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May 27, 2014

QinetiQ North America  
350 Second Ave.  
Waltham, MA 02451

Dear Chuck Deloid,

Enclosed is the EMC Wireless test report for compliance testing of the QinetiQ North America, MVSS, Collector as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B and ICES-003, Issue 5 August 2012 for a Class A Digital Device, and FCC Part 15 Subpart C and 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: (\QinetiQ North America\EMC38758D-FCC247 Rev. 3)

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## **Electromagnetic Compatibility Criteria Test Report**

for the

**QinetiQ North America  
MVSS, Collector**

**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 8, Dec. 2010  
for Intentional Radiators

**MET Report: EMC38758D-FCC247 Rev. 3**

May 27, 2014

**Prepared For:**

**QinetiQ North America  
350 Second Ave.  
Waltham, MA 02451**

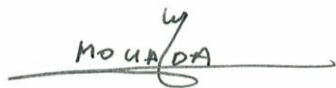
**Prepared By:**  
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914 W. Patapsco Ave.  
Baltimore, MD 21230

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for Intentional Radiators



Djed Mouada, 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 5 August 2012, RSS-210, Issue 8, Dec. 2010 under normal use and maintenance.



Asad Bajwa, Director  
Electromagnetic Compatibility Lab

## Report Status Sheet

| Revision | Report Date       | Reason for Revision                      |
|----------|-------------------|------------------------------------------|
| Ø        | January 8, 2014   | Initial Issue.                           |
| 1        | February 5, 2014  | Revised to reflect customer corrections. |
| 2        | February 25, 2014 | Revised to reflect engineer corrections. |
| 3        | May 27, 2014      | Revised to reflect engineer corrections. |

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## List of Terms and Abbreviations

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

# **I. Executive Summary**

## A. Purpose of Test

An EMC evaluation was performed to determine compliance of the QinetiQ North America MVSS, Collector, 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 MVSS, Collector. QinetiQ North America should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the MVSS, Collector, 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 QinetiQ North America, purchase order number T9G74-0116. All tests were conducted using measurement procedure ANSI C63.4-2003.

| FCC Reference<br>47 CFR Part 15.247:2005                  | IC Reference<br>RSS-210 Issue 8: 2010;<br>RSS-GEN Issue 3: 2010 | Description                                            | Compliance |
|-----------------------------------------------------------|-----------------------------------------------------------------|--------------------------------------------------------|------------|
| 47 CFR Part 15.107 (a)                                    | ICES-003 Issue 5 August 2012                                    | Conducted Emission Limits for a Class A Digital Device | Compliant  |
| 47 CFR Part 15.109 (a)                                    | ICES-003 Issue 5 August 2012                                    | Radiated Emission Limits for a Class A 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                              | Compliant  |
| Title 47 of the CFR, Part 15 §15.247(a)(2)                | RSS-Gen(4.6)                                                    | 6dB Occupied Bandwidth                                 | Compliant  |
|                                                           |                                                                 | 99% Occupied Bandwidth                                 | Compliant  |
| Title 47 of the CFR, Part 15 §15.247(b)                   | RSS-210(A8.4)                                                   | Peak Power Output                                      | Compliant  |
| 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           | Compliant  |
| Title 47 of the CFR, Part 15; §15.247(e)                  | RSS-210(A8.2)                                                   | Peak Power Spectral Density                            | Compliant  |
| Title 47 of the CFR, Part 15 §15.247(i)                   | RSS-Gen(5.6)                                                    | Maximum Permissible Exposure (MPE)                     | Compliant  |

**Table 1. Executive Summary of EMC Part 15.247 Compliance Testing**

## II. Equipment Configuration

## A. Overview

MET Laboratories, Inc. was contracted by QinetiQ North America to perform testing on the MVSS, Collector, under QinetiQ North America's purchase order number T9G74-0116.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the QinetiQ North America, MVSS, Collector.

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

|                                       |                                                         |                 |
|---------------------------------------|---------------------------------------------------------|-----------------|
| <b>Model(s) Tested:</b>               | MVSS, Collector                                         |                 |
| <b>Model(s) Covered:</b>              | MVSS, Collector                                         |                 |
| <b>EUT Specifications:</b>            | Primary Power: 120 VAC, 60 Hz                           |                 |
|                                       | FCC ID: YWLLWMV140002                                   |                 |
|                                       | IC: 10793A-LWMV140002                                   |                 |
|                                       | Type of Modulations:                                    | 2-FSK           |
|                                       | Equipment Code:                                         | DTS             |
|                                       | Peak RF Output Power:                                   | 14.31 dBm       |
|                                       | EUT Frequency Ranges:                                   | 2472 – 2479 MHz |
| <b>Analysis:</b>                      | The results obtained relate only to the item(s) tested. |                 |
| <b>Environmental Test Conditions:</b> | Temperature: 15-35° C                                   |                 |
|                                       | Relative Humidity: 30-60%                               |                 |
|                                       | Barometric Pressure: 860-1060 mbar                      |                 |
| <b>Evaluated by:</b>                  | Djed Mouada                                             |                 |
| <b>Report Date(s):</b>                | May 27, 2014                                            |                 |

**Table 2. EUT Summary Table**

## B. References

|                                      |                                                                                                                                                                       |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CFR 47, Part 15, Subpart C</b>    | Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies |
| <b>CFR 47, Part 15, Subpart B</b>    | Electromagnetic Compatibility: Criteria for Radio Frequency Devices                                                                                                   |
| <b>RSS-210, Issue 8, Dec. 2010</b>   | Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment                                                                      |
| <b>RSS-GEN, Issue 3, Dec. 2010</b>   | General Requirements and Information for the Certification of Radio Apparatus                                                                                         |
| <b>ICES-003, Issue 5 August 2012</b> | Information Technology Equipment (ITE) — Limits and methods of measurement                                                                                            |
| <b>ANSI C63.4:2003</b>               | Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz                                |
| <b>ISO/IEC 17025:2005</b>            | General Requirements for the Competence of Testing and Calibration Laboratories                                                                                       |
| <b>ANSI C63.10-2009</b>              | American National Standard for Testing Unlicensed Wireless Devices                                                                                                    |

**Table 3. References**

## C. Test Site

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

Radiated Emissions measurements were performed 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 QinetiQ North America MVSS, Collector, Equipment Under Test (EUT), is a device that collects voltage and current readings from MVSS sensors. These readings are sent by the MVSS collector onto a network for consumption by an electric utility company, and can also be read locally via Wi-Fi. The EUT has three radios. One of which is the 2.4 GHz modem addressed in this test report. The other two radios are addressed in separate test reports. All three radios can operate simultaneously. It was verified that when all three radios operate simultaneously there were no intermodulation products.

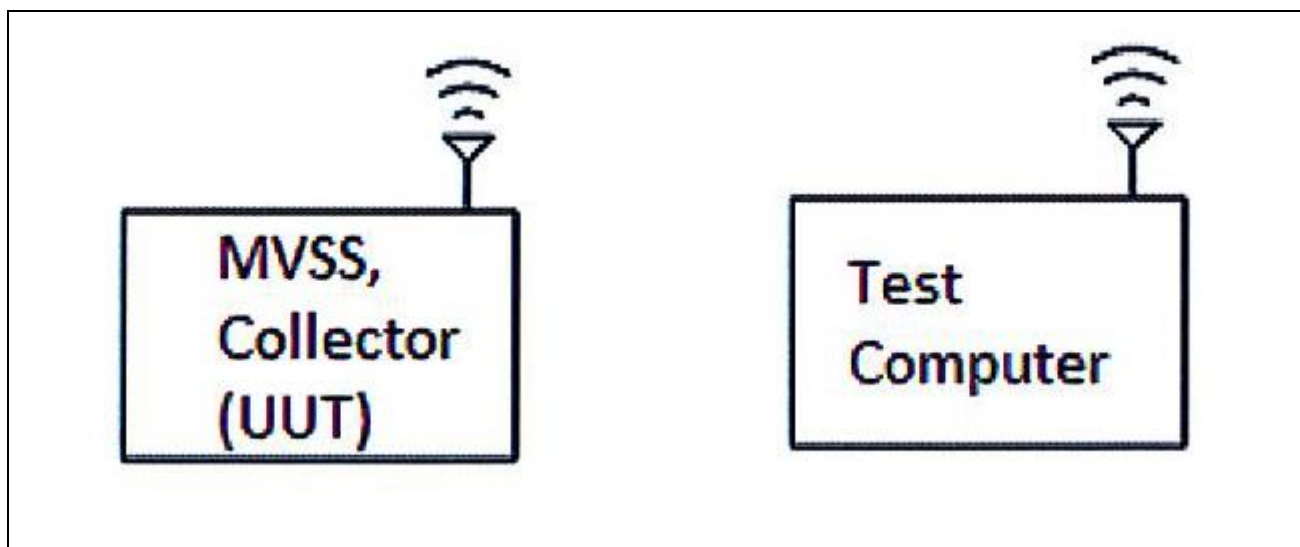


Figure 1. Block Diagram of Test Configuration

## 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 | Name / Description       | Model Number   | Part Number | Serial Number | Revision |
|---------|--------------------------|----------------|-------------|---------------|----------|
| N/A     | Product, MVSS, Collector | PRD-1102191004 | 1102191077  | 36            | 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 |
|-----------------------------------------------|--------------|--------------|---------------|
| PC/Laptop with Windows 7 OS                   | N/A          | N/A          | N/A           |
| Customer supported wifi configuration program | QinetiQ      | N/A          | N/A           |
| Wifi Card                                     | Netgear      | WNDA3100 v2  | N/A           |

**Table 5. Support Equipment**

## G. Mode of Operation

As the MVSS Collector uses 3 radios, each radio will need to be verified. This should be done by ensuring that each radio is capable of continuously sending and receiving “dummy” data packets representative of actual in-field data. The device should be able to send and receive this data both to other device (which will be represented by a provided test program) via the 900 MHz transceiver, to a Wi-Fi enabled tablet or computer via the 2.4 GHz radio. This data will be sent and received at the highest rated download and upload rate based on radio configuration. In addition to this streaming data, the device will be “pinged” and data will be sent directly to that source. The provided test software should be used to simulate nominal use.

## H. Method of Monitoring EUT Operation

The EUT will be considered operational if the testing laptop is able to establish communication, and the unit still accepts any of the commands outlined in QNA Doc# MEMO-1102190098, including changing the mode of the radio (note that the board needs to be cycled after changing the modes). A failure occurs if communication is lost or the unit is no longer able to change mode.

## I. Modifications

### a) Modifications to EUT

A ferrite was added to the EUT to control Digital emissions. The ferrite was placed 1 in away from the EUT enclosure.

The model number of ferrite is: 0446167281

### 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 QinetiQ North America 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 6. 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 6. 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.

| Frequency range<br>(MHz)                                                                                                                                                           | Class A Conducted Limits<br>(dBμV) |         | *Class B Conducted<br>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. |                                    |         |                                     |         |

**Table 6. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(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, 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 6 dB of the limit were re-measured using a quasi-peak and/or average detector as appropriate.

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

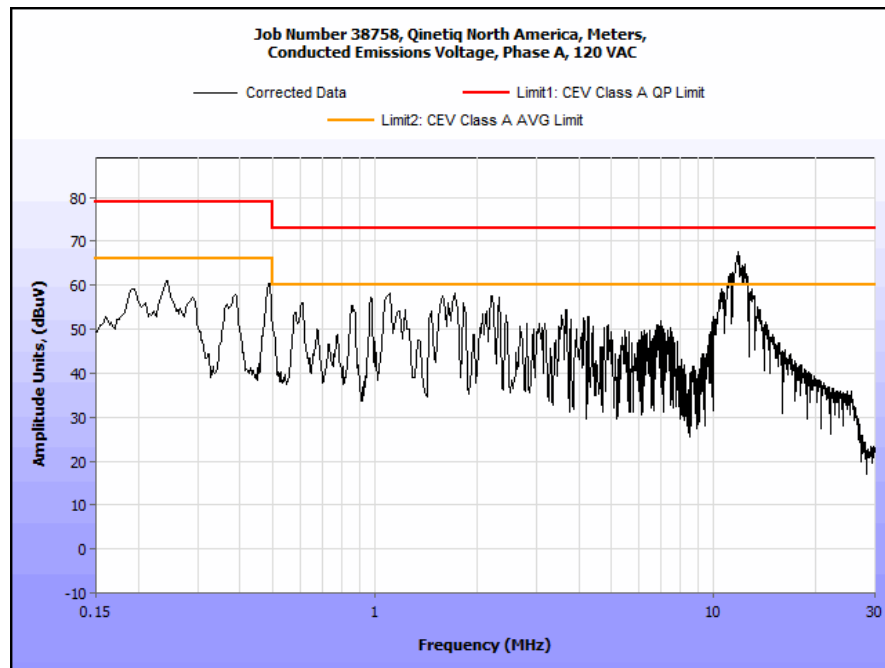
**Test Engineer(s):** Djed Mouada

**Test Date(s):** 06/05/13

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

| Frequency (MHz) | Uncorrected Meter Reading (dBμV) QP | Cable Loss (dB) | Corrected Measurement (dBμV) QP | Limit (dBμV) QP | Margin (dB) QP | Uncorrected Meter Reading (dBμV) Avg. | Cable Loss (dB) | Corrected Measurement (dBμV) AVG | Limit (dBμV) AVG | Margin (dB) AVG |
|-----------------|-------------------------------------|-----------------|---------------------------------|-----------------|----------------|---------------------------------------|-----------------|----------------------------------|------------------|-----------------|
| 0.2439          | 60.3                                | 0               | 60.3                            | 79              | -18.7          | 39.2                                  | 0               | 39.2                             | 66               | -26.8           |
| 0.435           | 58.87                               | 0               | 58.87                           | 79              | -20.13         | 27.7                                  | 0               | 27.7                             | 66               | -38.3           |
| 0.9378          | 56.6                                | 0               | 56.6                            | 73              | -16.4          | 52.27                                 | 0               | 52.27                            | 60               | -7.73           |
| 1.968           | 34.68                               | 0               | 34.68                           | 73              | -38.32         | 26.94                                 | 0               | 26.94                            | 60               | -33.06          |
| 11.83           | 61.11                               | 0.17            | 61.28                           | 73              | -11.72         | 46.92                                 | 0.17            | 47.09                            | 60               | -12.91          |
| 20.62           | 35.96                               | 0               | 35.96                           | 73              | -37.04         | 26.73                                 | 0               | 26.73                            | 60               | -33.27          |

Table 7. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)



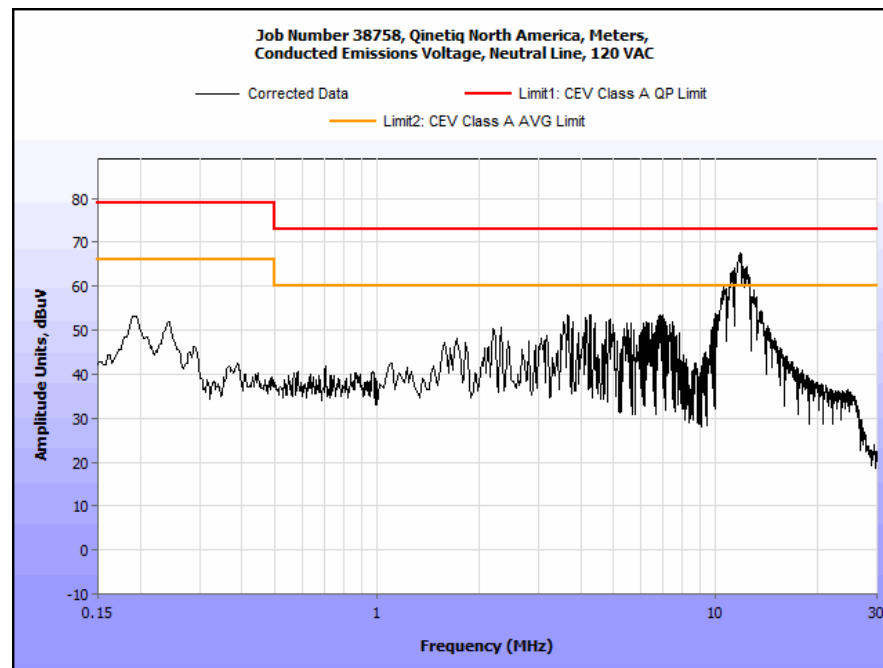
Plot 1. Conducted Emission, Phase Line Plot



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

| Frequency (MHz) | Uncorrected Meter Reading (dBμV) QP | Cable Loss (dB) | Corrected Measurement (dBμV) QP | Limit (dBμV) QP | Margin (dB) QP | Uncorrected Meter Reading (dBμV) Avg. | Cable Loss (dB) | Corrected Measurement (dBμV) AVG | Limit (dBμV) AVG | Margin (dB) AVG |
|-----------------|-------------------------------------|-----------------|---------------------------------|-----------------|----------------|---------------------------------------|-----------------|----------------------------------|------------------|-----------------|
| 0.1925          | 52.37                               | 0               | 52.37                           | 79              | -26.63         | 47.73                                 | 0               | 47.73                            | 66               | -18.27          |
| 0.3671          | 40.04                               | 0               | 40.04                           | 79              | -38.96         | 33.24                                 | 0               | 33.24                            | 66               | -32.76          |
| 0.6175          | 27.88                               | 0               | 27.88                           | 73              | -45.12         | 12.84                                 | 0               | 12.84                            | 60               | -47.16          |
| 5.49            | 50.21                               | 0.08            | 50.29                           | 73              | -22.71         | 42.95                                 | 0.08            | 43.03                            | 60               | -16.97          |
| 11.83           | 62.04                               | 0.17            | 62.21                           | 73              | -10.79         | 47.2                                  | 0.17            | 47.37                            | 60               | -12.63          |
| 25              | 33.39                               | 0.17            | 33.56                           | 73              | -39.44         | 24.78                                 | 0.17            | 24.95                            | 60               | -35.05          |

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



Plot 2. Conducted Emission, Neutral Line Plot

## Conducted Emission Limits Test Setup



**Photograph 1. Conducted Emissions, Test Setup**

## 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 9.

**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 9.

| Frequency (MHz) | Field Strength (dBµV/m)                    |                                           |
|-----------------|--------------------------------------------|-------------------------------------------|
|                 | §15.109 (b), Class A Limit<br>(dBµV) @ 10m | §15.109 (a), Class B Limit<br>(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 9. 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 3 m 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 A requirement(s) of this section. Measured emissions were below applicable limits.

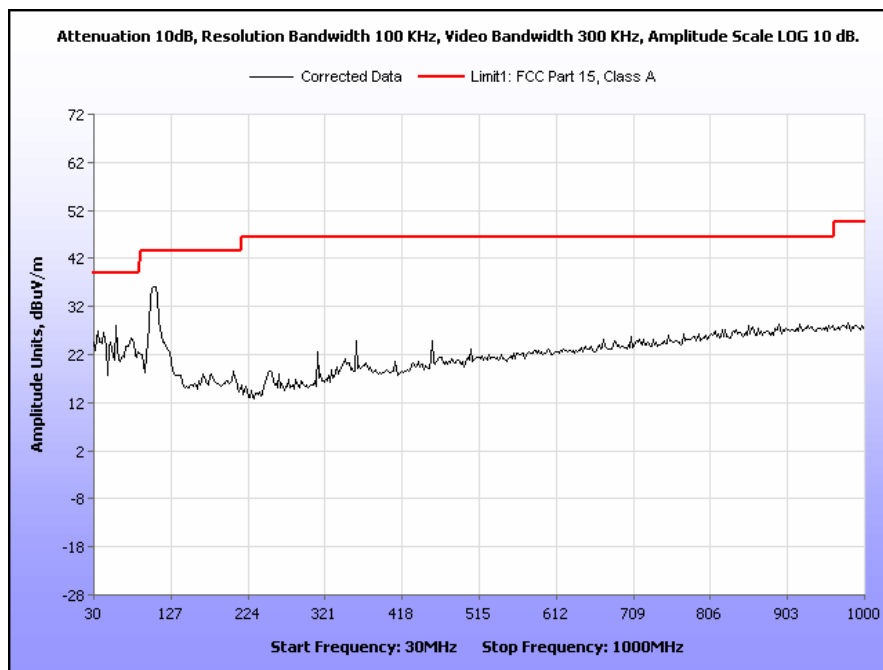
**Test Engineer(s):** Djed Mouada

**Test Date(s):** 11/06/13

## Radiated Emissions Limits Test Results, Class A

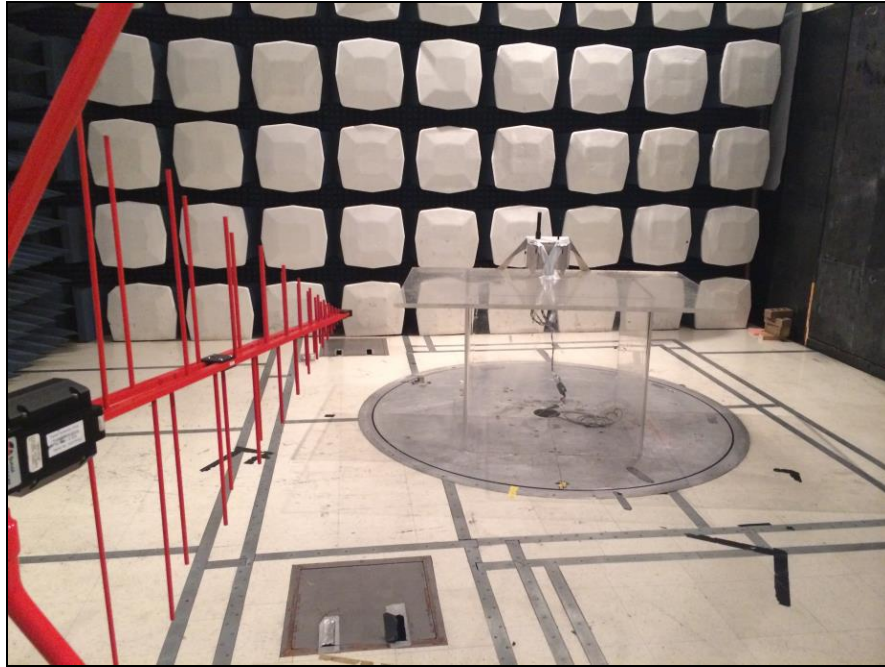
| Frequency (MHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna HEIGHT (m) | Uncorrected Amplitude (dBμV) | Antenna Correction Factor (dB) (+) | Cable Loss (dB) (+) | Distance Correction Factor (dB) (-) | Corrected Amplitude (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|-----------------------|------------------------|--------------------|------------------------------|------------------------------------|---------------------|-------------------------------------|------------------------------|----------------|-------------|
| 51.220566       | 355                   | H                      | 1.12               | 6.30                         | 8.33                               | 0.48                | 10.46                               | 4.65                         | 39.00          | -34.35      |
| 51.220566       | 350                   | V                      | 1.103              | 30.12                        | 8.33                               | 0.48                | 10.46                               | 28.47                        | 39.00          | -10.53      |
| 103.20641       | 31                    | H                      | 1.30               | 10.14                        | 11.16                              | 0.78                | 10.46                               | 11.62                        | 43.50          | -31.88      |
| 103.20641       | 50                    | V                      | 1.16               | 28.39                        | 11.16                              | 0.78                | 10.46                               | 29.87                        | 43.50          | -13.63      |
| 200             | 361                   | H                      | 1.43               | 6.51                         | 12.80                              | 0.91                | 10.46                               | 9.76                         | 43.50          | -33.74      |
| 200             | 196                   | V                      | 1.27               | 9.25                         | 12.80                              | 0.91                | 10.46                               | 12.50                        | 43.50          | -31.00      |
| 360.12024       | 333                   | H                      | 1.14               | 5.65                         | 15.40                              | 1.46                | 10.46                               | 12.05                        | 46.40          | -34.35      |
| 360.12024       | 27                    | V                      | 1.27               | 7.66                         | 15.40                              | 1.46                | 10.46                               | 14.06                        | 46.40          | -32.34      |
| 552.90581       | 20                    | H                      | 1.18               | 5.80                         | 18.66                              | 1.98                | 10.46                               | 15.98                        | 46.40          | -30.42      |
| 552.90581       | 55                    | V                      | 1.18               | 5.87                         | 18.66                              | 1.98                | 10.46                               | 16.05                        | 46.40          | -30.35      |
| 842.488         | 26                    | H                      | 1.19               | 5.95                         | 22.50                              | 2.54                | 10.46                               | 20.53                        | 46.40          | -25.87      |
| 842.488         | 355                   | V                      | 1.10               | 5.95                         | 22.50                              | 2.54                | 10.46                               | 20.53                        | 46.40          | -25.87      |

**Table 10. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz**



**Plot 3. Radiated Emissions, 30 MHz - 1 GHz, with Ferrite**

## Radiated Emissions Limits Test Setup



Photograph 2. Radiated Emissions, Test Setup



Photograph 3. Radiated Emissions, Test Setup, Ferrite Model Number



**Photograph 4. Radiated Emissions, Test Setup, Ferrite on Unit**

## **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. The unit is professionally installed.

**Test Engineer(s):** Djed Mouada

**Test Date(s):** 11/12/13

## 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  $\mu$ H/50  $\Sigma$  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<br>(MHz) | § 15.207(a), Conducted Limit (dB $\mu$ V) |         |
|--------------------------|-------------------------------------------|---------|
|                          | Quasi-Peak                                | Average |
| * 0.15- 0.45             | 66 - 56                                   | 56 - 46 |
| 0.45 - 0.5               | 56                                        | 46      |
| 0.5 - 30                 | 60                                        | 50      |

**Table 11. 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 inside a screen room. 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  $\Omega$ /50  $\mu$ 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  $\Omega$ /50  $\mu$ H LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

**Test Results:** The EUT was compliant with this requirement.

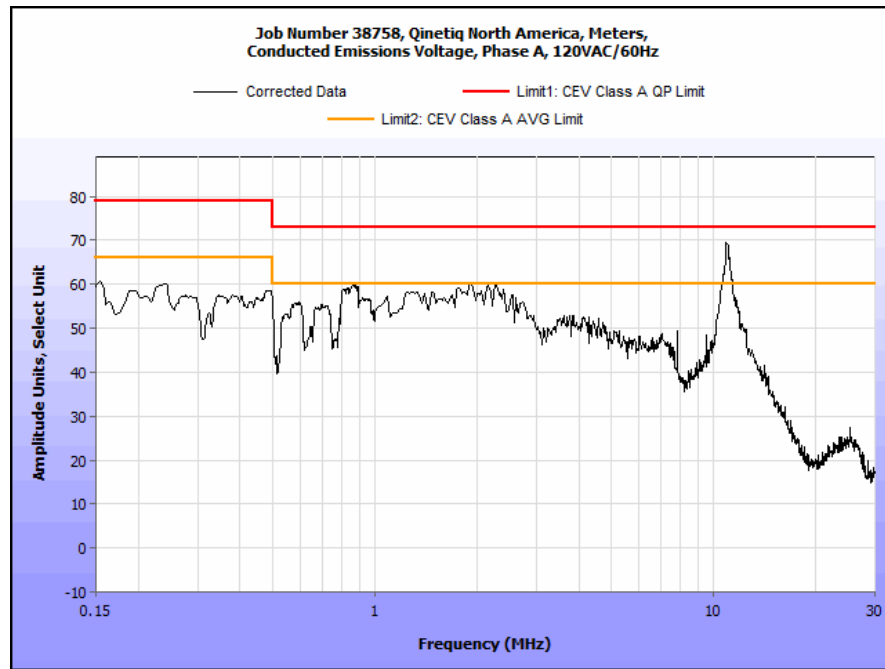
**Test Engineer(s):** Djed Mouada

**Test Date(s):** 10/25/13

### 15.207(a) Conducted Emissions Test Results

| Frequency (MHz) | Uncorrected Meter Reading (dBμV) QP | Cable Loss (dB) | Corrected Measurement (dBμV) QP | Limit (dBμV) QP | Margin (dB) QP | Uncorrected Meter Reading (dBμV) Avg. | Cable Loss (dB) | Corrected Measurement (dBμV) AVG | Limit (dBμV) AVG | Margin (dB) AVG |
|-----------------|-------------------------------------|-----------------|---------------------------------|-----------------|----------------|---------------------------------------|-----------------|----------------------------------|------------------|-----------------|
| 0.159           | 63.65                               | 0               | 63.65                           | 79              | -15.35         | 43.65                                 | 0               | 43.65                            | 66               | -22.35          |
| 0.4815          | 56.57                               | 0               | 56.57                           | 79              | -22.43         | 54.96                                 | 0               | 54.96                            | 66               | -11.04          |
| 0.956           | 53.54                               | 0               | 53.54                           | 73              | -19.46         | 50.65                                 | 0               | 50.65                            | 60               | -9.35           |
| 1.923           | 50.09                               | 0               | 50.09                           | 73              | -22.91         | 36.34                                 | 0               | 36.34                            | 60               | -23.66          |
| 10.97           | 64                                  | 0               | 64                              | 73              | -9             | 56.13                                 | 0               | 56.13                            | 60               | -3.87           |
| 25.2            | 17.85                               | 0               | 17.85                           | 73              | -55.15         | 10.54                                 | 0               | 10.54                            | 60               | -49.46          |

Table 12. Conducted Emissions, 15.207(a), Phase Line, Test Results

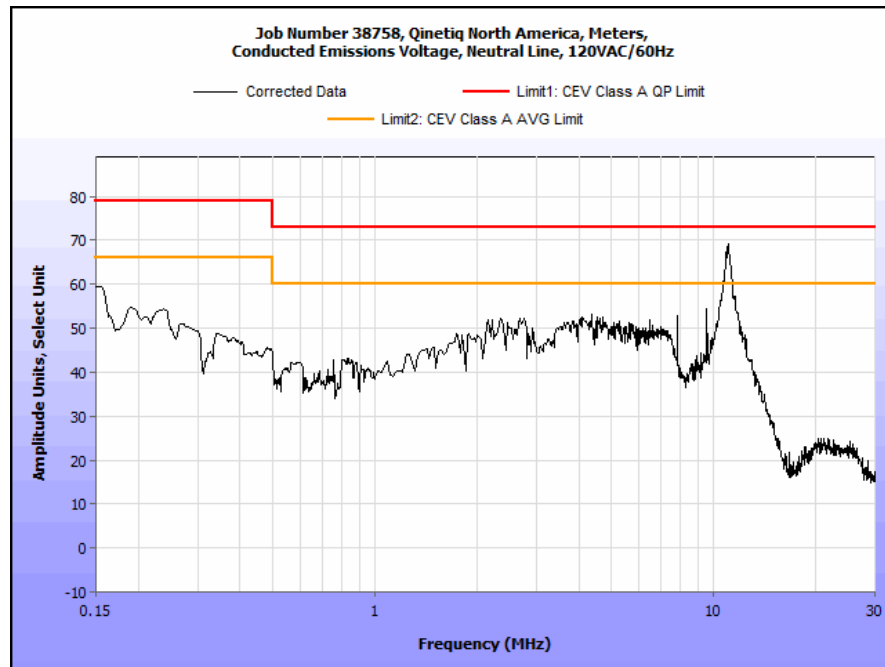


Plot 4. Conducted Emissions, 15.207(a), Phase Line

### 15.207(a) Conducted Emissions Test Results

| Frequency (MHz) | Uncorrected Meter Reading (dBμV) QP | Cable Loss (dB) | Corrected Measurement (dBμV) QP | Limit (dBμV) QP | Margin (dB) QP | Uncorrected Meter Reading (dBμV) Avg. | Cable Loss (dB) | Corrected Measurement (dBμV) AVG | Limit (dBμV) AVG | Margin (dB) AVG |
|-----------------|-------------------------------------|-----------------|---------------------------------|-----------------|----------------|---------------------------------------|-----------------|----------------------------------|------------------|-----------------|
| 0.1909          | 53.2                                | 0               | 53.2                            | 79              | -25.8          | 43.15                                 | 0               | 43.15                            | 66               | -22.85          |
| 0.302           | 41.54                               | 0               | 41.54                           | 79              | -37.46         | 32.8                                  | 0               | 32.8                             | 66               | -33.2           |
| 0.843           | 35.5                                | 0               | 35.5                            | 73              | -37.5          | 25.7                                  | 0               | 25.7                             | 60               | -34.3           |
| 7.817           | 48.2                                | 0               | 48.2                            | 73              | -24.8          | 27.09                                 | 0               | 27.09                            | 60               | -32.91          |
| 11              | 65.65                               | 0               | 65.65                           | 73              | -7.35          | 58.63                                 | 0               | 58.63                            | 60               | -1.37           |
| 21.77           | 18.81                               | 0               | 18.81                           | 73              | -54.19         | 9.5                                   | 0               | 9.5                              | 60               | -50.5           |

Table 13. Conducted Emissions, 15.207(a), Neutral Line, Test Results



Plot 5. Conducted Emissions, 15.207(a), Neutral Line

### 15.207(a) Conducted Emissions Test Setup Photo



Photograph 5. Conducted Emissions, 15.207(a), Test Setup

## 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 Procedure:** The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately 1% of the total emission bandwidth, VBW > RBW. The 6 dB Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

**Test Results** The EUT was compliant with § 15.247 (a)(2).

The 6 dB and 99% Bandwidth was determined from the plots on the following pages.

**Test Engineer(s):** Djed Mouada

**Test Date(s):** 5/09/14



**Figure 2. Block Diagram, Occupied Bandwidth Test Setup**

## Occupied Bandwidth Test Results

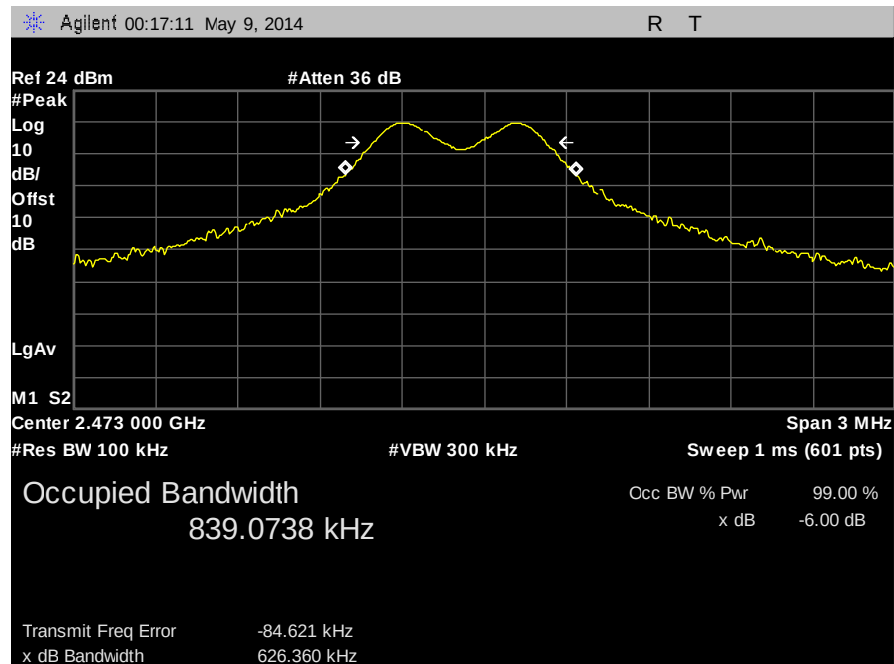
| Occupied Bandwidth |                    |                                  |
|--------------------|--------------------|----------------------------------|
| Carrier Channel    | Frequency<br>(MHz) | Measured 6 dB Bandwidth<br>(kHz) |
| Low                | 2472               | 626.360                          |
| High               | 2479               | 631.591                          |

Table 14. 6 dB Occupied Bandwidth, Test Results

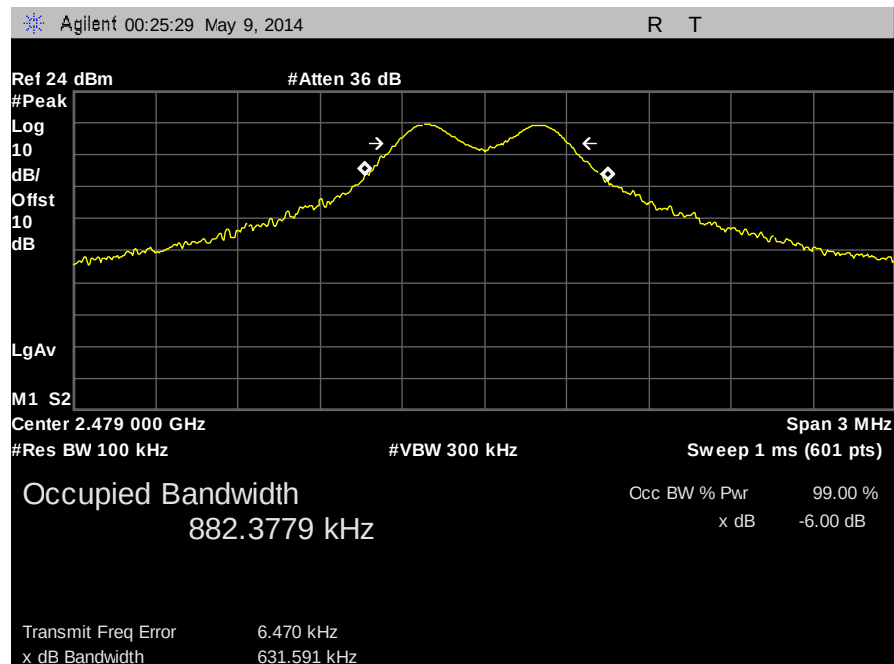
| Occupied Bandwidth |                    |                                 |
|--------------------|--------------------|---------------------------------|
| Carrier Channel    | Frequency<br>(MHz) | Measured 99% Bandwidth<br>(kHz) |
| Low                | 2472               | 824.1092                        |
| High               | 2479               | 943.8941                        |

Table 15. 99% Occupied Bandwidth, Test Results

## 6 dB Occupied Bandwidth Test Results

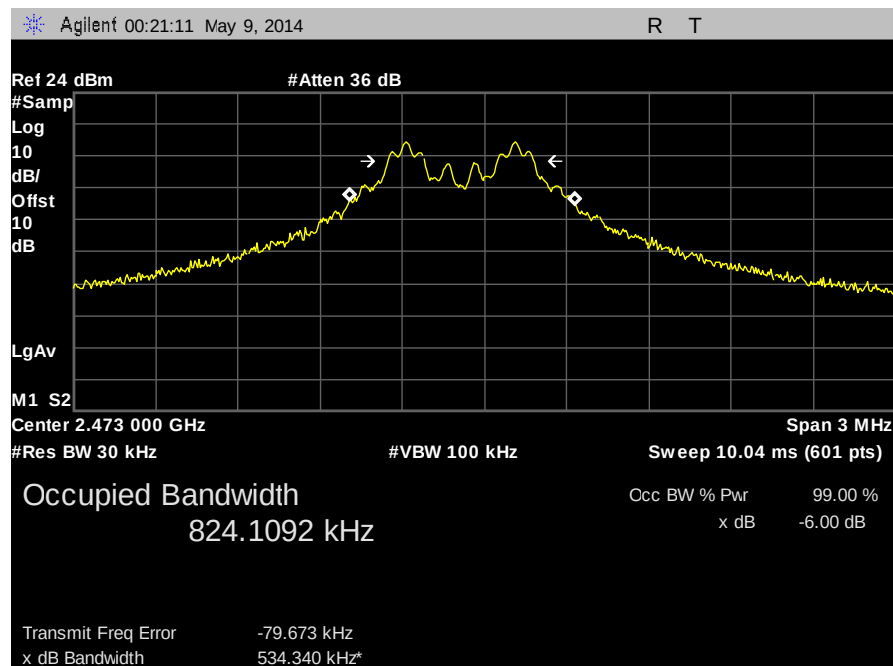


Plot 6. 6 dB Occupied Bandwidth, Low Channel

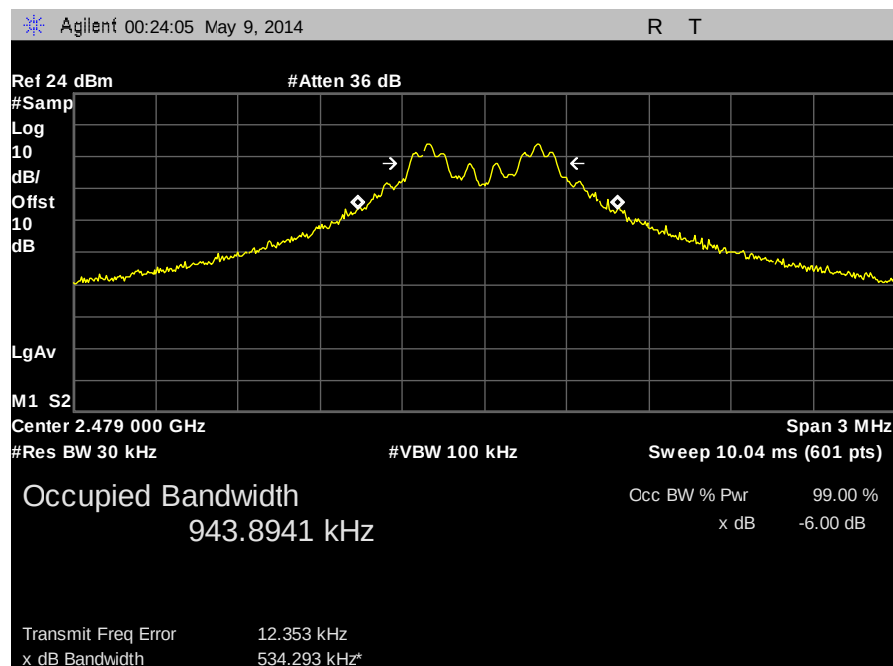


Plot 7. 6 dB Occupied Bandwidth, High Channel

## 99% Occupied Bandwidth Test Results



Plot 8. 99% Occupied Bandwidth, Low Channel



Plot 9. 99% Occupied Bandwidth, High Channel

## 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<br>(MHz) | Output Limit<br>(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(b)(4):** The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, 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):** Djed Mouada

**Test Date(s):** 5/8/14



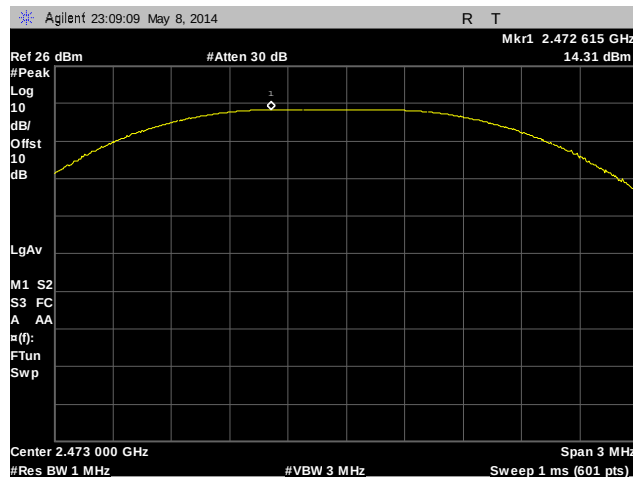
**Figure 3. Peak Power Output Test Setup**

## Peak Power Output Test Results

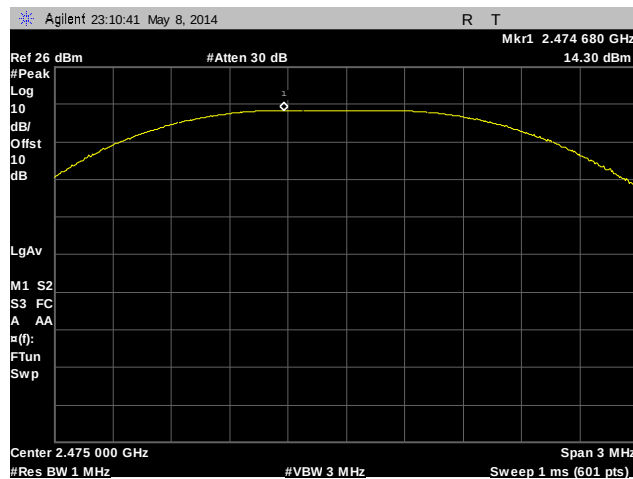
| Peak Conducted Output Power |                 |                                |
|-----------------------------|-----------------|--------------------------------|
| Carrier Channel             | Frequency (MHz) | Measured Peak Output Power dBm |
| Low                         | 2472            | 14.31                          |
| Mid                         | 2474            | 14.30                          |
| High                        | 2479            | 14.19                          |

Table 17. Peak Power Output, Test Results

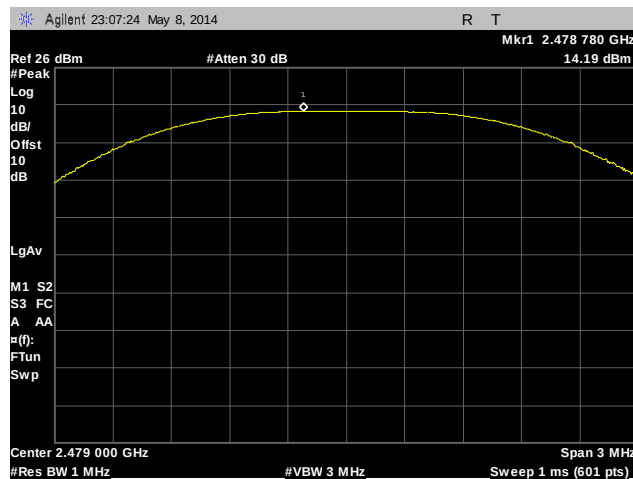
## Peak Power Output Test Results



Plot 10. Peak Power Output, Low Channel



Plot 13. Peak Power Output, Mid Channel



Plot 11. Peak Power Output, High Channel

## 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         |
| <sup>1</sup> 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       | ( <sup>2</sup> ) |

**Table 18. Restricted Bands of Operation**

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.

<sup>2</sup> 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 19.

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

**Table 19. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)**

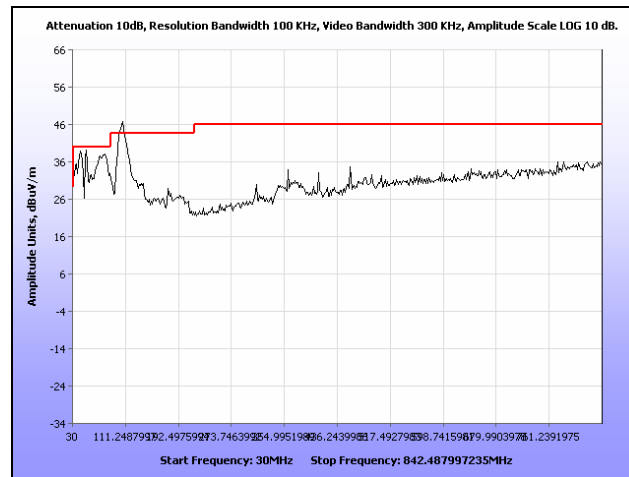
**Test Procedures:** The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was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

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

**Test Engineer(s):** Djed Mouada

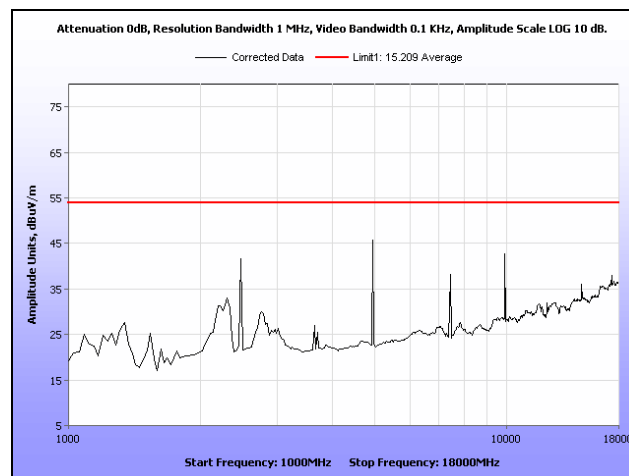
**Test Date(s):** 10/25/13 & 5/08/14

## Radiated Spurious Emissions Test Results

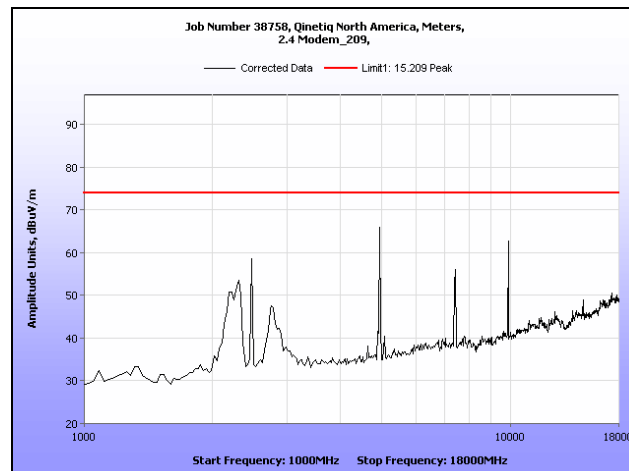


**Plot 12. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz**

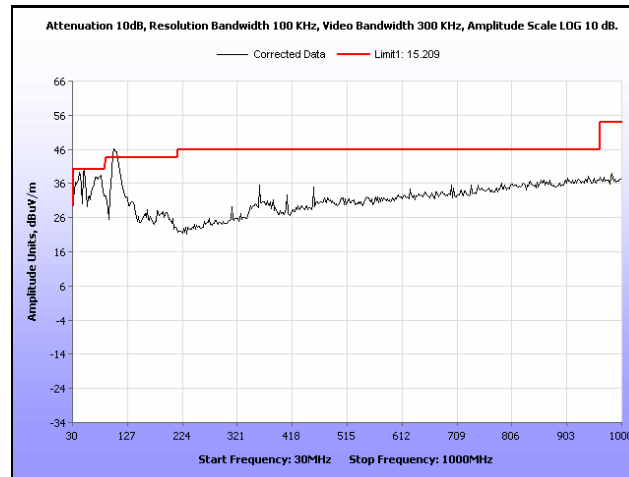
Note: The emission exceeding the 209 limit is exempt because it's a digital emission.



**Plot 13. Radiated Spurious Emissions, Low Channel, 1 GHz – 18 GHz, Average**

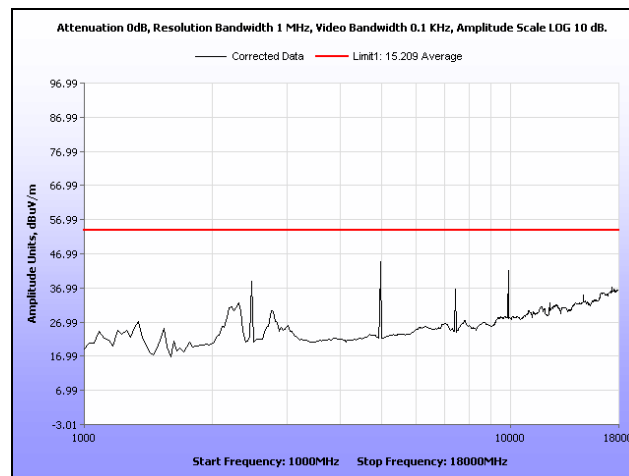


**Plot 14. Radiated Spurious Emissions, Low Channel, 1 GHz – 18 GHz, Peak**

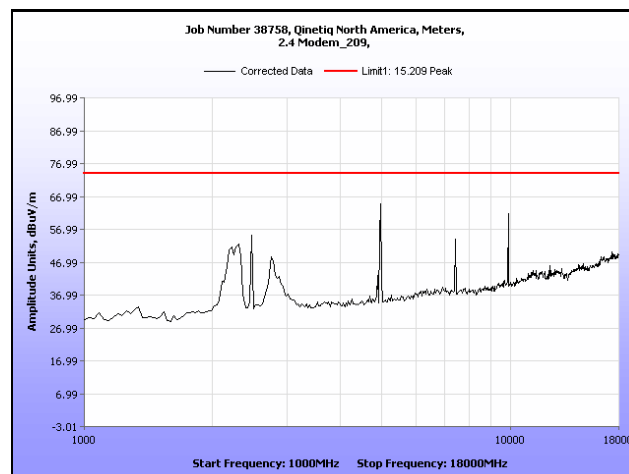


**Plot 15. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz**

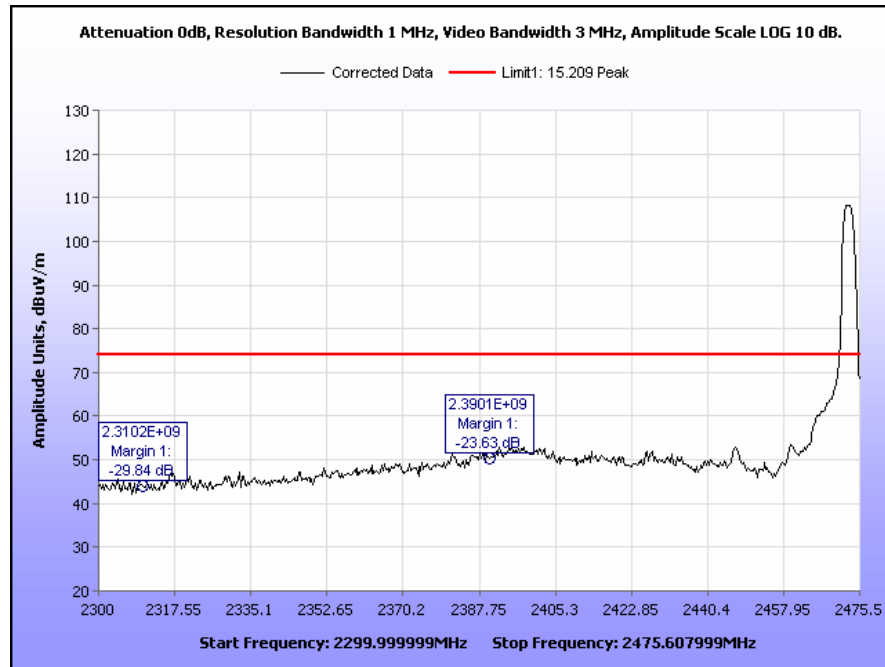
Note: The emission exceeding the 209 limit is exempt because it's a digital emission.



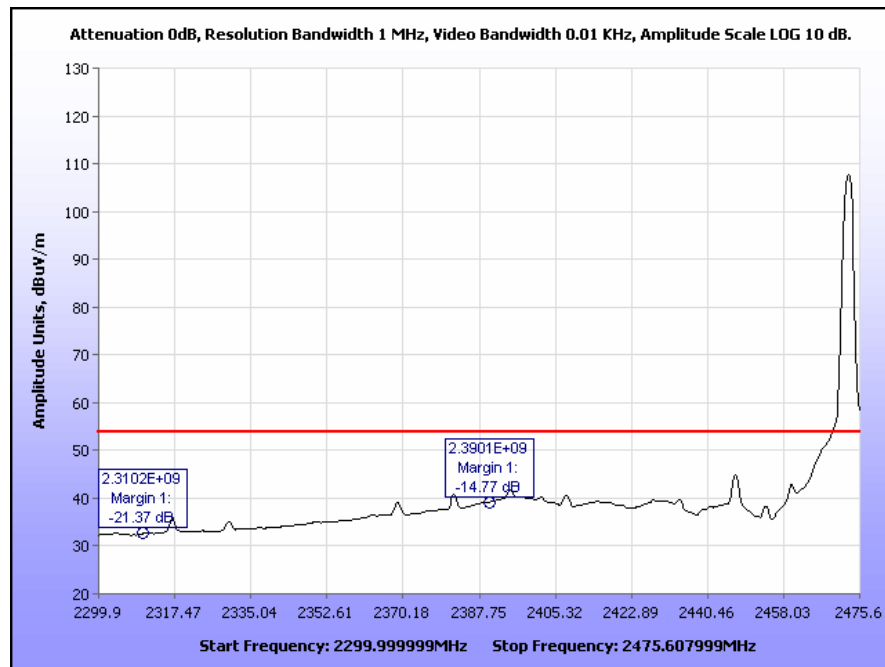
**Plot 16. Radiated Spurious Emissions, High Channel, 1 GHz – 18 GHz, Average**



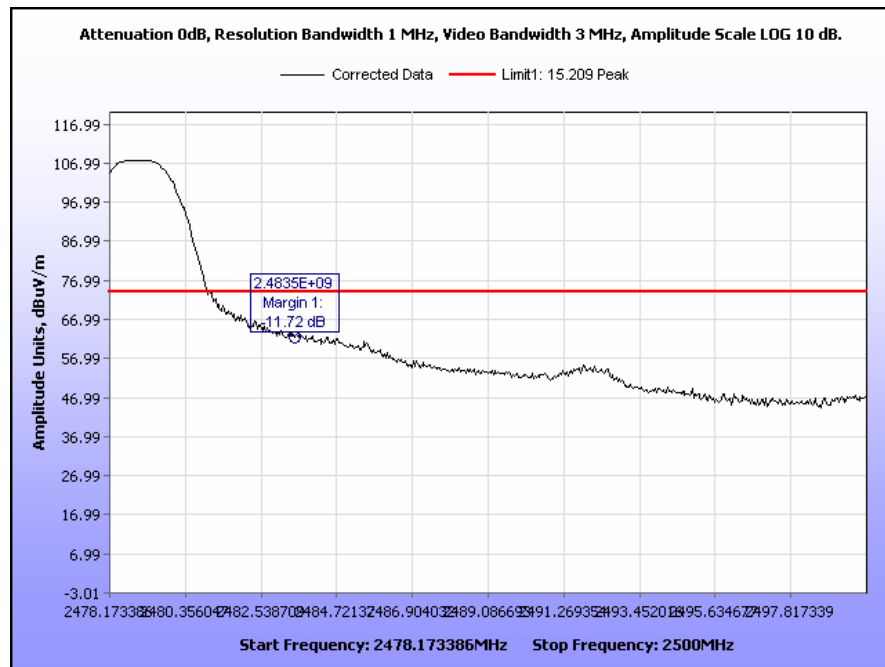
**Plot 17. Radiated Spurious Emissions, High Channel, 1 GHz – 18 GHz, Peak**



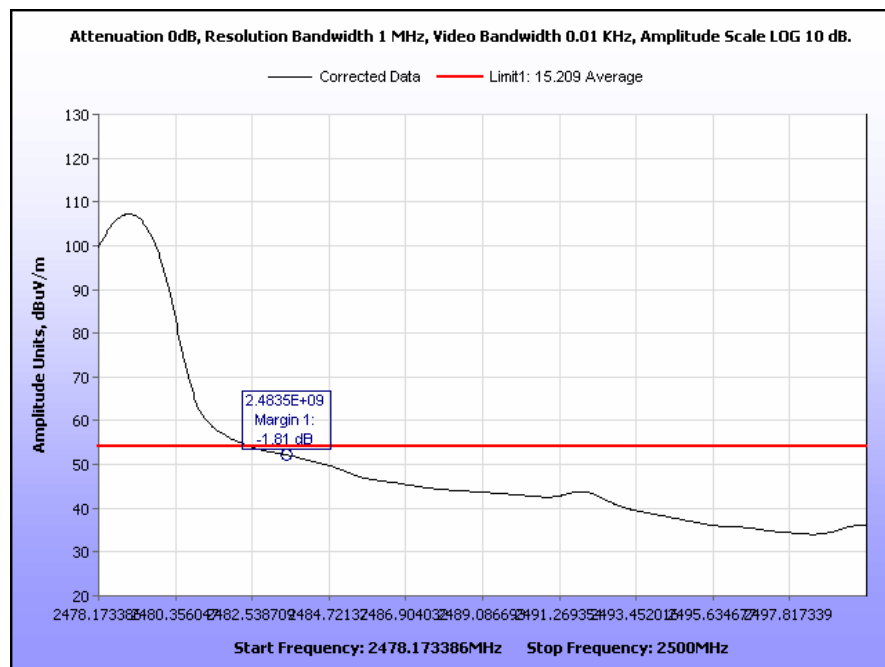
**Plot 18. Restricted band Peak, Low Channel**



**Plot 19. Restricted band Average, Low Channel**

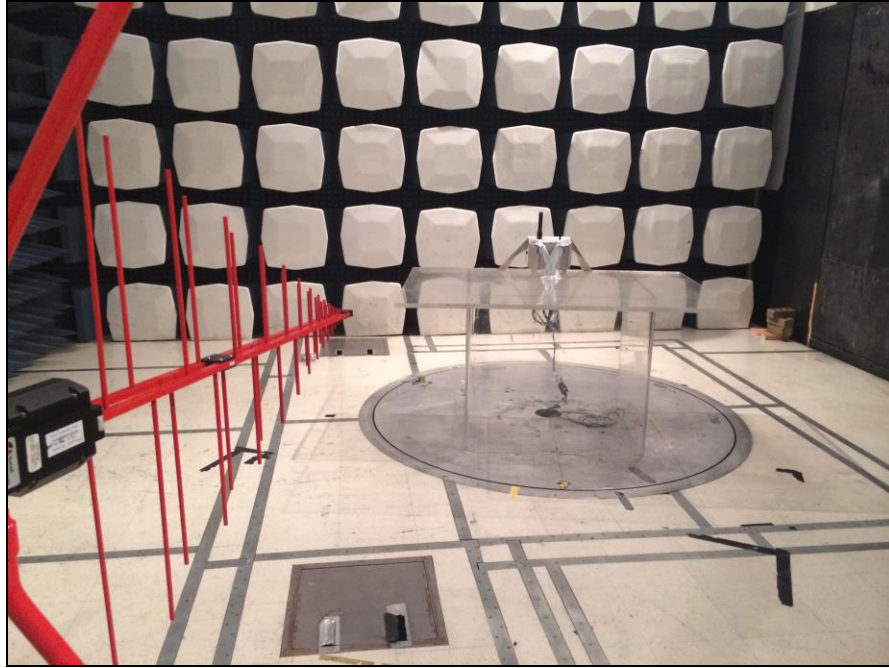


Plot 20. Restricted band Peak, High Channel

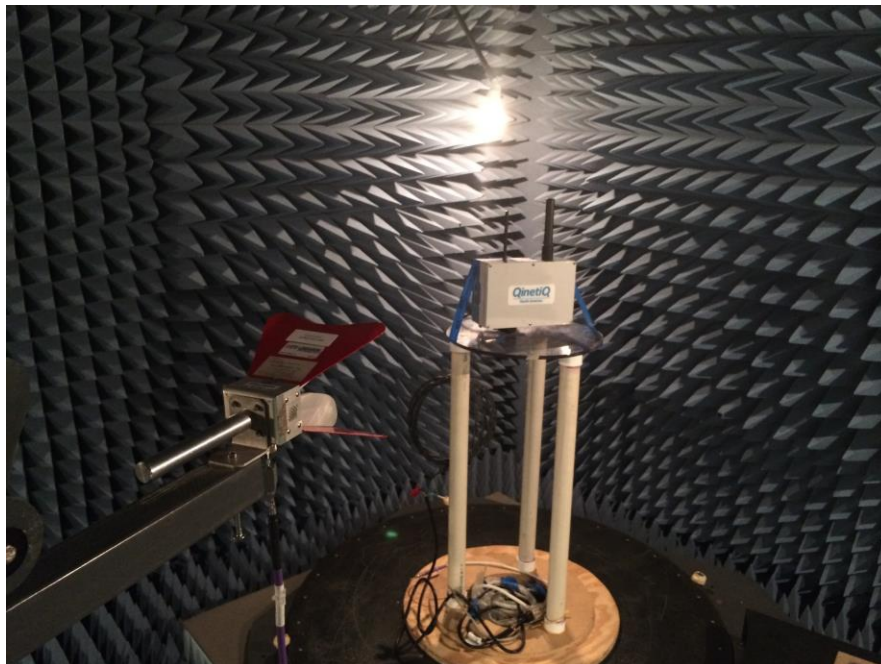


Plot 21. Restricted band Average, High Channel

## Radiated Spurious Emissions Test Setup



Photograph 6. Radiated Spurious Emissions, Test Setup



Photograph 7. Radiated Spurious Emissions, Test Setup Above 1GHz

## 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 10<sup>th</sup> harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

Since the EUT had an integral antenna, conducted measurements could not be performed. Measurements needed to be taken radiated. An antenna was located 3 m away from the EUT and plots were taken. The EUT was rotated through all three orthogonal axes. The plots were corrected for both antenna correction factor and cable loss.

See following pages for detailed test results with RF Conducted Spurious Emissions.

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

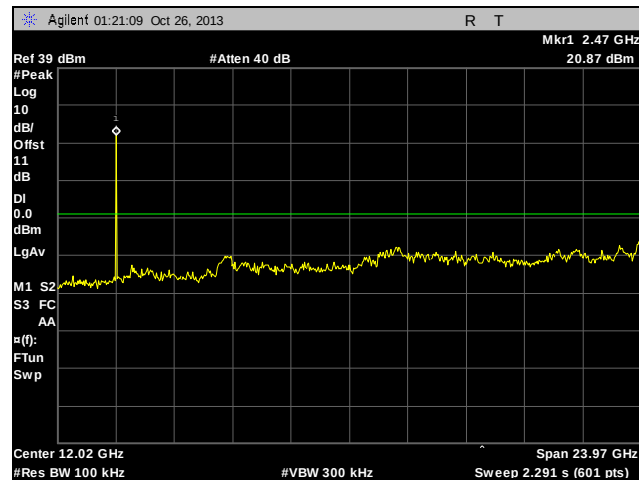
**Test Engineer(s):** Djed Mouada

**Test Date(s):** 10/25/13& 5/08/14

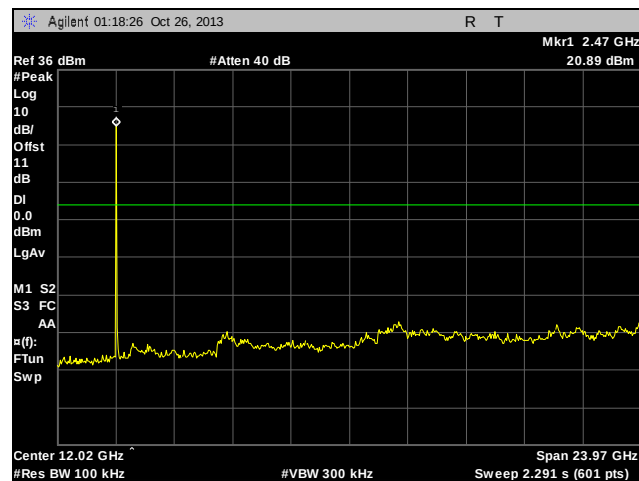


**Figure 4. Block Diagram, Conducted Spurious Emissions Test Setup**

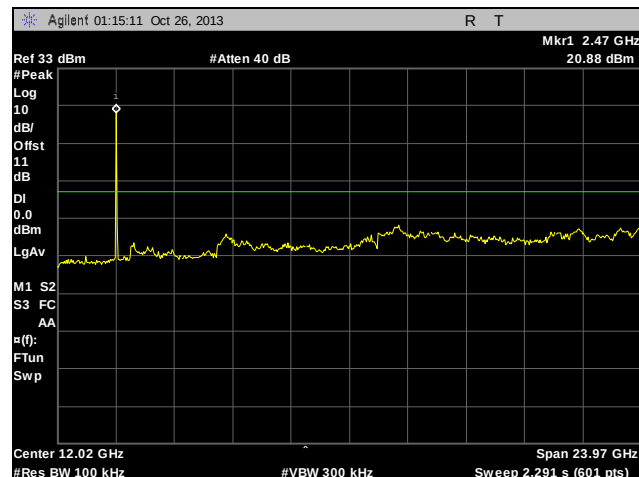
## Conducted Spurious Emissions Test Results



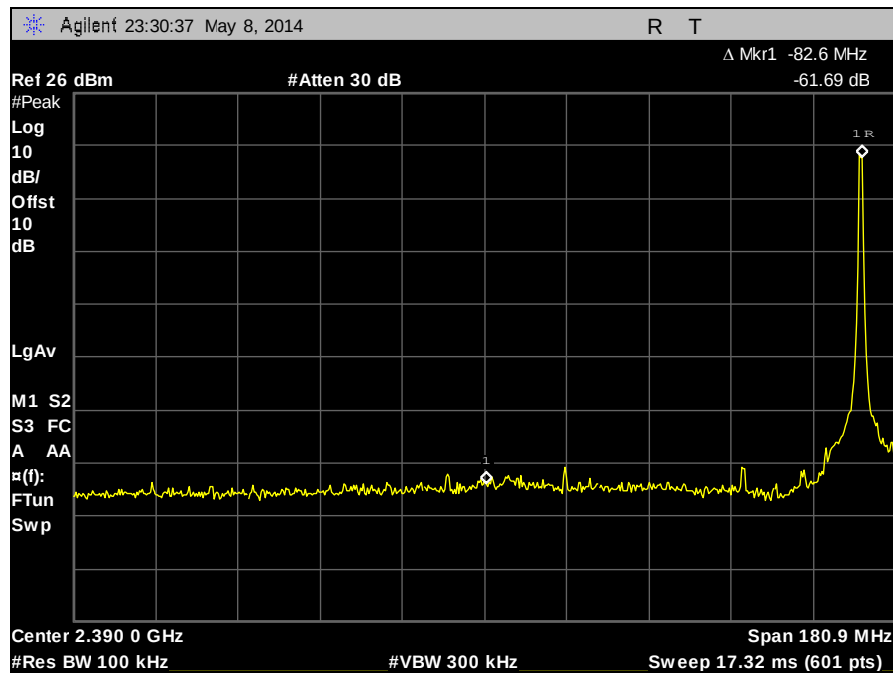
Plot 22. Conducted Spurious Emissions, Low Channel



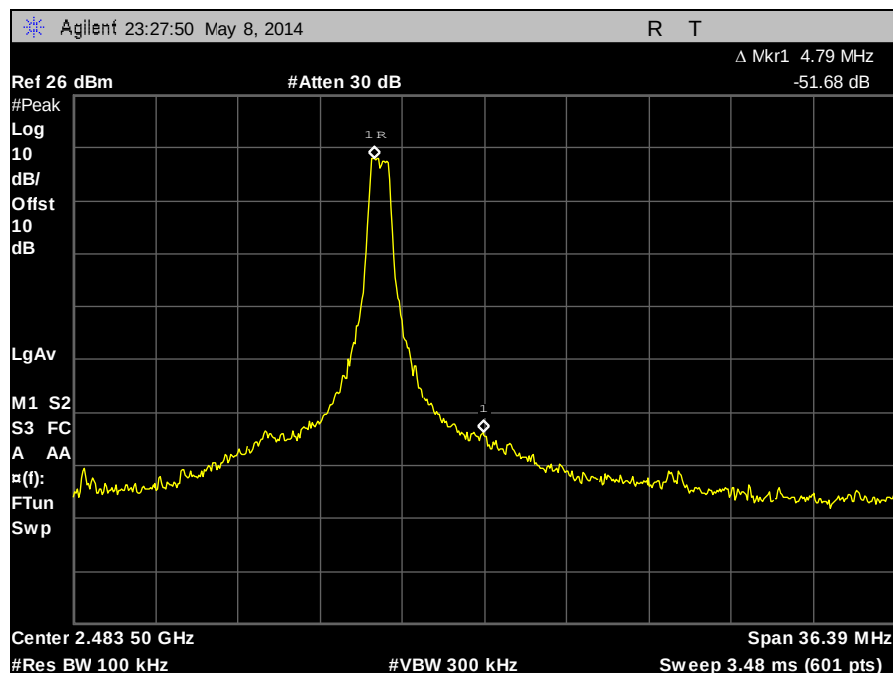
Plot 23. Conducted Spurious Emissions, Mid Channel



Plot 24. Conducted Spurious Emissions, High Channel



Plot 25. Conducted Band Edge, Low Channel



Plot 26. Conducted Band Edge, High Channel

## 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 Procedure:** The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level throughout each of the 100 sweeps of power averaging. The RBW was set to 3 kHz and a VBW set to 9 kHz or greater. The spectrum analyzer was set to an auto sweep time and a peak detector was used. Measurements were carried out at the low, mid and high channels.

**Test Results:** The EUT was compliant with the peak power spectral density limits of § 15.247 (e).

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

**Test Engineer:** Djed Mouada

**Test Date:** 5/08/14



Figure 5. Block Diagram, Peak Power Spectral Density Test Setup

## Peak Power Spectral Density Test Results

| Peak Power Spectral Density |                 |                     |             |             |
|-----------------------------|-----------------|---------------------|-------------|-------------|
| Carrier Channel             | Frequency (MHz) | Measured PPSD (dBm) | Limit (dBm) | Margin (dB) |
| Low                         | 2472            | 7.85                | 8           | -0.15       |
| Mid                         | 2475            | 7.79                | 8           | -0.21       |
| High                        | 2479            | 7.62                | 8           | -0.38       |

**Table 20. Peak Power Spectral Density, Test Results**

## Peak Power Spectral Density



Plot 27. Peak Power Spectral Density, Low Channel



Plot 28. Peak Power Spectral Density, Mid Channel



Plot 29. Peak Power Spectral Density, High Channel

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 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 = *14.31 dBm* (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm<sup>2</sup> or 10 W/m<sup>2</sup>**

EUT maximum antenna gain = *1 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, S = Power Density  
P = Power Input to antenna (27 mW)  
G = Antenna Gain (1.25 numeric)

$$S = (27 * 1.25 / 4\pi * 20^2) = 0.007 \text{ mW/cm}^2$$

## IV. Test Equipment

## Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

| MET Asset # | Equipment                       | Manufacturer             | Model                 | Last Cal Date | Cal Due Date |
|-------------|---------------------------------|--------------------------|-----------------------|---------------|--------------|
| 1T4409      | EMI RECEIVER                    | ROHDE & SCHWARZ          | ESIB7                 | 07/16/2012    | 07/16/2014   |
| 1T4751      | ANTENNA - BILOG                 | SUNOL SCIENCES           | JB6                   | 01/08/2013    | 7/8/2014     |
| 1T4442      | PRE-AMPLIFIER, MICROWAVE        | MITEQ                    | AFS42-01001800-30-10P | SEE NOTE      |              |
| 1T4149      | HIGH-FREQUENCY ANECHOIC CHAMBER | RAY-PROOF                | 81                    | NOT REQUIRED  |              |
| 1T4814      | COMB GENERATOR                  | COM-POWER                | CGO-5100              | SEE NOTE      |              |
| 1T4814      | COMB GENERATOR                  | COM-POWER                | CGO-5100              | SEE NOTE      |              |
| 1T4771      | PSA SPECTRUM ANALYZER           | AGILENT TECHNOLOGIES     | E4446A                | 2/15/2013     | 8/15/2014    |
| 1T4442      | PRE-AMPLIFIER, MICROWAVE        | MITEQ                    | AFS42-01001800-30-10P | SEE NOTE      |              |
| 1T4149      | HIGH-FREQUENCY ANECHOIC CHAMBER | RAY-PROOF                | 81                    | NOT REQUIRED  |              |
| 1T4814      | COMB GENERATOR                  | COM-POWER                | CGO-5100              | SEE NOTE      |              |
| 1T4642      | TRANSFORMER - BIPHASE           | SIGNAL TRANSFORMER       | DU-1                  | SEE NOTE      |              |
| 1T4504      | SHIELDED ROOM                   | UNIVERSAL SHIELDING CORP | N/A                   | NOT REQUIRED  |              |
| 1T4563      | LISN (10 AMP)                   | SOLAR ELECTRONICS        | 9322-50-R-10-BNC      | 11/27/2012    | 5/27/2014    |
| 2T6419      | THERMAL CONDUCTIVITY ANALYZER   | MSA                      | T-3                   | SEE NOTE      |              |
| 1T4483      | ANTENNA; HORN                   | ETS-LINDGREN             | 3117                  | 8/6/2012      | 2/6/2014     |
| 1T4483      | ANTENNA; HORN                   | ETS-LINDGREN             | 3117                  | 2/28/2014     | 8/28/2015    |

**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.<sup>1</sup> *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.

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<sup>1</sup> 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 user's 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 5 August 2012:

- 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 users' manual.

### Labeling Requirements:

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

CAN ICES-3 (A)/NMB-3(A)

# End of Report