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Dormakaba USA Inc.
TEST REPORT

SCOPE OF WORK
EMC TESTING – TRINITY

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EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 105079698LEX-003
Project Number: G105079698

Report Issue Date: 8/5/2022
Report Revised Date: 8/17/2023

Model(s) Tested: Trinity

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:
Dormakaba USA Inc.
1525 Bull Lea Rd. #100
Lexington, KY 40511
USA

Report prepared by

Seth Parker, Associate Engineer

Report reviewed by

Brian Lackey, Team Leader

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Table of Contents

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	Occupied Bandwidth (FCC Part 15.247, RSS-247 Issue 2 § 5.2(a))	Pass
7	Output Power (FCC Part 15.247(b)(3), RSS-247 Issue 2 § 5.4(d))	Pass
8	Carrier Frequency Separation (FCC Part 15.247, RSS-247 Issue 2 § 5.2)	Pass
9	Radiated Spurious Emissions & Band Edge (FCC Part 15.247, RSS Issue 2)	Pass
10	Power Spectral Density (FCC Part 15.247(e), RSS-247 Issue 2 § 5.2(b))	Pass
11	Conducted Spurious Emissions (FCC Part 15.247(d), RSS-247 Issue 2 § 5.5)	Pass
12	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:	Dormakaba USA Inc.
Address:	1525 Bull Lea Rd. #100 Lexington, KY 40511 USA
Contact:	James Adams
Email:	james.adams@dormakaba.com
Manufacturer Information	
Manufacturer Name:	Dormakaba USA Inc.
Manufacturer Address:	1525 Bull Lea Rd. #100 Lexington, KY 40511 USA

4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	Trinity
Model Number	TBDE-Box: DKAPXEB Lock: DKAPXMLK Entry: DKAPX81X
Test Start Date	8/15/2022
Test End Date	9/19/2022
Device Received Condition	Good
Test Sample Type	Production
Input Rating	100-240V ~ 50-60Hz 0.5A, Battery
Description of Equipment Under Test (provided by client)	
Electronic lock and keypad system with Bluetooth and NFC transceivers.	

4.1 Variant Models:

There were no variant models covered by this evaluation.

5 System Setup and Method

5.1 Method:

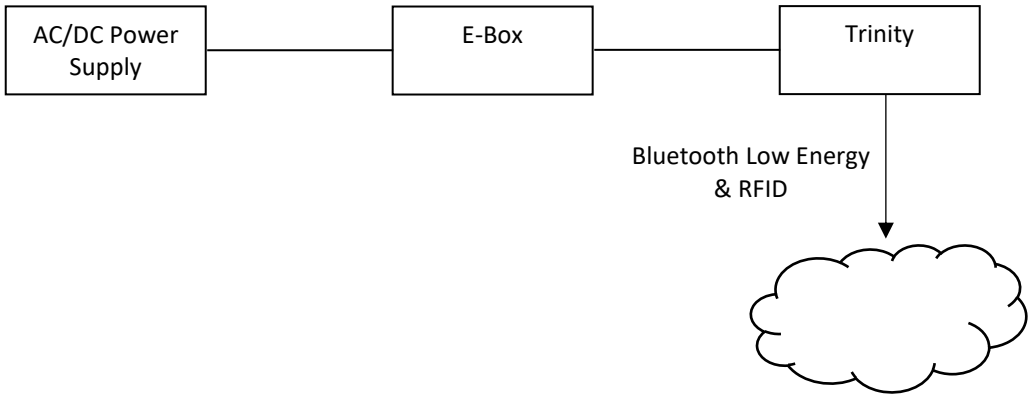
Configuration as required by ANSI C63.4: 2014 and ANSI C63.10:2013

No.	Descriptions of EUT Exercising
1	The EUT was powered by 120V/60Hz and configured to transmit a BLE signal continuously at a low, mid, or high channel.

Cables					
Qty	Description	Length (m)	Shielding	Ferrites	Termination
1	AC Mains	2	No	No	Plug
1	Ethernet	2	Yes	No	RJ45

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

5.2 EUT Block Diagram:



6 Occupied Bandwidth

6.1 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.

6.2 Test Method

Tests are performed in accordance with ANSI C63.10: 2013 clause 6.9.2 & clause 11.8.1.

6.3 Test Equipment Used:

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
Signal Analyzer	3981	Rohde & Schwarz	FSQ	9/16/2022	9/16/2023

6.4 Test Results

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

6.5 Test Conditions

Test Personnel:	Seth Parker	Test Date:	8/15/2022
Supervising/Reviewing Engineer:	Brian Lackey		
Product Standard:	FCC Part 15.247 & RSS-247 Issue 2	Ambient Temperature:	25.6C
Input Voltage:	120V/60Hz	Relative Humidity:	52.2%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

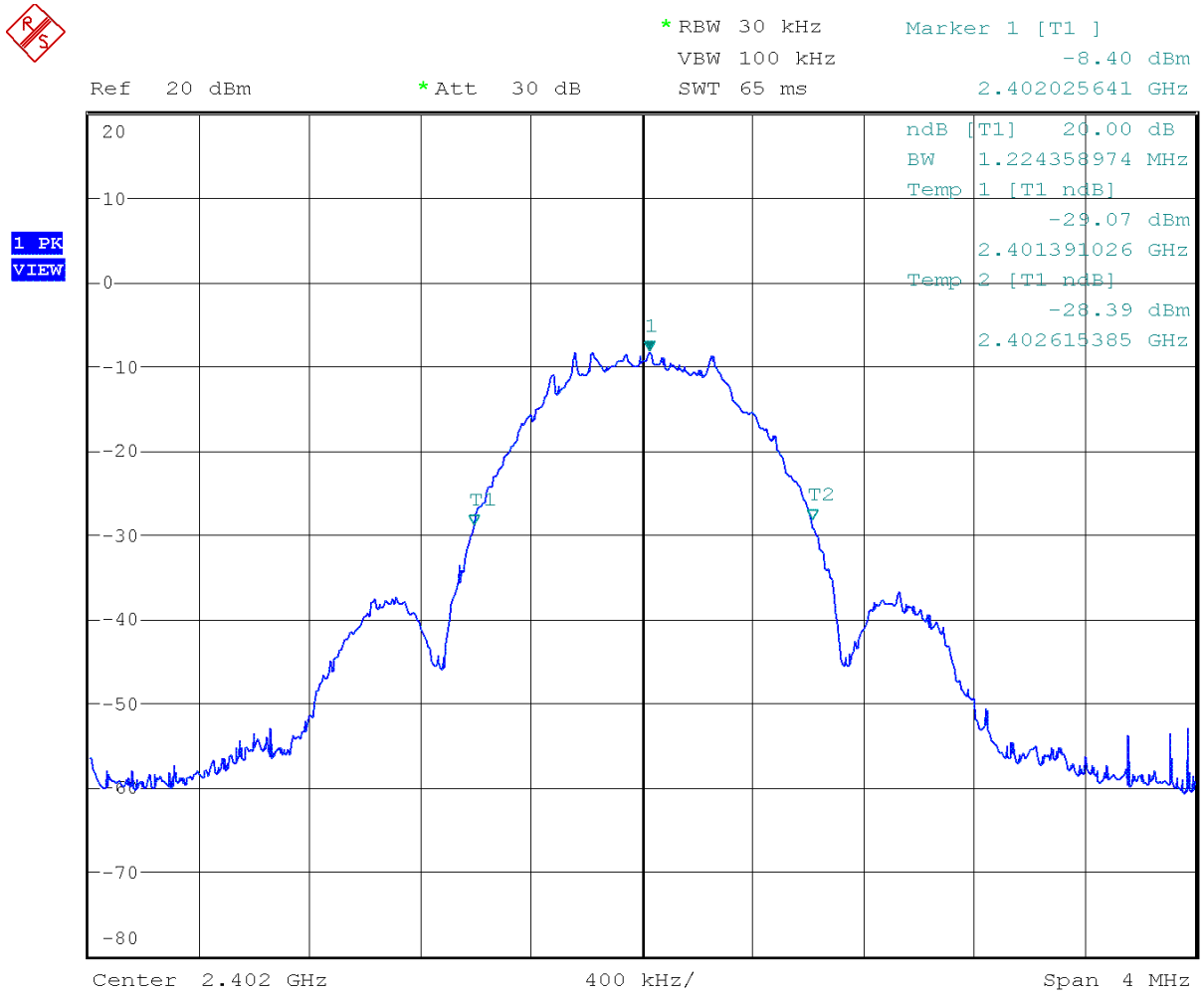
6.6 Test Data

Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	DTS Bandwidth (MHz)
2402	1.224	1.064	0.716
2440	1.216	1.064	0.707
2480	1.216	1.076	0.726

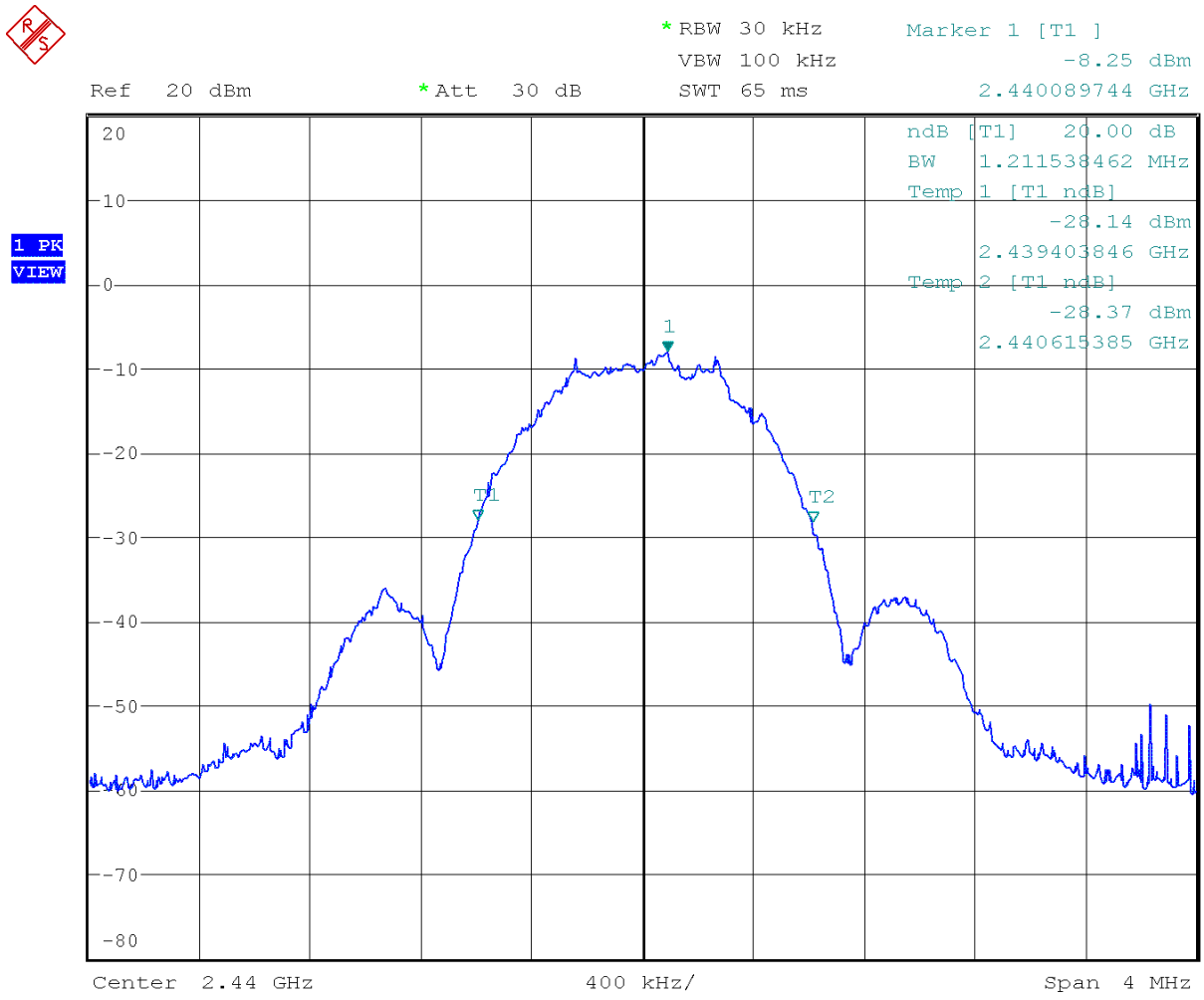
Deviations, Additions, or Exclusions: None

6.7 Spectrum Plots

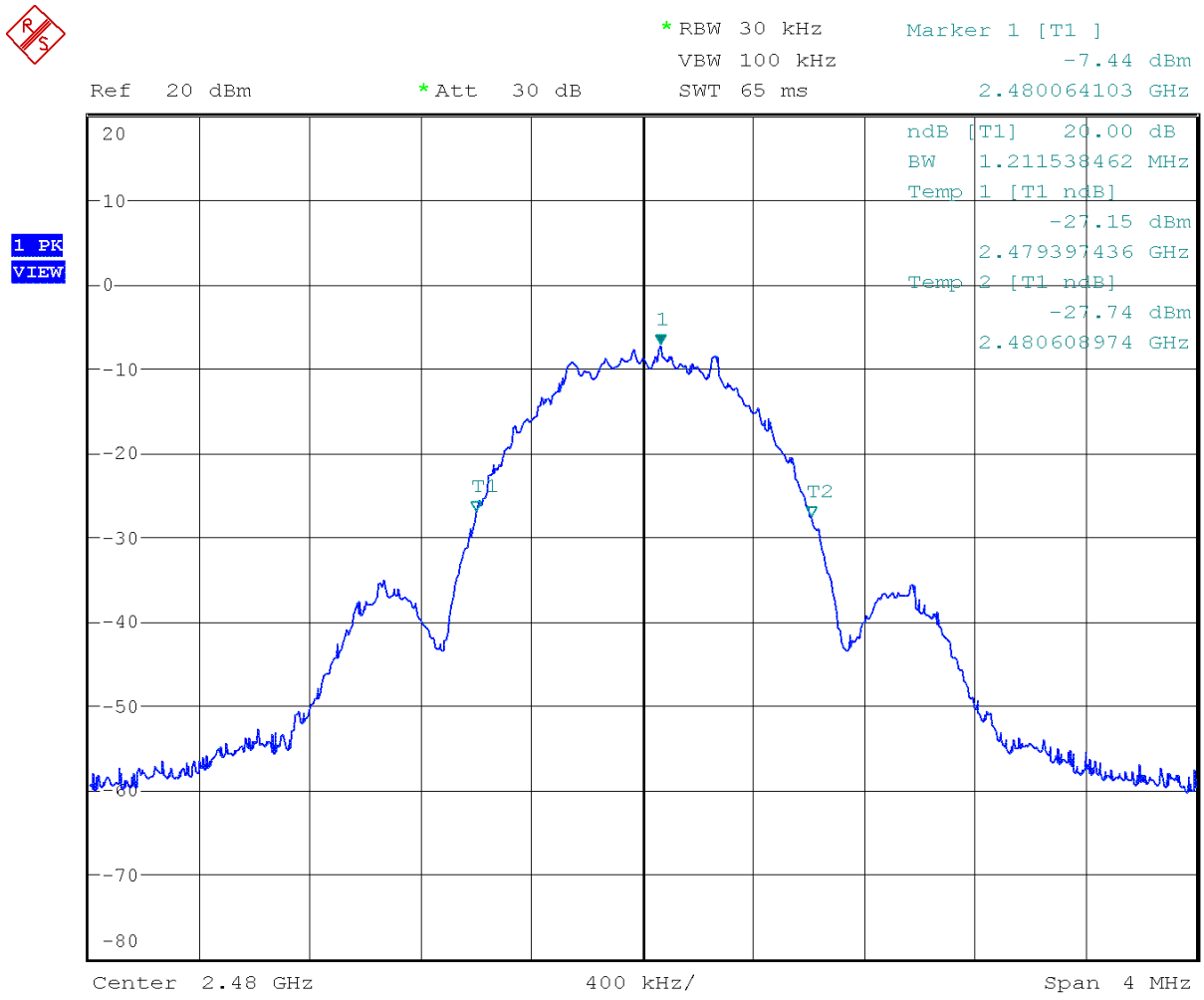
6.7.1 2402 MHz, 20dB Bandwidth



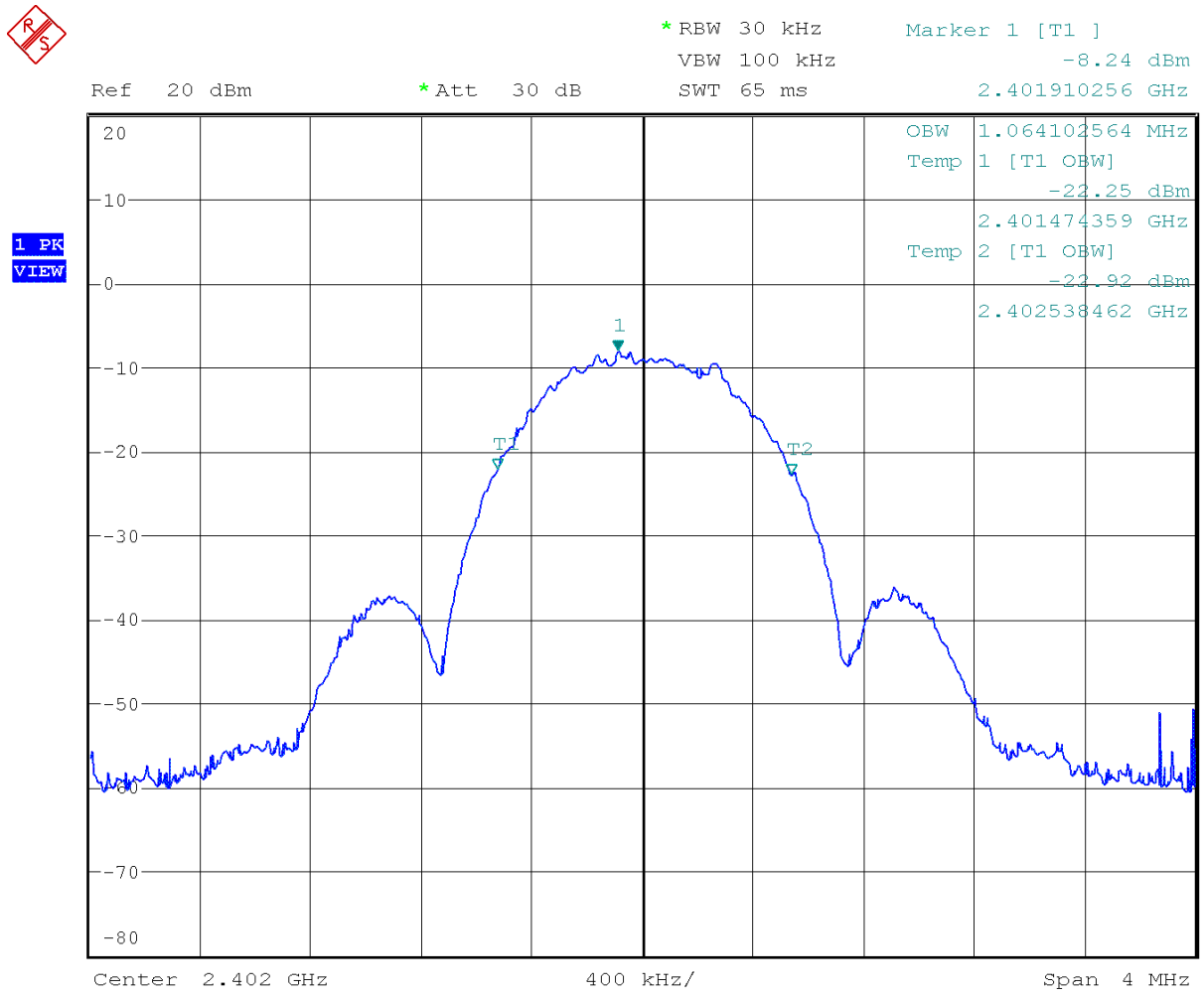
6.7.2 2440 MHz, 20dB Bandwidth



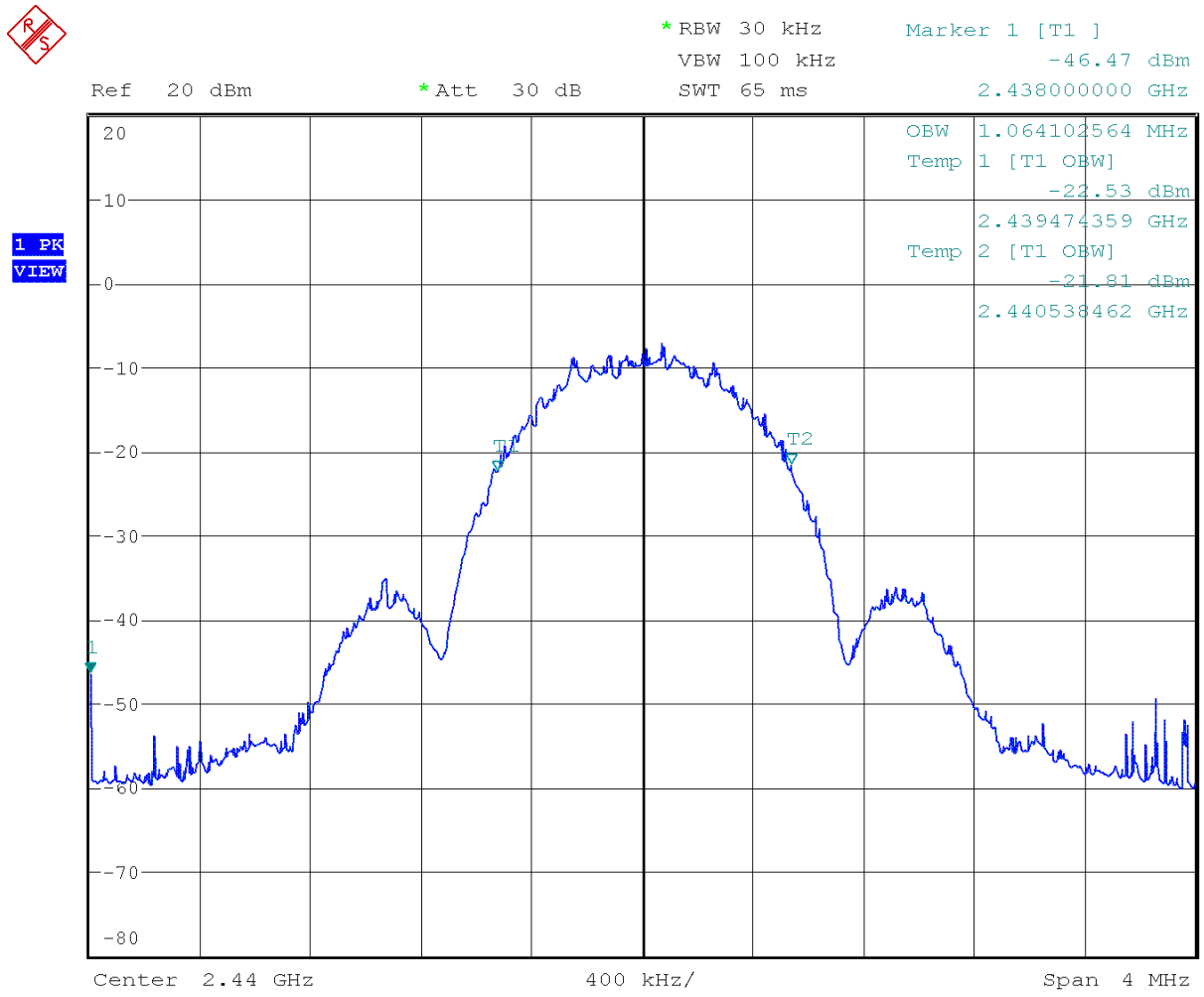
6.7.3 2480 MHz, 20dB Bandwidth



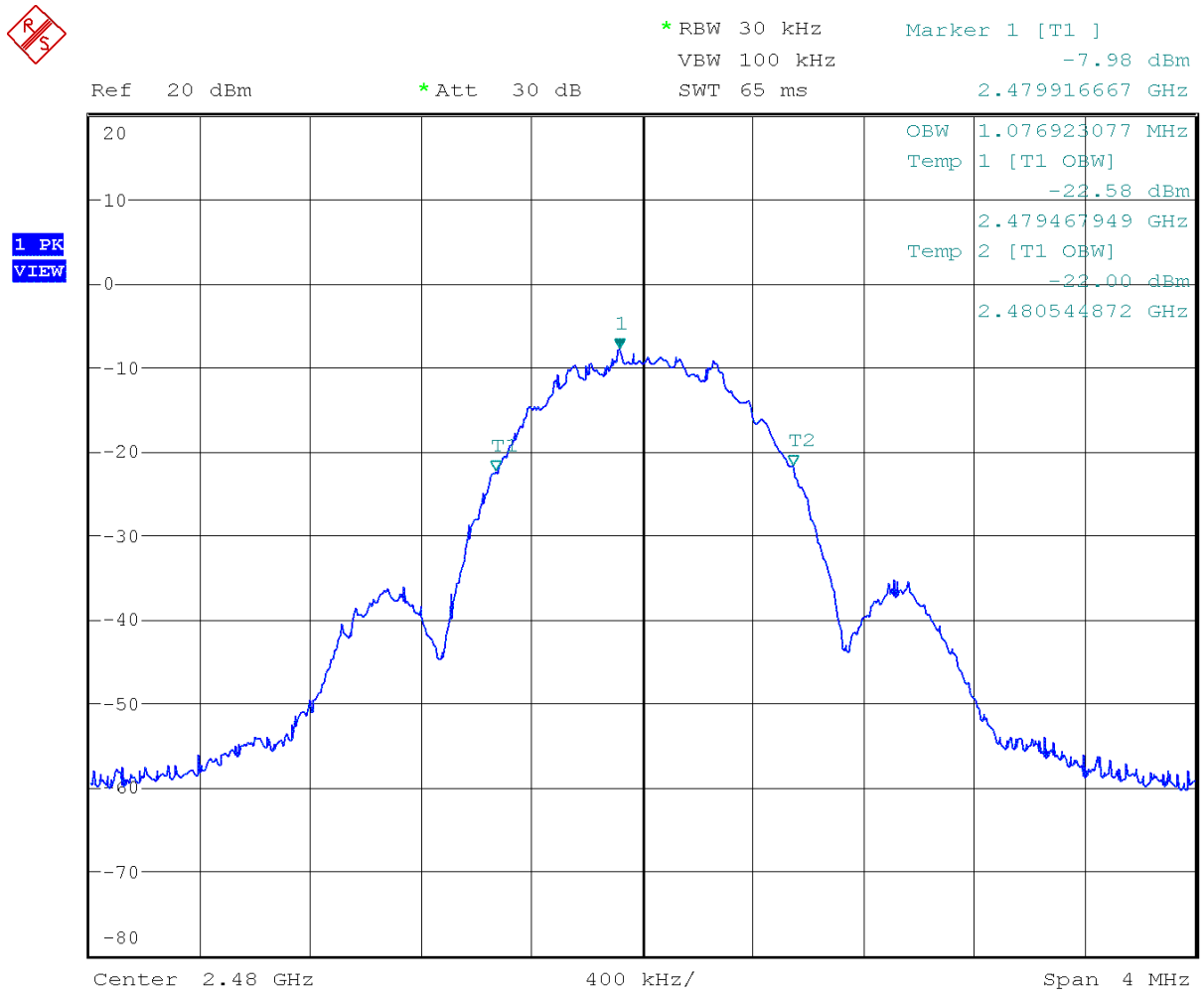
6.7.4 2402 MHz, 99% Bandwidth



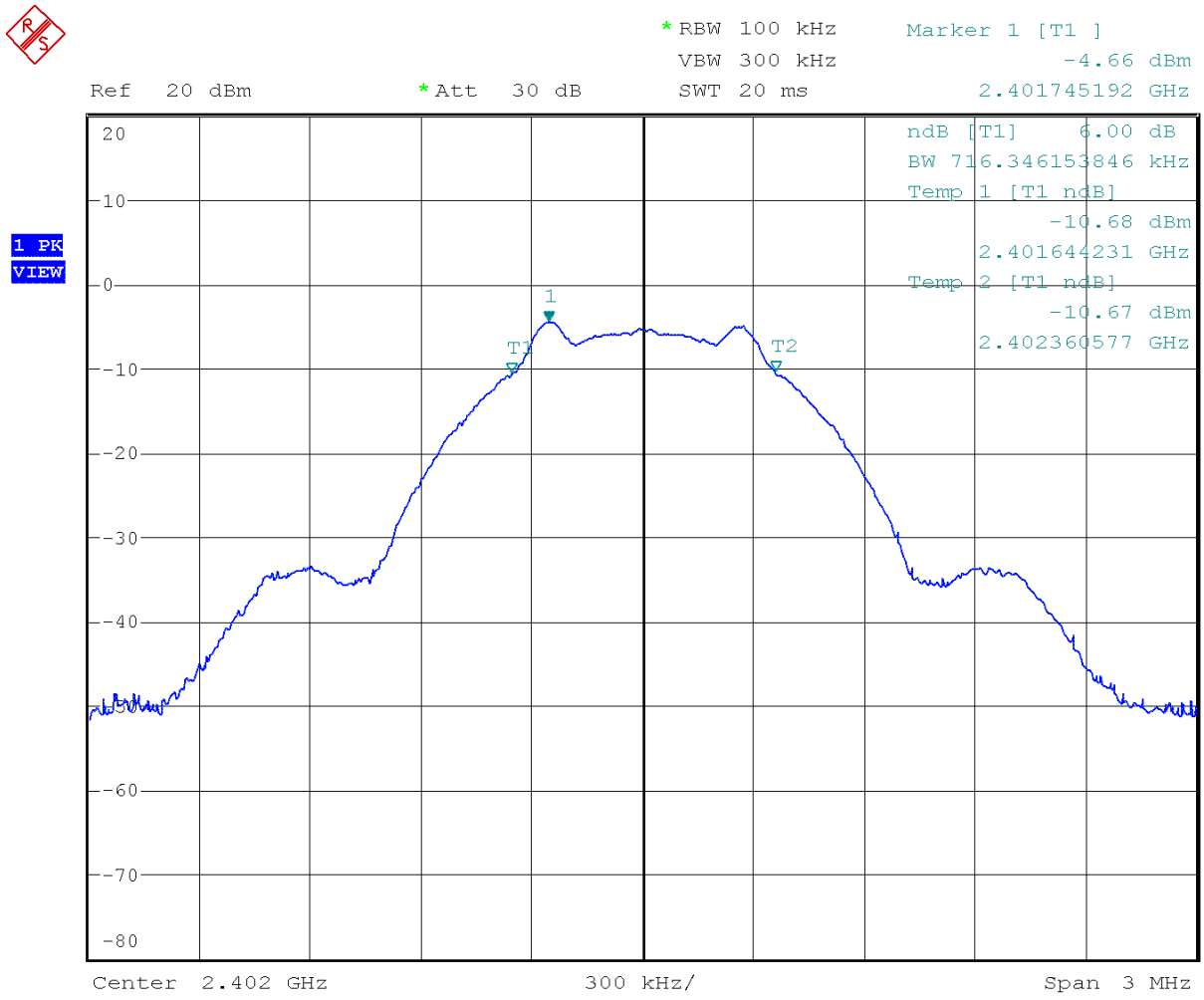
6.7.5 2440 MHz, 99% Bandwidth



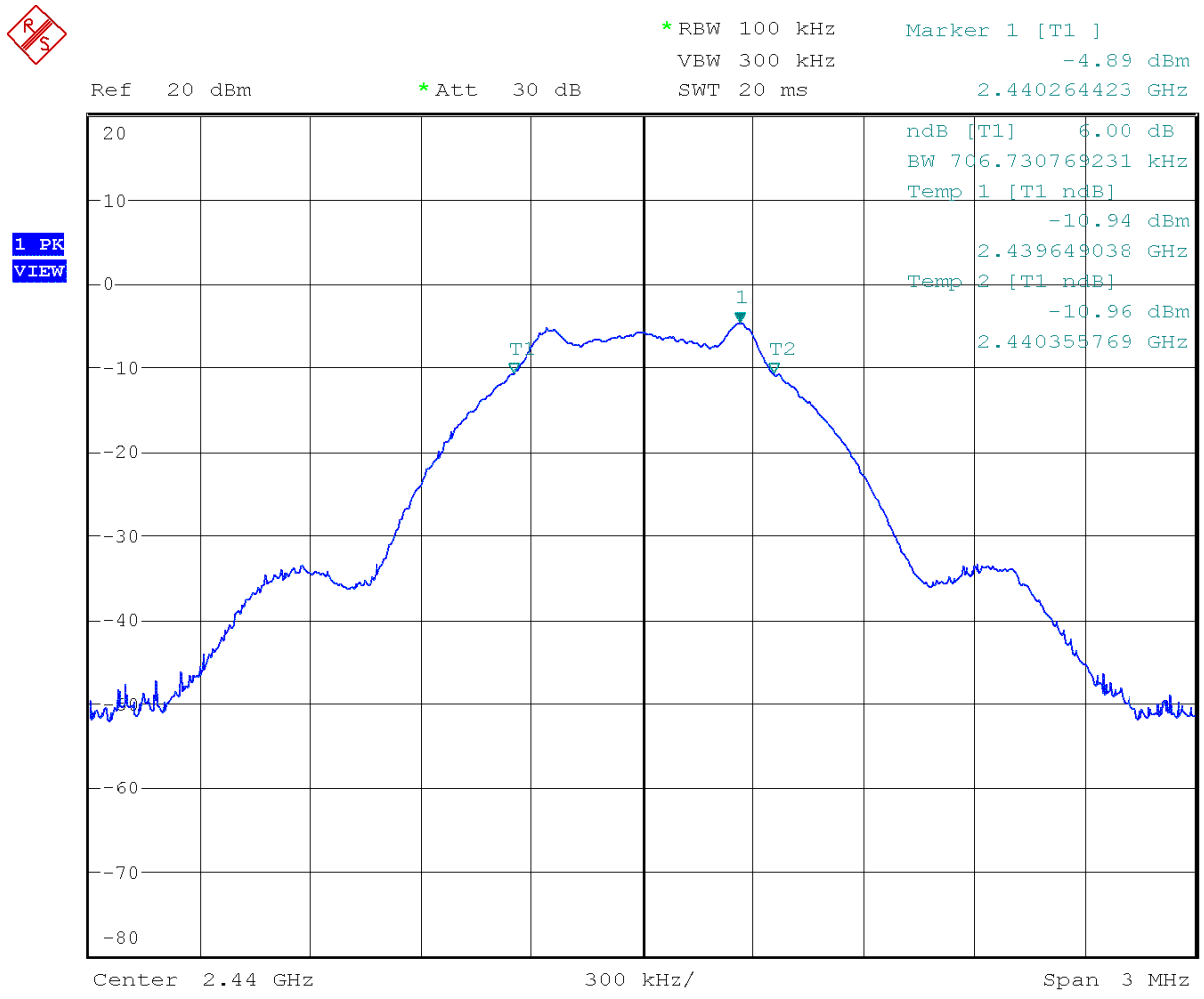
6.7.6 2480 MHz, 99% Bandwidth



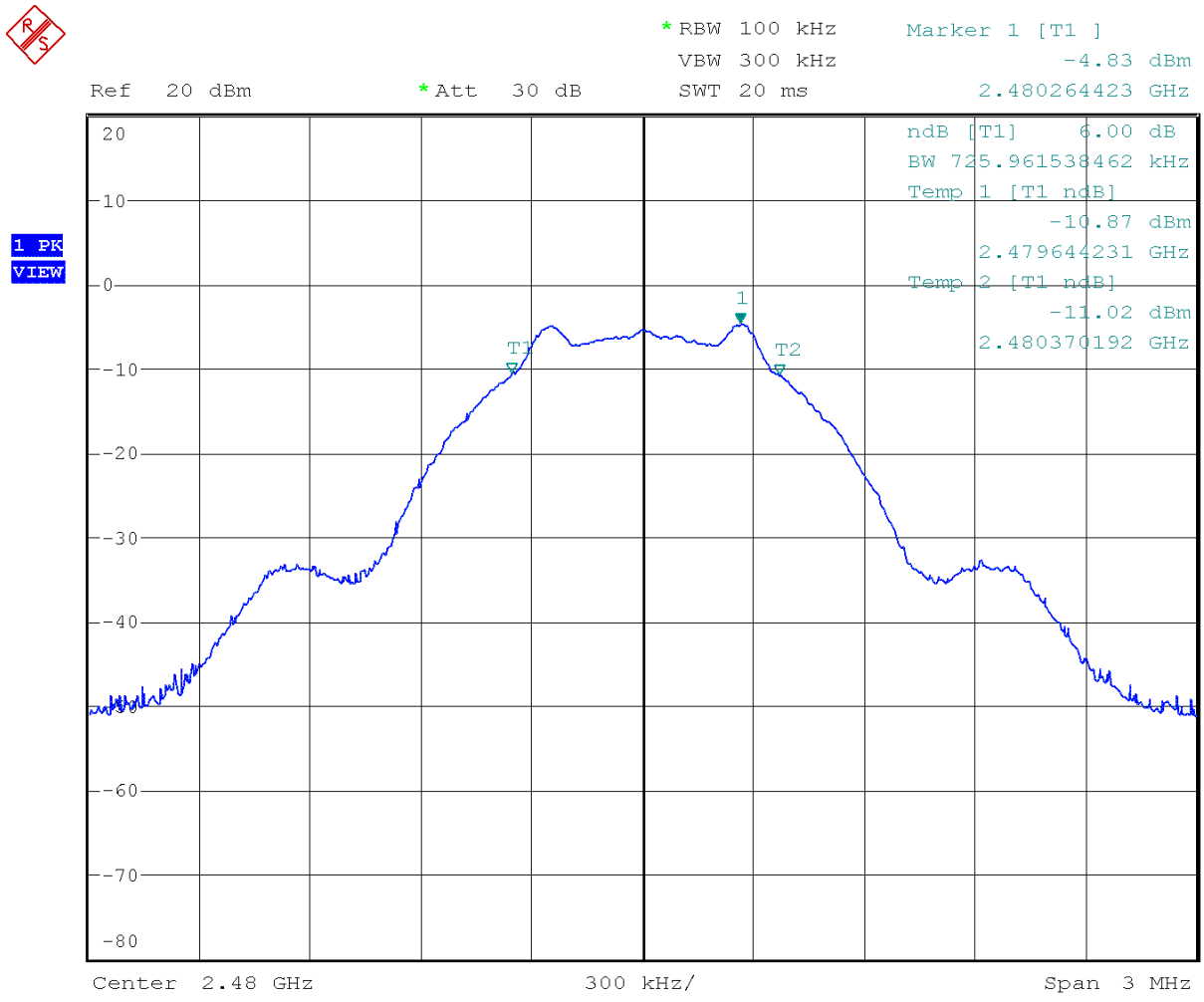
6.7.7 2402 MHz, DTS Bandwidth



6.7.8 2440 MHz, DTS Bandwidth



6.7.9 2480 MHz, DTS Bandwidth



7 Maximum Peak Output Power

7.1 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.

7.2 Test Method

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

7.3 Test Equipment Used:

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
Spectrum Analyzer	3981	Rohde & Schwarz	FSQ	9/16/22	9/16/23

7.4 Test Results

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

7.5 Test Data

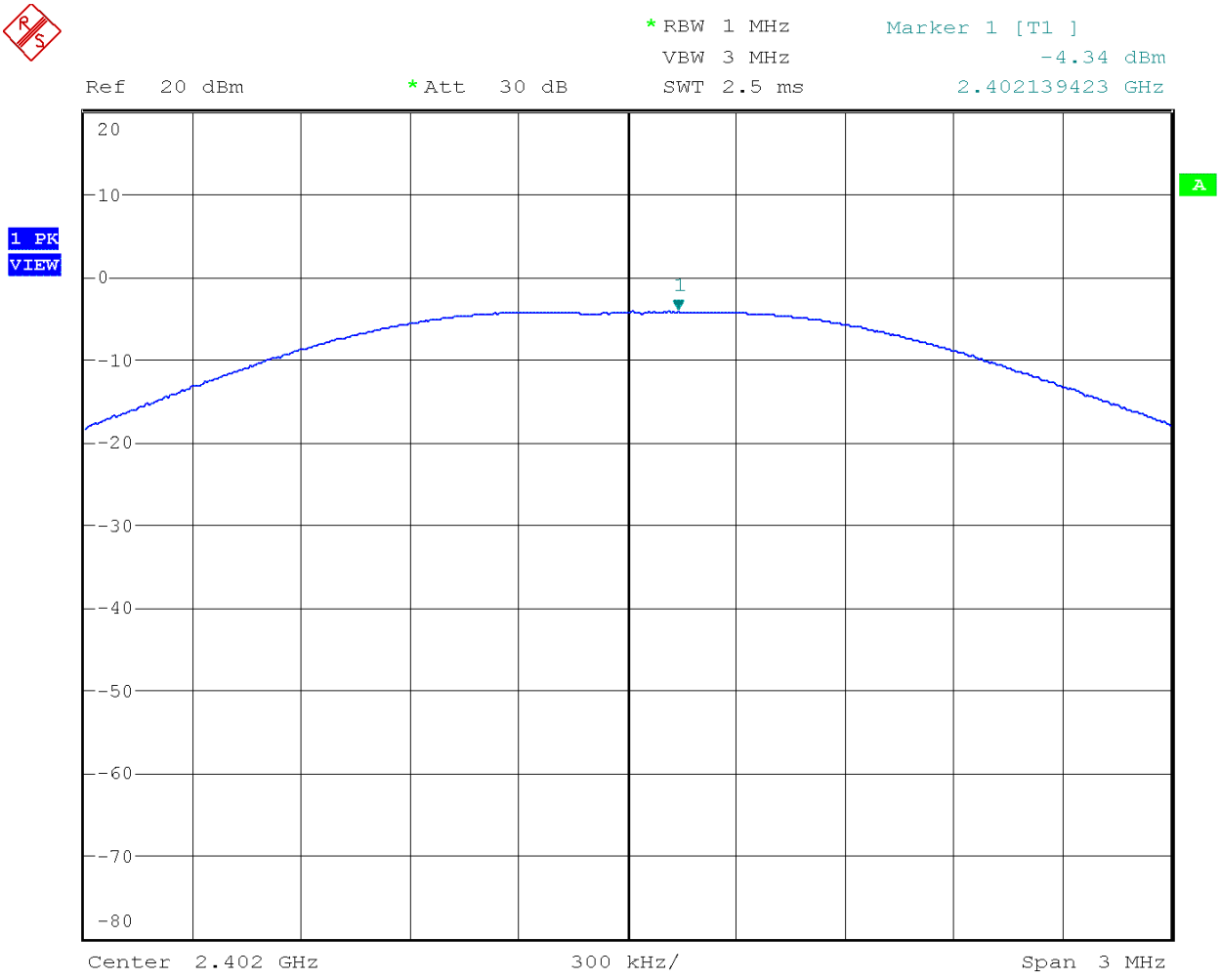
Frequency (MHz)	Conducted Power		Limit (mW)	Margin (mW)
	(dBm)	(mW)		
2402	-4.34	0.368	1000	999.632
2440	-4.61	0.345		999.655
2480	-4.73	0.336		999.664

Test Personnel:	Seth Parker	Test Date:	8/23/2022
Supervising/Reviewing Engineer:	Brian Lackey	Limit Applied:	See Above
Product Standard:	FCC Part 15.247 & RSS-247 Issue 2	Ambient Temperature:	25.6C
Input Voltage:	120V/60Hz	Relative Humidity:	52.2%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

Deviations, Additions, or Exclusions: None

7.6 Spectrum Plots

7.6.1 2402 MHz



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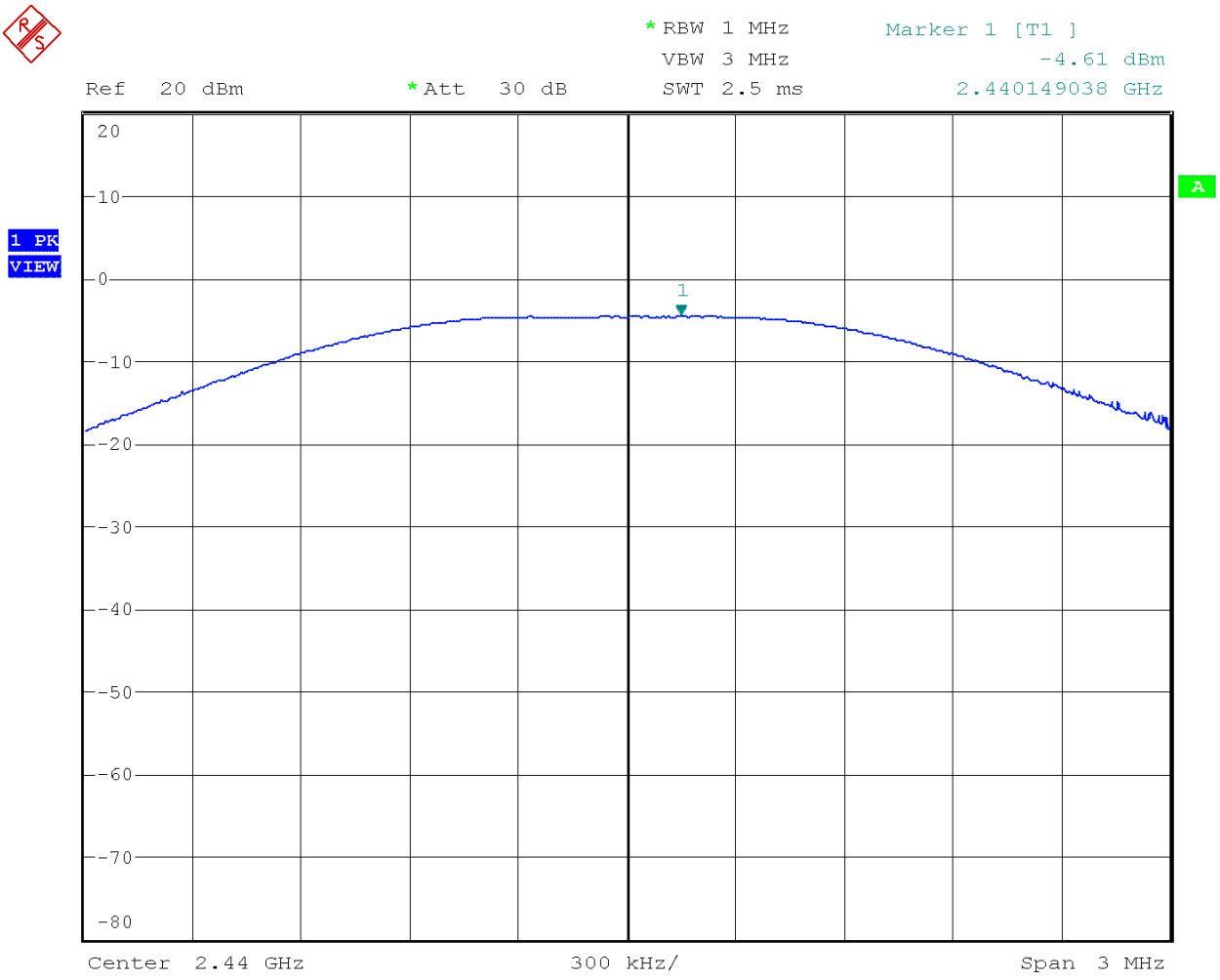
7.6.2 2440 MHz


*RBW 1 MHz
VBW 3 MHz
SWT 2.5 ms
Marker 1 [T1]
-4.61 dBm
2.440149038 GHz
Ref 20 dBm
*Att 30 dB
1 PK
VIEW
A
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
1
Center 2.44 GHz
300 kHz/
Span 3 MHz
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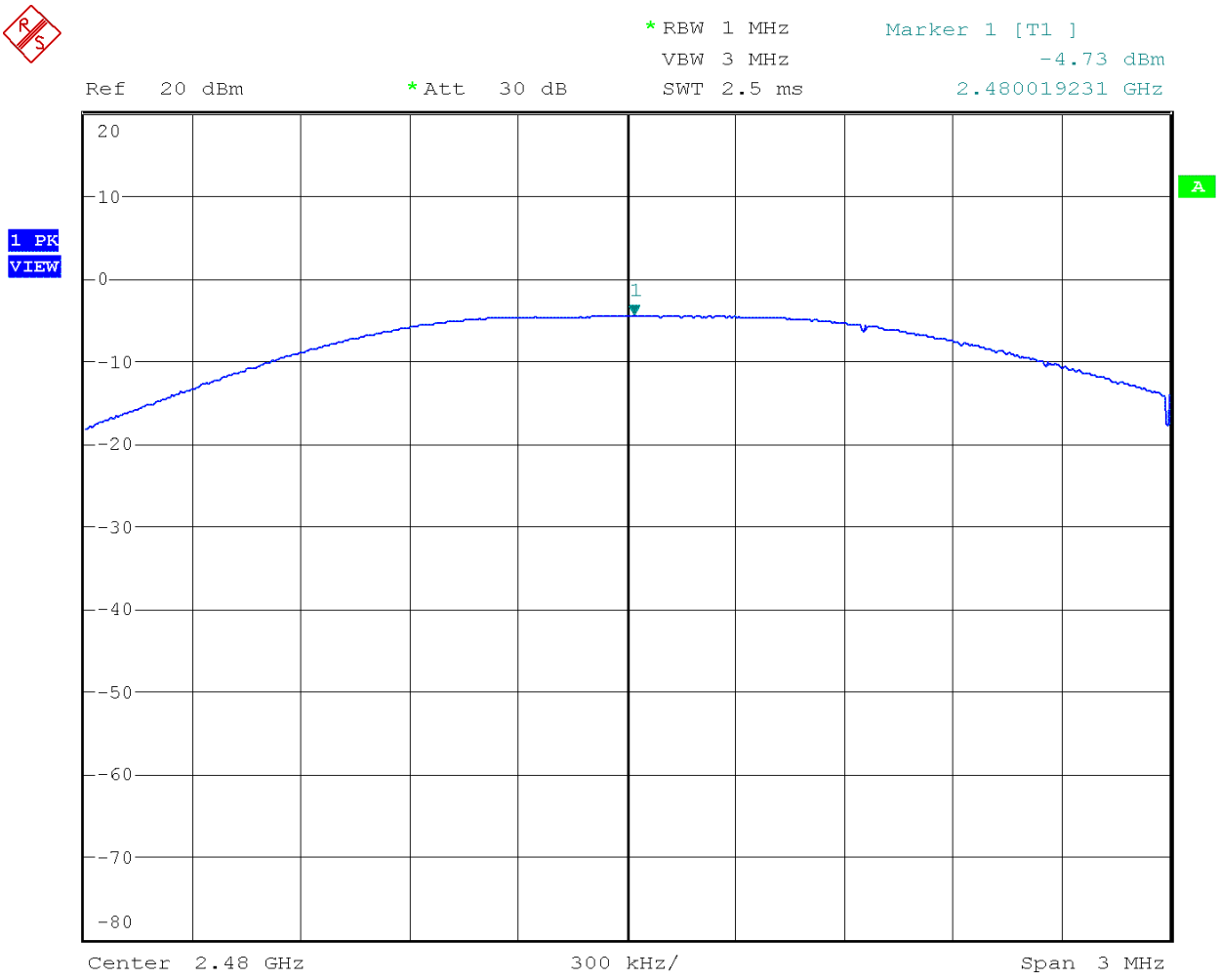
7.6.3 2480 MHz


*RBW 1 MHz
VBW 3 MHz
SWT 2.5 ms
Marker 1 [T1]
-4.73 dBm
2.480019231 GHz
Ref 20 dBm
*Att 30 dB
1 PK
VIEW
A
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
1
Center 2.48 GHz
300 kHz/
Span 3 MHz
Date: 7.JAN.2000 01:22:48

9 Radiated Spurious Emissions & Band Edge

9.1 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.

9.2 Test Method

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

TEST SITE: 10m ALSE

Site Designation: 10m Chamber

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	3.9dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.0dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.7dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.7dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.7dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.7dB	5.5 dB

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

9.3 Sample Calculation

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

FS = RA + AF + CF - AG

Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

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

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

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

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

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

Example:

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

9.4 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	8181	Rohde & Schwarz	ESW44	11/16/2021	11/16/2022
Bilog Antenna	7085	ETS	3142C	10/5/2021	10/5/2022
Horn Antenna	4001	ETS	3117	2/23/2022	2/23/2023
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	1/13/2022	1/13/2023
Coaxial Cable	3074			1/13/2022	1/13/2023
Coaxial Cable	2588			1/13/2022	1/13/2023
Coaxial Cable	2593			1/13/2022	1/13/2023
Coaxial Cable	8185			1/13/2022	1/13/2023
Coaxial Cable	8188			1/13/2022	1/13/2023
Coaxial Cable	3339			1/13/2022	1/13/2023
Preamplifier	3919	Rohde & Schwarz	TS-PR3	1/13/2022	1/13/2023
Coaxial Cable	3172			1/13/2022	1/13/2023
Coaxial Cable	2590			1/13/2022	1/13/2023
Coaxial Cable	8186			1/13/2022	1/13/2023
Coaxial Cable	8187			1/13/2022	1/13/2023
Coaxial Cable	7020			1/13/2022	1/13/2023
Coaxial Cable	7021			1/13/2022	1/13/2023
Preamplifier (18-40GHz)	3921	Rohde & Schwarz	TS-PR40	1/13/2022	1/13/2023
Horn Antenna (18-40GHz)	3779	ETS	3116c	7/30/2021	9/28/2022[1]

9.5 Software Utilized

Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 10.60.20

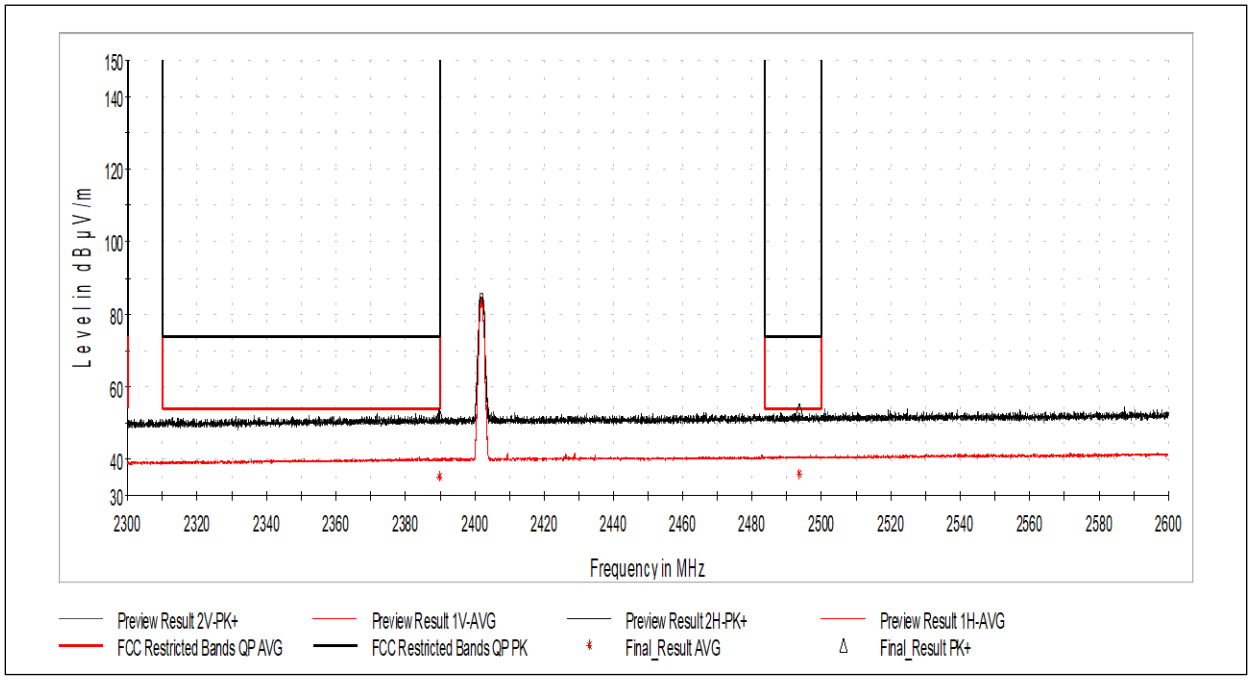
9.6 Test Results

The sample tested was found to be **compliant**. The data presented represents the worst-case emissions with the device positioned in three orthogonal positions. All observed emissions outside of the band of operation were attenuated by at least 20dB.

1 Operating under a calibration extension during the time of testing.

9.7 Test Data: Radiated Band Edge

9.7.1 2402 MHz



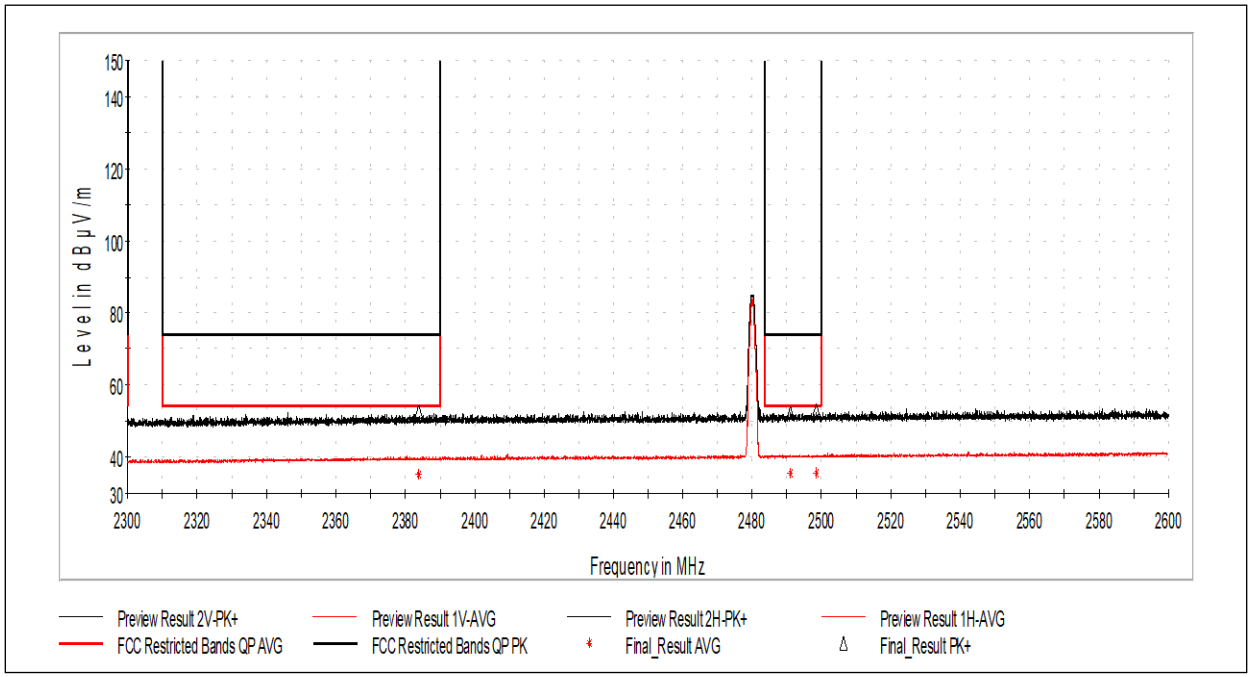
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2389.769231	52.31	73.979	21.67	1000.000	410.0	H	209.0	38.13
2493.615385	53.59	73.979	20.39	1000.000	211.0	V	44.0	38.55

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2389.769231	35.24	53.979	18.74	1000.000	410.0	H	209.0	38.13
2493.615385	36.03	53.979	17.95	1000.000	211.0	V	44.0	38.55

Test Personnel:	Seth Parker	Test Date:	8/23/2022
Supervising/Reviewing Engineer:	Brian Lackey	Limit Applied:	Limits from 15.209 in restricted bands from 15.205.
Product Standard:	FCC Part 15.247 & RSS-247 Issue 2	Ambient Temperature:	23.5C
Input Voltage:	120V/60Hz	Relative Humidity:	66%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

Deviations, Additions, or Exclusions: None

9.7.2 2480 MHz



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2383.884615	52.69	73.979	21.29	1000.000	245.0	V	298.0	38.19
2490.903846	52.33	73.979	21.65	1000.000	277.0	V	349.0	38.53
2498.461539	52.87	73.979	21.11	1000.000	306.0	V	70.0	38.59

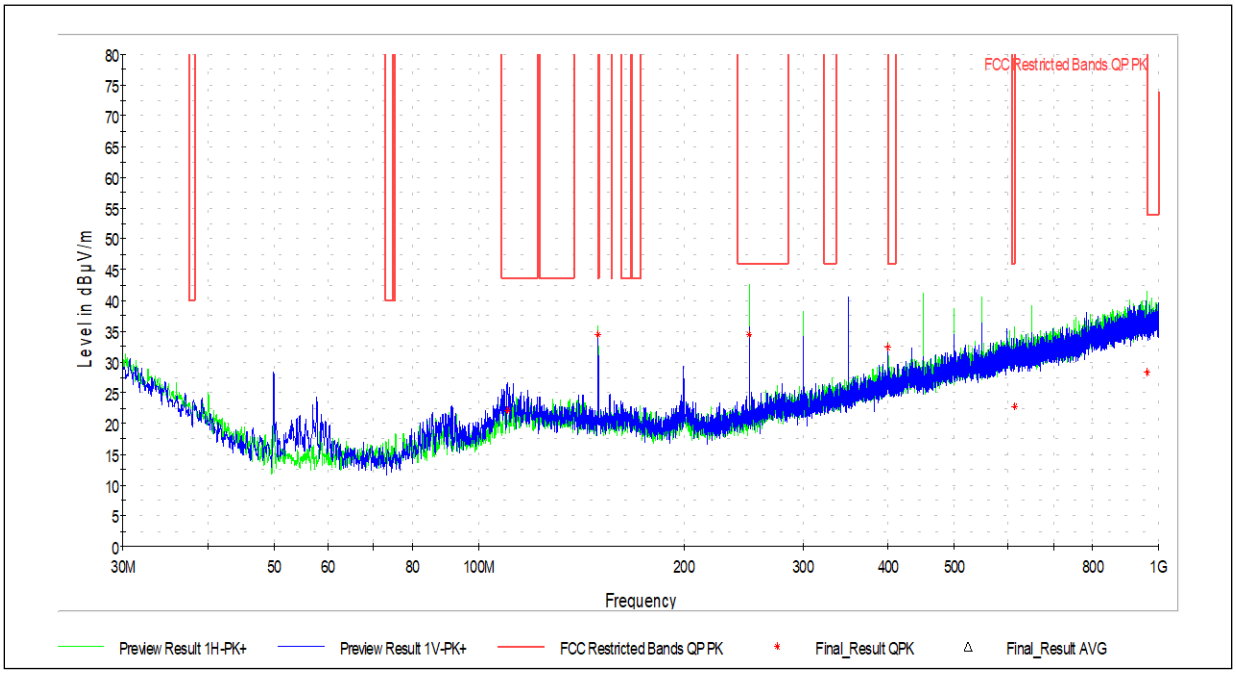
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2383.884615	35.17	53.979	18.81	1000.000	245.0	V	298.0	38.19
2490.903846	35.65	53.979	18.33	1000.000	277.0	V	349.0	38.53
2498.461539	35.62	53.979	18.36	1000.000	306.0	V	70.0	38.59

Test Personnel:	Seth Parker	Test Date:	8/23/2022
Supervising/Reviewing Engineer:	Brian Lackey	Limit Applied:	See Above
Product Standard:	FCC Part 15.247 & RSS-247 Issue 2	Ambient Temperature:	23.5C
Input Voltage:	120V/60Hz	Relative Humidity:	66%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

Deviations, Additions, or Exclusions: None

9.8 Test Data: 30 MHz – 1 GHz

9.8.1 2441 MHz



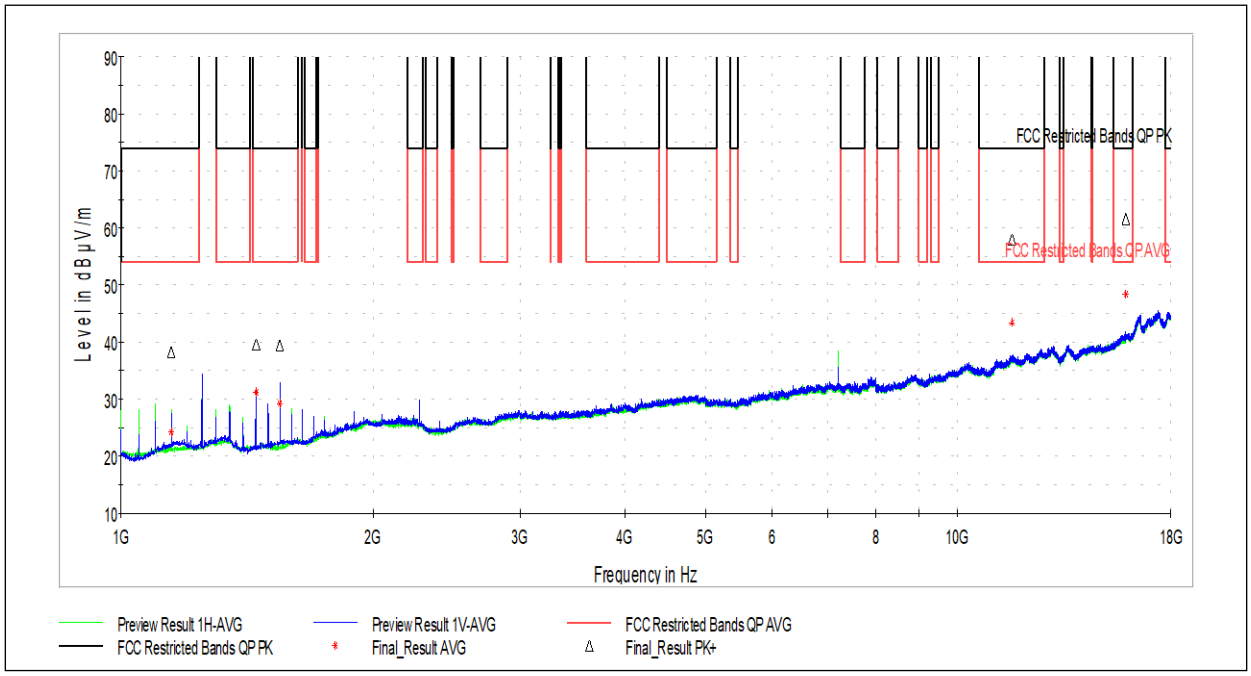
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
110.240556	22.06	43.522	21.46	120.000	100.0	V	261.0	21.07
149.956667	34.40	43.522	9.12	120.000	105.0	H	18.0	21.47
249.920556	34.40	46.021	11.62	120.000	207.0	H	49.0	21.55
399.947222	32.34	46.021	13.68	120.000	120.0	H	252.0	26.81
613.347222	22.70	46.021	23.32	120.000	400.0	H	143.0	31.65
961.415556	28.27	53.979	25.71	120.000	177.0	H	54.0	36.83

Test Personnel:	Jeremiah Andrade	Test Date:	8/23/2022
Supervising/Reviewing Engineer:	Brian Lackey	Limit Applied:	See Above
Product Standard:	FCC Part 15.247 & RSS-247 Issue 2	Ambient Temperature:	23.5C
Input Voltage:	120V/60Hz	Relative Humidity:	66%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

Deviations, Additions, or Exclusions: Testing represents the worst case of low, middle, and high channels.

9.9 Test Data: 1 GHz – 18 GHz

9.9.1 2402 MHz



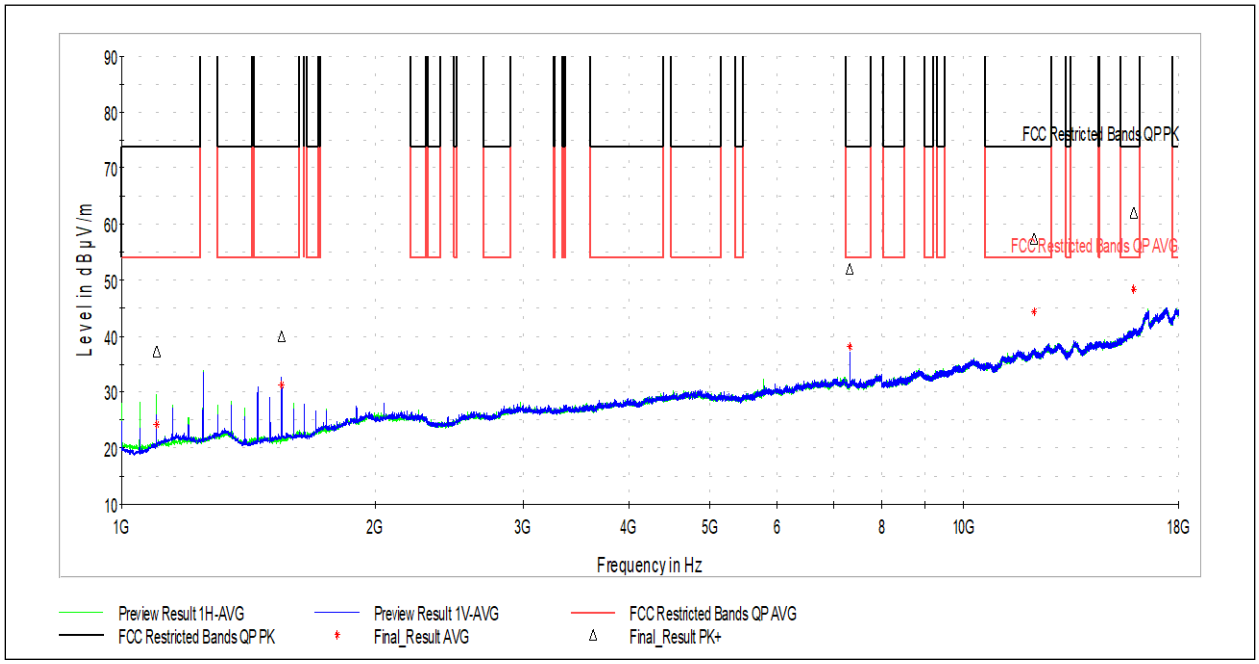
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1149.500000	38.28	73.979	35.70	1000.000	362.0	V	109.0	-1.44
1450.000000	39.56	73.979	34.42	1000.000	194.0	V	104.0	-1.56
1549.500000	39.43	73.979	34.55	1000.000	259.0	V	109.0	-0.63
11612.000000	58.02	73.979	15.96	1000.000	109.0	V	201.0	19.18
15909.000000	61.61	73.979	12.37	1000.000	117.0	V	86.0	24.58

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1149.500000	24.22	53.979	29.76	1000.000	362.0	V	109.0	-1.44
1450.000000	31.11	53.979	22.87	1000.000	194.0	V	104.0	-1.56
1549.500000	29.21	53.979	24.77	1000.000	259.0	V	109.0	-0.63
11612.000000	43.47	53.979	10.51	1000.000	109.0	V	201.0	19.18
15909.000000	48.49	53.979	5.49	1000.000	117.0	V	86.0	24.58

Test Personnel:	Jordan Coughenour	Test Date:	8/23/2022
Supervising/Reviewing Engineer:	Brian Lackey	Limit Applied:	See Above
Product Standard:	FCC Part 15.247 & RSS-247 Issue 2	Ambient Temperature:	23.5C
Input Voltage:	120V/60Hz	Relative Humidity:	66%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

Deviations, Additions, or Exclusions: None

9.9.2 2441 MHz



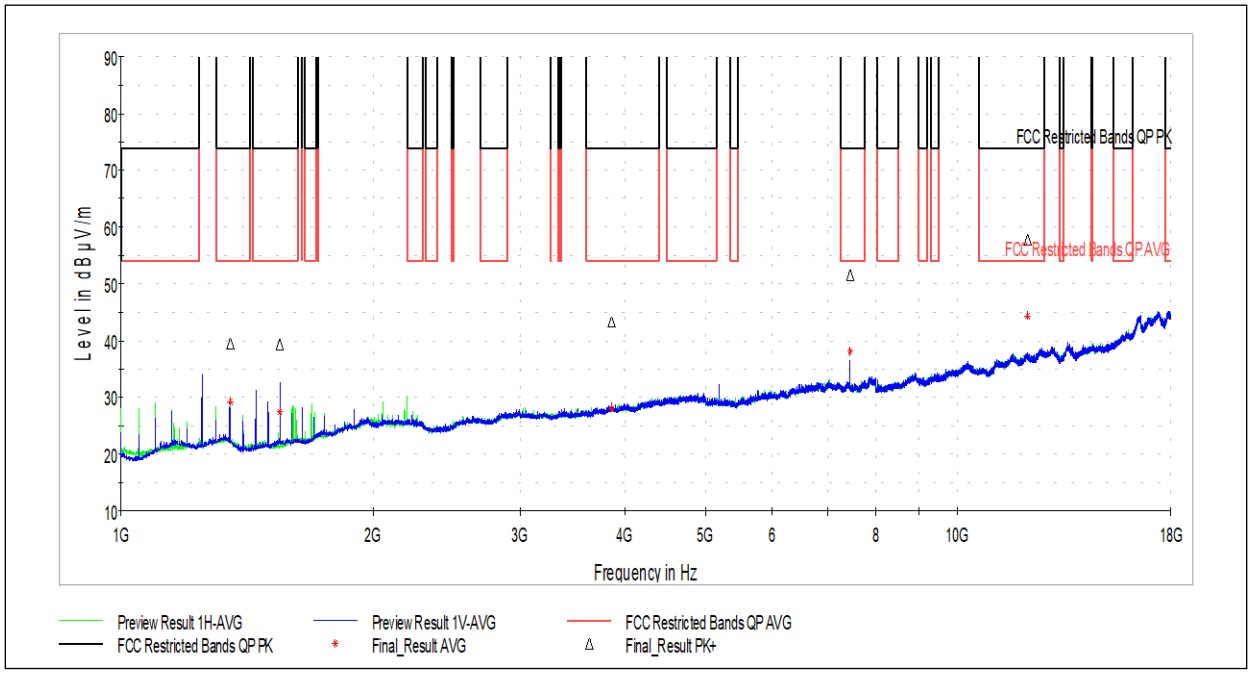
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1099.500000	37.41	73.979	36.57	1000.000	304.0	H	0.0	-2.40
1550.000000	39.89	73.979	34.09	1000.000	362.0	V	97.0	-0.62
7319.500000	52.08	73.979	21.90	1000.000	257.0	V	313.0	12.53
12128.500000	57.45	73.979	16.53	1000.000	127.0	V	186.0	20.02
15933.000000	61.96	73.979	12.02	1000.000	356.0	V	289.0	24.64

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1099.500000	24.37	53.979	29.61	1000.000	304.0	H	0.0	-2.40
1550.000000	31.33	53.979	22.65	1000.000	362.0	V	97.0	-0.62
7319.500000	38.23	53.979	15.75	1000.000	257.0	V	313.0	12.53
12128.500000	44.37	53.979	9.61	1000.000	127.0	V	186.0	20.02
15933.000000	48.49	53.979	5.49	1000.000	356.0	V	289.0	24.64

Test Personnel:	Seth Parker	Test Date:	8/23/2022
Supervising/Reviewing Engineer:	Brian Lackey	Limit Applied:	See Above
Product Standard:	FCC Part 15.247 & RSS-247 Issue 2	Ambient Temperature:	23.5C
Input Voltage:	120V/60Hz	Relative Humidity:	66%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

Deviations, Additions, or Exclusions: None

9.9.3 2480 MHz



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1350.000000	39.60	73.979	34.38	1000.000	161.0	H	186.0	-0.44
1549.500000	39.35	73.979	34.63	1000.000	357.0	V	100.0	-0.63
3859.000000	43.35	73.979	30.63	1000.000	288.0	V	189.0	7.31
7440.500000	51.69	73.979	22.29	1000.000	166.0	V	300.0	12.58
12120.500000	57.88	73.979	16.10	1000.000	410.0	V	329.0	20.01

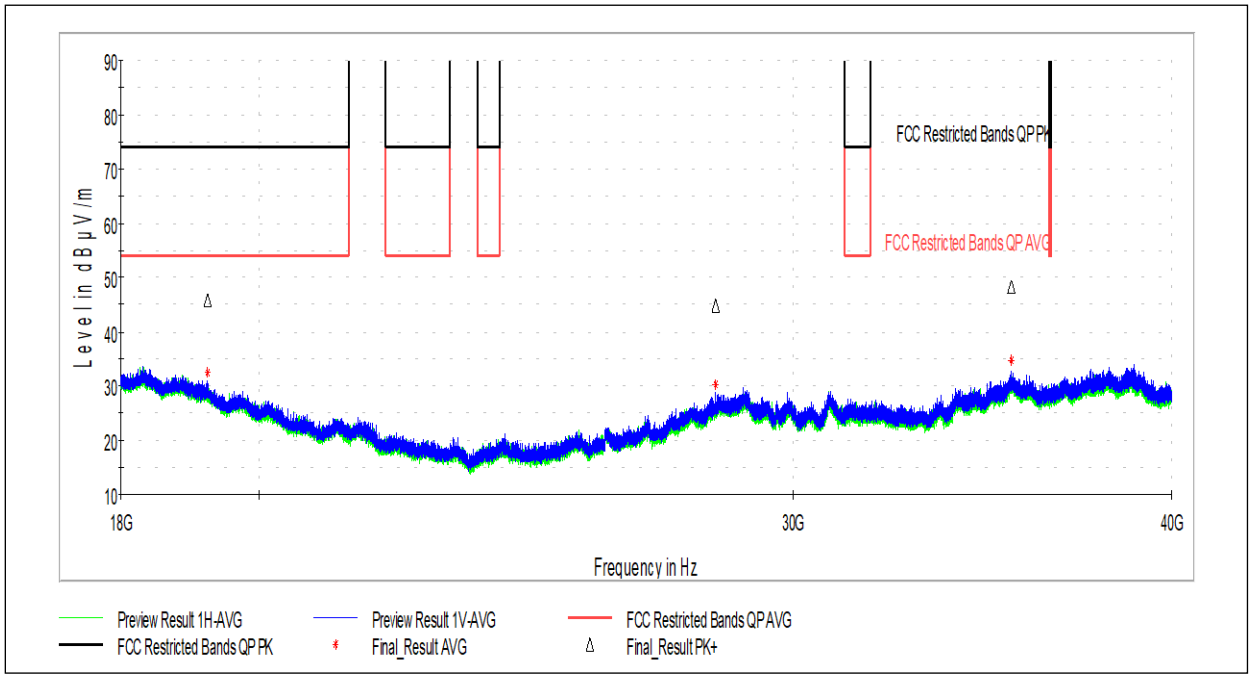
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1350.000000	29.27	53.979	24.71	1000.000	161.0	H	186.0	-0.44
1549.500000	27.51	53.979	26.47	1000.000	357.0	V	100.0	-0.63
3859.000000	28.09	53.979	25.89	1000.000	288.0	V	189.0	7.31
7440.500000	38.18	53.979	15.80	1000.000	166.0	V	300.0	12.58
12120.500000	44.45	53.979	9.53	1000.000	410.0	V	329.0	20.01

Test Personnel:	Seth Parker	Test Date:	8/23/2022
Supervising/Reviewing Engineer:	Brian Lackey	Limit Applied:	See Above
Product Standard:	FCC Part 15.247 & RSS-247 Issue 2	Ambient Temperature:	23.5C
Input Voltage:	120V/60Hz	Relative Humidity:	66%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

Deviations, Additions, or Exclusions: None

9.10 Test Data: 18 GHz – 40 GHz

9.10.1 2441 MHz



Test Personnel:	Jordan Coughenour	Test Date:	8/23/2022
Supervising/Reviewing Engineer:	Brian Lackey	Limit Applied:	See Above
Product Standard:	FCC Part 15.247 & RSS-247 Issue 2	Ambient Temperature:	25.6C
Input Voltage:	120V/60Hz	Relative Humidity:	52.2%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

Deviations, Additions, or Exclusions: Testing represents the worst case of all modes and of low, middle, and high channels.

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 C63.10:2013 § 11.10.2 Method PKPSD (peak PSD). EIRP measurements were converted to conducted PPSD values based on customer-supplied antenna gain.

10.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
Spectrum Analyzer	3981	Rohde & Schwarz	FSQ	9/16/22	9/16/23

10.4 Test Results

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

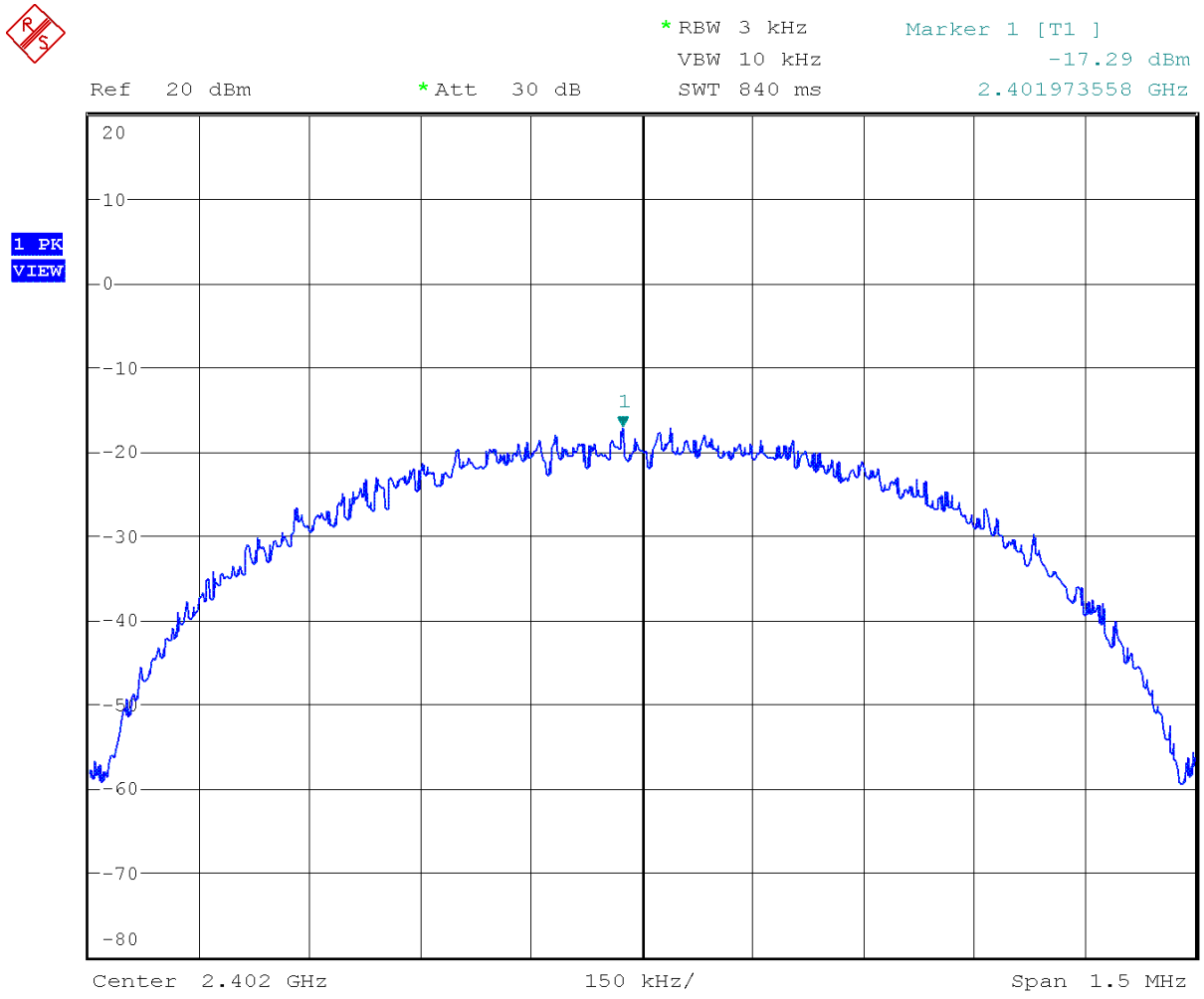
10.5 Test Data

Frequency (MHz)	PPSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
2402	-17.29	8.00	25.29	PASS
2440	-17.25	8.00	25.25	PASS
2480	-16.94	8.00	24.94	PASS

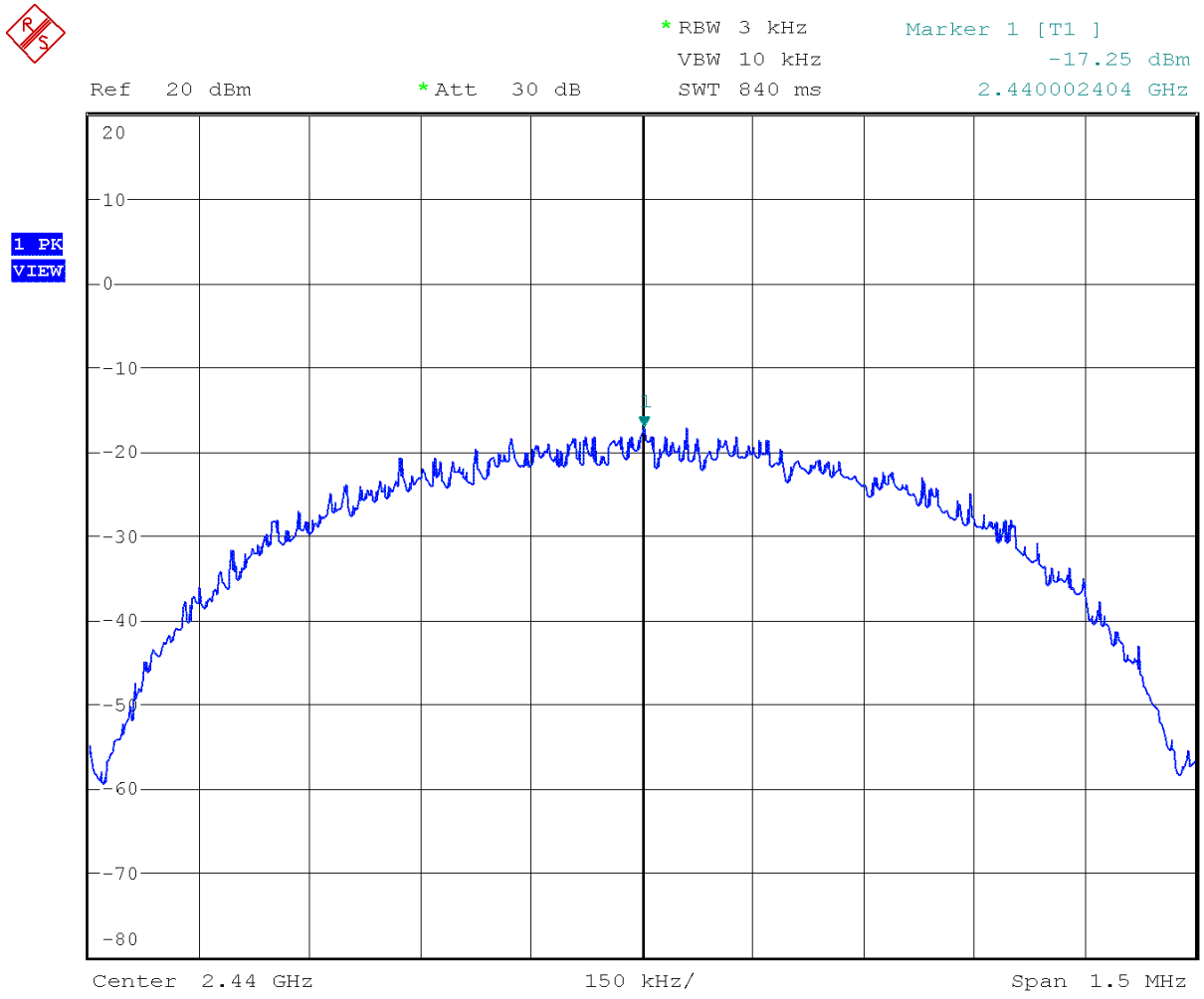
Test Personnel:	Seth Parker	Test Date:	8/23/2022
Supervising/Reviewing Engineer: (Where Applicable)	Brian Lackey	Limit Applied:	See Above
Product Standard:	FCC Part 15.247 RSS-247 Issue 2	Ambient Temperature:	23.5C
Input Voltage:	Battery	Relative Humidity:	66%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

Deviations, Additions, or Exclusions: None.

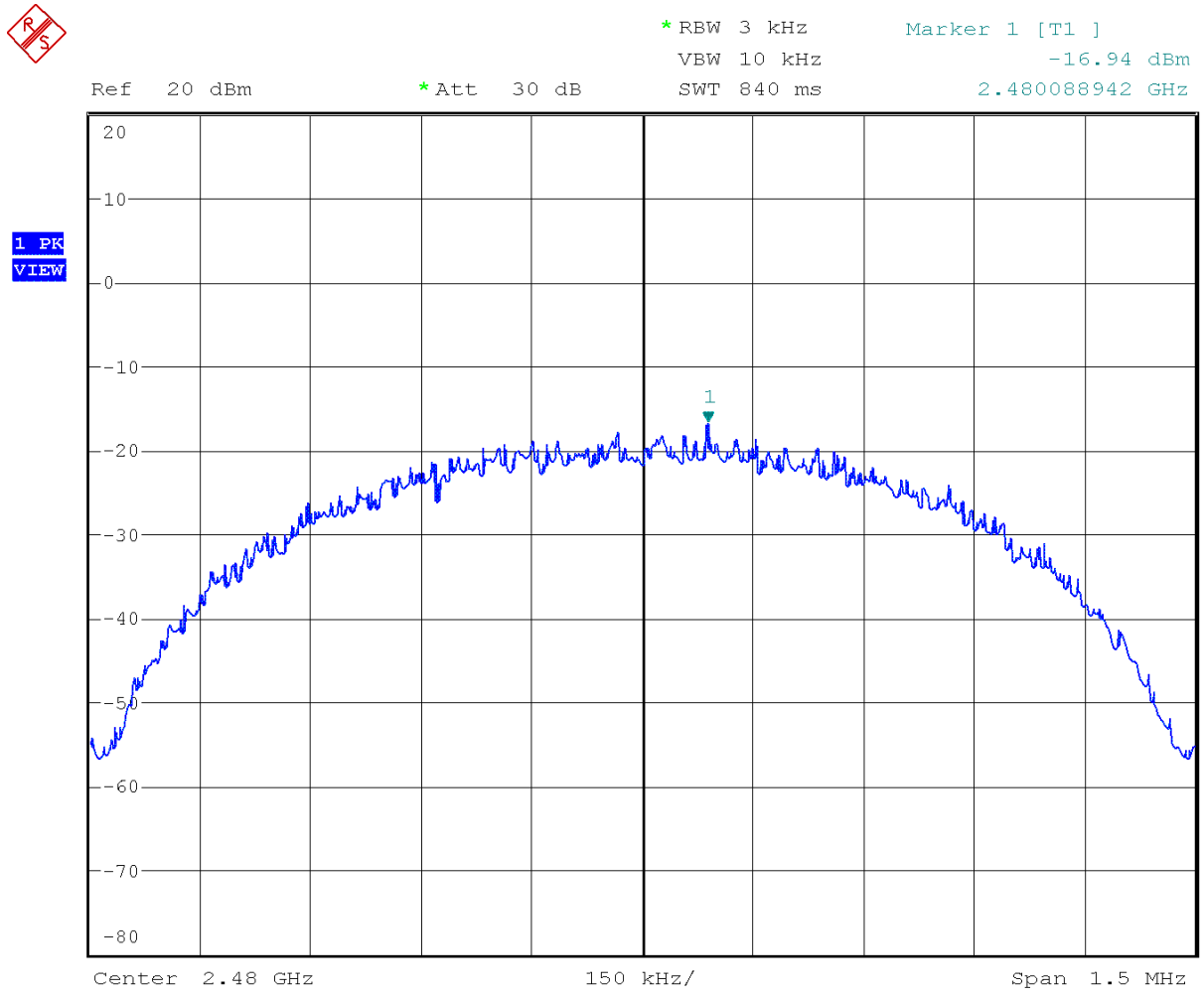
10.6 PPSD, 2402 MHz



10.7 PPSD, 2440 MHz



10.8 PPSD, 2480 MHz



11 Conducted Spurious Emissions

11.1 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.

11.2 Test Method

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

11.3 Test Equipment Used

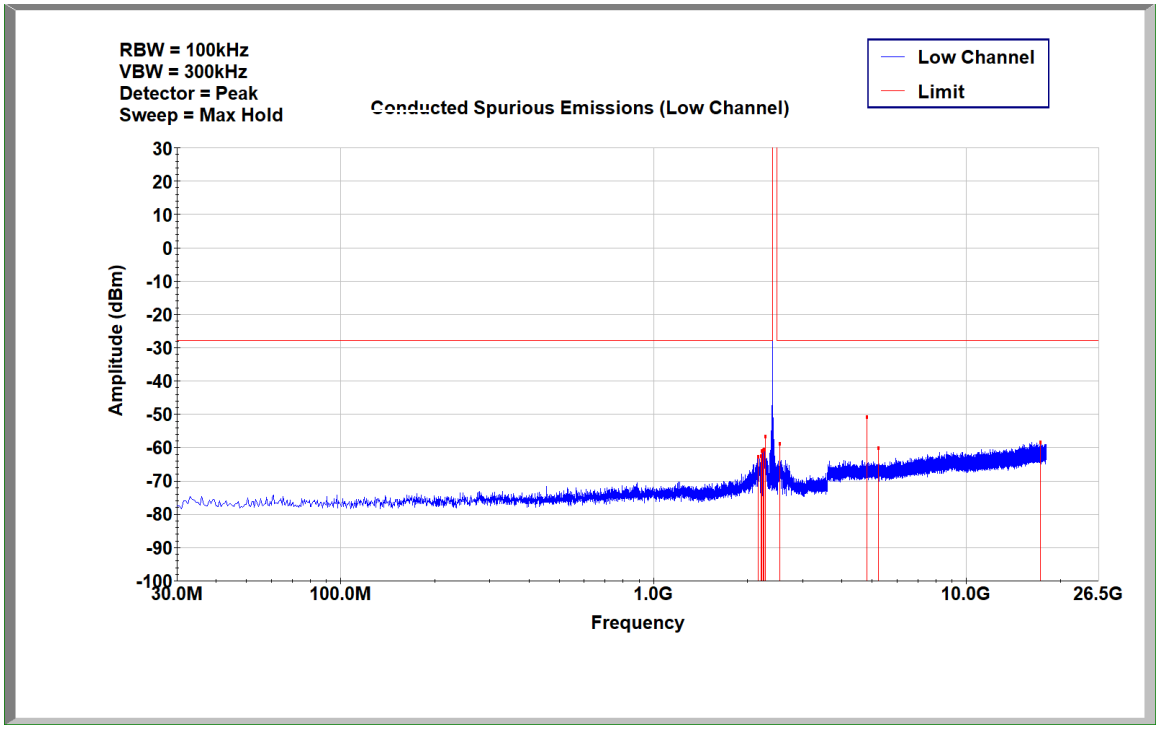
Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	3/10/2022	3/10/2023

11.4 Test Results

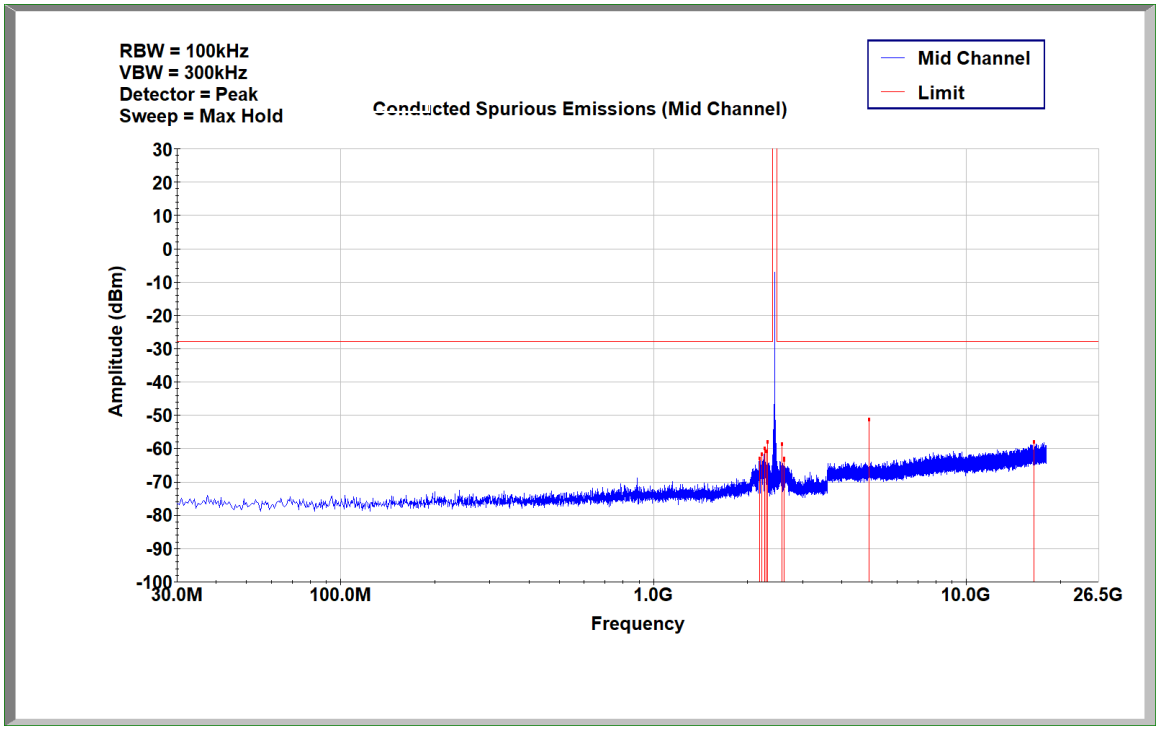
The device was found to be **compliant**. All spurious emissions were found to be attenuated more than 20dB below the level of the fundamental.

11.5 Test Data

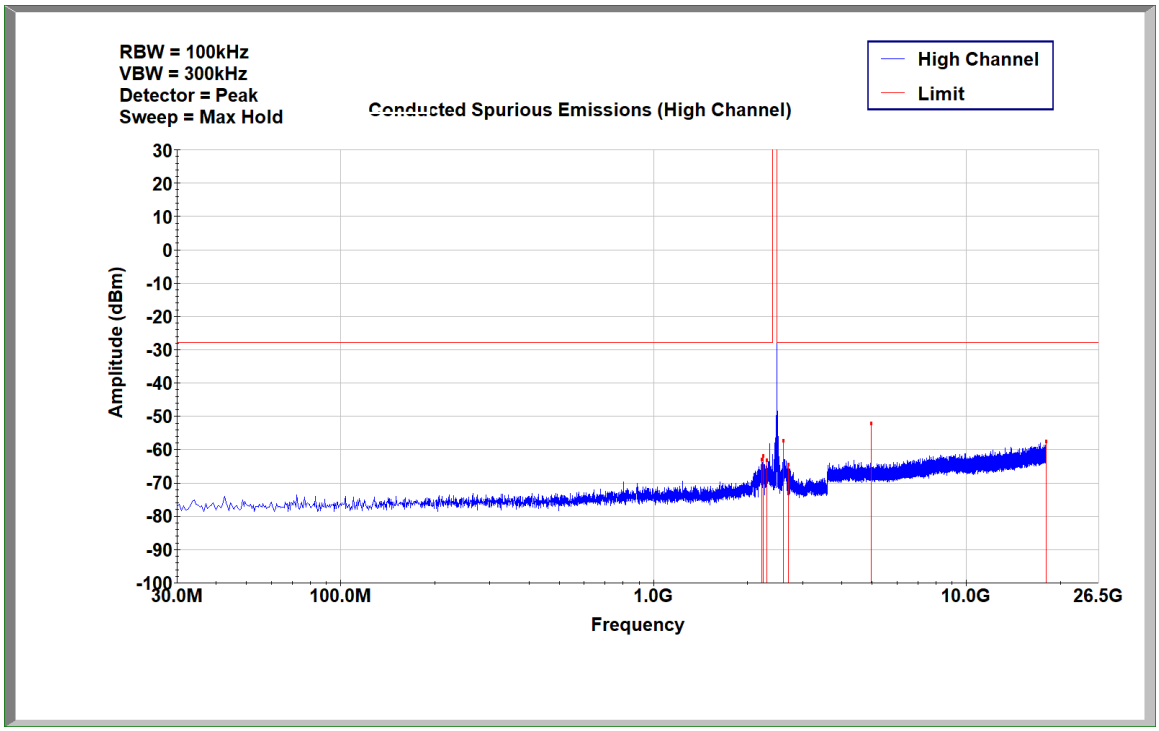
11.5.1 2402 MHz



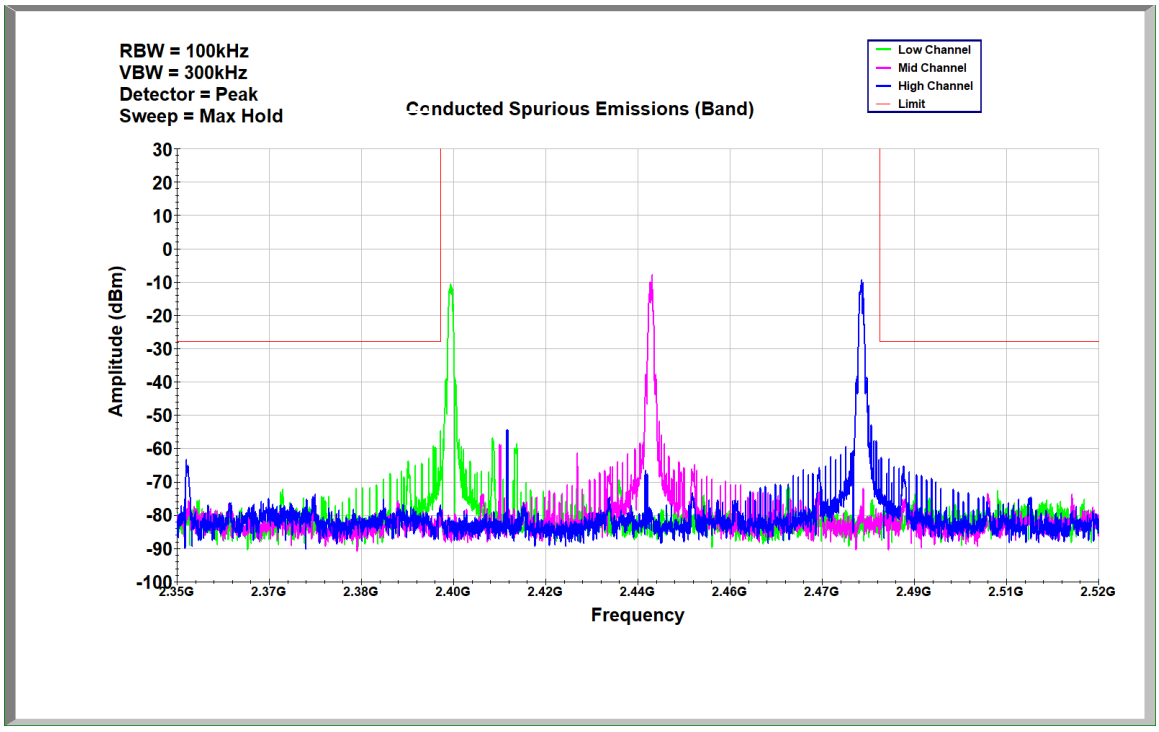
11.5.2 2440 MHz



11.5.3 2480 MHz



11.5.4 Band Edge



12 Antenna Requirement

12.1 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 license-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

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

Testing shall be performed using the highest gain antenna of each combination of license-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).

12.2 Test Results

The device was found to be **compliant**. The device is using a permanently installed internal antenna.

13 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	8/17/2023	105079698LEX-003			Original Issue