EMC & RF Test Report

As per

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

Unlicensed Intentional Radiators

on the

SKIIN Underwear

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Testing produced for

MYANT

See Appendix A for full client & EUT details.

Innovation, Science and Economic Development Canada
Registration # 6844A-3

Testing Laboratory Certificate #2955.02

R-14023, G-20072
C-14498, T-20060

Registration # CA6844

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Report Scope

This report addresses the EMC verification testing and test results of the **Skiin Underwear** Model: **1011-001-001v8** 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

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.

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Summary

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

EUT:	SKIIN Underwear
FCC Certification #, FCC ID:	2AXVL-UW01
Industry Canada Certification #, IC:	26604-UW01
EUT passed all tests performed	Yes
Tests conducted by	Amir Emami
Report reviewed by	Min Xie

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

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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(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	Antenna Conducted 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 ‘*’.

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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 5.4(d)), the unit uses a ceramic chip antenna (2 dBi peak gain - Taiyo Yuden, Model AH168M245001-T) which is less than the 6 dBi maximum 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.

The EUT was mounted in three orthogonal axes to determine the worst-case radiated emissions. The worst-case results were obtained with the EUT mounted in the Z-axis orientation. Worst case results are presented. See Appendix B for axis details.

The EUT runs on a rechargeable battery and has a USB dock for charging. While charging, under normal operation, the transmitter does not stream any raw data, but it is still able to communicate to the phone or hub. Transmitter peak radiated power and harmonics have also been verified while the EUT was in the dock, charging, and transmitting and results were the same as the EUT running on battery. Worst-case case results with the EUT running on battery are presented. All tests were performed with the battery fully charged.

The SKIIN Underwear is available in two versions. Model: 1011-001-001v8 and 1011-001-001v9. The difference between these two versions is the placement of one passive heat flux sensor on the bottom side of the PCBA. This heat flux sensor is a passive component that generates a voltage based on the heat flux coming in or out of the Pod. The addition or lack of this sensor should have no impact on the RF performance of the Pod. The model tested throughout this report is the 1011-001-001v8 which contains this heat flux sensor.

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Sample Calculation(s)

Radiated Emission Test

E-Field Level = Received Signal + Antenna Factor + Cable Loss – Pre-Amp Gain
E-Field Level = 50dBµV + 10dB/m + 2dB – 20dB
E-Field Level = 42dBµV/m

Margin = Limit – E-Field Level
Margin = 50dBµV/m – 42dBµV/m
Margin = 8.0 dB (pass)

Power Line Conducted Emission Test

E-Field Level = Received Signal + Attenuation Factor + Cable Loss + LISN Factor
E-Field Level = 50dBµV + 10dB + 2.5dB + 0.5dB
E-Field Level = 63dBµV

Margin = Limit – E-Field Level
Margin = 73dBµV – 63dBµV
Margin = 10.0 dB (pass)

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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	Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators
CISPR 32:2012	Electromagnetic Compatibility of Multimedia Equipment – Emission Requirements
FCC KDB 558074: 2019	FCC KDB 558074 Digital Transmission Systems, measurements and procedures
FCC KDB 447498: 2015	RF exposure procedures and equipment authorization policies for mobile and portable devices
ICES-003 Issue 6 2019	Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
RSS-GEN Issue 5 2019	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 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories

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Document Revision Status

Revision	Date	Description	Initials
000	December 2, 2020	Initial Release	AE
-	-	-	-

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Definitions and Acronyms

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

DTS – Digital Transmission System
LISN – Line Impedance Stabilization Network
NCR – No Calibration Required
NSA – Normalized Site Attenuation
N/A – Not Applicable
RF – Radio Frequency

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

Antenna Port – Port, other than a broadcast receiver tuner port, for connection of an antenna used for intentional transmission and/or reception of radiated RF energy.

BW – Bandwidth. Unless otherwise stated, this 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. Has a primary function of entry, storage, display, retrieval, transmission, processing, switching, or control of data and/or telecommunication messages and which may be equipped with one or more ports typically for information transfer.

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Testing Facility

Testing for EMC on the EUT was carried out at TÜV SÜD Canada testing lab near Toronto, Ontario. The testing lab has calibrated 3m semi-anechoic chambers which allow measurements on a EUT that has a maximum width or length of up to 2m and a height of up to 3m. The testing lab also has a calibrated 10m Open Area Test Site (OATS). The chambers are equipped with a turntable that is capable of testing devices up to 5000lb in weight and are 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. This facility is capable of testing products that are rated for single phase or 3-phase AC input and DC capability is also available. 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), Innovation, Science and Economic Development Canada (ISED, 6844A-3) and Voluntary Control Council for Interference (VCCI, R-14023, G-20072, C-14498, and T-20060). 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 #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 biennial basis as listed for each respective test.

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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)
October 2 & 5, 2020	Radiated Emissions	AE	22 – 24	39 – 43	101 – 102
October 9, 2020	Antenna Conducted Emissions	AE	22.1	43.6	101.3
October 13, 2020	Power Line Conducted Emissions	AE	22.1	43.6	101.3

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Detailed Test Results Section

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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 and Method

The limit is as specified in FCC Part 15.247(a)2 and RSS-247 5.2(a).

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 FCC KDB 558074 Section 8.1 and ANSI C63.10.

Results

The EUT passed.
The minimum 6 dB Bandwidth measured was 721 kHz
The maximum 99% Occupied Bandwidth was 1060 kHz.

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	0.726	1.06
Mid	2442	0.721	1.05
High	2480	0.726	1.06

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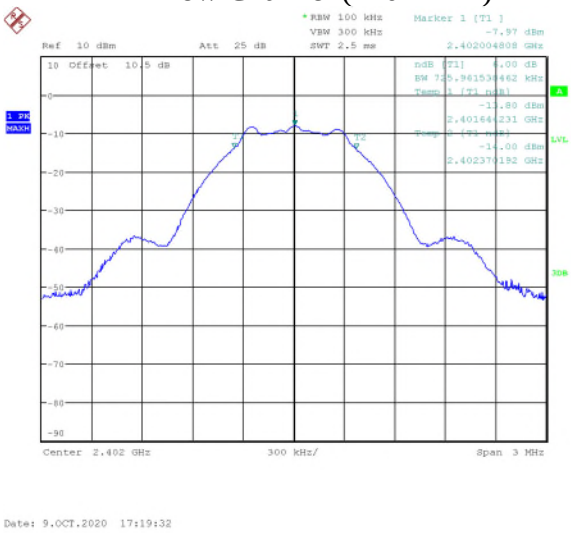
Graphs

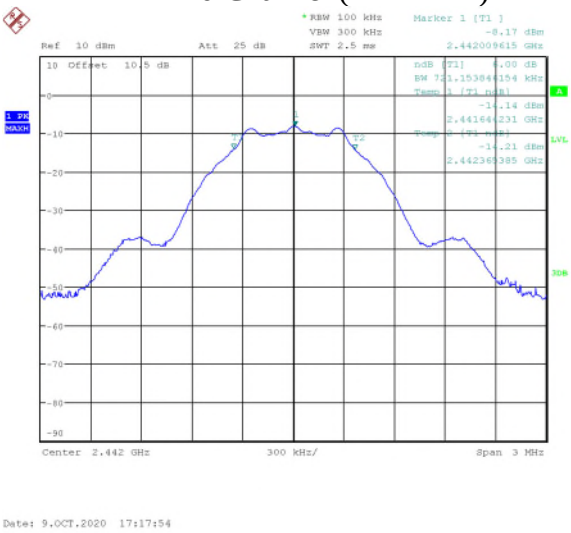
The graphs shown below show the OBW of the device during the conducted measurement operation of the EUT. This is measured by a max hold on the spectrum analyzer.

6dB Bandwidth

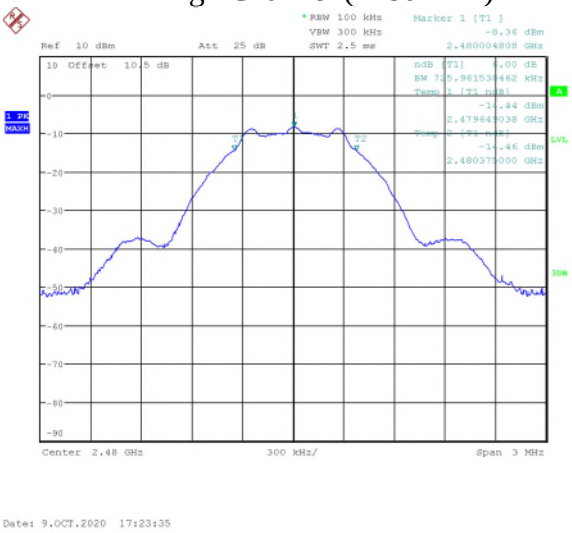
Low Channel (2402MHz)



Mid Channel (2442MHz)



High Channel (2480MHz)



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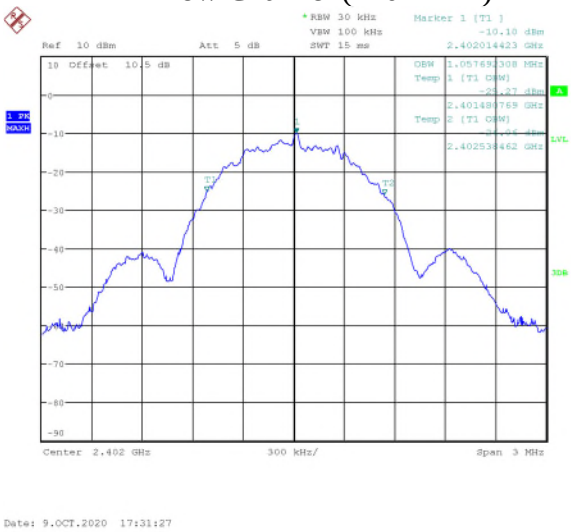
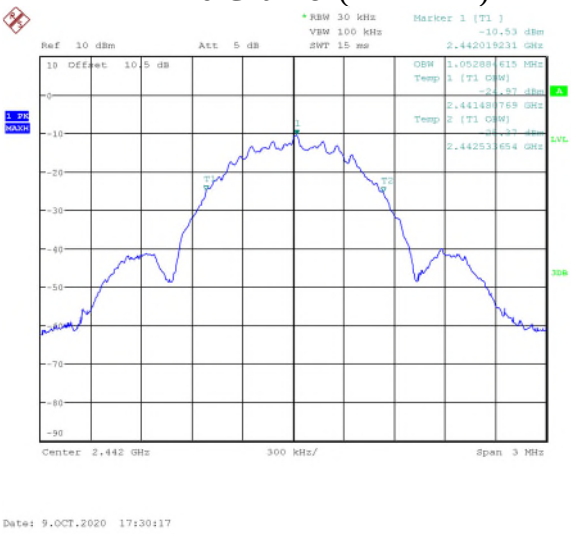
99% Bandwidth

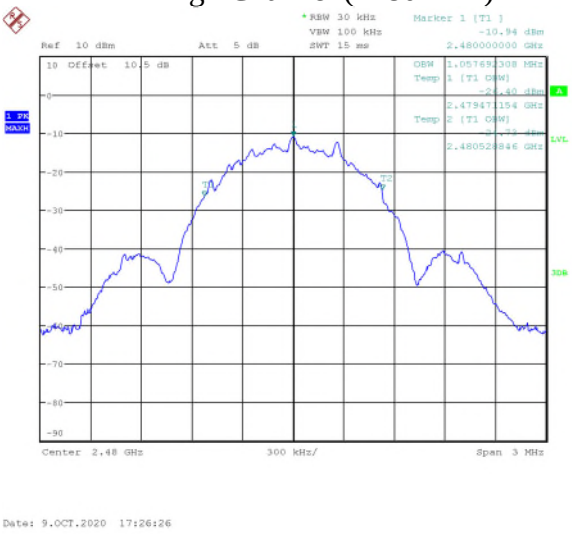
Low Channel (2402MHz)



Mid Channel (2442MHz)



High Channel (2480MHz)



Note: See ‘Appendix B – EUT & Test Setup Photos’ for photos showing the test set-up.

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Signal Analyzer	FSQ 26	Rohde & Schwarz	Oct. 25, 2019	Oct. 25, 2021	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

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Maximum Peak Envelope Conducted Power

Purpose

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

Limits and Method

The limits are defined in FCC Part 15.247(b) and RSS-247 5.4(d).
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 (30 dBm).

The method is given in FCC KDB 558074 Section 9.1.2 and ANSI C63.10.

Results

The EUT passed.

Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power (mW)
Low	2402	-7.30	0.19
Mid	2442	-7.51	0.18
High	2480	-7.68	0.17

Note: The external attenuator and cable loss are accounted for as reference offset in the spectrum analyzer

Graphs

The graphs shown below show the peak power output of the device during the conducted measurement operation of the EUT. The measurement RBW is ≥ than the DTS bandwidth.

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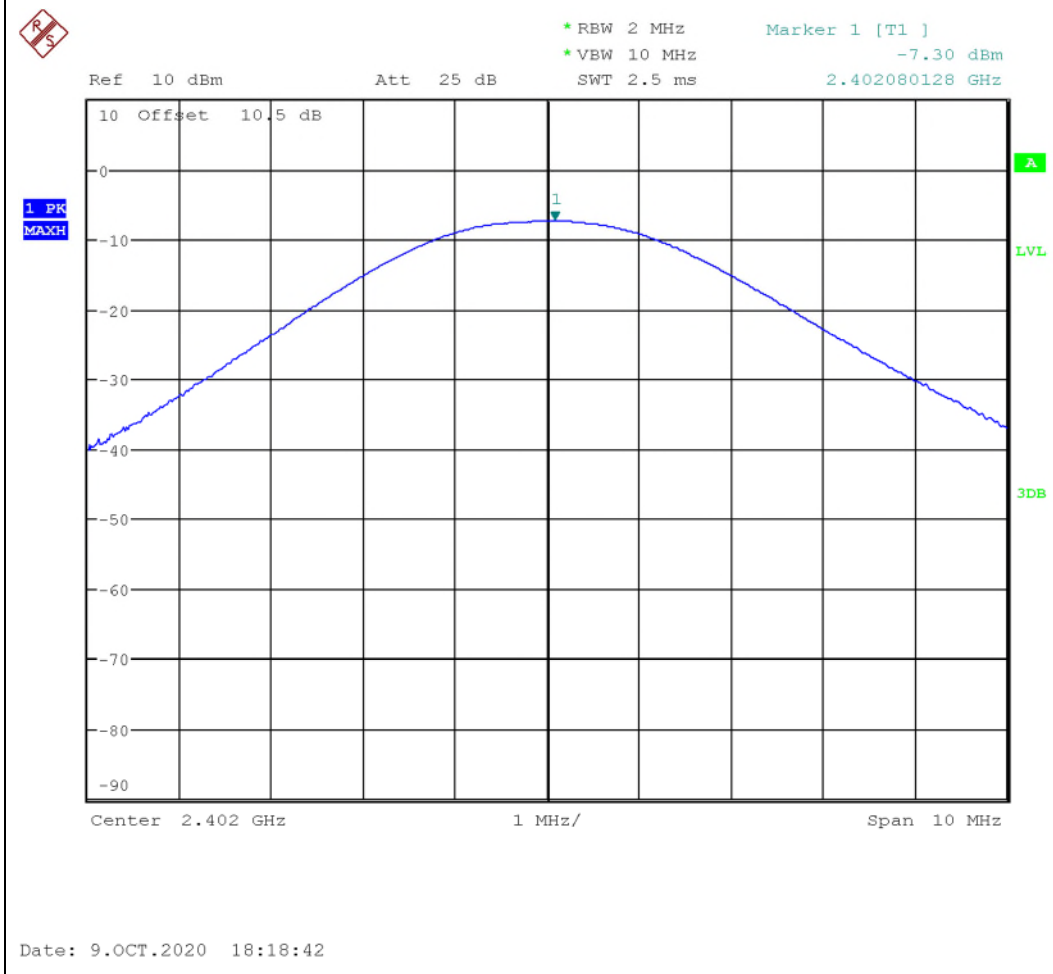
Peak Power

Low Channel



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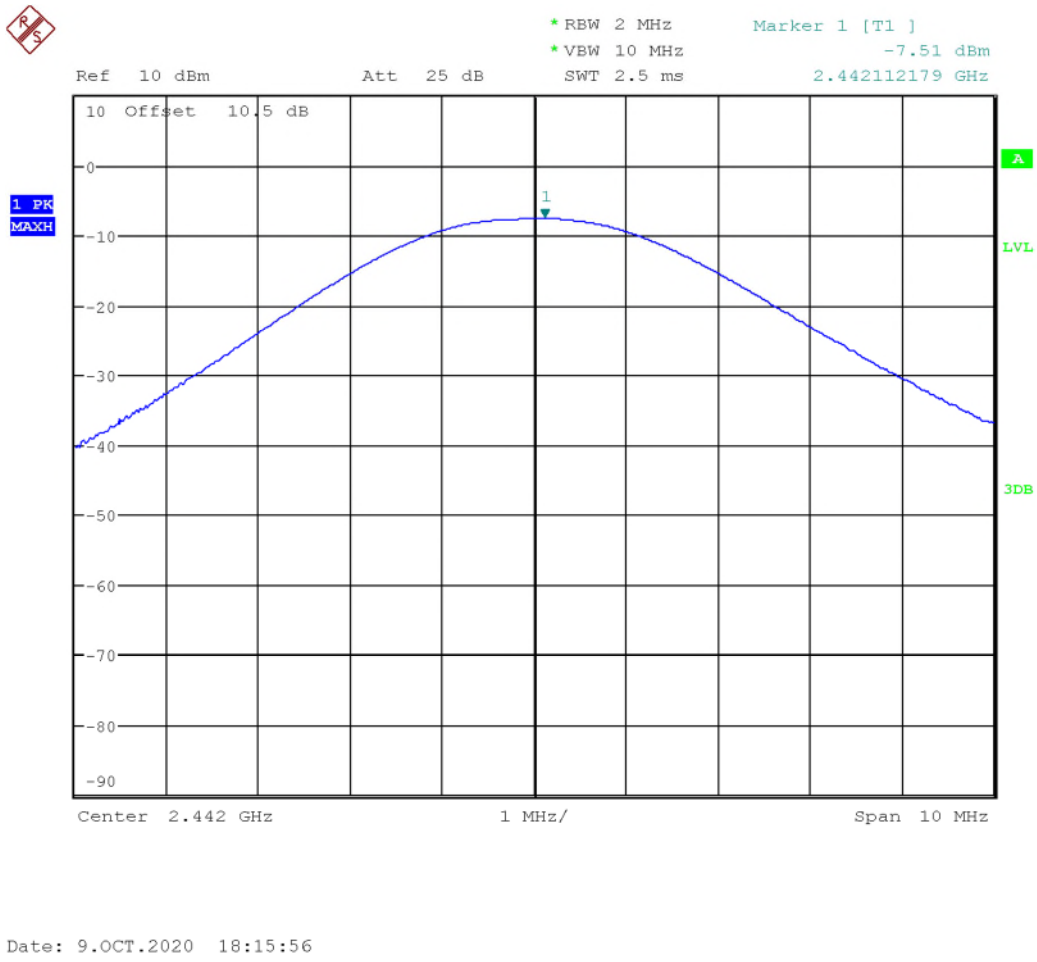
Peak Power
Mid Channel



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Peak Power
High Channel

See 'Appendix B – EUT and Test Setup Photos' for photos showing the test set-up.

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Signal Analyzer	FSQ 26	Rohde & Schwarz	Oct. 25, 2019	Oct. 25, 2021	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

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Antenna Spurious Conducted Emissions (-20 dBc Requirement)

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 Method

The limits are defined in 15.247(d) and RSS-247 5.5. 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.

The method is given in FCC KDB 558074 Section 11 and ANSI C63.10

Results

The EUT passed. Low, middle and high bands were measured. The worst case 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 and also for the higher band edge at 2.4835 GHz in the high band.

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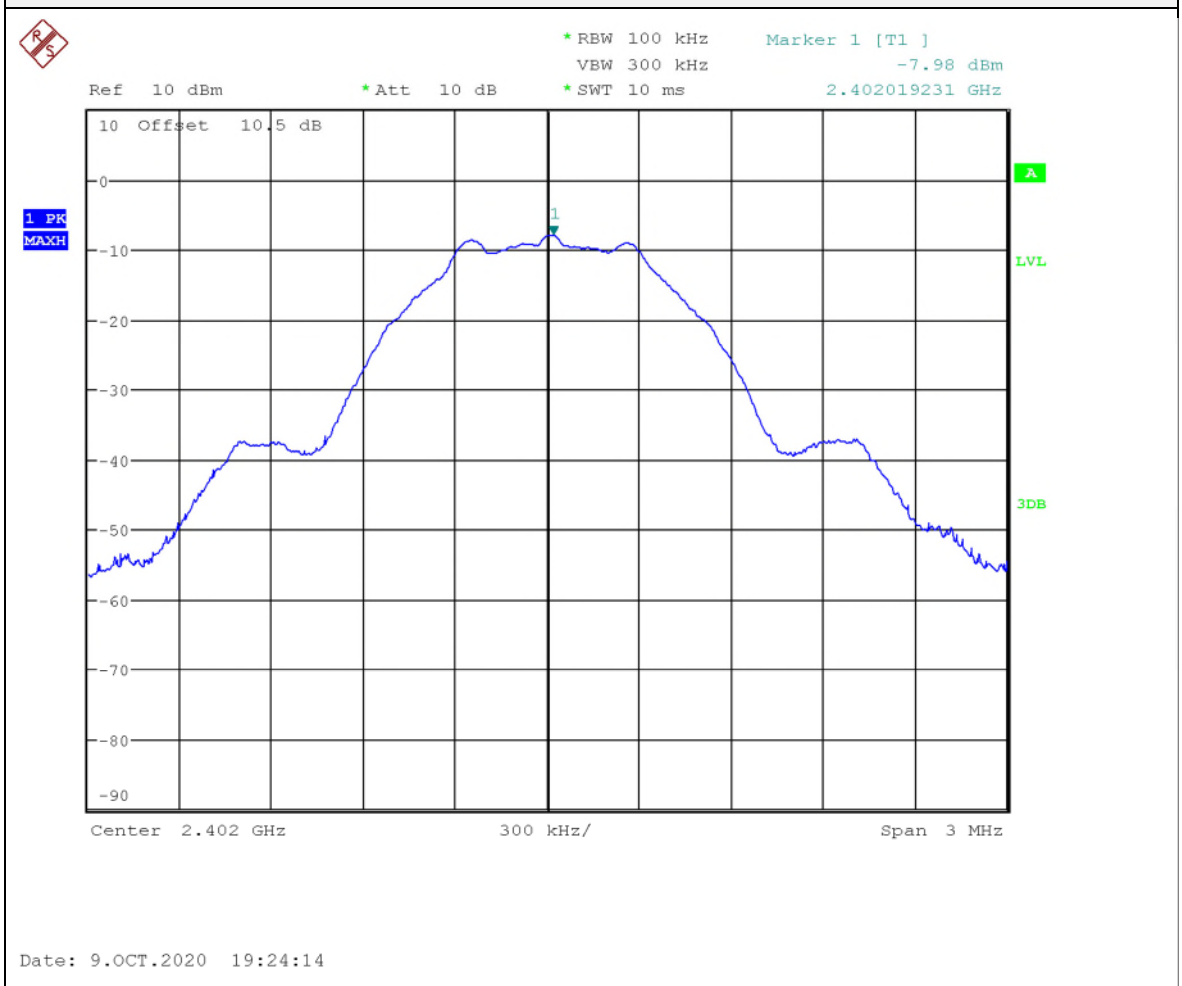
Graphs

The graphs shown below show the power output of the device during the conducted measurement operation of the EUT.

-20dBc

Reference Level: -7.97 dBm



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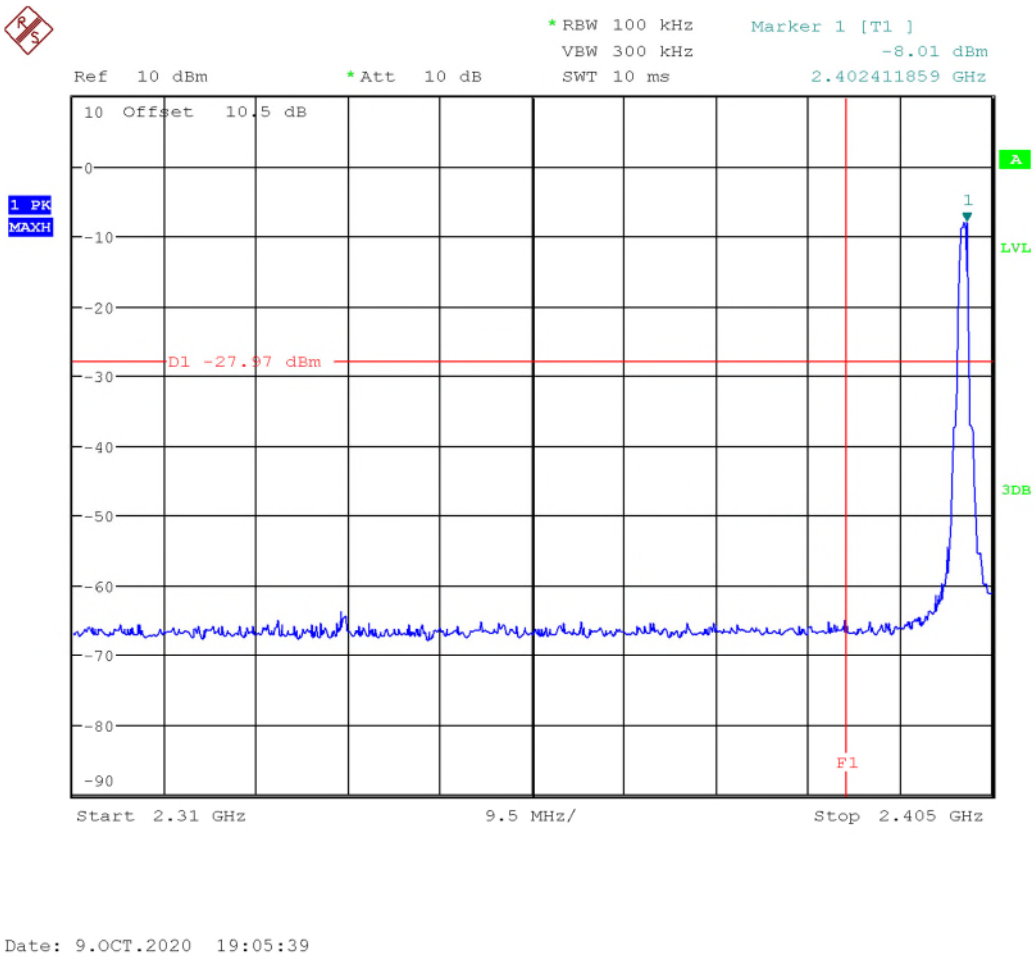
-20dBc

2400 MHz Band Edge



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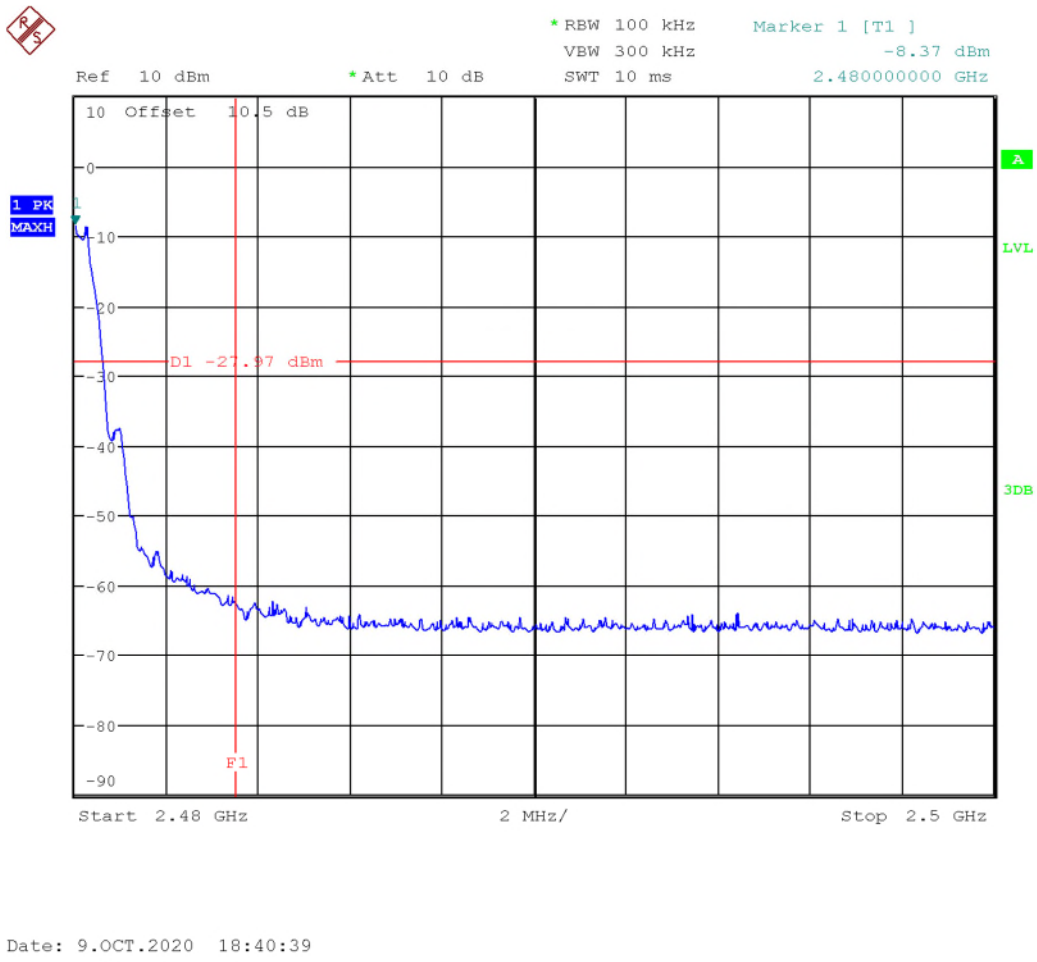
-20dBc

2483.5 MHz Band Edge



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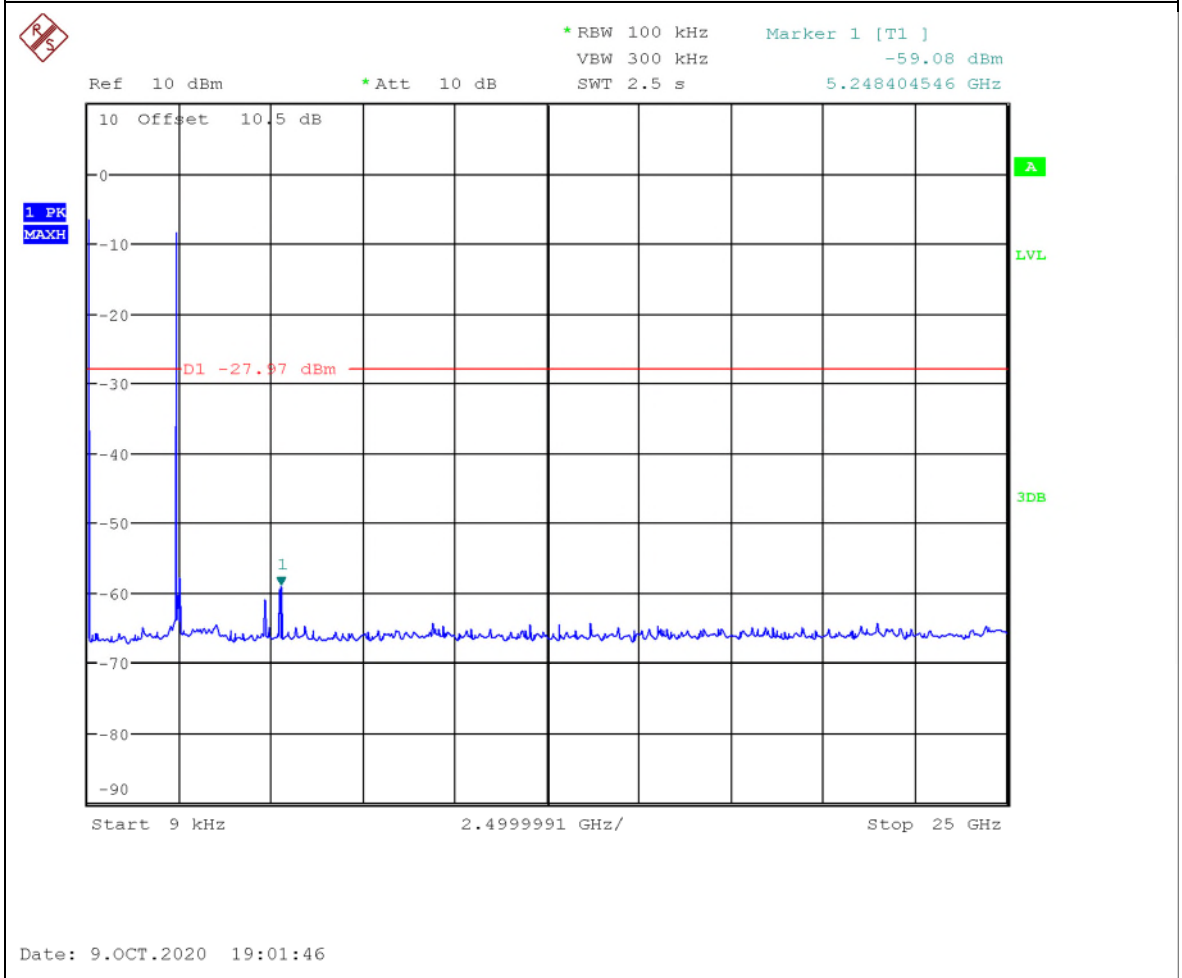
-20dBc

9kHz – 25GHz



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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Signal Analyzer	FSQ 26	Rohde & Schwarz	Oct. 25, 2019	Oct. 25, 2021	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

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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 FCC KDB 558074 Section 12.2 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	Field Strength Limit (µV/m)	Field Strength at 3m (dBµV/m)
0.009 MHz – 0.490 MHz	2400/F(kHz) [a] (at 300m)	128.5 to 93.8[a]
0.490 MHz – 1.705 MHz	24000/F(kHz)[a] (at 30m)	73.8 to 63.0[a]
1.705 MHz – 30 MHz	30[a] (at 30m)	69.5[a]
30 MHz – 88 MHz	100[a] (at 3m)	40.0[a]
88 MHz – 216 MHz	150[a] (at 3m)	43.5[a]
216 MHz – 960 MHz	200[a] (at 3m)	46.0[a]
Above 960 MHz	500[a] (at 3m)	54.0[a]
Above 1000 MHz	500[b] (at 3m)	54.0[b]
Above 1000 MHz	5 mV/m[c] (at 3m)	74.0[c]

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

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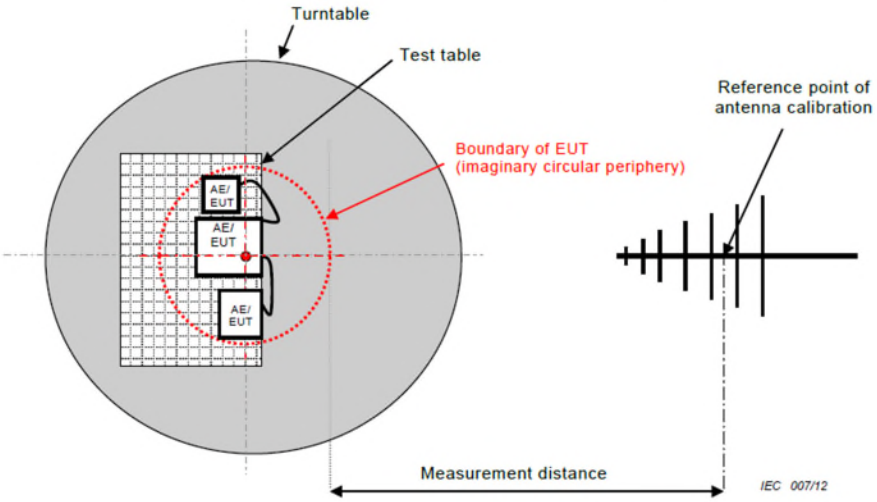
Typical Radiated Emissions Setup



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±5.67dB for 30MHz – 1GHz and ±4.58dB 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 10th 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.

Peak output power for low, middle and high channels and each in three orthogonal axes were checked. The worst case was used for the spurious emissions which was on the high channel and in the Z-axis.

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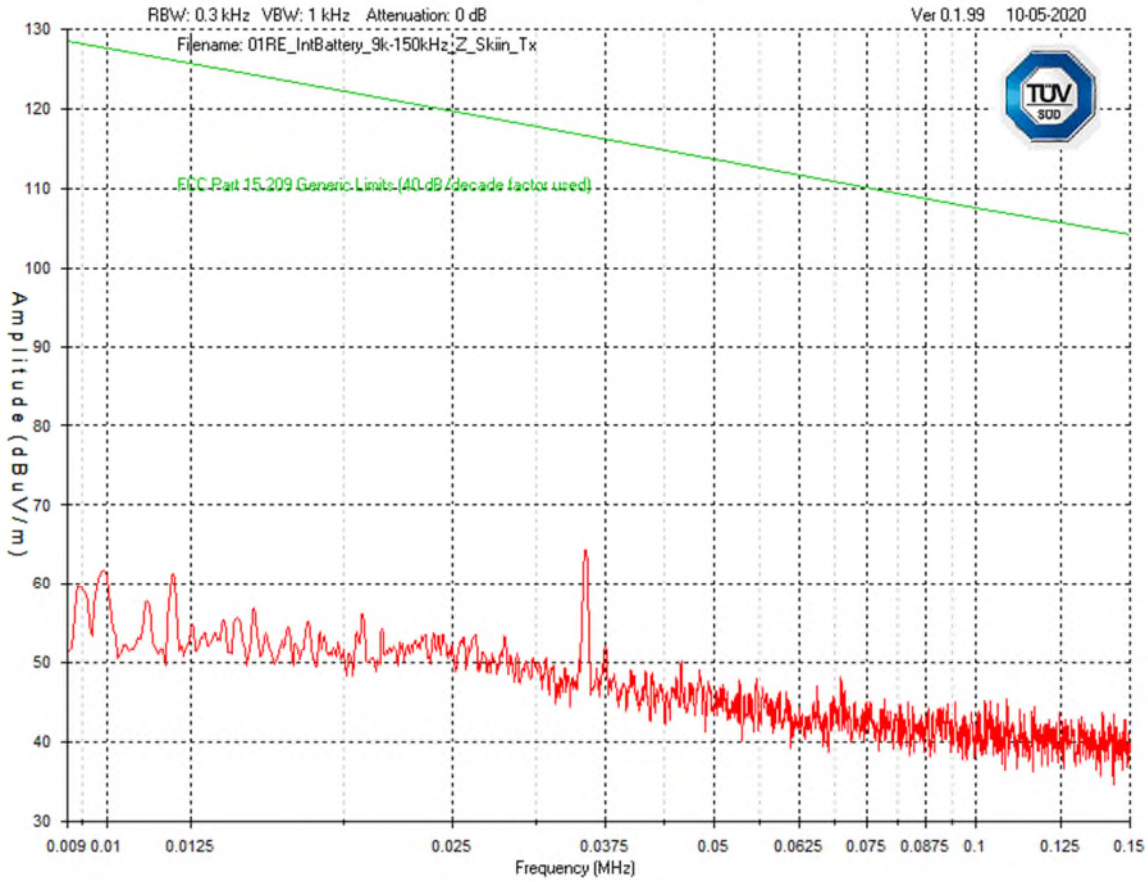
Band-edge measurement graphs are shown for illustration purposes. See final measurement section for all measurements. Graphs for the worst-case, Z-axis, are presented.

Spurious Emissions

High Channel
9 kHz – 150 kHz
Peak Emission Graph



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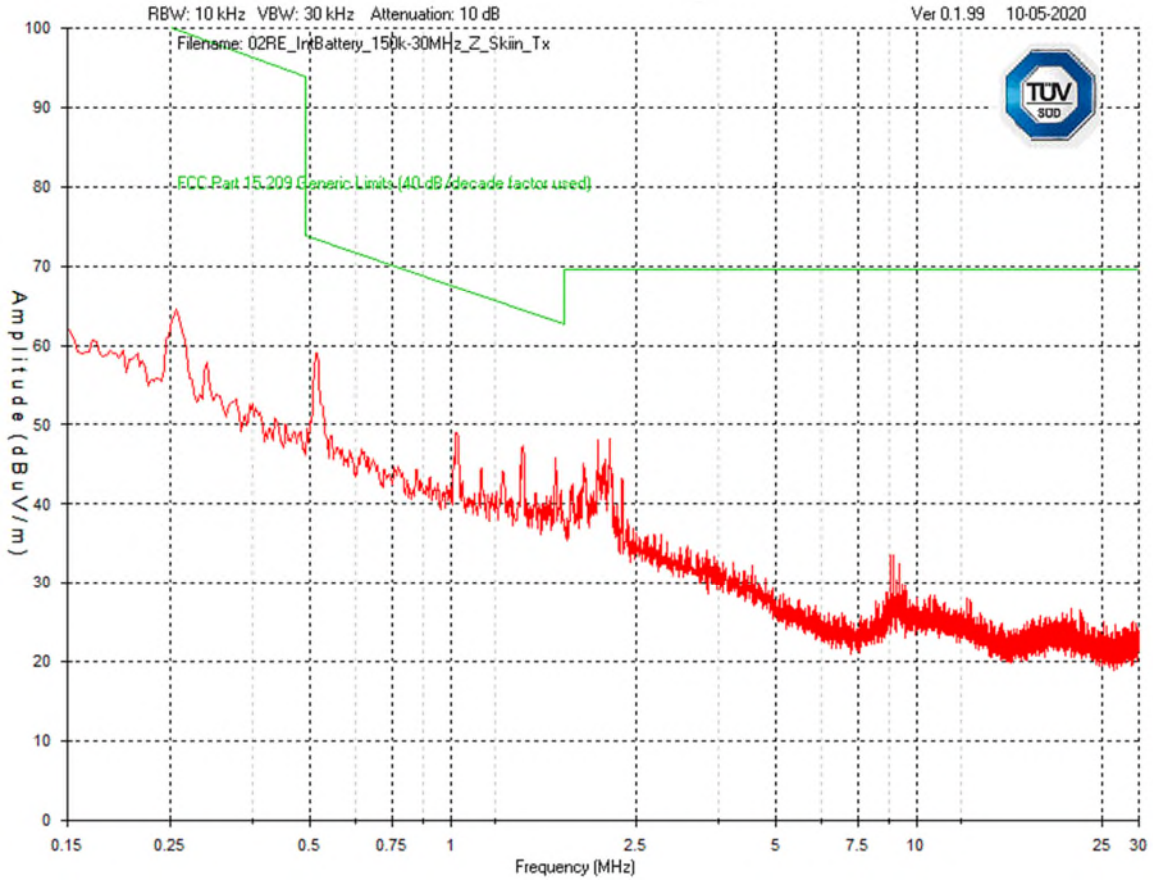
High Channel
150 kHz – 30 MHz
Peak Emission Graph



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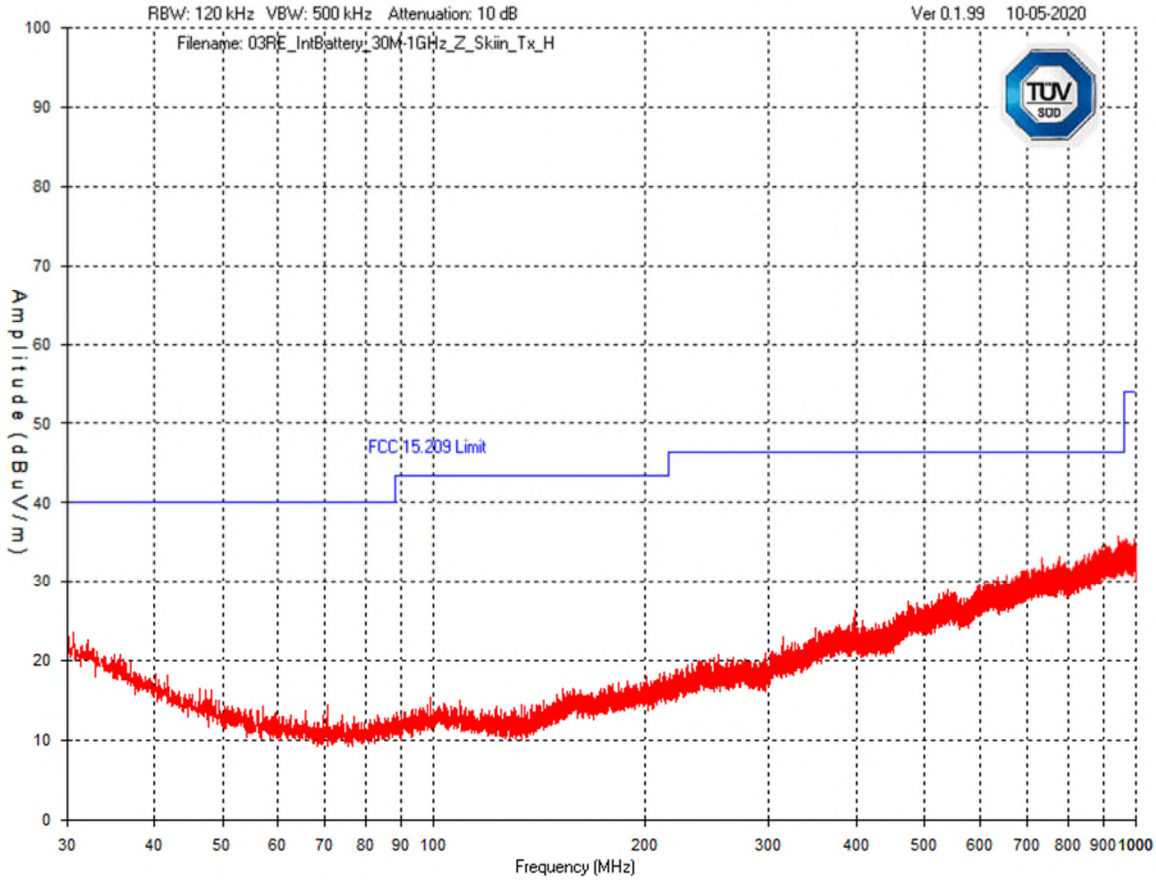
High Channel – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph



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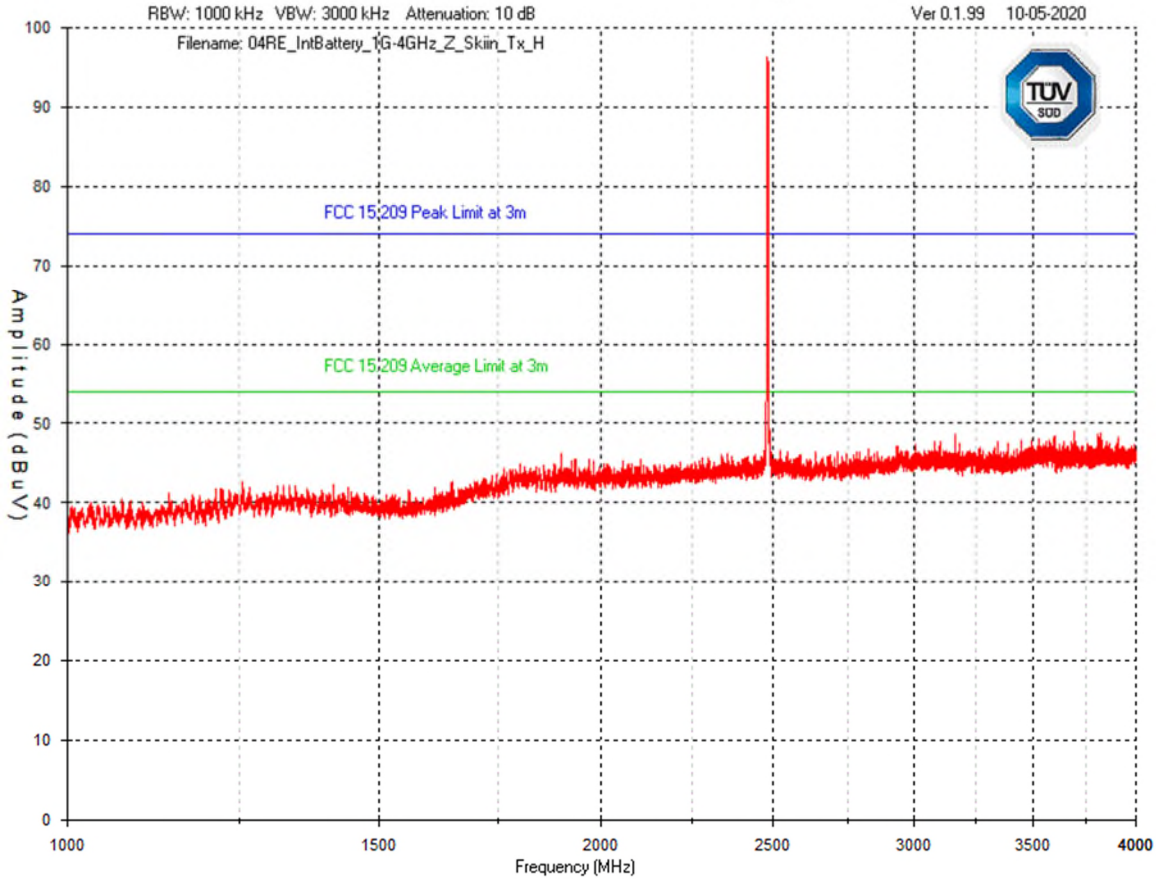
High Channel – 1 GHz – 4 GHz
Horizontal - Peak Emission Graph



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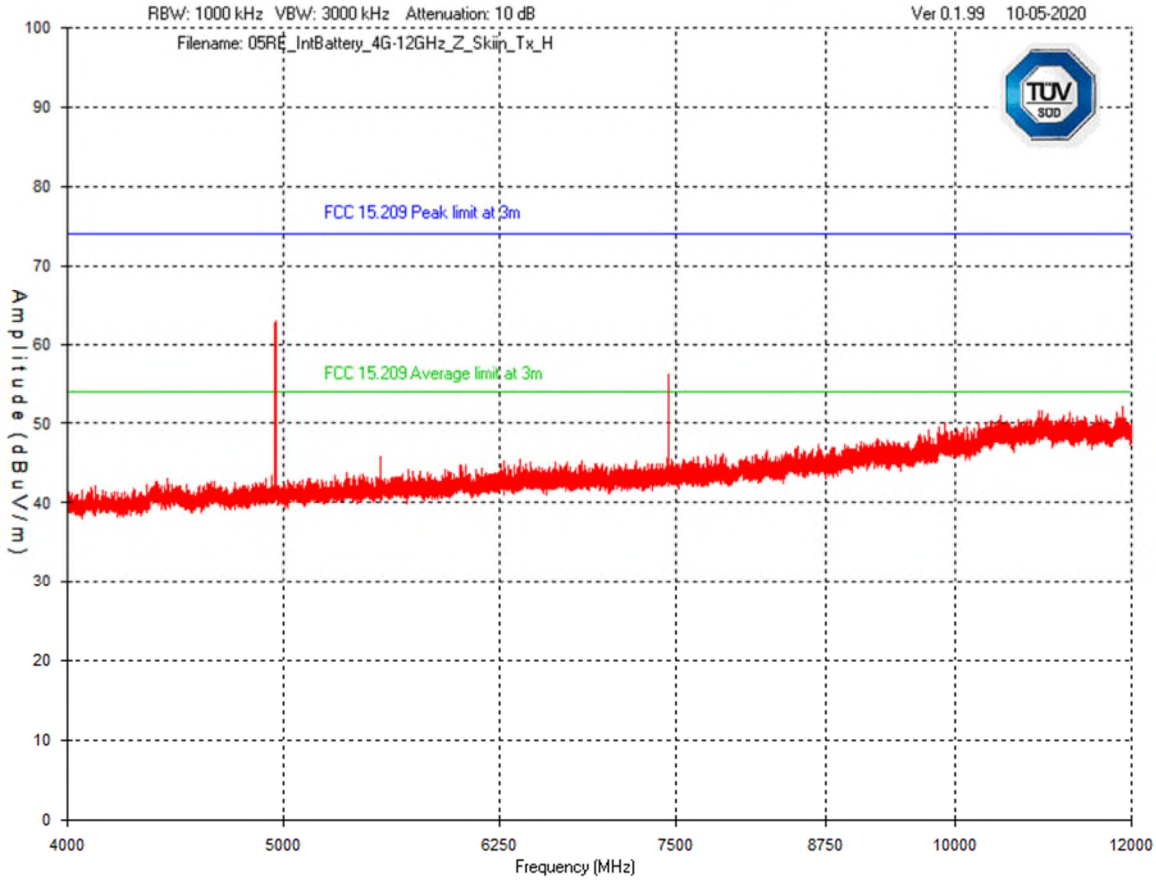
High Channel – 4 GHz – 12 GHz
Horizontal - Peak Emission Graph



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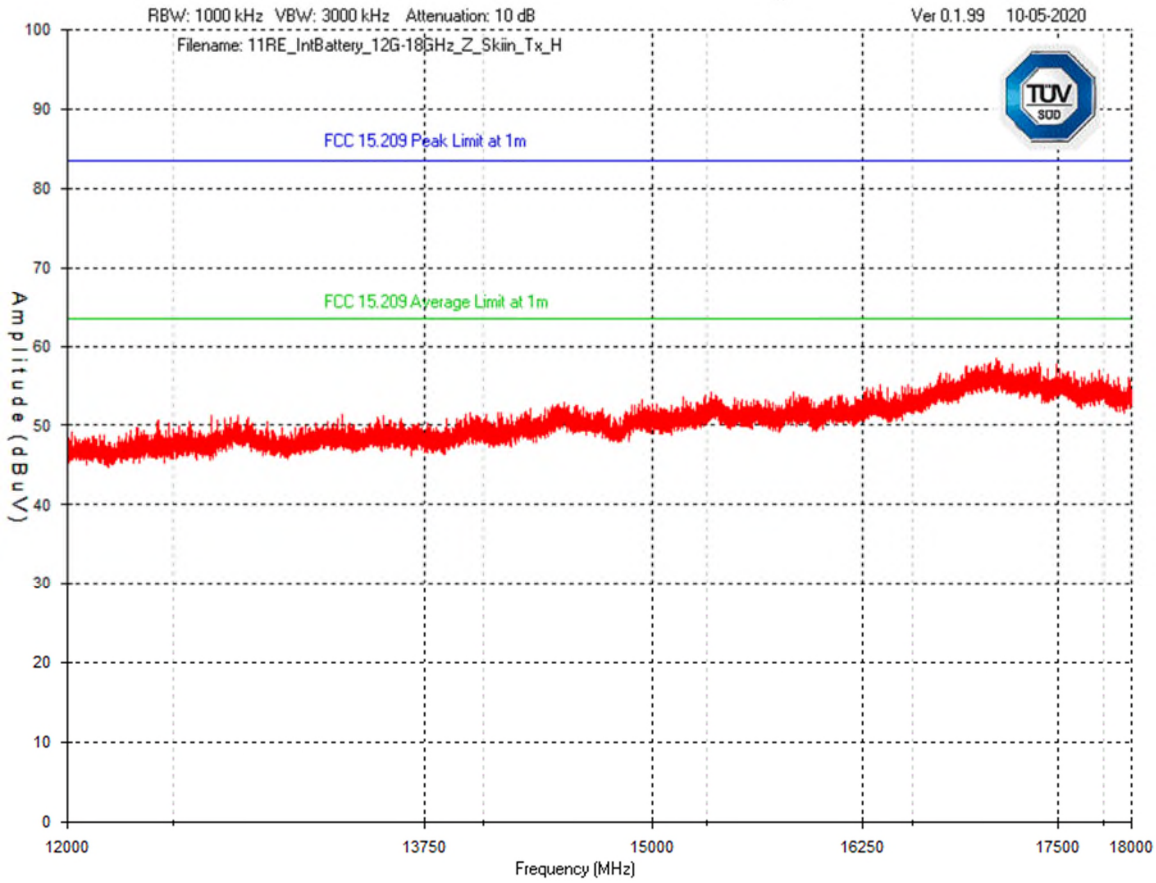
High Channel – 12 GHz – 18 GHz
Horizontal - Peak Emission Graph



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

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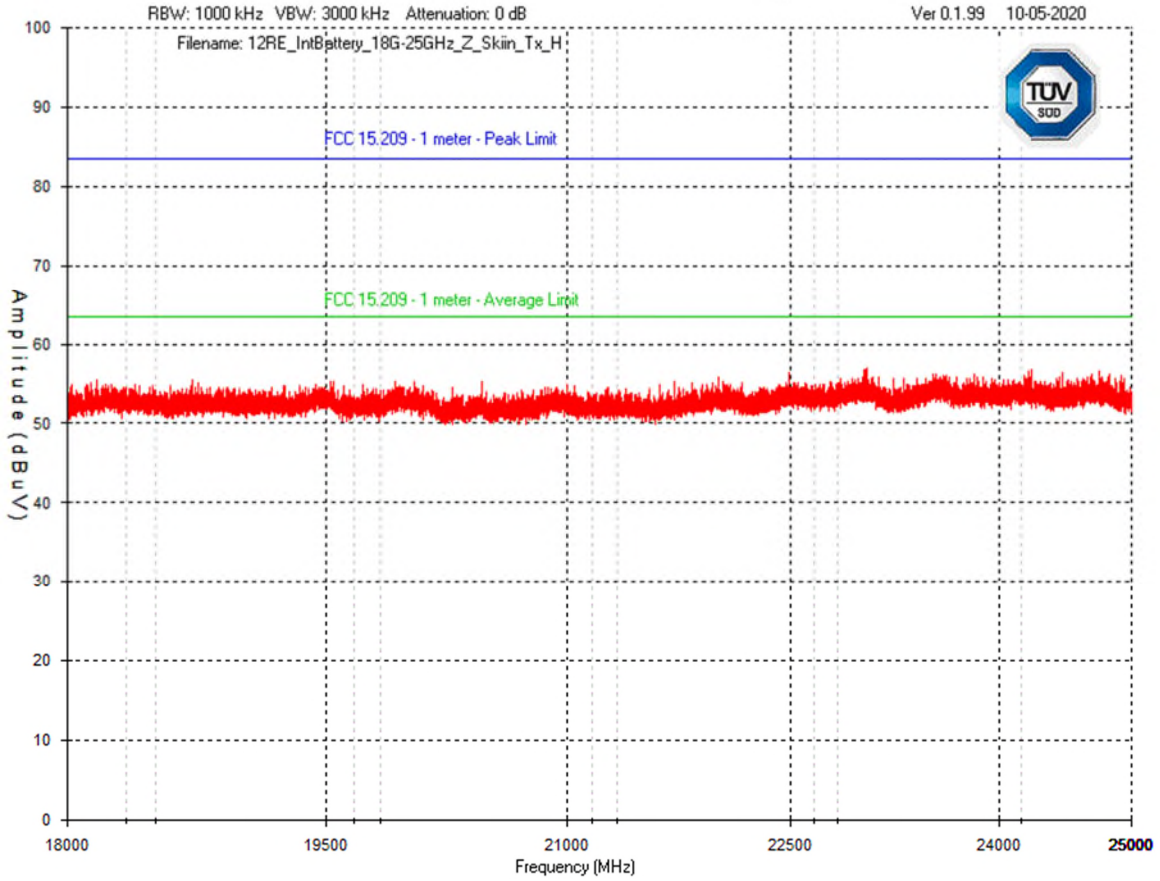
High Channel – 18 GHz – 25 GHz
Horizontal - Peak Emission Graph



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

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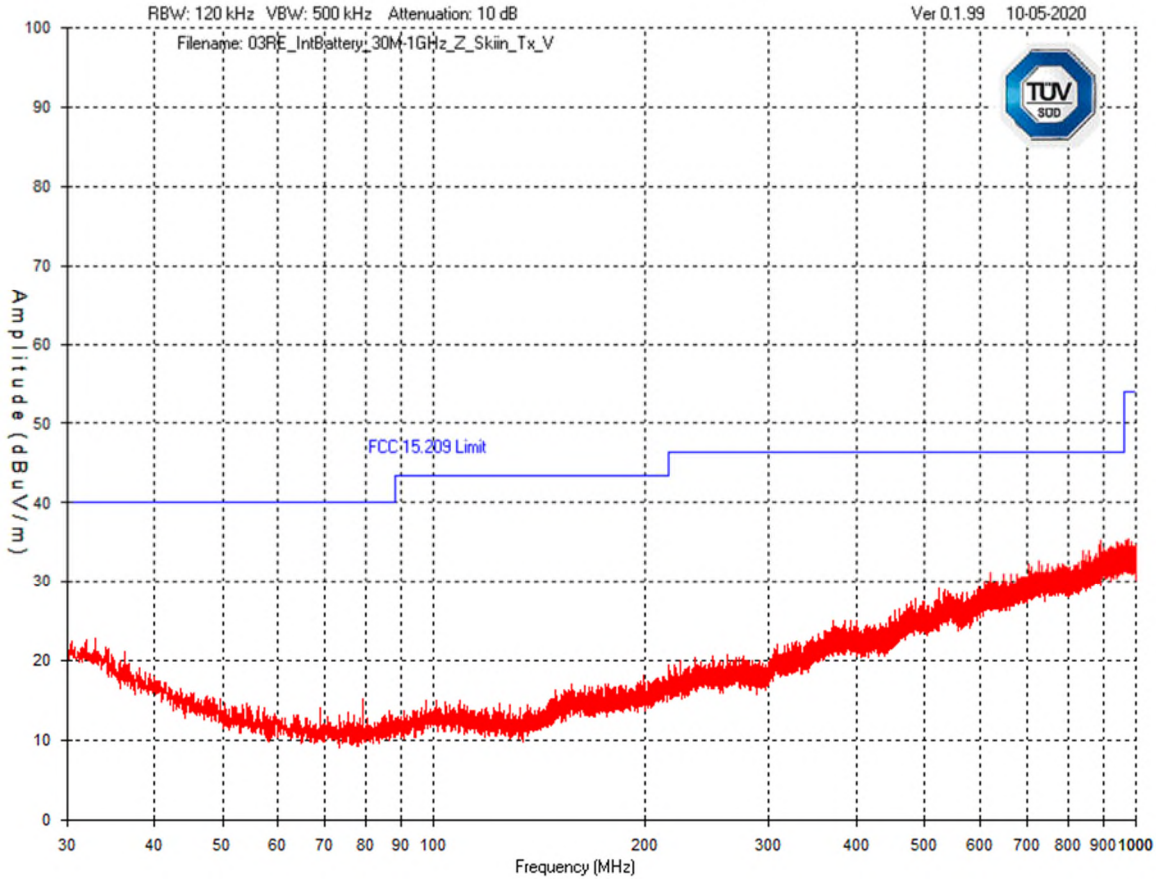
High Channel – 30 MHz – 1 GHz
Vertical - Peak Emission Graph



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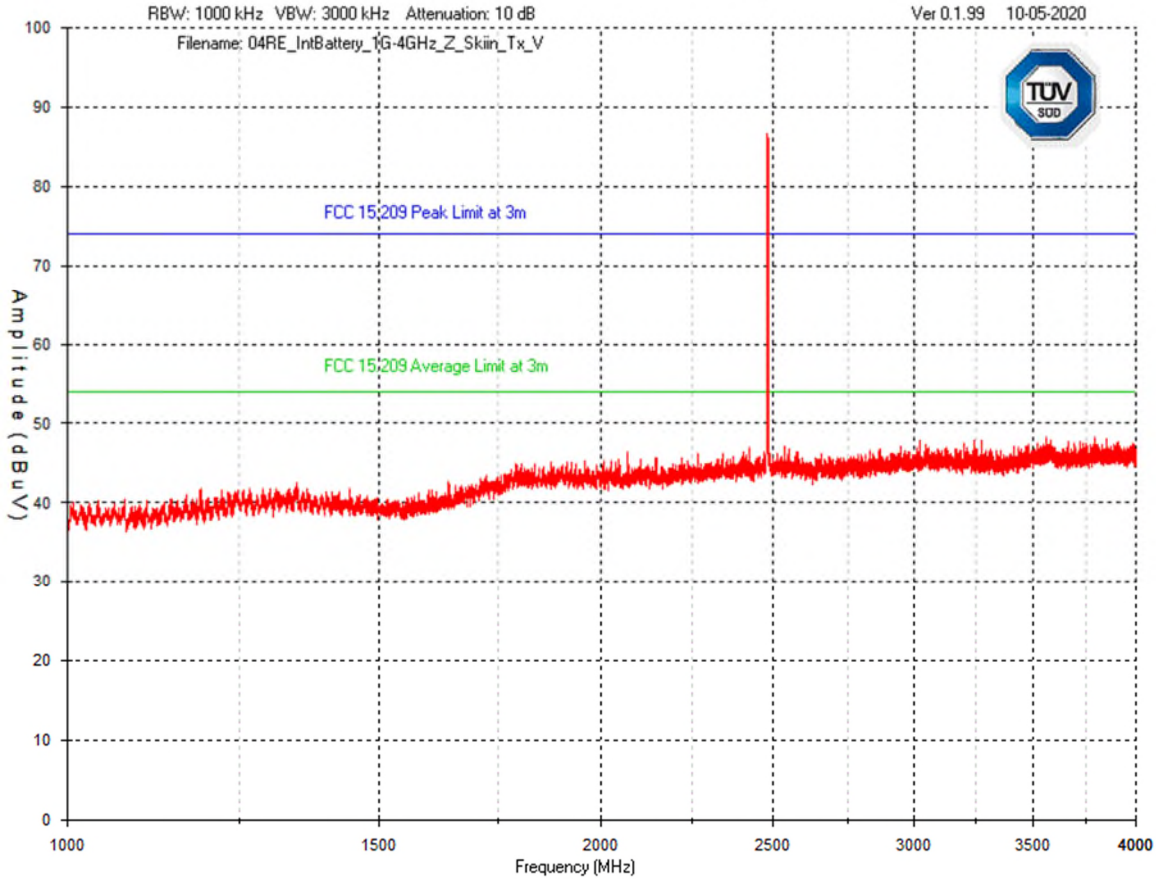
High Channel – 1 GHz – 4 GHz
Vertical - Peak Emission Graph



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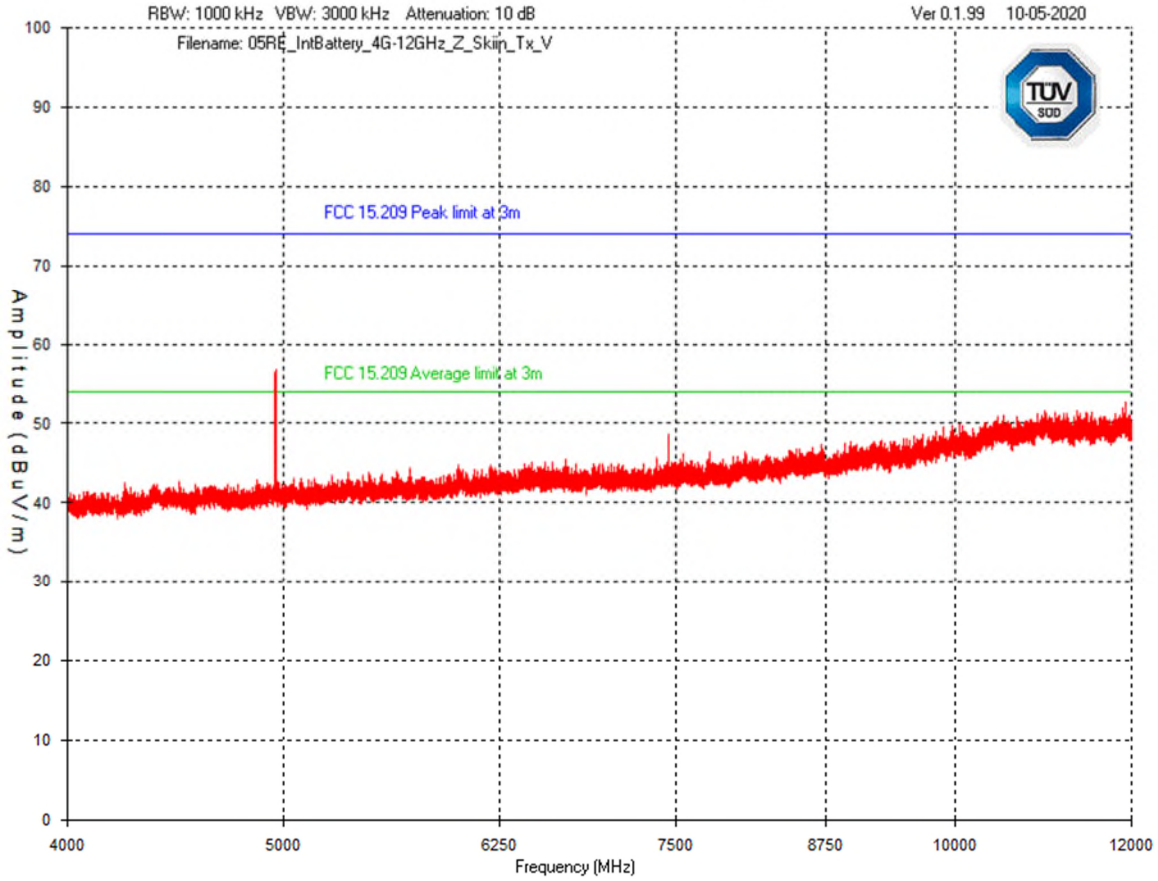
High Channel – 4 GHz – 12 GHz
Vertical - Peak Emission Graph



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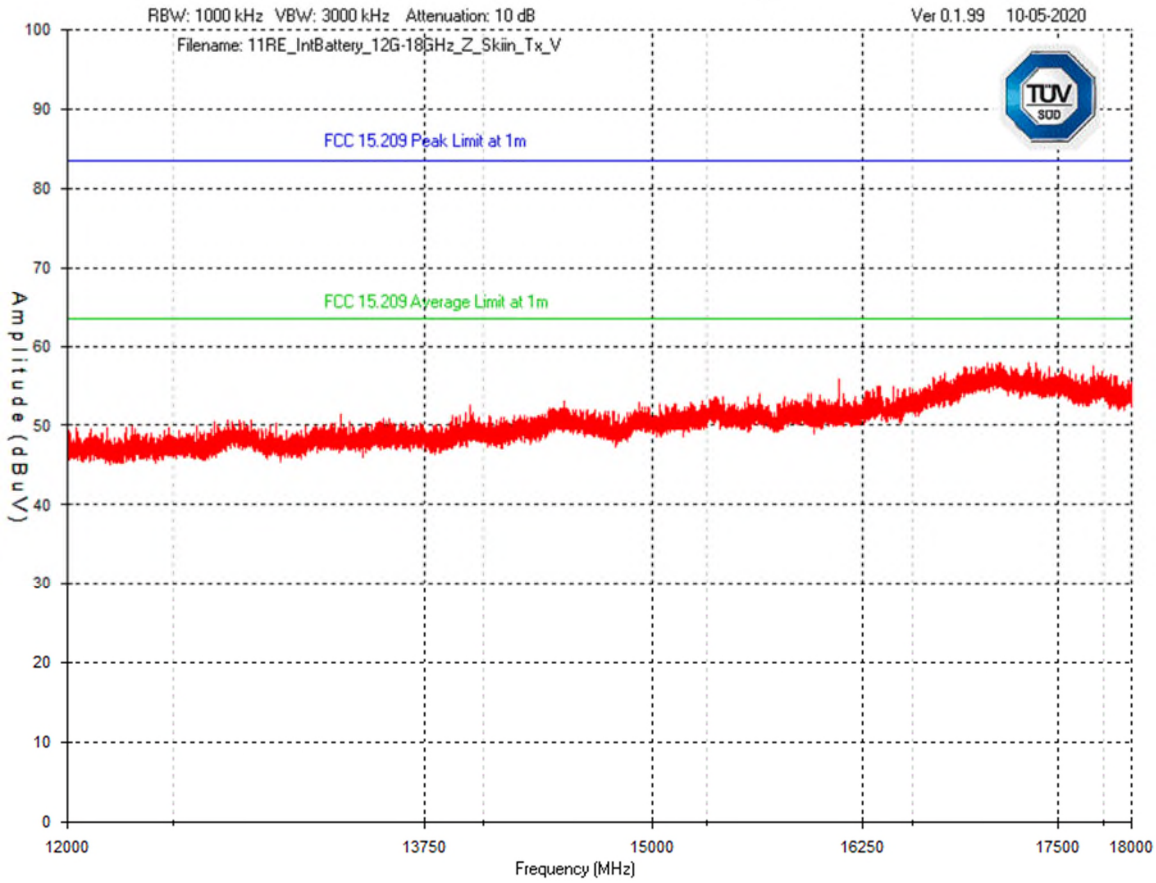
High Channel – 12 GHz – 18 GHz
Vertical - Peak Emission Graph



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

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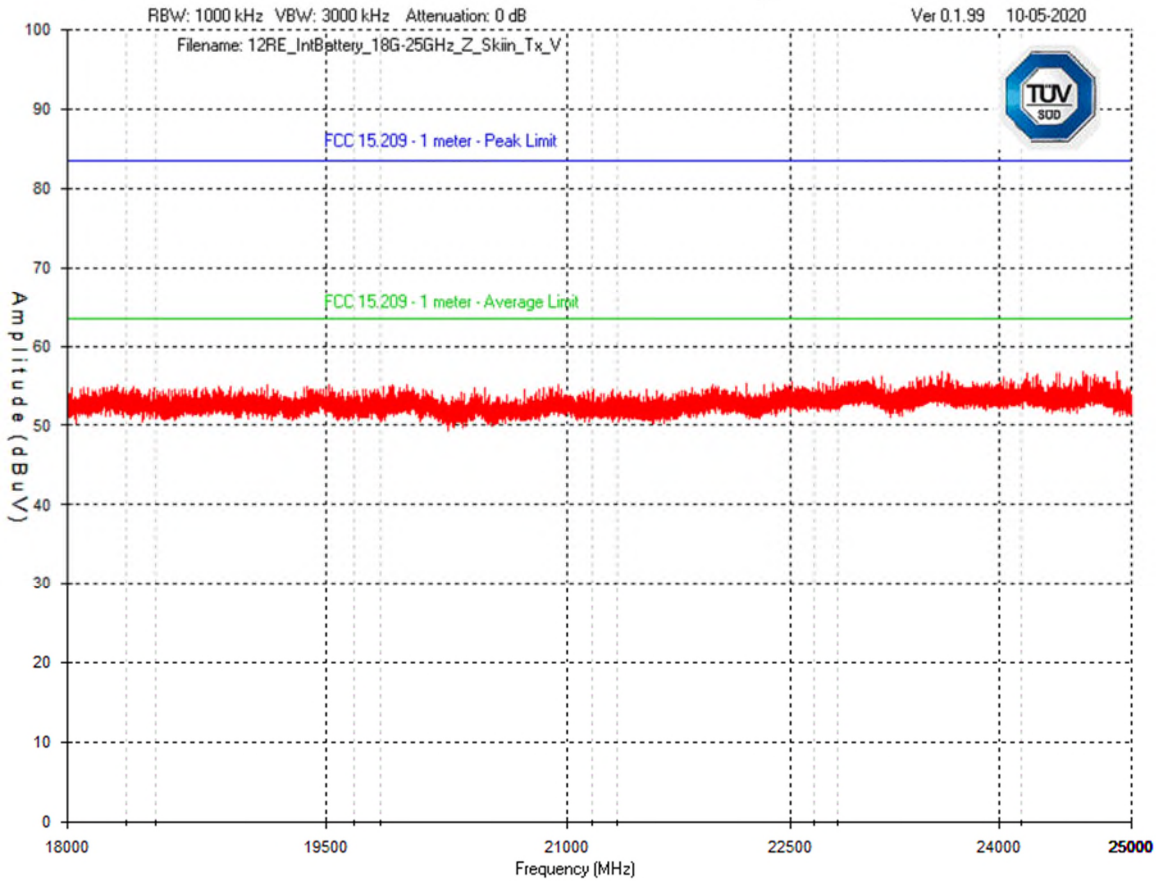
High Channel – 18 GHz – 25 GHz
Vertical - Peak Emission Graph



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

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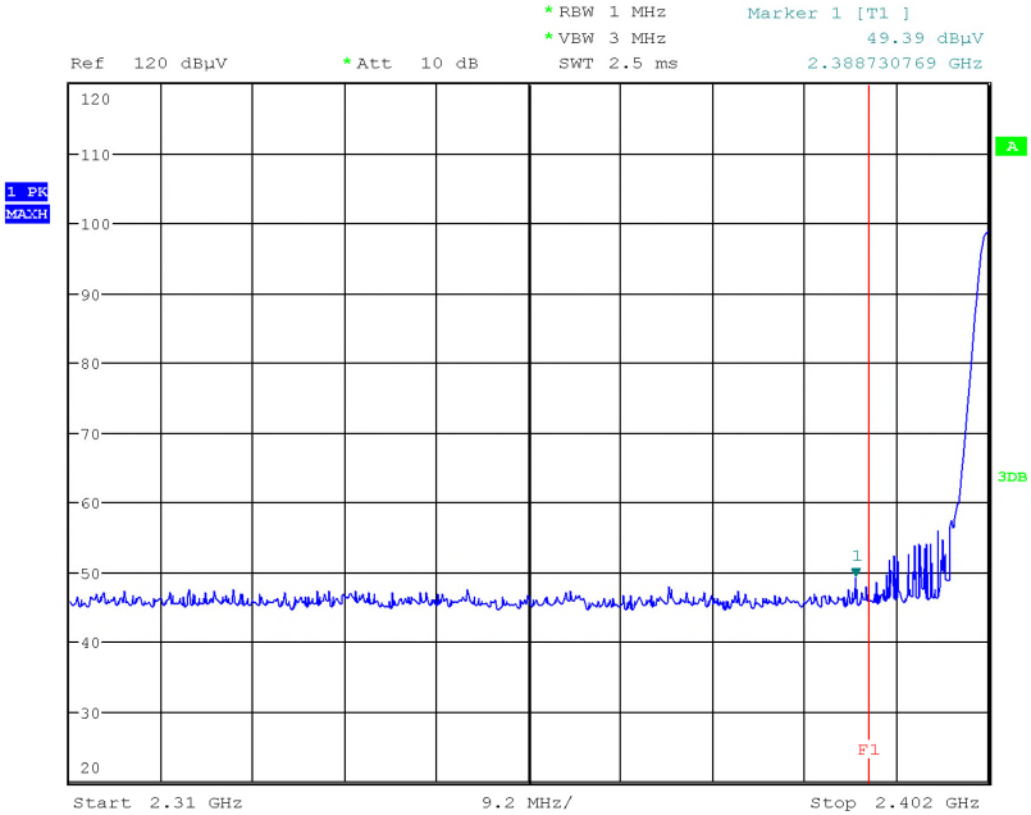
Band Edges

Band Edge – Low Channel
Z-Axis
Horizontal - Peak Emission



Date: 2.OCT.2020 18:27:13

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.

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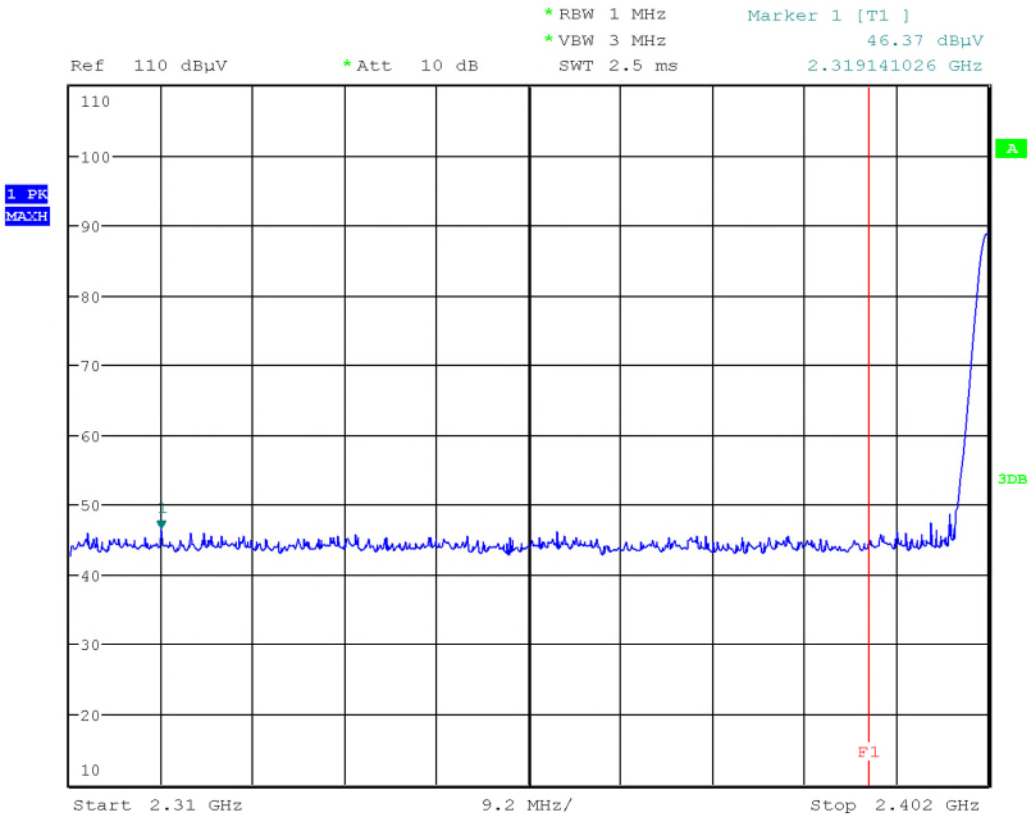
Band Edge – Low Channel
Z-Axis
Vertical - Peak Emission



Date: 2.OCT.2020 18:18:15

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.

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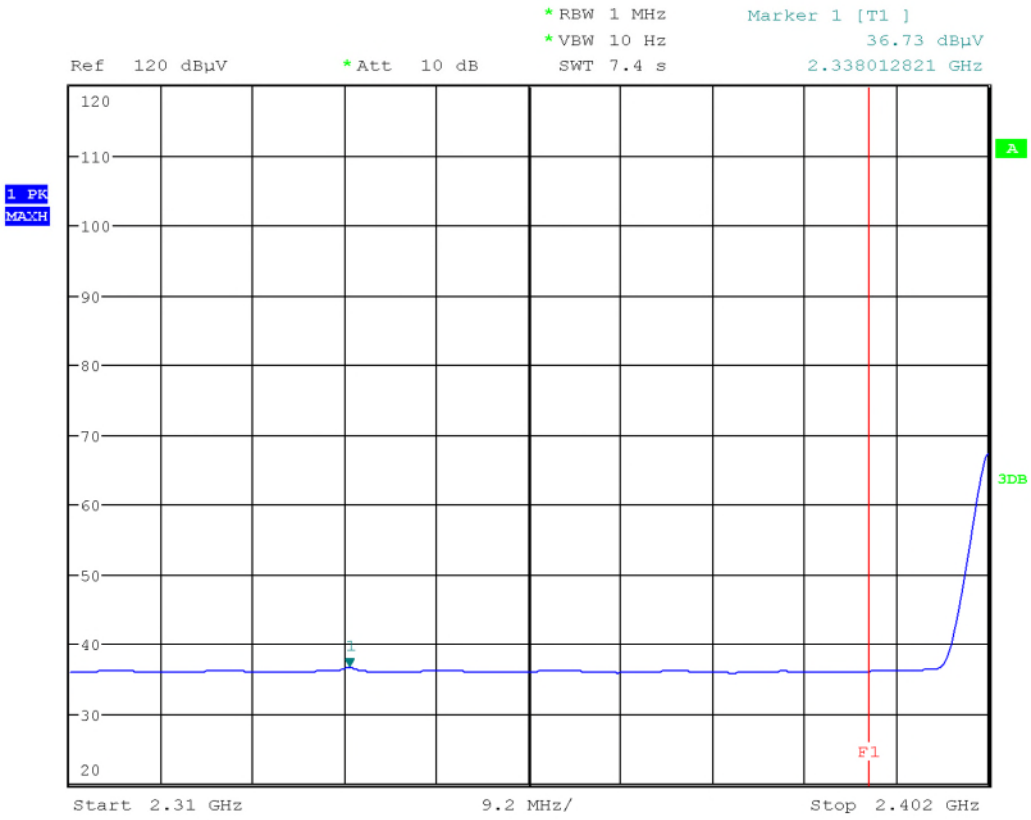
Band Edge – Low Channel
Z-Axis
Horizontal - Average Emission



Date: 2.OCT.2020 18:27:43

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.

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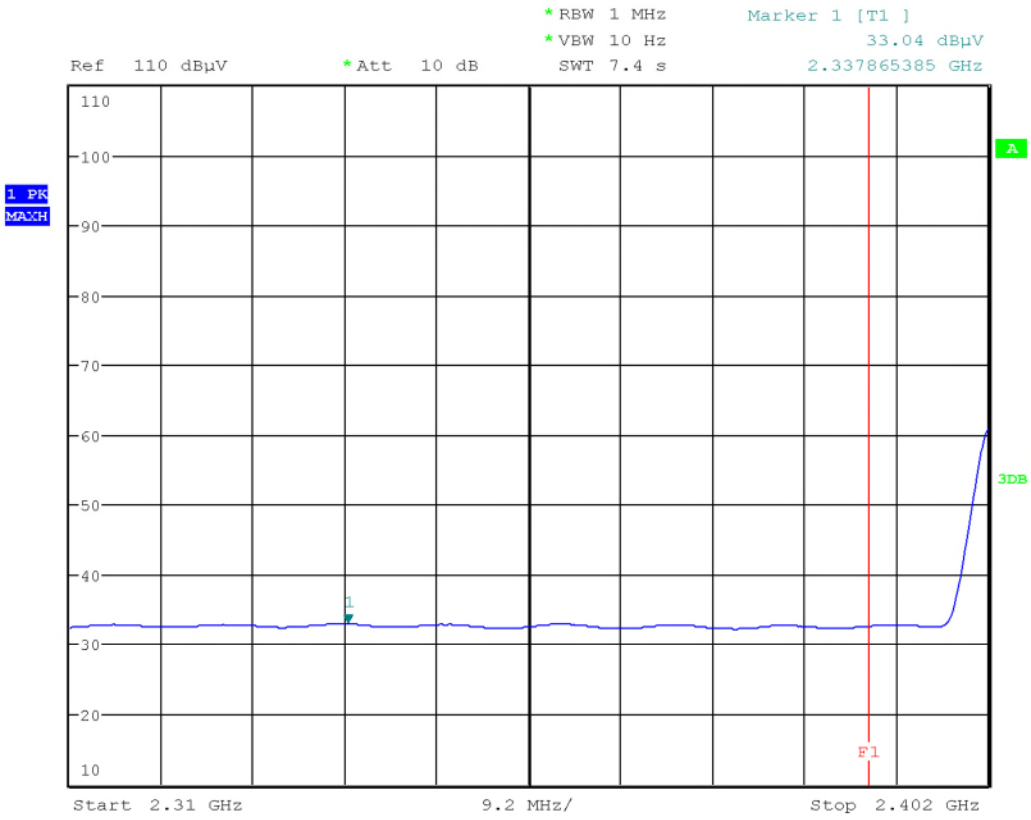
Band Edge – Low Channel
Z-Axis
Vertical – Average Emission



Date: 2.OCT.2020 18:18:45

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.

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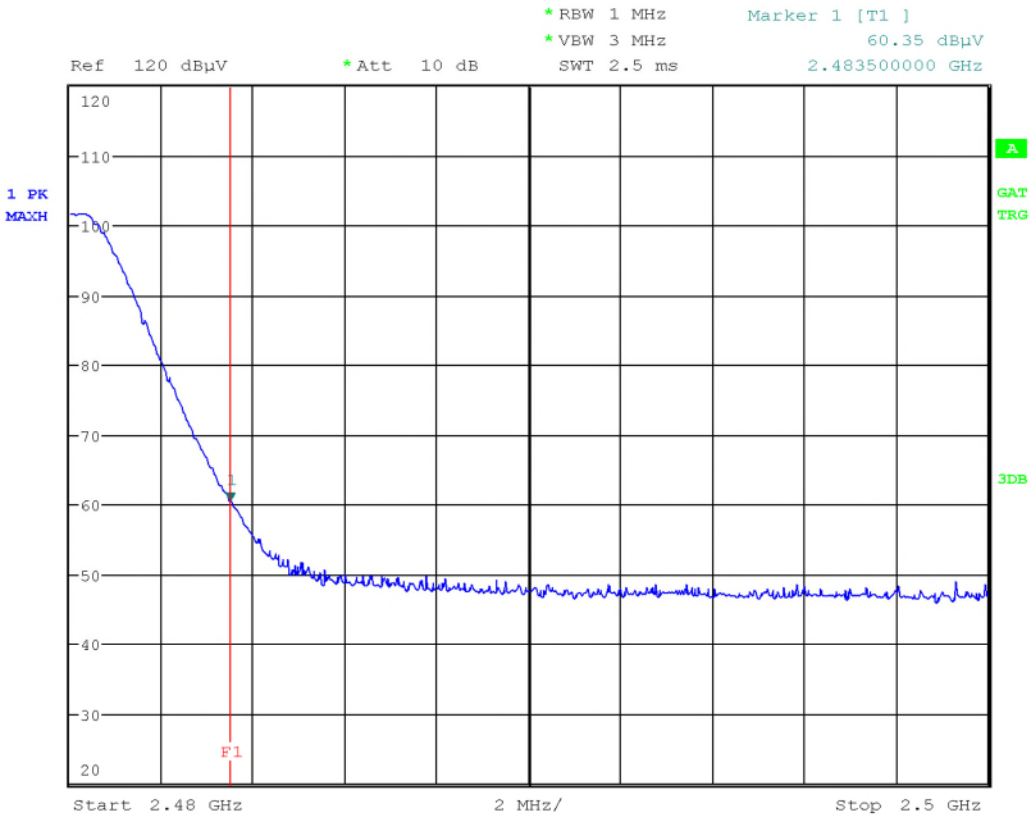
Band Edge – High Channel
Z-Axis
Horizontal - Peak Emission



Date: 2.OCT.2020 20:31:49

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.

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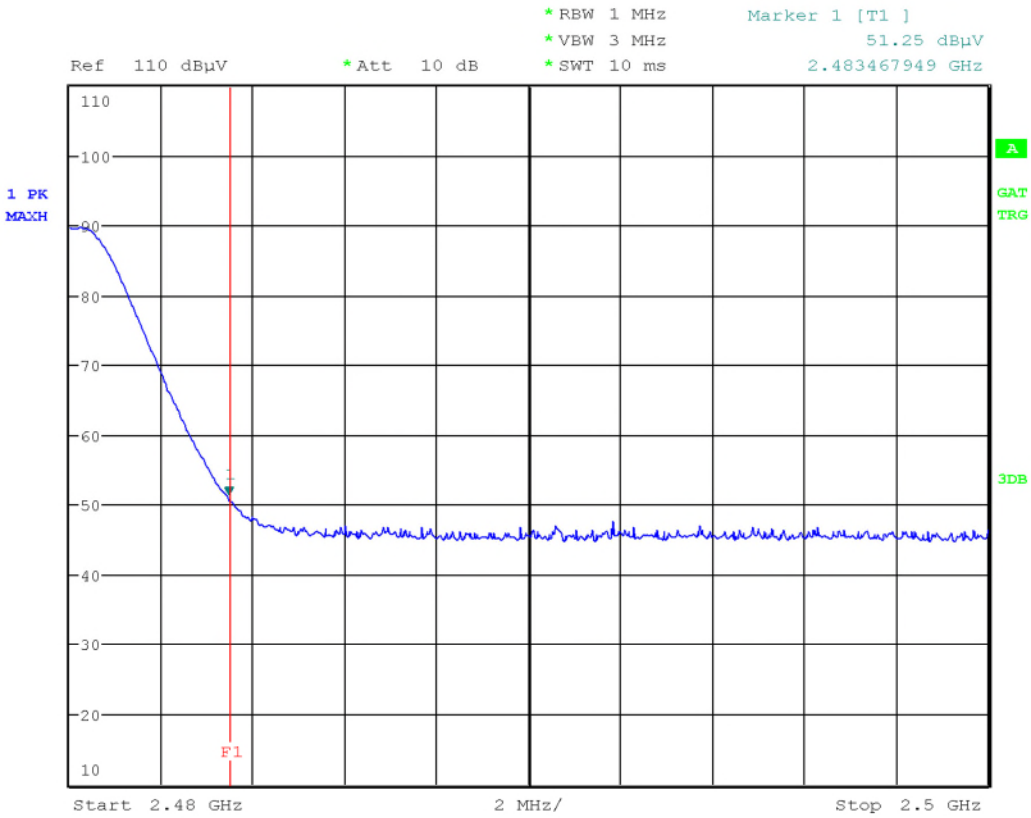
Band Edge – High Channel
Z-Axis
Vertical - Peak Emission



Date: 2.OCT.2020 20:42:19

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.

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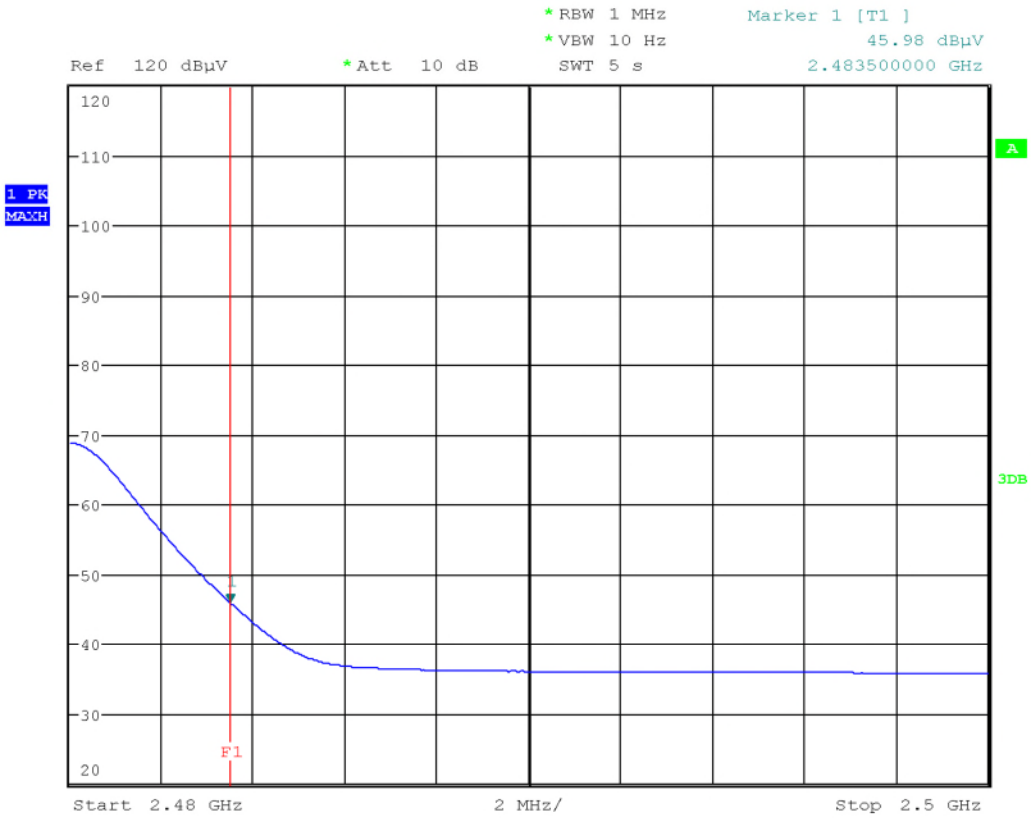
Band Edge – High Channel
Z-Axis
Horizontal - Average Emission



Date: 2.OCT.2020 20:28:24

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.

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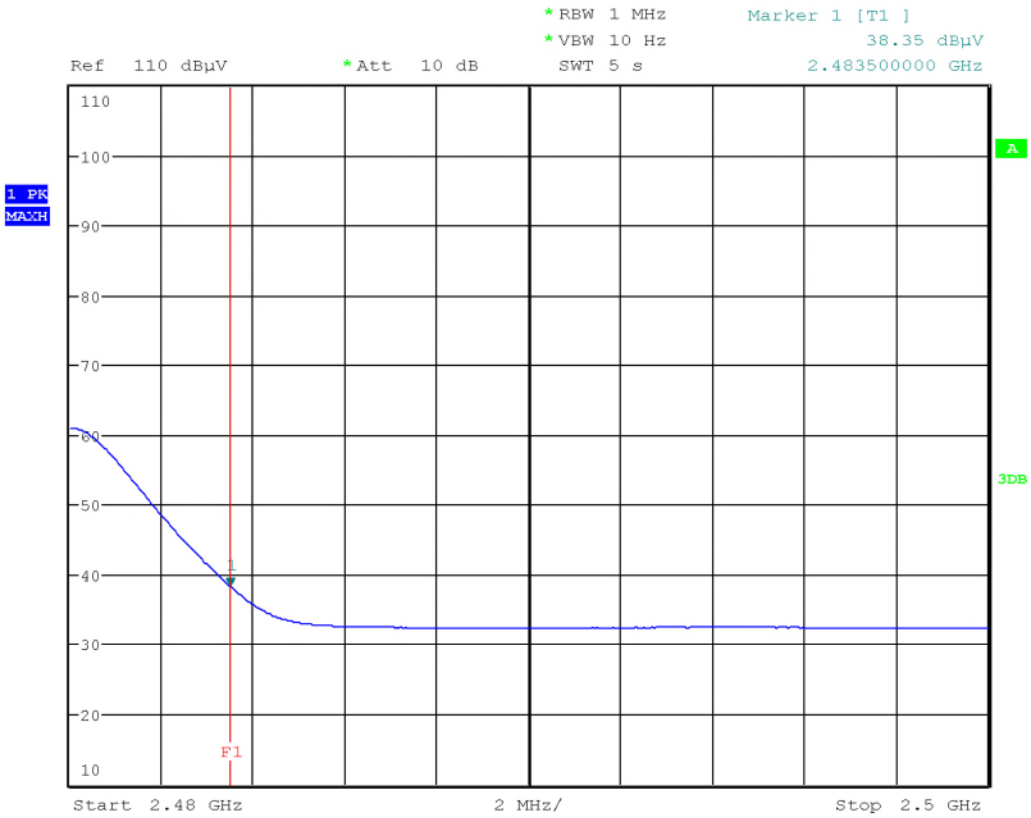
Band Edge – High Channel
Z-Axis
Vertical – Average Emission



Date: 2.OCT.2020 20:38:45

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.

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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.

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)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
Low Channel Z axis										
2402	Peak	Horz	98.7	26.4	4.7	-36.4	93.3			PASS
2402	Avg	Horz	67.3	26.4	4.7	-36.4	61.9			PASS
2402	Peak	Vert	88.9	26.4	4.7	-36.4	83.5			PASS
2402	Avg	Vert	60.7	26.4	4.7	-36.4	55.4			PASS
2321.6	Peak	Horz	49.4	26.4	4.6	-36.4	44.0	74.0	30.0	PASS
2387.3	Avg	Horz	36.7	26.4	4.7	-36.4	31.4	54.0	22.6	PASS
2319.1	Peak	Vert	46.4	26.4	4.6	-36.5	41.0	74.0	33.0	PASS
2337.9	Avg	Vert	33.0	26.5	4.6	-36.4	27.7	54.0	26.3	PASS
2483.7	Peak	Horz	46.2	26.2	4.7	-36.4	40.8	74.0	33.2	PASS
2492.6	Avg	Horz	31.8	26.2	4.7	-36.4	26.4	54.0	27.6	PASS
2493.2	Peak	Vert	46.0	26.2	4.7	-36.4	40.5	74.0	33.5	PASS
2483.8	Avg	Vert	31.5	26.2	4.7	-36.4	26.0	54.0	28.0	PASS
Low Channel X axis										
2402	Peak	Horz	95.7	26.4	4.7	-36.4	90.4			PASS
2402	Avg	Horz	65.9	26.4	4.7	-36.4	60.5			PASS
2402	Peak	Vert	95.8	26.4	4.7	-36.4	90.5			PASS
2402	Avg	Vert	65.9	26.4	4.7	-36.4	60.5			PASS
2389.9	Peak	Horz	48.2	26.4	4.7	-36.4	42.8	74.0	31.2	PASS
2338	Avg	Horz	36.6	26.5	4.6	-36.4	31.3	54.0	22.7	PASS
2389	Peak	Vert	49.1	26.4	4.7	-36.4	43.7	74.0	30.3	PASS
2338.2	Avg	Vert	36.6	26.5	4.6	-36.4	31.3	54.0	22.7	PASS
2491.2	Peak	Horz	46.1	26.2	4.7	-36.4	40.6	74.0	33.4	PASS
2492.9	Avg	Horz	31.7	26.2	4.7	-36.4	26.2	54.0	27.8	PASS
2486.7	Peak	Vert	46.2	26.2	4.7	-36.4	40.7	74.0	33.3	PASS
2493.2	Avg	Vert	31.7	26.2	4.7	-36.4	26.2	54.0	27.8	PASS
Low Channel Y axis										
2402	Peak	Horz	95.8	26.4	4.7	-36.4	90.5			PASS
2402	Avg	Horz	65.9	26.4	4.7	-36.4	60.5			PASS
2402	Peak	Vert	94.0	26.4	4.7	-36.4	88.6			PASS
2402	Avg	Vert	63.4	26.4	4.7	-36.4	58.0			PASS
2345.2	Peak	Horz	47.8	26.5	4.6	-36.4	42.5	74.0	31.5	PASS
2337.9	Avg	Horz	36.5	26.5	4.6	-36.4	31.2	54.0	22.8	PASS
2389.9	Peak	Vert	46.9	26.4	4.7	-36.4	41.5	74.0	32.5	PASS
2338	Avg	Vert	33.3	26.5	4.6	-36.4	28.0	54.0	26.0	PASS
2487.6	Peak	Horz	46.2	26.2	4.7	-36.4	40.7	74.0	33.3	PASS
2493	Avg	Horz	31.5	26.2	4.7	-36.4	26.1	54.0	27.9	PASS
2496	Peak	Vert	46.3	26.1	4.7	-36.4	40.8	74.0	33.2	PASS
2492.8	Avg	Vert	31.6	26.2	4.7	-36.4	26.1	54.0	27.9	PASS

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Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
Mid Channel Z axis										
2442	Peak	Horz	100.4	26.4	4.7	-36.4	95.1			PASS
2442	Avg	Horz	68.1	26.4	4.7	-36.4	62.7			PASS
2442	Peak	Vert	90.5	26.4	4.7	-36.4	85.1			PASS
2442	Avg	Vert	61.2	26.4	4.7	-36.4	55.9			PASS
Mid Channel X axis										
2442	Peak	Horz	95.0	26.4	4.7	-36.4	89.6			PASS
2442	Avg	Horz	63.5	26.4	4.7	-36.4	58.2			PASS
2442	Peak	Vert	96.1	26.4	4.7	-36.4	90.7			PASS
2442	Avg	Vert	64.1	26.4	4.7	-36.4	58.8			PASS
Mid Channel Y axis										
2442	Peak	Horz	96.3	26.4	4.7	-36.4	90.9			PASS
2442	Avg	Horz	64.2	26.4	4.7	-36.4	58.8			PASS
2442	Peak	Vert	95.2	26.4	4.7	-36.4	89.8			PASS
2442	Avg	Vert	63.6	26.4	4.7	-36.4	58.3			PASS

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Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
High Channel Z axis										
2480	Peak	Horz	101.7	26.2	4.7	-36.4	96.3			PASS
2480	Avg	Horz	68.8	26.2	4.7	-36.4	63.4			PASS
2480	Peak	Vert	89.7	26.2	4.7	-36.4	84.2			PASS
2480	Avg	Vert	61.0	26.2	4.7	-36.4	55.6			PASS
2352.2	Peak	Horz	46.2	26.5	4.6	-36.4	40.9	74.0	33.1	PASS
2352.1	Avg	Horz	33.3	26.5	4.6	-36.4	28.0	54.0	26.0	PASS
2344.9	Peak	Vert	45.9	26.5	4.6	-36.4	40.6	74.0	33.4	PASS
2336.8	Avg	Vert	32.1	26.5	4.6	-36.4	26.8	54.0	27.2	PASS
2483.6	Peak	Horz	60.4	26.2	4.7	-36.4	54.9	74.0	19.1	PASS
2483.5	Avg	Horz	46.0	26.2	4.7	-36.4	40.6	54.0	13.4	PASS
2483.6	Peak	Vert	51.3	26.2	4.7	-36.4	45.8	74.0	28.2	PASS
2483.5	Avg	Vert	38.3	26.2	4.7	-36.4	32.9	54.0	21.1	PASS
4960	Peak	Horz	62.8	28.0	7.2	-35.1	62.9	74.0	11.1	PASS
4960	Avg	Horz	44.2	28.0	7.2	-35.1	44.3	54.0	9.7	PASS
4960	Peak	Vert	56.7	28.0	7.2	-35.1	56.8	74.0	17.2	PASS
4960	Avg	Vert	41.2	28.0	7.2	-35.1	41.3	54.0	12.7	PASS
7440	Peak	Horz	54.4	29.2	8.9	-35.4	57.1	74.0	16.9	PASS
7440	Avg	Horz	38.2	29.2	8.9	-35.4	40.9	54.0	13.1	PASS
7440	Peak	Vert	50.7	29.2	8.9	-35.4	53.4	74.0	20.6	PASS
7440	Avg	Vert	35.3	29.2	8.9	-35.4	38.0	54.0	16.0	PASS
9920	Peak	Horz	44.3	31.6	10.4	-35.6	50.6	74.0	23.4	PASS
9920	Avg	Horz	28.9	31.6	10.4	-35.6	35.2	54.0	18.8	PASS
9920	Peak	Vert	44.0	31.6	10.4	-35.6	50.3	74.0	23.7	PASS
9920	Avg	Vert	28.8	31.6	10.4	-35.6	35.1	54.0	18.9	PASS
High Channel X axis										
2480	Peak	Horz	98.2	26.2	4.7	-36.4	92.7			PASS
2480	Avg	Horz	67.0	26.2	4.7	-36.4	61.6			PASS
2480	Peak	Vert	99.1	26.2	4.7	-36.4	93.7			PASS
2480	Avg	Vert	67.5	26.2	4.7	-36.4	62.1			PASS
2347.6	Peak	Horz	46.0	26.5	4.6	-36.4	40.7	74.0	33.3	PASS
2352.1	Avg	Horz	32.0	26.5	4.6	-36.4	26.8	54.0	27.2	PASS
2326.5	Peak	Vert	45.9	26.5	4.6	-36.4	40.6	74.0	33.4	PASS
2352.1	Avg	Vert	32.6	26.5	4.6	-36.4	27.3	54.0	26.7	PASS
2483.6	Peak	Horz	57.7	26.2	4.7	-36.4	52.2	74.0	21.8	PASS
2483.5	Avg	Horz	44.2	26.2	4.7	-36.4	38.8	54.0	15.2	PASS
2483.6	Peak	Vert	58.7	26.2	4.7	-36.4	53.3	74.0	20.7	PASS
2483.5	Avg	Vert	44.7	26.2	4.7	-36.4	39.3	54.0	14.7	PASS
High Channel Y axis										
2480	Peak	Horz	96.2	26.2	4.7	-36.4	90.8			PASS
2480	Avg	Horz	66.0	26.2	4.7	-36.4	60.6			PASS
2480	Peak	Vert	94.6	26.2	4.7	-36.4	89.1			PASS
2480	Avg	Vert	63.4	26.2	4.7	-36.4	58.0			PASS
2335	Peak	Horz	45.7	26.5	4.6	-36.4	40.3	74.0	33.7	PASS
2359.2	Avg	Horz	32.0	26.5	4.6	-36.4	26.7	54.0	27.3	PASS
2316	Peak	Vert	45.8	26.4	4.6	-36.5	40.4	74.0	33.6	PASS
2336.9	Avg	Vert	32.0	26.5	4.6	-36.4	26.7	54.0	27.3	PASS
2483.5	Peak	Horz	55.0	26.2	4.7	-36.4	49.6	74.0	24.4	PASS
2483.5	Avg	Horz	43.2	26.2	4.7	-36.4	37.8	54.0	16.2	PASS
2483.6	Peak	Vert	54.6	26.2	4.7	-36.4	49.2	74.0	24.8	PASS
2483.5	Avg	Vert	40.8	26.2	4.7	-36.4	35.3	54.0	18.7	PASS

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 15, 2020	Jan. 15, 2022	GEMC 233
Loop Antenna	EM 6871	Electro-Metrics	Feb 15, 2019	Feb 15, 2021	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	Feb 15, 2019	Feb 15, 2021	GEMC 71
BiLog Antenna	3142-C	ETS-Lindgren	Mar. 01, 2019	Mar. 01, 2021	GEMC 137
Horn Antenna 1 – 4 GHz	3117	ETS-Lindgren	Feb. 17, 2020	Feb. 17, 2022	GEMC 340
Horn Antenna 4 – 18 GHz	WBH218HN	Q-par	Apr. 1, 2020	Apr. 1, 2022	GEMC 6375
Horn Antenna 18 - 26.5 GHz	SAS-572	A.H. Systems	Oct. 23, 2018	Oct. 23, 2020	GEMC 6371
Attenuator 6 dB	612-6-1	Meca Electronics, Inc	NCR	NCR	GEMC 287
Pre-Amp 9 kHz – 1 GHz	LNA 6901	Teseq	Feb. 25, 2019	Feb. 25, 2021	GEMC 168
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Aug. 4, 2020	Aug. 4, 2022	GEMC 312
4GHz HPF	11SH10-4000/T12000-0/0	K & L Microwave	NCR	NCR	GEMC 119
RF Cable 10m	LMR-400-10M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 274
RF Cable 2m	Sucoflex 104A	Huber+Suhner	NCR	NCR	GEMC 271
Emissions Software	0.1.99	TUV SUD Canada, Inc.	NCR	NCR	GEMC 58

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Power Spectral Density

Purpose

The purpose of this test is to ensure that the maximum power spectral density to the radiating element does not exceed the limits specified. This ensures that the modulation is significantly wide enough, or low enough in power that it will allow for co-operation of other wireless devices operating within this frequency allocation.

Limits and Method

The limits are defined in 15.247(e) and RSS-247 5.2(b).

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 FCC KDB 558074 Section 10.2.

Results

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

Channel	Frequency (MHz)	PSD (dBm)
Low	2402	-21.45
Mid	2442	-20.14
High	2480	-22.47

Graphs

The graphs shown below show the power spectral density of the device during the conducted measurement operation of the EUT. The external attenuator and cable loss are accounted for as reference offset in the spectrum analyzer.

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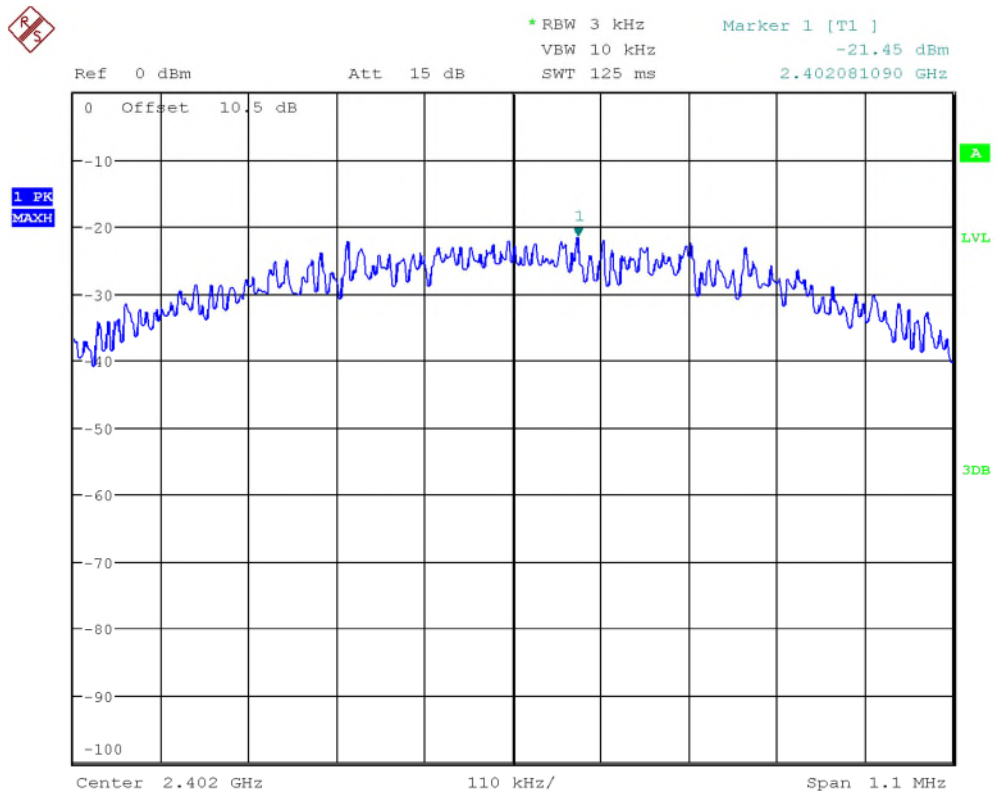
PSD

Low Channel



Date: 9.OCT.2020 18:28:11

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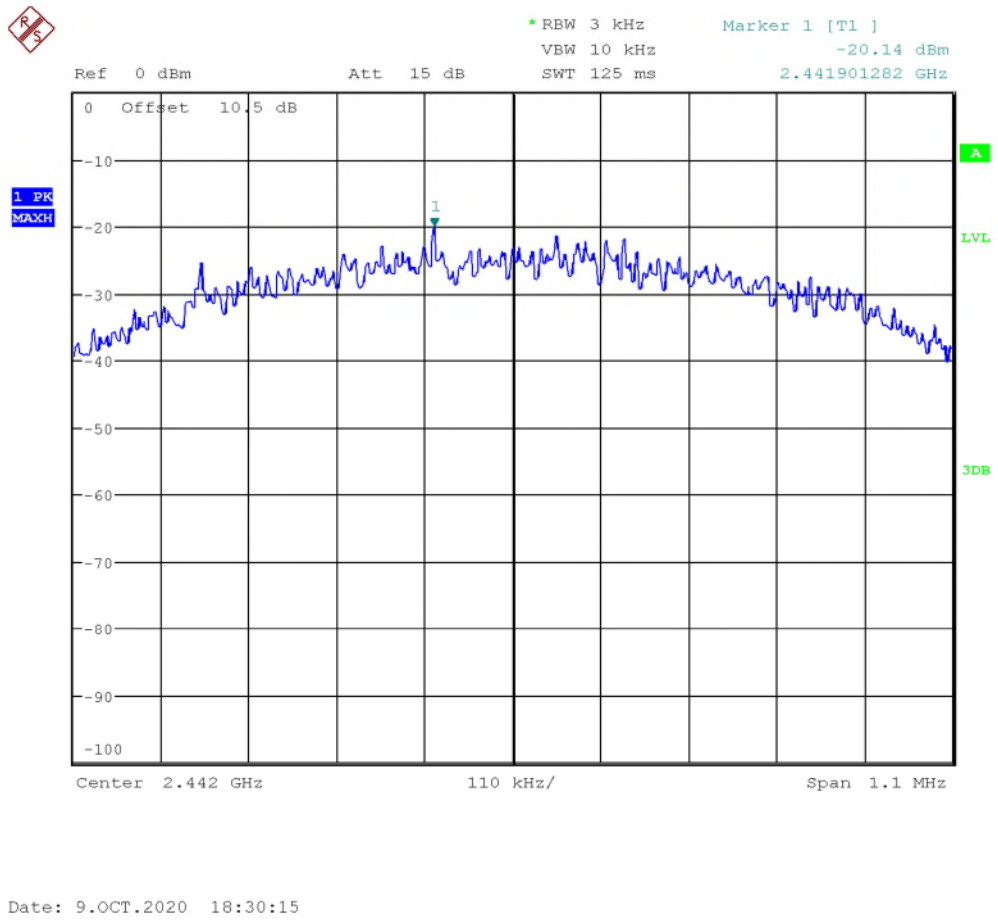
PSD
Mid Channel



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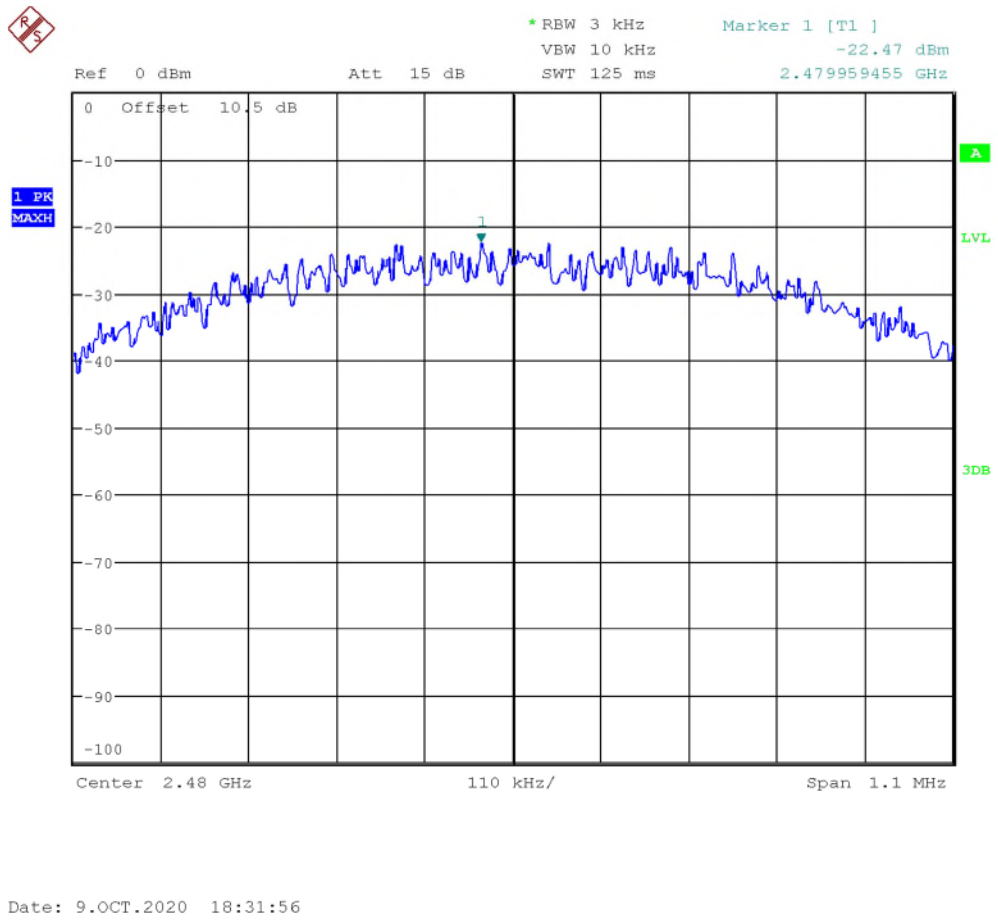
PSD
High Channel



See 'Appendix B – EUT and Test Setup Photos' for photos showing the test set-up.

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Signal Analyzer	FSQ 26	Rohde & Schwarz	Oct. 25, 2019	Oct. 25, 2021	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

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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 C63.4. The limits are as defined in FCC Part 15 Section 15.207:

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.

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

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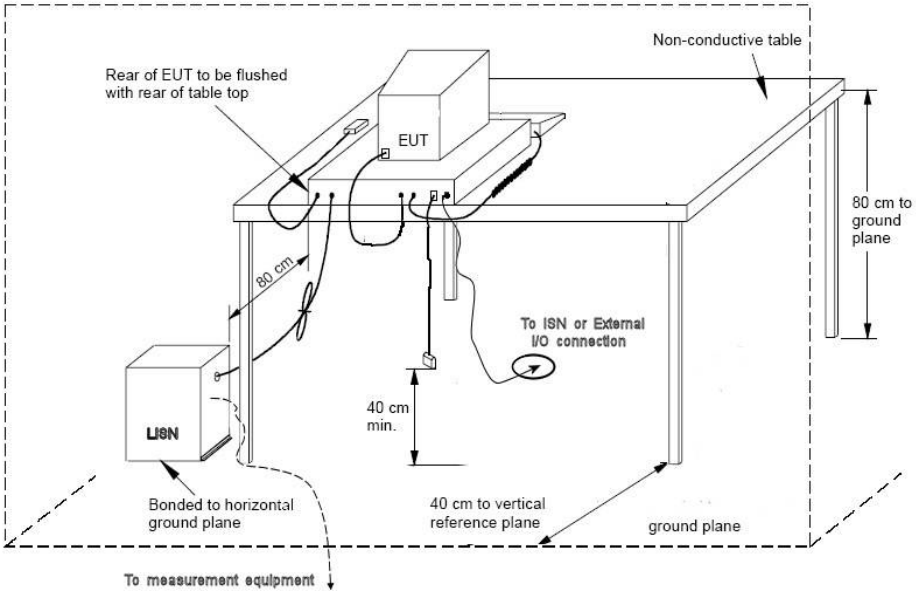
Typical Setup Diagram



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±2.27dB 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.

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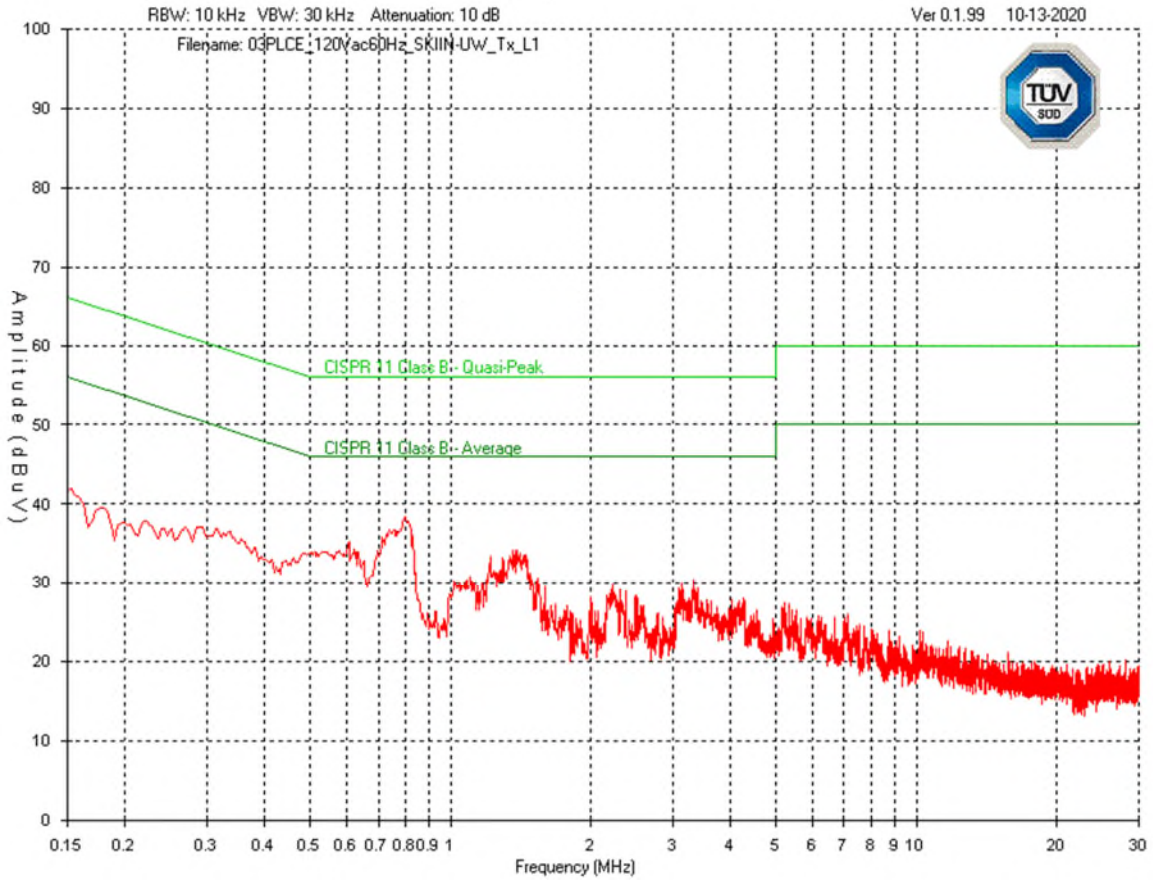
Line 1 (L1) – 120Vac 60Hz



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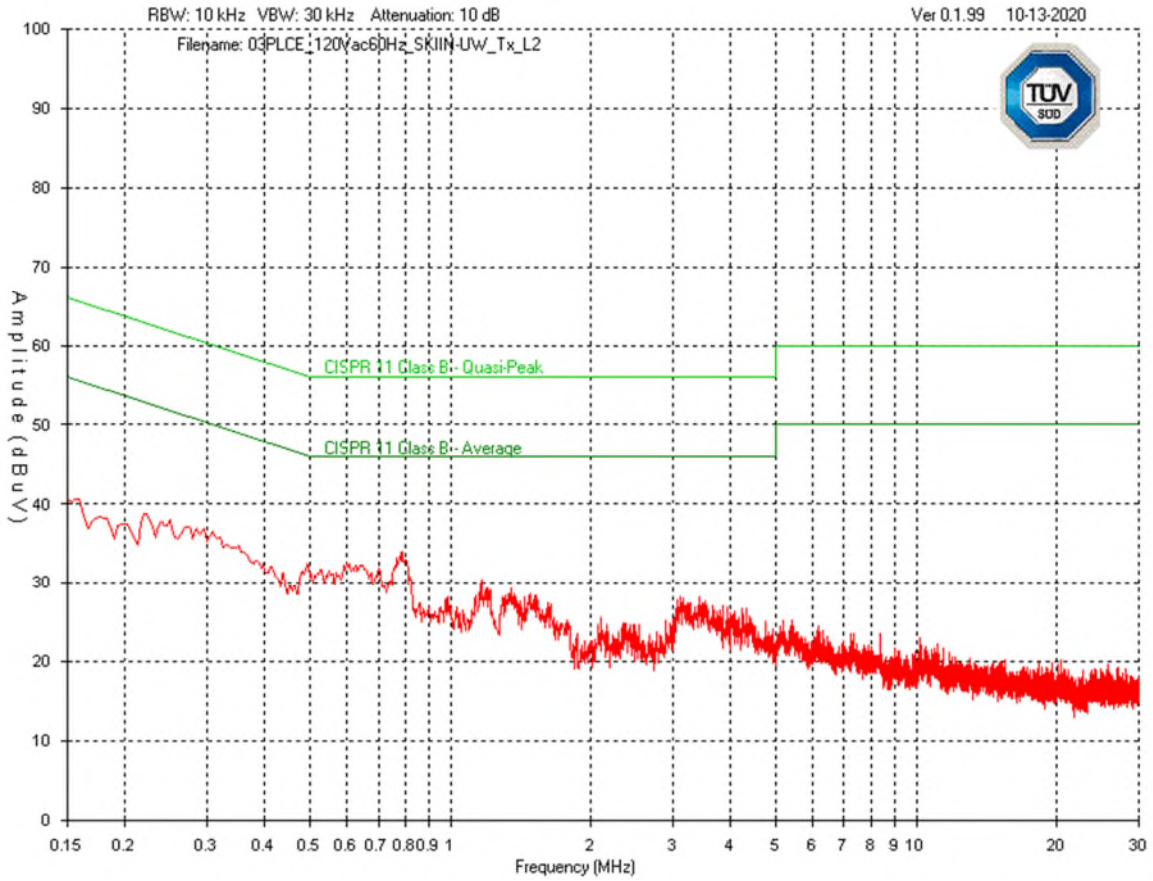
Line 2 (L2) – 120Vac 60Hz



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Final Measurements

Supply			120Vac 60Hz								
Frequency (MHz)	**Detector**	**Received Signal (dBµV)**	**Atten Factor (dB)**	**Cable Factor (dB)**	**LISN Factor (dB)**	**Level (dBµV)**	**QP Limit (dBµV)**	**AVG Limit (dBµV)**	**QP Margin (dB)**	**AVG Margin (dB)**	**Test Result**
Line 1											
0.801	PEAK	28.2	10	0.1	0.1	38.4	56.0	46.0	17.6	7.6	Pass
1.363	PEAK	24.1	10	0.1	0.1	34.3	56.0	46.0	21.7	11.7	Pass
0.153	PEAK	31.8	10	0.0	0.1	41.9	65.8	55.8	23.9	13.9	Pass
3.317	PEAK	20.3	10	0.1	0.1	30.5	56.0	46.0	25.5	15.5	Pass
2.230	PEAK	19.7	10	0.1	0.1	29.9	56.0	46.0	26.1	16.1	Pass
2.513	PEAK	18.2	10	0.1	0.1	28.4	56.0	46.0	27.6	17.6	Pass
Line 2											
0.160	PEAK	30.6	10	0.0	0.1	40.7	65.5	55.5	24.8	14.8	Pass
1.167	PEAK	20.2	10	0.1	0.1	30.4	56.0	46.0	25.6	15.6	Pass
3.118	PEAK	18.1	10	0.1	0.1	28.3	56.0	46.0	27.7	17.7	Pass
2.101	PEAK	15.5	10	0.1	0.1	25.7	56.0	46.0	30.3	20.3	Pass
10.216	PEAK	12.7	10	0.1	0.2	23.0	60.0	50.0	37.0	27.0	Pass
20.512	PEAK	9.4	10	0.1	0.8	20.3	60.0	50.0	39.7	29.7	Pass

Average and Quasi-Peak Emissions Table

Note:

Peak = Peak measurement
AVG = Average measurement
QP = Quasi-Peak measurement

See 'Appendix B – EUT, Peripherals and Test Setup Photos' for photos showing the test set-up for the highest line conducted emission

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESL 6	Rohde & Schwarz	Feb. 25, 2019	Feb. 25, 2021	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	Feb. 27, 2019	Feb. 27, 2021	GEMC 303
RF Cable 3m	LMR-400-3M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 276
Attenuator 10 dB	6N10W-10	Inmet	NCR	NCR	GEMC 350
Emissions Software	0.1.99	TUV SUD Canada, Inc.	NCR	NCR	GEMC 58

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Appendix A – EUT Summary

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

General EUT Description

Client	
Organization / Address	Myant Inc. 100 Ronson Drive Toronto, ON, M9W 1B6 Canada
Contact	Adrian Straka
Phone	416-423-7906
Email	adrian.straka@myant.ca
EUT Details	
EUT Name	SKIIN Underwear
Model	1011-001-001v8 (with Heat Flux sensor) 1011-001-001v9 (without Heat Flux sensor)
FCC ID	2AXVL-UW01
IC	26604-UW01
Equipment Category	Medical Electrical Device
Basic EUT Functionality	The SKIIN UW system captures multi-channel ECG, IMU, and ambient pod temperature data and packages this data for either internal buffering or transmission to a connected smartphone through BLE
Input Voltage	3.8Vdc Nominal
Connectors available on EUT	None
Peripherals Required for Test	Laptop to configure the test firmware on the EUT via UART
Intentional Radiator Frequency	2400 – 2483.5 MHz for BLE applications as described above.
EUT Configuration	Wireless configured to transmit continuously with the following commands: - Data Rate: 1Mbit (data_rate ble_1Mbit) - Tx Power: +4dBm (output_power pos4dBm) - Transmission Pattern: Random (transmit_pattern pattern_random) - Duty Cycle: 99% (start_tx_modulated_carrier 99)

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’.

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Appendix B – EUT and Test Setup Photos

Refer to the files separate from this test report

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