Global EMC Inc. Labs

EMC & RF Test Report

As per

RSS 247: 2015

&

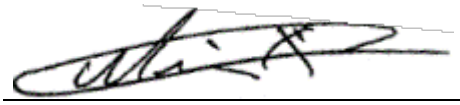
FCC Part 15 Subpart C: 2015

Unlicensed Intentional Radiators

on the

MUSE

Model: MU-02



Min Xie
Project Engineer
11 Gordon Collins Dr,
Gormley, ON, L0H 1G0 Canada
Ph: (905) 883-8189

Testing produced for

InteraXon

See Appendix A for full customer & EUT details.

Industry Canada
LAB REGISTRATION #6844A-3

CE

ACCREDITED
Testing Laboratory Certificate #2555.01

FCC
FCC REGISTRATION #377448

VCI
R-4023, G-506 T-1246, C-4498

Table of Contents

Report Scope

This report addresses the EMC verification testing and test results of Interaxon Inc's **MUSE, Model: MU-02**, herein referred to as EUT (Equipment Under Test) performed at Global EMC Labs.

The EUT was tested for compliance against the following standards:

RSS 247:2015
FCC Part 15 Subpart C 15:2015

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.

Summary

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

EUT FCC Certification #, FCC ID:	2ABZI-MU02
EUT Industry Canada Certification #, IC:	11834A-MU02
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Min Xie

Client	**Interxon Inc**
Product	**MUSE, Model: MU-02**
Standard(s)	RSS 247:2015 / FCC Part 15 Subpart C 15:2015

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS-GEN (Table 6)	Restricted Bands for intentional operation	QuasiPeak Average	Pass
FCC 15.207 RSS-GEN (Table 3)	Power line conducted emissions	QuasiPeak Average	Pass
FCC 15.209 RSS-GEN (Table 4)	Spurious Radiated emissions	QuasiPeak Average	Pass
FCC 15.247(a)2 RSS-247 5.2 (1)	6 dB Bandwidth	> 500 kHz	Pass
FCC 15.247(b)2 RSS-247 5.4 (4)	Max output power	< 1 Watt	Pass
FCC 15.247(b)(4) RSS-247 5.4 (4)	Antenna Gain	< 6 dBi	Pass See Justifications
FCC 15.247(d) RSS-247 5.5	Antenna conducted spurious	< 20 dBc	Pass
FCC 15.247(e) RSS-247 5.2 (2)	Spectral Density	< 8 dBm (3 kHz BW)	Pass
FCC 15.247(i) RSS-102	Maximum Permissible Exposure	> 20 cm separation.	Pass See justification and calculations
Overall Result			**PASS**

All tests were performed by Min Xie.

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 maximum permissible exposure, this device operates at less than 1 Watt at 2400 – 2483.5 MHz and is designed to operate less than 20 cm from any personnel during normal operation. The device is categorized as a Portable device and MPE evaluation is not applicable.

SAR assessment is applicable to the EUT. The separation distance between radiating structure of the EUT and human body is < 5 mm. According to FCC KDB 447498 Section 4.3.1 5), an assessment distance of 5 mm is applied. The maximum conducted power of the EUT is 4.8 mW which is less than the SAR Test Exclusion Power Threshold for 5 mm given in FCC KDB 447498 Appendix A. Therefore the device meets the SAR Test Exclusion criteria and no test is required.

For the Antenna requirement specified in FCC 15.203, the unit uses a permanently connected SMD antenna (3 dBi peak gain – Molex 479480001 2.4 GHz SMD Antenna) which is less than 6 dBi gain.

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

The EUT is not a hybrid system and FCC 15.247 (f) does not apply to it. However the 15.247 (d) requirement of power density were met and are detailed later in this test report.

For the scope of this test report the EUT was mounted in three orthogonal axes to maximize emissions. Worst case results are presented.

Power line conducted emissions were not applicable as the EUT is a battery operated device. It contains an rechargeable battery but the transmitter does not operate when the battery is being charged.

All tests were performed with the battery fully charged.

Applicable Standards, Specifications and Methods

ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2013	American national standard for testing unlicensed wireless devices
CFR 47 FCC 15	Code of Federal Regulations – Radio Frequency Devices
CISPR 22:2008	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
FCC KDB 558074:June 5, 2014	FCC KDB 558074 Digital Transmission Systems, measurements and procedures
ICES-003:2012	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-GEN Issue 4	General Requirements and Information for the Certification of Radio Apparatus
RSS-247 Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS 102 Issue 5	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

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 0 - October 6, 2015
Initial release

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 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, 377448), Industry Canada (IC, 6844A-3) and VCCI (R-4023, G-506, T-1246, and C-4498). This semi-anechoic chamber complies with the requirements of EN55016-2-3:2006, section 7.5 and the site attenuation requirements of EN55016-1-4. This chamber was additionally 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 chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. The NSA data is kept on file at Global EMC. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at Global EMC. Global EMC Inc is accredited to ISO 17025 by A2LA with Testing Certificate #2555.01. The laboratories current scope of accreditation listing can be found as listed on the A2LA website. 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)
2015/9/4	Radiated emission	MX	20-24ºC	39 - 50%	96 -102kPa
2015/9/8	Antenna conducted	MX	20-24ºC	39 - 50%	96 -102kPa

Detailed Test Results Section

6dB Bandwidth of Digitally Modulated Systems – 15.247

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 and Methods

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.

The method is given in Section 8.1 of FCC KDB 558074.

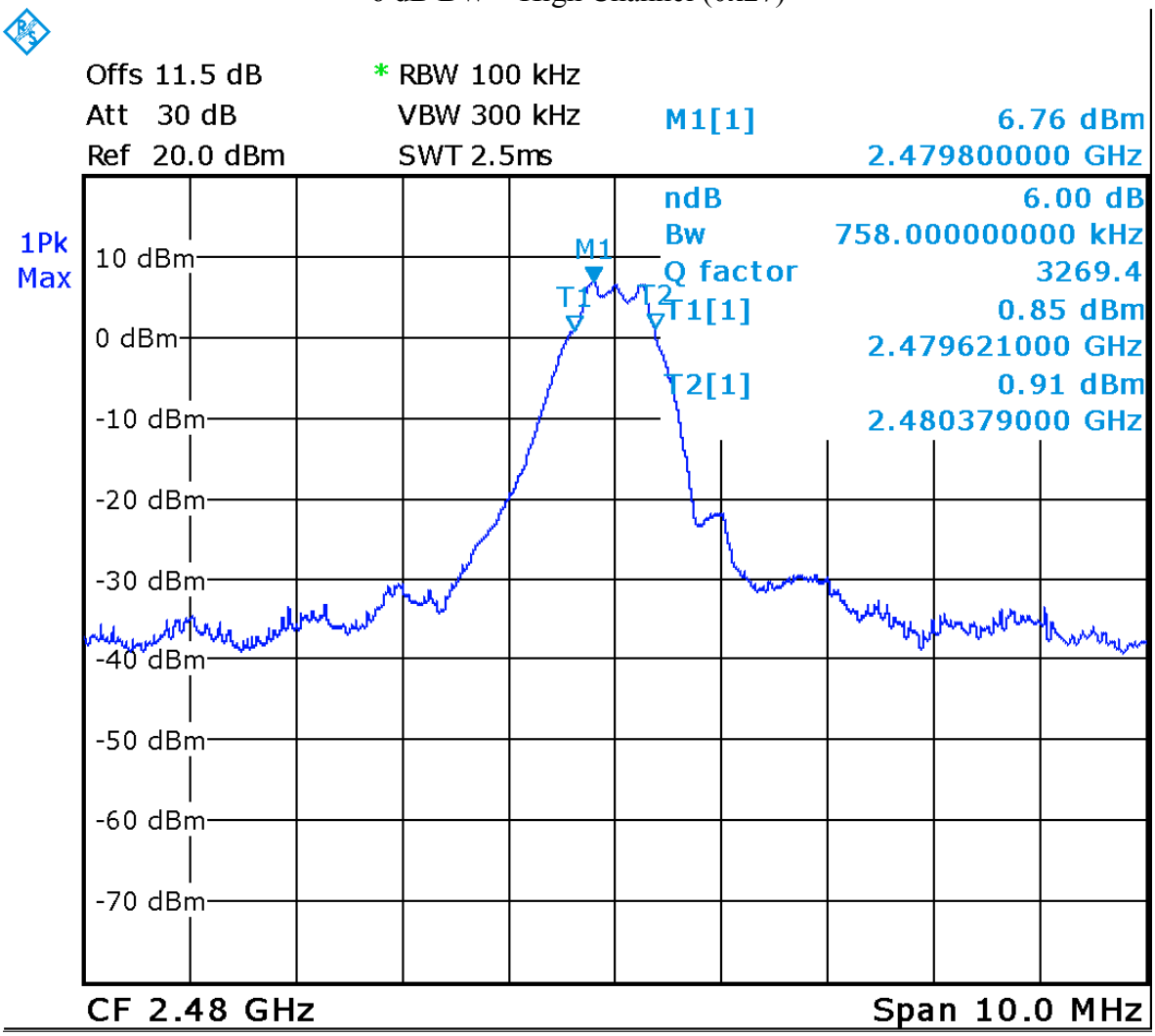
Results

The EUT passed. The minimum measured 6 dB BW was 739.0 kHz and the maximum 99% BW is 1.30 MHz.

Graph(s)

The graphs showed below shows the OBW 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 than 1 minute.

6 dB BW – High Channel (0x27)



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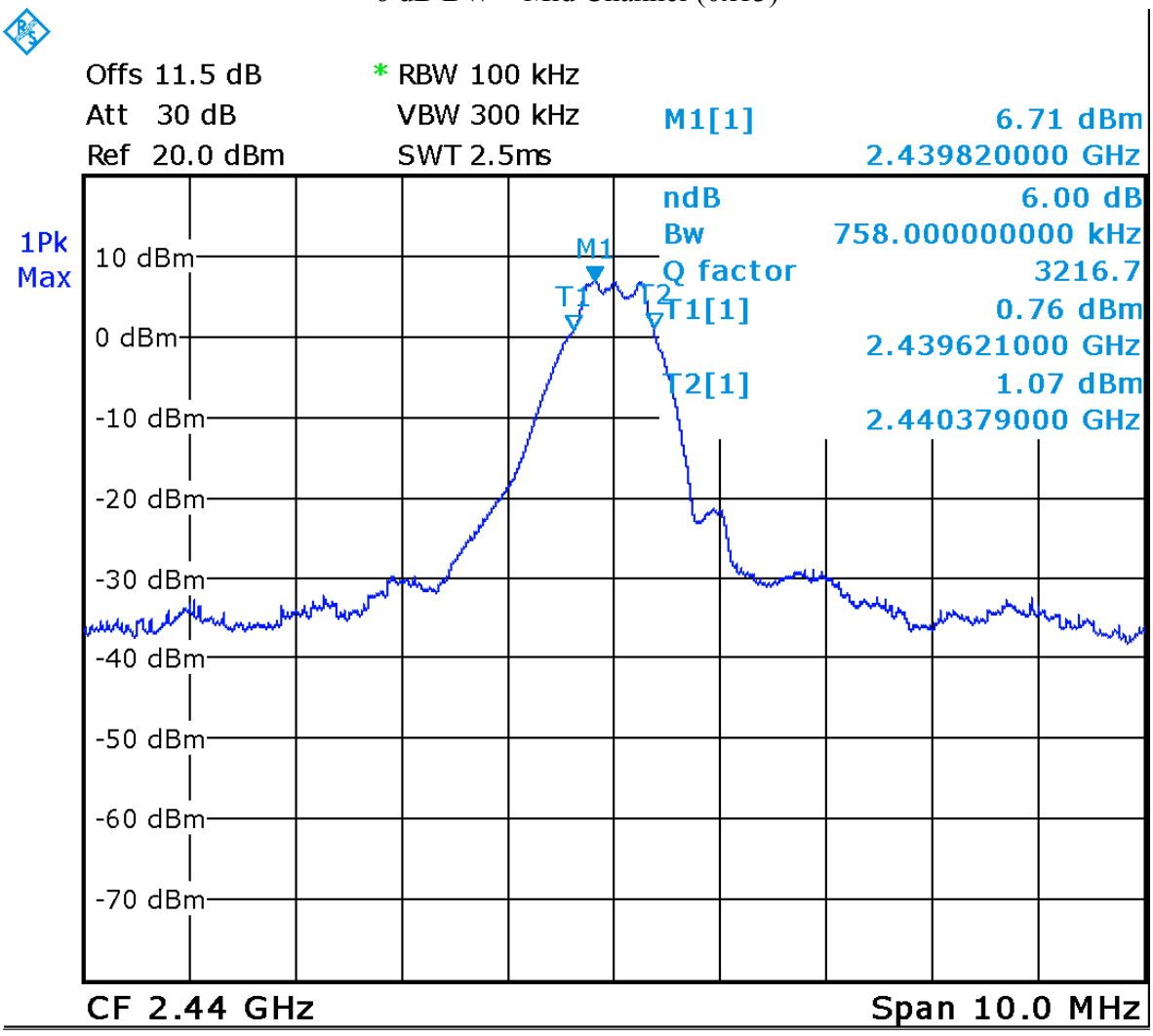
6 dB BW – Mid Channel (0x13)



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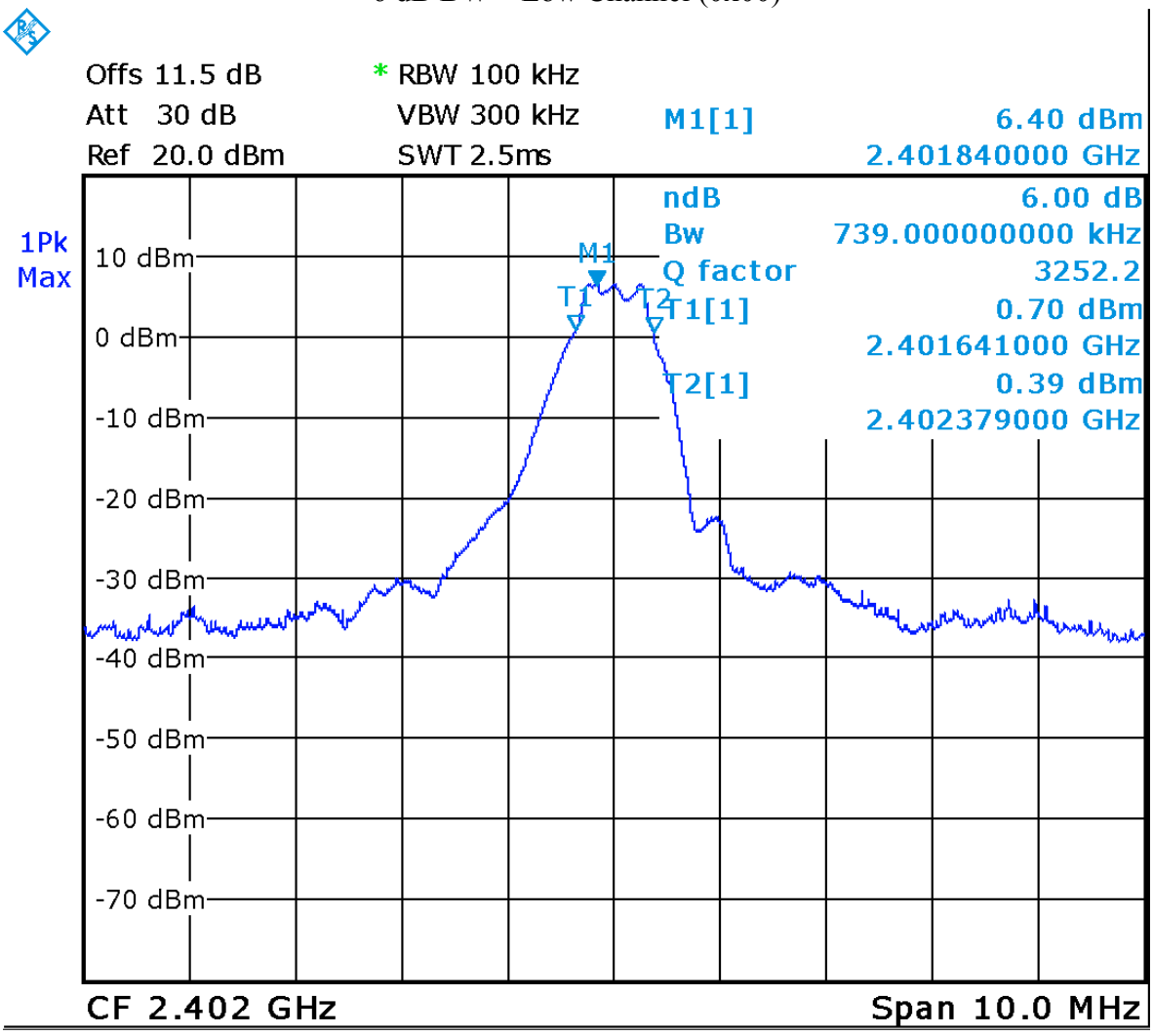
6 dB BW – Low Channel (0x00)



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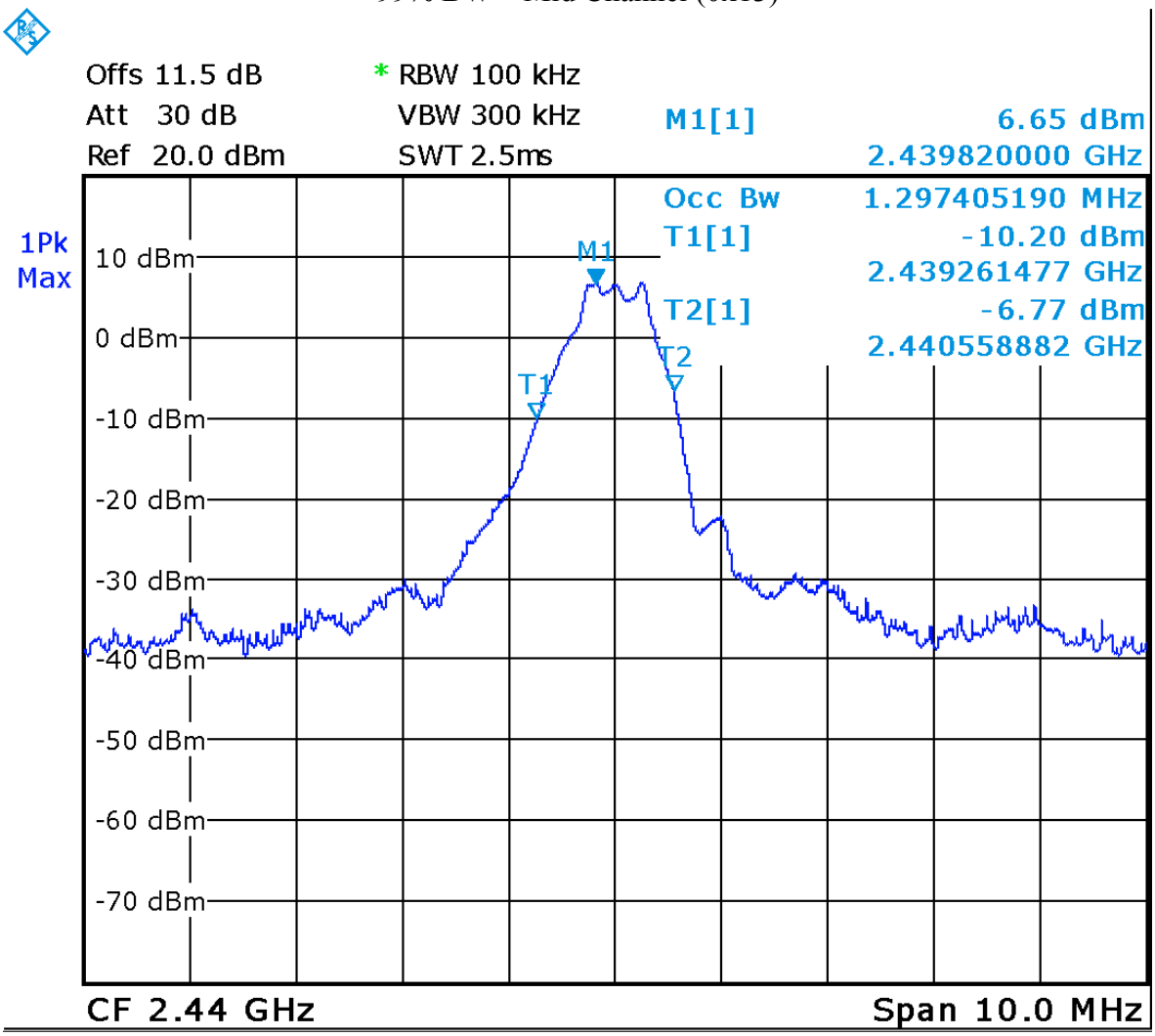
99% BW – Mid Channel (0x13)



Date: 8.SEP.2015 15:55:08

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

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration / Verification date	Next calibration/ Verification due date	Asset #
Spectrum Analyzer	ESL6	Rohde & Schwarz	Nov-15, 2013	Nov-15, 2015	GEMC 160
Attenuator 10 dB	8493B	Agilent	Feb 11, 2015	Feb 11, 2016	GEMC133
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	Feb-10, 2015	Feb-10, 2016	GEMC 29

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

Maximum Peak Envelope Conducted Power - DM

Purpose

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

Limits and Methods

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.

The method is given in Section 9.1.2 of FCC KDB 558074

Results

The EUT passed. The power of the EUT was set to transmit at maximum power. Three Channels were measured. The following table show the peak power:

Channel	Frequency (MHz)	Power (dBm) (raw)	Attenuator (dB)	Cable loss (dB)	Power (dBm)	Power (mW)
Lo Channel (0x00)	2402	-4.82	10	1.5	6.68	4.7
Mid Channel (0x13)	2440	-4.68	10	1.5	6.82	4.8
Hi Channel (0x27)	2480	-4.71	10	1.5	6.79	4.8

Readings

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

Tests were conducted using a power meter.

Figure 1: Antenna port conducted power - 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 / Verification date	Next calibration/ Verification due date	Asset #
Power Head	PH 2000	AR	Jan-22, 2015	Jan-22, 2017	GEMC 15
Power meter	PM 2002	AR	Jan-21, 2015	Jan-21, 2017	GEMC 16
Attenuator 10 dB	8493B	Agilent	Feb-11, 2015	Feb-11, 2016	GEMC133
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	Feb-10, 2015	Feb-10, 2016	GEMC 29

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

Antenna Spurious Conducted Emissions (-20 dBc Requirement) – 15.247

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 and Methods

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.

The method is given in Section 11 of FCC KDB 558074

Results

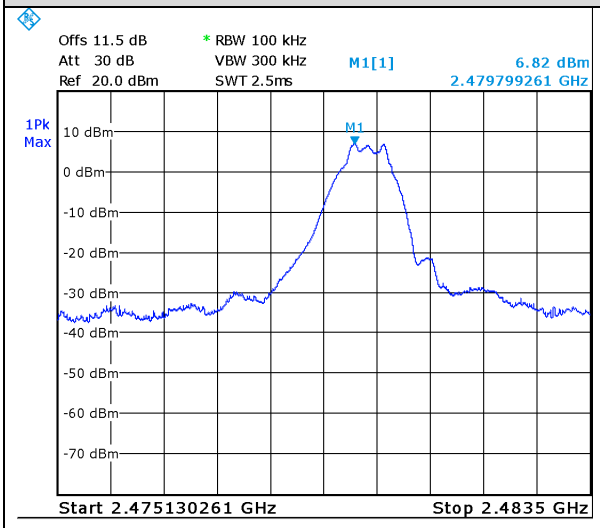
The EUT passed the limits. Low, middle and high channels were measured. The worst case was presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band. The -20 dBc requirement is also shown for the higher band edge at 2.4835 GHz in the high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

Graph(s)

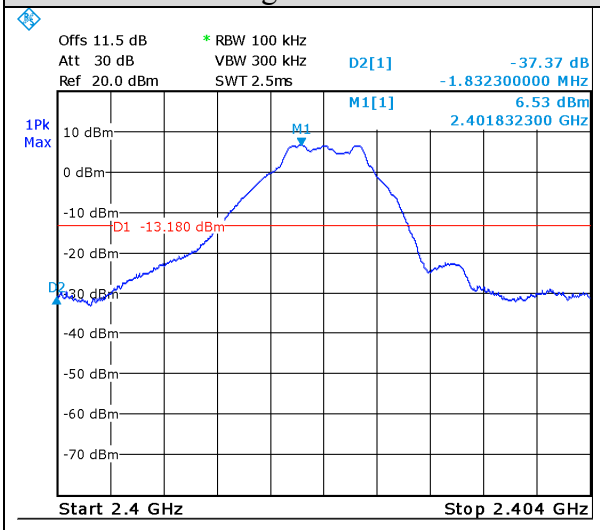
The graphs shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT.

-20 dBc

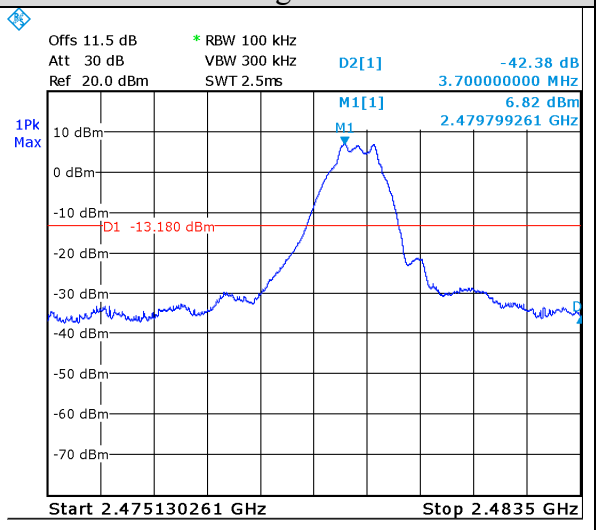
Reference level: 6.82 dBm



2400 MHz Bandedge

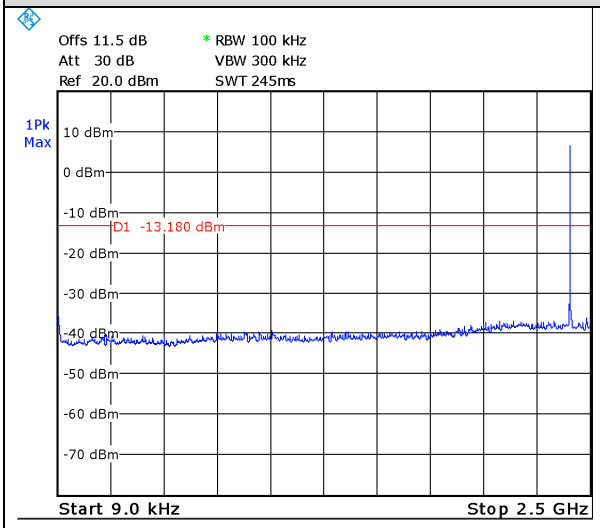


2483.5 MHz Bandedge

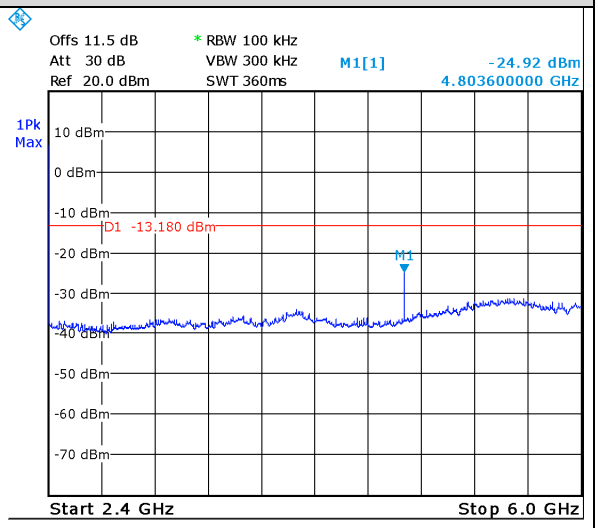


-20 dBc

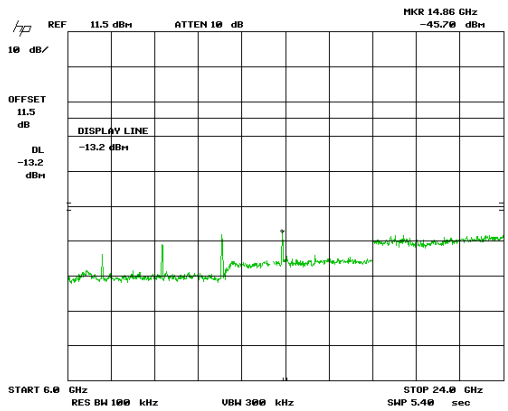
9 kHz – 2.5 GHz



2.4 GHz – 6 GHz



6 GHz – 24 GHz



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

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration / Verification date	Next calibration/ Verification due date	Asset #
Spectrum Analyzer	8566B	HP	Oct-9, 2014	Oct-9, 2016	GEMC 193
Quasi Peak Adapter	85650A	HP	May-22, 2014	May-22, 2016	GEMC 194
Spectrum Analyzer	ESL6	Rohde & Schwarz	Nov-15, 2013	Nov-15, 2015	GEMC 160
Attenuator 10 dB	8493B	Agilent	Feb-11, 2015	Feb-11, 2016	GEMC133
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	Feb-10, 2015	Feb-10, 2016	GEMC 29

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

Radiated Emissions – 15.247

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 and Method

The method is given in Section 12.1 of FCC KDB 558074: June 5, 2014
The limits are as defined in FCC Part 15, Section 15.209:

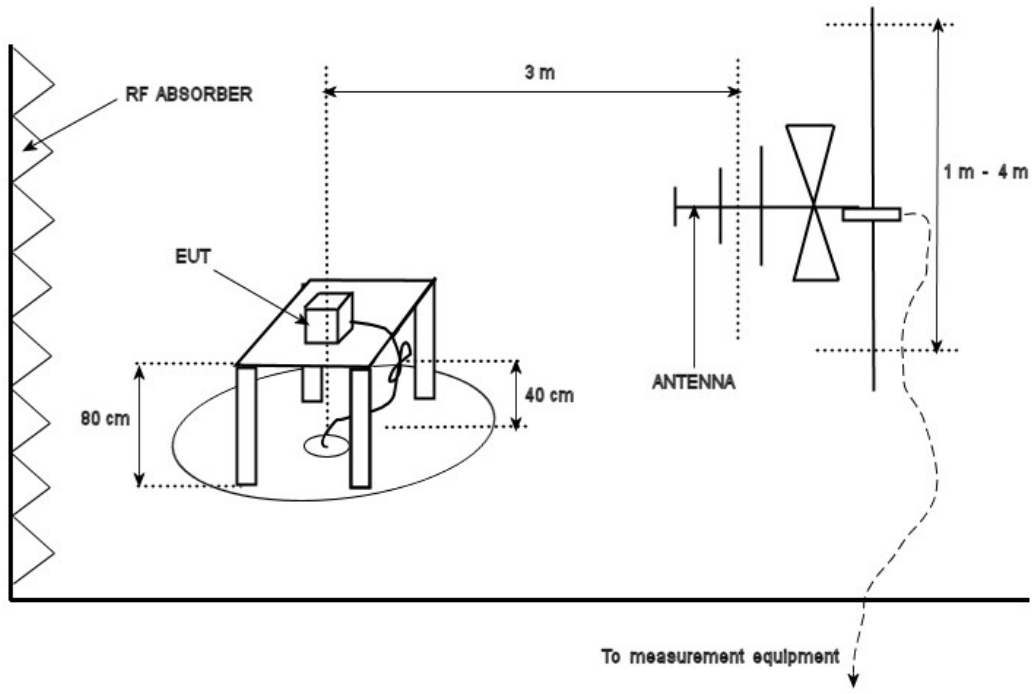
The limits, as defined in 15.247(d) for unintentional radiated emissions apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

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

0.009 MHz – 0.490 MHz, 2400/F (kHz) uV/m at 300 m[1]
0.490 MHz – 1.705 MHz, 24000/F (kHz) uV/m at 30 m[1]
1.705 MHz – 30 MHz, 30 uV/m at 30 m[1]
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 (46.0 dBuV/m[1]) at 3 m
Above 960 MHz, 500 uV/m (54.0 dBuV/m[1]) at 3 m
Above 1000 MHz, 500 uV/m (54 dBuV/m[2]) at 3m
Above 1000 MHz, 500 uV/m (74 dBuV/m[3]) at 3m

[1]Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1
[2]Limit is with 1 MHz measurement bandwidth and using an Average detector
[3]Limit is with 1 MHz measurement bandwidth and using a Peak detector

Typical Radiated Emissions Setup



Measurement Uncertainty

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

Preliminary Graphs

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

In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10^{th} harmonic (a minimum of a 24.835 GHz).

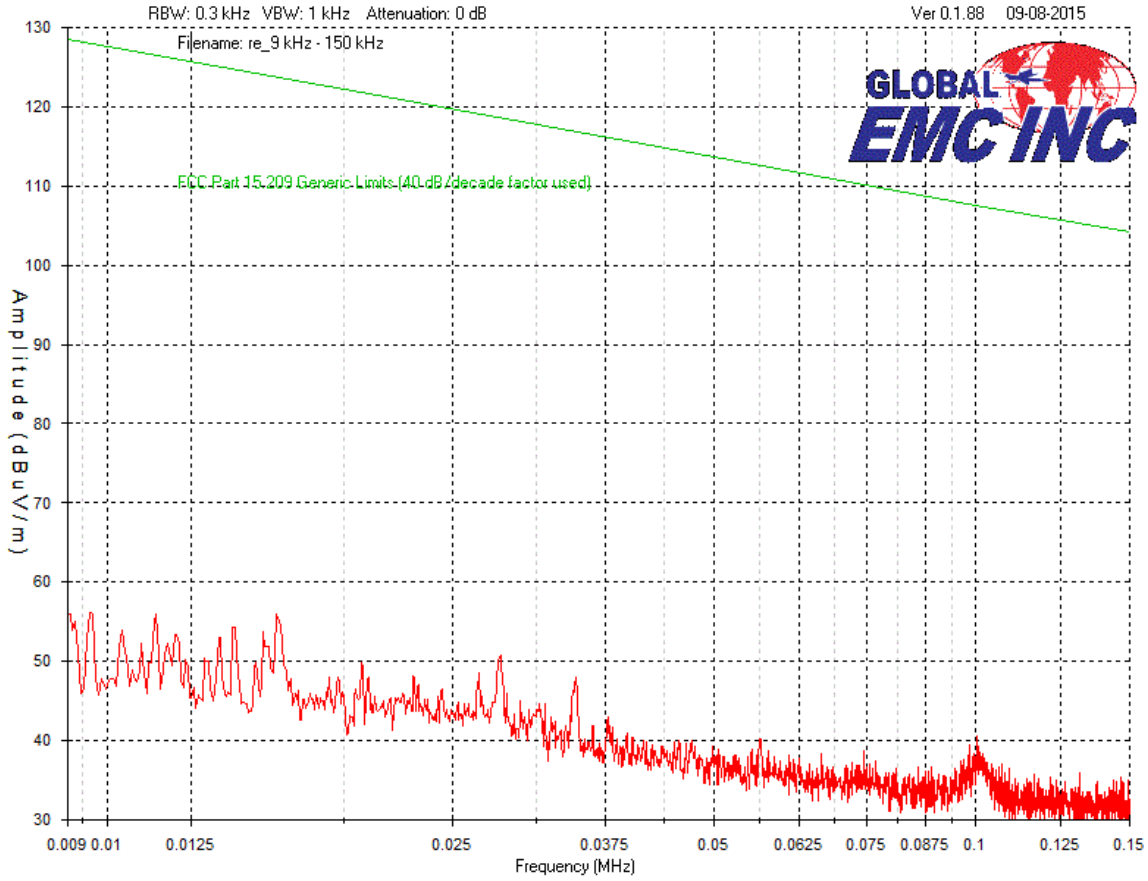
Devices scanned may be scanned at alternate test distances, and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above

30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m / 3m) is applied.

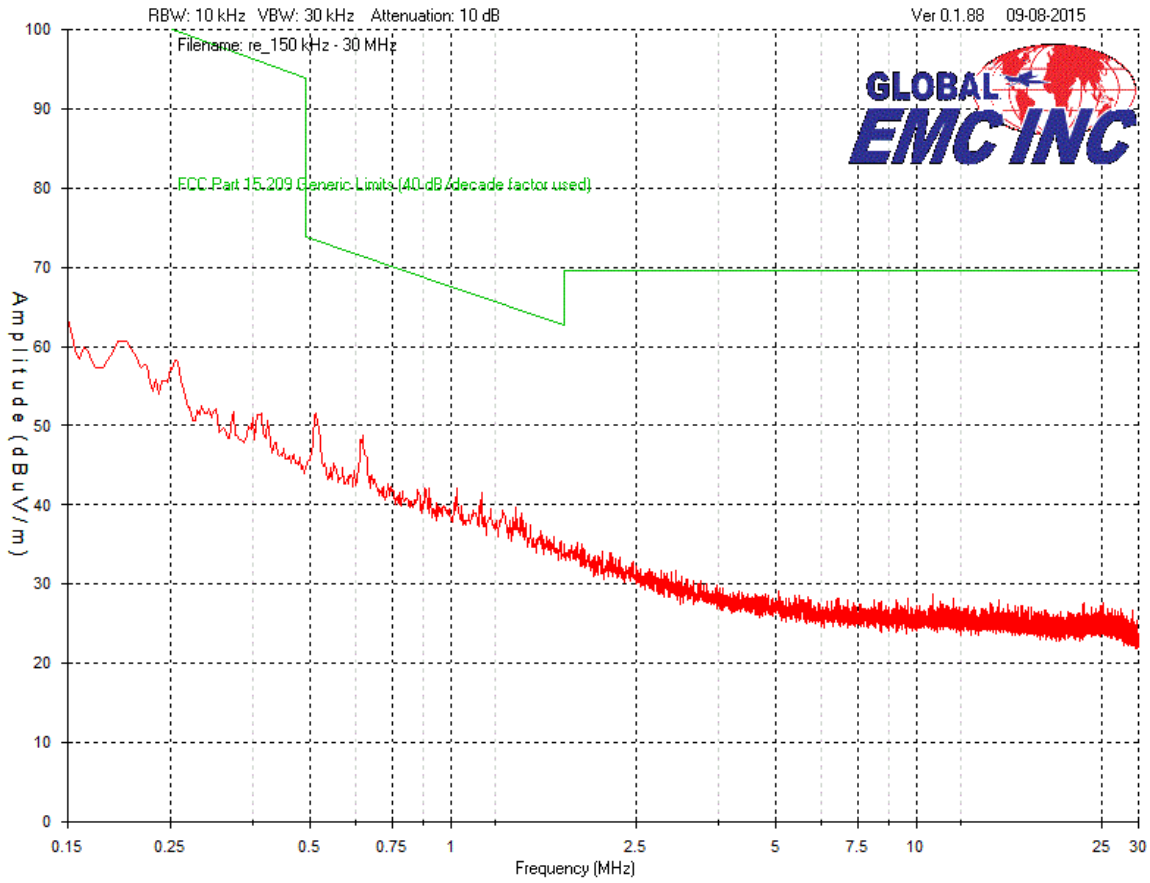
Low, middle and high channels were measured, each in three orthogonal axes were checked; however the worst case graphs are presented.

Band edge measure graphs were shown for illustrations purpose. See final measurement section for all measurements.

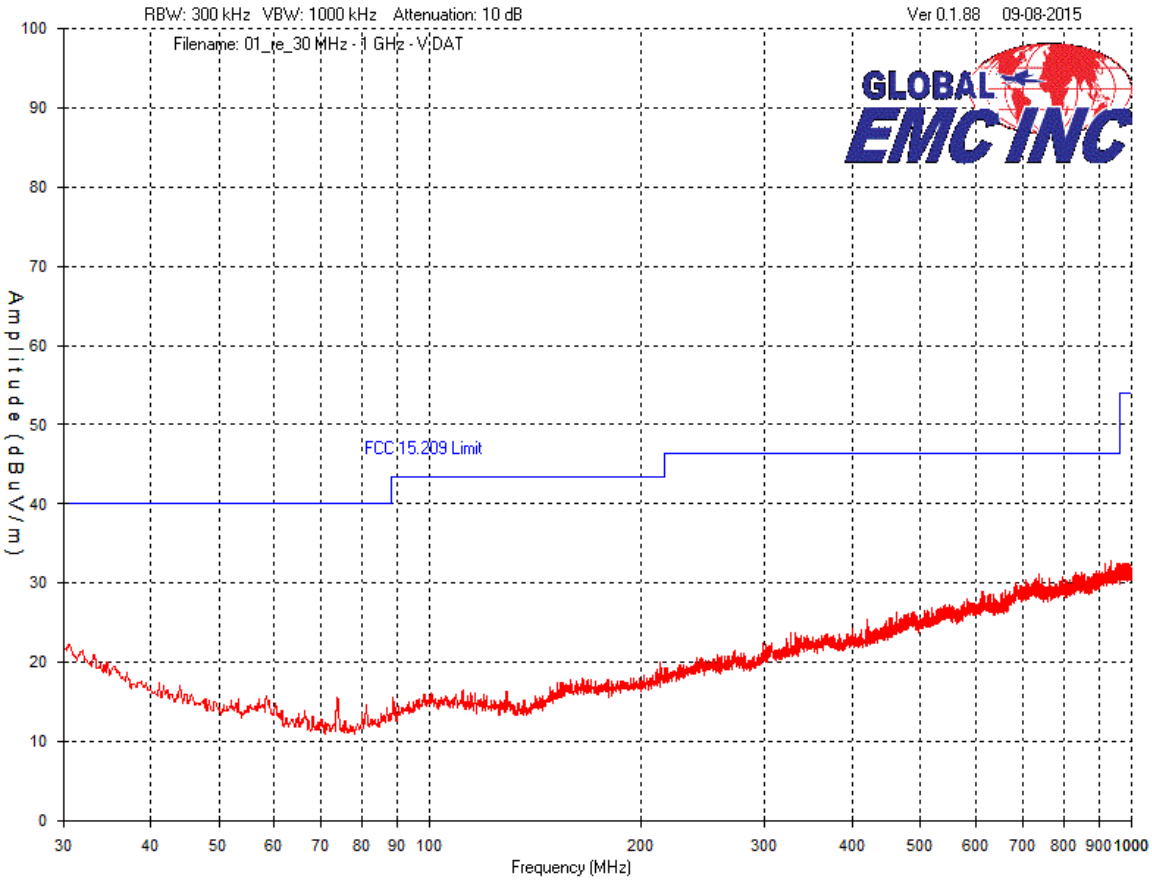
9 kHz – 150 kHz



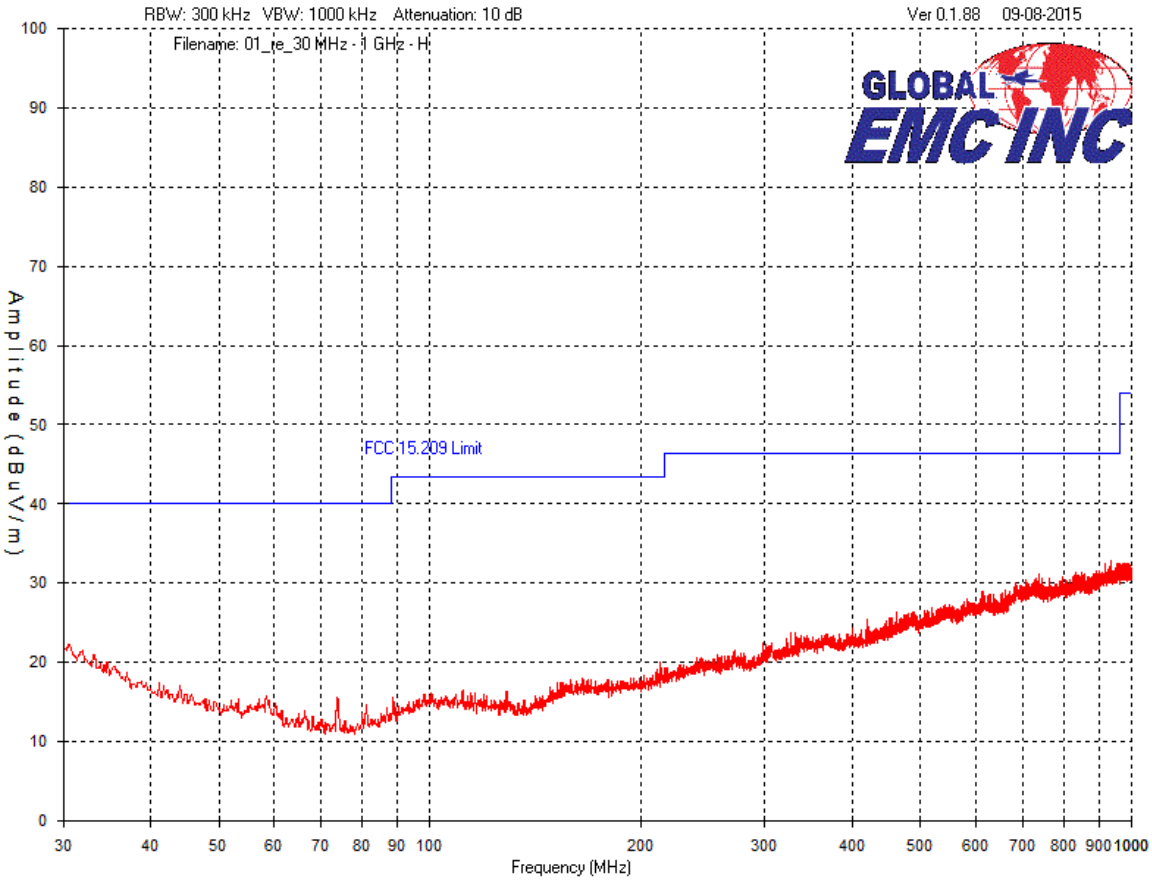
150 kHz – 30 MHz



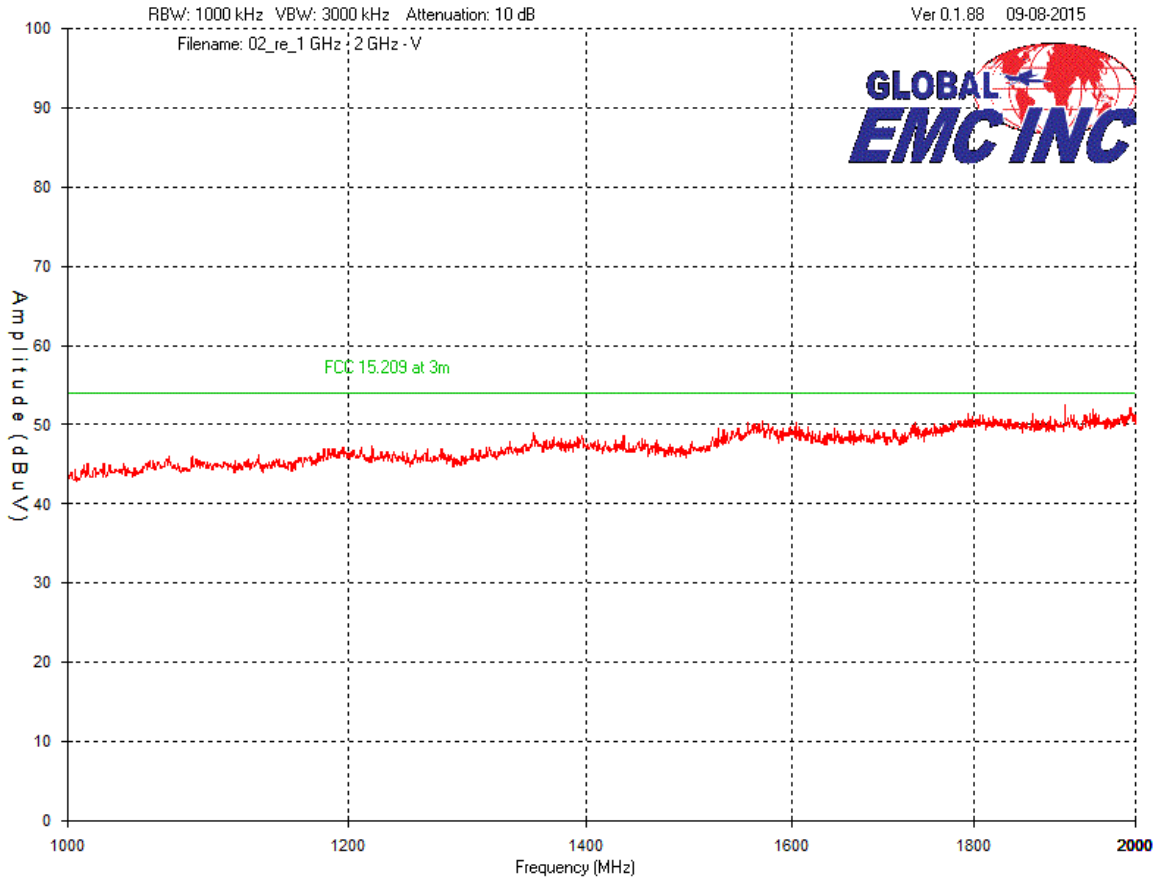
Mid Channel - 30 MHz – 1 GHz
Vertical – Peak Emission Graph



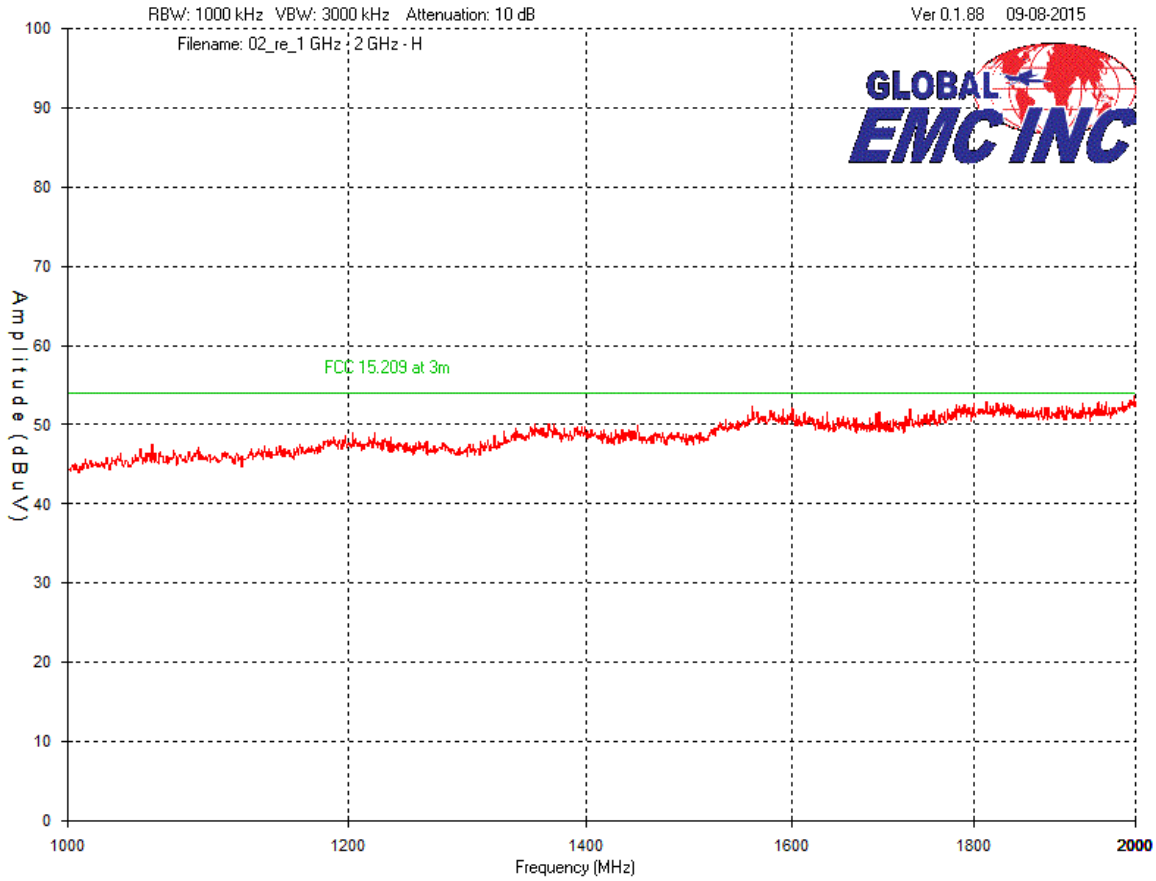
Mid Channel – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph



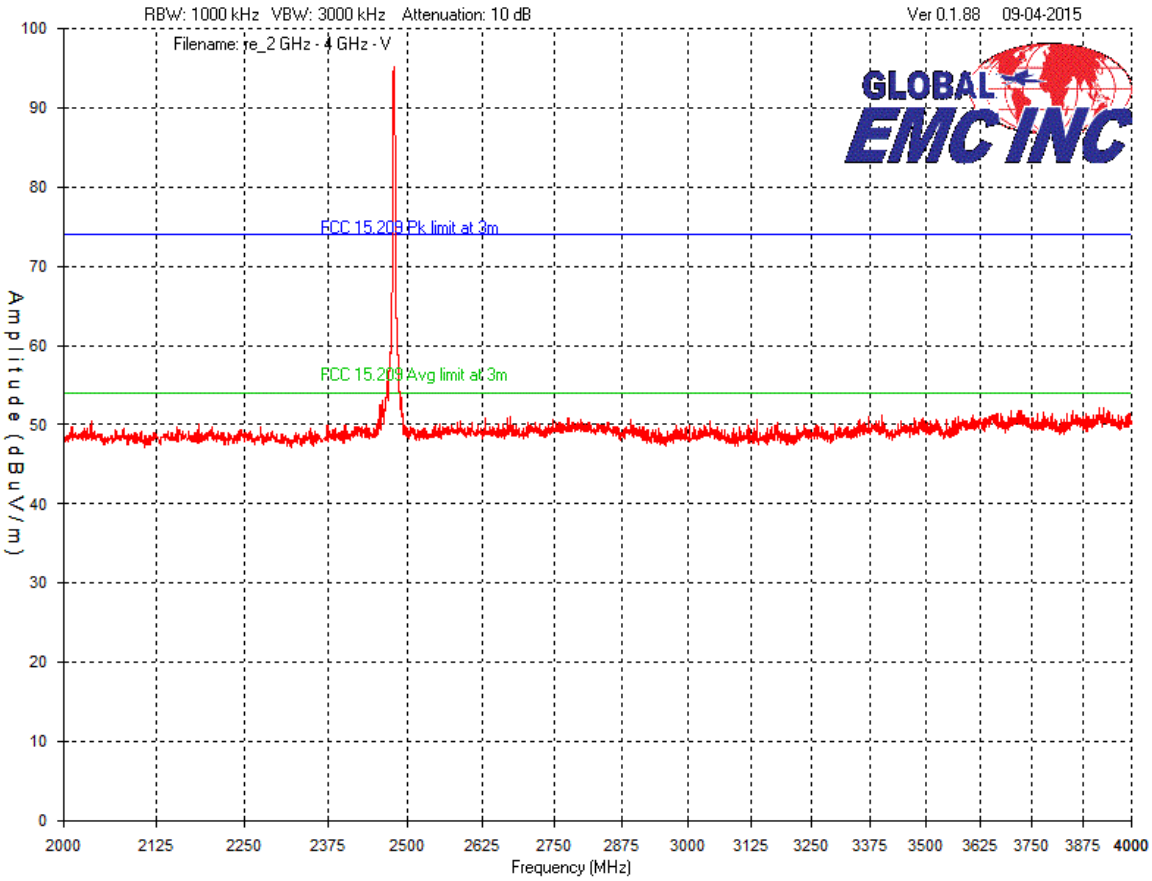
Mid Channel – 1 GHz – 2 GHz
Vertical - Peak Emission Graph



Mid Channel – 1 GHz – 2 GHz
Horizontal - Peak Emission Graph

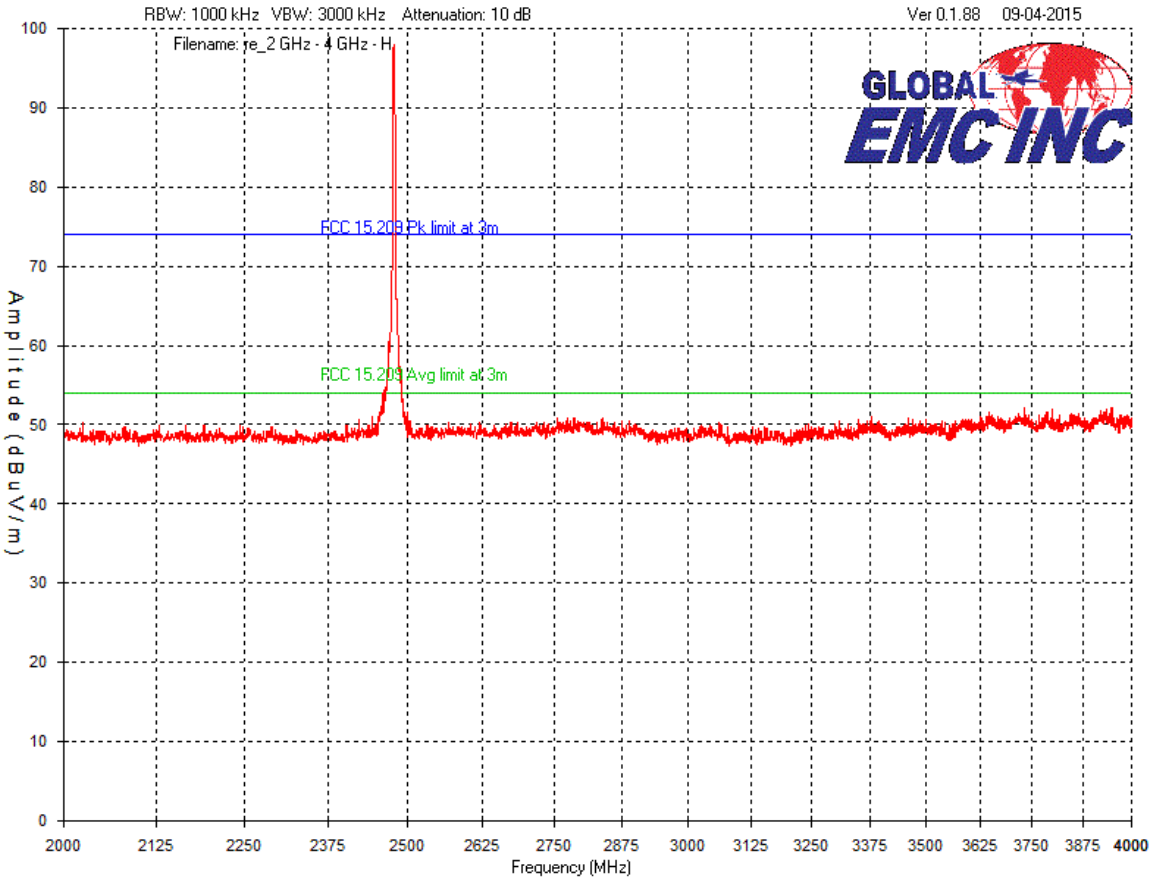


Mid Channel – 2 GHz – 4 GHz
Vertical - Peak Emission Graph



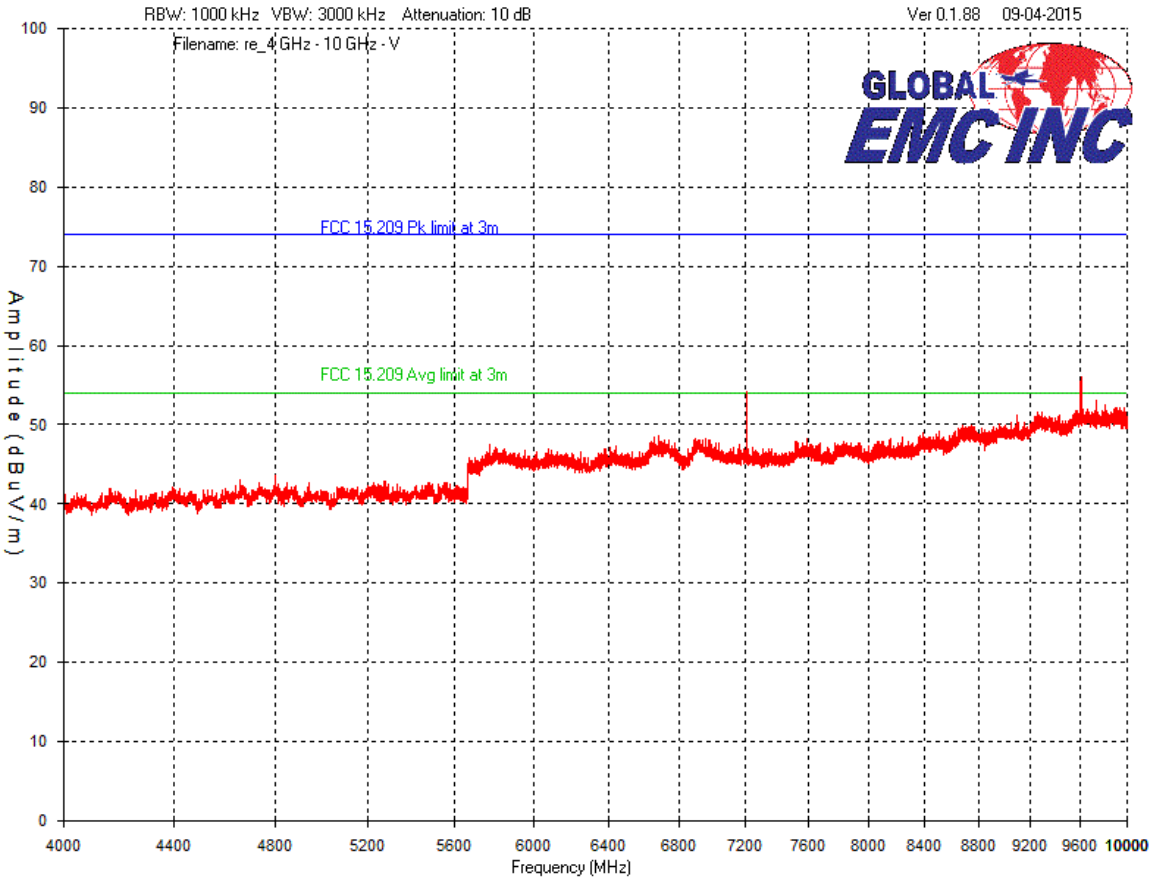
Note: See Final Measurements and Results section starting on page 50 for measurements.

Mid Channel – 2 GHz – 4 GHz
Horizontal - Peak Emission Graph



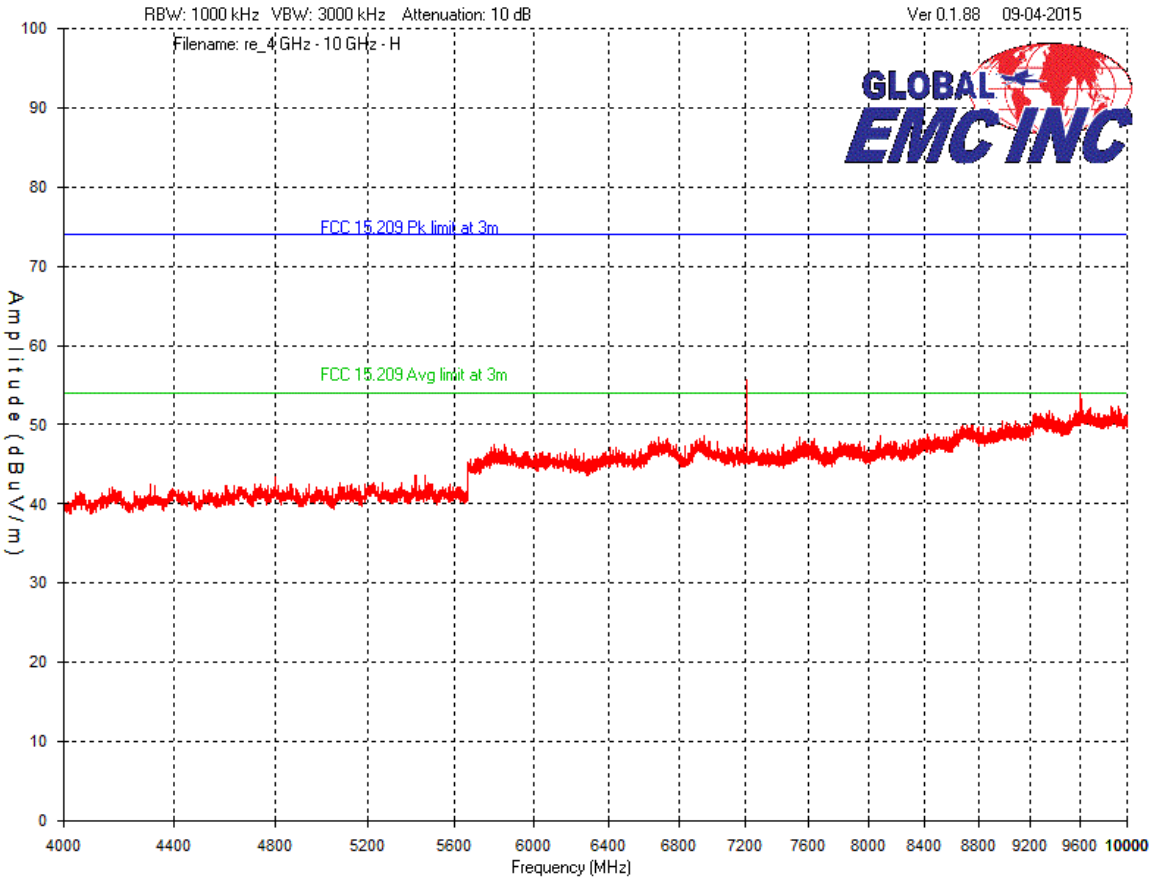
Note: See Final Measurements and Results section starting on page 50 for measurements.

Mid Channel – 4 GHz – 10GHz
Vertical - Peak Emission Graph



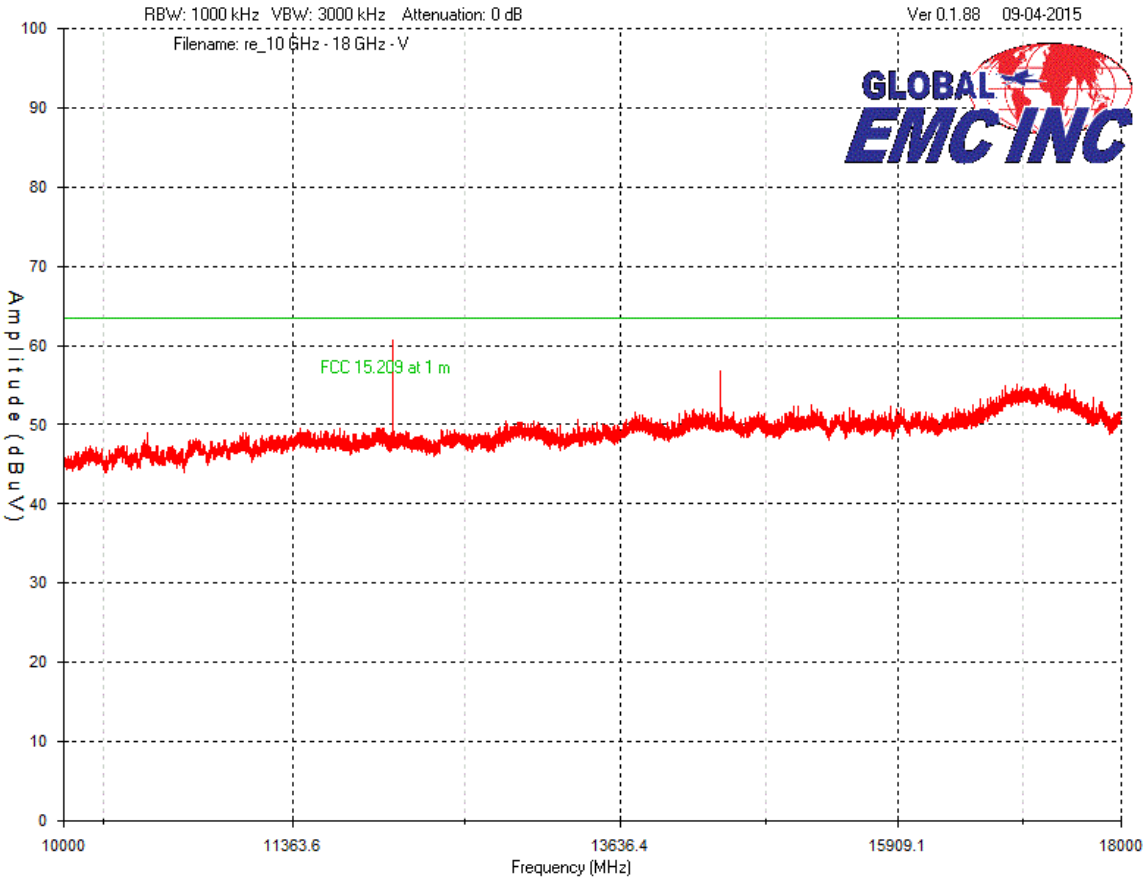
Note: See Final Measurements and Results section starting on page 50 for measurements.

Mid Channel – 6 GHz – 10 GHz
Vertical - Peak Emission Graph



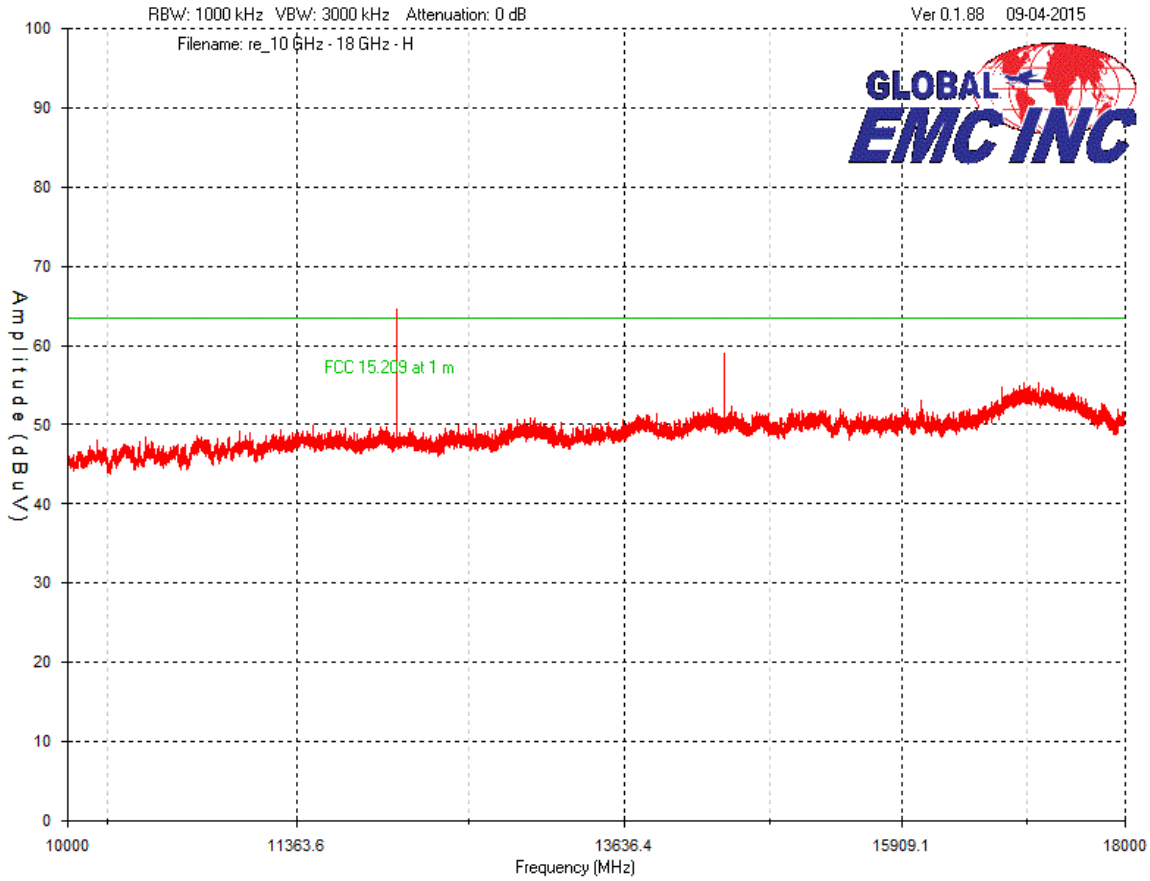
Note: See Final Measurements and Results section starting on page 50 for measurements.

Mid Channel – 10 GHz – 18 GHz
Vertical - Peak Emission Graph



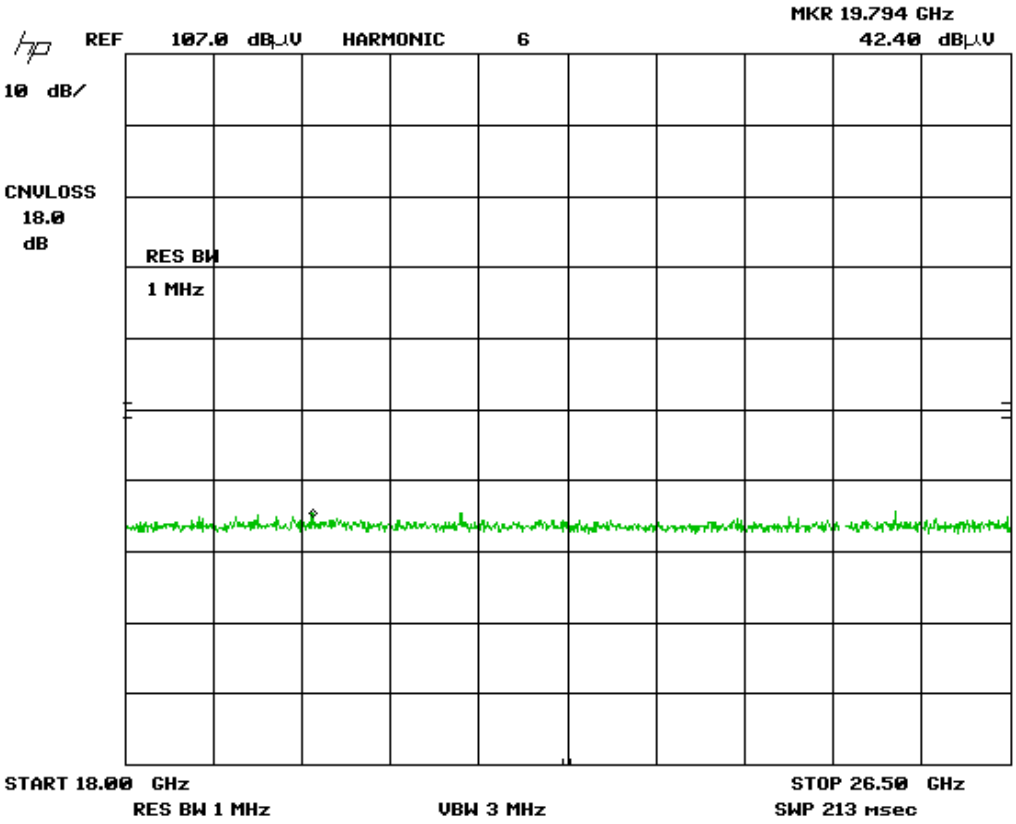
Note: See Final Measurements and Results section starting on page 50 for measurements.

Mid Channel – 10 GHz – 18 GHz
Horizontal - Peak Emission Graph



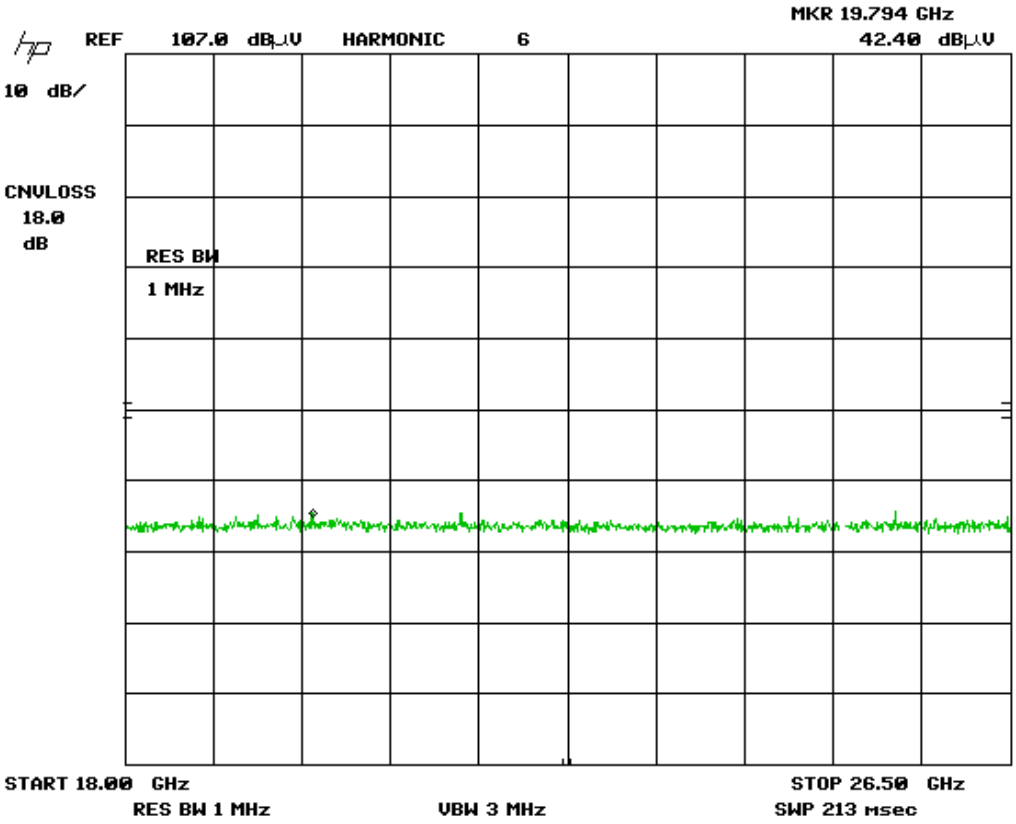
Note: See Final Measurements and Results section starting on page 50 for measurements.

Mid Channel – 18 GHz – 26 GHz
Horizontal - Peak Emission Graph



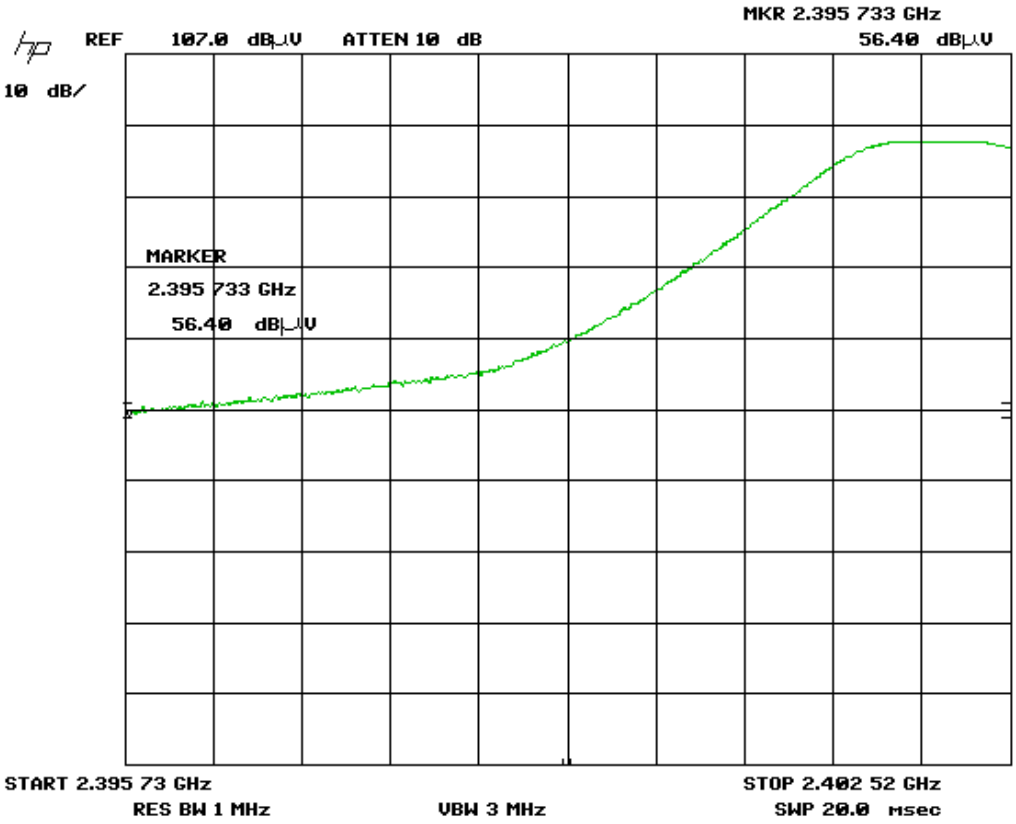
Plot was taken at 1 meter distances. All emissions shown were instrument noise floor of measurement instrument. No emissions were found in this frequency range.

Mid Channel – 18 GHz – 26 GHz
Vertical - Peak Emission Graph



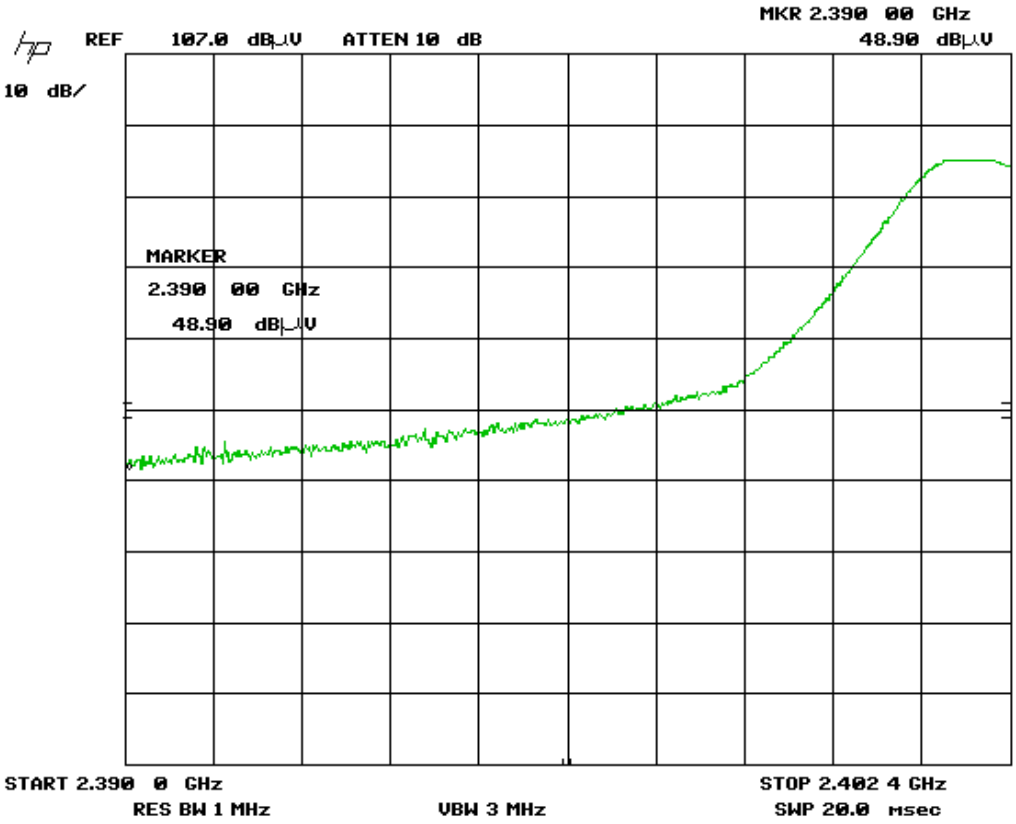
Plot was taken at 1 meter distances. All emissions shown were instrument noise floor of measurement instrument. No emissions were found in this frequency range.

Band Edge – Low Channel
Vertical - Peak Emission



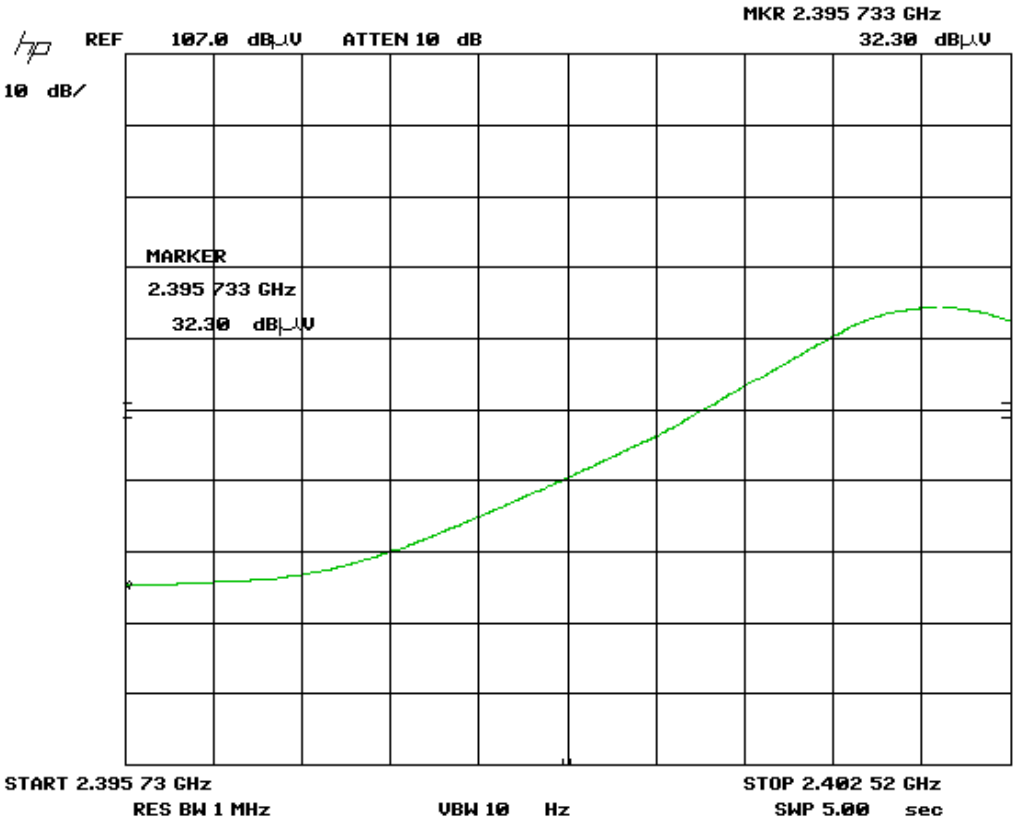
Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 50 for corrected values.

Band Edge – Low Channel
Horizontal - Peak Emission



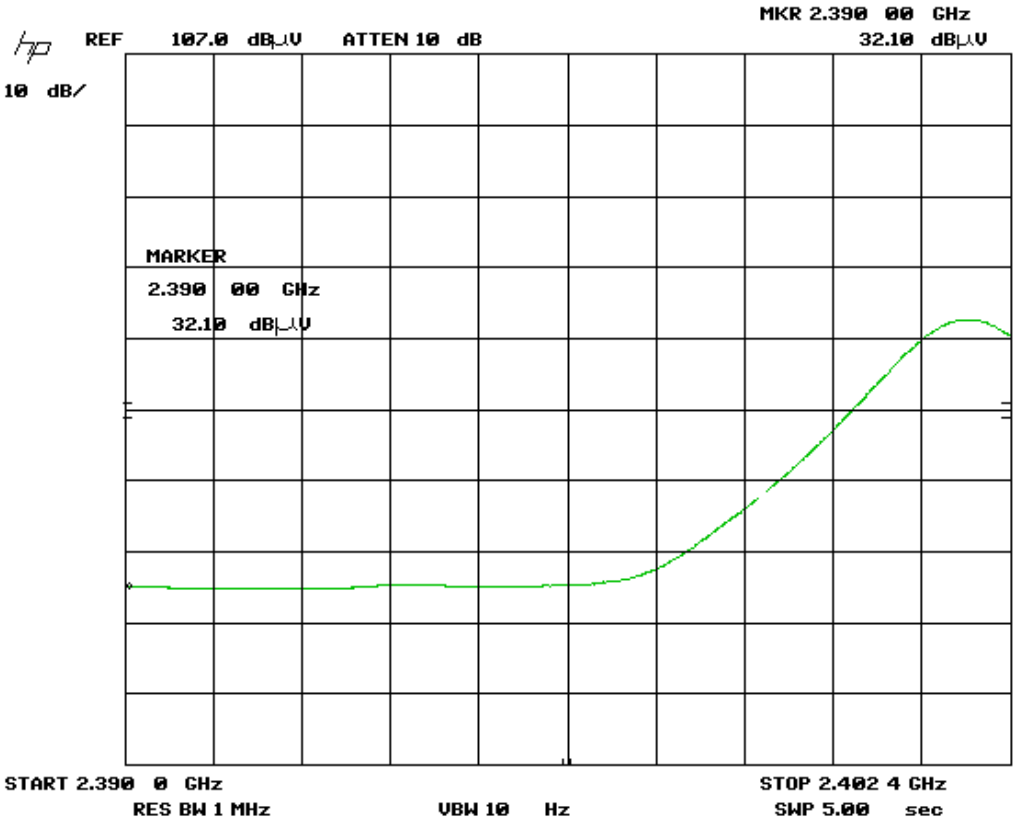
Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 50for corrected values.

Band Edge – Low Channel
Vertical – Average Emission



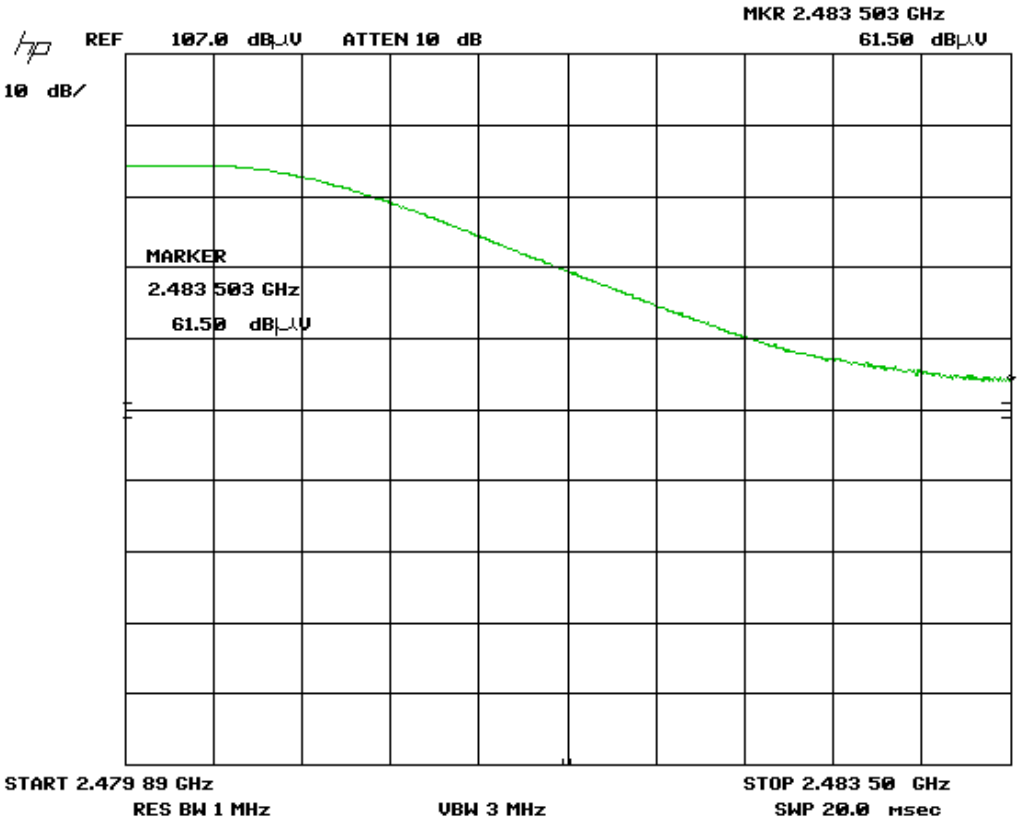
Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 50 for corrected values.

Band Edge – Low Channel
Horizontal - Average Emission



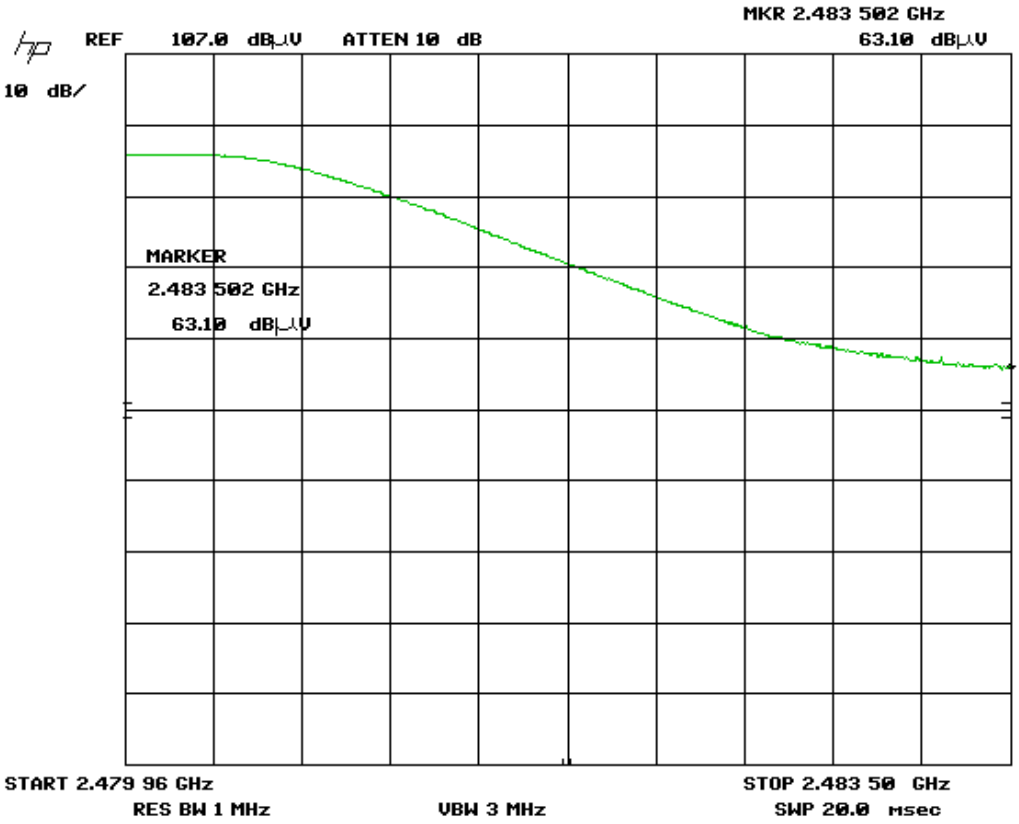
Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 50 for corrected values.

Band Edge – Hi Channel
Vertical - Peak Emission



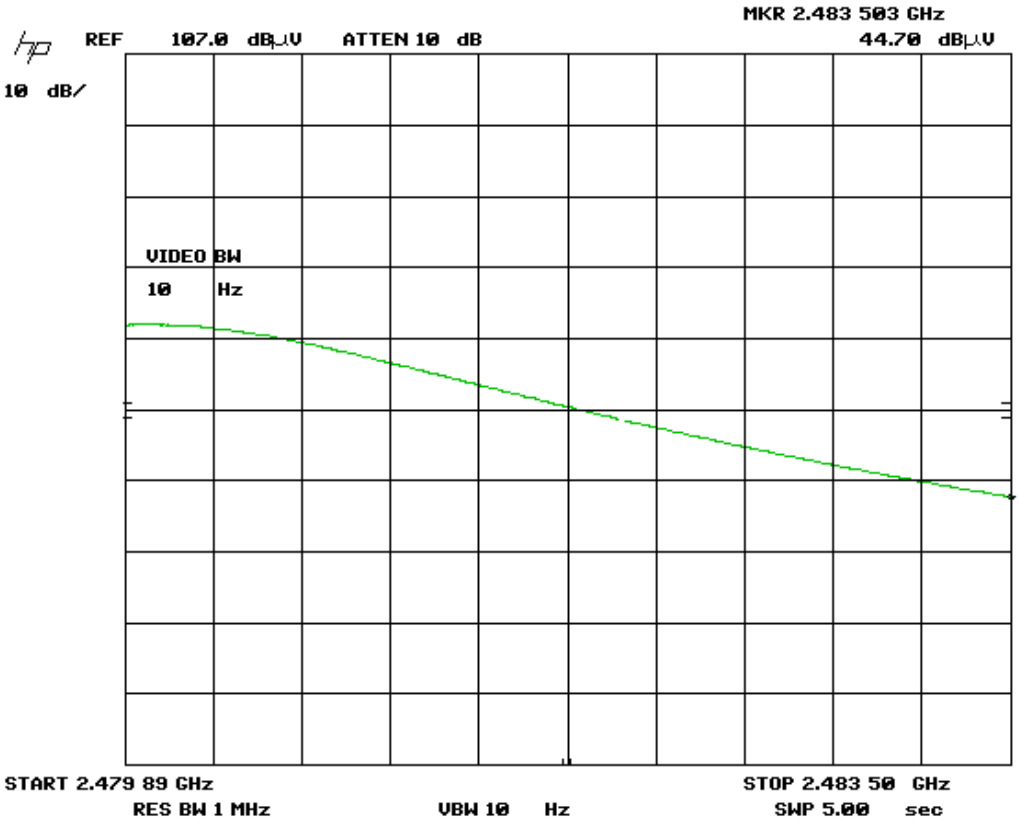
Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 50 for corrected values.

Band Edge – Hi Channel
Horizontal - Peak Emission



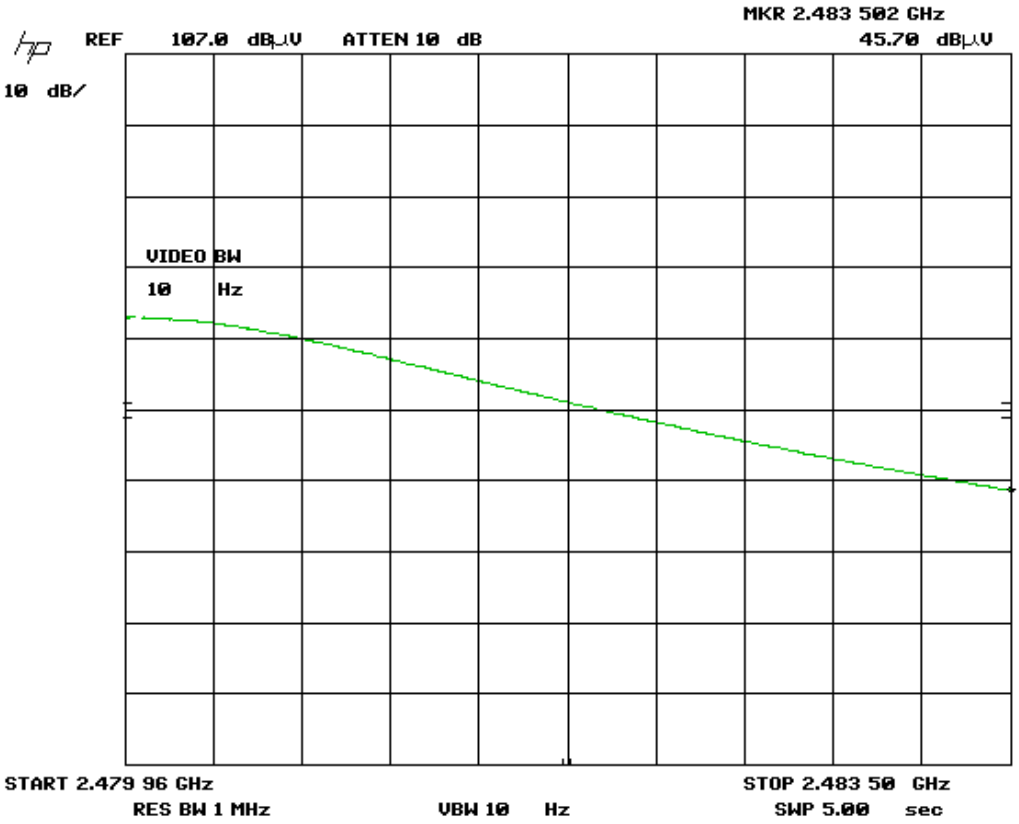
Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 50 for corrected values.

Band Edge – Hi Channel
Vertical - Average Emission



Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 50 for corrected values.

Band Edge – Hi Channel
Horizontal - Average Emission



Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 50 for corrected values.

Final Measurements and Results

The EUT passed the limits. Low, middle and high bands were measured.

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 final detector.

The measurements were maximized by rotating the turn table over a full 0-360 rotation and the antenna height was varied from 1 m to 4 m.

Test Frequency (MHz)	Detection mode	Antenna polarity (Horz/Vert)	Raw signal dB(µV)	Antenna factor dB	Cable loss dB	Attenuator dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB	Result
Low Channel (0x00) - Y axis (Vertical)											
2402	Peak	Horz	92.3	26.1	5.4	10.0	33.8	100.0			PASS
2402	Avg	Horz	69.7	26.1	5.4	10.0	33.8	77.4			PASS
2402	Peak	Vert	94.7	26.1	5.4	10.0	33.8	102.4			PASS
2402	Avg	Vert	71.3	26.1	5.4	10.0	33.8	79.0			PASS
2390	Peak	Horz	48.9	26.1	5.4	10.0	33.8	56.6	74.0	17.4	PASS
2390	Avg	Horz	32.1	26.1	5.4	10.0	33.8	39.8	54.0	14.2	PASS
2390	Peak	Vert	56.4	26.1	5.4	10.0	33.8	64.1	74.0	9.9	PASS
2390	Avg	Vert	32.3	26.1	5.4	10.0	33.8	40.0	54.0	14.0	PASS
4804	Peak	Horz	47.7	27.6	7.7	0.0	35.3	47.7	74.0	26.3	PASS
4804	Avg	Horz	36.3	27.6	7.7	0.0	35.3	36.3	54.0	17.7	PASS
4804	Peak	Vert	46.3	27.6	7.7	0.0	35.3	46.3	74.0	27.7	PASS
4804	Avg	Vert	34.5	27.6	7.7	0.0	35.3	34.5	54.0	19.5	PASS
7206	Peak	Horz	55.2	28.9	9.6	0.0	35.5	58.2	74.0	15.8	PASS
7206	Avg	Horz	46.4	28.9	9.6	0.0	35.5	49.4	54.0	4.6	PASS
7206	Peak	Vert	57.0	28.9	9.6	0.0	35.5	60.0	74.0	14.0	PASS
7206	Avg	Vert	48.4	28.9	9.6	0.0	35.5	51.4	54.0	2.6	PASS
9608	Peak	Horz	53.3	31.1	9.6	0.0	36.1	57.9	74.0	16.1	PASS
9608	Avg	Horz	42.2	31.1	9.6	0.0	36.1	46.8	54.0	7.2	PASS
9608	Peak	Vert	52.4	31.1	9.6	0.0	36.1	57.0	74.0	17.0	PASS
9608	Avg	Vert	40.8	31.1	9.6	0.0	36.1	45.4	54.0	8.6	PASS
12010	Peak	Horz	56.9	32.1	9.6	0.0	35.1	63.5	74.0	10.5	PASS
12010	Avg	Horz	46.2	32.1	9.6	0.0	35.1	52.8	54.0	1.2	PASS
12010	Peak	Vert	55.2	32.1	9.6	0.0	35.1	61.8	74.0	12.2	PASS
12010	Avg	Vert	43.3	32.1	9.6	0.0	35.1	49.9	54.0	4.1	PASS
14412	Peak	Horz	53.4	32.0	9.6	0.0	33.8	61.2	74.0	12.8	PASS
14412	Avg	Horz	39.2	32.0	9.6	0.0	33.8	47.0	54.0	7.0	PASS
14412	Peak	Vert	52.9	32.0	9.6	0.0	33.8	60.7	74.0	13.3	PASS
14412	Avg	Vert	38.7	32.0	9.6	0.0	33.8	46.5	54.0	7.5	PASS

Test Frequency (MHz)	Detection mode	Antenna polarity (Horz/Vert)	Raw signal dB(µV)	Antenna factor dB	Cable loss dB	Attenuator dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB	Result
Mid Channel (0x13) - Y axis (Vertical)											
2440	Peak	Horz	92.7	26.1	5.4	10.0	33.8	100.4			PASS
2440	Avg	Horz	70.1	26.1	5.4	10.0	33.8	77.8			PASS
2440	Peak	Vert	90.3	26.1	5.4	10.0	33.8	98.0			PASS
2440	Avg	Vert	68.4	26.1	5.4	10.0	33.8	76.1			PASS
High Channel (0x27) - Z axis (side)											
2480	Peak	Horz	89.4	26.1	5.4	10.0	33.8	97.1			PASS
2480	Avg	Horz	67.7	26.1	5.4	10.0	33.8	75.4			PASS
2480	Peak	Vert	89.9	26.1	5.4	10.0	33.8	97.6			PASS
2480	Avg	Vert	68.1	26.1	5.4	10.0	33.8	75.8			PASS
2483.5	Peak	Horz	59.7	26.1	5.4	10.0	33.8	67.4	74.0	6.6	PASS
2483.5	Avg	Horz	43.9	26.1	5.4	10.0	33.8	51.6	54.0	2.4	PASS
2483.5	Peak	Vert	59.9	26.1	5.4	10.0	33.8	67.6	74.0	6.4	PASS
2483.5	Avg	Vert	43.9	26.1	5.4	10.0	33.8	51.6	54.0	2.4	PASS
High Channel (0x27) - X axis (Horizontal)											
2480	Peak	Horz	90.0	26.1	5.4	10.0	33.8	97.7			PASS
2480	Avg	Horz	68.1	26.1	5.4	10.0	33.8	75.8			PASS
2480	Peak	Vert	92.7	26.1	5.4	10.0	33.8	100.4			PASS
2480	Avg	Vert	69.8	26.1	5.4	10.0	33.8	77.5			PASS
2483.5	Peak	Horz	60.1	26.1	5.4	10.0	33.8	67.8	74.0	6.2	PASS
2483.5	Avg	Horz	43.9	26.1	5.4	10.0	33.8	51.6	54.0	2.4	PASS
2483.5	Peak	Vert	62.6	26.1	5.4	10.0	33.8	70.3	74.0	3.7	PASS
2483.5	Avg	Vert	45.5	26.1	5.4	10.0	33.8	53.2	54.0	0.8	PASS
High Channel (0x27) -Y axis (Vertical)											
2480	Peak	Horz	93.0	26.1	5.4	10.0	33.8	100.7			PASS
2480	Avg	Horz	70.0	26.1	5.4	10.0	33.8	77.7			PASS
2480	Peak	Vert	91.3	26.1	5.4	10.0	33.8	99.0			PASS
2480	Avg	Vert	69.0	26.1	5.4	10.0	33.8	76.7			PASS
2483.5	Peak	Horz	63.1	26.1	5.4	10.0	33.8	70.8	74.0	3.2	PASS
2483.5	Avg	Horz	45.7	26.1	5.4	10.0	33.8	53.4	54.0	0.6	PASS
2483.5	Peak	Vert	61.5	26.1	5.4	10.0	33.8	69.2	74.0	4.8	PASS
2483.5	Avg	Vert	44.7	26.1	5.4	10.0	33.8	52.4	54.0	1.6	PASS

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration / Verification date	Next calibration/ Verification due date	Asset #
Spectrum Analyzer	8566B	HP	Oct-9, 2014	Oct-9, 2016	GEMC 193
Quasi Peak Adapter	85650A	HP	May-22, 2014	May-22, 2016	GEMC 194
Loop Antenna	EM 6871	Electro-Metrics	Feb 3, 2015	Feb 5, 2017	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	Feb 3, 2015	Feb 5, 2017	GEMC 71
BiLog Antenna	3142-C	ETS	Feb 4, 2013	Feb 4, 2015	GEMC 137
Attenuator 10 dB	8493B	Agilent	Feb 11, 2015	Feb 11, 2016	GEMC 133
4GHZ-12GHz High Pass filter	11SH10-4000/T12000-0/0	K & L Microwave	Apr 9, 2015	Apr 9, 2016	GEMC 119
Chase Preamp 9kHz - 2 GHz	CPA9231A	Chase	Sept 9, 2014	Sept 9, 2016	GEMC 6403
Q-Par Horn Antenna (2 to 18 GHz)	WBH218HN	Q-par	Jan-23, 2014	Jan-23,2016	GEMC 6375
Horn Antenna 18 GHz - 26.5 GHz	SAS-572	A.H. Systems	Sept 9, 2014	Sept 9, 2016	GEMC 6371
18.0-26.5 GHz Harmonic Mixer	11970K	HP	Jan 28, 2014	Jan 28, 2016	GEMC 158
1-26G pre-amp	HP 8449B	HP	Sept 9, 2014	Sept 9, 2016	GEMC 6351
2.0-8.0 GHz Amplifier	11975A	HP	Jan 28, 2014	Jan 28, 2016	GEMC157
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	Feb 10, 2015	Feb 10, 2016	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	Feb 10, 2015	Feb 10, 2016	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	Feb 10, 2015	Feb 10, 2016	GEMC 31

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

Power Spectral Density – 15.247 DM

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 and Methods

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.

The method is given in Section 10.2 of FCC KDB 558074.

Results

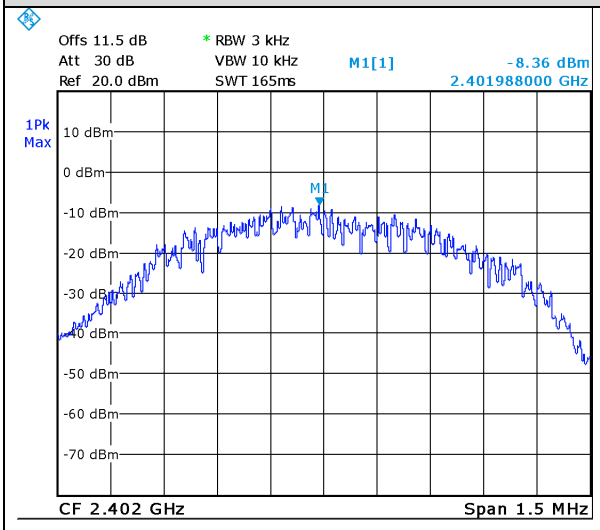
The EUT passed. Low, medium, and high band was tested. The worst case PSD is -8.17 dBm/3 kHz.

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, with the worst case being presented.

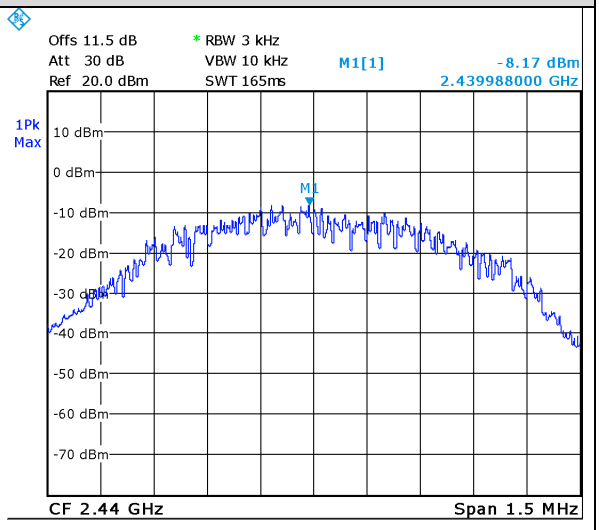
PSD

Low Channel



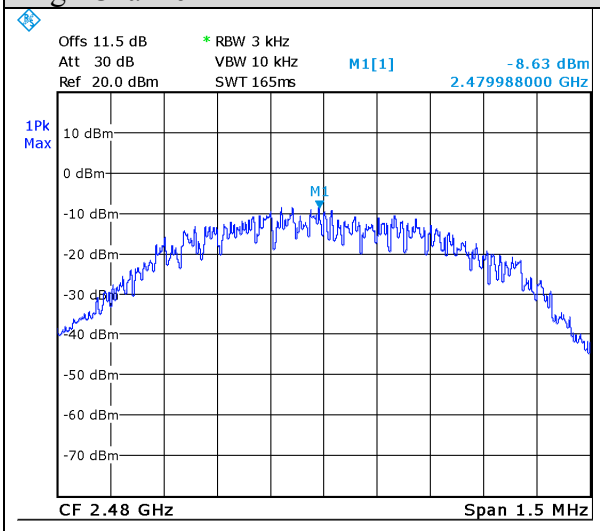
Date: 8.SEP.2015 16:42:03

Mid Channel



Date: 8.SEP.2015 16:40:46

High Channel



Date: 8.SEP.2015 16:05:50

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

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration / Verification date	Next calibration/ Verification due date	Asset #
Spectrum Analyzer	ESL6	Rohde & Schwarz	Nov-15, 2013	Nov-15, 2015	GEMC 160
Attenuator 10 dB	8493B	Agilent	Feb 11, 2015	Feb 11, 2016	GEMC133
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	Feb 10, 2015	Feb 10, 2016	GEMC 29

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	
Organization	Interaxon Inc 511 King Street West, Suite 303 Toronto, ON., Canada M5V 1K4
Contact	Sam Mackenzi
Phone	416 598 8989
Email	sam@choosemuse.com
EUT Details	
EUT Name (for report title)	MUSE
EUT Model / SN (if known)	MU-02
FCC ID	2ABZI-MU02
Industry Canada #	11834A-MU02
Equipment category	Residential
EUT is powered using	Rechargeable Battery
Input voltage range(s) (V)	5 VDC
Frequency range(s) (Hz)	DC
Rated input current (A)	250 mA
Number of power supplies in EUT	1
Transmits RF energy? (describe)	Yes
Basic EUT functionality description	EEG Device with Bluetooth LE

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'.

EUT Configuration

Please see Appendix B for a picture of the unit running in normal conditions.

- Wireless were configured to transmit at 100% duty cycle

Operational Setup

No additional device were required to be attached to the EUT for its normal operation.

Appendix B – EUT and Test Setup Photographs

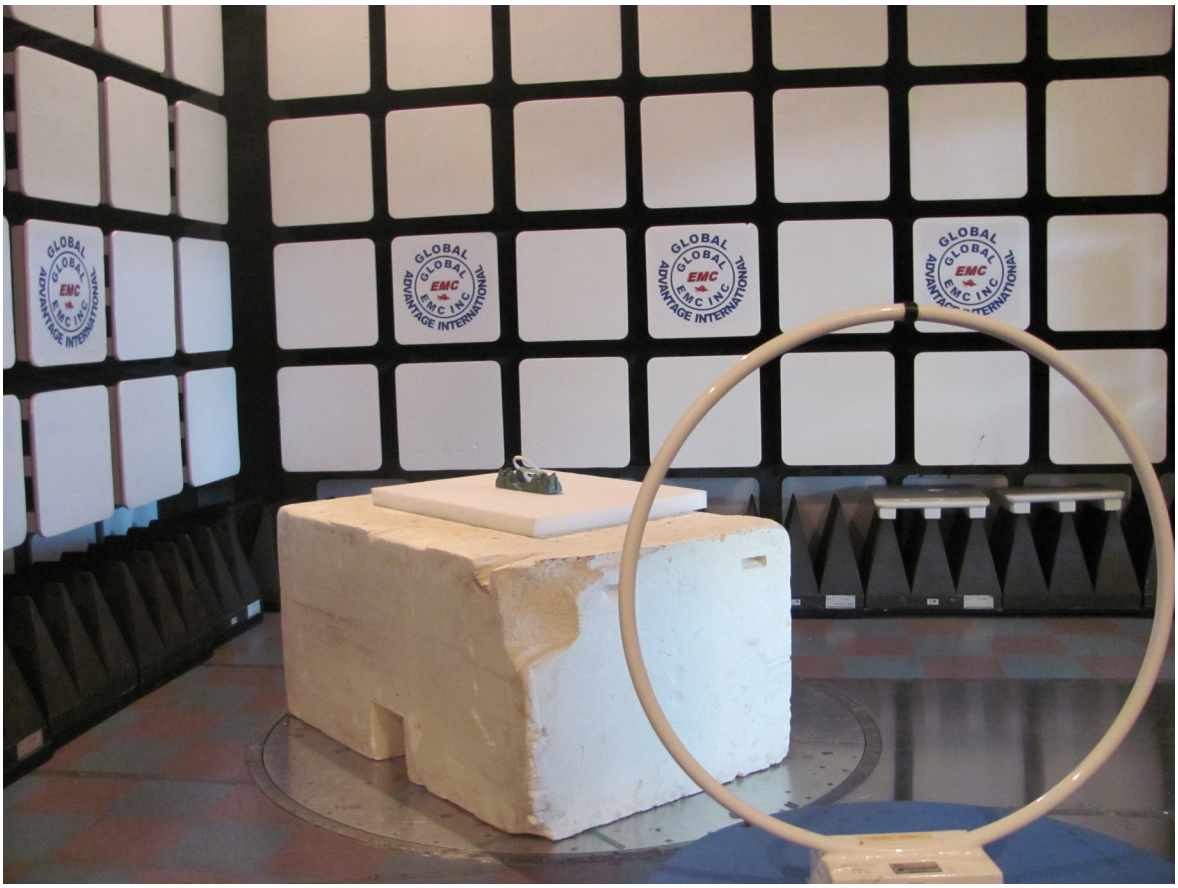


Figure 2: Radiated emissions setup – photo 1

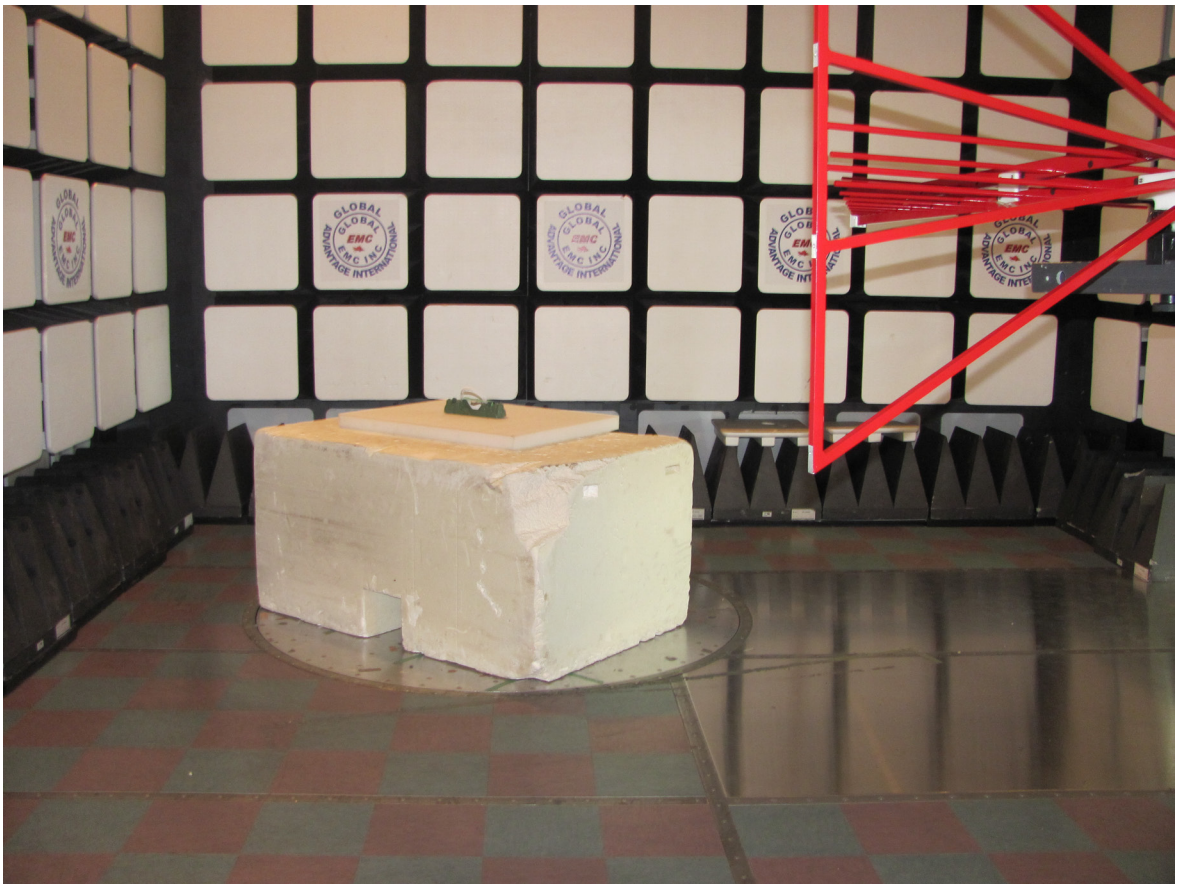


Figure 3: Radiated emission setup – photo 2

Figure 4: Radiated emission setup – photo 3

Figure 5: Antenna port conducted emission - photo