# Global EMC Inc. Labs

# EMC & RF Test Report

As per

## RSS 210 Issue 8:2010

## &

## FCC Part 15 Subpart C:2010

## Unlicensed Intentional Radiators

on the

## Artaflex Wireless Radio Modules (AW24TH)


Scott Drysdale, Narte Certified Technician
EMC Lab Manager
Global EMC Inc.
180 Brodie Dr, Unit 2
Richmond Hill, ON L4B 3K8
Canada
Ph: (905) 883-3919


Testing produced for

artaflex

See Appendix A for full customer & EUT details.

Industry Canada

**LAB REGISTRATION #6844A-2**

**FCC REGISTRATION #612361**

ACCREDITED

Testing Laboratory Certificate #2555.01

# Table of Contents

# Report Scope

This report addresses the EMC verification testing and test results of the Artaflex Wireless Radio Module (AW24TH), herein referred to as EUT (Equipment Under Test) performed at Global EMC Labs.

The EUT was tested for compliance against the following standards:

RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2010

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

The results contained in this report relate only to the item(s) tested.

This report does not imply product endorsement by A2LA or any other accreditation agency, any government, or Global EMC Inc.

Opinions/interpretations expressed in this report, if any, are outside the scope of Global EMC Inc accreditation. Any opinions expressed do not necessarily reflect the opinions of Global EMC Inc, unless otherwise stated.

| | |
|---|---|
| Client | **Artaflex** |
| Product | **Artaflex Wireless Radio Module (AW24TH)** |
| Standard(s) | RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2010 |

## Summary

The results contained in this report relate only to the item(s) tested.

| | |
|---|---|
| EUT FCC Certification #, FCC ID: | UP2AW24TH |
| EUT Industry Canada Certification #, IC: | 6797A-AW24TH |
| EUT Passed all tests performed. | Yes (see test results summary) |
| Tests conducted by | Scott Drysdale |

| | |
|---|---|
| Client | **Artaflex** |
| Product | **Artaflex Wireless Radio Module (AW24TH)** |
| Standard(s) | RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2010 |

## *Test Results Summary*

| Standard/Method | Description | Class/Limit | Result |
|---|---|---|---|
| FCC 15.203 | Antenna Requirement | Unique | Pass<br>See Justification |
| FCC 15.205<br>RSS 210 (Table 1) | Restricted Bands for intentional operation | QuasiPeak<br>Average | Pass |
| FCC 15.207 | Power line conducted emissions | QuasiPeak<br>Average | Pass<br>See Justification |
| FCC 15.209<br>RSS-210 (Table 2) | Spurious Radiated emissions | QuasiPeak<br>Average | Pass |
| FCC 15.247(a)2<br>RSS-210 A8.2(a) | 6 dB Bandwidth | > 500 kHz | Pass |
| FCC 15.247(b)2<br>RSS-210 A8.4(4) | Max output power | < 1 Watt | Pass |
| FCC 15.247(b)(4)<br>RSS-210 A8.4(5) | Antenna Gain | < 6 dBi | Pass<br>See Justifications |
| FCC 15.247(d)<br>RSS-210 A8.5 | Antenna conducted spurious | < 20 dBc | Pass |
| FCC 15.247(e)<br>RSS-210 A8.2(b) | Spectral Density | < 8 dBm<br>(3 kHz BW) | Pass |
| FCC 15.247(i)<br>IC Safety code 6 | Maximum Permissible Exposure / Specific Absorption Rate | MPE | Pass<br>See separate MPE report |
| **Overall Result** | | | **PASS** |

All tests were performed by Scott Drysdale.

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a ‘PASS’ grade. If not ‘FAIL’ grade will be issued.

## *Justifications, Descriptions, or Deviations*

The following justifications for tests not performed or deviations from the above listed specifications apply:

For the Antenna requirement specified in FCC 15.203 (RSS 210 section 5.5), this device incorporates several different options, each complying with the FCC requirements:

Reverse Polarity SMA
Right Angle Reverse Polarity SMA
U.Fl
PCB Chip antenna.

For all tests except antenna conducted emissions, all models were scanned and the worst case model is represented. For antenna conducted emissions all models except the PCB chip antenna were evaluated, and the worst case model is represented. Given the normal procedure would be to replace with the PCB chip antenna with an RF connector, the reverse polarity SMA antenna conducted readings were considered representative.

For the Restricted Bands of operation, the EUT is designed to only operate between 2400 and 2483.5 MHz

For the Antenna gain, for each antenna type used, this device has less than 6 dBi gain.

For maximum permissible exposure, this device operates in Digitally modulated mode at 24.2 dBm at 2.4 GHz, in mobile conditions, at distances greater than 20 cm from the end user and is therefore exempt from SAR evaluation. MPE calculation is provided as a separate exhibit.

Power line conducted emissions was not performed as the host board used was configured for battery operation.

## *Applicable Standards, Specifications and Methods*

| | |
|---|---|
| ANSI C63.4:2003 | - Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| ANSI C63.10:2009 | - American national standard for testing unlicensed wireless devices |
| CFR 47 FCC 15 | - Code of Federal Regulations – Radio Frequency Devices |
| CISPR 22:1997 | - Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement |
| FCC KDB 558074 | - FCC KDB 558074 Digital Transmission Systems, measurements and procedures |
| ICES-003:2004 | - Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard |
| ISO 17025:2005 | - General Requirements for the competence of testing and calibration laboratories |
| RSS 210:2010 | - Issue 8: Spectrum Management and Telecommunications Policy. Radio Standards Specification Low Power Licence-Exempt Radiocommunication Devices |

## *Sample calculation(s)*

Margin = limit – (received signal + antenna factor + cable loss – pre-amp gain)
Margin = 50.5dBuV/m – (50dBuV + 10dB + 2.5dB – 20dB)
Margin = 8.5 dB

## *Document Revision Status*

Revision 1 - May 8, 2012

Revision 2 - May28, 2012
Added reference to “KDB 558074 Digital Transmission Systems, measurements and procedures” as per TCB request
Added Horn antenna utilized for 18GHz to 25 GHz measurements

# Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

**AE** – Auxiallary Equipment.

**BW –** Bandwidth. Unless otherwise stated, this is refers to the 6 dB bandwidth.

**EMC** – Electro-Magnetic Compatibility

**EMI** – Electro-Magnetic Immunity

**EUT** – Equipment Under Test

**ITE –** Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

**LISN** – Line impedance stabilization network

**NCR** – No Calibration Required

**RF** – Radio Frequency

# Testing Facility

Testing for EMC on the EUT was carried out at Global EMC labs in Toronto, Ontario, Canada. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on an EUT with a maximum width or length of up to 2m and height up to 3m. The chamber is equipped with a turn table that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120 Vac and 240Vac single phase, or 208 Vac 3 phase input. DC capability is also available. The chamber is equipped with an antenna mast that controls polarization and height from the control room adjoining the shielded chamber. Radiated emissions measurements are performed using a Bilog, and Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN.

## *Calibrations and Accreditations*

The measurement site used is registered with Federal Communications Commission (FCC) and Industry Canada (IC). This site is calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”. The semi-anechoic chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

## *Testing Environmental Conditions and Dates*

Following were the environmental conditions in the facility during time of testing –

| Date | Test | Initials | Temperature (ºC) | Humidity (%) | Pressure (kPa) |
|---|---|---|---|---|---|
| April 19 – 24, 2012 | RE | SD | 20-25ºC | 30-45% | 100 -103 kPa |
| April 19, 2012 | Antenna conducted | SD | 20-25ºC | 30-45% | 100 -103 kPa |

# Detailed Test Results Section

## *Radiated Emissions*

### Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

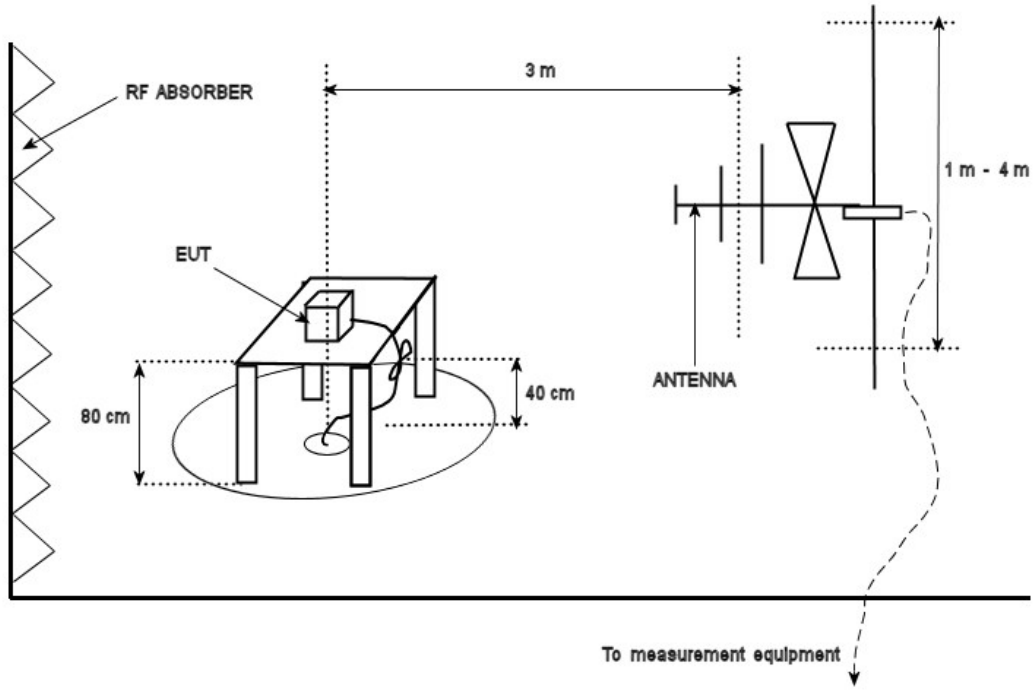
### Limit(s) and Method

The method is as defined in ANSI C63.4:2003.

The limits are as defined in FCC Part 15, Section 15.209:
30 MHZ – 88 MHz, 100 uV/m (40.0 dBuV/m[1]) at 3 m
88 MHz – 216 MHz, 150 uV/m (43.5 dBuV/m[1]) at 3 m
216 MHz – 960 MHz, 200 uV/m (46.4 dBuV/m[1]) at 3 m
Above 960 MHz, 500 uV/m (54.0 dBuV/m[1]) at 3 m
Above 1000 MHz, 500 uV/m (54 dBuV/m[2]) at 3m

[1]Limit is with 120 kHz measurement bandwidth and a using a Quasi Peak detector.
[2]Limit is with 1 MHz measurement bandwidth and using an Average detector

**Typical Radiated Emissions Setup**



## Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a 'k=2' coverage factor and a 95% confidence level.

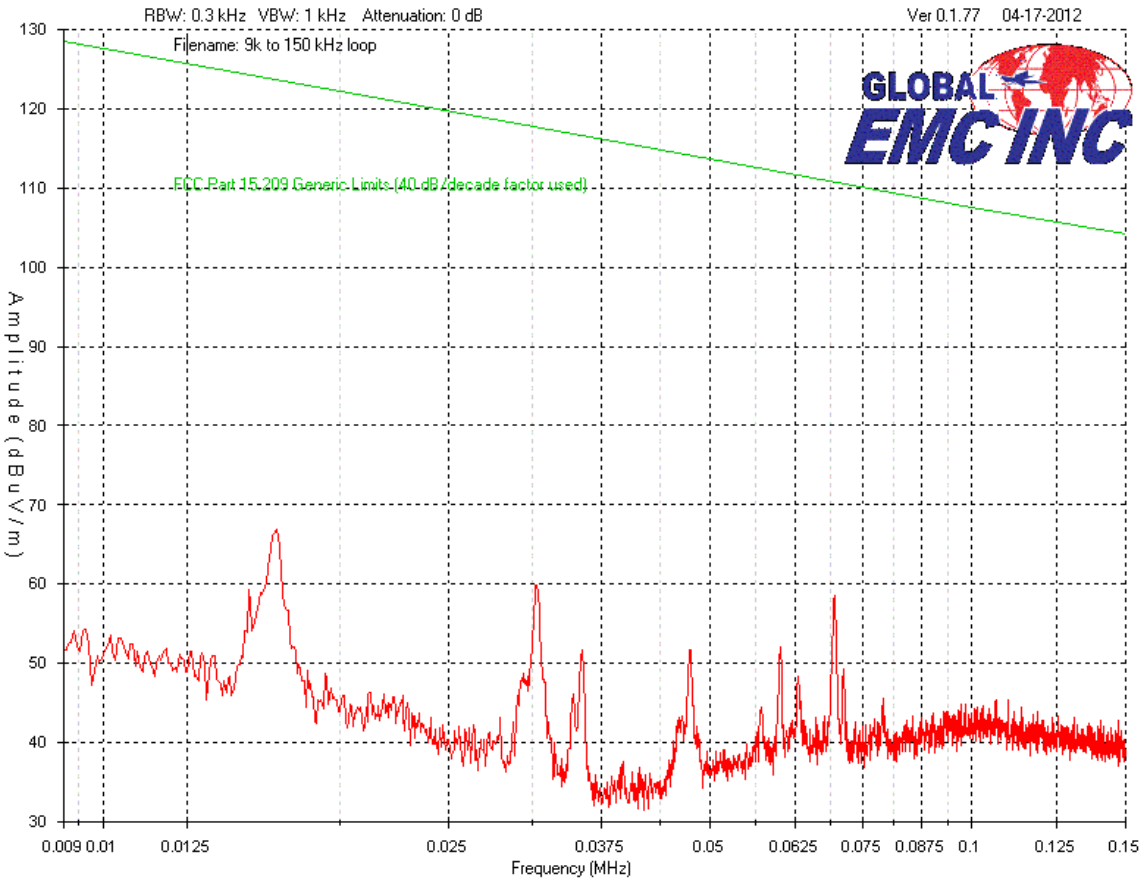
## Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graph shown below is a maximized peak measurement graph, measured with a resolution bandwidth greater then the final required detector and over a full 0-360 rotation. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement, and provides considerable time savings.

In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the $10^{th}$ harmonic ( a minimum of a 25 GHz).

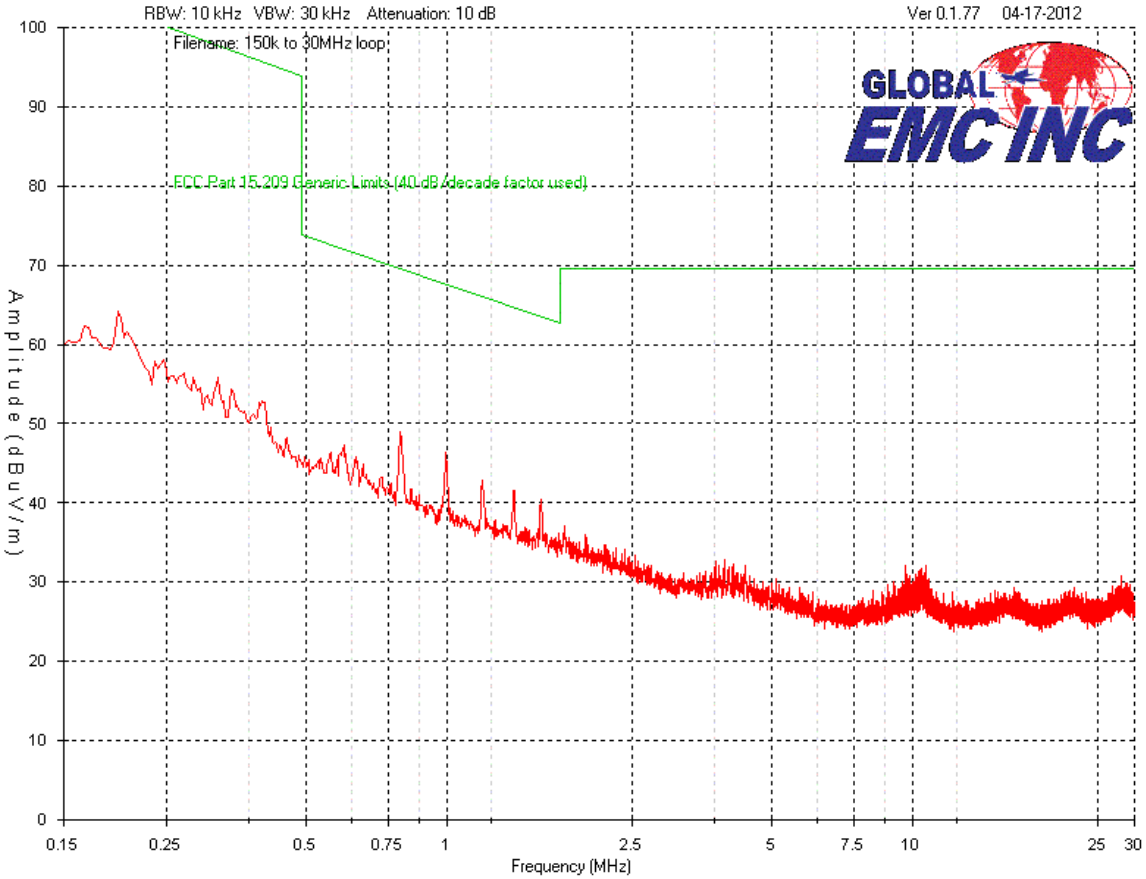
Devices scanned above 10 GHz were scanned at 1 meter test distance, and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used.

9 kHz to 150 kHz - Peak



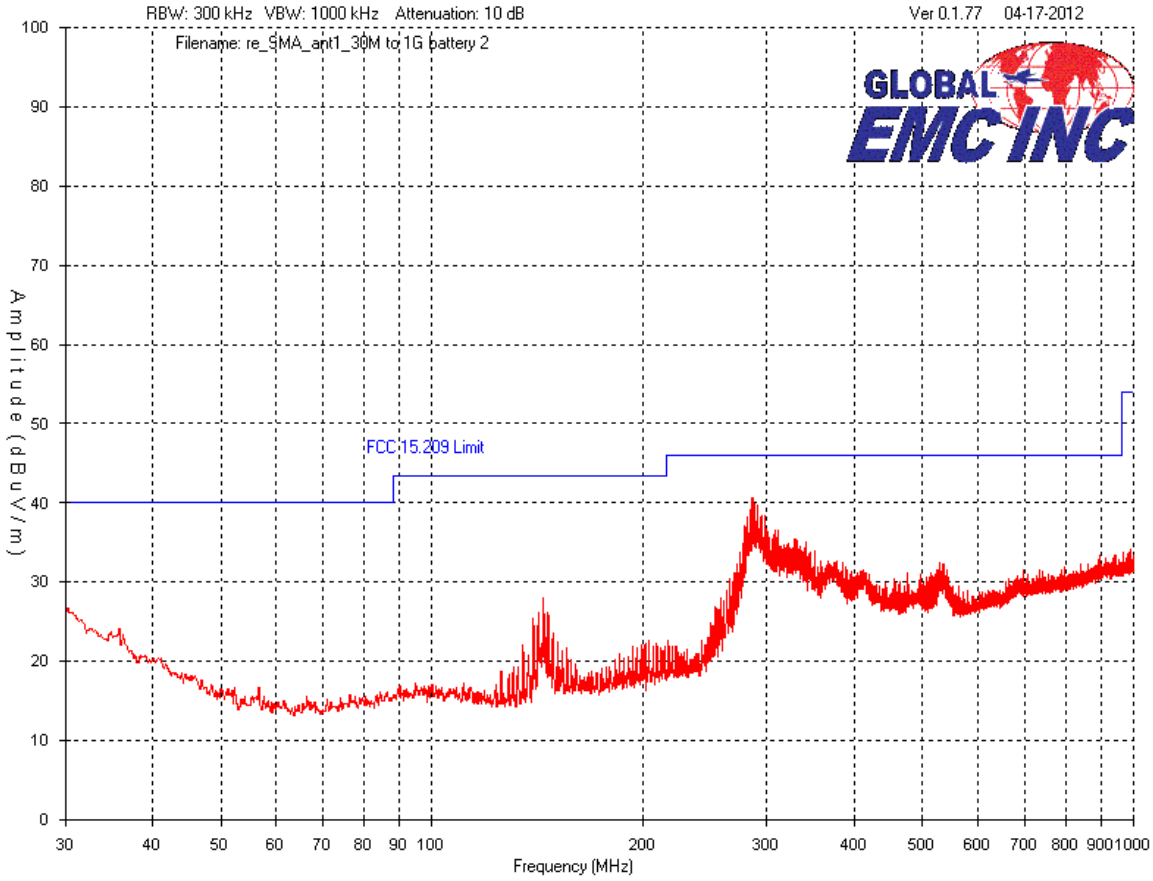

Worst-case/representative channel

150 kHz to 30 MHz - Peak

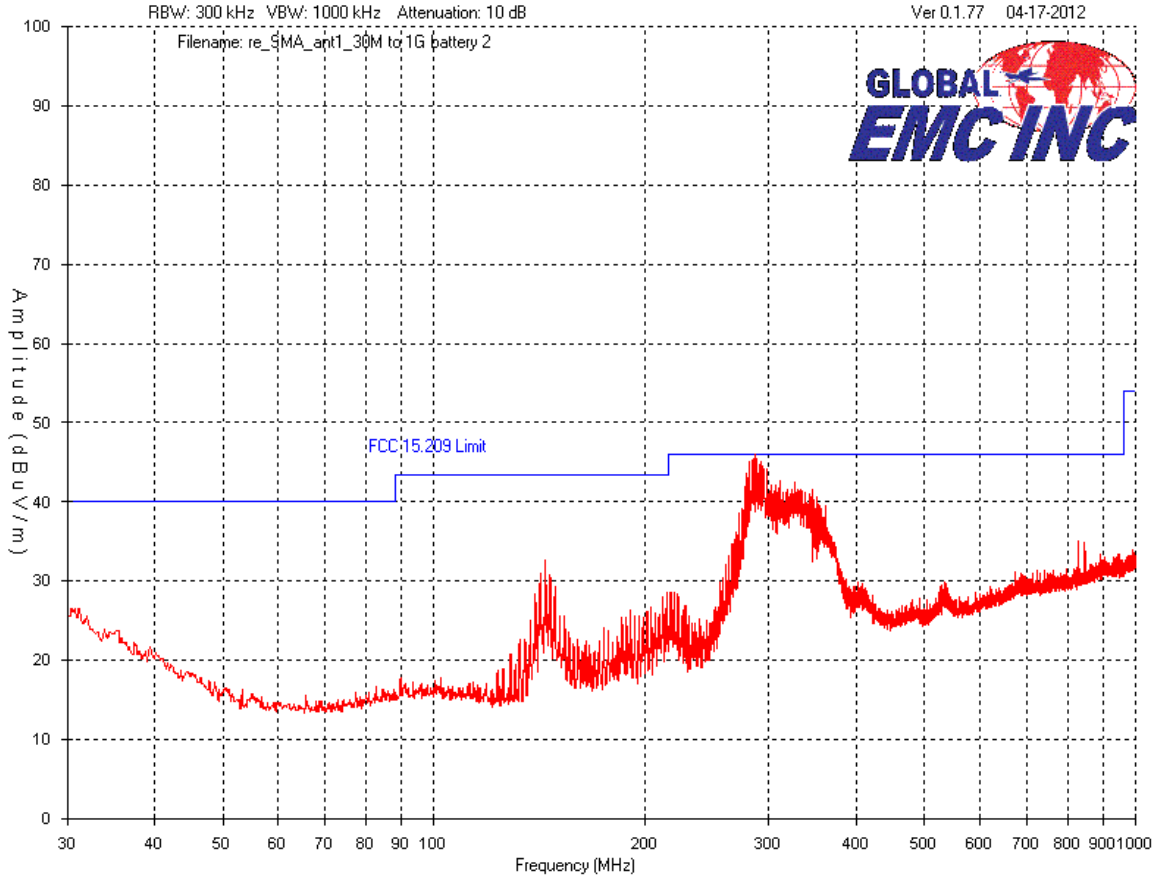



Worst-case/representative channel

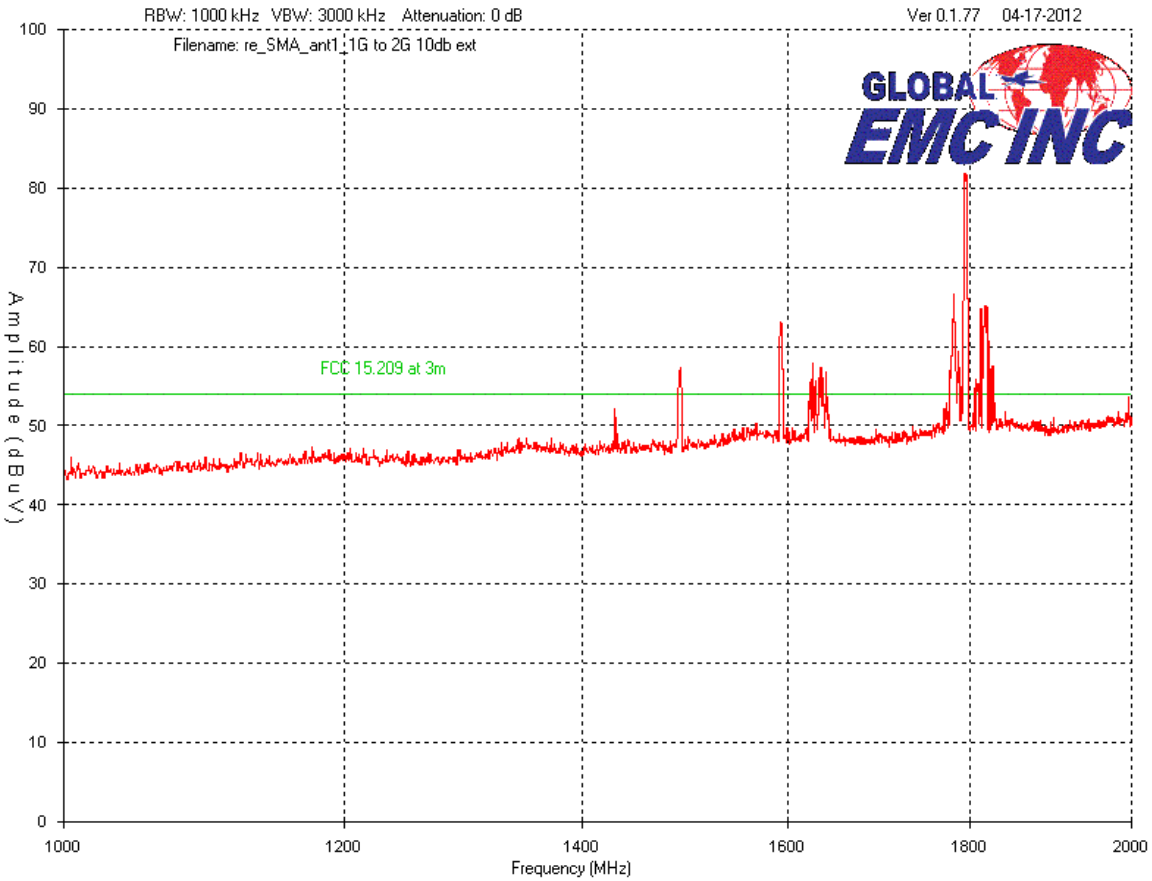
Vertical – Peak Emissions Graph 30 MHz – 1 GHz (worst case/representative channel)



Horizontal – Peak Emissions Graph 30MHz to 1 GHz (worst case/representative channel)



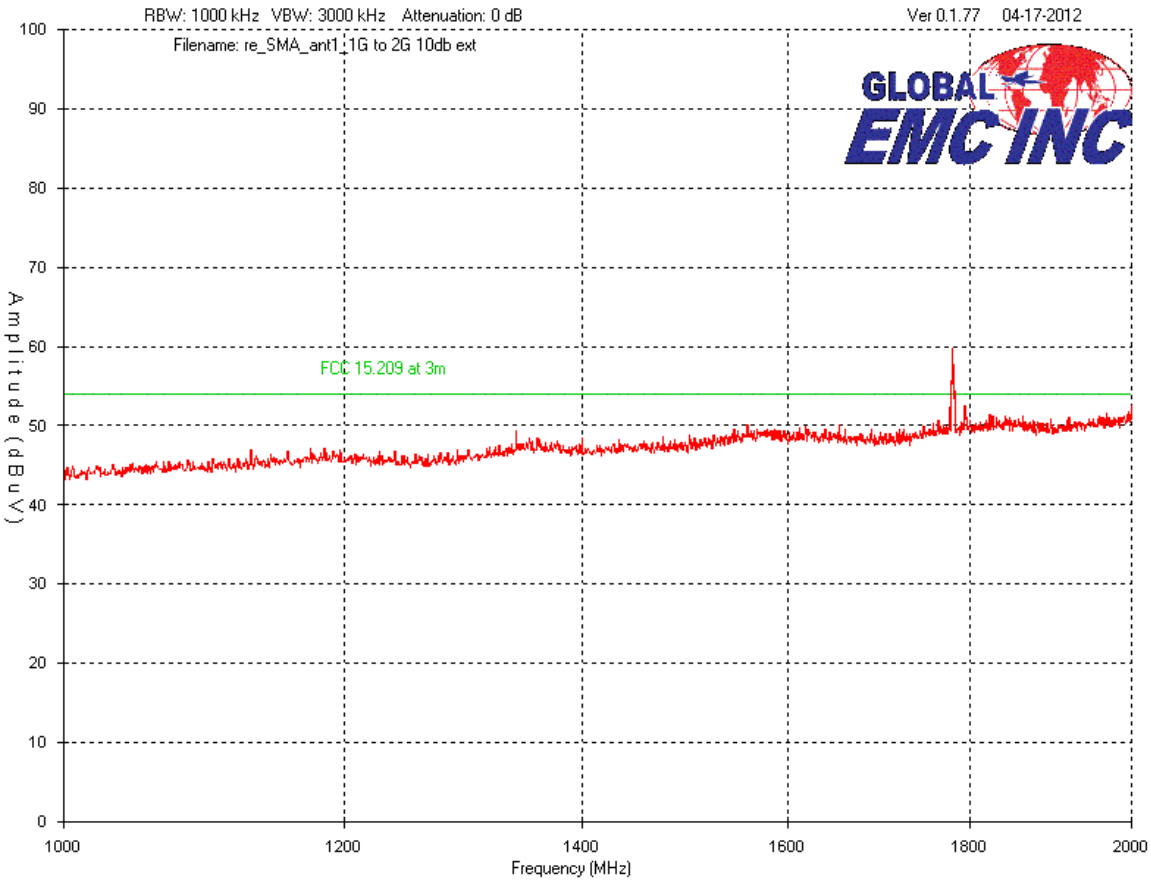
Vertical – 1GHz to 2 GHz – Peak emissions graphs




Worst-case/representative channel

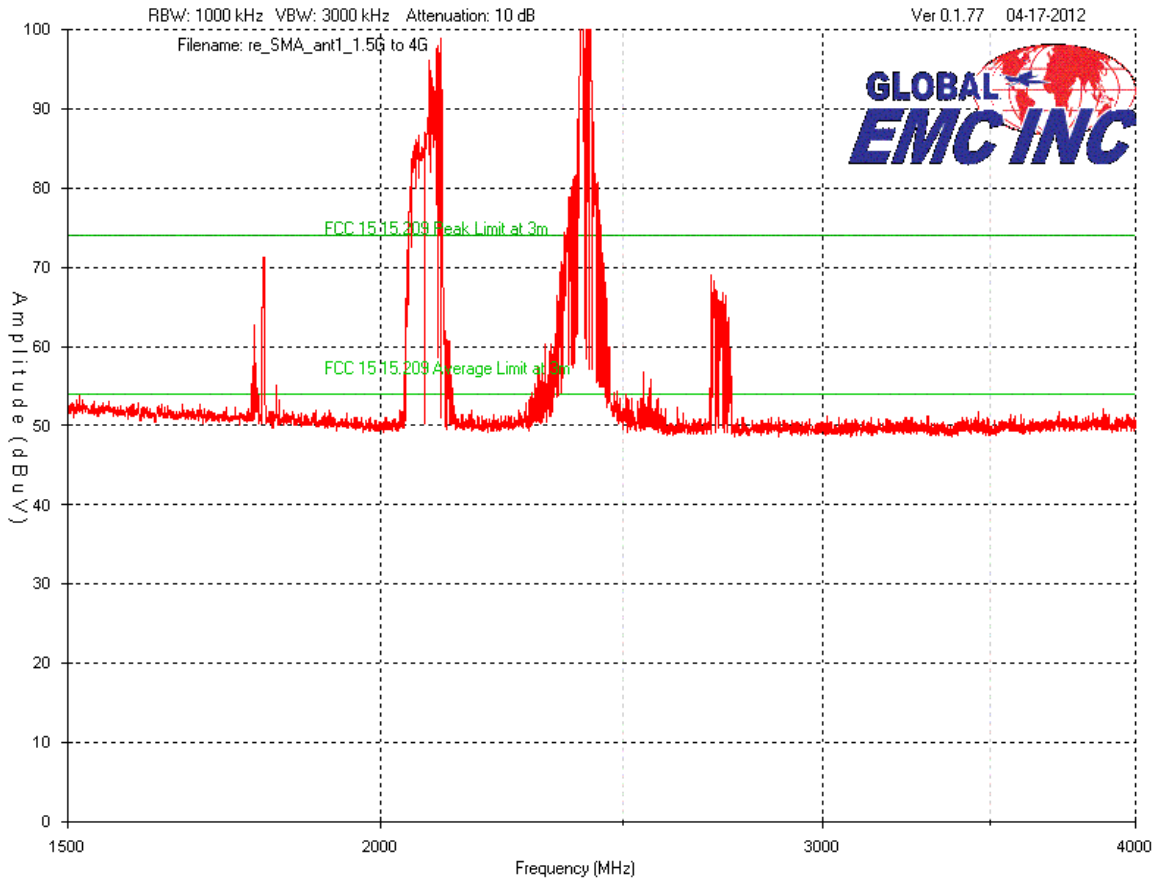
Note: Not all emissions shown above the limit in the graph above are within a restricted band. See the Average measurement tables follow the peak graphs for further details to determine if the 15.209 limits or the 20 dBc requirement applies and the applicable measurement.

Horizontal – 1 GHz to 2 GHz – Peak Emissions Graph



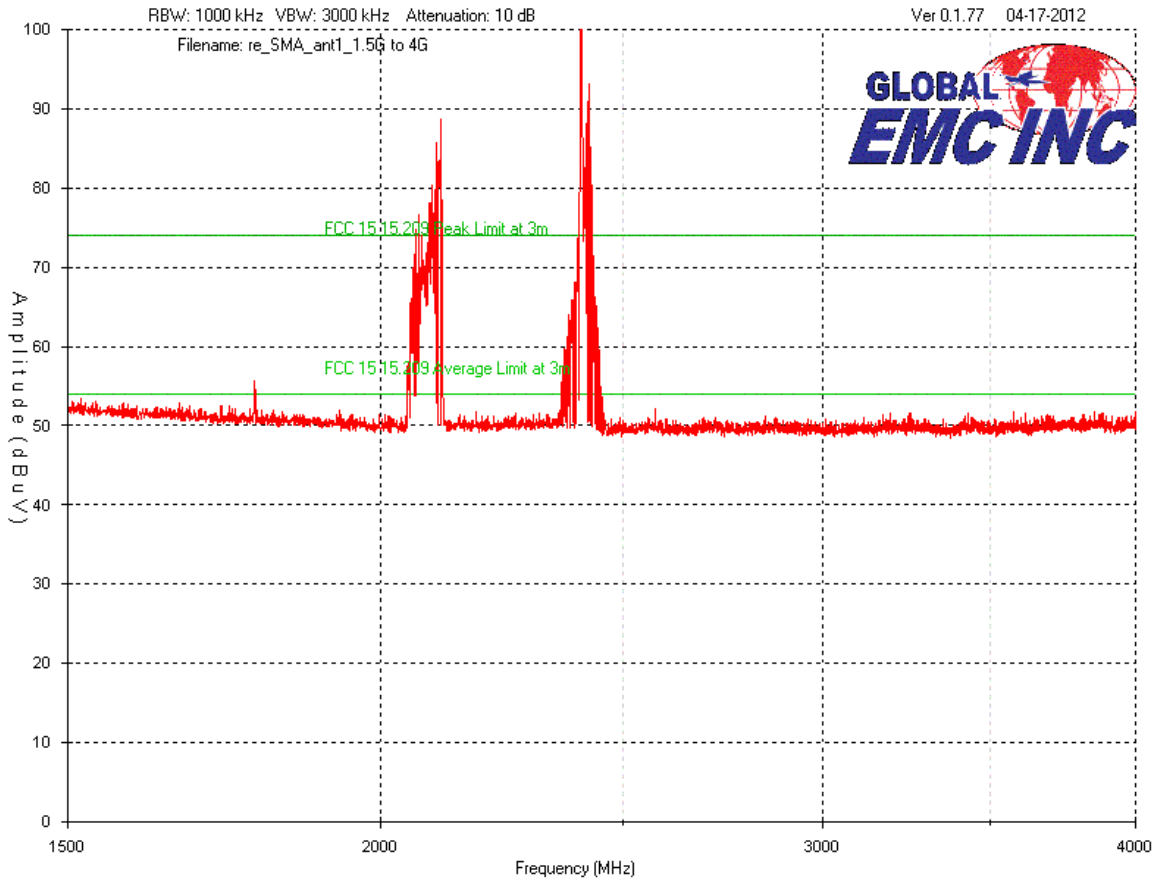

Worst-case/representative channel

Vertical – 2 GHz to 4 GHz – Peak Emissions Graph



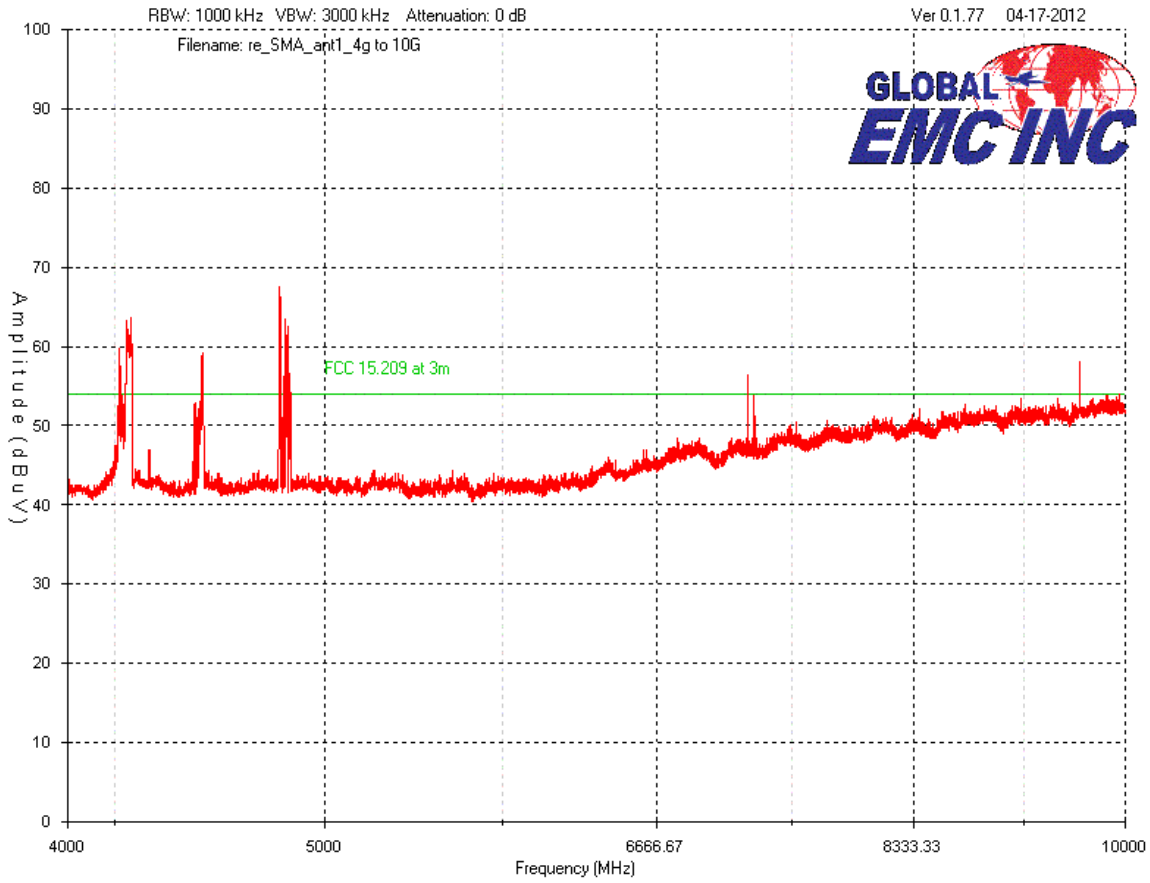

The above graph represents low channel as representative of peak digital modulated emissions. See table for final maximized peak/average measurements.

Horizontal – 2 GHz to 4 GHz



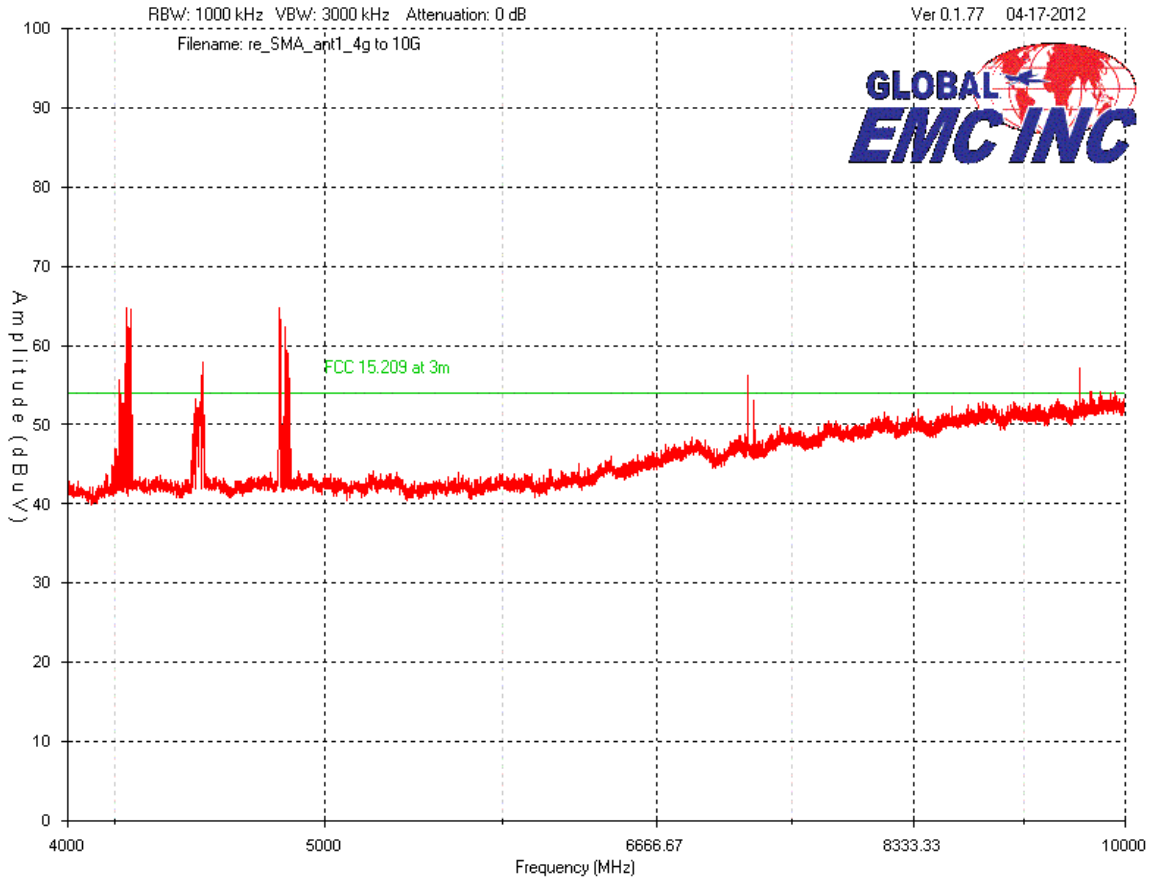

The above graph represents low channel as representative of peak digital modulated emissions. See table for final maximized peak/average measurements.

Vertical – 4 GHz to 10 GHz – Peak Emissions Graph




Note: The EUT was scanned up to 25 GHz with no significant emissions detected above 10 GHz.

Horizontal – 4 GHz to 10 GHz – Peak Emissions Graph




Note: The EUT was scanned up to 25 GHz with no significant emissions detected above 10 GHz.

## Final Measurements

Top Quasi-Peak / PK Emissions 30MHz to 1 GHz - Table - Vertical

| Frequency (MHz) | Detector | Raw (dBuV) | Ant. (dB/m) | Cable (dB) | Amp (dB ) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Pass/Fail |
|---|---|---|---|---|---|---|---|---|---|
| 286.177 | PK | 57.4 | 13.1 | 0.6 | -30.4 | 40.7 | 46 | 5.3 | Pass |
| 279.193 | PK | 54.2 | 12.8 | 0.6 | -30.4 | 37.2 | 46 | 8.8 | Pass |
| 30.194 | PK | 37.7 | 18.9 | 0.3 | -30.1 | 26.8 | 40 | 13.2 | Pass |
| 528.289 | PK | 43.5 | 18.5 | 0.7 | -30.2 | 32.5 | 46 | 13.5 | Pass |
| 144.072 | PK | 49.3 | 8.5 | 0.5 | -30.3 | 28 | 43.5 | 15.5 | Pass |
| 265.225 | PK | 47.8 | 12.5 | 0.6 | -30.4 | 30.5 | 46 | 15.5 | Pass |

Low, medium and high channel were investigated, Worst case results presented above (low channel)

Top Quasi-Peak Emissions 30 MHz to 1 GHz Table - Horizontal

| Frequency (MHz) | Detector | Raw (dBuV) | Ant. (dB/m) | Cable (dB) | Amp (dB ) | Level (dBuV/m) | Limit (dBuv/m) | Margin (dB) | Pass/Fail |
|---|---|---|---|---|---|---|---|---|---|
| 286.177 | QP | 57.9 | 13.1 | 0.6 | -30.4 | 41.2 | 46 | 4.8 | Pass |
| 298.011 | PK | 60.5 | 13.4 | 0.6 | -30.5 | 44 | 46 | 2 | Pass |
| 279.193 | PK | 60.7 | 12.8 | 0.6 | -30.4 | 43.7 | 46 | 2.3 | Pass |
| 311.591 | PK | 58.5 | 14.1 | 0.6 | -30.4 | 42.8 | 46 | 3.2 | Pass |
| 276.768 | PK | 59 | 12.8 | 0.6 | -30.4 | 42 | 46 | 4 | Pass |
| 351.749 | PK | 55 | 15.3 | 0.6 | -30.4 | 40.5 | 46 | 5.5 | Pass |

Low, medium and high channel were investigated, Worst case results presented above (low channel)

Average / Peak above 1 GHz

Note 1: 2390 MHz was worst-case emission between 2300 MHz and 2390 MHz.

| Low Channel (11 – 2405) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Test Frequency (MHz)** | **Detection mode** | **Antenna polarity (Horz/Vert)** | **Raw signal dB(µV)** | **Antenna factor dB** | **Cable loss dB + Preselecor** | **Attenuator dB** | **Pre-Amp Gain dB** | **Received signal dB(µV/m)** | **Emission limit dB(µV/m) 2** | **Margin dB(µV)** | **Result** |
| 1796.9 | Peak | Horz | 48.3 | 30.6 | 2.2 | 10.0 | 36.2 | 54.9 | 20 dBc | | PASS |
| 1796.9 | Peak | Vert | 65.2 | 30.6 | 2.2 | 10.0 | 36.2 | 71.8 | 20 dBc | | PASS |
| 2113.5 | Peak | Horz | 82.4 | 30.6 | 2.2 | 10.0 | 36.2 | 89.0 | 20 dBc | | PASS |
| 2113.5 | Peak | Vert | 93.2 | 30.6 | 2.2 | 10.0 | 36.2 | 99.8 | 20 dBc | | PASS |
| 2405 | Peak | Horz | 103.4 | 30.6 | 2.2 | 10.0 | 36.2 | 110.0 | | | PASS |
| 2405 | Avg | Horz | 68.7 | 30.6 | 2.2 | 10.0 | 36.2 | 75.3 | | | PASS |
| 2405 | Peak | Vert | 114.1 | 30.6 | 2.2 | 10.0 | 36.2 | 120.7 | | | PASS |
| 2405 | Avg | Vert | 70.6 | 30.6 | 2.2 | 10.0 | 36.2 | 77.2 | | | PASS |
| 2390 | Peak | Horz | 52.5 | 30.6 | 2.2 | 10.0 | 36.2 | 59.1 | 74.0 | 14.9 | PASS |
| 2390 | Avg | Horz | 40.0 | 30.6 | 2.2 | 10.0 | 36.2 | 46.6 | 54.0 | 7.4 | PASS |
| 2390 | Peak | Vert | 63.3 | 30.6 | 2.2 | 10.0 | 36.2 | 69.9 | 74.0 | 4.1 | PASS |
| 2390 | Avg | Vert | 40.0 | 30.6 | 2.2 | 10.0 | 36.2 | 46.6 | 54.0 | 7.4 | PASS |
| 4182.8 | Peak | Horz | 53.4 | 33.7 | 2.9 | 0.0 | 35.7 | 54.3 | 74.0 | 19.7 | PASS |
| 4182.8 | Avg | Horz | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4182.8 | Peak | Vert | 64.0 | 33.7 | 2.9 | 0.0 | 35.7 | 64.9 | 74.0 | 9.1 | PASS |
| 4182.8 | Avg | Vert | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4495.8 | Peak | Horz | 48.7 | 33.7 | 2.9 | 0.0 | 35.7 | 49.6 | 74.0 | 24.4 | PASS |
| 4495.8 | Avg | Horz | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4495.8 | Peak | Vert | 59.0 | 33.7 | 2.9 | 0.0 | 35.7 | 59.9 | 74.0 | 14.1 | PASS |
| 4495.8 | Avg | Vert | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4810 | Peak | Horz | 56.0 | 33.7 | 2.9 | 0.0 | 35.7 | 56.9 | 74.0 | 17.1 | PASS |
| 4810 | Avg | Horz | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4810 | Peak | Vert | 66.6 | 33.7 | 2.9 | 0.0 | 35.7 | 67.5 | 74.0 | 6.5 | PASS |
| 4810 | Avg | Vert | 42.5 | 33.7 | 2.9 | 0.0 | 35.7 | 43.4 | 54.0 | 10.6 | PASS |
| 7215 | Peak | Vert | 50.1 | 37.9 | 4.3 | 0.0 | 35.9 | 56.4 | 74.0 | 17.6 | PASS |
| 7215 | Avg | Vert | 40.0 | 37.9 | 4.3 | 0.0 | 35.9 | 46.3 | 54.0 | 7.7 | PASS |
| 7215 | Peak | Horz | 40.0 | 37.9 | 4.3 | 0.0 | 35.9 | 46.3 | 74.0 | 27.7 | PASS |
| 7215 | Avg | Horz | 40.0 | 37.9 | 4.3 | 0.0 | 35.9 | 46.3 | 54.0 | 7.7 | PASS |
| 9620 | Peak | Horz | 40.0 | 39.2 | 5.8 | 0.0 | 35.9 | 49.1 | 74.0 | 24.9 | PASS |
| 9620 | Avg | Horz | 40.0 | 39.2 | 5.8 | 0.0 | 35.9 | 49.1 | 54.0 | 4.9 | PASS |
| 9620 | Peak | Vert | 49.1 | 39.2 | 5.8 | 0.0 | 35.9 | 58.2 | 74.0 | 15.8 | PASS |

| Mid Channel (18 – 2440) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Test Frequency (MHz)** | **Detection mode** | **Antenna polarity (Horz/Vert)** | **Raw signal dB(µV)** | **Antenna factor dB** | **Cable loss dB + Preselecor** | **Attenuator dB** | **Pre-Amp Gain dB** | **Received signal dB(µV/m)** | **Emission limit dB(µV/m) 2** | **Margin dB(µV)** | **Result** |
| 1730 | Peak | Horz | 46.5 | 30.6 | 2.2 | 10.0 | 36.2 | 53.1 | 20 dBc | | PASS |
| 1730 | Avg | Horz | | 30.6 | 2.2 | 10.0 | 36.2 | 6.6 | N/A | | PASS |
| 1730 | Peak | Vert | 64.9 | 30.6 | 2.2 | 10.0 | 36.2 | 71.5 | 20dBc | | PASS |
| 1730 | Avg | Vert | | 30.6 | 2.2 | 10.0 | 36.2 | 6.6 | N/A | | PASS |
| 2098 | Peak | Horz | 81.6 | 30.6 | 2.2 | 10.0 | 36.2 | 88.2 | 20dBc | | PASS |
| 2098 | Avg | Horz | | 30.6 | 2.2 | 10.0 | 36.2 | 6.6 | N/A | | PASS |
| 2098 | Peak | Vert | 91.6 | 30.6 | 2.2 | 10.0 | 36.2 | 98.2 | 20dBc | | PASS |
| 2098 | Avg | Vert | | 30.6 | 2.2 | 10.0 | 36.2 | 6.6 | N/A | | PASS |
| 2440 | Peak | Horz | 103.1 | 30.6 | 2.2 | 10.0 | 36.2 | 109.7 | | | PASS |
| 2440 | Avg | Horz | 68.3 | 30.6 | 2.2 | 10.0 | 36.2 | 74.9 | | | PASS |
| 2440 | Peak | Vert | 112.2 | 30.6 | 2.2 | 10.0 | 36.2 | 118.8 | | | PASS |
| 2440 | Avg | Vert | 70.1 | 30.6 | 2.2 | 10.0 | 36.2 | 76.7 | | | PASS |
| 4169.6 | Peak | Horz | 53.4 | 33.7 | 2.9 | 0.0 | 35.7 | 54.3 | 74.0 | 19.7 | PASS |
| 4169.6 | Avg | Horz | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4169.6 | Peak | Vert | 63.0 | 33.7 | 2.9 | 0.0 | 35.7 | 63.9 | 74.0 | 10.1 | PASS |
| 4182.8 | Avg | Vert | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4526 | Peak | Horz | 47.2 | 33.7 | 2.9 | 0.0 | 35.7 | 48.1 | 74.0 | 25.9 | PASS |
| 4526 | Avg | Horz | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4526 | Peak | Vert | 57.5 | 33.7 | 2.9 | 0.0 | 35.7 | 58.4 | 74.0 | 15.6 | PASS |
| 4526 | Avg | Vert | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4880 | Peak | Horz | 54.5 | 33.7 | 2.9 | 0.0 | 35.7 | 55.4 | 74.0 | 18.6 | PASS |
| 4880 | Avg | Horz | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4880 | Peak | Vert | 65.8 | 33.7 | 2.9 | 0.0 | 35.7 | 66.7 | 74.0 | 7.3 | PASS |
| 4880 | Avg | Vert | 41.4 | 33.7 | 2.9 | 0.0 | 35.7 | 42.3 | 54.0 | 11.7 | PASS |
| 7320 | Peak | Vert | 48.2 | 37.9 | 4.3 | 0.0 | 35.9 | 54.5 | 74.0 | 19.5 | PASS |
| 7320 | Avg | Vert | 40.0 | 37.9 | 4.3 | 0.0 | 35.9 | 46.3 | 54.0 | 7.7 | PASS |
| 7320 | Peak | Horz | 40.0 | 37.9 | 4.3 | 0.0 | 35.9 | 46.3 | 74.0 | 27.7 | PASS |
| 7320 | Avg | Horz | 40.0 | 37.9 | 4.3 | 0.0 | 35.9 | 46.3 | 54.0 | 7.7 | PASS |
| 9760 | Peak | Horz | 40.0 | 39.2 | 5.8 | 0.0 | 35.9 | 49.1 | 74.0 | 24.9 | PASS |
| 9760 | Avg | Horz | 40.0 | 39.2 | 5.8 | 0.0 | 35.9 | 49.1 | 54.0 | 4.9 | PASS |
| 9760 | Peak | Vert | 48.1 | 39.2 | 5.8 | 0.0 | 35.9 | 57.2 | 74.0 | 16.8 | PASS |

| High Channel (30 – 2480) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Test Frequency (MHz)** | **Detection mode** | **Antenna polarity (Horz/Vert)** | **Raw signal dB(µV)** | **Antenna factor dB** | **Cable loss dB + Preselecor** | **Attenuator dB** | **Pre-Amp Gain dB** | **Received signal dB(µV/m)** | **Emission limit dB(µV/m) 2** | **Margin dB(µV)** | **Result** |
| 1703 | Peak | Horz | 46.4 | 30.6 | 2.2 | 10.0 | 36.2 | 53.0 | 74.0 | 21.0 | PASS |
| 1703 | Avg | Horz | 40.0 | 30.6 | 2.2 | 10.0 | 36.2 | 46.6 | 54.0 | 7.4 | PASS |
| 1703 | Peak | Vert | 62.3 | 30.6 | 2.2 | 10.0 | 36.2 | 68.9 | 74.0 | 5.1 | PASS |
| 1703 | Avg | Vert | 40.0 | 30.6 | 2.2 | 10.0 | 36.2 | 46.6 | 54.0 | 7.4 | PASS |
| 2092 | Peak | Horz | 80.9 | 30.6 | 2.2 | 10.0 | 36.2 | 87.5 | 20dBc | | PASS |
| 2092 | Peak | Vert | 92.0 | 30.6 | 2.2 | 10.0 | 36.2 | 98.6 | 20dBc | | PASS |
| 2480 | Peak | Horz | 101.1 | 30.6 | 2.2 | 10.0 | 36.2 | 107.7 | | | PASS |
| 2480 | Avg | Horz | 67.3 | 30.6 | 2.2 | 10.0 | 36.2 | 73.9 | | | PASS |
| 2480 | Peak | Vert | 111.2 | 30.6 | 2.2 | 10.0 | 36.2 | 117.8 | | | PASS |
| 2480 | Avg | Vert | 68.3 | 30.6 | 2.2 | 10.0 | 36.2 | 74.9 | | | PASS |
| 4182.4 | Peak | Horz | 51.1 | 33.7 | 2.9 | 0.0 | 35.7 | 52.0 | 74.0 | 22.0 | PASS |
| 4182.4 | Avg | Horz | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4182.4 | Peak | Vert | 61.8 | 33.7 | 2.9 | 0.0 | 35.7 | 62.7 | 74.0 | 11.3 | PASS |
| 4182.4 | Avg | Vert | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4569 | Peak | Horz | 46.4 | 33.7 | 2.9 | 0.0 | 35.7 | 47.3 | 74.0 | 26.7 | PASS |
| 4569 | Avg | Horz | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4569 | Peak | Vert | 57.0 | 33.7 | 2.9 | 0.0 | 35.7 | 57.9 | 74.0 | 16.1 | PASS |
| 4569 | Avg | Vert | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4960 | Peak | Horz | 53.1 | 33.7 | 2.9 | 0.0 | 35.7 | 54.0 | 74.0 | 20.0 | PASS |
| 4960 | Avg | Horz | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 4960 | Peak | Vert | 63.6 | 33.7 | 2.9 | 0.0 | 35.7 | 64.5 | 74.0 | 9.5 | PASS |
| 4960 | Avg | Vert | 40.0 | 33.7 | 2.9 | 0.0 | 35.7 | 40.9 | 54.0 | 13.1 | PASS |
| 7440 | Peak | Vert | 47.5 | 37.9 | 4.3 | 0.0 | 35.9 | 53.8 | 74.0 | 20.2 | PASS |
| 7440 | Avg | Vert | 40.0 | 37.9 | 4.3 | 0.0 | 35.9 | 46.3 | 54.0 | 7.7 | PASS |
| 7440 | Peak | Horz | 40.0 | 37.9 | 4.3 | 0.0 | 35.9 | 46.3 | 74.0 | 27.7 | PASS |
| 7440 | Avg | Horz | 40.0 | 37.9 | 4.3 | 0.0 | 35.9 | 46.3 | 54.0 | 7.7 | PASS |
| 9920 | Peak | Horz | 40.0 | 39.2 | 5.8 | 0.0 | 35.9 | 49.1 | 74.0 | 24.9 | PASS |
| 9920 | Avg | Horz | 40.0 | 39.2 | 5.8 | 0.0 | 35.9 | 49.1 | 54.0 | 4.9 | PASS |
| 9920 | Peak | Vert | 47.8 | 39.2 | 5.8 | 0.0 | 35.9 | 56.9 | 74.0 | 17.1 | PASS |
| 9920 | Avg | Vert | 40.0 | 39.2 | 5.8 | 0.0 | 35.9 | 49.1 | 54.0 | 4.9 | PASS |

Note 1: Out of band measurements obtained above the 15.209 limit were evaluated if they listed as a restricted band in 15.205. If not in a restricted band, the limit of '20 dBc' applies as per 15.247.

Note 2: Frequency was scanned to 25 GHz.

Note 3: 2390 MHz was worst-case emission between 2300 MHz and 2390 MHz.

## Test Equipment List

| Equipment | Model No. | Manufacturer | Last calibration date | Next calibration due date | Asset # |
|---|---|---|---|---|---|
| Loop Antenna | EM 6871 | Electro-Metrics | 2011-01-31 | 2013-01-31 | 70 |
| Loop Antenna | EM 6872 | Electro-Metrics | 2011-01-31 | 2013-01-31 | 71 |
| Spectrum Analyzer | ESL6 | Rohde & Schwarz | 26-Oct-11 | 26-Oct-13 | 160 |
| Quasi Peak Adapter | 85650A | HP | 2011-12-21 | 2013-12-21 | 7 |
| Spectrum Analyzer | 8566B | HP | 21-Dec-11 | 21-Dec-13 | 141 |
| BiLog Antenna | 3142-C | ETS | 17-Jan-11 | 17-Jan-13 | GEMC 137 |
| Attenuator 3 dB | FP-50-3 | Trilithic | NCR | NCR | GEMC 40 |
| Chase Preamp 9kHz - 2 GHz | CPA9231A | Chase | 8/25/2010 | 8/25/2012 | GEMC 6403 |
| Q-Par 1.5-18 GHz Horn | 6878/24 | Q-par | 8/25/2010 | 8/25/2012 | GEMC 65 |
| A.H. Systems Horn Antenna 18 GHz - 26.5 GHz | SAS-572 | AH | On file | 8/25/2012 | GEMC 6371 |
| 1-26G pre-amp | HP 8449B | HP | 8/25/2010 | 8/25/2012 | GEMC 68 |
| RF Cable 7m | LMR-400-7M-50OHM-MN-MN | LexTec | NCR | NCR | GEMC 28 |
| RF Cable 1m | LMR-400-1M-50OHM-MN-MN | LexTec | NCR | NCR | GEMC 29 |
| RF Cable 0.5M | LMR-400-0.5M-50OHM-MN-MN | LexTec | NCR | NCR | GEMC 31 |

**This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions_Rev1.doc"**

## *6dB Bandwidth of Digitally Modulated Systems*

### Purpose

The purpose of this test is to ensure that the bandwidth occupied exceeds a stated minimum. This helps ensure the utilization of the frequency allocation is sufficiently wide. This also helps prevent corruption of data by ensuring adequate data separation to distinguish the reception of the intended information.

### Limits

The Limit is as specified in FCC Part 15 and RSS 210.

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz. This should be measured with a 100 kHz RBW and a 300 kHz VBW.

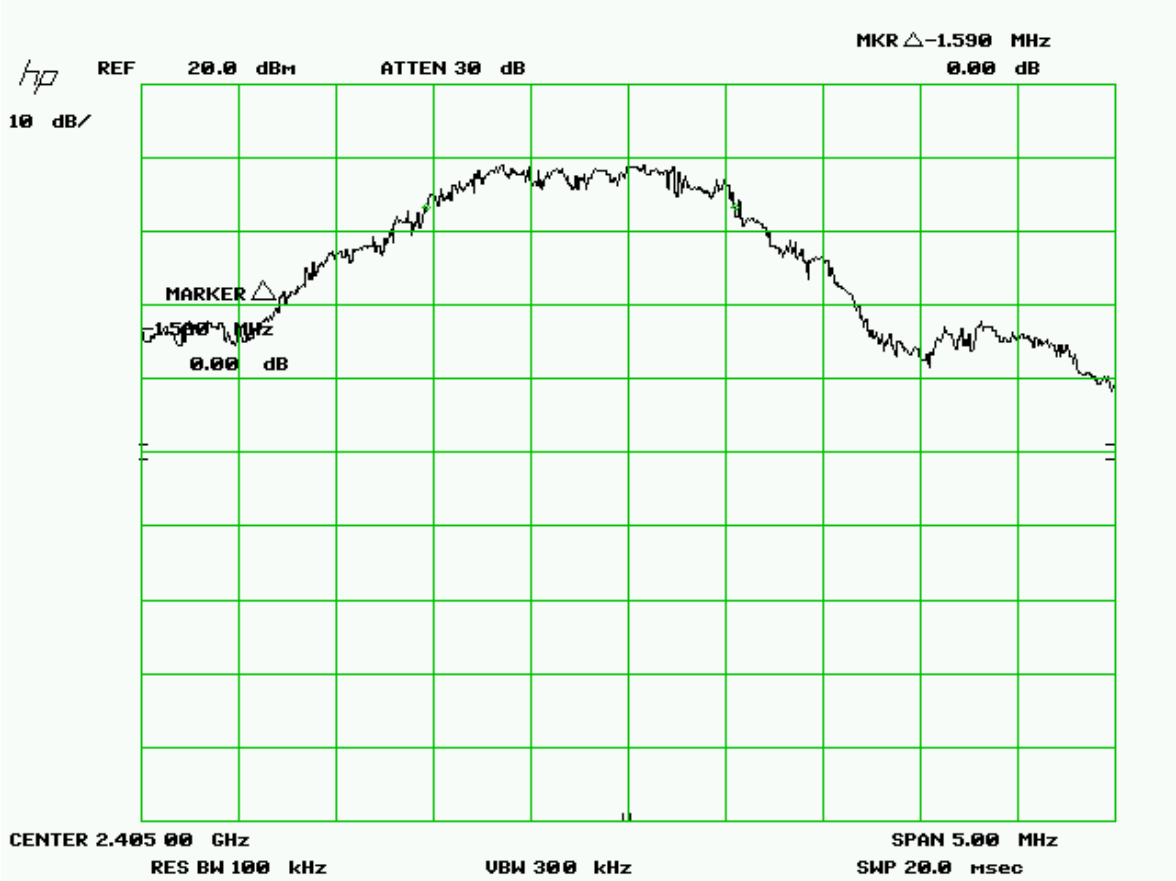
### Results

The EUT passed. The minimum 6 dB BW measured was 1.59 MHz

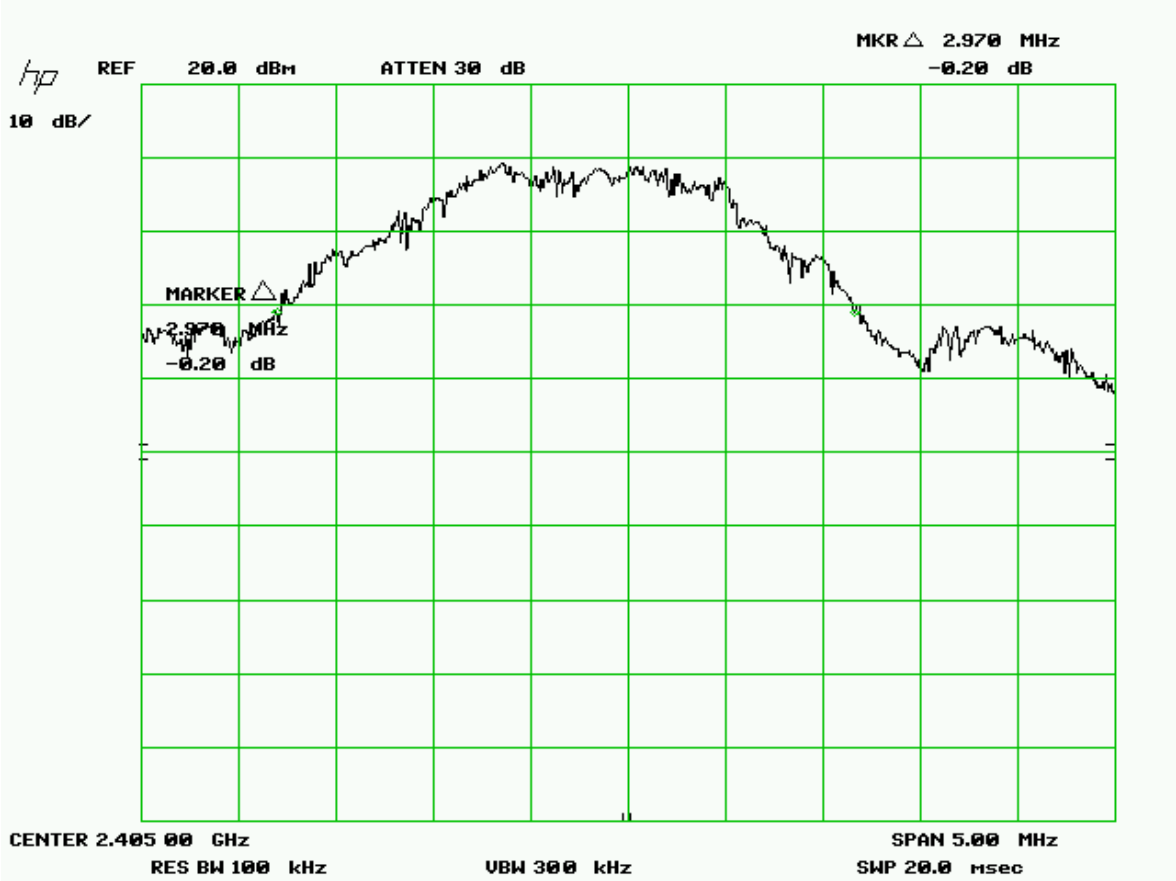
## Graph(s)

The graphs shown below shows the channel spacing during the operation of the device. This is measured by a max hold on the spectrum analyzer and the highest resolution bandwidth that is sufficiently low to exhibit the 6 dB bandwidth of a channel during operation of the EUT. This measurement is a peak measurement. Max hold is performed for a duration of not less then 1 minute.

Test Graph




6 dB BW = 1.59 MHz




20 dB BW = 2.97 MHz

Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

## Test Equipment List

| Equipment | Model No. | Manufacturer | Last calibration date | Next calibration due date | Asset # |
|---|---|---|---|---|---|
| Attenuator 20 dB | FP-50-20 | Trilithic | NCR | NCR | GEMC 43 |
| Spectrum Analyzer | 8566B | HP | 21-Dec-11 | 21-Dec-13 | 141 |
| RF Cable 1m | LMR-400-1M-50OHM-MN-MN | LexTec | NCR | NCR | GEMC 29 |
| Power Attenuator 20 dB | 25-A-FFN-20 | Bird / Hutton | NCR | NCR | GEMC 49 |

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

## *Maximum Peak Envelope Conducted Power - DM*

### Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element does not exceed the limits specified. This ensures that if the end-user replaces the antenna, that the maximum power does not exceed an amount which may create an an excessive power level.

### Limits

The limits are defined in FCC Part 15.247(b) and RSS 210.
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands, the peak limit is 1 watt.

### Results

The EUT passed. The peak power measured was 24.2 dBm.

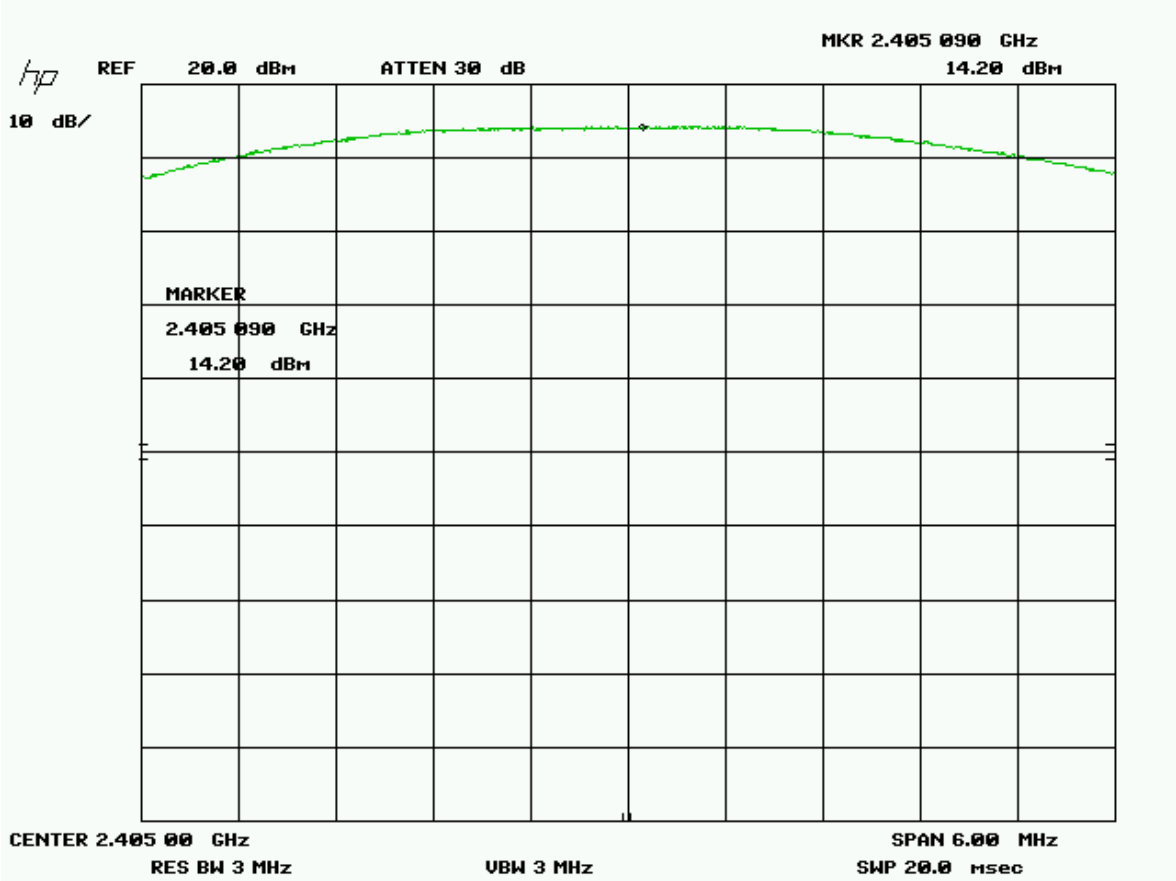
## Table(s)

The tables shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT.

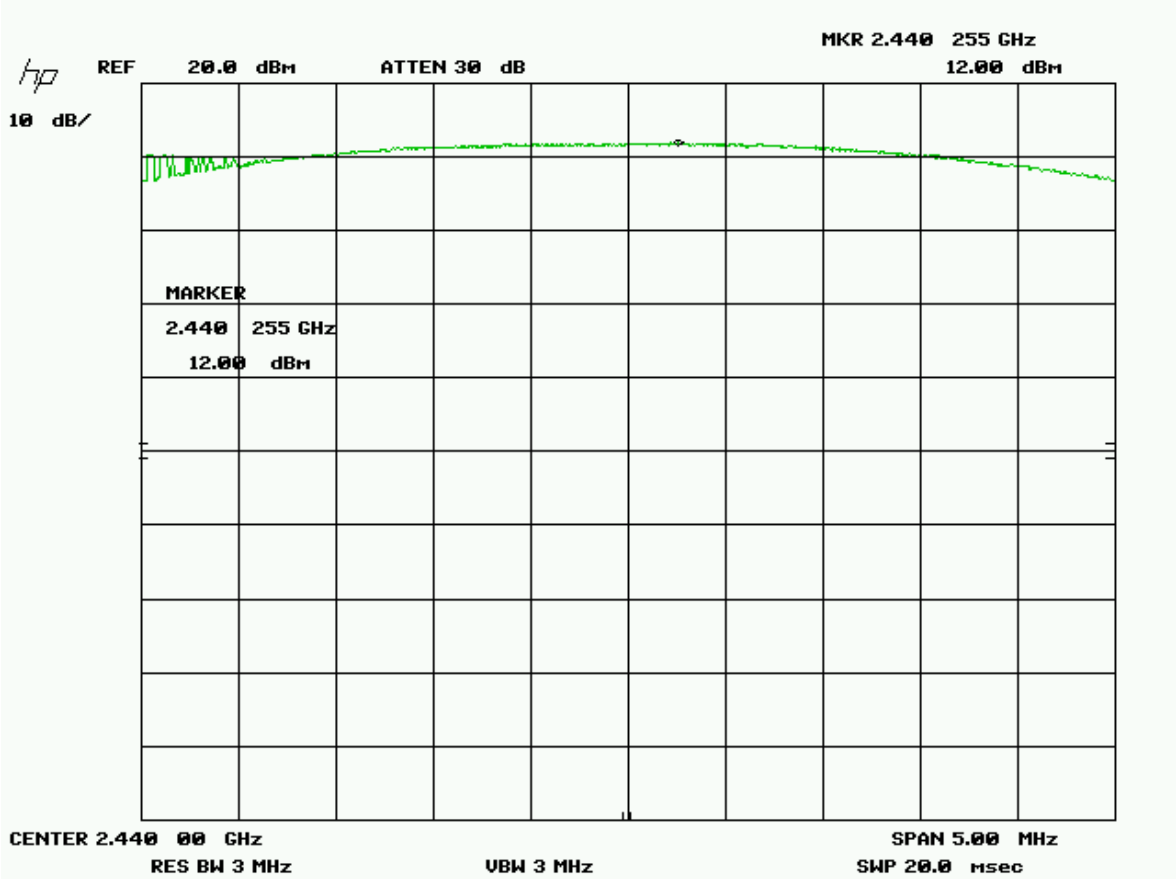
| Band | Channel | Frequency (GHz) | Reading (dBm) |
|---|---|---|---|
| Low | 11 | 2405 | 24.2 |
| Medium | 18 | 2440 | 22.0 |
| High | 26 | 2480 | 20.4 |

Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

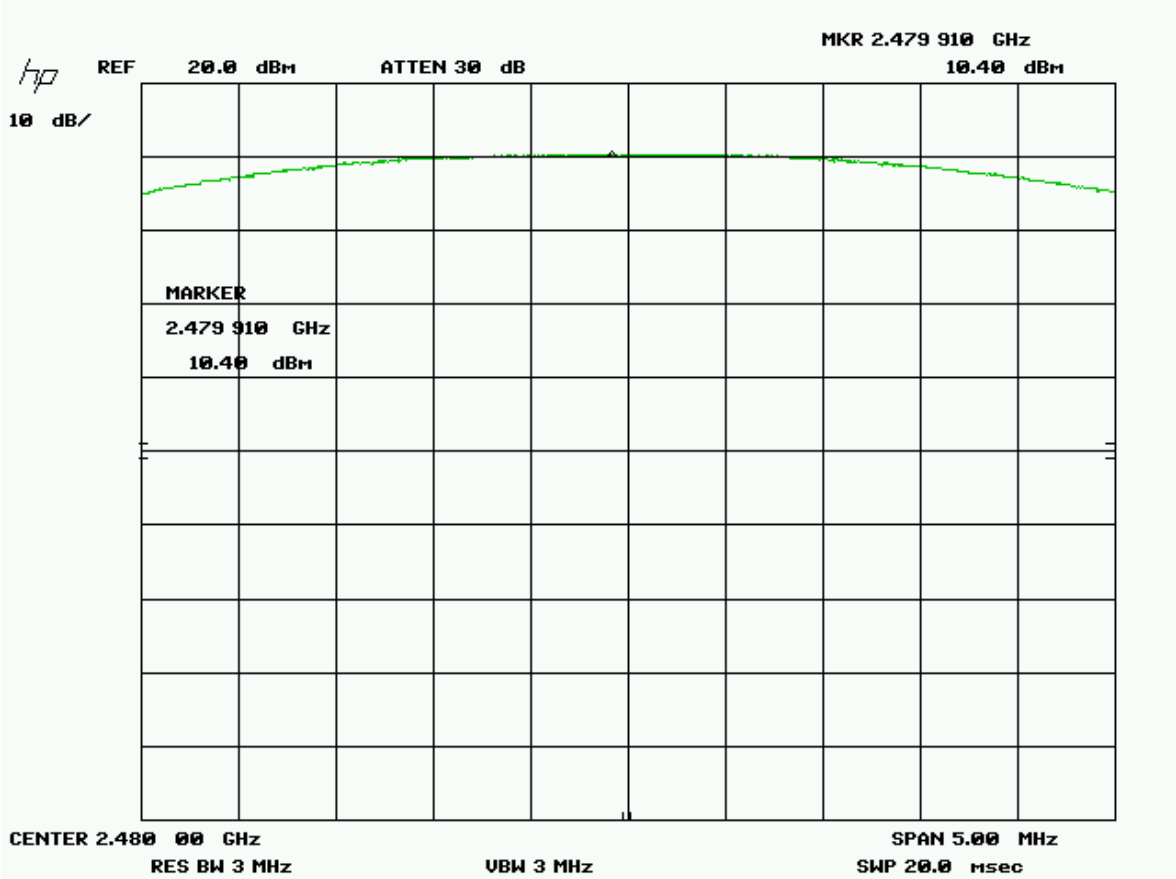
Low



Middle



high



## Test Equipment List

| Equipment | Model No. | Manufacturer | Last calibration date | Next calibration due date | Asset # |
|---|---|---|---|---|---|
| Spectrum Analyzer | 8566B | HP | 21-Dec-11 | 21-Dec-13 | 141 |
| Power Head | PH 2000 | AR | 2011-01-31 | 2013-01-31 | GEMC 15 |
| Power meter | PM 2002 | AR | 2011-01-31 | 2013-01-31 | GEMC 16 |
| RF Cable 1m | LMR-400-1M-50OHM-MN-MN | LexTec | NCR | NCR | GEMC 29 |
| Power Attenuator 20 dB | 25-A-FFN-20 | Bird / Hutton | NCR | NCR | GEMC 49 |

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"