EMC & RF Test Report

As per

RSS-247 Issue 2:2017
&
FCC Part 15 Subpart 15.247:2016

Unlicensed Intentional Radiators

on the

Gamma V4

Issued by: **TÜV SÜD Canada Inc.**
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Testing produced for

See Appendix A for full client & EUT details.

Industry Canada
Registration # 6844B-1

Testing Laboratory Certificate #2955.02

Registration # 382292

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Report Scope

This report addresses the EMC verification testing and test results of the Gamma V4 and is herein referred to as EUT (Equipment Under Test). The EUT was tested for compliance against the following standards:

RSS-247 Issue 2:2017

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:	Gamma V4
FCC Certification #, FCC ID:	V95-VTG
Industry Canada Certification #, IC:	7591A-VTG
EUT passed all tests performed	Yes (see test results summary)
Tests conducted by	Scott Drysdale

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 See Justification
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(a)	6 dB Bandwidth	> 500 kHz	Pass
FCC 15.247(b)2 RSS-247 5.4(d)	Max Output Power	< 1 Watt	Pass
FCC 15.247(b)4 RSS-247 5.4(d)	Antenna Gain	< 6 dBi	Pass See Justifications
FCC 15.247(d) RSS-247 5.5	Spurious	< 20 dBc	Pass
FCC 15.247(e) RSS-247 5.2(b)	Spectral Density	< 8 dBm (3 kHz BW)	Pass
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 Restricted Bands of operation, the EUT is designed to only operate between 2400 – 2483.5 MHz.

For power line conducted emissions, this device is battery operated without any provisions for any direct or indirect connection to AC mains, so this requirement is not applicable.

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.

The EUT was mounted in three orthogonal axis. Worst case results were obtained with the EUT in the X-axis. Worst case results are presented. See Appendix B for axis details.

For the antenna requirement, this device uses a PCB trace design, with an estimated maximum gain of 2.15 dBi based on the dipole design. Based on the antenna conducted emissions compared to the radiated emissions, the estimated measured gain is 2.1 dB, which is consistent with the estimated maximum gain.

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 2:2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories

Document Revision Status

Revision 000 - First Release. May 23, 2018

Revision 001 – Added HVIN as per TCB request, June 4, 2018

Revision 002 – Corrected appendix A as per TCB request. June 5, 2018

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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 testing lab in Lval (Montréal), Québec, Canada. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on a 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, 382292) and Industry Canada (IC, 6844B-1). 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/IEC 17025 by A2LA with Testing Certificate #2955.02. 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 (°C)	Humidity (%)	Pressure (kPa)
Dec 4-22, 2018	Radiated Emissions	SD	20 – 24	40 – 51	98.0 – 102.0
Dec 4-22, 2018	Antenna Conducted tests	SD	20 – 24	40 – 51	98.0 – 102.0

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 C63.4.

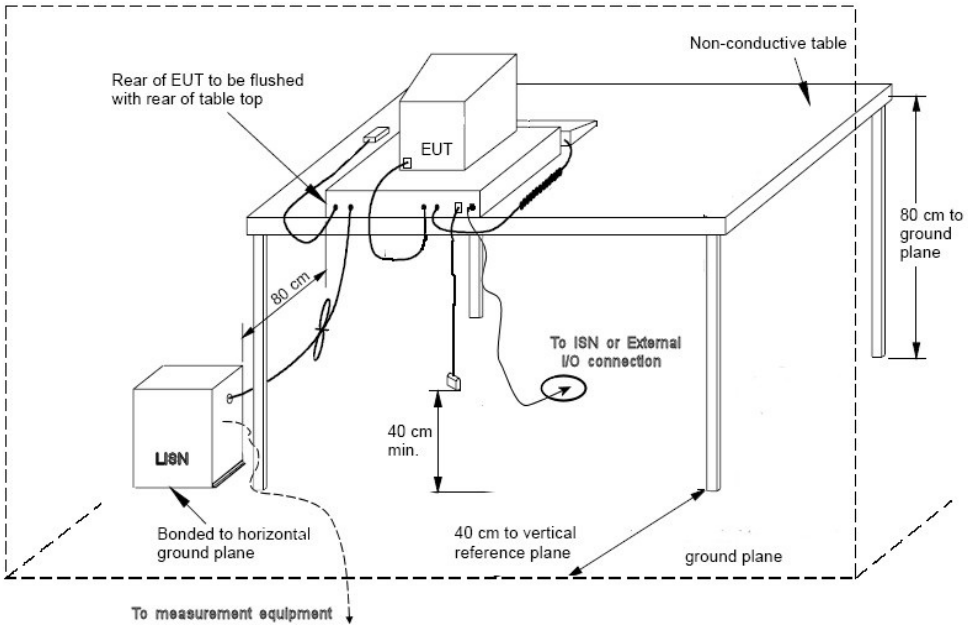
Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

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

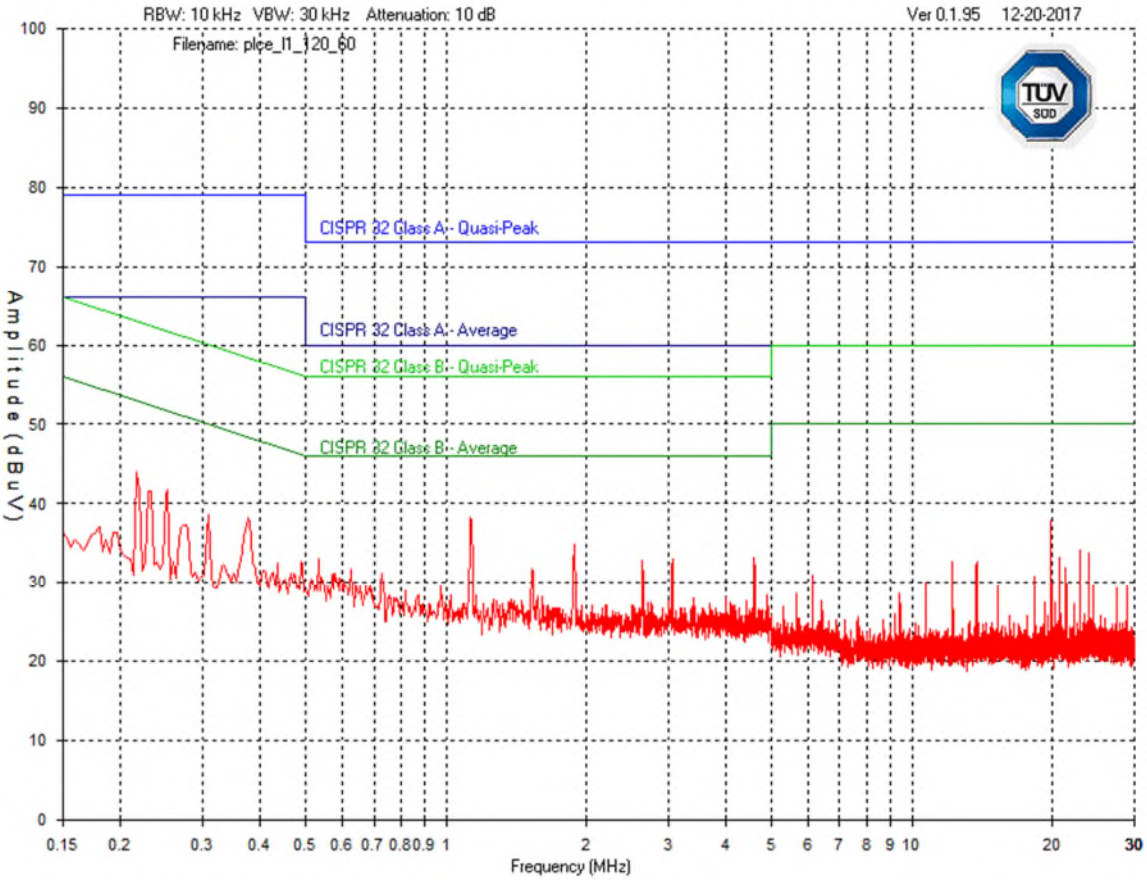
Measurement Uncertainty

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.

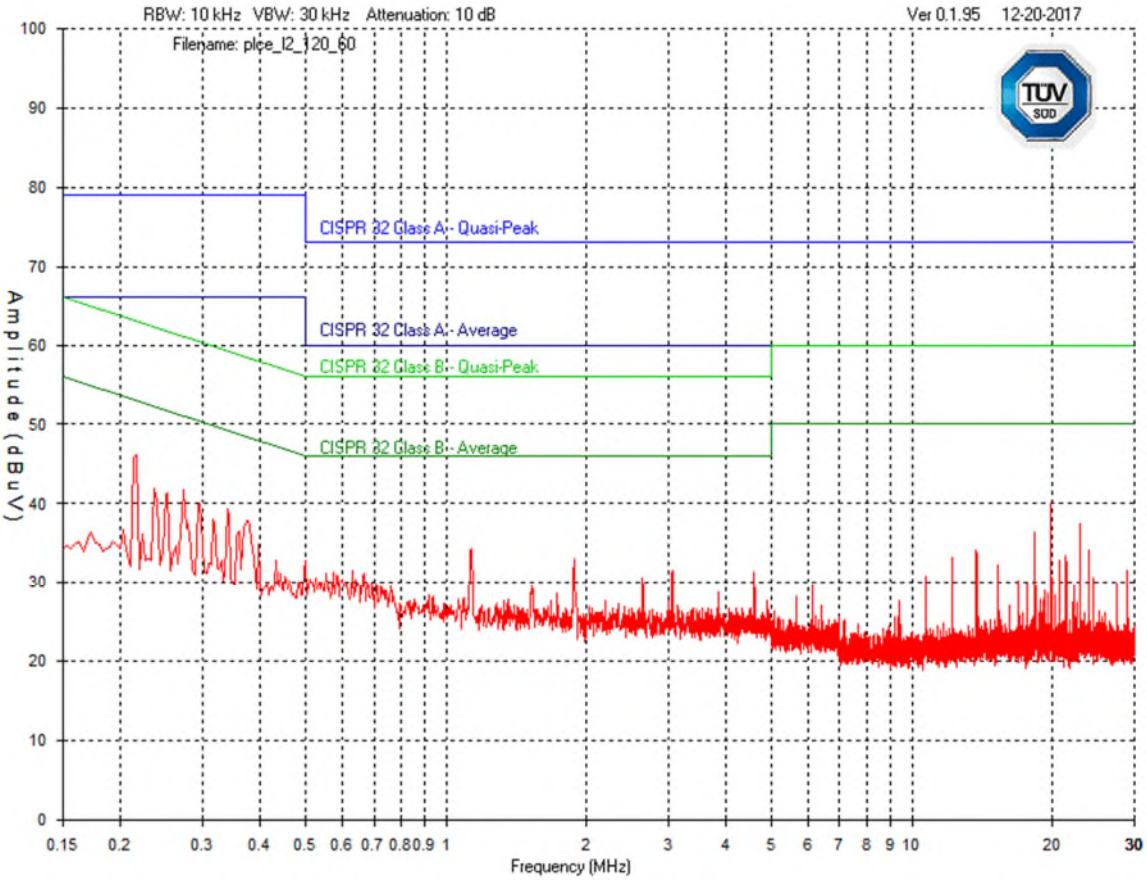
Preliminary Graphs

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)



Test Equipment List Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset#
Spectrum Analyzer	ESU 40	Rohde & Schwarz	4/20/2017	4/20/2019	4092
LISN	FCC-LISN-50/250-16-2-01	FCC	Feb. 1, 2017	Feb. 1, 2019	GEMC 65
RF Cable 7m	LMR-400-7M-50Ω-MN-MN	LexTec	Feb 1, 2017	Feb 1, 2019	GEMC 4025
RF Cable 10m	LMR-400-10M-50Ω-MN-MN	LexTec	Feb 1, 2017	Feb 1, 2019	GEMC 4026
Emissions Software	0.1.94	Global EMC	NCR	NCR	GEMC 58

1: For cables and attenuators, verification dates apply.

Transmitter Spurious Radiated Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limits and Method

The method is as defined in Section 12.2 of FCC KDB 558074 and ANSI C63.10.

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).

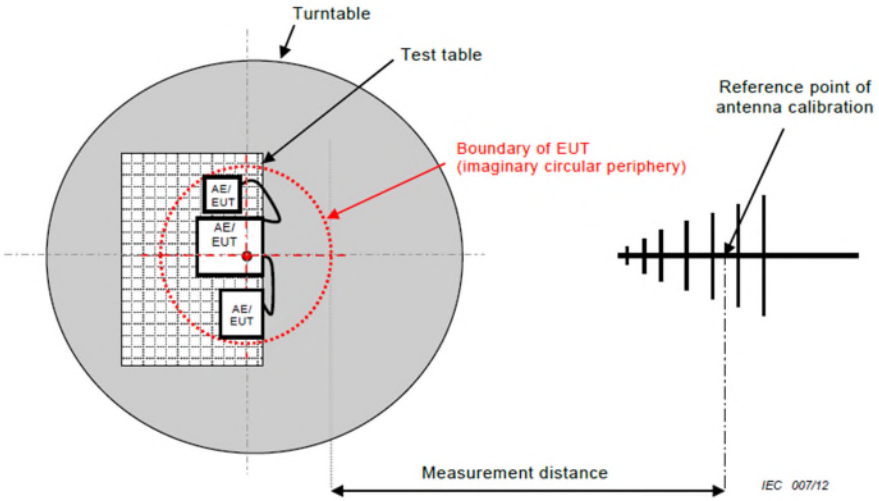
All unintentional emissions must also meet the 'Spurious Conducted Emissions' requirements of -20 dBc or greater. See also 'Antenna Spurious Conducted Emissions (-20dBc)' for further details.

Frequency	Limit
0.009 MHz – 0.490 MHz	2400/F(kHz) uV/m at 300m[1]
0.490 MHz – 1.705 MHz	24000/F(kHz) uV/m at 30m[1]
1.705 MHz – 30 MHz	30 uV/m at 30m[1]
30 MHz – 88 MHz	100 uV/m (40.0 dBuV/m[1]) at 3m
88 MHz – 216 MHz	150 uV/m (43.5 dBuV/m[1]) at 3m
216 MHz – 960 MHz	200 uV/m (46.0 dBuV/m[1]) at 3m
Above 960 MHz	500 uV/m (54.0 dBuV/m[1]) at 3m
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

Based on ANSI C63.4 Section 4.2, if the Peak detector measurements do not exceed the Quasi-Peak limits, where defined, then the EUT is deemed to have passed the requirements.

Typical Radiated Emissions Setup



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±4.25dB for 30MHz – 1GHz and ±4.93dB for 1GHz – 18GHz with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

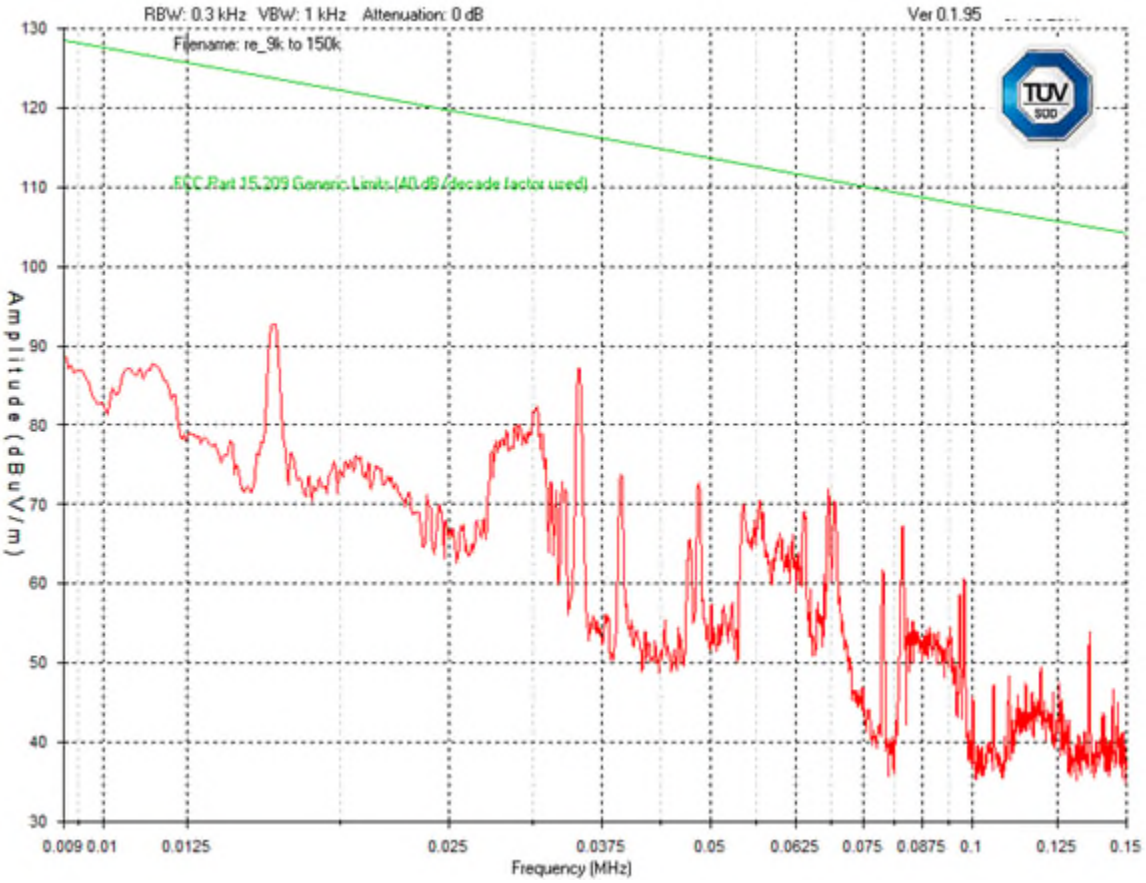
The graphs shown below are maximized peak measurement graphs measured with a resolution bandwidth greater than or equal to the final required detector over a full 0-360°. This peaking process is done as a worst case measurement and enables the detection of frequencies of concern for final measurement. For final measurements with the appropriate detector, where applicable, please refer to the tables under Final Measurements.

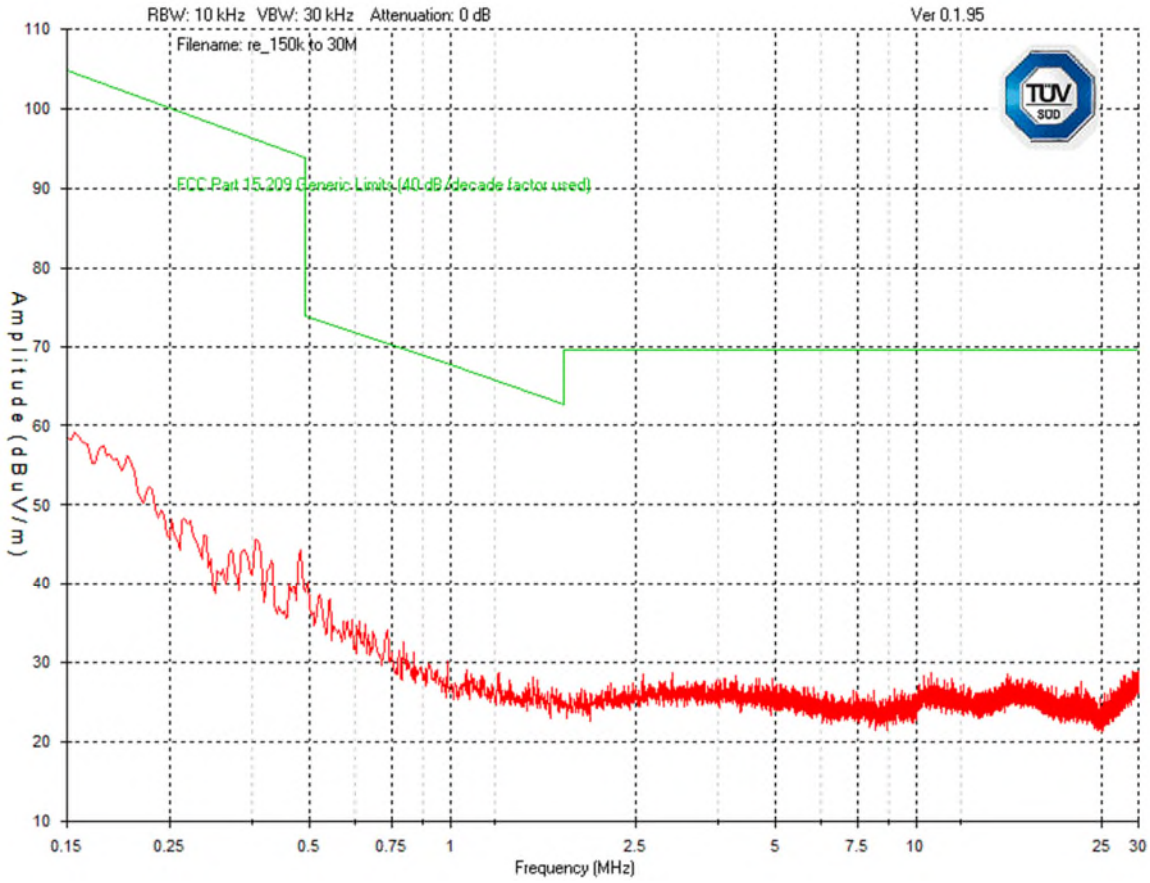
In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10^{th} harmonic (a minimum of 24.835 GHz).

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, each in three orthogonal axis were checked. However, the worst case graphs are presented. See final measurement section for all measurements.

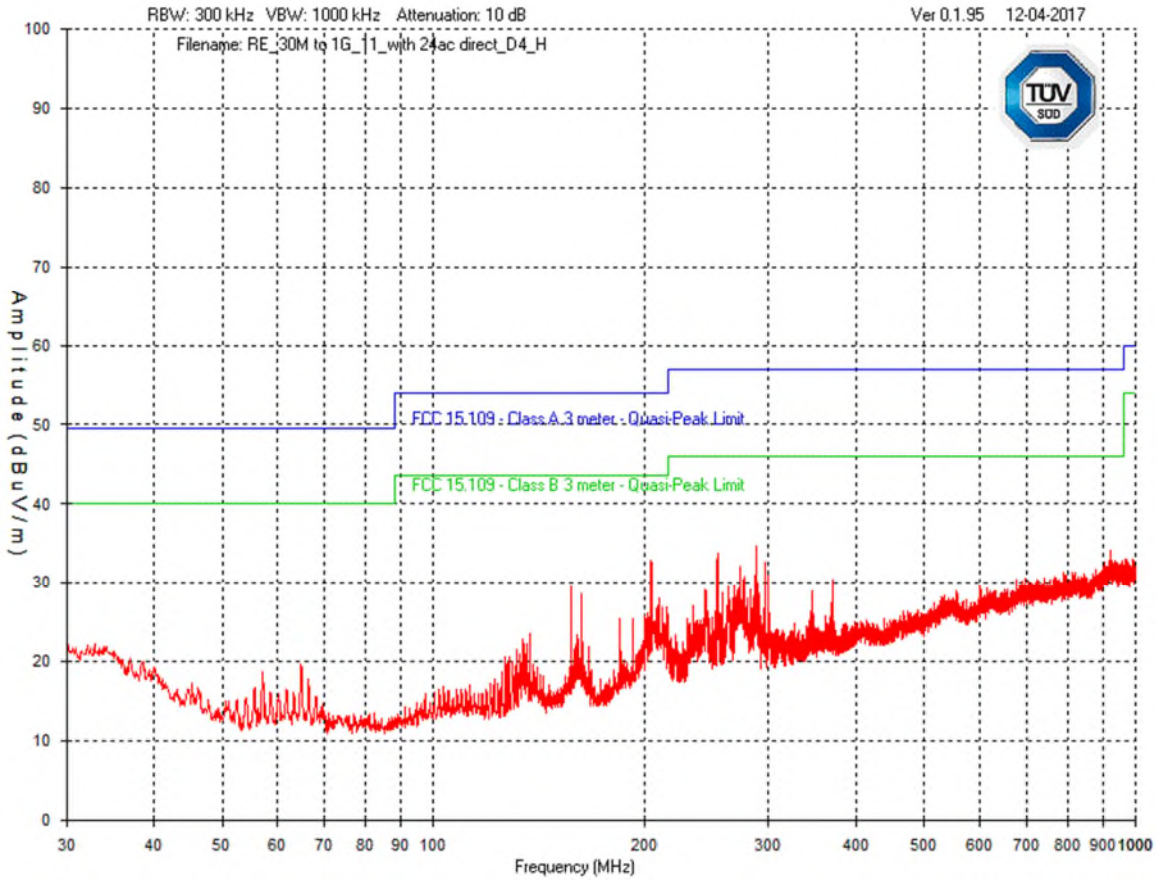
9 kHz to 30 MHz



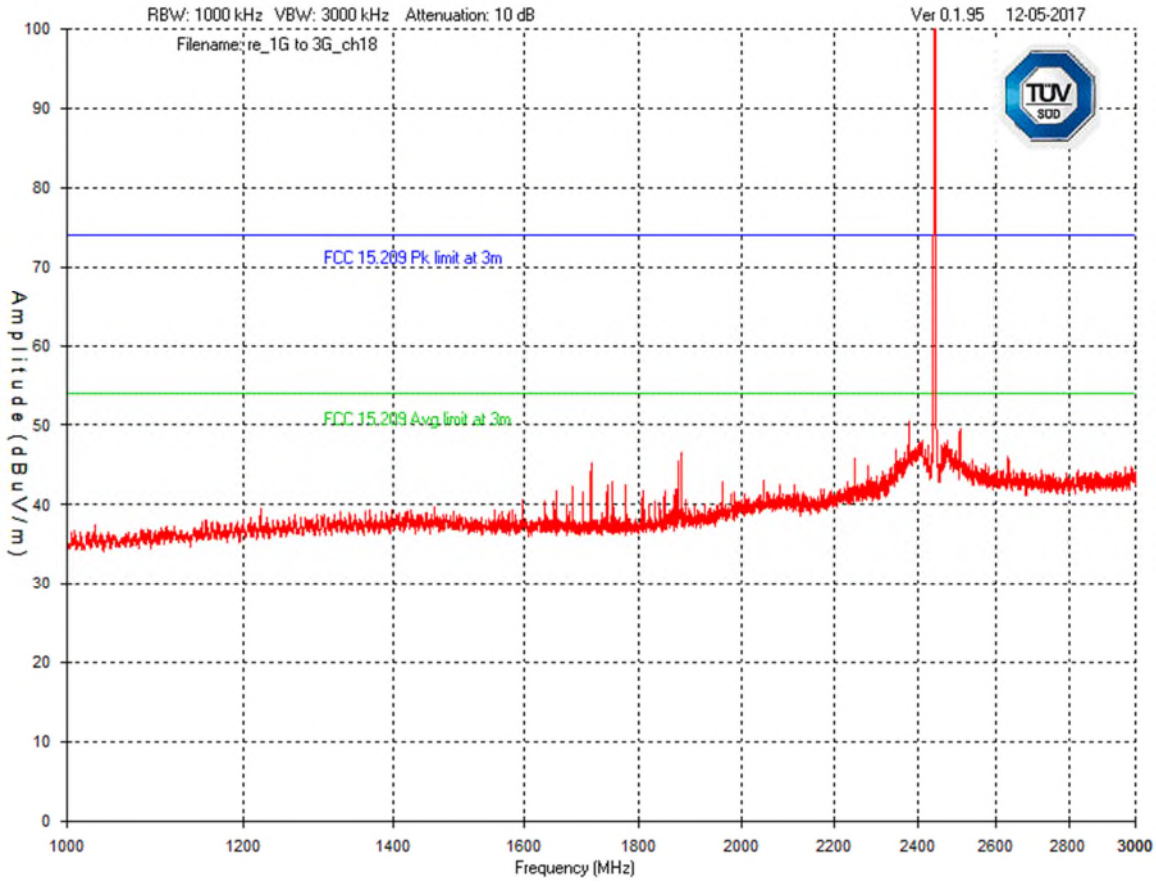


Mid Channel – 30 MHz – 1 GHz

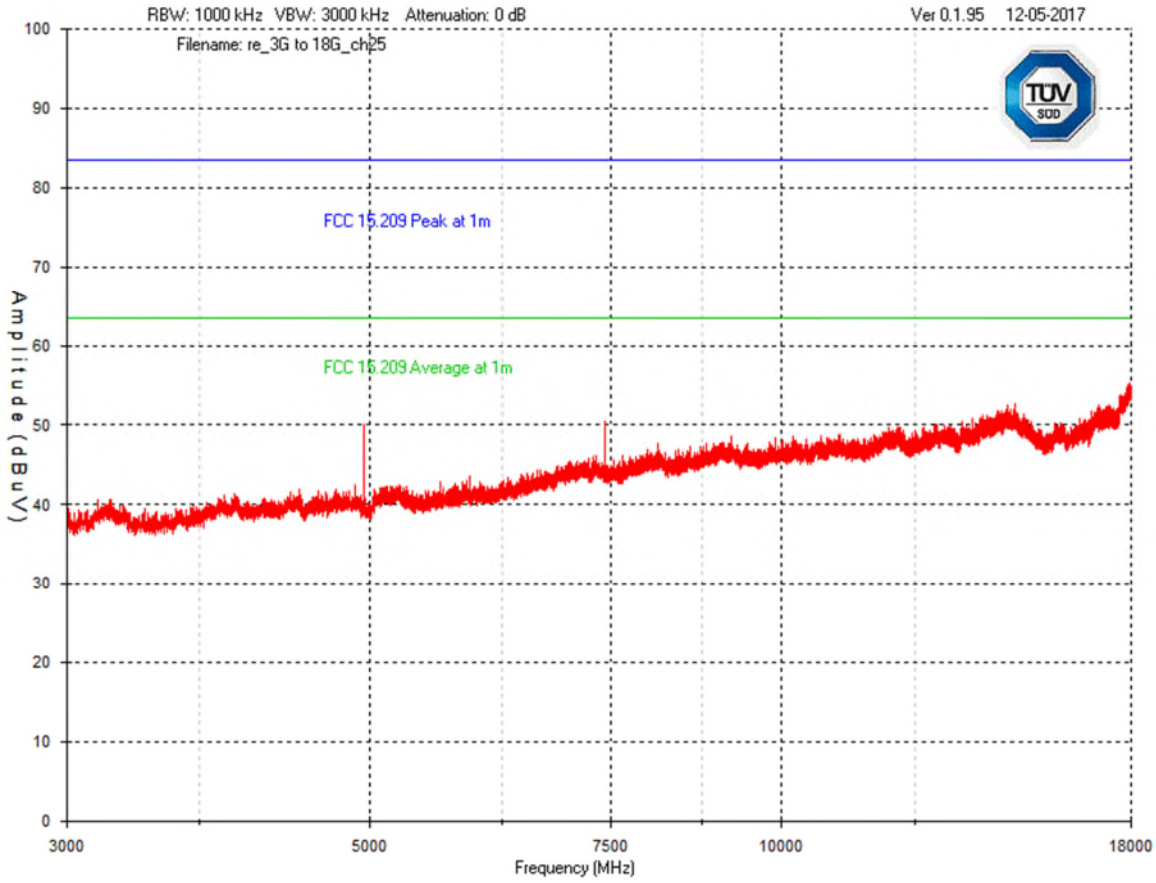
Horizontal - Peak Emission Graph



Mid Channel – 1 GHz – 3 GHz
Horizontal - Peak Emission Graph

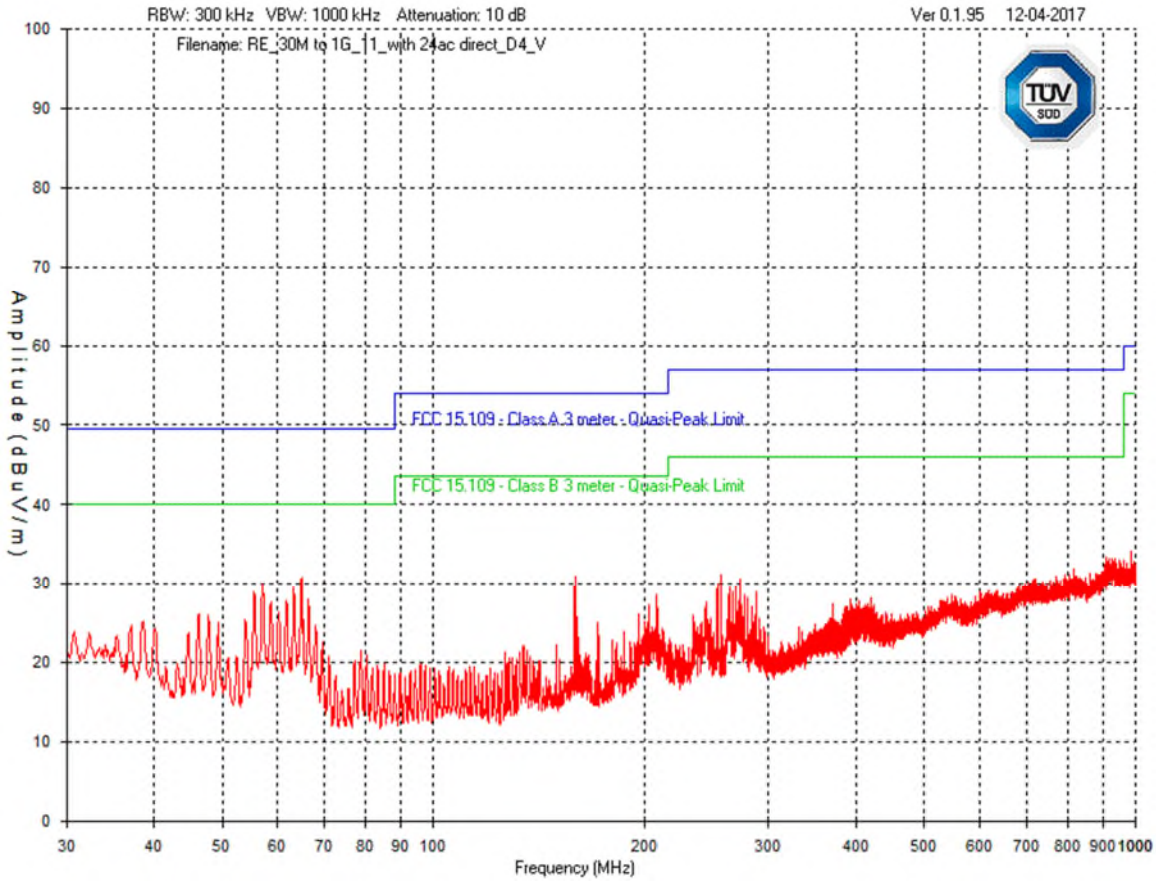


Mid Channel – 3 GHz – 18 GHz
Horizontal - Peak Emission Graph

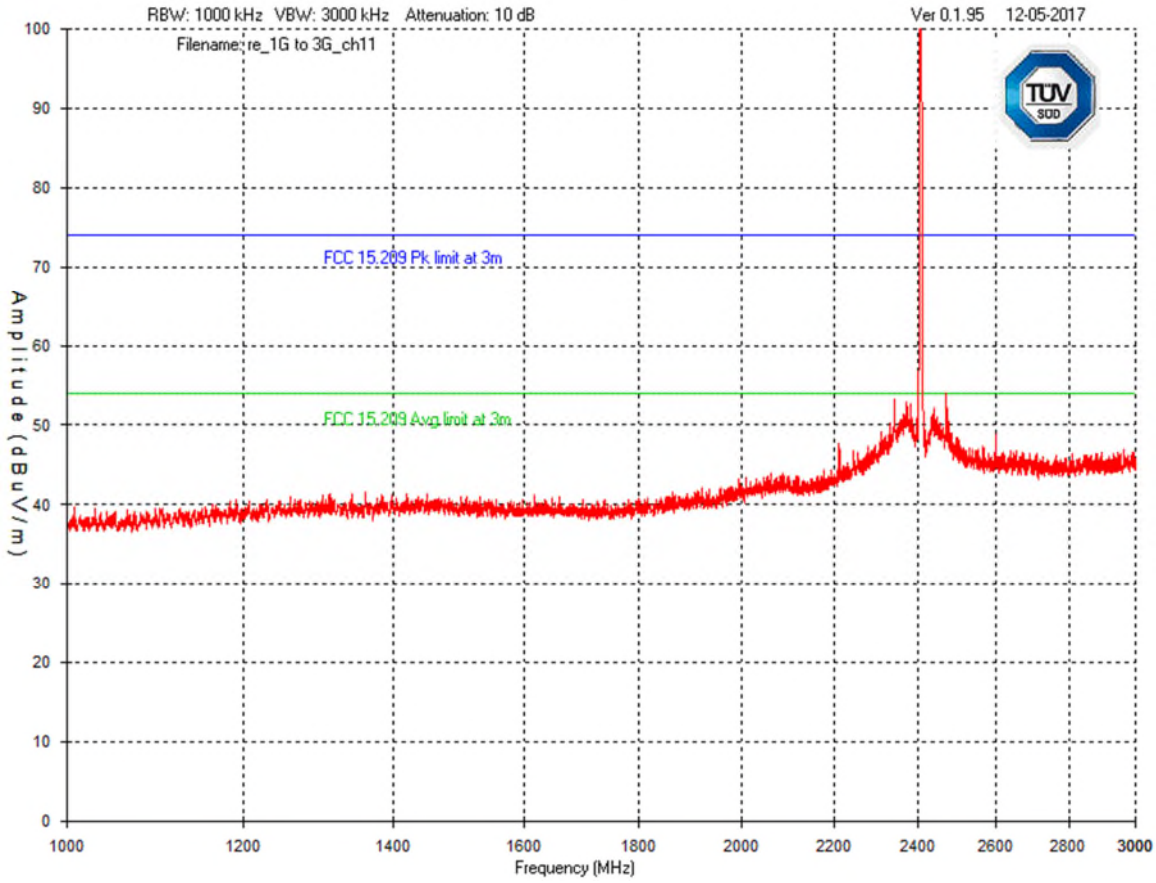


Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. Emissions were scanned to 25 GHz. No emissions were found above 18 GHz and the noise floor of the measurement was below the applicable limit.

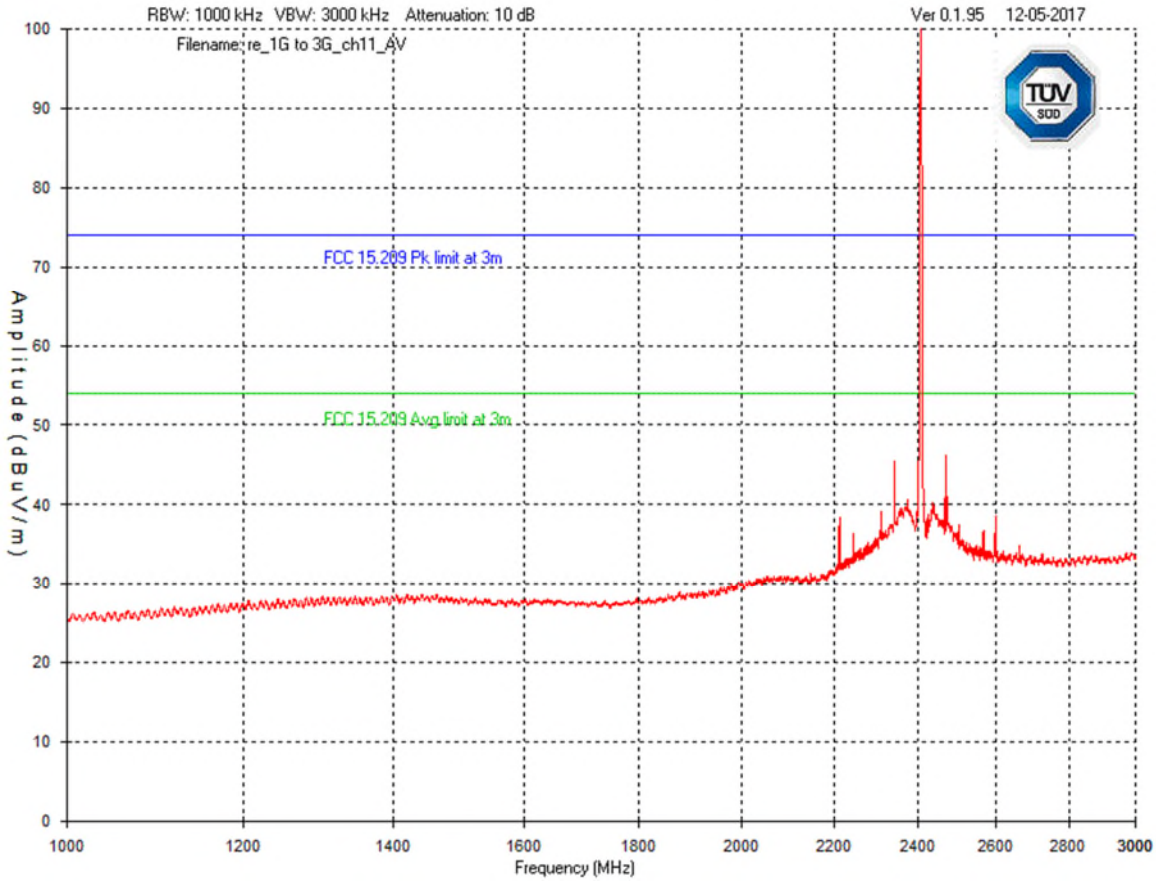
Mid Channel – 30 MHz – 1 GHz
Vertical - Peak Emission Graph



Mid Channel – 1 GHz – 3 GHz
Vertical - Peak Emission Graph



Mid Channel – 1 GHz – 3 GHz
Vertical - Average Emission Graph



Mid Channel – 3 GHz – 18 GHz
Vertical - Peak Emission Graph

Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. Emissions were scanned to 25 GHz. No emissions were found above 18 GHz and the noise floor of the measurement was below the applicable limit.

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The marker shows the raw value. See the Final Measurements and Results section below for correct values.

Final Measurements and Results

The EUT passed. 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. Emissions inside the restricted bands were measured for informational purposes.

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.

No peak emissions over the 30 MHz to 1GHz range exceeded the quasi-peak limits, or came within 6 dB of the quasi-peak limits. The peak readings shown were determined to be sufficient for the purpose of declaring compliance.

Test Frequency (MHz)	Detection mode (Q-Peak)	Antenna polarity (Horz/Vert)	Raw signal dB(µV)	Antenna factor dB	Cable loss dB + Preselector	Attenuator dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB(µV)	Result
Low Channel											
2405	Peak	Horz	100.3	30.6	5.2	0.0	33.0	103.1			PASS
2405	PEAK 3	Horz	100.7	30.6	5.2	0.0	33.0	103.5			PASS
2405	Peak	Vert	79.6	30.6	5.2	0.0	33.0	82.4			PASS
2405	PEAK 3	Vert	79.8	30.6	5.2	0.0	33.0	82.6			PASS
2405	Avg	Horz	68.3	30.6	5.2	0.0	33.0	71.1			PASS
2405	Avg	Vert	47.6	30.6	5.2	0.0	33.0	50.4			PASS
2390	Peak	Horz	48.0	30.6	5.2	0.0	33.0	50.8	54.0	3.2	PASS
2390	Peak	Vert	39.8	0.0	0.0	0.0	0.0	39.8	54.0	14.2	PASS
2400	Peak	Horz	63.4	30.6	5.2	0.0	33.0	66.2	83.1	16.9	PASS
2400	Peak	Vert	39.2	30.6	5.2	0.0	33.0	42.0	62.4	20.4	PASS
4810	Peak	Horz	57.4	33.7	2.9	0.0	35.7	58.3	74.0	15.7	PASS
4810	Avg	Horz	25.3	33.7	2.9	0.0	35.7	26.2	54.0	27.8	PASS
4810	Peak	Vert	50.1	33.7	2.9	0.0	35.7	51.0	54.0	3.0	PASS
7215	Peak	Vert	46.7	37.9	4.3	0.0	35.9	53.0	54.0	1.0	PASS
7215	Peak	Horz	41.4	37.9	4.3	0.0	35.9	47.7	54.0	6.3	PASS
Mid channel											
2440	Peak	Horz	100.4	30.6	5.2	0.0	33.0	103.2			PASS
2440	Avg	Horz	68.4	30.6	5.2	0.0	33.0	71.2			PASS
4880	Peak	Horz	57.5	33.7	2.9	0.0	35.7	58.4	74.0	15.6	PASS
4880	Avg	Horz	25.4	33.7	2.9	0.0	35.7	26.3	54.0	27.7	PASS
4880	Peak	Vert	50.0	33.7	2.9	0.0	35.7	50.9	54.0	3.1	PASS

7320	Peak	Vert	45.4	37.9	5.8	0.0	35.9	53.2	54.0	0.8	PASS
7320	Peak	Horz	40.2	37.9	5.8	0.0	35.9	48.0	54.0	6.0	PASS
High channel 25											
2475	Peak	Horz	100.2	30.6	5.2	0.0	33.0	103.0			PASS
2475	Peak3	Horz	100.4	30.6	5.2	0.0	33.0	103.2			PASS
2475	Avg	Horz	68.2	30.6	5.2	0.0	33.0	71.0			PASS
2475	Peak	Vert	80.2	30.6	5.2	0.0	33.0	83.0			PASS
2475	Peak3	Vert	80.3	30.6	5.2	0.0	33.0	83.1			PASS
2475	Avg	Vert	48.0	30.6	5.2	0.0	33.0	50.8			PASS
2483.5	Peak	Horz	56.0	30.6	5.2	0.0	33.0	58.8	74.0	15.2	PASS
2483.5	Avg	Horz	24.0	30.6	5.2	0.0	33.0	26.8	54.0	27.2	PASS
2483.5	Peak	Vert	41.1	30.6	5.2	0.0	33.0	43.9	54.0	10.1	PASS
4950	Peak	Horz	57.5	33.7	2.9	0.0	35.7	58.4	74.0	15.6	PASS
4950	Avg	Horz	25.4	33.7	2.9	0.0	35.7	26.3	54.0	27.7	PASS
4950	Peak	Vert	50.0	33.7	2.9	0.0	35.7	50.9	74.0	23.1	PASS
7425	Peak	Vert	45.4	37.9	0.0	0.0	35.9	47.4	74.0	26.6	PASS
7425	Peak	Horz	40.2	37.9	0.0	0.0	35.9	42.2	74.0	31.8	PASS

Note: Where the peak limit met the average limit, this was deemed to meet the requirements. The Average emissions at the fundamental and at the harmonics was obtained by applying duty cycle factor of 20 Log (2.5 mS / 100 mS) dB , as per the maximum duty cycle declared by the client.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	4/20/2017	4/20/2019	4092
Horn Antenna	EM-6960	Electro-Metrics	5/3/2017	5/3/2019	4062
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Oct 12, 2016	Oct 12, 2018	GEMC 6351
Horn Antenna 18 – 26.5 GHz	SAS-572	A.H. Systems	Oct 11, 2016	Oct 11, 2018	GEMC 6371
Loop Antenna	EM 6871	Electro-Metrics	Feb 13, 2017	Feb 13, 2019	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	Feb 13, 2017	Feb 13, 2019	GEMC 71
BiLog Antenna	3142-C	ETS	Oct 5, 2016	Oct 5, 2018	GEMC 8
2.4GHz-2.5GHz Notch Filter	BRM50702	Micro-Tronics	July 11, 2016	July 11, 2018	GEMC 230
RF Cable 7m	LMR-400-7M-50Ω-MN-MN	LexTec	Feb 1, 2017	Feb 1, 2018	GEMC 4025
RF Cable 10m	LMR-400-10M-50Ω-MN-MN	LexTec	Feb 1, 2017	Feb 1, 2018	GEMC 4026
RF Cable 0.5m	LMR-400-0.5M-50Ω-MN-MN	LexTec	Feb 1, 2017	Feb 1, 2018	GEMC 4029
Emissions Software	0.1.94	Global EMC	NCR	NCR	GEMC 58

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 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.

Method

The DTS bandwidth method is as per Ansi C63.10 for the 6 dB BW. ANSI C63.10 Section 6.9.1 was used for occupied bandwidth.

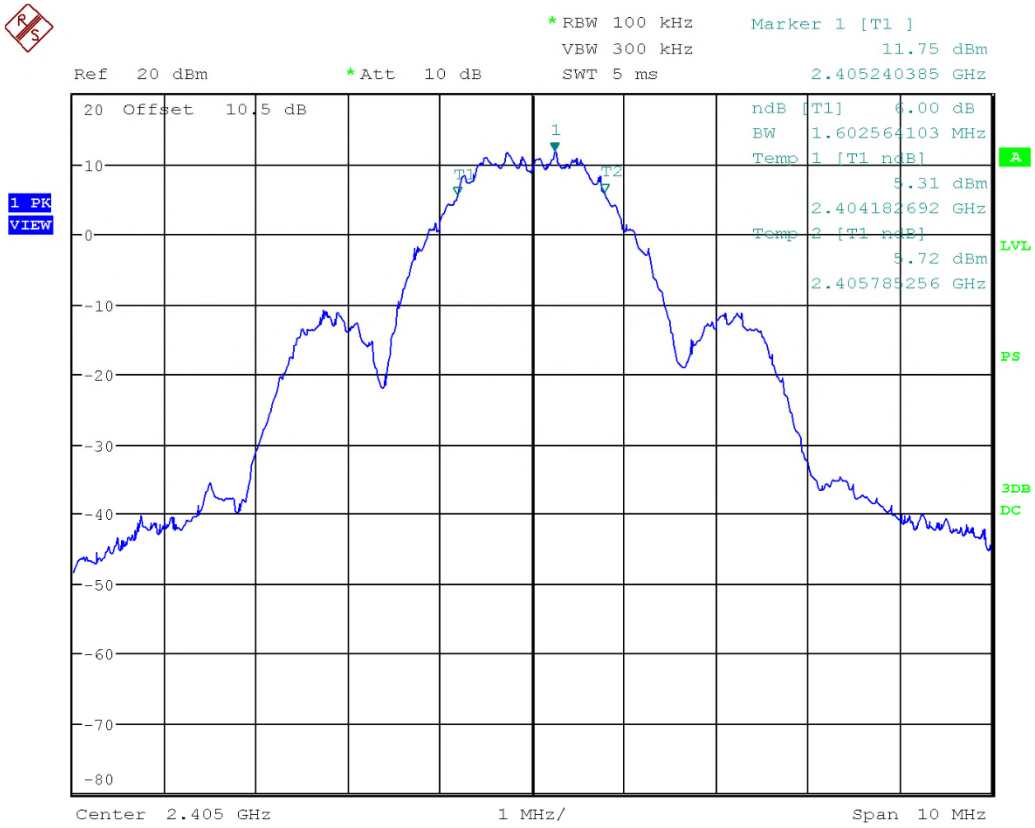
Results

The EUT passed. The minimum 6 dB BW measured was 1.602 MHz. For information purposes, the 99% occupied BW was measured to be 2.612 MHz

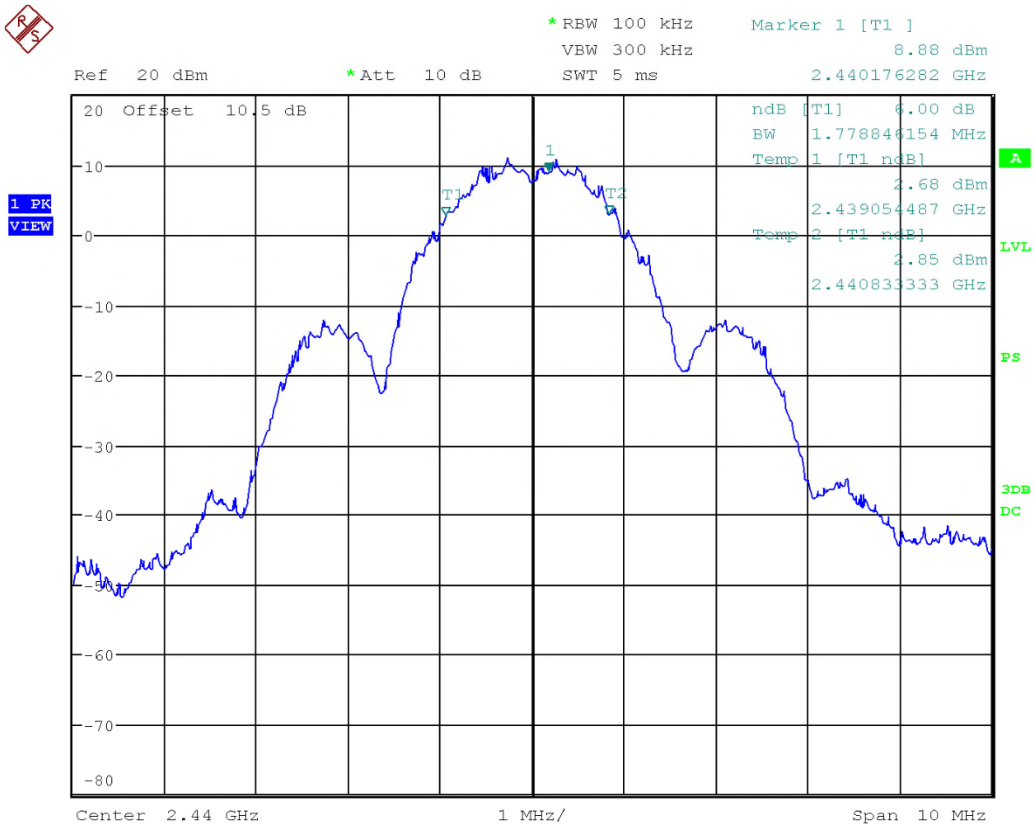
Graph(s)

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

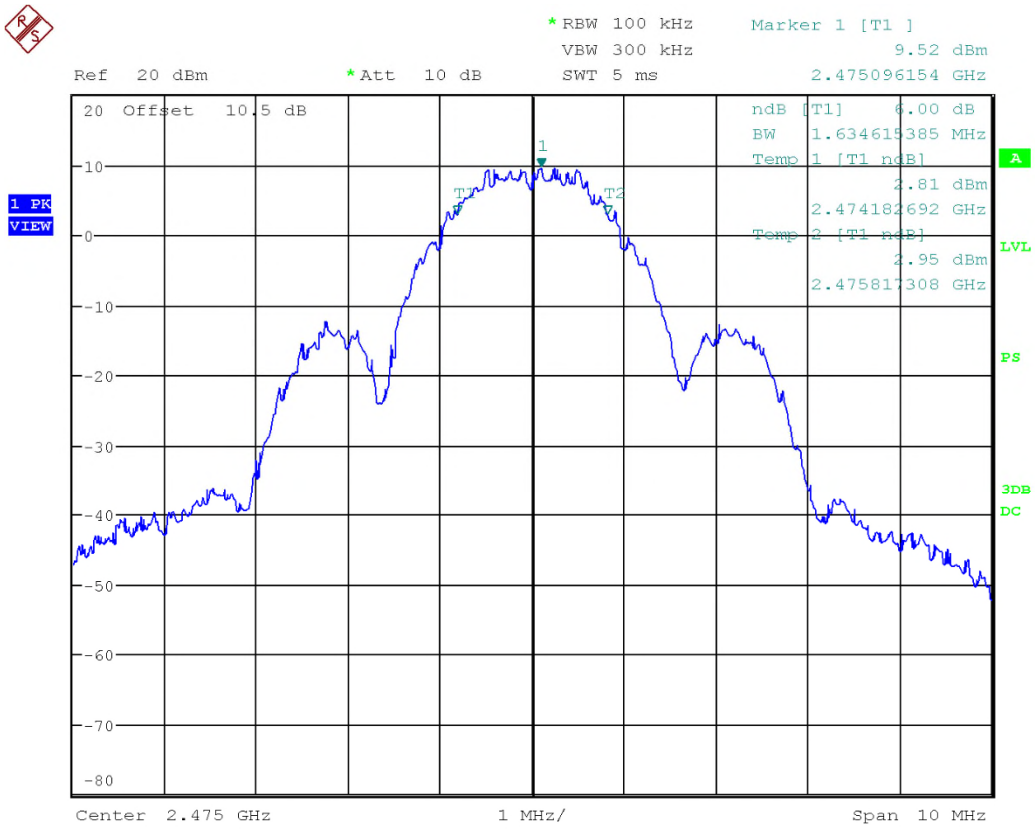
6 dB BW



Date: 21.DEC.2017 20:19:00

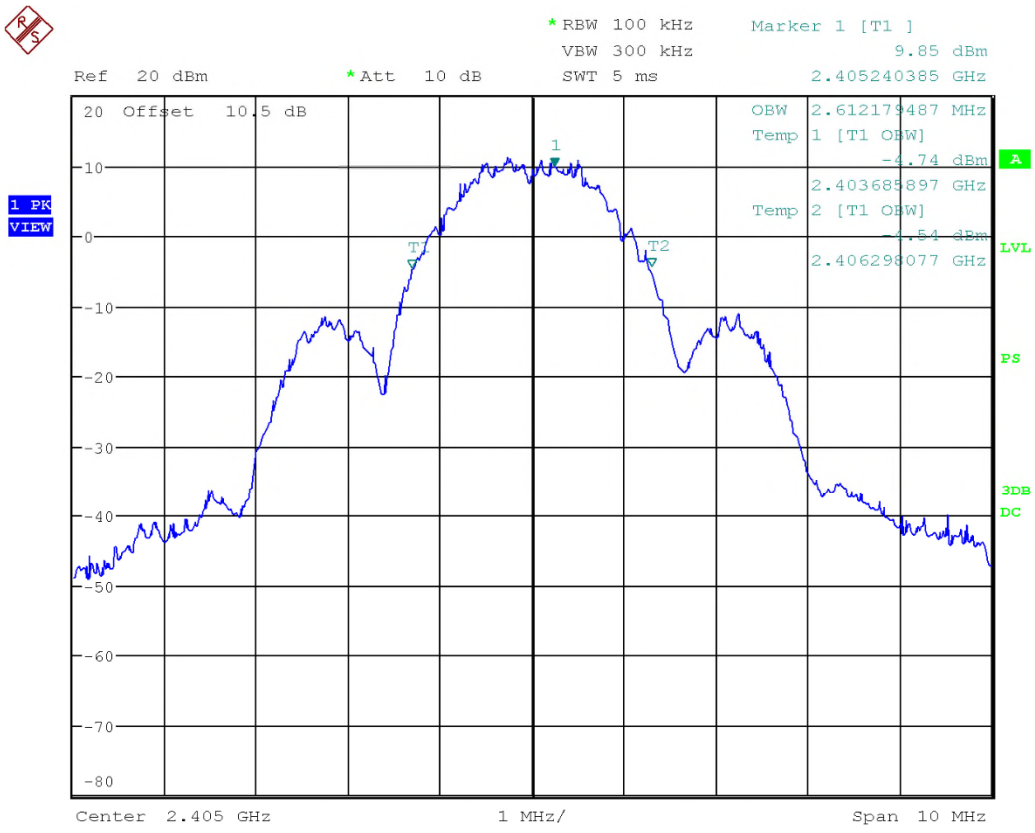


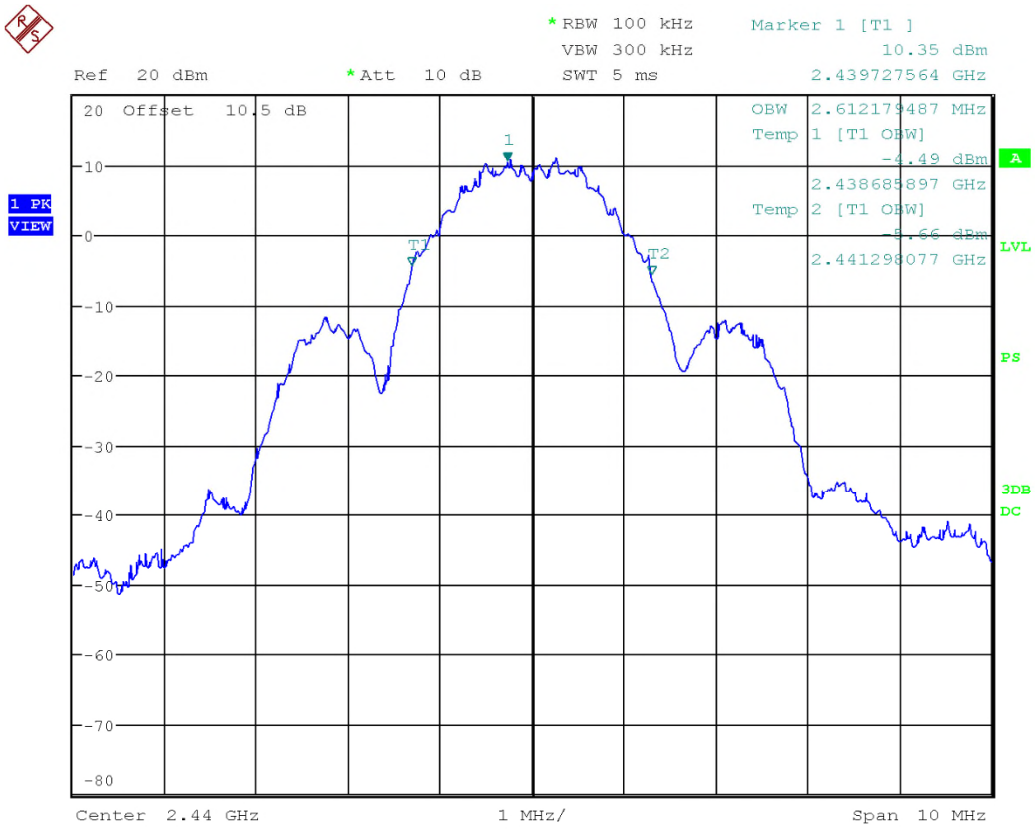
Date: 21.DEC.2017 20:30:08



6 dB BW Low = 1.602 MHz
6 dB BW Mid = 1.779 MHz
6 dB BW High = 1.634MHz

Occupied Bandwidth





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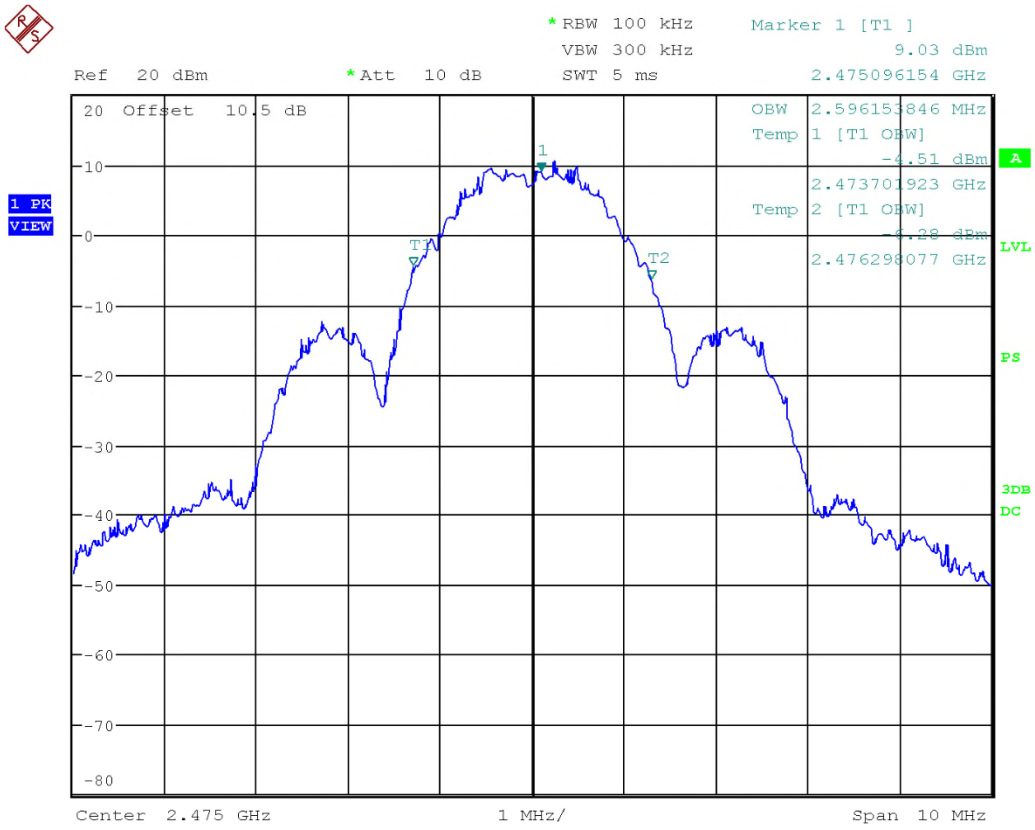

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Occupied BW Low = 2.612 MHz
Occupied BW Mid = 2.612MHz
Occupied BW High = 2.596 MHz

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

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Attenuator 20 dB	FP-50-20	Trilithic	1-28-17	1-28-19	4038
Spectrum Analyzer	ESU 40	Rohde & Schwarz	4/20/2017	4/20/2019	4092

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

Maximum conducted output 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 excessive power level.

Limits

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.

Method

Method was as per ANSI C63.10.

Results

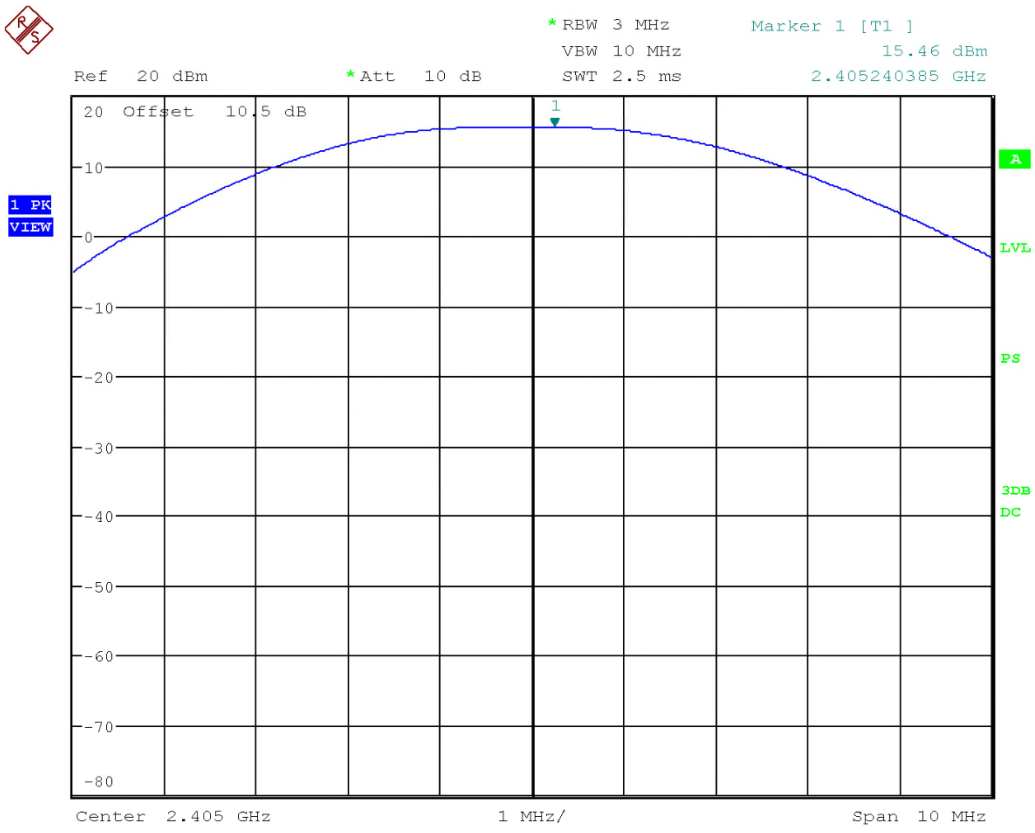
The EUT passed. The maximum conducted (peak) output power measured was dBm (mW).
This value meets the requirement of being less than 30 dBm.

Table(s)

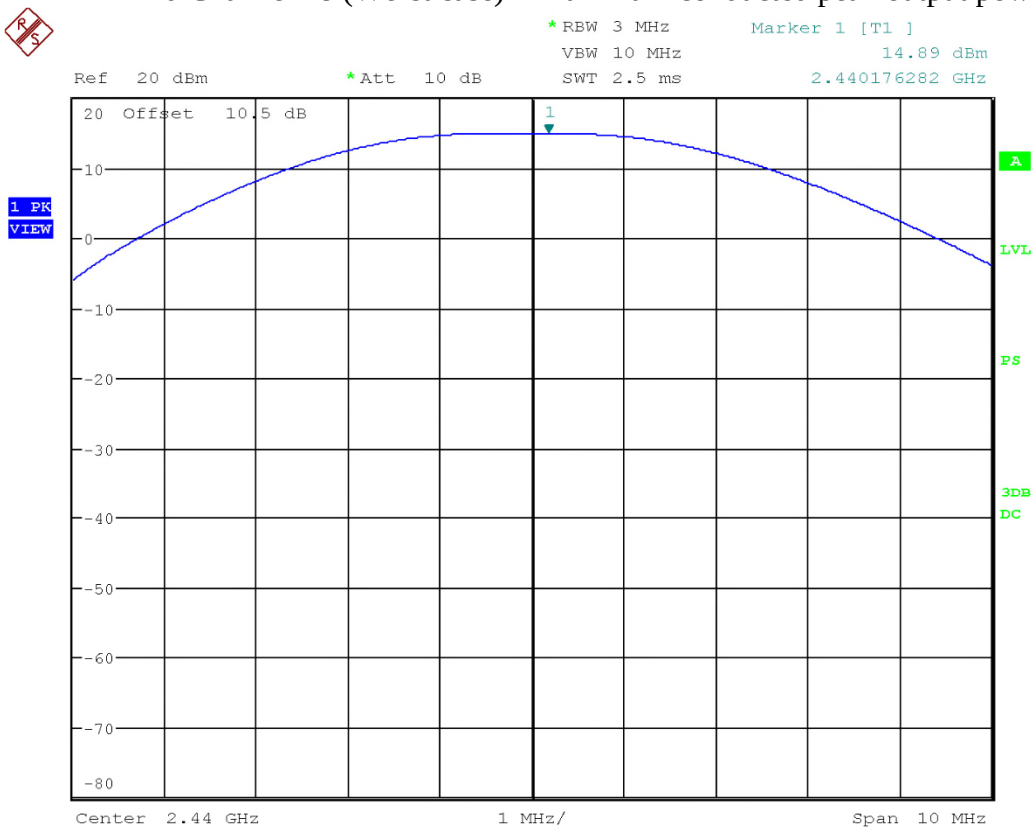
The tables shown below shows the Maximum conducted (peak) output power output of the device during the antenna conducted measurement during transmit operation of the EUT.

Band	Channel	Frequency (GHz)	Raw Peak Reading (dBm)	Atten.+Cable Factor(dB)	Maximum conducted (peak) output power (dBm)
Low	11	2.405	4.96	10.5	15.46
Medium	18	2.440	4.39	10.5	14.89
High	25	2.475	3.91	10.5	14.41

Low Channel



Mid Channel 18 (Worst case) – Maximum conducted peak output power



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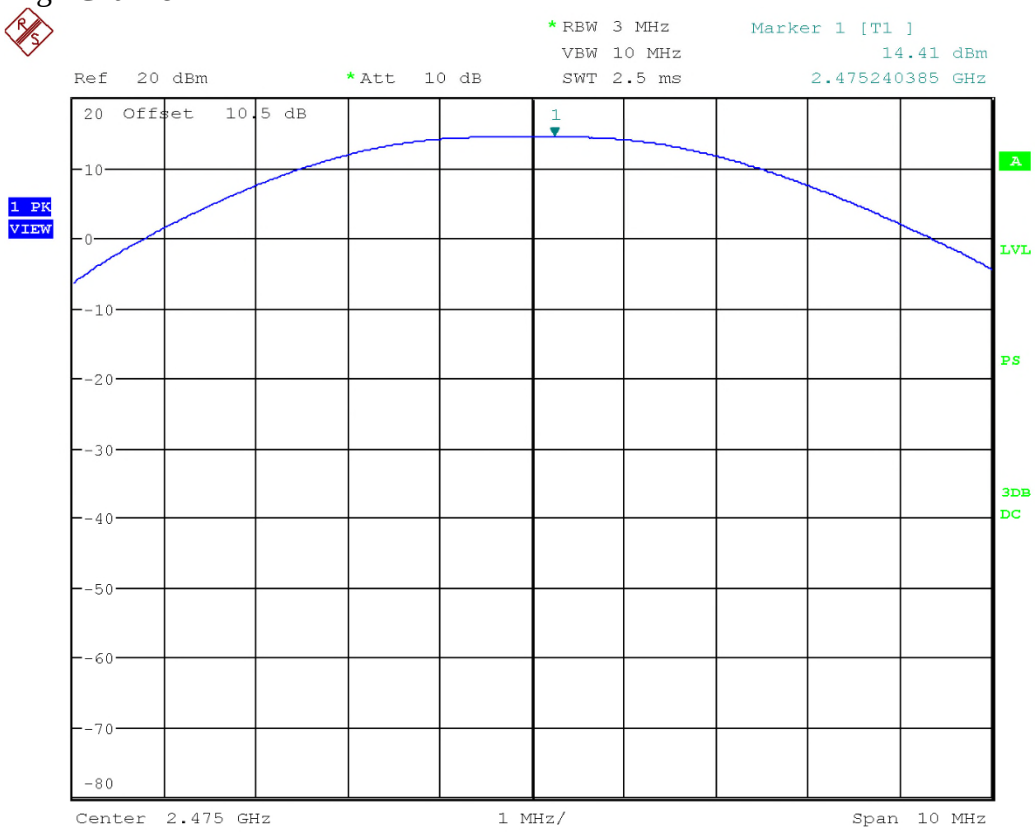
High Channel



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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 date	Next calibration due date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	4/20/2017	4/20/2019	4092
RF Cable 0.5m	LMR-400-0.5M-50OHM-MN-MN	LexTec	1-28-17	1-28-19	4029

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). As peak power was used, 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 10th harmonic. This -20 dBc requirement also applies at the 'band edge' or 2.4 GHz and 2.4835 GHz.

Method

Method was as per Ansi C 63.10.

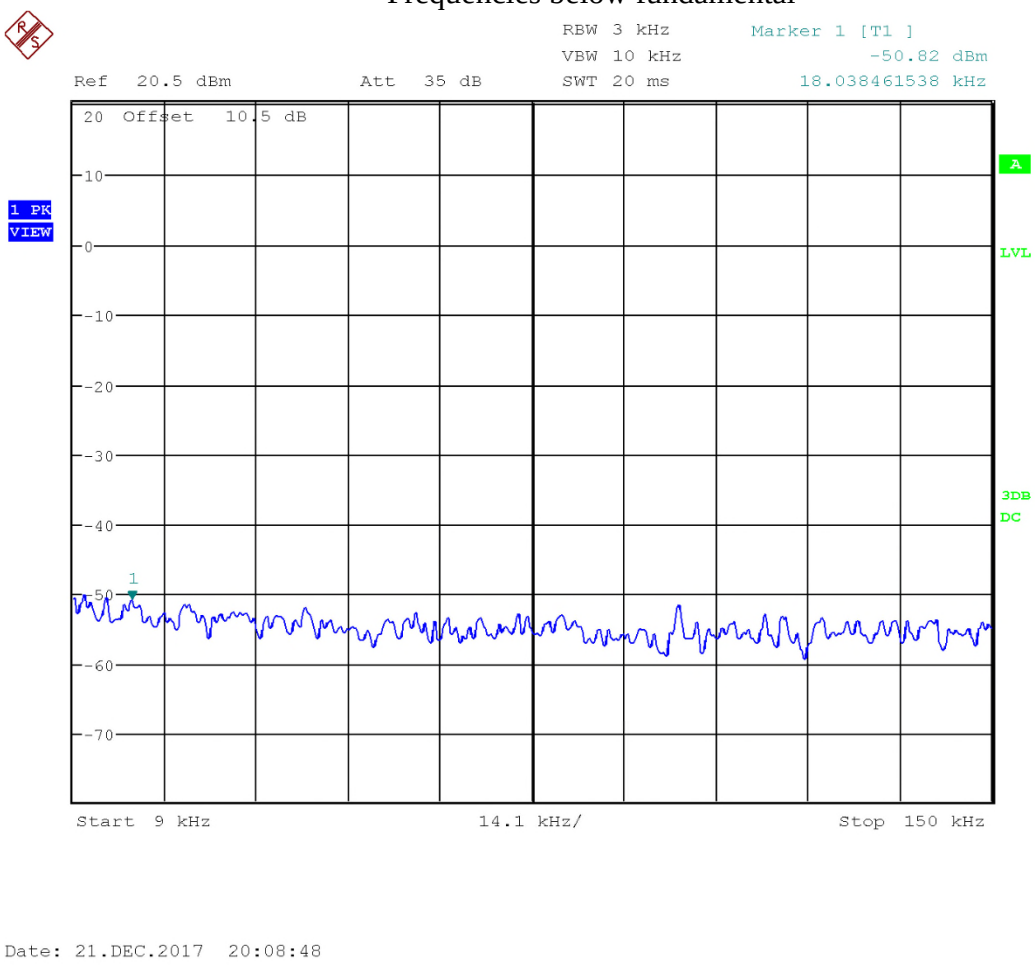
Results

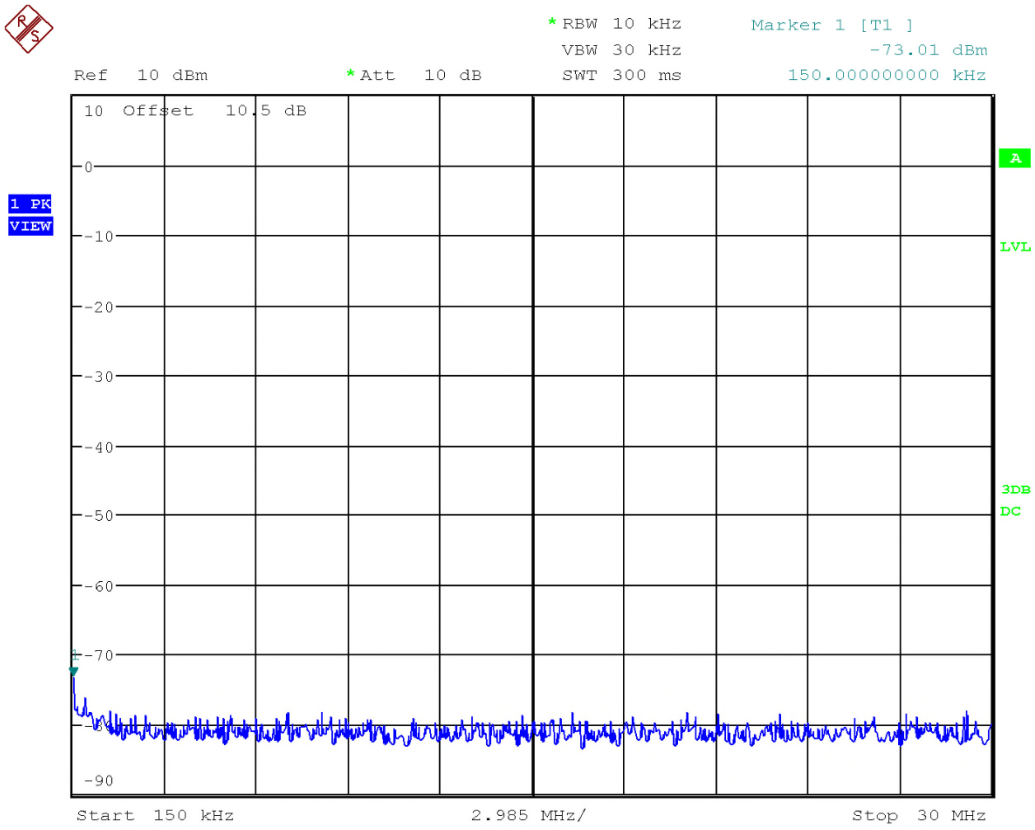
The EUT pass. Low, middle and high band was measured. The worst case for each mode is presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band. The -20 dBc requirement is also shown for the higher band edge at 2.4835 GHz in the high band. Note this device also complies with the -30 dBc requirement as shown in the graphs below.

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





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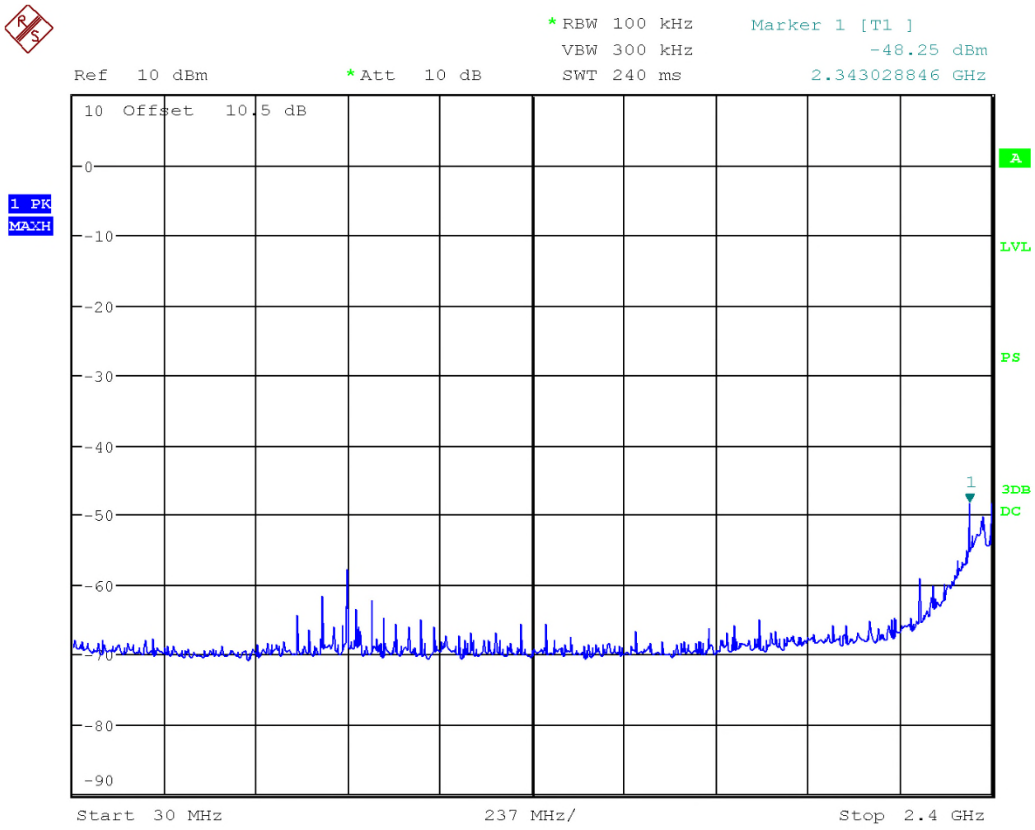

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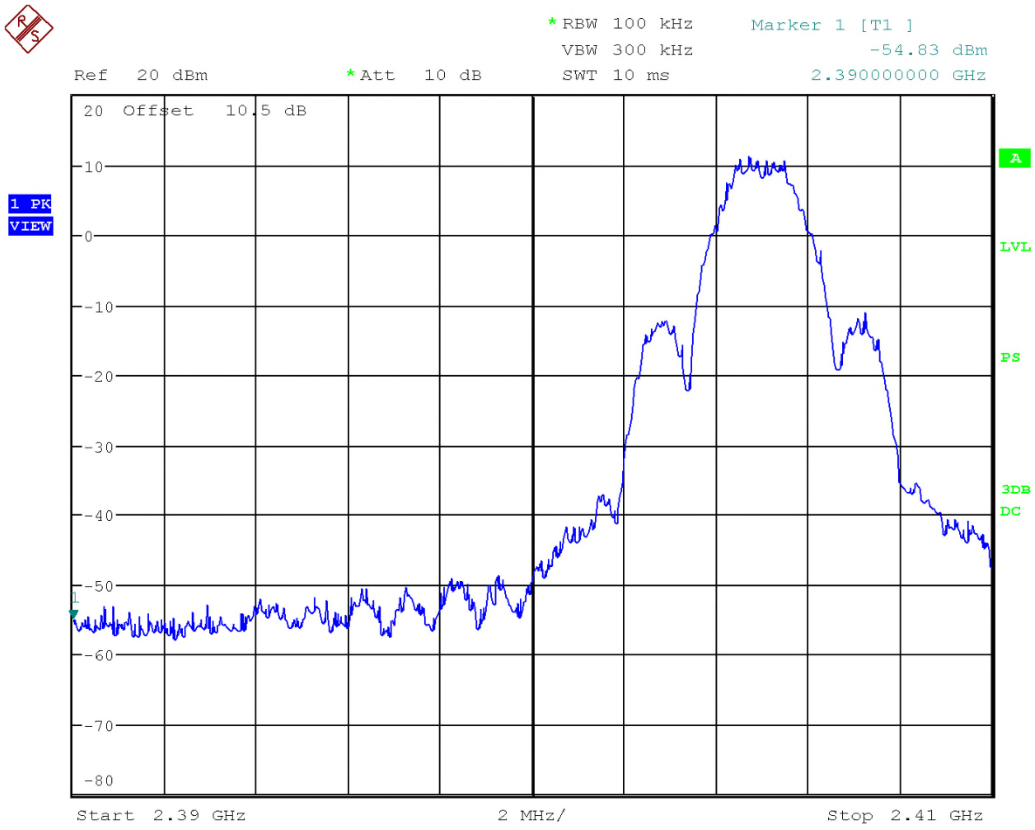
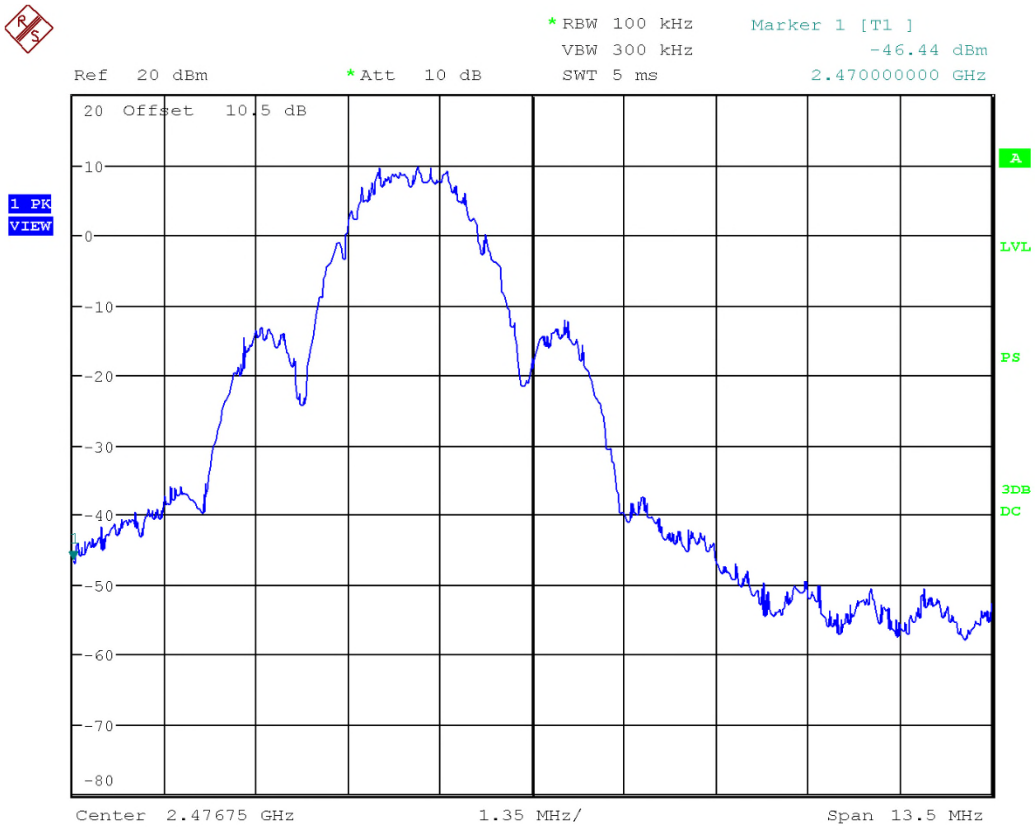
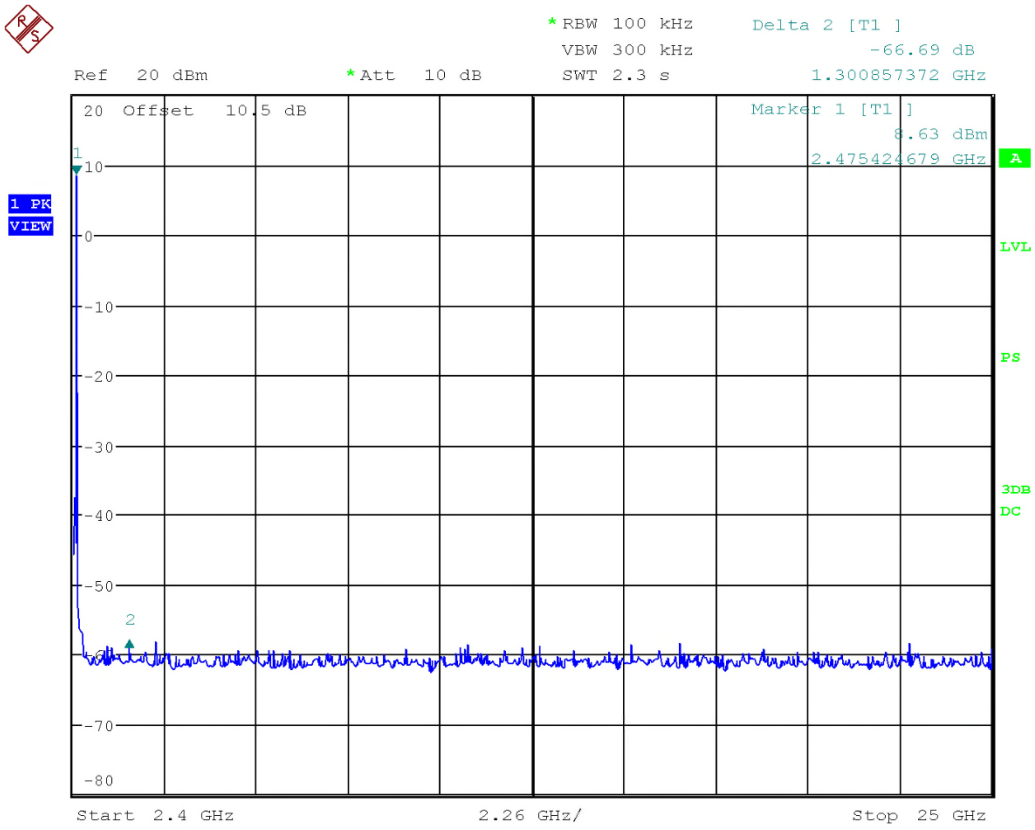


Worst case shown with low channel setting.



Worst case high channel shown above.



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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date[1]	Next Calibration Date[1]	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	4/20/2017	4/20/2019	4092
Attenuator 3 dB	FP-50-3	Trilithic	1-28-17	1-28-19	4028
Emission software	0.1.87	TUV SUD Canada	1-28-17	1-28-19	58

Power Spectral Density - 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

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.

Method

Method was as per ANSI C63.10

Results

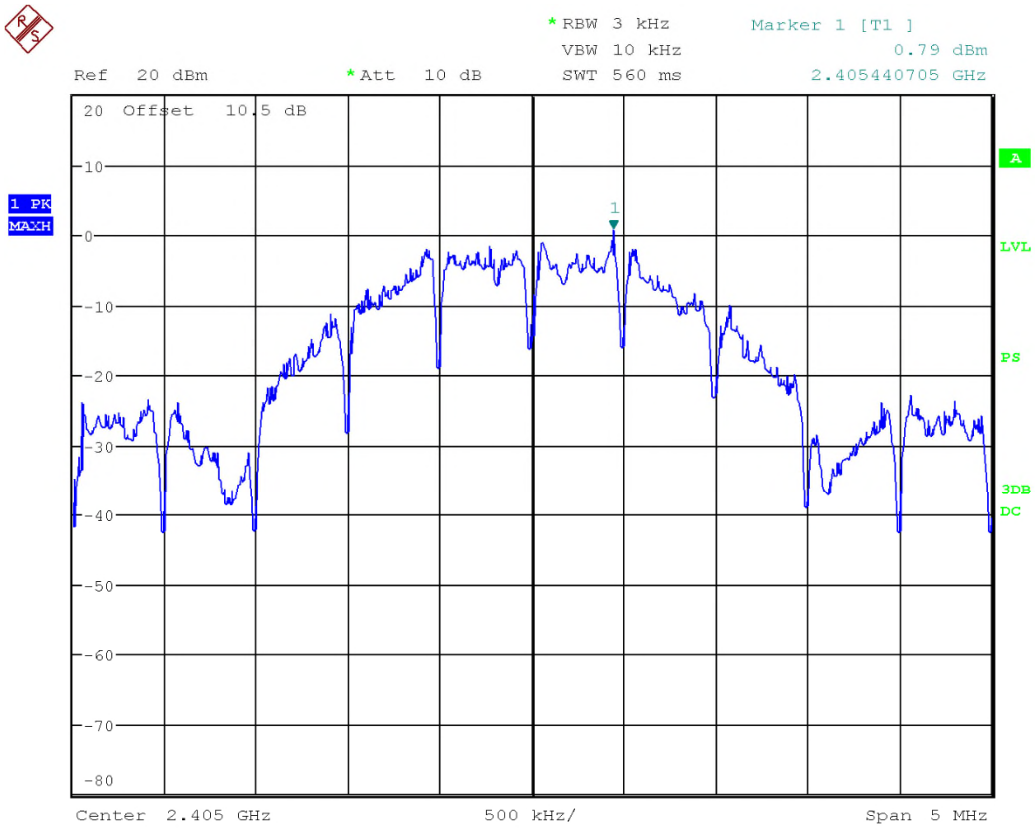
The EUT passed. Each mode was tested at low, medium, and high band. The worst case value is dBm as measured with a 3 kHz resolution bandwidth (maximum peak conducted PSD power).

Band	Channel	Frequency (GHz)	PSD
Low	11	2.405	0.79
Medium	18	2.440	-1.59
High	25	2.475	

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.

Low channel



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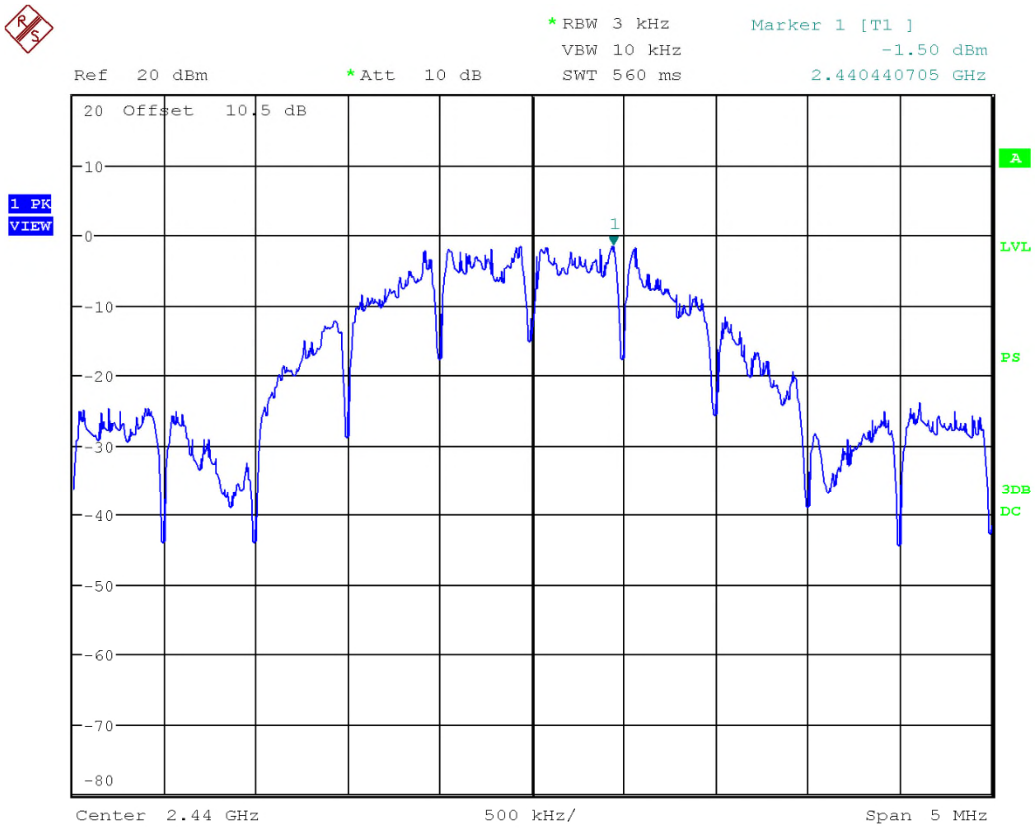

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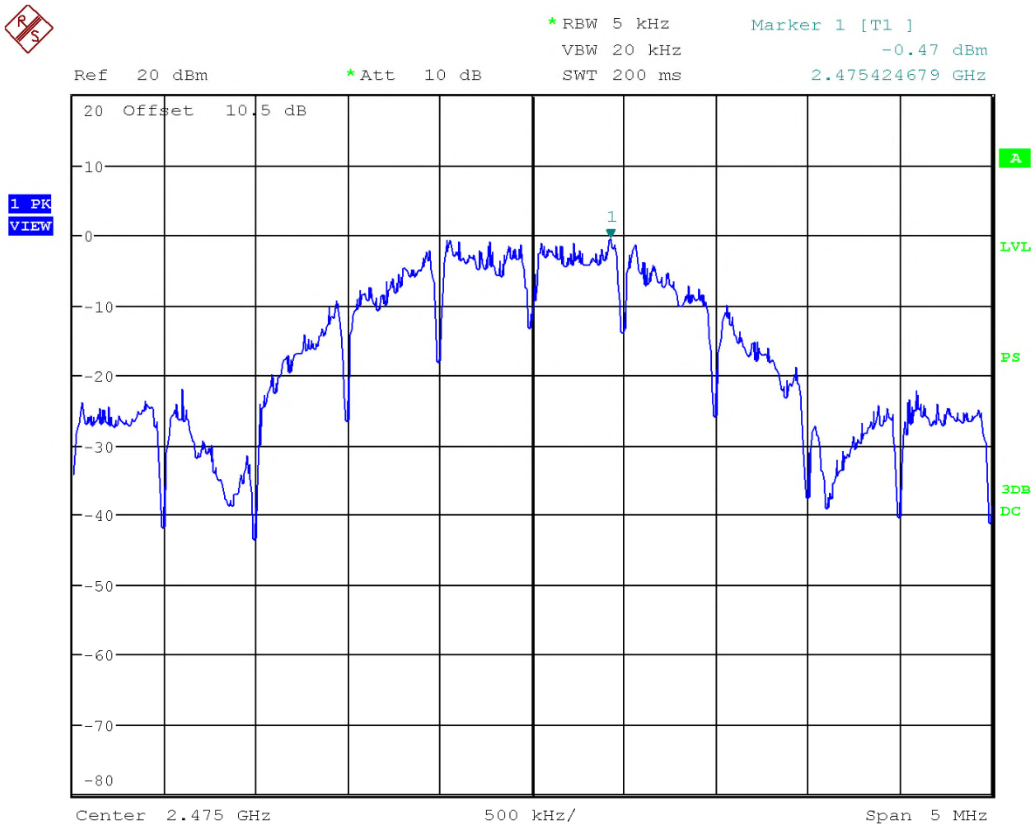

Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	4/20/2017	4/20/2019	4092
Power Attenuator 20 dB	25-A-FFN-20	Bird / Hutton	N/A	N/A	4038

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.

Client	
Organization	Viconics Electronics Inc. 9245 Langelier Blvd. Montreal, Quebec, Canada, H1P 3K9
Contact	Emmanuel Stathopoulos
Phone	514-906-8594
Email	emmanuel.stathopoulos@schneider-electric.com
EUT Details	
EUT Name (for report title)	Gamma V4
FCC ID	V95-VTG
Industry Canada #	7591A-VTG
Equipment category	Wireless Thermostat
HVIN(s)	SER8350A5B00P SER8350A5B11P SE8650U5B00P SE8650U5B11P SE8350U5B00P SE8350U5B11P VTR8350A5500BP VT8350U5500BP VT8650U5500BP
EUT is powered using	DC Battery only
Frequency range(s) (Hz)	DC
Rated input current (A)	< 0.05A
Nominal power consumption (W)	0.3W
Number of power supplies in EUT	1
Transmits RF energy? (describe)	Yes
Basic EUT functionality description	EUT is a wireless device for sending data related to temperature and humidity.

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

Appendix B – EUT and Test Setup Photographs

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

Figure 1 Power line conducted Emissions Setup – Photo 1

Figure 2 Power line conducted Emissions Setup – Photo 1

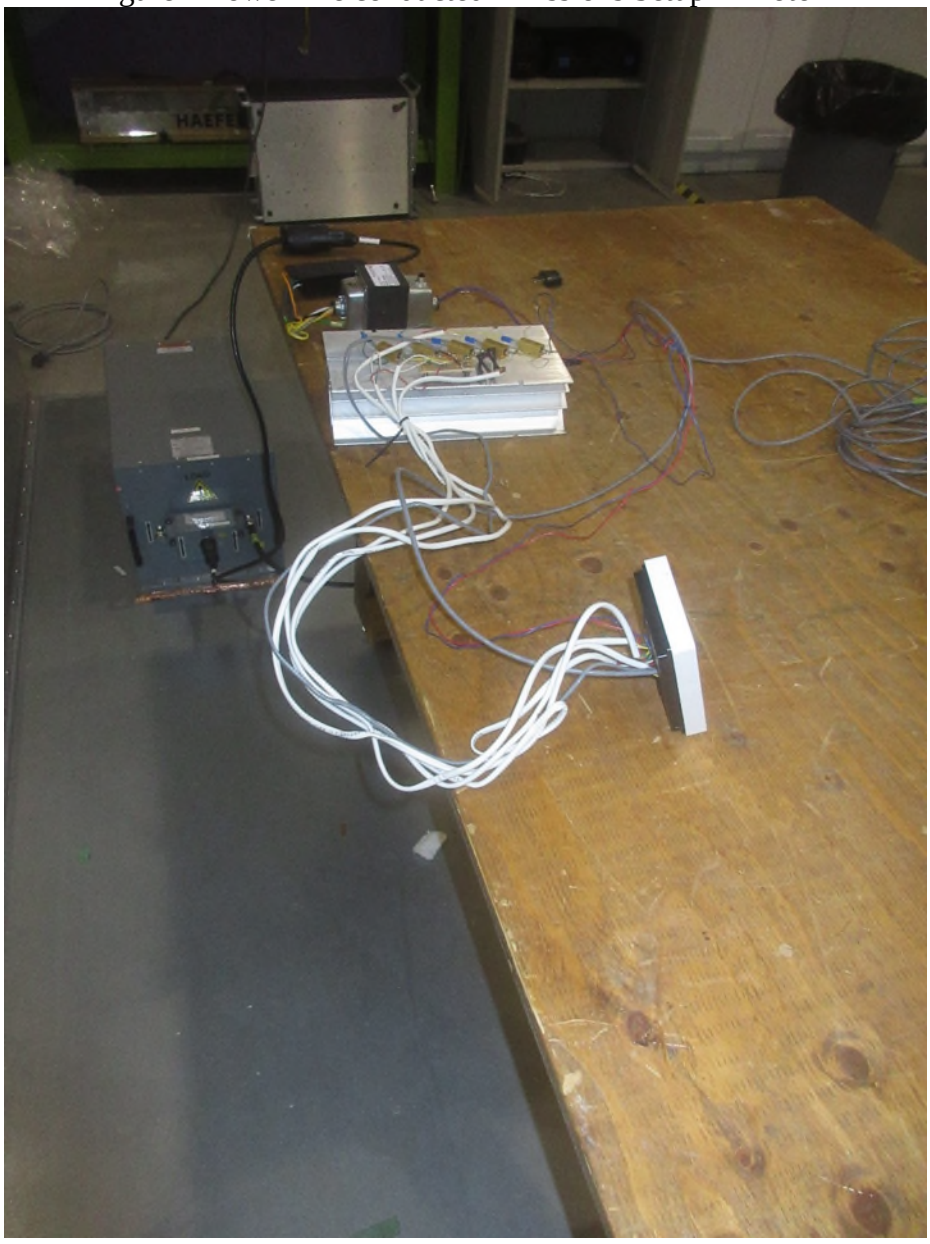

Figure 3 Radiated Emissions Setup – Photo 1

Figure 4 – Radiated Emissions Setup – Photo 2

Note: As per ANSI C63.10 Clause 6.3.1, below 1GHz, the height of the EUT was set to 80cm.

Figure 5 – Radiated Emissions Setup – Photo 3

Note: As per ANSI C63.10 Clause 6.3.1, above 1GHz, the height of the EUT was set to 1.5m.

Figure 6 – Antenna Conducted Emissions Setup