Global EMC Inc. Labs

EMC & RF Test Report

As per

RSS 210 Issue 7:2007

&

FCC Part 15 Subpart C:2008

Unlicensed Intentional Radiators

on the

Artaflex Wireless Radio Module (AW24MUFL)

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-1

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 (AW24MUFL), 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 15:2008

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 (AW24MUFL)
Standard(s)	RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2008

Summary

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

EUT FCC Certification #, FCC ID:	UP2 AW24MUFL
EUT Industry Canada Certification #, IC:	6797A-AW24UFL
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Scott Drysdale

Client	**Artaflex**
Product	Artaflex Wireless Radio Module (AW24MUFL)
Standard(s)	RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2008

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS 210 (Table 1)	Restricted Bands for intentional operation	QuasiPeak Average	Pass
FCC 15.207	Power line conducted emissions	QuasiPeak Average	Pass
FCC 15.209 RSS-210 (Table 2)	Spurious Radiated emissions	QuasiPeak Average	Pass
FCC 15.247(a)2 RSS-210 A8.2(a)	6 dB Bandwidth	> 500 kHz	Pass
FCC 15.247(b)2 RSS-210 A8.4(4)	Max output power	< 1 Watt	Pass
FCC 15.247(b)(4) RSS-210 A8.4(5)	Antenna Gain	< 6 dBi	Pass See Justifications
FCC 15.247(d) RSS-210 A8.5	Antenna conducted spurious	< 20 dBc	Pass
FCC 15.247(e) RSS-210 A8.2(b)	Spectral Density	< 8 dBm (3 kHz BW)	Pass
FCC 15.247(i) IC Safety code 6	Portable. Maximum Permissible Exposure	< 24 mW @ 2.45 GHz	Pass 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 'U.FL' connector which is deemed to be unique.

This device was tested with two different antennas, however no significant measurable differences were observed. Both antennas have the same rated gain. Both antennas are the same type and design; however they differ by the plastic covering, which did not appear to affect the RF properties. Both are as depicted in Appendix B.

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

For the power line conducted emissions requirements, the EUT is DC powered, and this test does not apply, however the results are included using a typical DC adaptor for information purposes.

For the Antenna gain, the rated antenna again according to the manufacturer is 2 dBi maximum.

For maximum permissible exposure or Specific Absorption Rate requirements this device operates at less than 2.5 mW. No SAR testing is required as per FCC KDB 447498 2(a)(i), 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 – September 28, 2009

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)
Sept 9 – 25, 2009	All	SD	20-25ºC	30-45%	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

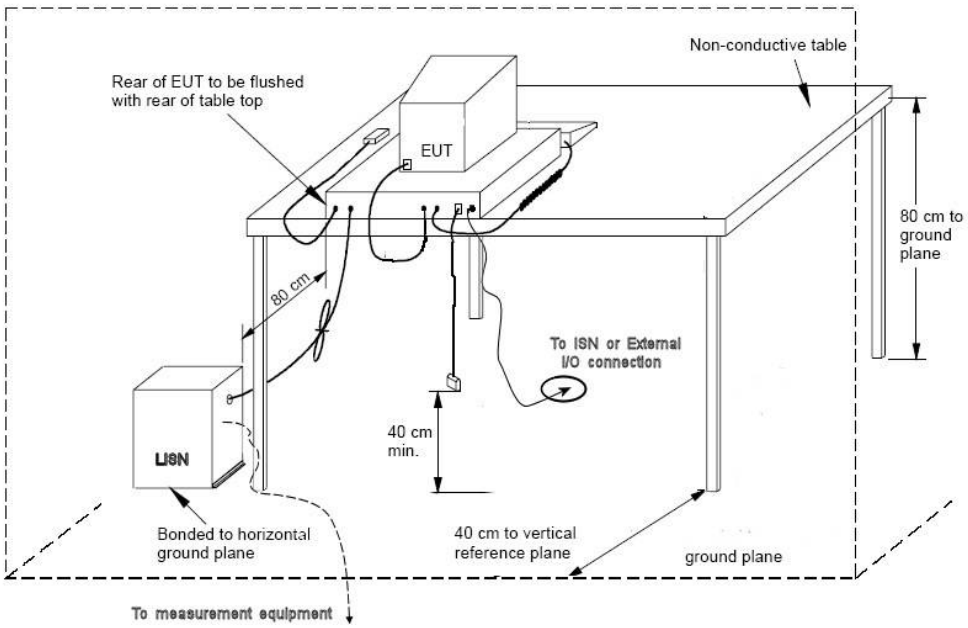
Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

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

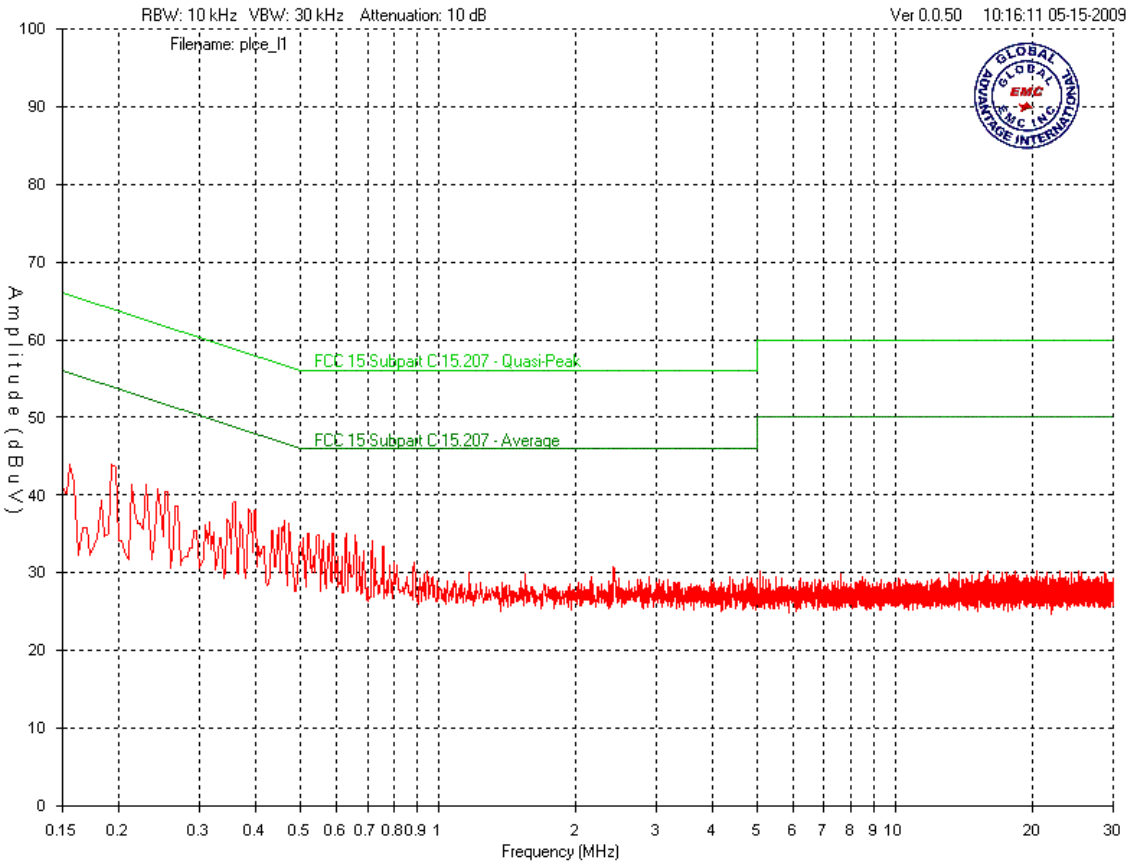
Measurement Uncertainty

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.

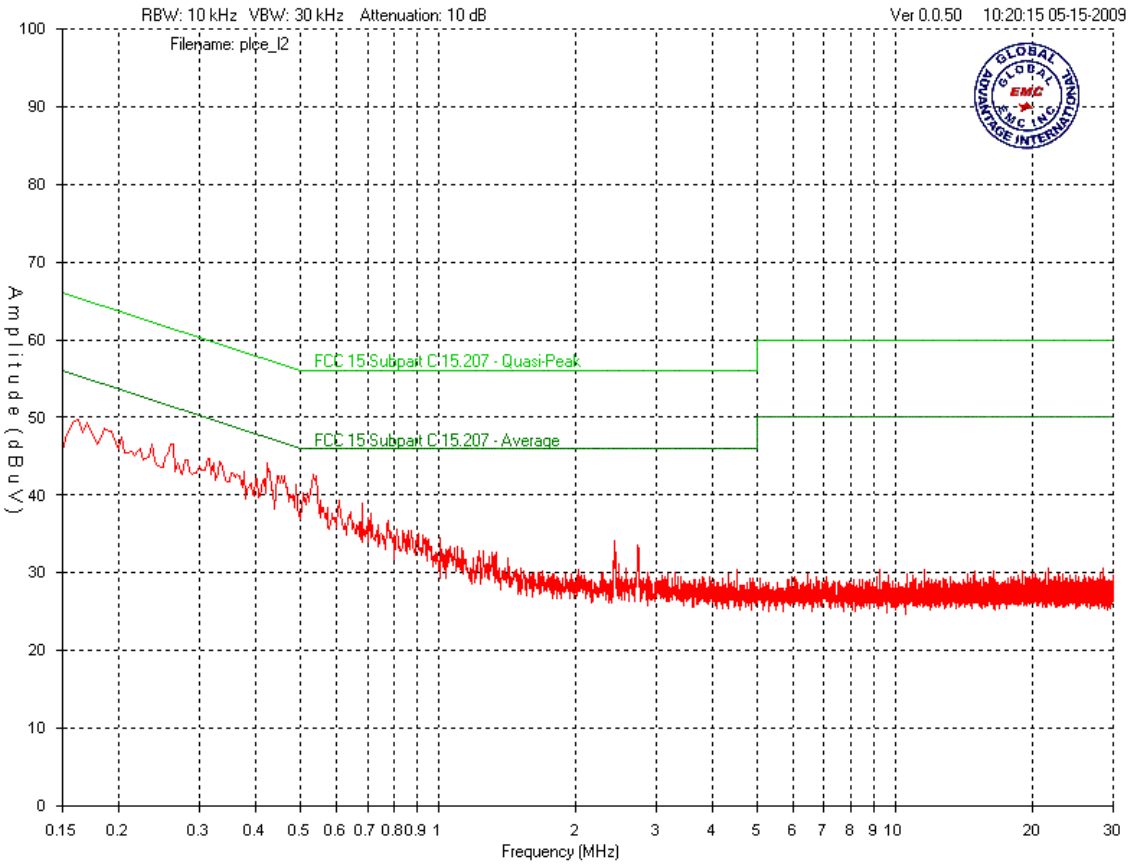
Preliminary Graphs

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. This 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

The peak emissions as shown in the graphs above did not exceed the average limits, therefore no average or quasi-peak measurements were deemed necessary for the purpose of declaring compliance.

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 #
Spectrum Analyzer	8566B	HP	2008-02-28	2010-02-28	GEMC 6
Quasi Peak Adapter	85650A	HP	2008-02-28	2010-02-28	GEMC 7
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

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.

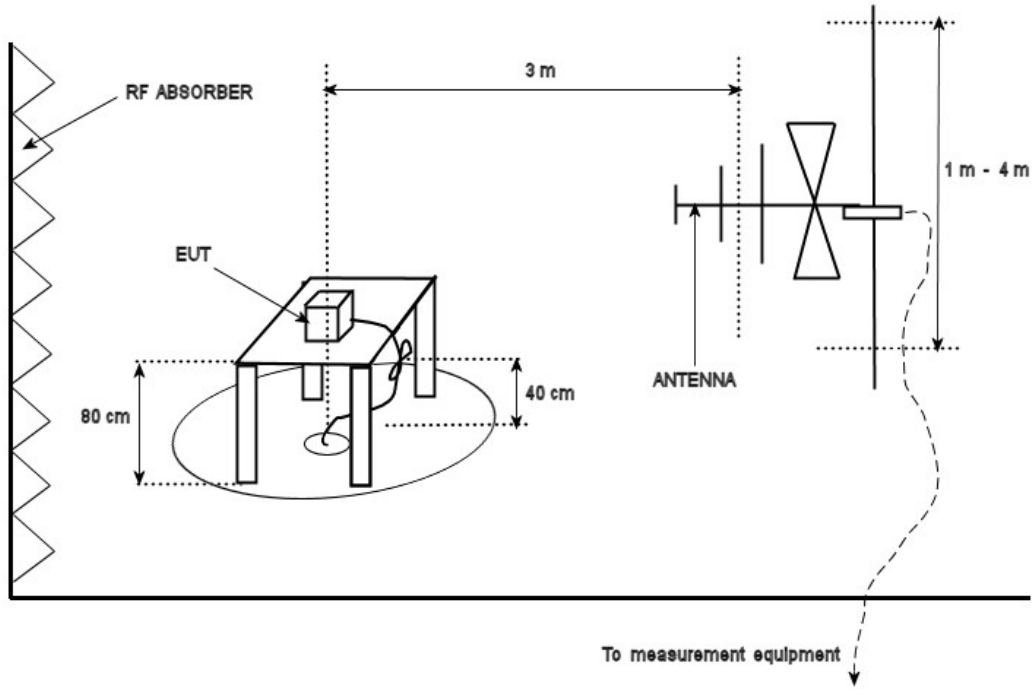
The limits, as defined in 15.247(d) for unintentional radiated emissions apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

All unintentional emissions must also meet the 'Spurious Conducted Emissions' requirements of -20 dBc or greater. See also 'Spurious Conducted Emissions' for further details.

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).

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.

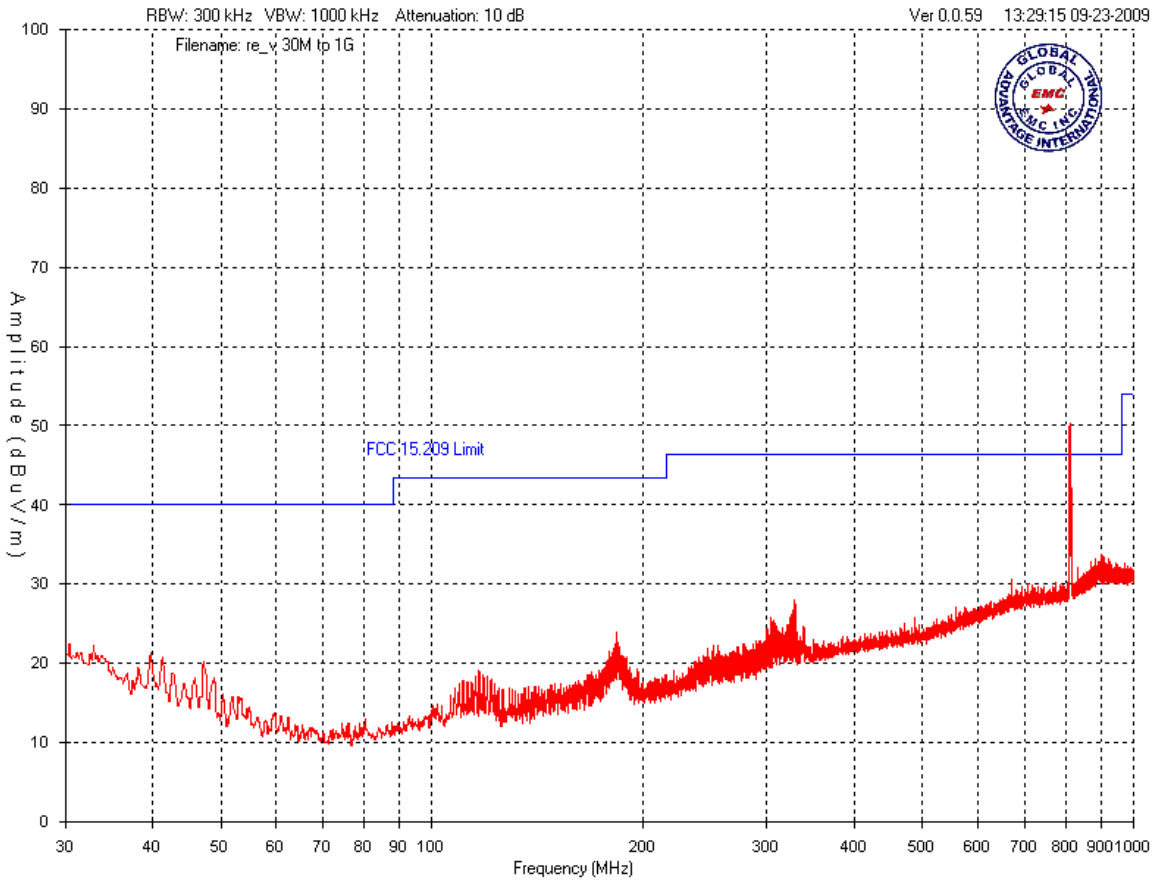
Preliminary Graphs

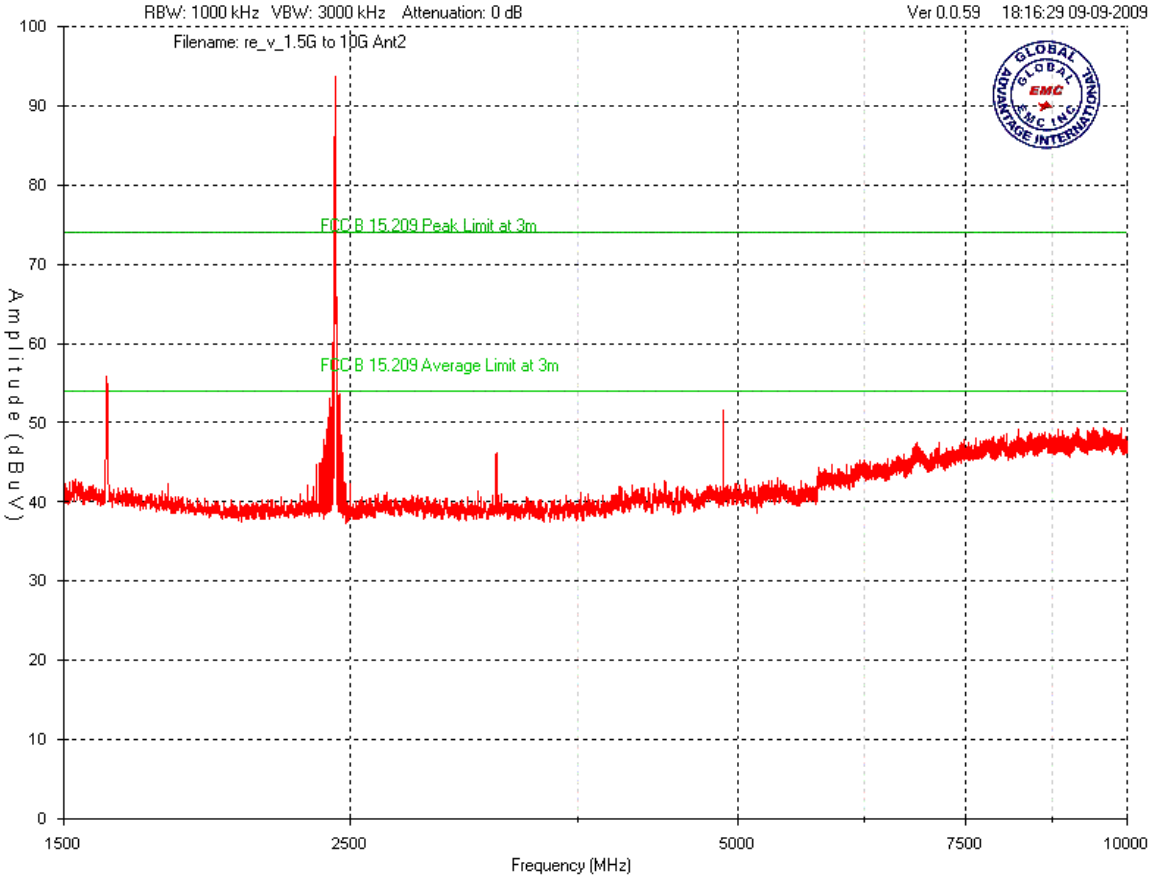
Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graph shown below is a maximized peak measurement graph, measured with a resolution bandwidth greater than the final 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 graphs shown are representative of low, middle and high band emissions and each type of antenna.

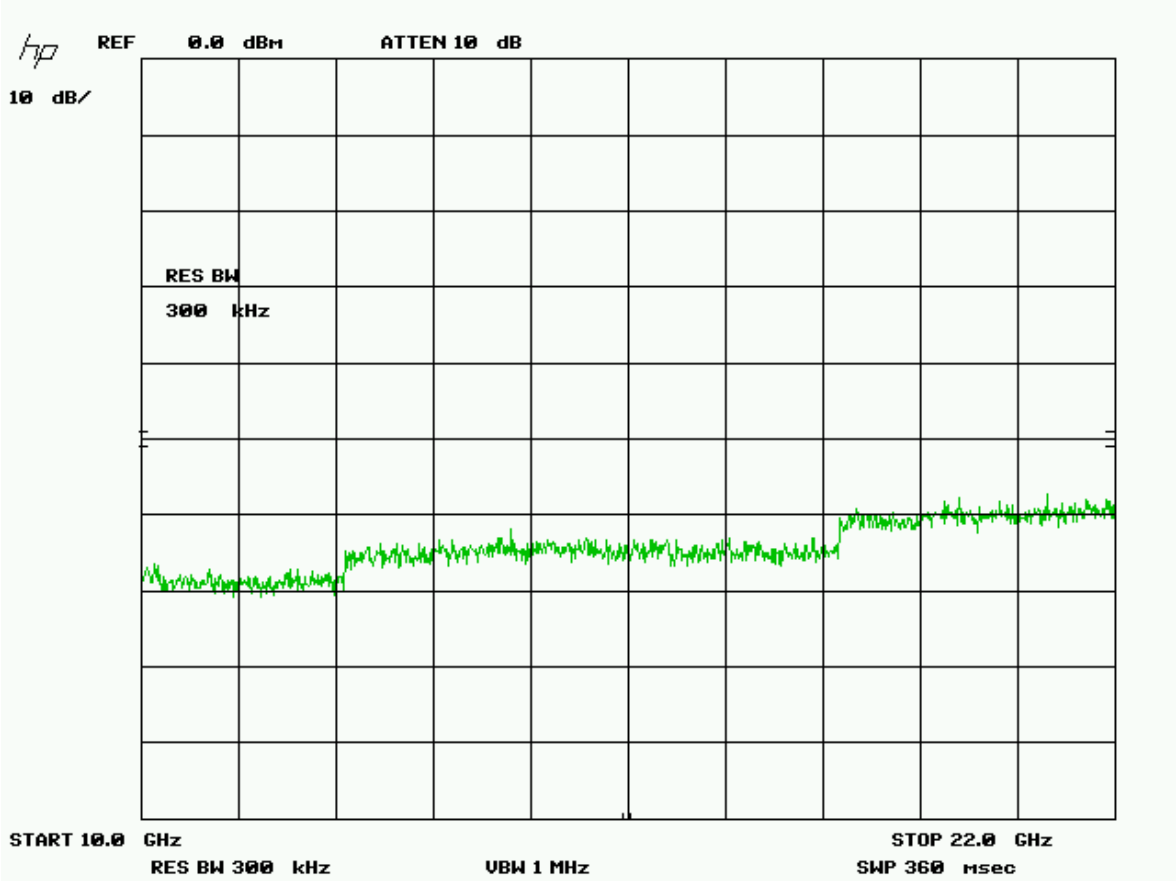
In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to a minimum of a 25 GHz.

Vertical – Peak Emissions Graph – Mid Channel (worst case)



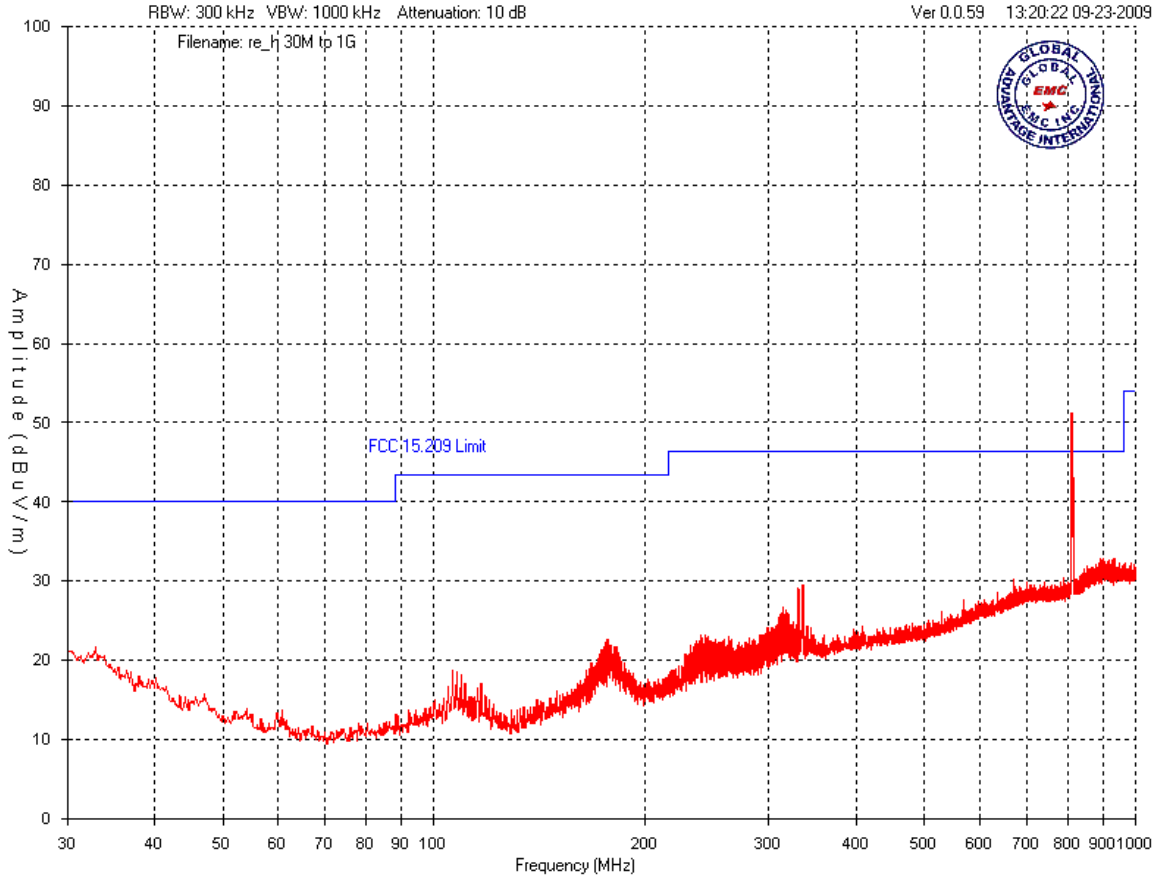


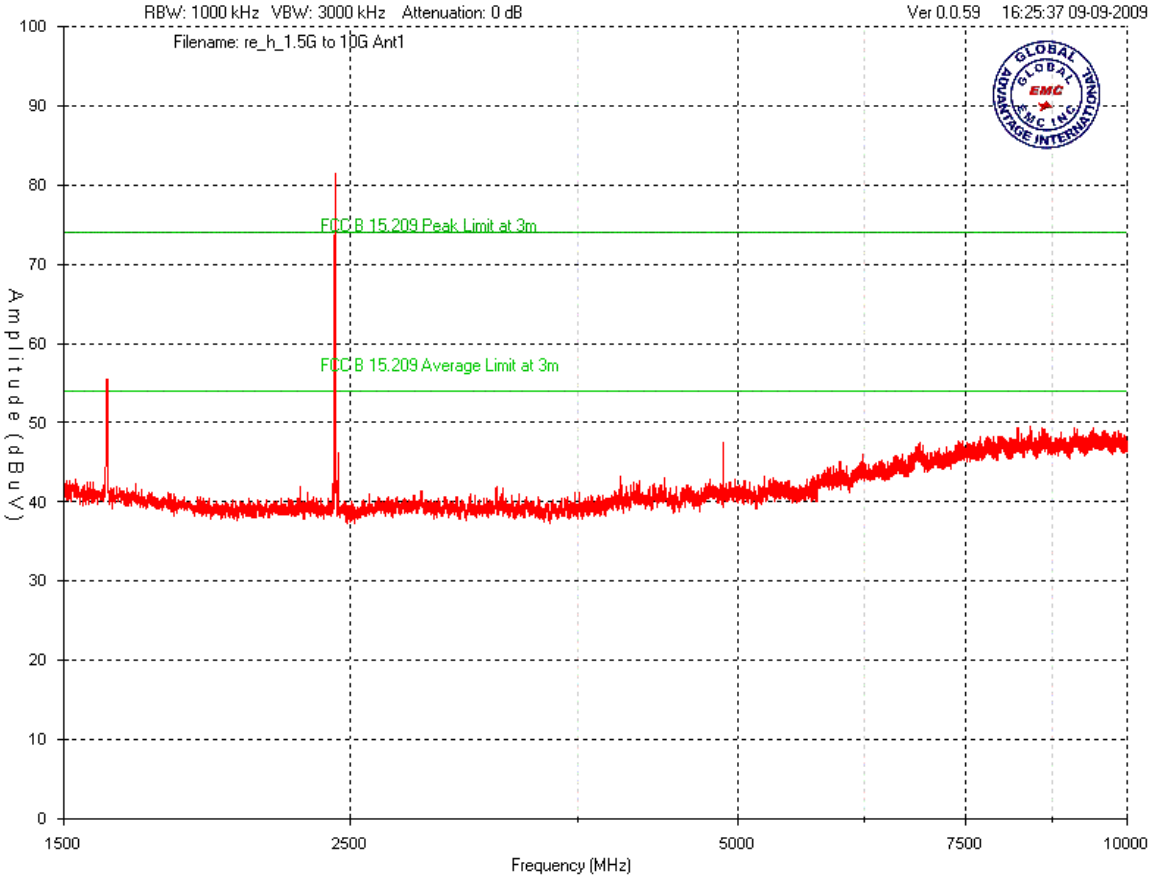
Radiated emissions vertical at 1 meter

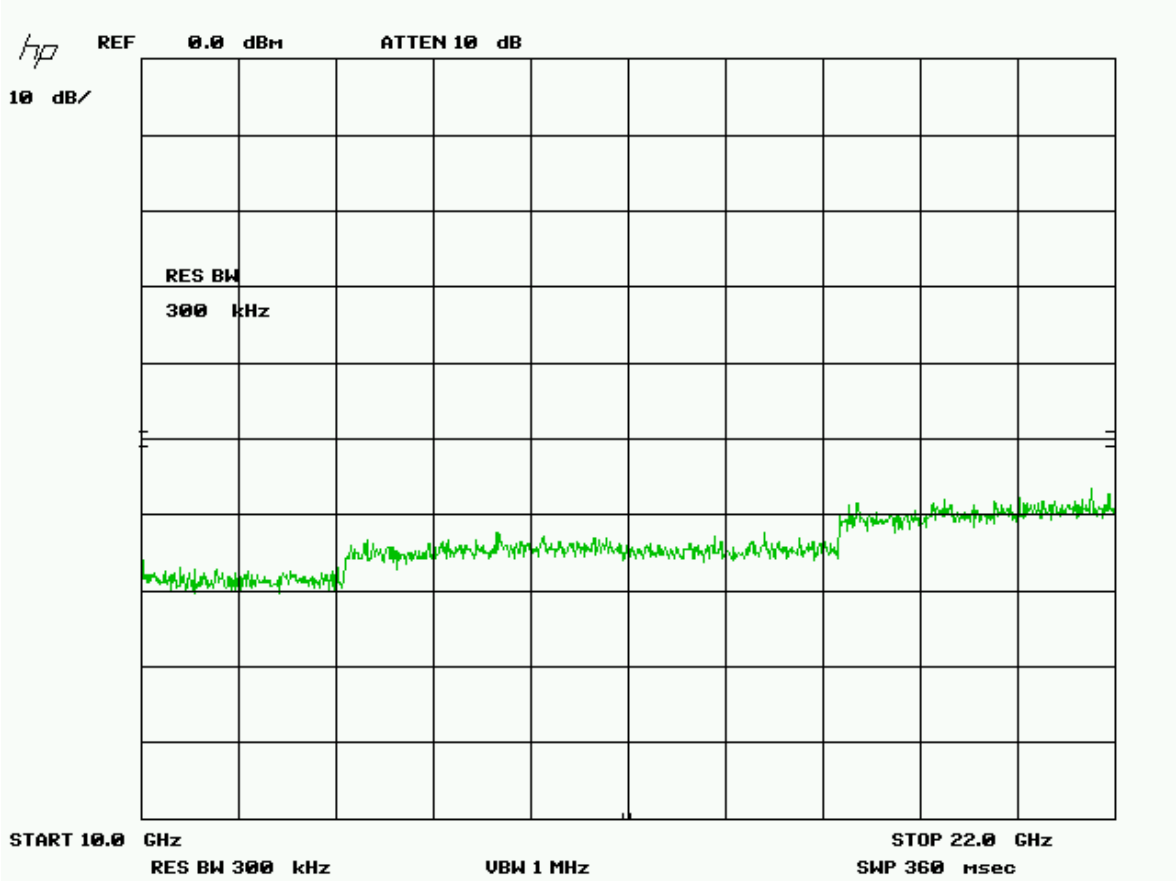


Note: Radiated emissions measurements above 10 GHz were performed at a 1 meter test distance, and in accordance with FCC 15.31(f)(1) an extrapolation factor of 9.5 dB was applied. No emissions above the 3rd harmonic were detected at 1 meter. The system noise floor at the 10th harmonic was approximately 12 dB at 1m.

Horizontal – Peak Emissions Graph – Mid Channel (worst case)







Note: Radiated emissions measurements above 10 GHz were performed at a 1 meter test distance, and in accordance with FCC 15.31(f)(1) an extrapolation factor of 9.5 dB was applied. 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.

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. However all peak emissions exceeding the 15.209 have been recorded using the applicable detector.

The requirement of -20dBc is verified by the conducted method, please see 'Spurious Antenna Conducted Emissions' section of this report.

Radiated Emissions Measurements (Antenna 1)

Quasi Peak Emissions Table – Vertical Antenna 1
Mid channel (Worst Case)

Frequency (MHz)	Detector	Raw (dBuV)	Ant. (dB/m)	Cable (dB)	Amp (dB)	Level (dBuV/m)	Limit (dB)	Margin (dB)	Pass/Fail
813	Peak	57.3	22.2	1.2	-30.4	50.3			Pass
813	QP	49.3	22.2	1.2	-30.4	42.3	46.4	4.1	Pass

Quasi Peak Emissions Table – Horizontal Antenna 1
Mid Channel (Worst Case)

Frequency (MHz)	Detector	Raw (dBuV)	Ant. (dB/m)	Cable (dB)	Amp (dB)	Level (dBuV/m)	Limit (dB)	Margin (dB)	Pass/Fail
813	Peak	58.2	22.2	1.2	-30.4	51.2			Pass
813	QP	50.2	22.2	1.2	-30.4	43.2	46.4	3.2	Pass

Test Frequency (MHz)	Detection mode (Q-Peak)	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)	Margin dB	Result
Low Channel 0 2402											
1605.9	Peak	Horz	56.6	31.2	4.0	0.0	36.0	55.8	74.0	18.2	PASS
1605.9	Avg	Horz		31.2	4.0	0.0	36.0		54.0		PASS
1605.9	Peak	Vert	48.8	31.2	4.0	0.0	36.0	48.0	74.0	26.0	PASS
1605.9	Avg	Vert		31.2	4.0	0.0	36.0		54.0		PASS
2402	Peak	Horz	84.2	31.6	4.0	0.0	36.0	83.8			PASS
2402	Avg	Horz	28.5	31.6	4.0	0.0	36.0	28.1			PASS
2402	Peak	Vert	91.8	31.6	4.0	0.0	36.0	91.4			PASS
2402	Avg	Vert	35.8	31.6	4.0	0.0	36.0	35.4			PASS
2390	Peak	Horz	49.3	31.6	4.0	0.0	36.0	48.9	74.0	25.1	PASS
2390	Avg	Horz		31.6	4.0	0.0	36.0		54.0		PASS
2390	Peak	Vert	52.5	31.6	4.0	0.0	36.0	52.1	74.0	21.9	PASS
2390	Avg	Vert		31.6	4.0	0.0	36.0		54.0		PASS
4804	Peak	Horz	46.5	30.0	11.0	0.0	36.0	51.5	74.0	22.5	PASS
4804	Avg	Horz		30.0	11.0	0.0	36.0		54.0		PASS
4804	Peak	Vert	48.4	30.0	11.0	0.0	36.0	53.4	74.0	20.6	PASS
4804	Avg	Vert		30.0	11.0	0.0	36.0		54.0		PASS
7206	Peak	Vert		36.0	12.0	0.0	35.8		74.0		PASS
7206	Avg	Vert		36.0	12.0	0.0	35.8		54.0		PASS
7206	Peak	Horz		36.0	12.0	0.0	35.8		74.0		PASS
7206	Avg	Horz		36.0	12.0	0.0	35.8		54.0		PASS

Mid channel 39 2441											
1625	Peak	Horz	54.2	31.2	4.0	0.0	36.0	53.4	74.0	20.6	PASS
1625	Avg	Horz		31.2	4.0	0.0	36.0		54.0		PASS
1625	Peak	Vert	46.8	31.2	4.0	0.0	36.0	46.0	74.0	28.0	PASS
1625	Avg	Vert		31.2	4.0	0.0	36.0		54.0		PASS
2441	Peak	Horz	82.0	31.6	4.0	0.0	36.0	81.6			PASS
2441	Avg	Horz	25.0	31.6	4.0	0.0	36.0	24.6			PASS
2441	Peak	Vert	95.5	31.6	4.0	0.0	36.0	95.1			PASS
2441	Avg	Vert	36.5	31.6	4.0	0.0	36.0	36.1			PASS
4882	Peak	Horz	47.6	30.0	11.0	0.0	36.0	52.6	74.0	21.4	PASS
4882	Avg	Horz		30.0	11.0	0.0	36.0		54.0		PASS
4882	Peak	Vert	48.9	30.0	11.0	0.0	36.0	53.9	74.0	20.1	PASS
4882	Avg	Vert		30.0	11.0	0.0	36.0		54.0		PASS
7323	Peak	Vert		36.0	12.0	0.0	35.8		74.0		PASS
7323	Avg	Vert		36.0	12.0	0.0	35.8		54.0		PASS
7323	Peak	Horz		36.0	12.0	0.0	35.8		74.0		
7323	Avg	Horz		36.0	12.0	0.0	35.8		54.0		
High Channel 79 -2480											
1653.4	Peak	Horz	47.8	31.2	4.0	0.0	36.0	47.0	74.0	27.0	PASS
1653.4	Peak	Horz		31.2	4.0	0.0	36.0		54.0		
1653.4	Peak	Vert	56.2	31.2	4.0	0.0	36.0	55.4	74.0	18.6	PASS
1653.4	Avg	Vert		31.2	4.0	0.0	36.0		54.0		
2480	Peak	Horz	76.2	31.6	4.0	0.0	36.0	91.5			PASS
2480	Avg	Horz	25.0	31.6	4.0	0.0	36.0	34.4			PASS
2480	Peak	Vert	91.9	31.5	4.0	0.0	36.0	75.7			PASS
2480	Avg	Vert	34.8	31.6	4.0	0.0	36.0	24.6			PASS
2483.5	Peak	Horz	38.2	31.6	4.0	0.0	36.0	37.8	74.0	36.2	Marker Delta
2483.5	Avg	Horz		31.6	4.0	0.0	36.0		54.0		
2483.5	Peak	Vert	53.5	31.6	4.0	0.0	36.0	53.1	74.0	20.9	PASS
2483.5	Avg	Vert		31.6	4.0	0.0	36.0		54.0		
2485.5	Peak	Horz	63.8	31.6	4.0	0.0	36.0	63.4	74.0	10.6	PASS
2485.5	Avg	Horz	35.5	31.6	4.0	0.0	36.0	35.1	54.0	18.9	PASS
2485.5	Peak	Vert	49.7	31.6	4.0	0.0	36.0	49.3	74.0	24.7	PASS
2485.5	Avg	Vert		31.6	4.0	0.0	36.0		54.0		
4960	Peak	Horz	43.8	30.0	11.0	0.0	36.0	48.8	74.0	25.2	PASS
4960	Avg	Horz		30.0	11.0	0.0	36.0		54.0		
4960	Peak	Vert	46.1	30.0	11.0	0.0	36.0	51.1	74.0	22.9	PASS
4960	Avg	Vert		30.0	11.0	0.0	36.0		54.0		
7440	Peak	Vert		36.0	12.0	0.0	35.8		74.0		
7440	Avg	Vert		36.0	12.0	0.0	35.8		54.0		
7440	Peak	Horz		36.0	12.0	0.0	35.8		74.0		
7440	Avg	Horz		36.0	12.0	0.0	35.8		54.0		

Quasi Peak Emissions Table – Vertical Antenna 1
Mid channel (Worst Case)

Frequency (MHz)	Detector	Raw (dBuV)	Ant. (dB/m)	Cable (dB)	Amp (dB)	Level (dBuV/m)	Limit (dB)	Margin (dB)	Pass/Fail
813	Peak	56.3	22.2	1.2	-30.4	49.3			Pass
813	QP	48.3	22.2	1.2	-30.4	41.3	46.4	5.1	Pass

Quasi Peak Emissions Table – Horizontal Antenna 1
Mid Channel (Worst Case)

Frequency (MHz)	Detector	Raw (dBuV)	Ant. (dB/m)	Cable (dB)	Amp (dB)	Level (dBuV/m)	Limit (dB)	Margin (dB)	Pass/Fail
813	Peak	57.1	22.2	1.2	-30.4	49.9			Pass
813	QP	49.1	22.2	1.2	-30.4	42.1	46.4	4.3	Pass

Test Frequency (MHz)	Detection mode (Q-Peak)	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)	Margin dB	Result
Low Channel 0 2402											
1605.9	Peak	Horz	55.8	31.2	4.0	0.0	36.0	55.0	74.0	19.0	PASS
1605.9	Avg	Horz		31.2	4.0	0.0	36.0		54.0		PASS
1605.9	Peak	Vert	47.2	31.2	4.0	0.0	36.0	46.4	74.0	27.6	PASS
1605.9	Avg	Vert		31.2	4.0	0.0	36.0		54.0		PASS
2402	Peak	Horz	82.9	31.6	4.0	0.0	36.0	82.5			PASS
2402	Avg	Horz	27.6	31.6	4.0	0.0	36.0	27.2			PASS
2402	Peak	Vert	89.9	31.6	4.0	0.0	36.0	89.5			PASS
2402	Avg	Vert	33.9	31.6	4.0	0.0	36.0	33.5			PASS
2390	Peak	Horz	48.6	31.6	4.0	0.0	36.0	48.2	74.0	25.8	PASS
2390	Avg	Horz		31.6	4.0	0.0	36.0		54.0		PASS
2390	Peak	Vert	50.6	31.6	4.0	0.0	36.0	50.2	74.0	23.8	PASS
2390	Avg	Vert		31.6	4.0	0.0	36.0		54.0		PASS
4804	Peak	Horz	46.1	30.0	11.0	0.0	36.0	51.1	74.0	22.9	PASS
4804	Avg	Horz		30.0	11.0	0.0	36.0		54.0		PASS
4804	Peak	Vert	48.2	30.0	11.0	0.0	36.0	53.2	74.0	20.8	PASS
4804	Avg	Vert		30.0	11.0	0.0	36.0		54.0		PASS
7206	Peak	Vert		36.0	12.0	0.0	35.8		74.0		PASS
7206	Avg	Vert		36.0	12.0	0.0	35.8		54.0		PASS
7206	Peak	Horz		36.0	12.0	0.0	35.8		74.0		PASS
7206	Avg	Horz		36.0	12.0	0.0	35.8		54.0		PASS
Mid channel 39 2441											
1625	Peak	Horz	52.5	31.2	4.0	0.0	36.0	51.7	74.0	22.3	PASS

1625	Avg	Horz		31.2	4.0	0.0	36.0		54.0		PASS
1625	Peak	Vert	46.7	31.2	4.0	0.0	36.0	45.9	74.0	28.1	PASS
1625	Avg	Vert		31.2	4.0	0.0	36.0		54.0		PASS
2441	Peak	Horz	80.7	31.6	4.0	0.0	36.0	80.3			PASS
2441	Avg	Horz	24.9	31.6	4.0	0.0	36.0	24.5			PASS
2441	Peak	Vert	94.2	31.6	4.0	0.0	36.0	93.8			PASS
2441	Avg	Vert	35.7	31.6	4.0	0.0	36.0	35.3			PASS
4882	Peak	Horz	47.4	30.0	11.0	0.0	36.0	52.4	74.0	21.6	PASS
4882	Avg	Horz		30.0	11.0	0.0	36.0		54.0		PASS
4882	Peak	Vert	47.3	30.0	11.0	0.0	36.0	52.3	74.0	21.7	PASS
4882	Avg	Vert		30.0	11.0	0.0	36.0		54.0		PASS
7323	Peak	Vert		36.0	12.0	0.0	35.8		74.0		PASS
7323	Avg	Vert		36.0	12.0	0.0	35.8		54.0		PASS
7323	Peak	Horz		36.0	12.0	0.0	35.8		74.0		PASS
7323	Avg	Horz		36.0	12.0	0.0	35.8		54.0		PASS
High Channel 79 -2480											
1653.4	Peak	Horz	46.3	31.2	4.0	0.0	36.0	45.5	74.0	28.5	PASS
1653.4	Peak	Horz		31.2	4.0	0.0	36.0		54.0		PASS
1653.4	Peak	Vert	56.1	31.2	4.0	0.0	36.0	55.3	74.0	18.7	PASS
1653.4	Avg	Vert		31.2	4.0	0.0	36.0		54.0		PASS
2480	Peak	Horz	75.3	31.6	4.0	0.0	36.0	90.7			PASS
2480	Avg	Horz	24.8	31.6	4.0	0.0	36.0	33.6			PASS
2480	Peak	Vert	91.1	31.5	4.0	0.0	36.0	74.8			PASS
2480	Avg	Vert	34.0	31.6	4.0	0.0	36.0	24.4			PASS
2483.5	Peak	Horz	37.1	31.6	4.0	0.0	36.0	36.7	74.0	37.3	Marker Delta
2483.5	Avg	Horz		31.6	4.0	0.0	36.0		54.0		PASS
2483.5	Peak	Vert	53.2	31.6	4.0	0.0	36.0	52.8	74.0	21.2	PASS
2483.5	Avg	Vert		31.6	4.0	0.0	36.0		54.0		PASS
2485.5	Peak	Horz	62.5	31.6	4.0	0.0	36.0	62.1	74.0	11.9	PASS
2485.5	Avg	Horz	34.1	31.6	4.0	0.0	36.0	33.7	54.0	20.3	PASS
2485.5	Peak	Vert	49.5	31.6	4.0	0.0	36.0	49.1	74.0	24.9	PASS
2485.5	Avg	Vert		31.6	4.0	0.0	36.0		54.0		PASS
4960	Peak	Horz	42.5	30.0	11.0	0.0	36.0	47.5	74.0	26.5	PASS
4960	Avg	Horz		30.0	11.0	0.0	36.0		54.0		PASS
4960	Peak	Vert	44.8	30.0	11.0	0.0	36.0	49.8	74.0	24.2	PASS
4960	Avg	Vert		30.0	11.0	0.0	36.0		54.0		PASS
7440	Peak	Vert		36.0	12.0	0.0	35.8		74.0		PASS
7440	Avg	Vert		36.0	12.0	0.0	35.8		54.0		PASS
7440	Peak	Horz		36.0	12.0	0.0	35.8		74.0		PASS
7440	Avg	Horz		36.0	12.0	0.0	35.8		54.0		PASS

For information purposes, the fundamental was measured to be 95.1 dBuV/m, peak, at 3 meters, and none of the unintentional radiated emissions that fall outside of the restricted bands exceeded the -20dBc (or 75.1 dBuV/m) requirement.

See ‘Spurious Antenna Conducted Emissions’ measurements for -20 dBc requirements.

Test Equipment List

Equipment	Model #	Manufacturer	Cal date (yyyy-mm-dd)	Due Date (yyyy-mm-dd)	Equipment ID# (GEMC xxx)
Spectrum Analyzer	8566B	HP	2008-02-28	2010-02-28	6
Quasi Peak Adapter	85650A	HP	2008-02-28	2010-02-28	7
BiLog Antenna	3142-C	ETS	2009-02-12	2011-02-12	8
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	29
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	30
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	31
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	40
IFR Spectrum Analyzer	AN940	IFR	NCR	NCR	6350
A.H. Systems Horn Antenna 18 GHz - 26.5 GHz	SAS-572	AH	NCR	NCR	6371
Schaffner Preamp 9kHz - 2 GHz	CPA9231A	Schaffner	8/26/2008	8/26/2010	116
Q-Par 1.5-18 GHz Horn	6878/24	Q-par	8/25/2008	8/25/2010	6365
HP Preamp	HP-8449B	HP	8/25/2008	8/25/2010	6351

This report module is based on GEMC template “FCC - 15.209 - Radiated Emissions_Rev2.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.

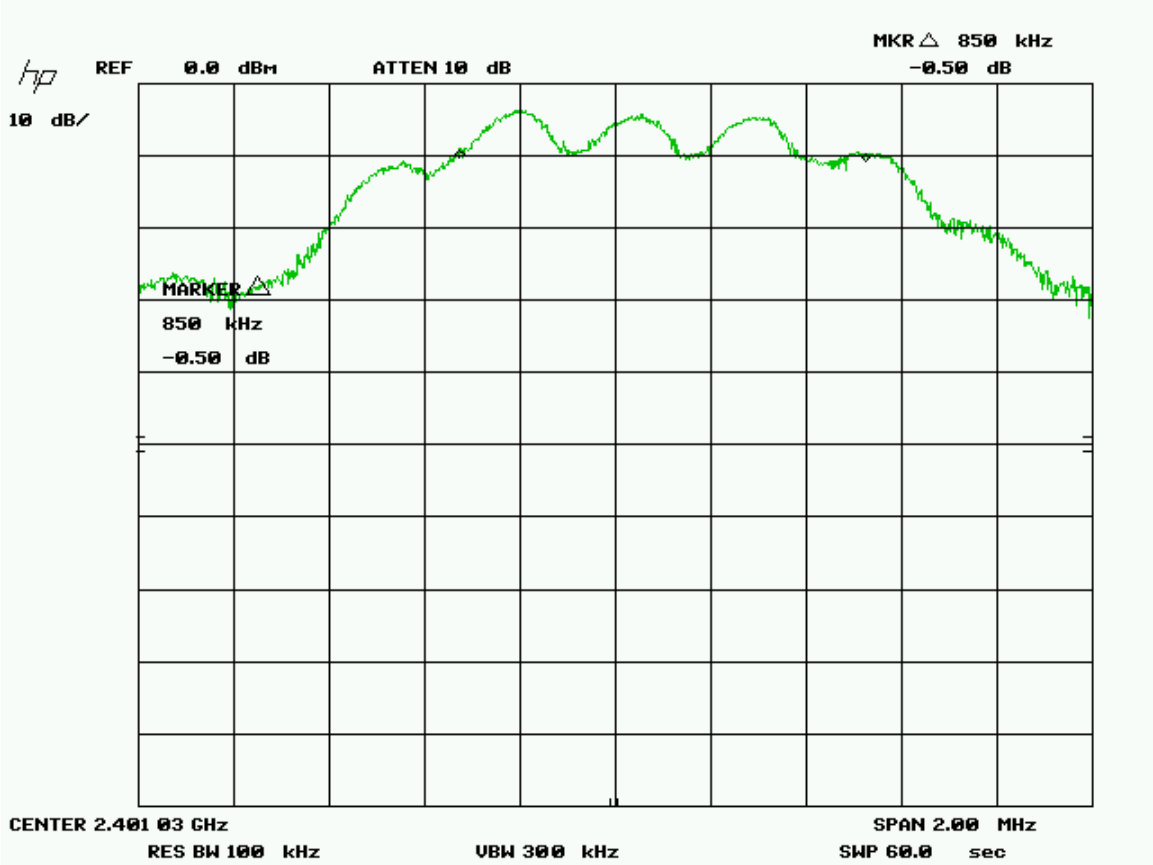
Results

The EUT passed. The lowest 6 dB BW measured was 850 kHz

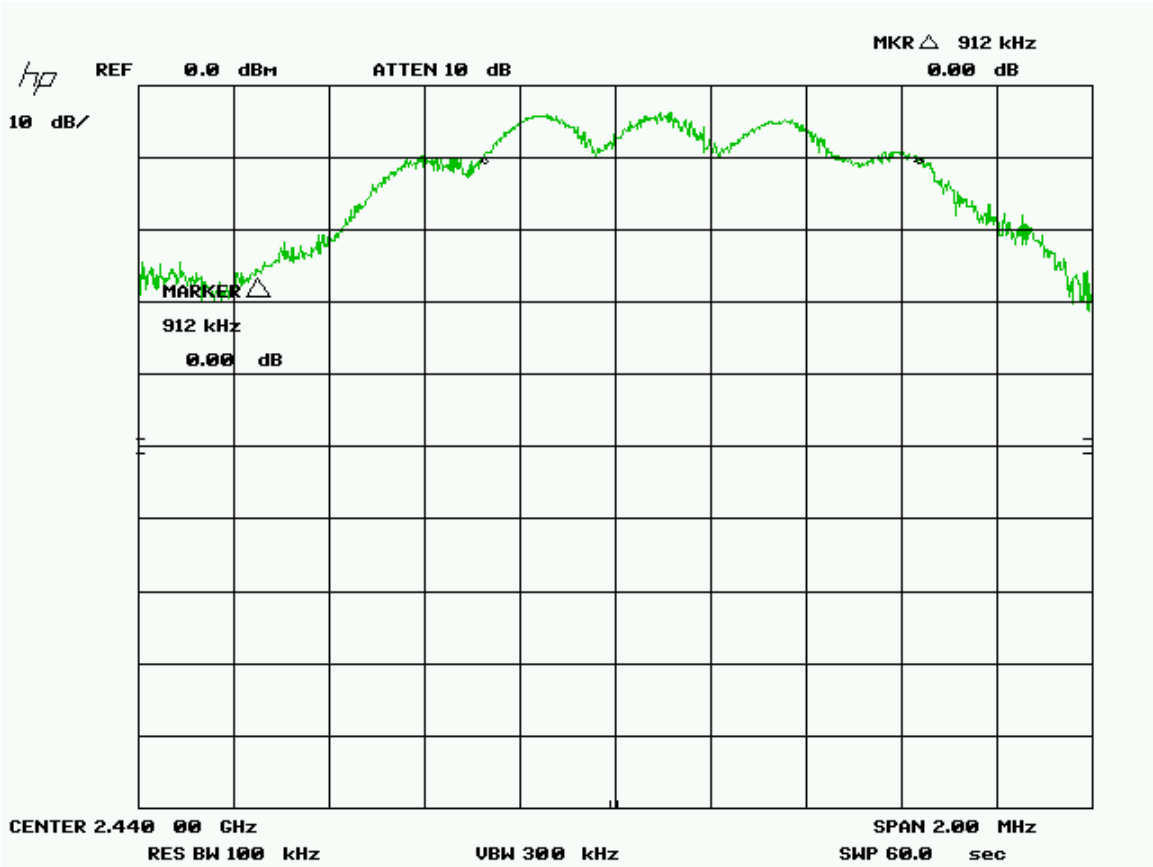
Graph(s)

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.

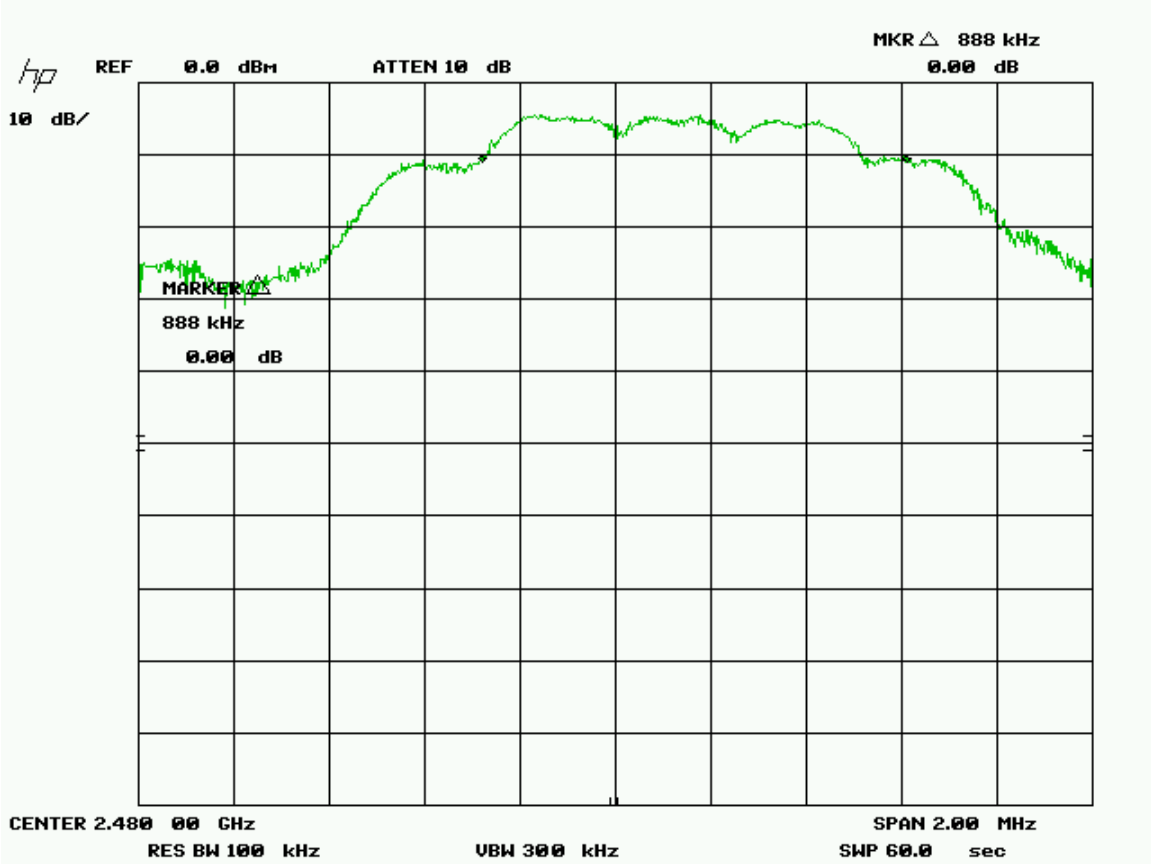
Low Channel – 6 dB Bandwidth



Mid Channel 6 dB Bandwidth



High Channel 6 dB Bandwidth



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

Test Equipment List

Equipment	Model #	Manufacturer	Cal date (yyyy-mm-dd)	Due Date (yyyy-mm-dd)	Equipment ID# (GEMC xxx)
Spectrum Analyzer	8566B	HP	2008-02-28	2010-02-28	6
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	31

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

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 2.0 dBm (1.6 mW).

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.

Test Data

Band	Channel	Frequency (GHz)	Output Power (dBm)
Low	0	2402	1.2
Medium	39	2441	2.0
High	79	2480	1.5

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 #
Spectrum Analyzer	8566B	HP	2008-02-28	2010-02-28	6
Power meter	PM 2002	AR	2008-07-17	2010-07-19	GEMC 16
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

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

Spurious Conducted Emissions

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element at frequencies outside of the authorized spectrum does not exceed the limits specified. This ensures that the only the intended signal is delivered to the radiating element.

Limits

The limits are defined in 15.247(d). In any 100 kHz band, the peak spurious harmonics emissions must be at least 20 dB below the fundamental. Spurious Conducted emissions are to be evaluated up to the 10^{th} harmonic. This -20 dBc requirement also applies at the 'band edge' or 2.4 GHz and 2.4835 GHz.

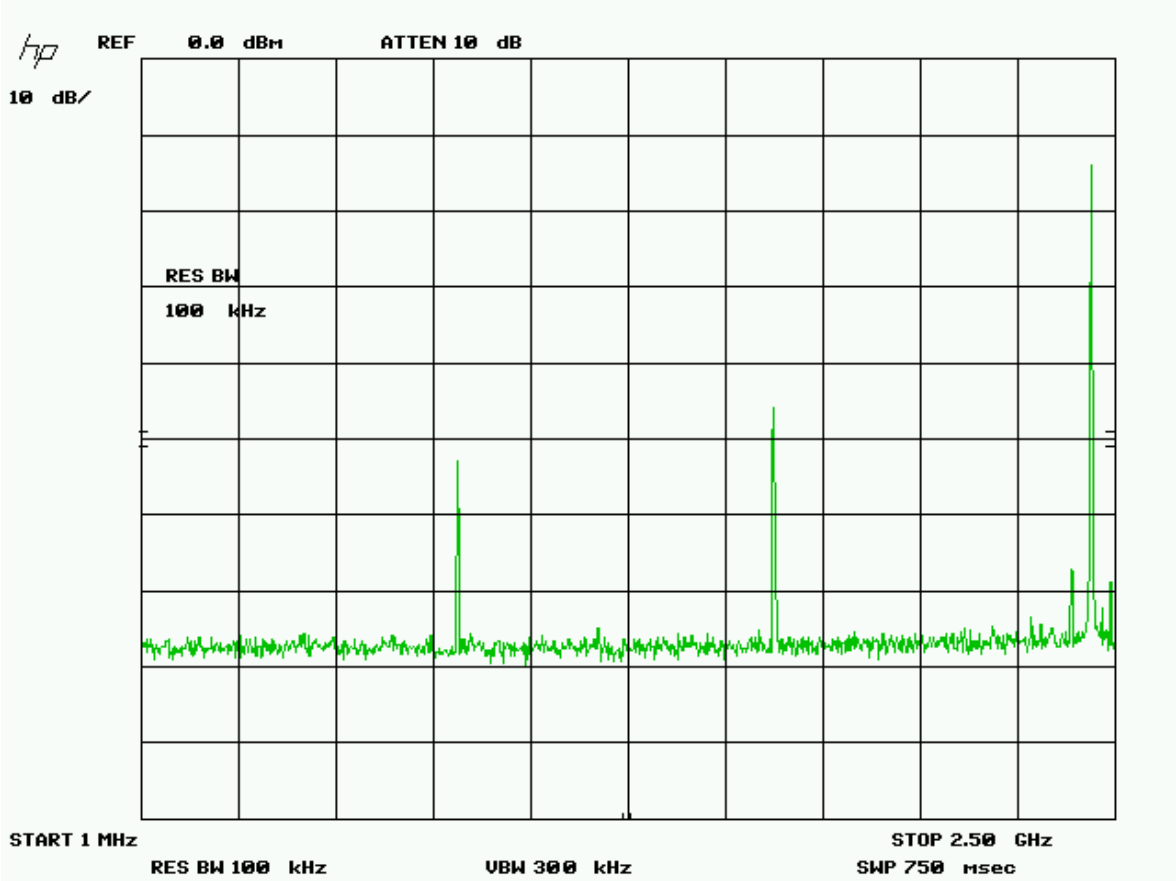
Results

The EUT passed. Low, middle and high band was measured. The worst case graphs for the spectrum are shown.

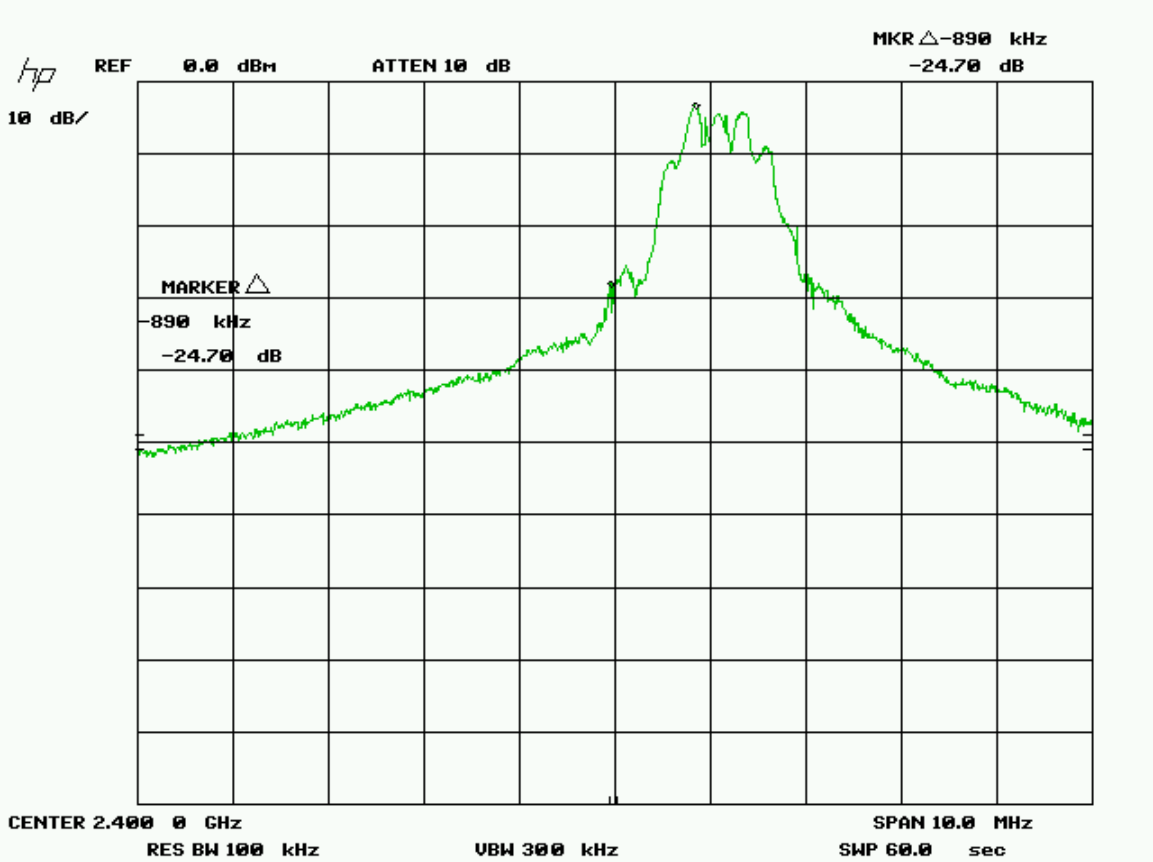
Graph(s)

The graphs shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT. Note there was 20 dB of external attenuation taken during this measurement.

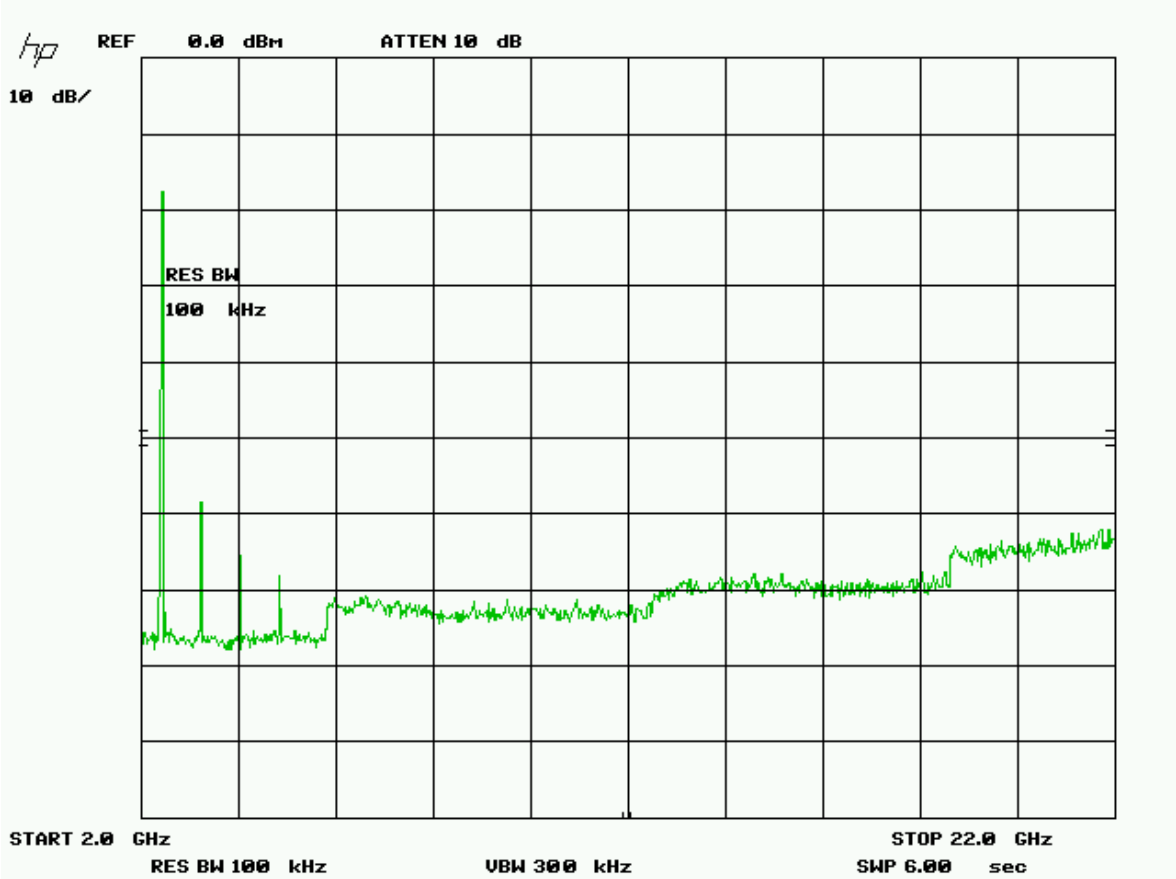
Frequencies below fundamental – Mid Channel



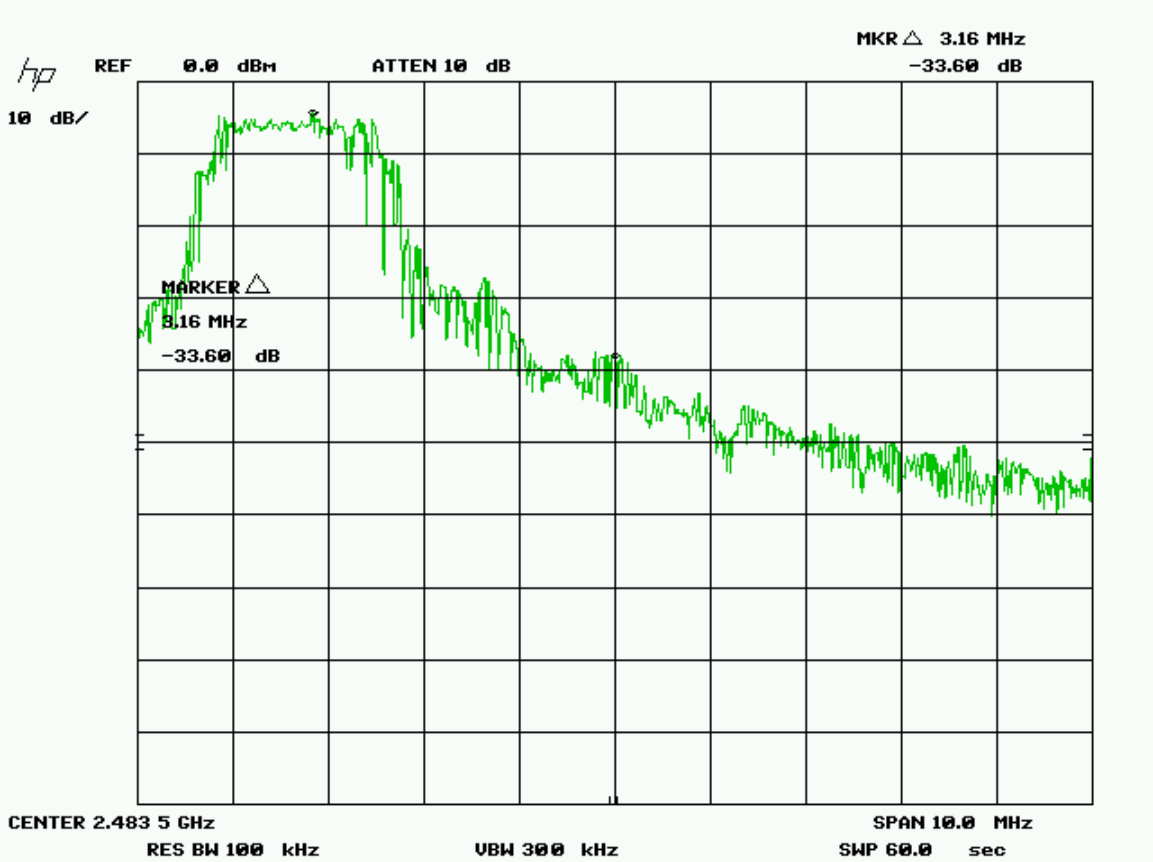
Band edge -20dBc – Low Channel



Harmonics – Mid Channel



Band Edge – High channel



The frequency range of 22 – 25 GHz, the 10th harmonic and 9th harmonic where applicable, was additionally scanned using an alternate spectrum analyzer, in low, middle and high band for each mode. No emissions were detected at the 9th and 10th harmonic.

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 1 dB	FP-50-1	Trilithic	NCR	NCR	GEMC 38
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	GEMC 40
Attenuator 6 dB	FP-50-6	Trilithic	NCR	NCR	GEMC 41
Attenuator 10 dB	FP-50-10	Trilithic	NCR	NCR	GEMC 42
Attenuator 20 dB	FP-50-20	Trilithic	NCR	NCR	GEMC 43
Spectrum Analyzer	8566B	HP	2006-08-09	2008-08-09	GEMC 6
Quasi Peak Adapter	85650A	HP	2006-08-07	2008-08-07	GEMC 7
IFR Spectrum Analyzer	AN940	IFR	NCR	NCR	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.

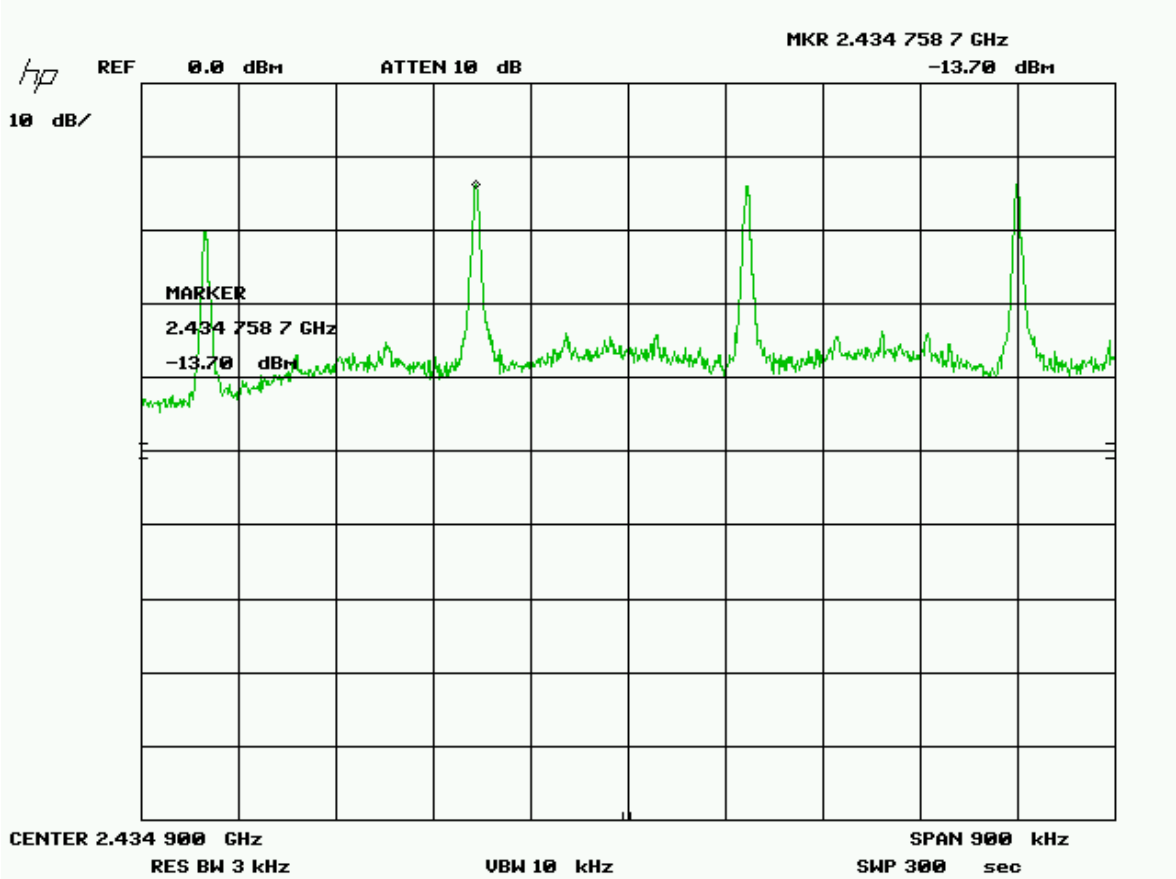
Results

The EUT passed. Each mode was tested at low, medium, and high band. The worst case value is -3.7 dBm. The maximum peak power output is significantly less than 8 dBm, therefore this device meets this requirement by design.

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.

Mid 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 #
Spectrum Analyzer	8566B	HP	2008-02-28	2010-02-28	6
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

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 2.5cm, as this is the distance that a body worn device is to use for the purpose of calculation.

Results

The EUT passed the requirements. The worst case calculated power density was 0.033 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 = 2.0 dBm or 1.6 mW as per Peak power conducted output
Where G = 2 dBi, or numerically 1.6
Where R = 2.5 cm

$P_d = (1.6\ mW * 1.6) / (4 * pi * 2.5\ cm^2)$
$P_d = 2.56\ mW / 78.5\ cm^2$
$P_d = 0.033\ mW/cm^2$

Appendix A – EUT Summary

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

General EUT Description

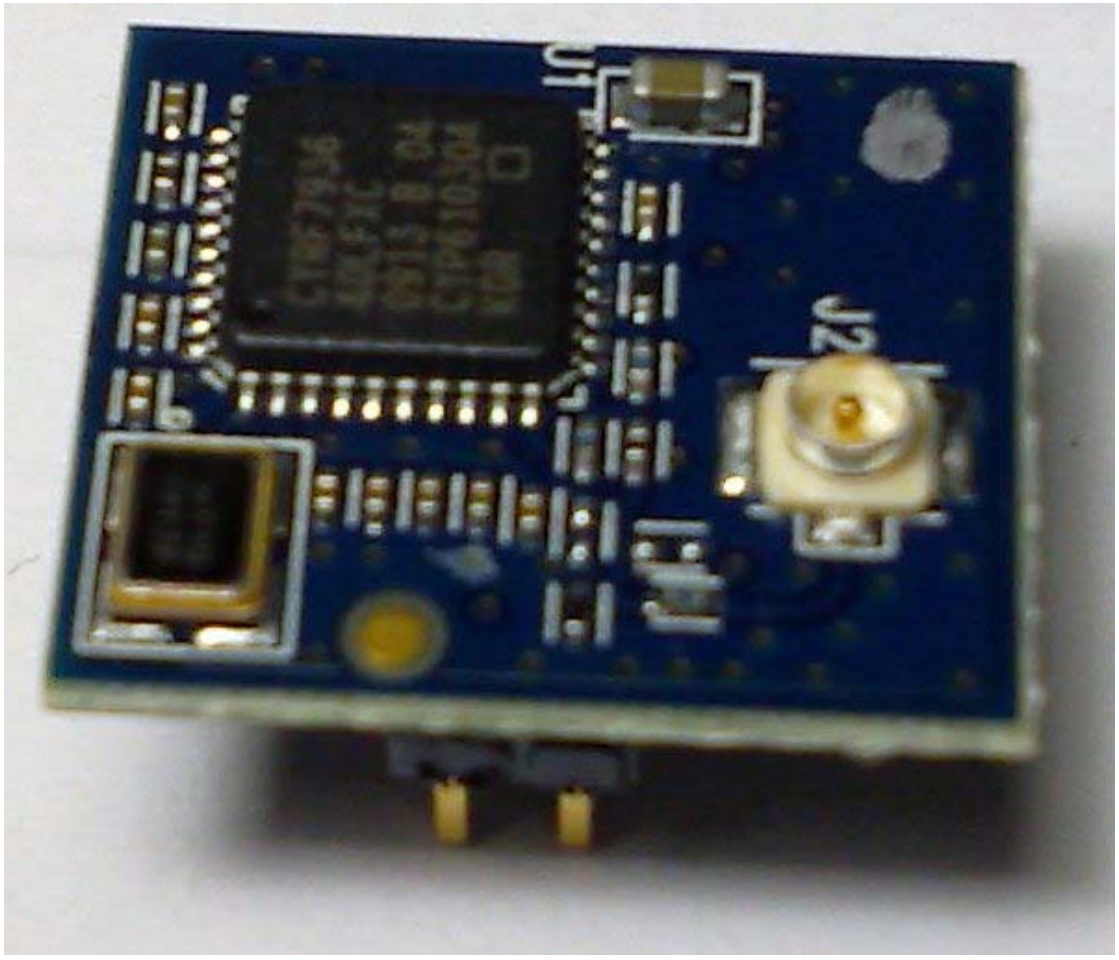
Company & Address	Artaflex
	215 Konrad Crescent Markham, ON L3R 8T9 Canada
EUT Name	Artaflex Wireless Radio Module (AW24MUFL)
FCCID	UP2 AW24MUFL
IC #	6797A-AW24MUFL
Approximate Size (LxWxH)	16mm x 14mm x 7mm
Input Voltage and Frequency	120 Vac, 60 Hz
Rated Input Current	< 100 mA
Intentional RF (If yes describe)	Yes- 2.4 GHz @ < 2.5 mW
Table Top / Wall mount / Floor standing (choose table top if unsure)	Table top.
I/O Connectors available on EUT	None
Peripherals required for test	The EUT requires a testbed platform.
Minimum Separation distance from operator	The device could be body worn.
Types and lengths of all I/O cables	No I/O cables.

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'.

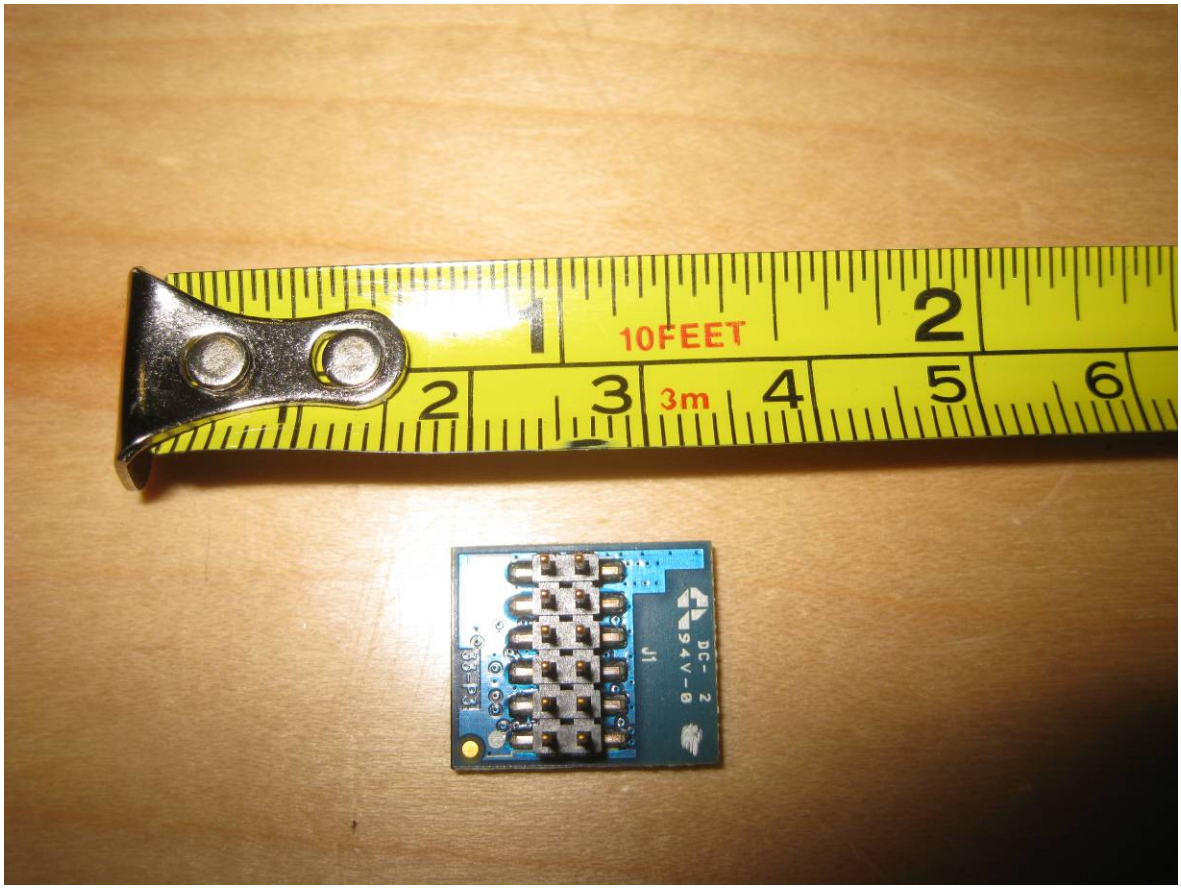
Appendix B – EUT and Test Setup Photographs

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

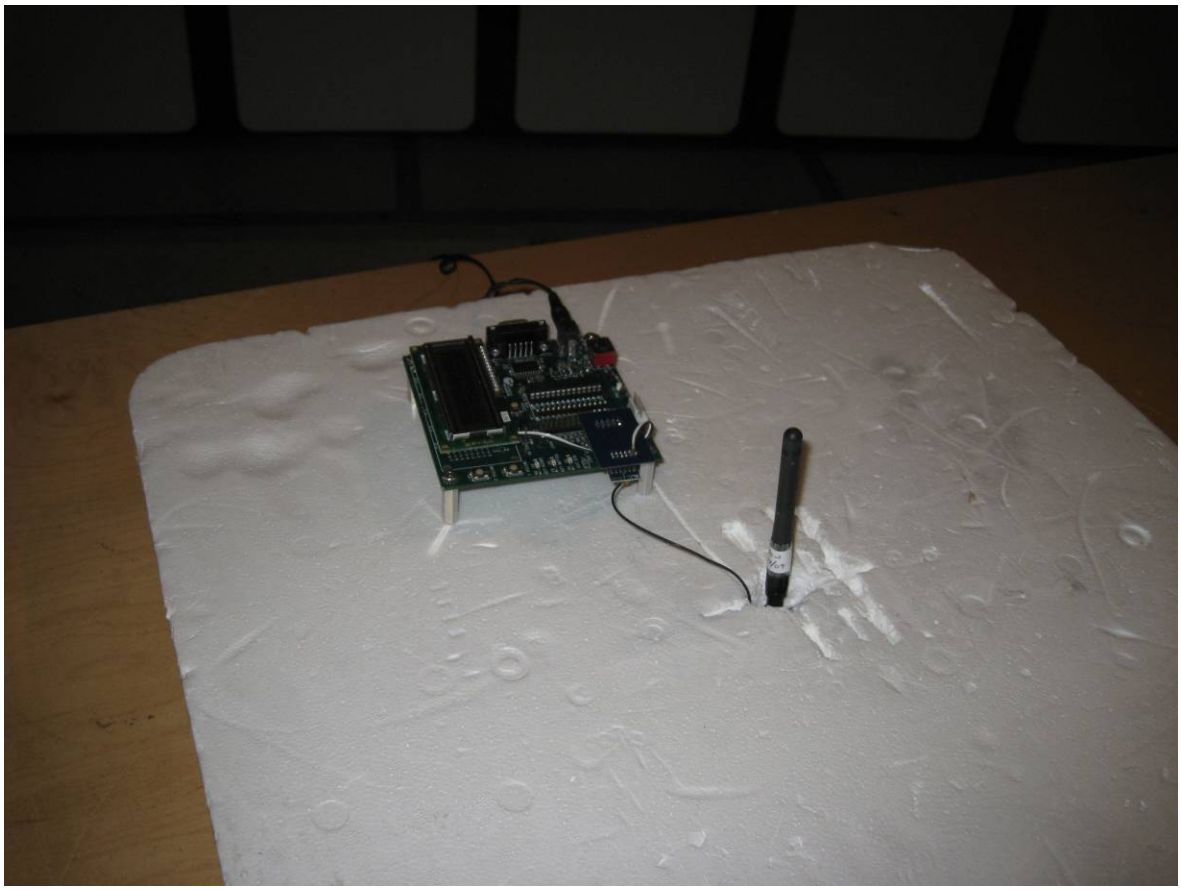
EUT – Front



EUT – Back

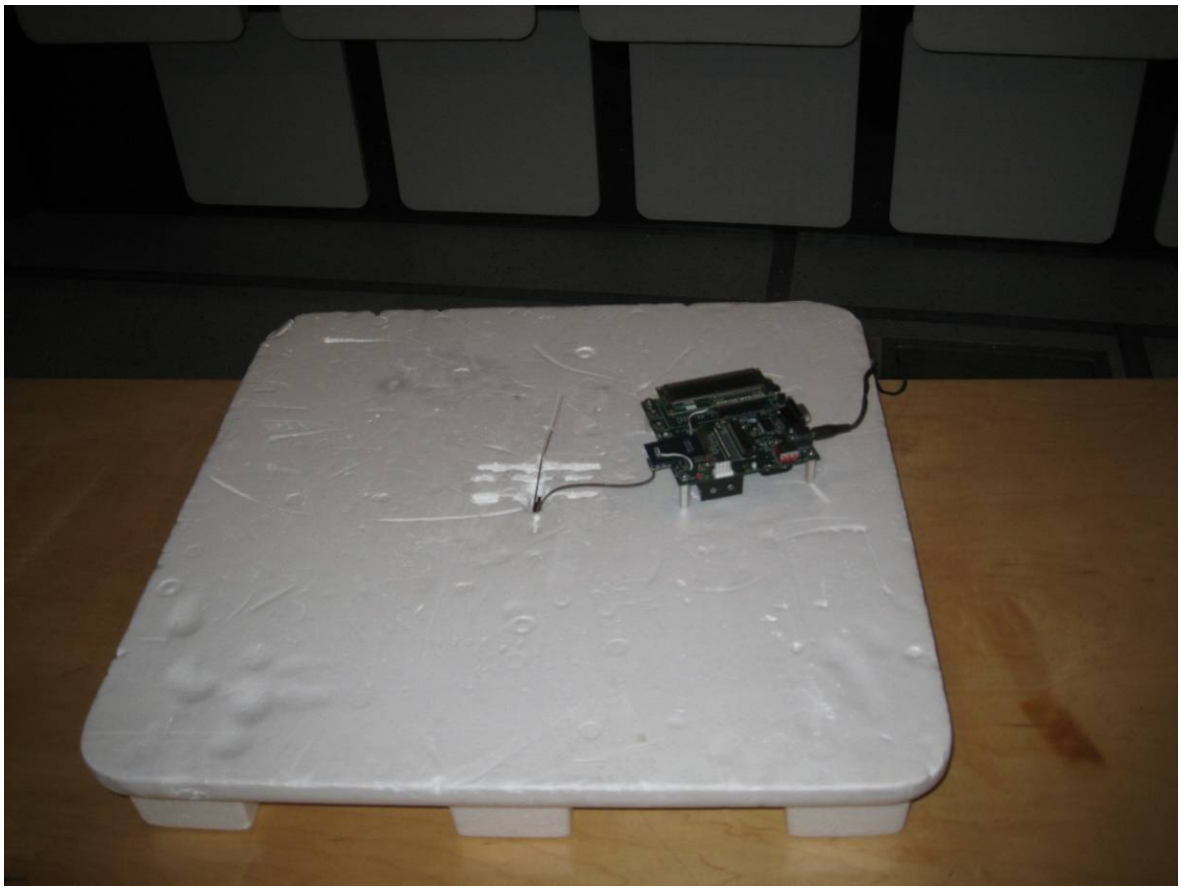


Radiated Emissions – Photo 1 – Antenna 1



Radiated Emissions – Photo 2 – Antenna 1

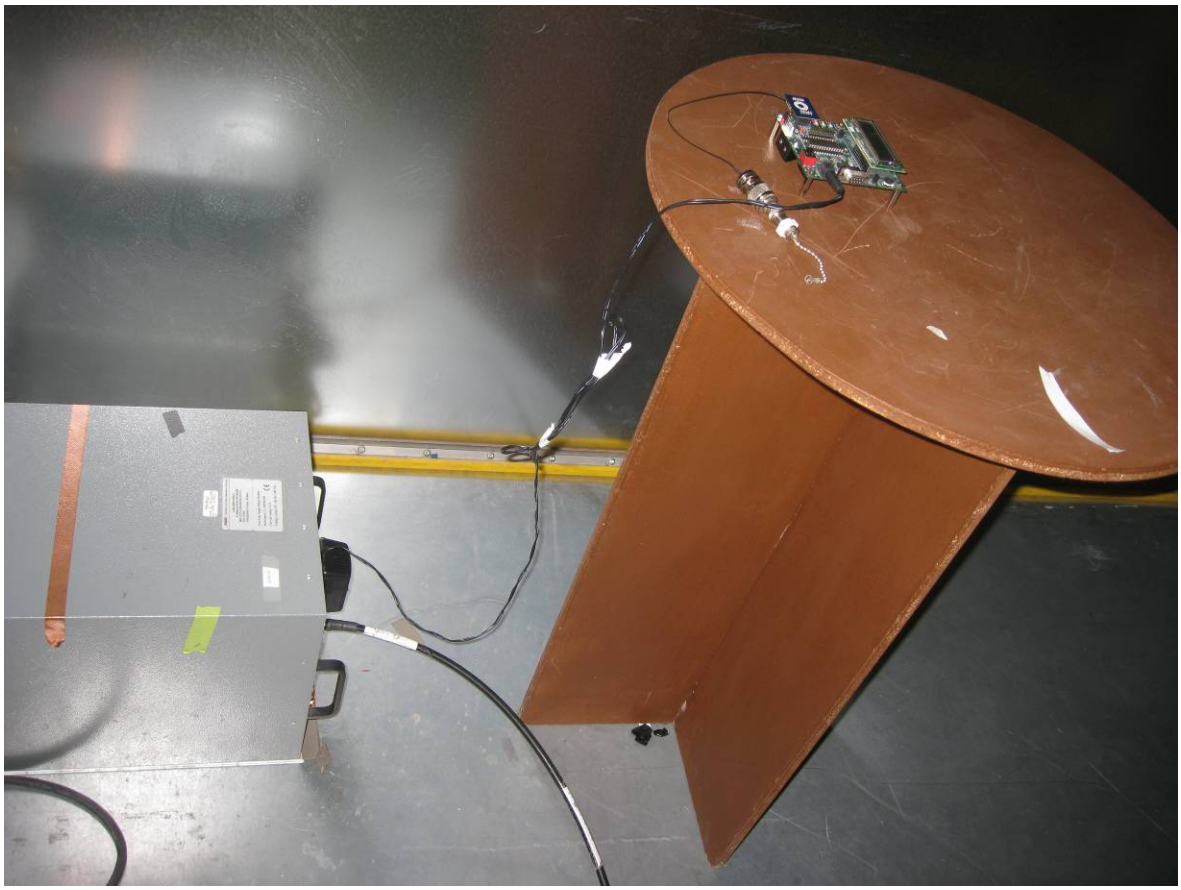
Radiated Emissions – Photo 3 – Antenna 2



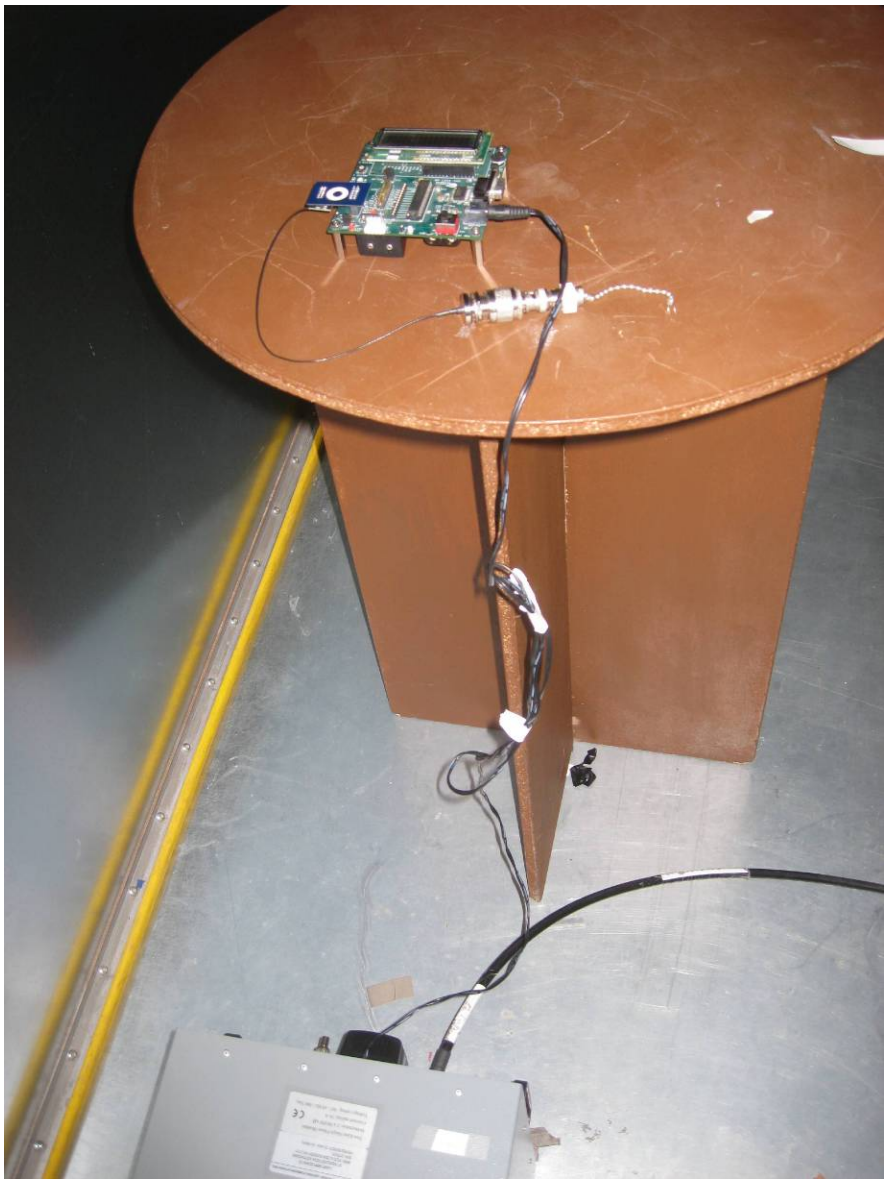
Antennas Close Up

Note: Antenna 1 on top, Antenna 2 on bottom.

Power Line Conducted Emissions – Photo 1



Power Line Conducted Emissions – Photo 2



Antenna Conducted Measurements