Engineering and Testing for EMC and Safety Compliance

# CERTIFICATION APPLICATION REPORT
# FCC PART 15.247 CERTIFICATION & INDUSTRY CANADA CERTIFICATION

| Test Lab: | Applicant Information: |
|---|---|
| Rhein Tech Laboratories, Inc.<br>360 Herndon Parkway<br>Suite 1400<br>Herndon, VA 20170 | Phone: 703-689-0368<br>Fax: 703-689-2056<br>Web Site: www.rheintech.com<br>E-Mail : FCCINFO@rheintech.com | Vocollect<br>Contact: Doug Zatezalo<br>701 Rodi Road<br>Pittsburgh, PA 15235 | Phone: 412-829-8145<br>Fax: 412-829-0972<br>E-Mail: dzatezalo@vocollect.com |

| | | | |
|---|---|---|---|
| **FCC ID:** | MQOTT600-22300 | **GRANTEE FRN NUMBER:** | 0007-0735-47 |
| **PLAT FORM:** | N/A | **RTL WORK ORDER NUMBER:** | 2002140 |
| **MODEL(S):** | TT-600 | **RTL QUOTE NUMBER:** | QRTL02-513 |
| **DATE OF TEST REPORT:** | September 5, 2002 | | |

| | |
|---|---|
| **American National Standard Institute:** | ANSI C63.4: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| **FCC Classification:** | DSS – Part 15 Spread Spectrum Transmitter |
| **FCC Rule Part(s):** | Part 15.247: Operation within the bands 920-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz<br>Frequency Hopping System<br>DA000705: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems |
| **Industry Canada Standard:** | RSS-210: Low Power License-Exempt Radio Communication Devices (All Frequency Bands) |
| **Digital Interface Information** | Digital Interface was found to be compliant |
| **Receiver Information** | Receiver was found to be compliant |

| Frequency Range (MHz) | Output Power (W) | Frequency Tolerance | Emission Designator |
|---|---|---|---|
| 2402-2480 | 0.115 | N/A | N/A |

* output power is maximum peak conducted

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 the FCC Part 2, FCC Part 15, Industry Canada RSS-210, ANSI C63.4, and FCC DA 00-705.

Signature: _____ Date: September 5, 2002

Typed/Printed Name: Desmond A. Fraser Position: President

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# 1 GENERAL INFORMATION

## 1.1 SCOPE

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.

IC RSS-210 Section 6.2.2(o): Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.

A direct sequence (DS) system is a spread spectrum (SS) system in which the carrier has been modulated by a high speed spreading code and an information data stream. The high-speed code sequence dominates the "modulating function" and is the direct cause of the wide spreading of the transmitted signal.

## 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 C63.4 1992).

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

This is an original application for Certification for Talkman T2, M/N: TT-600, FCC ID: MQOTT600-22300. The IF, LO and up to the 2$^{nd}$ LO were investigated and tested.

# 2 TEST INFORMATION

## 2.1 TEST JUSTIFICATION

The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. Low channel (2402 MHz), middle channel (2440 MHz), and upper channel (2480 MHz) were tested and investigated from 9 kHz to 24 GHz. Data for all three channels are presented in this report.

The EUT contains an internal dipole antenna. The dipole antenna transmits, receives, and is connected to the internal antenna port.

The worst-case data taken in this report represents the highest data rate at 11 Mbps. Data rates of 5.5 Mbps, 2 Mbps and 1 Mbps were investigated and found to be in compliance. The change in envelope did not cause the EUT to be non-compliant in any of the aforementioned modes.

## 2.2 EXERCISING THE EUT

The EUT was provided with software to continuously transmit during testing. The carrier was also checked to verify that information was being transmitted.

## 2.3 TEST RESULT SUMMARY

### TABLE 2-1: TEST RESULT SUMMARY WITH FCC RULES AND REGULATIONS

| STANDARD | TEST | PASS/FAIL OR N/A |
|---|---|---|
| FCC 15.205 | Compliance with the Restricted Band Edge | Pass |
| FCC 15.207 | Conducted Emissions | Pass |
| FCC 15.209 | Radiated Emissions | Pass |
| FCC 15.247(a)(2) | Modulated Bandwidth | Pass |
| FCC 15.247(b) | Power Output | Pass |
| FCC 15.247(c) | Antenna Conducted Spurious Emissions | Pass |
| FCC 15.247(d) | Power Spectral Density | Pass |

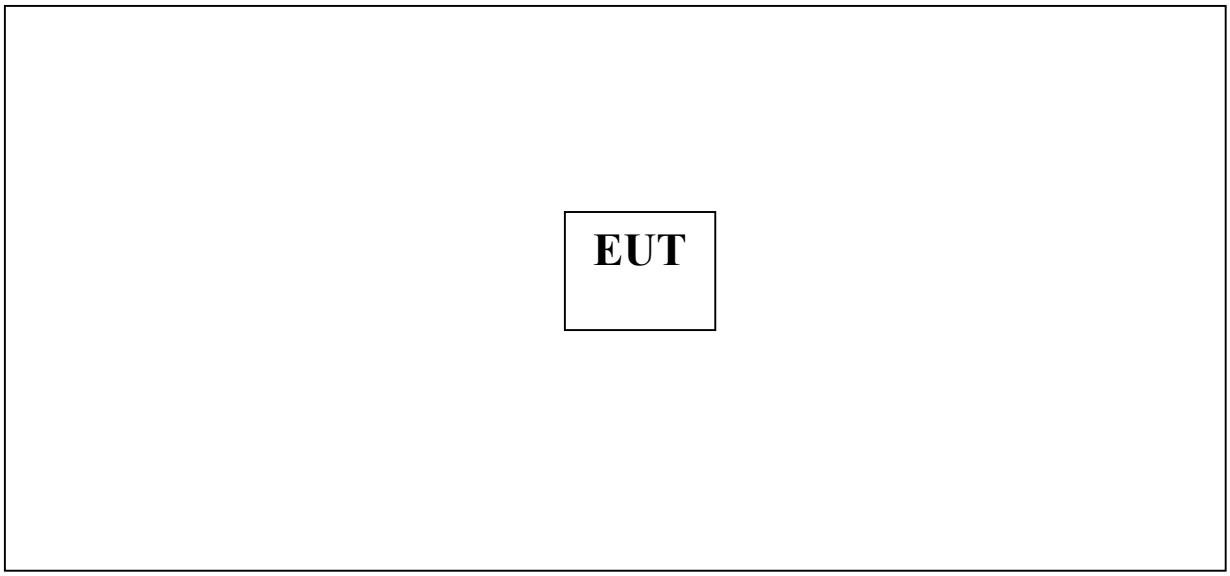
## 2.4 TEST SYSTEM DETAILS

The FCC Identifiers for all equipment, plus descriptions of all cables used in the tested system are:

### TABLE 2-2: EQUIPMENT UNDER TEST (EUT)

| PART | MANUFACTURER | MODEL | SERIAL NUMBER | FCC ID | CABLE DESCRIPTION | RTL BAR CODE |
|---|---|---|---|---|---|---|
| TALKMAN | VOCOLLECT, INC. | T2 | 6114115777 | MQOTT600-22300 | N/A | 014387 |
| BATTERY | VOCOLLECT, INC. | 1500MAH | 0038 | N/A | N/A | 014394 |
| WALL MOUNT CHARGER | VOCOLLECT, INC. | CM-601-1 | 42172872 | N/A | UNSHIELDED | 014547 |
| WIRELESS LAN ADAPTER | SYMBOL TECHNOLOGIES, INC. | LA-3021 | 00A82Y93N | H9PL3021-100 | N/A | 014604 |

## 2.5 CONFIGURATION OF TESTED SYSTEM




### FIGURE 1: WORST CASE CONFIGURATION OF SYSTEM UNDER TEST

# 3 COMPLIANCE WITH THE RESTRICTED BAND EDGE - §15.205

## 3.1 TEST PROCEDURE

Compliance with the band edges was performed using the FCC's "Radiated Measurement at a Band Edge" guidance document. The data taken in this report represents the worst case at 11 Mbps. Data rates of 5.5 Mbps, 2 Mbps and 1 Mbps were investigated and found to be in compliance. The hopping mode was disabled to conduct this test. A conducted plot with the display line referenced –20 dB from peak is also shown.

## 3.2 BAND EDGE TEST EQUIPMENT

## TABLE 3-1: BAND EDGE TEST EQUIPMENT

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 900878 | Rhein Tech Labs | AM3-1197-0005 | 3 meter antenna mast, polarizing | Outdoor Range 1 | N/A |
| 900913 | Hewlett Packard | 85462A | EMI Receiver RF Section, 9 KHz - 6.5 GHz | 3325A00159 | 12/5/02 |
| 900914 | Hewlett Packard | 8546OA | RF Filter Section, 100 KHz to 6.5 GHz | 3330A00107 | 12/5/02 |
| 900814 | Electro-Metrics | EM-6961 (RGA-60) | Double Ridged Guide Antenna 1-18 GHz | 2310 | 2/26/03 |
| 901242 | Rhein Tech Labs | WRT-000-0003 | Wood rotating table | N/A | N/A |
| 901231 | IW Microwave Products | KPS-1503-2400-KPS | High frequency RF cables | 240" | N/A |
| 901235 | IW Microwave Products | KPS-1503-360-KPS | High frequency RF cables | 36" | N/A |
| 900931 | HP | 8566B | Spectrum Analyzer (100Hz – 22 GHz) | 3138A07771 | 5/10/03 |

## 3.3 COMPLIANCE WITH THE RESTRICTED BAND EDGE TEST DATA

Calculation of Lower Band Edge

The level 114.8 dBuV/m is the Peak Field Strength measurement (worst case), from which the delta measurement of 62.5 dB is subtracted (reference plots), which is equivalent to a level of 52.3 dB. This level has a margin of 1.7 dB below the limit of 54 dBuV/m.

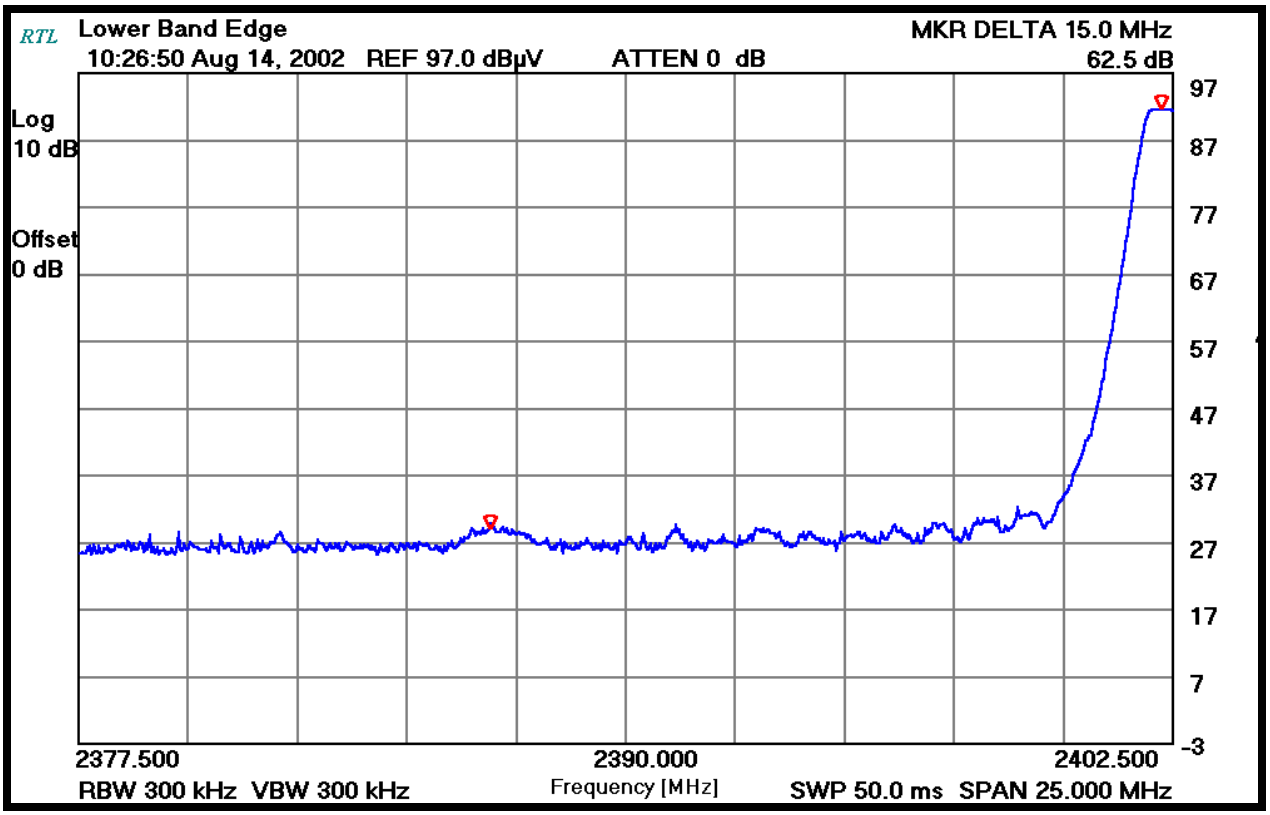
Calculation: 114.8 dBuV/m – 62.5 dB – 54 dBuV/m = -1.7 dB

## 3.4 COMPLIANCE WITH RESTRICTED BAND EDGE PLOTS

**Channel Number:** Lower
**Frequency (MHz):** 2402
**Resolution Bandwidth (kHz):** 300
**Video Bandwidth (kHz):** 300
**Sweep Time (ms):** 50

### PLOT 3-1: LOWER BAND EDGE: RADIATED DELTA MEASUREMENT METHOD

Peak Field Strength (1 MHz/1 MHz) = 114.8 dBuV/m
Average Field Strength (1 MHz/10 Hz) = 114.3 dBuV/m

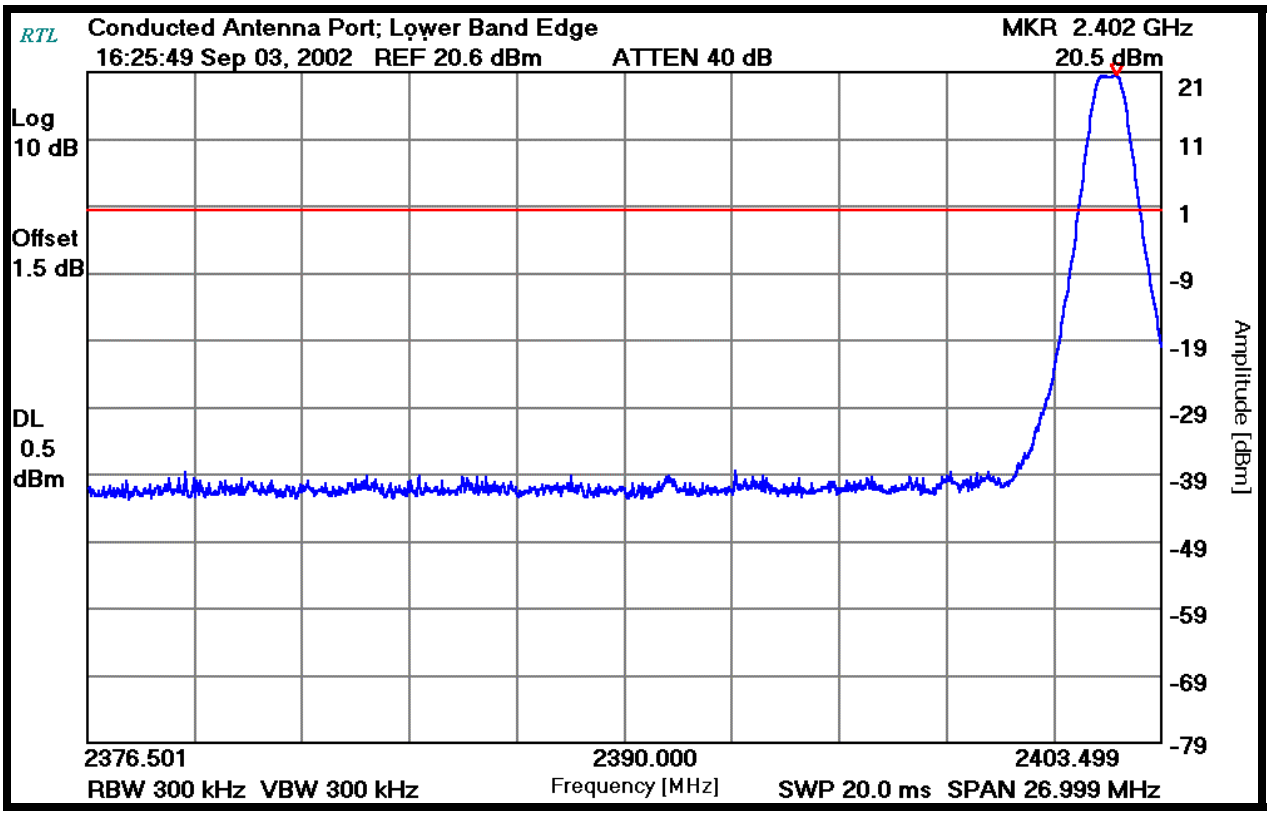



**TEST PERSONNEL:**

| Daniel W. Baltzell | | August 14, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

## PLOT 3-2: LOWER BAND EDGE: CONDUCTED MEASUREMENT

Conducted Power = 20.6 dBm




**TEST PERSONNEL:**

| Daniel W. Baltzell | | September 3, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

Calculation of Upper Band Edge

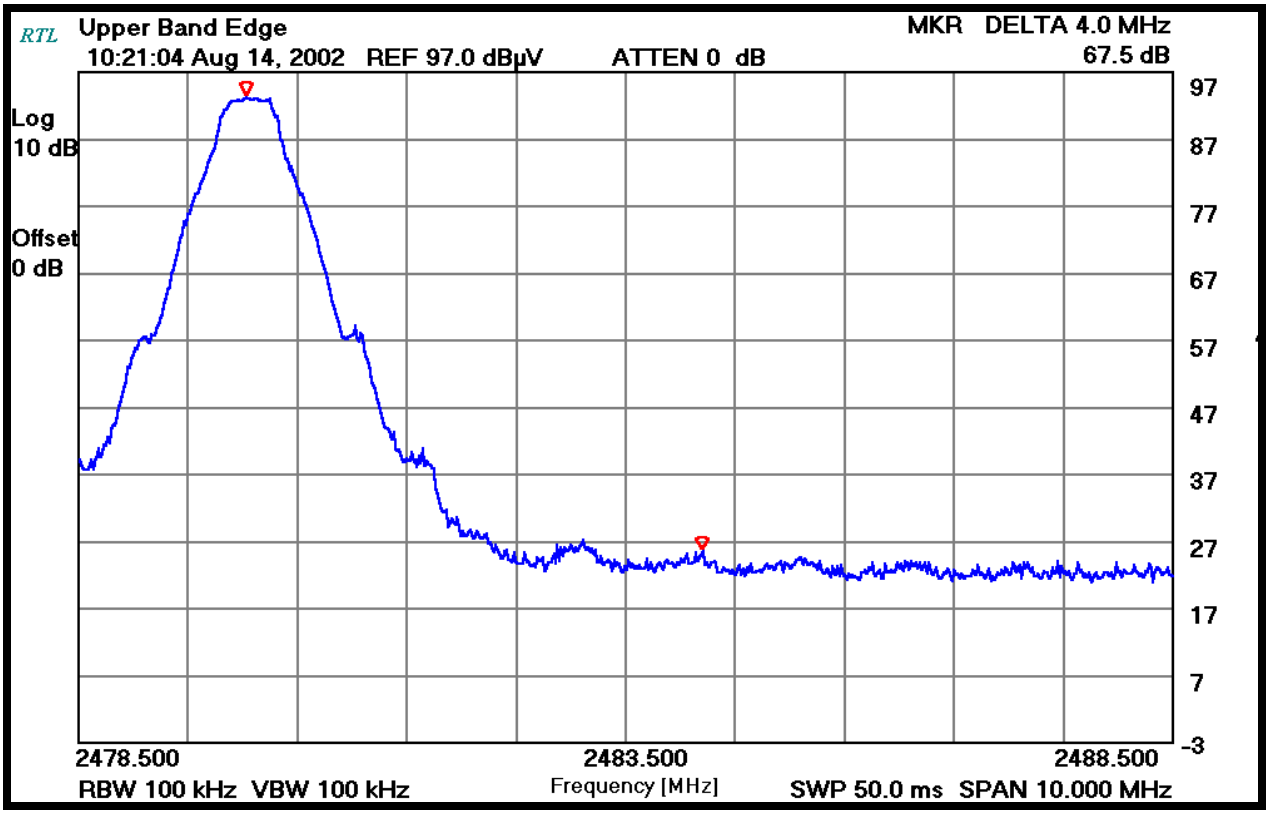
The level 116.2 dBuV/m is the Peak Field Strength measurement (worst case), from which the delta measurement of 67.5 dB is subtracted (reference plots), which is equivalent to a level of 48.7 dB. This level has a margin of 5.3 dB below the limit of 54 dBuV/m.

Calculation: 116.2 dBuV/m – 67.5 dB – 54 dBuV/m = -5.3 dB

| | |
|---|---|
| **Channel:** | Upper |
| **Frequency (MHz):** | 2480 |
| **Resolution Bandwidth (kHz):** | 100 |
| **Video Bandwidth (kHz):** | 100 |
| **Sweep Time (ms.):** | 50.0 |

**PLOT 3-3: UPPER BAND EDGE: RADIATED DELTA MEASUREMENT METHOD**

Peak Field Strength (1 MHz/1 MHz) = 116.2 dBuV/m
Average Field Strength (1 MHz/10 Hz) = 115.7 dBuV/m

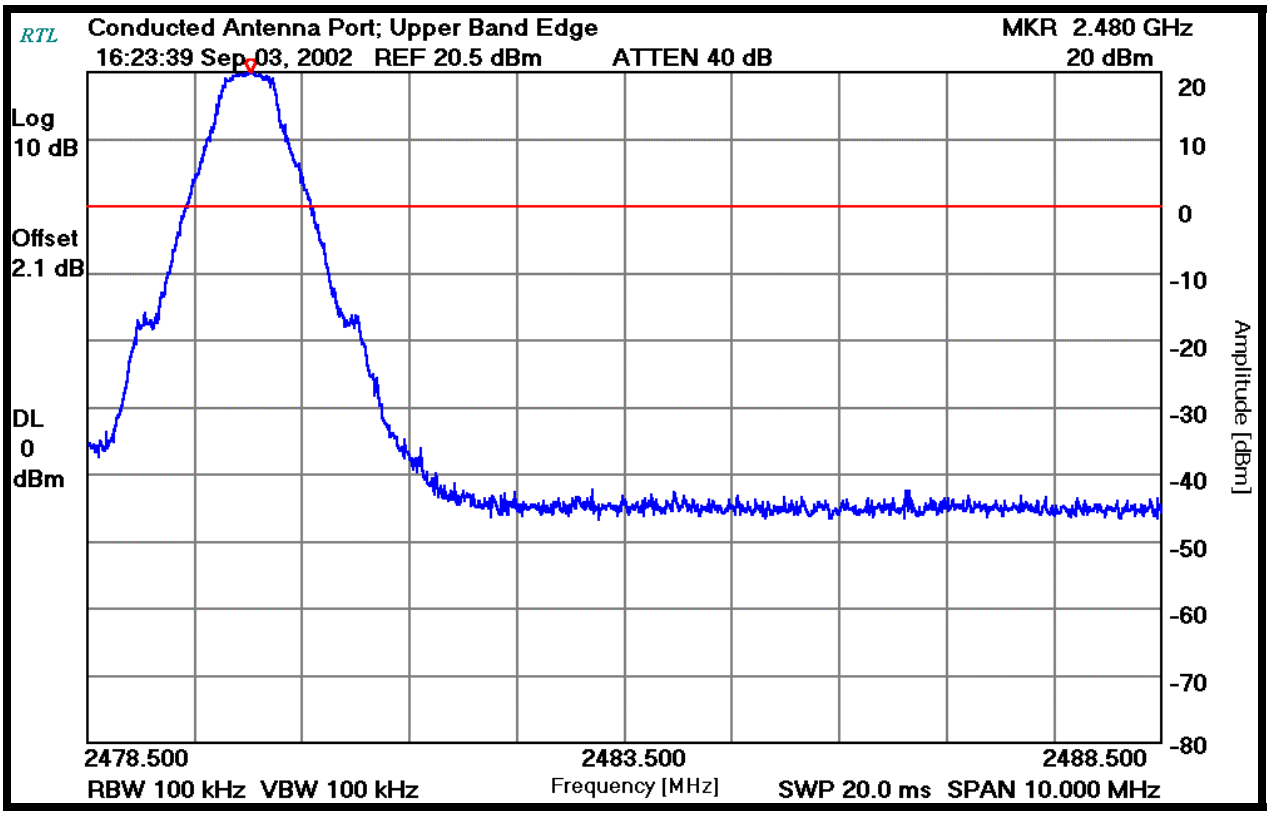



**TEST PERSONNEL:**

| Daniel W. Baltzell | | August 14, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

## PLOT 3-4: UPPER BAND EDGE: CONDUCTED MEASUREMENT

Conducted Power = 20.5 dBm




**TEST PERSONNEL:**

| Daniel W. Baltzell | | September 3, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

# 4 CONDUCTED LIMITS - §15.207

## 4.1 TEST METHODOLOGY FOR CONDUCTED LINE EMISSIONS MEASUREMENTS

The power line conducted emission measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 centimeters high. Power was fed to the EUT through a 50 ohm / 50 micro Henry Line Impedance Stabilization Network (EUT LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed A.C. power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the A.C. line through an isolation transformer. The 50-ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar 400 kHz high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 400 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable). The analyzer's 6 dB bandwidth was set to 9 kHz. No video filter less than 10 times the resolution bandwidth was used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, and by increasing the sweep time in order to obtain a calibrated measurement. The emission spectrum was scanned from (150/450) kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limit were measured and have been recorded in this report.

*Note: Rhein Tech Laboratories, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the Rhein Tech quality manual, section 6.1. Rhein Tech implements the following procedures to minimize errors that may occur: yearly as well as daily calibration methods, technician training, and emphasis to employees on avoiding error.*

## 4.2 CONDUCTED LINE EMISSION TEST

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. If the conducted emissions exceed the limit with the instrument set to the quasi-peak mode, then measurements are made in the average mode. If the quasi-peak measurement is at least 6dB higher than the amplitude in the average mode, the level measured in the quasi-peak mode may be reduced by 13dB before comparing it to the limit.

The conducted test was performed with the EUT exercise program loaded, and the emissions were scanned between 450 kHz to 30 MHz on the NEUTRAL SIDE and PHASE SIDE.

## 4.3 CONDUCTED LINE TEST EQUIPMENT

### TABLE 4-1: CONDUCTED LINE TEST EQUIPMENT

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 900931 | HP | 8566B | Spectrum Analyzer (100 Hz - 22 GHz) | 3138A07771 | 5/10/03 |
| 901084 | AFJ international | LS16 | 16A LISN | 16010020082 | 9/5/03 |

## 4.4 CONDUCTED LINE EMISSION TEST DATA

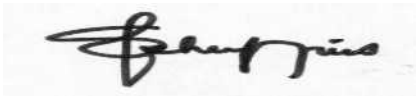
### TABLE 4-2: CONDUCTED EMISSIONS (NEUTRAL SIDE)

| Emission Frequency (MHz) | Test Detector | Analyzer Reading (dBuV) | Site Correction Factor (dB) | Emission Level (dBuV) | Limit (dBuV) | Margin (dBuV) |
|---|---|---|---|---|---|---|
| 0.787 | Pk | 30.6 | 0.7 | 31.3 | 48.0 | -16.7 |
| 2.236 | Pk | 33.6 | 1.2 | 34.8 | 48.0 | -13.2 |
| 2.608 | Pk | 35.2 | 1.3 | 36.5 | 48.0 | -11.5 |
| 5.075 | Pk | 33.4 | 1.6 | 35.0 | 48.0 | -13.0 |
| 10.150 | Pk | 32.9 | 2.1 | 35.0 | 48.0 | -13.0 |
| 20.580 | Pk | 22.9 | 3.2 | 26.1 | 48.0 | -21.9 |

### TABLE 4-3: CONDUCTED EMISSIONS (PHASE SIDE)

| Emission Frequency (MHz) | Test Detector | Analyzer Reading (dBuV) | Site Correction Factor (dB) | Emission Level (dBuV) | Limit (dBuV) | Margin (dBuV) |
|---|---|---|---|---|---|---|
| 0.578 | Pk | 30.3 | 0.7 | 31.0 | 48.0 | -17.0 |
| 1.088 | Pk | 30.4 | 0.7 | 31.1 | 48.0 | -16.9 |
| 2.344 | Pk | 33.1 | 1.2 | 34.3 | 48.0 | -13.7 |
| 3.600 | Pk | 35.0 | 1.4 | 36.4 | 48.0 | -11.6 |
| 5.120 | Pk | 29.6 | 1.7 | 31.3 | 48.0 | -16.7 |
| 18.460 | Pk | 29.1 | 3.0 | 32.1 | 48.0 | -15.9 |

**TEST PERSONNEL:**



| Franck Schuppius | | July 15, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

# 5 RADIATED EMISSION LIMITS RECEIVER/DIGITAL INTERFACE - §15.209

## 5.1 RECEIVER/DIGITAL INTERFACE RADIATED EMISSION LIMITS TEST PROCEDURE

Emissions apply to spurious emissions that fall in the restricted and non-restricted bands. The restricted bands are listed in Part 15.205. The maximum permitted average field strength for the restricted band is listed in Part 15.209. The IF, LO and up to the 2nd LO were investigated and tested. The lower, middle, and upper channels were tested and investigated in the transmitting and receiving mode between 10kHz and 1GHz.

## 5.2 RECEIVER/DIGITAL INTERFACE RADIATED EMISSIONS TEST EQUIPMENT

### TABLE 5-1: RECEIVER/DIGITAL INTERFACE RADIATED EMISSIONS TEST EQUIPMENT

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 900878 | Rhein Tech Labs | AM3-1197-0005 | 3 meter antenna mast, polarizing | Outdoor Range 1 | N/A |
| 900889 | Hewlett Packard | 85685A | RF Preselector for HP 8566B or 8568B (20Hz-2GHz) | 3146A01309 | 11/21/02 |
| 900905 | RTL | PR-1040 | Amplifier | 900905 | N/A |
| 900931 | HP | 8566B | Spectrum Analyzer (100 Hz - 22 GHz) | 3138A07771 | 5/10/03 |
| 900969 | Hewlett Packard | 85650A | Quasi-Peak Adapter | 2412A00414 | 5/10/03 |
| 901053 | Schaffner Chase | CBL6112B | Bi-Log Antenna (20 MHz - 2 GHz) | 2648 | 5/22/03 |
| 901242 | Rhein Tech Labs | WRT-000-0003 | Wood rotating table | N/A | N/A |

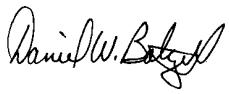
## 5.3 RECEIVER/DIGITAL INTERFACE RADIATED EMISSION LIMITS TEST DATA

### TABLE 5-2: RECEIVER/DIGITAL INTERFACE RADIATED EMISSIONS

| Temperature: 84°F Humidity: 74% | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Emission Frequency (MHz)** | **Test Detector** | **Antenna Polarity (H/V)** | **Turntable Azimuth (deg)** | **Antenna Height (m)** | **Analyzer Reading (dBuV)** | **Site Correction Factor (dB/m)** | **Emission Level (dBuV/m)** | **Limit (dBuV/m)** | **Margin (dB)** |
| 103.233 | Qp | V | 0 | 1.0 | 35.2 | -12.1 | 23.1 | 43.5 | -20.4 |
| 206.470 | Qp | H | 0 | 1.0 | 41.1 | -11.4 | 29.7 | 43.5 | -13.8 |
| 309.699 | Qp | V | 180 | 1.4 | 41.0 | -6.6 | 34.4 | 46.0 | -11.6 |
| 412.940 | Qp | H | 0 | 1.0 | 38.0 | -2.5 | 35.5 | 46.0 | -10.5 |
| 516.166 | Qp | H | 0 | 1.0 | 35.9 | 0.6 | 36.5 | 46.0 | -9.5 |
| 619.401 | Qp | H | 0 | 1.0 | 36.0 | 2.7 | 38.7 | 46.0 | -7.3 |
| 722.636 | Qp | H | 0 | 1.0 | 35.2 | 5.2 | 40.4 | 46.0 | -5.6 |

QP: RES. =100 KHZ, VID= 100 KHZ

**TEST PERSONNEL:**



| Daniel W. Baltzell | | July 16, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

# 6 RADIATED EMISSION LIMITS; SPURIOUS AND HARMONICS - §15.247

## 6.1 RADIATED SPURIOUS EMISSION LIMITS TEST PROCEDURE

Radiated Spurious Emissions applies to harmonics and spurious emissions that fall in the restricted and non-restricted bands. The restricted bands are listed in Part 15.205. The maximum permitted average field strength for the restricted band is listed in Part 15.209. The EUT was tested in the X-Y, X-Z and Y-Z orthogonal planes.

## 6.2 RADIATED SPURIOUS TEST EQUIPMENT

### TABLE 6-1: RADIATED SPURIOUS EMISSIONS TEST EQUIPMENT

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 900772 | EMCO | 3161-02 | Horn Antenna | 9804-1044 | N/A |
| 900321 | EMCO | 3161-03 | Horn Antennas (4-8,2GHz) | 9508-1020 | N/A |
| 900323 | EMCO | 3160-7 | Horn Antennas (8,2-12.4 GHz) | 9605-1054 | N/A |
| 900356 | EMCO | 3160-08 | Horn Antennas (12.4 – 18 GHz) | 9607-1044 | N/A |
| 900325 | EMCO | 3160-9 | Horn Antennas (18 - 26.5 GHz) | 9605-1051 | N/A |
| 900814 | Electro-Metrics | EM-6961 (RGA-60) | Double Ridged Guide Antenna 1-18 GHz | 2310 | 2/26/03 |
| 900878 | Rhein Tech Labs | AM3-1197-0005 | 3 meter antenna mast, polarizing | Outdoor Range 1 | N/A |
| 900889 | Hewlett Packard | 85685A | RF Preselector for HP 8566B or 8568B (20Hz-2GHz) | 3146A01309 | 11/21/02 |
| 900905 | RTL | PR-1040 | Amplifier | 900905 | N/A |
| 900931 | Hewlett Packard | 8566B | Spectrum Analyzer | 3138A07771 | 5/10/03 |
| 900666 | Hewlett Packard | 8449B | Microwave Preamplifier, 1 to 26.5 GHz | 3008A00505 | N/A |
| 900969 | Hewlett Packard | 85650A | Quasi-Peak Adapter | 2412A00414 | 5/10/03 |
| 901242 | Rhein Tech Labs | WRT-000-0003 | Wood rotating table | N/A | N/A |

## 6.3 RADIATED EMISSIONS HARMONICS/SPURIOUS TEST DATA

**Operating Frequency (MHz):** 2402
**Channel:** Low

### TABLE 6-2: RADIATED EMISSIONS HARMONICS/SPURIOUS (LOW CHANNEL; 2402 MHZ)

| Emission Frequency (MHz) | Peak Test Detector (dBuV) | Average Test Detector (dBuV) | Site Correction Factor (dB/m) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 4804.00 | 46.7 | 37.0 | 15.0 | 52.0 | 54.0 | -2.0 |
| 12010.00 | 22.7 | 14.2 | 16.7 | 30.9 | 54.0 | -23.1 |

Peak: Res. =1 MHz, VID= 1MHz; Average: Res. =1 MHz, VID= 10Hz

**TEST PERSONNEL:**

| Daniel W. Baltzell | | July 18, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

**Operating Frequency (MHz):** 2440
**Channel:** Middle

## TABLE 6-3: RADIATED EMISSIONS HARMONICS/SPURIOUS (MIDDLE CHANNEL; 2440 MHZ)

| Emission Frequency (MHz) | Peak Test Detector (dBuV) | Average Test Detector (dBuV) | Site Correction Factor (dB/m) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 4880.00 | 43.0 | 30.2 | 14.8 | 45.0 | 54.0 | -9.0 |
| 7320.00 | 37.7 | 36.8 | 11.5 | 48.2 | 54.0 | -5.8 |
| 12200.00 | 25.4 | 16.8 | 16.6 | 33.4 | 54.0 | -20.6 |

PEAK: RES. =1 MHZ, VID= 1MHZ; AVERAGE: RES. =1 MHZ, VID= 10HZ

**TEST PERSONNEL:**

| Daniel W. Baltzell | | July 18, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

**Operating Frequency (MHz):** 2480
**Channel:** Upper

## TABLE 6-4: RADIATED EMISSIONS HARMONICS/SPURIOUS (UPPER CHANNEL; 2480 MHZ)

| Emission Frequency (MHz) | Peak Test Detector (dBuV) | Average Test Detector (dBuV) | Site Correction Factor (dB/m) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 4960.00 | 41.7 | 30.8 | 14.1 | 45.0 | 54.0 | -9.0 |
| 7440.00 | 46.0 | 36.0 | 11.5 | 47.5 | 54.0 | -6.5 |
| 12400.00 | 25.4 | 16.8 | 16.6 | 33.4 | 54.0 | -20.6 |

PEAK RES. = 1 MHZ, VID= 1 MHZ; AVERAGE: RES. =1 MHZ, VID= 10HZ

**TEST PERSONNEL:**

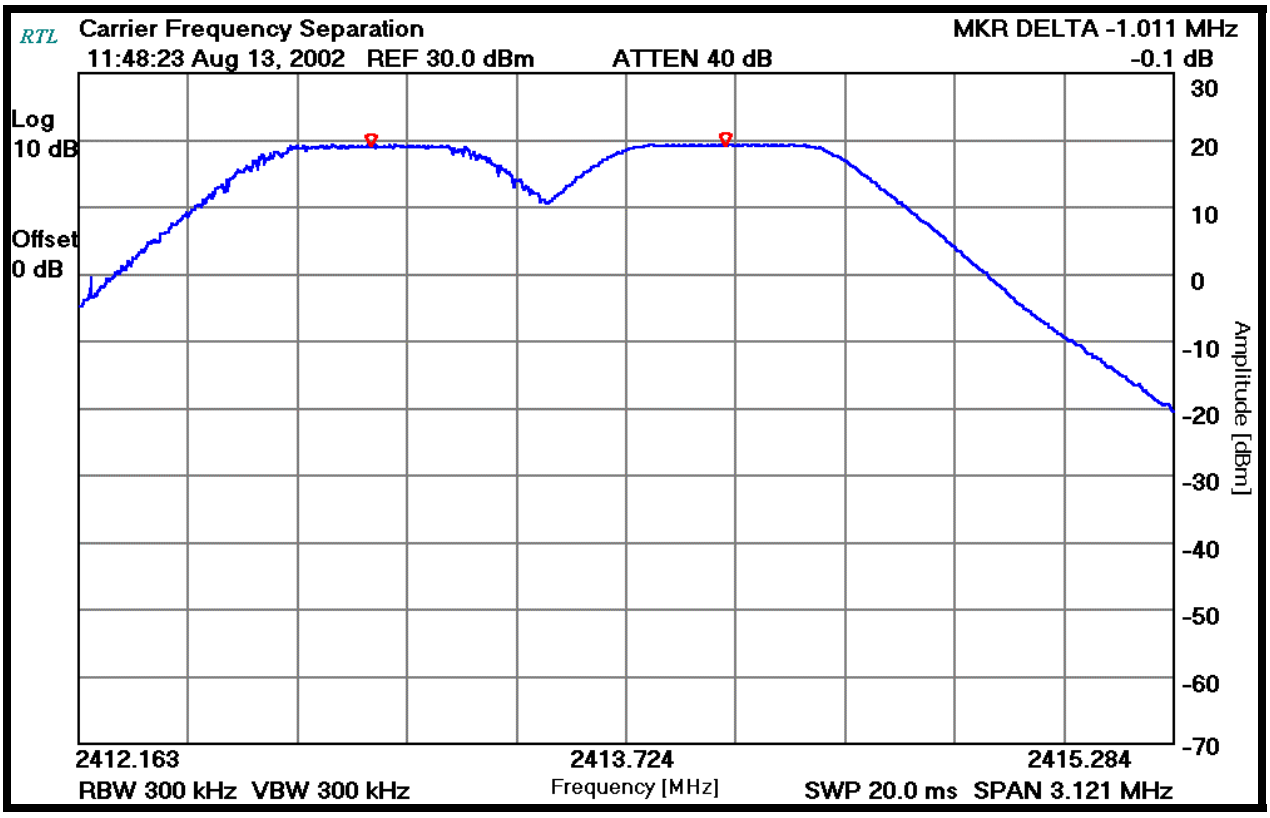
| Daniel W. Baltzell | | July 18, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

# 7 CARRIER FREQUENCY SEPARATION - §15.247 (A)(1)

Frequency Hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Measured frequency separation = 1.011 MHz

## PLOT 7-1: CARRIER FREQUENCY SEPARATION




**TEST PERSONNEL:**

| Daniel W. Baltzell | | August 13, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

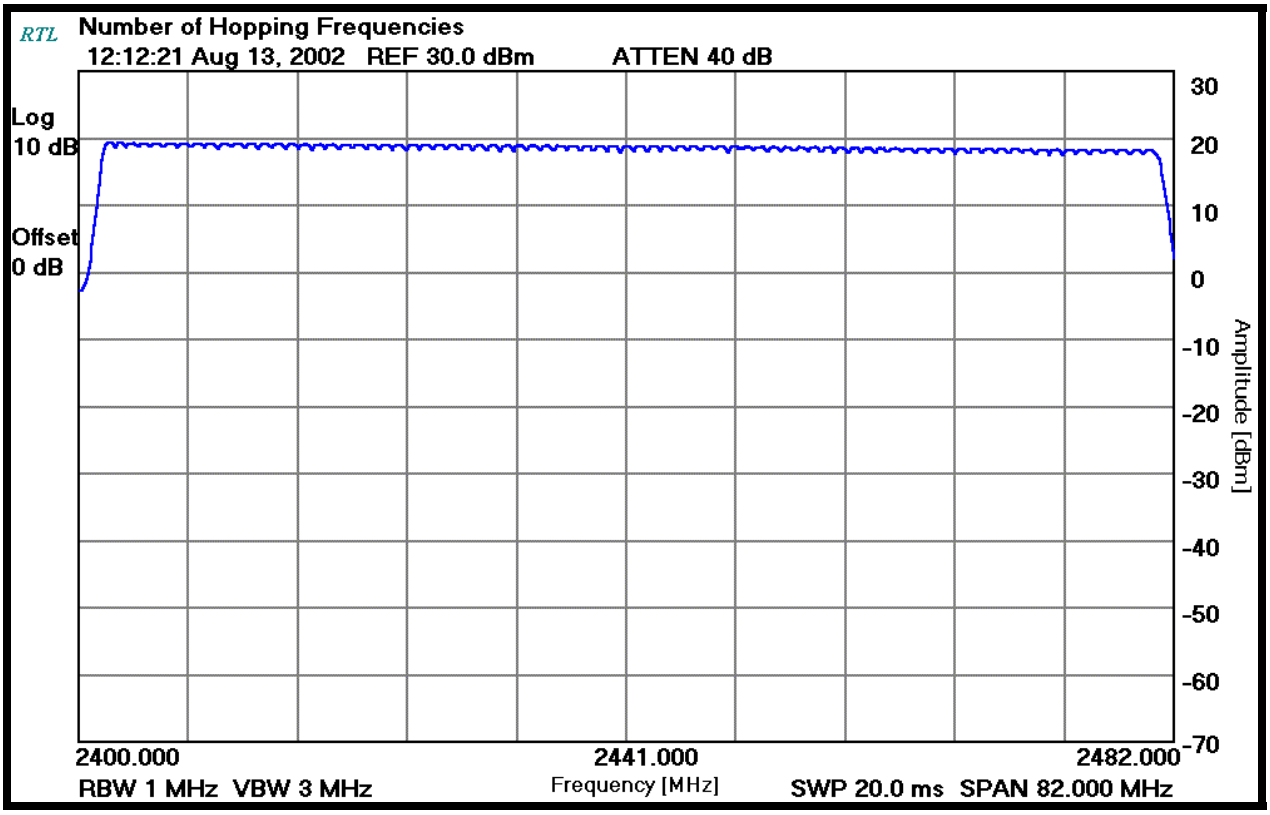
# 8 HOPPING CHARACTERISTICS - §15.247 (A)(1)(II)

Frequency hopping systems operating in the 2400–2483.5 MHz and 5725–5850 MHz bands shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

## 8.1 NUMBER OF HOPPING FREQUENCIES

Measured number of hopping frequencies = 79

**PLOT 8-1: NUMBER OF HOPPING FREQUENCIES**




**TEST PERSONNEL:**

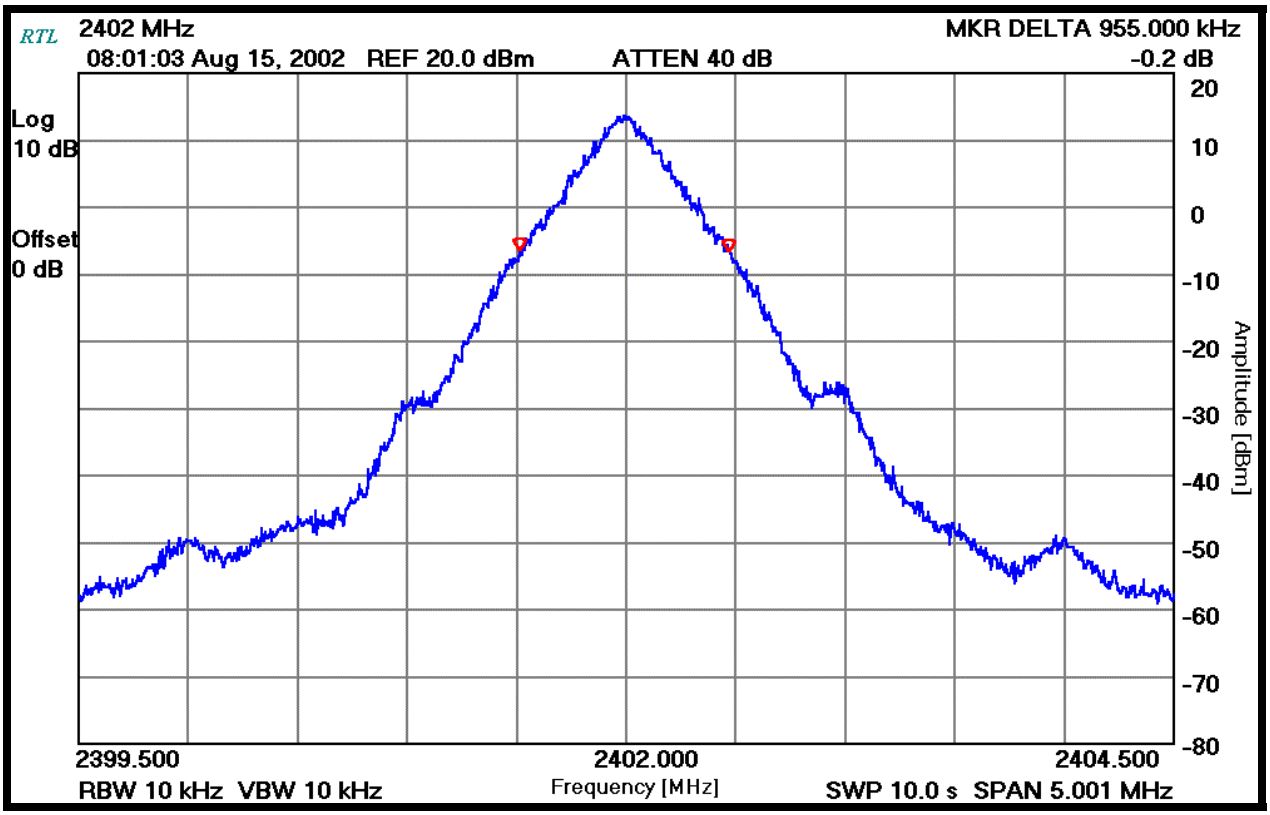
| Daniel W. Baltzell | | August 13, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

## 8.2 20 DB BANDWIDTH TEST DATA

### TABLE 8-1: 20 DB BANDWIDTH TEST DATA

| CHANNEL | 20 dB BANDWIDTH (kHz) |
|---|---|
| Low | 955 |
| Middle | 960 |
| High | 920 |

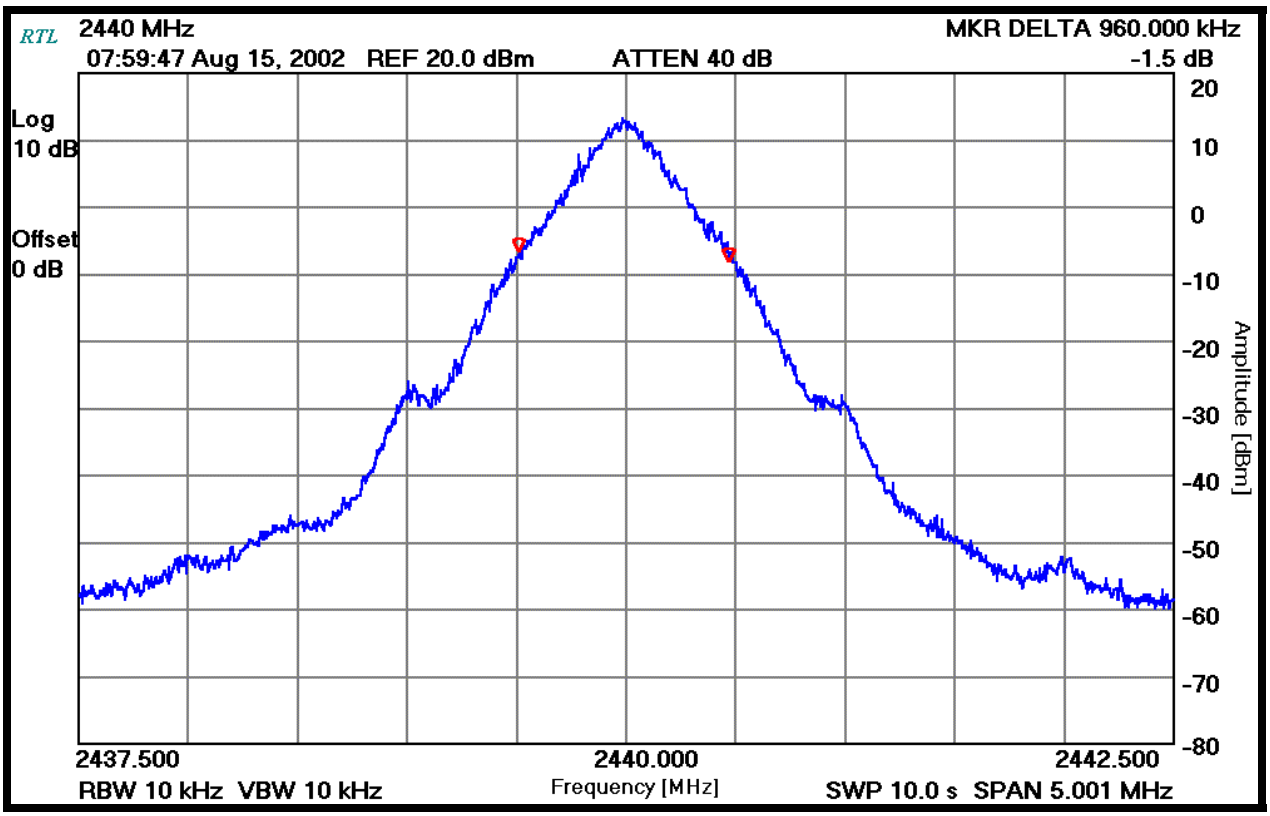
### PLOT 8-2: 20 DB BANDWIDTH – LOW CHANNEL (2402 MHZ)




**TEST PERSONNEL:**

| Daniel W. Baltzell | | August 15, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

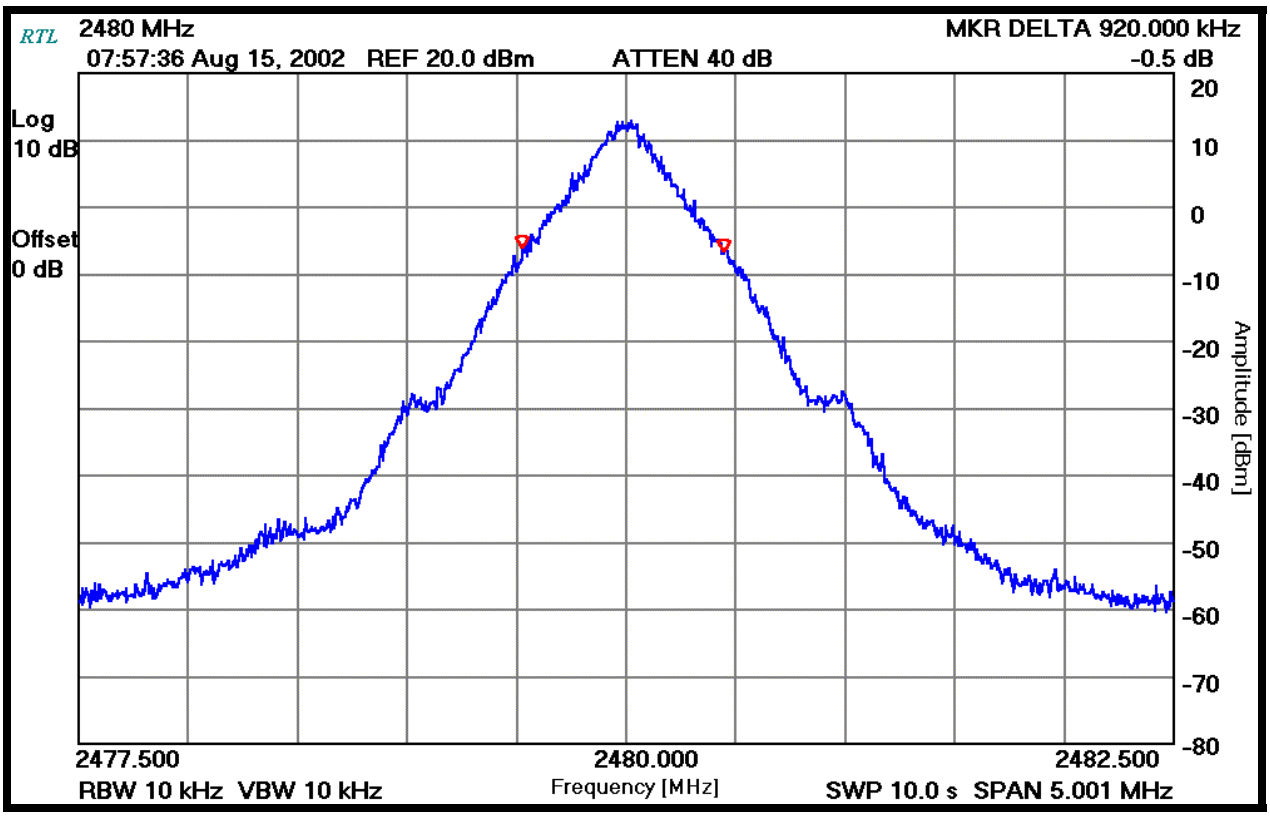
## PLOT 8-3: 20 DB BANDWIDTH – MIDDLE CHANNEL (2440 MHZ)




**TEST PERSONNEL:**

| Daniel W. Baltzell | | August 15, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

## PLOT 8-4: 20 DB BANDWIDTH – UPPER CHANNEL (2480 MHZ)




**TEST PERSONNEL:**

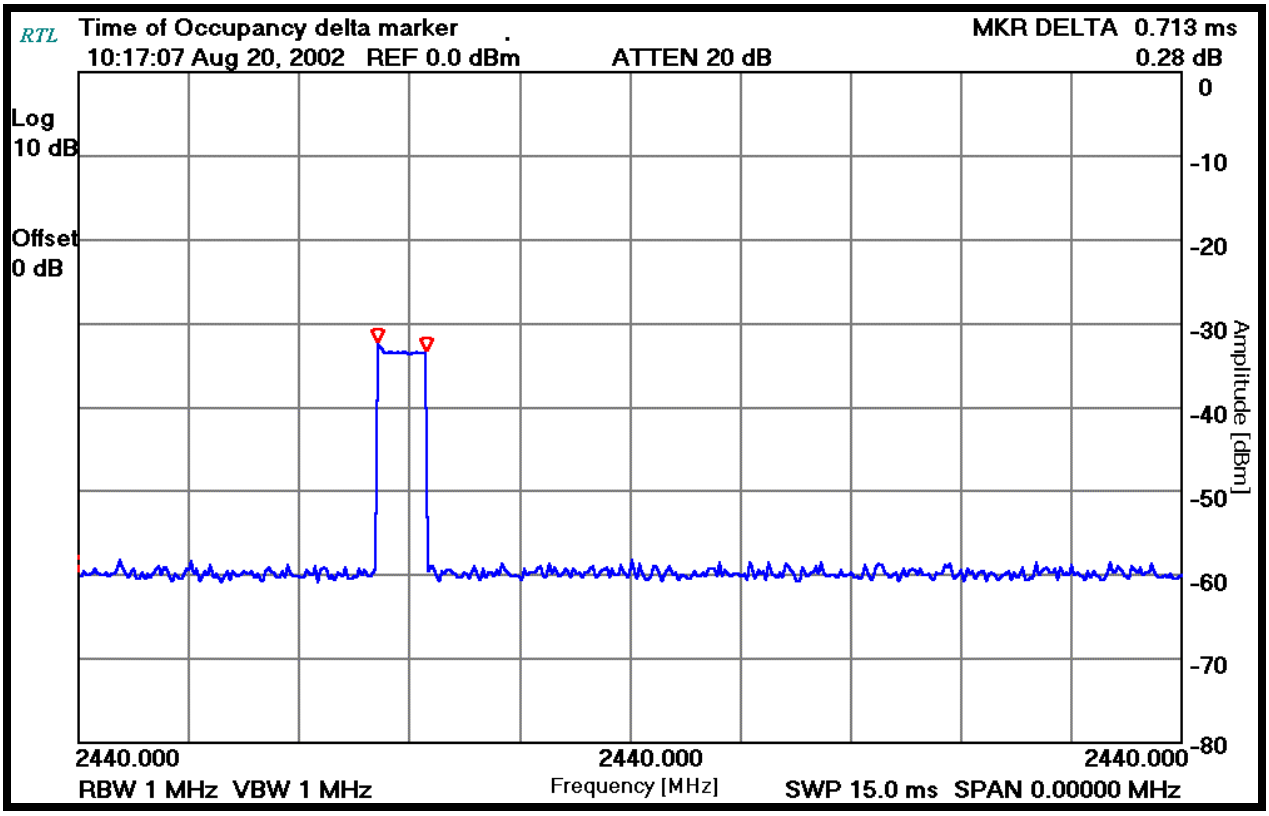
| Daniel W. Baltzell | | August 15, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

## 8.3 AVERAGE TIME OF OCCUPANCY

The spectrum analyzer sweep was set to 0.015 second, with a zero span and max hold until a pulse from the device under test was captured. A marker delta was used to measure dwell time for this plot. The sweep was then set to single sweep for 30 seconds for the required average time and the number of pulses counted to calculate the average time of occupancy as:

Number of pulses in 30 seconds (22) X Dwell Time measured (0.713 milliseconds) = 15.7 ms average occupancy in 30 seconds.

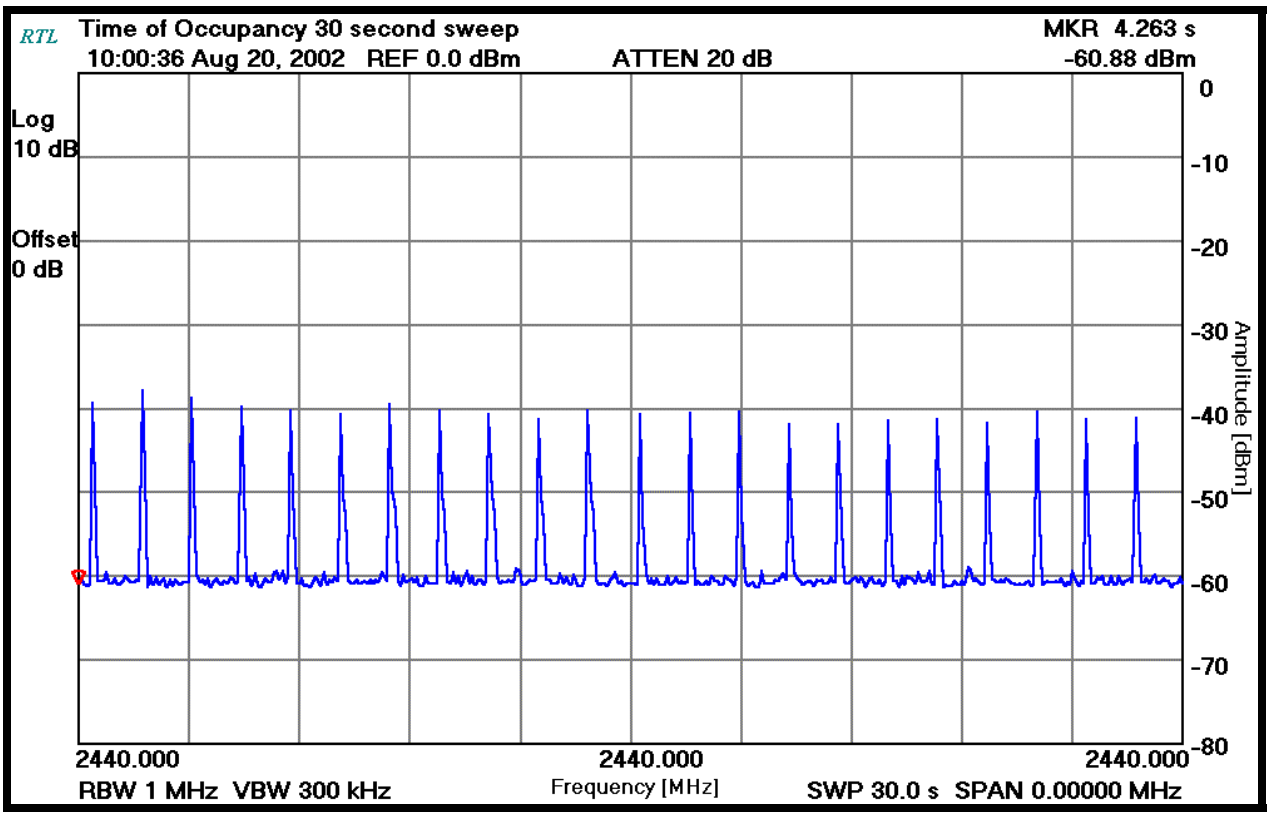
## PLOT 8-5: TIME OF OCCUPANCY (DWELL TIME)




**TEST PERSONNEL:**

| Daniel W. Baltzell | | August 20, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

## PLOT 8-6: TIME OF OCCUPANCY (DWELL TIME 30 SECOND SWEEP)




**TEST PERSONNEL:**

| Daniel W. Baltzell | | August 20, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

# 9 MODULATED BANDWIDTH - §15.247(A)(2)

## 9.1 MODULATED BANDWIDTH TEST PROCEDURE – MINIMUM 6 DB BANDWIDTH

The minimum 6 dB bandwidths per FCC 15.247 (a)(2) were measured using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 300 kHz. The device was modulated using the maximum 11Mbps data rate. The minimum 6 dB bandwidths are as follows:

## 9.2 BANDWIDTH TEST EQUIPMENT

### TABLE 9-1: BANDWIDTH TEST EQUIPMENT

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 900931 | HP | 8566B | Spectrum Analyzer (100Hz – 22 GHz) | 3138A07771 | 5/10/03 |

## 9.3 BANDWIDTH TEST DATA

### TABLE 9-2: MINIMUM 6 DB BANDWIDTH TEST DATA

| CHANNEL | 6 dB BANDWIDTH (kHz) |
|---|---|
| Low | 585 |
| Middle | 585 |
| High | 582 |

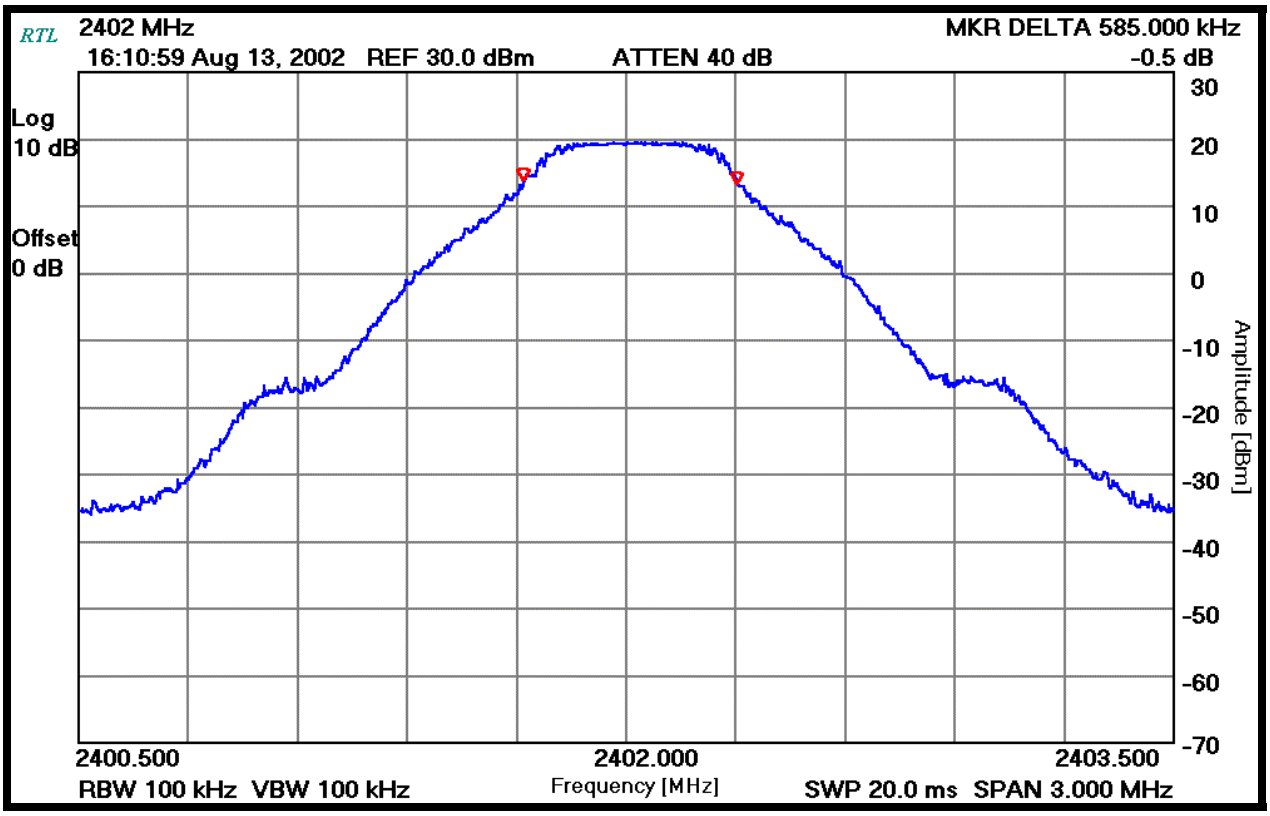
**TEST PERSONNEL:**

| Daniel W. Baltzell | | August 5, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

## 9.4 MODULATED BANDWIDTH PLOTS

**Channel Number:** Lower
**Frequency (MHz):** 2402
**Resolution Bandwidth (kHz):** 100
**Video Bandwidth (kHz):** 100
**Sweep Time (ms):** 20

### PLOT 9-1: MODULATED BANDWIDTH LOWER CHANNEL

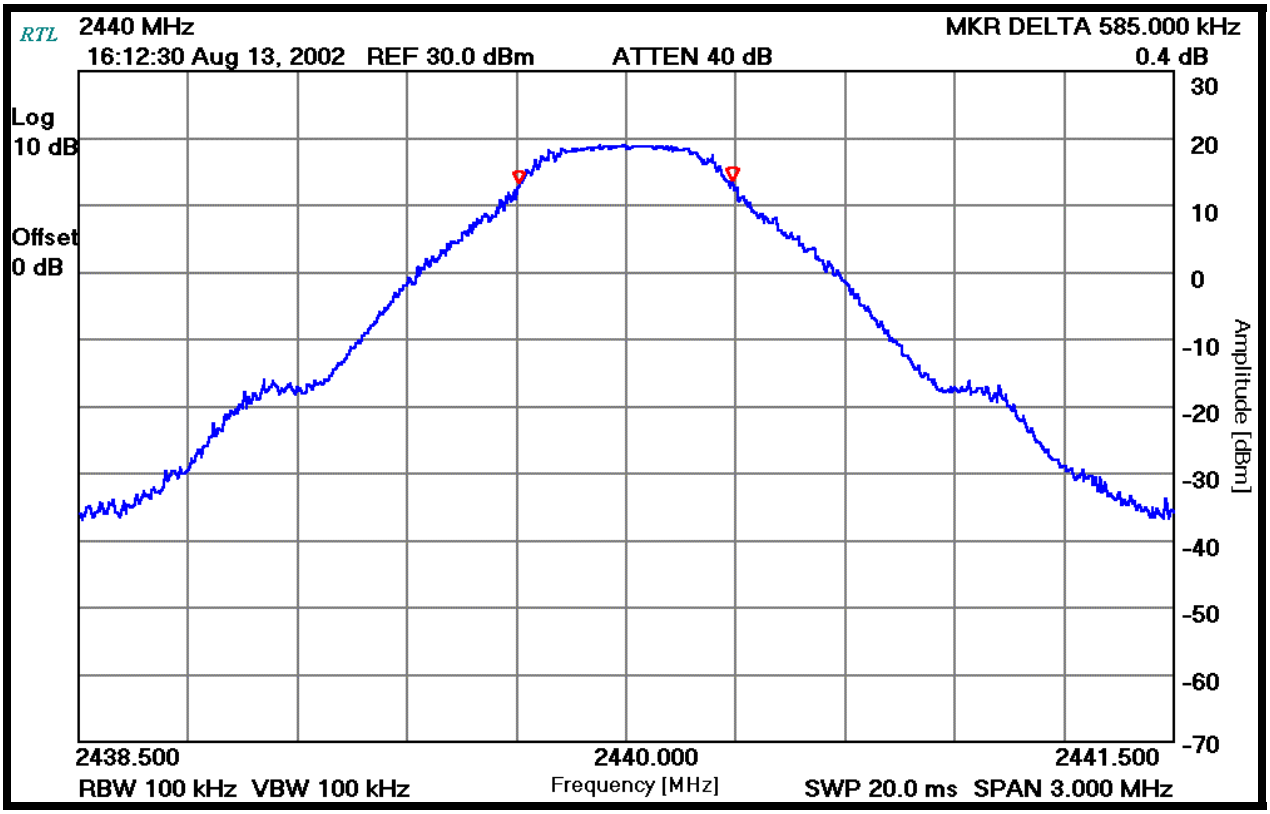



**TEST PERSONNEL:**

| Daniel W. Baltzell | | August 13, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

| | |
|---|---|
| **Channel Number:** | Middle |
| **Frequency (MHz):** | 2440 |
| **Resolution Bandwidth (kHz):** | 100 |
| **Video Bandwidth (kHz):** | 100 |
| **Sweep Time (ms):** | 20.0 |

**PLOT 9-2: MODULATED BANDWIDTH MIDDLE CHANNEL**

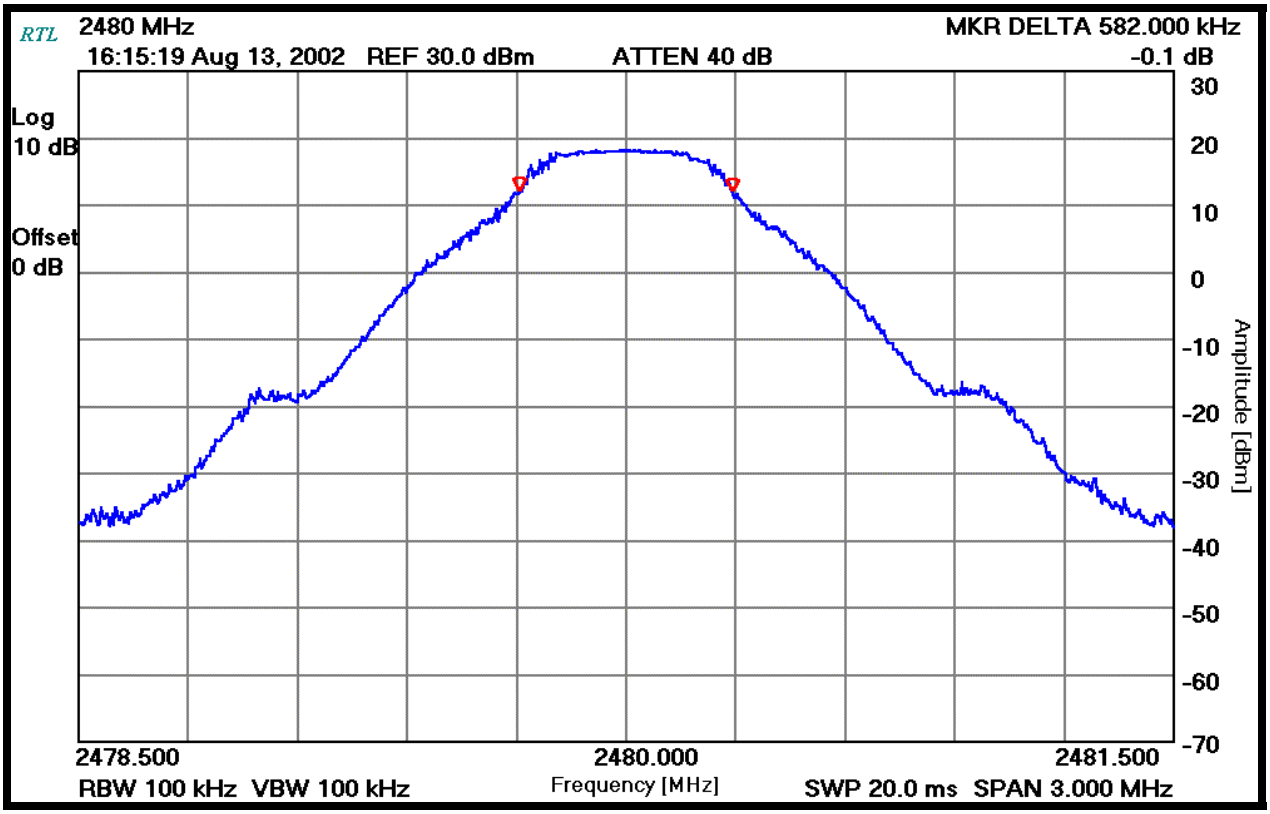



**TEST PERSONNEL:**

| | | |
|---|---|---|
| Daniel W. Baltzell | | August 13, 2002 |
| EMC Test Engineer | Signature | Date Of Test |

| | |
|---|---|
| **Channel Number:** | Upper |
| **Frequency (MHz):** | 2480 |
| **Resolution Bandwidth (kHz):** | 100 |
| **Video Bandwidth (kHz):** | 100 |
| **Sweep Time (ms):** | 20.0 |

**PLOT 9-3: MODULATED BANDWIDTH UPPER CHANNEL**




**TEST PERSONNEL:**

| | | |
|---|---|---|
| Daniel W. Baltzell | | August 13, 2002 |
| EMC Test Engineer | Signature | Date Of Test |

# 10 PEAK OUTPUT POWER - §15.247(B)(1)

## 10.1 POWER OUTPUT TEST PROCEDURE

A conducted power measurement of the EUT was measured using an Agilent 4416A EPM-P Series Power Meter with a E9323A Peak and Average Power Sensor while the Frequency Hopping was disabled.

## 10.2 POWER OUTPUT TEST EQUIPMENT

## TABLE 10-1: POWER OUTPUT TEST EQUIPMENT

| RTL ASSET # | MANUFACTURER | MODEL | PART TYPE | SERIAL NUMBER | CALIBRATION DUE DATE |
|---|---|---|---|---|---|
| 901186 | Agilent Technologies | E9323A (50MHz-6GHz) | Peak & Avg. Power Sensor | US40410380 | 6/25/02 |
| 901184 | Agilent Technologies | E4416A | EPM-P Power Meter, single channel | GB41050573 | 7/5/02 |

## 10.3 POWER OUTPUT TEST DATA

| FREQUENCY (MHZ) | CHANNEL | PEAK POWER CONDUCTED OUTPUT (dBm) |
|---|---|---|
| 2402 | Low | 20.6 |
| 2440 | Middle | 20.5 |
| 2480 | Upper | 20.5 |

**TEST PERSONNEL:**

| Daniel W. Baltzell | | August 5, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

# 11 ANTENNA CONDUCTED SPURIOUS EMISSIONS - §15.247(C)

## 11.1 ANTENNA CONDUCTED SPURIOUS EMISSIONS TEST PROCEDURES

Antenna spurious emission per FCC 15.247(c) was measured from the EUT antenna port using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 300 kHz. The modulated carrier was identified at 2.402GHz for the lower channel, 2.440GHz for the middle channel, and 2.480GHz for the upper channel. No other harmonics or spurs were found within 20 dB of the carrier level from 9kHz to the carrier $10^{th}$ harmonic. See antenna conducted spurious noise table. The low, middle, and upper channels were investigated and tested. Notch filter used was found to have no effect on emission levels so it was not used in data presented.

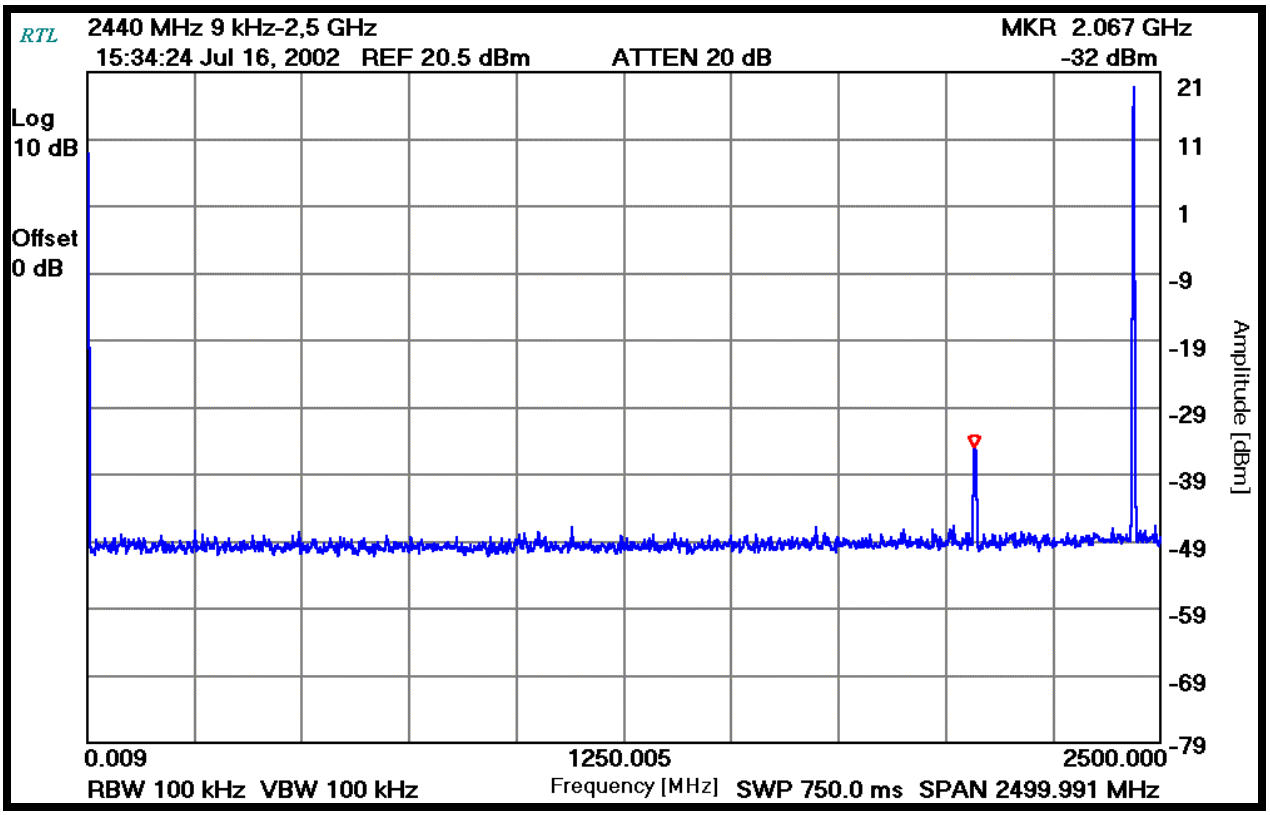
## 11.2 ANTENNA CONDUCTED SPURIOUS TEST EQUIPMENT

## TABLE 11-1: ANTENNA CONDUCTED SPURIOUS TEST EQUIPMENT

| RTL ASSET # | MANUFACTURER | MODEL | PART TYPE | SERIAL NUMBER | CALIBRATION DUE DATE |
|---|---|---|---|---|---|
| 900931 | HP | 8566B | Spectrum Analyzer (100Hz – 22 GHz) | 3138A07771 | 5/10/03 |
| 901137 | Par Electronics | 2.4-2.4850 GHz | Notch Filter | N/A | N/A |

## 11.3 ANTENNA CONDUCTED SPURIOUS PLOTS

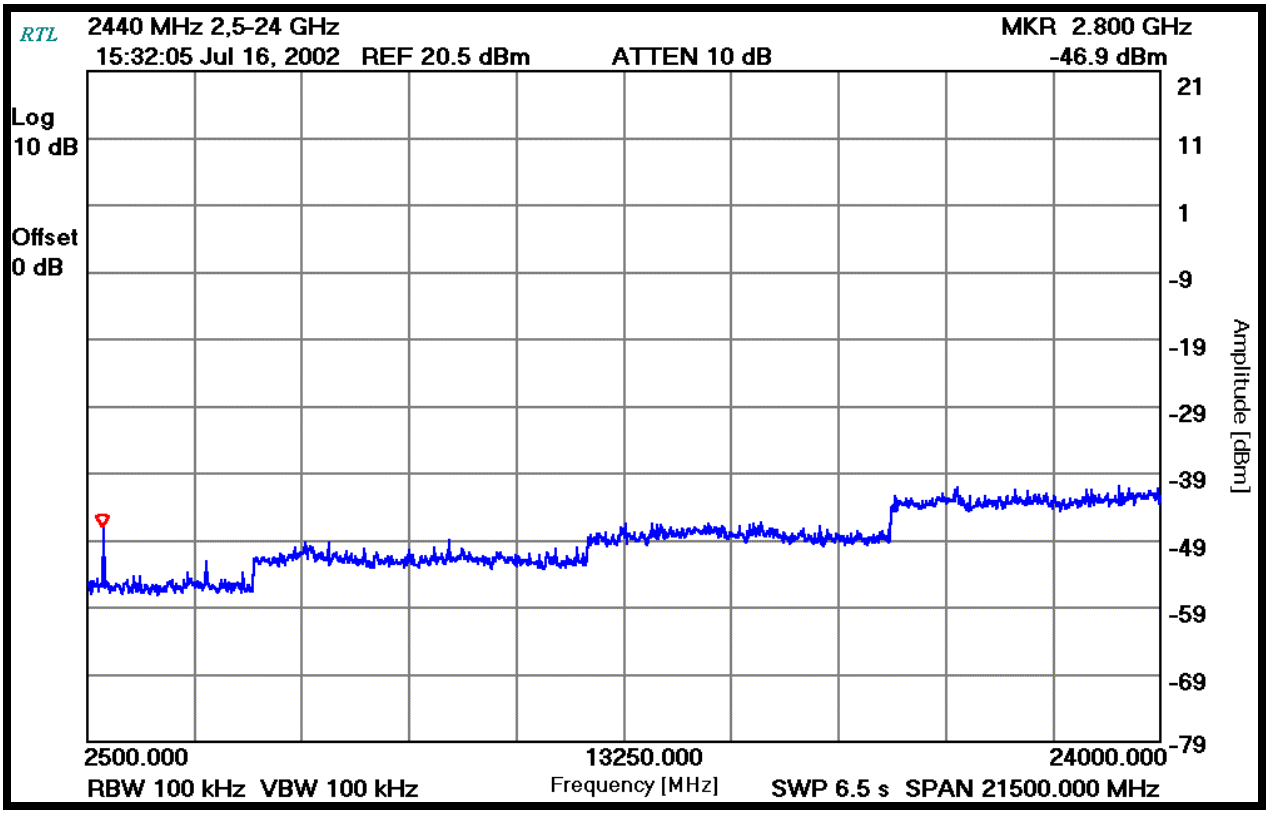
### PLOT 11-1: ANTENNA CONDUCTED SPURIOUS (9 KHZ-2.5 GHZ; MID CHANNEL 2440 MHZ)




**TEST PERSONNEL:**

| Daniel W. Baltzell | | July 16, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

## PLOT 11-2: ANTENNA CONDUCTED SPURIOUS (2.5-24 GHZ; MID CHANNEL 2440 MHZ)




**TEST PERSONNEL:**

| Daniel W. Baltzell | | July 16, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

## 11.4 ANTENNA CONDUCTED SPURIOUS EMISSIONS LOWER CHANNEL

**Operating Frequency (MHz):** 2402
**Channel:** Lower
**Measured Level at 100kHz (dBm):** 19.9
**Limit (dBm):** -0.1

## TABLE 11-2: ANTENNA CONDUCTED SPURIOUS EMISSIONS LOWER CHANNEL

| Frequency (MHz) | Measured Level (dBm) | Insertion Loss (dB) | Measured Level (dBc) | Limit (dBc) | Margin (dB) |
|---|---|---|---|---|---|
| 1663.550 | -32.1 | 0.2 | 67.4 | -20.0 | -47.4 |
| 4804.000 | -48.3 | 0.8 | 59.5 | -20.0 | -39.5 |
| 7206.000 | -42.8 | 3.2 | 56.7 | -20.0 | -36.7 |
| 9608.000 | -44.8 | 8.0 | 60.9 | -20.0 | -40.9 |
| 12010.000 | -45.8 | 4.8 | 52.7 | -20.0 | -32.7 |
| 14412.000 | -42.0 | 9.2 | 46.5 | -20.0 | -26.5 |
| 16814.000 | -44.3 | 17.7 | 55.4 | -20.0 | -35.4 |
| 19216.000 | -44.3 | 8.8 | 52.4 | -20.0 | -32.4 |
| 21618.000 | -41.3 | 8.8 | 50.1 | -20.0 | -30.1 |
| 24020.000 | -39.0 | 8.8 | 51.8 | -20.0 | -31.8 |

**TEST PERSONNEL:**

| Daniel W. Baltzell | | August 5, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

## 11.5 ANTENNA CONDUCTED SPURIOUS EMISSIONS MIDDLE CHANNEL

**Operating Frequency (MHz):** 2440
**Channel:** Middle
**Measured Level at 100kHz (dBm):** 19.6
**Limit (dBm):** -0.4

## TABLE 11-3: ANTENNA CONDUCTED SPURIOUS EMISSIONS MIDDLE CHANNEL

| Frequency (MHz) | Measured Level (dBm) | Insertion Loss (dB) | Measured Level (dBc) | Limit (dBc) | Margin (dB) |
|---|---|---|---|---|---|
| 2068.958 | -32.2 | 0.2 | 51.6 | -20.0 | -31.6 |
| 4880.000 | -45.5 | 1.2 | 63.9 | -20.0 | -43.9 |
| 7320.000 | -42.5 | 3.0 | 59.1 | -20.0 | -39.1 |
| 9760.000 | -44.8 | 8.2 | 56.2 | -20.0 | -36.2 |
| 12200.000 | -44.5 | 9.7 | 54.4 | -20.0 | -34.4 |
| 14640.000 | -41.2 | 6.2 | 54.6 | -20.0 | -34.6 |
| 17080.000 | -40.7 | 12.0 | 48.3 | -20.0 | -28.3 |
| 19520.000 | -41.7 | 6.3 | 55.0 | -20.0 | -35.0 |
| 21960.000 | -41.5 | 6.3 | 54.8 | -20.0 | -34.8 |
| 24400.000 | -40.5 | 6.3 | 53.8 | -20.0 | -33.8 |

**TEST PERSONNEL:**

| Daniel W. Baltzell | | August 5, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

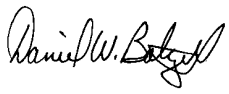
## 11.6 ANTENNA CONDUCTED SPURIOUS EMISSIONS UPPER CHANNEL

**Operating Frequency (MHz):** 2480
**Channel:** Upper
**Measured Level at 100kHz (dBm):** 19.1
**Limit (dBc):** -0.9

## TABLE 11-4: ANTENNA CONDUCTED SPURIOUS EMISSIONS UPPER CHANNEL

| Frequency (MHz) | Measured Level (dBm) | Insertion Loss (dB) | Measured Level (dBc) | Limit (dBc) | Margin (dB) |
|---|---|---|---|---|---|
| 2108.961 | -29.4 | 0.2 | 48.3 | -20.0 | -28.3 |
| 4960.000 | -44.8 | 1.2 | 62.8 | -20.0 | -42.8 |
| 7440.000 | -43.3 | 3.8 | 58.6 | -20.0 | -38.6 |
| 9920.000 | -45.0 | 6.2 | 57.9 | -20.0 | -37.9 |
| 12400.000 | -43.8 | 7.0 | 55.9 | -20.0 | -35.9 |
| 14880.000 | -43.0 | 6.0 | 56.1 | -20.0 | -36.1 |
| 17360.000 | -42.7 | 12.5 | 49.3 | -20.0 | -29.3 |
| 19840.000 | -43.0 | 7.3 | 54.8 | -20.0 | -34.8 |
| 22320.000 | -42.5 | 7.3 | 54.3 | -20.0 | -34.3 |
| 24800.000 | -40.0 | 7.3 | 51.8 | -20.0 | -31.8 |

**TEST PERSONNEL:**



| Daniel W. Baltzell | | August 5, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

# 12 POWER SPECTRAL DENSITY - §15.247(D)

## 12.1 POWER SPECTRAL DENSITY TEST PROCEDURE

The Power spectral density per FCC 15.247(d) was measured using a 50 ohm spectrum analyzer with the resolution and video bandwidth set at 3 kHz, and the sweep time set at 70 seconds, i.e. (span/3 kHz) or 200000 Hz / 3000 Hz = 67 seconds. The spectral lines were resolved for the modulated carriers at 2.402GHz, 2.440GHz, and 2.480GHz respectively. These levels are below the +8 dBm limit. See power spectral density table and plots.

## 12.2 POWER SPECTRAL DENSITY TEST EQUIPMENT

### TABLE 12-1: POWER SPECTRAL DENSITY TEST EQUIPMENT

| RTL ASSET # | MANUFACTURER | MODEL | PART TYPE | SERIAL NUMBER | CALIBRATION DUE DATE |
|---|---|---|---|---|---|
| 900931 | HP | 8566B | Spectrum Analyzer (100Hz – 22 GHz) | 3138A07771 | 5/10/03 |

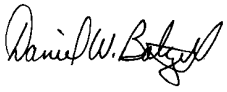
## 12.3 POWER SPECTRAL DENSITY TEST DATA

**Operating Frequency (MHz):** 2402, 2440 & 2480
**Channel:** Lower, Middle, Upper
**Measured Conducted Power (dBm):** 20.6; 20.5; 20.5
**Modulation Bandwidth (kHz):** 585
**Limit (dBm):** 8

### TABLE 12-2: POWER SPECTRAL DENSITY TEST DATA

| CHANNEL | POWER SPECTRAL DENSITY LIMIT = +8dBm |
|---|---|
| 1 | 0.6 |
| 6 | -1.2 |
| 11 | -1.6 |

**TEST PERSONNEL:**

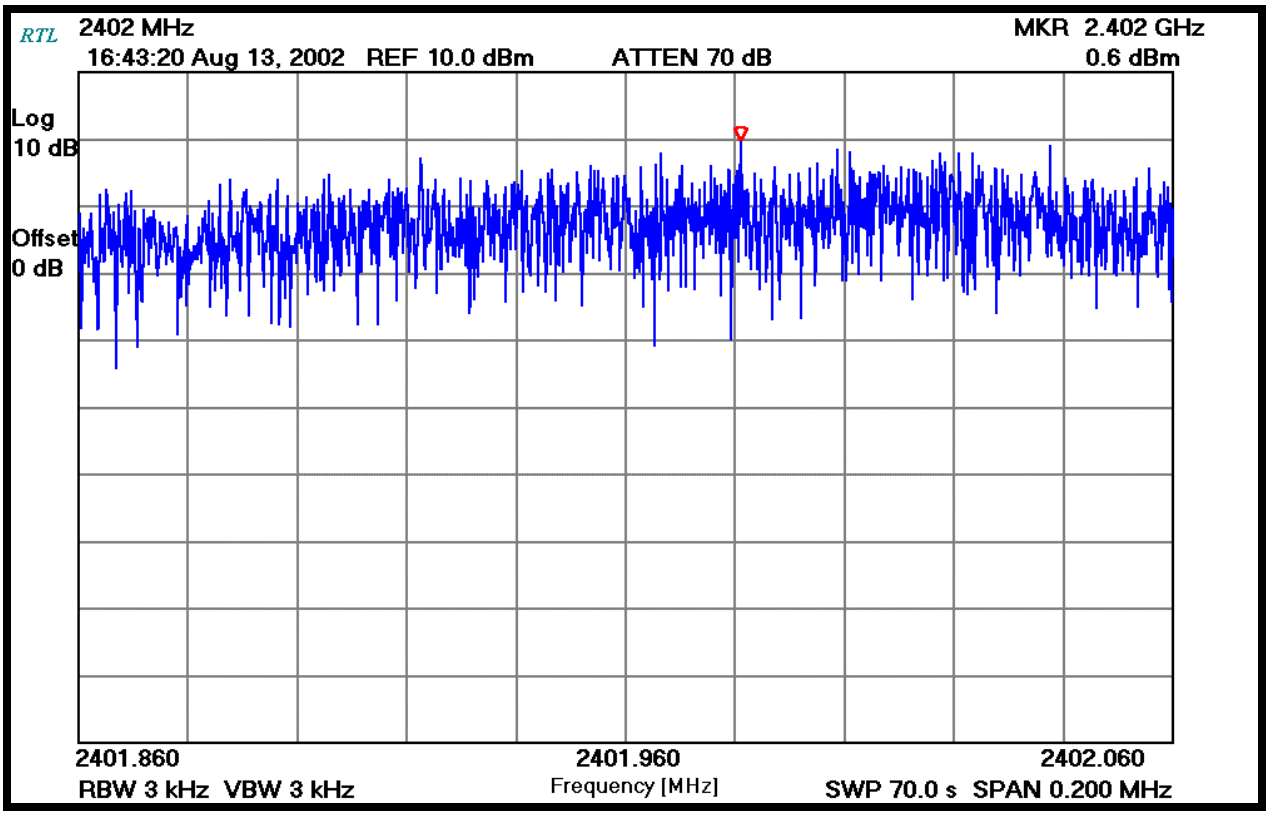


| Daniel W. Baltzell | | August 14, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

## 12.4 POWER SPECTRAL DENSITY PLOTS

| | |
|---|---|
| **Operating Frequency (MHz):** | 2402 |
| **Channel:** | Lower |
| **Measured Conducted Power (dBm):** | 19.9 |
| **Bandwidth Resolution (kHz):** | 3 |
| **Bandwidth Video (kHz):** | 3 |
| **Sweep Time (sec.):** | 70 |

**PLOT 12-1: POWER SPECTRAL DENSITY: CHANNEL 1**

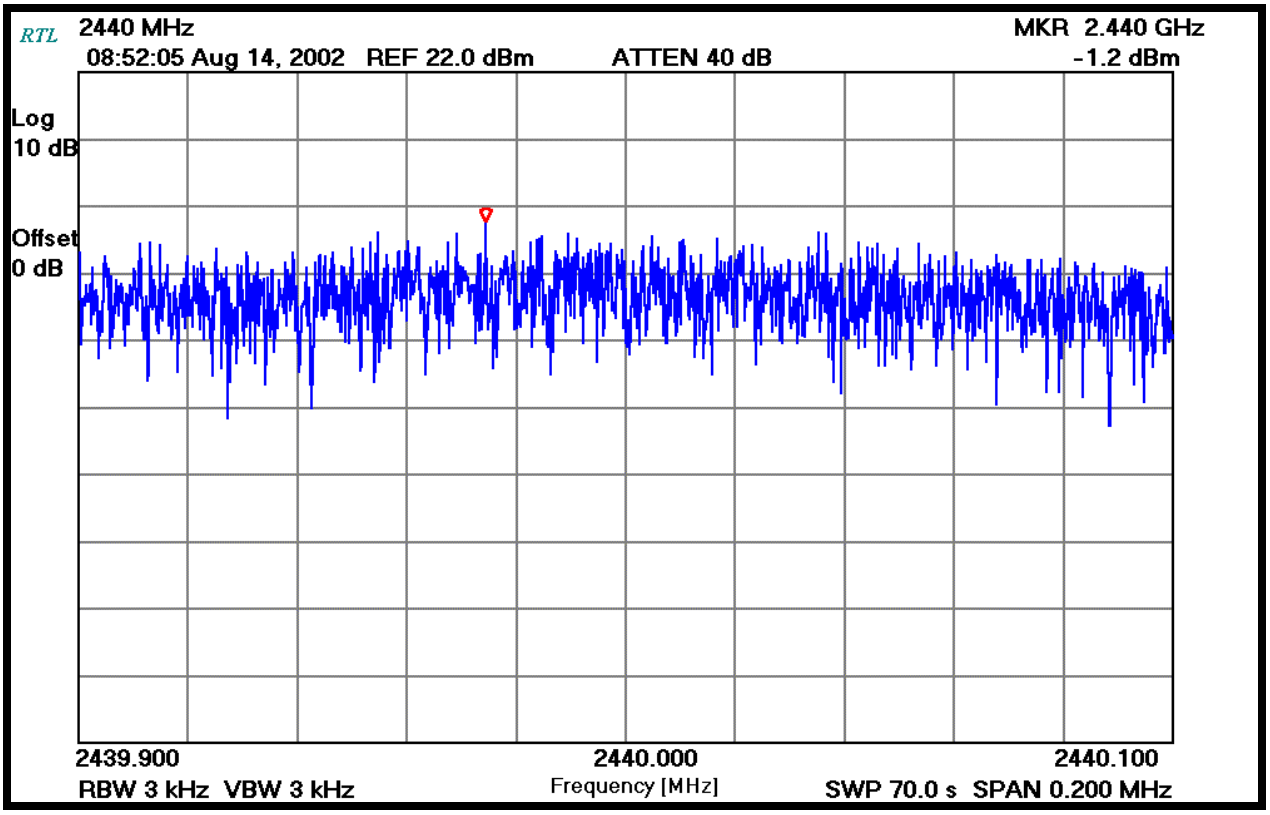



**TEST PERSONNEL:**

| | | |
|---|---|---|
| Daniel W. Baltzell | | August 14, 2002 |
| EMC Test Engineer | Signature | Date Of Test |

| | |
|---|---|
| **Operating Frequency (MHz):** | 2440 |
| **Channel:** | Middle |
| **Measured Conducted Power (dBm):** | 19.6 |
| **Bandwidth Resolution (kHz):** | 3 |
| **Bandwidth Video (kHz):** | 3 |
| **Sweep Time (sec.):** | 70 |

**PLOT 12-2: POWER SPECTRAL DENSITY: CHANNEL 6**

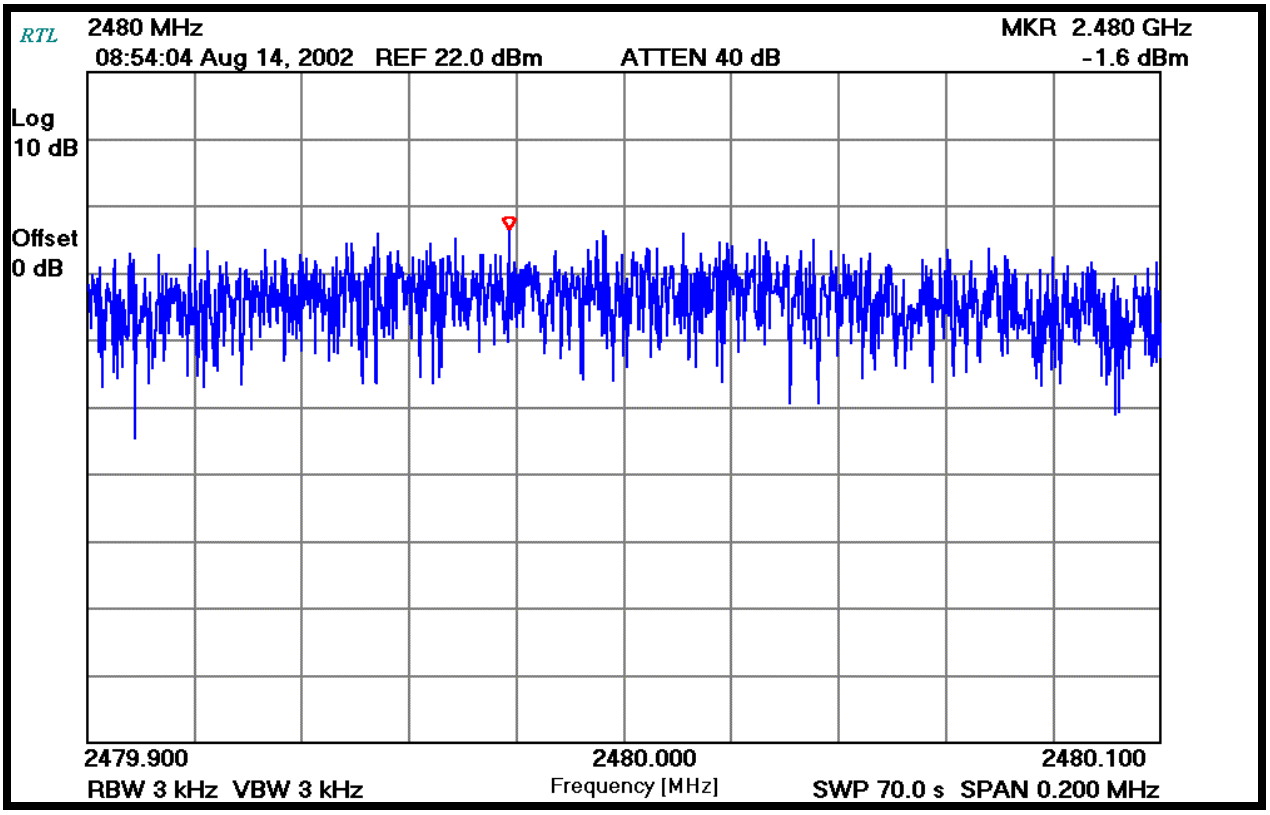



**TEST PERSONNEL:**

| Daniel W. Baltzell | | August 14, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

| | |
|---|---|
| **Operating Frequency (MHz):** | 2480 |
| **Channel:** | Upper |
| **Measured Conducted Power (dBm):** | 18.9 |
| **Bandwidth Resolution (kHz):** | 3 |
| **Bandwidth Video (kHz):** | 3 |
| **Sweep Time(sec.):** | 70 |

**PLOT 12-3: POWER SPECTRAL DENSITY: UPPER CHANNEL**




**TEST PERSONNEL:**

| Daniel W. Baltzell | | August 14, 2002 |
|---|---|---|
| EMC Test Engineer | Signature | Date Of Test |

# 13 CONCLUSION

The data in this measurement report shows that Vocollect, Inc. Talkman T2 Model: TT-600, FCC ID: MQOTT600-22300, complies with all the requirements of Parts 2 and 15 of the FCC Rules and Industry Canada RSS-210.