# Global EMC Inc. Labs

# EMC & RF Test Report

As per

## RSS 210 Issue 7:2007

## &

## FCC Part 15 Subpart C:2010

## Unlicensed Intentional Radiators

on the

## VTR7355A5500W

## Terminal Equipment Controller


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Testing produced for


See Appendix A for full customer & EUT details.

Industry Canada
**LAB REGISTRATION #6844A-1**

CE

**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 VTR7355A5500W  Terminal Equipment Controller, 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 7:2007 / 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 | **Viconics** |
| Product | VTR7355A5500W  Terminal Equipment Controller |
| Standard(s) | RSS 210 Issue 7:2007 / 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: | V95-VTR |
| EUT Industry Canada Certification #,  IC: | 7591A-VTR |
| EUT Passed all tests performed. | Yes (see test results summary) |
| Tests conducted by | Scott Drysdale |

| | |
|---|---|
| Client | **Viconics** |
| Product | VTR7355A5500W Terminal Equipment Controller |
| Standard(s) | RSS 210 Issue 7:2007 / 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 |
| 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<br>See Justifications |
| FCC 15.247(e)<br>RSS-210 A8.2(b) | Spectral Density | < 8 dBm<br>(3 kHz BW) | Pass<br>See Justifications |
| FCC 15.247(i)<br>IC Safety code 6 | Maximum Permissible Exposure | > 20 cm<br>separation. | Pass<br>See justification and calculations |
| **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. Note that 'PASS' / 'FAIL' grade is independent of any measurement uncertainties. A 'PASS' / 'FAIL' grade within measurement uncertainty is marked with a '*'.

## *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 uses a PCB trace antenna with no provision for replacement.

For the Restricted Bands of operation, the EUT is designed to only operate between 2.4 GHz and 2.4835 GHz

For the Antenna gain, this device has a PCB trace antenna with less than 6 dBi gain.

For the Power Spectral Density requirement, this device was measured as having a peak power output significantly less than the 8 dBm requirement (-4 dBm) when measured using a resolution bandwidth much wider than 3 kHz and as was deemed to meet this requirement.

For maximum permissible exposure, this device operates at less then 1 Watt at 2.4 GHz and 2.4835 MHz and is designed to operate greater then 20 cm from personnel during normal operation. No testing is required, however worst case calculated exposure compliance follows later in this report.

## *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 |
| 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 |
| 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 210:2007 | - Issue 7: 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 - First Revision

Revision 2 - Data/references added as per TCB request.

# 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 | Init. | Temperature (ºC) | Humidity (%) | Pressure (kPa) |
|---|---|---|---|---|---|
| May 5-28 | All | SD | 20-25ºC | 30-65% | 100 -103kPa |

# Detailed Test Results Section

*Power Line Conducted Emissions*

## Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard, as measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio operators, maritime radio, CB radio, and so on, from unwanted interference.

## Limits & Method

The limits are as defined in 47 CFR FCC Part 15 Section 15.207
Method is as defined in ANSI C64:2003

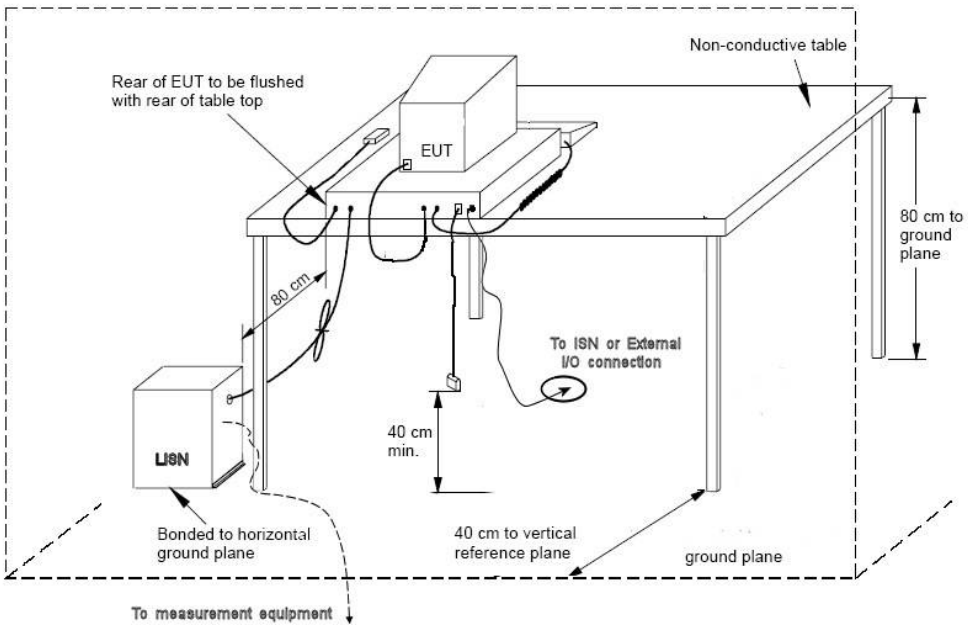
| Average Limits | | QuasiPeak Limits | |
|---|---|---|---|
| 150 kHz – 500 kHz | 56 to 46 dBuV | 150 kHz – 500 kHz | 66 to 56 dBuV |
| 500 kHz – 5 MHz | 46 dBuV | 500 kHz – 5 MHz | 56 dBuV |
| 5 MHz – 30 MHz | 50 dBuV | 500 kHz – 30 MHz | 60 dBuV |

The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

Note: If the Peak or Quasi Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

Both limits are applicable, and each is specified as being measured with a 9 kHz measurement bandwidth .

## Typical Setup Diagram




Note: The vertical reference plane is optional as per ANSI C63.4 section 5.2.2

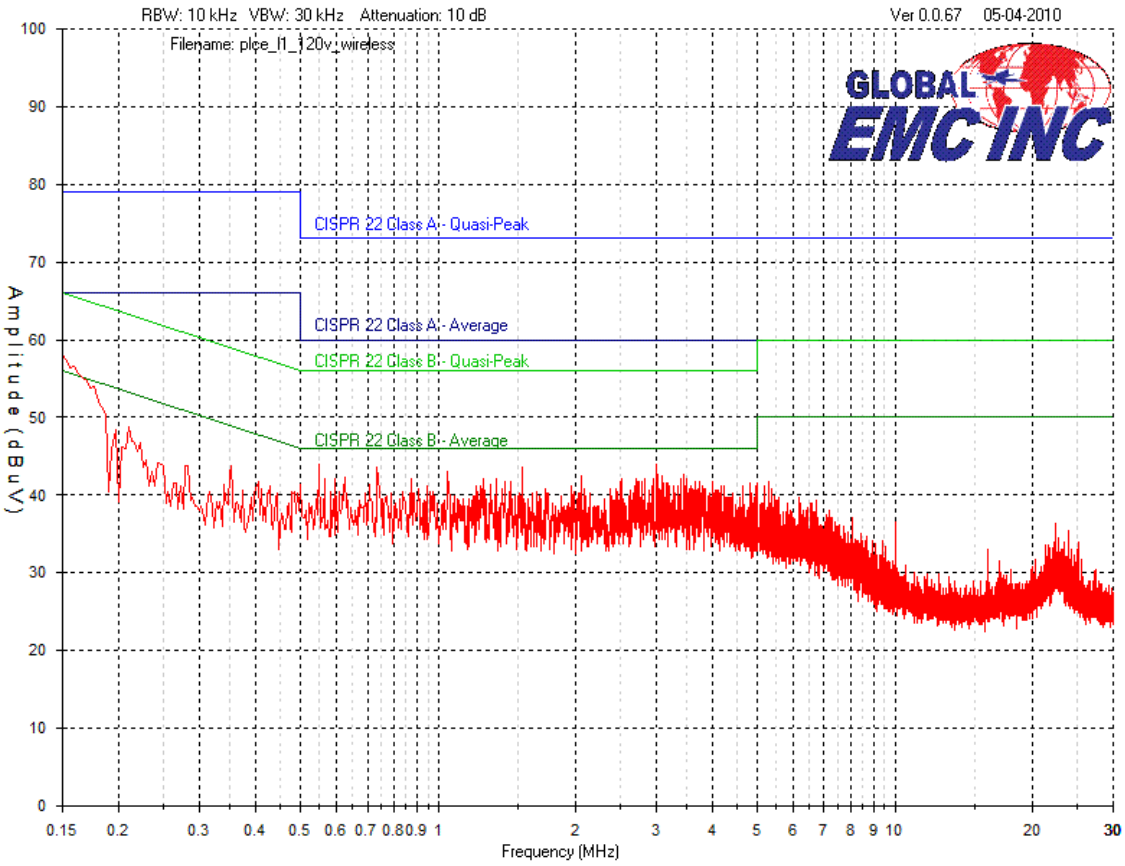
## Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-3.6 dB with a 'k=2' coverage factor and a 95% confidence level.

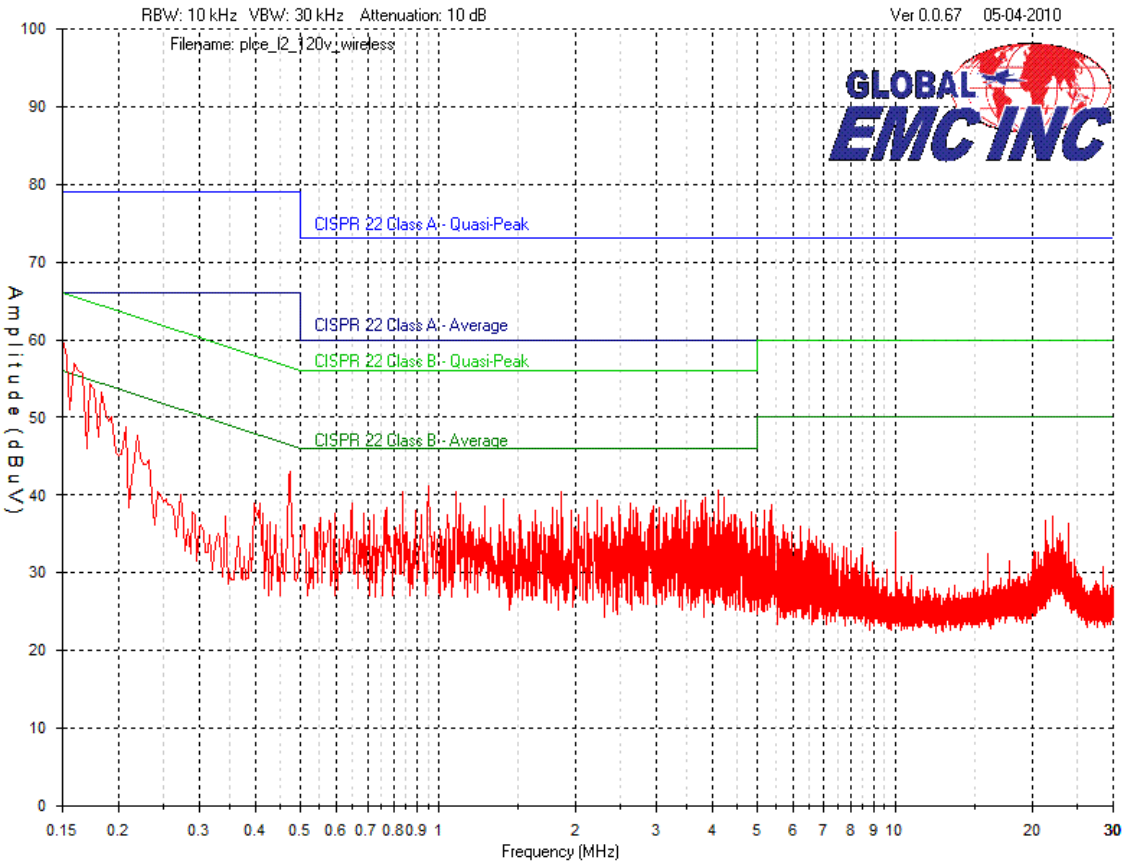
## Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector where applicable, please refer to the table. The graph shown below is a peak measurement graph, measured with a resolution bandwidth greater then or equal to the final required detector. These graphs are performed as a worst case measurement to enable the detection of frequencies of concern and for considerable time savings.

Phase (Black/Brown)



Neutral (White/Blue)



## Final Measurements

Line 1 – Phase (Black/Brown)

| Frequency (MHz) | Raw (dBuV) | Atten Factor (dB) | LISN Factor (dB) | Level (dBuV) | Limit (dB) | Margin (dB) | Pass/Fail |
|---|---|---|---|---|---|---|---|
| 0.15018 | 21 | 10 | 1.5 | 32.5 | 56 | 23.5 | Pass |
| 2.99095 | 15.1 | 10 | 0.2 | 25.3 | 46 | 20.7 | Pass |
| 0.56859 | 15.8 | 10 | 0.2 | 26 | 46 | 20 | Pass |
| 1.55229 | 14.5 | 10 | 0.2 | 24.7 | 46 | 21.3 | Pass |
| 0.72059 | 15.9 | 10 | 0.2 | 26.1 | 46 | 19.9 | Pass |
| 3.0145 | 15 | 10 | 0.2 | 25.2 | 46 | 20.8 | Pass |

Line 2 – Neutral (White/Blue)

| Frequency (MHz) | Raw (dBuV) | Atten Factor (dB) | LISN Factor (dB) | Level (dBuV) | Limit (dB) | Margin (dB) | Pass/Fail |
|---|---|---|---|---|---|---|---|
| 0.15021 | 16.8 | 10 | 1.5 | 28.3 | 56 | 27.7 | Pass |
| 0.16311 | 16.6 | 10 | 1.3 | 27.9 | 55.3 | 27.4 | Pass |
| 0.48796 | 9.7 | 10 | 0.2 | 19.9 | 46.2 | 26.3 | Pass |
| 0.95338 | 9.1 | 10 | 0.2 | 19.3 | 46 | 26.7 | Pass |
| 0.20893 | 17.7 | 10 | 0.9 | 28.6 | 53.2 | 24.6 | Pass |
| 4.08146 | 1 | 10 | 0.2 | 11.2 | 46 | 34.8 | Pass |

No peak emissions exceeded the quasi-peak limits, therefore the unit was deemed to meet the quasi-peak requirements based on the peak emissions. The tables above represent the peak emissions readings with respect to the average limit.

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

## Test Equipment List

| Equipment | Model No. | Manufacturer | Last calibration date | Next calibration due date | Asset # |
|---|---|---|---|---|---|
| IFR Spectrum Analyzer | AN940 | IFR | 12/29/2009 | 12/29/2011 | GEMC 6350 |
| LISN | FCC-LISN-50/250-16-2-01 | FCC | 2009-02-11 | 2011-02-11 | GEMC 65 |
| 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 |
| Attenuator 10 dB | FP-50-10 | Trilithic | NCR | NCR | GEMC 42 |

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

## *Spurious Radiated Emissions / 20 dBc Requirement*

### 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, as defined in 15.247(d) for unintentional radiated emissions apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

All unintentional emissions (including band edge) must also meet the requirements of -20 dBc or greater

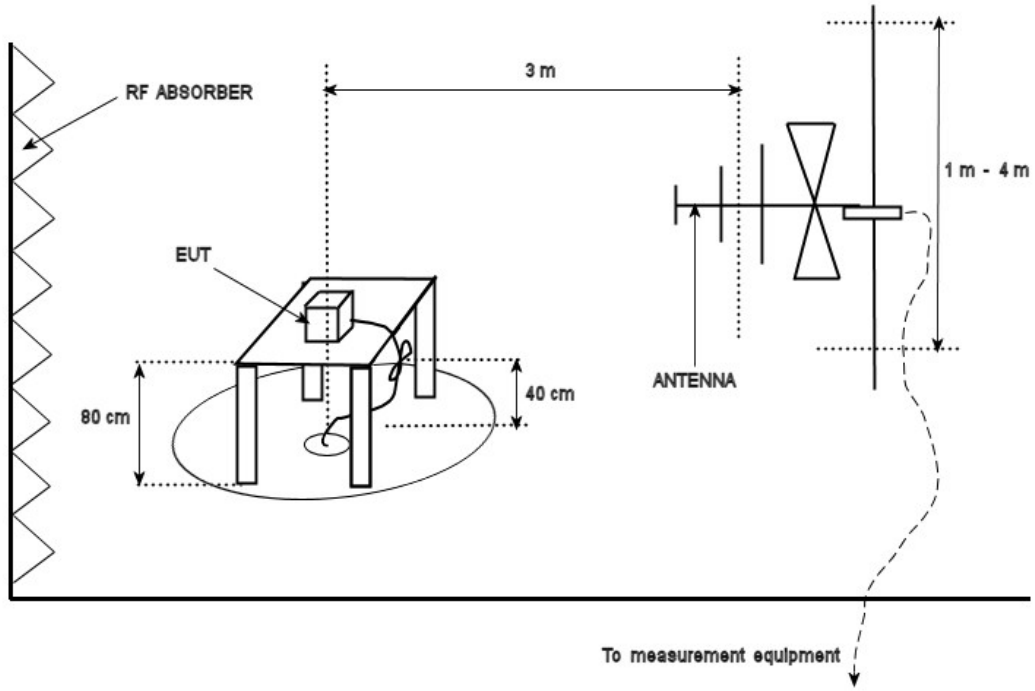
30 MHZ – 88 MHz, 100 uV/m (40.0 dBuV/m[1]) at 3 m
88 MHz – 216 MHz, 150 uV/m (43.5 dBuV/m[1]) at 3 m
216 MHz – 960 MHz, 200 uV/m (46.4 dBuV/m[1]) at 3 m
Above 960 MHz, 500 uV/m (54.0 dBuV/m[1]) at 3 m
Above 1000 MHz, 500 uV/m (54.0 dBuV/m[2]) at 3m

[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, scanned in accordance with 15.33 to above the 10th harmonic (25 GHz).

### Results

The EUT passed the limits. Low, middle and high band was measured. The worst case for each mode is presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band. The -20 dBc requirement is also shown for the higher band edge at 2.4835 GHz in the high band.

**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

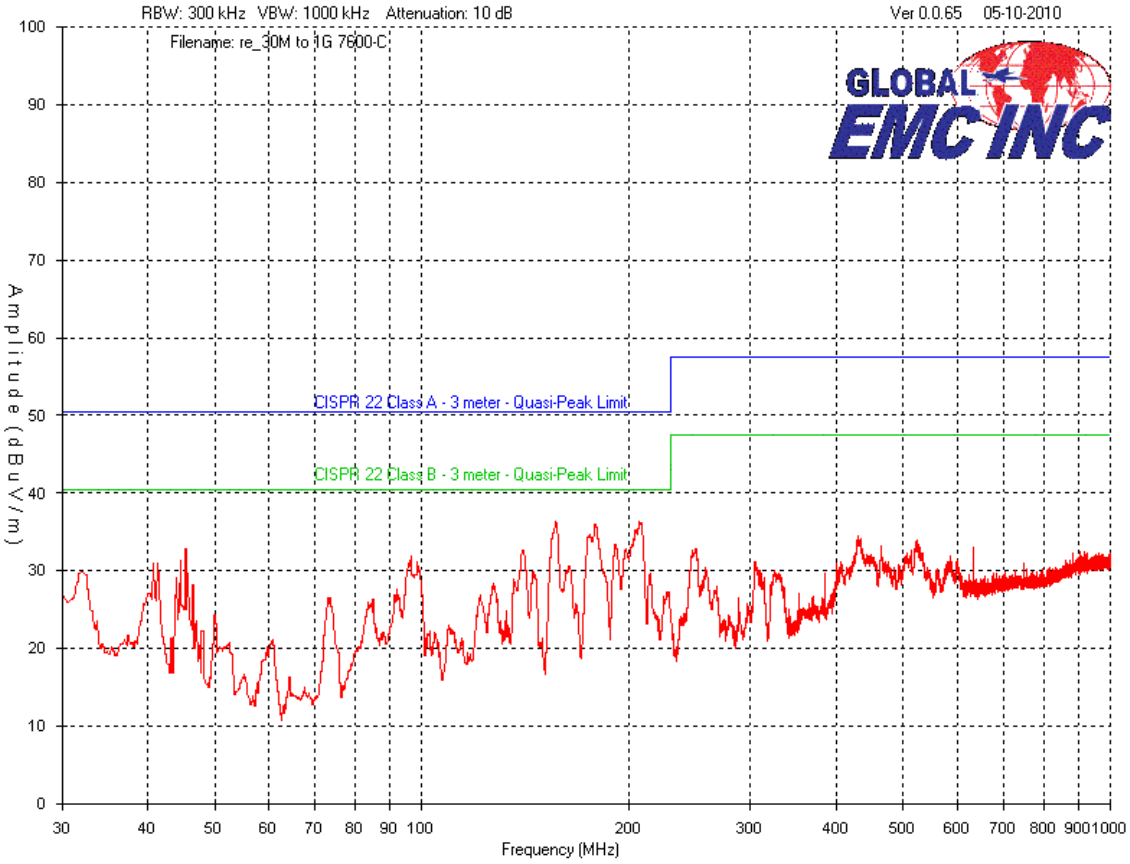
Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graph shown below is a maximized peak measurement graph, measured with a resolution bandwidth greater then the final 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.

The worst case or representative mode graphs are shown for 30 MHz to 2 GHz, however the device was scanned at low, middle, and high channel.

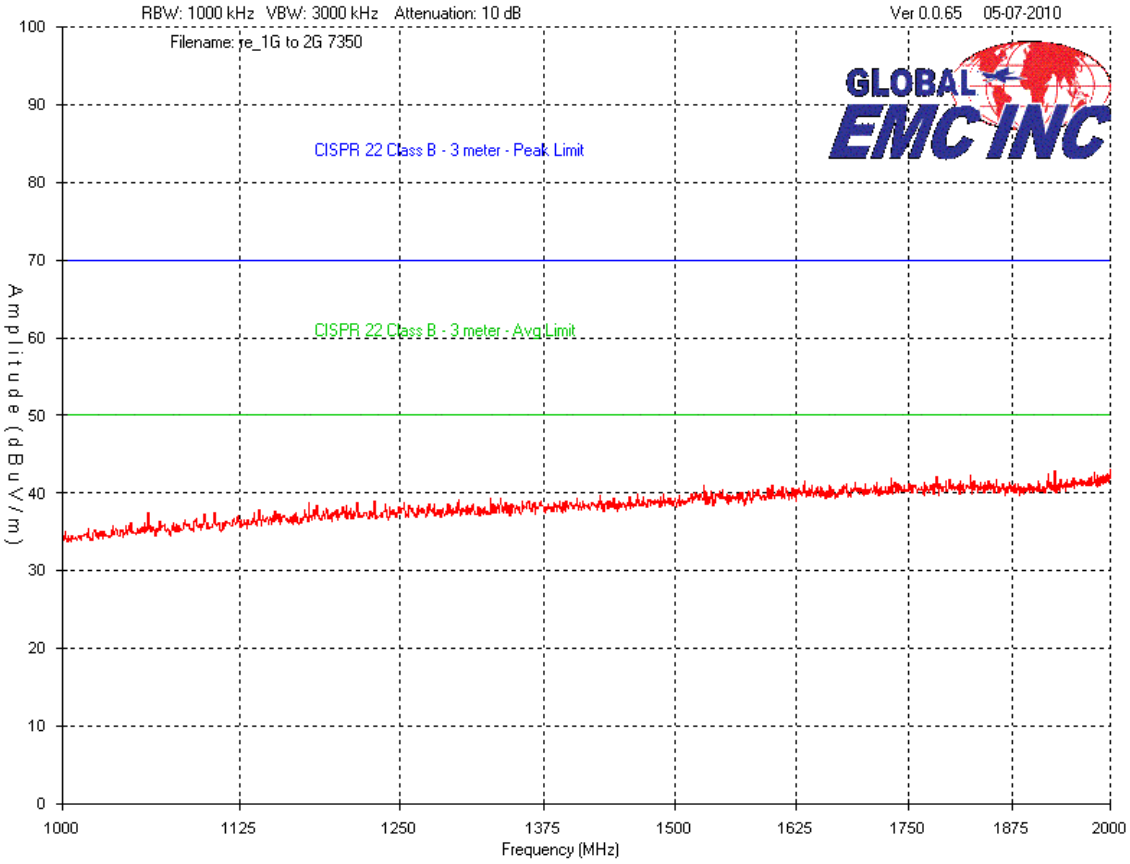
In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to a minimum of a 25 GHz.

The graphs shown below shows the peak power output of the device during the radiated measurement at 300 kHz bandwidth during transmit operation of the EUT from 30 MHz – 1 GHz, since the RBW used is greater than the value required by the standard (100 kHz) this is a worst case reading and still complied with the limits. None of the spurious exceeded the 70.9 dbuV/m limit (-20dbc from max reading of 90.9 dbuV/m).

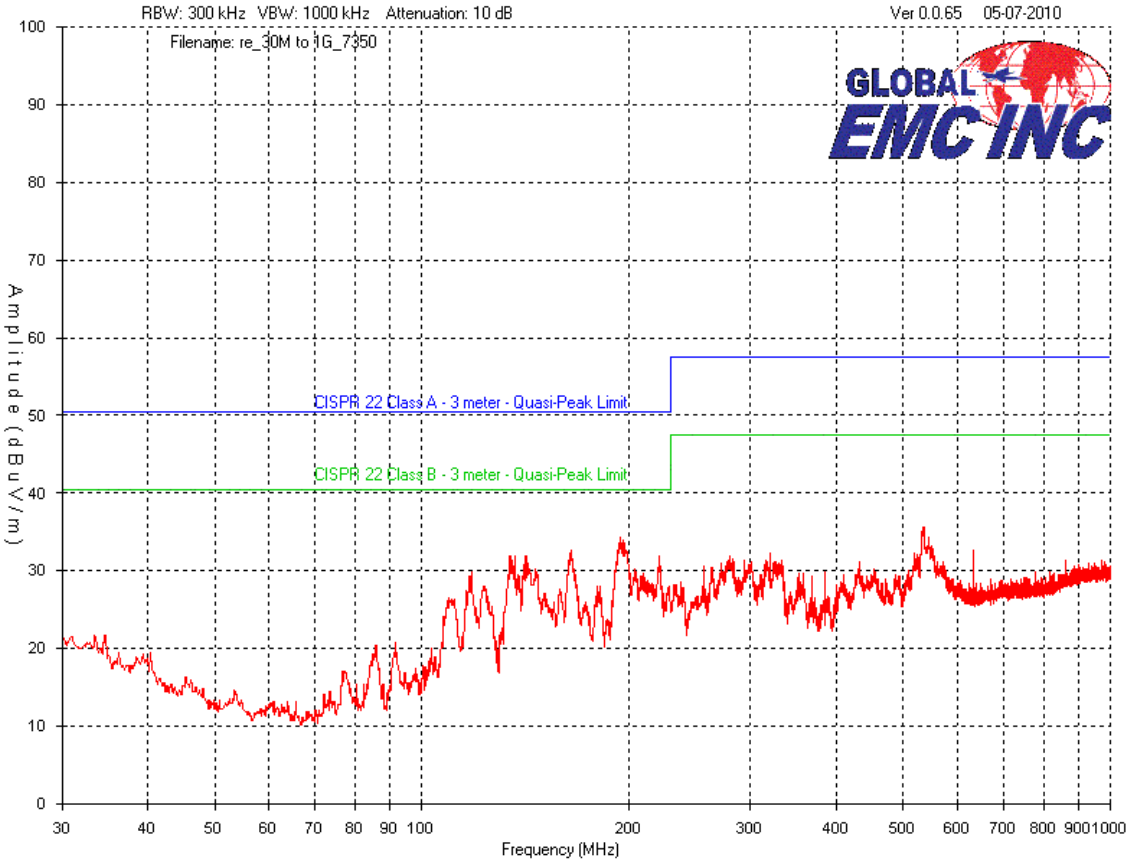
Vertical – Peak Emissions Graph – Mid channel (worst case 30 M – 1 GHz)



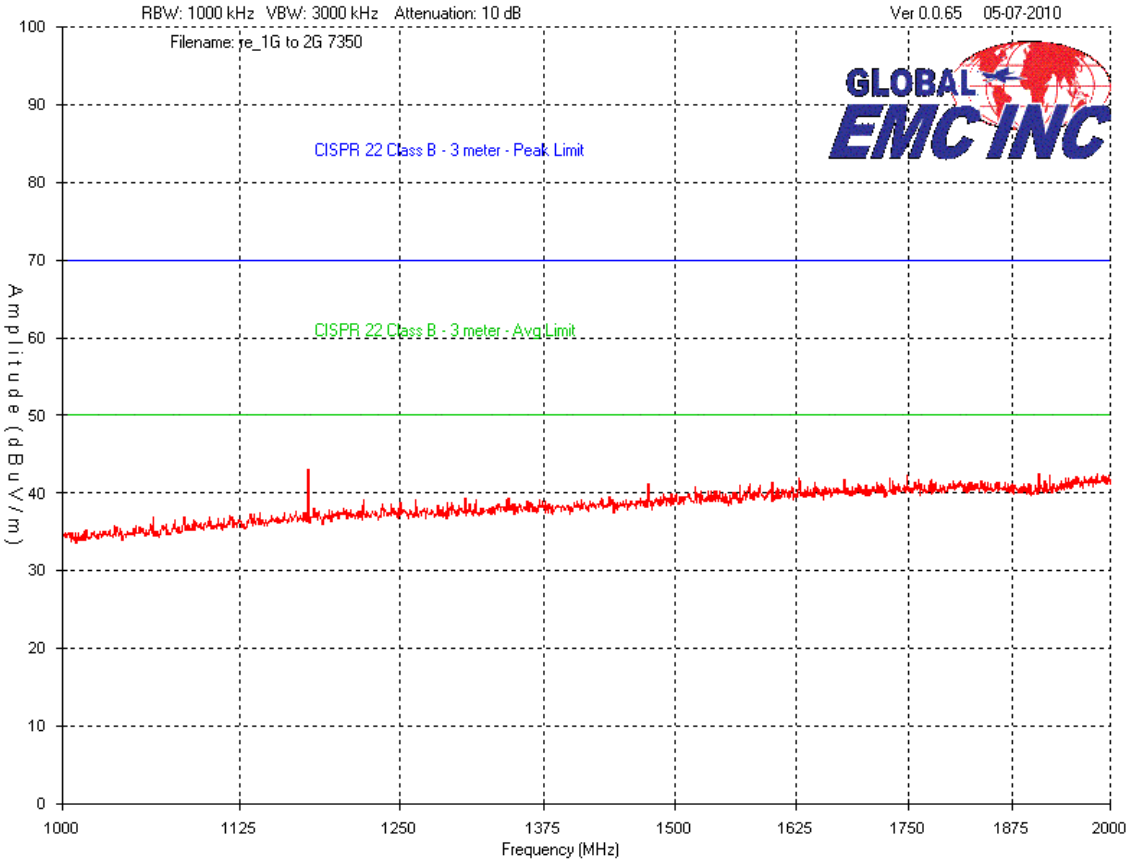
Vertical – Peak Emissions Graph – Mid channel (worst case 1 GHz – 2 GHz)



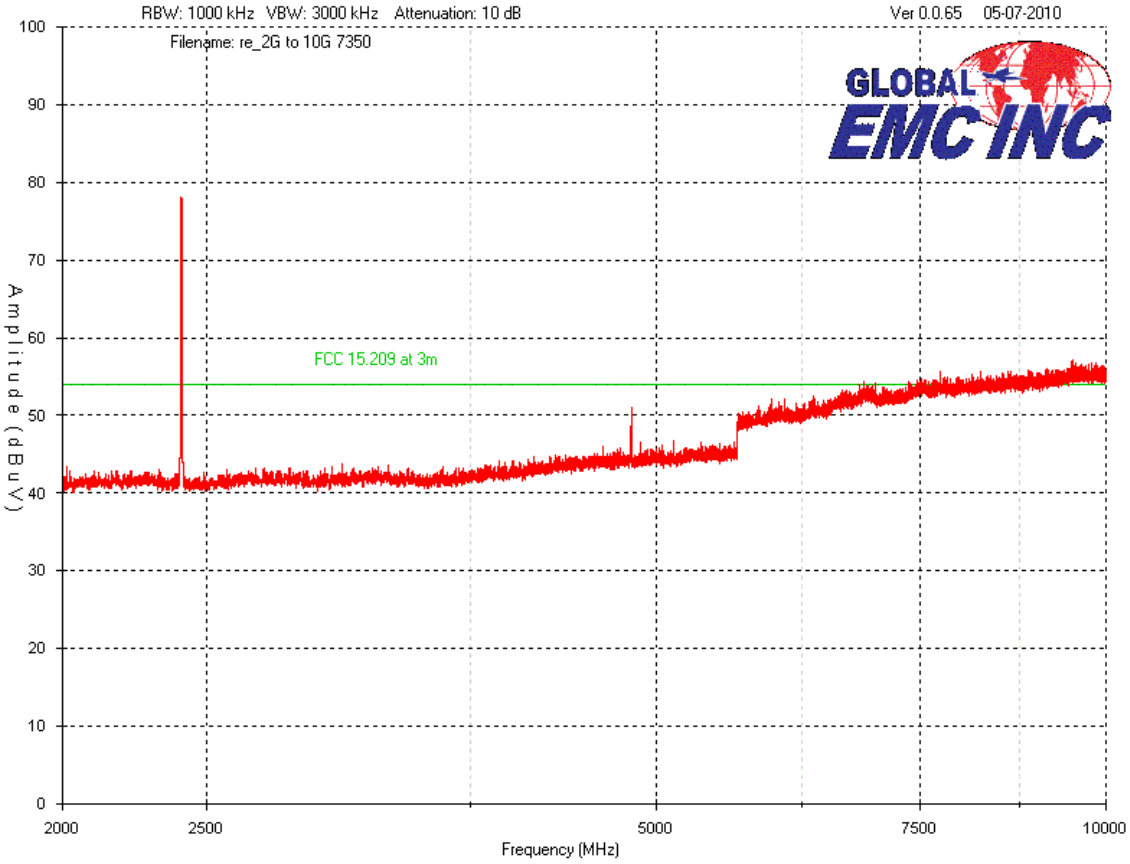
Horizontal – Peak Emissions Graph – Mid channel (worst case 30 MHz to 1 GHz)



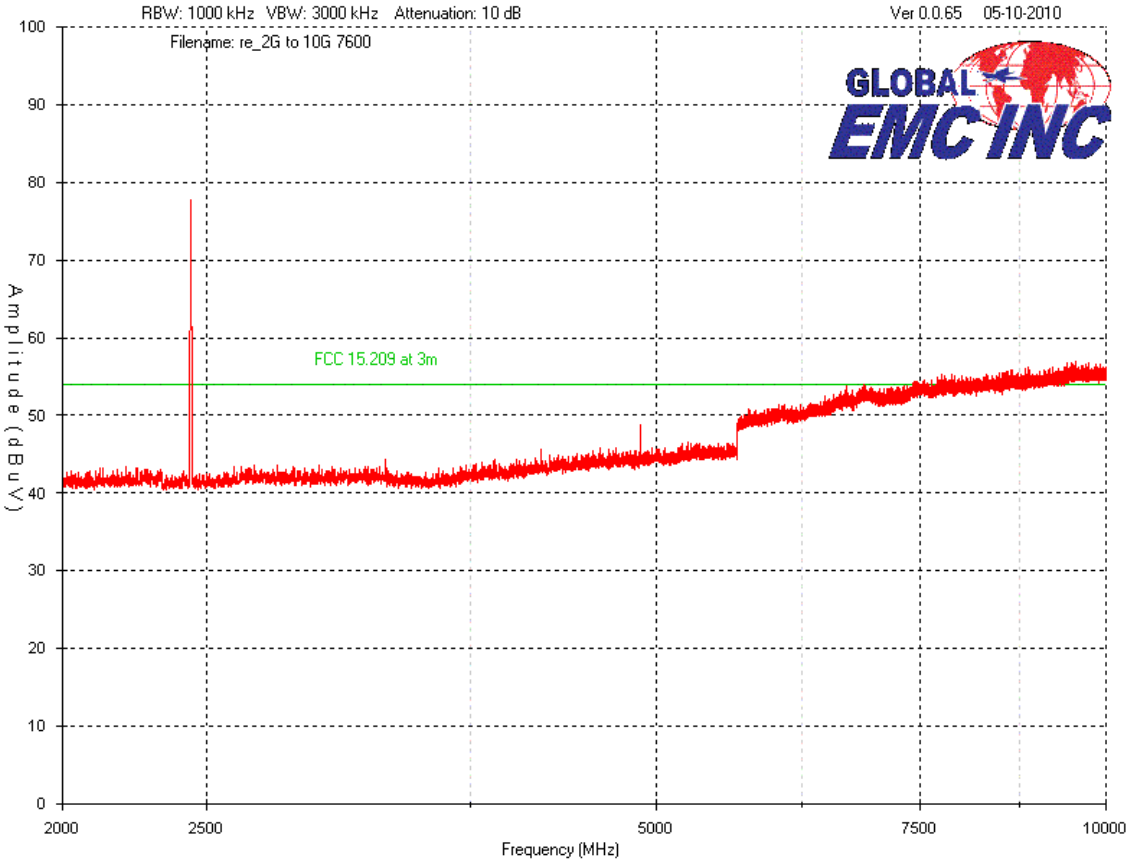
Horizontal – Peak Emissions Graph – Mid channel (worst case 1 GHz to 2 GHz)



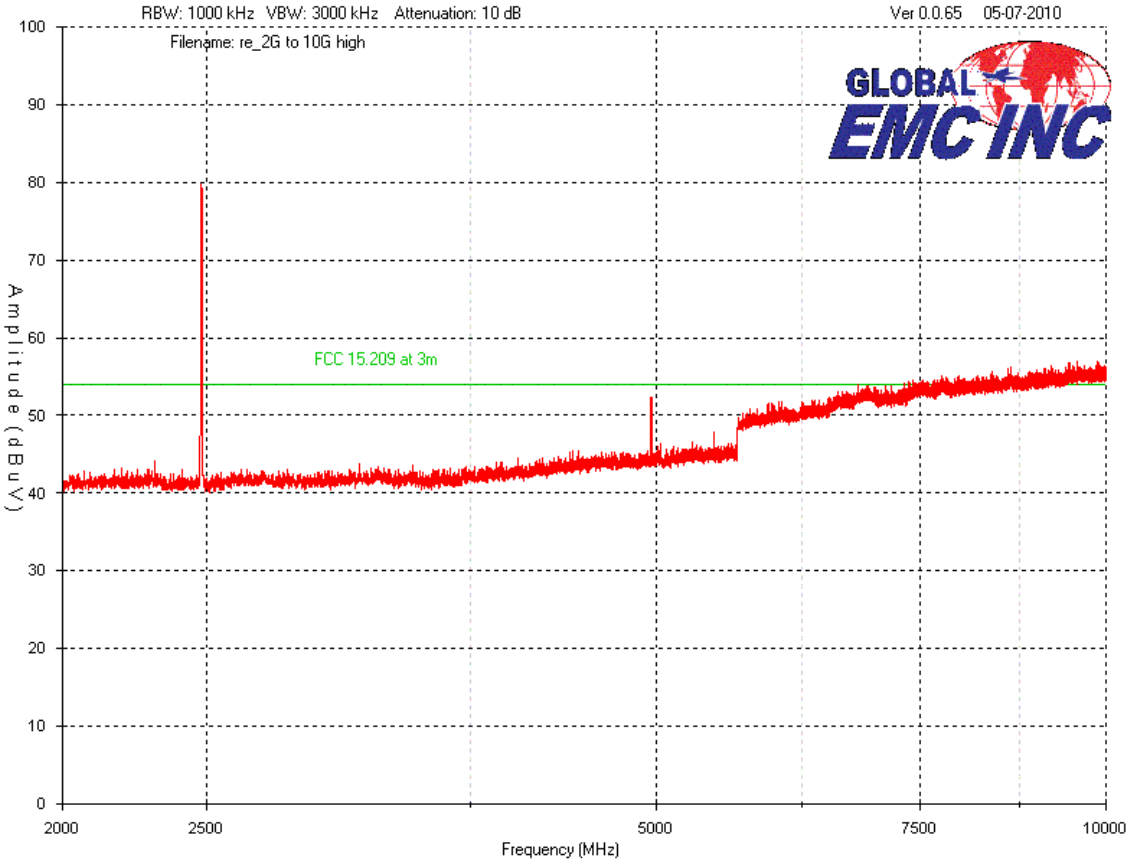
Vertical – Peak Emissions Graph – Low channel (2G to 10 GHz)



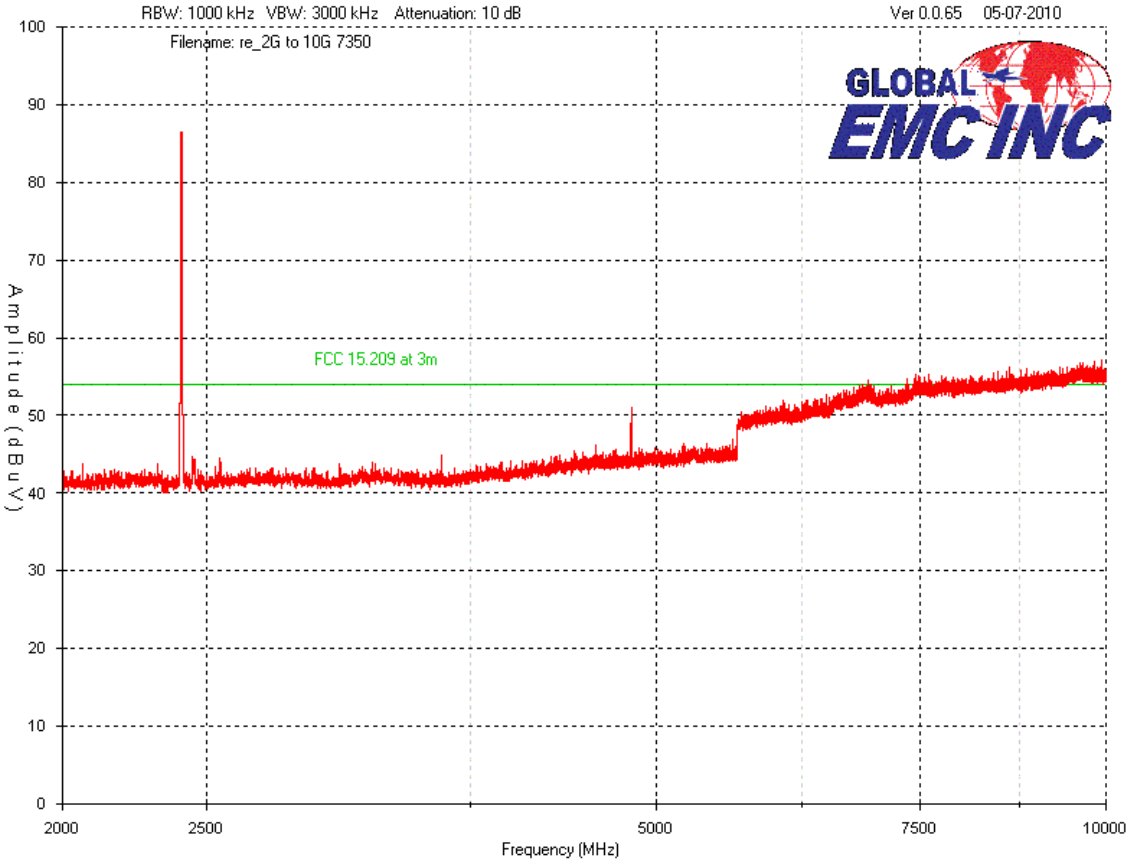
Vertical – Peak Emissions Graph – Mid channel (2G to 10 GHz)



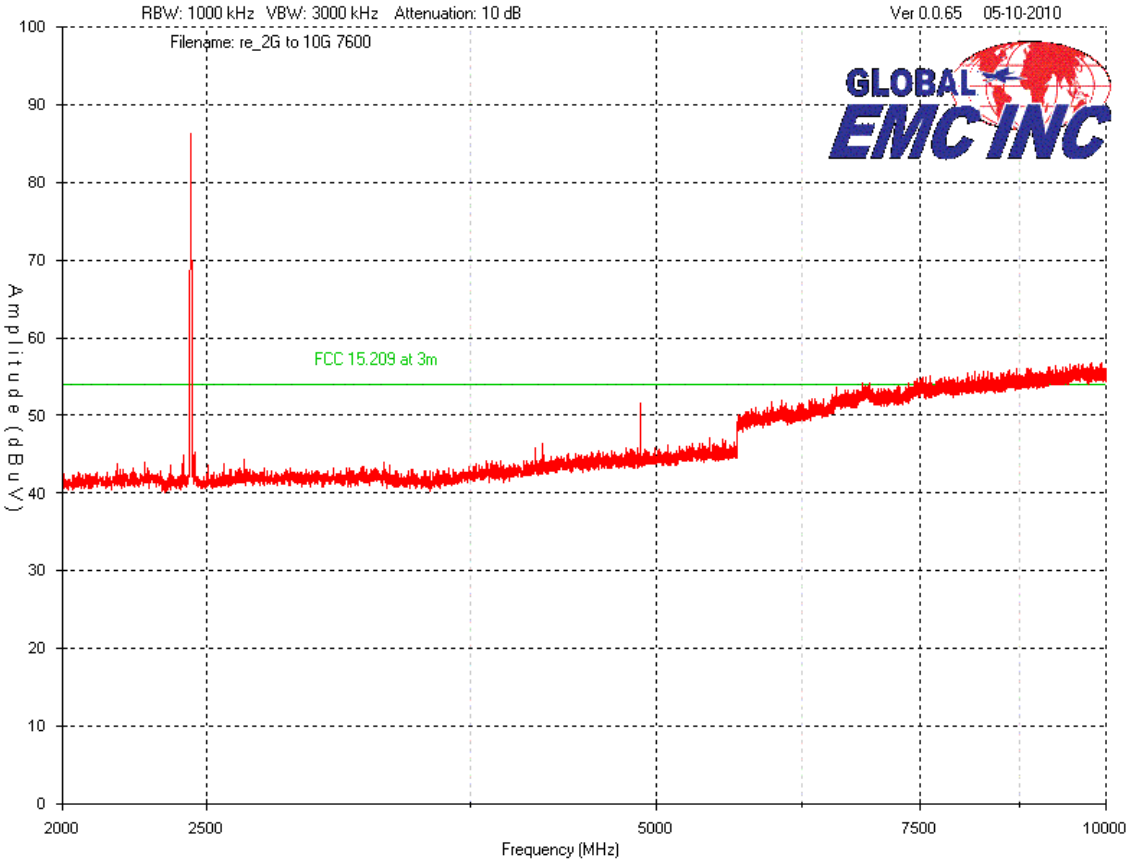
Vertical – Peak Emissions Graph – High channel (2G to 10 GHz)



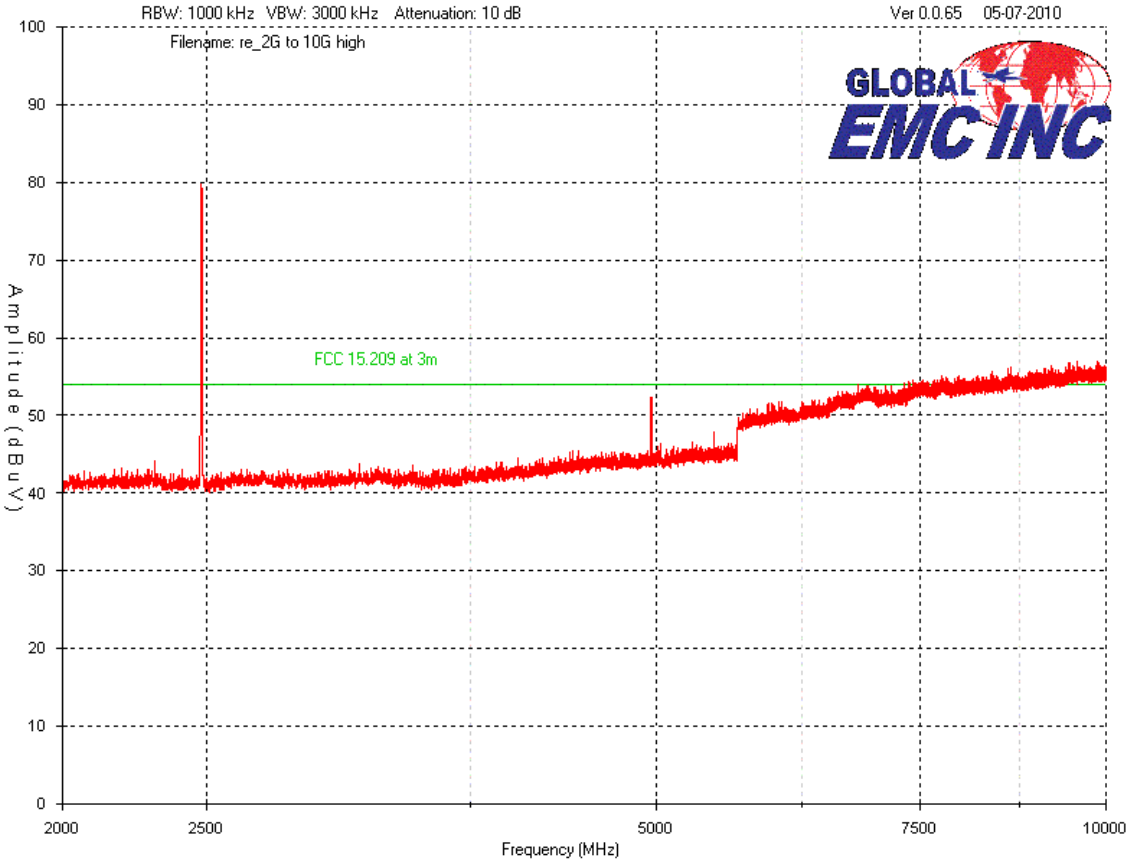
Horizontal – Peak Emissions Graph – Low Channel (2GHz to 10GHz)



Horizontal – Peak Emissions Graph – Mid Channel (2GHz to 10GHz)



‘Horizontal – Peak Emissions Graph – High Channel (2GHz to 10GHz)



## Final Measurements

Note: In accordance with 15.247(d), only radiated emissions exceeding the 15.209 limit that occur within the bands listed in 15.205, need to be verified with a quasi-peak detector or an average detector.

The frequency shown on the peak graph between does not fall within a restricted band as listed in FCC 15.205 and does not need to be verified.

For information purposes, the fundamental was measured to be 90.9 dBuV/m at 3 meters, and none of the unintentional radiated emissions that fall outside of the restricted bands exceeded the -20dBc (or 70.9 dBuV/m) requirement.

The following measurements were made at the harmonics shown in the above graphs.

## Radiated Emissions Measurements

| Test Freq. (MHz) | Detector. | Polh | 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) | Margin dB(µV) | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Low Channel | | | | | | | | | | | |
| 2405 | Peak | Horz | 93.3 | 30.6 | 2.2 | 0.0 | 36.2 | 89.9 | | | PASS |
| 2405 | Avg | Horz | 90.6 | 30.6 | 2.2 | 0.0 | 36.2 | 87.2 | | | PASS |
| 2405 | Peak | Vert | 83.7 | 30.6 | 2.2 | 0.0 | 36.2 | 80.3 | | | PASS |
| 2405 | Avg | Vert | 81.4 | 30.6 | 2.2 | 0.0 | 36.2 | 78.0 | | | PASS |
| 2390 | Peak | Horz | 46.5 | 30.6 | 2.2 | 0.0 | 36.2 | 43.1 | 74.0 | 30.9 | PASS |
| 2390 | Avg | Horz | 34.1 | 30.6 | 2.2 | 0.0 | 36.2 | 30.7 | 54.0 | 23.3 | PASS |
| 2390 | Peak | Vert | 45.6 | 30.6 | 2.2 | 0.0 | 36.2 | 42.2 | 74.0 | 31.8 | PASS |
| 2390 | Avg | Vert | 33.4 | 30.6 | 2.2 | 0.0 | 36.2 | 30.0 | 54.0 | 24.0 | PASS |
| 4810 | Peak | Horz | 52.4 | 33.7 | 2.9 | 0.0 | 35.7 | 53.3 | 74.0 | 20.7 | PASS |
| 4810 | Avg | Horz | 42.2 | 33.7 | 2.9 | 0.0 | 35.7 | 43.1 | 54.0 | 10.9 | PASS |
| 4810 | Peak | Vert | 51.0 | 33.7 | 2.9 | 0.0 | 35.7 | 51.9 | 74.0 | 22.1 | PASS |
| 4810 | Avg | Vert | 40.4 | 33.7 | 2.9 | 0.0 | 35.7 | 41.3 | 54.0 | 12.7 | PASS |
| 7215 | Peak | Vert | 48.6 | 37.9 | 4.3 | 0.0 | 35.9 | 54.9 | 74.0 | 19.1 | PASS |
| 7215 | Avg | Vert | 35.2 | 37.9 | 4.3 | 0.0 | 35.9 | 41.5 | 54.0 | 12.5 | PASS |
| 7215 | Peak | Horz | 48.3 | 37.9 | 4.3 | 0.0 | 35.9 | 54.6 | 74.0 | 19.4 | PASS |
| 7215 | Avg | Horz | 34.1 | 37.9 | 4.3 | 0.0 | 35.9 | 40.4 | 54.0 | 13.6 | PASS |
| 2400 | Peak | Horz | 54.6 | 30.6 | 2.2 | 0.0 | 36.2 | 51.2 | 74.0 | 22.8 | PASS |
| 2400 | Avg | Horz | 42.0 | 30.6 | 2.2 | 0.0 | 36.2 | 38.6 | 54.0 | 15.4 | PASS |
| 2400 | Peak | Vert | 50.9 | 30.6 | 2.2 | 0.0 | 36.2 | 47.5 | 74.0 | 26.5 | PASS |
| 2400 | Avg | Vert | 37.4 | 30.6 | 2.2 | 0.0 | 36.2 | 34.0 | 54.0 | 20.0 | PASS |
| 9620 | Peak | Horz | 48.8 | 39.2 | 5.8 | 0.0 | 35.9 | 57.9 | 74.0 | 16.1 | PASS |
| 9620 | Avg | Horz | 34.9 | 39.2 | 5.8 | 0.0 | 35.9 | 44.0 | 74.0 | 30.0 | PASS |
| 9620 | Peak | Vert | 39.4 | 39.2 | 5.8 | 0.0 | 35.9 | 48.5 | 74.0 | 25.5 | PASS |
| 9620 | Avg | Vert | 34.5 | 39.2 | 5.8 | 0.0 | 35.9 | 43.6 | 54.0 | 10.4 | PASS |
| Mid channel | | | | | | | | | | | |
| 2445 | Peak | Horz | 92.4 | 30.6 | 2.2 | 0.0 | 36.2 | 89.0 | | | PASS |
| 2445 | Avg | Horz | 90.0 | 30.6 | 2.2 | 0.0 | 36.2 | 86.6 | | | PASS |
| 2445 | Peak | Vert | 83.3 | 30.6 | 2.2 | 0.0 | 36.2 | 79.9 | | | PASS |
| 2445 | Avg | Vert | 80.9 | 30.6 | 2.2 | 0.0 | 36.2 | 77.5 | | | PASS |
| 4890 | Peak | Horz | 50.6 | 33.7 | 2.9 | 0.0 | 35.7 | 51.5 | 74.0 | 22.5 | PASS |
| 4890 | Avg | Horz | 40.8 | 33.7 | 2.9 | 0.0 | 35.7 | 41.7 | 54.0 | 12.3 | PASS |
| 4890 | Peak | Vert | 53.2 | 33.7 | 2.9 | 0.0 | 35.7 | 54.1 | 74.0 | 19.9 | PASS |
| 4890 | Avg | Vert | 43.4 | 33.7 | 2.9 | 0.0 | 35.7 | 44.3 | 54.0 | 9.7 | PASS |
| 7335 | Peak | Vert | 48.4 | 37.9 | 4.3 | 0.0 | 35.9 | 54.7 | 74.0 | 19.3 | PASS |
| 7335 | Avg | Vert | 34.0 | 37.9 | 4.3 | 0.0 | 35.9 | 40.3 | 54.0 | 13.7 | PASS |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7335 | Peak | Horz | 48.7 | 37.9 | 4.3 | 0.0 | 35.9 | 55.0 | 74.0 | 19.0 | PASS |
| 7335 | Avg | Horz | 34.0 | 37.9 | 4.3 | 0.0 | 35.9 | 40.3 | 54.0 | 13.7 | PASS |
| High channel 25 | | | | | | | | | | | |
| 2475 | Peak | Horz | 93.4 | 30.6 | 2.2 | 0.0 | 36.2 | 90.0 | | | PASS |
| 2475 | Avg | Horz | 88.7 | 30.6 | 2.2 | 0.0 | 36.2 | 85.3 | | | PASS |
| 2475 | Peak | Vert | 94.3 | 30.6 | 2.2 | 0.0 | 36.2 | 90.9 | | | PASS |
| 2475 | Avg | Vert | 90.0 | 30.6 | 2.2 | 0.0 | 36.2 | 86.6 | | | PASS |
| 2483.5 | Peak | Horz | 49.0 | 30.6 | 2.2 | 0.0 | 36.2 | 45.6 | 74.0 | 28.4 | PASS |
| 2483.5 | Avg | Horz | 33.6 | 30.6 | 2.2 | 0.0 | 36.2 | 30.2 | 54.0 | 23.8 | PASS |
| 2483.5 | Peak | Vert | 47.3 | 30.6 | 2.2 | 0.0 | 36.2 | 43.9 | 74.0 | 30.1 | PASS |
| 2483.5 | Avg | Vert | 33.0 | 30.6 | 2.2 | 0.0 | 36.2 | 29.6 | 54.0 | 24.4 | PASS |
| 4950 | Peak | Horz | 50.6 | 33.7 | 2.9 | 0.0 | 35.7 | 51.5 | 74.0 | 22.5 | PASS |
| 4950 | Avg | Horz | 40.3 | 33.7 | 2.9 | 0.0 | 35.7 | 41.2 | 54.0 | 12.8 | PASS |
| 4950 | Peak | Vert | 50.5 | 33.7 | 2.9 | 0.0 | 35.7 | 51.4 | 74.0 | 22.6 | PASS |
| 4950 | Avg | Vert | 39.8 | 33.7 | 2.9 | 0.0 | 35.7 | 40.7 | 54.0 | 13.3 | PASS |
| 7425 | Peak | Vert | 50.4 | 37.9 | 4.3 | 0.0 | 35.9 | 56.7 | 74.0 | 17.3 | PASS |
| 7425 | Avg | Vert | 39.0 | 37.9 | 4.3 | 0.0 | 35.9 | 45.3 | 54.0 | 8.7 | PASS |
| 7425 | Peak | Horz | 52.6 | 37.9 | 4.3 | 0.0 | 35.9 | 58.9 | 74.0 | 15.1 | PASS |
| 7425 | Avg | Horz | 44.1 | 37.9 | 4.3 | 0.0 | 35.9 | 50.4 | 54.0 | 3.6 | PASS |
| | | | | | | | | | | | |
| High channel 2 26 | | | | | | | | | | | |
| 2480 | Peak | Horz | 90.8 | 30.6 | 2.2 | 0.0 | 36.2 | 87.4 | | | PASS |
| 2480 | Avg | Horz | 88.1 | 30.6 | 2.2 | 0.0 | 36.2 | 84.7 | | | PASS |
| 2480 | Peak | Vert | 77.8 | 30.6 | 2.2 | 0.0 | 36.2 | 74.4 | | | PASS |
| 2480 | Avg | Vert | 75.2 | 30.6 | 2.2 | 0.0 | 36.2 | 71.8 | | | PASS |
| 2483.5 | Peak | Horz | 67.1 | 30.6 | 2.2 | 0.0 | 36.2 | 63.7 | 74.0 | 10.3 | PASS |
| 2483.5 | Avg | Horz | 56.0 | 30.6 | 2.2 | 0.0 | 36.2 | 52.6 | 54.0 | 1.4 | PASS |
| 2483.5 | Peak | Vert | 55.1 | 30.6 | 2.2 | 0.0 | 36.2 | 51.7 | 74.0 | 22.3 | PASS |
| 2483.5 | Avg | Vert | 45.7 | 30.6 | 2.2 | 0.0 | 36.2 | 42.3 | 54.0 | 11.7 | PASS |
| 4960 | Peak | Horz | 50.1 | 33.7 | 2.9 | 0.0 | 35.7 | 51.0 | 74.0 | 23.0 | PASS |
| 4960 | Avg | Horz | 40.3 | 33.7 | 2.9 | 0.0 | 35.7 | 41.2 | 54.0 | 12.8 | PASS |
| 4960 | Peak | Vert | 51.0 | 33.7 | 2.9 | 0.0 | 35.7 | 51.9 | 74.0 | 22.1 | PASS |
| 4960 | Avg | Vert | 39.2 | 33.7 | 2.9 | 0.0 | 35.7 | 40.1 | 54.0 | 13.9 | PASS |
| 7440 | Peak | Vert | 48.7 | 37.9 | 4.3 | 0.0 | 35.9 | 55.0 | 74.0 | 19.0 | PASS |
| 7440 | Avg | Vert | 34.4 | 37.9 | 4.3 | 0.0 | 35.9 | 40.7 | 54.0 | 13.3 | PASS |
| 7440 | Peak | Horz | 48.9 | 37.9 | 4.3 | 0.0 | 35.9 | 55.2 | 74.0 | 18.8 | PASS |
| 7440 | Avg | Horz | 34.4 | 37.9 | 4.3 | 0.0 | 35.9 | 40.7 | 54.0 | 13.3 | PASS |

Note: No emissions above the 3rd harmonic were detected at 1 meter. The system noise floor at the 10th harmonic was approximately 12 dB at 1m. Note that the peak emissions without average measurement or duty cycle correction complied with the average limit requirements, therefore average measurements and duty cycle correction were not applied.

## Test Equipment List

| Equipment | Model No. | Manufacturer | Last calibration date | Next calibration due date | Asset # |
|---|---|---|---|---|---|
| BiLog Antenna | 3142-C | ETS | 2009-02-12 | 2011-02-12 | GEMC 8 |
| IFR Spectrum Analyzer | AN940 | IFR | 12/29/2009 | 12/29/2011 | GEMC 6350 |
| Horn Antenna | 6878/24 | Q-Par | 8/25/2008 | 8/25/2010 | GEMC 6365 |
| 1-26G pre-amp | HP 8449B | HP | 8/25/2008 | 8/25/2010 | GEMC 6351 |
| Attenuator 3 dB | FP-50-3 | Trilithic | NCR | NCR | GEMC 40 |
| Schaffner Preamp 9kHz - 2 GHz | CPA9231A | Schaffner | 8/26/2008 | 8/26/2010 | 116 |
| Horn Antenna | SAS-572 | AH | NCR | NCR | GEMC 6371 |
| 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_Rev2.doc”

*Maximum Peak Envelope Conducted Power*

## 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 400 uW. Since the EUT has a patch antenna and there was no provision to perform this measurement using the conducted power method, a radiated peak dbuV/m reading was captured and recorded. Vertical orientations of the antenna at 3m yielded the worst case readings

## 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 (dBuV/m) | Factor (dBuV/m to dBm for 3 m) | Output Power (dBm) |
|---|---|---|---|---|---|
| Low | 1 | 2405 | 91.1 | 95.2 | -4.1 |
| Medium | 11 | 2445 | 90.2 | 95.2 | -5.0 |
| High | 25 | 2475 | 91.2 | 95.2 | -4.0 |
| High 2 | 26 | 2480 | 88.6 | 95.2 | -6.6 |

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

## Factor Calculations

Where P is power in Watts, D is distance in meters and E is received field strength in uV/m

Represent the power density as

$$P_{Density} = \frac{P_{Trans}}{4 \cdot \pi \cdot D^2}$$

Then the electric field, in microvolts per meter, can be represented as

$$E = 1 \cdot 10^6 \sqrt{\frac{377 \cdot P_{Trans}}{4 \cdot \pi \cdot D^2}}$$

Now solve the equation to isolate transmitted power

$$P_{Trans} = \frac{4 \cdot \pi \cdot D^2}{377} \cdot \left(\frac{E}{1 \cdot 10^6}\right)^2$$

$$P_{Trans}(dBm) = 10 \cdot \log\left[\frac{4 \cdot \pi \cdot D^2}{377} \cdot \left(\frac{E}{1 \cdot 10^6}\right)^2\right] + 30$$

Finally, this equation can be simplified to

$$P_{Trans}(dBm) = 20 \cdot \log(D \cdot E) - 104.7713$$

If the distance is three meters as is the case with many 47 CFR 15 specifications, the equation becomes

$$P_{Trans}(dBm) = 20 \cdot \log(E) - 95.2289$$

## Test Equipment List

| Equipment | Model No. | Manufacturer | Last calibration date | Next calibration due date | Asset # |
|---|---|---|---|---|---|
| IFR Spectrum Analyzer | AN940 | IFR | 12/29/2009 | 12/29/2011 | GEMC 6350 |
| Horn Antenna | 6878/24 | Q-Par | 8/25/2008 | 8/25/2010 | GEMC 6365 |
| 1-26G pre-amp | HP 8449B | HP | 8/25/2008 | 8/25/2010 | GEMC 6351 |
| 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 Permissible Exposure*

### Purpose

The purpose of this test is to ensure that the RF energy intentionally transmitted, in terms of power density emitted from the EUT at a stated operating distance does not exceed the limits listed below as defined in the applicable test standard, as calculated based upon readings obtained during testing. This helps protect human exposure to excessive RF fields.

### Limit(s) and Method

The limits, as defined in FCC 15.247(i), and FCC 1.1310 Table 1 (B) limits for general public exposure was applied. The limit for the frequency range of 1.5 GHz to 100 GHz was applied. This is a limit of 1.0 mW/ $cm^2$ The distance used for calculations was 1 cm, as this is the minimum distance an operator will be from the EUT during normal operation, as stated by the manufacturer.

## Results

The EUT passed the requirements. The worst case calculated power density was 0.063 $mW/cm^2$, this is significantly under the 1.0 $mW/cm^2$ requirement.

## Calculations

Method 1 (conducted power)

$P_d = (P_t*G) / (4*pi*R^2)$
Where Pt = -4 dBm or 0.4 mW as per Peak power conducted output calculated from radiated emissions

Where G = 2 dBi, or numerically 1.6
Where R = 1 cm

$P_d = (0.4\ mW * 2) / (4 * pi * 1\ cm^2)$
$P_d = 0.8\ mW / 12.6\ cm^2$
$P_d = 0.063\ mW/cm^2$

*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.

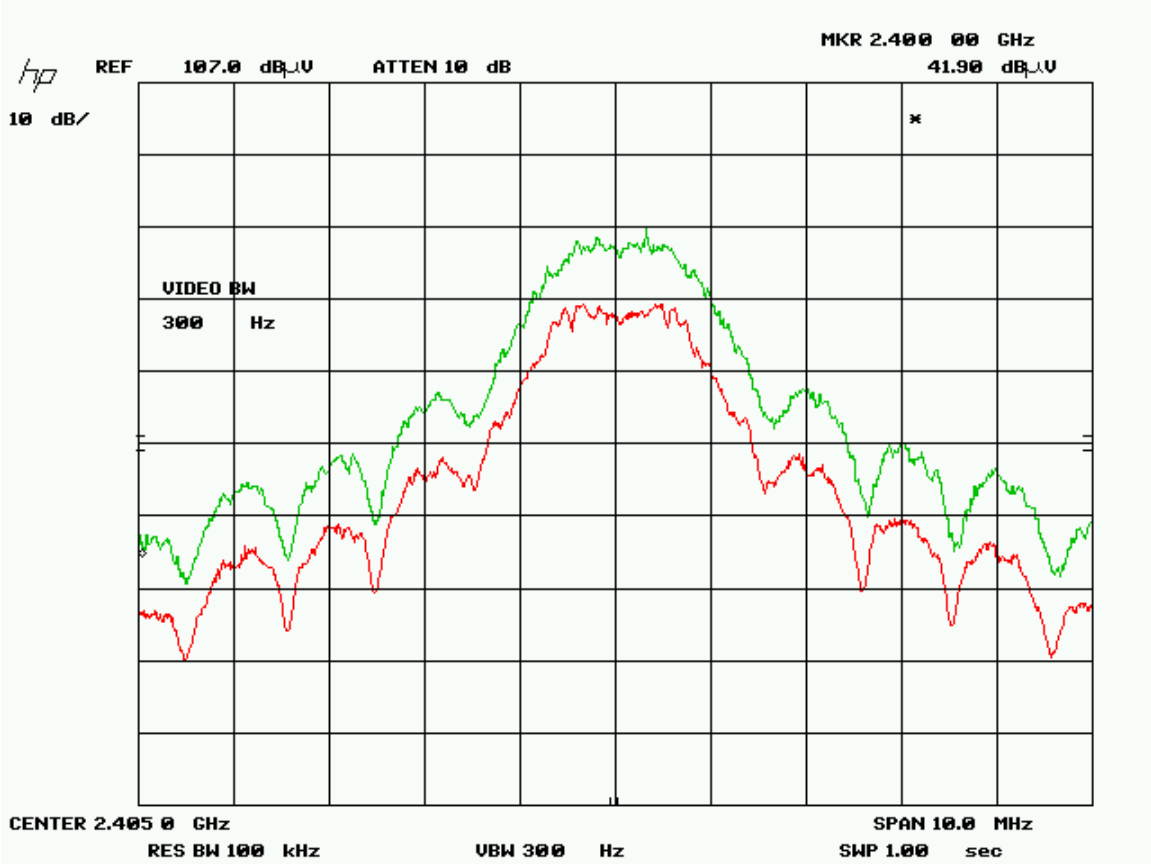
## Results

The EUT passed. The 6 dB BW measured was 1.63 MHz

## Graph(s)

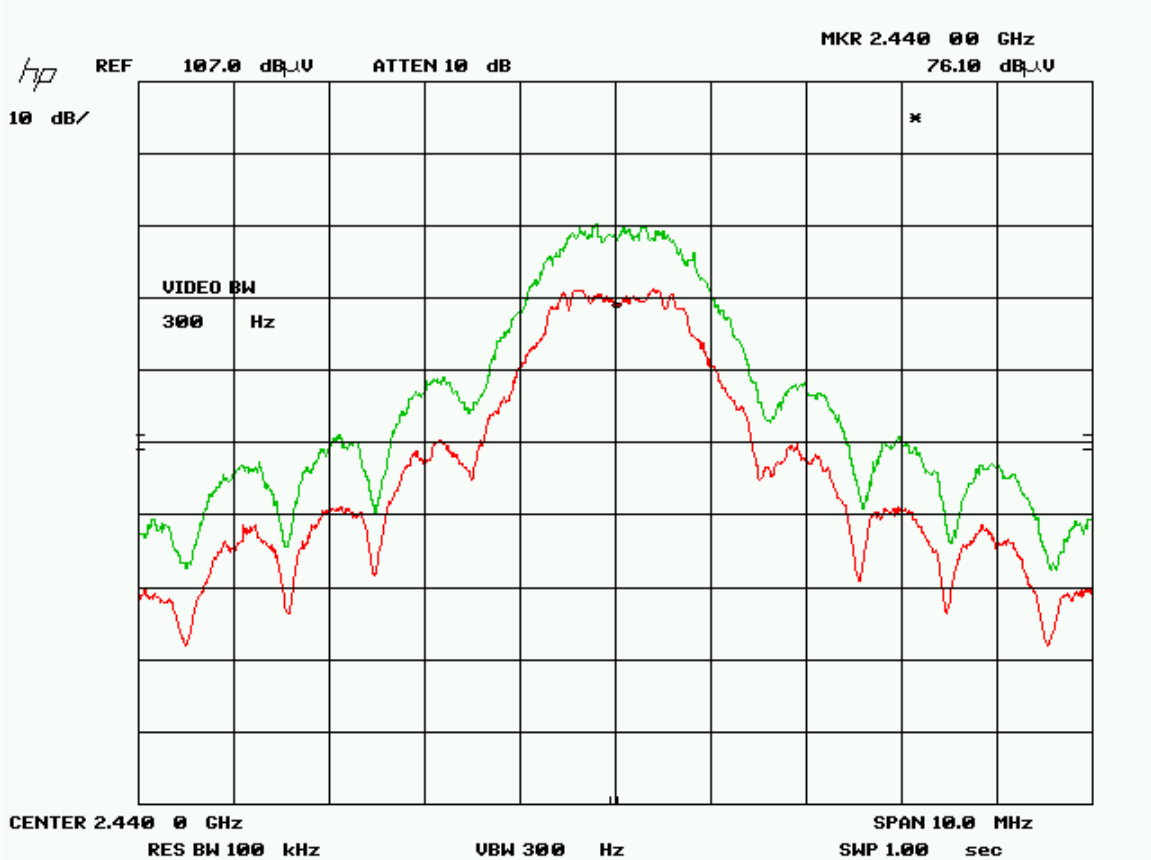
The graphs shown below shows the channel spacing during the operation of the device. This is measured by a max hold on the spectrum analyzer and the highest resolution bandwidth that is sufficiently low to exhibit the 6 dB bandwidth of a channel during operation of the EUT.  This measurement is a peak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

Low Channel



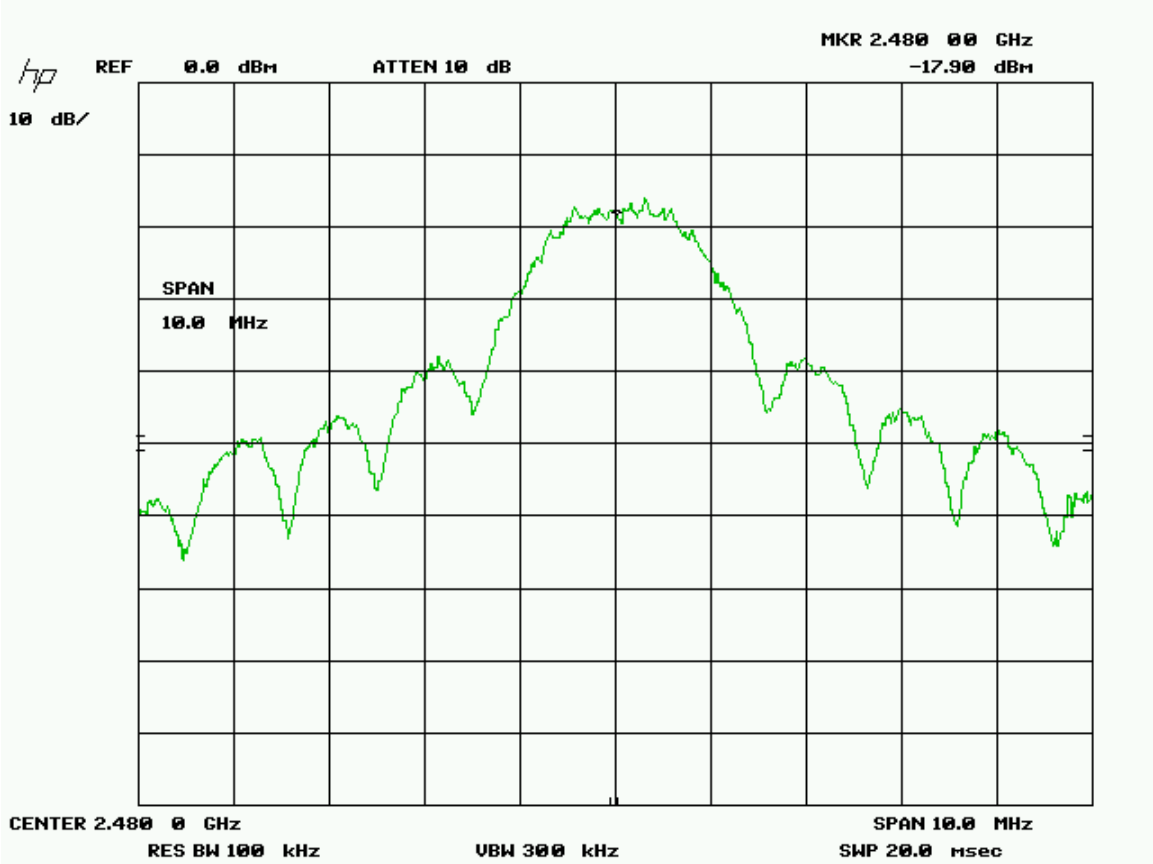

6 dB BW = 1.62 MHz
20 dB BW = 2.4 MHz

Mid channel




6 dB BW = 1.62 MHz
20 dB BW = 2.4 MHz

High Channel




6 dB BW = 1.63 MHz
20 dB BW = 2.4 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 |
| IFR Spectrum Analyzer | AN940 | IFR | 12/29/2009 | 12/29/2011 | GEMC 6350 |
| 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"

## *Power Spectral Density*

### Purpose

The purpose of this test is to ensure that the maximum power spectral density to the radiating element does not exceed the limits specified. This ensures that the modulation is significantly wide enough, or low enough in power that it will allow for co-operation of other wireless devices operating within this frequency allocation.

### Limits

The limits are defined in 15.247(e).

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### Results

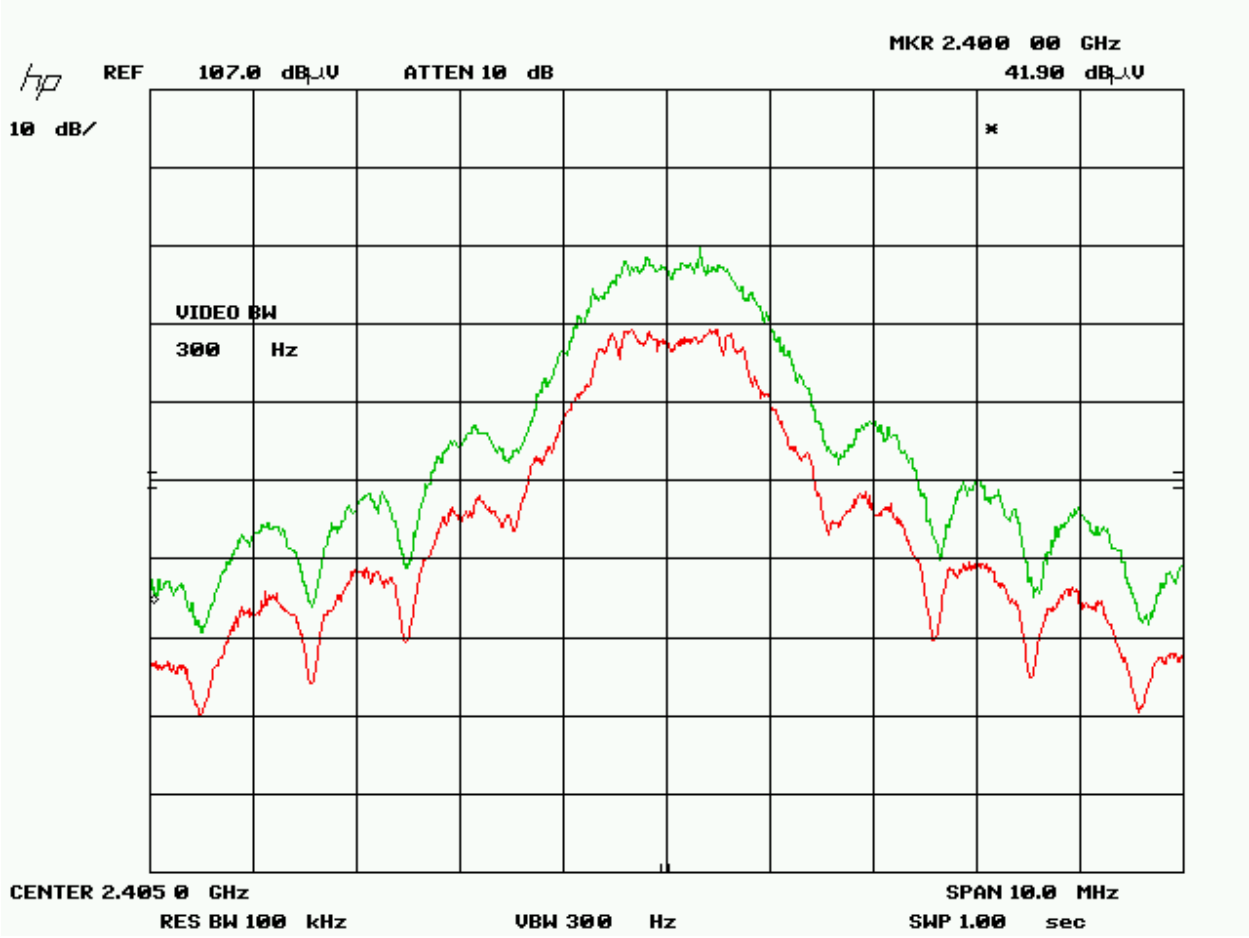
The EUT passed. Each mode was tested at low, medium, and high band. The worst case value is -5.2 dBm as measured with a worst case 100 kHz resolution bandwidth (peak power).

| Test Frequency (MHz) | Detection mode (Q-Peak) | Antenna polarity (Horz/Vert) | Raw signal dB(µV) | Antenna factor dB | Cable loss dB + Preselector | Attenuator dB | Pre-Amp Gain dB | Received signal dB(µV/m) | Factor dBuV to dBm | EiRP (dBm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2405 | Peak | Horz | 93.3 | 30.6 | 2.2 | 0.0 | 36.2 | 89.9 | -95.2 | -5.3 | PASS |
| 2445 | Peak | Horz | 92.4 | 30.6 | 2.2 | 0 | 36.2 | 89 | -95.2 | -6.2 | PASS |
| 2475 | Peak | Horz | 93.4 | 30.6 | 2.2 | 0 | 36.2 | 90 | -95.2 | -5.2 | PASS |

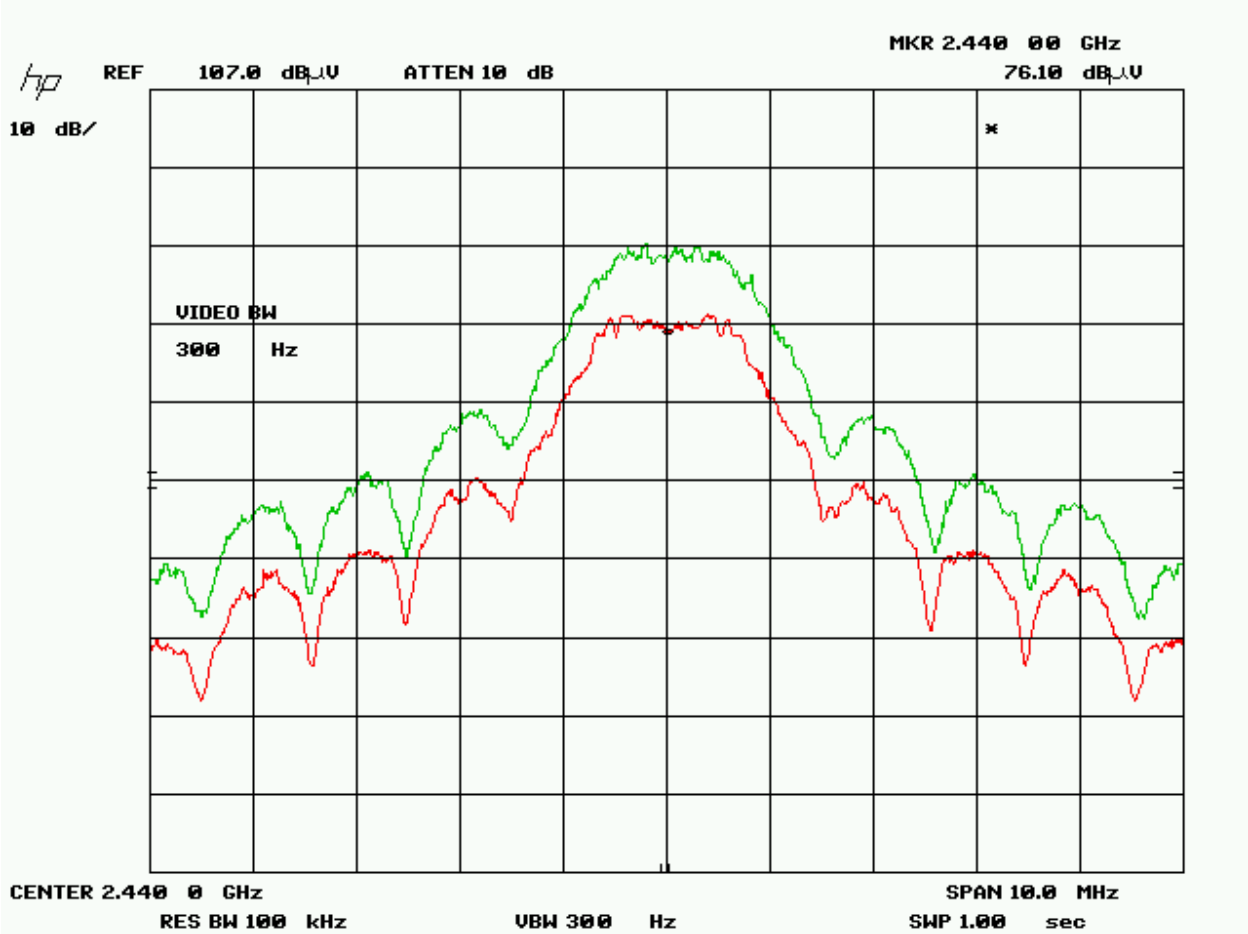
### Graph(s)

The graphs shown below show the power spectral density of the device during the conducted measurement operation of the EUT. Low, middle, and high channel was investigated in each mode. Peak readings shown were taken with a 100 kHz Resolution using the radiated method and are raw readings. This is deemed to be worse than 3 kHz readings, which were deemed not technically necessary for the purpose of demonstrating compliance.

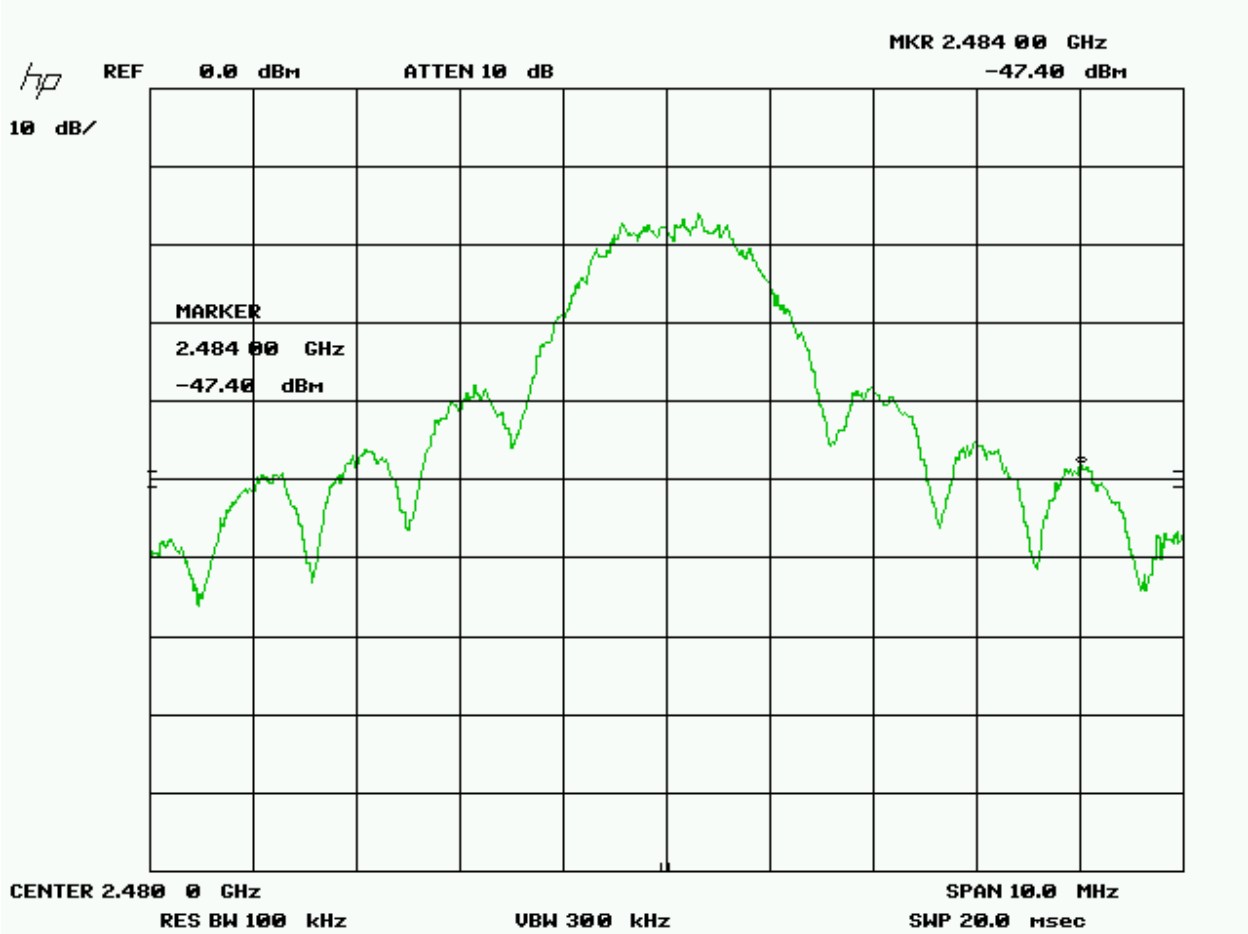
Low channel



Mid channel



High channel




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 # |
|---|---|---|---|---|---|
| IFR Spectrum Analyzer | AN940 | IFR | 12/29/2009 | 12/29/2011 | GEMC 6350 |
| 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"

# Appendix A – EUT Summary

For further details for filing purposes, refer to filing package.

## General EUT Description

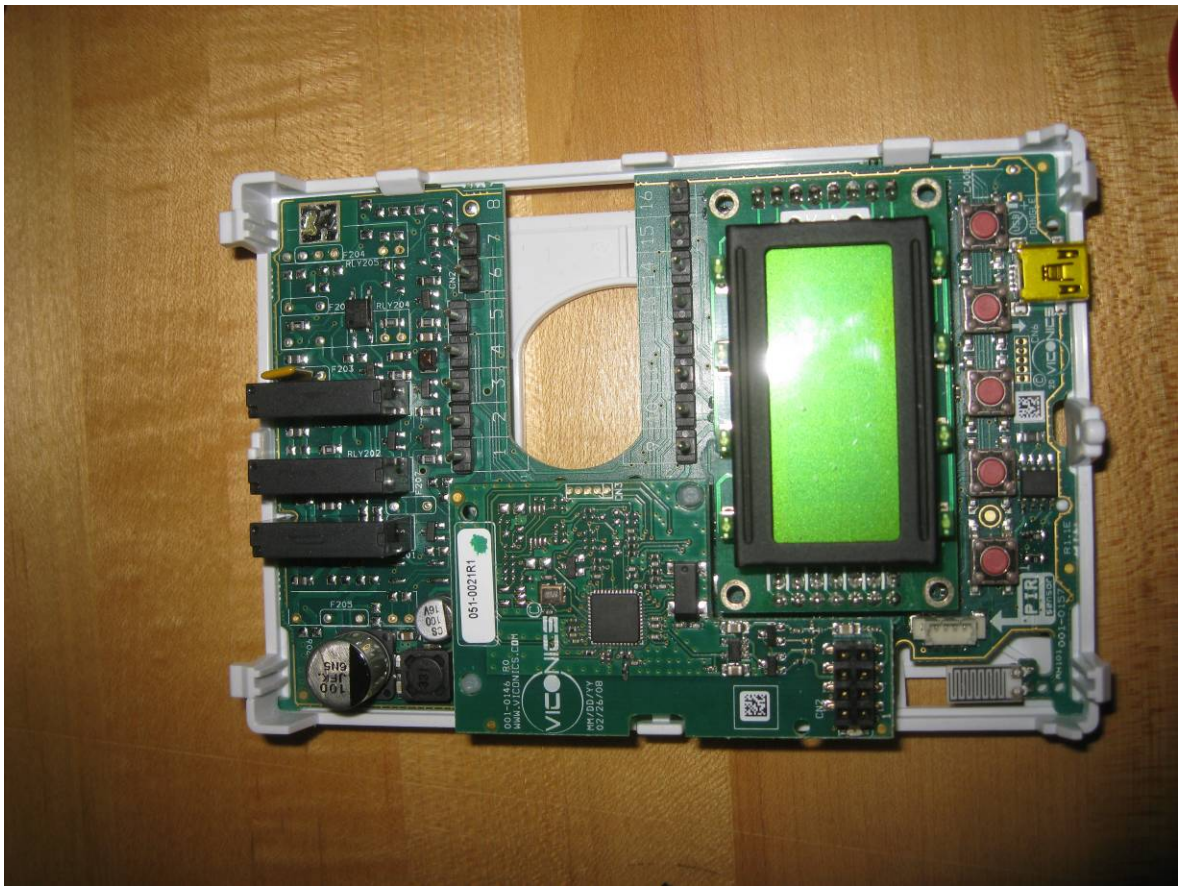
| Client Details | |
|---|---|
| Organization / Address | Viconics Electronics Inc.<br>9245 Langelier Blvd.<br>Montreal, Quebec, Canada, H1P 3K9 |
| Phone | 514-321-5660 |
| **EUT (Equipment Under Test) Details** | |
| EUT Name (for report title) | Terminal Equipment Controller |
| EUT Model / SN (if known) | VTR7355A5500W (with Zigbee module) |
| FCC ID | V95 |
| Industry Canada # | 7591A |
| Equipment category | HVAC Controller |
| EUT is powered using | DC |
| Input voltage range(s) (V) | 6.5Vdc – 9Vdc |
| Frequency range(s) (Hz) | DC |
| Rated input current (A) | 0.08A |
| Nominal power consumption (W) | 0.3W |
| Number of power supplies in EUT | 1 |
| Transmits RF energy? (describe) | Yes |
| Basic EUT functionality description | Data terminal device which commands I/Os on relay pack device. Measures temperature and humidity. |

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see 'Appendix B – EUT & Test Setup Photographs'

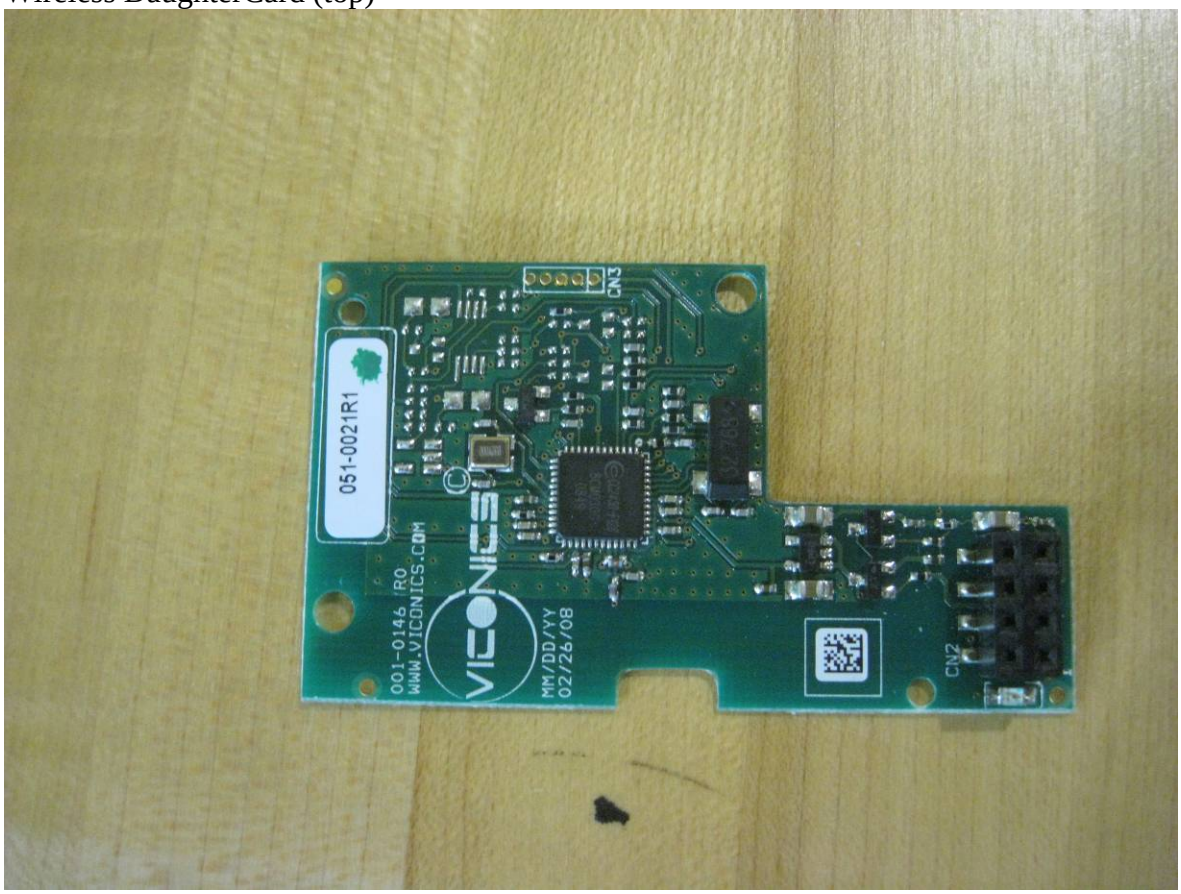
# Appendix B – EUT and Test Setup Photographs

Note:  These photos are for information purposes only.  Also refer to PDF files that are separate from this test report.

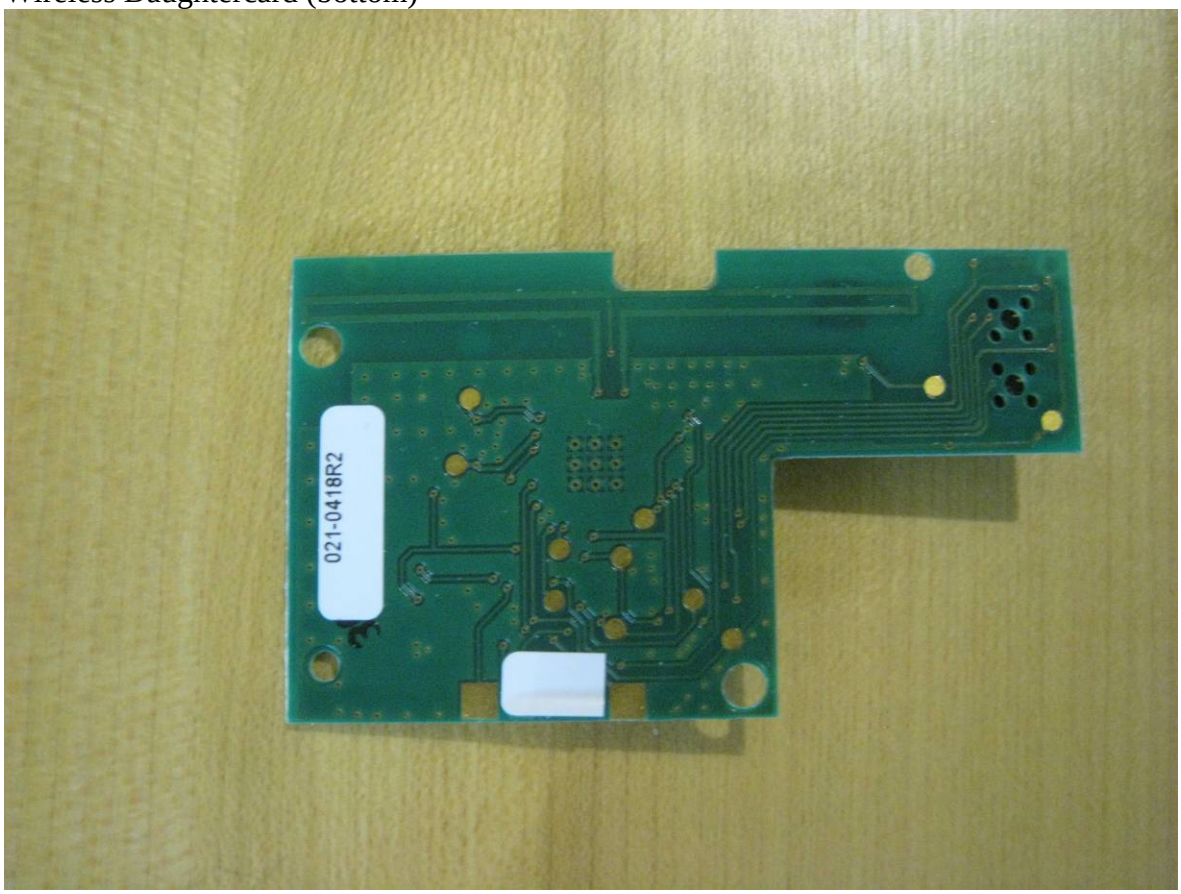
EUT



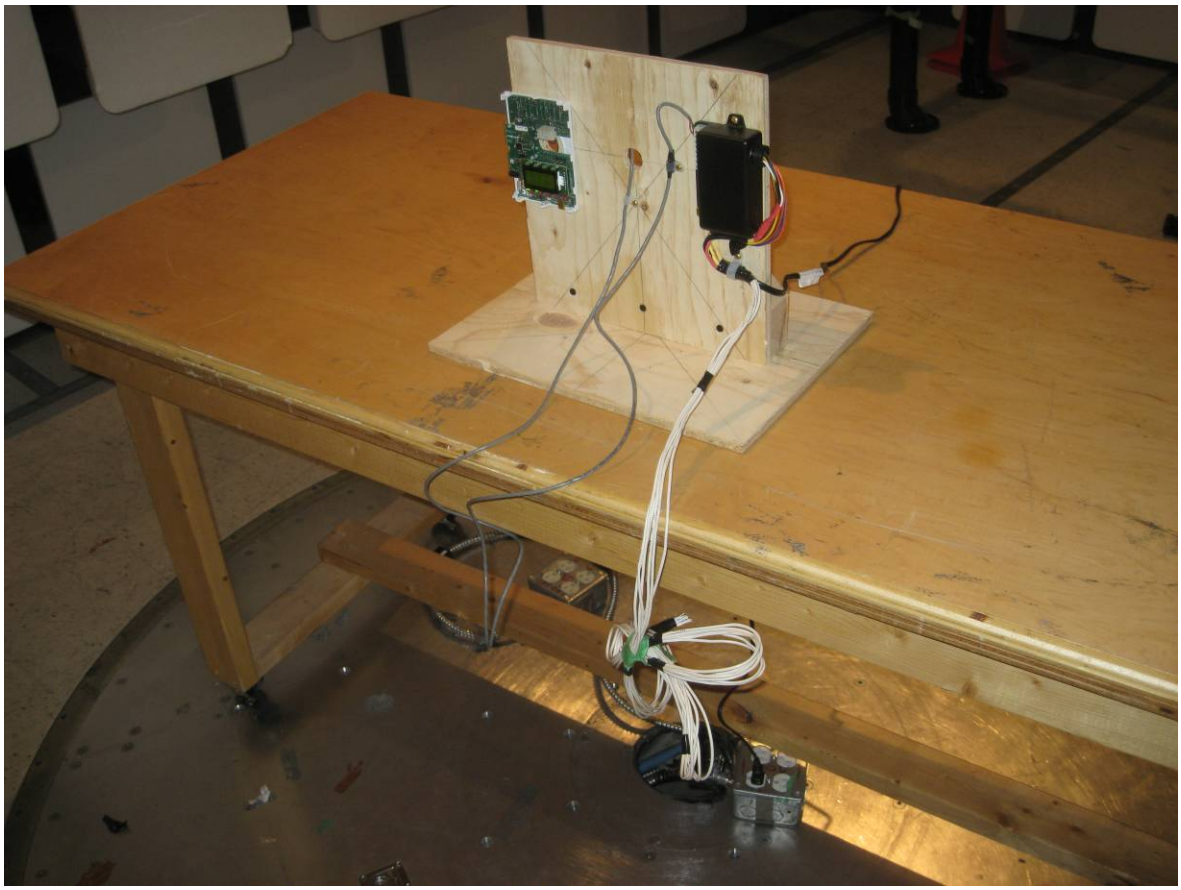
Wireless DaughterCard (top)



Wireless Daughtercard (bottom)



Radiated Emissions Photo 1



Radiated Emissions Photo 2

Radiated Emissions Photo 3

Power Line Conducted Emissions