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Ademco Inc. TEST REPORT

SCOPE OF WORK

EMC TESTING – ADT7AIO2 HOME SECURITY PANEL

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EMC TEST REPORT
(FULL COMPLIANCE)

Report Number: 104517828LEX-003

Project Number: G104517828

Report Issue Date: 1/18/2020

Model(s) Tested: ADT7AIO2 Home Security Panel

Standards: Title 47 CFR Part 15.247
RSS-247 Issue 2
RSS-Gen Issue 5

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

Client:
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Report prepared by



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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
7	Receiver Spurious Emissions (ANSI C63.4: 2014)	Pass
8	Transmitter Spurious Emissions (FCC Part 15.247(d), RSS-247 Issue 2 § 5.5)	Pass
9	Output Power (FCC Part 15.247(b)(3), RSS-247 Issue 2 § 5.4(d))	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	Conducted Spurious Emissions (FCC Part 15.247(d), RSS-247 Issue 2 § 5.5)	Pass
13	Antenna Requirement (FCC Part 15.203, RSS-Gen Issue 5 § 6.8)	Pass
14	Conducted Emissions (ANSI C63.3: 2013)	Pass



3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	Ademco Inc.
Address:	2 Corporate Center Drive Suite 100 Melville, NY 11747 USA
Contact:	Divya Venkat
Email:	Divya.venkat@resideo.com
Manufacturer Information	
Manufacturer Name:	Ademco Inc.
Manufacturer Address:	2 Corporate Center Drive Suite 100 Melville, NY 11747 USA



4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	ADT7AIO2 Home Security Panel
Model Number	ADT7AIO2
Serial Number	Test Sample 1
Supported Transmit Bands	RF6 2405 – 2475MHz
Receive Date	12/15/2020
Test Start Date	12/23/2020
Test End Date	1/19/2020
Device Received Condition	Good
Test Sample Type	Production
Rated Voltage	120VAC / 60Hz (into AC / DC Power Adapter)
Antenna	Two PCB Trace Antennas (gain values provided by client and may impact test results) Antenna 1 4.4dBi Gain Antenna 2: 3.4dBi Gain
Test Channels / Frequencies	Channel 11 2405MHz Channel 19 2445MHz Channel 25 2475MHz
Description of Equipment Under Test (provided by client)	
The ADT7AIO2 Home Security Panel was a touch screen security panel with wireless connectivity.	

4.1 Variant Models:

There were no variant models covered by this evaluation.



5 System Setup and Method

5.1 Method:

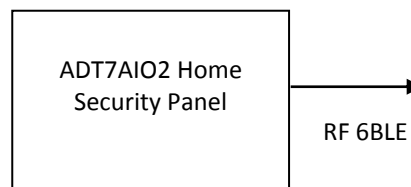
Configuration as required by ANSI C63.4: 2014 and ANSI C63.10:2013

No.	Descriptions of EUT Exercising
1	Special test code allowed for the transmission at 100% duty cycle on low, mid, and high channels on transmit antenna 1 and transmit antenna 2.
2	Idle, not transmitting.

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
None					

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
None			

5.2 EUT Block Diagram:

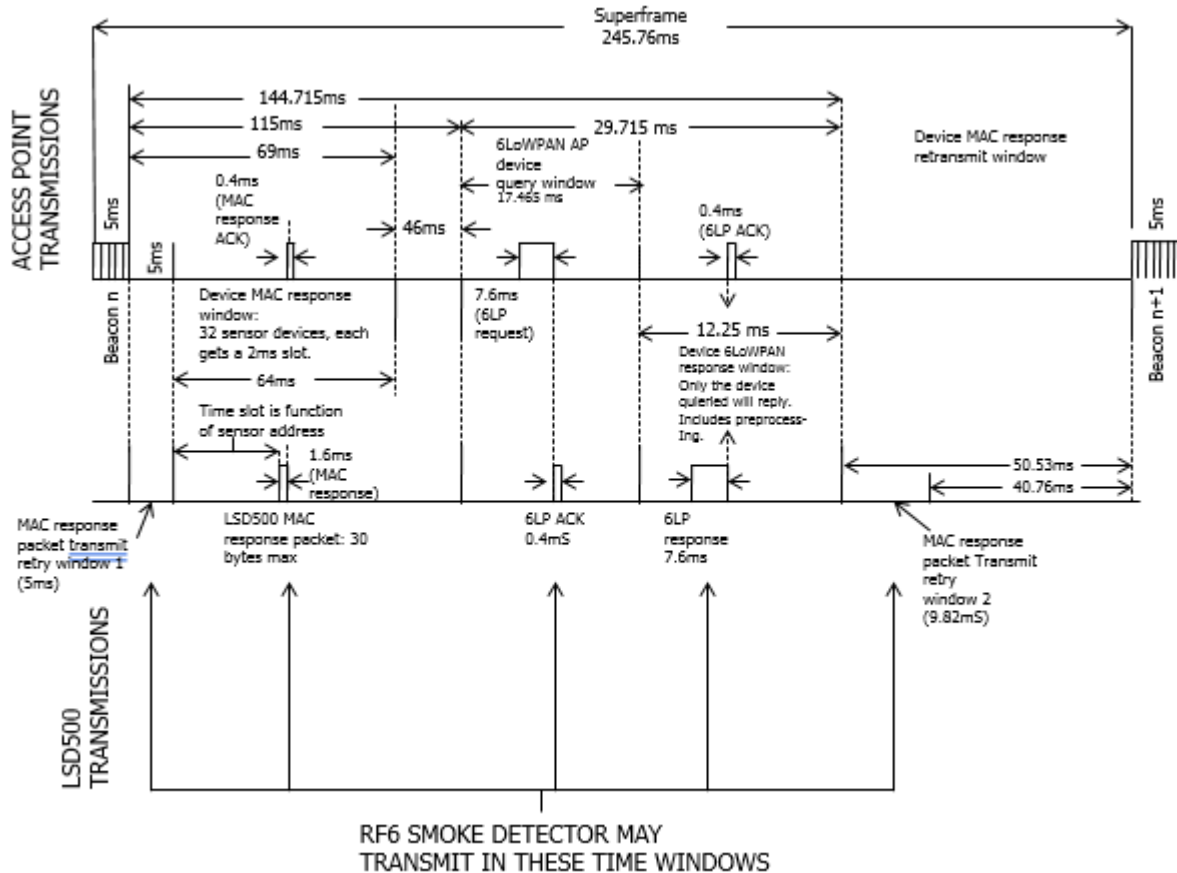




6 Duty Cycle Correction Factor

The following information was provided by the client and may influence measurement results:

The Access Point (coordinator) generates beacon every 245.76ms (superframe). As shown in the figure, the duration of the beacon is 5ms.



In the worst case, these four RF6 transmissions may occur within a 100ms window:

Retry Packet 1: 30 Bytes @ 250 kbps = $(30 * 8) * (1 / [250 * 10^3]) = 960 \mu\text{s}$

Alarm Packet: 30 Bytes @ 250 kbps = $(30 * 8) * (1 / [250 * 10^3]) = 960 \mu\text{s}$

Retry Packet 2: 30 Bytes @ 250 kbps = $(30 * 8) * (1 / [250 * 10^3]) = 960 \mu\text{s}$

6LowPan Packet: 128 Bytes @ 250 kbps = $(128 * 8) * (1 / [250 * 10^3]) = 4096 \mu\text{s}$

The Total Transmit Time is:

Retry Packet 1 (960uS) + Alarm Packet (960uS) + Retry Packet 2 (960uS) + 6LowPan Packet (4096uS)
= 960 uS + 960 uS + 960 uS + 4096 uS = **6.976 ms**

Duty cycle for purposes of calculating average radiated emissions is thus 6.976ms/100ms = 6.976%.

The Duty Cycle Correction Factor is therefore calculated as $20\log_{10}(6.976/100) = -23.12\text{dB}$ which will be applied to some measurement results when an average amplitude value is required to demonstrate compliance.



7 Receiver Spurious Emissions

7.1 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)	U _{CISPR}
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.



7.2 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 dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- 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 dB μ V 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 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

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

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$
$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

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



7.3 Test Equipment Used

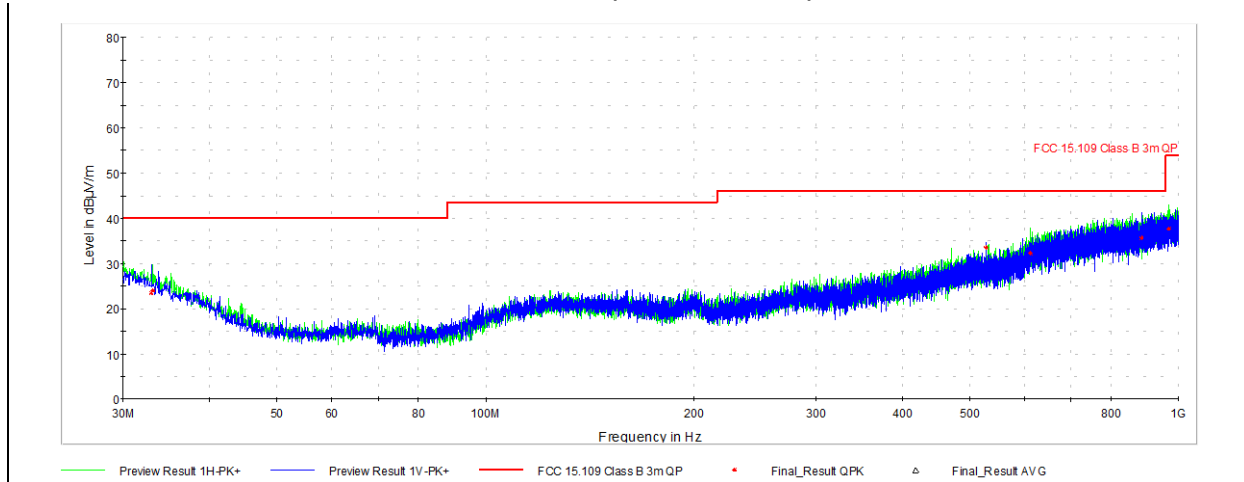
Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	10/5/2020	10/5/2021
Bilog Antenna (30MHz-1GHz)	7085	SunAR	JB6	9/4/2020	9/4/2021
Horn Antenna	4001	ETS	3117	1/16/2020	1/16/2021
System Controller	4096	ETS Lindgren	2090	Verify at Time of Use	Verify at Time of Use
System Controller	3957	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
Coaxial Cable	3074			12/21/2020	12/21/2021
Coaxial Cable	3918	Rohde & Schwarz	TS-PR18	12/21/2020	12/21/2021
Coaxial Cable	2588			12/21/2020	12/21/2021
Coaxial Cable	2593			12/21/2020	12/21/2021
Coaxial Cable	3339			12/21/2020	12/21/2021
Coaxial Cable	2592			12/21/2020	12/21/2021

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 Plots/Data: Radiated Emissions, 30MHz – 1GHz (Transmitters Idle)**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
32.963889	23.41	40.00	16.59	120.000	104.3	V	331.0	25.3
33.125556	24.08	40.00	15.92	120.000	399.9	H	337.0	26.6
527.987222	33.49	46.02	12.53	120.000	105.2	V	182.0	29.8
611.083889	32.29	46.02	13.73	120.000	278.1	H	55.0	32.3
884.785556	35.61	46.02	10.41	120.000	294.4	V	304.0	35.9
969.445000	37.70	53.98	16.28	120.000	393.0	H	210.0	37.5

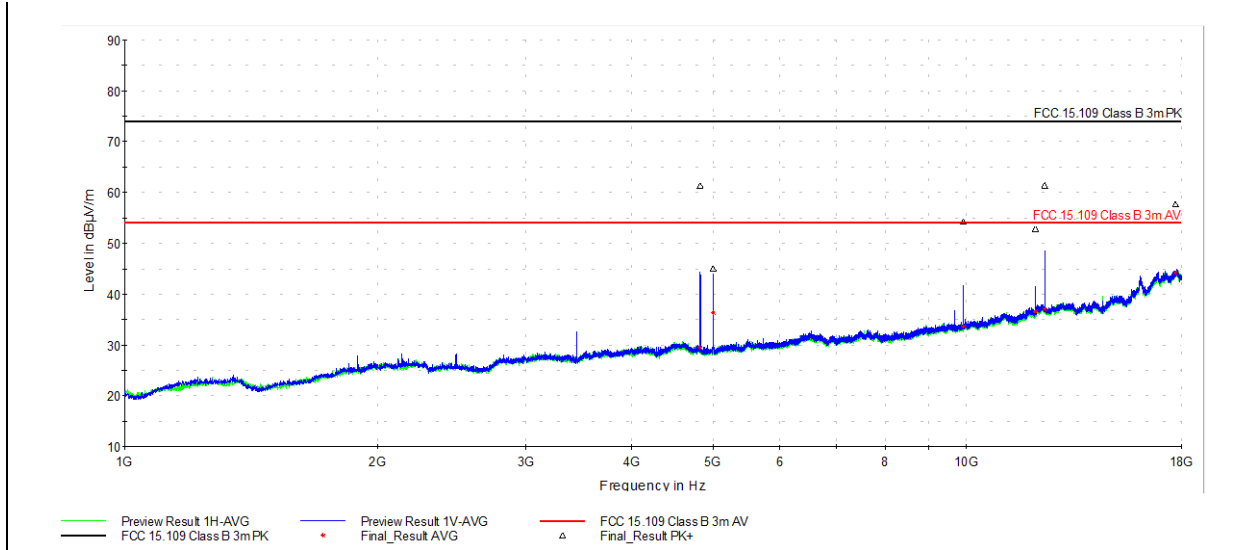
Test Personnel: Bryan Taylor
 Supervising/Reviewing Engineer: NA
 (Where Applicable) FCC Part 15B
 Product Standard: ICES-003 Issue 6
 Input Voltage: 120VAC / 60Hz
 Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 12/22/2020
 Limit Applied: Class B
 Ambient Temperature: 26.3 °C
 Relative Humidity: 40.5 %
 Atmospheric Pressure: 985.3 mbar

Deviations, Additions, or Exclusions: None



7.7 Plots/Data: Radiated Emissions, 1GHz – 18GHz (Transmitters Idle)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4831.000000	61.34	73.98	12.64	1000.000	374.0	V	325.0	8.2
5000.000000	45.12	73.98	28.86	1000.000	192.0	V	193.0	8.3
9902.000000	54.35	73.98	19.63	1000.000	410.0	V	302.0	14.9
12077.500000	52.92	73.98	21.06	1000.000	279.0	V	78.0	17.9
12377.500000	61.46	73.98	12.52	1000.000	311.0	V	260.0	18.6
17698.000000	57.78	73.98	16.20	1000.000	410.0	H	292.0	26.2

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4831.000000	29.55	53.98	24.43	1000.000	374.0	V	325.0	8.2
5000.000000	36.30	53.98	17.68	1000.000	192.0	V	193.0	8.3
9902.000000	33.63	53.98	20.35	1000.000	410.0	V	302.0	14.9
12077.500000	36.56	53.98	17.42	1000.000	279.0	V	78.0	17.9
12377.500000	37.02	53.98	16.96	1000.000	311.0	V	260.0	18.6
17698.000000	44.24	53.98	9.74	1000.000	410.0	H	292.0	26.2

Test Personnel:	Bryan Taylor	Test Date:	12/22/2020
Supervising/Reviewing Engineer:	NA	Limit Applied:	Class B
(Where Applicable)	FCC Part 15B	Ambient Temperature:	26.3 °C
Product Standard:	ICES-003 Issue 6	Relative Humidity:	40.5 %
Input Voltage:	120VAC / 60Hz	Atmospheric Pressure:	985.3 mbar
Pretest Verification w / Ambient Signals or BB Source:	Yes		

Deviations, Additions, or Exclusions: None



8 Transmitter 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 § 5.5:

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.

8.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.12.1 Radiated emission measurements and KDB558074D.01.



8.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	10/5/2020	10/5/2021
Bilog Antenna (30MHz-1GHz)	7085	SunAR	JB6	9/4/2020	9/4/2021
Horn Antenna (18-40GHz)	3779	ETS	3116c	7/23/2020	7/23/2021
Horn Antenna	4001	ETS	3117	1/16/2020	1/16/2021
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 (18-40GHz)	3921	Rohde & Schwarz	TS-PR40	12/21/2020	12/21/2021
Coaxial Cable	3074			12/21/2020	12/21/2021
Coaxial Cable	3918			12/21/2020	12/21/2021
Coaxial Cable	2588			12/21/2020	12/21/2021
Coaxial Cable	2593			12/21/2020	12/21/2021
Coaxial Cable	3339			12/21/2020	12/21/2021
Coaxial Cable	2592			12/21/2020	12/21/2021

8.4 Software Utilized

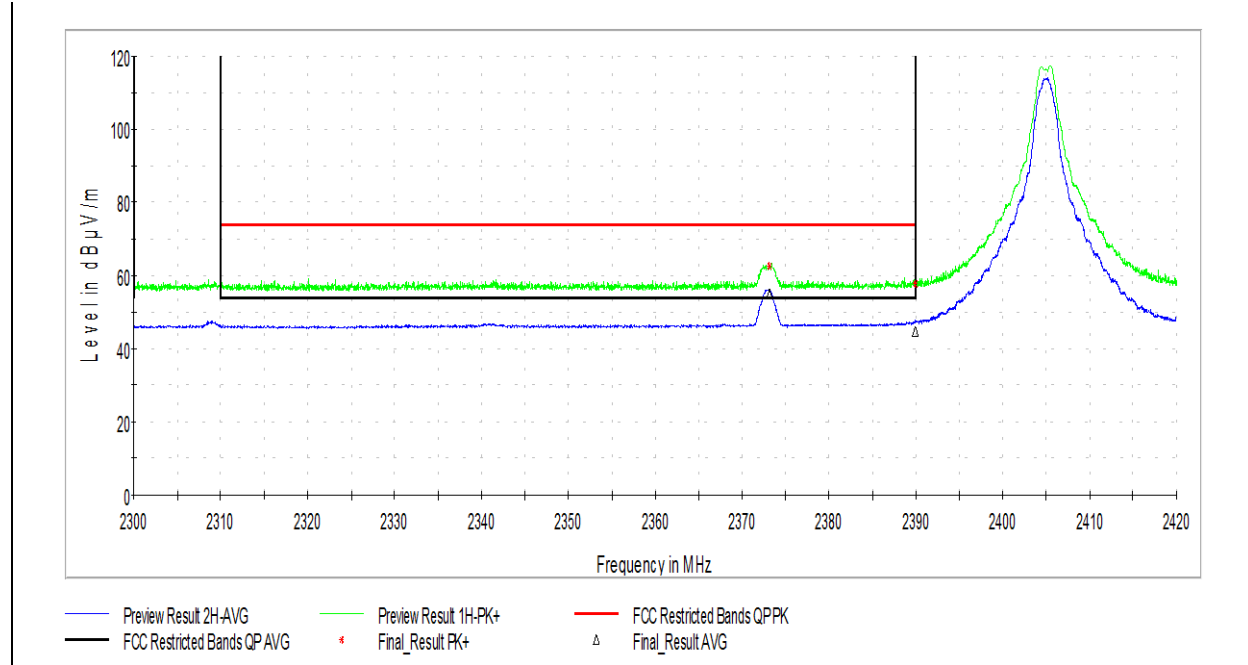
Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 9.15.02

8.5 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. All observed emissions outside of the band of operation were attenuated by at least 20dB. The frequency range from 18 – 26GHz was investigated at a 1m test distance and there were no observable spurious emissions detected.



8.6 Radiated Spurious Emissions (Antenna 1, Low Band Edge)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2373.153846	62.53	73.98	11.45	1000.000	306.0	H	184.0	38.6
2389.976923	57.67	73.98	16.31	1000.000	307.0	H	184.0	38.6

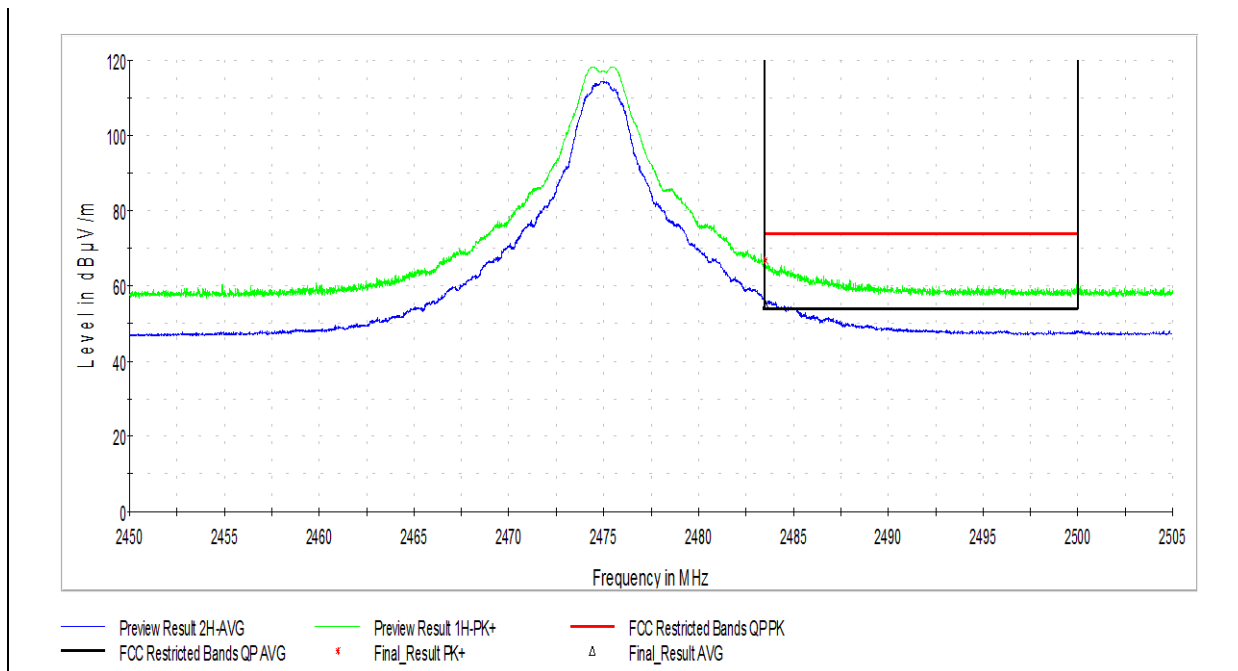
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2373.153846	(31.81) 54.93	53.98	22.17	1000.000	306.0	H	184.0	38.6
2389.976923	44.88	53.98	9.10	1000.000	307.0	H	184.0	38.6

Test Personnel:	Bryan Taylor	Test Date:	1/6/2021
Supervising/Reviewing Engineer:	(Where Applicable) N/A	Limit Applied:	15.205 Restricted Bands
Product Standard:	Issue2	Ambient Temperature:	24.3°C
Input Voltage:	120VAC/60Hz	Relative Humidity:	52.8%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	987.3 mbar

Deviations, Additions, or Exclusions: Measurements appearing in parentheses (xxx) had an additional duty cycle correction factor applied (20log[duty cycle]) in order to arrive at the true average value due to the pulsed nature of the signal. See KDB558074D.01, Section 11, Question 3, Answer C.



8.7 Radiated Spurious Emissions (Antenna 1, High Band Edge)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.518269	66.87	73.98	7.11	1000.000	310.0	H	1.0	39.2

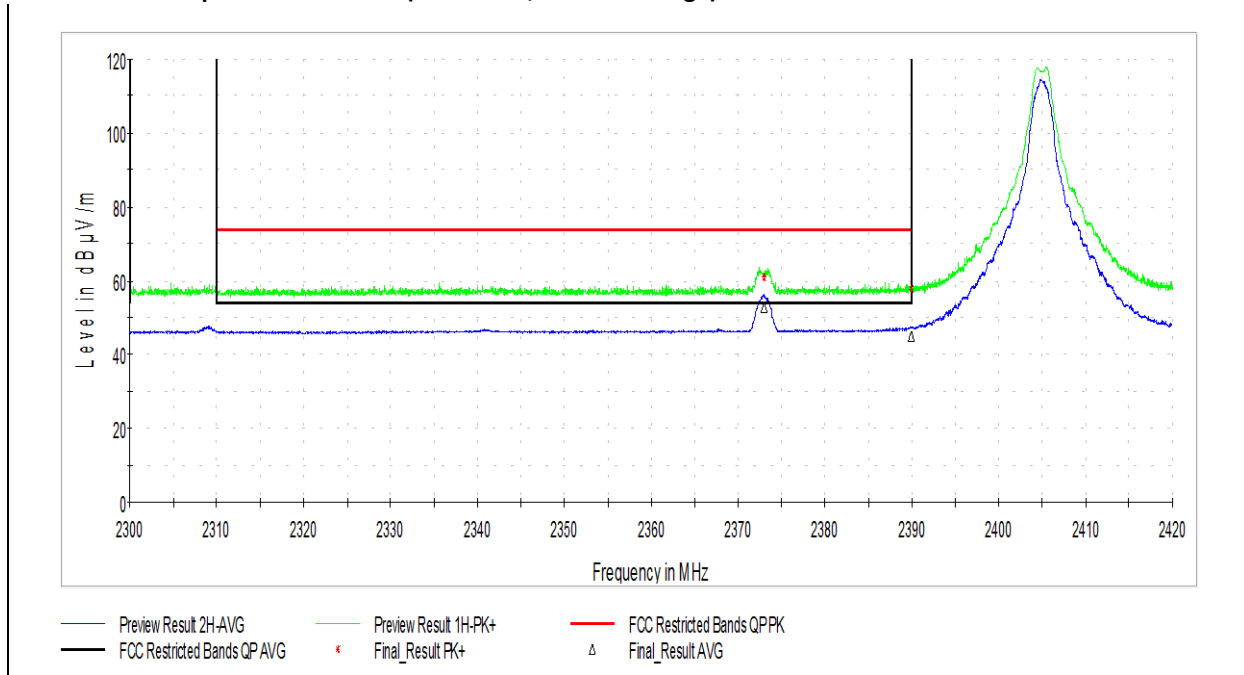
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.518269	(31.70) 54.82	53.98	22.28	1000.000	310.0	H	1.0	39.2

Test Personnel:	<u>Bryan Taylor</u>	Test Date:	<u>1/6/2021</u>
Supervising/Reviewing Engineer:	<u>(Where Applicable) N/A</u>	Limit Applied:	<u>15.205 Restricted Bands</u>
Product Standard:	<u>FCC Part 15C, RSS-247 Issue2</u>	Ambient Temperature:	<u>24.3°C</u>
Input Voltage:	<u>120V AC / 60Hz</u>	Relative Humidity:	<u>52.8%</u>
Pretest Verification w / Ambient Signals or BB Source:	<u>Yes</u>	Atmospheric Pressure:	<u>987.3 mbar</u>

Deviations, Additions, or Exclusions: Measurements appearing in parentheses (xxx) had an additional duty cycle correction factor applied (20log[duty cycle]) in order to arrive at the true average value due to the pulsed nature of the signal. See KDB558074D.01, Section 11, Question 3, Answer C.



8.8 Radiated Spurious Emissions (Antenna 2, Low Band Edge)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2372.992308	60.78	73.98	13.20	1000.000	356.0	H	0.0	38.6
2389.930769	57.65	73.98	16.33	1000.000	200.0	H	198.0	38.6

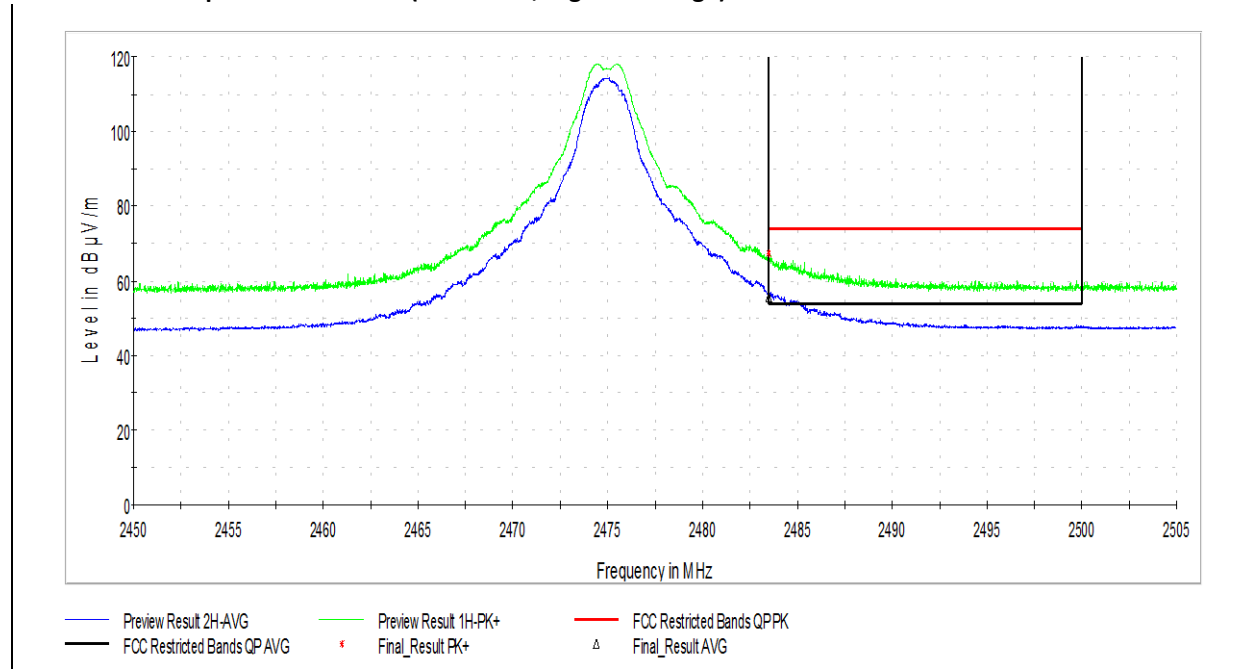
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2372.992308	(29.82) 52.94	53.98	24.16	1000.000	356.0	H	0.0	38.6
2389.930769	44.96	53.98	9.02	1000.000	200.0	H	198.0	38.6

Test Personnel:	<u>Bryan Taylor</u>	Test Date:	<u>1/17/2021</u>
Supervising/Reviewing Engineer:	<u>N/A</u>	Limit Applied:	<u>15.205 Restricted Bands</u>
(Where Applicable)	<u>FCC Part 15C, RSS-247</u>	Ambient Temperature:	<u>24.3°C</u>
Product Standard:	<u>Issue2</u>	Relative Humidity:	<u>52.8%</u>
Input Voltage:	<u>120VAC/60Hz</u>	Atmospheric Pressure:	<u>987.3 mbar</u>
Pretest Verification w / Ambient Signals or BB Source:	<u>Yes</u>		

Deviations, Additions, or Exclusions: Measurements appearing in parentheses (xxx) had an additional duty cycle correction factor applied (20log[duty cycle]) in order to arrive at the true average value due to the pulsed nature of the signal. See KDB558074D.01, Section 11, Question 3, Answer C.



8.9 Radiated Spurious Emissions (Antenna 2, High Band Edge)



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.507692	67.33	73.98	6.65	1000.000	306.0	H	9.0	39.2

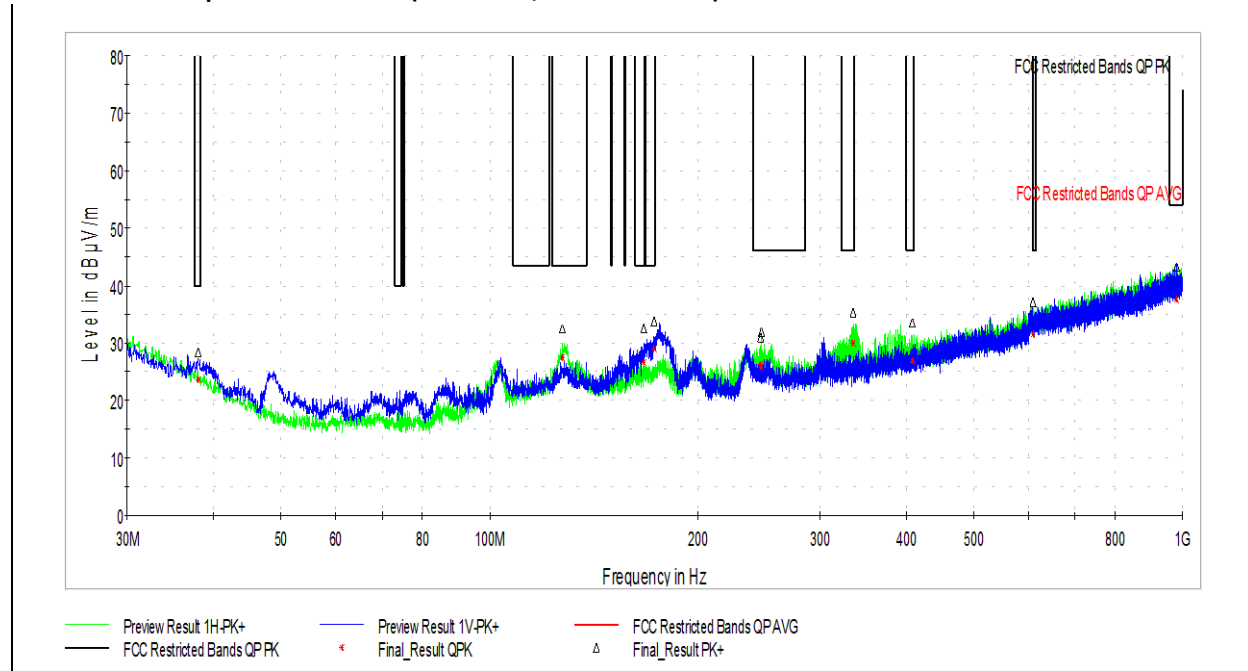
Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.507692	(32.54) 55.66	53.98	21.44	1000.000	306.0	H	9.0	39.2

Test Personnel:	<u>Bryan Taylor</u>	Test Date:	<u>1/17/2021</u>
Supervising/Reviewing Engineer:	<u>(Where Applicable) N/A</u>	Limit Applied:	<u>15.205 Restricted Bands</u>
Product Standard:	<u>FCC Part 15C, RSS-247</u>	Ambient Temperature:	<u>24.3°C</u>
Input Voltage:	<u>120V AC / 60Hz</u>	Relative Humidity:	<u>52.8%</u>
Pretest Verification w / Ambient Signals or BB Source:	<u>Yes</u>	Atmospheric Pressure:	<u>987.3 mbar</u>

Deviations, Additions, or Exclusions: Measurements appearing in parentheses (xxx) had an additional duty cycle correction factor applied (20log[duty cycle]) in order to arrive at the true average value due to the pulsed nature of the signal. See KDB558074D.01, Section 11, Question 3, Answer C.



8.10 Radiated Spurious Emissions (Antenna 1, 30MHz – 1 GHz)



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
37.975556	23.54	40.00	16.46	120.000	98.2	V	-1.0	21.7
127.323333	27.37	43.52	16.15	120.000	225.5	H	319.0	22.0
167.039445	26.69	43.52	16.83	120.000	102.0	V	198.0	21.5
172.805556	29.02	43.52	14.50	120.000	100.1	V	230.0	21.1
245.932778	26.25	46.02	19.77	120.000	99.9	H	0.0	21.4
247.064445	25.71	46.02	20.31	120.000	106.5	H	0.0	21.4
335.065000	30.06	46.02	15.96	120.000	101.3	H	341.0	24.8
407.491667	26.84	46.02	19.18	120.000	99.9	H	37.0	26.8
609.143889	31.64	46.02	14.38	120.000	177.5	H	228.0	31.6
980.815556	37.50	53.98	16.48	120.000	399.9	V	227.0	37.3

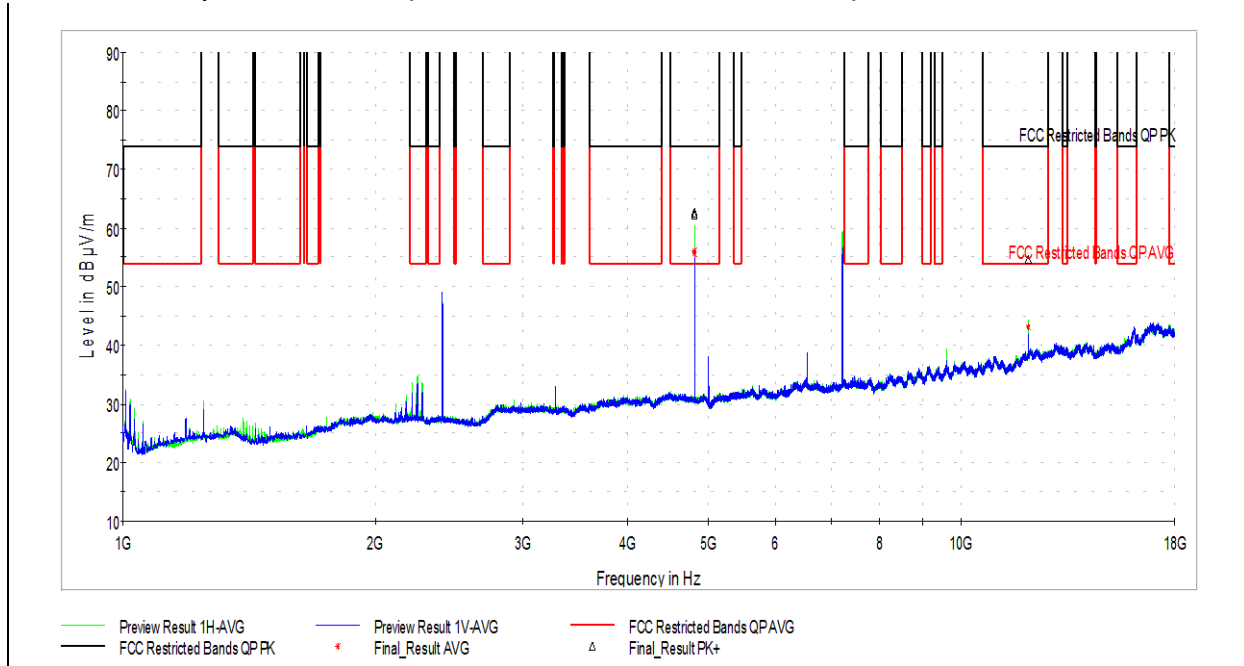
Test Personnel: Bryan Taylor
 Supervising/Reviewing Engineer: N/A
 (Where Applicable)
 Product Standard: FCC Part 15C, RSS-247 Issue2
 Input Voltage: 120V AC / 60Hz
 Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 1/6/2021
 Limit Applied: 15.205 Restricted Bands
 Ambient Temperature: 24.3°C
 Relative Humidity: 52.8%
 Atmospheric Pressure: 987.3 mbar

Deviations, Additions, or Exclusions: None



8.11 Radiated Spurious Emissions (Antenna 1, Low Channel, 1GHz – 18GHz)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4809.000000	62.62	73.98	11.36	1000.000	177.0	V	65.0	9.3
4811.000000	62.35	73.98	11.63	1000.000	271.0	H	46.0	9.4
12027.000000	54.67	73.98	19.31	1000.000	185.0	H	0.0	19.6

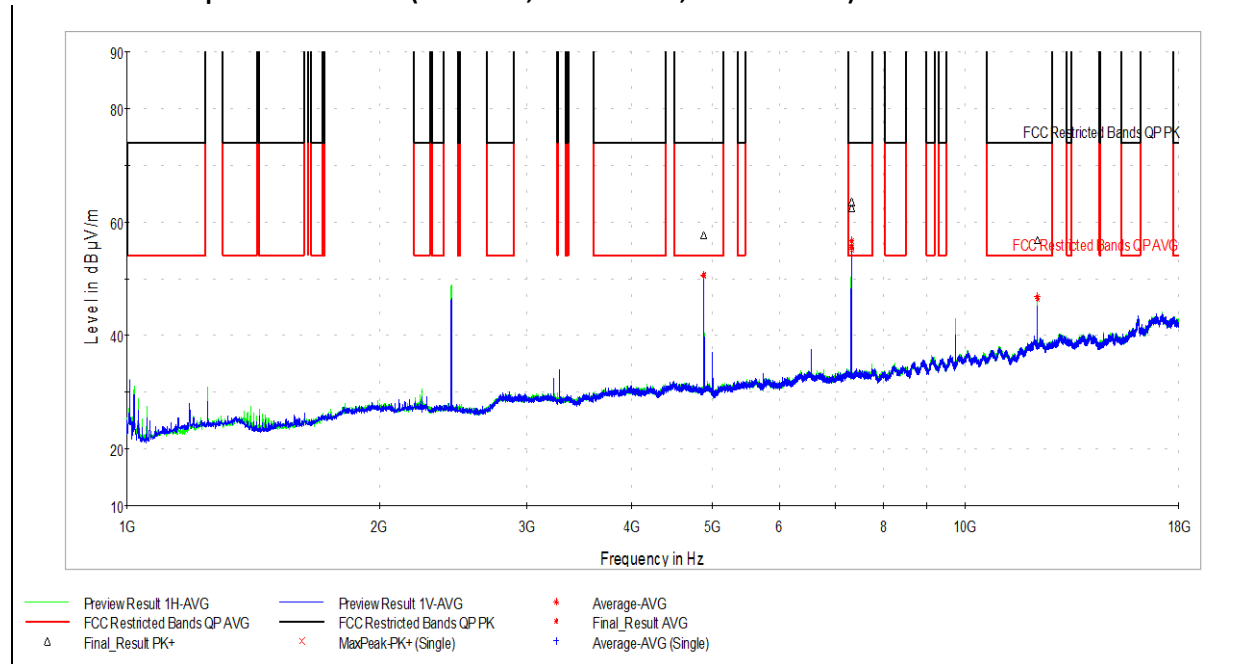
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4809.000000	(32.98) 56.10	53.98	21.00	1000.000	177.0	V	65.0	9.3
4811.000000	(22.67) 55.65	53.98	31.31	1000.000	271.0	H	46.0	9.4
12027.000000	43.11	53.98	10.87	1000.000	185.0	H	0.0	19.6

Test Personnel:	<u>Bryan Taylor</u>	Test Date:	<u>1/6/2021</u>
Supervising/Reviewing Engineer:	<u>N/A</u>	Limit Applied:	<u>15.205 Restricted Bands</u>
(Where Applicable)	<u>FCC Part 15C, RSS-247</u>	Ambient Temperature:	<u>24.3°C</u>
Product Standard:	<u>Issue2</u>	Relative Humidity:	<u>52.8%</u>
Input Voltage:	<u>120V AC / 60Hz</u>	Atmospheric Pressure:	<u>987.3 mbar</u>
Pretest Verification w / Ambient Signals or BB Source:	<u>Yes</u>		

Deviations, Additions, or Exclusions: Measurements appearing in parentheses (xxx) had an additional duty cycle correction factor applied (20log[duty cycle]) in order to arrive at the true average value due to the pulsed nature of the signal. See KDB558074D.01, Section 11, Question 3, Answer C.



8.12 Radiated Spurious Emissions (Antenna1, Mid Channel, 1GHz – 18GHz)



Frequency (MHz)	Max Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4879	57.63	73.98	16.35	1000	147	H	48	9.9
12197	56.74	73.98	17.24	1000	205	H	0	19.7
7318.5	62.57	73.98	11.41	1000	324	H	18	13.3
7321.5	63.65	73.98	10.33	1000	186	H	109	13.4

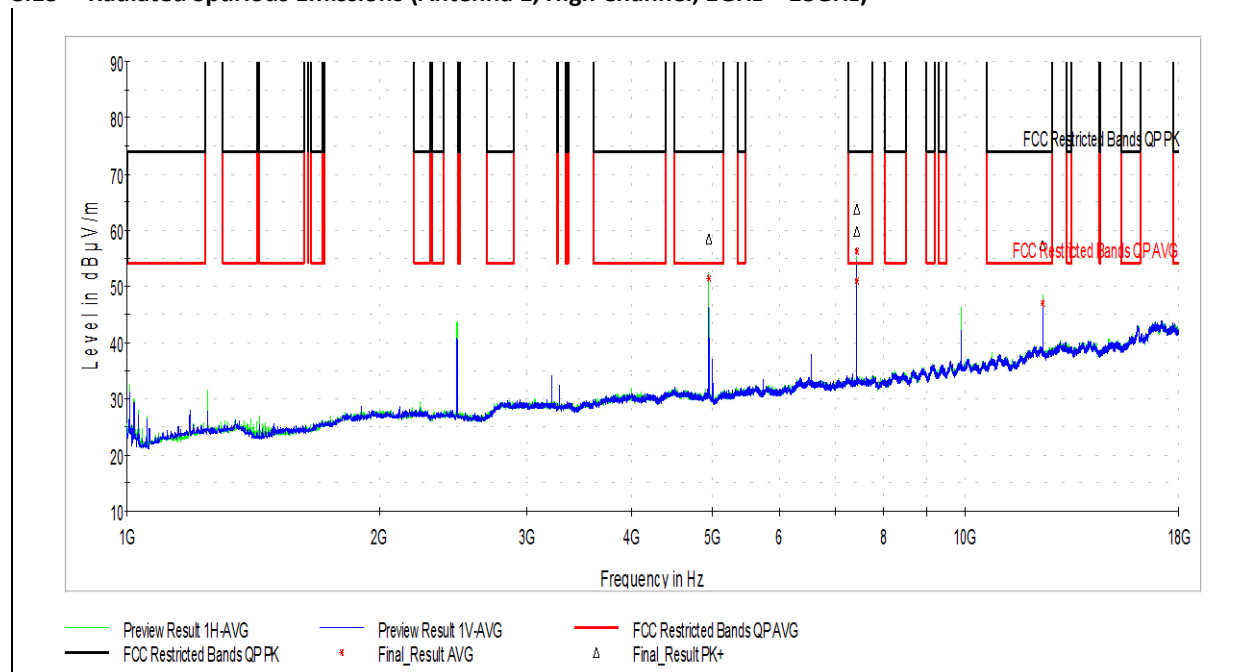
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4879	50.38	53.98	3.6	1000	147	H	48	9.9
12197	46.39	53.98	7.59	1000	205	H	0	19.7
7318.5	(31.92) 55.05	53.98	21.06	1000	324	H	18	13.3
7321.5	(32.38) 55.5	53.98	21.60	1000	186	H	109	13.4

Test Personnel:	<u>Bryan Taylor</u>	Test Date:	<u>1/6/2021</u>
Supervising/Reviewing Engineer:	<u>N/A</u>	Limit Applied:	<u>15.205 Restricted Bands</u>
(Where Applicable)	<u>FCC Part 15C, RSS-247</u>	Ambient Temperature:	<u>24.3°C</u>
Product Standard:	<u>Issue2</u>	Relative Humidity:	<u>52.8%</u>
Input Voltage:	<u>120V AC / 60Hz</u>	Atmospheric Pressure:	<u>987.3 mbar</u>
Pretest Verification w / Ambient Signals or BB Source:	<u>Yes</u>		

Deviations, Additions, or Exclusions: Measurements appearing in parentheses (xxx) had an additional duty cycle correction factor applied (20log[duty cycle]) in order to arrive at the true average value due to the pulsed nature of the signal. See KDB558074D.01, Section 11, Question 3, Answer C.



8.13 Radiated Spurious Emissions (Antenna 1, High Channel, 1GHz – 18GHz)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4949.000000	58.47	73.98	15.51	1000.000	224.0	H	252.0	10.1
7423.500000	59.70	73.98	14.28	1000.000	269.0	H	294.0	13.2
7426.500000	63.81	73.98	10.17	1000.000	272.0	V	67.0	13.1
12377.500000	57.31	73.98	16.67	1000.000	211.0	H	228.0	20.6

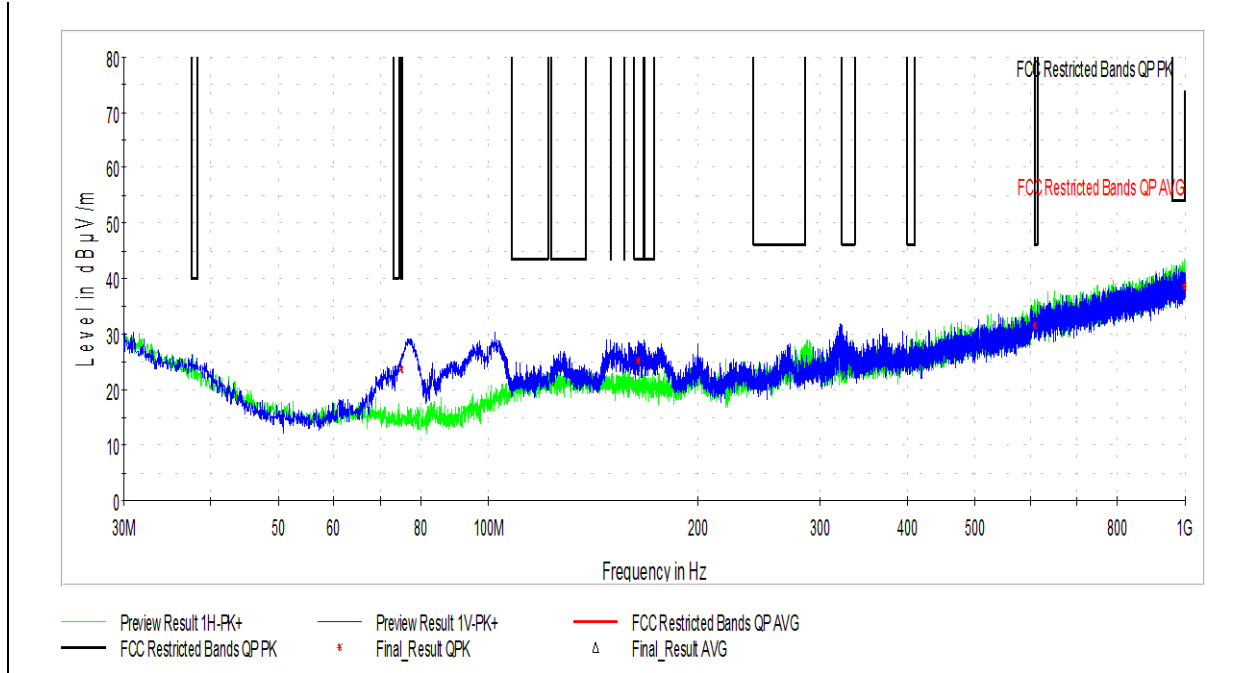
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4949.000000	51.43	53.98	2.55	1000.000	224.0	H	252.0	10.1
7423.500000	50.92	53.98	3.06	1000.000	269.0	H	294.0	13.2
7426.500000	(33.26) 56.38	53.98	20.72	1000.000	272.0	V	67.0	13.1
12377.500000	47.04	53.98	6.94	1000.000	211.0	H	228.0	20.6

Test Personnel:	Bryan Taylor	Test Date:	1/6/2021
Supervising/Reviewing Engineer:	(Where Applicable) N/A	Limit Applied:	15.205 Restricted Bands
Product Standard:	FCC Part 15C, RSS-247 Issue2	Ambient Temperature:	24.3°C
Input Voltage:	120V AC / 60Hz	Relative Humidity:	52.8%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	987.3 mbar

Deviations, Additions, or Exclusions: Measurements appearing in parentheses (xxx) had an additional duty cycle correction factor applied (20log[duty cycle]) in order to arrive at the true average value due to the pulsed nature of the signal. See KDB558074D.01, Section 11, Question 3, Answer C.



8.14 Radiated Spurious Emissions (Antenna 2, 30MHz – 1 GHz)



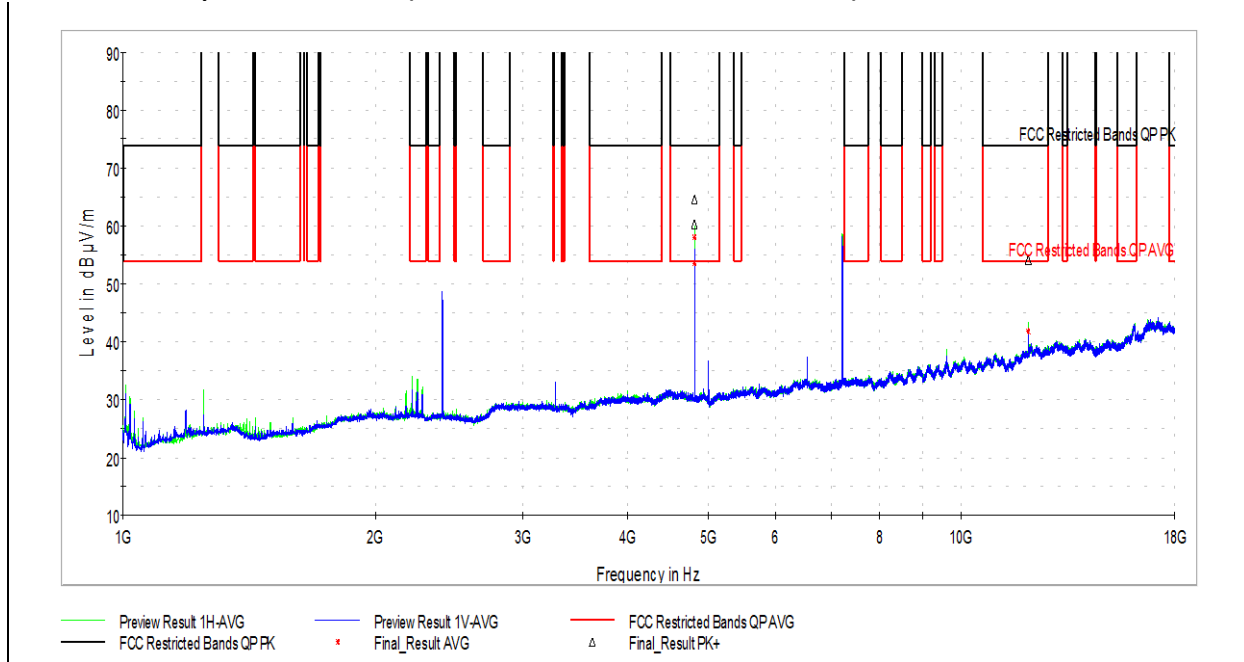
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
75.051111	23.60	40.00	16.40	120.000	104.5	V	59.0	14.9
164.237222	25.27	43.52	18.25	120.000	99.5	V	336.0	21.6
609.036111	31.67	46.02	14.35	120.000	100.0	H	7.0	31.6
997.467222	38.55	53.98	15.43	120.000	130.7	H	91.0	38.4

Test Personnel:	<u>Bryan Taylor</u>	Test Date:	<u>1/5/2021</u>
Supervising/Reviewing Engineer:	<u>N/A</u>	Limit Applied:	<u>15.205 Restricted Bands</u>
(Where Applicable)	<u>FCC Part 15C, RSS-247</u>	Ambient Temperature:	<u>24.3°C</u>
Product Standard:	<u>Issue2</u>	Relative Humidity:	<u>52.8%</u>
Input Voltage:	<u>120V AC / 60Hz</u>	Atmospheric Pressure:	<u>987.3 mbar</u>
Pretest Verification w / Ambient Signals or BB Source:	<u>Yes</u>		

Deviations, Additions, or Exclusions: None



8.15 Radiated Spurious Emissions (Antenna 2, Low Channel, 1GHz – 18GHz)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4809.000000	60.31	73.98	13.67	1000.000	315.0	H	43.0	9.4
4811.000000	64.67	73.98	9.31	1000.000	252.0	H	0.0	9.4
12027.500000	54.04	73.98	19.94	1000.000	288.0	H	0.0	19.6

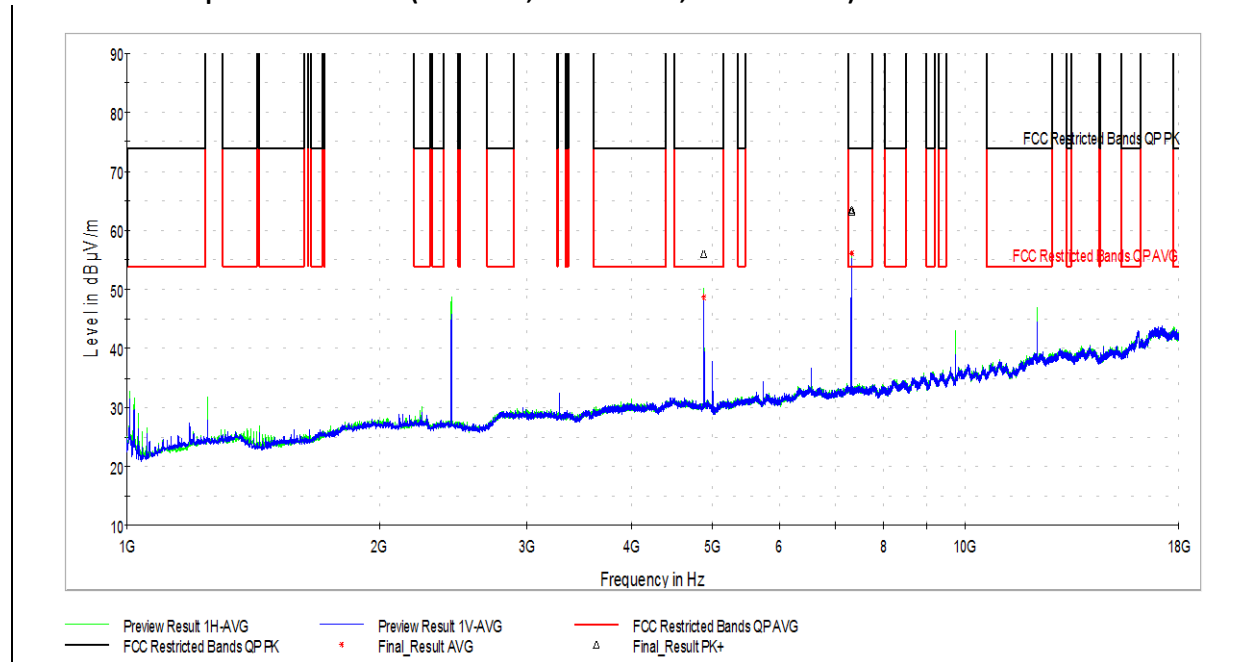
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4809.000000	53.62	53.98	0.36	1000.000	315.0	H	43.0	9.4
4811.000000	(34.91) 58.03	53.98	23.12	1000.000	252.0	H	0.0	9.4
12027.500000	41.81	53.98	12.17	1000.000	288.0	H	0.0	19.6

Test Personnel:	Bryan Taylor	Test Date:	1/5/2021
Supervising/Reviewing Engineer:	(Where Applicable) N/A	Limit Applied:	15.205 Restricted Bands
Product Standard:	Issue2	Ambient Temperature:	24.3°C
Input Voltage:	120V AC / 60Hz	Relative Humidity:	52.8%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	987.3 mbar

Deviations, Additions, or Exclusions: Measurements appearing in parentheses (xxx) had an additional duty cycle correction factor applied (20log[duty cycle]) in order to arrive at the true average value due to the pulsed nature of the signal. See KDB558074D.01, Section 11, Question 3, Answer C.



8.16 Radiated Spurious Emissions (Antenna2, Mid Channel, 1GHz – 18GHz)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4879.000000	56.17	73.98	17.81	1000.000	262.0	H	236.0	9.9
7318.500000	63.28	73.98	10.70	1000.000	297.0	H	300.0	13.3
7321.500000	63.54	73.98	10.44	1000.000	295.0	H	302.0	13.4

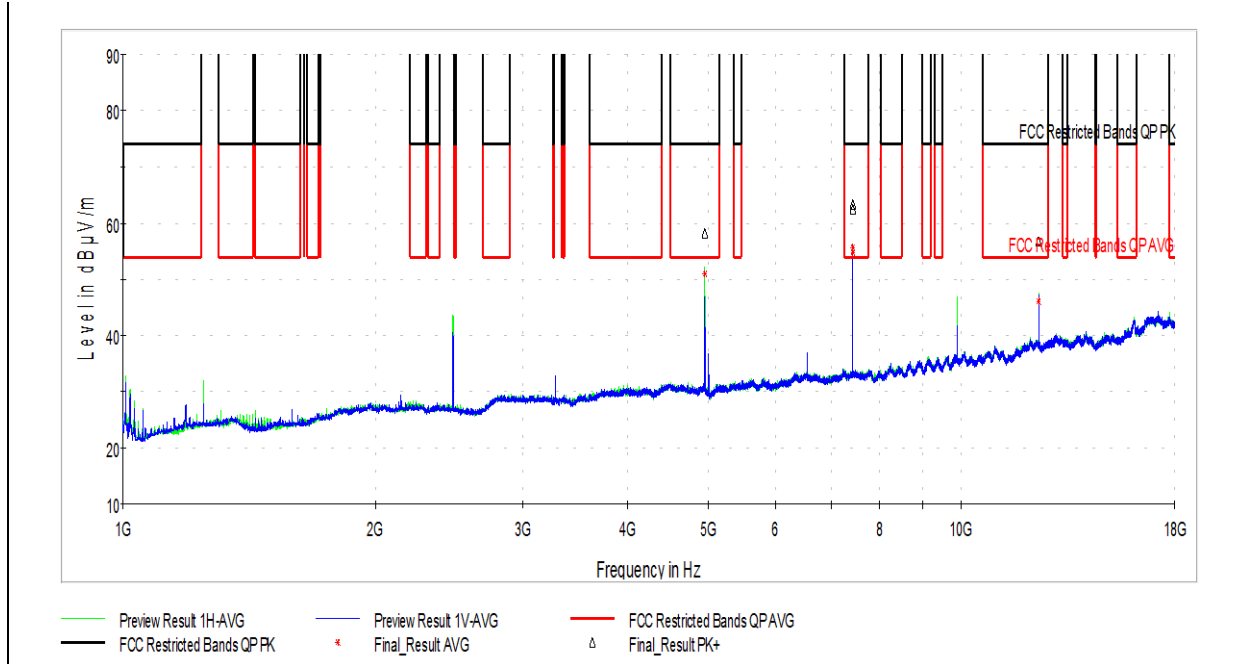
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4879.000000	48.71	53.98	5.27	1000.000	262.0	H	236.0	9.9
7318.500000	(32.93) 56.05	53.98	21.05	1000.000	297.0	H	300.0	13.3
7321.500000	(32.92) 56.04	53.98	21.06	1000.000	295.0	H	302.0	13.4

Test Personnel:	<u>Bryan Taylor</u>	Test Date:	<u>1/6/2021</u>
Supervising/Reviewing Engineer:	<u>N/A</u>	Limit Applied:	<u>15.205 Restricted Bands</u>
(Where Applicable)	<u>FCC Part 15C, RSS-247</u>	Ambient Temperature:	<u>24.3°C</u>
Product Standard:	<u>Issue2</u>	Relative Humidity:	<u>52.8%</u>
Input Voltage:	<u>120V AC / 60Hz</u>	Atmospheric Pressure:	<u>987.3 mbar</u>
Pretest Verification w / Ambient Signals or BB Source:	<u>Yes</u>		

Deviations, Additions, or Exclusions: Measurements appearing in parentheses (xxx) had an additional duty cycle correction factor applied (20log[duty cycle]) in order to arrive at the true average value due to the pulsed nature of the signal. See KDB558074D.01, Section 11, Question 3, Answer C.



8.17 Radiated Spurious Emissions (Antenna 2, High Channel, 1GHz – 18GHz)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4951.000000	58.12	73.98	15.86	1000.000	234.0	H	250.0	10.1
7423.500000	63.36	73.98	10.62	1000.000	255.0	V	68.0	13.1
7426.500000	62.53	73.98	11.45	1000.000	263.0	V	60.0	13.1
12372.000000	56.76	73.98	17.22	1000.000	281.0	H	0.0	20.6

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4951.000000	50.96	53.98	3.02	1000.000	234.0	H	250.0	10.1
7423.500000	(32.47) 55.59	53.98	21.51	1000.000	255.0	V	68.0	13.1
7426.500000	(31.71) 54.83	53.98	22.27	1000.000	263.0	V	60.0	13.1
12372.000000	46.06	53.98	7.92	1000.000	281.0	H	0.0	20.6

Test Personnel:	<u>Bryan Taylor</u>	Test Date:	<u>1/6/2021</u>
Supervising/Reviewing Engineer:	<u>N/A</u>	Limit Applied:	<u>15.205 Restricted Bands</u>
(Where Applicable)	<u>FCC Part 15C, RSS-247</u>	Ambient Temperature:	<u>24.3°C</u>
Product Standard:	<u>Issue2</u>	Relative Humidity:	<u>52.8%</u>
Input Voltage:	<u>120V AC / 60Hz</u>	Atmospheric Pressure:	<u>987.3 mbar</u>
Pretest Verification w / Ambient Signals or BB Source:	<u>Yes</u>		

Deviations, Additions, or Exclusions: Measurements appearing in parentheses (xxx) had an additional duty cycle correction factor applied (20log[duty cycle]) in order to arrive at the true average value due to the pulsed nature of the signal. See KDB558074D.01, Section 11, Question 3, Answer C.



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).

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.



9.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.9.1.3 (PKPM1) and 11.9.2.3.1 (AVGPM)

9.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
Wideband RF Power Meter	4022	Rohde & Schwarz	NRP-Z81	9/22/2020	9/22/2021

9.4 Test Results

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

9.5 Test Conditions

Test Personnel:	<u>Bryan Taylor</u>	Test Date:	<u>12/23/2020</u>
Supervising/Reviewing Engineer: (Where Applicable)	<u>NA</u>	Limit Applied:	<u>See Above</u>
	<u>FCC Part 15.247</u>	Ambient Temperature:	<u>22.2C</u>
Product Standard:	<u>RSS-247 Issue 2</u>	Relative Humidity:	<u>40.5%</u>
Input Voltage:	<u>120VAC / 60Hz</u>	Atmospheric Pressure:	<u>990.2mbar</u>
Pretest Verification w / Ambient Signals or BB Source:	<u>Yes</u>		

Deviations, Additions, or Exclusions: None

**9.6 Test Data (Peak Power, Antenna Path 1)**

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
11	2405	21.99	30	8.01	PASS
19	2445	21.91	30	8.09	PASS
25	2475	21.77	30	8.23	PASS

Note: Testing was performed with 100% Duty Cycle

9.7 Test Data (Average Power, Antenna Path 1)

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
11	2405	21.93	30	8.07	PASS
19	2445	21.85	30	8.15	PASS
25	2475	21.71	30	8.29	PASS

Note: Testing was performed with 100% Duty Cycle

9.8 Test Data (Peak Power, Antenna Path 2)

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
11	2405	21.98	30	8.02	PASS
19	2445	21.91	30	8.09	PASS
25	2475	21.78	30	8.22	PASS

Note: Testing was performed with 100% Duty Cycle

9.9 Test Data (Average Power, Antenna Path 2)

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
11	2405	21.92	30	8.08	PASS
19	2445	21.86	30	8.14	PASS
25	2475	21.72	30	8.28	PASS

Note: Testing was performed with 100% Duty Cycle



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 § 11.8.1, 6.9.2, and 6.9.3

10.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3720	Rohde & Schwarz	FSEK30	10/13/2020	10/13/2021

10.4 Test Results

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

10.5 Test Conditions

Test Personnel:	<u>Bryan Taylor</u>	Test Date:	<u>12/23/2020</u>
Supervising/Reviewing Engineer:	<u>NA</u>	Limit Applied:	<u>See Above</u>
(Where Applicable)	<u>FCC Part 15.247</u>	Ambient Temperature:	<u>22.2C</u>
Product Standard:	<u>RSS-247 Issue 2</u>	Relative Humidity:	<u>40.5%</u>
Input Voltage:	<u>120VAC / 60Hz</u>	Atmospheric Pressure:	<u>990.2mbar</u>
Pretest Verification w / Ambient Signals or BB Source:	<u>Yes</u>		

Deviations, Additions, or Exclusions: None



10.6 Test Data (Antenna Path 1)

Channel	Frequency (MHz)	DTS BW (kHz)	6dB BW (kHz)	99% BW (kHz)
11	2405	1603	1533	2384
19	2445	1663	1823	2464
25	2475	1683	1873	2505

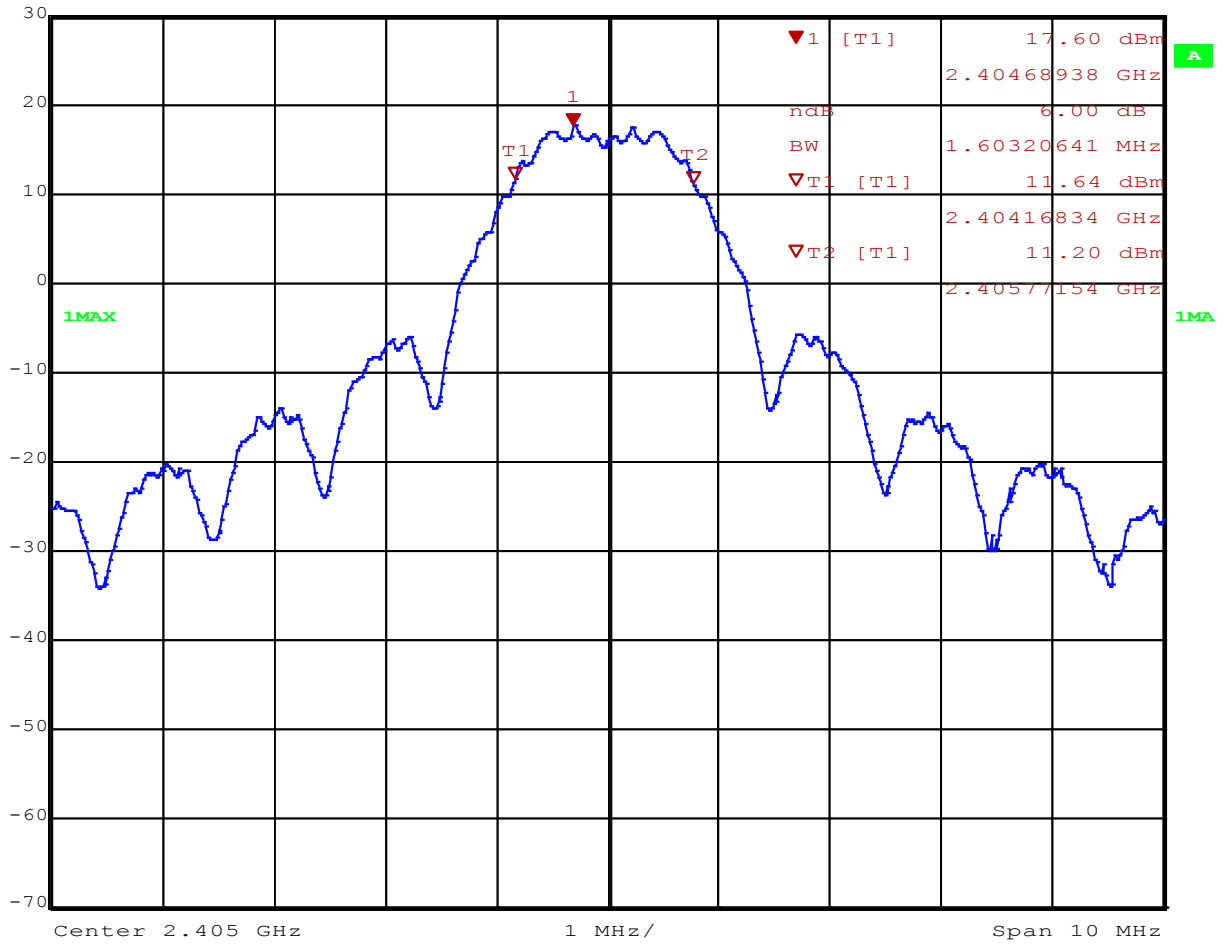
10.7 Test Data (Antenna Path 2)

Channel	Frequency (MHz)	DTS BW (kHz)	6dB BW (kHz)	99% BW (kHz)
11	2405	1603	1553	2384
19	2445	1643	1833	2464
25	2475	1683	1863	2505



10.8 DTS Bandwidth Plots (Antenna Path 1)

	Marker 1 [T1 ndB]	RBW	100 kHz	RF Att	40 dB
Ref Lvl	ndB	6.00 dB	VBW	300 kHz	
30 dBm	BW	1.60320641 MHz	SWT	100 ms	Unit dBm

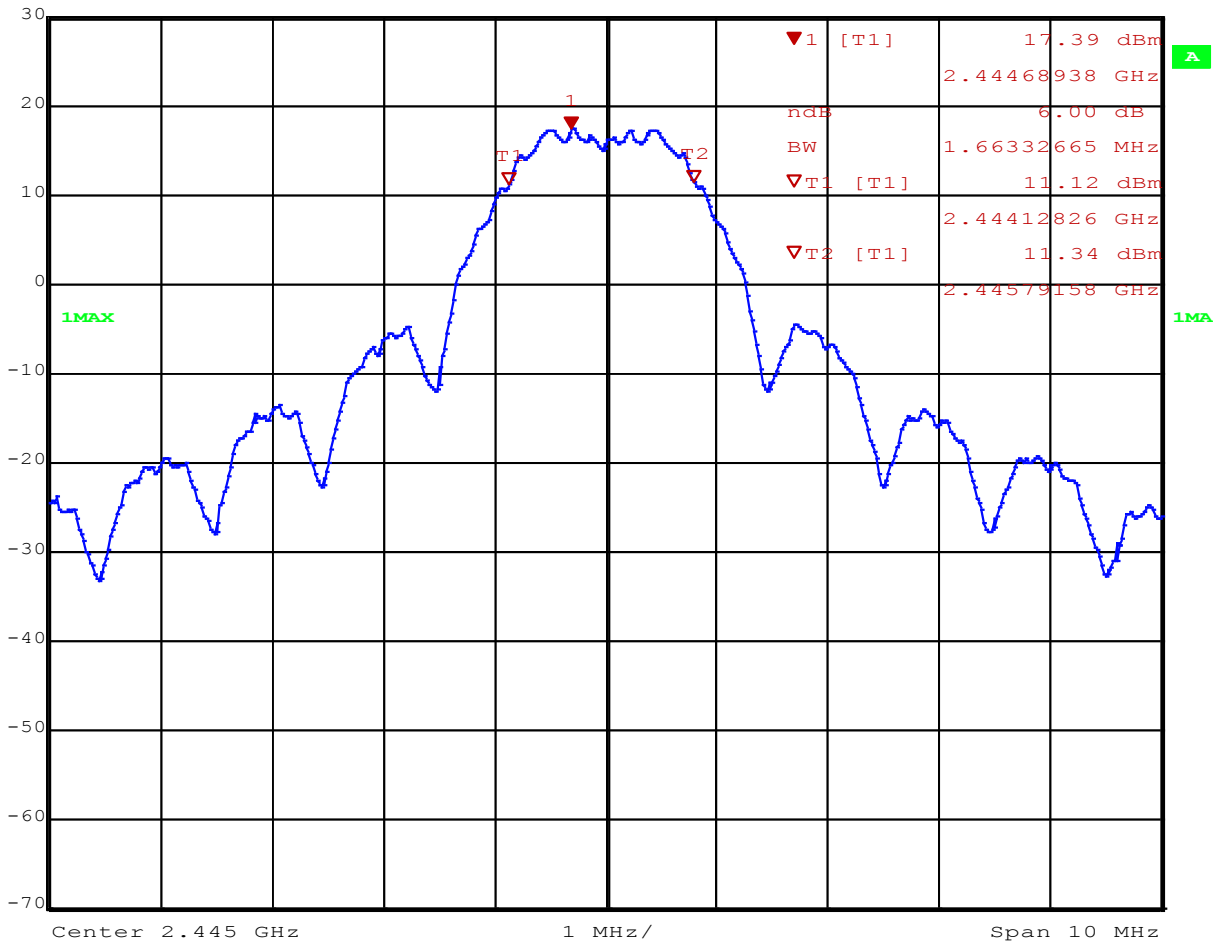


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DTS Bandwidth Channel 11, Antenna 1



Ref Lvl	Marker 1 [T1 ndB]	RBW	100 kHz	RF Att	40 dB
30 dBm	ndB	6.00 dB	VBW	300 kHz	
	BW	1.66332665 MHz	SWT	100 ms	Unit dBm

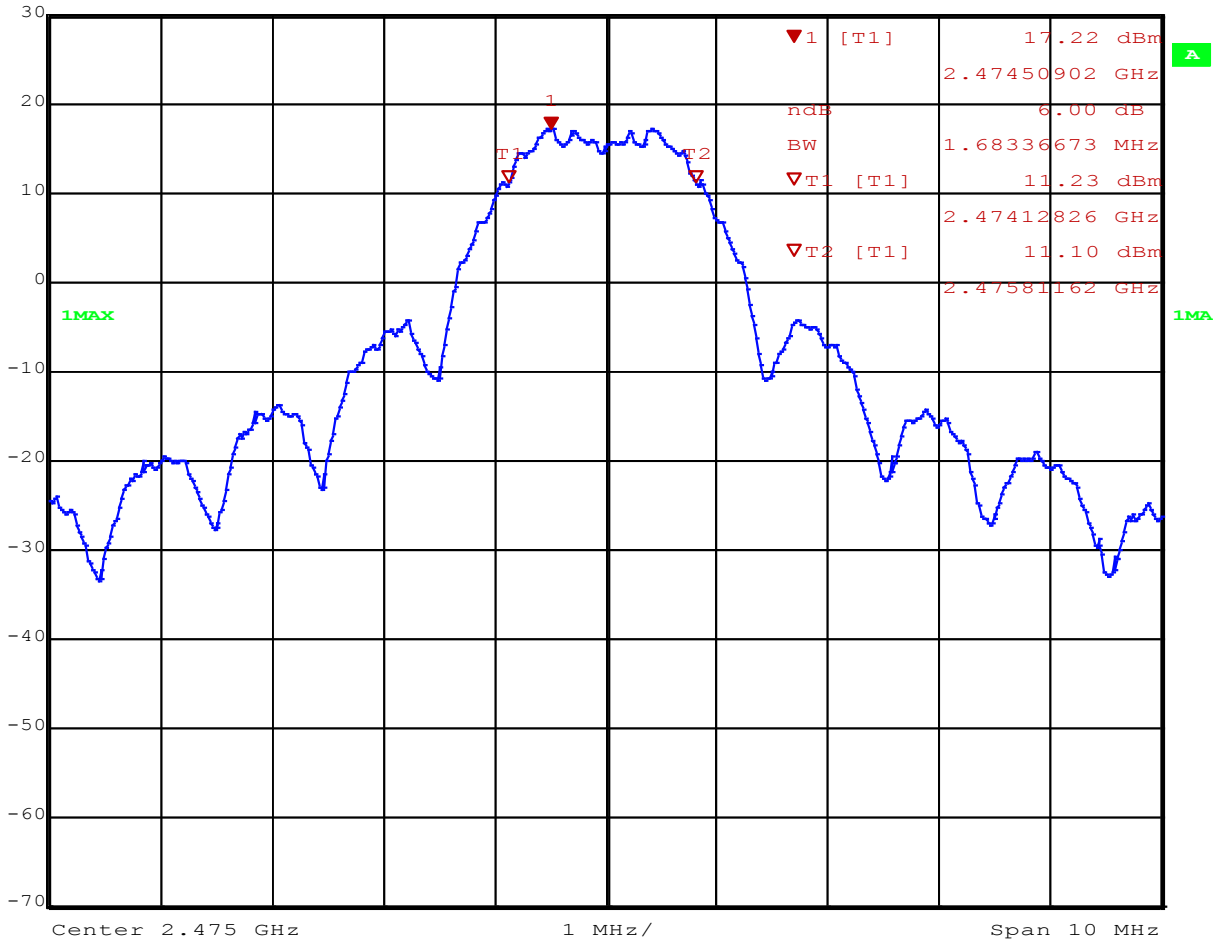


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DTS Bandwidth Channel 19, Antenna 1



Ref Lvl	Marker 1 [T1 ndB]	RBW	100 kHz	RF Att	40 dB
30 dBm	ndB	6.00 dB	VBW	300 kHz	
	BW	1.68336673 MHz	SWT	100 ms	Unit dBm



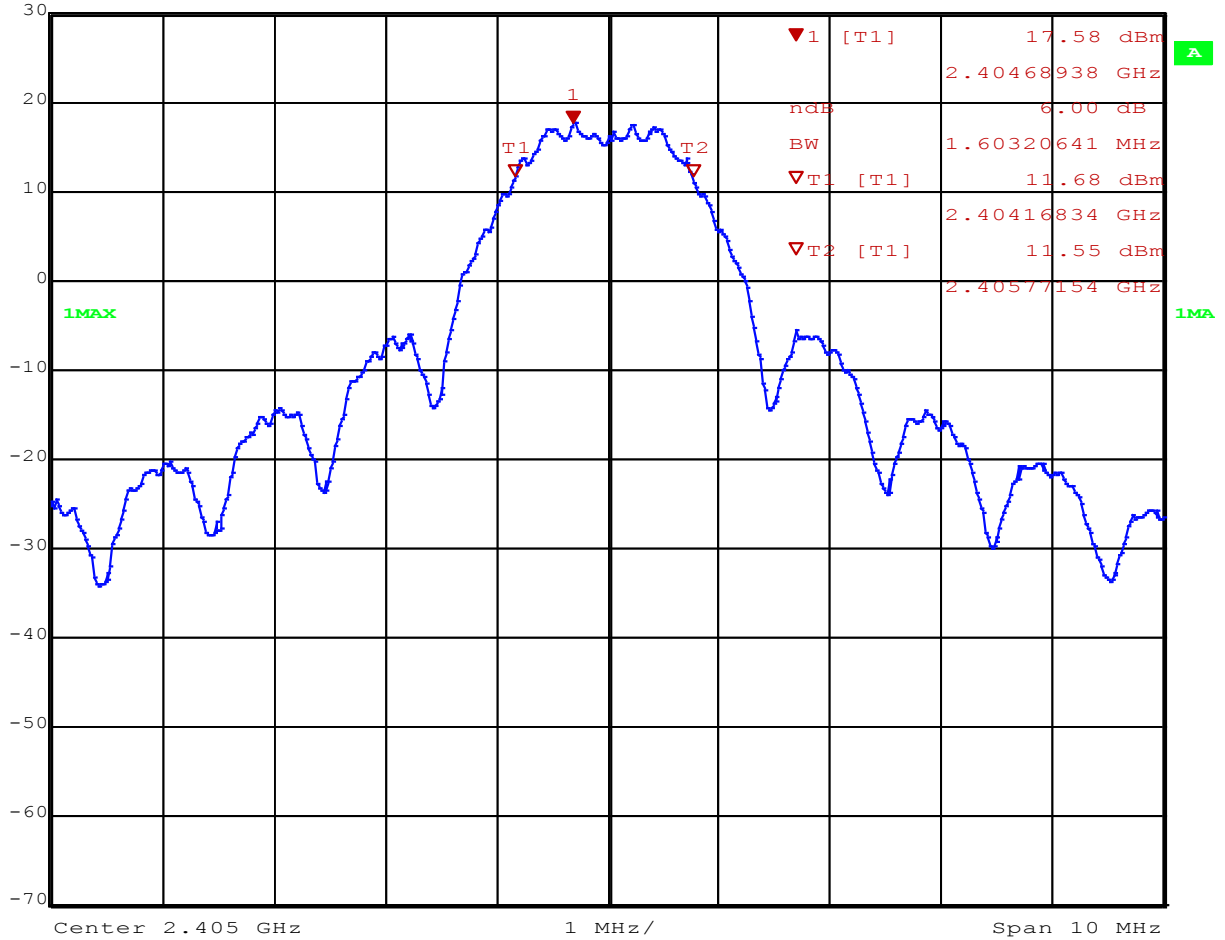
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DTS Bandwidth Channel 25, Antenna 1



10.9 DTS Bandwidth Plots (Antenna Path 2)

	Marker 1 [T1 ndB]	RBW	100 kHz	RF Att	40 dB
Ref Lvl	ndB	6.00 dB	VBW	300 kHz	
30 dBm	BW	1.60320641 MHz	SWT	100 ms	Unit dBm

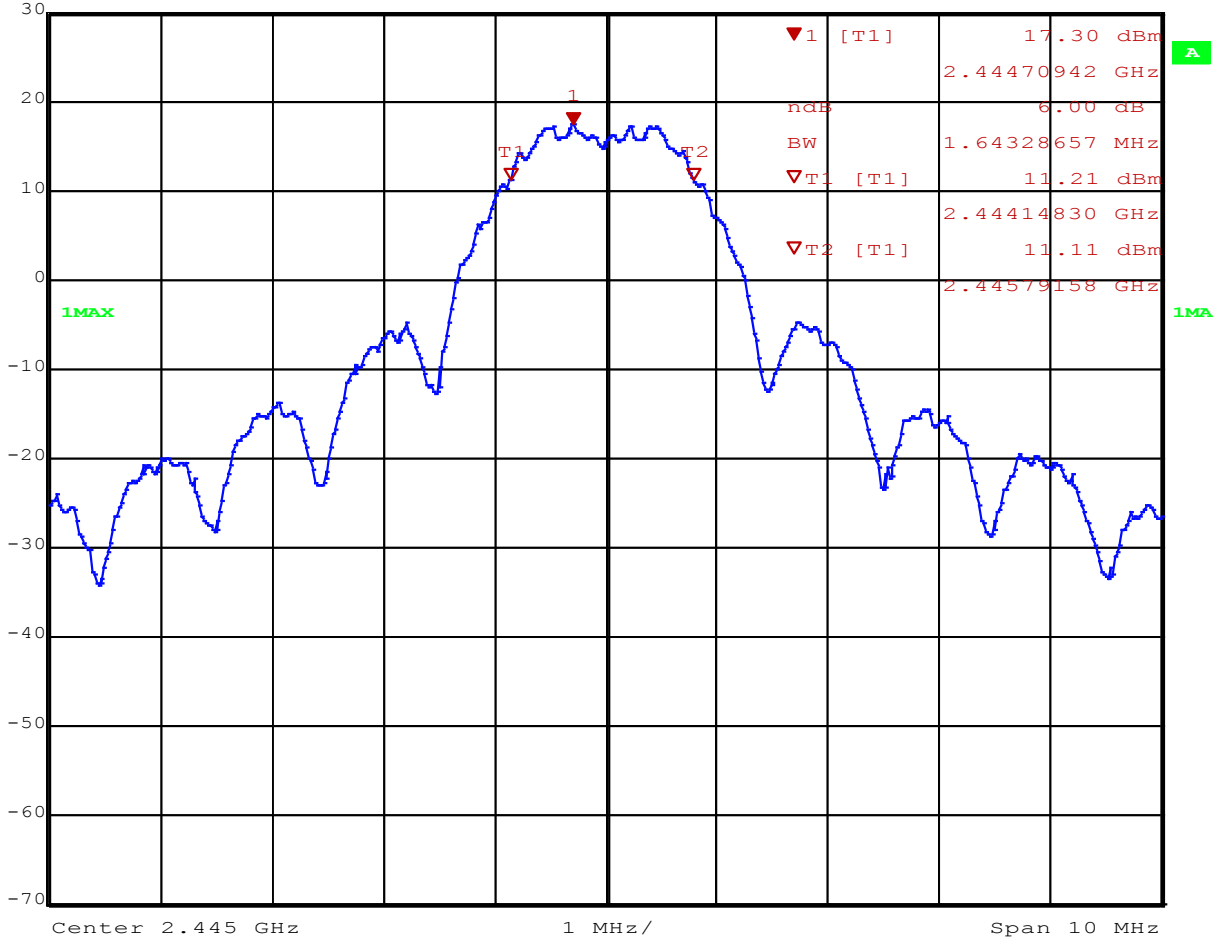


Date: 23.DEC.2020 08:51:09

DTS Bandwidth Channel 11, Antenna 2



Ref Lvl	30 dBm	Marker 1 [T1 ndB]	ndB	6.00 dB	RBW	100 kHz	RF Att	40 dB
		BW	1.64328657 MHz		VBW	300 kHz		
					SWT	100 ms	Unit	dBm

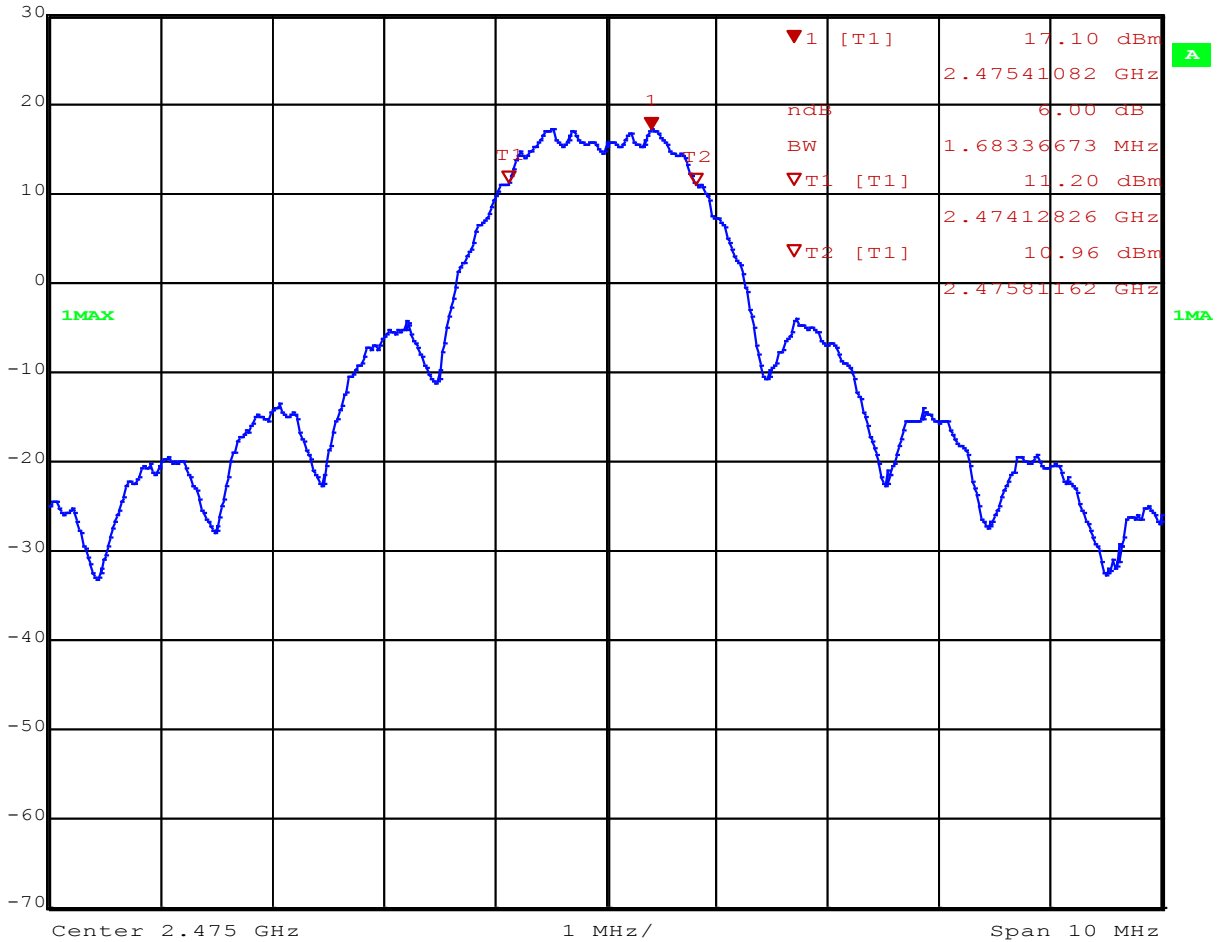


Date: 23.DEC.2020 08:51:49

DTS Bandwidth Channel 19, Antenna 2



Ref Lvl	Marker 1 [T1 ndB]	RBW	100 kHz	RF Att	40 dB
30 dBm	ndB	6.00 dB	VBW	300 kHz	
	BW	1.68336673 MHz	SWT	100 ms	Unit dBm

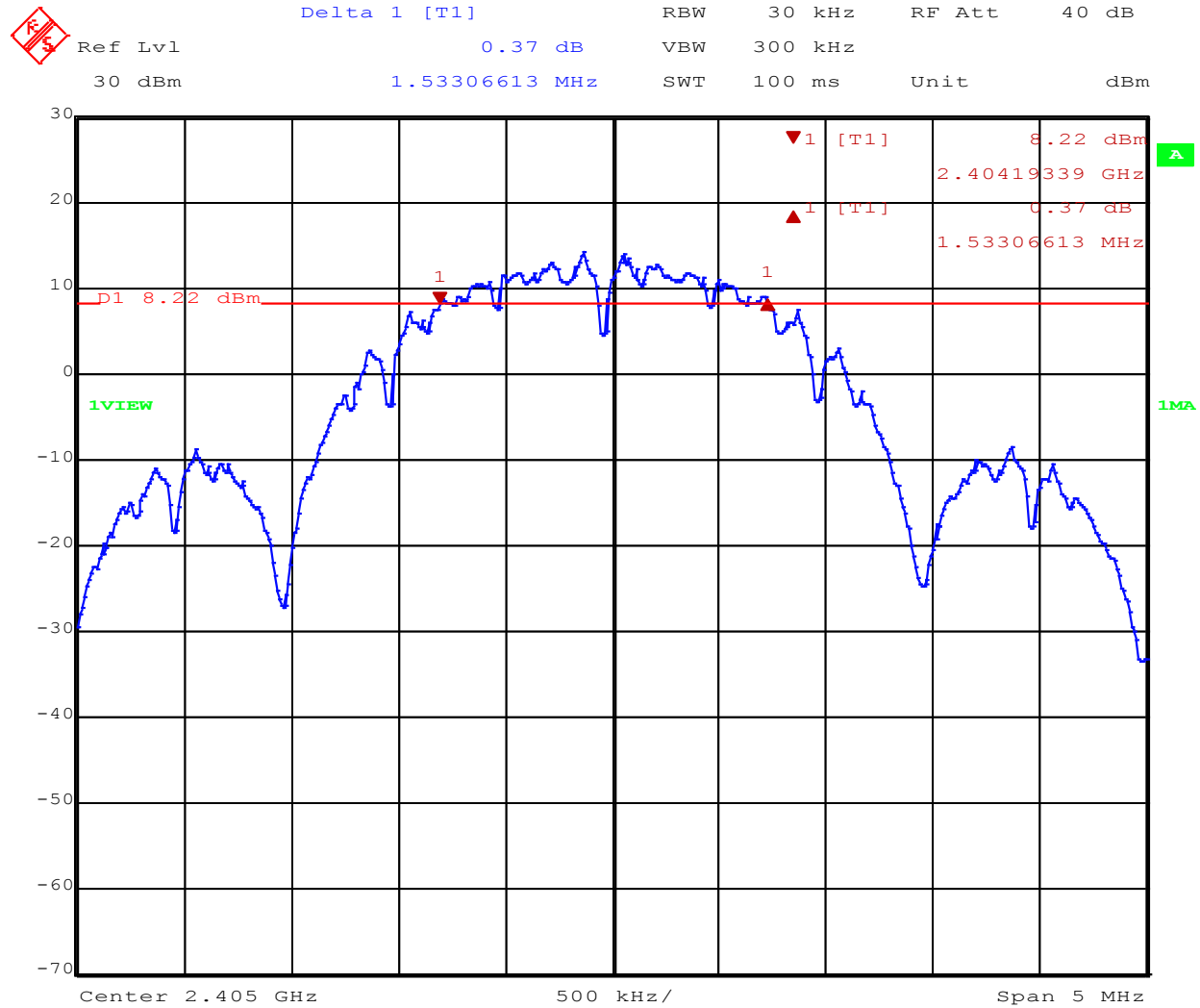


Date: 23.DEC.2020 08:52:28

DTS Bandwidth Channel 25, Antenna 2



10.10 6dB Bandwidth Plots (Antenna Path 1)

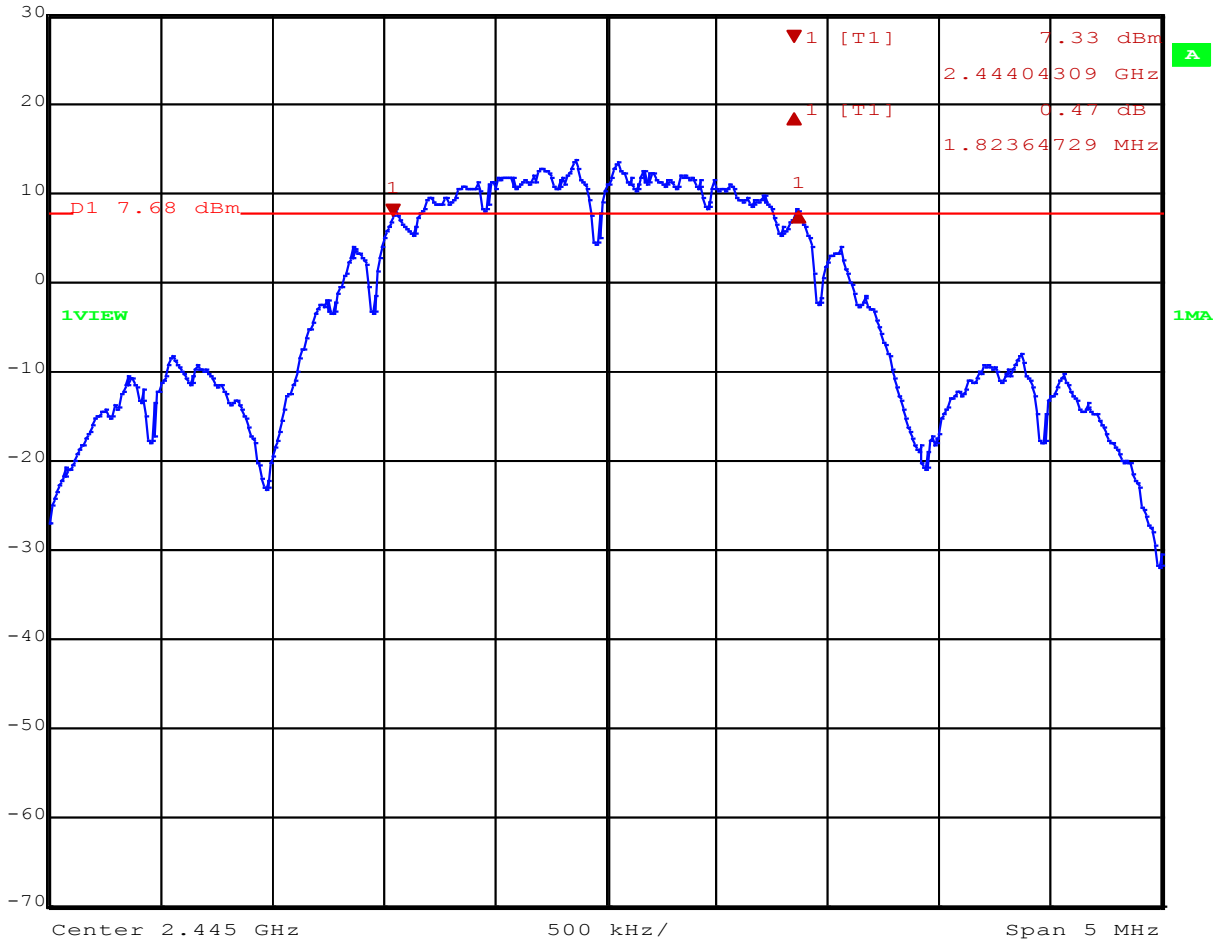


Date: 23.DEC.2020 08:57:54

6dB Bandwidth Channel 11, Antenna 1



Ref Lvl	Delta 1 [T1]	RBW	30 kHz	RF Att	40 dB
30 dBm	0.47 dB	VBW	300 kHz		
	1.82364729 MHz	SWT	100 ms	Unit	dBm

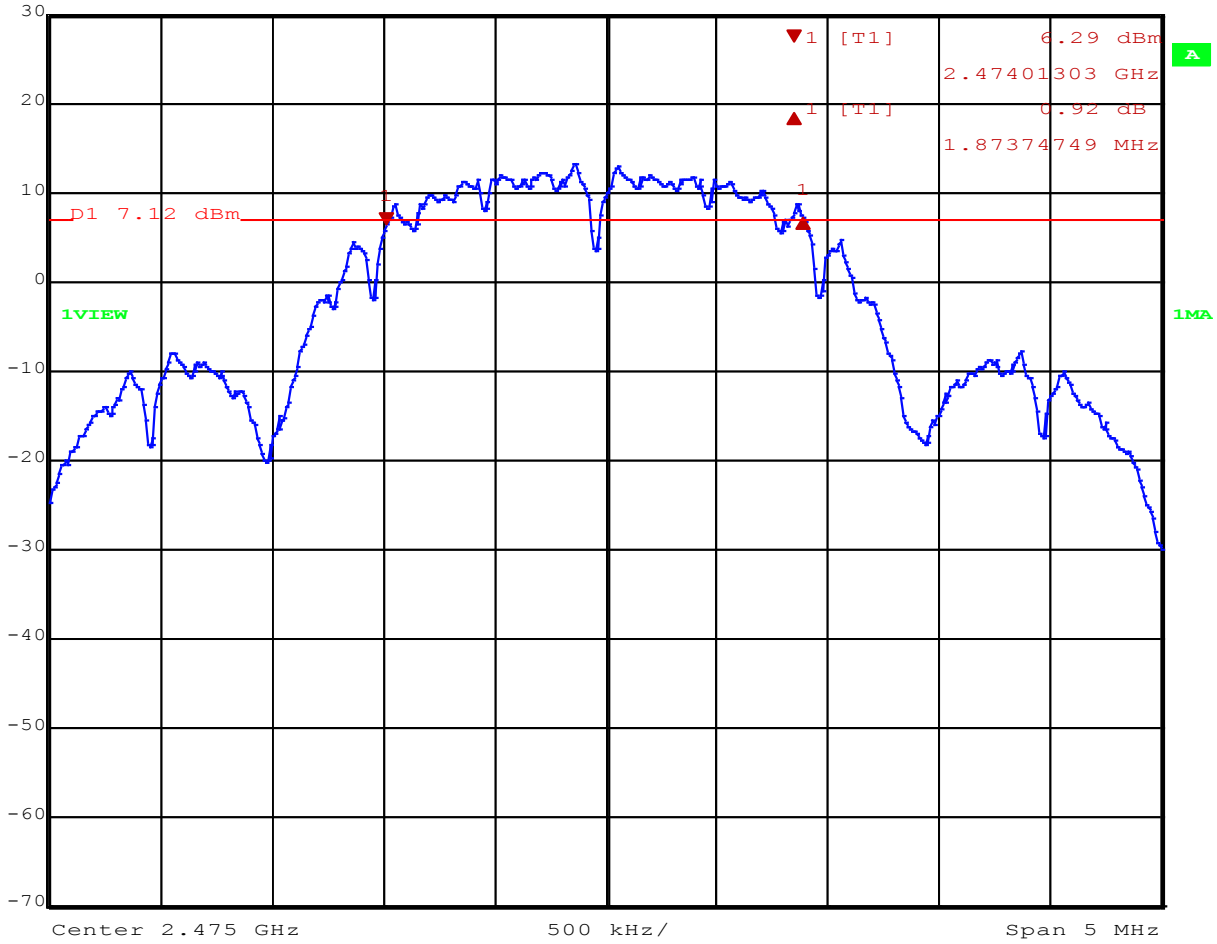


Date: 23.DEC.2020 08:59:37

6dB Bandwidth Channel 19, Antenna 1



	Delta 1 [T1]	RBW	30 kHz	RF Att	40 dB
	Ref Lvl	0.92 dB	VBW	300 kHz	
	30 dBm	1.87374749 MHz	SWT	100 ms	Unit dBm



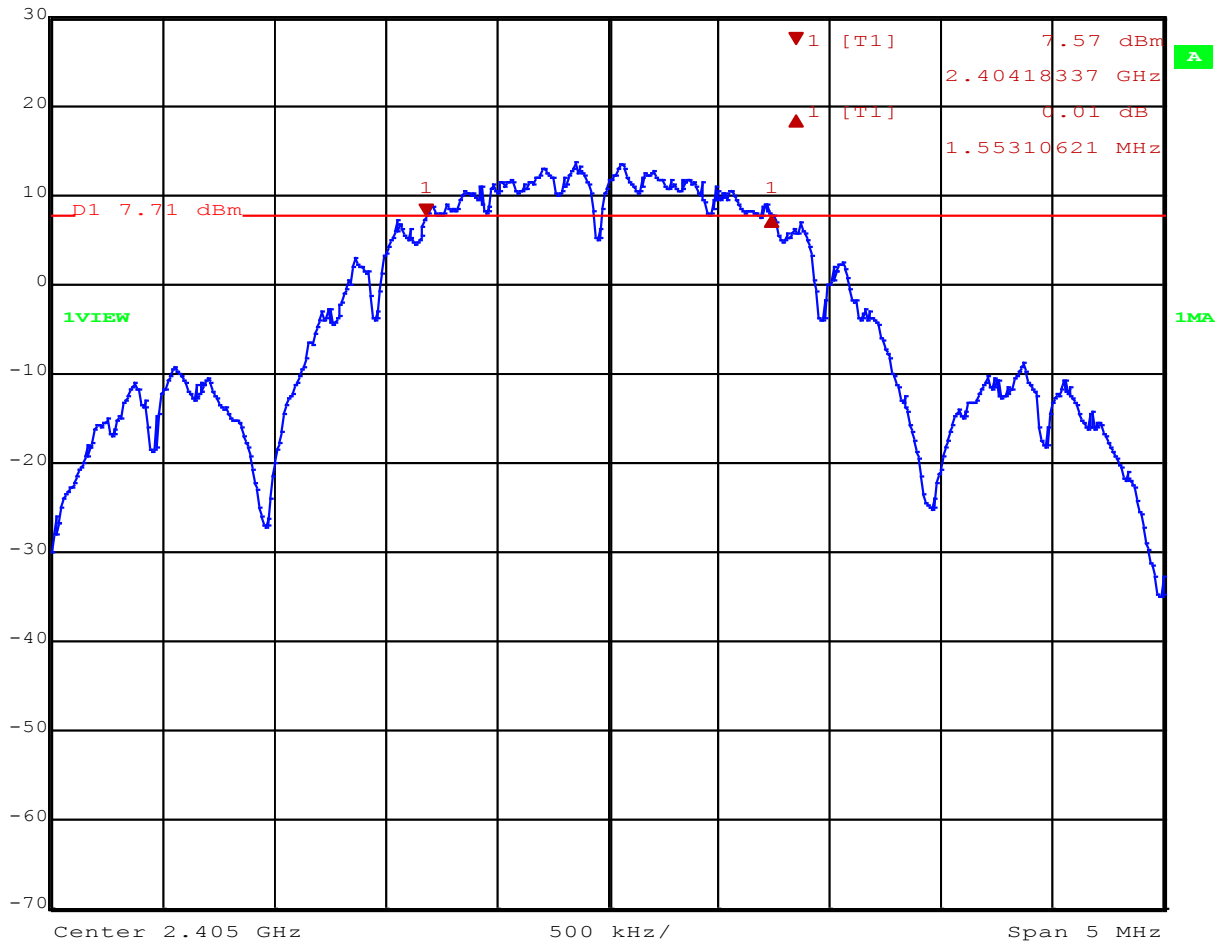
Date: 23.DEC.2020 09:01:30

6dB Bandwidth Channel 25, Antenna 1



10.11 6dB Bandwidth Plots (Antenna Path 2)


	Delta 1 [T1]	RBW	30 kHz	RF Att	40 dB
	Ref Lvl	0.01 dB	VBW	300 kHz	
	30 dBm	1.55310621 MHz	SWT	100 ms	Unit dBm

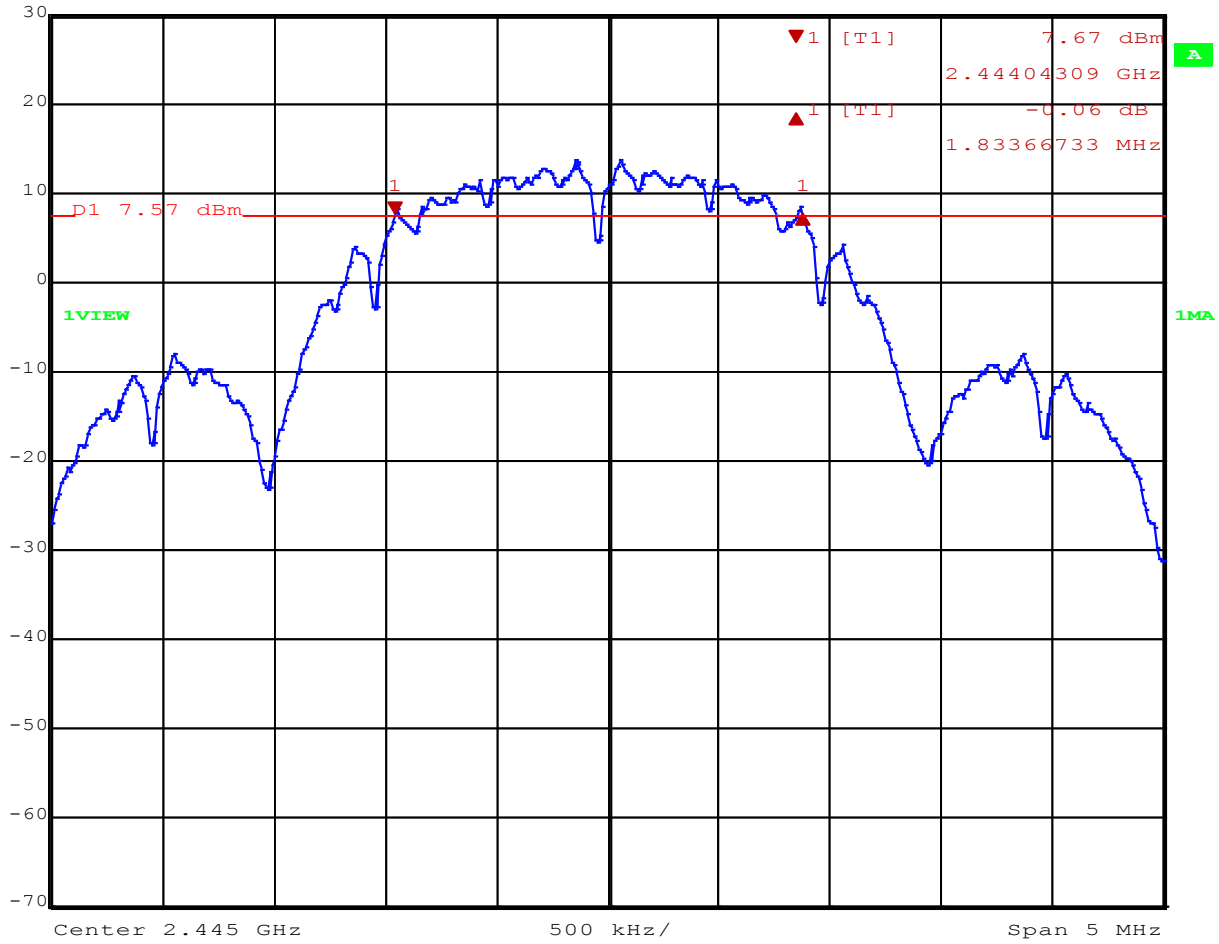


Date: 23.DEC.2020 09:07:21

6dB Bandwidth Channel 11, Antenna 2



 Delta 1 [T1] RBW 30 kHz RF Att 40 dB
Ref Lvl -0.06 dB VBW 300 kHz
30 dBm 1.83366733 MHz SWT 100 ms Unit dBm

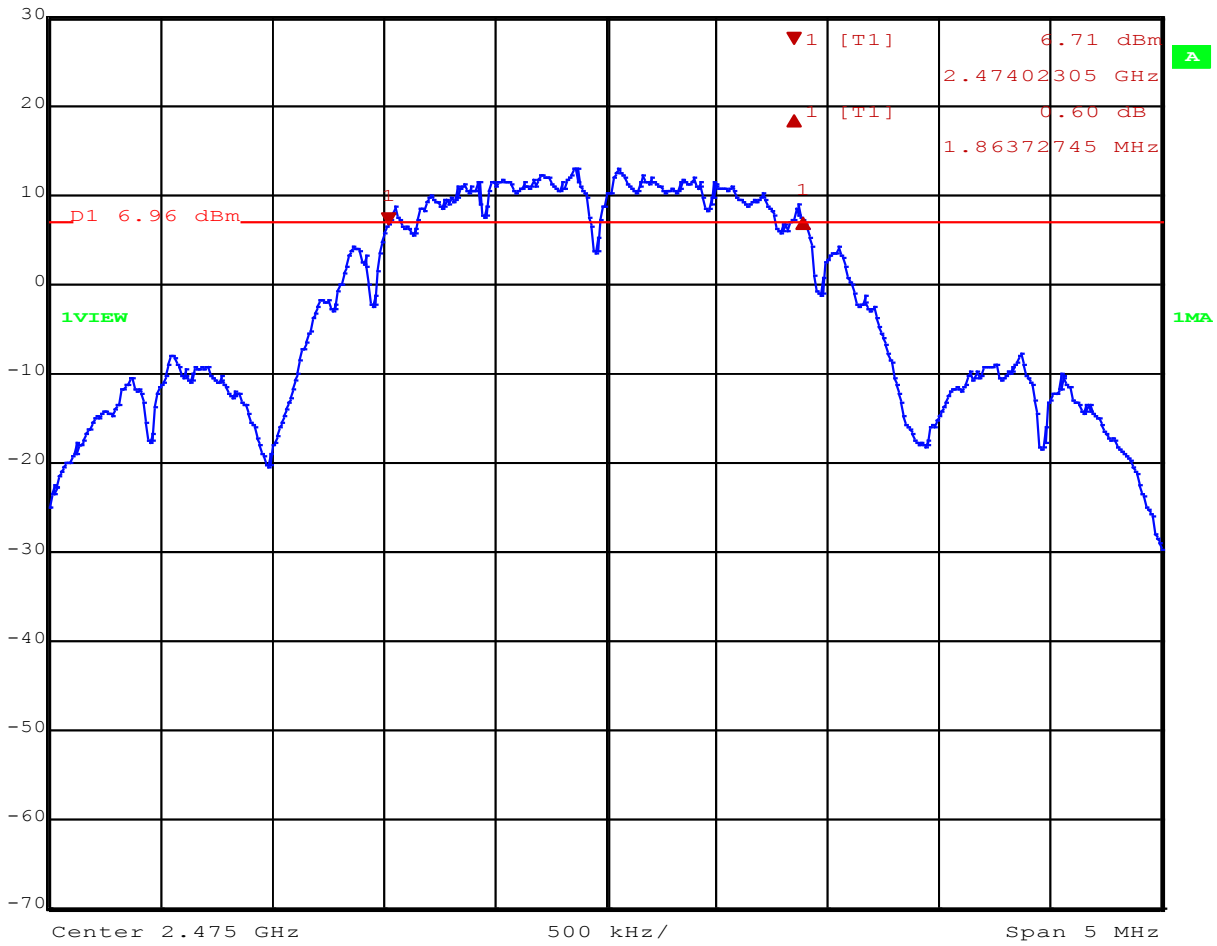


Date: 23.DEC.2020 09:09:00

6dB Bandwidth Channel 19, Antenna 2



Ref Lvl	Delta 1 [T1]	RBW	30 kHz	RF Att	40 dB
30 dBm	0.60 dB	VBW	300 kHz		
	1.86372745 MHz	SWT	100 ms	Unit	dBm



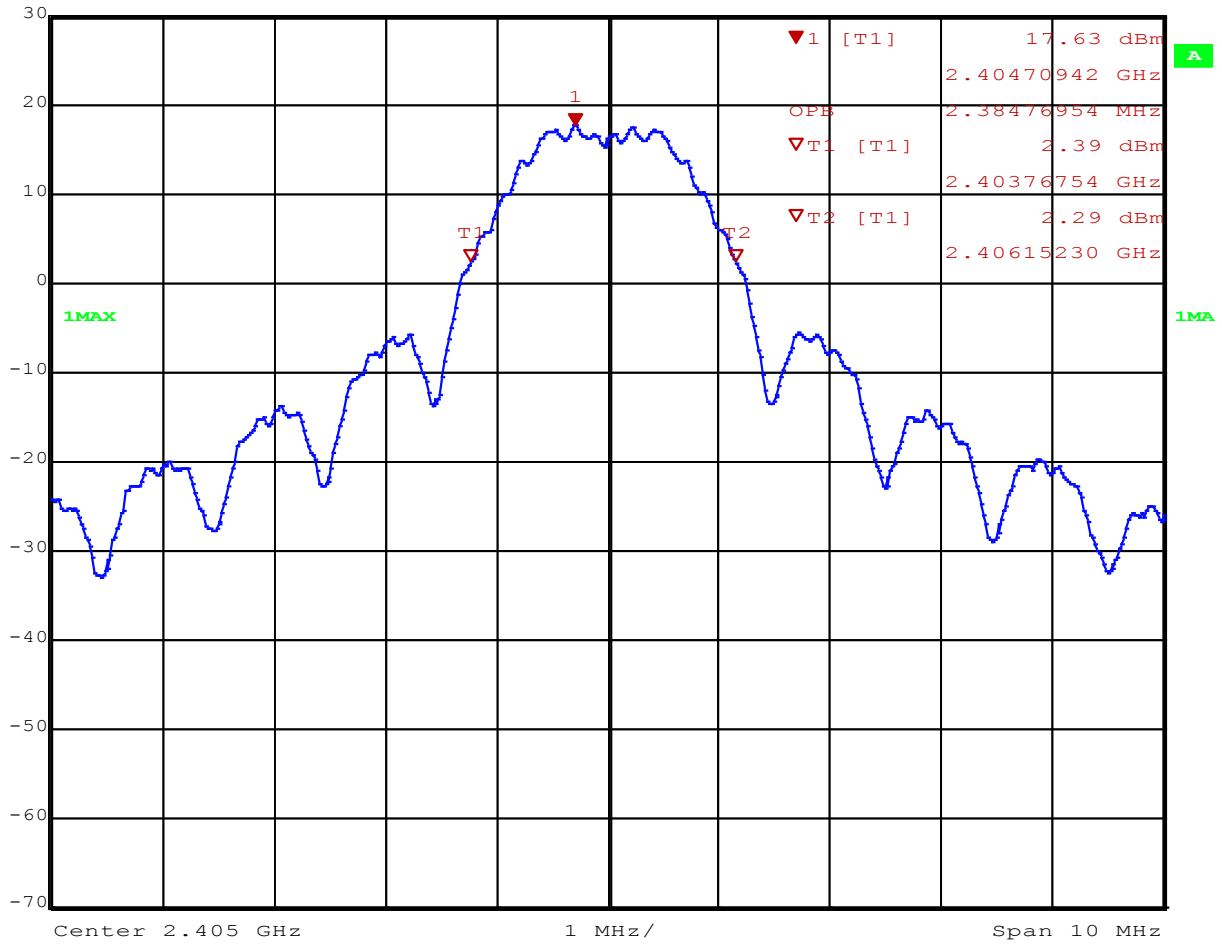
Date: 23.DEC.2020 09:10:14

6dB Bandwidth Channel 25, Antenna 2



10.12 99% Bandwidth Plots (Antenna Path 1)

	Ref Lvl	17.63 dBm	RBW	100 kHz	RF Att	40 dB
	30 dBm	2.40470942 GHz	VBW	300 kHz		
			SWT	100 ms	Unit	dBm

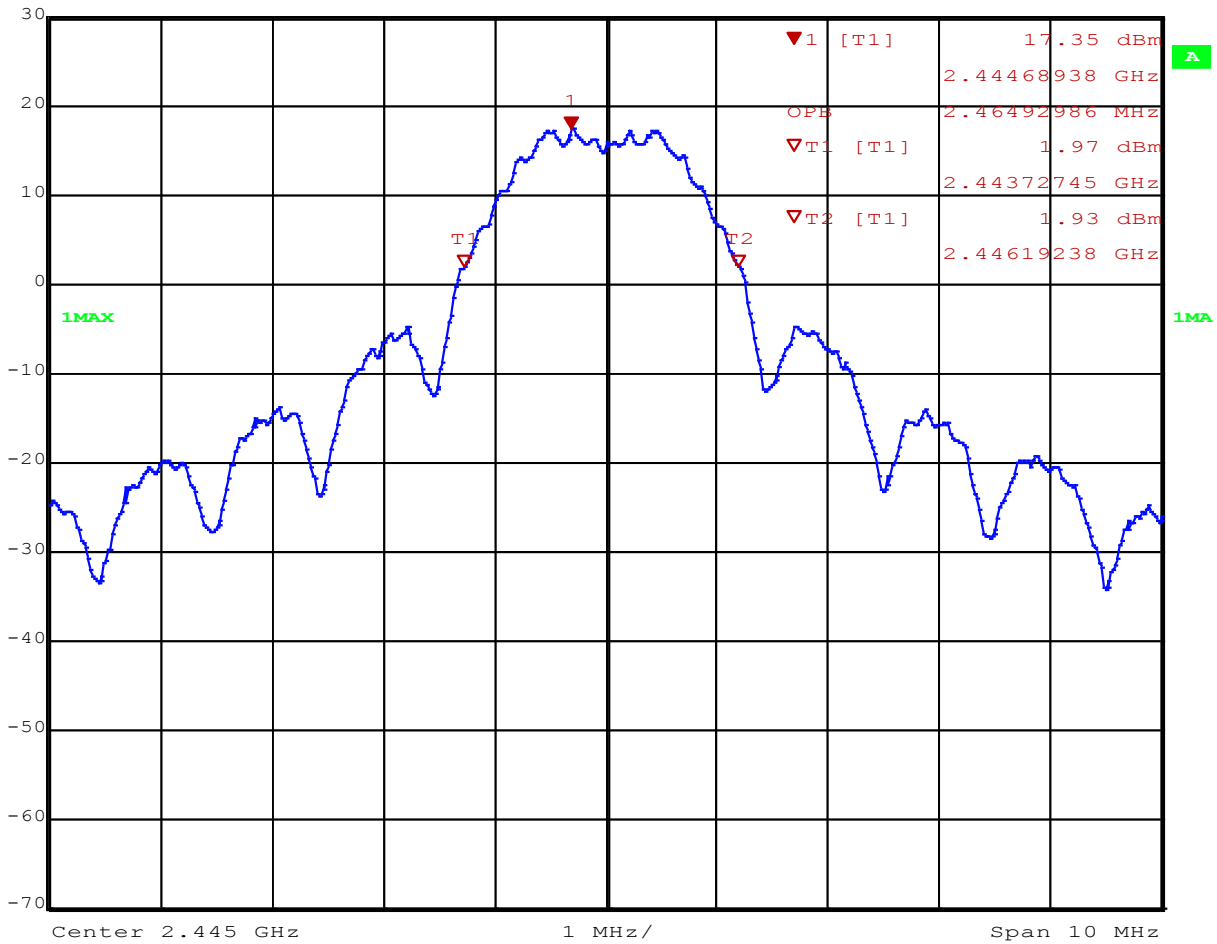


Date: 23.DEC.2020 08:17:05

99% Bandwidth Channel 11, Antenna 1



Ref Lvl	30 dBm	Marker 1 [T1]	17.35 dBm	RBW	100 kHz	RF Att	40 dB
			2.44468938 GHz	VBW	300 kHz		
				SWT	100 ms	Unit	dBm

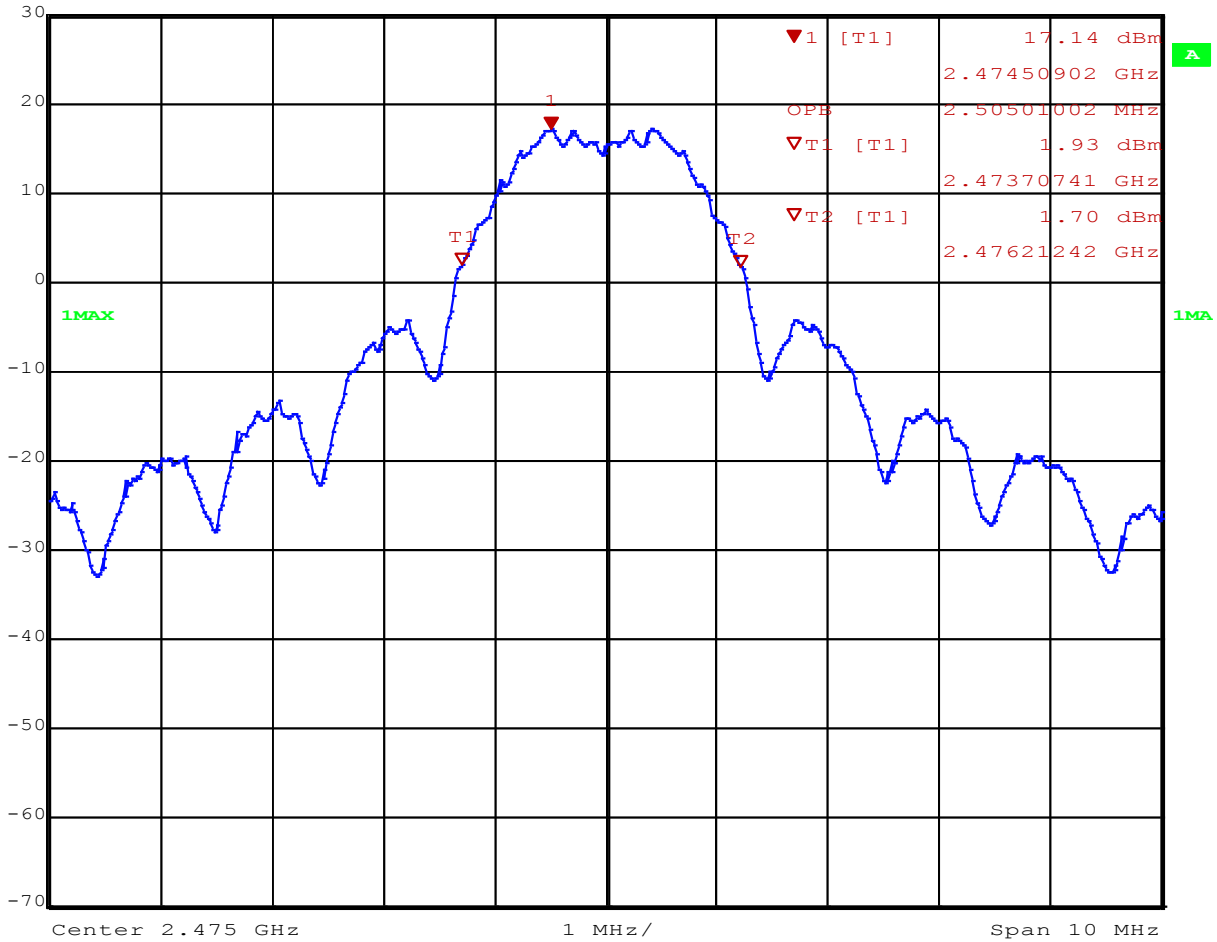


Date: 23.DEC.2020 08:19:33

99% Bandwidth Channel 19, Antenna 1



Ref Lvl	30 dBm	Marker 1 [T1]	17.14 dBm	RBW	100 kHz	RF Att	40 dB
			2.47450902 GHz	VBW	300 kHz		
				SWT	100 ms	Unit	dBm



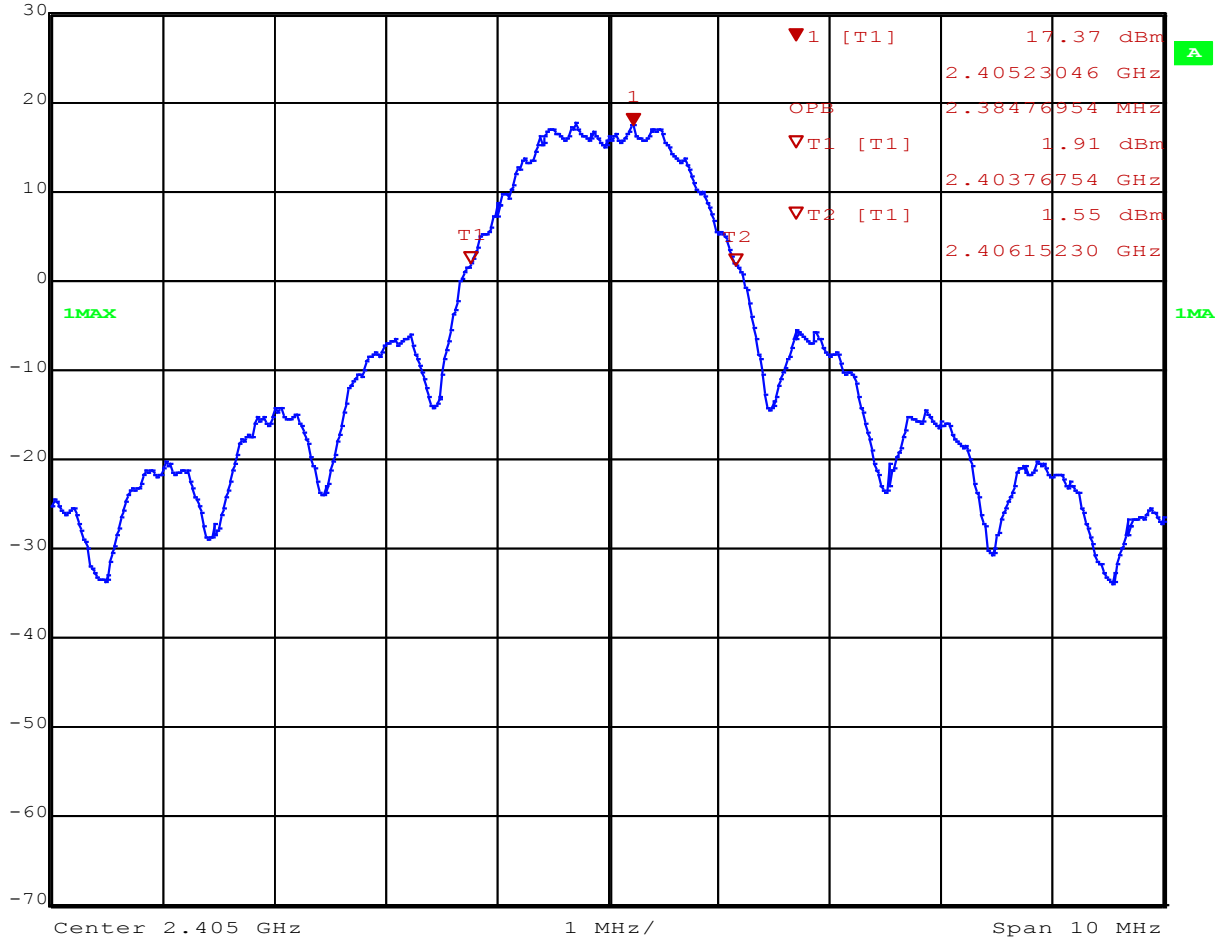
Date: 23.DEC.2020 08:21:14

99% Bandwidth Channel 25, Antenna 1



10.13 99% Bandwidth Plots (Antenna Path 2)

	Ref Lvl	17.37 dBm	RBW	100 kHz	RF Att	40 dB
	30 dBm	2.40523046 GHz	VBW	300 kHz		
			SWT	100 ms	Unit	dBm

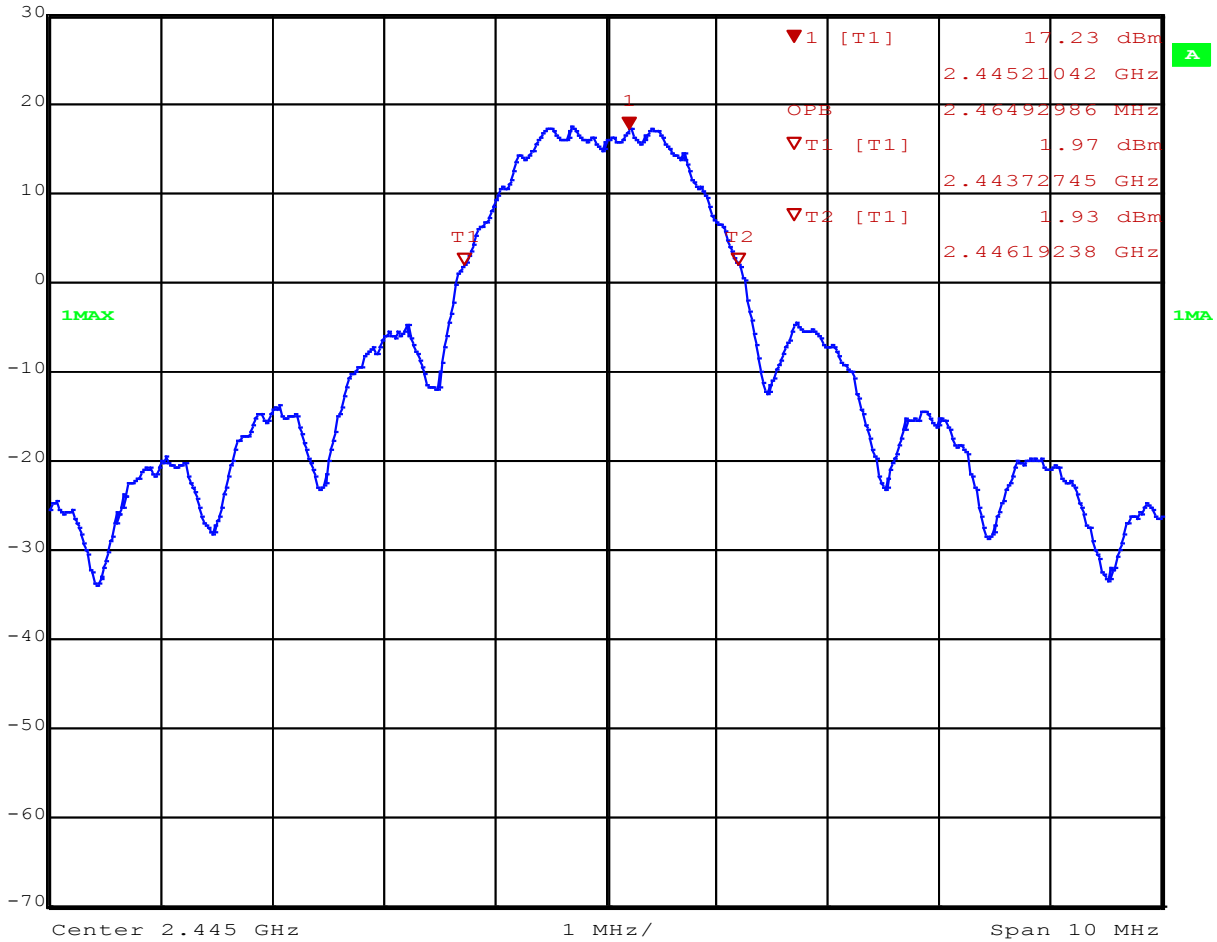


Date: 23.DEC.2020 08:22:42

99% Bandwidth Channel 11, Antenna 2



Ref Lvl	30 dBm	Marker 1 [T1]	17.23 dBm	RBW	100 kHz	RF Att	40 dB
			2.44521042 GHz	VBW	300 kHz		
				SWT	100 ms	Unit	dBm

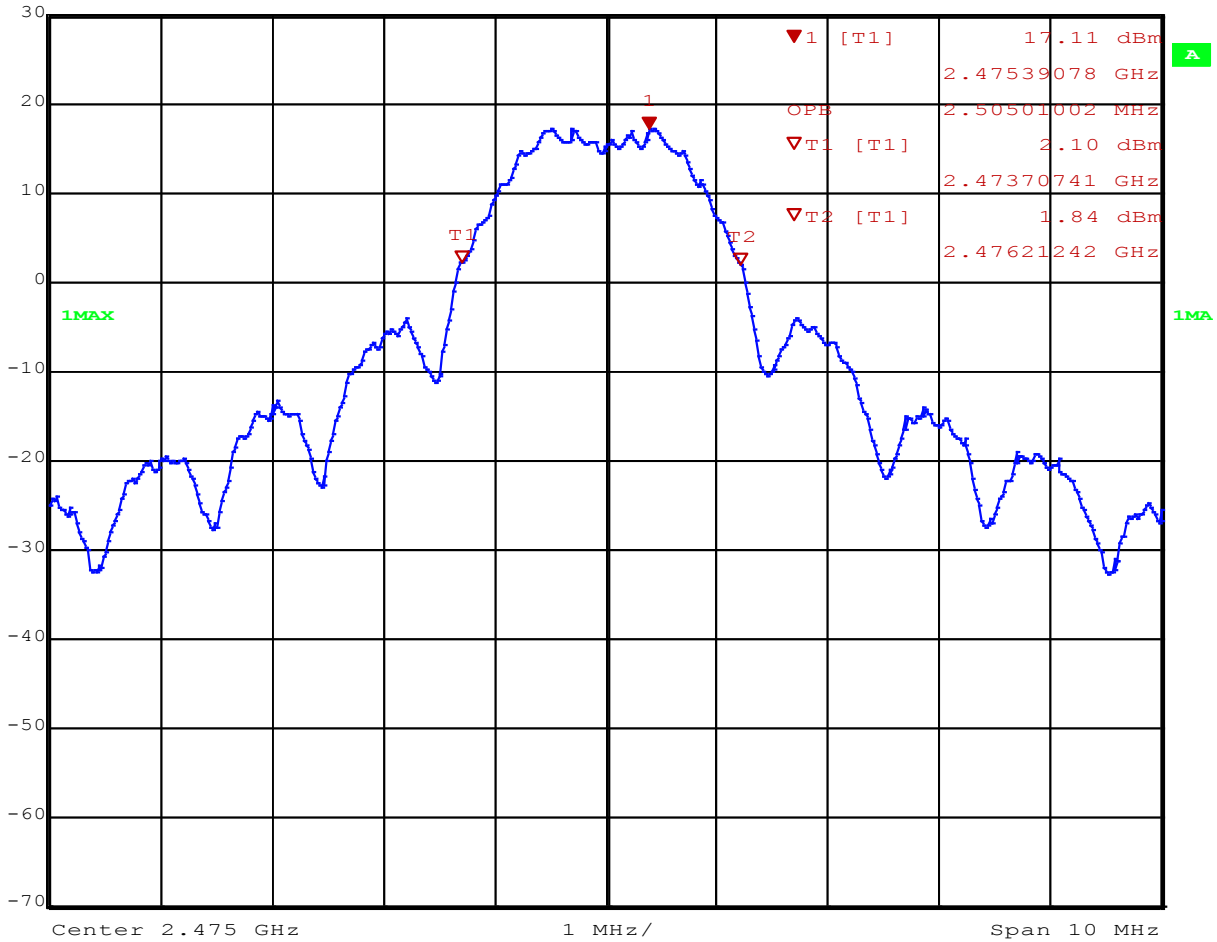


Date: 23.DEC.2020 08:23:35

99% Bandwidth Channel 19, Antenna 2



Ref Lvl	30 dBm	Marker 1 [T1]	17.11 dBm	RBW	100 kHz	RF Att	40 dB
			2.47539078 GHz	VBW	300 kHz		
				SWT	100 ms	Unit	dBm



Date: 23.DEC.2020 08:24:33

99% Bandwidth Channel 25, Antenna 2



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 § 11.10.3 Method APSD-1 (average PSD) since average power was used to demonstrate compliance with the output power criteria.

11.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3065	Rohde & Schwarz	FSP3	9/22/2020	9/22/2021

11.4 Test Results

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

11.5 Test Conditions

Test Personnel:	<u>Bryan Taylor</u>	Test Date:	<u>12/23/2020</u>
Supervising/Reviewing Engineer: (Where Applicable)	<u>NA</u>	Limit Applied:	<u>See Above</u>
Product Standard:	<u>FCC Part 15.247</u>	Ambient Temperature:	<u>22.2C</u>
Input Voltage:	<u>RSS-247 Issue 2</u>	Relative Humidity:	<u>40.5%</u>
Pretest Verification w / Ambient Signals or BB Source:	<u>120VAC / 60Hz</u>	Atmospheric Pressure:	<u>990.2mbar</u>
	<u>Yes</u>		

Deviations, Additions, or Exclusions: None

**11.6 Test Data (Antenna Path 1)**

Channel	Frequency (MHz)	PPSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
11	2405	4.01	8	3.99	PASS
19	2445	4.26	8	3.74	PASS
25	2475	4.21	8	3.79	PASS

11.7 Test Data (Antenna Path 2)

Channel	Frequency (MHz)	PPSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
11	2405	4.23	8	3.77	PASS
19	2445	4.06	8	3.94	PASS
25	2475	4.21	8	3.79	PASS

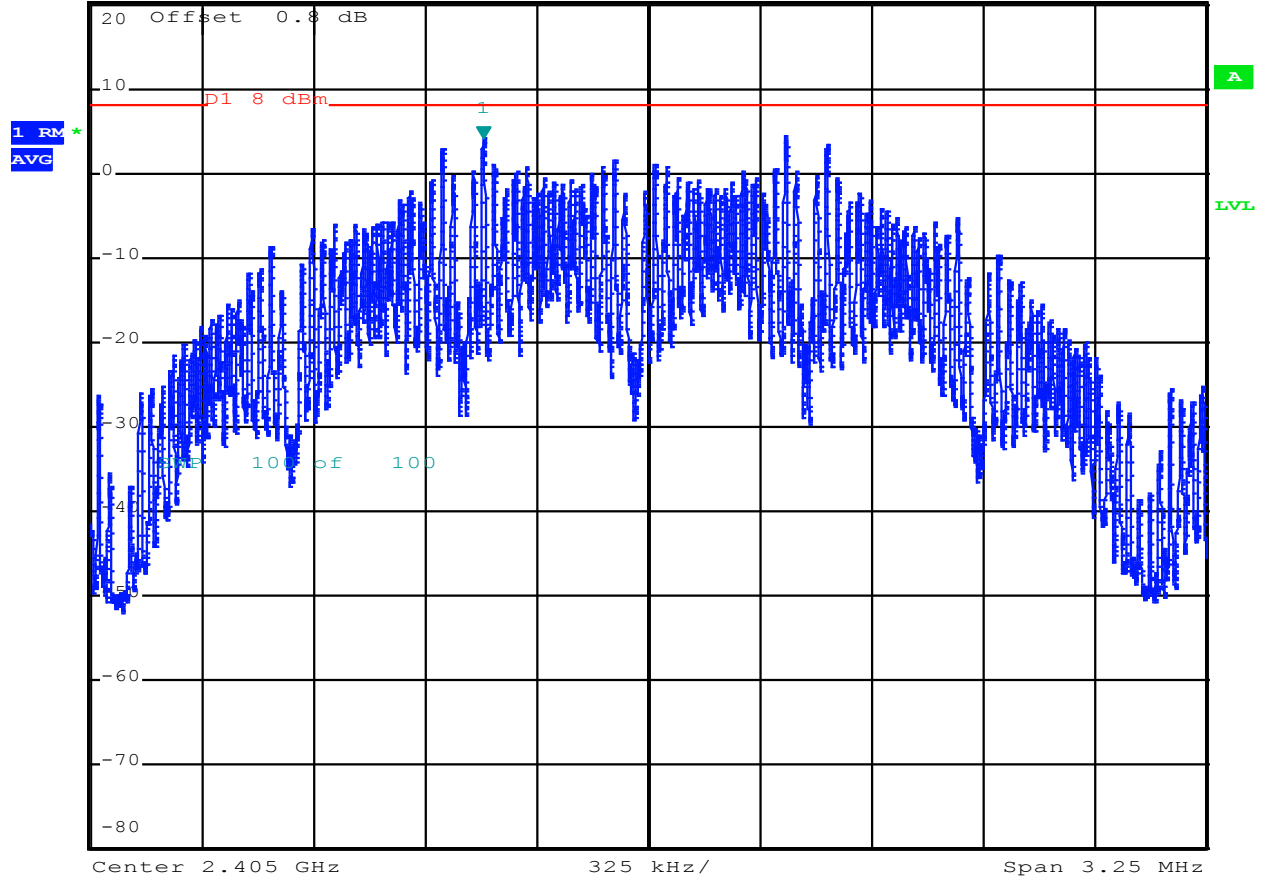


11.8 APSD Plots (Antenna Path 1)



MARKER 1
 2.404519813 GHz
 Ref 20 dBm Att 50 dB

*RBW 3 kHz Marker 1 [T1]
 VBW 30 kHz 4.01 dBm
 SWT 370 ms 2.404519812 GHz

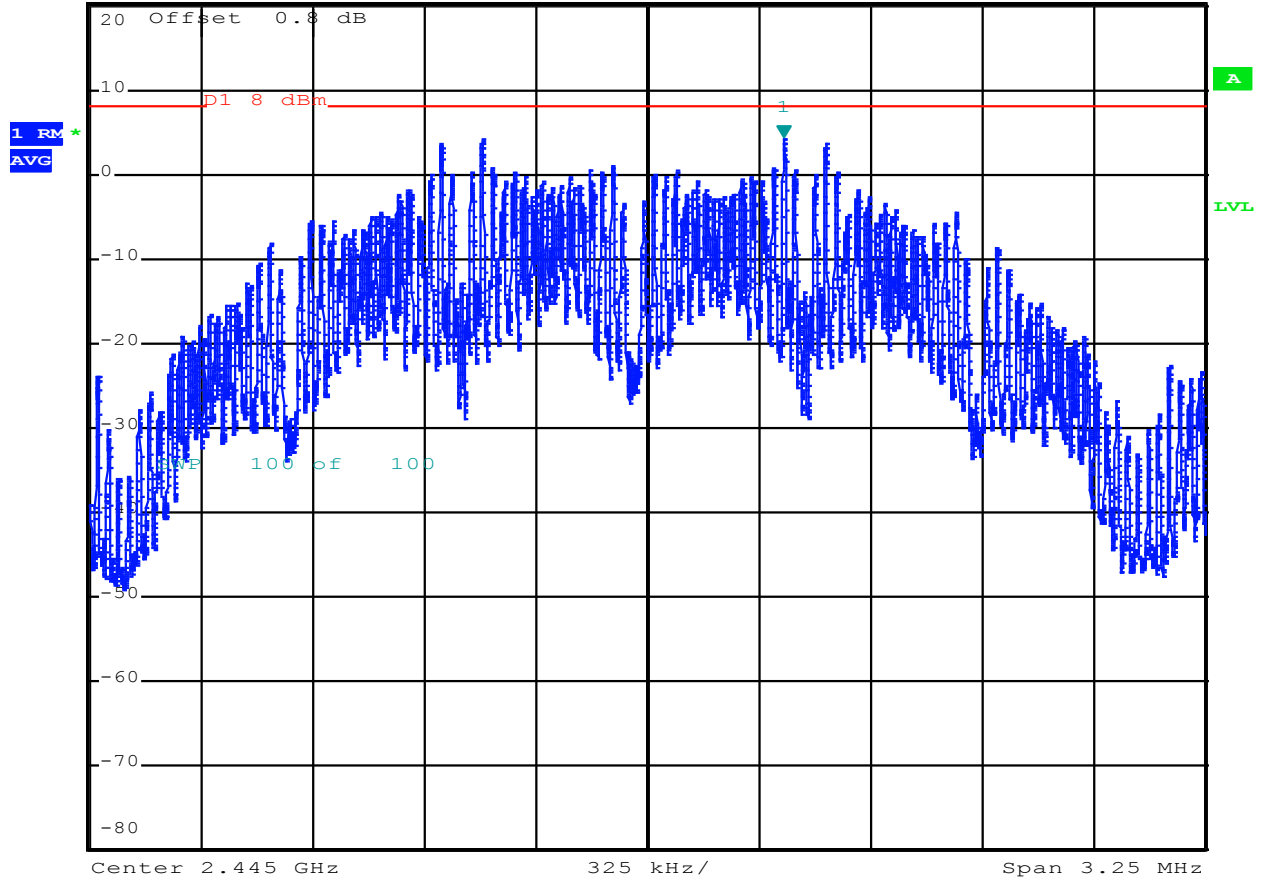


Date: 23.DEC.2020 10:30:57

Average Power Spectral Density (Method AVGPSD-1) Channel 11, Antenna 1



MARKER 1
2.445395281 GHz
Ref 20 dBm Att 50 dB
*RBW 3 kHz Marker 1 [T1]
VBW 30 kHz 4.26 dBm
SWT 370 ms 2.445395281 GHz

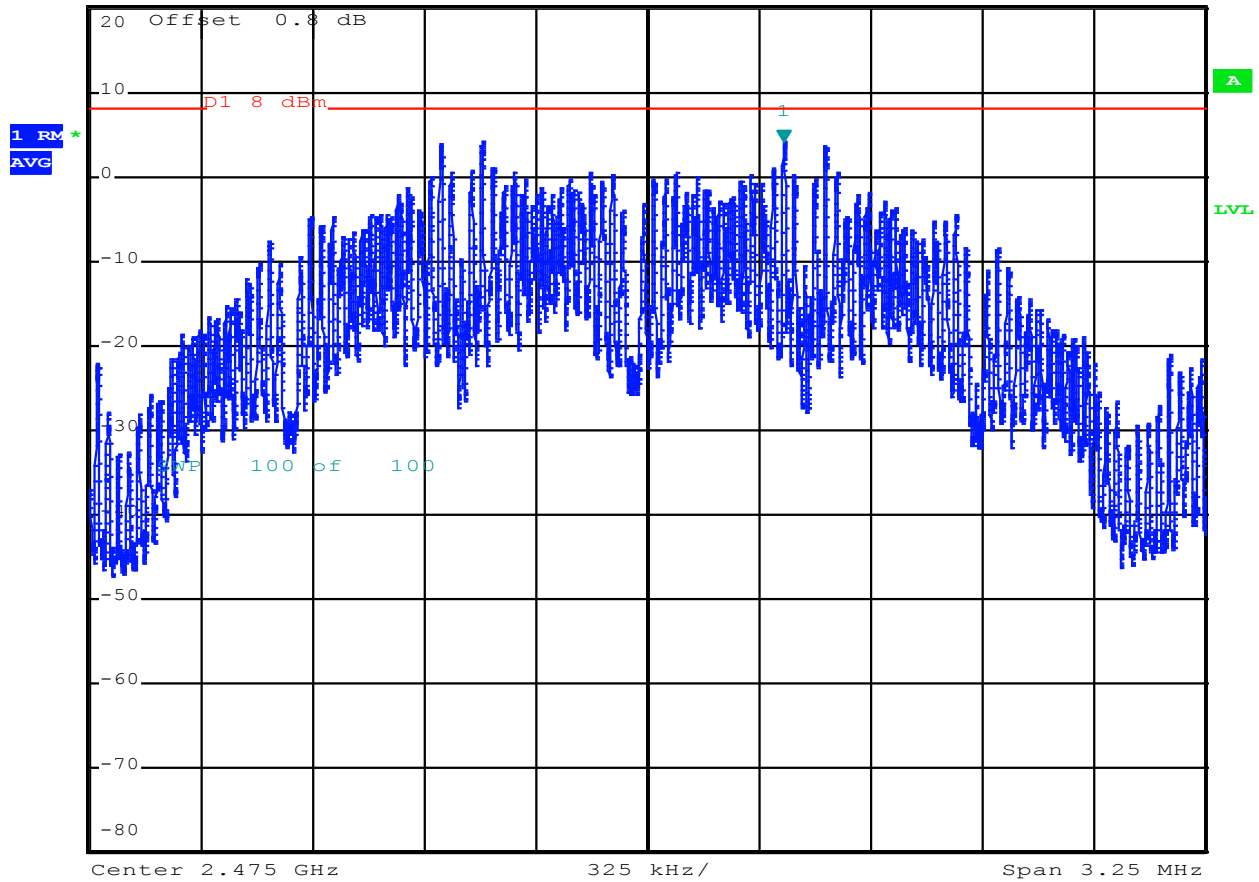


Date: 23.DEC.2020 10:32:31

Average Power Spectral Density (Method AVGPS-1) Channel 19, Antenna 1



MARKER 1
2.475394875 GHz
Ref 20 dBm Att 50 dB
*RBW 3 kHz Marker 1 [T1]
VBW 30 kHz 4.21 dBm
SWT 370 ms 2.475394875 GHz



Date: 23.DEC.2020 10:34:09

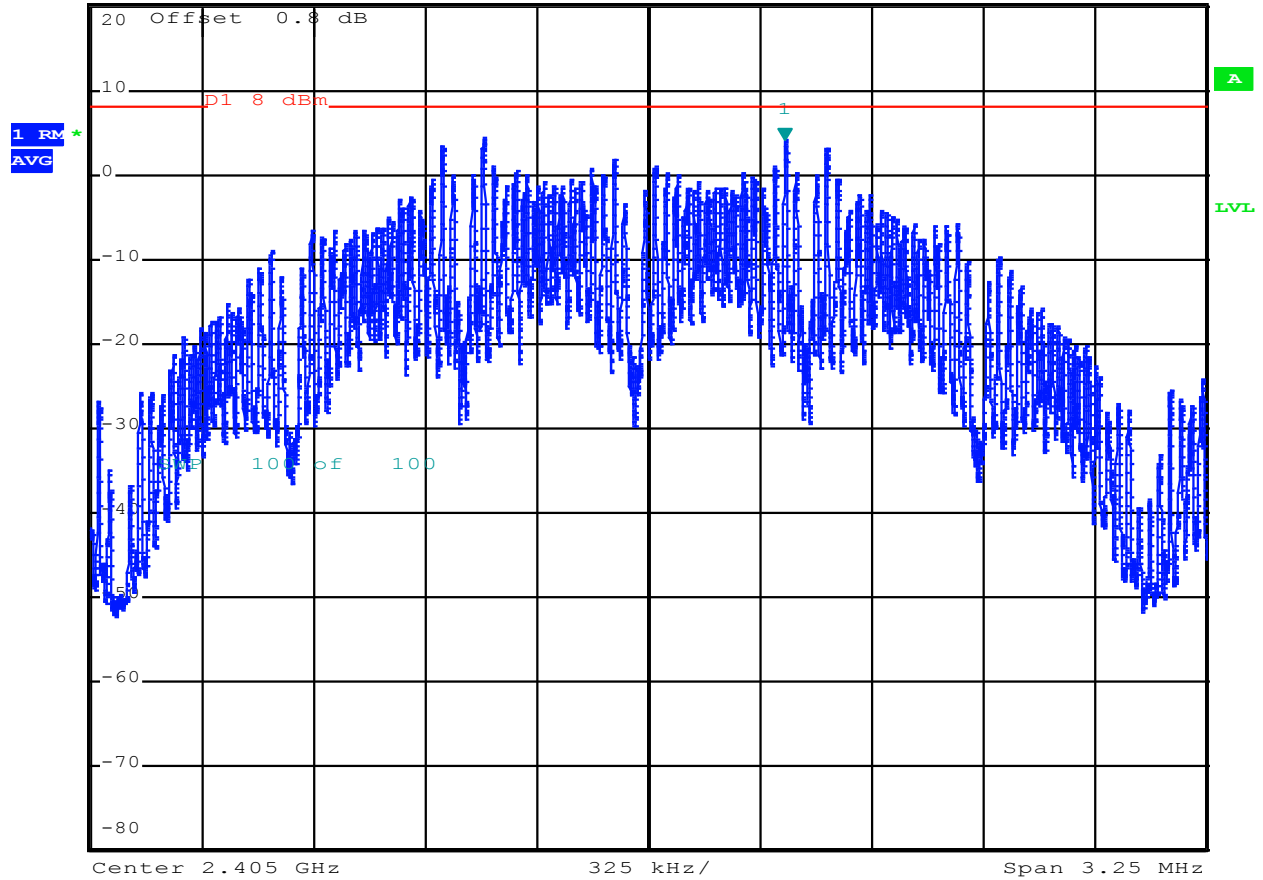
Average Power Spectral Density (Method AVGPS-1) Channel 25, Antenna 1



11.9 PPSD Plots (Antenna Path 2)



MARKER 1
2.405396094 GHz
Ref 20 dBm Att 50 dB
*RBW 3 kHz Marker 1 [T1]
VBW 30 kHz 4.23 dBm
SWT 370 ms 2.405396094 GHz

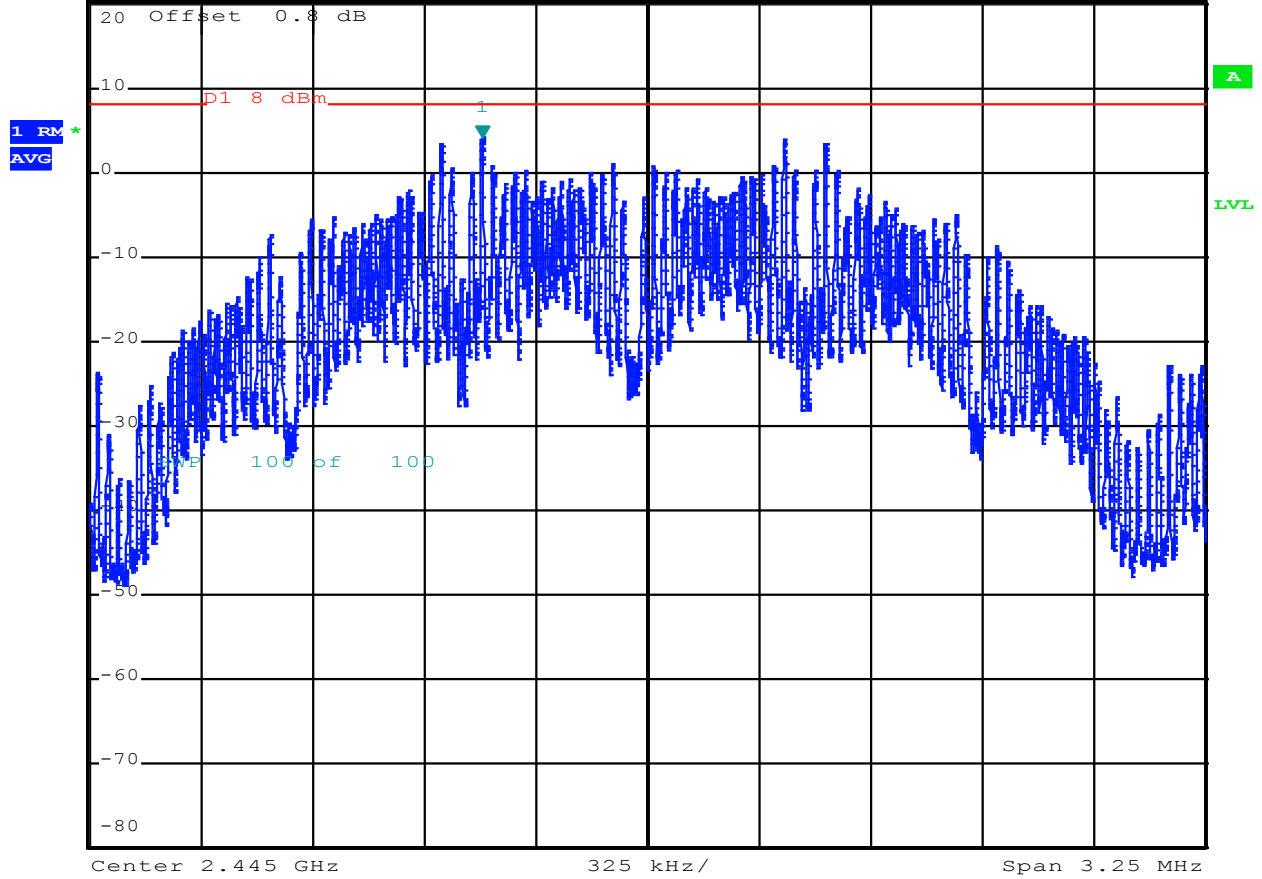


Date: 23.DEC.2020 10:36:04

Average Power Spectral Density (Method AVGPS-1) Channel 11, Antenna 2



MARKER 1
2.444519406 GHz
Ref 20 dBm Att 50 dB
*RBW 3 kHz Marker 1 [T1]
VBW 30 kHz 4.06 dBm
SWT 370 ms 2.444519406 GHz



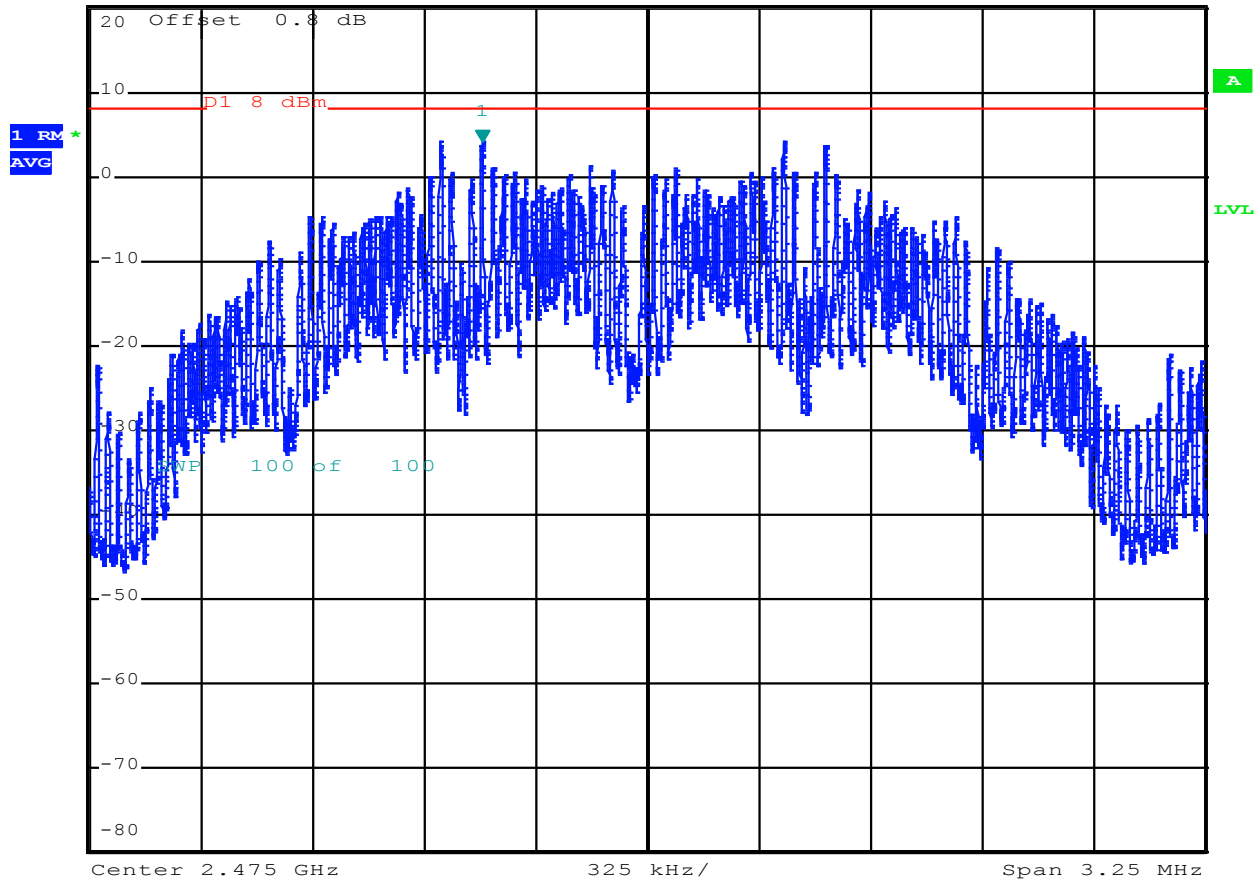
Date: 23.DEC.2020 10:37:20

Average Power Spectral Density (Method AVGPS-1) Channel 19, Antenna 2



MARKER 1
2.474519 GHz
Ref 20 dBm Att 50 dB

*RBW 3 kHz Marker 1 [T1]
VBW 30 kHz 4.21 dBm
SWT 370 ms 2.474519000 GHz



Date: 23.DEC.2020 10:38:57

Average Power Spectral Density (Method AVGPS-1) Channel 25, Antenna 2



12 Conducted Spurious Emissions

12.1 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.

12.2 Test Method

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

12.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3720	Rohde & Schwarz	FSEK30	10/13/2020	10/13/2021

12.4 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.

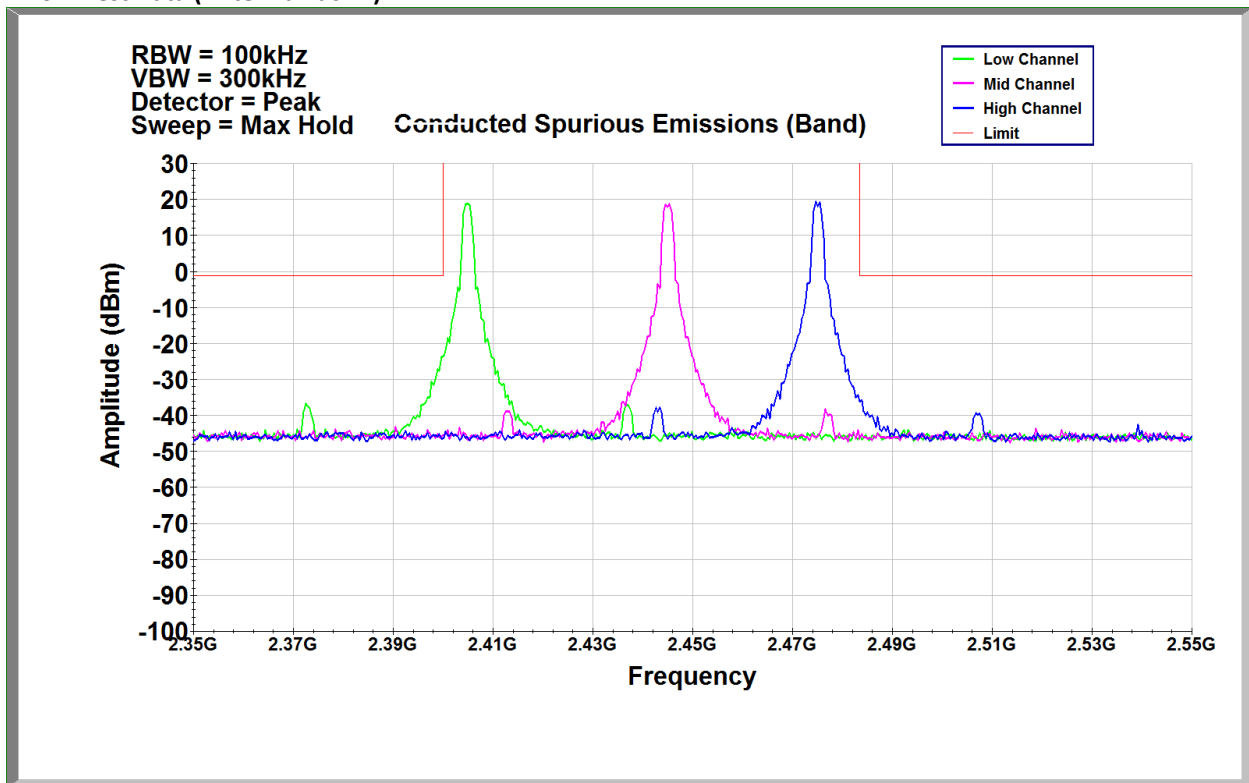


12.5 Test Conditions

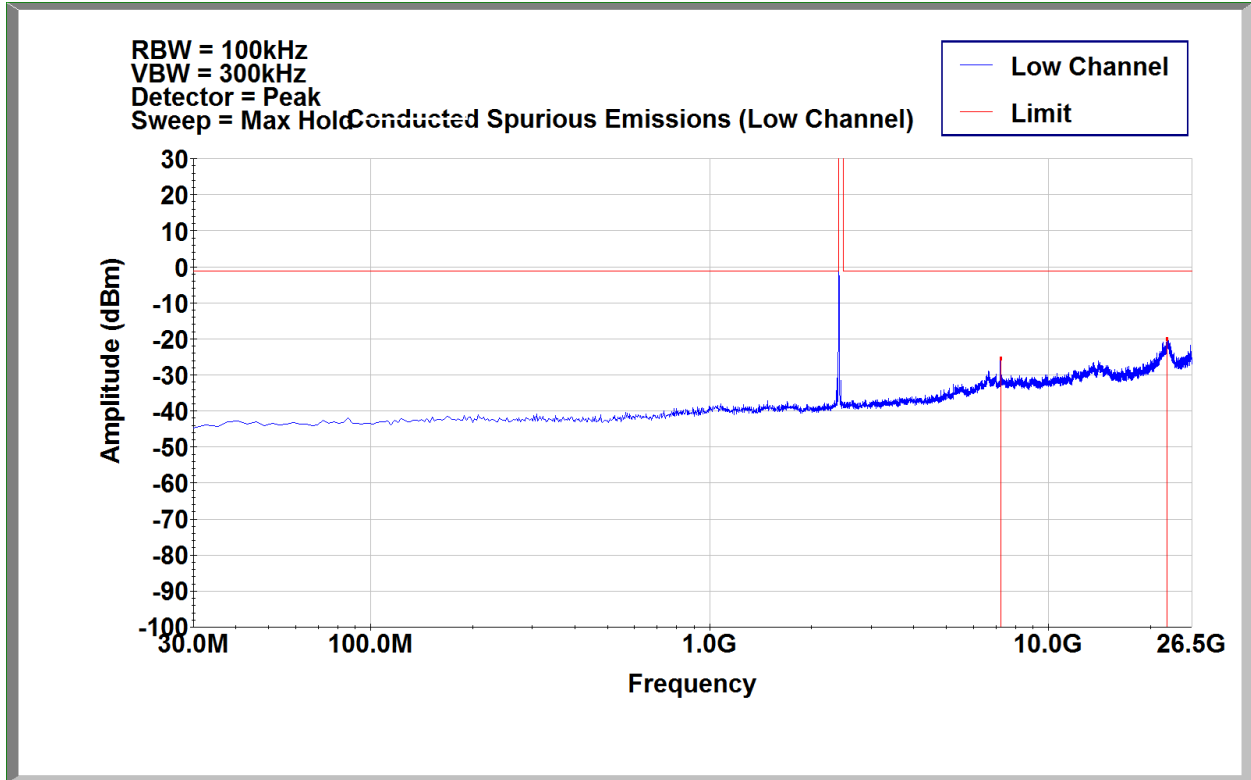
Test Personnel:	<u>Bryan Taylor</u>	Test Date:	<u>12/23/2020</u>
Supervising/Reviewing Engineer:	<u>NA</u>	Limit Applied:	<u>See Above</u>
(Where Applicable)	<u>FCC Part 15.247</u>		
Product Standard:	<u>RSS-247 Issue 2</u>	Ambient Temperature:	<u>22.2C</u>
Input Voltage:	<u>120VAC / 60Hz</u>	Relative Humidity:	<u>40.5%</u>
Pretest Verification w / Ambient		Atmospheric Pressure:	<u>990.2mbar</u>
Signals or BB Source:	<u>Yes</u>		

Deviations, Additions, or Exclusions: None

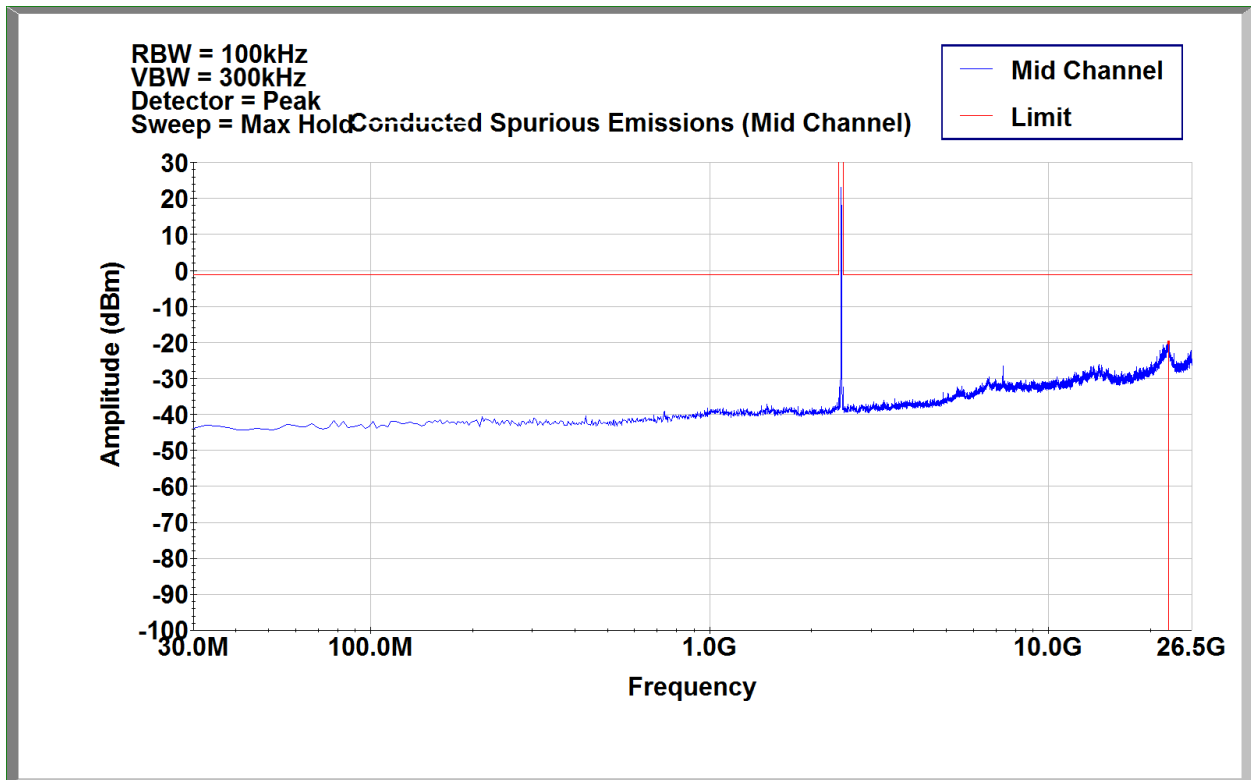
12.6 Test Data (Antenna Path 1)



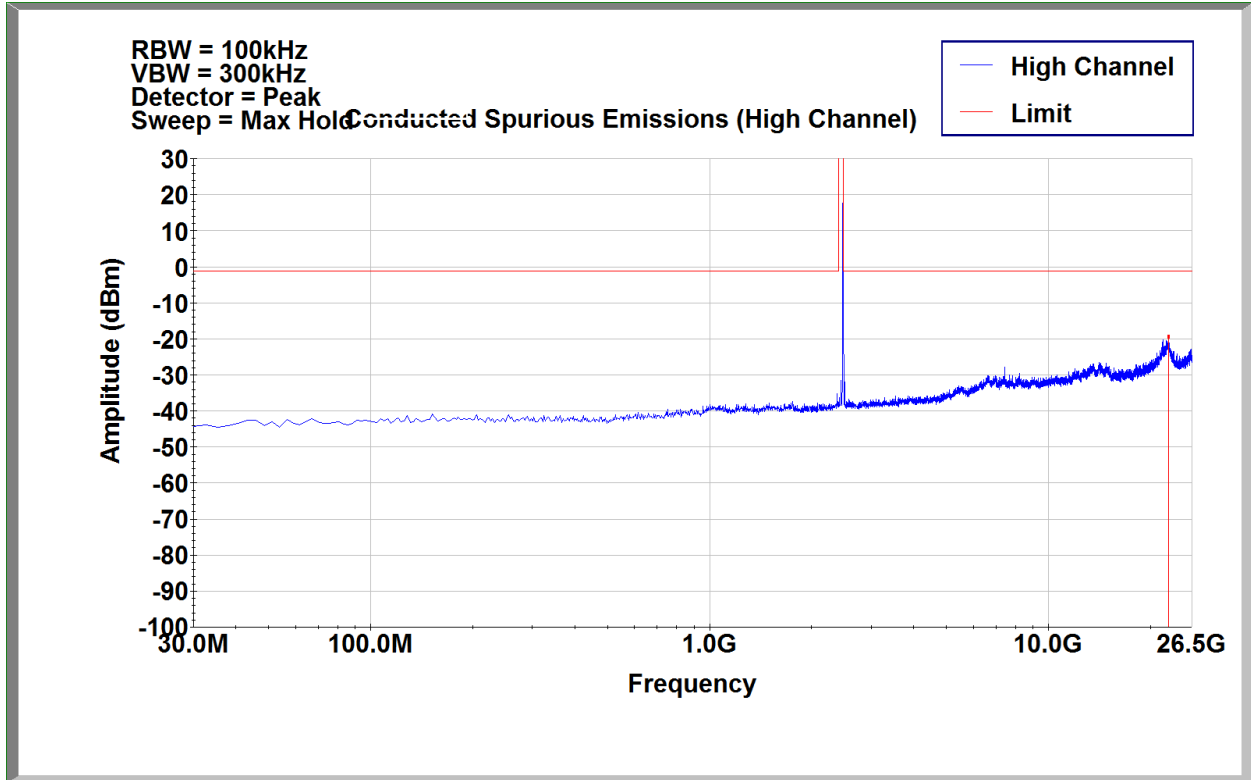
Conducted Spurious Emissions, Antenna 1 (Band Edge)



Conducted Spurious Emissions Channel 11, Antenna 1



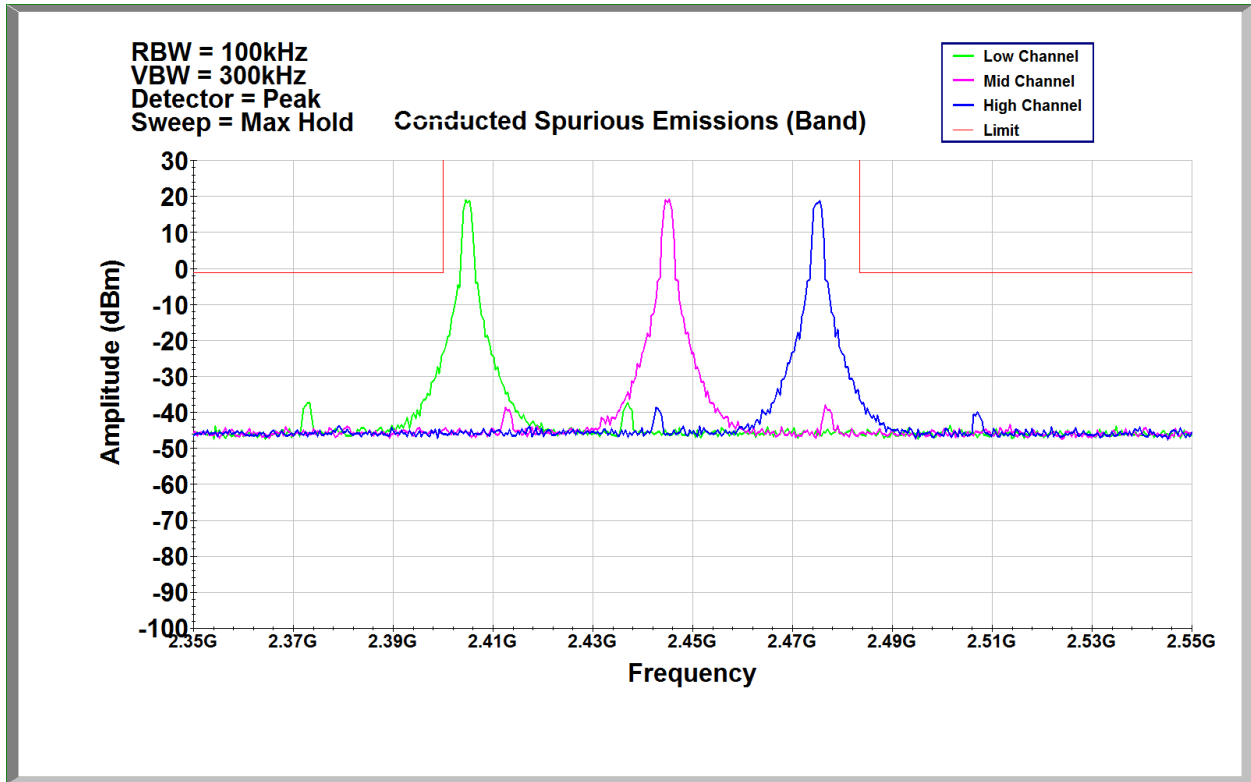
Conducted Spurious Emissions Channel 19, Antenna 1



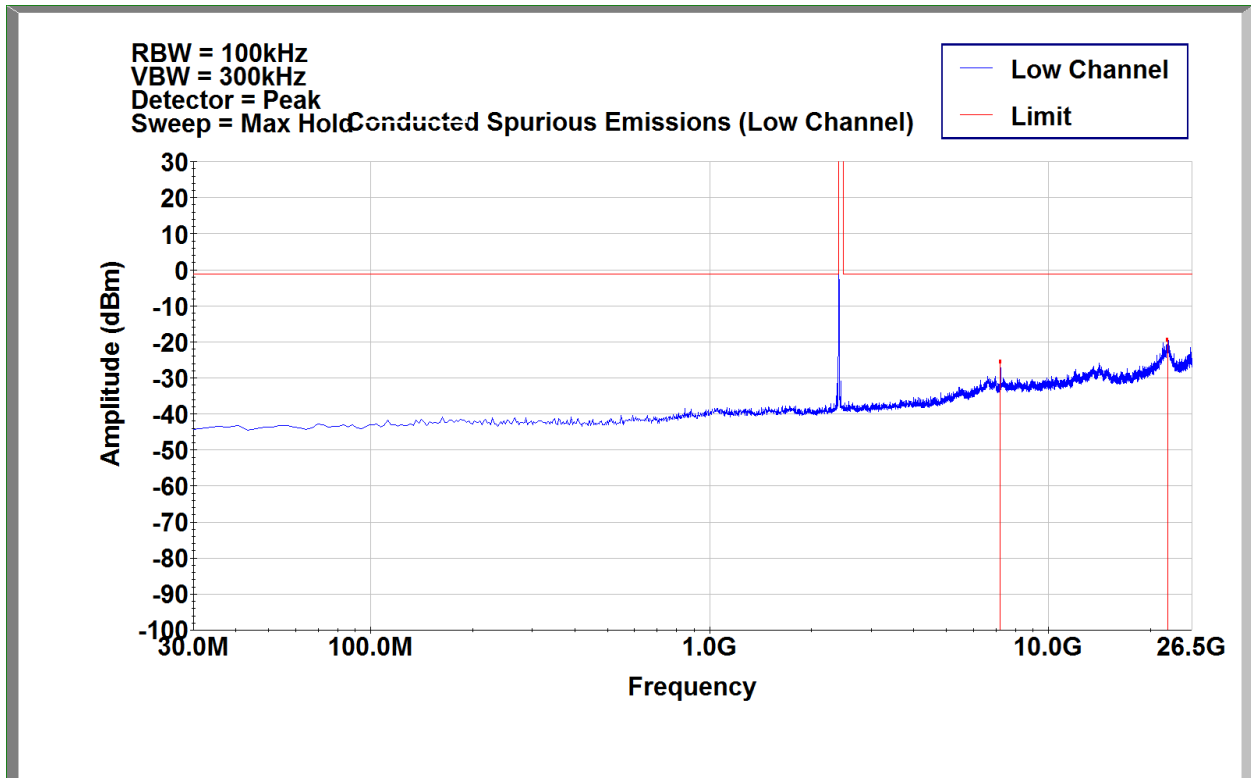
Conducted Spurious Emissions Channel 25, Antenna 1



12.7 Test Data (Antenna Path 2)

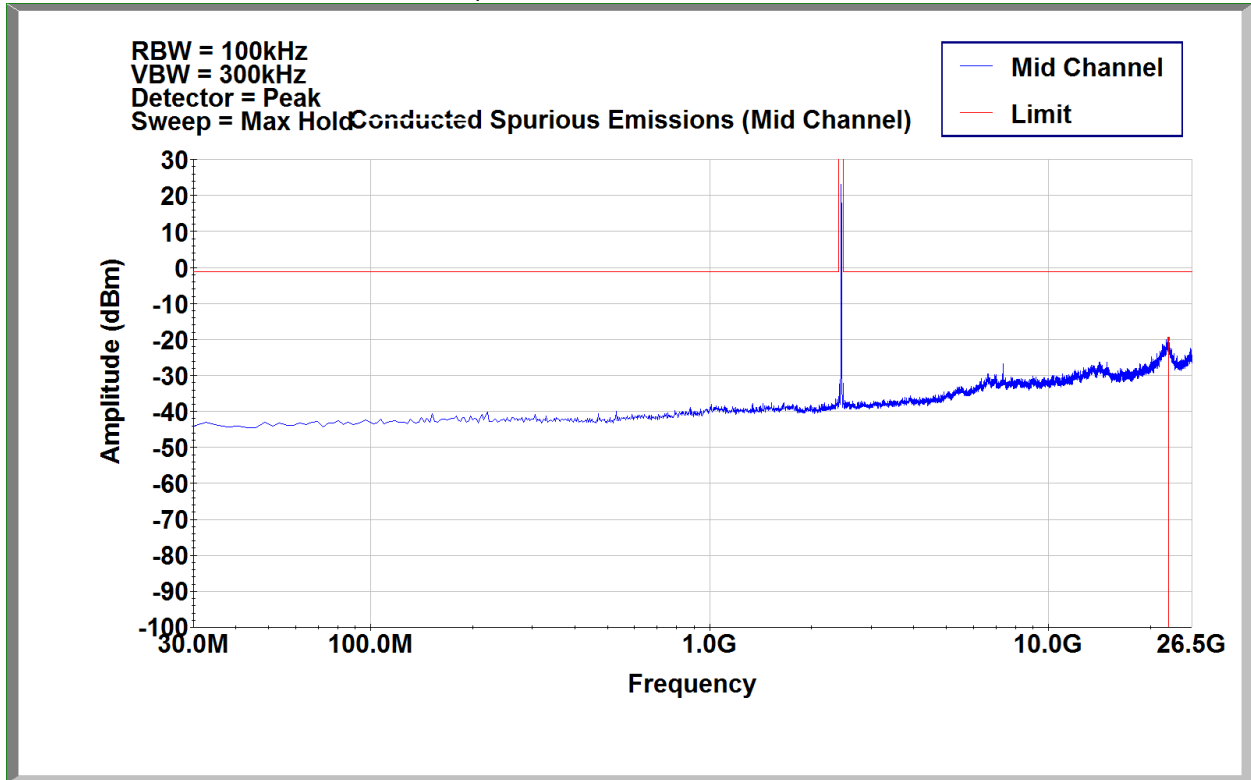


Conducted Spurious Emissions, Antenna 2 (Band Edge)

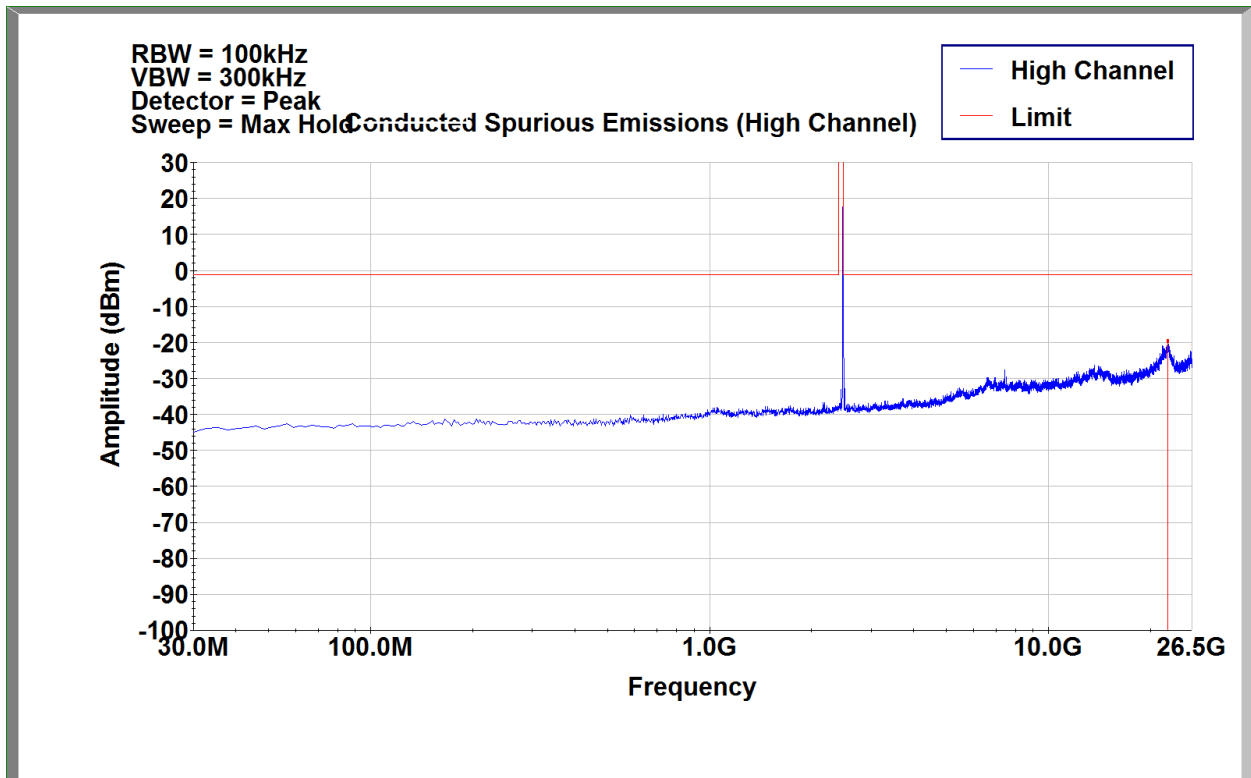




Conducted Spurious Emissions Channel 11, Antenna 2



Conducted Spurious Emissions Channel 19, Antenna 2



Conducted Spurious Emissions Channel 25, Antenna 2



13 Antenna Requirement

13.1 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).

13.2 Test Results

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



14 Conducted Emissions

14.1 Method

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

TEST SITE: Ground Plane

Site Designation: Ground Plane

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisp
Power Line Conducted Emissions	150 kHz - 30 MHz	3.1dB	3.4dB

As shown in the table above our conducted 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.

14.2 Sample Calculations

The following is how net line-conducted readings were determined:

$$NF = RF + LF + CF + AF$$

Where NF = Net Reading in dBμV

RF = Reading from receiver in dBμV

LF = LISN or ISN Correction Factor in dB

CF = Cable Correction Factor in dB

AF = Attenuator Loss Factor in dB

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

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

NF = Net Reading in dBμV

Example:

$$NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 \text{ dB}\mu\text{V}$$

$$UF = 10^{(49.1 \text{ dB}\mu\text{V} / 20)} = 285.1 \mu\text{V/m}$$

**14.3 Test Equipment Used:**

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde&Schwarz	ESI26	10/9/2020	10/9/2021
LISN	2509	Fischer Custom Communication	FCC-LISN-50-50-2M	4/21/2020	4/21/2021
Coaxial Cable	6026			12/21/2020	12/21/2021

14.4 Software Utilized:

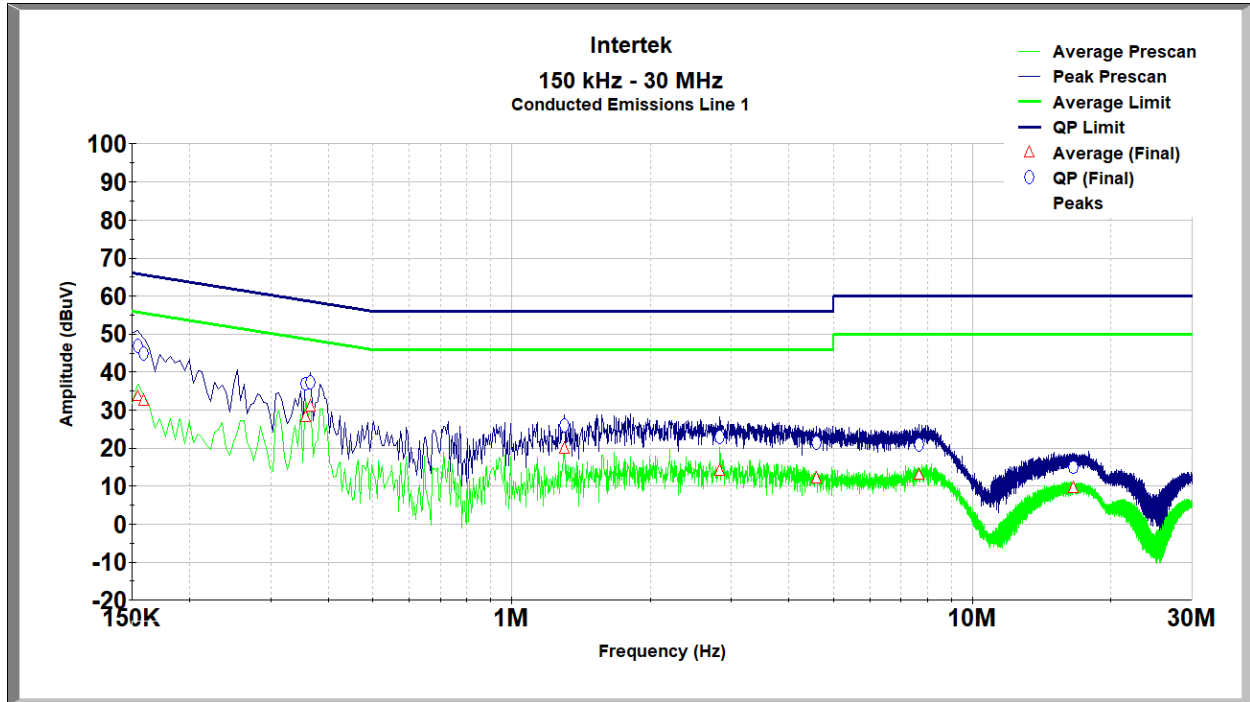
Name	Manufacturer	Version
TILE	ETS Lindgren	V7.0.6.545

14.5 Results:

The sample tested was found to Comply.



14.6 Plots/Data: Conducted Emissions (Line)



Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.155	46.985	65.871	18.886	33.675	55.871	22.196
0.159	44.804	65.743	20.939	32.446	55.743	23.297
0.357	37.134	60.086	22.951	28.160	50.086	21.926
0.366	37.349	59.829	22.480	30.891	49.829	18.937
1.302	25.868	56.000	30.132	19.787	46.000	26.213
2.832	23.018	56.000	32.982	14.104	46.000	31.896
4.580	21.477	56.000	34.523	12.084	46.000	33.916
7.673	20.794	60.000	39.206	13.069	50.000	36.931
16.596	14.995	60.000	45.005	9.512	50.000	40.488

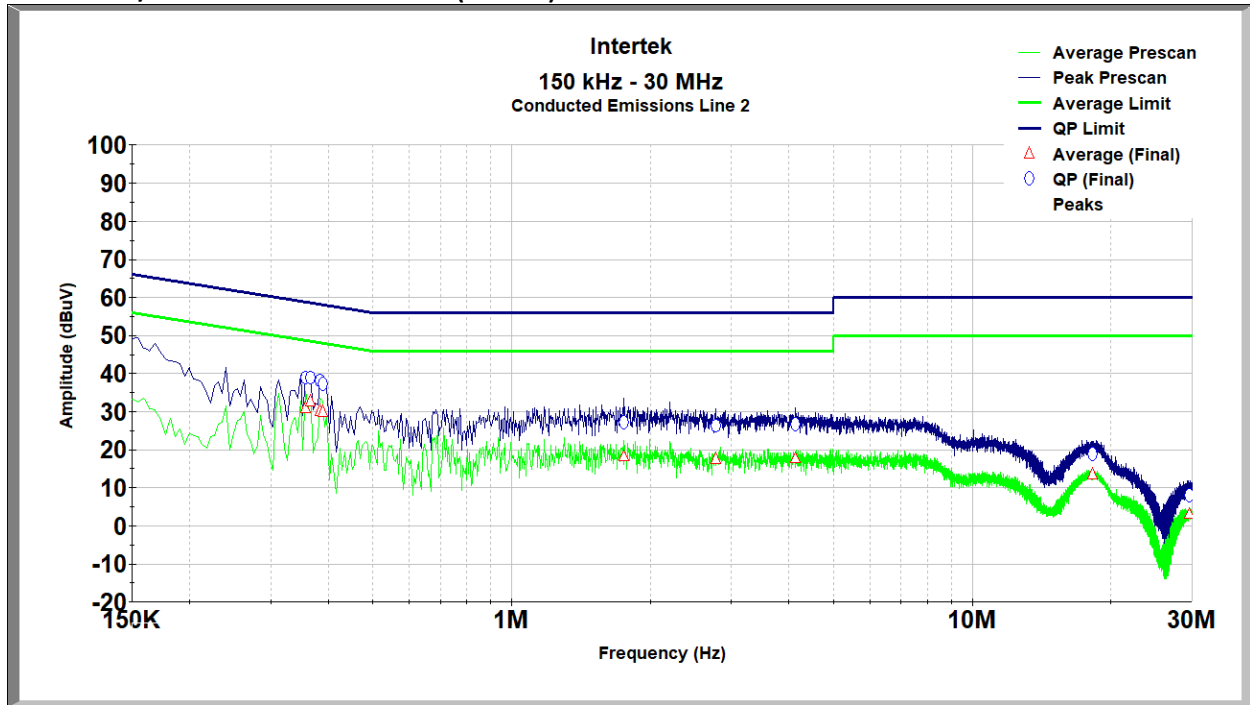
Test Personnel: Bryan Taylor
 Supervising/Reviewing Engineer: NA
 (Where Applicable)
 Product Standard: FCC Part 15.207
 Input Voltage: 120VAC 60Hz
 Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 1/18/2020
 Limit Applied: Class B
 Ambient Temperature: 22.4°C
 Relative Humidity: 31.2%
 Atmospheric Pressure: 986 mbar

Deviations, Additions, or Exclusions: None



14.7 Plots/Data: Conducted Emissions (Neutral)



Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.357	39.006	60.086	21.080	30.893	50.086	19.193
0.366	39.131	59.829	20.698	32.639	49.829	17.190
0.384	38.404	59.314	20.910	30.166	49.314	19.148
0.389	37.357	59.186	21.829	29.944	49.186	19.242
1.752	27.313	56.000	28.687	18.324	46.000	27.676
2.769	26.463	56.000	29.537	17.527	46.000	28.473
4.125	26.597	56.000	29.403	17.773	46.000	28.227
18.262	18.913	60.000	41.087	13.557	50.000	36.443
29.580	8.092	60.000	51.908	3.267	50.000	46.733

Test Personnel: Bryan Taylor
 Supervising/Reviewing Engineer: NA
 (Where Applicable)
 Product Standard: FCC Part 15.207
 Input Voltage: 120VAC 60Hz
 Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 1/18/2020
 Limit Applied: Class B
 Ambient Temperature: 22.4°C
 Relative Humidity: 31.2%
 Atmospheric Pressure: 986 mbar

Deviations, Additions, or Exclusions: None



15 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	1/18/2020	104517828LEX-003	BCT	BZ	Original Issue