**MET Laboratories, Inc.** *Safety Certification - EMI - Telecom Environmental Simulation*
914 WEST PATAPSCO AVENUE ! BALTIMORE, MARYLAND 21230-3432 ! PHONE (410) 354-3300 ! FAX (410) 354-3313

June 9, 2005

Scinetic Engineering
61 Kaki Bukit Avenue 1 #06-09
Shun Li Industrial Park, Singapore 4179

Dear Yap Kok Yeong,

Enclosed is the EMC test report for compliance testing of the IBM 7054 Mobile Tablet for Retail Scanner, manufactured by Scinetic Engineering. as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-03 ed.), Part 15 Subpart C, §15.247 for Intentional Radiators and FCC Declaration of Conformity under CFR, Part 15, Subpart B For a Class A Unintentional Radiator.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
MET LABORATORIES, INC.

Marie Ann Confroy
Documentation Department

Reference: (\Scinetic Engineering\ Scanner \ EMC17220B-FCC247)

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# Electromagnetic Compatibility Criteria Test Report

For the

## IBM 7054 Mobile Tablet for Retail Scanner
## Manufactured by Scinetic Engineering

Tested under

**FCC Certification Rules**
**Title 47 of the CFR, Part 15, Subpart C for Intentional Radiators**

**MET Report: EMCB17220B-FCC247**

June 9, 2005

**Prepared For:**

**Scinetic Engineering**
**61 Kaki Bukit Avenue 1 #06-09**
**Shun Li Industrial Park, Singapore 4179**

**Prepared By:**
**MET Laboratories, Inc.**
914 West Patapsco Avenue
Baltimore, MD 21230

# Electromagnetic Compatibility Criteria
# Test Report

For the

## IBM 7054 Mobile Tablet for Retail Scanner
## Manufactured by Scinetic Engineering

Tested Under

**FCC Certification Rules**
**Title 47 of the CFR, Part 15, Subpart C for Intentional Radiators**

Kevin Mehaffey
Electromagnetic Compatibility Lab

Marie Ann Confroy
Documentation Department

**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 15, §15.247 of the FCC Rules under normal use and maintenance.

Christopher Eckert
Electromagnetic Compatibility Lab

  

# Report Status Sheet

| Revision | Report Date | Reason for Revision |
|---|---|---|
| 0 | June 9, 2005 | Initial Issue. |

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# List of Terms and Abbreviations

| | |
|---|---|
| **AC** | **A**lternating **C**urrent |
| **ACF** | **A**ntenna **C**orrection **F**actor |
| **Cal** | **Cal**ibration |
| **d** | **M**easurement **D**istance |
| **dB** | **D**eci **B**els |
| **dBΦV** | **D**eci-**B**els above one **micro V**olt |
| **dBΦV/m** | **D**eci-**B**els above one **micro V**olt **per m**eter |
| **DC** | **D**irect **C**urrent |
| **DCF** | **D**istance **C**orrection **F**actor |
| **E** | **E**lectric Field |
| **DSL** | **D**igital **S**ubscriber **L**ine |
| **ESD** | **E**lectro**s**tatic **D**ischarge |
| **EUT** | **E**quipment **U**nder **T**est |
| **f** | **F**requency |
| **FCC** | **F**ederal **C**ommunications **C**ommission |
| **H** | Magnetic Field |
| **GHz** | **G**iga **H**ertz |
| **Hz** | **H**ertz |
| **ICES** | **I**nterference-**C**ausing **E**quipment **S**tandard |
| **kHz** | **k**ilo**h**ertz |
| **kPa** | **k**ilo**pa**scal |
| **kV** | **k**ilo **V**olt |
| **LISN** | **L**ine **I**mpedance **S**tabilization **N**etwork |
| **MHz** | **M**ega**H**ertz |
| **ΦH** | **micro H**enry |
| **ΦF** | **micro F**arad |
| **Φs** | **micro s**econds |
| **RF** | **R**adio **F**requency |
| **RMS** | **R**oot-**M**ean-**S**quare |

# 1.0 Requirements Summary

| Reference | Description | Compliance |
|---|---|---|
| Title 47 of the CFR, Part 15, Subpart C, §15.203 | Antenna Requirement | Compliant |
| Title 47 of the CFR, Part 15, Subpart C, §15.205 | Emissions at Restricted Band | Compliant |
| Title 47 of the CFR, Part 15, Subpart C, §15.207(a); | Electromagnetic Compatibility - Conducted Emissions for Intentional Radiators | Compliant[1] |
| Title 47 of the CFR, Part 15, Subpart C, §15.209(a); §15.247(a) and (b) | Electromagnetic Compatibility - Radiated Emissions for Intentional Radiators | Compliant |
| Title 47 of the CFR, Part 15, Subpart C, §15.247(a) | Bandwidth & Channelization | Complaint[2,3] |
| Title 47 of the CFR, Part 15, Subpart C, §15.247(i) | Output Power and RF Exposure | Compliant |
| Title 47 of the CFR, Part 15, Subpart C, §15.247(c) | Spurious Emissions - Radiated and RF Conducted | Complaint |
| Title 47 of the CFR, Part 15, Subpart C, §15.247(d) | Power Spectral Density | Not Applicable. The EUT is a frequency hopping device. |
| Title 47 of the CFR, Part 15, Subpart C, §15.247(f) | Hybrid Requirements | Not Applicable. The EUT is a frequency hopping device. |
| Title 47 of the CFR, Part 15, Subpart C, §15.247(g) | Hopping Capability | Compliant [1,3] |
| Title 47 of the CFR, Part 15, Subpart C, §15.247(h) | Non-Coordination Requirements | Compliant [1,3] |

**Table 1 Requirements Summary of EMC Part 15.247 ComplianceTesting**

NOTE: Spread spectrum systems are sharing these bands on a noninterference basis with systems supporting critical Government requirements that have been allocated the usage of these bands, secondary only to ISM equipment operated under the provisions of part 18 of this chapter. Many of these Government systems are airborne radiolocation systems that emit a high EIRP which can cause interference to other users. Also, investigations of the effect of spread spectrum interference to U. S. Government operations in the 902-928 MHz band may require a future decrease in the power limits allowed for spread spectrum operation.

1) Testing was not preformed at MET Laboratories.
2) The 20 dB bandwidth was measured to demonstrate compliance with this section.
3. The EUT contains a certified Bluetooth module and is therefore considered to meet the channelization, hopping and non-coordination requirements.

# 2.0 Equipment Configuration

## 2.1 Overview

An EMC evaluation to determine compliance of the IBM 7054 Mobile Tablet for Retail Scanner, manufactured by Scinetic Engineering, with the requirements of Part 15, Subpart C, §15.247 was performed. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the IBM 7054 Mobile Tablet for Retail Scanner, manufactured by Scinetic Engineering. Scinetic Engineering should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the IBM 7054 Mobile Tablet for Retail Scanner has been **permanently** discontinued.

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, §15.247, in accordance with Scinetic Engineering, purchase order number 202085. All tests were conducted using measurement procedure ANSI C63.4-1992.

| | | |
|---|---|---|
| **Type of Submission/Rule:** | Part 15.247 Original Filing | |
| **Model(s) Tested:** | IBM 7054 Mobile Tablet for Retail Scanner, manufactured by Scinetic Engineering P/N 65P6350 | |
| **Model(s) Covered:** | IBM 7054 Mobile Tablet for Retail Scanner, manufactured by Scinetic Engineering P/N 65P6350; PN 65P6433; 7054-100, 7054-110, and 7054-200 | |
| **EUT Specifications:** | **Primary Power:** | Battery powered |
| | **FCC ID:** | ANO-7054SC |
| | **Equipment Code:** | DSS |
| | **RF Power Output:** | 0.17 mW Conducted |
| | **Equipment Frequency Range:** | 2.40GHz- 2.4835GHz |
| **Analysis:** | The results obtained relate only to the item(s) tested. | |
| **Evaluated by:** | Christopher Eckert | |
| **Date(s):** | June7, 2005 | |

## 2.2 Test Site

All testing was performed at MET Laboratories, Inc., 914 West Patapsco Avenue, Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed semi-anechoic chamber. In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories. In accordance with §2.948(d), MET Laboratories has been accredited by the National Voluntary Laboratory Accreditation Program (Lab Code: 100273-0).

## 2.3 Description of Test Sample

IBM Mobile Tablet for Retail is a point of sale product. It is intended for use by shoppers for applications such as personal shopper or self checkout. It consists of a mini-computer running the Windows operating system and a hand-help scanner.

The scanner, covered by this report, is Bluetooth equipped to enable the 'scan and bag' feature of the system.


**Figure 1. Tablet With Docked Scanner**

**Figure 2. Scanner**

## 2.4 Equipment Configuration

The EUT was set up as outlined in Figure 1. All equipment incorporated as part of the EUT is included in the following list.

| Name / Description | Model Number | Part Number | Serial Number |
|---|---|---|---|
| Scanner | N/A | IBM P/N 65P6350 | 41-00024 |

**Table 2. Equipment Configuration**

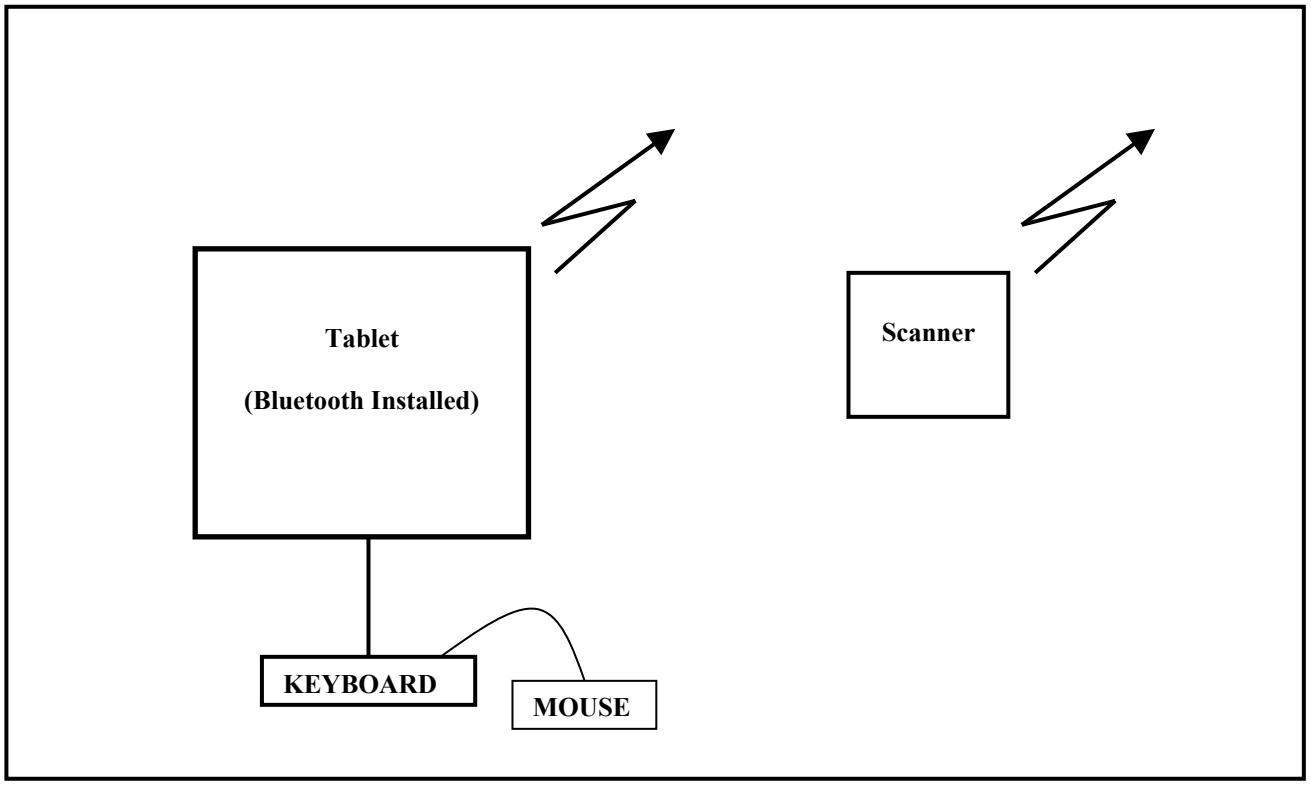



**Figure 3. Block Diagram of Test Configuration**

## 2.5 Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

| Name / Description | Manufacturer | Model Number | Serial Number |
|---|---|---|---|
| Serial Interface Board | IBM | N/A | N/A |
| Serial Interface Power | Baracoda | N/A | N/A |

**Table 3. Support Equipment**

## 2.6 Ports and Cabling Information

| Port Name on EUT | Cable Description | Qty. | Length (m) | Shielded (Y/N) |
|---|---|---|---|---|
| Serial | Serial Cable | 1 | 0.20 | N |
| Serial Board AC | Power Cable | 1 | 1.5 | N |

**Table 4. Ports and Cabling Information**

The cables listed above were used in setting the transmitter to maximum power and data rate at each tested channel. These cables were left in the set-up for convenience during conducted RF antenna port testing.

## 2.7 Mode of Operation

Almond 2 is operating with WIFI together with Bluetooth. The WLAN transmitter is being operated using the Atheros Radio Transmitter (ART) software program. This program allows operation in both 802.11b and 802.11g modes at all data rates for any of the 11 channels. A USB keyboard and mouse is attached to allow interaction with the program options. BlueTest was added to the scanner to allow the test lab to turn hopping off and control the Bluetooth transceiver parameters as needed

## 2.8 Method of Monitoring EUT Operation

The ART software program allows for continuous transmit on selectable channels at selectable power output levels. The outputs and levels were measurement verified. As long as the ART software is operational, then the system is performing its intended operation.

Concerning Bluetooth, the winIOtest testcase, when operating, cycles the scanner LEDs and emits several beeps giving you visual and audio feedback that BT is operating. BlueTest allows the user to set the transmit and receive channels and output power for test purposes.

## 2.9 Modifications

### 2.9.1 Modifications to EUT

No modifications were made to the EUT.

### 2.9.2 Modifications to Test Standard

No modifications were made to the test standard.

## 2.10 Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to IBM upon completion of testing.

# 3.0 Electromagnetic Compatibility Criteria for Intentional Radiators

## 3.1 Antenna Requirement

**Test Requirement:** **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

**Results:** The EUT complies with the requirements of this section.

The EUT as tested meets the criteria of this rule by virtue of having an integral antenna.

Type of Antenna: integral antenna

Gain of Antenna: 2.1 dBi

**Test Engineer(s):** Christopher Eckert

**Test Date(s):** 5/18/2005

## 3.2 Conducted Limits

**Test Requirement(s):** **15.207(a)**, Except as shown in paragraphs (b) and (c) of this section*, charging, AC adapters or battery eliminators the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the Table 5, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Note: *Testing is applicable except to carrier current systems operating as intentional radiators on frequencies below 30 MHz, containing their fundamental emission within the frequency band 535–1705 kHz and intended to be received using a standard AM broadcast receiver, or devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines *15.207 (b)*, or for an intentional radiator that is designed to be connected to the public utility (AC) power line*15.207 (c)*.

| Frequency range (MHz) | Class A Conducted Limits (dBµV) | | *Class B Conducted Limits (dBµV) | |
|---|---|---|---|---|
| | Quasi-Peak | Average | Quasi-Peak | Average |
| * 0.15- 0.45 | 79 | 66 | 66 - 56 | 56 - 46 |
| 0.45 - 0.5 | 79 | 66 | 56 | 46 |
| 0.5 - 30 | 73 | 60 | 60 | 50 |
| Note 1 — The lower limit shall apply at the transition frequencies.<br>Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz.<br>* -- Limits per Subsection 15.207(a). | | | | |

**Table 5. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Section 15.207(a)**

**Results:** Testing was not preformed at MET Laboratories. (See Appendix A)

## 3.3 Radiated Spurious Emissions Limits

**Test Requirement(s):** **§ 15.205 (a):** Except as shown in paragraph (d) of **15.205 Restricted bands of operation**, only spurious emissions are permitted in any of the frequency bands specified in Table 6:

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090–0.110 | 16.42–16.423 | 399.9–410 | 4.5–5.15 |
| 0.495–0.505 (Note 1) | 16.69475–16.69525 | 608–614 | 5.35–5.46 |
| 2.1735–2.1905 | 16.80425–16.80475 | 960–1240 | 7.25–7.75 |
| 4.125–4.128 | 25.5–25.67 | 1300–1427 | 8.025–8.5 |
| 4.17725–4.17775 | 37.5–38.25 | 1435–1626.5 | 9.0–9.2 |
| 4.20725–4.20775 | 73–74.6 | 1645.5–1646.5 | 9.3–9.5 |
| 6.215–6.218 | 74.8–75.2 | 1660–1710 | 10.6–12.7 |
| 6.26775–6.26825 | 108–121.94 | 1718.8–1722.2 | 13.25–13.4 |
| 6.31175–6.31225 | 123–138 | 2200–2300 | 14.47–14.5 |
| 8.291–8.294 | 149.9–150.05 | 2310–2390 | 15.35–16.2 |
| 8.362–8.366 | 156.52475–156.52525 | 2483.5–2500 | 17.7–21.4 |
| 8.37625–8.38675 | 156.7–156.9 | 2655–2900 | 22.01–23.12 |
| 8.41425–8.41475 | 162.0125–167.17 | 3260–3267 | 23.6–24.0 |
| 12.29–12.293 | 167.72–173.2 | 3332–3339 | 31.2–31.8 |
| 12.51975–12.52025 | 240–285 | 3345.8–3358 | 36.43–36.5 |
| 12.57675–12.57725 | 322–335.4 | 3600–4400 | (Note 2) |
| 13.36–13.41. | | | |
| Note 1: Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.<br>Note 2: Above 38.6 | | | |

**Table 6. Restricted Bands of Operation from FCC Part 15, § 15.205**

**§ 15.205 (b):** Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209.

**§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 7.

| Frequency (MHz) | §15.209(a),Radiated Emission Limits (dB:V) @ 3m |
|---|---|
| 30 - 88 | 40.00* |
| 88 - 216 | 43.50* |
| 216 - 960 | 46.00* |
| Above 960 | 54.00 |
| * -- Except perimeter protection systems operating under paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Subpart. | |

**Table 7. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)**

Radiated Emissions above 960 MHz from a device operating under this section shall not exceed the average limits of Table 7 when measured using a RBW of 1 MHz.

**Test Procedure:** The EUT was placed on a 0.8m high wooden table located in a shielded enclosure (See Photograph 1). Various antennas were placed near the EUT and measurements were taken of the field strengths and frequencies. For final radiated measurements, the EUT was placed in a semi-anechoic chamber, and located 1 m and 3 m from an adjustable antenna mast. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst case orientation for maximum emissions. For frequencies from 30 MHz to 1 GHz, measurements were made using a quasi-peak detector with a 120 kHz bandwidth. For frequencies above 1 GHz, peak measurements were made with a resolution bandwidth of 1 MHz and a video bandwidth of 1MHz and average measurements were made with RBW = 1MHz and VBW = 10 Hz.

For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

In accordance with §15.35(b) the limit on the radio frequency emissions as measured using instrumentation with a peak detector function shall be 20dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

**Test Results:** The EUT complies with the requirements of this section.

**Test Engineer(s):** Christopher Eckert

**Test Date(s):** 5/18/2005

# Radiated Spurious Emissions Data

## High Frequency (1GHz-24.80GHz) Radiated Emissions Test Results, 15.209 (a)

| Frequency (GHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna Height (m) | Amplitude (dBuv) @3 m | ACF (dB) (+) | Cable Loss (dB) (-) | DCF 3 m to 10 m (dB) (-) | Corrected Amplitude @ 10 m (dBuv) | Class A Limit @ 10 m (dBuv) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 4.882 | 20 | H | 1 | 24.42 | 33.79 | -2.99 | 9.54 | 51.66 | 54 | -2.34* |
| 4.882 | 270 | V | 1 | 21.39 | 33.69 | -2.99 | 9.54 | 48.53 | 54 | -5.47 |
| 7.323 | 75 | H | 1.1 | 19.23 | 37.08 | -3.67 | 9.54 | 50.44 | 54 | -3.56 |
| 7.323 | 0 | V | 1 | 19.72 | 36.98 | -3.67 | 9.54 | 50.83 | 54 | -3.17 |

## High Frequency (1GHz-24.80GHz) Radiated Emissions Test Results, 15.35 (b)

| Frequency (GHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna Height (m) | Amplitude (dBuv) @3 m | ACF (dB) (+) | Cable Loss (dB) (-) | DCF 3 m to 10 m (dB) (-) | Corrected Amplitude @ 10 m (dBuv) | Class A Limit @ 10 m (dBuv) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 4.882 | 30 | H | 1.1 | 32.06 | 33.79 | -2.99 | 9.54 | 59.30 | 74 | -14.70 |
| 4.882 | 330 | V | 1.2 | 30.12 | 33.69 | -2.99 | 9.54 | 57.26 | 74 | -16.74 |
| 7.323 | 75 | H | 1.1 | 31.3 | 37.08 | -3.67 | 9.54 | 62.51 | 74 | -11.49 |
| 7.323 | 0 | V | 1 | 31.09 | 36.98 | -3.67 | 9.54 | 62.20 | 74 | -11.80 |

Note 1: * - At this frequency, the measured electric-field strength exhibits a margin of compliance that is less than 3dB below the specification limit. We recommend that every emission measured, have at least a 3dB margin to allow for deviations in the emission characteristics that may occur during the production process.

Note 2: The EUT was tested at 1 m. The data has been corrected for comparison with the 10 m limit using the formula: 20log (1 m/ 3 m) as expressed in the 'Distance Correction' column.

Note 3: There were no significant emissions below 1GHz or above the third harmonic.

## Radiated Spurious Emissions Test Set-up

**Photograph 1. Radiated Spurious Emissions Test Set Up**

## 3.4 Bandwidth & Channelization Requirements

**Test Requirements:** **§ 15.247(a):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. For DTS, the minimum 6dB bandwidth shall be at least 500 kHz. For frequency hopping systems, the EUT 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.

**Test Procedure:** The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately equal to 1% of the total emission bandwidth, VBW> RBW. The 20 dB bandwidth was measured and recorded.

**Test Results** The EUT complies with the requirements of this section.

This device has the following technical specifications:

1. The radio hops through seventy-nine frequencies.
2. The dwell time of each frequency is 0.3797 seconds in a 30 second period.
3. The carrier frequency separation is 1 MHz according to the Bluetooth Core Specification.
4. The hopping sequence is a random list that is unique for each system.

(See Appendix B for more detail)

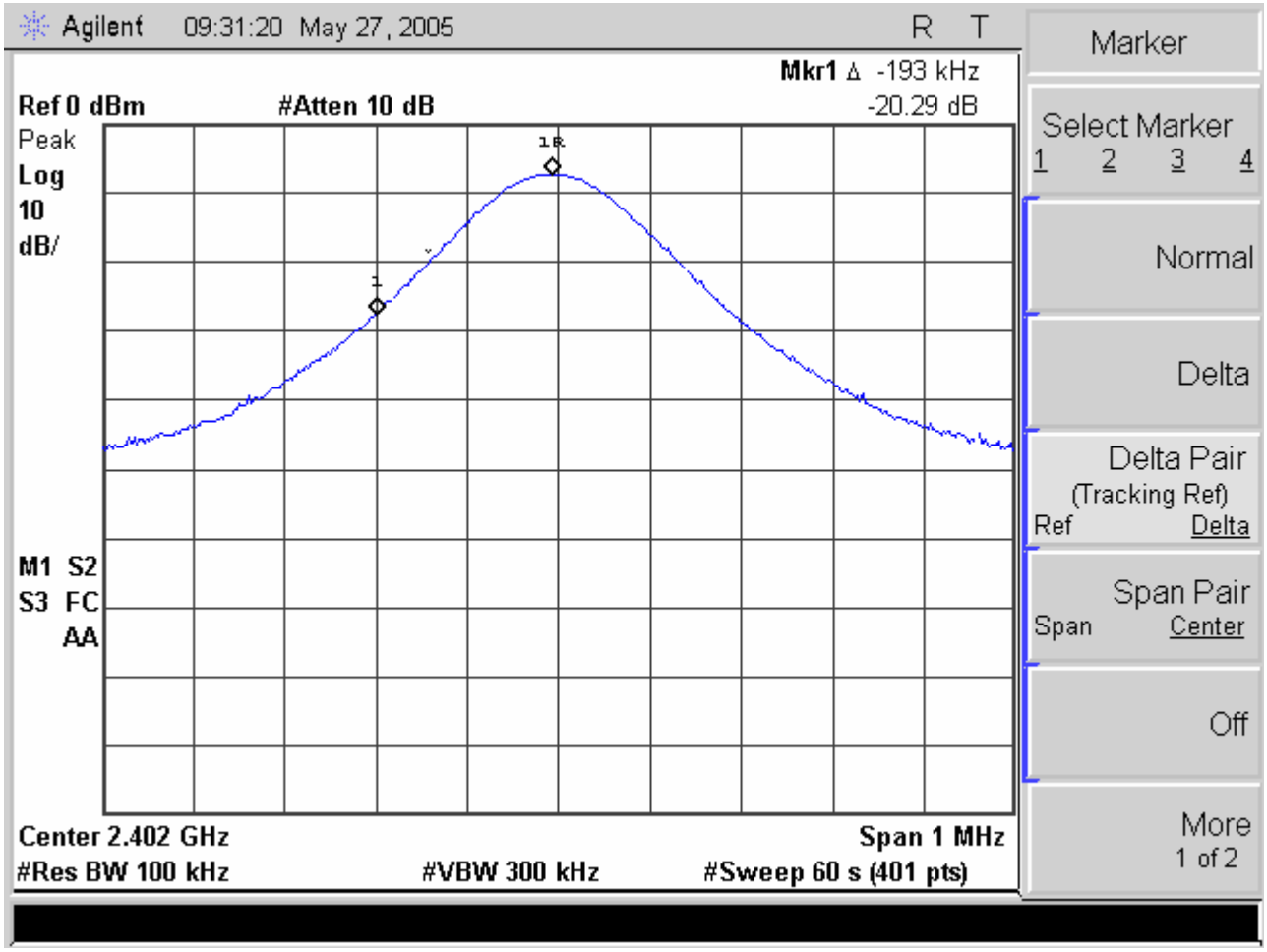
**Test Engineer:** Christopher Eckert

**Test Date:** 5/27/2005

## Occupied Bandwidth Test Data

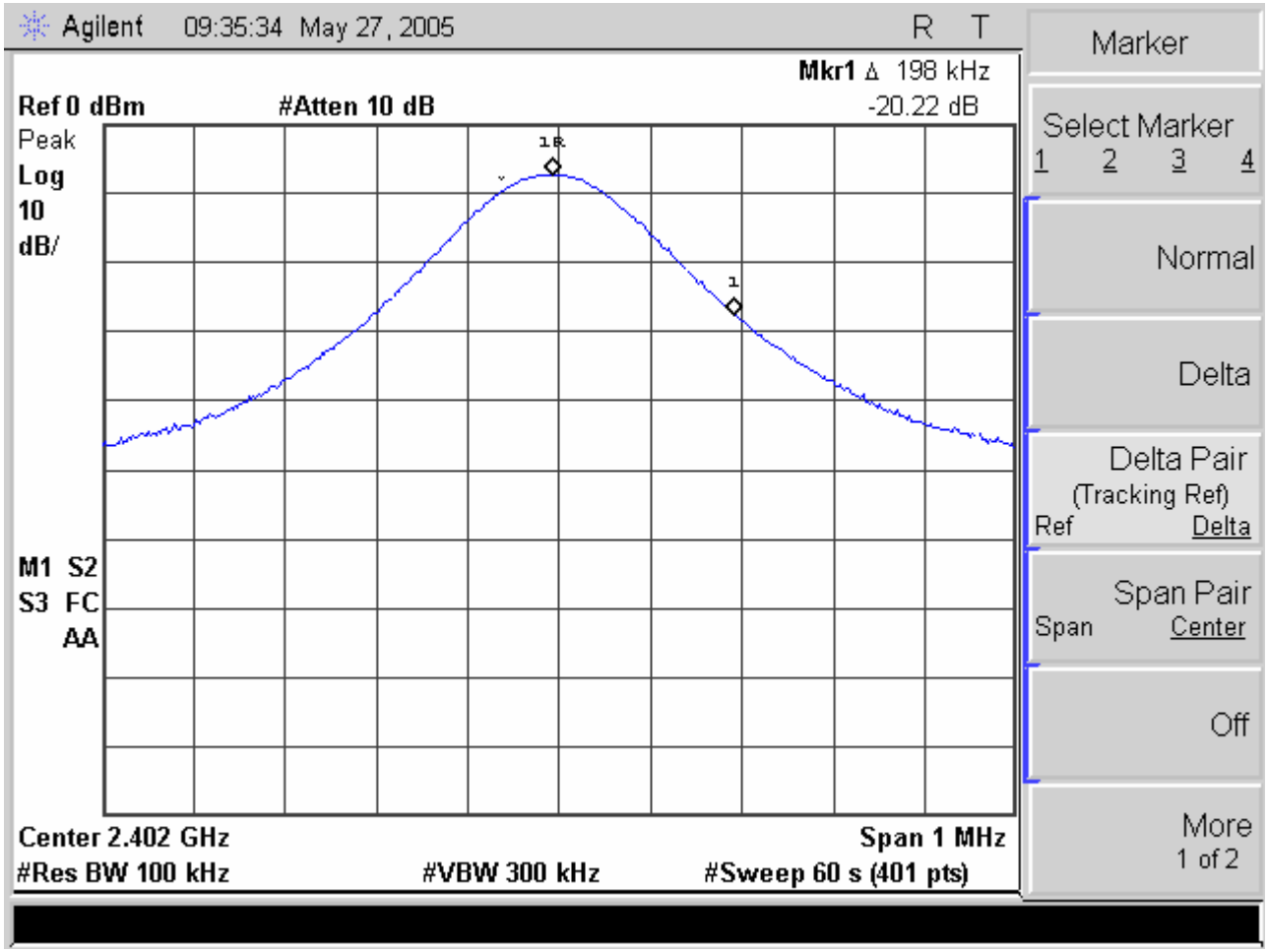
### Occupied Bandwidth (2.402GHz)




**Plot 1. Occupied Bandwidth; Test Results (2.402GHz); $F_{Low}$**

## Occupied Bandwidth Test Data

**Occupied Bandwidth (2.402GHz)**

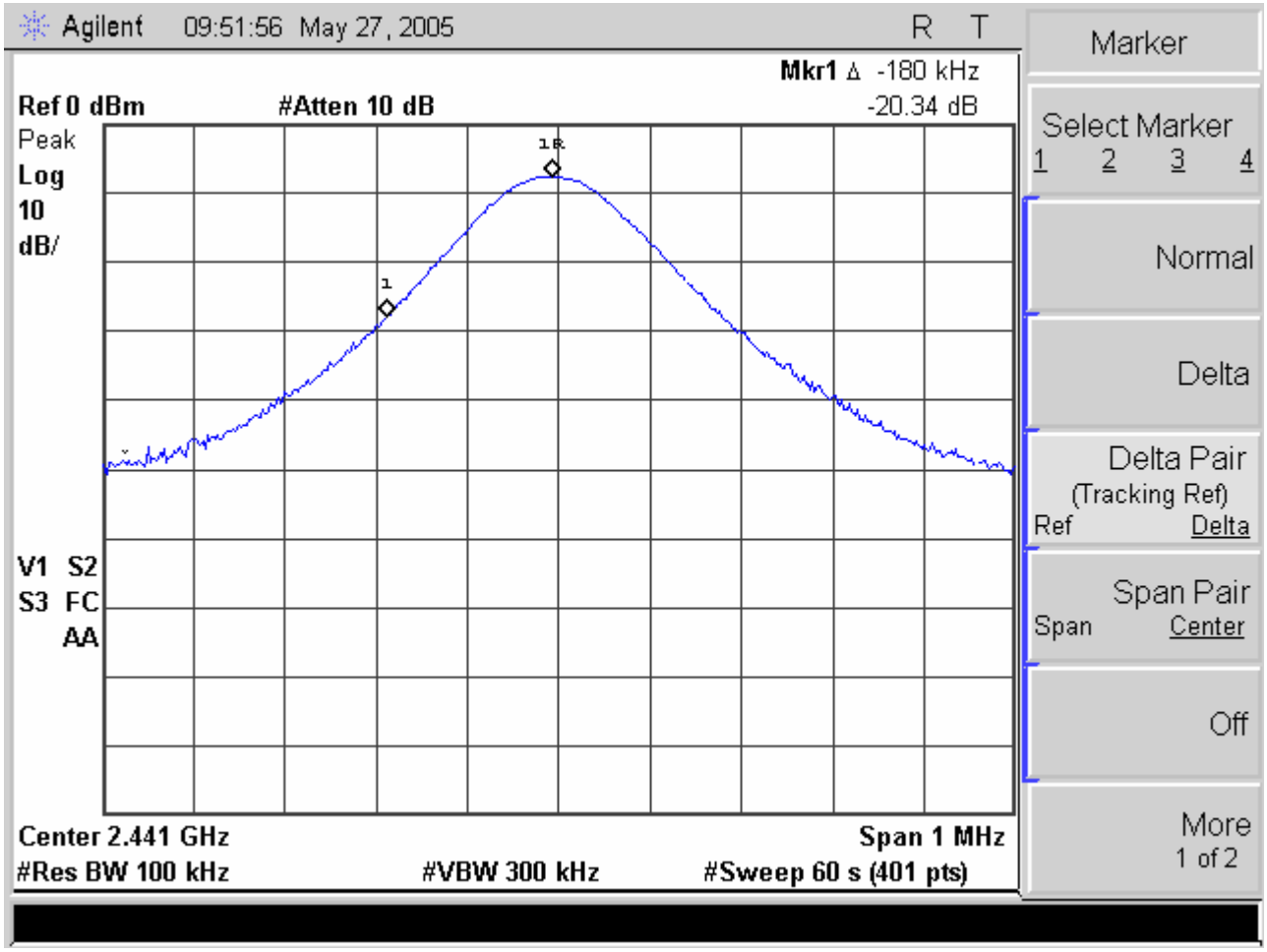



**Plot 2. Occupied Bandwidth; Test Results (2.402GHz); $F_{HIGH}$**

**20 dB bandwidth = 193 kHz + 198 kHz = 391 kHz**

## Occupied Bandwidth Test Data

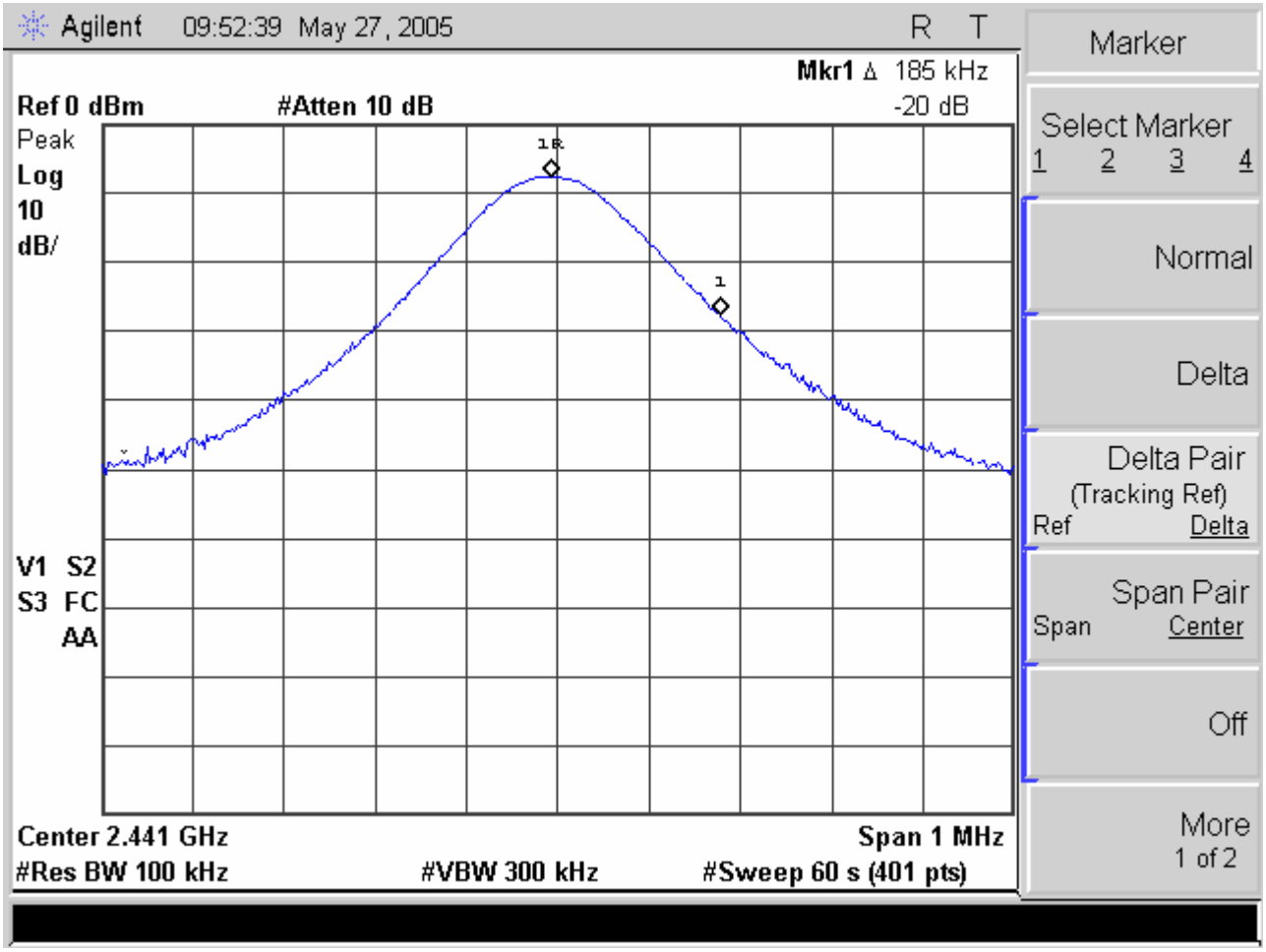
**Occupied Bandwidth (2.441GHz)**




**Plot 3. Occupied Bandwidth; Test Results (2.441GHz); $F_{LOW}$**

## Occupied Bandwidth Test Data

**Occupied Bandwidth (2.441GHz)**

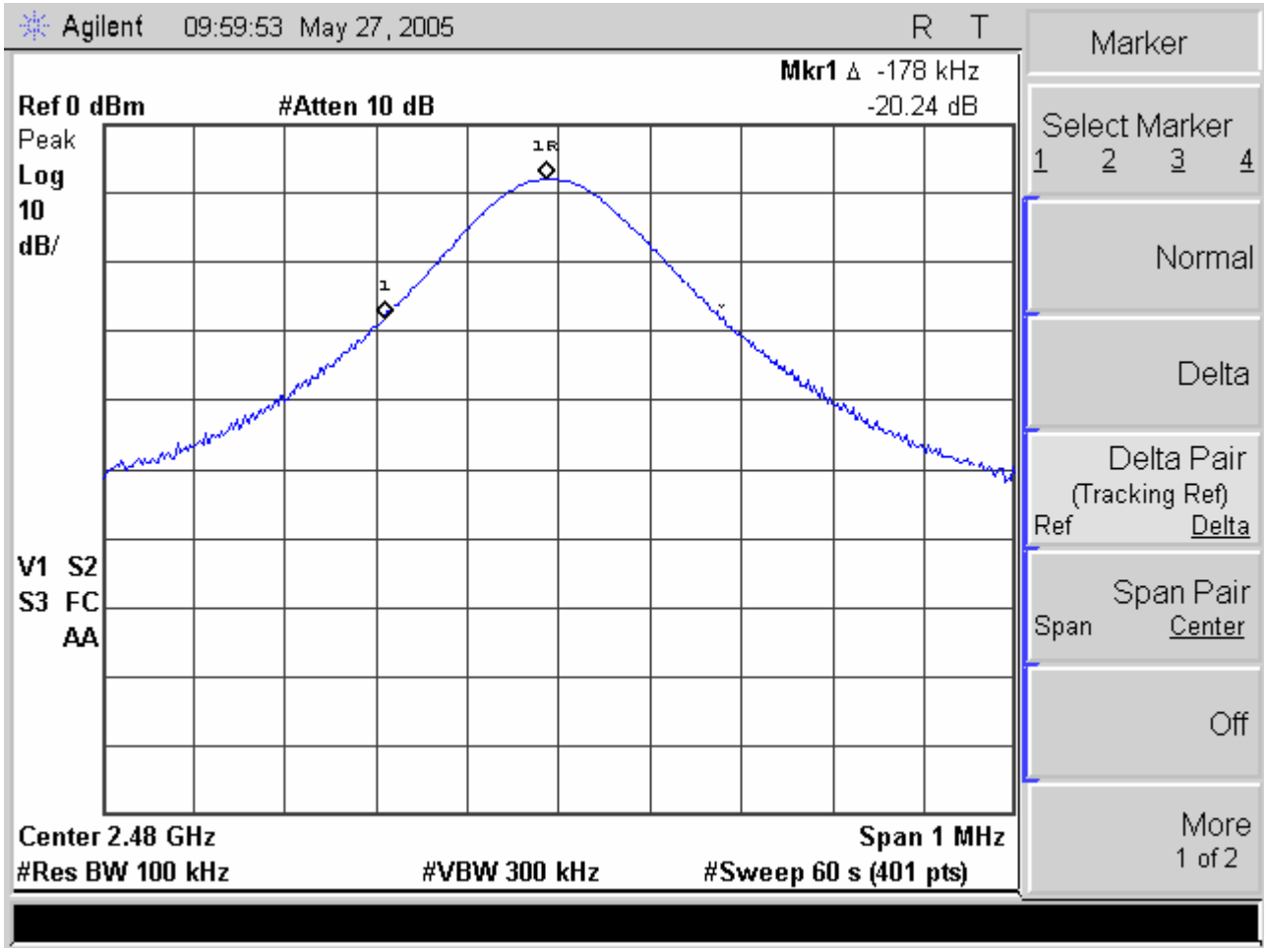



**Plot 4. Occupied Bandwidth; Test Results (2.441GHz); $F_{HIGH}$**

**20 dB bandwidth = 180 kHz + 185 kHz = 365 kHz**

## Occupied Bandwidth Test Data

**Occupied Bandwidth (2.480GHz)**

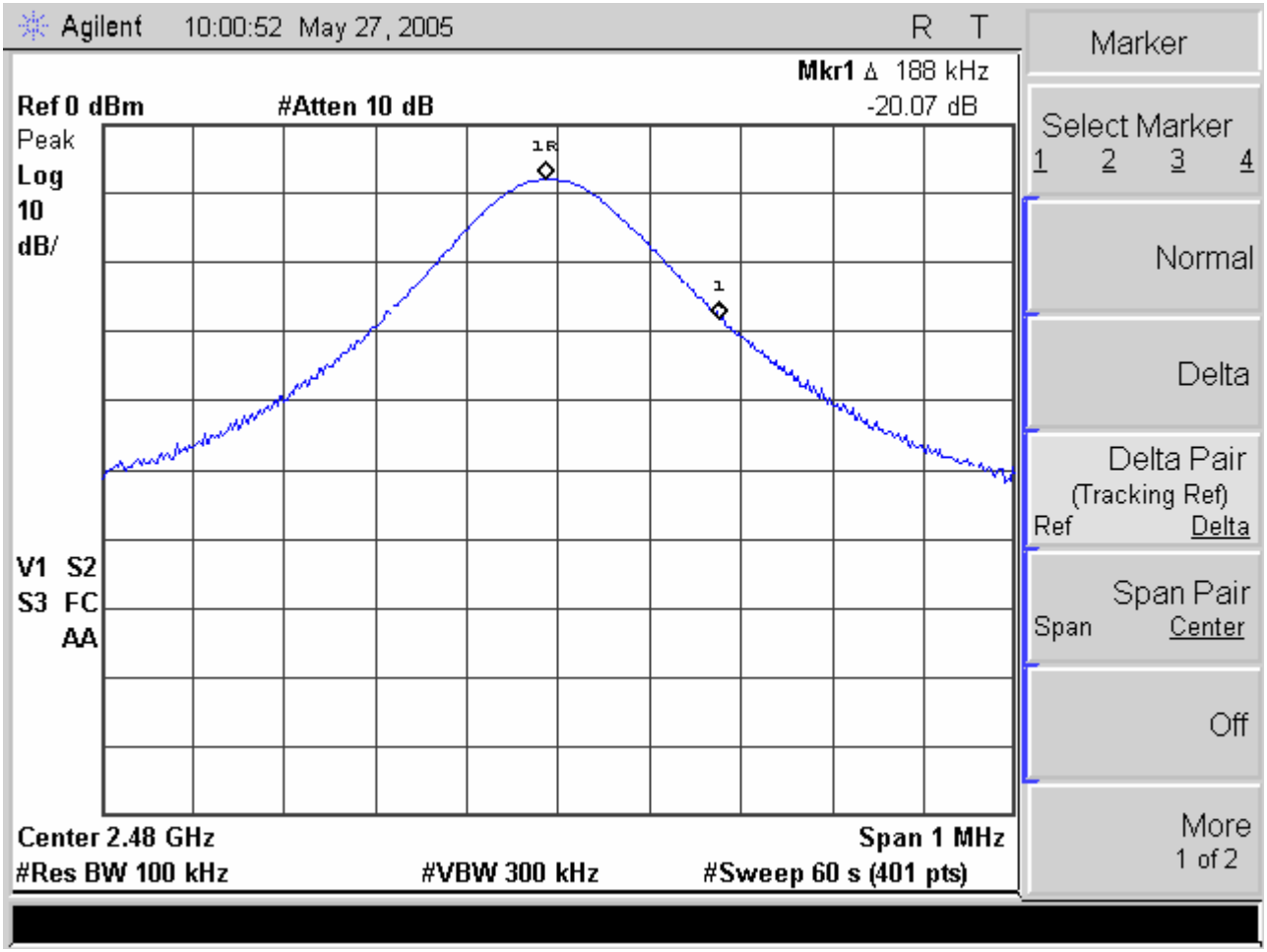



**Plot 5. Occupied Bandwidth; Test Results (2.480GHz); $F_{LOW}$**

**20 dB bandwidth = 178 kHz + 188 kHz = 366 kHz**

## Occupied Bandwidth Test Data

**Occupied Bandwidth (2.480GHz)**




**Plot 6. Occupied Bandwidth; Test Results (2.480GHz); $F_{HIGH}$**

**20 dB bandwidth = 178 kHz + 188 kHz = 366 kHz**

## 3.5 Output Power and RF Exposure

**Test Requirements:** **§15.247(i):** The maximum peak output power of the intentional radiator shall not exceed the following:

.

| Frequency Hopping Systems Band (MHz) | Output Limit for systems with 25 to <50 Channels (Watts) | Output Limit for systems with ≥ 50 Channels (Watts) |
|---|---|---|
| 902-928 | 0.250 | 1.000 |
| 2400–2483.5 MHz | 0.125 | 1.000 |
| 5725– 5850 MHz | 1.000 | 1.000 |

**Table 8. Output Power Requirements from §15.247**

Except for:

Systems operating in the 2400– 2483.5 MHz band, and

5725– 5850 MHz band that are used exclusively for fixed, point-to-point operations,

if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the Table 8, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400– 2483.5 MHz band may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725– 5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Fixed, point-to-point operation excludes the use of point-to-multipoint systems, omni-directional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

**RF Exposure Requirements - §15.247(b)(5); §1.1307(b)(1):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

**Test Procedure:** The transmitter output was connected to the spectrum analyzer through an attenuator. The RBW is larger than the bandwidth of the emission, VBW≥ RBW.

**Test Results:** The EUT complies with the requirements of this section.

Peak Output Power = 0.17 mW Conducted

The peak output power was determined from the plots on the following page(s).

MPE Calculation:

The TCB exclusion list defines the low power threshold in milliwatts for devices transmitting closer than 2.5cm as 60/f, where f is the midband frequency in GHz. The midband frequency for the EUT was 2.441 GHz., yielding a low power threshold of 24.58 mW. This is the threshold power below which SAR testing is not required.

The conducted output power of the device was 0.17 mW. The isotropic gain for the integral antenna was given as 2.1 dBi. Then the Effective Isotropic Radiated Power (EIRP) is 0.17 mW * $10^{2.1/10}$ = 0.28 mW. No other action is necessary, but an MPE calculation of the minimum allowable distance is presented for review:

The maximum permitted exposure for the general population is 1mW/cm$^2$. The formula used for MPE calculations is:

$Pd = PG / 4\pi r^2$ where

Pd = power density in W/cm$^2$

G = numerical antenna gain

r = minimum allowable distance

P = RF power to the antenna

Solving for r using the power density limit of 1mW/cm$^2$,

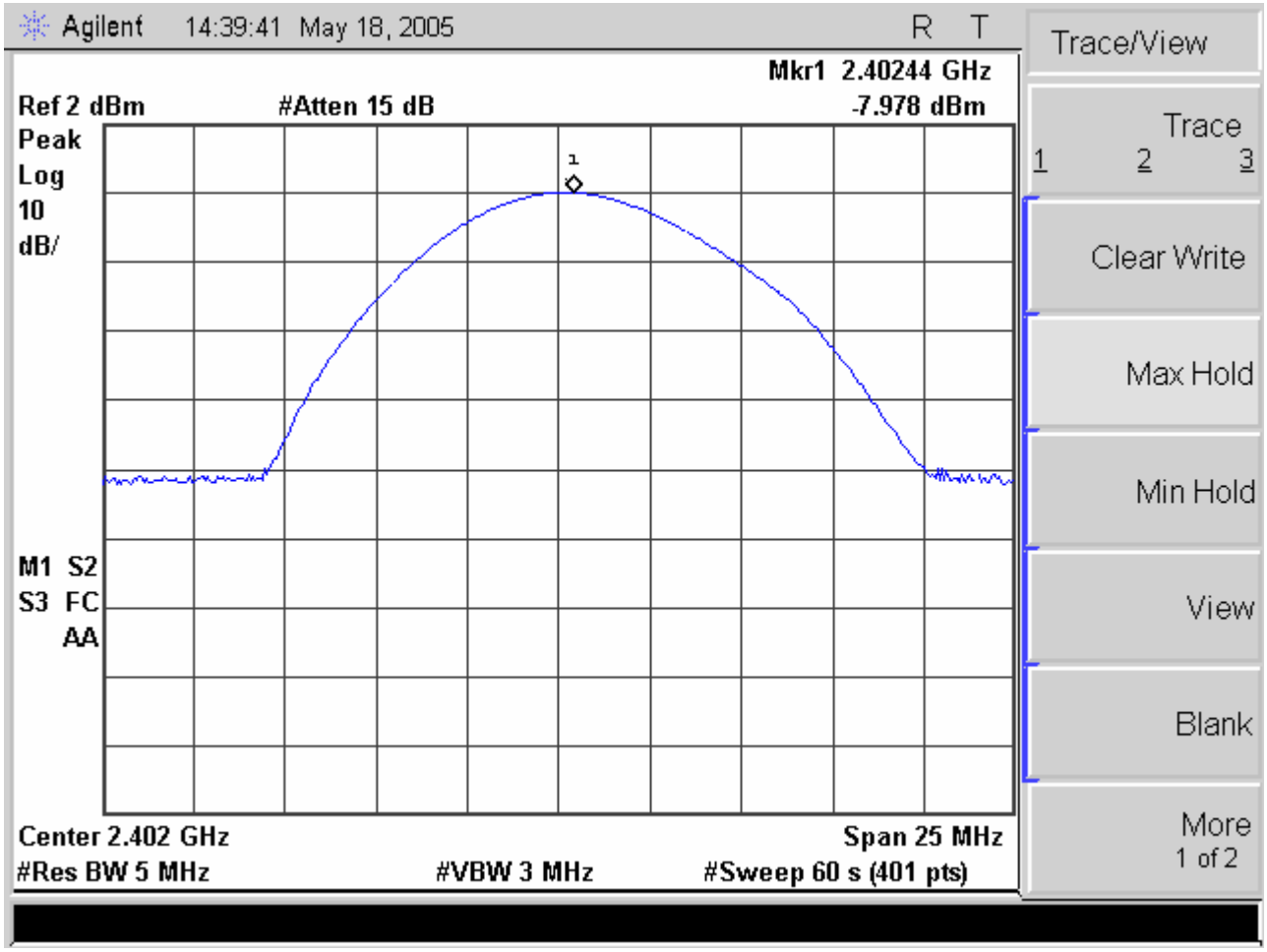
$r = (PG / 4\pi Pd)^{1/2} = (0.00028 / 4\pi)^{1/2} = 0.00472$ cm

**Test Engineer:** Christopher Eckert

**Test Date:** 5/18/2005

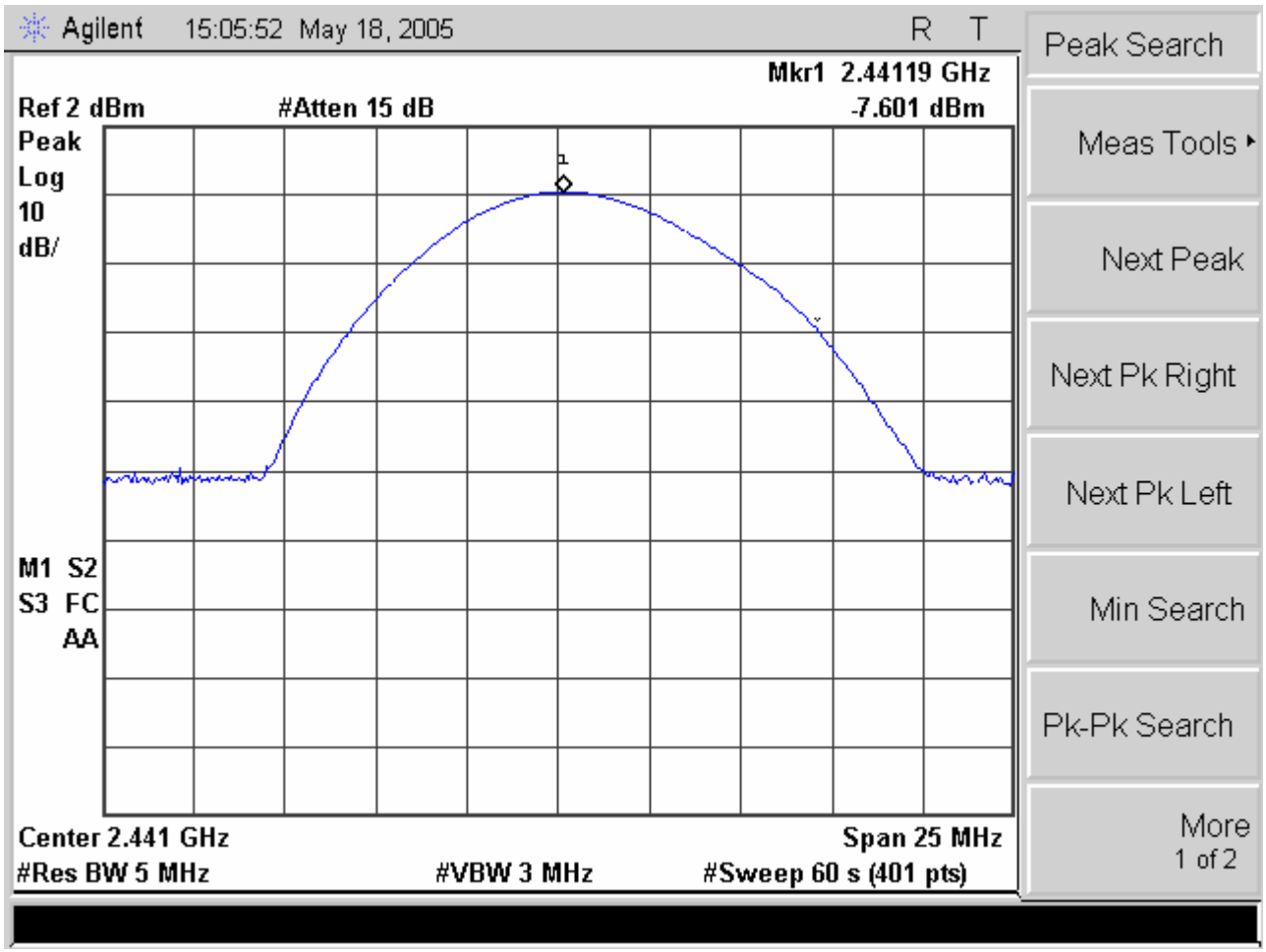
  

## Output Power and RF Exposure Test Results



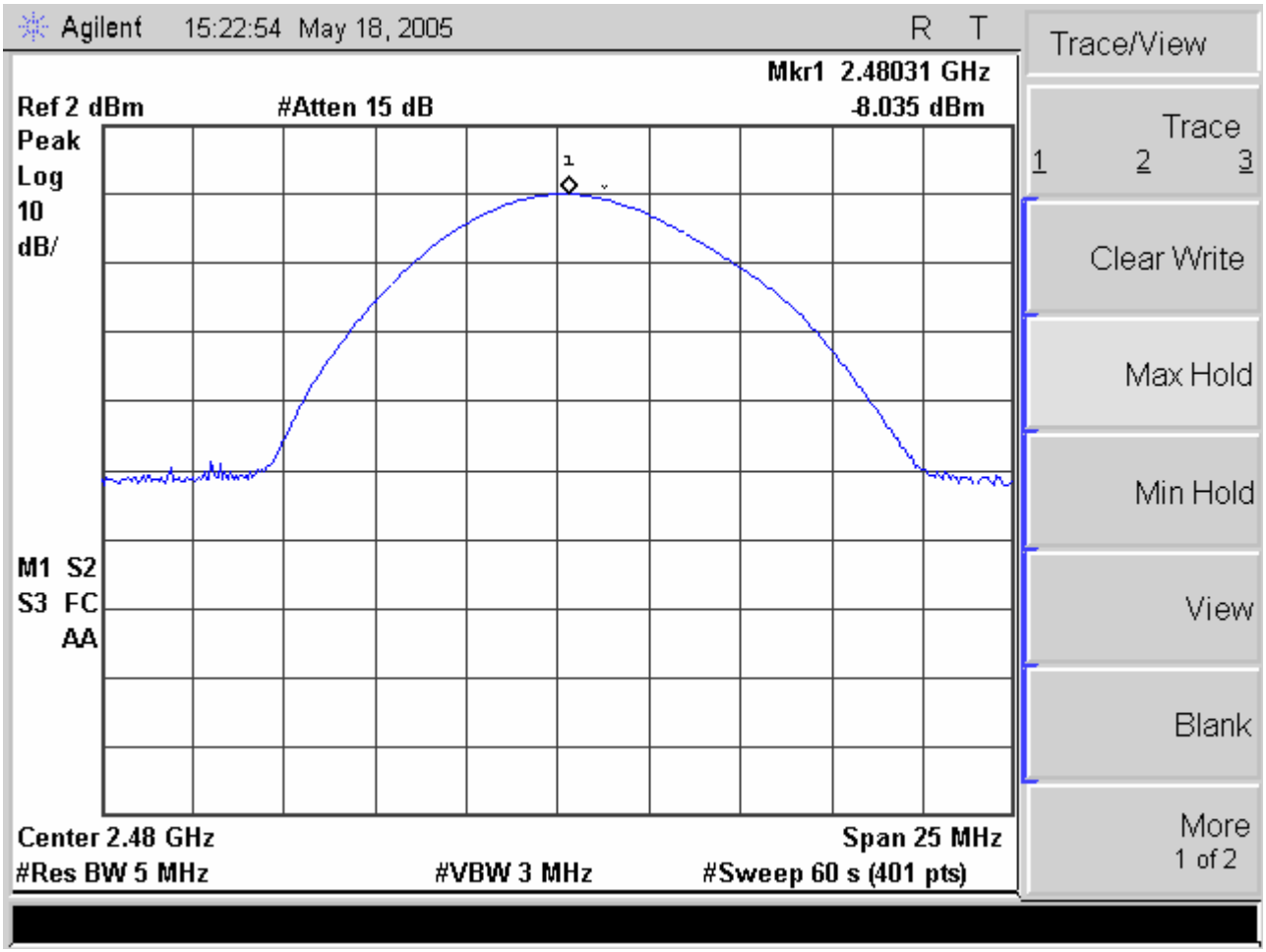

**Plot 7. Output Power Test Results (2.402 GHz)**

## Output Power and RF Exposure Test Results




**Plot 8. Output Power Test Results (2.441 GHz)**

## Output Power and RF Exposure Test Results




**Plot 9. Output Power Test Results (2.48 GHz)**

## Output Power and RF Exposure Test Set-up


**Photograph 2. Output Power; Test Setup**

## 3.6 Spurious Emissions Requirements - RF Conducted

**Test Requirements:** **§15.247(c);15.205 (a) ; 15.209(a):**

**§15.247(c):** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

**§15.205(a):** Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands in Table 6.

**Test Procedure:** The EUT was placed on a 0.8 m high wooden table inside a shielded enclosure. An antenna was placed near the EUT and measurements of frequencies and amplitudes of field strengths were recorded for reference during final measurements. For final radiated testing, measurements were performed in free space. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst case orientation for maximum emissions.

For frequencies from 30 MHz to 1 GHz, measurements were made using a quasi-peak detector with a 120 kHz bandwidth. For frequencies above 1 GHz, peak measurements were made with a resolution bandwidth of 1 MHz and a video bandwidth of 1MHz and average measurements were made with RBW = 1MHz and VBW = 10 Hz.

For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the $10^{th}$ harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

In accordance with §15.35(b) the limit on the radio frequency emissions as measured using instrumentation with a peak detector function shall be 20dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

For RF Conducted Emissions, the transmit output connected to the analyzer through the attenuator. RBW = 100 kHz, VBW $\geq$ RBW.

**Test Results:** The EUT complies with the requirements of this section.

**Test Engineer:** Christopher Eckert

**Test Date:** 5/18/2005

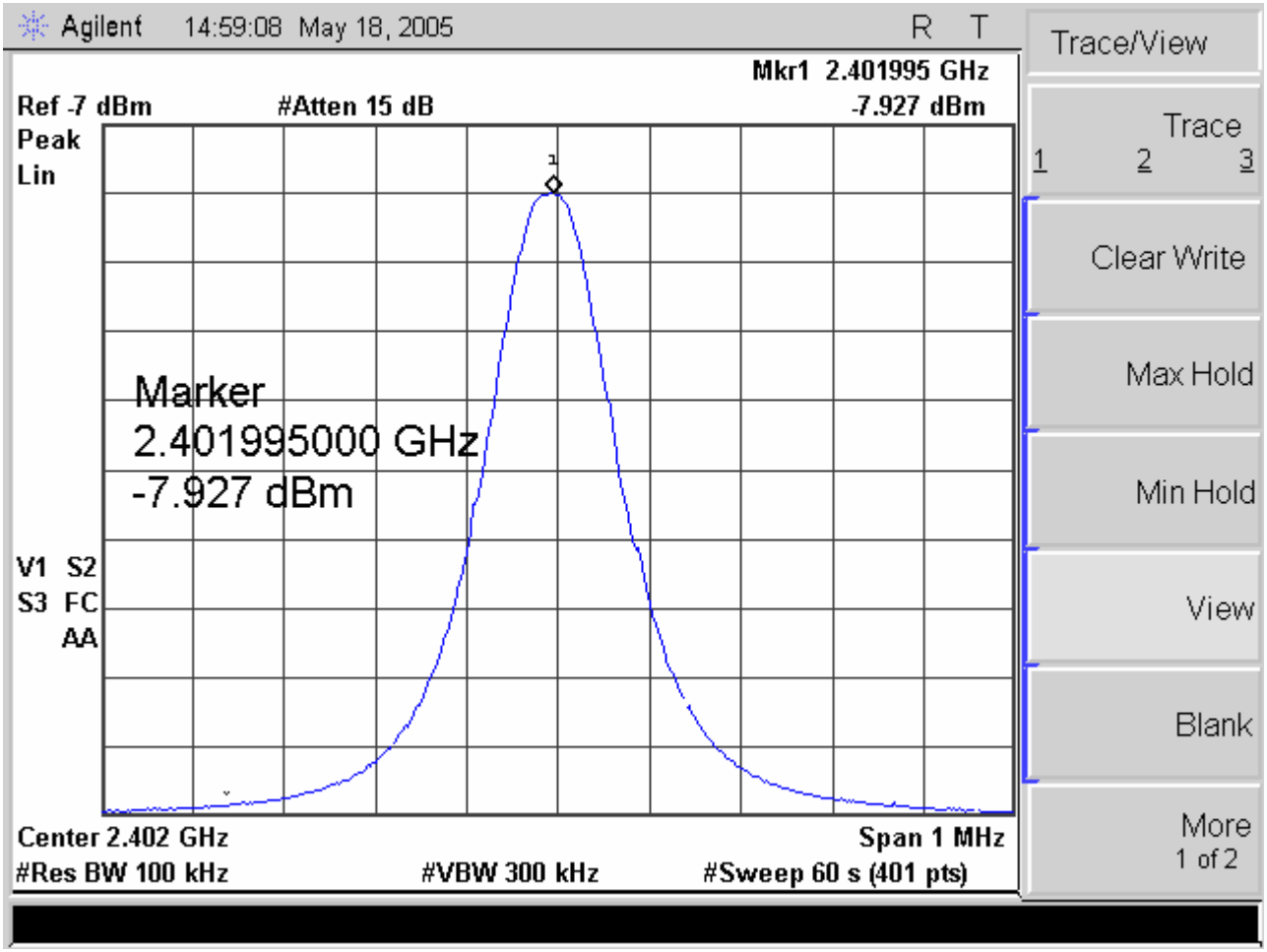
## Spurious Emissions Requirements –RF Conducted Test Data

### RF Conducted Results –Low Channel

| Harmonic | Frequency (GHz) | Max Transmit Power (dBm) | Measured Conducted Power (dBm) | Limit (dBm) | Margin (dB) | Comment |
|---|---|---|---|---|---|---|
| 1 | 2.4020 | N/A | -7.93 | N/A | N/A | Reference |
| 2 | 4.8040 | -7.93 | -59.09 | -27.93 | -31.16 | PASS |
| 3 | 7.2060 | -7.93 | -64.53 | -27.93 | -36.60 | PASS |
| 4 | 9.6080 | -7.93 | -68.76 | -27.93 | N/A | Noise Floor |
| 5 | 12.0100 | -7.93 | -81.77 | -27.93 | N/A | Noise Floor |
| 6 | 14.4120 | -7.93 | -78.36 | -27.93 | N/A | Noise Floor |
| 7 | 16.8140 | -7.93 | N/A | -27.93 | N/A | Noise Floor |
| 8 | 19.2160 | -7.93 | N/A | -27.93 | N/A | Noise Floor |
| 9 | 21.6180 | -7.93 | N/A | -27.93 | N/A | Noise Floor |
| 10 | 24.0200 | -7.93 | N/A | -27.93 | N/A | Noise Floor |

## Spurious Emissions Requirements –RF Conducted Test Data

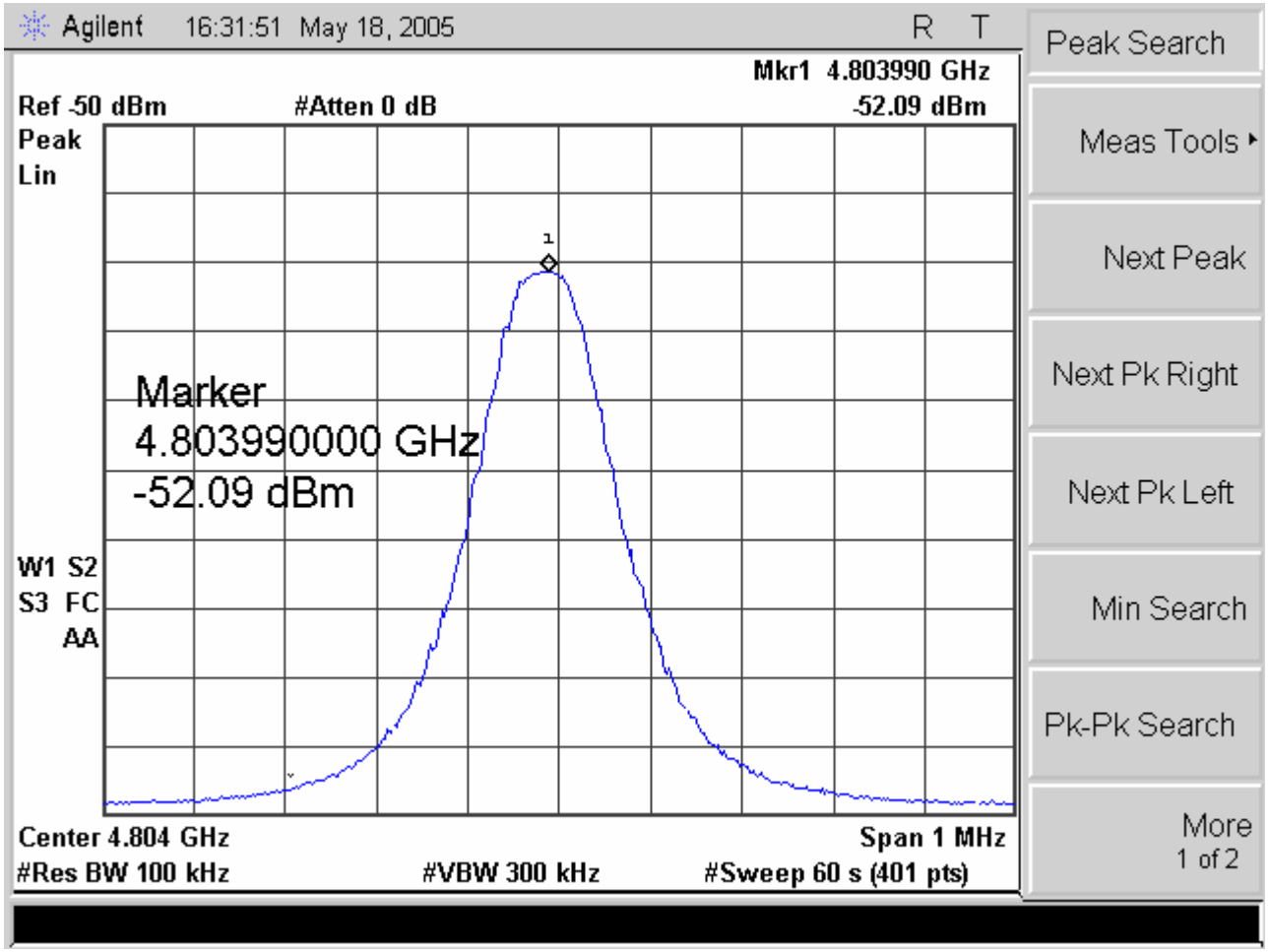
### RF Conducted Results –Low Channel




**Plot 10. RF Conducted Results –Low Channel; Test Results**

## Spurious Emissions Requirements –RF Conducted Test Data

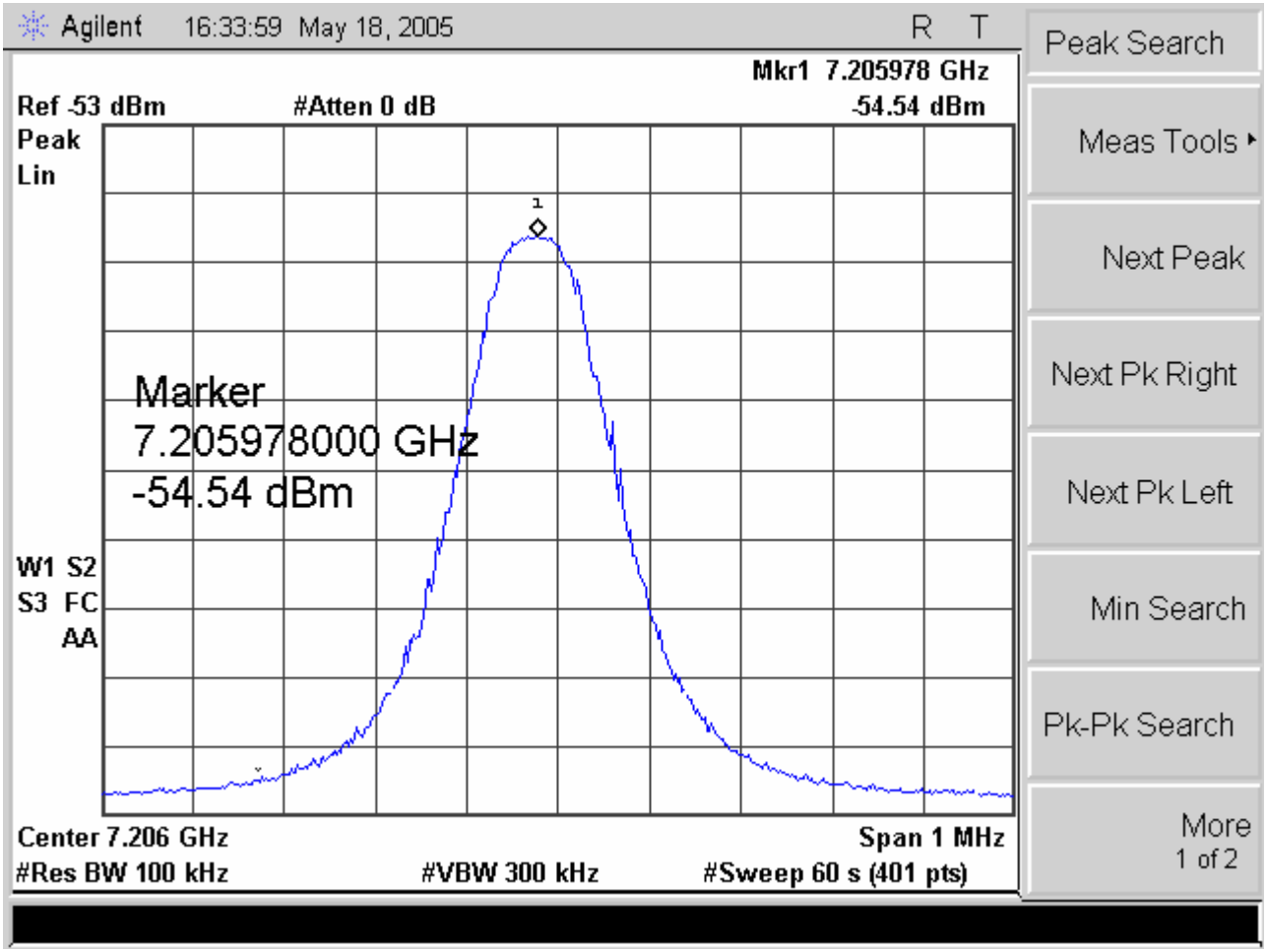
### RF Conducted Results –Low Channel




**Plot 11. RF Conducted Results –Low Channel; Test Results**

## Spurious Emissions Requirements –RF Conducted Test Data

**RF Conducted Results –Low Channel**




**Plot 12. RF Conducted Results –Low Channel; Test Results**

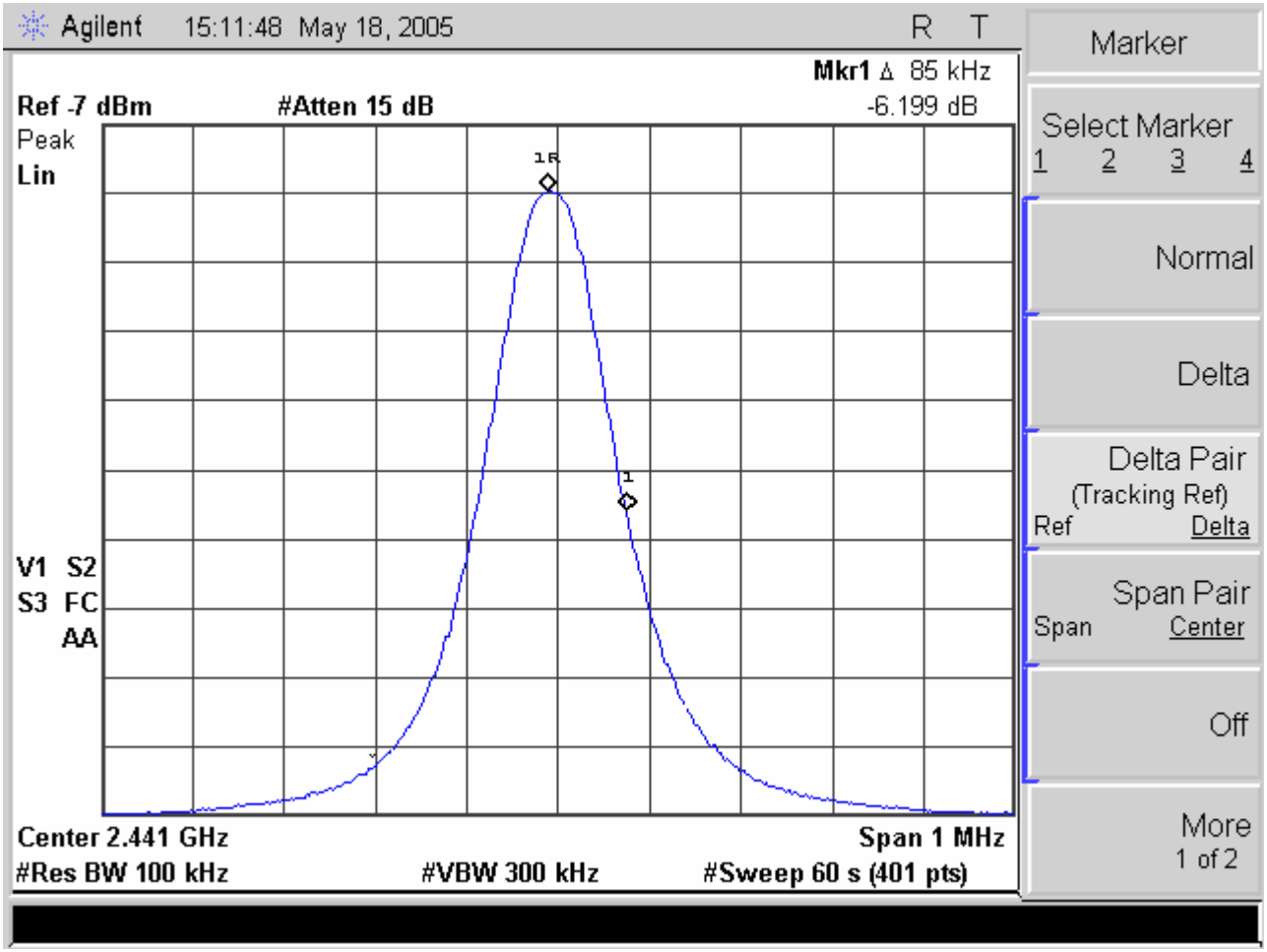
## Spurious Emissions Requirements –RF Conducted Test Data

### RF Conducted Results Mid Channel

| Harmonic | Frequency (GHz) | Max Transmit Power (dBm) | Measured Conducted Power (dBm) | Limit (dBm) | Margin (dB) | Comment |
|---|---|---|---|---|---|---|
| 1 | 2.4410 | -7.97 | -7.97 | N/A | N/A | Reference |
| 2 | 4.8820 | -7.97 | -57.19 | -27.97 | -29.22 | PASS |
| 3 | 7.3230 | -7.97 | -67.86 | -27.97 | -39.89 | PASS |
| 4 | 9.7640 | -7.97 | -74.74 | -27.97 | N/A | Noise Floor |
| 5 | 12.2050 | -7.97 | -80.84 | -27.97 | N/A | Noise Floor |
| 6 | 14.6460 | -7.97 | N/A | -27.97 | N/A | Noise Floor |
| 7 | 17.0870 | -7.97 | N/A | -27.97 | N/A | Noise Floor |
| 8 | 19.5280 | -7.97 | N/A | -27.97 | N/A | Noise Floor |
| 9 | 21.9690 | -7.97 | N/A | -27.97 | N/A | Noise Floor |
| 10 | 24.4100 | -7.97 | N/A | -27.97 | N/A | Noise Floor |

## Spurious Emissions Requirements –RF Conducted Test Data

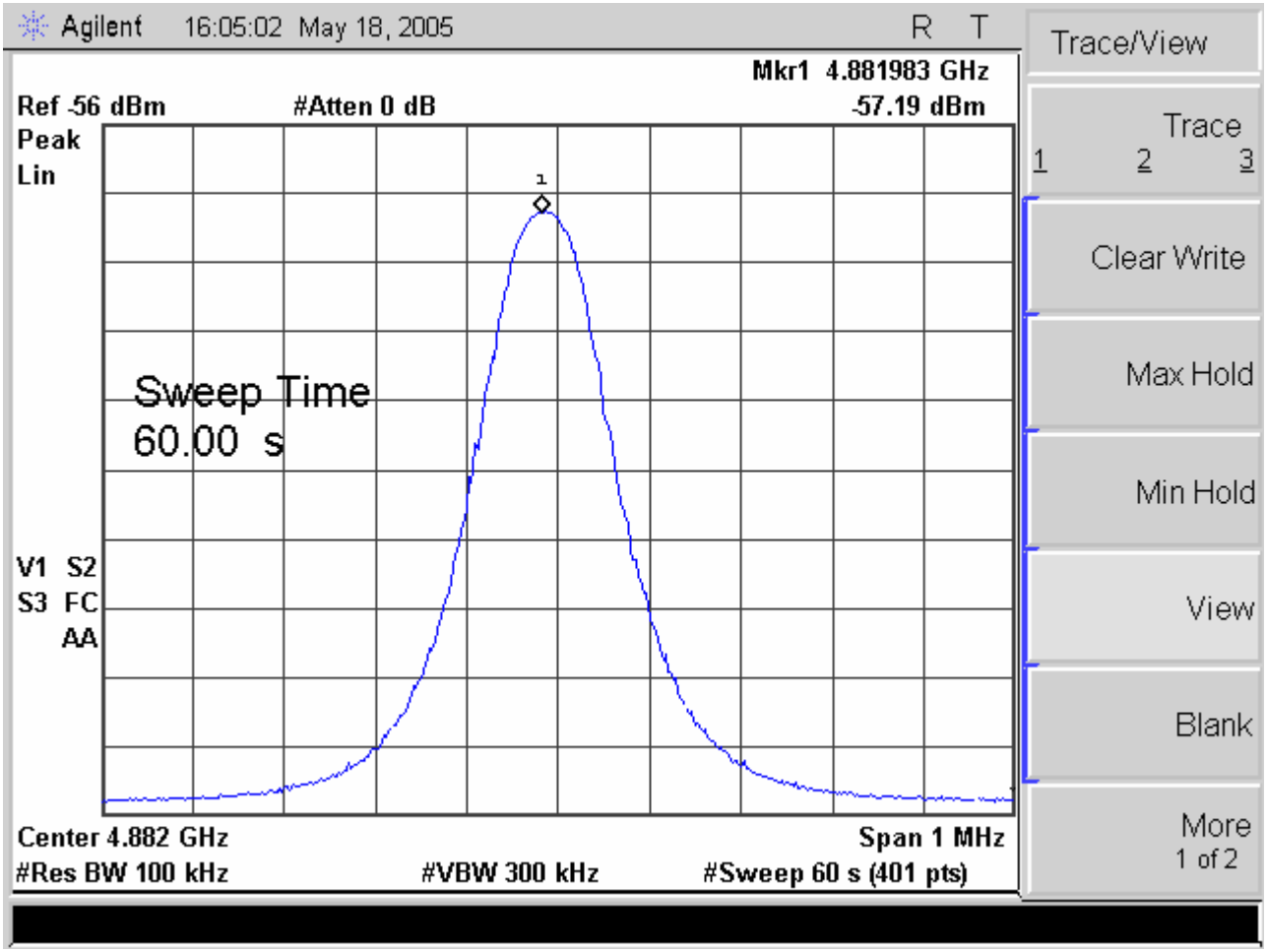
### RF Conducted Results –Mid Channel




**Plot 13. RF Conducted Results –Mid Channel; Test Results**

## Spurious Emissions Requirements –RF Conducted Test Data

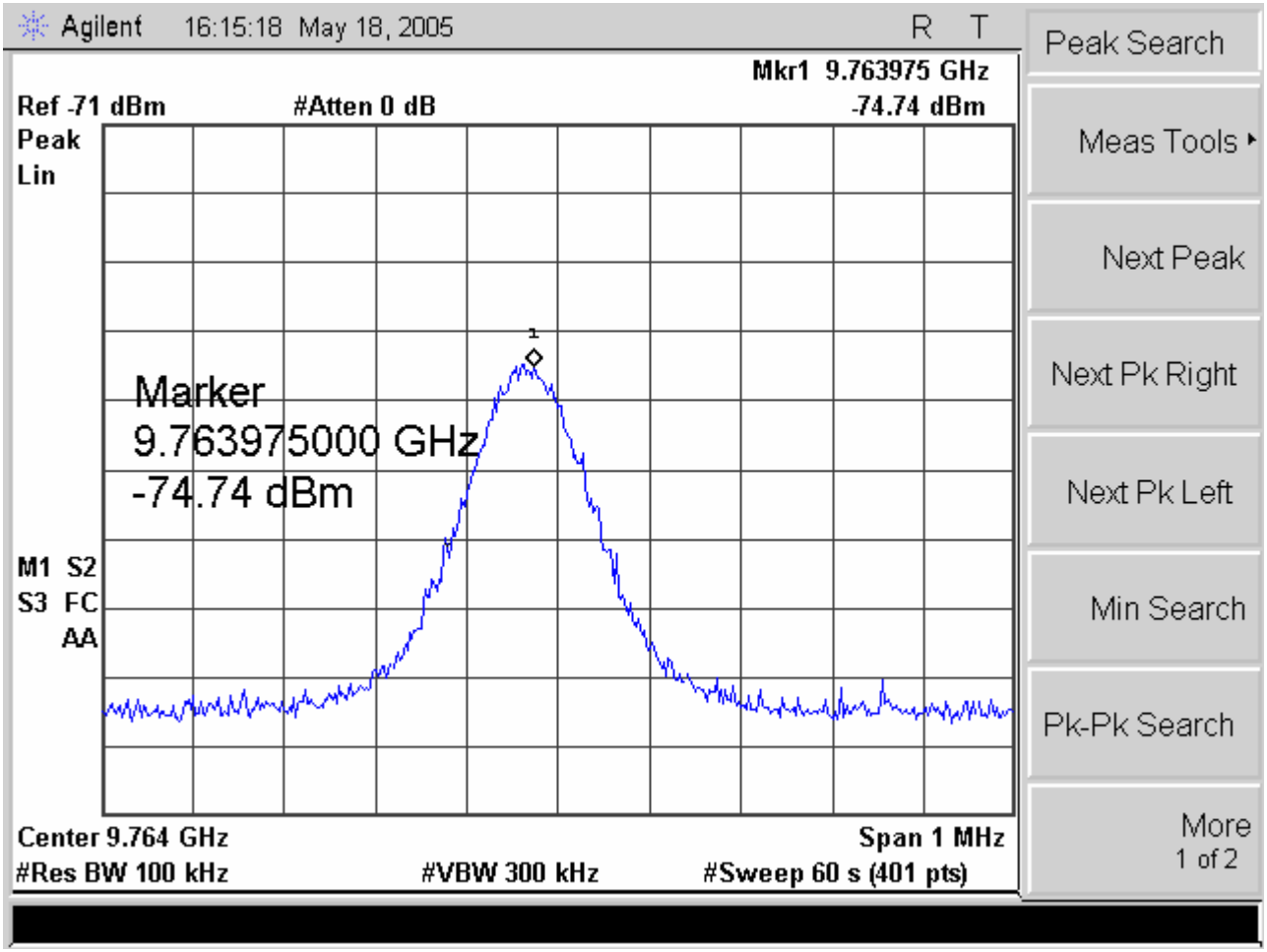
**RF Conducted Results –Mid Channel**




**Plot 14. RF Conducted Results –Mid Channel; Test Results**

## Spurious Emissions Requirements –RF Conducted Test Data

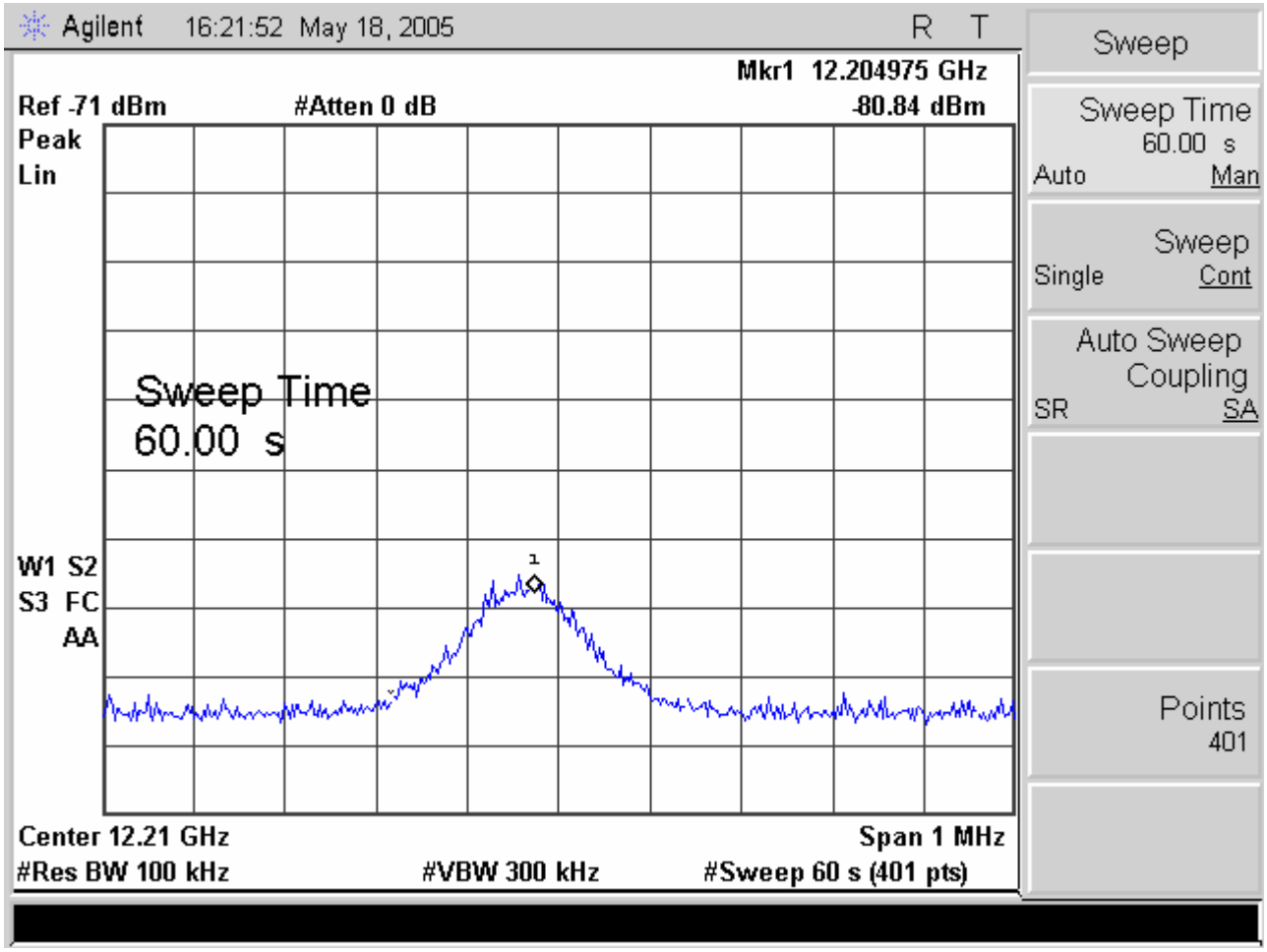
**RF Conducted Results –Mid Channel**




**Plot 15. RF Conducted Results –Mid Channel; Test Results**

## Spurious Emissions Requirements –RF Conducted Test Data

**RF Conducted Results –Mid Channel**




**Plot 16. RF Conducted Results –Mid Channel; Test Results**

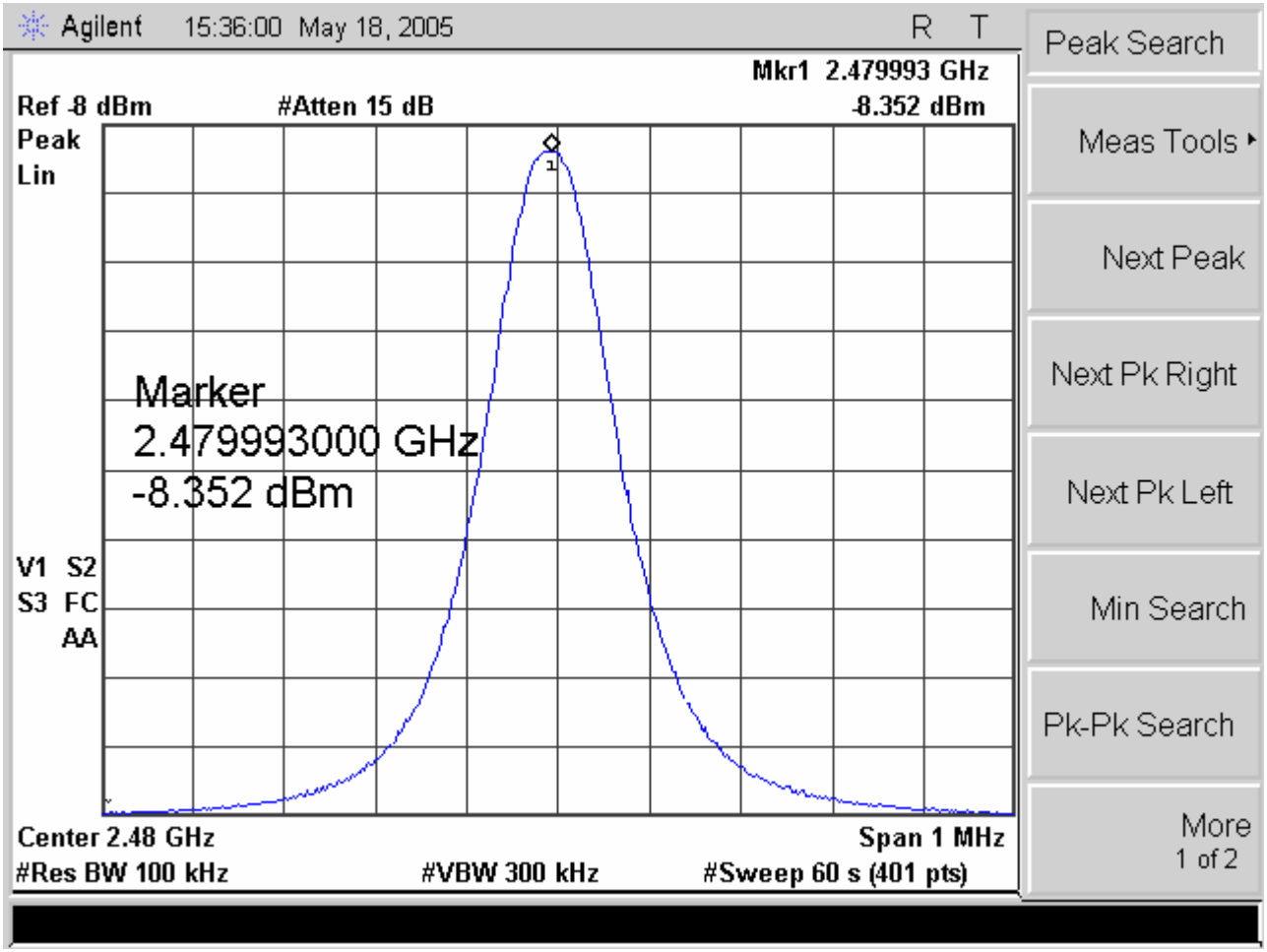
## Spurious Emissions Requirements –RF Conducted Test Data

### RF Conducted Results –High Channel

| Harmonic | Frequency (GHz) | Max Transmit Power (dBm) | Measured Conducted Power (dBm) | Limit (dBm) | Margin (dB) | Comment |
|---|---|---|---|---|---|---|
| 1 | 2.4800 | -8.35 | -8.352 | N/A | N/A | Reference |
| 2 | 4.9600 | -8.35 | -62.62 | -28.35 | -34.27 | PASS |
| 3 | 7.4400 | -8.35 | -64.68 | -28.35 | -36.33 | PASS |
| 4 | 9.9200 | -8.35 | -82.27 | -28.35 | N/A | Noise Floor |
| 5 | 12.4000 | -8.35 | N/A | -28.35 | N/A | Noise Floor |
| 6 | 14.8800 | -8.35 | N/A | -28.35 | N/A | Noise Floor |
| 7 | 17.3600 | -8.35 | N/A | -28.35 | N/A | Noise Floor |
| 8 | 19.8400 | -8.35 | N/A | -28.35 | N/A | Noise Floor |
| 9 | 22.3200 | -8.35 | N/A | -28.35 | N/A | Noise Floor |
| 10 | 24.8000 | -8.35 | N/A | -28.35 | N/A | Noise Floor |

## Spurious Emissions Requirements –RF Conducted Test Data

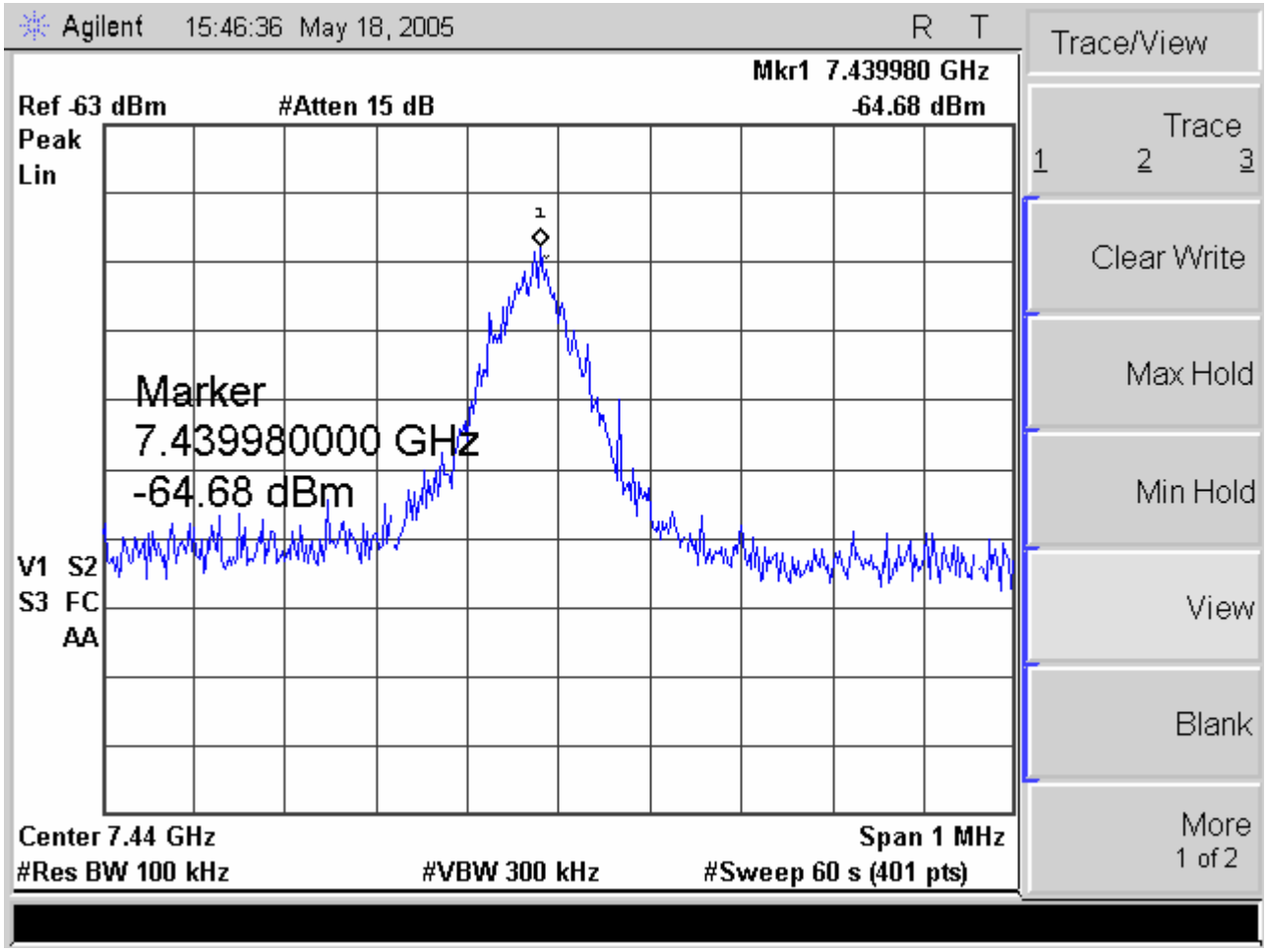
**RF Conducted Results –High Channel**




**Plot 17. RF Conducted Results –High Channel; Test Results**

## Spurious Emissions Requirements –RF Conducted Test Data

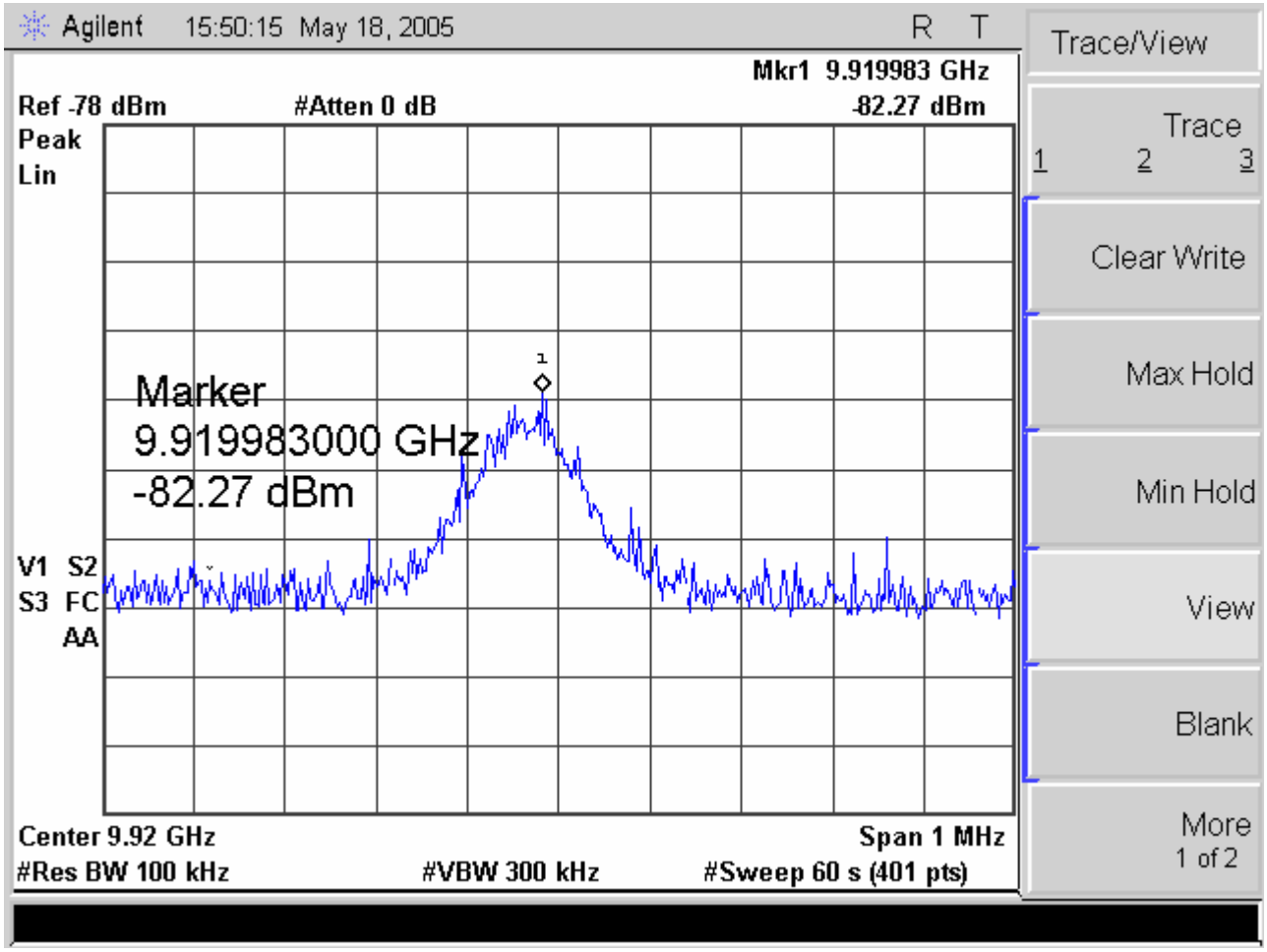
**RF Conducted Results –High Channel**




**Plot 18. RF Conducted Results –High Channel; Test Results**

## Spurious Emissions Requirements –RF Conducted Test Data

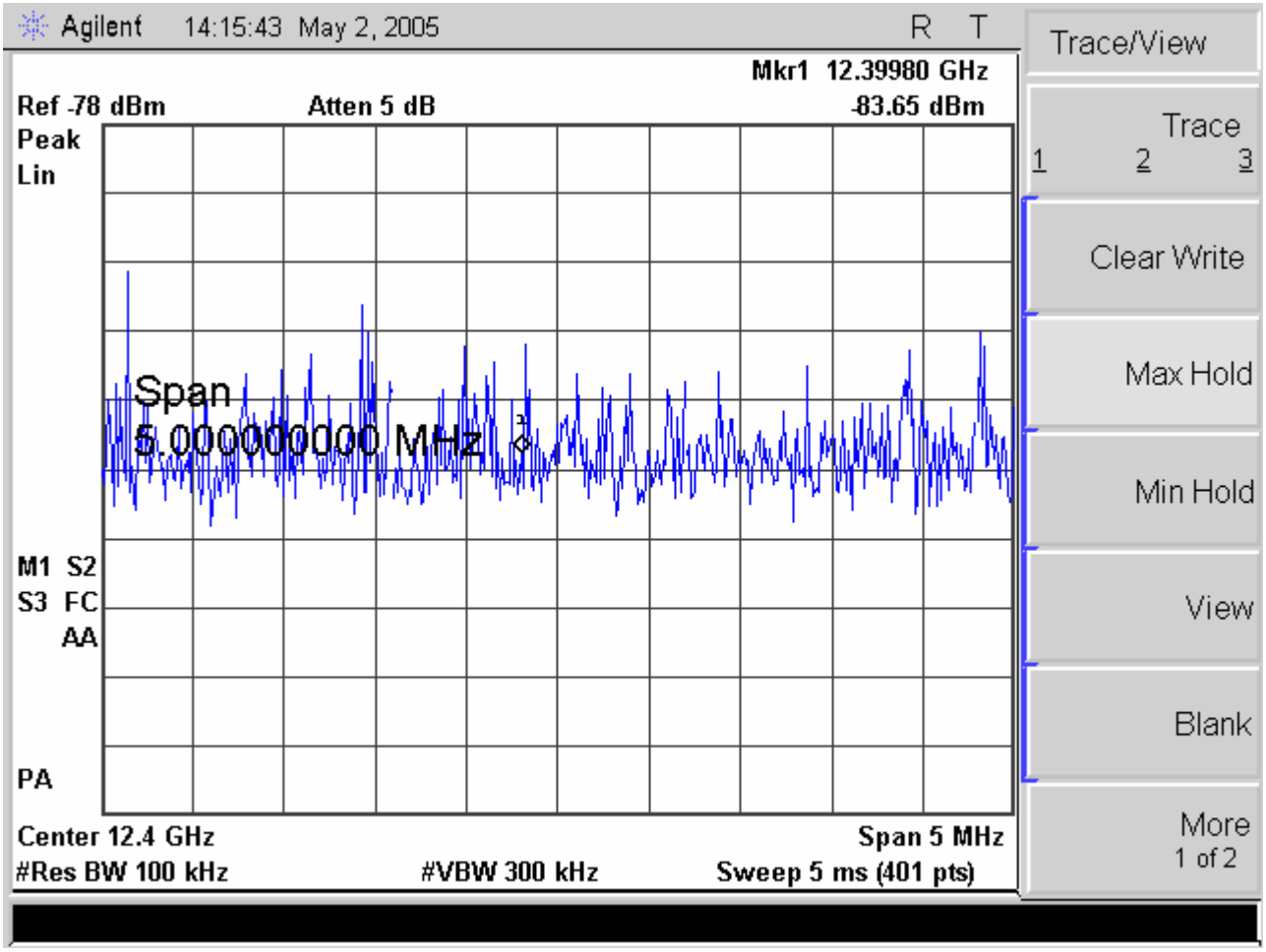
**RF Conducted Results –High Channel**




**Plot 19. RF Conducted Results –High Channel; Test Results**

## Spurious Emissions Requirements –RF Conducted Test Data

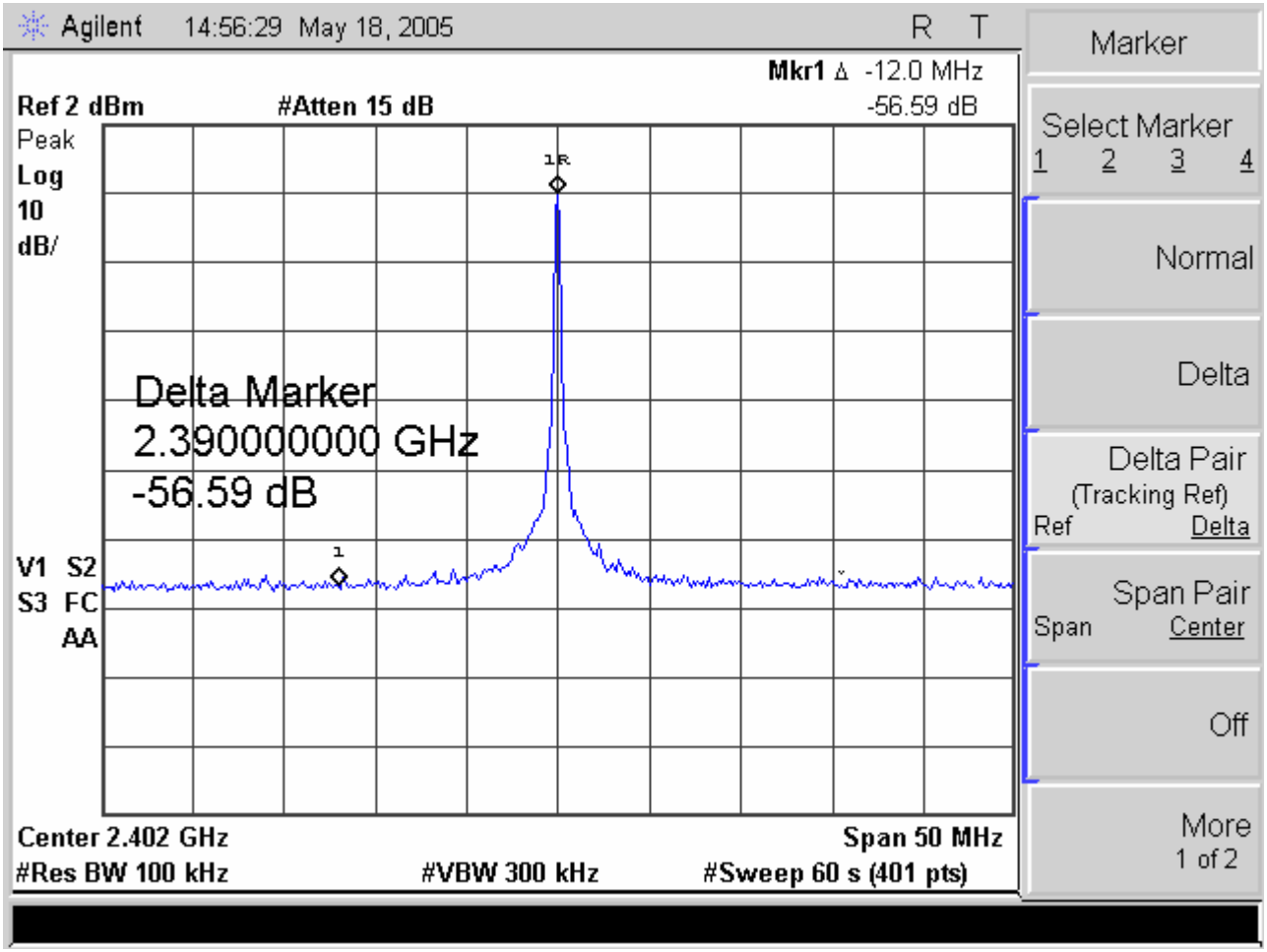
**RF Conducted Results –High Channel**




**Plot 20. RF Conducted Results –High Channel; Test Results**

## Spurious Emissions Requirements –RF Conducted Test Data – Band Edge Plots

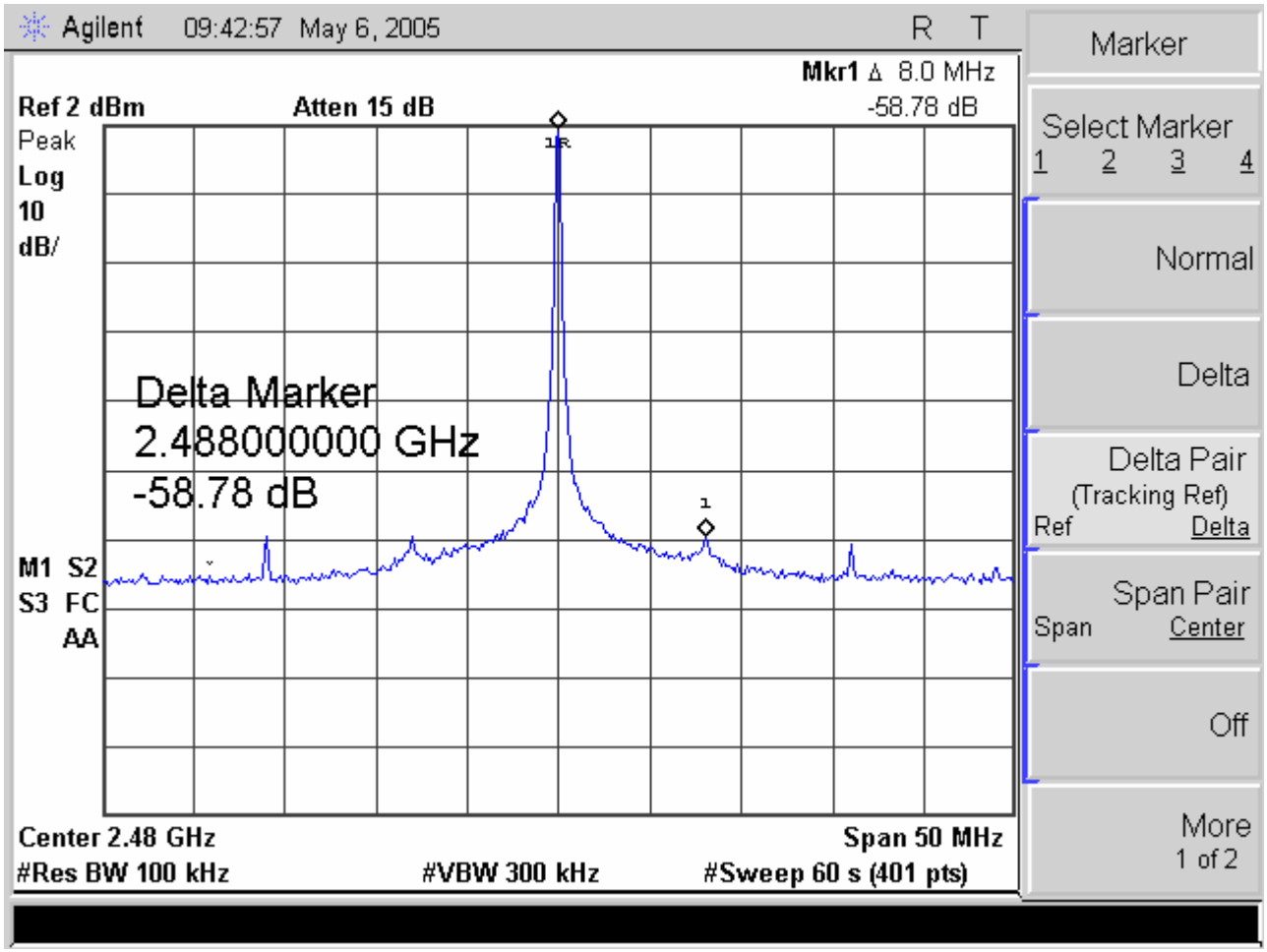
**Lower Band Edge**:




**Plot 21. RF Conducted Results – Lower Band Edge**

## Spurious Emissions Requirements –RF Conducted Test Data – Band Edge Plots

**Upper Band Edge**:




**Plot 22. RF Conducted Results – Upper Band Edge**

## 3.7 Hopping Capability Requirements

**Test Requirements:** **§15.247(g):** Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

**Test Procedure:** As required by this section, a statement describing the hopping capability of this EUT is submitted as a separate exhibit.

**Test Results:** The EUT complies with the requirements of this section. (See Appendix B)

## 3.8 Non-Coordinating Requirements

**Test Requirements:** **§15.247(h):** The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of voiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

**Test Procedure:** As required by this section, a statement describing the non-coordinating capability of this EUT is submitted as a separate exhibit.

**Test Results:** The EUT complies with the requirements of this section. (See Appendix B)

## 4.0 Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

| Test Name: **Antenna Port Conducted Emissions** | | | | | Test Date(s): **5/2/2005, 5/26/2005** |
|---|---|---|---|---|---|
| **MET Asset #** | **Nomenclature** | **Manufacturer** | **Model** | **Last Cal Date** | **Cal Due Date** |
| 1T4351 | SPECTRUM ANALYZER | AGILENT | E7405A | 09/28/2004 | 09/28/2005 |
| 1T4459 | THERMO-HYGROMETER | FISHER SCIENTIFIC | 11-661-71D | 11/08/2004 | 11/08/2006 |
| Test Name: **Radiated Spurious Emissions** | | | | | Test Date(s): **05/24/2005** |
| **MET Asset #** | **Nomenclature** | **Manufacturer** | **Model** | **Last Cal Date** | **Cal Due Date** |
| 1T4351 | SPECTRUM ANALYZER | AGILENT | E7405A | 09/28/2004 | 09/28/2005 |
| 1T2511 | ANTENNA; HORN | EMCO | 3115 | 07/14/2004 | 07/14/2005 |
| 1T4354 | SIGNAL GENERATOR | HEWLETT PACKARD | 83752A | 12/13/2004 | 12/13/2005 |
| 1T4459 | THERMO-HYGROMETER | FISHER SCIENTIFIC | 11-661-71D | 11/08/2004 | 11/08/2006 |

Note 1: The cable supplied for the antenna port tests was about 4 inches long and was soldered directly to the antenna port terminals. The loss of this cable was considered to be negligible.

# 5.0 Compliance Information

## 5.1 Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

**§ 2.801 Radio-frequency device defined.**

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

(a) The various types of radio communication transmitting devices described throughout this chapter.

*(b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.*

(c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.

(d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

**§ 2.803 Marketing of radio frequency devices prior to equipment authorization.**

(a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:

(1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or

(2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.

(d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

*(i) Compliance testing;*

(ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or

(v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

**The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:**

**§ 2.901 Basis and Purpose**

(a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.[1] *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer*, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.

(b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

**§ 2.907 Certification.**

(a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.

(b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

[1] In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

## § 2.948 Description of measurement facilities.

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

*(i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.*

(ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.

(2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

## 5.2 Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

**§ 15.19 Labeling requirements.**

*(a) In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:*

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

*This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.*

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

**§ 15.21 Information to user.**

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

## § 15.27 Special Accessories.

(a) Equipment marketed to a consumer must be capable of complying with the necessary regulations in the configuration in which the cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer, without additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in §2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

## § 15.105 Information to the user.

(a) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

> Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
>
> – Reorient or relocate the receiving antenna.
>
> – Increase the separation between the equipment and receiver.
>
> – Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
>
> – Consult the dealer or an experienced radio/TV technician for help.

## 6.0 Bluetooth Declaration Per FCC 15.247 Requirements

**1. Co-ordination of the hopping sequence in data mode to avoid simultaneous occupancy by multiple transmitters:**

Bluetooth units which want to communicate with other units must be organized in a structure called piconet. This piconet consist of max. 8 Bluetooth units. One unit is the master the other seven are the slaves. The master co-ordinates frequency occupation in this piconet for all units. As the master hop sequence is derived from it's BD address which is unique for every Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences.

**2. Example of a hopping sequence in data mode:**

Example of a 79 hopping sequence in data mode:
40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65, 54, 67,
56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59,
72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75,
09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06,
01, 51, 03, 55, 05, 04

**3. Equally average use of frequencies in data mode and behavior for short transmissions:**

The generation of the hopping sequence in connection mode depends essentially on two input values:

1. LAP/UAP of the master of the connection

2. Internal master clock The LAP (lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 BD_ADDRESS.

3. The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronization with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5 µs. The clock has a cycle of about one day (23h30). In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire LAP (24 bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used.

4. With this input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the sequence. This will be done at the beginning of every new transmission. Regarding short transmissions the Bluetooth system has the following behaviors:

> The first connection between the two devices is established, a hopping sequence was generated. For transmitting the wanted data the complete hopping sequence was not used. The connection ended.

5. The second connection will be established. A new hopping sequence is generated. Due to the fact that the Bluetooth clock has a different value, because the period between the two transmission is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5 µs). The hopping sequence will always differ from the first one.

**4. Receiver input bandwidth and behaviors for repeated single or multiple packets:**

The input bandwidth of the receiver is 1 MHz.
In every connection one Bluetooth device is the master and the other one is the slave.

The master determines the hopping sequence (see chapter 5). The slave follows this sequence:

Both devices shift between RX and TX time slot according to the clock of the master.

Additionally the type of connection (e.g. single or multislot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings.

Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

**5. Dwell time in data mode**
The dwell time of 0.3797s within a 30 second period in data mode is independent from the packet type (packet length). The calculation for a 30 second period is a follows:

Dwell time = time slot length * hop rate / number of hopping channels *30s

Example for a DH1 packet (with a maximum length of one time slot)

Dwell time = 625 µs * 1600 1/s / 79 * 30s = 0.3797s (in a 30s period)

For multislot packet the hopping is reduced according to the length of the packet.
Example for a DH5 packet (with a maximum length of five time slots)

Dwell time = 5 * 625 µs * 1600 * 1/5 *1/s / 79 * 30s = 0.3797s (in a 30s period)

This is according the Bluetooth Core Specification V 1.0B (+ critical errata) for all Bluetooth devices. There for all Bluetooth devices **comply** with the FCC dwell time requirement in data mode. This was checked during the Bluetooth Qualification tests. The Dwell time in hybrid mode is measured and stated in the test report.