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ELECTROMAGNETIC COMPATIBILITY TEST REPORT

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American Association for Laboratory Accreditation Certificate Number: 3657.02

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Applicable Test Standards:	FCC Title 47 CFR Part 15: Subpart B FCC Title 47 CFR Part 15: Subpart C 15.231 ICES-003 Issue 6 RSS-210 Issue 9 RSS-Gen Issue 5
Equipment Tested:	Versa Plus Dual (Wireless Home Security Sensor for Windows and Doors)
Model Number(s):	VPD
FCC ID:	2AD9X-VPD
IC Certification Number:	12637A-VPD
Manufacturer:	Versa Wireless

REVISION HISTORY

Date	Report Number	Rev #	Details	Author's Initials
Sept 06, 2019	E10676_1903_VersaWireless_VersaPlusDual_V	1.0	Final Release	MK
May 07, 2019	E10676_1903_VersaWireless_VersaPlusDual_V	0.0	Initial release	MK
All previous versions of this report have been superseded by the latest dated revision as listed in the above table. Please dispose of all previous electronic and paper printed revisions accordingly.				

REPORT AUTHORIZATION

The data documented in this report is for equipment provided by Versa Wireless. The tests were performed on the sample equipment as requested by Versa Wireless for the purpose of demonstrating compliance with FCC Title 47 CFR Part 15: Subpart B and SubpartC, 15.231, ICES-003 Issue 6, RSS-210 Issue 9, and RSS-Gen Issue 5 as agreed upon by Versa Wireless as per Quote 19SH01314.

Versa Wireless is responsible for the tested product configuration, continued product compliance, and for the appropriate auditing of subsequent products as required. This report may comprise partial list of tests that are required for FCC or IC Declaration of Conformity and can only be produced by the manufacturer.

This is to certify that the following report is true and correct to the best of our knowledge.

Radio Testing by Bruce Balston, Senior RF/EMC Test Engineer

Emissions Testing & Report by Maryam Kashi, RF/EMC Test Engineer

Approved by Parminder Singh Director of EMC Department

QAI FACILITIES

Founded in 1994 by a group of experienced certification and testing experts, QAI is an independent third-party testing, inspection and certification organization which serves the building industry, government and individuals with cost effective solutions through our in-house capabilities / services, and an established world-wide network of qualified affiliates. To help get your product to market, trust the provider that many leading global manufacturers do: QAI.

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QAI EMC ACCREDITATION

QAI EMC is your one-stop regulatory compliance partner for electromagnetic compatibility (EMC) and electromagnetic interference (EMI). Products are tested to the latest and applicable EMC/EMI requirements for domestic and international markets. QAI EMC goes above and beyond being a testing facility—we are your regulatory compliance partner. QAI EMC has the capability to perform RF Emissions and Immunity for all types of electronics manufacturing including Industrial, Scientific, Medical, Information Technology, Telecom, Wireless, Automotive, Marine and Avionics.

EMC Laboratory Location	FCC Designation (3m SAC)	IC Registration (3m SAC)	A2LA Certificate
Burnaby, BC, Canada	CA9543	21146-1	3657.02

Headquarters & EMC Laboratory in Burnaby, BC

TABLE OF CONTENTS

Section I: EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this report is to demonstrate and document the compliance of "Versa Plus Dual" as per Sections 1.2 & 1.3 of this report.

1.2 Scope

The information documented in this report is based on the test methods and levels as per Quote 19SH01314:

- **FCC Title 47 CFR Part 15** – Radio Frequency Devices, Subpart B- Unintentional Radiators.
- **ICES-003 Issue 6** – Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement.
- **FCC Title 47 CFR Part 15** – Radio Frequency Devices, Subpart C - Intentional Radiators
  - §15.231 - Periodic Operation in the band 40.66-40.70 MHz and above 70 MHz
- **RSS-210 Issue 9** – License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
  - Annex 1 - Momentarily Operated Devices and Remote Control
- **RSS-Gen Issue 5** – General Requirements and Information for the Certification of Radio Apparatus

1.3 Summary of Results

The following tests demonstrate the testimony to "FCC and IC" Mark Electromagnetic compatibility radio testing for the "Versa Plus" device manufactured by Ion Digital Canada.

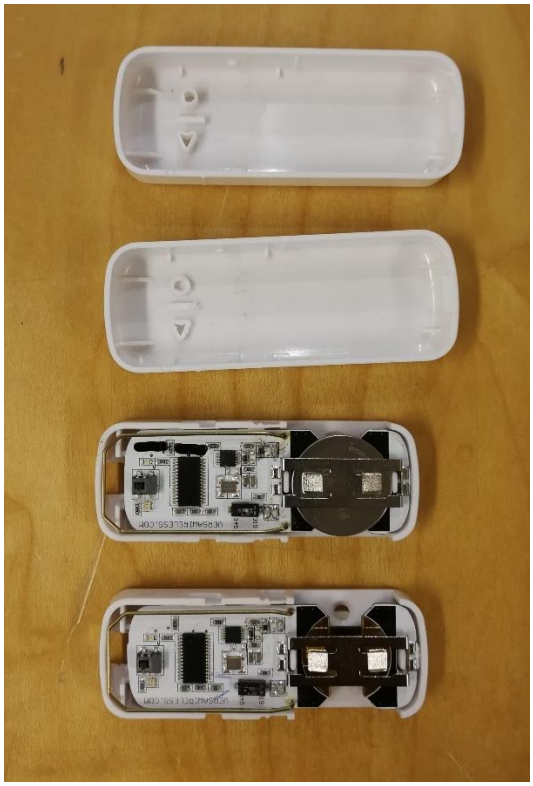
The following testing was performed pursuant to FCC & IC Radio and RF Emissions Standards

Test Description	Applicable FCC Test Standard	Applicable IC Test Standard	Test Method	Result
Antenna Requirement	Title 47 CFR Part 15: Subpart C §15.203	Rss-Gen Issue 5 Section 7.1.2	N/A	PASS
Transmission Time	Title 47 CFR Part 15: Subpart C §15.231 (a)	RSS-210 Issue 9	N/A	PASS
Duty cycle Correction Factor CaLculation	Title 47 CFR Part 15: Subpart C	Rss-Gen Issue 4	ANSI C63.10-2013	PASS
Field Strength of Carrier Frequency	Title 47 CFR Part 15: Subpart C §15.231 (b)	RSS-210 Issue 9 RSS-Gen Issue 5	ANSI C63.10-2013	PASS
99% Occupied Bandwidth	Title 47 CFR Part 15: Subpart C §15.231 (c)	RSS-210 Issue 9 RSS-Gen Issue 4	ANSI C63.10-2013	PASS
Intentional Spurious Emissions	Title 47 CFR Part 15: Subpart C §15.231 (b)	RSS-210 Issue 9 RSS-Gen Issue 5	ANSI C63.10-2013	PASS
Receiver Radiated Emissions	Title 47 CFR Part 15: Subpart B §15.109 in Restricted Bands	RSS-Gen Issue 5	ANSI C63.4-2014	PASS

Section II: GENERAL INFORMATION

2.1 Product Description

The information provided in this section is for the Equipment Under Test (EUT) and corresponding Auxiliary Equipment required to perform the tests as a complete system.



EUT – Versa Plus Dual: Casing, normal operation and CW units

Battery – 3VDC CR2032

Equipment Under Test (EUT) Information

EUT	Versa Plus Dual
Description	Wireless Home Security Sensor for Windows and Doors
FCC ID	2AD9X-VPD
IC Number	12637A-VPD
Manufacturer	Versa Wireless
Model No. (HVIN)	VPD
PMN	Versa Plus Dual
Serial No.	
Operating Frequency	319.5 or 345 MHz
Transmit Power	-7 dBm e.i.r.p.
Modulation Type	ASK - OOK
Test Channels	319.5 and 345 MHz
Data Rate	2 kbps
Antenna Type	Loop
Antenna Gain	-20 dBi
Input Power	2 x 3 VDC CR2032, Coin Cell Battery

2.2 Environmental Conditions

The equipment under test was operated and tested under the following environmental conditions:

Parameter	Conditions
Location	Indoors
Temperature	22-28ºC
Relative Humidity	39.7 - 54.4%

2.3 Measurement Uncertainty

Parameter	Uncertainty
Radiated Emissions, 30MHz-1GHz	± 2.40 dB
Radiated Emissions, 1GHz-40GHz	± 2.48 dB
Radio Frequency	±1.5 x 10-5 MHz
Total RF Power Conducted	±1.36 dB
Spurious Emissions, Conducted	±1.36 dB
RF Power Density, Conducted	±1.36 dB
Temperature	±1ºC
Humidity	±5 %
DC and low frequency voltages	±3 %

2.4 Worst Test Case

Worst-case orientation was determined during the preliminary testing. The final radiated emissions were performed in the worst-case orientation.

2.5 Sample Calculations of Emissions Data

Radiated and conducted emissions were performed using EMC32 software developed by Rohde & Schwarz. Transducer factors like Antenna factors, Cable Losses and Amplifier gains were stored in the test templates which are used to perform the emissions measurements. After test is finished, data is generated from the EMC32 consisting of product details, emission plots and final data tables as shown below.

Frequency (MHz)	Q-Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Ant. Ht. (cm)	Pol	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
42.663900	33.0	1000.000	120.000	100.0	H	70.0	13.2	7.5	40.5

Quasi Peak reading shown in the table above is already corrected by the software using correction factor shown in column “Corr.” The correction factor listed under “Corr.” table calculated as:

Corr.(dB) = Antenna factor + Cable loss

Or

Corr. (dB) = Antenna factor + Cable Loss - Amp gain (if pre-amplifier was used)

The final Quasi-peak reading shown in the data is calculated by the software using following equation:

Corrected Quasi Peak (dBµV/m) = Raw Quasi-Peak Reading + Antenna factor + Cable loss

To obtain the final Quasi-Peak or Average reading during power line conducted emissions, transducer factors are included in the final measurement as shown below.

Frequency (MHz)	Q-Peak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150	44.3	1000.000	9.000	GND	0.6	21.7	66.0

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150	27.2	1000.000	9.000	GND	0.6	28.8	56.0

Quasi-Peak or Average reading shown in above table is already corrected by the software using the correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

The final Quasi-peak or Average reading shown in the data is calculated by the software using following equation:

Corr. Quasi-Peak/Average Reading (dBµV) = Raw Quasi Peak/Average Reading + Antenna factor + Cable loss

The allowable margins from the limits, as per the standards, were calculated for both radiated and conducted emissions:

Margin (dB) = Limit – Quasi-Peak or Average reading

2.6 Test Equipment List

The tables below contain all the equipment used by QAI Laboratories in conducting all tests on the Equipment Under Test (EUT) as per Section 1.3.

Emissions Test Equipment

Manufacturer	Model	Description	Serial No.	Calibration Due Date
Sunol Sciences	SM46C	Turntable	051204-2	N/A
Sunol Sciences	TWR95	Mast	TREML0001	N/A
EMCO	6502	Loop Antenna	6502	11/13/2020
Sunol Sciences	JB1	Biconilog Antenna 30MHz – 2GHz	A070209	2020-Aug-16
Sunol Sciences	DRH-118	Horn Antenna 1GHz-18GHz	A050905	2022-Mar-10
ETS Lindgren	2165	Turntable	00043677	N/A
ETS Lindgren	2125	Mast	00077487	N/A
Rohde & Schwarz	ESU40	EMI Receiver	100011	2019-Dec-01
Fischer	FCC-LISN-50-25-2-08	LISN (150kHz-30MHz)	2041	2021-Nov-19
ETS Lindgren	S201	5-meter Semi-Anechoic Chamber	1030	N/A
AH Systems	PAM118	Amplifier 10KHz-18GHz	189	Conditional Use
WEINSCHEL ENGINEERING	44	6db attenuator	665	N/A
Insulated Wire Inc.	SPS-1753-1140-SPS	Yellow cable, 3m	102395	N/A
Insulated Wire Inc.	SPS-1753-2400-SPS	Yellow cable, 6m	091096	N/A

Note: *Equipment listed above have 3 years calibration interval.*

Measurement Software List

Manufacturer	Model	Version	Description
Rhode & Schwarz	EMC 32	6.20.0	Emissions Test Software

Section III: TEST RESULTS

3.1 Antenna Requirement

Date Performed:

March 26, 2019

Test Standard:

FCC 47 CFR Part 15.203 and IC RSS-Gen Section 7.1.2

Applicable Regulation:

The purpose of this requirement is to make certain that no other antenna, except for that provided by the responsible party, shall be used with the Equipment-Under-Test (EUT) as defined in FCC CFR 47 Part 15.203 & RSS-Gen:

> "An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited." … "the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded."

Modifications:

No modification was required to comply for this test.

Result:

An integrated antenna is used on this product and it is not field replaceable.

3.2 Transmission Time

Date Performed:

March 26, 2019

Test Standard:

- Title 47 CFR Part 15: Subpart C, §15.231 (a)
- RSS-210 Issue 9, A.1.1

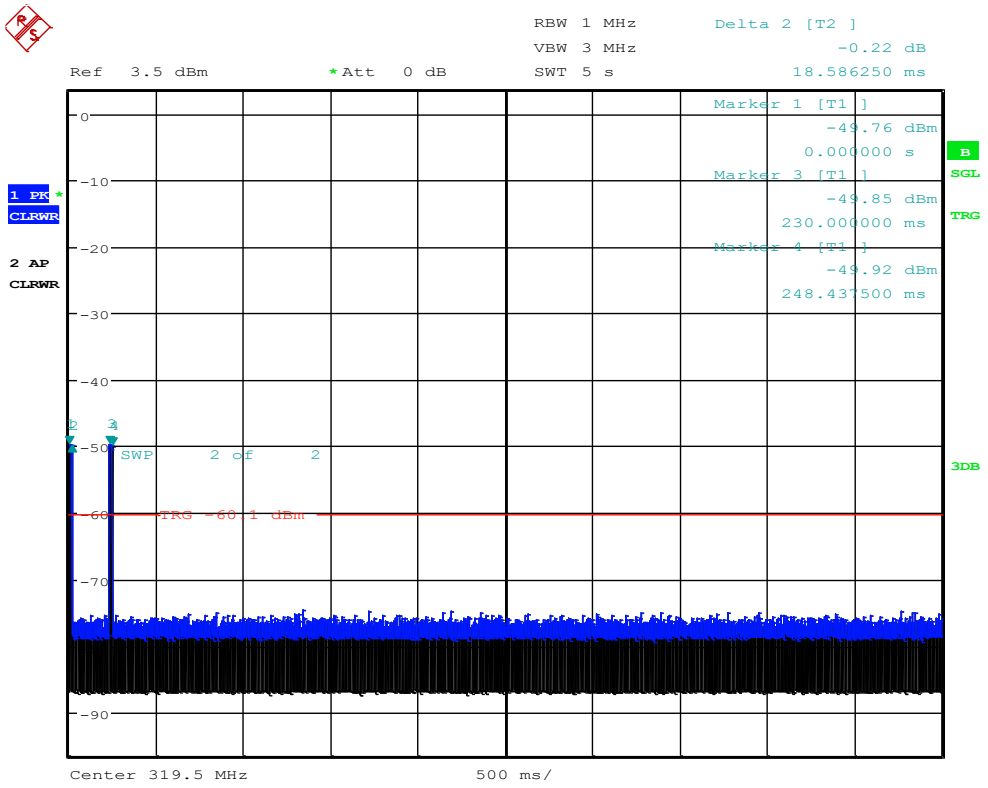
Requirement(s):

- A manually operated transmitter shall be equipped with a push-to-operate switch and be under manual control at all times during transmission. When released, the transmitter shall cease transmission within no more than 5 seconds of being released.
- A transmitter that has been activated automatically shall cease transmission within 5 seconds of activation.

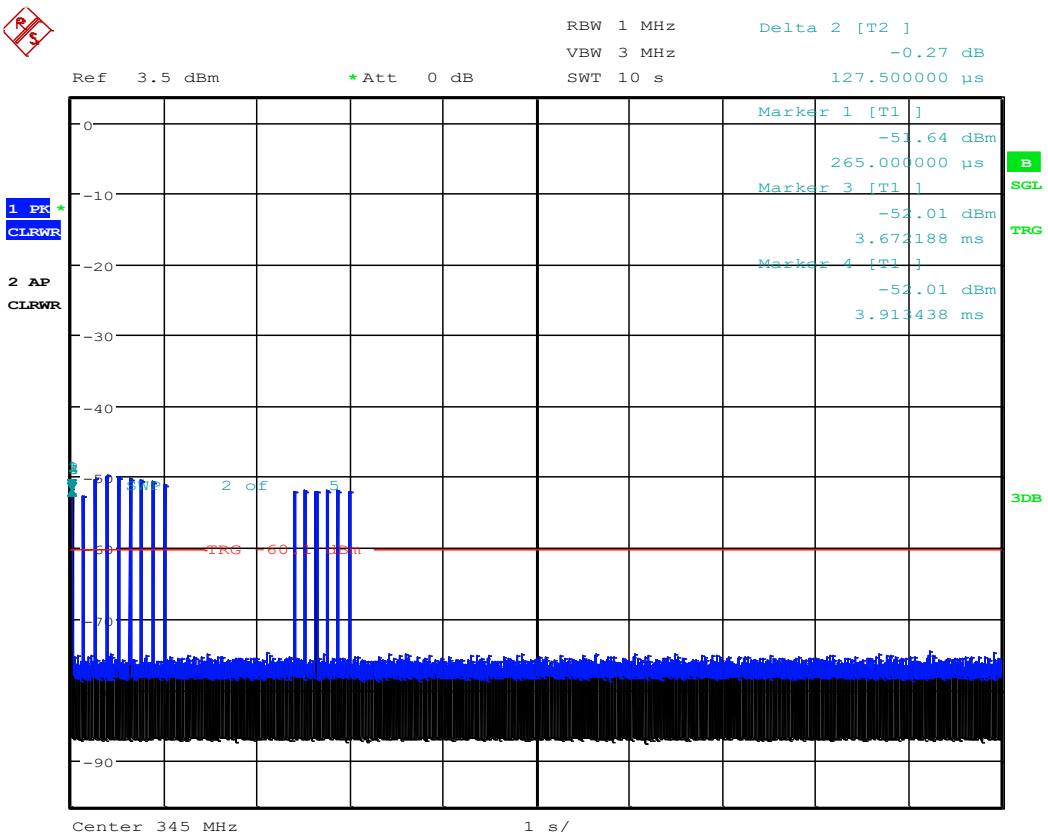
Result:

The EUT complies with the applicable standard.

Data/Plot:



Plot 1: Transmission Time Measurement at 319.5 MHz



Plot 2: Transmission Time Measurement at 345 MHz

Operating freq. (MHz)	Measured TX Transmission Time	Limit	Result
319.5	230 ms	< 5 s	PASS
345	3.1 s	< 5 s	PASS

Table 1: Transmission time measurement data

3.3 Duty Cycle Correction Factor Calculation

Date Performed:

March 27, 2019

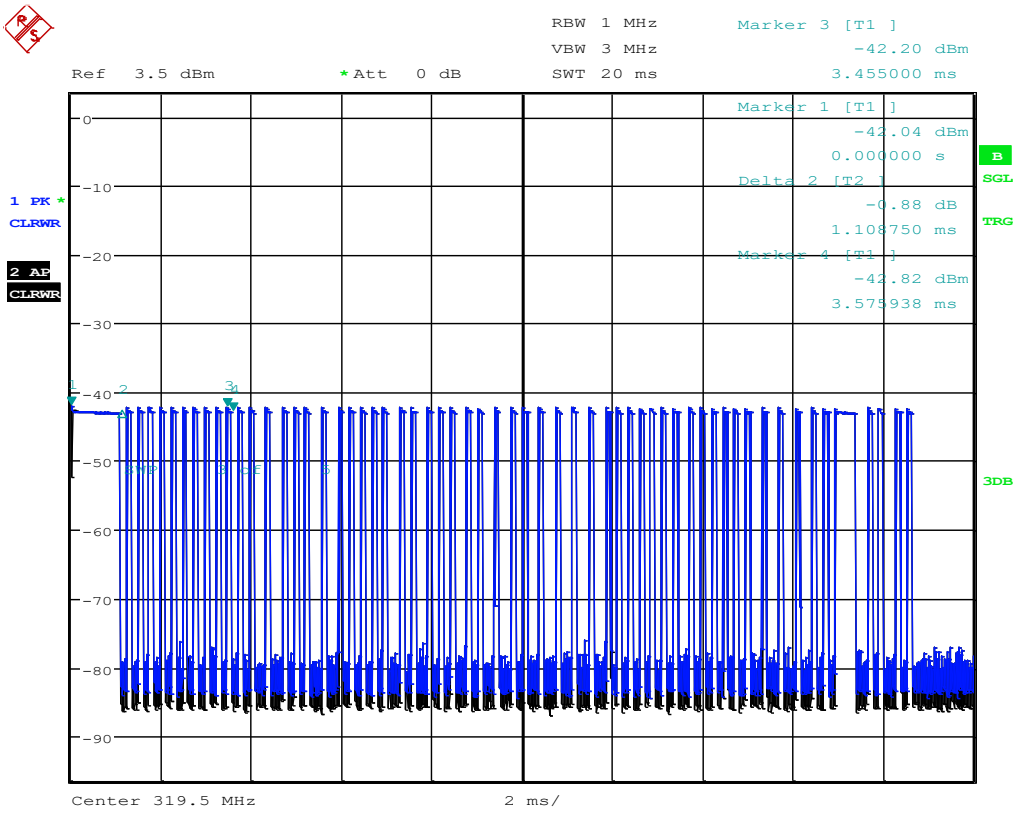
Requirement(s):

- *§ 15.35(c)* - Unless otherwise specified, e.g. § 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

Method of Measurement:

- ANSI C63.10-2013 standard.

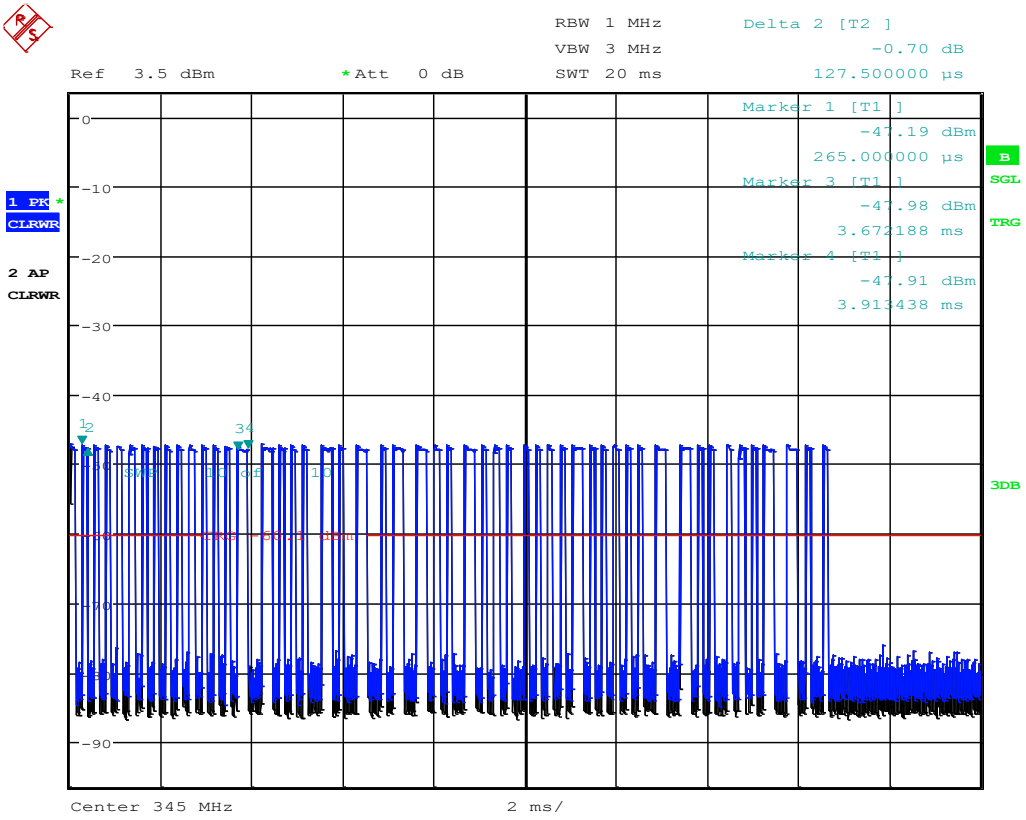
Data/Plots:



Plot 3 - RF Duty Cycle at 319.5 MHz

Table 2: Duty Cycle Correction Factor Calculation at 319.5 MHz

Data Transmissions		Number of pulses
Long Pulse Duration	1.108 ms	1
Medium Pulse Duration	0.475 ms	1
Short pulse Duration	0.114 ms	58
Total Transmissions Duration	(1x1.108) + (1x0.491) + (58x0.121) = 8,287 ms	8.617
On Time within 100 msec	8.617 ms	
Duty Cycle Correction factor	**20log (8.617/100) = -21.29 dB**	



Plot 4 - RF Duty Cycle at 345 MHz

Table 3: Duty Cycle Correction Factor Calculation at 345 MHz

Data Transmissions		Number of pulses
Long Pulse Duration	0.241 ms	12
Short pulse Duration	0.1275 ms	39
Total Transmissions Duration	(12x0.241) + (39x0.1275) = 8,287 ms	7.865
On Time within 100 msec	7.865 ms	
Duty Cycle Correction factor	**20log (7.865/100) = -22.09 dB**	

3.4 Field Strength of Carrier Frequency

Date Performed:

March 23, 2018

Test Standard:

- Title 47 CFR Part 15: Subpart C, §15.231 (b)
- RSS-210 Issue 9, A.1.2
- RSS-Gen Issue 5, 8.9 & 8.10

Test Method:

- ANSI C63.10-2013

Required Limit(s):

The field strength of emissions from intentional radiators operated under this section (§15.231) shall not exceed the following:

Fundamental Frequency, *f* (MHz)	Field strength of Fundamental (µV/m)	Field strength of Fundamental (dBµV/m)
40.66 – 40.70	2250	67.0
70 – 130	1250	62.0
130 – 174	1250 – 3750*	62.0 – 71.5*
174 – 260	3750	71.5
260 – 470	3750 – 12500*	71.5 – 82.0*
above 470	12500	82.0

* - Linear interpolation with frequency, *f*, in MHz:
For 130-174 MHz: Field Strength (µV/m) = (56.82 x *f*) – 6136
For 260-470 MHz: Field Strength (µV/m) = (41.67 x *f*) – 7083

Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

Data:

Freq.	Raw Peak at 3m	Ant. Pol.	System Loss/Correction Factor	Corrected Peak at 3m	Duty Cycle Corr. Factor	Avg FS	Limit Avg	Margin	EUT Orientation
MHz	dBuV/m		dB	dBuV/m	dB	dBuV/m	dBuV/m	dB	
319.5	67.7	V	23.3	91.0	21.3	67.7	80.8	13.1	PCB face up
319.5	51.2	H	23.3	74.5	21.3	53.2	80.8	27.6	PCB face up
345	67.5	V	23.8	91.3	22.1	69.2	80.8	11.6	PCB face up
345	51.8	H	23.8	75.6	22.1	53.5	80.8	27.3	PCB face up

Note: EUT was tested in xy (flat), yz, and xz-plane orientations. Reported results above pertain to the worst case.
Result: The EUT complies with the applicable standard.

3.5 99% Occupied Bandwidth

Date Performed:

March 26, 2019

Test Standard:

- Title 47 CFR Part 15: Subpart C, §15.231 (c)
- RSS-210 Issue 9, A.1.3
- RSS-Gen Issue 5, 6.6

Test Method:18.6

- ANSI C63.10-2013

Required Limit(s):

- The 99% bandwidth of momentarily operated devices shall be less or equal to 0.25% of the centre frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the 99% bandwidth shall be less or equal to 0.5% of the centre frequency.

Method of Measurement:

- As called in the ANSI C63.10-2013 standard.

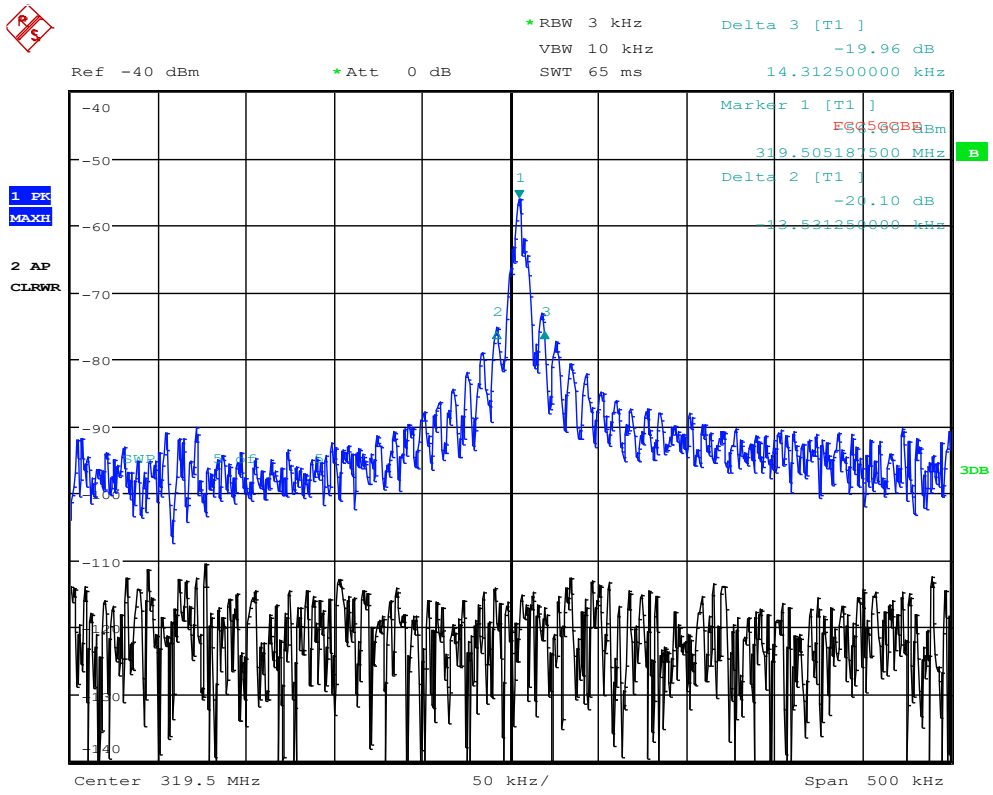
Modifications:

No modification was required to comply for this test.

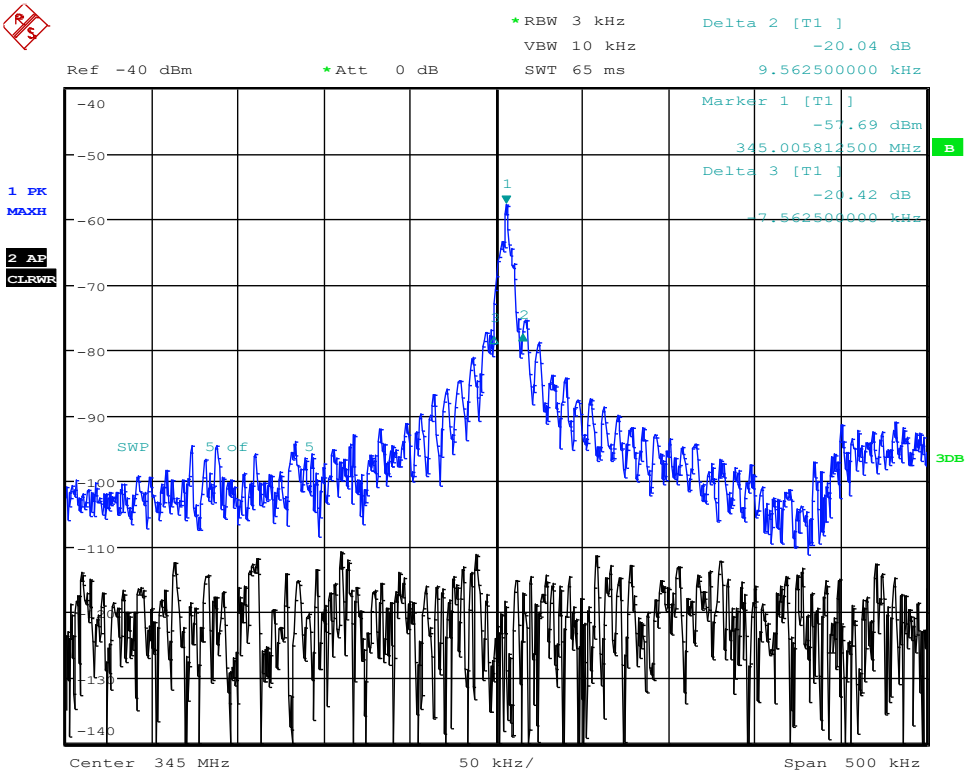
Result:

The EUT complies with the applicable standard.

Data/Plots:



Plot 5: 99% Occupied Bandwidth at 319.5 MHz



Plot 6: 99% Occupied Bandwidth at 345 MHz

Table 4: 99% OBW Data

Frequency (MHz)	Measured 99% BW (MHz)	Limit (MHz)	Result
319.5	0.0278	1082.5	PASS
345	0.0172	1082.5	PASS

.8.83.6 Intentional Spurious Emissions

Date Performed:

1-6 GHz: March 15, 2019
30 MHz-1 GHz: March 25, 2019
1 kHz – 30 MHz: April 11, 2019

Test Standard:

- Title 47 CFR Part 15: Subpart C, §15.231 (b)
- RSS-210 Issue 9, A.1.2
- RSS-Gen Issue 5, 8.9 & 8.10

Test Method:

- ANSI C63.10-2013

Required Limit(s):

The field strength of emissions from intentional radiators operated under this section (§15.231) shall not exceed the following:

Fundamental Frequency, *f* (MHz)	Field strength of Fundamental (µV/m)	Field strength of Fundamental (dBµV/m)	Field strength of Spurious Emissions (µV/m)	Field strength of Spurious Emissions (dBµV/m)
40.66 – 40.70	2250	67.0	225	47.0
70 – 130	1250	62.0	125	62.0
130 – 174	1250 – 3750*	62.0 – 71.5*	125 – 375*	42.0 – 51.5*
174 – 260	3750	71.5	375	51.5
260 – 470	3750 – 12500*	71.5 – 82.0*	375 – 1250*	51.5 – 62.0*
above 470	12500	82.0	1250	62.0
* - Linear interpolation with frequency, *f*, in MHz: For 130-174 MHz: Field Strength (µV/m) = (56.82 x *f*) – 6136 For 260-470 MHz: Field Strength (µV/m) = (41.67 x *f*) – 7083				
Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.				

The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

Frequency, *f* (MHz)	Field strength (dBµV/m)
0.009 – 0.490	(20*log(2400/*f* (kHz))) + 40 dB
0.490 – 1.705	(20*log(24000/*f* (kHz))) + 20 dB
1.705 – 30.0	49.5
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0
Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges. **Note 2:** The emissions limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.	

Unwanted emissions that fall into the restricted bands specified on the table below shall comply with the limits specified on the table limits above as per §15.209 and Clause 8.9 of RSS-Gen.

FCC Restricted Bands:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

IC/RSS Restricted Bands:

MHz	MHz	GHz
0.090-0.110	240-285	9.0-9.2
2.1735-2.1905	322-335.4	9.3-9.5
3.020-3.026	399.9-410	10.6-12.7
4.125-4.128	608-614	13.25-13.4
4.17725-4.17775	960-1427	14.47-14.5
4.20725-4.20775	1435-1626.5	15.35-16.2
5.677-5.683	1645.5-1646.5	17.7-21.4
6.215-6.218	1660-1710	22.01-23.12
6.26775-6.26825	1718.8-1722.2	23.6-24.0
6.31175-6.31225	2200-2300	31.2-31.8
8.291-8.294	2310-2390	36.43-36.5
8.362-8.366	2655-2900	Above 38.6
8.37625-8.38675	3260-3267	
8.41425-8.41475	3332-3339	
12.29-12.293	3345.8-3358	
12.51975-12.52025	3500-4400	
12.57675-12.57725	4500-5150	
13.36-13.41	5350-5460	
16.42-16.423	7250-7750	
16.69475-16.69525	8025-8500	
16.80425-16.80475		
25.5-25.67		
37.5-38.25		
73-74.6		
74.8-75.2		
108-138		
156.52475-156.52525		
156.7-156.9		

Method of Measurement:

The EUT was tested in our 3 m SAC and was positioned on the center of the turntable. The transmitter was set for continuous transmission. The operating frequency of the device was measured for all radiated emissions 10 kHz to 6 GHz up to the 10th harmonic of the highest fundamental frequency. The EUT was pre-scanned in 3 different orthogonal orientations and was found to radiate highest when placed flat on the table top as indicated in the test photos.
Transmission is generated once button is pressed. Since this involved human intervention in the SAC, EUT with Continuous Wave (CW) was tested, and Duty Cycle Correction Facture (DDCF) as per 4.4 was applied to calculate results for modulated transmission.

Modifications:

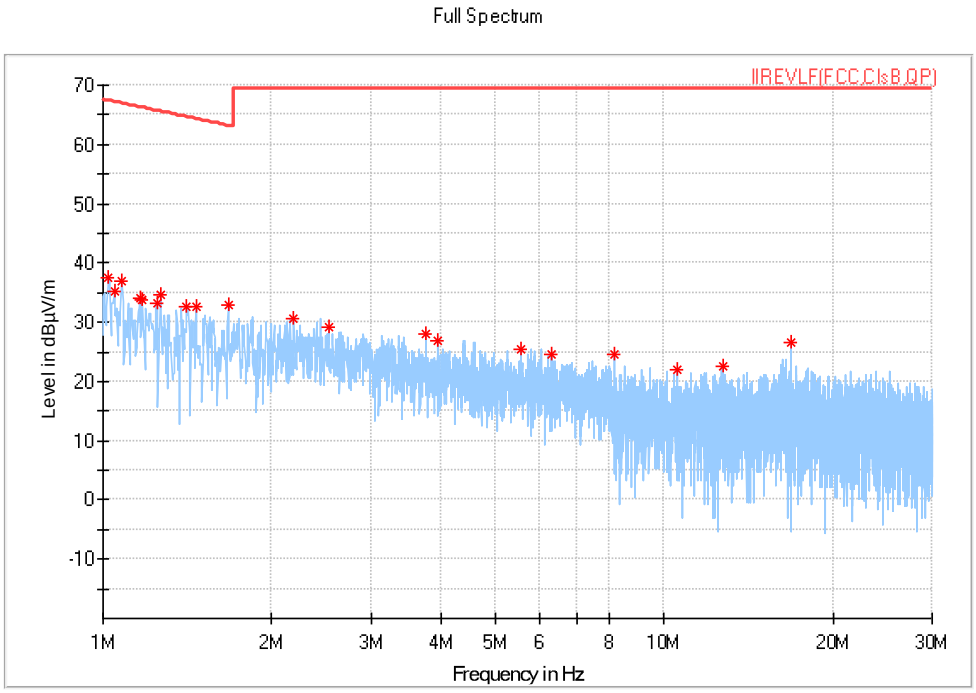
No modification was required to comply for this test.

Result:

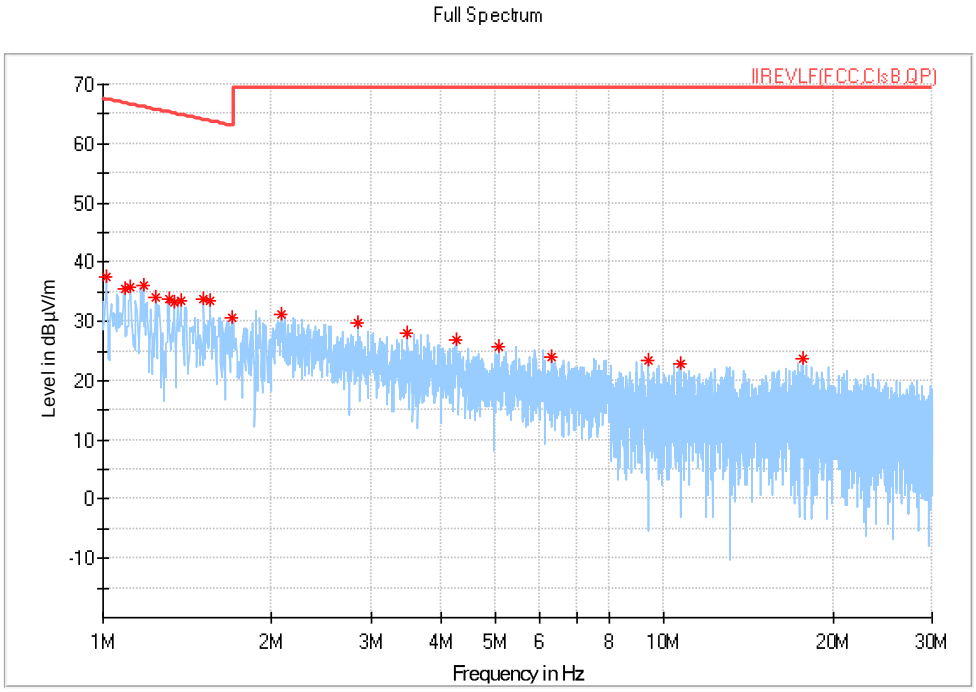
The EUT complies with the applicable standard.

Data/Plot:

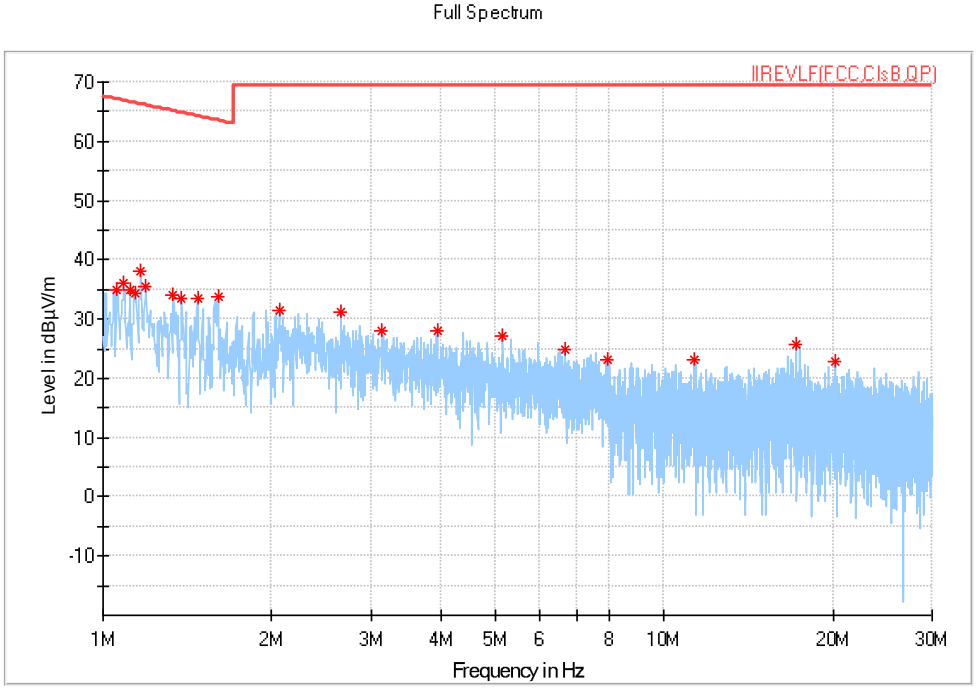
1 – 30 MHz:



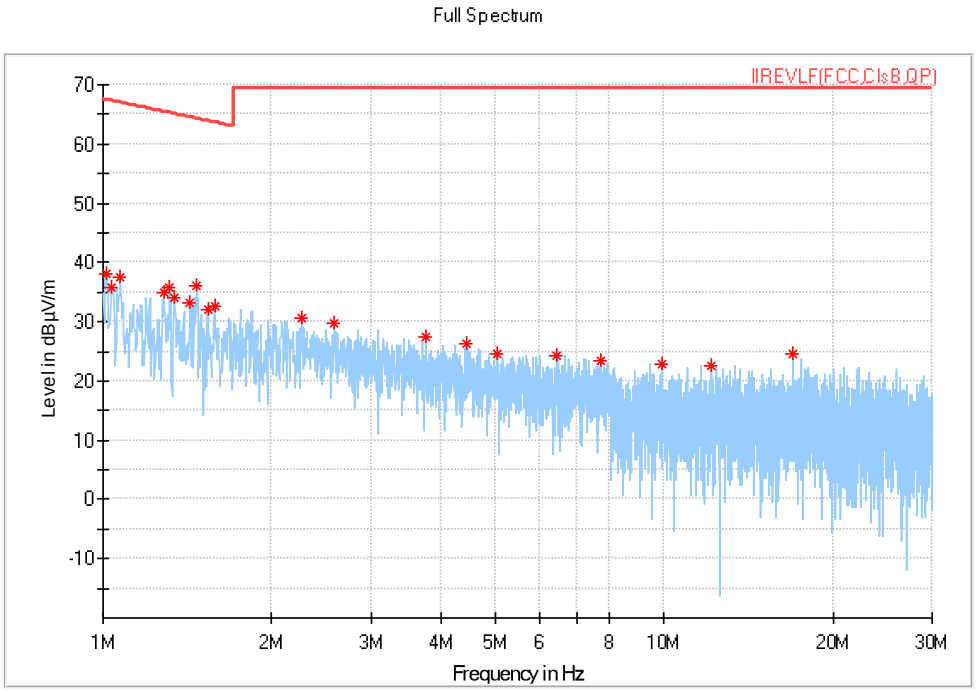
Plot 7: Radiated Emissions (1-30M Hz) – 319.5 MHz, Vertical Pol.



Plot 8: Radiated Emissions (1-30M Hz) – 319.5 MHz, Parallel Pol.



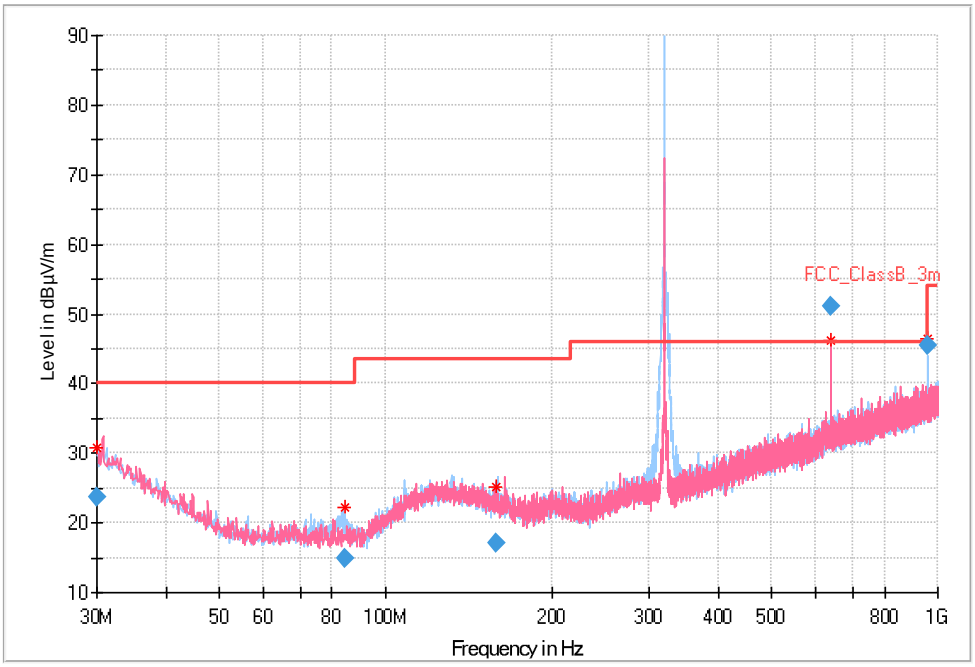
Plot 9: Radiated Emissions (1-30M Hz) – 345 MHz, Vertical Pol.



Plot 10: Radiated Emissions (1-30M Hz) – 345 MHz, Parallel Pol.

Note: No emissions found within 20 dB margin of limit line.

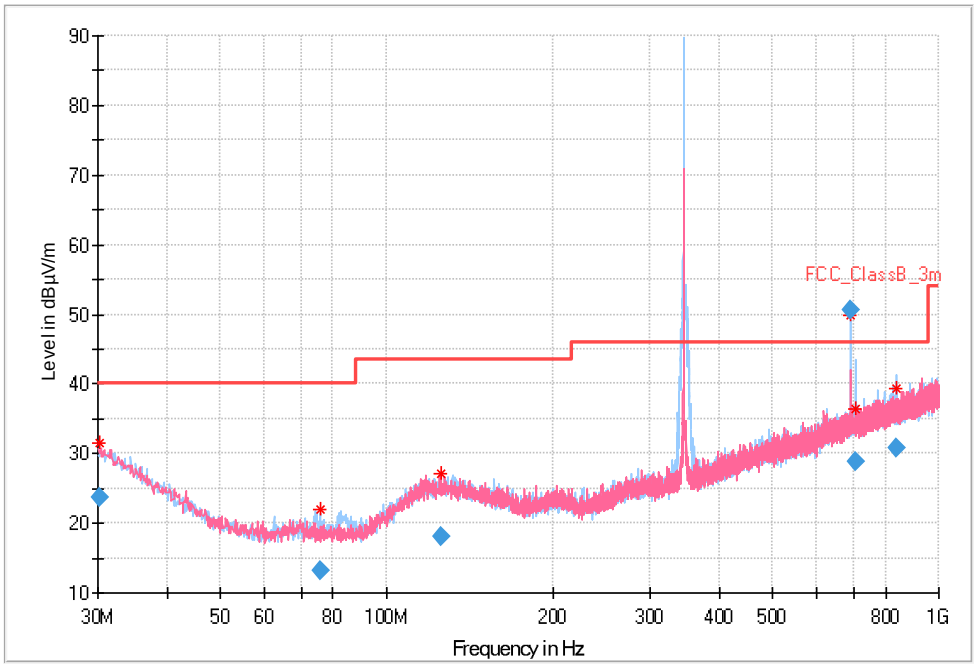
30 MHz – 1 GHz:



Plot 11: Radiated Emissions (30MHz-1GHz) scanned at 3m SAC, 319.5 MHz, CW

Results for 319.5 MHz

Frequency (MHz)	QuasiPeak (dBµV/m)	DCCF (dB)	DCCF_Corrected QuasiPeak (dBuV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.092194	23.70	-	-	40.00	16.30	1000.0	120.000	172.0	V	11.0	27.1
84.154750	14.85	-	-	40.00	25.15	1000.0	120.000	148.0	H	197.0	15.6
158.982500	17.06	-	-	43.50	26.44	1000.0	120.000	200.0	H	42.0	21.0
639.030950	51.05	21	30.05	46.00	15.95	1000.0	120.000	139.0	H	197.0	30.4
958.521150	45.49	21	24.49	46.00	21.51	1000.0	120.000	98.0	H	11.0	34.8

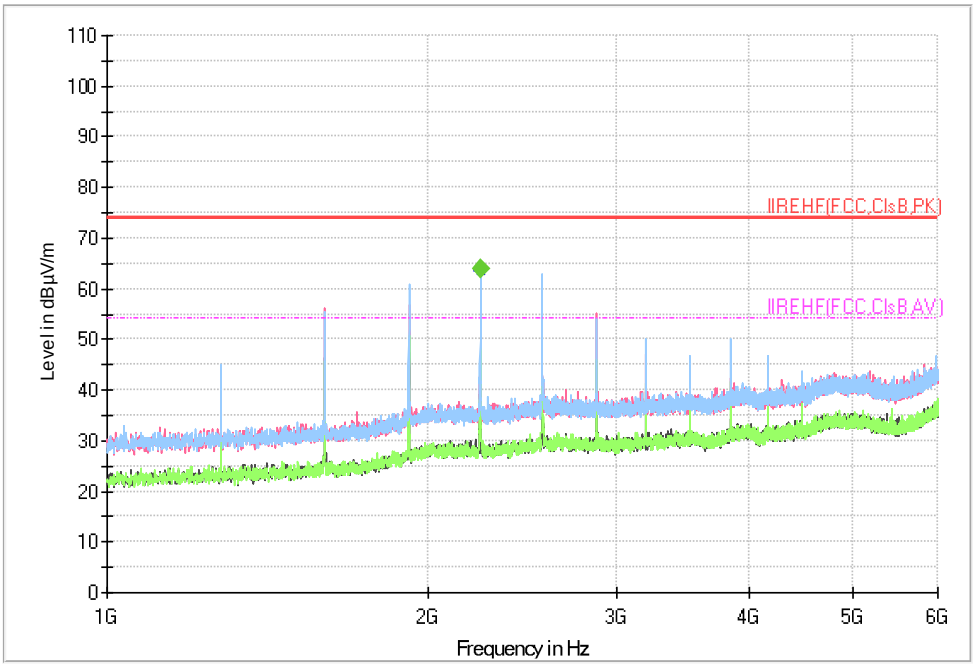


Plot 12: Radiated Emissions (30MHz-1GHz) scanned at 3m SAC, 345 MHz, CW

Results for 345 MHz

Frequency (MHz)	QuasiPeak (dBµV/m)	DCCF (dB)	DCCF_Corrected QuasiPeak (dBuV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.171327	23.59	-	-	40.00	16.41	1000.0	120.000	285.0	V	274.0	27.0
75.802900	13.15	-	-	40.00	26.85	1000.0	120.000	193.0	H	223.0	15.7
125.792000	18.09	-	-	43.50	25.41	1000.0	120.000	121.0	V	11.0	22.1
690.007600	50.65	22	28.65	46.00	17.36	1000.0	120.000	130.0	H	0.0	31.1
707.092100	28.94	-	-	46.00	17.06	1000.0	120.000	300.0	H	255.0	31.3
839.078400	30.76	-	-	46.00	15.24	1000.0	120.000	195.0	H	300.0	33.2

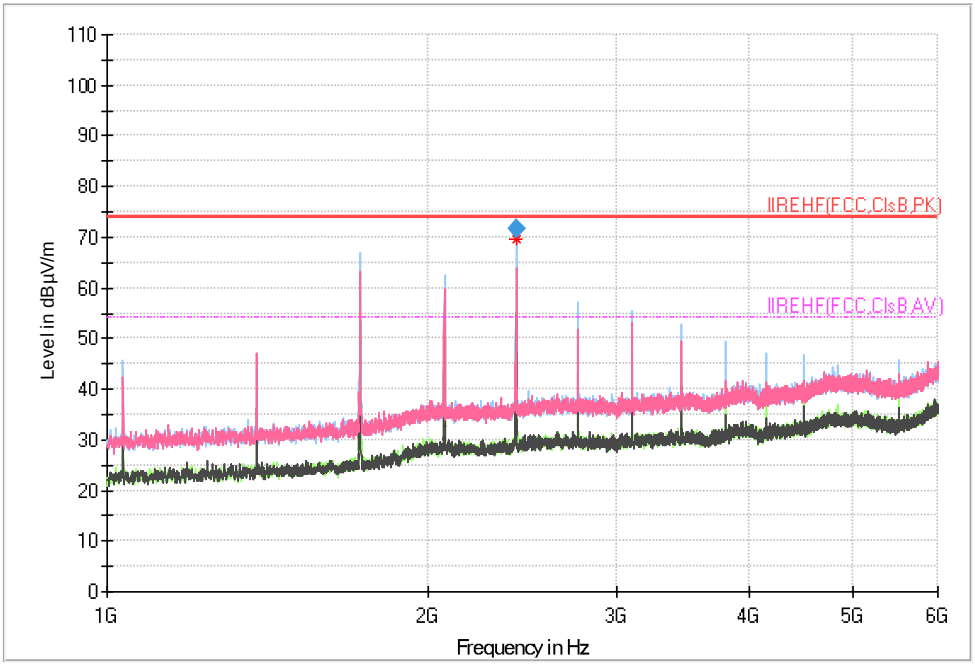
1 – 6 GHz:



Plot 2: Radiated Emissions (1GHz-6GHz) scanned at 3m SAC, 319.5 MHz, CW

Results for 319.5 MHz

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	DCCF (dB)	DCCF-corrected Results (dBuV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band width (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1597.5	---	56.38	22	34.38	54	19.62	1000.0	1000	180	V	208	-4.5
1917	---	60.86	22	38.86	54	15.14	1000.0	1000	155	H	182	-1.4
2236.5	---	64.51	22	42.51	54	11.49	1000.0	1000	155	H	182	-0.1
2556	---	64.37	22	42.37	54	11.63	1000.0	1000	155	H	182	1.2
2875.5	---	56.14	22	34.14	54	19.86	1000.0	1000	180	H	41	1.4



Plot 3: Radiated Emissions (1GHz-6GHz) scanned at 3m SAC, 345 MHz, CW

Results for 345 MHz

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	DCCF (dB)	DCCF-corrected Results (dBuV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band width (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1725	---	66.31	21	45.31	54	8.69	1000.0	1000	205	H	196	-3.7
2070	---	62.65	21	41.65	54	12.35	1000.0	1000	155	H	181	-0.2
2415	78.69	---	21	57.69	74	16.31	1000.0	1000	180	H	164	0.7
2415	---	69.67	21	48.67	54	5.33	1000.0	1000	180	H	164	0.7
2760	---	57.76	21	36.76	54	17.24	1000.0	1000	155	H	359	1.5
3105		56.98	21	35.98	54	18.02	1000.0	1000	155	H	181	1.4

3.7 Receiver Radiated Emissions

Date Performed:

March 28, 2019

Test Standard:

- RSS-Gen Issue 5, 7.1

Test Method:

- ANSI C63.4-2014

Required Limit(s):

Spurious emissions from receivers shall not exceed the radiated limits shown below

Frequency, *f* (MHz)	Field strength (dBµV/m)
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0
Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.	

Method of Measurement:

The EUT was tested in our 3 m SAC and was positioned on the center of the turntable. The transmitter was set for continuous transmission. The device was measured for all radiated emissions from 30 MHz to 3 GHz. The EUT was pre-scanned in 3 different orthogonal orientations and was found to radiate highest when placed flat on the table top as indicated in the test photos.

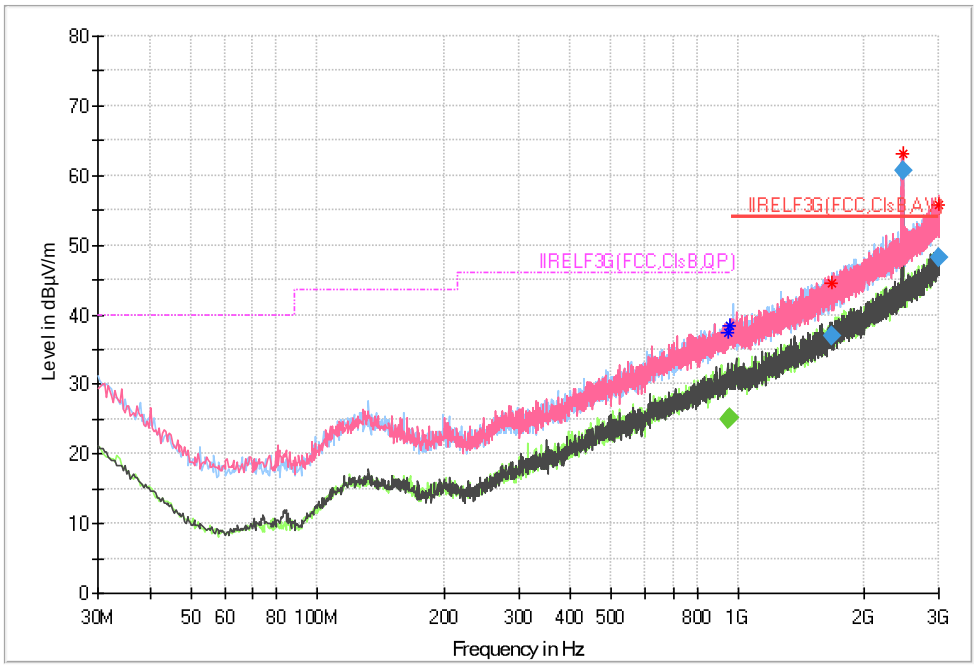
Modifications:

No modification was required to comply for this test.

Result:

The EUT complies with the applicable standard.

Data/Plot:



Plot 4: SAC Radiated Emissions at 3m, normal operation unit

Note:

- 319.5 and 345 MHz rendered equivalent results. Data for 345 MHz presented.
- 2.4 GHz signal was determined to be ambient and not of the EUT.

Results: No emissions above the noise floor observed.

3.8 RF Exposure Evaluation

Date Performed: April 16, 2019

Test Standard: FCC 47 CFR §1.1310: RSS-102 Section 2.5.2:

CC CFR 47 §1.1310:

"Radiofrequency radiation exposure limits for General Population/Uncontrolled Exposure at Frequency range 1500 - 100000 MHz: 1.0 mW/cm^2"

RSS-102 Section 2.5.2:

"RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

-at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1.31 x 10-2 f^0.6834 W (adjusted for tune-up tolerance), where f is in MHz

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived."

MPE Results:

The calculation below is used to consider situations in which simultaneous exposure to fields of different frequencies occur. The calculation is performed by the sum of each relative exposure for each equipment according to the following criteria

$$\text{Power Density} = \frac{EIRP}{4\pi r2}\ \text{mW/cm}^2$$

Carrier Frequency	Peak Field Strength at 3m	dBuV/m to dBm Conversion Factor	EIRP	EIRP	Spherical Surface Area at 20 cm	Power Density	Limit	Result
MHz	dBuV/m	dB	dBm	mW	cm^2	mW/cm^2	mW/cm^2	
319.5	67.7	95.2	-26	0.0025	4*pi*20^2 = 5027	0.00000050	1.0	RF Exposure Test not required
345	67.5	95.2	-27.5	0.0018	4*pi*20^2 = 5027	0.00000035	1.0	RF Exposure Test not required

EIRP (dBm) = Filed Strength at 3m (dBuV) (from Section 3.4 of this report) – 95.2 dB

Notes:

- Calculation employs max. output power (hor. polarization).
- Calculation includes tune-up tolerance.
- Single antenna -beamforming considerations do not apply.

Appendix A: TEST SETUP PHOTOS

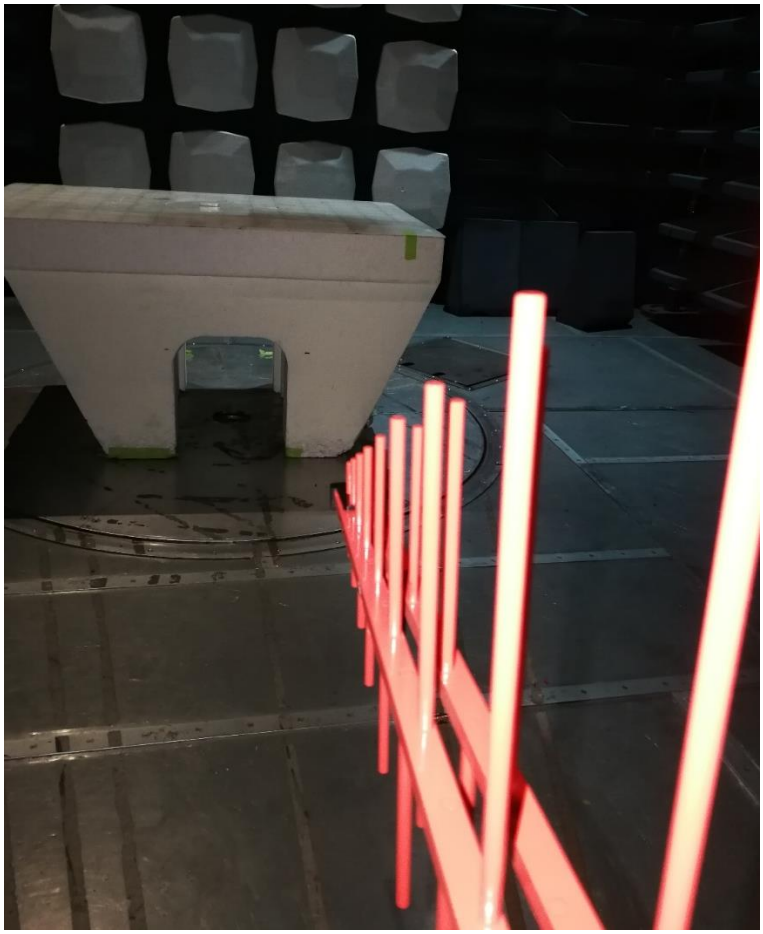


Figure 1: SAC Radiated Spurious Emissions (30 MHz – 1 GHz) at 3m

Figure 2: SAC Radiated Spurious Emissions (1 - 30 MHz) at 3m

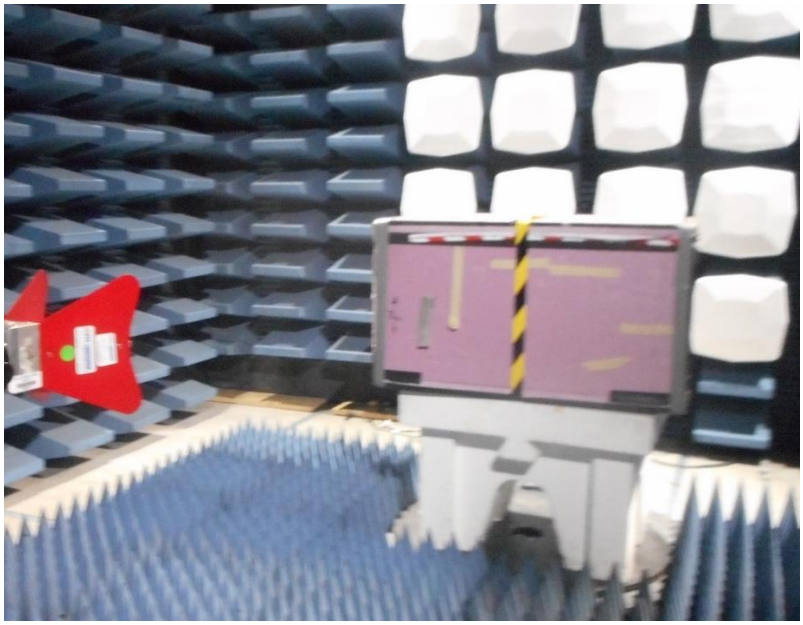


Figure 3: SAC Radiated Spurious Emissions (> 1 GHz) at 3m

Appendix B: ABBREVIATIONS

Abbreviation	Definition
AC	Alternating Current
AM	Amplitude Modulation
CE	European Conformity
CISPR	Comité International Spécial des Perturbations Radioélectriques
DC	Direct Current
EFT	Electrical Fast Transient
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
ESD	ElectroStatic Discharge
EUT	Equipment Under Test
FCC	Federal Communications Commission
IC	Industry Canada
ICES	Interference Causing Equipment Standard
IEC	International Electrotechnical Commission
LISN	Line Impedance Stabilizing Network
OATS	Open Area Test Site
RF	Radio Frequency
RMS	Root-Mean-Square
SAC	Semi-Anechoic Chamber

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END OF REPORT