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TEST REPORT

Report Number: 104273165MPK-001B
Project Number: G104273165
July 30, 2020

Testing performed on the
Proxess MX-Series Mortise Lockset
Model Number: MX Mortise
HVIN: PXH01-MX02-DC
HVIN: PXH01-MX02-B

FCC ID: 2AKUZPXH01
IC: 22335-PXH01

to

FCC Part 15 Subpart C (15.225)
Industry Canada RSS-210 Issue 10
FCC Part 15, Subpart B
Industry Canada ICES-003

For

Proxess LLC

Test Performed by:	**Test Authorized by:**
Intertek	Proxess LLC
1365 Adams Court	8100 Southpark Way - Suite A4
Menlo Park, CA 94025 USA	Littleton, CO 80120 USA

Prepared by: _____ **Date:** July 30, 2020
Todd Moy

Reviewed by: _____ **Date:** July 30, 2020
Krishna Vemuri

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Report No. 104273165MPK-001B

Equipment Under Test:	Proxess MX-Series Mortise Lockset
Trade Name:	Proxess LLC
Model Number:	MX Mortise
Serial Number:	104273165-002
Applicant:	Proxess LLC
Contact:	Jeff Cahill
Address:	8100 Southpark Way - Suite A4 Littleton, CO 80120
Country	USA
Email	Jeff.cahill@proxess.com
Applicable Regulation:	FCC Part 15 Subpart C (15.225) Industry Canada RSS-210 Issue 10 FCC Part 15, Subpart B Industry Canada ICES-003 Issue 6
Test Site Location:	ITS – Site 1 1365 Adams Drive Menlo Park, CA 94025
Date of Test:	April 27-July 16, 2020

We attest to the accuracy of this report:

Todd Moy Project Engineer	Krishna K Vemuri EMC Manager

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1.0 Summary of Tests

TEST	REFERENCE FCC 15.225	REFERENCE RSS-210	RESULTS
Field Strength of Fundamental	15.225(a)	B.6	Complies
Radiated Emissions Outside the band	15.225(b), 15.225(c), 15.225(d), 15.209	B.6	Complies
Frequency Tolerance of the Carrier	15.225(e)	B.6	Complies
Line Conducted Emissions	15.207	RSS-GEN	Complies
Occupied Bandwidth	15.215	RSS-GEN	Complies
Antenna requirement	15.203	RSS-GEN	Complies[1]

[1] The EUT utilizes an internal Antenna.

2.0 General Description

2.1 Product Description

Proxess LLC supplied the following description of the EUT:

The Proxess MX mortise lock extends the family of e-locks to include locks requiring mortise prep and deadbolt applications. Like other Proxess products, the MX mortise lock is equipped with Bluetooth (BLE) and 13.56 MHz RF high-frequency technologies to communicate with our most advanced contactless smart cards, mobile apps, and BLE bridges, creating automatic updates to the system software.

Overview of the EUT

Applicant name & address	Proxess LLC 8100 Southpark Way - Suite A4 Littleton, CO 80120
Contact info / Email	Jeff Cahill / jeff.cahill@proxess.com
Model	MX Mortise
HVIN:	PXH01-MX02-DC, PXH01-MX02-B
FCC Identifier	2AKUZPXH01
IC Identifier	22335-PXH01
Operating Frequency	13.56 MHz
Number of Channels	1 each frequency (RFID)
Type of Modulation	ASK Modulation (RFID)
Antenna Type	PCB Trace Antenna (13.56 MHz)

EUT receive date: April 27, 2020
EUT receive condition: The EUT was received in good condition with no apparent damage. As declared by the Applicant it is identical to the production units.
Test start date: April 27, 2020
Test completion date: July 16, 2020

2.2 Related Submittal(s) Grants

None

2.3 Test Methodology

Both AC mains line-conducted and radiated emissions measurements were performed according to the procedures in ANSI C63.4: 2014. Radiated tests were performed at an antenna to EUT distance of 10 meters, unless stated otherwise in this test report. All other measurements were made in accordance with the procedures in part 2 of CFR 47 7, ANSI C63.10: 2013, ANSI C63.4-2014 & RSS-GEN Issue 5.

2.4 Test Facility

The radiated emission test site and conducted measurement facility used to collect the data is 10m semi-anechoic chamber located in Menlo Park, California. This test facility and site measurement data have been fully placed on file with the FCC and Industry Canada (Site # 2042L-1).

2.5 Measurement Uncertainty

Compliance with the limits was based on the results of the measurements and doesn't take into account the measurement uncertainty.

Estimated Measurement Uncertainty

Measurement	Expanded Uncertainty (k=2)		
	0.15 MHz – 1 GHz	1 GHz – 2.5 GHz	> 2.5 GHz
RF Power and Power Density – antenna conducted	-	0.7 dB	-
Unwanted emissions - antenna conducted	1.1 dB	1.3 dB	1.9 dB
Bandwidth – antenna conducted	-	30 Hz	-

Measurement	Expanded Uncertainty (k=2)		
	0.15 MHz – 30MHz	30 MHz – 1 GHz	1 GHz – 18 GHz
Radiated emissions	-	4.7	5.1 dB
AC mains conducted emissions	2.1 dB	-	-

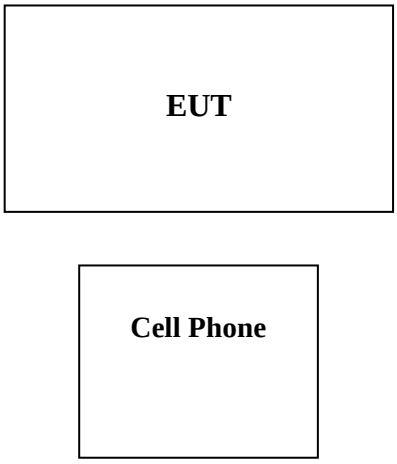
2.0 System Test Configuration

3.1 Block Diagram of Test Setup

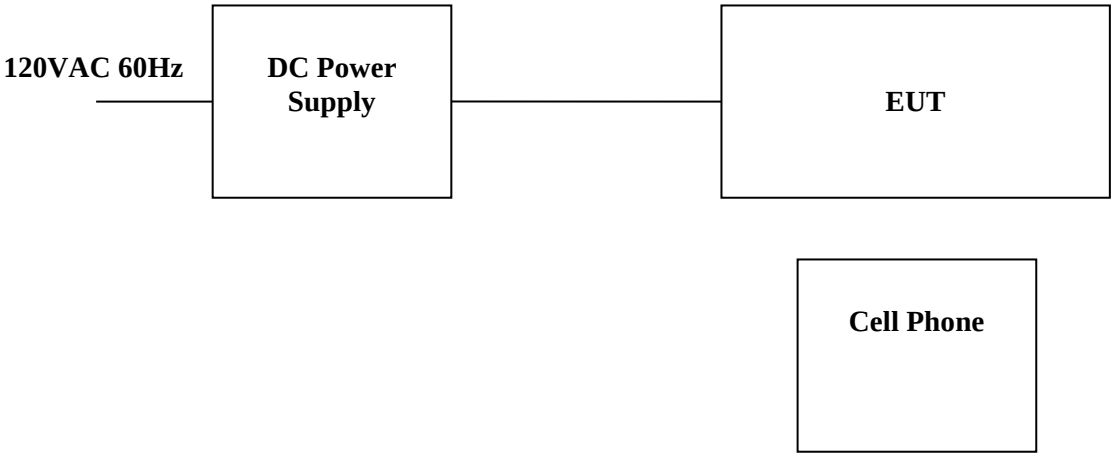
The diagram shown below details the interconnection of the EUT and support equipment. For specific layout, refer to the test configuration photograph in the relevant section of this report.

Support Equipment		
Description	**Manufacturer**	**Model No.**
DC Power Supply	B&K Precision	1550
Cell Phone	Samsung	SM-J327U

Battery Configuration



DC Supply Configuration



S = Shielded U = Unshielded	F = With Ferrite m = Length in Meters

3.2 Justification

For radiated emission measurements the EUT is placed on a non-conductive table. The EUT was configured to continuously transmit.

Evaluation for spurious emissions of pre-certified radio module installed inside Host equipment was performed. Radio module FCC ID: SH6MDBT50Q. See Appendix A for test data and setup photos.

3.3 Software Exercise Program

None

3.4 Mode of Operation during test

The MX Mortise was set up to continuously transmitting at 13.56MHz. In addition, during tests the EUT was paired and exercised with cell phone for BLE connection.

3.5 Modifications required for Compliance

No modifications were made by the manufacturer to bring the EUT into compliance.

3.6 Additions, deviations and exclusions from standards

No additions, deviations or exclusion have been made from standard.

4.0 Measurement Results

4.1 Field Strength of Fundamental and Radiated Emissions Outside the band

4.1.1 Requirements

FCC Rules 15.225, 15.209

a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter (84 dBuV) at 30 meters.

b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

§15.209 Radiated emission limits; general requirements.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

4.1.2 Procedure

Radiated Measurements Below 30 MHz

During the test the EUT is rotated and the measuring antenna angles are varied during the search for maximum signal level.

Radiated emissions are taken at ten meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Measurements for below 30 MHz were made at 10 meters. Data results below are corrected for distance back to 30 meters.

Radiated Measurements Above 30 MHz

During the test the EUT is rotated and the measuring antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at ten meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Measurements for above 30 MHz were made at 10 meters.

Radiated emission measurements were performed from 9kHz to 1 GHz.
Analyzer resolution is:

200Hz or greater for 9kHz to 150kHz
9 kHz or greater for 150kHz to 30 MHz
120 kHz or greater for 30MHz to 1000 MHz
For those frequencies quasi-peak detector applies

Data includes of the worst-case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

Field Strength 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 is as follows:

FS = RA + AF + CF – AG – DCF

Where FS = Field Strength in dB (μV/m)

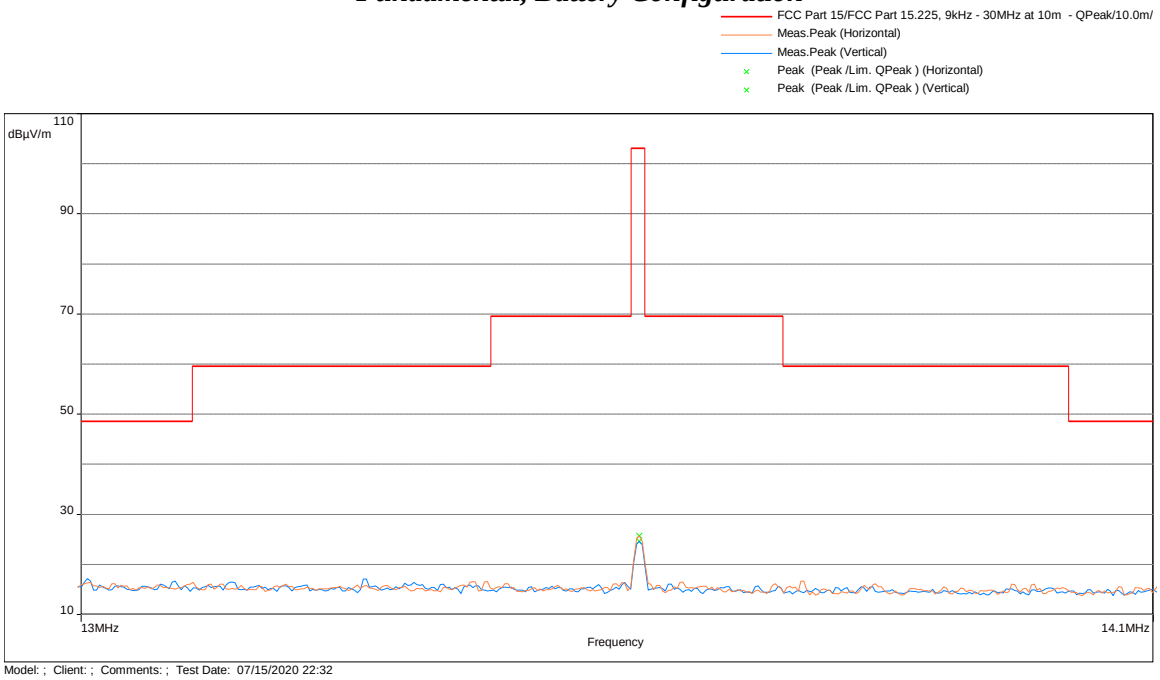
RA = Receiver Amplitude (including preamplifier) in dB (μV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB (1/m)
AG = Amplifier Gain in dB
DCF = Distance Correction Factor

Note: FS was measured with loop antenna below 30MHz

4.1.3 Test Result 15.225 (a)(b)(c)

The data below shows the significant emission frequencies, the limit and the margin of compliance.
Note: Measurements were performed at parallel and perpendicular orientation of loop antenna. The worst-case data was presented below.

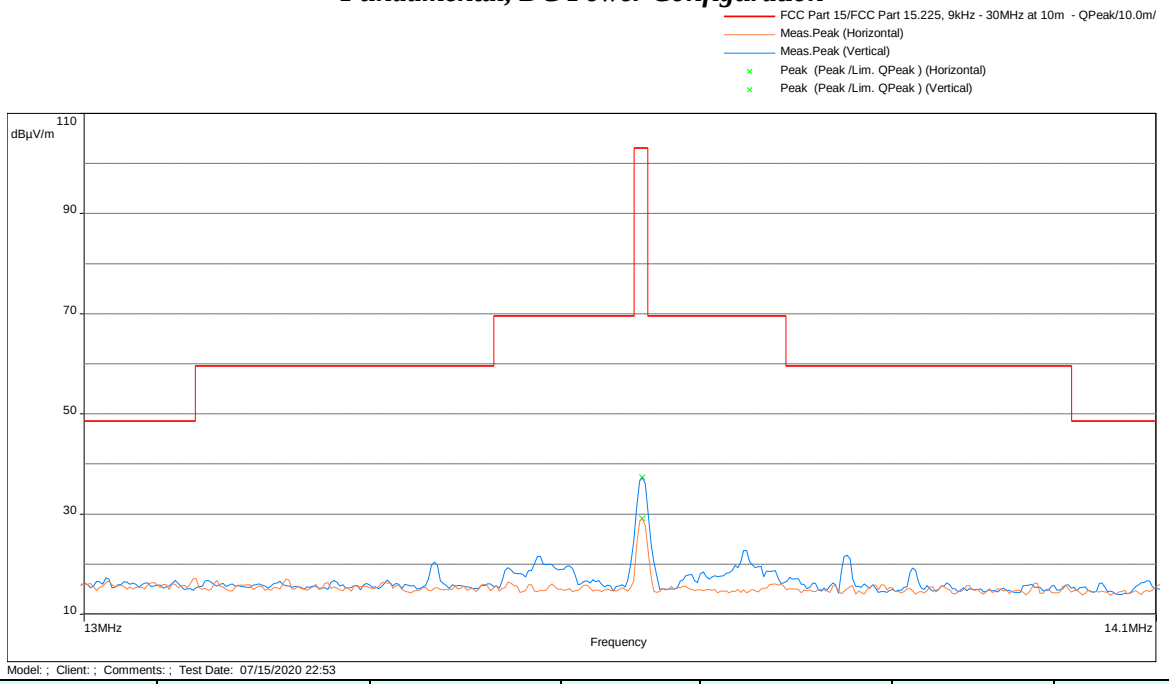
Fundamental, Battery Configuration



Frequency (MHz)	Peak FS@10m dB(uV/m)	Limit@10m dB(uV/m)	Margin dB	Polarity	RA@10m dB(uV)	Correction dB
13.56	25.7	103.1	-77.4	Parallel	23.0	2.7
13.56	24.6	103.1	-78.5	Perpendicular	21.9	2.7

Note: Correction = AF+CF–AG–distance correction factor
Distance correction factor=40*log10(limit distance/measured distance)

Fundamental, DC Power Configuration

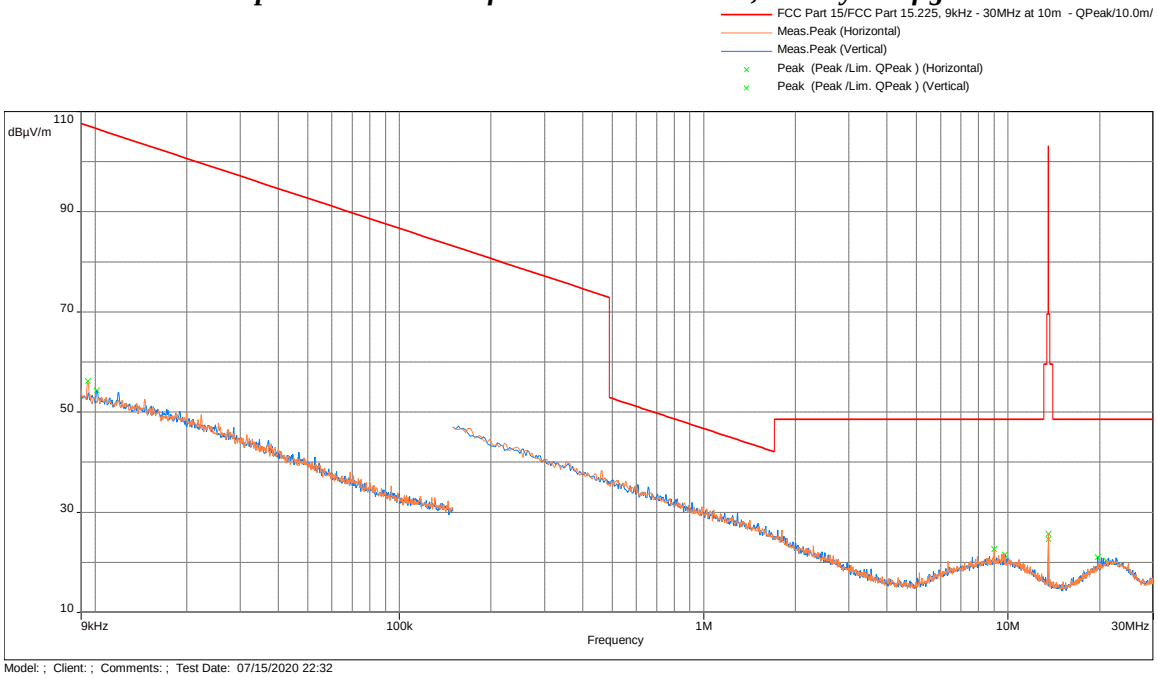


Frequency (MHz)	Peak FS@10m dB(uV/m)	Limit@10m dB(uV/m)	Margin dB	Polarity	RA@10m dB(uV)	Correction dB
13.56	29.1	103.1	-74.0	Parallel	26.5	2.7
13.56	37.3	103.1	-65.8	Perpendicular	34.7	2.7

Note: Correction = AF+CF–AG- distance correction factor
Distance correction factor=40*log10(limit distance/measured distance)

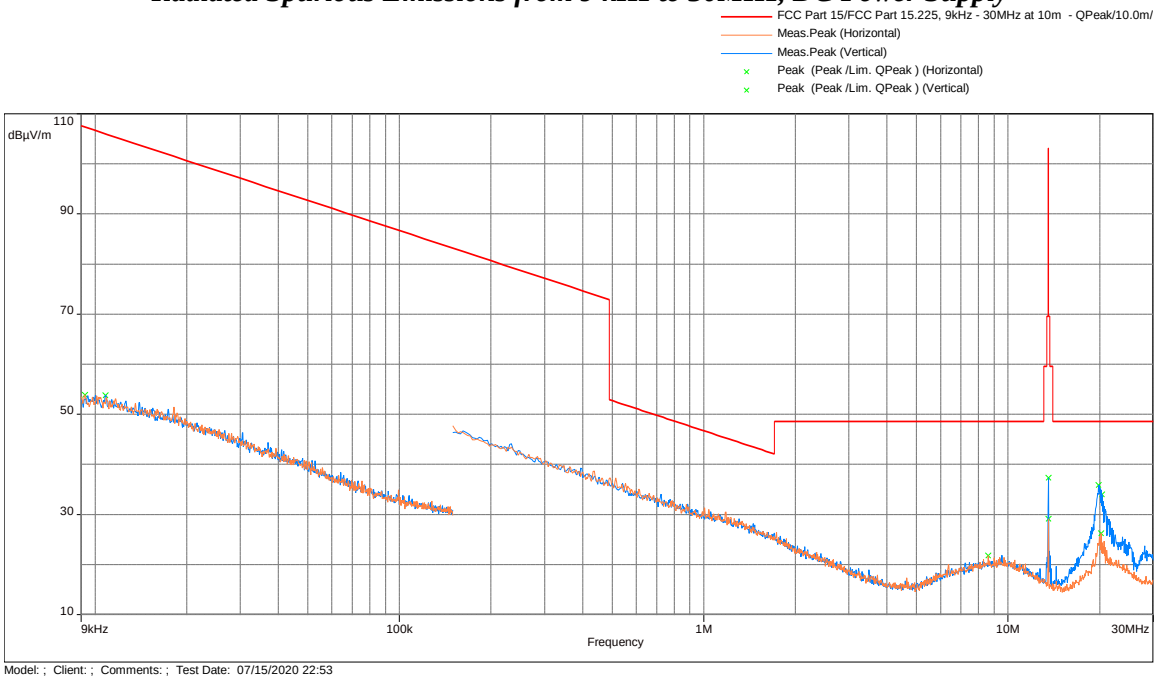
4.1.4 Test Result 15.225 (d) and 15.209

Radiated Spurious Emissions from 9 kHz to 30MHz, Battery Configuration



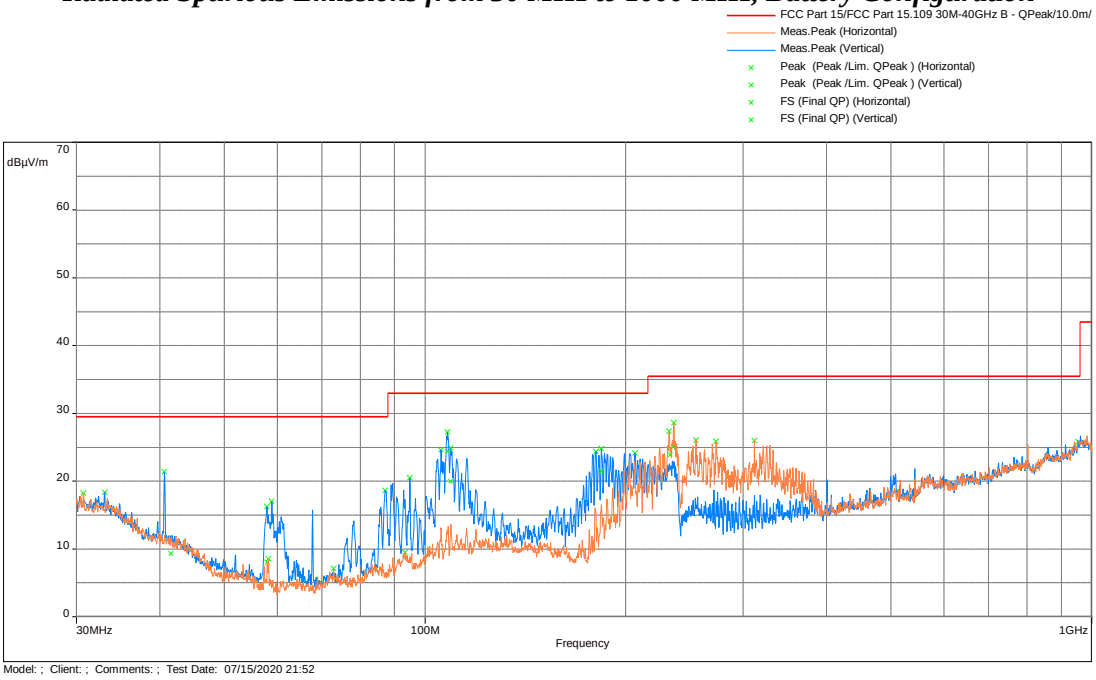
Model: ; Client: ; Comments: ; Test Date: 07/15/2020 22:32

Radiated Spurious Emissions from 9 kHz to 30MHz, DC Power Supply



Model: ; Client: ; Comments: ; Test Date: 07/15/2020 22:53

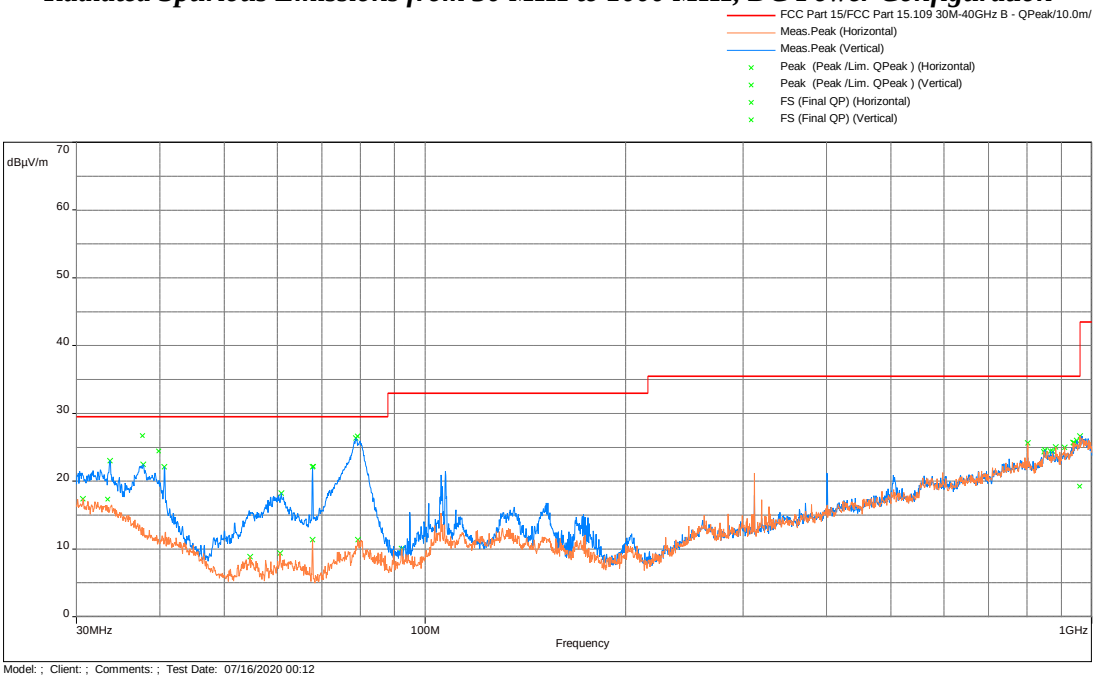
Radiated Spurious Emissions from 30 MHz to 1000 MHz, Battery Configuration



Freq (MHz)	FS @10m dB(uV/m)	Limit@10m dB(uV/m)	Margin (dB)	Azimuth (Deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
41.530	9.3	29.5	-20.2	148.5	3.6	Vertical	23.6	-14.7
108.298	24.4	33	-8.6	306.75	1.06	Vertical	40.9	-16.4
109.199	20.0	33	-13.0	335.25	1.16	Vertical	36.3	-16.3
183.803	21.4	33	-11.6	357	1	Vertical	39.3	-17.9
233.104	23.9	35.5	-11.6	31	3.92	Horizontal	40.0	-16.1
235.856	25.1	35.5	-10.4	40.75	3.64	Horizontal	40.9	-15.8

Note: FS = RA + Correction
Correction = AF + CF – Preamp

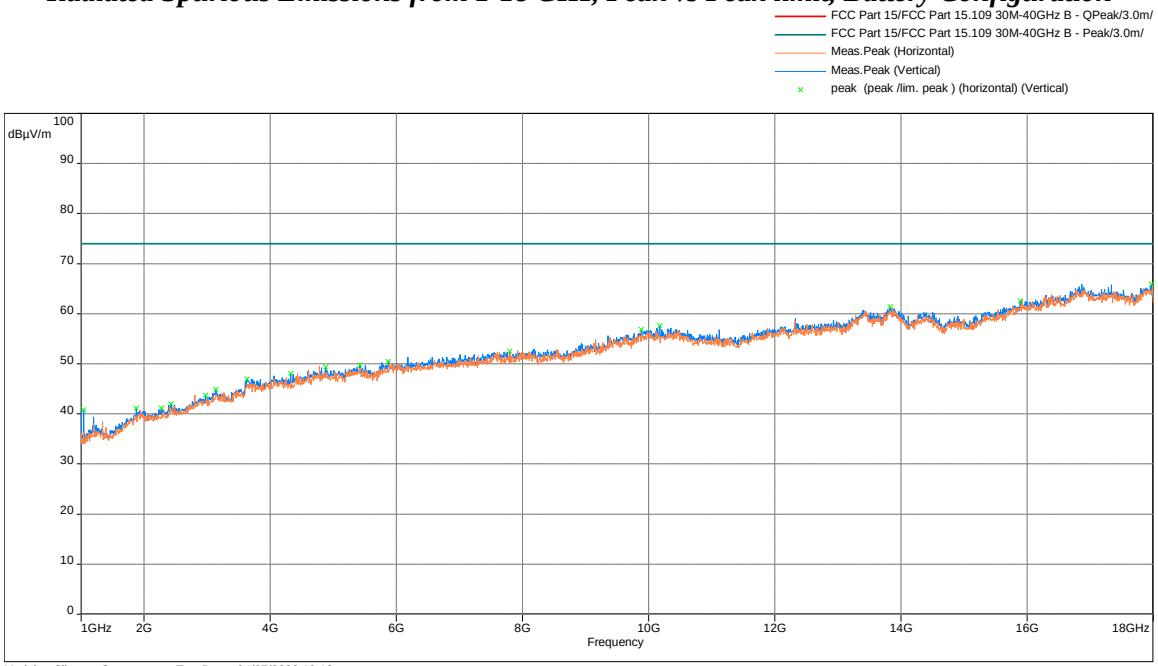
Radiated Spurious Emissions from 30 MHz to 1000 MHz, DC Power Configuration



Freq (MHz)	FS @10m dB(uV/m)	Limit@10m dB(uV/m)	Margin (dB)	Azimuth (Deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
33.387	17.3	29.5	-12.2	133.25	1	Vertical	27.9	-10.4
37.682	26.7	29.5	-2.8	164.5	1	Vertical	39.4	-12.7
39.843	24.5	29.5	-5.1	182.25	2.18	Vertical	38.7	-13.8
67.998	22.2	29.5	-7.3	195	2.1	Vertical	43.4	-21.2
79.205	26.6	29.5	-2.9	33.75	1.39	Vertical	46.7	-20.0
959.195	19.3	35.5	-16.2	89.75	1.74	Horizon tal	17.2	2.1

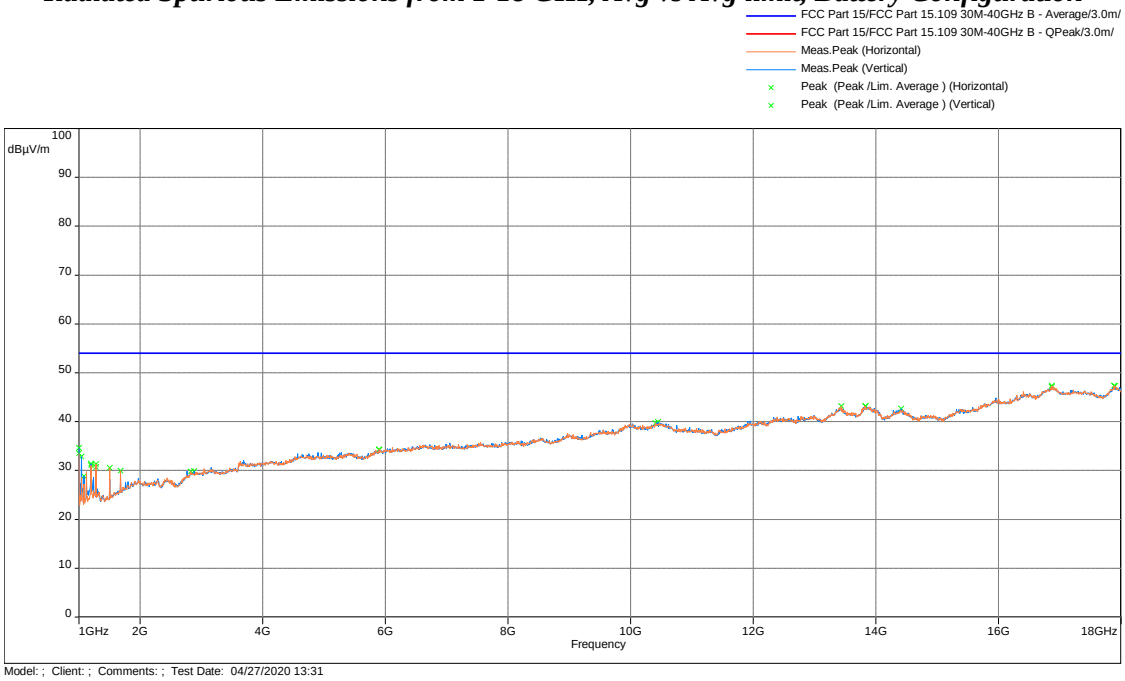
Note: FS = RA + Correction
Correction = AF + CF – Preamp

Radiated Spurious Emissions from 1-18 GHz, Peak vs Peak limit, Battery Configuration



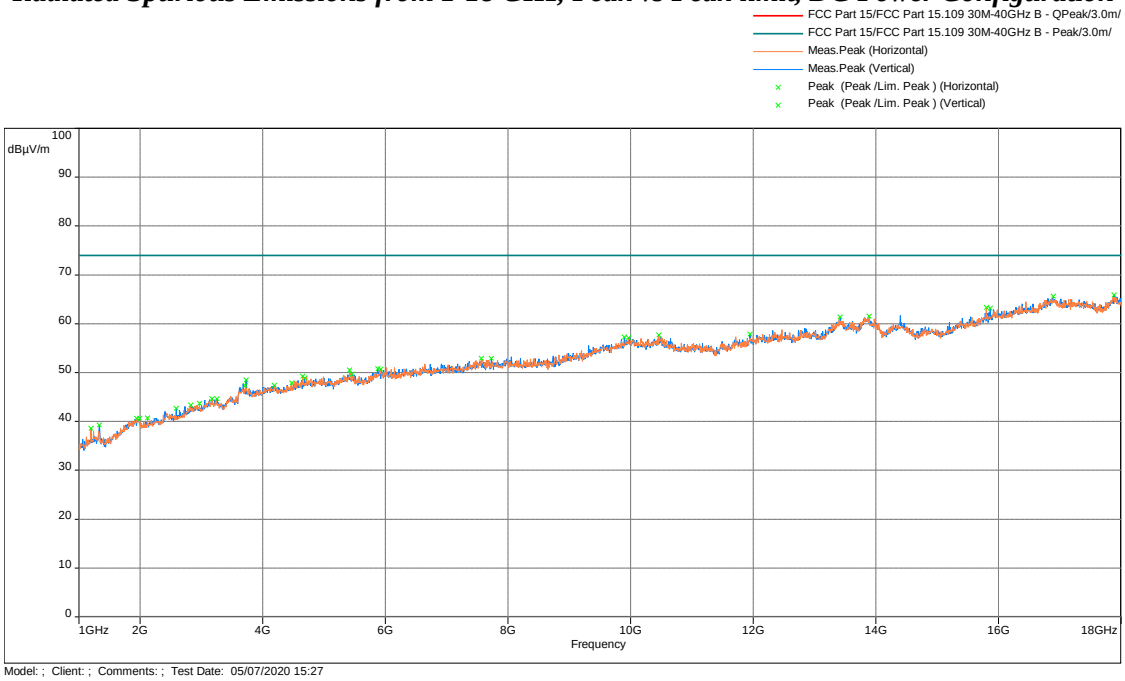
Model: ; Client: ; Comments: ; Test Date: 04/27/2020 13:16

Radiated Spurious Emissions from 1-18 GHz, Avg vs Avg limit, Battery Configuration

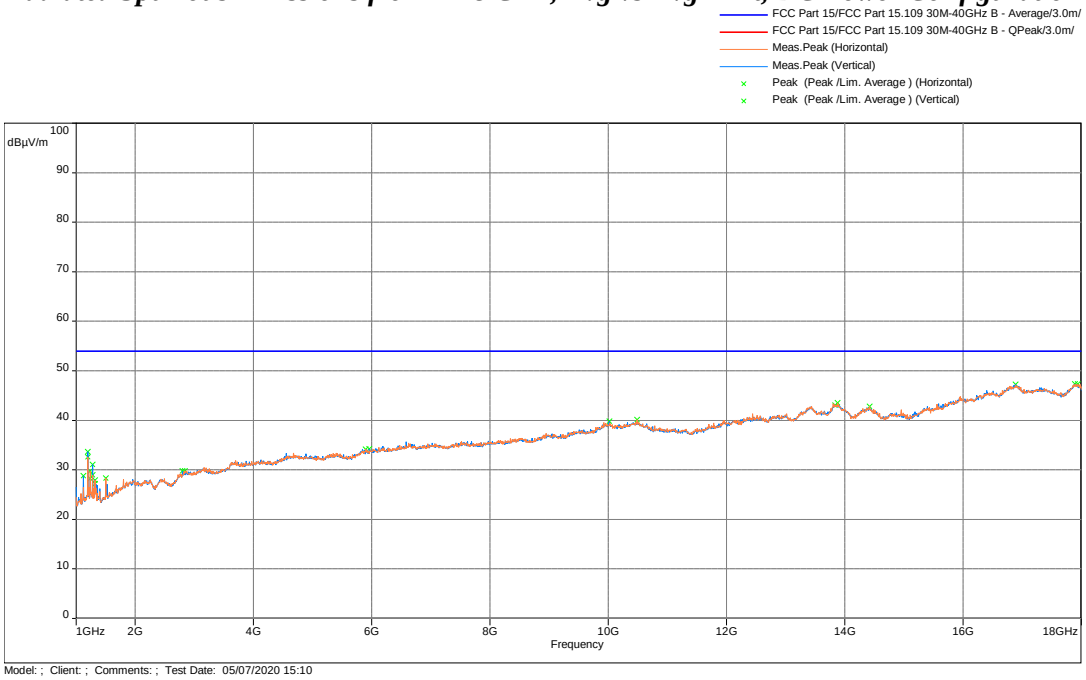


Model: ; Client: ; Comments: ; Test Date: 04/27/2020 13:31

Radiated Spurious Emissions from 1-18 GHz, Peak vs Peak limit, DC Power Configuration



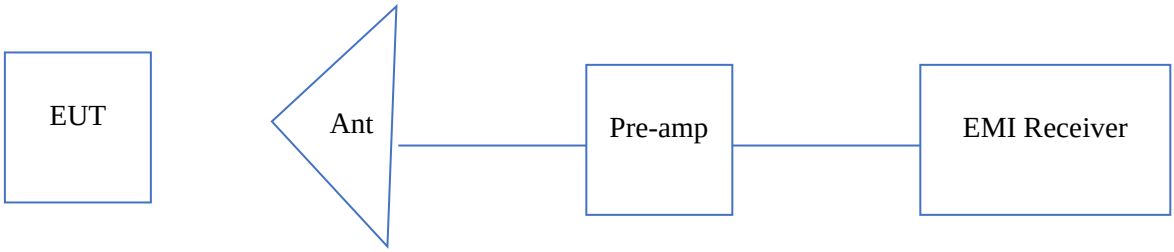
Radiated Spurious Emissions from 1-18 GHz, Avg vs Avg limit, DC Power Configuration



Result	**Complies** by 2.8 dB

4.1.5 Test Configuration Photographs

The following photographs show the testing configurations used.



4.2 Frequency Tolerance

4.2.1 Requirement
FCC 15.225 (e)

The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

4.2.2 Procedure

The EUT was placed in the temperature chamber. The frequency counter was connected to the transmitter output. For each temperature, the carrier frequency was recorded. In addition, the carrier frequency was recorded when the power was set to 13.8 V DC (115% of 12V DC) and to 10.2 V DC (85% of 12V DC).

4.2.3 Test Results 15.225 (e)

Nominal Frequency: 13561437 Hz

Voltage (DC)	Temperature (C)	Measured Frequency (Hz)	Deviation from Reference (Hz)	Deviation (%)
12	-20	13561445	8	5.9E-05
12	-10	13561439	2	1.47E-05
12	0	13561457	19.5	0.000144
12	10	13561462	25	0.000184
12	20	13561437	0	0
12	30	13561452	15	0.000111
12	40	13561434	-3.5	-2.6E-05
12	50	13561415	-22	-0.00016
10.2	20	13561438.5	1.5	1.1061E-05
13.8	20	13561439	2	1.4748E-05

4.3 Occupied Bandwidth
FCC 15.215

4.3.1 Requirements

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

4.3.2 Procedure

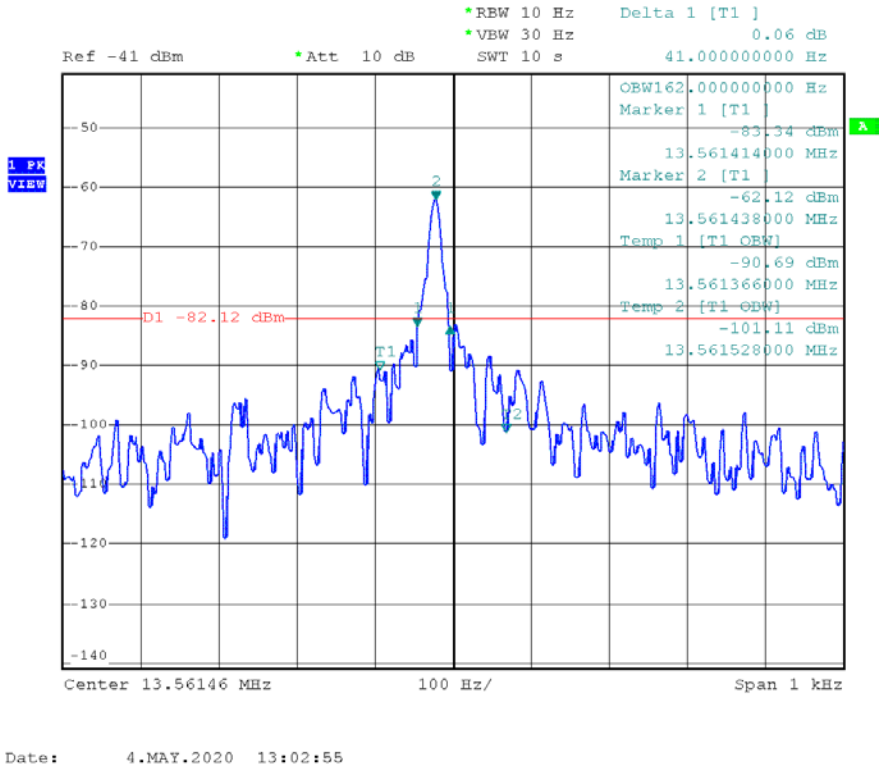
The EUT was setup to transmit in normal operating condition.

Measurements were made with the loop antenna in close proximity of the EUT. Following the procedures of ANSI 63.10: 2013, the 20dB bandwidth measurements were taken. The following plots show Occupied Bandwidth.

4.3.3 Test Results

Frequency (MHz)	-20 dB Channel Bandwidth (Hz)	99% Channel Bandwidth (Hz)
13.56	41.0	162.0

-20dB & 99% Channel Bandwidth Plot



4.4 AC Line Conducted Emission
FCC Rule 15.207, FCC 15.107

4.4.1 Requirement

Frequency Band MHz	Class B Limit dB(μV)		Class A Limit dB(μV)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15-0.50	66 to 56 *	56 to 46 *	79	66
0.50-5.00	56	46	73	60
5.00-30.00	60	50	73	60

*Note: *Decreases linearly with the logarithm of the frequency. At the transition frequency the lower limit applies.*

4.4.2 Procedure

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

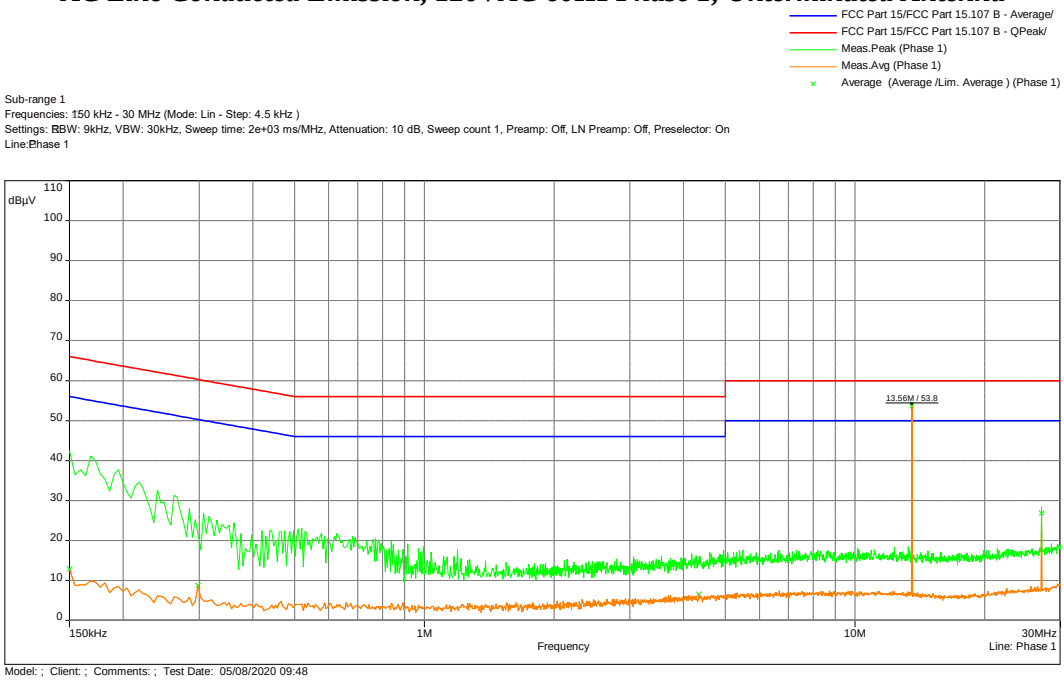
Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

EUT was placed in transmission mode then tested for conducted emissions per ANSI C63.10: 2013, ANSI C63.4-2014 to ensure the device complies with 15.207 & 15.107.

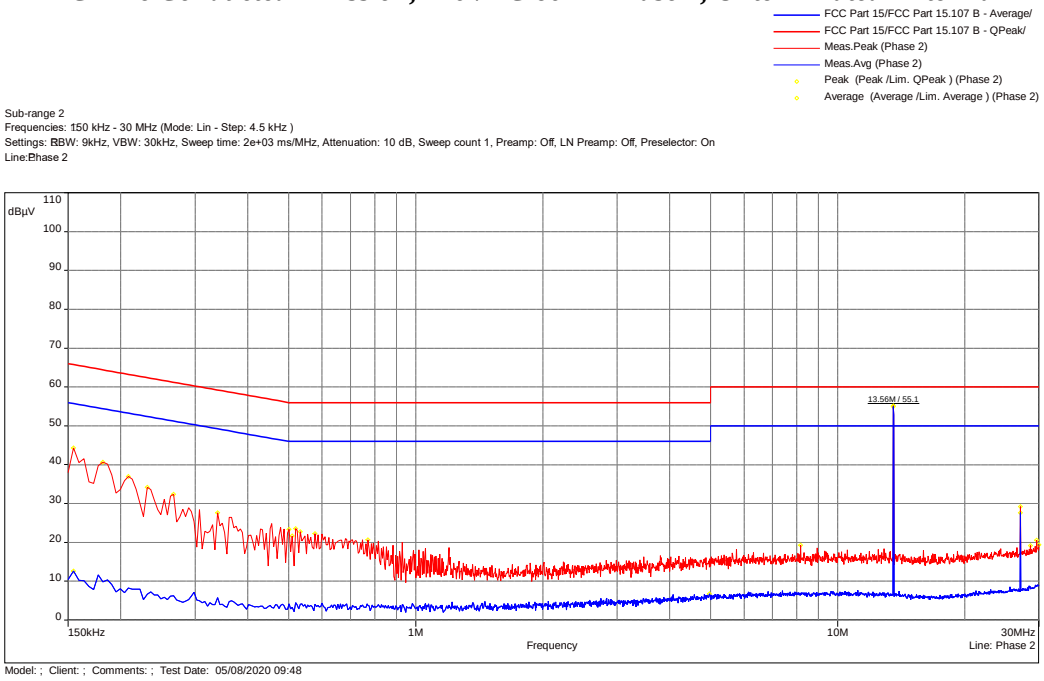
4.4.3 Test Result

15.107 & 15.207

AC Line Conducted Emission, 120VAC 60Hz Phase 1, Unterminated Antenna



AC Line Conducted Emission, 120VAC 60Hz Phase 2, Unterminated Antenna



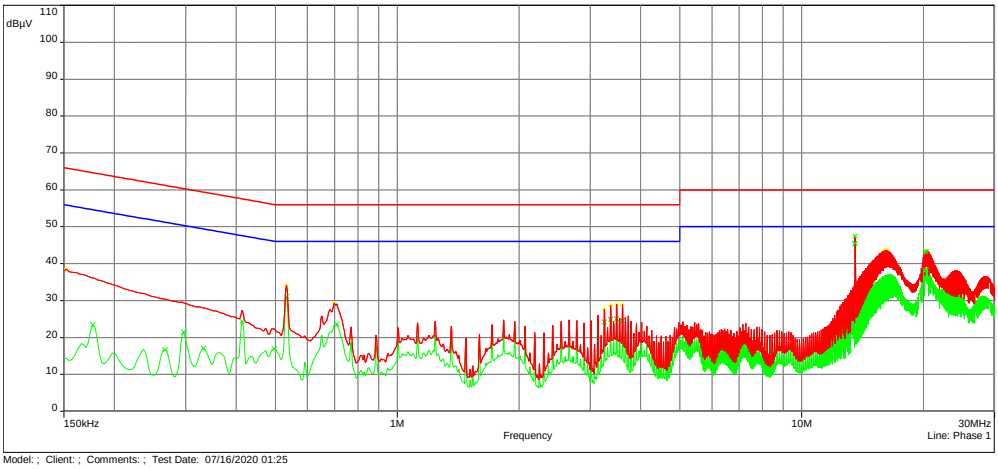
Frequency (MHz)	QPeak (dBµV)	Lim. QPeak (dBµV)	Margin (dB)	Comment	Correction (dB)
0.150	42.5	66	-23.5	Phase 1	10.7
0.155	44.3	65.75	-21.5	Phase 2	10.7
0.168	41.2	65.06	-23.9	Phase 1	10.7
0.182	40.7	64.42	-23.7	Phase 2	10.6
0.195	37.7	63.82	-26.1	Phase 1	10.6
0.209	36.9	63.26	-26.3	Phase 2	10.5
0.218	34.6	62.91	-28.3	Phase 1	10.5
0.231	34.2	62.41	-28.2	Phase 2	10.5
0.240	32.7	62.1	-29.4	Phase 1	10.5
0.263	31.3	61.35	-30.0	Phase 1	10.5
0.267	32.4	61.21	-28.8	Phase 2	10.5
0.339	27.7	59.23	-31.6	Phase 2	10.4
0.501	23.4	56	-32.6	Phase 2	10.3
0.510	23.0	56	-33.0	Phase 1	10.3
0.510	21.7	56	-34.3	Phase 2	10.3
0.519	23.2	56	-32.9	Phase 1	10.4
0.519	23.5	56	-32.5	Phase 2	10.4
0.528	22.2	56	-33.8	Phase 1	10.4
0.533	22.8	56	-33.2	Phase 2	10.4
0.578	21.8	56	-34.2	Phase 1	10.4
0.578	22.2	56	-33.8	Phase 2	10.4
0.627	21.7	56	-34.3	Phase 1	10.3
0.771	20.7	56	-35.3	Phase 2	10.4
0.771	20.5	56	-35.5	Phase 1	10.4
8.169	19.3	60	-40.7	Phase 2	10.6
27.123	28.4	60	-31.6	Phase 1	10.6
27.123	29.2	60	-30.8	Phase 2	10.6
28.590	19.2	60	-40.8	Phase 1	10.6
28.662	19.2	60	-40.8	Phase 2	10.6
29.540	19.1	60	-40.9	Phase 1	10.6
29.630	20.6	60	-39.4	Phase 2	10.6
29.711	18.7	60	-41.3	Phase 1	10.6
29.913	18.9	60	-41.1	Phase 1	10.6
30.000	19.4	60	-40.6	Phase 2	10.6

Frequency (MHz)	Avg (dBµV)	Lim. Avg (dBµV)	Margin (dB)	Comment	Correction (dB)
0.150	12.9	56	-43.1	Phase 1	10.7
0.155	12.7	55.75	-43.1	Phase 2	10.7
0.299	8.8	50.28	-41.5	Phase 1	10.4
4.344	6.5	46	-39.5	Phase 1	10.5
4.965	6.7	46	-39.3	Phase 2	10.5
27.123	26.8	50	-23.2	Phase 1	10.6
27.123	27.7	50	-22.3	Phase 2	10.6

AC Line Conducted Emission, 120VAC 60Hz Phase 1, Terminated Antenna

CISPR Limit/CISPR Limit B - Average/
CISPR Limit/CISPR Limit B - QPeak/
Meas.QPeak (Phase 1)
Mes. CISPR AVG (Phase 1)
QPeak (QPeak /Lim. QPeak) (Phase 1)
CISPR AVG (CISPR AVG /Lim. Average) (Phase 1)
Ave Level (dBuV) (Final QP and Ave) (Phase 1)
QP Level (dBuV) (Final QP and Ave) (Phase 1)

Sub-range 1
Frequencies: 150 kHz - 30 MHz (Mode: - Step: 2.25 kHz)
Settings: RBW: 9kHz, VBW: 30kHz, Sweep time: 1e+03 ms, Attenuation: 10 dB, Sweep count 3, Preamp: Off, LN Preamp: Off, Preselector: On
Line:Phase 1

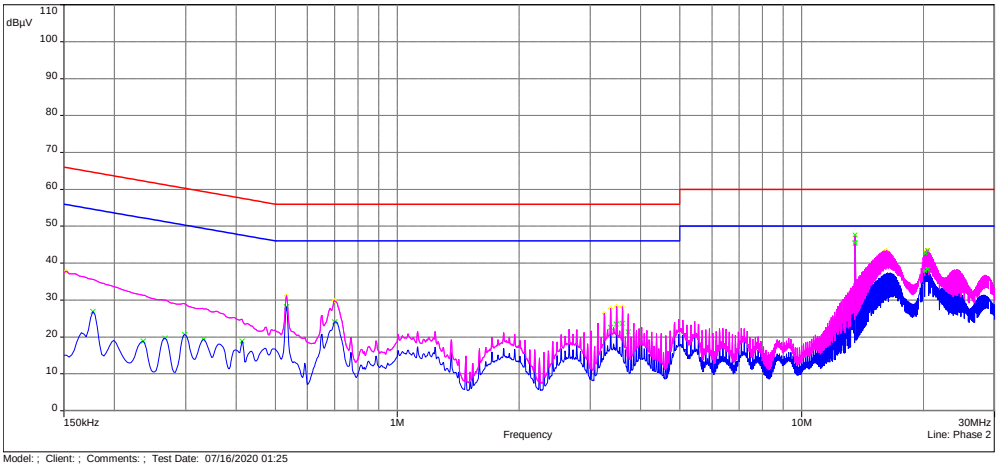


Model: ; Client: ; Comments: ; Test Date: 07/16/2020 01:25

AC Line Conducted Emission, 120VAC 60Hz Phase 2, Terminated Antenna

CISPR Limit/CISPR Limit B - Average/
CISPR Limit/CISPR Limit B - QPeak/
Meas.QPeak (Phase 2)
Mes. CISPR AVG (Phase 2)
QPeak (QPeak /Lim. QPeak) (Phase 2)
CISPR AVG (CISPR AVG /Lim. Average) (Phase 2)
Ave Level (dBuV) (Final QP and Ave) (Phase 2)
QP Level (dBuV) (Final QP and Ave) (Phase 2)

Sub-range 2
Frequencies: 150 kHz - 30 MHz (Mode: - Step: 2.25 kHz)
Settings: RBW: 9kHz, VBW: 30kHz, Sweep time: 1e+03 ms, Attenuation: 10 dB, Sweep count 1, Preamp: Off, LN Preamp: Off, Preselector: On
Line:Phase 2



Model: ; Client: ; Comments: ; Test Date: 07/16/2020 01:25

Frequency (MHz)	Ave Level (dBµV)	QP Level (dBµV)	Ave Limit (dBµV)	QP Limit (dBµV)	Ave Margin (dB)	QP Margin (dB)	Line	Correction (dB)
13.562	45.5	47.5	50	60	-4.5	-12.5	Phase 1	11.3
20.224	38.2	43.2	50	60	-11.8	-16.9	Phase 1	11.4
20.342	38.3	43.3	50	60	-11.7	-16.7	Phase 1	11.4
13.561	45.6	47.6	50	60	-4.4	-12.4	Phase 2	11.3
20.226	37.9	42.7	50	60	-12.1	-17.3	Phase 2	11.5
20.462	38.3	43.4	50	60	-11.7	-16.6	Phase 2	11.5

Result	**Complies** by 4.4 dB

4.5 Radiated Emissions on Digital Parts

FCC Ref: 15.109, ICES 003, RSS Gen

4.5.1 Test Limit

Limits for Electromagnetic Radiated Emissions FCC Section 15.109(b), ICES 003*, RSS GEN

Frequency (MHz)	**Class A at 10m dB(µV/m)**	**Class B at 3m dB(µV/m)**
30-88	39	40.0
88-216	43.5	43.5
216-960	46.4	46.0
Above 960	49.5	54.0

* According to FCC Part 15.109(g) an alternative to the radiated emission limits shown above, digital devices may be shown to comply with the limit of CISPR Pub. 22

4.5.2 Procedures

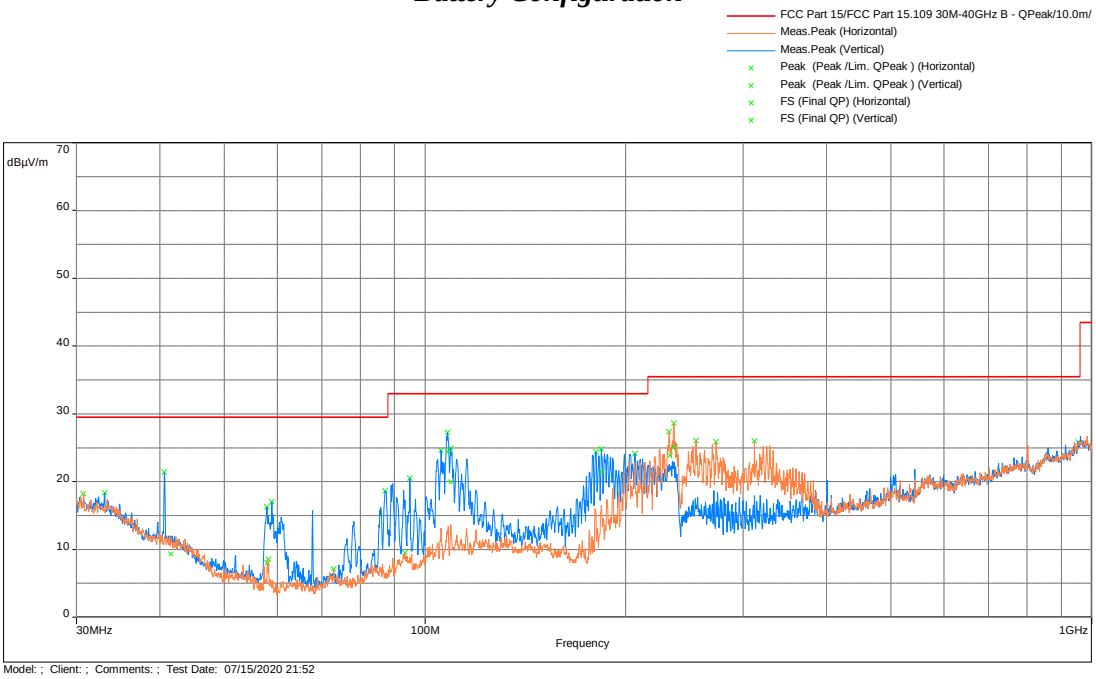
Radiated measurements were taken. 120 kHz resolution bandwidth was used from 30 MHz - 1 GHz. 1 MHz resolution bandwidth was used for measurements done above 1 GHz. All plots are corrected for cable loss, antenna factor, and preamp.

Radiated emission measurements were performed from 30 MHz to 18000 MHz. The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

Measurements recorded in this section were made with the Transmitter in Tx mode.

4.5.3 Test Results

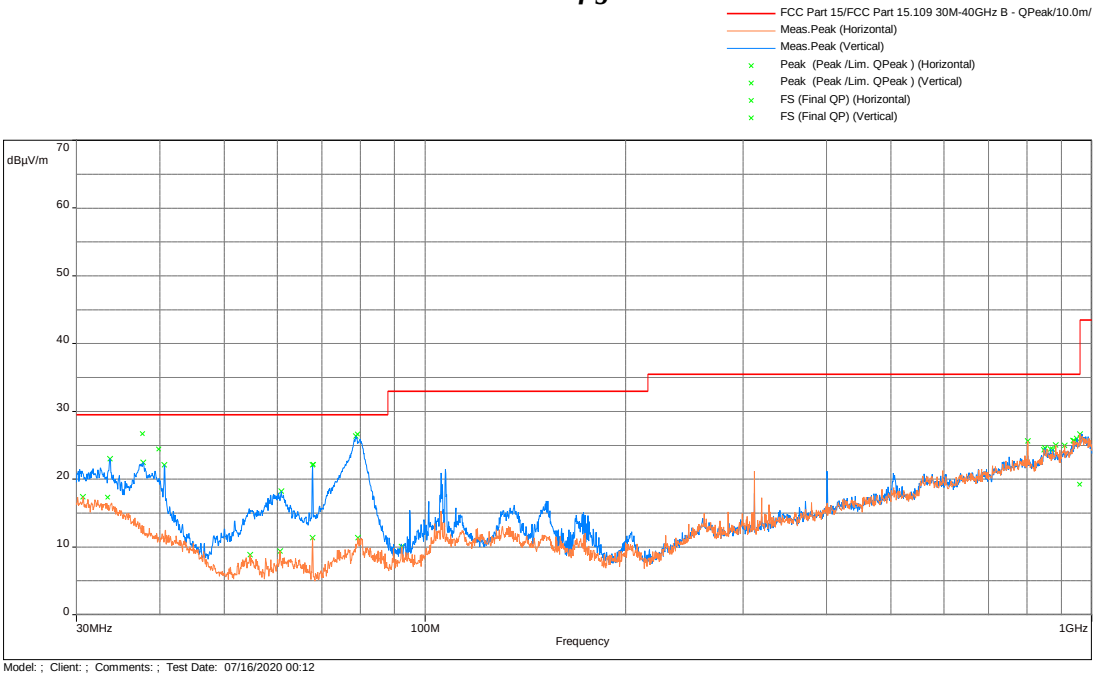
FCC Part 15 Subpart B and ICES-003, Radiated Disturbance, 30 MHz to 1000 MHz, Battery Configuration



Freq (MHz)	FS @10m dB(uV/m)	Limit dB(uV/m)	Margin (dB)	Azimuth (Deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
41.530	9.3	29.5	-20.2	148.5	3.6	Vertical	23.6	-14.7
108.298	24.4	33	-8.6	306.75	1.06	Vertical	40.9	-16.4
109.199	20.0	33	-13.0	335.25	1.16	Vertical	36.3	-16.3
183.803	21.4	33	-11.6	357	1	Vertical	39.3	-17.9
233.104	23.9	35.5	-11.6	31	3.92	Horizontal	40.0	-16.1
235.856	25.1	35.5	-10.4	40.75	3.64	Horizontal	40.9	-15.8

Note: FS = RA + Correction
Correction = AF + CF – Preamp

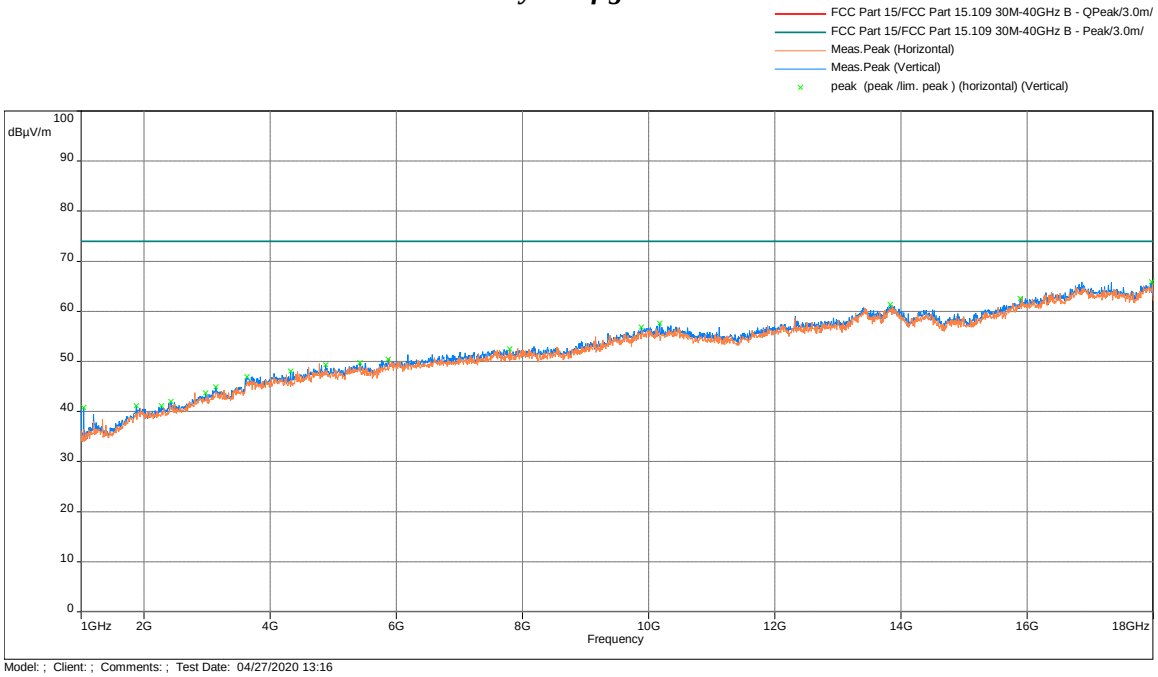
FCC Part 15 Subpart B and ICES-003, Radiated Disturbance, 30 MHz to 1000 MHz, DC Power Configuration



Freq (MHz)	FS @10m dB(uV/m)	Limit dB(uV/m)	Margin (dB)	Azimuth (Deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
33.387	17.3	29.5	-12.2	133.25	1	Vertical	27.9	-10.4
37.682	26.7	29.5	-2.8	164.5	1	Vertical	39.4	-12.7
39.843	24.5	29.5	-5.1	182.25	2.18	Vertical	38.7	-13.8
67.998	22.2	29.5	-7.3	195	2.1	Vertical	43.4	-21.2
79.205	26.6	29.5	-2.9	33.75	1.39	Vertical	46.7	-20.0
959.195	19.3	35.5	-16.2	89.75	1.74	Horizontal	17.2	2.1

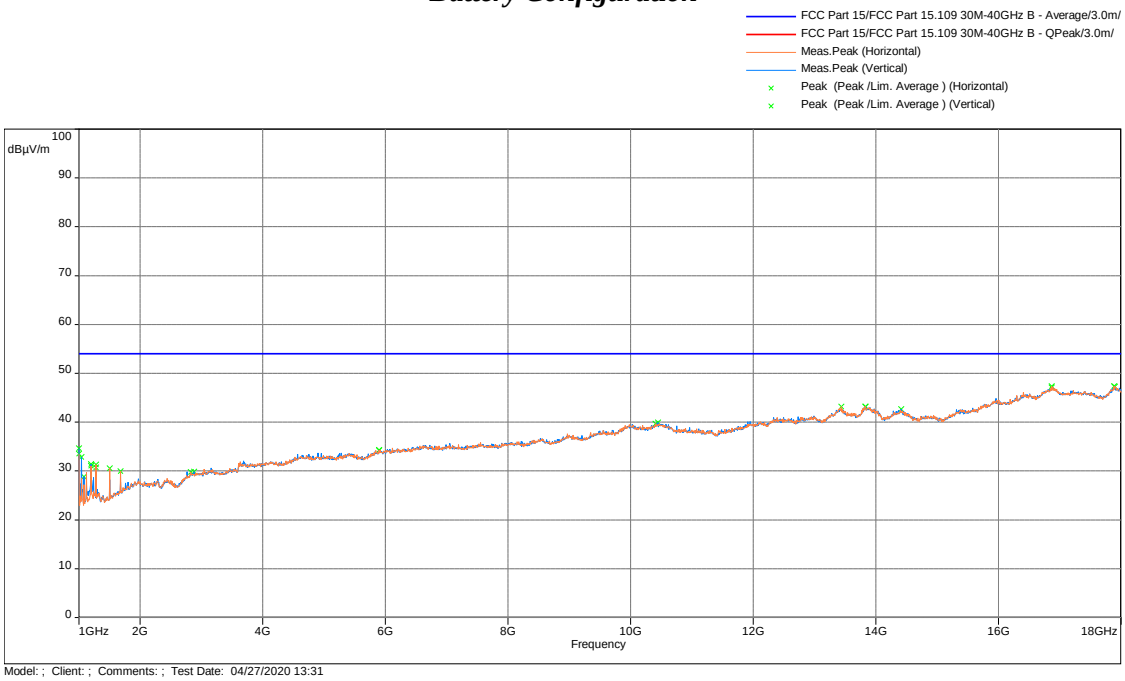
Note: FS = RA + Correction
Correction = AF + CF – Preamp

FCC Part 15 Subpart B and ICES-003, Radiated Disturbance, 1-18 GHz, Peak vs Peak limit, Battery Configuration



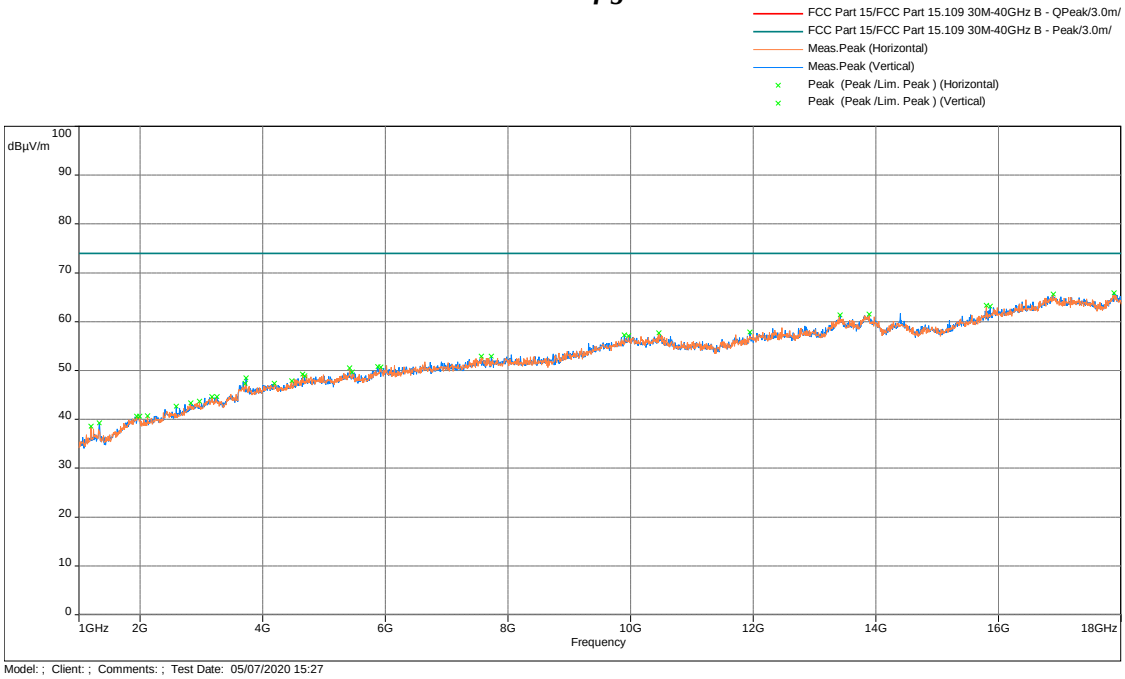
Model: ; Client: ; Comments: ; Test Date: 04/27/2020 13:16

FCC Part 15 Subpart B and ICES-003, Radiated Disturbance, from 1-18 GHz, Avg vs Avg limit, Battery Configuration



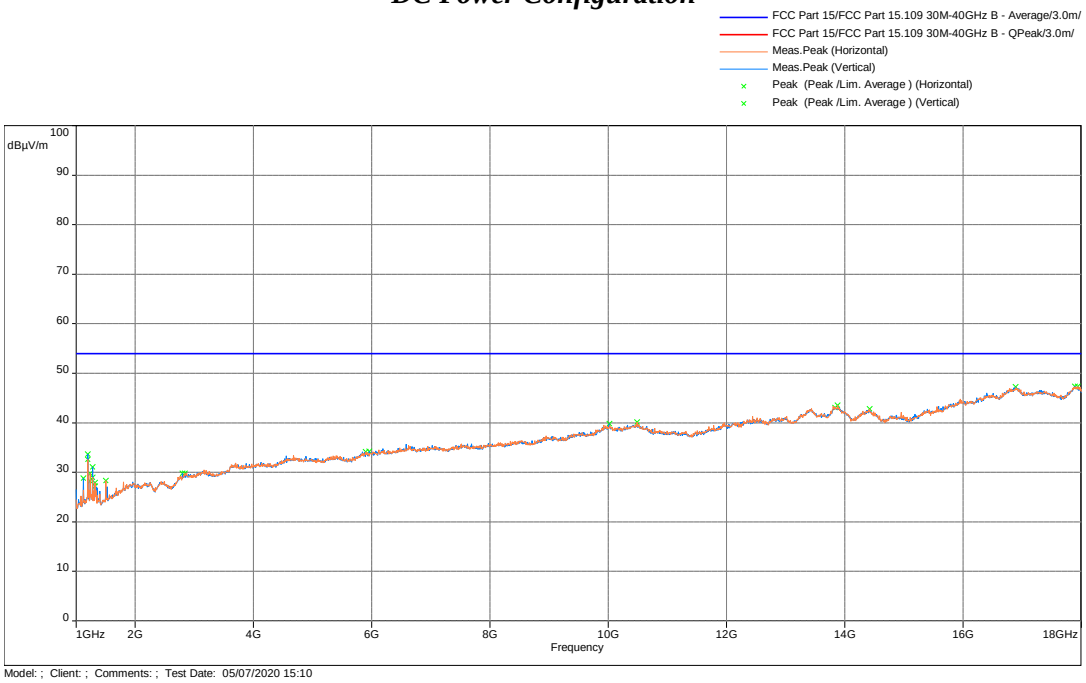
Model: ; Client: ; Comments: ; Test Date: 04/27/2020 13:31

FCC Part 15 Subpart B and ICES-003, Radiated Disturbance, 1-18 GHz, Peak vs Peak limit, DC Power Configuration



Model: ; Client: ; Comments: ; Test Date: 05/07/2020 15:27

FCC Part 15 Subpart B and ICES-003, Radiated Disturbance, 1-18 GHz, Avg vs Avg limit, DC Power Configuration

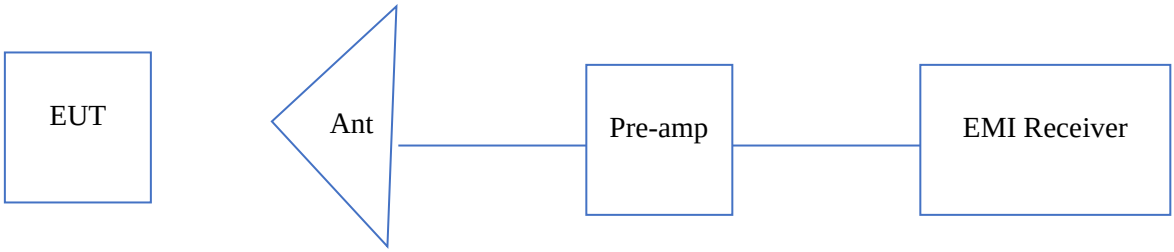


Model: ; Client: ; Comments: ; Test Date: 05/07/2020 15:10

Result	**Complies** by 2.8 dB

4.5.4 Test Configuration Photographs

The following photographs show the testing configurations used.



5.0 List of test equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Asset No.	Calibration	Cal Due
EMI Receiver	Rohde and Schwarz	ESR	ITS 01607	12	10/23/20
EMI Test Receiver	Rohde and Schwarz	ESU	ITS 01375	12	06/16/21
Spectrum Analyzer	Rohde and Schwarz	FSU	ITS 00913	12	03/26/21
Passive Loop Antenna	EMCO	6512	ITS 001598	12	10/22/20
Pre-Amplifier	Sonoma	310	ITS 00942	12	03/15/21
BI-Log Antenna	Antenna Research	LPB-2513	ITS 00355	12	04/24/21
Horn Antenna	ETS-Lindgren	3117-PA	ITS 01636	12	01/17/21
Horn Antenna	ETS Lindgren	3116C	ITS 01376	12	04/15/21
Pre-Amplifier	Miteq	TTA1840-35-S-M	ITS 01393	12	03/02/21
Notch Filter	Micro-Tronics	BRM50702	ITS 01166	12	05/14/21
Loop Sensor	Solar Electronics	7334-1	ITS 01608	12	10/09/20
RF Cable	Megaphase	EMC1-K1K1-236	ITS 01537	12	04/17/21
RF Cable	TRU Corporation	TRU CORE 300	ITS 01330	12	05/09/21
RF Cable	TRU Corporation	TRU CORE 300	ITS 00465	12	08/16/21
RF Cable	TRU Corporation	TRU CORE 300	ITS 01470	12	08/16/21
LISN	FCC	FCC-LISN-50-50-M-H	ITS 00551	12	11/13/20

Software used for emission compliance testing utilized the following:

Name	Manufacturer	Version	Template/Profile
BAT-EMC	Nexio	3.17.0.10	Proxess April 23 Radiated Emissions.bpp

6.0 Document History

Revision/ Job Number	Writer Initials	Reviewer Initials	Date	Change
1.0 / G104273165	TM	KV	July 30, 2020	Original document

7. Appendix A: Evaluation for spurious emissions of pre-certified radio module installed inside the host equipment per KDB 996369 D04.

A1.0 Radiated Emissions (ANSI C63.10)

A1.1 Method

Tests are performed in accordance with ANSI C63.10, FCC 47CFR PT 15.247.

TEST SITE: 10m ALSE

10m ALSE**:** The test facility is located at 1365 Adams Court, Menlo Park, California. The test site is a 10-meter semi-anechoic chamber. The site meets the characteristics of ANSI C63.10:2013. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters.
Above 1 GHz an antenna mast with boresight capabilities is used.

The A2LA certificate number for this site is 1755-01

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-200 MHz	4.7 dB	6.3 dB
Radiated Emissions, 10m	200-1000 MHz	4.6 dB	6.3 dB
Radiated Emissions, 3m	1-18 GHz	5.1 dB	5.2 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 32.

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 dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
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 dBμV 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 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

A1.2 Test Equipment Used:

See Section 5.0 for specific equipment used for this test

Software Utilized:

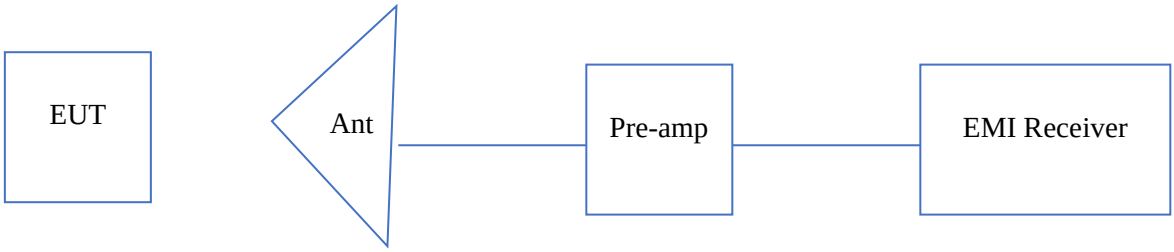
Name	Manufacturer	Version
BAT-EMC	NEXIO	3.19.1.19

A1.3 Result:

The sample tested was found to comply.

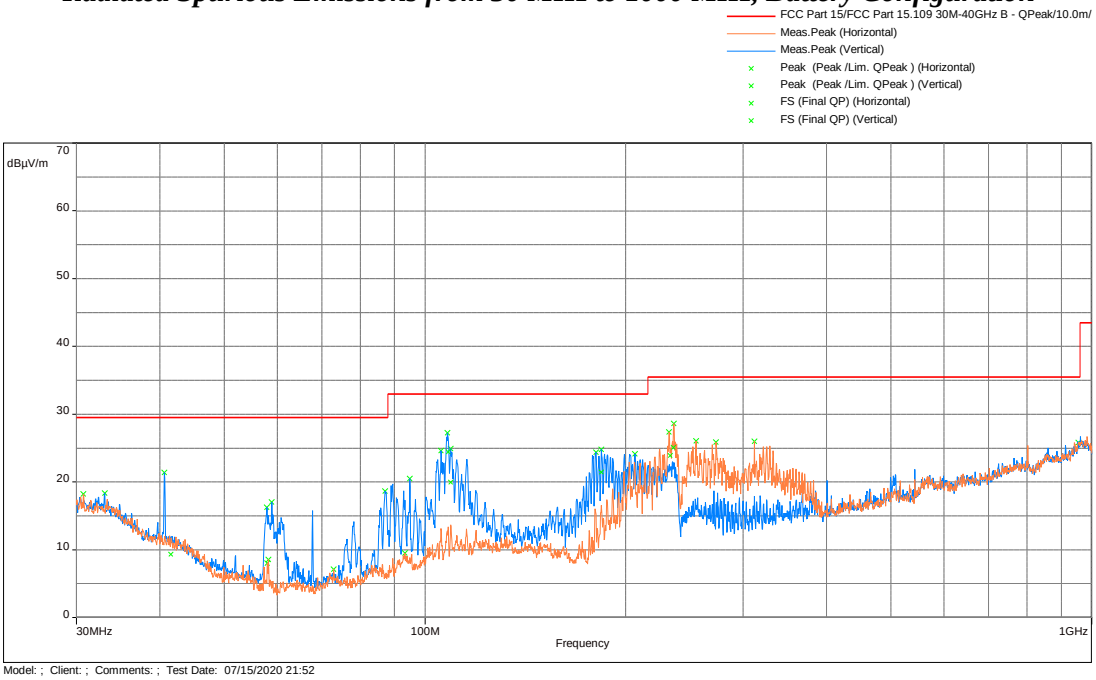
A1.4 Photographs:

The following photographs show the testing configurations used.



A1.5 Test Data

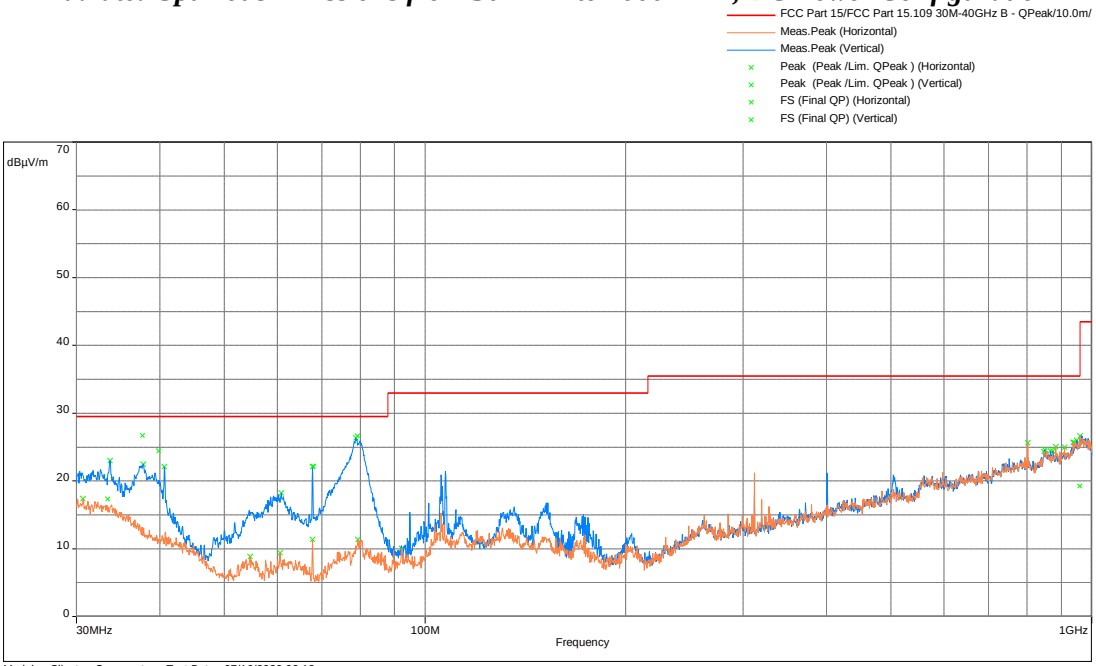
Radiated Spurious Emissions from 30 MHz to 1000 MHz, Battery Configuration



Freq (MHz)	FS @10m dB(uV/m)	Limit@10m dB(uV/m)	Margin (dB)	Azimuth (Deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
41.530	9.3	29.5	-20.2	148.5	3.6	Vertical	23.6	-14.7
108.298	24.4	33	-8.6	306.75	1.06	Vertical	40.9	-16.4
109.199	20.0	33	-13.0	335.25	1.16	Vertical	36.3	-16.3
183.803	21.4	33	-11.6	357	1	Vertical	39.3	-17.9
233.104	23.9	35.5	-11.6	31	3.92	Horizontal	40.0	-16.1
235.856	25.1	35.5	-10.4	40.75	3.64	Horizontal	40.9	-15.8

Note: FS = RA + Correction
Correction = AF + CF – Preamp

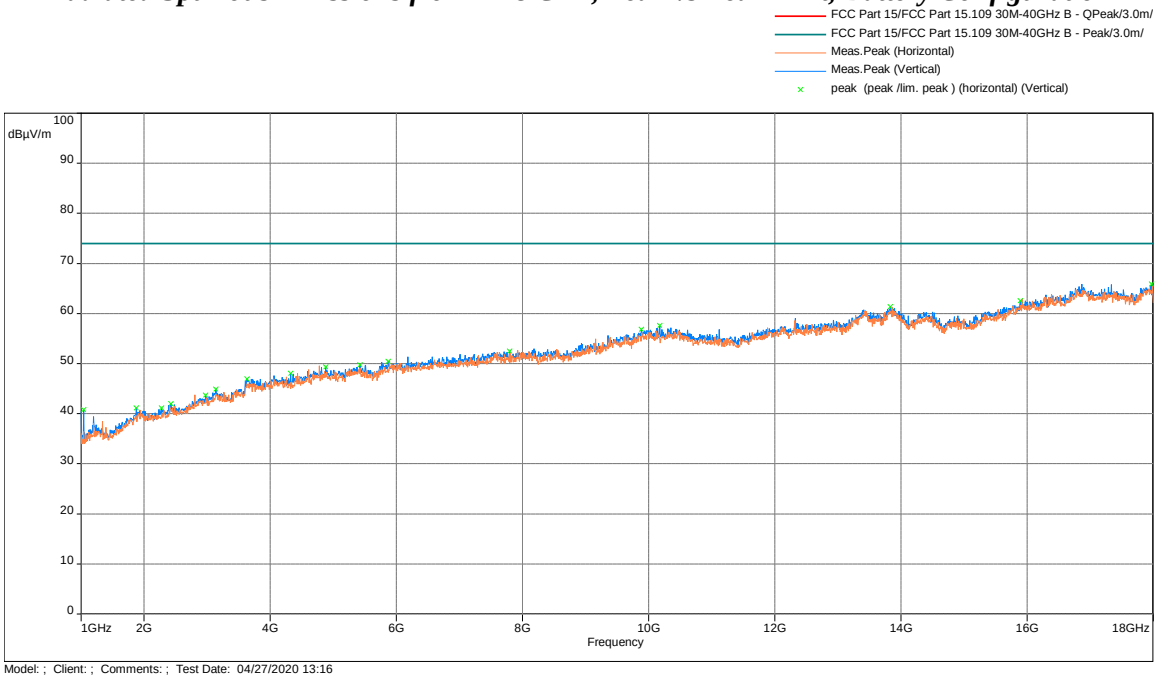
Radiated Spurious Emissions from 30 MHz to 1000 MHz, DC Power Configuration



Freq (MHz)	FS @10m dB(uV/m)	Limit@10m dB(uV/m)	Margin (dB)	Azimuth (Deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
33.387	17.3	29.5	-12.2	133.25	1	Vertical	27.9	-10.4
37.682	26.7	29.5	-2.8	164.5	1	Vertical	39.4	-12.7
39.843	24.5	29.5	-5.1	182.25	2.18	Vertical	38.7	-13.8
67.998	22.2	29.5	-7.3	195	2.1	Vertical	43.4	-21.2
79.205	26.6	29.5	-2.9	33.75	1.39	Vertical	46.7	-20.0
959.195	19.3	35.5	-16.2	89.75	1.74	Horizontal	17.2	2.1

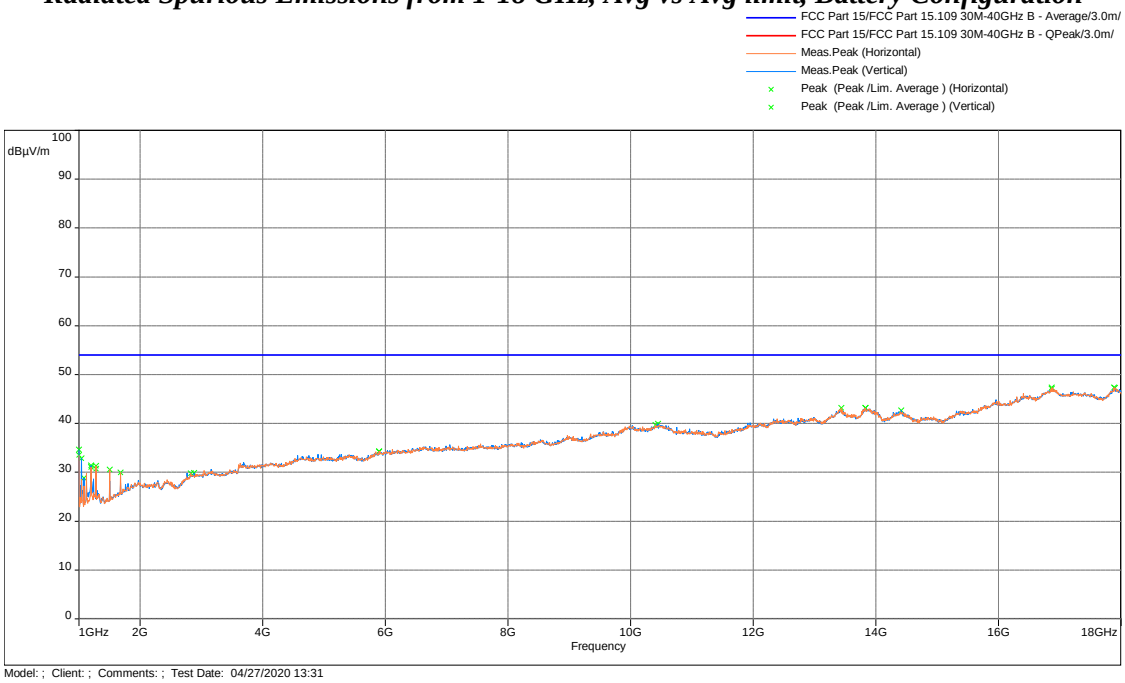
Note: FS = RA + Correction
Correction = AF + CF – Preamp

Radiated Spurious Emissions from 1-18 GHz, Peak vs Peak limit, Battery Configuration



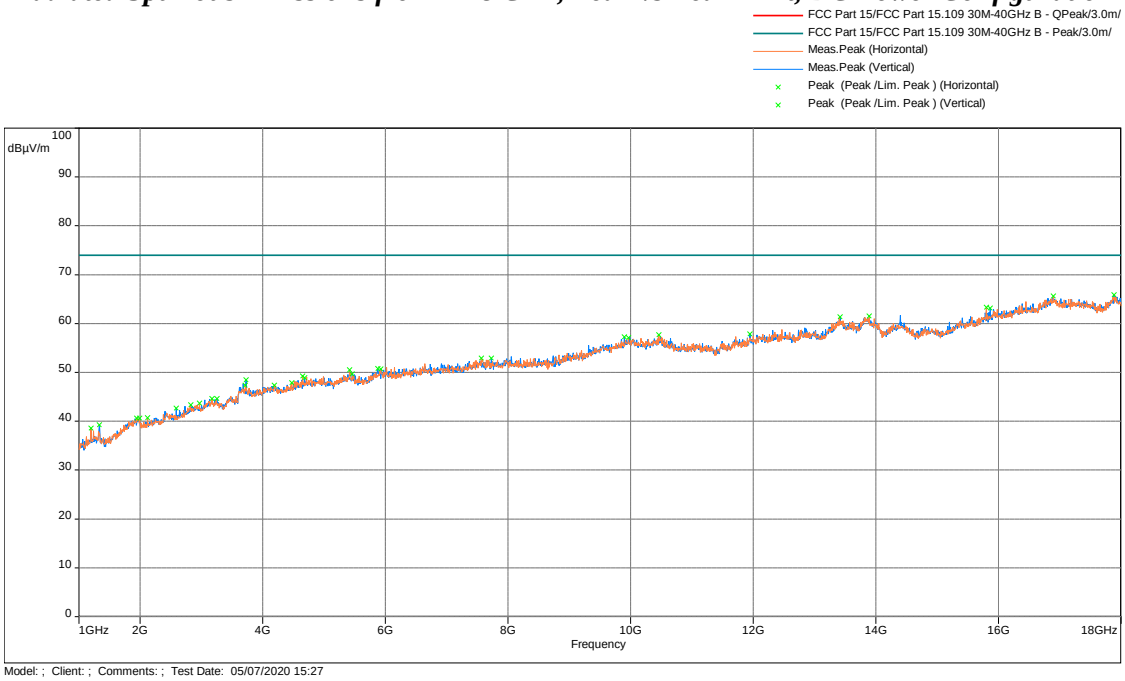
Model: ; Client: ; Comments: ; Test Date: 04/27/2020 13:16

Radiated Spurious Emissions from 1-18 GHz, Avg vs Avg limit, Battery Configuration



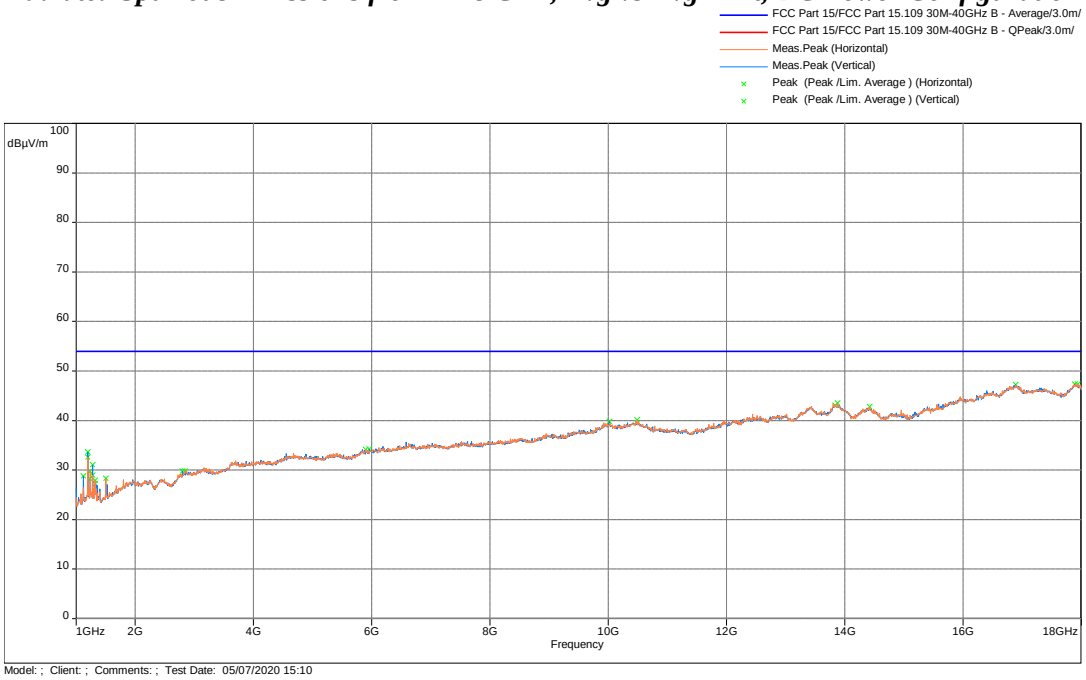
Model: ; Client: ; Comments: ; Test Date: 04/27/2020 13:31

Radiated Spurious Emissions from 1-18 GHz, Peak vs Peak limit, DC Power Configuration



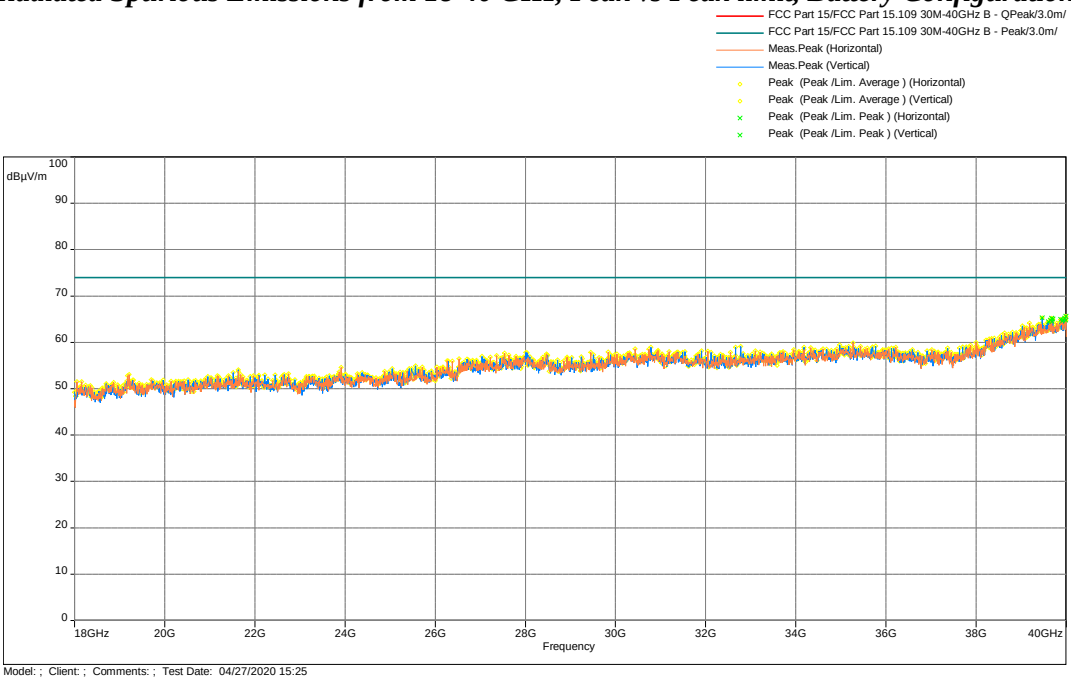
Model: ; Client: ; Comments: ; Test Date: 05/07/2020 15:27

Radiated Spurious Emissions from 1-18 GHz, Avg vs Avg limit, DC Power Configuration



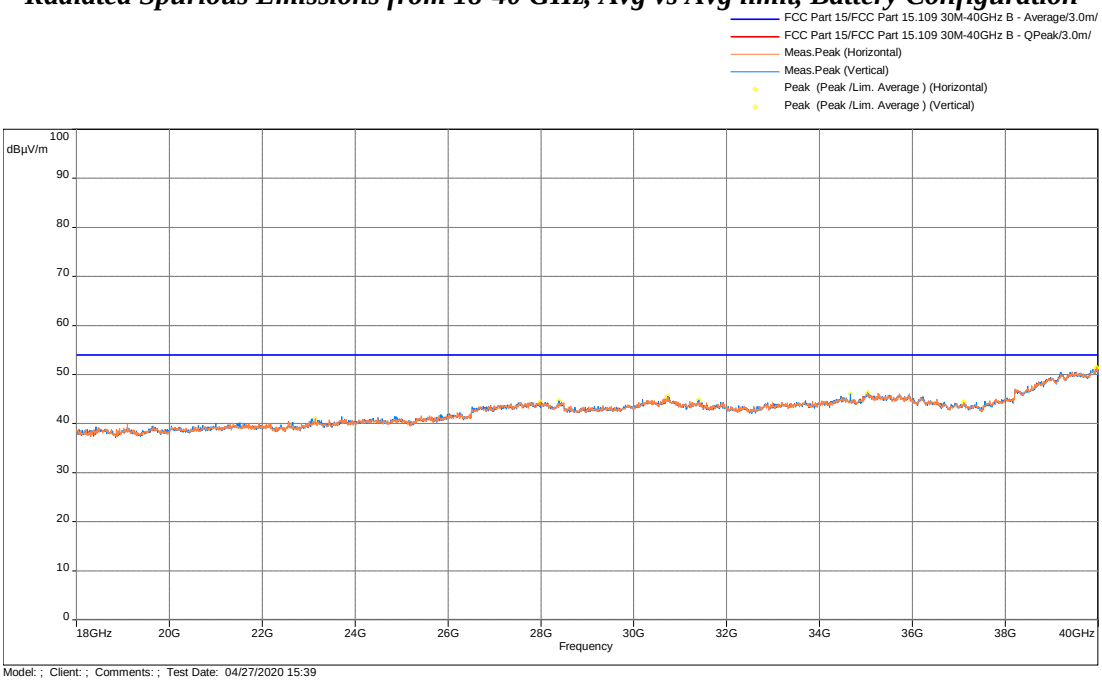
Model: ; Client: ; Comments: ; Test Date: 05/07/2020 15:10

Radiated Spurious Emissions from 18-40 GHz, Peak vs Peak limit, Battery Configuration



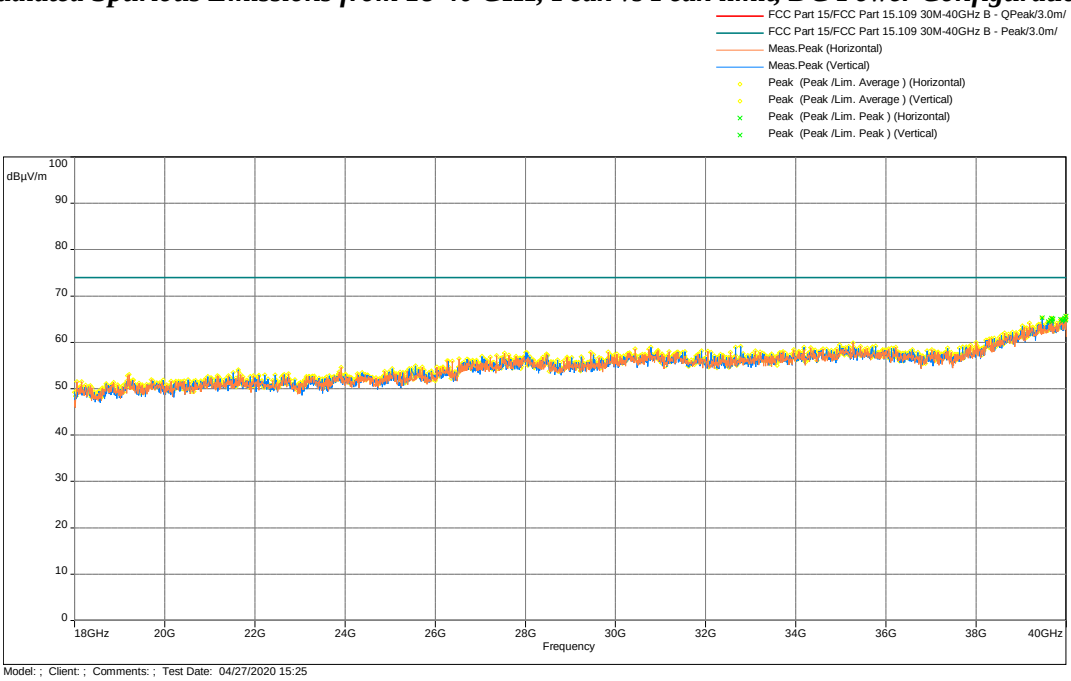
Model: ; Client: ; Comments: ; Test Date: 04/27/2020 15:25

Radiated Spurious Emissions from 18-40 GHz, Avg vs Avg limit, Battery Configuration

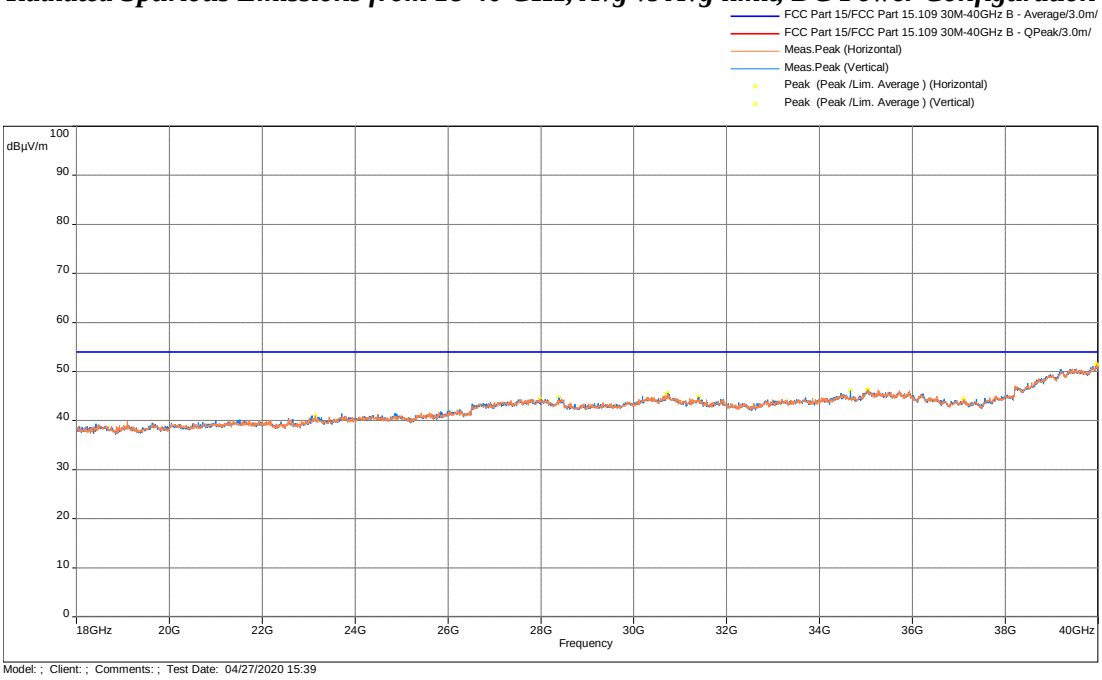


Model: ; Client: ; Comments: ; Test Date: 04/27/2020 15:39

Radiated Spurious Emissions from 18-40 GHz, Peak vs Peak limit, DC Power Configuration



Radiated Spurious Emissions from 18-40 GHz, Avg vs Avg limit, DC Power Configuration



Result	**Complies** by 2.8 dB

END OF REPORT