
TABLE 10-2: CONDUCTED SPURIOUS EMISSIONS (CHANNEL 1 AT 380 MHZ)

Operating Frequency (MHz): 380  
Channel: 1  
Measured Conducted Power (dBm): 36.7  
Modulation: Analog  
Limit (dBc): 56.7 (50+10LogP)

| Frequency (MHz) | Spectrum Analyzer Level (dBm) | Notch Filter Insertion Loss (dB) | Corrected Spectrum Analyzer Level (dBc) | Margin (dB) |
|-----------------|-------------------------------|----------------------------------|-----------------------------------------|-------------|
| 760.0           | -50.9                         | 1.2                              | 86.4                                    | -29.7       |
| 1140.0          | -72.2                         | 0.4                              | 108.5                                   | -51.8       |
| 1520.0          | -71.8                         | 0.7                              | 107.8                                   | -51.1       |
| 1900.0          | -72.0                         | 0.6                              | 108.1                                   | -51.4       |
| 2280.0          | -60.8                         | 0.5                              | 97.0                                    | -40.3       |
| 2660.0          | -63.9                         | 0.6                              | 100.0                                   | -43.3       |
| 3040.0          | -53.3                         | 0.3                              | 89.7                                    | -33.0       |
| 3420.0          | -64.8                         | 1.1                              | 100.4                                   | -43.7       |
| 3800.0          | -77.1                         | 0.3                              | 113.5                                   | -56.8       |

#### TEST PERSONNEL:

DANIEL BALTZELL  
TEST ENGINEER



SIGNATURE

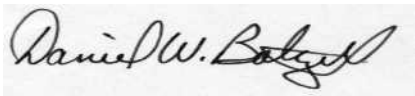
AUGUST 22, 2004  
DATE OF TEST

**TABLE 10-3: CONDUCTED SPURIOUS EMISSIONS (CHANNEL 2 AT 425 MHZ)**

Operating Frequency (MHz): 425  
Channel: 2  
Measured Conducted Power (dBm): 37.1  
Modulation: Analog  
Limit (dBc): 57.1 (50+10LogP)

| Frequency (MHz) | Spectrum Analyzer Level (dBm) | Notch Filter Insertion Loss (dB) | Corrected Spectrum Analyzer Level (dBc) | Margin (dB) |
|-----------------|-------------------------------|----------------------------------|-----------------------------------------|-------------|
| 850.0           | -47.1                         | 0.9                              | 83.3                                    | -26.2       |
| 1275.0          | -73.0                         | 0.3                              | 109.8                                   | -52.7       |
| 1700.0          | -63.3                         | 0.3                              | 100.1                                   | -43.0       |
| 2125.0          | -67.8                         | 1.1                              | 103.8                                   | -46.7       |
| 2550.0          | -59.9                         | 0.3                              | 96.7                                    | -39.6       |
| 2975.0          | -71.1                         | 0.2                              | 108.0                                   | -50.9       |
| 3400.0          | -64.6                         | 1.1                              | 100.6                                   | -43.5       |
| 3825.0          | -68.9                         | 0.5                              | 105.5                                   | -48.4       |
| 4250.0          | -83.5                         | 5.1                              | 115.5                                   | -58.4       |

**TEST PERSONNEL:**

|                                  |                                                                                                   |                                 |
|----------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------|
| DANIEL BALTZELL<br>TEST ENGINEER | <br>SIGNATURE | AUGUST 22, 2004<br>DATE OF TEST |
|----------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------|

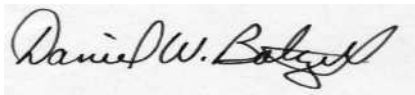


**TABLE 10-4: CONDUCTED SPURIOUS EMISSIONS (CHANNEL 3 AT 470 MHZ)**

Operating Frequency (MHz): 470  
Channel: 3  
Measured Conducted Power (dBm): 36.73  
Modulation: Analog  
Limit (dBc): 56.73 (50+10LogP)

| Frequency (MHz) | Spectrum Analyzer Level (dBm) | Notch Filter Insertion Loss (dB) | Corrected Spectrum Analyzer Level (dBc) | Margin (dB) |
|-----------------|-------------------------------|----------------------------------|-----------------------------------------|-------------|
| 940.0           | -54.3                         | 1.1                              | 89.9                                    | -32.7       |
| 1410.0          | -87.7                         | 0.4                              | 124.0                                   | -66.8       |
| 1880.0          | -70.3                         | 0.8                              | 106.2                                   | -49.0       |
| 2350.0          | -58.7                         | 1.0                              | 94.4                                    | -37.2       |
| 2820.0          | -64.9                         | 0.1                              | 101.5                                   | -44.3       |
| 3290.0          | -50.7                         | 0.9                              | 86.5                                    | -29.3       |
| 3760.0          | -70.3                         | 0.4                              | 106.6                                   | -49.4       |
| 4230.0          | -69.1                         | 5.8                              | 100.0                                   | -42.8       |
| 4700.0          | -68.1                         | 3.2                              | 101.6                                   | -44.4       |

**TEST PERSONNEL:**

|                                  |                                                                                                   |                                 |
|----------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------|
| DANIEL BALTZELL<br>TEST ENGINEER | <br>SIGNATURE | AUGUST 22, 2004<br>DATE OF TEST |
|----------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------|

## **11 RADIATED SPURIOUS AND HARMONIC EMISSIONS - §2.1053; RSS-119 §6.3**

### **11.1 RADIATED SPURIOUS AND HARMONIC EMISSIONS - §2.1053**

A receiving antenna located 3 meters from the turntable received any signal radiated from the transmitter and its operating accessories. The receiving antenna was varied from 1 to 4 meters

ERP Measurements by Substitution Method:

The EUT was placed on a turntable 3-meters from the receive antenna. The EUT was placed on the turntable with the transmitter transmitting into a non-radiating load. The field of maximum intensity was found by rotating the EUT approximately 360 degrees and changing the height of the receive antenna from 1 to 4 meters and the polarization was varied to determine the worst-case emission level. The spectrum analyzer level was recorded from a calibrated spectrum analyzer for each channel being tested. A dipole or horn antenna was substituted in place of the EUT and was fed by a signal generator, and the input level adjusted to the same field strength level as the EUT. The conducted power from the signal generator was recorded at the point of the antenna using a power splitter to compensate for any impedance mismatch between the 50 ohm signal generator and the transmitting antenna. The signal generator level was corrected by subtracting the connecting cable loss, and further corrected with the antenna gain referenced to a ½ wave dipole measurement.

## 11.2 RADIATED SPURIOUS TEST EQUIPMENT

**TABLE 11-1: RADIATED SPURIOUS TEST EQUIPMENT**

| RTL Asset # | Manufacturer                | Model            | Part Type                                     | Serial Number | Cal Due Date |
|-------------|-----------------------------|------------------|-----------------------------------------------|---------------|--------------|
| 901053      | Schaffner Chase             | CBL6112B         | Bi-Log Antenna (20 MHz – 2 GHz)               | 2648          | 9/3/04       |
| 901215      | Hewlett Packard             | 8596EM           | EMC Analyzer (9 kHz - 12.8 GHz)               | 3826A00144    | 8/27/04      |
| 900928      | Hewlett Packard             | 83752A           | Synthesized Sweeper (0.01 GHz – 20 GHz)       | 3610A00866    | 8/5/05       |
| 900905      | Rhein Tech Labs             | PR-1040          | Amplifier (30 MHz - 2 GHz)                    | 900905        | 9/10/04      |
| 900814      | Electro-Metrics             | EM-6961 (RGA-60) | Double Ridges Guide Antenna (1 - 18 GHz)      | 2310          | 2/17/06      |
| 900772      | EMCO                        | 3161-02          | Horn antenna (2.0 - 4.0 GHz)                  | 9804-1044     | 5/20/07      |
| 900321      | EMCO                        | 3161-03          | Horn antenna (4.0 - 8.2 GHz)                  | 9508-1020     | 5/20/07      |
| 900932      | Hewlett Packard             | 8449B OPT H02    | Preamplifier (1 - 26.5 GHz)                   | 3008A00505    | 5/5/05       |
| 900930      | Hewlett Packard             | 85662A           | Spectrum Analyzer Display Section             | 3144A20839    | 6/23/05      |
| 900931      | Hewlett Packard             | 8566B            | Spectrum Analyzer (100 Hz – 22 GHz)           | 3138A07771    | 6/23/05      |
| 900889      | Hewlett Packard             | 85685A           | RF Preselector for HP 8566B (20 Hz - 2 GHz)   | 3146A01309    | 3/10/05      |
| 900352      | Werlatone                   | C1795            | Directional Coupler, 100 watt, (1 – 1000 MHz) | 4067          | 7/1/2005     |
| 901341      | Narda Microwave Corporation | 3003-20-40       | Coaxial Directional Coupler                   | 2             | 7/1/2005     |
| 901342      | Narda Microwave Corporation | 3044-10          | Coaxial Directional Coupler                   | 901           | 7/1/2005     |
| 901345      | Narda Microwave Corporation | 3002-30          | Coaxial Directional Coupler                   | 20032         | 7/1/2005     |

### 11.3 RADIATED SPURIOUS EMISSIONS TEST DATA - §2.1053

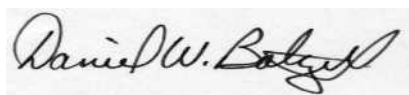
Operating Frequency (MHz): 380  
Channel: 1  
Measured Conducted Power (dBm): 36.7  
Modulation: Analog narrowband  
Distance (m): 3  
Limit (dBc): 56.7 (50+10LogP)

TABLE 11-2: RADIATED SPURIOUS EMISSIONS DATA §2.1053

| Frequency (MHz) | Spectrum Analyzer Peak Level (dBuV) | Spectrum Analyzer Average Level (dBuV) | Signal Generator Level (dBm) | Cable Loss (dB) | Antenna Gain (dBd) | Corrected Level (dBc) | Margin (dB) |
|-----------------|-------------------------------------|----------------------------------------|------------------------------|-----------------|--------------------|-----------------------|-------------|
| 760.0           | 54.7                                | 49.5                                   | -67.4                        | 0.7             | -1.2               | 106.0                 | -49.3       |
| 1140.0          | 53.7                                | 46.7                                   | -59.9                        | 0.9             | 1.2                | 96.3                  | -39.6       |
| 1520.0          | 52.0                                | 42.5                                   | -59.9                        | 1.4             | 4.7                | 93.3                  | -36.6       |
| 1900.0          | 49.6                                | 42.1                                   | -56.8                        | 1.1             | 4.8                | 89.8                  | -33.1       |
| 2280.0          | 38.3                                | 32.1                                   | -60.7                        | 6.5             | 5.0                | 98.9                  | -42.2       |
| 2660.0          | 41.0                                | 32.2                                   | -58.5                        | 7.3             | 5.5                | 97.0                  | -40.3       |
| 3040.0          | 47.7                                | 43.0                                   | -49.0                        | 7.6             | 6.2                | 87.1                  | -30.4       |
| 3420.0          | 31.1                                | 21.4                                   | -70.6                        | 7.6             | 6.0                | 108.9                 | -52.2       |
| 3800.0          | 31.6                                | 26.5                                   | -64.7                        | 8.1             | 5.9                | 103.6                 | -46.9       |

#### TEST PERSONNEL:

DANIEL BALTZELL  
TEST ENGINEER



SIGNATURE

AUGUST 21, 2004  
DATE OF TEST

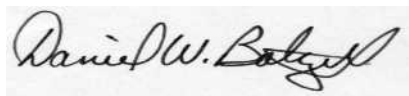
Operating Frequency (MHz): 425  
Channel: 2  
Measured Conducted Power (dBm): 37.1  
Modulation: Analog narrowband  
Distance (m): 3  
Limit (dBc): 57.1 (50+10LogP)

TABLE 11-3: RADIATED SPURIOUS EMISSIONS DATA §2.1053

| Frequency (MHz) | Spectrum Analyzer Peak Level (dBuV) | Spectrum Analyzer Average Level (dBuV) | Signal Generator Level (dBm) | Cable Loss (dB) | Antenna Gain (dBd) | Corrected Level (dBc) | Margin (dB) |
|-----------------|-------------------------------------|----------------------------------------|------------------------------|-----------------|--------------------|-----------------------|-------------|
| 850.0           | 44.3                                | 41.1                                   | -72.4                        | 0.5             | -0.2               | 110.2                 | -53.1       |
| 1275.0          | 43.6                                | 41.6                                   | -61.9                        | 0.9             | 2.5                | 97.4                  | -40.3       |
| 1700.0          | 53.1                                | 47.2                                   | -54.6                        | 1.2             | 4.7                | 88.2                  | -31.1       |
| 2125.0          | 43.5                                | 33.5                                   | -59.2                        | 6.1             | 4.9                | 97.5                  | -40.4       |
| 2550.0          | 43.4                                | 35.0                                   | -55.5                        | 7.4             | 5.3                | 94.7                  | -37.6       |
| 2975.0          | 43.6                                | 38.9                                   | -53.3                        | 7.5             | 6.2                | 91.7                  | -34.6       |
| 3400.0          | 37.1                                | 27.6                                   | -64.4                        | 7.6             | 6.0                | 103.1                 | -46.0       |
| 3825.0          | 35.5                                | 26.8                                   | -64.0                        | 8.0             | 5.9                | 103.2                 | -46.1       |
| 4250.0          | 31.2                                | 24.8                                   | -63.3                        | 8.2             | 6.5                | 102.1                 | -45.0       |

TEST PERSONNEL:

DANIEL BALTZELL  
TEST ENGINEER



SIGNATURE

AUGUST 21, 2004  
DATE OF TEST

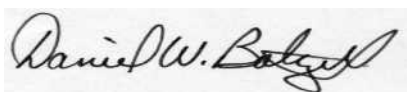
Operating Frequency (MHz): 470  
Channel: 3  
Measured Conducted Power (dBm): 36.7  
Modulation: Analog narrowband  
Distance (m): 3  
Limit (dBc): 56.7 (50+10LogP)

TABLE 11-4: RADIATED SPURIOUS EMISSIONS DATA §2.1053

| Frequency (MHz) | Spectrum Analyzer Peak Level (dBuV) | Spectrum Analyzer Average Level (dBuV) | Signal Generator Level (dBm) | Cable Loss (dB) | Antenna Gain (dBd) | Corrected Level (dBc) | Margin (dB) |
|-----------------|-------------------------------------|----------------------------------------|------------------------------|-----------------|--------------------|-----------------------|-------------|
| 940.0           | 47.2                                | 41.3                                   | -71.4                        | 0.9             | -1.2               | 110.2                 | -53.5       |
| 1410.0          | 48.7                                | 42.8                                   | -60.6                        | 0.8             | 3.8                | 94.3                  | -37.6       |
| 1880.0          | 53.6                                | 44.7                                   | -54.6                        | 0.7             | 4.8                | 87.2                  | -30.5       |
| 2350.0          | 44.3                                | 33.0                                   | -59.8                        | 6.2             | 5.1                | 97.6                  | -40.9       |
| 2820.0          | 28.8                                | 34.0                                   | -57.8                        | 7.4             | 5.9                | 96.0                  | -39.3       |
| 3290.0          | 41.4                                | 34.2                                   | -57.6                        | 7.8             | 6.1                | 96.0                  | -39.3       |
| 3760.0          | 35.9                                | 27.9                                   | -63.4                        | 7.9             | 5.9                | 102.1                 | -45.4       |
| 4230.0          | 46.3                                | 41.0                                   | -46.9                        | 8.5             | 6.4                | 85.7                  | -29.0       |
| 4700.0          | 44.8                                | 41.7                                   | -46.5                        | 7.8             | 7.0                | 84.0                  | -27.3       |

TEST PERSONNEL:

DANIEL BALTZELL  
TEST ENGINEER



SIGNATURE

AUGUST 21, 2004  
DATE OF TEST

## **12 FREQUENCY STABILITY / TEMPERATURE VARIATION - §2.1055; RSS-119 §7**

### **12.1 MEASUREMENT METHOD:**

The frequency stability of the transmitter was measured by:

1. Temperature: The temperature was varied from -30°C to +50°C at intervals no more than 10°C throughout the temperature range using an environmental chamber. A period of time sufficient to stabilize all of the components in the equipment shall be allowed prior to each frequency measurement.
2. Primary Supply Voltage: The primary supply voltage was varied from 85% to 115% of the voltage normally at the input to the device or at the power supply terminals if cables are not normally supplied. The EUT was tested down to the battery endpoint.

### **12.2 TIME PERIOD AND PROCEDURE:**

1. The carrier frequency of the transmitter was measured at room temperature (25°C to 27°C to provide a reference).
2. The equipment was subjected to a three hour "soak" at -30°C without any power applied.
3. After the "soak" at -30°C, the measurement of the carrier frequency of the transmitter was made within a three-minute interval after applying power to the transmitter.
4. Frequency measurements were made at 10°C intervals up to +50°C, then back to room temperature. A minimum period of one hour was provided to allow stabilization of the equipment at each temperature level.

### **12.3 FREQUENCY TOLERANCE:**

The minimum frequency stability shall be +2.5 ppm referenced to a received carrier frequency from a base station.

## 12.4 FREQUENCY STABILITY TEST EQUIPMENT

TABLE 12-1: FREQUENCY STABILITY TEST EQUIPMENT

| RTL Asset # | Manufacturer            | Model  | Part Type                         | Serial Number | Cal Due Date |
|-------------|-------------------------|--------|-----------------------------------|---------------|--------------|
| 900946      | Tenney Engineering, Inc | TH65   | Temperature Chamber with Humidity | 11380         | 2/3/05       |
| 901247      | Wavetek                 | DM25XT | Multimeter                        | 40804098      | 3/3/05       |

## 12.5 FREQUENCY STABILITY TEST DATA - §2.1055

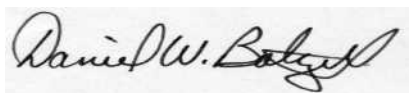
Operating Frequency (MHz): 425  
Channel: 2  
Reference Voltage: 7.5 VDC  
Deviation Limit: 2.5 PPM

TABLE 12-2: FREQUENCY STABILITY DATA - §2.1055: TEMPERATURE

| Temperature (°C) | Measured Frequency (MHz) | ppm   |
|------------------|--------------------------|-------|
| -30              | 424.999620               | -0.89 |
| -20              | 424.999705               | -0.69 |
| -10              | 424.999655               | -0.81 |
| 0                | 424.999650               | -0.82 |
| 10               | 424.999780               | -0.52 |
| 20               | 425.000000               | 0.00  |
| 30               | 425.000020               | 0.05  |
| 40               | 425.000060               | 0.14  |
| 50               | 425.000060               | 0.14  |

## TEST PERSONNEL:

DANIEL BALTZELL  
TEST ENGINEER

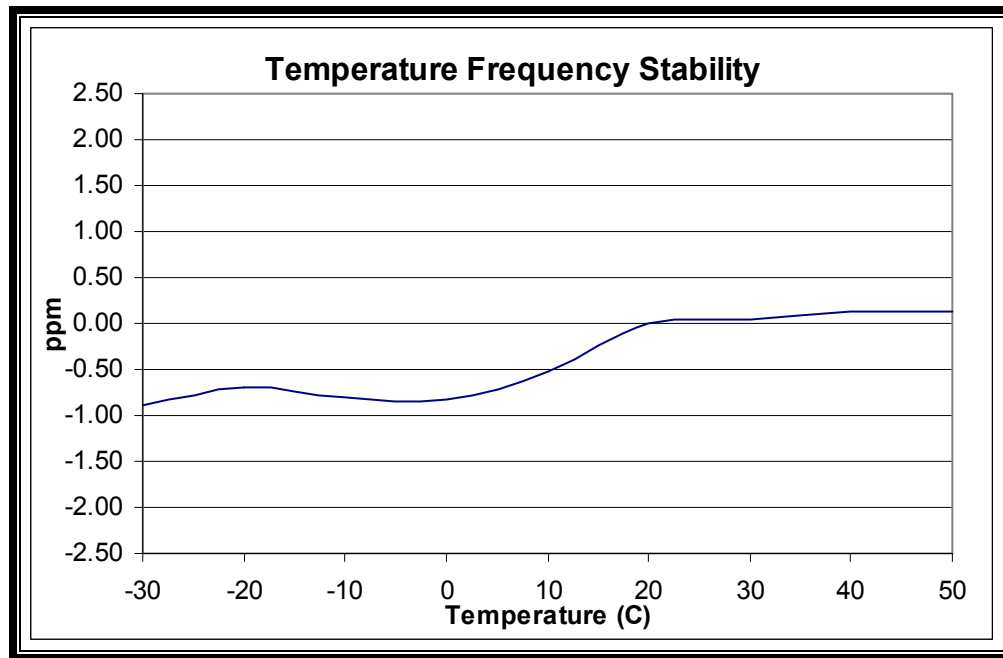


SIGNATURE

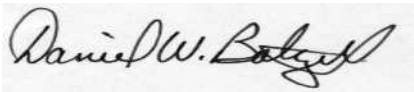
SEPTEMBER 10, 2004  
DATE OF TEST



**PLOT 12-1: TEMPERATURE FREQUENCY STABILITY - §2.1055**



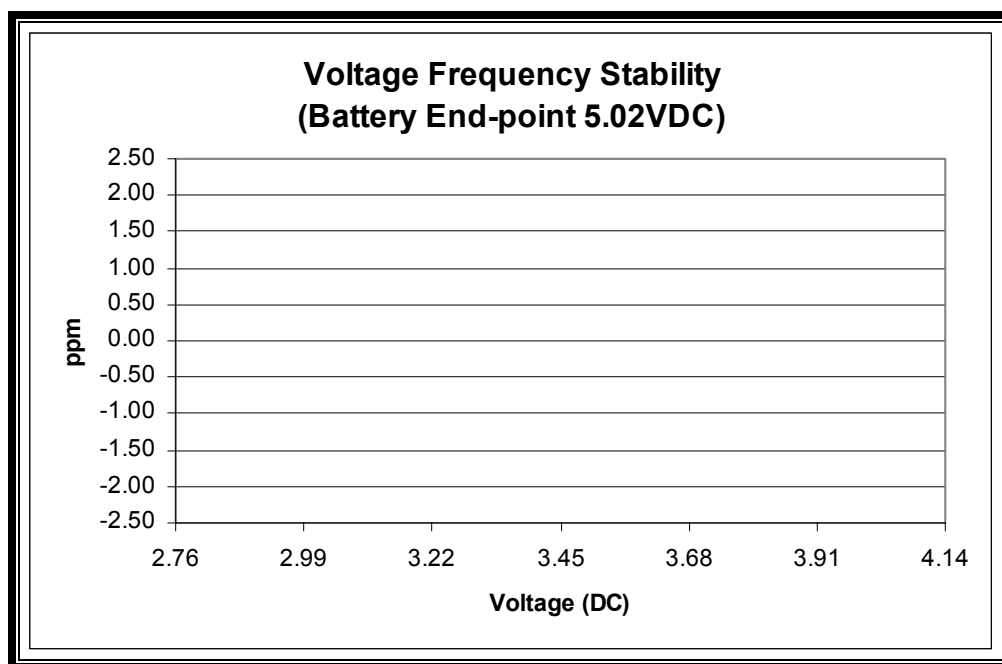
**TEST PERSONNEL:**

|                 |                                                                                      |                    |
|-----------------|--------------------------------------------------------------------------------------|--------------------|
| DANIEL BALTZELL |  | SEPTEMBER 10, 2004 |
| TEST ENGINEER   | SIGNATURE                                                                            | DATE OF TEST       |

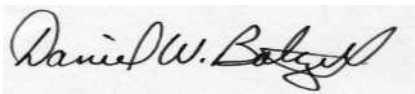
**TABLE 12-3: FREQUENCY STABILITY DATA - §2.1055: VOLTAGE**

| Voltage (DC)             | Measured Frequency (MHz) | ppm  |
|--------------------------|--------------------------|------|
| 5.02 (Battery End-point) | 425.000217               | 0.51 |
| 6.375                    | 425.000211               | 0.50 |
| 7.5                      | 425.000205               | 0.48 |
| 8.625                    | 425.000201               | 0.47 |

**PLOT 12-2: VOLTAGE FREQUENCY STABILITY - §2.1055**



**TEST PERSONNEL:**

|                                  |                                                                                                   |                                    |
|----------------------------------|---------------------------------------------------------------------------------------------------|------------------------------------|
| DANIEL BALTZELL<br>TEST ENGINEER | <br>SIGNATURE | SEPTEMBER 10, 2004<br>DATE OF TEST |
|----------------------------------|---------------------------------------------------------------------------------------------------|------------------------------------|

### 13 FCC PART 90 §90.214; RSS-119 §6.5: TRANSIENT FREQUENCY BEHAVIOR

#### 13.1 TRANSIENT FREQUENCY BEHAVIOR TEST PROCEDURE

ANSI/TIA/EIA-603-2002, section 2.2.19

#### 13.2 TRANSIENT FREQUENCY BEHAVIOR LIMITS

**TABLE 13-1: REQUIREMENTS FOR EUT WITH 25 KHZ CHANNEL SPACING**

| Time Intervals (*)(**) | Maximum Frequency Difference (***) | 150-174 MHz | 421-512 MHz |
|------------------------|------------------------------------|-------------|-------------|
| t1(****)               | ± 25 kHz                           | 5.0 mSec    | 10.0 mSec   |
| t2                     | ± 12.5 kHz                         | 20.0 mSec   | 25.0 mSec   |
| t3(****)               | ± 25 kHz                           | 5.0 mSec    | 10.0 mSec   |

**TABLE 13-2: REQUIREMENTS FOR EUT WITH 12.5 KHZ CHANNEL SPACING**

| Time Intervals (*)(**) | Maximum Frequency Difference(***) | 150-174 MHz | 421-512 MHz |
|------------------------|-----------------------------------|-------------|-------------|
| t1(****)               | ± 12.5 kHz                        | 5.0 mSec    | 10.0 mSec   |
| t2                     | ± 6.25 kHz                        | 20.0 mSec   | 25.0 mSec   |
| t3(****)               | ± 12.5 kHz                        | 5.0 mSec    | 10.0 mSec   |

(\*)  $t_{on}$  is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

$t_1$  is the time period immediately following  $t_{on}$ .

$t_2$  is the time period immediately following  $t_1$ .

$t_3$  is the time period from the instant when the transmitter is turned off until  $t_{off}$ .

$t_{off}$  is the instant when the 1 kHz test signal starts to rise.

(\*\*) During the time from the end of  $t_2$  to the beginning of  $t_3$ , the frequency difference must not exceed the limits specified in §90.213.

(\*\*\*) The difference between the actual transmitter frequency and the assigned transmitter frequency.

(\*\*\*\*) If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

Maximum frequency difference between time T2 and T3: Calculation for Channel 5:

The frequency stability is required to be 2.5 PPM.

Calculation for Channel 5:

4 div. on scope represent 12.5 kHz for narrow band channel.

Therefore,  $481.0125 \text{ MHz} \times 2.5 \text{ PPM} \times \pm 4 \text{ Divisions}$

12.5kHz

$= \approx \pm 0.39 \text{ division}$

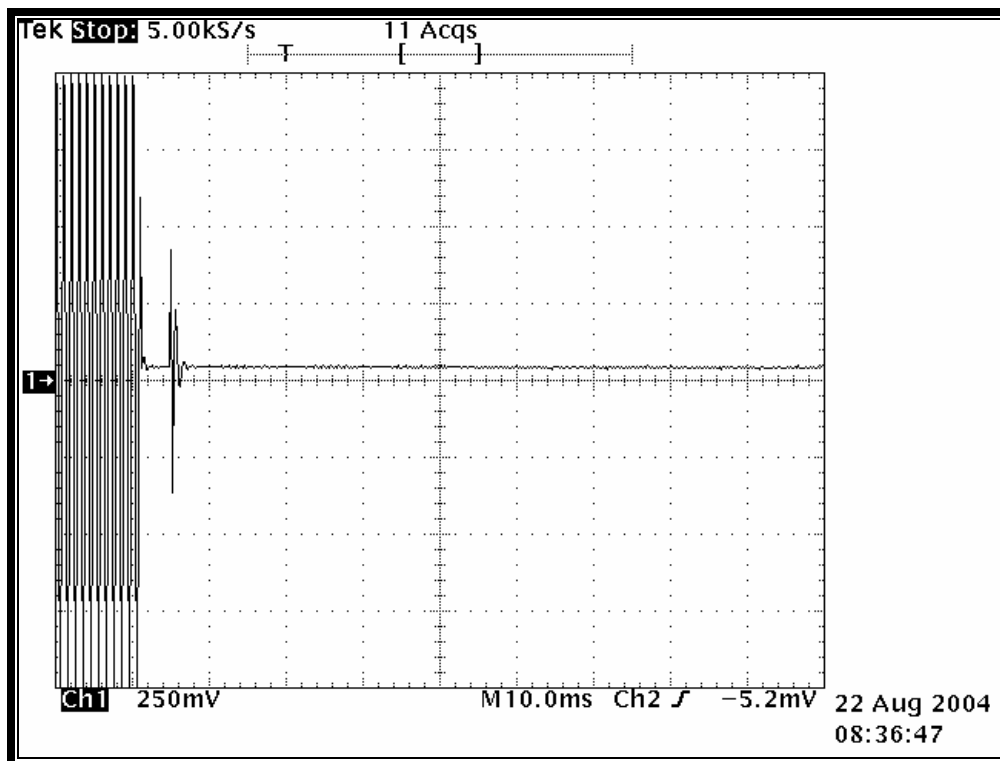
0.39 Div. corresponds to 1.233 kHz

**TABLE 13-3: TRANSIENT FREQUENCY BEHAVIOR TEST EQUIPMENT**

| RTL Asset # | Manufacturer    | Model                 | Part Type                                           | Serial Number | Cal Due Date    |
|-------------|-----------------|-----------------------|-----------------------------------------------------|---------------|-----------------|
| 900917      | Hewlett Packard | 8648C                 | Synthesized Signal Generator<br>(9 kHz To 3200 MHz) | 3537A01741    | 4/19/03         |
| 901055      | Hewlett Packard | 8901A Opt.<br>002-003 | Modulation Analyzer                                 | 2545A04102    | 7/31/02         |
| 900561      | Tektronix       | TDS540A               | Oscilloscope                                        | B020129       | 2/11/03         |
| 900913      | Hewlett Packard | 85462A                | EMI Receiver RF Section,<br>(9 kHz - 6.5 GHz)       | 3325A00159    | 12/5/02         |
| 901214      | Hewlett Packard | HP8471D               | Detector                                            | 2952A19822    | Not<br>Required |

### 13.3 TRANSIENT FREQUENCY BEHAVIOR TEST DATA

PLOT 13-1: ON TIME – CHANNEL 2: 425 MHZ; 12.5 KHZ NARROW BAND



Carrier ON time:  
Power: 5.2 W rated  
Channel 2: 425 MHz NB (12.5 kHz)  
RF Signal Generator: Modulation 12.5 kHz deviation

Timebase: 10 ms/div  
Trigger: On negative edge of Ch 2, level -5.2mV  
Ch 1: 250 mV/div, Probe 1.000:1  
Vertical scale: +/- 4 div. corresponds to +/- 12.5 kHz

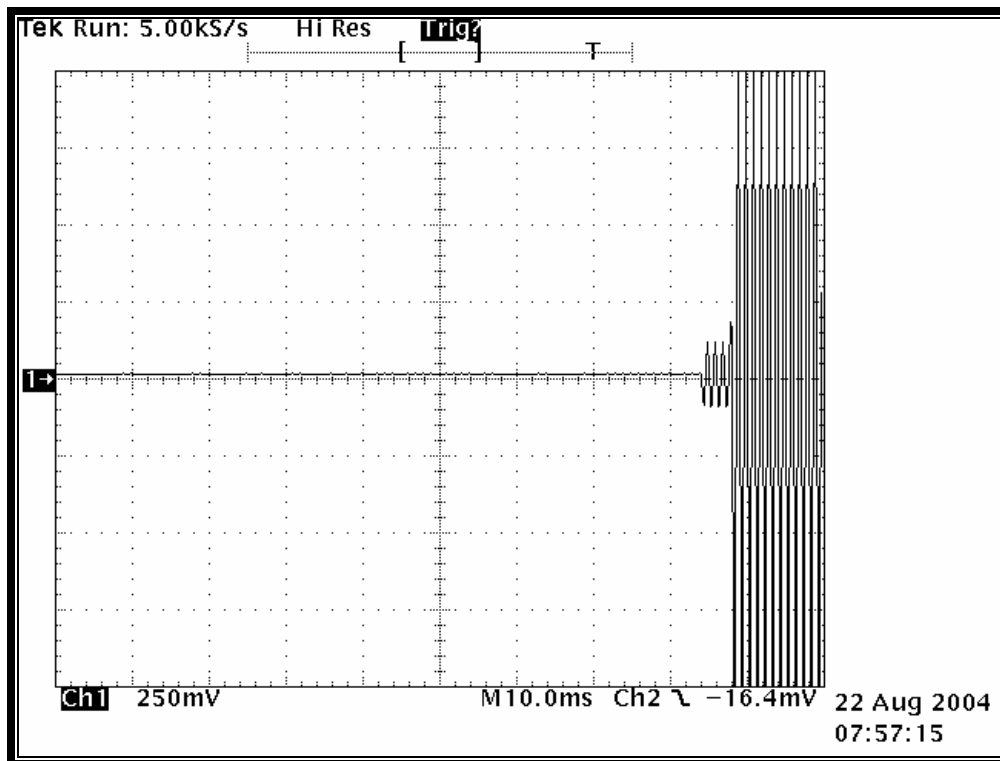
#### TEST PERSONNEL:

DANIEL BALTZELL  
TEST ENGINEER

SIGNATURE

AUGUST 22, 2004  
DATE OF TEST

**PLOT 13-2: OFF TIME – CHANNEL 2: 425 MHZ; 12.5 KHZ NARROW BAND**



Carrier OFF time:  
Power: 5 W rated  
Channel 2: 425 MHz NB (12.5 kHz)  
RF Signal Generator: Modulation 12.5 kHz deviation

Timebase: 10 ms/div  
Trigger: On negative edge of Ch 2, level -16.4 mV  
Ch 1: 250 mV/div, Probe 1.000:1  
Vertical scale: +/- 4 div. corresponds to +/- 12.5 kHz

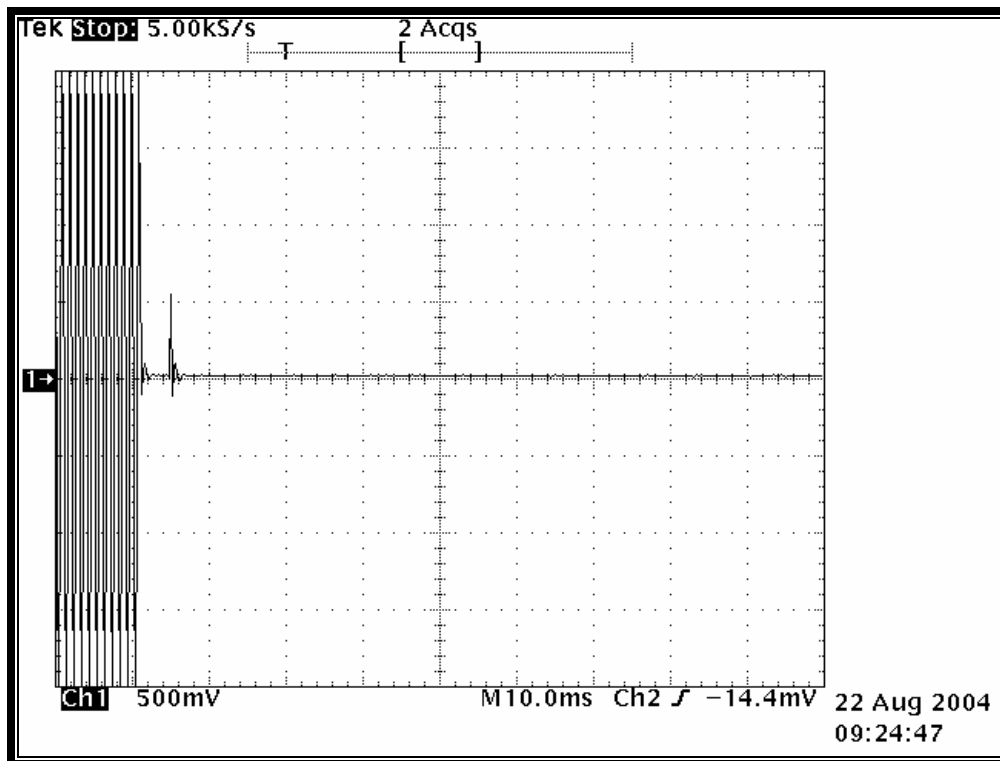
**TEST PERSONNEL:**

DANIEL BALTZELL  
TEST ENGINEER

SIGNATURE

AUGUST 22, 2004  
DATE OF TEST

**PLOT 13-3: ON TIME – CHANNEL 2: 425 MHZ; 25 KHZ WIDE BAND**



Carrier ON time:  
Power: 5 W rated  
Channel 2: 425 MHz WB (25 kHz)  
RF Signal Generator: Modulation 25 kHz deviation

Timebase: 10 ms/div  
Trigger: On negative edge of Ch 2, level -14.4 mV  
Ch 1: 500 mV/div, Probe 1.000:1  
Vertical scale: +/- 4 div. corresponds to +/- 12.5 kHz

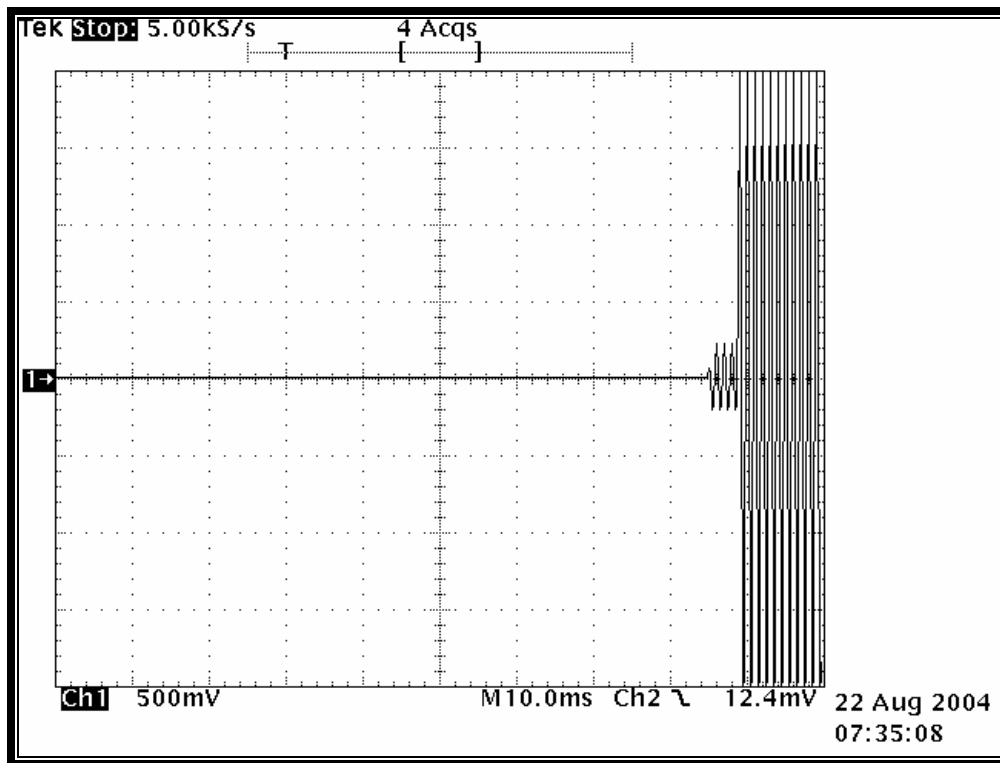
**TEST PERSONNEL:**

DANIEL BALTZELL  
TEST ENGINEER

SIGNATURE

AUGUST 22, 2004  
DATE OF TEST

**PLOT 13-4: OFF TIME – CHANNEL 2: 425 MHZ; 25 KHZ WIDE BAND**



Carrier OFF time:  
Power: 5 W rated  
Channel 2: 425 MHz WB (25 kHz)  
RF Signal Generator: Modulation 25 kHz deviation

Timebase: 10 ms/div  
Trigger: On positive edge of Ch 2, level 12.4 mV  
Ch 1: 500 mV/div, Probe 1.000:1  
Vertical scale: +/- 4 div. corresponds to +/- 12.5 kHz

**TEST PERSONNEL:**

DANIEL BALTZELL  
TEST ENGINEER

SIGNATURE

AUGUST 22, 2004  
DATE OF TEST



## 14 FCC PART 2.202: NECESSARY BANDWIDTH AND EMISSION BANDWIDTH

Type of Emission: F3E and F1E

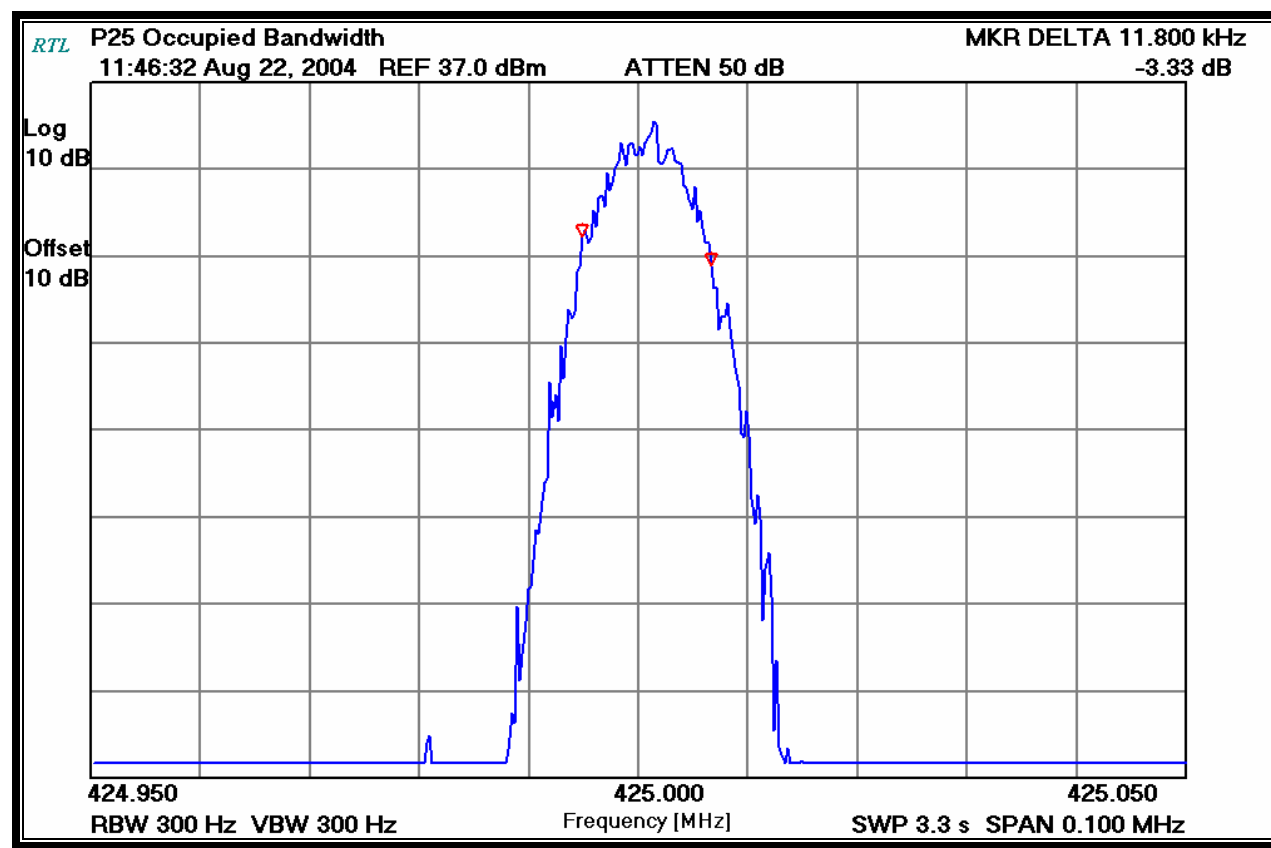
Necessary Bandwidth and Emission Bandwidth calculation

The 25 kHz Analog modulation necessary bandwidth:  $B_n = 16K0F3E$

The measured P25 Digital modulation necessary bandwidth:  $B_n = 11K8F1E$

The 12.5 kHz Analog modulation bandwidth =  $11K0F3E$

**PLOT 14-1: P25 OCCUPIED BANDWIDTH**



Calculation:

Max modulation (M) in kHz: 3

Max deviation (D) in kHz for (25 KHz channel spacing analog): 5

Max deviation for (D) in kHz for (12.5 KHz channel spacing): 2.5

Constant factor (K): 1

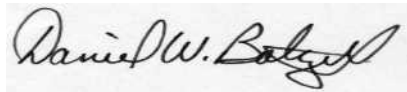
$B_{n(25\text{KHz analog})} = 2 \times M + 2 \times DK = (2 \times 3) + (2 \times 5 \times 1) = 16 \text{ kHz}$

$B_{n(P25 \text{ Digital})} = 11.8 \text{ kHz}$

$B_{n(12.5\text{KHz})} = 2 \times M + 2 \times DK = (2 \times 3) + (2 \times 2.5 \times 1) = 11 \text{ kHz}$

**TEST PERSONNEL:**

DANIEL BALTZELL  
TEST ENGINEER



SIGNATURE

AUGUST 22, 2004  
DATE OF TEST

## 15 CONCLUSION

The data in this measurement report shows that E.F. Johnson Model 242-513x, FCC ID: ATH2425131, complies with all the requirements of Parts 2 and 90 of the FCC Rules and Industry Canada RSS-119.