Intertek
731 Enterprise Drive
Lexington, KY 40510

Tel 859 226 1000
Fax 859 226 1040

www.intertek.com

Computational Systems Inc. TEST REPORT

SCOPE OF WORK
EMC TESTING – AMS WIRELESS VIBRATION MONITOR, MODEL A9530V3

REPORT NUMBER
104182906LEX-003.2

ISSUE DATE
4/21/2020

REVISED DATE
5/21/2020

PAGES
54

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

EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 104182906LEX-003.2
Project Number: G104182906

Report Issue Date: 5/21/2020

Model(s) Tested: AMS Wireless Vibration Monitor,
Model A9530V3

Standards: Title 47 CFR Part 15.247
RSS-247 Issue 2
RSS-Gen Issue 4

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

Client:
Computational Systems Inc.
835 Innovation Drive
Knoxville TN, 37932-2563
USA

Report prepared by

Bryan Taylor, Team Leader

Report reviewed by

Brian Lackey, Staff Engineer

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 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	Receiver Radiated Spurious Emissions (ANSI C63.4: 2014)	Pass
7	Transmitter Radiated Spurious Emissions and Restricted Band Edge (FCC Part 15.247(d), RSS-247 Issue 2 § 5.5)	Pass
0	Transmitter Conducted Spurious Emissions (FCC Part 15.247(d), RSS-247 Issue 2 § 5.5)	Pass
9	Output Power (FCC Part 15.247(b)(1), RSS-247 Issue 2 § 5.4(b))	Pass
10	Occupied Bandwidth (FCC Part 15.247, RSS-247 Issue 2 § 5.2(a))	Pass
11	Power Spectral Density (FCC Part 15.247(e), RSS-247 Issue 2 § 5.2(b))	Pass
12	Antenna Requirement (FCC Part 15.203, RSS-Gen Issue 4 § 8.3)	Pass
-	Conducted Emissions (ANSI C63.4: 2014)	NA[1]

[1] Test it not applicable. Unit is battery powered and does not connect directly or indirectly to AC Mains.

3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	Computational Systems Inc.
Address:	835 Innovation Drive Knoxville TN, 37932-2563 USA
Contact:	Dwayne Beeler
Telephone:	(865)-675-2400
Email:	Dwayne.beeler@emerson.com
Manufacturer Information	
Manufacturer Name:	Computational Systems Inc.
Manufacturer Address:	835 Innovation Drive Knoxville TN, 37932-2563 USA

4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	AMS Wireless Vibration Monitor, Model A9530V3
Model Number	A 9530V3
Serial Number	Test Sample E5A
Receive Date	12/17/2019
Test Start Date	12/17/2019
Test End Date	12/30/2019
Device Received Condition	Good
Test Sample Type	Production
Rated Voltage	2.6VDC - 3.6VDC
Software Used By EUT	None
Temperature Range:	-40C to 85C
Peak Antenna Gain (dBi):	3.7dBi
Frequency Range:	2405 – 2475MHz
Test Channels:	Channel 0: 2405MHz Channel 7: 2440MHz Channel 14: 2475MHz
Description of Equipment Under Test (provided by client)	
The AMS Wireless Vibration Monitor, Model A9530V3 is a monitoring device which utilizes a wireless HART radio module.	

4.1 Variant Models:

There will be two models in the A9530 family of products. The A9530V1 and the A9530V3. The hardware, firmware and radio circuitry will be identical. There will be two differences. First, the A9530V3 will have all features available to the user while the A9530V1 will have some features disabled by way of licensing flags held in permanent memory.

The A9530V3 was the model that was tested.

5 System Setup and Method

5.1 Method:

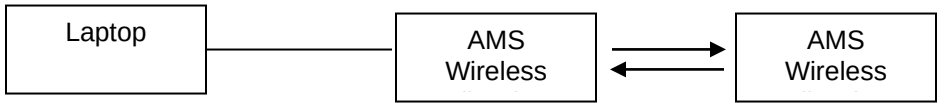
Configuration as required by ANSI C63.4: 2014 and ANSI C63.10:2013

No.	Descriptions of EUT Exercising
1	Continuous transmit mode: Transmitting on low, mid, or high channels with the use of test utility to force continuous transmission.
2	Paired mode: the AMS Wireless Vibration Monitor, Model A9530V3 was paired with a second AMS Wireless Vibration Monitor, Model A9530V3 and data packets were transmitted back and forth between them. The packets were verified via a test tool on a laptop computer which was connected to a debug port on one of the AMS Wireless Vibration Monitor, Model A9530V3 units.
3	Receive mode: During this mode the device was set to receive continuously.

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
---	None	---	---	---	---

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop Computer	HP	EliteBook	CNU238BS44
AMS Wireless Vibration Monitor, Model A9530V3	Computational Systems Inc.	9530	---

5.2 EUT Block Diagram:



6 Receiver Spurious Emissions

6.1 Test Method

Tests are performed in accordance with ANSI C63.4: 2014

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.

6.2 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

6.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	9/18/2019	9/18/2020
Bilog Antenna (30MHz-1GHz)	7085	SunAR	JB6	8/8/2019	8/8/2020
Horn Antenna (1 – 18GHz)	3780	ETS Lindgren	3117	6/7/2019	6/7/2020
Preamplifier (1 - 18GHz)	3918	Rohde & Schwarz	TS-PR18	12/4/2019	12/4/2020
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
Coaxial Cable	3074			12/6/2019	12/6/2020
Coaxial Cable	2588			12/6/2019	12/6/2020
Coaxial Cable	2593			12/6/2019	12/6/2020
Coaxial Cable	2592			12/6/2019	12/6/2020
Coaxial Cable	3339			12/6/2019	12/6/2020

6.4 Software Utilized

Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 9.15.02

6.5 Test Results

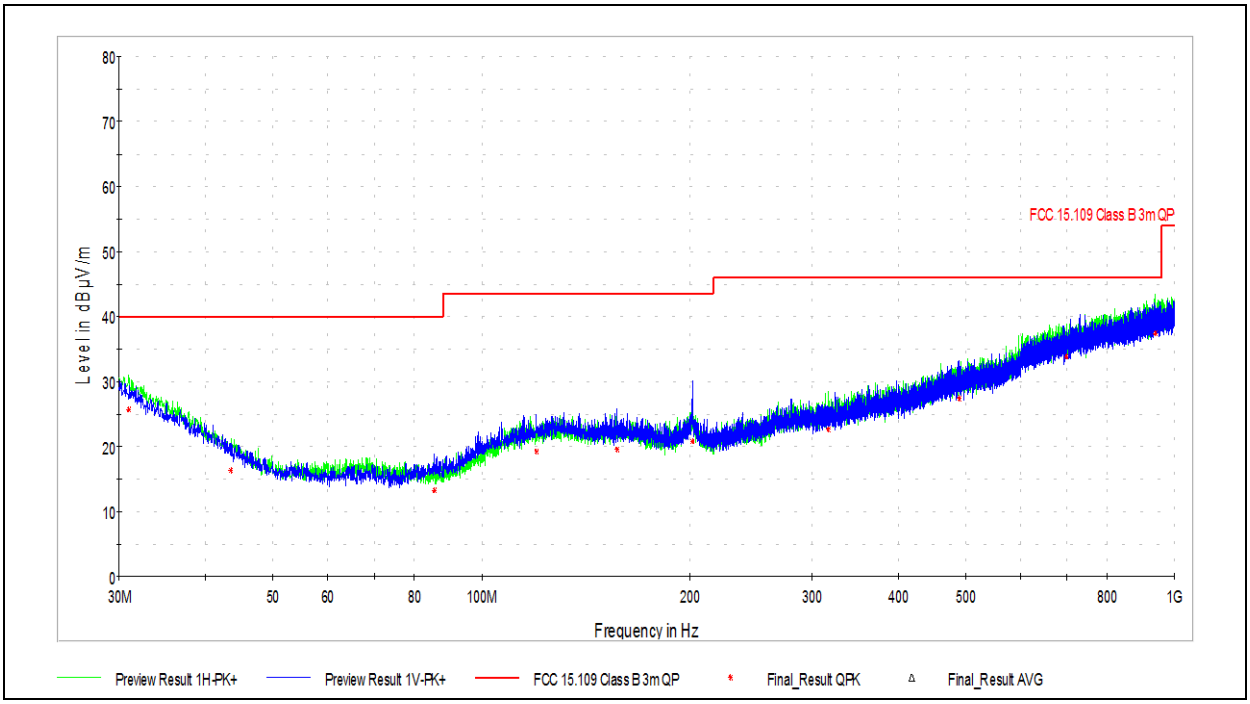
The sample tested was found to be **compliant**.

6.6 Test Conditions

Test Personnel:	Bryan Taylor, Ben Coolbear	Test Date:	12/17/2019 – 12/18/2019
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	FCC Part 15.109
Product Standard:	FCC Part 15.247 RSS-247 Issue 2	Ambient Temperature:	20.4C
Input Voltage:	Battery	Relative Humidity:	33.1%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	988.4mbar

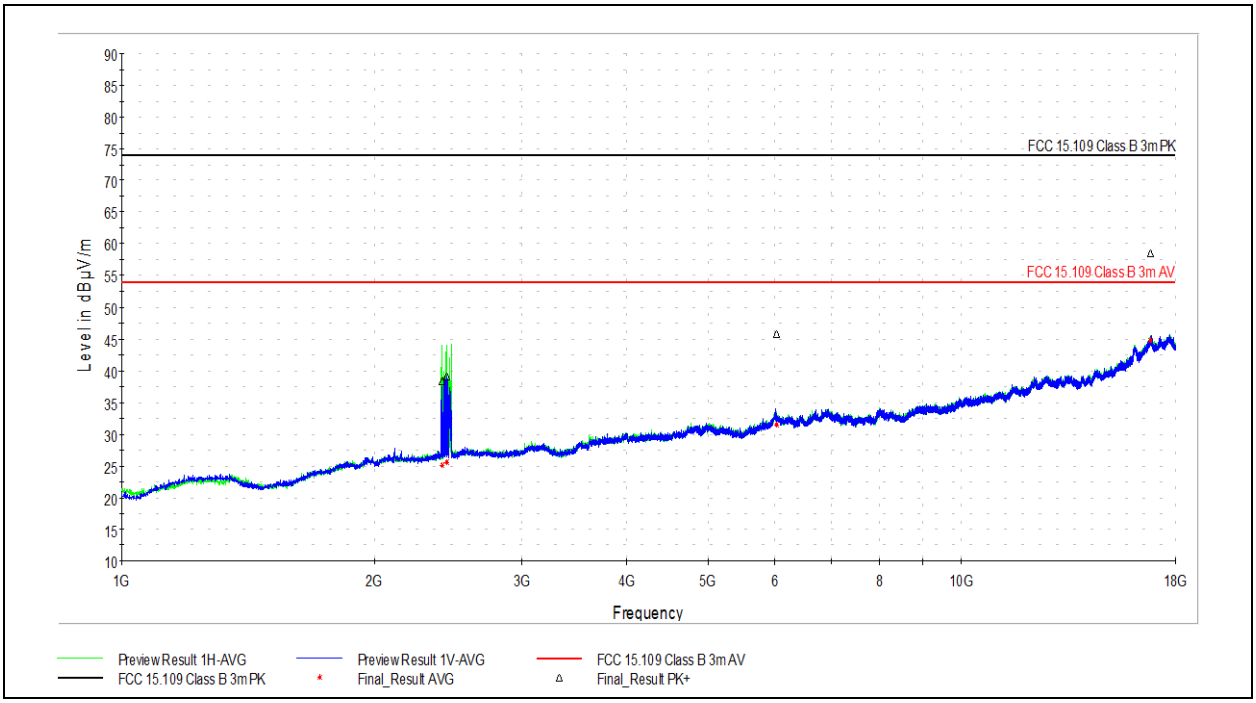
Deviations, Additions, or Exclusions: None

6.7 Test Data: 30MHz – 1GHz



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.970000	25.63	40.00	14.37	120.000	321.0	H	208.0	28.1
43.526111	16.29	40.00	23.71	120.000	106.7	H	118.0	19.1
85.451667	13.29	40.00	26.71	120.000	399.9	V	292.0	16.3
120.102222	19.17	43.52	24.35	120.000	202.2	V	0.0	22.0
156.908333	19.52	43.52	24.00	120.000	332.6	V	122.0	21.6
201.636111	20.76	43.52	22.76	120.000	105.5	V	10.0	22.4
316.419445	22.62	46.02	23.40	120.000	320.3	H	345.0	24.7
488.325000	27.43	46.02	18.59	120.000	154.3	V	208.0	29.1
698.599444	33.77	46.02	12.25	120.000	309.9	H	182.0	34.0
938.297222	37.35	46.02	8.67	120.000	100.3	H	319.0	37.4

6.8 Test Data: 1GHz – 18GHz



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2407.500000	38.47	73.98	35.51	1000.000	100.0	H	178.0	3.7
2437.500000	39.17	73.98	34.81	1000.000	305.0	H	108.0	4.2
6026.000000	45.78	73.98	28.20	1000.000	100.0	H	46.0	10.4
16809.500000	58.57	73.98	15.41	1000.000	410.0	H	291.0	26.2

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2407.500000	25.13	53.98	28.85	1000.000	100.0	H	178.0	3.7
2437.500000	25.62	53.98	28.36	1000.000	305.0	H	108.0	4.2
6026.000000	31.55	53.98	22.43	1000.000	100.0	H	46.0	10.4
16809.500000	44.83	53.98	9.15	1000.000	410.0	H	291.0	26.2

7 Transmitter 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.

7.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	9/18/2019	9/18/2020
Bilog Antenna (30MHz-1GHz)	7085	SunAR	JB6	8/8/2019	8/8/2020
Horn Antenna (1 – 18GHz)	3780	ETS Lindgren	3117	6/7/2019	6/7/2020
Horn Antenna (18-40GHz)	3779	ETS	3116c	6/10/2019	6/10/2020
Preamplifier (18-40GHz)	3921	Rohde & Schwarz	TS-PR40	12/4/2019	12/4/2020
Preamplifier (1 - 18GHz)	3918	Rohde & Schwarz	TS-PR18	12/4/2019	12/4/2020
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
Coaxial Cable	3074			12/6/2019	12/6/2020
Coaxial Cable	2588			12/6/2019	12/6/2020
Coaxial Cable	2593			12/6/2019	12/6/2020
Coaxial Cable	2592			12/6/2019	12/6/2020
Coaxial Cable	3339			12/6/2019	12/6/2020

7.4 Software Utilized

Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 9.15.02

7.5 Test Results

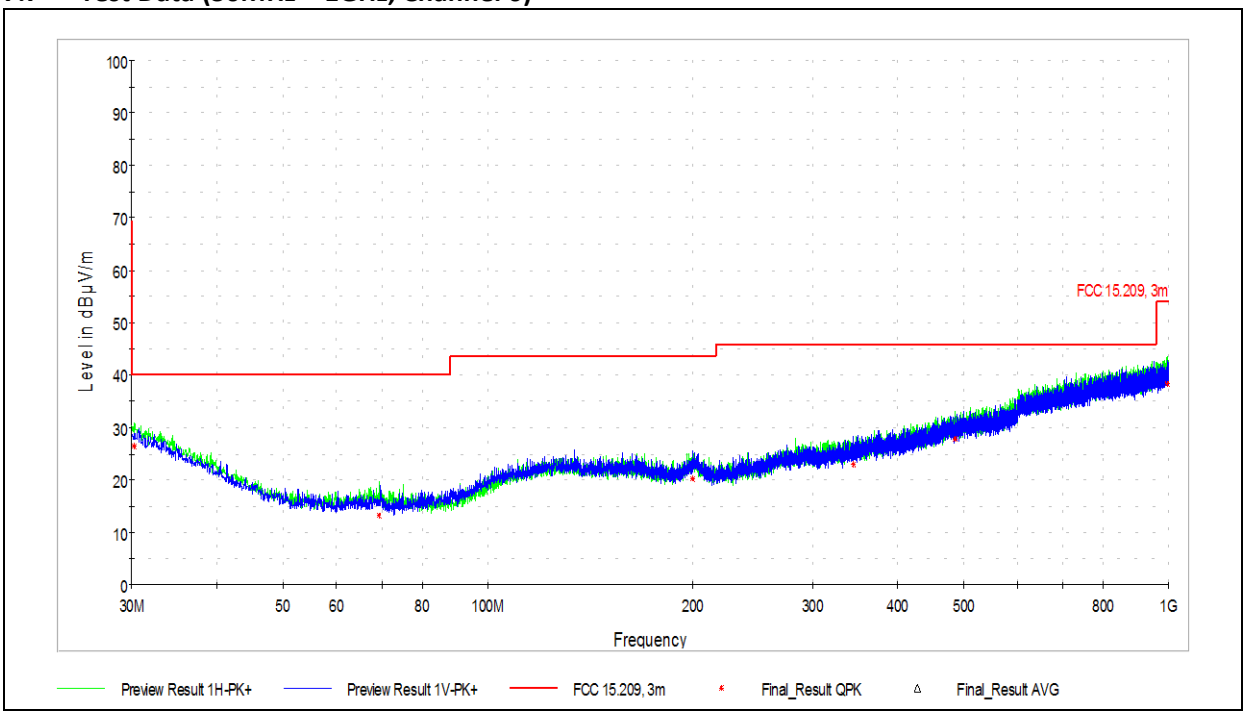
The sample tested was found to be **compliant**.

7.6 Test Conditions

Test Personnel:	Bryan Taylor, Ben Coolbear	Test Date:	12/17/2019 – 12/18/2019
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	FCC Part 15.209
Product Standard:	FCC Part 15.247 RSS-247 Issue 2	Ambient Temperature:	20.4C
Input Voltage:	Battery	Relative Humidity:	33.1%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	988.4mbar

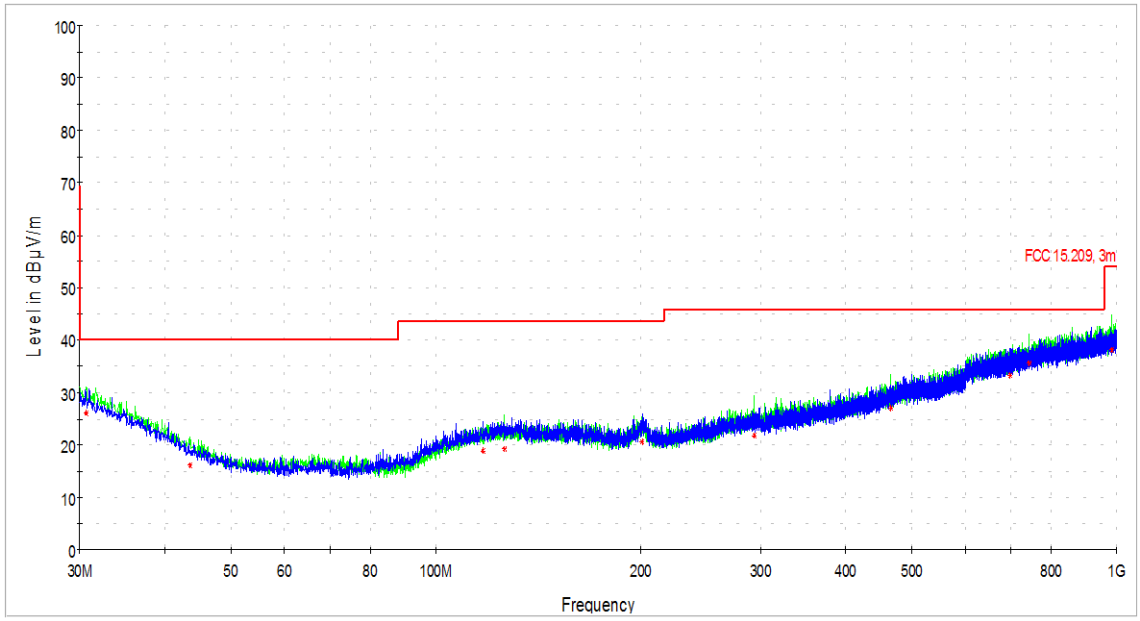
Deviations, Additions, or Exclusions: None

7.7 Test Data (30MHz – 1GHz, Channel 0)



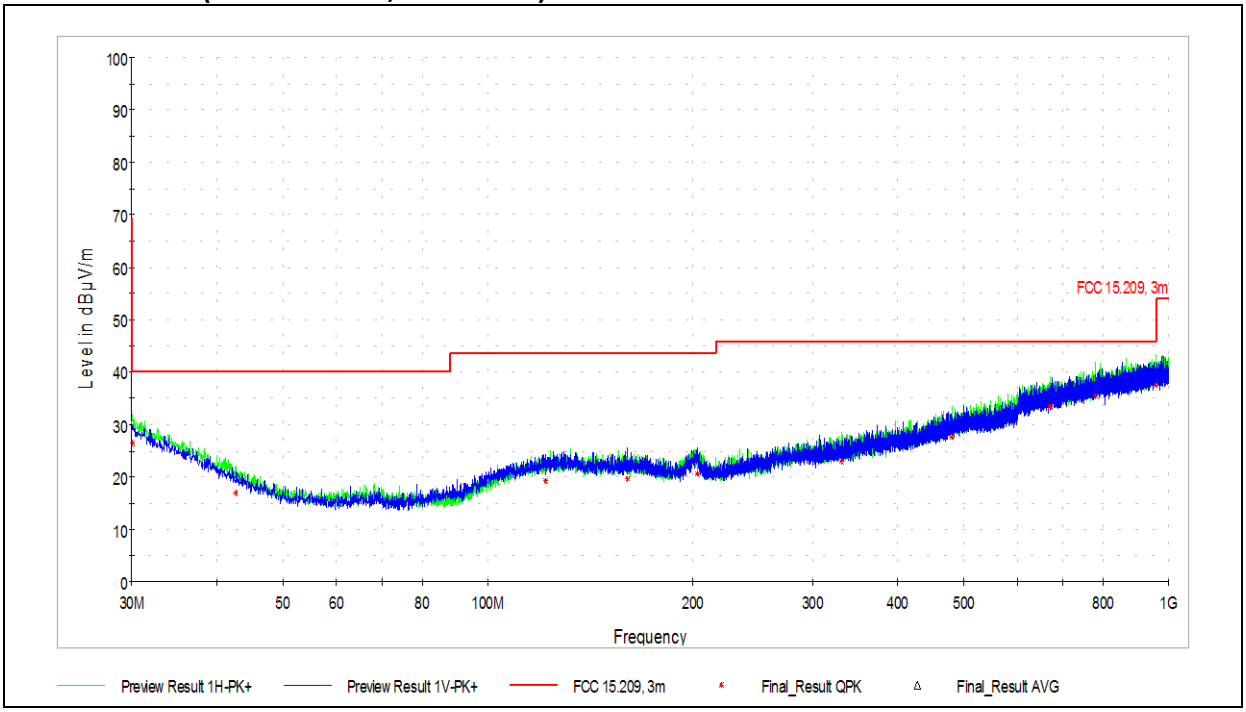
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.215556	26.37	40.0	13.63	120.000	130.0	H	302.0	28.6
69.285000	13.15	40.0	26.85	120.000	99.8	H	227.0	15.7
199.803889	20.3	43.5	23.2	120.000	105.3	V	166.0	22.0
344.711111	22.99	46.0	23.01	120.000	308.4	V	18.0	25.0
486.169444	27.74	46.0	18.26	120.000	252.7	H	227.0	29.4
995.635000	38.26	54.0	15.74	120.000	261.3	H	-1.0	38.1

7.8 Test Data (30MHz – 1GHz, Channel 7)



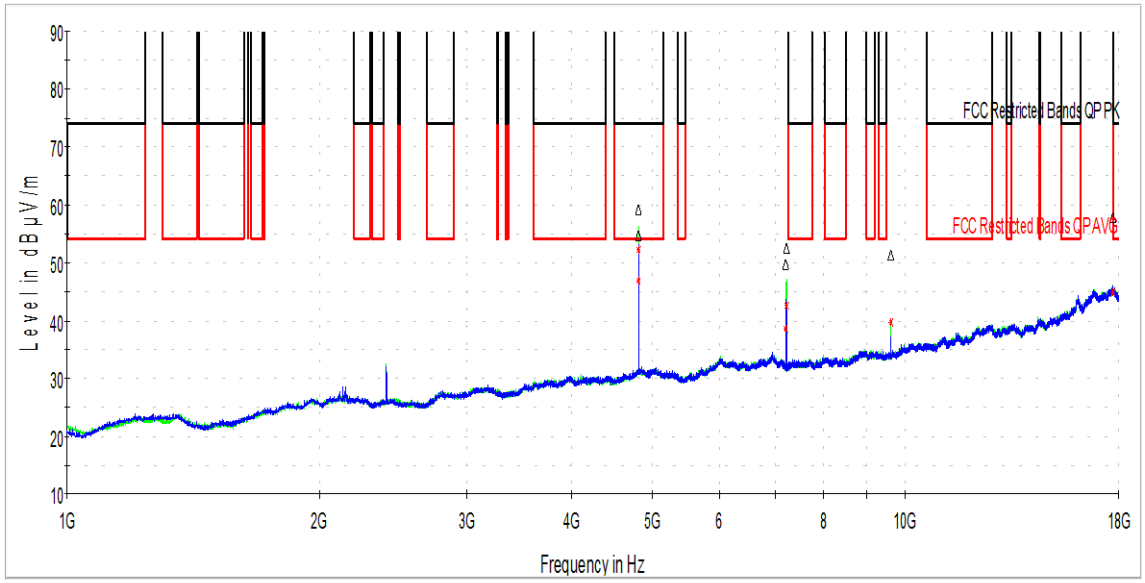
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.646667	25.98	40.0	14.02	120.000	160.0	H	210.0	28.3
43.633889	16.24	40.0	23.76	120.000	100.0	H	277.0	19.0
117.246111	18.95	43.5	24.55	120.000	100.0	V	56.0	21.9
126.245556	19.2	43.5	24.3	120.000	292.0	H	328.0	22.0
201.258889	20.65	43.5	22.85	120.000	232.0	V	302.0	22.3
293.624445	21.83	46.0	24.17	120.000	148.0	H	7.0	24.0
466.553889	27.12	46.0	18.88	120.000	364.0	H	0.0	28.9
698.006667	33.35	46.0	12.65	120.000	292.0	V	276.0	33.5
743.596667	35.67	46.0	10.33	120.000	208.0	H	286.0	34.6
984.102778	38.1	54.0	15.9	120.000	256.0	H	36.0	37.9

7.9 Test Data (30MHz – 1GHz, Channel 14)



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.107778	26.43	40.0	13.57	120.000	105.1	H	55.0	28.7
42.610000	16.86	40.0	23.14	120.000	260.8	H	109.0	19.7
121.449445	19.3	43.5	24.2	120.000	165.6	V	102.0	22.2
160.680556	19.56	43.5	23.94	120.000	202.1	V	246.0	21.8
203.414445	20.62	43.5	22.88	120.000	105.0	V	246.0	22.0
330.322778	23	46.0	23	120.000	249.1	H	8.0	25.0
480.618889	27.63	46.0	18.37	120.000	299.2	H	238.0	29.3
670.469444	33.42	46.0	12.58	120.000	165.7	H	36.0	33.5
781.426667	35.48	46.0	10.52	120.000	388.1	H	238.0	35.5
958.343889	37.63	46.0	8.37	120.000	391.5	H	36.0	37.5

7.10 Test Data (1GHz – 18GHz, Channel 0)

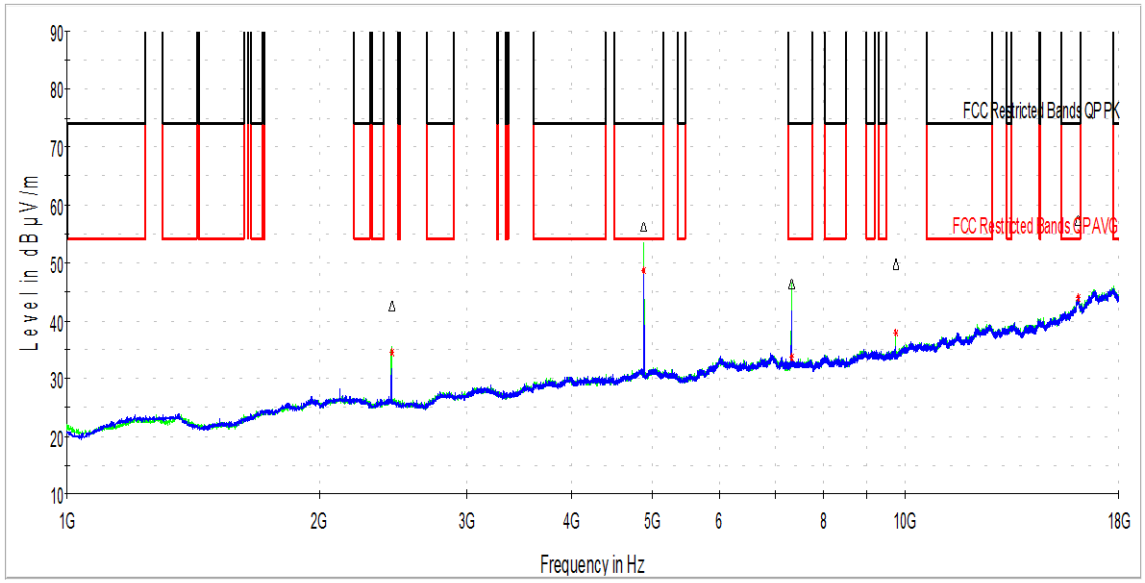


Note: During the prescan which used peak detection the emission at 4811MHz appeared above the restricted band limit. When that emission was measured with average detection it was found to be below the average limit. See final measurement below.

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4809.000000	54.75	73.98	19.23	1000.000	200.0	V	212.0	8.2
4811.000000	59.18	73.98	14.80	1000.000	196.0	H	146.0	8.3
17704.500000	57.76	73.98	16.22	1000.000	333.0	H	332.0	26.0

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4809.000000	46.88	53.98	7.10	1000.000	200.0	V	212.0	8.2
4811.000000	52.23	53.98	1.75	1000.000	196.0	H	146.0	8.3
17704.500000	44.85	53.98	9.13	1000.000	333.0	H	332.0	26.0

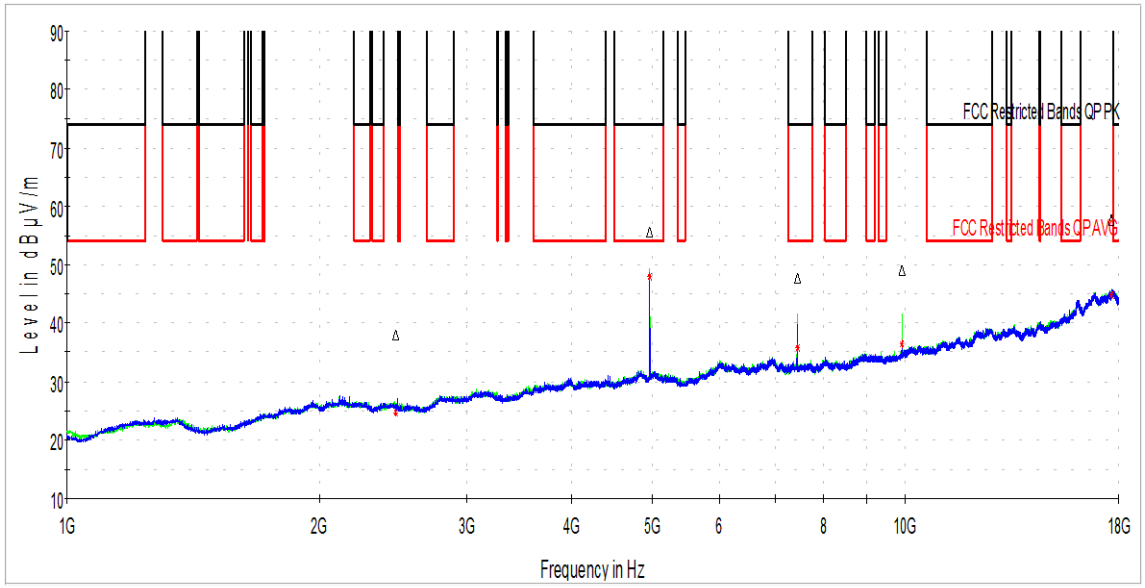
7.11 Test Data (1GHz – 18GHz, Channel 7)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4879.000000	56.37	73.98	17.61	1000.000	251.0	H	193.0	8.3
7321.500000	46.34	73.98	27.64	1000.000	358.0	H	197.0	11.5
16097.000000	57.36	73.98	16.62	1000.000	197.0	H	0.0	26.2

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4879.000000	48.59	53.98	5.39	1000.000	251.0	H	193.0	8.3
7321.500000	33.70	53.98	20.28	1000.000	358.0	H	197.0	11.5
16097.000000	43.90	53.98	10.08	1000.000	197.0	H	0.0	26.2

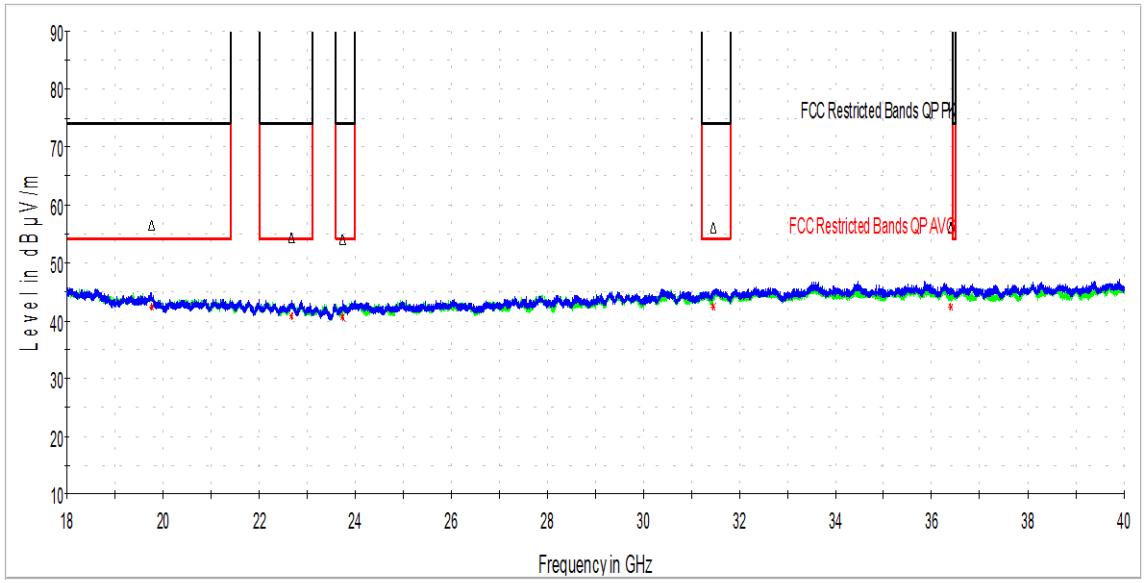
7.12 Test Data (1GHz – 18GHz, Channel 14)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4959.000000	55.73	73.98	18.25	1000.000	305.0	H	203.0	8.2
7441.500000	47.78	73.98	26.20	1000.000	302.0	H	201.0	11.6

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4959.000000	47.86	53.98	6.12	1000.000	305.0	H	203.0	8.2
7441.500000	35.69	53.98	18.29	1000.000	302.0	H	201.0	11.6

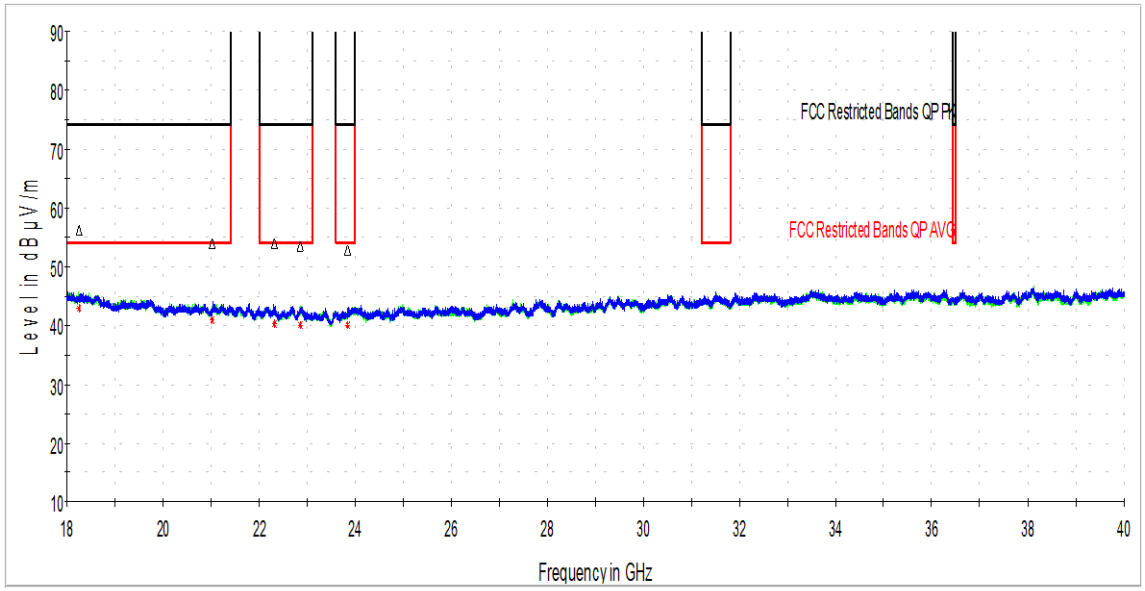
7.13 Test Data (18GHz – 40GHz, Channel 0)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
19757.000000	56.41	73.98	17.57	1000.000	303.0	V	84.0	15.5
22675.500000	54.16	73.98	19.82	1000.000	109.0	V	336.0	6.8
23729.000000	54.02	73.98	19.96	1000.000	410.0	V	331.0	5.9
31452.500000	55.98	73.98	18.00	1000.000	109.0	V	260.0	10.8

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
19757.000000	42.42	53.98	11.56	1000.000	303.0	V	84.0	15.5
22675.500000	40.84	53.98	13.14	1000.000	109.0	V	336.0	6.8
23729.000000	40.46	53.98	13.52	1000.000	410.0	V	331.0	5.9
31452.500000	42.30	53.98	11.68	1000.000	109.0	V	260.0	10.8

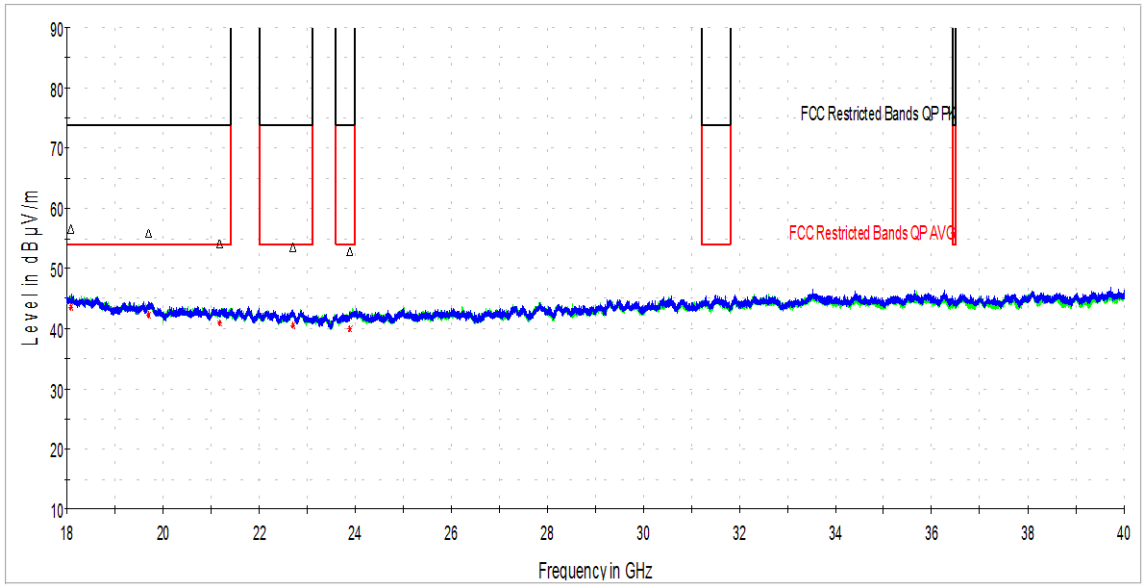
7.14 Test Data (18GHz – 40GHz, Channel 7)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
18248.000000	56.20	73.98	17.78	1000.000	100.0	V	20.0	20.3
21022.000000	53.87	73.98	20.11	1000.000	100.0	H	182.0	10.7
22309.000000	54.06	73.98	19.92	1000.000	100.0	H	115.0	7.6
22855.000000	53.62	73.98	20.36	1000.000	100.0	H	0.0	6.3
23841.500000	52.77	73.98	21.21	1000.000	100.0	V	27.0	6.2

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
18248.000000	42.89	53.98	11.09	1000.000	100.0	V	20.0	20.3
21022.000000	40.84	53.98	13.14	1000.000	100.0	H	182.0	10.7
22309.000000	40.36	53.98	13.62	1000.000	100.0	H	115.0	7.6
22855.000000	40.15	53.98	13.83	1000.000	100.0	H	0.0	6.3
23841.500000	39.96	53.98	14.02	1000.000	100.0	V	27.0	6.2

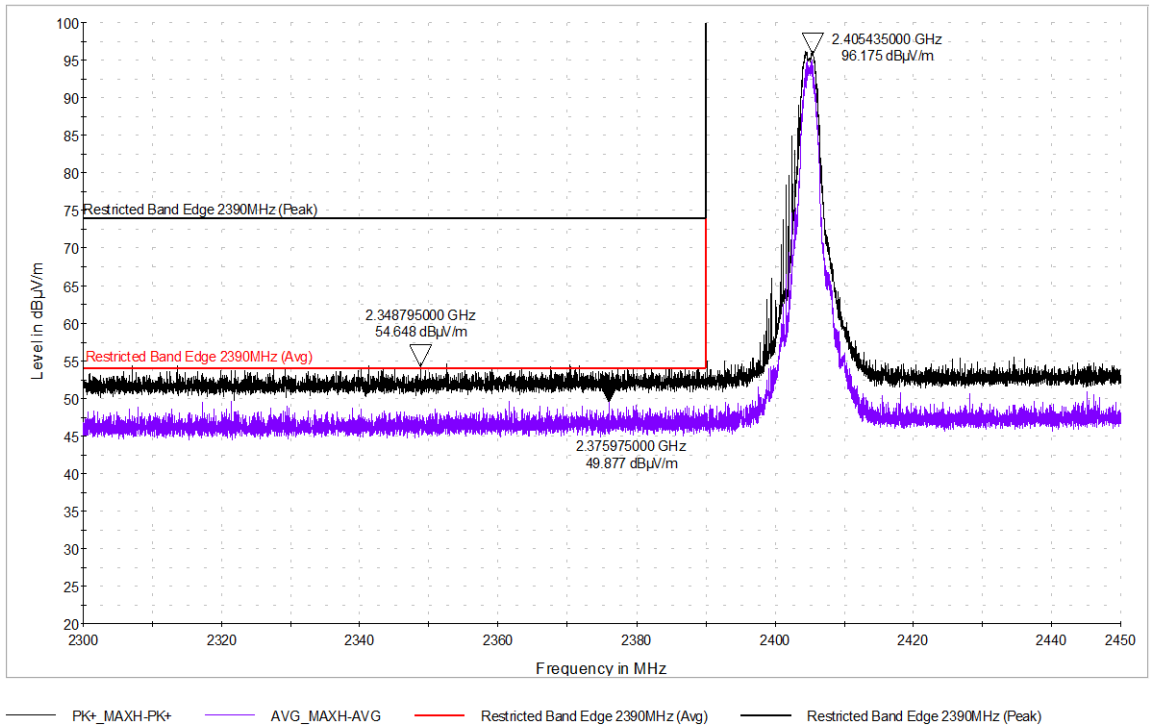
7.15 Test Data (18GHz – 40GHz, Channel 14)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
18072.000000	56.63	73.98	17.35	1000.000	399.0	H	326.0	20.8
19691.000000	55.85	73.98	18.13	1000.000	116.0	H	190.0	15.7
21169.500000	54.08	73.98	19.90	1000.000	258.0	V	152.0	10.6
22694.000000	53.61	73.98	20.37	1000.000	100.0	H	196.0	6.7
23881.000000	52.89	73.98	21.09	1000.000	100.0	H	256.0	6.0

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
18072.000000	43.60	53.98	10.38	1000.000	399.0	H	326.0	20.8
19691.000000	42.21	53.98	11.77	1000.000	116.0	H	190.0	15.7
21169.500000	40.88	53.98	13.10	1000.000	258.0	V	152.0	10.6
22694.000000	40.61	53.98	13.37	1000.000	100.0	H	196.0	6.7
23881.000000	39.90	53.98	14.08	1000.000	100.0	H	256.0	6.0

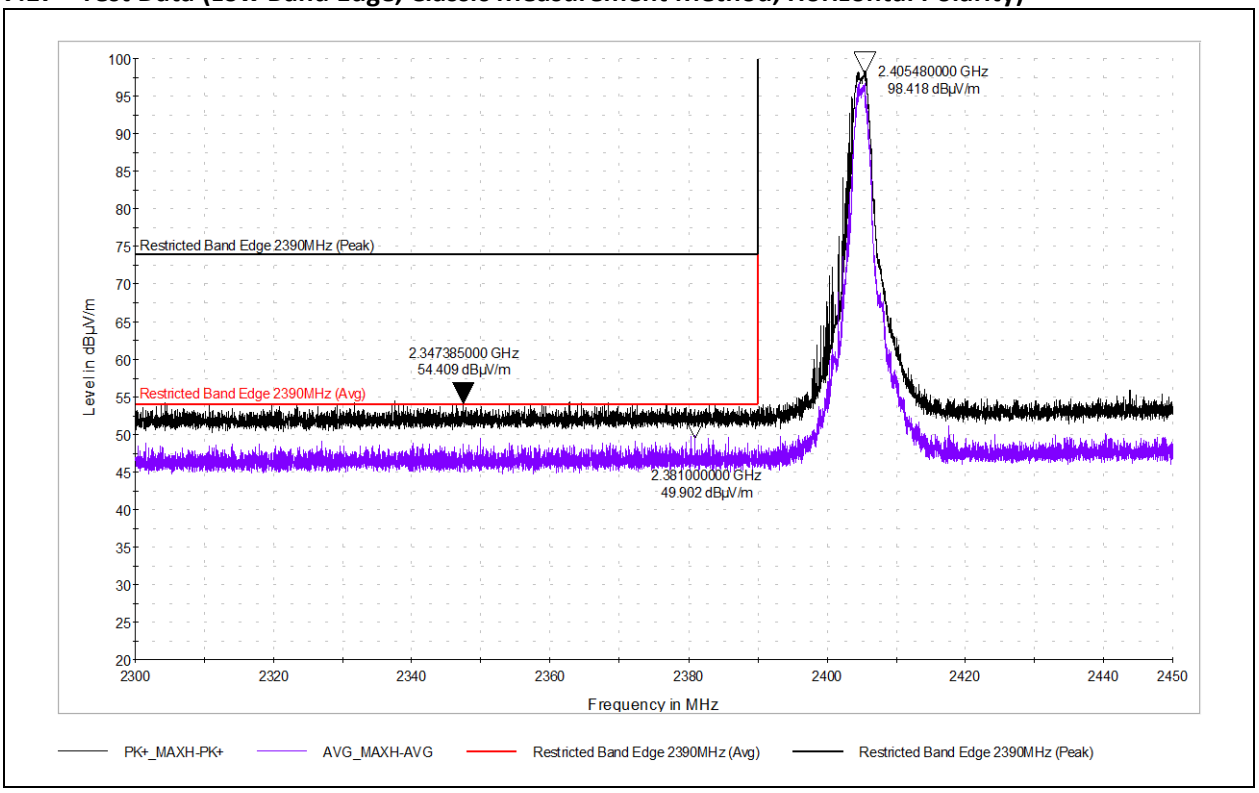
7.16 Test Data (Low Band Edge, Classic Measurement Method, Vertical Polarity)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Pol	Corr. (dB)
2348.7	54.648	74.00	19.352	1000.000	V	37.2

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Pol	Corr. (dB)
2375.975	49.877	54.00	4.123	1000.000	V	37.2

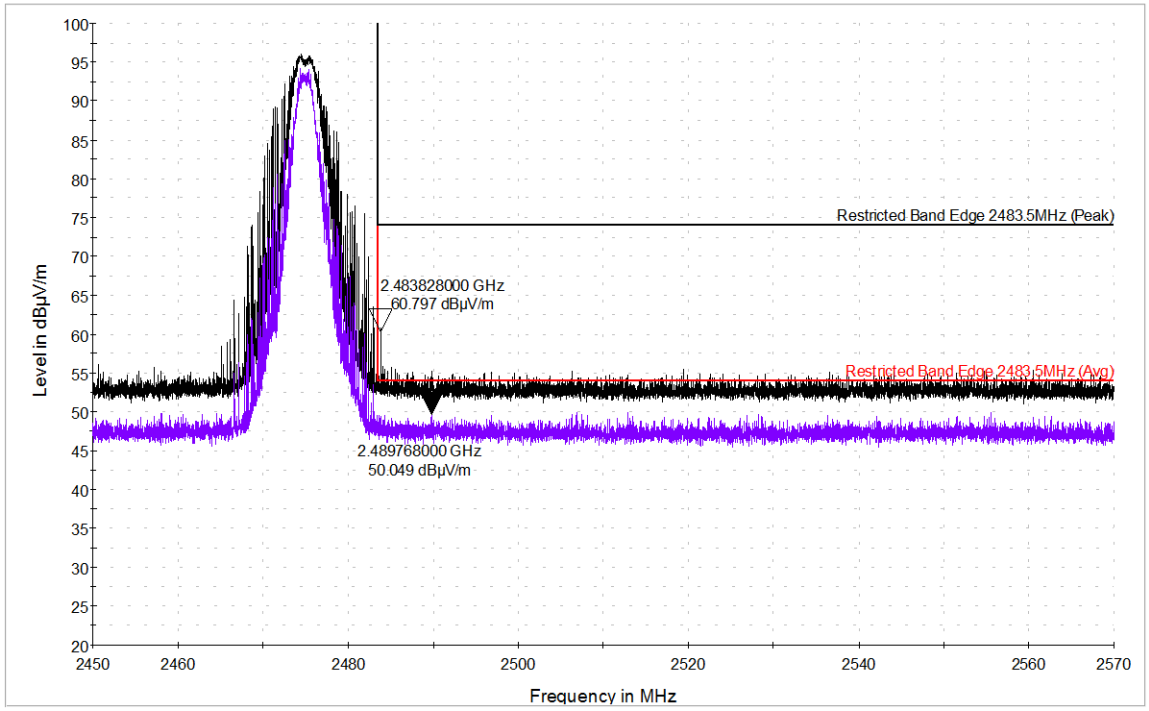
7.17 Test Data (Low Band Edge, Classic Measurement Method, Horizontal Polarity)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Pol	Corr. (dB)
2347.3	54.409	74.00	19.591	1000.000	H	37.2

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Pol	Corr. (dB)
2381.0	49.902	54.00	4.098	1000.000	H	37.2

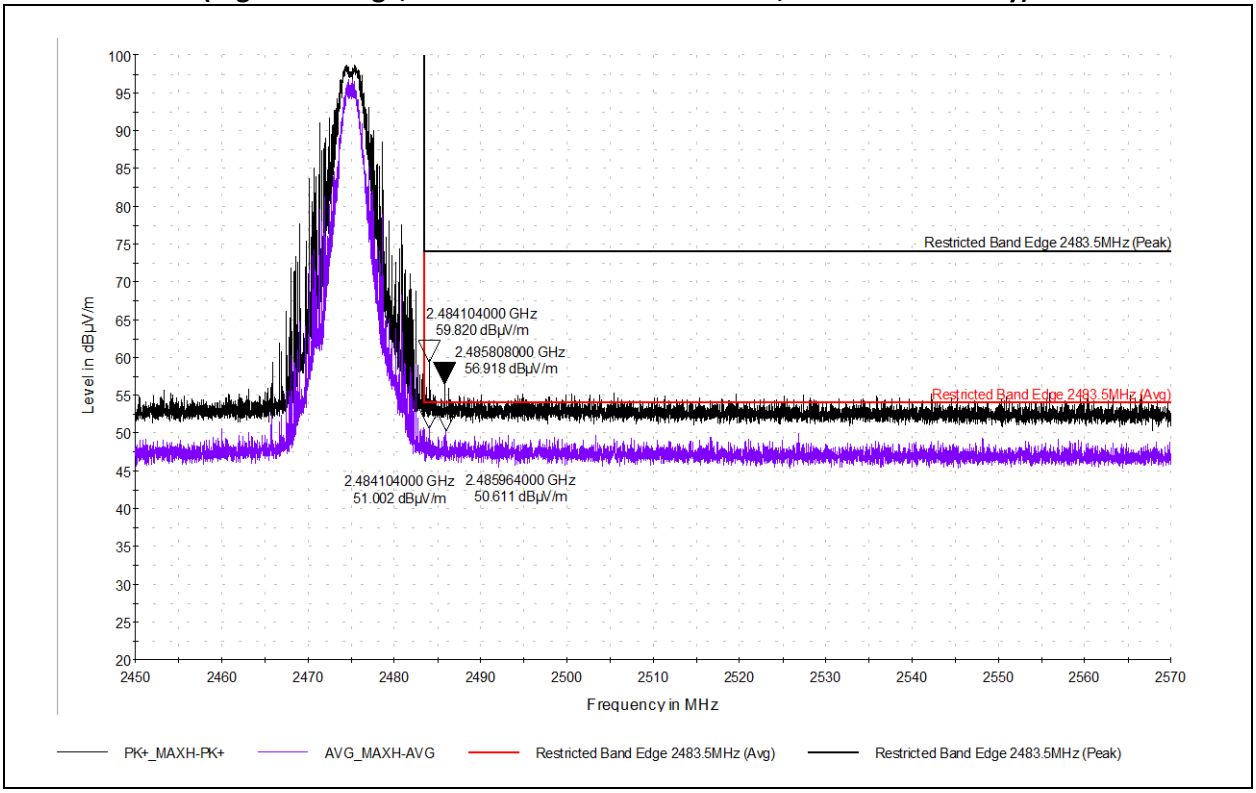
7.18 Test Data (High Band Edge, Classic Measurement Method, Vertical Polarity)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Pol	Corr. (dB)
2483.82	60.797	74.0	13.203	1000.000	V	37.2

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Pol	Corr. (dB)
2489.77	50.049	54.00	3.951	1000.000	V	37.2

7.19 Test Data (High Band Edge, Classic Measurement Method, Horizontal Polarity)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Pol	Corr. (dB)
2484.10	59.820	74.0	14.18	1000.000	H	37.2
2485.81	56.918	74.0	17.082	1000.000	H	37.2

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Pol	Corr. (dB)
2484.10	51.002	54.0	2.998	1000.000	H	37.2
2485.96	50.611	54.0	3.389	1000.000	H	37.2

8 Conducted Spurious Emissions

8.1 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 § 5.4(b):

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.

8.2 Test Method

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

8.3 Test Equipment Used

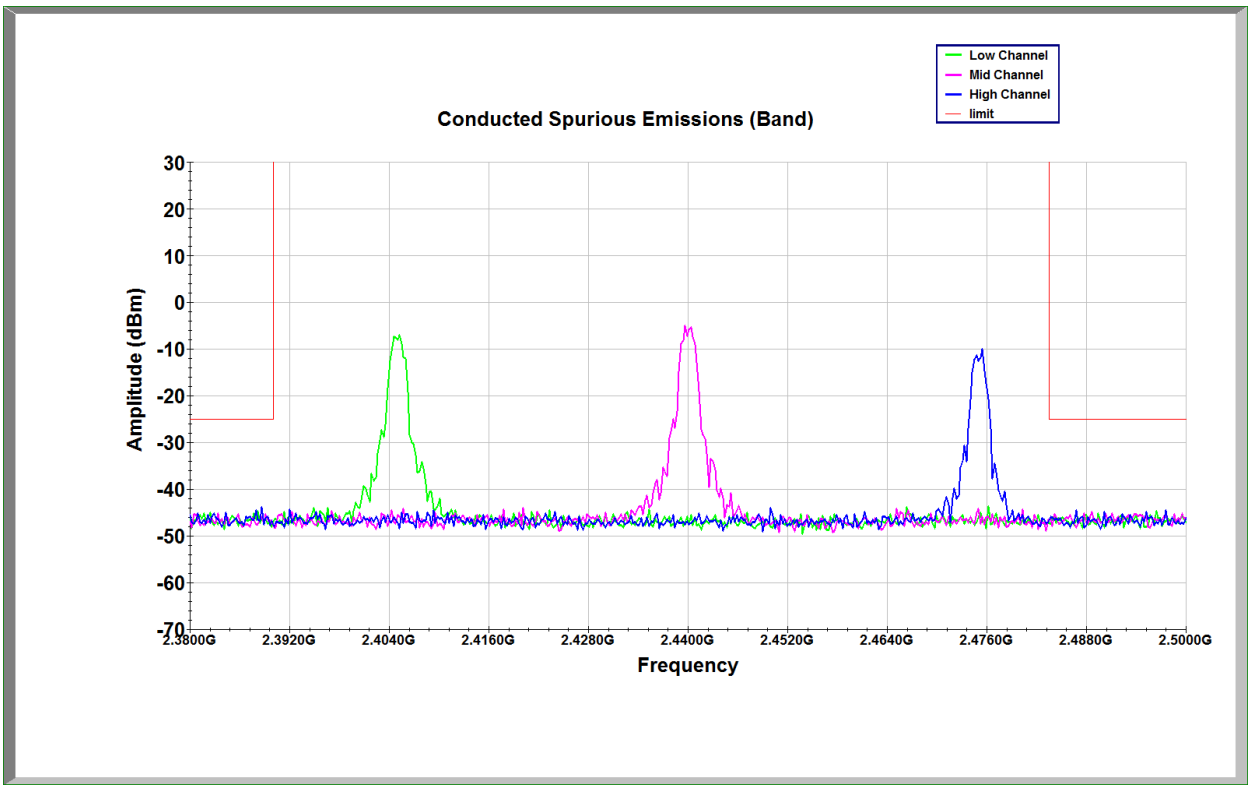
Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ESI26	9/30/2019	9/30/2020

8.4 Test Results

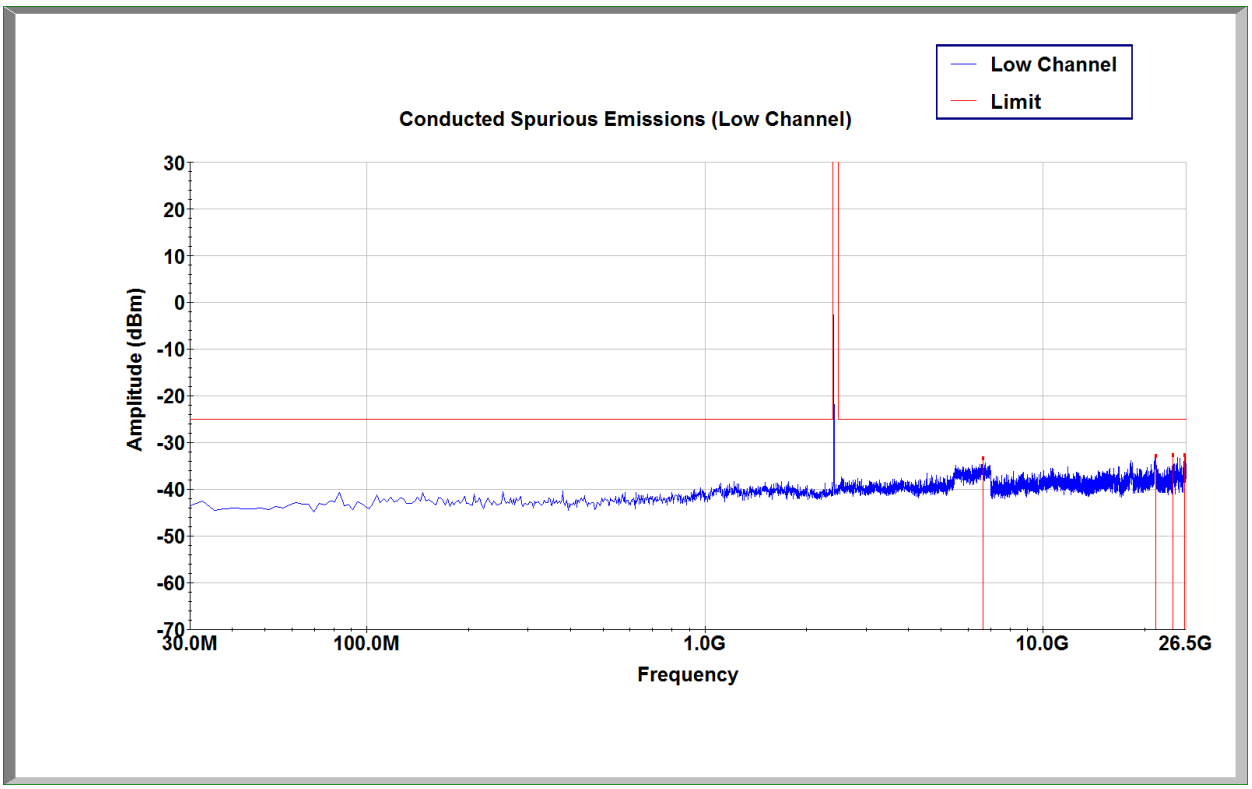
The device was found to be **compliant**. All spurious emissions met the 20dB down criteria.

8.5 Test Conditions

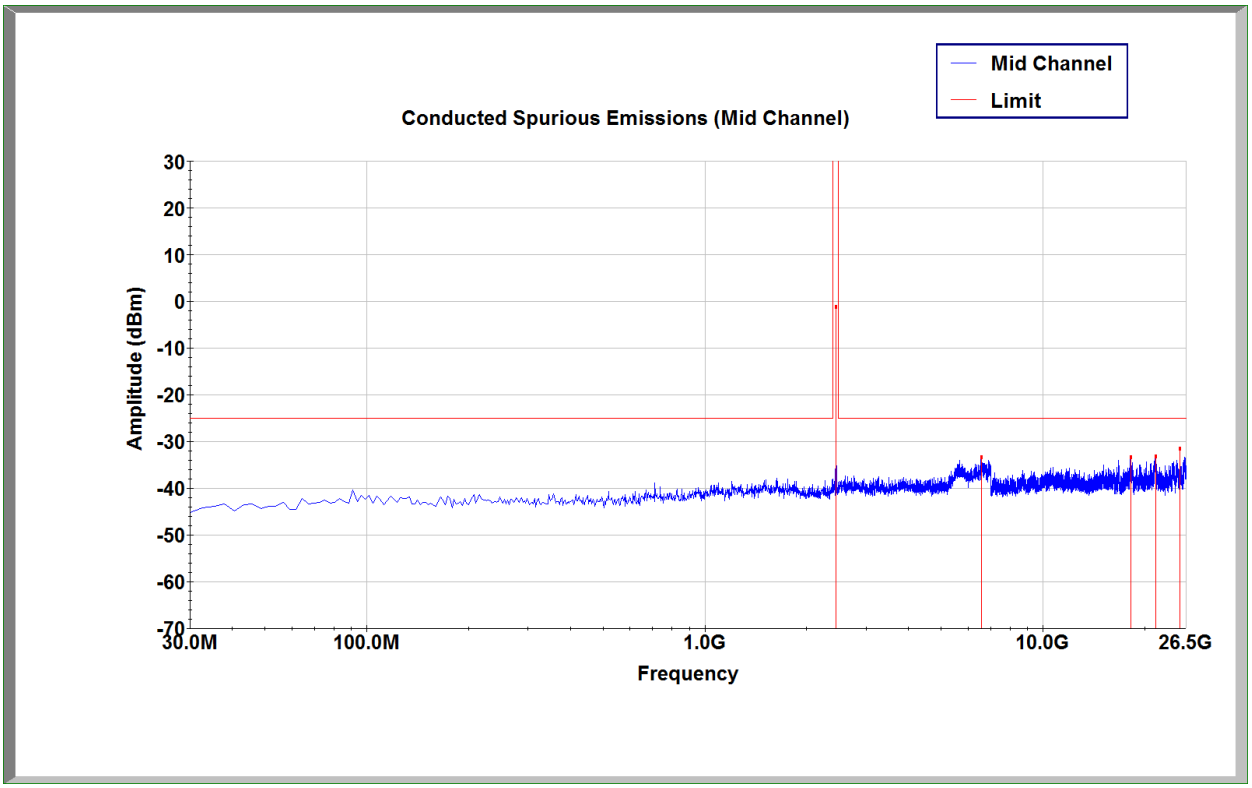
Test Personnel:	Bryan Taylor	Test Date:	12/19/2019
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	-20dB Down
Product Standard:	FCC Part 15.247 RSS-247 Issue 2	Ambient Temperature:	25.3C
Input Voltage:	Battery	Relative Humidity:	46.7%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	988.8mbar



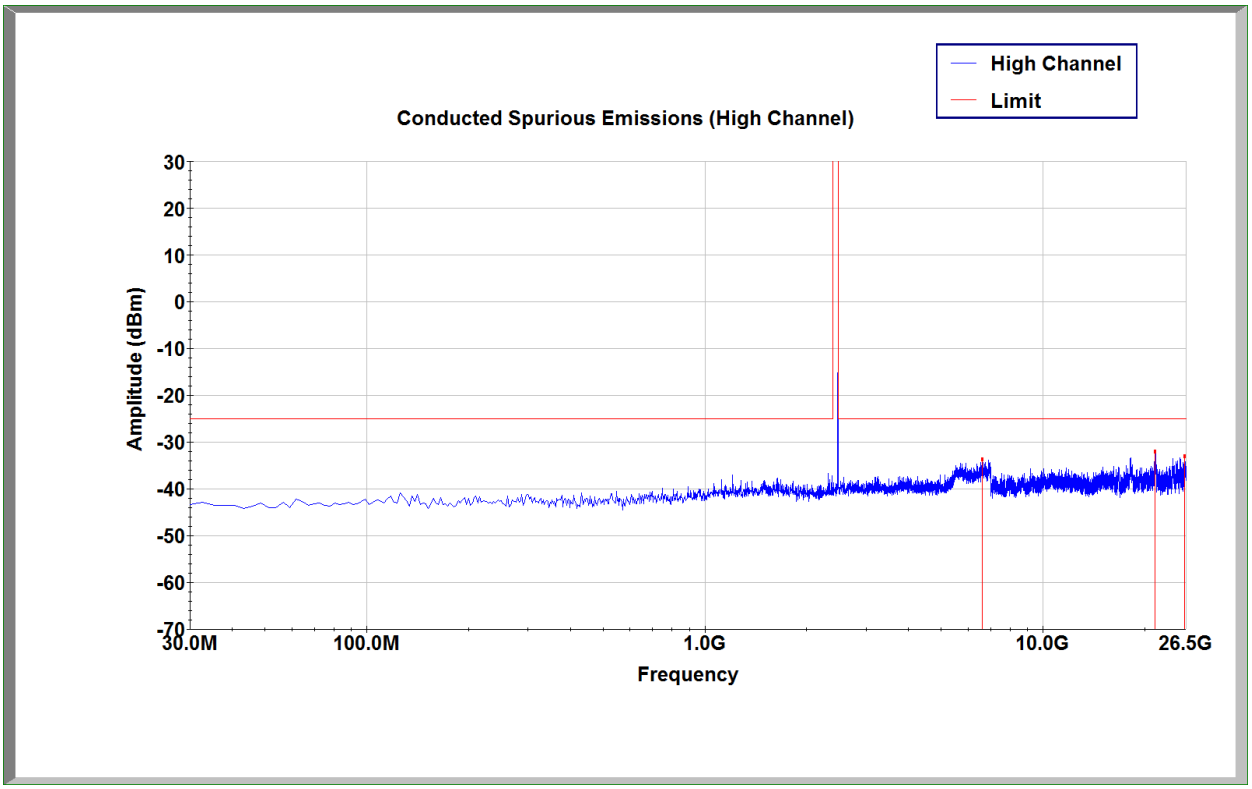
Conducted Spurious Emisisons (Band)



Channel 0 Conducted Spurious Emisisons



Channel 7 Conducted Spurious Emissions



Channel 14 Conducted Spurious Emissions

9 Output Power

9.1 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).

9.2 Test Method

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

9.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ESI26	9/30/2019	9/30/2020

9.4 Software Utilized:

Name	Manufacturer	Version
TILE	ETS Lindgren	V7.0.6.545

9.5 Test Results

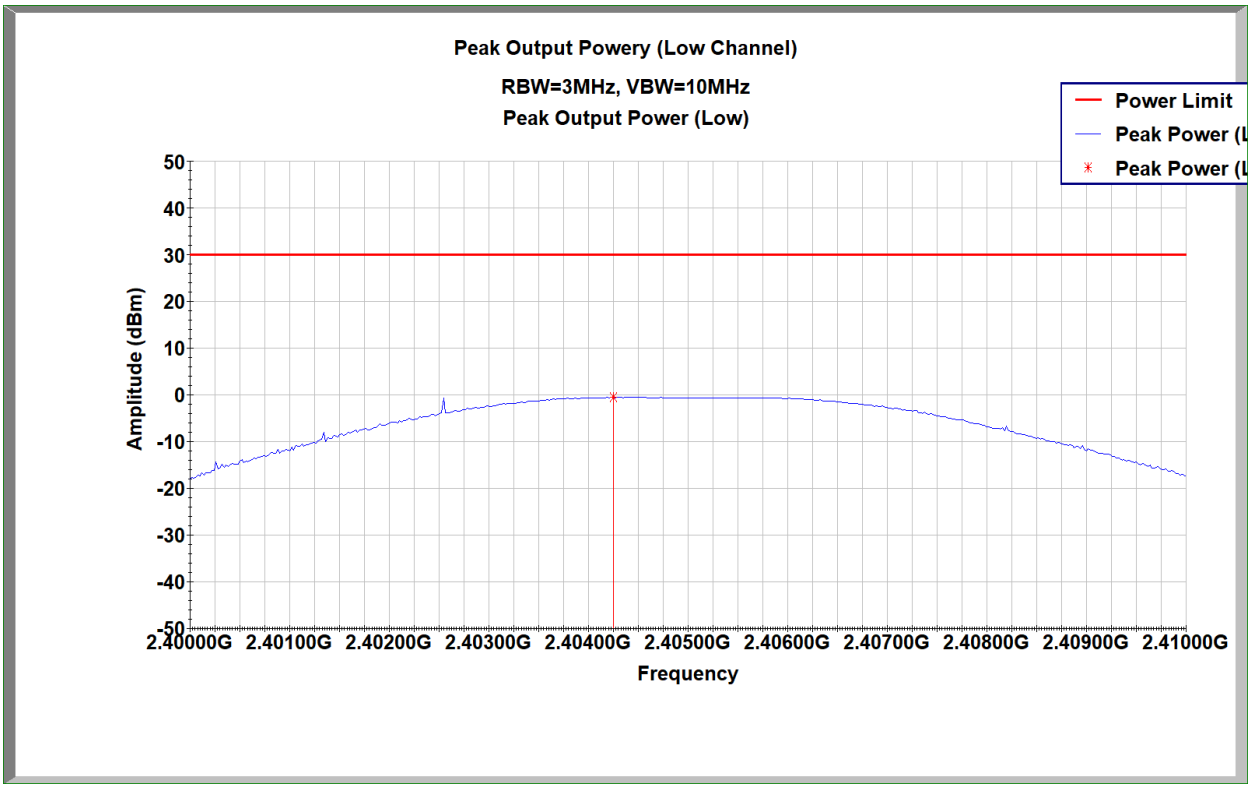
The device was found to be **compliant**. The output power was less than 1W.

9.6 Test Conditions

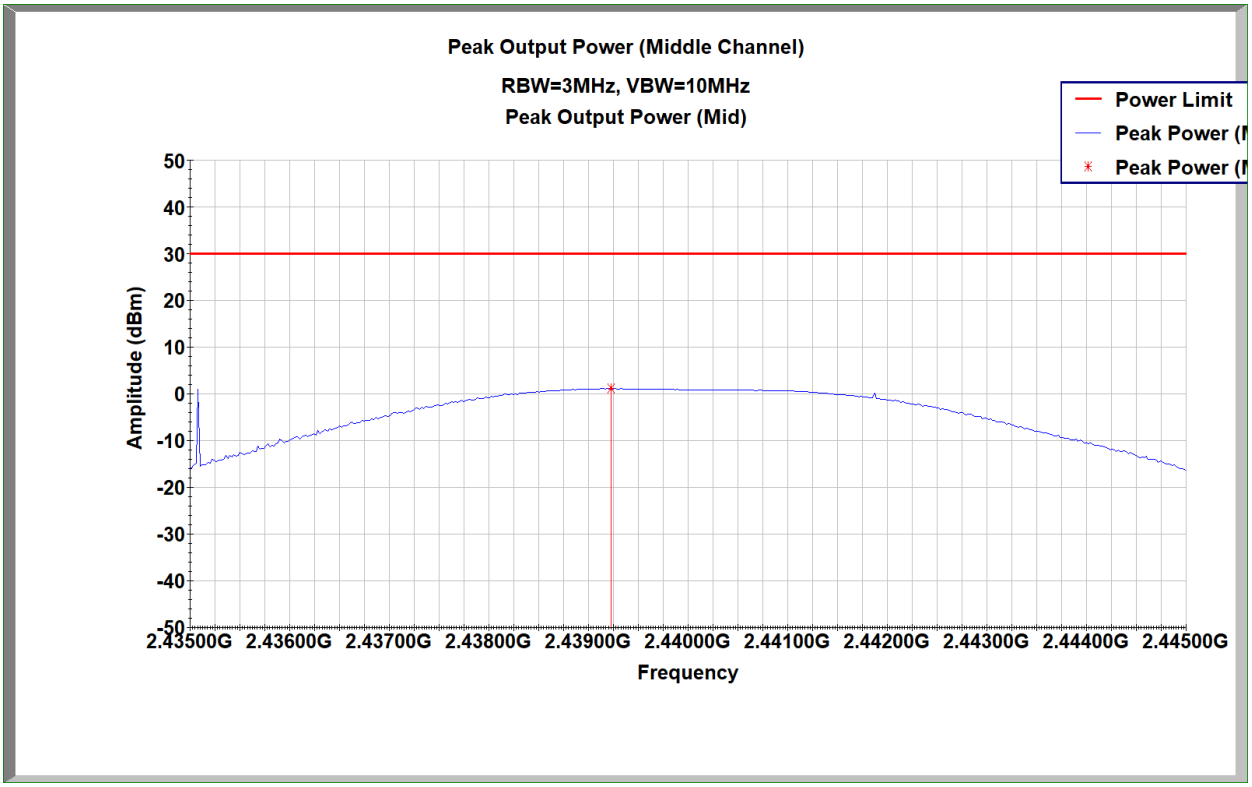
Test Personnel:	Bryan Taylor	Test Date:	12/20/2019
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	See Above
Product Standard:	FCC Part 15.247 RSS-247 Issue 2	Ambient Temperature:	22.1C
Input Voltage:	Battery	Relative Humidity:	31.2%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	9991.7mbar

9.7 Test Data

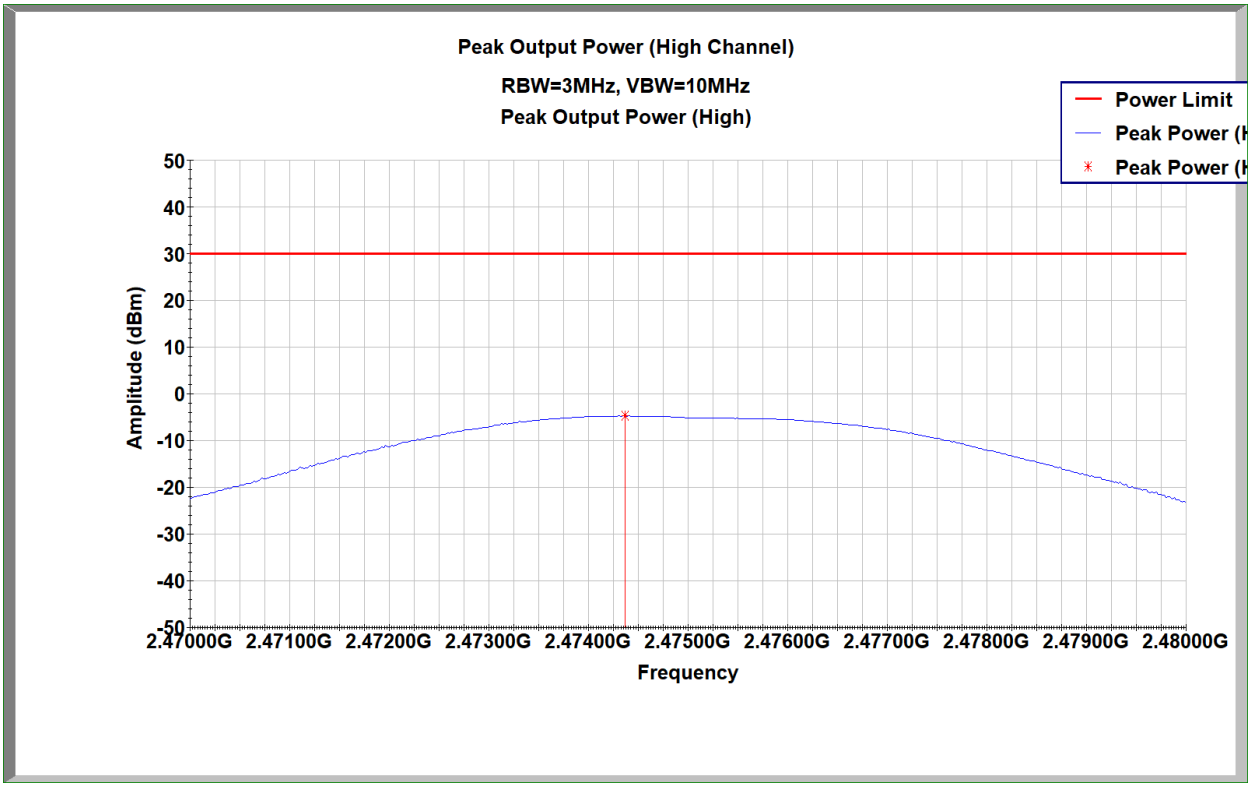
Channel	Frequency	Peak Output Power (dBm)	Limit (dBm)	Margin (dB)	Result
0	2.405 GHz	-0.567	30	30.567	Pass
7	2.440 GHz	1.124	30	28.876	Pass
15	2.475 GHz	-4.711	30	34.711	Pass



Channel 0 Peak Output Power



Channel 7 Peak Output Power



Channel 15 Peak Output Power

10 Occupied Bandwidth

10.1 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.

10.2 Test Method

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

10.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ESI26	9/30/2019	9/30/2020

10.4 Test Results

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

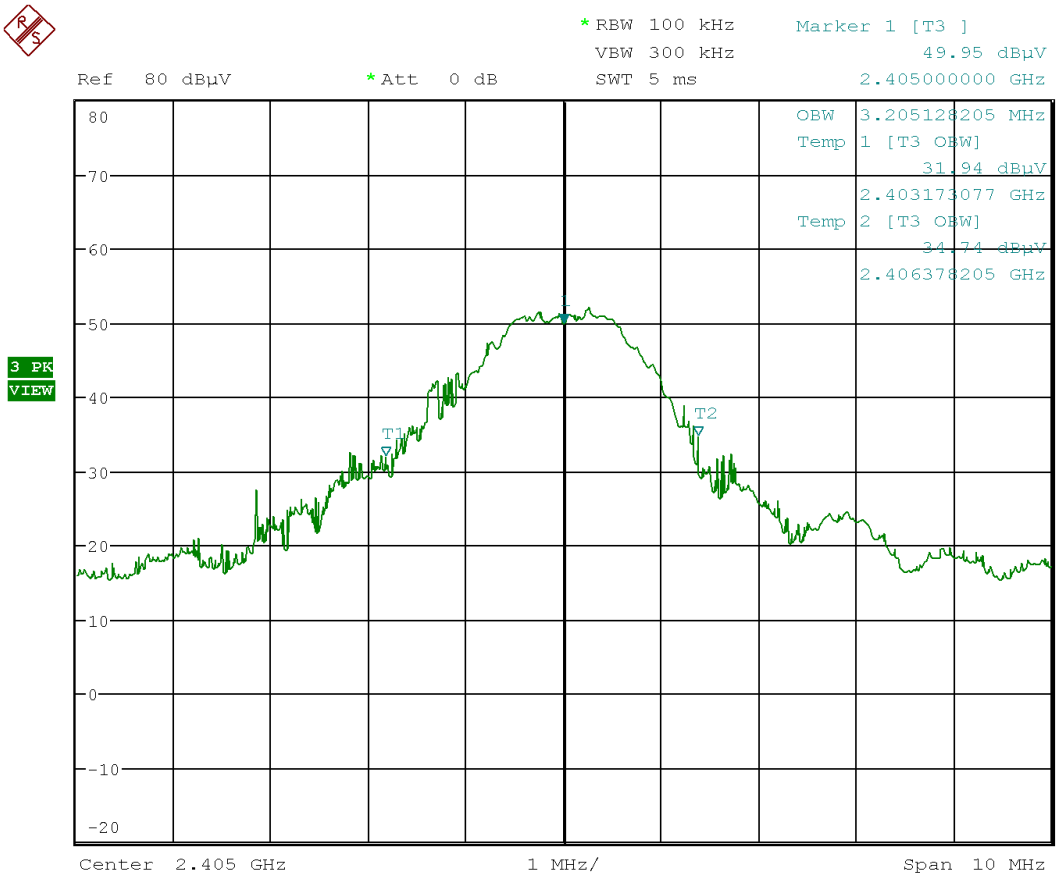
10.5 Test Conditions

Test Personnel:	Bryan Taylor	Test Date:	12/19/2019
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	500kHz
Product Standard:	FCC Part 15.247 RSS-247 Issue 2	Ambient Temperature:	22.4C
Input Voltage:	Battery	Relative Humidity:	29.4%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	988.4mbar

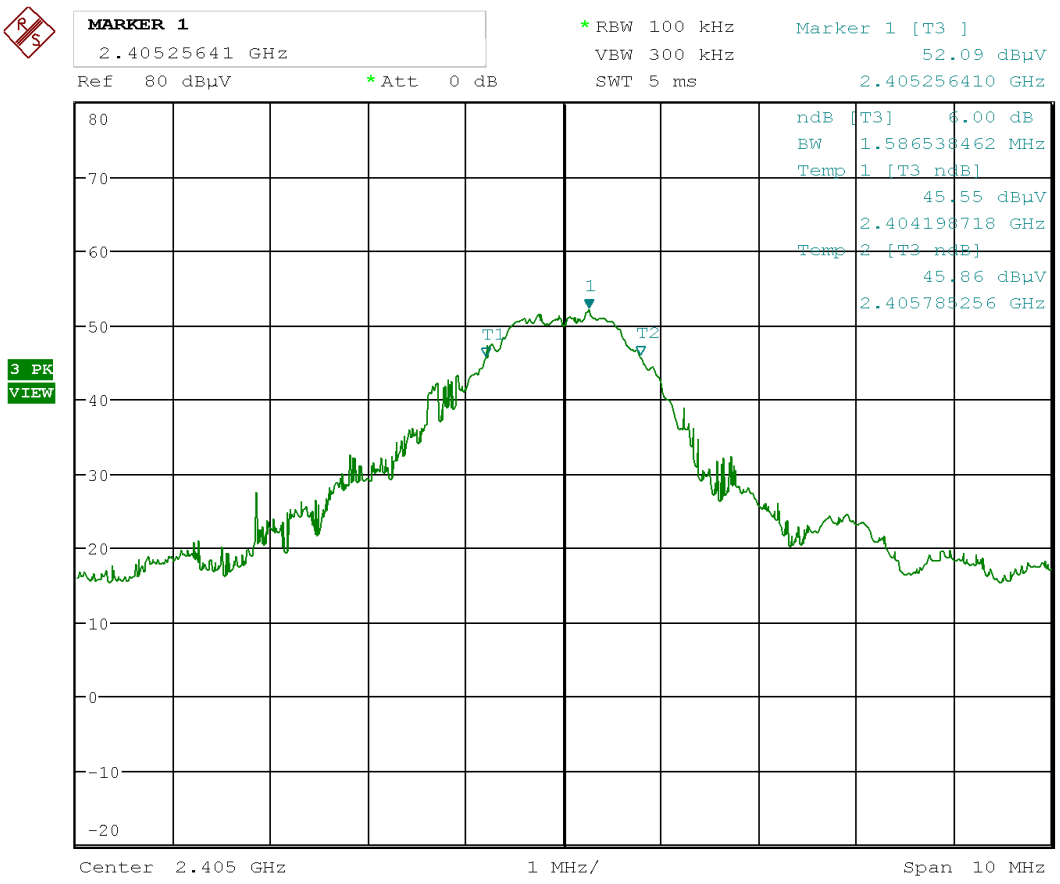
Deviations, Additions, or Exclusions: None

10.6 Test Data

Channel	Frequency (MHz)	6dB BW	20dB BW	99% BW
0	2.405 GHz	1.58MHz	3.07MHz	3.21MHz
7	2.440 GHz	1.58MHz	3.30MHz	3.76MHz
14	2.475 GHz	1.58MHz	2.90MHz	3.02MHz

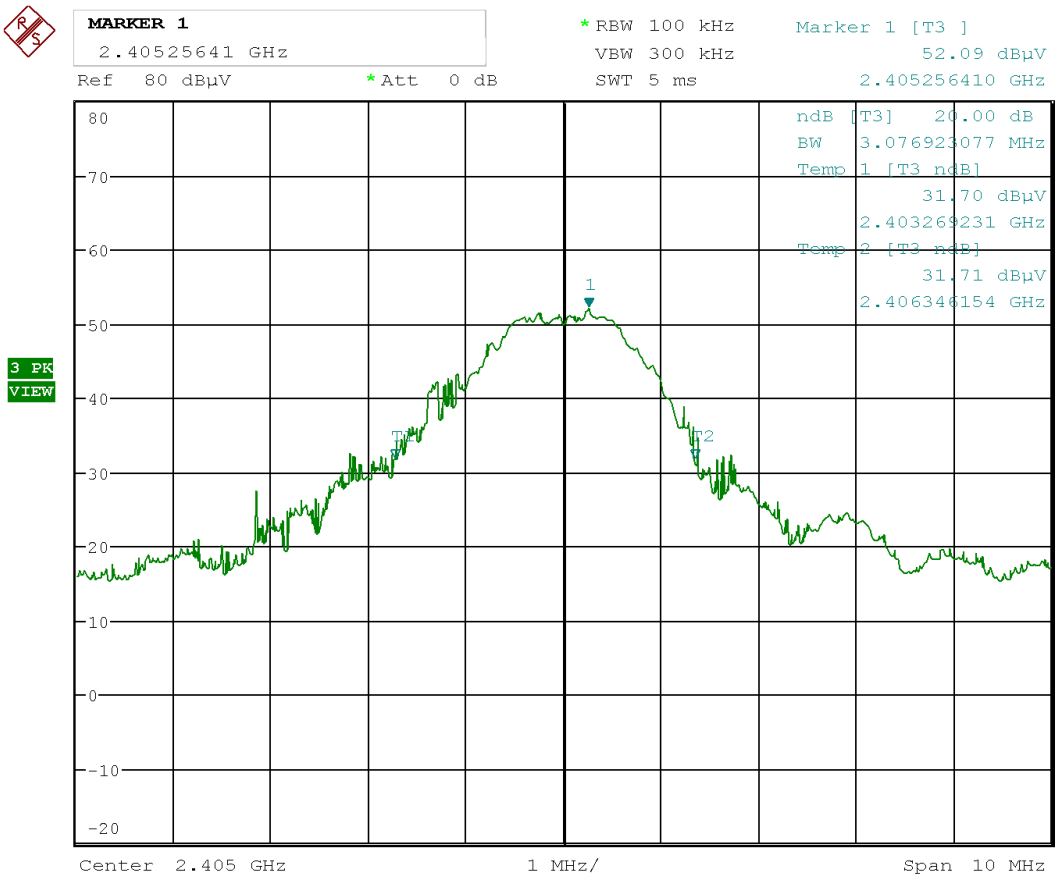


Ch 0, 99% Power Bandwidth = 3.21MHz



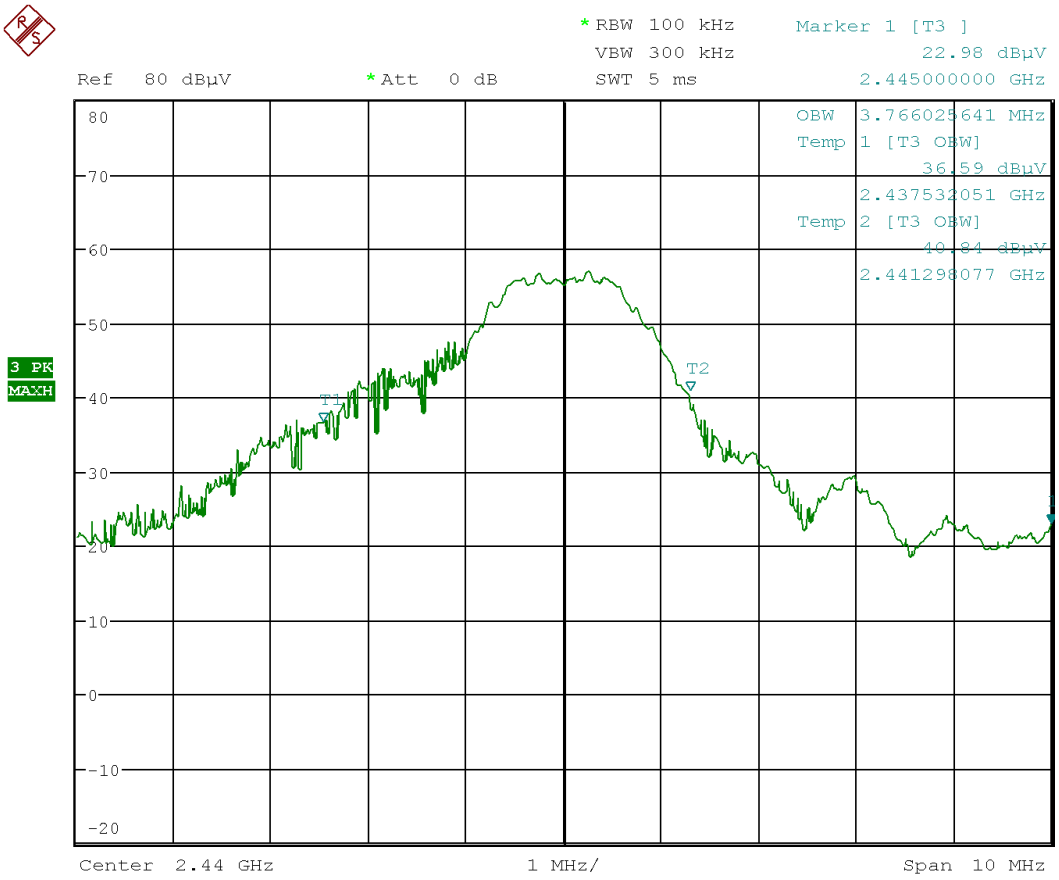
Date: 19.DEC.2019 14:18:54

Ch 0, 6dB Bandwidth = 1.58MHz

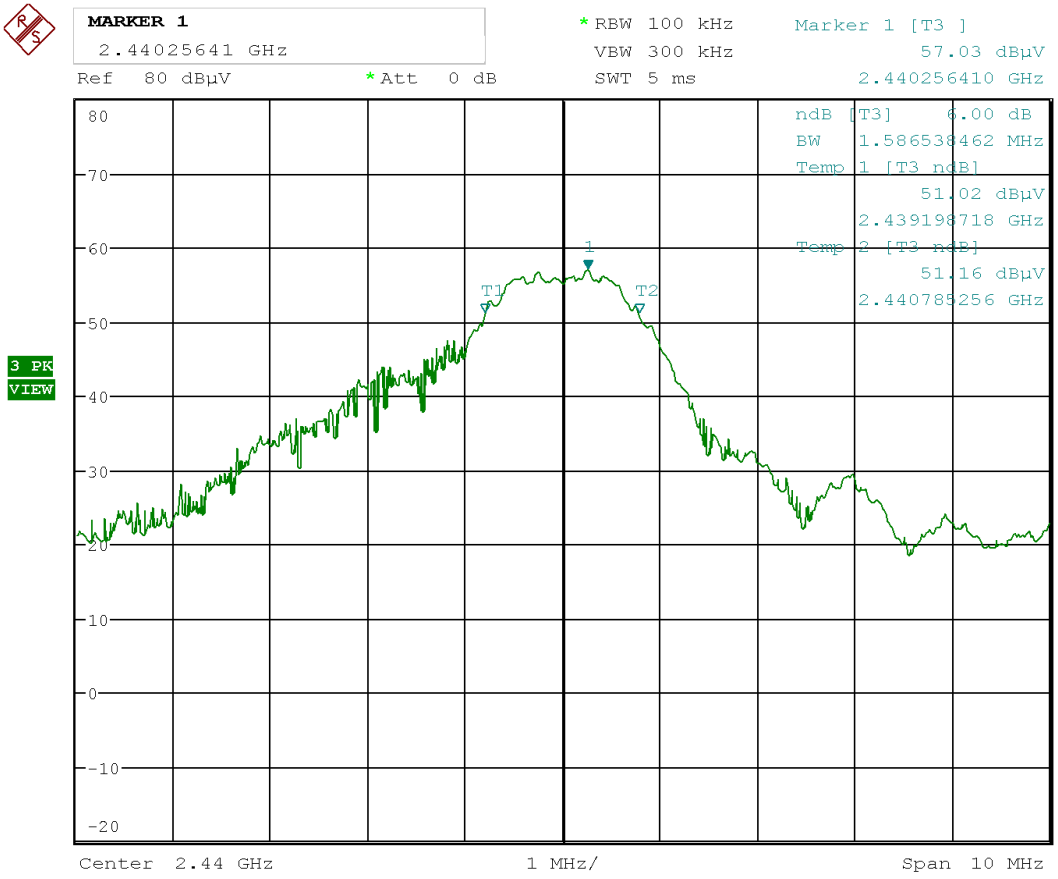


Date: 19.DEC.2019 14:19:37

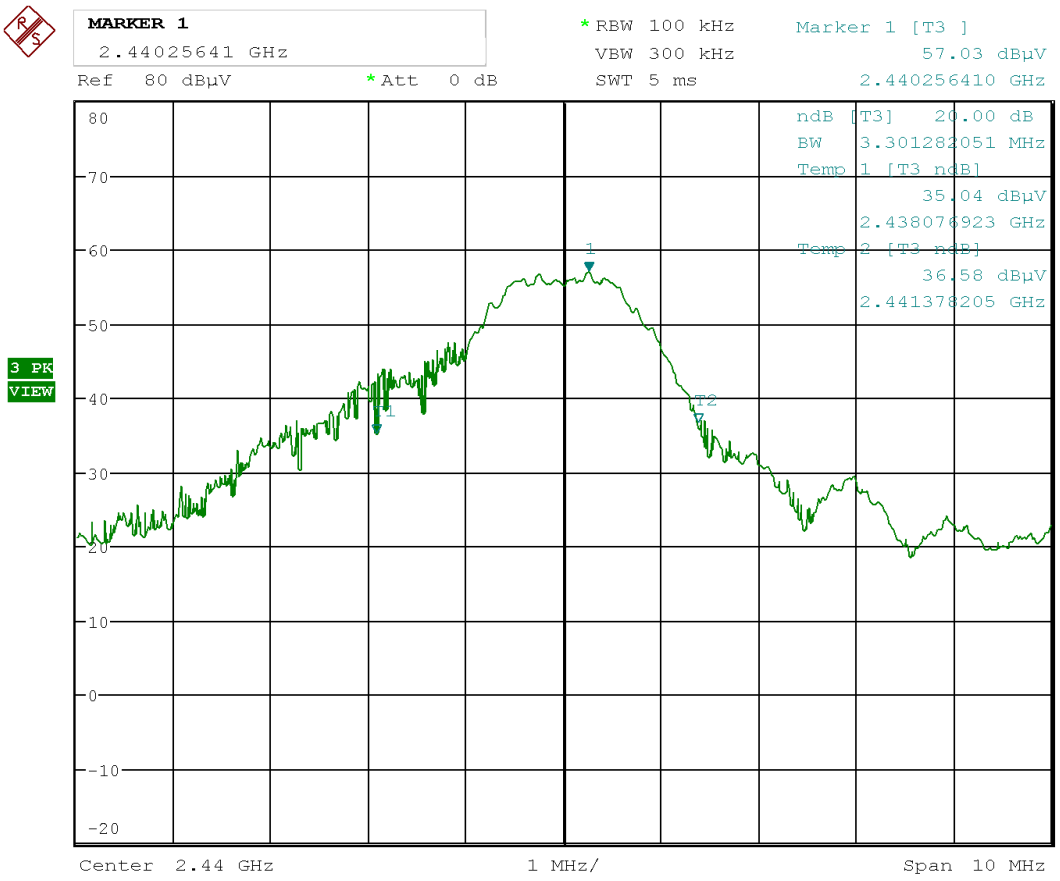
Ch 0, 20dB Bandwidth = 3.07MHz



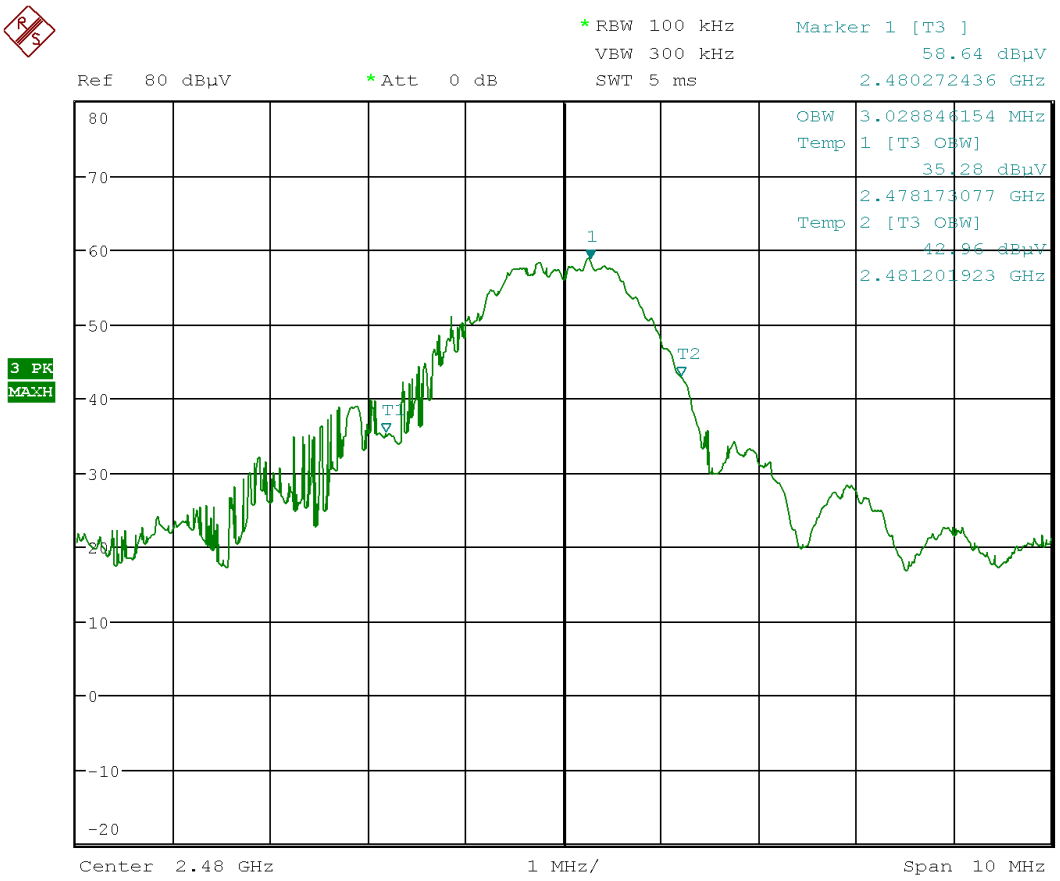
Ch 7, 99% Power Bandwidth = 3.76MHz



Ch 7, 6dB Bandwidth = 1.58MHz

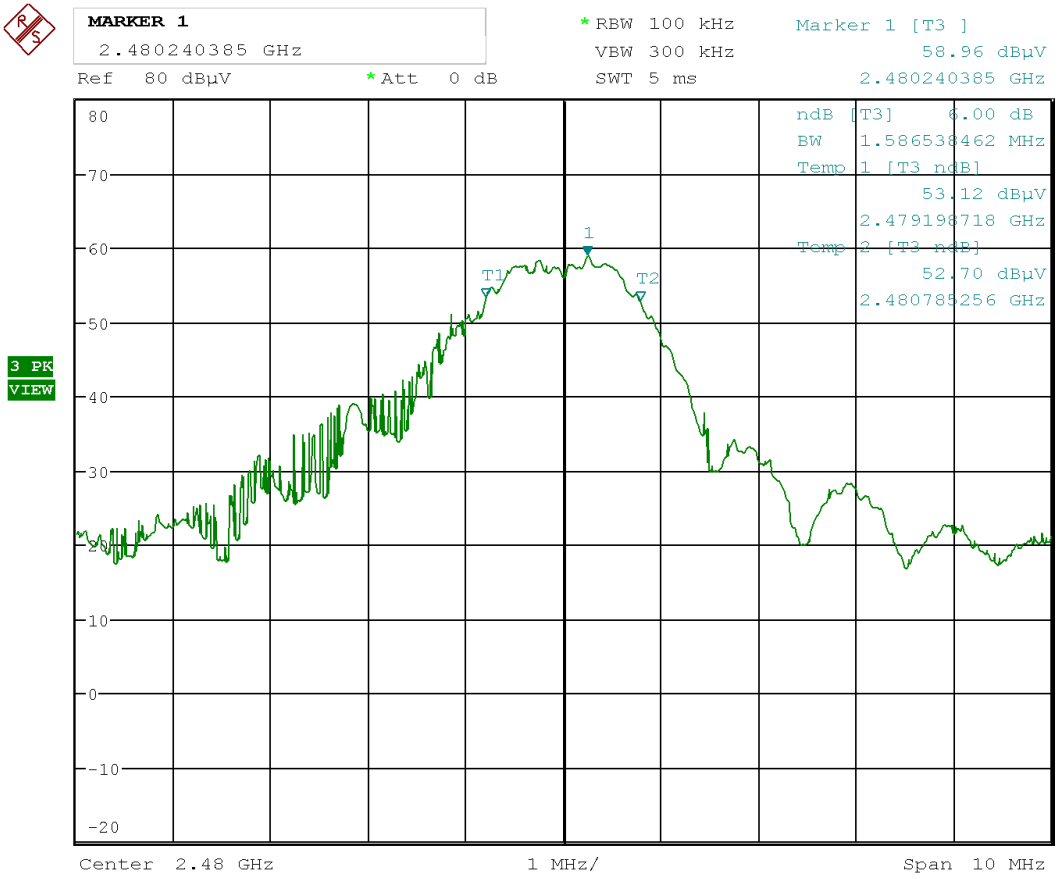


Ch 7, 20dB Bandwidth = 3.30MHz



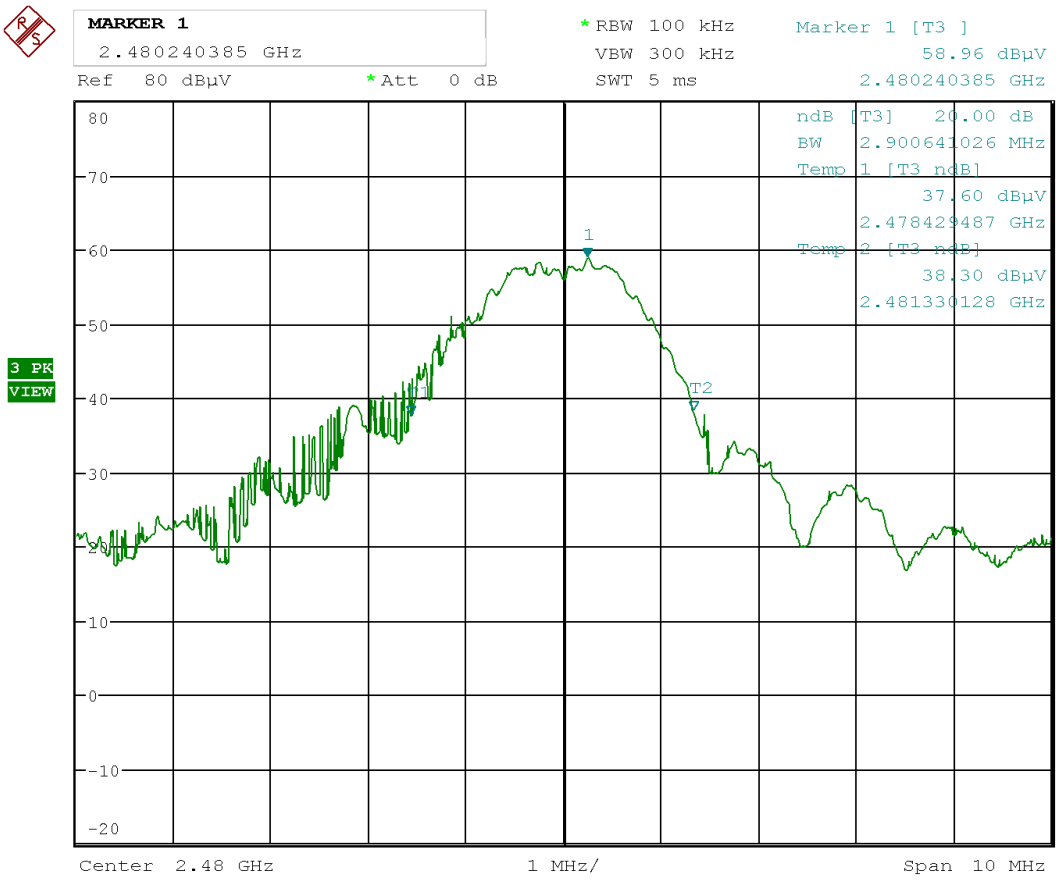
Date: 19.DEC.2019 13:43:52

Ch 14, 99% Power Bandwidth = 3.02MHz



Date: 19.DEC.2019 13:46:45

Ch 14, 6dB Bandwidth = 1.58MHz



Ch 14, 20dB Bandwidth = 2.90MHz

11 Power Spectral Density

11.1 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).

11.2 Test Method

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

11.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ESI26	9/30/2019	9/30/2020

11.4 Software Utilized:

Name	Manufacturer	Version
TILE	ETS Lindgren	V7.0.6.545

11.5 Test Results

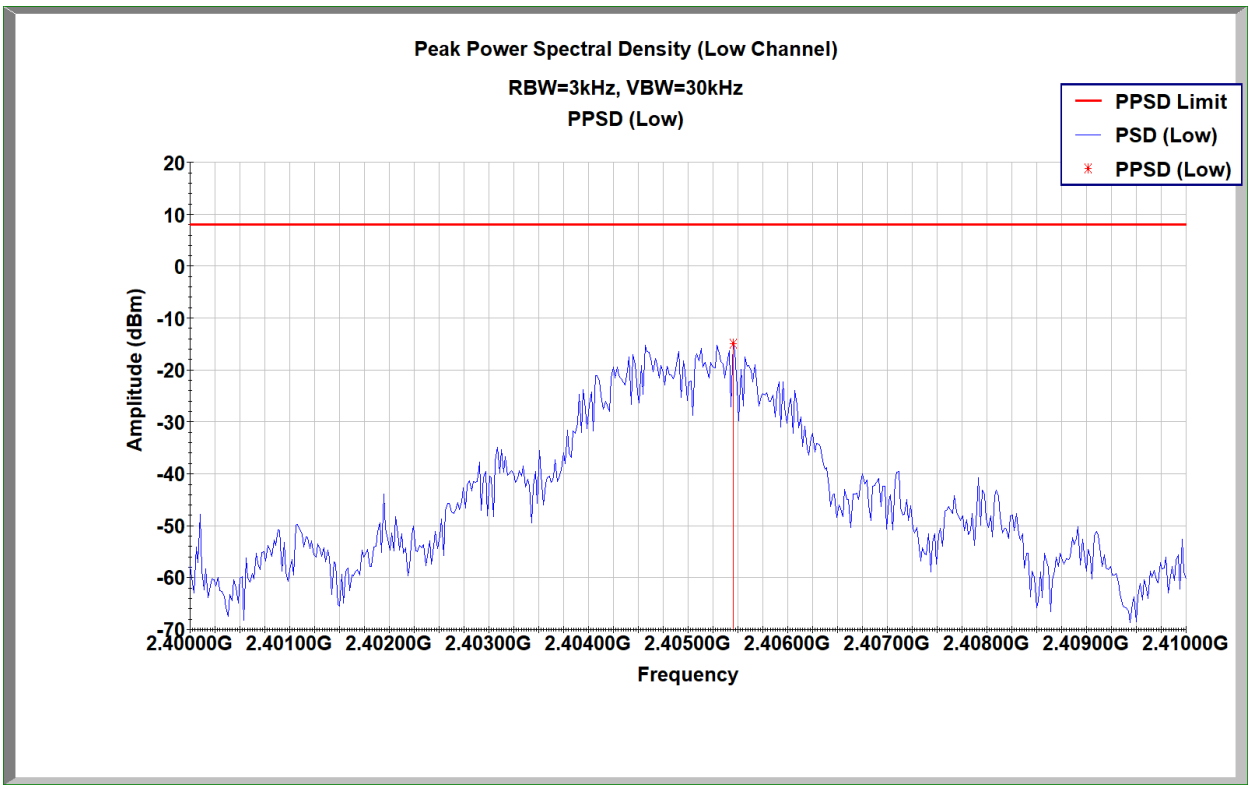
The device was found to be **compliant**. The peak power spectral density was less than 8dBm.

11.6 Test Conditions

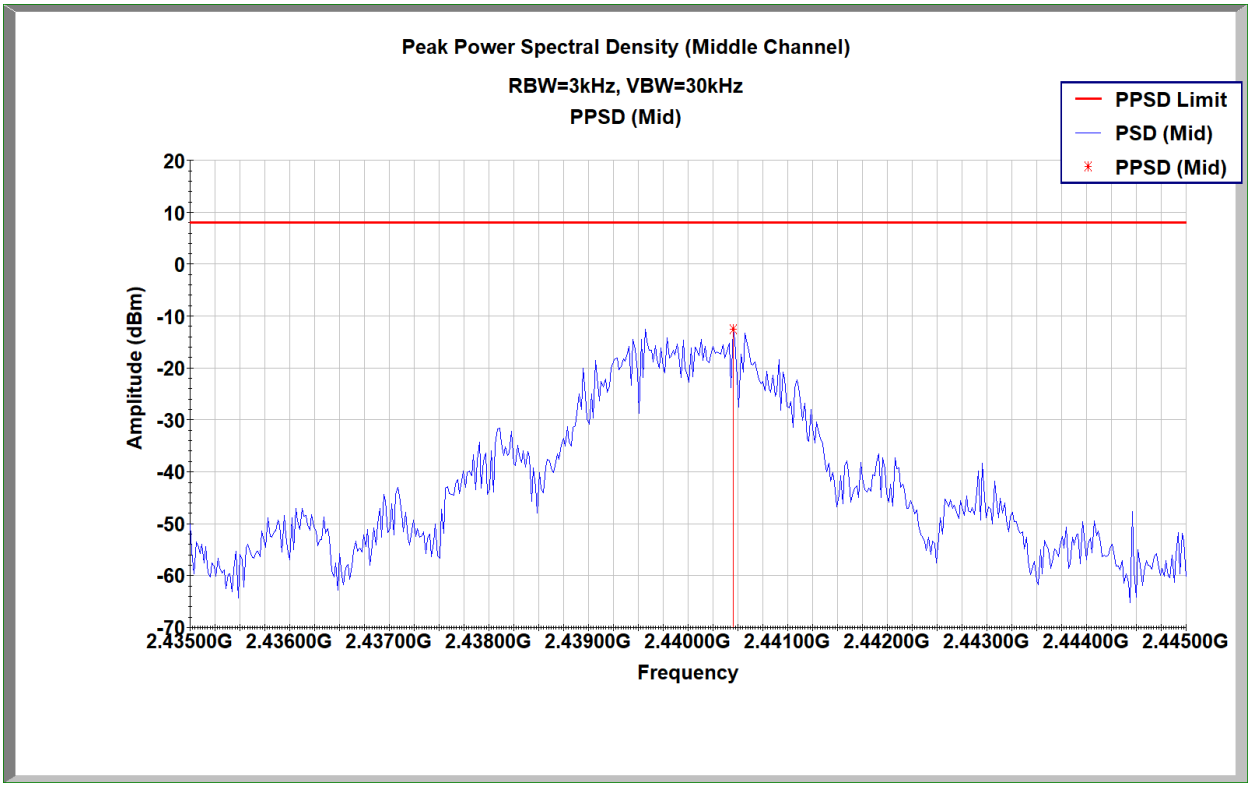
Test Personnel:	Bryan Taylor	Test Date:	12/30/2020
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	See Above
Product Standard:	FCC Part 15.247 RSS-247 Issue 2	Ambient Temperature:	22.2C
Input Voltage:	Battery	Relative Humidity:	33.4%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	989.7mbar

11.7 Test Data

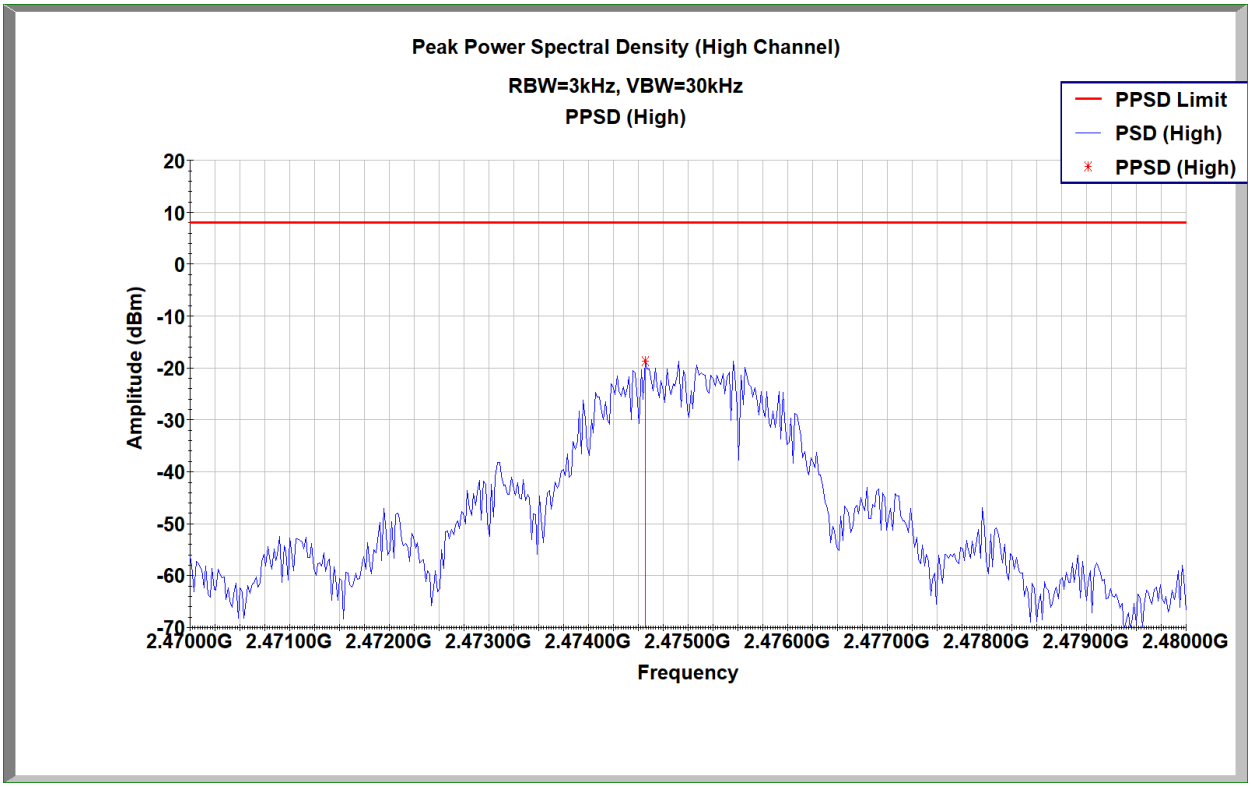
Channel	Frequency	RBW	PPSD (dBm)	Limit (dBm)	Margin (dB)	Result
0	2.405 GHz	3kHz	-14.958	8	22.958	Pass
7	2.440 GHz	3kHz	-12.572	8	20.572	Pass
14	2.475 GHz	3kHz	-18.648	8	26.648	Pass



Power Spectral Density Channel 0



Power Spectral Density Channel 7



Power Spectral Density Channel 14

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 4 § 8.3:

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).

12.2 Test Results

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

13 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	3/16/2018	104182906LEX-003	BL	BCT	Original Issue
1	5/1/2020	104182906LEX-003.1	BL	BCT	Revised due to name and model change
2	5/21/2020	104182906LEX-003.2	BL	BCT	Corrected the model number and antenna gain. Indicated the variant model on page 6.