EMC & RF Test Report

As per

RSS-247 Issue 2:2017
&
FCC Part 15 Subpart 15.247:2018

Unlicensed Intentional Radiators (DTS)

on the

EB-SMSWV-01

Issued by: **TÜV SÜD Canada Inc.**
11 Gordon Collins Dr,
Gormley, ON, L0H 1G0
Canada
Ph: (905) 883-7255

Testing produced for

See Appendix A for full client &EUT details.

Raymond Lee Au,
Project Engineer

Industry Canada
Registration # 6844A-3

Testing Laboratory Certificate #2955.02

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

Registration # CA6844

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Report Scope

This report addresses the EMC verification testing and test results of the **Ecobee Inc.'s EB-SMSWV-01**, and is herein referred to as EUT (Equipment Under Test).

The EUT was tested for compliance following a Class II Permissive Change (C2PC) per FCC part 2.1043, and ISED RSP-100 section 7, against the following standards:

RSS-247 Issue 2:2017

FCC Part 15 Subpart C 15.247:2018

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

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

This report does not imply product endorsement by 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:	EB-SMSWV-01
FCC Certification #, FCC ID:	WR9EBSMSW1V001
Industry Canada Certification #, IC:	7981A- EBSMSW1V001
EUT passed all tests performed	Yes
Tests conducted by	Raymond Lee Au

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

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS-GEN (Table 6)	Restricted Bands for intentional operation	QuasiPeak Average	Pass
FCC 15.209 RSS-GEN (Table 4)	Spurious Radiated emissions	QuasiPeak Average	Pass
FCC 15.247(b)(4) RSS-247 5.4 (4)	Antenna Gain	< 6 dBi	Pass
FCC 15.247(i) RSS-102	Maximum Permissible Exposure	> 20 cm separation.	Pass See justification and calculations
Overall Result			**PASS**

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a ‘PASS’ grade. If not ‘FAIL’ grade will be issued. Note that ‘PASS’ / ‘FAIL’ grade is independent of any measurement uncertainties.

Notes, Justifications, or Deviations

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

This report incorporates test results performed following an antenna change on the EUT by the manufacturer. As per the manufacturer, there are no other changes to the EUT other than the antenna for the 2.4 – 2.4835 GHz transmission range.

For the antenna requirement specified in FCC 15.203 (RSS-247 section 5.5), the updated 2.4 GHz antenna is a monopole flex PCB antenna with a gain of -2.3 dBi, which is less than 6 dBi gain.

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

The EUT is not a hybrid system and FCC 15.247 (f) does not apply to it.

The EUT contains a 902 – 928 MHz FHSS transmitter and a 2400 – 2483.5 MHz DTS transmitter. The Firmware guarantees simultaneous will not occur. Antenna co-location testing is therefore not applicable.

As per the manufacturer, the 902 – 928 MHz transmitter and antenna has not been modified in the scope of this project.

For maximum permissible exposure, this device operates at less than 1 Watt at 2400 – 2483.5 MHz and is designed to operate greater than 20 cm from any personnel during normal operation. No testing is required, however worst case calculated exposure compliance is shown in the RF Exposure exhibits.

The EUT is an 802.11 complaint transceiver. It has B/G/N protocols. The N protocol operates with 20 MHz bandwidth. Each protocol have multiple modulation schemes and data rates. For each protocol, bandwidth and power were pre-scanned and the worst case results were presented in this report.

Sample Calculation(s)

Radiated Emission Test

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

Power Line Conducted Emission Test

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

Applicable Standards, Specifications and Methods

ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2013	American National Standard For Testing Unlicensed Wireless Devices
CFR 47 FCC 15 Subpart C:2018	Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators
CISPR 22:2008	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
ICES-003 Issue 6 2017	Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
RSS-GEN Issue 4 2014	General Requirements and Information for the Certification of Radio Apparatus
RSS-247 Issue 2:2017	Issue 2: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS 102 Issue 5 2015	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
FCC KDB 447498 v06	RF Exposure Procedures And Equipment Authorization Policies For Mobile And Portable Devices
ISO 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories

Document Revision Status

Revision 000 May 1, 2018
- Initial Release

Definitions and Acronyms

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

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

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

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

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

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

ITE – Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

LISN – Line Impedance Stabilization Network

NCR – No Calibration Required

RF – Radio Frequency

Testing Facility

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

Calibrations and Accreditations

The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, CA6844), Industry Canada (IC, 6844A-3) and Voluntary Control Council for Interference (VCCI, R-4023, G-506, C-4498, and T-1246). This chamber was calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. The NSA data is kept on file at TÜV SÜD Canada. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at TÜV SÜD Canada. TÜV SÜD Canada Inc is accredited to ISO 17025 by A2LA with Testing Certificate #2555.01. The laboratory's current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

Testing Environmental Conditions and Dates

Following environmental conditions were recorded in the facility during time of testing

Date	Test	Initials	Temperature (°C)	Humidity (%)	Pressure (kPa)
2018/03/29	Radiated Emissions (9 kHz – 2 GHz)	RA	21.7	36.0	101.5
2018/03/28	Radiated Emissions (above 2 GHz)	RA	23.5	32.5	101.6

Detailed Test Results Section

Antenna Gain

Purpose

The purpose of this test is to determine if the gain of the new antenna remains < 6 dBi, and that conducted output power limits remain valid per FCC 15.247(b) and RSS-247.

Limits and Methods

The requirements are defined in FCC Part 15.247(b)(4) and RSS 247.
Peak radiated emissions are performed with RBW = 1 MHz and VBW = 3 x RBW (per the method given in ANSI C63.10 Clause 11.9.1.2.) to obtain E.I.R.P. This is compared with the conducted output obtained under similar methods to determine antenna gain.

Results

The EIRP is obtained at low, mid, and high channel. The max at G-mode is presented below.

The max antenna gain is -2.3 dBi, and does not exceed 6 dBi.

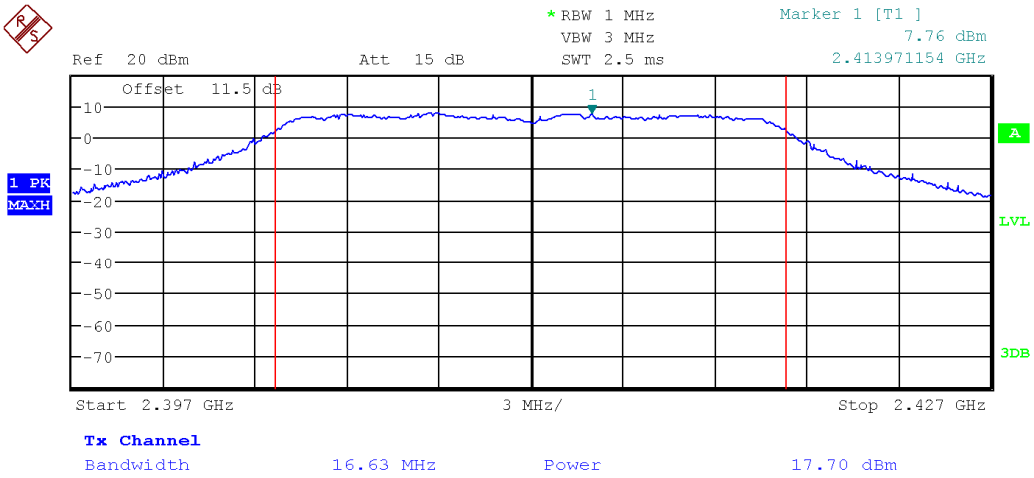
G-Mode

Channel	Frequency (MHz)	Polarity	Detector	Raw signal dB(µV)	Antenna factor (dB)	Cable Factor (dB)	Pre-Amp Gain (dB)	Radiated Level (dBuV/m)	EIRP (dBm)	Conducted Power (dBm)	Antenna Gain (dBi)
1	2412	V	Peak	100.17	26.4	3.6	-32.7	97.47	2.27	7.76	-5.49
6	2437	V	Peak	103.31	26.3	3.6	-32.7	100.51	5.31	7.65	**-2.34**
11	2462	V	Peak	104.01	26.3	3.6	-32.7	101.21	6.01	9.96	-3.95

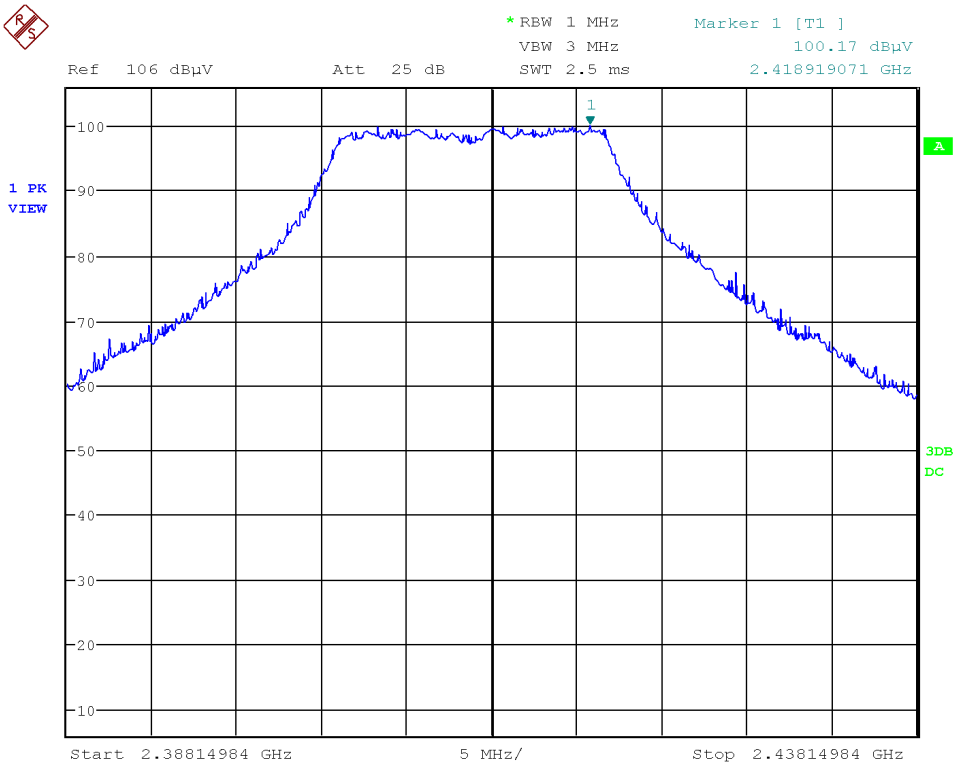
Readings

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

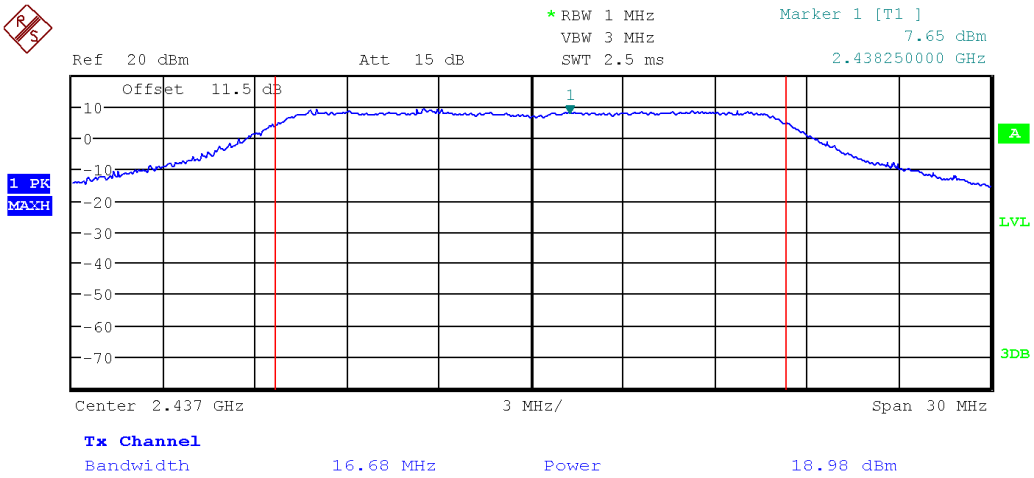
Peak Conducted Power: G-Mode
Low Channel 1



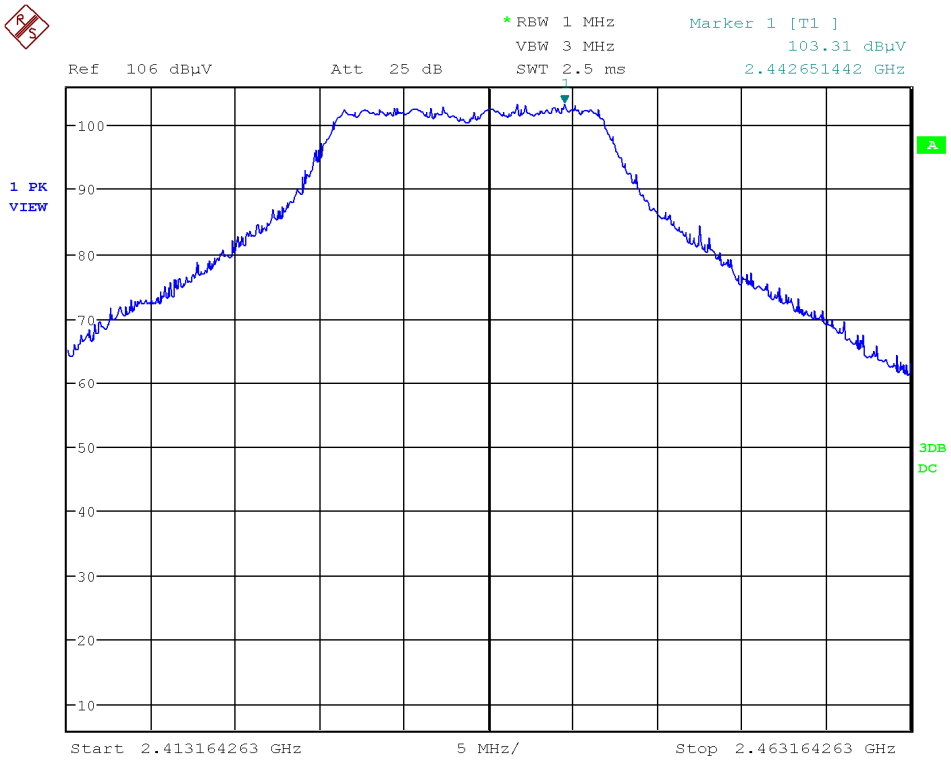
Peak Radiated Field: G-Mode
Low Channel 1



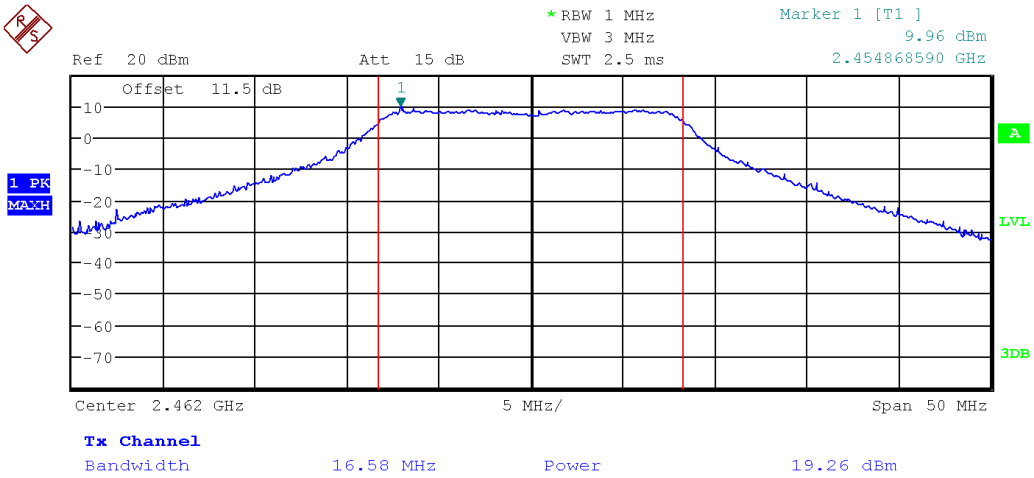
Peak Power: G-Mode
Mid Channel 6



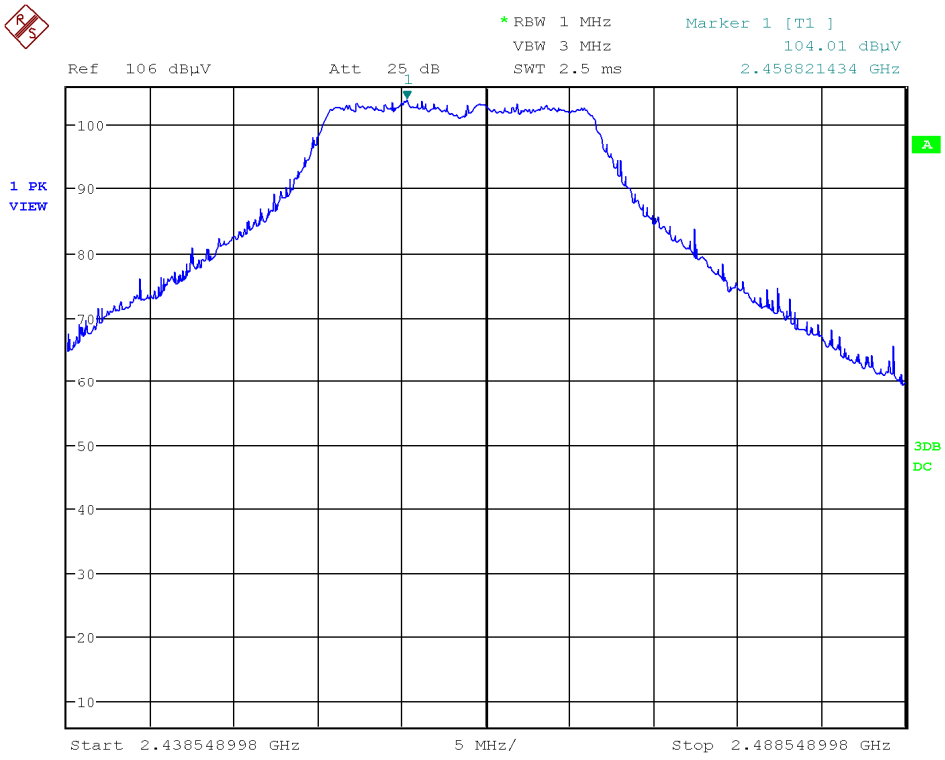
Peak Radiated Field: G-Mode
Mid Channel 6



Peak Power: G-Mode
High Channel11



Peak Radiated Field: G-Mode
High Channel 11



Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration / Verification date	Next calibration/ Verification due date	Asset #
Conducted Measurements					
26.5GHz Spectrum Analyzer	FSU26	Rohde & Schwarz	Feb-15, 2017	Feb-15, 2019	GEMC 232
10 dB attenuator (SMA)	3M-10	Weinschel	NCR	NCR	GEMC 279
Radiated Measurements					
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 12, 2018	Jan. 12, 2020	GEMC 233
Horn Antenna 2 – 18 GHz	WBH218HN	Q-par	Feb. 12, 2016	Feb. 12, 2018	GEMC 6375
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Oct. 27, 2017	Oct. 27, 2019	GEMC 279
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

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

Radiated Emissions in Restricted Band & Band Edges

Purpose

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

Limit and Method

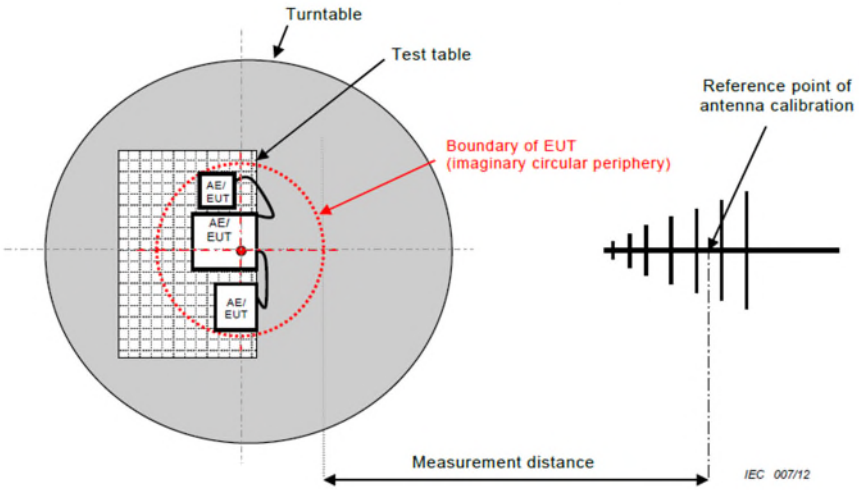
The method is given in ANSI C 63.10
The limits are as defined in FCC Part 15, Section 15.209 and RSS GEN:

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

0.009 MHz – 0.490 MHz, 2400/F (kHz) uV/m at 300 m[1]
0.490 MHz – 1.705 MHz, 24000/F (kHz) uV/m at 30 m[1]
1.705 MHz – 30 MHz, 30 uV/m at 30 m[1]
30 MHz – 88 MHz, 100 uV/m (40.0 dBuV/m[1]) at 3 m
88 MHz – 216 MHz, 150 uV/m (43.5 dBuV/m[1]) at 3 m
216 MHz – 960 MHz, 200 uV/m (46.0 dBuV/m[1]) at 3 m
Above 960 MHz, 500 uV/m (54.0 dBuV/m[1]) at 3 m
Above 1000 MHz, 500 uV/m (54 dBuV/m[2]) at 3m
Above 1000 MHz, 500 uV/m (74 dBuV/m[3]) at 3m

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

Typical Radiated Emissions Setup



Measurement Uncertainty

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

Preliminary Graphs

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

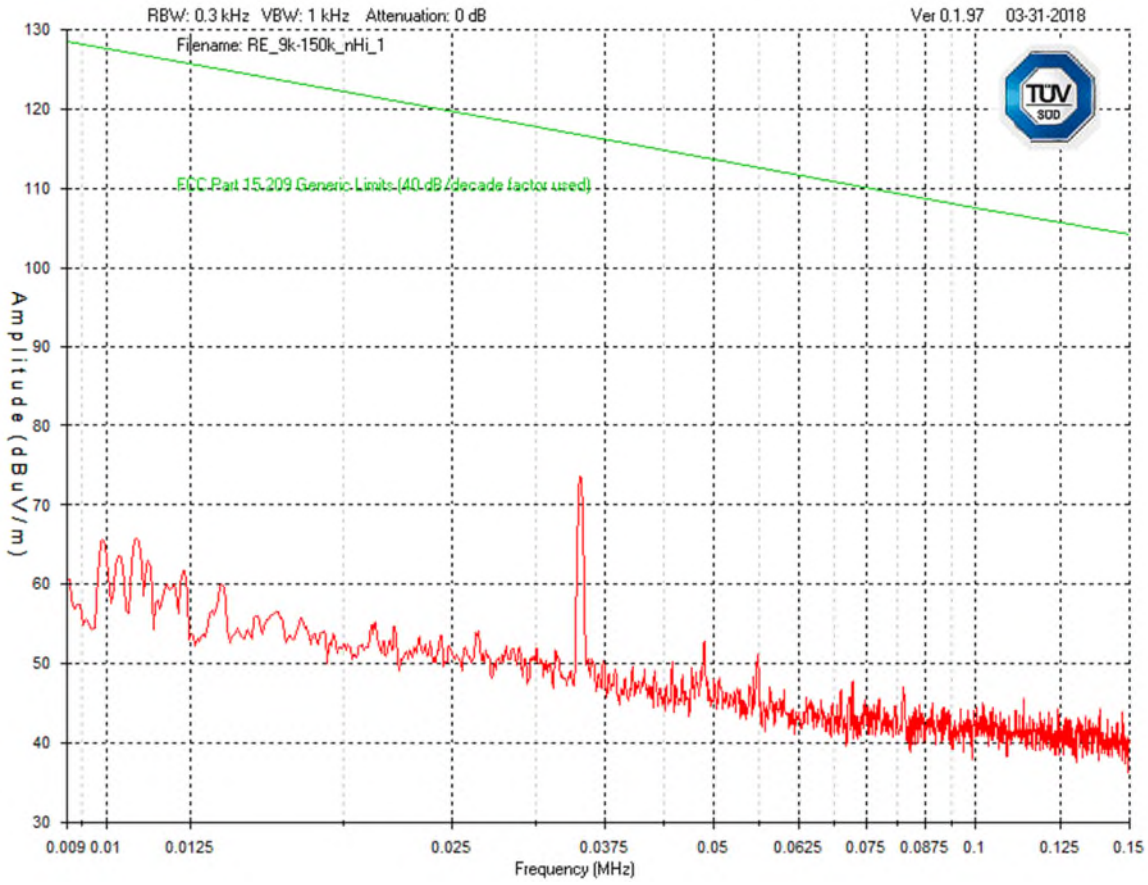
In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10th harmonic (a minimum of a 24.835 GHz).

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

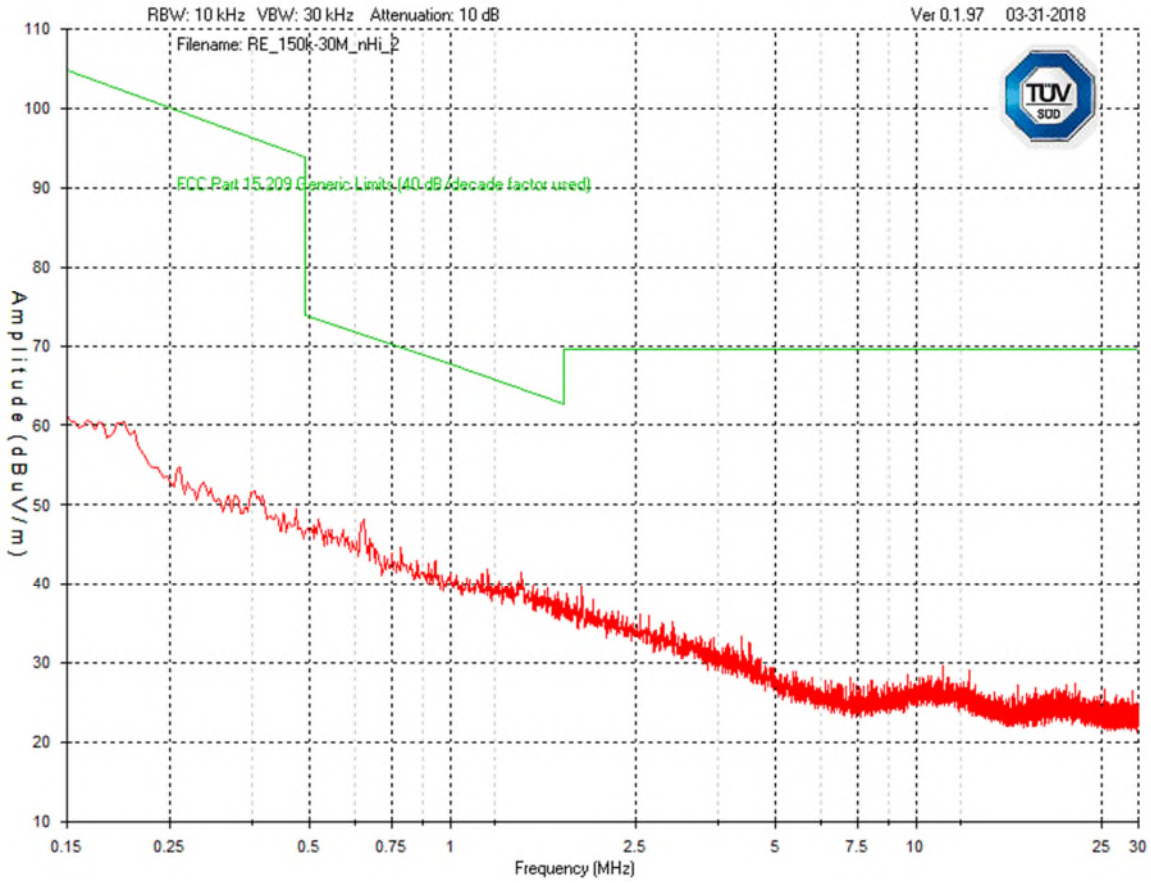
The EUT was set to transmit at maximum power. The EUT supports three modes of operation, 802.11 b/g/n. Low, middle and high channels in each mode were measured; however the worst case graphs are presented.

See Final Measurements and Results section for measurements.

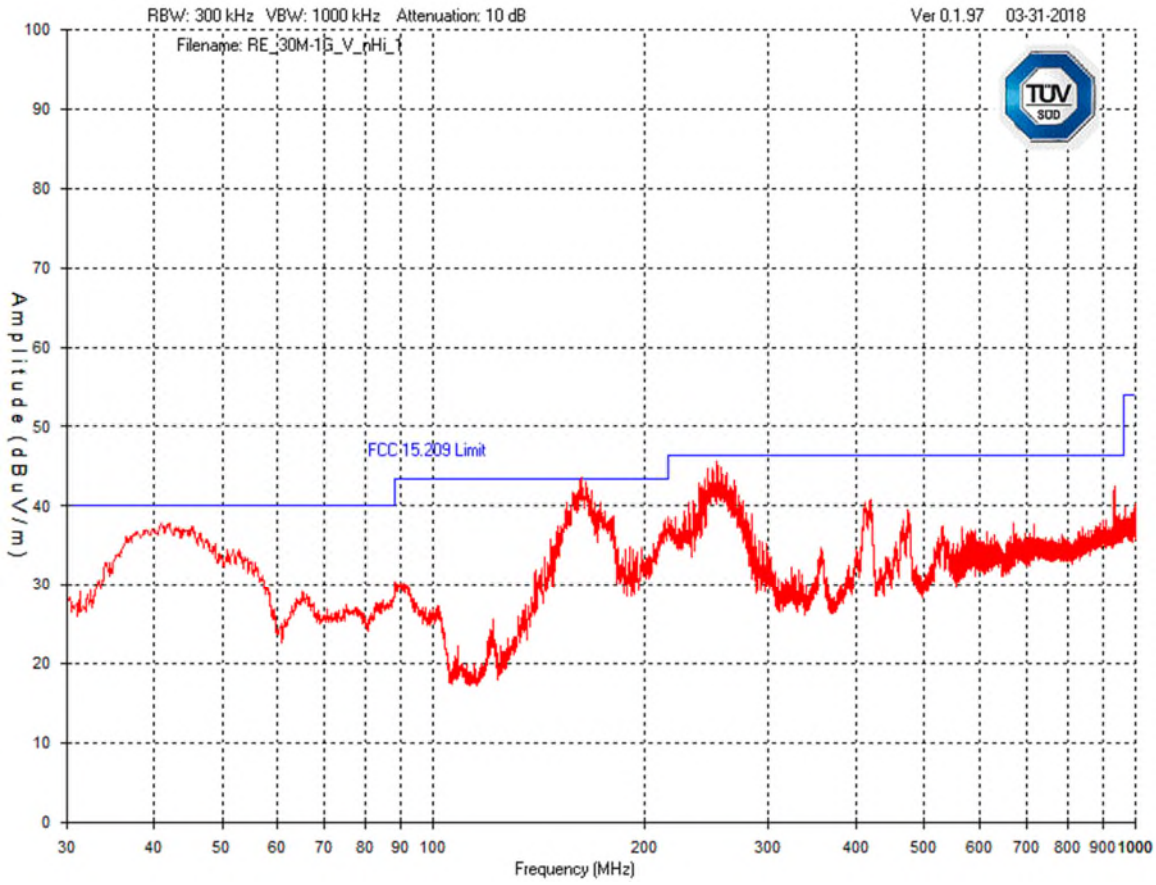
9 kHz – 150 kHz



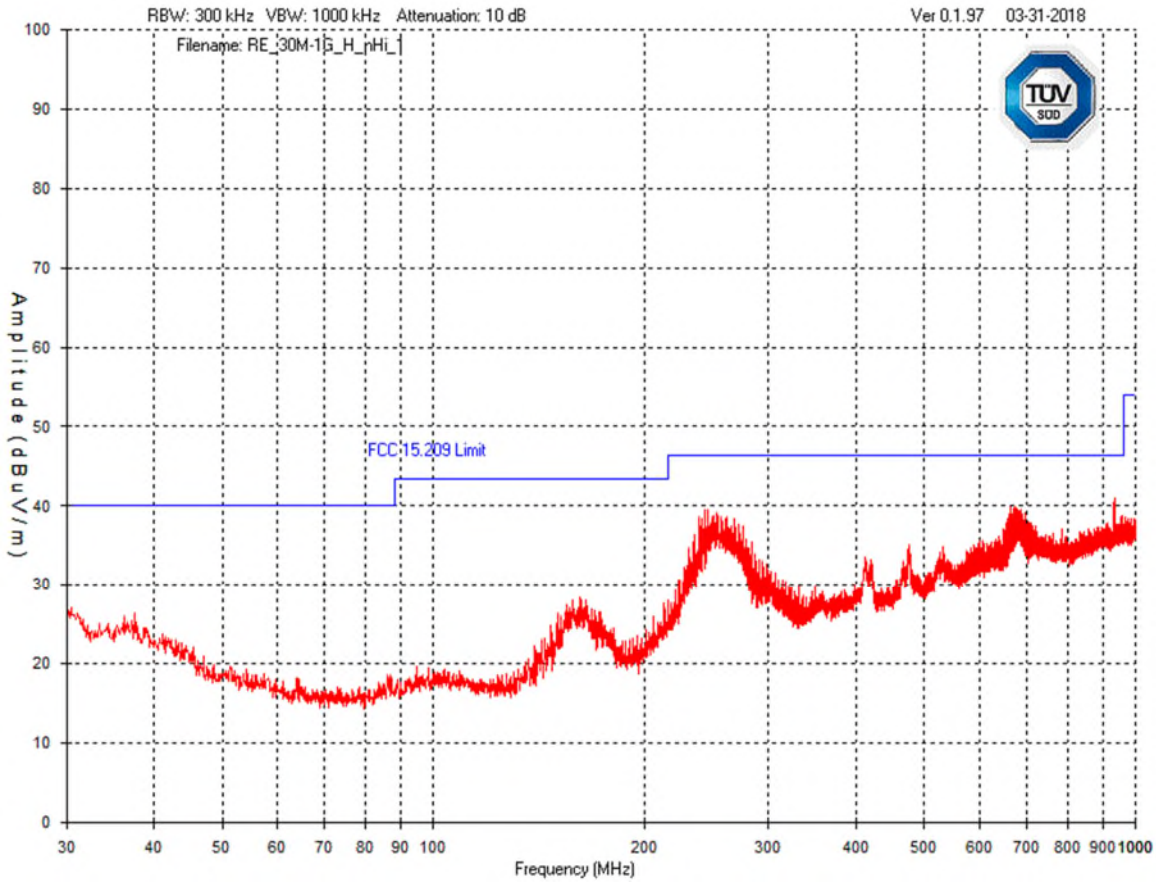
150 kHz – 30 MHz



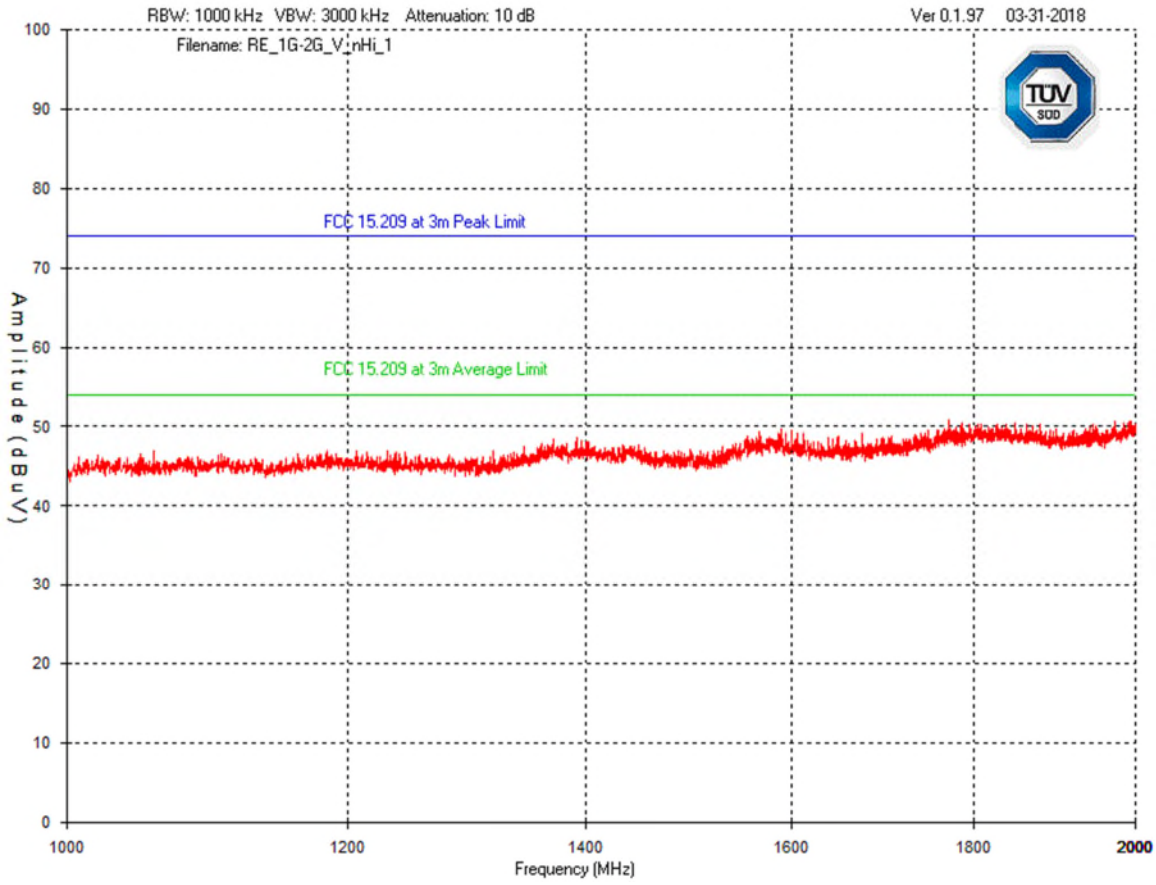
High Channel - 30 MHz – 1 GHz
Vertical – Peak Emission Graph



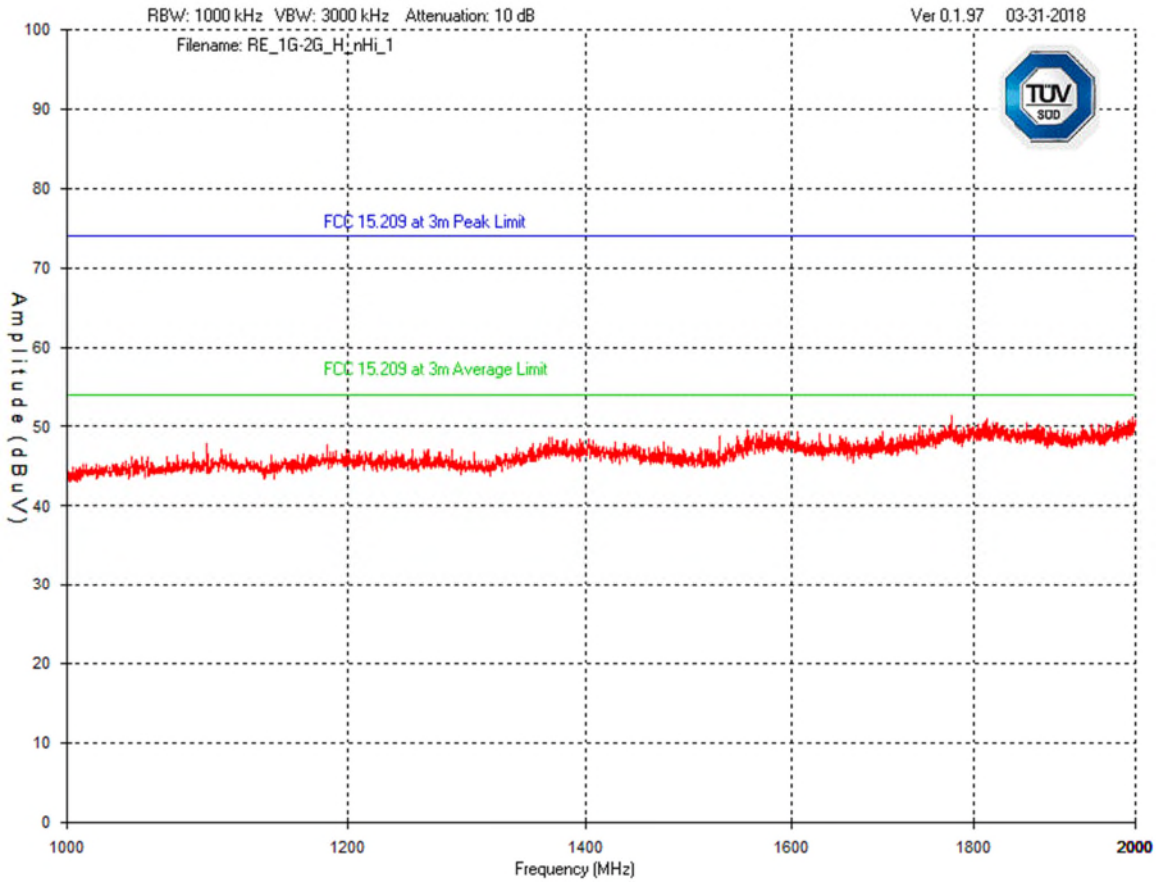
High Channel – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph



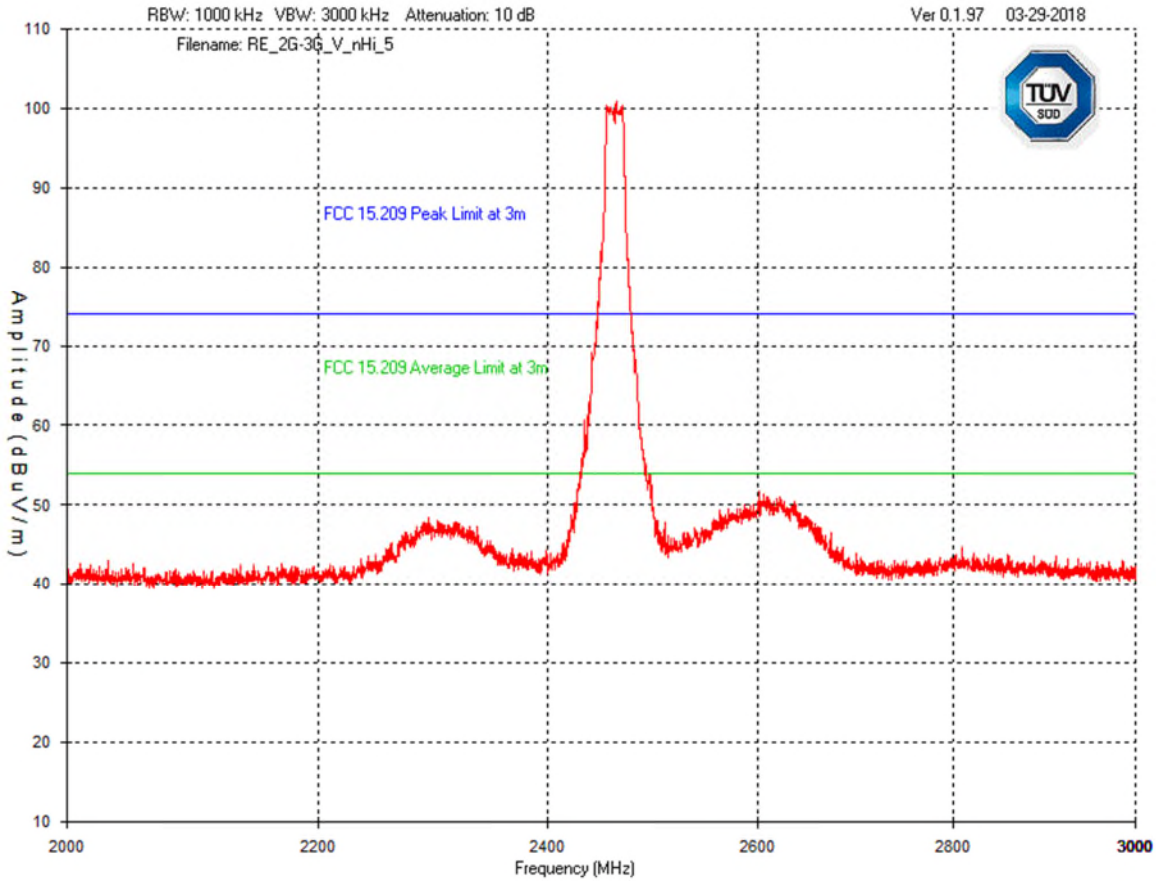
High Channel – 1 GHz – 2 GHz
Vertical - Peak Emission Graph



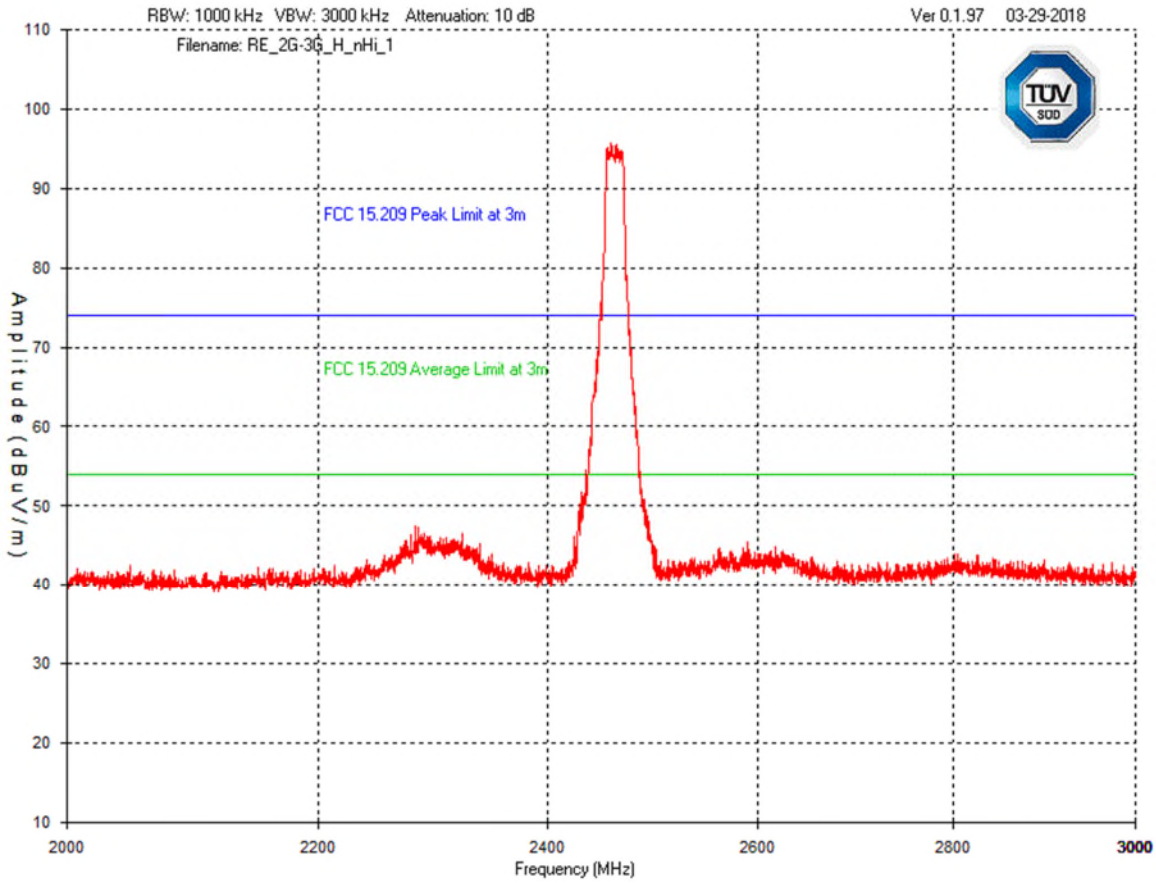
High Channel – 1 GHz – 2 GHz
Horizontal - Peak Emission Graph



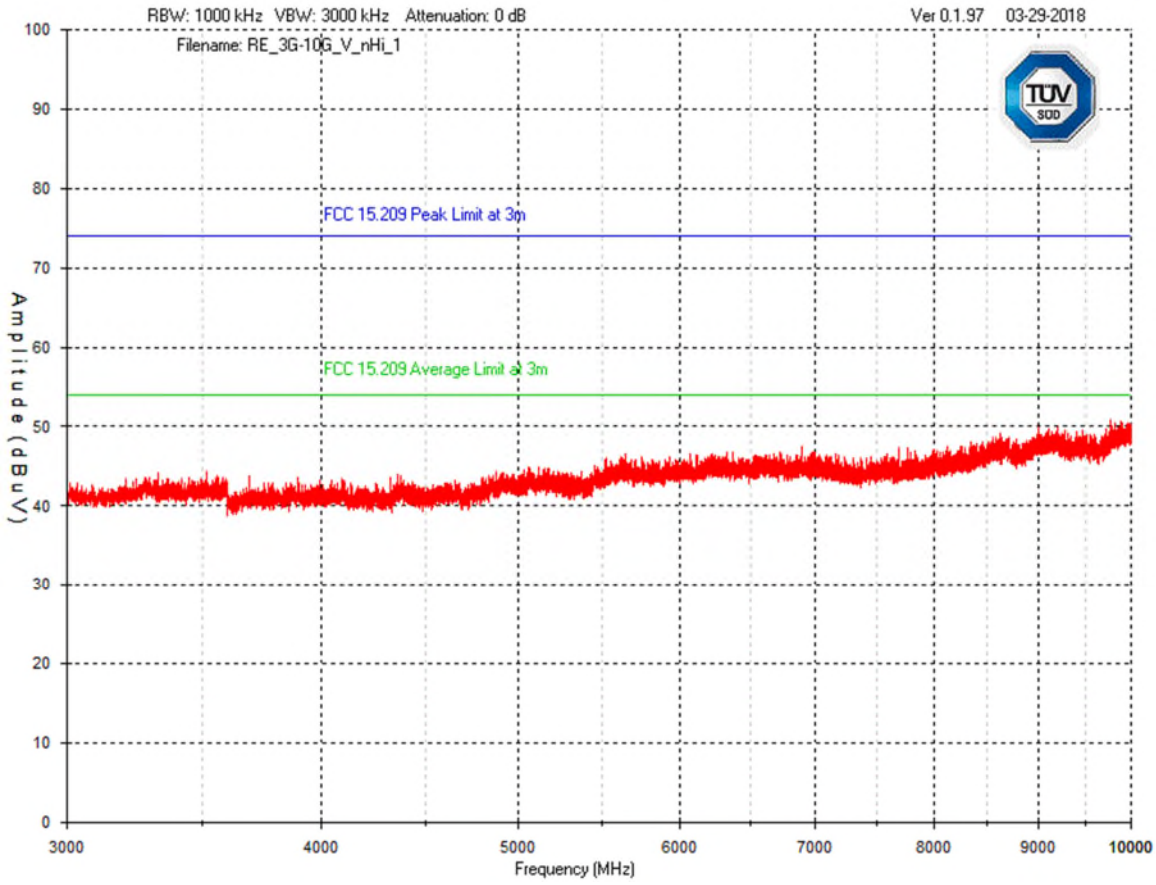
High Channel – 2 GHz – 3 GHz
Vertical - Peak Emission Graph



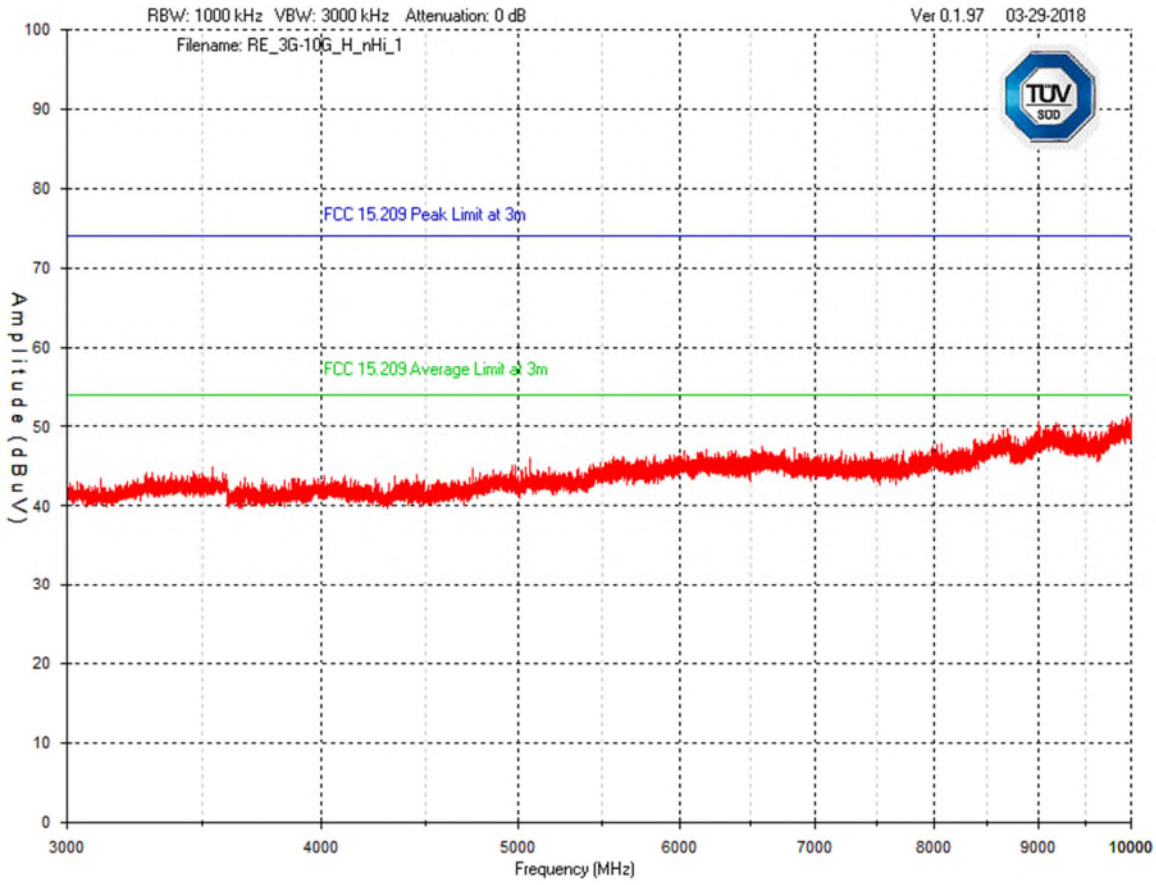
High Channel – 2 GHz – 3 GHz
Horizontal - Peak Emission Graph



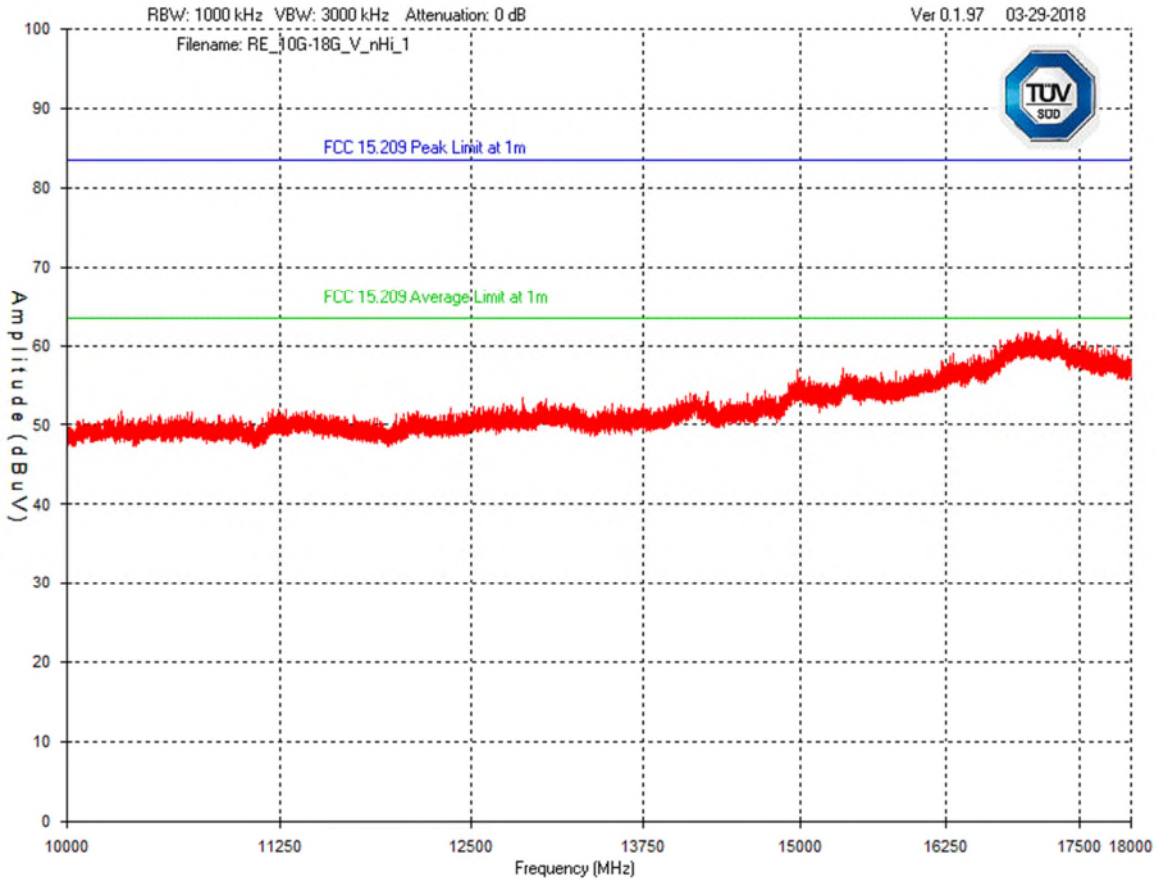
High Channel – 3 GHz – 10 GHz
Vertical - Peak Emission Graph



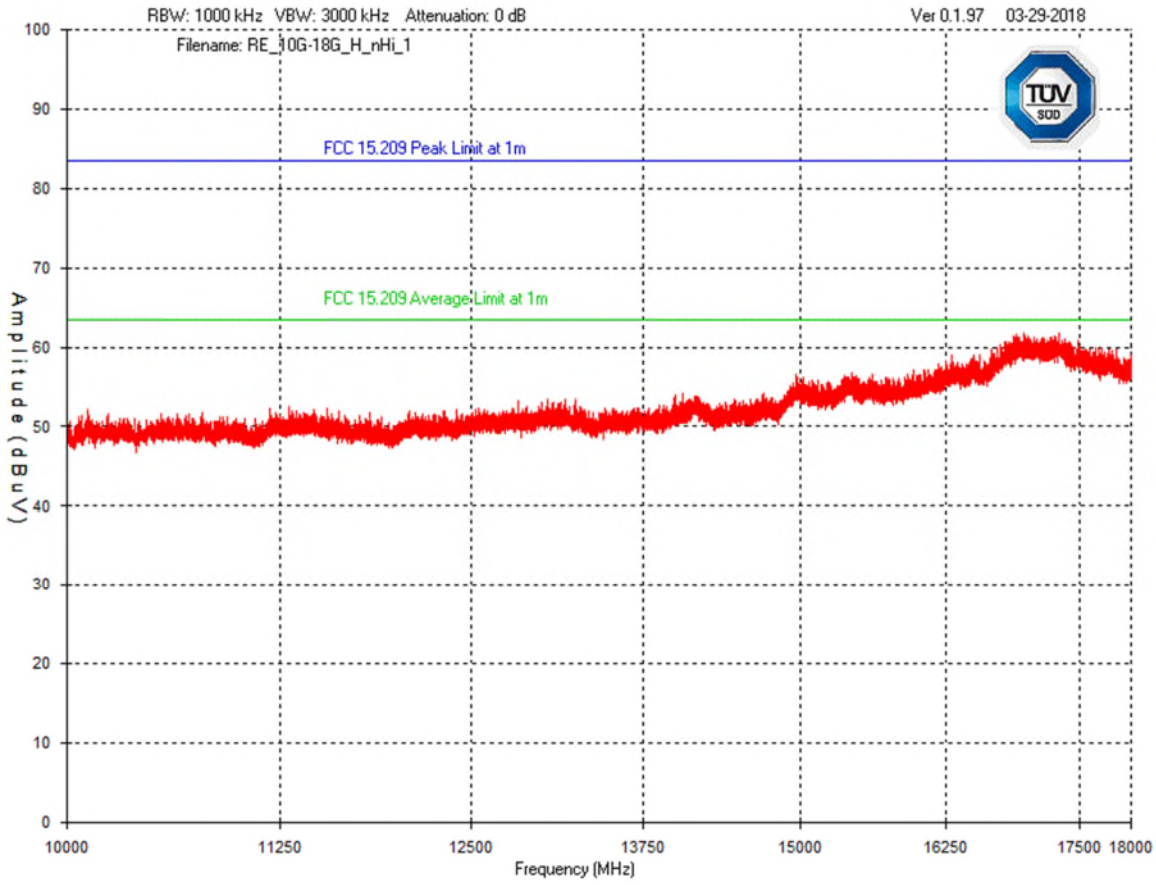
High Channel – 3 GHz – 10 GHz
Horizontal - Peak Emission Graph



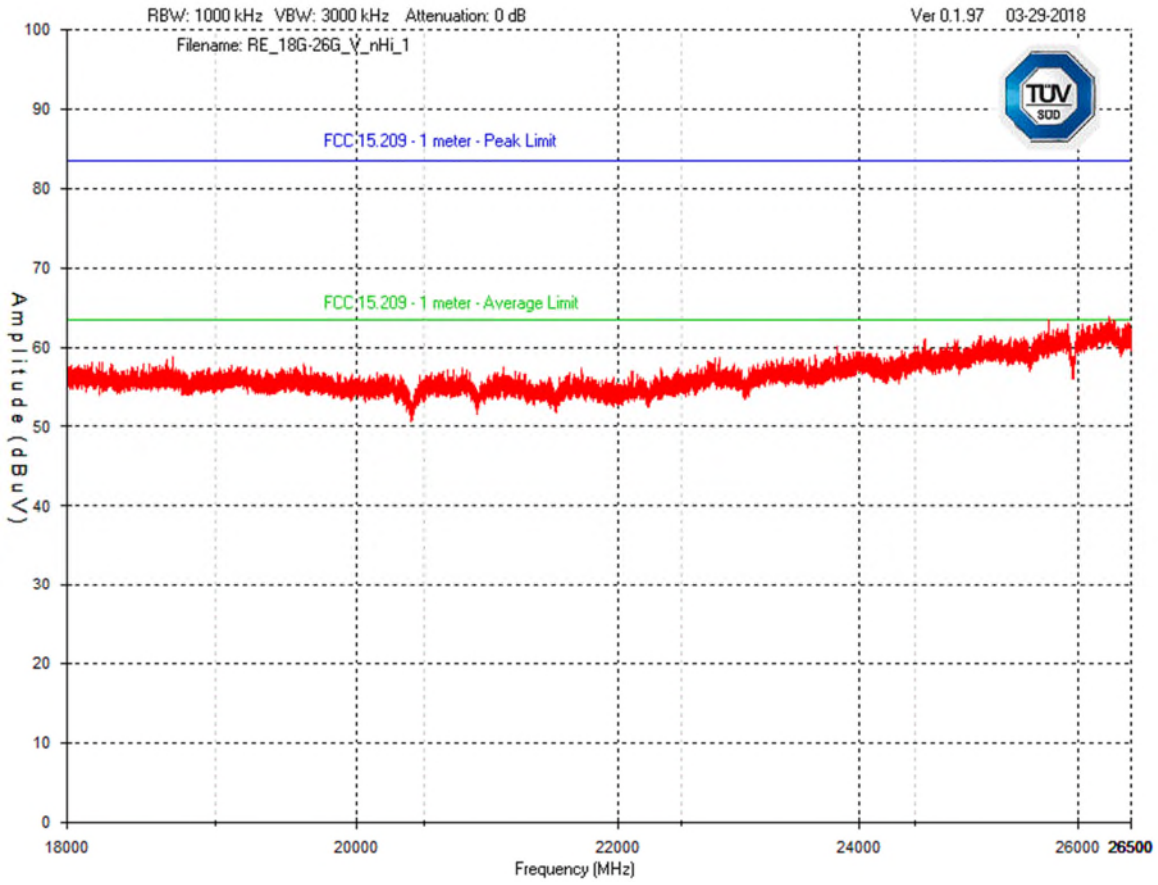
High Channel – 10 GHz – 18 GHz
Vertical - Peak Emission Graph



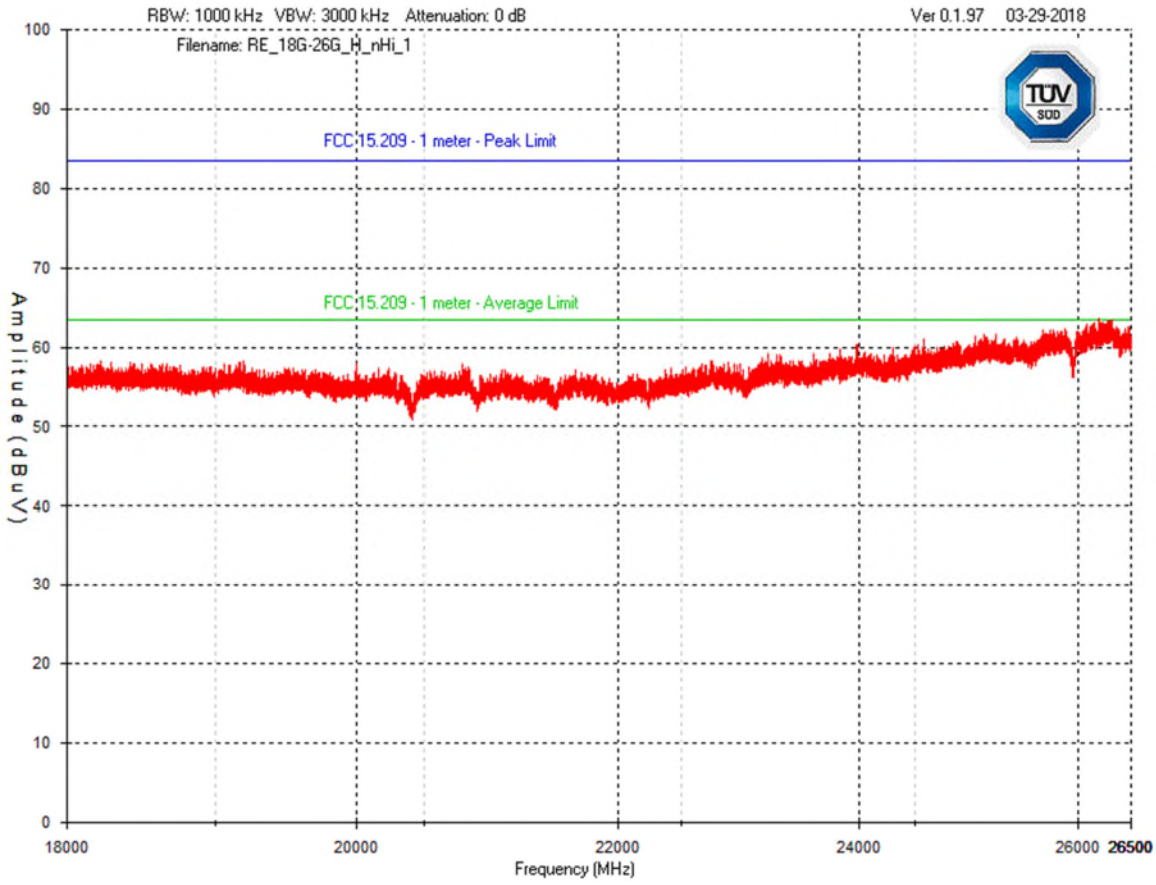
High Channel – 10 GHz – 18 GHz
Horizontal - Peak Emission Graph



High Channel – 18 GHz – 26.5 GHz
Vertical - Peak Emission Graph

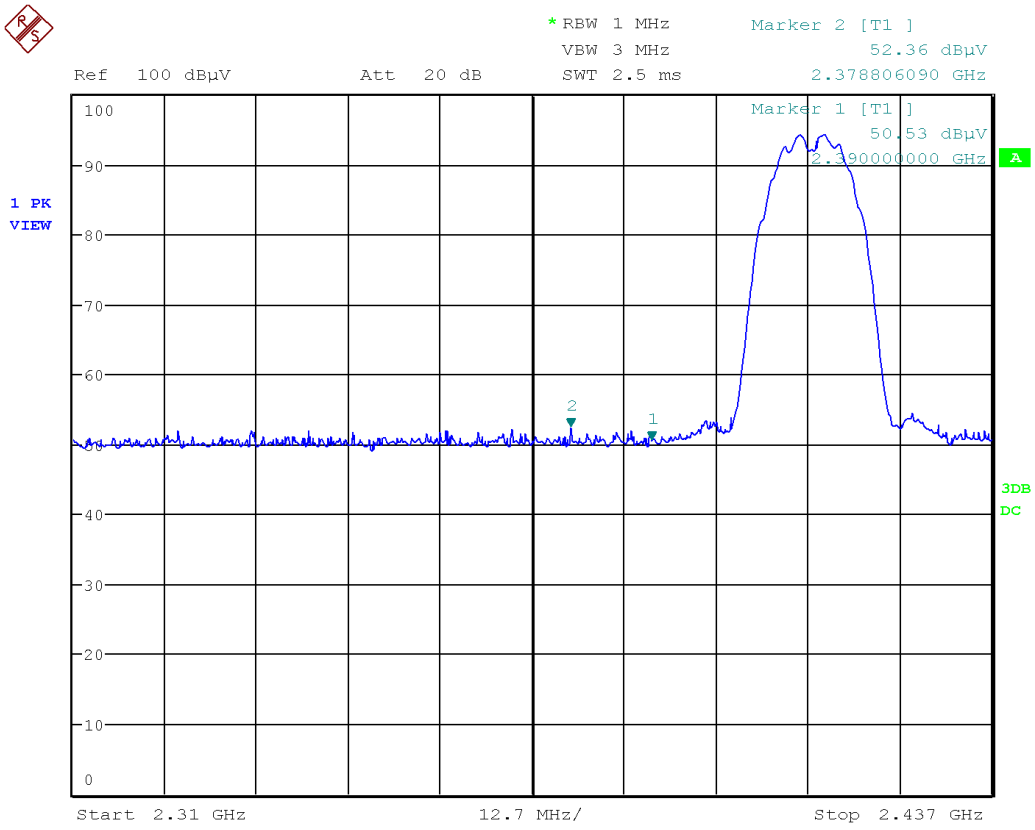


High Channel – 18 GHz – 26.5 GHz
Horizontal - Peak Emission Graph



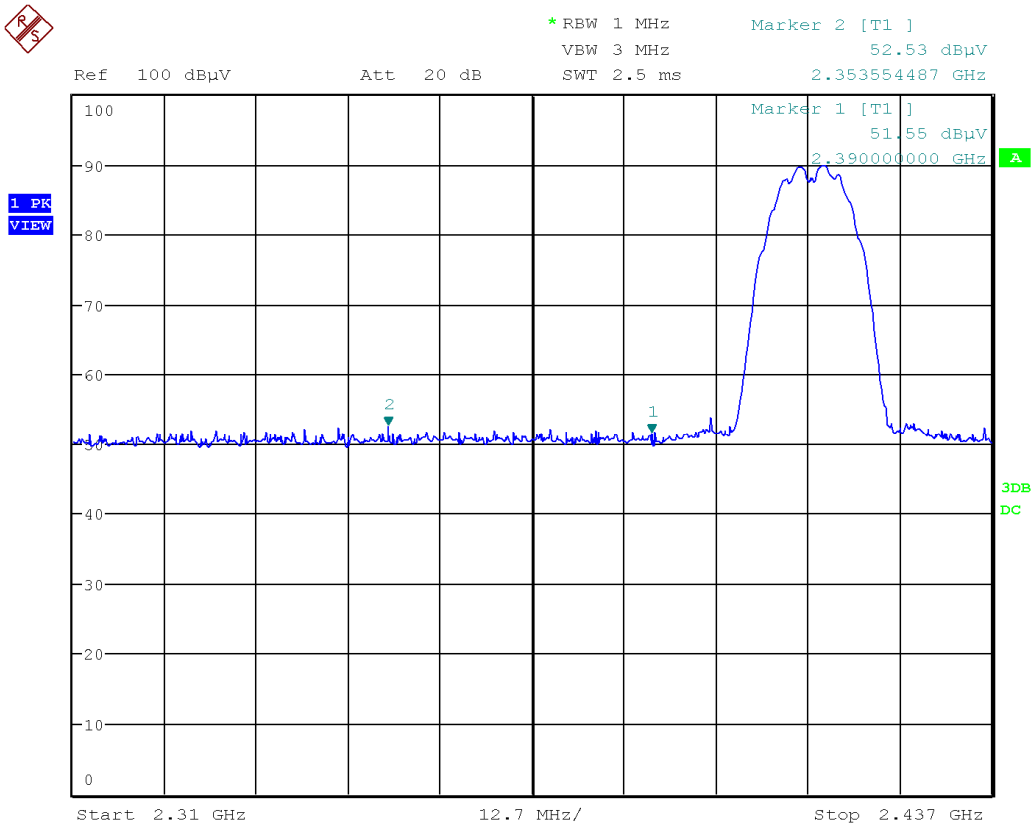
Band edge measurements – B-Mode

Band Edge – Low Channel
Vertical - Peak Emission



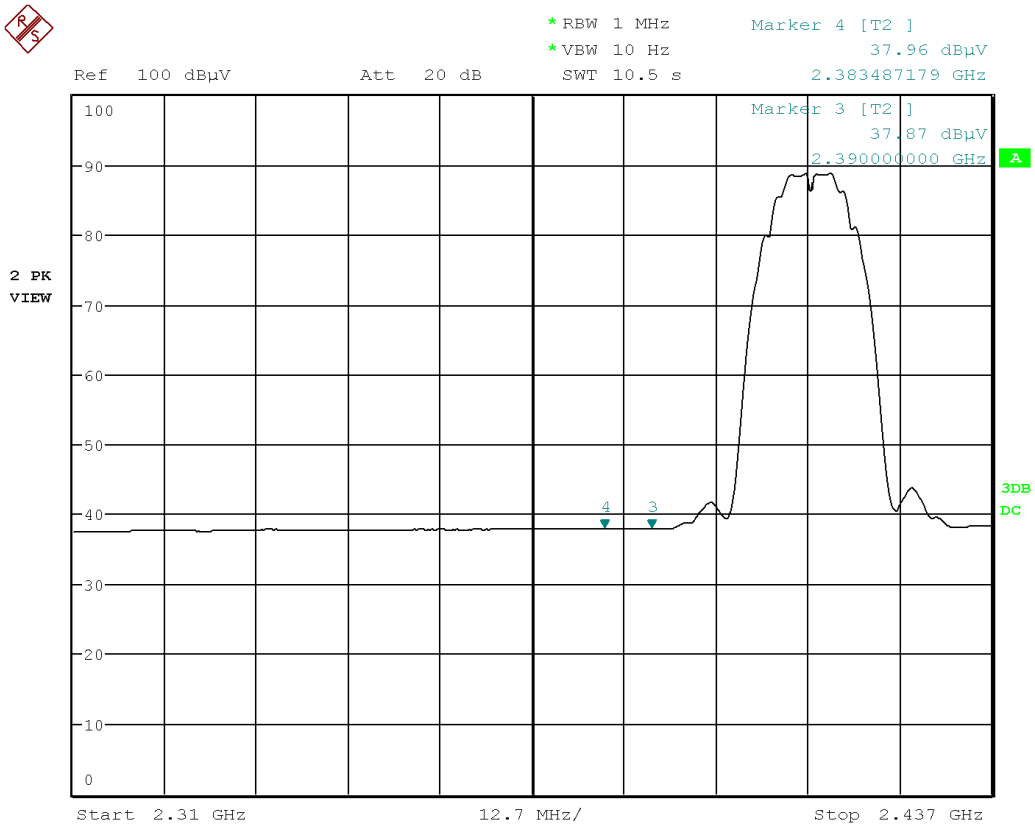
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Low Channel
Horizontal - Peak Emission



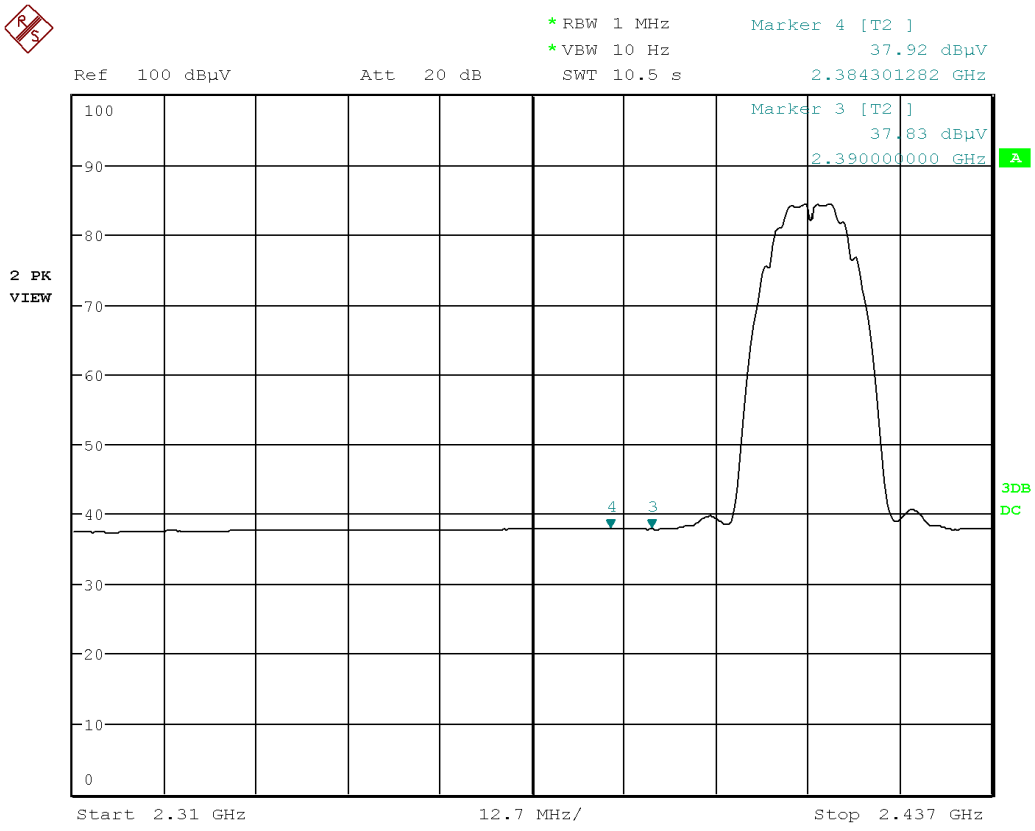
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Low Channel
Vertical – Average Emission



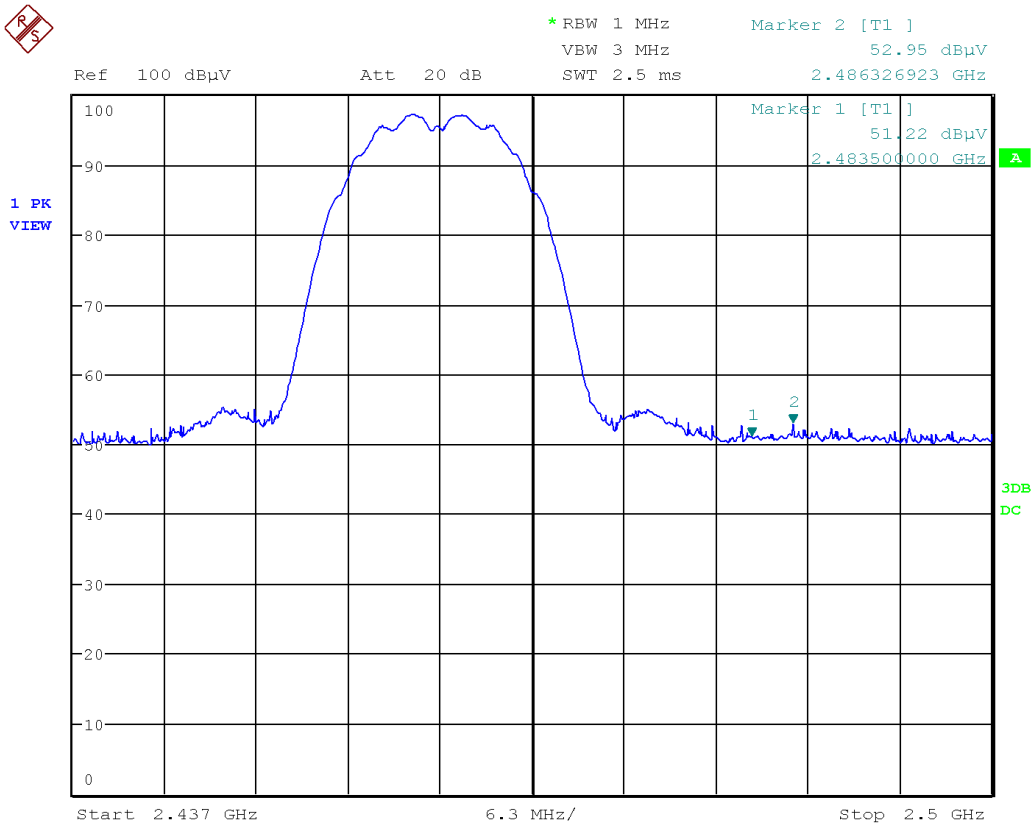
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Low Channel
Horizontal - Average Emission



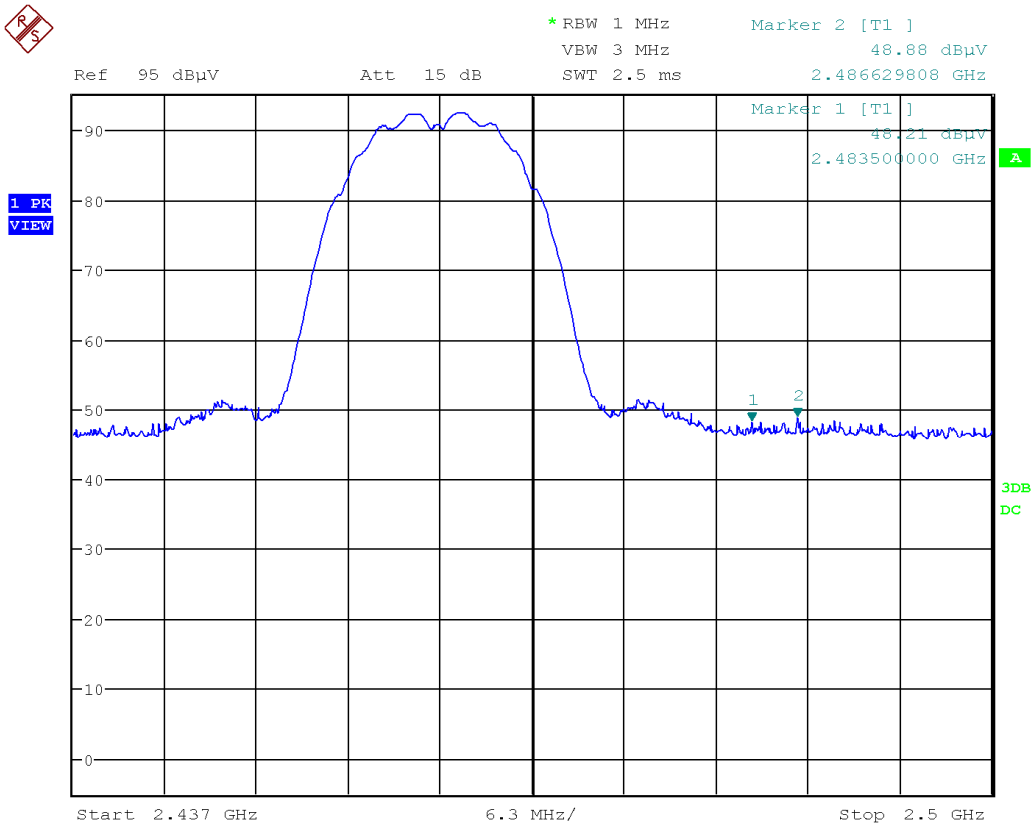
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Hi Channel
Vertical - Peak Emission



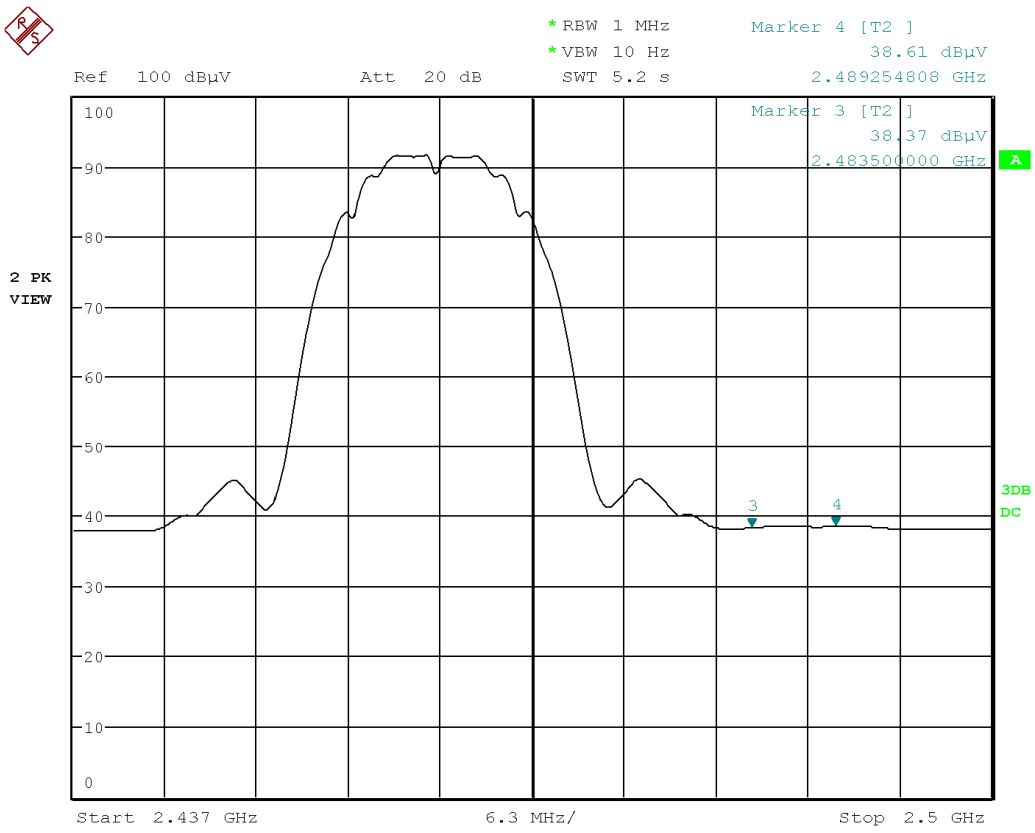
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values..

Band Edge – Hi Channel
Horizontal - Peak Emission



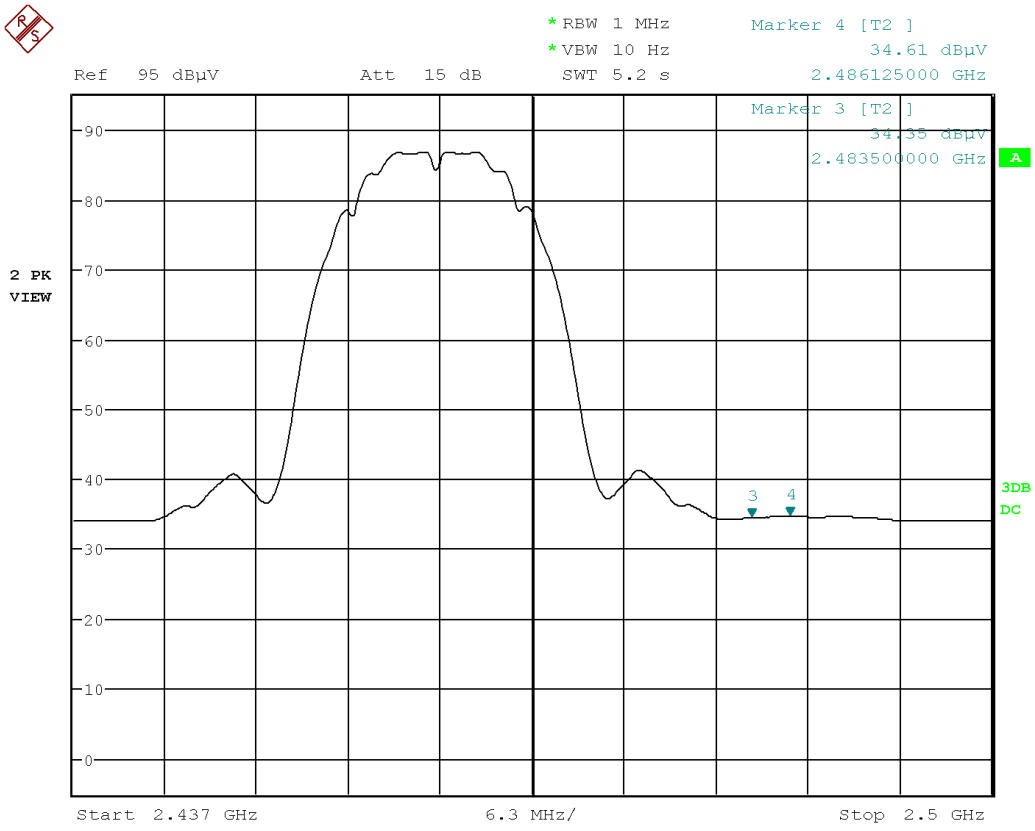
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Hi Channel
Vertical - Average Emission



Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

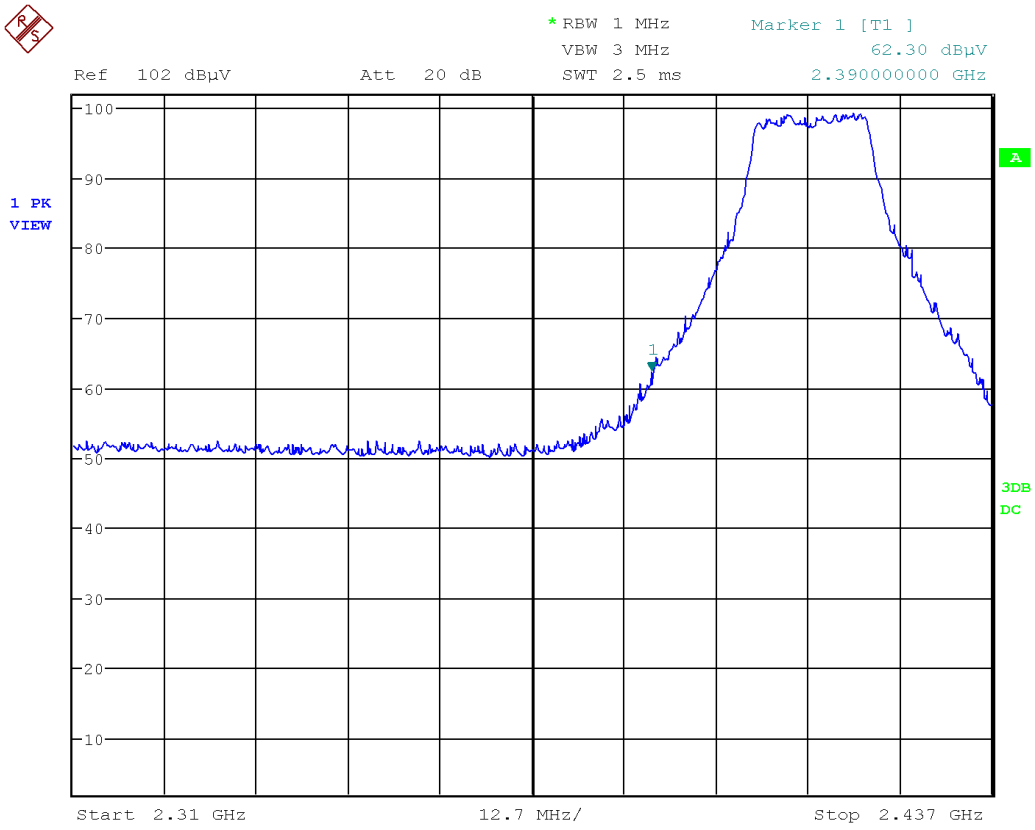
Band Edge – Hi Channel
Horizontal - Average Emission



Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

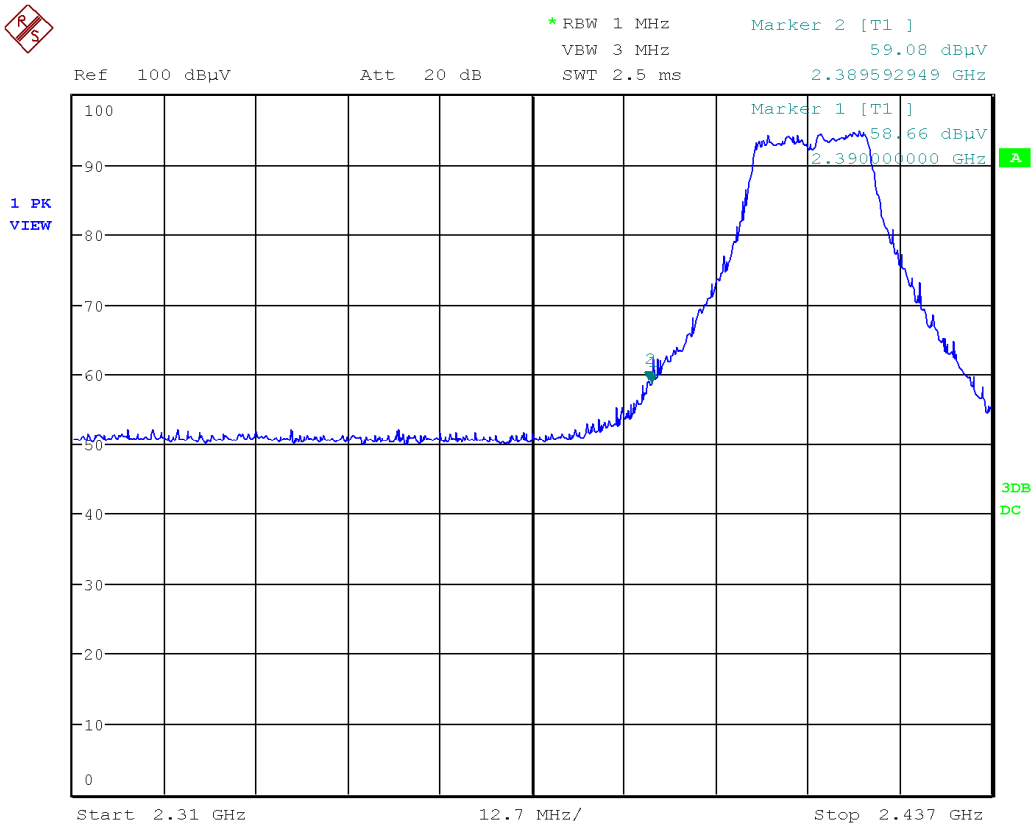
Band edge measurements – G-Mode

Band Edge – Low Channel
Vertical - Peak Emission



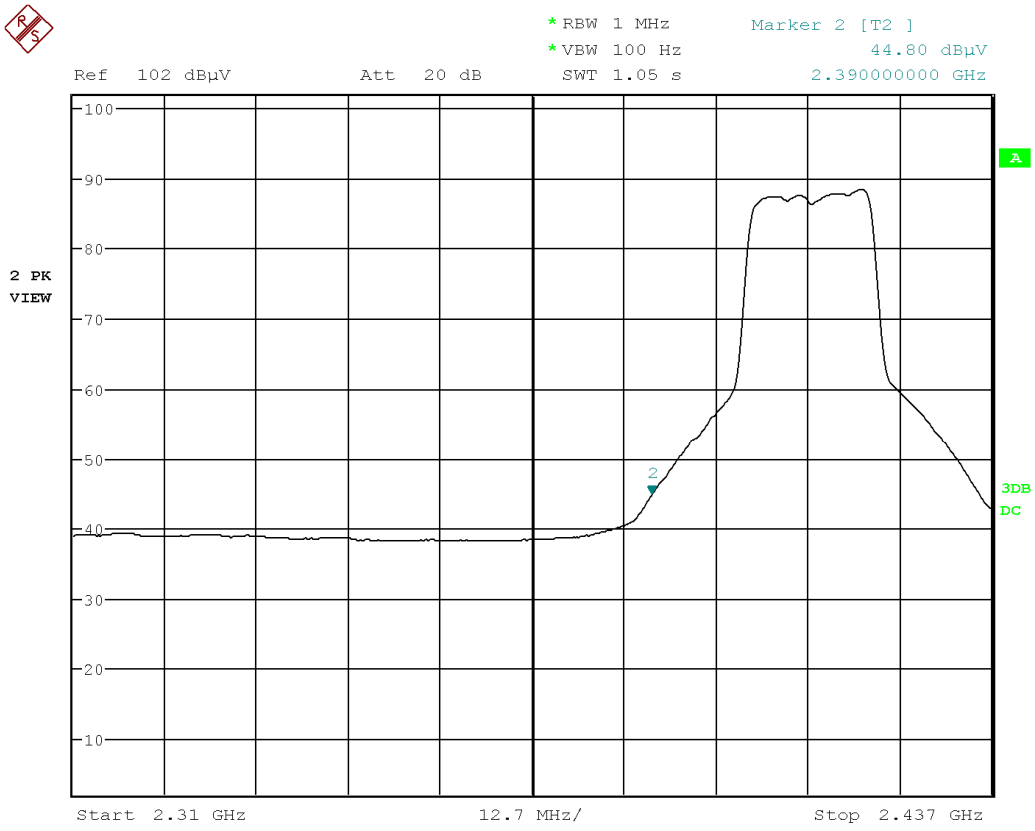
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Low Channel
Horizontal - Peak Emission



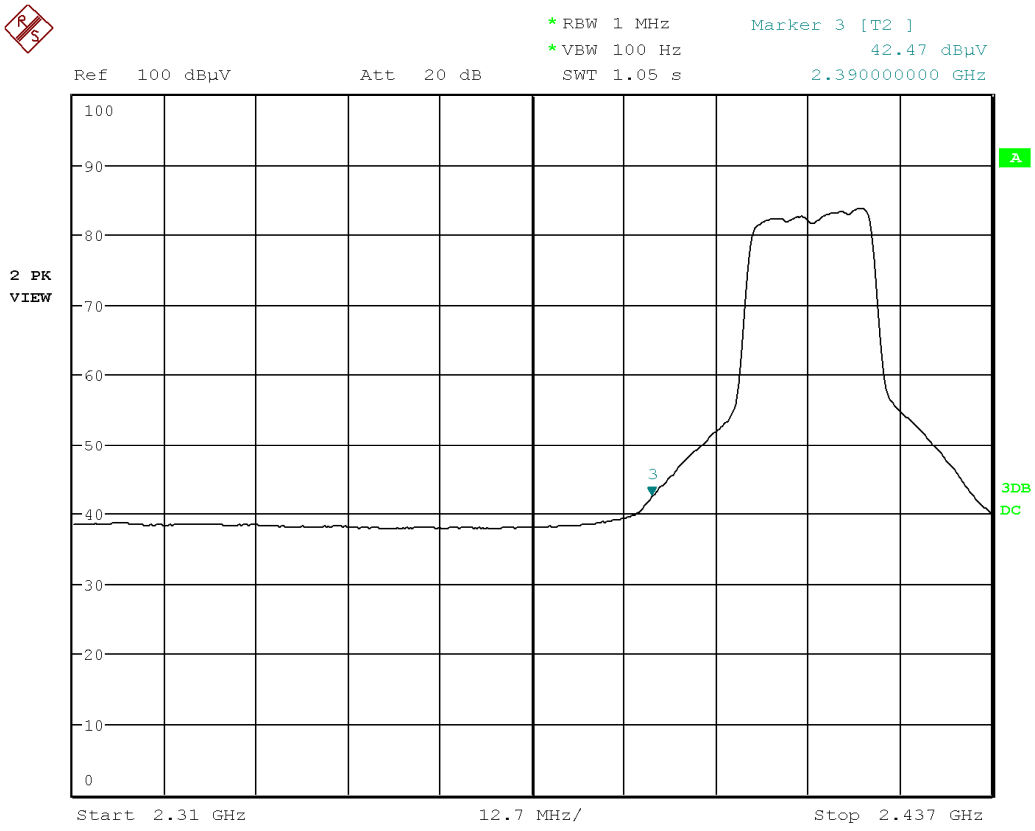
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Low Channel
Vertical – Average Emission



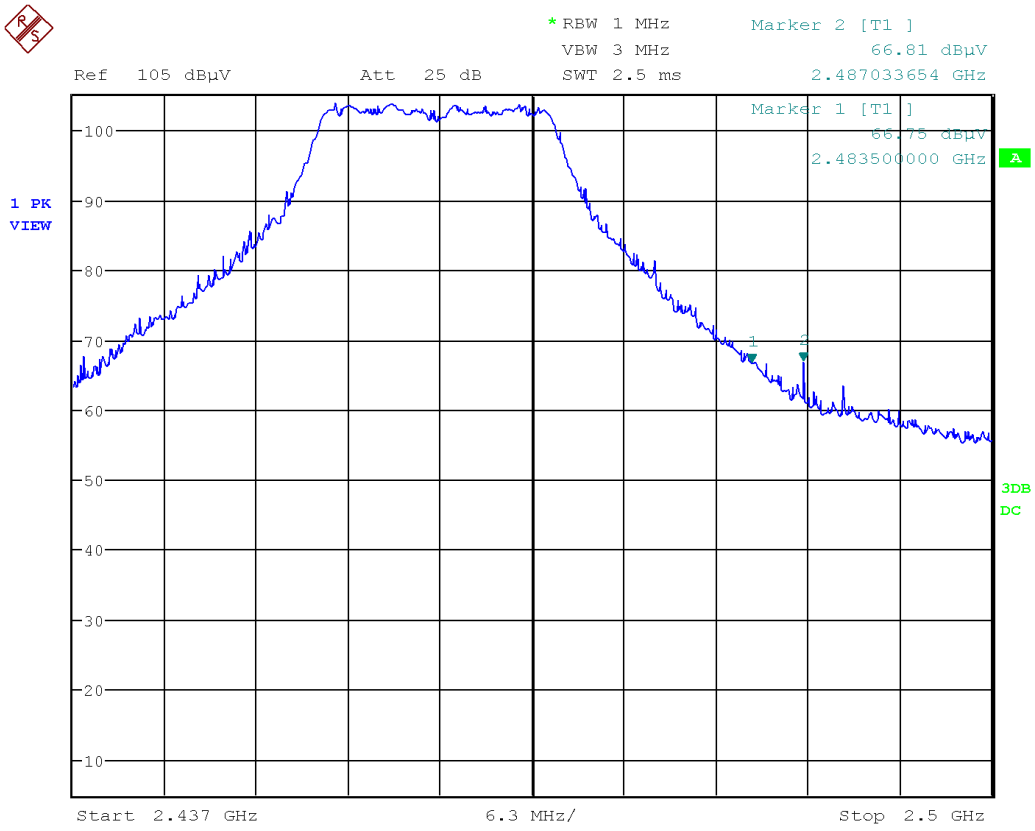
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Low Channel
Horizontal - Average Emission



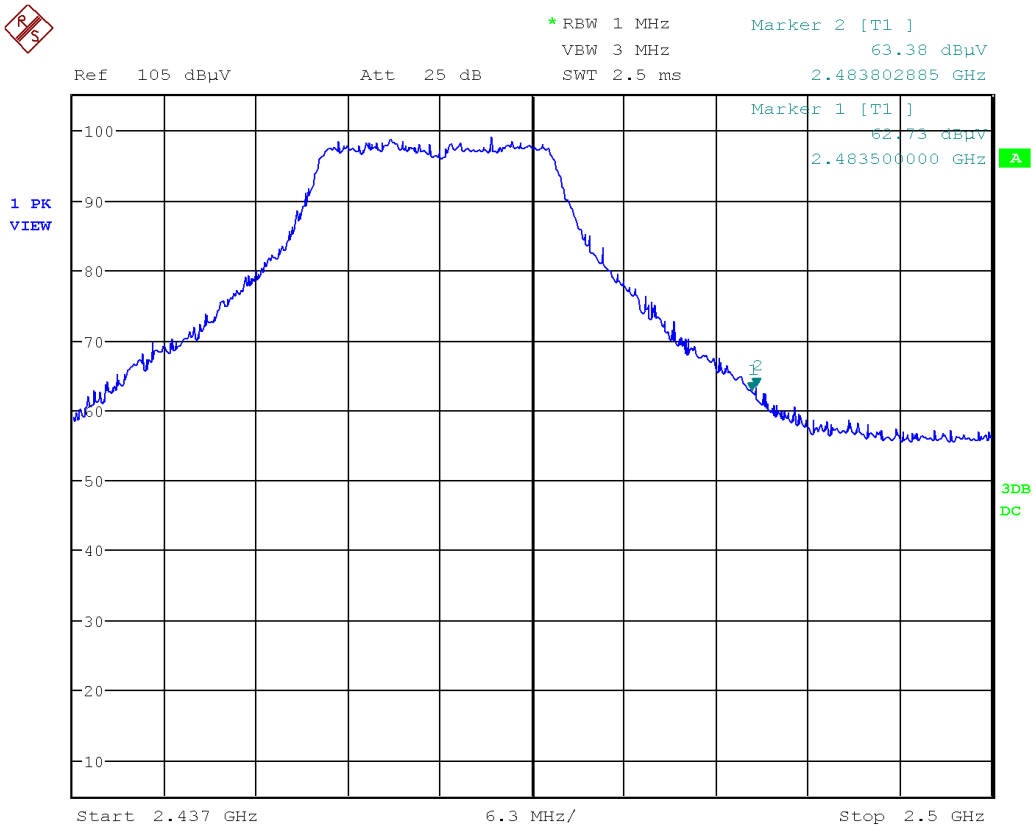
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Hi Channel
Vertical - Peak Emission



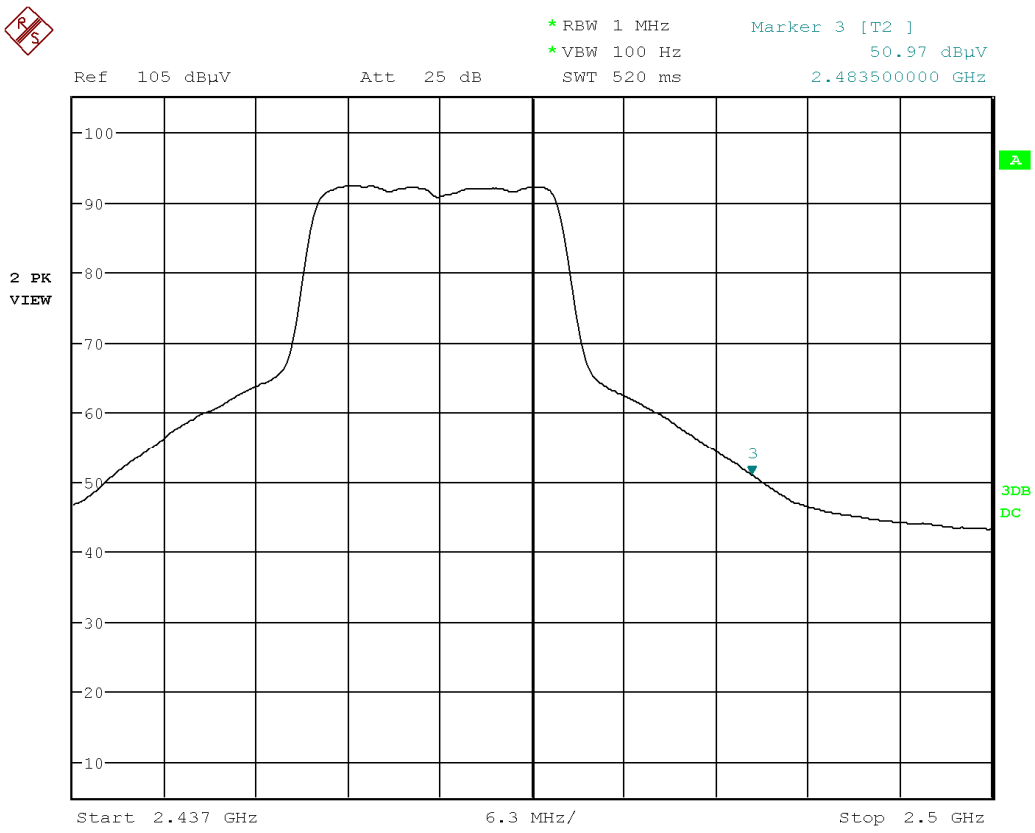
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Hi Channel
Horizontal - Peak Emission



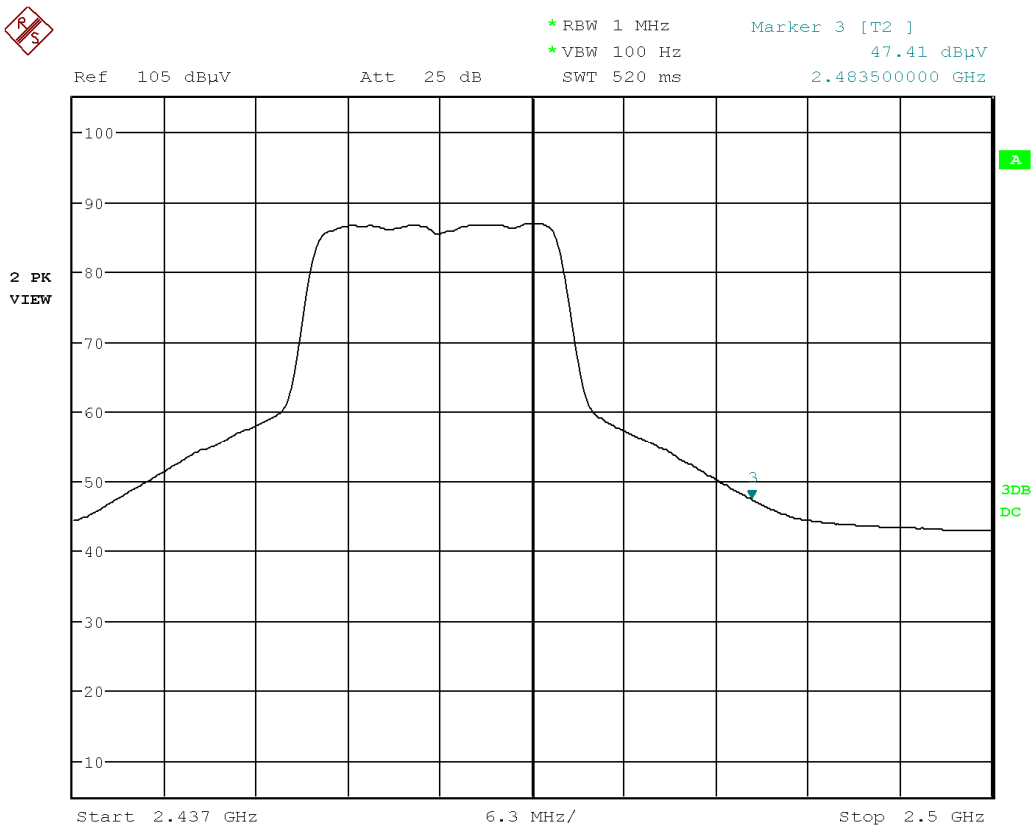
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Hi Channel
Vertical - Average Emission



Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

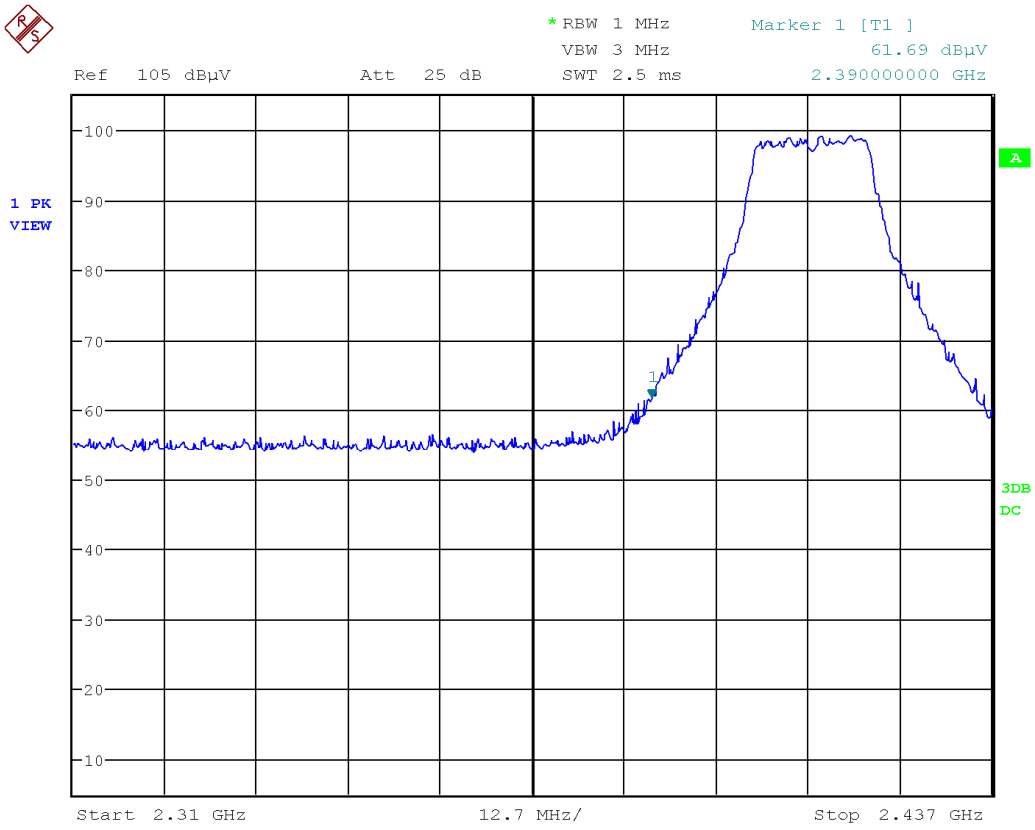
Band Edge – Hi Channel
Horizontal - Average Emission



Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

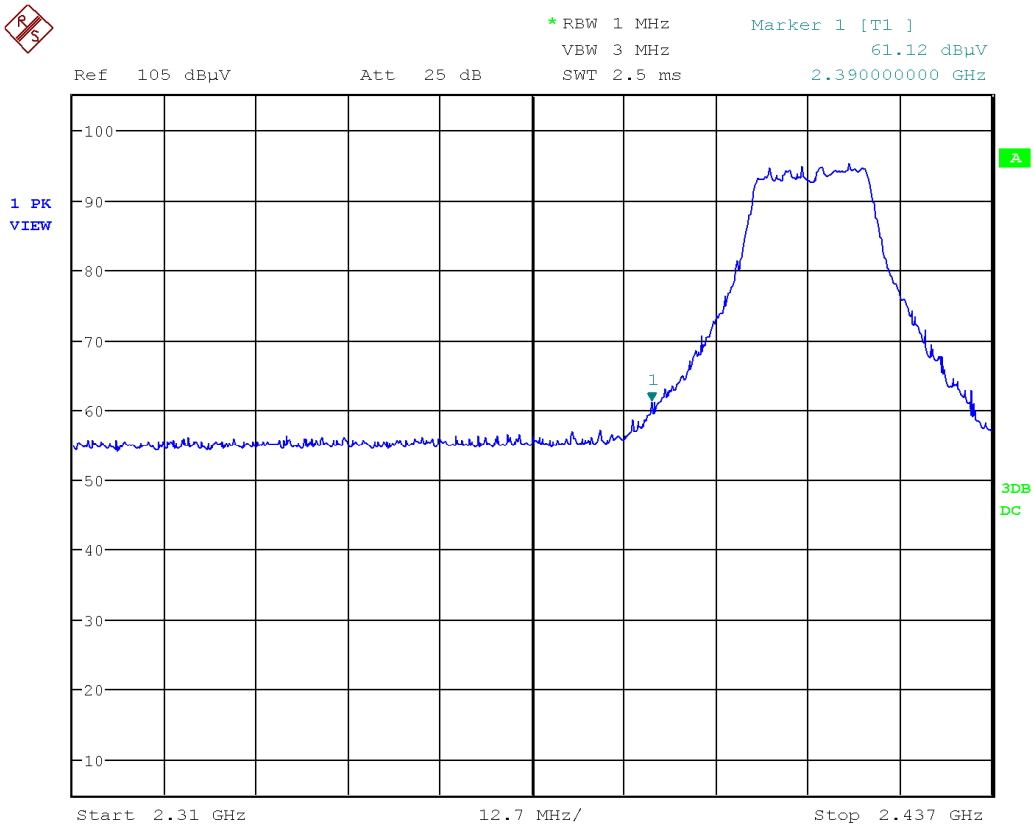
Band edge measurements – N-Mode

Band Edge – Low Channel
Vertical - Peak Emission



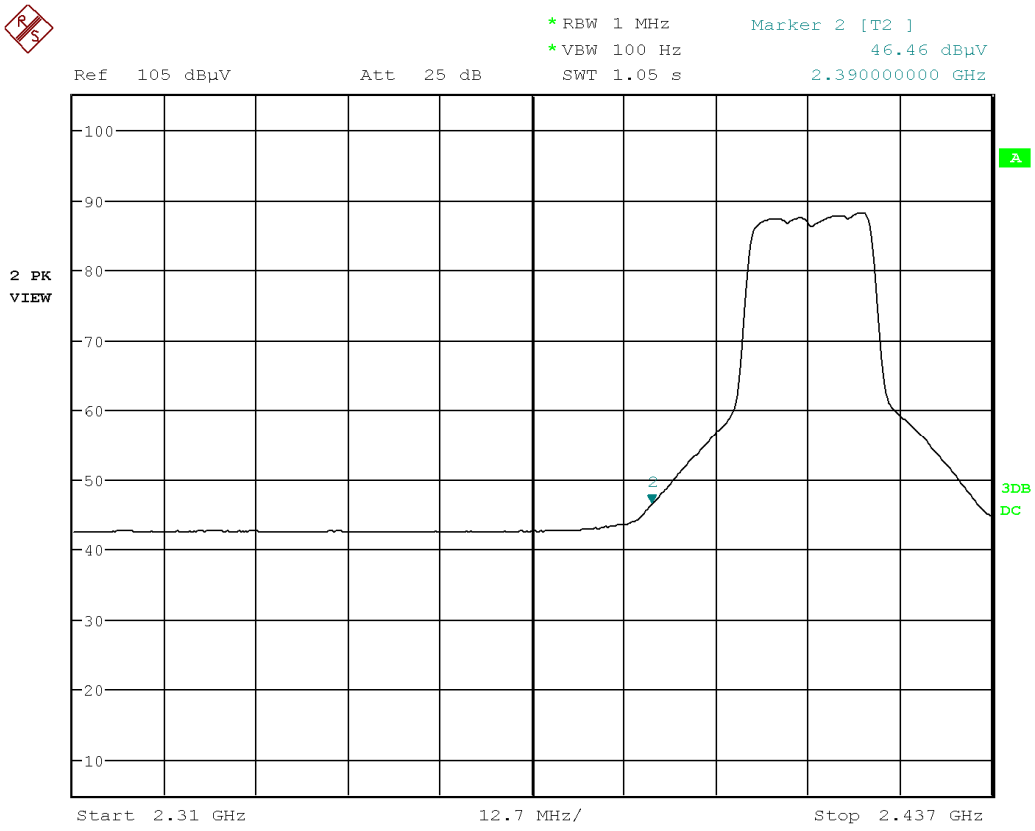
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Low Channel
Horizontal - Peak Emission



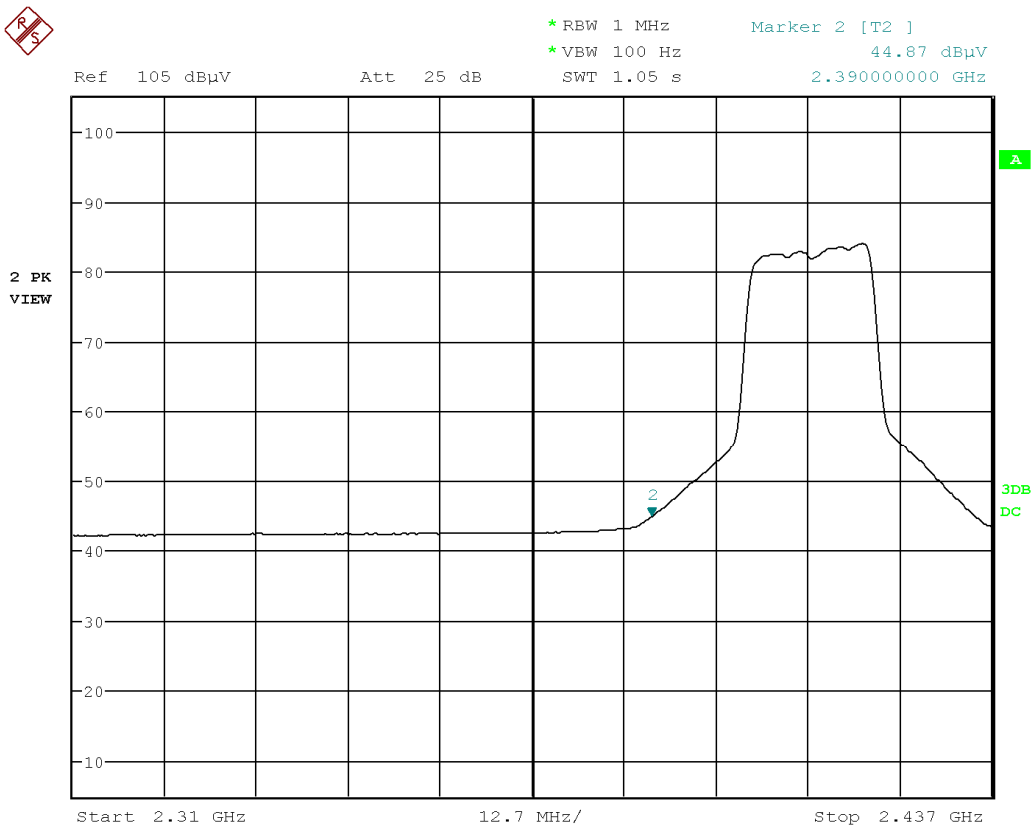
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Low Channel
Vertical – Average Emission



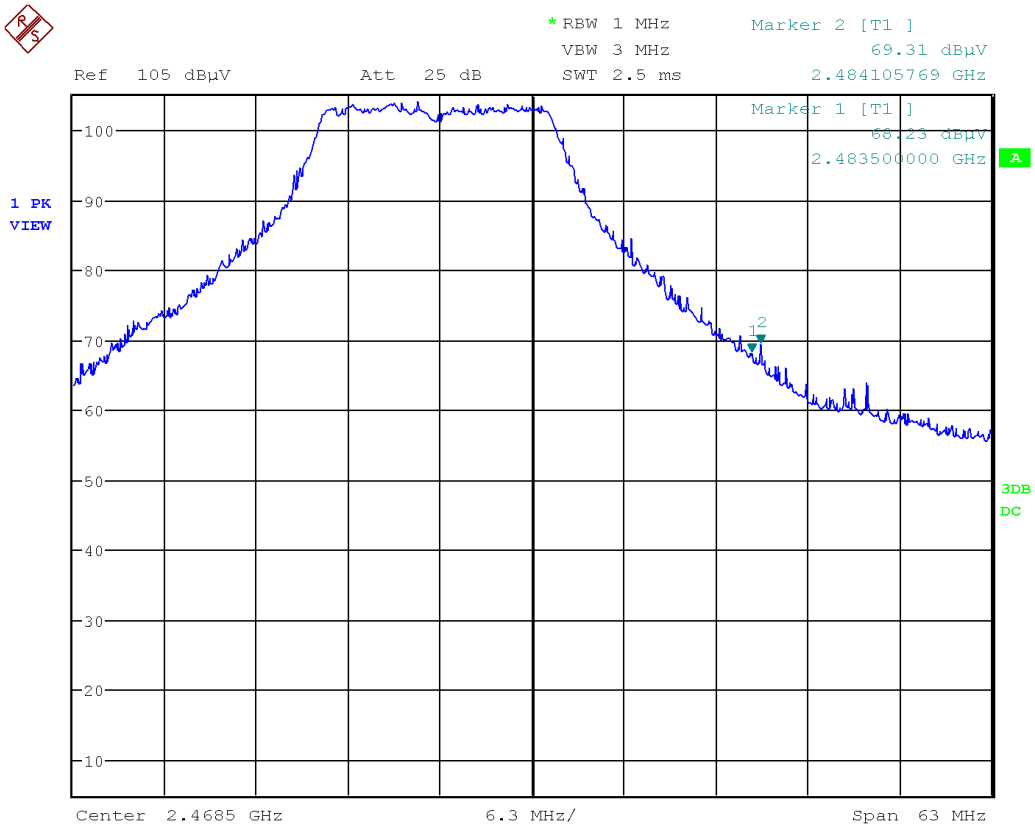
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Low Channel
Horizontal - Average Emission



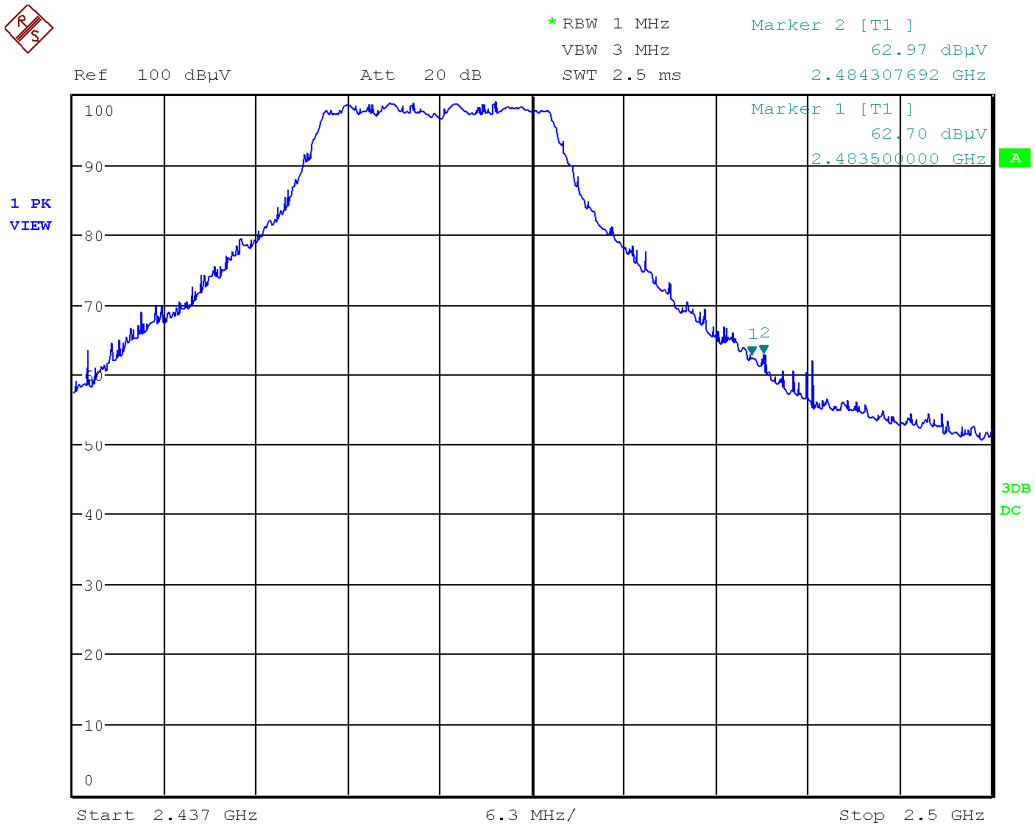
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Hi Channel
Vertical - Peak Emission



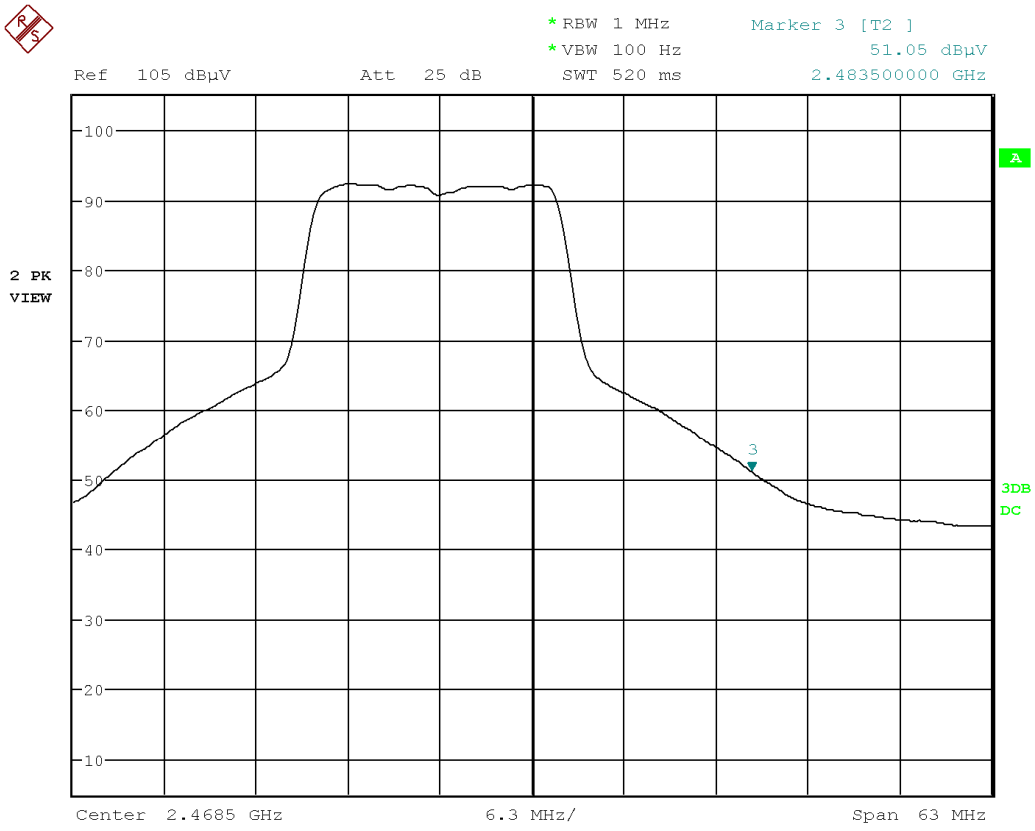
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Hi Channel
Horizontal - Peak Emission



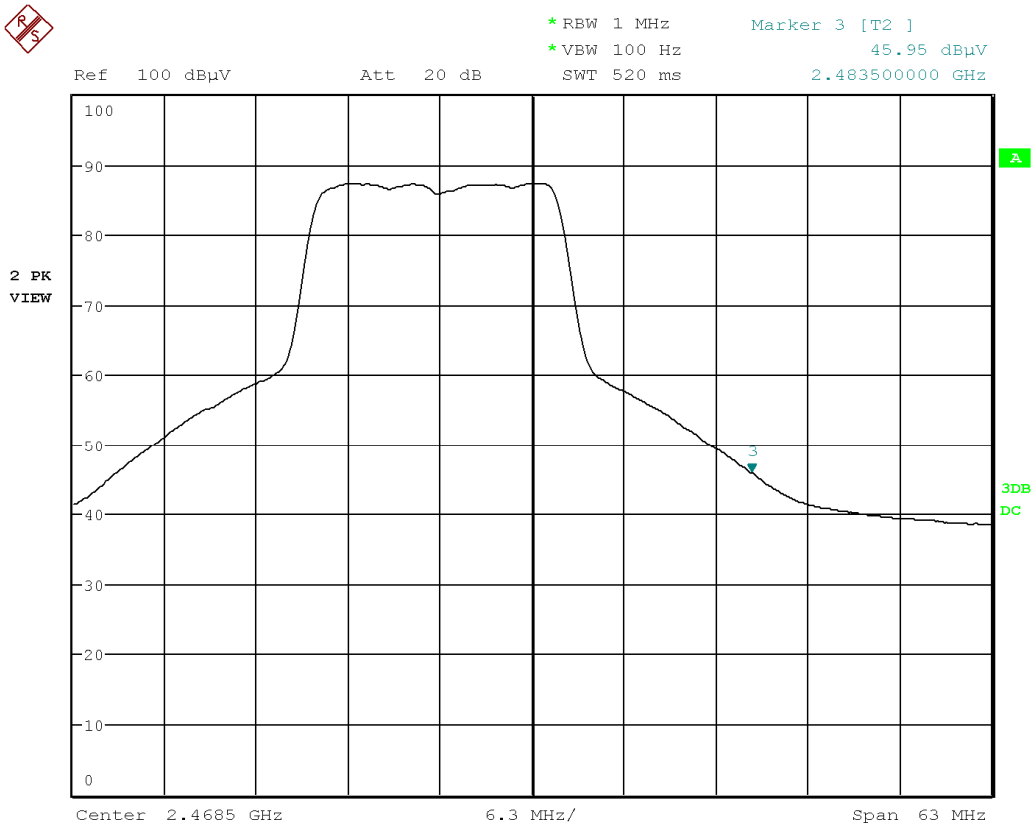
Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Band Edge – Hi Channel
Vertical - Average Emission



Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values

Band Edge – Hi Channel
Horizontal - Average Emission



Note: Band edge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section starting on page 60 for corrected values.

Final Measurements and Results

The EUT passed the limits. Low, middle and high bands were measured, with worst case presented.

In accordance with 15.247(d), only frequencies exceeding the 15.209 limit that occur within the bands listed in 15.205, need to be verified with a final detector. Emission outside the restricted bands were measured for informational purposes.

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

Frequency (MHz)	Detector	Raw (dBuV)	Correction Factors (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/Fail
Vertical Antenna Polarity							
162.1	QP	53.6	-15.8	37.8	43.5	5.7	Pass
253.6	QP	54	-12.4	41.6	46.4	4.8	Pass
42.0	QP	40.6	-14.7	25.9	40	14.1	Pass
243.0	Peak	56.1	-12.8	43.3	46.4	3.1	Pass
238.6	Peak	55.8	-13	42.8	46.4	3.6	Pass
931.7	Peak	41.2	1.3	42.5	46.4	3.9	Pass
Horizontal Antenna Polarity							
931.6	Peak	39.8	1.3	41.1	46.4	5.3	Pass
664.8	Peak	42.5	-2.5	40	46.4	6.4	Pass
246.0	Peak	52.2	-12.6	39.6	46.4	6.8	Pass
238.6	Peak	51.6	-13	38.6	46.4	7.8	Pass
475.3	Peak	41.0	-5.8	35.2	46.4	11.2	Pass
411.6	Peak	41.3	-7.6	33.7	46.4	12.7	Pass

Emissions at Band Edges
B-mode

Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Attenuator (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
Low Channel - B mode											
2390	Peak	Horz	51.6	26.6	3.6	0.0	-32.7	49.0	74.0	25.0	Pass
2390	Avg.	Horz	37.8	26.6	3.6	0.0	-32.7	35.3	54.0	18.7	Pass
2390	Peak	Vert	50.5	26.6	3.6	0.0	-32.7	48.0	74.0	26.0	Pass
2390	Avg.	Vert	37.9	26.6	3.6	0.0	-32.7	35.3	54.0	18.7	Pass
2353.5	Peak	Horz	52.53	26.5	3.5	0.0	-32.7	49.9	74.0	24.1	Pass
2384.3	Avg.	Horz	37.92	26.6	3.6	0.0	-32.7	35.3	54.0	18.7	Pass
2378.8	Peak	Vert	52.4	26.6	3.6	0.0	-32.7	49.7	74.0	24.3	Pass
2383.5	Avg.	Vert	38.0	26.6	3.6	0.0	-32.7	35.4	54.0	18.6	Pass
High Channel - B mode											
2483.5	Peak	Horz	48.2	26.3	3.6	0.0	-32.8	45.4	74.0	28.6	Pass
2483.5	Avg.	Horz	34.4	26.3	3.6	0.0	-32.8	31.5	54.0	22.5	Pass
2483.5	Peak	Vert	51.2	26.3	3.6	0.0	-32.8	48.4	74.0	25.6	Pass
2483.5	Avg.	Vert	38.4	26.3	3.6	0.0	-32.8	35.5	54.0	18.5	Pass
2486.6	Peak	Horz	48.9	26.3	3.6	0.0	-32.8	46.0	74.0	28.0	Pass
2486.6	Avg.	Horz	34.6	26.3	3.6	0.0	-32.8	31.8	54.0	22.2	Pass
2486.3	Peak	Vert	53.0	26.3	3.6	0.0	-32.8	50.1	74.0	23.9	Pass
2486.3	Avg.	Vert	38.6	26.3	3.6	0.0	-32.8	35.8	54.0	18.2	Pass

Emissions at Band Edges
G-mode

Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Attenuator (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
Low Channel - G mode											
2390	Peak	Horz	58.7	26.6	3.6	0.0	-32.7	56.1	74.0	17.9	Pass
2390	Avg.	Horz	42.5	26.6	3.6	0.0	-32.7	39.9	54.0	14.1	Pass
2390	Peak	Vert	62.3	26.6	3.6	0.0	-32.7	59.7	74.0	14.3	Pass
2390	Avg.	Vert	44.8	26.6	3.6	0.0	-32.7	42.2	54.0	11.8	Pass
2389.6	Peak	Horz	59.08	26.6	3.6	0.0	-32.7	56.5	74.0	17.5	Pass
High Channel - G mode											
2483.5	Peak	Horz	62.7	26.3	3.6	0.0	-32.8	59.9	74.0	14.1	Pass
2483.5	Avg.	Horz	47.4	26.3	3.6	0.0	-32.8	44.6	54.0	9.4	Pass
2483.5	Peak	Vert	66.8	26.3	3.6	0.0	-32.8	63.9	74.0	10.1	Pass
2483.5	Avg.	Vert	51.0	26.3	3.6	0.0	-32.8	48.1	54.0	5.9	Pass
2483.8	Peak	Horz	63.4	26.3	3.6	0.0	-32.8	60.5	74.0	13.5	Pass
2487	Peak	Vert	66.8	26.3	3.6	0.0	-32.8	64.0	74.0	10.0	Pass

Emissions at Band Edges
N-mode

Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Attenuator (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
Low Channel - N mode											
2390	Peak	Horz	61.1	26.6	3.6	0.0	-32.7	58.5	74.0	15.5	Pass
2390	Avg.	Horz	44.9	26.6	3.6	0.0	-32.7	42.3	54.0	11.7	Pass
2390	Peak	Vert	61.7	26.6	3.6	0.0	-32.7	59.1	74.0	14.9	Pass
2390	Avg.	Vert	46.5	26.6	3.6	0.0	-32.7	43.9	54.0	10.1	Pass
High Channel - N mode											
2483.5	Peak	Horz	63.0	26.3	3.6	0.0	-32.8	60.1	74.0	13.9	Pass
2483.5	Avg.	Horz	46.0	26.3	3.6	0.0	-32.8	43.1	54.0	10.9	Pass
2483.5	Peak	Vert	68.2	26.3	3.6	0.0	-32.8	65.4	74.0	8.6	Pass
2483.5	Avg.	Vert	51.1	26.3	3.6	0.0	-32.8	48.2	54.0	5.8	Pass
2484.3	Peak	Horz	63.0	26.3	3.6	0.0	-32.8	60.1	74.0	13.9	Pass
2484.1	Peak	Vert	69.3	26.3	3.6	0.0	-32.8	66.5	74.0	7.5	Pass

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 12, 2018	Jan. 12, 2020	GEMC 233
Loop Antenna 9 – 150 KHz	EM 6871	Electro-Metrics	Feb 13, 2017	Feb 13, 2019	GEMC 70
Loop Antenna 150 kHz – 30 MHz	EM 6872	Electro-Metrics	Feb 13, 2017	Feb 13, 2019	GEMC 71
BiLog Antenna 30 MHz – 2 GHz	3142-C	ETS	Oct. 5, 2016	Oct. 5, 2018	GEMC 8
Horn Antenna 2 – 18 GHz	WBH218HN	Q-par	Feb. 27, 2018	Feb. 27, 2020	GEMC 6375
Horn Antenna 18 GHz - 26.5 GHz	SAS-572	A.H. Systems	Oct 11, 2016	Oct 11, 2018	GEMC 6371
Pre-amp 9KHz - 1GHz	CPA9230	Chase	Feb. 28, 2018	Feb. 28, 2020	GEMC 301
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Oct. 27, 2017	Oct. 27, 2019	GEMC 297
Attenuator 6 dB	612-6-1	Meca Electronics, Inc	NCR	NCR	GEMC 286
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	0.1.97	TUV SUD Canada, Inc	NCR	NCR	GEMC 58

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

Appendix A – EUT Summary

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

General EUT Description

Client	
Organization / Address	Ecobee Inc 207 Queens Quay W, Suite 600 Toronto, ON Canada, M5J 1A7
Contact	Kashif Ahmed
Phone	416 987 1048
Email	kashif@ecobee.com
EUT Details	
EUT Name	EB-SMSWV-01
FCC ID	WR9EBSMSW1V001
Industry Canada #	7981A- EBSMSW1V001
Equipment Category	Low power wireless light switch
Basic EUT Functionality	EUT is a smart light switch that have a 2400 – 2483.5 MHz DTS (802.11 b/g/n) transmitter and a 902 – 928 MHz FHSS transmitter.
Input Voltage and Frequency	120 Vac 60 Hz
Rated Input Current	2 A
Connectors available on EUT	1 (terminals for HVAC control)
Peripherals Required for Test	None
Release type	Final
Intentional Radiator Frequency	2400 – 2483.5 MHz for 802.11 b/g/n DTS 902 – 928 MHz FHSS
EUT Configuration	Wireless configured to transmit continuously at 100% duty cycle

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

EUT Configuration

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

- Wireless were configured to transmit at maximum possible duty cycle
- The following commands were used to set the chipset for its test operation where "xx" is the transmit channel (1 = low channel, 6 = mid channel, 11 = high channel):
  B mode transmission: "athtestcmd -i wlan0 --tx tx99 --txfreq xx --txpwr 20 --txrate 1"
  G mode transmission: "athtestcmd -i wlan0 --tx tx100 --txfreq xx --txpwr 20 --txrate 11"
  N mode transmission: "athtestcmd -i wlan0 --tx tx100 --txfreq xx --txpwr 20 --txrate 18"

Operational Setup

These devices are required to be attached to the EUT for its normal operation.

- A debug board was connected to the EUT to issue test commands.