RF Test Report

As per

RSS-210 Annex B.6, Issue 10:2019 & FCC Part 15 Subpart 15.225

Low Power Licence Exempt Radio Communication Devices Intentional Radiators

on the

Alto

Issued by:

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Testing produced for

See Appendix A for full client & EUT details.

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

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Report Scope

This report addresses the EMC verification testing and test results of the **Alto** unit from **Nicoya Lifesciences Inc.** This unit is herein referred to as EUT (Equipment Under Test). The EUT was tested for compliance against the following standards:

RSS-210 Annex B.6, Issue 10:2019,

FCC Part 15 Subpart C 15.225

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.

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Summary

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

EUT Model:	ALTO
EUT FCC Certification #, FCC ID:	2AYVDALTO
ISED Certification #, IC:	27039-ALTO
EUT passed all tests performed	Yes
Tests conducted by	Raymond Lee Au
Report reviewed by	Amir Emami

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

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Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass [α]
FCC 15.225 (a), (b), (c) RSS-210 B.6 a. i, ii, iii.	Operation within the band 13.110-14.010 MHz (Field Strength)	Quasi-Peak Average	Pass
FCC 15.225 (d) FCC 15.209 RSS-210 B.6 a. iv RSS-GEN (Tables 5 & 6)	Transmitter Spurious Radiated Emissions	Quasi-Peak Average	Pass
FCC 15.225 (e) RSS-210 B.6 b. RSS-Gen 6.11	Operation within the band 13.110-14.010 MHz (Frequency Stability at Extreme Temperatures)	±0.01% -20°C – +50°C	Pass
FCC 15.225 (e) RSS-210 B.6 b. RSS-Gen 6.11	Operation within the band 13.110-14.010 MHz (Frequency Stability at Extreme Voltages)	±0.01% 85% – 115%	Pass
FCC 15.205 RSS-GEN (Table 7)	Restricted Bands for Intentional Operation	QuasiPeak Average	Pass [α]
FCC 15.207 RSS-GEN (Table 4)	Power Line Conducted Emissions	QuasiPeak Average	Pass
Overall Result			**Pass**

[α] See *Notes, Justifications, or Deviations* section for more details.

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.

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Notes, Justifications, or Deviations

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

Alto is a surface plasmon resonance (SPR) system that measures molecular interactions in laboratory-based research. It has 13.56 MHz NFC capabilities to identify the cartridge type loaded into the bay.

For the antenna requirement specified in FCC 15.203, the NFC loop antenna is printed on the wireless board's PCB which is sealed within the unit's enclosure. It is not meant to be replicable by the user, nor is it accessible.

The EUT is rated to be operated between 15°C – 35°C. However, the 13.56 MHz transmission is tested between -20°C to +50°C.

For the Restricted Bands of operation, the NFC function of the EUT is designed to only operate between 13.110-14.010 MHz.

The EUT's output is set to transmit continuously at 100% duty cycle at the maximum output power used by the manufacturer.

The EUT also contains the following pre-certified wireless module.

Contains: FCC ID: RYK-WPEQ261ACNIBT
IC: 6158A-EQ261ACNIBT

All testing is performed with all the EUT's functions active, including the certified wireless module, for worst case test results.

See separate RF Exposure Exhibit for this unit regarding the permissible RF exposure levels.

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Sample Calculation(s)

Radiated Emission Test

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

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

Power Line Conducted Emission Test

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

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

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Applicable Standards, Specifications and Methods

ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2013	American National Standard For Testing Unlicensed Wireless Devices
CFR 47 FCC 15 Subpart C	Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators
FCC KDB 996369: 2019	FCC KDB 996369 Modular Transmitter Integration Guide. Guidance For Host Product Manufacturers
RSS-Gen Issue 5 2019	General Requirements and Information for the Certification of Radio Apparatus
RSS 210:2019	Issue 10: Licence-Exempt Radio Apparatus: Category I Equipment
ISO 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories

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Document Revision Status

Revision 000	July 26, 2021 - Initial Release

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Definitions and Acronyms

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

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

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

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

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

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

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

LISN – Line Impedance Stabilization Network

NCR – No Calibration Required

RF – Radio Frequency

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Testing Facility

Testing for EMC on the EUT was carried out at TÜV SÜD Canada testing lab near Toronto, Ontario. The testing lab has calibrated 3m semi-anechoic chambers which allow measurements on a EUT that has a maximum width or length of up to 2m and a height of up to 3m. The testing lab also has a calibrated 10m Open Area Test Site (OATS). The chambers are equipped with a turntable that is capable of testing devices up to 5000lb in weight and are equipped with a mast that controls the polarization and height of the antenna. Control of the mast occurs in the control room adjoining the shielded chamber. This facility is capable of testing products that are rated for single phase or 3-phase AC input and DC capability is also available. Radiated emission measurements are performed using a BiLog antenna and a Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN and using the vertical ground plane if applicable.

Calibrations and Accreditations

The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, CA6844), Innovation, Science and Economic Development Canada (ISED, 6844A-3) and Voluntary Control Council for Interference (VCCI, R-14023, G-20072, C-14498, and T-20060). This chamber was calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. The NSA data is kept on file at TÜV SÜD Canada. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at TÜV SÜD Canada. TÜV SÜD Canada Inc. is accredited to ISO 17025 by A2LA with Testing Certificate #2955.02. The laboratory's current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or biennial basis as listed for each respective test.

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Testing Environmental Conditions and Dates

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

Date	Test	Initials	Temperature (ºC)	Humidity (%)	Pressure (kPa)
May 18, 2021	Operation within the band 13.110-14.010 MHz (Field Strength)	RA	25.0	32.3	102.6
May 19, 2021	Transmitter Spurious Radiated Emissions	RA	25.4	33.4	102.6
May 18, 2021	20dB and 99% Occupied Bandwidth	RA	25.0	32.3	102.6
Jun. 9, 2021	Frequency Stability at Extreme Temperatures	RA	23.3 (Outside temperature chamber)	64.2	101.3
Jun. 11, 2021	Frequency Stability at Extreme Voltages	RA	24.2	35.5	101.4
May 31, 2021	Power Line Conducted Emissions	RA	24.7	32.2	102.4

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Detailed Test Results Section

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Radiated Emission Field Strength

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 other devices which may be using the same spectrum allocations for similar or other purposes and also ensures the transmit range of the device is within the pre-determined suitable range. This also ensures public safety by not exceeding a level which has been deemed safe for human exposure.

Limits and Method

The method is as defined in ANSI C63.4.
The limits are defined in FCC Part 15.225 (a), (b), (c), and RSS-210 B.6.
The field strength of any emissions within the bands given in the table below shall not exceed the limits specified.
The testing is performed using a loop antenna.

Frequency Range (MHz)	Limit (uV/m)[1] at 30m	Limit (dBuV/m)[1] at 3m
< 13.110	Emission limits of FCC 15.209 apply. See *Transmitter Spurious Radiated Emissions* section	
13.110 – 13.410	106	80.5
13.410 – 13.553	334	90.5
13.553 – 13.567	15,848	124.0
13.567 – 13.710	334	90.5
13.710 – 14.010	106	80.5
> 14.010	Emission limits of FCC 15.209 apply. See *Transmitter Spurious Radiated Emissions* section	

[1] Limit is with a Quasi-Peak detector with bandwidths as defined in CISPR-16-1-1

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.

In accordance with FCC Part 15, section 15.31(f)(2), testing was performed at a 3 meter test distance and an extrapolation factor of 40 dB/decade was applied. For example, an extrapolation of 30m to 3m is 20Log(uV/m) + 40Log(30m/3m).

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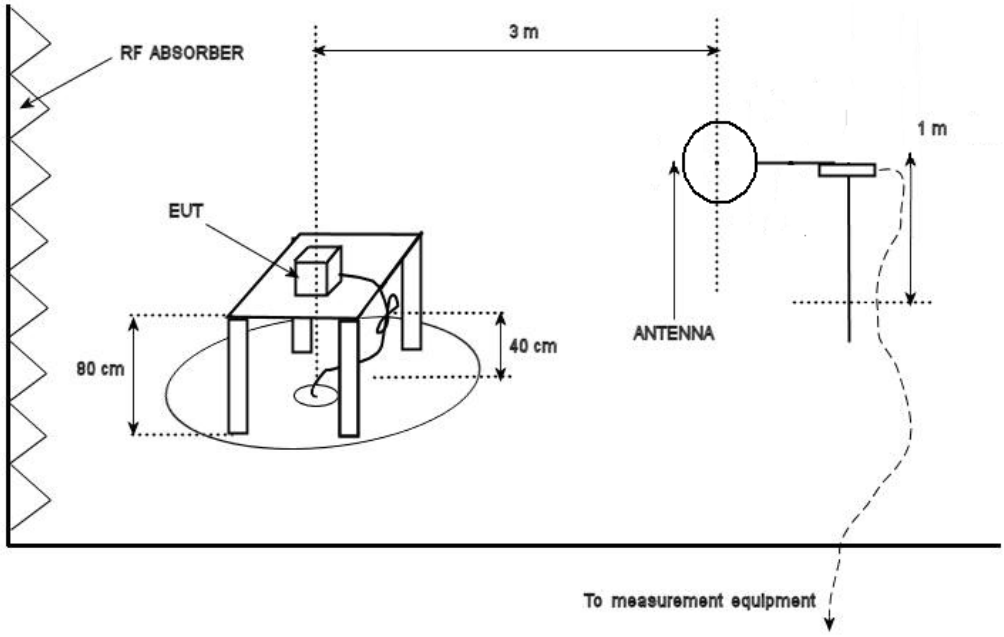
Typical Radiated Emissions Setup



Measurement Uncertainty

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

Preliminary Graphs

The graphs shown below are maximized peak measurement graphs over a full 0-360° rotation. The loop was orientated at 0 degrees and 90 degrees and a maximized reading is shown. The marker shows the value before factors are applied. See the *Final Measurements* section following for factor corrected values.

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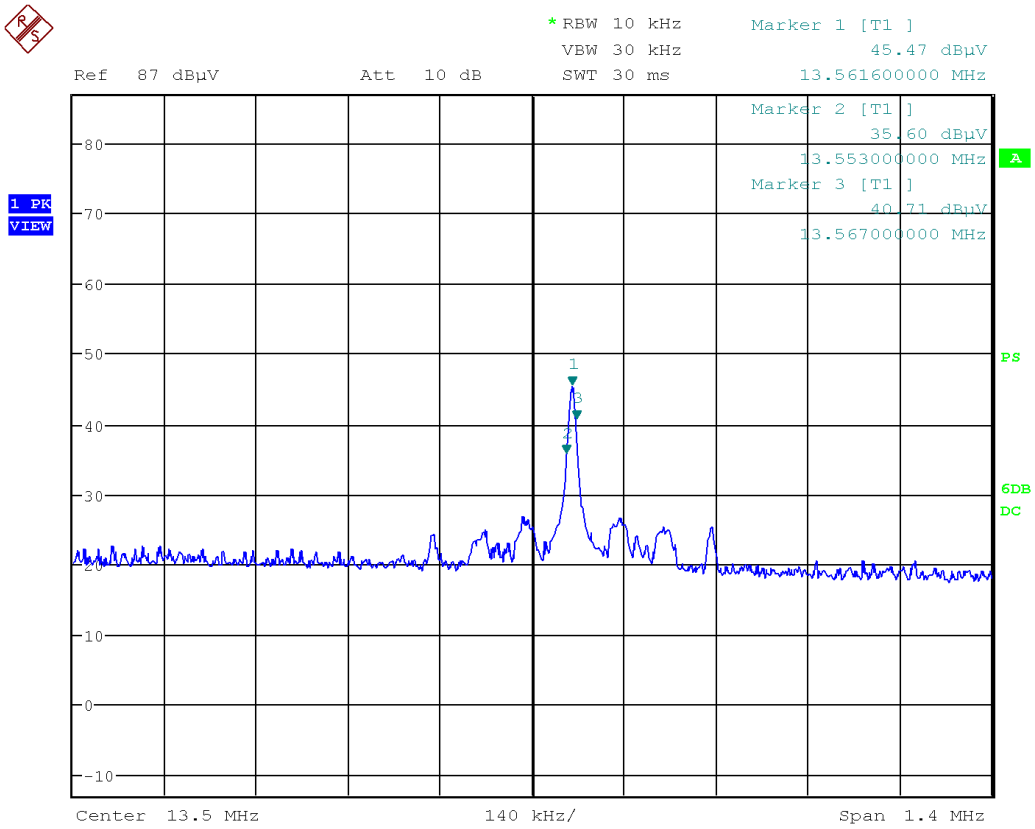
Peak Emission
Max Fundamental Emission & Band Edges
13.553-13.567 MHz
3m test distance
(Factors not incorporated. See *Final Measurements.*)



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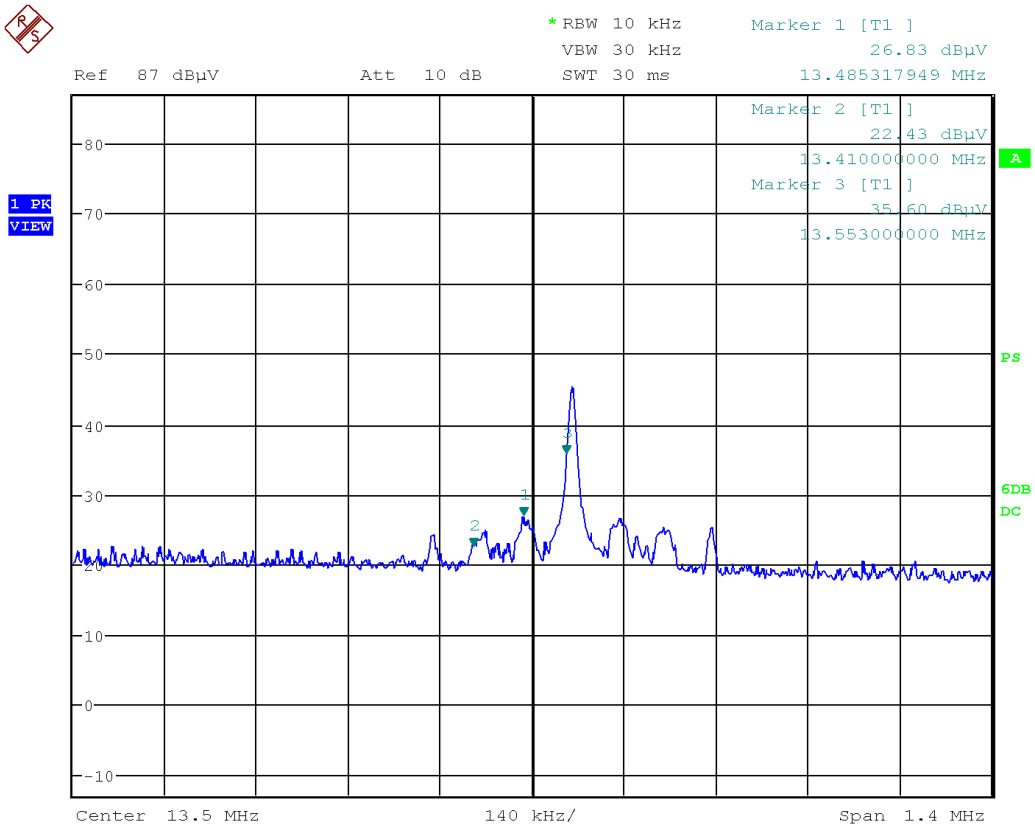
Peak Emission
Band Edges
13.410-13.553 MHz
3m test distance
(Factors not incorporated. See *Final Measurements.*)



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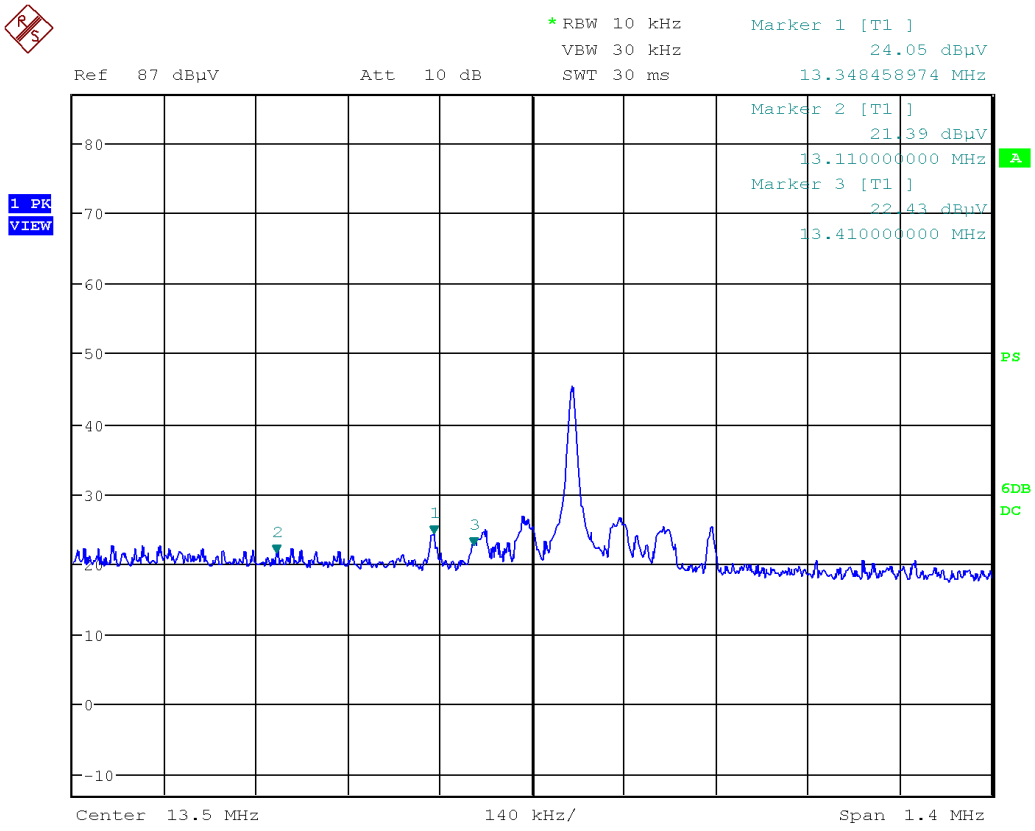
Peak Emission
Band Edges
13.110-13.410 MHz
3m test distance
(Factors not incorporated. See *Final Measurements.*)



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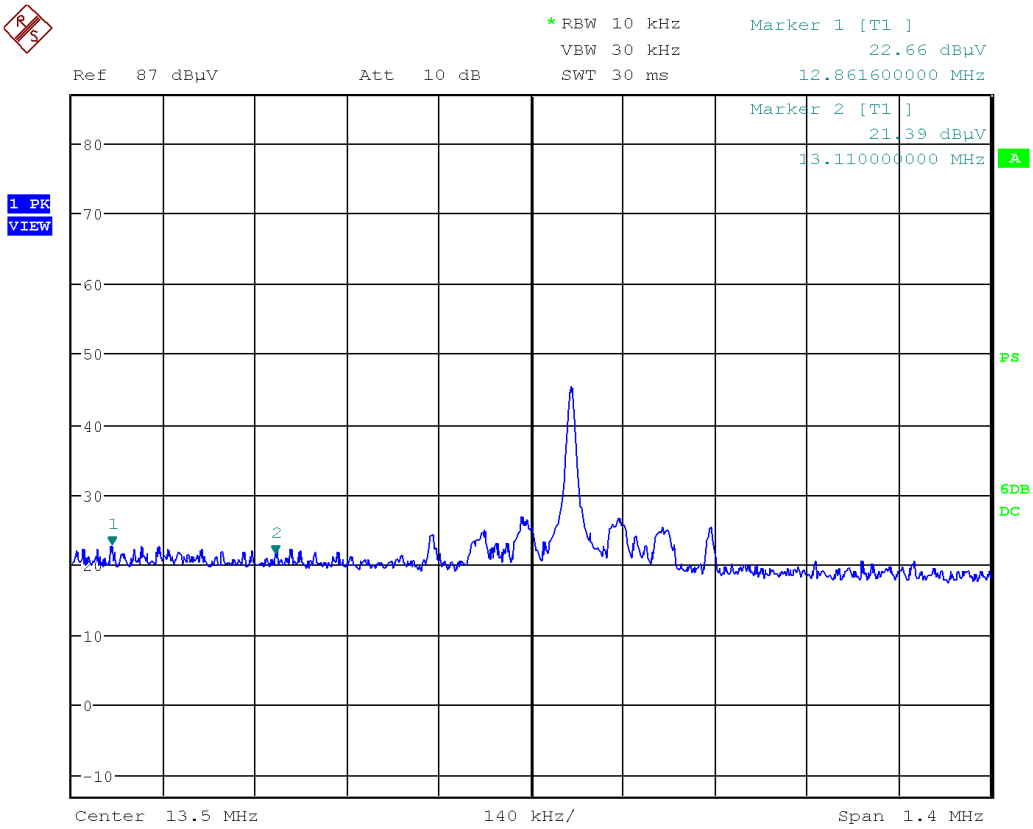
Peak Emission
Band Edges
< 13.110 MHz
3m test distance
(Factors not incorporated. See *Final Measurements*.)



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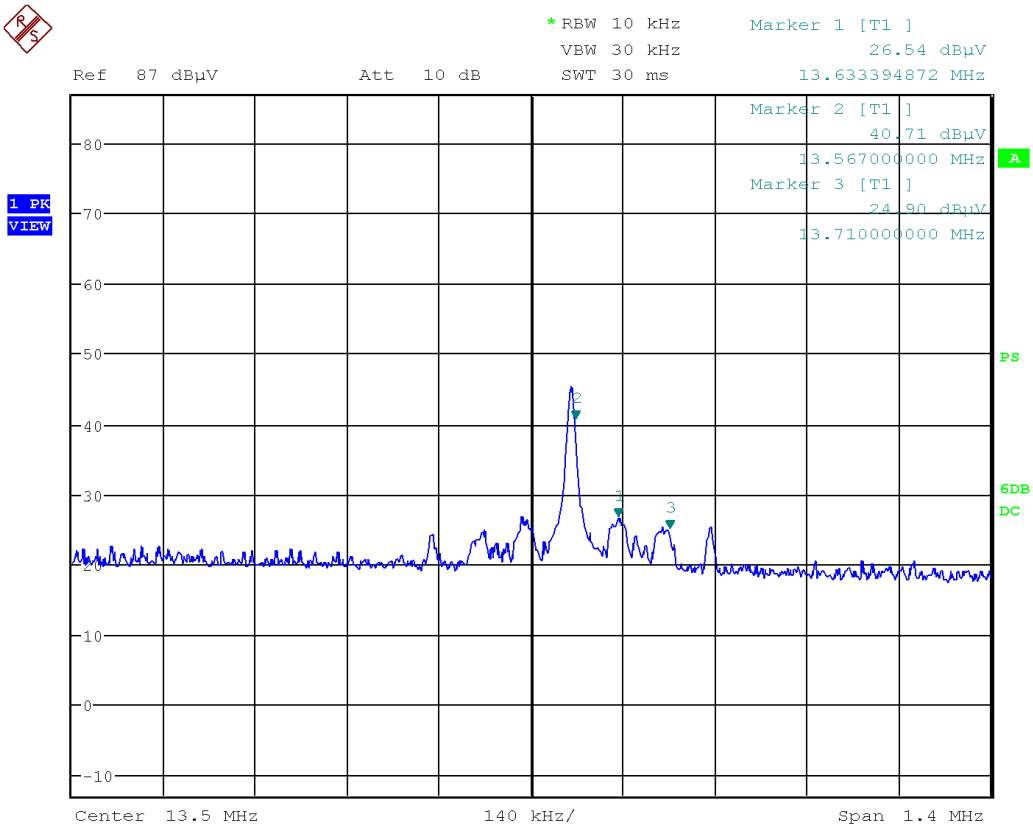
Peak Emission
Band Edges
13.567-13.710 MHz
3m test distance
(Factors not incorporated. See *Final Measurements.*)



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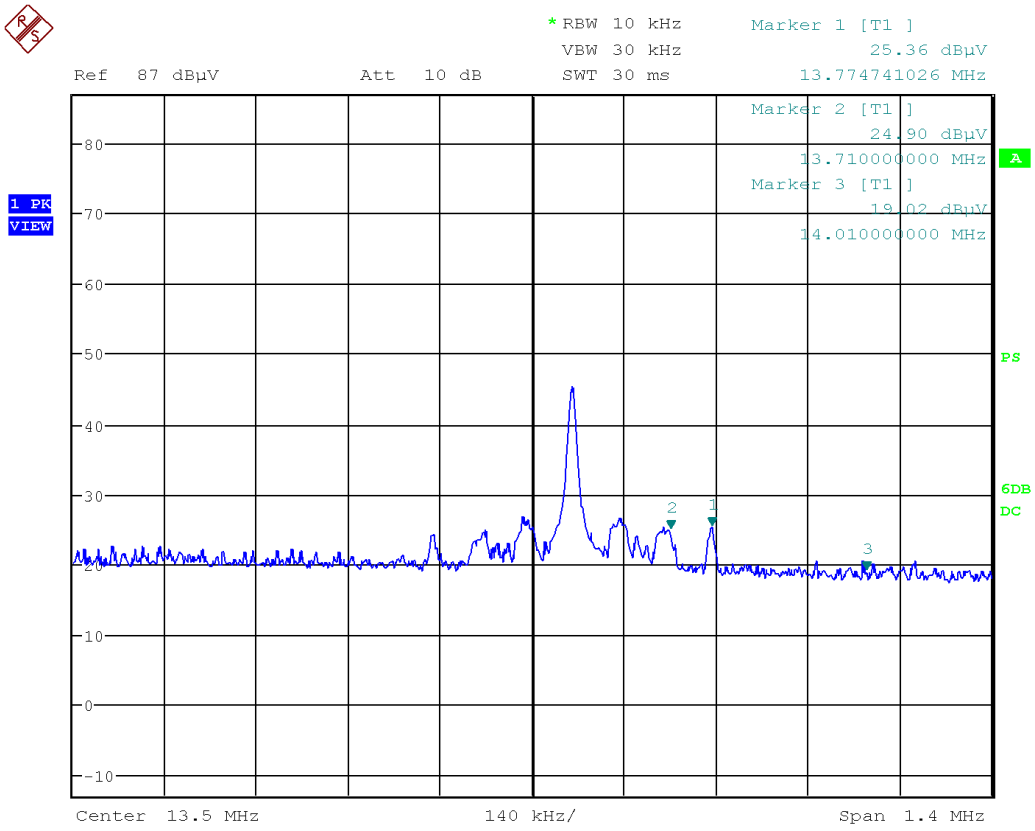
Peak Emission
Band Edges
13.710-14.010 MHz
3m test distance
(Factors not incorporated. See *Final Measurements*.)



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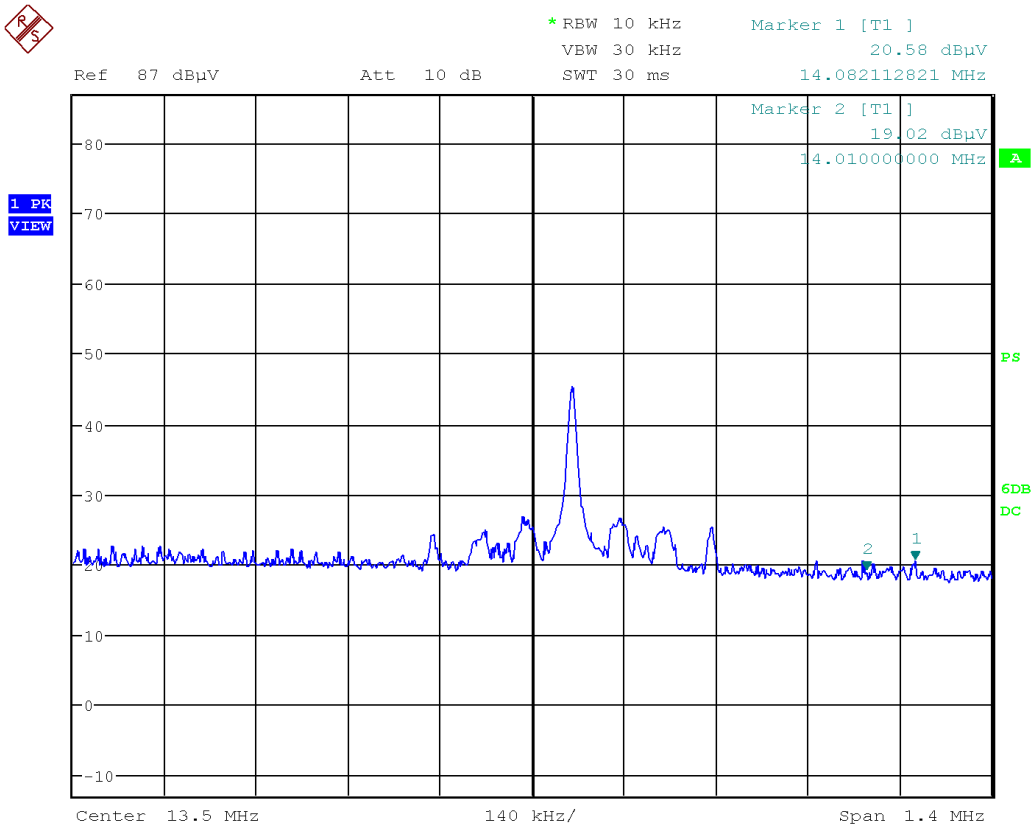
Peak Emission
Band Edges
> 14.010 MHz
3m test distance
(Factors not incorporated. See *Final Measurements*.)



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Final Measurements

Radiated Emissions Table - 15.225
Fundamental

Test Frequency (MHz)	Detection mode	Raw signal (dBµV)	Cable loss + Pre-selector (dB)	Current to voltage conversion factor (dB)	Antenna factor (dBS/m)	Pre-Amp Gain (dB)	Received signal (dBµV/m)	Emission limit (dBµV/m)	Margin (dB)	Result
13.562	Peak	45.47	0.4	51.5	-17.1	-28.4	51.83	123.9	72.07	Pass

Radiated Emissions Table - 15.225
Band Edges

Test Frequency (MHz)	Detection mode	Raw signal (dBµV)	Cable loss + Pre-selector (dB)	Current to voltage conversion factor (dB)	Antenna factor (dBS/m)	Pre-Amp Gain (dB)	Received signal (dBµV/m)	Emission limit (dBµV/m)	Margin (dB)	Result
12.862	Peak	22.66	0.4	51.5	-17.1	-28.4	29.018	69.5	40.48	Pass
13.110	Peak	21.39	0.4	51.5	-17.1	-28.4	27.748	69.5	41.75	Pass
13.348	Peak	24.05	0.4	51.5	-17.1	-28.4	30.408	80.5	50.09	Pass
13.410	Peak	22.43	0.4	51.5	-17.1	-28.4	28.788	80.5	51.71	Pass
13.485	Peak	26.83	0.4	51.5	-17.1	-28.4	33.188	90.47	57.28	Pass
13.553	Peak	35.6	0.4	51.5	-17.1	-28.4	41.958	90.47	48.51	Pass
13.567	Peak	40.71	0.4	51.5	-17.1	-28.4	47.049	90.47	43.42	Pass
13.633	Peak	26.54	0.4	51.5	-17.1	-28.4	32.879	90.47	57.59	Pass
13.710	Peak	24.9	0.4	51.5	-17.1	-28.4	31.239	80.5	49.26	Pass
13.775	Peak	25.36	0.4	51.5	-17.1	-28.4	31.699	80.5	48.80	Pass
14.010	Peak	19.02	0.4	51.5	-17.1	-28.4	25.359	69.5	44.14	Pass
14.082	Peak	20.58	0.4	51.5	-17.1	-28.4	26.919	69.5	42.58	Pass

Notes:

See *Transmitter Spurious Radiated Emissions* section in this report for spurious emissions test results outside of the FCC 15.225 bands.

See photo exhibits for photos showing the test set-up.

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 15, 2020	Jan. 15, 2022	GEMC 233
Loop Antenna	EM 6872	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 71
Pre-Amp	LNA 6901	Teseq	Feb. 12, 2021	Feb. 12, 2023	GEMC 168
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

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Transmitter Spurious Radiated Emissions

Purpose

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

Limits and Method

The method is defined in ANSI C63.10.
The requirement is stated in FCC 15.225(d), and RSS-210 B.6 a. iv.
The limits are as defined in 47 CFR FCC Part 15.209 and RSS-Gen (Table 5 and Table 6).
The limits apply for emissions that fall outside the 13.110‑14.010 MHz band.

These limits are as follows:

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

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

In the 30MHz – 1GHz frequency region, the limits are equivalent to FCC 15.109 Class B.

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

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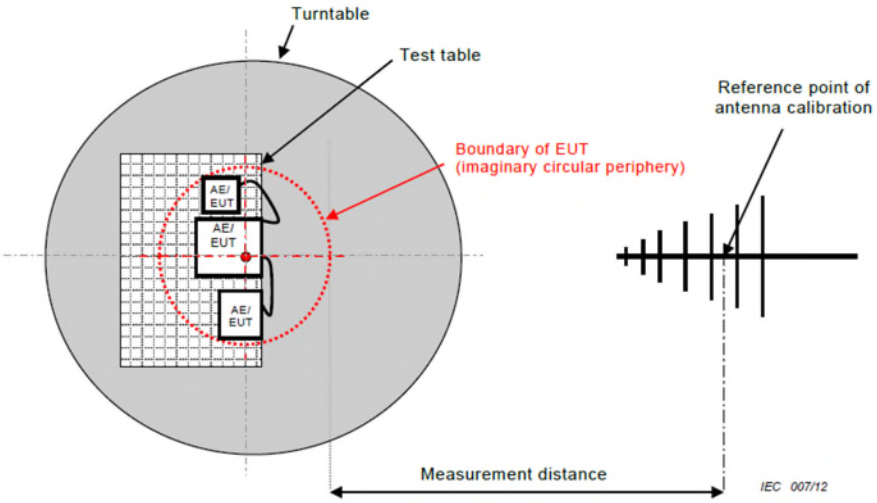
Typical Radiated Emissions Setup



Measurement Uncertainty

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

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Preliminary Graphs

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

In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10th harmonic.

Devices 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.

All functions of the EUT and its wireless transmitters are on and transmitting during testing to provide the worst case emissions results.

Plots and measurements are made at a 3 meter distance.

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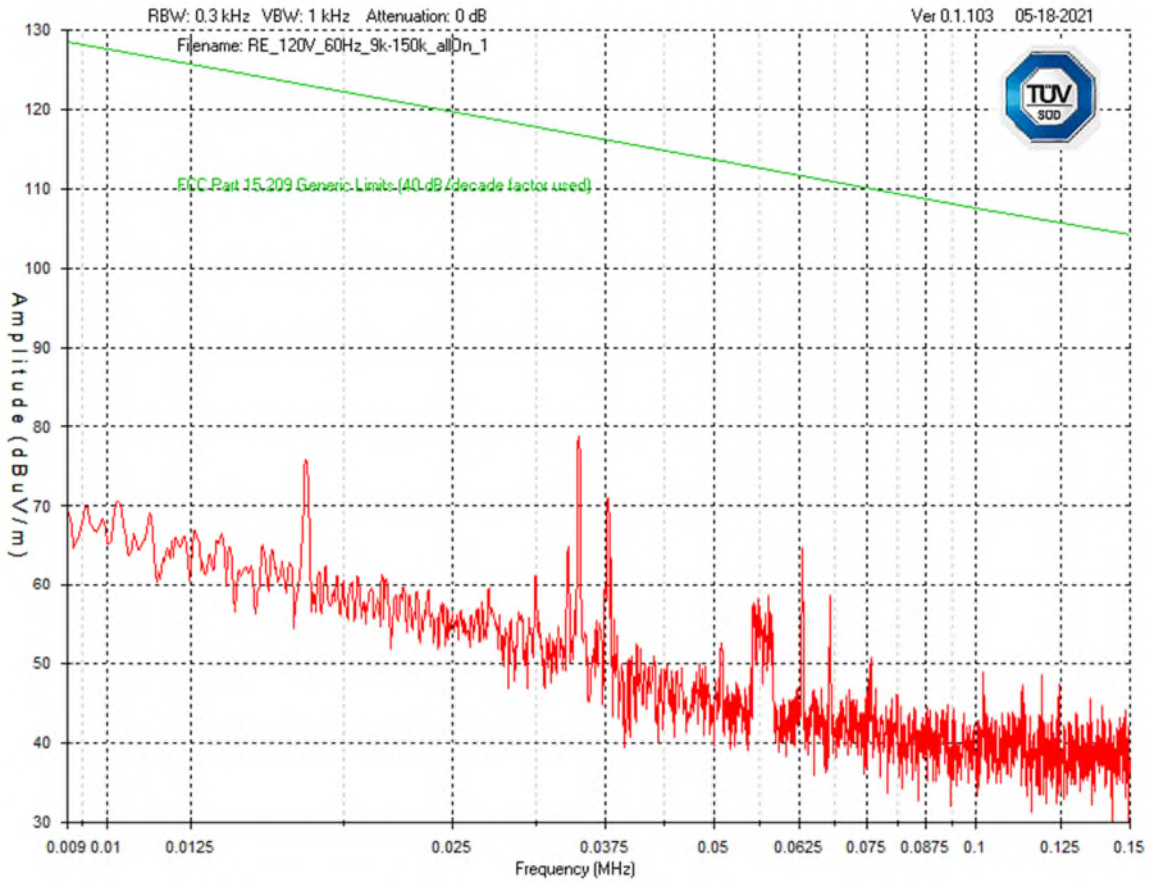
9 kHz – 150 kHz
Peak Emission Graph



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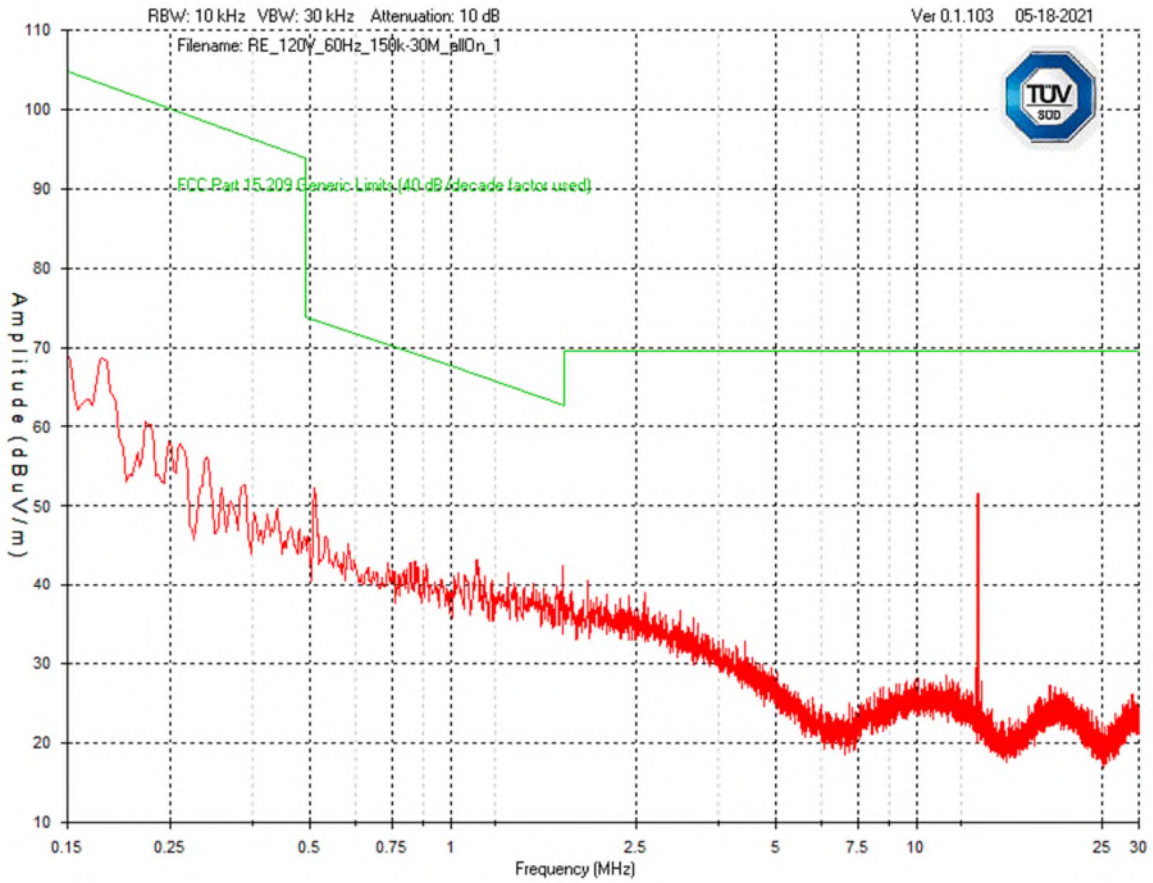
150 kHz – 30 MHz
Peak Emission Graph



Note: Peak emission between 10 – 25 MHz is the fundamental NFC transmission, and is not subjected to these limits.

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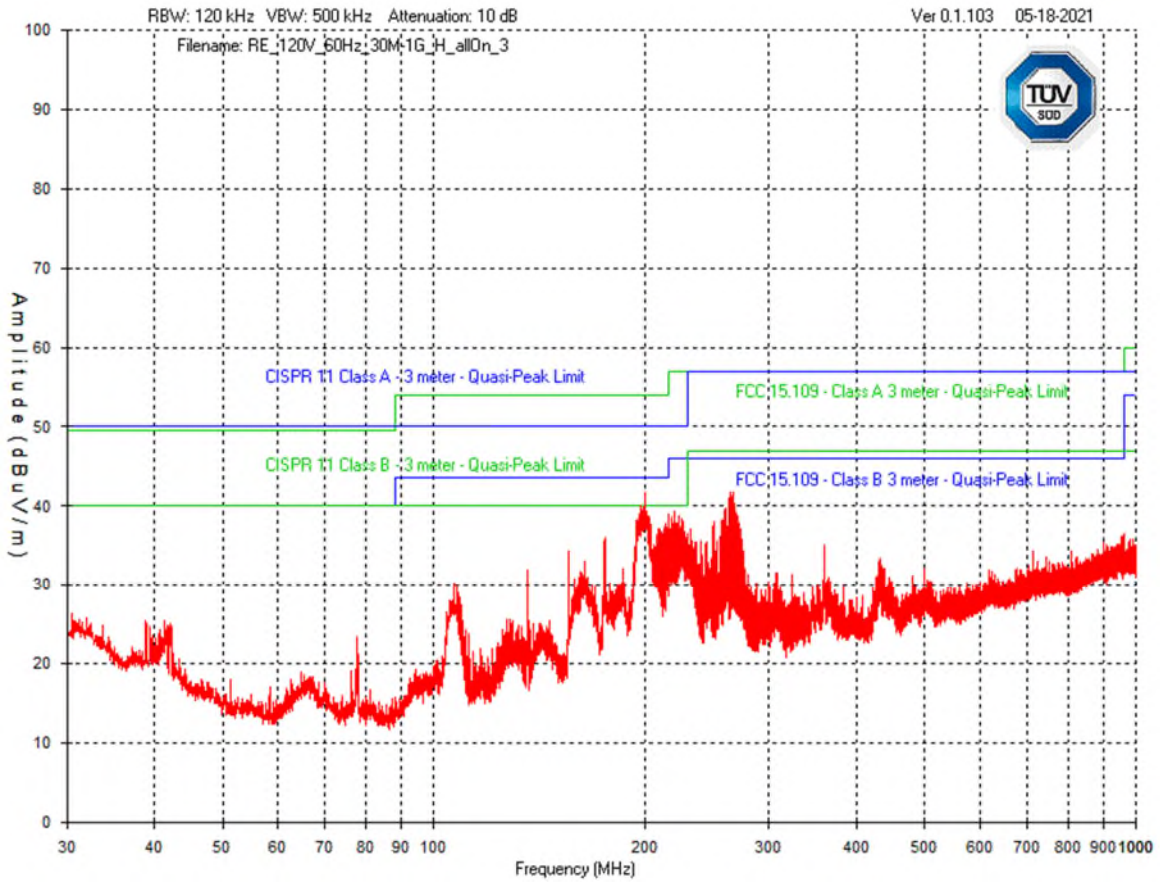
30 MHz – 1 GHz
Horizontal - Peak Emission Graph



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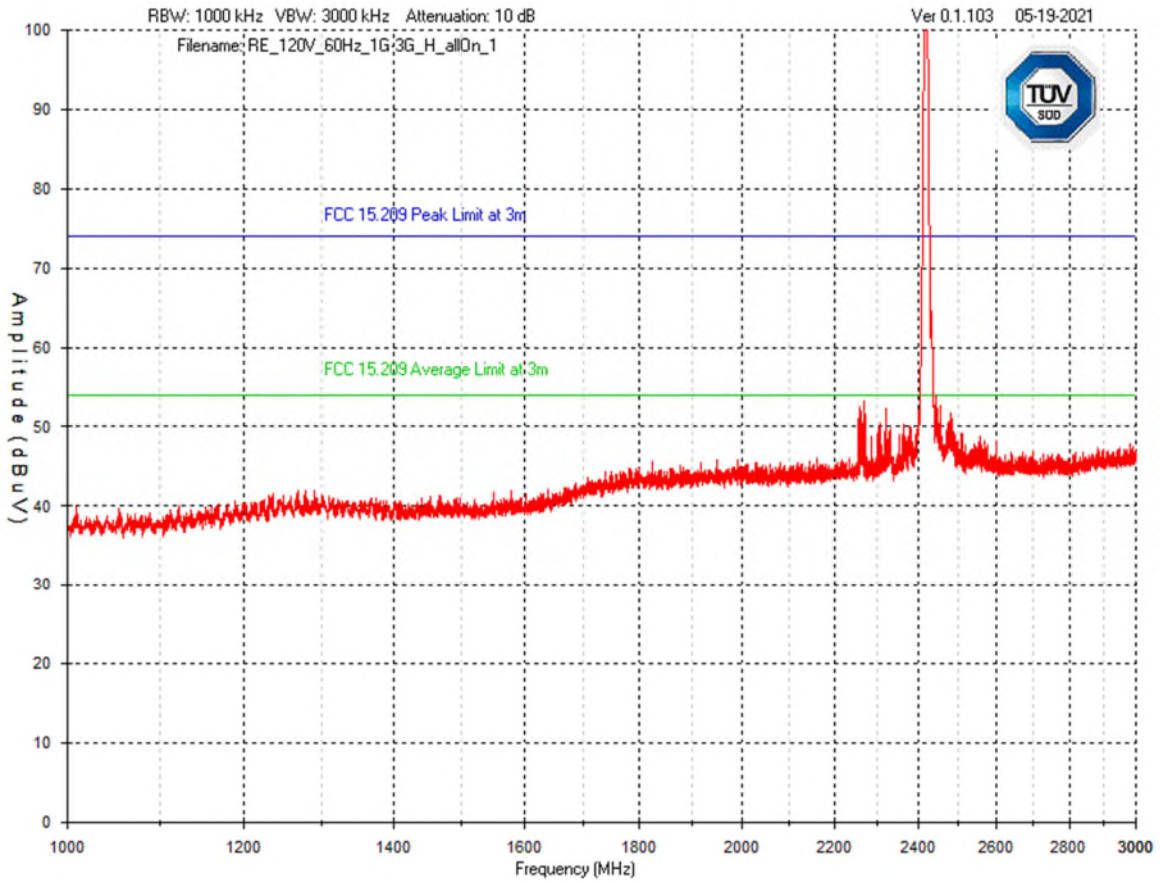
1GHz – 3GHz
Horizontal - Peak Emission Graph



Note: Peak emissions between 2400 – 2600 MHz are intentional transmissions from the certified wireless module and are not subjected to these limits.

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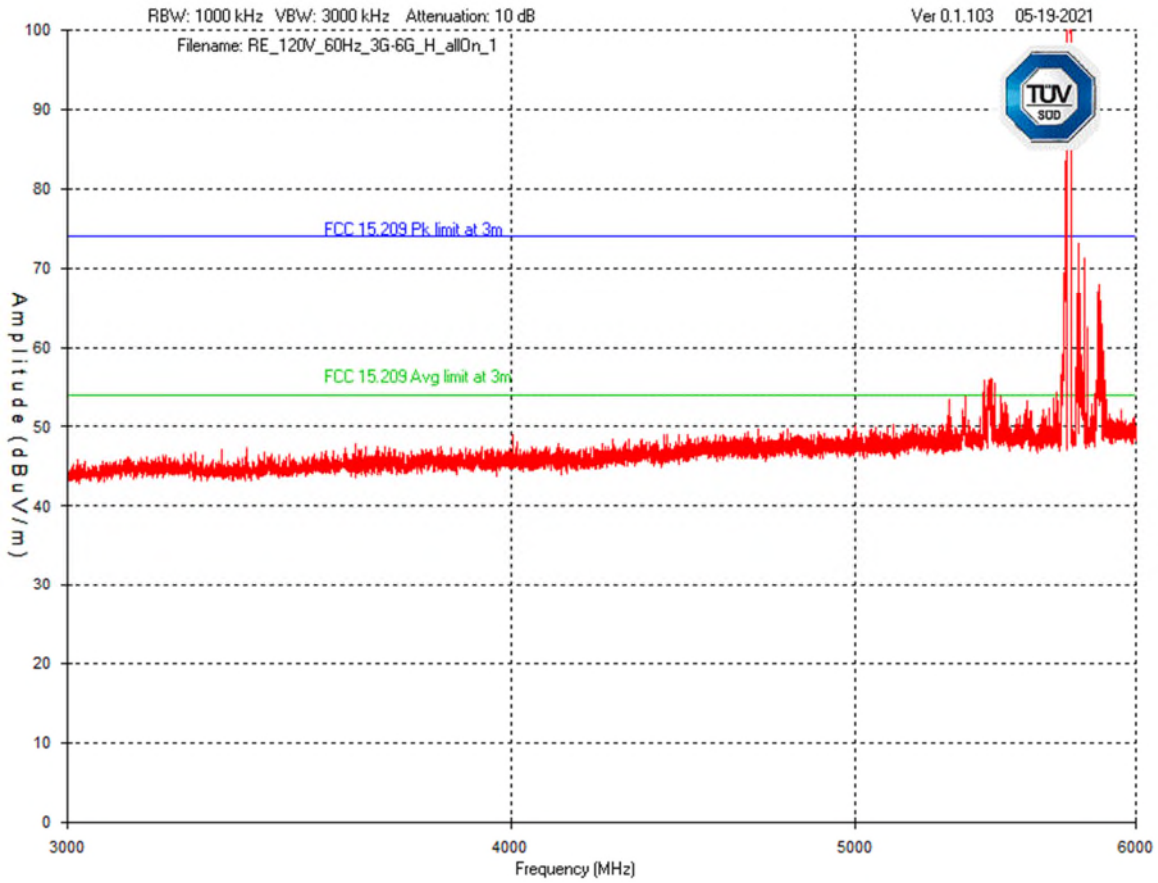
3GHz – 6GHz
Horizontal - Peak Emission Graph



Note: Peak emissions between 5000 – 6000 MHz are intentional transmissions from the certified wireless module, and are not subjected to these limits.

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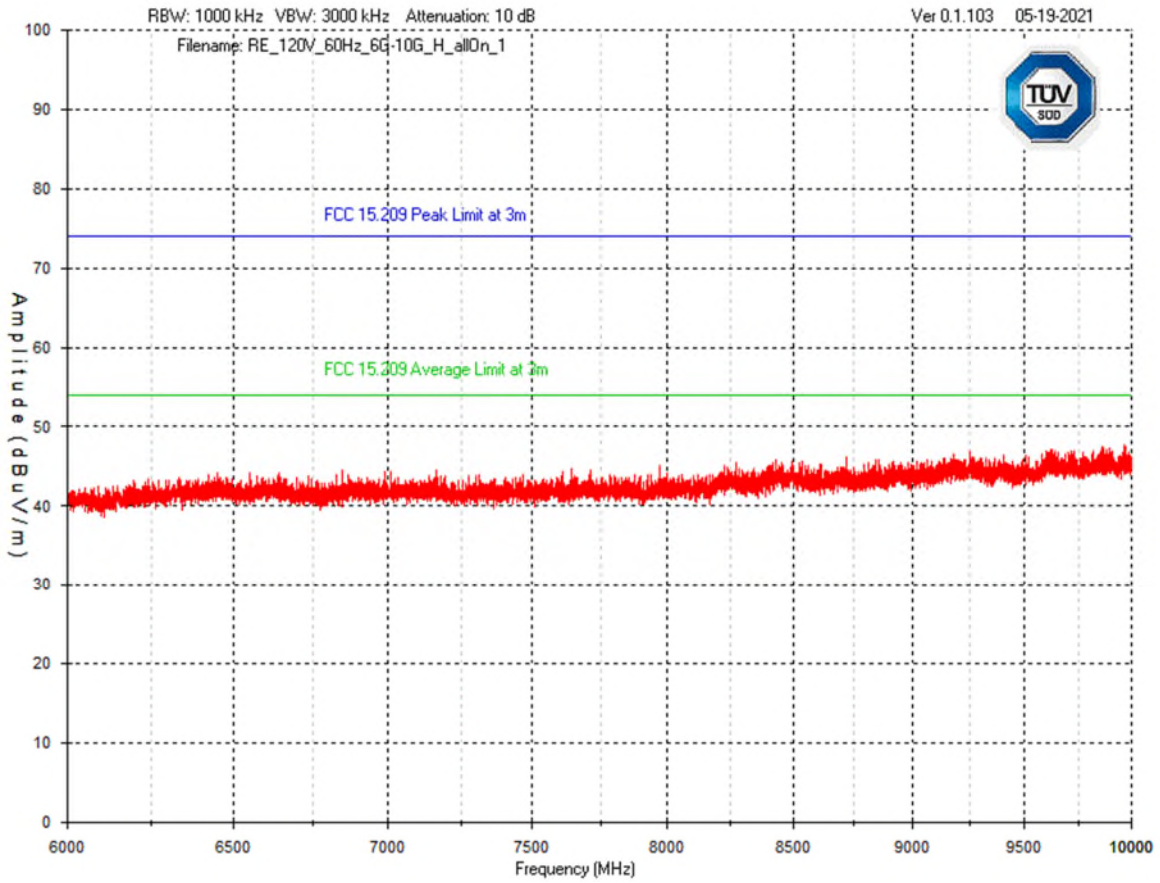
6GHz – 10GHz
Horizontal - Peak Emission Graph



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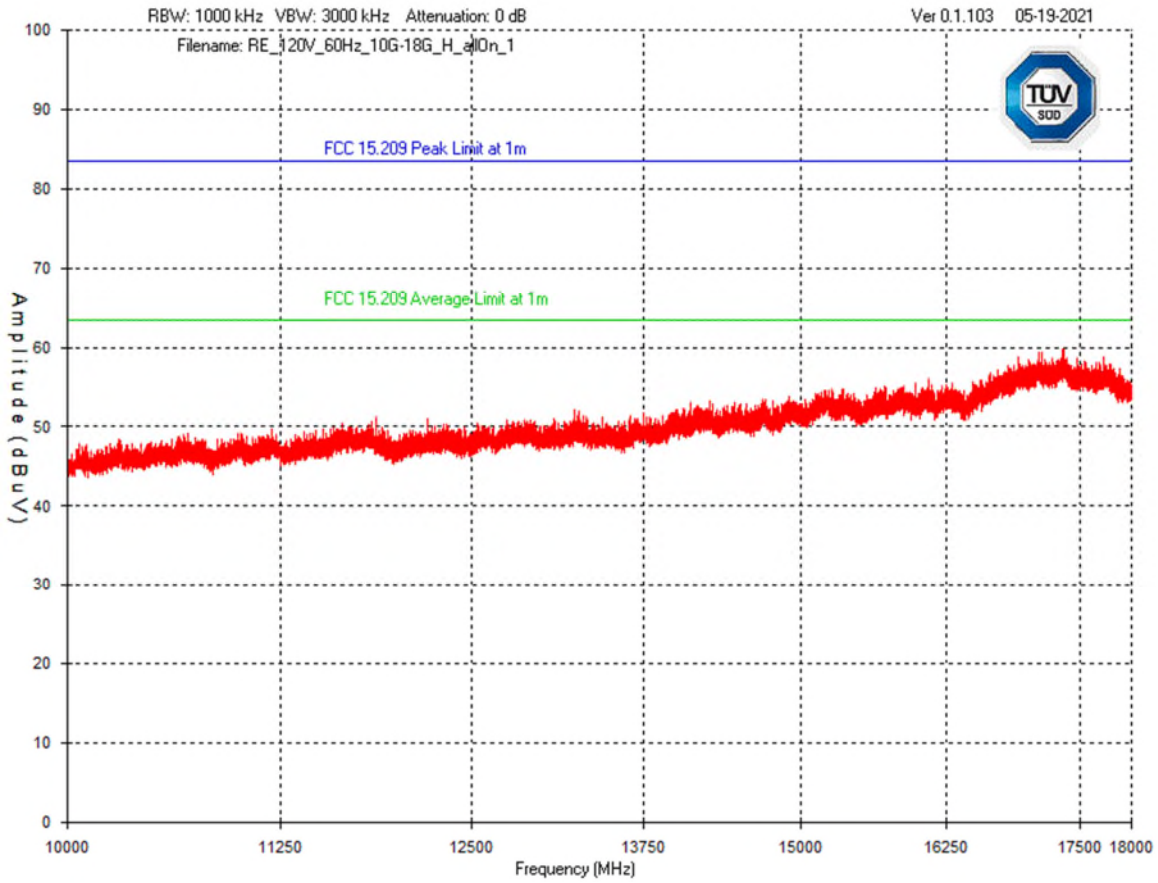
10GHz – 18GHz
Horizontal - Peak Emission Graph



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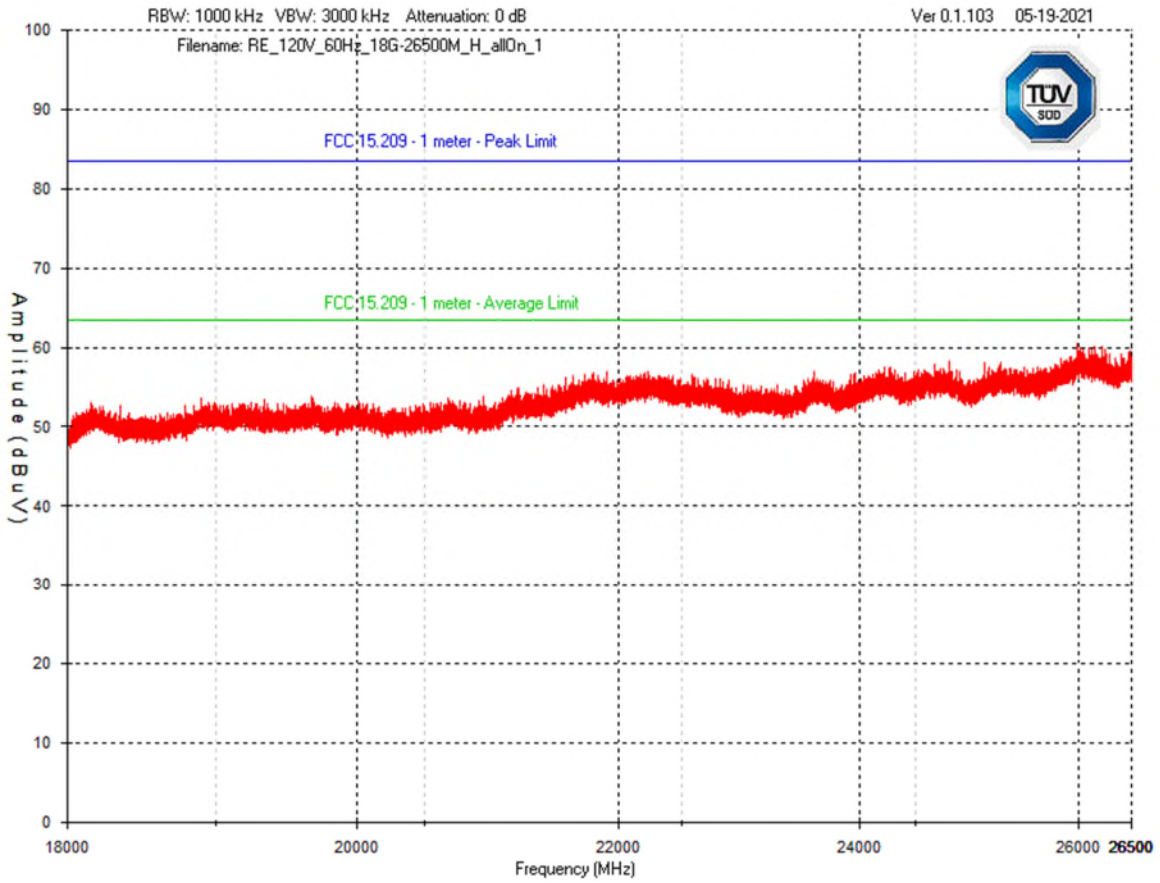
18GHz – 26.5GHz
Horizontal - Peak Emission Graph



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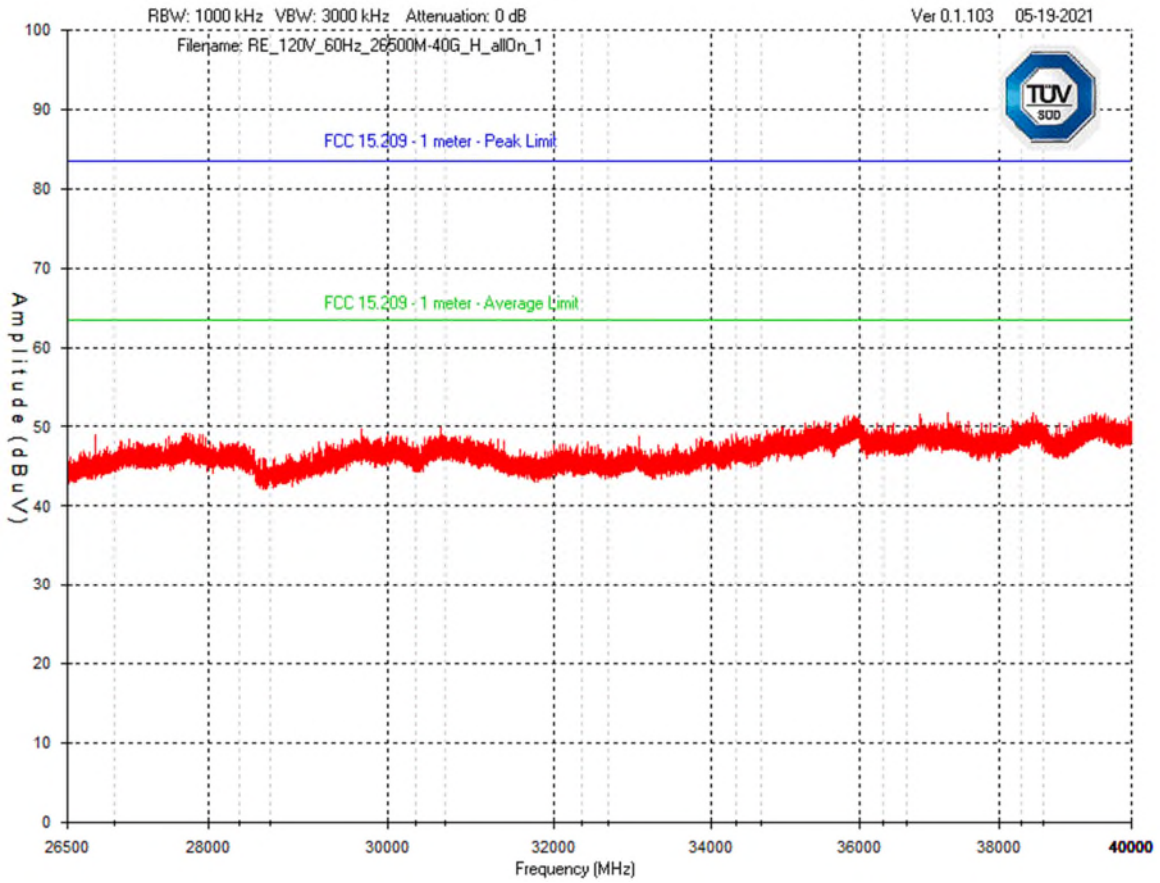
26.5GHz – 40GHz
Horizontal - Peak Emission Graph



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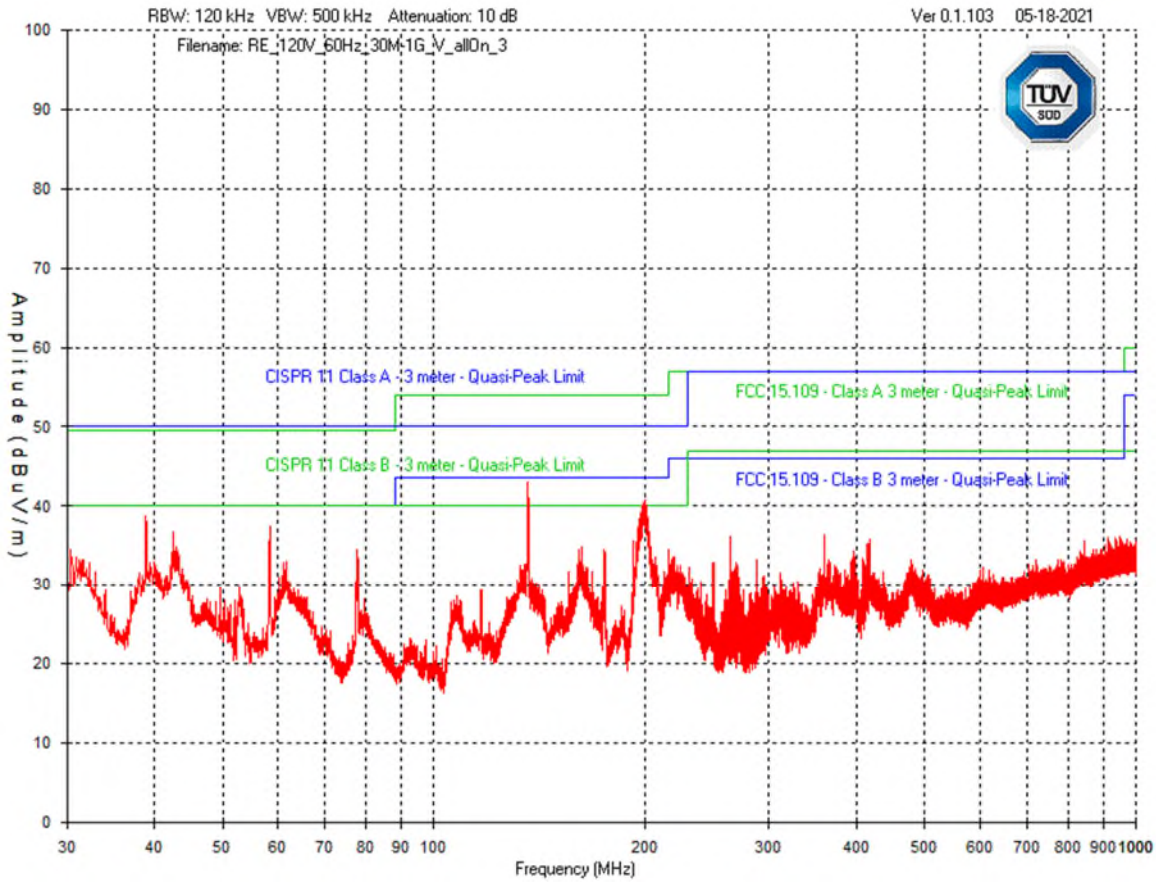
30 MHz – 1 GHz
Vertical - Peak Emission Graph



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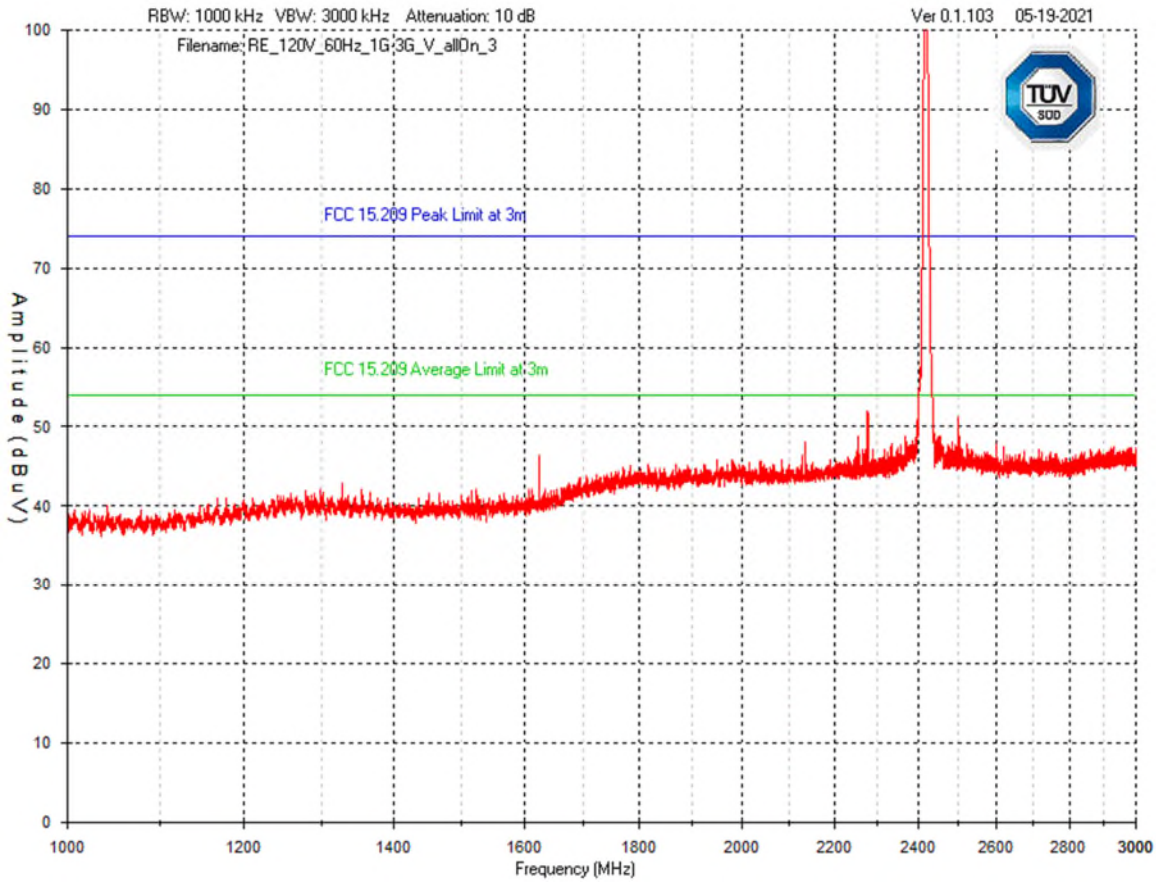
1 GHz – 3 GHz
Vertical - Peak Emission Graph



Note: Peak emissions between 2400 – 2600 MHz are intentional transmissions from the certified wireless module, and are not subjected to these limits.

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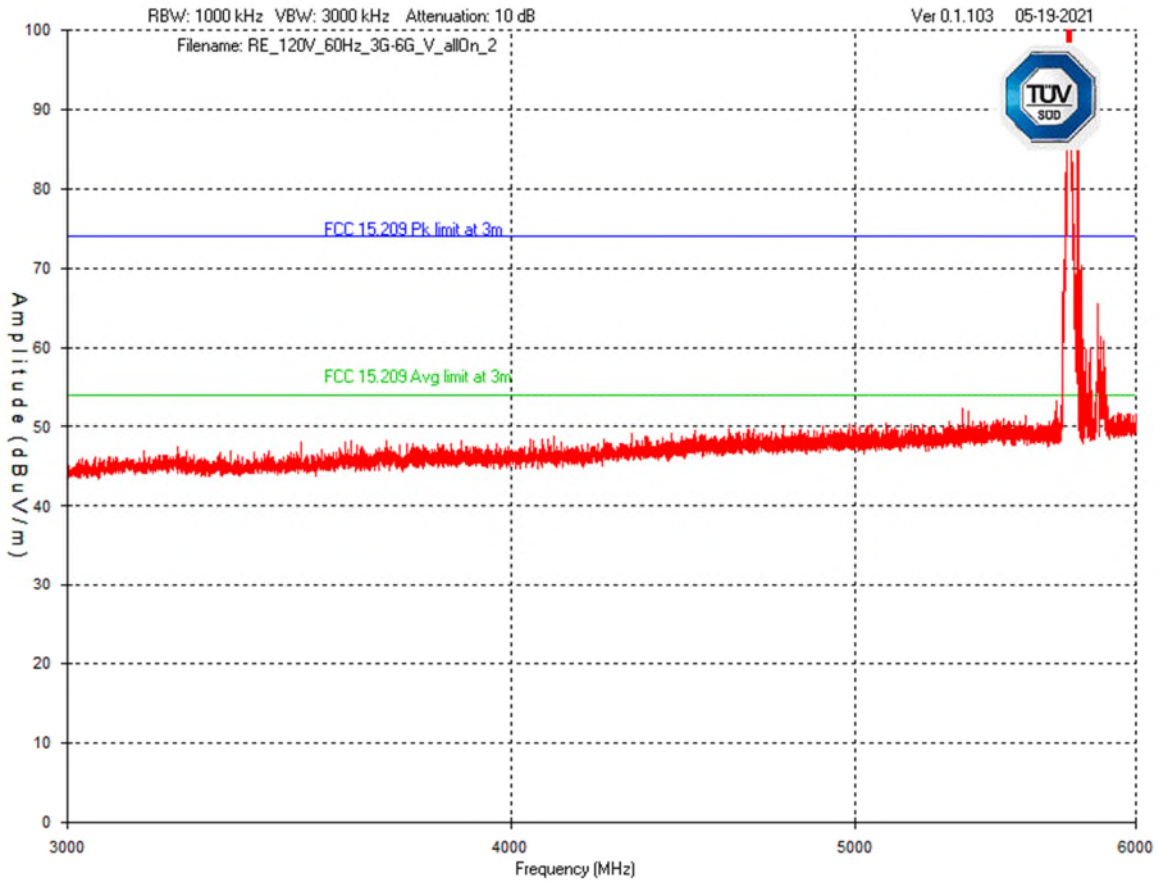
3GHz – 6GHz
Vertical - Peak Emission Graph



Note: Peak emissions between 5000 – 6000 MHz are intentional transmissions from the certified wireless module, and are not subjected to these limits.

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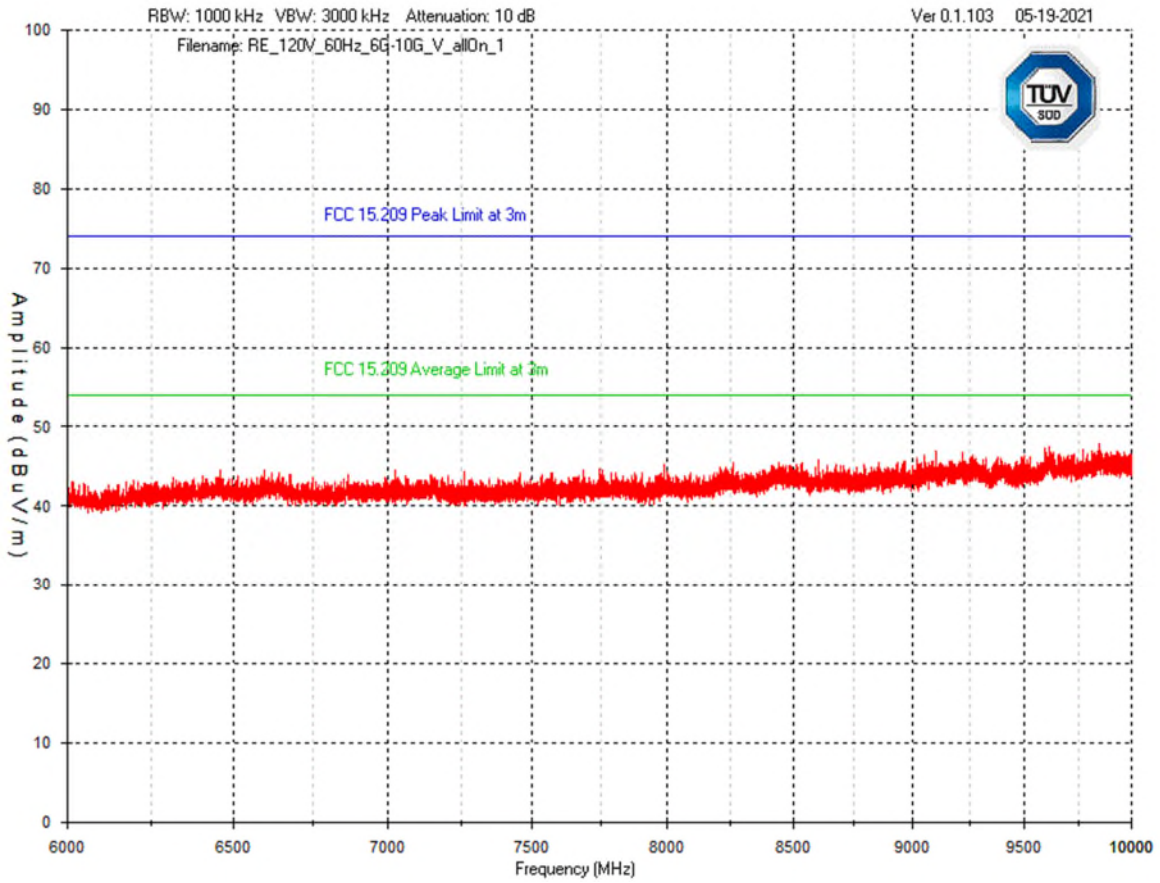
6GHz – 10GHz
Vertical - Peak Emission Graph



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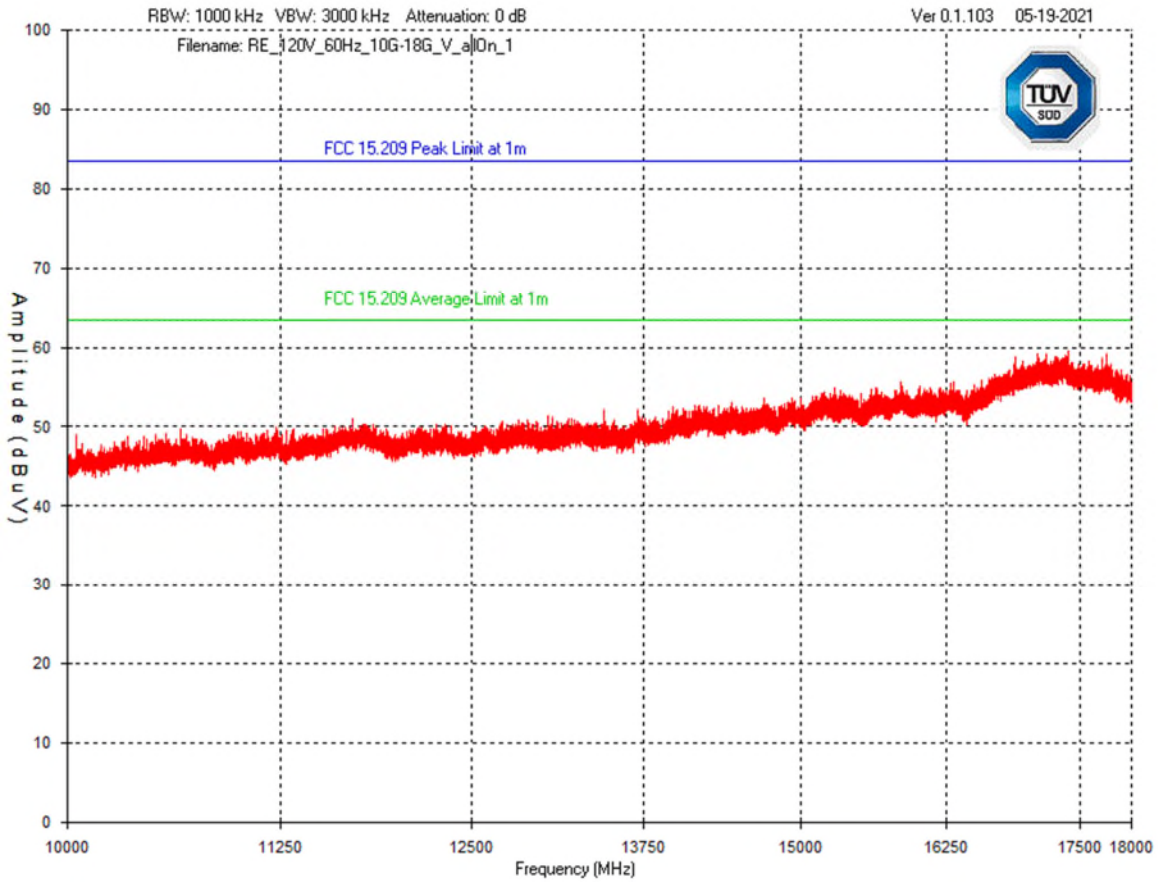
10GHz – 18GHz
Vertical - Peak Emission Graph



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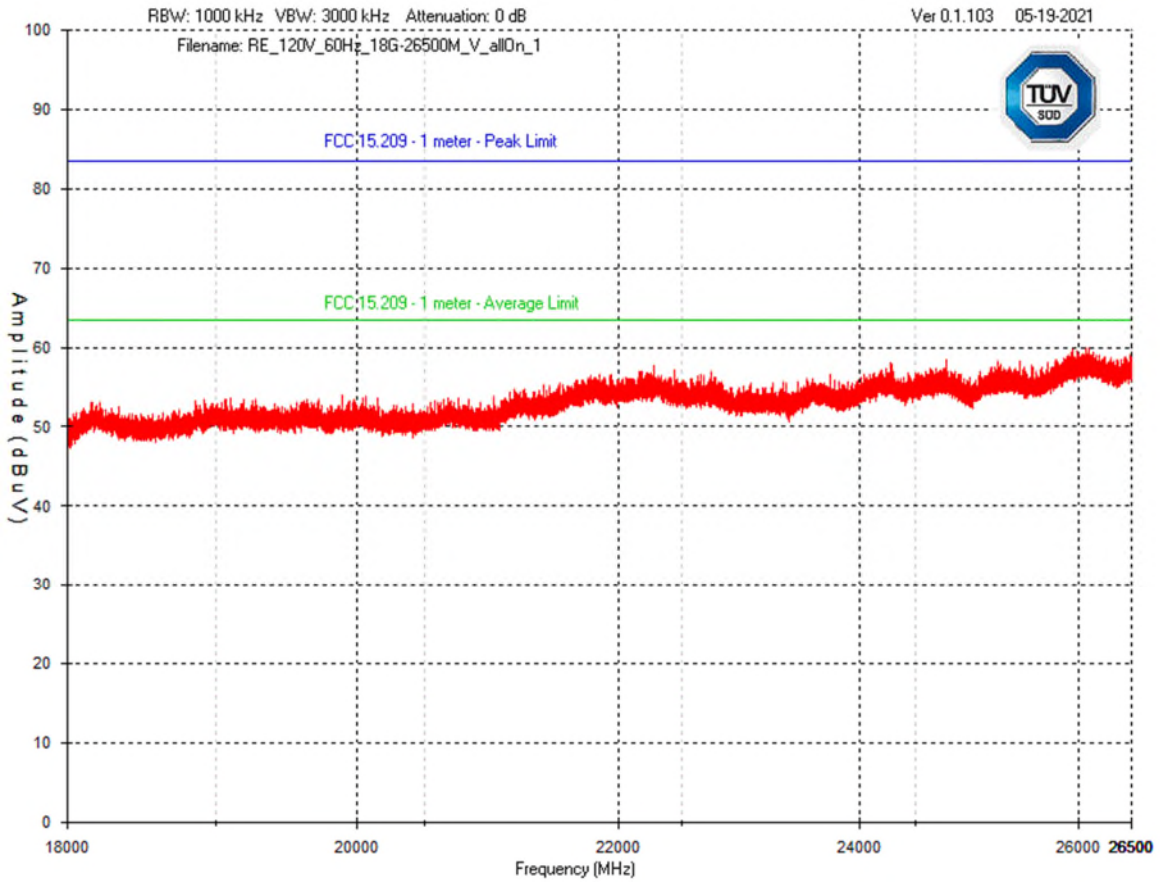
18GHz – 26.5GHz
Vertical - Peak Emission Graph



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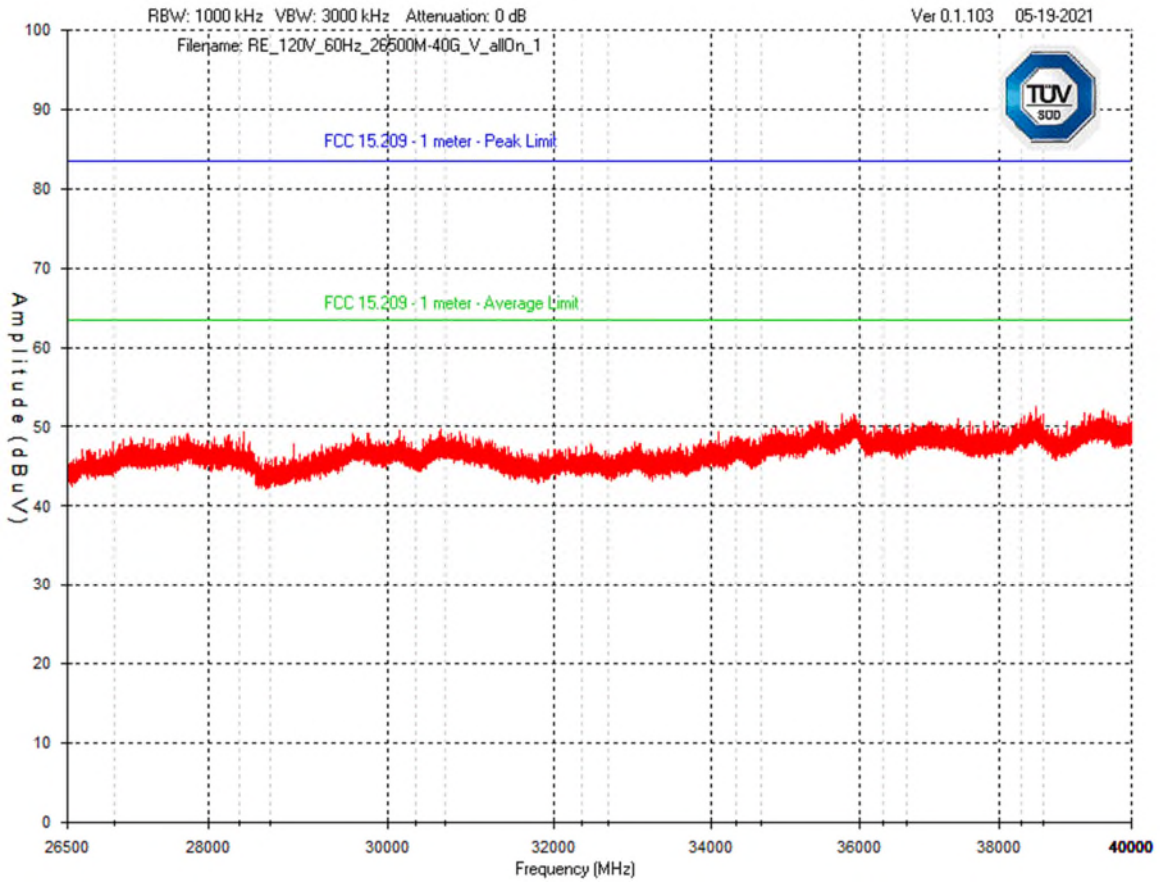
26.5GHz – 40GHz
Vertical - Peak Emission Graph



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Final Measurements and Results

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.

Spurious Radiated Emissions Table

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									
199.55	QP	48.3	15.9	1.5	-28.4	37.3	43.5	6.2	Pass
263.98	PEAK	49.7	18.7	1.9	-28.5	41.8	46.0	4.2	Pass
214.26	PEAK	48.0	16.6	1.6	-28.5	37.7	43.5	5.8	Pass
175.17	PEAK	47.3	15.7	1.4	-28.4	36.0	43.5	7.5	Pass
155.69	PEAK	46.1	15.4	1.3	-28.4	34.4	43.5	9.1	Pass
360.01	PEAK	39.4	21.8	2.3	-28.6	34.9	46.0	11.1	Pass
2268.51	PEAK	51.4	31.7	4.6	-34.2	53.5	74.0	20.5	Pass
2268.51	AVG	41.4	31.7	4.6	-34.2	43.5	54.0	10.5	Pass
2321.06	PEAK	50.3	31.8	4.6	-34.3	52.4	74.0	21.6	Pass
2321.06	AVG	44.4	31.8	4.6	-34.3	46.5	54.0	7.5	Pass
5858.94	PEAK	57.1	35.1	8.0	-32.3	67.9	74.0	6.1	Pass
5858.94	AVG	38.7	35.1	8.0	-32.3	49.5	54.0	4.5	Pass
5439.98	PEAK	45.7	34.7	7.7	-32.4	55.7	74.0	18.3	Pass
5439.98	AVG	38.2	34.7	7.7	-32.4	48.2	54.0	5.8	Pass
Vertical Antenna Polarization									
136.04	QP	49.5	13.1	1.2	-28.4	35.4	43.5	8.1	Pass
38.89	QP	46.8	18.6	0.6	-28.4	37.6	40.0	2.4	Pass
58.37	QP	47.9	13.3	0.7	-28.4	33.5	40.0	6.5	Pass
199.66	QP	50.3	15.9	1.5	-28.4	39.3	43.5	4.2	Pass
42.46	PEAK	47.6	16.9	0.6	-28.4	36.7	40.0	3.3	Pass
77.63	PEAK	49.9	12.2	0.9	-28.4	34.6	40.0	5.4	Pass
2275.18	PEAK	50.0	31.7	4.6	-34.3	52.0	74.0	22.0	Pass
2275.18	AVG	40.8	31.7	4.6	-34.3	42.8	54.0	11.2	Pass
2499.80	PEAK	48.1	32.2	4.7	-33.7	51.3	74.0	22.7	Pass
2499.80	AVG	42.2	32.2	4.7	-33.7	45.4	54.0	8.6	Pass
5850.84	PEAK	54.7	35.1	8.0	-32.4	65.4	74.0	8.6	Pass
5850.84	AVG	41.9	35.1	8.0	-32.4	52.6	54.0	1.4	Pass

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification 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 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 – 6 GHz	3117	ETS-Lindgren	Feb. 17, 2020	Feb. 17, 2022	GEMC 340
Horn Antenna 6 – 18 GHz	WBH218HN	Q-par	Apr. 1, 2020	Apr. 1, 2022	GEMC 6375
Horn Antenna 18 - 26.5 GHz	SAS-572	A.H. Systems	Dec. 1, 2020	Dec. 1, 2022	GEMC 6371
Horn Antenna 26.5 GHz – 40 GHz	QSH22F20S	Q-par	Jan. 10, 2020	Jan. 10, 2022	GEMC 6376
Pre-Amp 9 kHz – 1 GHz	LNA 6901	Teseq	Feb. 12, 2021	Feb. 12, 2023	GEMC 168
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Dec. 20, 2019	Dec. 20, 2021	GEMC 189
Pre-Amp 26.5 – 40 GHz	PAM-840A	Com-Power Corporation	May 13, 2021	May 13, 2023	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	0.1.103	TUV SUD Canada, Inc.	NCR	NCR	GEMC 58

FCC - 15.209 -Radiated Emissions_Rev1

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Carrier Frequency Stability

Purpose

The purpose of this test is to ensure that the frequency tolerance of the carrier signal is maintained within the required limits during extreme temperature and voltage variations. This helps protect radio broadcasts and receivers with spectrum nearby to the equipment under test from unwanted interference. This also helps ensure proper reception of the intended signal by ensuring the transmit frequency is correct over the expected temperature and voltage range.

Limits and Method

The limits are as defined in FCC Part 15, Section 15.225 (e). The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20°C to +50°C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20˚C.

Results (Temperature Variation)

There is no deviation in the fundamental frequency during the tests which would cause it to be non-compliant with the requirements. The EUT is only rated to be used within 15°C - 35°C. However, the fundamental transmission is tested between -20°C to +50°C. The results are presented in the chart below.

The frequencies do not vary beyond the operating frequency at a normal temperature of 20°C (13.56142628 MHz) by ±0.001% (i.e. 13.5600701393718 MHz - 13.5627824246282 MHz).

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Frequency Tolerance Table

	Fundamental Frequency Recorded After EUT is Turned On (MHz)			
Temperature	**Immediately**	**+2 mins**	**+5 mins**	**+10 mins**
+50°C	13.561397436	13.561397436	13.561397436	13.561397436
+40 °C	13.561405449	13.561405449	13.561405449	13.561405449
+30 °C	13.561407051	13.561407051	13.561423077	13.561423077
+20 °C	13.561434295	13.561426282	13.561426282	13.561426282
+15 °C	13.561464744	13.561464744	13.561464744	13.561464744
+10°C	13.561480288	13.561480288	13.561480288	13.561480288
0 °C	13.561493590	13.561493590	13.561493590	13.561493590
-10 °C	13.561495192	13.561495192	13.561495192	13.561495192
-20 °C	13.561466346	13.561466346	13.561466346	13.561466346

Results (Voltage Variation)

There is no deviation in the fundamental frequency during the tests which would cause it to be non-compliant with the requirements. The EUT is powered by mains. Its rated input voltage is 100-240V. The voltage is varied between 85% to 115% of the rated voltage at a temperature of 20 °C. The voltage is varied between 85V-276V, at 60Hz. The results are presented in the chart below.

The frequency remained steady over the voltage variation. The frequencies do not vary beyond the operating frequency at a normal temperature of 20°C (13.561443000 MHz) by ±0.001% (i.e. 13.5600868557 MHz - 13.5627991443 MHz).

Voltage Variation Table

Mains Voltage (V)	Fundamental Frequency (MHz)
85	13.561443000
102	13.561443000
120	13.561443000
138	13.561443000
276	13.561443000

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification Date	Asset #
Spectrum Analyzer	FSQ 26	Rohde & Schwarz	Oct. 25, 2019	Oct. 25, 2021	GEMC 234
Loop Antenna	EM 6872	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 71
Pre-Amp	LNA-10-20	RF Bay Inc.	Feb. 12, 2021	Feb. 12, 2023	GEMC 244
Temperature & Humidity Monitor	TM500	Extech	May 17, 2021	May 17, 2022	CANE 170
Digital Multimeter	3000 FC	Fluke	Apr. 16, 2021	Apr. 16, 2022	CANE 230

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Power Line Conducted Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard, 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 defined in FCC 15.207 and RSS-Gen Table 4.
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.

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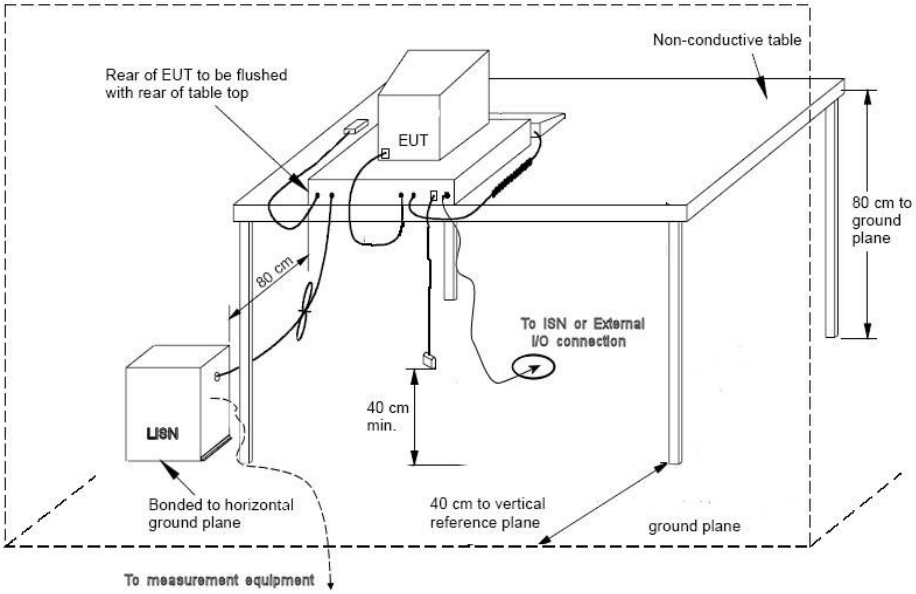
Typical Setup Diagram



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±2.73dB 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.

This test is performed with the NFC, mainboard, and touchscreen active, and using Schaffner power cord, part number IF13-US3-H05-3100-WF-200.

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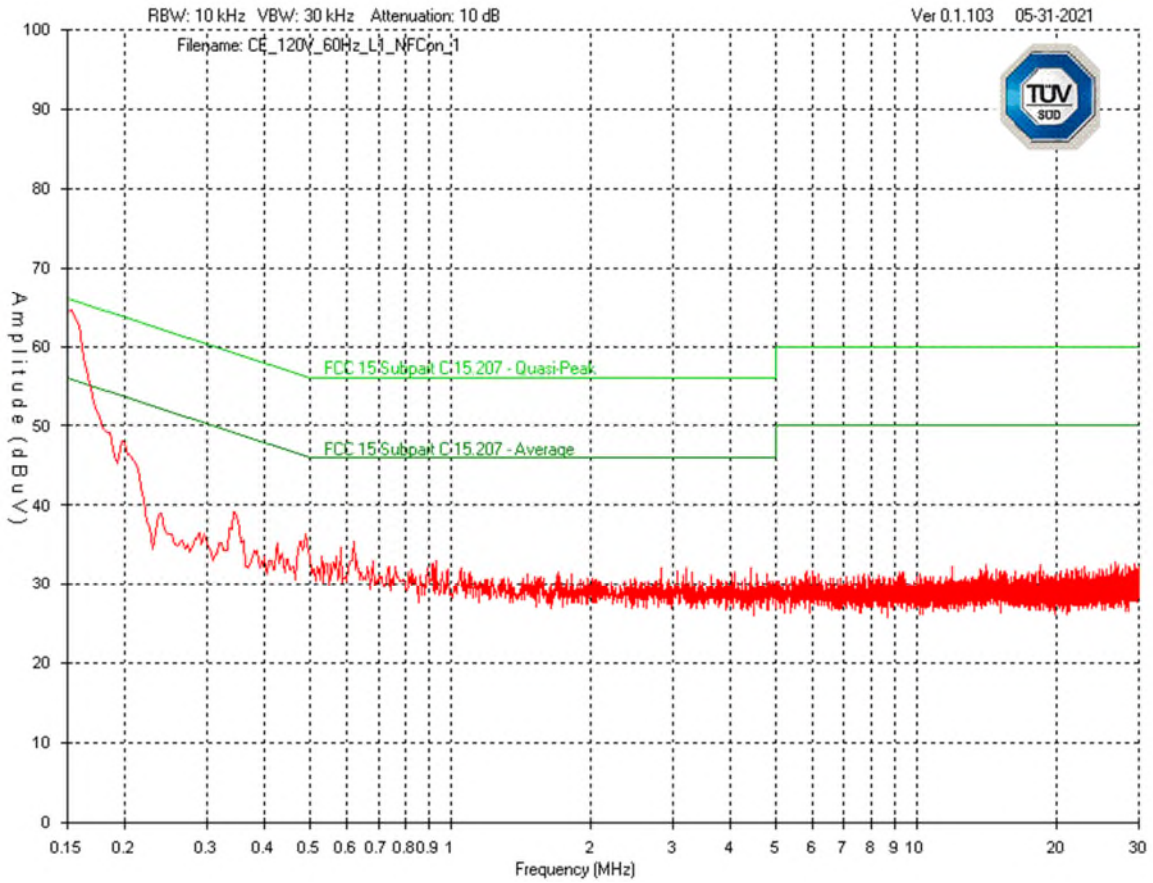
Line 1 (L1) – 120Vac 60Hz



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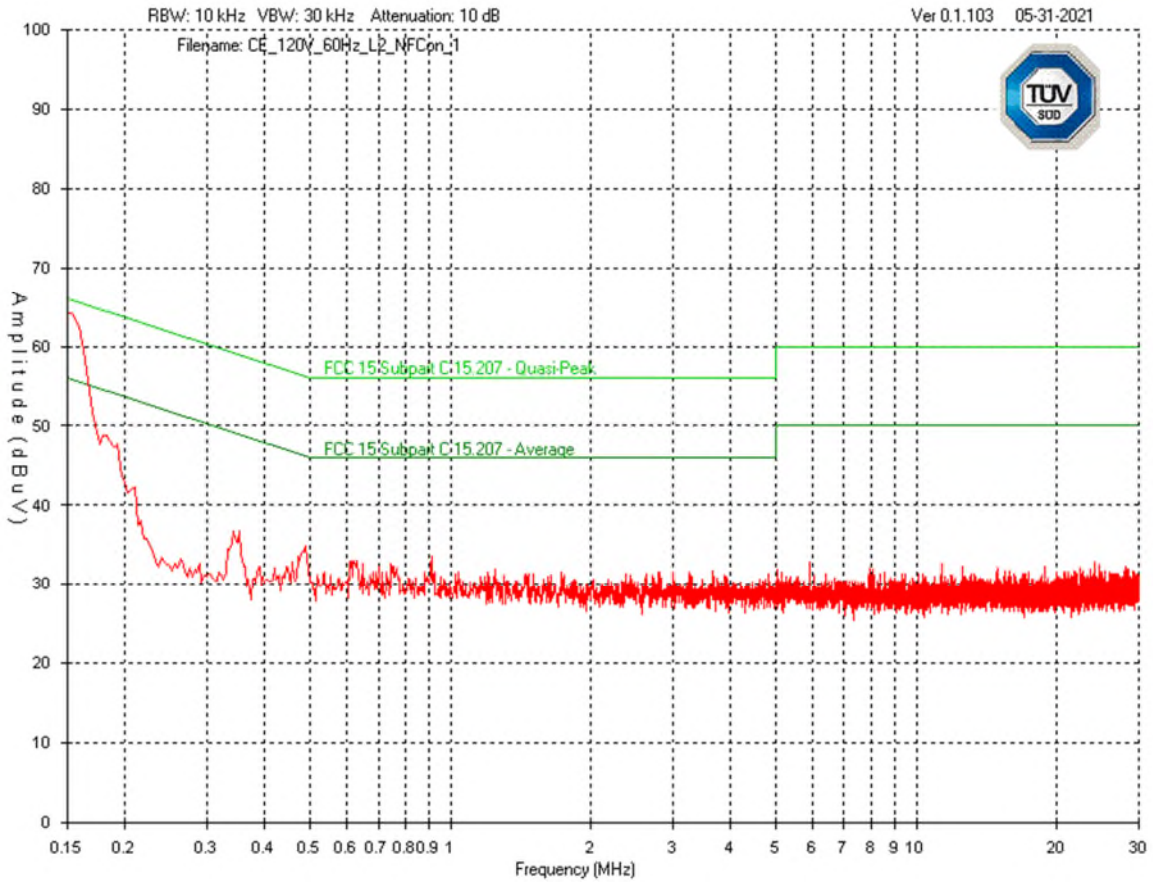
Line 2 (L2) – 120Vac 60Hz



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Final Measurements

Power Line Conducted Emissions Table
120V, 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											
0.153	PEAK	54.5	10	0.0	0.1	64.6	65.8	--	1.2	--	Pass
0.153	AVG	36.7	10	0.0	0.1	46.8	--	55.8	--	9.0	Pass
0.346	PEAK	28.9	10	0.1	0.1	39.1	59.1	49.1	20.0	10.0	Pass
26.713	PEAK	21.8	10	0.1	1.0	32.9	60.0	50.0	27.1	17.1	Pass
18.445	PEAK	21.8	10	0.1	0.6	32.5	60.0	50.0	27.5	17.5	Pass
14.073	PEAK	21.9	10	0.1	0.5	32.5	60.0	50.0	27.5	17.5	Pass
29.493	PEAK	17.2	10	0.1	1.1	28.4	60.0	50.0	31.6	21.6	Pass
Neutral											
0.153	PEAK	54.0	10	0.0	0.1	64.1	65.8	--	1.7	--	Pass
0.153	AVG	36.5	10	0.0	0.1	46.6	--	55.8	--	9.2	Pass
0.488	PEAK	24.7	10	0.1	0.1	34.9	56.2	46.2	21.3	11.3	Pass
0.352	PEAK	26.6	10	0.1	0.1	36.8	58.9	48.9	22.1	12.1	Pass
24.096	PEAK	22.1	10	0.1	0.7	32.9	60.0	50.0	27.1	17.1	Pass
5.895	PEAK	22.6	10	0.1	0.2	32.9	60.0	50.0	27.1	17.1	Pass
11.370	PEAK	22.2	10	0.1	0.3	32.6	60.0	50.0	27.4	17.4	Pass

Notes:

PEAK = Peak measurement
AVG = Average measurement

See photo exhibits for photos showing the test set-up.

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESL 6	Rohde & Schwarz	Feb. 12, 2021	Feb. 12, 2023	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	Feb. 10, 2021	Feb. 10, 2023	GEMC 303
RF Cable 3m	LMR-400-3M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 276
Attenuator 10 dB	6N10W-10	Inmet	NCR	NCR	GEMC 350
Emissions Software	0.1.103	TUV SUD Canada, Inc.	NCR	NCR	GEMC 58

'FCC_ICES003_CE_Rev1'

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20dB and 99% Occupied Bandwidth

Purpose

The purpose of this test is to find the 20 dB and 99% occupied bandwidths of the 13.56 MHz emission. This is the bandwidth which is attenuated 20 dB from the peak of the intentional transmission, and the bandwidth which contains 99% transmitted power, respectively.

Limits and Method

The method is as defined in ANSI C63.10.
There are no applicable limits for the 13.56 MHz emission. Its results are for informational purposes only.

Results

The 20dB BW measured is: 898 Hz
The 99% BW measured is: 1.990 kHz

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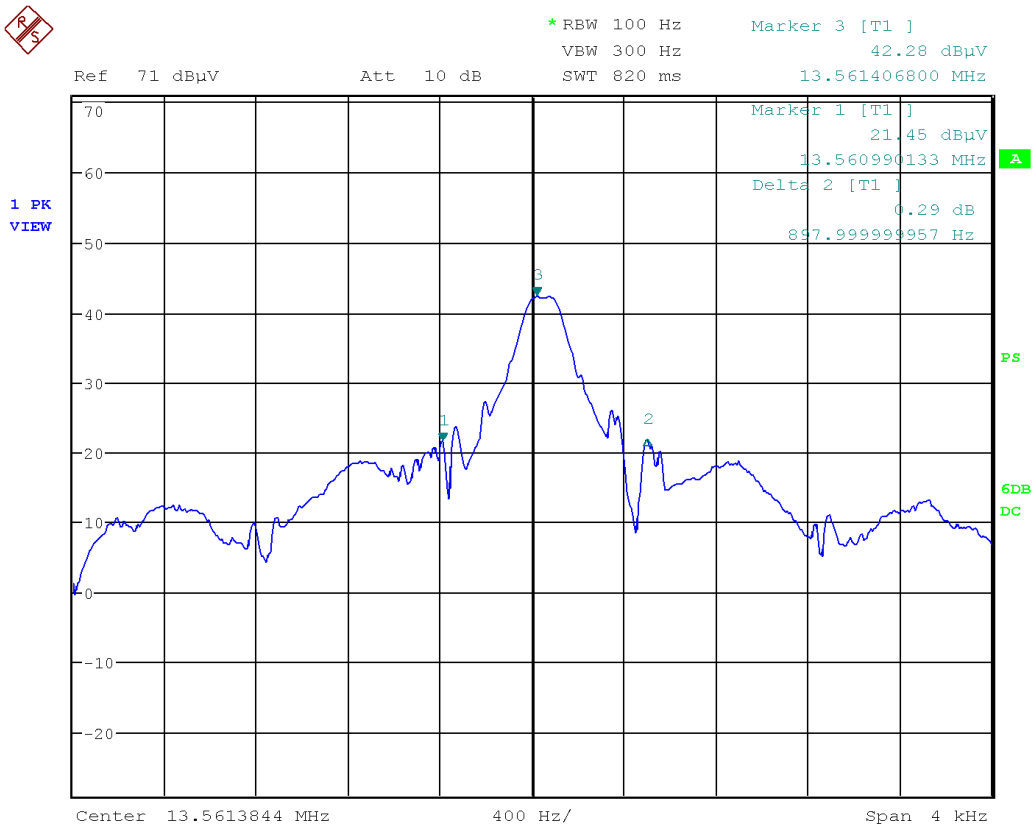
Graphs

20dB Bandwidth



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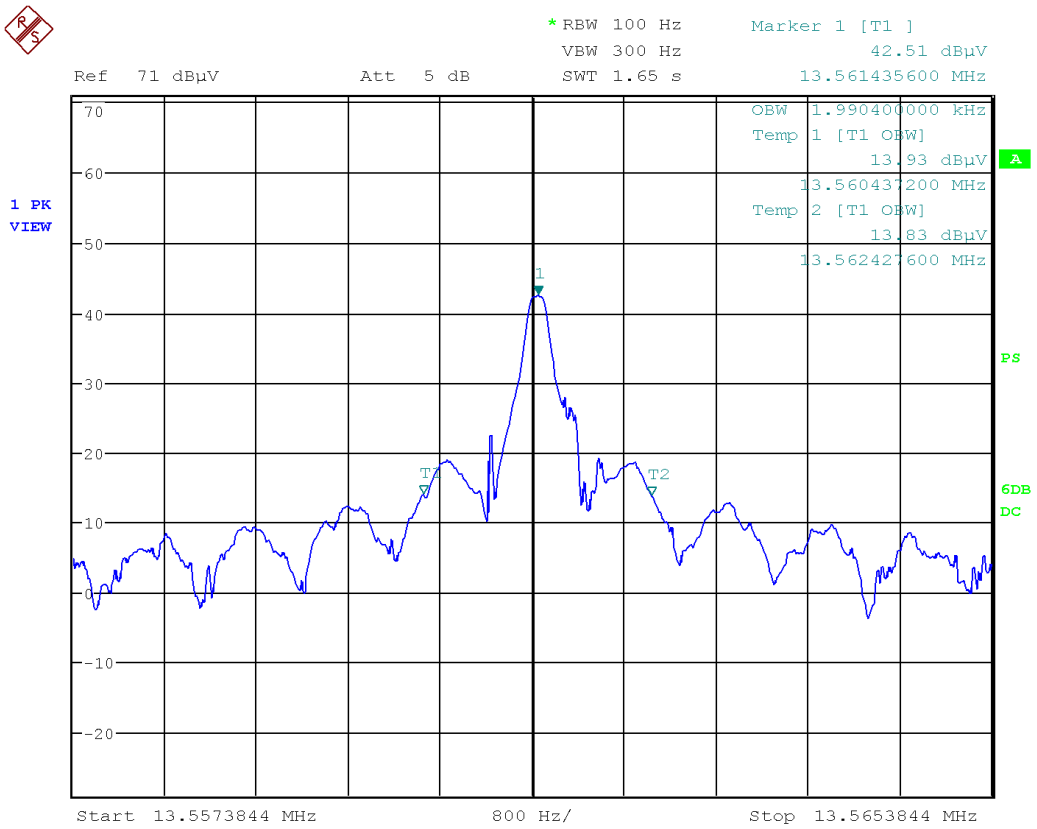
99% Bandwidth



See photo exhibits for photos showing the test set-up.

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 15, 2020	Jan. 15, 2022	GEMC 233
Loop Antenna	EM 6872	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 71
Pre-Amp	LNA 6901	Teseq	Feb. 12, 2021	Feb. 12, 2023	GEMC 168
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

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Appendix A – EUT Summary

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

General EUT Description

Client Details	
Organization / Address	Nicoya Lifesciences Inc. B-29 King Street East Kitchener, Ontario Canada, N2G 2K4
Contact	Jason Garr
Phone	1 877-673-6777
Email	jason@nicoyalife.com
EUT (Equipment Under Test) Details	
EUT Model/Name	Alto
Input voltage range(s) (V)	100-240
Frequency range(s) (Hz)	50-60
Rated input current (A)	4
Nominal power consumption (W)	400W
Basic EUT functionality description	The Alto instrument is used primarily by drug discovery labratories and research facilities for performing SPR analysis on molecule interactions.
I/O cable description	2x USB 3.0 Type A-B 3ft 2x Cat6 RJ45 6ft 1x RS-232 DB9-F-M 6ft
Peripherals required to exercise EUT	Keyboard + Mouse (usb) Laptop Computer
Dimensions of product (approx.)	L 510mm W 350mm H 405mm

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

For close-up pictures of the EUT, see photo exhibits.

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