EMC & RF Test Report

As per

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

Unlicensed Intentional Radiators

on the

Mero Technologies
Traffic V3 & Paper SB8.1

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Testing produced for

Mero Technologies Inc.

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 certification testing and test results of the **Paper SB8.1** and **Traffic V3** units from Mero Technologies. Both units host identical 2.4 GHz BLE transmitter limited module designs operating in 1 Mbps mode. This report refers to the BLE transmitter as the EUT (Equipment Under Test), except where indicated as otherwise. The **Paper SB8.1** and **Traffic V3** will be referred to as the **Paper** and **Traffic** units respectively for simplicity. This report contains the results of full FCC certification testing done on the BLE transmitter module on the Paper unit as representative of both. Spurious Radiated Emissions testing is also performed on the Traffic unit to verify compliance when mounted on this host product

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:	Paper SB8.1 Traffic V3
FCC Certification #, FCC ID:	2A6KHMEROS10
Industry Canada Certification #, IC:	28448-MEROS10
EUT passed all tests performed	Yes
Tests conducted by	Raymond Au
Report reviewed by	Min Xie

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

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS-GEN (Table 6)	Restricted Bands for Intentional Operation	QuasiPeak Average	Pass See Justification
FCC 15.207 RSS-GEN (Table 3)	Power Line Conducted Emissions	QuasiPeak Average	N/A See Justification
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.

N/A = Not Applicable.

Notes, Justifications, or Deviations

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

The EUT is a 2.4 GHz BLE transmitter design to be installed only in the client/manufacturer's own products. The host products include the Paper SB8.1 and the Traffic V3 evaluated in the scope of this report. As the BLE design is identical, test requirements on the fundamental are performed on one unit only (the Paper). Spurious radiated tests are performed on both host products. The Paper is a sensor used to monitor the consumption of supplies such as paper towels in typical commercial facilities. The Traffic is a sensor used to monitor traffic going into and out of an area.

For the antenna requirements specified in FCC 15.203, the EUT uses a chip antenna soldered onto the PCB, model Johanson Technology 2450AT18B100, with 0.5 dBi peak gain. It is located within the host product's enclosure and is not meant to be replicable by the user.

The EUT is tested using a 1 Mbps data rate, as per its usage.

All testing is performed while constantly transmitting modulated data at the maximum power used (EUT setting is "4 dBm").

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

The EUT was tested positioned in the three orthogonal axes. Worst case results are presented, and occurs with the PCB positioned flat, with the side which the antenna is soldered onto facing up.

The EUT was configured to 100% duty cycle for testing purposes.

Both host products are battery operated. The Traffic unit uses a CR2477 cell. The Paper unit uses a rechargeable LiPo battery, however, as per the client/manufacturer, it will not transmit while it is charging, and is not supplied with a charger. It will be charged only at their facilities. Power line conducted emissions testing is not applicable to the EUT.

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)

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
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 7 2020	Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
RSS-GEN Issue 5 2021	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	2022-07-12	Initial Release	MX

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)
Apr. 29, 2022	Radiated Emissions (All > 4 GHz, Paper 1 – 4 GHz)	RA	22.2	24.1	102.3
May 2, 2022	Radiated Emissions (All < 1 GHz, Traffic 1 – 4 GHz)	RA	22.2	38.8	101.6
May 2, 2022	Antenna Conducted Emissions	RA	22.2	39.7	101.4

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).

For systems using digital modulation techniques operating in the 902 - 928 MHz and 2400 - 2483.5 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 697 kHz
The maximum 99% Occupied Bandwidth was 1.06 MHz.

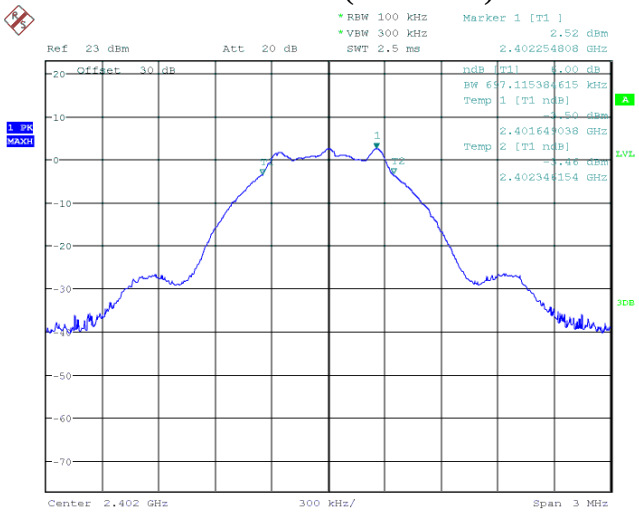
Channel	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	0.697	1.05
Mid	2440	0.702	1.06
High	2480	0.707	1.05

Graphs

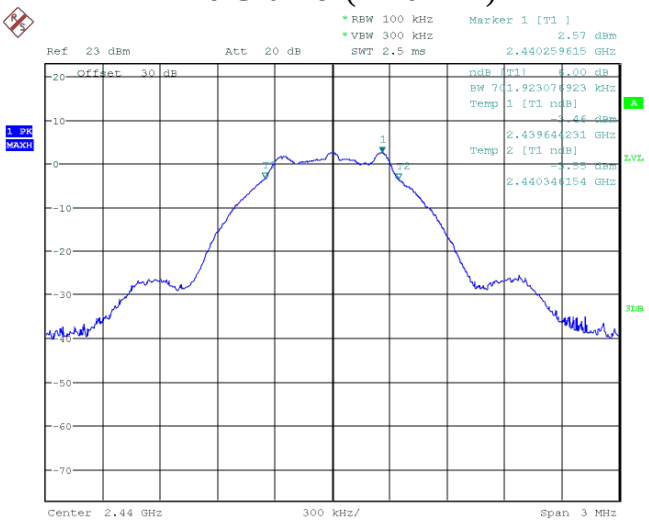
The graphs shown below show the OBW of the device during the conducted measurement operation of the EUT. This is measured by a max hold on the spectrum analyzer.

6dB Bandwidth

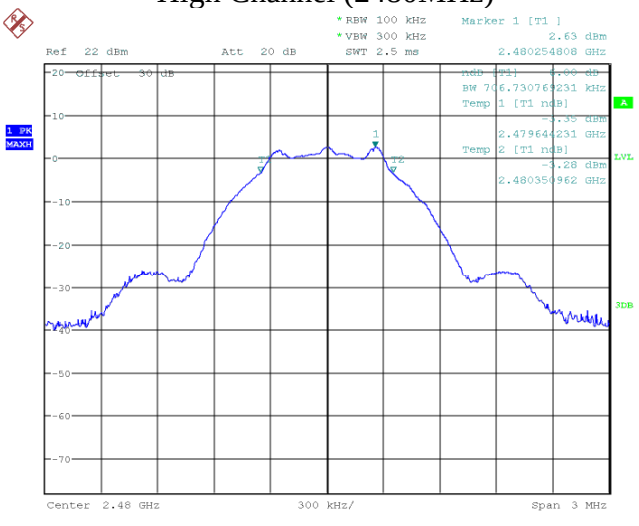
Low Channel (2402MHz)



Mid Channel (2440MHz)

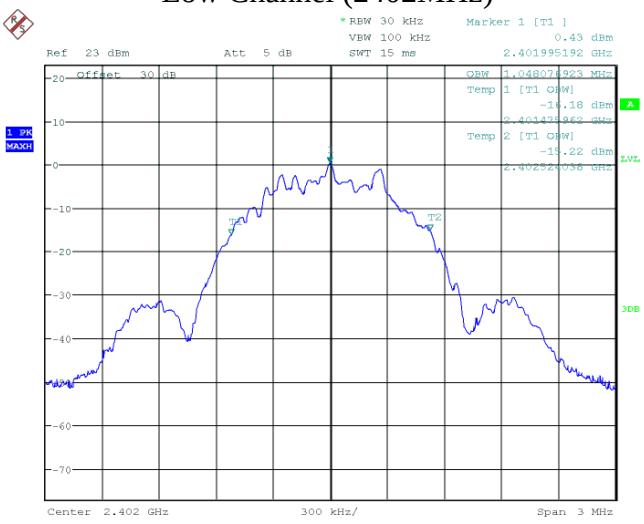


High Channel (2480MHz)

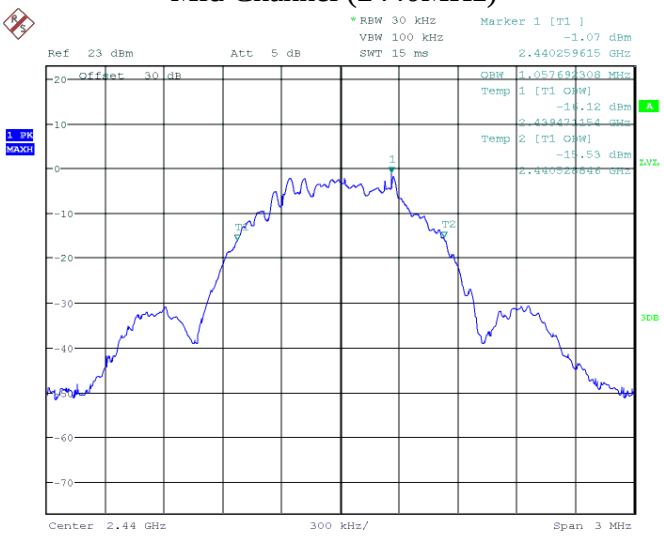


99% Bandwidth

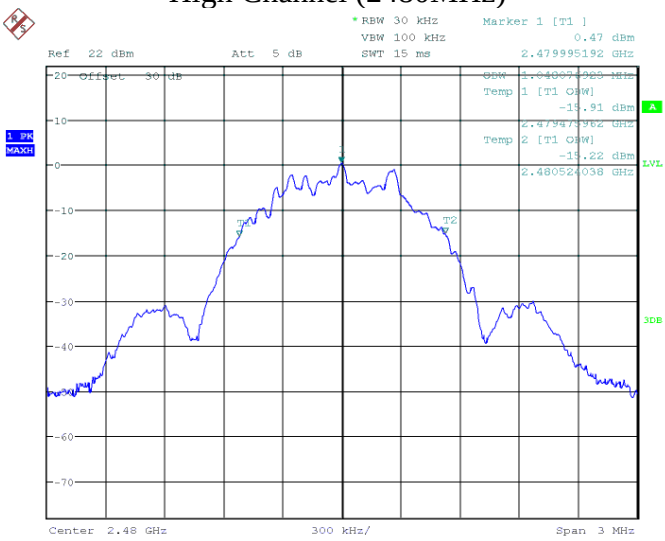
Low Channel (2402MHz)



Mid Channel (2440MHz)



High Channel (2480MHz)



Note: See exhibits for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	FSQ 26	Rohde & Schwarz	Nov. 23, 2021	Nov. 23, 2023	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133
Attenuator 20 dB	3M-20	Weinschel	NCR	NCR	GEMC 280

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.

Conducted			
Channel	**Frequency (MHz)**	**Peak Power (dBm)**	**Peak Power (mW)**
Low	2402	3.02	2.00
Mid	2440	3.08	2.03
High	2480	**3.10**	**2.04**

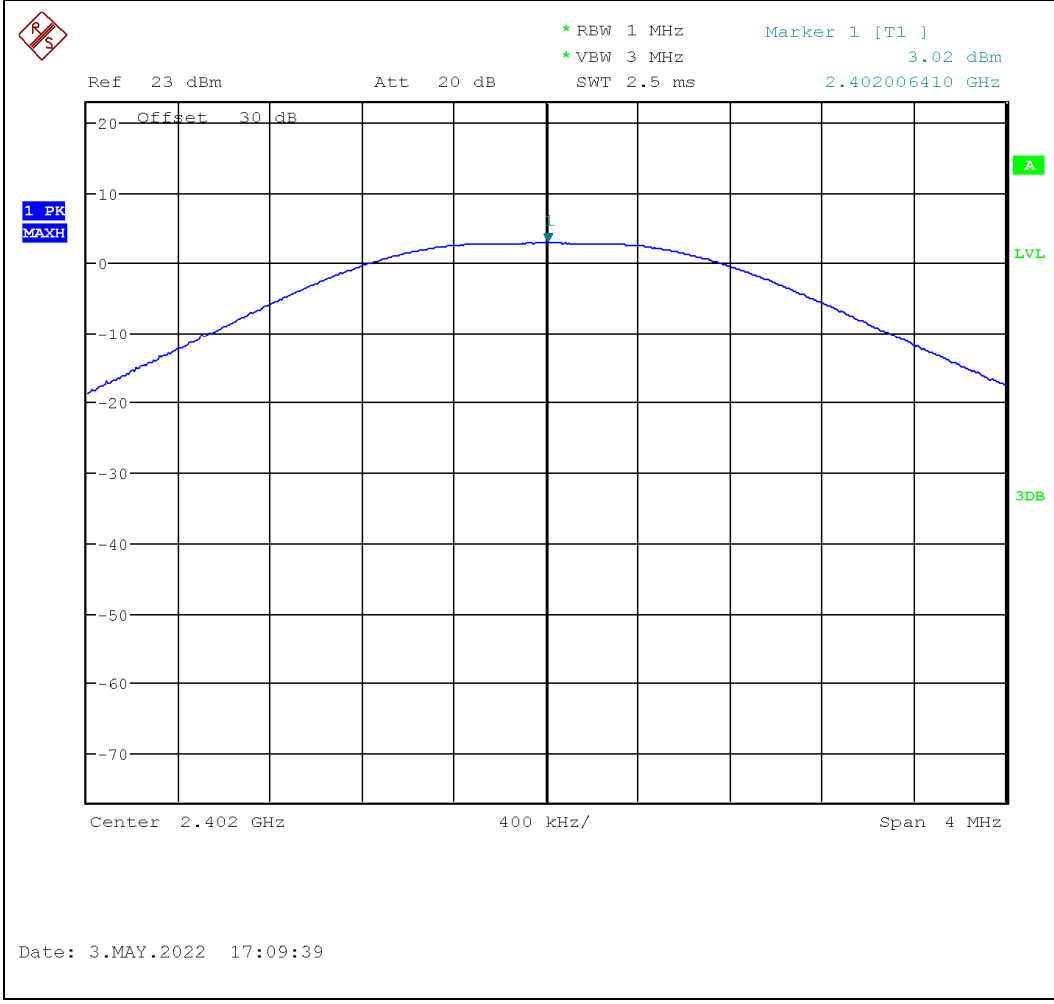
Note: The external attenuator and cable loss are accounted for as reference offset in the spectrum analyzer

Conducted 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.

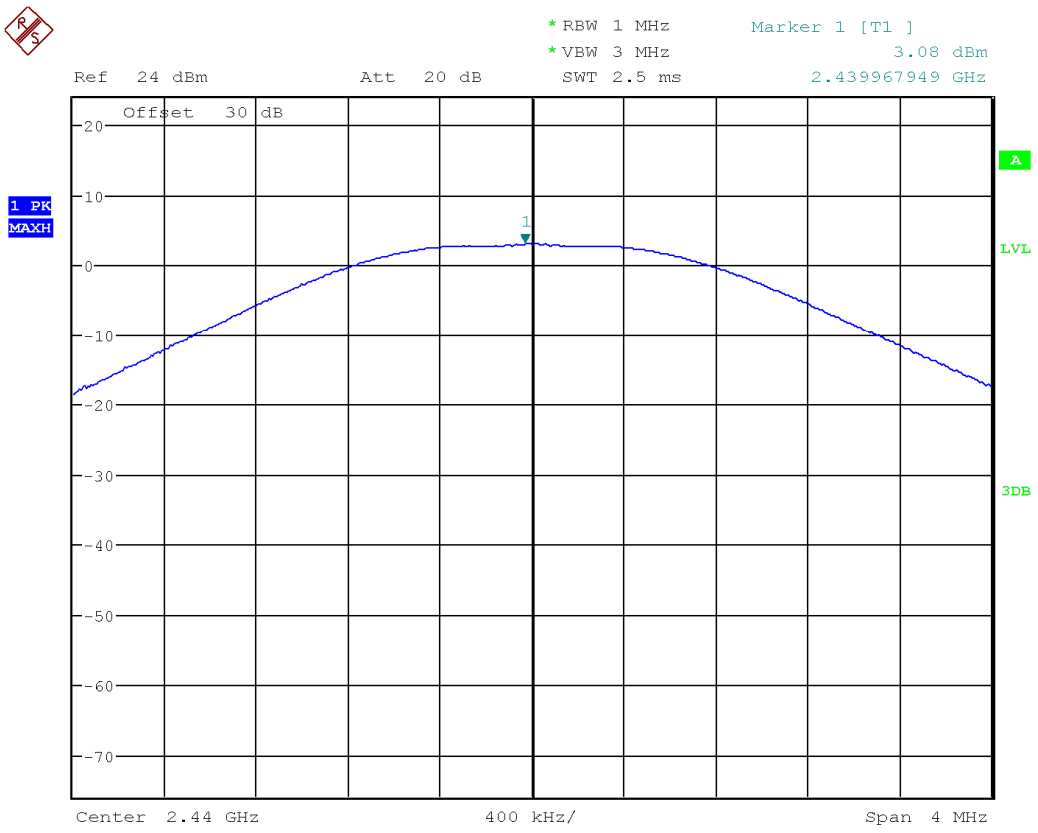
Peak Conducted Power

Low Channel



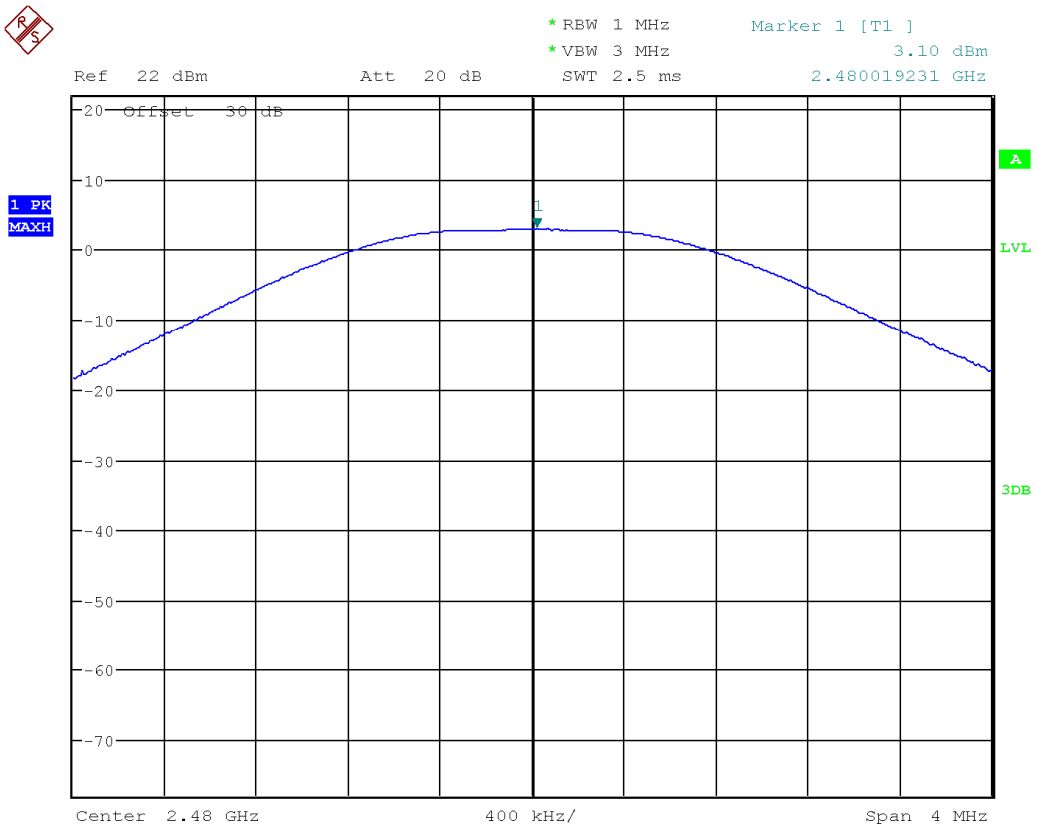
Peak Conducted Power

Mid Channel



Peak Conducted Power

High Channel



See exhibits for photos showing the test set-ups.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	FSQ 26	Rohde & Schwarz	Nov. 23, 2021	Nov. 23, 2023	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133
Attenuator 20 dB	3M-20	Weinschel	NCR	NCR	GEMC 280

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

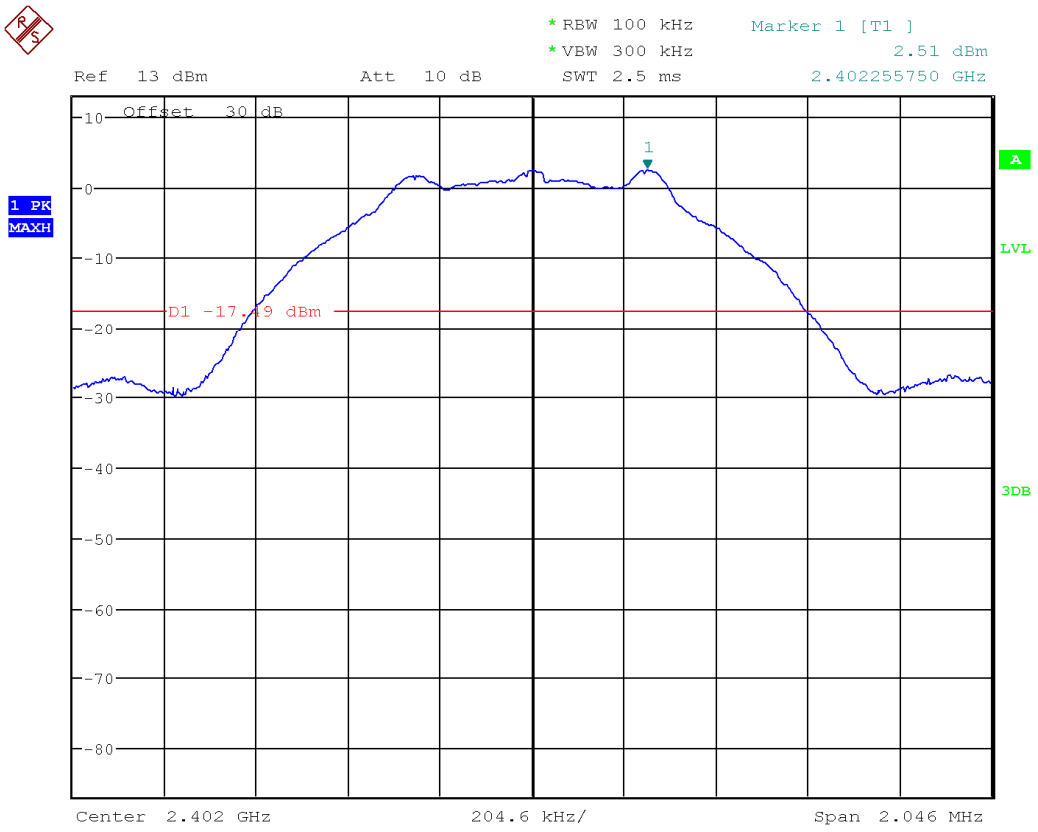
The EUT passed. Low, middle and high bands were measured. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band and for the higher band edge at 2.4835 GHz in the high band.

Graphs

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

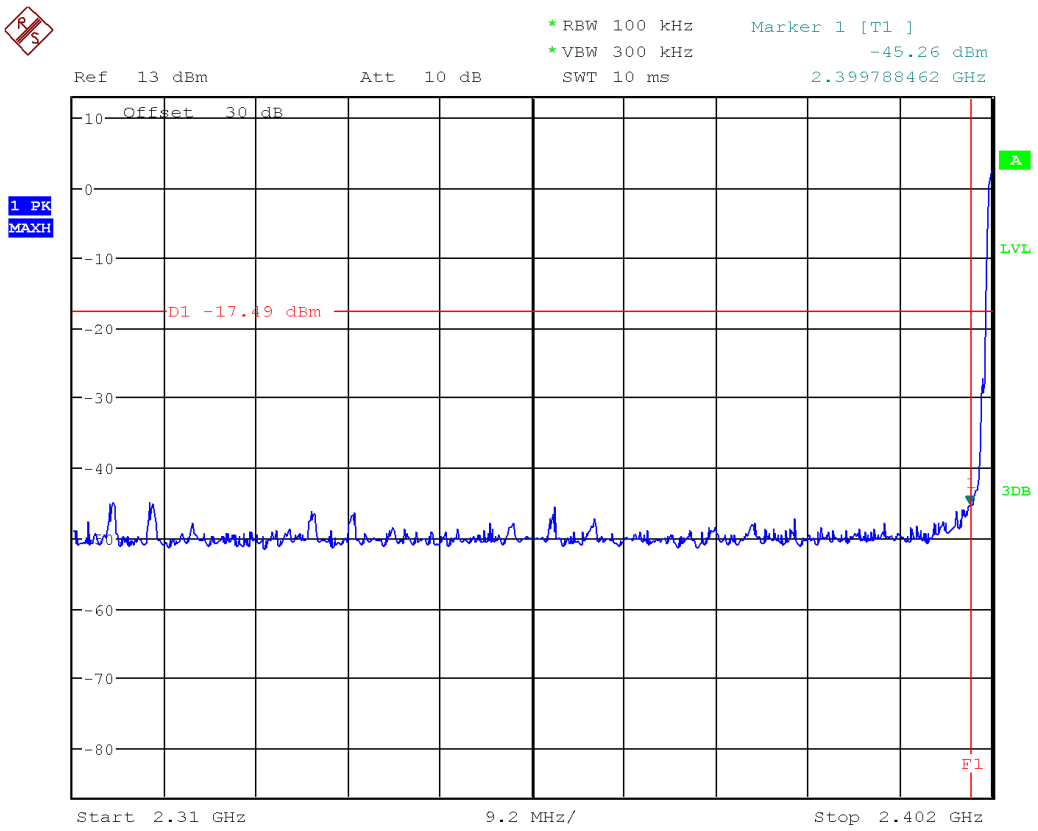
-20dBc – Low Channel

Reference Level: 2.51 dBm
Limit Line: -17.49 dBm



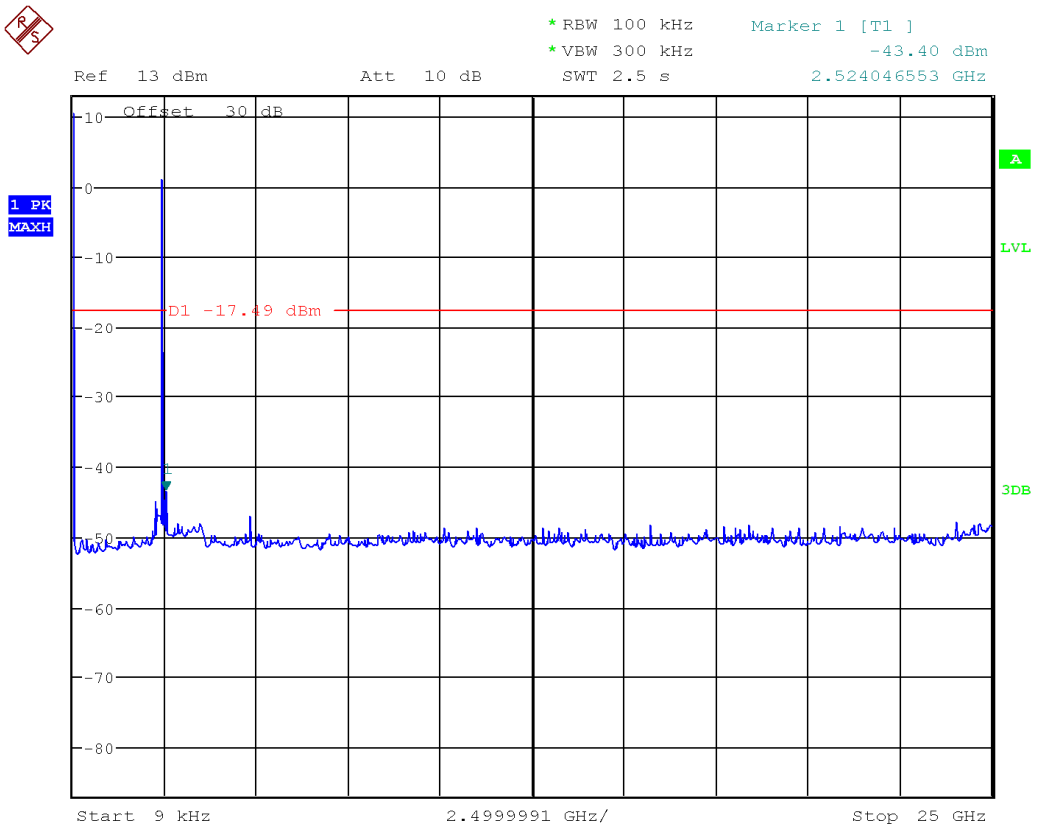
-20dBc – Low Channel

2400 MHz Band Edge



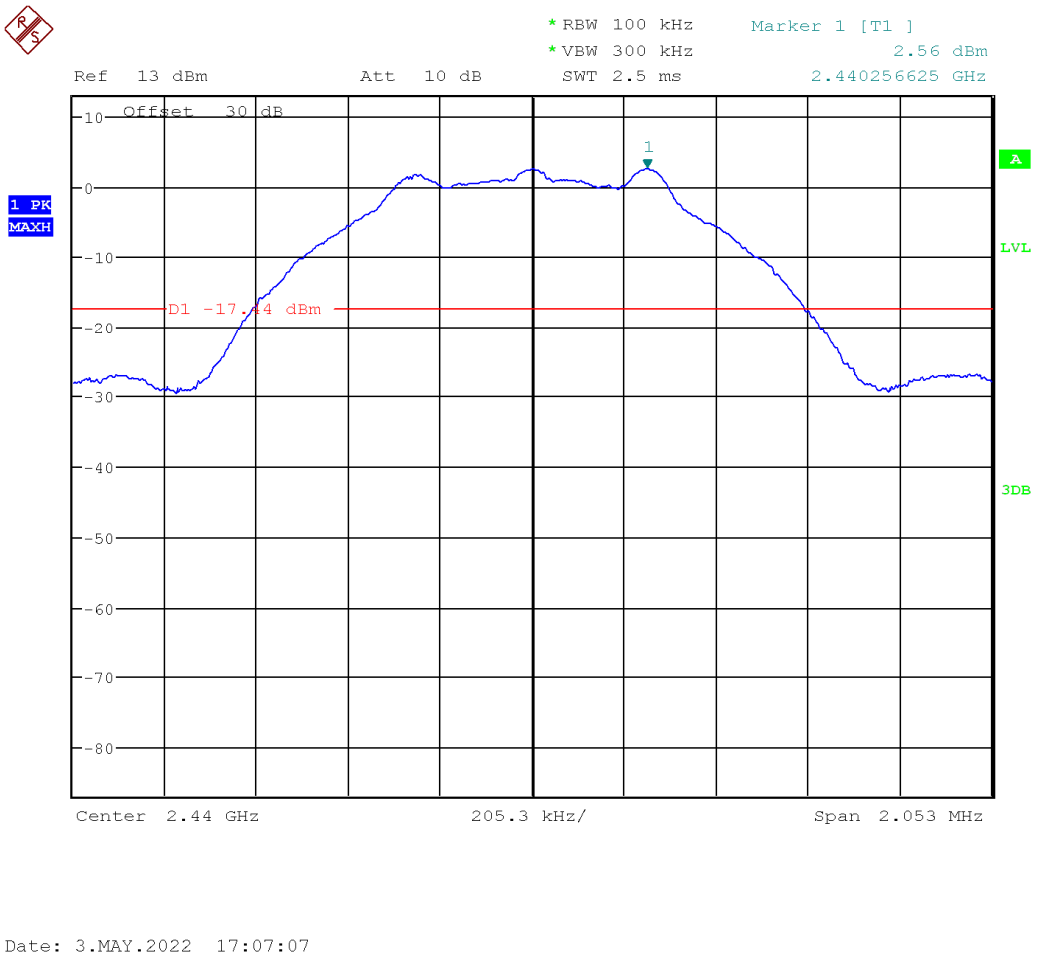
-20dBc – Low Channel

9kHz – 25GHz



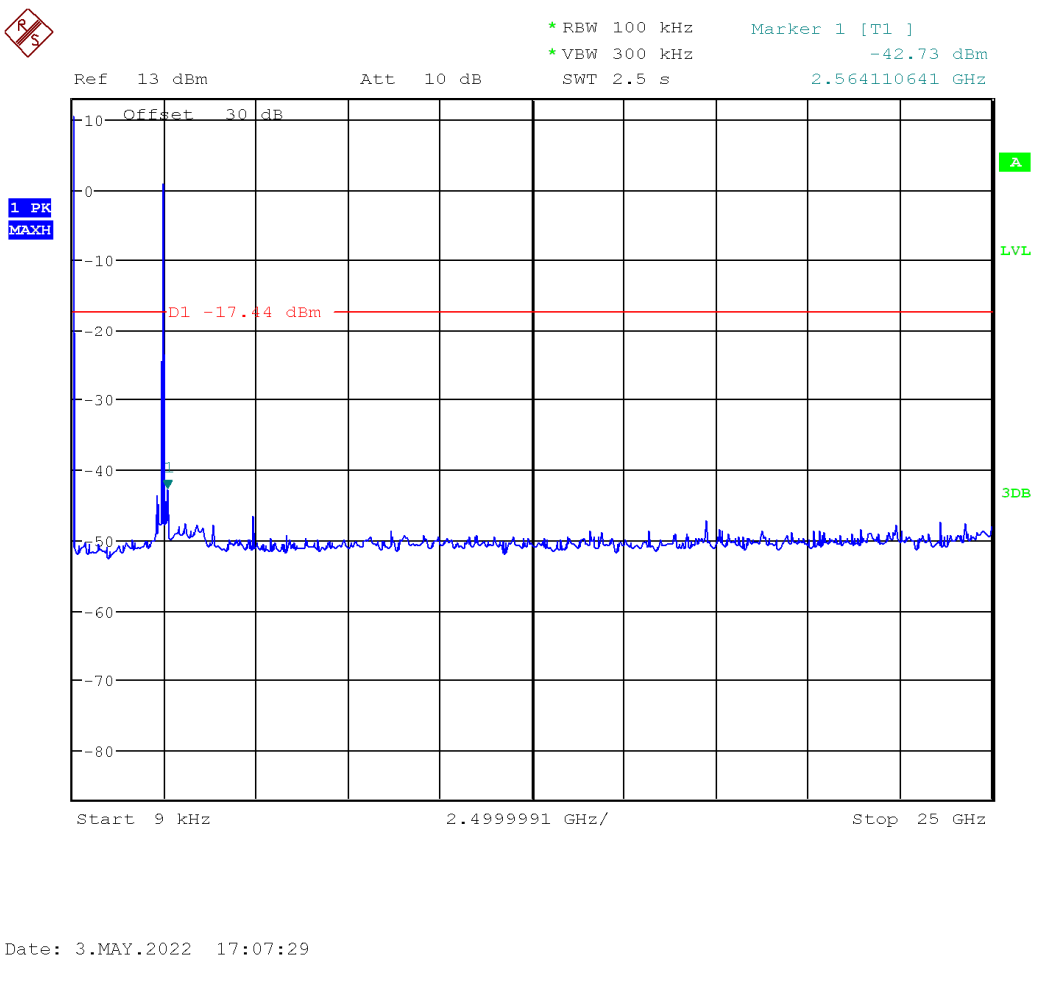
-20dBc – Mid Channel

Reference Level: 2.56 dBm
Limit Line: -17.44 dBm



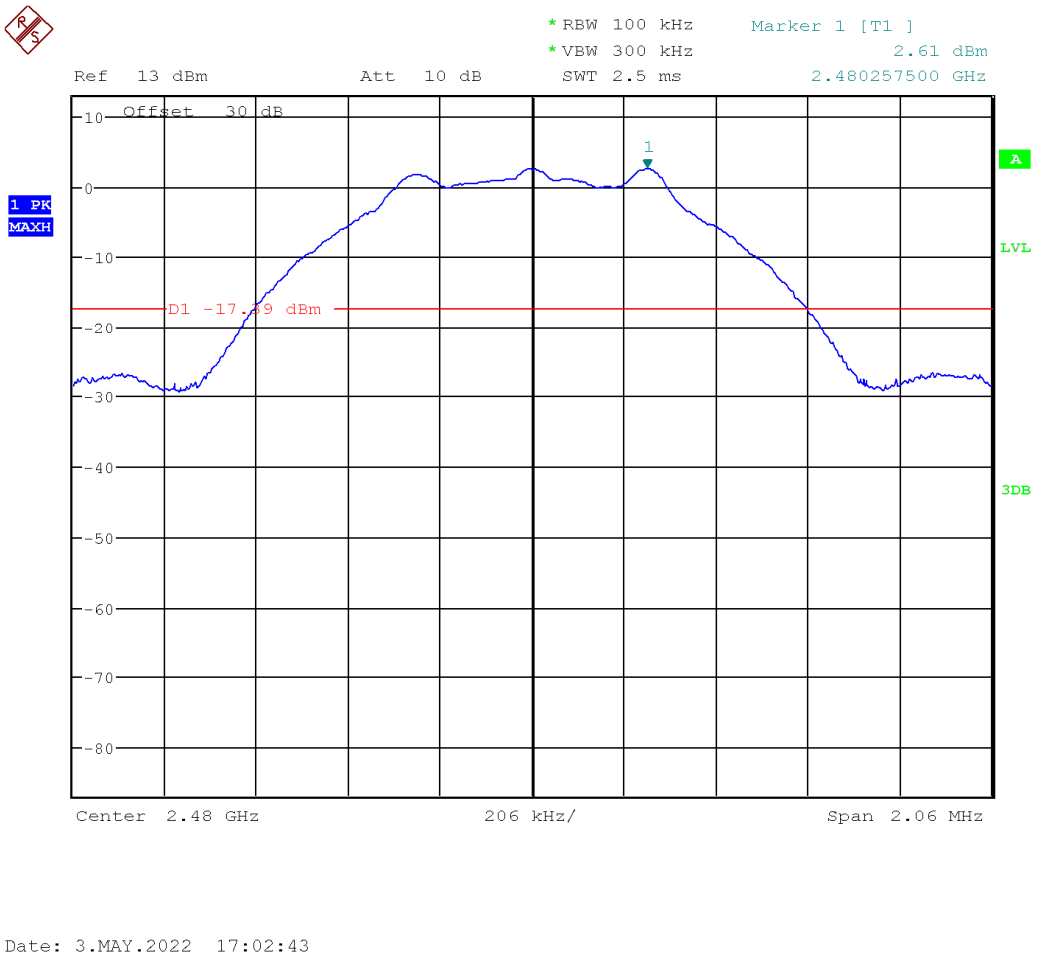
-20dBc – Mid Channel

9kHz – 25GHz



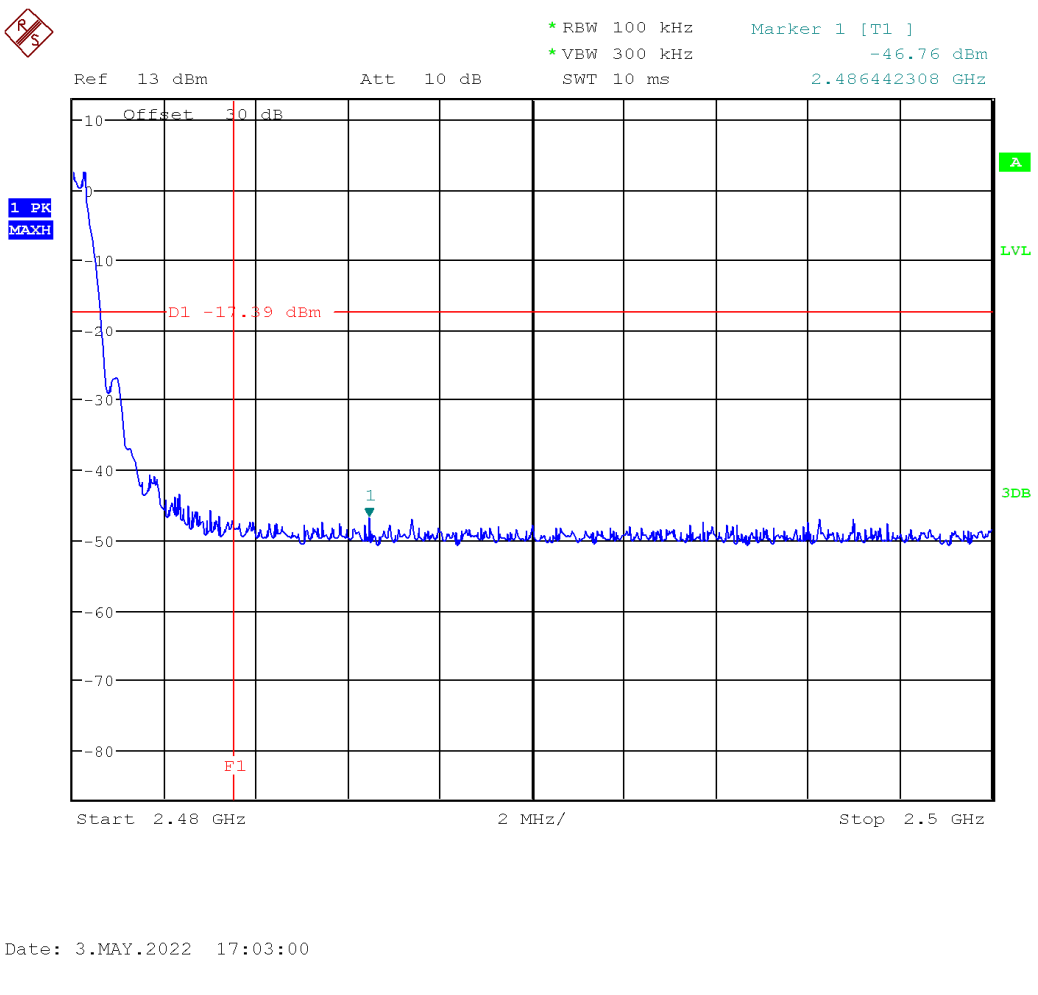
-20dBc – High Channel

Reference Level: 2.61 dBm
Limit Line: -17.39 dBm



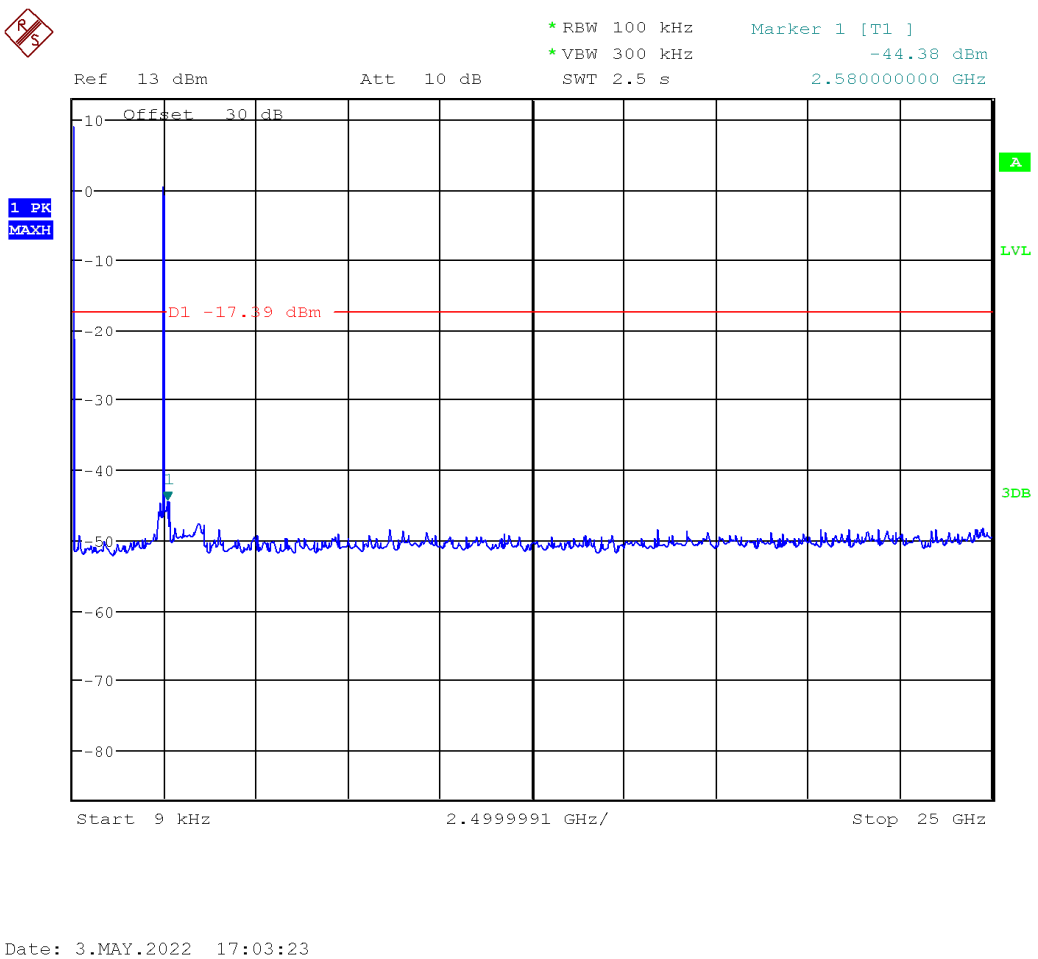
-20dBc – High Channel

2483.5 MHz Band Edge



-20dBc – High Channel

9kHz – 25GHz



See exhibits for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	FSQ 26	Rohde & Schwarz	Nov. 23, 2021	Nov. 23, 2023	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133
Attenuator 20 dB	3M-20	Weinschel	NCR	NCR	GEMC 280

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).

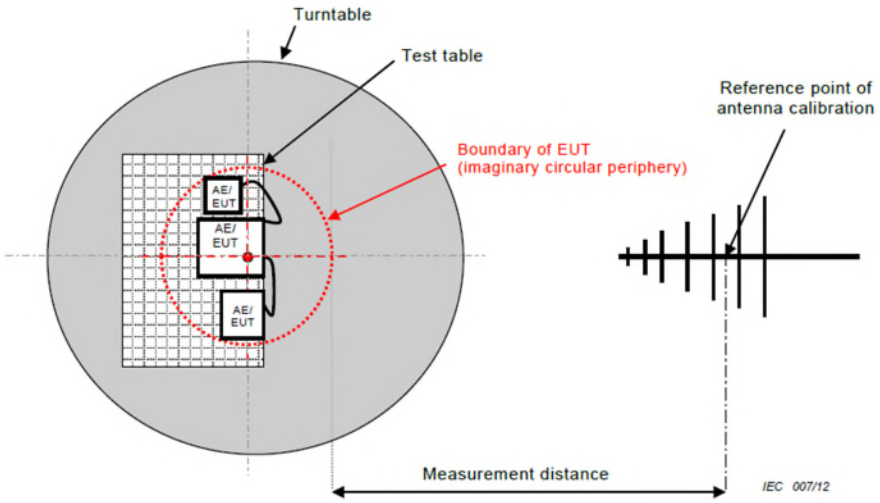
All unintentional emissions must also meet the 'Spurious Conducted Emissions' requirements of -20 dBc or greater. See also 'Antenna Spurious Conducted Emissions (-20dBc)' for further details.

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.

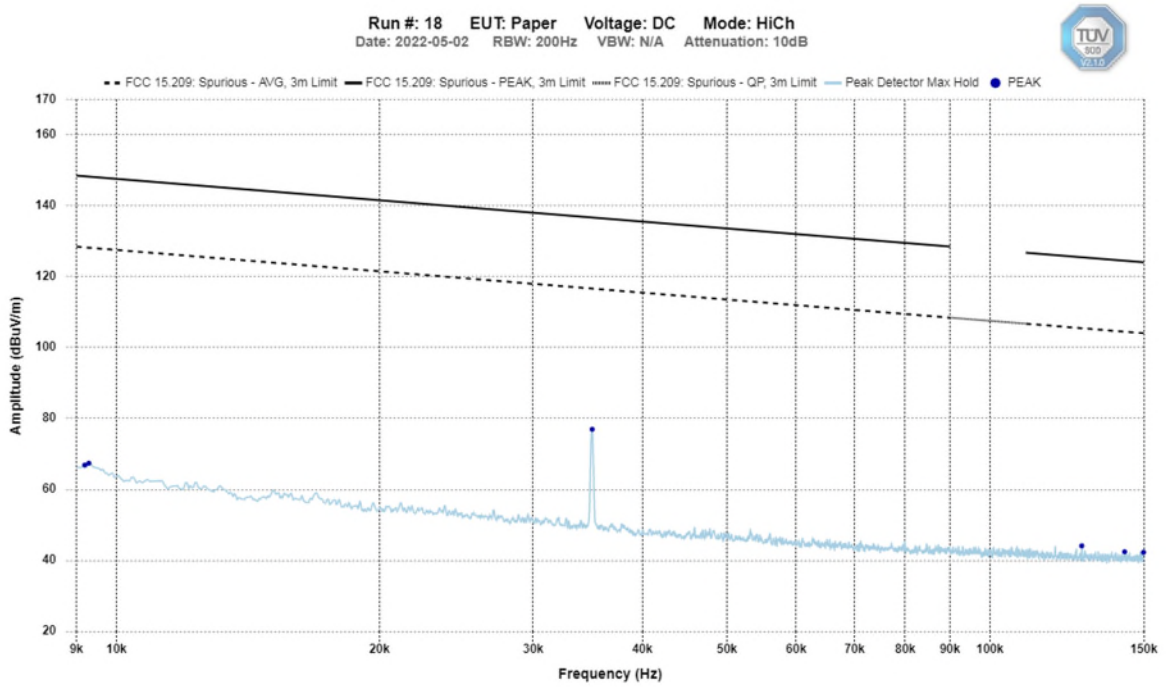
Peak radiated output for low, middle and high channels and each of the orthogonal axes of the EUT were checked. The worst case was used for the spurious emissions testing.

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

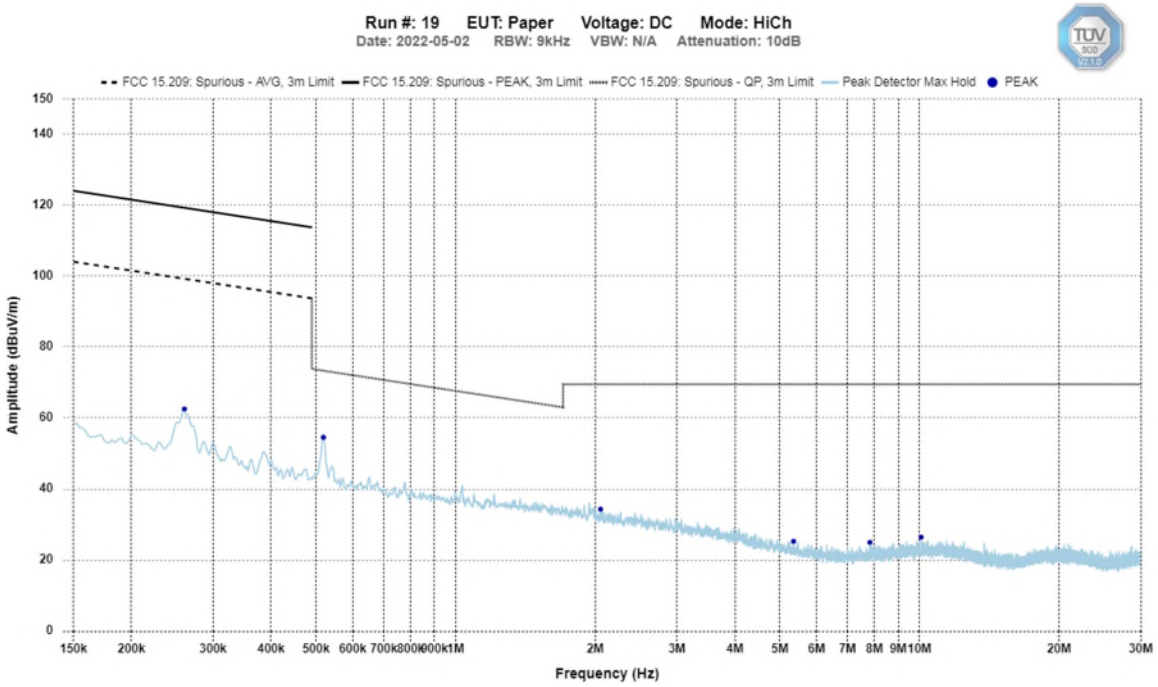
EUT: Paper

Spurious Emissions

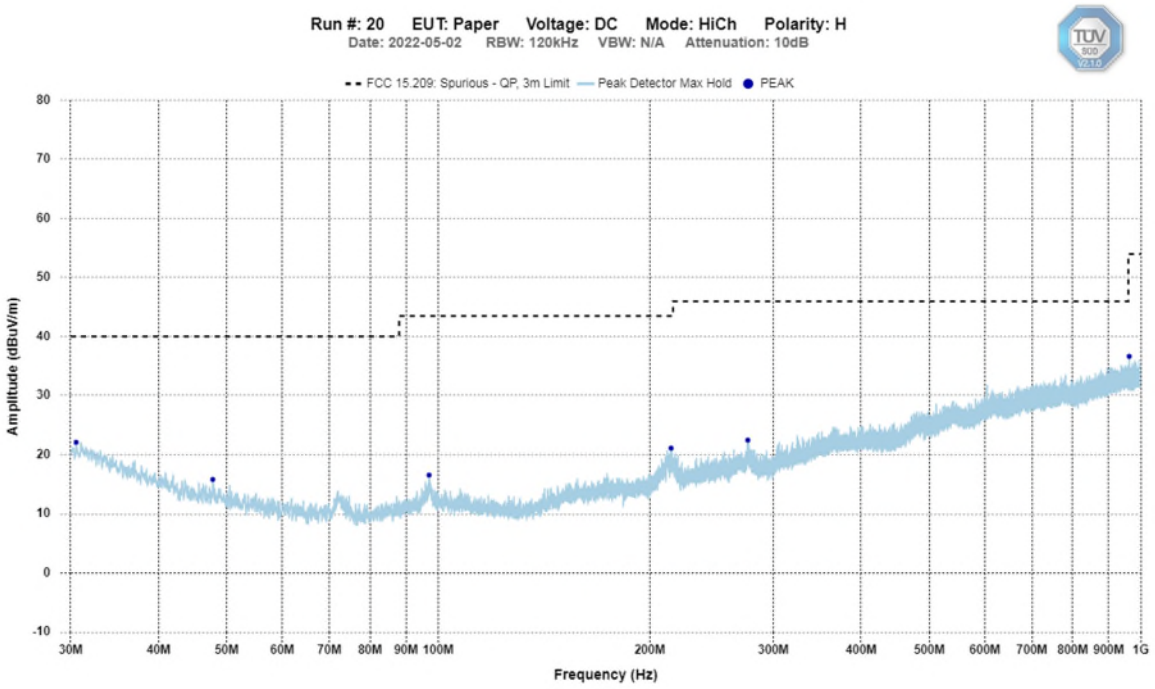
High Channel
9 kHz – 150 kHz
Peak Emission Graph



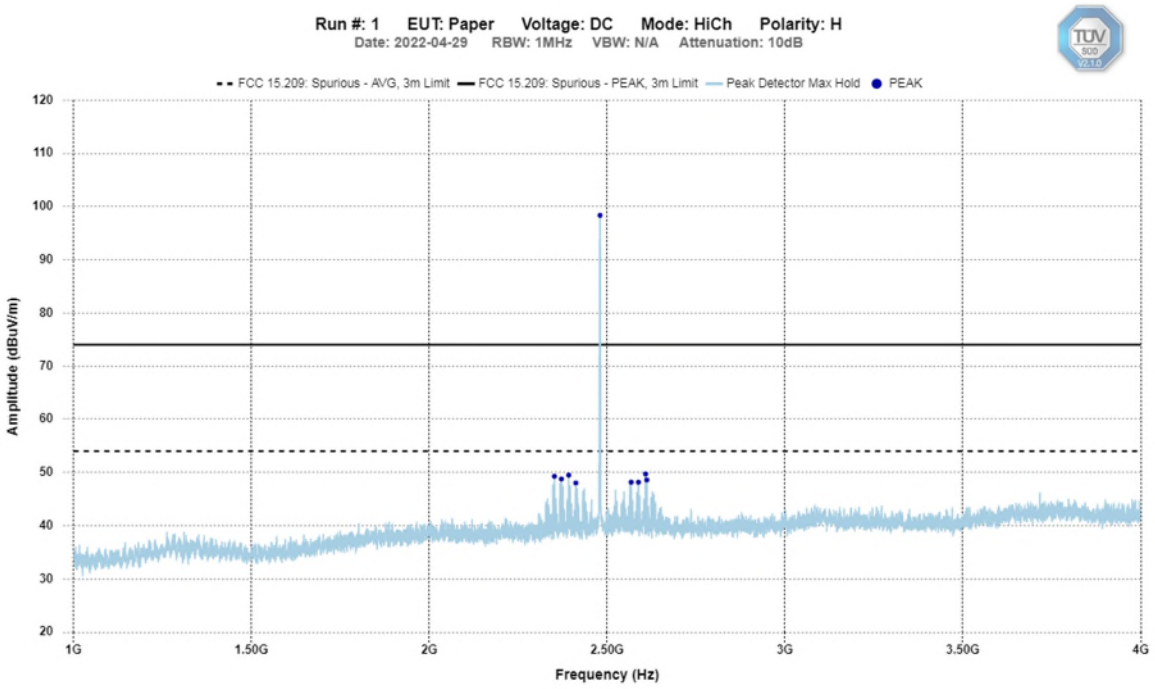
High Channel
150 kHz – 30 MHz
Peak Emission Graph



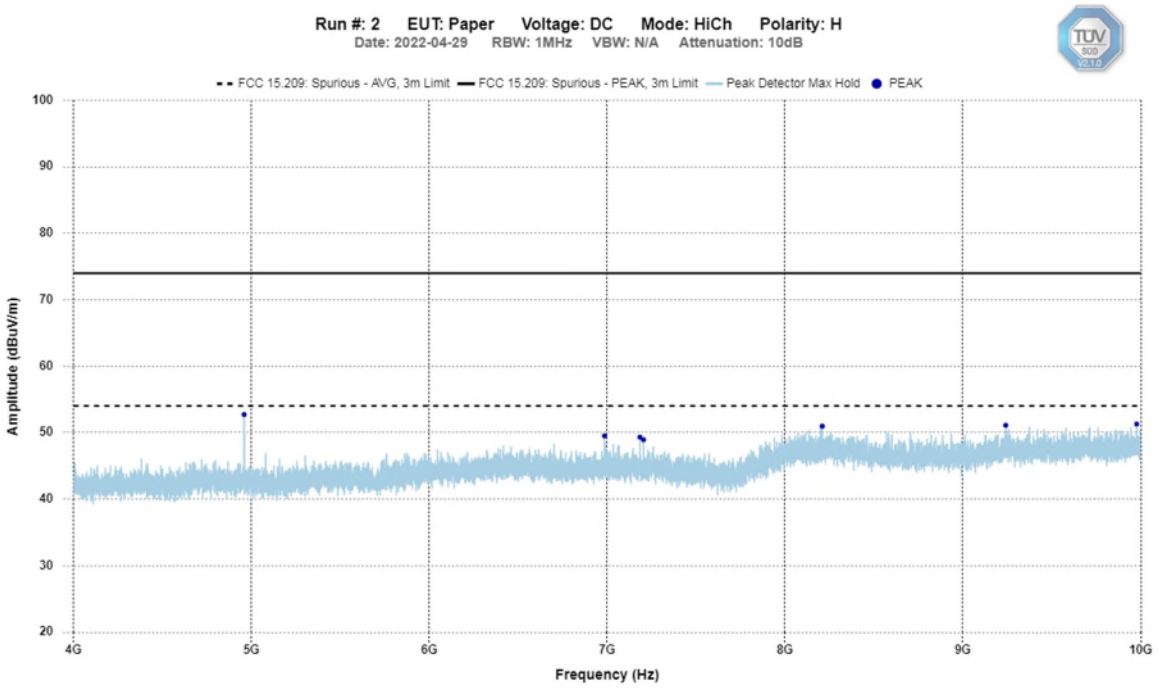
High Channel – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph



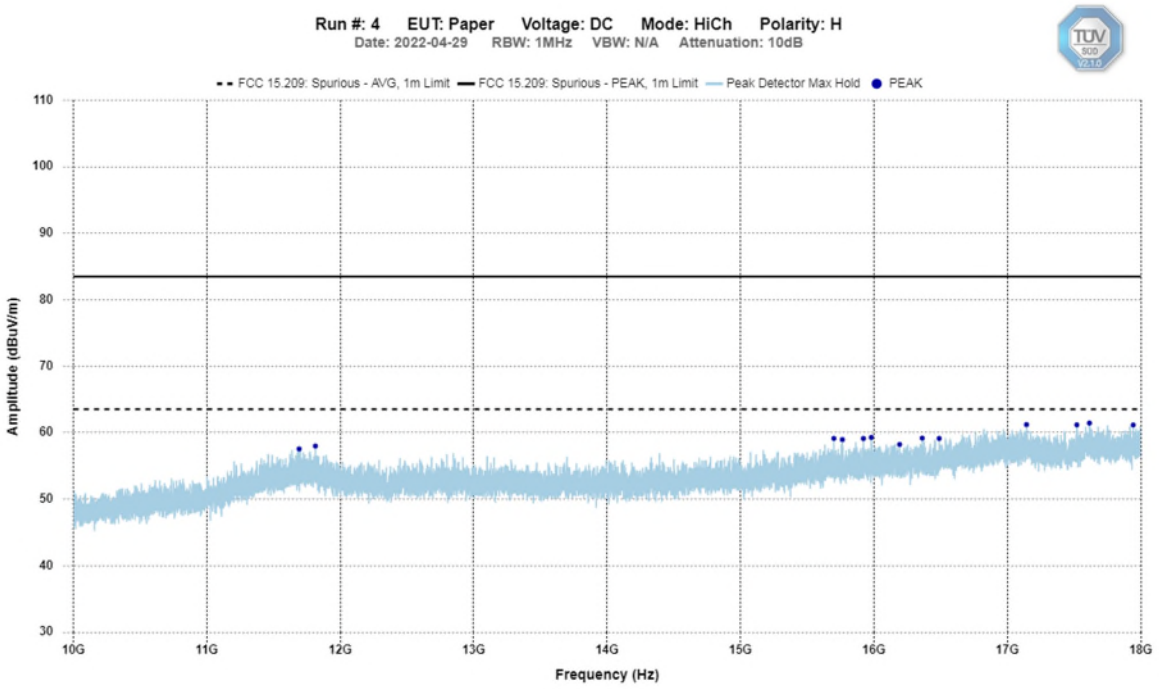
High Channel – 1 GHz – 4 GHz
Horizontal - Peak Emission Graph



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

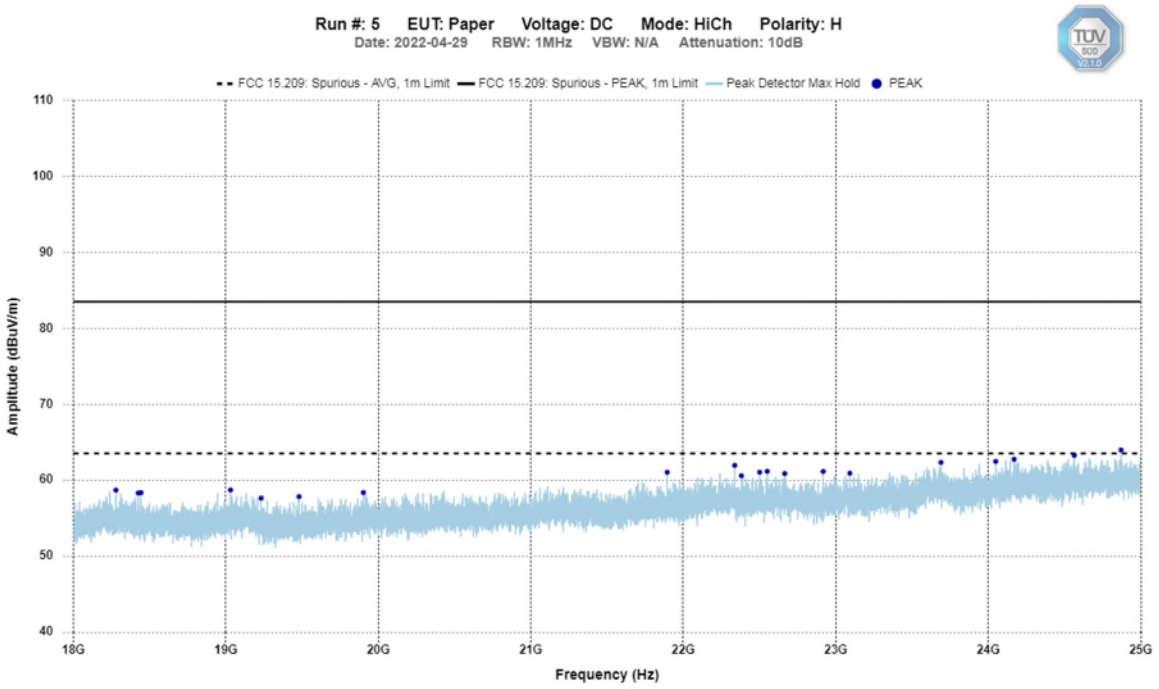


High Channel – 10 GHz – 18 GHz
Horizontal - Peak Emission Graph



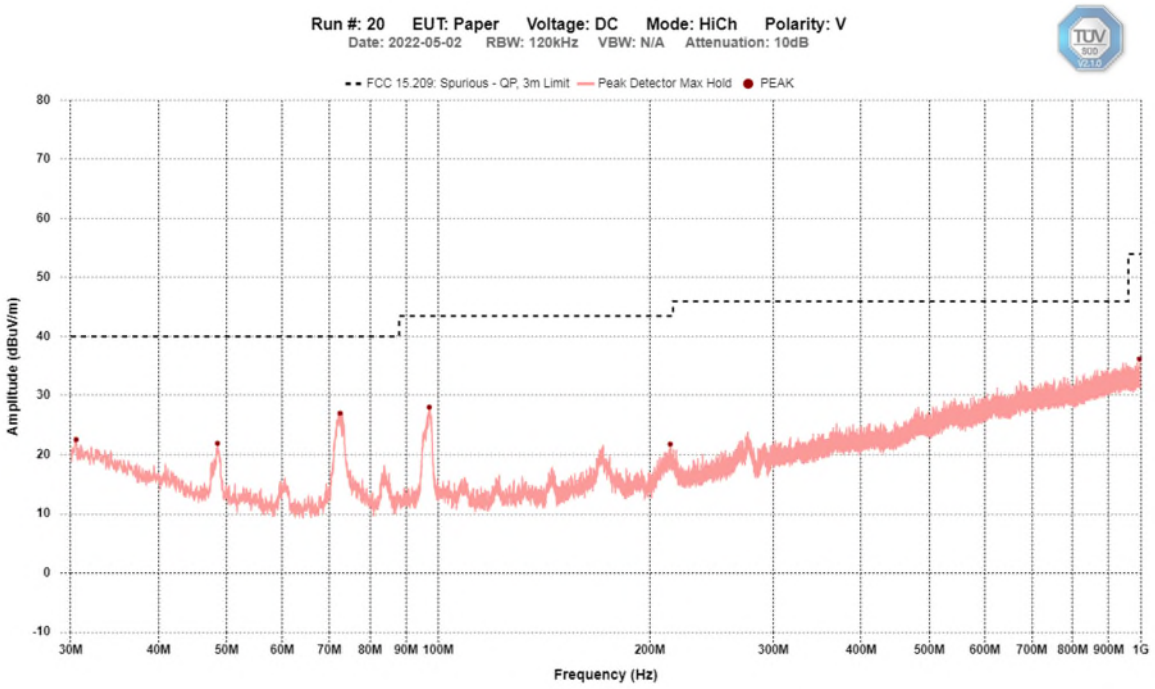
Plot was taken at a 1 meter distance.

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

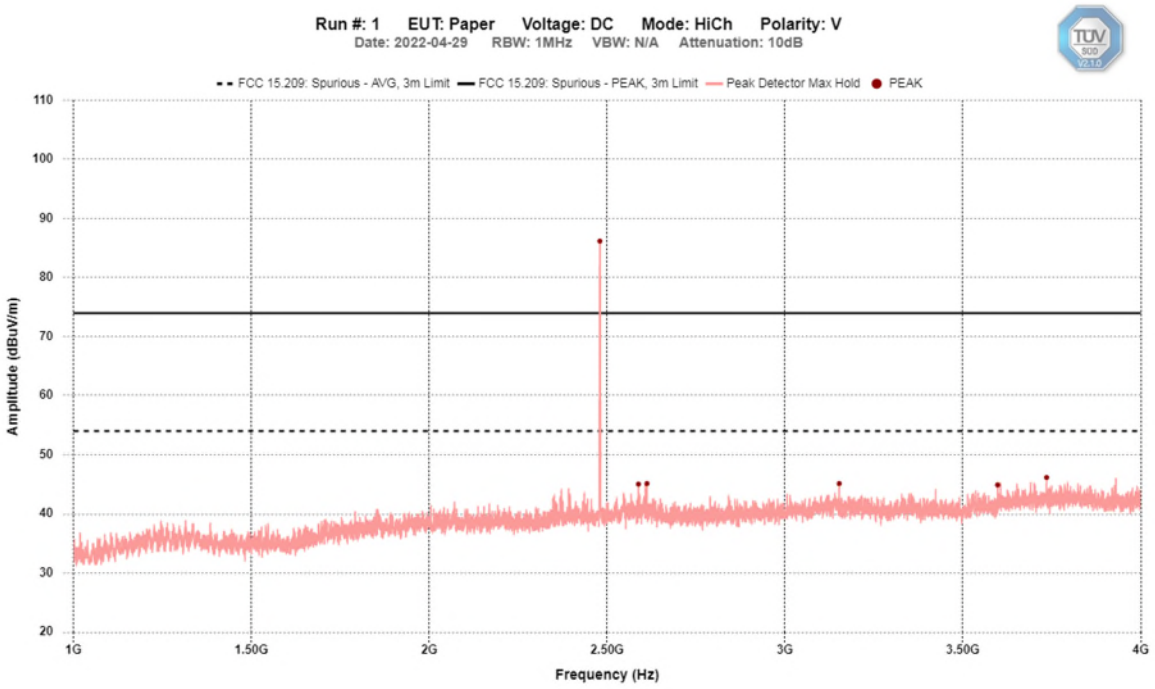


Plot was taken at a 1 meter distance.

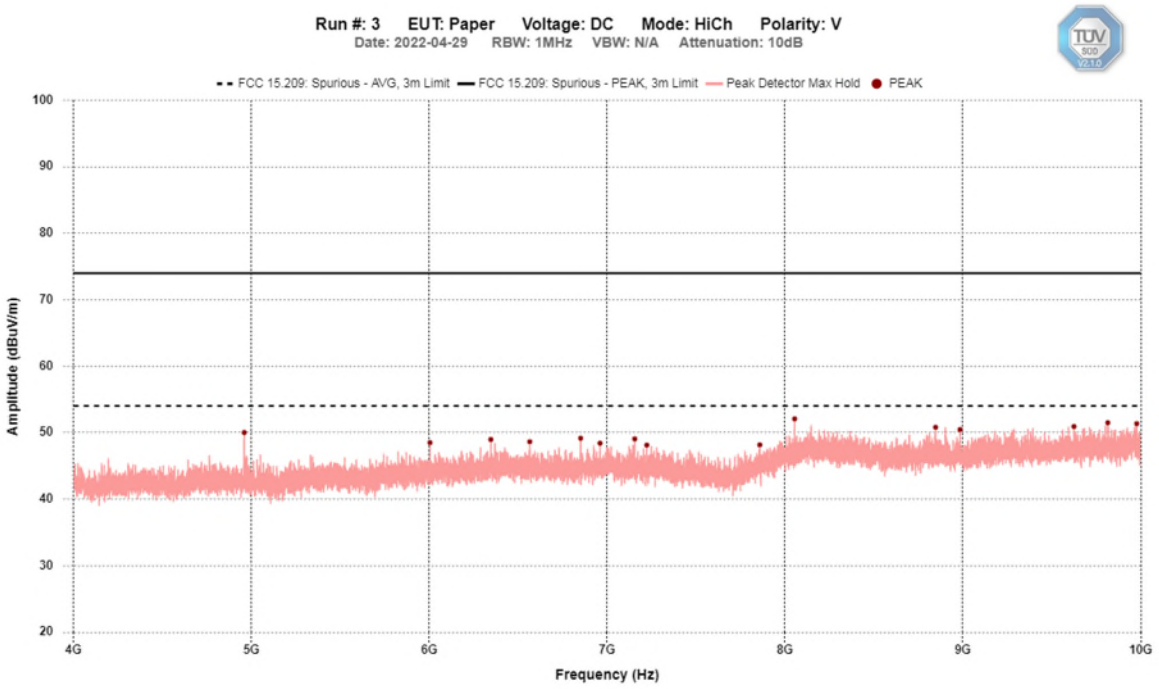
High Channel – 30 MHz – 1 GHz
Vertical - Peak Emission Graph



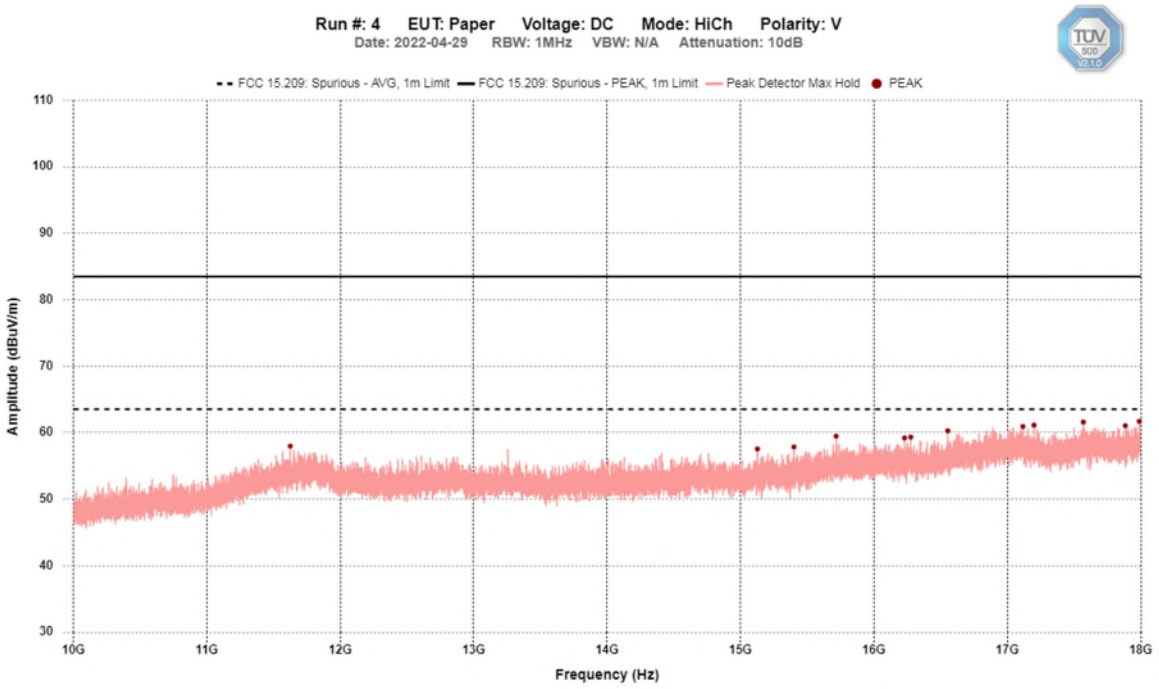
High Channel – 1 GHz – 4 GHz
Vertical - Peak Emission Graph



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

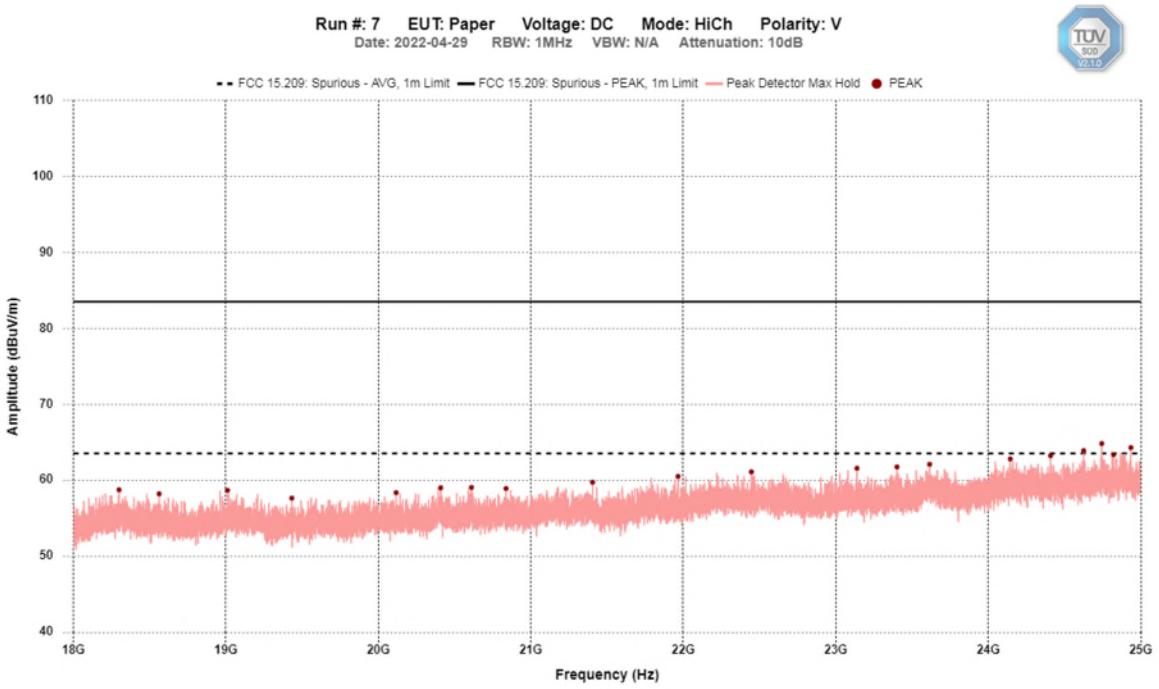


High Channel – 10 GHz – 18 GHz
Vertical - Peak Emission Graph



Plot was taken at a 1 meter distance.

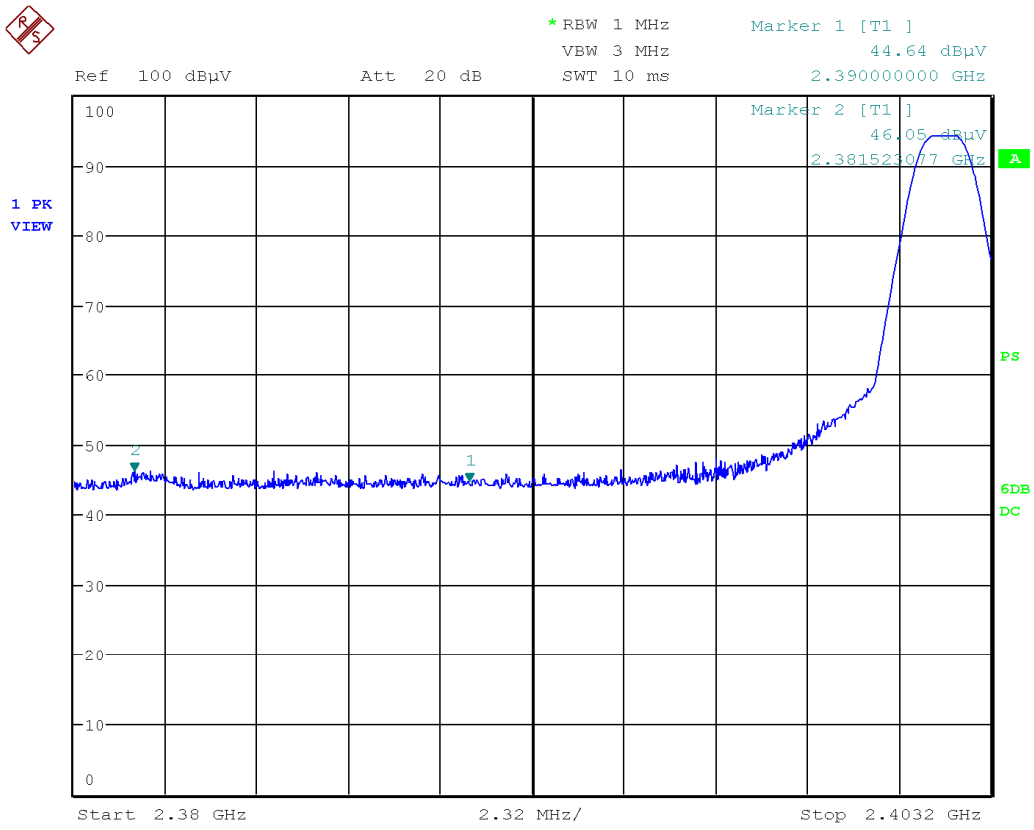
High Channel – 18 GHz – 25 GHz
Vertical - Peak Emission Graph



Plot was taken at a 1 meter distance.

Band Edges

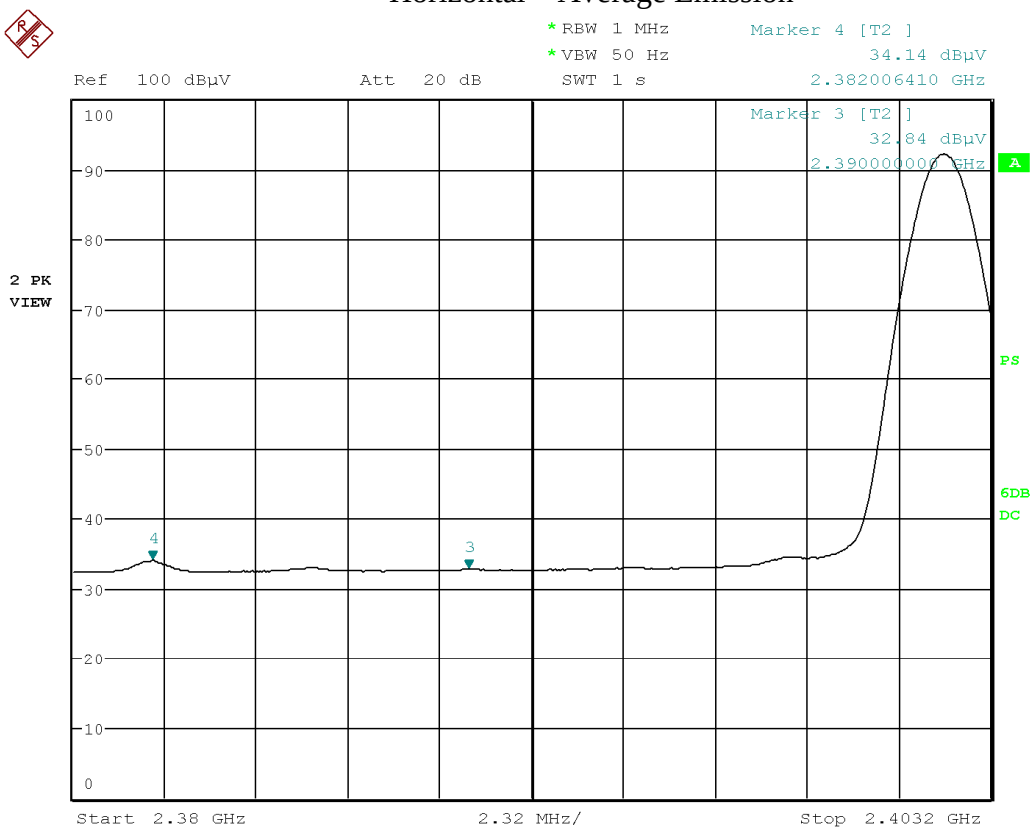
Band Edge – Low Channel
Horizontal – Peak Emission



Date: 29.APR.2022 12:53:11

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

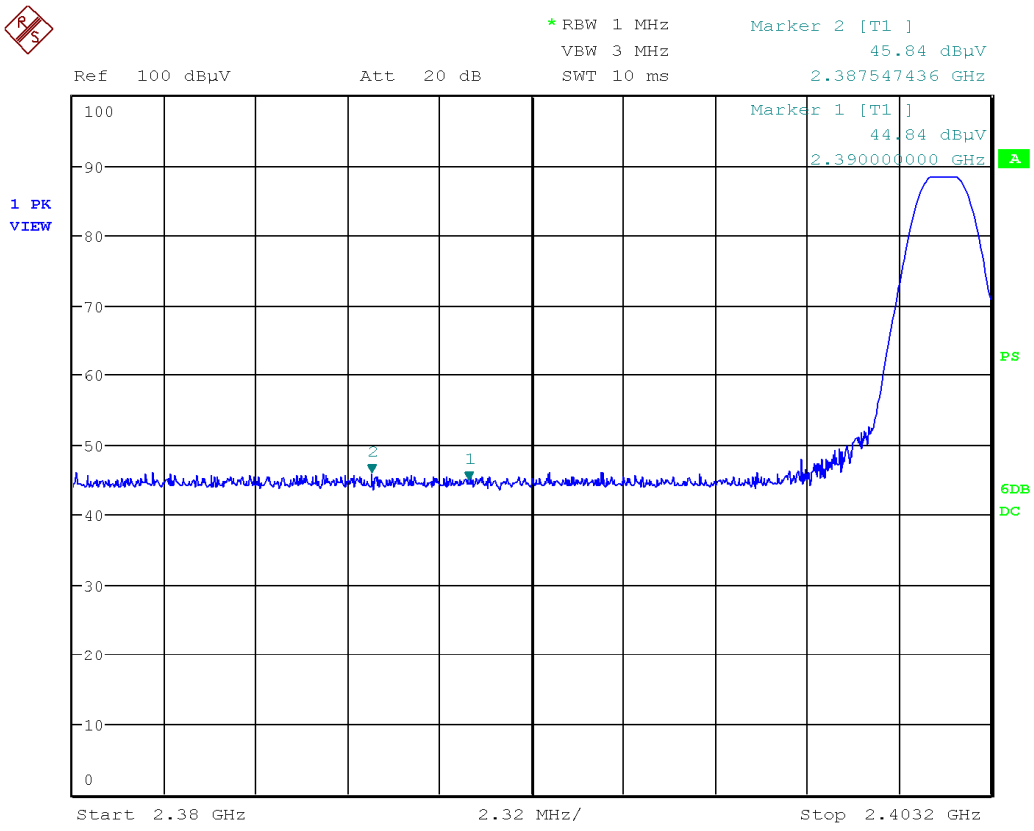
Band Edge – Low Channel
Horizontal – Average Emission



Date: 29.APR.2022 12:58:03

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

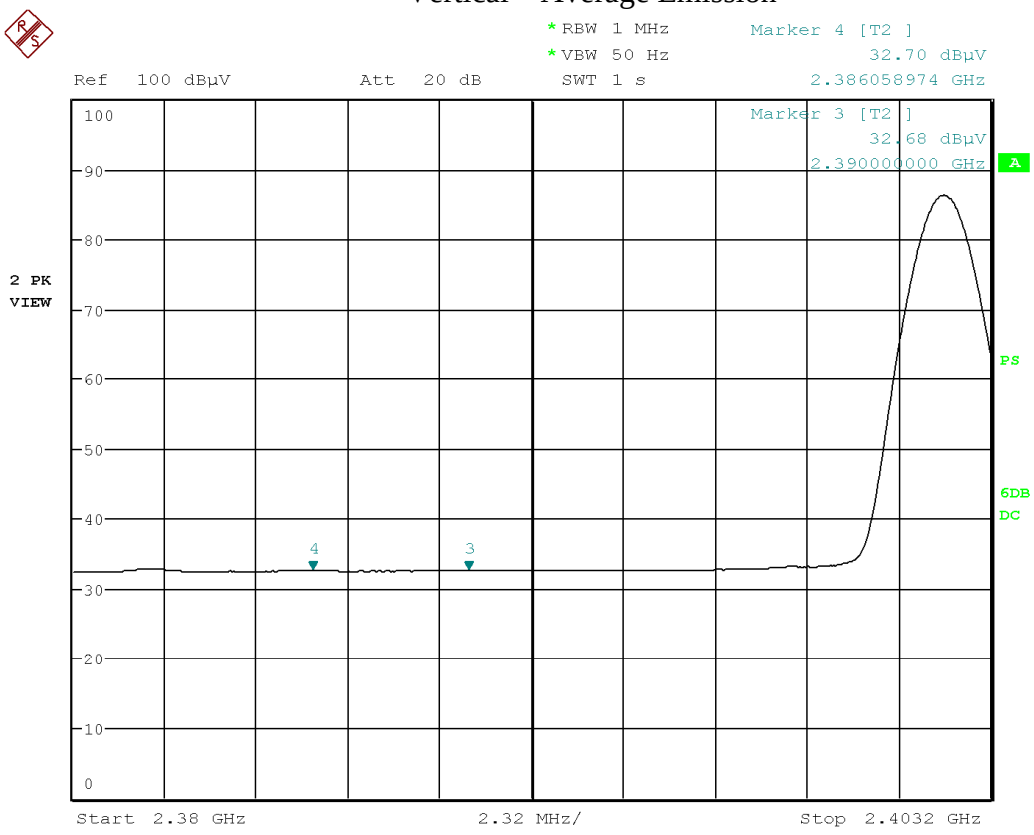
Band Edge – Low Channel
Vertical – Peak Emission



Date: 29.APR.2022 12:38:26

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

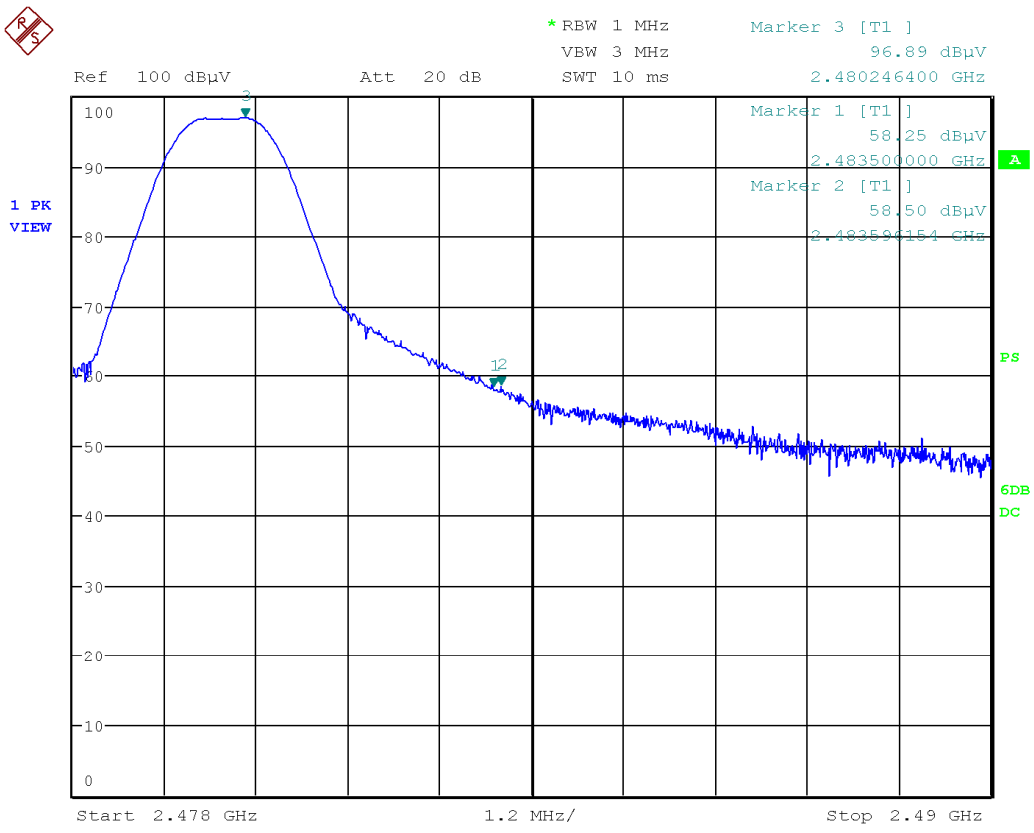
Band Edge – Low Channel
Vertical – Average Emission



Date: 29.APR.2022 12:46:42

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

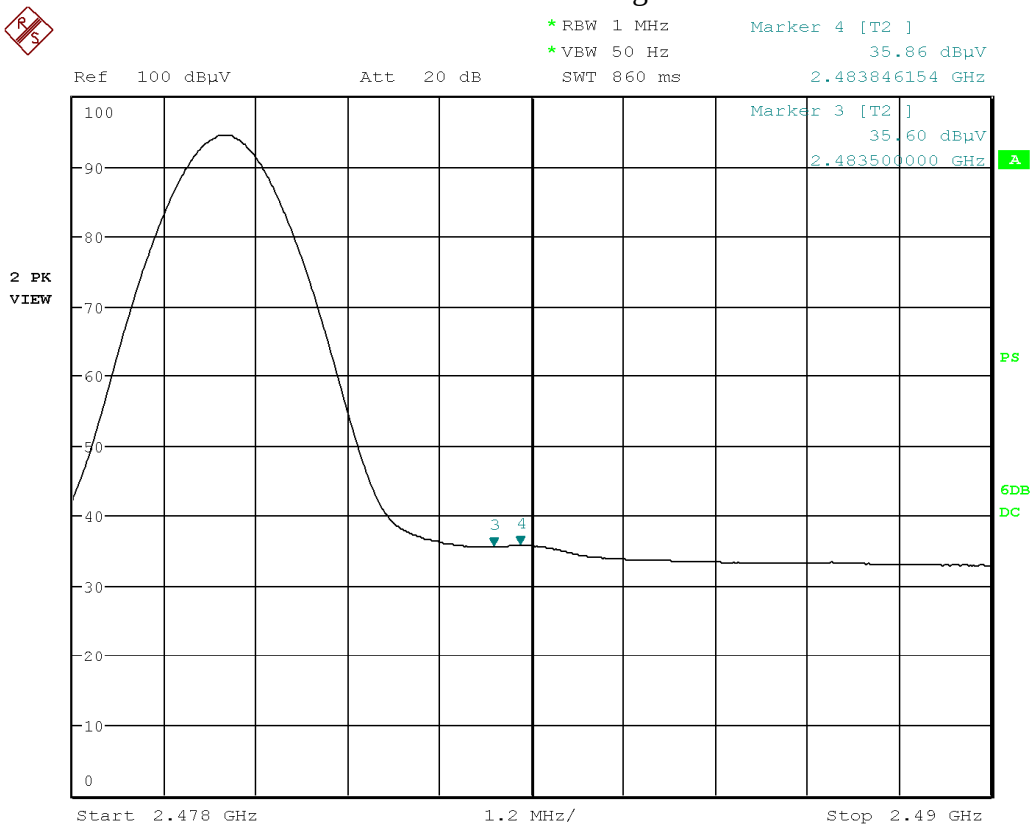
Band Edge – High Channel
Horizontal – Peak Emission



Date: 29.APR.2022 11:57:10

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

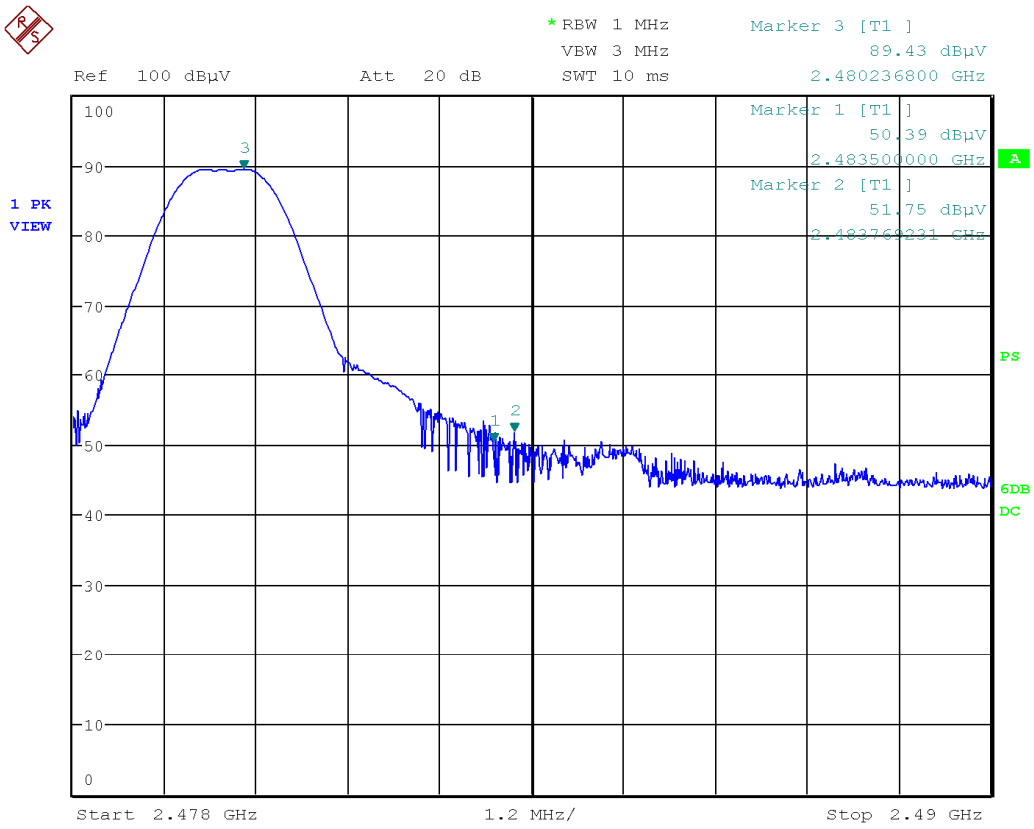
Band Edge – High Channel
Horizontal –Average Emission



Date: 29.APR.2022 12:05:34

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

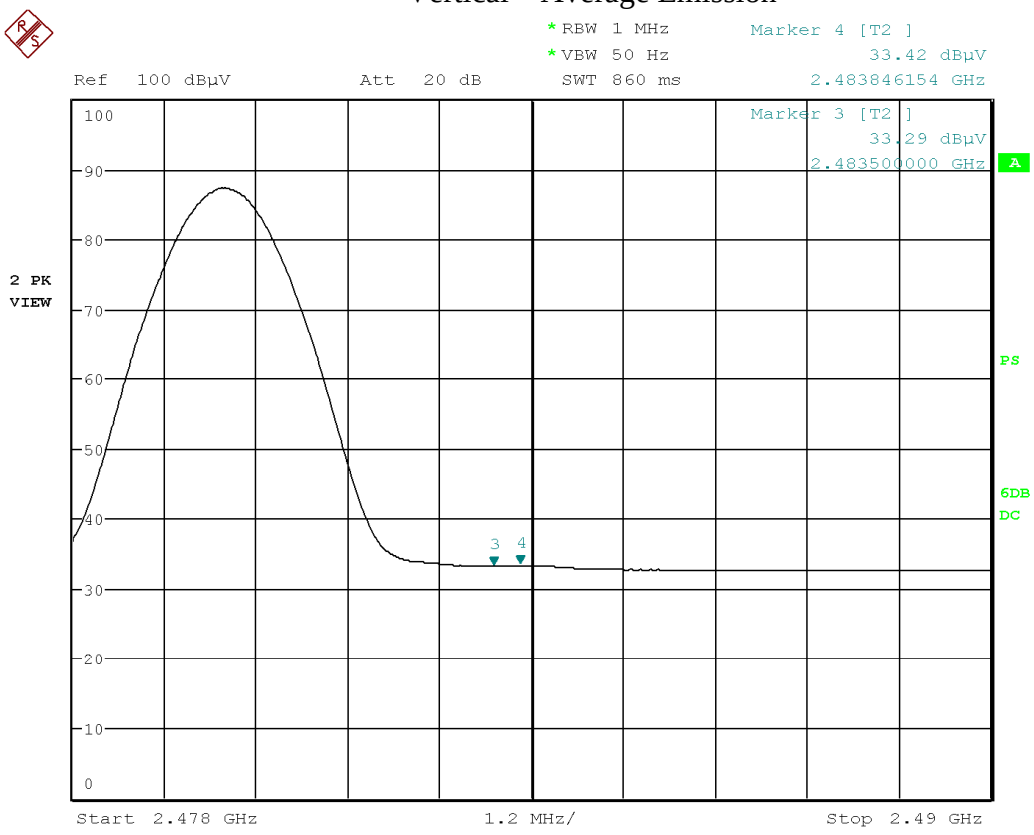
Band Edge – High Channel
Vertical – Peak Emission



Date: 29.APR.2022 12:14:45

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

Band Edge – High Channel
Vertical – Average Emission



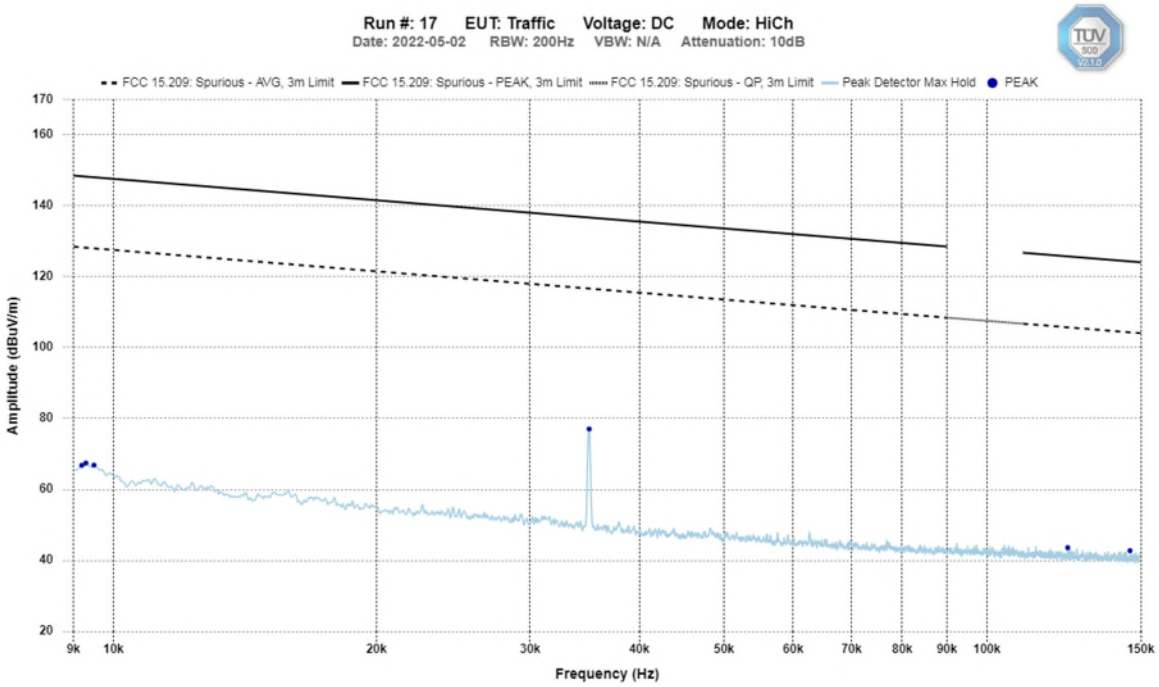
Date: 29.APR.2022 12:20:54

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

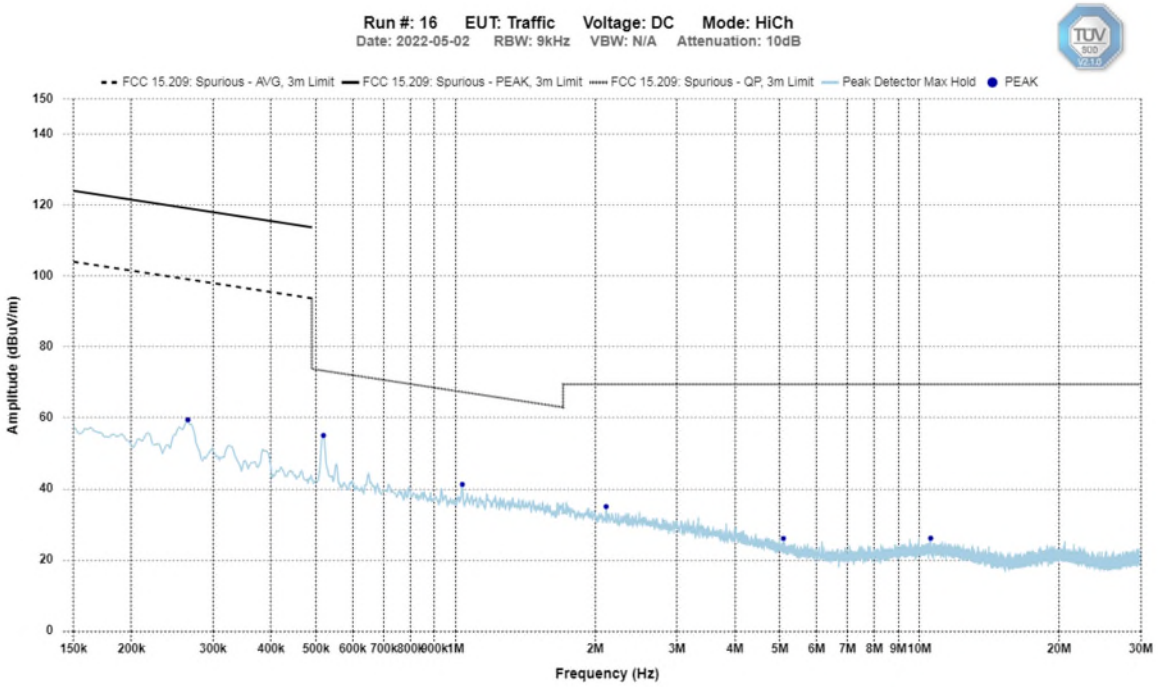
EUT: Traffic

Spurious Emissions

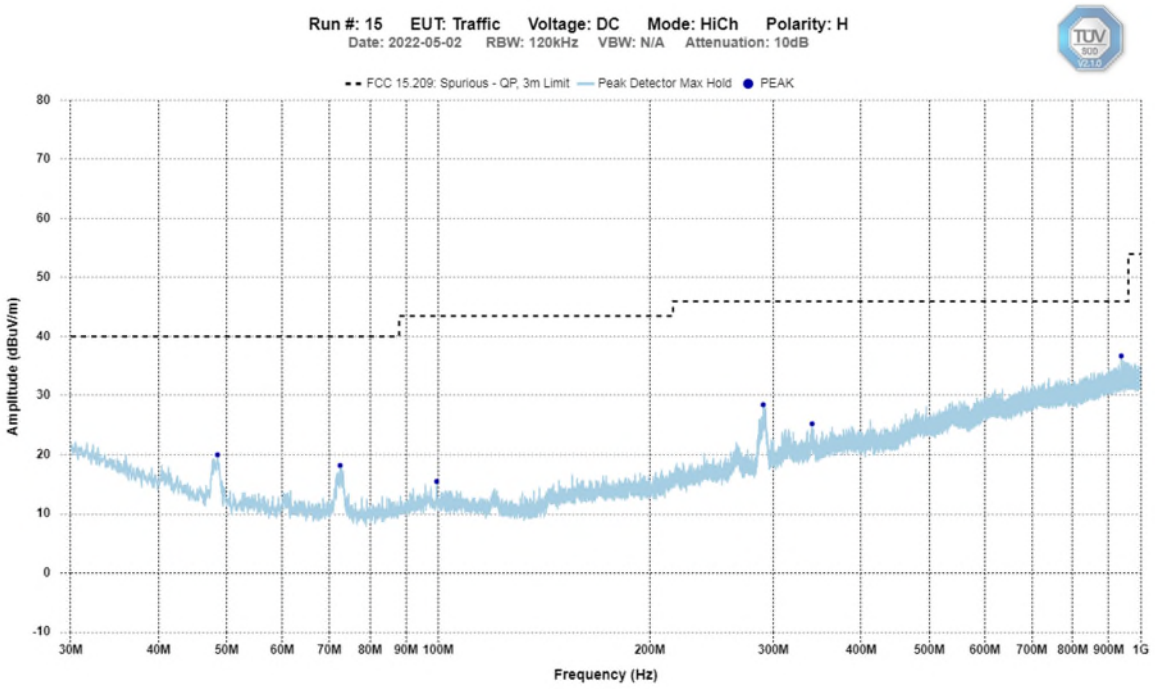
High Channel
9 kHz – 150 kHz
Peak Emission Graph



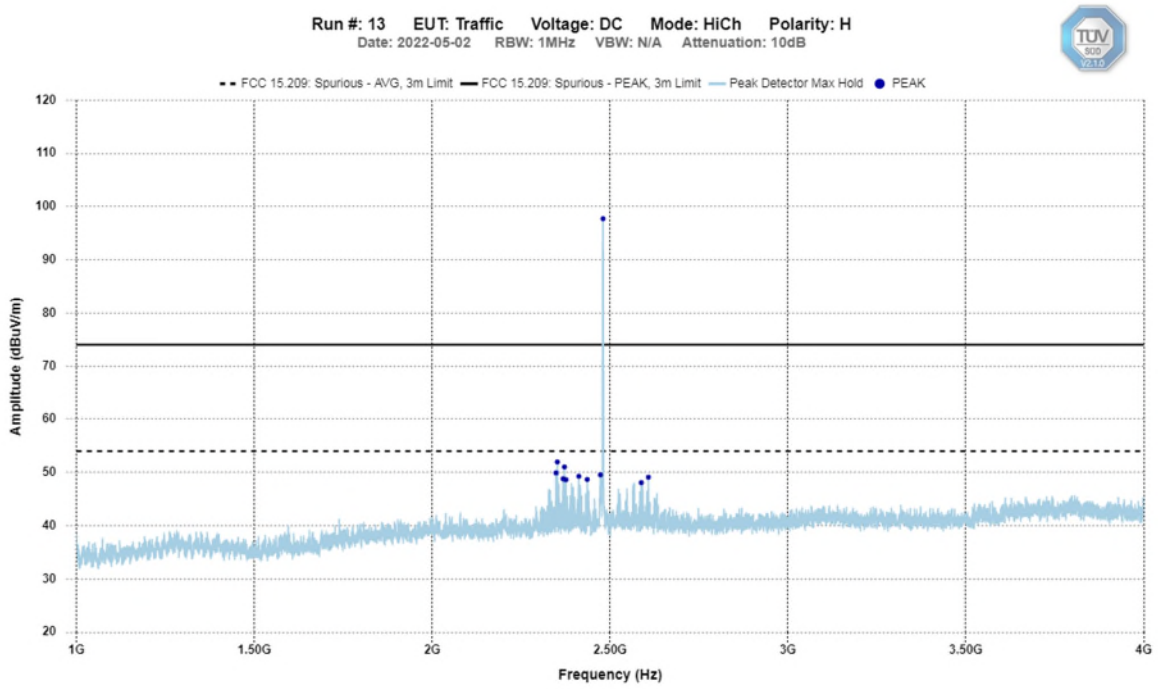
High Channel
150 kHz – 30 MHz
Peak Emission Graph



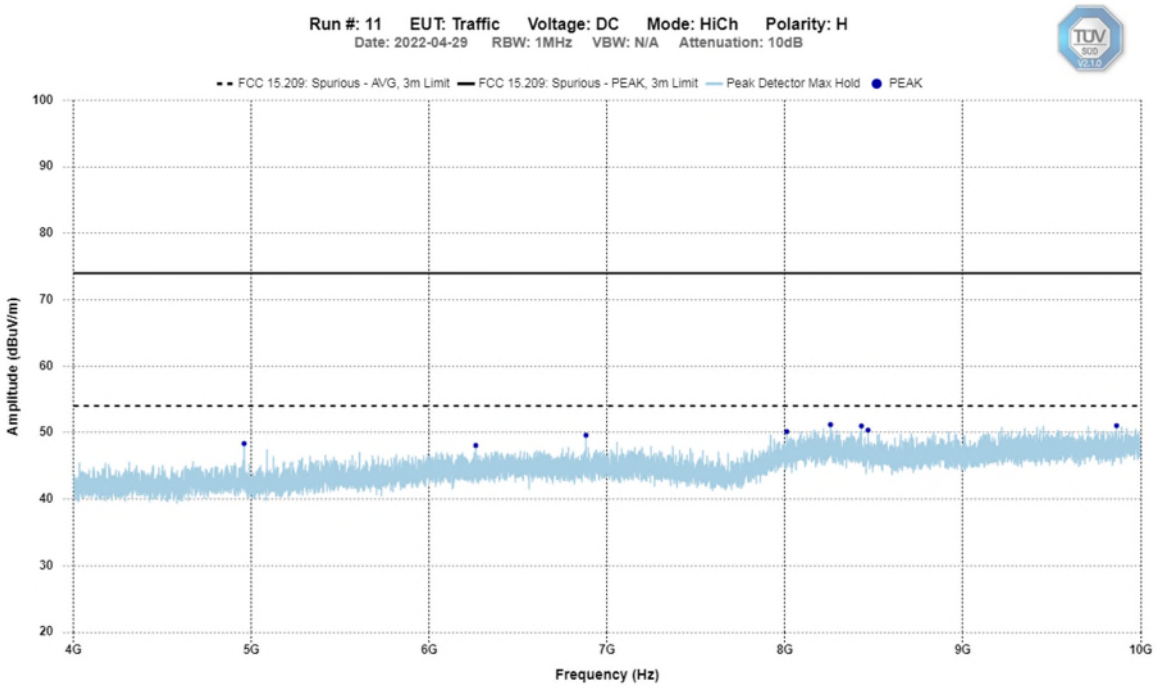
High Channel – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph



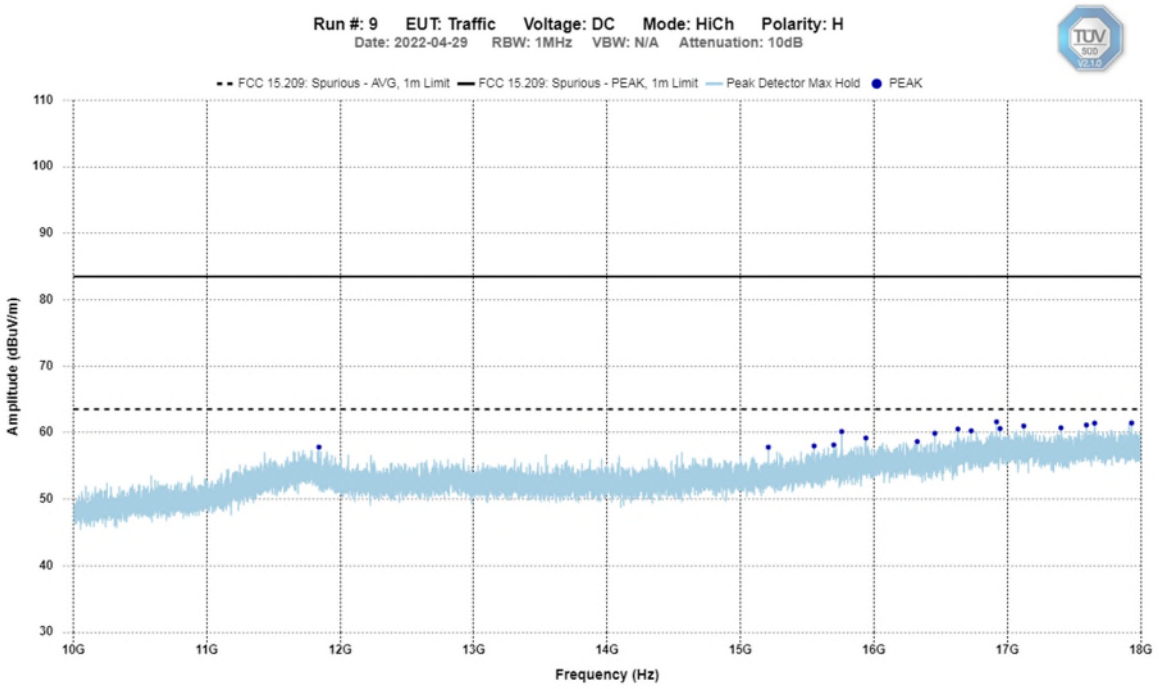
High Channel – 1 GHz – 4 GHz
Horizontal - Peak Emission Graph



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

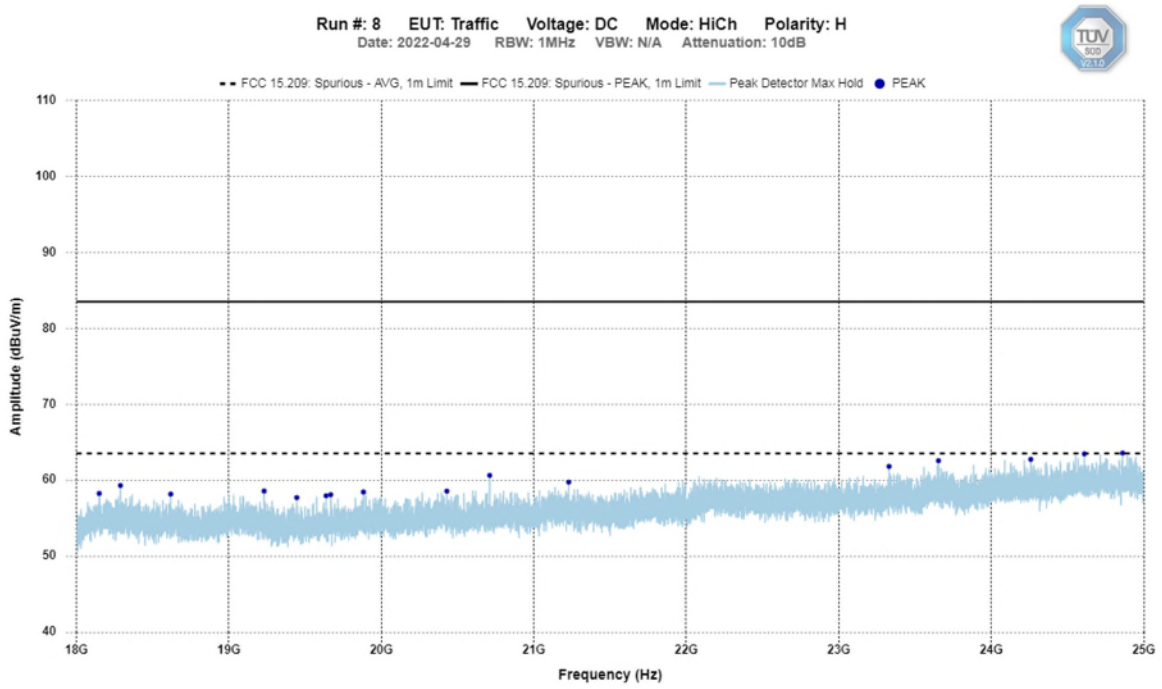


High Channel – 10 GHz – 18 GHz
Horizontal - Peak Emission Graph



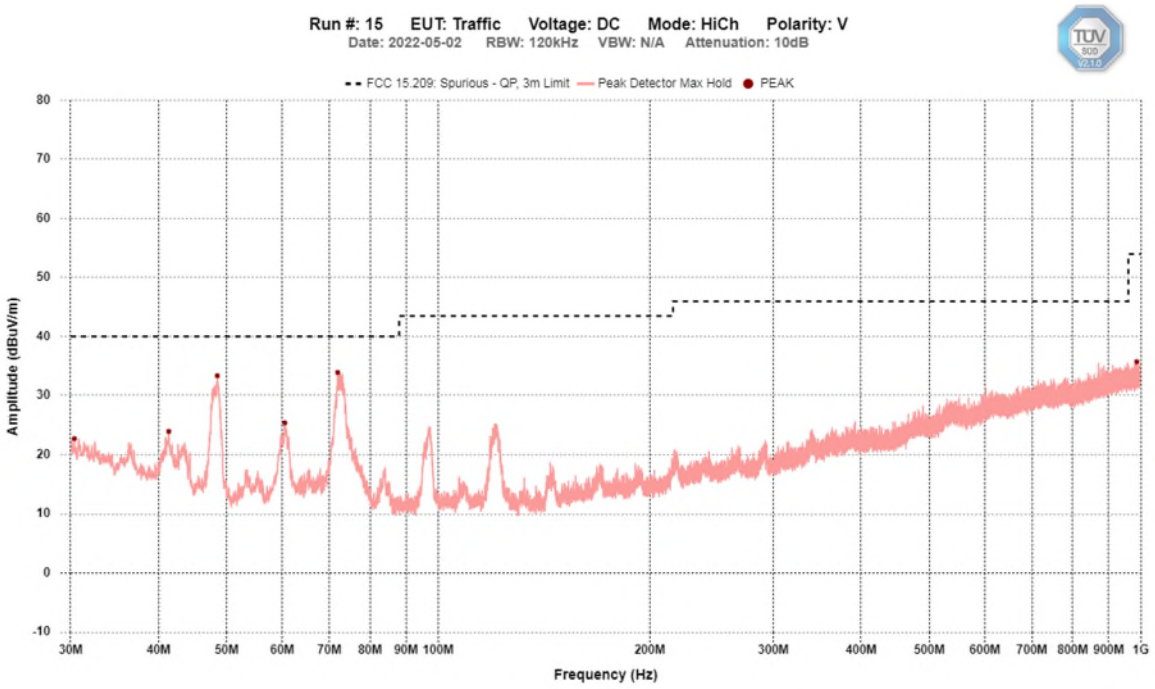
Plot was taken at a 1 meter distance.

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

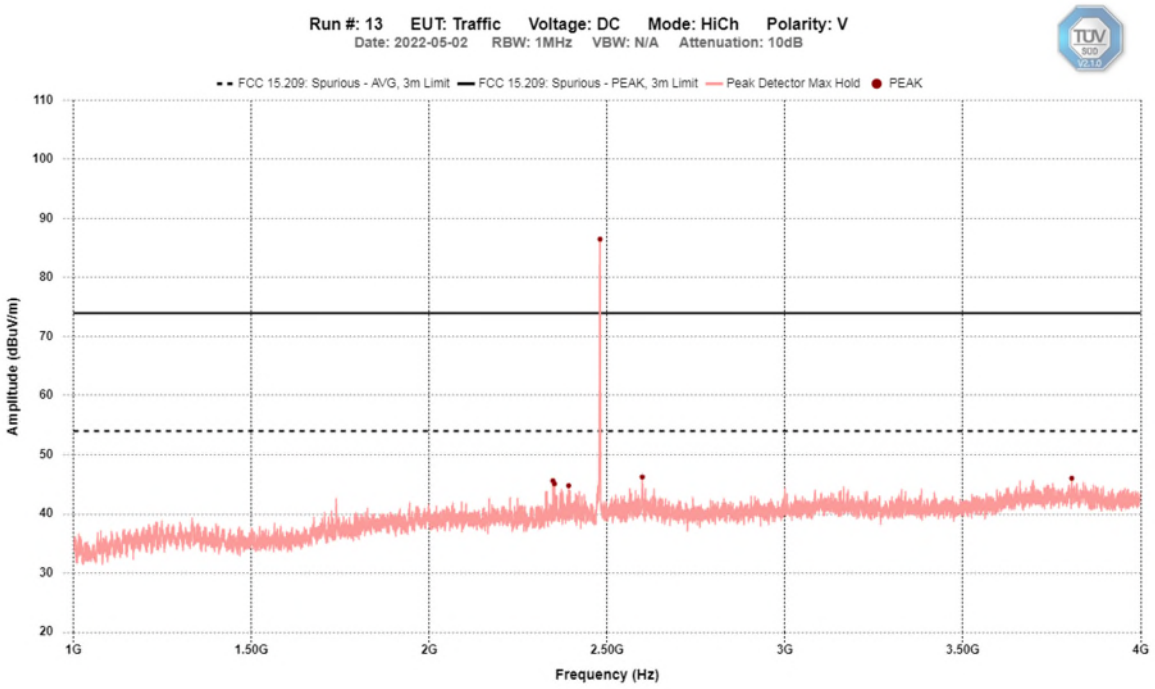


Plot was taken at a 1 meter distance.

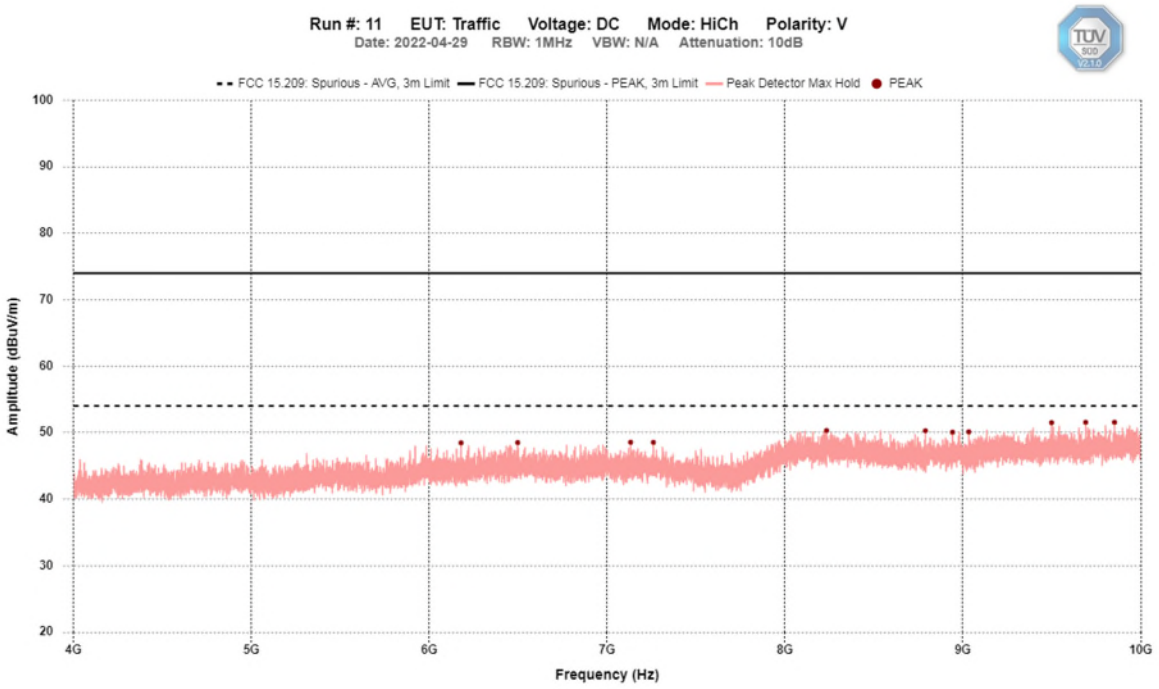
High Channel– 30 MHz – 1 GHz
Vertical - Peak Emission Graph



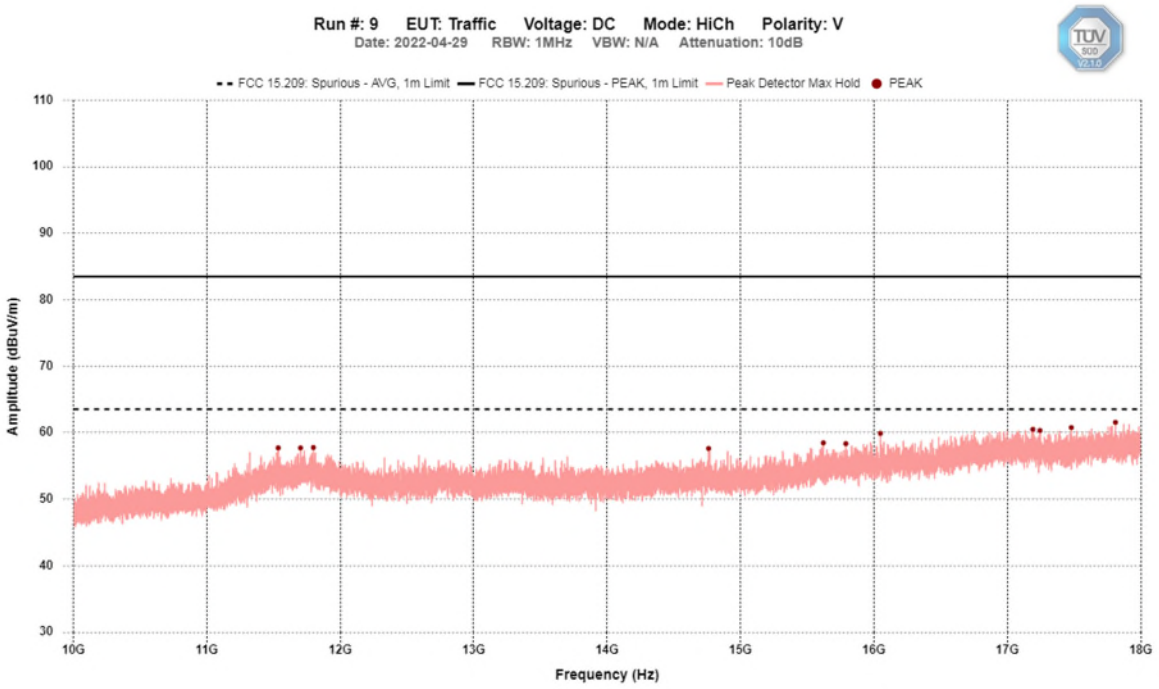
High Channel– 1 GHz – 4 GHz
Vertical - Peak Emission Graph



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

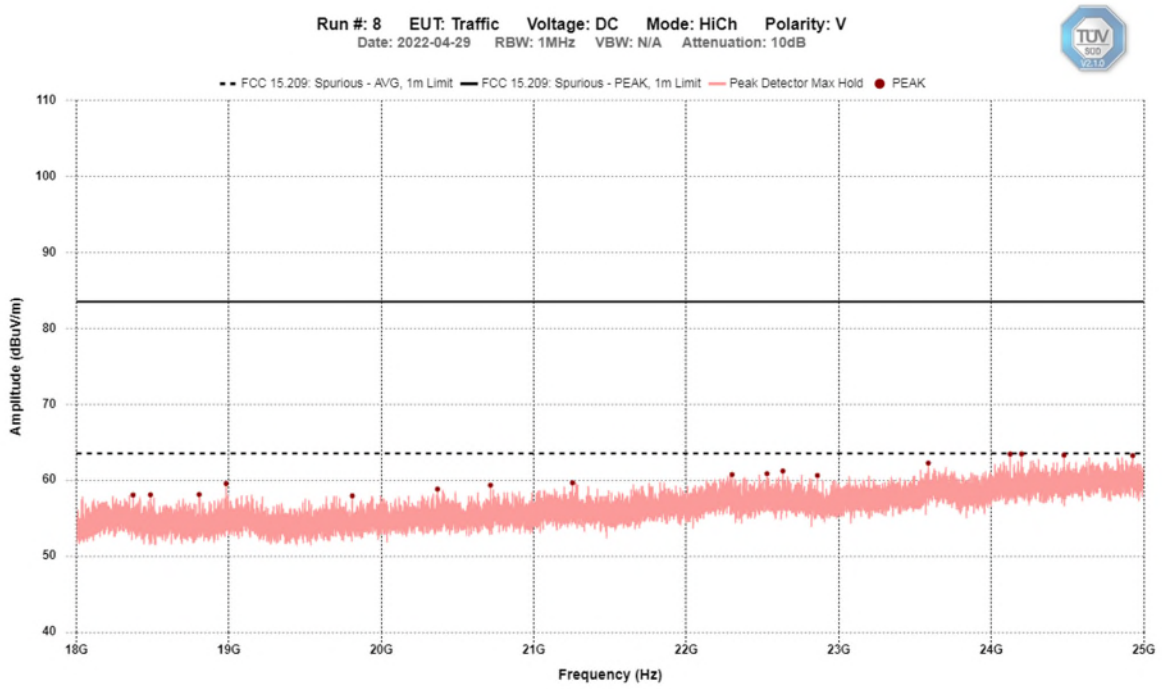


High Channel– 10 GHz – 18 GHz
Vertical - Peak Emission Graph



Plot was taken at a 1 meter distance.

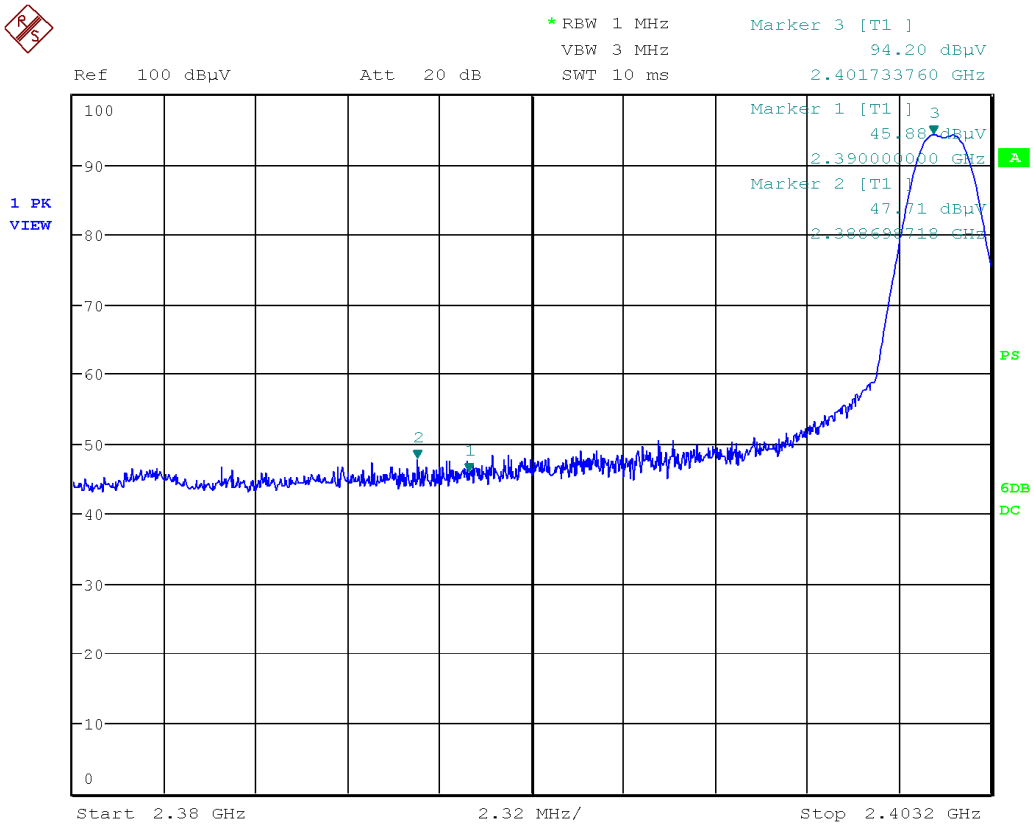
High Channel – 18 GHz – 25 GHz
Vertical - Peak Emission Graph



Plot was taken at a 1 meter distance.

Band Edges

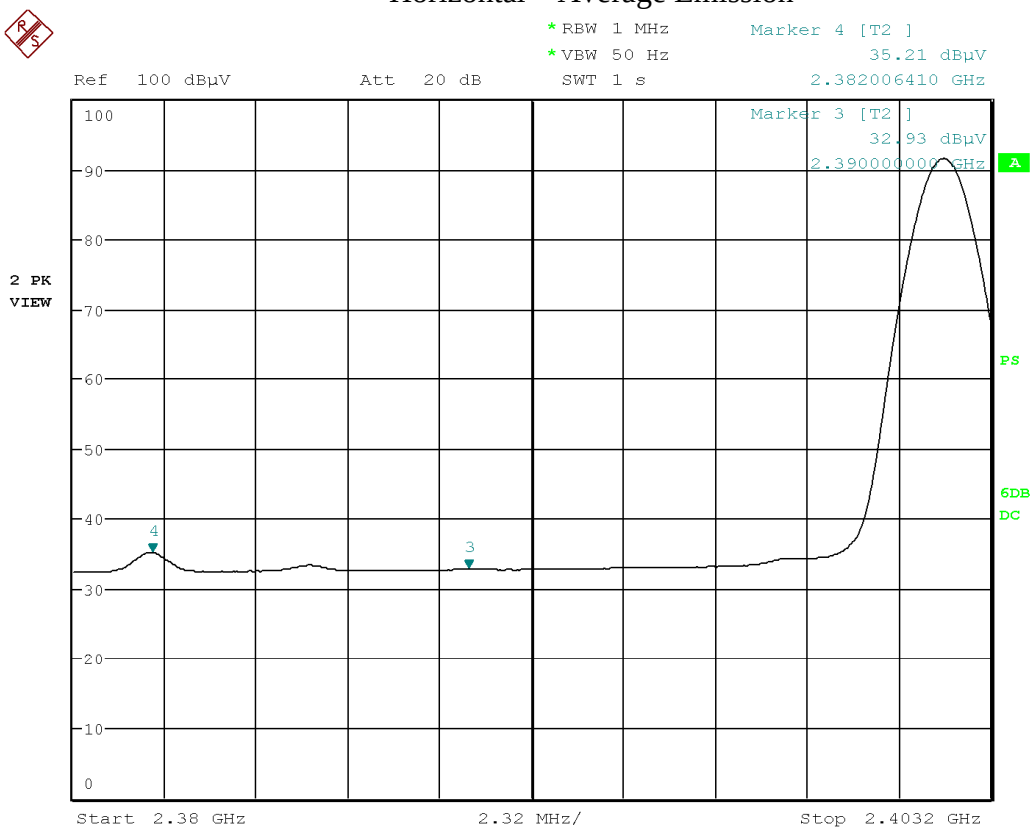
Band Edge – Low Channel
Horizontal – Peak Emission



Date: 29.APR.2022 18:20:43

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

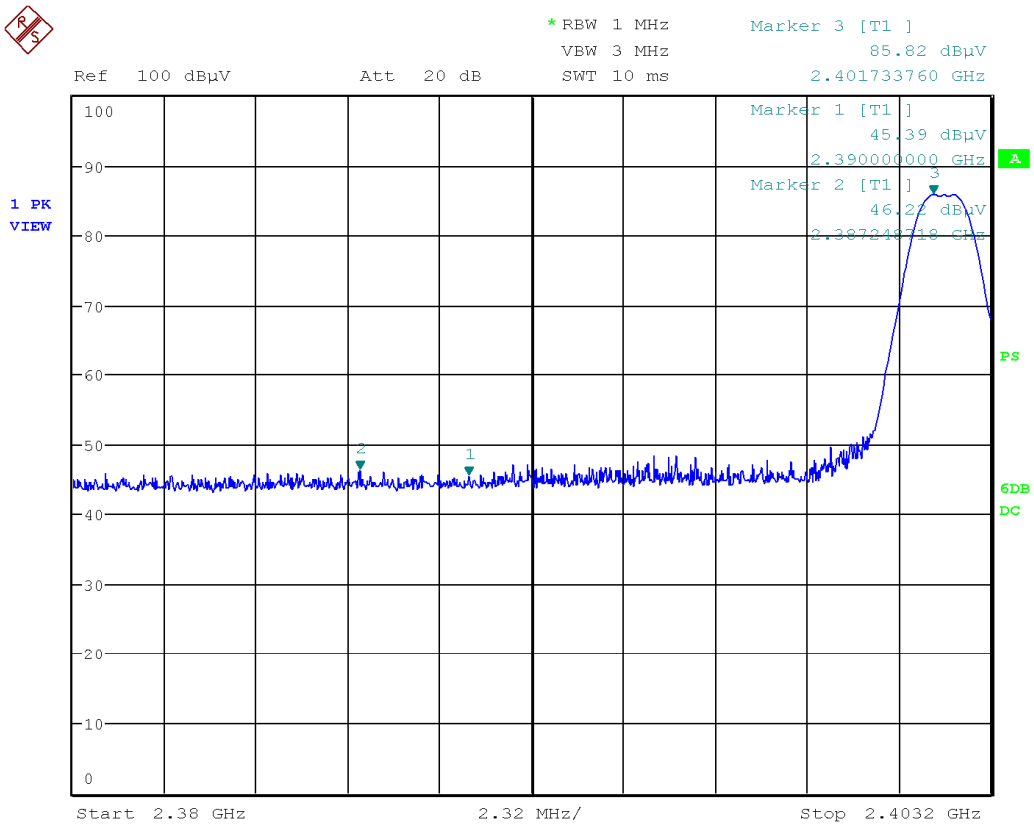
Band Edge – Low Channel
Horizontal – Average Emission



Date: 29.APR.2022 18:24:33

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

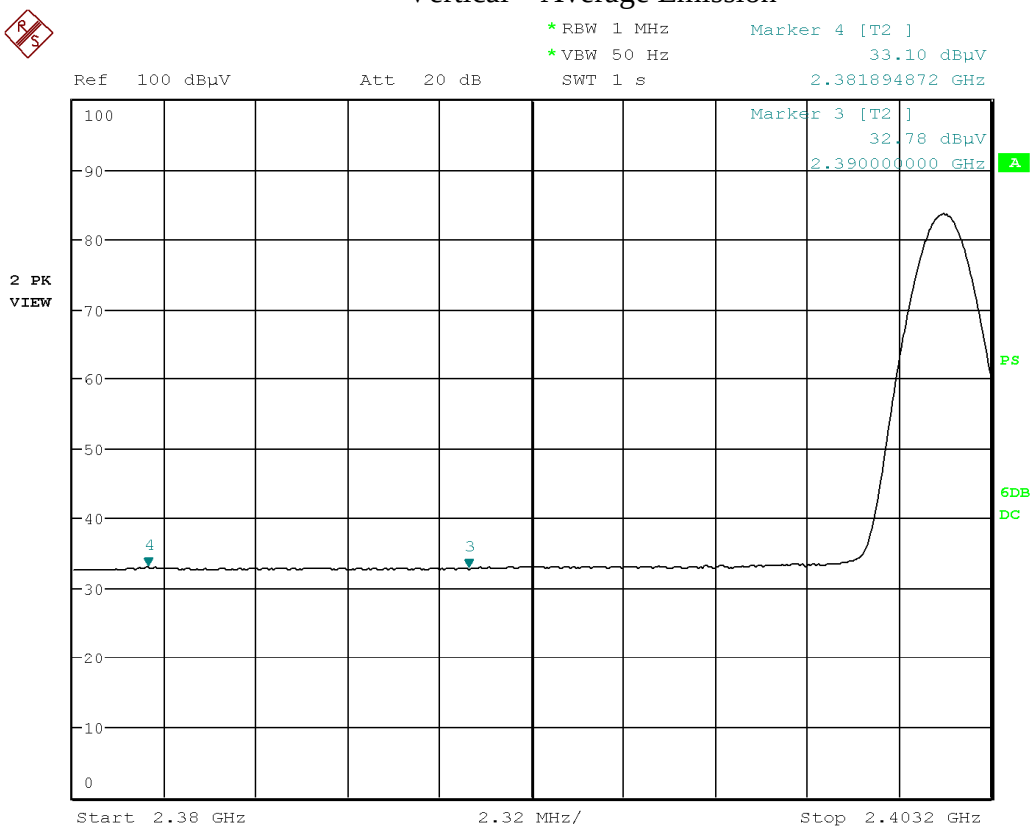
Band Edge – Low Channel
Vertical – Peak Emission



Date: 29.APR.2022 18:28:52

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

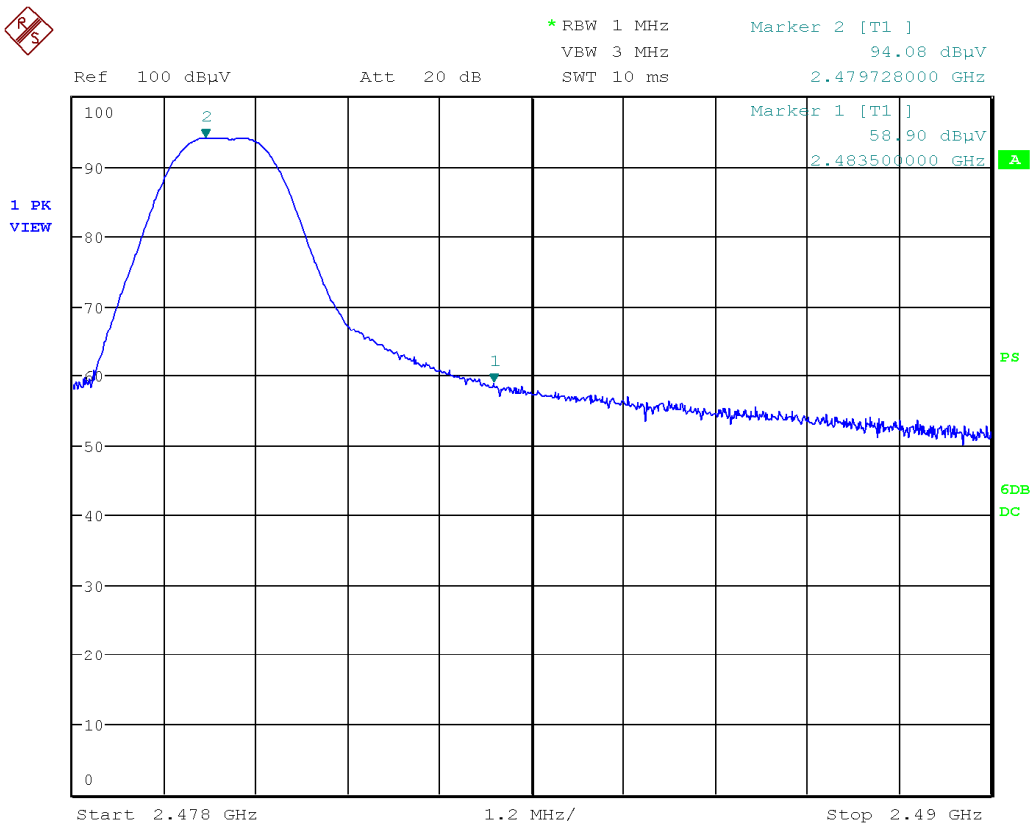
Band Edge – Low Channel
Vertical – Average Emission



Date: 29.APR.2022 18:33:48

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

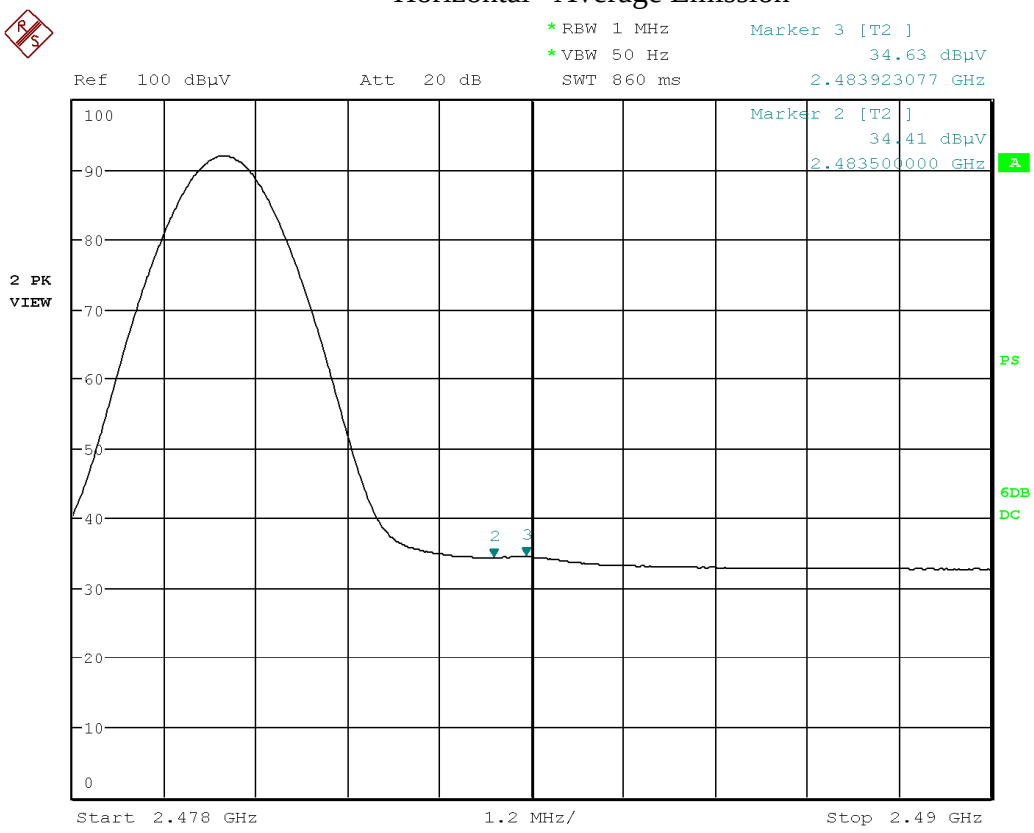
Band Edge – High Channel
Horizontal – Peak Emission



Date: 29.APR.2022 18:00:08

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

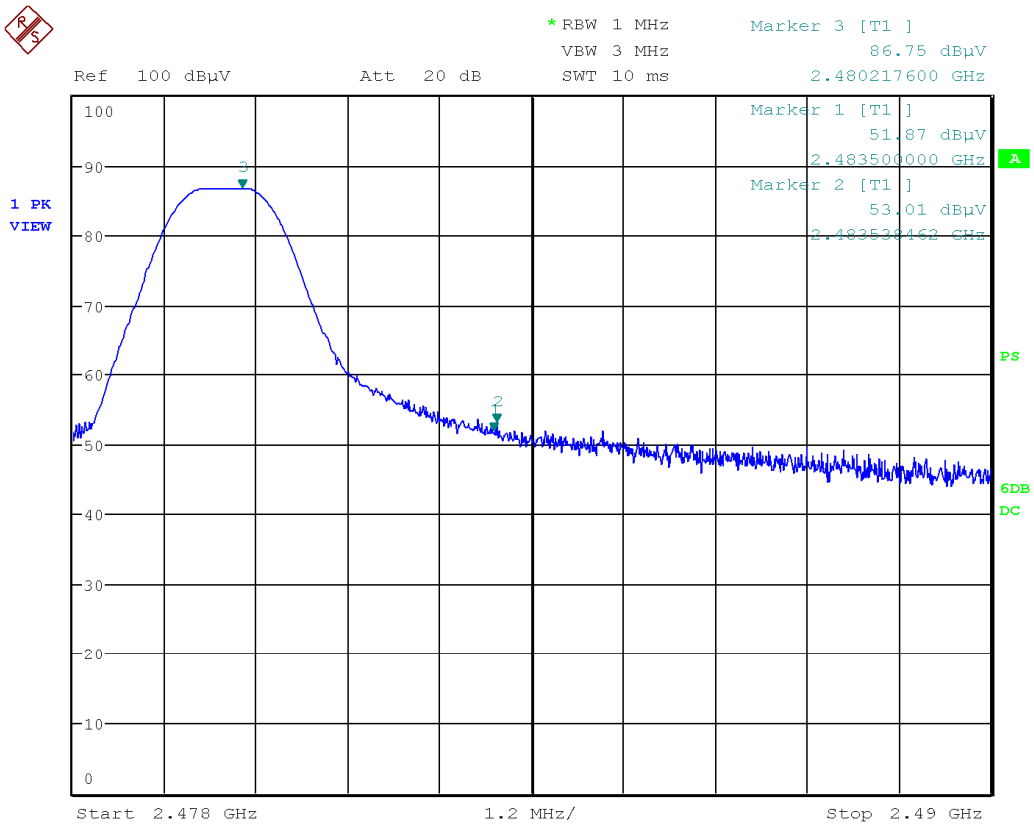
Band Edge – High Channel
Horizontal –Average Emission



Date: 29.APR.2022 18:04:32

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

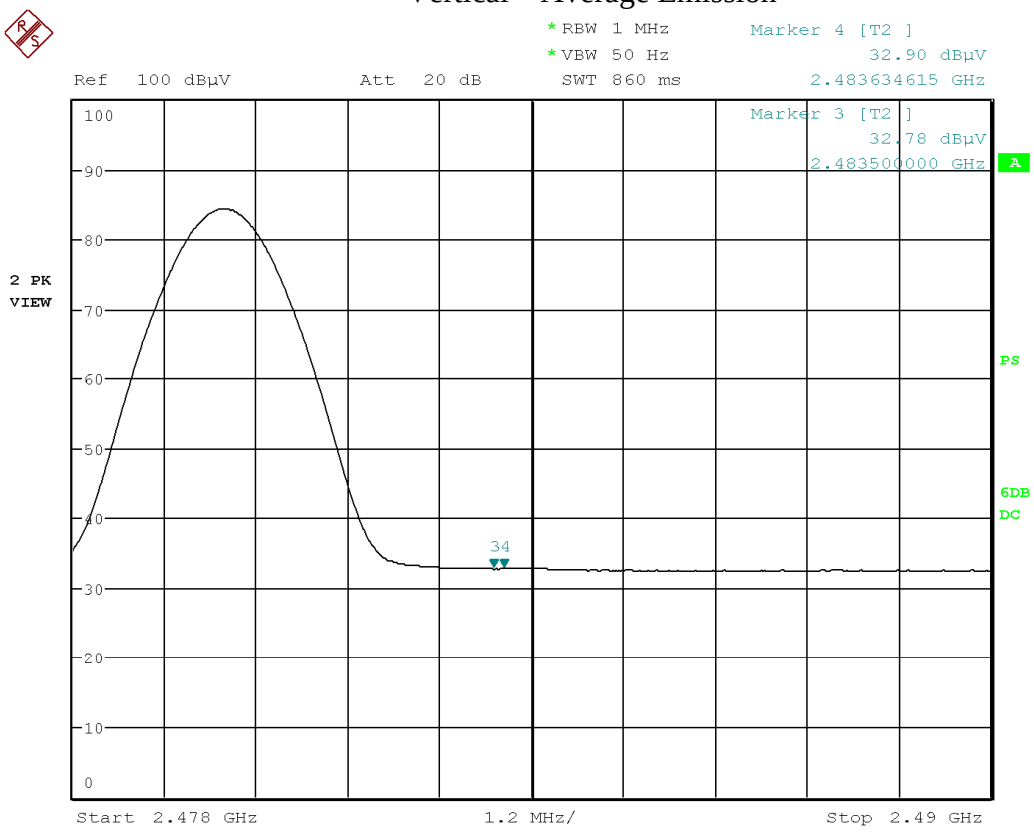
Band Edge – High Channel
Vertical – Peak Emission



Date: 29.APR.2022 18:10:06

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

Band Edge – High Channel
Vertical – Average Emission



Date: 29.APR.2022 18:14:36

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The markers show 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.

EUT: Paper
Spurious Emissions

Frequency (Hz)	Detector	Correction Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Test Result
Horizontal Antenna Polarization						
963.21M	PEAK	7.9	36.6	54.0	17.4	Pass
30.54M	PEAK	-4.6	22.1	40.0	17.9	Pass
214.59M	PEAK	-9.7	21.1	43.5	22.4	Pass
275.97M	PEAK	-7.3	22.5	46.0	23.5	Pass
47.79M	PEAK	-12.4	15.8	40.0	24.2	Pass
97.11M	PEAK	-13.2	16.6	43.5	26.9	Pass
4.96G	PEAK	6.5	52.7	74.0	21.3	Pass
4.96G	AVG	6.5	49.6	54.0	4.4	Pass
9.98G	PEAK	12.7	51.3	74.0	22.7	Pass
9.98G	AVG	12.7	43.3	54.0	10.7	Pass
24.87G	PEAK	25.2	63.9	83.5	19.6	Pass
24.87G	AVG	25.2	55.0	63.5	8.5	Pass
24.56G	PEAK	25.2	63.2	83.5	20.3	Pass
24.56G	AVG	25.2	54.2	63.5	9.3	Pass
Vertical Antenna Polarization						
72.54M	QP	-15.0	24.9	40.0	15.2	Pass
97.17M	PEAK	-13.2	28.0	43.5	15.5	Pass
30.54M	PEAK	-4.6	22.6	40.0	17.4	Pass
995.85M	PEAK	8.1	36.2	54.0	17.8	Pass
48.54M	PEAK	-12.6	21.9	40.0	18.1	Pass
214.02M	PEAK	-9.8	21.8	43.5	21.7	Pass
8.06G	PEAK	10.8	52.1	74.0	21.9	Pass
8.06G	AVG	10.8	41.5	54.0	12.5	Pass
4.96G	PEAK	6.6	50.0	74.0	24.0	Pass

4.96G	AVG	6.6	45.2	54.0	8.9	Pass
24.75G	PEAK	25.1	64.8	83.5	18.7	Pass
24.75G	AVG	25.1	54.6	63.5	8.9	Pass
24.94G	PEAK	25.2	64.3	83.5	19.2	Pass
24.94G	AVG	25.2	54.1	63.5	9.4	Pass
24.63G	PEAK	25.2	63.9	83.5	19.6	Pass
24.63G	AVG	25.2	53.9	63.5	9.6	Pass

EUT: Paper
Band Edges

Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/ Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
Low Channel										
2390.00	PEAK	Horz	44.64	32	3.2	-34.1	45.74	74	28.26	PASS
2381.52	PEAK	Horz	46.05	32	3.2	-34.1	47.15	74	26.85	PASS
2390.00	AVG	Horz	32.84	32	3.2	-34.1	33.94	54	20.06	PASS
2382.01	AVG	Horz	34.14	32	3.2	-34.1	35.24	54	18.76	PASS
2390.0	PEAK	Vert	44.84	32	3.2	-34.1	45.94	74	28.06	PASS
2387.55	PEAK	Vert	45.84	32	3.2	-34.1	46.94	74	27.06	PASS
2390.00	AVG	Vert	32.68	32	3.2	-34.1	33.78	54	20.22	PASS
2386.06	AVG	Vert	32.7	32	3.2	-34.1	33.8	54	20.2	PASS
High Channel										
2483.50	PEAK	Horz	58.25	32.2	3.2	-33.8	59.85	74	14.15	PASS
2483.60	PEAK	Horz	58.5	32.2	3.2	-33.8	60.1	74	13.9	PASS
2483.50	AVG	Horz	35.6	32.2	3.2	-33.8	37.2	54	16.8	PASS
2483.85	AVG	Horz	35.86	32.2	3.2	-33.8	37.46	54	16.54	PASS
2483.50	PEAK	Vert	50.39	32.2	3.2	-33.8	51.99	74	22.01	PASS
2483.77	PEAK	Vert	51.75	32.2	3.2	-33.8	53.35	74	20.65	PASS
2483.50	AVG	Vert	33.29	32.2	3.2	-33.8	34.89	54	19.11	PASS
2483.85	AVG	Vert	33.42	32.2	3.2	-33.8	35.02	54	18.98	PASS

EUT: Traffic
Spurious Emissions

Frequency (Hz)	Detector	Correction Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Test Result
Horizontal Antenna Polarization						
938.43M	PEAK	7.8	36.7	46.0	9.3	Pass
290.22M	PEAK	-7.8	28.5	46.0	17.5	Pass
48.54M	PEAK	-12.6	20.0	40.0	20.0	Pass
340.68M	PEAK	-5.1	25.2	46.0	20.8	Pass
72.54M	PEAK	-15.0	18.2	40.0	21.8	Pass
99.54M	PEAK	-13.1	15.5	43.5	28.0	Pass
2.35G	PEAK	1.1	52.0	74.0	22.0	Pass
2.35G	AVG	1.1	46.5	54.0	7.6	Pass
2.37G	PEAK	1.3	51.0	74.0	23.0	Pass
2.37G	AVG	1.3	46.9	54.0	7.1	Pass
24.86G	PEAK	25.2	63.6	83.5	19.9	Pass
24.86G	AVG	25.2	54.0	63.5	9.5	Pass
24.61G	PEAK	25.2	63.4	83.5	20.1	Pass
24.61G	AVG	25.2	54.2	63.5	9.3	Pass
Vertical Antenna Polarization						
71.97M	QP	-15.0	32.1	40.0	7.9	Pass
48.51M	PEAK	-12.6	33.4	40.0	6.6	Pass
60.51M	PEAK	-14.4	25.4	40.0	14.6	Pass
41.37M	PEAK	-10.3	23.9	40.0	16.1	Pass
30.36M	PEAK	-4.4	22.7	40.0	17.3	Pass
987.39M	PEAK	8.0	35.7	54.0	18.3	Pass
24.20G	PEAK	24.7	63.4	83.5	20.1	Pass
24.20G	AVG	24.7	53.3	63.5	10.2	Pass
24.12G	PEAK	24.6	63.4	83.5	20.1	Pass
24.12G	AVG	24.6	53.2	63.5	10.3	Pass

EUT: Traffic
Band Edges

Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/ Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
Low Channel										
2390.00	PEAK	Horz	47.71	32	3.2	-34.1	48.81	74	25.19	PASS
2388.70	PEAK	Horz	47.71	32	3.2	-34.1	48.81	74	25.19	PASS
2390.00	AVG	Horz	32.93	32	3.2	-34.1	34.03	54	19.97	PASS
2382.01	AVG	Horz	35.21	32	3.2	-34.1	36.31	54	17.69	PASS
2390.00	PEAK	Vert	45.39	32	3.2	-34.1	46.49	74	27.51	PASS
2387.25	PEAK	Vert	46.22	32	3.2	-34.1	47.32	74	26.68	PASS
2390.00	AVG	Vert	32.78	32	3.2	-34.1	33.88	54	20.12	PASS
2381.89	AVG	Vert	33.1	32	3.2	-34.1	34.2	54	19.8	PASS
High Channel										
2483.50	PEAK	Horz	58.9	32.2	3.2	-33.8	60.5	74	13.5	PASS
2483.50	AVG	Horz	34.41	32.2	3.2	-33.8	36.01	54	17.99	PASS
2483.92	AVG	Horz	34.63	32.2	3.2	-33.8	36.23	54	17.77	PASS
2483.50	PEAK	Vert	51.87	32.2	3.2	-33.8	53.47	74	20.53	PASS
2483.54	PEAK	Vert	53.01	32.2	3.2	-33.8	54.61	74	19.39	PASS
2483.50	AVG	Vert	32.78	32.2	3.2	-33.8	34.38	54	19.62	PASS
2483.63	AVG	Vert	32.9	32.2	3.2	-33.8	34.5	54	19.5	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	Feb. 11, 2022	Feb. 11, 2024	GEMC 233
Loop Antenna 9 – 150 kHz	EM 6871	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 70
Loop Antenna 150 kHz – 30 MHz	EM 6872	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 71
BiLog Antenna 30 MHz – 1 GHz	3142-C	ETS-Lindgren	Nov. 25, 2020	Nov. 25, 2022	GEMC 8
Horn Antenna 1 – 18 GHz	3117	ETS-Lindgren	Mar. 11, 2022	Mar. 11, 2024	GEMC 340
Horn Antenna 18 - 25 GHz	SAS-572	A.H. Systems	Dec. 1, 2020	Dec. 1, 2022	GEMC 6371
Pre-Amp 9 kHz – 1 GHz	LNA 6901	Teseq	Feb. 12, 2021	Feb. 12, 2023	GEMC 168
Pre-Amp 1 – 25 GHz	HP 8449B	HP	Mar. 11, 2022	Mar. 11, 2024	GEMC 189
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	V2.1.0	TUV SUD Canada, Inc.	NCR	NCR	GEMC 361

Power Spectral Density

Purpose

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

Limits and Method

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

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

The method is given in FCC KDB 558074 Section 10.2.

Results

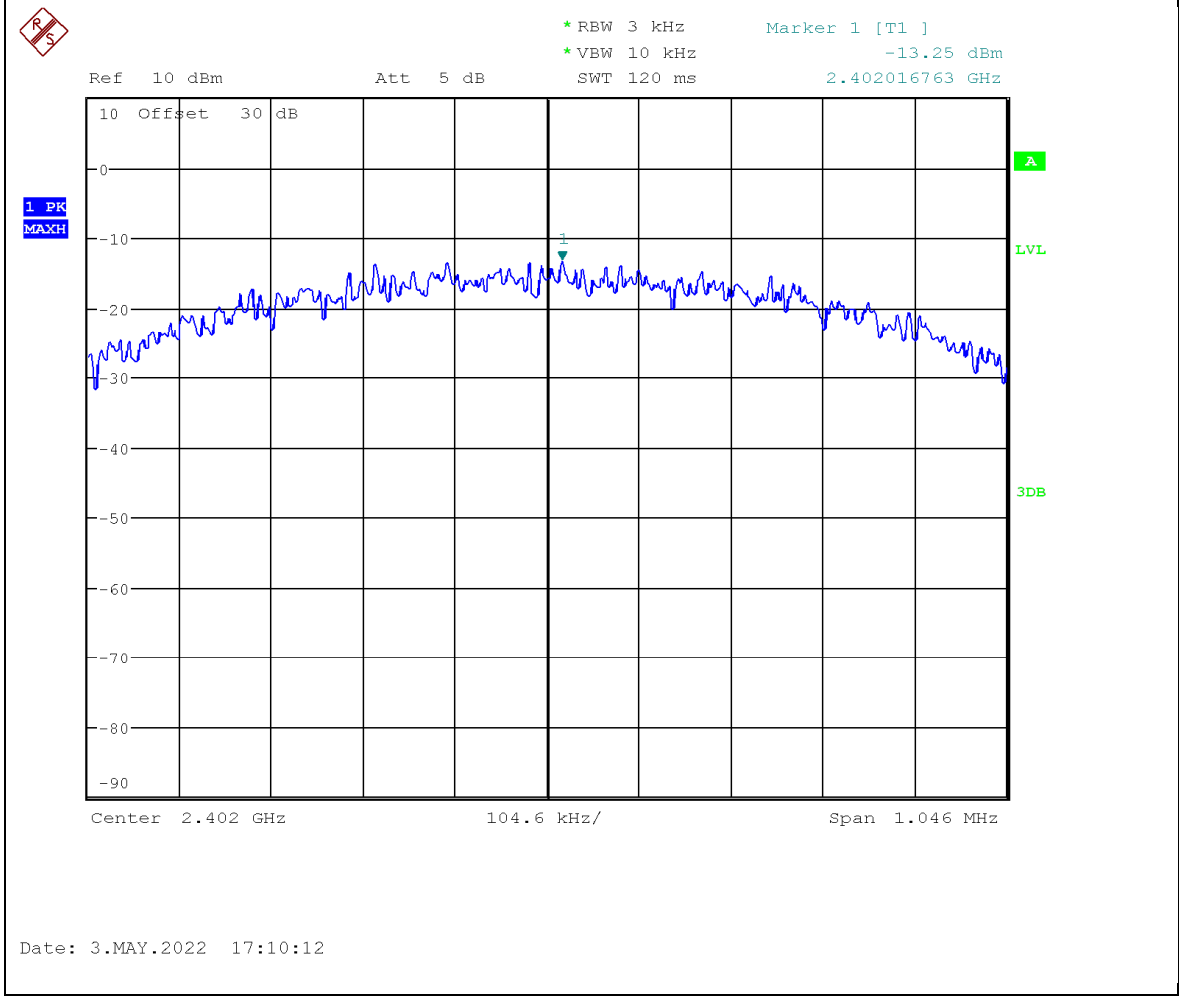
The EUT passed. Low, middle and high bands were measured.

Channel	Frequency (MHz)	PSD (dBm)
Low	2402	-13.25
Mid	2440	-13.13
High	2480	-13.37

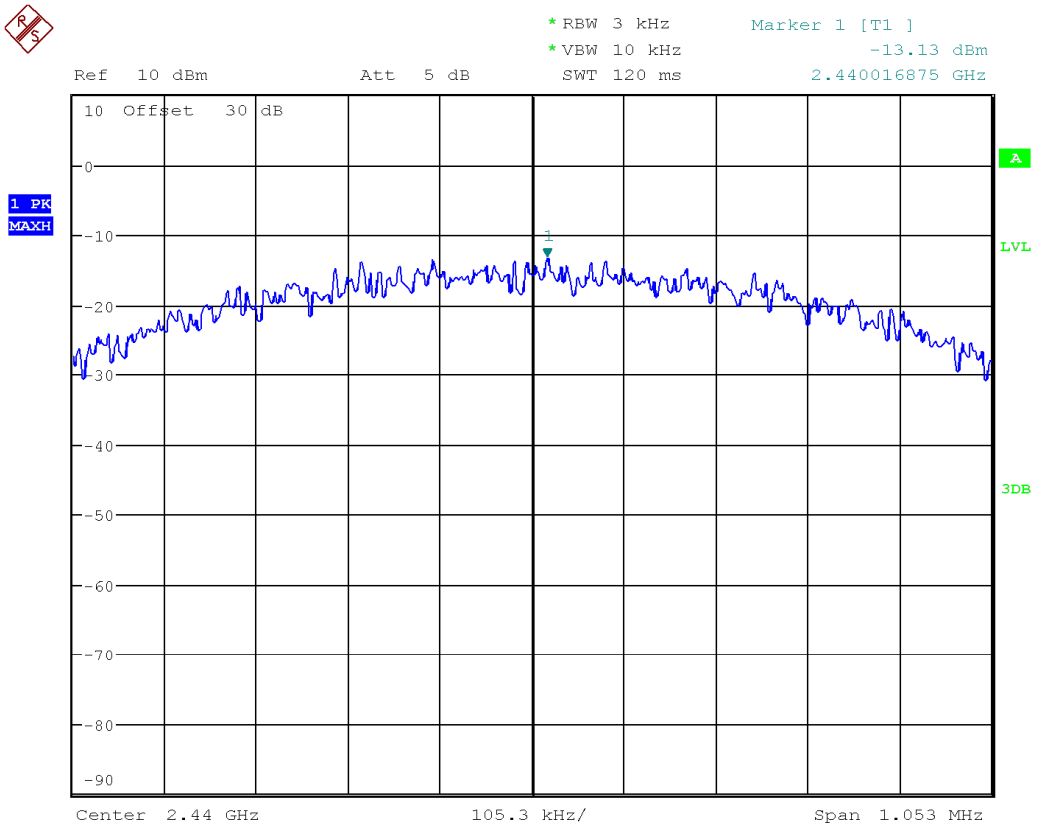
Graphs

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.

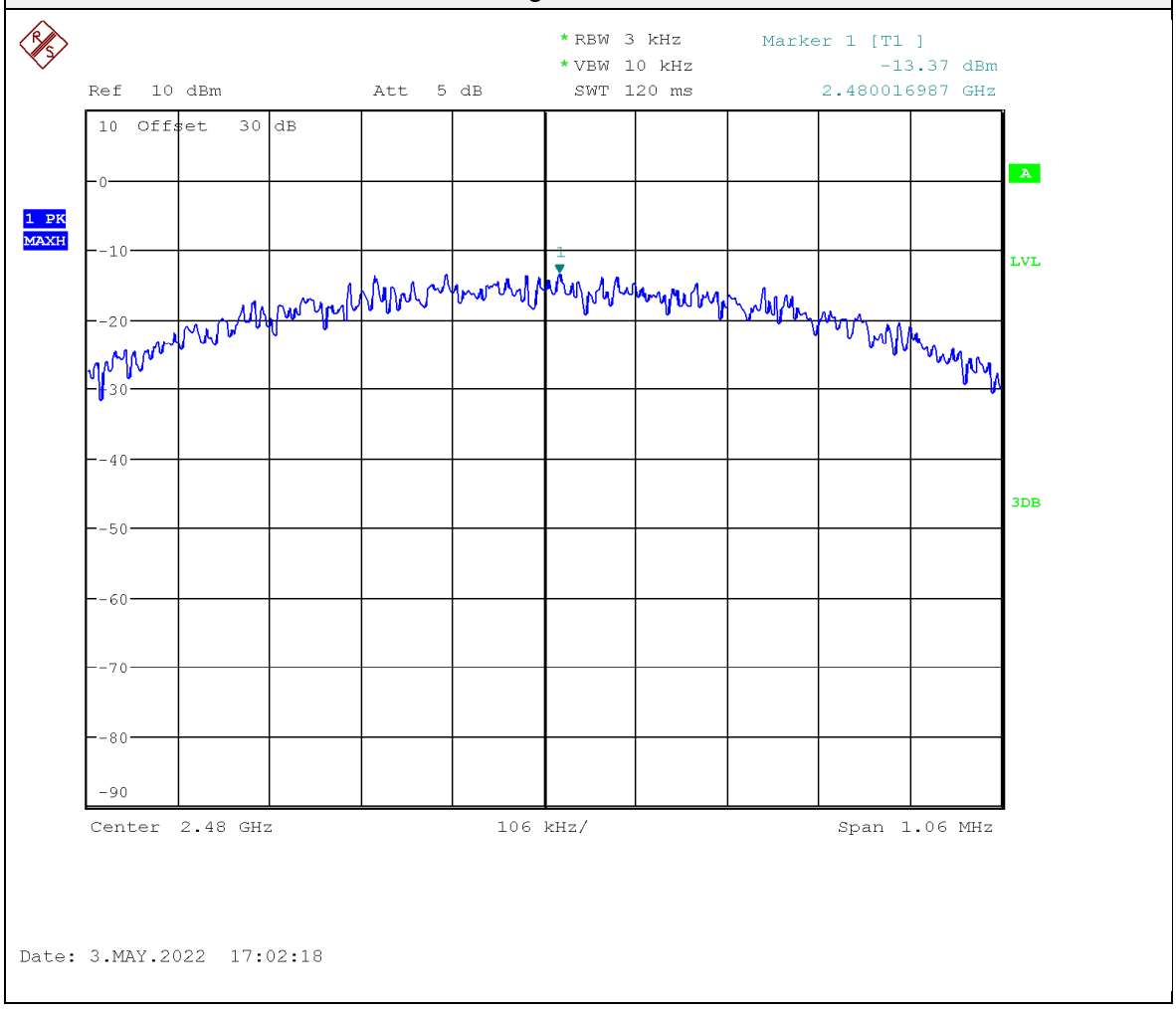
Low Channel



Mid Channel



High Channel



See exhibits for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	FSQ 26	Rohde & Schwarz	Oct. 25, 2019	Oct. 25, 2021	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133
Attenuator 20 dB	3M-20	Weinschel	NCR	NCR	GEMC 280

Appendix A – EUT Summary

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

General EUT Description

Client / Manufacturer Details	
Organization / Address	Mero Technologies Inc. 30 Duncan St. Suite 605 Toronto, Ontario Canada, M5V 2C3
Contact	Andreas Gerl
Phone	647-372-1188
Email	agerl@mero.co
EUT (Equipment Under Test) Details	
EUT Name	Paper SB8.1 Traffic V3
FCC ID	2A6KHMEROS10
IC ID	28448-MEROS10
Equipment category	BLE
EUT is powered using	5 VDC for testing Paper: 3.7 VDC battery Traffic: 3 VDC battery
Input voltage range(s) (V)	2 – 5 VDC VDC
Rated input current (A)	< 1 amp
Nominal power consumption (W)	< 1 watt
Number of power supplies in EUT	1
Transmits RF energy?	2402MHz ~2480MHz
Basic EUT functionality description	Bluetooth Low Energy Radio
Modes of operation	Bluetooth Low Energy 1Mbps
Frequency of all clocks present in EUT	38.4MHz, 32.7kHz
I/O cable description	None
Available connectors on EUT	None
Peripherals required to exercise EUT	HP laptop PC el 14-fq008ca HP E3615A benchtop power supply
Dimensions of product (approx.)	Paper 3.75" x 1.75" x 0.1" Traffic 3″ x 5.5″ x 1.8″

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For pictures of the EUT, see exhibits.

EUT Configuration

Please see separate exhibits for pictures.

- Wireless configured to transmit continuously at 100% duty cycle with modulation at max power.
- Low Channel: Ch 37 = 2402MHz
- Middle Channel: Ch 17 = 2440MHz
- High Channel: Ch 39 = 2480MHz
- The results presented for Spurious Radiated Emissions are obtained with the transmitter set to high channel. Preliminary emissions tests were performed, and this configuration resulted in the worse case emissions levels.