

TEST REPORT

Report Number: 105113177MPK-001
Project Number: G105113177
Original Issue Date: November 02, 2022

Testing performed on
Researcher Ring
Model Number: AT01

FCC ID: 2A754-AT01
IC: 29615-AT01

to

FCC Part 15 Subpart C (15.247)
ISED RSS-247 Issue 2

For

Senstream, Inc.

Test Performed by:
Intertek
1365 Adams Court
Menlo Park, CA 94025 USA

Test Authorized by:
Senstream, Inc.
314 Ski Way
Incline Village, NV 89451 USA

Prepared by:



Gilberto Gallegos Rangel

Date: November 02, 2022

Reviewed by:


Minh Ly

Date: November 02, 2022

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Report No. 105113177MPK-001

Equipment Under Test:	Researcher Ring
Model Number:	AT01
Applicant:	Senstream, Inc.
Contact:	James Phillips
Address:	Senstream, Inc. 314 Ski Way Incline Village, NV 89451 USA
Country:	USA
Tel. Number:	(650) 274-6422
Email:	jim@senstream.com
Applicable Regulation:	FCC Part 15 Subpart C (15.247) ISED RSS-247 Issue 2
Date of Test:	September 26 – October 20, 2022

We attest to the accuracy of this report:



Gilberto Gallegos Rangel
EMC Engineer



Minh LY
EMC Team Lead

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1.0 Summary of Tests

Test	Reference FCC	Reference Industry Canada	Result
RF Output Power	15.247(b)(3)	RSS-247, 5.4.d)	Complies
6 dB Bandwidth	15.247(a)(2)	RSS-247, 5.2.a)	Complies
Power Density	15.247(e)	RSS-247, 5.2.b)	Complies
Out of Band Antenna Conducted Emission	15.247(d)	RSS-247, 5.5	Complies
Transmitter Radiated Emissions	15.247(d), 15.209, 15.205	RSS-247, 5.5	Complies
AC Line Conducted Emission	15.207	RSS-GEN	Complies
Antenna Requirement	15.203	RSS-GEN	Complies (Internal Antenna)

EUT receive date: September 26, 2022

EUT receive condition: The pre-production version of 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: September 26, 2022

Test completion date: October 20, 2022

The test results in this report pertain only to the item tested.

2.0 General Information

2.1 Product Description

Senstream, Inc. supplied the following description of the EUT:

The Researcher Ring is a finger ring formfactor wearable that records and streams sensor data over BLE.

For more information, see user's manual provided by the manufacturer.

This test report covers only the 2.4GHz BLE radio.

Information about the BLE radio is presented below:

Applicant	Senstream, Inc.
Model No.	AT01
FCC Identifier	2A754-AT01
IC Identifier	29615-AT01
Type of transmission	Digital Transmission System (DTS)
Rated RF Output	1.06 dBm
Antenna(s) & Gain	Internal Antenna, Gain: +0.5 dBi
Frequency Range	2402 – 2480 MHz
Type of modulation/data rate	GFSK/1Mbit/s
Number of Channel(s)	40
Applicant Name & Address	Senstream, Inc. 314 Ski Way Incline Village, NV 89451 USA

2.2 Related Submittal(s) Grants

None.

2.3 Test Facility

The test site used to collect the radiated data is site 1 (10-m semi-anechoic chamber). This test facility and site measurement data have been fully placed on file with the FCC, IC and A2LA accredited.

2.4 Test Methodology

Antenna conducted measurements were performed according to the FCC documents "Guidance for Performing Compliance Measurement on Digital Transmission Systems (DTS) Operating under §15.247" (KDB 558074 D01 DTS Meas Guidance v05r02), and RSS-247 Issue 2, RSS-GEN Issue 5.

Radiated emissions and AC mains conducted emissions measurements were performed according to the procedures in ANSI C63.10: 2013. Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "Data Sheet" of this report.

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 – 200 MHz	200 MHz – 1 GHz	1 GHz – 18 GHz
Radiated emissions	-	4.7	4.6	5.1 dB
AC mains conducted emissions	2.1 dB	-	-	-

3.0 System Test Configuration

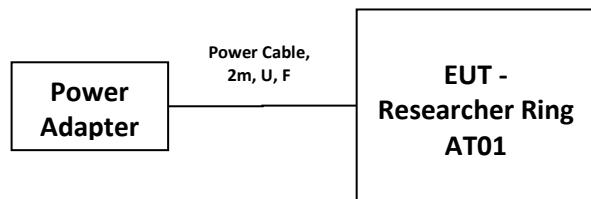
3.1 Support Equipment

Support Equipment		
Description	Manufacturer	Model
Phone	Apple	iPhone 11 Pro
AC/DC Adapter	Samsung	EP-TA20JWE

3.2 Block Diagram of Test Setup

Equipment Under Test			
Description	Manufacturer	Model	Serial Number/ID
Researcher Ring (Radiated Unit)	Senstream, Inc.	AT01	ring #21239
Researcher Ring (Conducted Unit)	Senstream, Inc.	AT01	ring #21251

Radiated Measurements
Charging Mode



Radiated Measurements
Normal Mode



S = Shielded
U = Unshielded

F = With Ferrite
m = Length in Meters

EUT Photos



3.3 Justification

For radiated emission measurements the EUT is placed on a non-conductive table. The EUT was configured to continuously transmit. Different orientation of the EUT were tested and only the worse-case emissions were reported.

The EUT was tested in 2 configurations with EUT in horizontal and upright positions:

- A/ Charging mode: tested with power adapter
- B/ Normal mode: tested in battery mode

3.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was provided by Senstream, Inc.

3.5 Mode of Operation during Test

During the transmitter tests, the transmitter was setup to transmit maximum communication and RF power levels.

EUT was placed into transmit mode at the lowest (2402MHz) middle (2442MHz), and highest (2480MHz) channels.

3.6 Modifications Required for Compliance

No modifications were made by the manufacturer or Intertek to the EUT in order to bring the EUT into compliance.

3.7 Additions, Deviations and Exclusions from Standards

No additions, deviations or exclusions from the standard were made.

4.0 Measurement Results

4.1 6-dB Bandwidth and 99% Occupied Bandwidth
FCC Rule: 15.247(a)(2); RSS-247, 5.2.a) and RSS-GEN;

4.1.1 Requirement

The minimum 6-dB bandwidth shall be at least 500 kHz

4.1.2 Procedure

A spectrum analyzer was connected to the antenna port of the transmitter.

For FCC 6dB Channel Bandwidth the Procedure described in the FCC Publication KDB 558074 D01 Meas Guidance v05r02 was used to determine the DTS occupied bandwidth. Section 11.8.1 Option 1 of ANSI 63.10 was used.

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

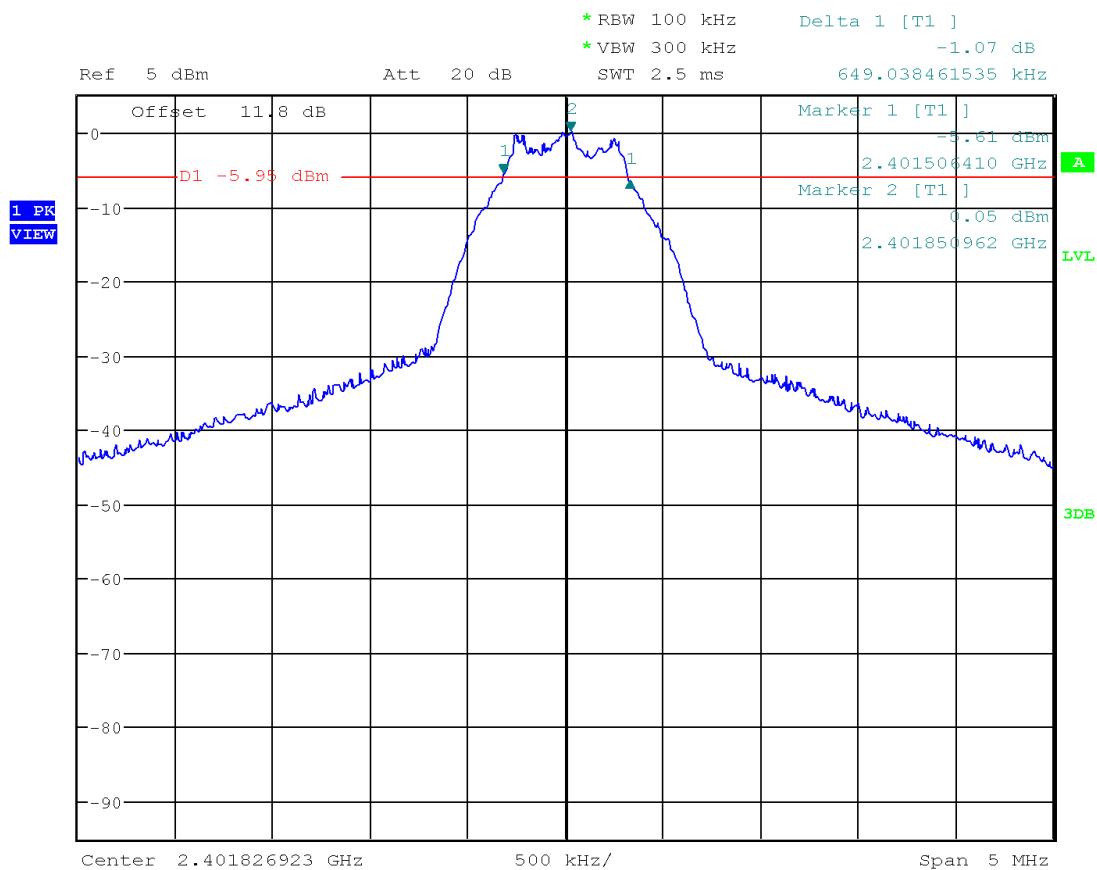
For 99% power bandwidth measurement, the bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer. The resolution bandwidth is set to 1% of the selected span as is without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.

4.1.3 Test Result

Frequency (MHz)	6-dB bandwidth FCC 15.247 & RSS-GEN, kHz	Occupied bandwidth, RSS-GEN, MHz	Plot
2402	649.038	--	1.1
	--	1.019	1.4
2442	655.128	--	1.2
	--	1.019	1.5
2480	649.038	--	1.3
	--	1.019	1.6

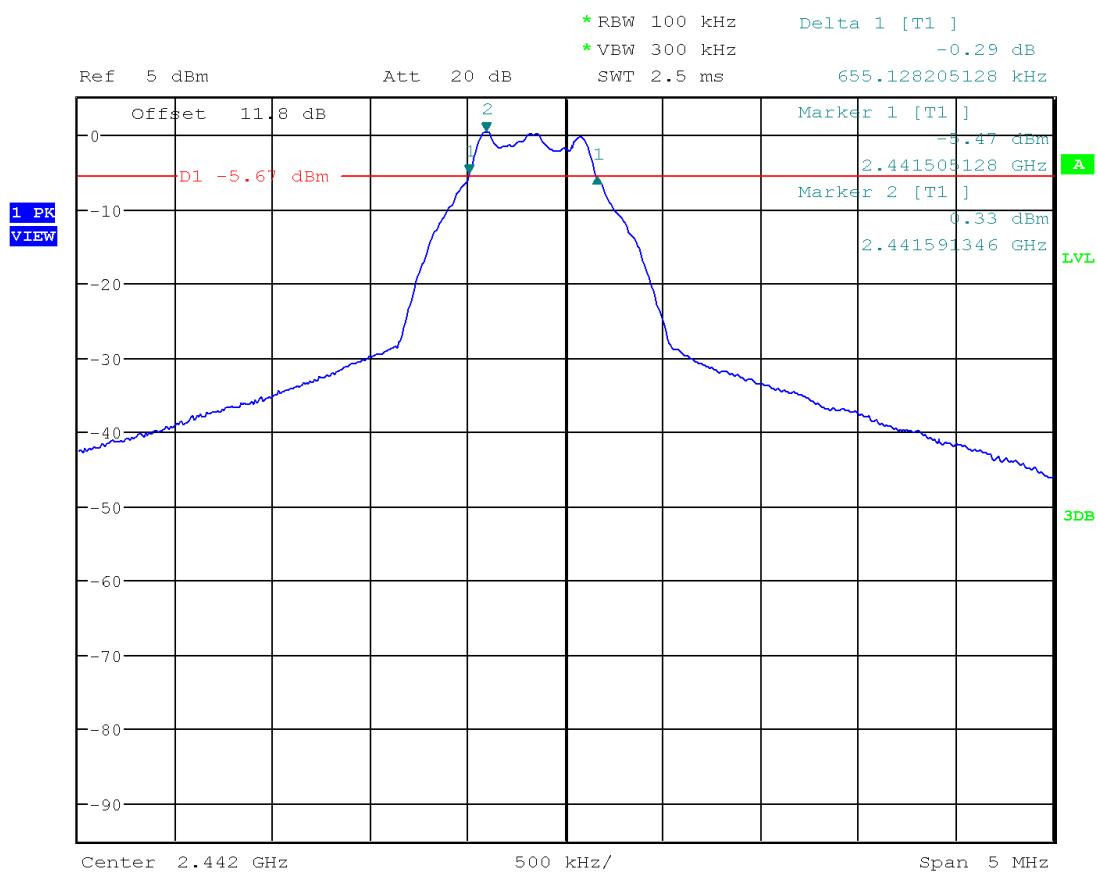
Tested By	Test Date	Results
Gilberto Gallegos Rangel	October 19 & 20, 2022	Complies

Plot 1. 1



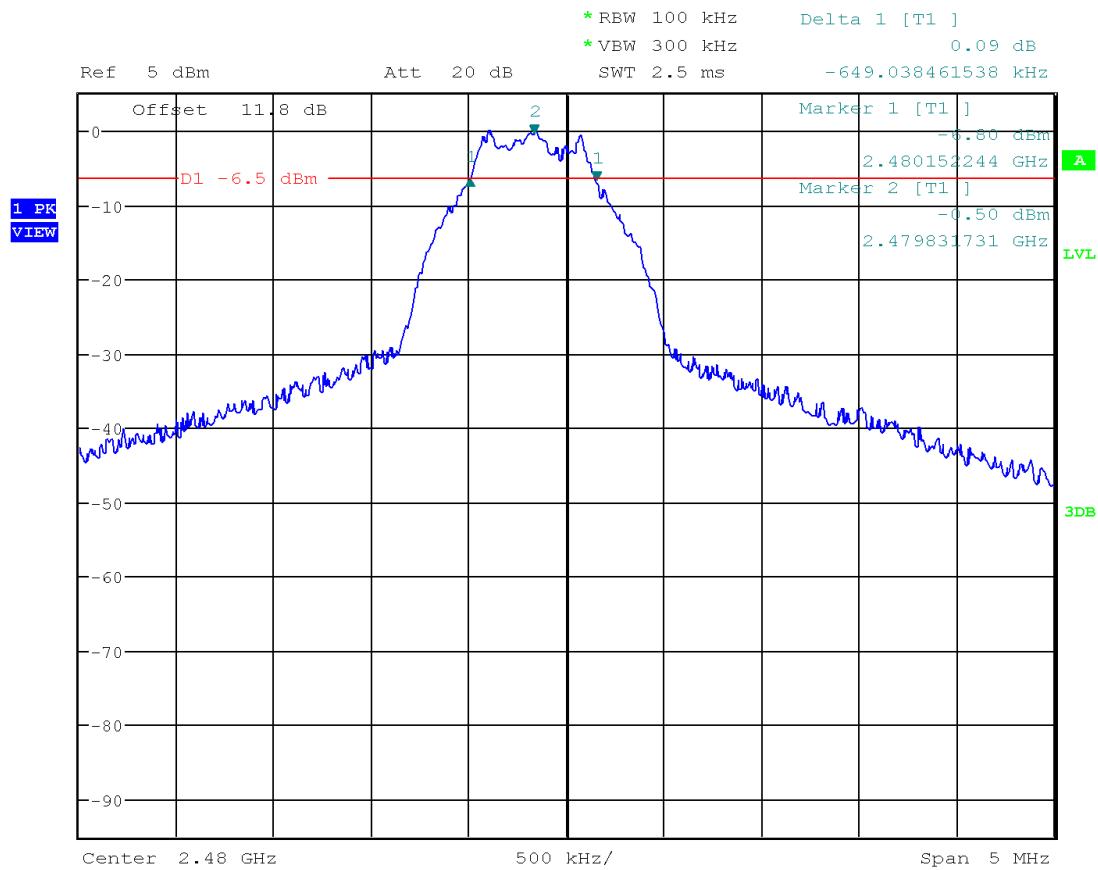
Date: 20.OCT.2022 21:54:37

Plot 1. 2



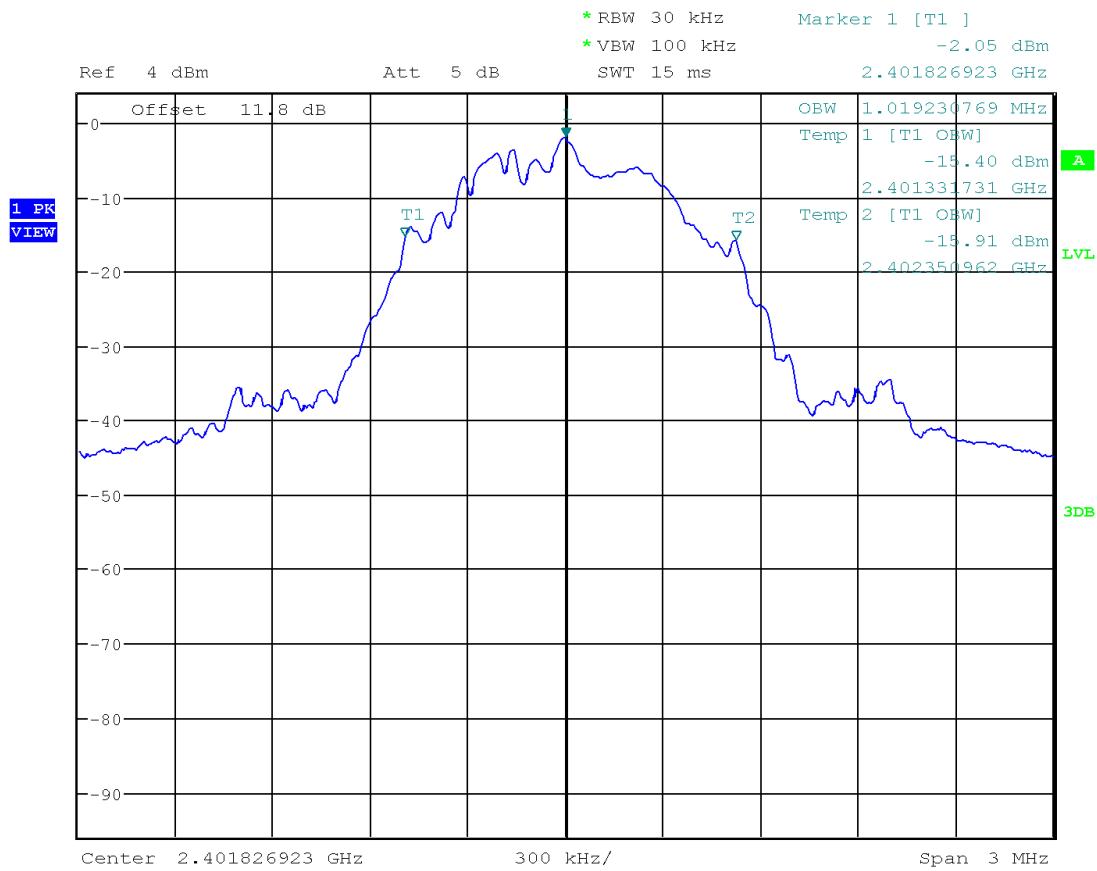
Date: 19.OCT.2022 23:26:44

Plot 1. 3



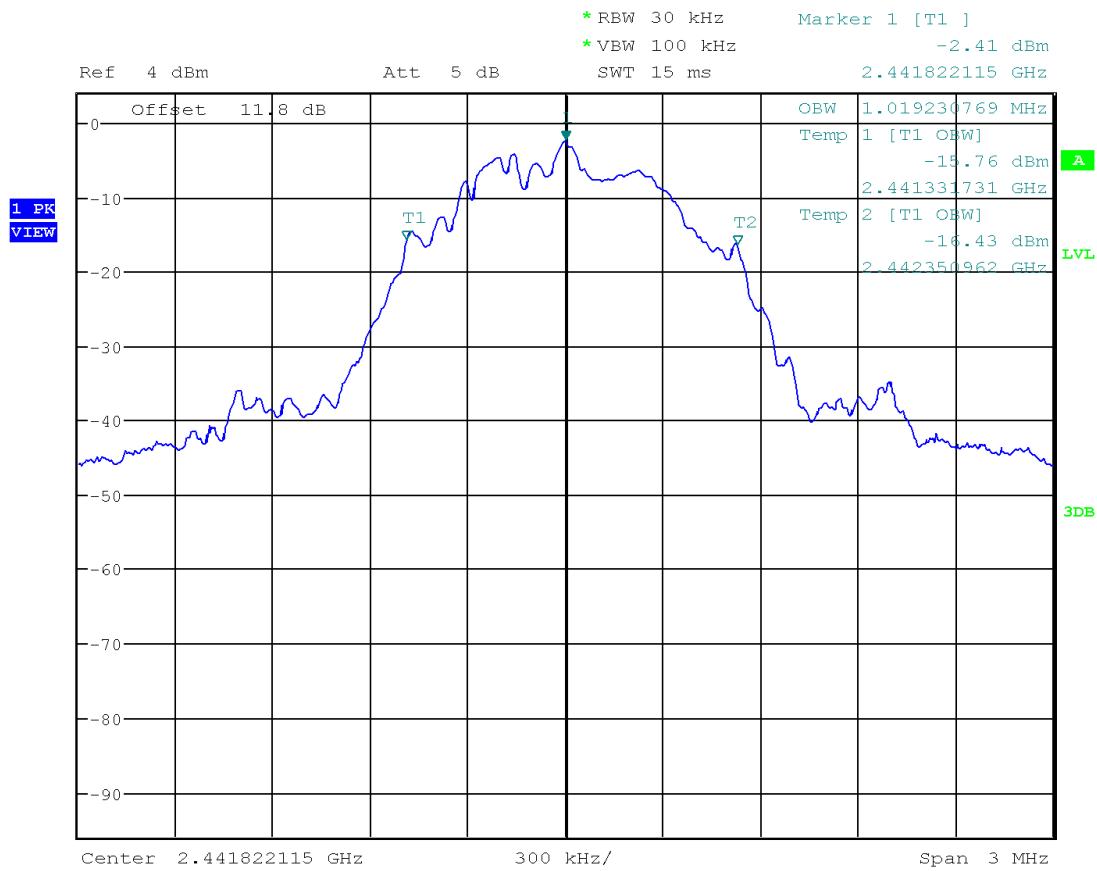
Date: 20.OCT.2022 21:57:14

Plot 1. 4



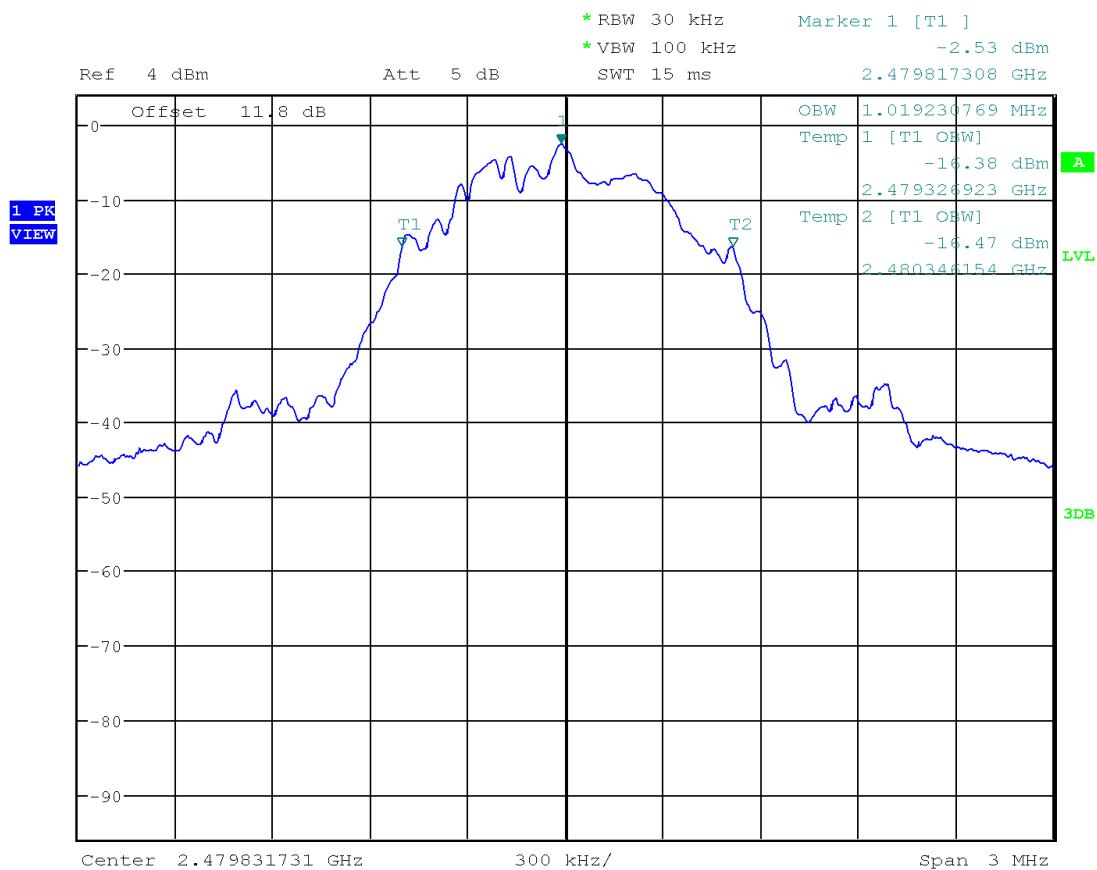
Date: 20.OCT.2022 21:49:40

Plot 1.5



Date: 20.OCT.2022 22:02:08

Plot 1.6



Date: 20.OCT.2022 22:00:11

Results

Complies

4.2 Maximum Peak Conducted Output Power at Antenna Terminals
FCC Rule: 15.247(b)(3); RSS-247, 5.4.d);

4.2.1 Requirement

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt or 30 dBm. For antennas with gains greater than 6 dBi, transmitter output level must be decreased appropriately, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.2.2 Procedure

The procedure described in FCC Publication KDB 558074 D01 Meas Guidance v05r02 was used. Specifically, section 11.9.1.1 $RBW \geq DTS$ bandwidth in ANSI 63.10.

1. Set the $RBW \geq DTS$ Bandwidth
2. Set the $VBW \geq 3 \times RBW$
3. Set the span $\geq 3 \times RBW$
4. Detector = Peak
5. Sweep time = Auto couple
6. Trace mode = Max Hold
7. Allow trace to fully stabilize
8. Use peak marker function to determine the peak amplitude level.

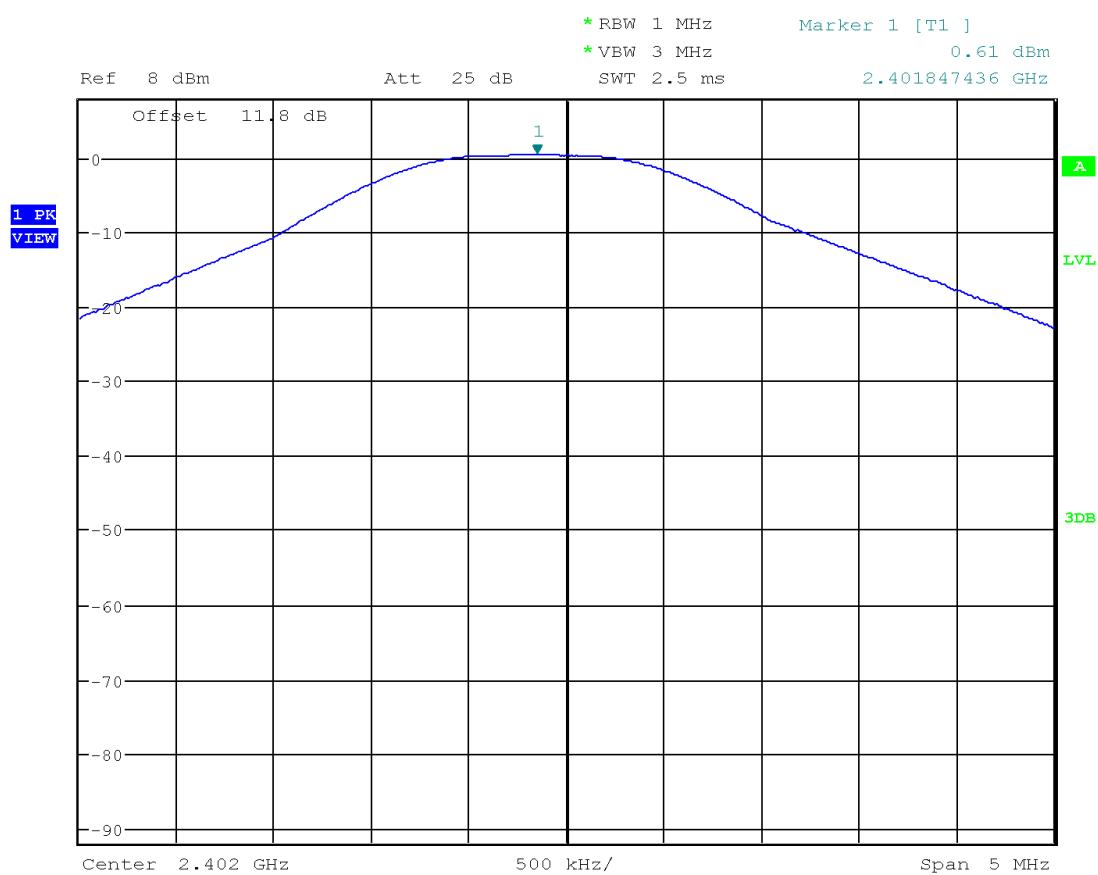
A spectrum analyzer was connected to the antenna port of the transmitter.

4.2.3 Test Result

Refer to the following plots 2.1 – 2.3 for the test details.

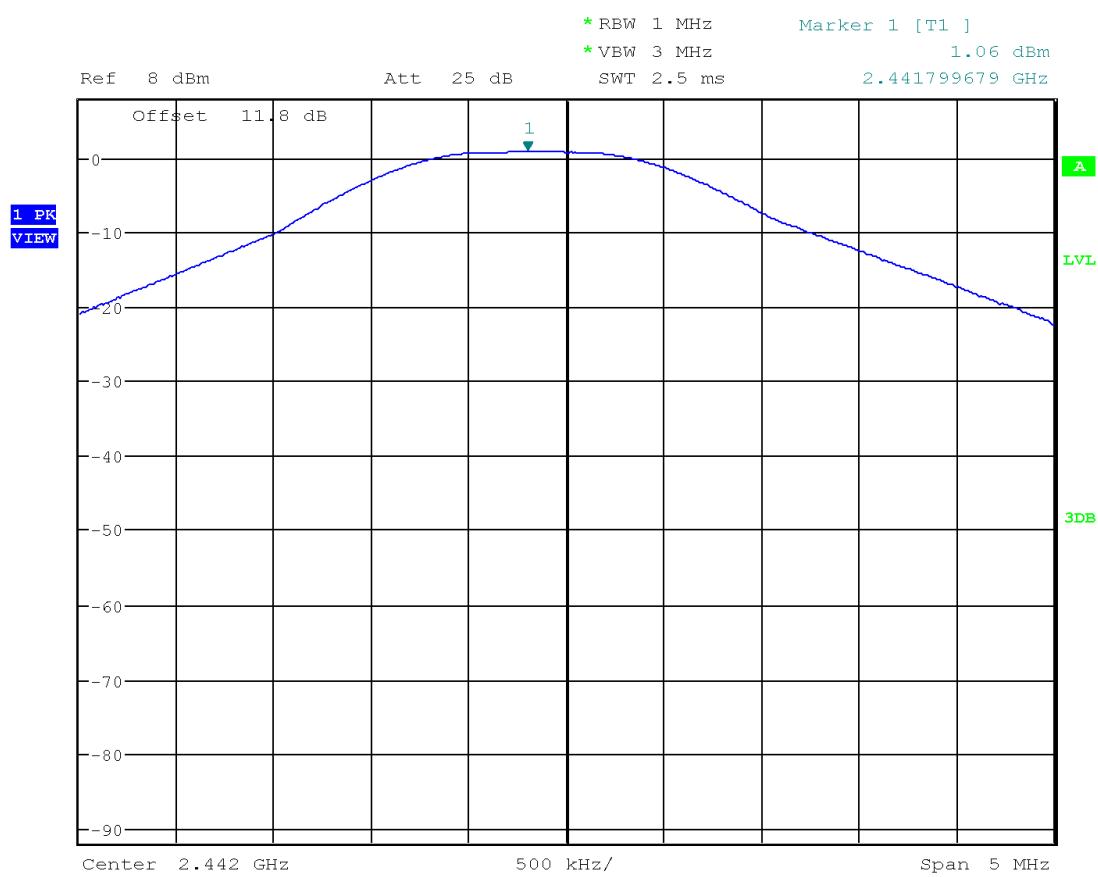
Frequency	Conducted Power (peak)		Plot	
	MHz	dBm		
2402		0.61	1.151	2.1
2442		1.06	1.276	2.2
2480		0.86	1.219	2.3

Tested By	Test Date	Results
Gilberto Gallegos Rangel	October 19, 2022	Complies

Plot 2. 1

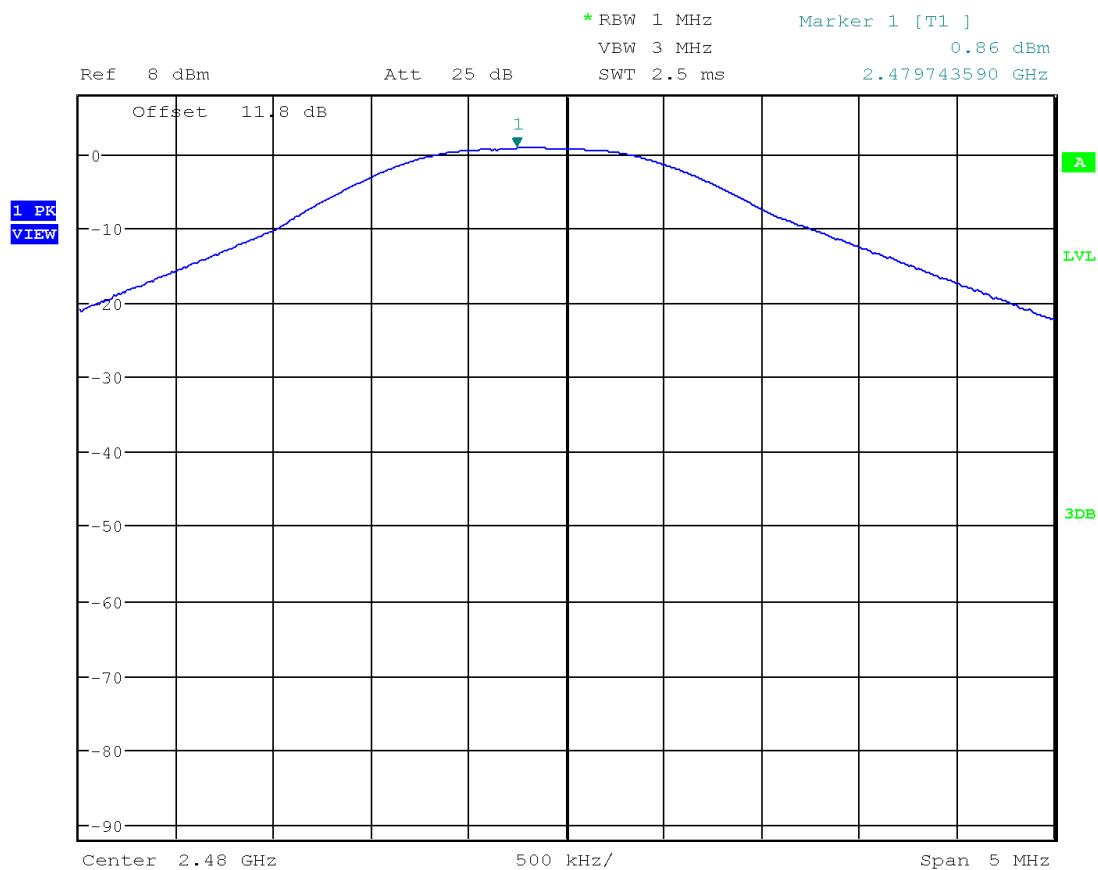
Date: 19.OCT.2022 22:57:42

Plot 2.2



Date: 19.OCT.2022 22:59:44

Plot 2.3



Date: 19.OCT.2022 22:50:30

Results	Complies
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4.3 Maximum Power Spectral Density

FCC: 15.247 (e); RSS-247, 5.2.b);

4.3.1 Requirement

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna should not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.3.2 Procedure

A spectrum analyzer was connected to the antenna port of the transmitter.

The procedure described in FCC Publication KDB 558074 D01 Meas Guidance v05r02, specifically section 11.10.2 Method PKPSD (peak PSD) of ANSI 63.10.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the *DTS bandwidth*.
3. Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
4. Set the VBW $\geq 3 \times \text{RBW}$.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

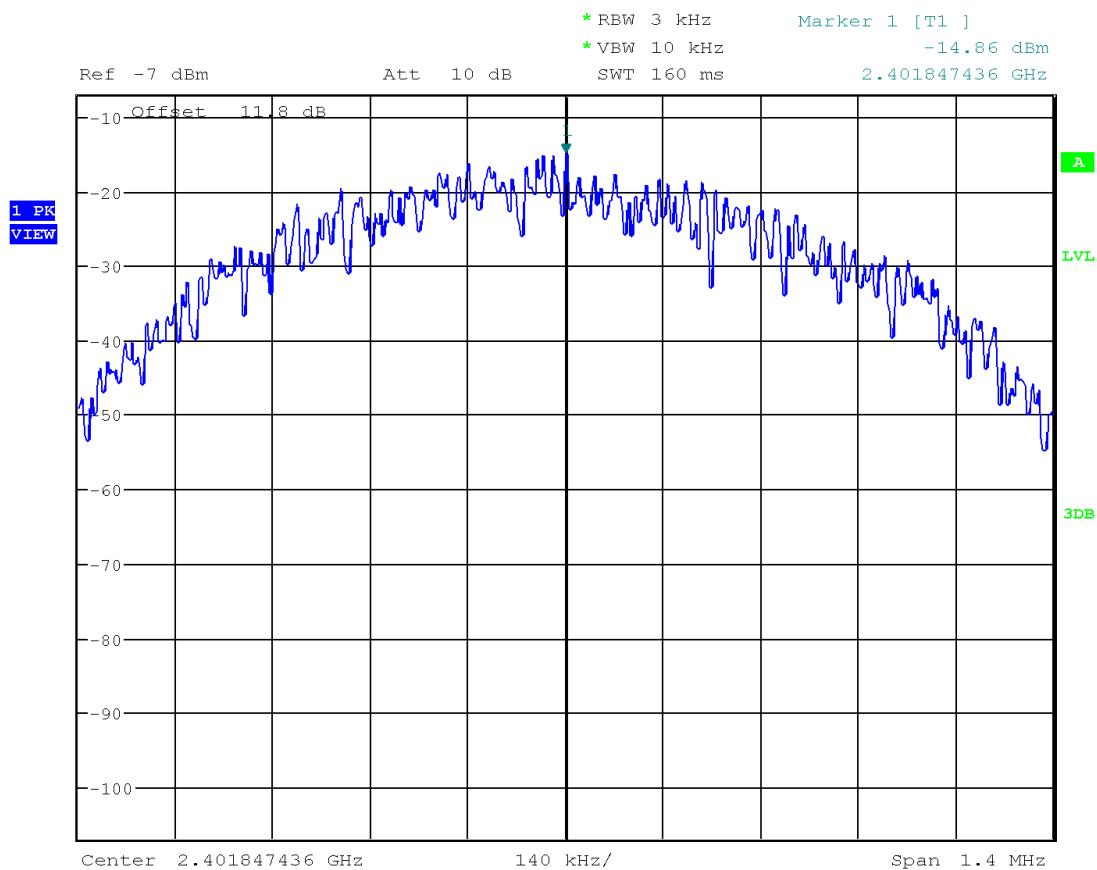
4.3.3 Test Result

Refer to the following plots for the test result

Frequency, MHz	Maximum Power Spectral Density, dBm	Maximum Power Spectral Density Limit, dBm	Margin, dB	Plot
2402	-14.86	8.0	-22.86	3.1
2442	-14.38	8.0	-22.38	3.2
2480	-14.65	8.0	-22.65	3.3

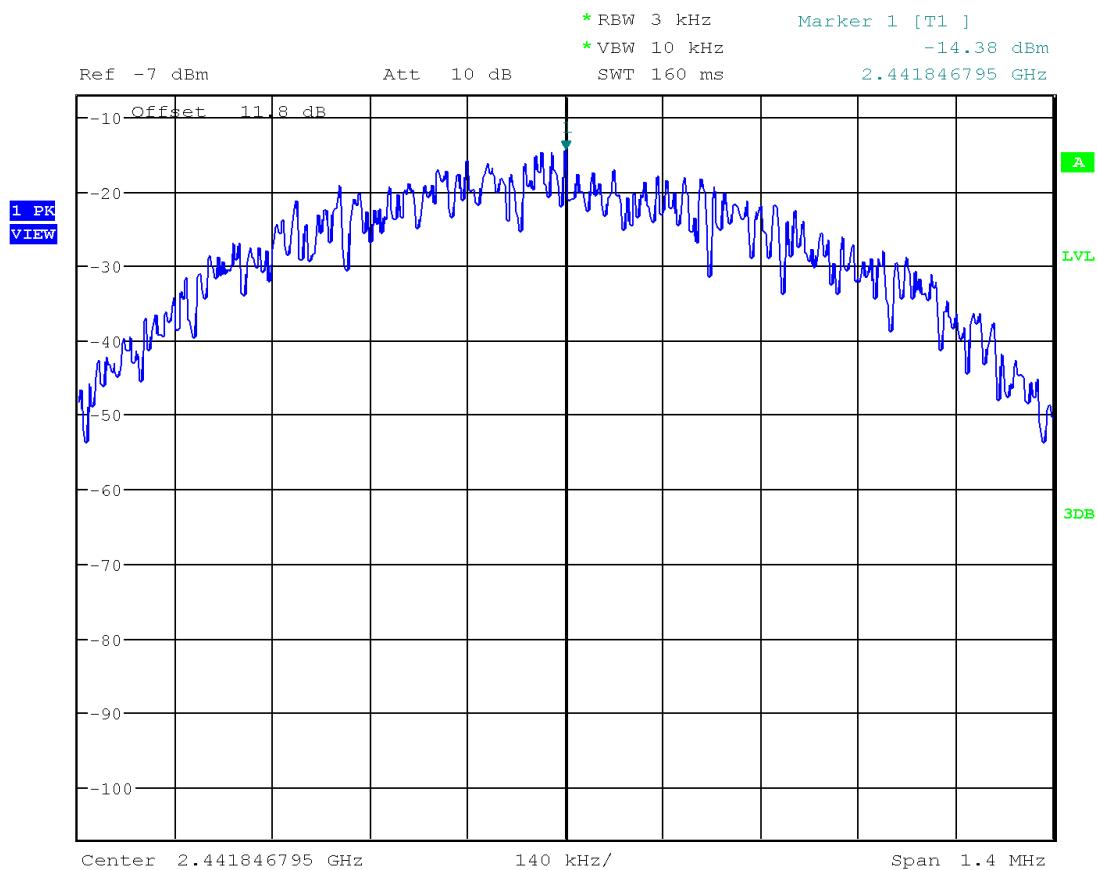
Tested By	Test Date	Results
Gilberto Gallegos Rangel	October 19, 2022	Complies

Plot 3. 1



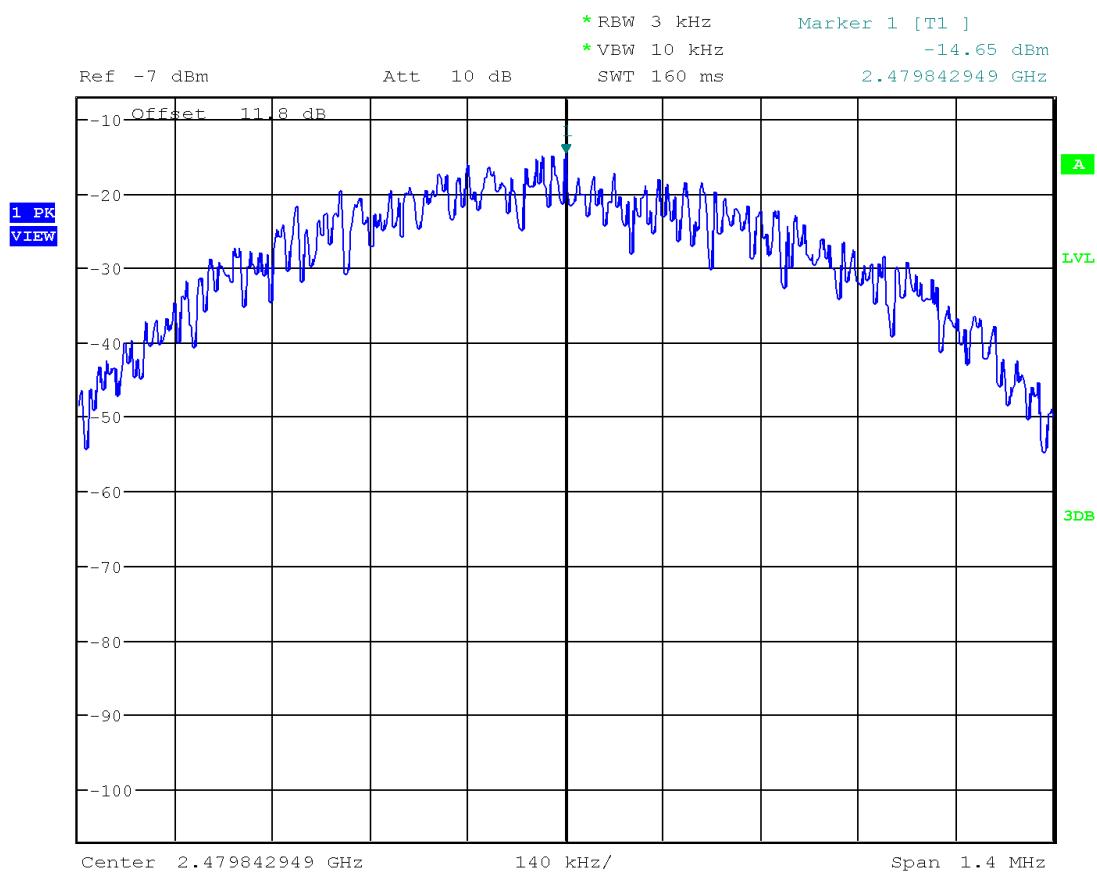
Date: 19.OCT.2022 22:54:50

Plot 3. 2



Date: 19.OCT.2022 23:01:22

Plot 3. 3



Date: 19.OCT.2022 22:52:14

Results	Complies
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4.4 Out of Band Antenna Conducted Emission
FCC: 15.247(d); RSS-247, 5.5;

4.4.1 Requirement

In any 100 kHz bandwidth outside the EUT pass-band, the RF power shall be below the maximum in-band 100 kHz emissions by at least 20 dB (if peak power of in-band emission is measured) or 30 dB (if average power of in-band emission is measured).

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)

4.4.2 Procedure

The procedure described in FCC Publication KDB 558074 D01 Meas Guidance v05r02, specifically section 11.11 DTS Emissions in non-restricted frequency bands of ANSI 63.10.

A spectrum analyzer was connected to the antenna port of the transmitter.

1. Set the RBW = 100 kHz.
2. Set the VBW $\geq 3 \times$ RBW.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

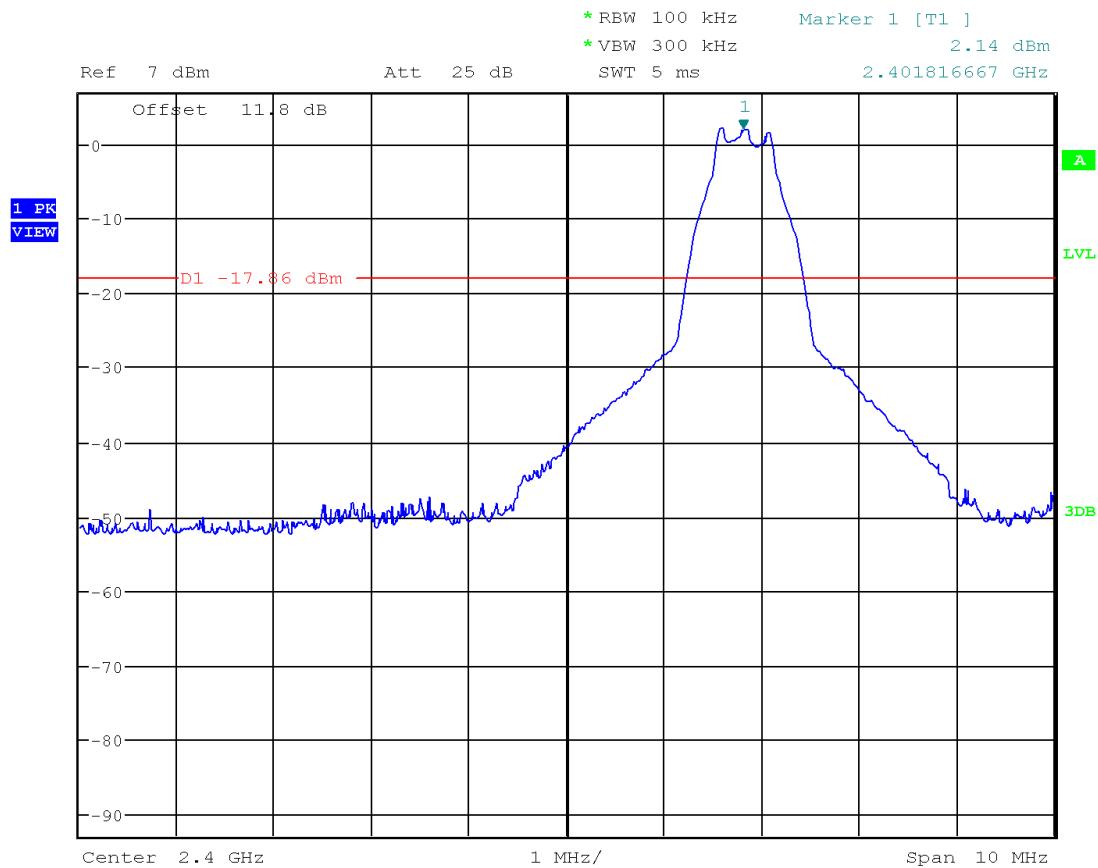
The unwanted emissions were measured from 30 MHz to 25 GHz. Plots below are corrected for cable loss and then compared to the limits.

4.4.3 Test Result

Refer to the following plots 4.1 – 4.5 for unwanted conducted emissions. The plot shows -20dB attenuation limit line.

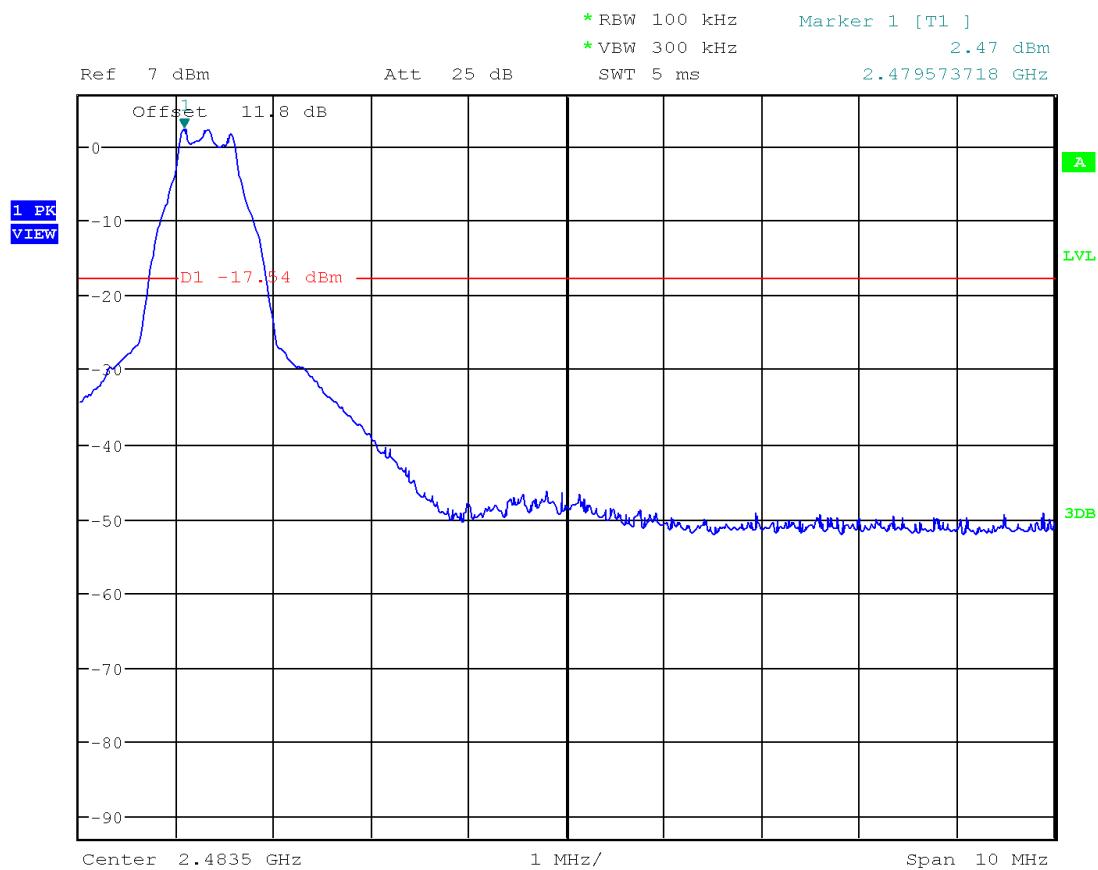
Tested By	Test Date	Results
Gilberto Gallegos Rangel	September 26, 2022	Complies

Tx @ Low Channel, 2402 MHz Band Edge
Plot 4.1



Date: 26.SEP.2022 19:47:41

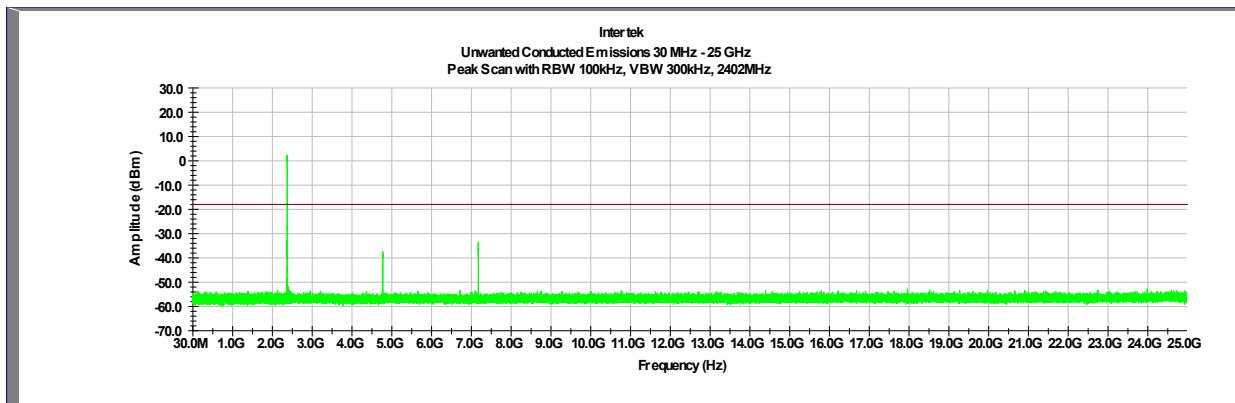
Tx @ High Channel, 2480 MHz Band Edge
Plot 4.2



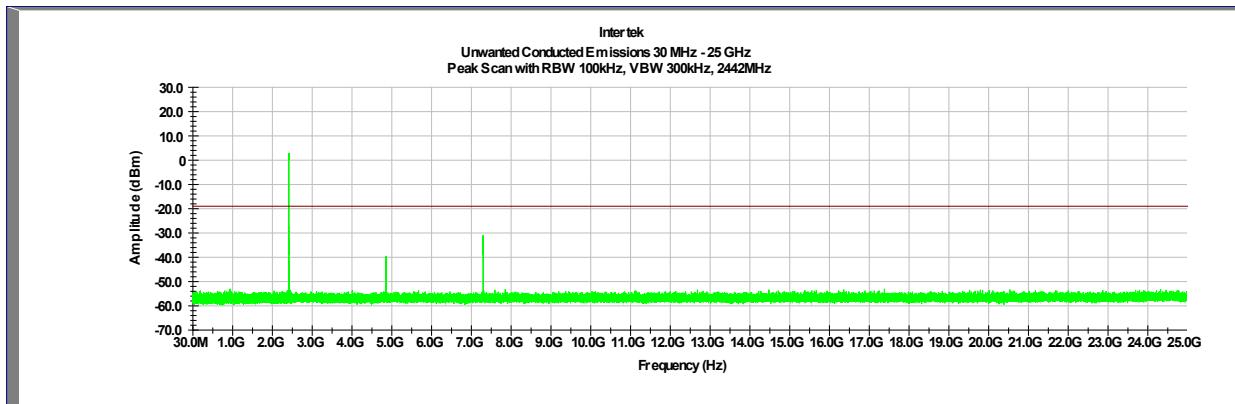
Date: 26.SEP.2022 19:53:14

Results	Complies
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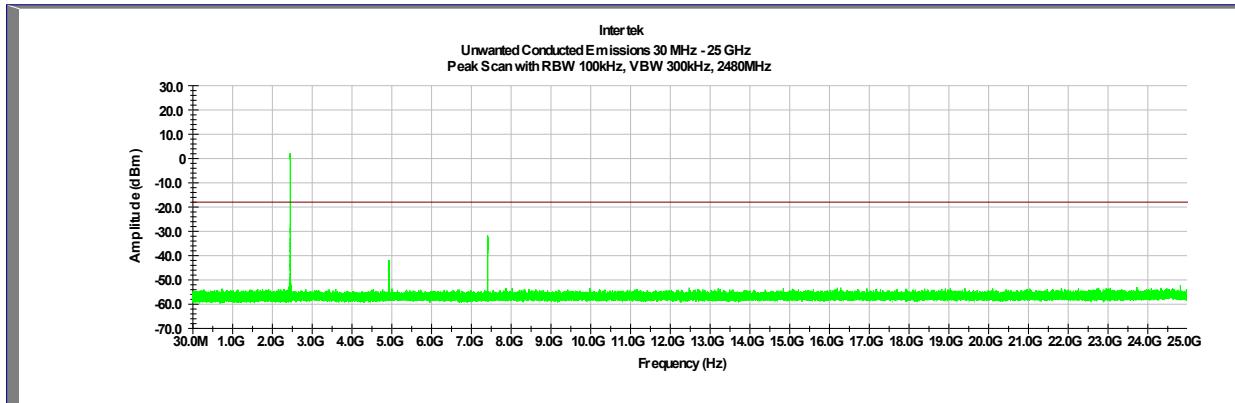
Tx @ Low Channel, 2402 MHz
30MHz -26GHz Conducted Spurious
Plot 4.3



Tx @ Mid Channel, 2442 MHz
30MHz -26GHz Conducted Spurious
Plot 4.4



Tx @ High Channel, 2480 MHz
30MHz -26GHz Conducted Spurious
Plot 4.5



Results

Complies

4.5 Transmitter Radiated Emissions

FCC Rules: 15.247(d), 15.209, 15.205; RSS-247, 5.5;

4.5.1 Requirement

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)).

For out of band radiated emissions (except for frequencies in restricted bands), in any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

4.5.2 Procedure

Radiated emission measurements were performed from 9 kHz to 26.5 GHz according to the procedure described in ANSI C63.10: 2013. Spectrum Analyzer Resolution Bandwidth is 200Hz or greater for frequencies 9kHz to 30MHz, 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz for frequencies above 1000 MHz. Above 1000 MHz Peak and Average measurements were performed.

The EUT is placed on a plastic turntable that is 80 cm in height for below 1000MHz and 1.5m in height for above 1GHz. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The 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 3 meters for frequencies above 1 GHz and at 10 meters for frequencies below 1 GHz.

Measurements made from 1 GHz to 18GHz had a 2.4-2.5GHz notch filter in place. A preamp was used from 9kHz to 26.5GHz.

All measurements were made with a Peak Detector and compared to QP limits for 30MHz – 1GHz and Average limits for 1GHz – 26.5GHz.

Correlation measurements were performed below 30MHz between 10m ALSE and Open Field site according to FCC KDB 414788 D01 Radiated Test Site v01r01 section 2. All readings were within the acceptable tolerance.

EUT was tested in both horizontal and upright position. Data is included of the worst-case configuration (the configuration which resulted in the highest emission levels).

4.5.3 Field Strength Calculation

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 with a sample calculation is as follows:

FS = RA + AF + CF – AG; if measurement is performed at a distance other than specified in the rule, a Distance Correction Factor (DCF) shall be added.

Where FS = Field Strength in dB(μ V/m)

RA = Receiver Amplitude (including preamplifier) in dB(μ V); AF = Antenna Factor in dB(1/m)

CF = Cable Attenuation Factor in dB; AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dB(μ V) is obtained. The antennas factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving 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 dB(μ V)

AF = 7.4 dB(1/m)

CF = 1.6 dB

AG = 29.0 dB

FS = 52.0+7.4+1.6-29.0 = 32 dB(μ V/m).

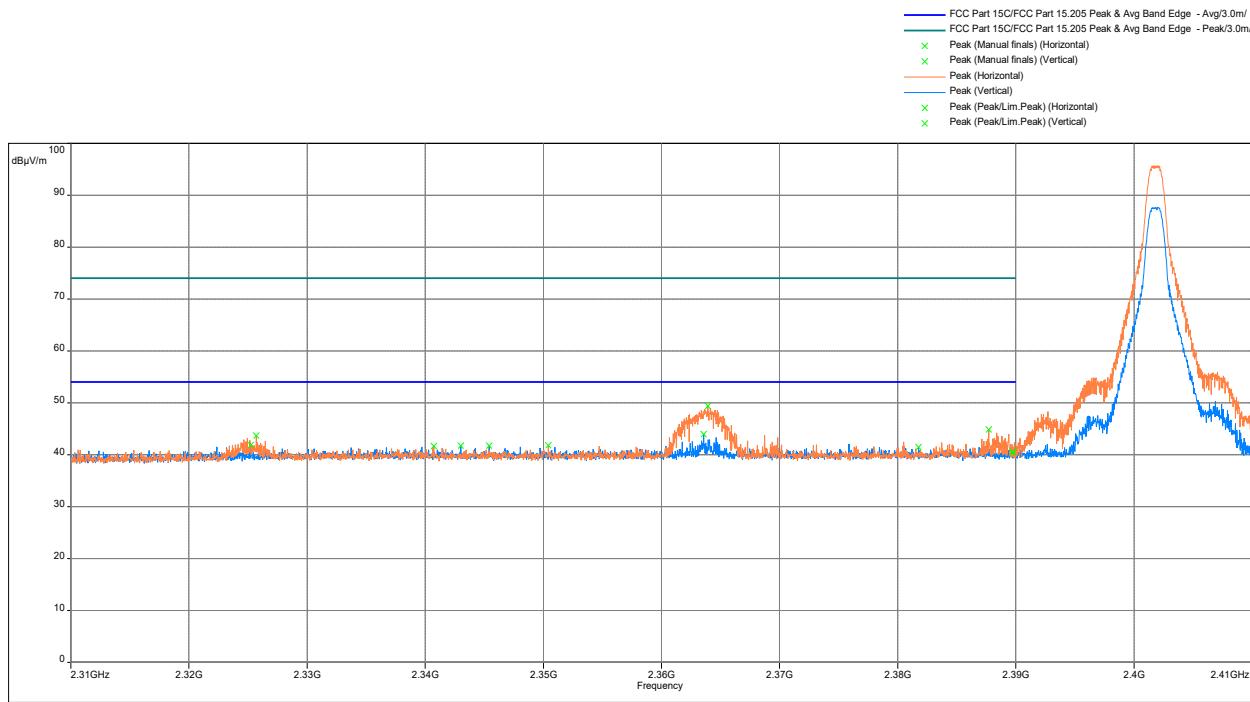
Level in μ V/m = Common Antilogarithm [(32 dB μ V/m)/20] = 39.8 μ V/m.

4.5.4 Test Results

All testing in this section were performed by radiated measurements.

Tested By	Test Date	Results
Gilberto Gallegos Rangel	September 26 – October 20, 2021	Complies

Test Results: 15.209/15.205 Radiated Restricted Band Emissions

 Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
 2310–2390 MHz, Peak Scan with Peak Limit and Average Limit
 Charging Mode


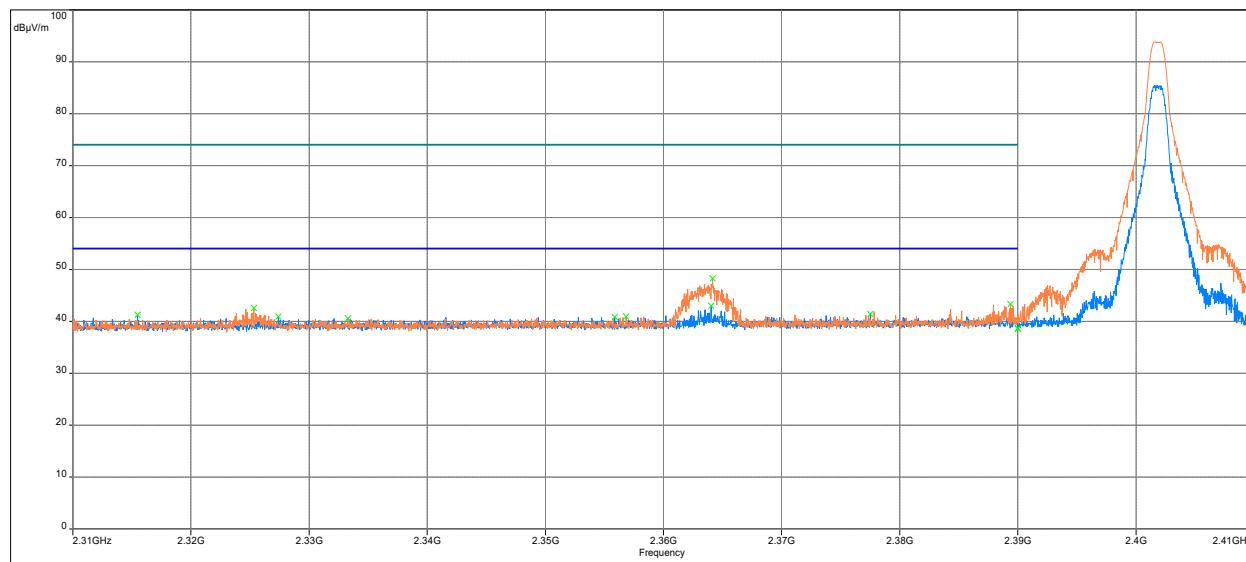
Model: ; Client: ; Comments: ; Test Date: 10/19/2022 18:06

Freq. MHz	Peak@3m dB(uV/m)	Ave Limit dB(μV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
2390.0	40.46	54.0	-13.540	1.51	0	Horizontal	-12.2
2390.0	40.49	54.0	-13.51	3.49	305.25	Vertical	-12.2
2363.92	49.37	54.0	-4.63	1.51	0	Horizontal	-12.39
2363.573	43.93	54.0	-10.07	2.49	84	Vertical	-12.4

Note: Correction = AF + CF + DCF – Preamp

**Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2310–2390 MHz, Peak Scan with Peak Limit and Average Limit
Normal Mode**

— FCC Part 15C/FCC Part 15.205 Peak & Avg Band Edge - Avg/3.0m/
 — FCC Part 15C/FCC Part 15.205 Peak & Avg Band Edge - Peak/3.0m/
 — Peak (Horizontal)
 — Peak (Vertical)
 ✕ Peak (Peak/Lim.Peak) (Horizontal)
 ✕ Peak (Peak/Lim.Peak) (Vertical)
 ✕ Peak (Manual finals) (Horizontal)
 ✕ Peak (Manual finals) (Vertical)

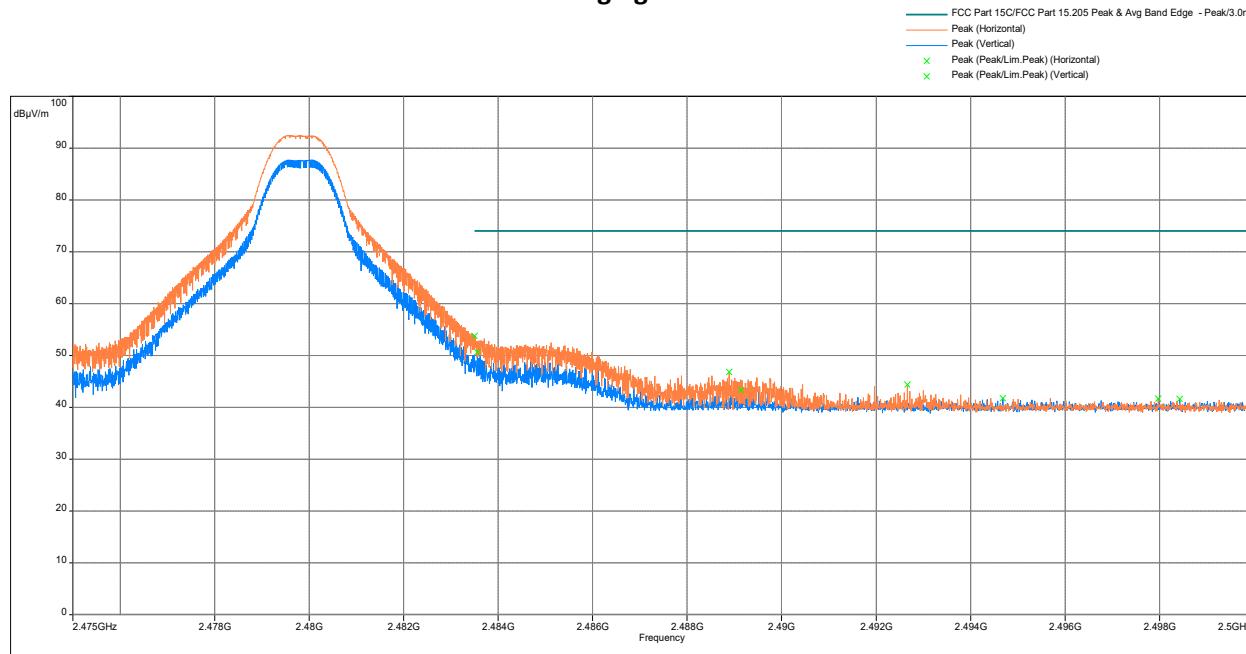


Model: ; Client: ; Comments: ; Test Date: 09/29/2022 18:50

Freq. MHz	Peak@3m dB(μV/m)	Ave Limit dB(μV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
2390.0	38.69	54.0	-15.31	2.49	3	Vertical	-12.16
2390.0	38.52	54.0	-15.48	2.51	347	Horizontal	-12.16
2364.157	48.26	54.0	-5.74	1.51	0.25	Horizontal	-12.37
2364.03	42.96	54.0	-11.04	3.49	272.25	Vertical	-12.37

Note: Correction = AF + CF + DCF – Preamp

**Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2483.5–2500 MHz, Peak Scan with Peak Limit
Charging Mode**

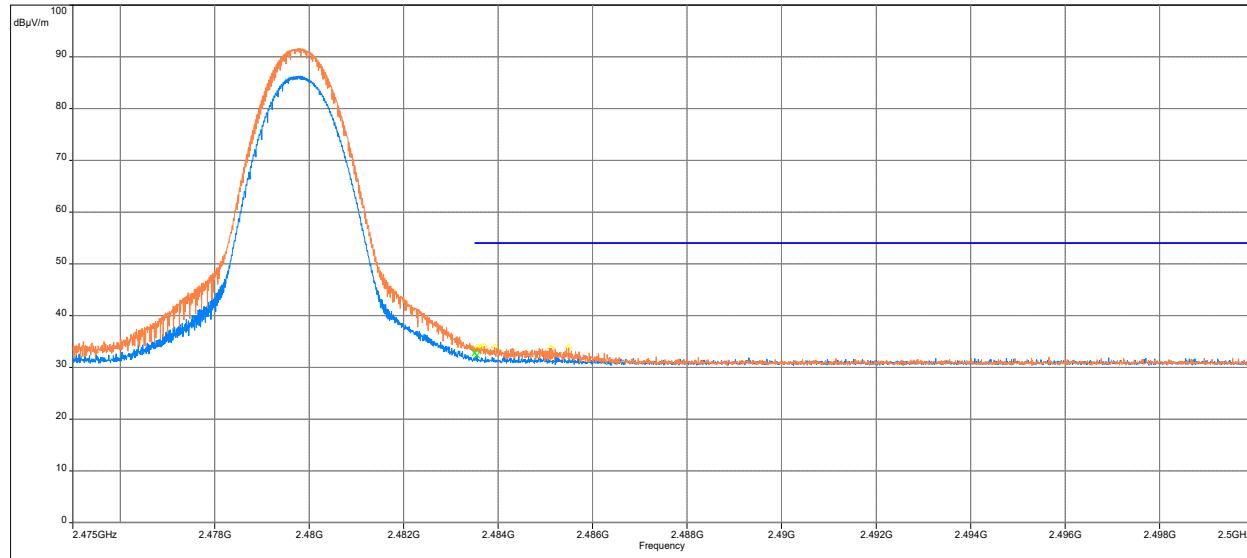


Freq. MHz	Peak@3m dB(uV/m)	Peak Limit dB(μV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
2483.5	53.76	74	-20.24	1.51	1.25	Horizontal	-11.91
2483.5	50.66	74	-23.34	1.51	89.5	Vertical	-11.91

Note: Correction = AF + CF + DCF – Preamp

Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2483.5–2500 MHz, Average Scan with Average Limit
Charging Mode

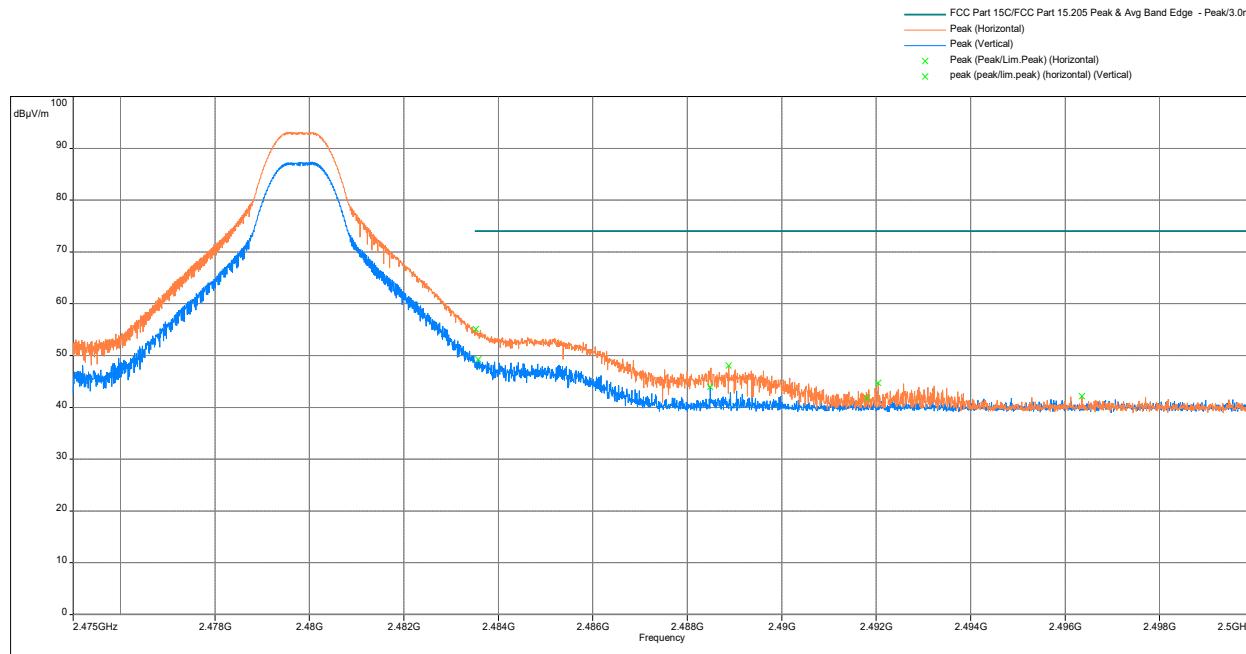
— FCC Part 15C/FCC Part 15.205 Avg Band Edge - Avg/3.0m/
— FCC Part 15C/FCC Part 15.205 Avg Band Edge - Q-Peak/3.0m/
x Peak (Manual finals) (Horizontal)
x Peak (Manual finals) (Vertical)
— Peak (Horizontal)
— Peak (Vertical)
◊ Peak (Peak/Lim Avg) (Horizontal)



Freq. MHz	Ave@3m dB(μV/m)	Ave Limit dB(μV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
2483.5	32.81	54	-21.19	358.75	1.51	Horizontal	-11.91
2483.5	32.37	54	-21.63	251.5	3.5	Vertical	-11.91

Note: Correction = AF + CF + DCF – Preamp

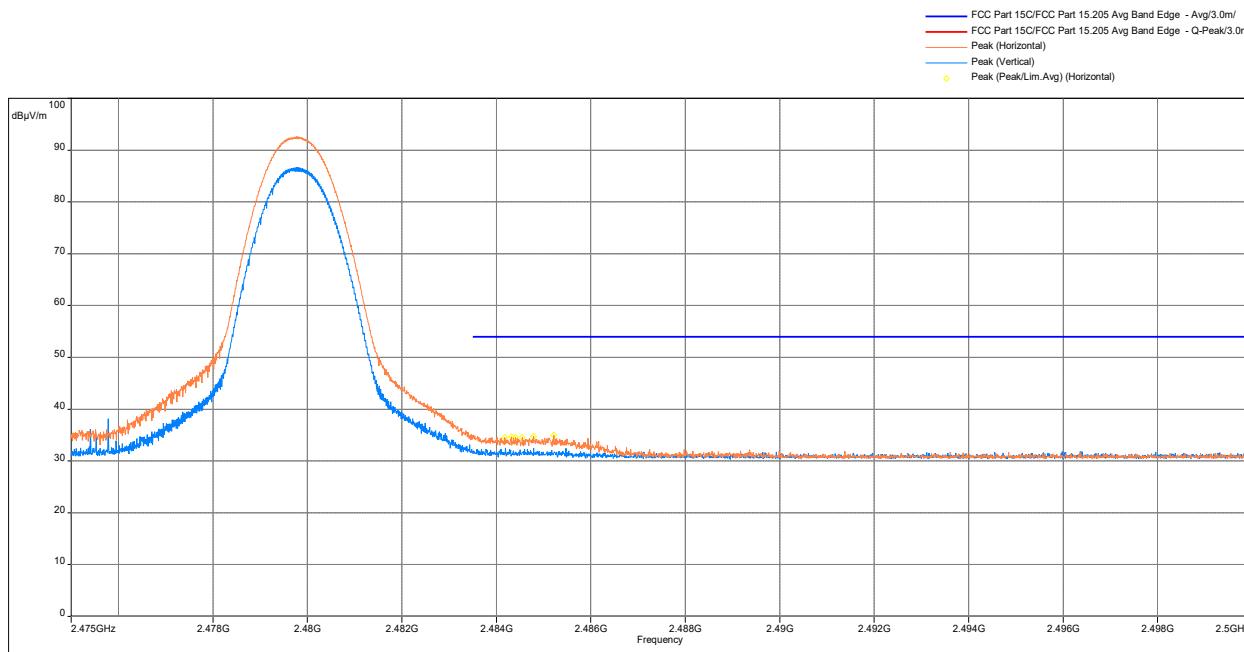
Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2483.5–2500 MHz, Peak Scan with Peak Limit
Normal Mode



Freq. MHz	Peak@3m dB(uV/m)	Peak Limit dB(μV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
2483.5	55.1	74	-18.9	1.51	0	Horizontal	-11.85
2483.5	49.23	74	-24.77	3.49	281.5	Vertical	-11.85

Note: Correction = AF + CF + DCF – Preamp

Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2483.5–2500 MHz, Average Scan with Average Limit
Normal Mode



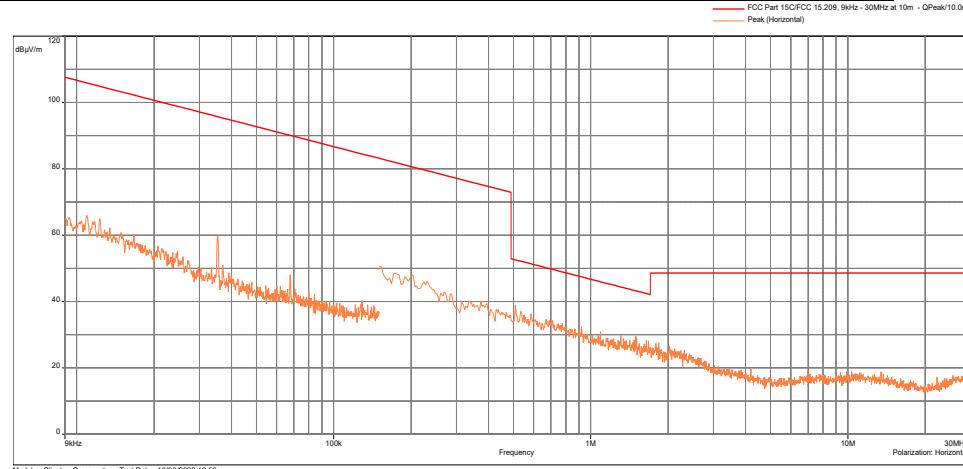
Freq. MHz	Ave@3m dB(μV/m)	Ave Limit dB(μV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
2483.5	32.2	54	-21.8	2.51	8	Horizontal	-11.85
2483.5	30.99	54	-23.01	3.49	303.5	Vertical	-11.85

Note: Correction = AF + CF + DCF – Preamp

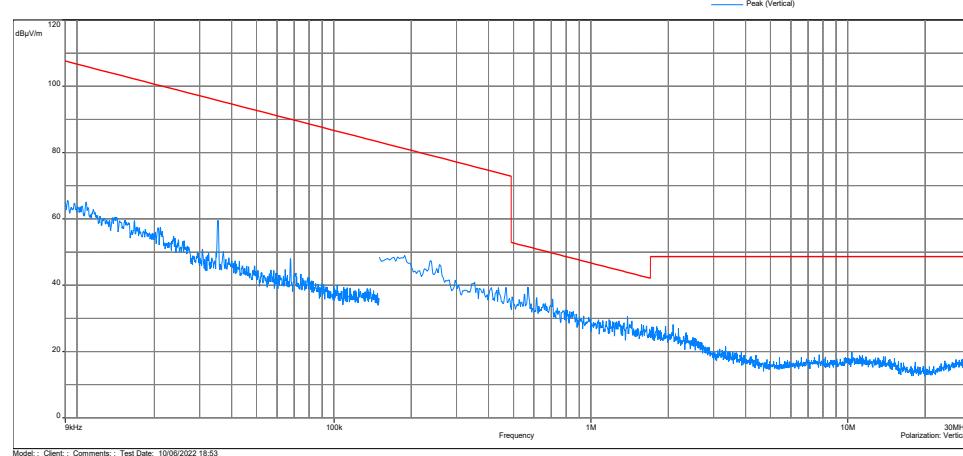
Results	Complies
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Out-of-Band Radiated Spurious Emissions Low Channel, Tx at 2402MHz Normal Mode

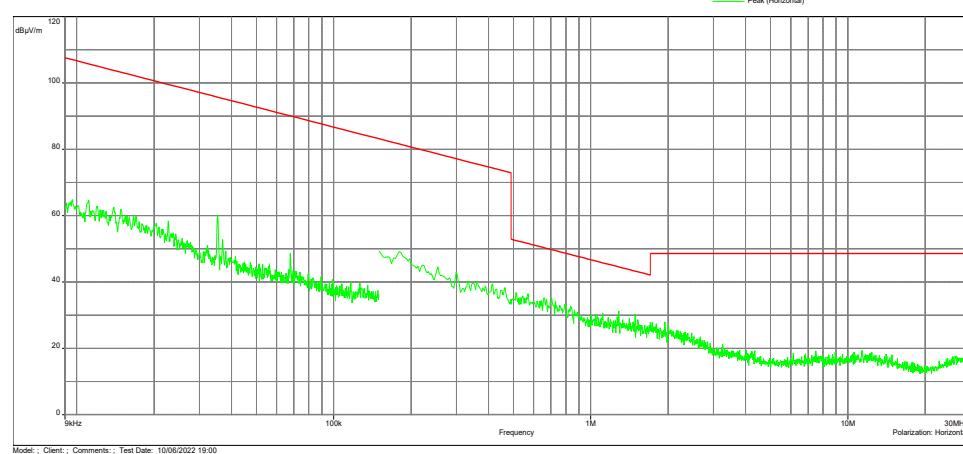
Antenna Position -
Coaxial



Antenna Position -
Coplanar



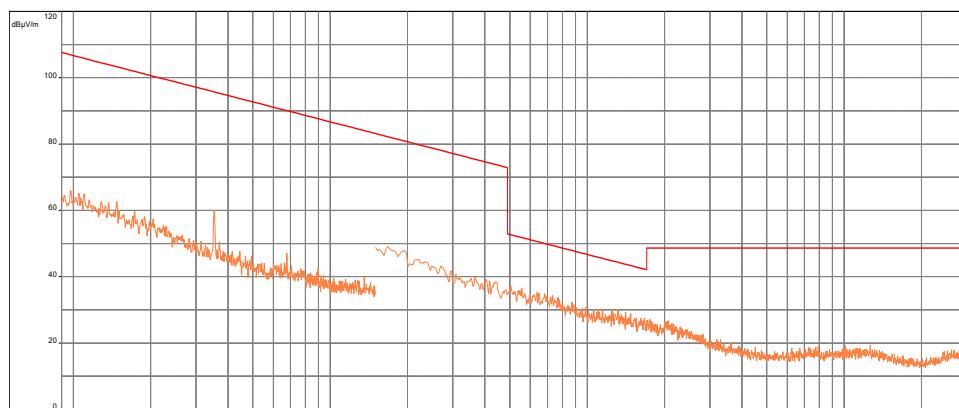
Antenna Position -
Horizontal



Out-of-Band Radiated Spurious Emissions Mid Channel, Tx at 2442MHz Normal Mode

FCC Part 15CFCC 15.209, 9kHz - 30MHz at 10m - QPeak/10.0m

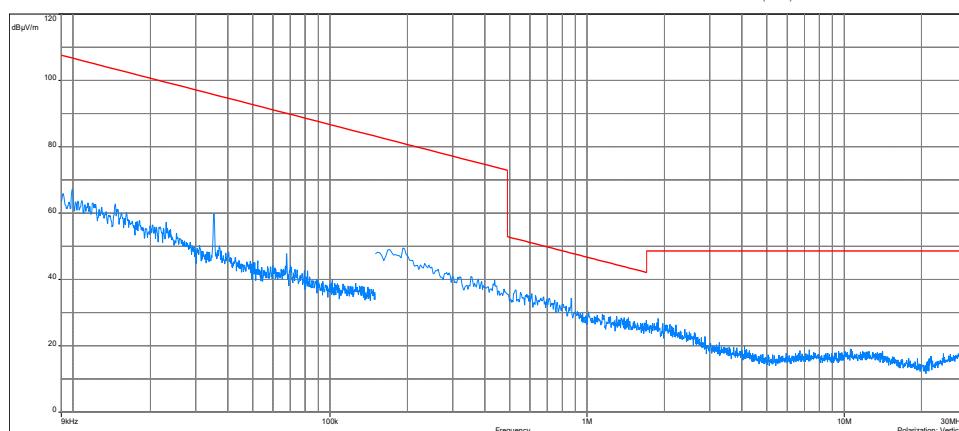
Peak (Horizontal)

 Antenna
Position -
Coaxial


Model: ; Client: ; Comments: ; Test Date: 10/06/2022 18:34

FCC Part 15CFCC 15.209, 9kHz - 30MHz at 10m - QPeak/10.0m

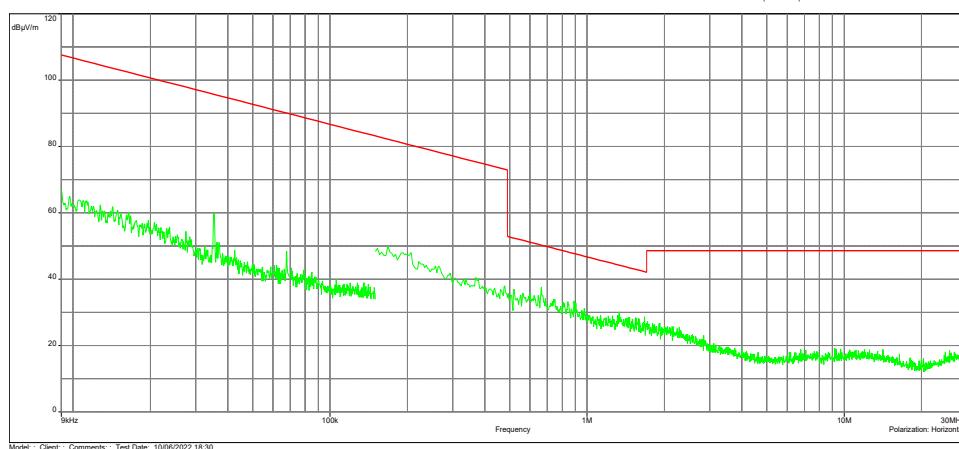
Peak (Horizontal)

 Antenna
Position -
Coplanar


Model: ; Client: ; Comments: ; Test Date: 10/06/2022 18:34

FCC Part 15CFCC 15.209, 9kHz - 30MHz at 10m - QPeak/10.0m

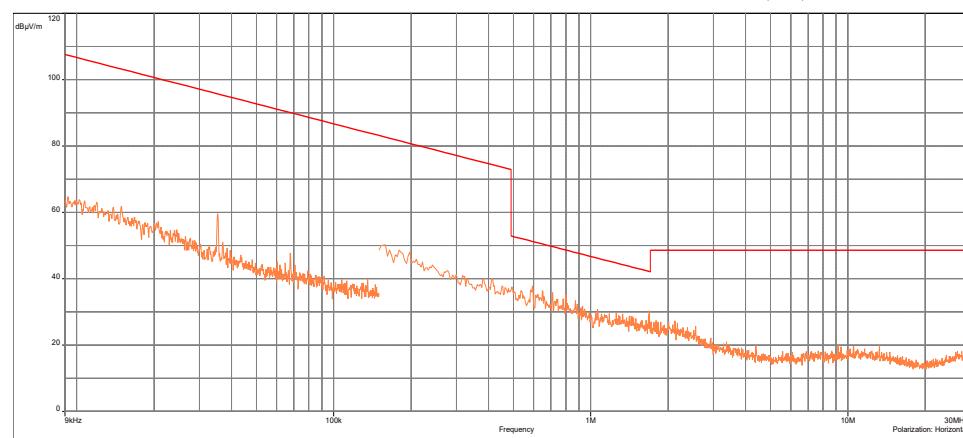
Peak (Vertical)

 Antenna
Position -
Horizontal


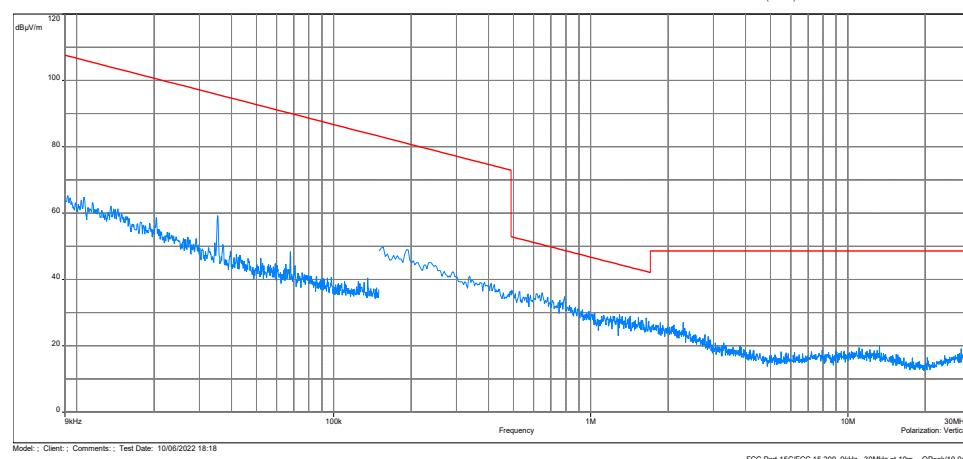
Model: ; Client: ; Comments: ; Test Date: 10/06/2022 18:30

Out-of-Band Radiated Spurious Emissions High Channel, Tx at 2480MHz Normal Mode

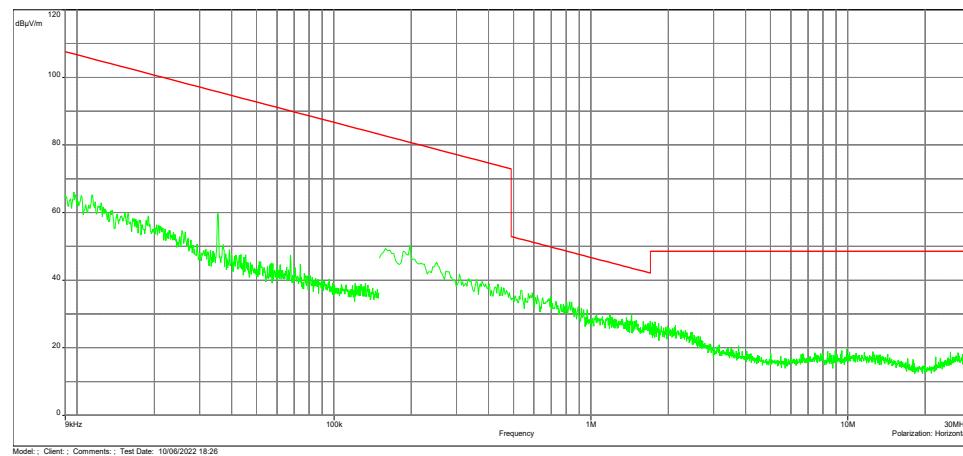
Antenna Position -
Coaxial



Antenna Position -
Coplanar

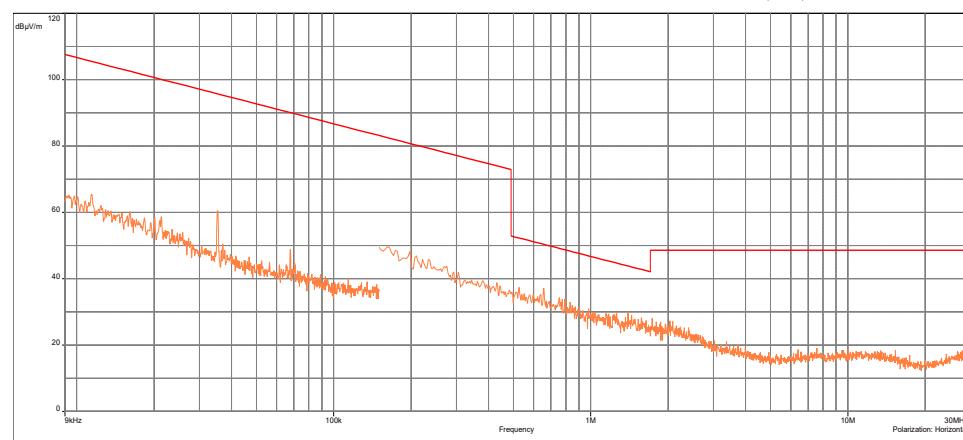


Antenna Position -
Horizontal

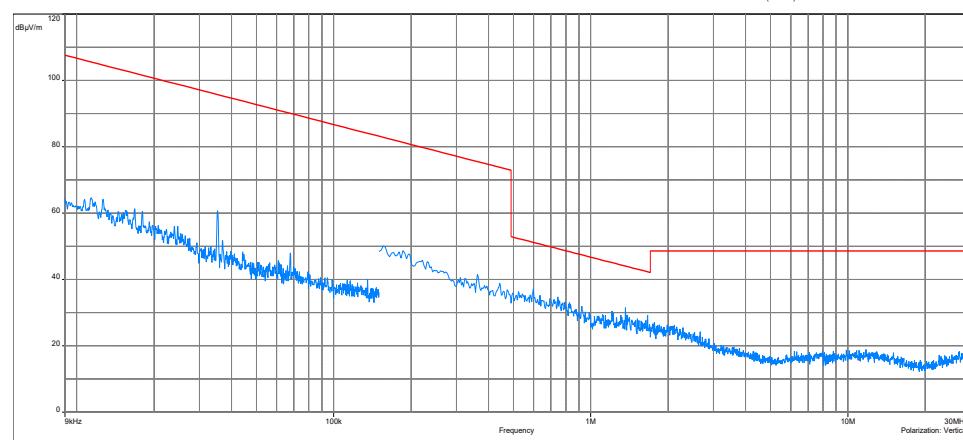


Out-of-Band Radiated Spurious Emissions Low Channel, Tx at 2402MHz Charging Mode

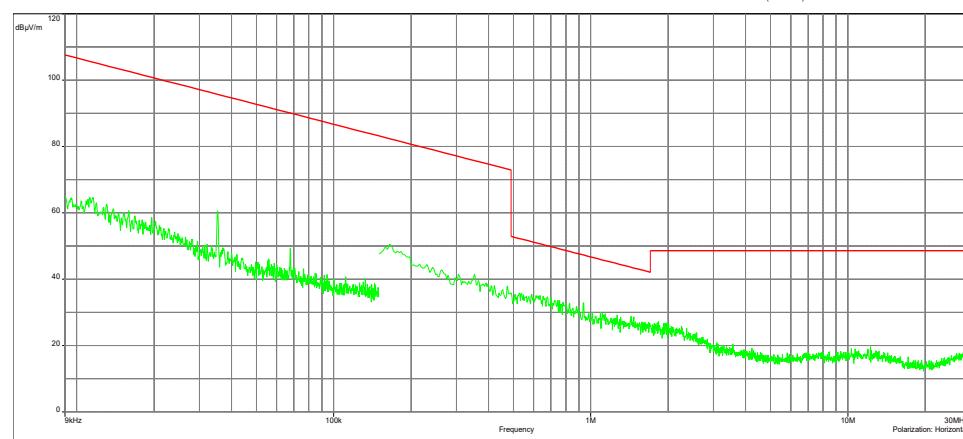
Antenna Position -
Coaxial



Antenna Position -
Coplanar

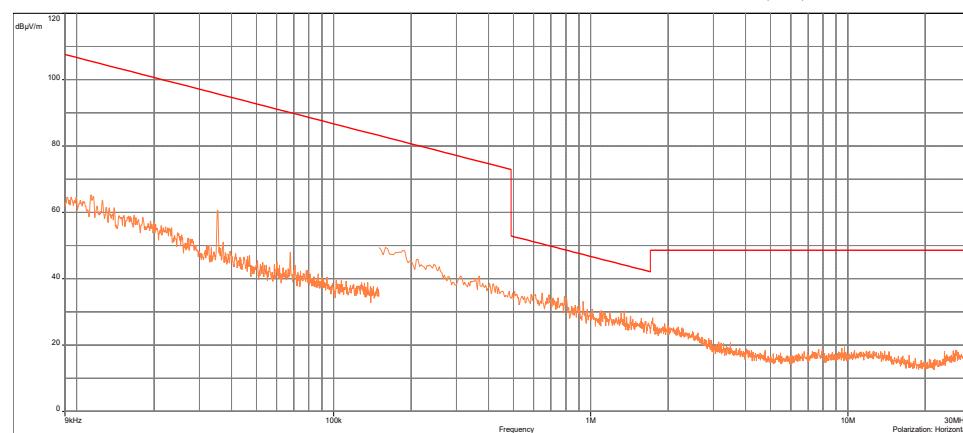


Antenna Position -
Horizontal

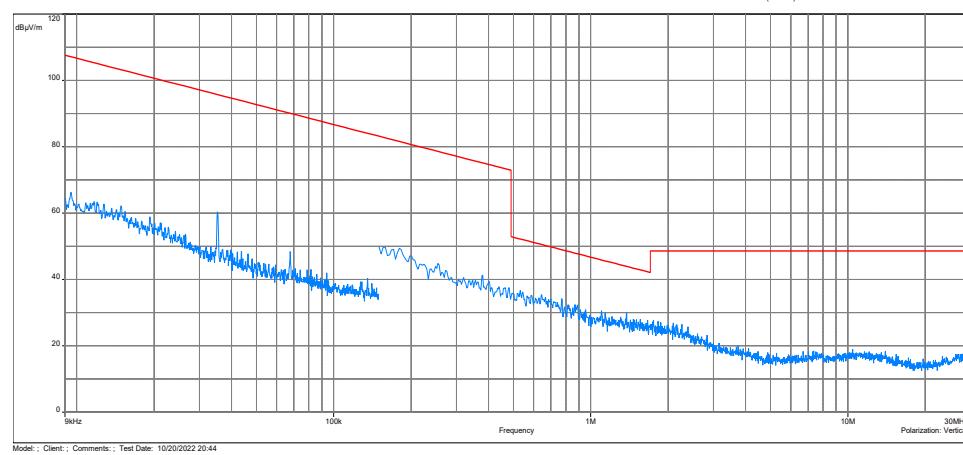


Out-of-Band Radiated Spurious Emissions Mid Channel, Tx at 2442MHz Charging Mode

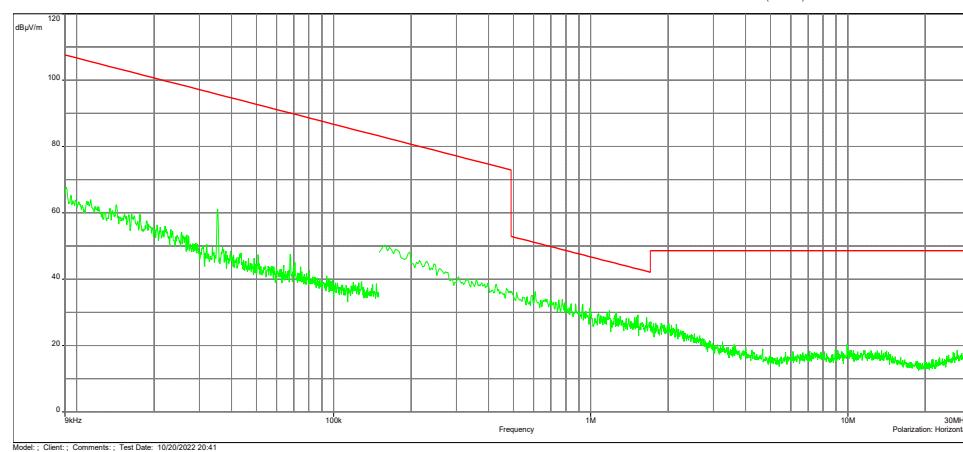
Antenna Position -
Coaxial



Antenna Position -
Coplanar

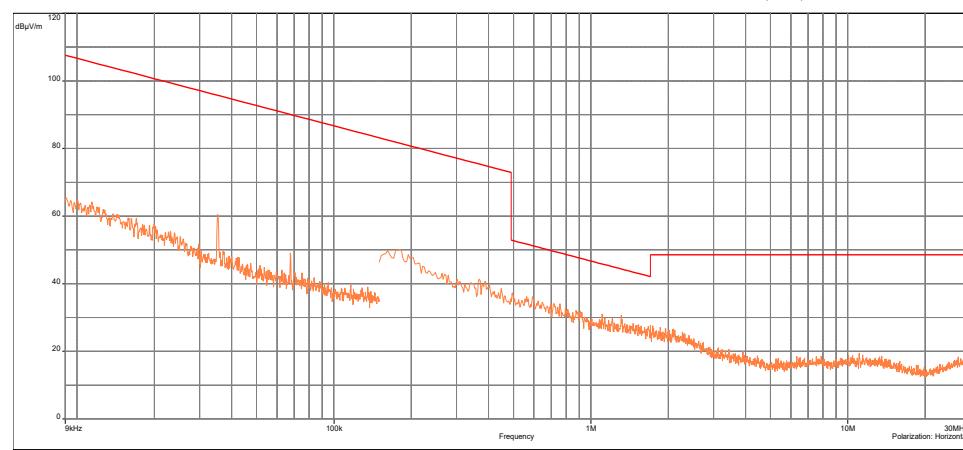


Antenna Position -
Horizontal

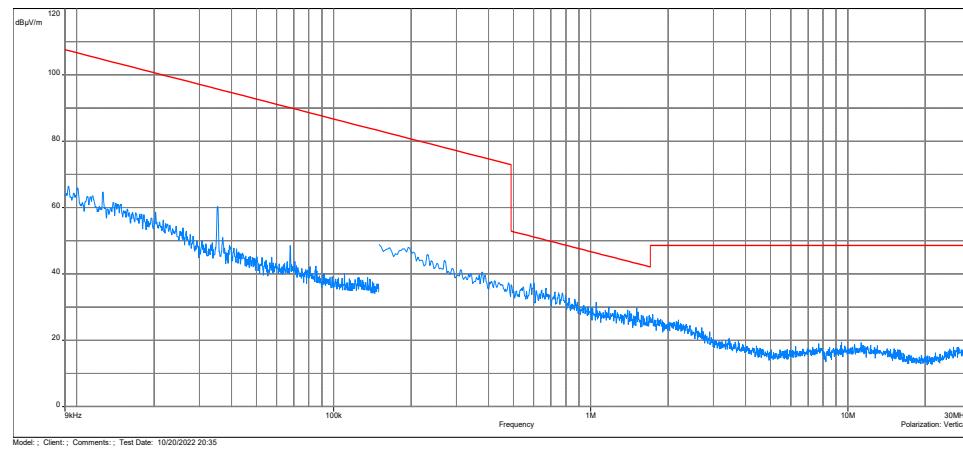


Out-of-Band Radiated Spurious Emissions High Channel, Tx at 2480MHz Charging Mode

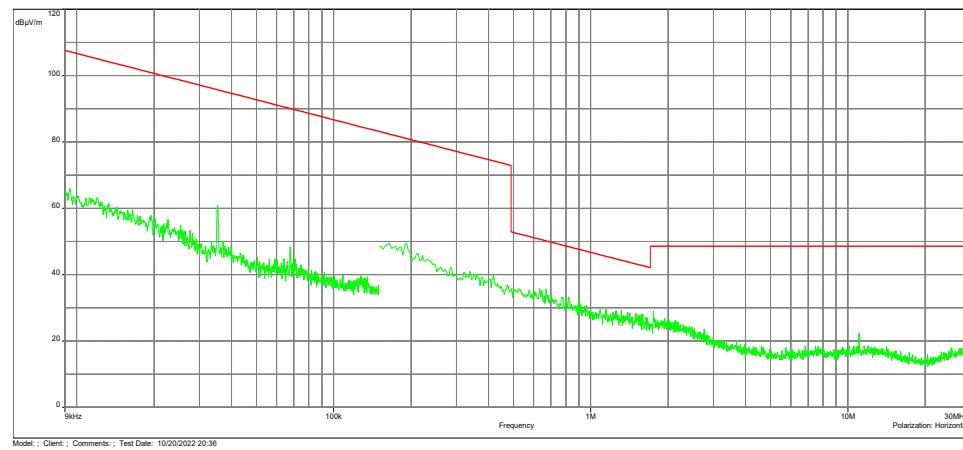
Antenna Position -
Coaxial



Antenna Position -
Coplanar

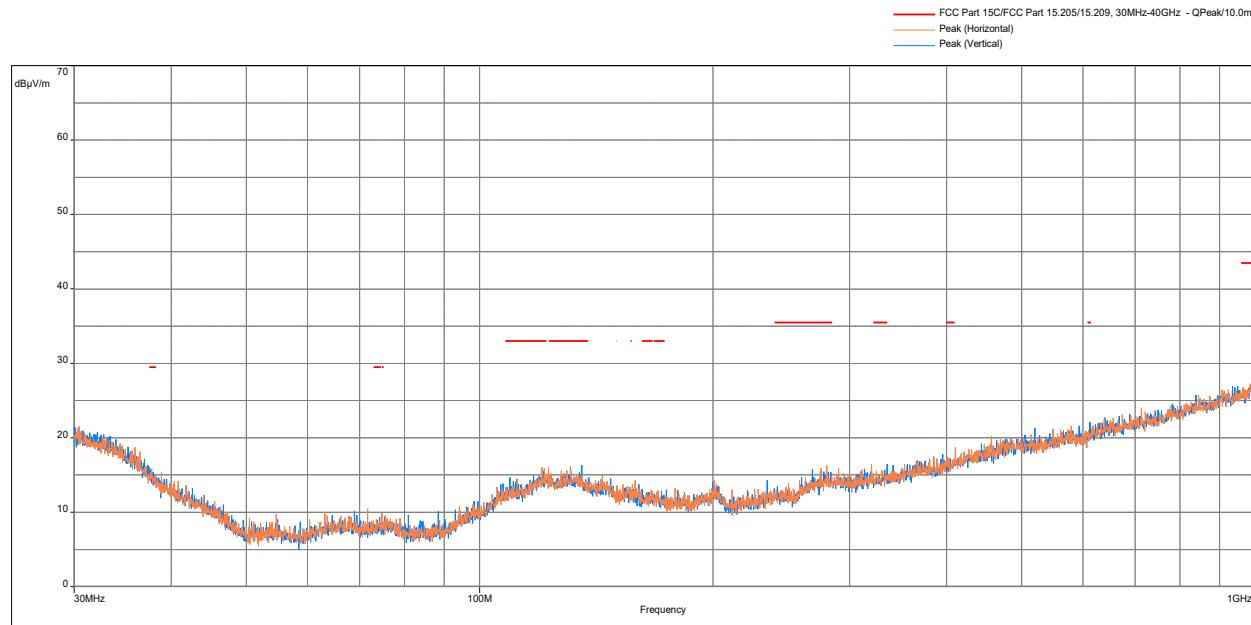


Antenna Position -
Horizontal

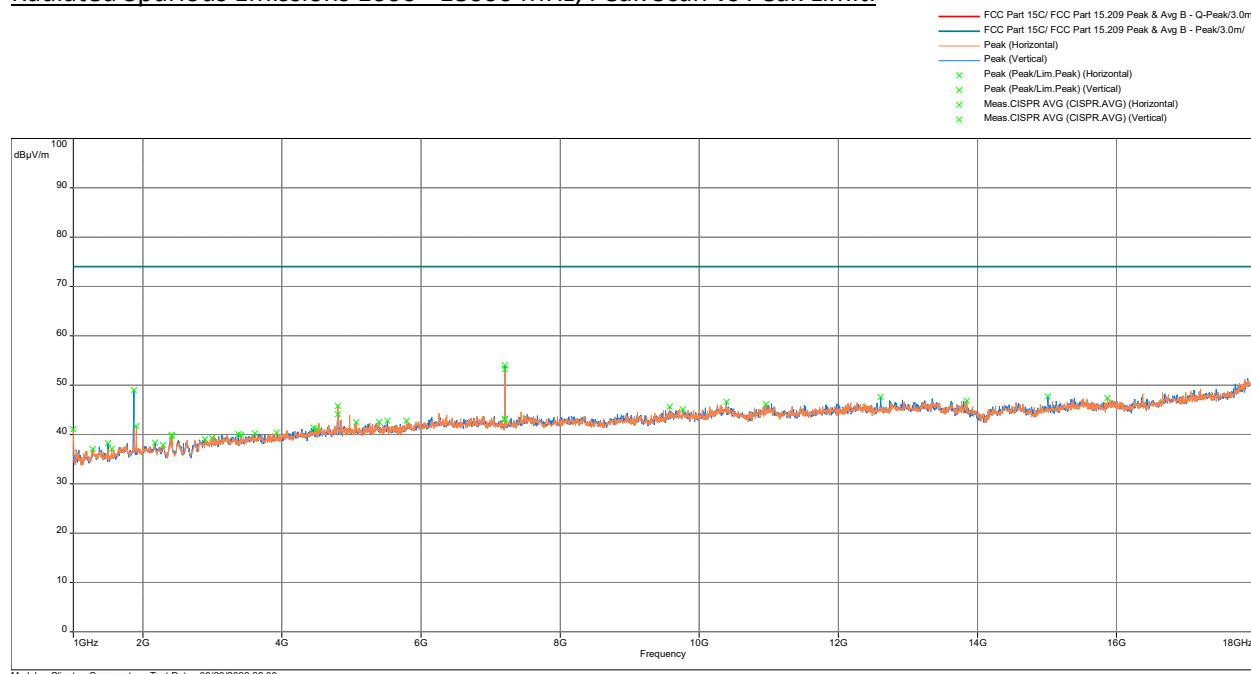


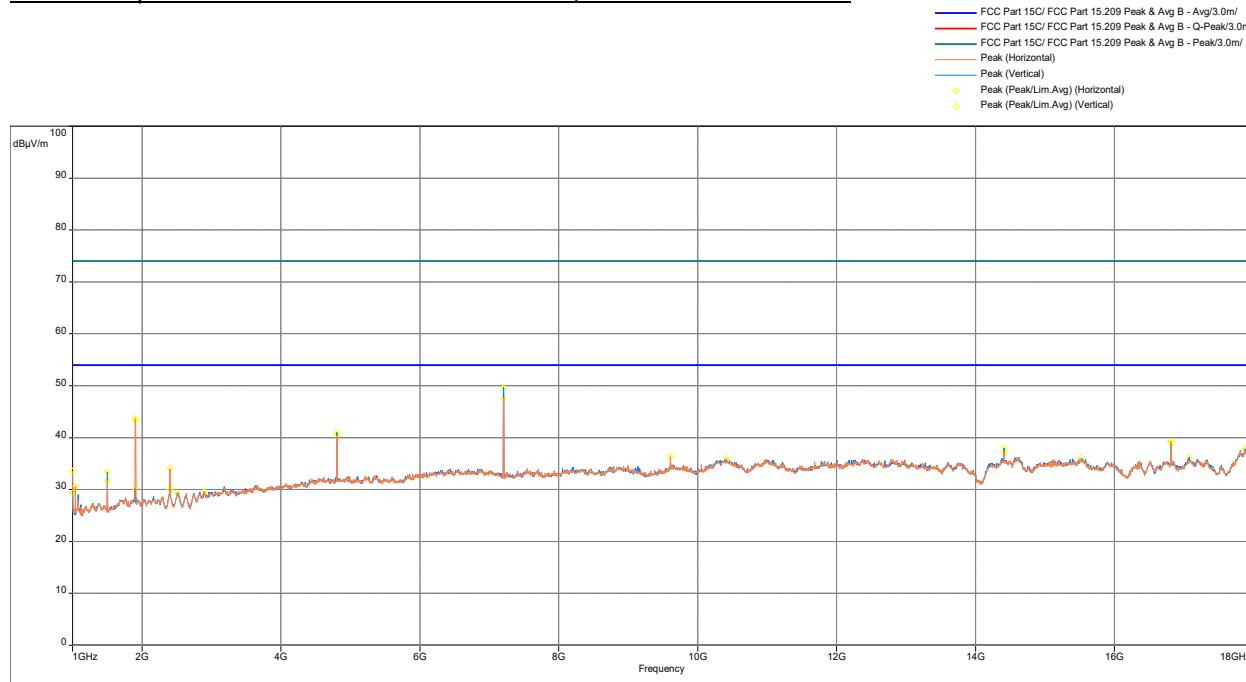
Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 2402MHz Normal Mode

Radiated Spurious Emissions 30 MHz - 1000 MHz



Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak Limit.

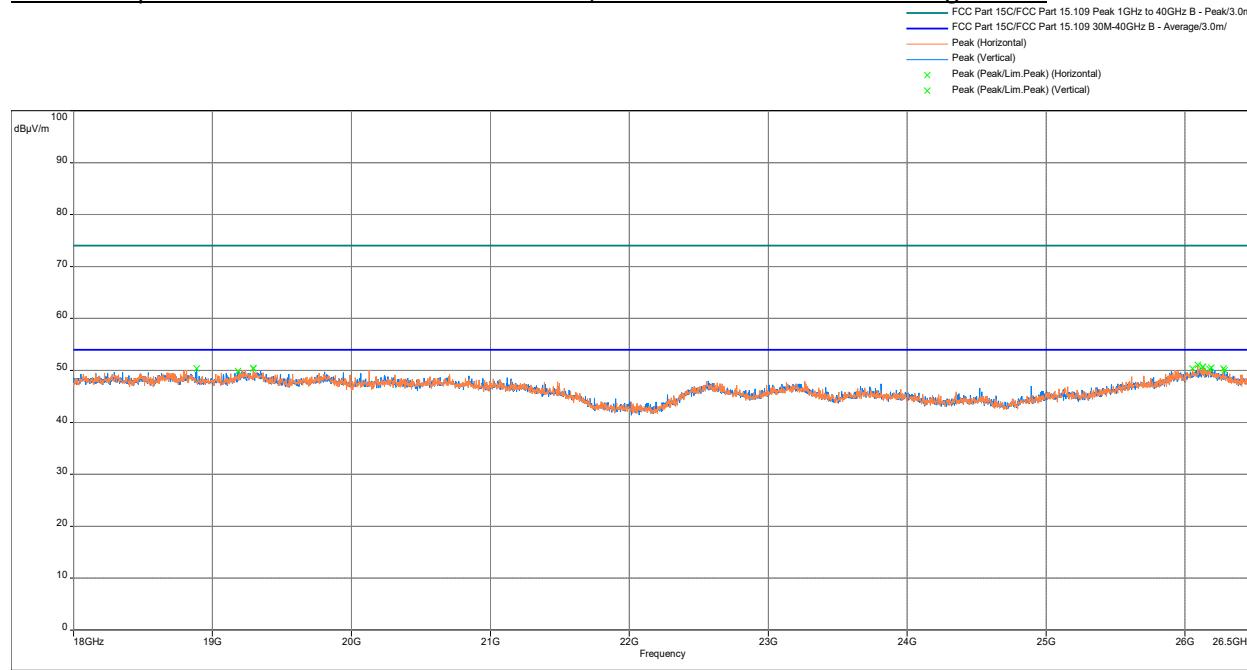


Radiated Spurious Emissions 1000 - 18000 MHz, Ave Scan vs Ave Limit.


Model: ; Client: ; Comments: ; Test Date: 09/29/2022 22:58

Frequency (MHz)	Ave @3m (dB μ V/m)	Lim. Ave @3m (dB μ V/m)	Margin dB	Height (m)	Angle (°)	Comment	Correction (dB)
7204.433	49.68	54	-4.32	1.49	173	Vertical	-3.46
7205	47.62	54	-6.38	1.51	143.5	Horizontal	-3.46
1900.433	43.67	54	-10.33	2.51	129.75	Horizontal	-14
1908.933	43.35	54	-10.65	2.51	108.5	Horizontal	-14.02
4803.467	41.05	54	-12.95	1.49	151.25	Vertical	-6.77
4803.467	40.48	54	-13.52	3.49	253	Horizontal	-6.77

Note: Correction = AF + CF - Preamp

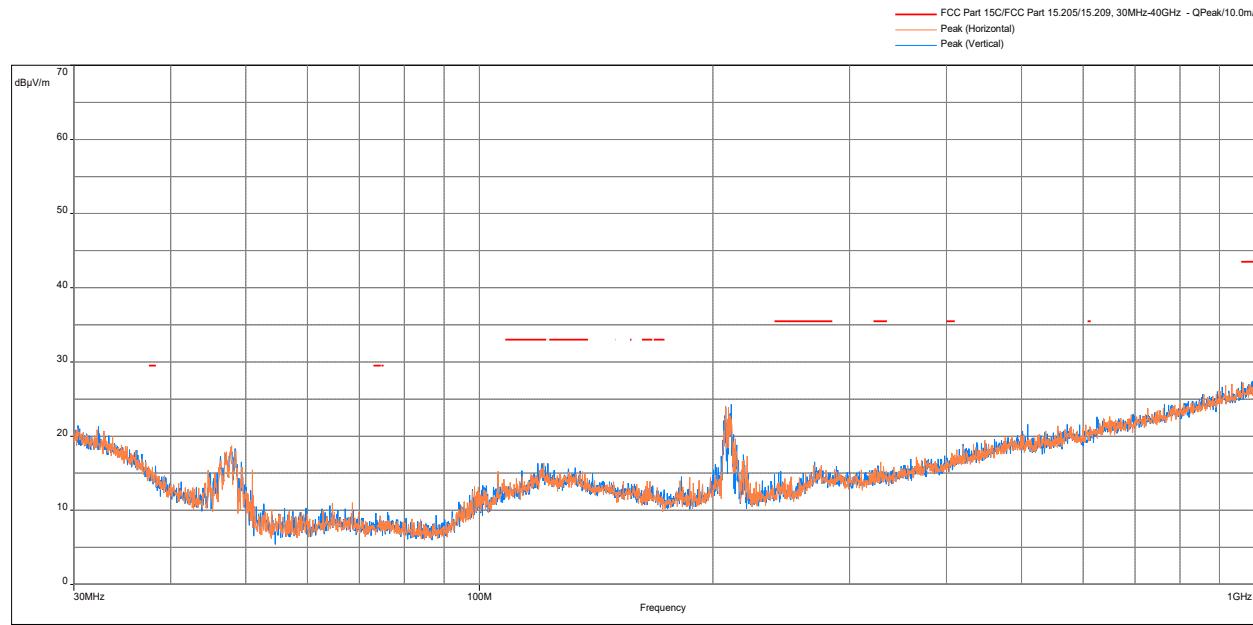
Radiated Spurious Emissions 18000 - 26000 MHz, Peak Scan vs Peak and Average Limit.

Note: Correction = AF + CF - Preamp

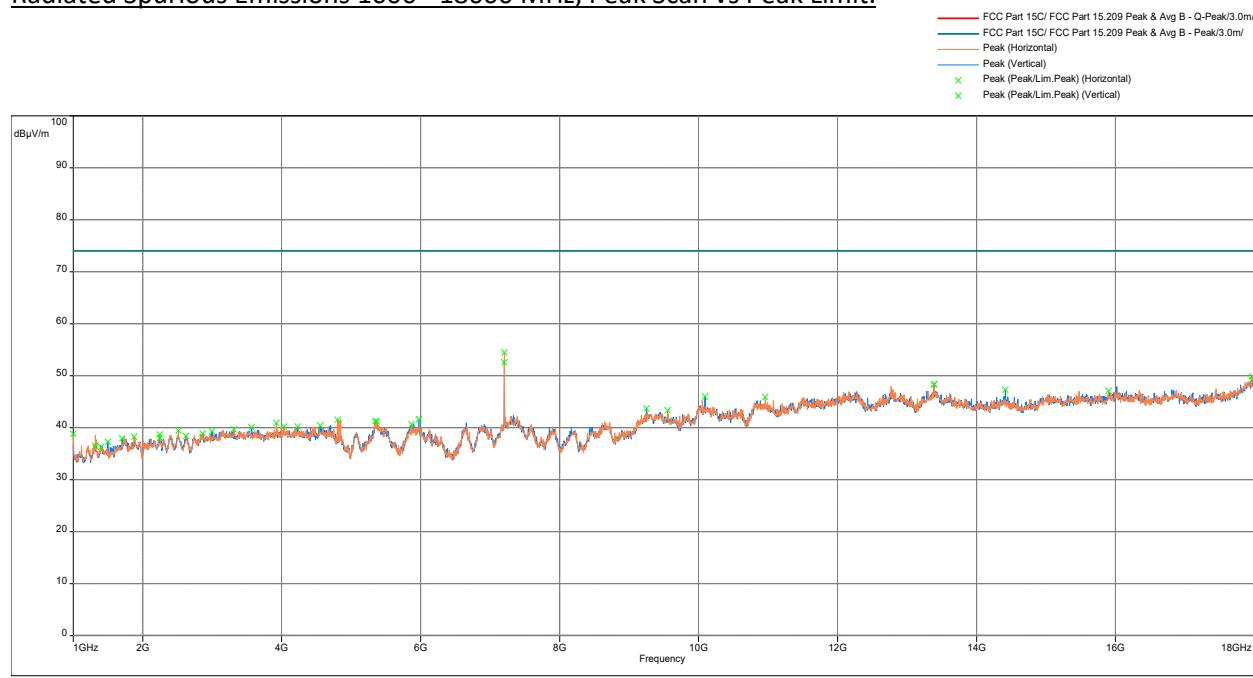
Results**Complies**

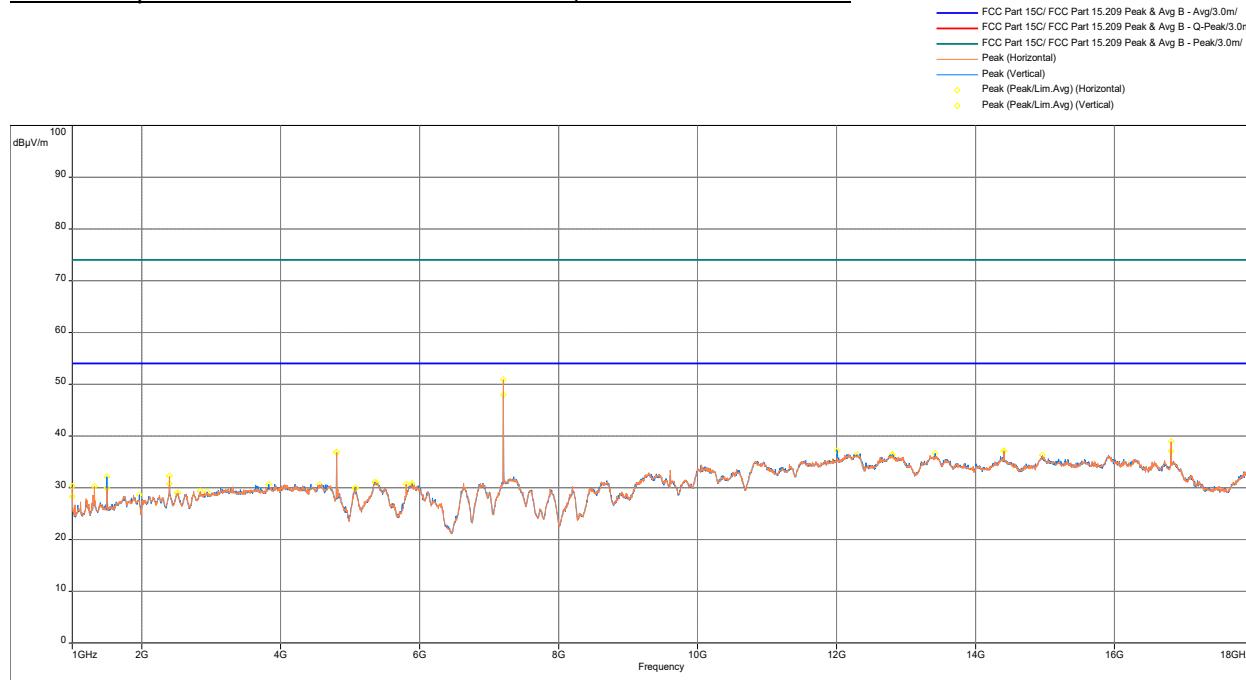
Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 2402MHz Charging Mode

Radiated Spurious Emissions 30 MHz - 1000 MHz



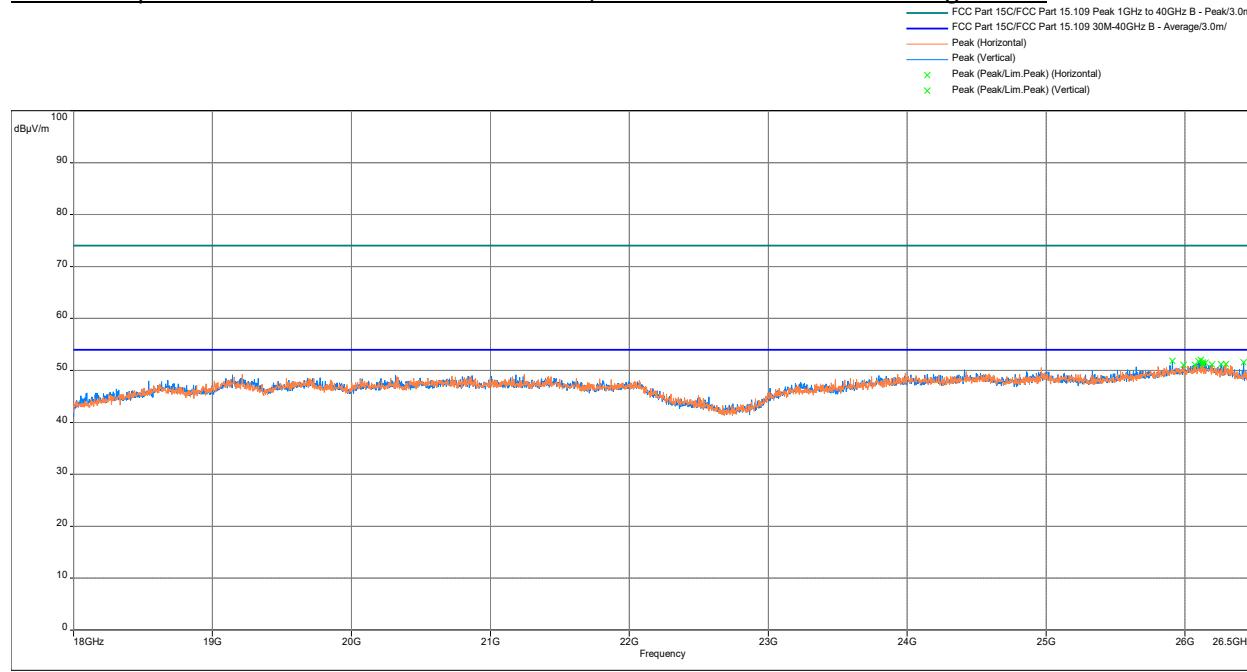
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak Limit.



Radiated Spurious Emissions 1000 - 18000 MHz, Ave Scan vs Ave Limit.


Frequency (MHz)	Ave @3m (dBµV/m)	Lim. Ave @3m (dBµV/m)	Margin dB	Height (m)	Angle (°)	Comment	Correction (dB)
7205	50.94	54	-3.06	2.51	65	Horizontal	-3.99
7205	48.03	54	-5.97	1.51	195	Vertical	-3.99
16814.53	38.94	54	-15.06	2.51	65	Horizontal	3.77
12010.33	37.21	54	-16.79	3.49	43.5	Vertical	-0.09
14410.73	37.14	54	-16.86	1.51	282.75	Vertical	-0.5
16814.53	37.11	54	-16.89	3.49	152.25	Vertical	3.77

Note: Correction = AF + CF - Preamp

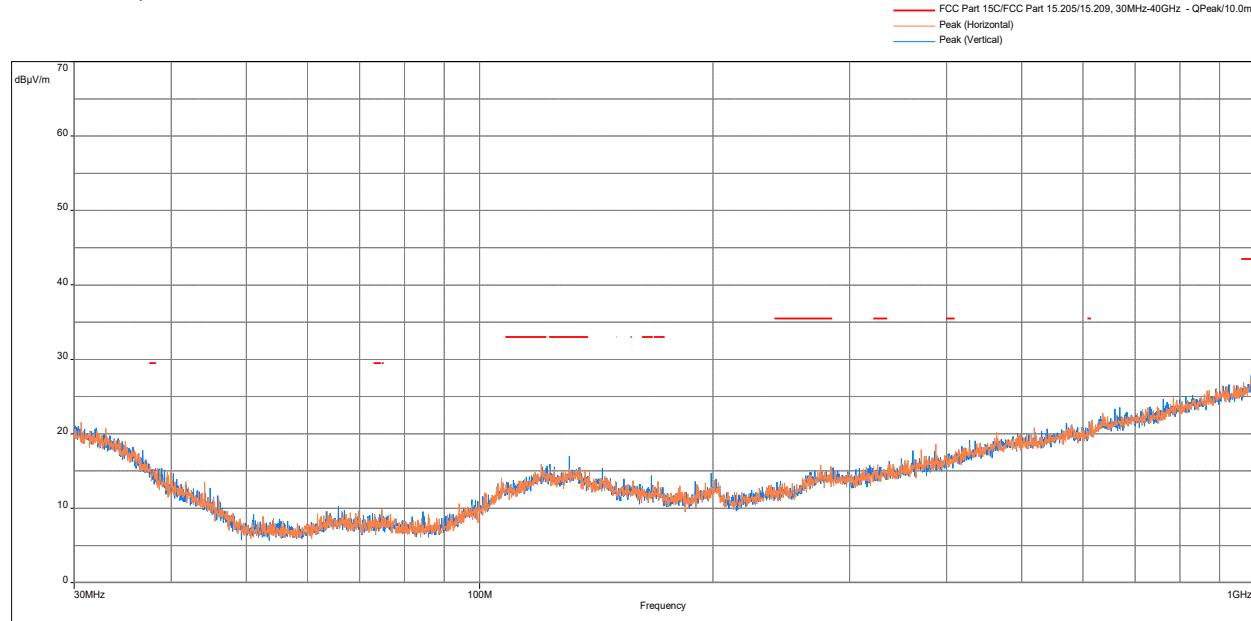
Radiated Spurious Emissions 18000 - 26000 MHz, Peak Scan vs Peak and Average Limit.

Note: Correction = AF + CF - Preamp

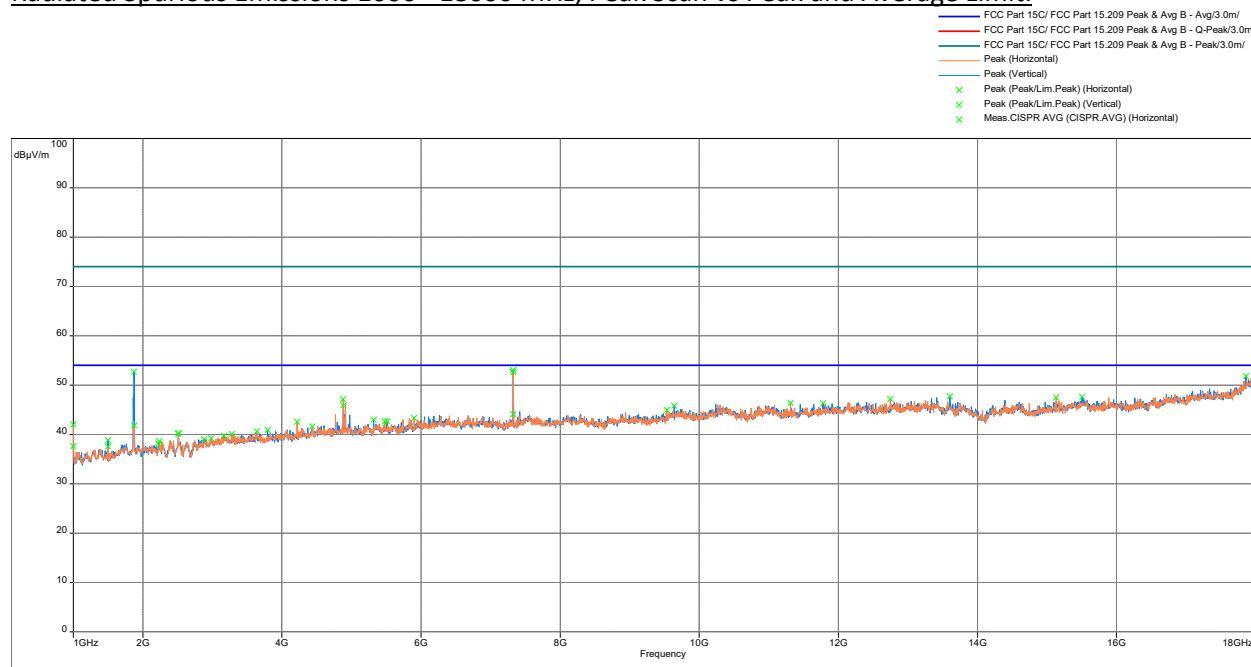
Results**Complies**

Test Results: 15.209 Radiated Spurious Emissions Mid Channel, Tx at 2442 MHz Normal Mode

Radiated Spurious Emissions 30 MHz - 1000 MHz



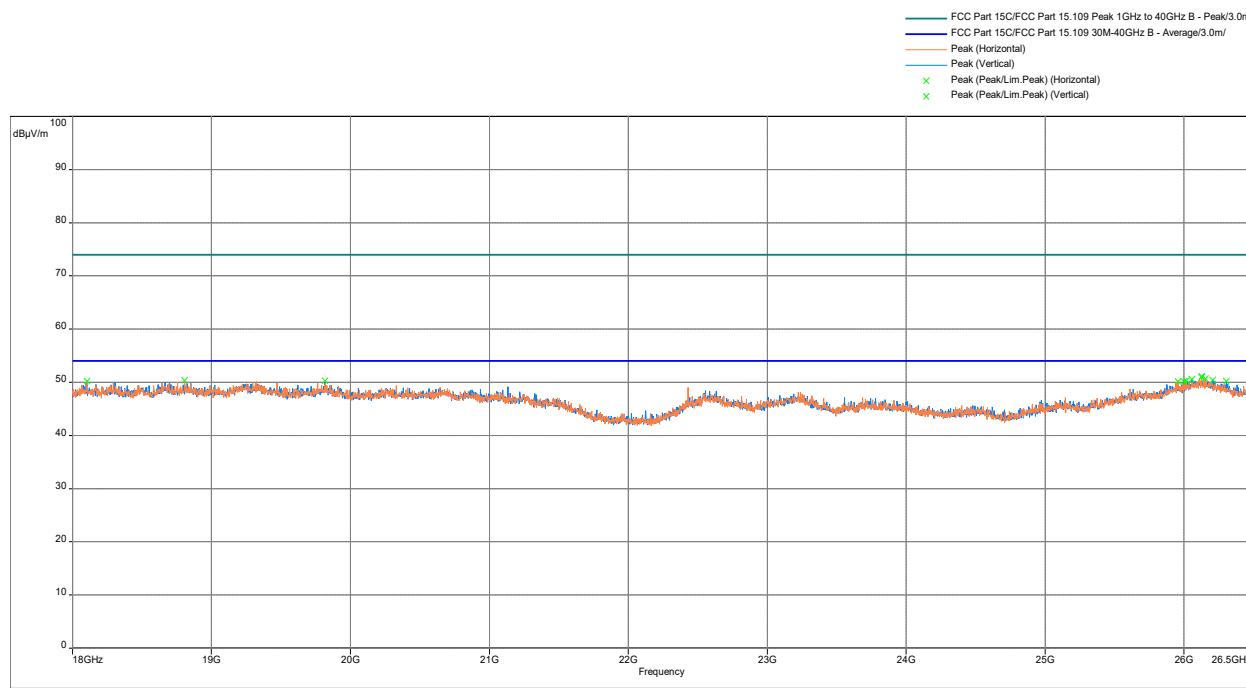
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak and Average Limit.



Frequency (MHz)	Peak @3m (dB μ V/m)	Lim. Ave @3m (dB μ V/m)	Margin dB	Height (m)	Angle (°)	Comment	Correction (dB)
7325.7	53.03	54	-0.97	1.51	252.75	Horizontal	-3.36
1869.833	52.68	54	-1.32	3.51	223.75	Vertical	-14.09
7324.567	52.66	54	-1.34	3.51	168	Vertical	-3.36
17861.17	51.83	54	-2.17	2.51	325.25	Vertical	8.24
17981.3	51.54	54	-2.46	3.49	239	Horizontal	9.16
13602.1	47.74	54	-6.26	3.51	311.5	Vertical	2.23

Note: Correction = AF + CF - Preamp

Radiated Spurious Emissions 18000 - 26000 MHz, Peak Scan vs Peak and Average Limit.

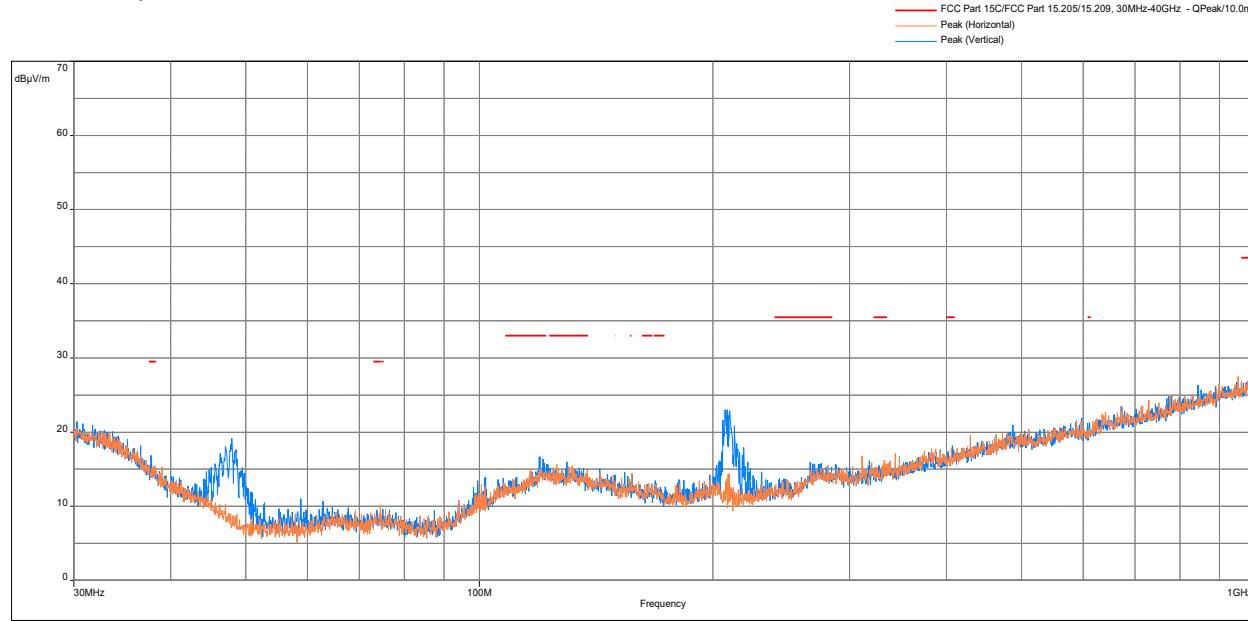


Note: Correction = AF + CF - Preamp

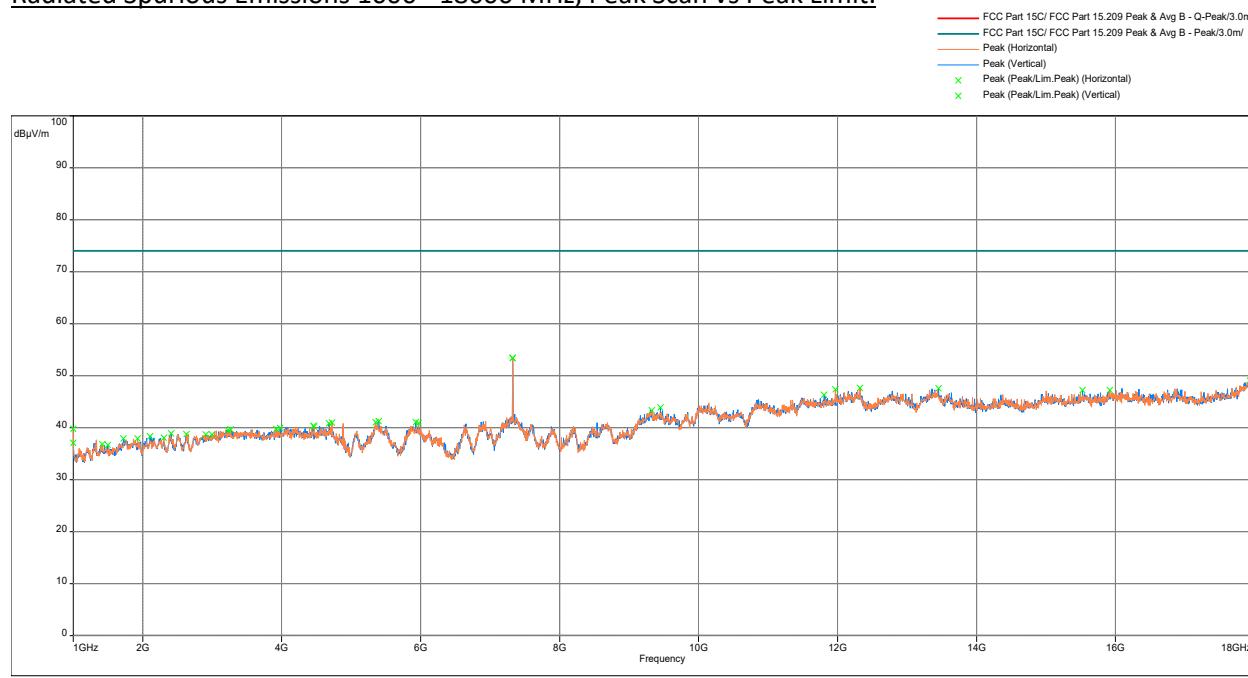
Results	Complies
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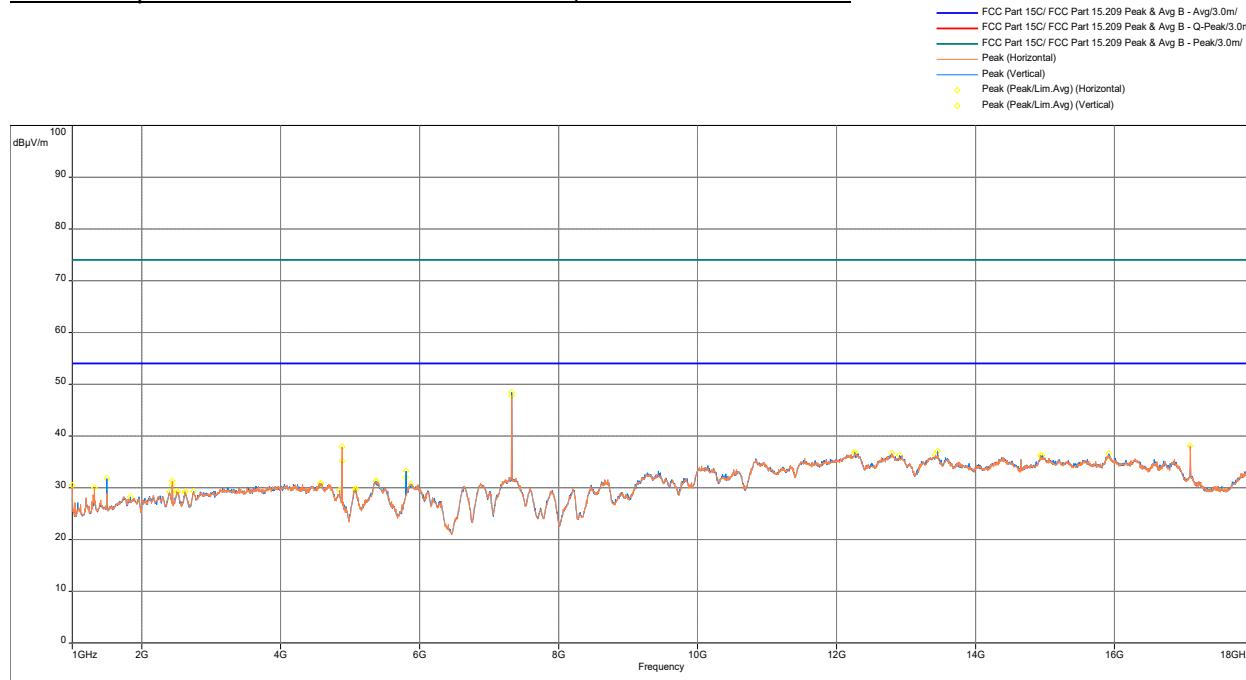
Test Results: 15.209 Radiated Spurious Emissions Mid Channel, Tx at 2442 MHz Charging Mode

Radiated Spurious Emissions 30 MHz - 1000 MHz



Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak Limit.

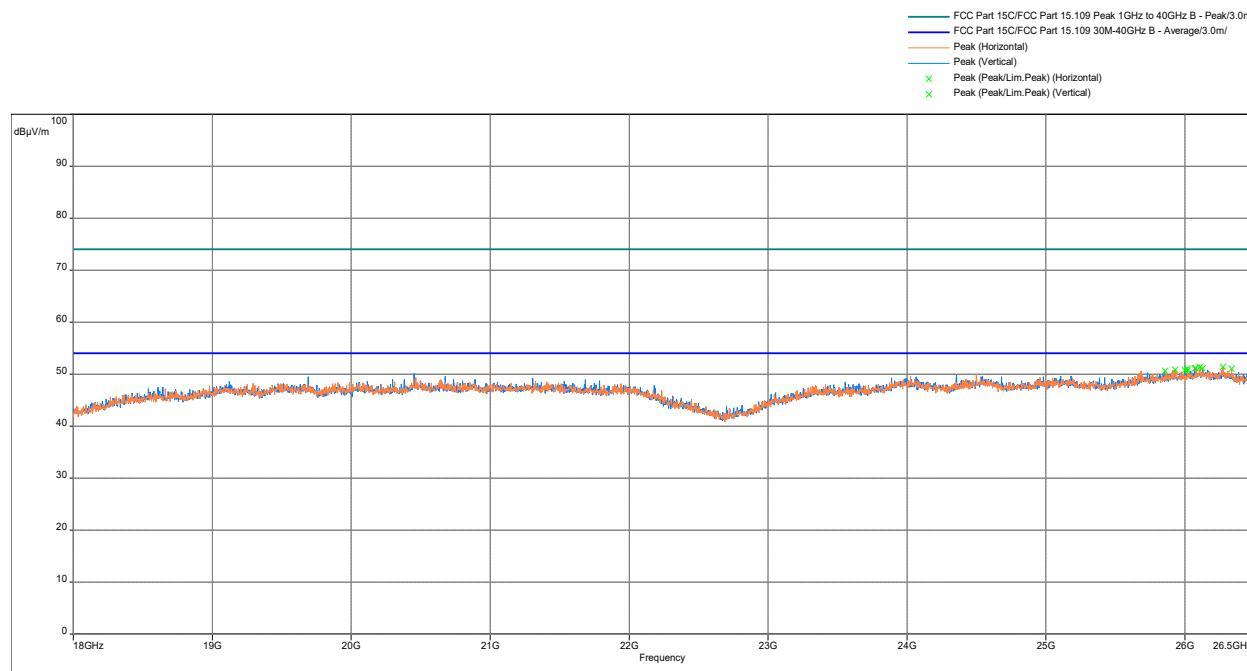


Radiated Spurious Emissions 1000 - 18000 MHz, Ave Scan vs Ave Limit.


Model: ; Client: ; Comments: ; Test Date: 10/19/2022 20:15

Frequency (MHz)	Ave @3m (dB μ V/m)	Lim. Ave @3m (dB μ V/m)	Margin dB	Height (m)	Angle (°)	Comment	Correction (dB)
7326.267	48.51	54	-5.49	1.51	195	Vertical	-3.89
7325.133	47.78	54	-6.22	3.49	57.5	Horizontal	-3.89
17091.07	38.13	54	-15.87	2.51	64.75	Horizontal	4.41
4883.367	37.92	54	-16.08	2.51	260.5	Horizontal	-7.15
13453.07	37.07	54	-16.93	2.49	165.25	Vertical	2.39
12261.37	36.88	54	-17.12	1.51	87	Vertical	0.02

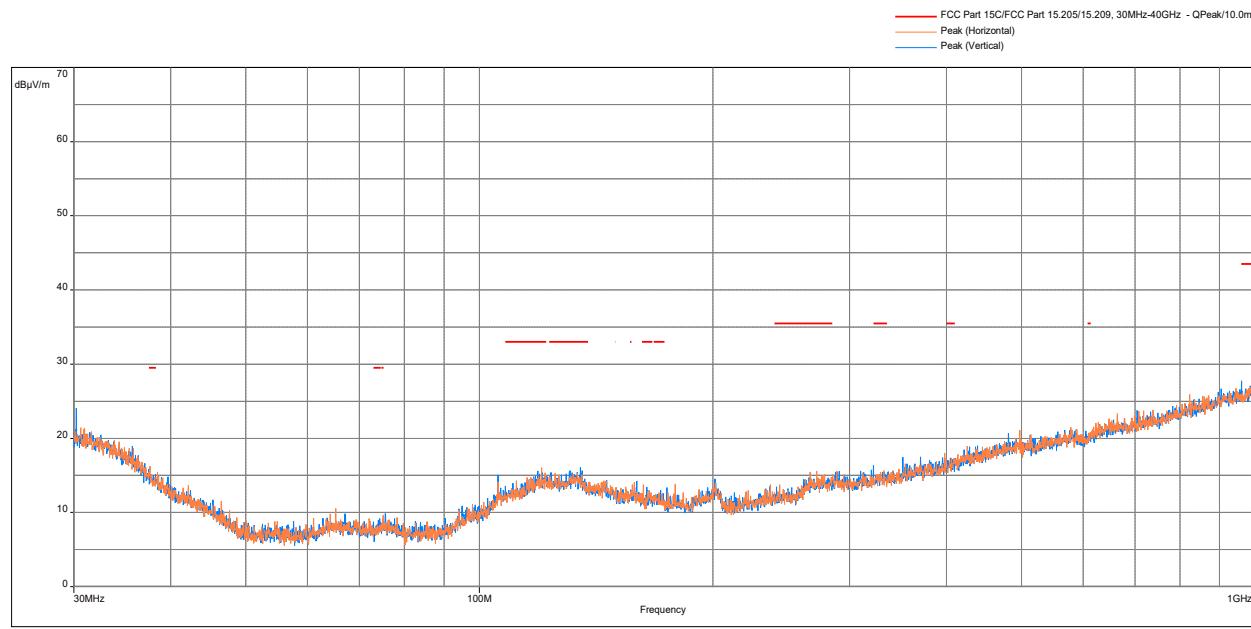
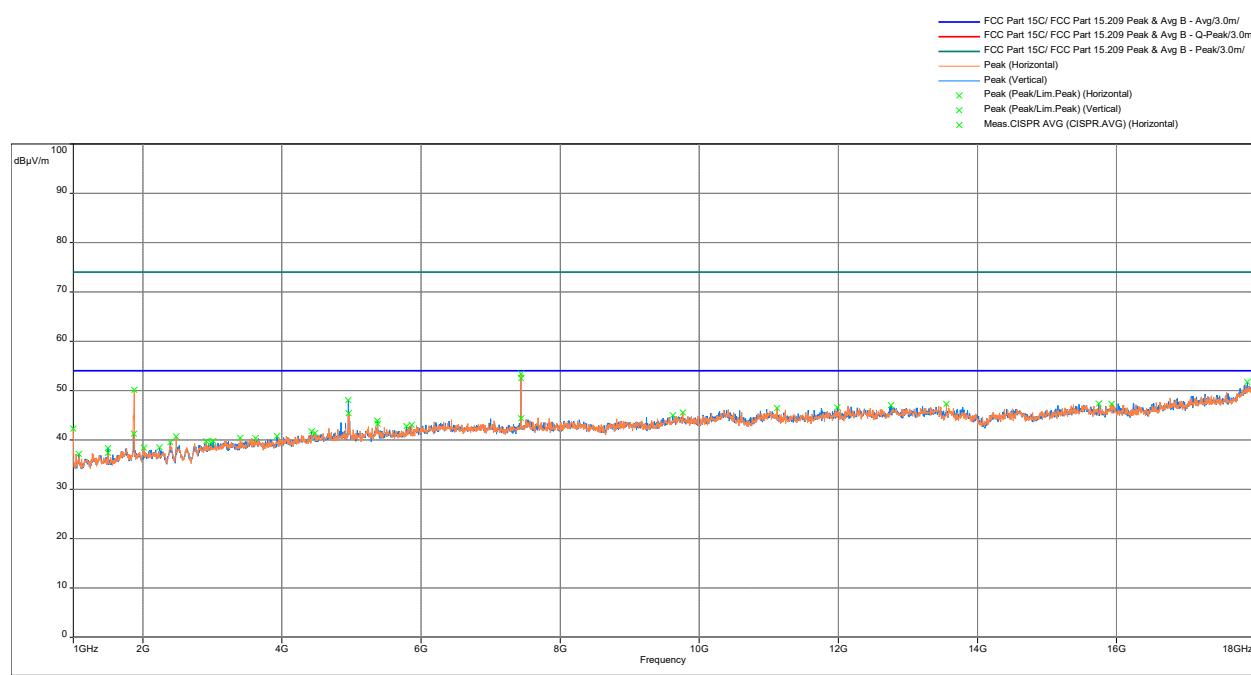
Note: Correction = AF + CF - Preamp

Radiated Spurious Emissions 18000 - 26000 MHz, Peak Scan vs Peak Limit.

Note: Correction = AF + CF - Preamp

Results**Complies**

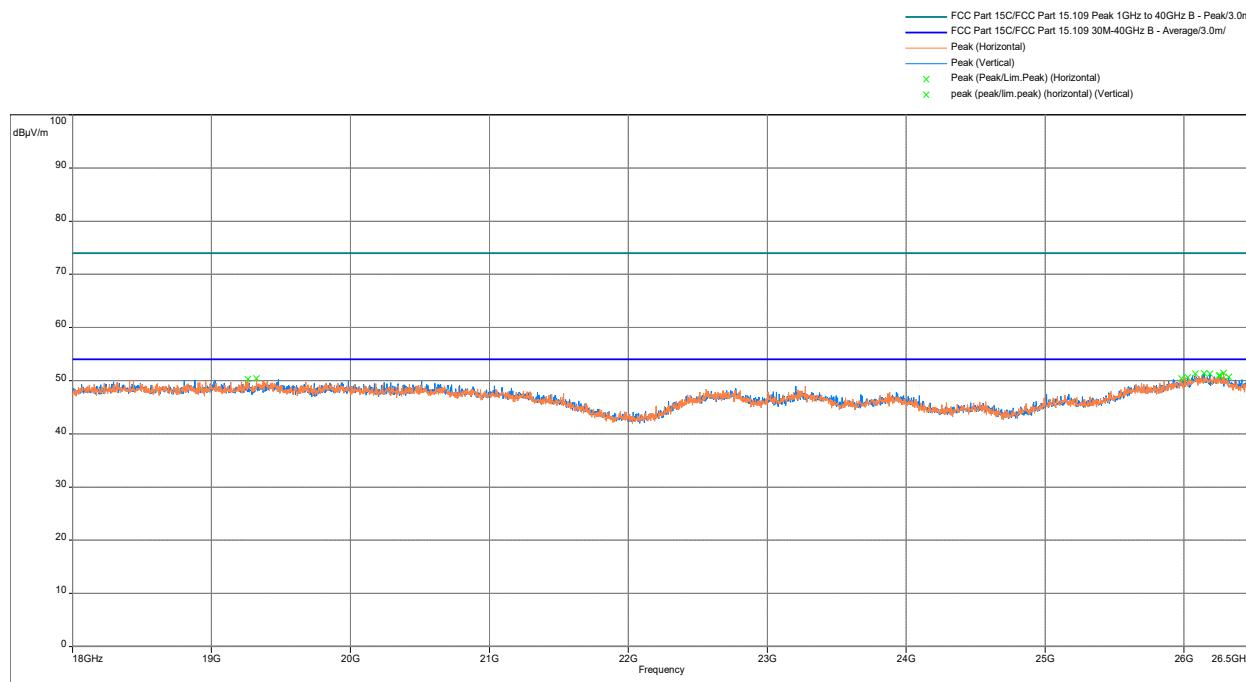
Test Results: 15.209 Radiated Spurious Emissions High Channel, Tx at 2480MHz Normal Mode

Radiated Spurious Emissions 30 MHz - 1000 MHz

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak and Average Limit.


Frequency (MHz)	Peak @3m (dB μ V/m)	Lim. Ave @3m (dB μ V/m)	Margin dB	Height (m)	Angle (°)	Comment	Correction (dB)
7439.6	53.41	54.0	-0.59	2.51	260.25	Horizontal	-3.12
7438.467	52.52	54.0	-1.48	3.49	147.25	Vertical	-3.12
17882.13	51.72	54.0	-2.28	1.51	2	Vertical	8.4
17984.13	51.23	54.0	-2.77	3.49	136.75	Horizontal	9.18
1877.767	50.16	54.0	-3.84	2.51	112.25	Horizontal	-14.05
4954.767	48.05	54.0	-5.95	1.51	99.25	Vertical	-6.66

Note: Correction = AF + CF - Preamp

Radiated Spurious Emissions 18000 - 26000 MHz, Peak Scan vs Peak and Average Limit.



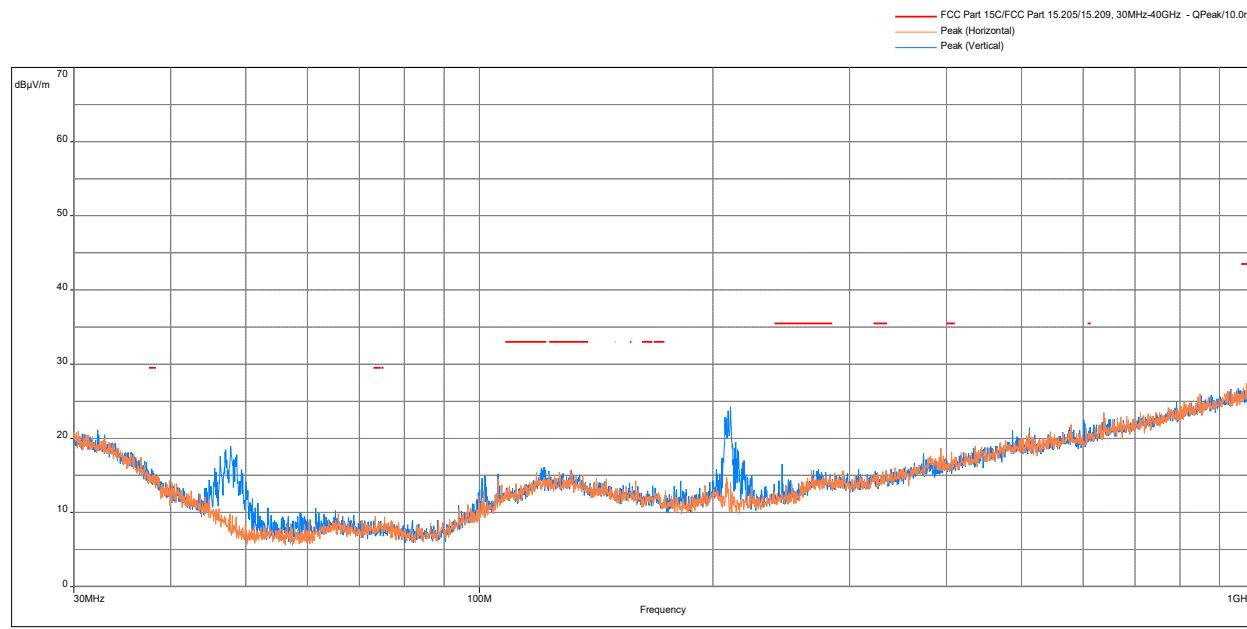
Note: Correction = AF + CF - Preamp

Results

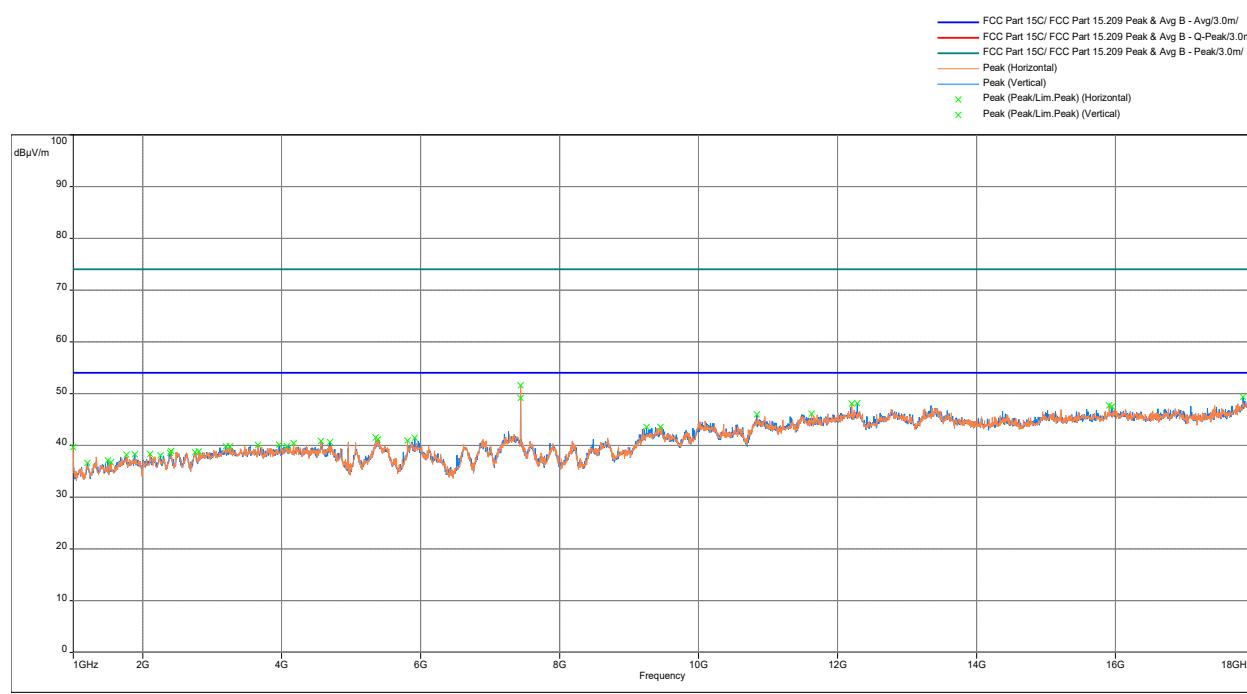
Complies

Test Results: 15.209 Radiated Spurious Emissions High Channel, Tx at 2480MHz Charging Mode

Radiated Spurious Emissions 30 MHz - 1000 MHz



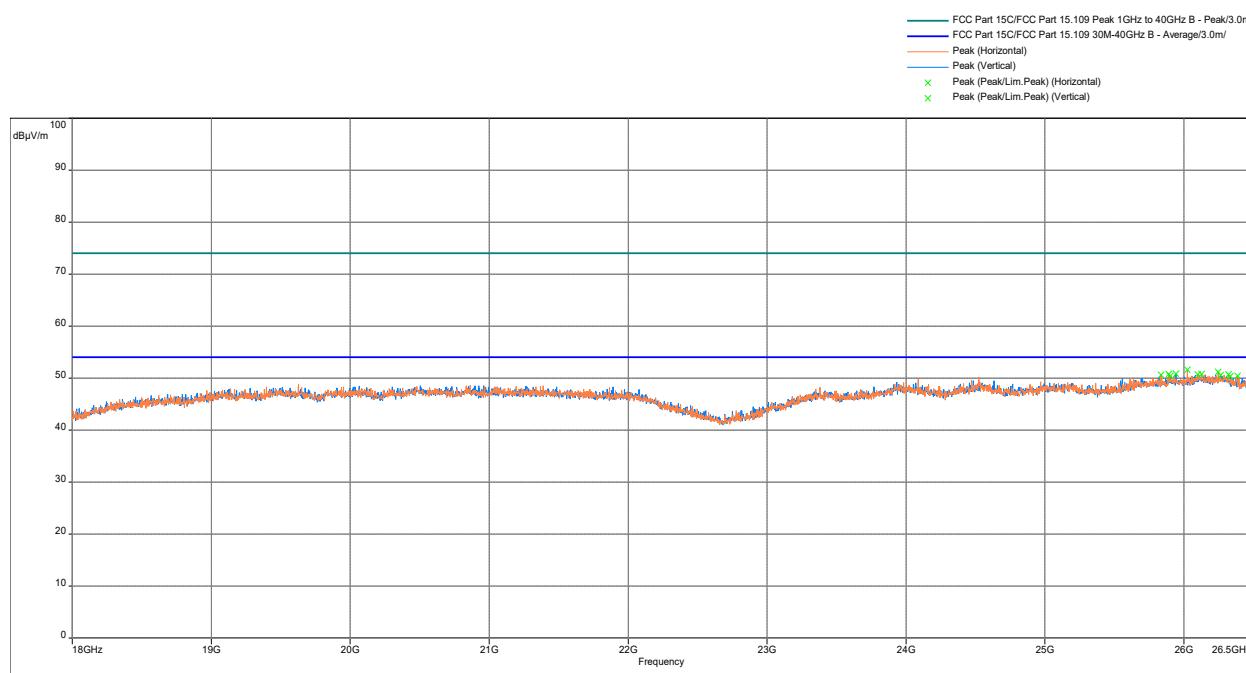
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak and Average Limit.



Frequency (MHz)	Peak @3m (dB μ V/m)	Lim. Ave @3m (dB μ V/m)	Margin dB	Height (m)	Angle (°)	Comment	Correction (dB)
7440.167	51.64	54.0	-2.36	3.49	50.5	Horizontal	-3.66
17947.87	50.08	54.0	-3.92	1.51	150.5	Horizontal	7.85
17835.1	49.35	54.0	-4.65	2.49	337.25	Vertical	7.07
7438.467	49.15	54.0	-4.85	1.51	151.25	Vertical	-3.66
12284.6	48.1	54.0	-5.9	3.49	347.75	Vertical	0.06
12205.27	48.08	54.0	-5.92	2.51	37.5	Horizontal	-0.03

Note: Correction = AF + CF - Preamp

Radiated Spurious Emissions 18000 - 26000 MHz, Peak Scan vs Peak Limit.



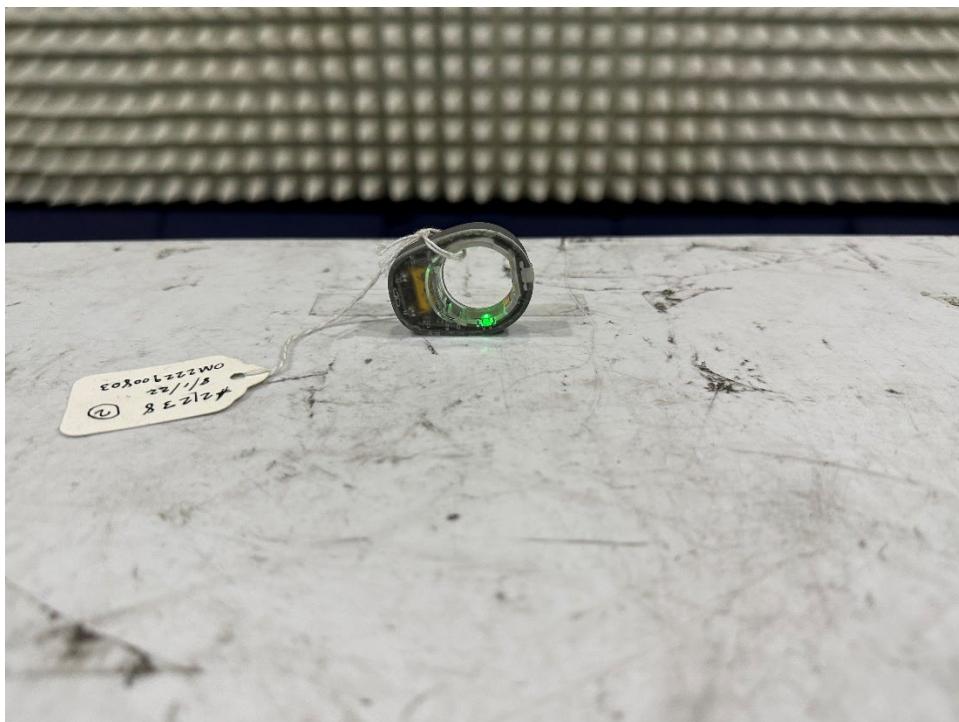
Note: Correction = AF + CF - Preamp

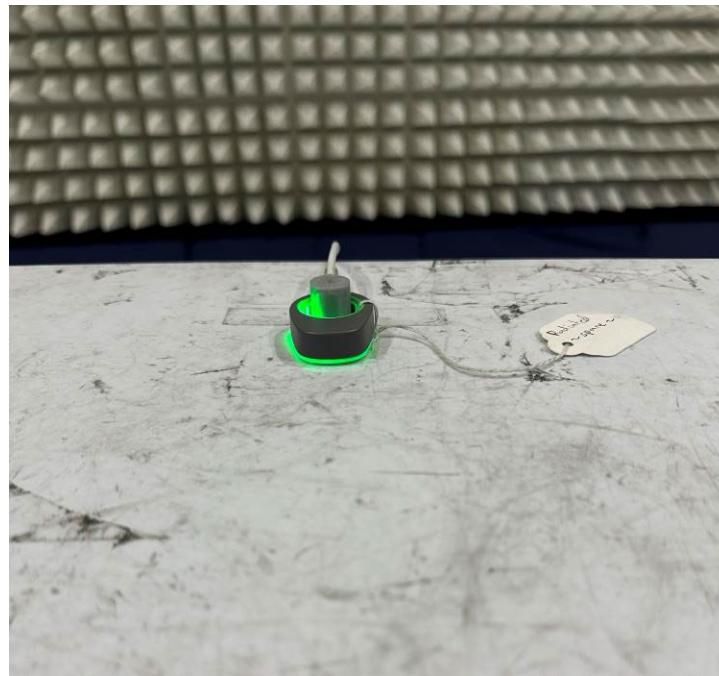
Results

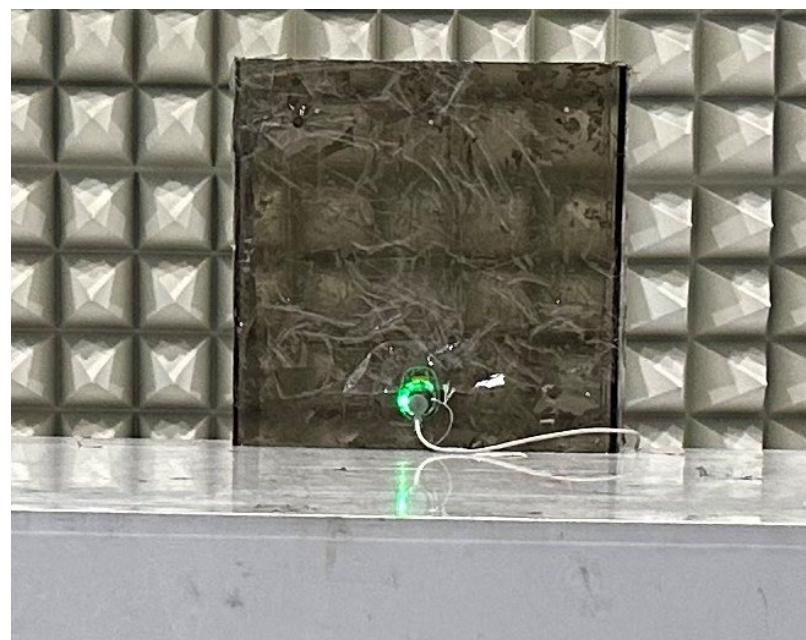
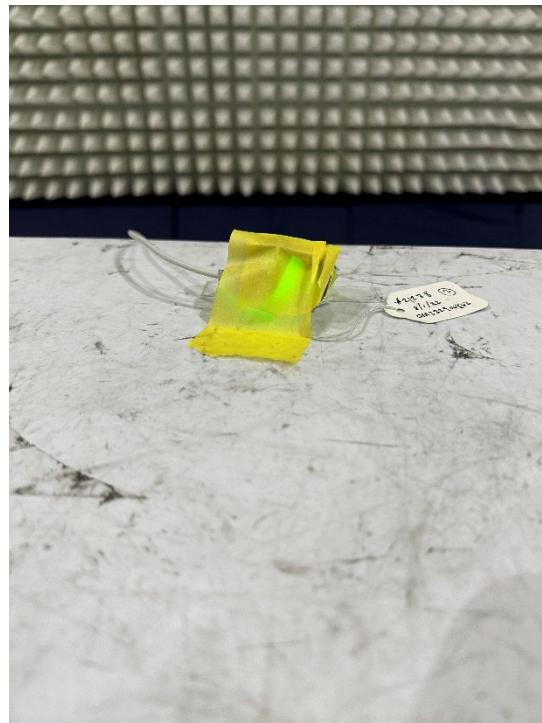
Complies

4.5.5 Test Setup Configuration

The following photographs show the testing configurations used.









4.5.5 Test Setup Configuration (Continued)



4.5.5 Test Setup Configuration (Continued)

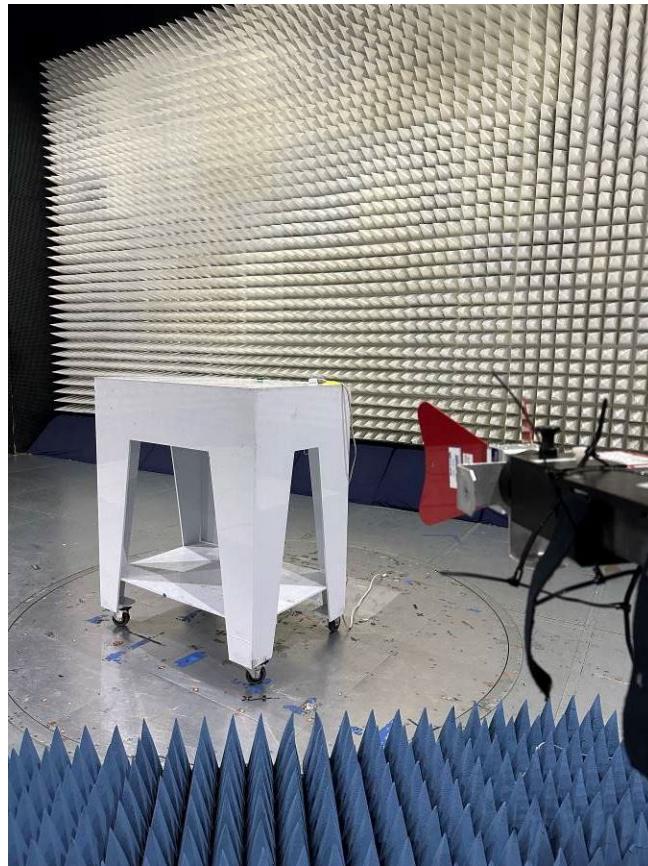
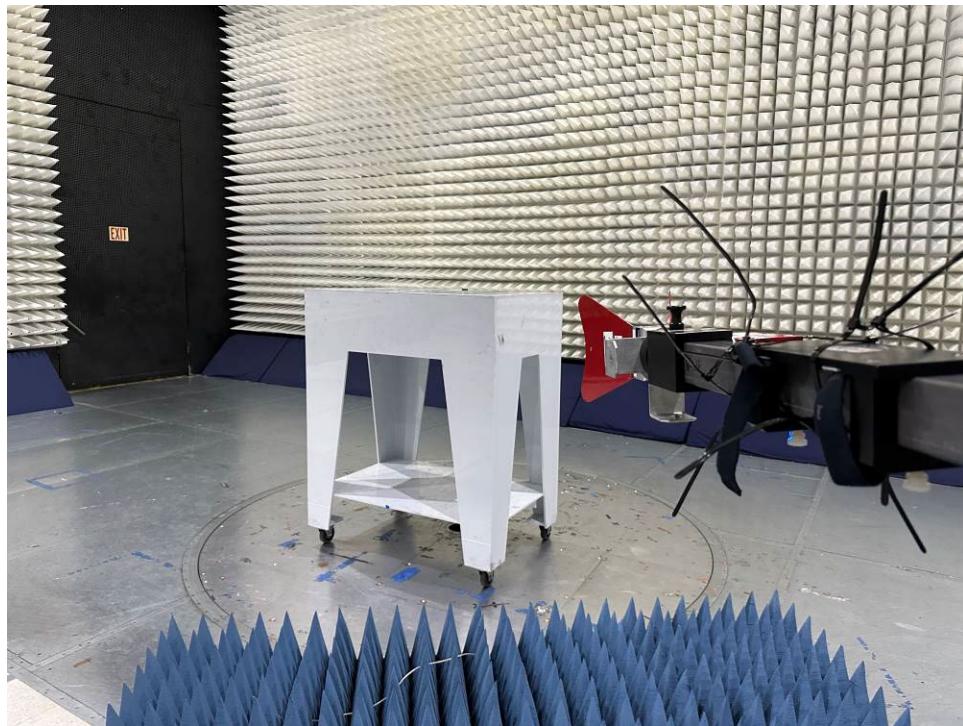




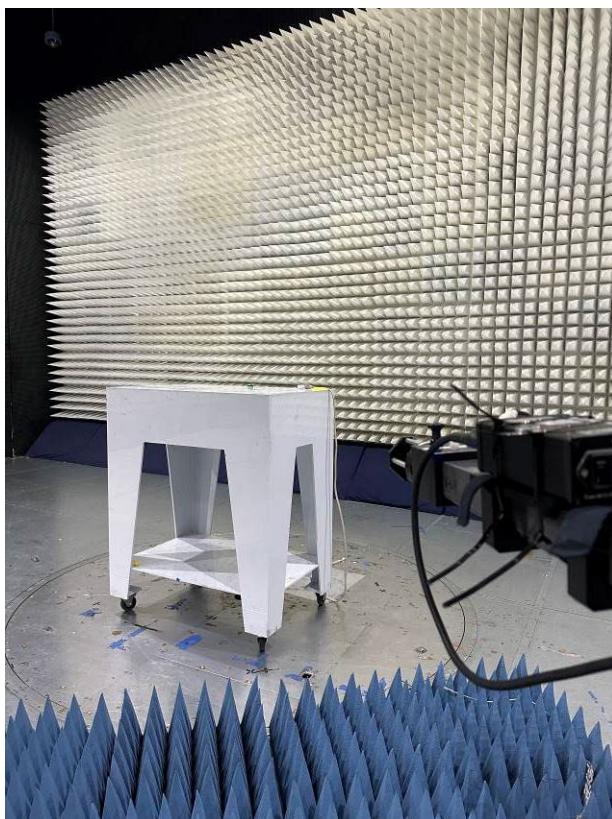
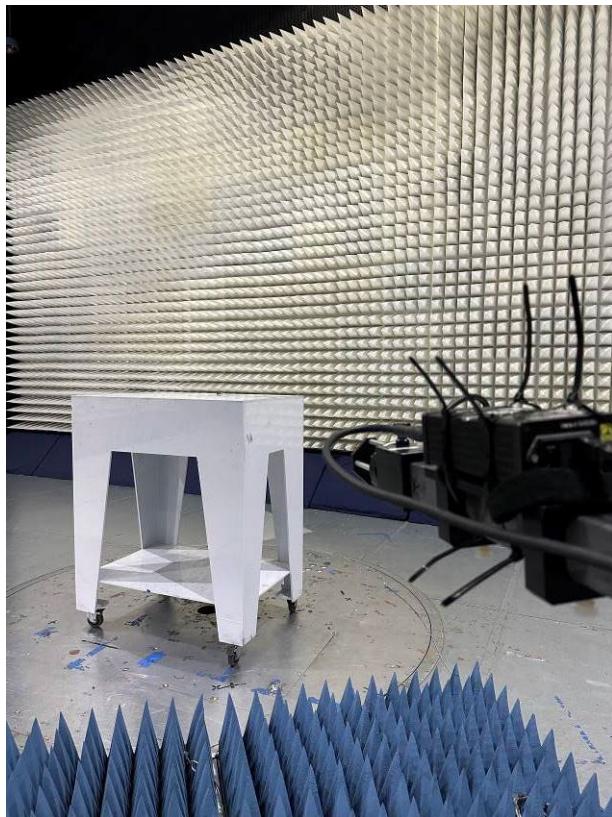
4.5.5 Test Setup Configuration (Continued)



4.5.5 Test Setup Configuration (Continued)



4.5.5 Test Setup Configuration (Continued)



4.6 AC Line Conducted Emission

FCC: 15.207; RSS-GEN;

4.6.1 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.*

4.6.2 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.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.10-2013.

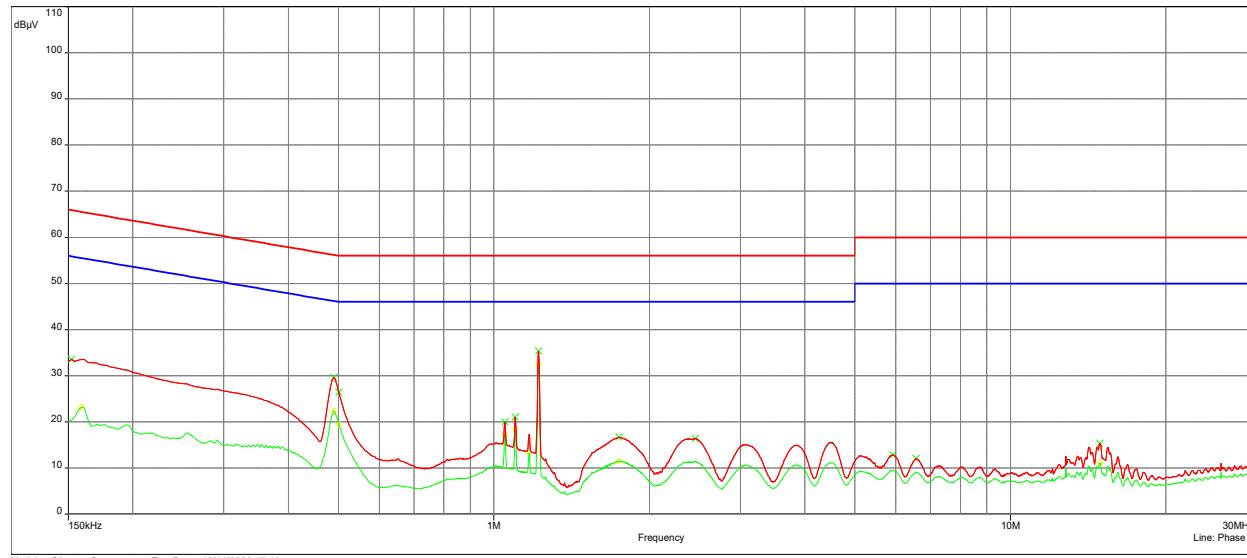
Tested By	Test Date	Results
Gilberto Gallegos Rangel	October 14, 2022	Complies

4.6.3 Test Result

15.207: Conducted Emissions 120VAC 60Hz

Phase 1

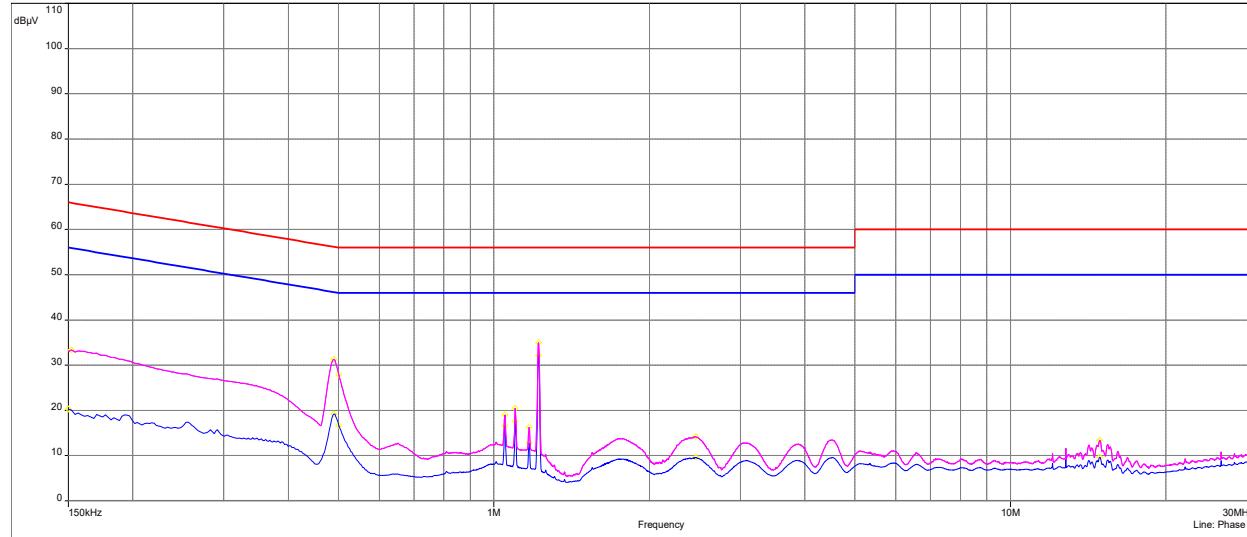
Sub-range 1
 Frequencies: 150 kHz - 30 MHz (Mode: - Step: 2.25 kHz)
 Settings: RBW: 9kHz, VBW: 30kHz, Sweep time: 2e+03 ms, Attenuation: 10 dB, Sweep count 10, Preamp: Off, LN Preamp: Off, Preselector: On
 Line:Phase 1



Model: ; Client: ; Comments: ; Test Date: 10/14/2022 17:43

Phase 2

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



Model: ; Client: ; Comments: ; Test Date: 10/14/2022 17:43

4.6.3 Test Results (Continued)

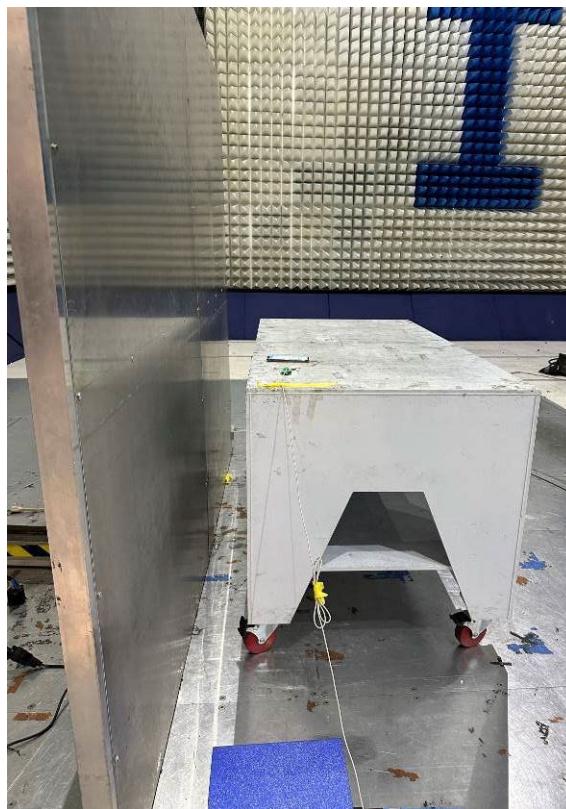
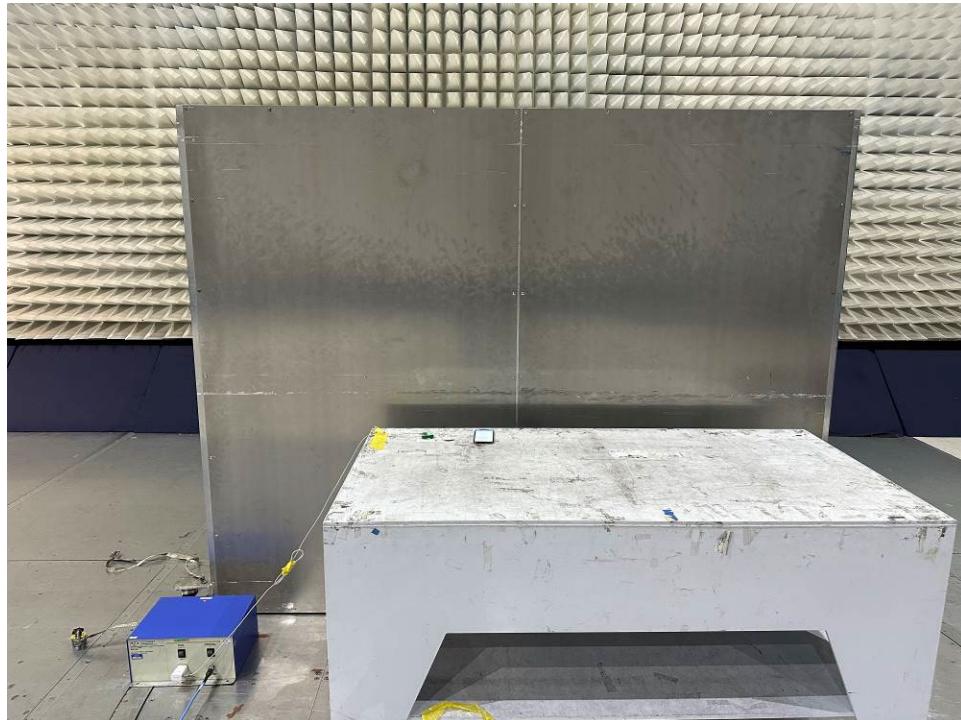
Frequency (MHz)	Q-Peak (dB μ V)	Limit Q-Peak (dB μ V)	Margin Q-Peak (dB)	Line	Correction (dB)
1.221	35.32	56	-20.68	Phase 1	10.58
1.221	34.96	56	-21.04	Phase 2	10.58
0.48975	31.32	56.17	-24.85	Phase 2	10.55
0.48975	29.57	56.17	-26.6	Phase 1	10.55
0.501	27.9	56	-28.1	Phase 2	10.55
0.501	26.45	56	-29.55	Phase 1	10.55
0.15225	33.56	65.88	-32.32	Phase 1	10.53
0.15225	33.38	65.88	-32.49	Phase 2	10.53

Frequency (MHz)	CISPR AVG (dB μ V)	Limit Avg (dB μ V)	Margin Avg (dB)	Line	Correction (dB)
1.221	32.44	46	-13.56	Phase 1	10.58
1.221	32.15	46	-13.85	Phase 2	10.58
0.48975	22.33	46.17	-23.85	Phase 1	10.55
0.501	19.43	46	-26.57	Phase 1	10.55
0.48975	19.18	46.17	-26.99	Phase 2	10.55
1.0995	18.41	46	-27.59	Phase 1	10.58
1.0995	17.58	46	-28.42	Phase 2	10.58
1.05	17.22	46	-28.78	Phase 1	10.57

Results	Complies by 13.56 dB
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4.6.4 Test Setup Photographs

The following photographs show the testing configurations used.



5.0 List of Test Equipment

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

Equipment	Manufacturer	Model/Type	Asset #	Cal Int	Cal Due
EMI Test Receiver 40GHz	Rohde & Schwarz	ESU40	ITS 00961	12	03/10/2023
150kHz-30MHz LISN	COM-POWER	LIN-120A	ITS 01400	12	12/14/2022
30MHz-2GHz Bi-Log Antenna	SunAR RF Motion	JB1	ITS 01577	12	02/10/2023
1-18GHz Horn Antenna	ETS Lindgren	3117-PA	ITS 01325	12	10/26/2022
18-40GHz Preamp	uComp Nordic	MCNS-50-18004000335P	ITS 01799	12	03/24/2023
9kHz-1GHz Pre-Amplifier	Sonoma Instruments	310N	ITS 00415	12	05/03/2023
18 - 26.5GHz Horn Antenna	EMCO	3160-09	ITS 00571	#	#
NOTCH FILTER	MICRO-TRONICS	BRC50702	ITS 01166	12	06/24/2023
1-40GHz RF CABLE 1 METER	MEGA PHASE	TM40-K1K1-59	ITS 01156	12	08/25/2023
Spectrum Analyzer 20hz-26.5ghz	Rohde & Schwarz	FSU	ITS 00913	12	05/17/2023
9kHz-30MHz Loop Antenna (Passive)	ETS Lindgren	6512	ITS 01573	12	11/09/2022
10m Semi-anechoic chamber	Panashield	10m Chamber	ITS 00984	36	07/29/23

Calibration not required.

Software used for emission compliance testing utilized the following:

Name	Manufacturer	Version	Template/Profile
BAT-EMC	Nexio	3.20.0.23	ESU and ESR Intertek Emissions Template
Tile	Quantum Change	3.4.K.22	Conducted Spurious_30M-26GHz
RS Commander	Rohde Schwarz	1.6.4	Not Applicable (Screen grabber)

6.0 Document History

Revision/ Job Number	Writer Initials	Reviewers Initials	Date	Change
1.0 / G105113177	GGR	ML	November 02, 2022	Original document

END OF REPORT