EMC Test Report

As per

FCC Part 15 Subpart 15.250

Unlicensed Intentional Radiator

on the

Tenera Beacon

Issued by:

TÜV SÜD Canada Inc.
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Testing produced for

See Appendix A for full client & EUT details.

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

Testing Laboratory Certificate #2955.02

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

Registration # CA6844

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FCC_KDB_ICES003_Emissions_Rev1

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Report Scope

This report addresses the EMC verification testing and test results of the **Tenera Beacon**, herein referred to as EUT (Equipment Under Test). The EUT was tested for emissions compliance against the following standards:

FCC Part 15 Subpart 15.250

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.

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Summary

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

EUT:	Tenera Beacon
FCC Certification #, FCC ID:	2AYOO-TCB10001
EUT passed all tests performed	Yes
Tests conducted by	Min Xie

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

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Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.207	Power line conducted emissions	QuasiPeak Average	Pass
FCC 15.250 (a)	10 dB Bandwidth / Frequency Stability	Within 5920 – 7250 MHz Band	Pass
FCC 15.250 (b)	10 dB Bandwidth	> 50 MHz	Pass
15.250 (d) (4)/ FCC 15.209	Radiated emissions below 960 MHz	QuasiPeak	Pass
FCC 15.250 (d) (1)	Radiated Emission above 960 MHz	RMS Average 1 MHz Bandwidth	Pass
FCC 15.250 (d) (3)	Peak Power in 50 MHz Bandwidth	< 0 dBm EIRP	Pass
FCC 15.250 (d) (2)	Radiated Emission in GPS Band	RMS Average 1 kHz Bandwidth	Pass
FCC 1.1307 (b) (1)	Maximum Permissible Exposure	> 20 cm separation.	Pass See justification and calculations
Overall Result			**PASS**

If the product as tested complies with the specification or requirement, the EUT is deemed to comply and is issued a 'PASS' grade. If not, 'FAIL' grade is issued.

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Notes, Justifications, or Deviations

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

For the Antenna requirement specified in FCC 15.203, the unit uses a 1.39 dBi PCB antenna which is less than 6 dBi gain.

For maximum permissible exposure is designed to operate greater than 20 cm from any personnel during normal operation. No testing is required, however worst-case calculated exposure compliance follows later in this report.

A later revision of the standard may have been substituted in place of the previous dated referenced revision. The year of the specification used is listed under applicable standards. Using the later revision accomplishes the goal of ensuring compliance to the intent of the previous specification, while allowing the laboratory to incorporate the extensions and clarifications made available by a later revision.

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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

Margin = Limit – (Received Signal + Attenuation Factor + Cable Loss + LISN Factor)
Margin = 73.0dBµV – (50dBµV + 10dB + 2.5dB + 0.5dB)
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 447498 v06	RF Exposure Procedures And Equipment Authorization Policies For Mobile And Portable Devices
ISO 17025:2017	General requirements for the competence of testing and calibration laboratories

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Document Revision Status

Revision	Date	Description
Draft		Initial Release

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Definitions and Acronyms

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

LISN – Line Impedance Stabilization Network
NCR – No Calibration Required
NSA – Normalized Site Attenuation
N/A – Not Applicable
RF – Radio Frequency
RBW – Resolution Bandwidth

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 refers to the 6 dB bandwidth

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 of telecommunication messages and which may be equipped with one or more terminal ports typically operated for information transfer.

EMC Test Plan – An EMC test plan established prior to testing. See 'Appendix A – EUT & Client Provided Details'

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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)
2020 May 19 - 22	Transmitter Spurious	MX	22.9 – 24.5	26.6 – 33.4	101.7 – 102.4
2020 Jun 8	Bandwidth	MX	22.8	53.1	99.9
2020 Jun 8	Fundamental Emission	MX	22.8	53.1	99.9
2020 Jul 27	Frequency Stability	MX	25.1	62.5	100.5
2020 Jun 6	Power Line Conducted Emission	MX	25.6	47.5	101.0

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Detailed Test Result Section

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Temperature Frequency Stability

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the permitted bandwidth during extreme temperature 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 in any temperature.

Limit(s) and Method

The methods are given in FCC Part C63.10. There limits given in FCC Part 15.250 a).

The −10 dB bandwidth of a device operating under the provisions of this section must be contained within the 5925-7250 MHz band under all conditions of operation including the effects from stepped frequency, frequency hopping or other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

Frequency must be maintained from -20 C to +50 C. The EUT is monitored at each 10 degree increment. At each temperature, the device is checked after a stabilization period required for the device to reach the temperature.

Measurements

The worst case results are presented, with the frequency shown. The device was checked at each 10 degrees increment of temperature

Temperature (^oC)	-10 dB Band Edges		FCC 15.250 Frequency Band		Results
	F_L (MHz)	F_H (MHz)	F_{MIN} (MHz)	F_{MAX} (MHz)	
50	6165	6774	5925	7250	Pass
40	6161	6791	5925	7250	Pass
30	6161	6771	5925	7250	Pass
20	6165	6707	5925	7250	Pass
10	6152	6774	5925	7250	Pass
0	6142	6771	5925	7250	Pass
-10	6139	6776	5925	7250	Pass
-20	6161	6707	5925	7250	Pass

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Voltage (Vac, 60 Hz) @ 20 °C	-10 dB Band Edges		FCC 15.250 Frequency Band		Results
	F_L (MHz)	F_H (MHz)	F_{MIN} (MHz)	F_{MAX} (MHz)	
85	6165	6779	5925	7250	Pass
120	6165	6707	5925	7250	Pass
276	6163	6779	5925	7250	Pass

Note: the power supply is rated from 100 – 240 Vac 50/60 Hz. The supply voltage is

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	FSQ26	Rohde & Schwarz	Oct. 25, 2019	Oct. 25, 2021	GEMC 234
AC Power Source	5001 iX	California Instruments	Feb. 12, 2019	Feb. 12, 2021	GEMC 47
Data Acquisition	3470A	Agilent	Nov 20, 2019	Nov 20, 2020	CANE00201
Thermocouple Module	TM500	Extech	Jul 02, 2020	Jul 02, 2021	CANE00199
Environmental Chamber	SH-241	ESPEC	NCR	NCR	CANE00196

This report module is based on GEMC template "FCC - 15.225 - RFID Freq Stab_Rev1.doc"

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10 Bandwidth

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

The Limit is as specified in FCC Part 15.250 (b).

The −10 dB bandwidth of the fundamental emission shall be at least 50 MHz.

Results

The EUT complies with the requirements.

f_M	Highest emission peak	6.5349 GHz
F_L	10 dB below highest peak	6.2013 GHz
F_H	10 dB below highest peak	6.7687 GHz
Bandwidth	Calculated (F_H - F_L)	0.5674 GHz

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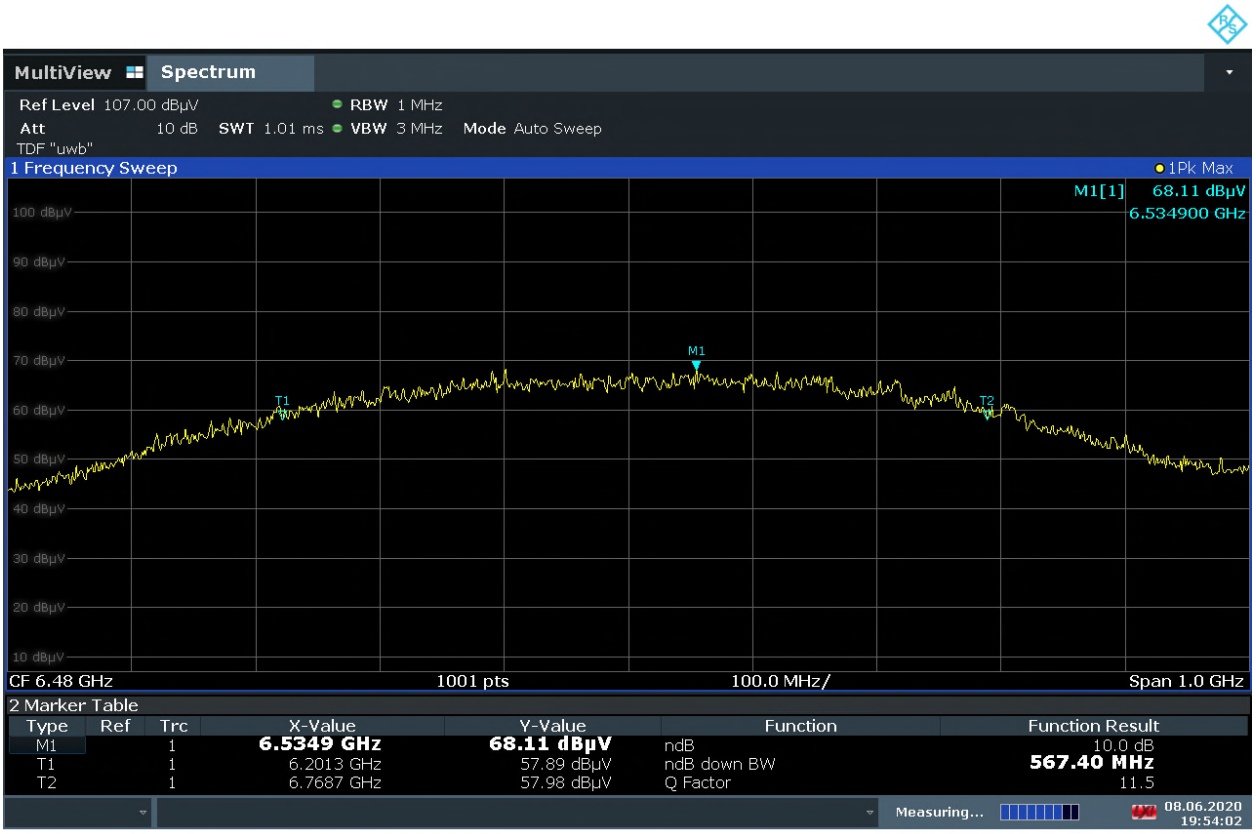
Graph(s)

The graphs showed below shows the -10 dB bandwidth during the operation of the device. This is measured by a max hold on the spectrum analyzer with a 1 MHz resolution bandwidth and a 3 MHz video bandwidth. This measurement is a peak measurement.

-10 dB Bandwidth



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Note: See 'Appendix B – EUT & Test Setup Photographs' 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 due date	Asset #
Spectrum Analyzer	FSW26	Rohde & Schwarz	Jul 11, 2019	Jul 11, 2020	Rental
Horn Antenna 1 – 18 GHz	3117	ETS-Lindgren	Feb. 17, 2020	Feb. 17, 2022	GEMC 340
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Jun. 12, 2018	Jun. 12, 2020	GEMC 312
RF Cable 2.2 m	Micro-Coax	UTiFLEX	Mar. 23, 2020	Mar, 23, 2021	GEMC 344

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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.

Limit(s) and Method

The method is as defined in C63.10 and 15.250 (e). The limits are as defined in FCC Part 15.250 (d) Emissions from a transmitter operating under this section shall not exceed the following equivalent isotropically radiated power (EIRP) density levels:

(1) The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following RMS average limits based on measurements using a 1 MHz resolution bandwidth.

Frequency (MHz)	EIRP (dBm)	Field Strength at 3m (dBµV/m)	Field Strength at 1m (dBµV/m)
960-1610	−75.3	19.9	29.5
1610-1990	−63.3	31.9	41.5
1990-3100	−61.3	33.9	43.5
3100-5925	−51.3	43.9	53.5
5925-7250	−41.3	53.9	63.5
7250-10600	−51.3	43.9	53.5
Above 10600	−61.3	33.9	43.5

(2) In addition to the radiated emission limits specified in the table in paragraph (d)(1) of this section, transmitters operating under the provisions of this section shall not exceed the following RMS average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency (MHz)	EIRP (dBm)	Field Strength at 3m (dBµV/m)	Field Strength at 1m (dBµV/m)
1164-1240	−85.3	9.9	19.5
1559-1610	−85.3	9.9	19.5

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The relationship between field strength and EIRP is give in ANSI C 63.10 Section 9.5, Equation (22):

ERIP(dBm) = E(dBµV/m) + 20log(d) – 104.7

And rearranging the equation for field strength:

E(dBµV/m) = ERIP(dBm) - 20log(d) + 104.7

(4) Radiated emissions at or below 960 MHz shall not exceed the emission levels in §15.209:

Frequency (MHz)	Field Strength	Field Strength at 3m (dBµV/m) [a]
0.009 MHz – 0.490 MHz	2400/F(kHz) uV/m at 300m[a]	128.5 to 93.8
0.490 MHz – 1.705 MHz	24000/F(kHz) uV/m at 30m[a]	73.8 to 63
1.705 MHz – 30 MHz	30 uV/m at 30m[a]	69.5
30 MHz – 88 MHz	100 uV/m at 3m	40
88 MHz – 216 MHz	150 uV/m at 3m	43.5
216 MHz – 960 MHz	200 uV/m at 3m	46

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

Spurious radiated emissions of the EUT was performed at 1 meter for frequencies above 960 MHz and at 3 meters for frequencies below 960 MHz.

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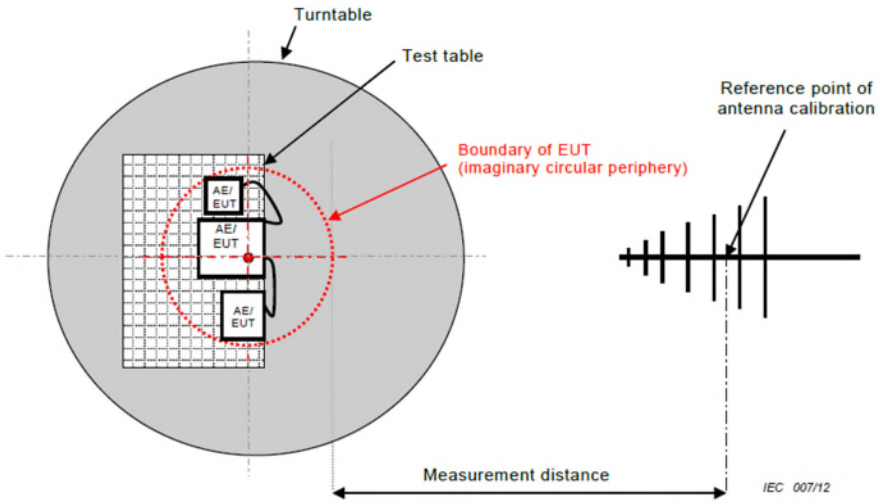
Typical Radiated Emissions Setup



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±5.67dB for 30MHz – 1GHz and ±4.58dB for 1GHz – 18GHz with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

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 0-360 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 of the highest fundamental frequency or to 40 GHz, whichever is lower.

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.

Measurement with the loop antennas are performed in three octangular axis, and the worst case results are presented.

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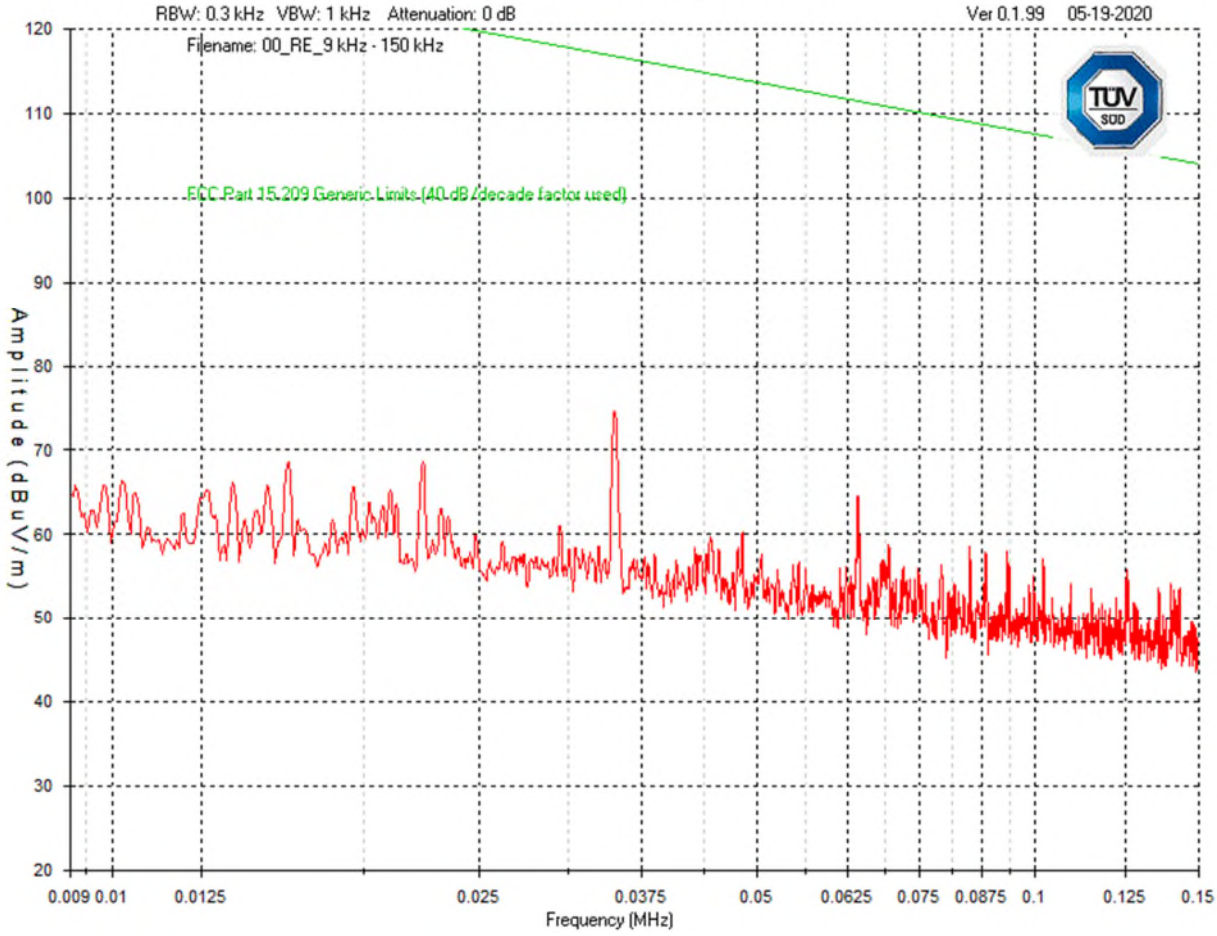
9 kHz – 150 kHz
Peak Emission Graph



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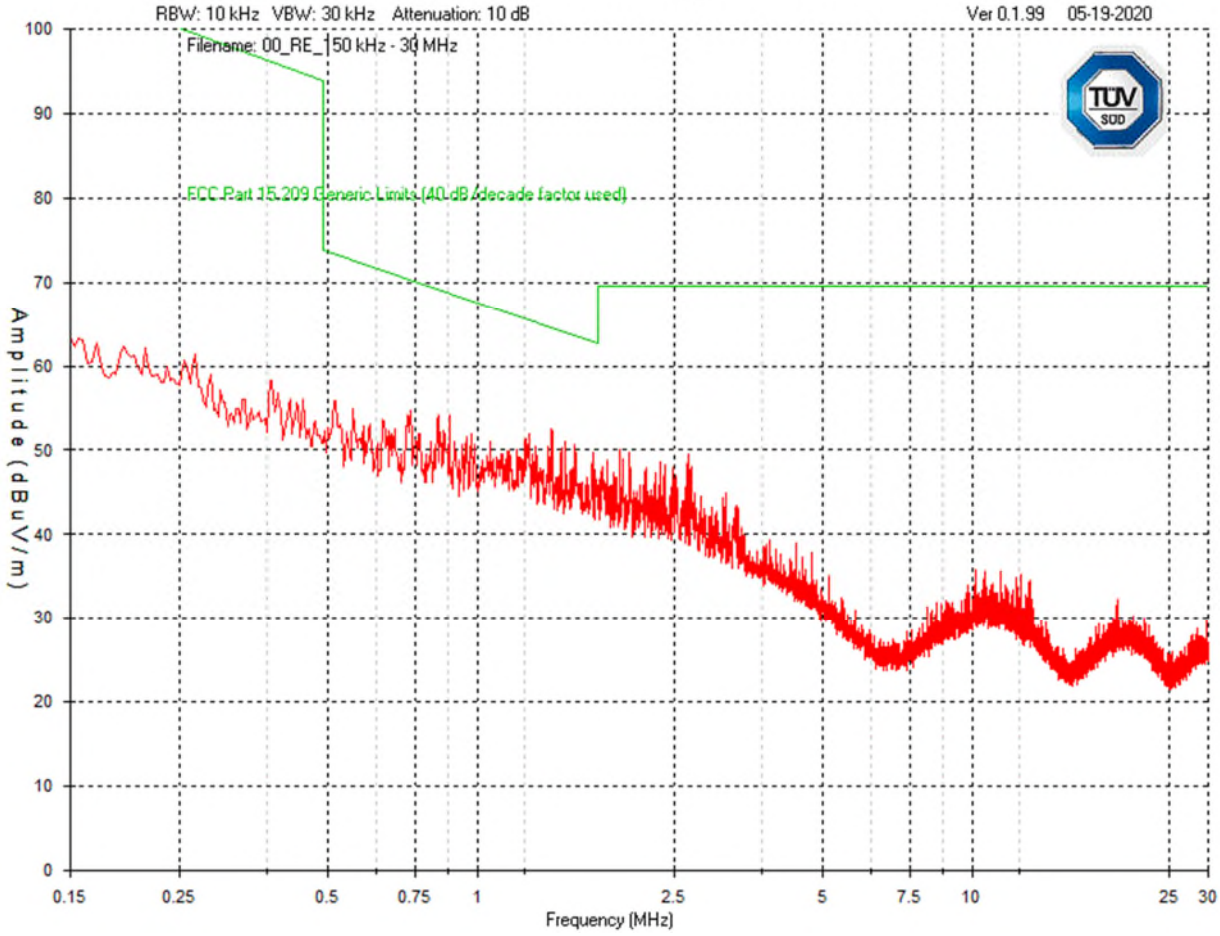
150 kHz – 30 MHz
Peak Emission Graph



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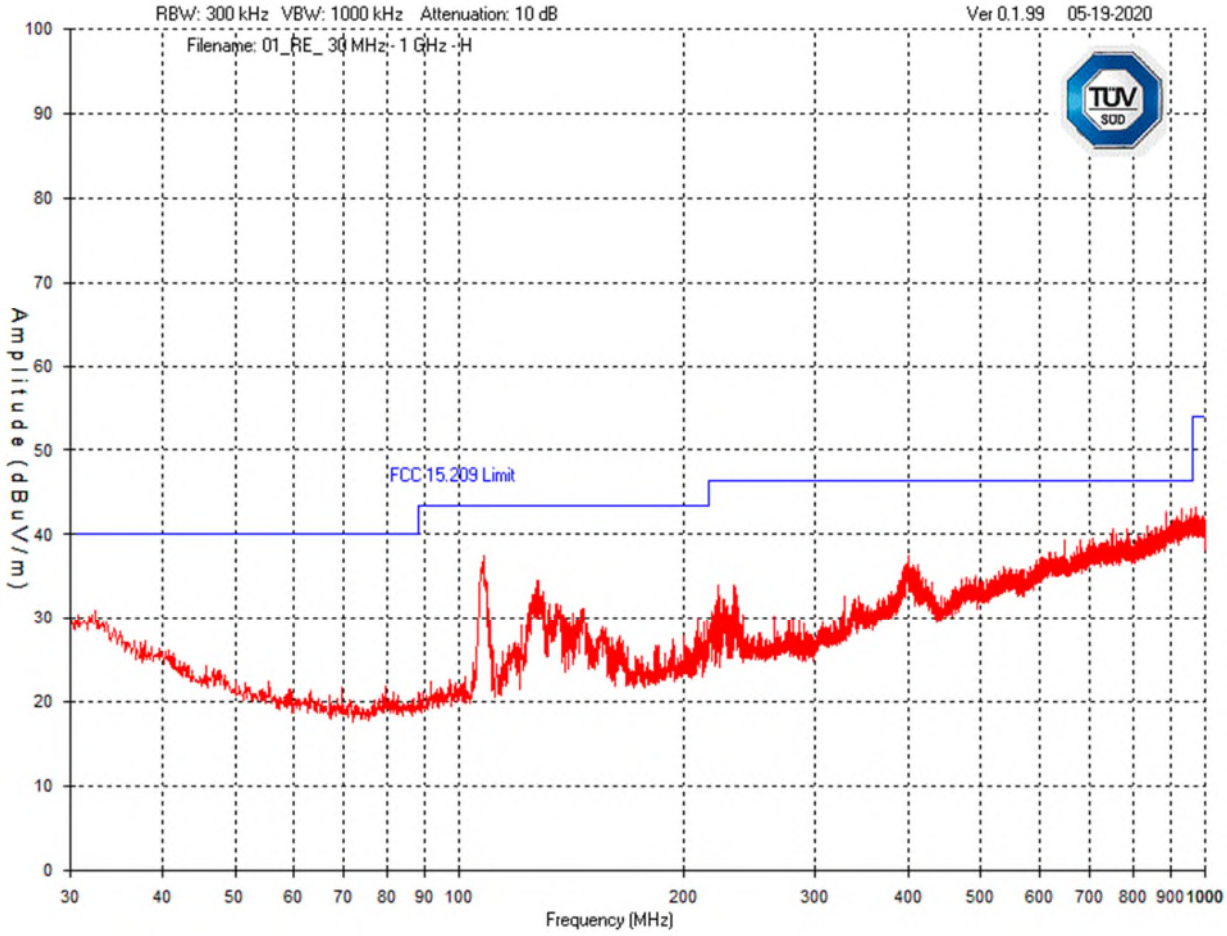
30 MHz – 960 MHz
Horizontal - Peak Emission Graph



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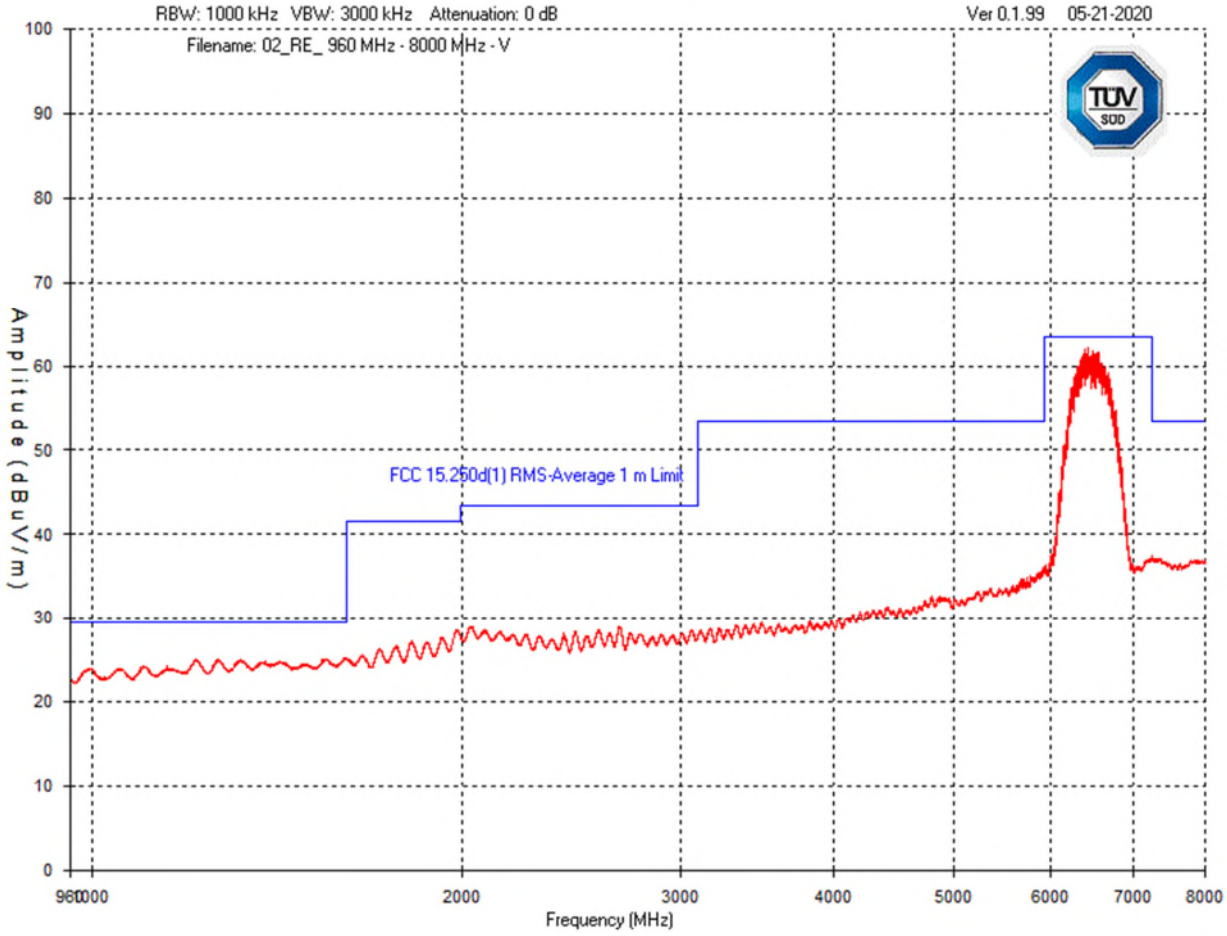
0.96 GHz – 8 GHz
Horizontal – RMS Average Graph



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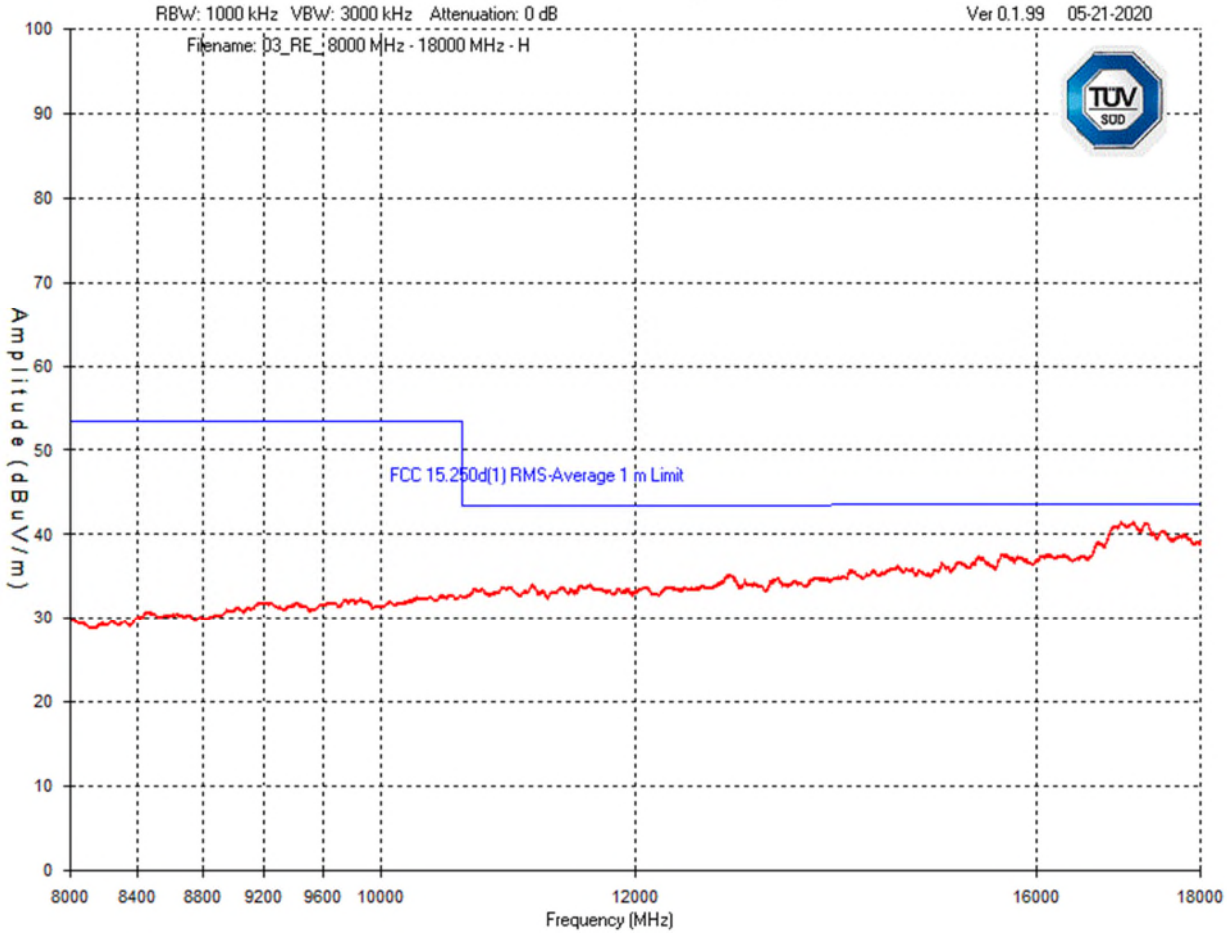
8 GHz – 18 GHz
Horizontal - RMS Average Graph



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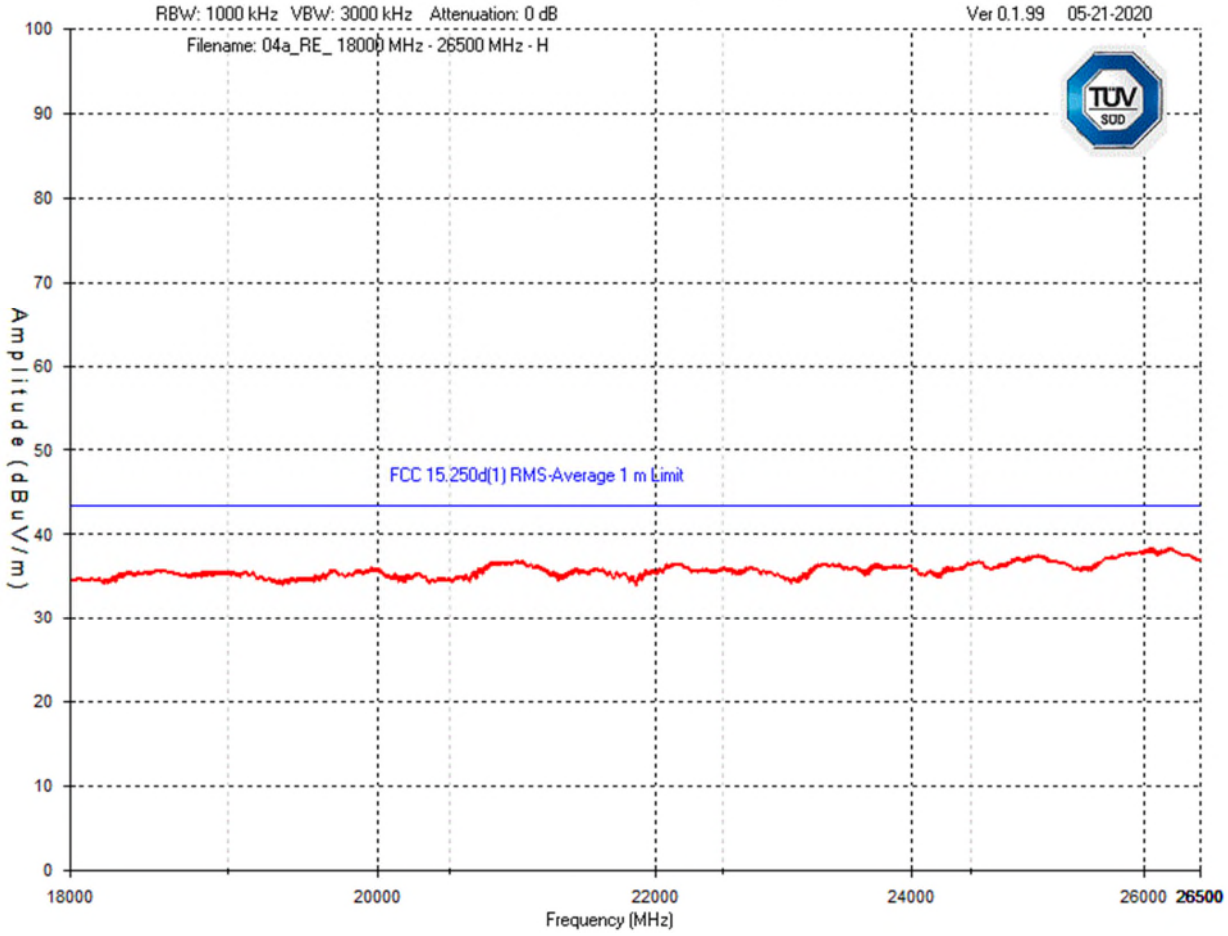
18 GHz – 26.5 GHz
Horizontal - RMS Average Graph



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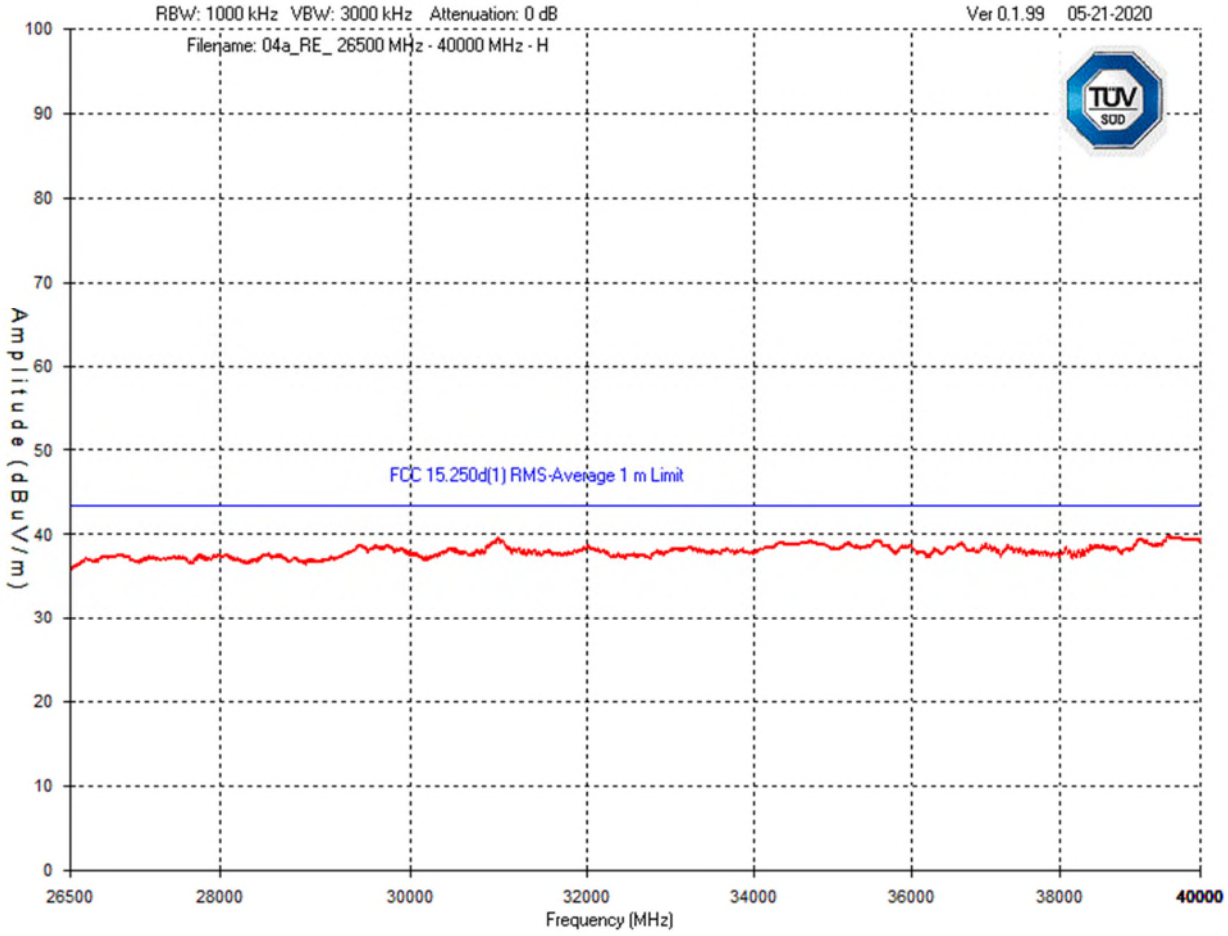
26 GHz – 40 GHz
Horizontal - RMS Average Graph



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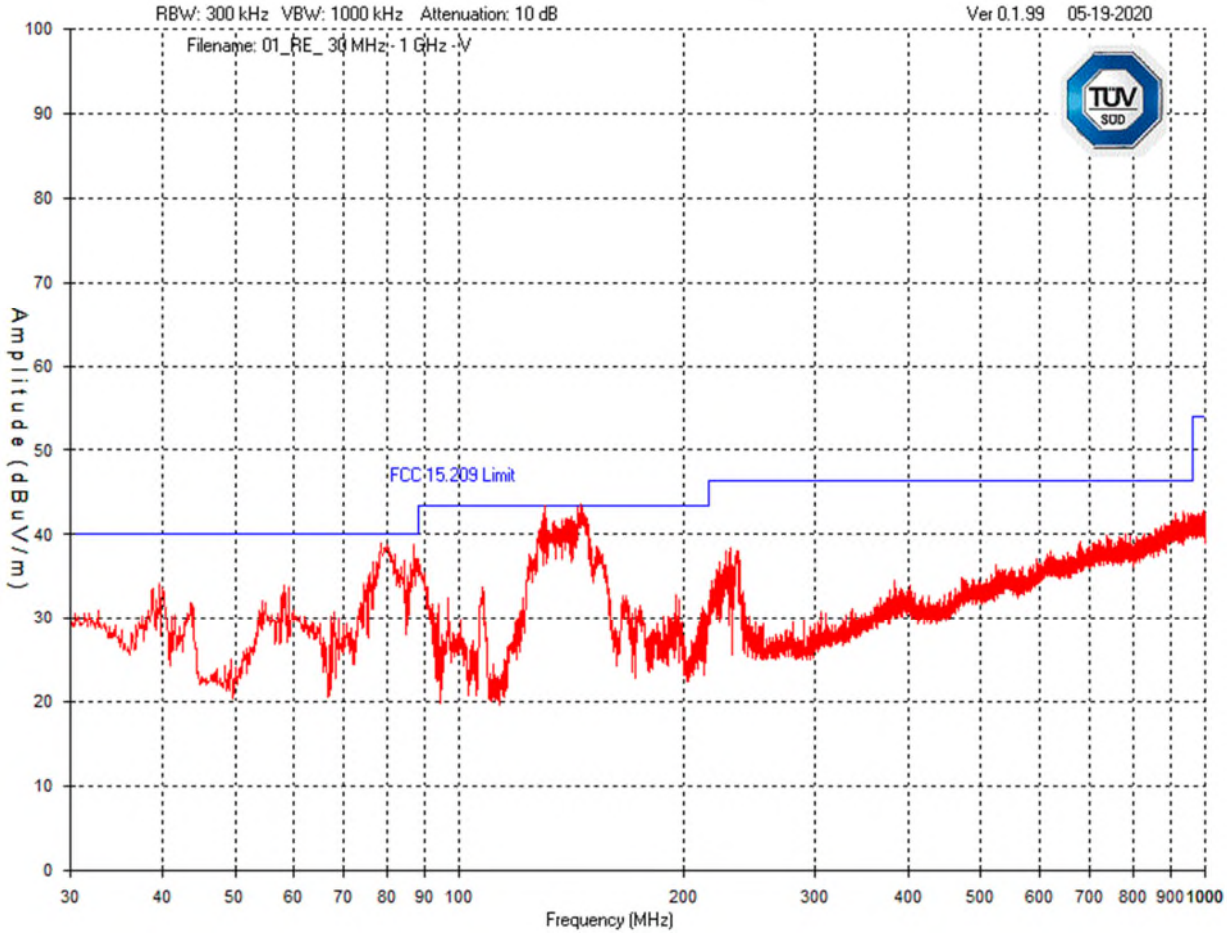
30 MHz – 960 MHz
Vertical- Peak Emission Graph



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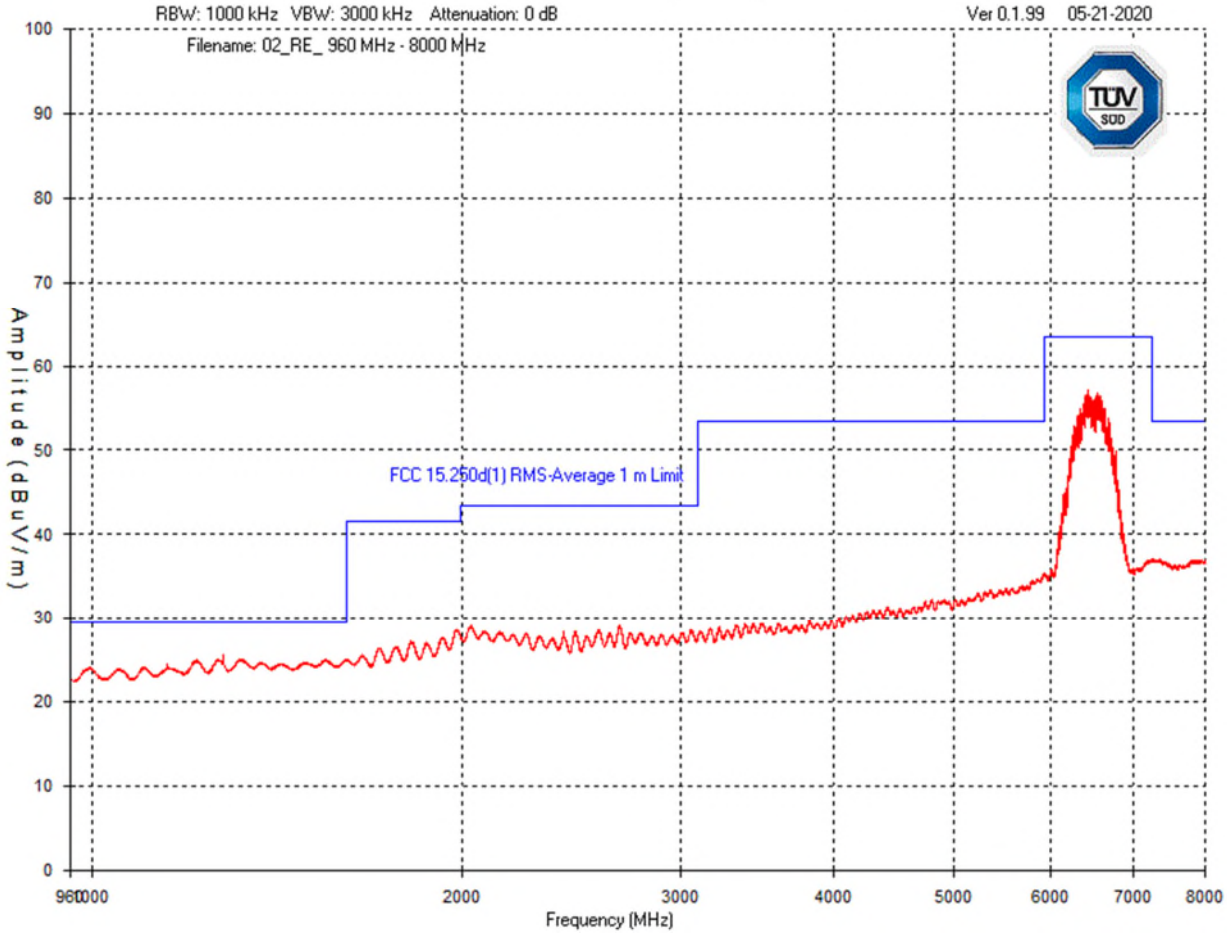
0.96 GHz – 8 GHz
Vertical– RMS Average Graph



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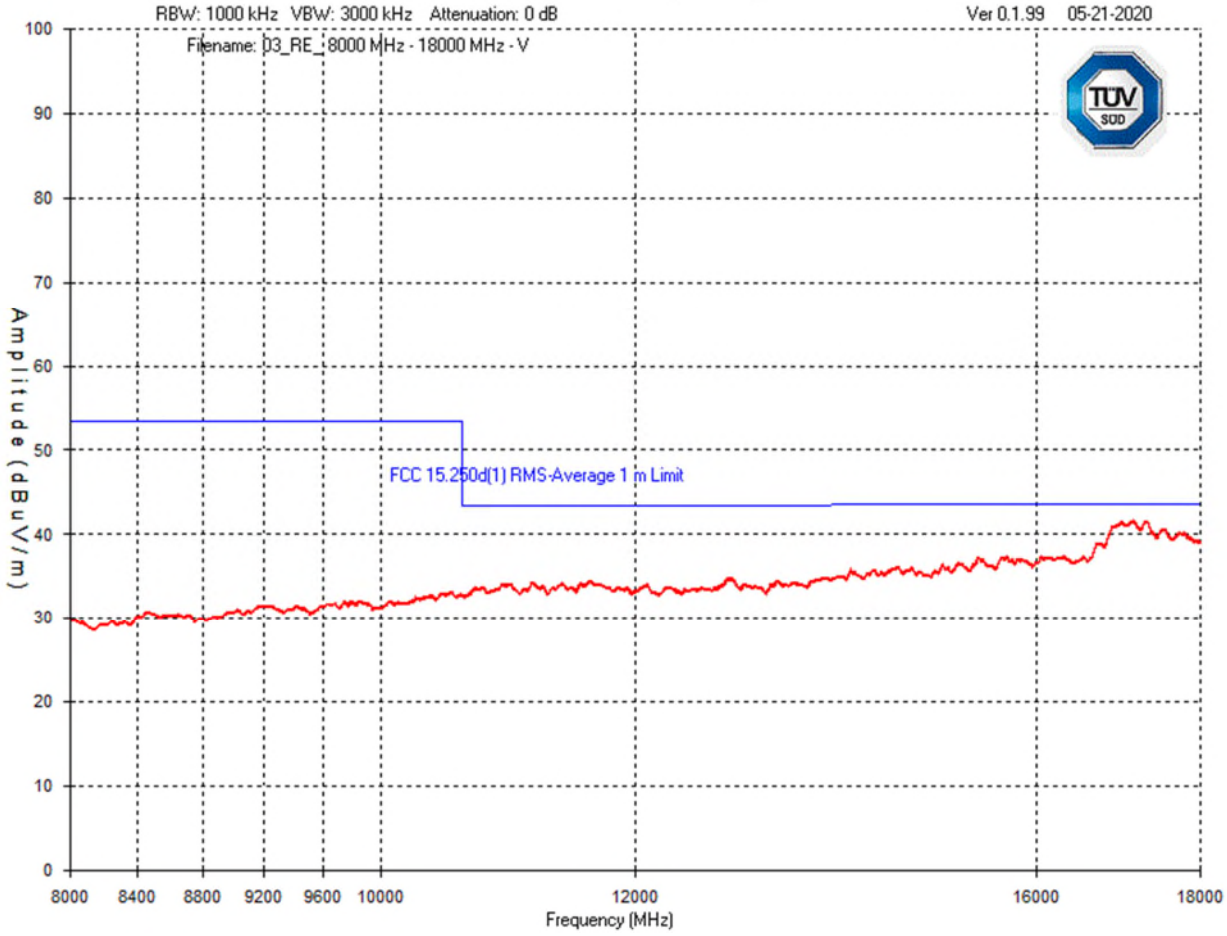
8 GHz – 18 GHz
Vertical- RMS Average Graph



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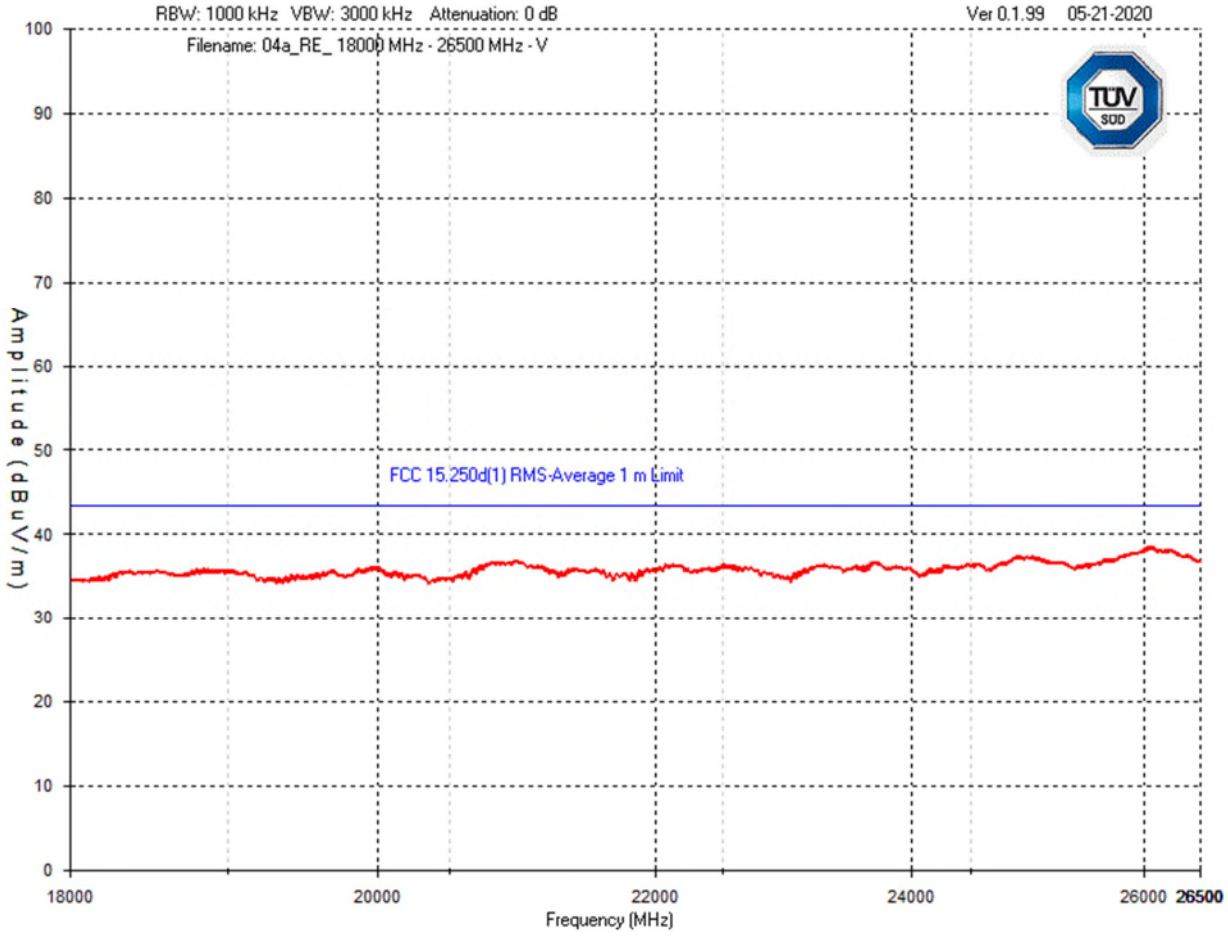
18 GHz – 26.5 GHz
Vertical- RMS Average Graph



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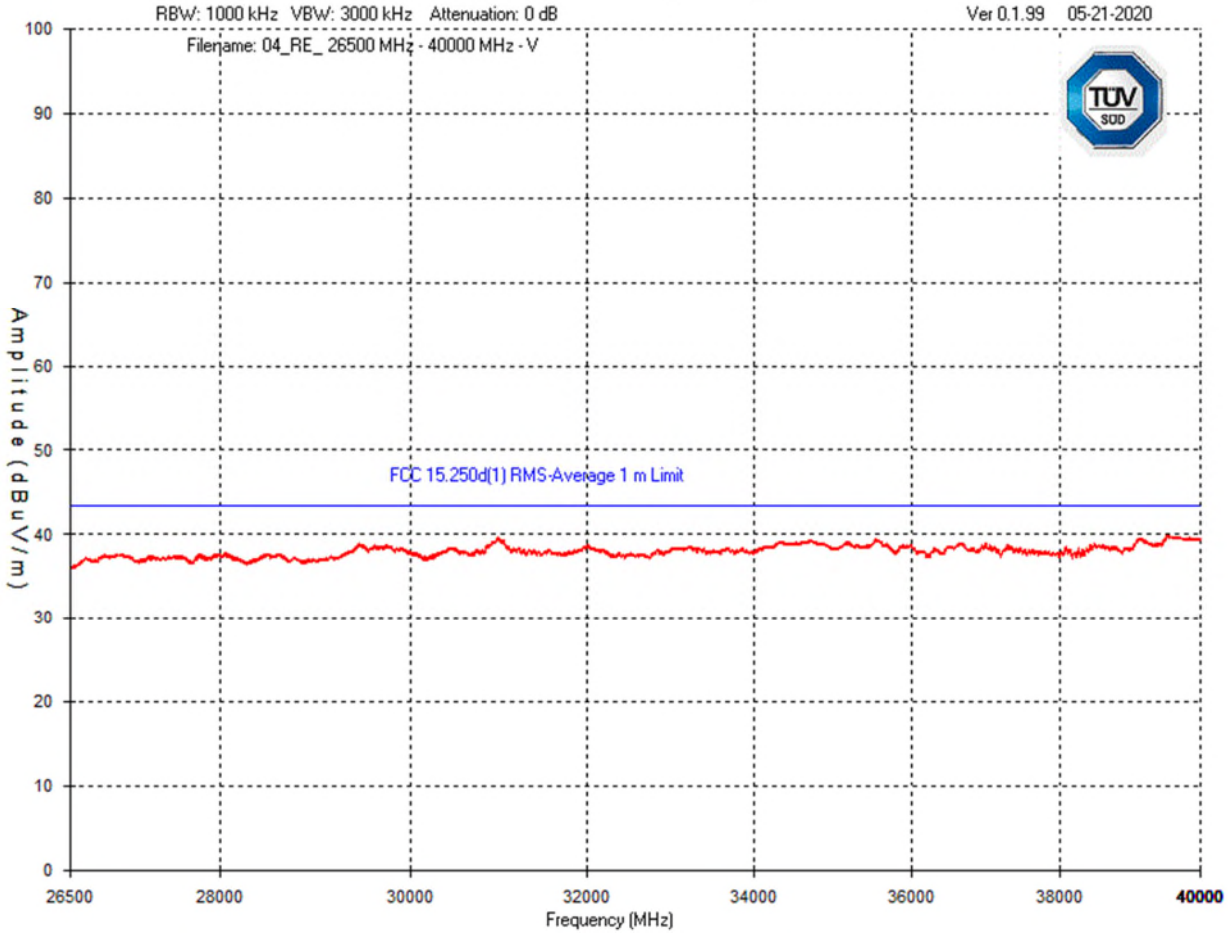
26.5 GHz – 40 GHz
Vertical- RMS Average Graph



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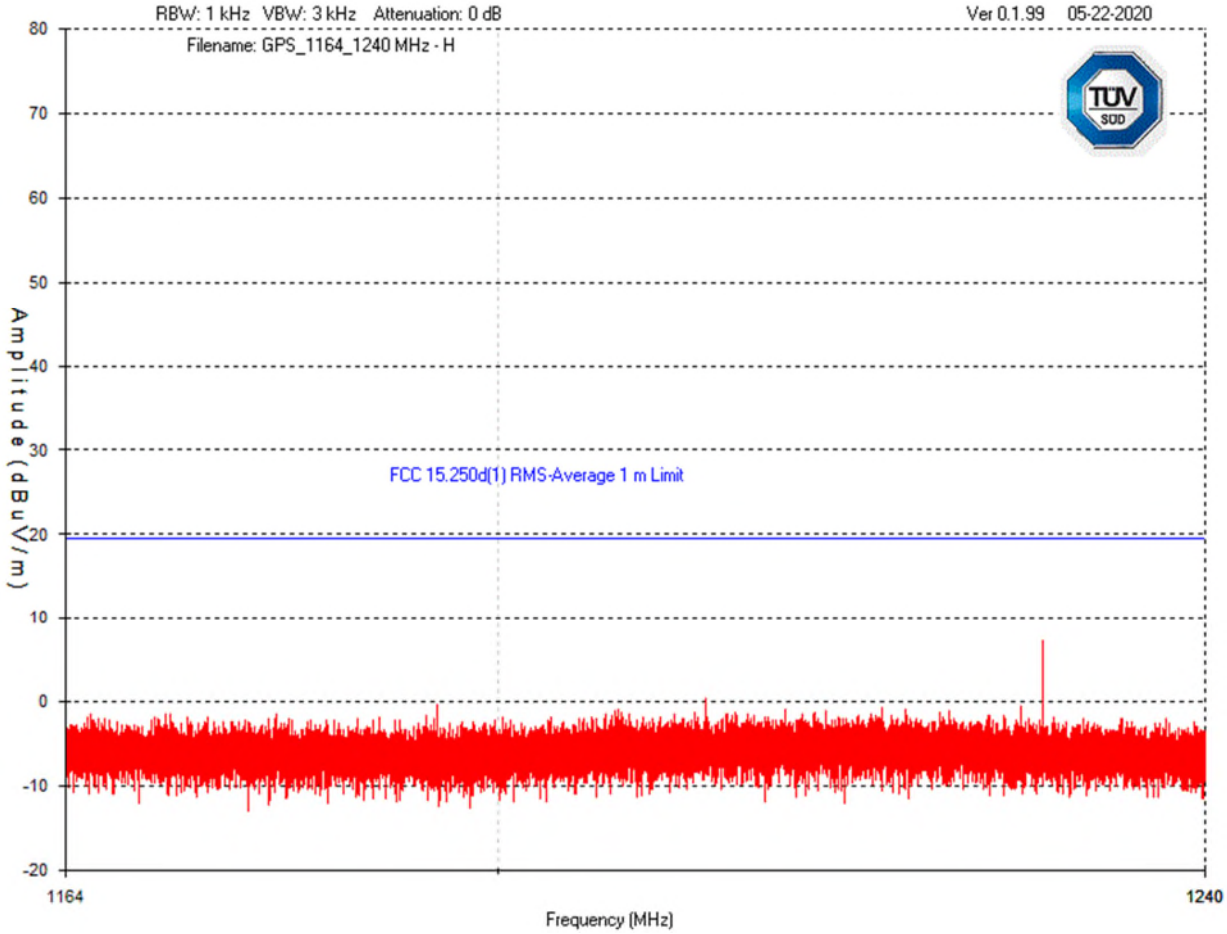
Emission in GPS Band

1164 MHz – 1240 MHz

Horizontal – RMS Emission with RBW = 1 kHz



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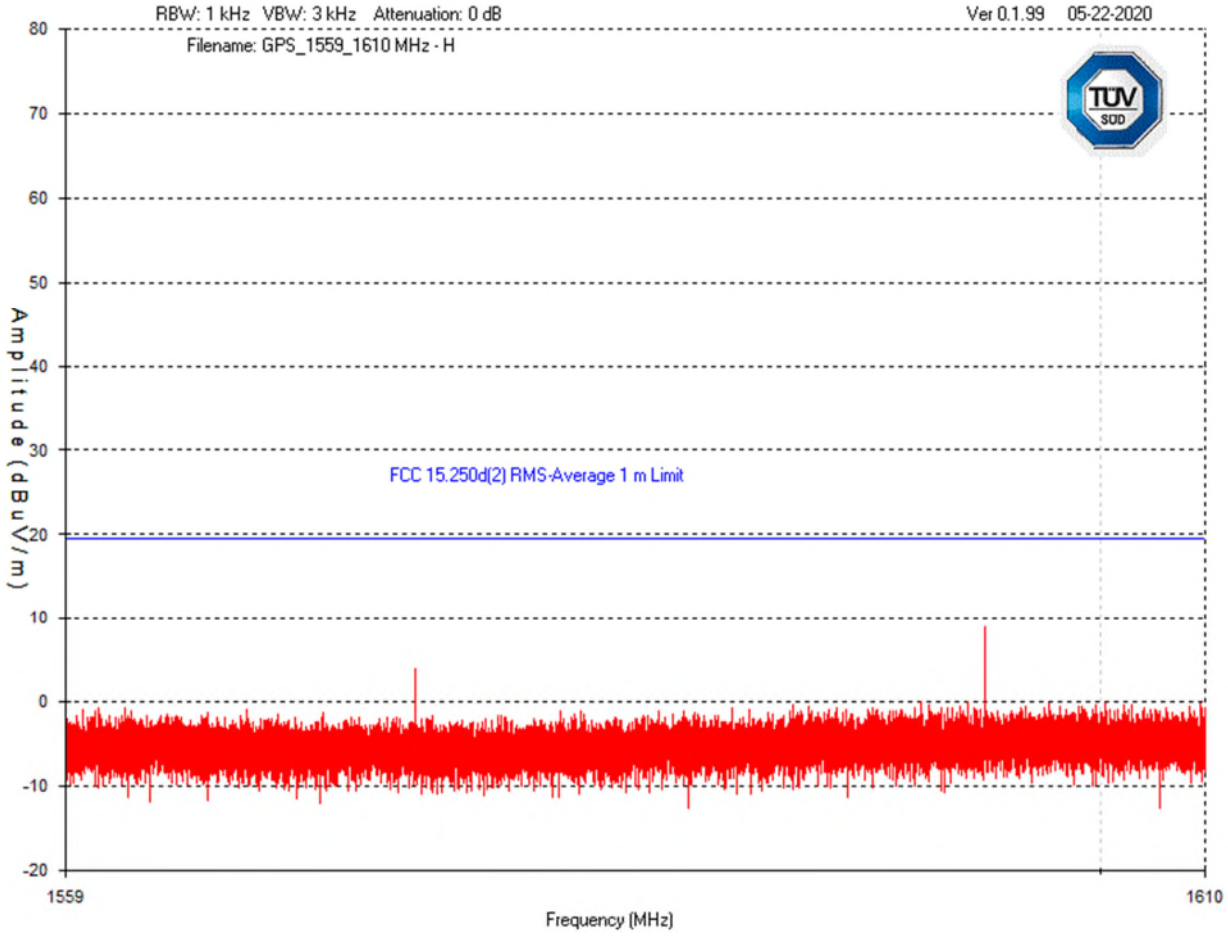
1559 MHz – 1610 MHz
Horizontal – RMS Emission with RBW = 1 kHz



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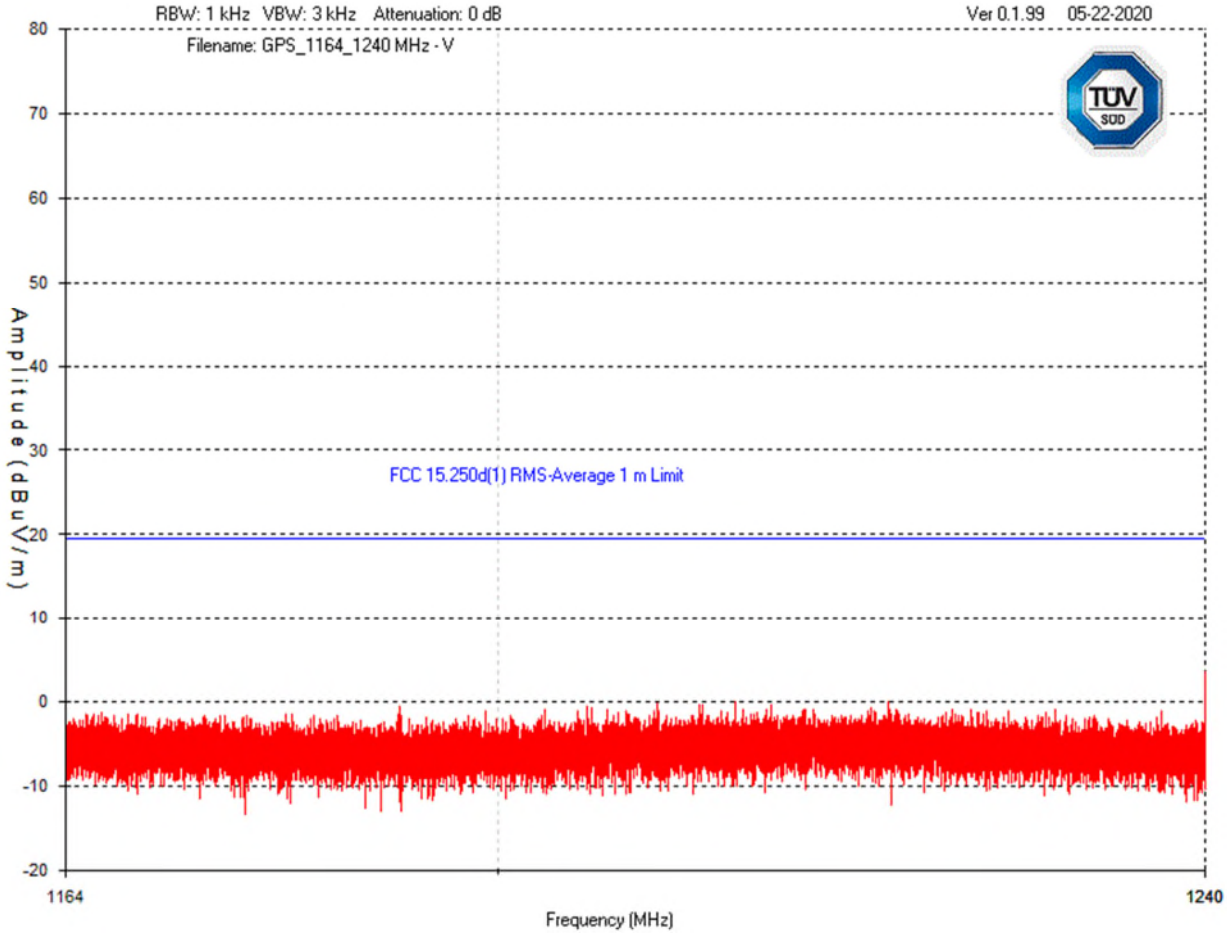
1164 MHz – 1240 MHz
Vertical – RMS Emission with RBW = 1 kHz



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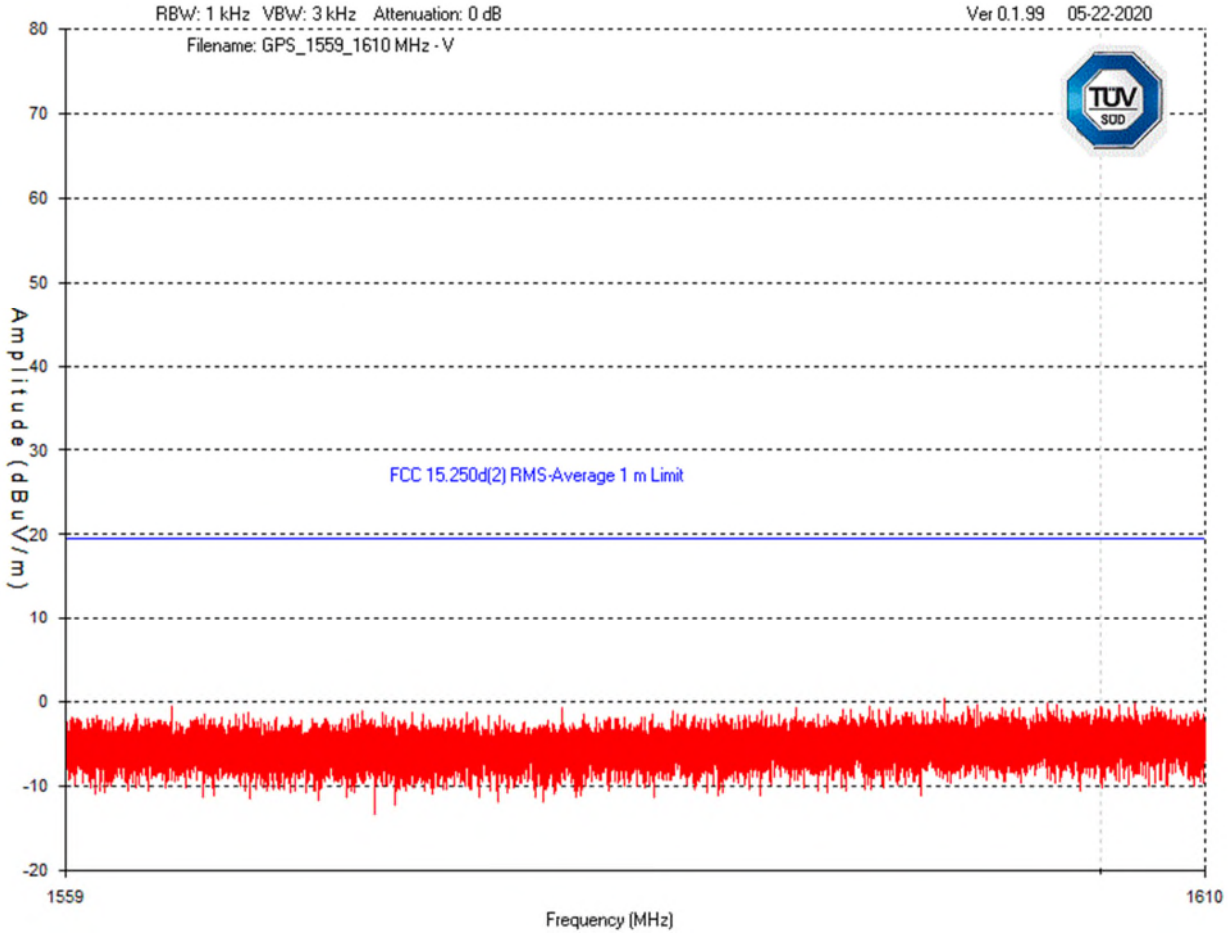
1559 MHz – 1610 MHz
Vertical – RMS Emission with RBW = 1 kHz



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Final Measurements and Results

The EUT passed.

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.

Frequency (MHz)	Detector	Received Signal (dBµV)	Antenna Factor (dB/m)	Atten Factor (dB)	Cable Factor (dB)	Pre-Amp (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Test Result
Horizontal Antenna Polarization										
107.78	PEAK	51.1	13.9	0	1.0	-28.5	37.5	43.5	6.0	Pass
127.39	PEAK	49.1	12.8	0	1.1	-28.4	34.6	43.5	8.9	Pass
400.43	PEAK	41.4	22.1	0	2.6	-28.6	37.5	46.4	8.9	Pass
32.52	PEAK	36.8	22.1	0	0.5	-28.5	30.9	40.0	9.1	Pass
132.24	PEAK	46.2	12.8	0	1.2	-28.5	31.7	43.5	11.8	Pass
146.13	PEAK	44.1	14.3	0	1.3	-28.5	31.2	43.5	12.3	Pass
17146.90	RMS	30.3	36.8	0	3.1	-28.7	41.5	43.5	2.0	Pass
Vertical Antenna Polarization										
145.25	QP	42.3	14.1	0	1.3	-28.5	29.2	43.5	14.3	Pass
130.01	QP	39.5	12.8	0	1.2	-28.5	25.0	43.5	18.5	Pass
78.35	QP	37.1	12.2	0	0.9	-28.5	21.7	40.0	18.3	Pass
86.90	QP	35.6	12.9	0	0.9	-28.5	20.9	40.0	19.1	Pass
74.96	QP	29.5	12.2	0	0.8	-28.5	14.0	40.0	26.0	Pass
39.61	PEAK	43.8	18.3	0	0.6	-28.5	34.2	40.0	5.8	Pass
17149.80	RMS	30.3	37.0	0	3.1	-28.7	41.7	43.5	1.8	Pass

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

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

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 12, 2018	Jan. 12, 2020	GEMC 233
Loop Antenna	EM 6871	Electro-Metrics	Feb 13, 2017	Feb 13, 2019	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	Feb 13, 2017	Feb 13, 2019	GEMC 71
BiLog Antenna	3142-C	ETS-Lindgren	Oct. 19, 2018	Oct. 19, 2020	GEMC 8
Horn Antenna 1 – 18 GHz	3117	ETS-Lindgren	Feb. 17, 2020	Feb. 17, 2022	GEMC 340
BiLog Antenna	HLP-3003C	TDK RF Solutions	Oct. 19, 2018	Oct. 19, 2020	GEMC 231
Horn Antenna 2 – 18 GHz	WBH218HN	Q-par	Feb. 27, 2018	Feb. 27, 2020	GEMC 6375
Horn Antenna 18 – 26.5 GHz	SAS-572	A.H. Systems	Oct 11, 2016	Oct 11, 2018	GEMC 6371
Horn Antenna 26.5 to 40GH)	QSH22F20S	Q-par	Jan. 10, 2020	Jan. 10, 2022	GEMC 6376
Pre-Amp 9 kHz – 1 GHz	LNA 6901	Teseq	Feb. 25, 2019	Feb. 25, 2021	GEMC 168
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Jun. 12, 2018	Jun. 12, 2020	GEMC 312
Pre-Amp 18-40GHz	PAM-840A	Com-Power Corporation	Mar. 20, 2019	Mar. 20, 2021	GEMC 252
Attenuator 6 dB	612-6-1	Meca Electronics, Inc	NCR	NCR	GEMC 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
RF Cable 2.2 m	Micro-Coax	UTiFLEX	Mar. 23, 2020	Mar, 23, 2021	GEMC 344
Emissions Software	0.1.99	Global EMC	NCR	NCR	GEMC 58

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Output 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.

Limit(s) and Method

The method is as defined in C63.10 and 15.250 (e). The limits are as defined in FCC Part 15.250 (d) Emissions from a transmitter operating under this section shall not exceed the following equivalent isotropically radiated power (EIRP) density levels:

(1) The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following RMS average limits based on measurements using a 1 MHz resolution bandwidth.

Frequency (MHz)	EIRP (dBm)	Field Strength at 3m (dBµV/m)
5925-7250	−41.3	53.9

(3) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, and this 50 MHz bandwidth must be contained within the 5925-7250 MHz band. The peak EIRP limit is 20 log (RBW/50) dBm where RBW is the resolution bandwidth in megahertz that is employed by the measurement instrument. Using an RBW of 50 MHz, the peak EIRP limit is 0 dBm.

Frequency (MHz)	EIRP (dBm)	Field Strength at 3m (dBµV/m)
5925-7250	0	95.2

The relationship between field strength and EIRP is give in ANSI C 63.10 Section 9.5, Equation (22):

$$ERIP(dBm) = E(dB\mu V/m) + 20\log(d) - 104.7$$

And rearranging the equation for field strength:

$$E(dB\mu V/m) = ERIP(dBm) - 20\log(d) + 104.7$$

Spurious radiated emissions of the EUT was performed at 3 meters.

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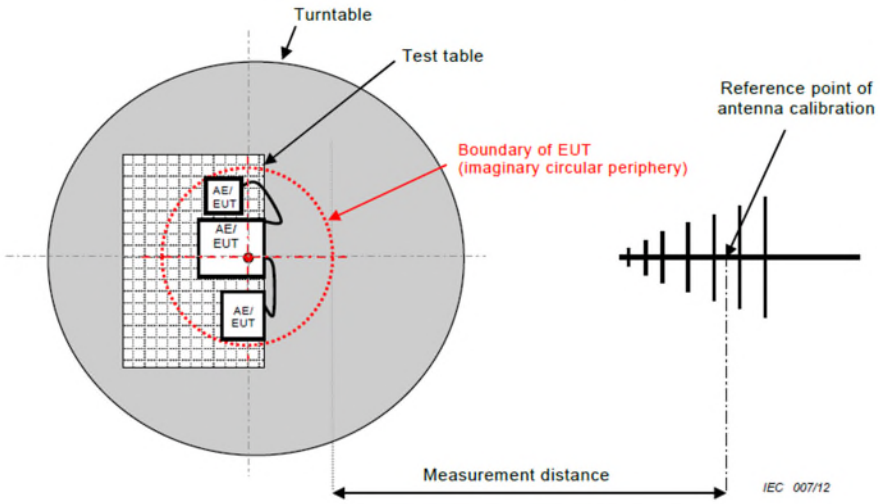
Typical Radiated Emissions Setup



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±5.67dB for 30MHz – 1GHz and ±4.58dB for 1GHz – 18GHz with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

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 0-360 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.

Note: Antenna factor, cable loss, and pre-amp gain are entered into the spectrum analyzer as transducer factor (TDF).

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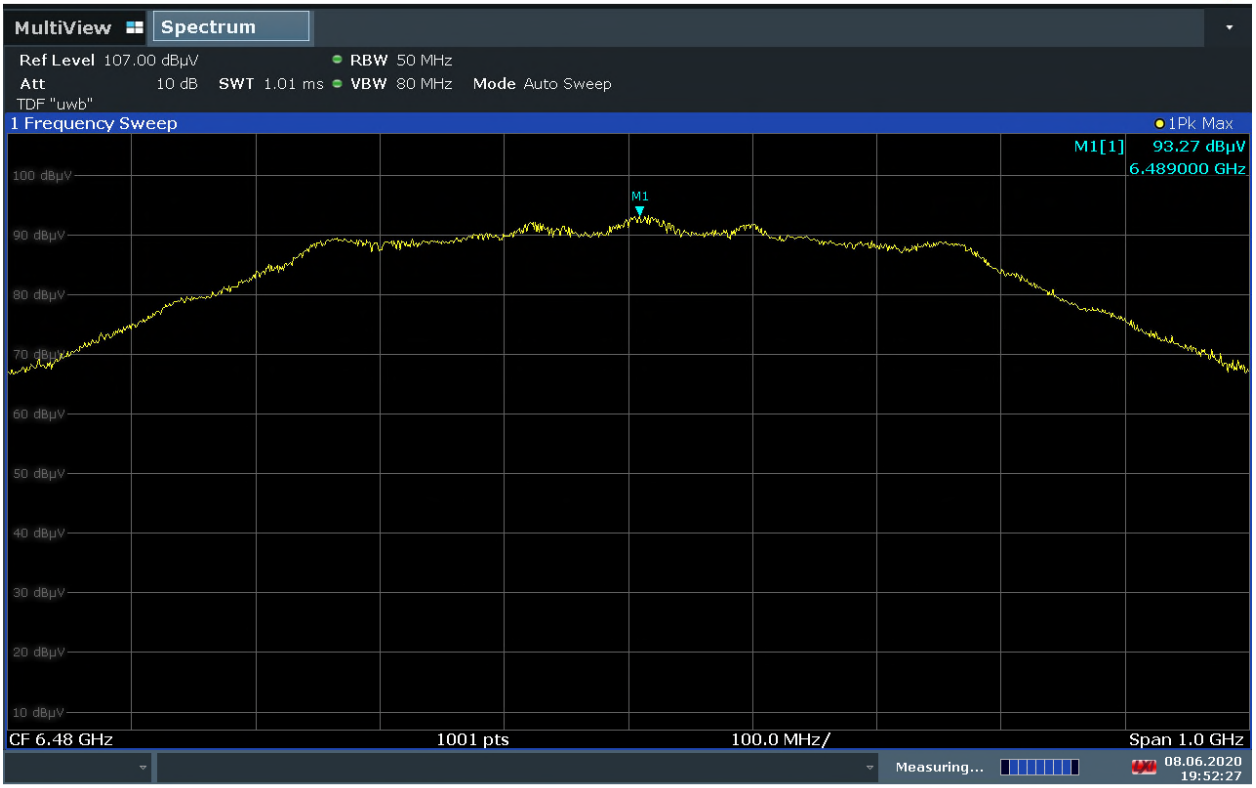
Horizontal – Peak Emission



19:52:28 08.06.2020

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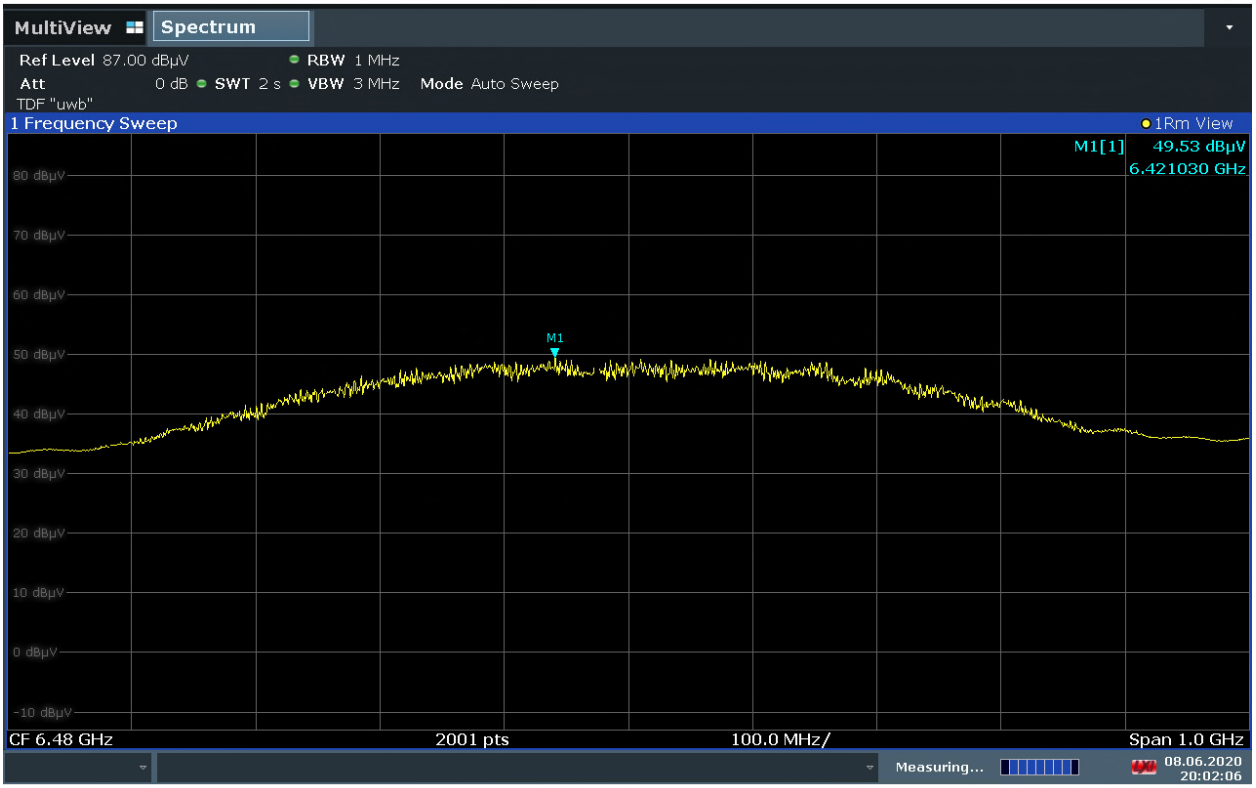
Horizontal – RMS Average Emission



20:02:07 08.06.2020

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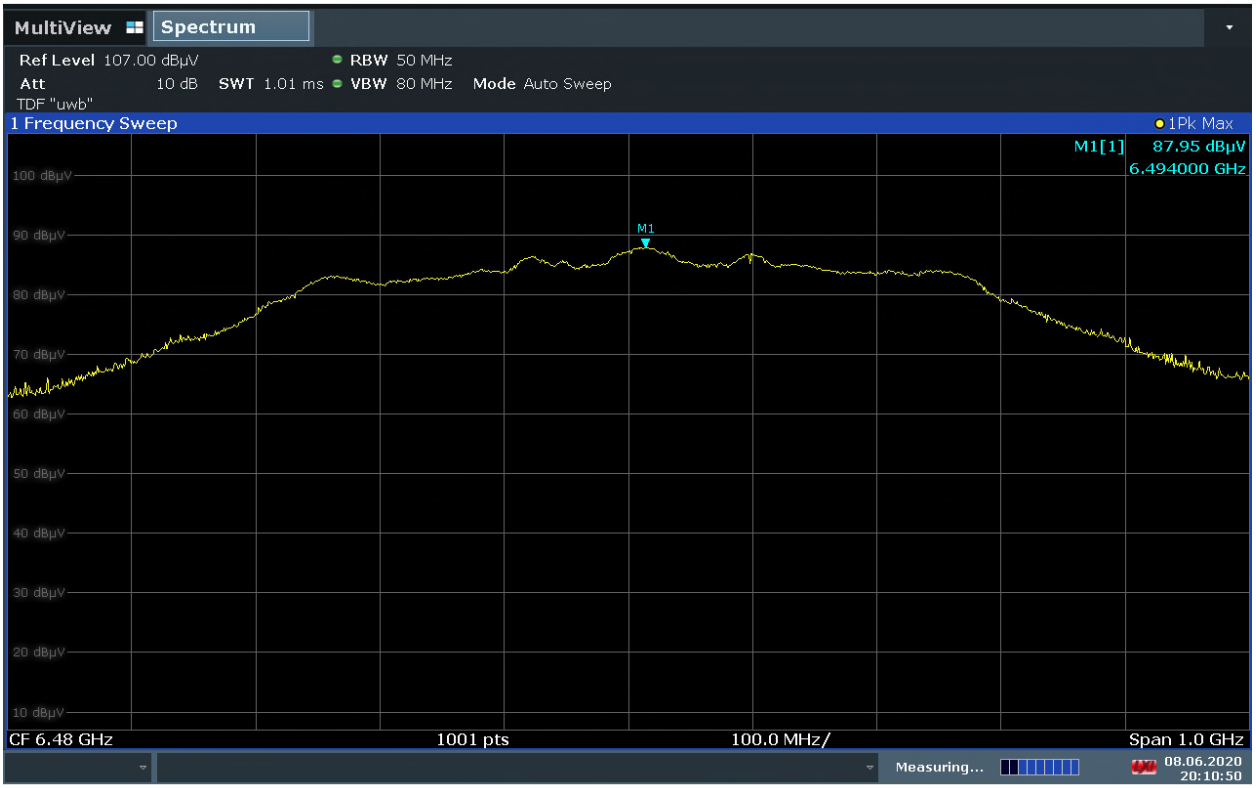
Vertical – Peak Emission



20:10:51 08.06.2020

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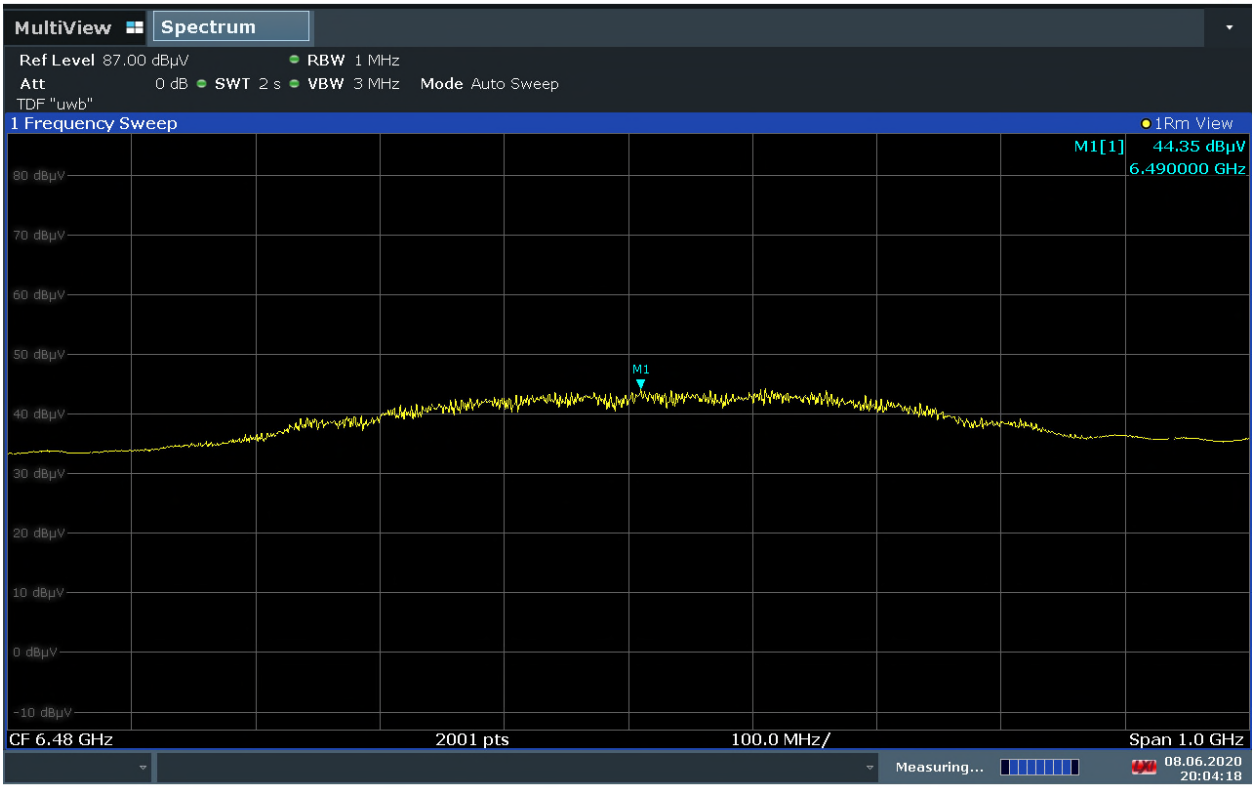
Vertical – RMS Average Emission



20:04:19 08.06.2020

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Final Measurements and Results

The EUT passed.

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.

Frequency (MHz)	Detector	Antenna Polarity	Received Signal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Test Result
6489	PEAK	Horz	93.3	95.2	1.9	Pass
6421	RMS	Horz	49.5	53.9	4.4	Pass
6494	PEAK	Vert	88.0	95.2	7.2	Pass
6490	RMS	Vert	44.4	53.9	9.5	Pass

The highest received signal is 93.3 dBuV/m which gives an E.I.R.P -1.9 dBm (0.65 mW).

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification Date	Asset #
Spectrum Analyzer	FSW26	Rohde & Schwarz	Jul 11, 2019	Jul 11, 2020	Rental
Horn Antenna 1 – 18 GHz	3117	ETS-Lindgren	Feb. 17, 2020	Feb. 17, 2022	GEMC 340
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Jun. 12, 2018	Jun. 12, 2020	GEMC 312
RF Cable 2.2 m	Micro-Coax	UTiFLEX	Mar. 23, 2020	Mar, 23, 2021	GEMC 344

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Power Line Conducted Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard and measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio, maritime radio, CB radio, and so on, from unwanted interference.

Limits & Method

The method is as defined in ANSI C63.10. The limits are as defined in FCC Part 15 Section 15.207 and RSS-GEN:

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.

If the Peak or Quasi-Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

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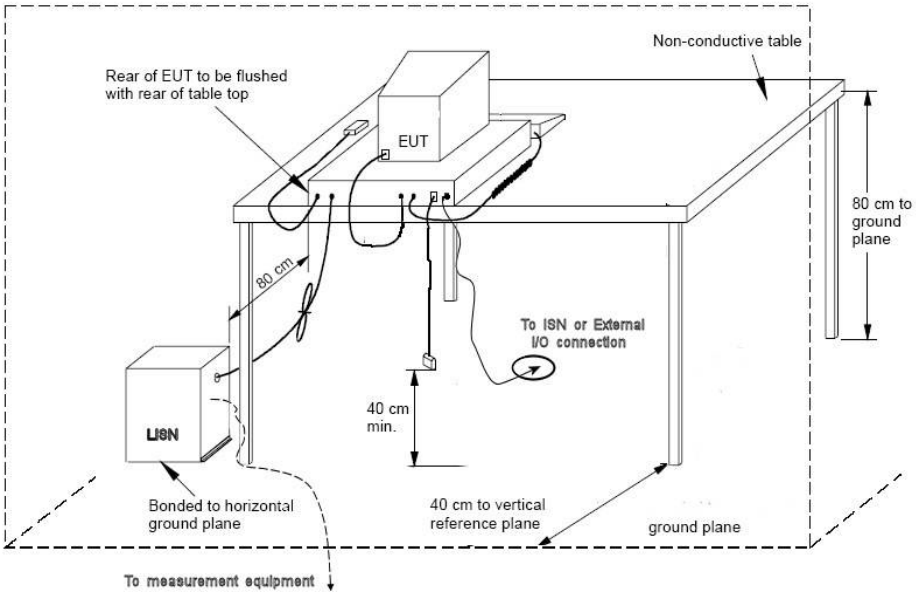
Typical Setup Diagram



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±2.27dB with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

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

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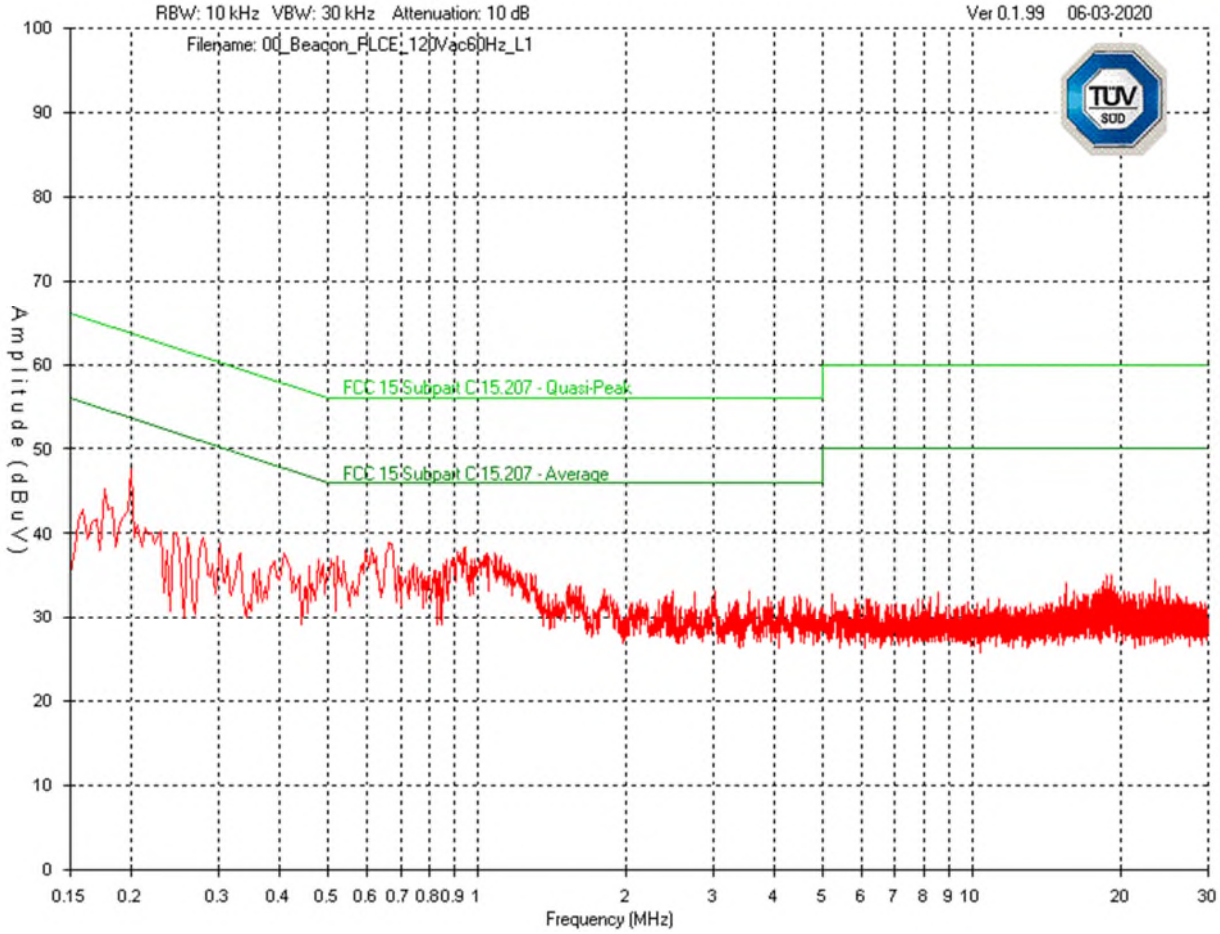
Line (L1) – 120Vac 60Hz



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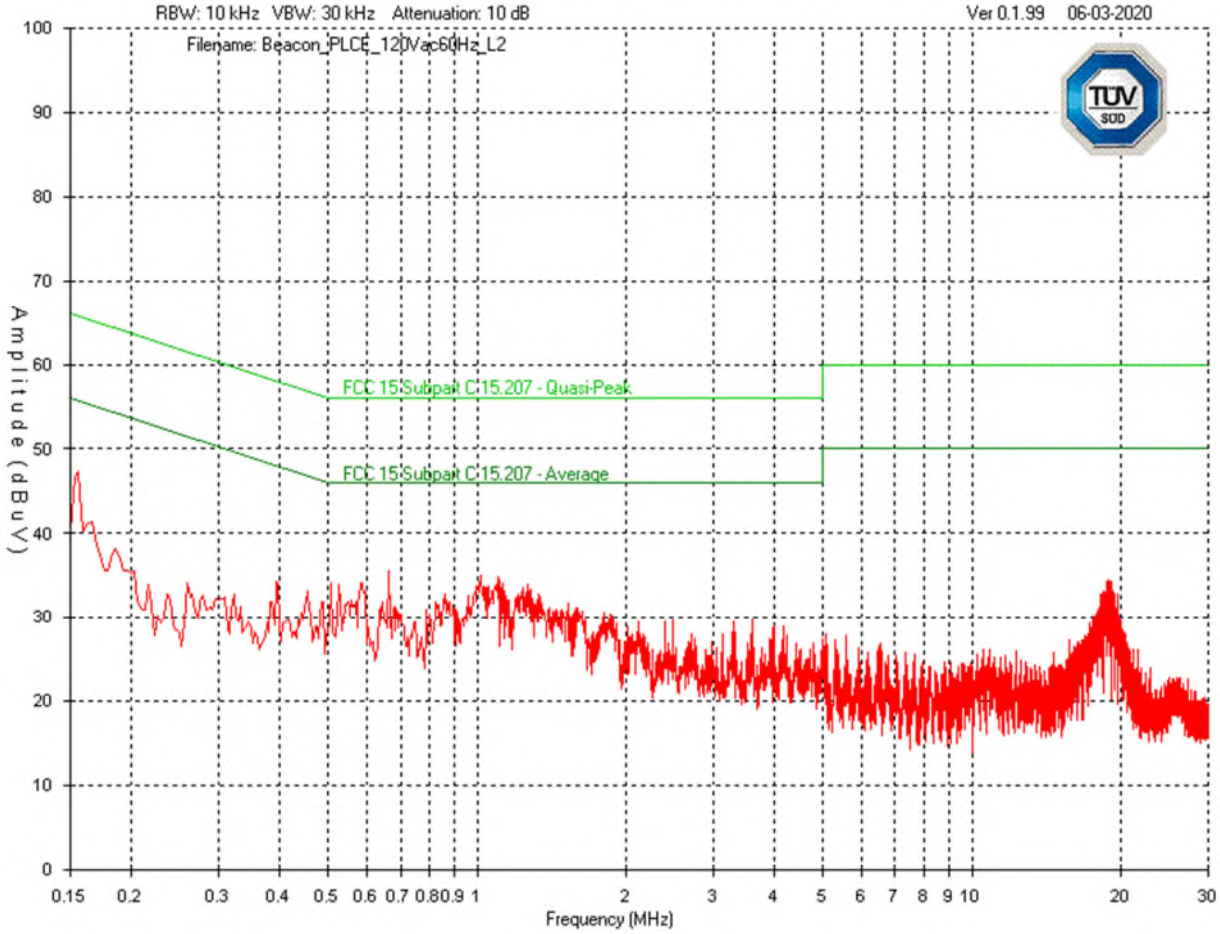
Neutral (L2) – 120Vac 60Hz



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Final Measurements

Average and Quasi-Peak Emissions Table

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											
0.200	PEAK	37.6	10	0.0	0.1	47.7	63.6	53.6	15.9	5.9	Pass
0.664	PEAK	28.8	10	0.1	0.0	38.9	56.0	46.0	17.1	7.1	Pass
0.946	PEAK	28.3	10	0.1	0.1	38.5	56.0	46.0	17.5	7.5	Pass
0.522	PEAK	27.2	10	0.1	0.1	37.4	56.0	46.0	18.6	8.6	Pass
0.505	PEAK	26.8	10	0.1	0.1	37.0	56.0	46.0	19.0	9.0	Pass
0.177	PEAK	35.2	10	0.0	0.1	45.3	64.6	54.6	19.3	9.3	Pass
Neutral											
0.157	PEAK	37.2	10	0.0	0.1	47.3	65.6	55.6	18.3	8.3	Pass
0.661	PEAK	25.4	10	0.1	0.0	35.5	56.0	46.0	20.5	10.5	Pass
1.016	PEAK	24.9	10	0.1	0.1	35.1	56.0	46.0	20.9	10.9	Pass
1.125	PEAK	24.1	10	0.1	0.1	34.3	56.0	46.0	21.7	11.7	Pass
0.585	PEAK	24.1	10	0.1	0.0	34.2	56.0	46.0	21.8	11.8	Pass
0.505	PEAK	24.0	10	0.1	0.1	34.2	56.0	46.0	21.8	11.8	Pass

Note:

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

All peak emission were below the average limit thus the EUT was deemed to meet power line conducted emission limits based on peak emission.

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

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESL 6	Rohde & Schwarz	Feb. 25, 2019	Feb. 25, 2021	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	Jan. 16, 2020	Jan. 16, 2022	GEMC 302
RF Cable 3m	LMR-400-3M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 276
Attenuator 10 dB	10-A-MFN-10	Bird/Hutton	NCR	NCR	GEMC 323
Emissions Software	0.1.99	TUV SUD Canada, Inc.	NCR	NCR	GEMC 58

This report module is based on report template 'FCC_ICES003_CE_Rev1'

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Appendix A – EUT & Client Provided Details

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General EUT Description

Client Details	
Organization / Address	GeoNavo Positioning Systems operating as Tenera 26 Oxer Close Hammonds Plains, NS, B4B 2B8
Contact	Greg Heard
Phone	902-229-2672
Email	Greg@tenera.care
EUT (Equipment Under Test) Details	
EUT Name (for report title)	Tenera Beacon
EUT Model / SN (if known)	Gen 2.3.1
EUT revision	New product
Software version	__TeNeRa_CaRe__ May 18 2020 16:43:22__
Equipment category	Wall Mount
EUT is powered using	AC
If mains powered, how many plugs?	1 Are they powering separate things or redundant? N/A
Input voltage range(s) (V)	Battery Voltage 3V - 4.2V Charing is 4.2V
Frequency range(s) (Hz)	6489.6MHz
Rated input current (A)	Charging 0.15A
Nominal power consumption (W)	1W
Number of power supplies in EUT	1
Transmits RF energy? (describe)	Yes IEEE802.15.4-2011 UWB, IEEE802.11 b/g/n
Basic EUT functionality description	Beacons are wall mounted devices that listen for UWB Ch 5 (6.4896 GHz) messages from the mobile tags.
Modes of operation	Normal & Provisioning. Normal mode uses UWB and WiFi while provisioning uses BLE. Provisioning mode is only used once by a trained installer.
Frequency of all clocks present in EUT	38.4 Mhz & 32.768Khz RTC & 40Mhz

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I/O cable description Specify length and type	Micro USB Cable for power. Any length accepted by USB standard, 3ft, 6ft and 10ft cables to be provided.
Available connectors on EUT	The EUT has a micro-usb port which is connected to a local power supply which will be provided.
Peripherals required to exercise EUT Ex. Signal generator	External USB Power Supply which will be provided.
Dimensions of product	L 147.20mm W 23.20mm H 88.80mm

EUT Functional Description

Beacons are wall mounted devices that listen for UWB Ch 5 (6.4896 GHz) messages from the mobile tags.

EUT Configuration

Transmitter is configured to transmit continuously.

Operational Setup

This report does not represent compliance of any peripheral device(s) attached to the EUT for its test operation in any way. The following peripheral device(s) were attached to the EUT during testing:

- None

Modifications for Compliance

No modifications were made during testing for the sample to achieve compliance with the testing requirements.

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Appendix B – EUT, Peripherals, and Test Setup Photos

(See Test Setup Exhibit)

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