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August 27, 2010

Apple Inc.
1 Infinite Loop, M/S 26A
Cupertino, CA 95014

Dear Mike Kriege,

Enclosed is the EMC Wireless test report for compliance testing of the Apple Inc., Model A1378 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B, ICES-003, Issue 4 February 2004 for a Class A Digital Device and FCC Part 15 Subpart C, RSS-210, Issue 7, June 2007 for Intentional Radiators.

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.

Jennifer Warnell
Documentation Department

Reference: (\Apple Inc.\EMCS82333B-FCC247 Rev. 2)

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Electromagnetic Compatibility Criteria Test Report

for the

**Apple Inc.
Model A1378**

Tested under
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B & ICES-003
for Class A Digital Devices
&
15.247 Subpart C & RSS-210, Issue 7, June 2007
for Intentional Radiators

MET Report: EMCS82333B-FCC247 Rev. 2

August 27, 2010

Prepared For:

**Apple Inc.
1 Infinite Loop, M/S 26A
Cupertino, CA 95014**

Prepared By:
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914 W. Patapsco Ave
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&
15.247 Subpart C & RSS-210, Issue 7, June 2007
for Intentional Radiators



Minh Ly, Project Engineer
Electromagnetic Compatibility Lab



Jennifer Warnell
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 the FCC Rules Parts 15B, 15.247 and Industry Canada standards ICES-003, Issue 4 February 2004, RSS-210, Issue 7, June 2007 under normal use and maintenance.



Shawn McMillen,
Wireless Manager, Electromagnetic Compatibility Lab

Report Status Sheet

| Revision | Report Date | Reason for Revision |
|----------|-----------------|--|
| Ø | August 25, 2010 | Initial Issue. |
| 1 | August 25, 2010 | Revised to reflect correct customer address. |
| 2 | August 27, 2010 | Revised to reflect engineer corrections. |

Table of Contents

| | | |
|-------------|---|-----------|
| I. | Executive Summary | 1 |
| | A. Purpose of Test | 2 |
| | B. Executive Summary | 2 |
| II. | Equipment Configuration | 3 |
| | A. Overview | 4 |
| | B. References | 5 |
| | C. Test Site | 5 |
| | D. Description of Test Sample | 6 |
| | E. Equipment Configuration | 6 |
| | F. Support Equipment | 6 |
| | G. Ports and Cabling Information | 6 |
| | H. Mode of Operation | 6 |
| | I. Modifications | 7 |
| | a) Modifications to EUT | 7 |
| | b) Modifications to Test Standard | 7 |
| | J. Disposition of EUT | 7 |
| III. | Electromagnetic Compatibility Criteria for Unintentional Radiators | 8 |
| | § 15.107(a) Conducted Emissions Limits | 9 |
| | § 15.109(a) Radiated Emissions Limits | 12 |
| IV. | Electromagnetic Compatibility Criteria for Intentional Radiators | 14 |
| | § 15.203 Antenna Requirement | 15 |
| | § 15.207(a) Conducted Emissions Limits | 16 |
| | § 15.247(a) Bandwidth & Channelization Requirements | 19 |
| | § 15.247 Carrier Frequency Separation | 25 |
| | § 15.247 Number of Channels and Time of Occupancy | 26 |
| | § 15.247(b) Peak Power Output and RF Exposure | 31 |
| | § 15.247(b) RF Exposure | 35 |
| | § 15.247(d) Radiated Spurious Emissions Requirements and Band Edge | 36 |
| | RSS-GEN Receiver Spurious Emissions | 46 |
| | § 15.247(d) RF Conducted Spurious Emissions Requirements and Band Edge | 48 |
| V. | Test Equipment | 52 |
| VI. | Certification & User's Manual Information | 54 |
| | A. Certification Information | 55 |
| | B. Label and User's Manual Information | 59 |
| VII. | ICES-003 Procedural & Labeling Requirements | 61 |

List of Tables

| | |
|---|----|
| Table 1. Executive Summary of EMC Part 15.247 Compliance Testing | 2 |
| Table 2. EUT Summary Table..... | 4 |
| Table 3. References | 5 |
| Table 4. Equipment Configuration | 6 |
| Table 5. Support Equipment..... | 6 |
| Table 6. Ports and Cabling Information | 6 |
| Table 7. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b) and 15.207(a) | 9 |
| Table 8. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)..... | 10 |
| Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)..... | 11 |
| Table 10. Radiated Emissions Limits calculated from FCC Part 15, § 15.109 (a) (b) | 12 |
| Table 11. Radiated Emissions Limits, Test Results | 13 |
| Table 13. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a) | 16 |
| Table 14. Conducted Emissions, 15.207, Test Results..... | 17 |
| Table 15. Occupied Bandwidth, Test Results, GFSK Modulation | 20 |
| Table 16. Occupied Bandwidth, Test Results, 8PSK Modulation..... | 20 |
| Table 17. Output Power Requirements from §15.247 | 31 |
| Table 18. Peak Conducted Output Power, Test Results, GFSK Modulation..... | 32 |
| Table 19. Peak Conducted Output Power, Test Results, 8PSK..... | 32 |
| Table 20. Restricted Bands of Operation..... | 36 |
| Table 21. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a) | 37 |
| Table 22. Radiated Harmonics, Low Channel (2402MHz) | 38 |
| Table 23. Radiated Harmonics, Mid Channel (2441MHz)..... | 38 |
| Table 24. Radiated Harmonics, High Channel (2480MHz) | 38 |
| Table 25. Spurious Emission Limits for Receivers | 46 |
| Table 26. Test Equipment List | 53 |

List of Plots

| | |
|---|----|
| Plot 1. Conducted Emission, Phase Line Plot | 10 |
| Plot 2. Conducted Emission, Neutral Line Plot..... | 11 |
| Plot 3. Radiated Emissions, 30 MHz - 1 GHz..... | 13 |
| Plot 5. Conducted Emissions, Phase Line | 18 |
| Plot 6. Conducted Emissions, Neutral Line..... | 18 |
| Plot 7. Occupied Bandwidth, Low Channel (2402MHz), GFSK Modulation, 20dB BW | 21 |
| Plot 8. Occupied Bandwidth, Mid Channel (2441MHz), GFSK Modulation, 20dB BW | 21 |
| Plot 9. Occupied Bandwidth, High Channel (2480MHz), GFSK Modulation, 20dB BW | 21 |
| Plot 10. Occupied Bandwidth, Low Channel (2402MHz), GFSK Modulation, 99% BW | 22 |
| Plot 11. Occupied Bandwidth, Mid Channel (2441MHz), GFSK Modulation, 99% BW | 22 |
| Plot 12. Occupied Bandwidth, High Channel (2480MHz), GFSK Modulation, 99% BW | 22 |
| Plot 13. Occupied Bandwidth, Low Channel (2402MHz), 8PSK Modulation, 20dB BW | 23 |
| Plot 14. Occupied Bandwidth, Mid Channel (2441MHz), 8PSK Modulation, 20dB BW | 23 |
| Plot 15. Occupied Bandwidth, High Channel (2480MHz), 8PSK Modulation, 20dB BW | 23 |
| Plot 16. Occupied Bandwidth, Low Channel (2402 MHz), 8PSK Modulation, 99% BW | 24 |
| Plot 17. Occupied Bandwidth, Mid Channel (2441 MHz), 8PSK Modulation, 99% BW | 24 |
| Plot 18. Occupied Bandwidth, High Channel (2480 MHz), 8PSK Modulation, 99% BW | 24 |
| Plot 19. Hopping Frequency Separation, Channel 0 and 1 | 25 |
| Plot 20. Hopping Frequency Separation, Channel 38 and 39..... | 25 |
| Plot 21. Hopping Frequency Separation, Channel 77 and 78..... | 25 |
| Plot 22. Number of Channels, Segment 1 | 27 |

| | |
|--|----|
| Plot 23. Number of Channels, Segment 2 | 27 |
| Plot 24. DH 1, Pulse Width | 28 |
| Plot 25. DH 1, Number of Times a Channel is Repeated in a 3.16 second Period | 28 |
| Plot 26. DH 3, Pulse Width | 29 |
| Plot 27. DH 3, Number of Times a Channel is Repeated in a 3.16 second Period | 29 |
| Plot 28. DH 5, Pulse Width | 30 |
| Plot 29. DH 5, Number of Times a Channel is Repeated in a 3.16 second Period | 30 |
| Plot 30. Peak Output Power, Low Channel (2402MHz), GFSK Modulation..... | 33 |
| Plot 31. Peak Output Power, Mid Channel (2441MHz), GFSK Modulation | 33 |
| Plot 32. Peak Output Power, High Channel (2480MHz), GFSK Modulation | 33 |
| Plot 33. Peak Output Power, Low Channel (2402MHz), 8GFSK | 34 |
| Plot 34. Peak Output Power, Mid Channel (2441MHz), 8GFSK..... | 34 |
| Plot 35. Peak Output Power, High Channel (2480MHz), 8GFSK | 34 |
| Plot 36. Radiated Spurious Emissions, Low Channel (2402MHz), 30 MHz – 1 GHz | 39 |
| Plot 37. Radiated Spurious Emissions, Low Channel (2402MHz), 1 GHz – 18 GHz..... | 39 |
| Plot 38. Radiated Spurious Emissions, Mid Channel (2441MHz), 30 MHz – 1 GHz..... | 39 |
| Plot 39. Radiated Spurious Emissions, Mid Channel (2441MHz), 1 GHz – 18 GHz | 40 |
| Plot 40. Radiated Spurious Emissions, High Channel (2480MHz), 30 MHz – 1 GHz | 40 |
| Plot 41. Radiated Spurious Emissions, High Channel (2480MHz), 1 GHz – 18 GHz..... | 40 |
| Plot 42. Radiated Restricted Band, Low Channel (2402MHz), Peak, GFSK Modulation | 42 |
| Plot 43. Radiated Restricted Band, Low Channel (2402MHz), Average, GFSK Modulation | 42 |
| Plot 44. Radiated Restricted Band, High Channel (2480MHz), Peak, GFSK Modulation..... | 43 |
| Plot 45. Radiated Restricted Band, High Channel (2480MHz), Average, GFSK Modulation..... | 43 |
| Plot 46. Radiated Restricted Band, High Channel (2480MHz), Marker Delta, GFSK Modulation | 43 |
| Plot 47. Radiated Restricted Band, Low Channel (2402MHz), Peak, 8PSK Modulation | 44 |
| Plot 48. Radiated Restricted Band, Low Channel (2402MHz), Average, 8PSK Modulation | 44 |
| Plot 49. Radiated Restricted Band, High Channel (2480MHz), Peak, 8PSK Modulation | 44 |
| Plot 50. Radiated Restricted Band, High Channel (2480MHz), Average, 8PSK Modulation..... | 45 |
| Plot 51. Receiver Spurious Emission, 30 MHz – 1 GHz..... | 47 |
| Plot 52. Receiver Spurious Emission, 1 GHz – 10 GHz | 47 |
| Plot 53. Conducted Spurious Emissions, 30 MHz – 1 GHz | 49 |
| Plot 54. Conducted Spurious Emissions, 1 GHz – 3 GHz..... | 49 |
| Plot 55. Conducted Spurious Emissions, 3 GHz – 26.5 GHz..... | 49 |
| Plot 56. Conducted Band Edge with Hopping, Low Channel (2402MHz), GFSK Modulation..... | 50 |
| Plot 57. Conducted Band Edge with Hopping, High Channel (2440MHz), GFSK Modulation | 50 |
| Plot 58. Conducted Band Edge with Hopping, Low Channel (2402MHz), 8PSK Modulation..... | 50 |
| Plot 59. Conducted Band Edge with Hopping, High Channel (2480MHz), 8PSK Modulation | 51 |

List of Figures

| | |
|---|----|
| Figure 1. Block Diagram, Occupied Bandwidth Test Setup..... | 19 |
| Figure 2. Peak Power Output Test Setup..... | 31 |
| Figure 3. Block Diagram, Conducted Receiver Spurious Emissions Test Setup | 46 |
| Figure 4. Block Diagram, Conducted Spurious Emissions Test Setup..... | 48 |

List of Terms and Abbreviations

| | |
|------------------------------|--|
| AC | Alternating Current |
| ACF | Antenna Correction Factor |
| Cal | Calibration |
| <i>d</i> | Measurement Distance |
| dB | Decibels |
| dBμA | Decibels above one microamp |
| dBμV | Decibels above one microvolt |
| dBμA/m | Decibels above one microamp per meter |
| dBμV/m | Decibels above one microvolt per meter |
| DC | Direct Current |
| E | Electric Field |
| DSL | Digital Subscriber Line |
| ESD | Electrostatic Discharge |
| EUT | Equipment Under Test |
| <i>f</i> | Frequency |
| FCC | Federal Communications Commission |
| GRP | Ground Reference Plane |
| H | Magnetic Field |
| HCP | Horizontal Coupling Plane |
| Hz | Hertz |
| IEC | International Electrotechnical Commission |
| kHz | kilohertz |
| kPa | kilopascal |
| kV | kilovolt |
| LISN | Line Impedance Stabilization Network |
| MHz | Megahertz |
| μH | microhenry |
| μF | microfarad |
| μs | microseconds |
| NEBS | Network Equipment-Building System |
| PRF | Pulse Repetition Frequency |
| RF | Radio Frequency |
| RMS | Root-Mean-Square |
| TWT | Traveling Wave Tube |
| V/m | Volts per meter |
| VCP | Vertical Coupling Plane |

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Apple Inc. Model A1378, with the requirements of Part 15, §15.247. 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 Model A1378. Apple Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Model A1378, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247, in accordance with Apple Inc., purchase order number 0478295456. All tests were conducted using measurement procedure ANSI C63.4-2003.

| FCC Reference 47 CFR Part 15.247:2005 | IC Reference RSS-210 Issue 7: 2007 | Description | Compliance |
|---|---------------------------------------|---|------------|
| 47 CFR Part 15.107 (a) | ICES-003 Issue 4 February 2004 | Conducted Emission Limits for a Class B Digital Device | Compliant |
| 47 CFR Part 15.109 (a) | ICES-003 Issue 4 February 2004 | Radiated Emission Limits for a Class B Digital Device | Compliant |
| Title 47 of the CFR, Part 15 §15.203 | N/A | Antenna Requirement | Compliant |
| Title 47 of the CFR, Part 15 §15.207(a) | RSS-210(7.2.2) | Conducted Emission Voltage | Compliant |
| Title 47 of the CFR, Part 15 §15.247(a)(1) | RSS-210(A8.1) | Channel Separation Occupied Bandwidth Number of Hopping Channels Time of Occupancy | Compliant |
| Title 47 of the CFR, Part 15 §15.247(b) | RSS-210(A8.4) | RF Output Power | Compliant |
| Title 47 of the CFR, Part 15 §15.209, §15.247(d) | RSS-210(A8.5) | Radiated Spurious Emissions | Compliant |
| Title 47 of the CFR, Part 15 §15.205 | RSS-210(A8.5) | Emissions at Restricted Band | Compliant |
| Title 47 of the CFR, Part 15 §15.209, §15.247(d) | RSS-210(A8.5) | Conducted Spurious Emissions | Compliant |
| Title 47 of the CFR, Part 15 §15.247(f) | RSS-210(A8.3) | Hybrid System Requirements | N/A |
| Title 47 of the CFR, Part 15 15.247(g) | RSS-210(A8.1) | Hopping Capability | Compliant |
| Title 47 of the CFR, Part 15 §15.247(h) | RSS-210(A8.1) | Hopping Coordination Requirement | Compliant |
| Title 47 of the CFR, Part 15 §15.247(i) | RSS-Gen(5.5) | Maximum Permissible Exposure | Compliant |
| N/A | RSS-Gen(4.8) | Receiver Spurious Emissions | Compliant |

Table 1. Executive Summary of EMC Part 15.247 Compliance Testing

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Apple Inc. to perform testing on the Model A1378, under Apple Inc.'s purchase order number 0478295456.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Apple Inc., Model A1378.

The results obtained relate only to the item(s) tested.

| | | |
|---------------------------------------|---|---------------------|
| Model(s) Tested: | Model A1378 | |
| Model(s) Covered: | Model A1378 | |
| EUT Specifications: | Primary Power: 120 VAC, 60 Hz | |
| | FCC ID: BCGA1378 IC: 579C-A1378 | |
| | Type of Modulations: | FHSS |
| | Equipment Code: | DSS |
| | Peak RF Output Power: | 10.32dBm |
| | EUT Frequency Ranges: | 2402 MHz – 2480 MHz |
| Analysis: | The results obtained relate only to the item(s) tested. | |
| Environmental Test Conditions: | Temperature: 15-35° C | |
| | Relative Humidity: 30-60% | |
| | Barometric Pressure: 860-1060 mbar | |
| Evaluated by: | Minh Ly | |
| Report Date(s): | August 27, 2010 | |

Table 2. EUT Summary Table

B. References

| | |
|--|---|
| CFR 47, Part 15, Subpart C | Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies |
| RSS-210, Issue 7, June 2007 | Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment |
| CFR 47, Part 15, Subpart B | Electromagnetic Compatibility: Criteria for Radio Frequency Devices |
| ICES-003, Issue 4 February 2004 | Electromagnetic Compatibility: Criteria for Radio Frequency Devices |
| ANSI C63.4:2003 | Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz |
| ANSI/NCSL Z540-1-1994 | Calibration Laboratories and Measuring and Test Equipment - General Requirements |
| ANSI/ISO/IEC 17025:2000 | General Requirements for the Competence of Testing and Calibration Laboratories |
| ANSI C63.10-2009 | American National Standard for Testing Unlicensed Wireless Devices |

Table 3. References

C. Test Site

All testing was performed at MET Laboratories, Inc., 3162 Belick Street, Santa Clara, CA 95054. 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 in a 10 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

D. Description of Test Sample

The Model A1378, Equipment Under Test (EUT) for the remainder of this document, is a wireless media client device.

E. Equipment Configuration

All cards, racks, etc., incorporated as part of the EUT is included in the following list.

| Ref. ID | Name / Description | Model Number | Serial Number |
|---------|--------------------|--------------|-----------------------|
| B | A1378 | A1378 | PT525669 and PT532993 |

Table 4. Equipment Configuration

F. Support Equipment

| Ref. ID | Name / Description | Manufacturer | Model Number | Serial Number |
|---------|-------------------------|--------------|--------------|---------------|
| A | Insignia LCD TV | Insignia | NS—L19Q-1-0A | V1297JA003853 |
| C | Access Point | Apple | A1354 | 6F92605BACC |
| D | Access Point AC Adapter | Apple | A1202 | MV92309W1ZBRA |
| M | Laptop | Apple | Macbook Pro | PT429161 |

Table 5. Support Equipment

G. Ports and Cabling Information

| Ref. ID | Port Name on EUT | Cable Description | Qty. | Length (m) | Shielded (Y/N) | Termination Point |
|---------|-------------------|-------------------|------|------------|----------------|-------------------|
| E | HDMI | HDMI Cable | 1 | 1.5 | Y | A |
| F | Ethernet | Ethernet | 1 | 1 | Y | C |
| G | DC | DC cable | 1 | 3 | Y | D |
| H | Fiber optic Audio | Fiber | 1 | 1.5 | N | A |
| I | USB console | USB | 1 | 1 | N | C |

Table 6. Ports and Cabling Information

H. Mode of Operation

The device operates using 802.11b, 802.11g, 802.11a and 802.11n (ht20, mcs0-7 only). This device also supports Frequency Hopping Spread Spectrum with GFSK and 8PSK modulations.

I. Modifications

a) Modifications to EUT

Installed a low pass filter in the 2.4GHz path.

b) Modifications to Test Standard

No modifications were made to the test standard.

J. Disposition of EUT

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

III. Electromagnetic Compatibility Criteria for Unintentional Radiators

Electromagnetic Compatibility Criteria

§ 15.107 Conducted Emissions Limits

Test Requirement(s): **15.107 (a)** Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, 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 Table 7. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

15.107 (b) For a Class A digital device that is designed to be connected to the public utility (AC) power line, 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 Table 7. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

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 7, as measured using a 50 μ H/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.

| Frequency range (MHz) | Class A Conducted Limits (dB μ V) | | *Class B Conducted Limits (dB μ V) | |
|---|--|---------|---|---------|
| | 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. Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz. * -- Limits per Subsection 15.207(a). | | | | |

Table 7. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b) and 15.207(a)

Test Results: The EUT was compliant with the Class B requirement(s) of this section. Measured emissions were below applicable limits.

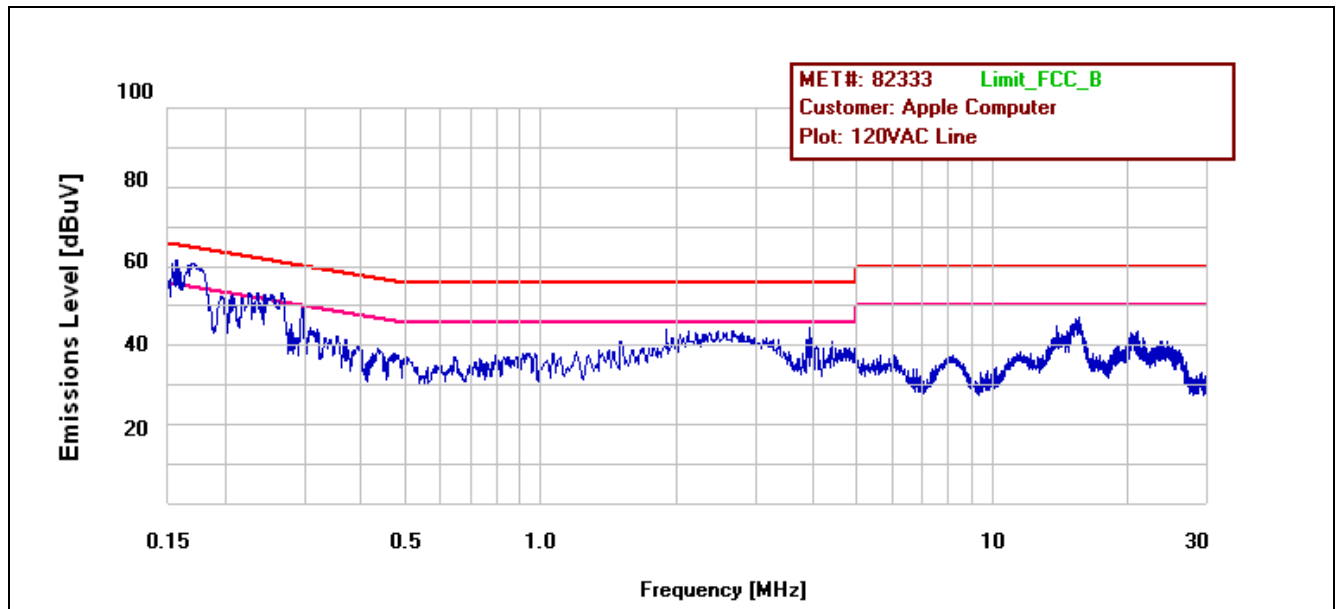
Test Engineer(s): Minh Ly

Test Date(s): 08/06/10

Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

| Line | Freq (MHz) | QP Amplitude | QP Limit | Delta | Pass | Average Amplitude | Average Limit | Delta | Pass | Notes |
|-------------|------------|--------------|----------|---------|------|-------------------|---------------|---------|------|--|
| 120VAC Line | 0.153 | 52.34 | 65.836 | -13.496 | Pass | 20.22 | 55.836 | -35.616 | Pass | Measured emissions are below applicable limits |
| 120VAC Line | 0.239 | 51.97 | 62.141 | -10.171 | Pass | 29.01 | 52.141 | -23.131 | Pass | Measured emissions are below applicable limits |
| 120VAC Line | 0.254 | 50.29 | 61.637 | -11.347 | Pass | 47.82 | 51.637 | -3.817 | Pass | Measured emissions are below applicable limits |
| 120VAC Line | 2.558 | 38.4 | 56 | -17.6 | Pass | 29.36 | 46 | -16.64 | Pass | Measured emissions are below applicable limits |
| 120VAC Line | 4.006 | 32.93 | 56 | -23.07 | Pass | 25.62 | 46 | -20.38 | Pass | Measured emissions are below applicable limits |
| 120VAC Line | 15.24 | 40.68 | 60 | -19.32 | Pass | 32.93 | 50 | -17.07 | Pass | Measured emissions are below applicable limits |

Table 8. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

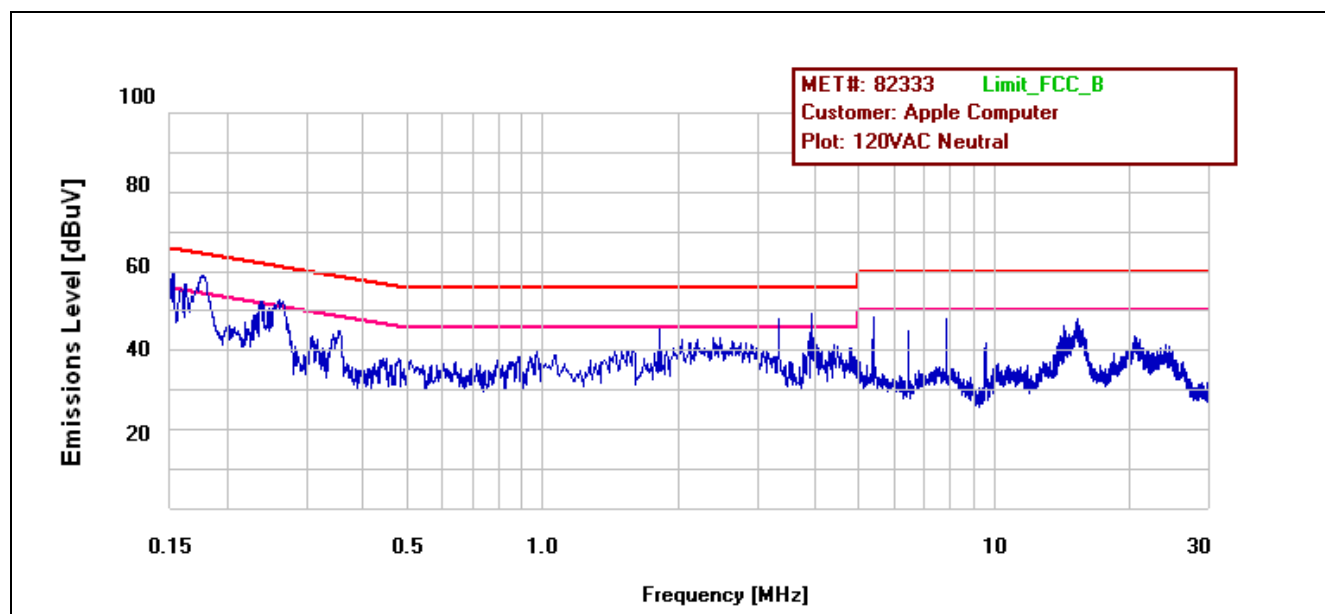


Plot 1. Conducted Emission, Phase Line Plot

Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)

| Line | Freq (MHz) | QP Amplitude | QP Limit | Delta | Pass | Average Amplitude | Average Limit | Delta | Pass | Notes |
|----------------|------------|--------------|----------|---------|------|-------------------|---------------|---------|------|--|
| 120VAC Neutral | 0.153 | 51.8 | 65.836 | -14.036 | Pass | 36.46 | 55.836 | -19.376 | Pass | Measured emissions are below applicable limits |
| 120VAC Neutral | 0.224 | 42.64 | 62.678 | -20.038 | Pass | 27.09 | 52.678 | -25.588 | Pass | Measured emissions are below applicable limits |
| 120VAC Neutral | 1.815 | 34.32 | 56 | -21.68 | Pass | 24.92 | 46 | -21.08 | Pass | Measured emissions are below applicable limits |
| 120VAC Neutral | 3.078 | 34.38 | 56 | -21.62 | Pass | 25.69 | 46 | -20.31 | Pass | Measured emissions are below applicable limits |
| 120VAC Neutral | 3.977 | 38.08 | 56 | -17.92 | Pass | 26.79 | 46 | -19.21 | Pass | Measured emissions are below applicable limits |
| 120VAC Neutral | 5.38 | 37.02 | 60 | -22.98 | Pass | 22.44 | 50 | -27.56 | Pass | Measured emissions are below applicable limits |
| 120VAC Neutral | 7.817 | 42.36 | 60 | -17.64 | Pass | 23.15 | 50 | -26.85 | Pass | Measured emissions are below applicable limits |

Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)



Plot 2. Conducted Emission, Neutral Line Plot

Radiated Emission Limits

§ 15.109 Radiated Emissions Limits

Test Requirement(s): **15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 10.

15.109 (b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the Class A limits expressed in Table 10.

| Frequency (MHz) | Field Strength (dBµV/m) | |
|-----------------|--|---|
| | §15.109 (b), Class A Limit (dBµV) @ 10m | §15.109 (a), Class B Limit (dBµV) @ 3m |
| 30 - 88 | 39.00 | 40.00 |
| 88 - 216 | 43.50 | 43.50 |
| 216 - 960 | 46.40 | 46.00 |
| Above 960 | 49.50 | 54.00 |

Table 10. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)

Test Procedures: The EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 3m from the EUT on an adjustable mast. A pre-scan was first performed in order to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

Test Results: The EUT was compliant with the Class B requirement(s) of this section. Measured emissions were below applicable limits.

Test Engineer(s): Minh Ly

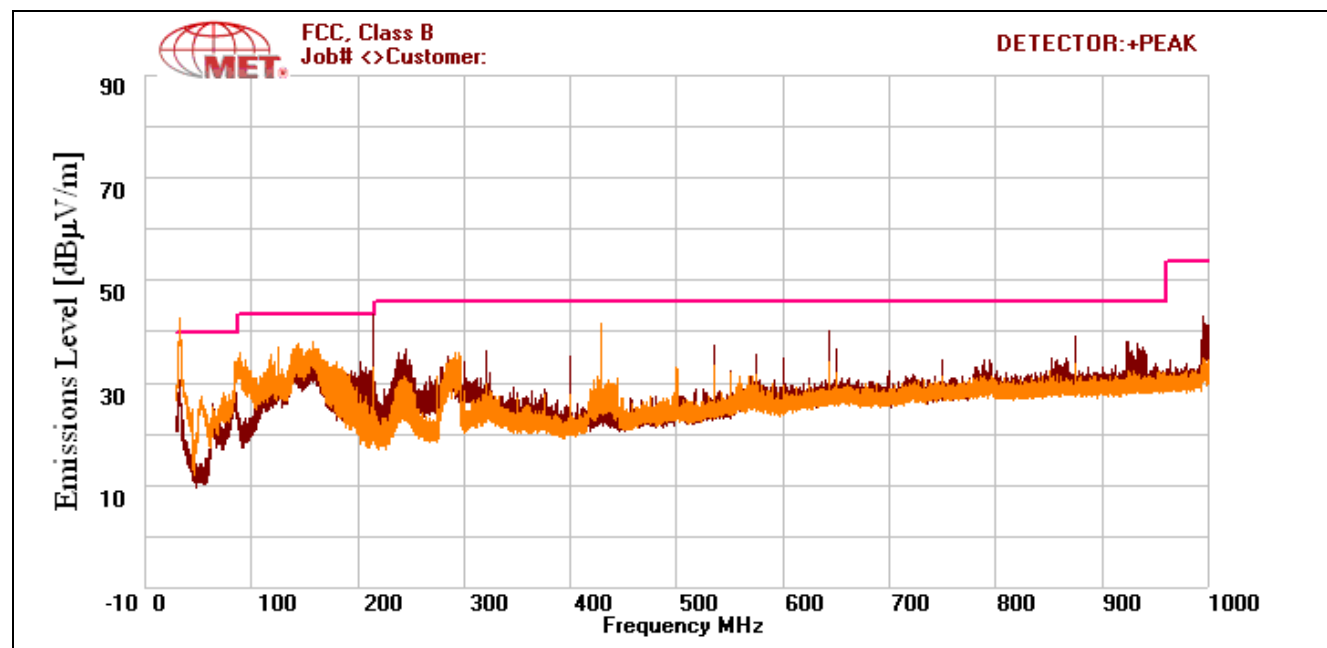
Test Date(s): 08/04/10

Radiated Emissions Limits Test Results, Class B

| Frequency (MHz) | Antenna Polarity | EUT Azimuth (Degrees) | Antenna Height (cm) | Uncorrected Amplitude (dBuV) | ACF (dB/m) | Pre Amp Gain (dB) | CBL (dB) | DCF (dB) | Corrected Amplitude (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|-----------------|------------------|-----------------------|---------------------|------------------------------|------------|-------------------|----------|----------|------------------------------|----------------|-------------|
| 32.72 | V | 296 | 100 | 1.2 | 16.168 | 0 | 1.328 | 0 | 18.696 | 40 | -21.304 |
| 81.28 | V | 69 | 148 | 18.23 | 7.033 | 0 | 2.446 | 0 | 27.709 | 40 | -12.291 |
| 139.48 | V | 179 | 100 | 7.59 | 12.442 | 0 | 3.268 | 0 | 23.3 | 43.5 | -20.2 |
| 214.28 | H | 0 | 100 | 1.46 | 10.172 | 0 | 3.861 | 0 | 15.493 | 43.5 | -28.007 |
| 250 | H | 360 | 110 | 11.52 | 12.9 | 0 | 3.74 | 0 | 28.16 | 46 | -17.84 |
| 300 | H | 0 | 100 | 12.18 | 13.9 | 0 | 3.57 | 0 | 29.65 | 46 | -16.35 |

Table 11. Radiated Emissions Limits, Test Results

Note: 32.72MHz (V), 150.16MHz (H), 643MHz (H), 535MHz (H) are from support equipment (monitor).



Plot 3. Radiated Emissions, 30 MHz - 1 GHz

IV. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 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 must 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 as tested is compliant the criteria of §15.203 by being a permanently attached integral antenna.

Test Engineer(s): Minh Ly

Test Date(s): 06/02/10

| Model | Type | Frequency (MHz) | Gain (dBi) |
|----------|------|-----------------|------------|
| 820-2808 | PIFA | 2400 - 2483.5 | 0.49 |

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207 Conducted Emissions Limits

Test Requirement(s): § 15.207 (a): For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω 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 frequency ranges.

| Frequency range (MHz) | § 15.207(a), Conducted Limit (dB μ V) | |
|--------------------------|---|---------|
| | Quasi-Peak | Average |
| * 0.15- 0.45 | 66 - 56 | 56 - 46 |
| 0.45 - 0.5 | 56 | 46 |
| 0.5 - 30 | 60 | 50 |

Table 12. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a 0.8 m-high wooden table. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω /50 μ H Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-2003 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω /50 μ H LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on.

Test Results: The EUT was compliant with this requirement. Measured emissions were below applicable limits.

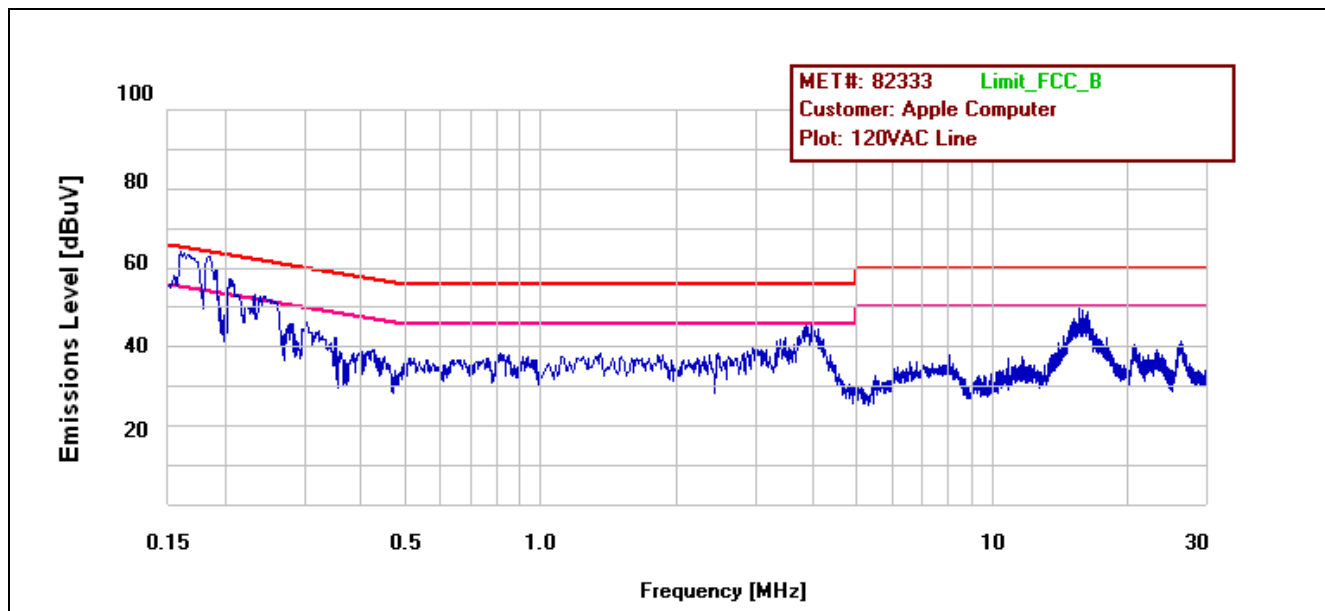
Test Engineer(s): Minh Ly

Test Date(s): 08/06/10

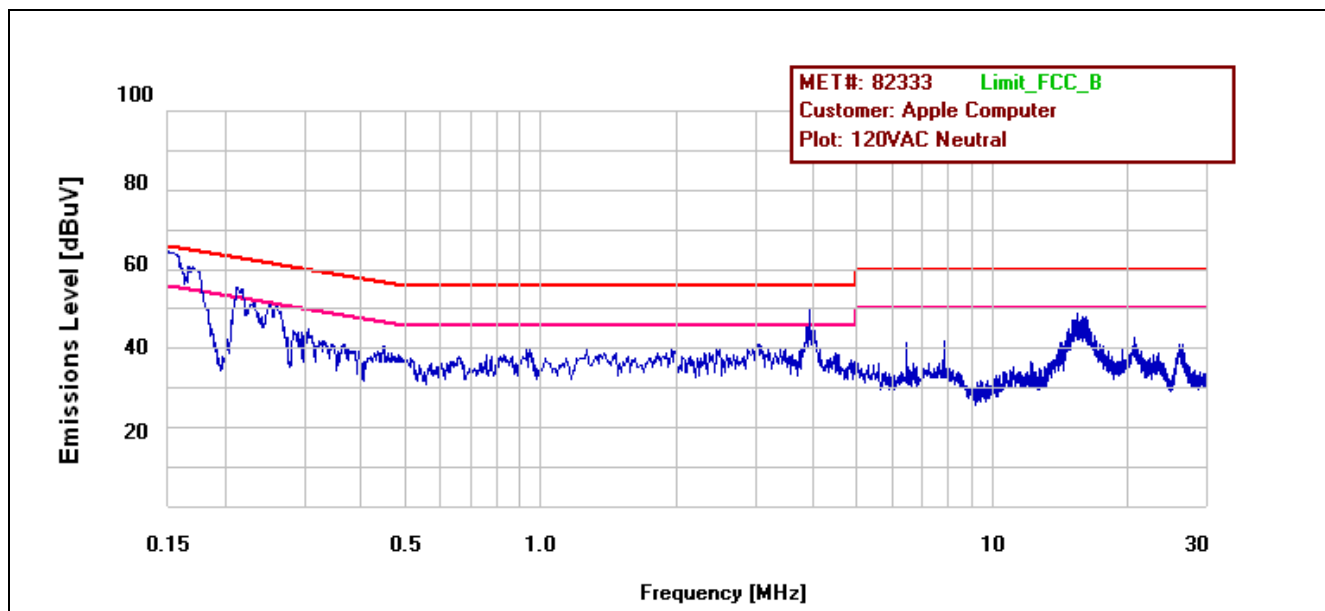
15.207 Conducted Emissions Test Results

| Line | Freq (MHz) | QP Amplitude | QP Limit | Delta | Pass | Average Amplitude | Average Limit | Delta | Pass | Notes |
|----------------|------------|--------------|----------|---------|------|-------------------|---------------|---------|------|--|
| 120VAC Line | 0.159 | 58.83 | 65.517 | -6.687 | Pass | 43.8 | 55.517 | -11.717 | Pass | Measured emission were below applicable limits |
| 120VAC Line | 0.182 | 40.98 | 64.398 | -23.418 | Pass | 24.99 | 54.398 | -29.408 | Pass | Measured emission were below applicable limits |
| 120VAC Line | 0.212 | 45.43 | 63.134 | -17.704 | Pass | 21.23 | 53.134 | -31.904 | Pass | Measured emission were below applicable limits |
| 120VAC Line | 0.248 | 49.46 | 61.835 | -12.375 | Pass | 37.6 | 51.835 | -14.235 | Pass | Measured emission were below applicable limits |
| 120VAC Line | 3.975 | 41.35 | 56 | -14.65 | Pass | 31.22 | 46 | -14.78 | Pass | Measured emission were below applicable limits |
| 120VAC Line | 15.9 | 33.92 | 60 | -26.08 | Pass | 31.68 | 50 | -18.32 | Pass | Measured emission were below applicable limits |
| Line | Freq (MHz) | QP Amplitude | QP Limit | Delta | Pass | Average Amplitude | Average Limit | Delta | Pass | Notes |
| 120VAC Neutral | 0.159 | 56.12 | 65.517 | -9.397 | Pass | 43.18 | 55.517 | -12.337 | Pass | Measured emission were below applicable limits |
| 120VAC Neutral | 0.206 | 47.85 | 63.372 | -15.522 | Pass | 17.57 | 53.372 | -35.802 | Pass | Measured emission were below applicable limits |
| 120VAC Neutral | 0.253 | 49 | 61.67 | -12.67 | Pass | 36.4 | 51.67 | -15.27 | Pass | Measured emission were below applicable limits |
| 120VAC Neutral | 3.928 | 42.27 | 56 | -13.73 | Pass | 25.03 | 46 | -20.97 | Pass | Measured emission were below applicable limits |
| 120VAC Neutral | 15.15 | 38.79 | 60 | -21.21 | Pass | 30.91 | 50 | -19.09 | Pass | Measured emission were below applicable limits |
| 120VAC Neutral | 0.153 | 55.35 | 65.836 | -10.486 | Pass | 39.2 | 55.836 | -16.636 | Pass | Measured emission were below applicable limits |

Table 13. Conducted Emissions, 15.207, Test Results



Plot 4. Conducted Emissions, Phase Line



Plot 5. Conducted Emissions, Neutral Line

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a) 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 6 dB 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 bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately equal to 1% of the total emission bandwidth. The 20 dB bandwidth was measured and recorded.

Test Results: The EUT was found compliant with the Radiated Emission limits of §15.247(a) for Intentional Radiators. See following pages for detailed test results.

Test Engineer(s): Minh Ly

Test Date(s): 08/05/10

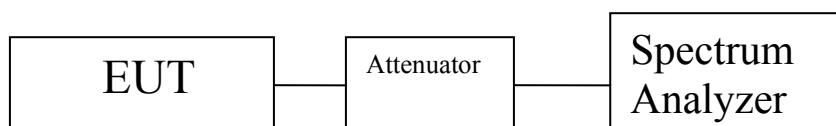


Figure 1. Block Diagram, Occupied Bandwidth Test Setup

Occupied Bandwidth Test Results

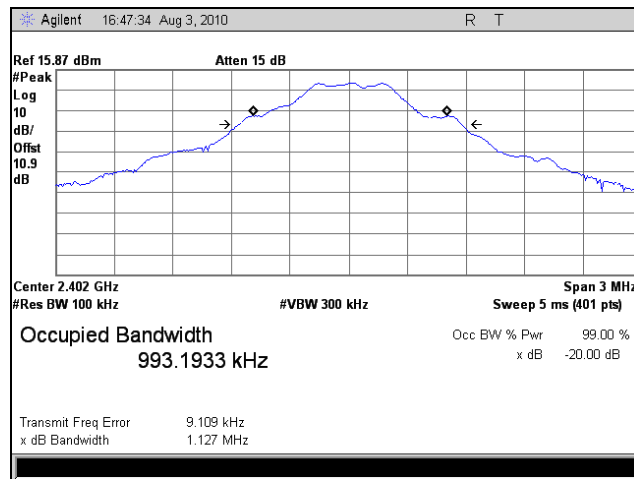
| Carrier Channel | Frequency (MHz) | Measured 20 dB Bandwidth (MHz) | Measured 99% Bandwidth (MHz) |
|-----------------|-----------------|--------------------------------|------------------------------|
| GFSK Modulation | 2402 | 1.127 | 985.0783 |
| GFSK Modulation | 2441 | 1.127 | 990.1364 |
| GFSK Modulation | 2480 | 1.125 | 984.6909 |

Table 14. Occupied Bandwidth, Test Results, GFSK Modulation

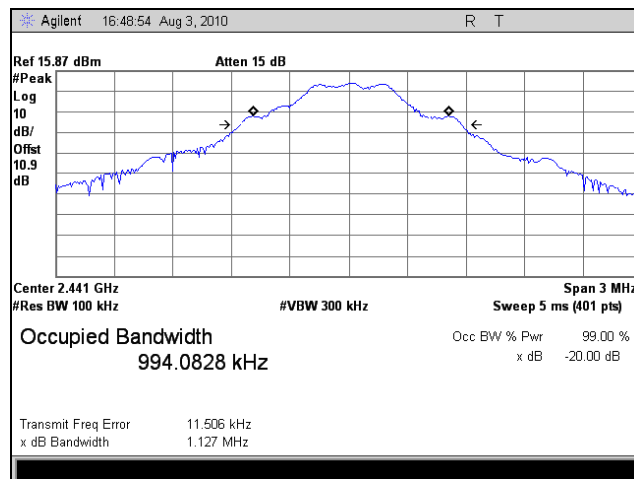
| Carrier Channel | Frequency (MHz) | Measured 20 dB Bandwidth (MHz) | Measured 99% Bandwidth (MHz) |
|-----------------|-----------------|--------------------------------|------------------------------|
| 8FSK Modulation | 2402 | 1.372 | 1.1302 |
| 8FSK Modulation | 2441 | 1.392 | 1.1327 |
| 8FSK Modulation | 2480 | 1.394 | 1.1315 |

Table 15. Occupied Bandwidth, Test Results, 8PSK Modulation

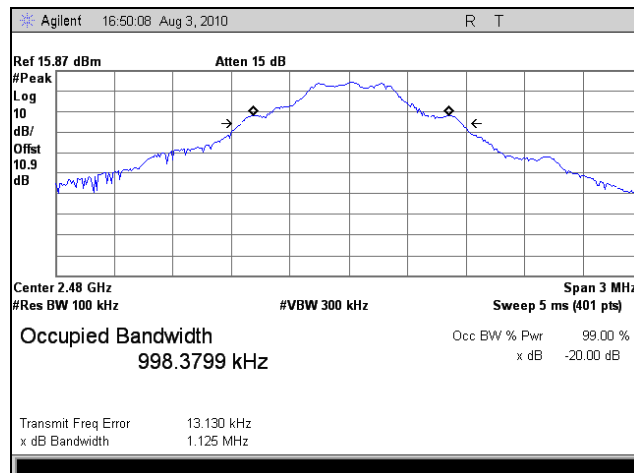
Occupied Bandwidth Test Results



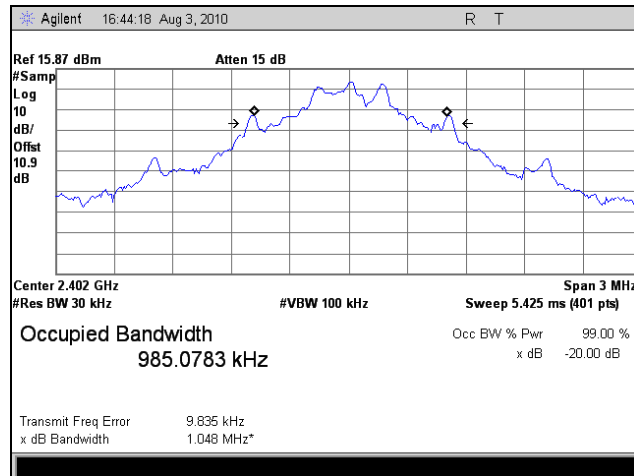
Plot 6. Occupied Bandwidth, Low Channel (2402MHz), GFSK Modulation, 20dB BW



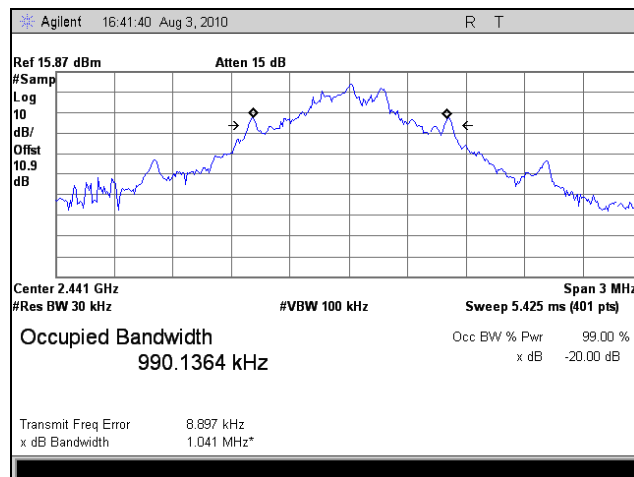
Plot 7. Occupied Bandwidth, Mid Channel (2441MHz), GFSK Modulation, 20dB BW



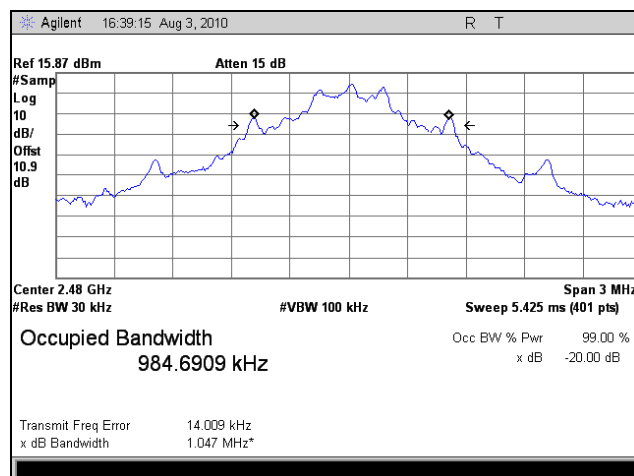
Plot 8. Occupied Bandwidth, High Channel (2480MHz), GFSK Modulation, 20dB BW



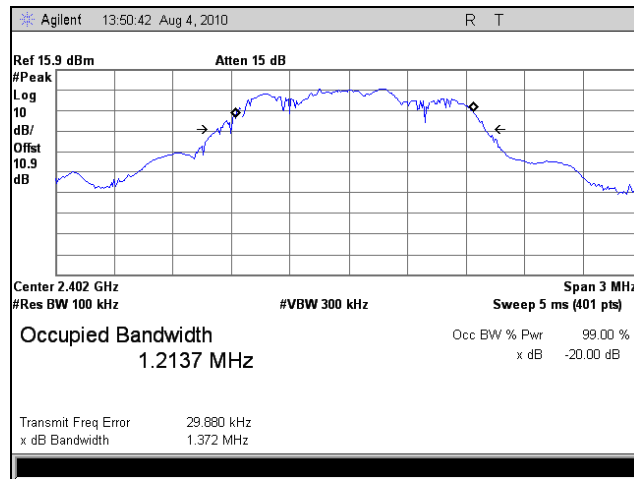
Plot 9. Occupied Bandwidth, Low Channel (2402MHz), GFSK Modulation, 99% BW



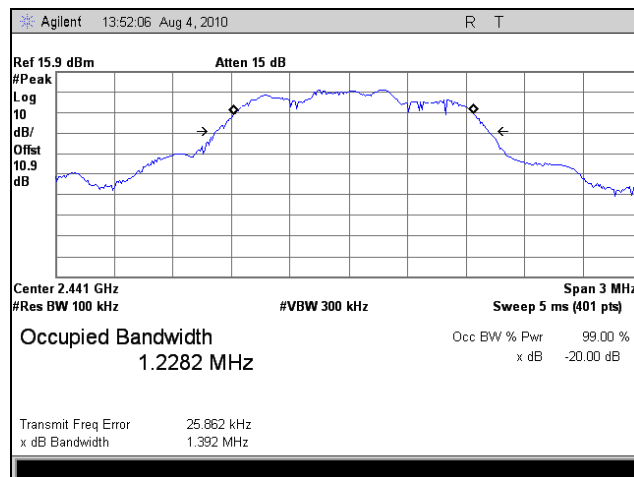
Plot 10. Occupied Bandwidth, Mid Channel (2441MHz), GFSK Modulation, 99% BW



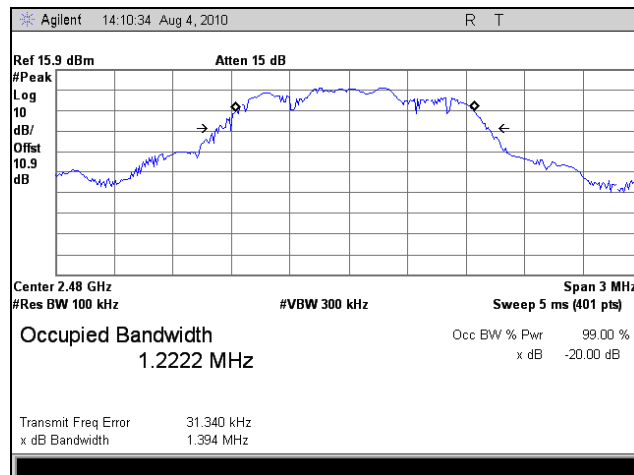
Plot 11. Occupied Bandwidth, High Channel (2480MHz), GFSK Modulation, 99% BW



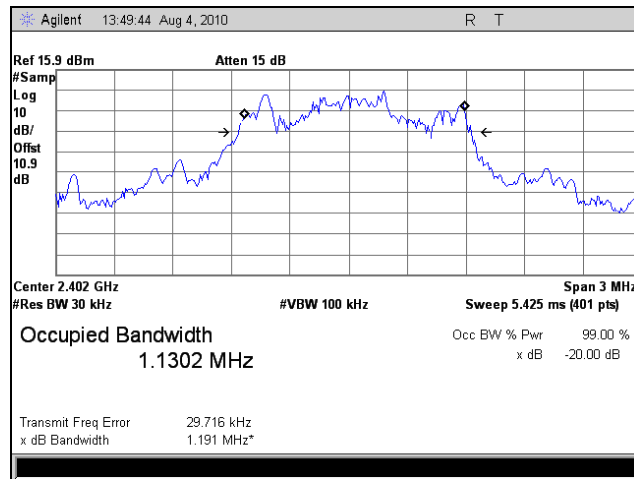
Plot 12. Occupied Bandwidth, Low Channel (2402MHz), 8PSK Modulation, 20dB BW



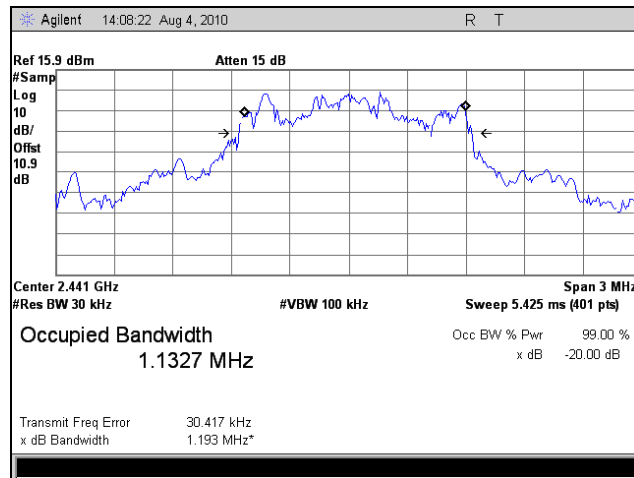
Plot 13. Occupied Bandwidth, Mid Channel (2441MHz), 8PSK Modulation, 20dB BW



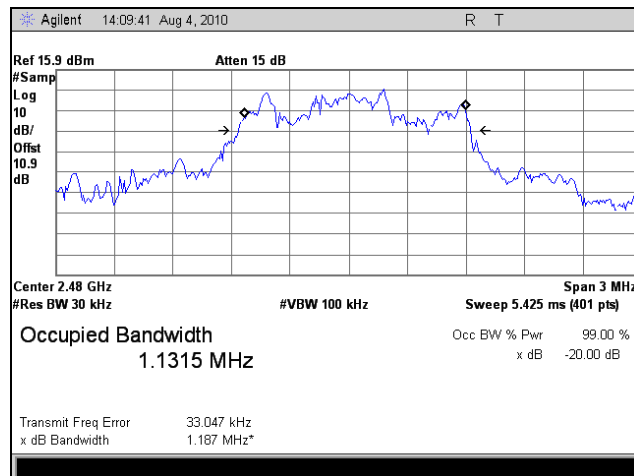
Plot 14. Occupied Bandwidth, High Channel (2480MHz), 8PSK Modulation, 20dB BW



Plot 15. Occupied Bandwidth, Low Channel (2402 MHz), 8PSK Modulation, 99% BW



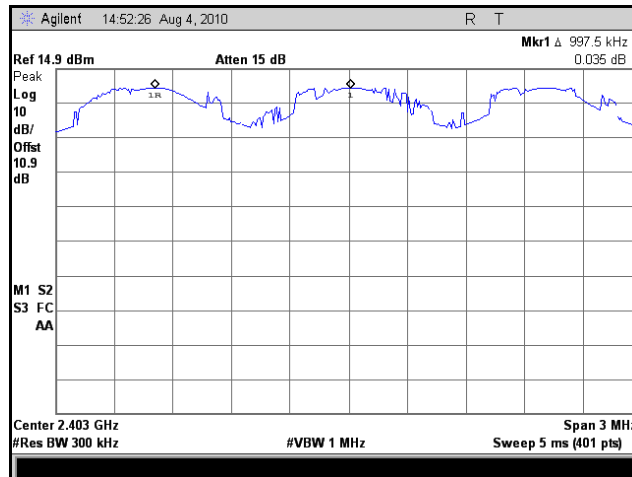
Plot 16. Occupied Bandwidth, Mid Channel (2441 MHz), 8PSK Modulation, 99% BW



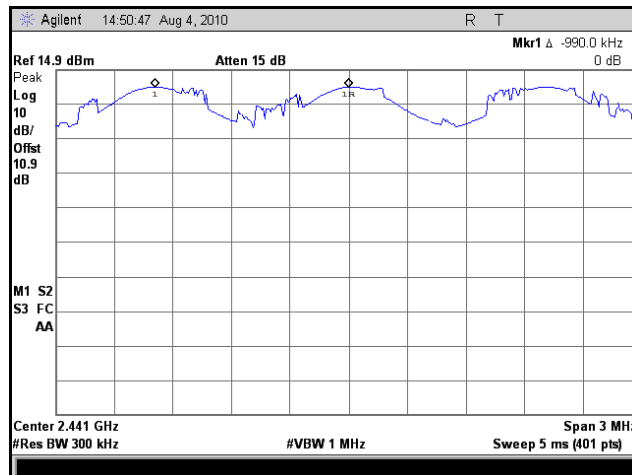
Plot 17. Occupied Bandwidth, High Channel (2480 MHz), 8PSK Modulation, 99% BW

§ 15.247 Carrier Frequency Separation

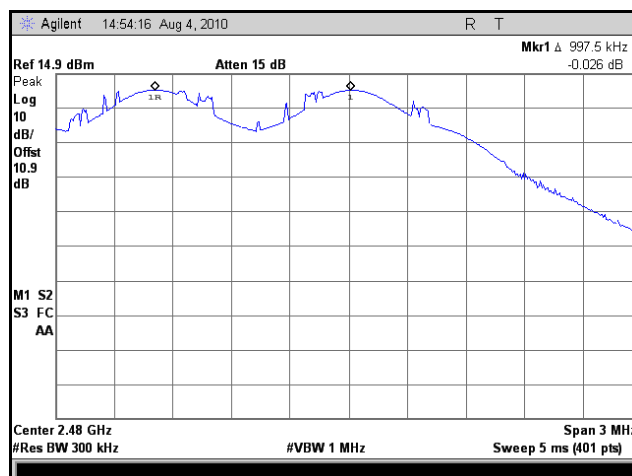
Remarks: Total hopping channels = 79. The EUT meets the specifications of **Section 15.247(a) (1) (iii)** for Number of Hopping Channels.



Plot 18. Hopping Frequency Separation, Channel 0 and 1



Plot 19. Hopping Frequency Separation, Channel 38 and 39



Plot 20. Hopping Frequency Separation, Channel 77 and 78

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247 Number of Channels and Time of Occupancy

Test Requirements: § 15.247(a) (1) (iii): Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular frequency provided that a minimum of 15 channels are used.

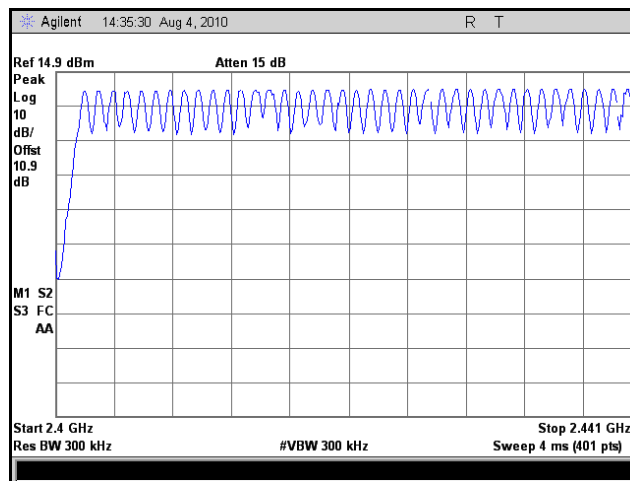
Test Procedures: The EUT's transmitter output was connected directly to the spectrum analyzer. Plots were taken in order to measure the number of channels and Dwell Time.

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

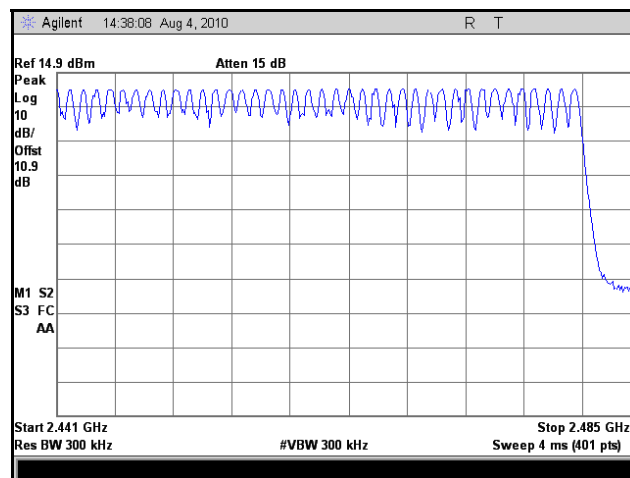
- 1) Number of Channels
This device has 79 channels.
- 2) Average Time Of Occupancy

The Dwell Time for each packet type is recorded. The device has 79 channels. The average time of occupancy in a 31.6 seconds period ($79 * 0.4$) is equal to $10 * (\text{\#of pulses}) * \text{pulse width}$.

NUMBER OF HOPPING CHANNELS



Plot 21. Number of Channels, Segment 1

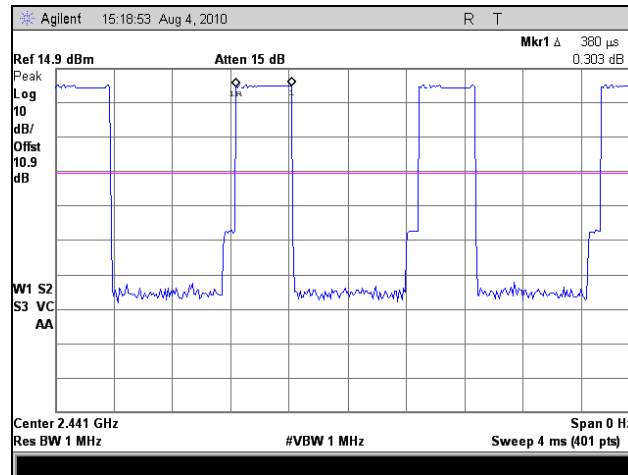


Plot 22. Number of Channels, Segment 2

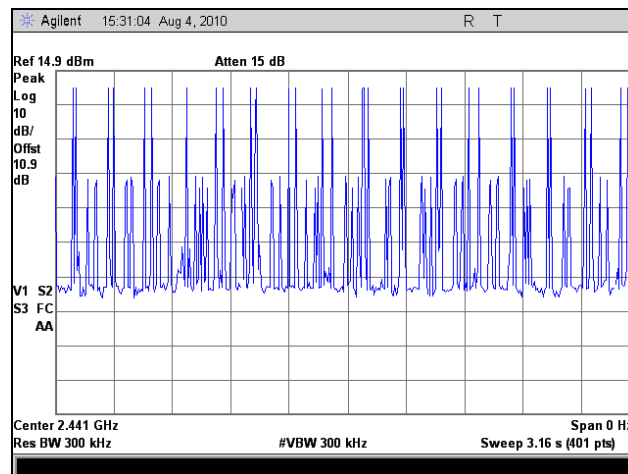
TIME OF OCCUPANCY

| DH Packet | Pulse Width (ms) | Number of Pulses | Dwell Time (Sec) | Limit (Second) | Margin |
|-----------|------------------|------------------|------------------|----------------|--------|
| 1 | 0.38 | 32 | 0.121 | 0.4 | 0.279 |
| 3 | 1.60 | 9 | 0.144 | 0.4 | 0.256 |
| 5 | 2.85 | 9 | 0.285 | 0.4 | 0.115 |

DH1

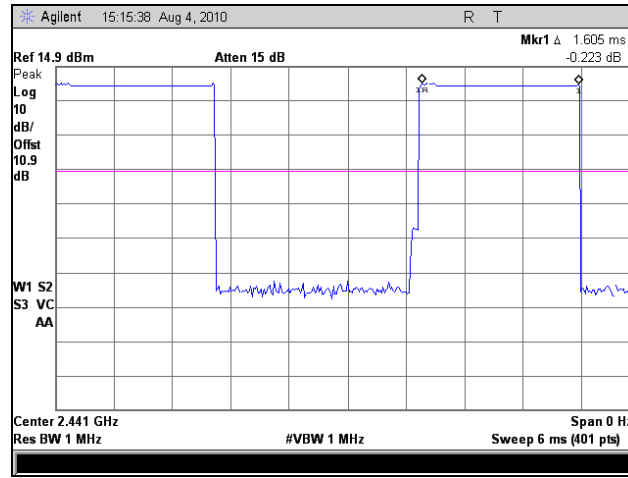


Plot 23. DH 1, Pulse Width

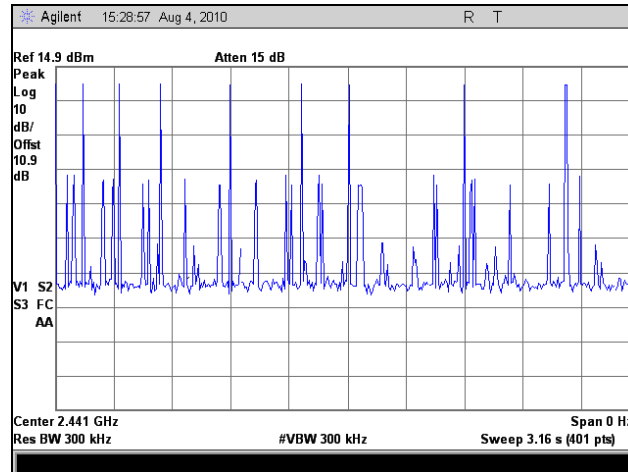


Plot 24. DH 1, Number of Times a Channel is Repeated in a 3.16 second Period

DH 3

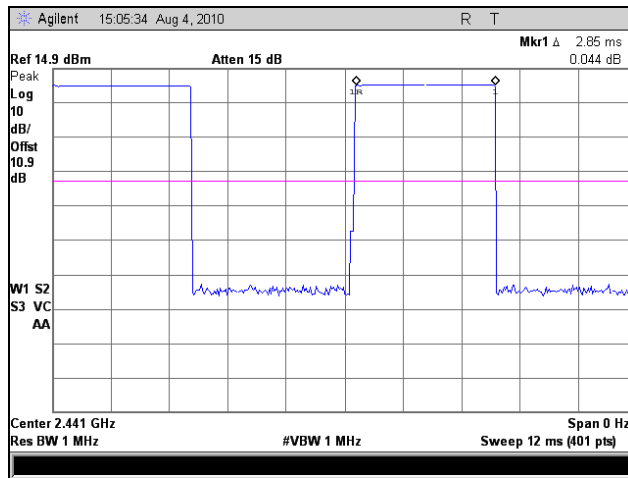


Plot 25. DH 3, Pulse Width

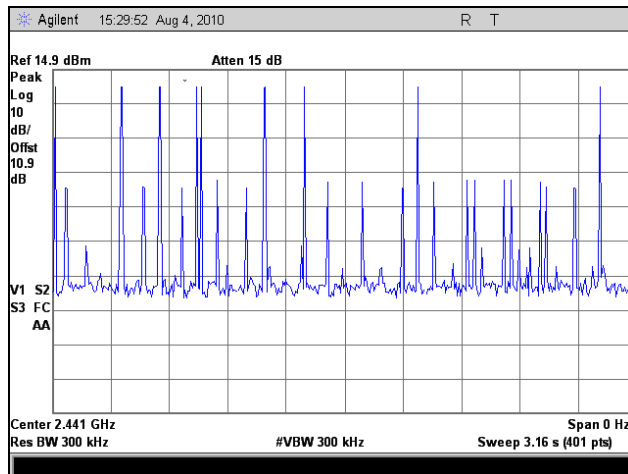


Plot 26. DH 3, Number of Times a Channel is Repeated in a 3.16 second Period

DH 5



Plot 27. DH 5, Pulse Width



Plot 28. DH 5, Number of Times a Channel is Repeated in a 3.16 second Period

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output and RF Exposure

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

| Digital Transmission Systems (MHz) | Output Limit (Watts) |
|---------------------------------------|-------------------------|
| 902-928 | 1.000 |
| 2400-2483.5 | 1.000 |
| 5725- 5850 | 1.000 |

Table 16. Output Power Requirements from §15.247

§15.247(c): 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 16, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test Procedure: The transmitter was connected to a calibrated spectrum analyzer. The EUT was measured at the low, mid and high channels of each band at the maximum power level.

Test Results: The EUT was compliant with the Peak Power Output limits of §15.247(b).

Test Engineer(s): Minh Ly

Test Date(s): 08/05/10

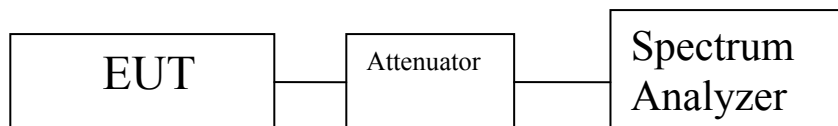


Figure 2. Peak Power Output Test Setup

RF Power Output Test Results

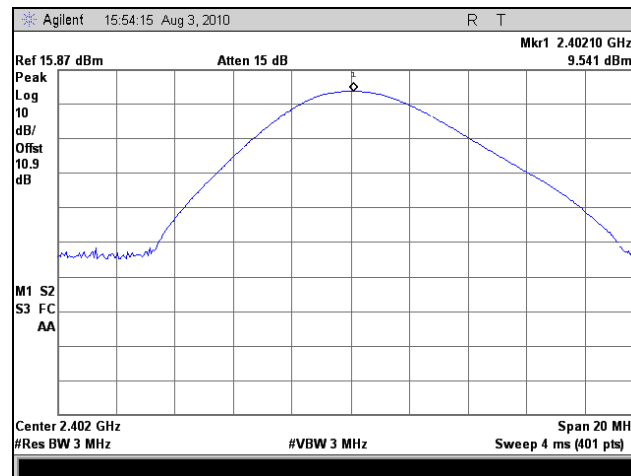
| Peak Conducted Output Power | | |
|-----------------------------|-----------------|--------------------------------|
| Carrier Channel | Frequency (MHz) | Measured Peak Output Power dBm |
| GFSK Modulation | 2402 | 9.541 |
| GFSK Modulation | 2441 | 10.06 |
| GFSK Modulation | 2480 | 10.32 |

Table 17. Peak Conducted Output Power, Test Results, GFSK Modulation

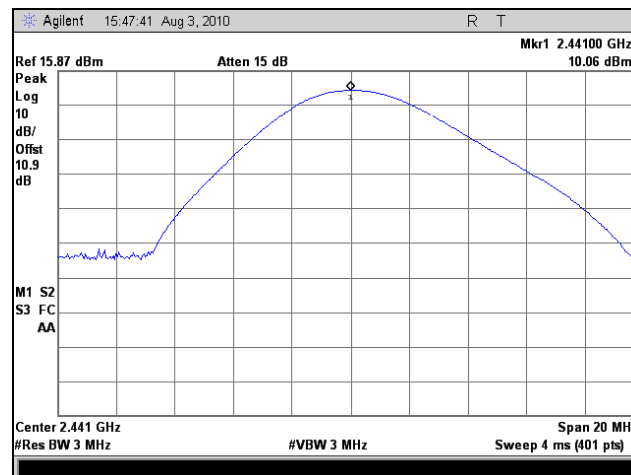
| Peak Conducted Output Power | | |
|-----------------------------|-----------------|--------------------------------|
| Carrier Channel | Frequency (MHz) | Measured Peak Output Power dBm |
| 8PSK Modulation | 2402 | 8.785 |
| 8PSK Modulation | 2441 | 9.292 |
| 8PSK Modulation | 2480 | 9.574 |

Table 18. Peak Conducted Output Power, Test Results, 8PSK

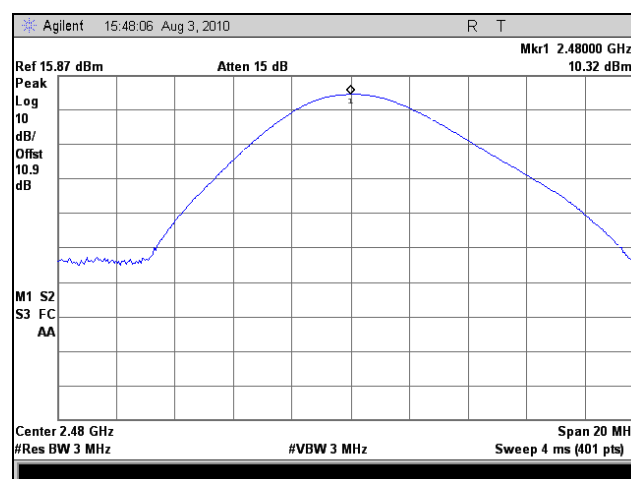
RF Output Power Test Results



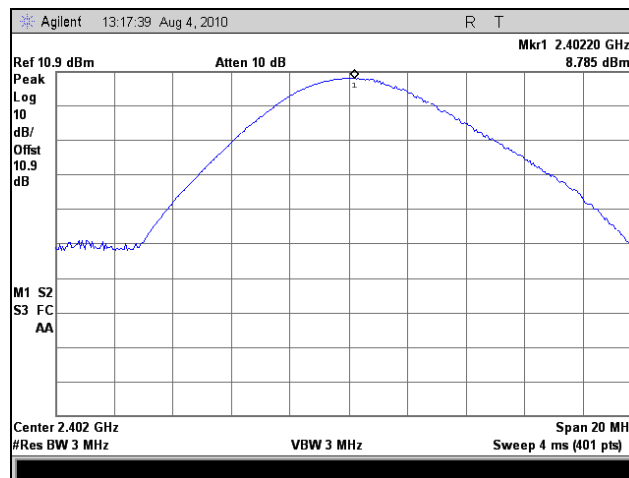
Plot 29. Peak Output Power, Low Channel (2402MHz), GFSK Modulation



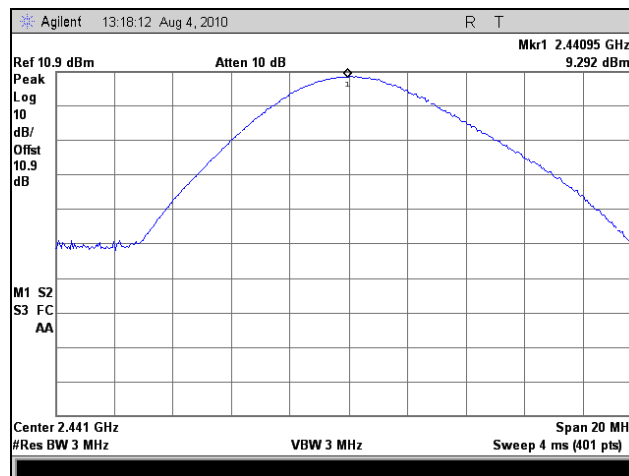
Plot 30. Peak Output Power, Mid Channel (2441MHz), GFSK Modulation



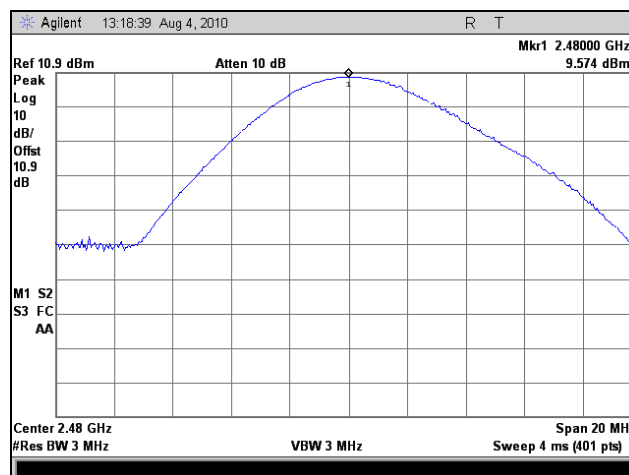
Plot 31. Peak Output Power, High Channel (2480MHz), GFSK Modulation



Plot 32. Peak Output Power, Low Channel (2402MHz), 8GFSK



Plot 33. Peak Output Power, Mid Channel (2441MHz), 8GFSK



Plot 34. Peak Output Power, High Channel (2480MHz), 8GFSK

§ 15.247(b) RF Exposure

RF Exposure Requirements: §1.1307(b)(1) and §1.1307(b)(2): 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.

RF Radiation Exposure Limit: §1.1310: As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

MPE Limit Calculation: EUT's operating frequencies @ 2402-2480 MHz; highest conducted power = *10.32 dBm* (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm² or 10 W/m²**

EUT maximum antenna gain = 0.49dBi

Equation from page 18 of OET 65, Edition 97-01

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{PG / 4\pi S}$$

where, S = Power Density (1 mW/cm²)
P = Power Input to antenna (650.13mW)
G = Antenna Gain (3.16 numeric)

$$S = (10.76 * 1.11 / 4 * 3.14 * 20.0^2) = (12.05 / 5024) = \mathbf{0.0023mW/cm^2 @ 20cm separation}$$

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Radiated Spurious Emissions Requirements and Band Edge

Test Requirements: §15.247(d); §15.205: Emissions outside the frequency band.

§15.247(d): 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 listed below:

| MHz | MHz | MHz | GHz |
|-------------------------------|---------------------|-----------------|------------------|
| 0.090–0.110----- | 16.42–16.423 | 399.9–410 | 4.5–5.15 |
| ¹ 0.495–0.505----- | 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 | (²) |

Table 19. Restricted Bands of Operation

¹ Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.

² Above 38.6

Test Requirement(s): § 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 20.

| Frequency (MHz) | § 15.209(a), Radiated Emission Limits (dB μ V) @ 3m |
|-----------------|--|
| 30 - 88 | 40.00 |
| 88 - 216 | 43.50 |
| 216 - 960 | 46.00 |
| Above 960 | 54.00 |

Table 20. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was measured above 18 GHz. All spurious emissions are measured with GFSK modulation which represents the worse case emission.

Test Results: The EUT was compliant with the Radiated Spurious Emission limits of § 15.247(d). No harmonics were detected. There were also no emissions above 18 GHz.

Test Engineer(s): Minh Ly

Test Date(s): 08/05/10

| Freq. (GHz) | Antenna Polarity (H/V) | Raw Amp. @ 3 m (Peak) / (Avg.) | P. Amp (dB) | Ant. Cor. Factor (dB/m) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBuV/m) | Limit Detector Peak / Avg. (Peak) / (Avg.) | Limit @ 3 m (dBuV/m) | Delta (dB) |
|-------------|------------------------|--------------------------------|-------------|-------------------------|-----------------|--|--|----------------------|------------|
| 4.804 | H | 43.78 | 34.63 | 33.29 | 5.07 | 47.50 | Peak | 74 | -26.50 |
| 7.206 | H | 44.68 | 35.00 | 35.65 | 6.23 | 51.56 | Peak | 74 | -22.44 |
| 7.206 | H | 31.71 | 35.00 | 35.65 | 6.23 | 38.59 | Avg. | 54 | -15.41 |
| 9.608 | H | 44.8 | 35.26 | 37.79 | 7.23 | 54.56 | Peak | 74 | -19.44 |
| 9.608 | H | 31.47 | 35.26 | 37.79 | 7.23 | 41.23 | Avg. | 54 | -12.77 |
| 12.01 | H | 44.02 | 34.20 | 39.89 | 9.44 | 59.15 | Peak | 74 | -14.85 |
| 12.01 | H | 31.51 | 34.20 | 39.89 | 9.44 | 46.64 | Avg. | 54 | -7.36 |

Table 21. Radiated Harmonics, Low Channel (2402MHz)

| Freq. (GHz) | Antenna Polarity (H/V) | Raw Amp. @ 3 m (Peak) / (Avg.) | P. Amp (dB) | Ant. Cor. Factor (dB/m) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBuV/m) | Limit Detector Peak / Avg. (Peak) / (Avg.) | Limit @ 3 m (dBuV/m) | Delta (dB) |
|-------------|------------------------|--------------------------------|-------------|-------------------------|-----------------|--|--|----------------------|------------|
| 4.882 | H | 44.41 | 34.73 | 33.52 | 5.06 | 48.26 | Peak | 74 | -25.74 |
| 7.323 | H | 43.98 | 35.13 | 35.98 | 6.34 | 51.17 | Peak | 74 | -22.83 |
| 7.323 | H | 30.92 | 35.13 | 35.98 | 6.34 | 38.11 | Avg. | 54 | -15.89 |
| 9.764 | H | 45.1 | 35.48 | 37.97 | 7.44 | 55.03 | Peak | 74 | -18.97 |
| 9.764 | H | 31.9 | 35.48 | 37.97 | 7.44 | 41.83 | Avg. | 54 | -12.17 |
| 12.205 | H | 42.88 | 33.85 | 39.47 | 9.14 | 57.64 | Peak | 74 | -16.36 |
| 12.205 | H | 30.47 | 33.85 | 39.47 | 9.14 | 45.23 | Avg. | 54 | -8.77 |

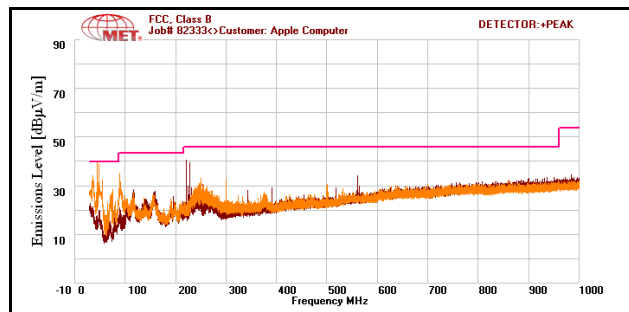
Table 22. Radiated Harmonics, Mid Channel (2441MHz)

| Freq. (GHz) | Antenna Polarity (H/V) | Raw Amp. @ 3 m (Peak) / (Avg.) | P. Amp (dB) | Ant. Cor. Factor (dB/m) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBuV/m) | Limit Detector Peak / Avg. (Peak) / (Avg.) | Limit @ 3 m (dBuV/m) | Delta (dB) |
|-------------|------------------------|--------------------------------|-------------|-------------------------|-----------------|--|--|----------------------|------------|
| 4.96 | H | 43.49 | 34.81 | 33.72 | 5.06 | 47.46 | Peak | 74 | -26.54 |
| 4.96 | H | 30.9 | 34.81 | 33.72 | 5.06 | 34.87 | Avg. | 54 | -19.13 |
| 7.44 | H | 43.7 | 35.35 | 36.28 | 6.41 | 51.04 | Peak | 74 | -22.96 |
| 7.44 | H | 30.87 | 35.35 | 36.28 | 6.41 | 38.21 | Avg. | 54 | -15.79 |
| 9.92 | H | 45.63 | 35.49 | 38.14 | 7.62 | 55.90 | Peak | 74 | -18.10 |
| 9.92 | H | 32.08 | 35.49 | 38.14 | 7.62 | 42.35 | Avg. | 54 | -11.65 |
| 12.4 | H | 43.16 | 33.73 | 39.00 | 8.63 | 57.05 | Peak | 74 | -16.95 |
| 12.4 | H | 30.51 | 33.73 | 39.00 | 8.63 | 44.40 | Avg. | 54 | -9.60 |

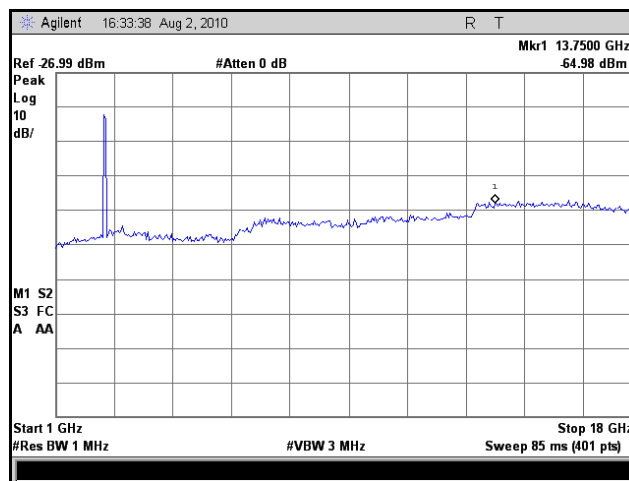
Table 23. Radiated Harmonics, High Channel (2480MHz)

*Note: All other emissions were measured at the noise floor of the spectrum analyzer.

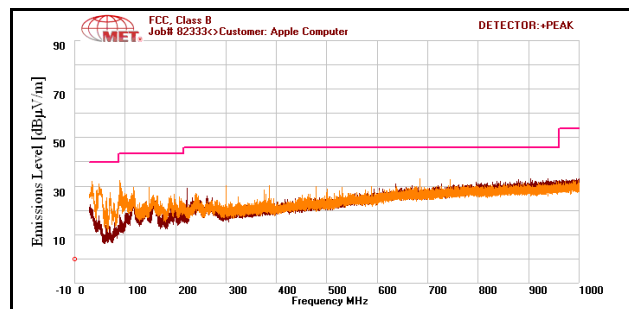
Radiated Spurious Emissions



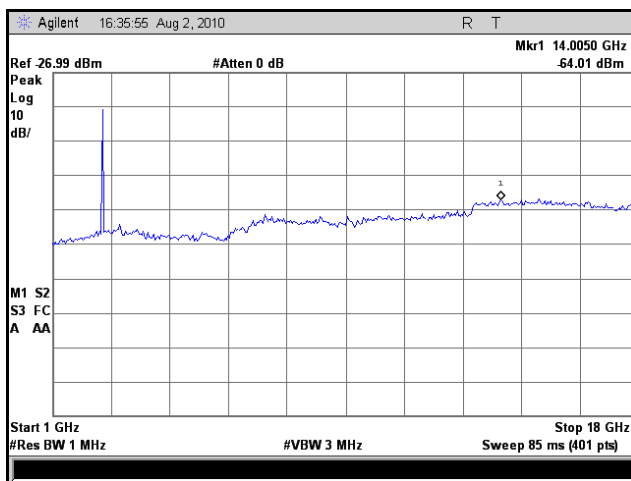
Plot 35. Radiated Spurious Emissions, Low Channel (2402MHz), 30 MHz – 1 GHz



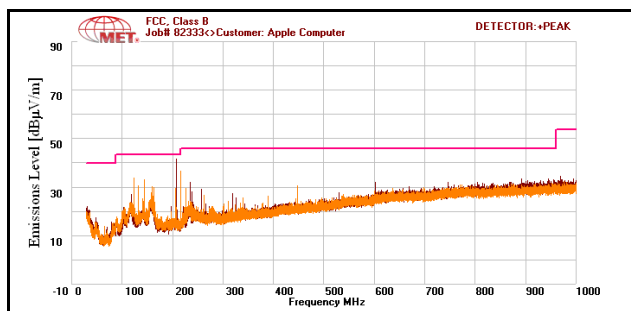
Plot 36. Radiated Spurious Emissions, Low Channel (2402MHz), 1 GHz – 18 GHz



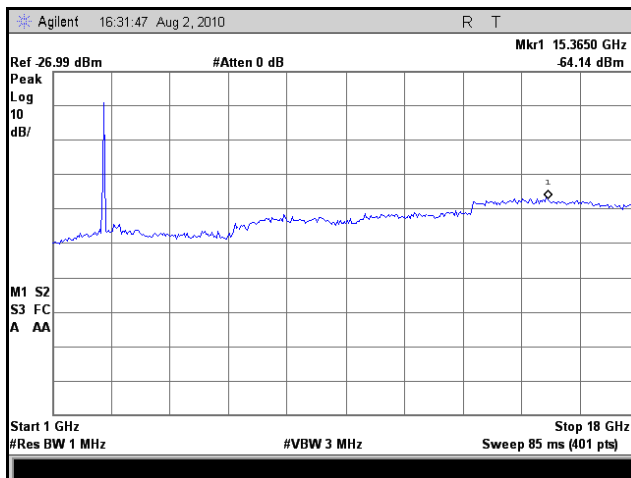
Plot 37. Radiated Spurious Emissions, Mid Channel (2441MHz), 30 MHz – 1 GHz



Plot 38. Radiated Spurious Emissions, Mid Channel (2441MHz), 1 GHz – 18 GHz



Plot 39. Radiated Spurious Emissions, High Channel (2480MHz), 30 MHz – 1 GHz



Plot 40. Radiated Spurious Emissions, High Channel (2480MHz), 1 GHz – 18 GHz

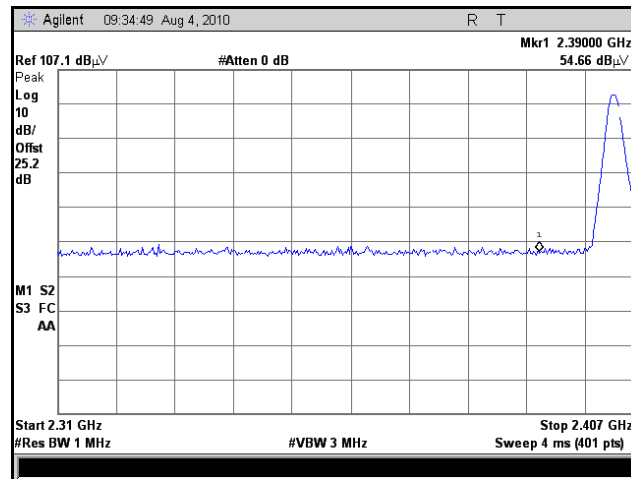
Radiated Band Edge Measurements

Test Procedures: The transmitter was tuned. Measurements were performed of the low and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for cable loss, antenna correction factor and distance. For high channel band edge measurement (GFSK), the delta marker method was used to determine compliance.

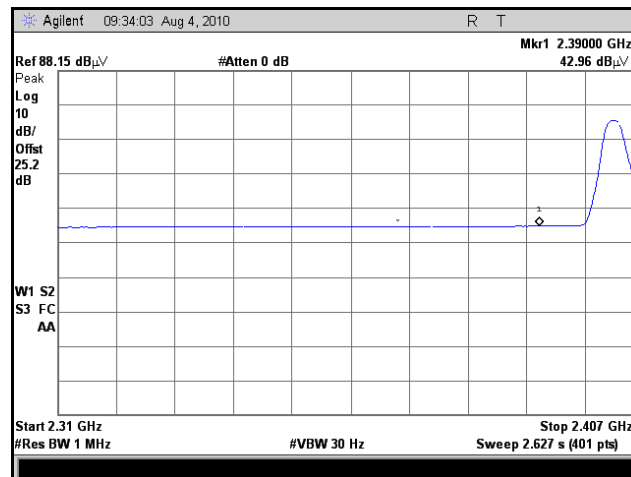
STEP 1 - The field strength of the fundamental emission was measured using a 1MHz RBW and a 3MHz VBW for the peak value and a 1MHz RBW and a 10Hz VBW for the average value.

STEP 2 – The spectrum analyzer was spanned to encompass both the peak of the fundamental emission and the band edge emission under investigation. The RBW was set to 30 kHz and the VBW to 3x the RBW. The delta between the peak levels of the fundamental emission at the relevant band edge emission was measured and recorded.

STEP 3 – The resulting delta value was used to determine compliance.

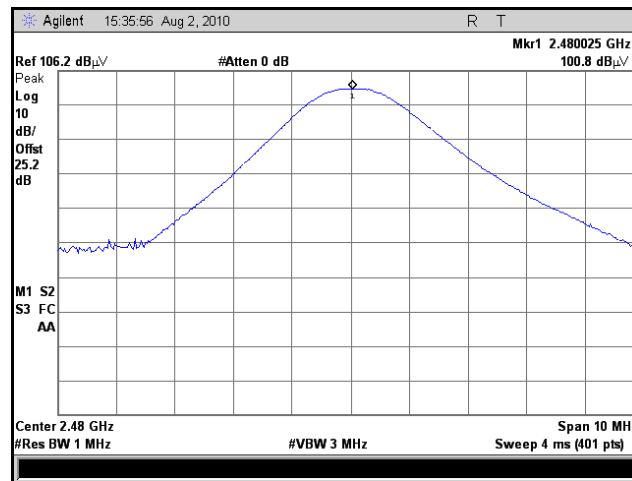


Plot 41. Radiated Restricted Band, Low Channel (2402MHz), Peak, GFSK Modulation

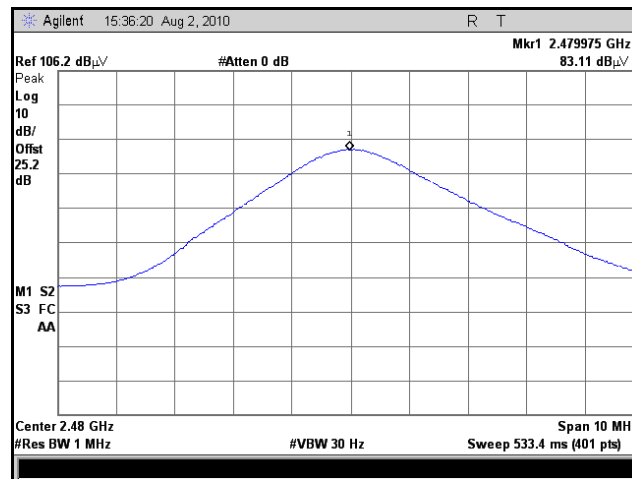


Plot 42. Radiated Restricted Band, Low Channel (2402MHz), Average, GFSK Modulation

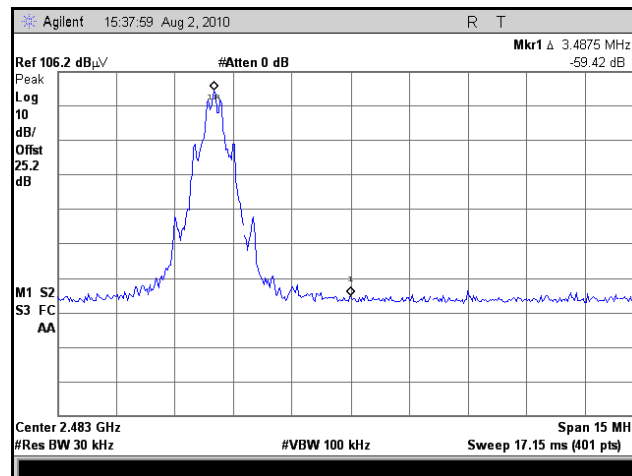
| Emission | Corrected Amplitude (dBuV) | Delta Method (dBuV) | Band Edge Measurement (dBuV) | Limit (dBuV) | Margin (dBuV) |
|----------|----------------------------|---------------------|------------------------------|--------------|---------------|
| Peak | 100.8 | 59.42 | 41.38 | 74 | 32.62 |
| Avg. | 83.11 | 59.42 | 23.69 | 54 | 30.31 |



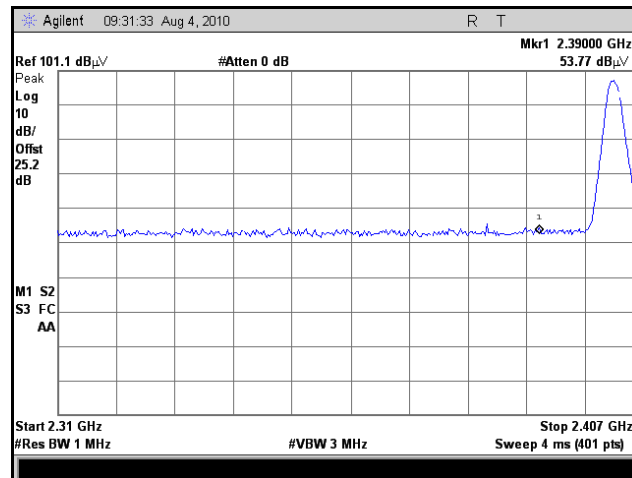
Plot 43. Radiated Restricted Band, High Channel (2480MHz), Peak, GFSK Modulation



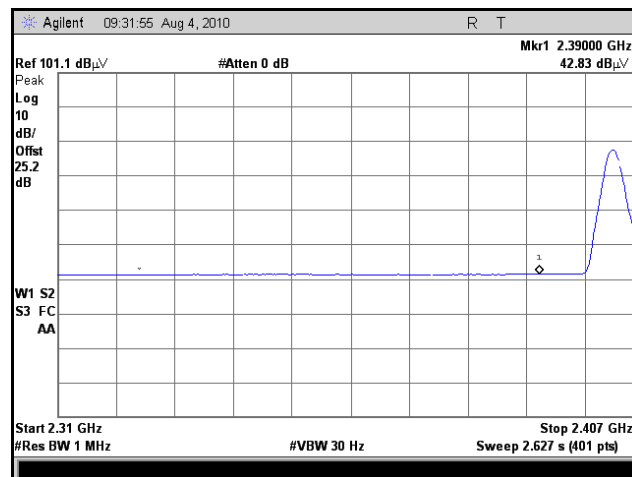
Plot 44. Radiated Restricted Band, High Channel (2480MHz), Average, GFSK Modulation



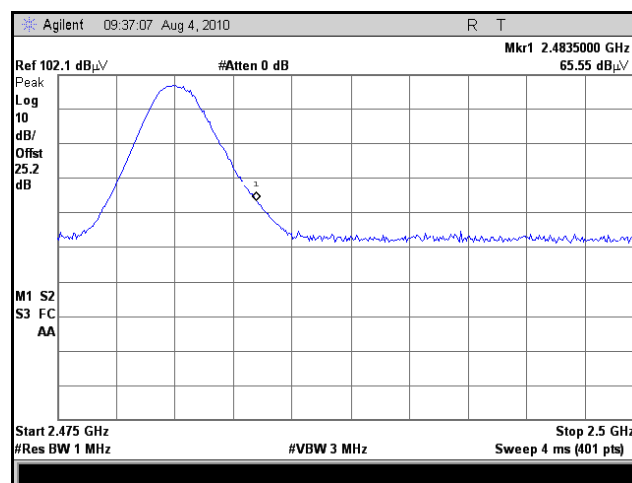
Plot 45. Radiated Restricted Band, High Channel (2480MHz), Marker Delta, GFSK Modulation



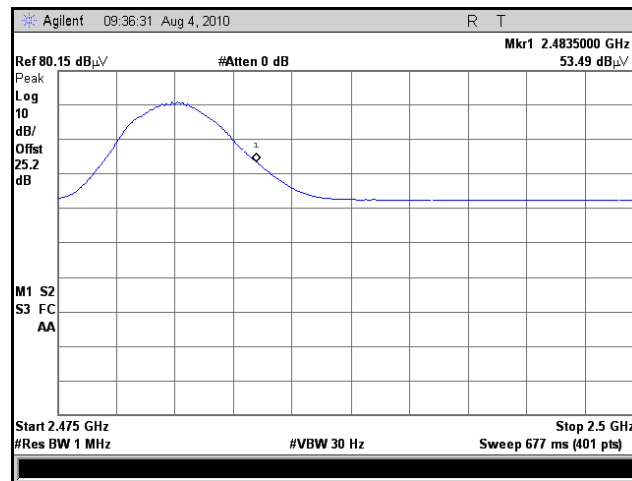
Plot 46. Radiated Restricted Band, Low Channel (2402MHz), Peak, 8PSK Modulation



Plot 47. Radiated Restricted Band, Low Channel (2402MHz), Average, 8PSK Modulation



Plot 48. Radiated Restricted Band, High Channel (2480MHz), Peak, 8PSK Modulation



Plot 49. Radiated Restricted Band, High Channel (2480MHz), Average, 8FSK Modulation

Electromagnetic Compatibility Criteria for Intentional Radiators

RSS-GEN Receiver Spurious Emissions Requirements

Test Requirement: The following receiver spurious emission limits shall be complied with:

- a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 24.

| Spurious Frequency (MHz) | Field Strength (microvolt/m at 3 metres) |
|--------------------------|--|
| 30-88 | 100 |
| 88-216 | 150 |
| 216-960 | 200 |
| Above 960 | 500 |

Table 24. Spurious Emission Limits for Receivers

- b) If a conducted measurement is made, no spurious output signals appearing at the antenna terminals shall exceed 2 nanowatts per any 4 kHz spurious frequency in the band 30-1000 MHz, or 5 nanowatts above 1 GHz.

Test Procedure: The receiver spurious emissions were tested conducted.

Test Results: The EUT was compliant with the Receiver Spurious Emission limits of this requirement.

Test Engineer(s): Minh Ly

Test Date(s): 08/05/10

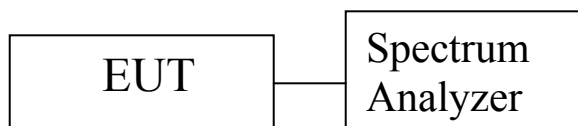
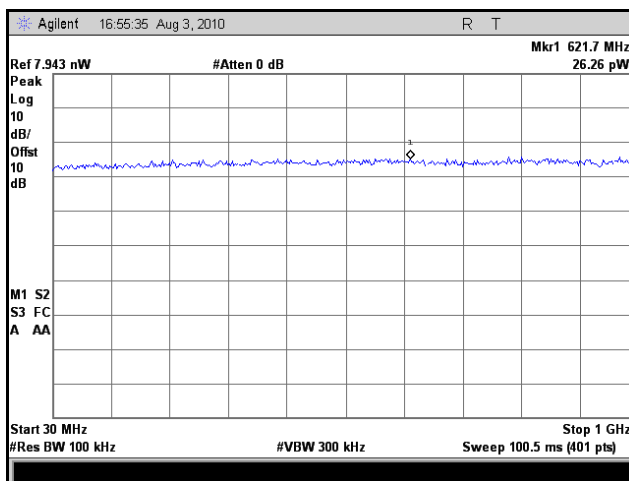
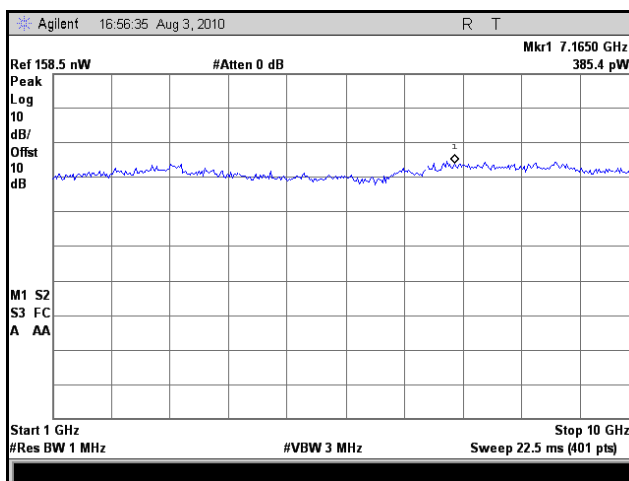


Figure 3. Block Diagram, Conducted Receiver Spurious Emissions Test Setup

Conducted Receiver Spurious Emissions



Plot 50. Receiver Spurious Emission, 30 MHz – 1 GHz



Plot 51. Receiver Spurious Emission, 1 GHz – 10 GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) RF Conducted Spurious Emissions Requirements and Band Edge

Test Requirement: **15.247(d)** 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Test Procedure: 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.

See following pages for detailed test results with RF Conducted Spurious Emissions. All spurious emissions are measured with GFSK modulation which represents the worse case emission.

Test Results: The EUT was compliant with the Conducted Spurious Emission limits of §15.247(d).

Test Engineer(s): Minh Ly

Test Date(s): 08/05/10

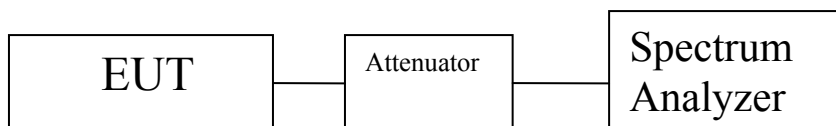
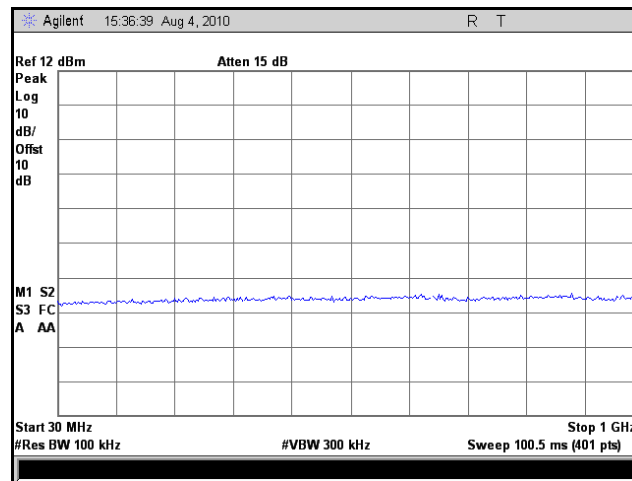
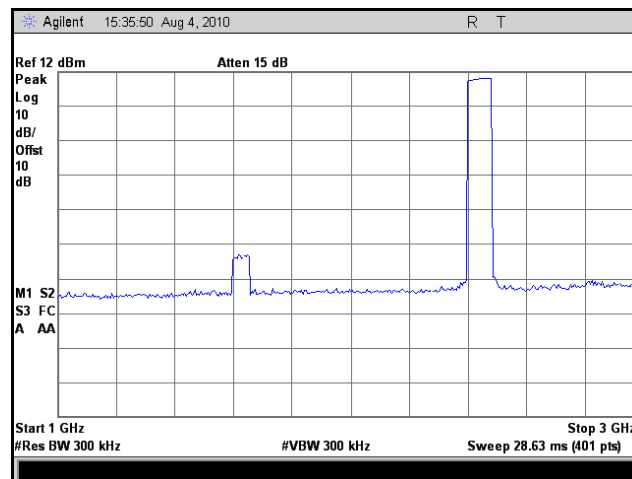


Figure 4. Block Diagram, Conducted Spurious Emissions Test Setup

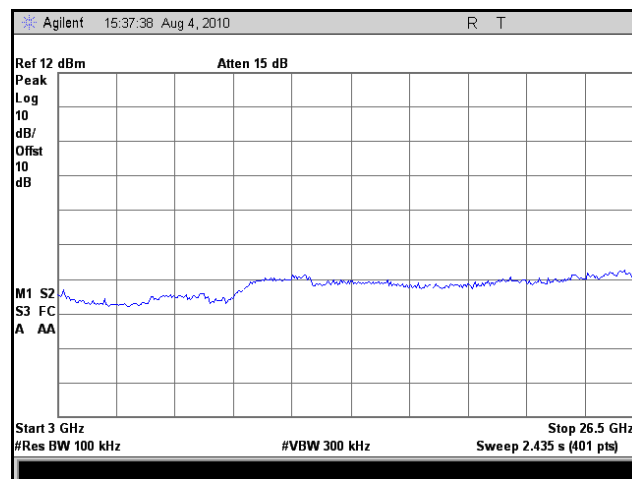
Conducted Spurious Emissions Test Results



Plot 52. Conducted Spurious Emissions, 30 MHz – 1 GHz

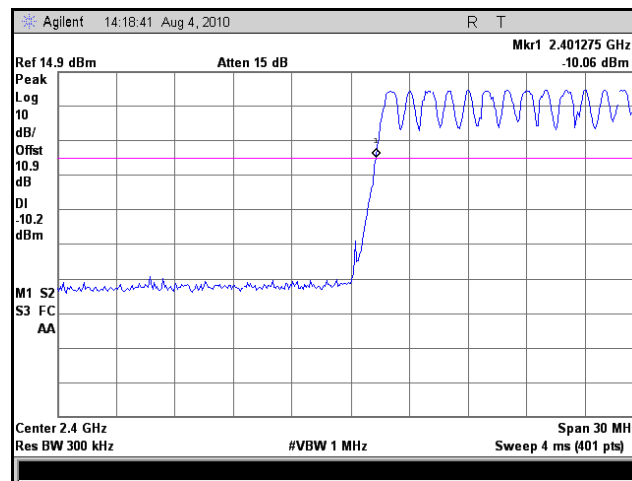


Plot 53. Conducted Spurious Emissions, 1 GHz – 3 GHz

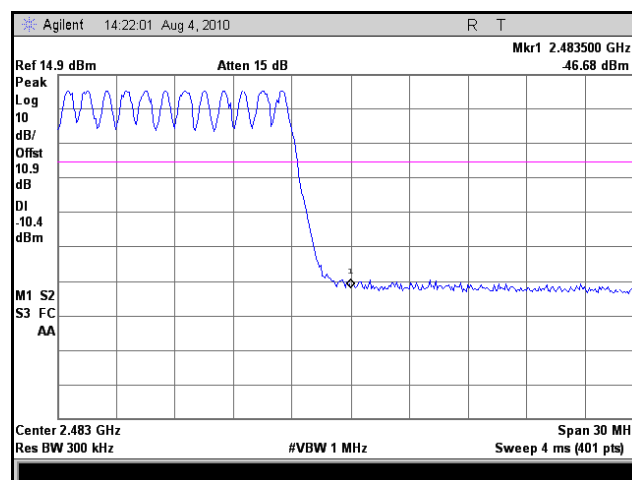


Plot 54. Conducted Spurious Emissions, 3 GHz – 26.5 GHz

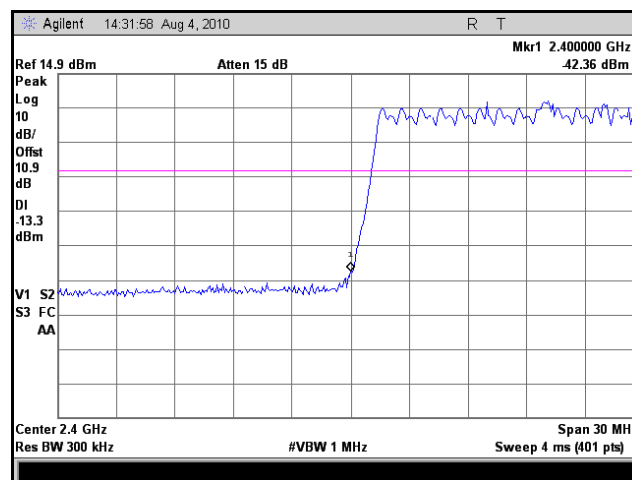
Conducted Band Edge Test Results



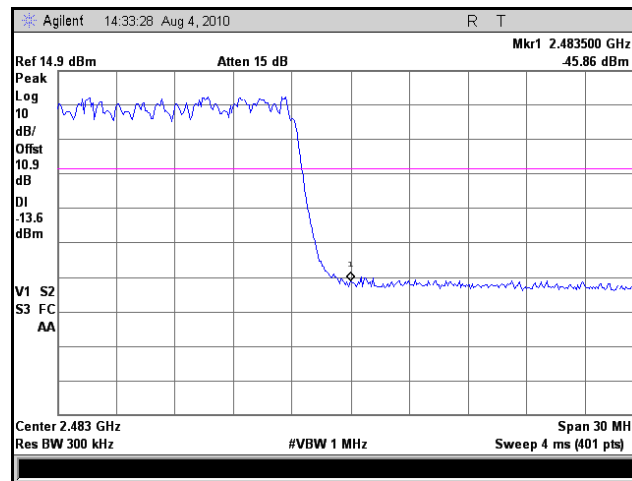
Plot 55. Conducted Band Edge with Hopping, Low Channel (2402MHz), GFSK Modulation



Plot 56. Conducted Band Edge with Hopping, High Channel (2440MHz), GFSK Modulation



Plot 57. Conducted Band Edge with Hopping, Low Channel (2402MHz), 8PSK Modulation



Plot 58. Conducted Band Edge with Hopping, High Channel (2480MHz), 8PSK Modulation

V. Test Equipment

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.

| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date |
|-------------|--------------------------------|-------------------------------|------------------|---------------|--------------|
| 1S2501 | EMI RECEIVER | ROHDE&SCHWARZ | ESU40 | 06/03/2010 | 06/03/2011 |
| 1S2484 | BILOG ANTENNA | TESEQ | CBL6112D | SEE NOTE | |
| 1S2399 | TURNNTABLE CONTROLLER | SUNOL SCIENCE | SC99V | NOT REQUIRED | |
| 1S2522 | DIGITAL THERMO/HYGROMETER | CONTROL COMPANY | 11-661-7D | 11/11/2009 | 11/11/2010 |
| 1S2482 | 5M CHAMBER | PANASHIELD | N/A | 10/16/2009 | 10/16/2010 |
| 1S2603 | DOUBLE RIDGED WAVEGUIDE HORN | ETS-LINGREN | 3117 | 04/09/2009 | 04/09/2011 |
| 1S2121 | PRE-AMPLIFIER | HEWLETT PACKARD | 8449B | SEE NOTE | |
| 1S2512 | TRANSIENT LIMITER | AGILENT | 11947A | SEE NOTE | |
| N/A | HIGH PASS FILTER | MICRO-TRONICS | HPM13146 | SEE NOTE | |
| 1S2034 | COUPLER, DIRECTIONAL 1-20 GHZ | KRYTAR | 101020020 | SEE NOTE | |
| 1S2583 | SPECTRUM ANALYZER | AGILENT | E4447A | 01/26/2010 | 01/26/2011 |
| 1S2460 | ANALYZER, SPECTRUM 9 KHZ-40GHZ | AGILENT | E4407B | 07/13/2010 | 07/13/2011 |
| 1S2229 | TEMPERATURE CHAMBER | TENNY ENGINEERING | T63C | 02/19/2010 | 02/19/2011 |
| 1S2630 | TRANSIENT LIMITER | FISCHER CUSTOM COMMUNICATIONS | FCC-450B-2.4-N | 01/24/2010 | 01/24/2011 |
| 1S2128 | HARMONIC MIXER | HEWLETT PACKARD | 11970A | 11/22/2008 | 11/22/2010 |
| 1S2501 | EMI TEST RECEIVER | ROHDE & SCHWARZ | ESU40 | 06/03/2010 | 06/03/2011 |
| 1S2488 | SCREEN ROOM | UNIVERSAL | Custom Made | 01/20/2010 | 01/20/2011 |
| 1S2507 | LISN | SOLAR ELECTRONICS | 9252-50-R-24-BNC | 08/06/2010 | 08/06/2011 |
| 1S2129 | HARMONIC MIXER | HEWLETT PACKARD | 11970K | 11/22/2008 | 11/22/2010 |

Table 25. Test Equipment List

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

VI. Certification & User's Manual Information

Certification & User's Manual Information

K. 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.

Certification & User's Manual Information

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.

Certification & User's Manual Information

§ 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.

Certification & User's Manual Information

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.

Verification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

§ 15.105 Information to the user.

- (a) For a Class A 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 A 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 commercial 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. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

- (b) 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.

ICES-003 Procedural & Labeling Requirements

From the Industry Canada Electromagnetic Compatibility Advisory Bulletin entitled, "Implementation and Interpretation of the Interference-Causing Equipment Standard for Digital Apparatus, ICES-003" (EMCAB-3, Issue 2, July 1995):

"At present, CISPR 22: 2002 and ICES technical requirements are essentially equivalent. Therefore, if you have CISPR 22: 2002 approval by meeting CISPR Publication 22, the only additional requirements are: to attach a note to the report of the test results for compliance, indicating that these results are deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations; to maintain these records on file for the requisite five year period; and to provide the device with a notice of compliance in accordance with ICES-003."

Procedural Requirements:

According to Industry Canada's Interference Causing Equipment Standard for Digital Apparatus ICES-003 Issue 4, February 2004:

- Section 6.1: A record of the measurements and results, showing the date that the measurements were completed, shall be retained by the manufacturer or importer for a period of at least five years from the date shown in the record and made available for examination on the request of the Minister.
- Section 6.2: A written notice indicating compliance must accompany each unit of digital apparatus to the end user. The notice shall be in the form of a label that is affixed to the apparatus. Where because of insufficient space or other constraints it is not feasible to affix a label to the apparatus, the notice may be in the form of a statement in the user's manual.

Labeling Requirements:

The suggested text for the notice, in English and in French, is provided below, from the Annex of ICES-003:

This Class [²] digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe [¹] est conforme à la norme NMB-003 du Canada.

² Insert either A or B but not both as appropriate for the equipment requirements.

End of Report