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 Module (AW24RUH)

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

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Report Scope

This report addresses the EMC verification testing and test results of the AWAC24U, 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	AW24RUH
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:	UP2AW24RUH
EUT Industry Canada Certification #, IC:	6797A-AW24RU
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Scott Drysdale

Client	**Artaflex**
Product	AW24RUH
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 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 (20 dB)	> 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	Maximum Permissible Exposure	> 20 cm separation.	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 contains a U.Fl connector.

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

For the power line conducted emissions requirements, the EUT is DC powered, and this test does not apply, however for the purposes of this report they are included with a representative host test bed system.

For the Antenna gain, this device uses an external monopole (rubber ducky) antenna with a gain less than 6 dBi.

For maximum permissible exposure, this device operates 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
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
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 - Jan 18, 2011

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)
Jan 2011	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

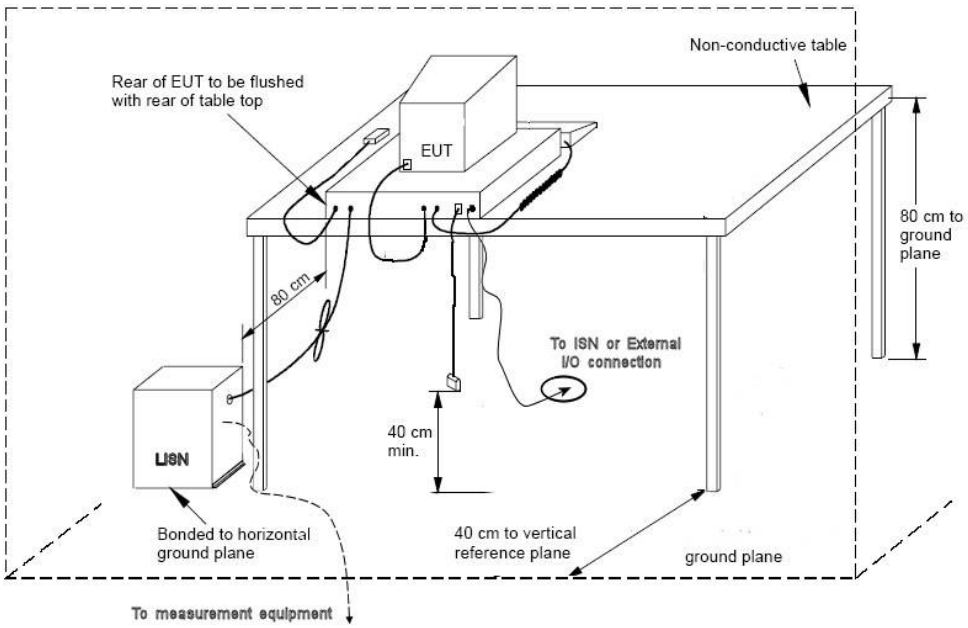
Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

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

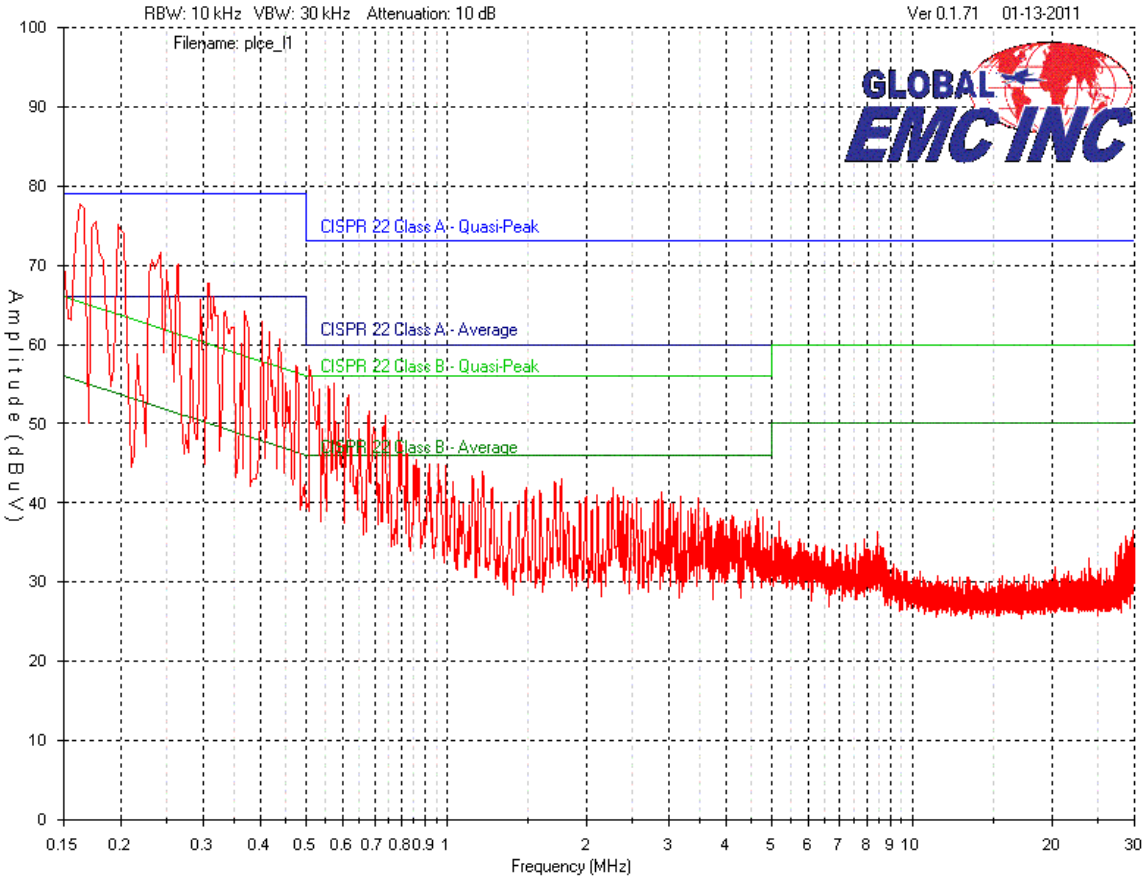
Measurement Uncertainty

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.

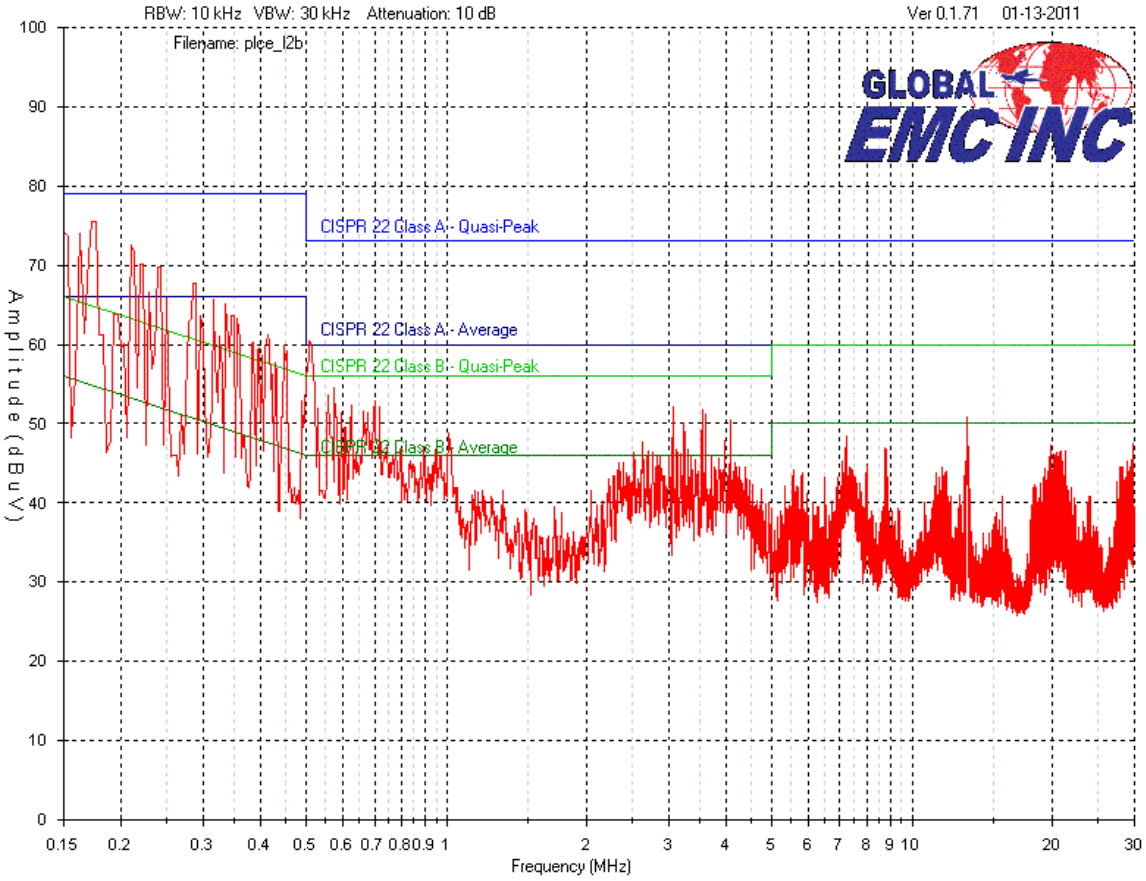
Preliminary Graphs

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. 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

The below tables represent the peak data compared to the average limits.

Line 1 – Phase (Black/Brown)

Freq. (MHz)	Raw (dBuV)	Atten Factor (dB)	LISN Factor (dB)	Level (dBuV)	Limit (dB)	Margin (dB)	Pass/Fail
0.163	43.3	10	1.4	54.7	55.3	0.6	Pass
0.196	41.1	10	1	52.1	53.8	1.7	Pass
0.177	41.3	10	1.2	52.5	54.6	2.1	Pass
0.243	37.8	10	0.8	48.6	52	3.4	Pass
0.266	36.5	10	0.7	47.2	51.2	4	Pass
0.306	34.2	10	0.5	44.7	50.1	5.4	Pass

Line 2 – Neutral (White/Blue)

Freq. (MHz)	Raw (dBuV)	Atten Factor (dB)	LISN Factor (dB)	Level (dBuV)	Limit (dB)	Margin (dB)	Pass/Fail
0.173	41.3	10	1.3	52.6	54.8	2.2	Pass
0.21	38.6	10	1	49.6	53.2	3.6	Pass
0.163	39.6	10	1.4	51	55.3	4.3	Pass
0.153	39.1	10	1.5	50.6	55.8	5.2	Pass
0.24	35.9	10	0.8	46.7	52.1	5.4	Pass
0.22	36.2	10	0.9	47.1	52.8	5.7	Pass

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
BiLog Antenna	3142-C	ETS	2009-02-12	2011-02-12	GEMC 8
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"

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

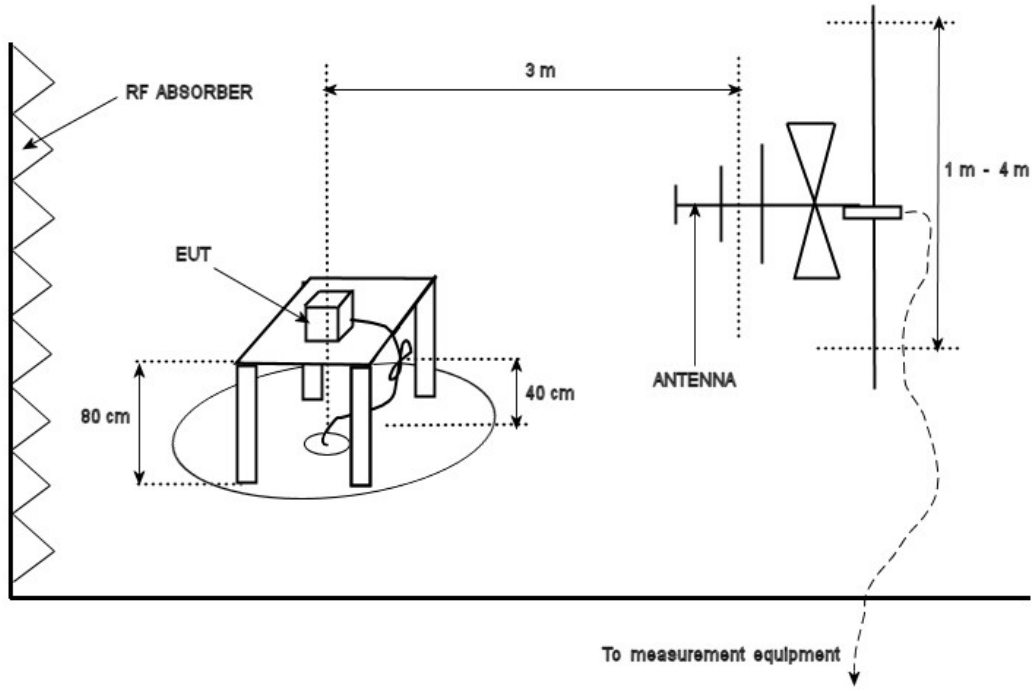
The method is as defined in ANSI C63.4:2003.
The limits are as defined in FCC Part 15, Section 15.209:
30 MHZ – 88 MHz, 100 uV/m (40.0 dBuV/m[1]) at 3 m
88 MHz – 216 MHz, 150 uV/m (43.5 dBuV/m[1]) at 3 m
216 MHz – 960 MHz, 200 uV/m (46.4 dBuV/m[1]) at 3 m
Above 960 MHz, 500 uV/m (54.0 dBuV/m[1]) at 3 m
Above 1000 MHz[2], 500 uV/m (54 dBuV/m) 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

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

Frequencies 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. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m / 3m) is applied.

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.

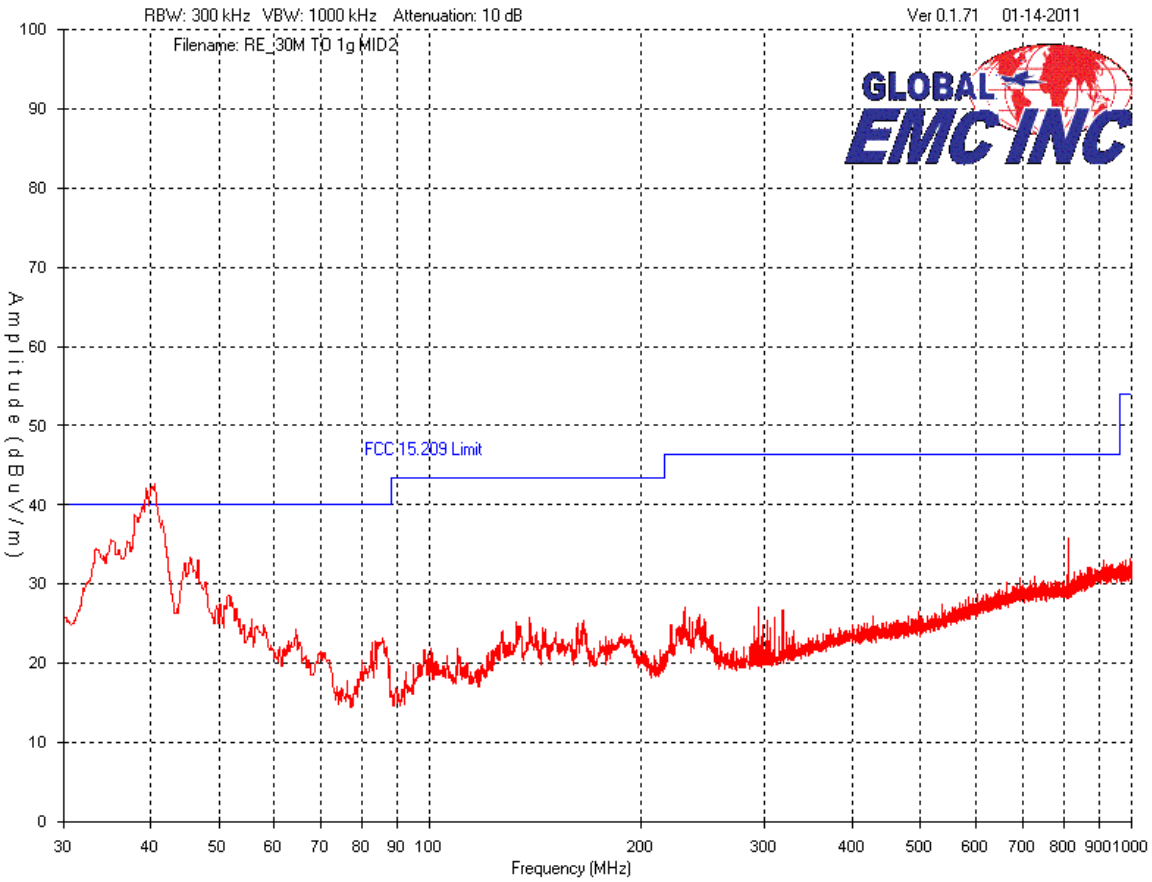
Low (2405 MHz), middle (2430 MHz) and high channels (2460 MHz) were investigated at the maximum power setting (PA7).

The side channels for Low (2402 MHz) and High (2475 MHz) were additionally investigated at the lower power setting (PA3).

Where applicable, the worst case/representative graphs (receive and transmit, each band, each power) for the 30 MHz to 1 GHz spectrum are presented.

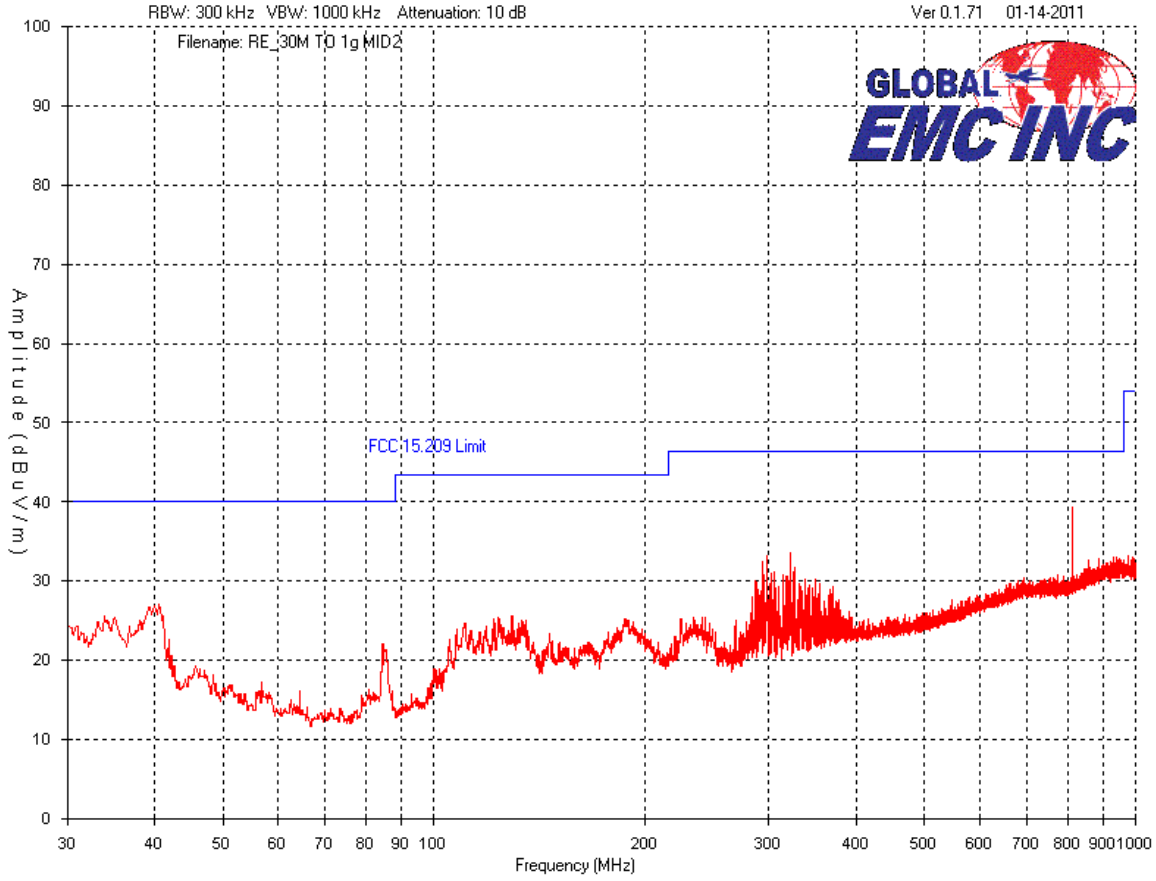
Vertical – Peak Emissions Graph

(30 MHz to 1 GHz – worst case shown)



Note: Receive mode was identical, with the exception of the frequency shown between 800 MHz and 828 was not present. No emissions were detected above 1 GHz in receive mode.

Horizontal – Peak Emissions Graph

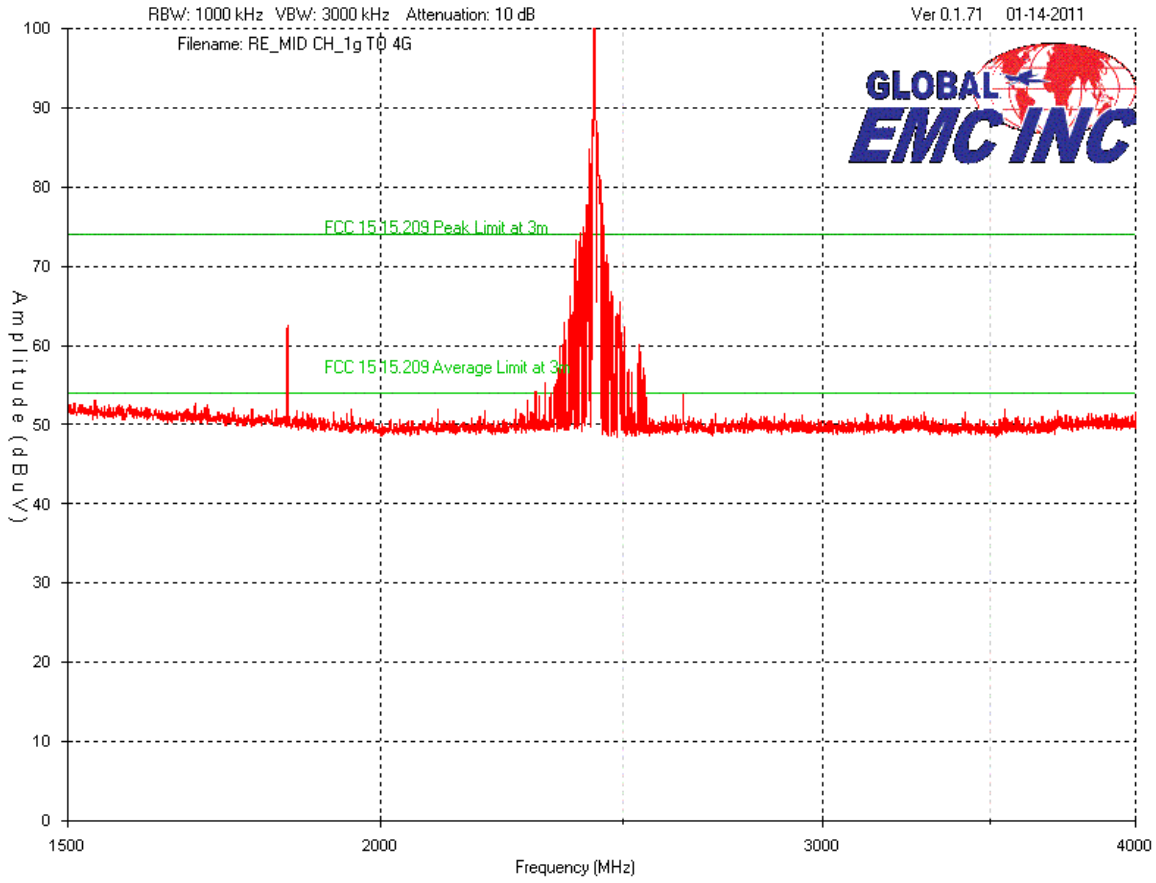


Note: Receive mode was identical, with the exception of the frequency shown between 800 MHz and 828 was not present. No emissions were detected above 1 GHz in receive mode.

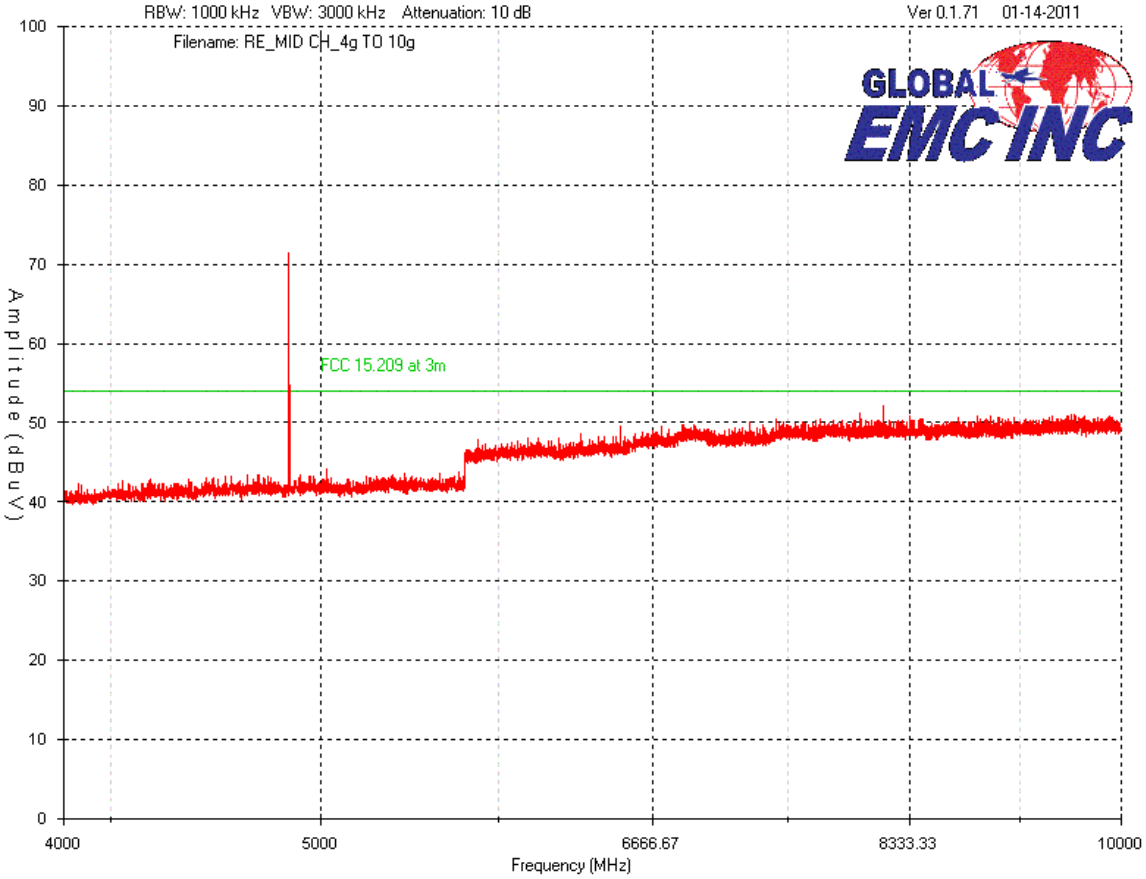
Low channel - 2310 to 2390 MHz

Note: Worst case between 2310 and 2390 appears at 2390.

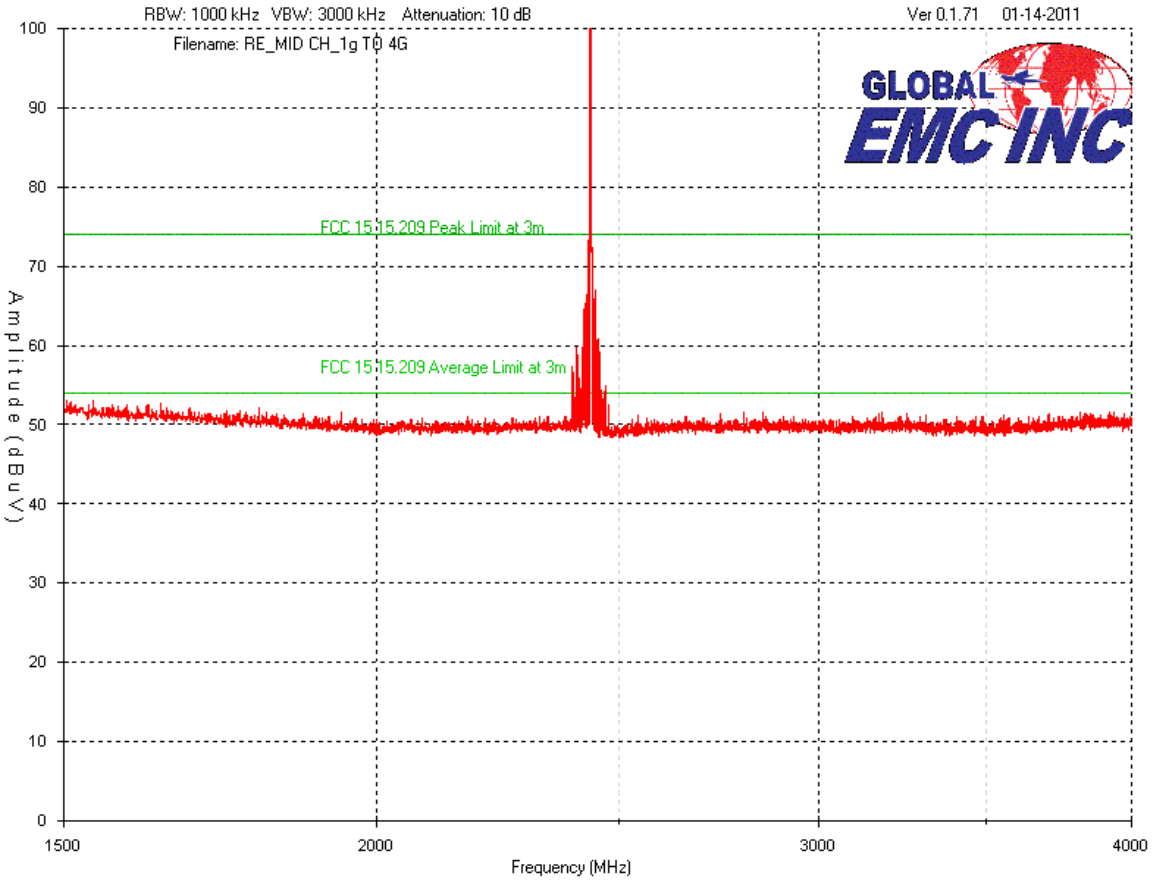
Mid Channel Vertical (PA7) - representative

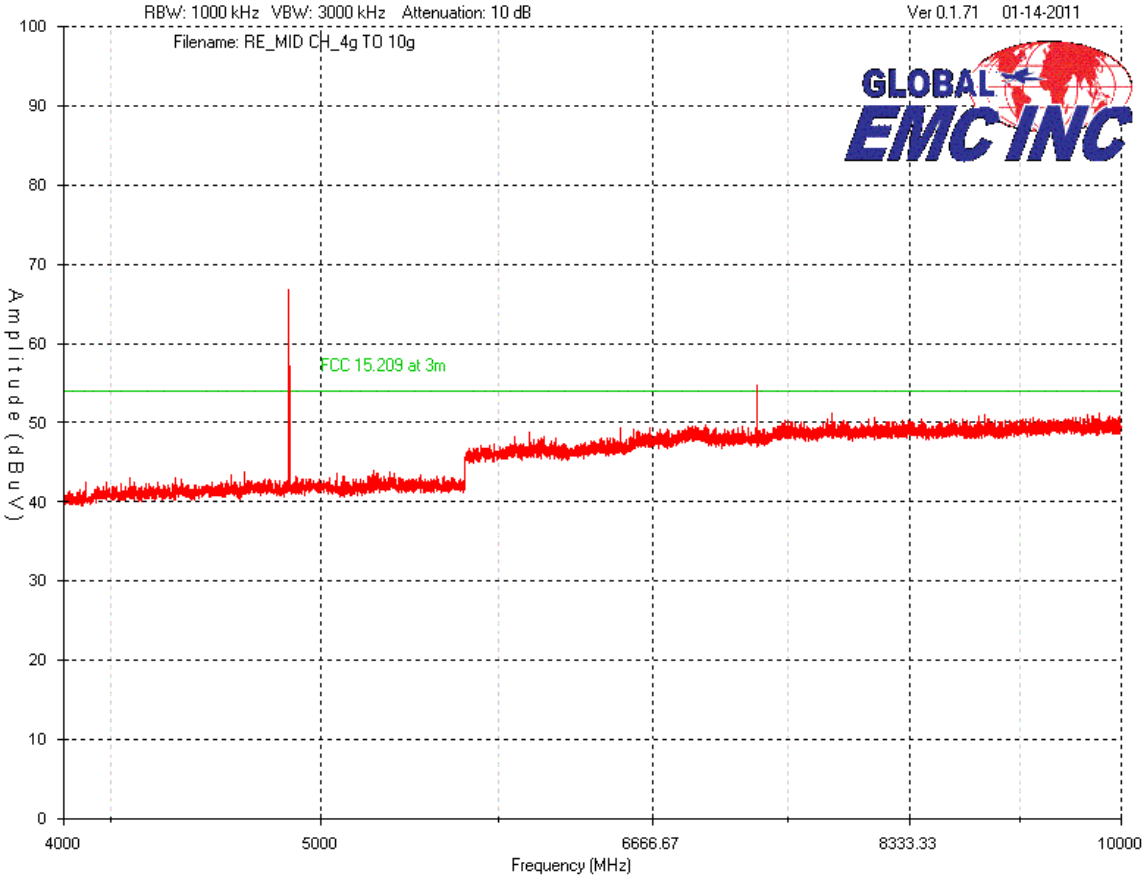


Note the emission shown at ~1850 MHz in the graph above was determined to be an artifact not related to the EUT.



Mid Channel Horizontal (PA7) - representative





Final Measurements

Quasi Peak Emissions Table – Vertical (worst case PA7)

Frequency (MHz)	Raw (dBuV)	Ant. (dB/m)	Cable (dB)	Amp (dB)	Level (dBuV/m)	Limit (dB)	Margin (dB)	Pass/Fail
40.476	53.9	12.5	0.3	-30.1	36.6	40	3.4	Pass
45.52	52.6	10.7	0.3	-30.1	33.5	40	6.5	Pass
811.335	42.5	22.2	1.2	-30.1	35.8	46.4	10.6	Pass
85.581	45.8	7.2	0.5	-30.2	23.3	40	16.7	Pass
138.543	47.7	7.8	0.5	-30.3	25.7	43.5	17.8	Pass
230.887	45.2	11.6	0.6	-30.4	27	46.4	19.4	Pass

Quasi Peak Emissions Table – Horizontal (worst case PA7)

Frequency (MHz)	Raw (dBuV)	Ant. (dB/m)	Cable (dB)	Amp (dB)	Level (dBuV/m)	Limit (dB)	Margin (dB)	Pass/Fail
811.141	46	22.2	1.2	-30.1	39.3	46.4	7.1	Pass
321.291	48.7	14.7	0.6	-30.4	33.6	46.4	12.8	Pass
40.476	44.4	12.5	0.3	-30.1	27.1	40	12.9	Pass
297.623	49.3	13.7	0.6	-30.5	33.1	46.4	13.3	Pass
293.549	48.8	13.6	0.6	-30.5	32.5	46.4	13.9	Pass
327.111	46.7	14.9	0.6	-30.4	31.8	46.4	14.6	Pass

Note: Both PA3 and PA7 were investigated at low, middle and high channels and the above measurements represent the worst case readings.

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 Power Amp Level 3 (PA3)											
2402	Peak	Horz	94.5	30.6	2.2	0.0	36.2	91.1			PASS
2402	Avg	Horz	45.0	30.6	2.2	0.0	36.2	41.6			PASS
2402	Peak	Vert	110.5	30.6	2.2	0.0	36.2	107.1			PASS
2402	Avg	Vert	45.0	30.6	2.2	0.0	36.2	41.6			PASS
2390	Peak	Horz	65.1	30.6	2.2	0.0	36.2	61.7	74.0	12.3	PASS
2390	Avg	Horz	45.0	30.6	2.2	0.0	36.2	41.6	54.0	12.4	PASS
2390 Note 1	Peak	Vert	77.1	30.6	2.2	0.0	36.2	73.7	74.0	0.3	PASS
2390	Avg	Vert	45.0	30.6	2.2	0.0	36.2	41.6	54.0	12.4	PASS
Low Channel 5 Power Amp Level 7 (PA7)											
2407	Peak	Horz	92.5	30.6	2.2	10.0	36.2	99.1			
2407	Avg	Horz	45.0	30.6	2.2	10.0	36.2	51.6			
2407	Peak	Vert	108.6	30.6	2.2	10.0	36.2	115.2			
2407	Avg	Vert	45.0	30.6	2.2	10.0	36.2	51.6			
2390	Peak	Horz	53.7	30.6	2.2	10.0	36.2	60.3	74.0	13.7	PASS
2390	Avg	Horz	35.0	30.6	2.2	10.0	36.2	41.6	54.0	12.4	PASS
2390 Note 1	Peak	Vert	67.2	30.6	2.2	10.0	36.2	73.8	74.0	0.2	PASS
2390	Avg	Vert	35.0	30.6	2.2	10.0	36.2	41.6	54.0	12.4	PASS
4804	Peak	Horz	60.3	33.7	2.9	0.0	35.7	61.2	74.0	12.8	PASS
4804	Avg	Horz	35.0	33.7	2.9	0.0	35.7	35.9	54.0	18.1	PASS
4804	Peak	Vert	71.1	33.7	2.9	0.0	35.7	72.0	74.0	2.0	PASS
4804	Avg	Vert	35.0	33.7	2.9	0.0	35.7	35.9	54.0	18.1	PASS
7206	Peak	Vert	35.0	37.9	4.3	0.0	35.9	41.3	74.0	32.7	PASS
7206	Avg	Vert	35.0	37.9	4.3	0.0	35.9	41.3	54.0	12.7	PASS
7206	Peak	Horz	35.0	37.9	4.3	0.0	35.9	41.3	74.0	32.7	PASS
7206	Avg	Horz	35.0	37.9	4.3	0.0	35.9	41.3	54.0	12.7	PASS
9608	Peak	Horz	35.0	39.2	5.8	0.0	35.9	44.1	74.0	29.9	PASS
9608	Avg	Horz	35.0	39.2	5.8	0.0	35.9	44.1	74.0	29.9	PASS
9608	Peak	Vert	35.0	39.2	5.8	0.0	35.9	44.1	74.0	29.9	PASS
9608	Avg	Vert	35.0	39.2	5.8	0.0	35.9	44.1	54.0	9.9	PASS
Mid channel 28 Power Amp Level 7 (PA7)											
2430	Peak	Horz	93.2	30.6	2.2	10.0	36.2	99.8			PASS
2430	Avg	Horz	45.0	30.6	2.2	10.0	36.2	51.6			PASS
2430	Peak	Vert	109.5	30.6	2.2	10.0	36.2	116.1			PASS
2430	Avg	Vert	45.0	30.6	2.2	10.0	36.2	51.6			PASS
4860	Peak	Horz	61.5	33.7	2.9	0.0	35.7	62.4	74.0	11.6	PASS

4860	Avg	Horz	35.0	33.7	2.9	0.0	35.7	35.9	54.0	18.1	PASS
4860	Peak	Vert	72.0	33.7	2.9	0.0	35.7	72.9	74.0	1.1	PASS
4860	Avg	Vert	35.0	33.7	2.9	0.0	35.7	35.9	54.0	18.1	PASS
7290	Peak	Vert	35.0	37.9	4.3	0.0	35.9	41.3	74.0	32.7	PASS
7290	Avg	Vert	35.0	37.9	4.3	0.0	35.9	41.3	54.0	12.7	PASS
7290	Peak	Horz	35.0	37.9	4.3	0.0	35.9	41.3	74.0	32.7	PASS
7290	Avg	Horz	35.0	37.9	4.3	0.0	35.9	41.3	54.0	12.7	PASS
High channel 58 Power Amp Level 7 (PA7)											
2460	Peak	Horz	96.2	30.6	2.2	10.0	36.2	102.8			PASS
2460	Avg	Horz	45.0	30.6	2.2	10.0	36.2	51.6			PASS
2460	Peak	Vert	111.9	30.6	2.2	10.0	36.2	118.5			PASS
2460	Avg	Vert	45.0	30.6	2.2	10.0	36.2	51.6			PASS
2483.5	Peak	Horz	54.5	30.6	2.2	10.0	36.2	61.1	74.0	12.9	PASS
2483.5	Avg	Horz	35.0	30.6	2.2	10.0	36.2	41.6	54.0	12.4	PASS
2483.5	Peak	Vert	67.1	30.6	2.2	10.0	36.2	73.7	74.0	0.3	PASS
2483.5	Avg	Vert	35.0	30.6	2.2	10.0	36.2	41.6	54.0	12.4	PASS
4920	Peak	Horz	61.5	33.7	2.9	0.0	35.7	62.4	74.0	11.6	PASS
4920	Avg	Horz	35.0	33.7	2.9	0.0	35.7	35.9	54.0	18.1	PASS
4920	Peak	Vert	72.5	33.7	2.9	0.0	35.7	73.4	74.0	0.6	PASS
4920	Avg	Vert	35.0	33.7	2.9	0.0	35.7	35.9	54.0	18.1	PASS
7380	Peak	Vert	35.0	37.9	4.3	0.0	35.9	41.3	74.0	32.7	PASS
7380	Avg	Vert	35.0	37.9	4.3	0.0	35.9	41.3	54.0	12.7	PASS
7380	Peak	Horz	35.0	37.9	4.3	0.0	35.9	41.3	74.0	32.7	PASS
7380	Avg	Horz	35.0	37.9	4.3	0.0	35.9	41.3	54.0	12.7	PASS
High channel 2 73 Power Amp Level 3 (PA3)											
2475	Peak	Horz	92.5	30.6	2.2	0.0	36.2	89.1			PASS
2475	Avg	Horz	45.0	30.6	2.2	0.0	36.2	41.6			PASS
2475	Peak	Vert	108.9	30.6	2.2	0.0	36.2	105.5			PASS
2475	Avg	Vert	45.0	30.6	2.2	0.0	36.2	41.6			PASS
2483.5	Peak	Horz	65.1	30.6	2.2	0.0	36.2	61.7	74.0	12.3	PASS
2483.5	Avg	Horz	35.0	30.6	2.2	0.0	36.2	31.6	54.0	22.4	PASS
2483.5	Peak	Vert	76.7	30.6	2.2	0.0	36.2	73.3	74.0	0.7	PASS
2483.5	Avg	Vert	35.0	30.6	2.2	0.0	36.2	31.6	54.0	22.4	PASS
4950	Peak	Horz	42.5	33.7	2.9	0.0	35.7	43.4	74.0	30.6	PASS
4950	Avg	Horz	35.0	33.7	2.9	0.0	35.7	35.9	54.0	18.1	PASS
4950	Peak	Vert	55.7	33.7	2.9	0.0	35.7	56.6	74.0	17.4	PASS
4950	Avg	Vert	35.0	33.7	2.9	0.0	35.7	35.9	54.0	18.1	PASS
7425	Peak	Vert	35.0	37.9	4.3	0.0	35.9	41.3	74.0	32.7	PASS
7425	Avg	Vert	35.0	37.9	4.3	0.0	35.9	41.3	54.0	12.7	PASS
7425	Peak	Horz	35.0	37.9	4.3	0.0	35.9	41.3	74.0	32.7	PASS
7425	Avg	Horz	35.0	37.9	4.3	0.0	35.9	41.3	54.0	12.7	PASS

Note 1: worst case between 2310 and 2390 was at 2390 MHz as reported above.

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

For information purposes, the fundamental was worst case measured to be 118.5 dBuV/m at 3 meters.

No emissions were detected above 10 GHz, however the device was scanned to 25 GHz. See 'Spurious Conducted' measurements for further details and for peak conducted emissions above 10 GHz.

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
BiLog Antenna	3142-C	ETS	2009-02-12	2011-02-12	GEMC 8
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
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.

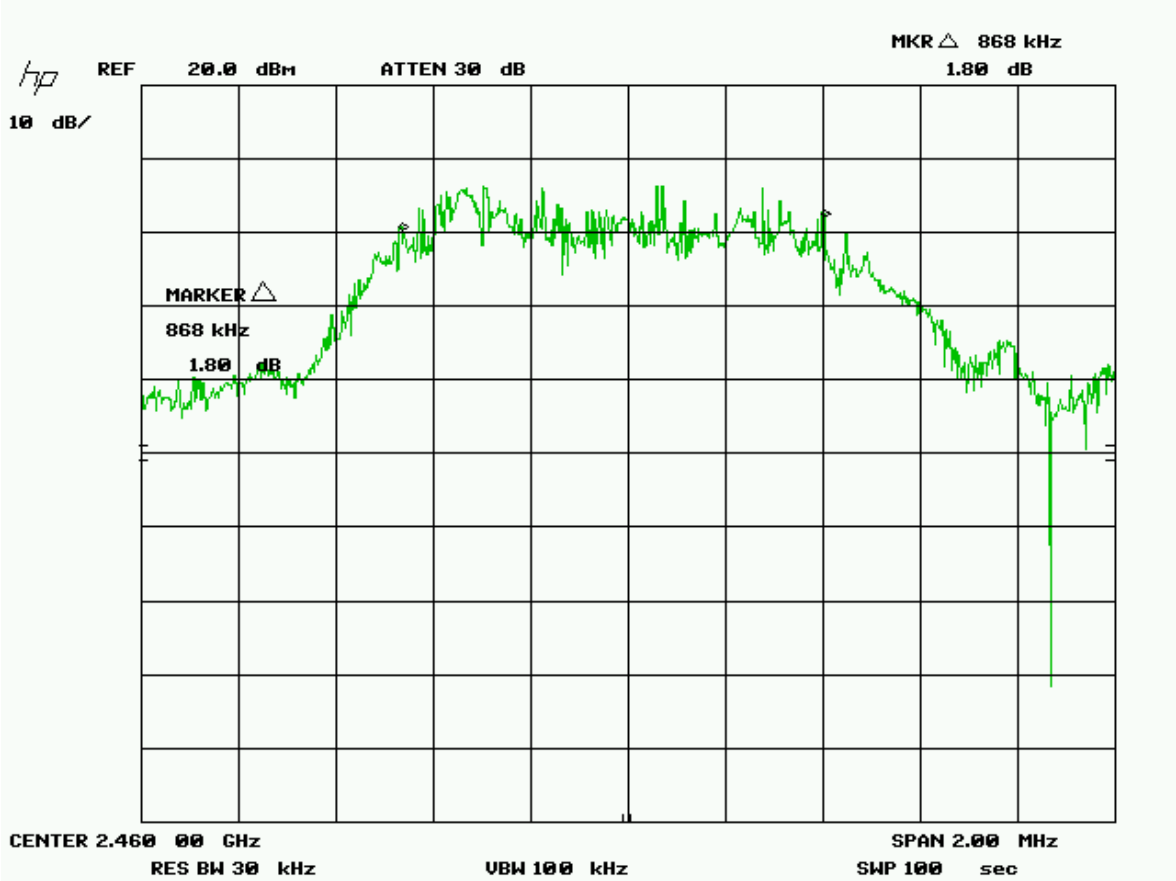
Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Results

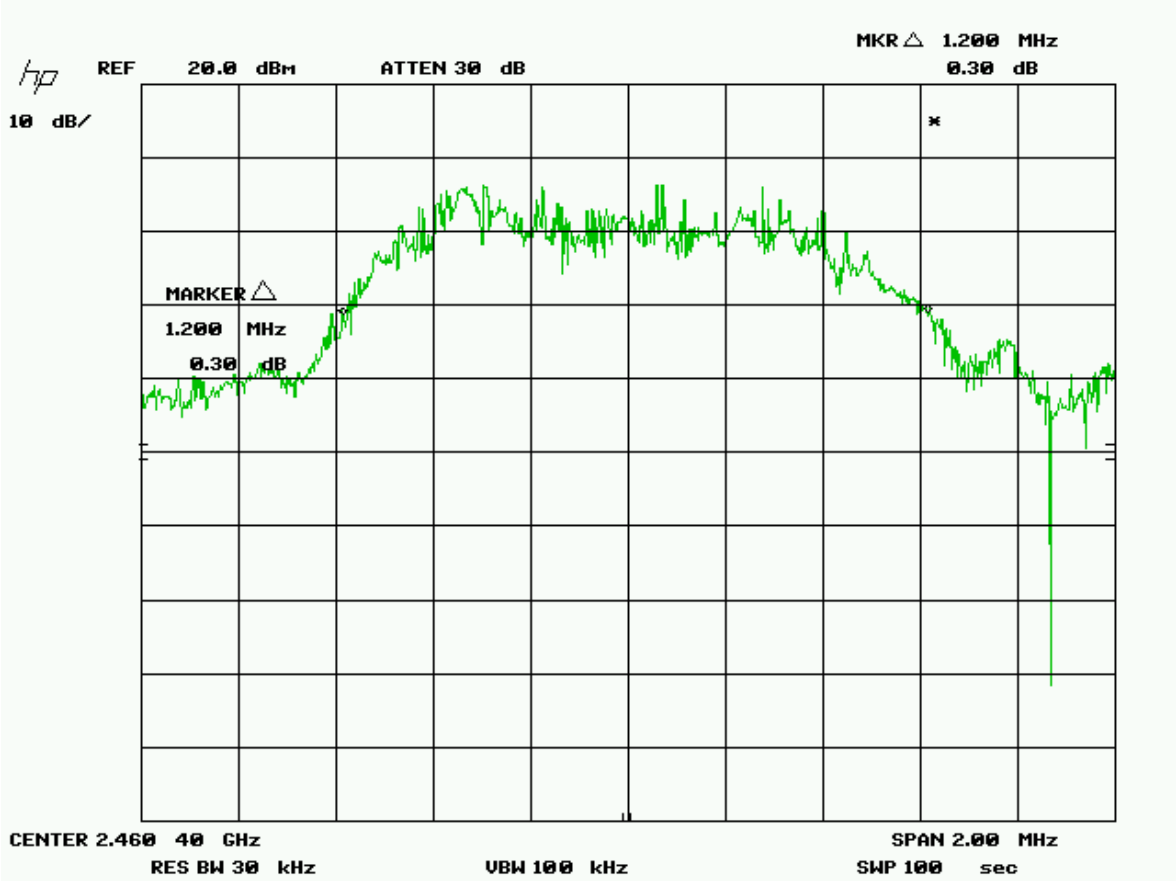
The EUT passed. The 6 dB BW measured was 868 kHz.

Graph(s)

The graphs shown below shows the maximum bandwidth 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.



For information purposes, the 20 dB BW is as per the below graph



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"

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

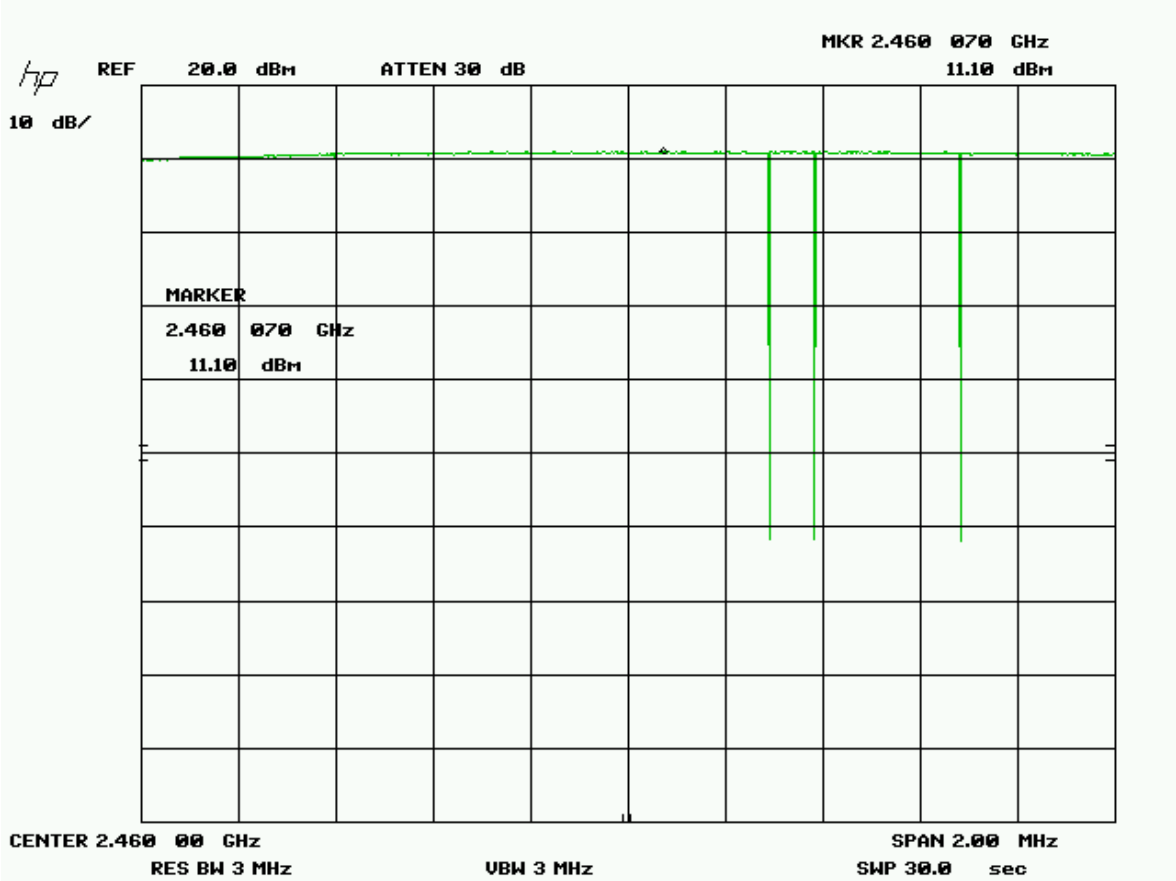
The limits are defined in FCC Part 15.247(b) and RSS 210.
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands, the peak limit is 1 watt.

Results

The EUT passed. The peak power measured was 21.1 dBm (128.8 mW), when PA7 is selected for the highest available PA7 channel 58 (2460 MHz). Channel 5 had 19.5 dBm and channel 28 had 20.3 dBm.

Graph(s)

The tables shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT. Note there was 10 dB of external attenuation taken during this measurement.



Note: All other channels were measured and this was found to be the channel with the highest output.

The calculated value is:
11.1 dBm + 10 dB (attenuator)
= 21.1 dBm

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"

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.

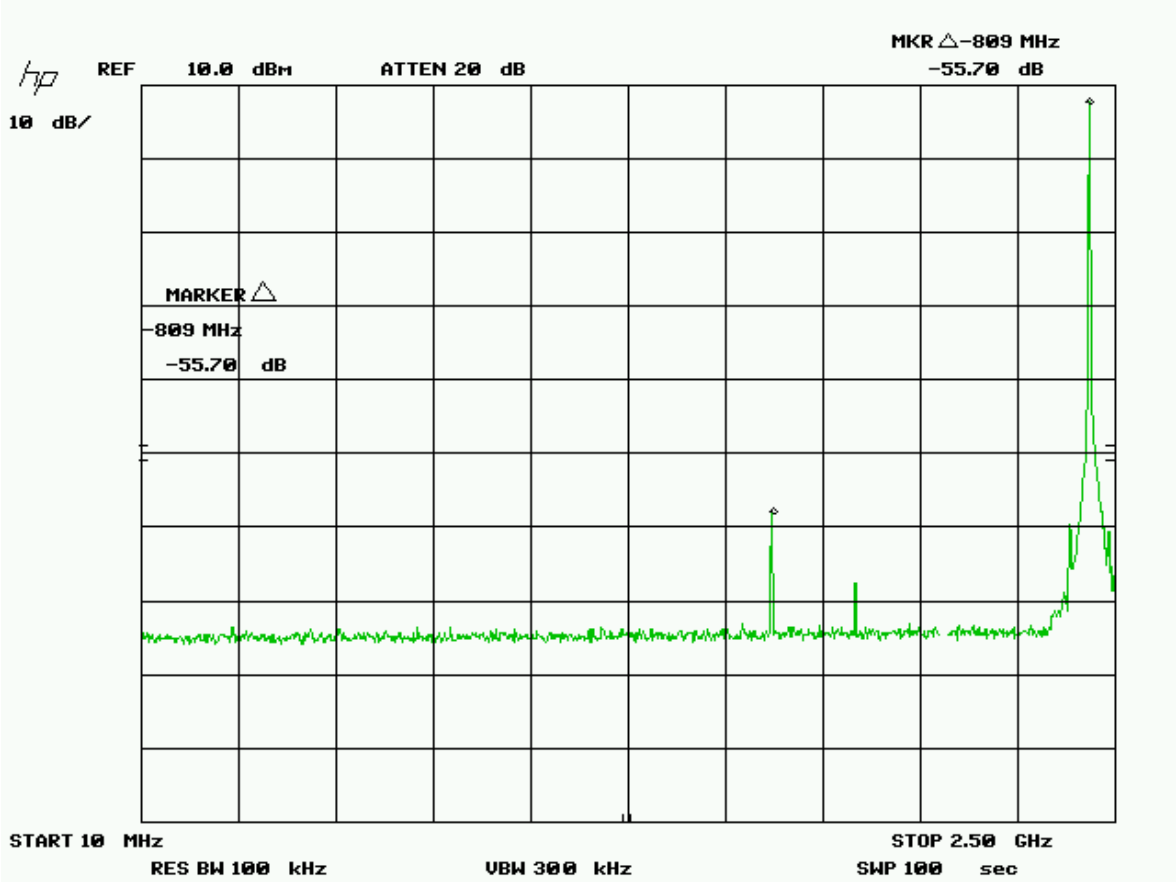
Results

The EUT pass. Low, middle and high band was measured for each PA3 and PA7 mode. 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 for both modes. The -20 dBc requirement is also shown for the higher band edge at 2.4835 GHz in the high band for both modes.

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.

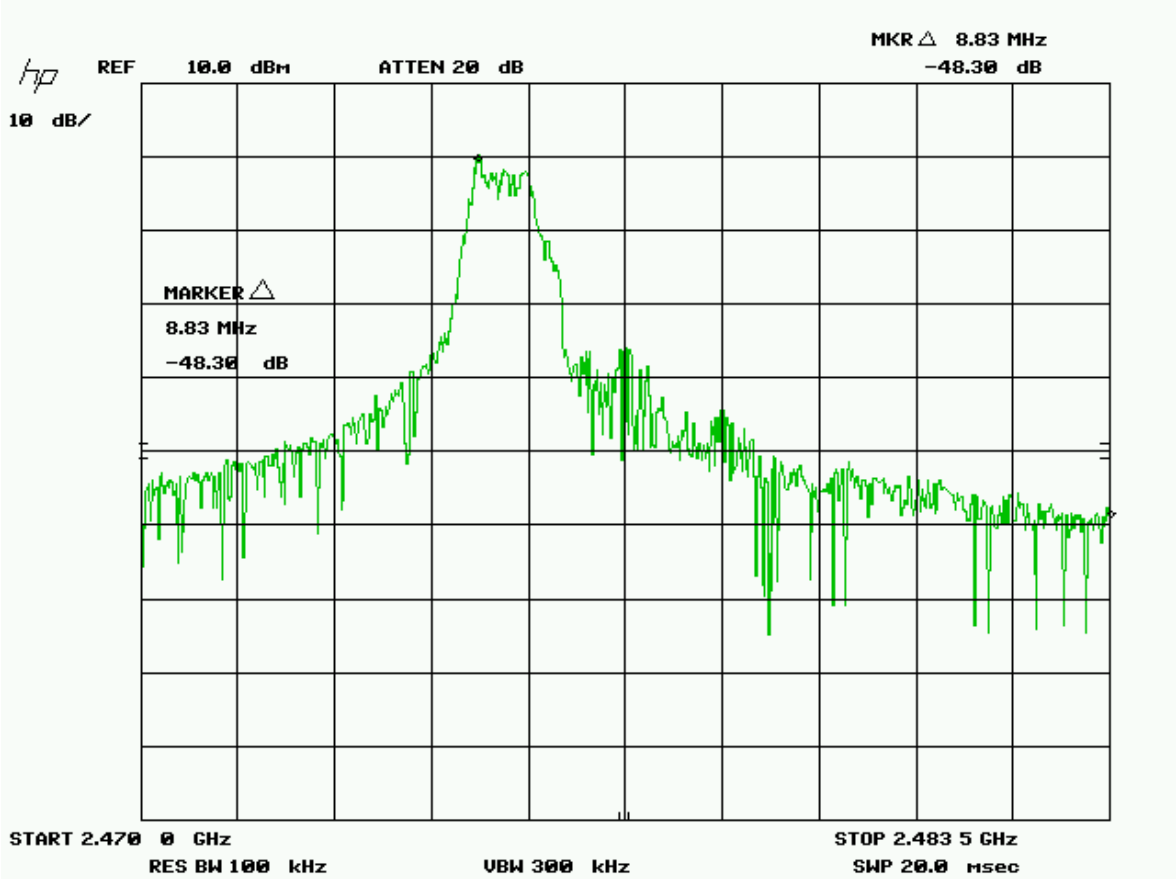
Frequencies below fundamental
PA7 mode (worst case shown)



Low Channel, Lower Band Edge
PA3 mode (worst case shown)

Note no emissions between 2310 MHz and 2390 MHz exceeded the value reported at 2390 MHz.

High Channel, Upper Band Edge
PA3 (worst case shown)



Frequencies above Fundamental (2rd to 9th Harmonics)
PA7 mode (worst case shown)

The frequency range of 20 – 25 GHz, the 8th and above harmonics, where applicable, was additionally scanned, in low, middle and high band for each mode. No emissions were detected.

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
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.

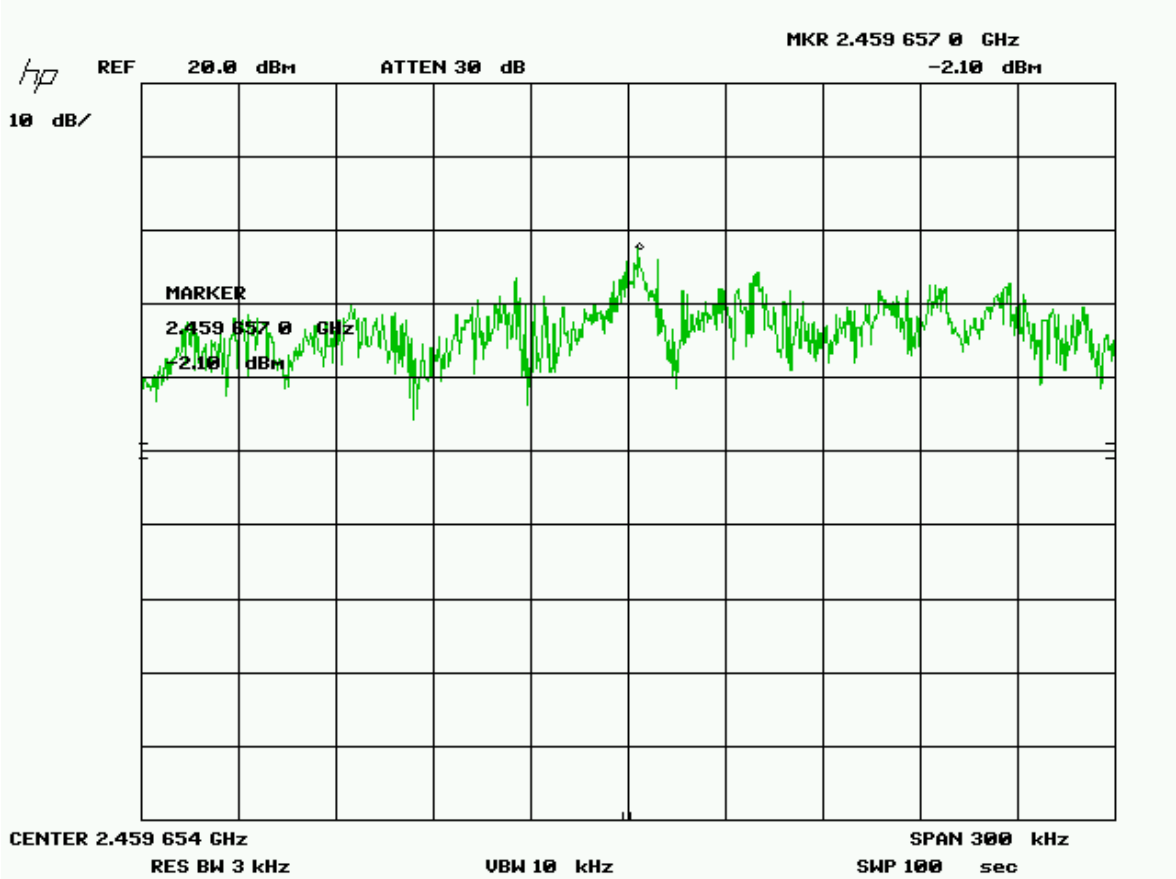
Results

The EUT passed. Each mode was tested at low, medium, and high band. The worst case value is 7.9 dBm as measured with a 3 kHz resolution bandwidth (peak power).

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 3 kHz Resolution using the conducted method and are raw readings. This was maximized for a period of not less than 3 minutes. A 10 dB external attenuator is added to calculate the final value.

High channel (worst case)



Calculations

Level = measured + attenuation
Level = -2.1 dBm + 10 dB
Level = 7.9 dBm.

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"

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 20 cm, as this is the minimum distance an operator will be from the EUT during normal operation.

Results

The EUT passed the requirements. The worst case calculated peak power density was 0.4 mW/cm^2 , this is under the 1.0 mW/cm^2 requirement.

Calculations

Method 1 (conducted power)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	21.10	(dBm)		
Maximum peak output power at antenna input terminal:	128.8249552	(mW)		
Antenna gain(typical):	2	(dBi)		
Maximum antenna gain:	1.584893192	(numeric)		
Time Averaging:	100	(%)		
Prediction distance:	20	(cm)		
Prediction frequency:	2460	(MHz)		
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)		
Power density at prediction frequency:	0.040619	(mW/cm^2)		
Margin of compliance:	-13.9	(dB)		
This equates to	0.406190858	W/m^2	PASS	
For information This equates to	12.37473044	V/m		

Appendix A – EUT Summary

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

General EUT Description

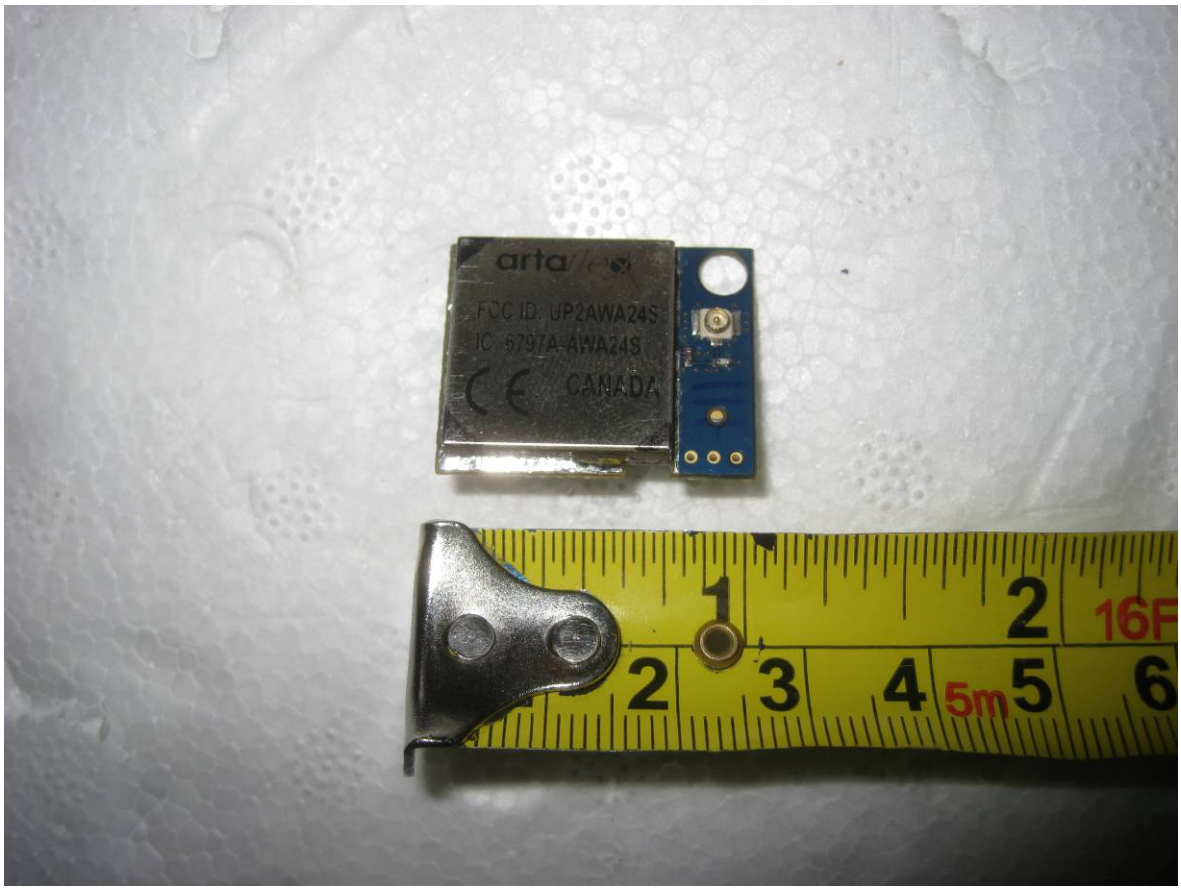
Company & Address	Artaflex
	215 Konrad Crescent Markham, ON L3R 8T9 Canada
EUT Name	Artaflex Wireless Radio Module (AWAC24U)
FCCID	UP2 AW24RUH
IC #	6797A- AW24RU
Approximate Size (LxWxH)	16mm x 14mm x 7mm
Input Voltage and Frequency	5V – 100ma
Rated Input Current	< 100 mA
Intentional RF (If yes describe)	Yes- 2.4 GHz @ ~ 20 dBm
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	20 cm.
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'.

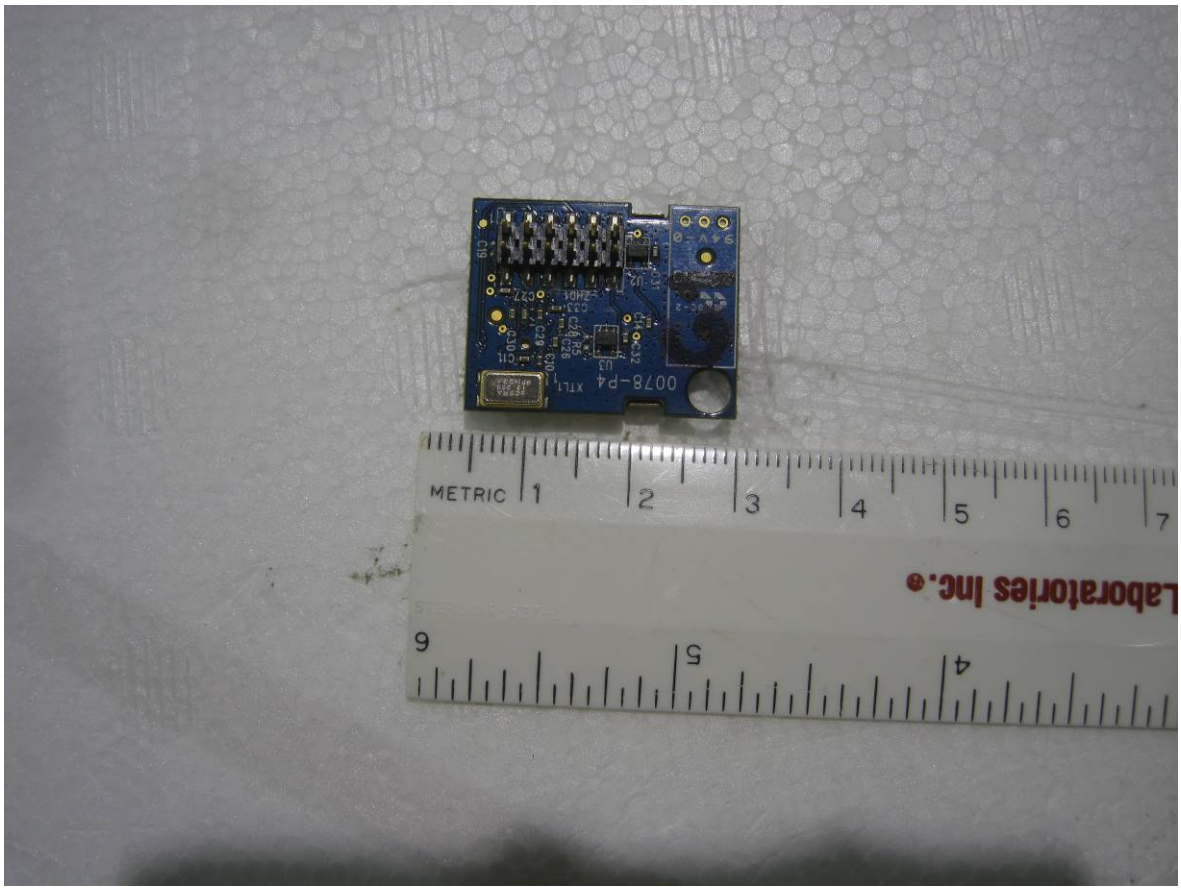
Appendix B – EUT and Test Setup Photographs

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

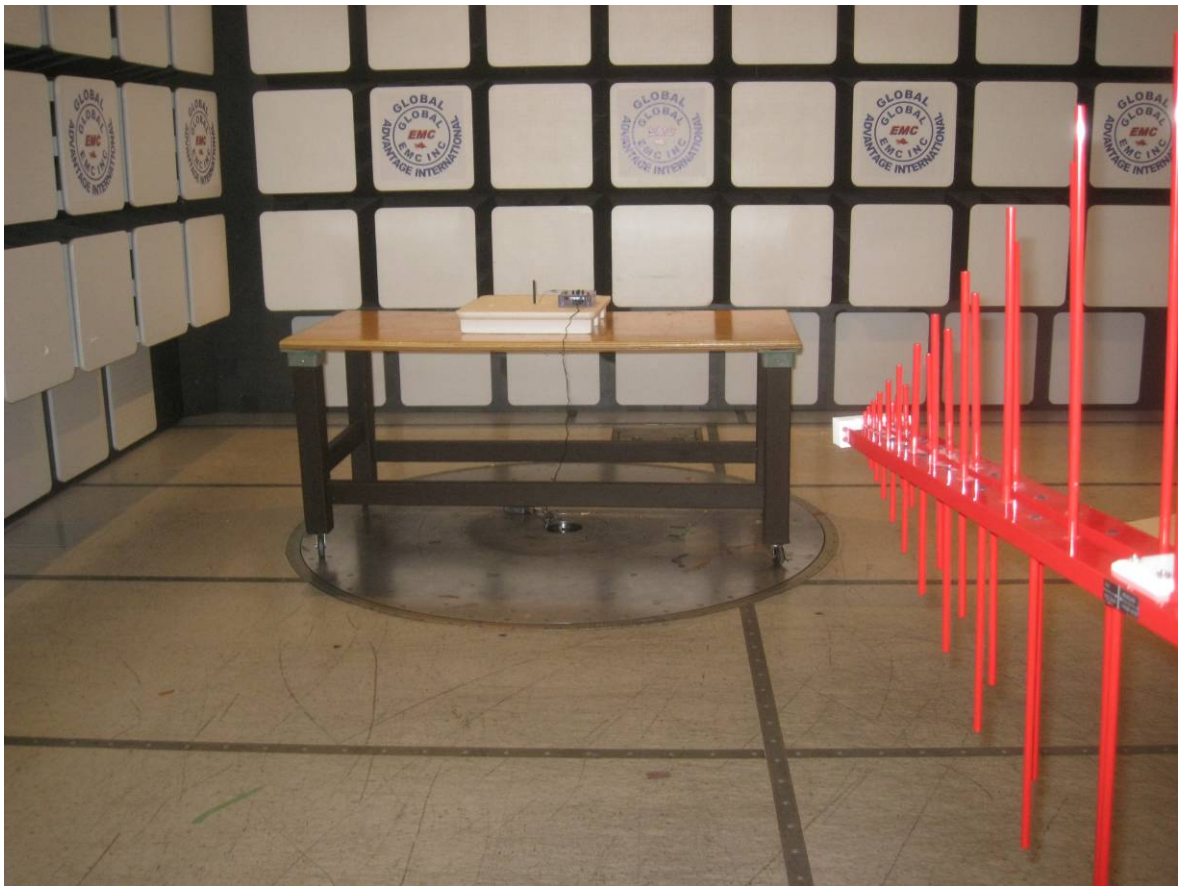
EUT – Front



EUT – Back



Radiated Emissions



Antenna Conducted Measurements