

Cutsforth Inc.

TEST REPORT

SCOPE OF WORK

EMISSIONS TESTING – EBHS001

REPORT NUMBER

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EMISSIONS TEST REPORT (FULL COMPLIANCE)

Report Number: 103663187BOX-033
Project Number: G103663187

Report Issue Date: 05/15/2019

Model(s) Tested: EBHS001

Model(s) Partially Tested: N/A

Model(s) Not Tested but declared equivalent by the client: N/A

Standards: CFR47 FCC Part 15.247 Subpart C: 04/2019,
CFR47 FCC Part 15 Subpart B: 04/2019,
RSS-247 Issue 2 February 2017,
ICES-003 Issue 6 Published: January 2016 Updated: April 2019,
RSS-Gen Issue 5 April 2018,
RSS-102 Issue 5 March 2015
KDB 558074 D01 15.247 Meas Guidance v05r02

Tested by:
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USA

Client:
Cutsforth Inc.
113 Cherry Street
#49017
Seattle, WA 98104-2205
USA

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Kouma Sinn/EMC Staff Engineer

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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test and Variant Models	--
5	System Setup and Method	--
6	Maximum Peak Output Power and Human RF exposure CFR47 FCC Part 15 Subpart C:04/2019, Section 15.247 (b)(3) RSS-247 Issue 2 February 2017, RSS-102 Issue 5 March 2015	Pass
7	6 dB Bandwidth and Occupied Bandwidth CFR47 FCC Part 15 Subpart C: 04/2019, Section 15.247 (a)(2) RSS-247 Issue 2 February 2017	Pass
8	Maximum Power Spectral Density CFR47 FCC Part 15 Subpart C: 04/2019, Section 15.247 (e) RSS-247 Issue 2 February 2017	Pass
9	Band Edge Compliance CFR47 FCC Part 15 Subpart C: 04/2019, Section 15.247 (d) RSS-247 Issue 2: 02/2017	Pass
10	Transmitter spurious emissions CFR47 FCC Part 15 Subpart C: 04/2019, Section 15.247 (d) RSS-247 Issue 2 February 2017	Pass
11	Digital Device and Receiver Radiated Spurious Emissions (CFR47 FCC Part 15 Subpart B 15.109: 04/2019, ICES-003 Issue 6 Published: January 2016 Updated: April 2019	Pass
--	AC Mains Conducted Emissions FCC 47CFR Part 15.107: 04/2019 ICES-003 Issue 6 Published: January 2016 Updated: April 2019	N/A
12	Revision History	--

Notes: The EUT powers from external battery with no connection to AC mains.

3 Client Information

This EUT was tested at the request of:

Client: Cutsforth Inc.
113 Cherry Street #49017
Seattle, WA 98104-2205
USA

Contact: Ben Waurms
Telephone: +1 (952) 258-3715
Fax: None
Email: bwaurms@cutsforth.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: Cutsforth Inc.
113 Cherry Street #49017
Seattle, WA 98104-2205
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Brush Monitoring System	Cutsforth Inc.	EBHS001	BOX1905081103-002 (Intertek Assigned)

Receive Date:	05/08/2019
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)	
The EUT is Brush Monitoring System	

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
9 V Battery	N/A	N/A	N/A

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Tx mode
2	Rx mode

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	BHS Version 2.6 nRF Connect Version 1.8.8

Radio/Receiver Characteristics	
Frequency Band(s)	2402-2480 MHz
Modulation Type(s)	GFSK
Maximum Output Power	Low Channel (2402 MHz): -1.8 dBm Mid Channel (2440 MHz): -1.9 dBm High Channel (2475 MHz): -2.0 dBm
Test Channels	Low Channel (2402 MHz) Mid Channel (2440 MHz) High Channel (2480 MHz)
Occupied Bandwidth	Low Channel (2402 MHz): 1.25 MHz Mid Channel (2440 MHz): 1.27 MHz High Channel (2480 MHz): 1.25 MHz
6 dB Bandwidth	Low Channel (2402 MHz): 0.79 MHz Mid Channel (2440 MHz): 0.75 MHz High Channel (2480 MHz): 0.71 MHz
Frequency Hopper: Number of Hopping Channels	N/A
Frequency Hopper: Channel Dwell Time	N/A
Frequency Hopper: Max interval between two instances of use of the same channel	N/A
MIMO Information (# of Transmit and Receive antenna ports)	1
Equipment Type	Standalone
ETSI LBT/Adaptivity	Non-Adaptive
ETSI Adaptivity Type	N/A
ETSI Temperature Category (I, II, III)	N/A
ETSI Receiver Category (1, 2, 3)	3
Antenna Type and Gain	Integrated, -1.5 dBi

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

N/A

5 System Setup and Method

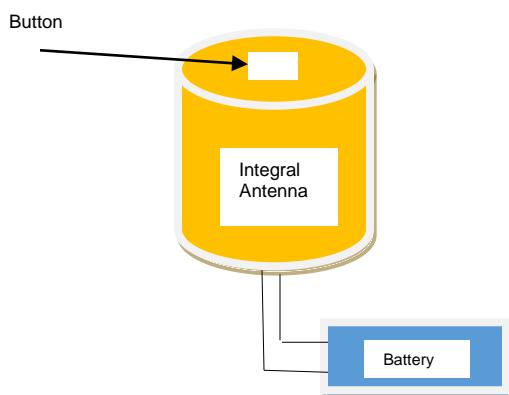
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
--	None	--	--	--	--

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
iPhone 6s	Apple	MN1M2LL/A	FK2WCJ1KHFLR

5.1 Method:

Configuration as required by Configuration as required by FCC Part 15 Subpart C 15.247: 04/2019, FCC Part 15 Subpart B: 04/2018, RSS 247 Issue 2: 02/2017, ICES 003 Issue 6: 01/2016 updated 06/2016, RSS-Gen Issue 5 April 2018, RSS-102 Issue 5 March 2015, ANSI C 63.10: 2013 and ANSI C 63.4: 2014, KDB558074 D01 15.247 Meas Guidance v05r02.

5.2 EUT Block Diagram:



6 Maximum Peak Output Power and Human RF exposure

6.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, RSS-102, and ANSI C63.10, KDB 558074 D01 15.247 Meas Guidance v05r02.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	5.6 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.9 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.4 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.9 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.6 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.6 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

FS = Field Strength in dB μ V/m

RA = Receiver Amplitude (including preamplifier) in dB μ V

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB

AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB/m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V/m}$$

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF/20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V}/20)} = 39.8 \mu\text{V/m}$$

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DS40'	Temp, humidity, pressure gauge	Digi Sense	68000-49	181717625	11/06/2018	11/06/2019
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Schwartz	FSW43	100646	10/15/2018	10/15/2019
ROS005-4'	Control Platform	Rohde and Schwarz	OSP120	101428	11/20/2018	11/20/2019
None'	Coaxial Cable (DUT1)	UTIFLEX MICRO-COAX	UFA210A-1-0787-300300	101709	02/01/2019	02/01/2020
None'	20 dB Attenuator (DUT1)	Pasernack	E7004-20	None	02/01/2019	02/01/2020
None'	Coaxial Cable (Receiver/RF In)	Micro-coax	UFA210A-0-0-0196-300300	101706	02/01/2019	02/01/2020

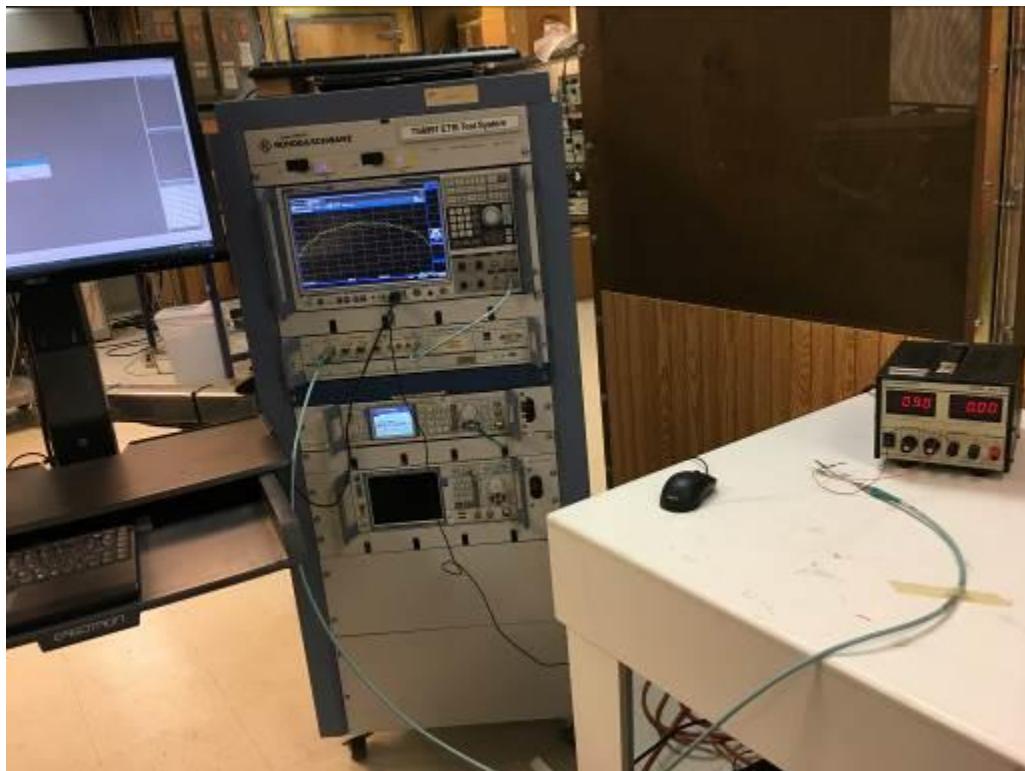
Software Utilized:

Name	Manufacturer	Version
R&S EMC32/AMS32/WMS32	Rohde & Schwarz	10.30.00

6.3 Results:

The sample tested was found to Comply.

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt or 30 dBm.

6.4 Setup Photograph:

6.5 Plots/Data:

FCC Part 47 §15.247 2400-2483.5 MHz 2016

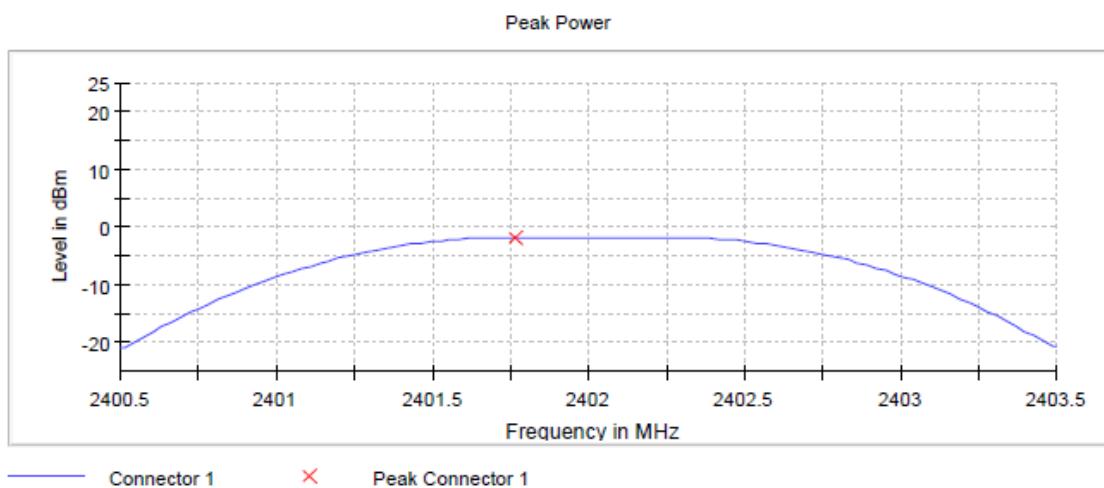
Peak output power (Sweep) (2402 MHz; 8.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Combined Uncertainty of absolute Level Measurement (K=2) < 0.8 dB

Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2402.000000	-1.8	30.0	PASS



Most recent KDB should be KDB 558074 D01 15.247 Meas Guidance v05r02

FCC Part 47 §15.247 2400-2483.5 MHz 2016

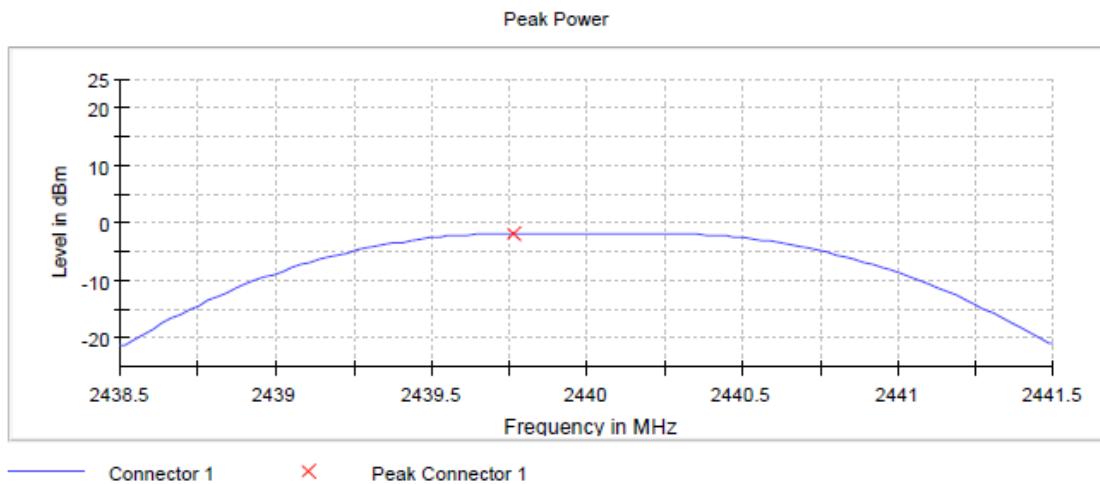
Peak output power (Sweep) (2440 MHz; 8.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Combined Uncertainty of absolute Level Measurement (K=2) < 0.8 dB

Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2440.000000	-1.9	30.0	PASS



Most recent KDB should be KDB 558074 D01 15.247 Meas Guidance v05r02

FCC Part 47 §15.247 2400-2483.5 MHz 2016

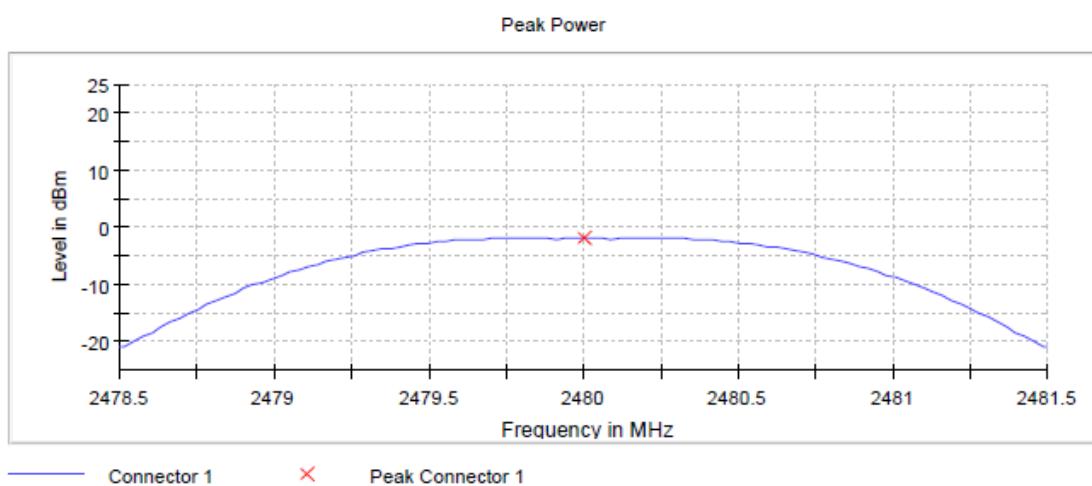
Peak output power (Sweep) (2480 MHz; 8.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Combined Uncertainty of absolute Level Measurement (K=2) < 0.8 dB

Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2480.000000	-2.0	30.0	PASS



Most recent KDB should be KDB 558074 D01 15.247 Meas Guidance v05r02

MPE Calculation

§ 1.1310: The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

Part 1.1310 Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f ²)	6
30–300	61.4	0.163	1.0	6
300–1500	.....	.....	f/300	6
1500–100,000	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30
30–300	27.5	0.073	0.2	30
300–1500	.....	.....	f/1500	30
1500–100,000	.....	.....	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

RSS-102 Issue 5 Exposure Limits:**Table 4: RF Field Strength Limits for Devices Used by the General Public
(Uncontrolled Environment)**

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	0.73/ <i>f</i>	-	6**
1.1-10	87/ <i>f</i> ^{0.5}	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ <i>f</i> ^{0.25}	0.1540/ <i>f</i> ^{0.25}	8.944/ <i>f</i> ^{0.5}	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 <i>f</i> ^{0.3417}	0.008335 <i>f</i> ^{0.3417}	0.02619 <i>f</i> ^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻³ <i>f</i>	616000/ <i>f</i> ^{1.2}

Note: *f* is frequency in MHz.
 *Based on nerve stimulation (NS).
 ** Based on specific absorption rate (SAR).

1.1 Test Procedure

An MPE evaluation for was performed in order to show that the device was compliant with §2.1091. The maximum power density was calculated for each transmitter at a separation distance of 20cm.

For each transmitter the maximum RF exposure at a 20 cm distance using the formula:

$$ConductedPower_{mW} = 10^{\frac{ConductedPower(dBm)}{10}}$$

$$PowerDensity = \frac{ConductedPower_{mW} \times Ant.Gain}{4\pi \times (20_{cm})^2}$$

1.2 Results:

- Maximum Conducted Output Power = 0.660693 mW
- Maximum Antenna Gain = -1.5 dBi = 10^{-1.5/10} = 0.707946

$$Power\ Density = (0.660693 \times 0.707946) / 5025.6$$

$$Power\ Density = 0.0000931\ mW/cm^2$$

$$Limit\ at\ 2.402\ GHz = 1\ mW/cm^2$$

$$RSS-102\ Issue\ 5\ Exposure\ Limit\ at\ 2.402GHz = 5.35\ W/m^2$$

$$Power\ Density = 0.000931\ W/m^2$$

The calculated maximum power density at 20cm distance is less than the limit for general population / uncontrolled exposure.

Test Personnel: Vathana Ven
Supervising/Reviewing
Engineer:
(Where Applicable) N/A
Product Standard: CFR47 FCC Part 15.247
RSS-247, RSS-102
Input Voltage: Battery Powered

Test Date: 05/10/2019
Limit Applied: See report section 6.3
Ambient Temperature: 22 °C
Relative Humidity: 53 %
Atmospheric Pressure: 1003 mbars

Deviations, Additions, or Exclusions: None

7 6 dB Bandwidth and Occupied Bandwidth

7.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, and ANSI C63.10, KDB 558074 D01 15.247 Meas Guidance v05r02.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DS40'	Temp, humidity, pressure gauge	Digi Sense	68000-49	181717625	11/06/2018	11/06/2019
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Schwartz	FSW43	100646	10/15/2018	10/15/2019
ROS005-4'	Control Platform	Rohde and Schwarz	OSP120	101428	11/20/2018	11/20/2019
None'	Coaxial Cable (DUT1)	UTIFLEX MICRO-COAX	UFA210A-1-0787-300300	101709	02/01/2019	02/01/2020
None'	20 dB Attenuator (DUT1)	Pasternack	E7004-20	None	02/01/2019	02/01/2020
None'	Coaxial Cable (Receiver/RF In	Micro-coax	UFA210A-0-0-0196-300300	101706	02/01/2019	02/01/2020
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	02/01/2019	02/01/2020

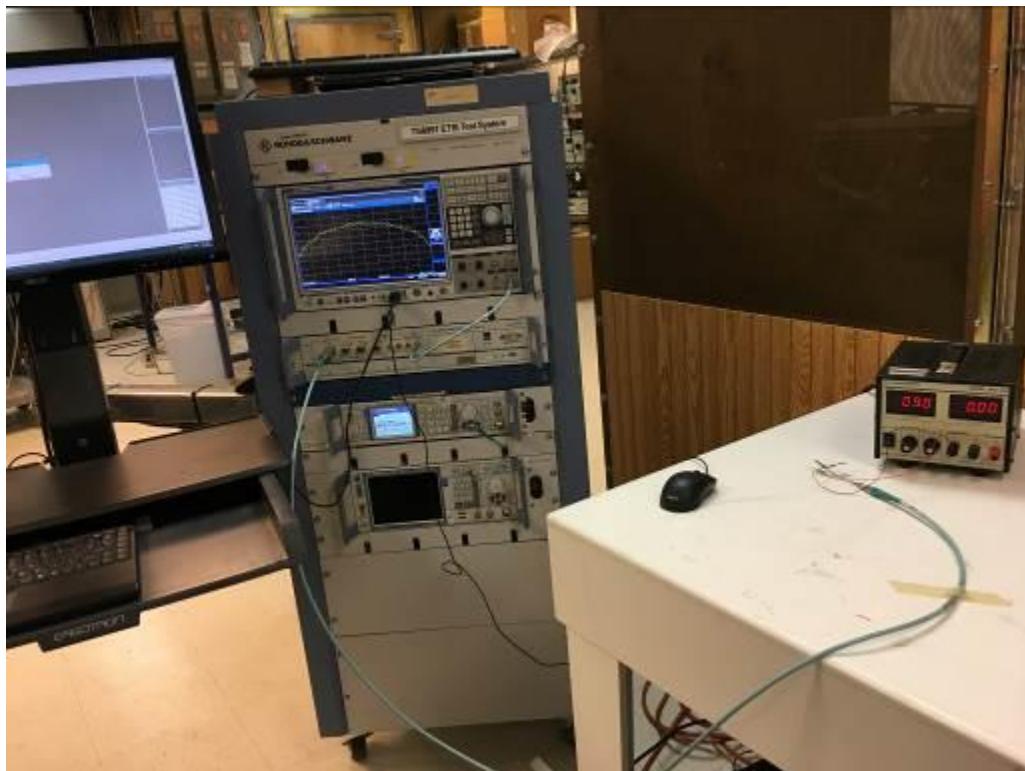
Software Utilized:

Name	Manufacturer	Version
R&S EMC32/AMS32/WMS32	Rohde & Schwarz	10.30.00

7.3 Results:

The sample tested was found to Comply.

§15.247 (a) (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

7.4 Setup Photograph:

7.5 Plots/Data:

FCC Part 47 §15.247 2400-2483.5 MHz 2016

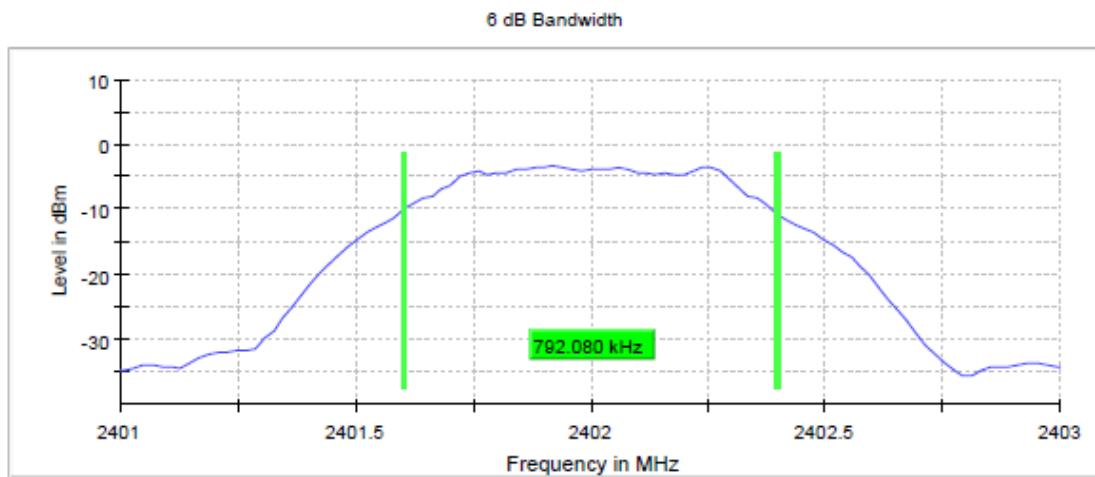
Minimum Emission Bandwidth 6 dB (2402 MHz; 8.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 2%

6 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Max Level (dBm)	Result
2402.000000	0.792080	0.500000	---	2401.603960	2402.396040	-3.3	PASS



Most recent KDB should be KDB 558074 D01 15.247 Meas Guidance v05r02

FCC Part 47 §15.247 2400-2483.5 MHz 2016

Emission Bandwidth 20 dB (2402 MHz; 8.000 dBm; 1 MHz)

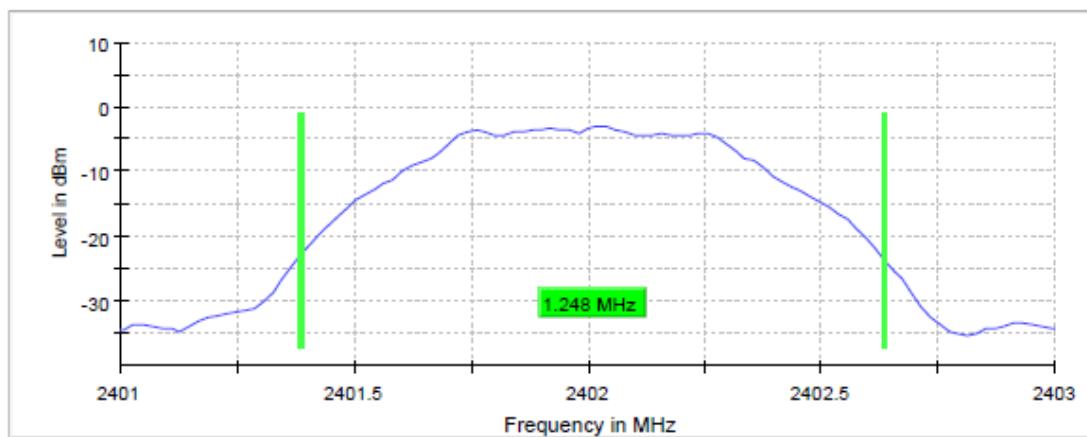
Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 2%

20 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Max Level (dBm)	Result
2402.000000	1.247524	---	---	2401.386139	2402.633663	-3.0	PASS

20 dB Bandwidth



Most recent KDB should be KDB 558074 D01 15.247 Meas Guidance v05r02

FCC Part 47 §15.247 2400-2483.5 MHz 2016

Minimum Emission Bandwidth 6 dB (2440 MHz; 8.000 dBm; 1 MHz)

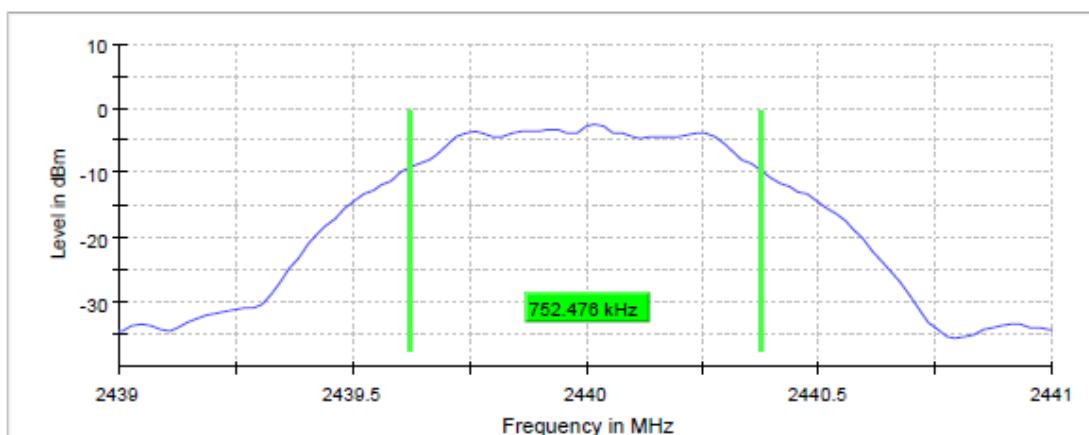
Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 2%

6 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Max Level (dBm)	Result
2440.000000	0.752476	0.500000	---	2439.623762	2440.376238	-2.5	PASS

6 dB Bandwidth



Most recent KDB should be KDB 558074 D01 15.247 Meas Guidance v05r02

FCC Part 47 §15.247 2400-2483.5 MHz 2016

Emission Bandwidth 20 dB (2440 MHz; 8.000 dBm; 1 MHz)

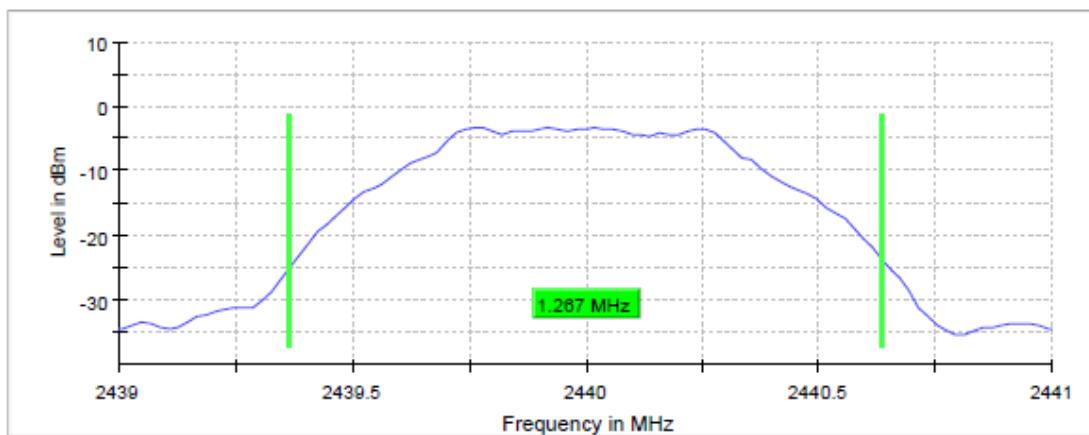
Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 2%

20 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Max Level (dBm)	Result
2440.000000	1.267326	---	---	2439.366337	2440.633663	-3.2	PASS

20 dB Bandwidth



Most recent KDB should be KDB 558074 D01 15.247 Meas Guidance v05r02

FCC Part 47 §15.247 2400-2483.5 MHz 2016

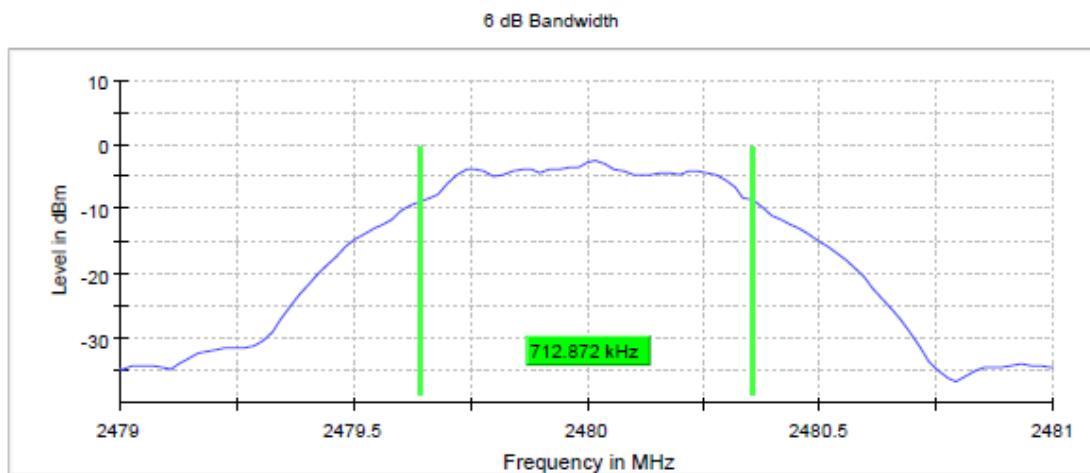
Minimum Emission Bandwidth 6 dB (2480 MHz; 8.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 2%

6 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Max Level (dBm)	Result
2480.000000	0.712872	0.500000	---	2479.643564	2480.356436	-2.6	PASS



Most recent KDB should be KDB 558074 D01 15.247 Meas Guidance v05r02

FCC Part 47 §15.247 2400-2483.5 MHz 2016

Emission Bandwidth 20 dB (2480 MHz; 8.000 dBm; 1 MHz)

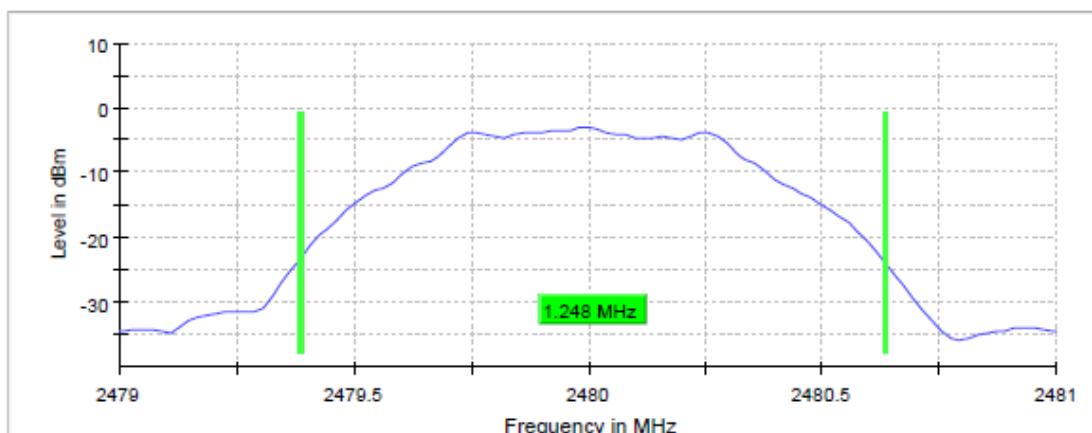
Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 2%

20 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Max Level (dBm)	Result
2480.000000	1.247524	---	---	2479.386139	2480.633663	-2.8	PASS

20 dB Bandwidth



Most recent KDB should be KDB 558074 D01 15.247 Meas Guidance v05r02

Test Personnel: Vathana Ven
 Supervising/Reviewing
 Engineer:
 (Where Applicable) N/A
 Product Standard: CFR47 FCC Part 15.247
 Input Voltage: RSS-247
 Pretest Verification w/
 Ambient Signals or
 BB Source: Battery Powered
N/A

Test Date: 05/10/2019
 Limit Applied: See report section 7.3
 Ambient Temperature: 22 °C
 Relative Humidity: 53 %
 Atmospheric Pressure: 1003 mbars

Deviations, Additions, or Exclusions: None

8 Maximum Power Spectral Density

8.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, and ANSI C63.10, KDB 558074 D01 15.247 Meas Guidance v05r02.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DS40'	Temp, humidity, pressure gauge	Digi Sense	68000-49	181717625	11/06/2018	11/06/2019
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Schwartz	FSW43	100646	10/15/2018	10/15/2019
ROS005-4'	Control Platform	Rohde and Schwarz	OSP120	101428	11/20/2018	11/20/2019
None'	Coaxial Cable (DUT1)	UTIFLEX MICRO-COAX	UFA210A-1-0787-300300	101709	02/01/2019	02/01/2020
None'	20 dB Attenuator (DUT1)	Pasternack	E7004-20	None	02/01/2019	02/01/2020
None'	Coaxial Cable (Receiver/RF In	Micro-coax	UFA210A-0-0-0196-300300	101706	02/01/2019	02/01/2020
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	02/01/2019	02/01/2020

Software Utilized:

Name	Manufacturer	Version
R&S EMC32/AMS32/WMS32	Rohde & Schwarz	10.30.00

8.3 Results:

The sample tested was found to Comply.

§15.247 (e) 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.

8.4 Setup Photograph:

8.5 Plots/Data:

FCC Part 47 §15.247 2400-2483.5 MHz 2016

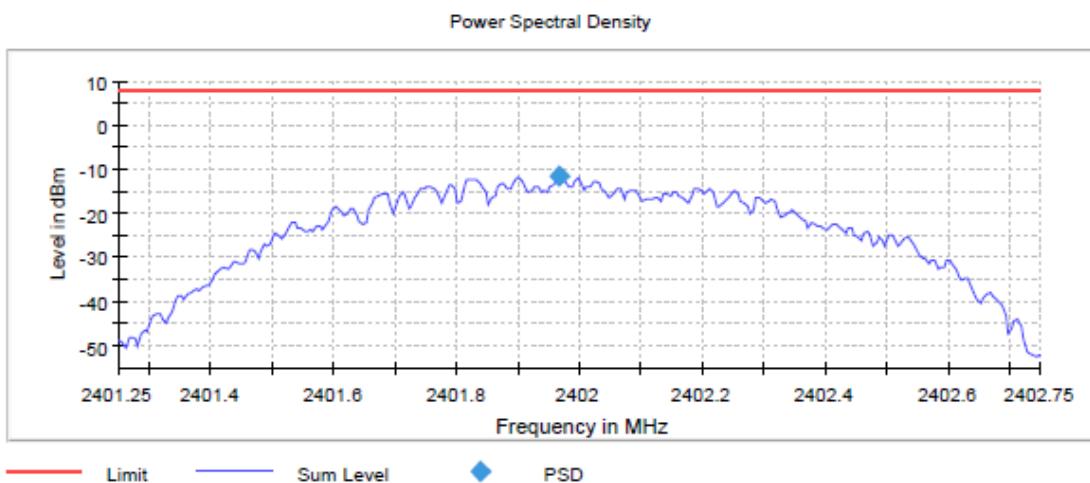
Peak Power Spectral Density (2402 MHz; 8.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 1.1 dB

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2402.000000	2401.967500	-11.707	8.0	PASS



Most recent KDB should be KDB 558074 D01 15.247 Meas Guidance v05r02

FCC Part 47 §15.247 2400-2483.5 MHz 2016

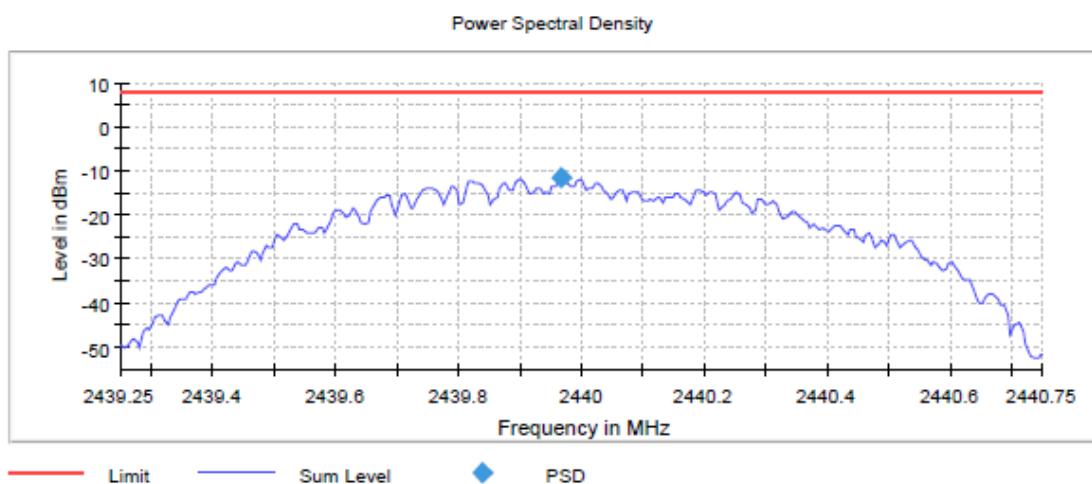
Peak Power Spectral Density (2440 MHz; 8.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 1.1 dB

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2440.000000	2439.967500	-11.684	8.0	PASS



Most recent KDB should be KDB 558074 D01 15.247 Meas Guidance v05r02

FCC Part 47 §15.247 2400-2483.5 MHz 2016

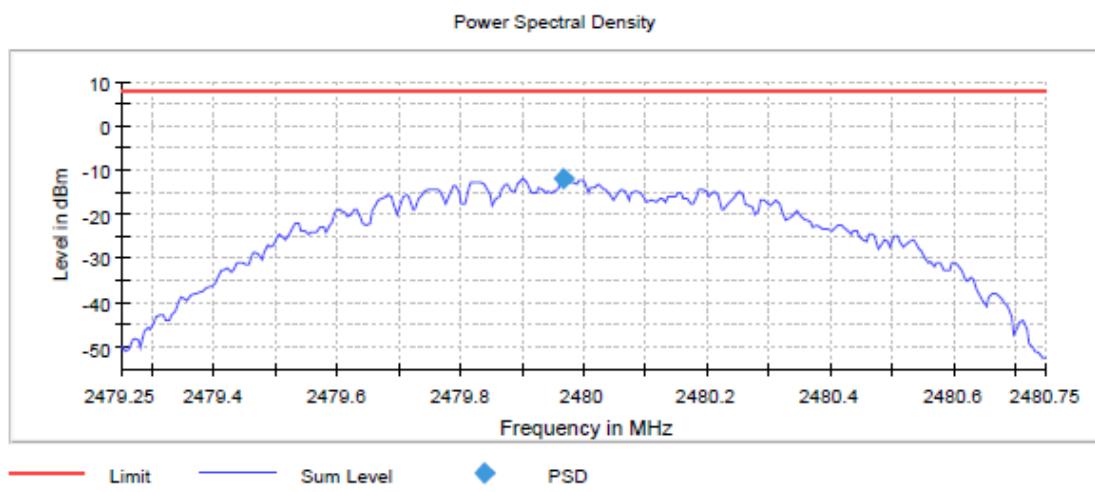
Peak Power Spectral Density (2480 MHz; 8.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 1.1 dB

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2480.000000	2479.967500	-11.802	8.0	PASS



Most recent KDB should be KDB 558074 D01 15.247 Meas Guidance v05r02

Test Personnel:	<u>Vathana Ven</u>	Test Date:	<u>05/10/2019</u>
Supervising/Reviewing Engineer:			
(Where Applicable)	<u>N/A</u>		
Product Standard:	<u>CFR47 FCC Part 15.247</u>	Limit Applied:	<u>See report section 8.3</u>
Input Voltage:	<u>RSS-247</u>		
	<u>Battery Powered</u>		
Pretest Verification w/ Ambient Signals or BB Source:	<u>N/A</u>	Ambient Temperature:	<u>22 °C</u>
		Relative Humidity:	<u>53 %</u>
		Atmospheric Pressure:	<u>1003 mbars</u>

Deviations, Additions, or Exclusions: None

9 Band Edge Compliance

9.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.247 RSS 247, ANSI C 63.10, and ANSI C 63.4, Most recent KDB should be KDB 558074 D01 15.247 Meas Guidance v05r02.

TEST SITE: EMC Lab & 10m ALSE

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

FS = Field Strength in $\text{dB}\mu\text{V}/\text{m}$

RA = Receiver Amplitude (including preamplifier) in $\text{dB}\mu\text{V}$

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB

AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 $\text{dB}\mu\text{V}$ is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 $\text{dB}\mu\text{V}/\text{m}$. This value in $\text{dB}\mu\text{V}/\text{m}$ was converted to its corresponding level in $\mu\text{V}/\text{m}$.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}/\text{m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V}/\text{m}$$

To convert from $\text{dB}\mu\text{V}$ to μV or mV the following was used:

$$UF = 10^{(NF/20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in } \text{dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V}/\text{m} / 20)} = 39.8 \mu\text{V}/\text{m}$$

9.2 Test Equipment Used:

Equipment Used For Antenna Port Measurement

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DS40'	Temp, humidity, pressure gauge	Digi Sense	68000-49	181717625	11/06/2018	11/06/2019
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	10/15/2018	10/15/2019
ROS005-4'	Control Platform	Rohde and Schwarz	OSP120	101428	11/20/2018	11/20/2019
None'	Coaxial Cable (DUT1)	UTIFLEX MICRO-COAX	UFA210A-1-0787-300300	101709	02/01/2019	02/01/2020
None'	20 dB Attenuator (DUT1)	Pasernack	E7004-20	None	02/01/2019	02/01/2020
None'	Coaxial Cable (Receiver/RF In)	Micro-coax	UFA210A-0-0-0196-300300	101706	02/01/2019	02/01/2020

Name	Manufacturer	Version
R&S EMC32/AMS32/WMS32	Rohde & Schwarz	10.30.00

Equipment Used For Radiated Measurement

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	06/21/2018	06/21/2019
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/28/2019	03/28/2020
ETS005'	1-18GHz horn antenna	ETS-Lindgren	3117	00218279	05/14/2018	05/14/2019
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2018	07/25/2019

Software Utilized:

Name	Manufacturer	Version
None	--	--

Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010

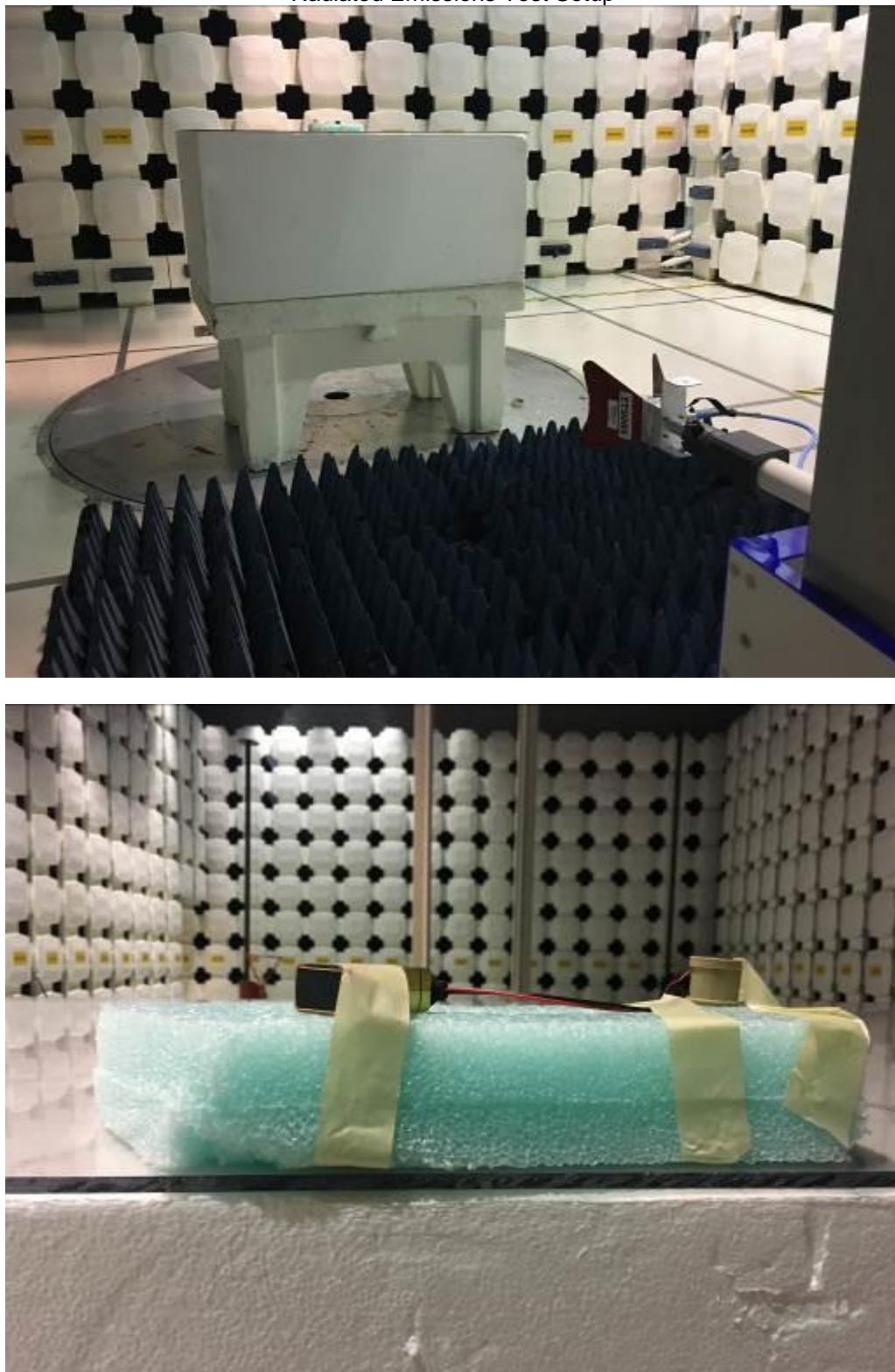
9.3 Results:

The sample tested was found to Comply.

15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

9.4 Setup Photographs:

Radiated Emissions Test Setup

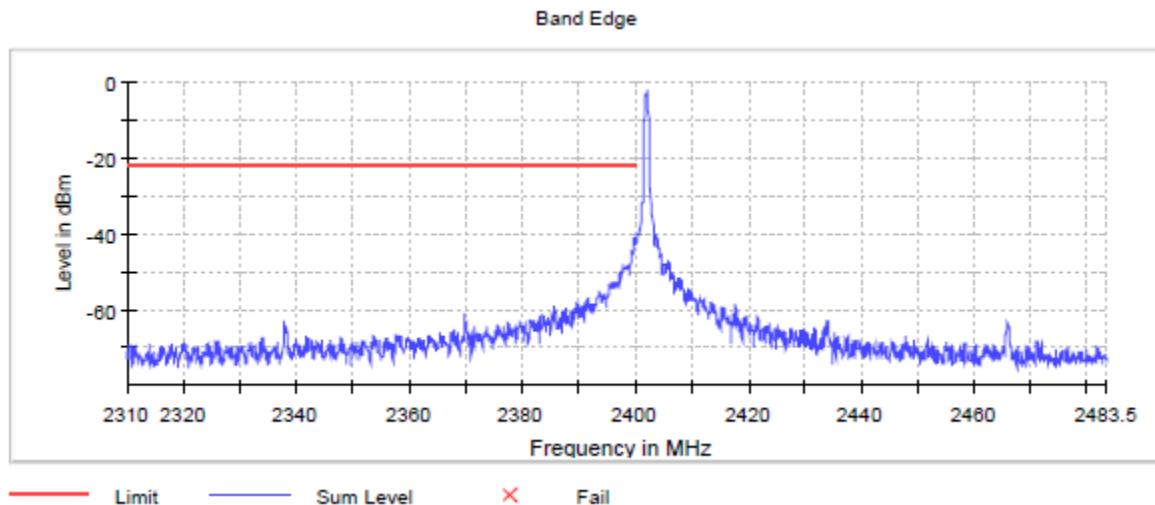


Antenna Port Conducted Test Setup

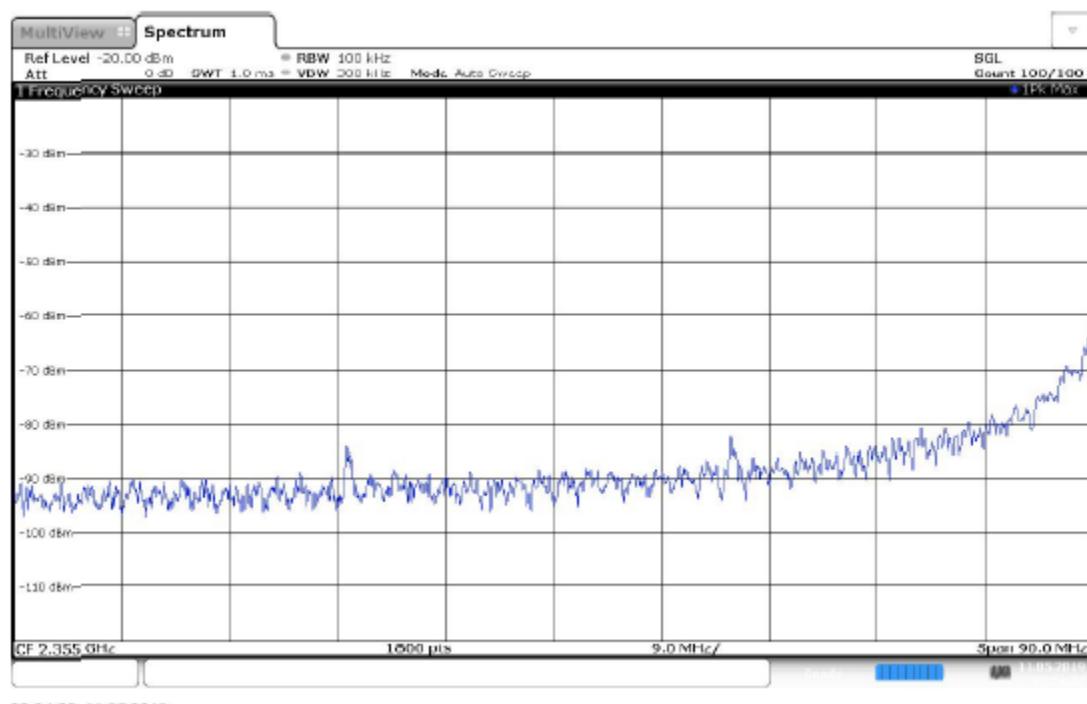


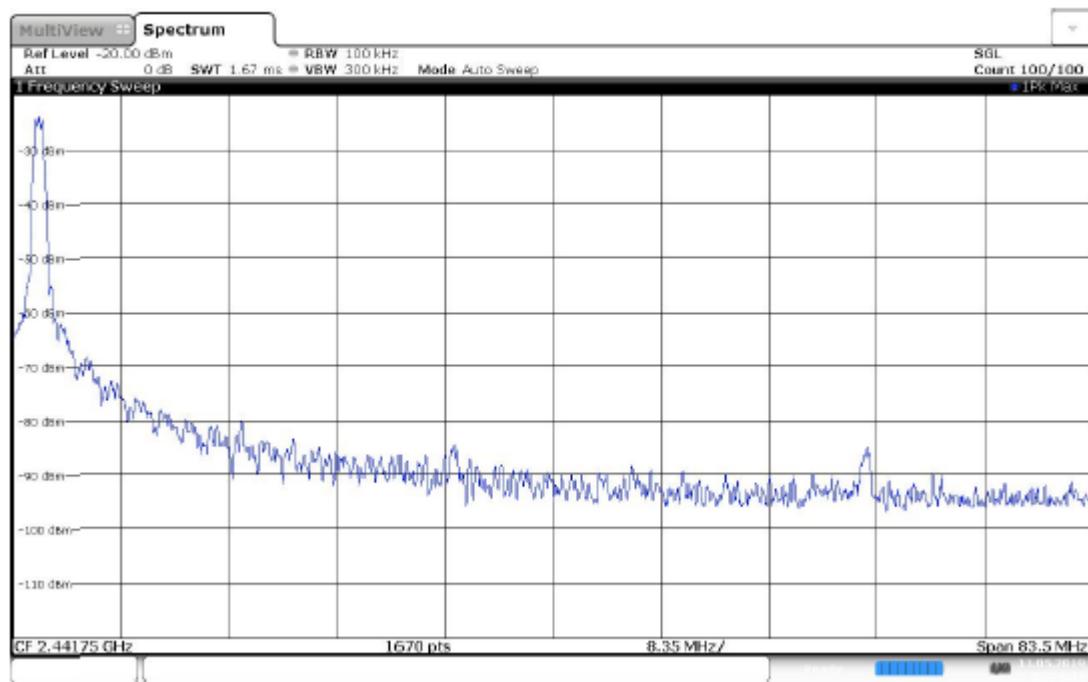
9.5 Plots/Data:

Antenna Port Conducted Lower Band Edge



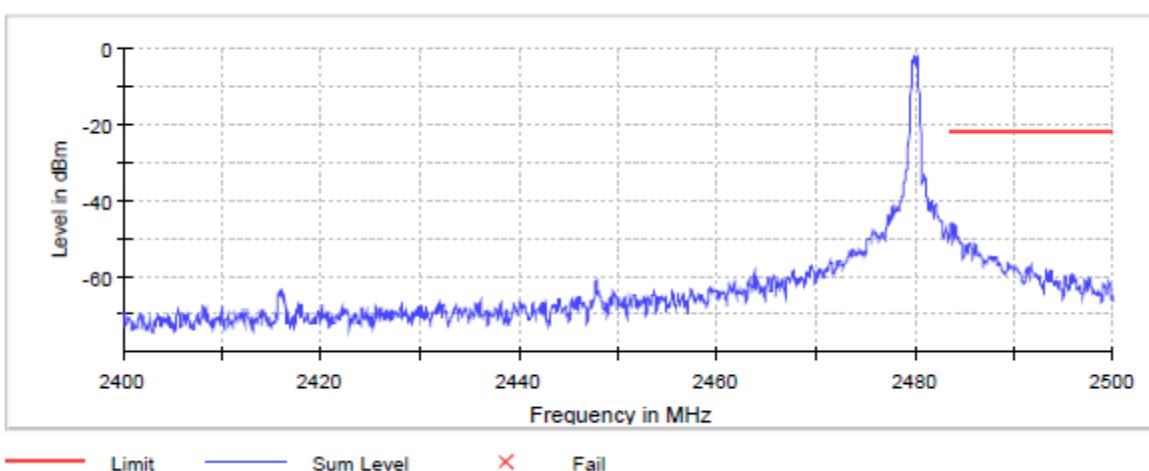
Band Edge Connector 1_0



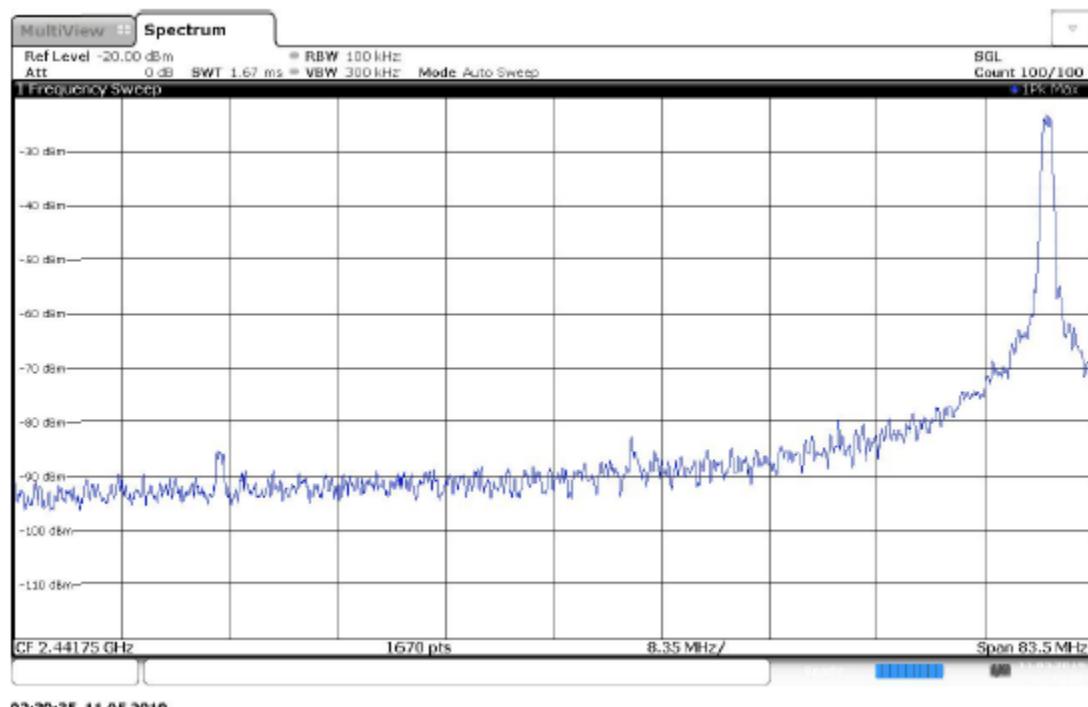
Band Edge Connector 1_1

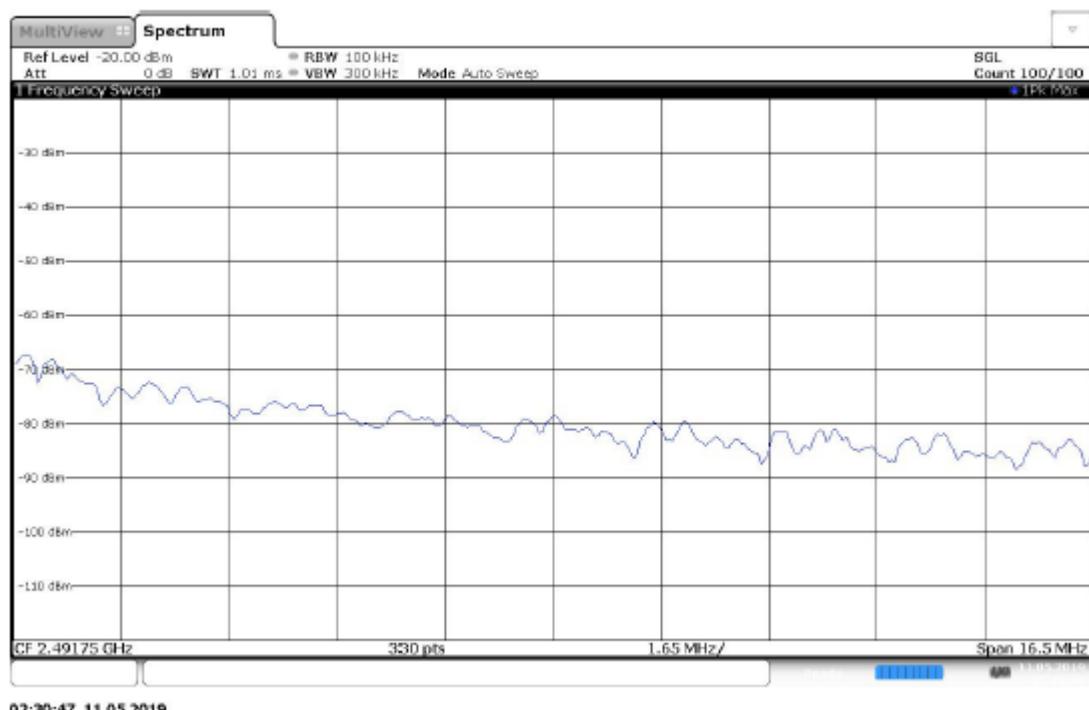
Antenna Port Conducted Upper Band Edge

Band Edge



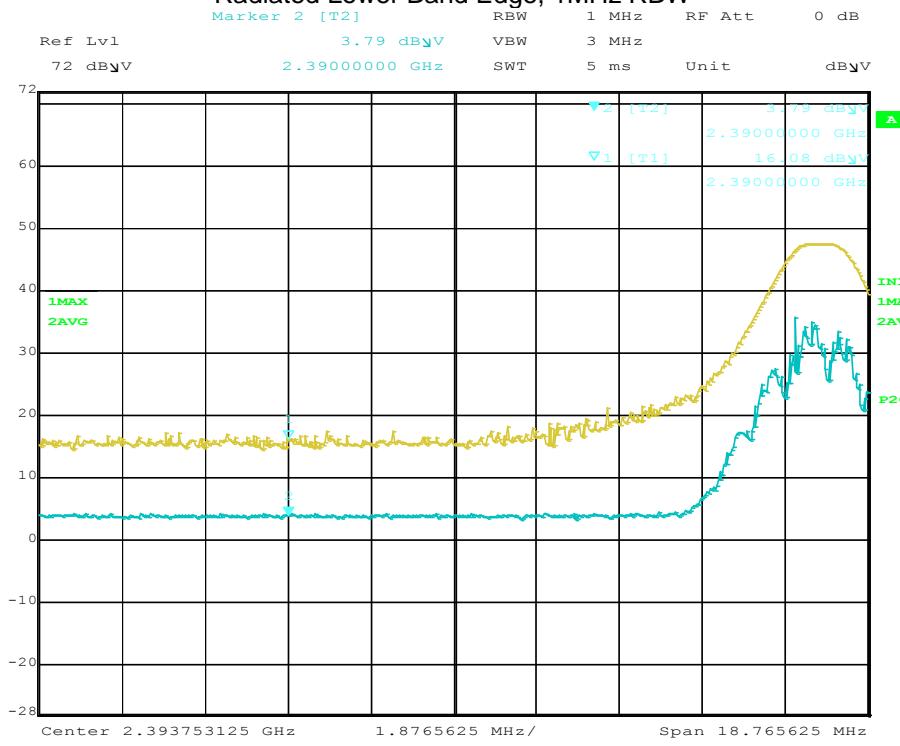
Band Edge Connector 1_0



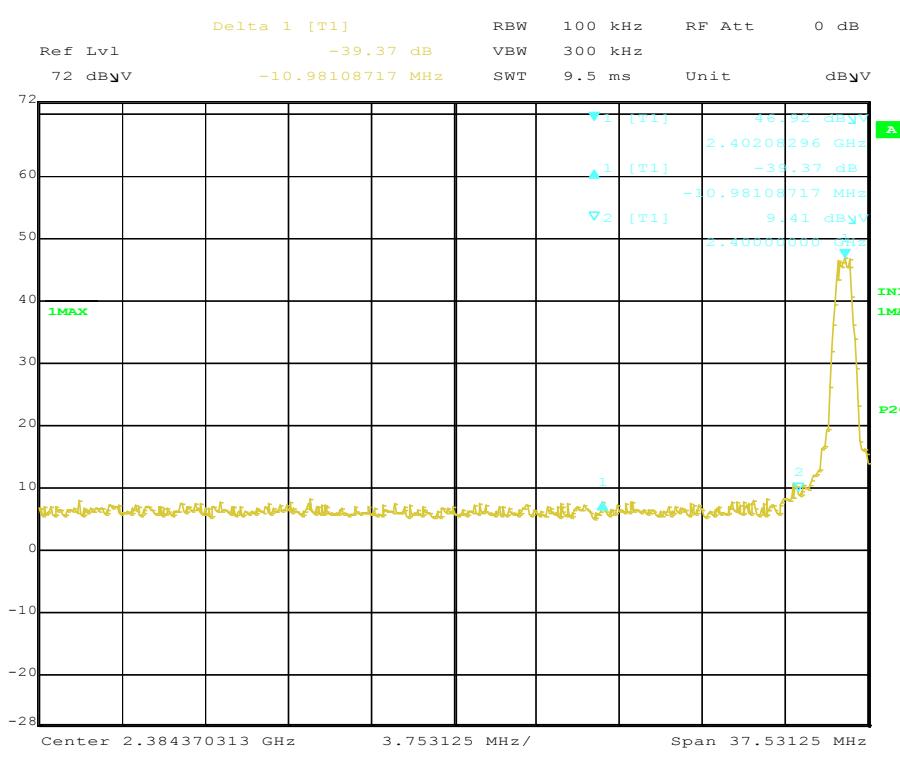
Band Edge Connector 1_1

Worst-case

Radiated Lower Band Edge, 1MHz RBW

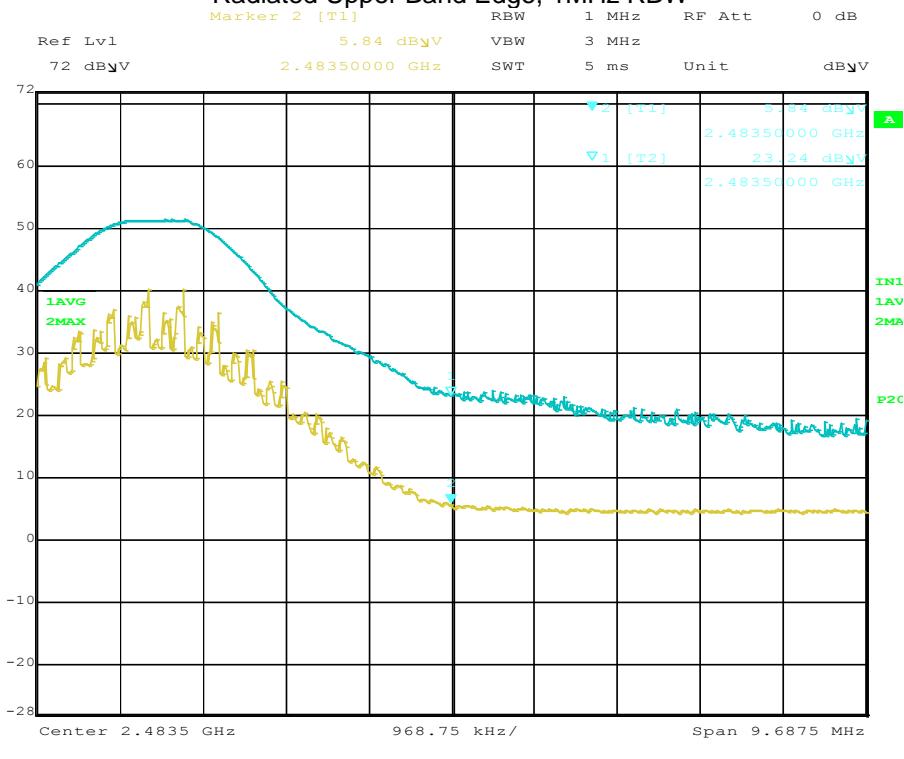


Radiated Lower Band Edge, 100kHz RBW

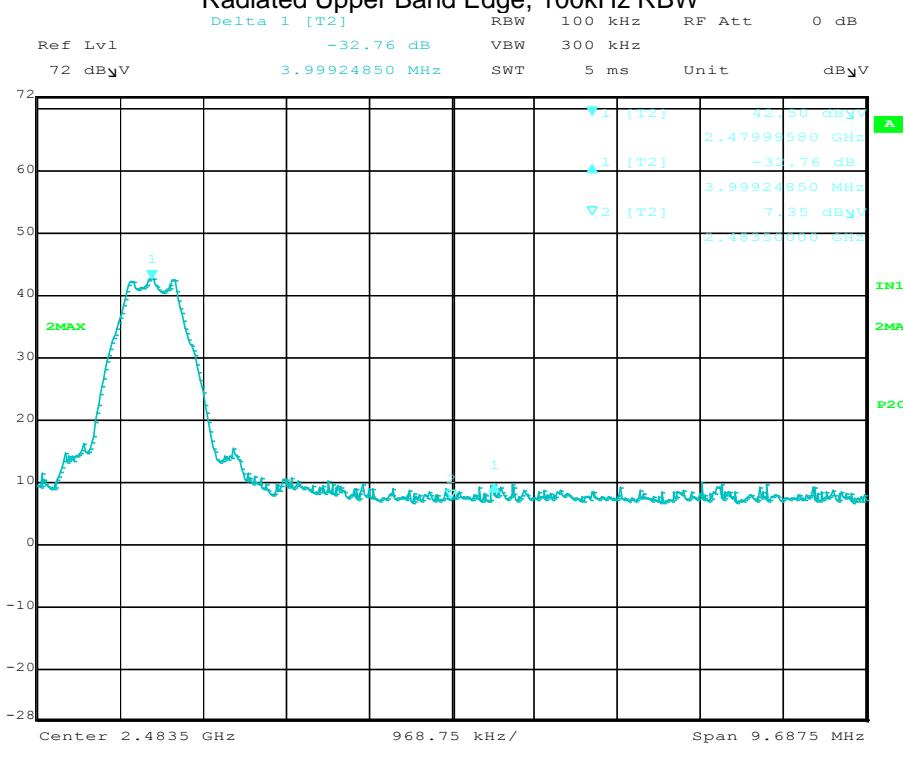


Worst-case

Radiated Upper Band Edge, 1MHz RBW



Radiated Upper Band Edge, 100kHz RBW



Special Radiated Emissions

Company: Cutsforth Inc.
 Model #: EBHS001
 Serial #: BOX1905081103 (Intertek Assigned)
 Engineers: Vathana Ven
 Project #: G103663187 Date(s): 05/09/19
 Standard: 15.247/RSS-247
 Receiver: R&S ESI (145-128) 03/28/2019 Limit Distance (m): 3
 PreAmp: NONE.
 PreAmp Used? (Y or N): N Voltage/Frequency: 9V Battery Frequency Range: See below
 Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
 Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC
Lower Band Edge Compliance, X-Axis													
PK	V	2390.000	14.84	32.56	6.77	0.00	0.00	54.17	74.00	-19.83	1/3 MHz	RB	RB
AVG	V	2390.000	3.90	32.56	6.77	0.00	0.00	43.23	54.00	-10.77	1/3 MHz	RB	RB
Upper Band Edge Compliance, X-Axis													
PK	H	2483.500	22.32	32.27	6.91	0.00	0.00	61.49	74.00	-12.51	1/3 MHz	RB	RB
AVG	H	2483.500	5.90	32.27	6.91	0.00	0.00	45.07	54.00	-8.93	1/3 MHz	RB	RB
Lower Band Edge Compliance, Y-Axis													
PK	H	2390.000	15.46	32.10	6.77	0.00	0.00	54.33	74.00	-19.67	1/3 MHz	RB	RB
AVG	H	2390.000	3.80	32.10	6.77	0.00	0.00	42.67	54.00	-11.33	1/3 MHz	RB	RB
Upper Band Edge Compliance, Y-Axis													
PK	H	2483.500	18.91	32.27	6.91	0.00	0.00	58.08	74.00	-15.92	1/3 MHz	RB	RB
AVG	H	2483.500	4.80	32.27	6.91	0.00	0.00	43.97	54.00	-10.03	1/3 MHz	RB	RB
Lower Band Edge Compliance, Z-Axis													
PK	H	2390.000	15.90	32.10	6.77	0.00	0.00	54.77	74.00	-19.23	1/3 MHz	RB	RB
AVG	H	2390.000	3.80	32.10	6.77	0.00	0.00	42.67	54.00	-11.33	1/3 MHz	RB	RB
Upper Band Edge Compliance, Z-Axis													
PK	H	2483.500	19.78	32.27	6.91	0.00	0.00	58.95	74.00	-15.05	1/3 MHz	RB	RB
AVG	H	2483.500	5.20	32.27	6.91	0.00	0.00	44.37	54.00	-9.63	1/3 MHz	RB	RB

Test Personnel: Vathana Ven
 Supervising/Reviewing
 Engineer:
 (Where Applicable) N/A
 Product Standard: CFR47 FCC Part 15.247
 Input Voltage: Battery Powered
 Pretest Verification w/
 Ambient Signals or
 BB Source: BB Source

Test Date: 05/09/2019, 05/10/2019
 Limit Applied: See report section 9.3
 Ambient Temperature: 25, 22 °C
 Relative Humidity: 24, 53 %
 Atmospheric Pressure: 1015, 1003 mbars

Deviations, Additions, or Exclusions: None

10 Transmitter spurious emissions

10.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.247, FCC Part 15 Subpart B, RSS 247 ICES 003, ANSI C 63.10, and ANSI C 63.4, Most recent KDB should be KDB 558074 D01 15.247 Meas Guidance v05r02.

TEST SITE: EMC Lab & 10m ALSE

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

FS = Field Strength in $\text{dB}\mu\text{V}/\text{m}$

RA = Receiver Amplitude (including preamplifier) in $\text{dB}\mu\text{V}$

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB

AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 $\text{dB}\mu\text{V}$ is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 $\text{dB}\mu\text{V}/\text{m}$. This value in $\text{dB}\mu\text{V}/\text{m}$ was converted to its corresponding level in $\mu\text{V}/\text{m}$.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}/\text{m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V}/\text{m}$$

To convert from $\text{dB}\mu\text{V}$ to μV or mV the following was used:

$$UF = 10^{(NF/20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in } \text{dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V}/\text{m}$$

Alternately, when BAT-EMC Emission Software is used, the "Level" includes all losses and gains and is compared directly in the "Margin" column to the "Limit". The "Correction" includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the "Level" column.

10.2 Test Equipment Used:

Equipment used for radiated emission measurement

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	06/21/2018	06/21/2019
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/28/2019	03/28/2020
145-410'	Cables 145-420 145-421 145-422 145-406	Huber + Suhner	10m Track A Cables	multiple	07/25/2018	07/25/2019
PRE11'	50dB gain pre-amp	Keith H	PRE11	PRE11	10/27/2018	10/27/2019
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	05/16/2018	05/16/2019
ETS005'	1-18GHz horn antenna	ETS-Lindgren	3117	00218279	05/14/2018	05/14/2019
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	06/14/2018	06/14/2019
REA008'	band reject filter 2.4GHz	Reactel, Inc	12RX7-2441.75-x140 S	17-01	07/13/2018	07/13/2019
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2018	07/25/2019
EMC04'	ANTENNA, RIDGED GUIDE, 18-40 GHZ	EMCO	3116	2090	10/26/2018	10/26/2019
REA004'	3GHz High Pass Filter	Reactel, Inc	7HSX-3G/18G-S11	06-1	02/25/2019	02/25/2020
CBLSHF103'	Cable, SMA - SMA, < 18GHz	Sucoflex (Huber Suhner)	104PE	CBLSHF103	11/15/2018	11/15/2019
145130'	Cable,SMA-SMA,1 meter,9kHz-40GHz, (Cable Kit 6)	Huber+Suhner	Sucoflex 102EA	3153/2EA	09/13/2018	09/13/2019
PRE9'	100MHz-40GHz Preamp	MITEQ	NSP4000-NFG	1260417	09/14/2018	09/14/2019

Equipment used for antenna port measurement

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DS40'	Temp, humidity, pressure gauge	Digi Sense	68000-49	181717625	11/06/2018	11/06/2019
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Schwartz	FSW43	100646	10/15/2018	10/15/2019
ROS005-4'	Control Platform	Rohde and Schwarz	OSP120	101428	11/20/2018	11/20/2019
None'	Coaxial Cable (DUT1)	UTIFLEX MICRO-COAX	UFA210A-1-0787-300300	101709	02/01/2019	02/01/2020
None'	20 dB Attenuator (DUT1)	Pasternack	E7004-20	None	02/01/2019	02/01/2020
None'	Coaxial Cable (Receiver/RF In)	Micro-coax	UFA210A-0-0-0196-300300	101706	02/01/2019	02/01/2020
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	02/01/2019	02/01/2020

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.17.0.3
EMI Boxborough.xls	Intertek	08/27/2010

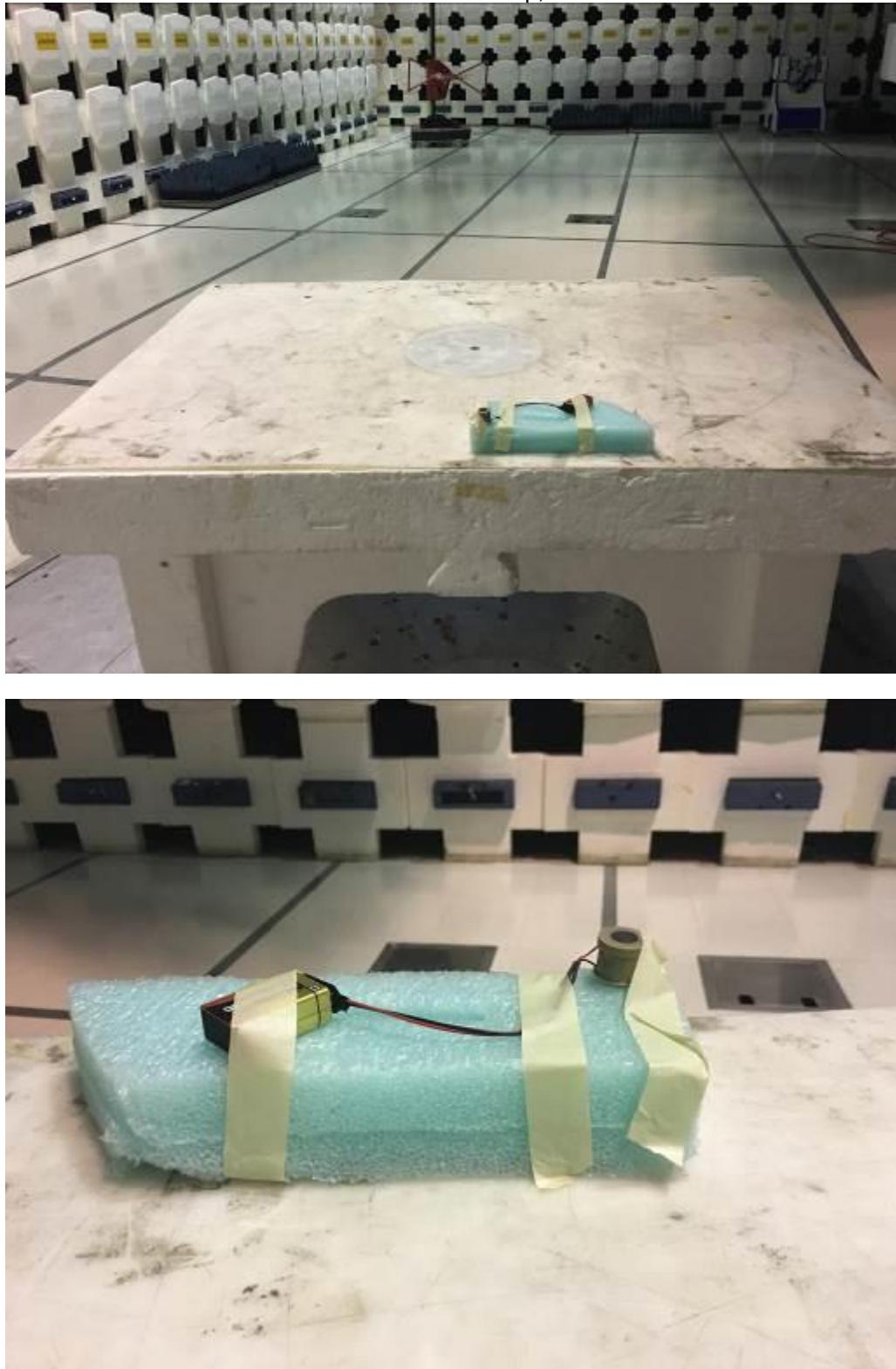
10.3 Results:

The sample tested was found to Comply.

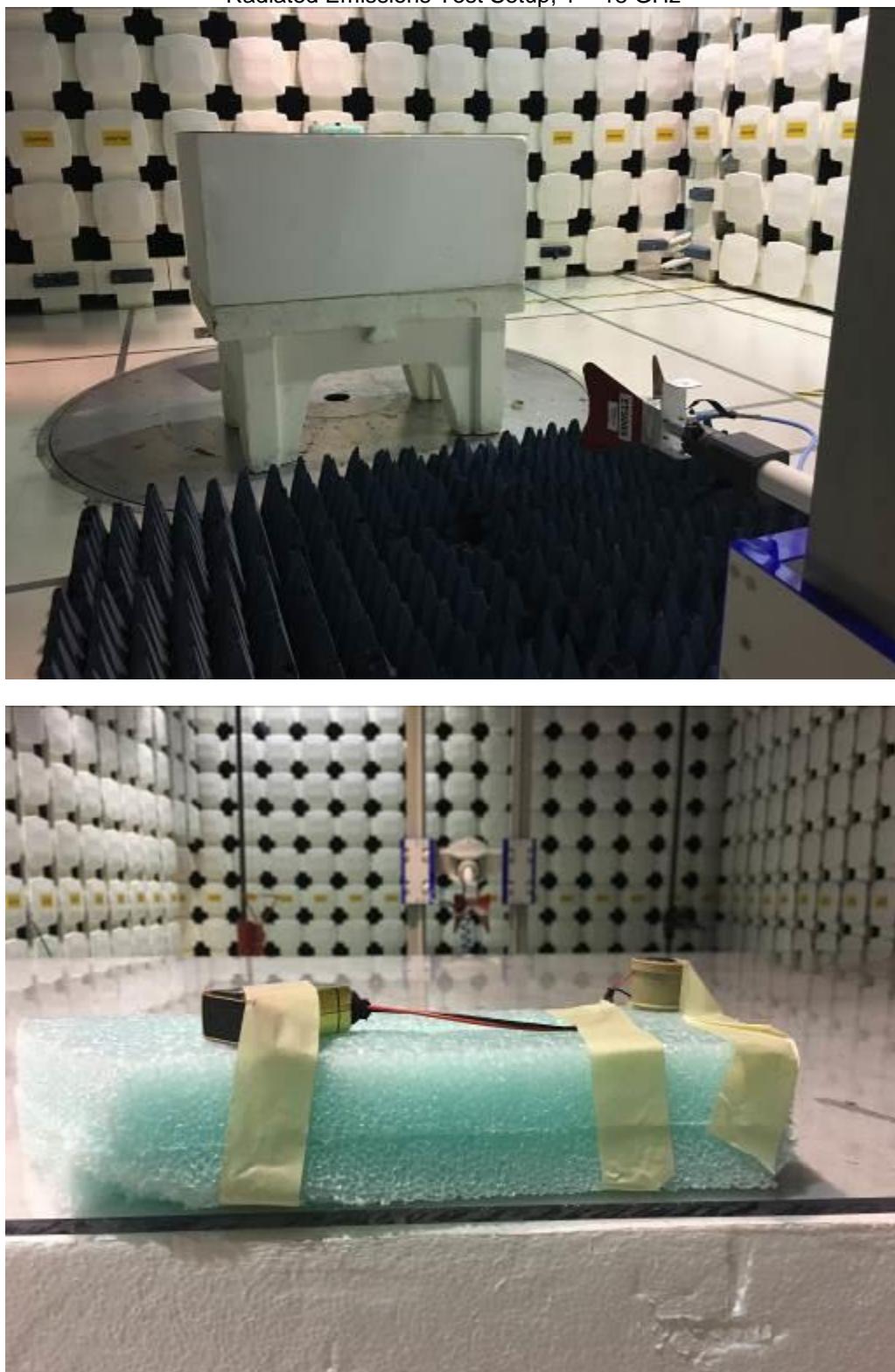
15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

10.4 Setup Photographs:

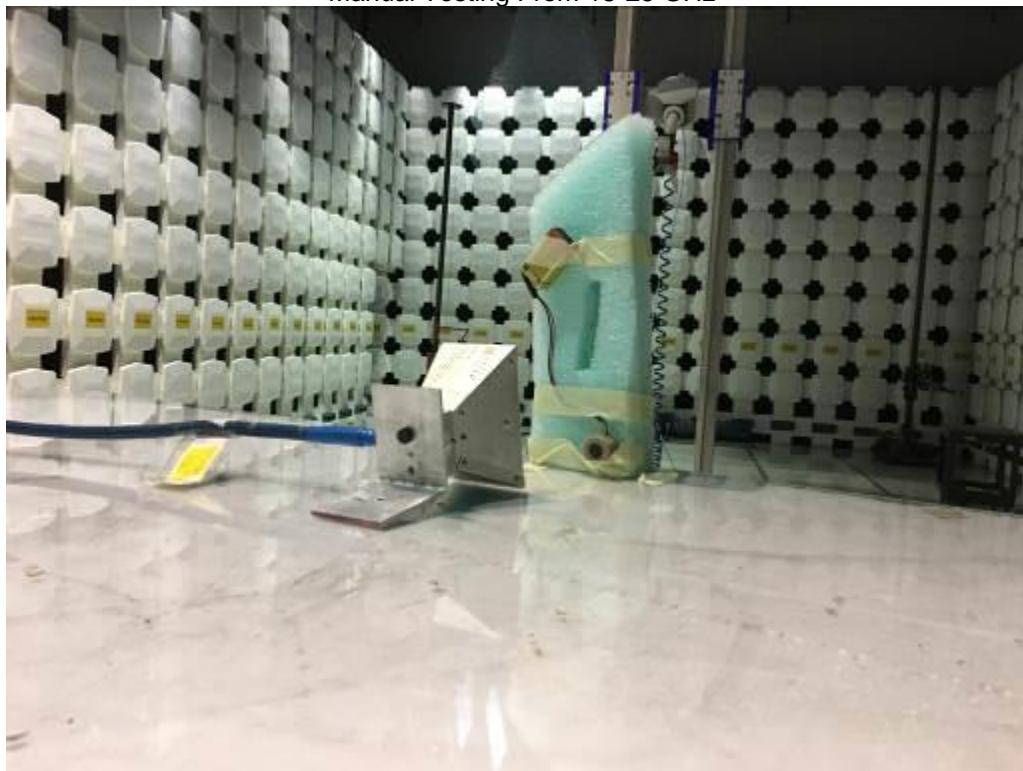
Radiated Emissions Test Setup, 30-1000 MHz



Radiated Emissions Test Setup, 1 – 18 GHz



Manual Testing From 18-25 GHz



Antenna Port Conducted Test Setup

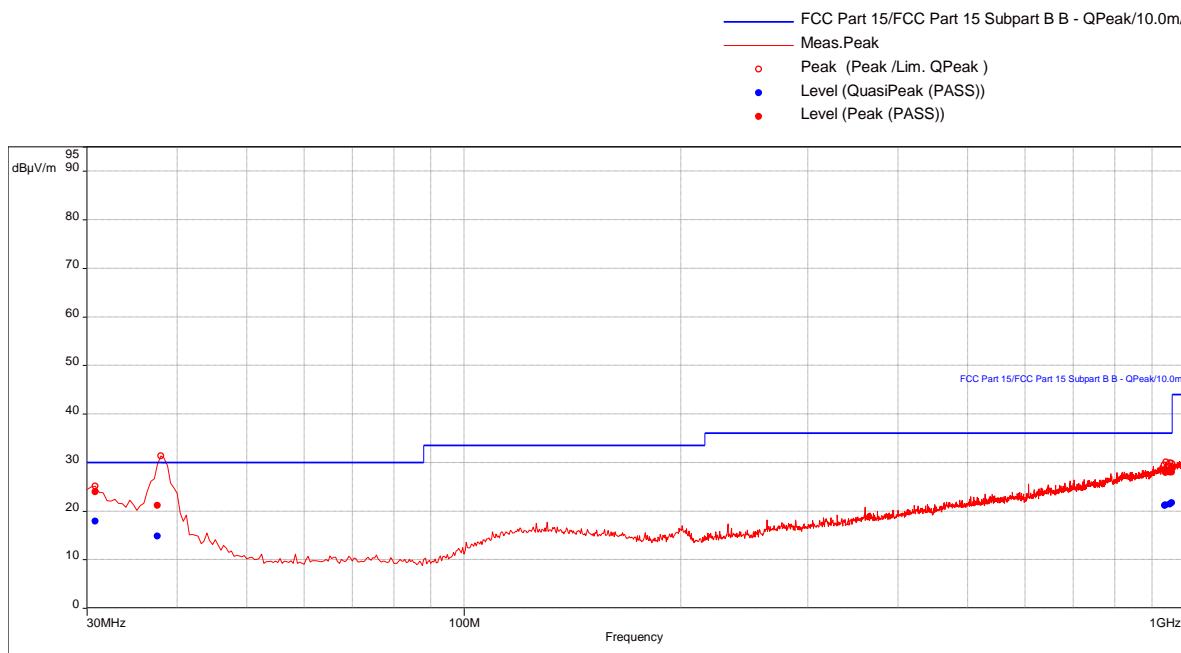


10.5 Plots/Data:

30-1000MHz, Battery Powered, Transmit @ Low Channel, EUT on X-axis

Test Information:

Date and Time	5/8/2019 7:17:15 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	32%
Atmospheric Pressure	1013 mB
Comments	RE 30-1000MHz_Tx mode_Low channel_X-axis

Graph:**Results:**

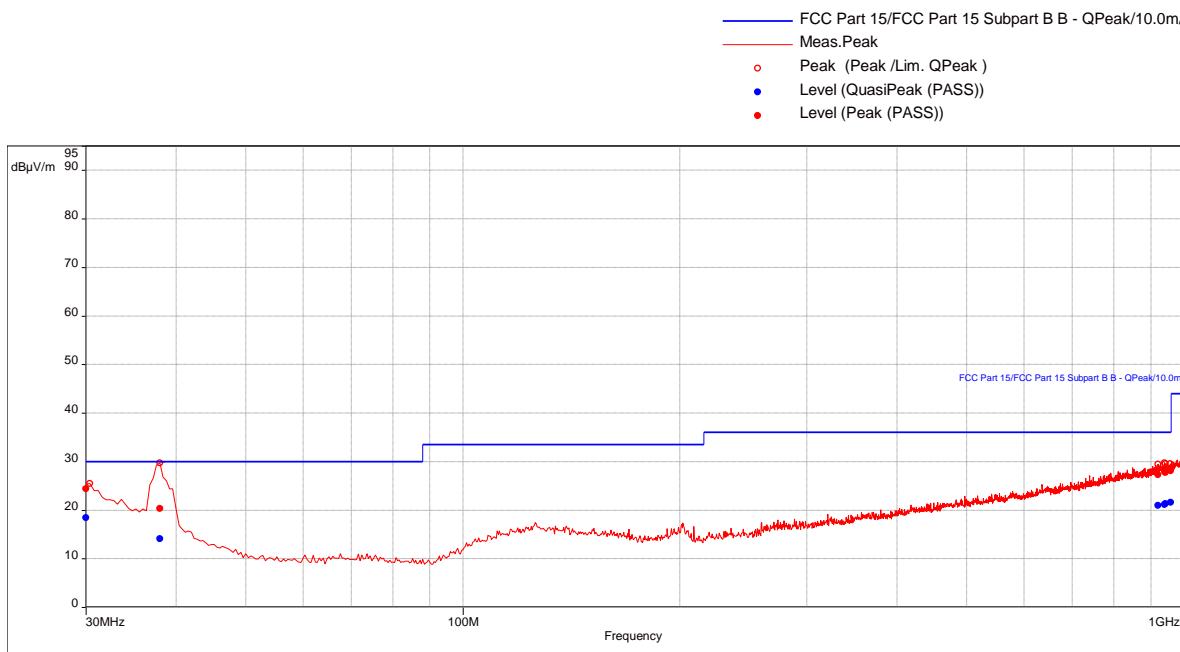
QuasiPeak (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
30.83157895	17.84	30.00	-12.16	276.00	3.78	Vertical	120000.00	-11.60
37.52631579	14.79	30.00	-15.21	143.00	2.17	Vertical	120000.00	-16.76
937.0526316	21.18	36.00	-14.82	359.00	1.14	Horizontal	120000.00	-4.84
940.7894737	21.18	36.00	-14.82	48.00	1.74	Vertical	120000.00	-4.84
953.6947368	21.42	36.00	-14.58	106.00	3.93	Vertical	120000.00	-4.53
958.7052632	21.67	36.00	-14.33	98.00	1.37	Vertical	120000.00	-4.42

30-1000MHz, Battery Powered, Transmit @ Low Channel, EUT on Y-axis

Test Information:

Date and Time	5/8/2019 7:20:54 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	32%
Atmospheric Pressure	1013 mB
Comments	RE 30-1000MHz_Tx mode_Low channel_Y-axis

Graph:**Results:**

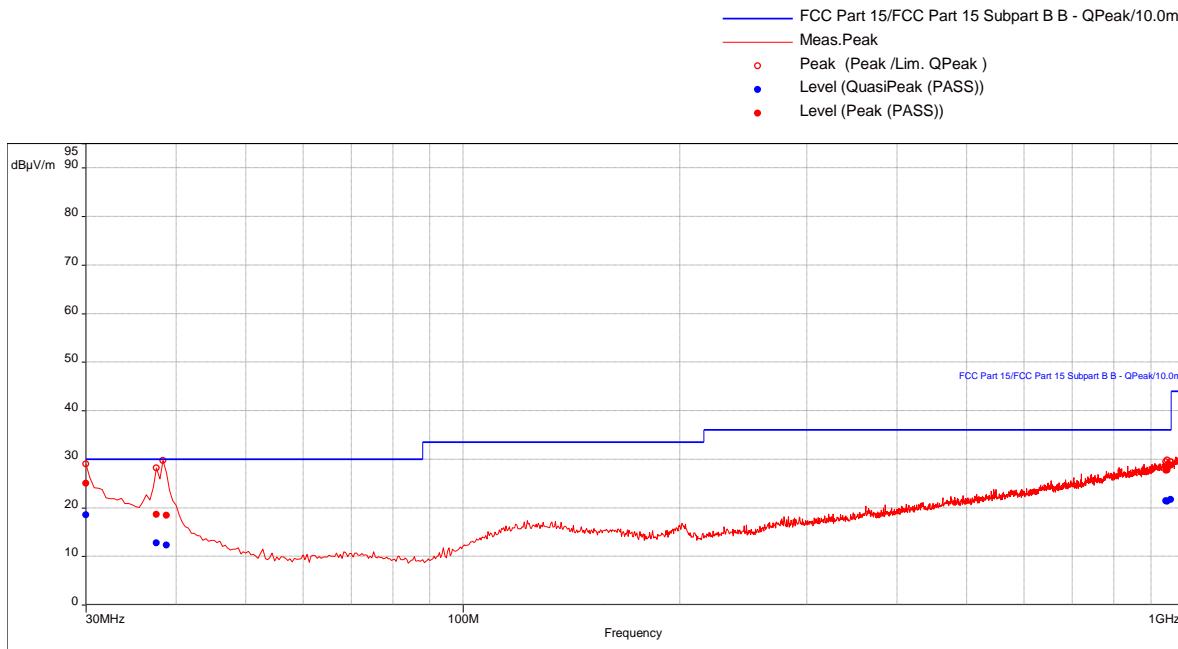
QuasiPeak (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
30.11578947	18.40	30.00	-11.60	327.00	1.58	Vertical	120000.00	-11.04
38.09473684	14.07	30.00	-15.93	25.00	1.00	Vertical	120000.00	-17.21
921.0526316	20.99	36.00	-15.01	128.00	1.37	Horizontal	120000.00	-5.03
940.5578947	21.18	36.00	-14.82	290.00	3.60	Horizontal	120000.00	-4.84
943.2526316	21.29	36.00	-14.71	359.00	2.55	Vertical	120000.00	-4.81
958.2105263	21.62	36.00	-14.38	174.00	1.44	Vertical	120000.00	-4.47

30-1000MHz, Battery Powered, Transmit @ Low Channel, EUT on Z-axis

Test Information:

Date and Time	5/8/2019 8:08:09 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	32%
Atmospheric Pressure	1013 mB
Comments	RE 30-1000MHz_Tx mode_Low channel_Z-axis

Graph:**Results:**

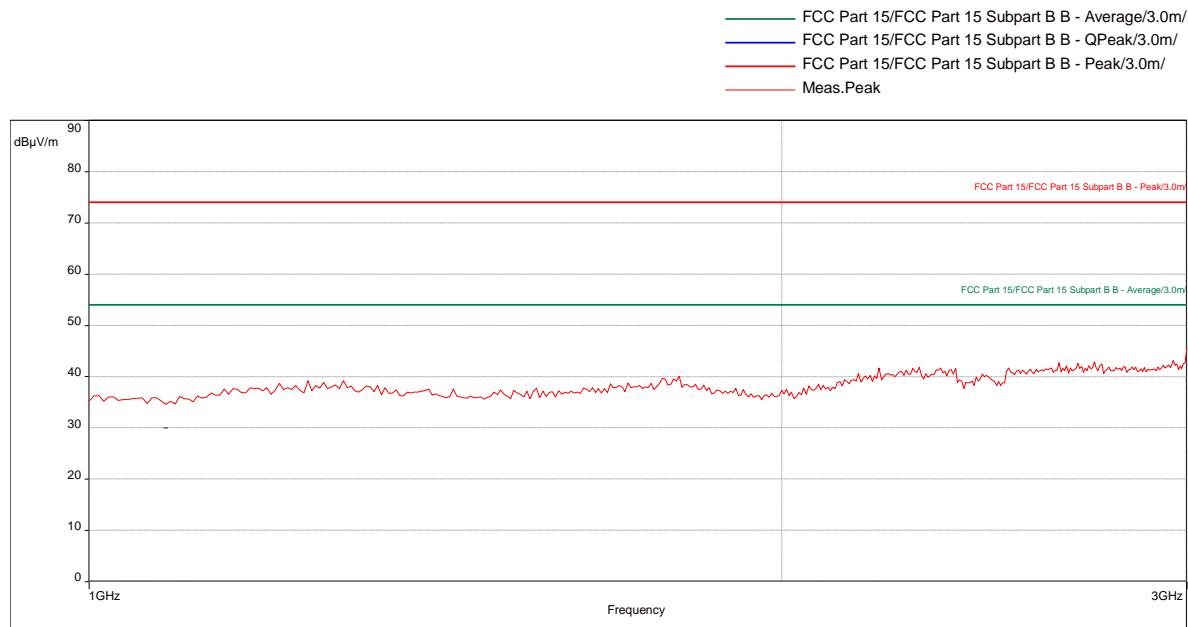
QuasiPeak (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
30.03157895	18.56	30.00	-11.44	359.00	3.89	Vertical	120000.00	-10.98
37.44210526	12.70	30.00	-17.30	91.00	2.41	Vertical	120000.00	-16.69
38.77894737	12.29	30.00	-17.71	25.00	3.13	Vertical	120000.00	-17.67
944.8421053	21.39	36.00	-14.61	328.00	2.04	Vertical	120000.00	-4.70
948.2210526	21.35	36.00	-14.65	224.00	1.28	Vertical	120000.00	-4.66
958.7052632	21.67	36.00	-14.33	18.00	1.51	Vertical	120000.00	-4.42

1-3 GHz, Battery Powered, Transmit @ Low Channel, EUT on X-axis

Test Information:

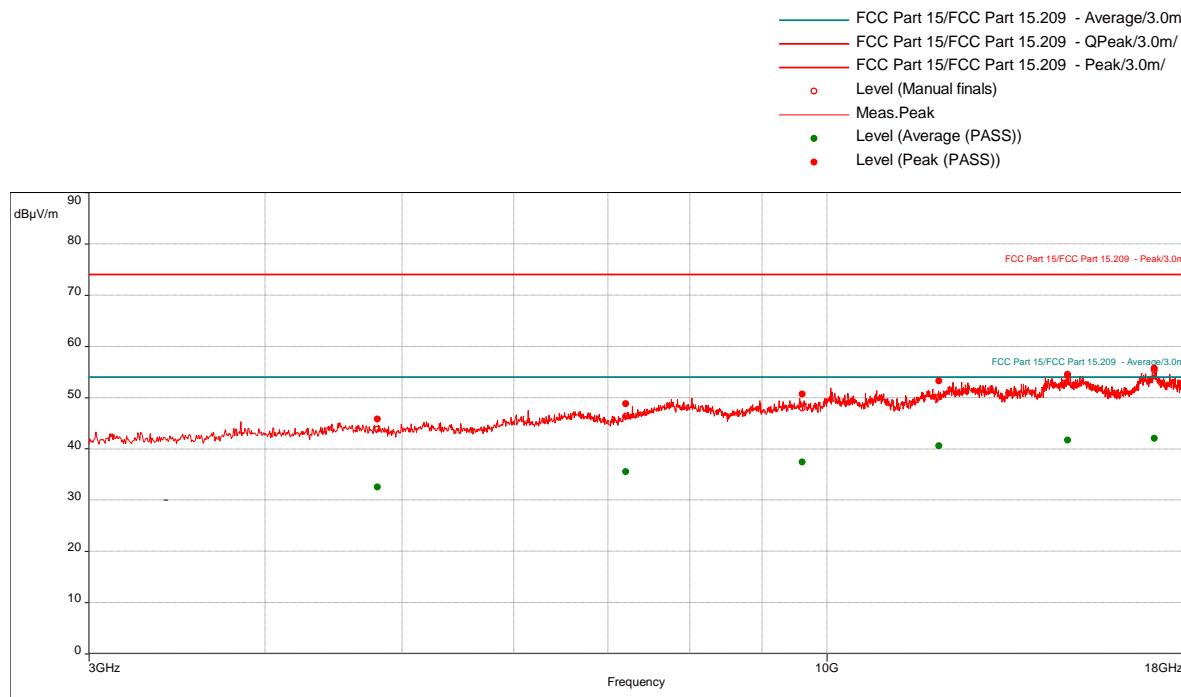
Date and Time	5/8/2019 10:39:18 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	32%
Atmospheric Pressure	1013 mB
Comments	RE 1 to 3 GHz_Tx mode_Low Channel_X-Axis

Graph:**Results:** No emissions were detected.

3-18 GHz, Battery Powered, Transmit @ Low Channel, EUT on X-axis

Test Information:

Date and Time	5/9/2019 8:30:55 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	24%
Atmospheric Pressure	1015 mB
Comments	RE 3 to 18 GHz_Tx mode_Low Channel_X-Axis

Graph:**Results:**

Peak (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4804.473684	45.79	74.00	-28.21	69.00	2.45	Vertical	1000000.00	-11.60
7203.421053	48.74	74.00	-25.26	92.00	2.15	Horizontal	1000000.00	-7.65
9610.526316	50.61	74.00	-23.39	313.00	1.50	Vertical	1000000.00	-4.71
12008.68421	53.25	74.00	-20.75	99.00	3.00	Vertical	1000000.00	-0.25
14815.78947	54.24	74.00	-19.76	209.00	1.40	Vertical	1000000.00	3.40
17072.36842	55.66	74.00	-18.34	0.00	1.10	Vertical	1000000.00	3.36

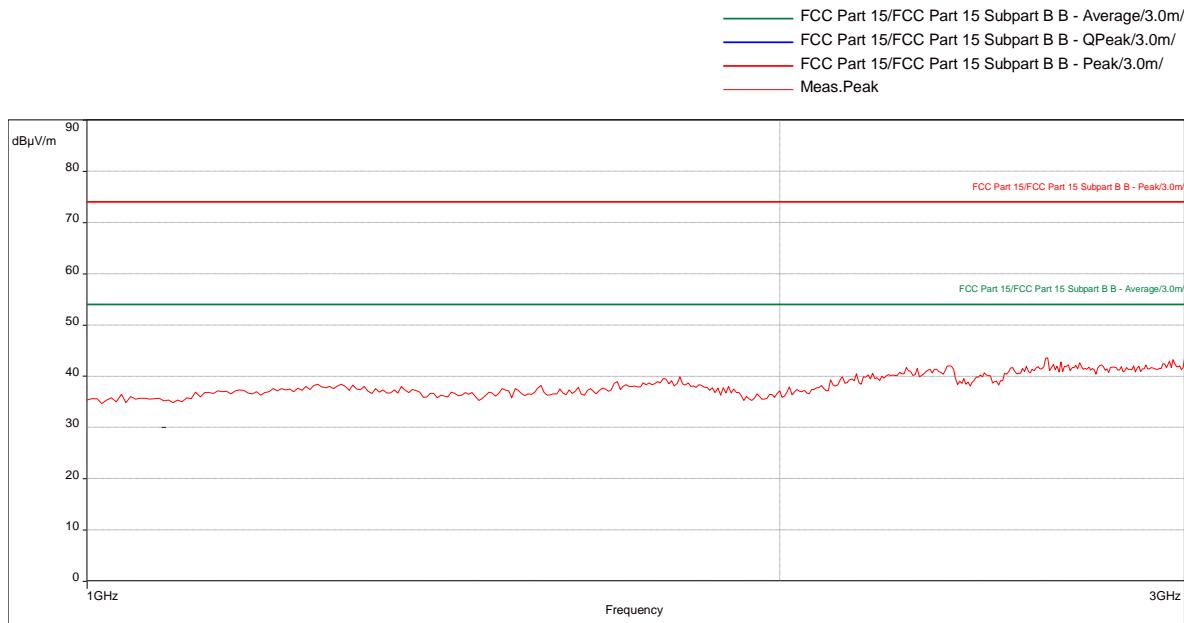
Average (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4804.473684	32.52	54.00	-21.48	69.00	2.45	Vertical	1000000.00	-11.60
7203.421053	35.50	54.00	-18.50	92.00	2.15	Horizontal	1000000.00	-7.65
9610.526316	37.36	54.00	-16.64	313.00	1.50	Vertical	1000000.00	-4.71
12008.68421	40.52	54.00	-13.48	99.00	3.00	Vertical	1000000.00	-0.25
14815.78947	41.64	54.00	-12.36	209.00	1.40	Vertical	1000000.00	3.40
17072.36842	42.01	54.00	-11.99	0.00	1.10	Vertical	1000000.00	3.36

1-3 GHz, Battery Powered, Transmit @ Low Channel, EUT on Y-axis

Test Information:

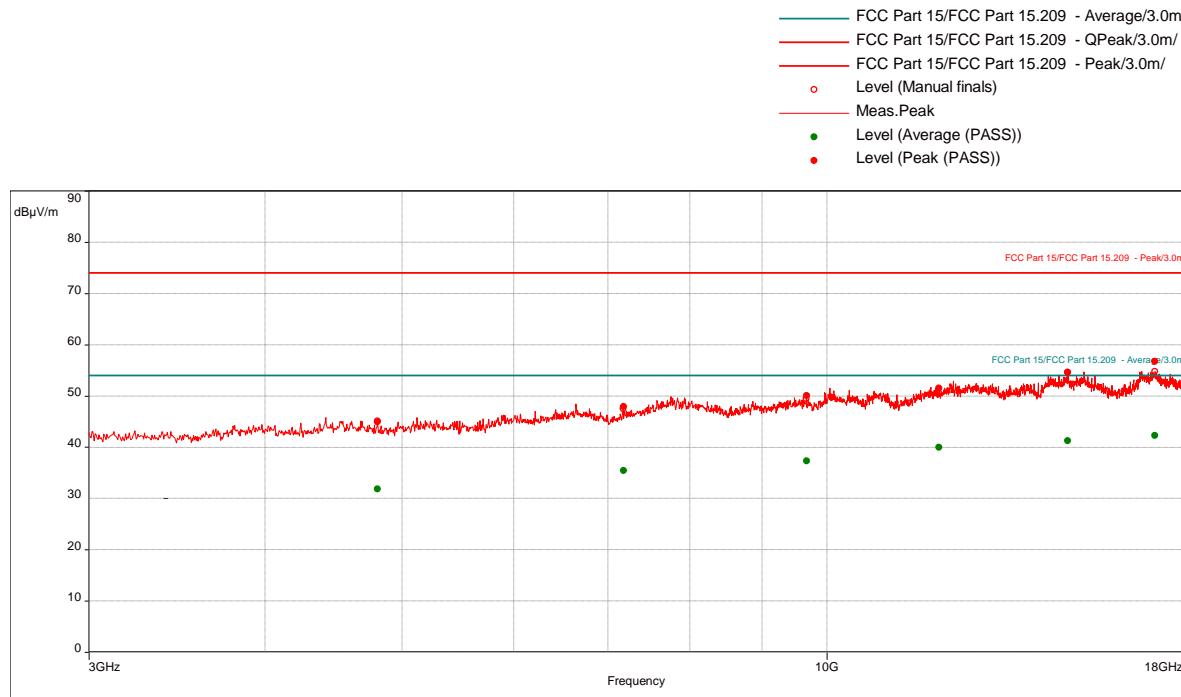
Date and Time	5/8/2019 10:45:33 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	32%
Atmospheric Pressure	1013 mB
Comments	RE 1 to 3 GHz_Tx mode_Low Channel_Y-Axis

Graph:**Results:** No emissions were detected.

3-18 GHz, Battery Powered, Transmit @ Low Channel, EUT on Y-axis

Test Information:

Date and Time	5/9/2019 9:05:50 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	24%
Atmospheric Pressure	1015 mB
Comments	RE 3 to 18 GHz_Tx mode_Low Channel_Y-Axis

Graph:**Results:**

Peak (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4804.210526	44.92	74.00	-29.08	224.00	1.50	Vertical	1000000.00	-11.60
7179.736842	47.95	74.00	-26.05	233.00	1.00	Horizontal	1000000.00	-7.65
9678.421053	50.08	74.00	-23.92	107.00	1.65	Horizontal	1000000.00	-4.58
12009.73684	51.52	74.00	-22.48	344.00	2.55	Horizontal	1000000.00	-0.24
14826.31579	54.60	74.00	-19.40	233.00	2.10	Horizontal	1000000.00	3.37
17089.47368	56.69	74.00	-17.31	106.00	3.98	Vertical	1000000.00	3.46

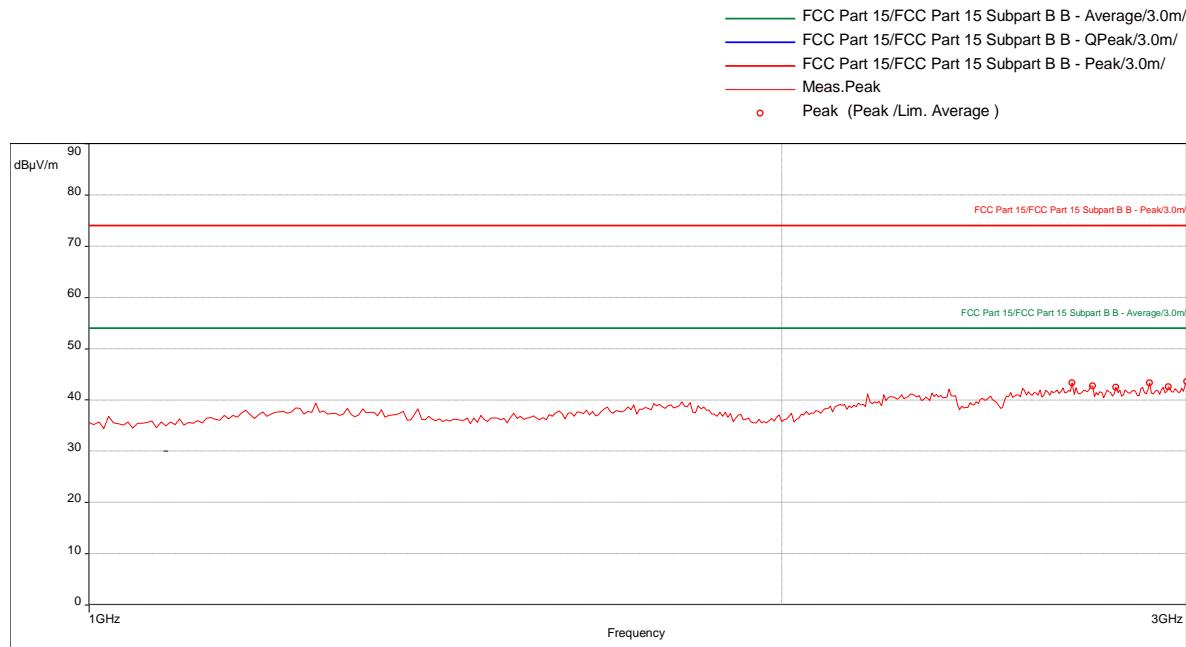
Average (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4804.210526	31.84	54.00	-22.16	224.00	1.50	Vertical	1000000.00	-11.60
7179.736842	35.45	54.00	-18.55	233.00	1.00	Horizontal	1000000.00	-7.65
9678.421053	37.34	54.00	-16.66	107.00	1.65	Horizontal	1000000.00	-4.58
12009.73684	39.93	54.00	-14.07	344.00	2.55	Horizontal	1000000.00	-0.24
14826.31579	41.26	54.00	-12.74	233.00	2.10	Horizontal	1000000.00	3.37
17089.47368	42.23	54.00	-11.77	106.00	3.98	Vertical	1000000.00	3.46

1-3 GHz, Battery Powered, Transmit @ Low Channel, EUT on Z-axis

Test Information:

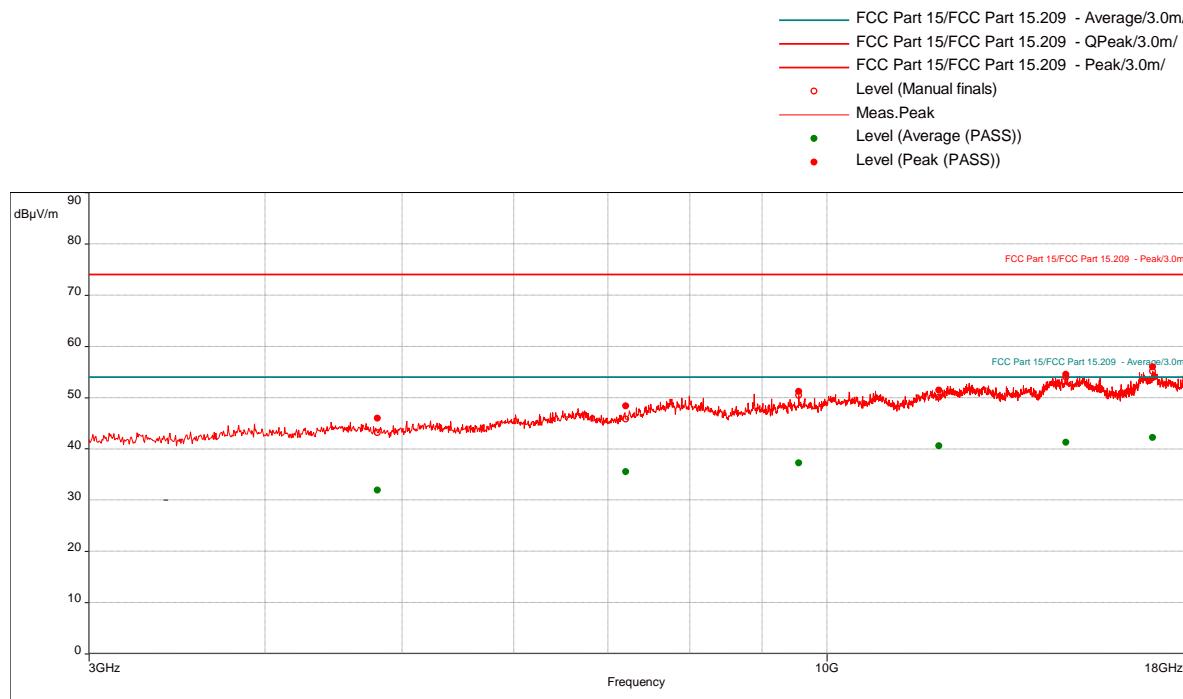
Date and Time	5/8/2019 10:50:18 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	32%
Atmospheric Pressure	1013 mB
Comments	RE 1 to 3 GHz_Tx mode_Low Channel_Z-Axis

Graph:**Results:** No emissions were detected.

3-18 GHz, Battery Powered, Transmit @ Low Channel, EUT on Z-axis

Test Information:

Date and Time	5/9/2019 9:39:44 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	24%
Atmospheric Pressure	1015 mB
Comments	RE 3 to 18 GHz_Tx mode_Low Channel_Z-Axis

Graph:**Results:**

Peak (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4803.947368	45.92	74.00	-28.08	209.00	3.34	Vertical	1000000.00	-11.60
7207.368421	48.35	74.00	-25.65	253.00	2.40	Vertical	1000000.00	-7.64
9557.105263	51.13	74.00	-22.87	292.00	3.00	Horizontal	1000000.00	-5.00
12010.52632	51.39	74.00	-22.61	343.00	2.80	Vertical	1000000.00	-0.24
14774.21053	54.50	74.00	-19.50	129.00	1.60	Vertical	1000000.00	3.40
17030.26316	55.95	74.00	-18.05	241.00	2.35	Horizontal	1000000.00	3.12

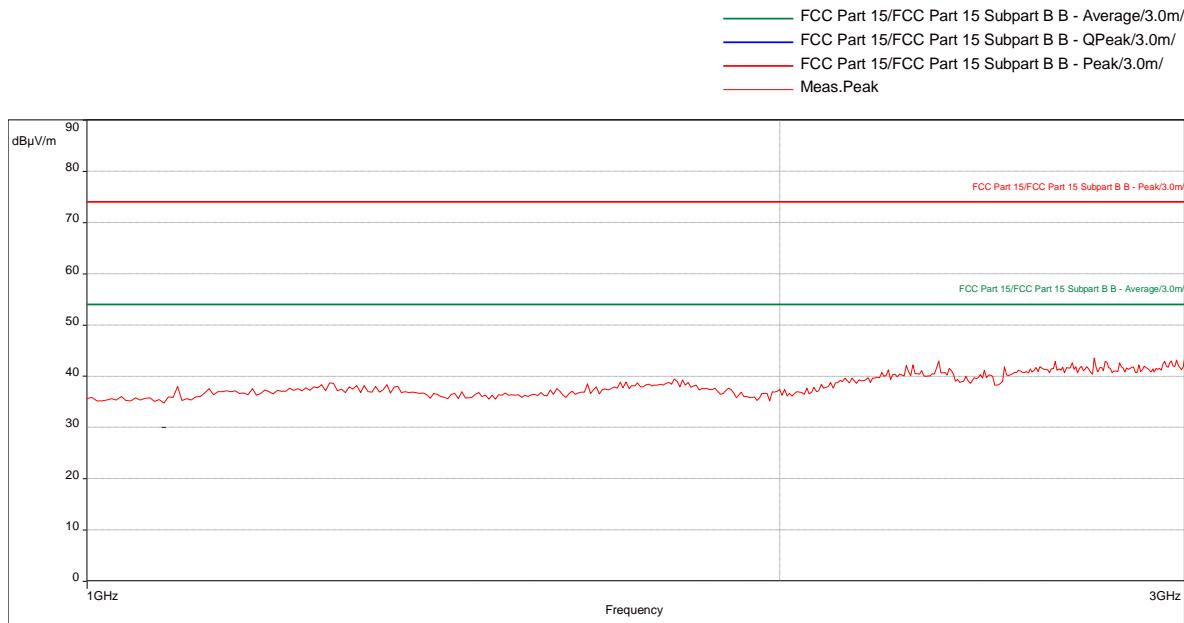
Average (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4803.947368	31.88	54.00	-22.12	209.00	3.34	Vertical	1000000.00	-11.60
7207.368421	35.52	54.00	-18.48	253.00	2.40	Vertical	1000000.00	-7.64
9557.105263	37.24	54.00	-16.76	292.00	3.00	Horizontal	1000000.00	-5.00
12010.52632	40.59	54.00	-13.41	343.00	2.80	Vertical	1000000.00	-0.24
14774.21053	41.26	54.00	-12.74	129.00	1.60	Vertical	1000000.00	3.40
17030.26316	42.20	54.00	-11.80	241.00	2.35	Horizontal	1000000.00	3.12

1-3 GHz, Battery Powered, Transmit @ Mid Channel, EUT on X-axis

Test Information:

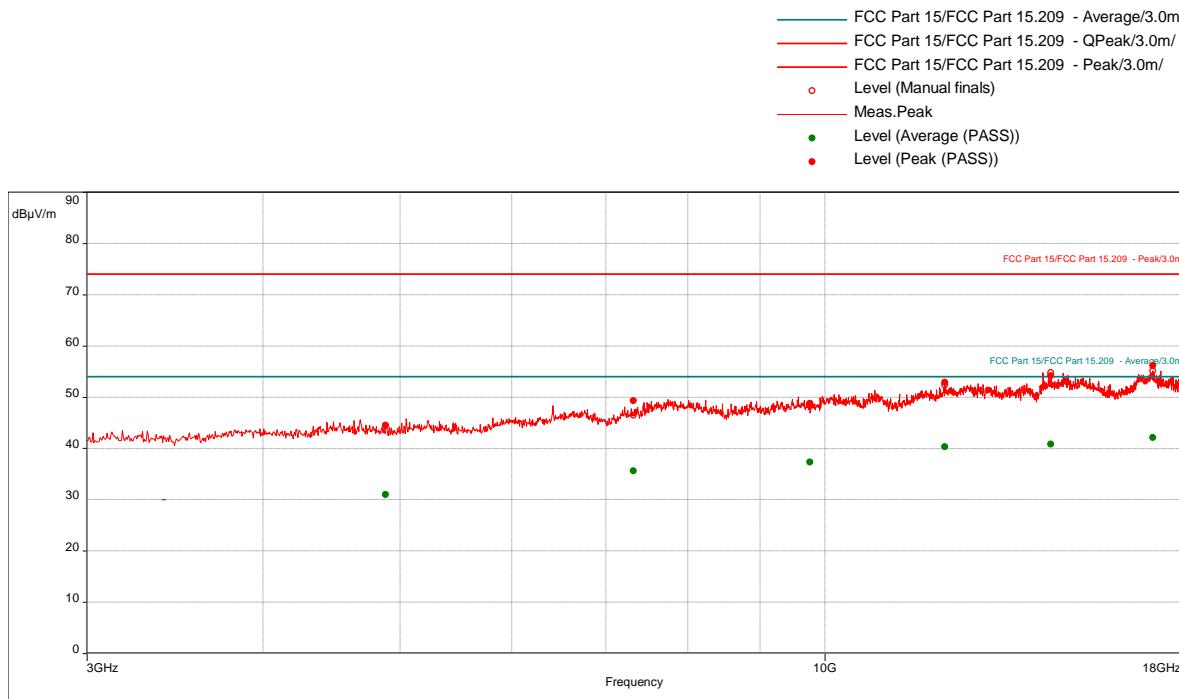
Date and Time	5/8/2019 11:10:20 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	32%
Atmospheric Pressure	1013 mB
Comments	RE 1 to 3 GHz_Tx mode_Mid Channel_X-Axis

Graph:**Results:** No emissions were detected.

3-18 GHz, Battery Powered, Transmit @ Mid Channel, EUT on X-axis

Test Information:

Date and Time	5/9/2019 6:45:16 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	24%
Atmospheric Pressure	1015 mB
Comments	RE 3 to 18 GHz_Tx mode_Mid Channel_X-Axis

Graph:**Results:**

Peak (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4884.473684	44.39	74.00	-29.61	61.00	1.95	Horizontal	1000000.00	-11.87
7320.789474	49.31	74.00	-24.69	203.00	1.30	Horizontal	1000000.00	-7.33
9762.631579	48.77	74.00	-25.23	180.00	1.80	Horizontal	1000000.00	-4.60
12168.94737	52.92	74.00	-21.08	195.00	2.00	Vertical	1000000.00	0.75
14462.10526	54.15	74.00	-19.85	129.00	3.49	Vertical	1000000.00	2.52
17085.52632	56.14	74.00	-17.86	77.00	1.01	Vertical	1000000.00	3.43

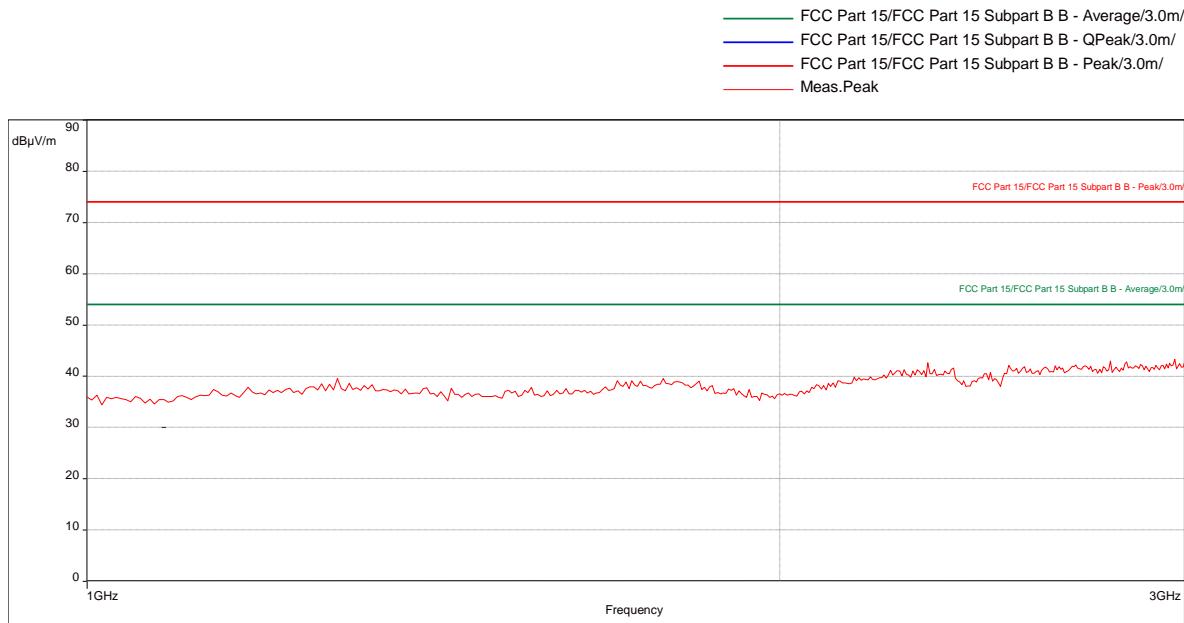
Average (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4884.473684	30.97	54.00	-23.03	61.00	1.95	Horizontal	1000000.00	-11.87
7320.789474	35.59	54.00	-18.41	203.00	1.30	Horizontal	1000000.00	-7.33
9762.631579	37.29	54.00	-16.71	180.00	1.80	Horizontal	1000000.00	-4.60
12168.94737	40.27	54.00	-13.73	195.00	2.00	Vertical	1000000.00	0.75
14462.10526	40.85	54.00	-13.15	129.00	3.49	Vertical	1000000.00	2.52
17085.52632	42.11	54.00	-11.89	77.00	1.01	Vertical	1000000.00	3.43

1-3 GHz, Battery Powered, Transmit @ Mid Channel, EUT on Y-axis

Test Information:

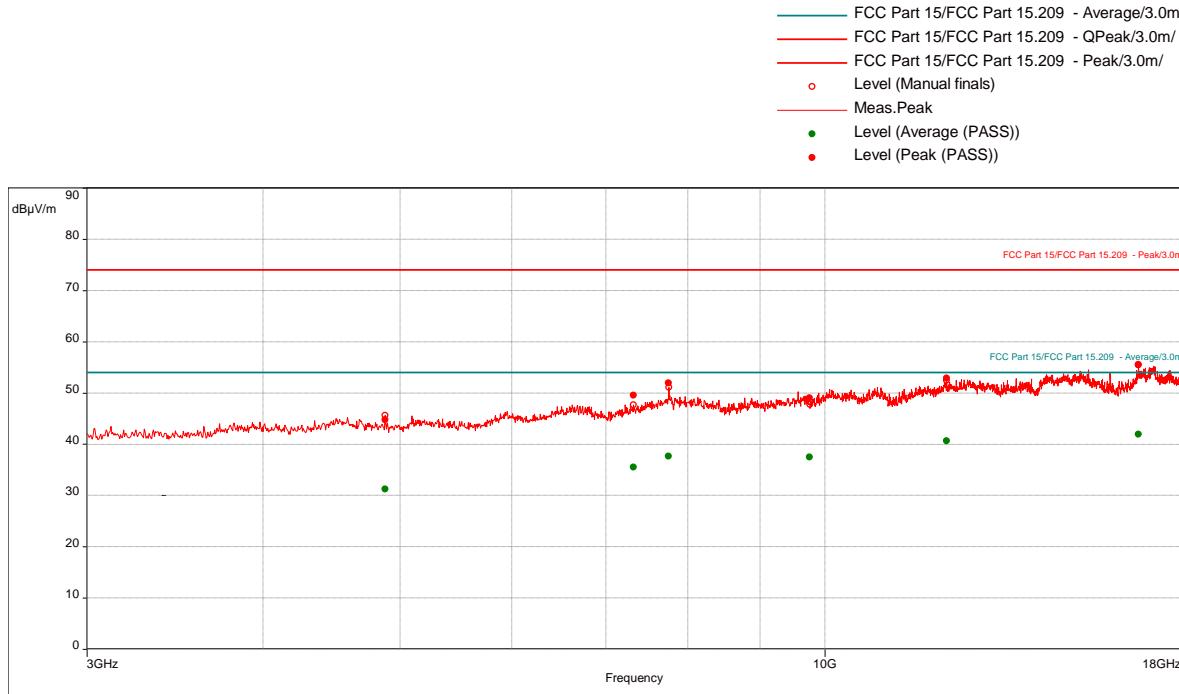
Date and Time	5/8/2019 11:05:16 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	32%
Atmospheric Pressure	1013 mB
Comments	RE 1 to 3 GHz_Tx mode_Mid Channel_Y-Axis

Graph:**Results:** No emissions were detected.

3-18 GHz, Battery Powered, Transmit @ Mid Channel, EUT on Y-axis

Test Information:

Date and Time	5/9/2019 7:18:29 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	24%
Atmospheric Pressure	1015 mB
Comments	RE 3 to 18 GHz_Tx mode_Mid Channel_Y-Axis

Graph:**Results:**

Peak (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4880.789474	44.78	74.00	-29.22	0.00	1.95	Horizontal	1000000.00	-11.86
7321.578947	49.57	74.00	-24.43	327.00	3.00	Vertical	1000000.00	-7.33
7750.263158	51.90	74.00	-22.10	224.00	2.40	Vertical	1000000.00	-5.13
9756.842105	49.04	74.00	-24.96	98.00	2.55	Vertical	1000000.00	-4.59
12203.68421	52.90	74.00	-21.10	195.00	2.45	Vertical	1000000.00	1.00
16690	55.47	74.00	-18.53	70.00	1.05	Horizontal	1000000.00	3.97

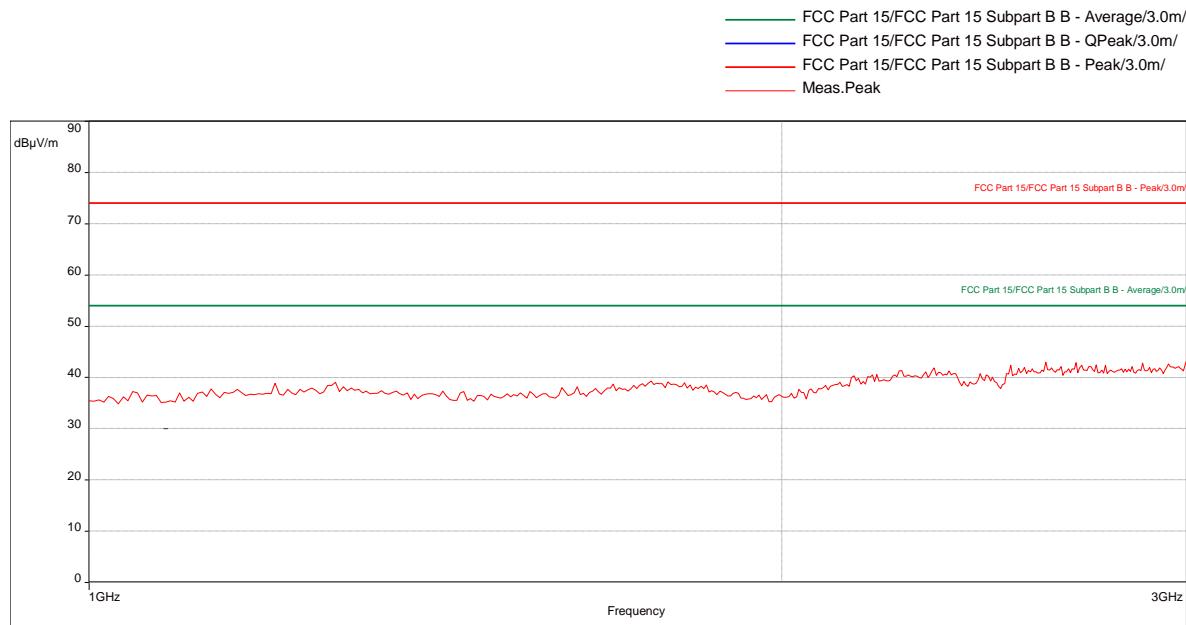
Average (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4880.789474	31.22	54.00	-22.78	0.00	1.95	Horizontal	1000000.00	-11.86
7321.578947	35.54	54.00	-18.46	327.00	3.00	Vertical	1000000.00	-7.33
7750.263158	37.66	54.00	-16.34	224.00	2.40	Vertical	1000000.00	-5.13
9756.842105	37.46	54.00	-16.54	98.00	2.55	Vertical	1000000.00	-4.59
12203.68421	40.64	54.00	-13.36	195.00	2.45	Vertical	1000000.00	1.00
16690	41.89	54.00	-12.11	70.00	1.05	Horizontal	1000000.00	3.97

1-3 GHz, Battery Powered, Transmit @ Mid Channel, EUT on Z-axis

Test Information:

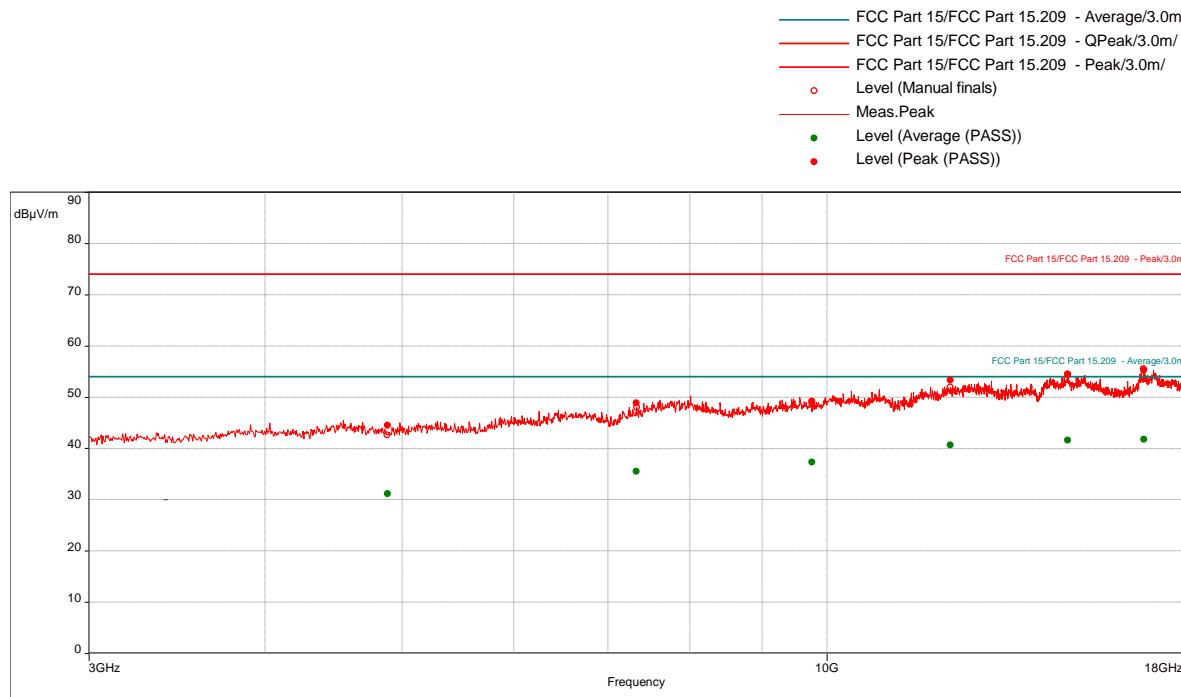
Date and Time	5/8/2019 10:59:26 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	32%
Atmospheric Pressure	1013 mB
Comments	RE 1 to 3 GHz_Tx mode_Mid Channel_Z-Axis

Graph:**Results:** No emissions were detected.

3-18 GHz, Battery Powered, Transmit @ Mid Channel, EUT on Z-axis

Test Information:

Date and Time	5/9/2019 7:54:02 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	24%
Atmospheric Pressure	1015 mB
Comments	RE 3 to 18 GHz_Tx mode_Mid Channel_Z-Axis

Graph:**Results:**

Peak (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4883.157895	44.52	74.00	-29.48	0.00	1.01	Horizontal	1000000.00	-11.87
7330.789474	48.83	74.00	-25.17	196.00	3.99	Horizontal	1000000.00	-7.30
9757.894737	49.17	74.00	-24.83	40.00	2.10	Horizontal	1000000.00	-4.59
12239.47368	53.28	74.00	-20.72	61.00	1.55	Vertical	1000000.00	0.85
14825	54.47	74.00	-19.53	356.00	3.49	Vertical	1000000.00	3.37
16778.15789	55.28	74.00	-18.72	143.00	2.65	Horizontal	1000000.00	3.78

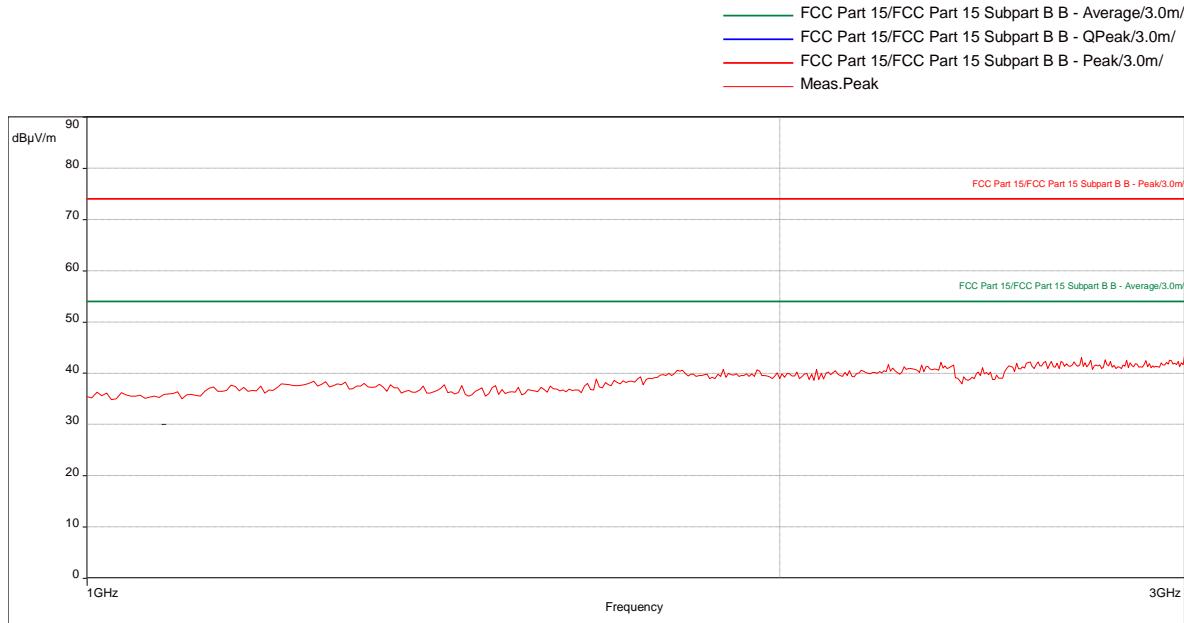
Average (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4883.157895	31.17	54.00	-22.83	0.00	1.01	Horizontal	1000000.00	-11.87
7330.789474	35.55	54.00	-18.45	196.00	3.99	Horizontal	1000000.00	-7.30
9757.894737	37.30	54.00	-16.70	40.00	2.10	Horizontal	1000000.00	-4.59
12239.47368	40.68	54.00	-13.32	61.00	1.55	Vertical	1000000.00	0.85
14825	41.56	54.00	-12.44	356.00	3.49	Vertical	1000000.00	3.37
16778.15789	41.73	54.00	-12.27	143.00	2.65	Horizontal	1000000.00	3.78

1-3 GHz, Battery Powered, Transmit @ High Channel, EUT on X-axis

Test Information:

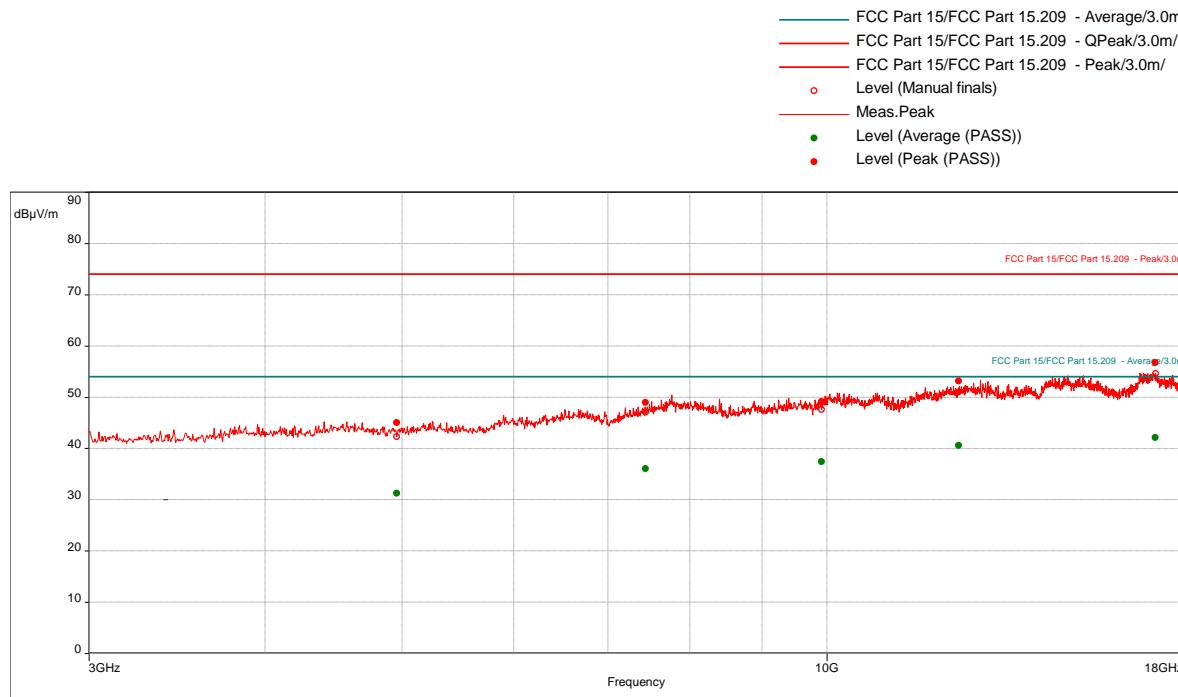
Date and Time	5/9/2019 4:42:32 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	24%
Atmospheric Pressure	1015 mB
Comments	RE 1 to 3 GHz_Tx mode_High Channel_X- Axis

Graph:**Results:** No emissions were detected.

3-18 GHz, Battery Powered, Transmit @ High Channel, EUT on X-axis

Test Information:

Date and Time	5/9/2019 6:10:07 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	24%
Atmospheric Pressure	1015 mB
Comments	RE 3 to 18 GHz_Tx mode_High Channel_X-Axis

Graph:Results:

Peak (PASS) (5)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4960.263158	44.97	74.00	-29.03	19.00	3.25	Horizontal	1000000.00	-11.80
7440.789474	48.97	74.00	-25.03	292.00	1.50	Vertical	1000000.00	-6.76
9917.894737	49.10	74.00	-24.90	0.00	1.40	Vertical	1000000.00	-4.52
12403.94737	53.11	74.00	-20.89	91.00	1.15	Horizontal	1000000.00	0.54
17101.05263	56.75	74.00	-17.25	335.00	1.45	Horizontal	1000000.00	3.52

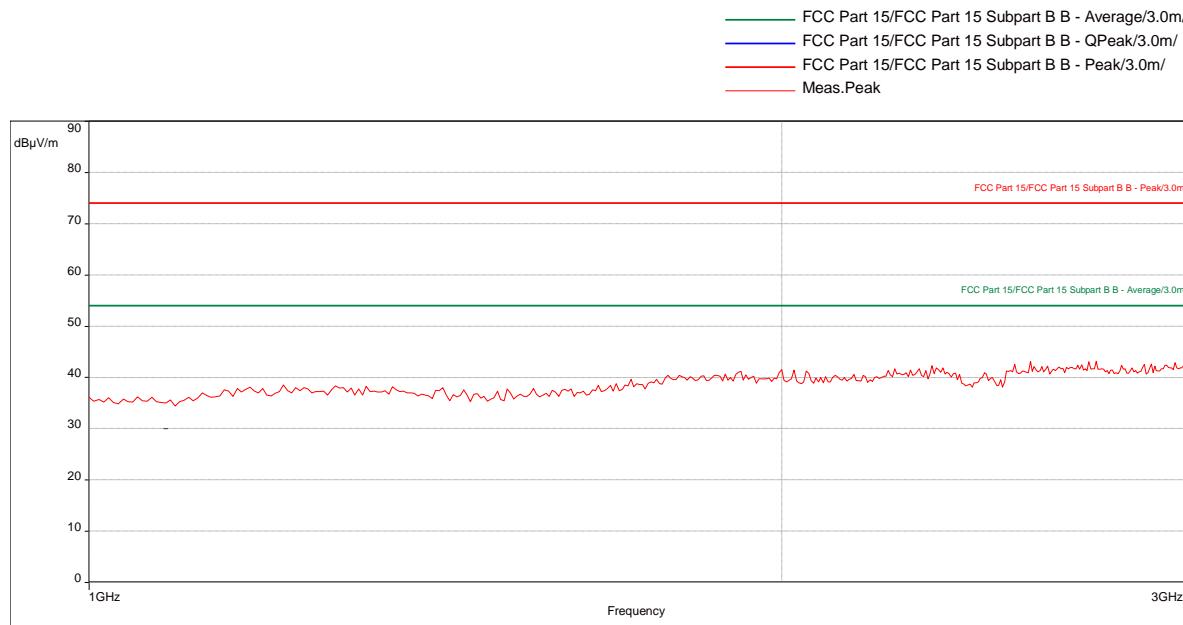
Average (PASS) (5)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4960.263158	31.20	54.00	-22.80	19.00	3.25	Horizontal	1000000.00	-11.80
7440.789474	36.05	54.00	-17.95	292.00	1.50	Vertical	1000000.00	-6.76
9917.894737	37.37	54.00	-16.63	0.00	1.40	Vertical	1000000.00	-4.52
12403.94737	40.54	54.00	-13.46	91.00	1.15	Horizontal	1000000.00	0.54
17101.05263	42.12	54.00	-11.88	335.00	1.45	Horizontal	1000000.00	3.52

1-3 GHz, Battery Powered, Transmit @ High Channel, EUT on Y-axis

Test Information:

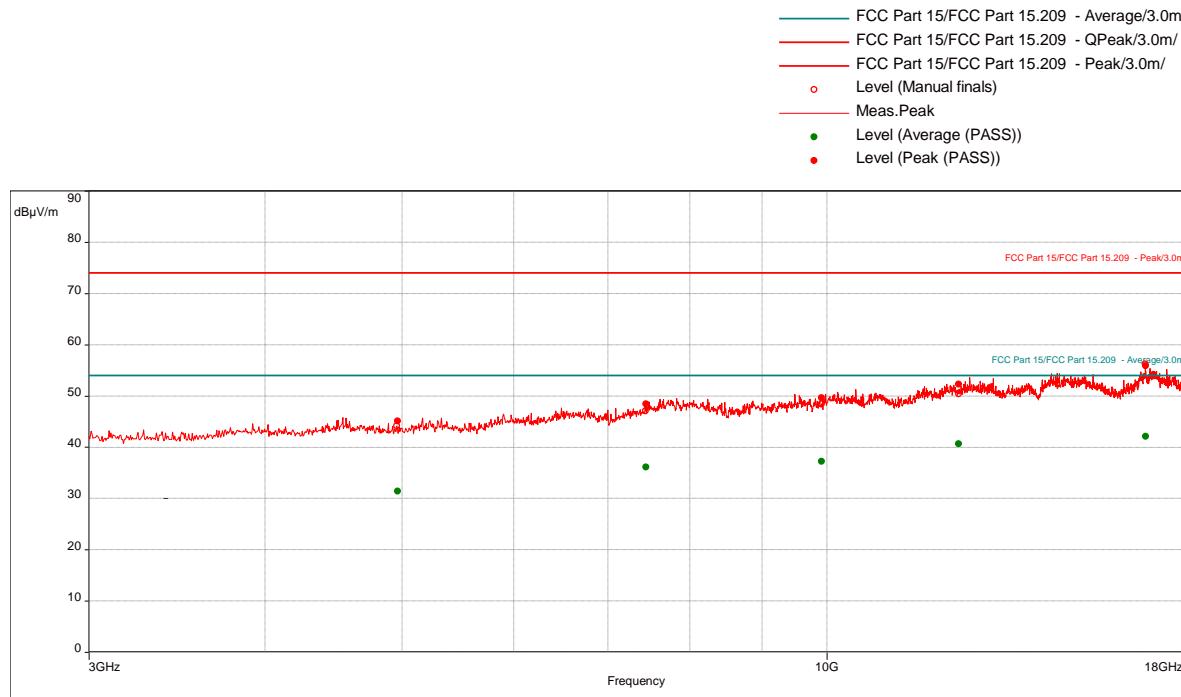
Date and Time	5/9/2019 4:48:22 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	24%
Atmospheric Pressure	1015 mB
Comments	RE 1 to 3 GHz_Tx mode_High Channel_Y-Axis

Graph:**Results:** No emissions were detected.

3-18 GHz, Battery Powered, Transmit @ High Channel, EUT on Y-axis

Test Information:

Date and Time	5/9/2019 5:40:07 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	24%
Atmospheric Pressure	1015 mB
Comments	RE 3 to 18 GHz_Tx mode_High Channel_Y-Axis

Graph:**Results:**

Peak (PASS) (5)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4962.631579	45.10	74.00	-28.90	0.00	3.39	Horizontal	1000000.00	-11.80
7442.894737	48.44	74.00	-25.56	306.00	2.20	Vertical	1000000.00	-6.75
9920.526316	49.64	74.00	-24.36	69.00	2.70	Vertical	1000000.00	-4.50
12401.31579	52.29	74.00	-21.71	313.00	2.20	Vertical	1000000.00	0.53
16823.42105	55.85	74.00	-18.15	4.00	3.89	Horizontal	1000000.00	3.55

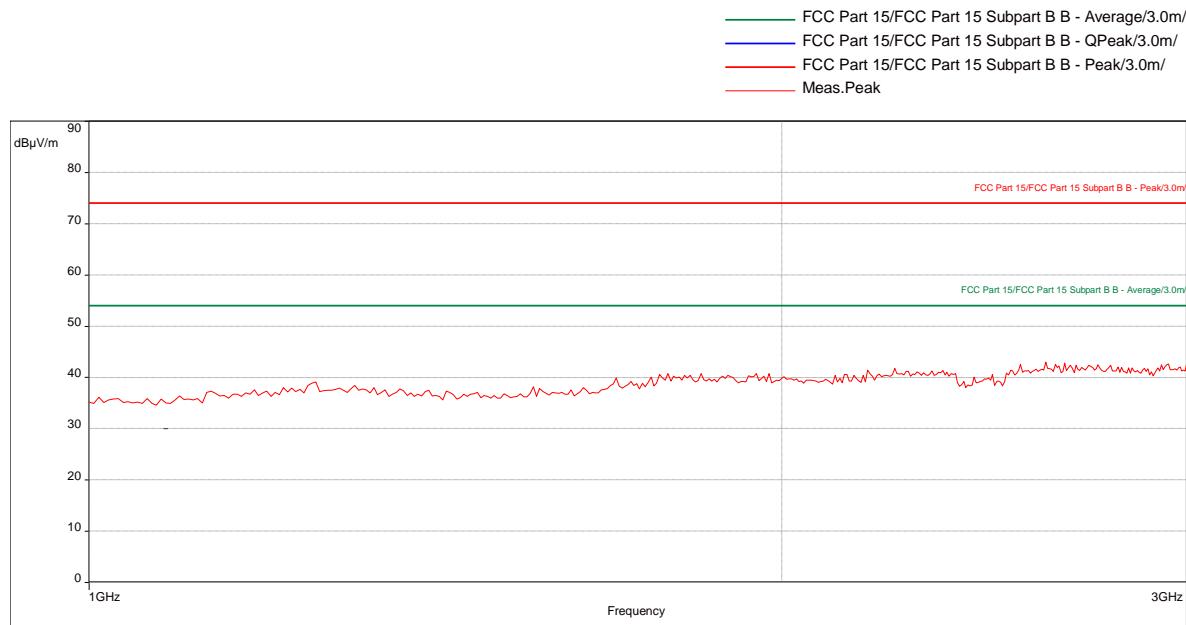
Average (PASS) (5)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4962.631579	31.41	54.00	-22.59	0.00	3.39	Horizontal	1000000.00	-11.80
7442.894737	36.15	54.00	-17.85	306.00	2.20	Vertical	1000000.00	-6.75
9920.526316	37.21	54.00	-16.79	69.00	2.70	Vertical	1000000.00	-4.50
12401.31579	40.64	54.00	-13.36	313.00	2.20	Vertical	1000000.00	0.53
16823.42105	42.12	54.00	-11.88	4.00	3.89	Horizontal	1000000.00	3.55

1-3 GHz, Battery Powered, Transmit @ High Channel, EUT on Z-axis

Test Information:

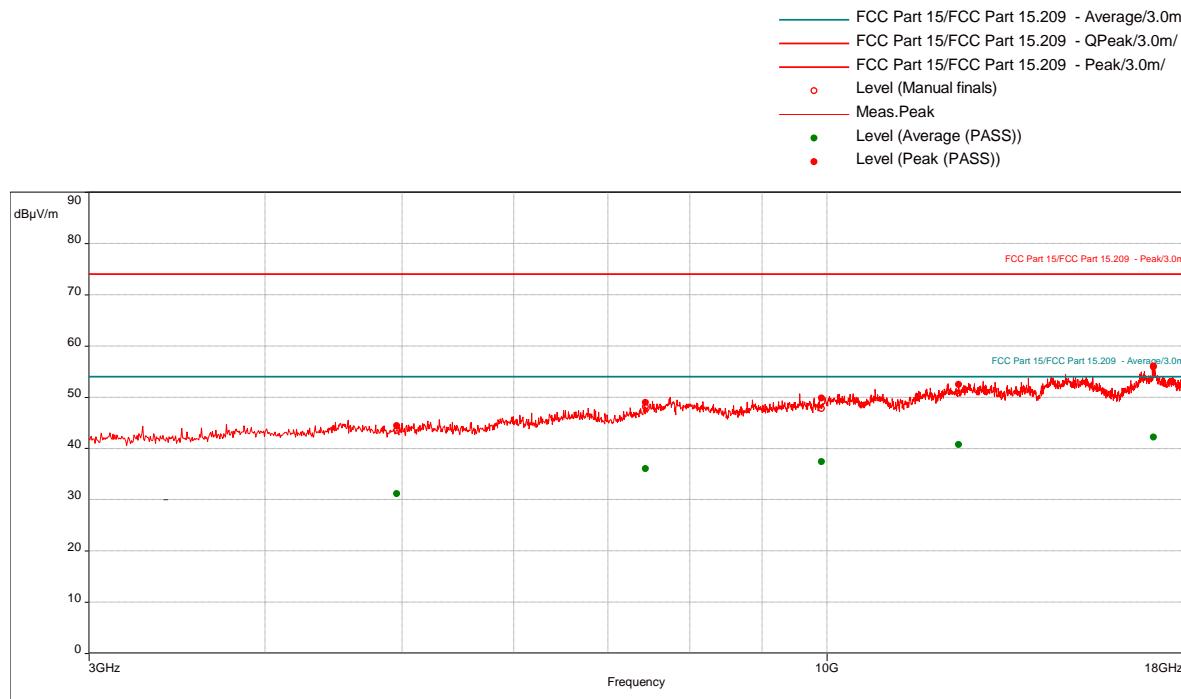
Date and Time	5/9/2019 4:53:00 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	24%
Atmospheric Pressure	1015 mB
Comments	RE 1 to 3 GHz_Tx mode_High Channel_Z-Axis

Graph:**Results:** No emissions were detected.

3-18 GHz, Battery Powered, Transmit @ High Channel, EUT on Z-axis

Test Information:

Date and Time	5/9/2019 5:05:13 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	24%
Atmospheric Pressure	1015 mB
Comments	RE 3 to 18 GHz_Tx mode_High Channel_Z-Axis

Graph:**Results:**

Peak (PASS) (5)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4958.684211	44.45	74.00	-29.55	359.00	1.35	Horizontal	1000000.00	-11.81
7440.526316	48.96	74.00	-25.04	142.00	2.40	Horizontal	1000000.00	-6.77
9920.789474	49.77	74.00	-24.23	349.00	2.40	Vertical	1000000.00	-4.50
12402.10526	52.43	74.00	-21.57	84.00	3.44	Horizontal	1000000.00	0.53
17042.89474	56.03	74.00	-17.97	172.00	3.49	Horizontal	1000000.00	3.19

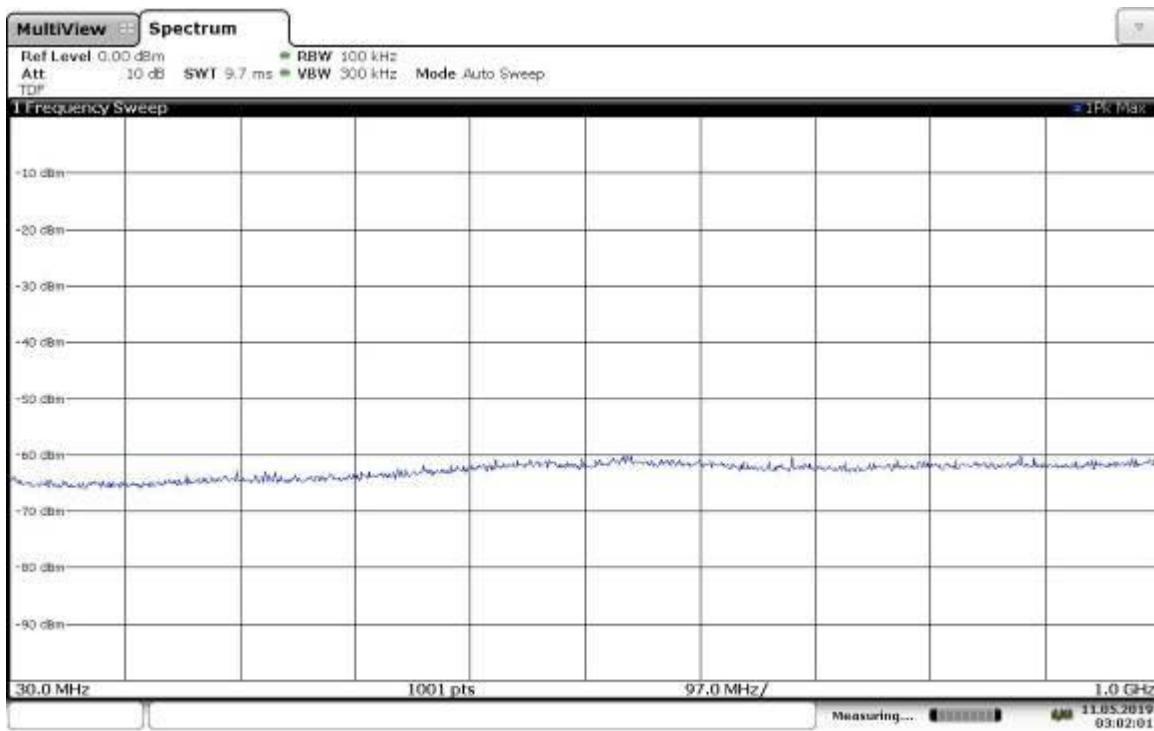
Average (PASS) (5)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4958.684211	31.16	54.00	-22.84	359.00	1.35	Horizontal	1000000.00	-11.81
7440.526316	36.01	54.00	-17.99	142.00	2.40	Horizontal	1000000.00	-6.77
9920.789474	37.37	54.00	-16.63	349.00	2.40	Vertical	1000000.00	-4.50
12402.10526	40.69	54.00	-13.31	84.00	3.44	Horizontal	1000000.00	0.53
17042.89474	42.19	54.00	-11.81	172.00	3.49	Horizontal	1000000.00	3.19

Radiated Emissions

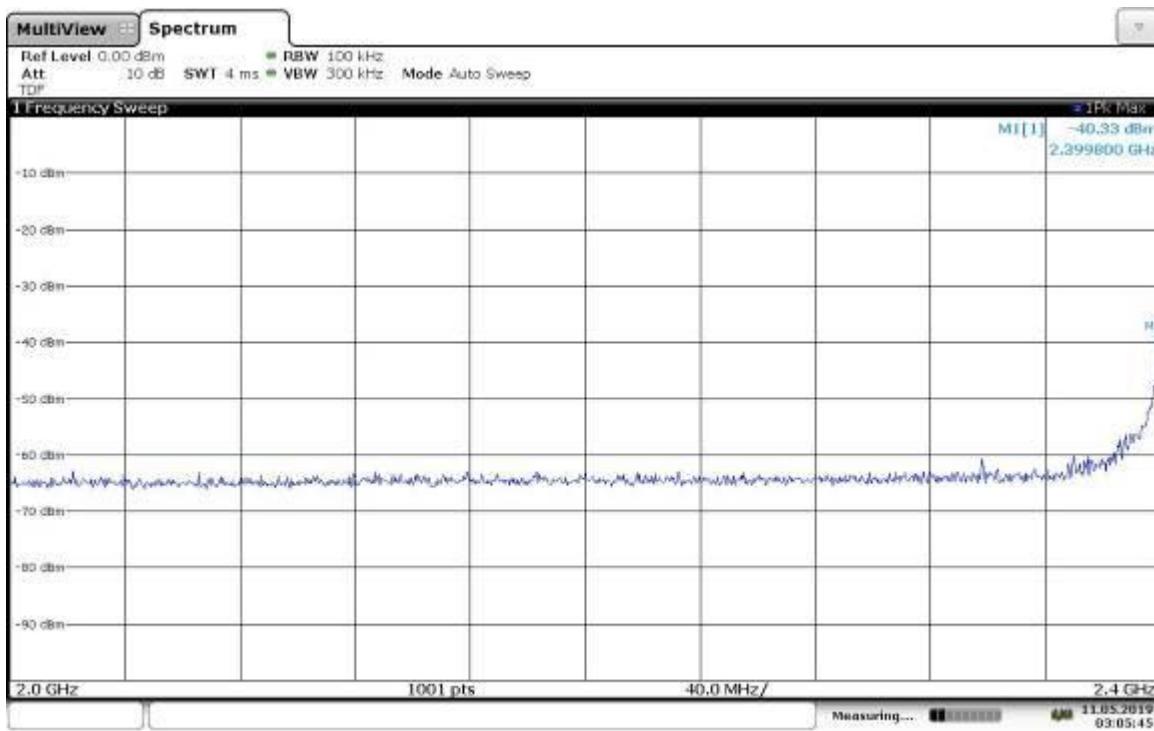
Company: Cutsforth Inc.	Antenna & Cables: N	Bands: N, LF, HF, SHF											
Model #: EBHS001	Antenna: EMC04_10-26-2019	EMC04_10-26-2019											
Serial #: BOX1905081103 (Intertek Assigned)	Cable(s): CBLSHF103	CBLSHF102											
Engineers: Vathana Ven	Location: 10M	Barometer: DAV002											
Project #: G103663187	Date(s): 05/09/19	Filter: NONE											
Standard: 15.247/RSS-247		Temp/Humidity/Pressure:											
Receiver: R&S ESI (145-128) 03/28/2019	Limit Distance (m): 3												
PreAmp: PRE8	Test Distance (m): 0.2												
PreAmp Used? (Y or N): Y	Voltage/Frequency: 9V Battery	Frequency Range: 18-25 GHz											
Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)													
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW													
Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC
No emissions were detected above the measuring equipment noise floor.													

Antenna Port Conducted Emissions – Low Channel, 30 MHz- 1 GHz



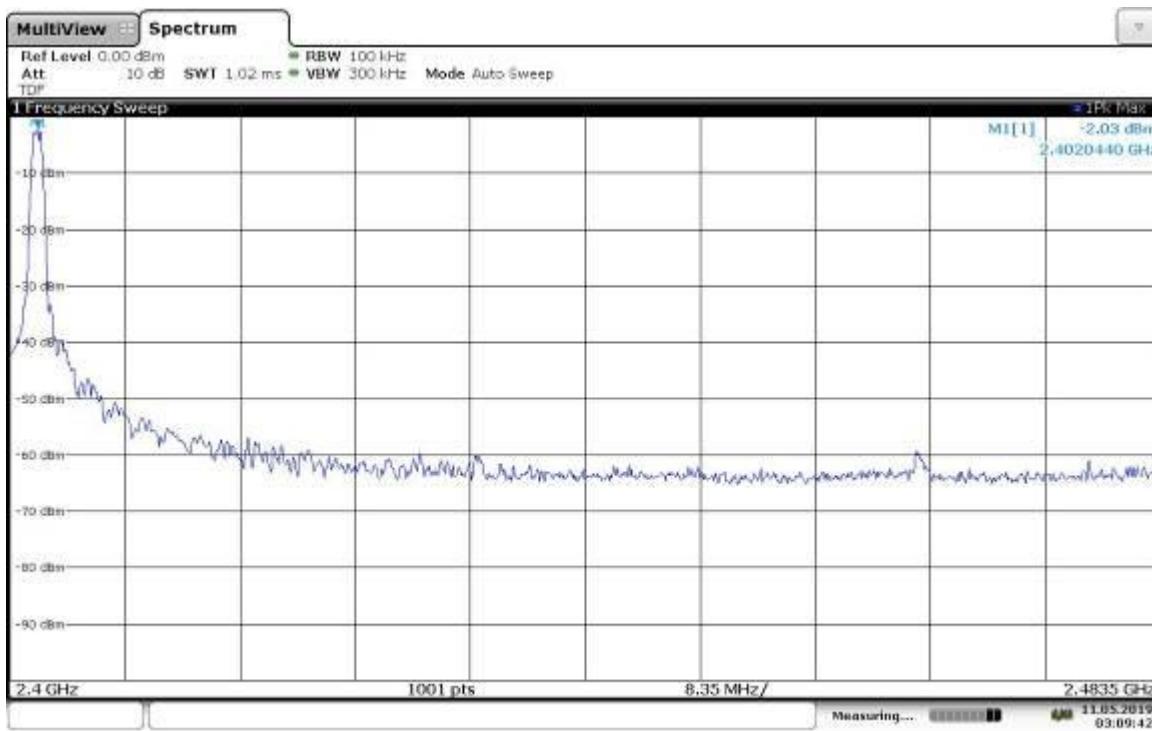
03:02:02 11.05.2019

Antenna Port Conducted Emissions – Low Channel, 1 – 2.4 GHz



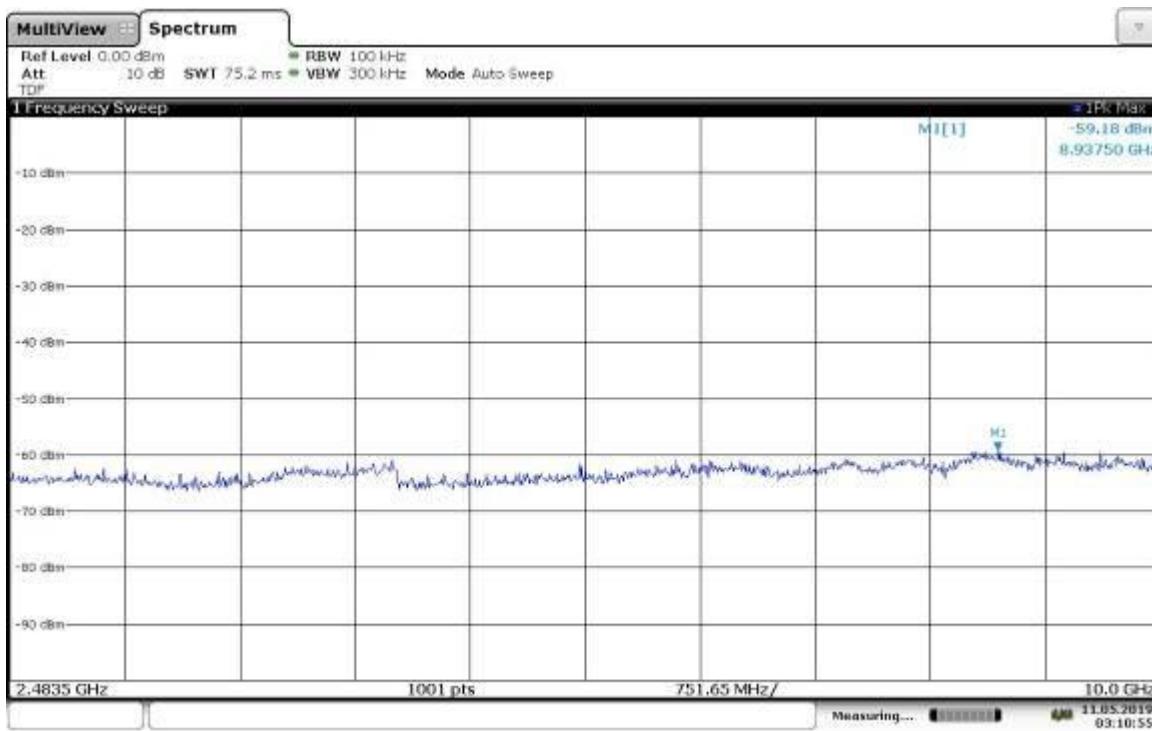
03:05:46 11.05.2019

Antenna Port Conducted Emissions – Low Channel, 2.4 – 2.4835 GHz



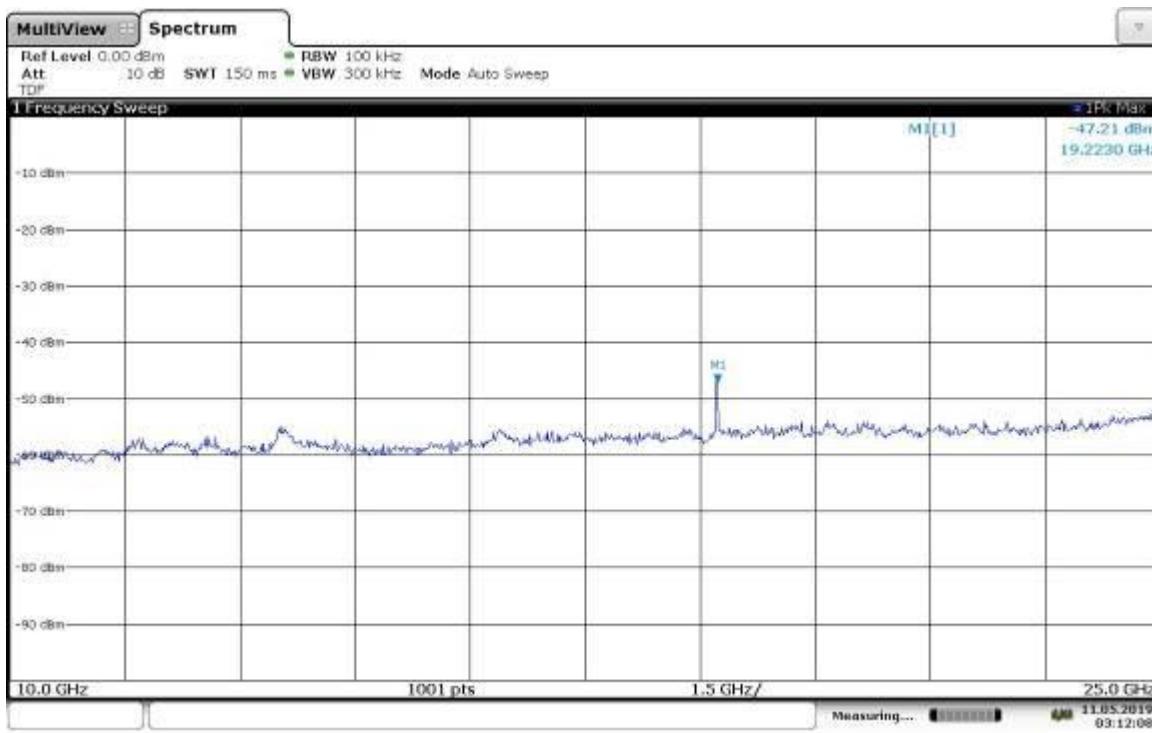
03:09:42 11.05.2019

Antenna Port Conducted Emissions – Low Channel, 2.4835 – 10 GHz



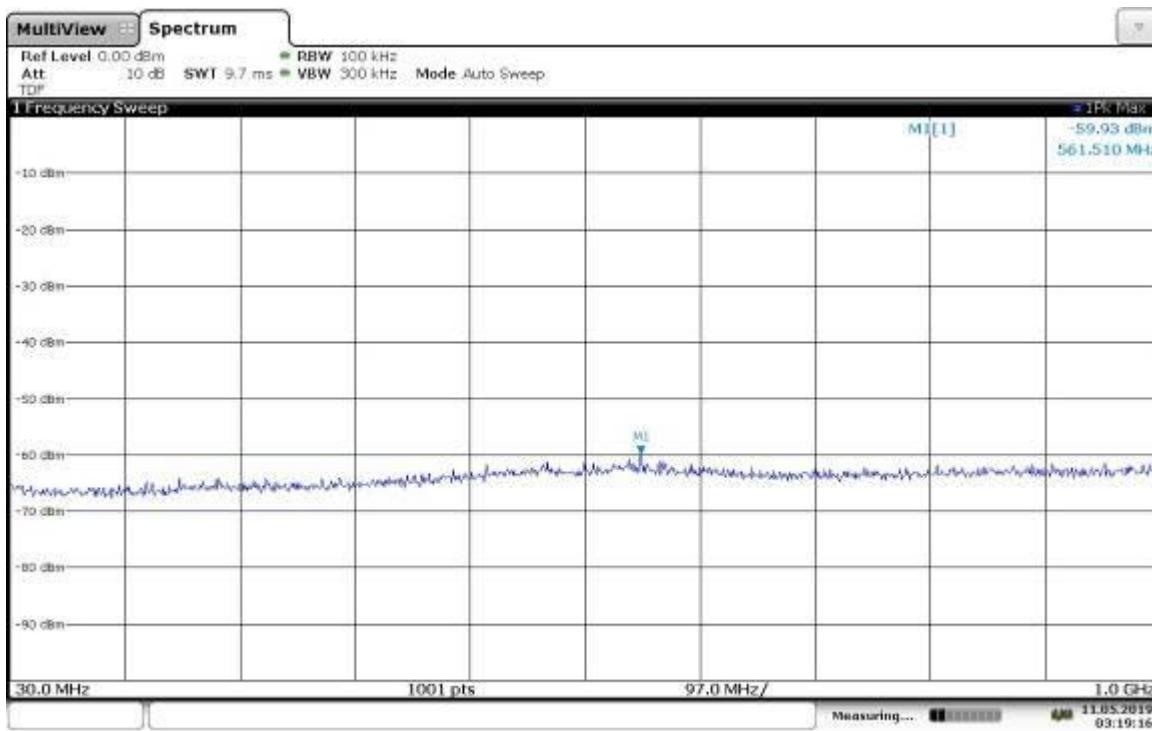
03:10:55 11.05.2019

Antenna Port Conducted Emissions – Low Channel, 10 – 25 GHz



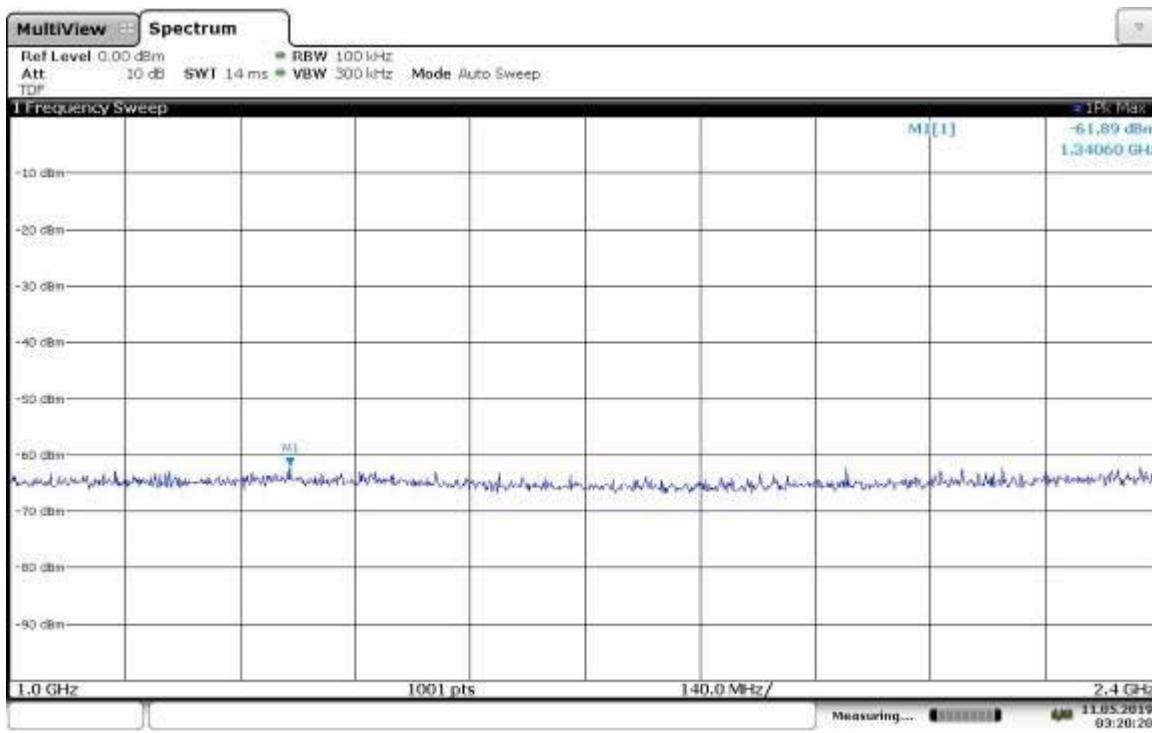
03:12:08 11.05.2019

Antenna Port Conducted Emissions – Mid Channel, 30 MHz- 1 GHz



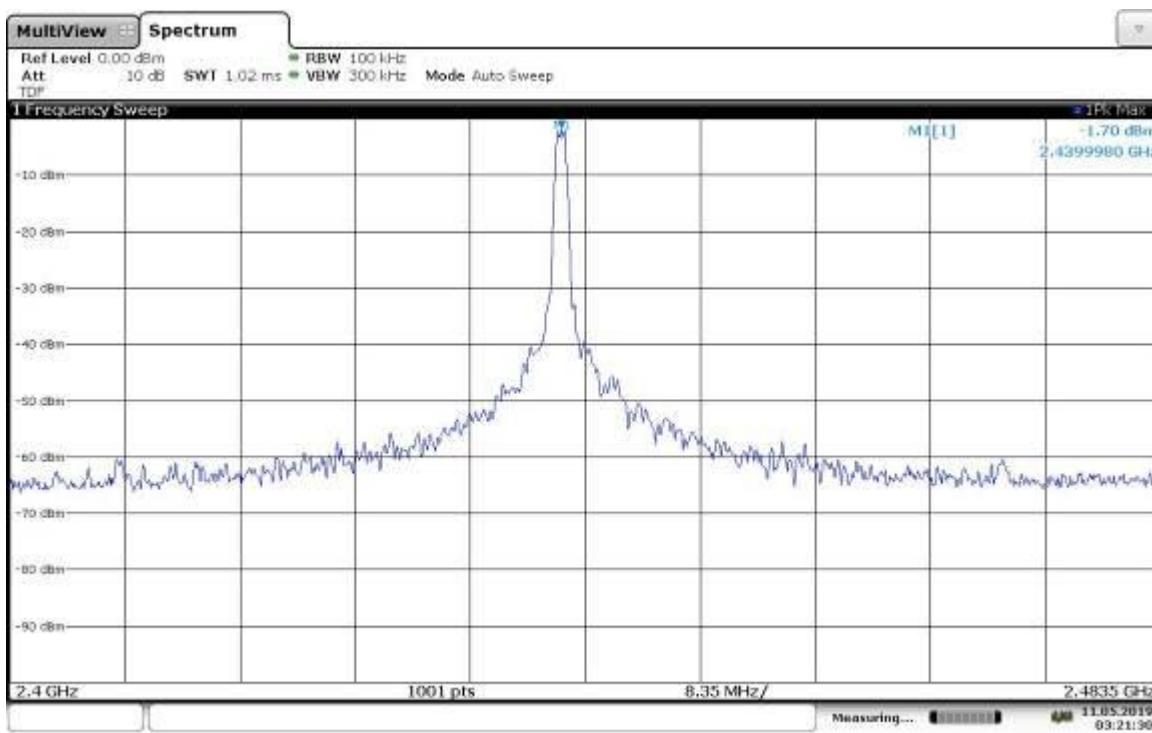
03:19:16 11.05.2019

Antenna Port Conducted Emissions – Mid Channel, 1- 2.4 GHz



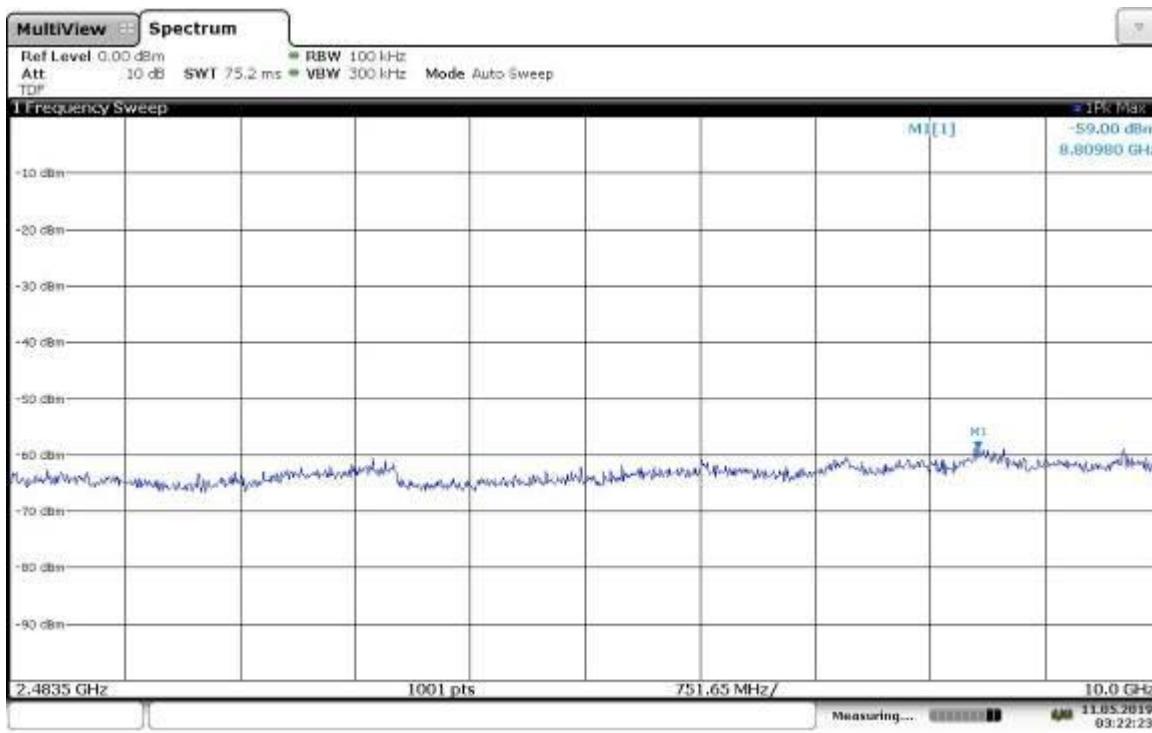
03:20:20 11.05.2019

Antenna Port Conducted Emissions – Mid Channel, 2.4 – 2.4835 GHz



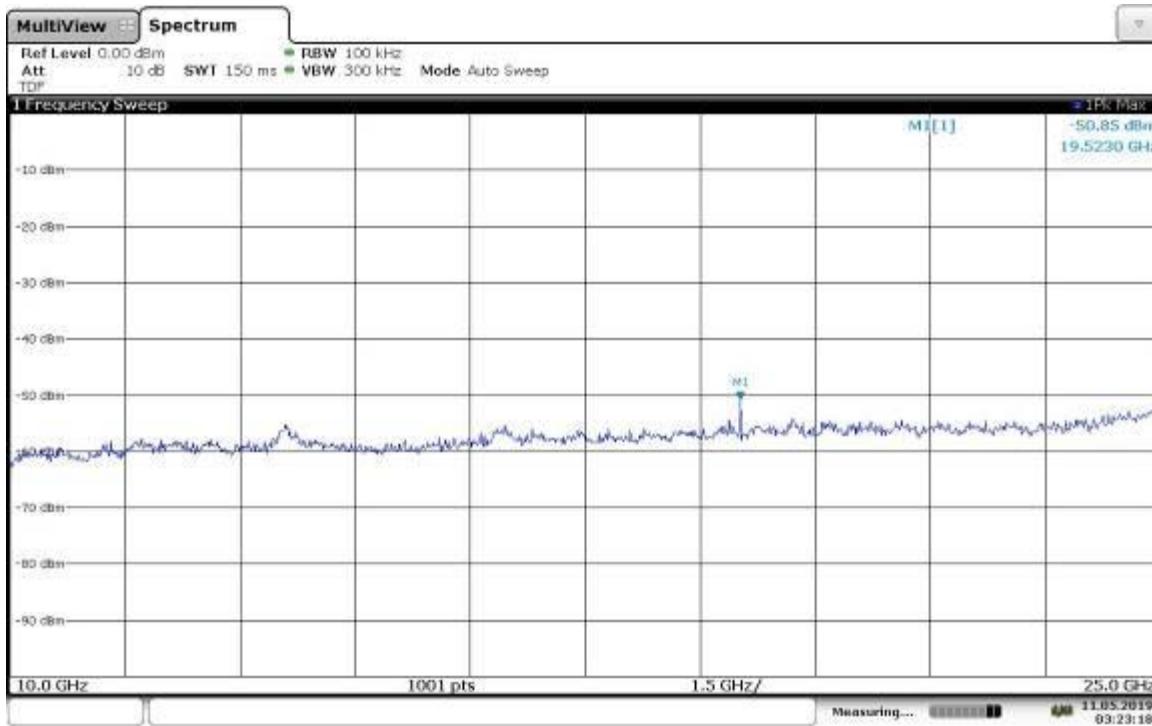
03:21:31 11.05.2019

Antenna Port Conducted Emissions – Mid Channel, 2.4835 - 10 GHz



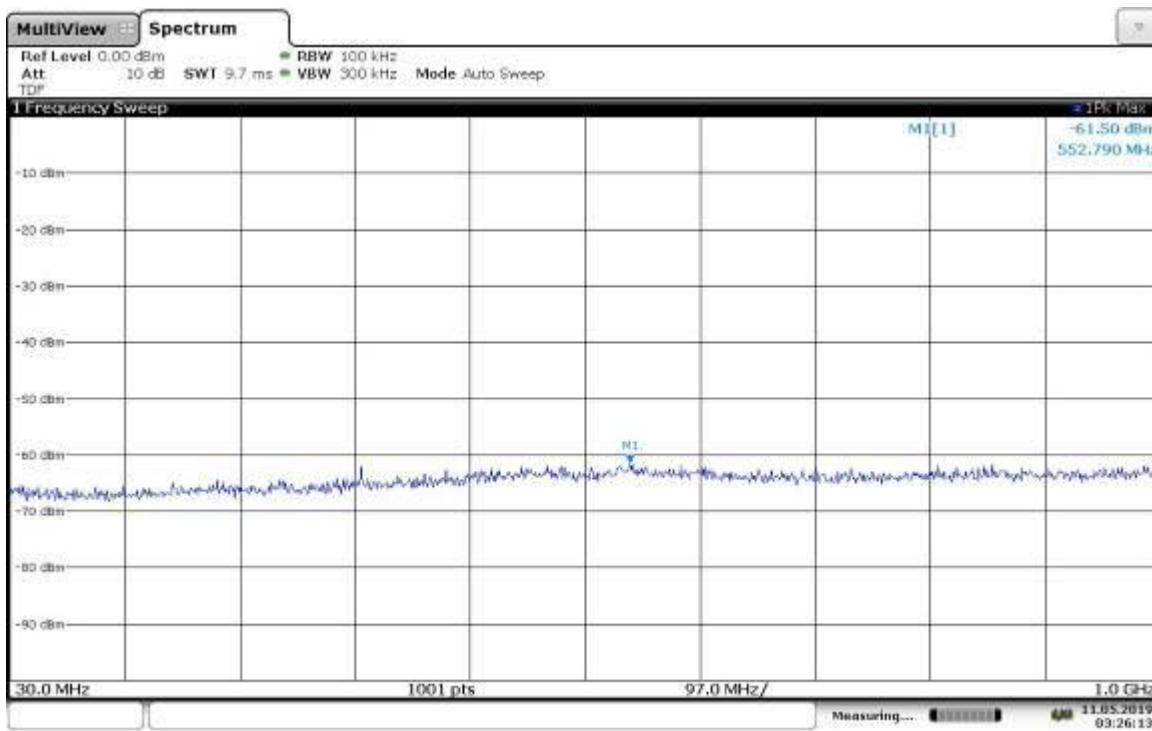
03:22:23 11.05.2019

Antenna Port Conducted Emissions – Mid Channel, 10 - 25 GHz



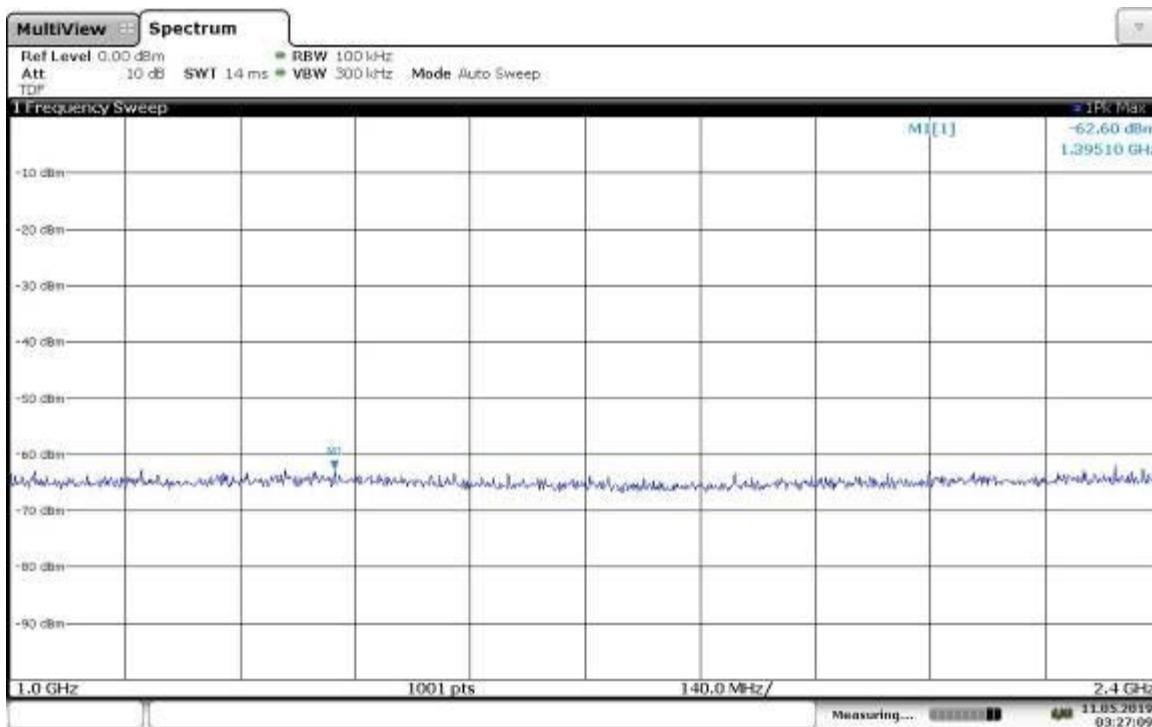
03:23:19 11.05.2019

Antenna Port Conducted Emissions – High Channel, 30 MHz- 1 GHz



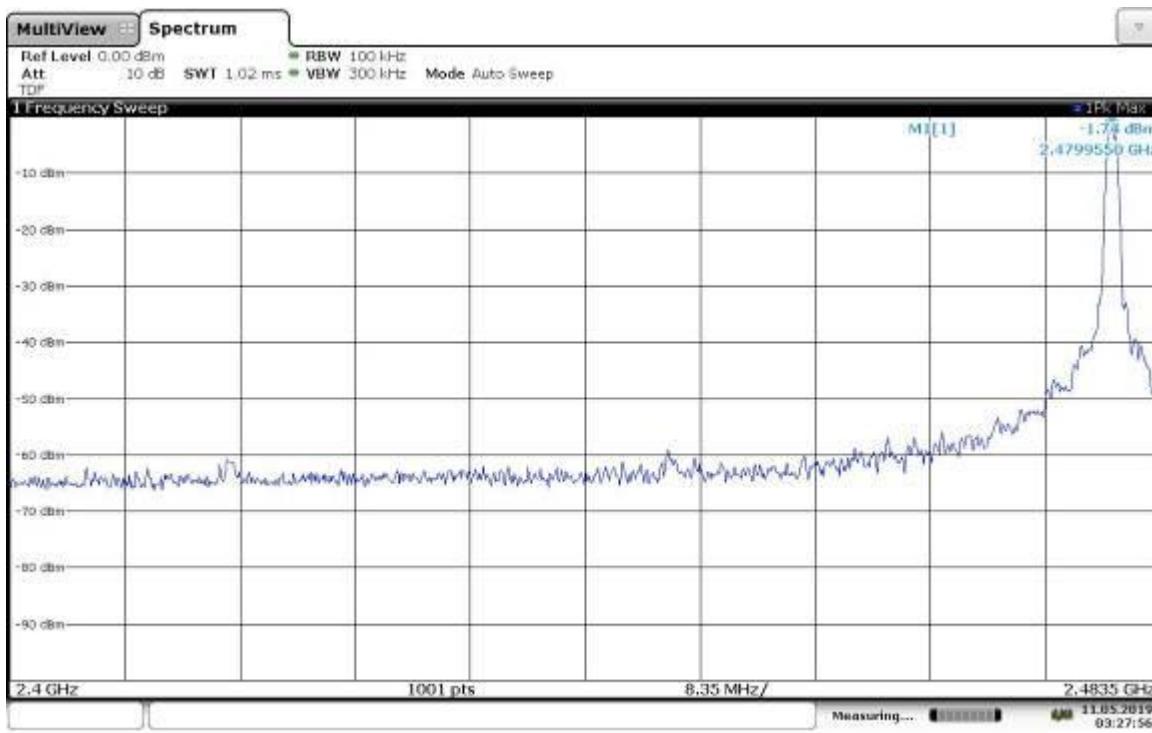
03:26:14 11.05.2019

Antenna Port Conducted Emissions – High Channel, 1 – 2.4 GHz



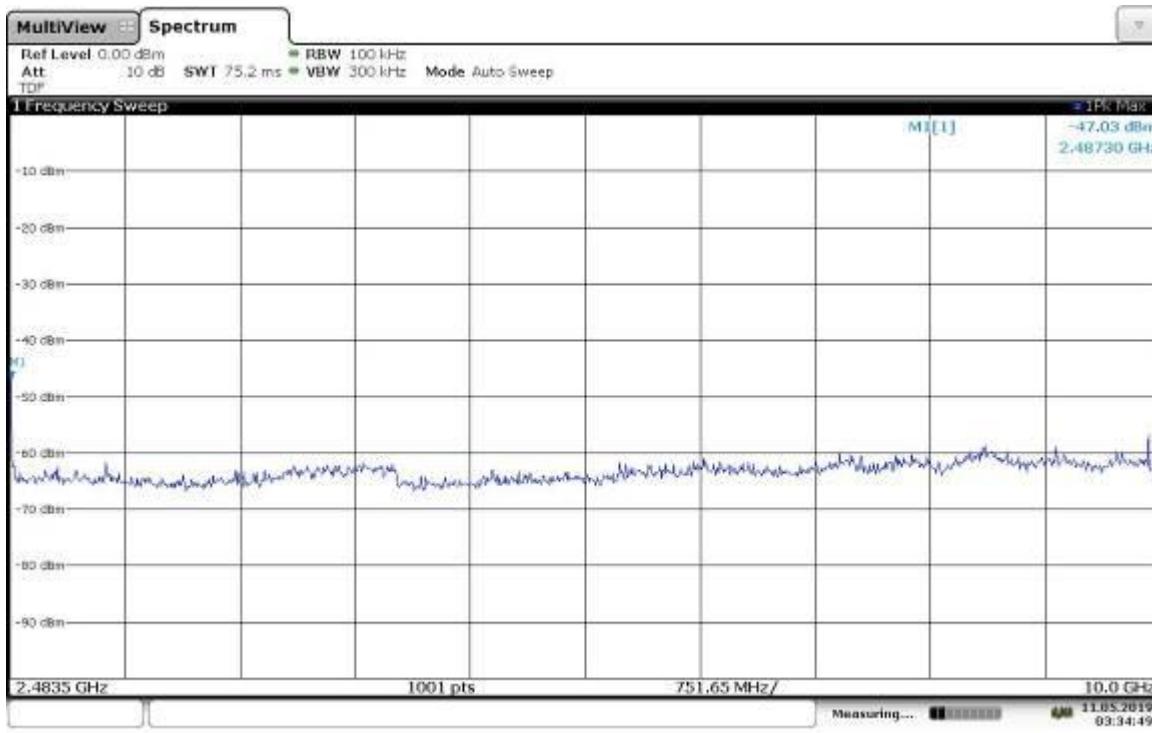
03:27:10 11.05.2019

Antenna Port Conducted Emissions – High Channel, 2.4 – 2.4835 GHz



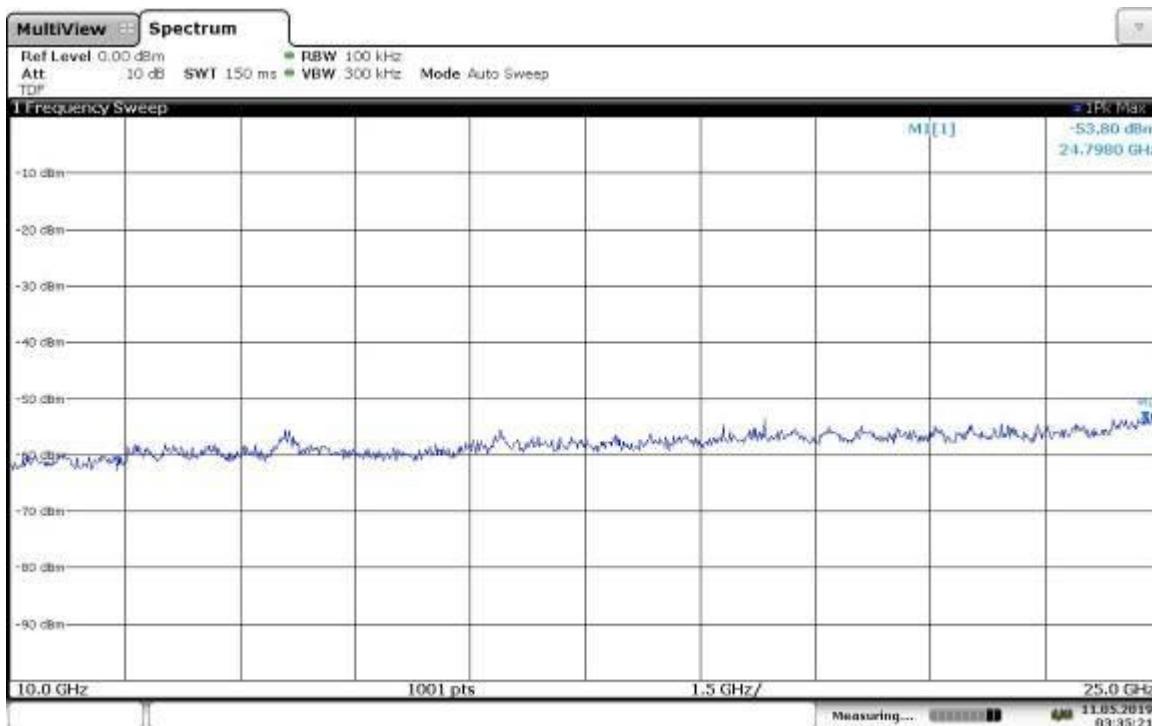
03:27:56 11.05.2019

Antenna Port Conducted Emissions – High Channel, 2.4835 – 10 GHz



03:34:50 11.05.2019

Antenna Port Conducted Emissions – High Channel, 10 – 25 GHz



03:35:21 11.05.2019

Test Personnel: Vathana Ven *VV*
 Supervising/Reviewing
 Engineer:
 (Where Applicable) N/A
 Product Standard: CFR47 FCC Part 15.247
 Input Voltage: RSS-247
Battery Powered

Pretest Verification w/
 Ambient Signals or
 BB Source: BB Source

Test Date: 05/09/2019, 05/10/2019Limit Applied: See report section 10.3Ambient Temperature: 25, 22 °CRelative Humidity: 24, 53 %Atmospheric Pressure: 1015, 1003 mbars

Deviations, Additions, or Exclusions: None

11 Digital Device and Receiver Radiated Spurious Emissions

11.1 Method

Tests are performed in accordance with FCC Part 15 Subpart B, ICES 003, and ANSI C 63.4.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

FS = Field Strength in $\text{dB}\mu\text{V}/\text{m}$

RA = Receiver Amplitude (including preamplifier) in $\text{dB}\mu\text{V}$

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB

AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 $\text{dB}\mu\text{V}$ is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 $\text{dB}\mu\text{V}/\text{m}$. This value in $\text{dB}\mu\text{V}/\text{m}$ was converted to its corresponding level in $\mu\text{V}/\text{m}$.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}/\text{m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V}/\text{m}$$

To convert from $\text{dB}\mu\text{V}$ to μV or mV the following was used:

$$UF = 10^{(NF/20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in } \text{dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V}/\text{m}$$

Alternately, when BAT-EMC Emission Software is used, the "Level" includes all losses and gains and is compared directly in the "Margin" column to the "Limit". The "Correction" includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the "Level" column.

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	06/21/2018	06/21/2019
145128	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/28/2019	03/28/2020
145-410'	Cables 145-420 145-421 145-422 145-406	Huber + Suhner	10m Track A Cables	multiple	07/25/2018	07/25/2019
PRE11'	50dB gain pre-amp	Keith H	PRE11	PRE11	10/27/2018	10/27/2019
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	05/16/2018	05/16/2019
ETS005'	1-18GHz horn antenna	ETS-Lindgren	3117	00218279	05/14/2018	05/14/2019
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	06/14/2018	06/14/2019
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2018	07/25/2019
145-020'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2018	07/25/2019

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.17.0.3

11.3 Results:

The sample tested was found to Comply.

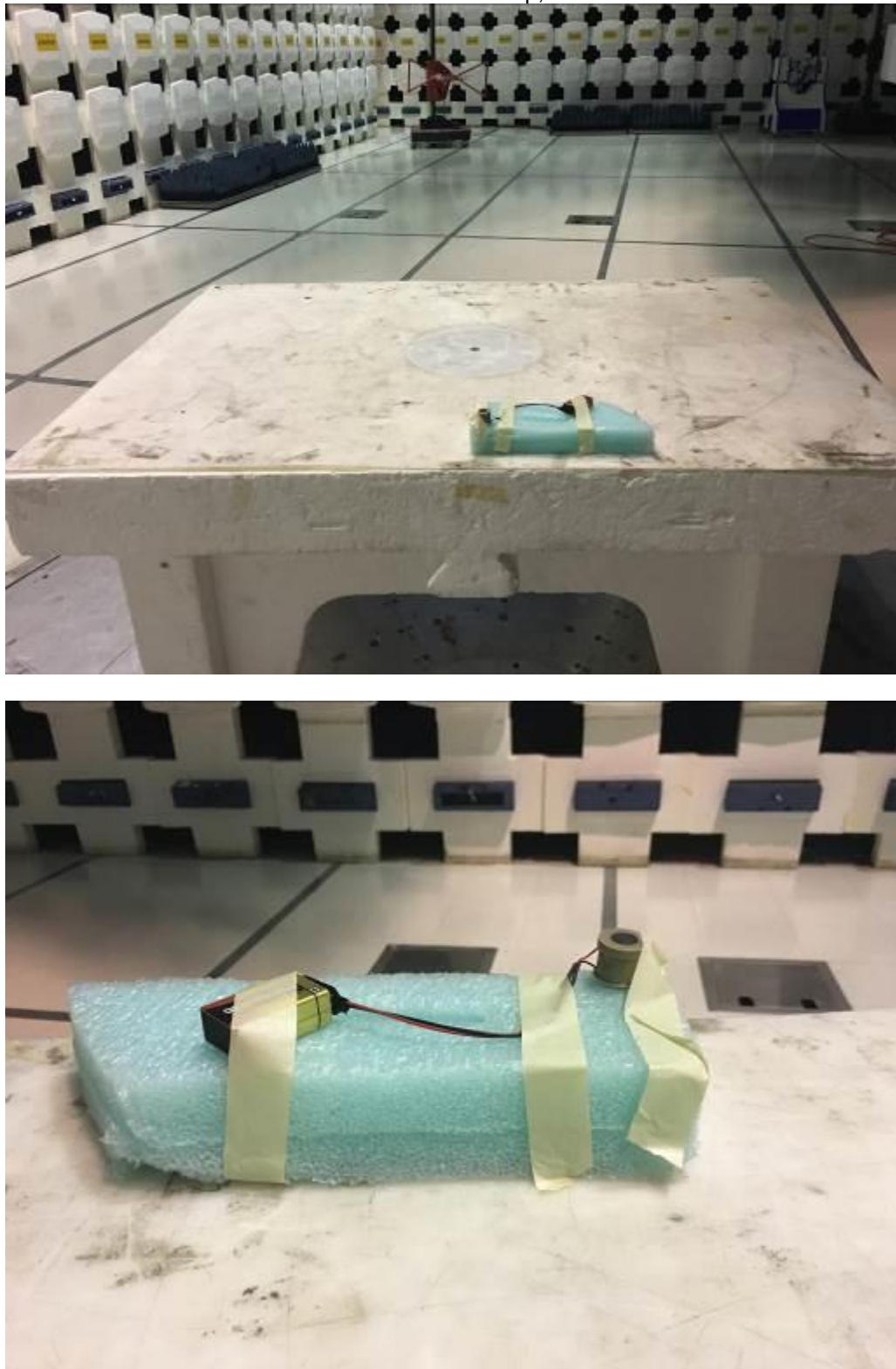
§15.109 Radiated emission limits.

The field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values.

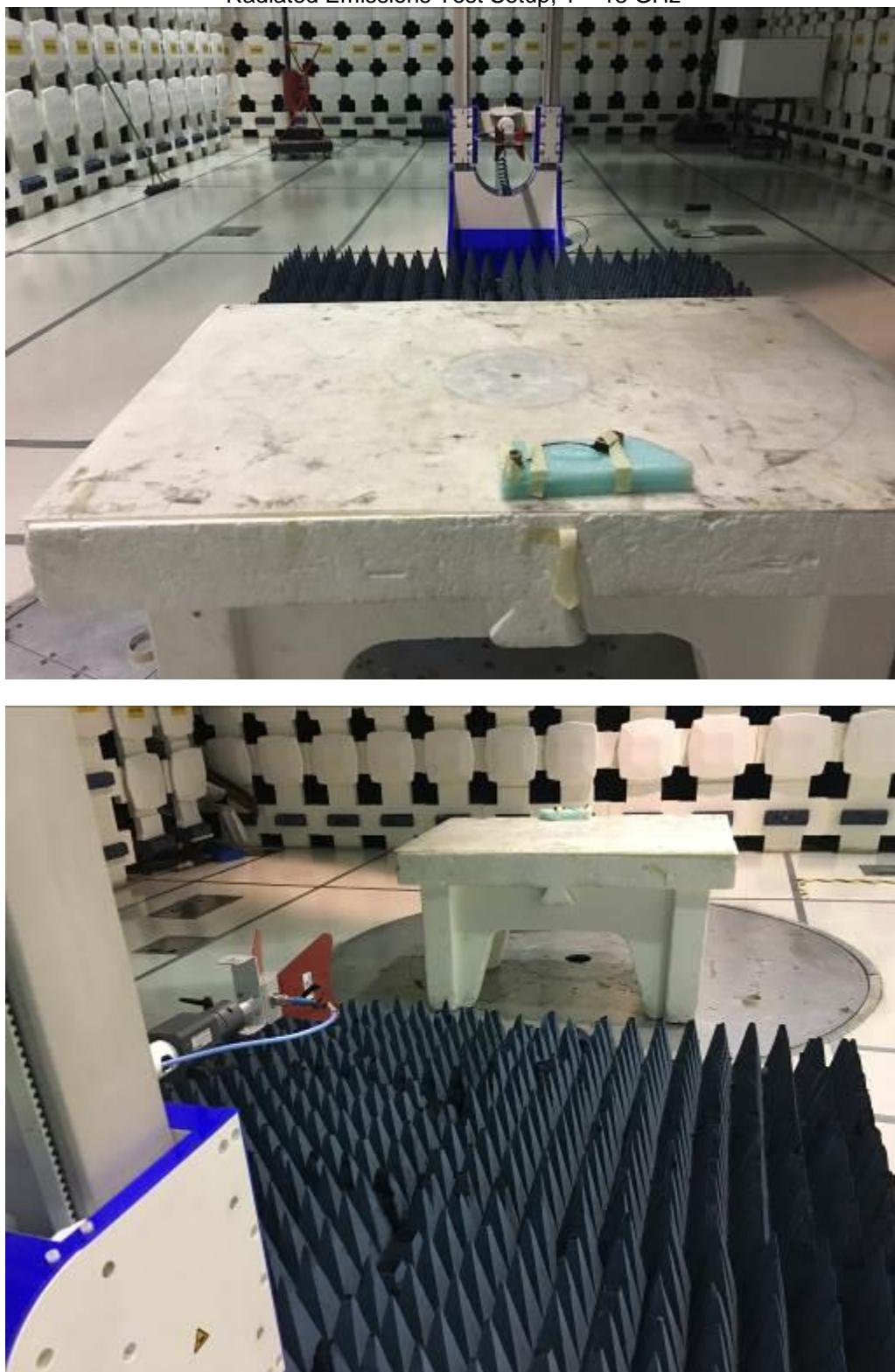
Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dB μ V/m)
30-88	100	40.00
88-216	150	43.52
216-960	200	46.02
Above 960	500	54.00

11.4 Setup Photographs:

Radiated Emissions Test Setup, 30-1000 MHz



Radiated Emissions Test Setup, 1 – 13 GHz

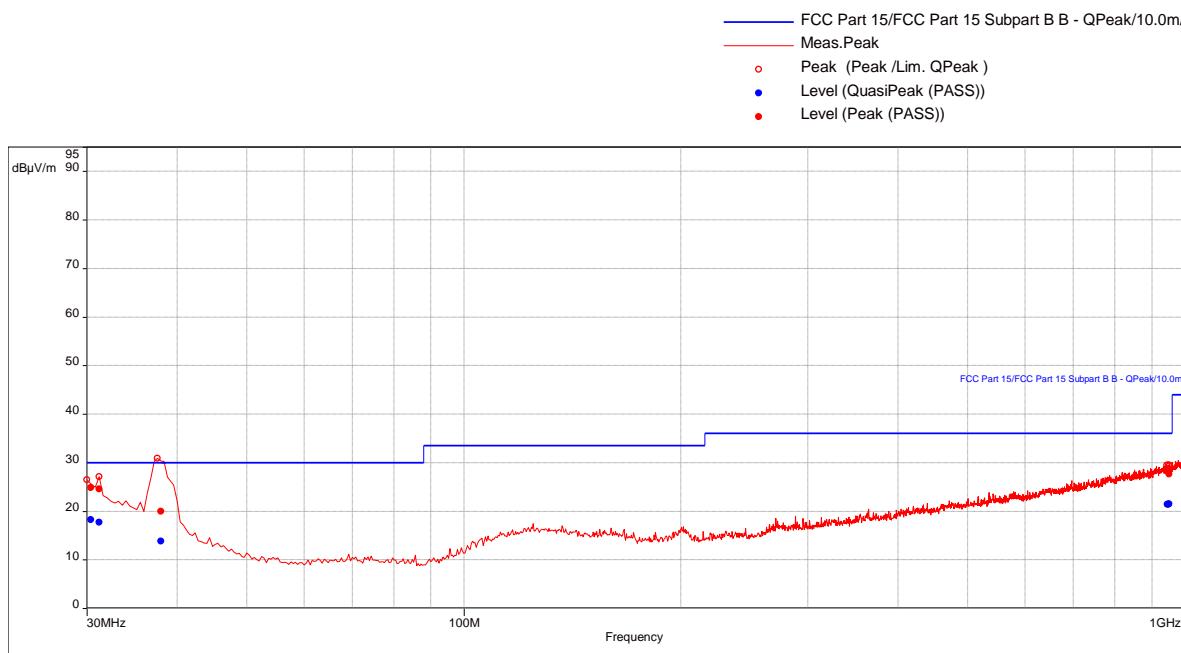


Antenna Port Conducted Test Setup



11.5 Plots/Data:**Radiated Emissions, 30-1000 MHz****Test Information:**

Date and Time	5/8/2019 9:00:07 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	32%
Atmospheric Pressure	1013 mB
Comments	RE 30-1000MHz_Rx mode_Low channel

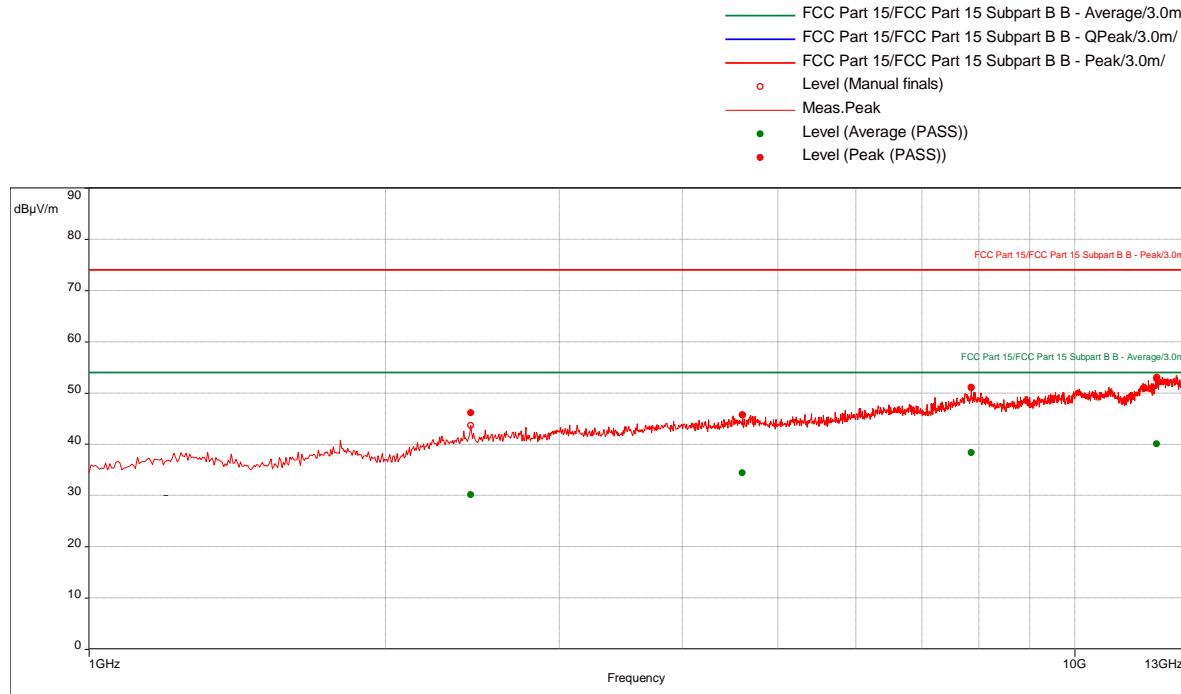
Graph:**Results:****QuasiPeak (PASS) (6)**

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
30.45789474	18.24	30.00	-11.76	359.00	3.78	Vertical	120000.00	-11.30
31.01052632	17.75	30.00	-12.25	0.00	3.94	Vertical	120000.00	-11.74
38.04210526	13.79	30.00	-16.21	24.00	2.92	Vertical	120000.00	-17.18
945.2421053	21.41	36.00	-14.59	202.00	3.25	Horizontal	120000.00	-4.68
949.2	21.38	36.00	-14.62	166.00	1.94	Vertical	120000.00	-4.64
951.2526316	21.47	36.00	-14.53	268.00	3.53	Vertical	120000.00	-4.55

Radiated Emissions, 1-13 GHz

Test Information:

Date and Time	5/8/2019 10:04:03 PM
Client and Project Number	Cutsforth_G103663187
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	32%
Atmospheric Pressure	1013 mB
Comments	RE 1 to 13 GHz_Rx mode

Graph:Results:

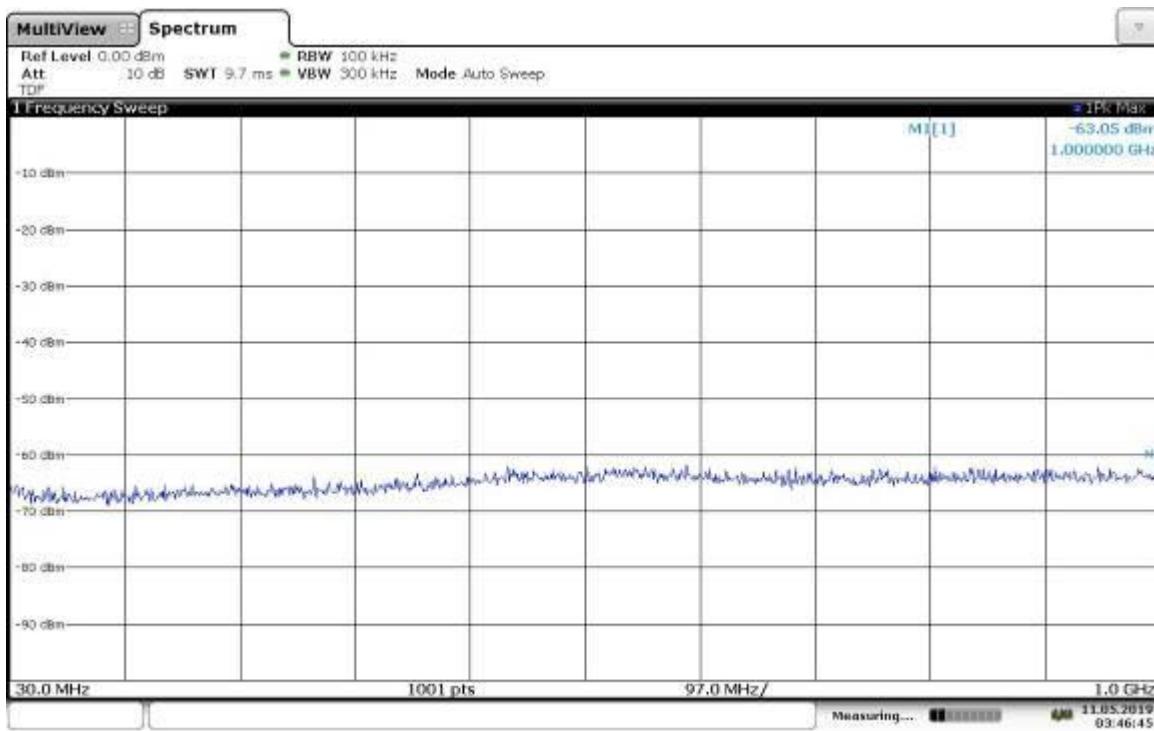
Peak (PASS) (4)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
2437.894737	46.09	74.00	-27.91	3.00	1.00	Vertical	1000000.00	-17.58
4600.789474	45.72	74.00	-28.28	254.00	3.49	Horizontal	1000000.00	-11.80
7856.842105	51.03	74.00	-22.97	122.00	2.80	Horizontal	1000000.00	-5.49
12120	52.78	74.00	-21.22	121.00	3.54	Horizontal	1000000.00	0.35

Average (PASS) (4)

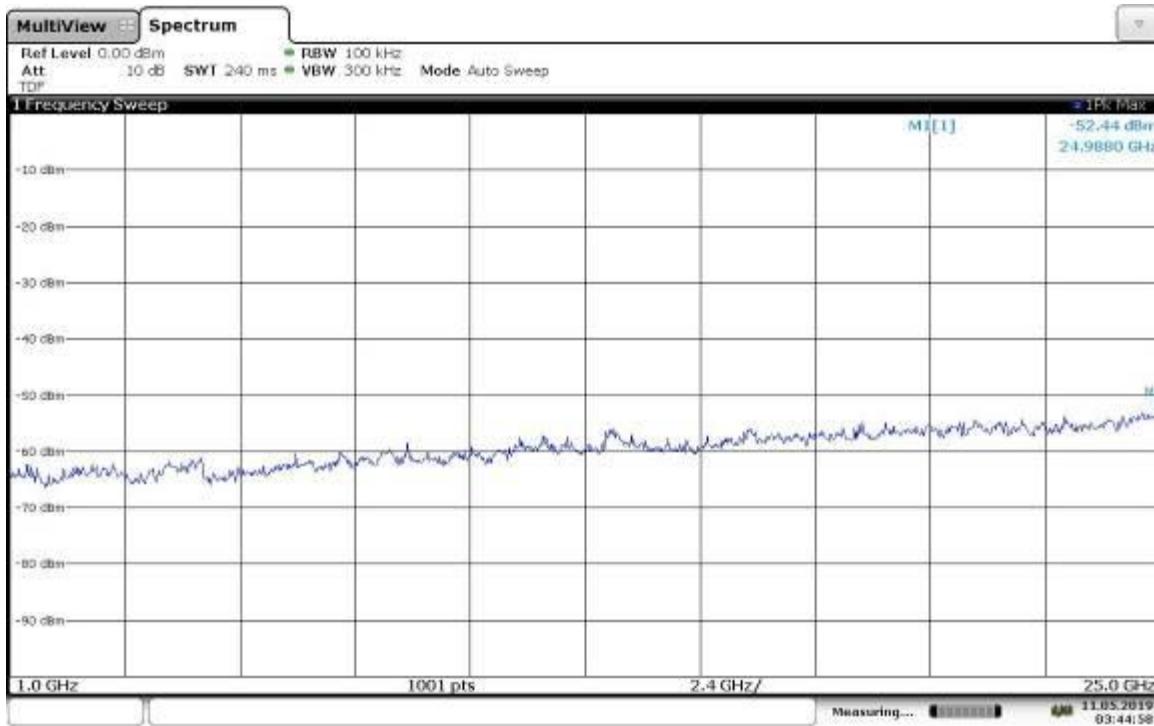
Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
2437.894737	30.10	54.00	-23.90	3.00	1.00	Vertical	1000000.00	-17.58
4600.789474	34.37	54.00	-19.63	254.00	3.49	Horizontal	1000000.00	-11.80
7856.842105	38.32	54.00	-15.68	122.00	2.80	Horizontal	1000000.00	-5.49
12120	40.06	54.00	-13.94	121.00	3.54	Horizontal	1000000.00	0.35

Antenna Port Conducted Emissions, 30 – 1000 MHz



03:46:45 11.05.2019

Antenna Port Conducted Emissions, 1 – 13 GHz



03:44:59 11.05.2019

Test Personnel: Vathana Ven
Supervising/Reviewing
Engineer:
(Where Applicable) N/A
Product Standard: FCC Part 15 Subpart B,
ICES-003
Input Voltage: Battery Powered
Pretest Verification w/
Ambient Signals or
BB Source: BB Source

Test Date: 05/10/2019
Limit Applied: See report section 11.3
Ambient Temperature: 22 °C
Relative Humidity: 23 %
Atmospheric Pressure: 1003 mbars

Deviations, Additions, or Exclusions: None

12 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	05/15/2019	103663187BOX-033	VFV <i>VJV</i>	KPS <i>KPS</i>	Original Issue
1	05/22/2019	103663187BOX-033	VFV <i>VJV</i>	KPS <i>KPS</i>	Removed “-“ from model number
2	06/03/2019	103663187BOX-033	VFV <i>VJV</i>	KPS <i>KPS</i>	Fixed typos