EMC & RF Test Report

As per

RSS-247 Issue 1:2015
&
FCC Part 15 Subpart 15.247:2016

Unlicensed Intentional Radiators

on the

AWAC24UR

Issued by:

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Min Xie,
EMC Project
Engineer

Testing produced for

artaflex

See Appendix A for full client & EUT details.

Industry Canada
Registration # 6844A-3

Testing Laboratory
Certificate #2955.02

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

Registration # CA6844

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Report Scope

This report addresses the EMC verification testing and test results of the **Artaflex Inc, Model: AWAC24UR**, and is herein referred to as EUT (Equipment Under Test). The EUT was tested for compliance against the following standards:

RSS-247 Issue 1:2015

FCC Part 15 Subpart C 15.247:2016

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

This report does not imply product endorsement by any government, accreditation agency, or TÜV SÜD Canada Inc.

Opinions or interpretations expressed in this report, if any, are outside the scope of TÜV SÜD Canada Inc accreditations. Any opinions expressed do not necessarily reflect the opinions of TÜV SÜD Canada Inc, unless otherwise stated.

Summary

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

EUT:	AWAC24UR
FCC Certification #, FCC ID:	UP2AWA24UR
Industry Canada Certification #, IC:	6797A-AWA24UR
EUT passed all tests performed	Yes
Tests conducted by	Min Xie

For testing dates, see "Testing Environmental Conditions and Dates".

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	RF Exposure	> 20 cm separation.	Pass See justification and Calculations
Overall Result			**Pass**

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 ‘*’.

Notes, Justifications, or Deviations

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

For the Antenna requirement specified in FCC 15.203 (RSS-247 section 5.5), the unit uses a SMD antenna (2.1 dBi peak gain antenna – Antenova A5887) with less than 6 dBi gain.

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

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 maximum permissible exposure, this device operates at less than 1 Watt at 2400 – 2483.5 MHz and is designed to operate greater than 20 cm from personnel during normal operation. No testing is required, however worst case calculated exposure compliance follows later in this report. See RF exposure exhibits for details.

Power line conducted emissions were performed on a Laptop computer with the EUT plugged in.

The EUT have two power settings PA5 and PA3. PA5 have higher output power than PA2. Channels 0 to 3 and 66 to 78 were set to PA3 and Channels 4 to 65 were set to PA5. Low band edge measurements were performed on Channels 0 and 4; high band edge were performed for Channels 65 and 78. All other measurements were performed at PA5.

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

Sample Calculation(s)

Radiated Emission Test

Margin = Limit – (Received Signal + Antenna Factor + Cable Loss – Pre-Amp Gain)
Margin = 50.5dBµV/m – (50dBµV + 10dB + 2.5dB – 20dB)
Margin = 8.0 dB (pass)

Power Line Conducted Emission Test

Margin = Limit – (Received Signal + Attenuation Factor + Cable Loss + LISN Factor)
Margin = 73.0dBµV – (50dBµV + 10dB + 2.5dB + 0.5dB)
Margin = 10.0 dB (pass)

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 Subpart C:2016	Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators
CISPR 22:2008	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
FCC KDB 558074: 2016	FCC KDB 558074 Digital Transmission Systems, measurements and procedures
ICES-003 Issue 6 2016	Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
RSS-GEN Issue 4 2014	General Requirements and Information for the Certification of Radio Apparatus
RSS-247 Issue 1:2015	Issue 1: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
ISO 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories

Document Revision Status

Revision 1 - November 23, 2016
Initial Release

Definitions and Acronyms

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

AE – Auxiliary Equipment. A digital accessory that feeds data into or receives data from another device (host) that in turn, controls its operation.

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

EMC – Electro-Magnetic Compatibility. The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

EMI – Electro-Magnetic Immunity. The ability to maintain a specified performance when the equipment is subjected to disturbance (unwanted) signals of specified levels.

EUT – Equipment Under Test. A device or system being evaluated for compliance that is representative of a product to be marketed.

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 TÜV SÜD Canada labs near Toronto, Ontario. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on an EUT that has a maximum width or length of up to 2m and a height of up to 3m. The chamber is equipped with a turntable that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120Vac and 240Vac single phase, or devices that are rated for a 208Vac 3 phase input. DC capability is also available for testing. The chamber is equipped with a mast that controls the polarization and height of the antenna. Control of the mast occurs in the control room adjoining the shielded chamber. Radiated emission measurements are performed using a BiLog antenna and a Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN and using the Vertical Ground plane if applicable.

Calibrations and Accreditations

The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, CA6844), Industry Canada (IC, 6844A-3) and Voluntary Control Council for Interference (VCCI, R-4023, G-506, C-4498, and T-1246). This chamber was 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 TÜV SÜD Canada. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at TÜV SÜD Canada. TÜV SÜD Canada Inc is accredited to ISO 17025 by A2LA with Testing Certificate #2555.01. The laboratory's 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 environmental conditions were recorded in the facility during time of testing

Date	Test	Initials	Temperature (ºC)	Humidity (%)	Pressure (kPa)
2016/7/28	Radiated Emissions	MX	20 – 24	40 – 51	98.0 – 102.0
2016/6/10	Antenna Conducted Emissions	MX	20 – 24	40 – 51	98.0 – 102.0
2016/8/8	Power Line Conducted Emission	MX	20 – 24	40 – 51	98.0 – 102.0

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 247.

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 ANSI C63.10 Clause 11.8 DTS bandwidth and Section 6.9.3 Occupied bandwidth test.

Results

The EUT passed. The minimum measured 6 dB BW was of all modulations were greater than 500 kHz.

Additionally, the 99% bandwidth were measured for information purpose. There is no requirement on 99% bandwidth.

Three channels were measured. The following tables show the 6 dB and 99% bandwidth:

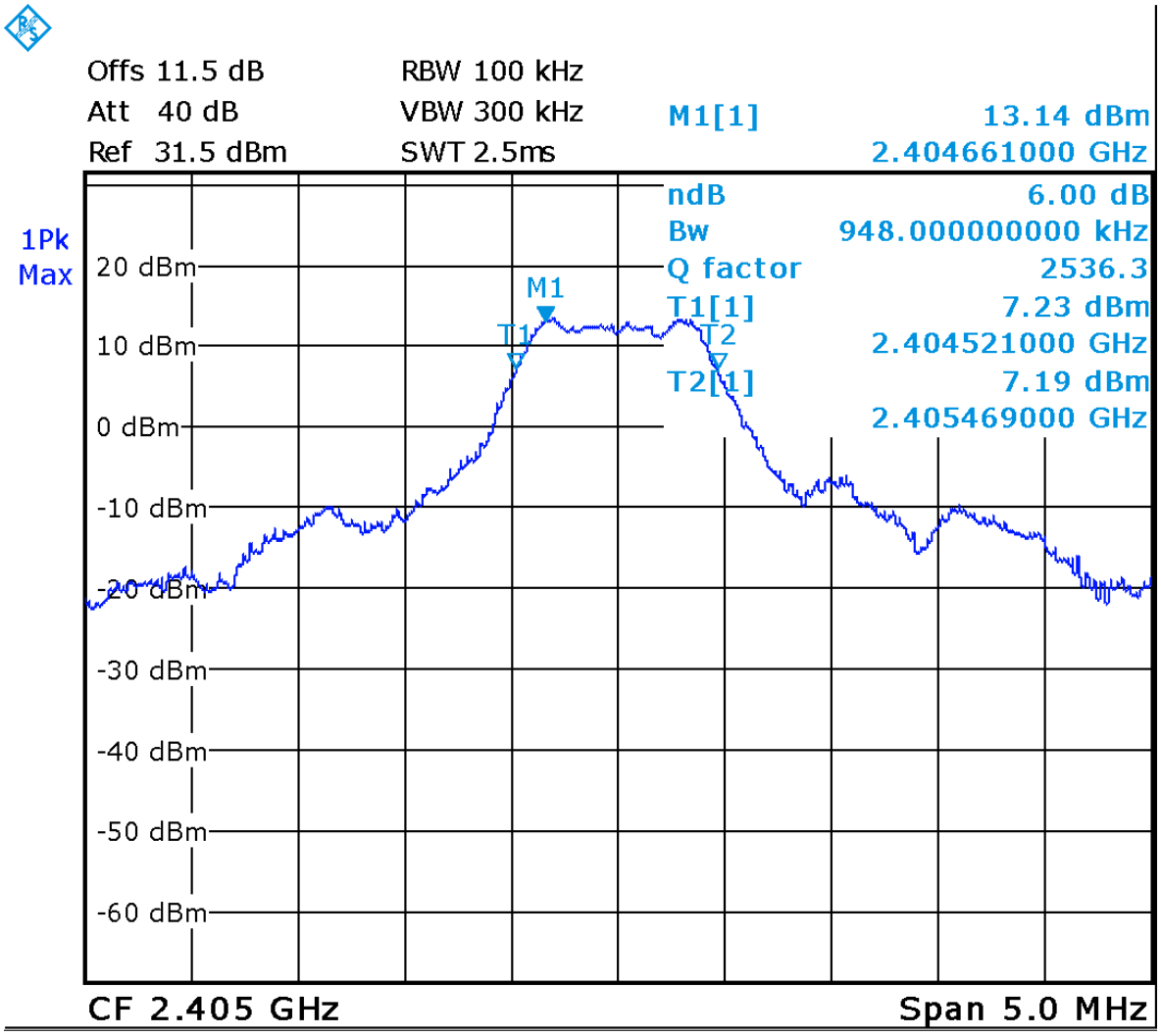
Bandwidth			
Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	99% Bandwidth (MHz)
4	2405	948.00	1.28
39	2440	948.00	1.30
65	2466	1008.00	1.70

Graph(s)

The graphs shown below show the DTS BW and OBW during the operation of the device. This measurement is a peak measurement. Max hold is performed for a duration of not less than 1 minute.

External attenuator and cable loss were accounted for as reference offset in the spectrum analyzer.

6 dB Bandwidth
Low Channel 4



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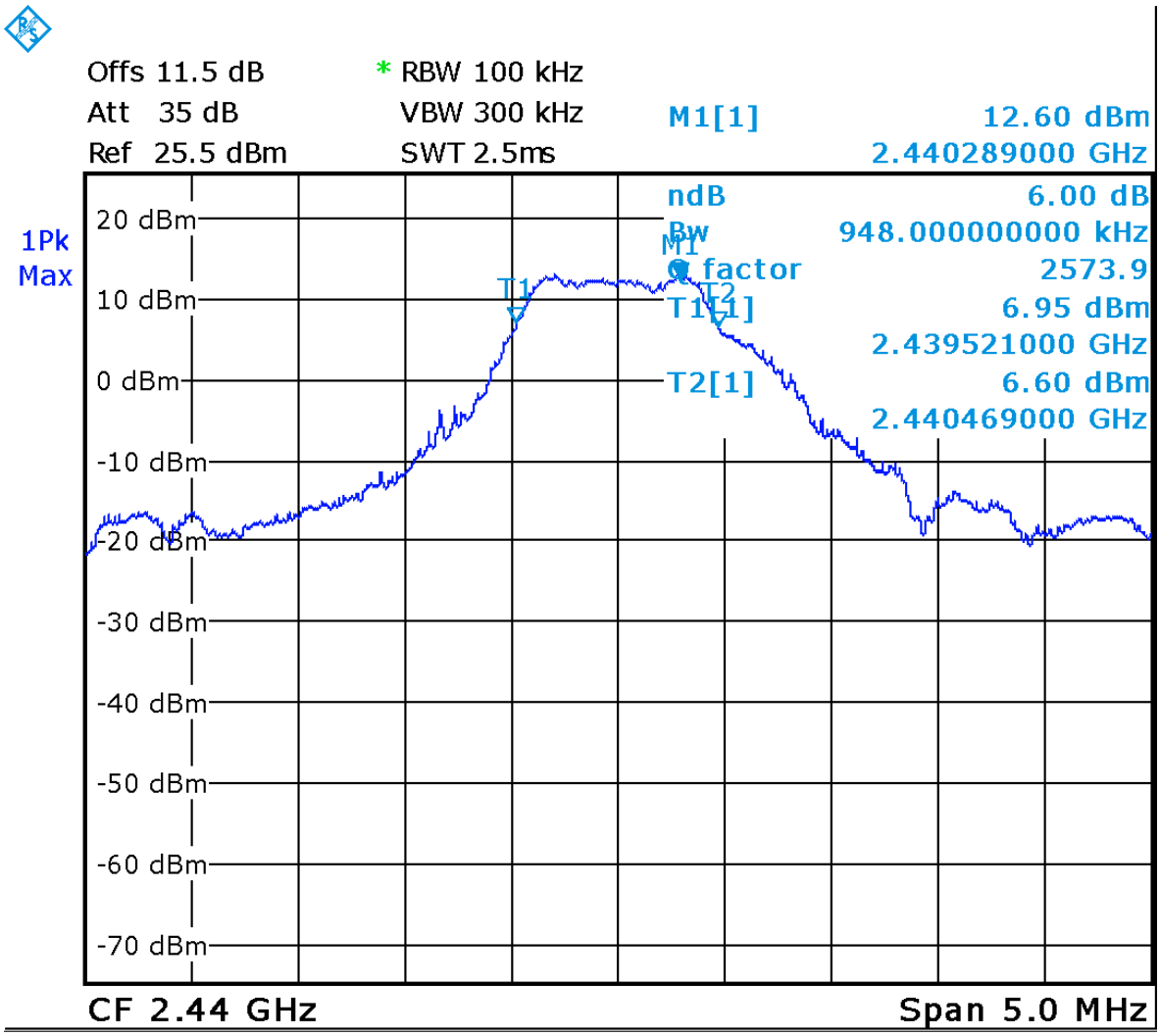
6 dB Bandwidth
Mid Channel 39



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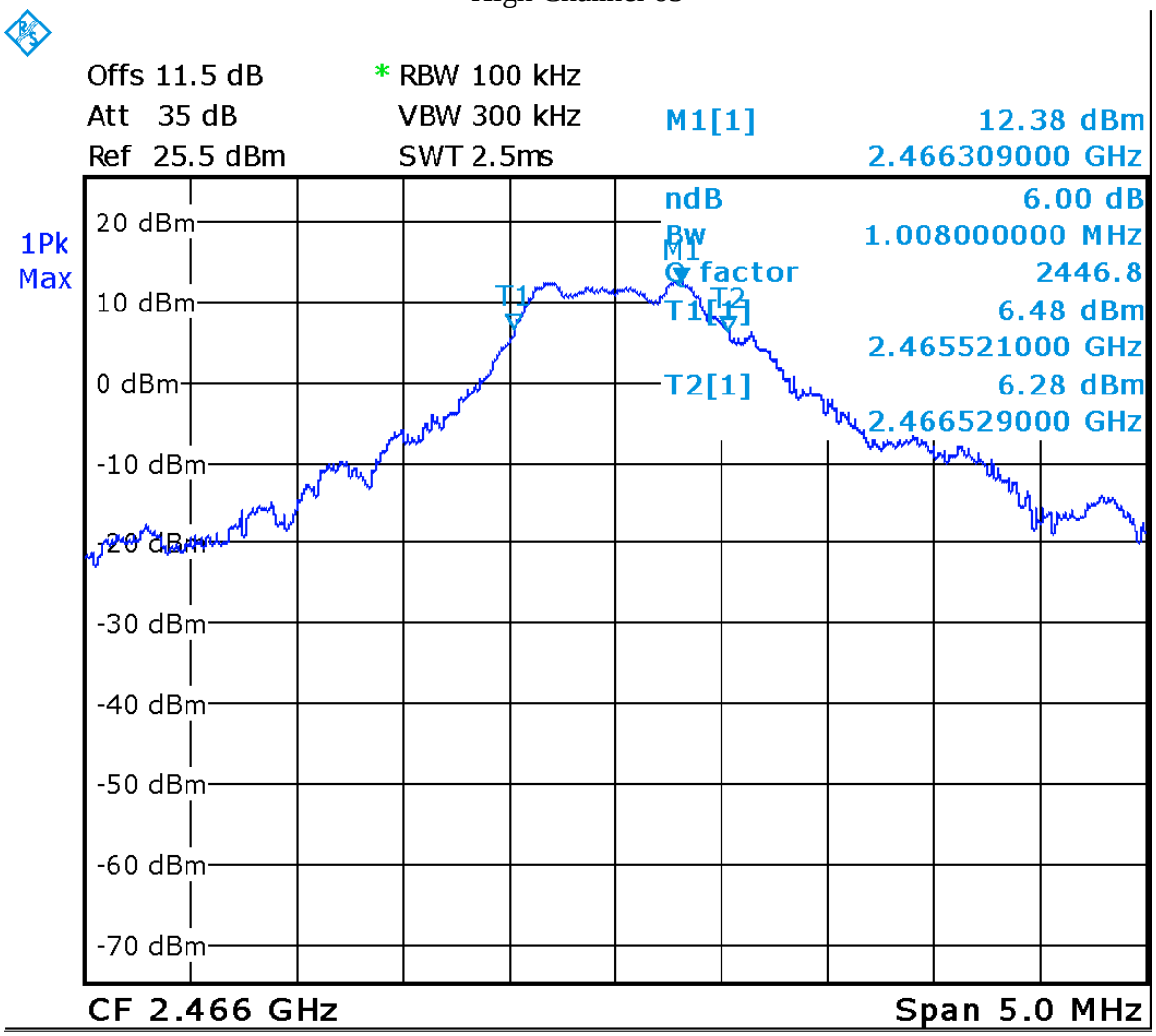
6 dB Bandwidth
High Channel 65



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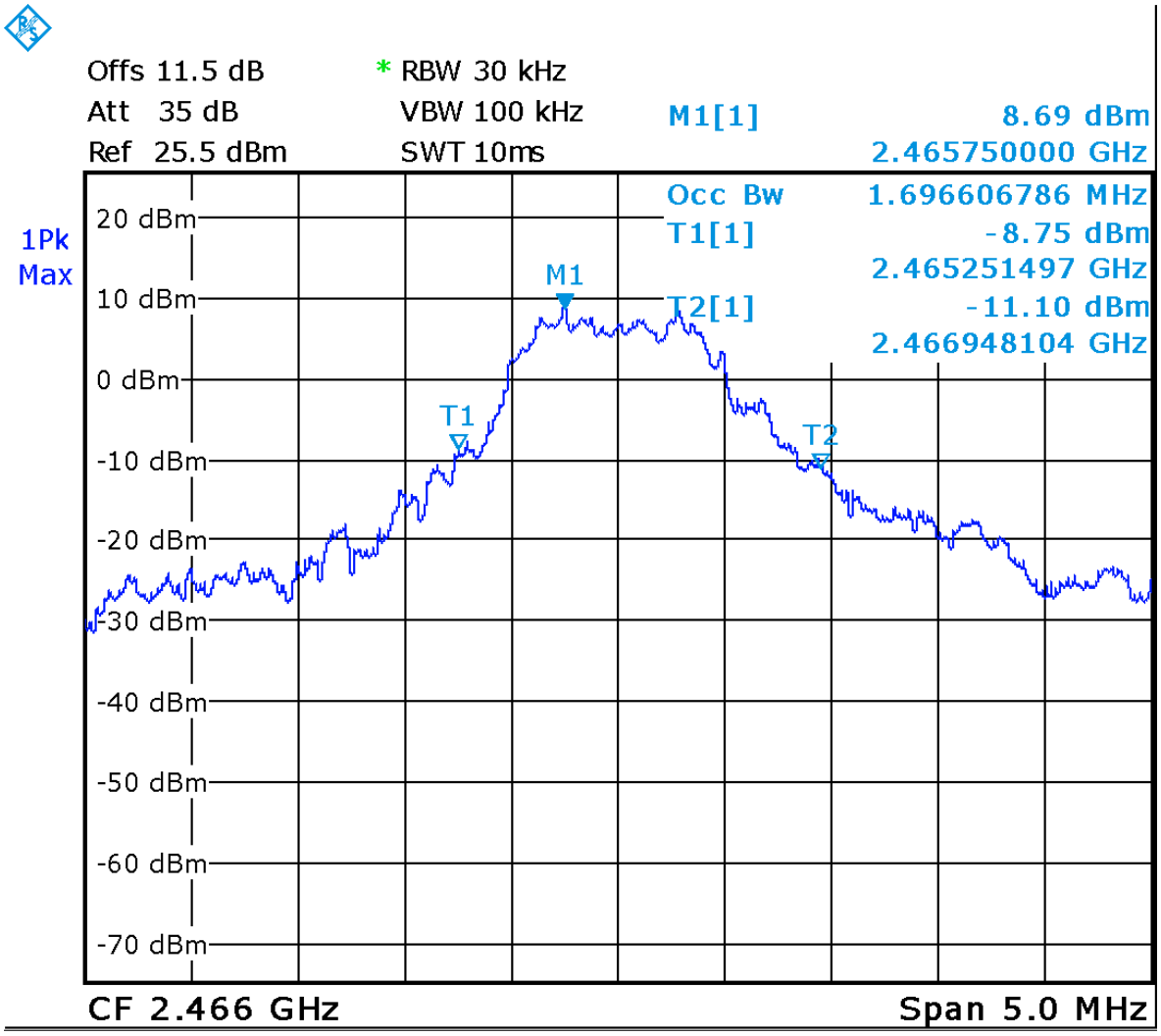
99% BW – Mid Channel 65



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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 25, 2015	Nov 25, 2017	GEMC 160
10 dB attenuator	605-10-1F18	Meca Electronics, Inc.	Jun 3, 2016	Jun 3, 2017	GEMC 225

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 247.
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 ANSI C63.10 Clause 11.9.1.1 RBW ≥ DTS bandwidth method.

Results

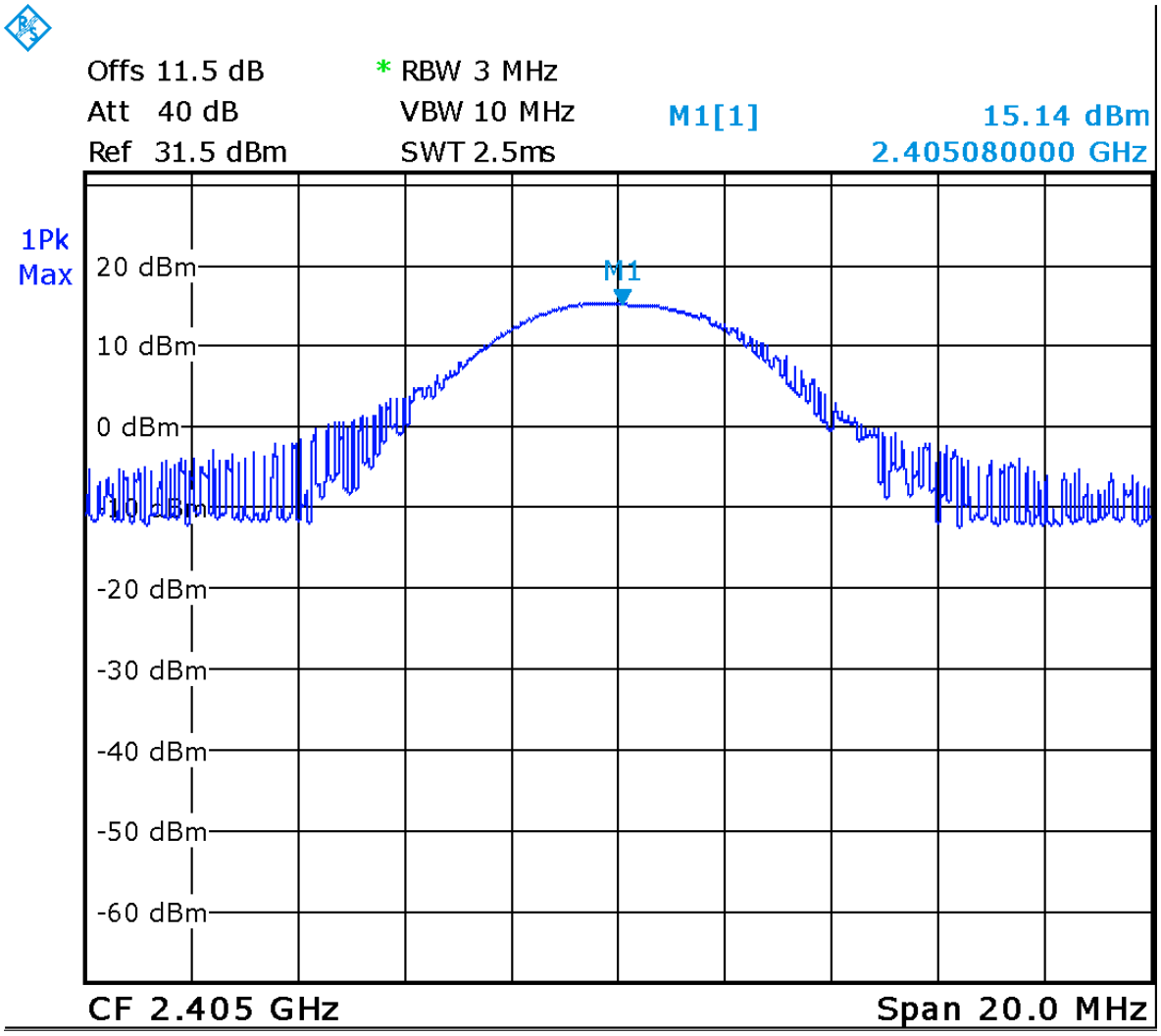
The EUT passed. The peak power of the EUT was set to transmit at maximum power. Three Channels were measured. The external attenuator and cable loss are accounted for as reference offset in the spectrum analyzer. The following table show the peak power:

Peak Power			
Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power (mW)
4	2405	15.14	32.66
39	2440	14.75	29.85
65	2466	14.42	27.67

Readings

The plots shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT. The measurement RBW is ≥ than the DTS bandwidth.

Peak Power
Channel 4



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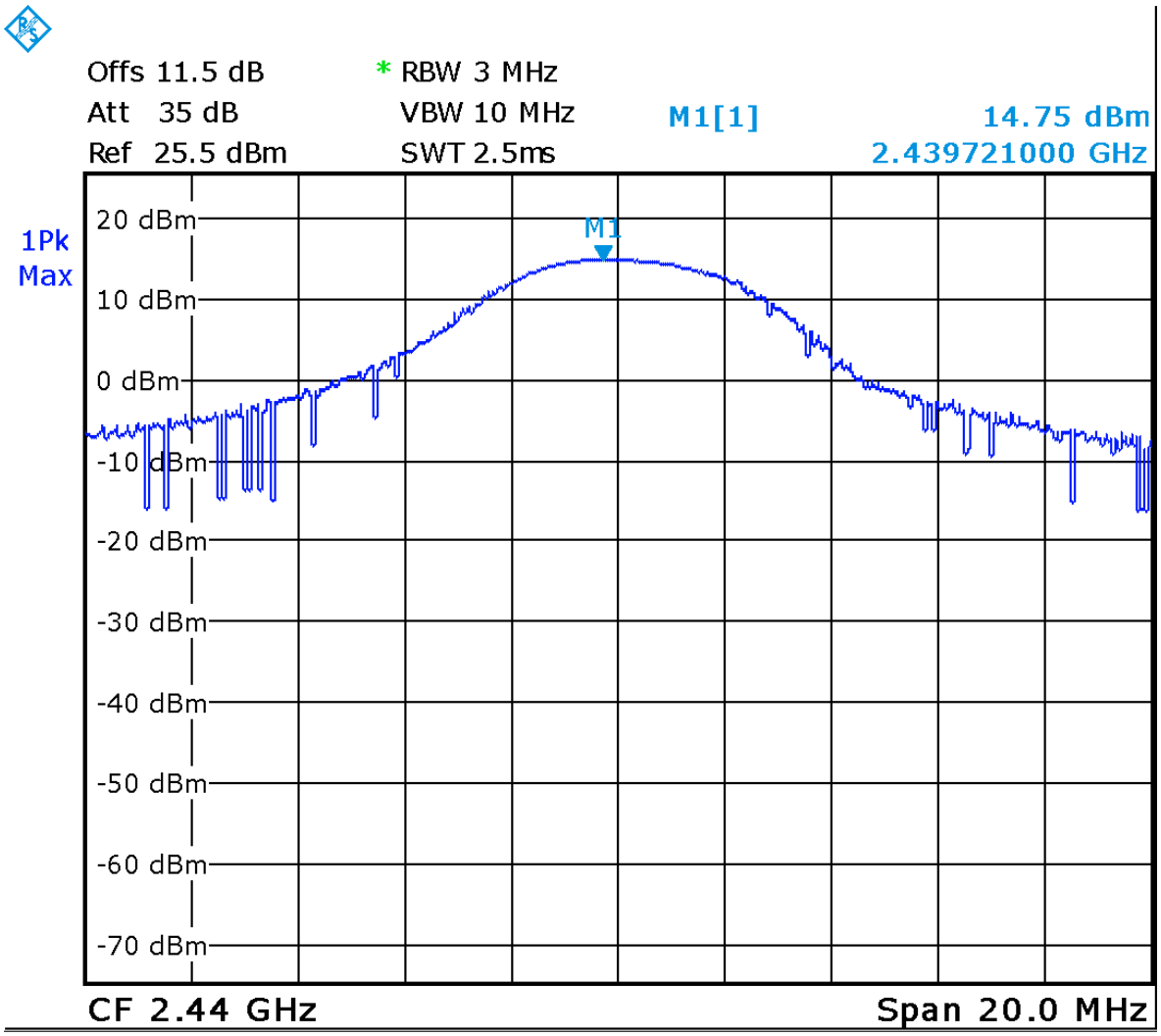
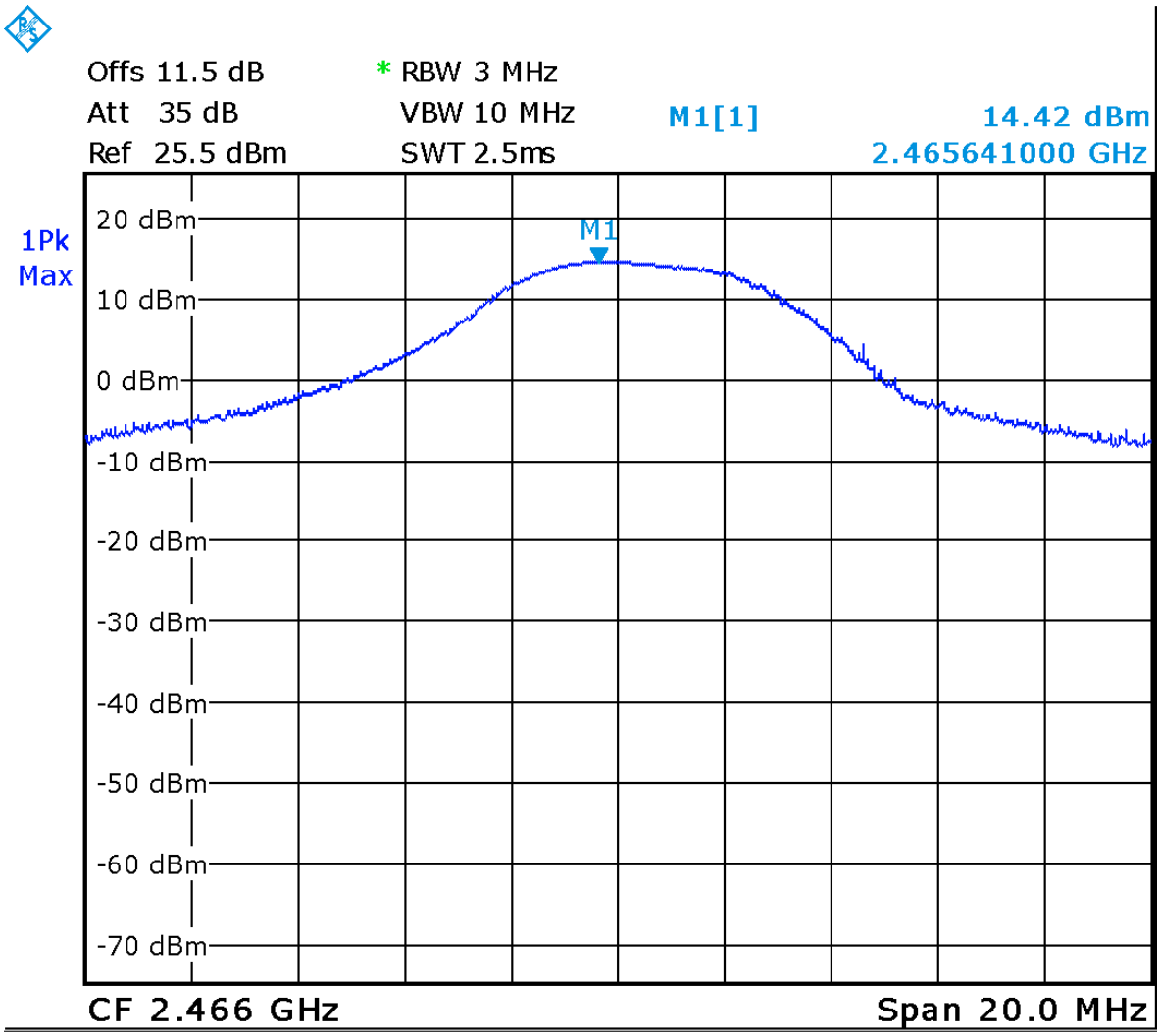
Peak Power
Channel 39



Date: 4.JUL.2016 13:32:18

Peak Power
Channel 65



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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 25, 2015	Nov 25, 2017	GEMC 160
10 dB attenuator	605-10-1F18	Meca Electronics, Inc.	Jun 3, 2016	Jun 3, 2017	GEMC 225

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) and RSS 247.

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 ANSI C63.10 Section 11.11 Emission in non-restricted frequency bands.

Results

The EUT passed the limits.

The EUT have two power settings PA5 and PA3. PA5 have higher output power than PA2. Channels 0 to 3 and 66 to 78 were set to PA3 and Channels 4 to 65 were set to PA5. Low band edge measurements were performed on Channels 0 and 4; high band edge were performed for Channels 65 and 78.

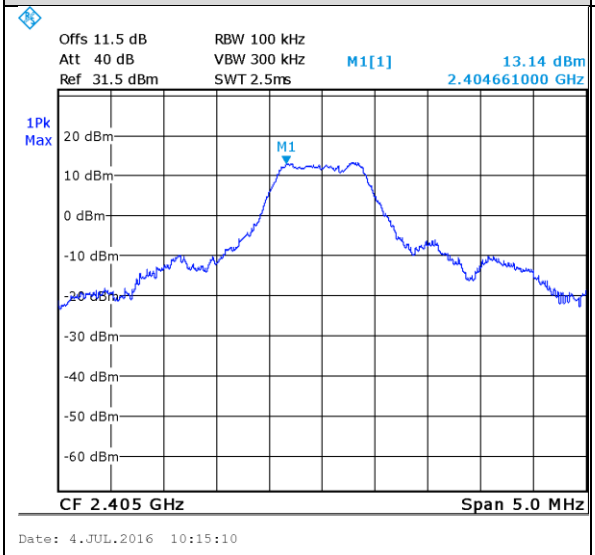
The worst case was presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band. The -20 dBc requirement is also shown for the higher band edge at 2.4835 GHz in the high band.

Graph(s)

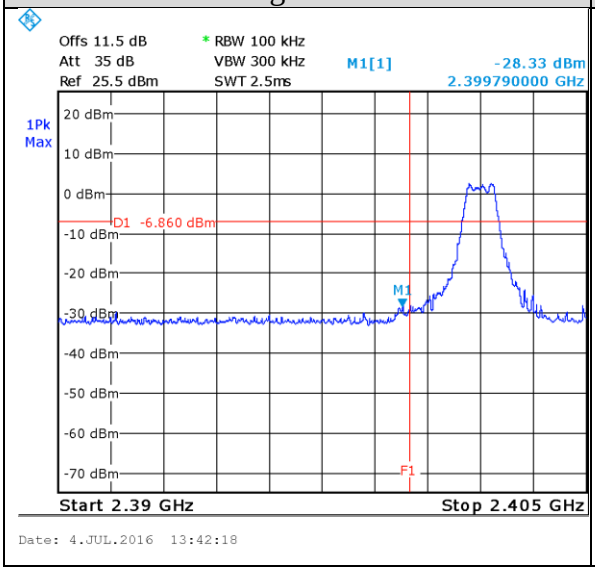
The graphs shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT. External attenuator and cable loss are accounted for as reference offset in the spectrum analyzer.

-20 dBc

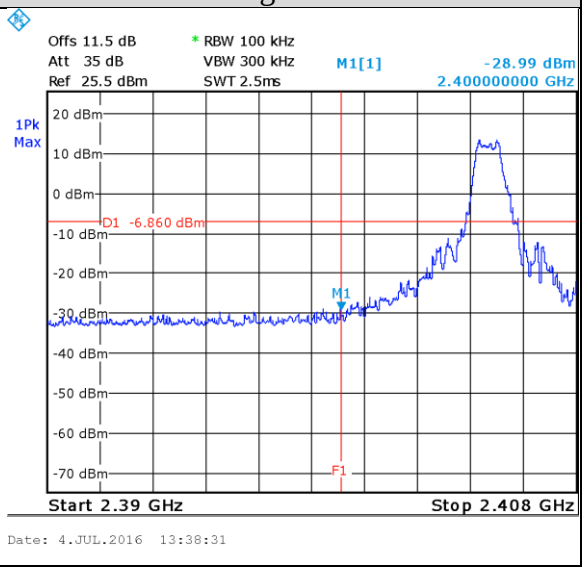
Reference level: -1.53dBm



2400 MHz Band edge – Ch 0

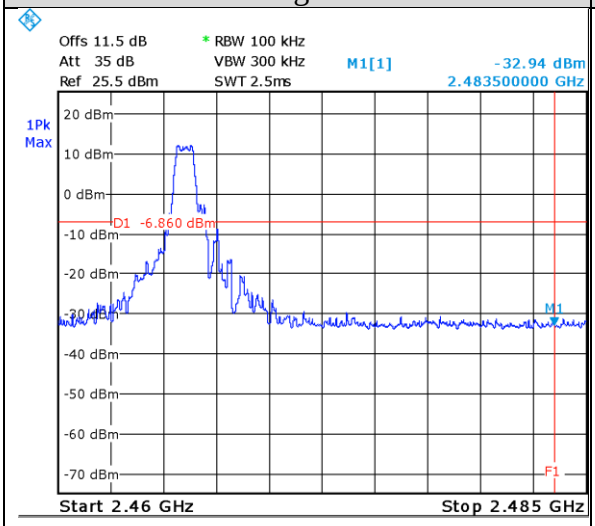


2400 MHz Band edge – Ch 4

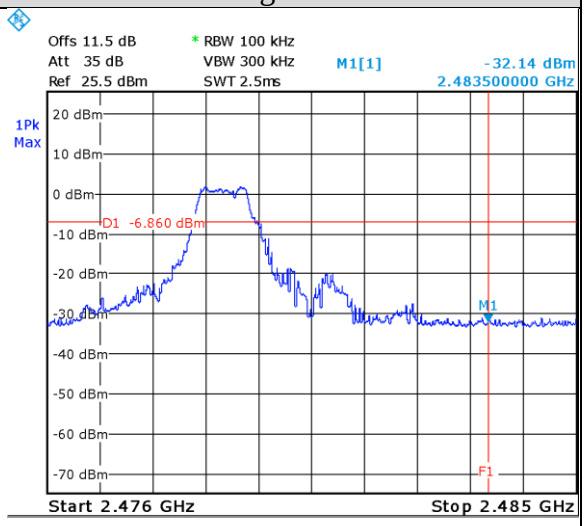


-20 dBc

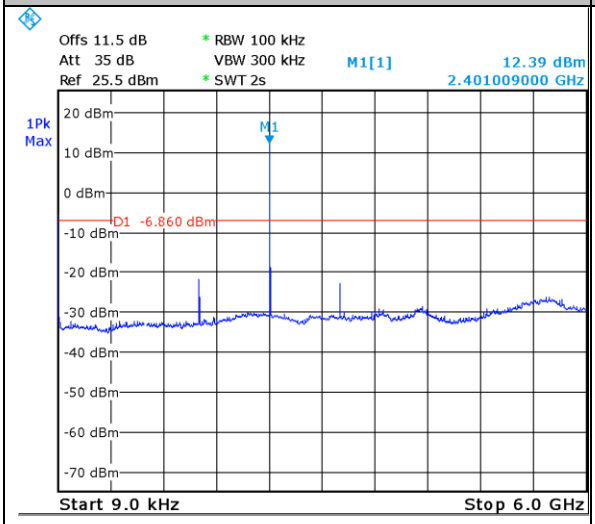
2483.5 MHz Band edge – Ch 65



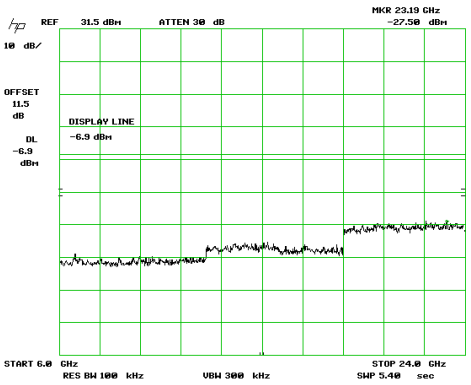
2400 MHz Band edge – Ch 78



9 kHz – 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	Nov 27, 2015	Nov 27, 2017	GEMC 190
Quasi Peak Adapter	85650A	HP	Nov 27, 2015	Nov 27, 2017	GEMC 191
Spectrum Analyzer	ESL6	Rohde & Schwarz	Nov 25, 2015	Nov 25, 2017	GEMC 160
10 dB attenuator	605-10-1F18	Meca Electronics, Inc.	Jun 3, 2016	Jun 3, 2017	GEMC 225
4GHZ-12GHz High Pass filter	11SH10-4000/T12000-0/0	K & L Microwave	Apr 9, 2015	Apr 9, 2016	GEMC 119

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 ANSI C 63.10
The limits are as defined in FCC Part 15, Section 15.209 and RSS GEN:

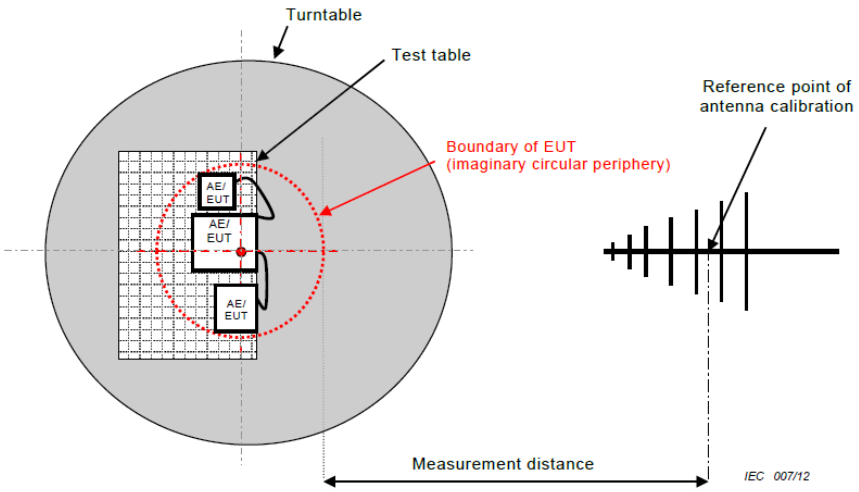
The limits, as defined in 15.247(d) for unintentional radiated emissions apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

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 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.

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).

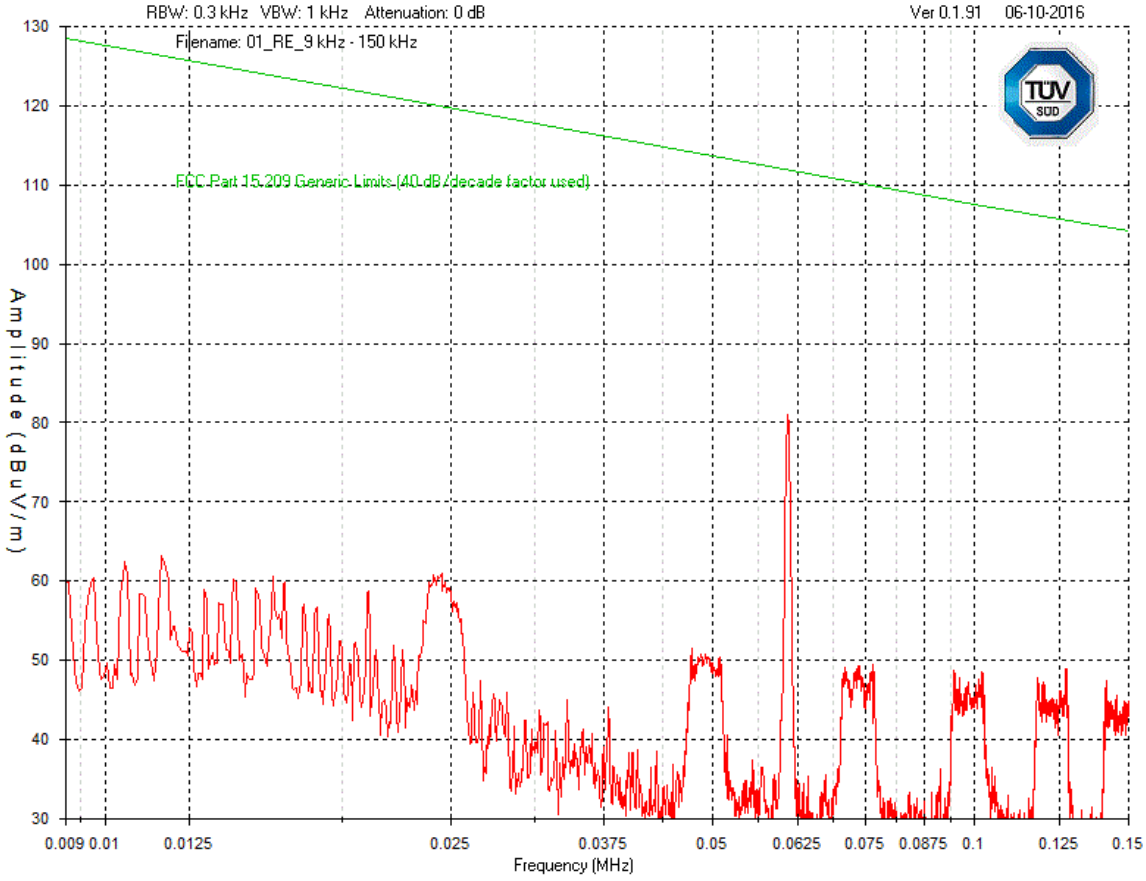
Devices scanned may be scanned at alternate test distances, and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m / 3m) is applied.

The EUT have two power settings PA5 and PA2. PA5 have higher output power than PA2. Channels 0 to 4 and 66 to 78 were set to PA2 and Channels 5 to 65 were set to PA5. Low

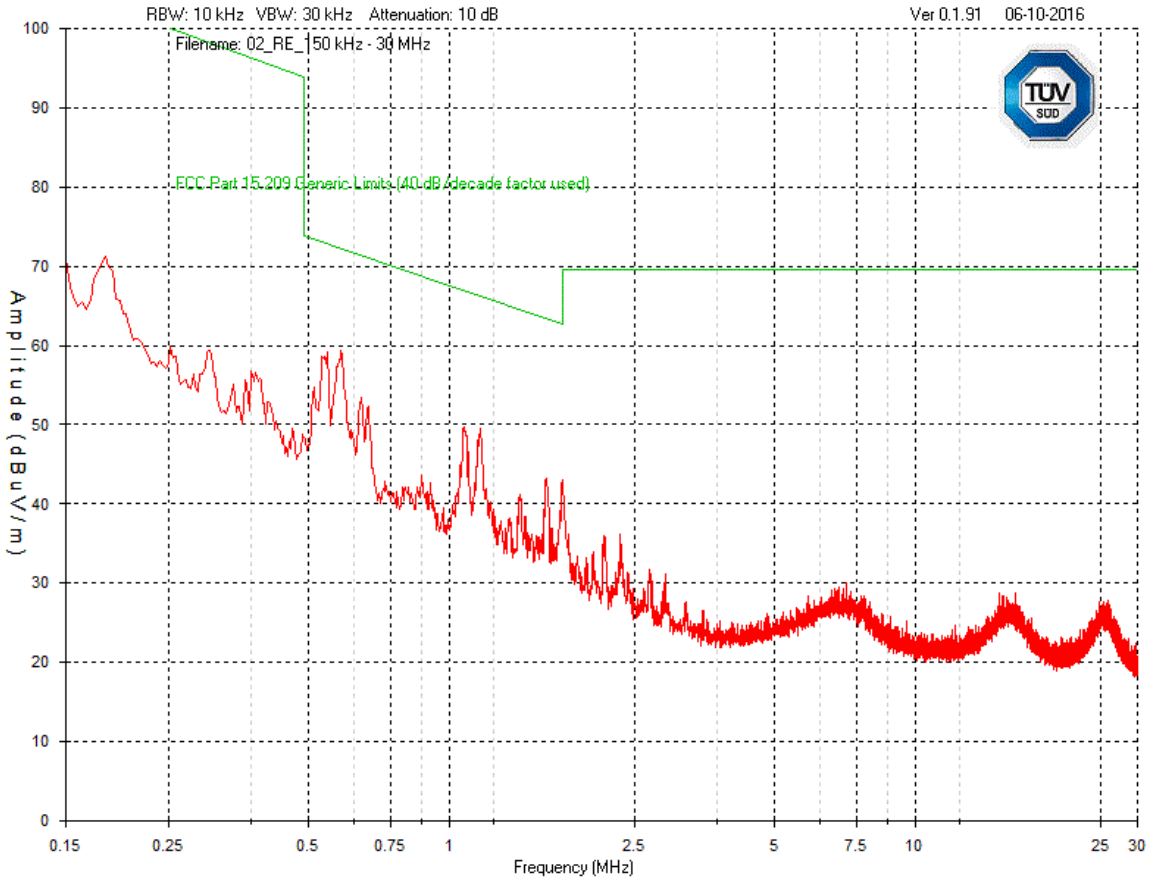
band edge measurements were performed on Channels 0 and 5; high band edge were performed for Channels 65 and 78.

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

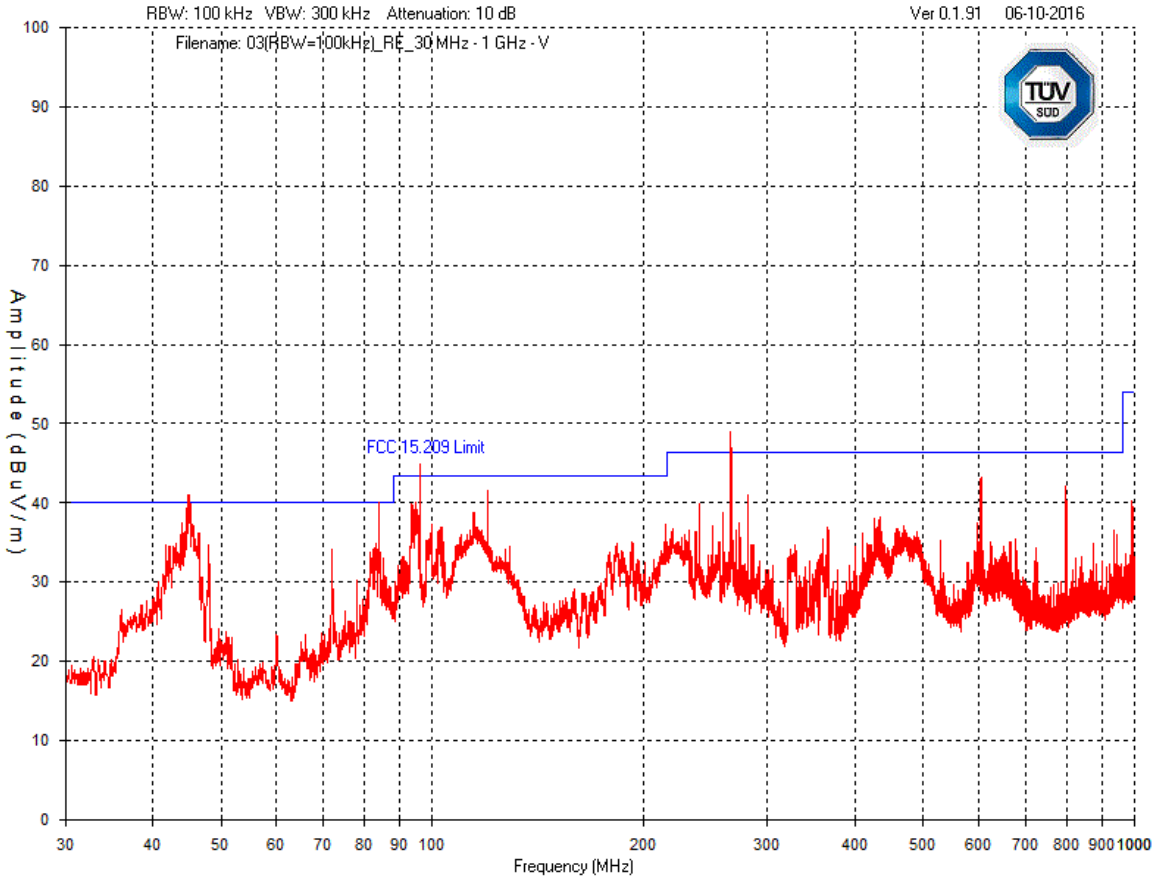
9 kHz – 150 kHz



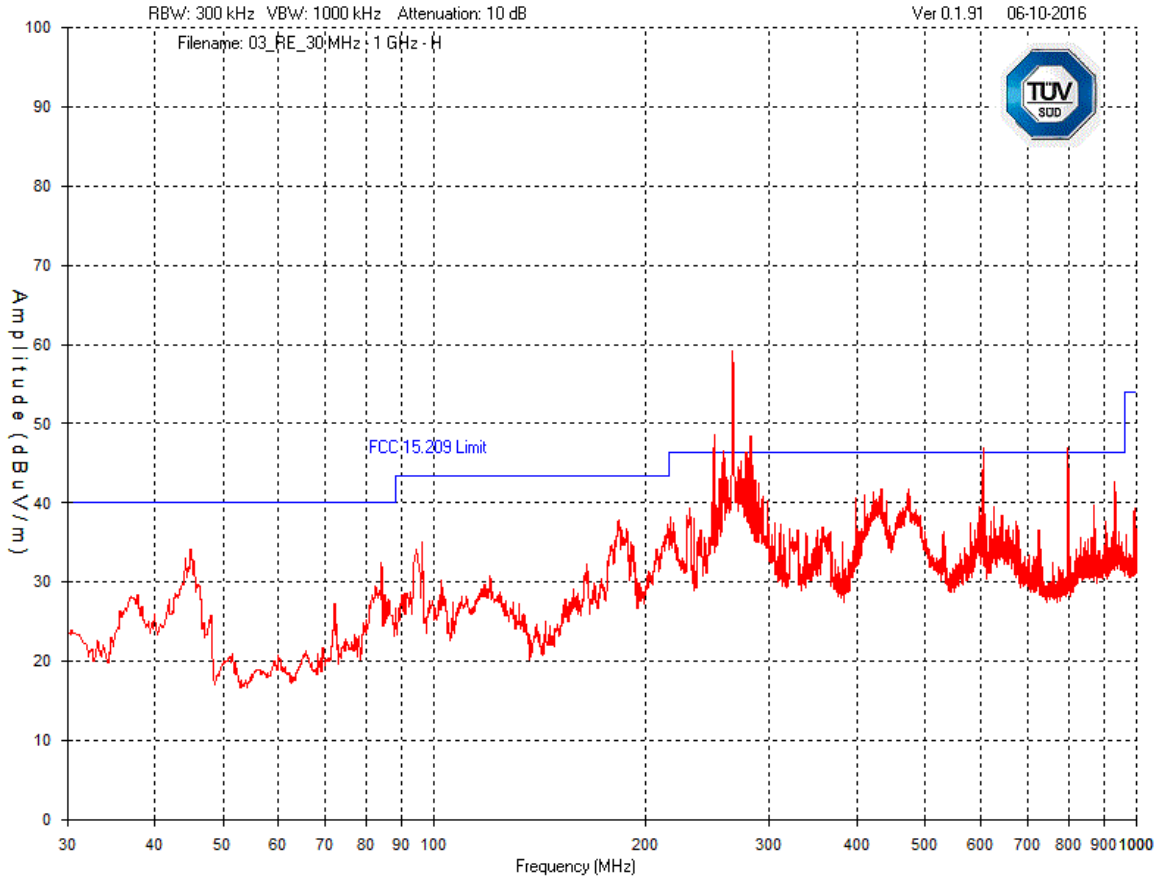
150 kHz – 30 MHz



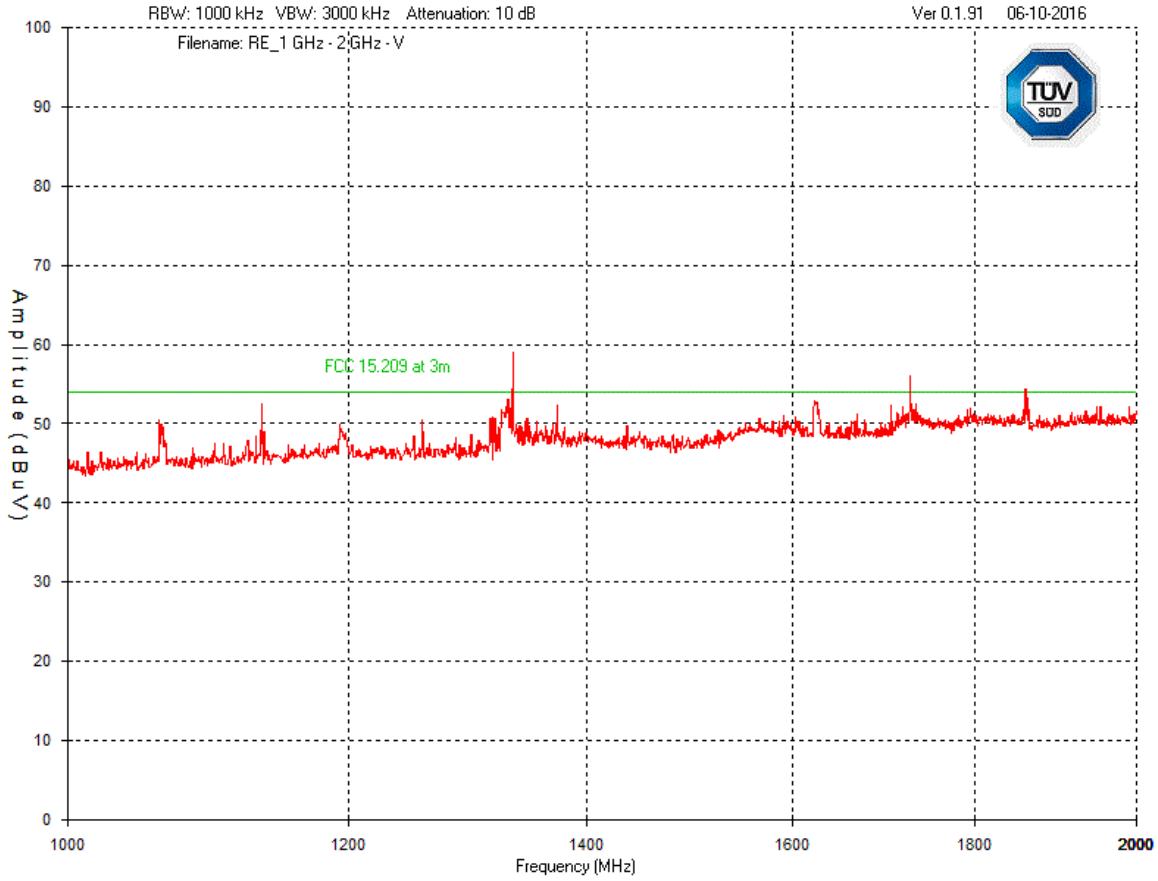
Low Channel - 30 MHz – 1 GHz
Vertical – Peak Emission Graph



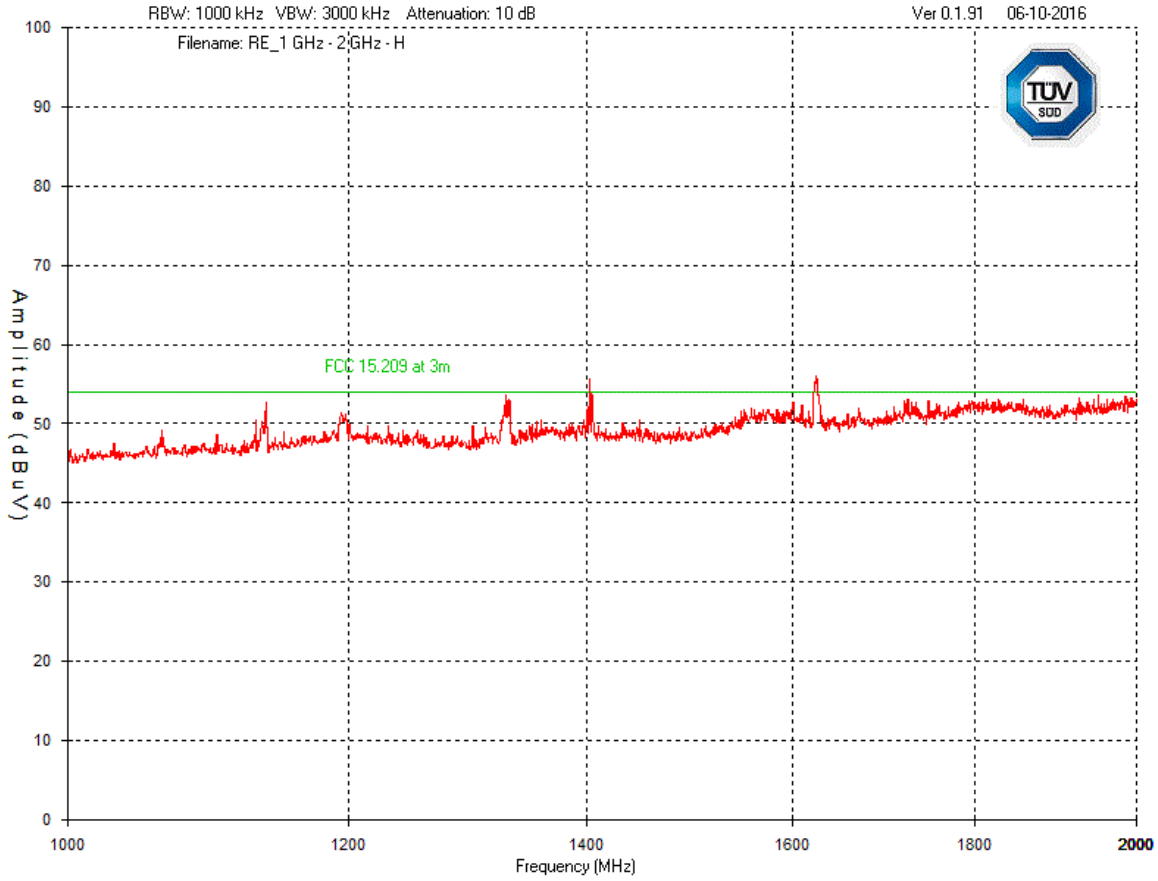
Low Channel – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph



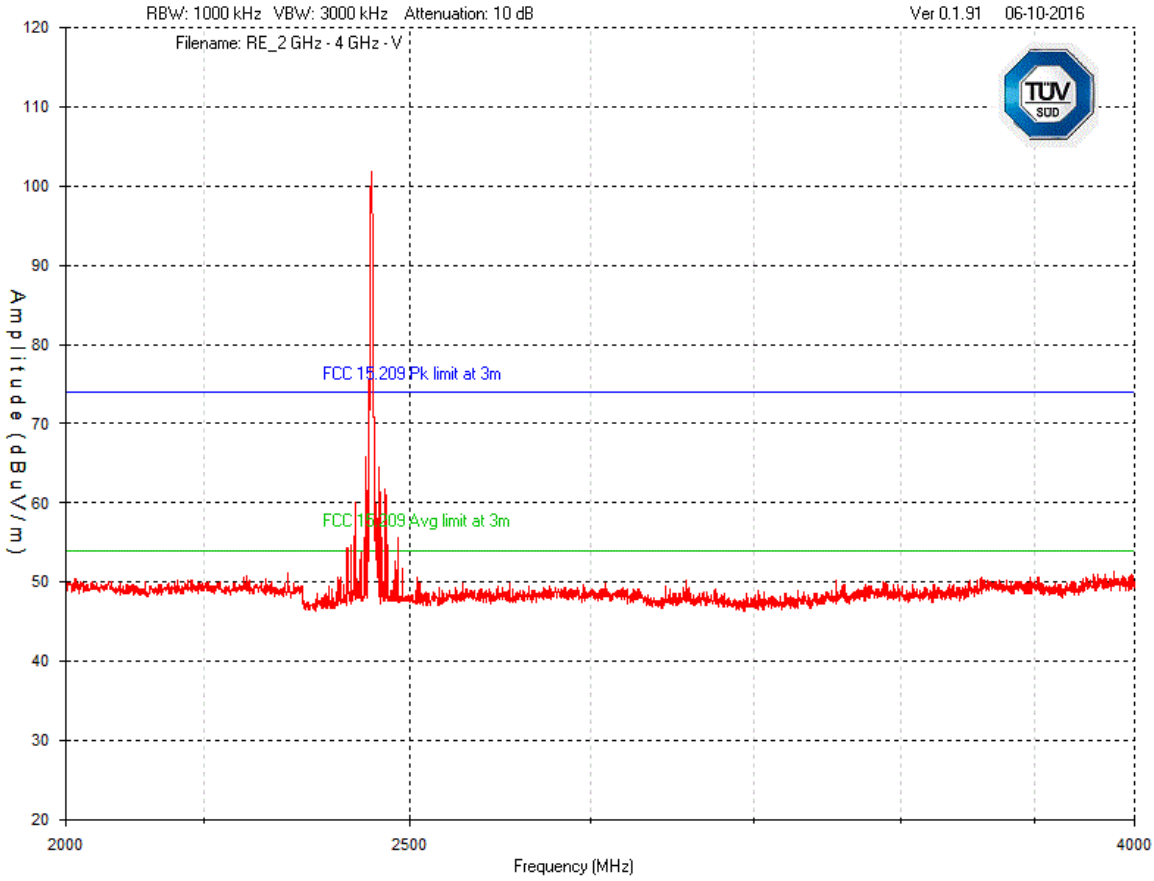
Low Channel – 1 GHz – 2 GHz
Vertical - Peak Emission Graph



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

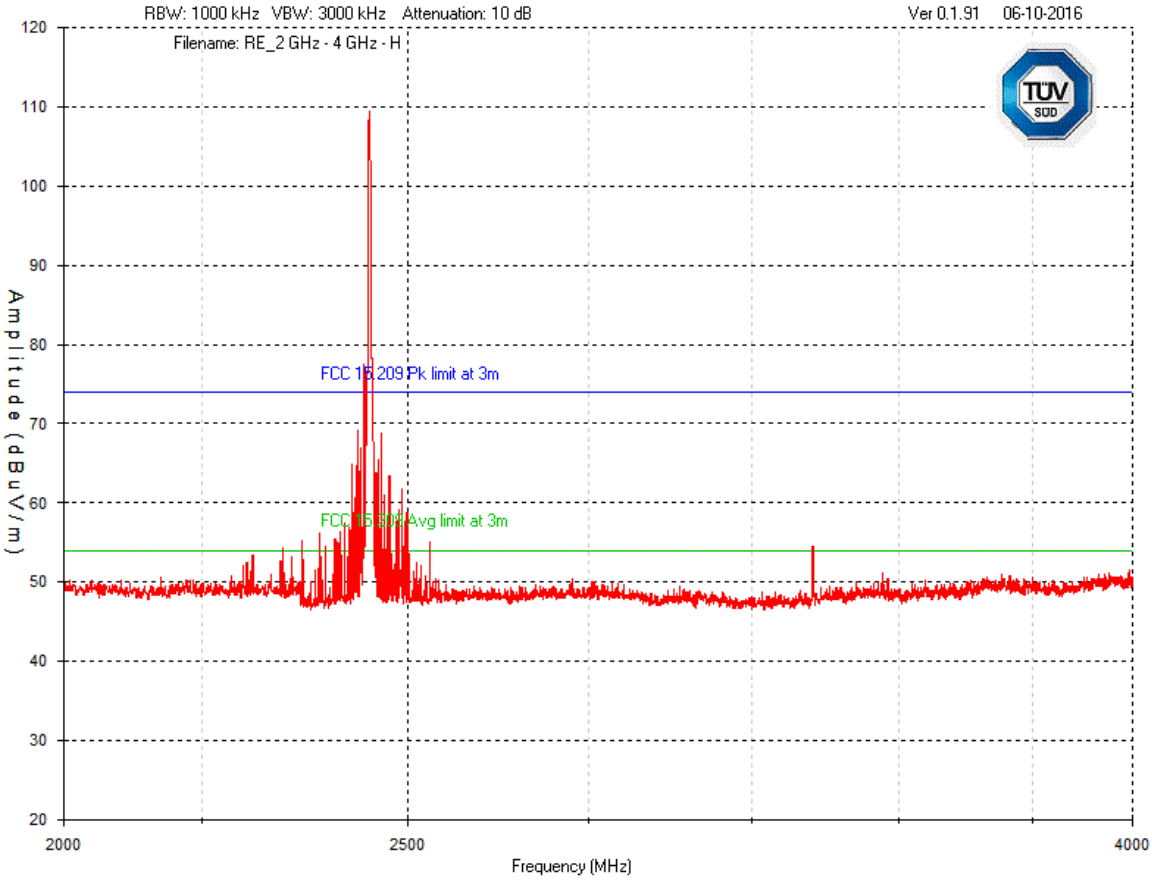


Low Channel – 2 GHz – 4 GHz
Vertical - Peak Emission Graph



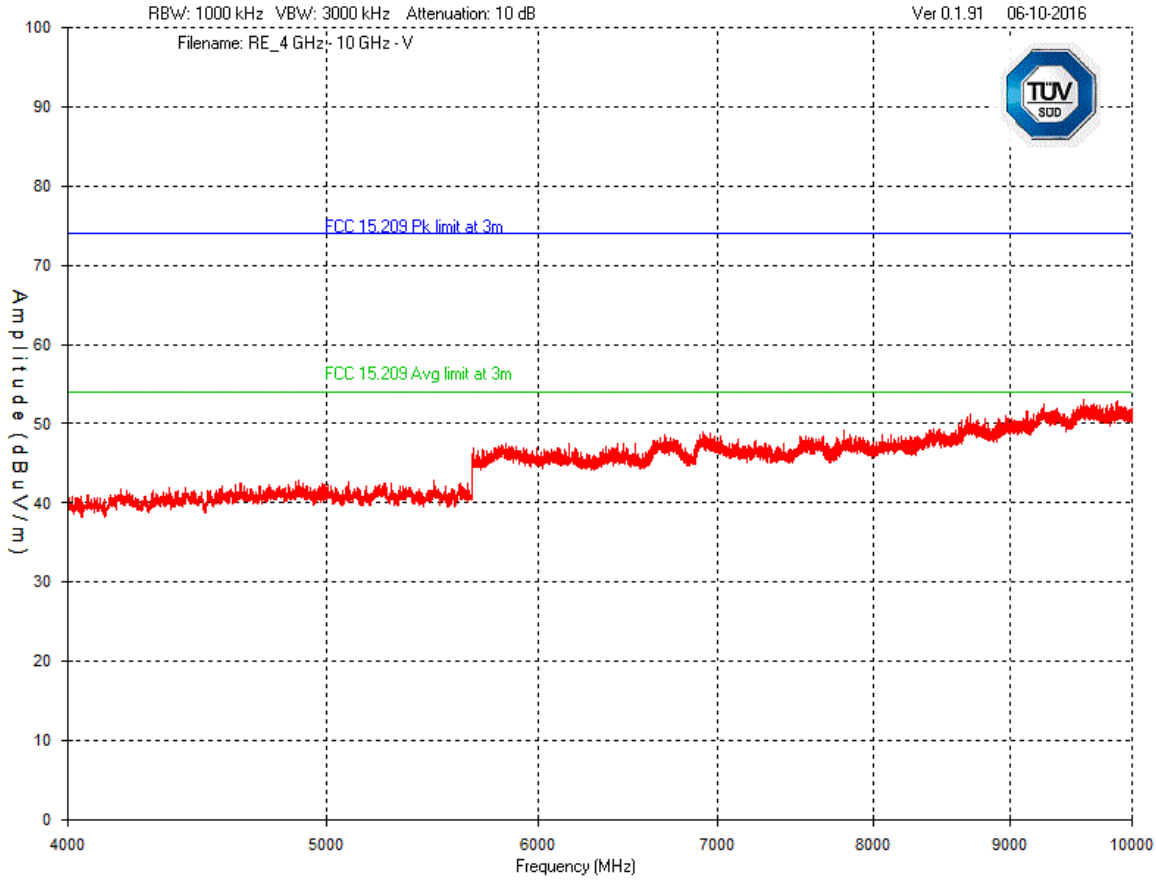
Note: See Final Measurements and Results section starting on page 52 for measurements.

Low Channel – 2 GHz – 4 GHz
Vertical - Average Emission Graph



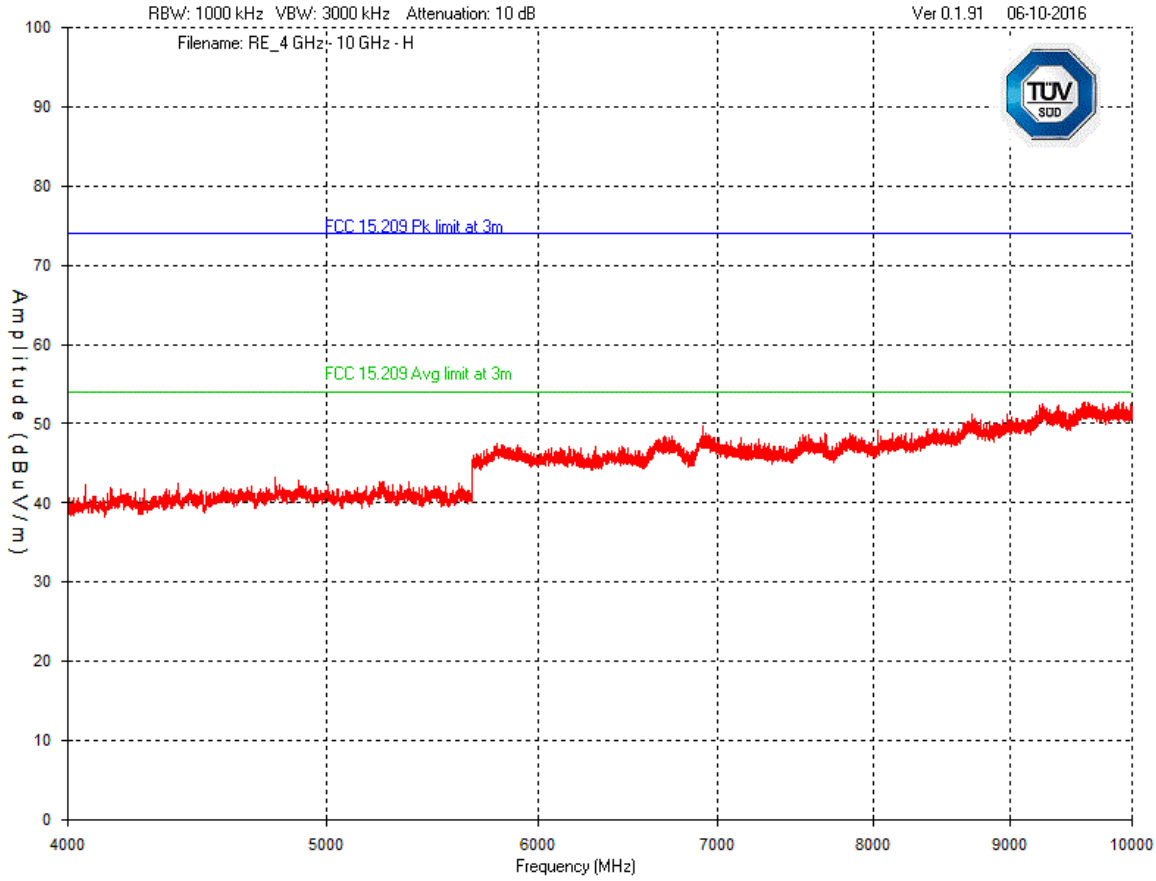
Note: See Final Measurements and Results section starting on page 52 for measurements. Emissions at 3.2 GHz is a modulation artifact of the EUT; its Average emission levels is derived from Peak emission; see emission table on page 52 for details.

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



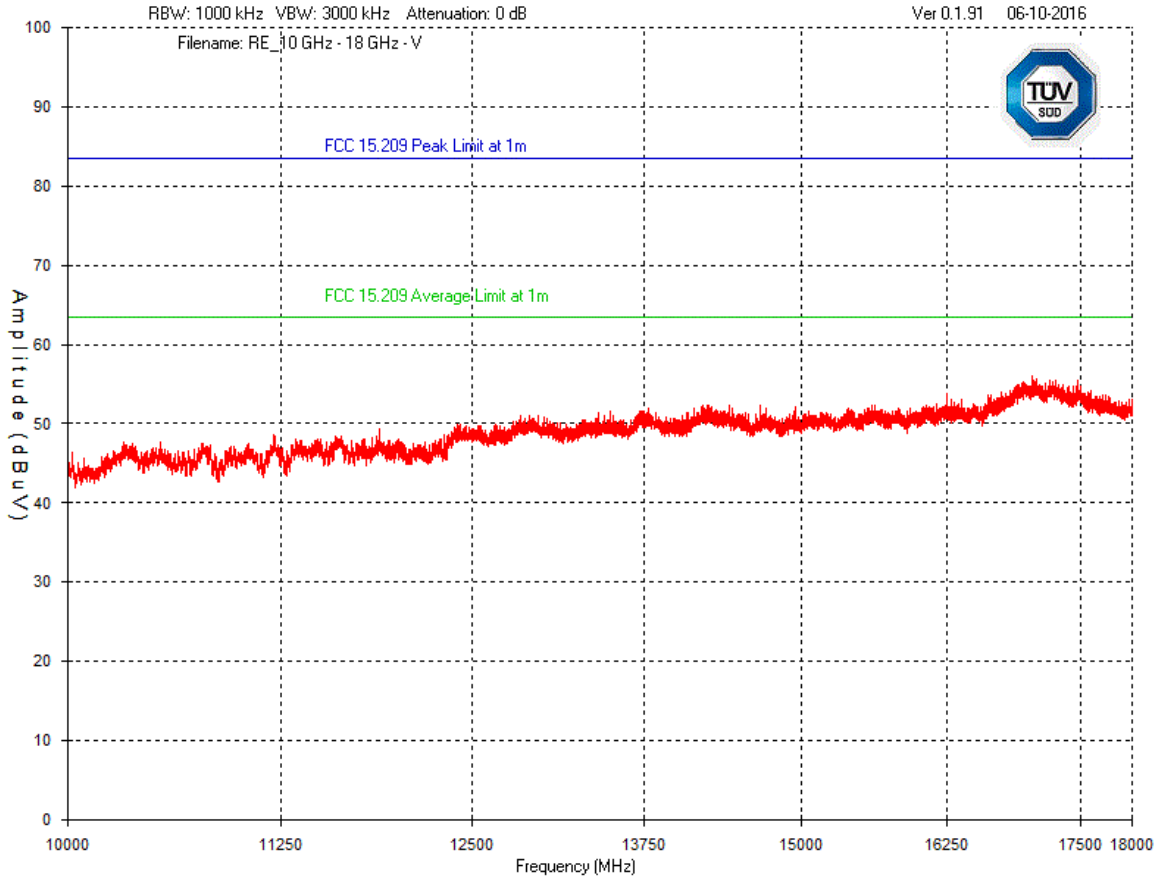
Note: See Final Measurements and Results section starting on page 52 for measurements.

Low Channel – 4 GHz – 10 GHz
Horizontal - Peak Emission Graph



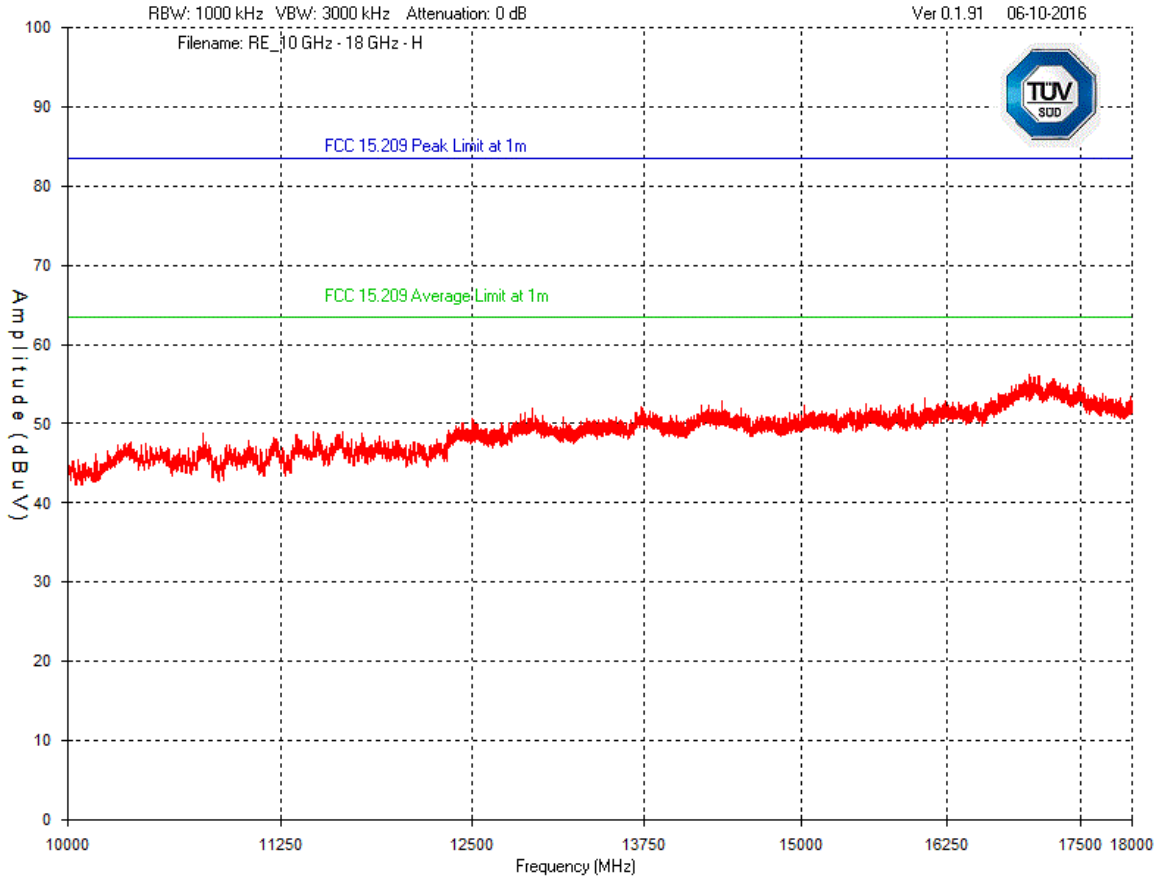
Note: See Final Measurements and Results section starting on page 52 for measurements.

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



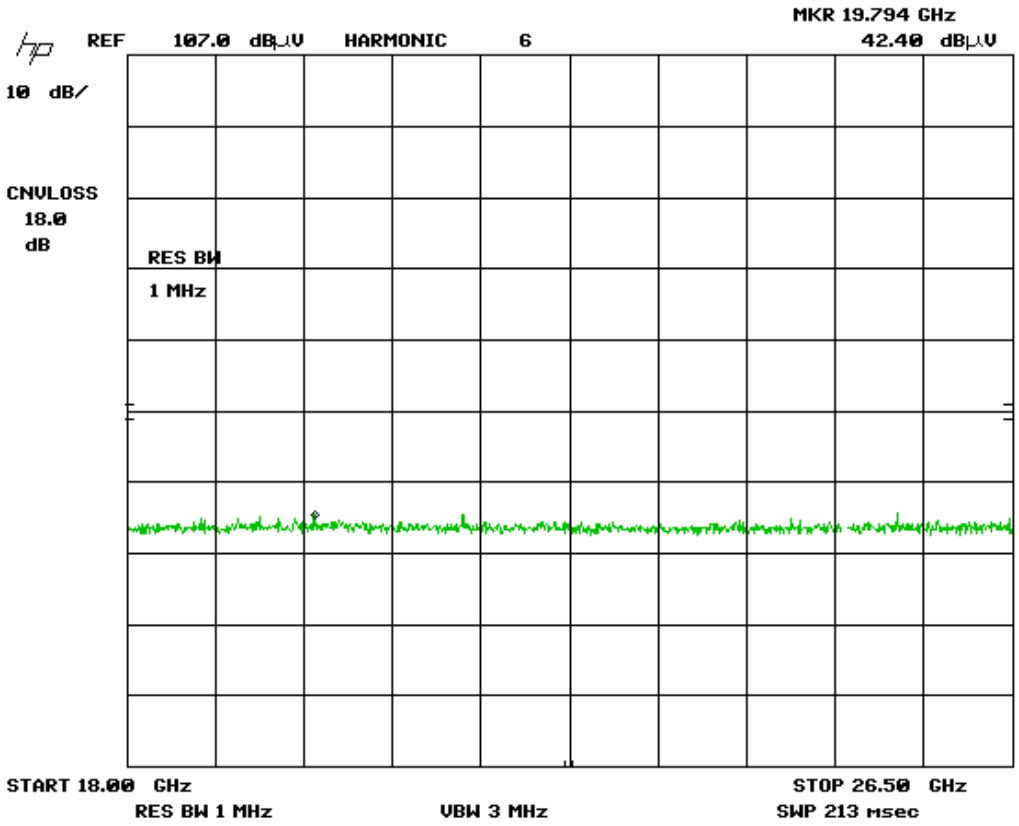
Note: See Final Measurements and Results section starting on page 52 for measurements.

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



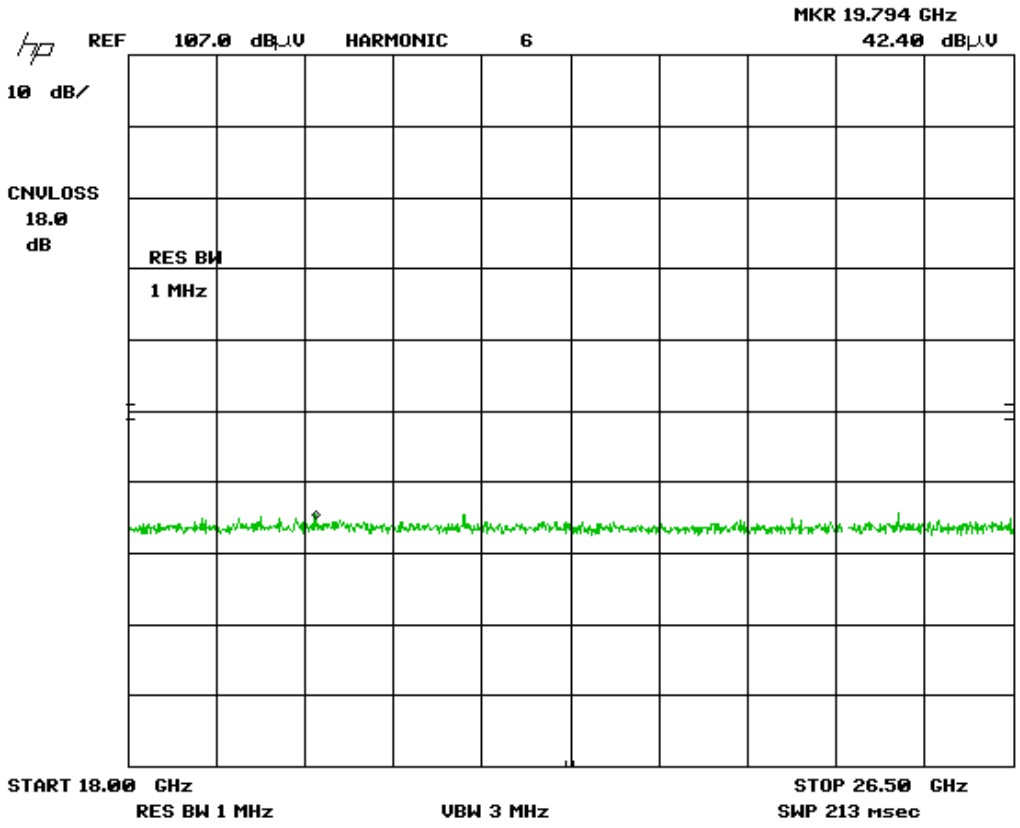
Note: See Final Measurements and Results section starting on page 52 for measurements.

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.

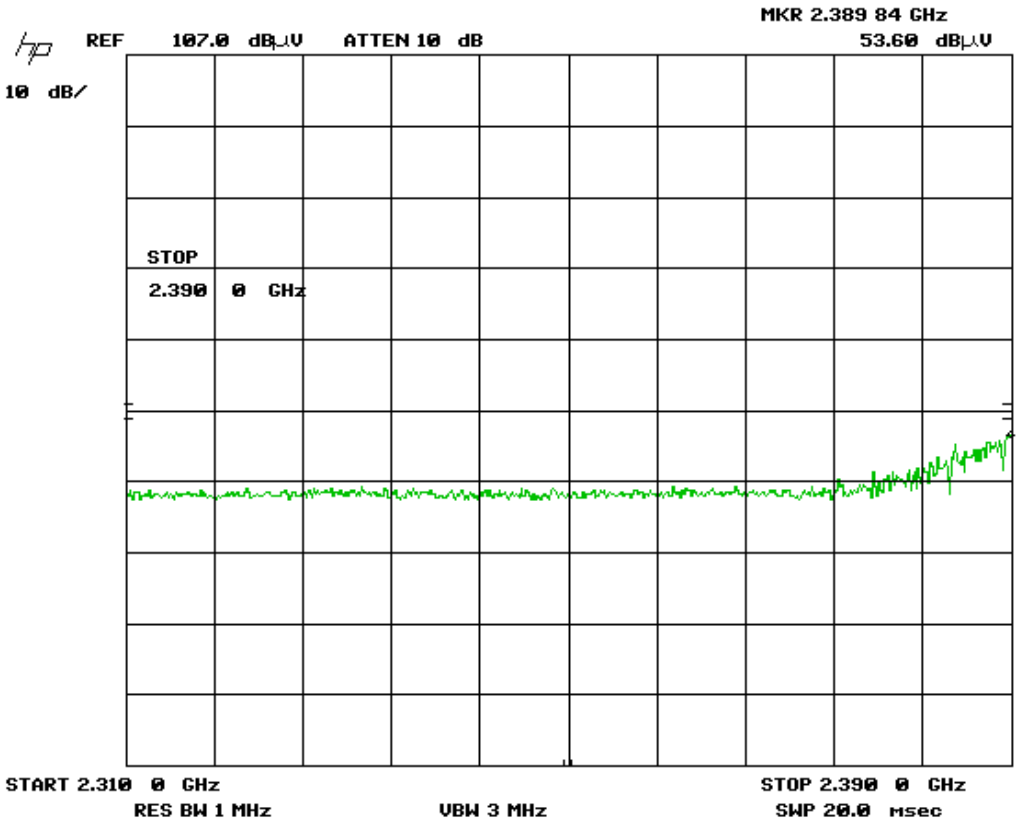
Mid Channel – 18 GHz – 26 GHz
Vertical - Peak Emission Graph



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.

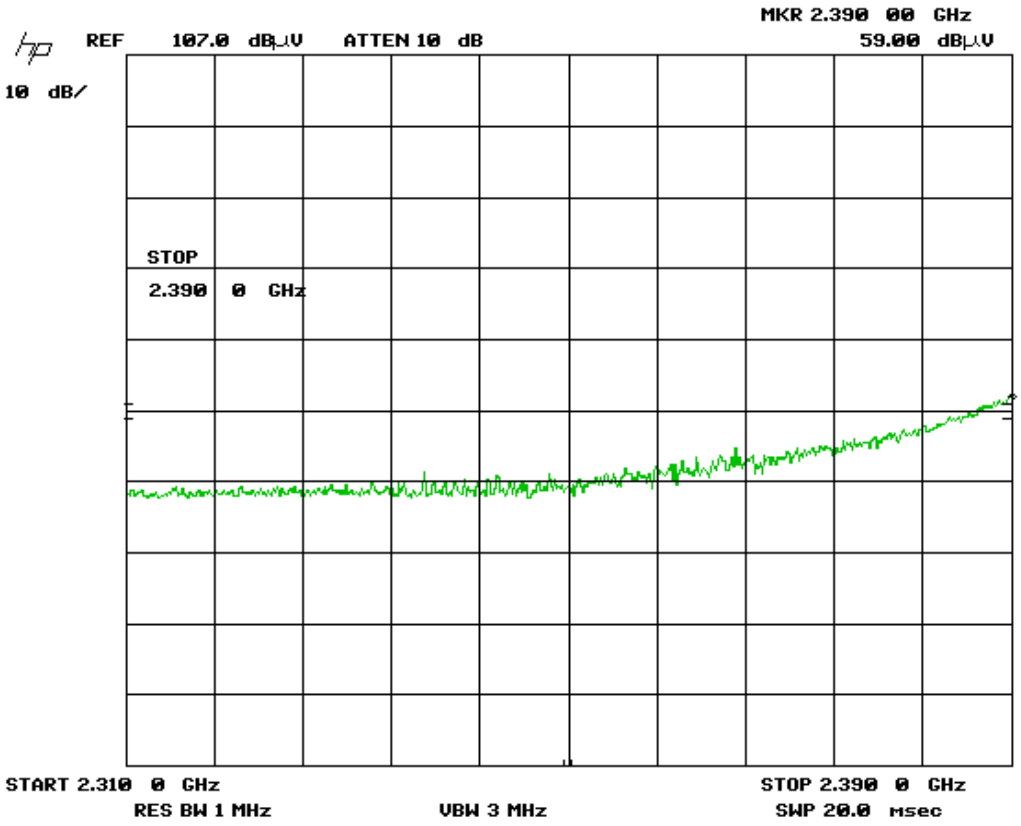
Band edge measurements

Band Edge – Low Channel 0
Vertical - Peak Emission



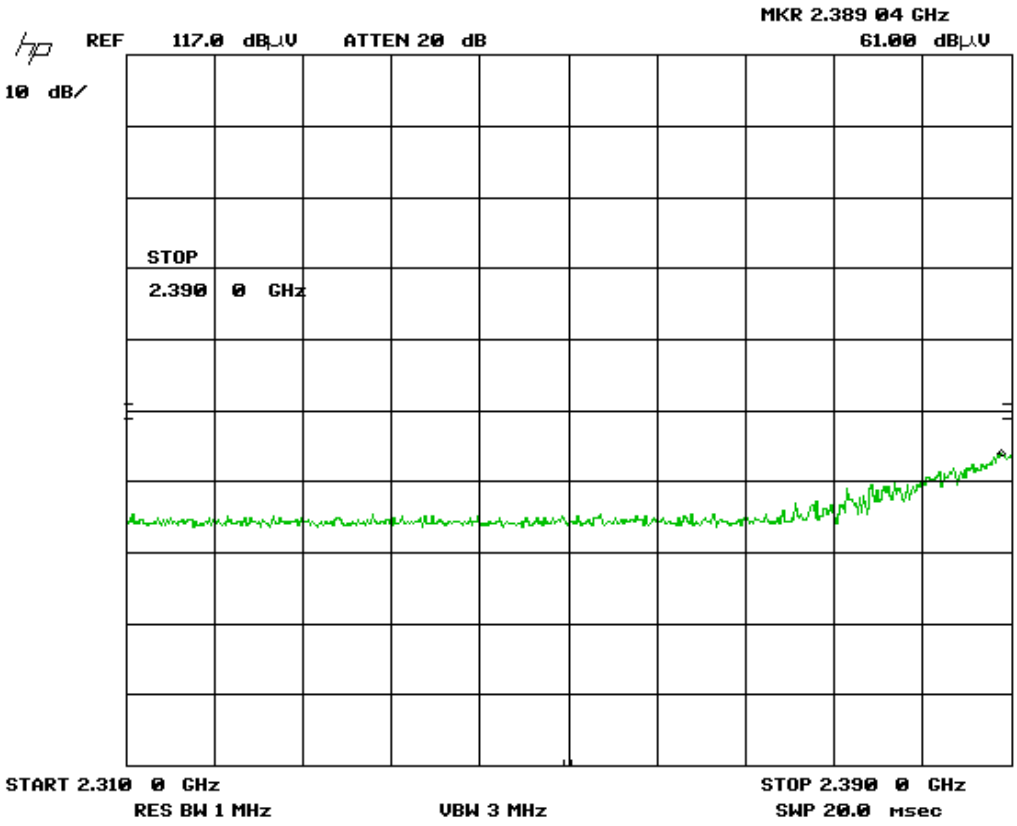
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 52 for corrected values.

Band Edge – Low Channel 0
Horizontal - Peak Emission



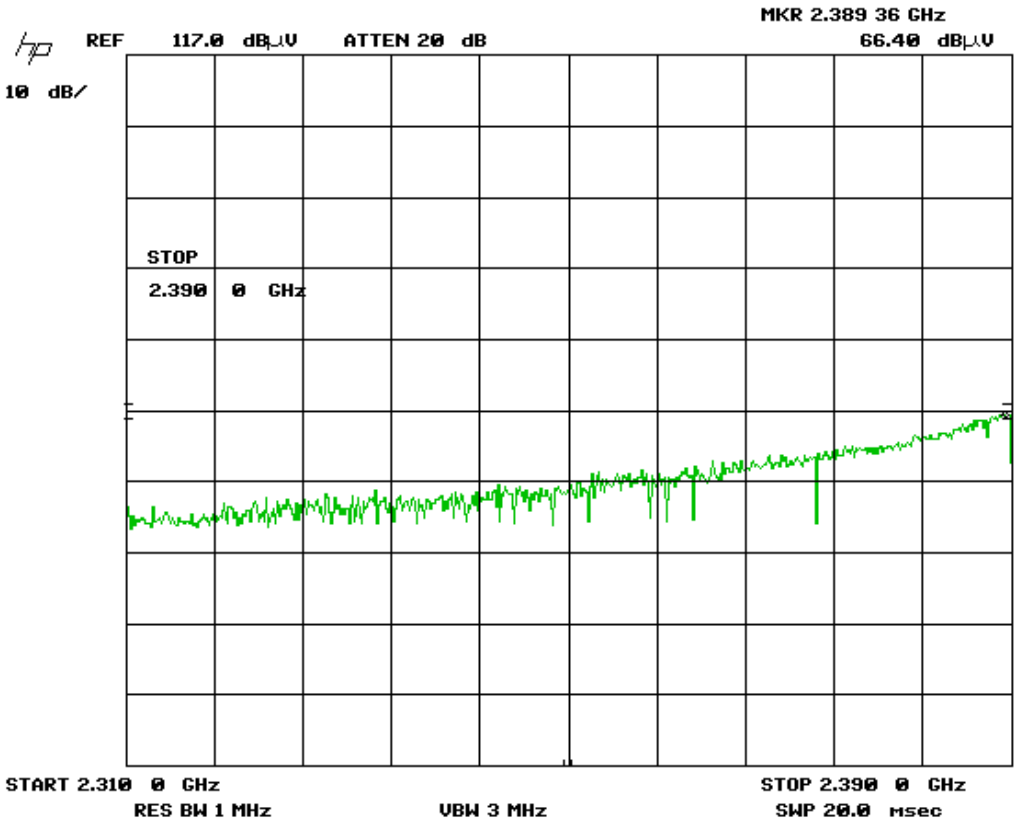
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 52for corrected values.

Band Edge – Low Channel 4
Vertical – Peak Emission



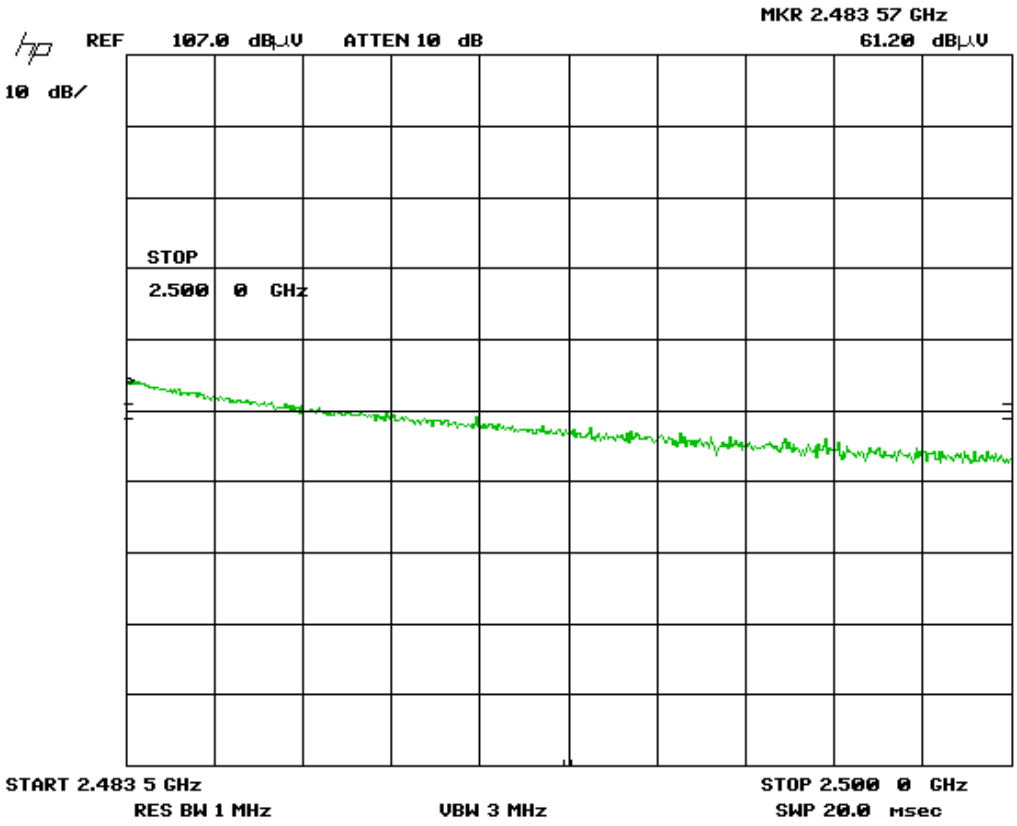
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 52 for corrected values.

Band Edge – Low Channel 4
Horizontal - Peak Emission



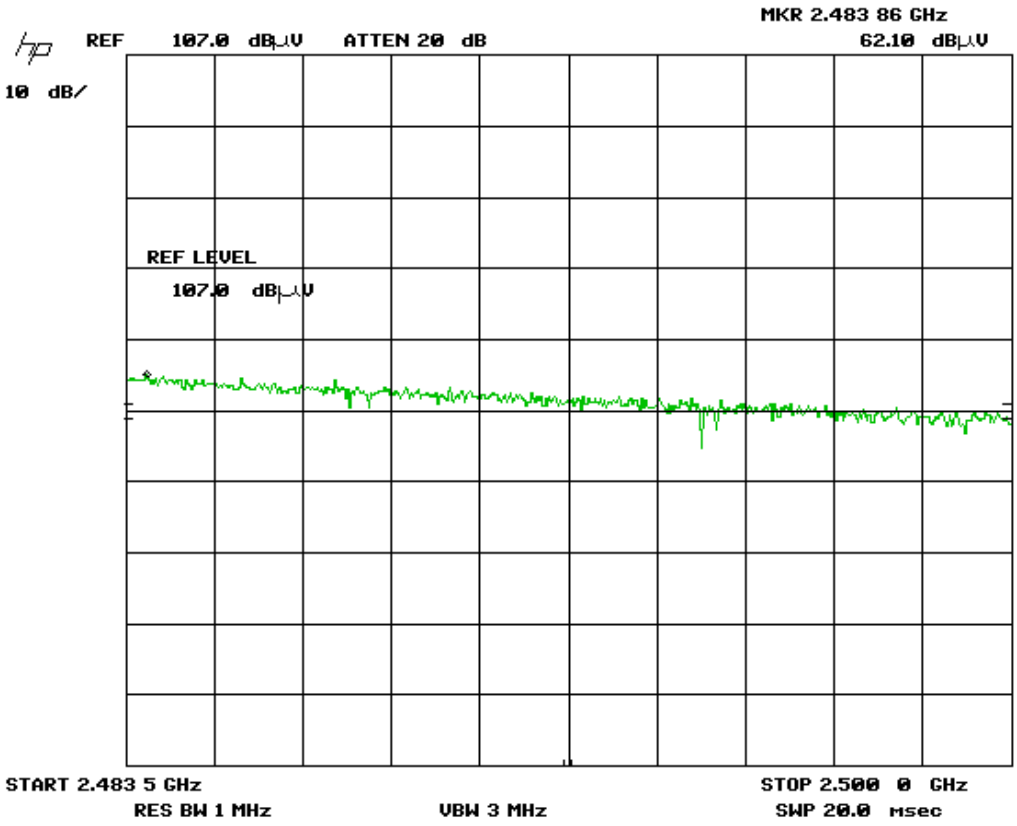
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 52 for corrected values.

Band Edge – Hi Channel 78
Vertical - Peak Emission



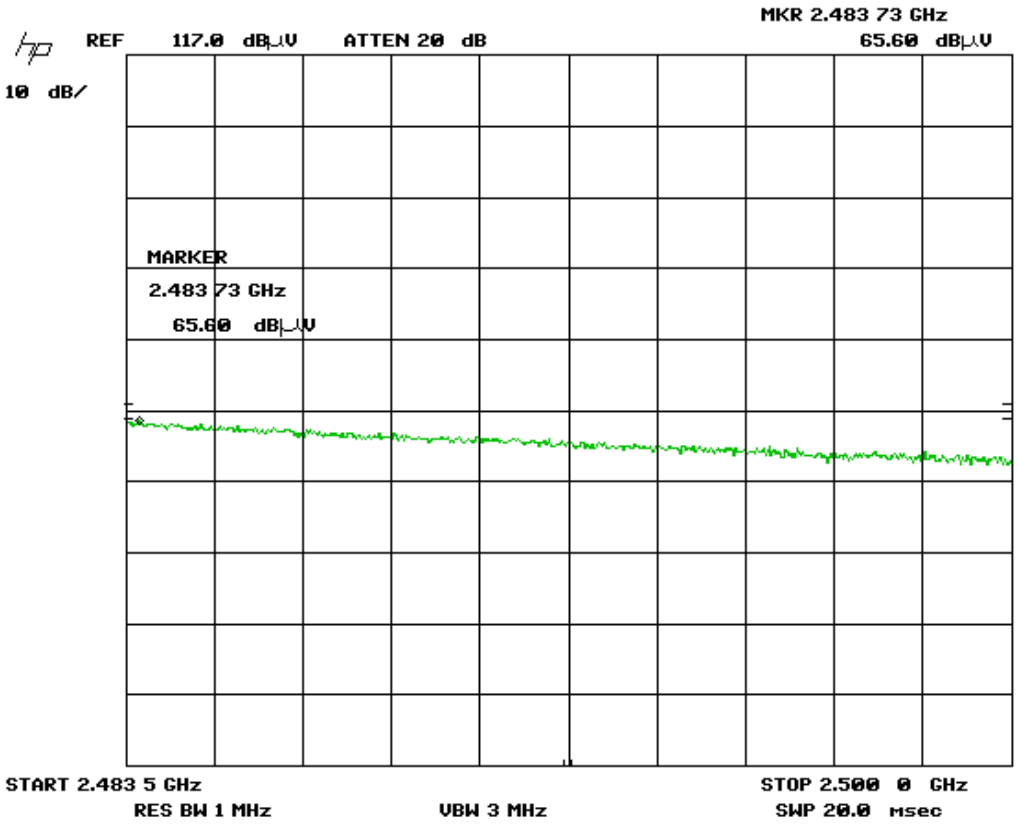
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 52 for corrected values.

Band Edge – Hi Channel 65
Vertical - Peak Emission (Orientation = Flat)



Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 52 for corrected values.

Band Edge – Hi Channel 65
Horizontal - Peak Emission (Orientation = Flat)



Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 52 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. Emission outside the restricted bands were measured for information purpose.

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.

Vertical Emission Table							
Frequency (MHz)	Detector	Raw (dBuV)	Correction Factors (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/Fail
265.678	QP	56.0	-18.4	37.6	46.4	8.8	Pass
96.057	QP	61.7	-22.5	39.2	43.5	4.3	Pass
44.938	QP	54.5	-22.6	31.9	40.0	8.1	Pass
84.0613	QP	55.6	-24.1	31.5	40.0	8.5	Pass
119.984	QP	62.2	-23.3	38.9	43.5	4.6	Pass
605.954	QP	43.3	-11.5	31.8	46.4	14.6	Pass
1335	AVG,	38.0	1.8	39.8	54.0	14.2	Pass
1727	AVG,	37.8	4.3	42.1	54.0	11.9	Pass
1134.33	AVG,	36.5	-0.5	36.0	54.0	18.0	Pass
1865.88	AVG,	34.0	4.3	38.3	54.0	15.7	Pass
Horizontal Emission Table							
265.807	QP	55.5	-18.3	37.2	46.4	9.2	Pass
250.481	QP	47.7	-19.1	28.6	46.4	17.8	Pass
280.648	QP	46.7	-18.3	28.4	46.4	18.0	Pass
796.882	QP	39.5	-7.4	32.1	46.4	14.3	Pass
604.531	QP	42.4	-10.7	31.7	46.4	14.7	Pass
258.435	QP	47.6	-18.9	28.7	46.4	17.7	Pass
270.96	QP	59.3	-18.2	41.1	46.4	5.3	Pass
284.14	QP	48.5	-18.3	30.2	46.4	16.2	Pass
1624.67	AVG,	26.3	5.7	32.0	54.0	22.0	Pass
1403.67	AVG,	36.8	3.9	40.7	54.0	13.3	Pass
1329	AVG,	36.4	2.8	39.2	54.0	14.8	Pass

1137.67	AVG,	37.5	1.1	38.6	54.0	15.4	Pass
3250.67	AVG,	26.4	5.6	32.0	54.0	22.0	Pass

Note: A duty cycle correction factor of -23.9 dB was used to derive Average emissions from peak emissions at 1624 MHz and 3250 MHz.

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 (4) PA5 (TX_CFG_ADR 12) Flat											
2405	Peak	Horz	102.9	26.1	3.8	13.0	35.8	110.0			PASS
2405	Avg	Horz	79.0	26.1	3.8	13.0	35.8	86.1			PASS
2405	Peak	Vert	98.0	26.1	3.8	13.0	35.8	105.1			PASS
2405	Avg	Vert	74.1	26.1	3.8	13.0	35.8	81.2			PASS
2390	Peak	Horz	66.4	26.1	3.8	13.0	35.8	73.5	74.0	0.5	PASS
2390	Avg	Horz	42.5	26.1	3.8	13.0	35.8	49.6	54.0	4.4	PASS
2390	Peak	Vert	61.0	26.1	3.8	13.0	35.8	68.1	74.0	5.9	PASS
2390	Avg	Vert	37.1	26.1	3.8	13.0	35.8	44.2	54.0	9.8	PASS
Low Channel (0) PA3 (TX_CFG_ADR 10) - Flat											
2402	Peak	Horz	92.8	26.1	3.8	13.0	35.8	99.9			PASS
2402	Avg	Horz	68.9	26.1	3.8	13.0	35.8	76.0			PASS
2402	Peak	Vert	87.8	26.1	3.8	13.0	35.8	94.9			PASS
2402	Avg	Vert	63.9	26.1	3.8	13.0	35.8	71.0			PASS
2390	Peak	Horz	59.0	26.1	3.8	13.0	35.8	66.1	74.0	7.9	PASS
2390	Avg	Horz	35.1	26.1	3.8	13.0	35.8	42.2	54.0	11.8	PASS
2390	Peak	Vert	53.6	26.1	3.8	13.0	35.8	60.7	74.0	13.3	PASS
2390	Avg	Vert	29.7	26.1	3.8	13.0	35.8	36.8	54.0	17.2	PASS

Note: A duty cycle correction factor of -23.9 dB was used to derive Average emissions from peak emissions.

Test Frequency (MHz)	Detection mode	Antenna polarity (Horz/Vert)	Raw signal dB(µV)	Antenna factor dB	Cable loss dB	Atten uator dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB	Result
Mid Channel (39) PA5 (TX_CFG_ADR 12) Flat											
2440	Peak	Horz	103.2	26.1	3.8	13.0	35.8	110.3			PASS
2440	Avg	Horz	79.3	26.1	3.8	13.0	35.8	86.4			PASS
2440	Peak	Vert	98.4	26.1	3.8	13.0	35.8	105.5			PASS
2440	Avg	Vert	74.5	26.1	3.8	13.0	35.8	81.6			PASS
4880	Peak	Horz	48.9	28.1	5.8	3.0	35.3	50.5	74.0	23.5	PASS
4880	Avg	Horz	25.0	28.1	5.8	3.0	35.3	26.6	54.0	27.4	PASS
4880	Peak	Vert	44.3	28.1	5.8	3.0	35.3	45.9	74.0	28.1	PASS
4880	Avg	Vert	20.4	28.1	5.8	3.0	35.3	22.0	54.0	32.0	PASS
High Channel (65) PA5 (TX_CFG_ADR 12) - Vertical											
2466	Peak	Horz	95.0	26.1	3.8	13.0	35.8	102.1			PASS
2466	Avg	Horz	71.1	26.1	3.8	13.0	35.8	78.2			PASS
2466	Peak	Vert	97.1	26.1	3.8	13.0	35.8	104.2			PASS
2466	Avg	Vert	73.2	26.1	3.8	13.0	35.8	80.3			PASS
2483.5	Peak	Horz	58.4	26.1	3.8	13.0	35.8	65.5	74.0	8.5	PASS
2483.5	Avg	Horz	34.5	26.1	3.8	13.0	35.8	41.6	54.0	12.4	PASS
2483.5	Peak	Vert	57.2	26.1	3.8	13.0	35.8	64.3	74.0	9.7	PASS
2483.5	Avg	Vert	33.3	26.1	3.8	13.0	35.8	40.4	54.0	13.6	PASS
High Channel (65) PA5 (TX_CFG_ADR 12)- Flat											
2466	Peak	Horz	103.1	26.1	3.8	13.0	35.8	110.2			PASS
2466	Avg	Horz	79.2	26.1	3.8	13.0	35.8	86.3			PASS
2466	Peak	Vert	98.6	26.1	3.8	13.0	35.8	105.7			PASS
2466	Avg	Vert	74.7	26.1	3.8	13.0	35.8	81.8			PASS
2483.5	Peak	Horz	65.6	26.1	3.8	13.0	35.8	72.7	74.0	1.3	PASS
2483.5	Avg	Horz	41.7	26.1	3.8	13.0	35.8	48.8	54.0	5.2	PASS
2483.5	Peak	Vert	62.1	26.1	3.8	13.0	35.8	69.2	74.0	4.8	PASS
2483.5	Avg	Vert	38.2	26.1	3.8	13.0	35.8	45.3	54.0	8.7	PASS
High Channel (65) PA5 (TX_CFG_ADR 12) - Side											
2466	Peak	Horz	103.0	26.1	3.8	13.0	35.8	110.1			PASS
2466	Avg	Horz	79.1	26.1	3.8	13.0	35.8	86.2			PASS
2466	Peak	Vert	98.9	26.1	3.8	13.0	35.8	106.0			PASS
2466	Avg	Vert	75.0	26.1	3.8	13.0	35.8	82.1			PASS
2483.5	Peak	Horz	64.1	26.1	3.8	13.0	35.8	71.2	74.0	2.8	PASS
2483.5	Avg	Horz	40.2	26.1	3.8	13.0	35.8	47.3	54.0	6.7	PASS
2483.5	Peak	Vert	61.5	26.1	3.8	13.0	35.8	68.6	74.0	5.4	PASS
2483.5	Avg	Vert	37.6	26.1	3.8	13.0	35.8	44.7	54.0	9.3	PASS
High Channel (78) PA3 (TX_CFG_ADR 10) - Flat											
2479	Peak	Horz	92.8	26.1	3.8	13.0	35.8	99.9			PASS
2479	Avg	Horz	68.9	26.1	3.8	13.0	35.8	76.0			PASS
2479	Peak	Vert	88.3	26.1	3.8	13.0	35.8	95.4			PASS
2479	Avg	Vert	64.4	26.1	3.8	13.0	35.8	71.5			PASS
2483.5	Peak	Horz	66.7	26.1	3.8	13.0	35.8	73.8	74.0	0.2	PASS
2483.5	Avg	Horz	42.8	26.1	3.8	13.0	35.8	49.9	54.0	4.1	PASS
2483.5	Peak	Vert	61.2	26.1	3.8	13.0	35.8	68.3	74.0	5.7	PASS
2483.5	Avg	Vert	37.3	26.1	3.8	13.0	35.8	44.4	54.0	9.6	PASS

Note: A duty cycle correction factor of -23.9 dB was used to derive Average emissions from peak emissions.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration / Verification date	Next calibration/ Verification due date	Asset #
Spectrum Analyzer	8566B	HP	Nov 27, 2015	Nov 27, 2017	GEMC 190
Quasi Peak Adapter	85650A	HP	Nov 27, 2015	Nov 27, 2017	GEMC 191
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	Sept 8, 2014	Sept 8, 2016	GEMC 8
Attenuator 10 dB	8493B	Agilent	Feb 11, 2016	Feb 11, 2017	GEMC 133
4GHZ-12GHz High Pass Filter	11SH10-4000/T12000-0/0	K & L Microwave	Apr 9, 2016	Apr 9, 2017	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	Feb 12, 2016	Feb 12, 2018	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	Feb 8, 2016	Feb 8, 2018	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	Feb 8, 2016	Feb 8, 2018	GEMC157
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	Feb 1, 2016	Feb 1, 2017	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	Feb 1, 2016	Feb 1, 2017	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	Feb 1, 2016	Feb 1, 2017	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) and RSS 247.

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 ANSI 63.10 11.10.2 Method PKPSD.

Results

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

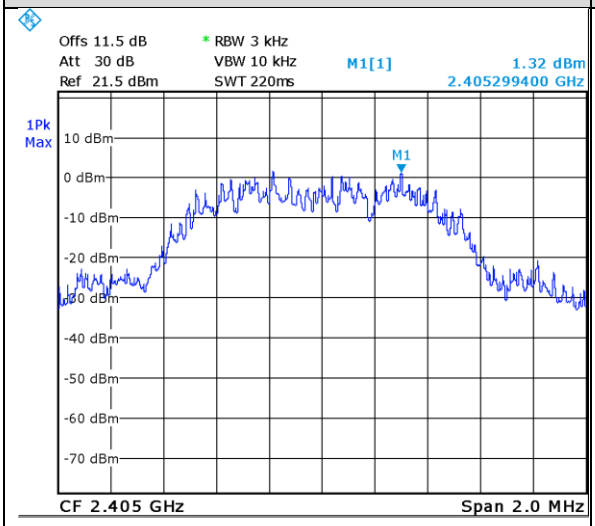
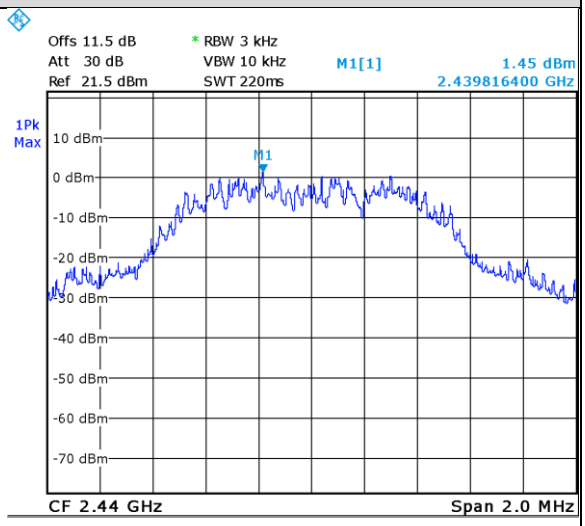
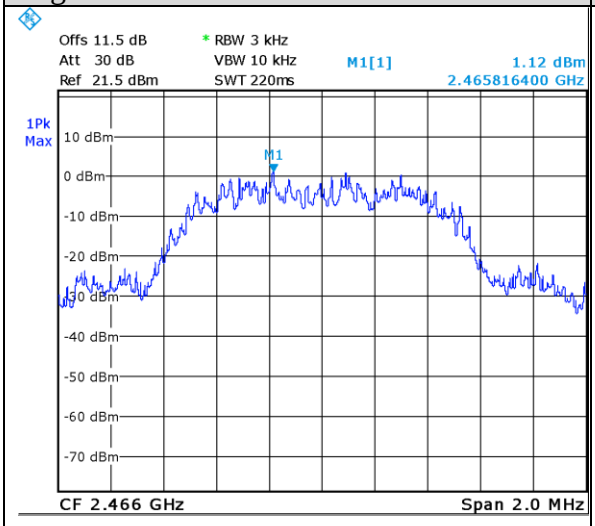
Peak PSD				
Channel	Frequency (MHz)	PSD/3kHz (dBm)	Limit (dBm/3kHz)	Pass/Fail
4	2405	1.32	8	Pass
39	2440	1.45	8	Pass
65	2466	1.12	8	Pass

Graph(s)

The graphs shown below show the power spectral density of the device. This is measured by a max hold on the spectrum analyzer using a RBW of 3 kHz. This measurement is a peak measurement. Max hold is performed for a duration of not less than 1 minute.

Low, middle, and high channel was investigated in each mode, with the worst case being presented.

External attenuator and cable loss were accounted for as reference offset in the spectrum analyzer.

PSD	
Low Channel	Mid Channel
	
High Channel	
	

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

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration / Verification date	Next calibration/ Verification due date	Asset #
Spectrum Analyzer	ESL6	Rohde & Schwarz	Nov 25, 2015	Nov 25, 2017	GEMC 160
10 dB attenuator	605-10-1F18	Meca Electronics, Inc.	Jun 3, 2016	Jun 3, 2017	GEMC 225

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

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 and measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio, maritime radio, CB radio, and so on, from unwanted interference.

Limits & Method

The method is as defined in ANSI C63.10. The limits are as defined in FCC Part 15 Section 15.207 and RSS-GEN:

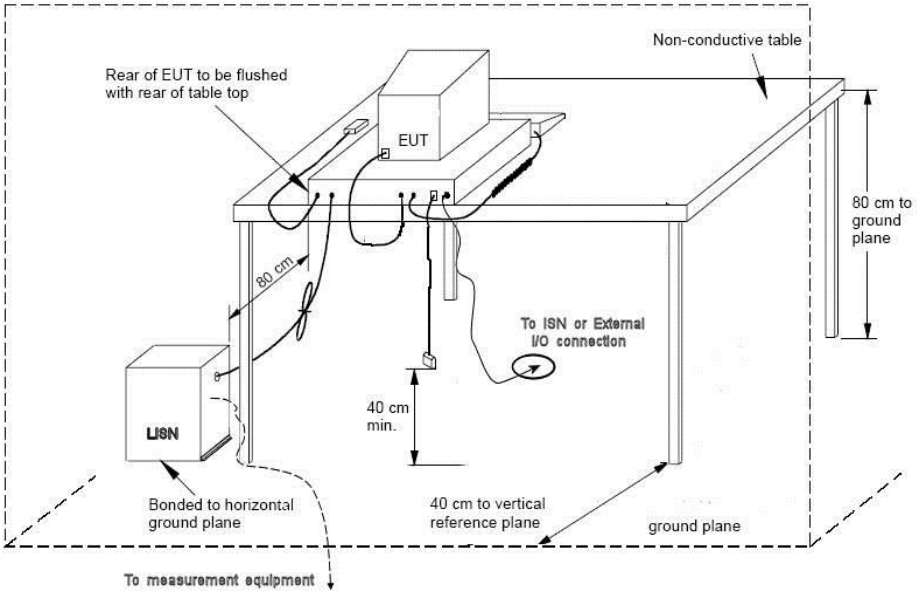
Average Limits		Quasi-Peak Limits	
150 kHz – 500 kHz	56 to 46* dBµV	150 kHz – 500 kHz	66 to 56* dBµV
500 kHz – 5 MHz	46 dBµV	500 kHz – 5 MHz	56 dBµV
5 MHz – 30 MHz	50 dBµV	5 MHz – 30 MHz	60 dBµV

* Decreases linearly with the logarithm of the frequency

Both Quasi-Peak and Average limits are applicable and each is specified as being measured with a resolution bandwidth of 9 kHz. For Quasi-Peak, a video bandwidth at least three times greater than the resolution bandwidth is used.

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

Typical Setup Diagram



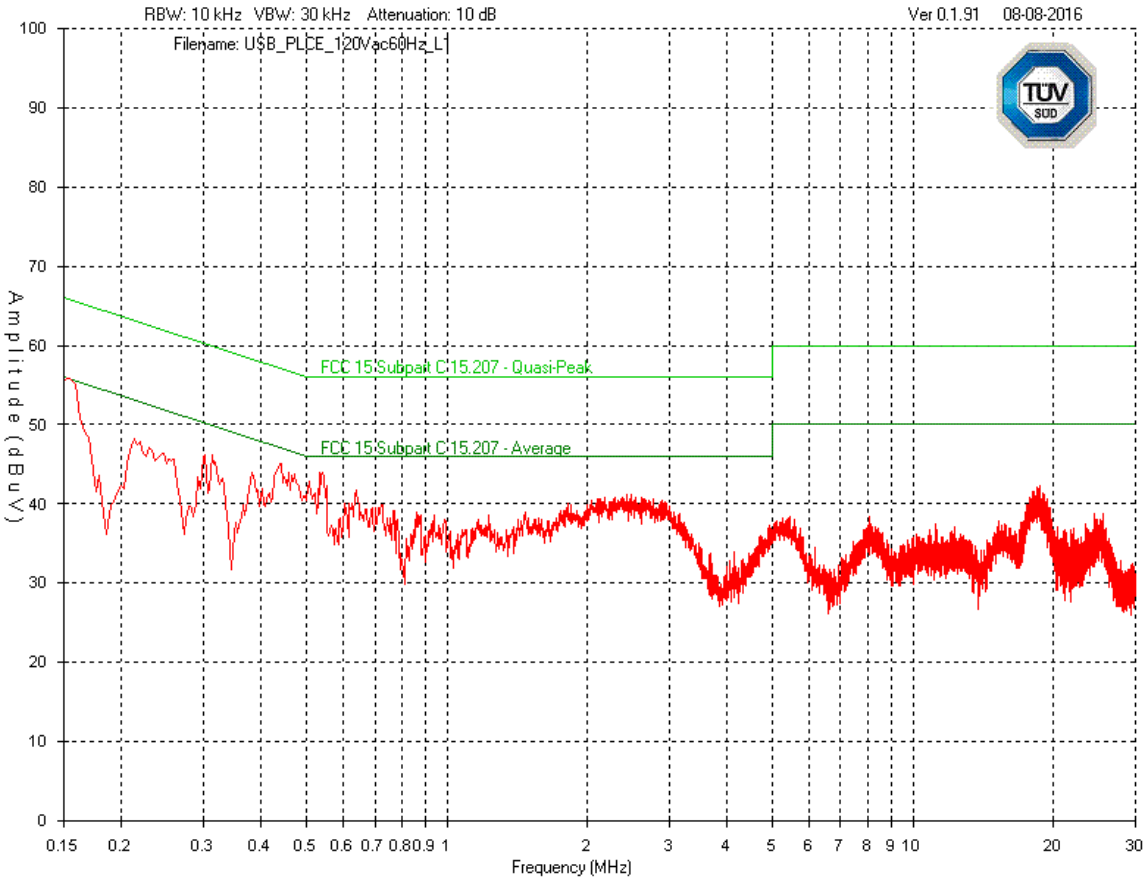
Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±2.91dB with a 'k=2' coverage factor and a 95% confidence level.

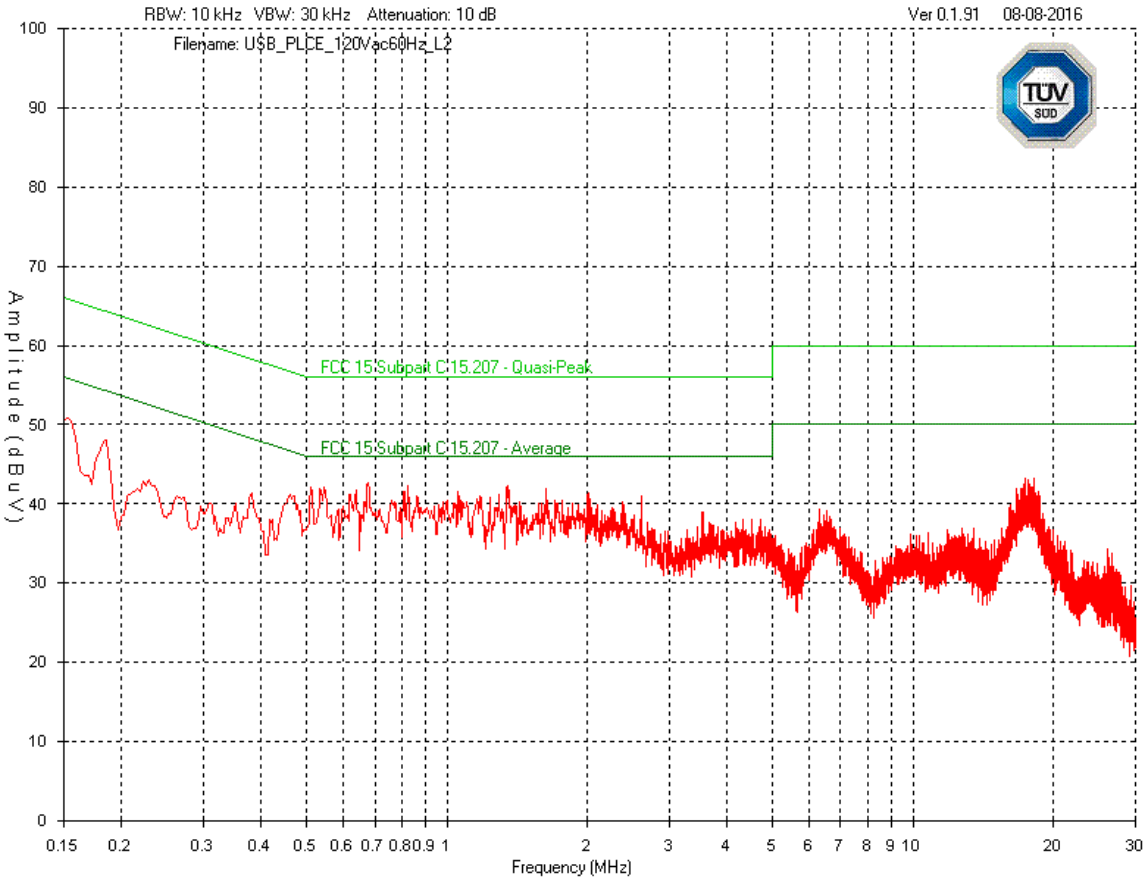
Preliminary Graphs

The graphs shown below are maximized peak measurement graphs measured with a resolution bandwidth greater than or equal to the final required detector. This peaking process is done as a worst case measurement and enables the detection of frequencies of concern for final measurement. For final measurements with the appropriate detector, where applicable, please refer to the tables under Final Measurements.

Line (L1) – 120Vac 60Hz



Neutral (L2) – 120Vac 60Hz



Final Measurements

Supply	120 Vac 60 Hz						
Line Emission Table							
Frequency (MHz)	Detector	Raw (dBuV)	Factors (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Pass/Fail
0.1533	AVG	38.2	10.0	48.2	55.8	7.6	Pass
0.4419	AVG	23.1	10.1	33.2	47.0	13.8	Pass
0.2225	AVG	29.6	10.1	39.7	49.9	10.2	Pass
0.6409	AVG	17.6	10.1	27.7	46.0	18.3	Pass
2.4385	AVG	22.1	10.1	32.2	46.0	13.8	Pass
0.1777	AVG	33.8	10.0	43.8	53.1	9.3	Pass
Neutral Emission Table							
0.6774	PEAK	32.6	10.1	42.7	46.0	3.3	Pass
1.3473	PEAK	32.2	10.1	42.3	46.0	3.7	Pass
0.8266	PEAK	32.2	10.1	42.3	46.0	3.7	Pass
0.5115	PEAK	32.0	10.1	42.1	46.0	3.9	Pass
1.6292	PEAK	31.7	10.1	41.8	46.0	4.2	Pass
0.6376	PEAK	31.7	10.1	41.8	46.0	4.2	Pass

See 'Appendix B – EUT, Peripherals and Test Setup Photos' 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 Date	Asset #
Spectrum Analyzer	ESL 6	Rohde & Schwarz	Nov. 25, 2015	Nov. 25, 2017	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	Jan. 15, 2015	Jan. 15, 2017	GEMC 65
RF Cable 7m	LMR-400-7M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 29
10dB Attenuator	FP-50-10	Trilithic	NCR	NCR	GEMC 42
Emissions Software	0.1.91	Global EMC	NCR	NCR	GEMC 58

This report module is based on report template 'FCC_ICES003_CE_Rev1'

Appendix A – EUT Summary

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

General EUT Description

Client	
Organization / Address	Artaflex 174 W. Beaver Creek Rd. Richmond Hill, ON L4B 1B4
Contact	Gerry Iuliano
Phone	905-4700109
Email	Gerry_iuliano@artaflex.com
EUT Details	
EUT Name	AWAC24UR
FCC ID	UP2AWA24UR
Industry Canada #	6797A-AWA24UR
Equipment Category	2.4 GHz wireless module
Input Voltage and Frequency	5VDC
Rated Input Current	< 100 mA
Connectors available on EUT	None
Peripherals Required for Test	Laptop computer
Release type	Final
Intentional Radiator Frequency	Yes
EUT Configuration	Wireless configured to transmit continuously at maximum duty cycle

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 and Test Setup Photos'.