EMC & RF Test Report

As per

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

Unlicensed Intentional Radiators

on the

rES7CD Module
BLE Transmitter

Issued by:

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Testing produced for

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

Table of Contents

Report Scope

This report addresses the EMC verification testing and test results of the **rES7CD Module, with 2.4 GHz BLE Transmitter**. This unit 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.

Summary

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

EUT:	rES7CD Module – BLE
FCC Certification #, FCC ID:	2ADCB-RES7CD
Industry Canada Certification #, IC:	6715C-RES7CD
EUT passed all tests performed	Yes
Tests conducted by	Raymond Au
Report reviewed by	Amir Emami

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	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.

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 is available with the following antenna models, each with less than 6 dBi gain:

- (122-00067-001) Pulse Electronics, 2.4GHz Helical SMD Antenna, Model: W3108, 1.5dBi max gain (Ref: Pulse SMD)
- (122-00060-001) Pulse Electronics, Nitinol Wire Monopole Antenna, Model: W9032, 3dBi max gain (Ref: Chicago Plenum Dual-Band)
- (801-00851-001/2) Pulse Electronics, Stick Monopole Antenna, Model: W1990XXX, 1dBi max gain (Ref: Stubby Dual-Band)

Transmitter spurious radiated emissions and band edges have been evaluated on all three antenna configurations. See *Appendix A* for EUT and antenna configuration details.

All testing is performed while constantly transmitting modulated data at its maximum power (BLE output set to “67”).

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 PCB was tested positioned in the three orthogonal axes while coupled with the Chicago Plenum Dual-Band and Stubby Dual-Band antennas in the three orthogonal axes. Worst case results are presented, and occurs with the PCB positioned upright, the Chicago Plenum Dual-Band positioned horizontally, and the Stubby Dual-Band positioned vertically during BLE testing. See *Appendix B* for test photos.

The EUT was configured to 100% duty cycle for testing purposes. However, as declared by the manufacturer, in production, the EUT has a maximum fixed (source based) duty cycle of 4.88% (4.88ms on time/100ms). The duty cycle cannot be changed or modified by either the device or the end user. As per C63.10 Section 7.5 and KDB 558074 Section 8.1, for the average radiated emission measurements of the band edges and of the spurious emissions in the restricted bands, the duty cycle correction factor of 4.88% [20log(4.88%) = -26.23dB] was applied to the peak measurement to obtain the average measurement.

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)

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

Document Revision Status

Revision	Date	Description	Initials
000	December 16, 2020	Initial Release	RA
-	-	-	-

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.

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.

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)
December 1 2020	Radiated Emissions (Chicago Plenum antenna)	RA	20.1	25.7	100.0
December 2 2020	Radiated Emissions (Stubby Dual-Band & Pulse SMD antennas)	RA	22.2	20.9	101.1
December 8, 2020	Antenna Conducted Emissions	RA	21.8	16.7	101.5
December 10, 2020	Power Line Conducted Emissions	AE	23.1	25.1	101.3

Detailed Test Results Section

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 683 kHz
The maximum 99% Occupied Bandwidth was 1043 kHz.

uFL connector (Output to Chicago Plenum or Stubby Dual-Band antennas)			
Channel	**Frequency (MHz)**	**6 dB Bandwidth (MHz)**	**99% Bandwidth (MHz)**
Low	2402	0.697	1.038
Mid	2440	0.692	1.038
High	2480	0.683	1.038

Output to Pulse SMD antenna			
Channel	**Frequency (MHz)**	**6 dB Bandwidth (MHz)**	**99% Bandwidth (MHz)**
Low	2402	0.697	1.038
Mid	2440	0.697	1.038
High	2480	0.692	1.043

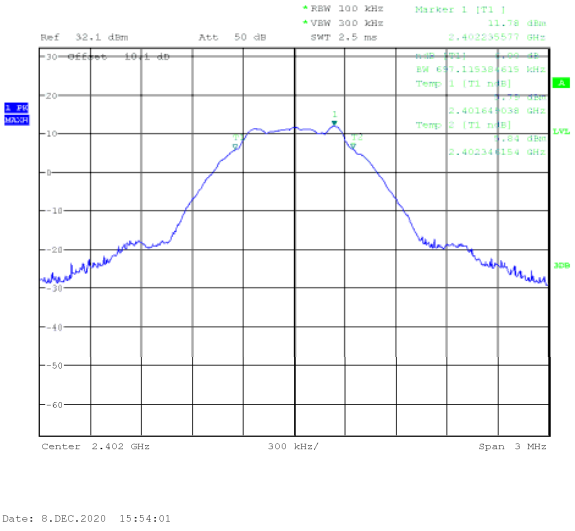
Graphs

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.

uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

6dB Bandwidth

Low Channel (2402MHz)



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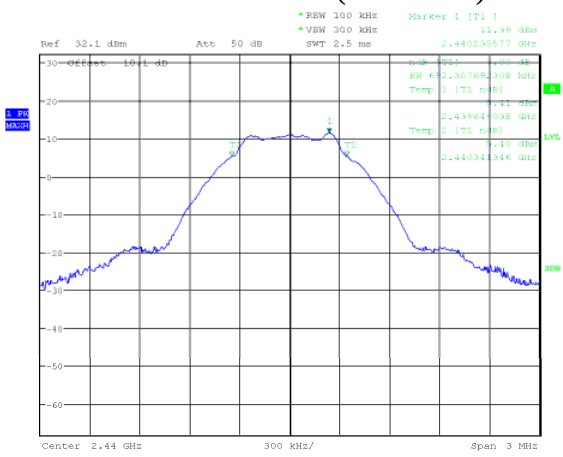
Mid Channel (2440MHz)



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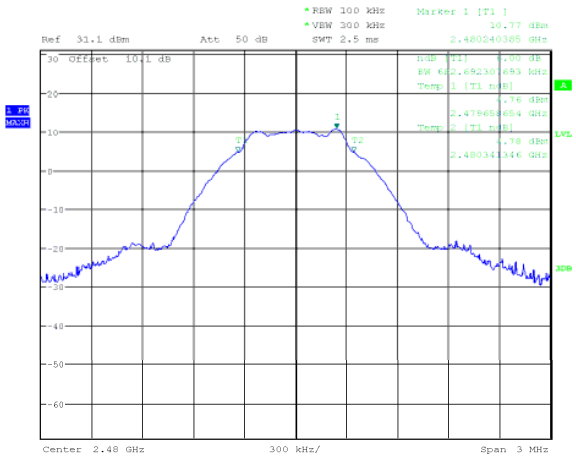
High Channel (2480MHz)



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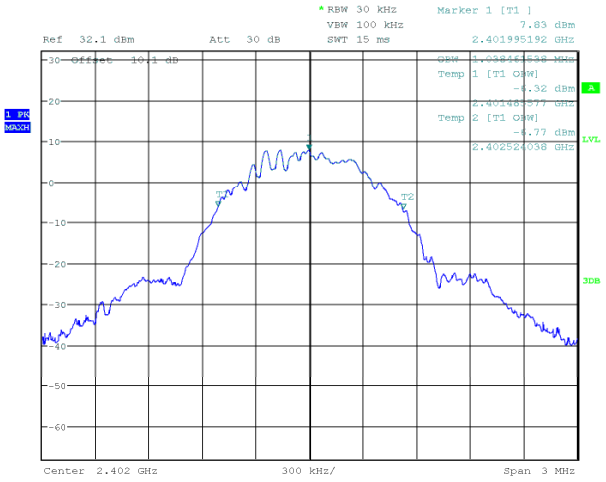
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

99% Bandwidth

Low Channel (2402MHz)



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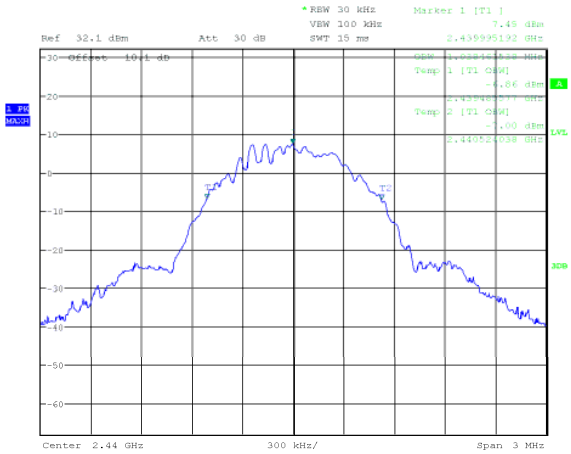
Mid Channel (2440MHz)



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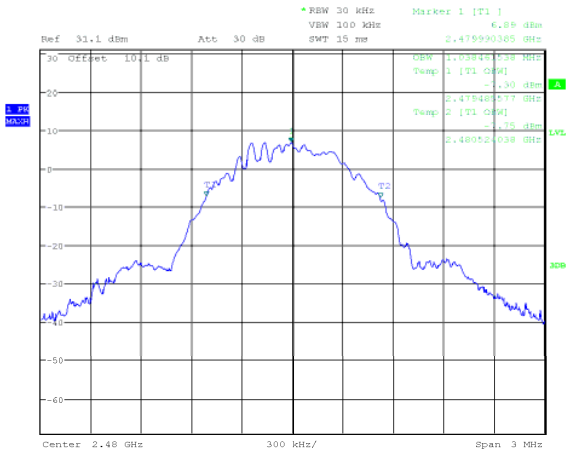
High Channel (2480MHz)



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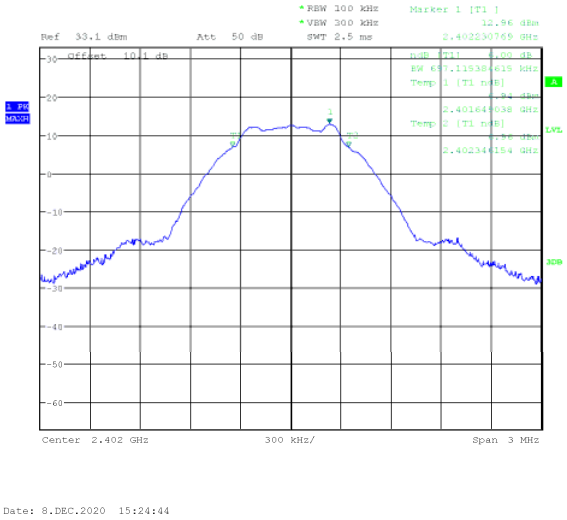
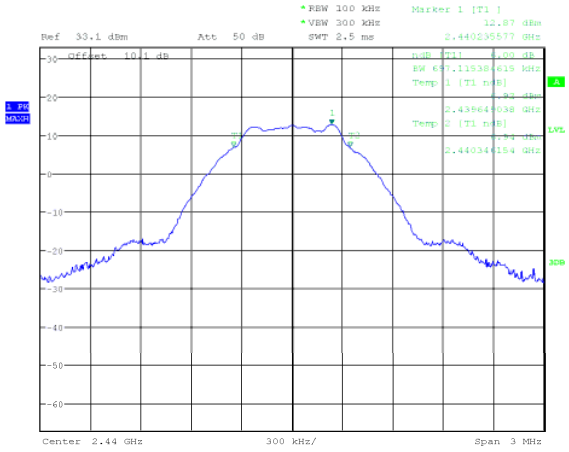
Output to Pulse SMD antenna

6dB Bandwidth

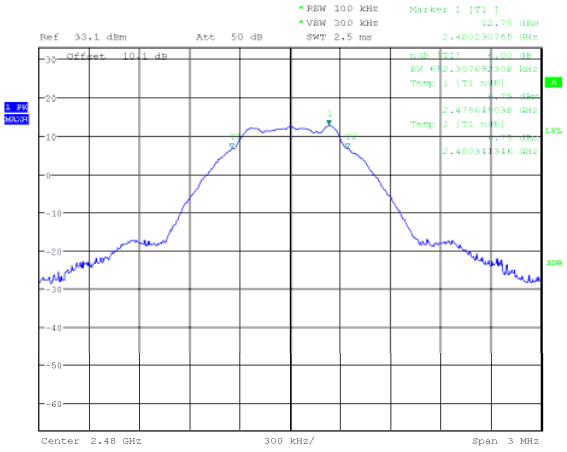
Low Channel (2402MHz)



Mid Channel (2440MHz)



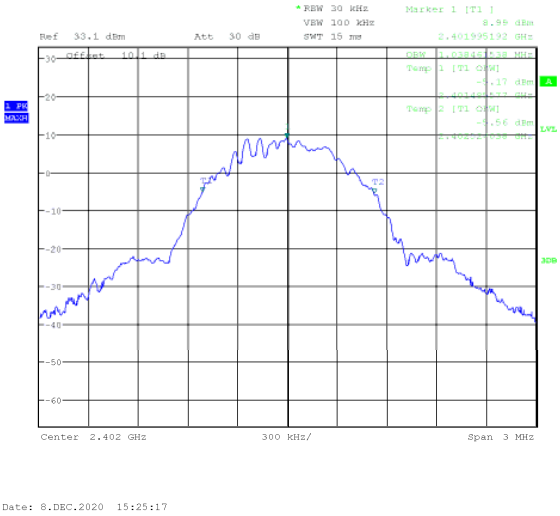
High Channel (2480MHz)



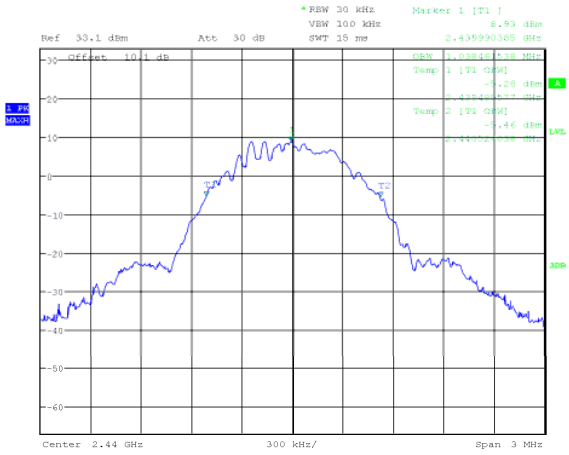
Output to Pulse SMD antenna

99% Bandwidth

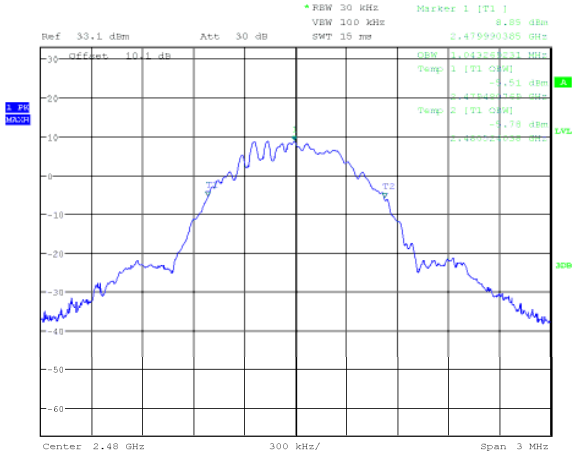
Low Channel (2402MHz)



Mid Channel (2440MHz)



High Channel (2480MHz)



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

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	FSU 26	Rohde & Schwarz	Oct. 28, 2019	Oct. 28, 2021	GEMC 231
Attenuator 10 dB	18N5W-10	Inmet	NCR	NCR	GEMC 358

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.

Output to Pulse SMD antenna			
Channel	**Frequency (MHz)**	**Peak Power (dBm)**	**Peak Power (mW)**
Low	2402	13.98	25.00
Mid	2440	13.91	24.60
High	2480	13.78	23.88

uFL connector (Output to Chicago Plenum or Stubby Dual-Band antennas)			
Channel	**Frequency (MHz)**	**Peak Power (dBm)**	**Peak Power (mW)**
Low	2402	12.81	19.10
Mid	2440	12.46	17.62
High	2480	11.85	15.31

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

Graphs

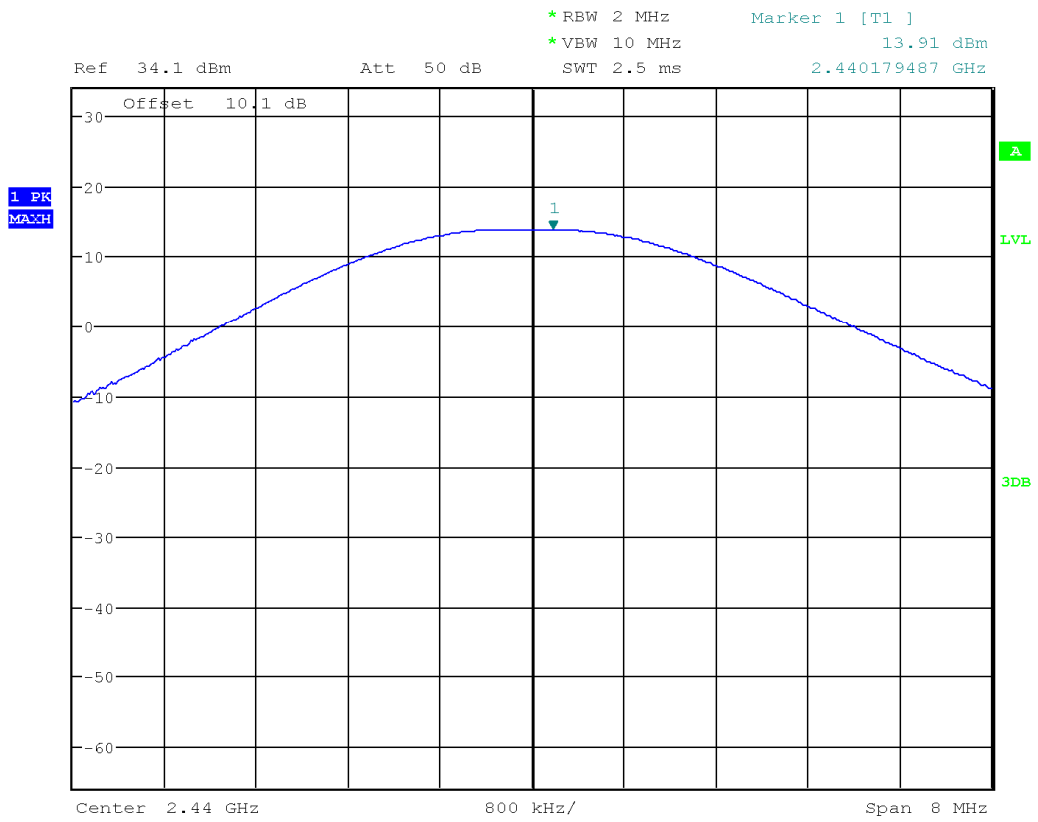
The graphs shown below show the peak power output of the device during the conducted measurement operation of the EUT. The measurement RBW is ≥ than the DTS bandwidth.

Peak Power
Output to Pulse SMD antenna

Low Channel

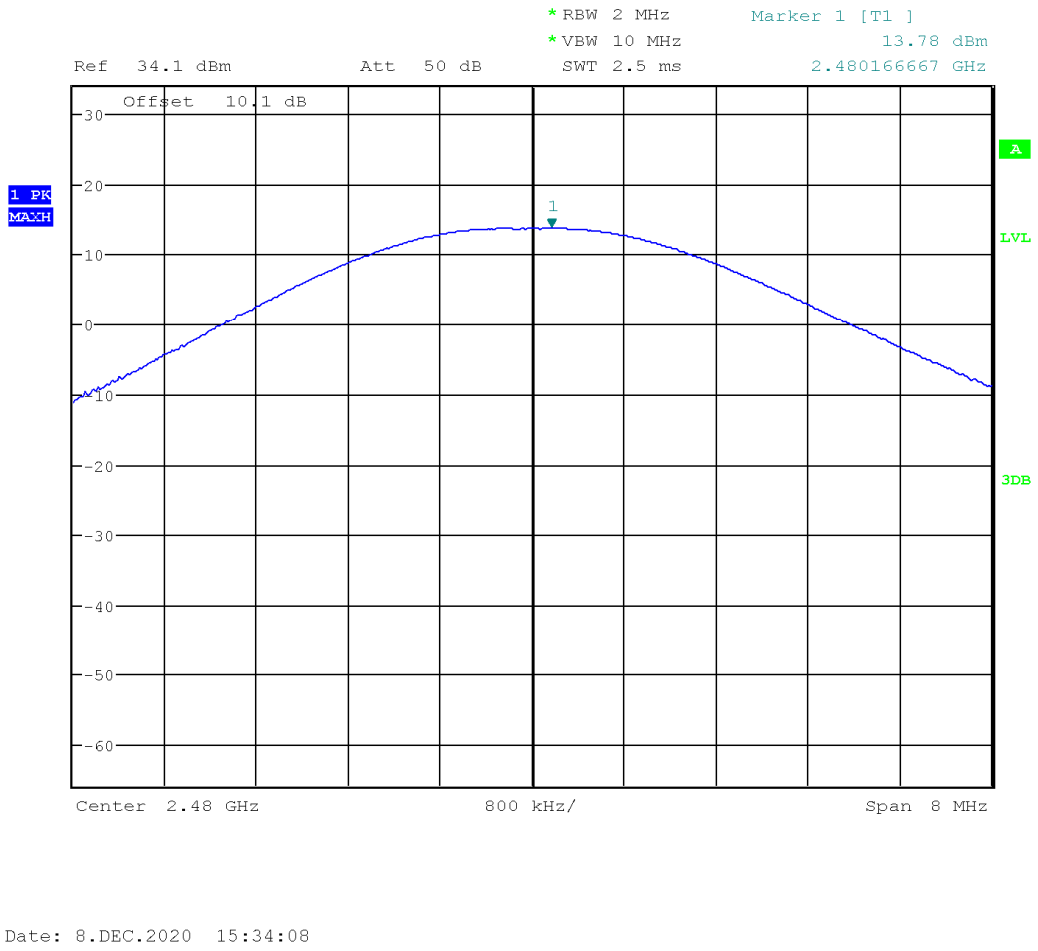
Peak Power
Output to Pulse SMD antenna

Mid Channel



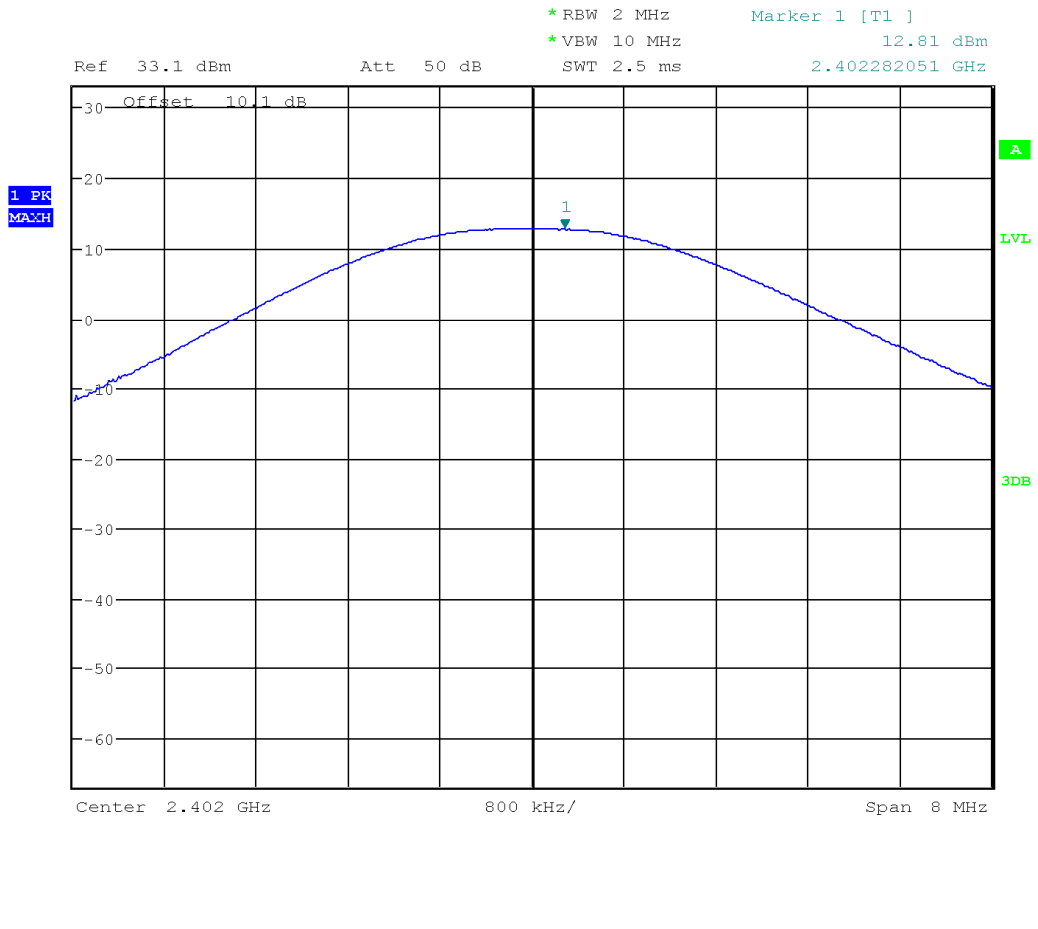
Peak Power
Output to Pulse SMD antenna

High Channel



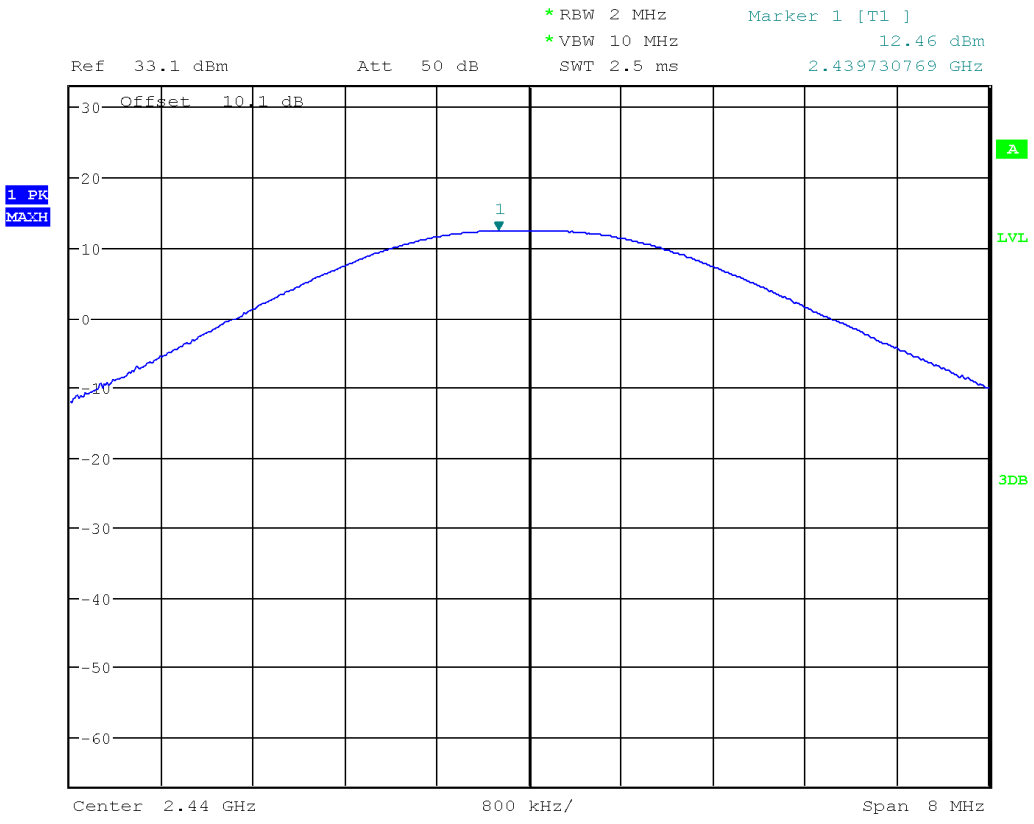
Peak Power
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

Low Channel



Peak Power
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

Mid Channel



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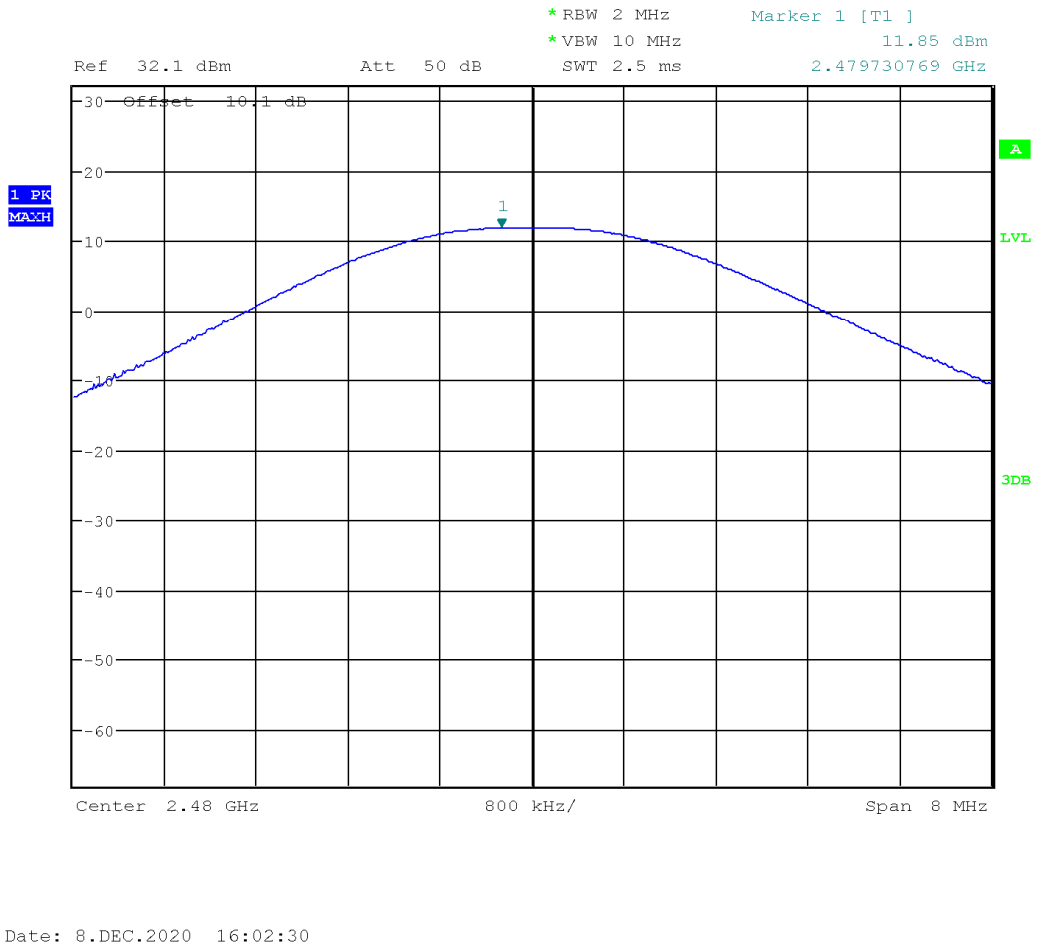
Peak Power
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

High Channel



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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
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Attenuator 10 dB	18N5W-10	Inmet	NCR	NCR	GEMC 358

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 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 FCC KDB 558074 Section 11 and ANSI C63.10

Results

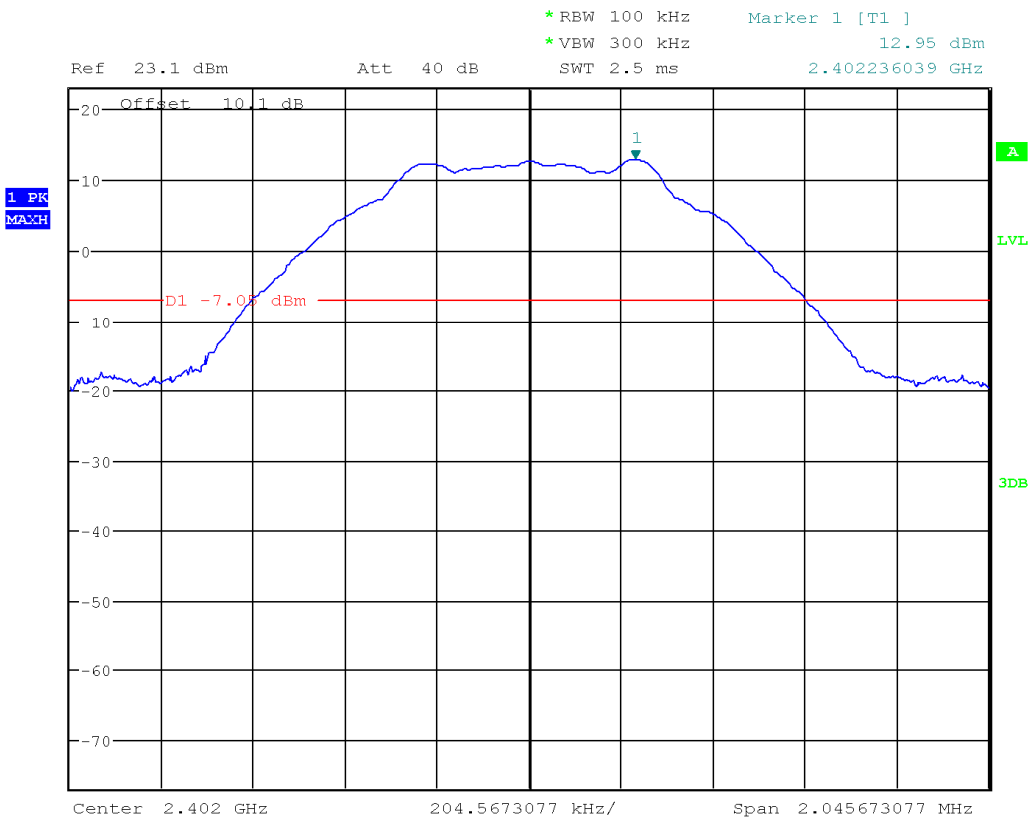
The EUT passed. Low, middle and high bands were measured. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band and for the higher band edge at 2.4835 GHz in the high band.

Graphs

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

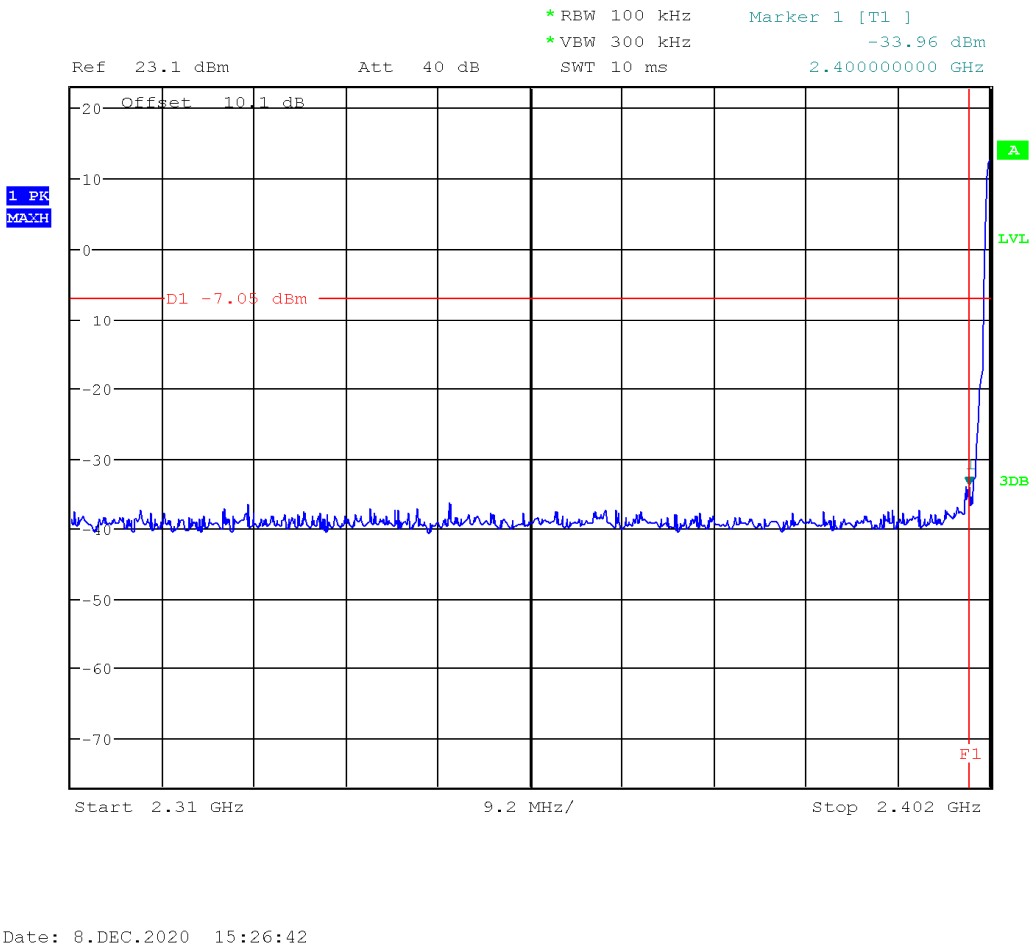
-20dBc – Low Channel
Output to Pulse SMD antenna

Reference Level: -7.05 dBm



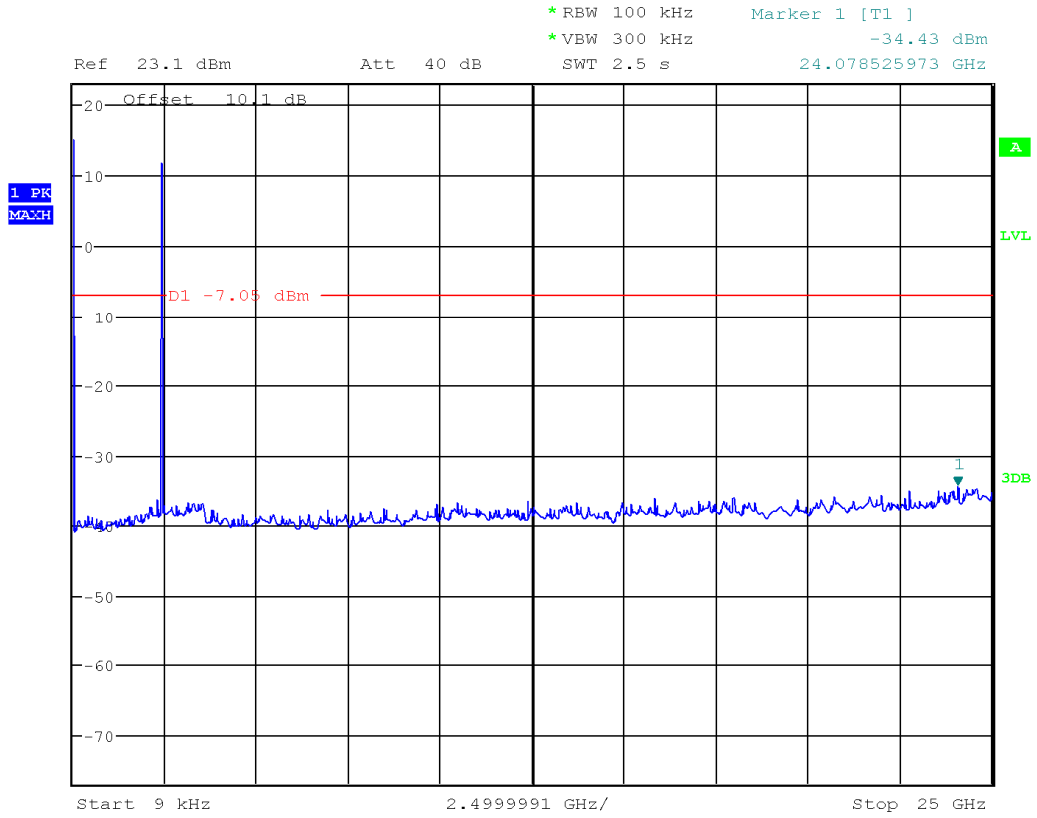
-20dBc – Low Channel
Output to Pulse SMD antenna

2400 MHz Band Edge



-20dBc – Low Channel
Output to Pulse SMD antenna

9kHz – 25GHz



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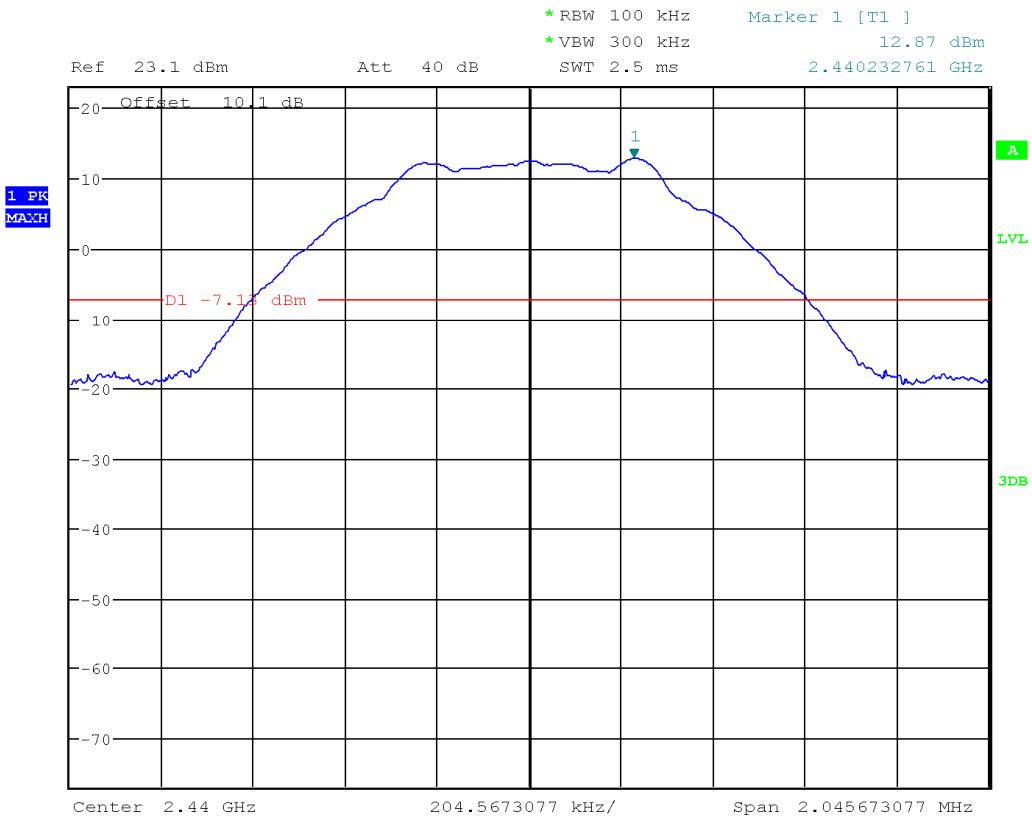
-20dBc – Mid Channel
Output to Pulse SMD antenna

Reference Level: -7.13 dBm



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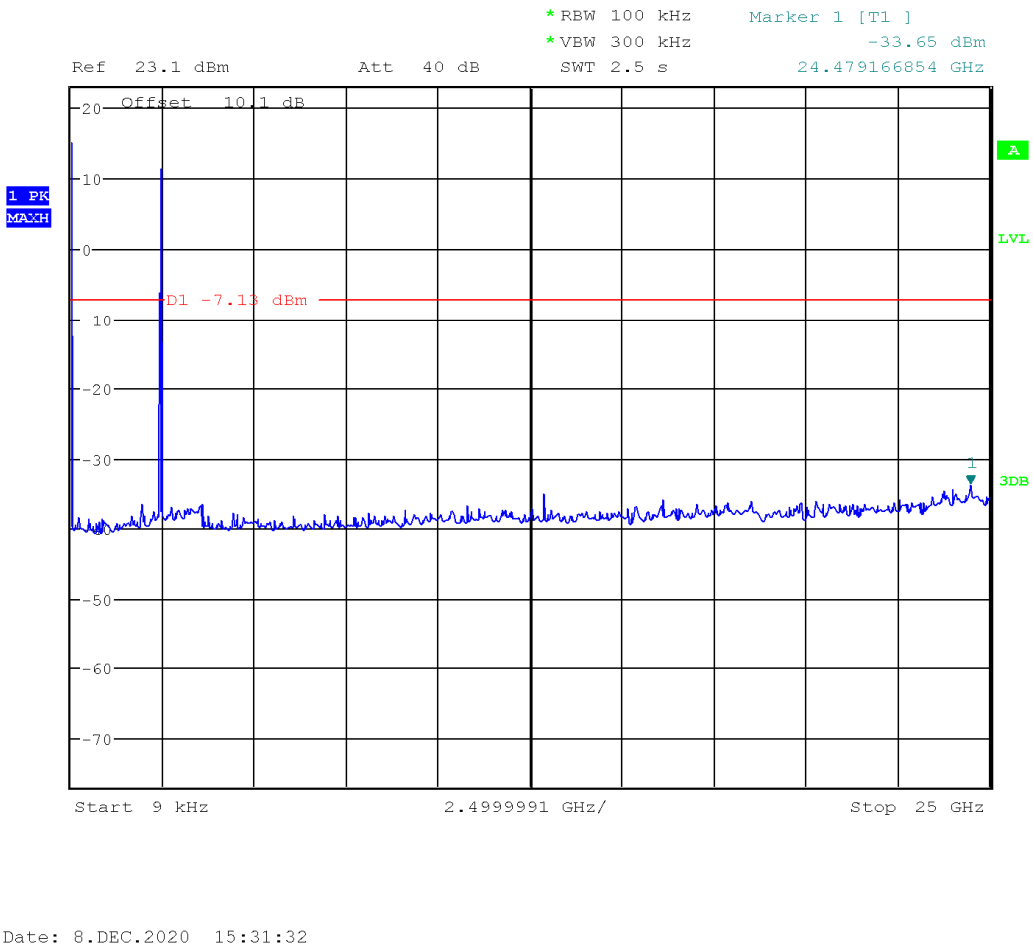
-20dBc – Mid Channel
Output to Pulse SMD antenna

9kHz – 25GHz



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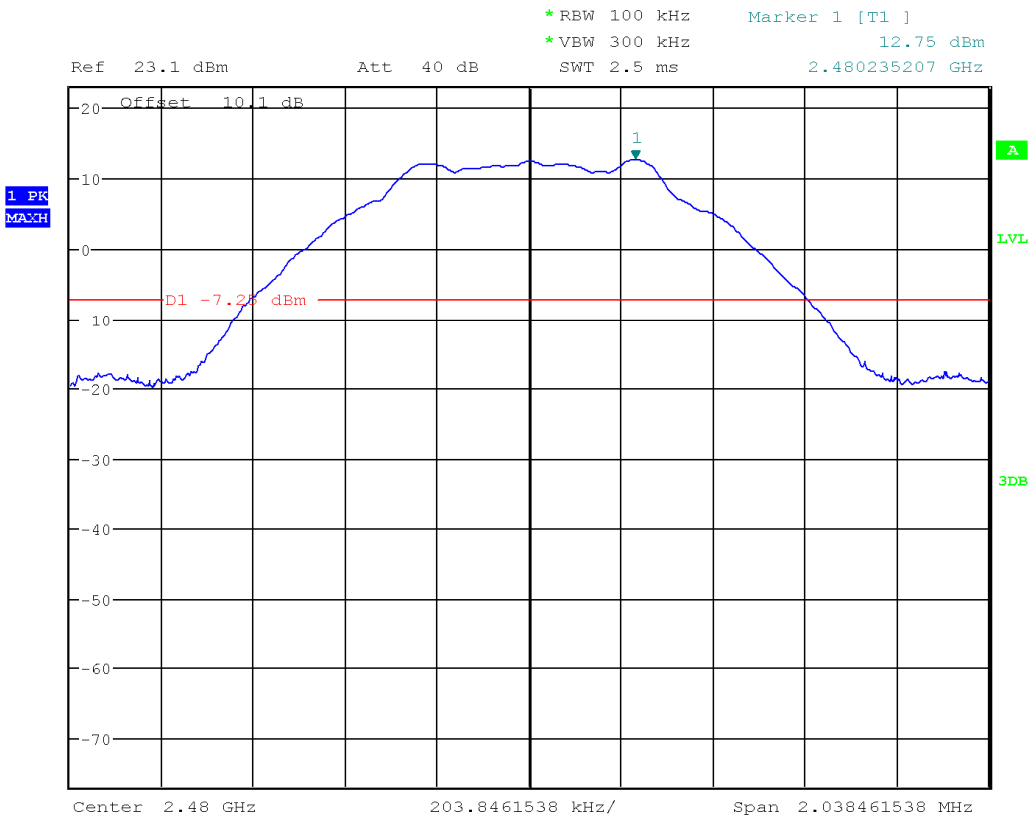
-20dBc – High Channel
Output to Pulse SMD antenna

Reference Level: -7.25 dBm



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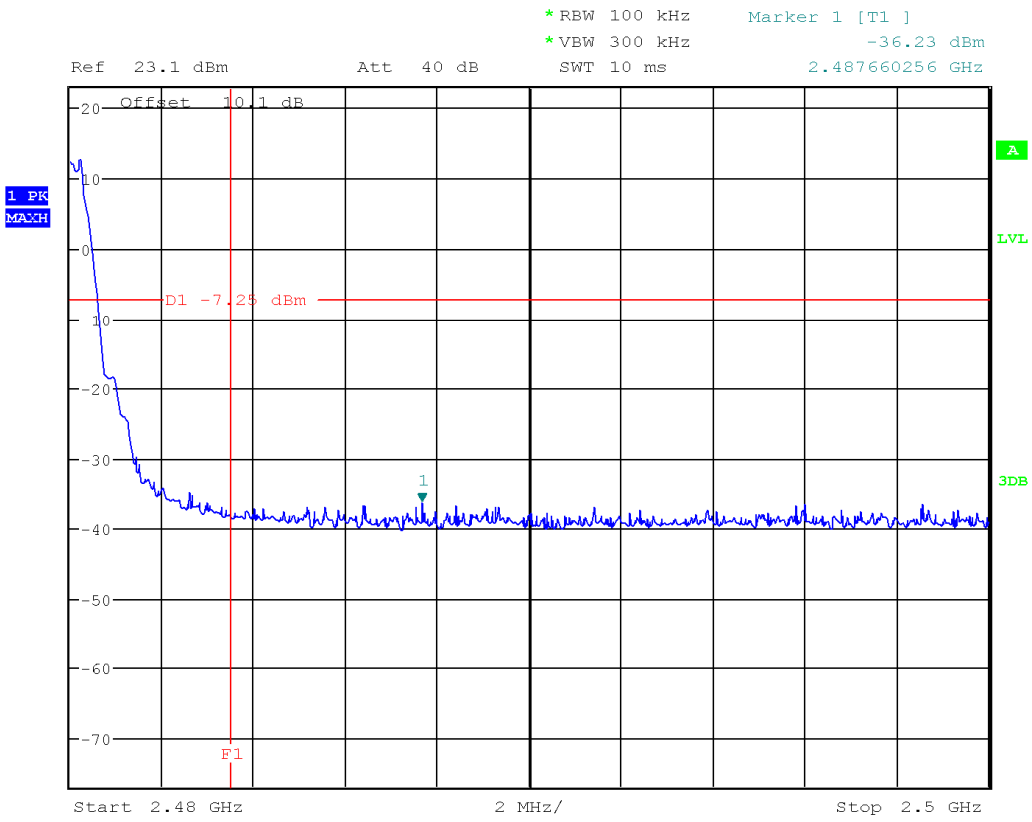
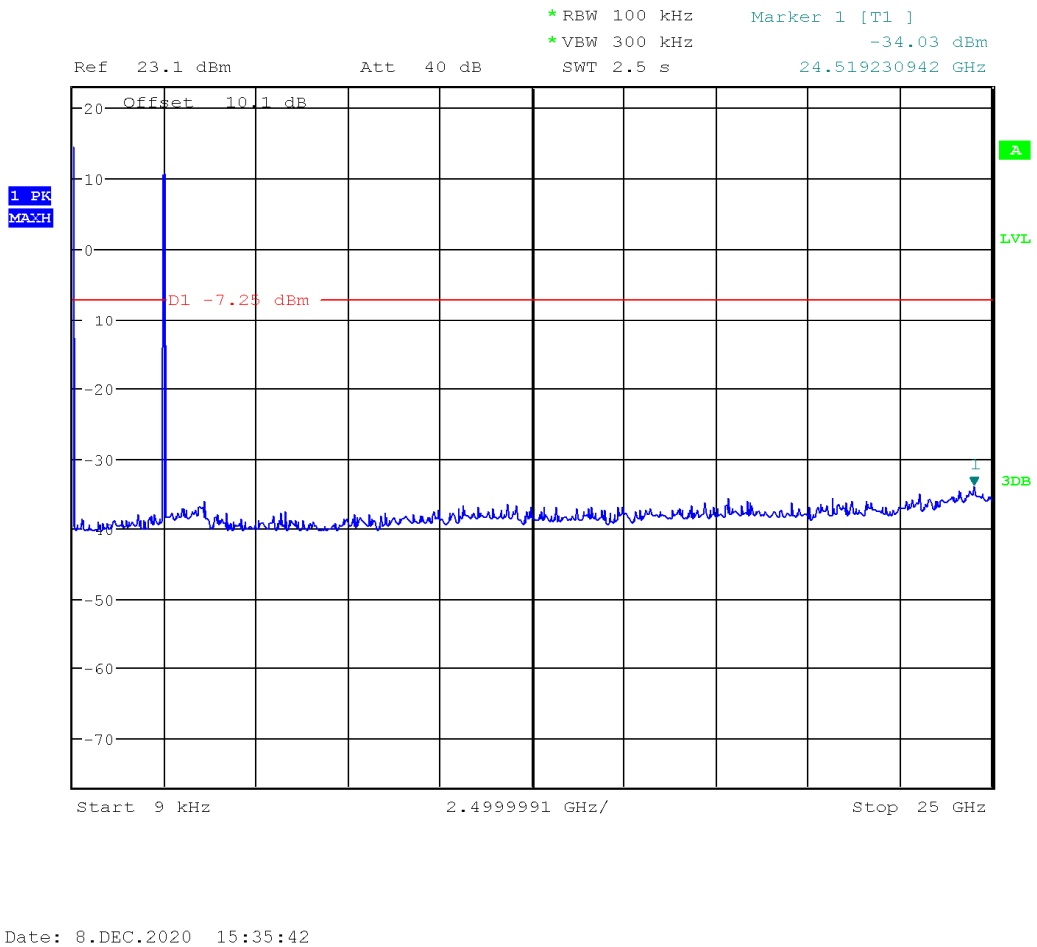
-20dBc – High Channel
Output to Pulse SMD antenna

2483.5 MHz Band Edge



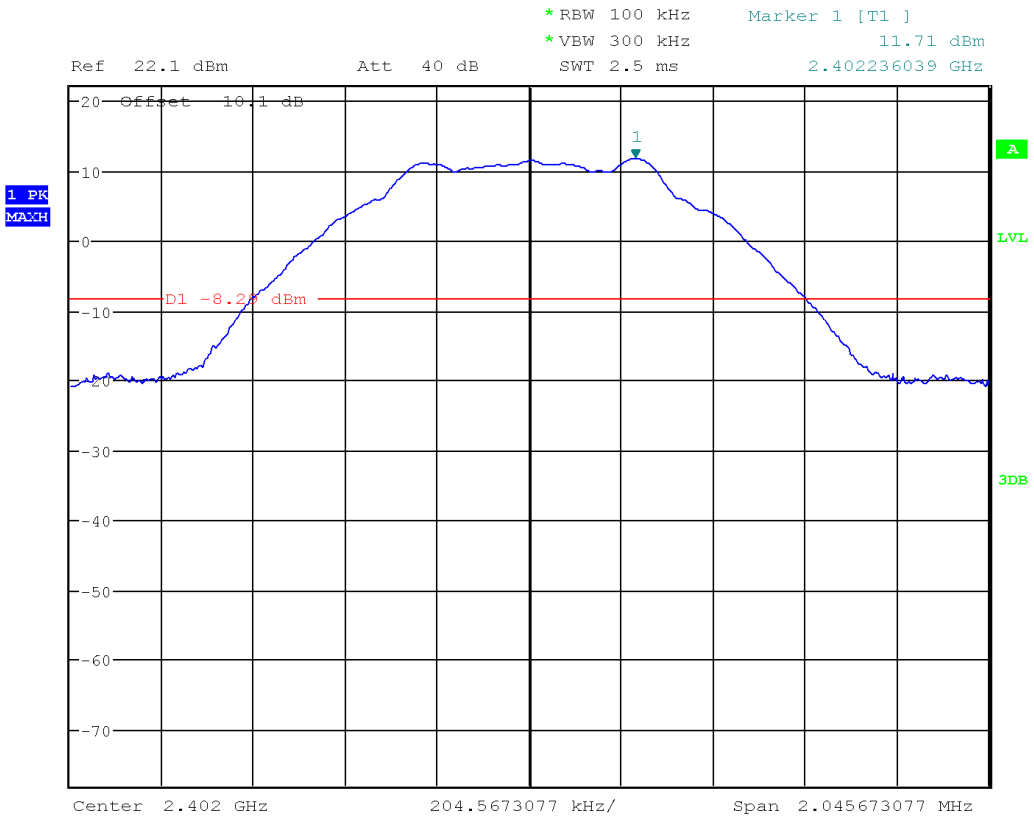
-20dBc – High Channel
Output to Pulse SMD antenna

9kHz – 25GHz



-20dBc – Low Channel
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

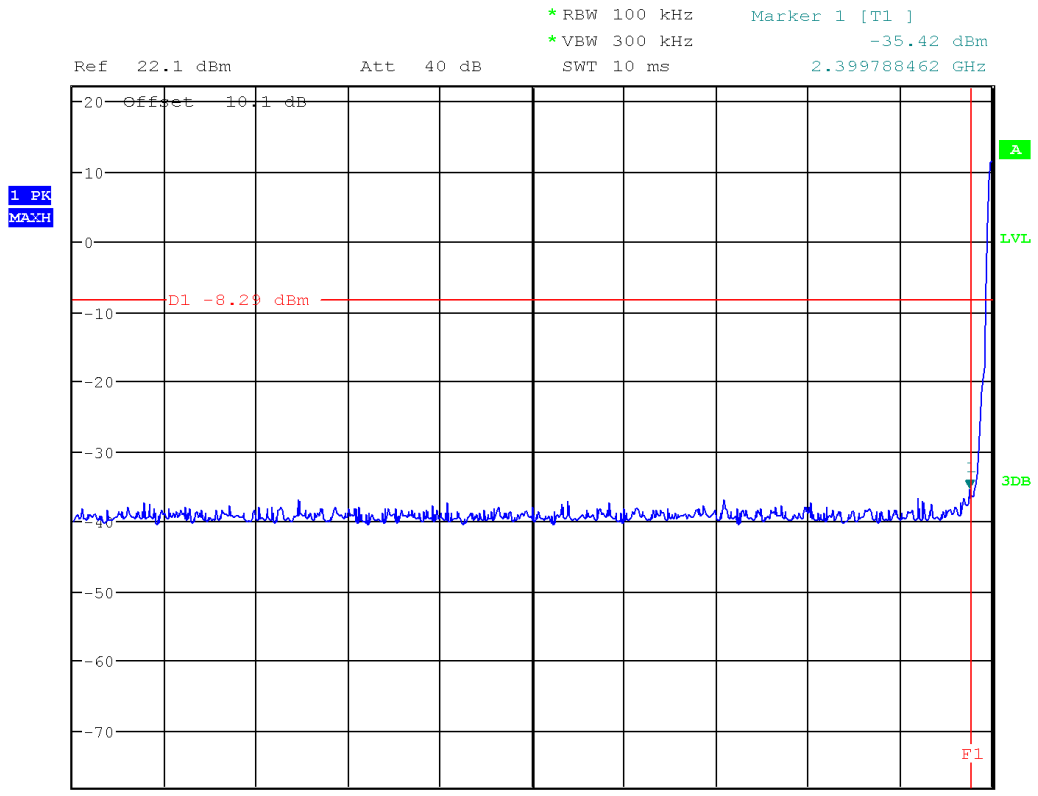
Reference Level: -8.25 dBm



Date: 8.DEC.2020 15:55:44

-20dBc – Low Channel
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

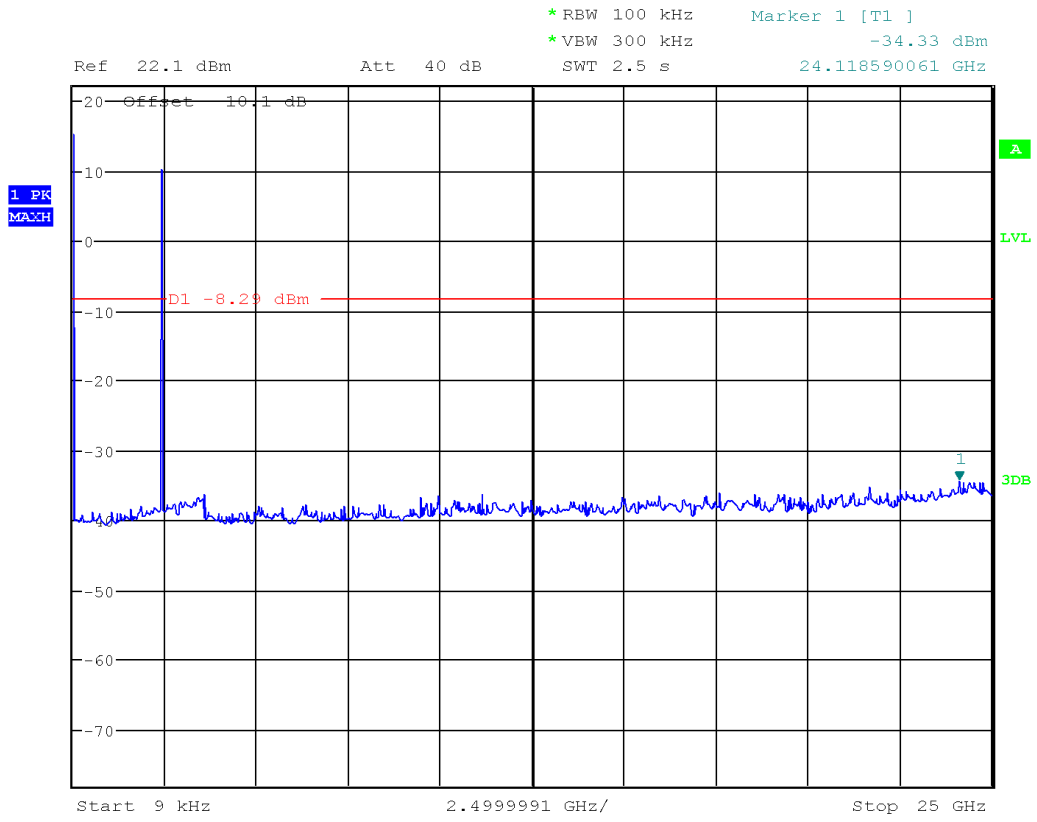
2400 MHz Band Edge



Date: 8.DEC.2020 15:56:01

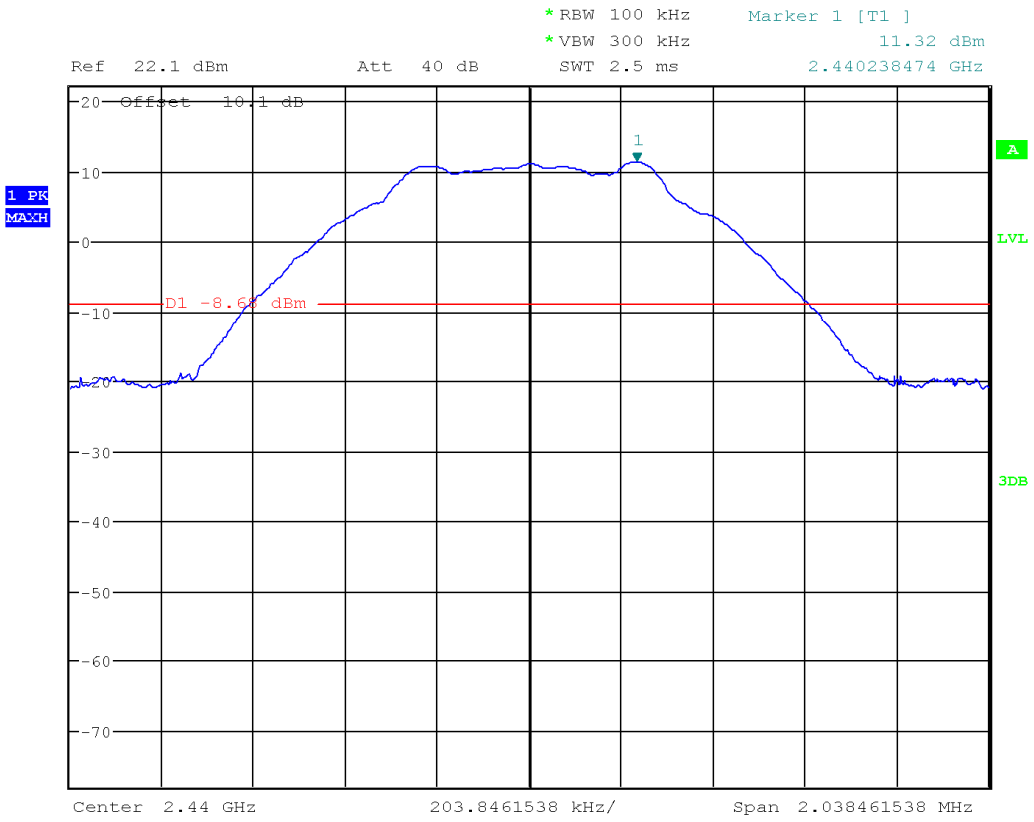
-20dBc – Low Channel
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

9kHz – 25GHz



-20dBc – Mid Channel
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

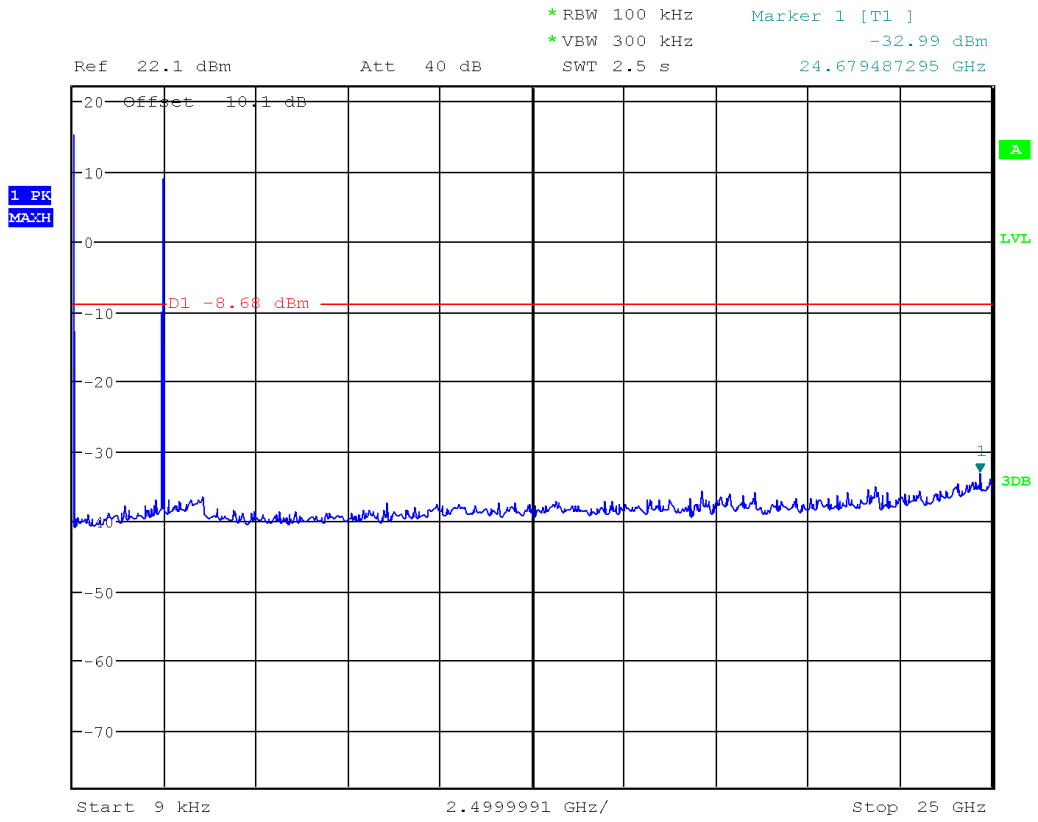
Reference Level: -8.68 dBm



Date: 8.DEC.2020 15:59:10

-20dBc – Mid Channel
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

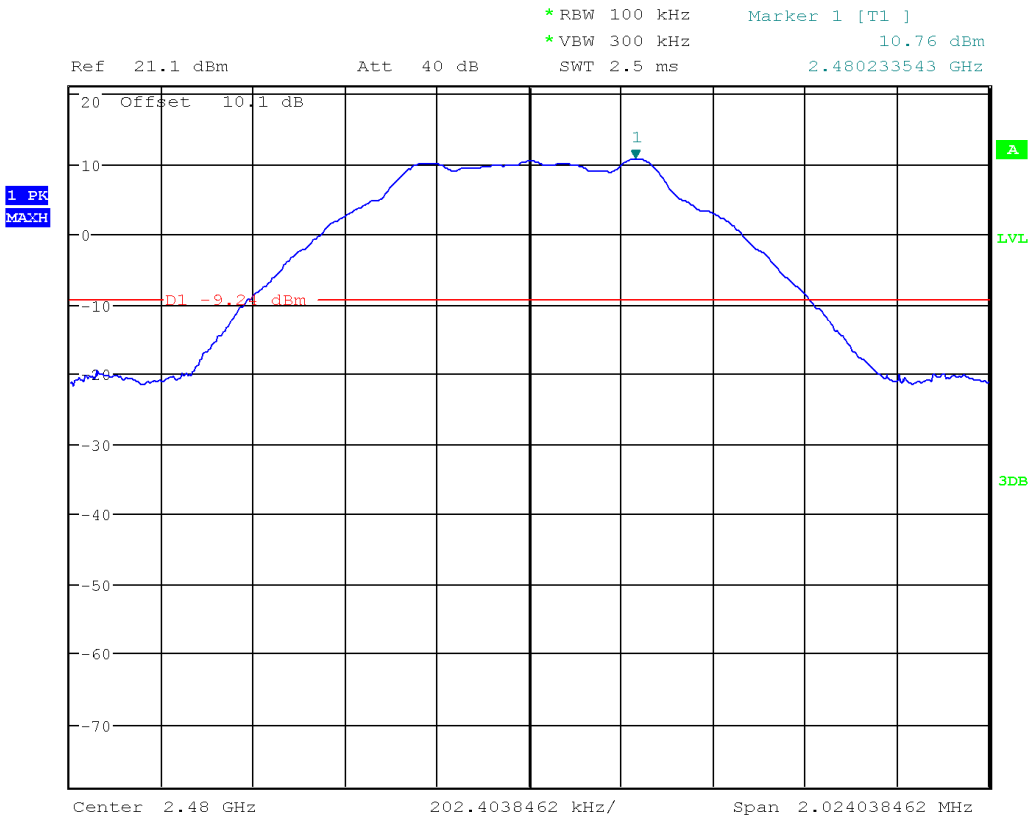
9kHz – 25GHz



Date: 8.DEC.2020 15:59:32

-20dBc – High Channel
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

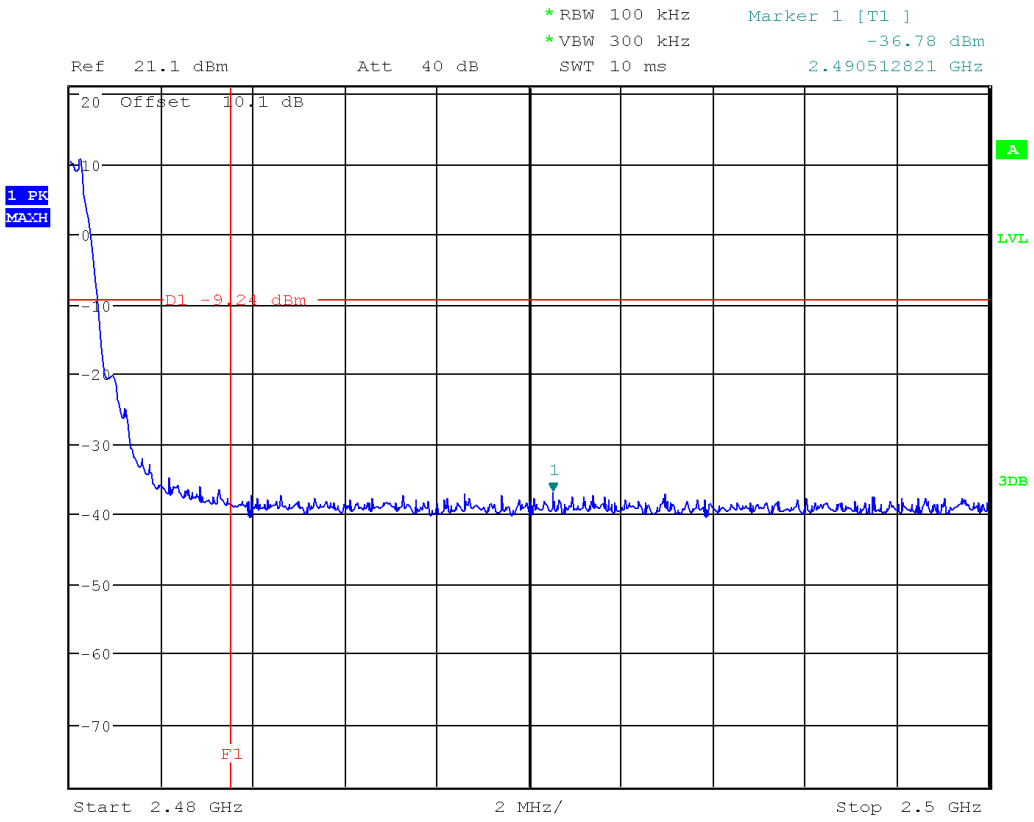
Reference Level: -9.24 dBm



Date: 8.DEC.2020 16:03:25

-20dBc – High Channel
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

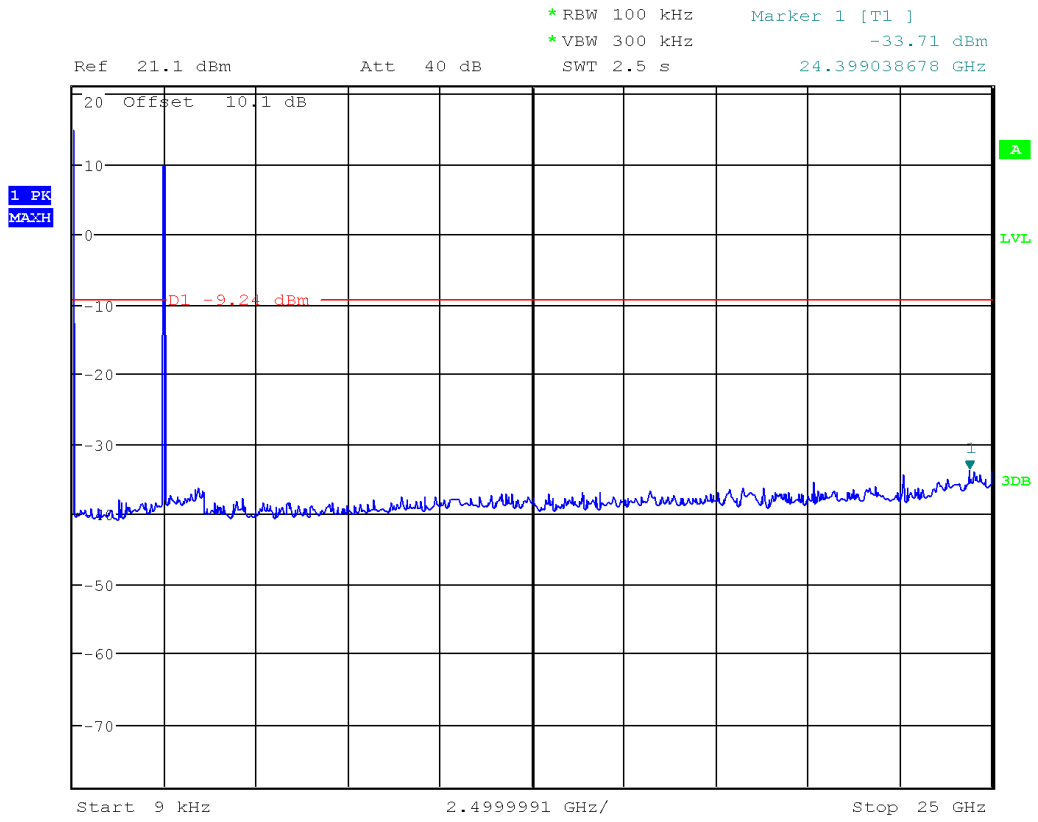
2483.5 MHz Band Edge



Date: 8.DEC.2020 16:03:42

-20dBc – High Channel
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

9kHz – 25GHz



Date: 8.DEC.2020 16:04:04

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

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	FSU 26	Rohde & Schwarz	Oct. 28, 2019	Oct. 28, 2021	GEMC 231
Attenuator 10 dB	18N5W-10	Inmet	NCR	NCR	GEMC 358

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).

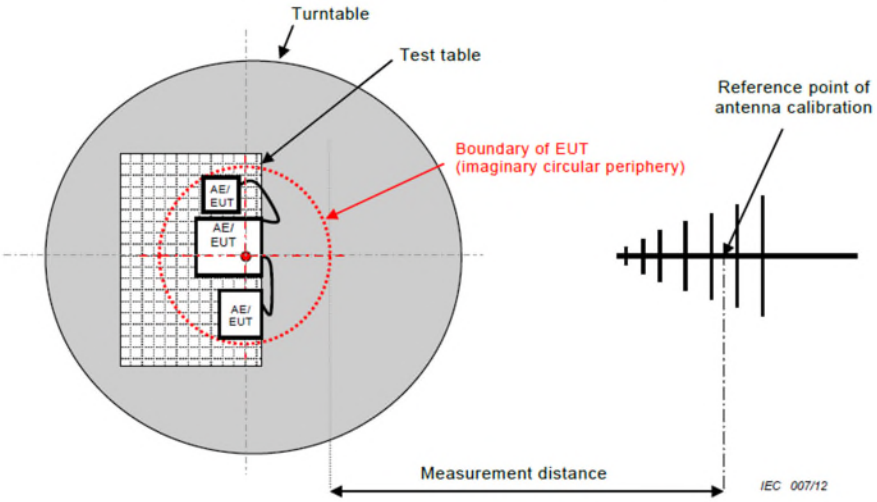
All unintentional emissions must also meet the 'Spurious Conducted Emissions' requirements of -20 dBc or greater. See also 'Antenna Spurious Conducted Emissions (-20dBc)' for further details.

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.

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 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.

Peak output power for low, middle and high channels and each of the orthogonal axes of the PCB and antennas were checked. The worst case was used for the spurious emissions for each antenna, all of which occurred at low channel.

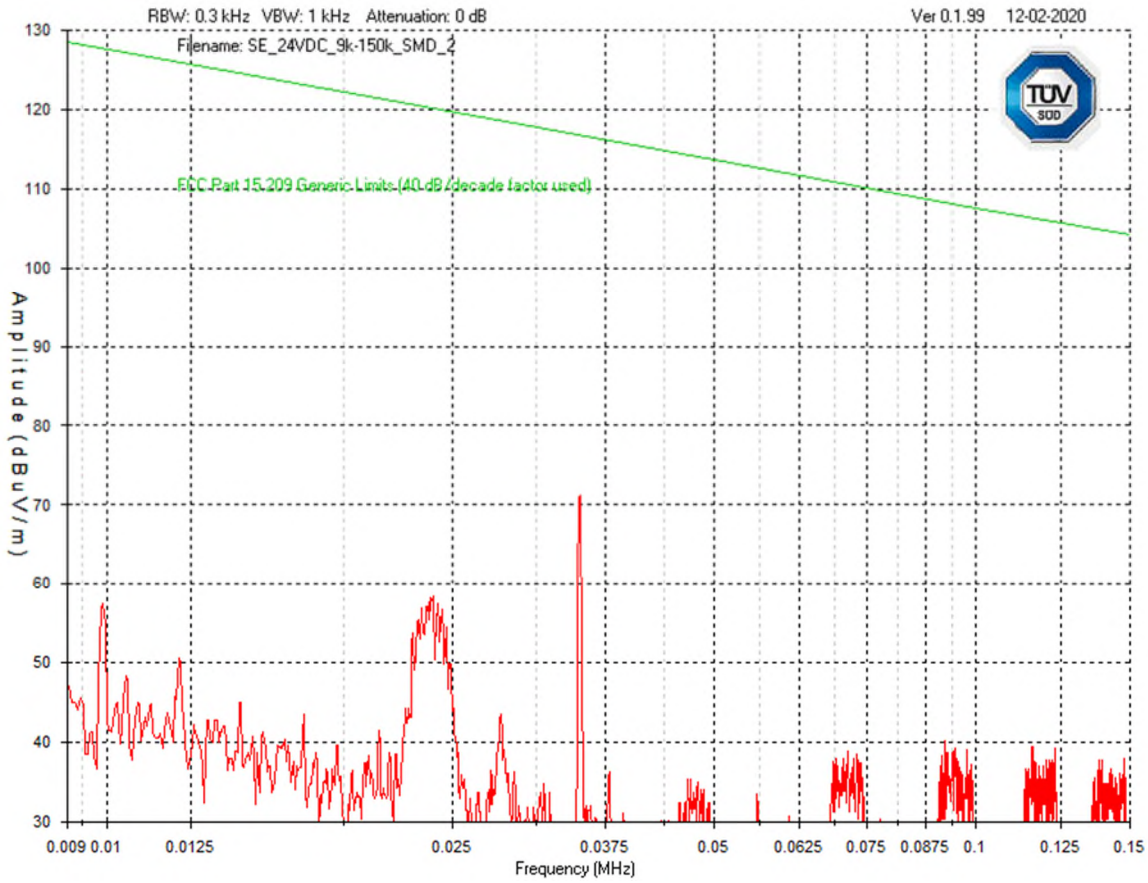
Band-edge measurement graphs are shown for illustration purposes. See final measurement section for all measurements. Graphs for the worst-case, are presented.

Note: A duty cycle correction factor of -26.23dB (from a duty cycle of 4.88% for the 2.4 GHz transmission) is applied to the high band edges at 2483.5 MHz.

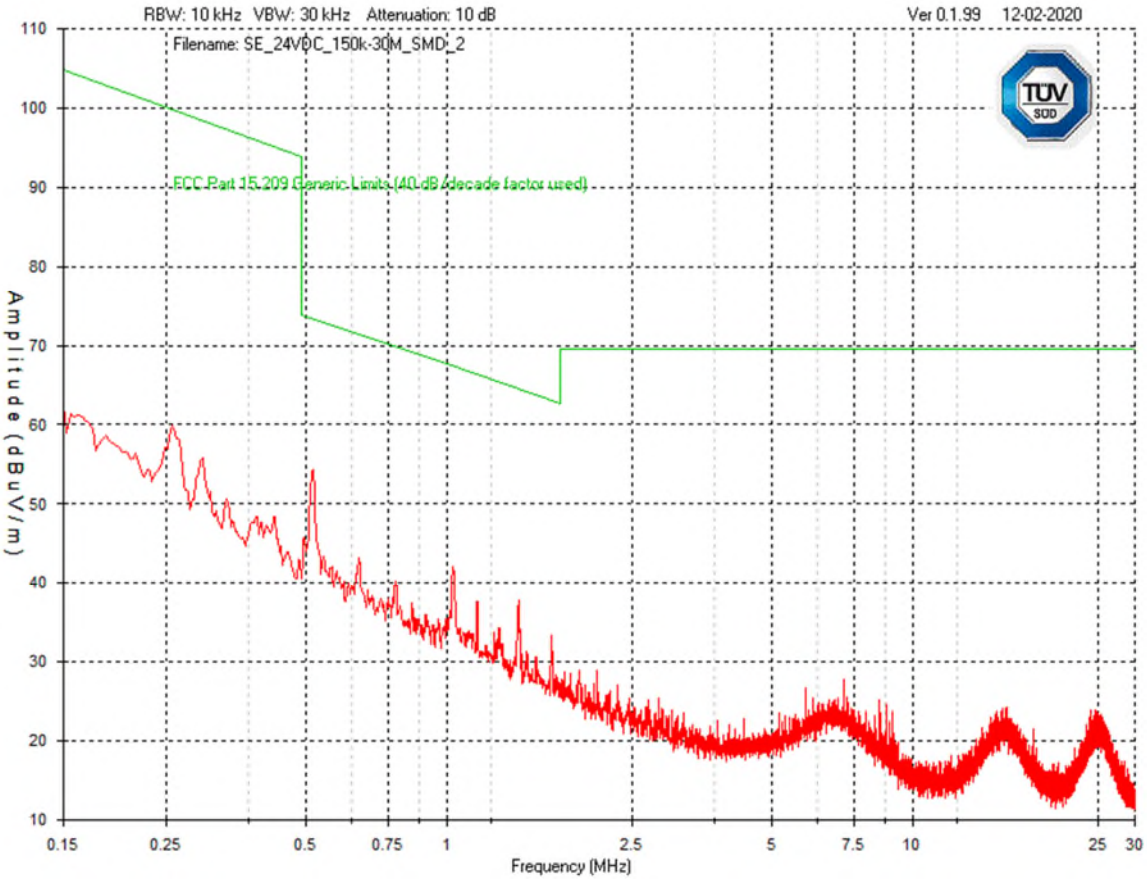
Pulse SMD Antenna Configuration

Spurious Emissions

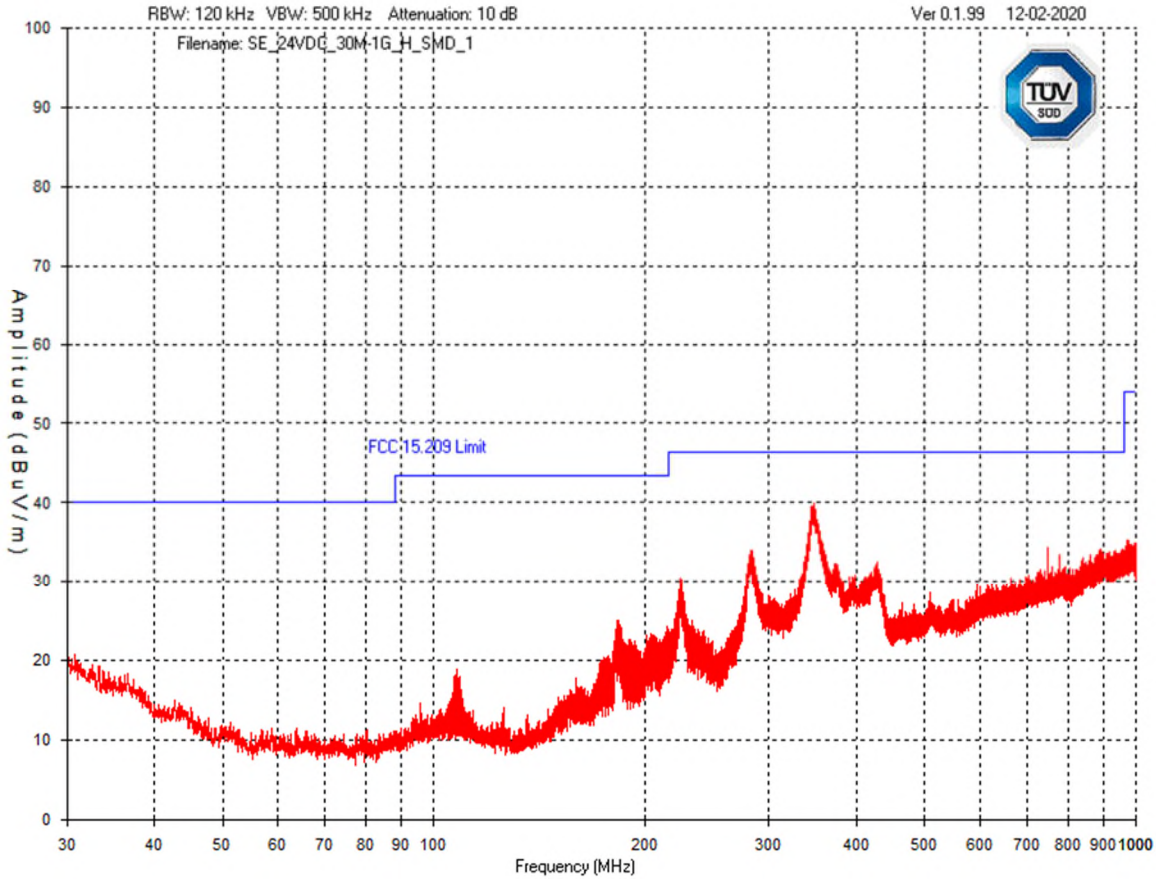
Low Channel
9 kHz – 150 kHz
Peak Emission Graph



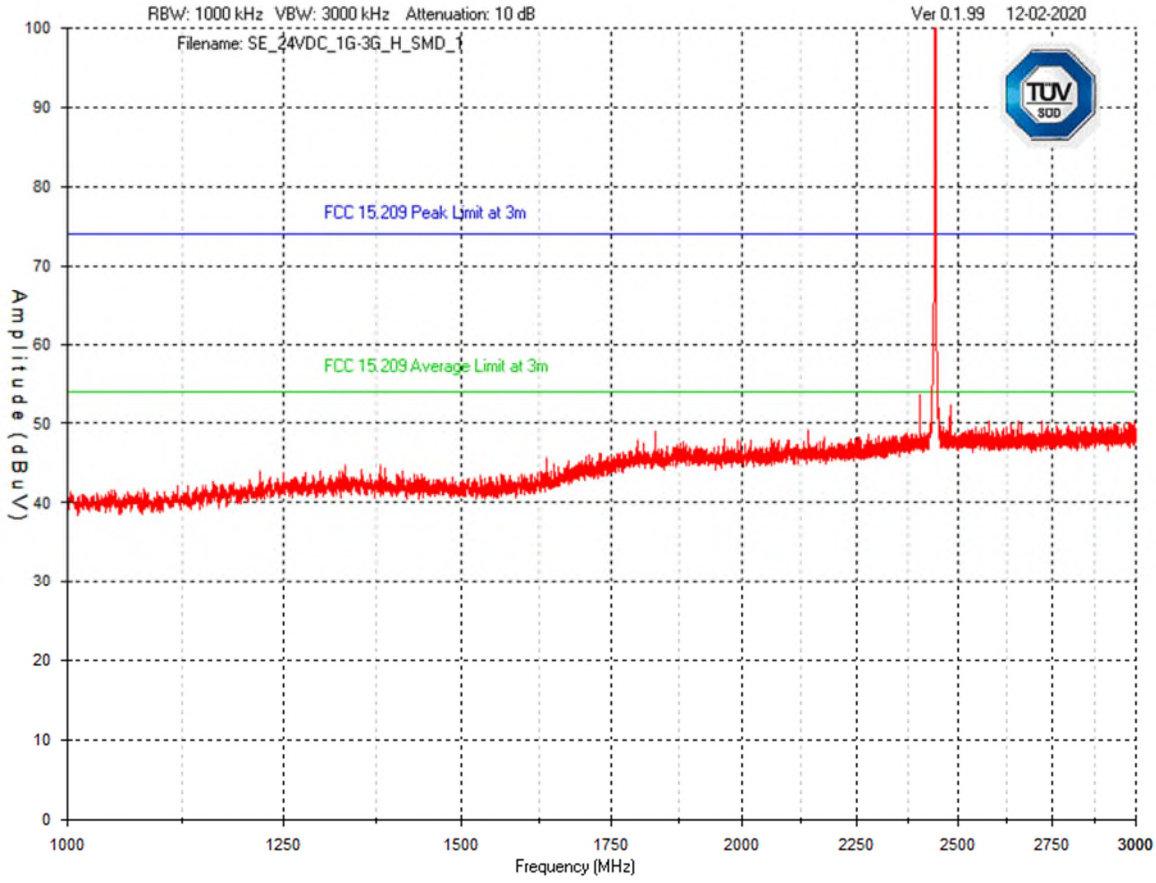
Low Channel
150 kHz – 30 MHz
Peak Emission Graph



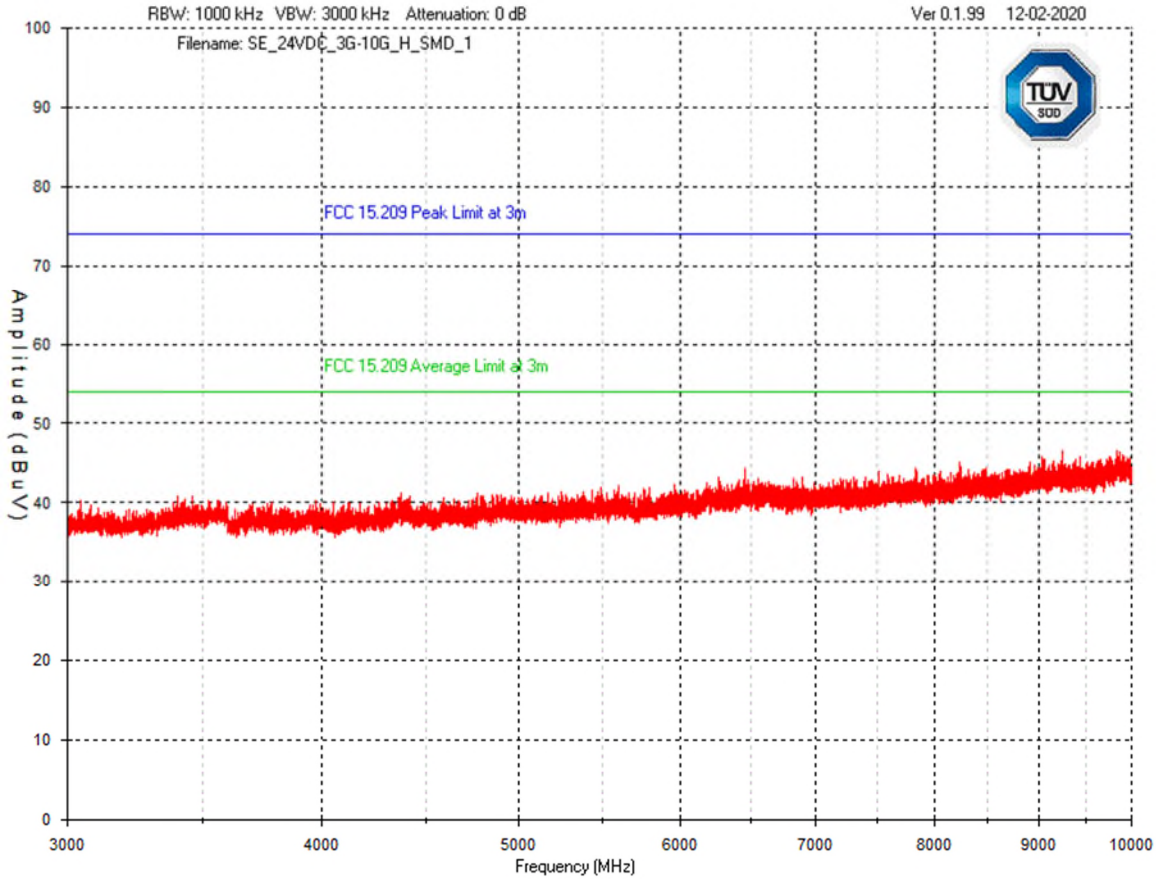
Low Channel – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph



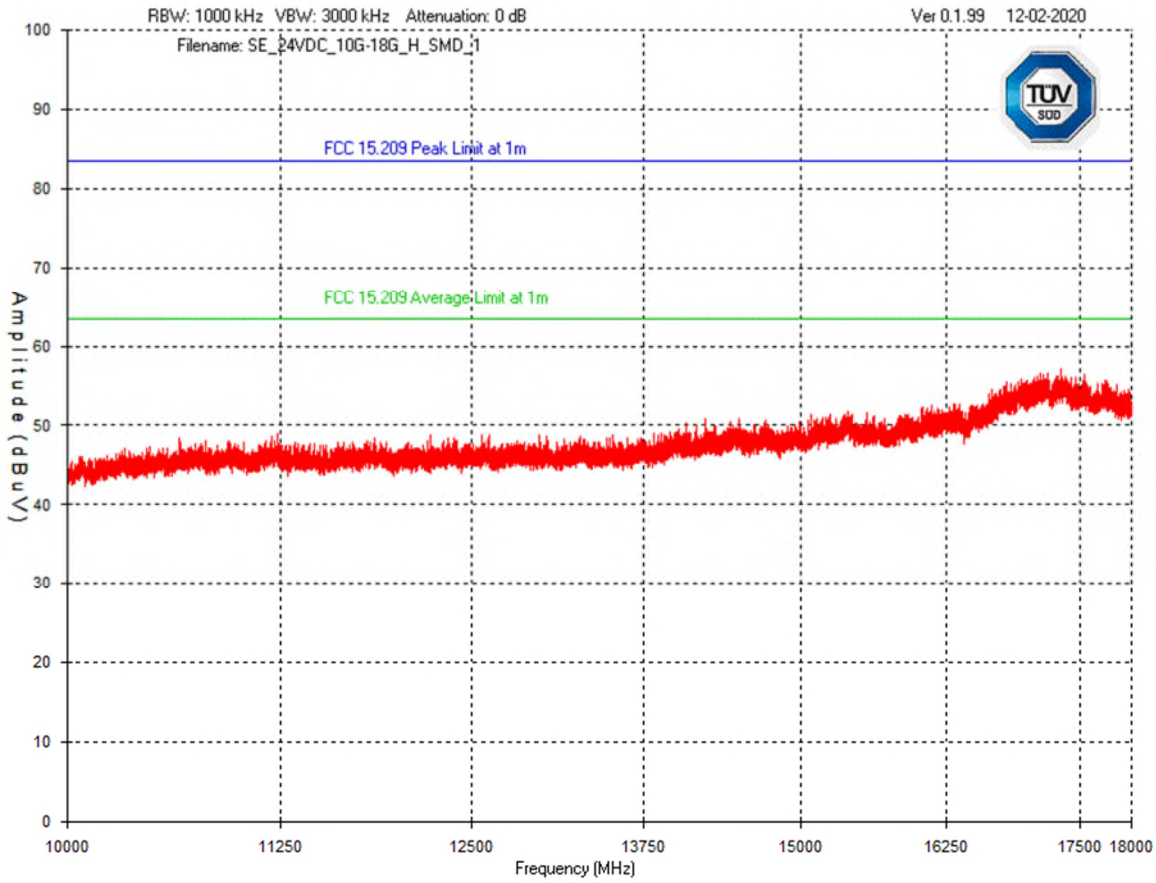
Low Channel – 1 GHz – 3 GHz
Horizontal - Peak Emission Graph



Low Channel – 3 GHz – 10 GHz
Horizontal - Peak Emission Graph

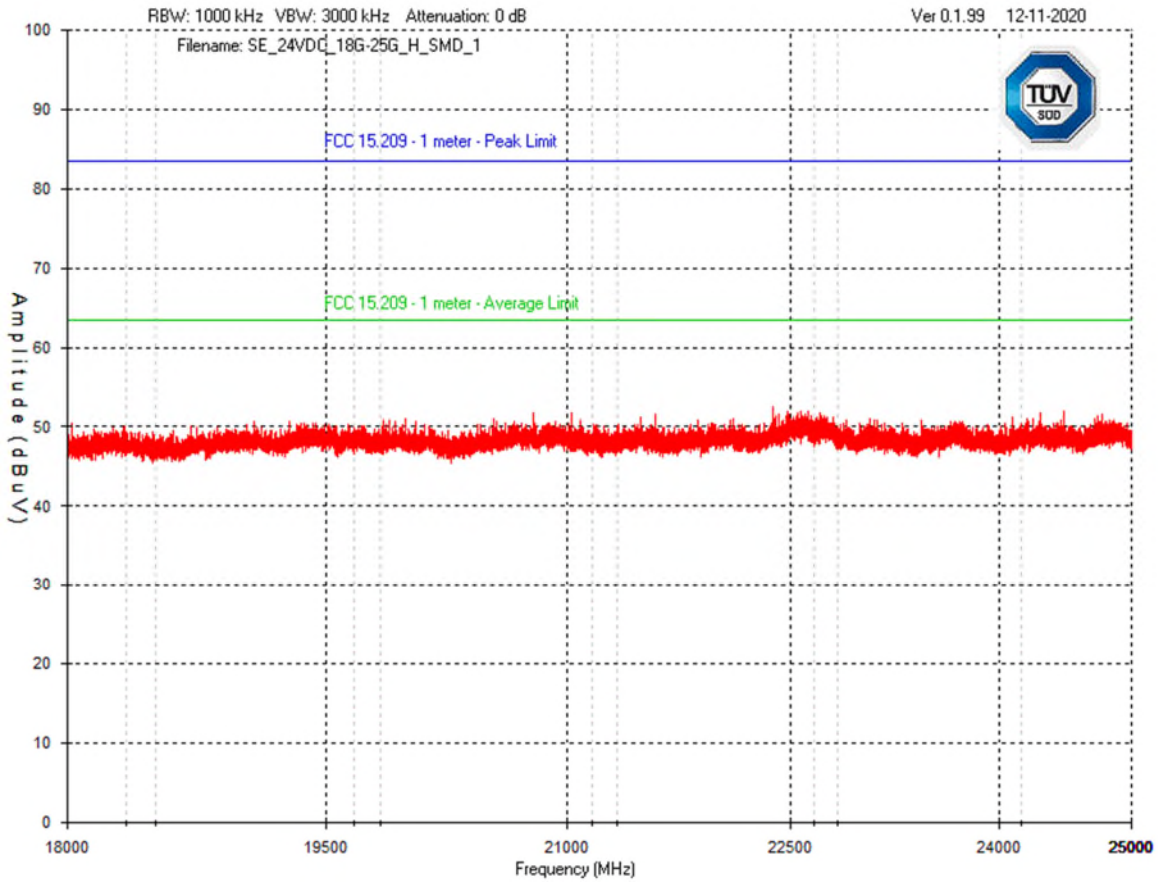


Low Channel – 10 GHz – 18 GHz
Horizontal - Peak Emission Graph



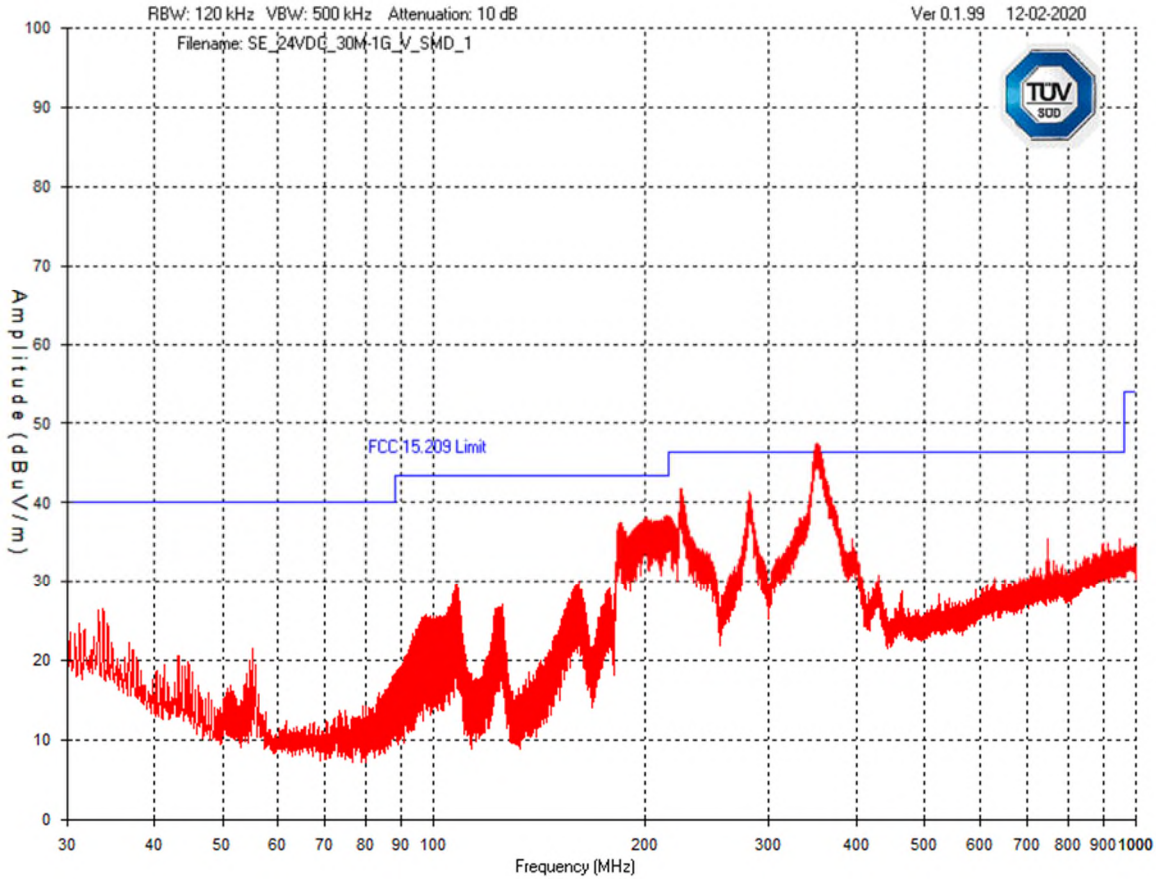
Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

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

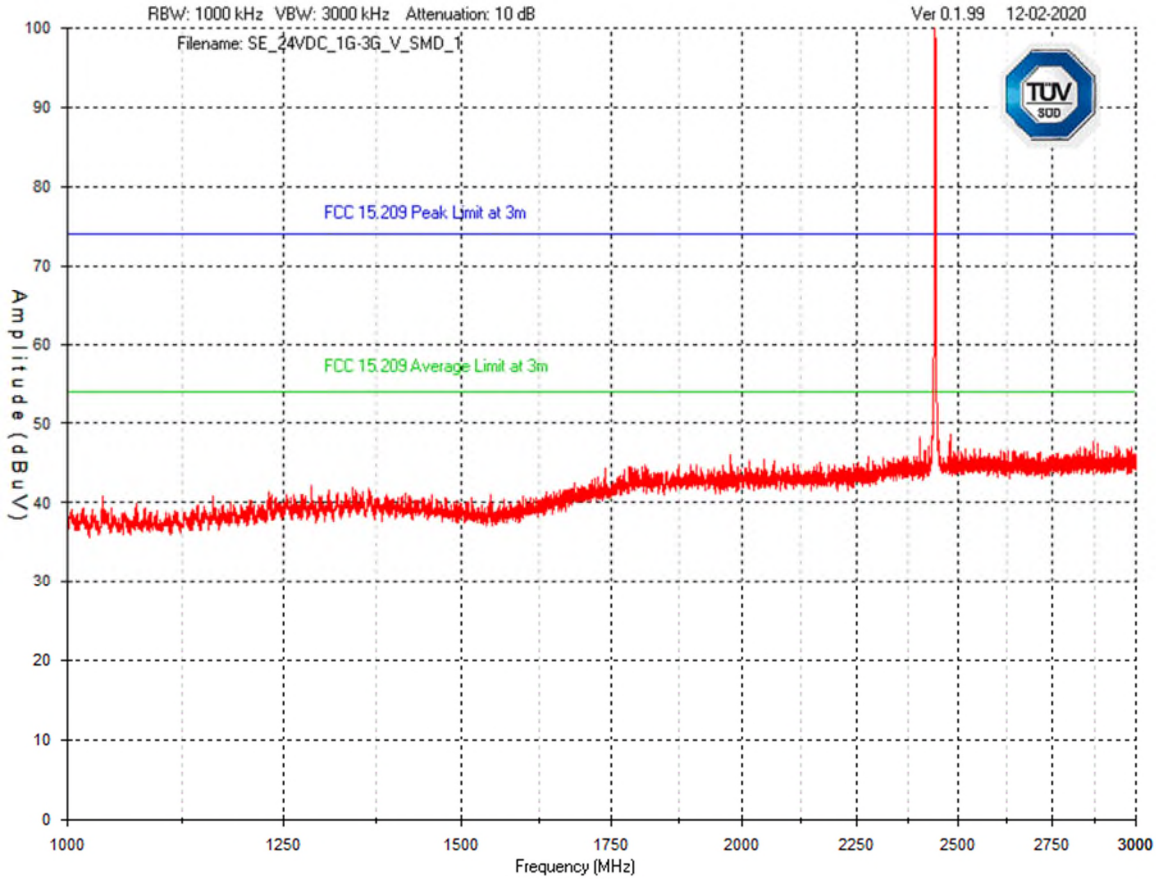


Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

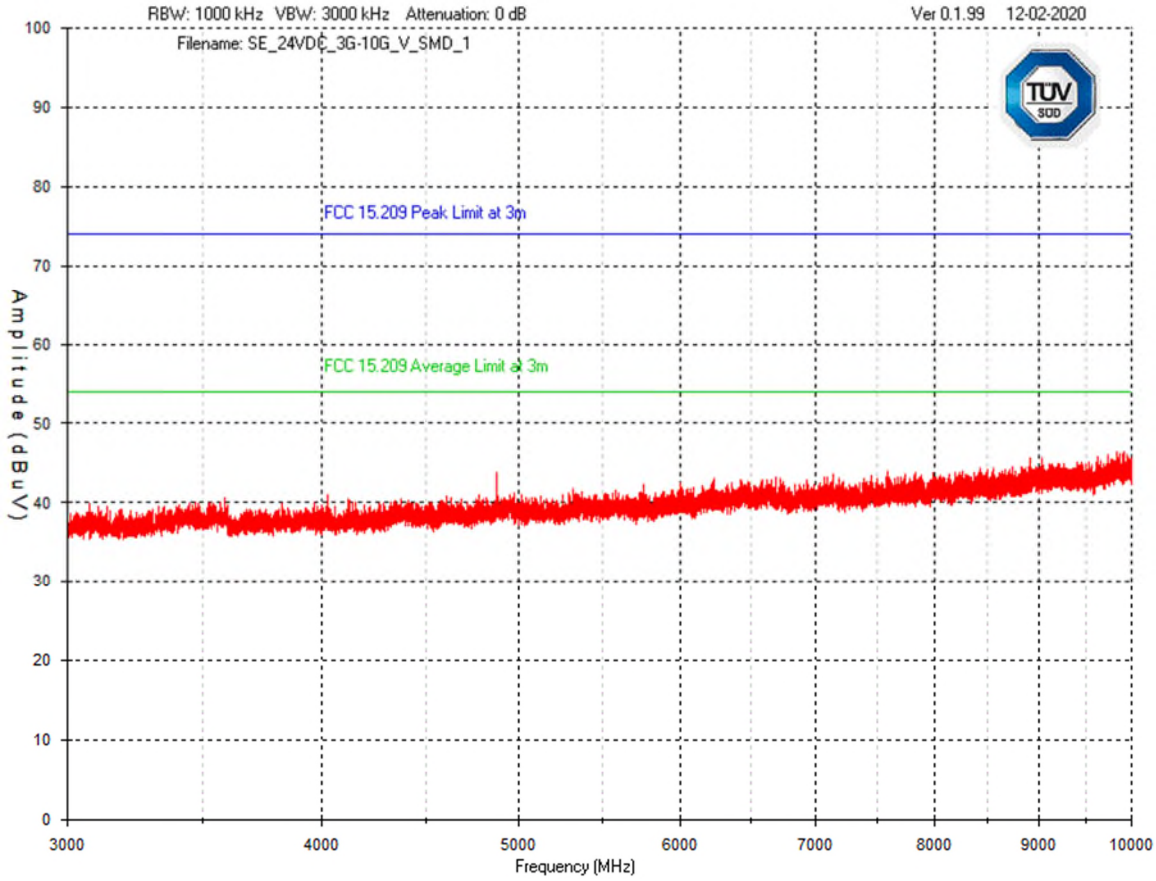
Low Channel – 30 MHz – 1 GHz
Vertical - Peak Emission Graph



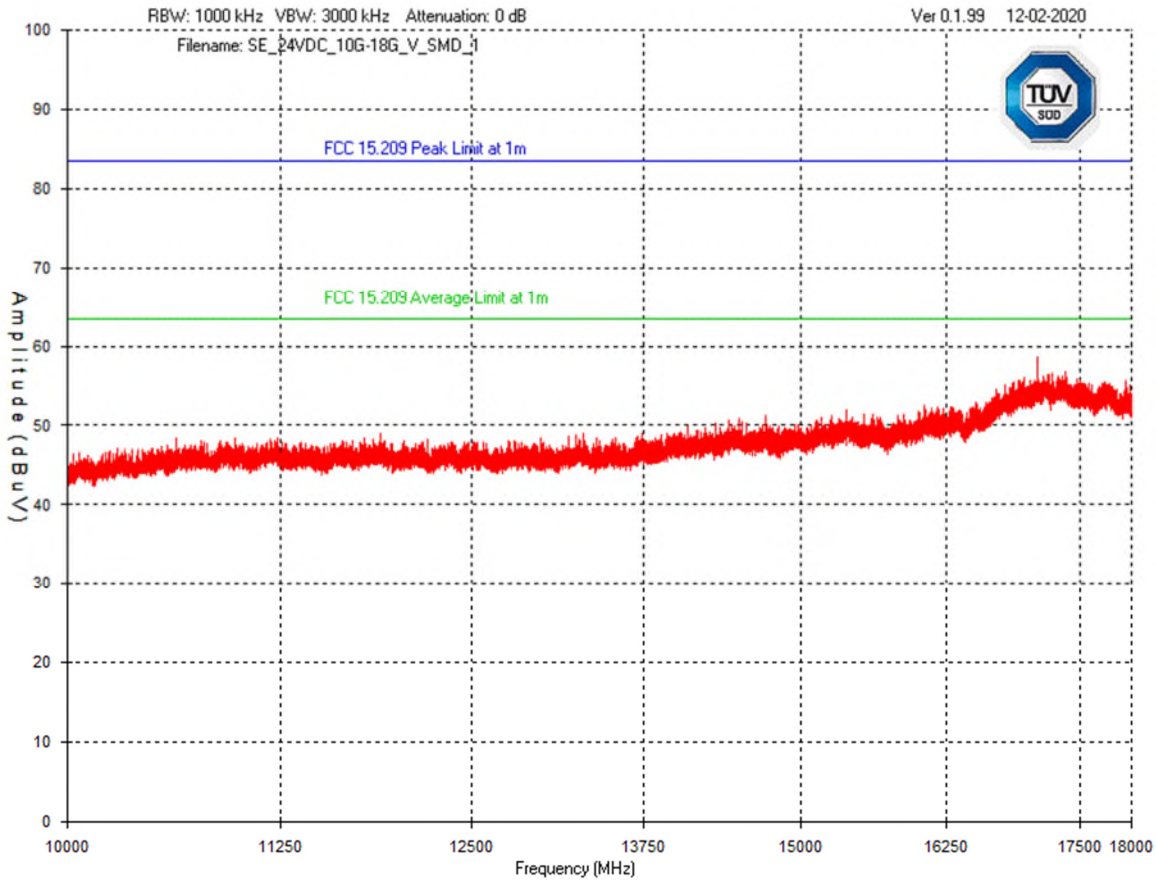
Low Channel – 1 GHz – 3 GHz
Vertical - Peak Emission Graph



Low Channel – 3 GHz – 10 GHz
Vertical - Peak Emission Graph

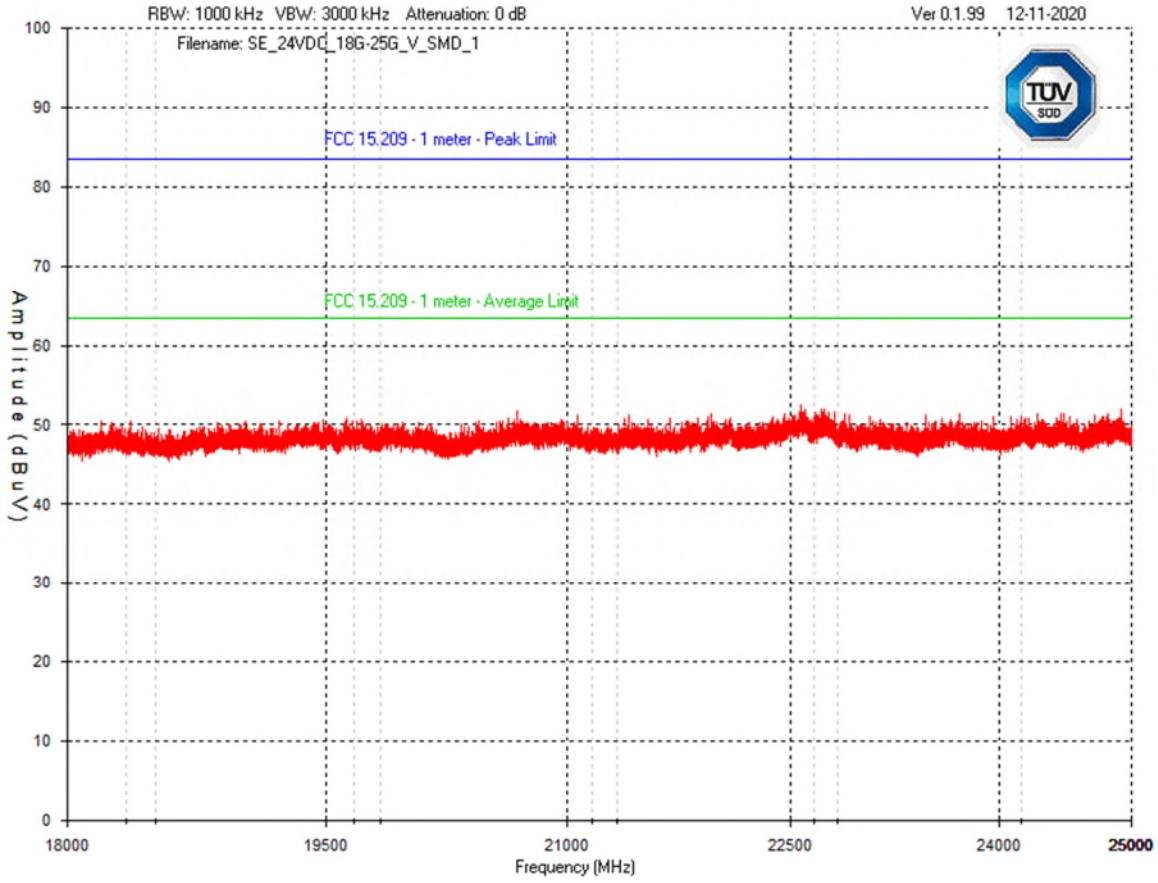


Low Channel – 10 GHz – 18 GHz
Vertical - Peak Emission Graph



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

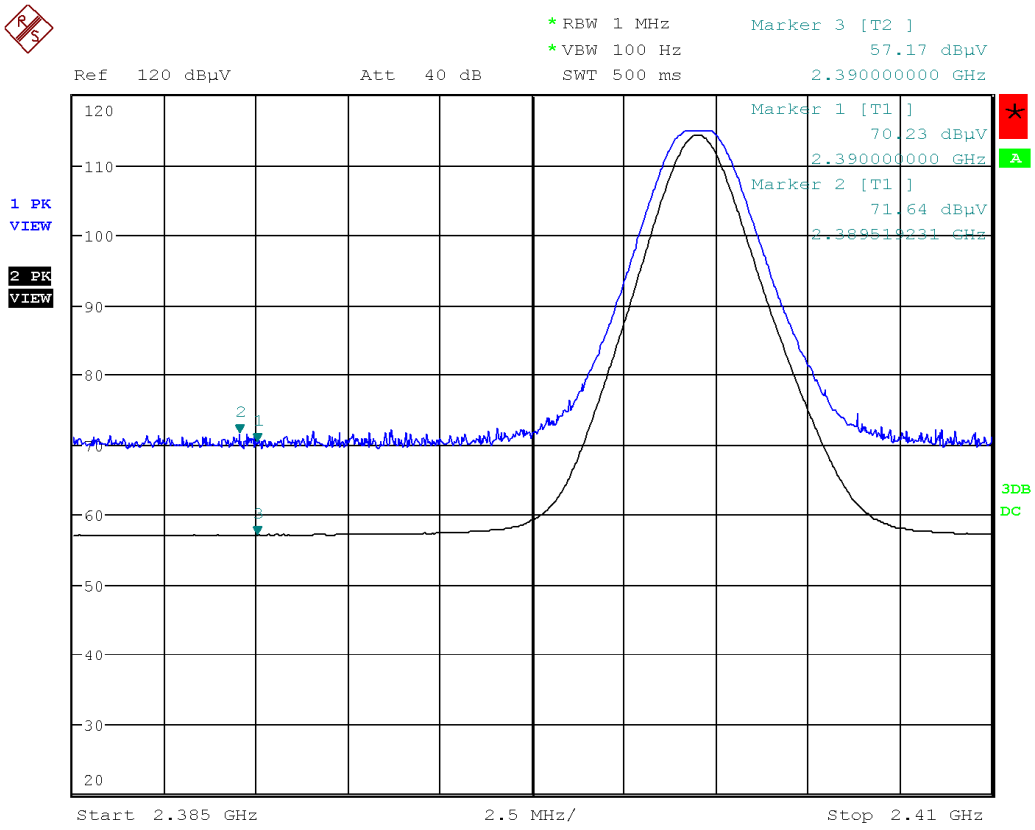
Low Channel – 18 GHz – 25 GHz
Vertical - Peak Emission Graph



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

Band Edges

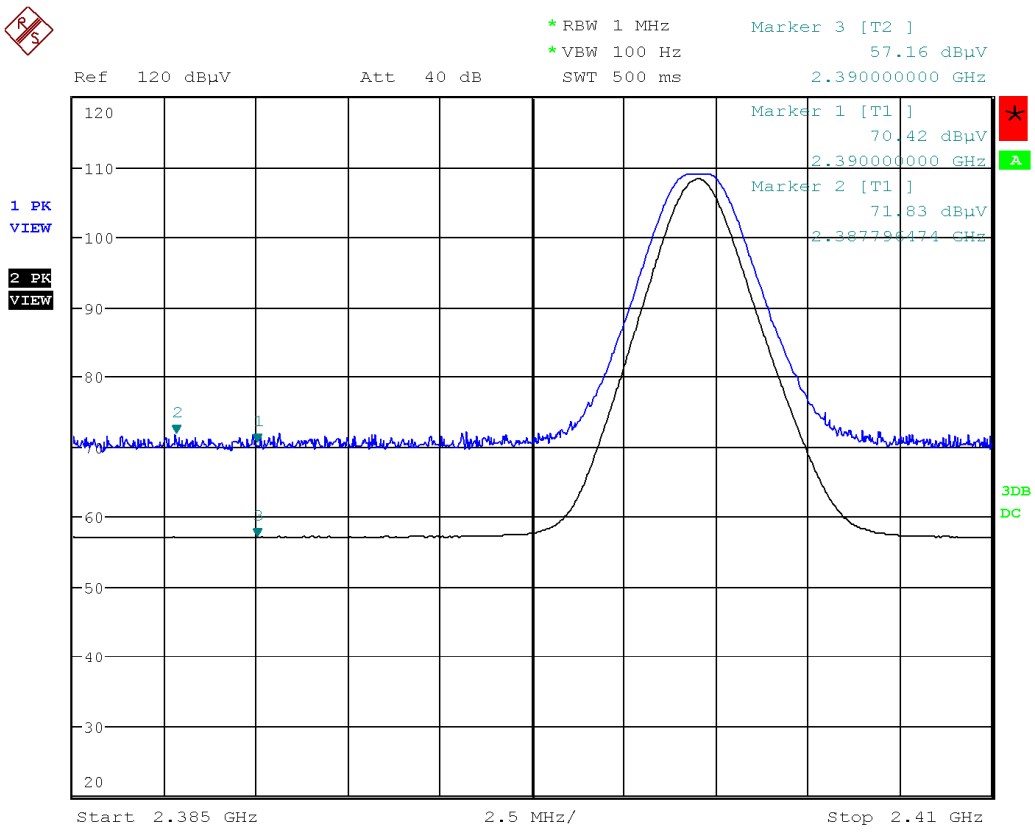
Band Edge – Low Channel
Horizontal – Peak & Average Emission



Date: 2.DEC.2020 16:35:43

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.

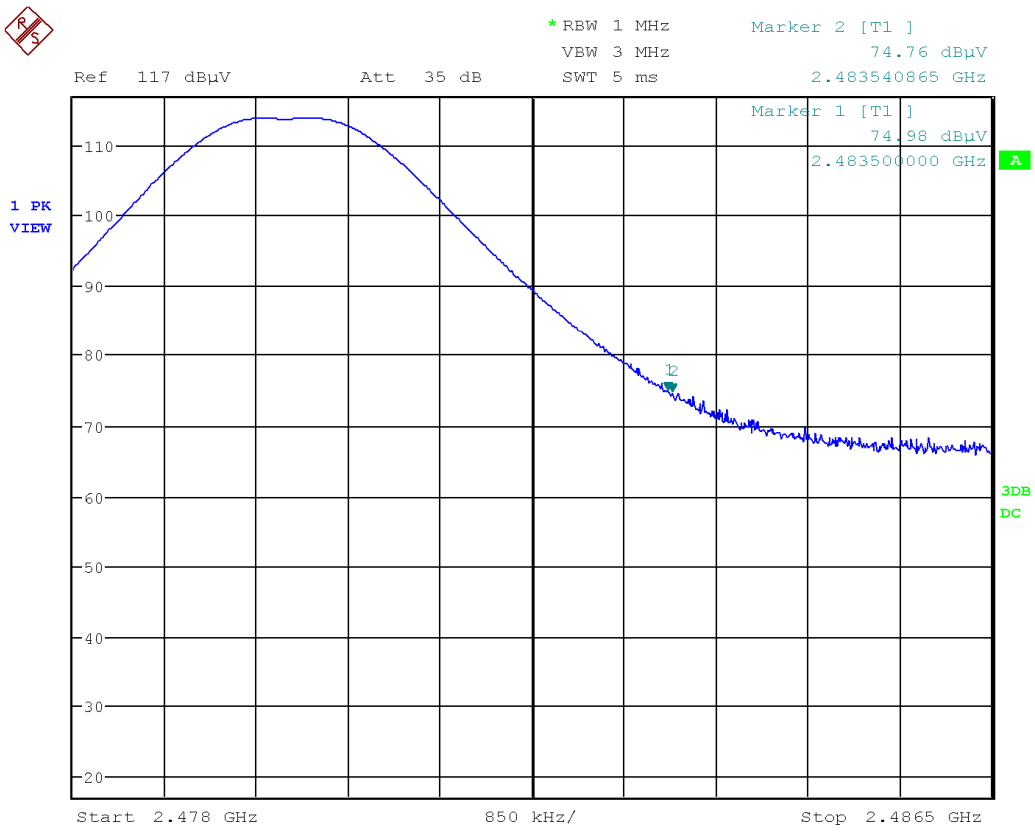
Band Edge – Low Channel
Vertical – Peak & Average Emission



Date: 2.DEC.2020 16:29:33

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.

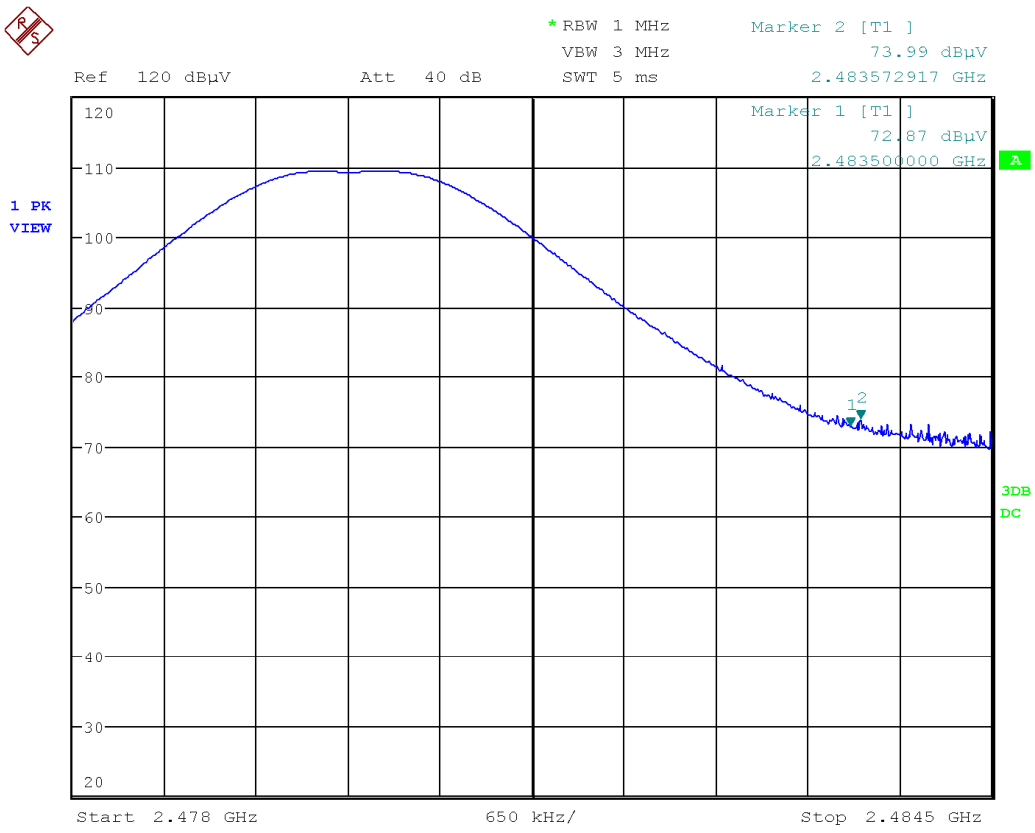
Band Edge – High Channel
Horizontal – Peak Emission



Date: 2.DEC.2020 17:40:41

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.

Band Edge – High Channel
Vertical – Peak Emission



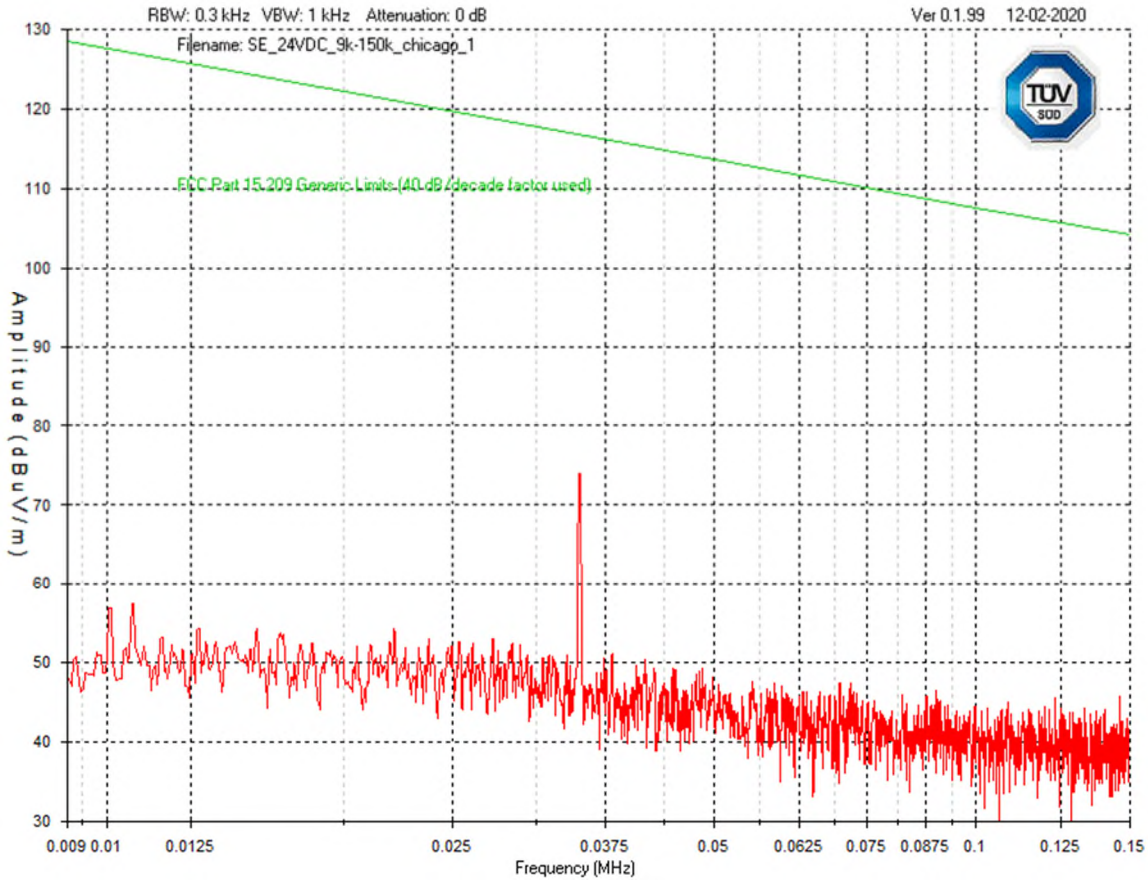
Date: 2.DEC.2020 17:13:54

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.

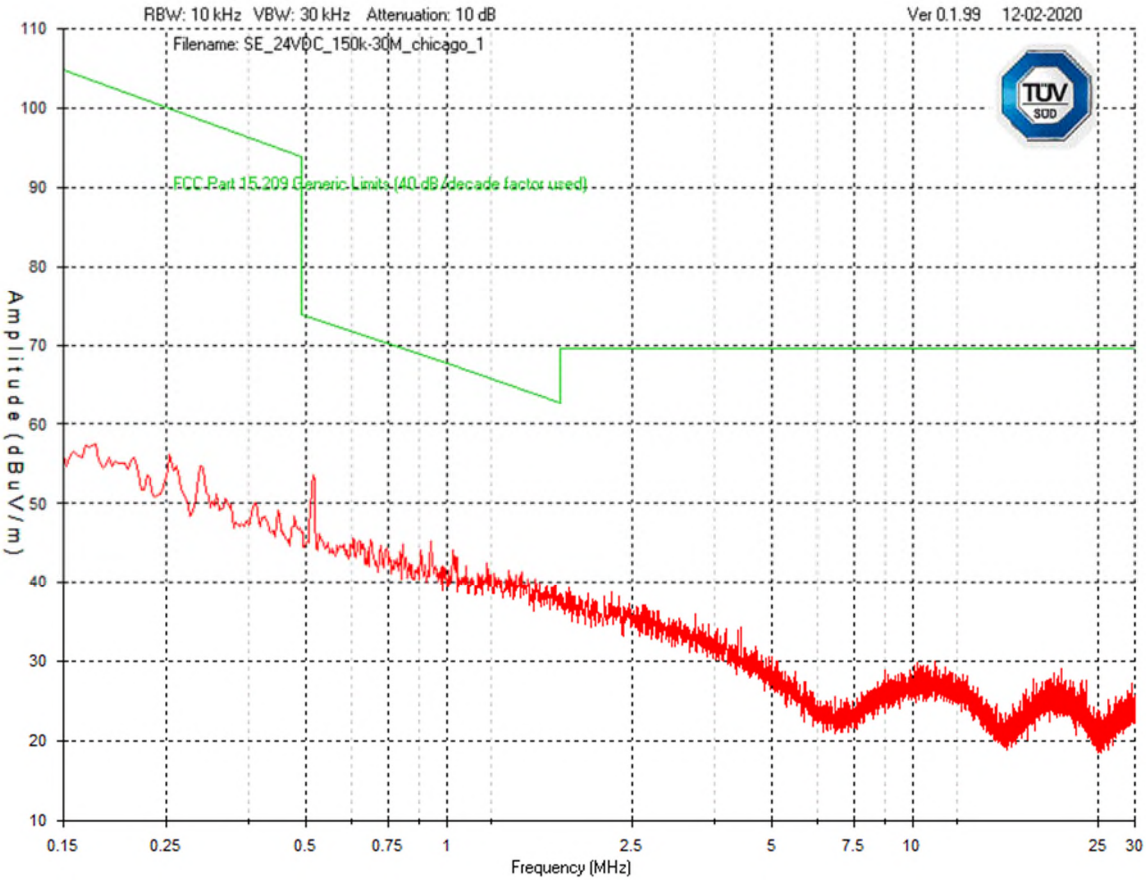
Chicago Plenum Dual-Band Antenna Configuration

Spurious Emissions

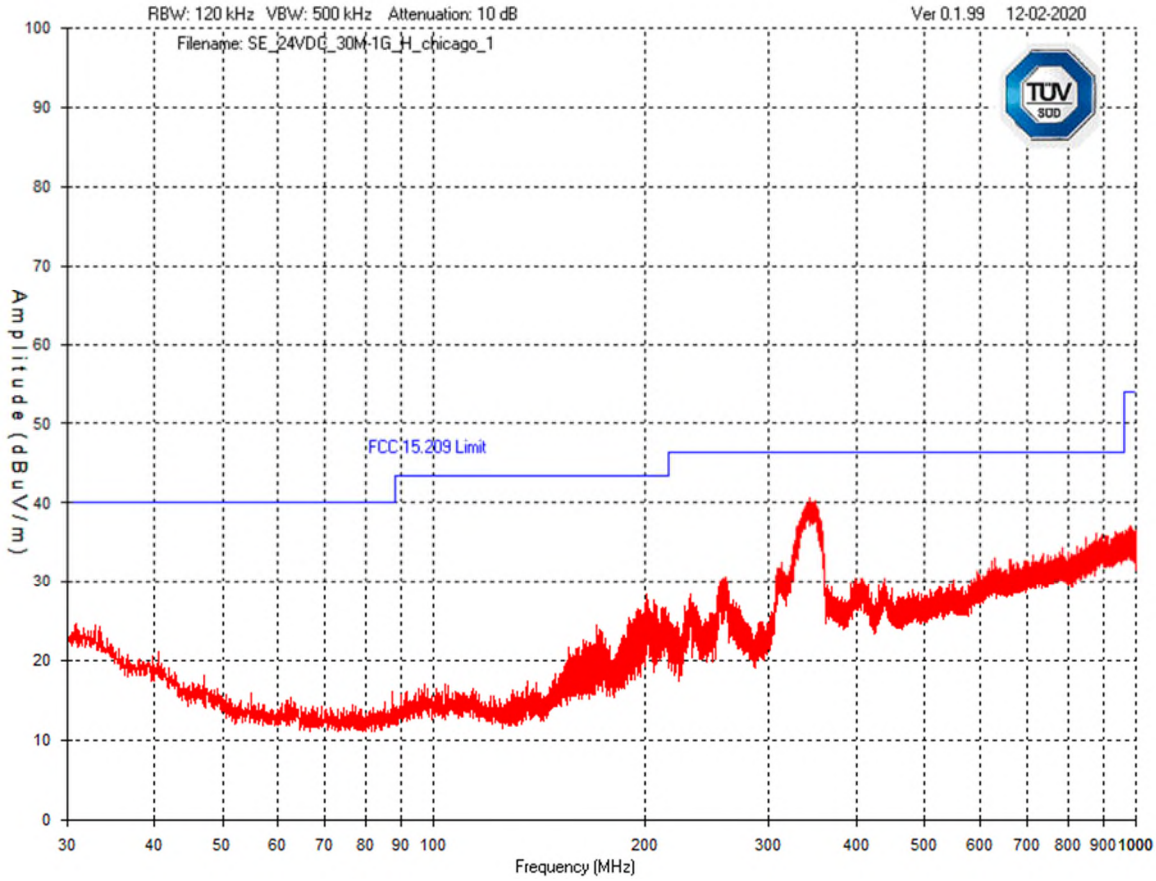
Low Channel
9 kHz – 150 kHz
Peak Emission Graph



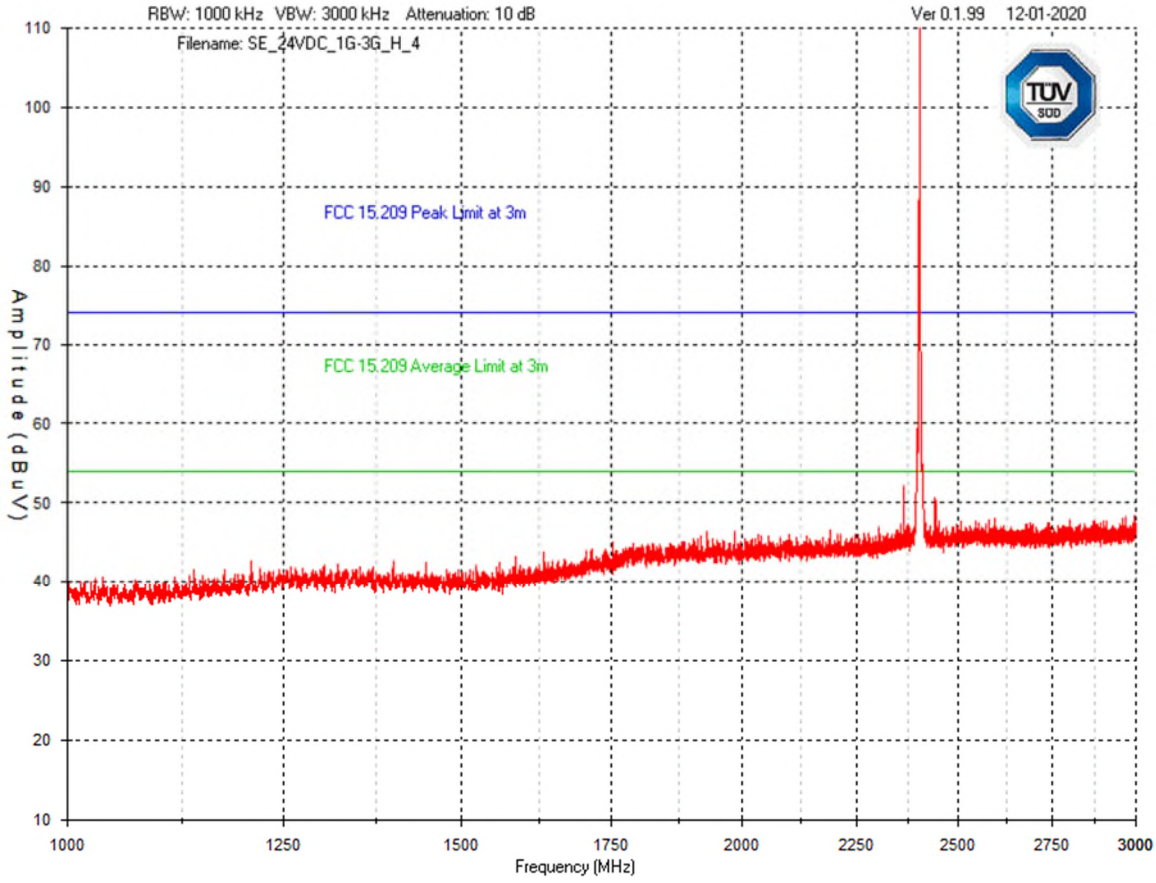
Low Channel
150 kHz – 30 MHz
Peak Emission Graph



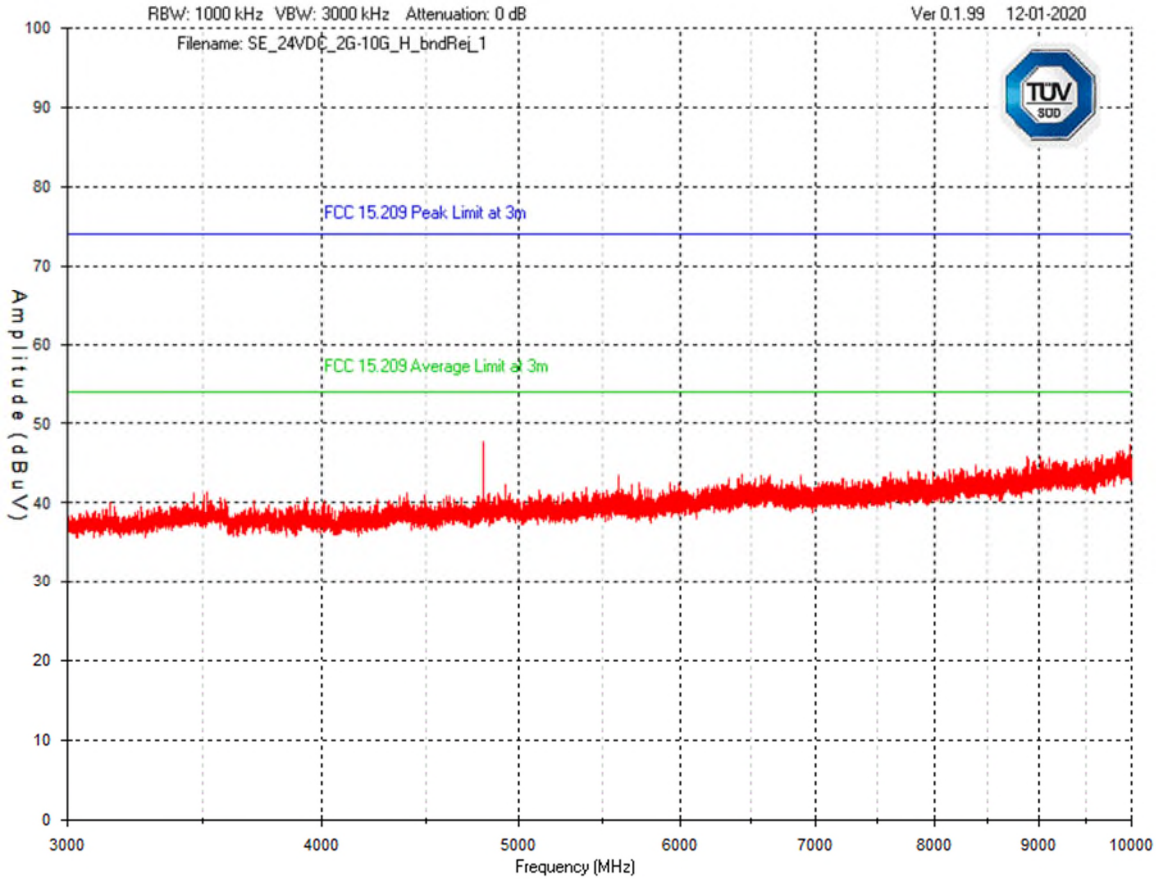
Low Channel – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph



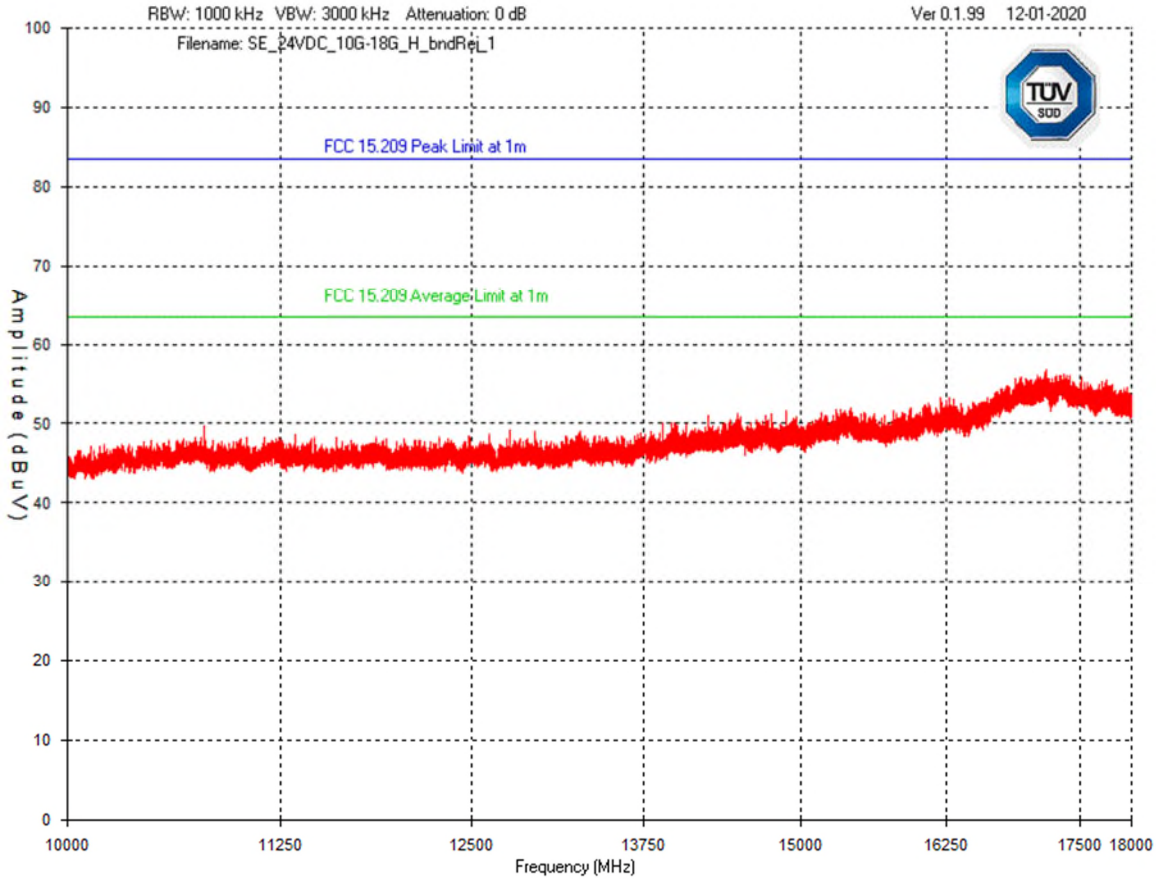
Low Channel – 1 GHz – 3 GHz
Horizontal - Peak Emission Graph



Low Channel – 3 GHz – 10 GHz
Horizontal - Peak Emission Graph

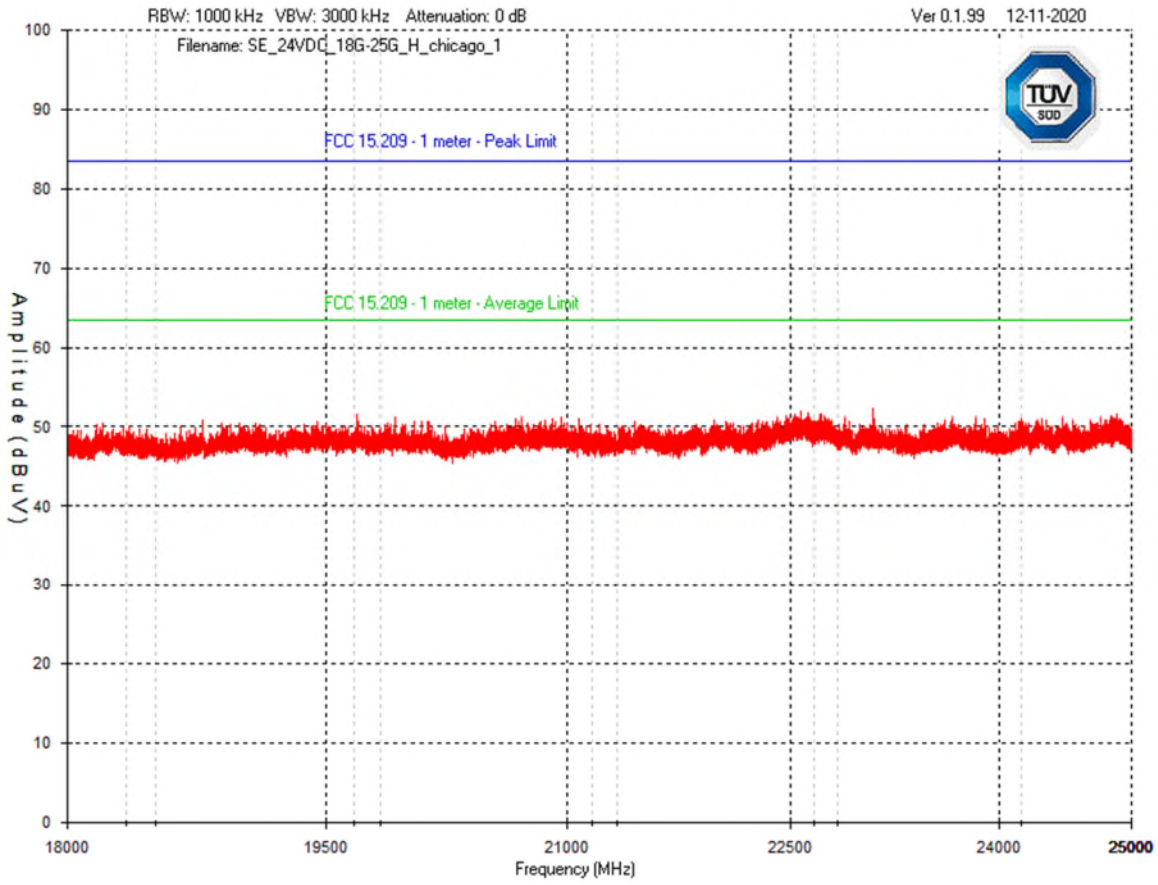


Low Channel – 10 GHz – 18 GHz
Horizontal - Peak Emission Graph



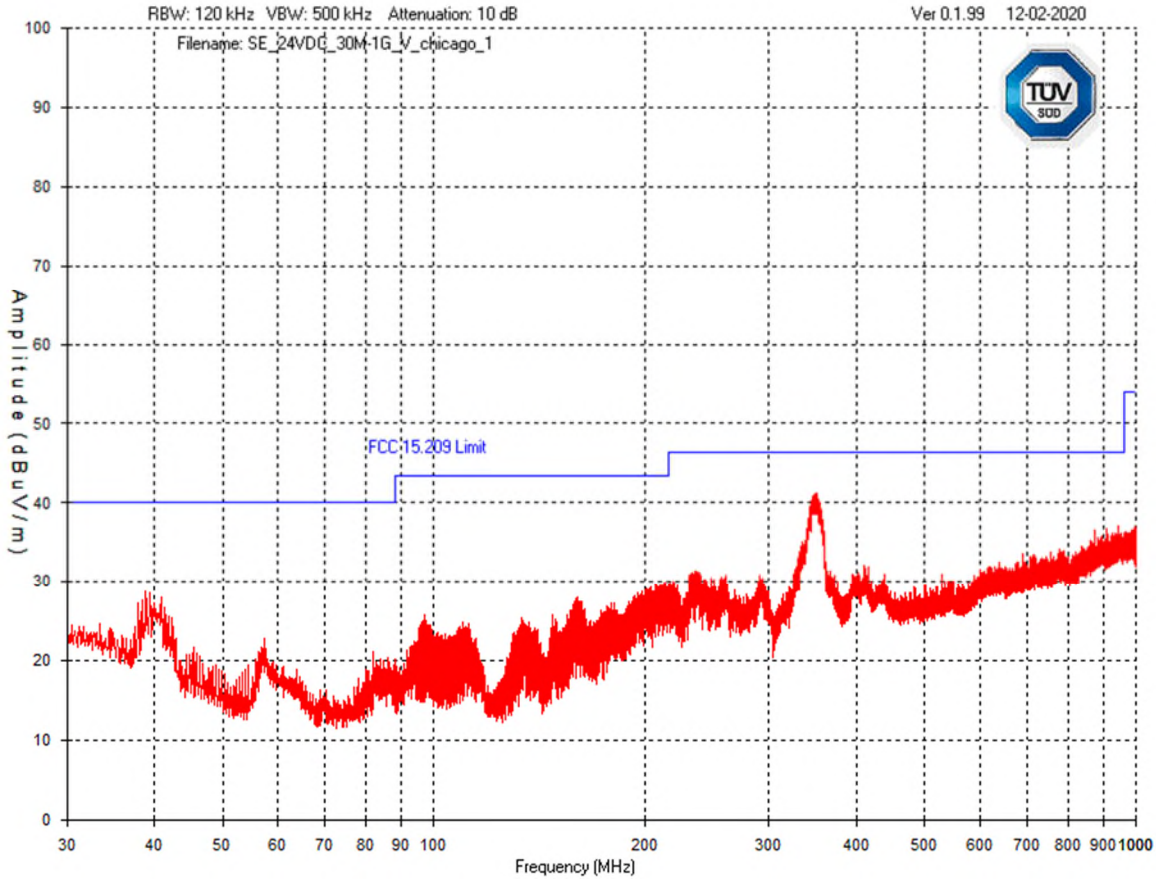
Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

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

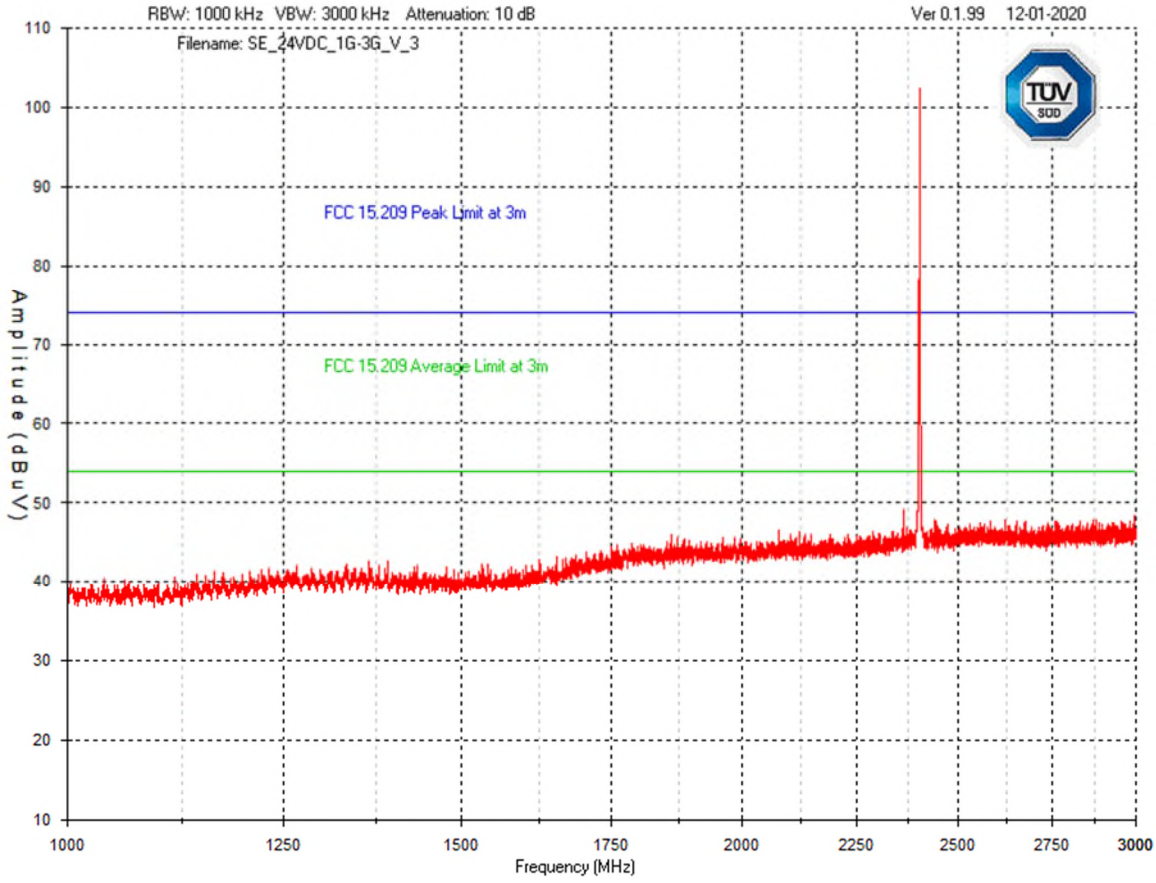


Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

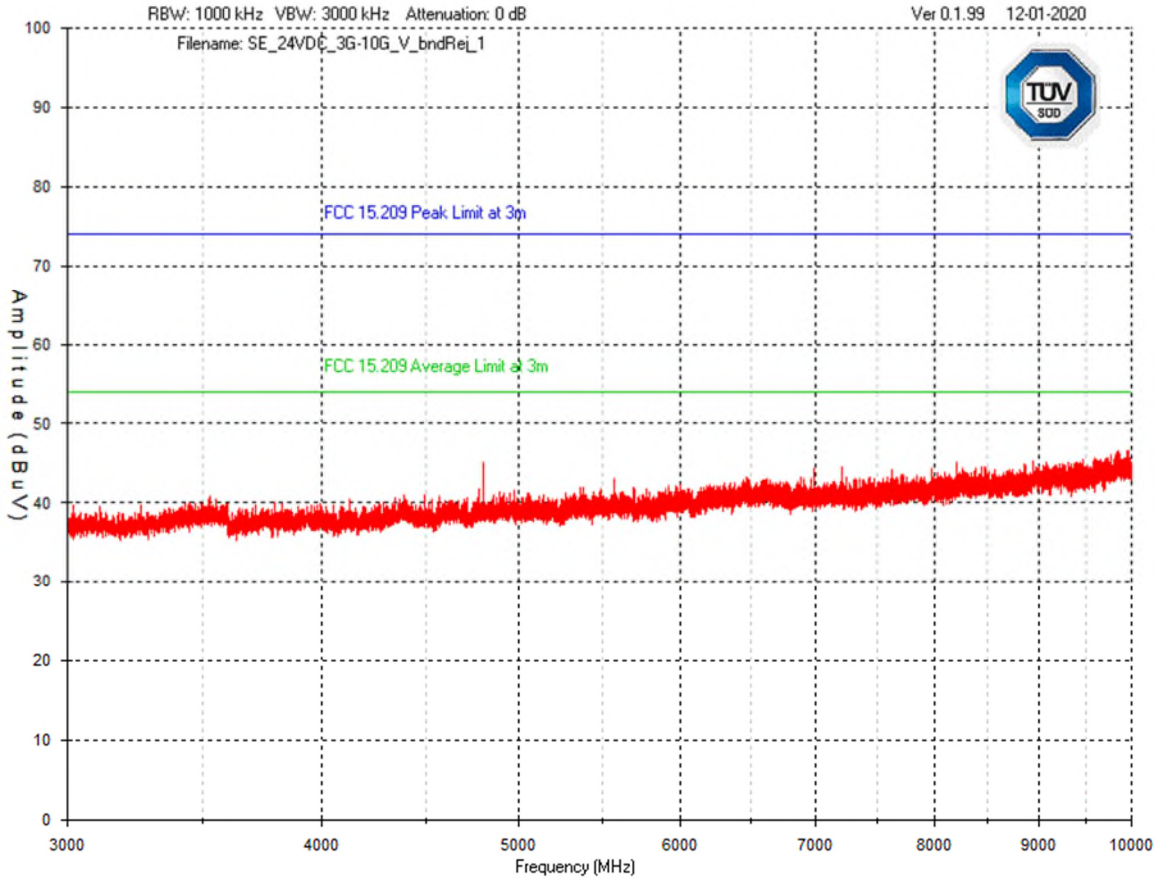
Low Channel– 30 MHz – 1 GHz
Vertical - Peak Emission Graph



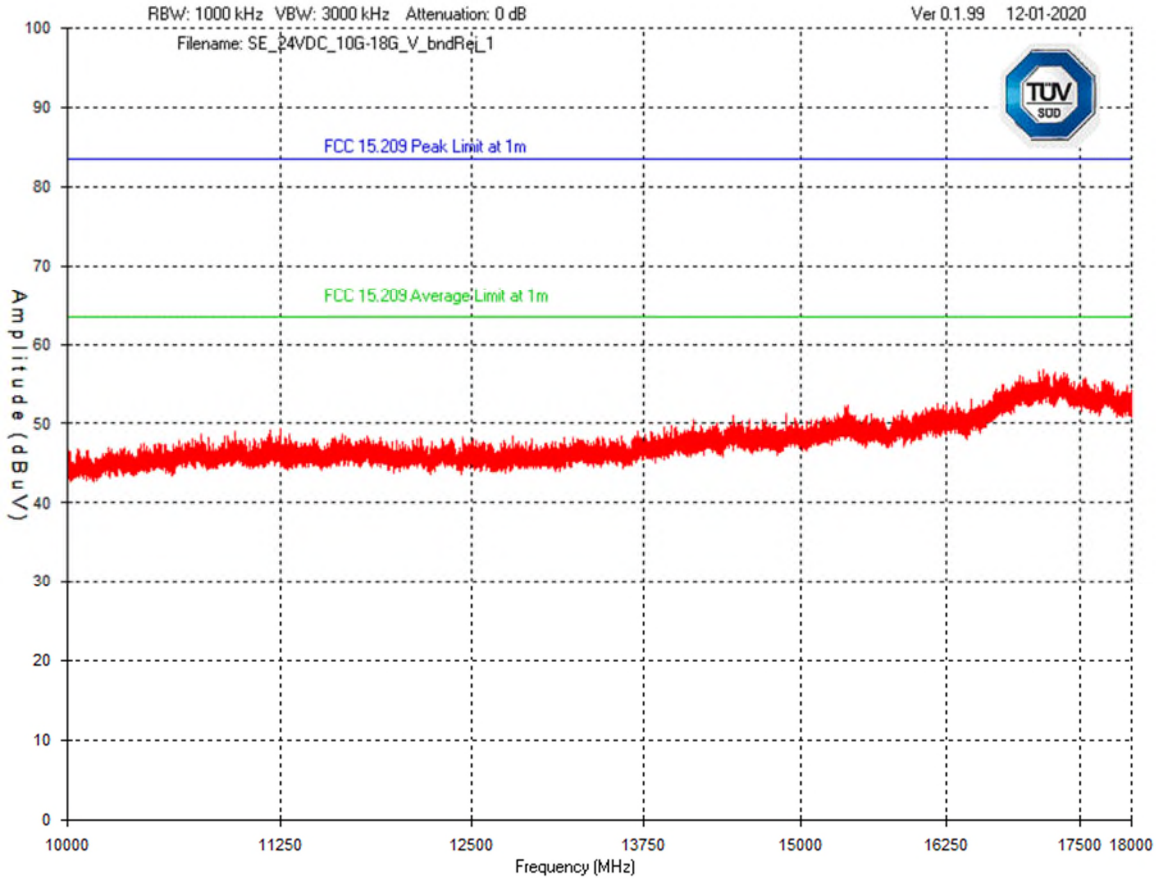
Low Channel– 1 GHz – 3 GHz
Vertical - Peak Emission Graph



Low Channel– 3 GHz – 10 GHz
Vertical - Peak Emission Graph

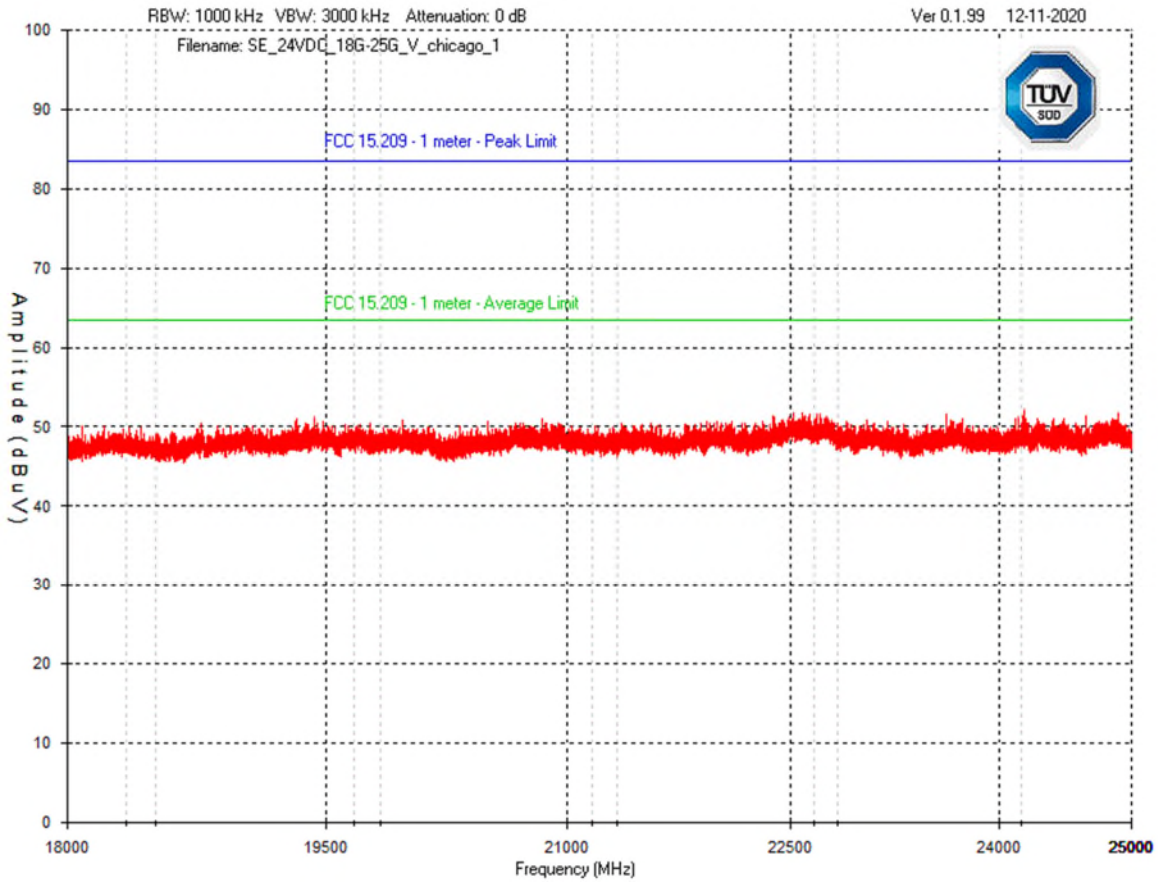


Low Channel– 10 GHz – 18 GHz
Vertical - Peak Emission Graph



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

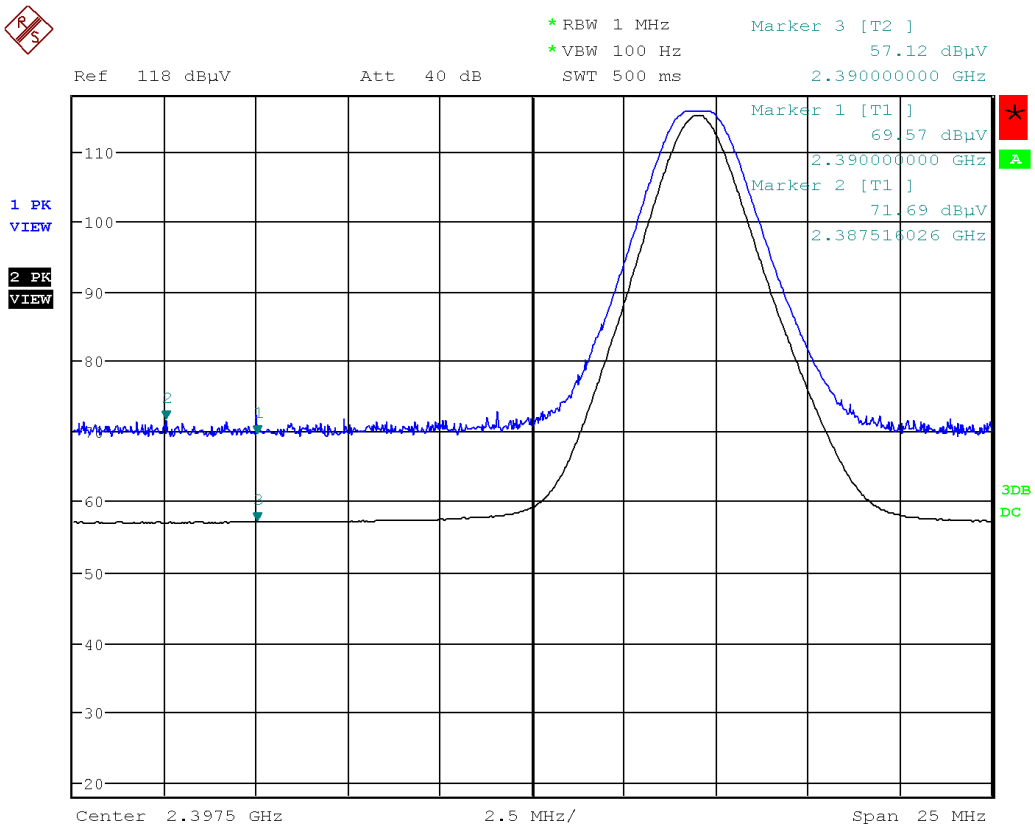
Low Channel – 18 GHz – 25 GHz
Vertical - Peak Emission Graph



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

Band Edges

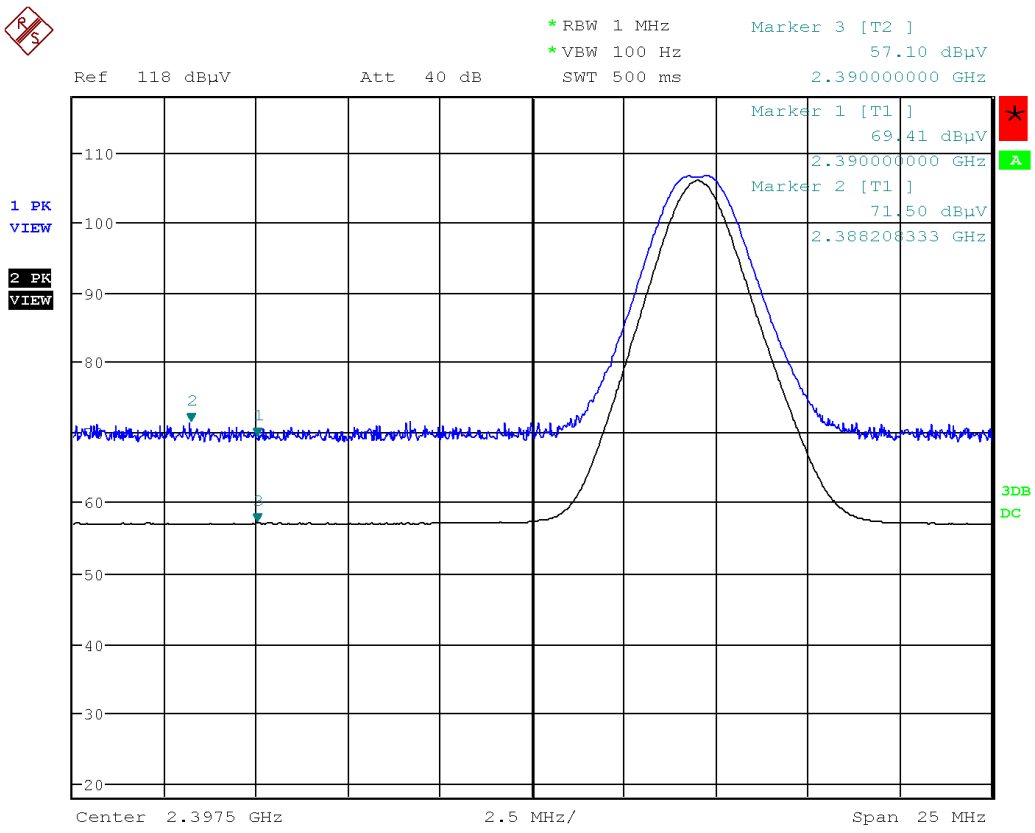
Band Edge – Low Channel
Horizontal - Peak & Average Emission



Date: 1.DEC.2020 17:04:33

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.

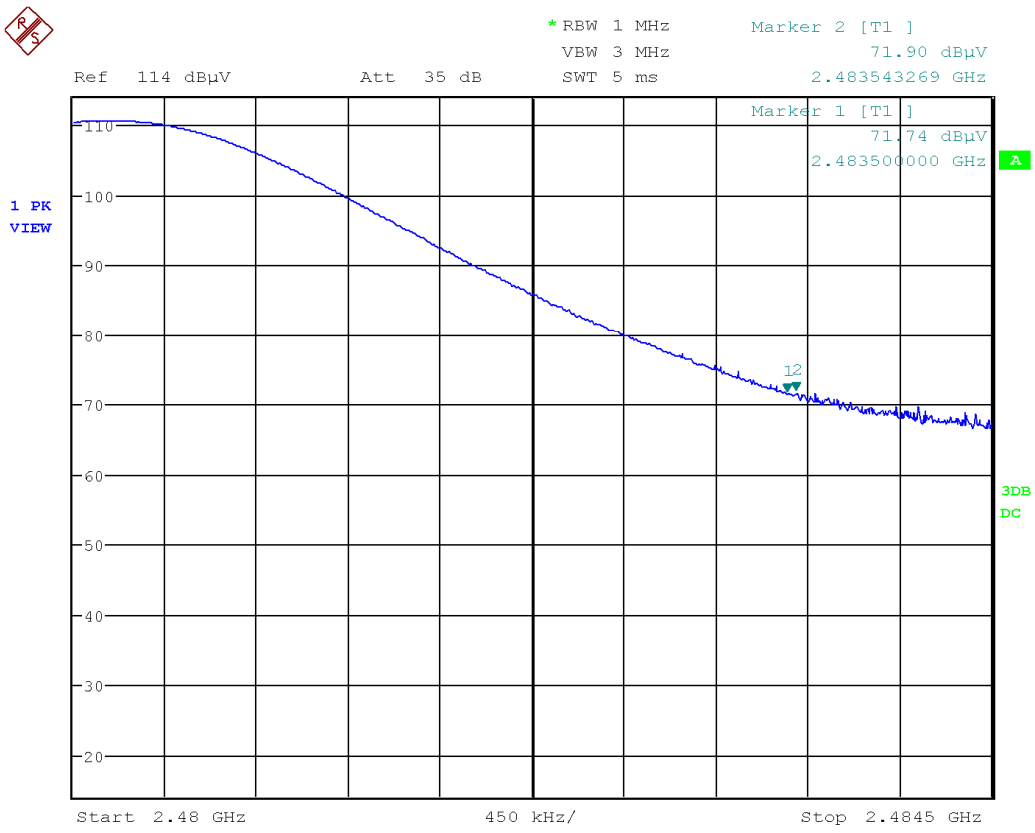
Band Edge – Low Channel
Vertical - Peak & Average Emission



Date: 1.DEC.2020 17:18:27

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.

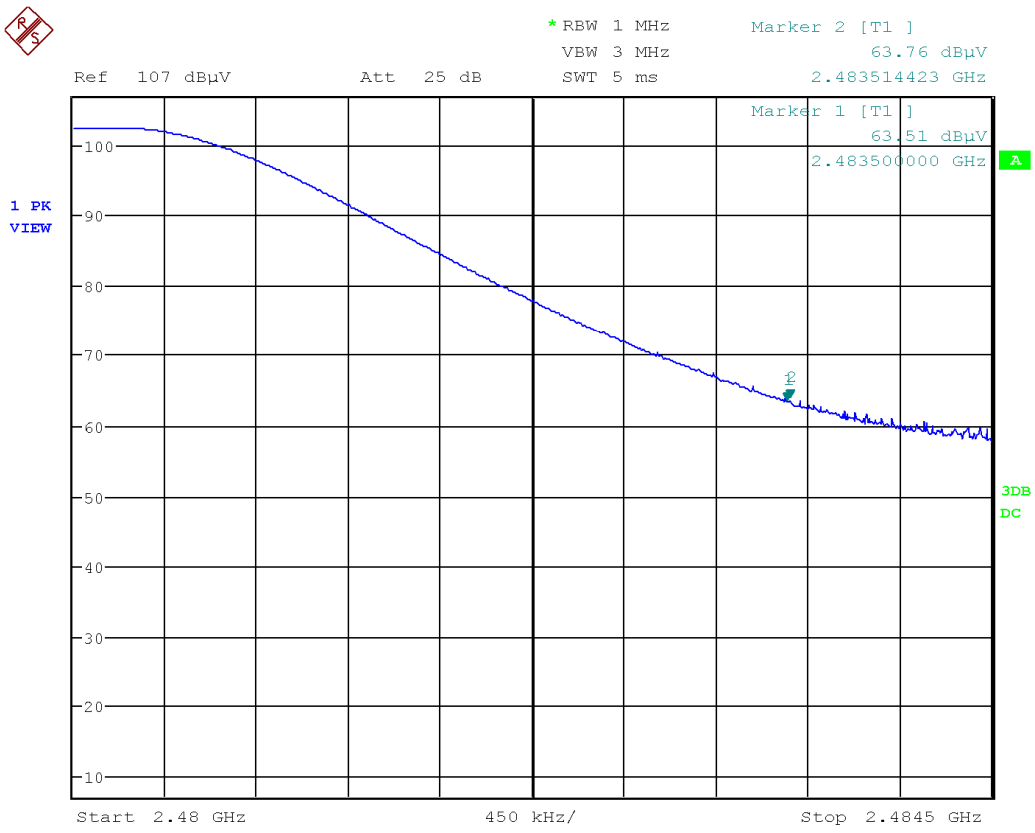
Band Edge – High Channel
Horizontal – Peak Emission



Date: 1.DEC.2020 16:04:13

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.

Band Edge – High Channel
Vertical – Peak Emission



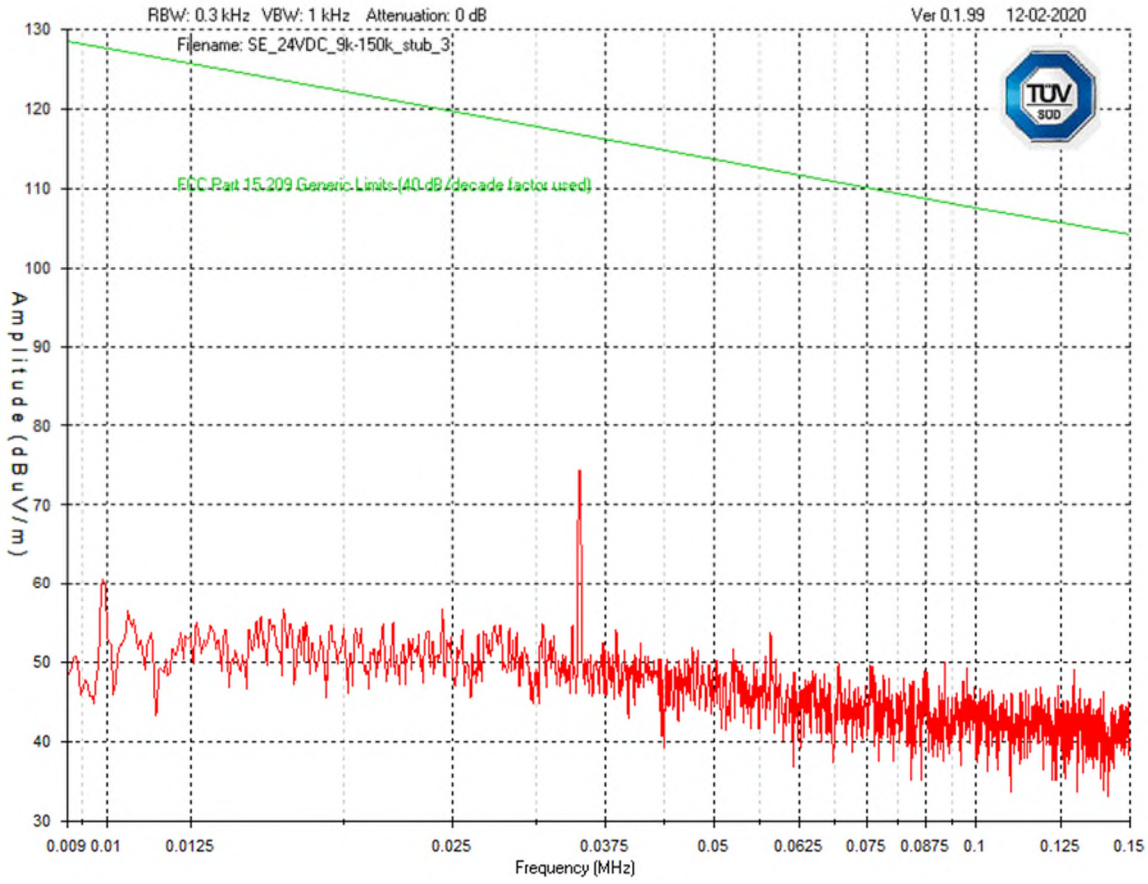
Date: 1.DEC.2020 15:56:06

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.

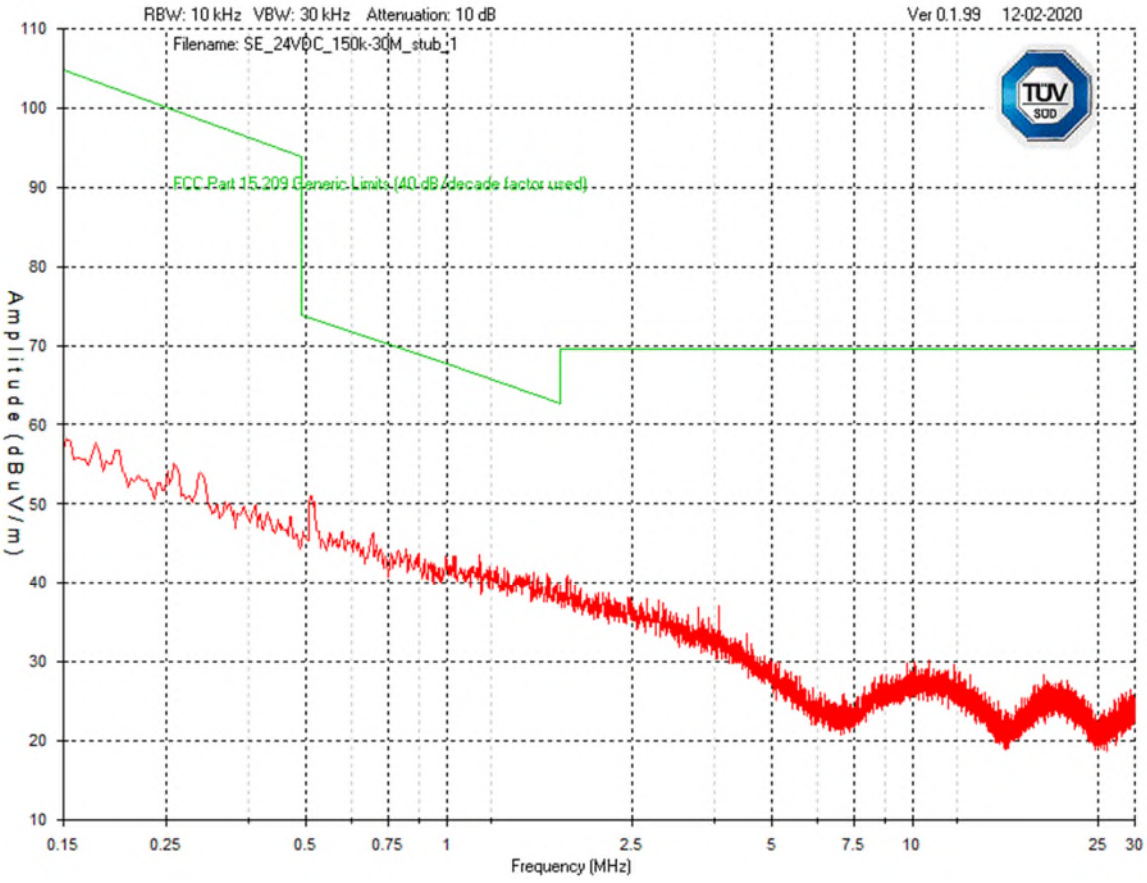
Stubby Dual-Band Antenna Configuration

Spurious Emissions

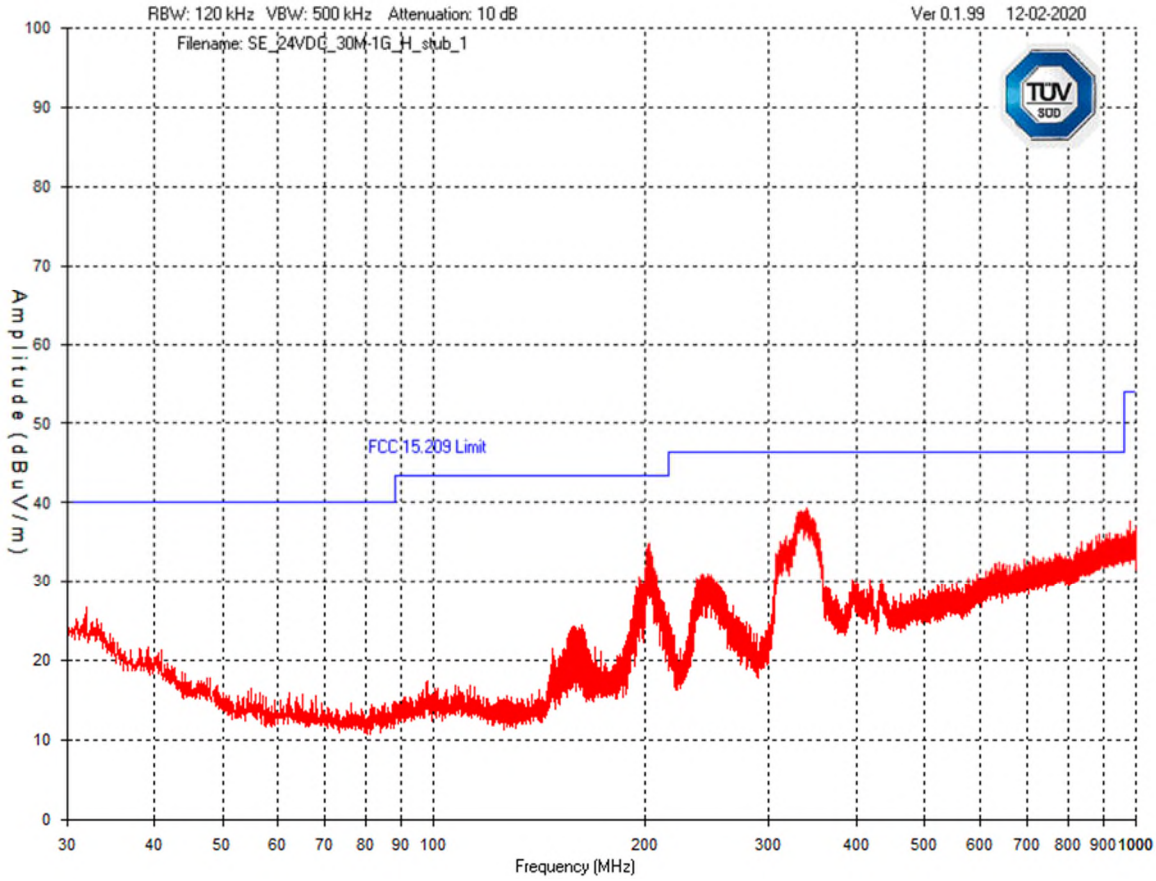
Low Channel
9 kHz – 150 kHz
Peak Emission Graph



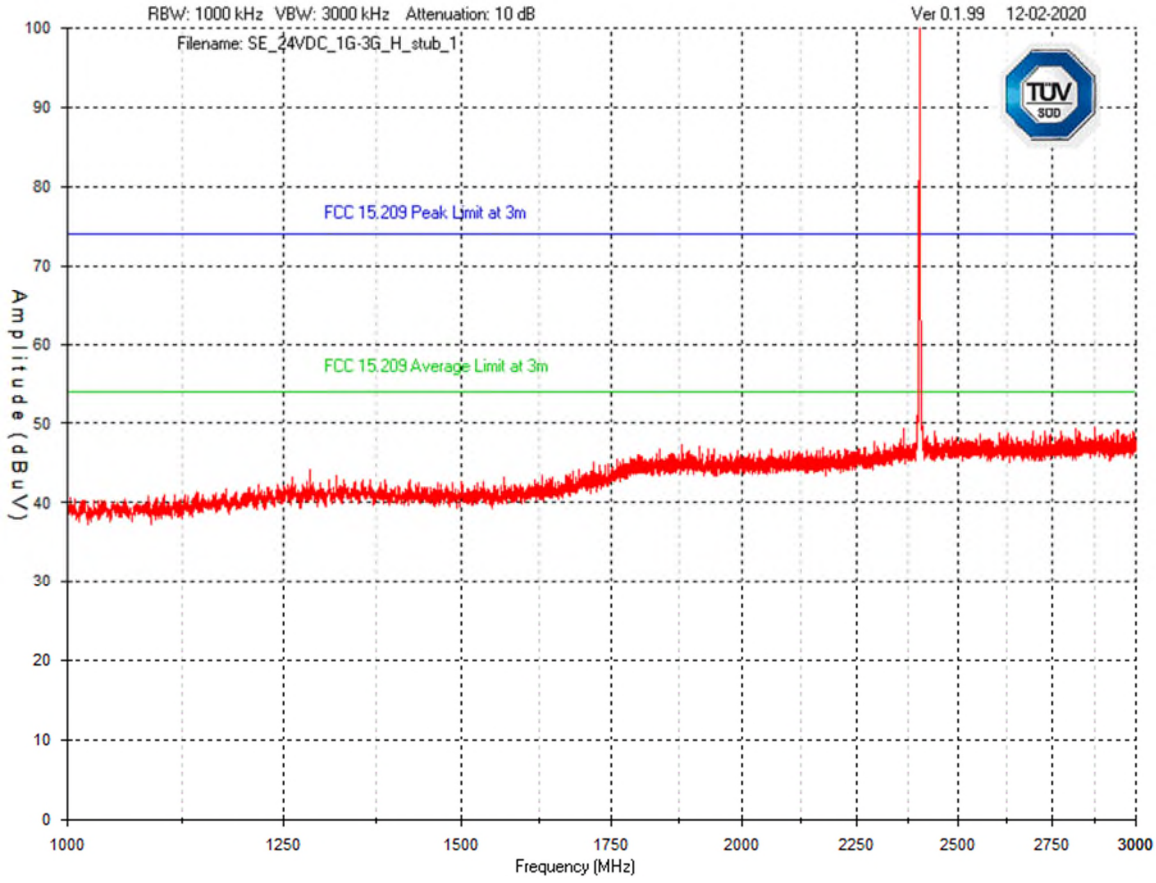
Low Channel
150 kHz – 30 MHz
Peak Emission Graph



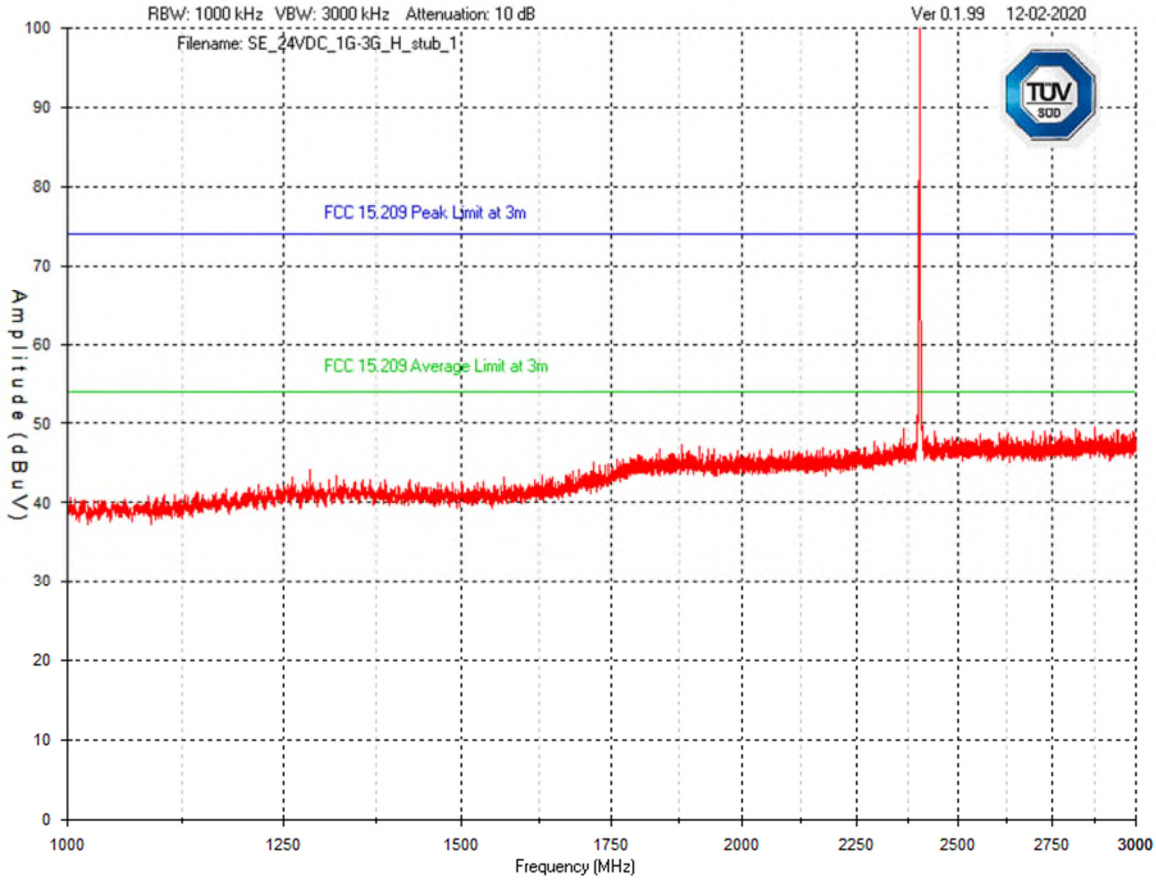
Low Channel– 30 MHz – 1 GHz
Horizontal - Peak Emission Graph



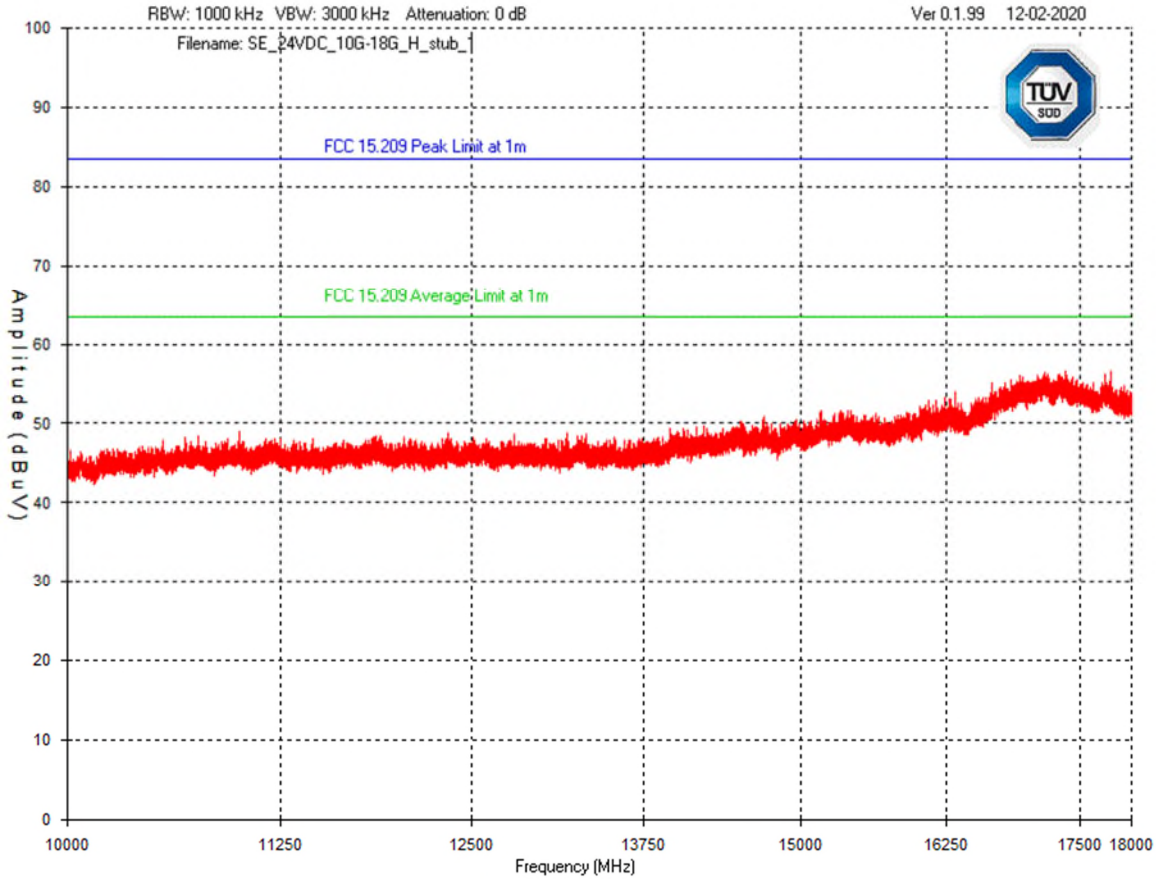
Low Channel– 1 GHz – 3 GHz
Horizontal - Peak Emission Graph



Low Channel– 3 GHz – 10 GHz
Horizontal - Peak Emission Graph

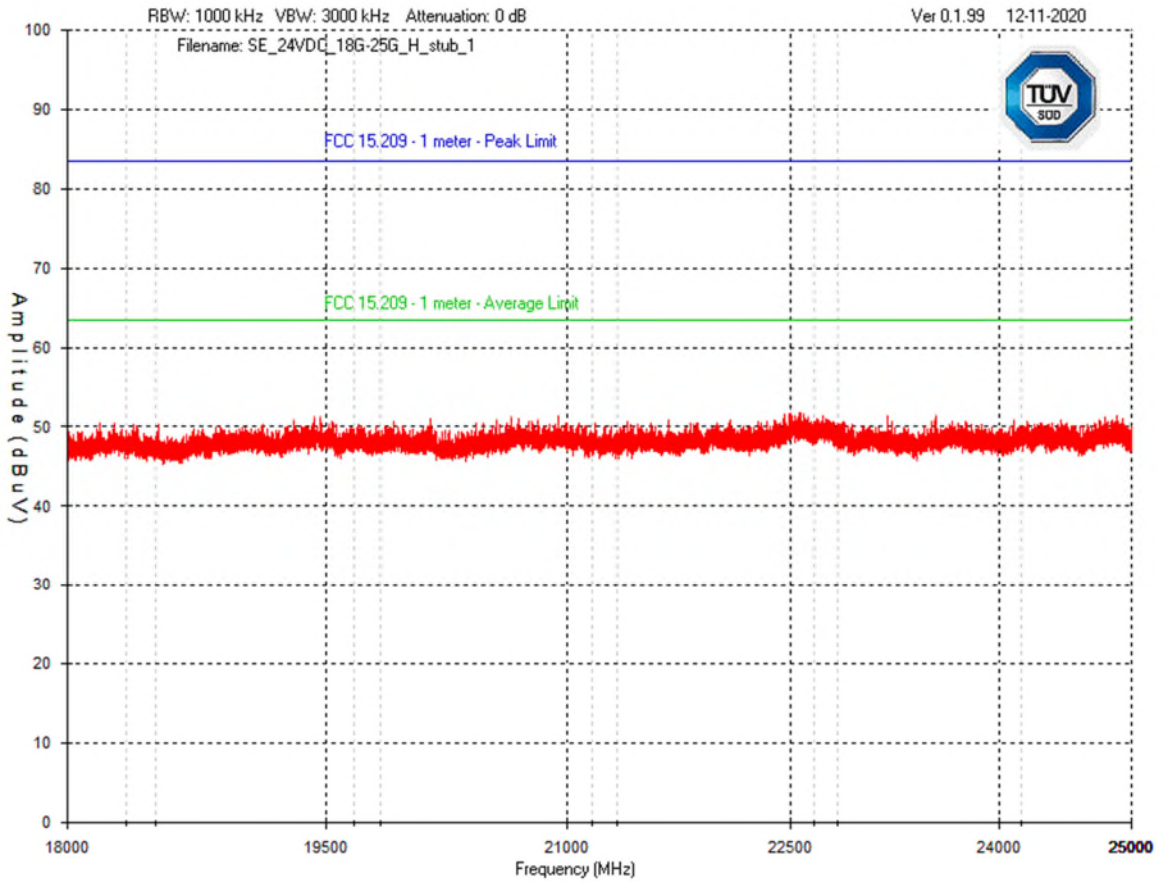


Low Channel– 10 GHz – 18 GHz
Horizontal - Peak Emission Graph



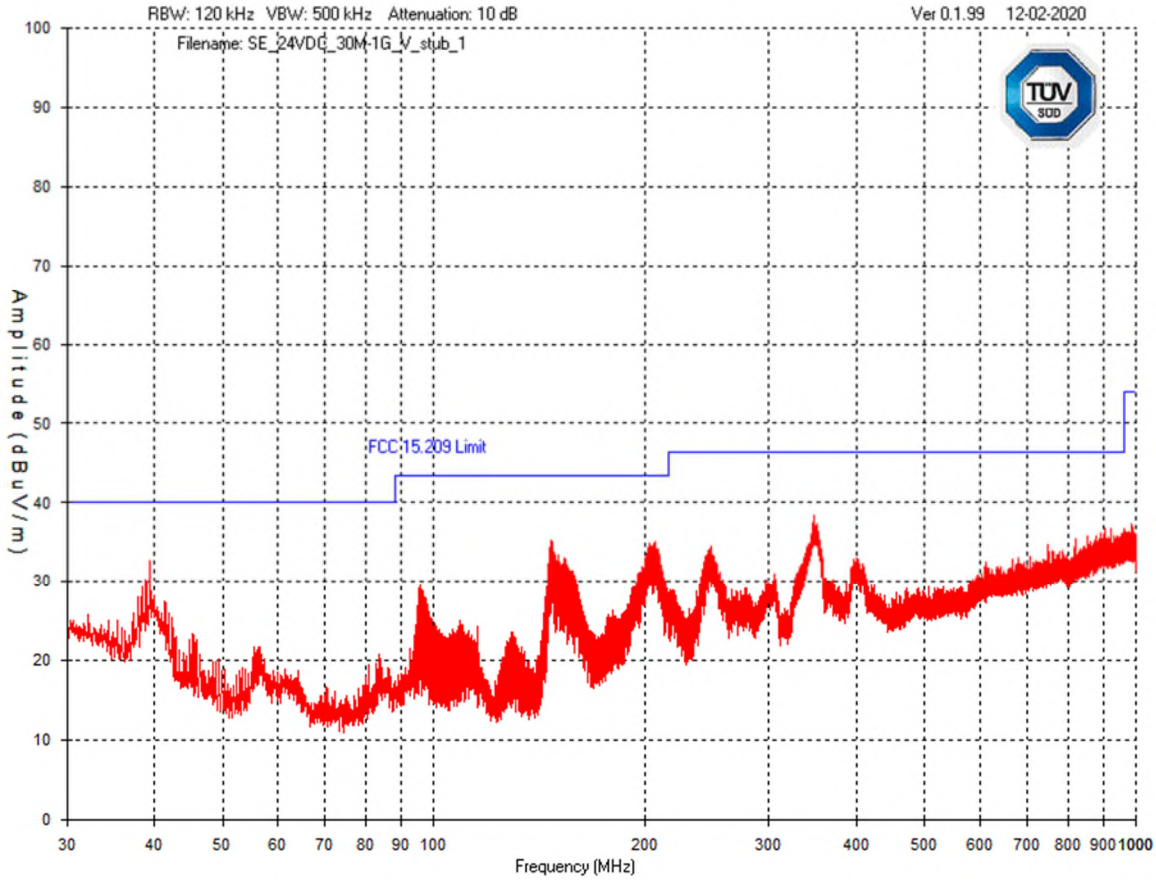
Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

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

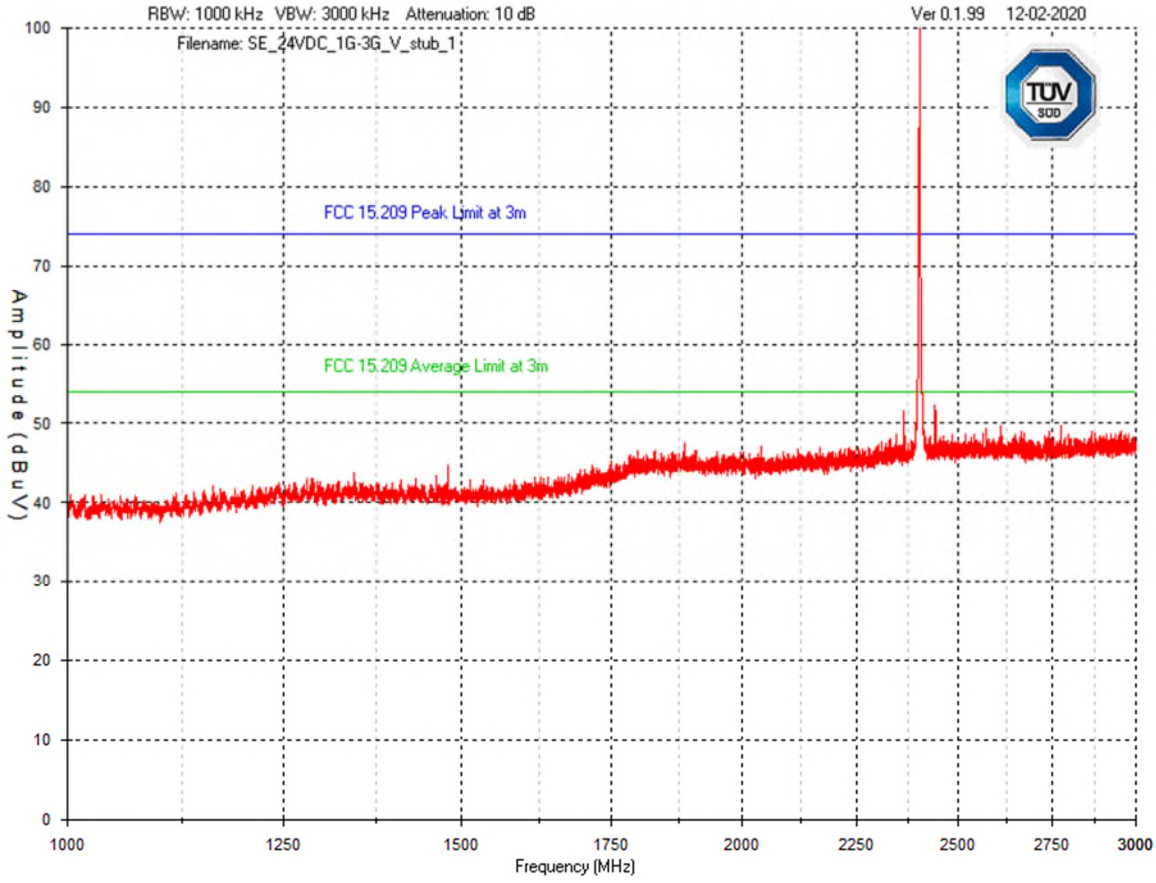


Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

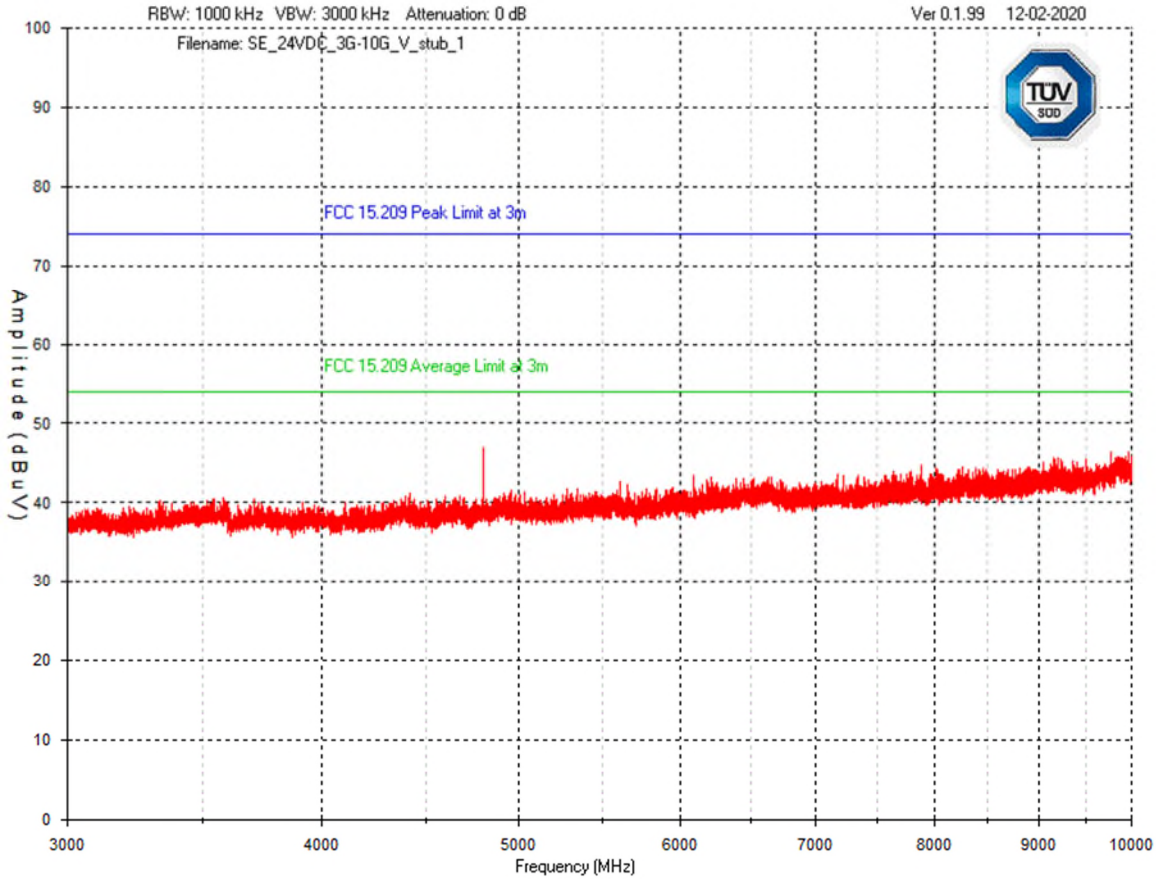
Low Channel – 30 MHz – 1 GHz
Vertical - Peak Emission Graph



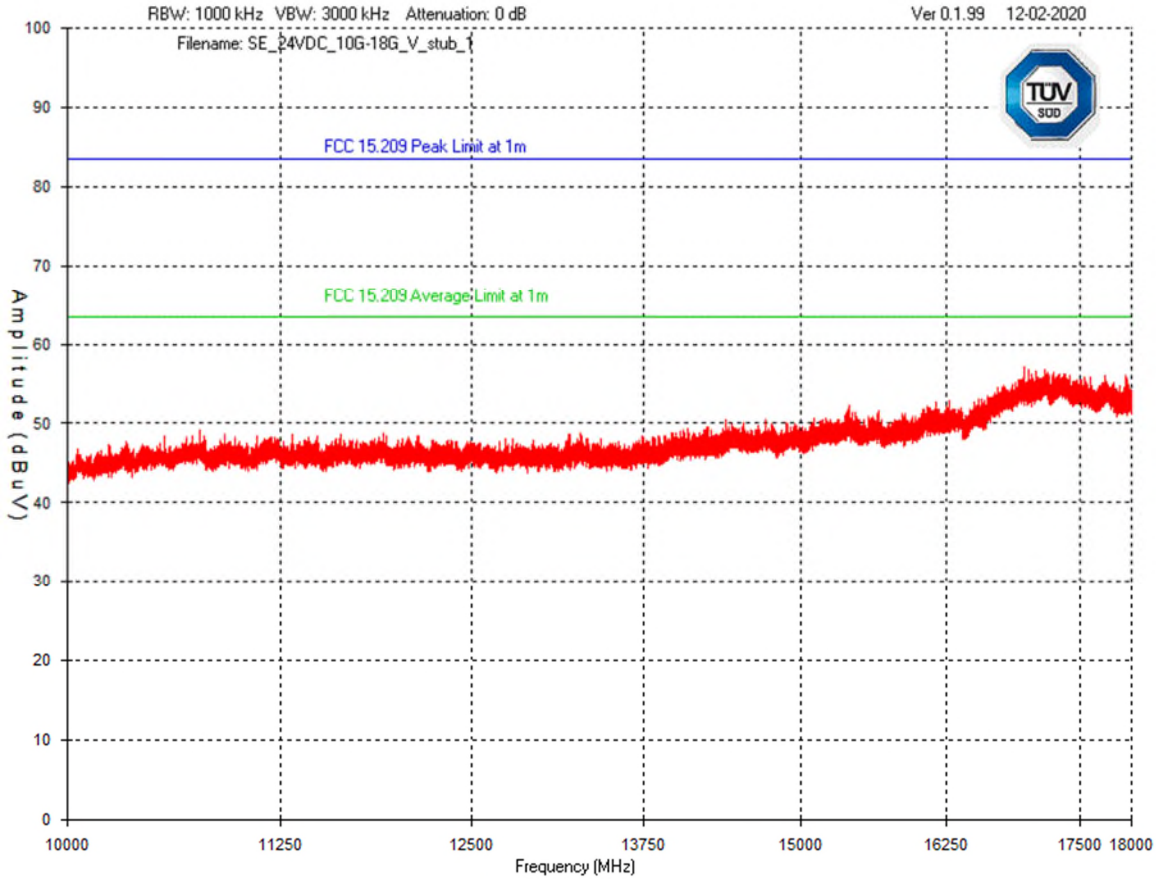
Low Channel – 1 GHz – 3 GHz
Vertical - Peak Emission Graph



Low Channel – 3 GHz – 10 GHz
Vertical - Pea k Emission Graph

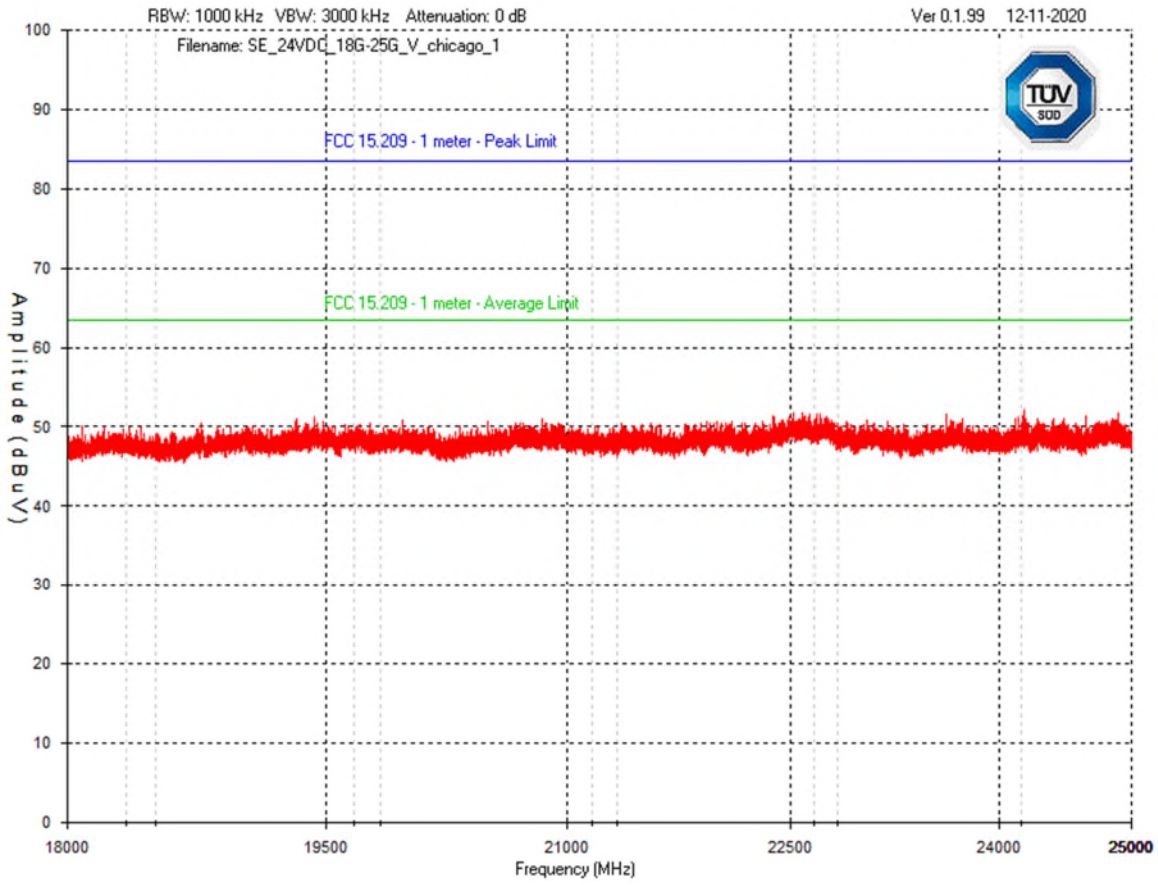


Low Channel – 10 GHz – 18 GHz
Vertical - Peak Emission Graph



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

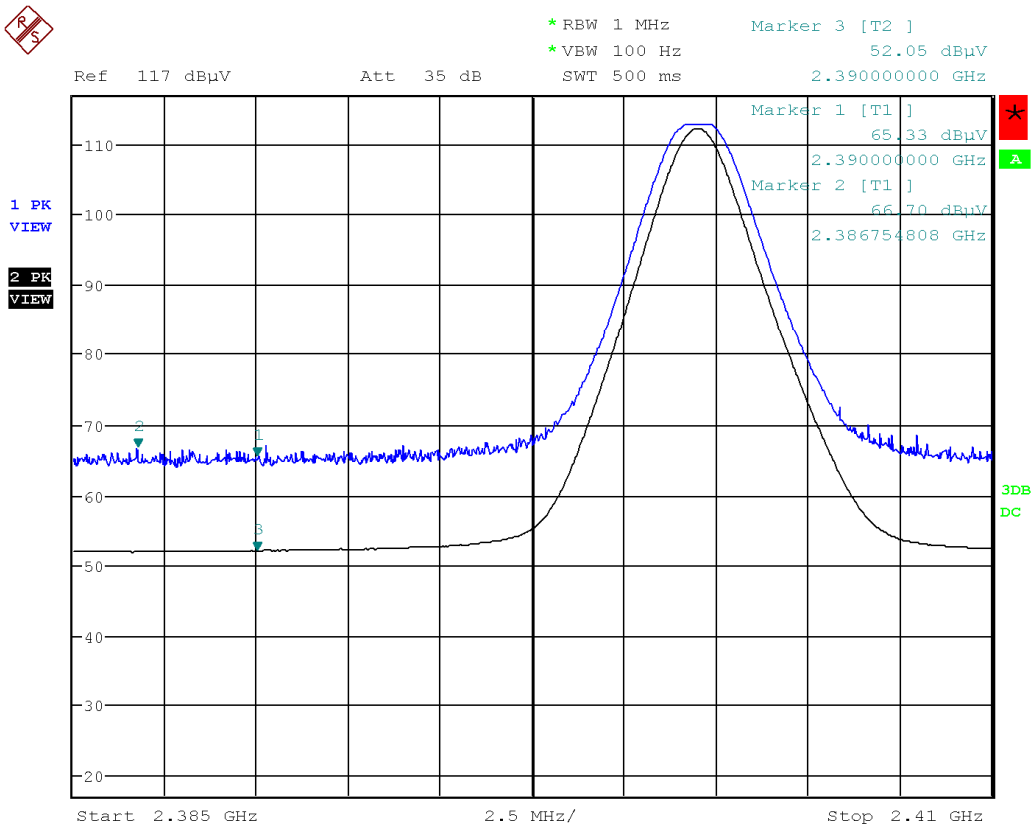
Low Channel – 18 GHz – 25 GHz
Vertical - Peak Emission Graph



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

Band Edges

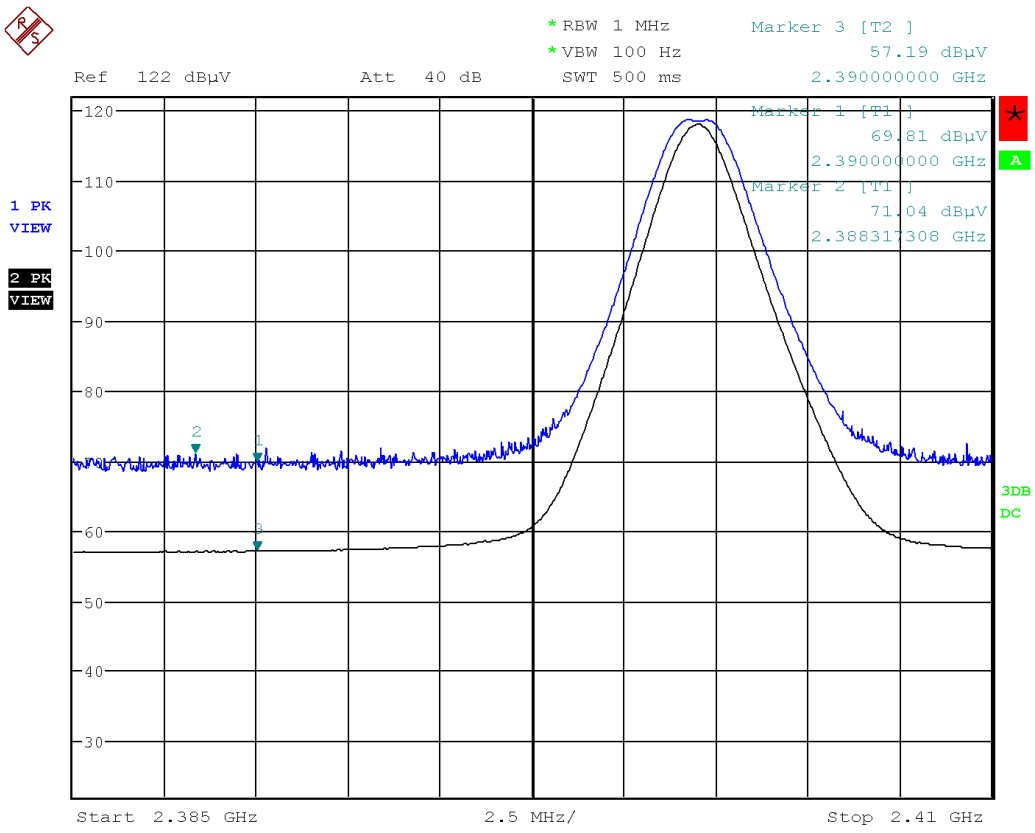
Band Edge – Low Channel
Horizontal - Peak & Average Emission



Date: 1.DEC.2020 20:37:05

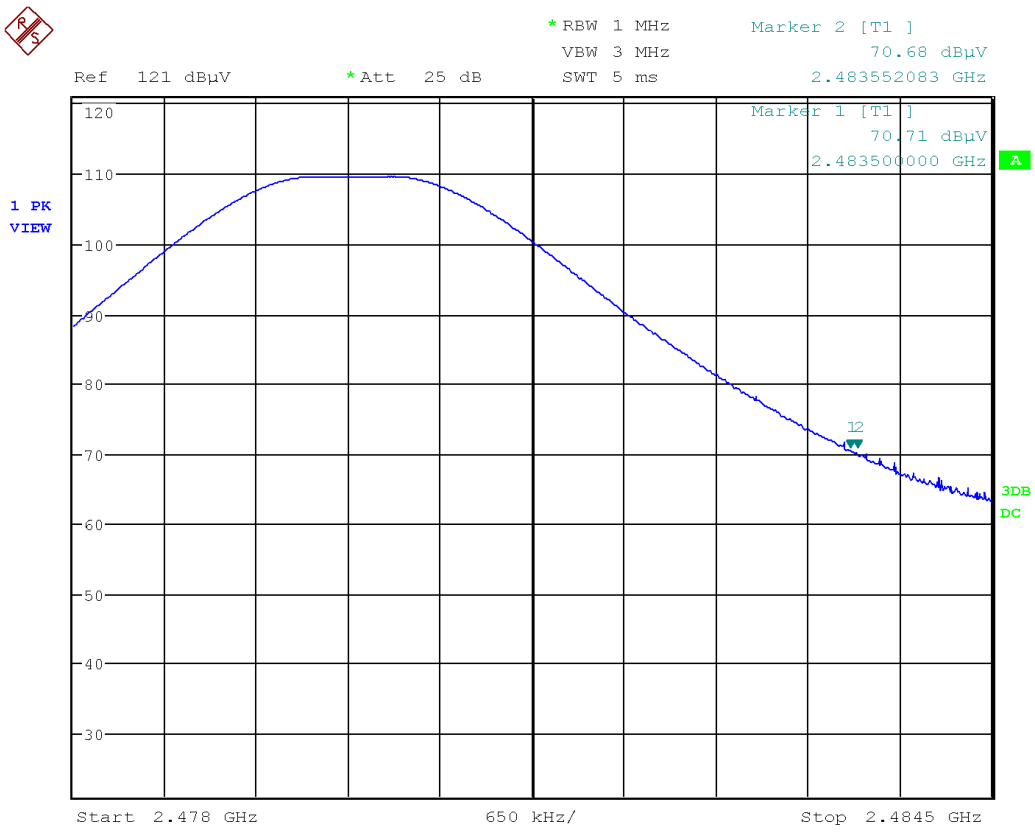
Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The marker shows the raw value. See the Final Measurements and Results section below for correct values.

Band Edge – Low Channel
Vertical - Peak & Average Emission



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.

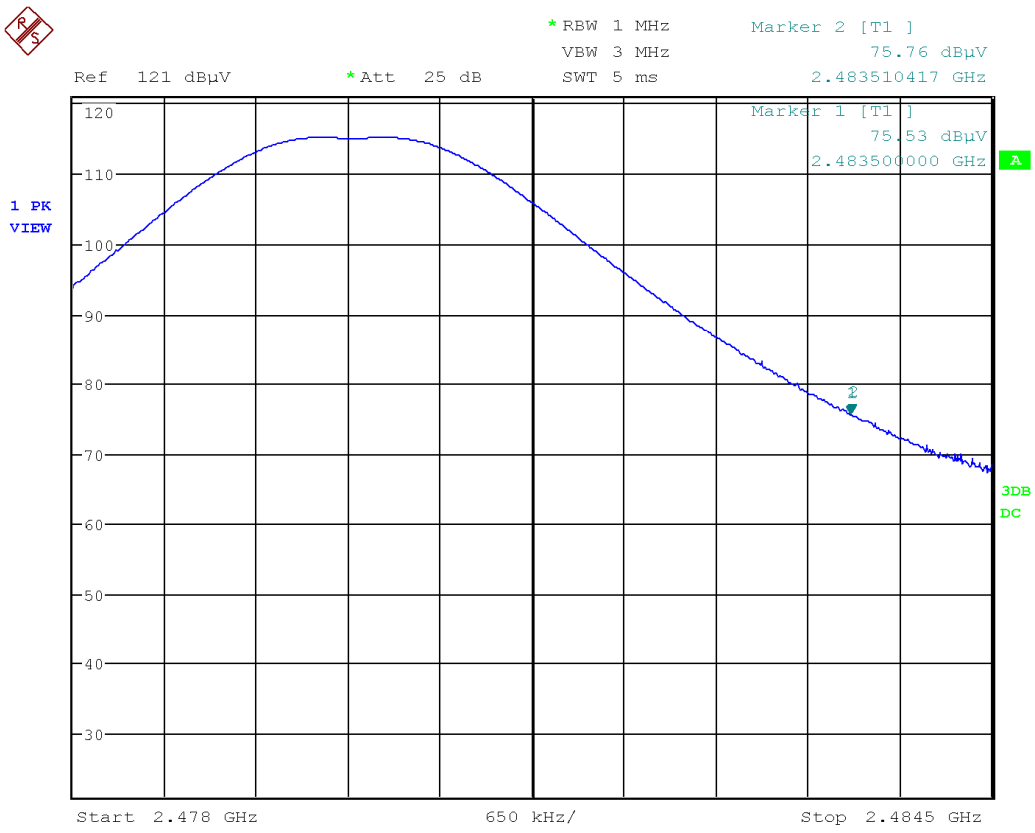
Band Edge – High Channel
Horizontal – Peak Emission



Date: 2.DEC.2020 11:21:31

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.

Band Edge – High Channel
Vertical – Peak Emission



Date: 2.DEC.2020 10:17:59

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

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.

Note: A duty cycle correction factor of -26.23dB (from a duty cycle of 4.88% for the 2.4 GHz transmission) is applied to the high band edges at 2483.5 MHz.

Pulse SMD Antenna Configuration
Spurious Emissions

Frequency (MHz)	Detector	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Test Result
Horizontal Antenna Polarization									
347.12	PEAK	49.5	21.1	2.3	-33.0	39.9	46.4	6.5	Pass
747.19	PEAK	33.0	27.8	4.1	-30.7	34.2	46.4	12.2	Pass
283.78	PEAK	47.2	18.1	2.0	-33.2	34.1	46.4	12.3	Pass
778.40	PEAK	31.1	28.6	4.3	-30.5	33.5	46.4	12.9	Pass
427.90	PEAK	40.3	22.2	2.7	-32.7	32.5	46.4	13.9	Pass
224.54	PEAK	44.8	17.4	1.7	-33.4	30.5	46.4	15.9	Pass
2401.36	PEAK	53.4	32.0	4.7	-36.4	53.7	74.0	20.3	Pass
2401.36	AVG	49.9	32.0	4.7	-36.4	50.2	54.0	3.8	Pass
2478.19	PEAK	51.7	32.2	4.7	-36.4	52.2	74.0	21.8	Pass
2478.19	AVG	48.9	32.2	4.7	-36.4	49.4	54.0	4.6	Pass
Vertical Antenna Polarization									
351.16	QP	54.4	21.3	2.3	-33.0	45.0	46.4	1.4	Pass
224.74	QP	54.5	17.4	1.7	-33.4	40.2	46.4	6.2	Pass
281.60	PEAK	54.5	18.1	1.9	-33.2	41.3	46.4	5.1	Pass
214.41	PEAK	53.4	16.7	1.6	-33.4	38.3	43.5	5.2	Pass
200.44	PEAK	54.1	16.0	1.5	-33.4	38.2	43.5	5.3	Pass
203.51	PEAK	53.7	16.0	1.5	-33.4	37.8	43.5	5.7	Pass

Pulse SMD Antenna Configuration
Band Edges

Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/ Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Atten (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
Low Channel											
2390	Peak	Horz	71.64	26.4	4.7	0.0	-36.4	66.3	74.0	7.7	PASS
2390	Avg	Horz	57.17	26.4	4.7	0.0	-36.4	51.8	54.0	2.2	PASS
2390	Peak	Vert	71.8	26.4	4.7	0.0	-36.4	66.5	74.0	7.5	PASS
2390	Avg	Vert	57.2	26.4	4.7	0.0	-36.4	51.8	54.0	2.2	PASS
High Channel											
2483.5	Peak	Horz	75.0	26.2	4.7	0.0	-36.4	69.6	74.0	4.4	PASS
2483.5	Avg	Horz	48.8	26.2	4.7	0.0	-36.4	43.3	54.0	10.7	PASS
2483.5	Peak	Vert	74.0	26.2	4.7	0.0	-36.4	68.6	74.0	5.4	PASS
2483.5	Avg	Vert	47.8	26.2	4.7	0.0	-36.4	42.3	54.0	11.7	PASS

Chicago Plenum Dual-Band Antenna Configuration
Spurious Emissions

No peak spurious emissions above limits. No measurements required.

Chicago Plenum Dual-Band Antenna Configuration
Band Edges

Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/ Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Atten (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
Low Channel											
2390	Peak	Horz	71.7	26.4	4.7	0.0	-36.4	66.3	74.0	7.7	PASS
2390	Avg	Horz	57.1	26.4	4.7	0.0	-36.4	51.8	54.0	2.2	PASS
2390	Peak	Vert	71.5	26.4	4.7	0.0	-36.4	66.1	74.0	7.9	PASS
2390	Avg	Vert	57.1	26.4	4.7	0.0	-36.4	51.7	54.0	2.3	PASS
High Channel											
2483.5	Peak	Horz	71.9	26.2	4.7	0.0	-36.4	66.5	74.0	7.5	PASS
2483.5	Avg	Horz	45.7	26.2	4.7	0.0	-36.4	40.2	54.0	13.8	PASS
2483.5	Peak	Vert	63.8	26.2	4.7	0.0	-36.4	58.3	74.0	15.7	PASS
2483.5	Avg	Vert	37.5	26.2	4.7	0.0	-36.4	32.1	54.0	21.9	PASS

Stubby Dual-Band Antenna Configuration
Spurious Emissions

No peak spurious emissions above limits. No measurements required.

Stubby Dual-Band Antenna Configuration
Band Edges

Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/ Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Atten (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
Low Channel											
2390	Peak	Horz	66.7	26.4	4.7	0.0	-36.4	61.3	74.0	12.7	PASS
2390	Avg	Horz	52.1	26.4	4.7	0.0	-36.4	46.7	54.0	7.3	PASS
2390	Peak	Vert	71.0	26.4	4.7	0.0	-36.4	65.7	74.0	8.3	PASS
2390	Avg	Vert	57.2	26.4	4.7	0.0	-36.4	51.8	54.0	2.2	PASS
High Channel											
2483.5	Peak	Horz	70.7	26.2	4.7	0.0	-36.4	65.3	74.0	8.7	PASS
2483.5	Avg	Horz	44.5	26.2	4.7	0.0	-36.4	39.0	54.0	15.0	PASS
2483.5	Peak	Vert	75.8	26.2	4.7	0.0	-36.4	70.3	74.0	3.7	PASS
2483.5	Avg	Vert	49.5	26.2	4.7	0.0	-36.4	44.1	54.0	9.9	PASS

Notes:

Peak = Peak measurement
Avg. = Average measurement
QP = Quasi-Peak measurement
Horz = Horizontal
Vert = Vertical
Atten = Attenuator factor

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 9 – 150 kHz	EM 6871	Electro-Metrics	Feb 15, 2019	Feb 15, 2021	GEMC 70
Loop Antenna 150 kHz – 30 MHz	EM 6872	Electro-Metrics	Feb 15, 2019	Feb 15, 2021	GEMC 71
BiLog Antenna 30 MHz – 1 GHz	3142-C	ETS-Lindgren	Mar. 01, 2019	Mar. 01, 2021	GEMC 137
Horn Antenna 1 – 3 GHz	3117	ETS-Lindgren	Feb. 17, 2020	Feb. 17, 2022	GEMC 340
Horn Antenna 3 – 18 GHz	WBH218HN	Q-par	Apr. 1, 2020	Apr. 1, 2022	GEMC 6375
Horn Antenna 18 - 25 GHz	SAS-572	A.H. Systems	Dec 1, 2020	Dec 1, 2022	GEMC 6371
Pre-Amp 9 kHz – 1 GHz	CPA9230	Chase	May 22, 2020	May 22, 2022	GEMC 301
Pre-Amp 1 – 18 GHz	HP 8449B	HP	Aug. 4, 2020	Aug. 4, 2022	GEMC 312
Pre-Amp 18 – 25 GHz	PAM-840A	Com-Power Corporation	Mar. 20, 2019	Mar. 20, 2021	GEMC 252
Attenuator 6 dB	612-6-1	Meca Electronics, Inc	NCR	NCR	GEMC 287
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

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.

Output to Pulse SMD antenna		
Channel	**Frequency (MHz)**	**PSD (dBm)**
Low	2402	-1.77
Mid	2442	-1.87
High	2480	-1.94-

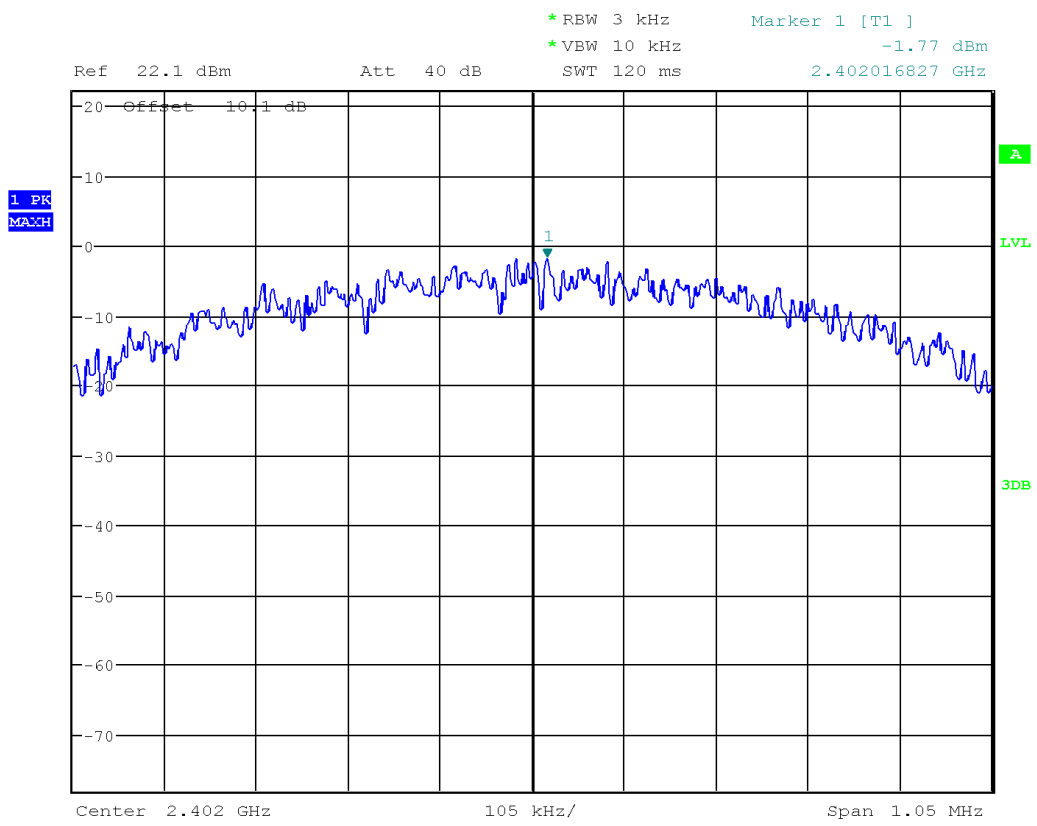
uFL connector (Output to Chicago Plenum or Stubby Dual-Band antennas)		
Channel	**Frequency (MHz)**	**PSD (dBm)**
Low	2402	-2.99
Mid	2442	-3.34
High	2480	-3.87

Graphs

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

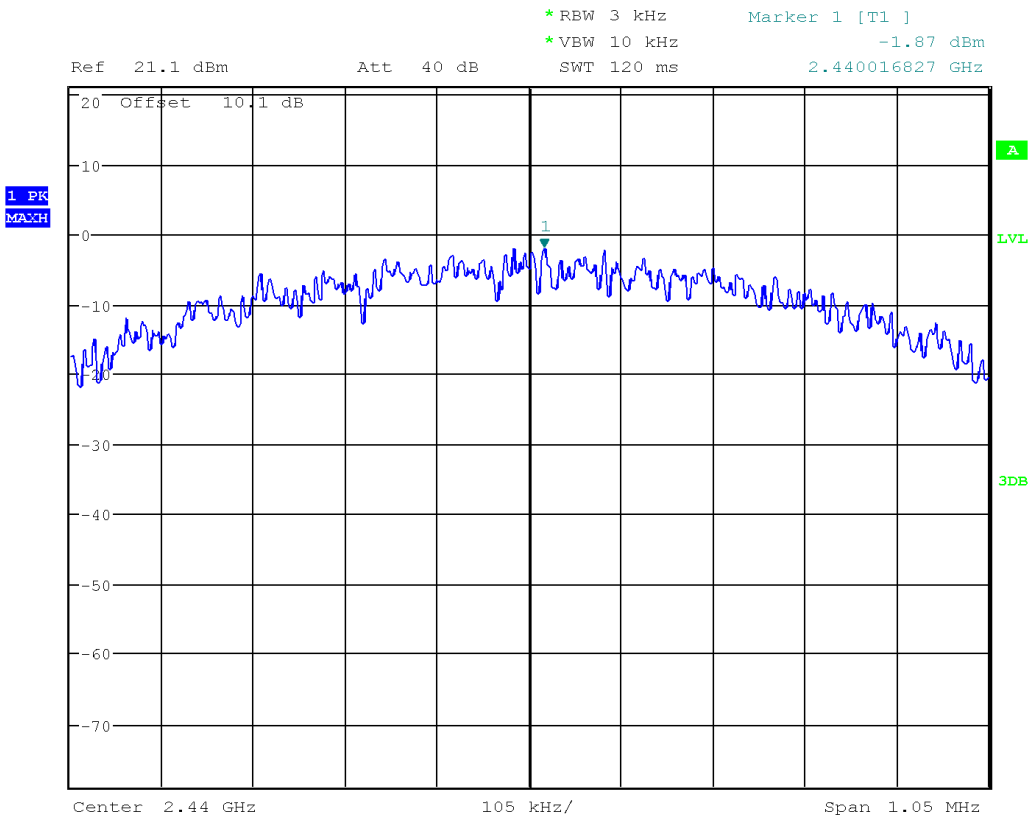
PSD
Output to Pulse SMD antenna

Low Channel



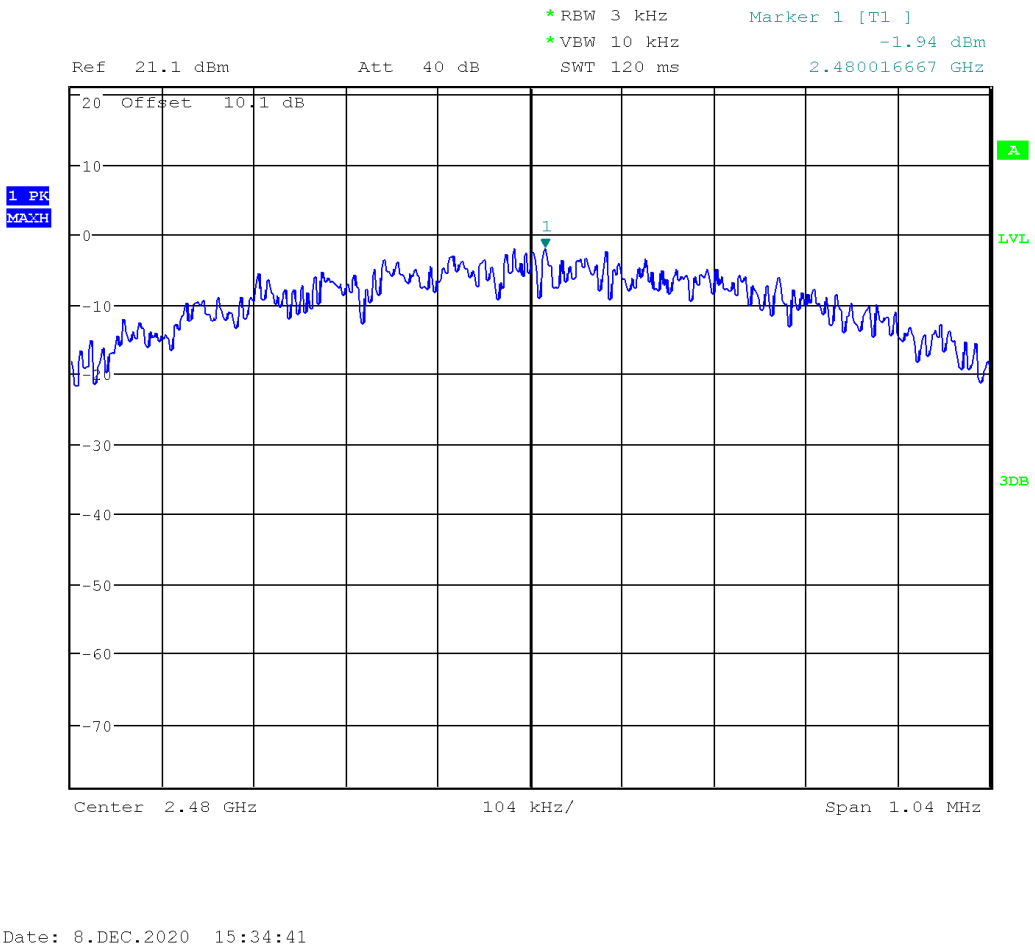
PSD
Output to Pulse SMD antenna

Mid Channel



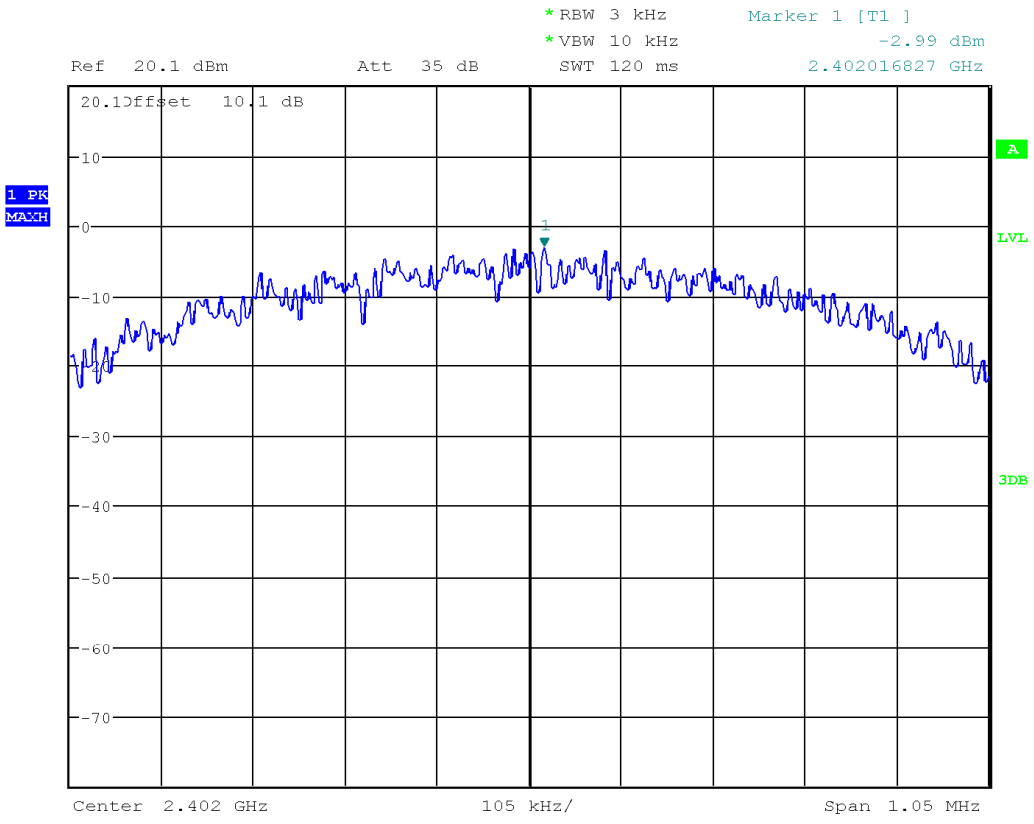
PSD
Output to Pulse SMD antenna

High Channel



PSD
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

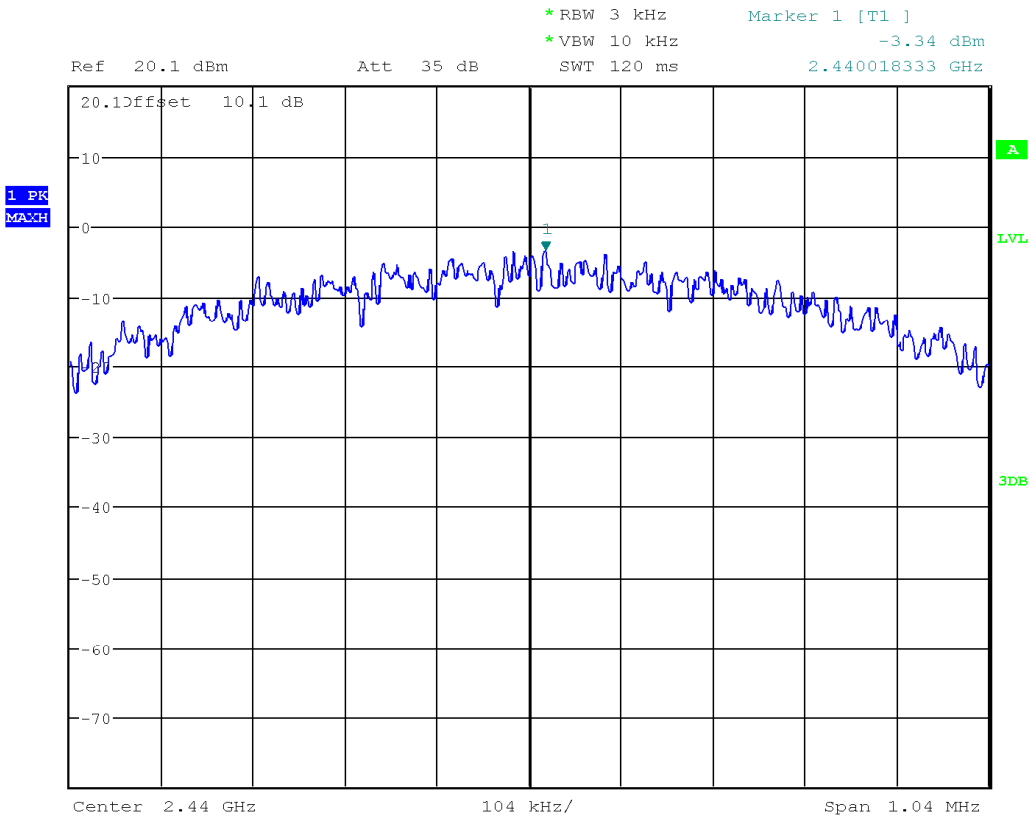
Low Channel



Date: 8.DEC.2020 15:55:22

PSD
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

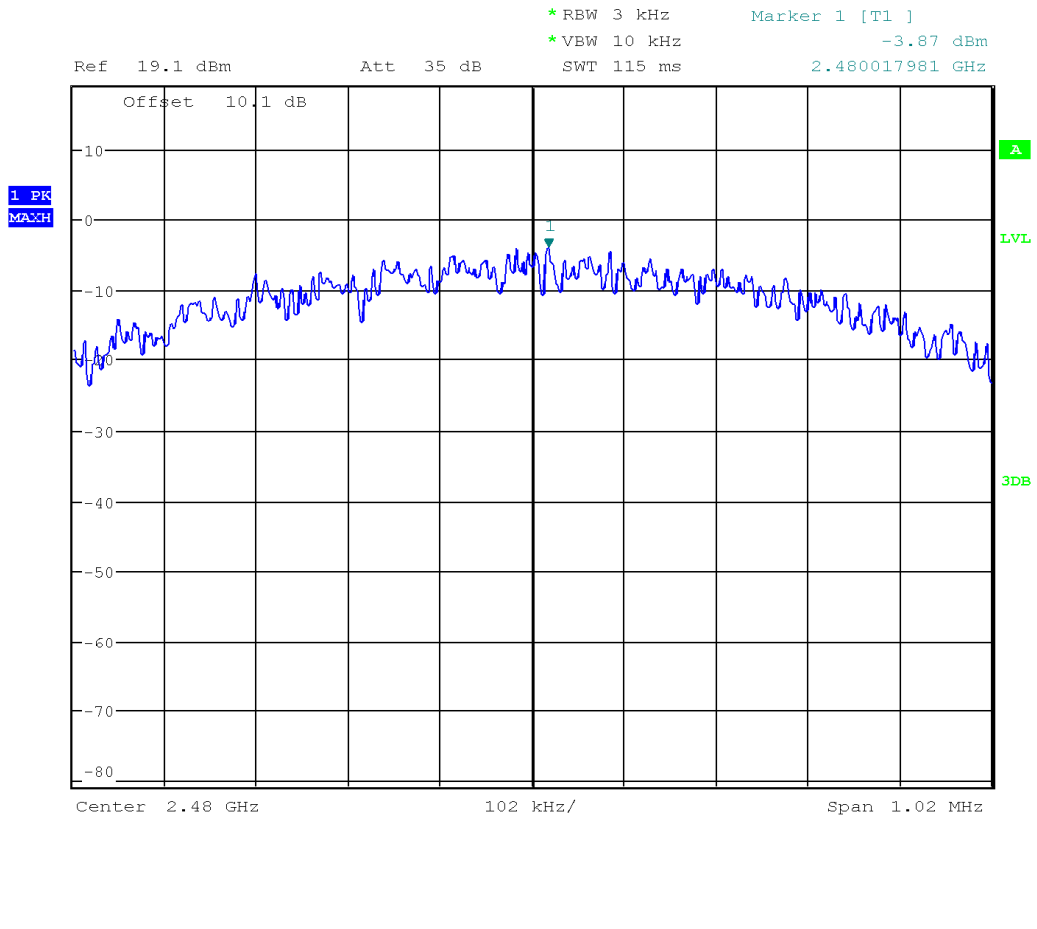
Mid Channel



Date: 8.DEC.2020 15:58:48

PSD
uFL connector
(Output to Chicago Plenum or Stubby Dual-Band antennas)

High Channel



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

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	FSU 26	Rohde & Schwarz	Oct. 28, 2019	Oct. 28, 2021	GEMC 231
Attenuator 10 dB	18N5W-10	Inmet	NCR	NCR	GEMC 358

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 and Method

The limits are as defined in 47 CFR FCC Part 15 Section 15.207
Method is as defined in ANSI C63.4

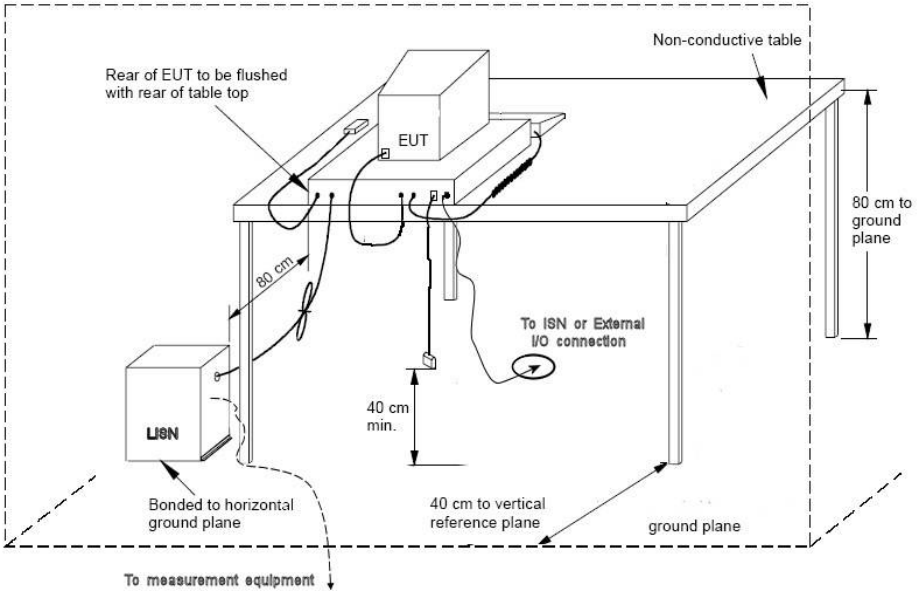
Average Limits		Quasi-Peak Limits	
150 kHz – 500 kHz	56 to 46* dBµV	150 kHz – 500 kHz	66 to 56* dBµV
500 kHz – 5 MHz	46 dBµV	500 kHz – 5 MHz	56 dBµV
5 MHz – 30 MHz	50 dBµV	5 MHz – 30 MHz	60 dBµV

* 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.

Typical Setup Diagram



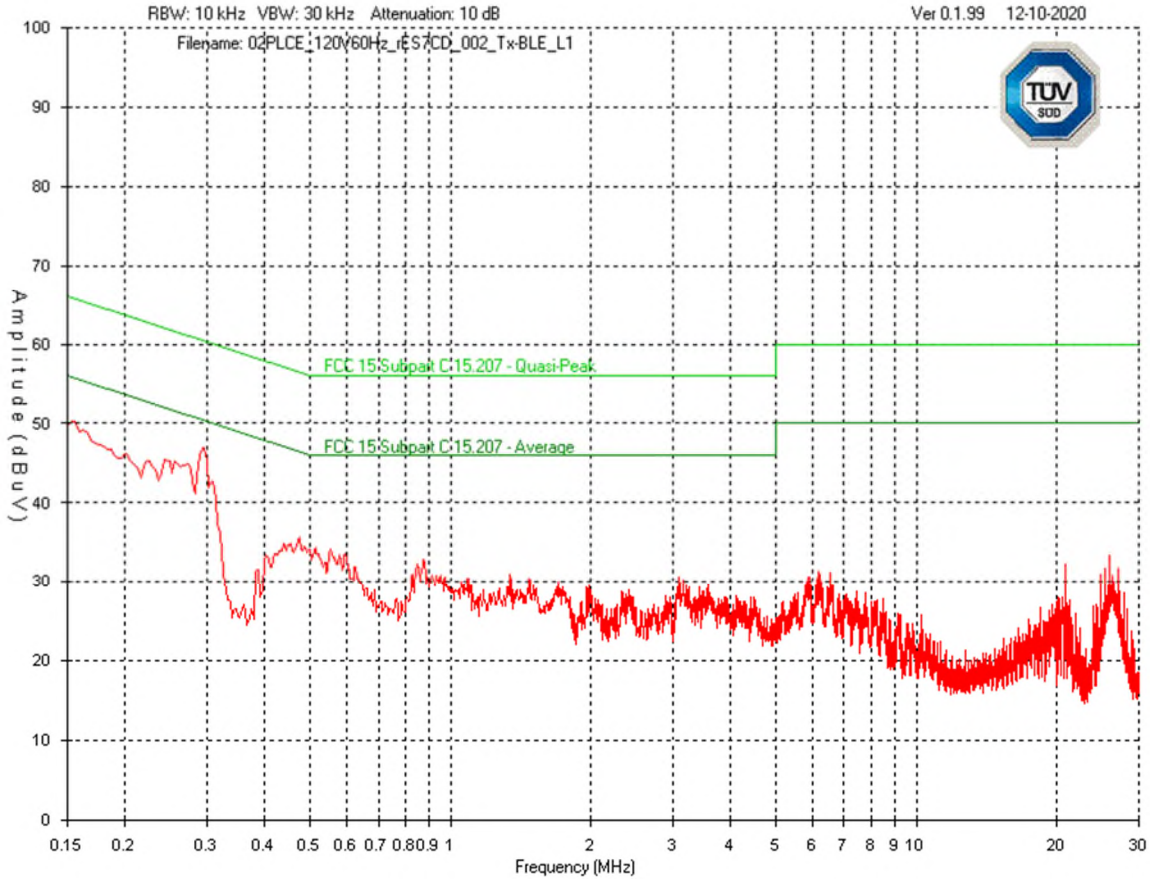
Measurement Uncertainty

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.

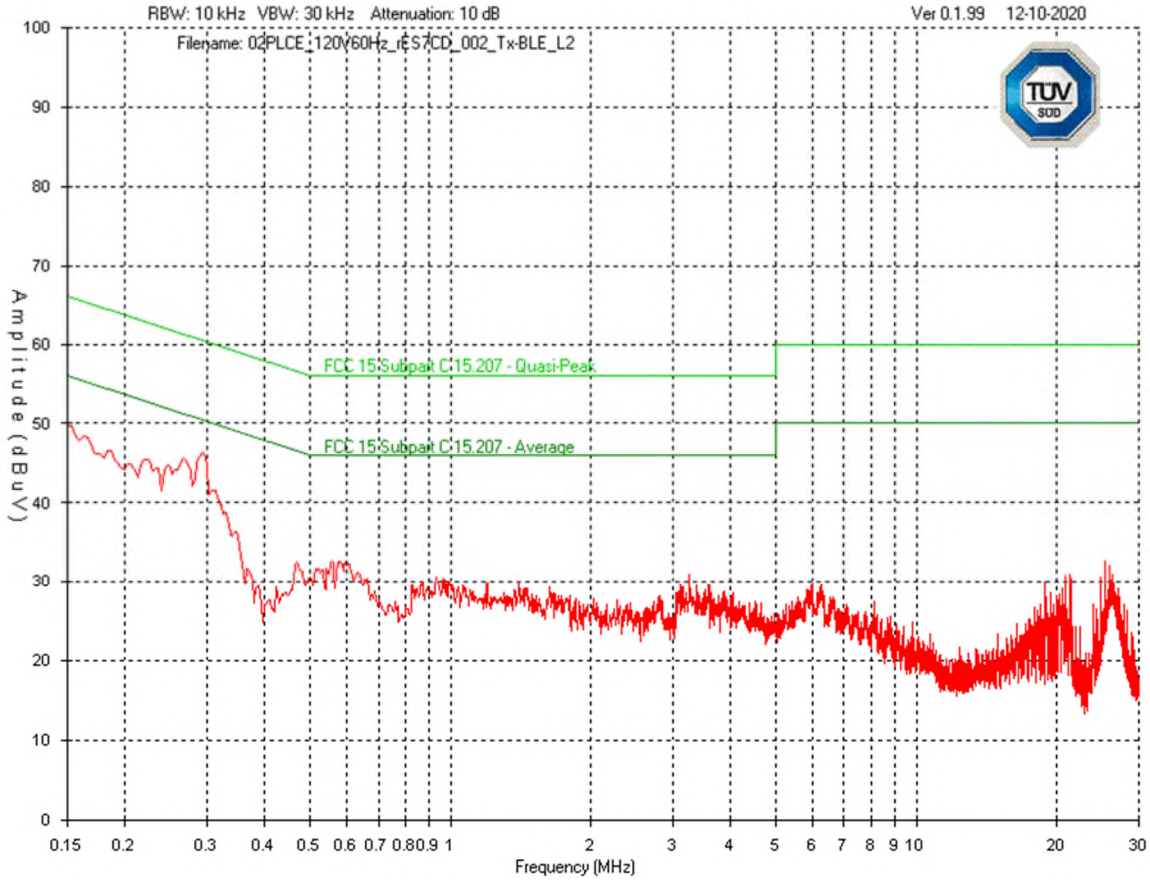
Preliminary Graphs

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.

Line 1 (L1) – 120Vac 60Hz



Line 2 (L2) – 120Vac 60Hz



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											
0.153	AVG	8.5	10	0.0	0.1	18.6	--	55.8	--	37.3	Pass
0.291	AVG	19.2	10	0.0	0.1	29.3	--	50.5	--	21.2	Pass
0.153	PEAK	40.3	10	0.0	0.1	50.4	65.8	--	15.4	--	Pass
0.476	PEAK	25.5	10	0.1	0.0	35.6	56.4	46.4	20.8	10.8	Pass
0.875	PEAK	22.7	10	0.1	0.0	32.8	56.0	46.0	23.2	13.2	Pass
3.101	PEAK	20.5	10	0.1	0.0	30.6	56.0	46.0	25.4	15.4	Pass
1.991	PEAK	19.4	10	0.1	0.0	29.5	56.0	46.0	26.5	16.5	Pass
25.932	PEAK	23.2	10	0.1	0.1	33.4	60.0	50.0	26.6	16.6	Pass
Line 2											
0.153	AVG	8.4	10	0.0	0.1	18.5	--	55.8	--	37.4	Pass
0.291	AVG	19.7	10	0.0	0.1	29.8	--	50.5	--	20.7	Pass
0.153	PEAK	39.7	10	0.0	0.1	49.8	65.8	--	16.0	--	Pass
0.575	PEAK	22.6	10	0.1	0.0	32.7	56.0	46.0	23.3	13.3	Pass
3.261	PEAK	20.9	10	0.1	0.0	31.0	56.0	46.0	25.0	15.0	Pass
25.417	PEAK	22.5	10	0.1	0.1	32.7	60.0	50.0	27.3	17.3	Pass
25.919	PEAK	21.9	10	0.1	0.1	32.1	60.0	50.0	27.9	17.9	Pass
21.436	PEAK	20.8	10	0.1	0.0	30.9	60.0	50.0	29.1	19.1	Pass

Average and Quasi-Peak Emissions Table

Notes:

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.

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	Jan. 16, 2020	Jan. 16, 2022	GEMC 302
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

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

General EUT Description

Client	
Organization / Address	Acuity Brands Lighting, Inc. 1 Acuity Way, Decatur, GA 30035 United States
Contact	Alex Bahk
Phone	770-593-5062
Email	Alex.Bahk@AcuityBrands.com
EUT Details	
EUT Name	rES7CD
FCC ID	2ADCB-RES7CD
IC ID	6715C-RES7CD
Equipment Category	Integrated Wireless Sensor
Basic EUT Functionality	In-fixture, low voltage, digital sensor providing embedded wireless lighting control, digital dimming, occupancy detection and daylight harvesting capabilities. BLE is used for commissioning the lighting fixture.
Input Voltage and Frequency	5Vdc to 60Vdc 24Vdc supplied to EUT via AC/DC adaptor. AC/DC Power Supply: Triad, Model: WS2U240-0500
Rated Input Current	300mA
Connectors available on EUT	Positive Supply, Negative Supply, Positive Control, Negative Control
Peripherals Required for Test	Laptop to configure the test firmware on the EUT via UART
Intentional Radiator Frequency	2400 to 2483.5 MHz (BLE)

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'.

EUT Configuration

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

- Wireless configured to transmit continuously at 100% duty cycle with modulation
- Low Channel: Ch 0 = 2402MHz
- Middle Channel: Ch 19 = 2440MHz
- High Channel: Ch 39 = 2480MHz
- Power Level Register Setting: 67
- For the Spurious Radiated Emissions and Power Line Conducted Emissions, the transmitter was set to Ch 0 which was the worst case.

PCB and Antenna configurations for spurious emissions:

Configuration	PCBA	Antenna
1	501-01432-001	Pulse SMD (122-00067-001)
2	501-01432-024	Chicago Plenum Dual-Band (122-00060-001) Diplexer
3	501-01432-024	Stubby Dual-Band (801-00851-001/2) Diplexer

Below is a list of all the representative PCBA variants to the samples tested as provided by the client.

PCBA Variants	Dimmer	PIR Sensor	Pressure Detect	Host Product	Antenna
501-01432-001	LED code	Yes	Yes	RES7	Pulse SMD
501-01432-002	LED code	Yes	Yes	RES7	Pulse SMD
501-01432-003	LED code	Yes	Yes	RES7	Pulse SMD
501-01432-004	LED code	Yes	Yes	RES7	External DualBand
501-01432-005	0-10V	Yes	Yes	RES7	Pulse SMD
501-01432-006	0-10V	Yes	Yes	RES7	Pulse SMD
501-01432-007	0-10V	Yes	Yes	RES7	External 900
501-01432-008	0-10V	Yes	Yes	RES7	External DualBand
501-01432-009	LED code	Yes	No	RES7	Pulse SMD
501-01432-010	LED code	Yes	No	RES7	Pulse SMD
501-01432-011	LED code	Yes	No	RES7	External 900
501-01432-012	LED code	Yes	No	RES7	External DualBand
501-01432-013	0-10V	Yes	No	RES7	Pulse SMD
501-01432-014	0-10V	Yes	No	RES7	Pulse SMD
501-01432-015	0-10V	Yes	No	RES7	External 900
501-01432-016	0-10V	Yes	No	RES7	External DualBand
501-01432-017	LED code	No	No	RIO	Pulse SMD
501-01432-018	LED code	No	No	RIO	Pulse SMD
501-01432-019	LED code	No	No	RIO	External 900
501-01432-020	LED code	No	No	RIO	External DualBand
501-01432-021	0-10V	No	No	RIO	Pulse SMD
501-01432-022	0-10V	No	No	RIO	Pulse SMD
501-01432-023	0-10V	No	No	RIO	External 900
501-01432-024	0-10V	No	No	RIO	External DualBand
501-01432-103	LED code	Yes (Lens 6-10)	Yes	RSBG	Pulse SMD
501-01432-107	0-10V	Yes (Lens 6-10)	Yes	RSBG	Pulse SMD
501-01432-203	LED code	Yes (Lens 40)	Yes	RSBG	Pulse SMD
501-01432-207	0-10V	Yes (Lens 40)	Yes	RSBG	Pulse SMD

Appendix B – EUT and Test Setup Photos

Refer to the files separate from this test report