**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
33439 WESTERN AVENUE ● UNION CITY, CALIFORNIA 94587 ● PHONE (510) 489-6300 ● FAX (510) 489-6372
3162 BELICK STREET ● SANTA CLARA, CALIFORNIA 95054 ● PHONE (408 748-3585 ● FAX (510) 489-6372
13301 MCCALLEN PASS ! AUSTIN, TX 78753 ! PHONE (512) 287-2500 ! FAX (512) 287-2513

March 2, 2012

Metrum Technologies
507 Main Street Suite B
Lake Dallas, TX 75065

Dear Dennis McCain,

Enclosed is the EMC Wireless test report for compliance testing of the Metrum Technologies, Endpoint Communication Module 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 B Digital Device and FCC Part 15 Subpart C, RSS-210, Issue 8, Dec. 2010 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: (\Metrum Technologies\EMCA33586-FCC247 Rev. 2)

# Electromagnetic Compatibility Criteria
# Test Report

for the

**Metrum Technologies**
**Endpoint Communication Module**

**Tested under**
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B & ICES-003
for Class B Digital Devices
&
15.247 Subpart C & RSS-210, Issue 8, Dec. 2010
for Intentional Radiators

**MET Report: EMCA33586-FCC247 Rev. 2**

March 2, 2012

**Prepared For:**

**Metrum Technologies**
**507 Main Street Suite B**
**Lake Dallas, TX 75065**

**Prepared By:**
**MET Laboratories, Inc.**
13301 McCallen Pass
Austin, TX 78753

  

# Electromagnetic Compatibility Criteria
# Test Report

for the

## Metrum Technologies
## Endpoint Communication Module

**Tested under**
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B & ICES-003
for Class B Digital Devices
&
15.247 Subpart C & RSS-210, Issue 8, Dec. 2010
for Intentional Radiators

Ram Shrestha, 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 8, Dec. 2010 under normal use and maintenance.

Shawn McMillen,
Wireless Manager, Electromagnetic Compatibility Lab

  

# Report Status Sheet

| Revision | Report Date | Reason for Revision |
|---|---|---|
| ∅ | January 12, 2012 | Initial Issue. |
| 1 | January 26, 2012 | Revised to add Industry Canada references. |
| 2 | March 2, 2012 | Revised to reflect engineer corrections. |

  

# Table of Contents

# List of Tables



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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 |
| **dBµA** | **D**eci**b**els above one **micro**amp |
| **dBµV** | **D**eci**b**els above one **micro**volt |
| **dBµA/m** | **D**eci**b**els above one **micro**amp **per m**eter |
| **dBµV/m** | **D**eci**b**els above one **micro**volt **per m**eter |
| **DC** | **D**irect **C**urrent |
| **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 |
| **GRP** | **G**round **R**eference **P**lane |
| **H** | Magnetic Field |
| **HCP** | **H**orizontal **C**oupling **P**lane |
| **Hz** | **H**ert**z** |
| **IEC** | **I**nternational **E**lectrotechnical **C**ommission |
| **kHz** | **k**ilo**h**ert**z** |
| **kPa** | **k**ilo**pa**scal |
| **kV** | **k**ilo**v**olt |
| **LISN** | **L**ine **I**mpedance **S**tabilization **N**etwork |
| **MHz** | **M**ega**h**ertz |
| **µH** | **microh**enry |
| **µ** | **microf**arad |
| **µs** | **micros**econds |
| **NEBS** | **N**etwork **E**quipment-**B**uilding **S**ystem |
| **PRF** | **P**ulse **R**epetition **F**requency |
| **RF** | **R**adio **F**requency |
| **RMS** | **R**oot-**M**ean-**S**quare |
| **TWT** | **T**raveling **W**ave **T**ube |
| **V/m** | **V**olts **per m**eter |
| **VCP** | **V**ertical **C**oupling **P**lane |

# I. Executive Summary

## A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Metrum Technologies Endpoint Communication Module, 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 Endpoint Communication Module. Metrum Technologies should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Endpoint Communication Module, 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 Metrum Technologies, purchase order number 0002939. All tests were conducted using measurement procedure ANSI C63.4-2003.

| FCC Reference 47 CFR Part 15.247:2005 | IC Reference RSS-210 Issue 8: 2010; RSS-GEN Issue 3: 2010 | 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-GEN (7.2.4) | Conducted Emission Limits | Refer to FCC ID: QPU3020. Refer to IC: 4523A-SN3020. |
| Title 47 of the CFR, Part 15 §15.247(a)(2) | RSS-Gen(4.6) | 6dB Occupied Bandwidth | Refer to FCC ID: QPU3020. Refer to IC: 4523A-SN3020. |
| | | 99% Occupied Bandwidth | Refer to FCC ID: QPU3020. Refer to IC: 4523A-SN3020. |
| Title 47 of the CFR, Part 15 §15.247(b) | RSS-210(A8.4) | Peak Power Output | Refer to FCC ID: QPU3020. Refer to IC: 4523A-SN3020. |
| Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205 | RSS-210(A8.5) | Radiated Spurious Emissions Requirements | Compliant |
| Title 47 of the CFR, Part 15 §15.247(d) | RSS-210(A8.5) | RF Conducted Spurious Emissions Requirements | Refer to FCC ID: QPU3020. Refer to IC: 4523A-SN3020. |
| Title 47 of the CFR, Part 15 §15.247(d) | RSS-210(A8.5) | RF Conducted Band Edge | Refer to FCC ID: QPU3020. Refer to IC: 4523A-SN3020. |
| Title 47 of the CFR, Part 15; §15.247(e) | RSS-210(A8.2) | Peak Power Spectral Density | Refer to FCC ID: QPU3020. Refer to IC: 4523A-SN3020. |
| Title 47 of the CFR, Part 15 §15.247(i) | RSS-Gen(5.6) | Maximum Permissible Exposure (MPE) | Compliant |
| N/A | RSS-Gen(4.10) | Receiver Spurious Emissions | Compliant |

**Table 1. Executive Summary of EMC Part 15.247 ComplianceTesting**

# II. Equipment Configuration

# A. Overview

MET Laboratories, Inc. was contracted by Metrum Technologies to perform testing on the Endpoint Communication Module, under Metrum Technologies's purchase order number 0002939.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Metrum Technologies, Endpoint Communication Module.

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

| | | |
|---|---|---|
| **Model(s) Tested:** | Endpoint Communication Module | |
| **Model(s) Covered:** | Endpoint Communication Module | |
| **EUT Specifications:** | Primary Power: 120 VAC, 60 Hz | |
| | FCC ID: A7E-UTILIWISEECM | |
| | Type of Modulations: | DSSS |
| | Equipment Code: | DTS |
| | EUT Frequency Ranges: | 2405 – 2480 MHz |
| **Analysis:** | The results obtained relate only to the item(s) tested. | |
| **Environmental Test Conditions:** | Temperature: 15-35º C | |
| | Relative Humidity: 30-60% | |
| | Barometric Pressure: 860-1060 mbar | |
| **Evaluated by:** | Ram Shrestha, Shawn McMillen | |
| **Report Date(s):** | March 2, 2012 | |

**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 |
| **CFR 47, Part 15, Subpart B** | Electromagnetic Compatibility: Criteria for Radio Frequency Devices |
| **RSS-210, Issue 8, Dec. 2010** | Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment |
| **RSS-GEN, Issue 3, Dec. 2010** | General Requirements and Information for the Certification of Radio Apparatus |
| **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., 13301 McCallen Pass, Austin, TX 78753. 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 3 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 Metrum Technologies Endpoint Communication Module, Equipment Under Test (EUT), is an under-the-cover IP-based wireless communications device integrated into a solid-state electricity meter. Using digital cellular as a means of connection between the Meter and the Billing system. Example: a host billing system may make a cellular call to the device to receive billing data. All hardware is completely internal, thus no external components.


**Photograph 1. Metrum Technologies Endpoint Communication Module**

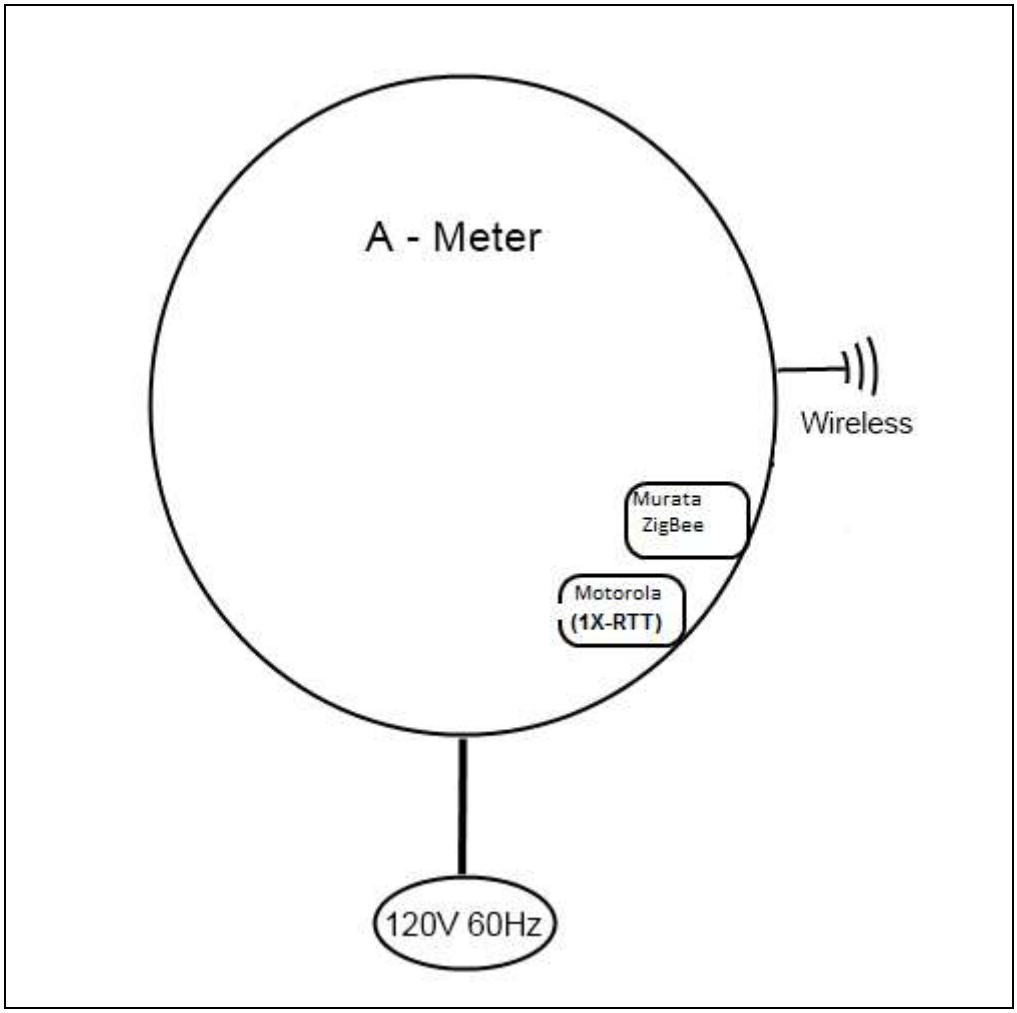



**Figure 1. Block Diagram of Test Configuration**

## E. Equipment Configuration

The EUT was set up as outlined in Figure 1, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

| Ref. ID | Slot # | Name / Description | Model Number | Part Number | Serial Number | Rev. # |
|---|---|---|---|---|---|---|
| A | N/A | Meter | Landis+Gyr Focus | AX-SD | 112619829 | N/A |

**Table 4. Equipment Configuration**

## F. 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 |
|---|---|---|---|
| ZigBee WSN Test Tool Software | Murata | Version 1.1.1 | Not Applicable |
| Laptop | Dell | Inspiron 1501 | HNH0BD1 |

**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 |
|---|---|---|---|---|---|---|
| N/A | Power | AC 3 wire power cable | 1 | 2 | N | 120V 60Hz |

**Table 6. Ports and Cabling Information**

## H. Mode of Operation

**Normal Operation:**

**Stand By Mode:** The Metrum ECM remains in stand-by / listen mode until it receives a Poll.

**Rx/Tx Mode:** The Metrum ECM communicates briefly with the cellular network every minute to maintain a steady state with the network. When an incoming data poll is detected, it receives data to the cellular device, and then passes data via the USART to the meter TTL interface making a serial connection. Then commands from the billing software via the IP connection initiate the bi-directional data transfer to and from the meter's processor.

**ZigBee FCC Testing:** Install and run the WSN Tool application on a PC and connect the EUT via the supplied USB cable. The baud rate should be set to 9600 with settings of 8 N 1 and NONE. Follow the instructions in the UART PC Tool Instructions to set the ZigBee channels and power for testing.

## I. Method of Monitoring EUT Operation

The Metrum ECM has a 4 bi-color LED Status indicators. The 4 LEDs are visible at the bottom of the Focus meter.

Solid green LEDs indicate the EUT modem board is powered properly and is operational.

If the LEDs are not ON, the EUT modem board is not powered correctly and will not operate.

## J. Modifications

**a) Modifications to EUT**

No modifications were made to the EUT.

**b) Modifications to Test Standard**

No modifications were made to the test standard.

## K. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Metrum Technologies 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 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.

| 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 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.

**Test Procedure**: The EUT was setup on a wooden table, 80cm above the ground plane. The method of testing, test conditions, and test procedures of ANSI C63.4 were used. The EUT was powered through a 50Ω/50µH LISN. An EMI receiver, connected to the measurement port of the LISN, scanned the frequency range from 150 kHz to 30 MHz in order to find the peak conducted emissions. All peak emissions within 20 dB of the limit, six highest peaks were re-measured using a quasi-peak and average detector. See Photograph 2 through Photograph 3 for pictures of the test setup. Jamila CE Rev 1.02 software was used to perform test.

| Environmental Conditions for Conducted Emissions | |
|---|---|
| **Ambient Temperature (°C)** | 22.5 |
| **Relative Humidity (%)** | 57.9 |
| **Atmospheric Pressure (kPa)** | 100.6 |

**Test Engineer(s):** Roel Garcia and Ram Shrestha

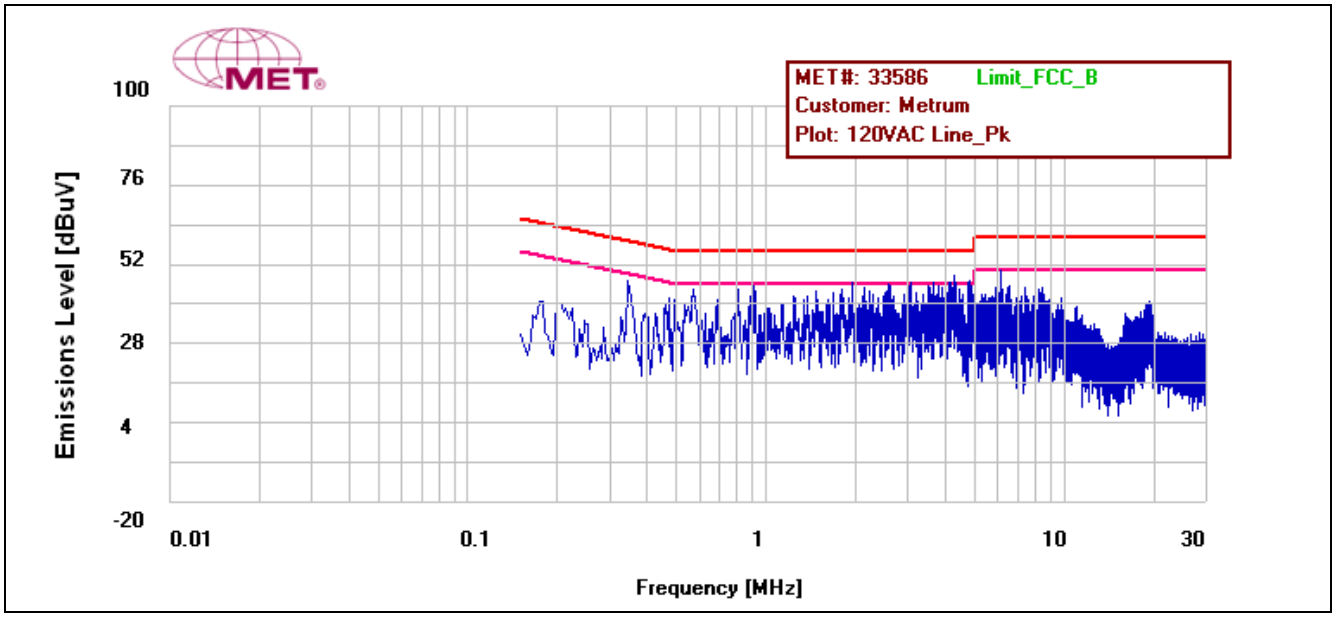
**Test Date(s):** 11/22/11

## 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 |
|---|---|---|---|---|---|---|---|---|---|
| 120VAC Line | 0.388 | 39.3 | 58.128 | -18.828 | Pass | 31.03 | 48.128 | -17.098 | Pass |
| 120VAC Line | 0.568 | 43.56 | 56 | -12.44 | Pass | 34.3 | 46 | -11.7 | Pass |
| 120VAC Line | 0.770 | 37.23 | 56 | -18.77 | Pass | 28.11 | 46 | -17.89 | Pass |
| 120VAC Line | 0.894 | 43.4 | 56 | -12.6 | Pass | 35.5 | 46 | -10.5 | Pass |
| 120VAC Line | 2.24 | 44.5 | 56 | -11.5 | Pass | 35.3 | 46 | -10.7 | Pass |
| 120VAC Line | 2.58 | 43.8 | 56 | -12.2 | Pass | 33.85 | 46 | -12.15 | Pass |
| 120VAC Line | 3.04 | 42.8 | 56 | -13.2 | Pass | 33.96 | 46 | -12.04 | Pass |
| 120VAC Line | 4.23 | 44.58 | 56 | -11.42 | Pass | 34.6 | 46 | -11.4 | Pass |
| 120VAC Line | 6.74 | 46.56 | 60 | -13.44 | Pass | 37.3 | 50 | -12.7 | Pass |

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

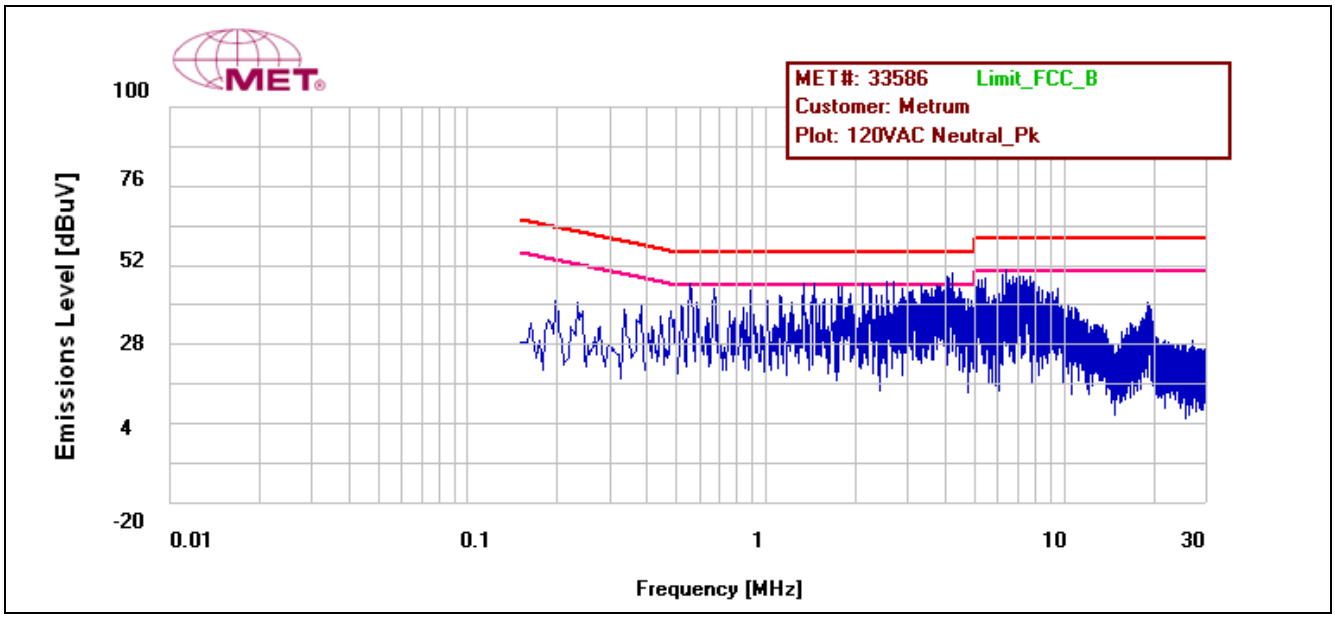



**Plot 1. Conducted Emission, Phase Line Plot**

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

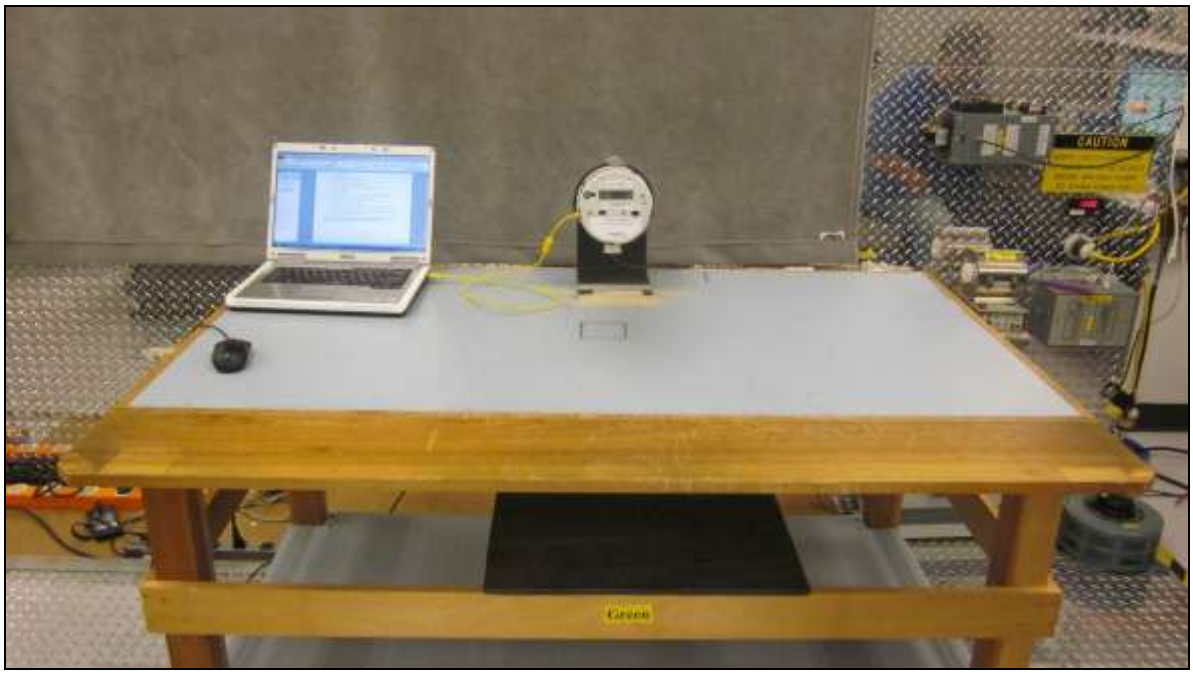
| Line | Freq. (MHz) | QP Amplitude | QP Limit | Delta | Pass | Average Amplitude | Average Limit | Delta | Pass |
|---|---|---|---|---|---|---|---|---|---|
| 120VAC Neutral | 0.560 | 45.8 | 56 | -10.2 | Pass | 39.1 | 46 | -6.9 | Pass |
| 120VAC Neutral | 0.676 | 42.5 | 56 | -13.5 | Pass | 34.79 | 46 | -11.21 | Pass |
| 120VAC Neutral | 0.896 | 43.75 | 56 | -12.25 | Pass | 35.85 | 46 | -10.15 | Pass |
| 120VAC Neutral | 1.46 | 44.3 | 56 | -11.7 | Pass | 35.4 | 46 | -10.6 | Pass |
| 120VAC Neutral | 1.80 | 44.2 | 56 | -11.8 | Pass | 34.7 | 46 | -11.3 | Pass |
| 120VAC Neutral | 2.70 | 41.1 | 56 | -14.9 | Pass | 33.4 | 46 | -12.6 | Pass |
| 120VAC Neutral | 3.93 | 44.67 | 56 | -11.33 | Pass | 35.1 | 46 | -10.9 | Pass |
| 120VAC Neutral | 4.26 | 45.65 | 56 | -10.35 | Pass | 36.38 | 46 | -9.62 | Pass |
| 120VAC Neutral | 5.19 | 43.39 | 60 | -16.61 | Pass | 35.7 | 50 | -14.3 | Pass |
| 120VAC Neutral | 6.58 | 45.6 | 60 | -14.4 | Pass | 37.01 | 50 | -12.99 | Pass |
| 120VAC Neutral | 7.52 | 45.56 | 60 | -14.44 | Pass | 37.6 | 50 | -12.4 | Pass |

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




**Plot 2. Conducted Emission, Neutral Line Plot**

## Conducted Emission Limits Test Setup



**Photograph 2. Conducted Emissions, Test Setup, Front View**

**Photograph 3. Conducted Emissions, Test Setup, Rear View**

## 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 setup on an acrylic table, 80cm above the ground plane, inside a semi-anechoic chamber. (See Photograph 4 through Photograph 6 for pictures of the test setup.) For final radiated measurements, the EUT was located at 10 meters in the frequency range from 30MHz to 1GHz from an adjustable antenna mast. For pre-scanning, the EMI Test Receiver scanned the frequency range from 30 MHz to 1 GHz to obtain an emission profile of the EUT. For each point of measurement, the turntable was rotated, and the antenna height was varied between 1 m and 4 m, in order to find the maximum radiated emissions. Measurements above 30 MHz were taken using the technique with the antenna in two polarizations: horizontal and vertical. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz resolution bandwidth (30 MHz – 1GHz). All peak emissions within 20 dB of the limit, six highest peaks were re-measured using a quasi-peak or average detector as appropriate
MET Labs uses software, Jamila RE (AU) 1.001, to gather information from test instrumentation for Radiated Emissions testing.

| Environmental Conditions for Radiated Emissions | |
|---|---|
| **Ambient Temperature (°C)** | 22.7 |
| **Relative Humidity (%)** | 52.2 |
| **Atmospheric Pressure (kPa)** | 100.4 |

**Test Results:** The EUT was compliant with the Class B requirement(s) of this section.

**Test Engineer(s):** Roel Garcia and Ram Shrestha

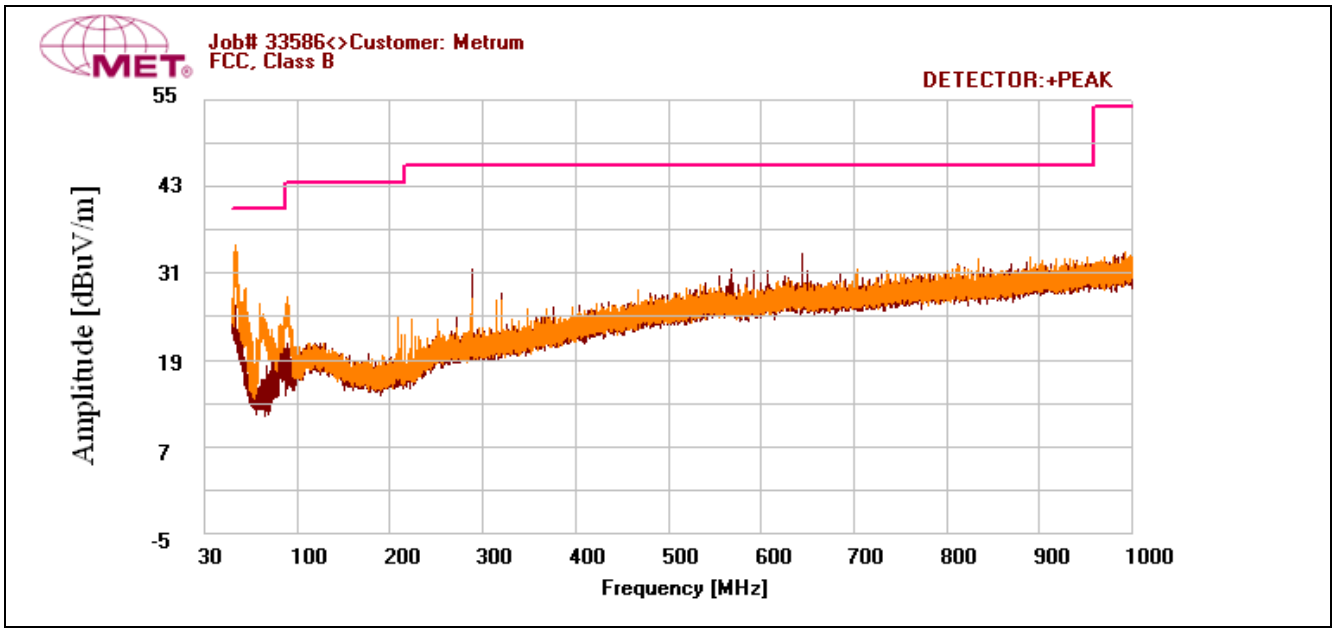
**Test Date(s):** 11/23/11

## 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) | Limit (dBuV) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.918 | V | 360 | 100 | 25.83 | 16.797 | 22.142 | 0 | 10.46 | 30.945 | 40 | -9.055 |
| 91.994 | V | 4 | 141 | 23.5 | 9.011 | 21.392 | 0 | 10.46 | 21.579 | 43.5 | -21.921 |
| 286.001 | H | 293 | 245 | 16.64 | 12.58 | 20.615 | 0 | 10.46 | 19.065 | 46 | -26.935 |
| 318.887 | H | 359 | 215 | 15.7 | 13.135 | 20.751 | 0 | 10.46 | 18.544 | 46 | -27.456 |
| 567.983 | H | 1 | 378 | 19.69 | 18.001 | 20.159 | 0 | 10.46 | 27.992 | 46 | -18.008 |
| 644.547 | H | 142 | 358 | 21.05 | 18.517 | 19.653 | 0 | 10.46 | 30.374 | 46 | -15.626 |

**Table 11. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz, FCC Limits**

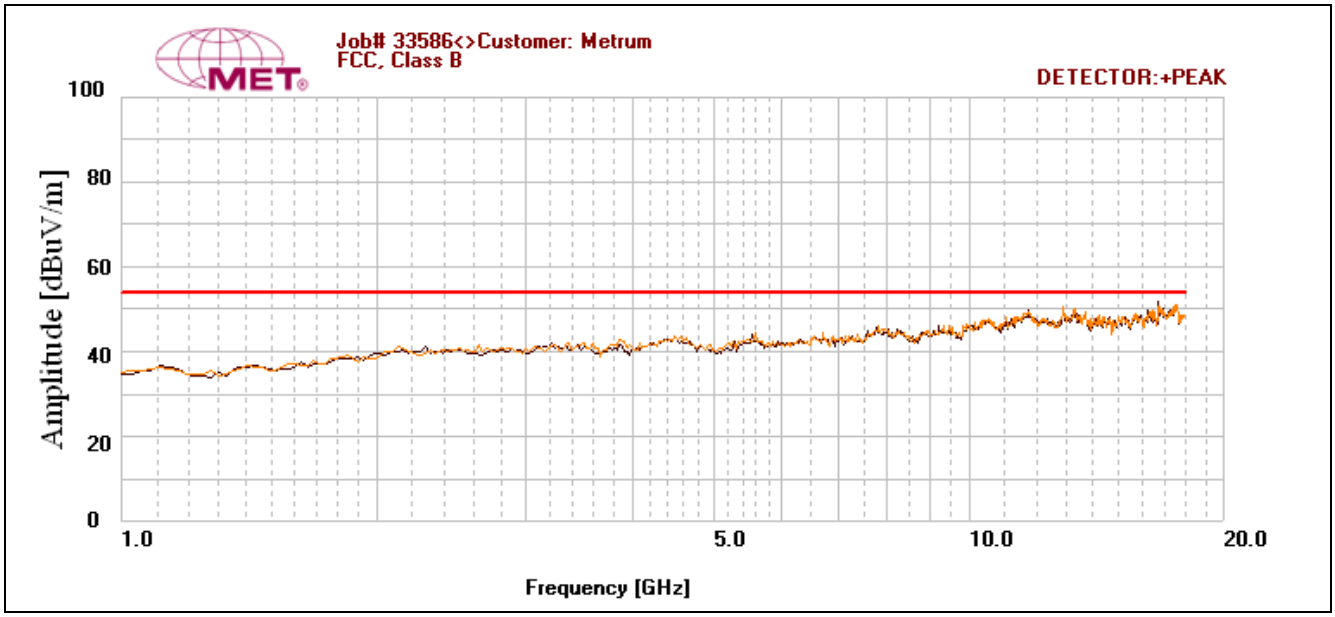



**Plot 3. Radiated Emissions, 30 MHz - 1 GHz, FCC Limits**

## 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) | Limit (dBuV) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 18000 | H | 360 | 300 | 33.07 | 41.8 | 39.34 | 0 | 0 | 35.53 | 54 | -18.47 |
| 18000 | V | 0 | 180 | 33.1 | 41.8 | 39.34 | 0 | 0 | 35.56 | 54 | -18.44 |

**Table 12. Radiated Emissions Limits, Test Results, Above 1 GHz, FCC Limits**

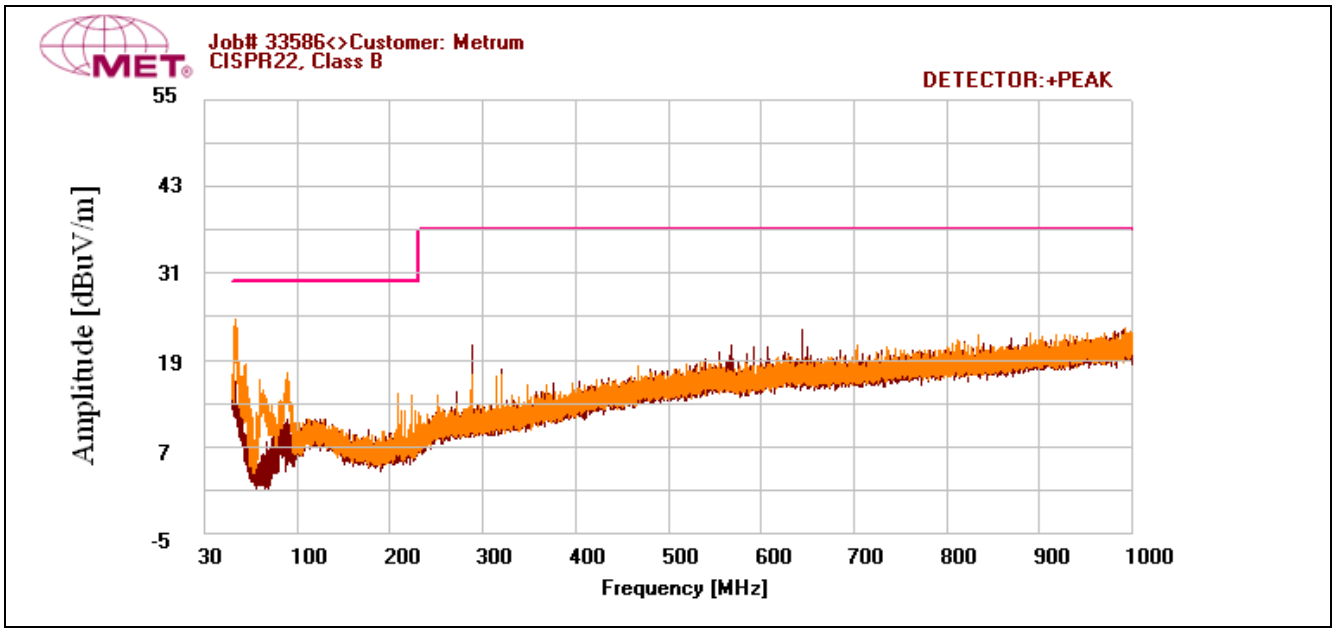



**Plot 4. Radiated Emissions, Above 1 GHz, FCC Limits**

## Radiated Emissions Limits Test Results, Class B

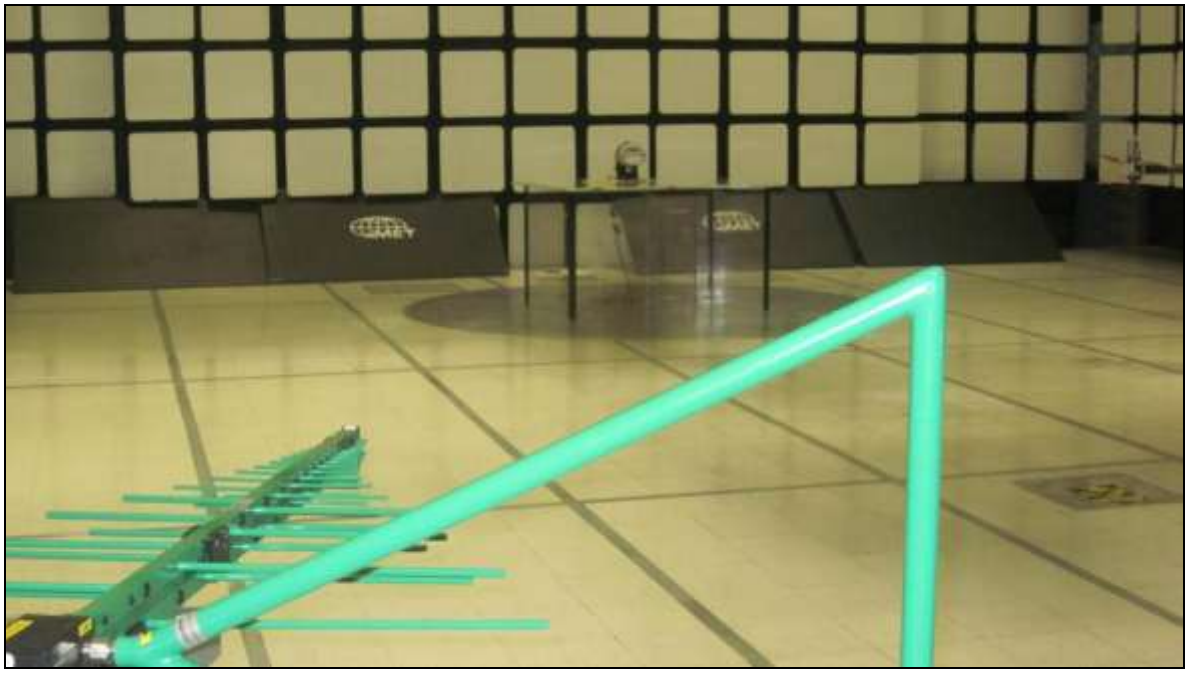
| Frequency (MHz) | Antenna Polarity | EUT Azimuth (Degrees) | Antenna Height (cm) | Uncorrected Amplitude (dBuV) | ACF (dB/m) | Pre Amp Gain (dB) | CBL (dB) | DCF (dB) | Corrected Amplitude (dBuV) | Limit (dBuV) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.918 | V | 360 | 100 | 25.83 | 16.797 | 22.142 | 0 | 0 | 20.485 | 30 | -9.515 |
| 91.994 | V | 4 | 141 | 23.5 | 9.011 | 21.392 | 0 | 0 | 11.119 | 30 | -18.881 |
| 286.001 | H | 293 | 245 | 16.64 | 12.58 | 20.615 | 0 | 0 | 8.605 | 37 | -28.395 |
| 318.887 | H | 359 | 215 | 15.7 | 13.135 | 20.751 | 0 | 0 | 8.084 | 37 | -28.916 |
| 567.983 | H | 1 | 378 | 19.69 | 18.001 | 20.159 | 0 | 0 | 17.532 | 37 | -19.468 |
| 644.547 | H | 142 | 358 | 21.05 | 18.517 | 19.653 | 0 | 0 | 19.914 | 37 | -17.086 |

**Table 13. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz, IC Limits**




**Plot 5. Radiated Emissions, 30 MHz - 1 GHz, IC Limits**

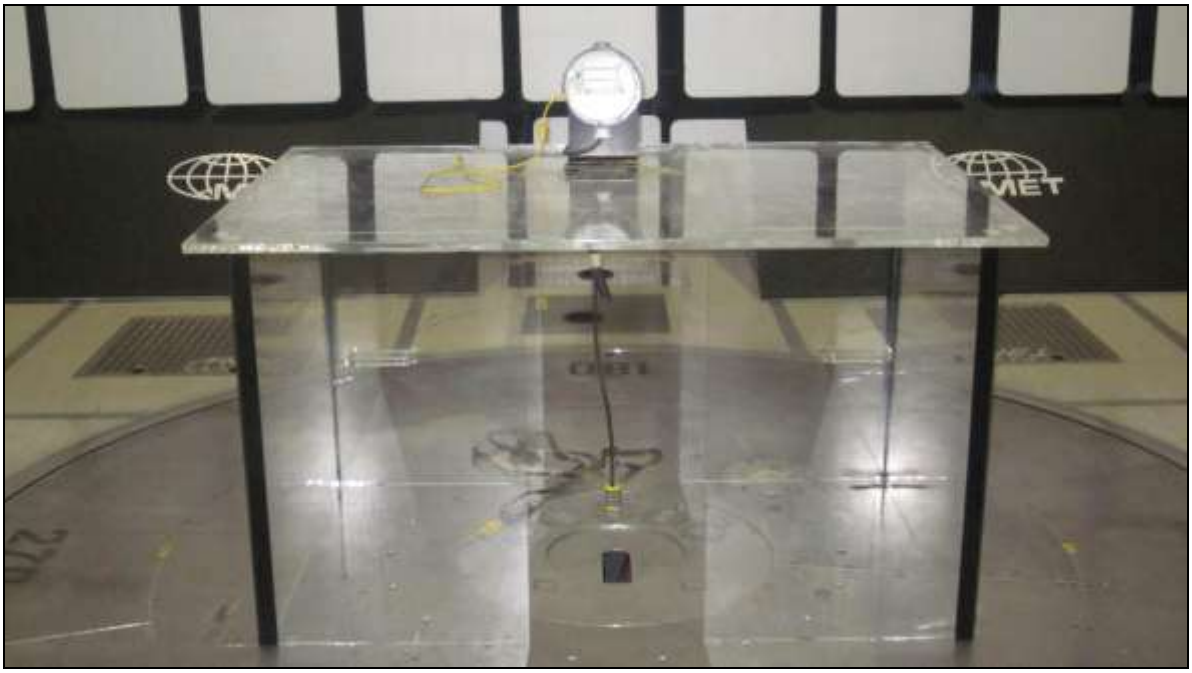
## Radiated Emission Limits Test Setup



**Photograph 4. Radiated Emissions, Test Setup, 30 MHz – 1 GHz**

**Photograph 5. Radiated Emissions, Test Setup, Rear View**



**Photograph 6. Radiated Emissions, Test Setup, Front View**

# 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. EUT uses an internal antenna which complies with option A as being permanently attached to the EUT.

**Test Engineer(s):** Shawn McMillen

**Test Date(s):** 12/06/11

| Gain | Type | Model | Manufacturer |
|---|---|---|---|
| 5 dBi | Flexible PCB Antenna | FXP70 Freedom 2.4 GHz | Taoglas |

**Table 14. Antenna List**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.207(a) 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 μH/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 (dBμV) | |
|---|---|---|
| | Quasi-Peak | Average |
| * 0.15- 0.45 | 66 - 56 | 56 - 46 |
| 0.45 - 0.5 | 56 | 46 |
| 0.5 - 30 | 60 | 50 |

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

**Test Results:** Refer to FCC ID: QPU3020. Refer to IC: 4523A-SN3020.

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.247(a)(2) 6 dB and 99% Bandwidth

**Test Requirements:** **§ 15.247(a)(2):** 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. The minimum 6dB bandwidth shall be at least 500 kHz.

**Test Results** Refer to FCC ID: QPU3020. Refer to IC: 4523A-SN3020.

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.247(b) Peak Power Output

**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(b)**

**§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.

Systems operating in the 2400 – 2483.5 MHz band and using a point to point application 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.

**Test Results:** Refer to FCC ID: QPU3020. Refer to IC: 4523A-SN3020.

# 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 17. 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 18.

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

**Table 18. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)**

| | |
|---|---|
| Low Channel | 2405 MHz |
| Mid Channel | 2440 MHz |
| High Channel | 2480 MHz |

**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. A notch filter was used to notch out the 2.4GHz band. Spurious frequencies that were above the average limit with peak detector were recorded. They were further investigated with Average limit and average detector and were found to be compliant.

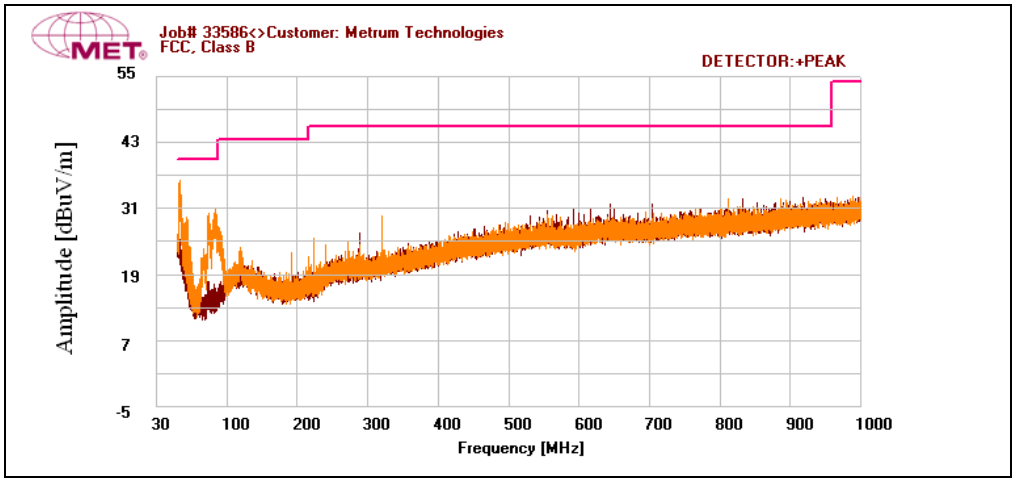
**Test Results:** The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.247(d)**.

**Test Engineer(s):** Ram Shrestha and Jeff Pratt

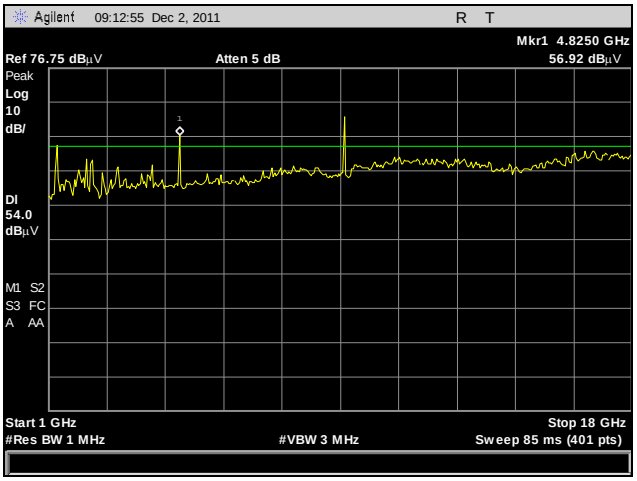
**Test Date(s):** 12/08/11 and 02/21/12 – 02/29/12

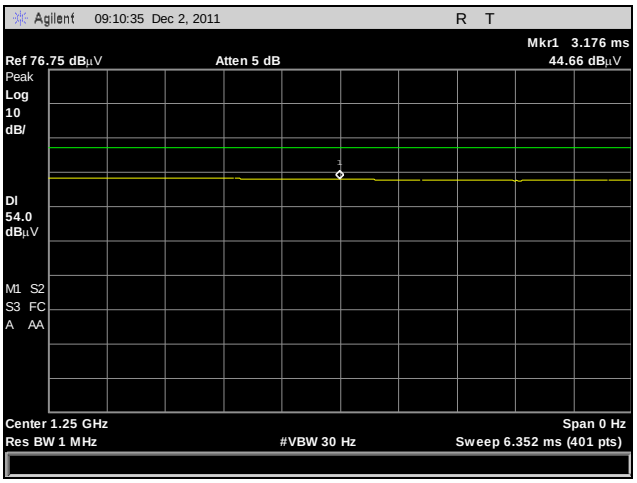
## Radiated Spurious Emissions Test Results




**Plot 6. Radiated Spurious Emissions, Low Channel, Quasi-Peak Limit, 30 MHz – 1 GHz, Peak Detector**

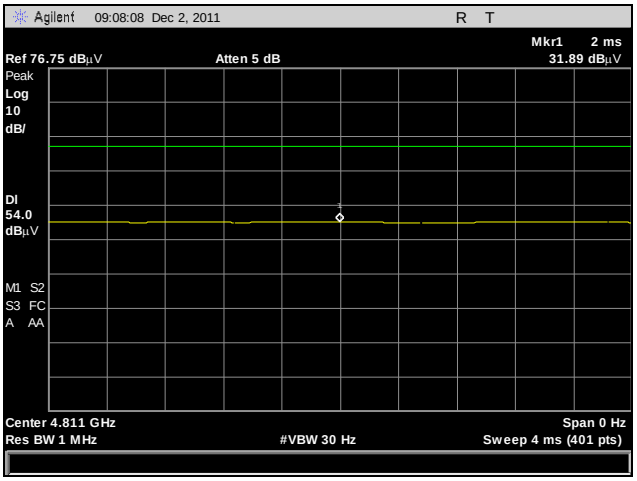



**Plot 7. Radiated Spurious Emissions, Low Channel, Average, 1 GHz – 18 GHz**

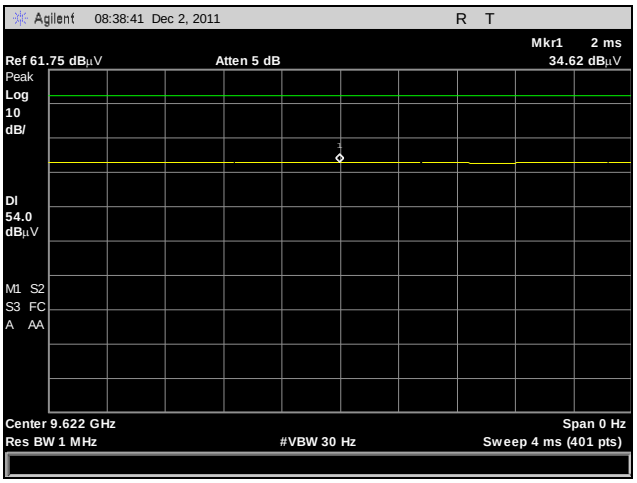



**Plot 8. Radiated Spurious Emissions, Low Channel, Average @ 1.25 GHz**

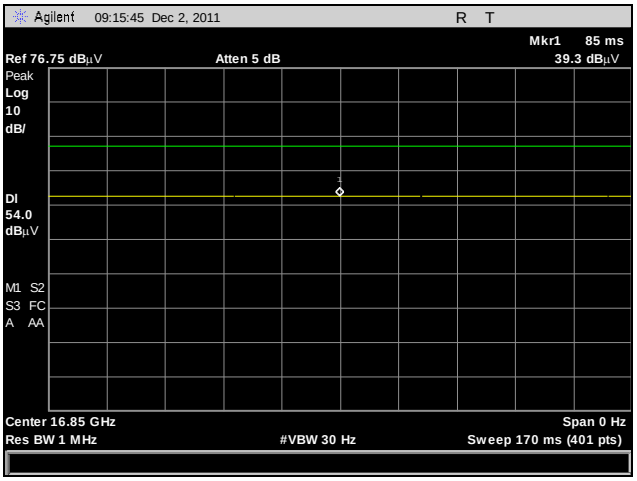
  




**Plot 9. Radiated Spurious Emissions, Low Channel, Average @ 2nd Harmonic**

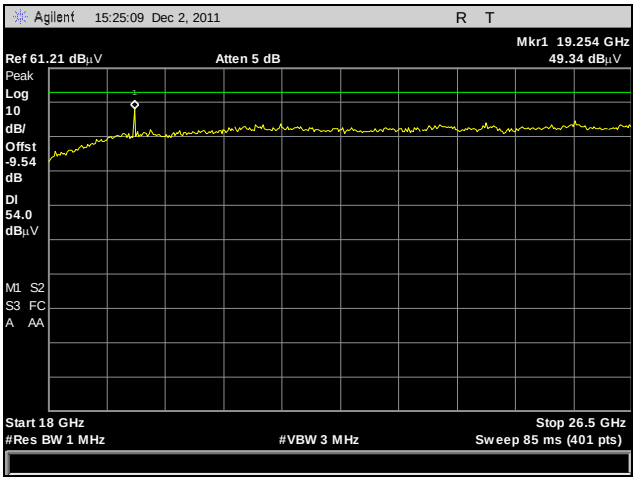



**Plot 10. Radiated Spurious Emissions, Low Channel, Average @ 4th Harmonic**

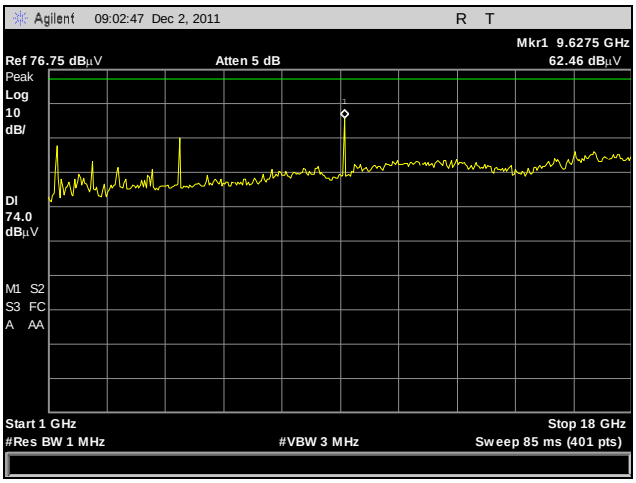



**Plot 11. Radiated Spurious Emissions, Low Channel, Average @ 16.85 GHz**

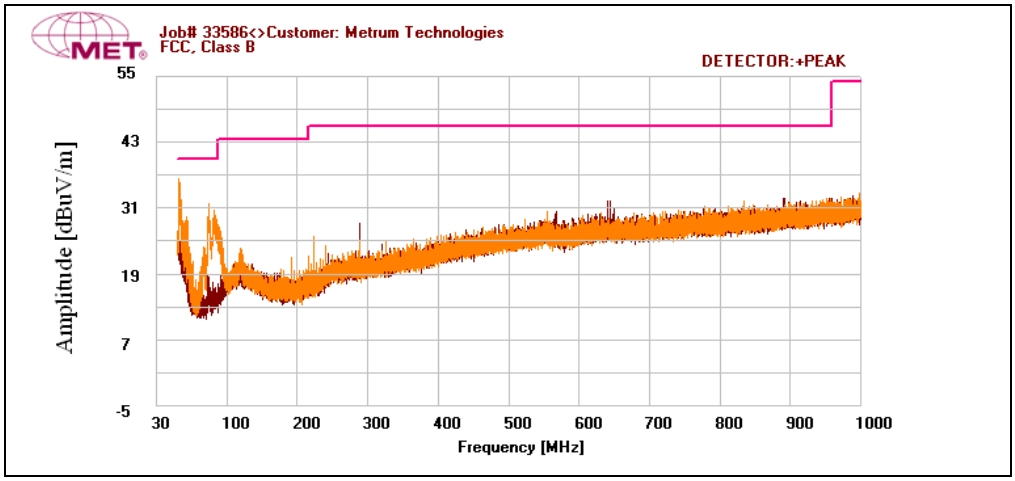
  



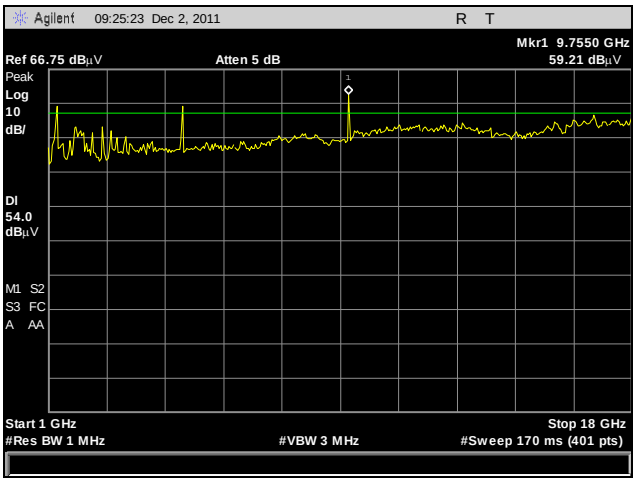

**Plot 12. Radiated Spurious Emissions, Low Channel, Average Limit, 18 GHz – 26.5 GHz, Peak Detector**



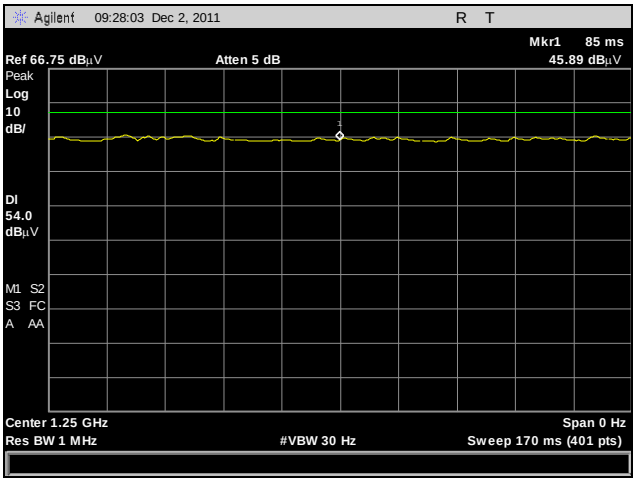

**Plot 13. Radiated Spurious Emissions, Low Channel, Peak Limit, 1 GHz – 18 GHz, Peak Detector**



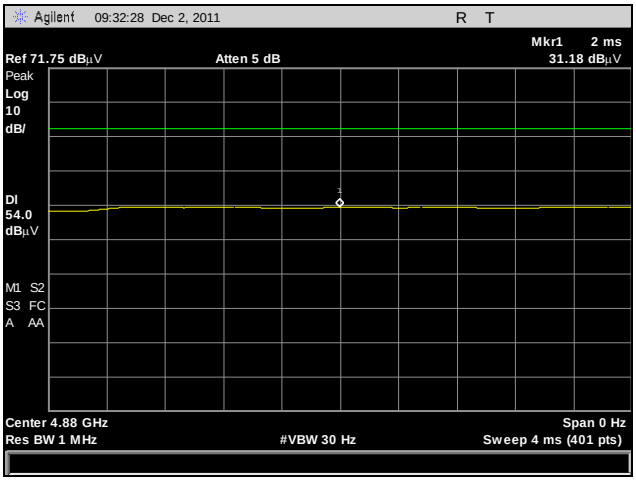

**Plot 14. Radiated Spurious Emissions, Mid Channel, Quasi-Peak Limit, 30 MHz – 1 GHz, Peak Detector**



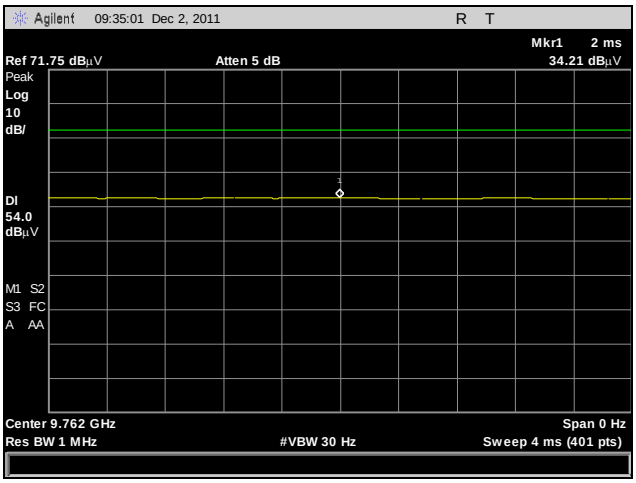

**Plot 15. Radiated Spurious Emissions, Mid Channel, Average Limit, 1 GHz – 18 GHz, Peak Detector**



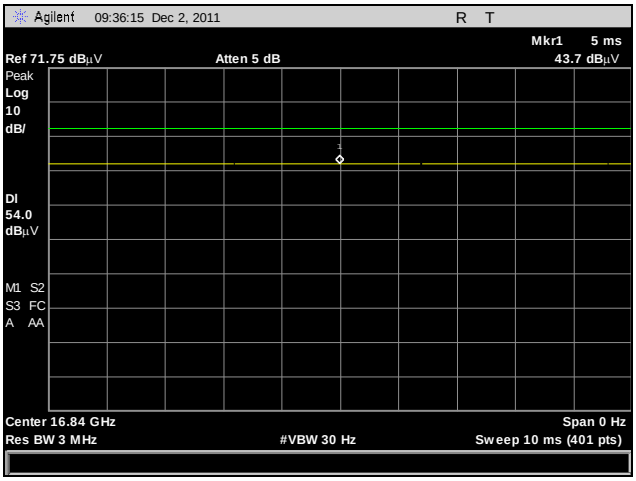

**Plot 16. Radiated Spurious Emissions, Mid Channel, Average @ 1.25 GHz**



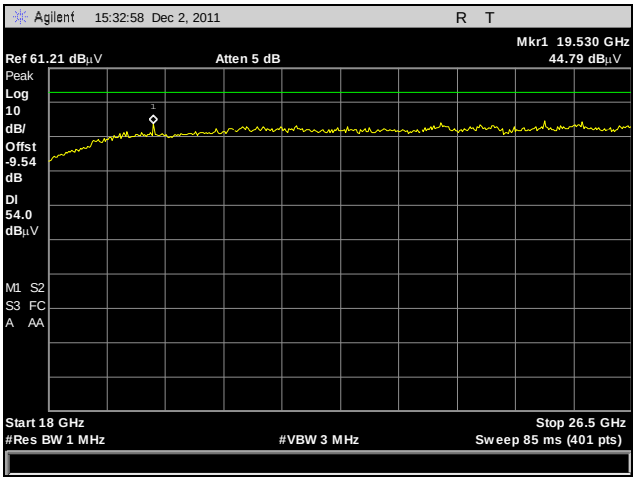

**Plot 17. Radiated Spurious Emissions, Mid Channel, Average @ 4.88 GHz**



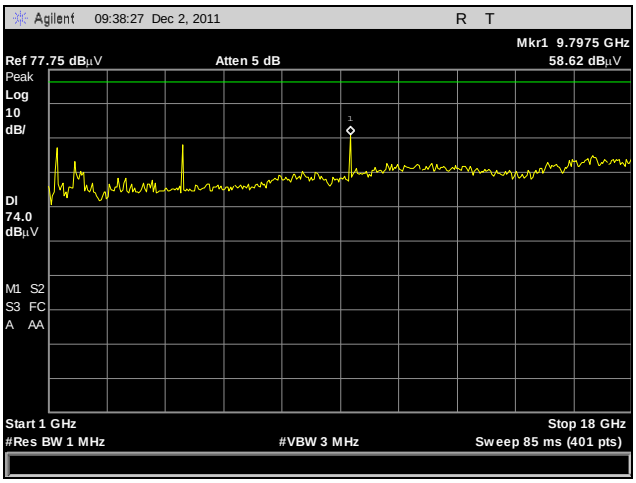

**Plot 18. Radiated Spurious Emissions, Mid Channel, Average @ 9.762 GHz**




**Plot 19. Radiated Spurious Emissions, Mid Channel, Average @ 16.84 GHz**

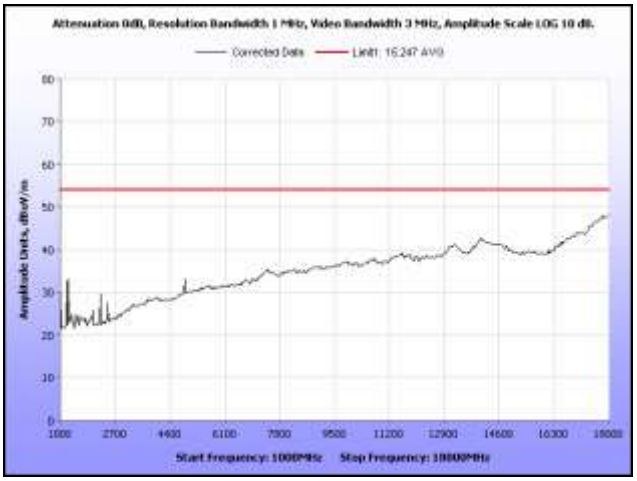



**Plot 20. Radiated Spurious Emissions, Mid Channel, Average Limit, 18 GHz – 26.5 GHz, Peak Detector**

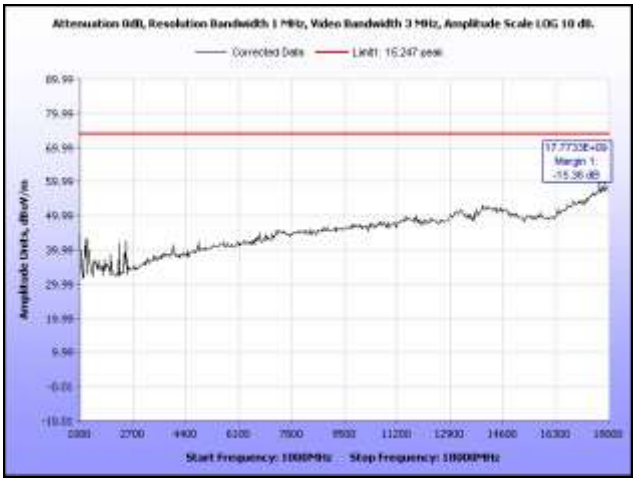



**Plot 21. Radiated Spurious Emissions, Mid Channel, Peak Limit, 1 GHz – 18 GHz, Peak Detector**

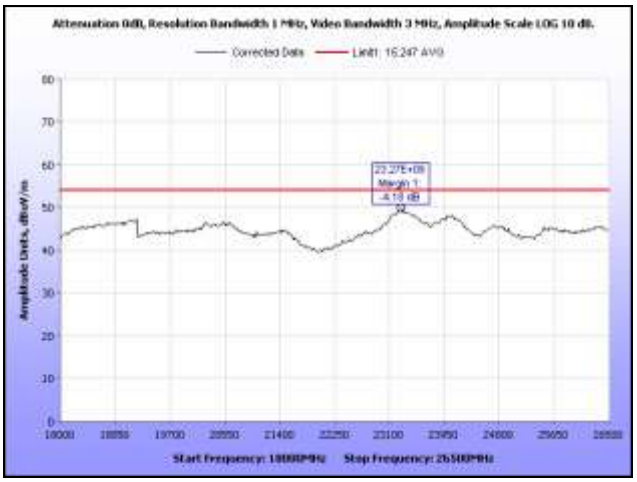
  



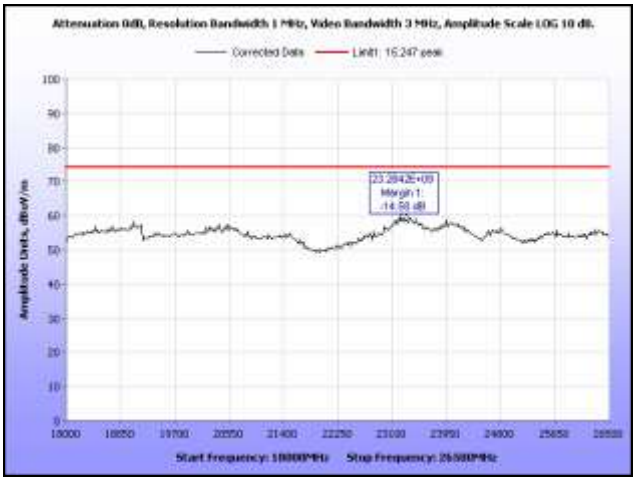

**Plot 22. Radiated Spurious Emissions, Channel 24, 1 GHz – 18 GHz, Average**



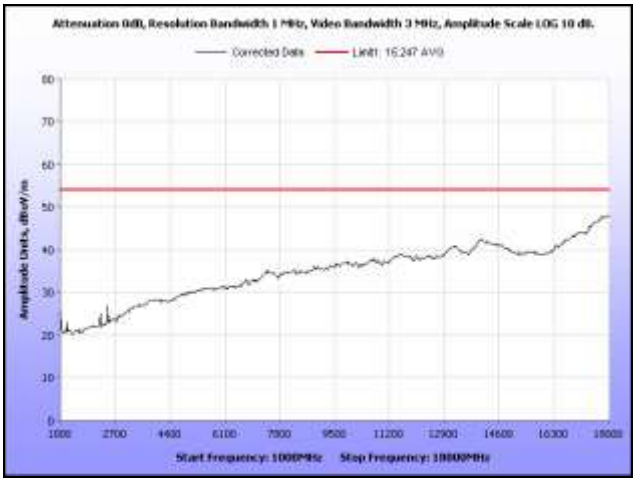

**Plot 23. Radiated Spurious Emissions, Channel 24, 1 GHz – 18 GHz, Peak**



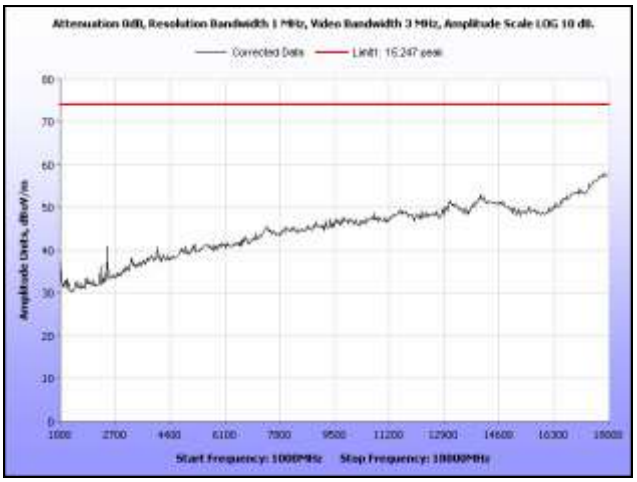

**Plot 24. Radiated Spurious Emissions, Channel 24, 18 GHz – 26.5 GHz, Average**



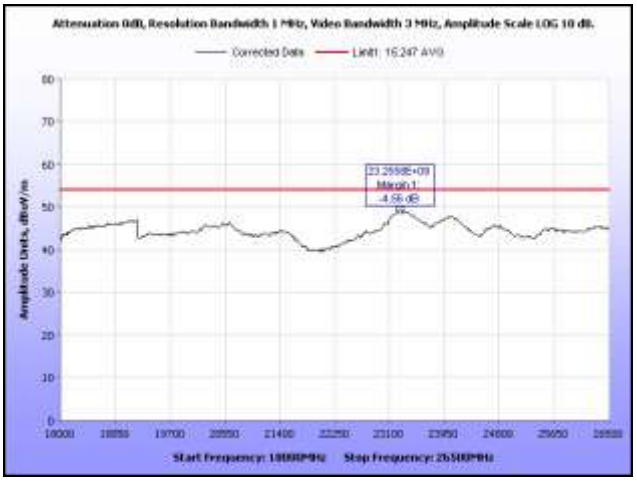

**Plot 25. Radiated Spurious Emissions, Channel 24, 18 GHz – 26.5 GHz, Peak**



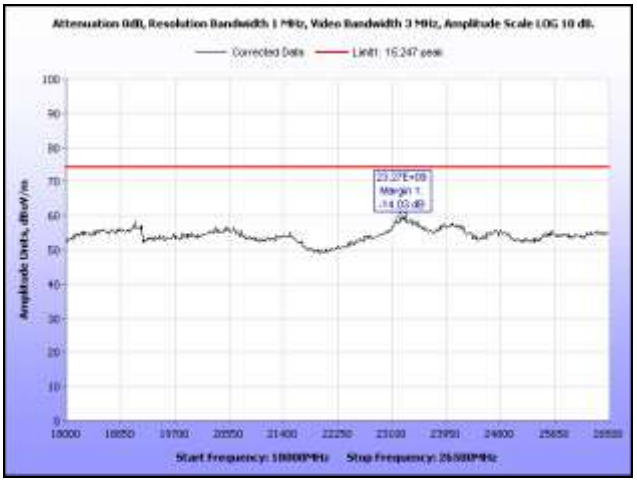

**Plot 26. Radiated Spurious Emissions, Channel 25, 1 GHz – 18 GHz, Average**



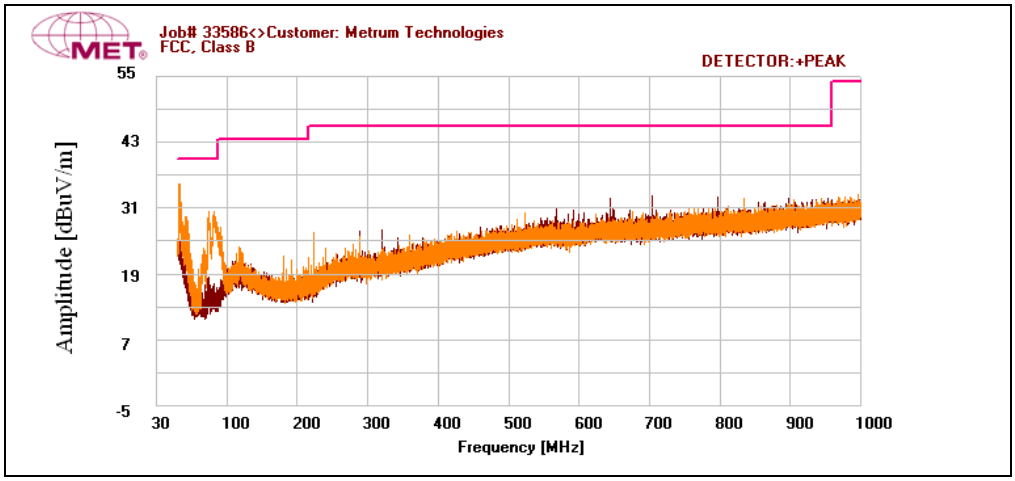

**Plot 27. Radiated Spurious Emissions, Channel 25, 1 GHz – 18 GHz, Peak**



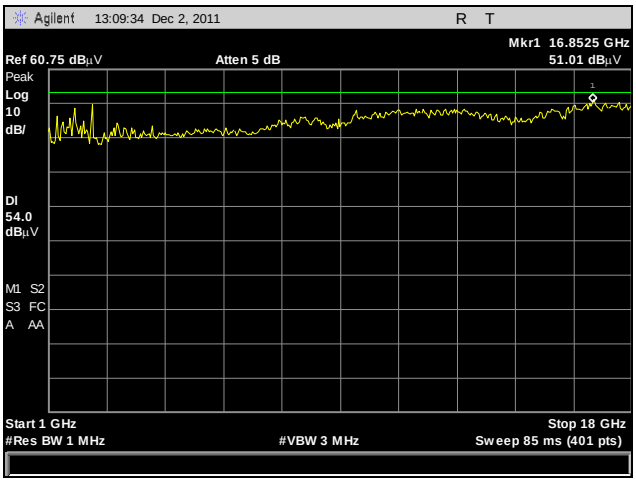

**Plot 28. Radiated Spurious Emissions, Channel 25, 18 GHz – 26.5 GHz, Average**



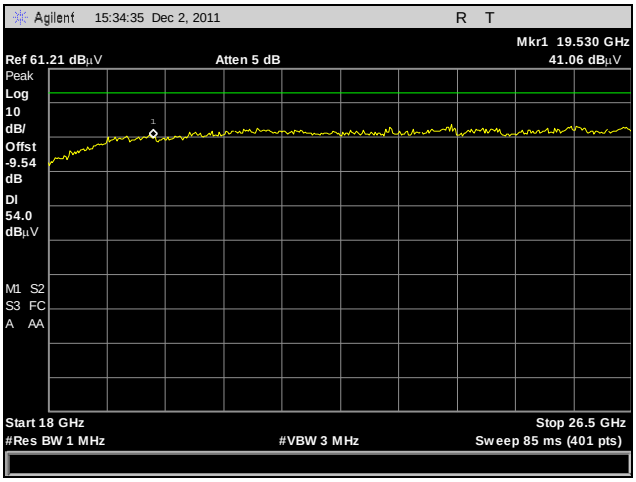

**Plot 29. Radiated Spurious Emissions, Channel 25, 18 GHz – 26.5 GHz, Peak**




**Plot 30. Radiated Spurious Emissions, High Channel, Quasi-Peak Limit, 30 MHz – 1 GHz, Peak Detector**




**Plot 31. Radiated Spurious Emissions, High Channel, Average, 1 GHz – 18 GHz, Peak Detector**




**Plot 32. Radiated Spurious Emissions, High Channel, Average Limit, 18 GHz – 26.5 GHz, Peak Detector**

## Radiated Band Edge Measurements

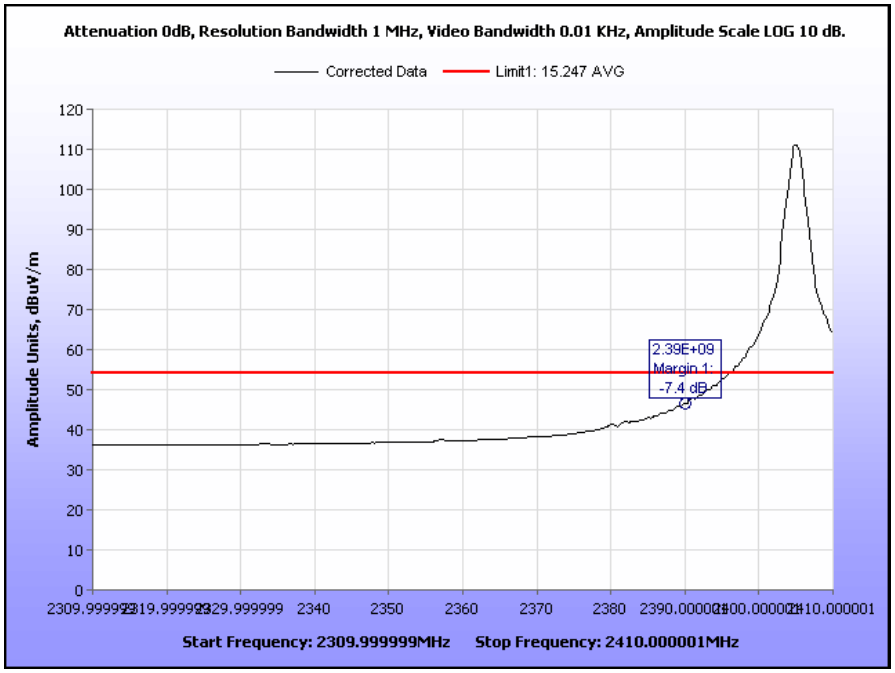
**Test Procedures:**

The transmitter was turned on. Measurements were performed of the low 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. To determine restricted band edge compliance:
For low channel, to meet average limit, at 2390MHz, field strength was measured using 1MHz RBW and 10 Hz VBW. For peak limit, the field strength was measured using 1MHz RBW and 3MHz VBW. The measurements were compared against the corresponding limits.

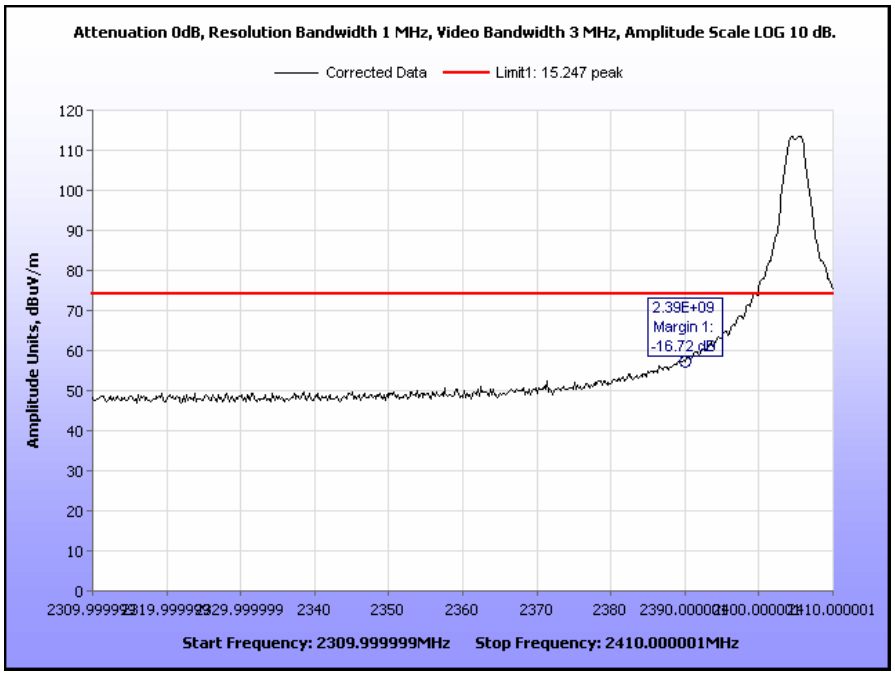
For high channel, to meet, to meet average limit at 2483.5 MHz, delta marker method was used. High Channel fundamental peak was recorded with 1 MHz RBW and 3 MHz VBW. The fundamental average was recorded with 1 MHz RBW and 10 Hz VBW. Then, the spectrum analyzer was spanned to encompass both the fundamental emission and the band edge emission under investigation with a peak detector using 30 kHz RBW and 100 kHz VBW. The delta between the average level of the fundamental emission and relevant band edge emission was measured and recorded. This delta was subtracted from the fundamental average to get the band edge measurement.
For peak limit, the field strength was measured using 1MHz RBW and 3MHz VBW. The measurements were compared against the corresponding limits.

| Emission | Corrected Amplitude (dBuV) | Delta Method (dBuV) | Band Edge Measurement (dBuV) | Limit (dBuV) | Margin (dB) |
|---|---|---|---|---|---|
| Avg. | 95.15 | 47.24 | 47.91 | 54 | -6.09 |

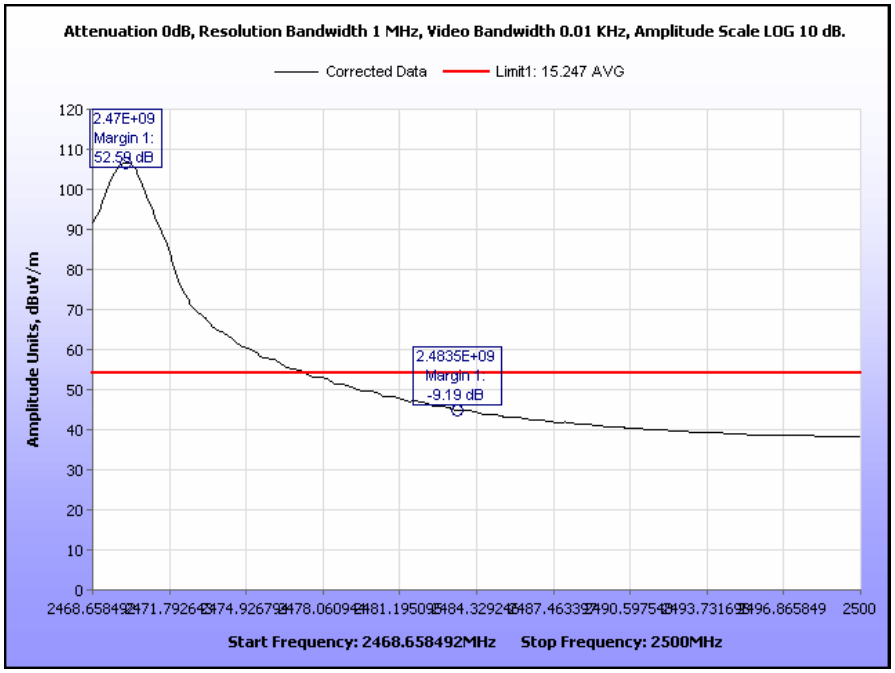
**Table 19. Delta Calculations**



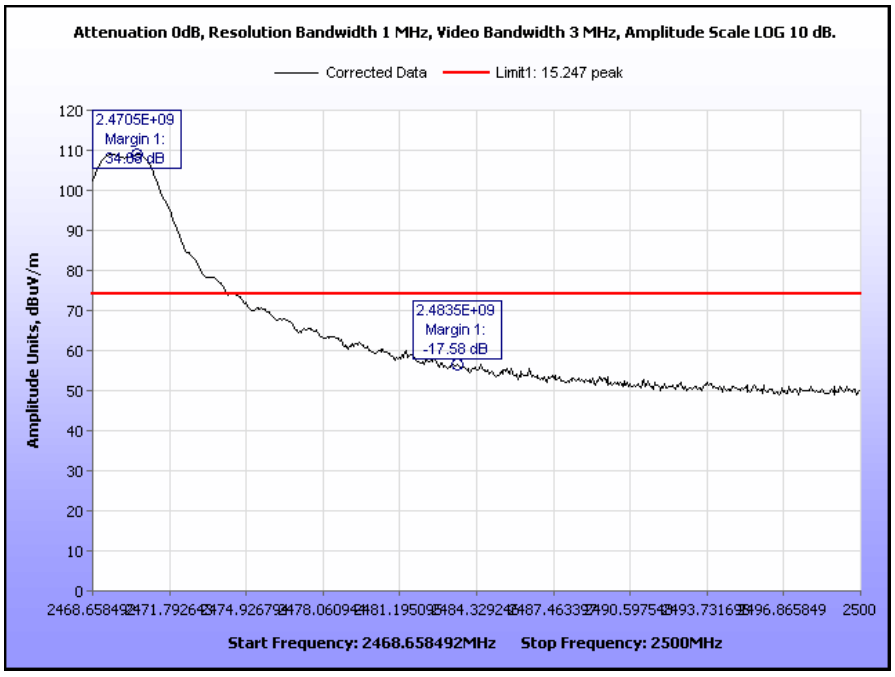

**Plot 33. Radiated Restricted Band Edge, Channel 11, Average**



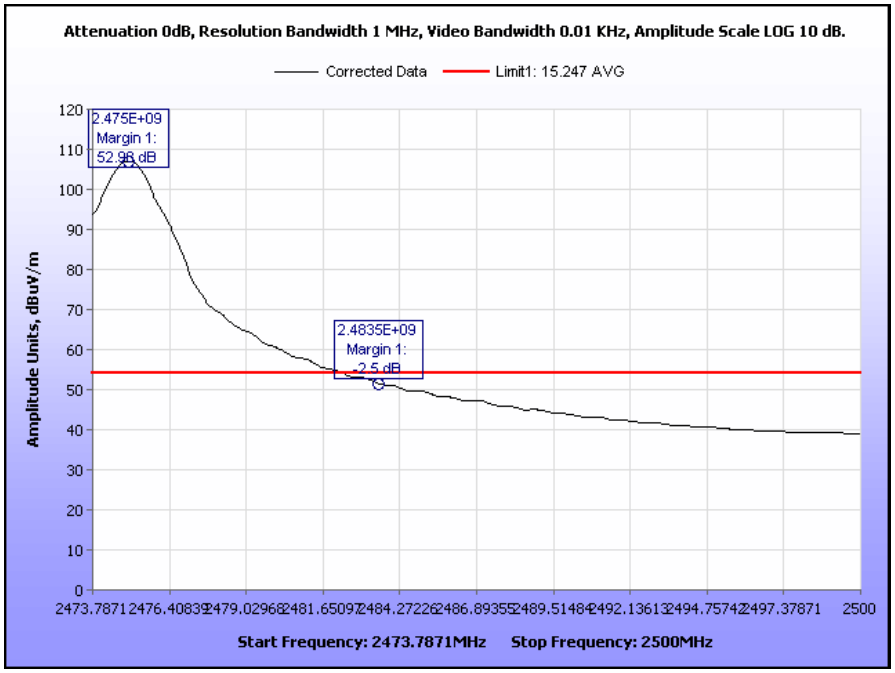

**Plot 34. Radiated Restricted Band Edge, Channel 11, Peak**



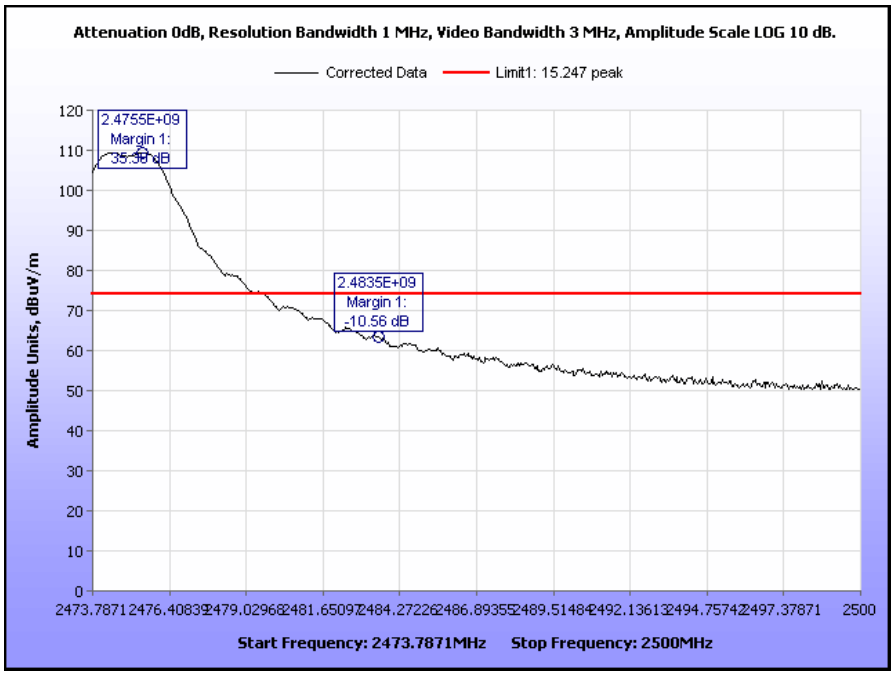

**Plot 35. Radiated Restricted Band Edge, Channel 24, Average**



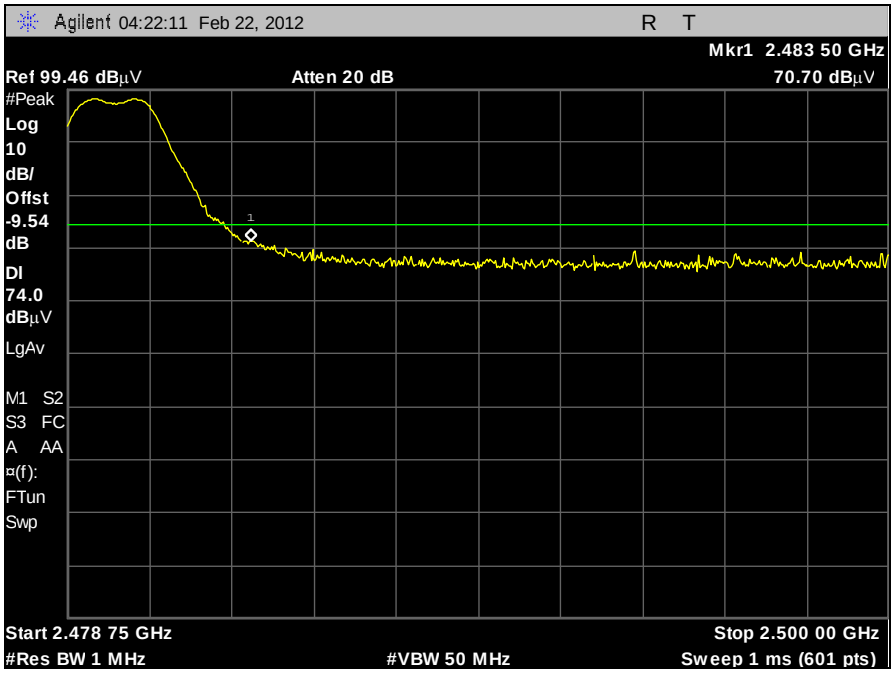

**Plot 36. Radiated Restricted Band Edge, Channel 24, Peak**



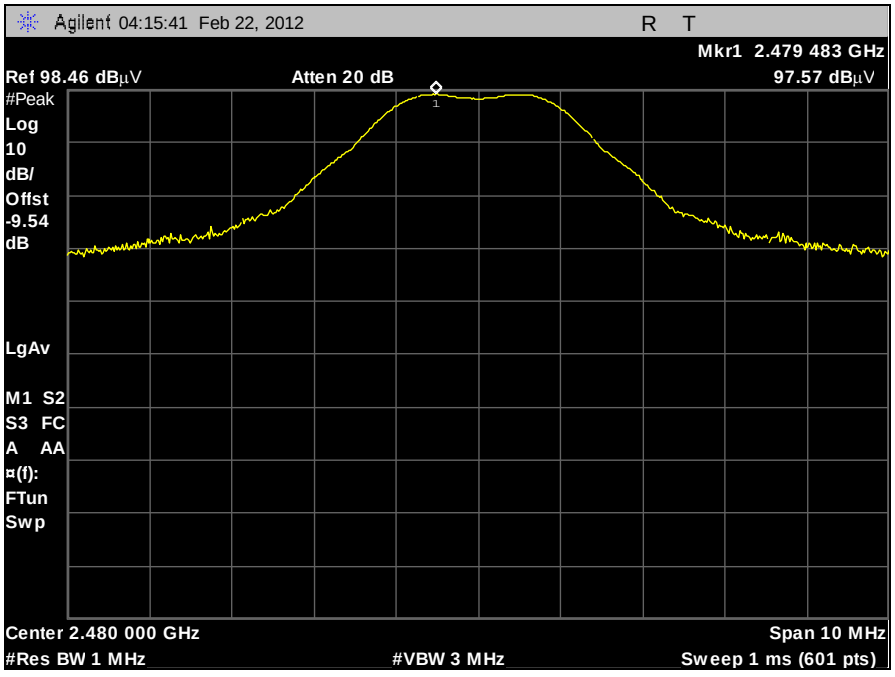

**Plot 37. Radiated Restricted Band Edge, Channel 25, Average**



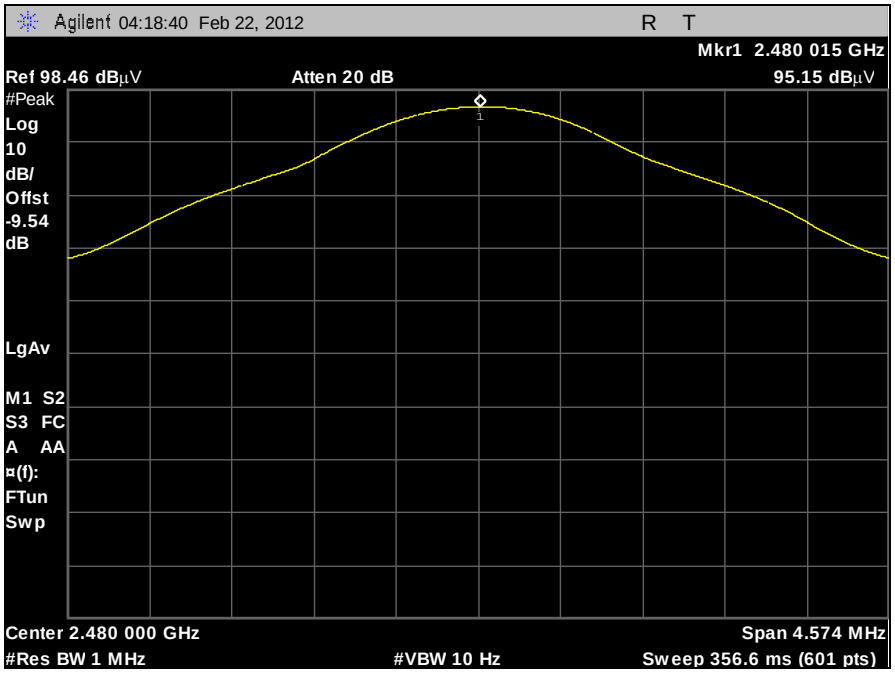

**Plot 38. Radiated Restricted Band Edge, Channel 25, Peak**



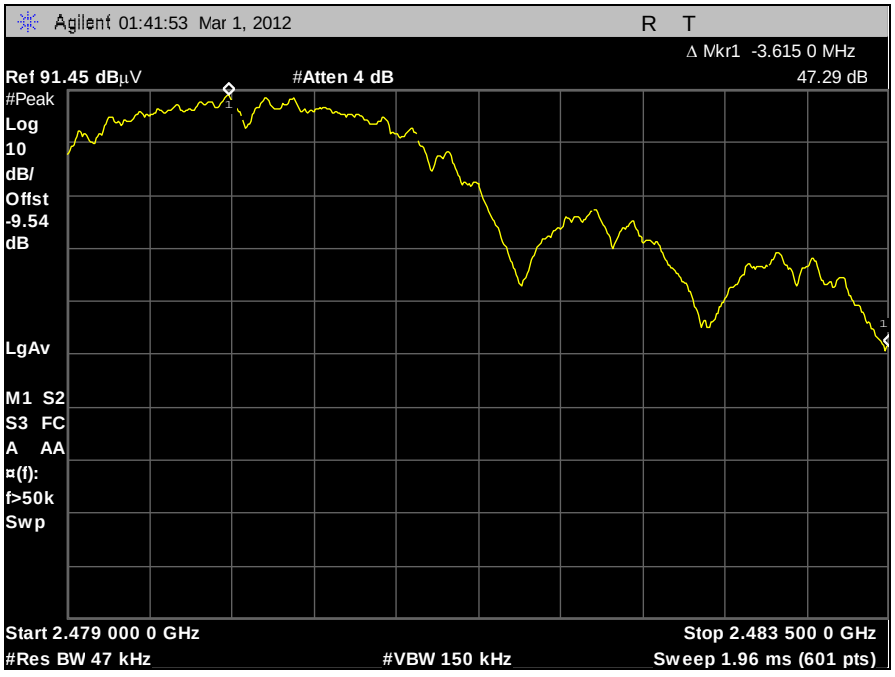

**Plot 39. Radiated Restricted Band Edge, Channel 26, Peak**




**Plot 40. Radiated Restricted Band Edge, Channel 26, Peak Field Strength**




**Plot 41. Radiated Restricted Band Edge, Channel 26, Average Field Strength**




**Plot 42. Radiated Restricted Band Edge, Channel 26, Marker Delta**

## Radiated Spurious Emissions Test Setup

**Photograph 7. Radiated Spurious Emissions, Test Setup**

# 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 Results:** Refer to FCC ID: QPU3020. Refer to IC: 4523A-SN3020.

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.247(e) Peak Power Spectral Density

**Test Requirements:** **§15.247(e):** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

**Test Results:** Refer to FCC ID: QPU3020. Refer to IC: 4523A-SN3020.

## § 15.247(i) Maximum Permissible 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 @ 2400-2483.5 MHz; highest conducted power = 22.38 *dBm* (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm$^2$ or 10 W/m$^2$**

EUT maximum antenna gain = 5 *dBi.*

MPE Limit Calculation: EUT's operating frequencies @ 1850-1910 MHz; maximum sourced based time-averaged transmit power is 0.125 Watts, **Limit for Uncontrolled exposure: 1 mW/cm$^2$ or 10 W/m$^2$**

EUT maximum antenna gain = 6 *dBi.*

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, R = Distance (20cm)
P = Power Input to antenna (mW)
G = Antenna Gain ( numeric)

**2.4 GHz Band**

$S = PG/4\pi R^2$

$$\frac{(173mW)(3.16)}{4\pi(20)^2}$$

$S1 = 0.1088$ mW/cm$^2$

**1900 MHz**

$S = PG/4\pi R^2$

$$\frac{(125mW)(3.98)}{4\pi(20)^2}$$

$S2 = 0.099$mW/cm$^2$

| S | Power density (mW/cm²) | General Population Limit (mW/cm²) | S as a fraction of the limit (%) |
|---|---|---|---|
| S1 | 0.1088 | 1 | 10.9 |
| S2 | 0.099 | 1 | 9.9 |

The total density is 0.1088+0.099 = 0.2078 mW/cm2.
The total density does not exceed 1 per OET 65 requirements when the spectral power density is calculated at least 20cm away from the unit.

MPE Limit Calculation: EUT's operating frequencies @ 2400-2483.5 MHz; highest conducted power = 22.38 *dBm* (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm$^2$ or 10 W/m$^2$**

EUT maximum antenna gain = 5 *dBi*.

MPE Limit Calculation: EUT's operating frequencies @ 824-849 MHz; maximum sourced based time-averaged transmit power is 0.25 Watts, **Limit for Uncontrolled exposure: 0.549 mW/cm$^2$ or 10 W/m$^2$**

EUT maximum antenna gain = 6 *dBi*.

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, R = Distance (20cm)
P = Power Input to antenna (mW)
G = Antenna Gain ( numeric)

**2.4 GHz Band**

$S = PG/4\pi R^2$

$$\frac{(173mW)(3.16)}{4\pi(20)^2}$$

$S1 = 0.1088$ mW/cm$^2$

**824 MHz**

$S = PG/4\pi R^2$

$$\frac{(250mW)(3.98)}{4\pi(20)^2}$$

$S2 = 0.198$mW/cm$^2$

| S | Power density (mW/cm²) | General Population Limit (mW/cm²) | S as a fraction of the limit (%) |
|---|---|---|---|
| S1 | 0.1088 | 1 | 10.9 |
| S1 | 0.198 | 0.549 | 36.1 |

The total density is 0.1088+0.198 = 0.3068 mW/cm2.
The total density does not exceed 0.549 per OET 65 requirements when the spectral power density is calculated at least 20cm away from the unit.

## Electromagnetic Compatibility Criteria for Intentional Radiators

### RSS-GEN Receiver Spurious Emissions Requirements

**Test Requirements:** 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 20.

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

**Table 20. 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 Procedures:** The EUT was programmed for receive mode only. Conducted measurements were taken at the antenna port of the EUT. 100 kHz resolution bandwidth was used from 30 MHz - 1 GHz and 300 kHz resolution was used for measurements done above 1 GHz. All plots are corrected for cable loss.

**Test Results:** Equipment is compliant with the Receiver Spurious Emissions Requirements of RSS-GEN.

**Test Engineer(s):** Ram Shrestha

**Test Date(s):** 12/05/11

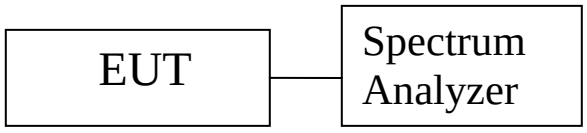
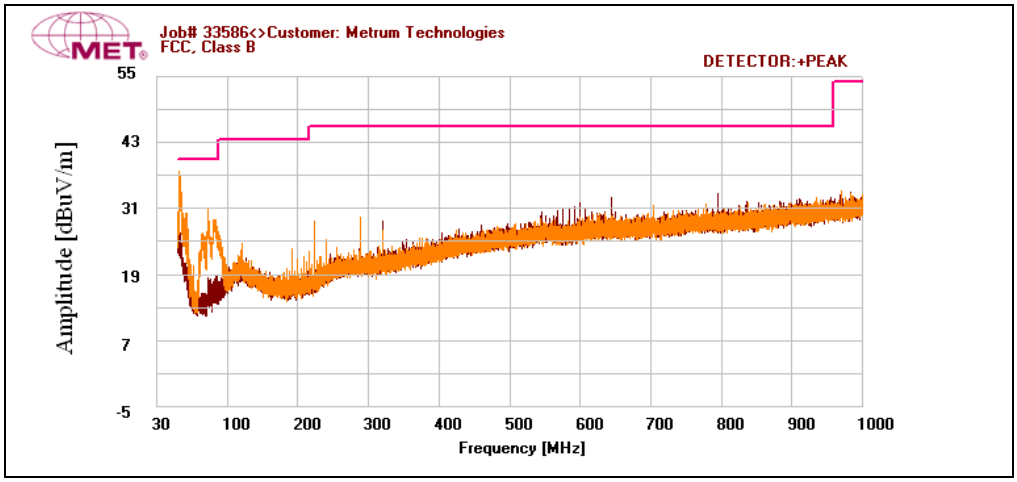


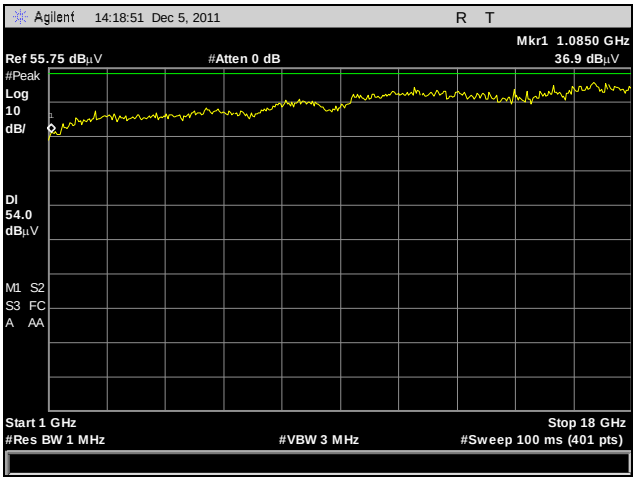

**Figure 2. Block Diagram, Conducted Receiver Spurious Emissions Test Setup**

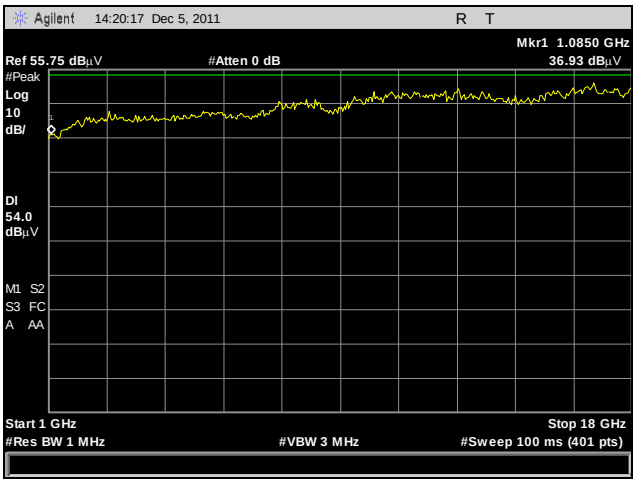
## Conducted Receiver Spurious Emissions




**Plot 43. Receiver Spurious Emission, 30 MHz – 1 GHz**

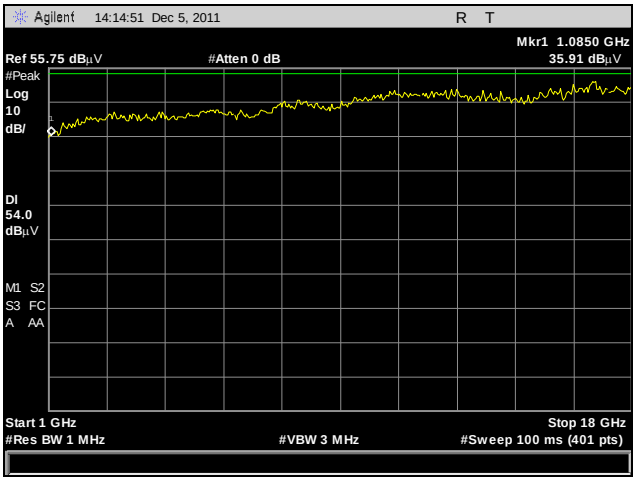



**Plot 44. Receiver Spurious Emission, 1 GHz – 18 GHz with Peak Detector, Low Channel**




**Plot 45. Receiver Spurious Emission, 1 GHz – 18 GHz with Peak Detector, Mid Channel**




**Plot 46. Receiver Spurious Emission, 1 GHz – 18 GHz with Peak Detector, High Channel**

# IV. 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.

| Test Name: Conducted Emissions ( Power) | | | Test Date(s): 11/22/2011 | | |
|---|---|---|---|---|---|
| **MET Asset #** | **Nomenclature** | **Manufacturer** | **Model** | **Last Cal Date** | **Cal Due Date** |
| 1A1065 | EMI RECEIVER | ROHDE & SCHWARZ | ESCI | 12/15/2010 | 12/15/2011 |
| 1A1087 | ATTENUATOR | ROHDE & SCHWARZ | ESH3Z2 | 3/11/2011 | 3/11/2012 |
| 1A1021 | VOLTAGE DISPLAY | NEWPORT | Q9000-FUR6 | 9/15/2010 | 3/15/2012 |
| 1A1076 | POWER TRANSFORMER | SUPERIOR ELECTRIC | POWERSTAT | FUNC VERIFY | FUNC VERIFY |
| 1A1019 | ESH3-25 LISN (AE) | ROHDE & SCHWARZ | 831-5518.2 | FUNC VERIFY | FUNC VERIFY |
| 1A1119 | TEST AREA | CUSTOM MADE | N/A | 3/28/2011 | 3/28/2012 |
| 1A1122 | LISN | TESEQ | NNB 51 | 3/31/2011 | 3/31/2012 |

| Test Name: Radiated Emissions | | | Test Date(s): 11/23/2011, 11/24/2011 | | |
|---|---|---|---|---|---|
| **MET Asset #** | **Nomenclature** | **Manufacturer** | **Model** | **Last Cal Date** | **Cal Due Date** |
| 1A1083 | EMI TEST RECEIVER | ROHDE & SCHWARZ | ESU40 | 2/22/2011 | 2/22/2012 |
| 1A1088 | PRE-AMP | RHODE & SCHWARZ | TS-PR1 | 5/2/2011 | 5/2/2012 |
| 1A1113 | PRE-AMP | MINI-CIRCUIT | ZVA-183+ | 4/4/2011 | 4/4/2012 |
| 1A1072 | PRE-AMP | MITEQ | AFS5-01001800-25-8P-6-PS | 4/4/2011 | 4/4/2012 |
| 1A1090 | PRE-AMP | MITEQ | AFS44-00182650-42-10P-44 | 4/4/2011 | 4/4/2012 |
| 1A1047 | HORN ANTENNA | ETS | 3117 | 7/28/2010 | 1/28/2012 |
| 1A1026 | 18-26.5GHZ ANTENNA | ETS | 011777-002 | 4/23/2010 | 4/23/2012 |
| 1A1050 | BI-CONILOG ANTENNA (30MHZ TO 1GHZ) | SCHAFFNER | CBL6112D | 4/22/2011 | 4/22/2012 |
| 1A1106 | 10M CHAMBER | ETS | SEMI-ANECHOIC | 9/12/2011 | 9/12/2012 |
| 1S2607 | SPECTRUM ANALYZER | AGILENT | E4407B | 08/09/2011 | 08/09/2012 |

**Table 21. Test Equipment List**

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

# V. Certification & User's Manual Information

# Certification & User's Manual Information

## A. 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

## 1. 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