

Intertek
731 Enterprise Drive
Lexington, KY 40510

Tel 859 226 1000
Fax 859 226 1040

www.intertek.com

SPR Therapeutics, INC TEST REPORT

SCOPE OF WORK

EMC TESTING – SPRINT PNS (EXTERNAL PULSE GENERATOR REF: 9610)

REPORT NUMBER

105410623LEX-002

ISSUE DATE

5/31/2023

REVISED DATE

6/22/2023

PAGES

38

DOCUMENT CONTROL NUMBER

Non-Specific EMC Report Shell Rev. December 2017
© 2017 INTERTEK



EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 105410623LEX-002**Project Number:** G105410623**Report Issue Date:** 5/31/2023**Report Revised Date:** 6/22/2023**Model(s) Tested:** SPRINT PNS (External Pulse Generator Ref: 9610)**Standards:** Title 47 CFR Part 15.247

RSS-247 Issue 2

RSS-Gen Issue 5

Tested by:

Intertek Testing Services NA, Inc.
731 Enterprise Dr.
Lexington, KY 40510
USA

Client:

SPR Therapeutics, INC
22901 Millcreek Blvd Ste 500
Cleveland, OH 44122-5724
USA

Report prepared by



David Perry, Engineer

Report reviewed by



Brian Lackey, Team Leader

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to copy or distribute this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.



Table of Contents

1	<i>Introduction and Conclusion</i>	4
2	<i>Test Summary</i>	4
3	<i>Client Information</i>	5
4	<i>Description of Equipment under Test and Variant Models</i>	6
5	<i>System Setup and Method</i>	8
6	<i>Transmitter Spurious Emissions & Band Edge</i>	9
7	<i>Conducted Spurious Emissions</i>	21
8	<i>Output Power</i>	24
9	<i>Occupied Bandwidth</i>	28
10	<i>Power Spectral Density</i>	34
11	<i>Antenna Requirement</i>	37
12	<i>Revision History</i>	38



1 Introduction and Conclusion

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

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

2 Test Summary

Section	Test full name	Result
6	Radiated Spurious Emissions (FCC Part 15.247(d), RSS-247 Issue 2 § 5.5)	Pass
7	Conducted Spurious Emissions (FCC Part 15.247(d), RSS-247 Issue 2 § 5.5)	Pass
8	Output Power (FCC Part 15.247(b)(3), RSS-247 Issue 2 § 5.4(d))	Pass
9	Occupied Bandwidth (FCC Part 15.247, RSS-247 Issue 2 § 5.2(a))	Pass
10	Power Spectral Density (FCC Part 15.247(e), RSS-247 Issue 2 § 5.2(b))	Pass
11	Antenna Requirement (FCC Part 15.203, RSS-Gen Issue 5 § 6.8)	Pass



3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	SPR Therapeutics, INC
Address:	22901 Millcreek Blvd Ste 500 Cleveland, OH 44122-5724 USA
Contact:	Jeff Waterman
Email:	jwaterman@sprtherapeutics.com
Manufacturer Information	
Manufacturer Name:	SPR Therapeutics, INC
Manufacturer Address:	22901 Millcreek Blvd Ste 500 Cleveland, OH 44122-5724 USA



4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	SPRINT PNS (External Pulse Generator Ref: 9610)
Model Numbers	9610
Serial Number	26221308, 03222489 (Unmodified EPG and Modified EPG) ¹
Receive Date	4/14/2023
Test Start Date	4/18/2023
Test End Date	4/27/2023
Device Received Condition	Good
Test Sample Type	Production
Rated Voltage	4V DC
Software Used By EUT	DEV-5045-XSF-000[08] & 5042-XSF-000[N]
Frequency Band(s)	2402MHz - 2480MHz
Modulation Type(s)	GFSK 4.1
Test Channel(s)	2402, 2440, 2480 MHz
Maximum Antenna Gain (dBi)	1.6dBi ²
Description of Equipment Under Test (provided by client)	
SPRINT PNS – External Pulse Generator. This device is a body-worn, 2 channel peripheral nerve stimulator with BLE user interface. The device generates stimulus pulse current through 1 or 2 percutaneous leads. The entirety of these tests utilized a Pulse Generator with an increased BLE transmit power (7).	

4.1 Variant Models:

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

- Endura – pulse generator configured to output stimulation only on one lead
- Extensa – pulse generator configured to output stimulation on two leads
- Extensa XT – pulse generator configured to output stimulation on two leads with additional software features

¹ Devices are electrically identical. One device was modified to have a coaxial connector in place of the antenna.

² Antenna gain not measured; values used are from § 4.1 Antenna Specifications, a client provided document.



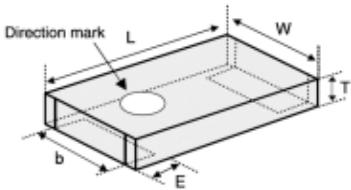
4.2 Antenna Specifications

The following information was provided by the client, Intertek does not make any claims of compliance for values other than shown below.

Spec Sheet

Chip Antennas(Multilayer)

AH316M245001-T



Features

- Item Summary: MonoPole, 3.2x1.6x0.5mm, for Bluetooth/W-LAN/ZigBee
- Lifecycle Stage: New PN available
- Standard packaging quantity (minimum): Taping Embossed 3000pcs

Products characteristics table

System	Bluetooth/W-LAN/ZigBee
Frequency Band Width	2400 to 2500 MHz
Center Frequency	2450 MHz
Gain1 (Peak Gain)(typ)	+1.6 dBi
Gain2 (Ave. Gain at OMNI plane)	-0.1 dBi
Efficiency (typ)	-1.4 dB (72 %)
VSWR (typ)	3
Type	MonoPole
Operating Temp. Range	-40 to +85 °C
RoHS Compliance (10 subst.)	Yes
REACH Compliance (223 subst.)	Yes
Halogen Free	Yes
Soldering	Reflow

External Dimensions

Dimension L	3.2 ±0.15 mm
Dimension W	1.6 ±0.15 mm
Dimension T	0.5 ±0.1 mm
Dimension E	0.5 ±0.2 mm
Dimension b	Min 1.0 mm

The data is reference only. Electrical characteristics vary depending on environment or measurement condition.
TAIYO YUDEN reserves the right to make change to the data at any time without notice.
Before making final selection, please check product specification.

2022.06.09

The data is reference only. Electrical characteristics vary depending on environment or measurement condition.
TAIYO YUDEN reserves the right to make change to the data at any time without notice.
Before making final selection, please check product specification.



5 System Setup and Method

5.1 Method:

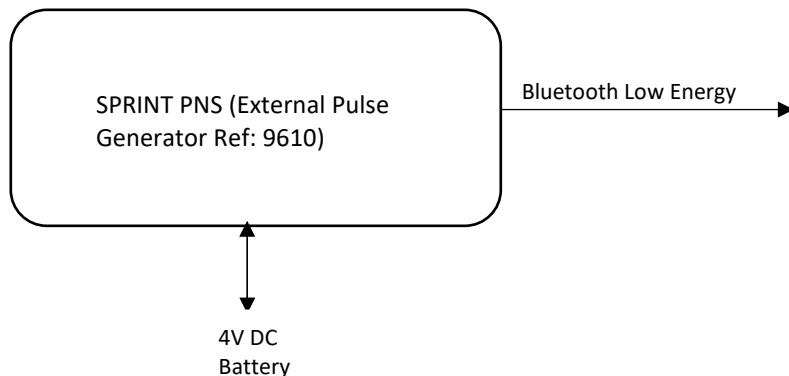
Configuration as required by ANSI C63.10:2013

No.	Descriptions of EUT Exercising
1	Transmitting a Bluetooth Low Energy (BLE) signal or low, middle, or high channel with a duty cycle >98%.

Cables					
Qty	Description	Length (m)	Shielding	Ferrites	Termination
-	-	-	-	-	-

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
-	-	-	-

5.2 EUT Block Diagram:





6 Transmitter Spurious Emissions & Band Edge

6.1 Test Limits

FCC Part 15.247(d):

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

RSS-247 Issue 2 § 5.5:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

6.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.12.1 Radiated emission measurements.



6.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	8285	Rohde & Schwarz	EW44	12/23/2022	12/23/2023
Bilog Antenna (30MHz-1GHz)	7085	SunAR	JB6	3/7/2023	3/7/2024
Horn Antenna (1-18GHz)	3780	ETS	3117	8/19/2022	8/19/2023
Horn Antenna (18-40GHz)	3779	ETS	3116c	8/29/2022	8/29/2023
System Controller	4096	ETS Lindgren	2090	Verify at Time of Use	Verify at Time of Use
System Controller	3957	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
Preamplifier	3918	Rohde & Schwarz	TS-PR18	1/10/2023	1/10/2024
Coaxial Cable	3074			1/10/2023	1/10/2024
Coaxial Cable	2588			1/10/2023	1/10/2024
Coaxial Cable	2593			1/10/2023	1/10/2024
Coaxial Cable	3918			1/10/2023	1/10/2024
Coaxial Cable	8185			1/10/2023	1/10/2024
Coaxial Cable	8188			1/10/2023	1/10/2024
Preamplifier (18-40GHz)	3921	Rohde & Schwarz	TS-PR40	1/12/2023	1/12/2024
Coaxial Cable	7020			1/12/2023	1/12/2024
Coaxial Cable	7021			1/12/2023	1/12/2024

6.4 Software Utilized

Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 10.60.20

6.5 Test Results

The sample tested was found to be **compliant**. The data presented represents the worst-case emissions with the device positioned in three orthogonal positions.

6.6 Test Conditions

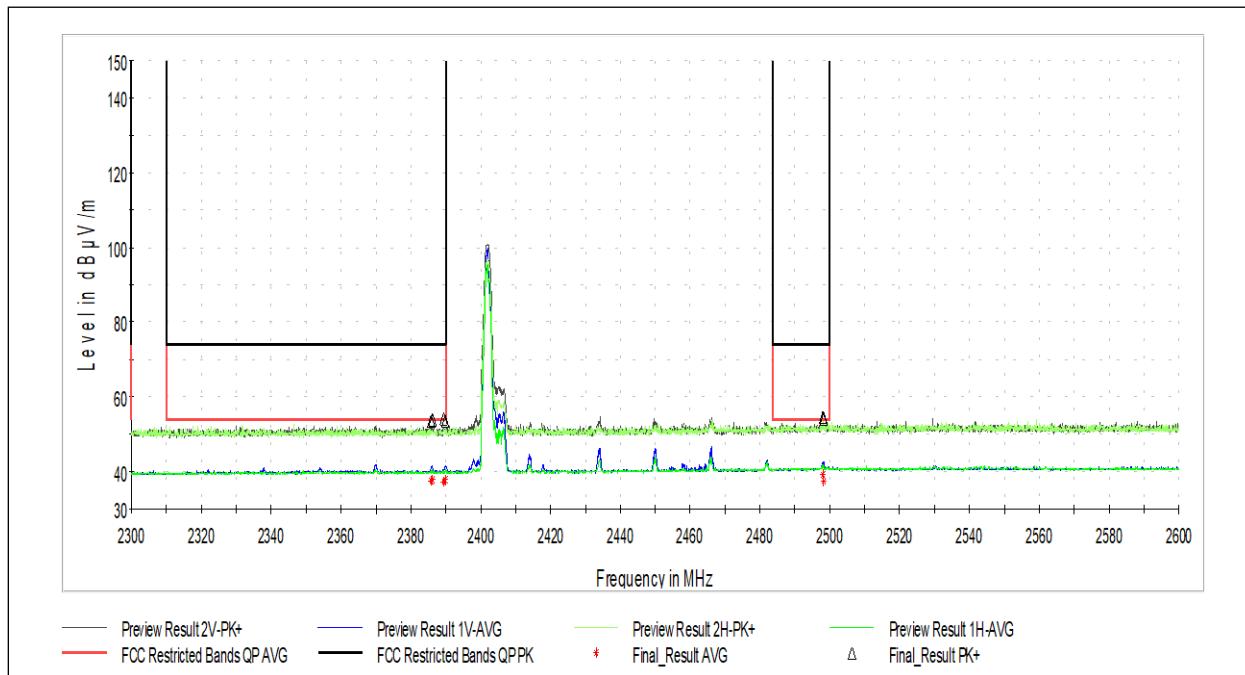
Test Personnel:	David Perry	Test Date:	4/27/2023
Supervising/Reviewing Engineer: (Where Applicable)	Brian Lackey	Limit Applied:	FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Product Standard:	FCC Part 15.247	Ambient Temperature:	21.3C
Input Voltage:	RSS-247 Issue 2	Relative Humidity:	32.4%
Pretest Verification w / Ambient Signals or BB Source:	4V DC	Atmospheric Pressure:	988.9mbar
	Yes		

Deviations, Additions, or Exclusions: None



6.7 Test Data: Radiated Band Edge

6.7.1 2402 MHz



Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2385.788	53.54	73.98	20.44	163.0	V	246.0	38.4
2386.135	53.70	73.98	20.28	107.0	V	248.0	38.4
2389.481	54.09	73.98	19.89	108.0	V	249.0	38.4
2389.885	53.56	73.98	20.42	158.0	V	238.0	38.4
2498.058	54.70	73.98	19.28	374.0	H	242.0	39.2
2498.288	54.33	73.98	19.65	115.0	V	0.0	39.1

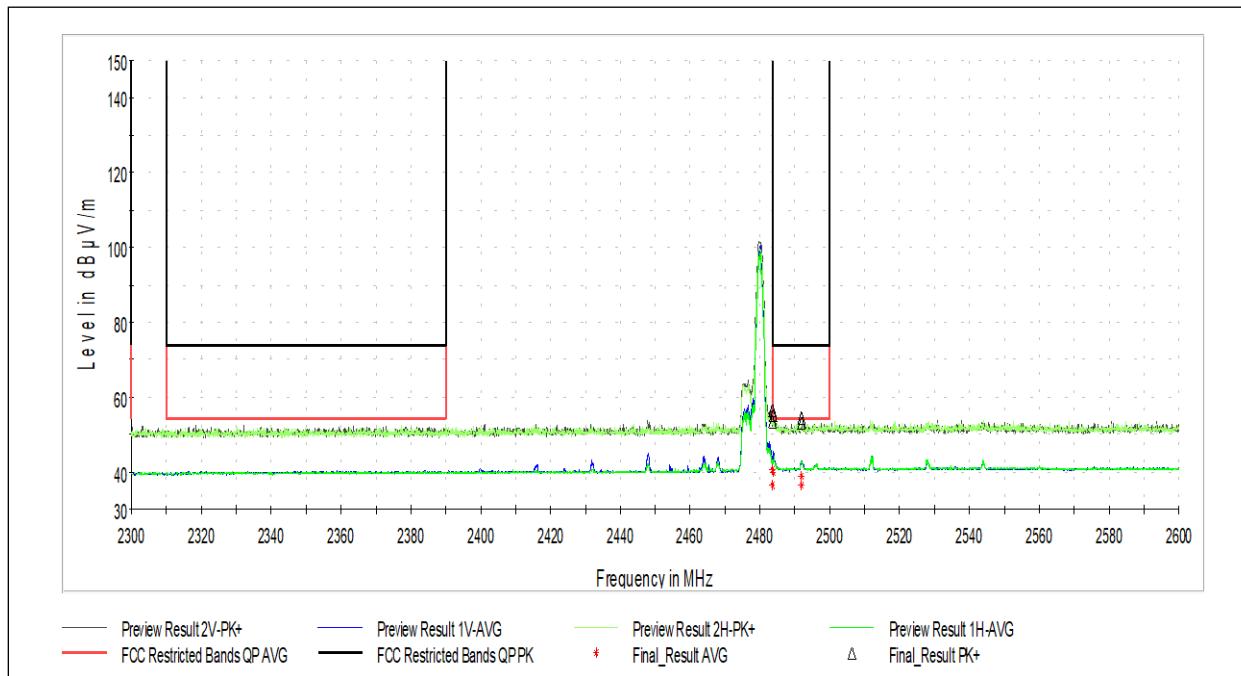
Frequency (MHz)	Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2385.788	37.52	53.98	16.46	163.0	V	246.0	38.4
2386.135	37.96	53.98	16.02	107.0	V	248.0	38.4
2389.481	37.11	53.98	16.87	108.0	V	249.0	38.4
2389.885	37.92	53.98	16.06	158.0	V	238.0	38.4
2498.058	39.19	53.98	14.79	374.0	H	242.0	39.2
2498.288	37.35	53.98	16.63	115.0	V	0.0	39.1

Test Personnel:	David Perry	Test Date:	4/27/2023
Supervising/Reviewing Engineer: (Where Applicable)	Brian Lackey	Limit Applied:	FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Product Standard:	FCC Part 15.247	Ambient Temperature:	21.3C
Input Voltage:	4V DC	Relative Humidity:	32.4%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	988.9mbar

Deviations, Additions, or Exclusions: None



6.7.2 2480 MHz



Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.519	53.30	73.98	20.68	349.0	V	216.0	38.9
2483.577	56.59	73.98	17.39	261.0	V	10.0	38.9
2483.808	55.23	73.98	18.75	108.0	V	240.0	38.9
2491.769	53.27	73.98	20.71	208.0	H	113.0	39.0
2491.885	54.41	73.98	19.57	142.0	V	240.0	39.0

Frequency (MHz)	Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.519	36.44	53.98	17.54	349.0	V	216.0	38.9
2483.577	40.52	53.98	13.46	261.0	V	10.0	38.9
2483.808	39.77	53.98	14.21	108.0	V	240.0	38.9
2491.769	36.60	53.98	17.38	208.0	H	113.0	39.0
2491.885	38.78	53.98	15.20	142.0	V	240.0	39.0

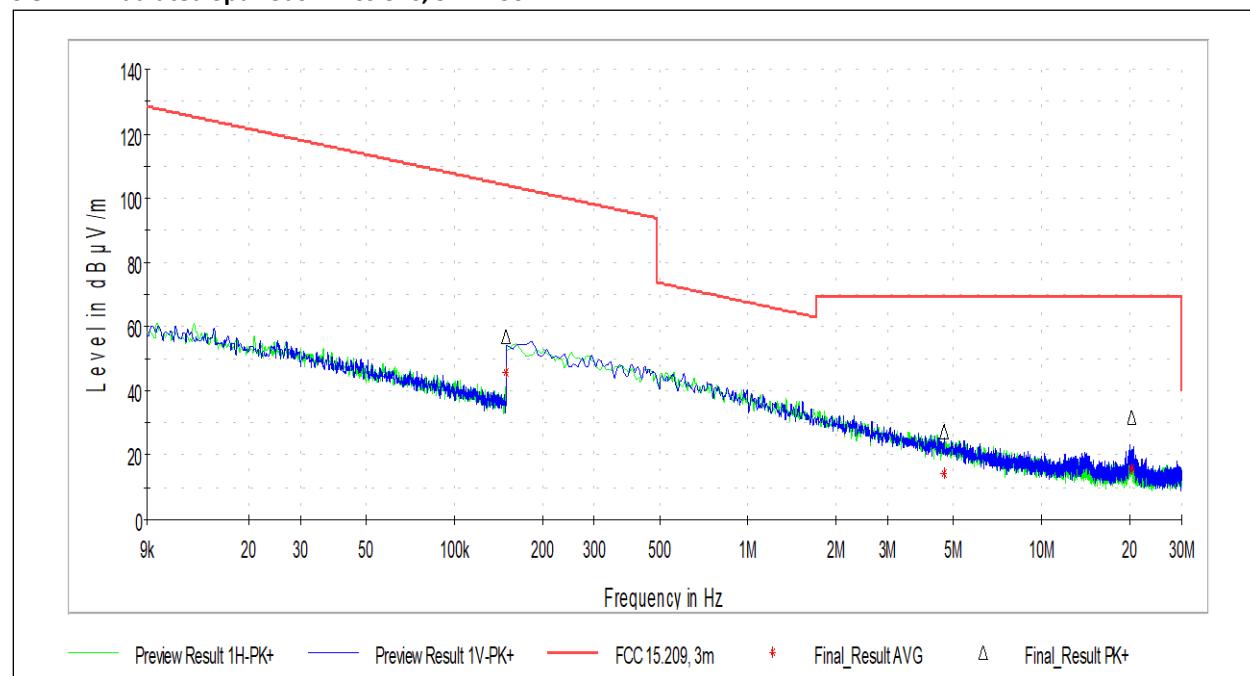
Test Personnel:	David Perry	Test Date:	4/27/2023
Supervising/Reviewing Engineer: (Where Applicable)	Brian Lackey	FCC Part 15.209 in Restricted Bands from FCC Part 15.205	
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	21.3C
Input Voltage:	4V DC	Relative Humidity:	32.4%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	988.9mbar

Deviations, Additions, or Exclusions: None



6.8 Test Data: Radiated Spurious Emissions

6.8.1 Radiated Spurious Emissions, 9KHz-30MHz:



Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Azimuth (deg)	Corr. (dB/m)
0.150	56.97	124.08	67.11	9.000	0.0	11.9
4.654	27.23	89.5	62.27	9.000	298.0	11.1
20.237	31.94	89.5	57.56	9.000	166.0	10.0

Frequency (MHz)	Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Azimuth (deg)	Corr. (dB/m)
0.150	45.77	104.08	58.31	9.000	0.0	11.9
4.654	14.17	69.50	55.33	9.000	298.0	11.1
20.237	15.79	69.50	53.71	9.000	166.0	10.0

Test Personnel: David Perry
Supervising/Reviewing Engineer: Brian Lackey
(Where Applicable)
Product Standard: FCC Part 15.247
Input Voltage: 4V DC
Pretest Verification w / Ambient Signals or BB Source: Yes

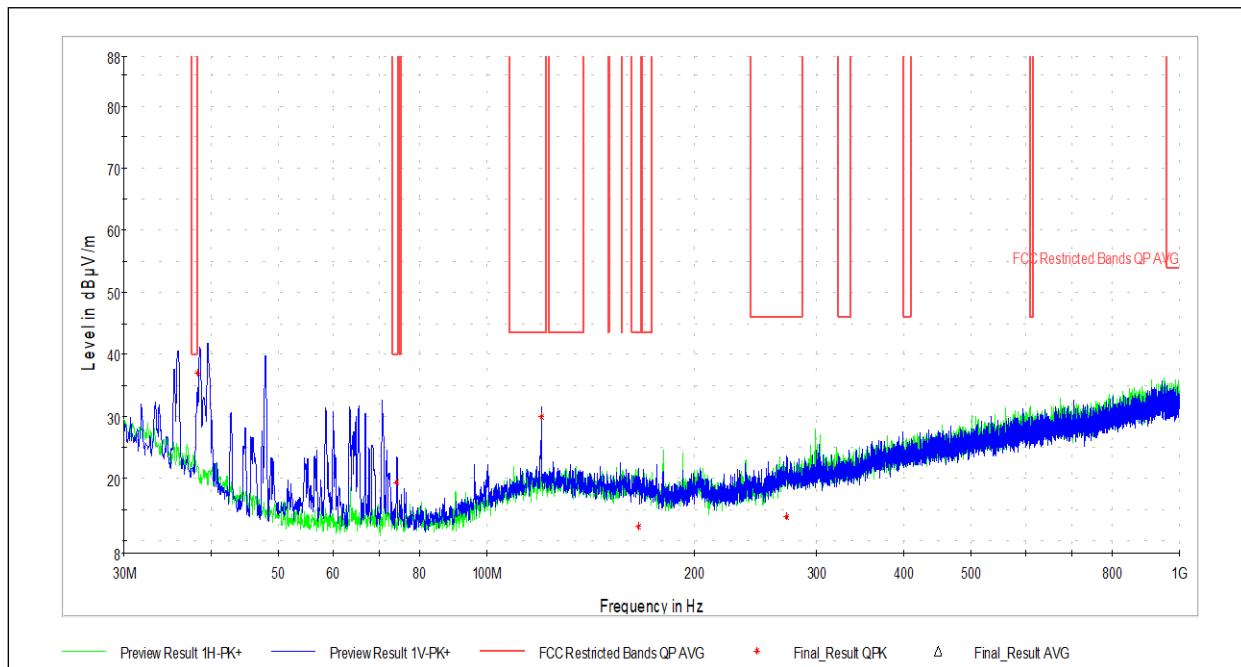
Test Date: 4/27/2023
FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Limit Applied:
Ambient Temperature: 21.3C
Relative Humidity: 32.4%
Atmospheric Pressure: 988.9mbar

Deviations, Additions, or Exclusions: Measurements with a max peak detector showed compliance with the quasi-peak limit and thereby the device is deemed to comply.

Note: Testing represents worst case of low, middle, and high channels.



6.8.2 Radiated Spurious Emissions, 2402MHz, 30MHz-1GHz:



Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
38.245	37.01	40.00	2.99	100.0	V	100.0	21.2
74.243	19.28	40.00	20.72	105.0	V	5.0	14.4
119.994	29.91	43.52	13.62	100.0	V	296.0	20.8
165.584	12.34	43.52	31.19	100.0	V	284.0	20.2
270.937	13.83	46.02	32.19	349.0	V	0.0	21.3

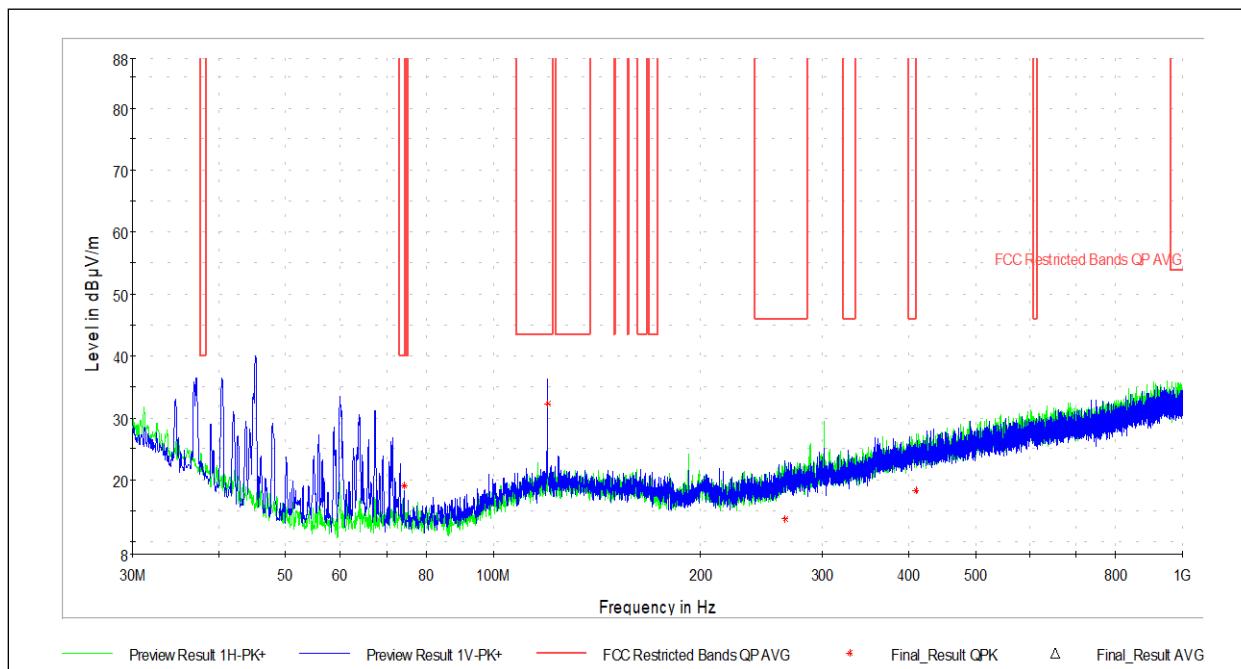
Test Personnel: David Perry
Supervising/Reviewing Engineer: David Perry
(Where Applicable) Brian Lackey
Product Standard: FCC Part 15.247
Input Voltage: 4V DC
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 4/27/2023
Limit Applied: FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Ambient Temperature: 21.3C
Relative Humidity: 32.4%
Atmospheric Pressure: 988.9mbar

Deviations, Additions, or Exclusions: None



6.8.3 Radiated Spurious Emissions, 2440MHz, 30MHz-1GHz:



Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
74.297	19.11	40.00	20.89	107.0	V	6.0	14.5
119.994	32.38	43.52	11.15	100.0	V	295.0	20.8
265.063	13.76	46.02	32.26	121.0	V	348.0	21.2

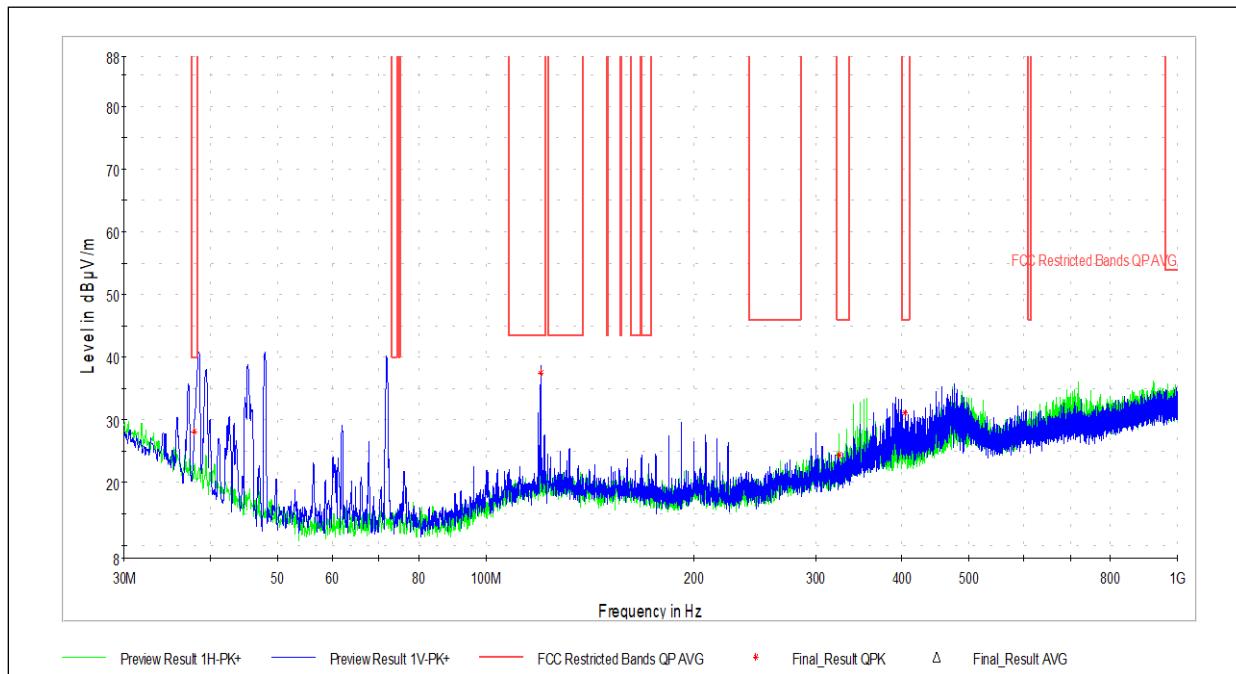
Test Personnel: David Perry
Supervising/Reviewing Engineer: Brian Lackey
(Where Applicable) FCC Part 15.247
Product Standard: RSS-247 Issue 2
Input Voltage: 4V DC
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 4/27/2023
Limit Applied: FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Ambient Temperature: 21.3C
Relative Humidity: 32.4%
Atmospheric Pressure: 988.9mbar

Deviations, Additions, or Exclusions: None



6.8.4 Radiated Spurious Emissions, 2480MHz, 30MHz-1GHz:



Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.922	28.23	40.00	11.77	100.0	V	127.0	21.4
119.994	37.55	43.52	5.97	100.0	V	0.0	20.8
323.964	24.41	46.02	21.61	95.0	H	240.0	22.6
403.989	31.20	46.02	14.82	106.0	V	6.0	24.2

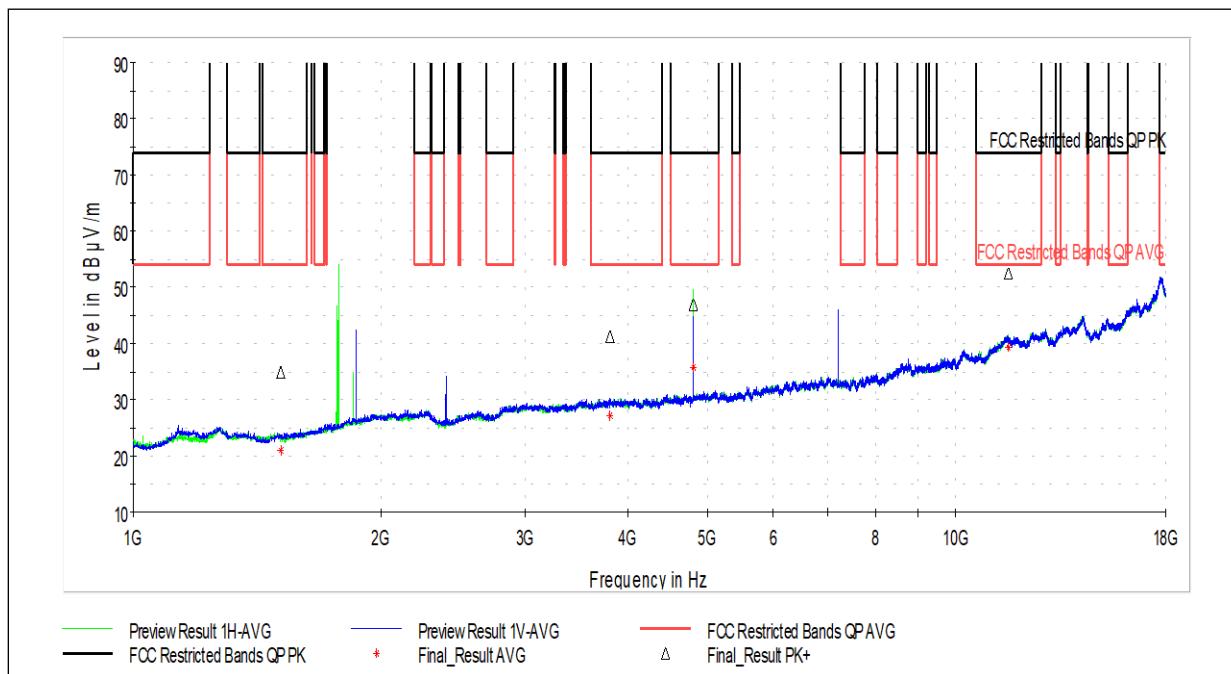
Test Personnel: David Perry
Supervising/Reviewing Engineer: David Perry
(Where Applicable) Brian Lackey
Product Standard: FCC Part 15.247
Input Voltage: RSS-247 Issue 2
Pretest Verification w / Ambient Signals or BB Source: 4V DC

Test Date: 4/27/2023
Limit Applied: FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Ambient Temperature: 21.3C
Relative Humidity: 32.4%
Atmospheric Pressure: 988.9mbar

Deviations, Additions, or Exclusions: None



6.8.5 Radiated Spurious Emissions, 2402MHz 1GHz-18GHz:



Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1511.000	34.96	73.98	39.02	223.0	V	127.0	-0.3
3807.500	41.34	73.98	32.64	100.0	V	11.0	8.6
4804.000	47.13	73.98	26.85	323.0	H	173.0	10.4
11598.500	52.47	73.98	21.51	125.0	H	349.0	21.0

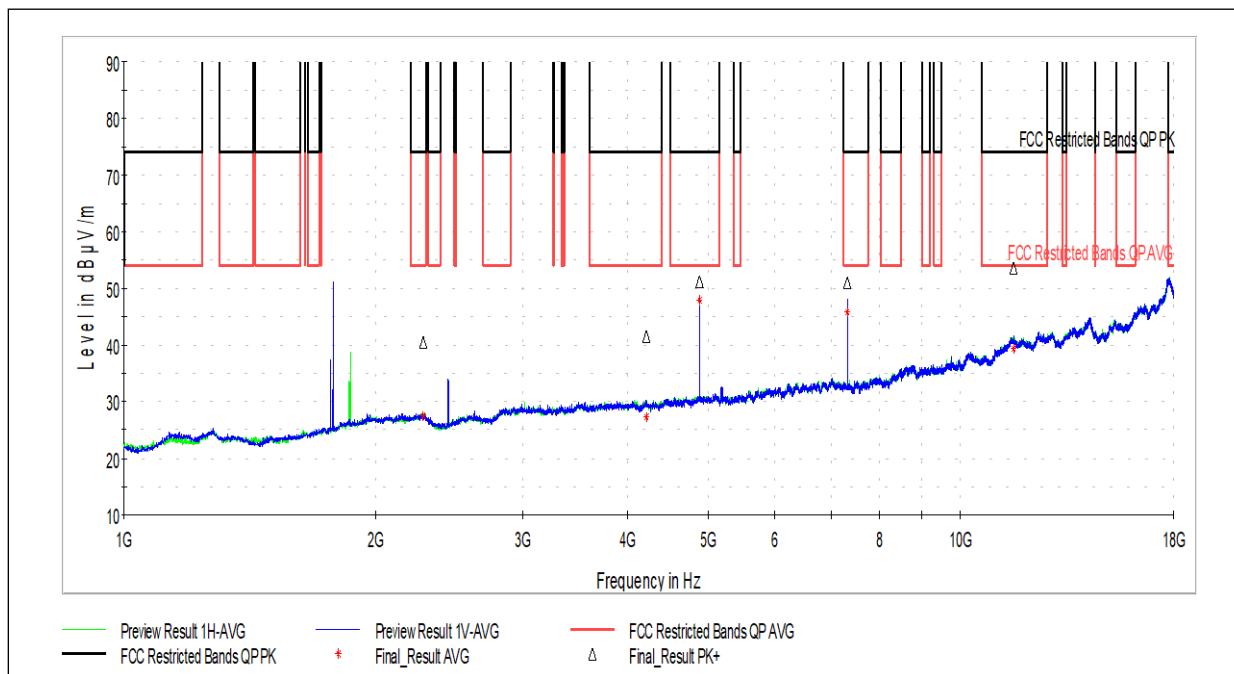
Frequency (MHz)	Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1511.000	21.09	53.98	32.89	223.0	V	127.0	-0.3
3807.500	27.09	53.98	26.89	100.0	V	11.0	8.6
4804.000	35.84	53.98	18.14	323.0	H	173.0	10.4
11598.500	39.27	53.98	14.71	125.0	H	349.0	21.0

Test Personnel: David Perry Test Date: 4/27/2023
Supervising/Reviewing Engineer: Brian Lackey Limit Applied: FCC Part 15.209 in Restricted Bands from FCC Part 15.205
(Where Applicable) FCC Part 15.247
Product Standard: RSS-247 Issue 2 Ambient Temperature: 21.3C
Input Voltage: 4V DC Relative Humidity: 32.4%
Pretest Verification w / Ambient Signals or BB Source: Yes Atmospheric Pressure: 988.9mbar

Deviations, Additions, or Exclusions: None



6.8.6 Radiated Spurious Emissions, 2440MHz 1GHz-18GHz:



Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2280.000	40.38	73.98	33.60	100.0	V	248.0	4.8
4208.500	41.39	73.98	32.59	100.0	H	68.0	9.1
4880.000	51.27	73.98	22.71	280.0	H	173.0	10.3
7320.000	50.95	73.98	23.03	270.0	V	293.0	14.4
11565.500	53.48	73.98	20.50	100.0	V	300.0	20.8

Frequency (MHz)	Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2280.000	27.37	53.98	26.61	100.0	V	248.0	4.8
4208.500	27.33	53.98	26.65	100.0	H	68.0	9.1
4880.000	48.04	53.98	5.94	280.0	H	173.0	10.3
7320.000	45.82	53.98	8.16	270.0	V	293.0	14.4
11565.500	39.23	53.98	14.75	100.0	V	300.0	20.8

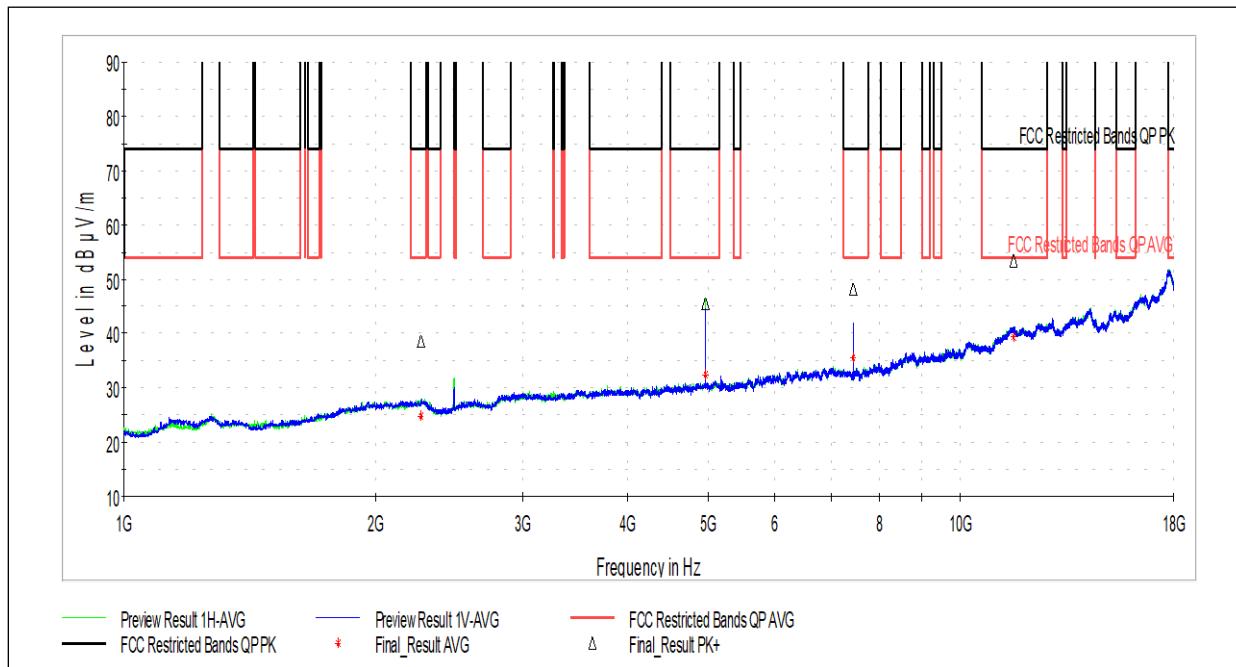
Test Personnel: David Perry
Supervising/Reviewing Engineer: David Perry
(Where Applicable) Brian Lackey
Product Standard: FCC Part 15.247
Input Voltage: 4V DC
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 4/27/2023
Limit Applied: FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Ambient Temperature: 21.3C
Relative Humidity: 32.4%
Atmospheric Pressure: 988.9mbar

Deviations, Additions, or Exclusions: None



6.8.7 Radiated Spurious Emissions, 2480MHz 1GHz-18GHz:



Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2265.500	38.67	73.98	35.31	100.0	H	55.0	4.8
4960.000	45.62	73.98	28.36	100.0	H	330.0	10.2
7440.500	48.12	73.98	25.86	126.0	V	138.0	13.9
11576.500	53.54	73.98	20.44	100.0	H	181.0	20.8

Frequency (MHz)	Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2265.500	24.92	53.98	29.06	100.0	H	55.0	4.8
4960.000	32.41	53.98	21.57	100.0	H	330.0	10.2
7440.500	35.65	53.98	18.33	126.0	V	138.0	13.9
11576.500	39.27	53.98	14.71	100.0	H	181.0	20.8

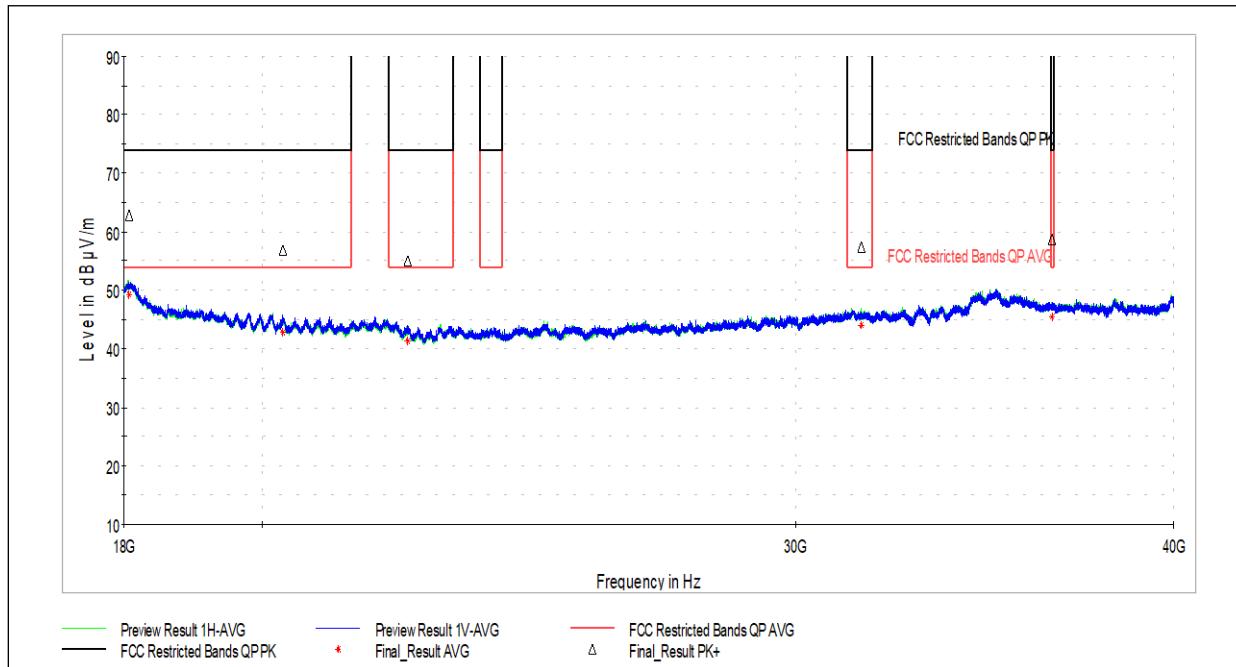
Test Personnel: David Perry
Supervising/Reviewing Engineer: Brian Lackey
(Where Applicable)
Product Standard: FCC Part 15.247
Input Voltage: 4V DC
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 4/27/2023
Limit Applied: FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Ambient Temperature: 21.3C
Relative Humidity: 32.4%
Atmospheric Pressure: 988.9mbar

Deviations, Additions, or Exclusions: None



6.8.8 Radiated Spurious Emissions, 18GHz-40GHz:



Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18075.000	62.92	73.98	11.06	331.0	H	0.0	31.2
20306.000	56.91	73.98	17.07	375.0	V	259.0	20.1
22330.000	55.07	73.98	18.91	100.0	V	265.0	14.6
31529.500	57.39	73.98	16.59	379.0	H	191.0	19.9
36459.500	58.60	73.98	15.38	100.0	V	68.0	21.0

Frequency (MHz)	Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18075.000	49.31	53.98	4.67	331.0	H	0.0	31.2
20306.000	42.74	53.98	11.24	375.0	V	259.0	20.1
22330.000	41.38	53.98	12.60	100.0	V	265.0	14.6
31529.500	44.04	53.98	9.94	379.0	H	191.0	19.9
36459.500	45.51	53.98	8.47	100.0	V	68.0	21.0

Test Personnel: David Perry
 Supervising/Reviewing Engineer: David Perry
 (Where Applicable) Brian Lackey
FCC Part 15.247
 Product Standard: RSS-247 Issue 2
 Input Voltage: 4V DC
 Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 4/27/2023
 FCC Part 15.209 in Restricted Bands from FCC Part 15.205
 Limit Applied: 21.3C
 Ambient Temperature: 21.3C
 Relative Humidity: 32.4%
 Atmospheric Pressure: 988.9mbar

Deviations, Additions, or Exclusions: None

Note: Testing represents worst case of low, middle, and high channels.



7 Conducted Spurious Emissions

7.1 Test Limits

FCC Part 15.247(d):

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

RSS-247 Issue 2 § 5.5:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

7.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.11 Emissions in nonrestricted frequency bands.

7.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	10/3/2022	10/3/2023

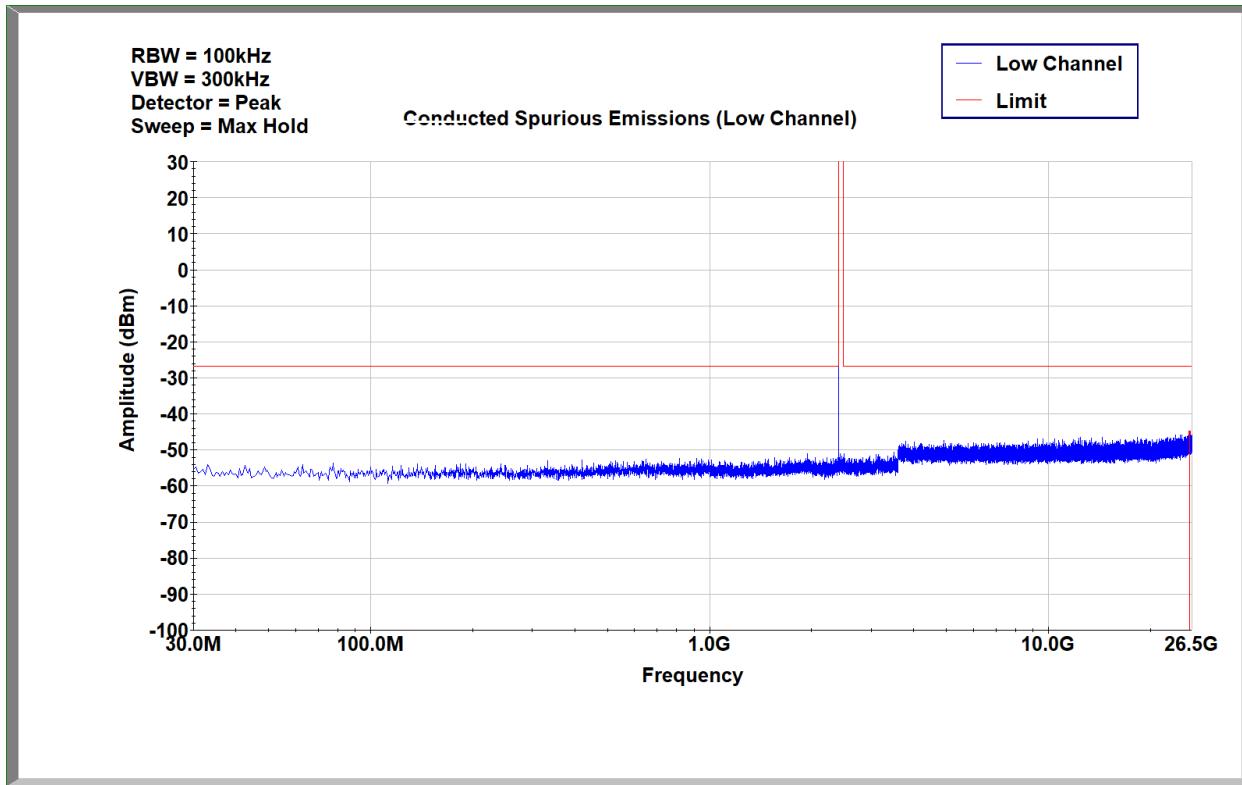
7.4 Test Results

The device was found to be **compliant**. All spurious emissions were found to be attenuated more than 20dB below the level of the fundamental.

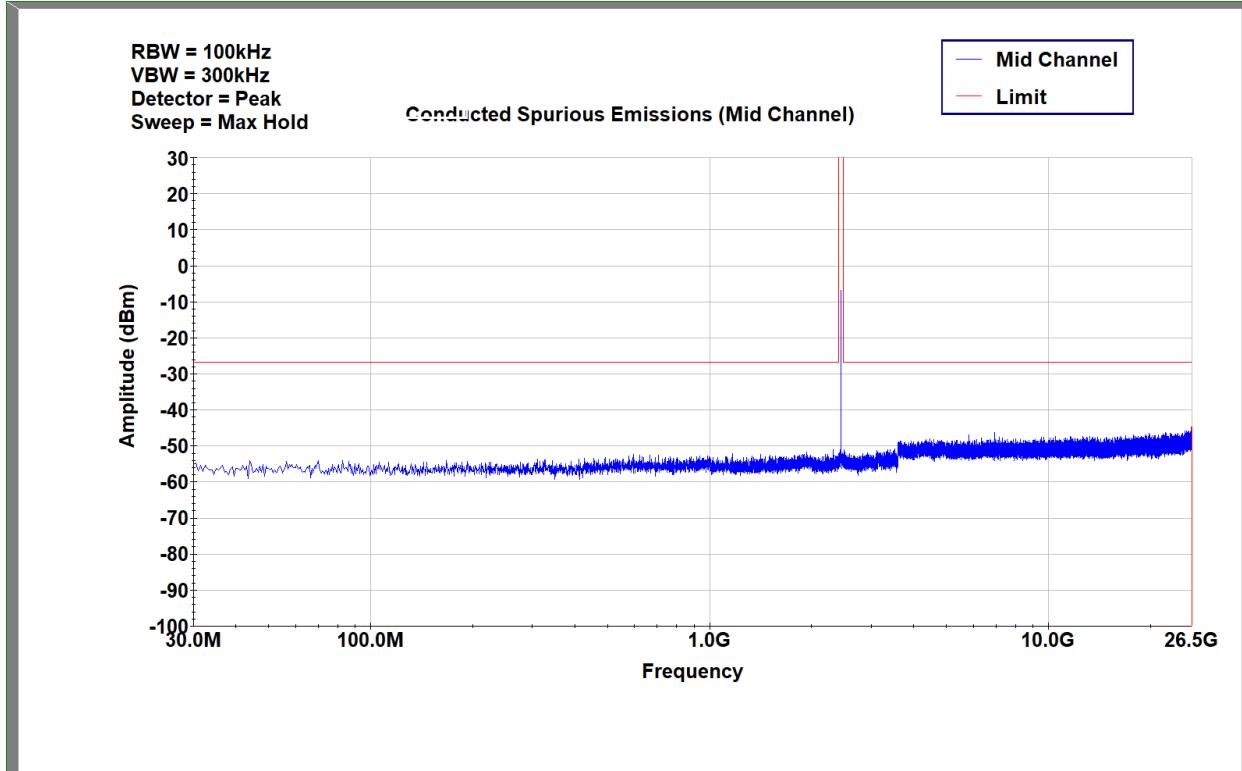


7.5 Test Data

7.5.1 2402 MHz



7.5.2 2440 MHz



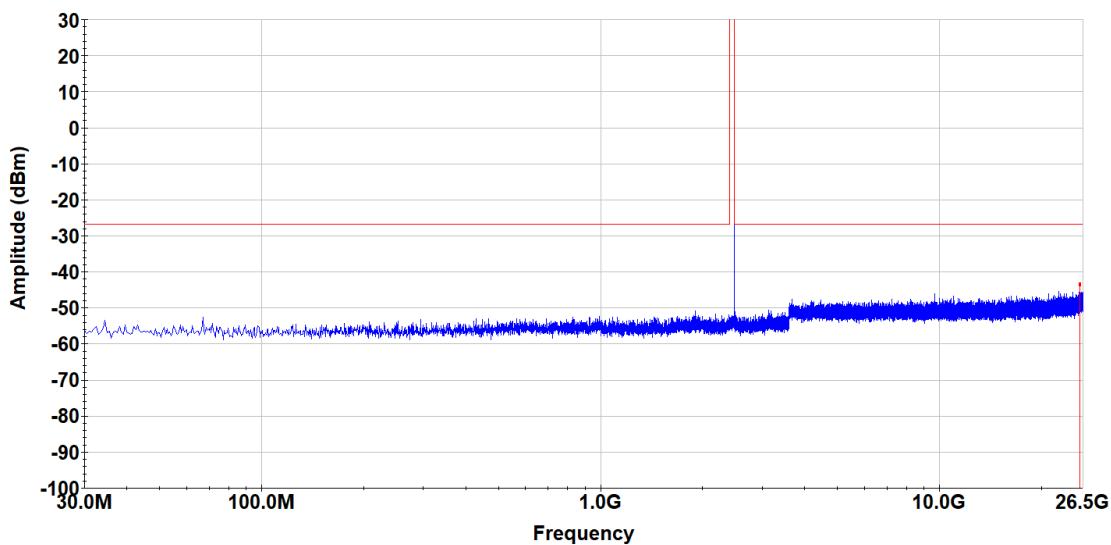


7.5.3 2480 MHz

RBW = 100kHz
VBW = 300kHz
Detector = Peak
Sweep = Max Hold

Conducted Spurious Emissions (High Channel)

High Channel
Limit

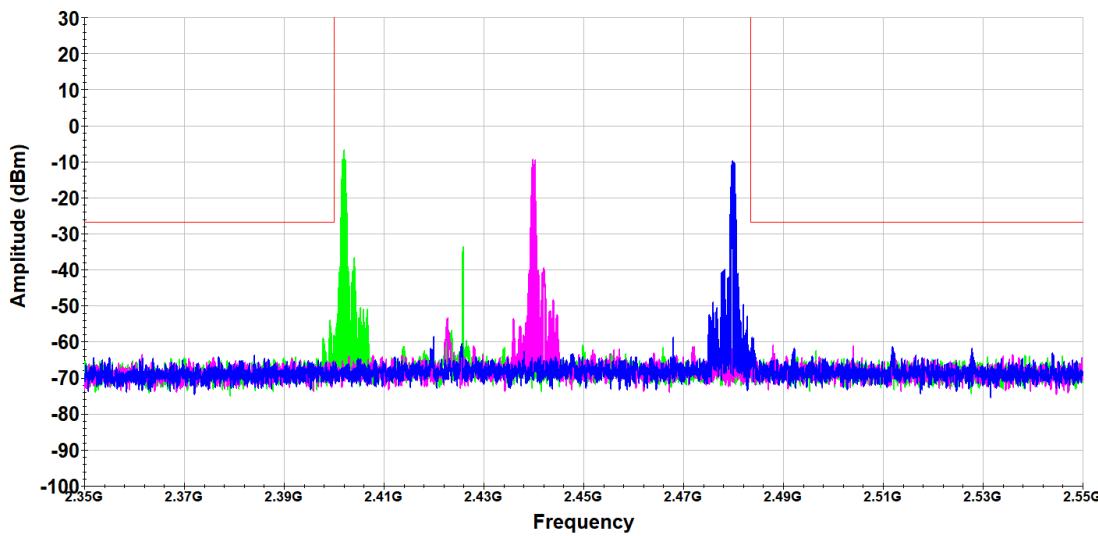


7.5.4 Band Edge

RBW = 100kHz
VBW = 300kHz
Detector = Peak
Sweep = Max Hold

Conducted Spurious Emissions (Band)

Low Channel
Mid Channel
High Channel
Limit





8 Output Power

8.1 Test Limits

FCC Part 15.247(b)(3):

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

RSS-247 Issue 2 § 5.4(d):

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

8.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.9.1.1

8.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	10/3/2022	10/3/2023



8.4 Test Results

The device was found to be **compliant**. The peak output power was less than 1W and the EIRP was less than 4W.

8.5 Test Conditions

Test Personnel:	David Perry	Test Date:	4/18/2023
Supervising/Reviewing Engineer: (Where Applicable)	Brian Lackey	Limit Applied:	From FCC Part 15.247(b)(3), RSS-247 Issue 2 § 5.4(d)
Product Standard:	FCC Part 15.247	Ambient Temperature:	23.3C
Input Voltage:	RSS-247 Issue 2	Relative Humidity:	34.4%
Pretest Verification w / Ambient Signals or BB Source:	4V DC	Atmospheric Pressure:	985.4mbar
Pretest Verification w / Ambient Signals or BB Source:	Yes		

Deviations, Additions, or Exclusions: None

8.6 Test Data

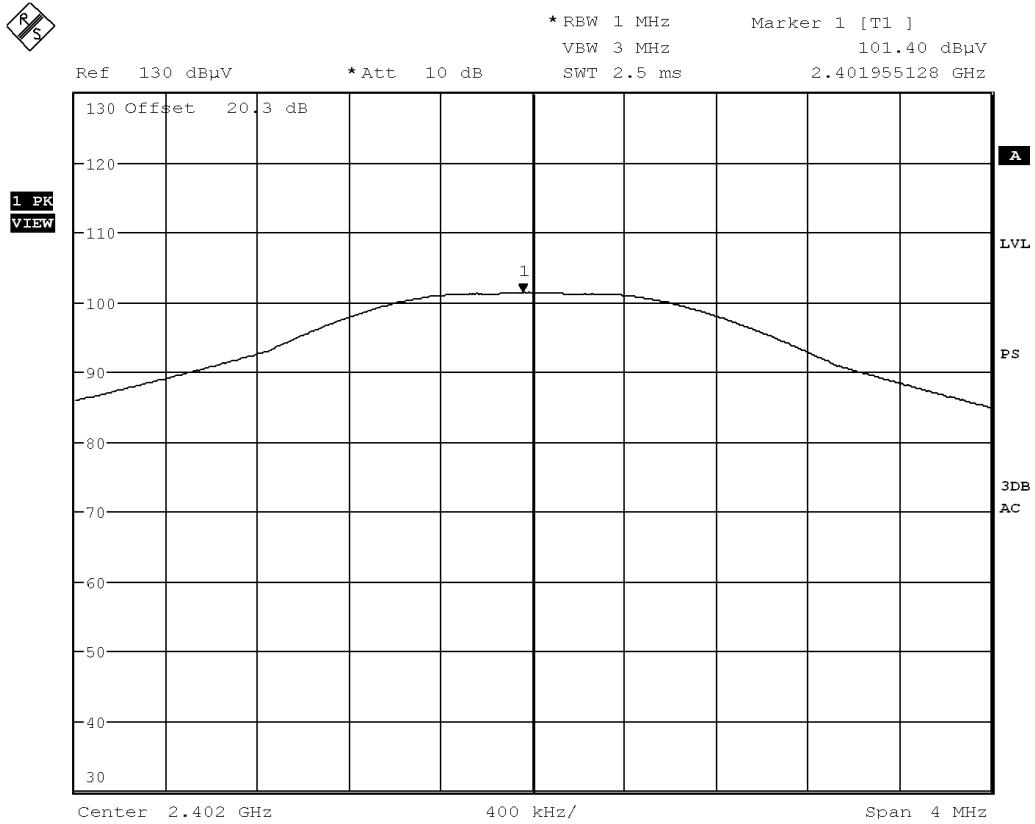
Frequency (MHz)	Max Peak (dB μ V)	Conducted Power (dBm)	Conducted Power Limit (dBm)	Max Antenna Gain ³ (dBi)	EIRP (dBm)	EIRP Limit (dBm)
2402	101.4	-5.6	30	1.6	-4	36.02
2440	98.74	-8.2	30	1.6	-6.6	36.02
2480	97.72	-9.3	30	1.6	-7.7	36.02

³ Antenna gain not measured; values used are from § 4.1 Antenna Specifications, a client provided document

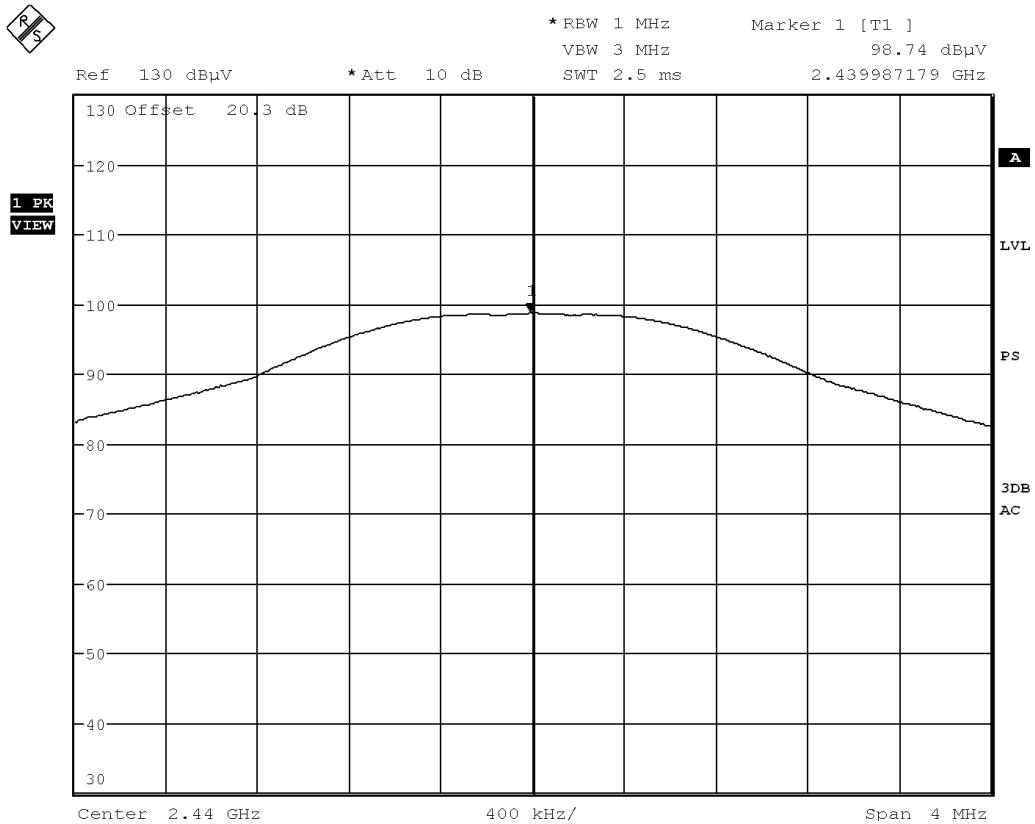


8.7 Spectrum Plots

8.7.1 2402 MHz

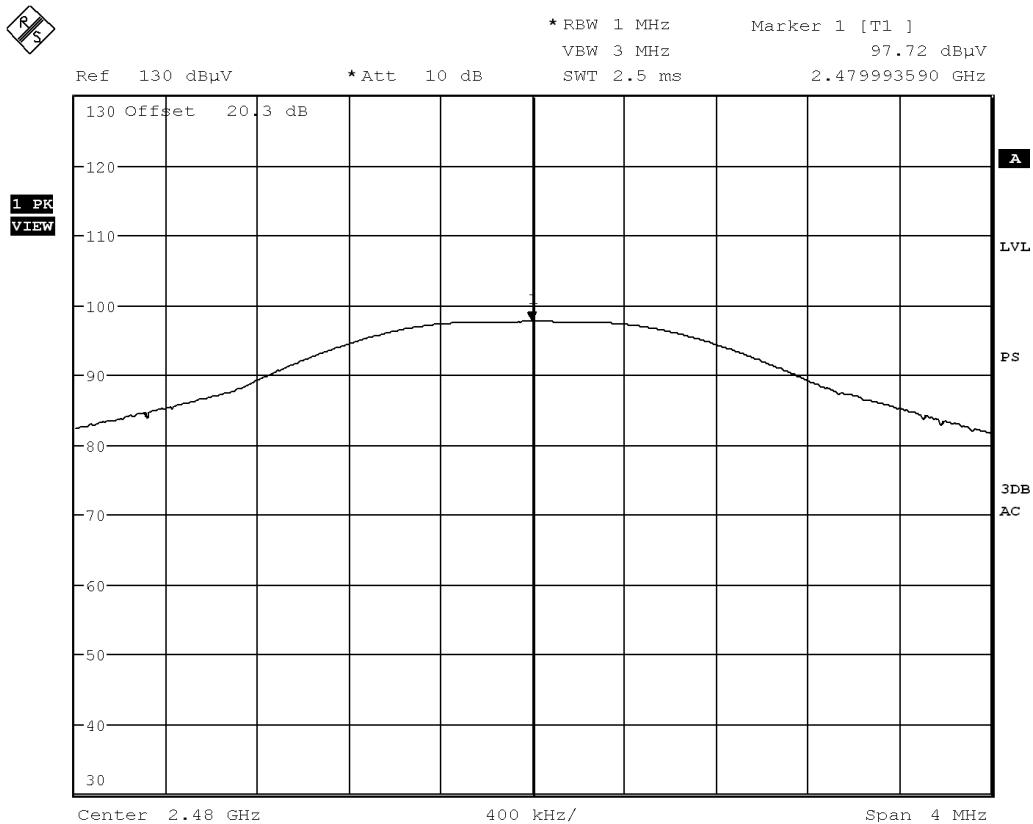


8.7.1 2440 MHz





8.7.2 2480 MHz





9 Occupied Bandwidth

9.1 Test Limits

FCC Part 15.247(a)(2):

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

RSS-247 Issue 2 § 5.2(a):

The minimum 6 dB bandwidth shall be 500 kHz.

9.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.8.1.

9.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	10/3/2022	10/3/2023

9.4 Test Results

The device was found to be **compliant**. The 6dB bandwidth was at least 500kHz.

9.5 Test Conditions

Test Personnel:	David Perry	Test Date:	4/18/2023
Supervising/Reviewing Engineer: (Where Applicable)	Brian Lackey	Limit Applied:	From FCC Part 15.247(b)(3), RSS-247 Issue 2 § 5.4(d)
Product Standard:	FCC Part 15.247	Ambient Temperature:	23.3C
Input Voltage:	4V DC	Relative Humidity:	34.4%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

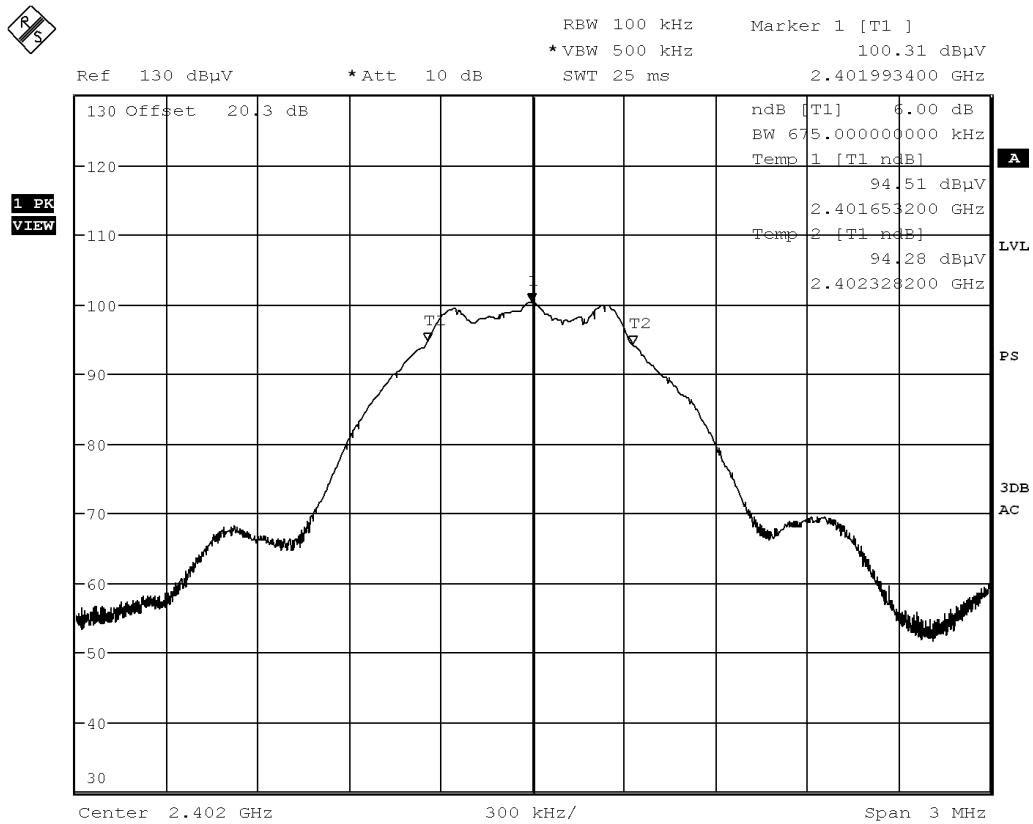
Deviations, Additions, or Exclusions: None

9.6 Test Data

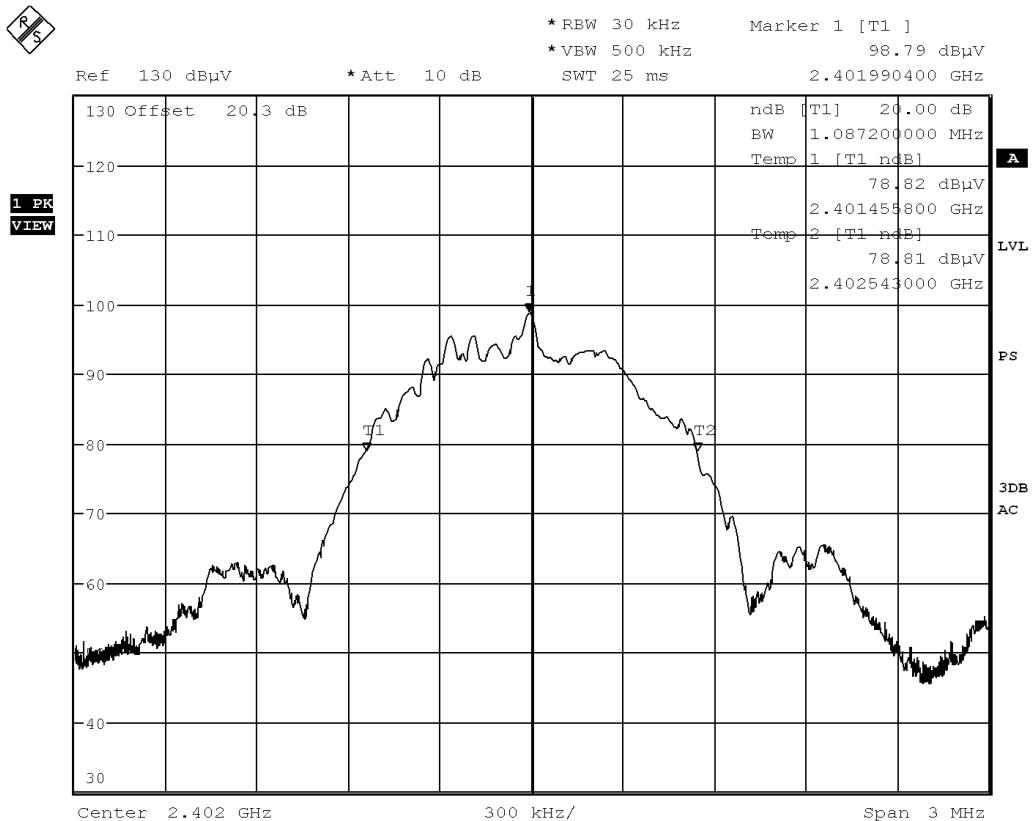
Frequency (MHz)	6dB BW (kHz)	20dB BW (kHz)	99% BW (kHz)
2402	675.00	1087	1022
2440	679.20	1090	1021
2480	682.8	1102	1020



9.6.1 2402MHz 6dB BW

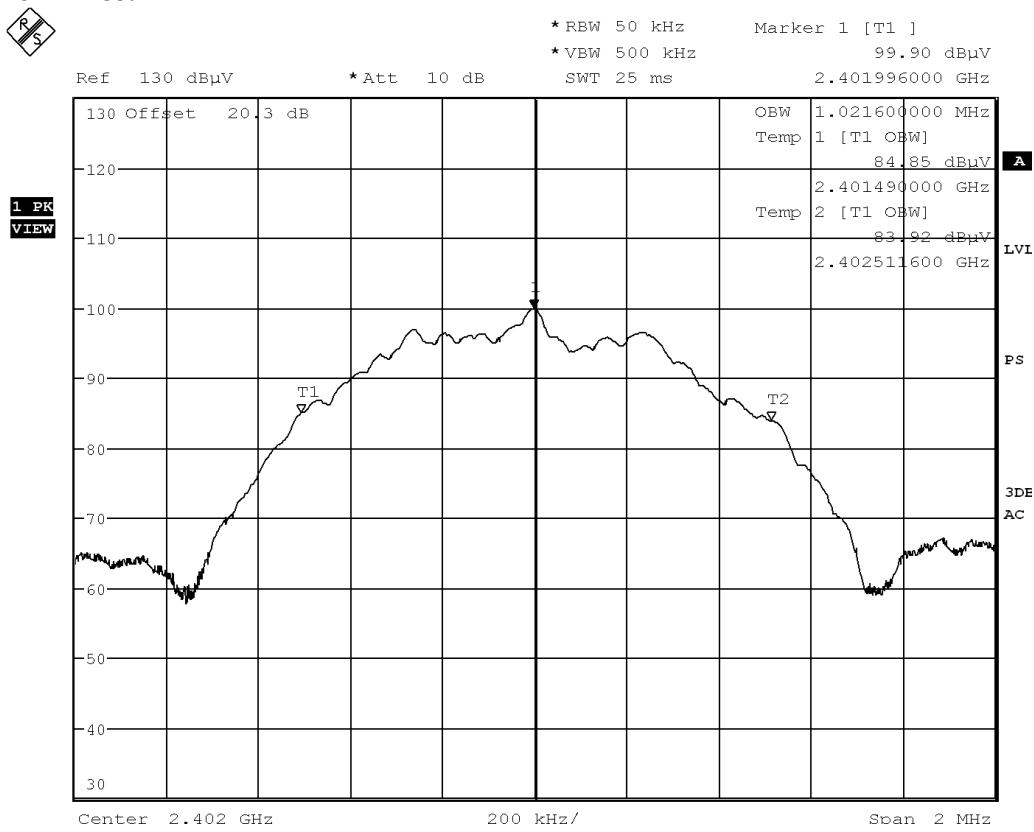


9.6.2 2402MHz 20dB BW

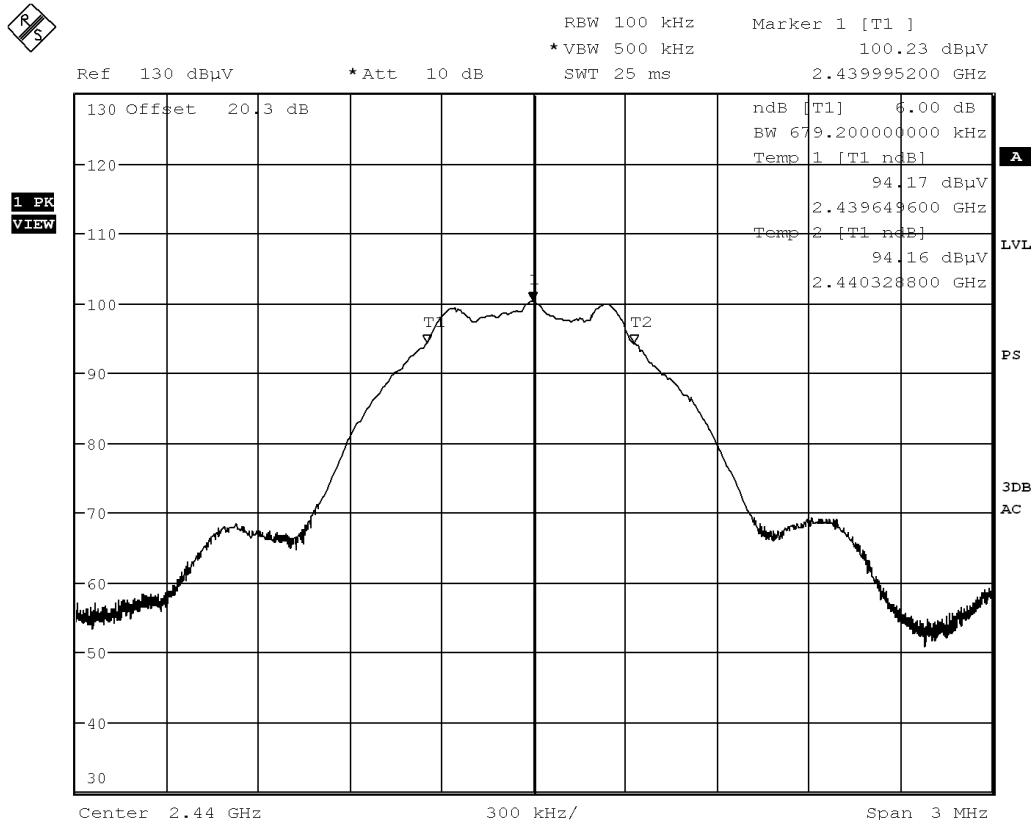




9.6.3 2402MHz 99% BW

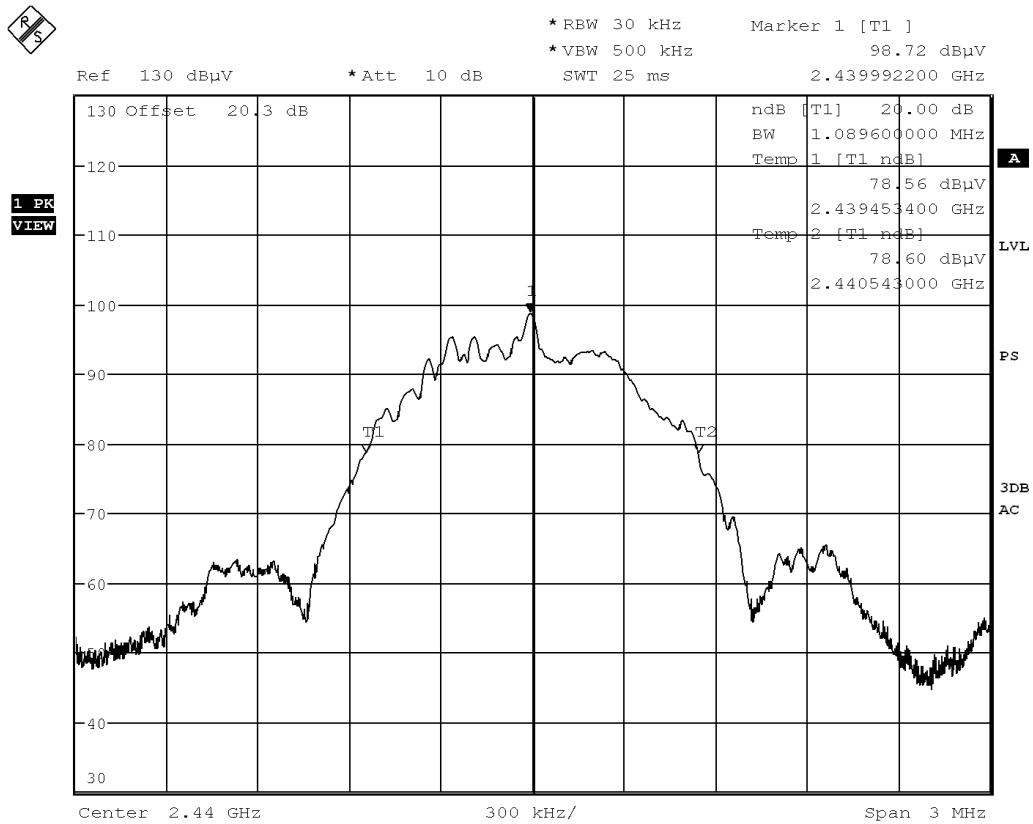


9.6.4 2440MHz 6dB BW

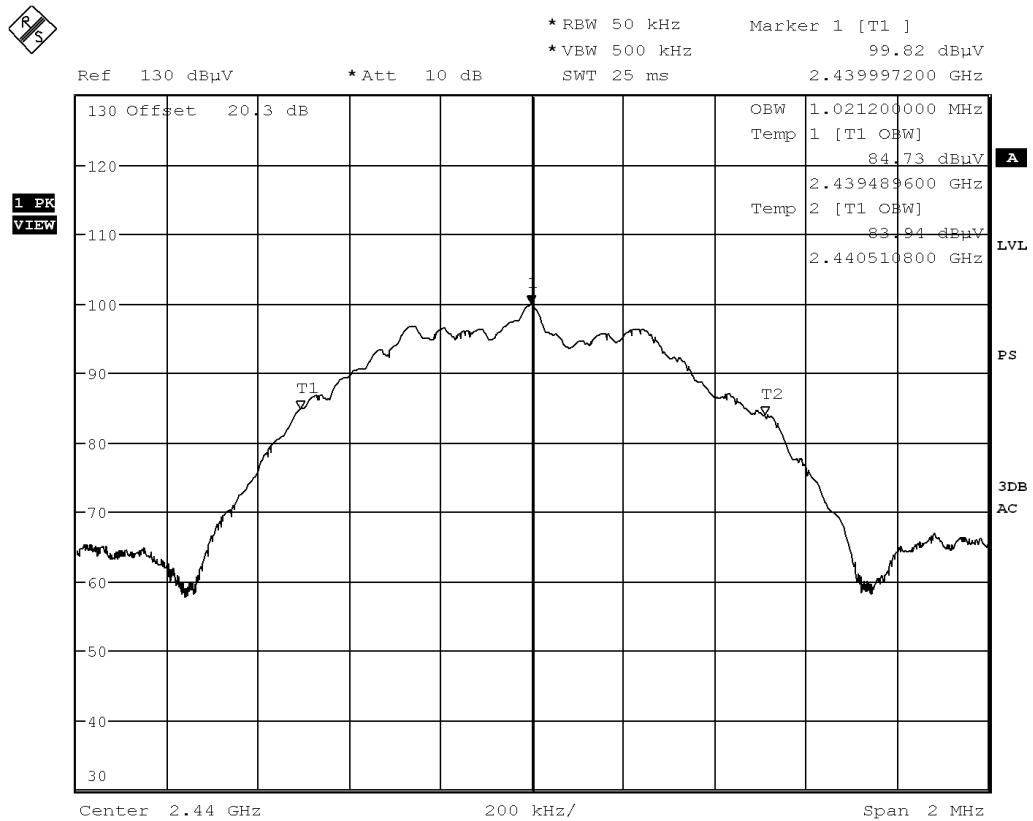




9.6.5 2440MHz 20dB BW

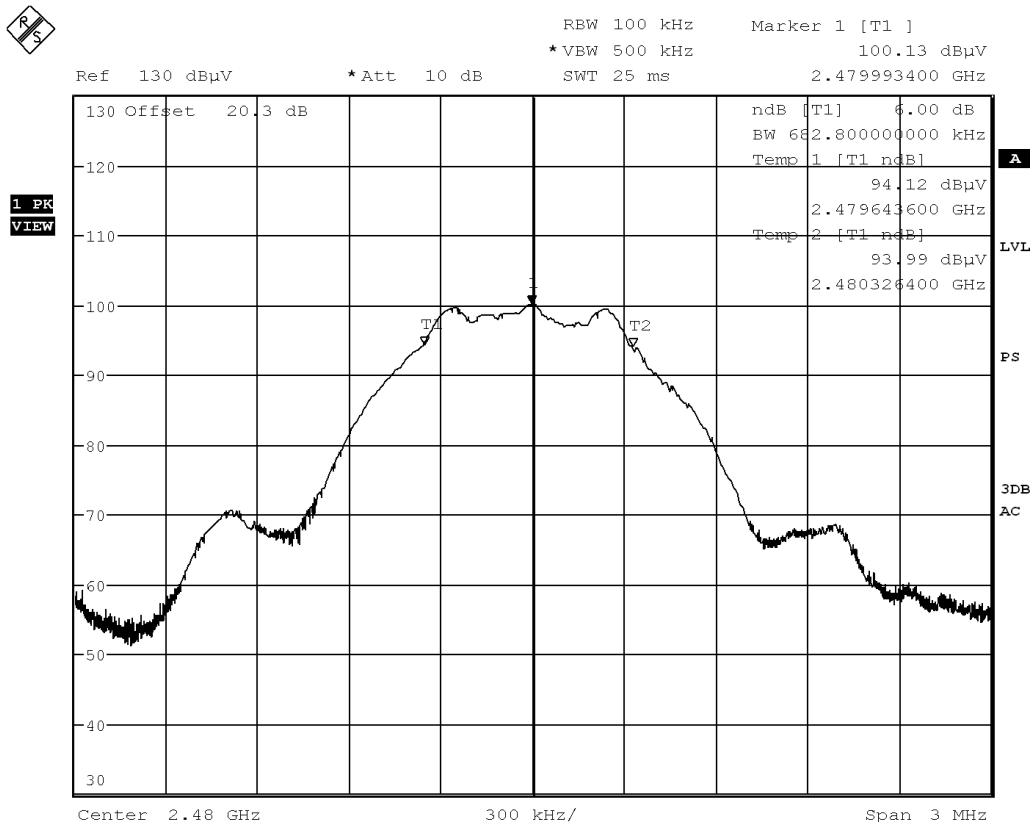


9.6.6 2440MHz 99% BW

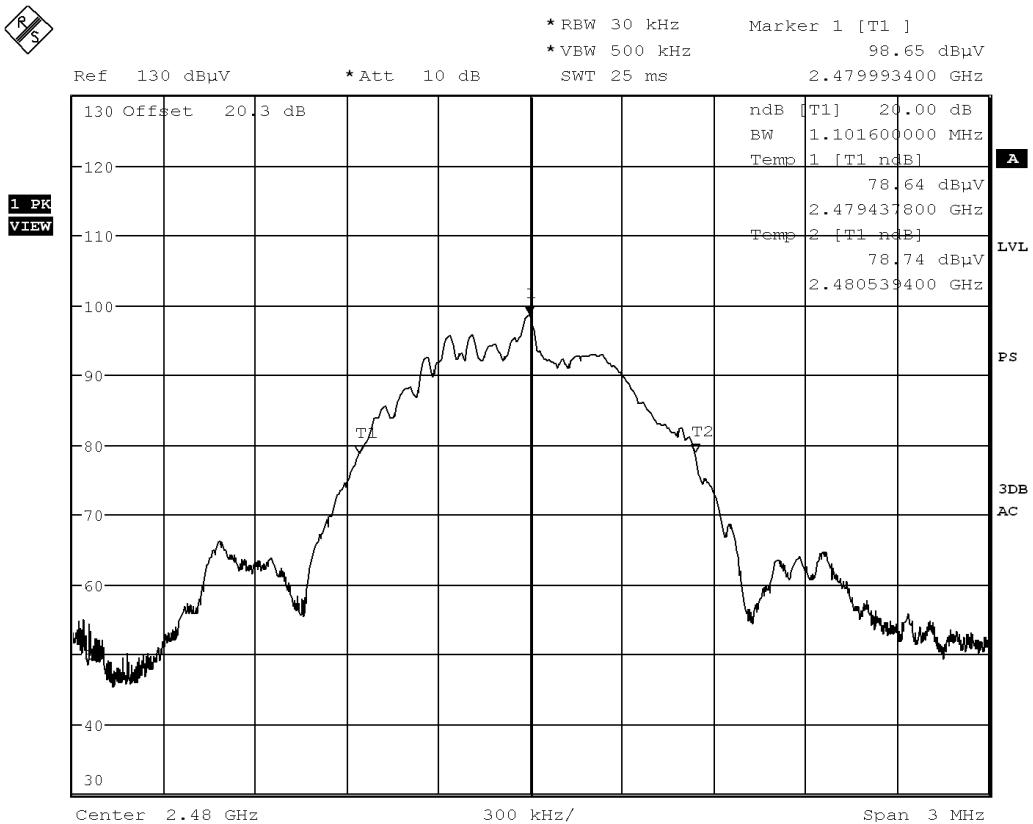




9.6.7 2480MHz 6dB BW

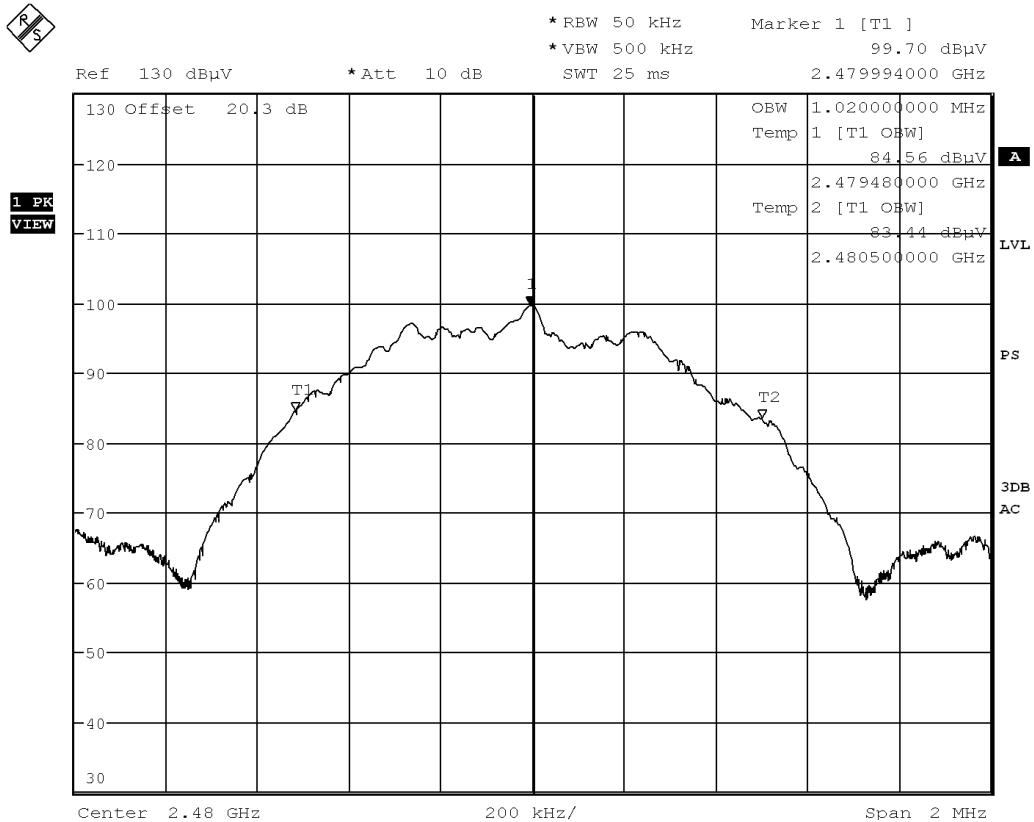


9.6.8 2480MHz 20dB BW





9.6.9 2480MHz 99% BW





10 Power Spectral Density

10.1 Test Limits

FCC Part 15.247(e):

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

RSS-247 Issue 2 § 5.2(b):

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e., the power spectral density shall be determined using the same method as is used to determine the conducted output power).

10.2 Test Method

Tests are performed in accordance with ANSI C63.10:2020 § 11.10.2 Method PKPSD (peak PSD).

10.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	10/3/2022	10/3/2023

10.4 Test Results

The device was found to be **compliant**. The peak power spectral density was less than 8dBm.



10.5 Test Conditions

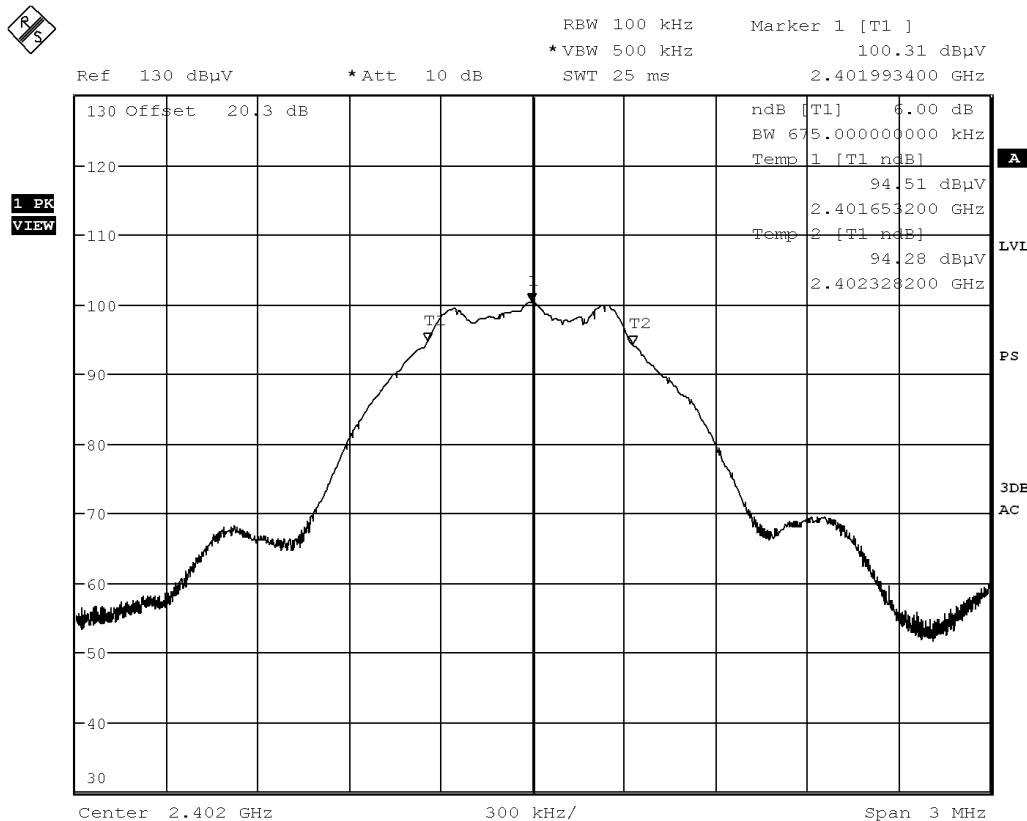
Test Personnel:	David Perry	Test Date:	4/18/2023
Supervising/Reviewing Engineer: (Where Applicable)	Brian Lackey	From FCC Part 15.247(b)(3), RSS-247 Issue 2 § 5.4(d)	
Product Standard:	FCC Part 15.247	Ambient Temperature:	23.3C
Input Voltage:	RSS-247 Issue 2	Relative Humidity:	34.4%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

Deviations, Additions, or Exclusions: Measurements were taken with an RBW of 100kHz. PPSD measurements taken with a RBW of 100kHz are greater than those taken with an RBW of 3kHz.

10.6 Test Data

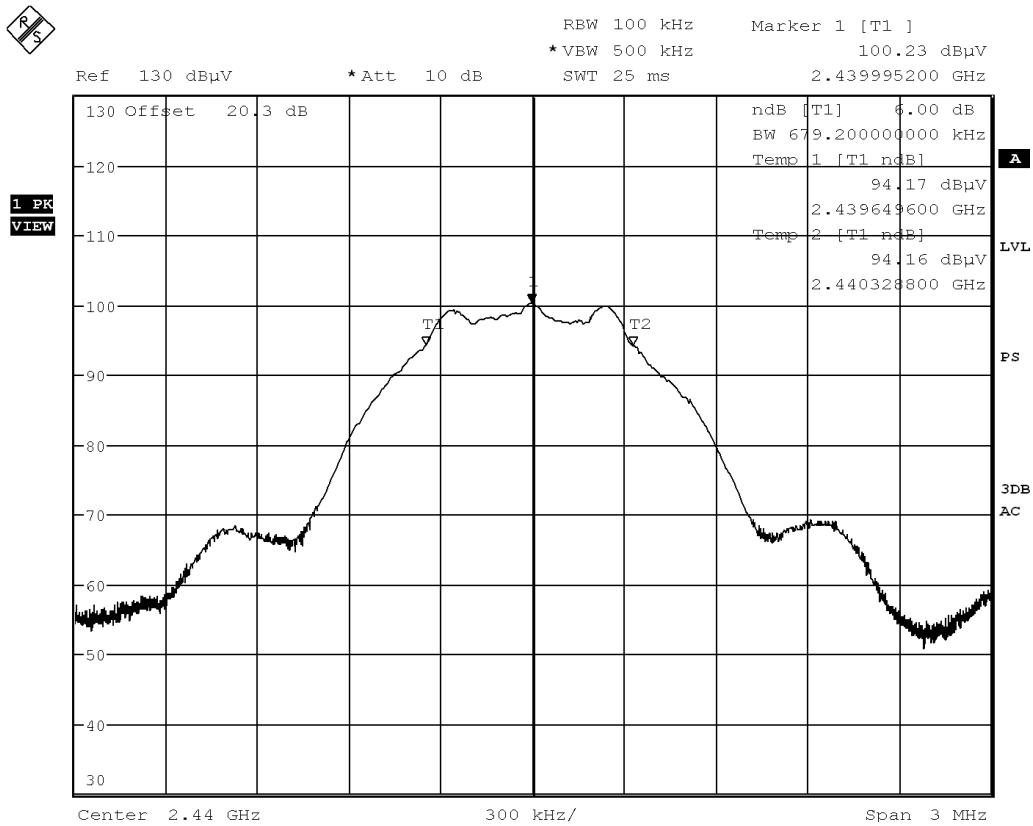
Frequency (MHz)	PPSD (dB μ V/100KHz)	PPSD (dBm/100KHz)	Limit (dBm/3KHz)	Result
2402	100.31	-6.7	8	Pass
2440	100.23	-6.8	8	Pass
2480	100.13	-6.9	8	Pass

10.6.1 2402MHz PPSD

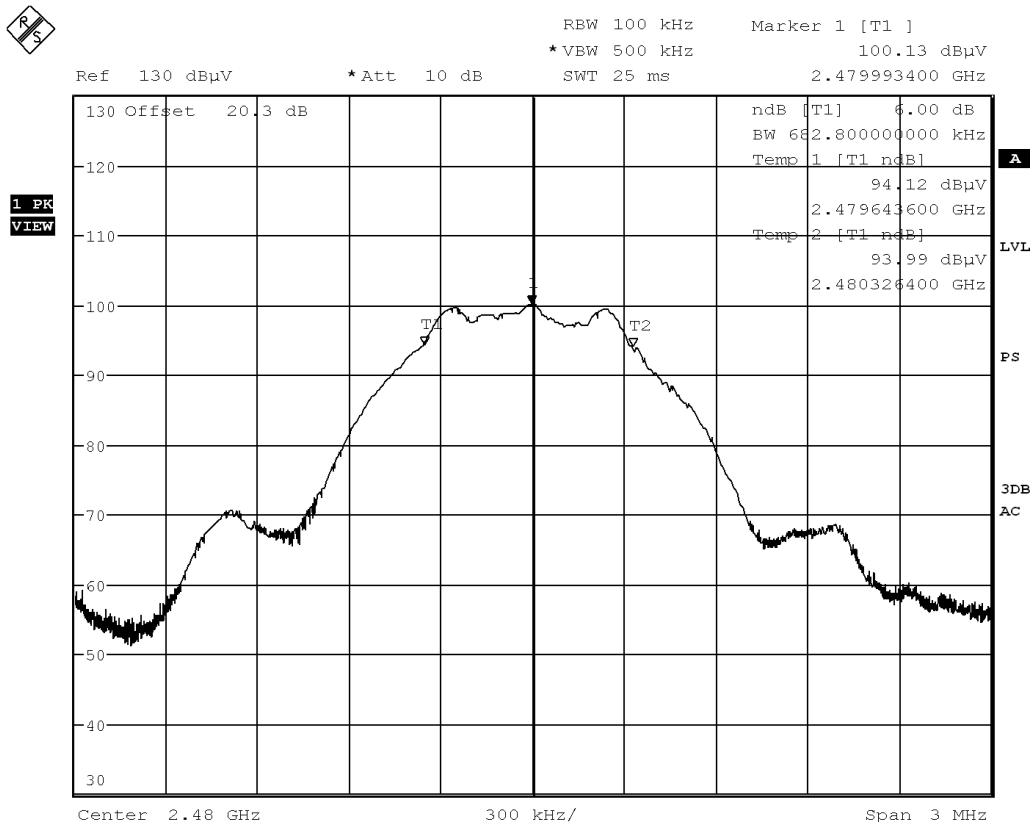




10.6.2 2440MHz PPSD



10.6.3 2480MHz PPSD





11 Antenna Requirement

11.1 Test Limits

FCC Part 15.203:

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 a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

RSS-Gen Issue 5 § 6.8:

The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the licence-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

Licence-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the licence-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level. When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna manufacturer.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi).

11.2 Test Results

The device was found to be **compliant**. The device has an internal, permanently affixed antenna.



12 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	5/31/2023	105410623LEX-002	JP	BL	Original Issue
1	6/22/2023	105410623LEX-002.1	JP	BL	Updated per TCB Review