

Intertek
731 Enterprise Drive
Lexington, KY 40510

Tel 859 226 1000
Fax 859 226 1040

www.intertek.com

Hydro Systems Company TEST REPORT

SCOPE OF WORK

EMC TESTING – DMX3 WAREWASH DISPENSER

REPORT NUMBER

104460717LEX-001

ISSUE DATE

8/11/2021

PAGES

45

DOCUMENT CONTROL NUMBER

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



EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 104460717LEX-001

Project Number: G104460717

Report Issue Date: 8/11/2021

Model(s) Tested: DMX3 Warewash Dispenser

Standards: FCC Title 47 CFR Part 15.247

RSS-247 Issue 2

RSS-Gen Issue 5

Tested by:

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

Client:

Hydro Systems Company
3798 Round Bottom Rd.
Cincinnati, OH 45244-2413
USA

Report prepared by



Bryan Taylor, Team Leader

Report reviewed by



Brian Lackey, Senior 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	<i>Introduction and Conclusion</i>	4
2	<i>Test Summary</i>	4
3	<i>Client Information</i>	5
4	<i>Description of Equipment under Test and Variant Models</i>	6
5	<i>System Setup and Method</i>	7
6	<i>Receiver Spurious Emissions</i>	8
7	<i>Transmitter Spurious Emissions</i>	13
8	<i>Output Power</i>	25
9	<i>Occupied Bandwidth</i>	28
10	<i>Power Spectral Density</i>	33
11	<i>Conducted Spurious Emissions</i>	36
12	<i>Conducted Emissions</i>	40
13	<i>Antenna Requirement</i>	44
14	<i>Revision History</i>	45



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 Spurious Emissions (ANSI C63.4: 2014)	Pass
7	Transmitter Spurious Emissions (FCC Part 15.247(d), RSS-247 Issue 2 § 5.5)	Pass
8	Output Power (FCC Part 15.247(b)(3), RSS-247 Issue 2 § 5.4(d))	Pass
9	Occupied Bandwidth (FCC Part 15.247, RSS-247 Issue 2 § 5.2(a))	Pass
10	Power Spectral Density (FCC Part 15.247(e), RSS-247 Issue 2 § 5.2(b))	Pass
11	Conducted Spurious Emissions (FCC Part 15.247(d), RSS-247 Issue 2 § 5.5)	Pass
12	Conducted Emissions (ANSI C63.4: 2014)	Pass
13	Antenna Requirement (FCC Part 15.203, RSS-Gen Issue 5 § 6.8)	Pass



3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	Hydro Systems Company
Address:	3798 Round Bottom Rd. Cincinnati, OH 45244-2413 USA
Contact:	Doug Menedick
Email:	dmenkedick@hydrosystemsco.com
Manufacturer Information	
Manufacturer Name:	Hydro Systems Company
Manufacturer Address:	3798 Round Bottom Rd. Cincinnati, OH 45244-2413 USA



4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	DMX3 Warewash Dispenser
Model Number	HYDDMX-3PE30BCBAX
Serial Number	0221D2446
Transmission Type	Bluetooth Low Energy
Frequency Range	2402 – 2480MHz
Antenna Type	Inverted-F PCB Antenna
Test Frequencies	2402MHz, 2440MHz, 2480MHz
Receive Date	7/6/2021
Test Start Date	7/9/2021
Test End Date	7/13/2021
Device Received Condition	Good
Test Sample Type	Production
Rated Voltage	120VAC / 60Hz
Description of Equipment Under Test (provided by client)	
The DMX3 Warewash Dispenser dispenses detergent, rinse aid, and sanitizer chemicals, depending on how it is configured, for commercial door and conveyor dishwashing machines. The dispenser requires an 100-230 VAC at 50/60 Hz at 1.0 Amps input voltage and current to operate. A switch mode power supply regulates the input voltage and current. The dish machine sends trigger signals of 24-250VAC at 50/60Hz up to 20mA or 24VDC up to 20mA to activate the pump motors during the wash and rinse cycle.	
The DMx product is configured by and collects dispenser usage data from an iOS or Android mobile device via Bluetooth Low Energy (BLE). A user must have a valid login to connect to the product. Once logged into the Hydro Connect app, the user may view realtime data, make configuration changes, and when exiting the app connects to the Hydro Connect Cloud program to upload data for historical reporting.	

4.1 Variant Models:

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

The product has several variants with different numbers of pumps or solenoids. Only the 3 Liquid Pump Variant (HYDDMX-3PE30BCBAX) was tested during this evaluation. Three other variants are considered to be covered by similarity to this worst case configuration, and are listed in the following table.

Model Number	Description
HYDDMX-2PE20BCBAX	2 liquid pump motors
HYDDMX-2PE11BCBAX	1 liquid pump motor and 1 solenoid valve
HYDDMX-3PE21BCBAX	2 liquid pump motors and 1 solenoid valve



5 System Setup and Method

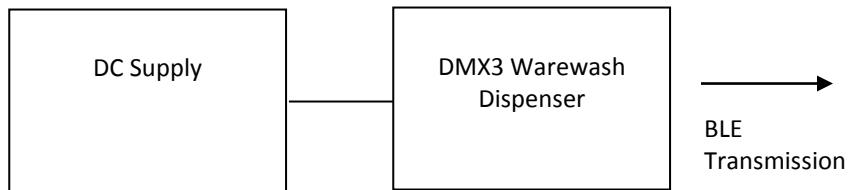
5.1 Method:

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

No.	Descriptions of EUT Exercising
1	Transmitting a BLE signal on low, mid, or high channels.
2	Transmitters in idle state

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	DC power cable	1	none	none	DC power supply

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 $\text{dB}\mu\text{V}/\text{m}$

RA = Receiver Amplitude (including preamplifier) in $\text{dB}\mu\text{V}$

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 $\text{dB}\mu\text{V}$ 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 $\text{dB}\mu\text{V}/\text{m}$. This value in $\text{dB}\mu\text{V}/\text{m}$ was converted to its corresponding level in $\mu\text{V}/\text{m}$.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}/\text{m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V}/\text{m}$$

To convert from $\text{dB}\mu\text{V}$ to μV or mV the following was used:

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

$$NF = \text{Net Reading in } \text{dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V}/\text{m}$$



6.3 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	1/26/2021	1/26/2022
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 (40GHz)	7020			12/21/2020	12/21/2021
Coaxial Cable (40GHz)	7021			12/21/2020	12/21/2021
Coaxial Cable	3074			12/21/2020	12/21/2021
Preamplifier	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	2592			12/21/2020	12/21/2021

6.4 Software Utilized

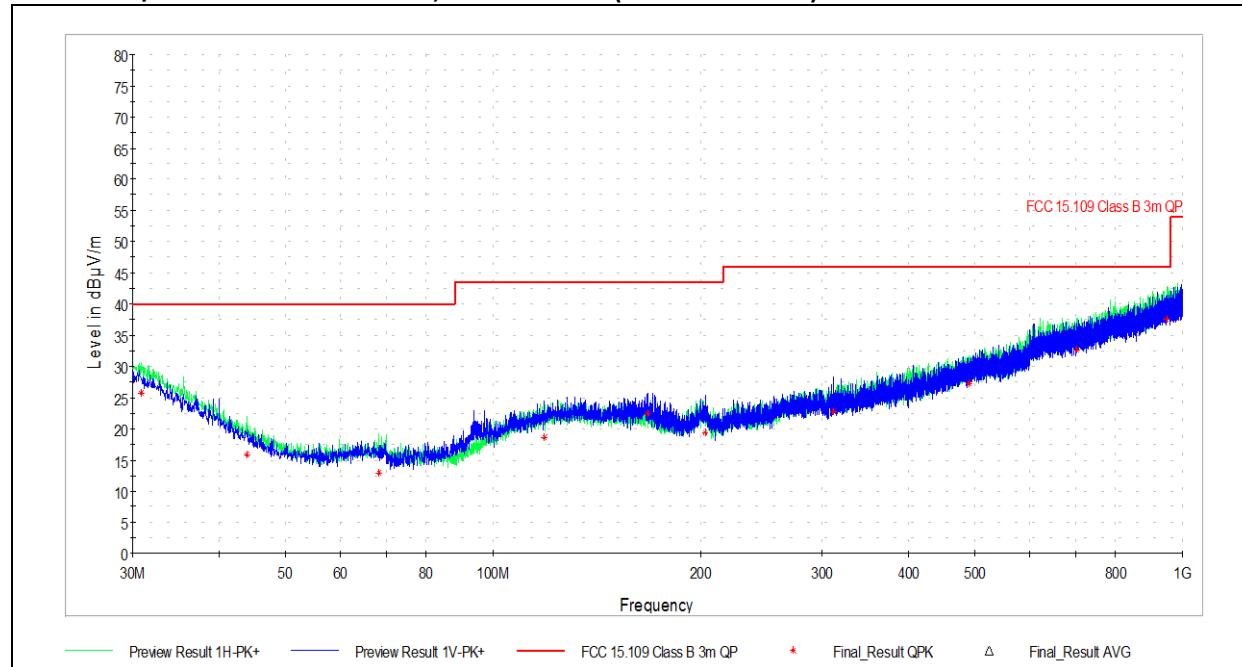
Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 9.15.02

6.5 Test Results

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



6.6 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/m)
30.862222	25.76	40.00	14.24	120.000	260.0	H	203.0	28
43.957222	15.89	40.00	24.11	120.000	212.0	H	222.0	19
68.261111	12.91	40.00	27.09	120.000	105.0	H	330.0	16
118.701111	18.65	43.52	24.87	120.000	117.0	V	0.0	22
167.308889	22.50	43.52	21.03	120.000	99.0	V	290.0	21
203.091111	19.44	43.52	24.09	120.000	100.0	V	50.0	22
312.431667	22.80	46.02	23.22	120.000	100.0	V	256.0	24
490.265000	27.24	46.02	18.78	120.000	299.0	H	0.0	29
703.772778	32.56	46.02	13.46	120.000	388.0	H	48.0	33
948.805556	37.57	46.02	8.46	120.000	335.0	H	116.0	38

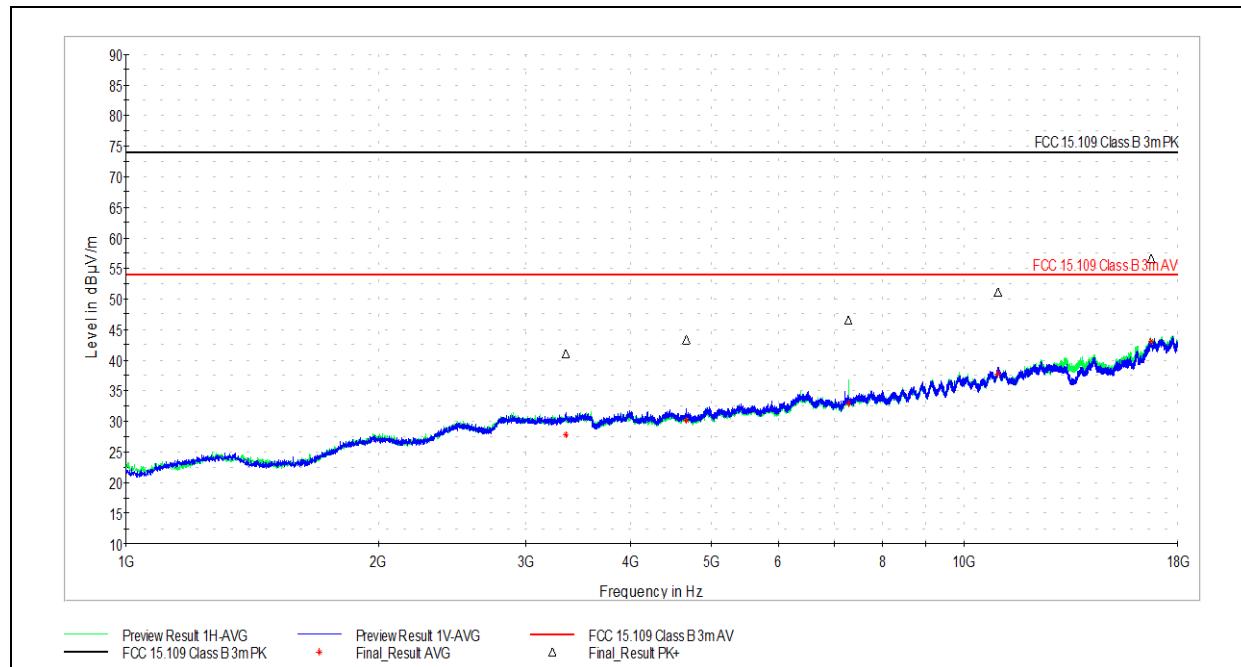
Test Personnel:	Bryan Taylor	Test Date:	7/8/2021
Supervising/Reviewing Engineer: (Where Applicable)	N/A	Limit Applied:	Class B
	FCC Part 15B		
Product Standard:	ICES-003	Ambient Temperature:	24.3°C
Input Voltage:	120VAC / 60Hz	Relative Humidity:	52.8%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	987.3 mbar

Deviations, Additions, or Exclusions: The FCC part 15B limits are used above as they are more restrictive than the ICES-003 limits.



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

Comment:



Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3349.500000	41.09	73.98	32.89	1000.000	100.0	V	0.0	7
4663.000000	43.45	73.98	30.53	1000.000	100.0	V	0.0	9
7277.500000	46.51	73.98	27.47	1000.000	100.0	H	174.0	14
10975.000000	51.16	73.98	22.82	1000.000	100.0	V	0.0	19
16716.500000	56.66	73.98	17.32	1000.000	225.0	H	233.0	25

Frequency (MHz)	Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3349.500000	27.80	53.98	26.18	1000.000	100.0	V	0.0	7
4663.000000	30.20	53.98	23.78	1000.000	100.0	V	0.0	9
7277.500000	32.90	53.98	21.08	1000.000	100.0	H	174.0	14
10975.000000	37.75	53.98	16.23	1000.000	100.0	V	0.0	19
16716.500000	43.10	53.98	10.88	1000.000	225.0	H	233.0	25

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

Test Date: 7/8/2021
Limit Applied: Class B
Ambient Temperature: 24.3°C
Relative Humidity: 52.8%
Atmospheric Pressure: 987.3 mbar

Deviations, Additions, or Exclusions: None



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 § 11.12.1 Radiated emission measurements.



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
Magnetic Loop Antenna	2366	ETS	6502	7/17/2020	7/17/2021
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	1/26/2021	1/26/2022
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 (40GHz)	7020			12/21/2020	12/21/2021
Coaxial Cable (40GHz)	7021			12/21/2020	12/21/2021
Coaxial Cable	3074			12/21/2020	12/21/2021
Preamplifier	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	2592			12/21/2020	12/21/2021

7.4 Software Utilized

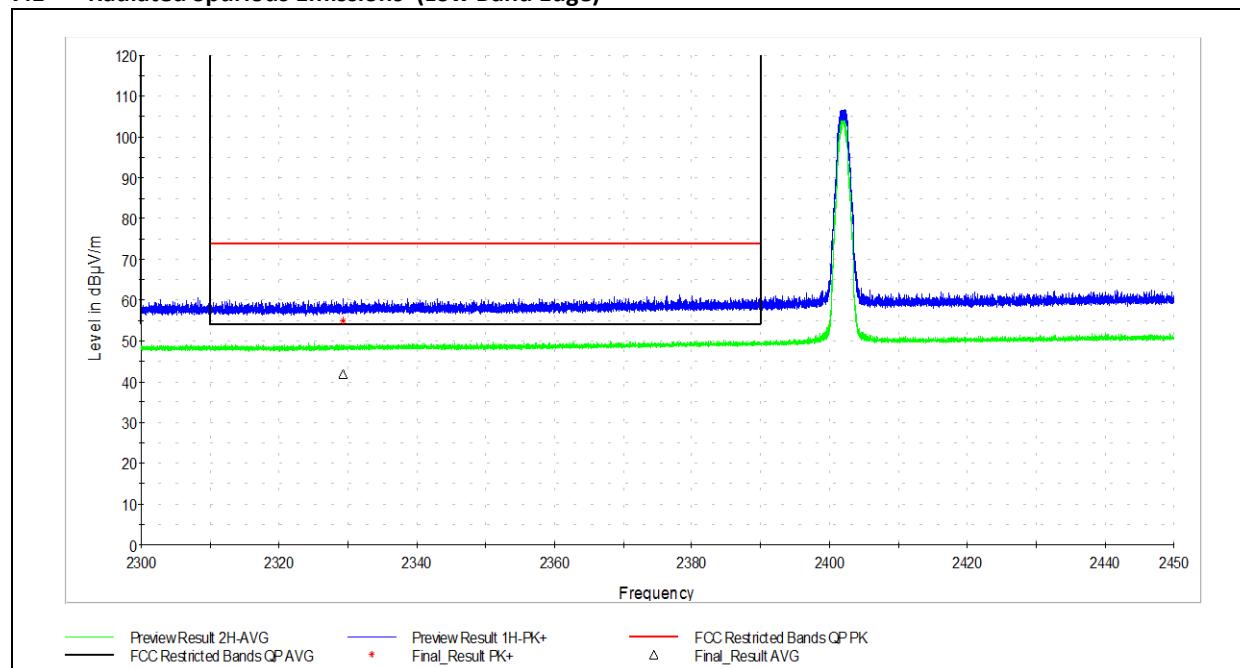
Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 9.15.02

7.5 Test Results

The sample tested was found to be **compliant**. All observed emissions outside of the band of operation were attenuated by at least 20dB.



7.1 Radiated Spurious Emissions (Low Band Edge)



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimut h (deg)	Corr. (dB/m)
2329.341667	55.00	73.98	18.98	1000.000	156.0	H	78.0	38

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimut h (deg)	Corr. (dB/m)
2329.341667	41.97	53.98	12.01	1000.000	156.0	H	78.0	38

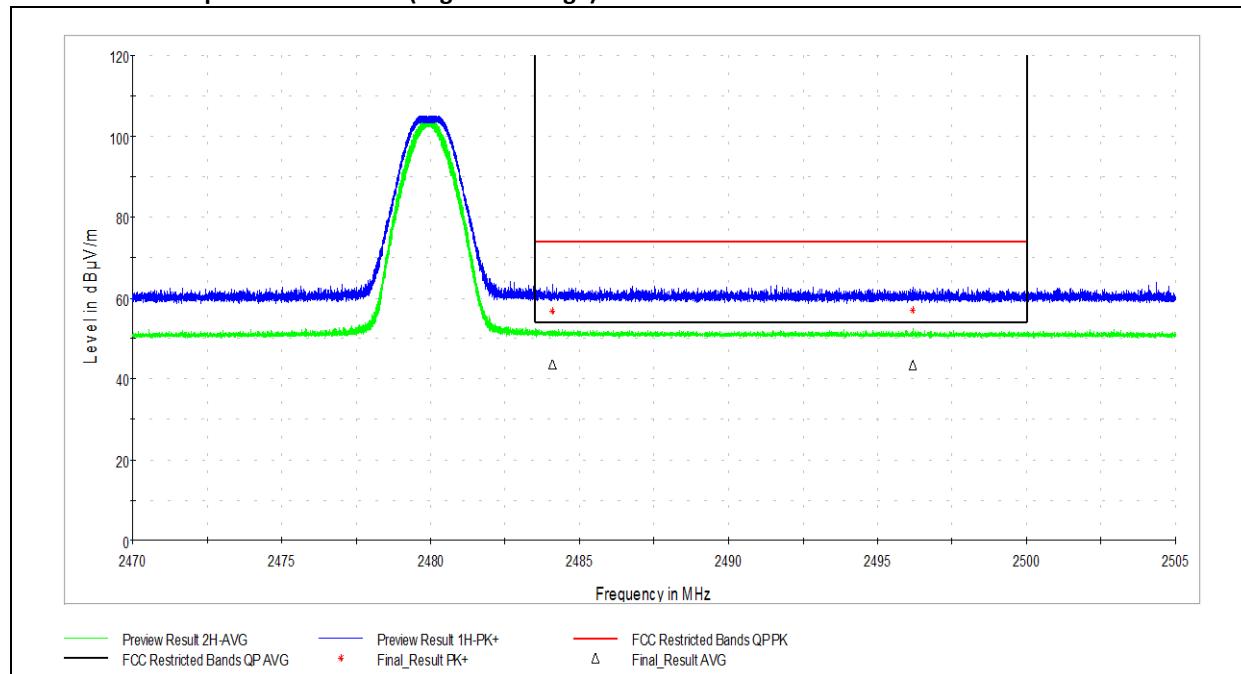
Test Personnel: Bryan Taylor
Supervising/Reviewing Engineer: _____
(Where Applicable) N/A
Product Standard: FCC Part 15.247
Input Voltage: RSS-247 Issue 2
120VAC / 60Hz
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 7/8/2021
Limit Applied: 15.205 Restricted Bands, 15.209
Ambient Temperature: 24.3°C
Relative Humidity: 52.8%
Atmospheric Pressure: 987.3 mbar

Deviations, Additions, or Exclusions: None



7.2 Radiated Spurious Emissions (High Band Edge)



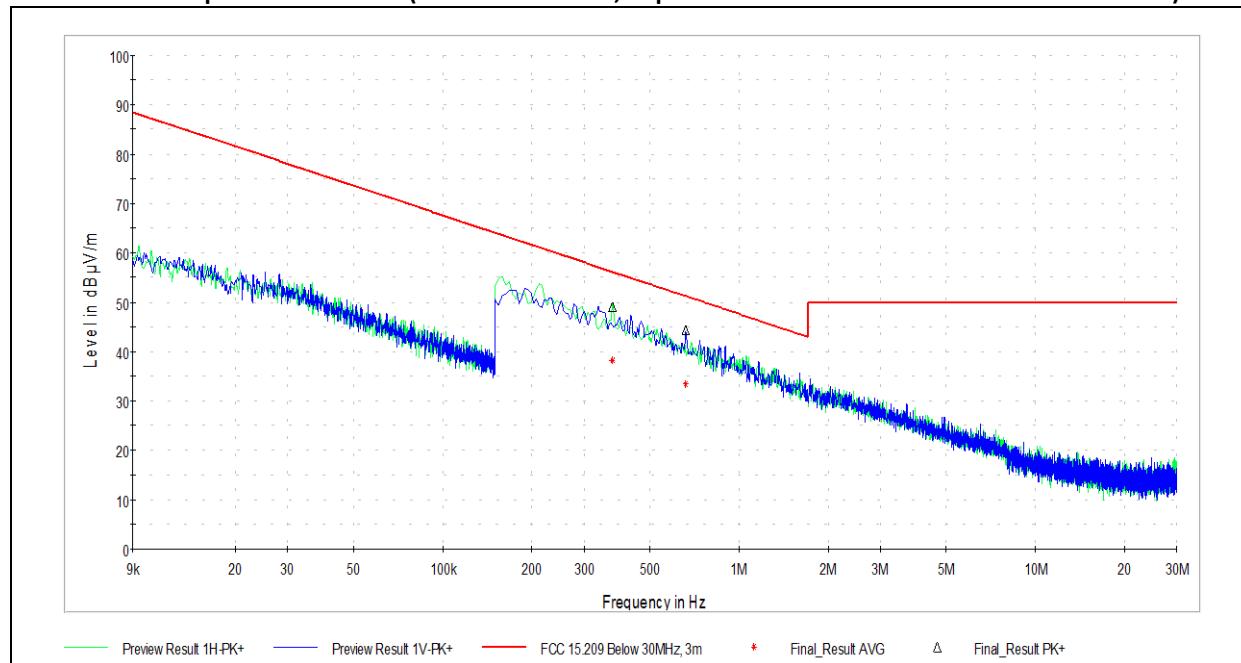
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2484.085556	56.82	73.98	17.16	1000.000	200.0	H	6.0	39
2496.181944	56.89	73.98	17.09	1000.000	300.0	H	89.0	39

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2484.085556	43.59	53.98	10.39	1000.000	200.0	H	6.0	39
2496.181944	43.48	53.98	10.50	1000.000	300.0	H	89.0	39

Test Personnel: Bryan Taylor
Supervising/Reviewing Engineer: _____
(Where Applicable) N/A
Product Standard: FCC Part 15.247
Input Voltage: RSS-247 Issue 2
120VAC / 60Hz
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 7/8/2021
Limit Applied: 15.205 Restricted Bands, 15.209
Ambient Temperature: 24.3°C
Relative Humidity: 52.8%
Atmospheric Pressure: 987.3 mbar

Deviations, Additions, or Exclusions: None

**7.3 Radiated Spurious Emissions (BLE 9kHz - 30MHz, Represents worst case from all transmit channels)**

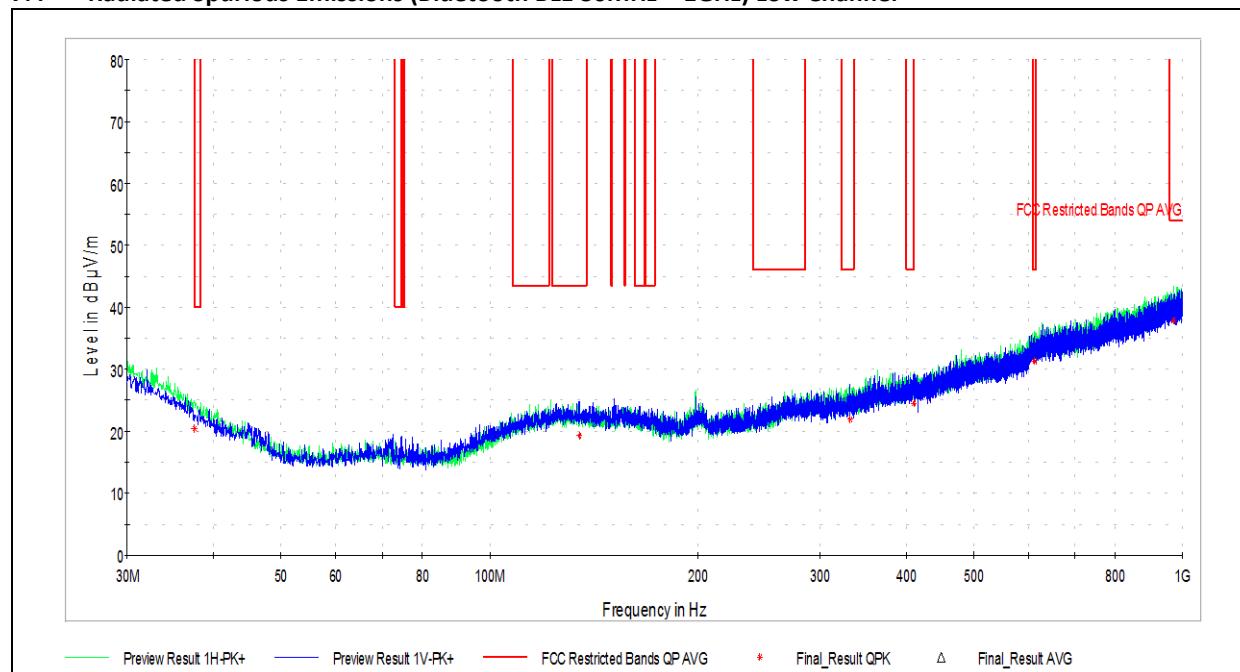
Frequency (MHz)	Average (dB μ V/m)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Azimuth (deg)	Corr. (dB/m)
0.373875	38.26	---	56.15	17.89	9.000	300.0	12
0.373875	---	49.08	---	---	9.000	300.0	12
0.659206	33.39	---	51.22	17.83	9.000	98.0	12
0.659206	---	44.42	---	---	9.000	192.0	12

Test Personnel: Bryan Taylor
Supervising/Reviewing Engineer: _____
(Where Applicable) N/A
Product Standard: FCC Part 15.247
Input Voltage: 120VAC / 60Hz
Pretest Verification w / Ambient Signals or BB Source: Yes
Test Date: 7/8/2021
Limit Applied: 15.205 Restricted Bands, 15.209
Ambient Temperature: 24.3°C
Relative Humidity: 52.8%
Atmospheric Pressure: 987.3 mbar

Deviations, Additions, or Exclusions: The results above represent the worst case from all transmit channels.



7.4 Radiated Spurious Emissions (Bluetooth BLE 30MHz – 1GHz) Low Channel



Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.544444	20.43	40.00	19.57	120.000	207.0	H	37.0	23
134.706111	19.23	43.52	24.30	120.000	164.0	V	0.0	22
331.723889	21.88	46.02	24.14	120.000	294.0	V	123.0	24
409.593333	24.49	46.02	21.53	120.000	246.0	H	268.0	27
611.946111	31.31	46.02	14.71	120.000	372.0	H	181.0	32
971.600556	37.93	53.98	16.04	120.000	162.0	H	172.0	38

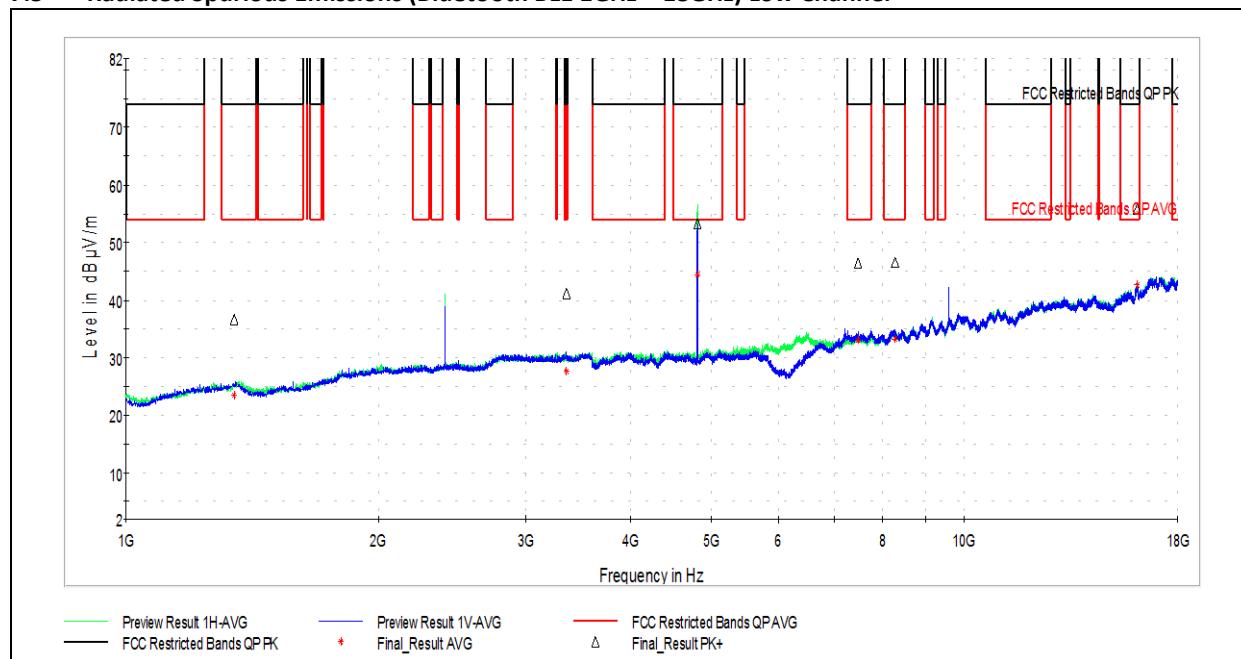
Test Personnel: Bryan Taylor
Supervising/Reviewing Engineer: _____
(Where Applicable) N/A
Product Standard: FCC Part 15.247
Input Voltage: RSS-247 Issue 2
120VAC / 60Hz
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 7/7/2021
Limit Applied: 15.205 Restricted Bands, 15.209
Ambient Temperature: 23.5°C
Relative Humidity: 58.7%
Atmospheric Pressure: 988.3 mbar

Deviations, Additions, or Exclusions: None



7.5 Radiated Spurious Emissions (Bluetooth BLE 1GHz – 18GHz) Low Channel



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1346.000000	36.61	73.98	37.37	1000.000	306.0	H	94.0	1
3352.500000	41.17	73.98	32.81	1000.000	285.0	V	299.0	7
4804.000000	53.25	73.98	20.73	1000.000	257.0	H	225.0	9
7476.000000	46.47	73.98	27.51	1000.000	281.0	V	259.0	13
8278.000000	46.66	73.98	27.32	1000.000	178.0	H	243.0	15
16091.000000	55.85	73.98	18.13	1000.000	227.0	H	128.0	25

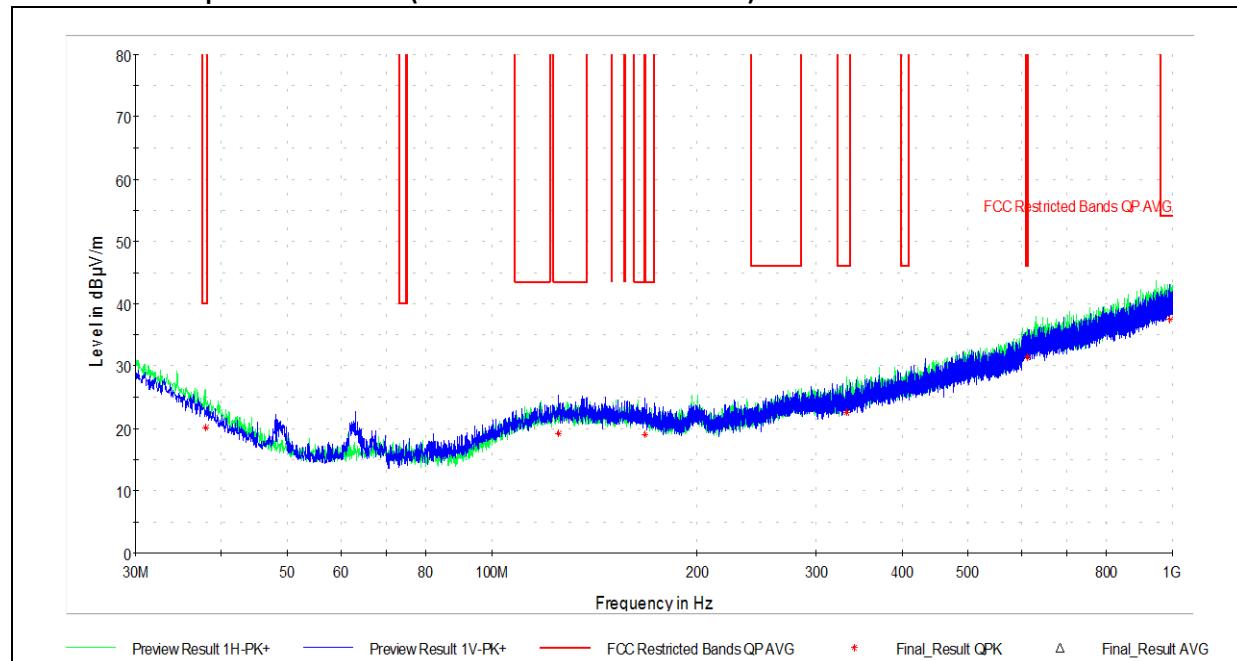
Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1346.000000	23.41	53.98	30.57	1000.000	306.0	H	94.0	1
3352.500000	27.59	53.98	26.39	1000.000	285.0	V	299.0	7
4804.000000	44.40	53.98	9.58	1000.000	257.0	H	225.0	9
7476.000000	33.09	53.98	20.89	1000.000	281.0	V	259.0	13
8278.000000	33.23	53.98	20.75	1000.000	178.0	H	243.0	15
16091.000000	42.57	53.98	11.41	1000.000	227.0	H	128.0	25

Test Personnel:	Bryan Taylor	Test Date:	7/7/2021
Supervising/Reviewing Engineer: (Where Applicable)	N/A	Limit Applied:	15.205 Restricted Bands, 15.209
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	23.5°C
Input Voltage:	120VAC / 60Hz	Relative Humidity:	58.7%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	988.3 mbar

Deviations, Additions, or Exclusions: None



7.6 Radiated Spurious Emissions (Bluetooth BLE 30MHz – 1 GHz) Mid Channel



Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.975556	20.07	40.00	19.93	120.000	325.0	H	0.0	23
125.113889	19.22	43.52	24.30	120.000	227.0	V	38.0	22
167.740000	19.03	43.52	24.50	120.000	100.0	V	79.0	21
331.670000	22.46	46.02	23.56	120.000	175.0	H	46.0	25
610.922222	31.41	46.02	14.61	120.000	368.0	H	49.0	32
992.617222	37.44	53.98	16.54	120.000	244.0	V	78.0	37

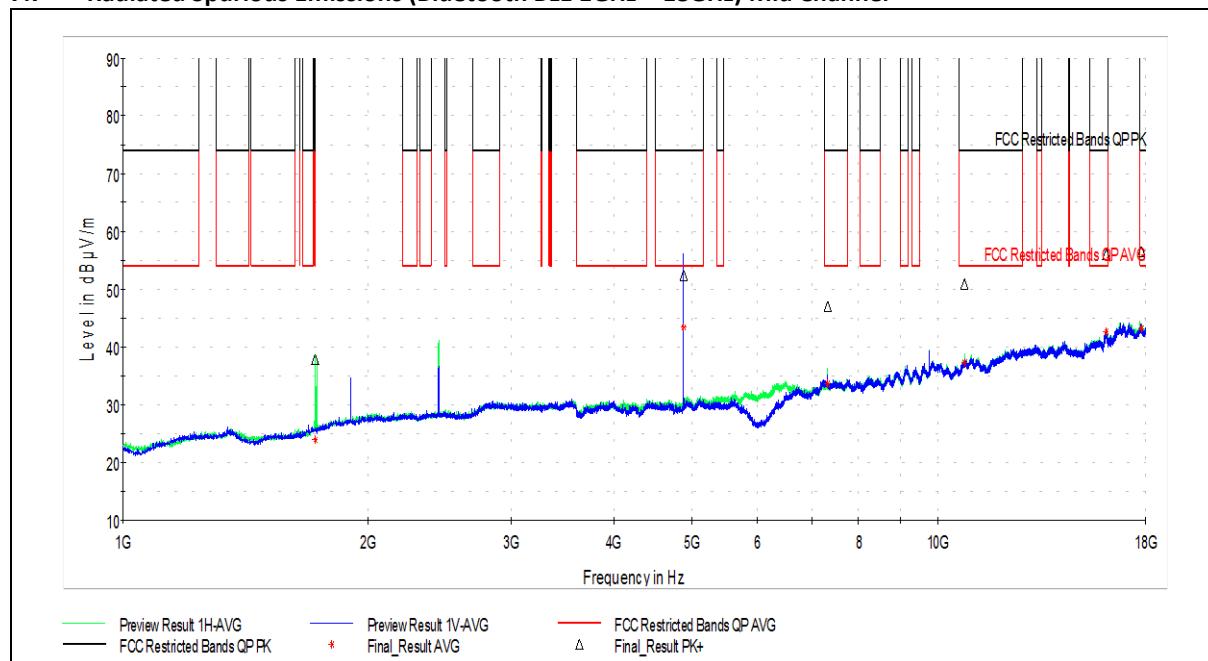
Test Personnel: Bryan Taylor
Supervising/Reviewing Engineer: _____
(Where Applicable) N/A
Product Standard: FCC Part 15.247
Input Voltage: 120VAC / 60Hz
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 7/7/2021
Limit Applied: 15.205 Restricted Bands, 15.209
Ambient Temperature: 23.5°C
Relative Humidity: 58.7%
Atmospheric Pressure: 988.3 mbar

Deviations, Additions, or Exclusions: None



7.7 Radiated Spurious Emissions (Bluetooth BLE 1GHz – 18GHz) Mid Channel



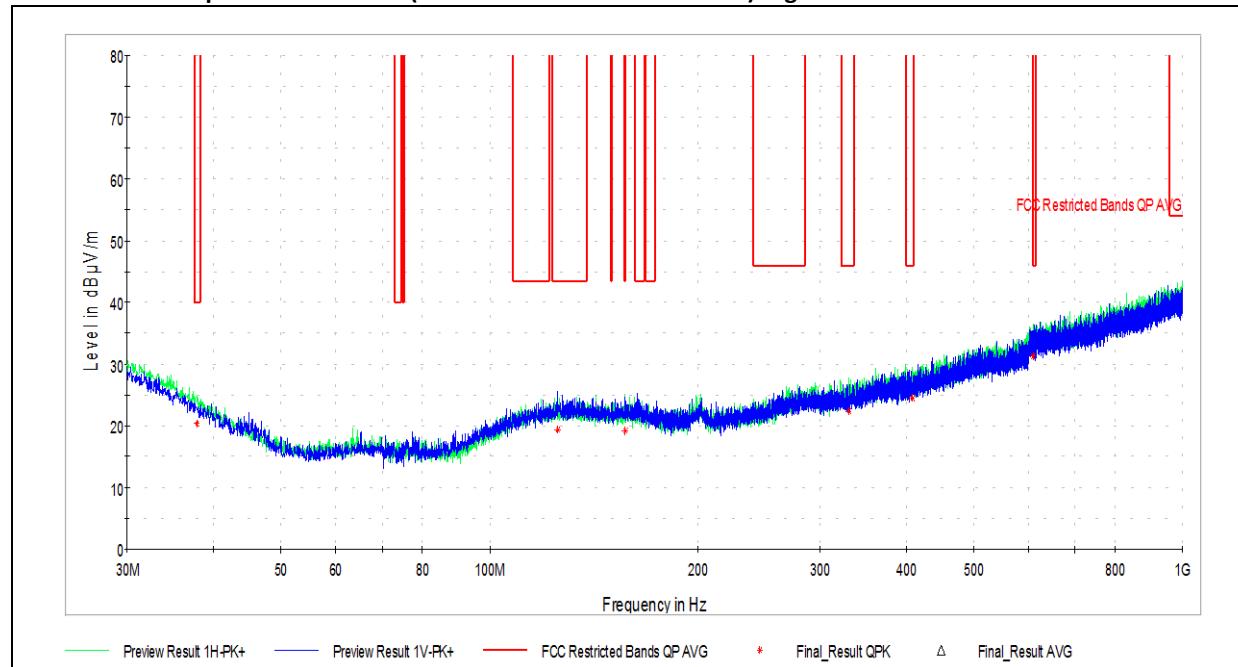
Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1720.500000	37.88	73.98	36.10	1000.000	288.0	H	301.0	2
4880.000000	52.35	73.98	21.63	1000.000	395.0	V	285.0	10
7320.500000	47.13	73.98	26.85	1000.000	410.0	H	232.0	13
10786.500000	50.90	73.98	23.08	1000.000	285.0	H	166.0	19
16092.500000	56.09	73.98	17.89	1000.000	351.0	H	72.0	25
17796.500000	56.52	73.98	17.46	1000.000	410.0	H	346.0	25

Frequency (MHz)	Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1720.500000	23.86	53.98	30.12	1000.000	288.0	H	301.0	2
4880.000000	43.44	53.98	10.54	1000.000	395.0	V	285.0	10
7320.500000	33.67	53.98	20.31	1000.000	410.0	H	232.0	13
10786.500000	37.29	53.98	16.69	1000.000	285.0	H	166.0	19
16092.500000	42.66	53.98	11.32	1000.000	351.0	H	72.0	25
17796.500000	43.23	53.98	10.75	1000.000	410.0	H	346.0	25

Test Personnel: Bryan Taylor
 Supervising/Reviewing Engineer: _____
 (Where Applicable) N/A
 Product Standard: FCC Part 15.247
 Input Voltage: RSS-247 Issue 2
 120VAC / 60Hz
 Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 7/7/2021
 Limit Applied: 15.205 Restricted Bands, 15.209
 Ambient Temperature: 23.5°C
 Relative Humidity: 58.7%
 Atmospheric Pressure: 988.3 mbar

Deviations, Additions, or Exclusions: None

**7.8 Radiated Spurious Emissions (Bluetooth BLE 30MHz – 1 GHz) High Channel**

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.760000	20.25	40.00	19.75	120.000	229.0	H	57.0	23
125.545000	19.29	43.52	24.24	120.000	163.0	V	286.0	22
156.800556	19.23	43.52	24.29	120.000	134.0	H	71.0	22
329.622222	22.36	46.02	23.67	120.000	163.0	H	328.0	25
407.815000	24.43	46.02	21.59	120.000	400.0	H	170.0	27
608.012222	31.29	46.02	14.73	120.000	105.0	H	8.0	32

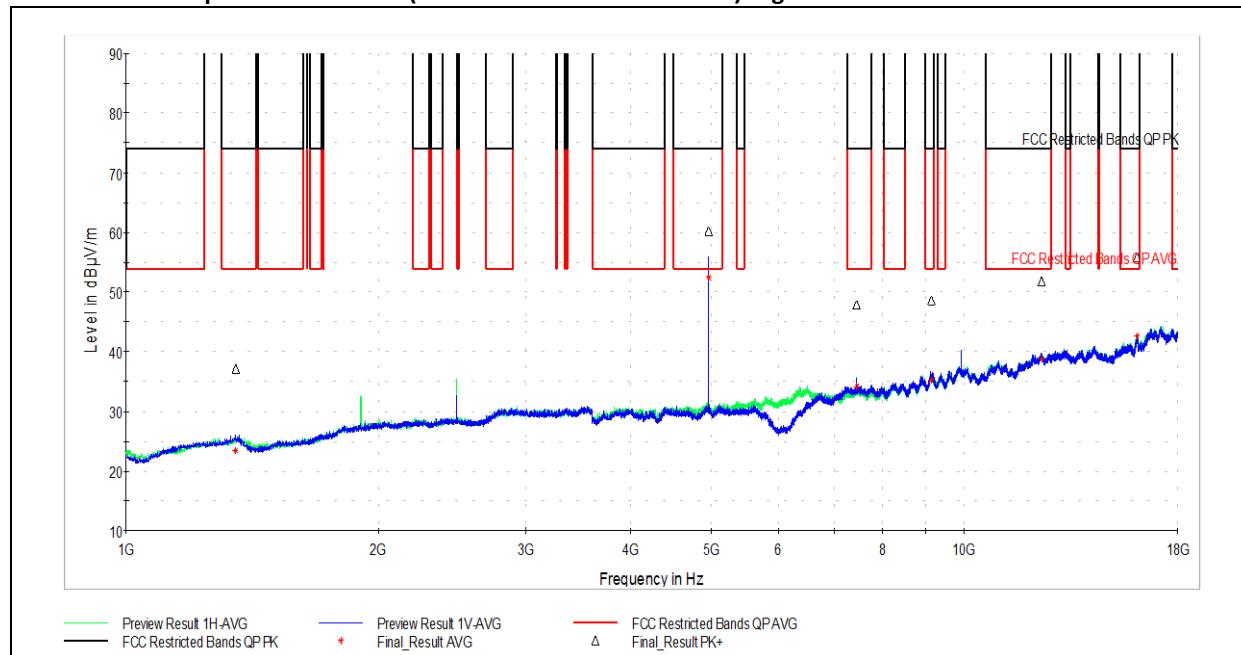
Test Personnel: Bryan Taylor
Supervising/Reviewing Engineer: _____
(Where Applicable) N/A
Product Standard: FCC Part 15.247
Input Voltage: 120VAC / 60Hz
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 7/7/2021
Limit Applied: 15.205 Restricted Bands, 15.209
Ambient Temperature: 23.5°C
Relative Humidity: 58.7%
Atmospheric Pressure: 988.3 mbar

Deviations, Additions, or Exclusions: None



7.9 Radiated Spurious Emissions (Bluetooth BLE 1GHz – 18GHz) High Channel



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1350.000000	37.10	73.98	36.88	1000.000	289.0	V	0.0	2
4960.000000	60.23	73.98	13.75	1000.000	265.0	V	316.0	10
7439.500000	47.92	73.98	26.06	1000.000	112.0	V	85.0	13
9137.000000	48.65	73.98	25.33	1000.000	283.0	V	225.0	16
12378.000000	51.88	73.98	22.10	1000.000	410.0	V	0.0	21
16099.500000	55.85	73.98	18.13	1000.000	410.0	H	157.0	25

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1350.000000	23.41	53.98	30.57	1000.000	289.0	V	0.0	2
4960.000000	52.38	53.98	1.60	1000.000	265.0	V	316.0	10
7439.500000	34.21	53.98	19.77	1000.000	112.0	V	85.0	13
9137.000000	35.15	53.98	18.83	1000.000	283.0	V	225.0	16
12378.000000	38.83	53.98	15.15	1000.000	410.0	V	0.0	21
16099.500000	42.62	53.98	11.36	1000.000	410.0	H	157.0	25

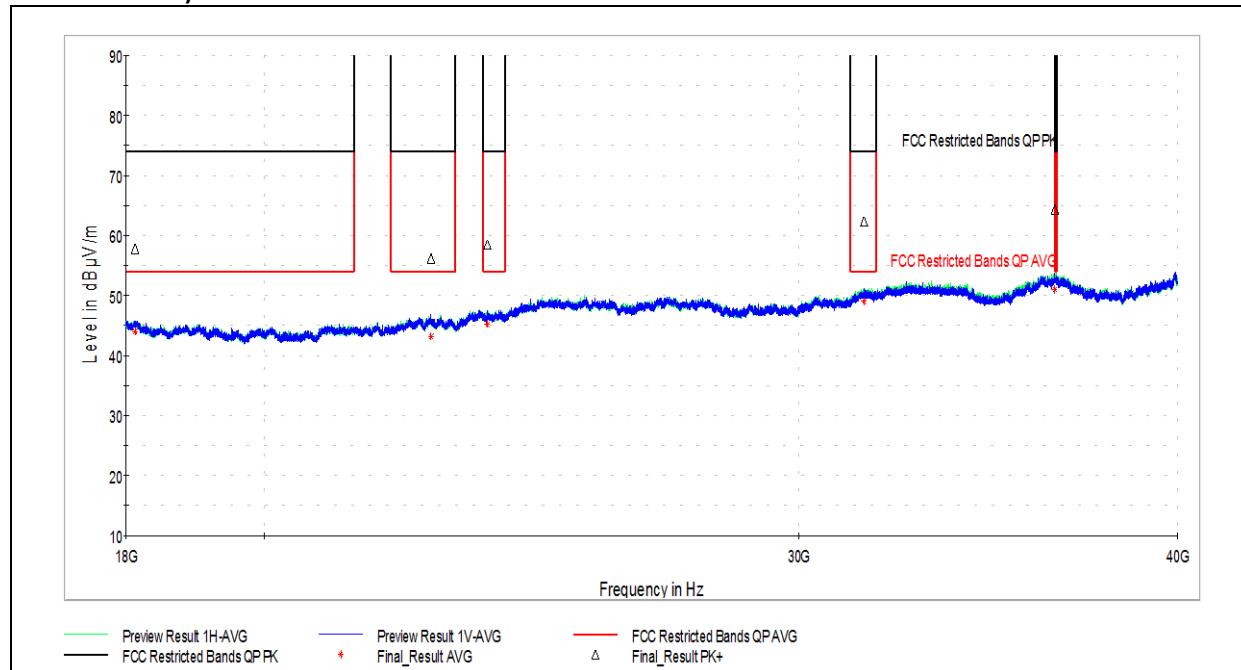
Test Personnel: Bryan Taylor
 Supervising/Reviewing Engineer: _____
 (Where Applicable) N/A
 Product Standard: FCC Part 15.247
 Input Voltage: 120VAC / 60Hz
 Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 7/7/2021
 Limit Applied: 15.205 Restricted Bands, 15.209
 Ambient Temperature: 23.5°C
 Relative Humidity: 58.7%
 Atmospheric Pressure: 988.3 mbar

Deviations, Additions, or Exclusions: None



7.10 Radiated Spurious Emissions (Bluetooth BLE 18GHz – 40GHz, Represents worst case from all transmit channels)



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18124.000000	57.76	73.98	16.22	1000.000	118.0	V	12.0	21
22690.500000	56.11	73.98	17.87	1000.000	385.0	V	0.0	11
23680.000000	58.56	73.98	15.42	1000.000	395.0	V	0.0	11
31519.000000	62.30	73.98	11.68	1000.000	100.0	V	335.0	17
36440.500000	64.30	73.98	9.68	1000.000	410.0	H	0.0	19

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18124.000000	44.02	53.98	9.96	1000.000	118.0	V	12.0	21
22690.500000	43.10	53.98	10.88	1000.000	385.0	V	0.0	11
23680.000000	45.15	53.98	8.83	1000.000	395.0	V	0.0	11
31519.000000	48.97	53.98	5.01	1000.000	100.0	V	335.0	17
36440.500000	50.96	53.98	3.02	1000.000	410.0	H	0.0	19

Test Personnel: Bryan Taylor
Supervising/Reviewing Engineer: (Where Applicable) N/A
Product Standard: FCC Part 15.247
Input Voltage: RSS-247 Issue 2
Pretest Verification w / Ambient Signals or BB Source: 120VAC / 60Hz
Yes

Test Date: 7/7/2021
Limit Applied: 15.205 Restricted Bands, 15.209
Ambient Temperature: 23.5°C
Relative Humidity: 58.7%
Atmospheric Pressure: 988.3 mbar

Deviations, Additions, or Exclusions: The results above represent the worst case from all transmit channels



8 Output Power

8.1 Test Limits

FCC Part 15.247(b)(3):

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

RSS-247 Issue 2 § 5.4(d):

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

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



8.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.9.1.3

8.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
Spectrum Analyzer	3720	Rohde & Schwarz	FSEK30	10/13/2020	10/13/2021

8.4 Test Results

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

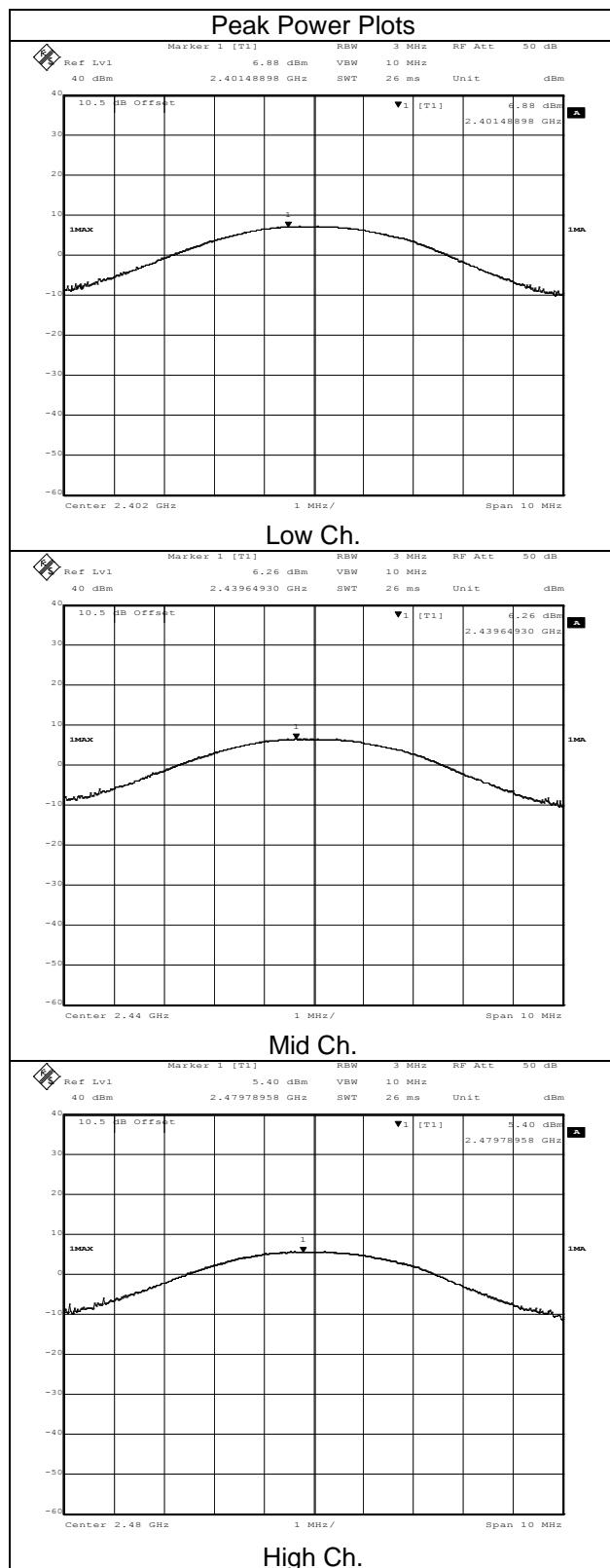
8.5 Test Conditions

Test Personnel:	Bryan Taylor	Test Date:	7/9/2021
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	See Above
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	23.6C
Input Voltage:	120VAC / 60Hz	Relative Humidity:	60.2%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.2mbar

Deviations, Additions, or Exclusions: None

8.6 Test Data (Peak Power)

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
0	2402	6.88	30	23.12	PASS
39	2440	6.26	30	23.74	PASS
79	2480	5.4	30	24.6	PASS





9 Occupied Bandwidth

9.1 Test Limits

FCC Part 15.247(a)(2):

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

RSS-247 Issue 2 § 5.2(a):

The minimum 6 dB bandwidth shall be 500 kHz.

9.2 Test Method

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

9.3 Test Equipment Used

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

9.4 Test Results

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

9.5 Test Conditions

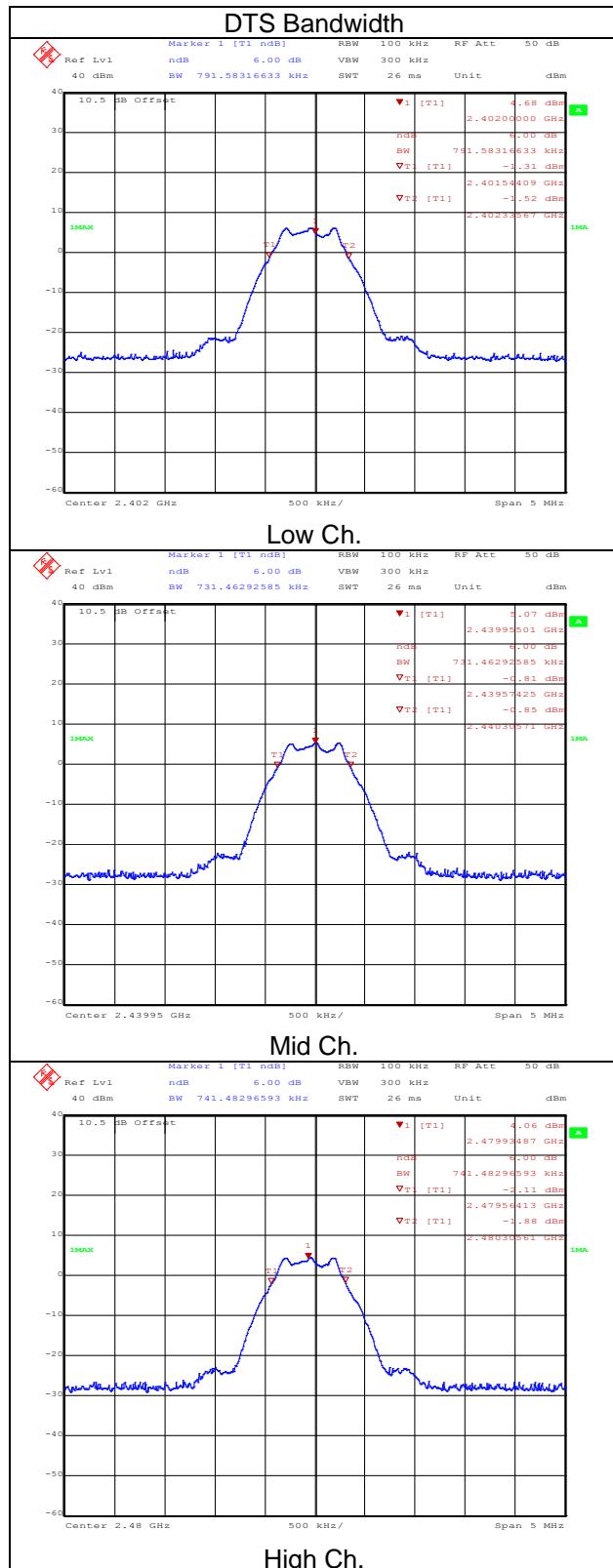
Test Personnel:	Bryan Taylor	Test Date:	7/9/2021
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	See Above
	FCC Part 15.247	Ambient Temperature:	23.6C
Product Standard:	RSS-247 Issue 2	Relative Humidity:	60.2%
Input Voltage:	120VAC / 60Hz	Atmospheric Pressure:	985.2mbar
Pretest Verification w / Ambient Signals or BB Source:	Yes		
Deviations, Additions, or Exclusions:	None		

9.6 Test Data

Channel	DTS BW (kHz)	6dB BW (kHz)	99% BW (kHz)	20dB BW (kHz)	DTS BW (kHz)
0	791.58	619.24	1040.08	1136.27	791.58
39	731.46	649.3	1052.1	1136.27	731.46
79	741.48	625.25	1058.12	1136.27	741.48

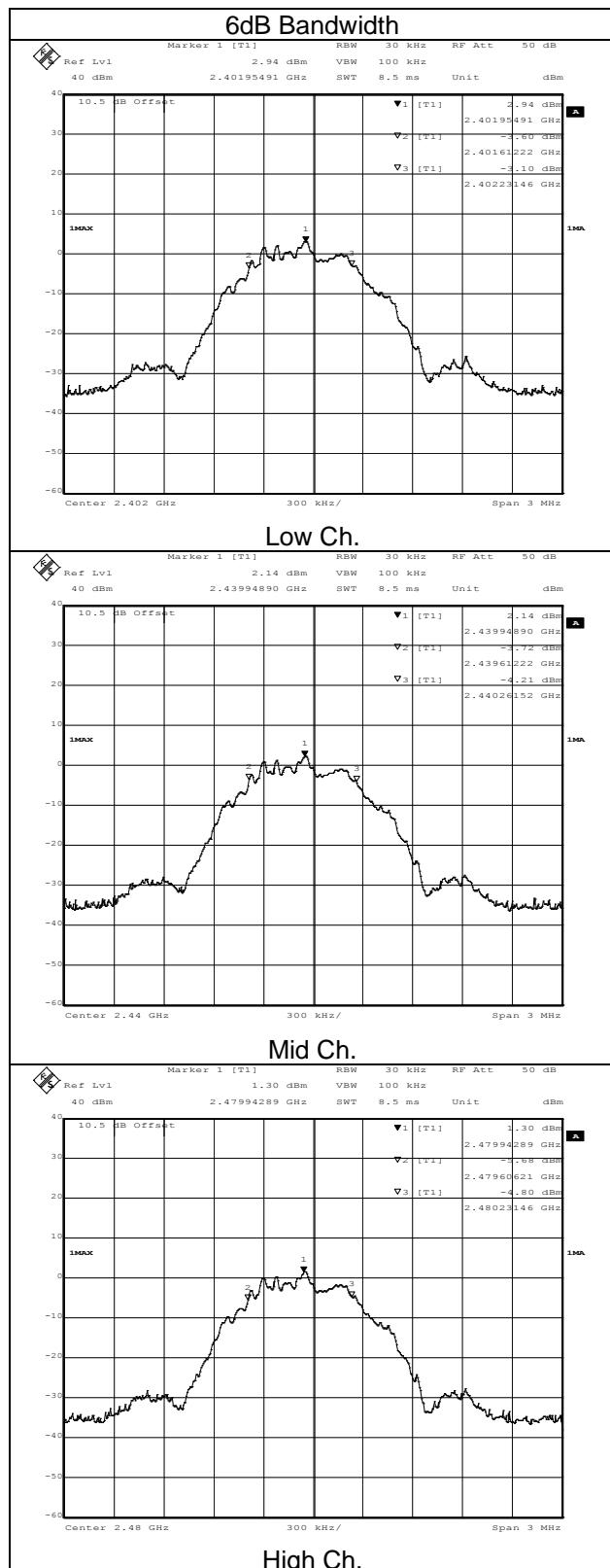


9.7 DTS Bandwidth Plots



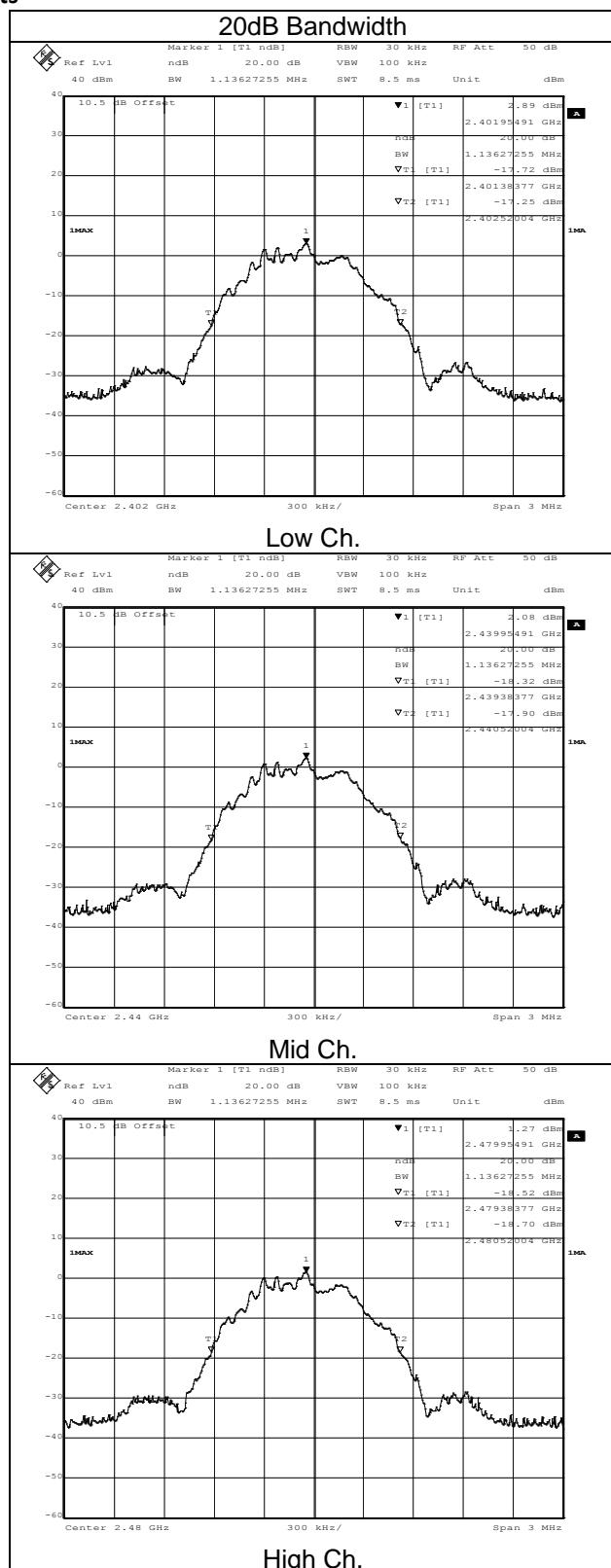


9.8 6dB Bandwidth Plots



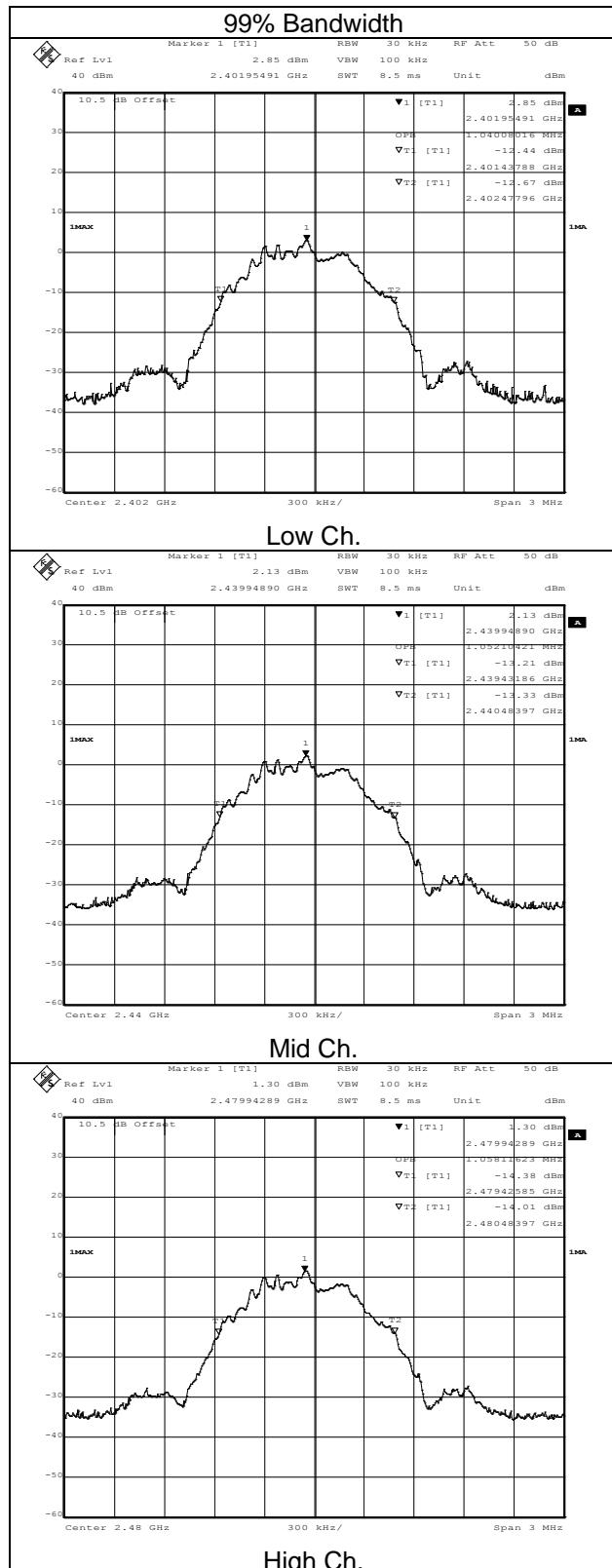


9.9 20dB Bandwidth Plots





9.10 99% Bandwidth Plots





10 Power Spectral Density

10.1 Test Limits

FCC Part 15.247(e):

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

RSS-247 Issue 2 § 5.2(b):

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

10.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.10.2 Method PKPSD (peak PSD).

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 peak power spectral density was less than 8dBm.

10.5 Test Conditions

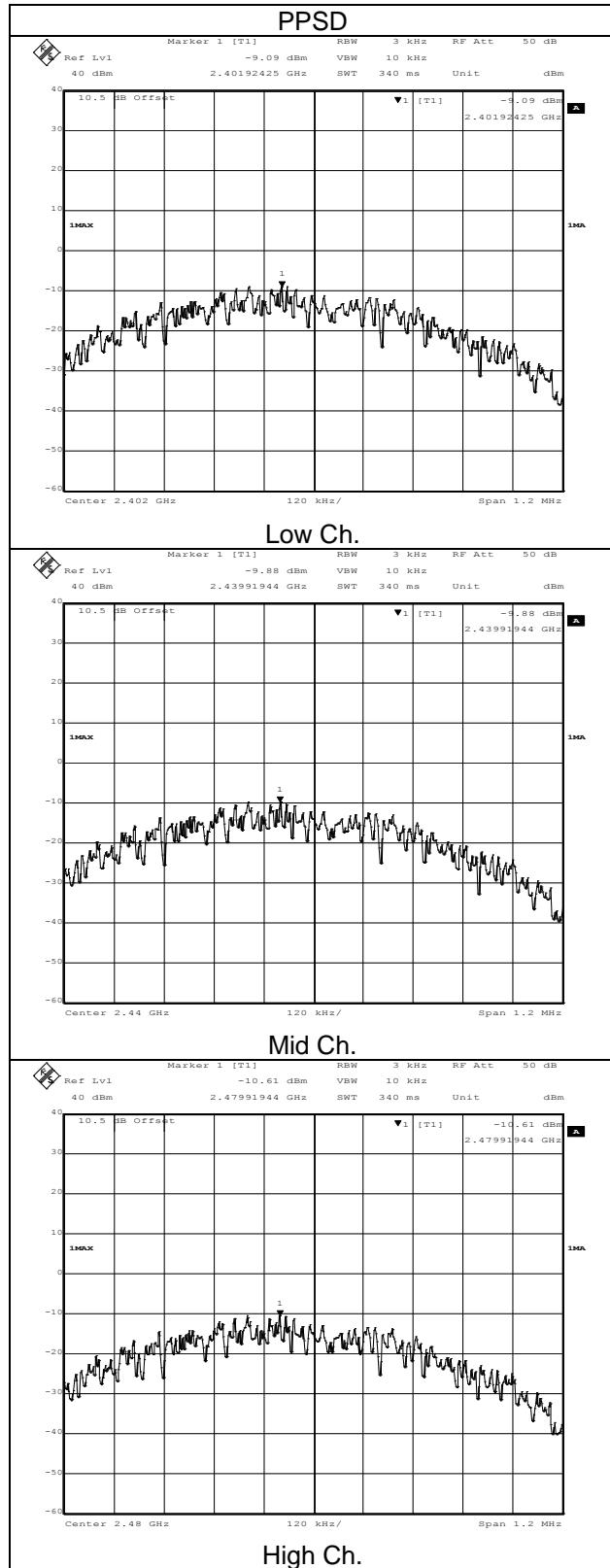
Test Personnel:	Bryan Taylor	Test Date:	7/9/2021
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	See Above
	FCC Part 15.247	Ambient Temperature:	23.6C
Product Standard:	RSS-247 Issue 2	Relative Humidity:	60.2%
Input Voltage:	120VAC / 60Hz	Atmospheric Pressure:	985.2mbar
Pretest Verification w / Ambient Signals or BB Source:	Yes		
Deviations, Additions, or Exclusions:	None		

**10.6 Test Data**

Channel	Frequency (MHz)	PPSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
0	2402	-9.09	8	17.09	PASS
39	2440	-9.88	8	17.88	PASS
79	2480	-10.61	8	18.61	PASS



10.7 PPSD Plots





11 Conducted Spurious Emissions

11.1 Test Limits

FCC Part 15.247(d):

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

RSS-247 Issue 2 § 5.5:

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

11.2 Test Method

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

11.3 Test Equipment Used

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



11.4 Test Results

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

11.5 Test Conditions

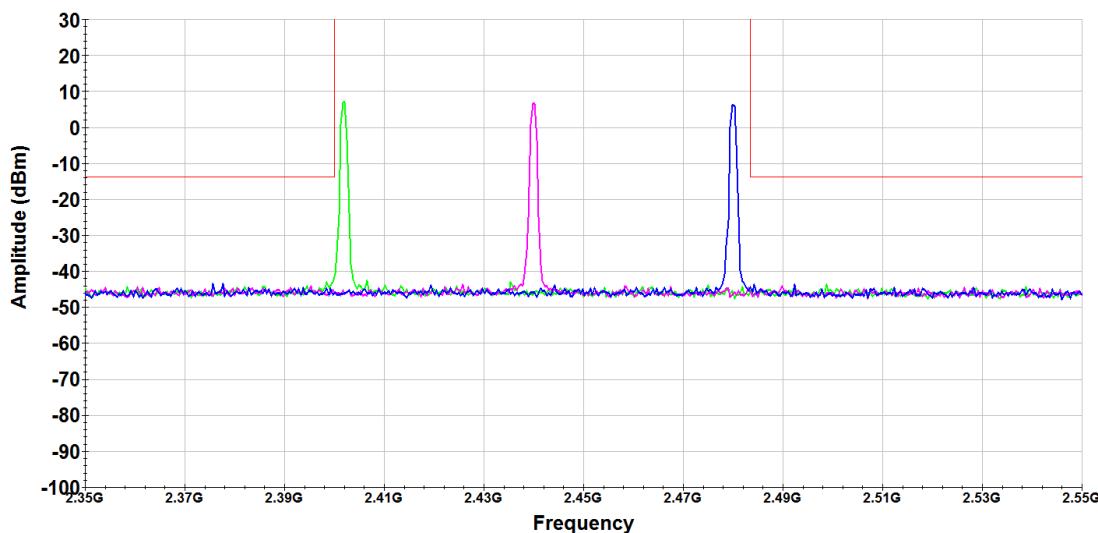
Test Personnel:	Bryan Taylor	Test Date:	7/9/2021
Supervising/Reviewing Engineer:		Limit Applied:	See Above
(Where Applicable)	NA	Ambient Temperature:	23.6C
	FCC Part 15.247	Relative Humidity:	60.2%
Product Standard:	RSS-247 Issue 2		
Input Voltage:	120VAC / 60Hz	Atmospheric Pressure:	985.2mbar
Pretest Verification w / Ambient Signals or BB Source:	Yes		
Deviations, Additions, or Exclusions: None			



11.6 Test Data

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

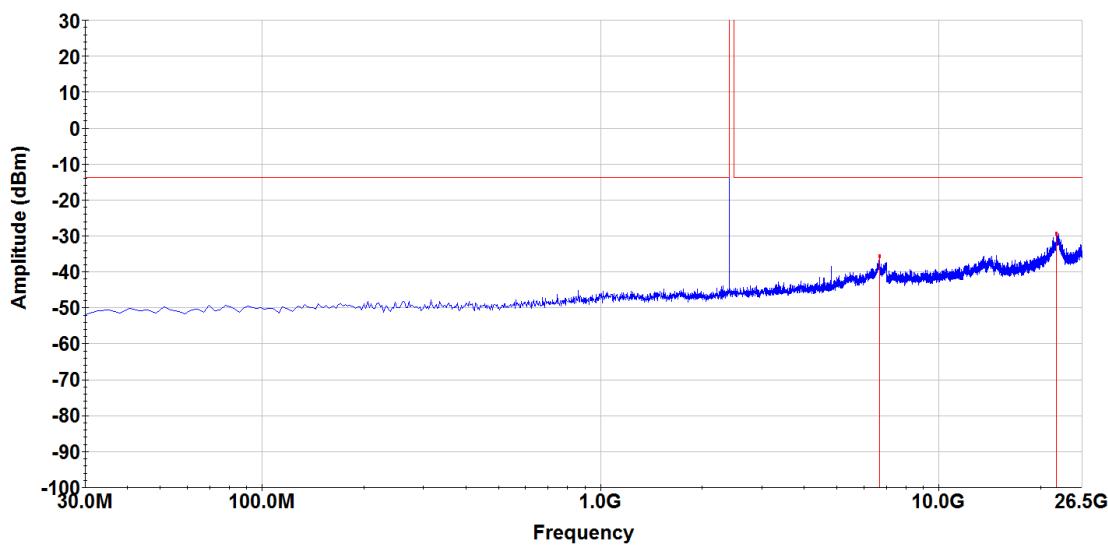
Conducted Spurious Emissions (Band)



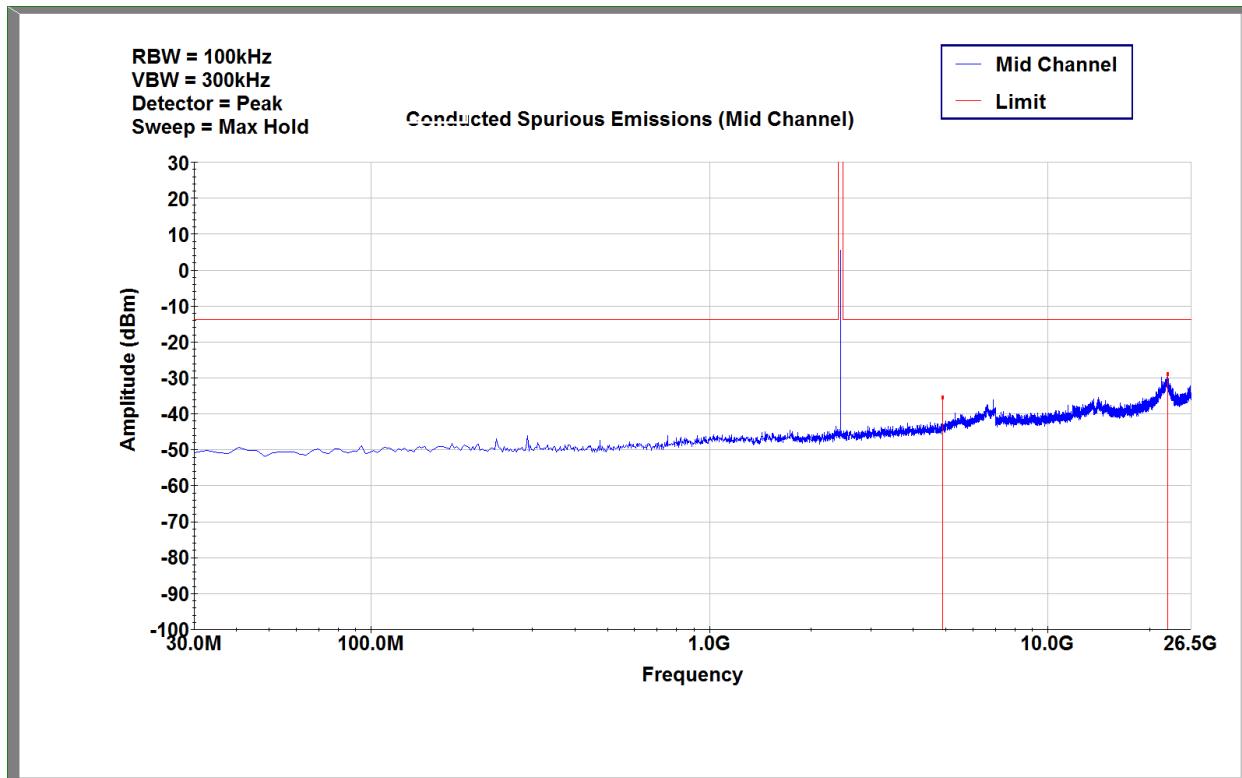
Conducted Spurious Emissions (Band Edge)

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

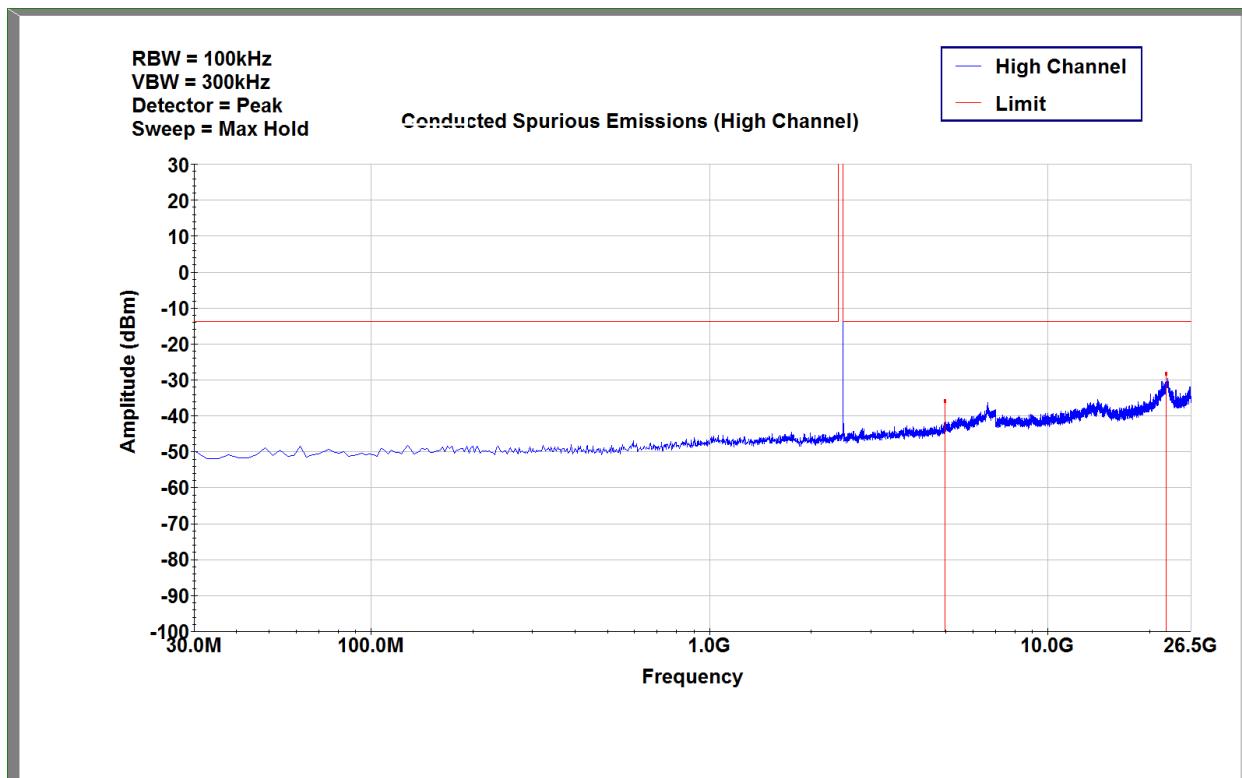
Conducted Spurious Emissions (Low Channel)



Conducted Spurious Emissions (2402MHz)



Conducted Spurious Emissions (2440MHz)



Conducted Spurious Emissions (2480MHz)



12 Conducted Emissions

12.1 Method

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

TEST SITE: Ground Plane

Site Designation: Ground Plane

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
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.

12.2 Sample Calculations

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

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

Where NF = Net Reading in dB μ V

RF = Reading from receiver in dB μ V

LF = LISN or ISN Correction Factor in dB

CF = Cable Correction Factor in dB

AF = Attenuator Loss Factor in dB

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 = Net Reading in dB μ V

Example:

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

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

**12.3 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	3333	Teseq	NNB52	5/7/2021	5/7/2022
Coaxial Cable (COND 3)	6026			12/21/2020	12/21/2021

12.4 Software Utilized:

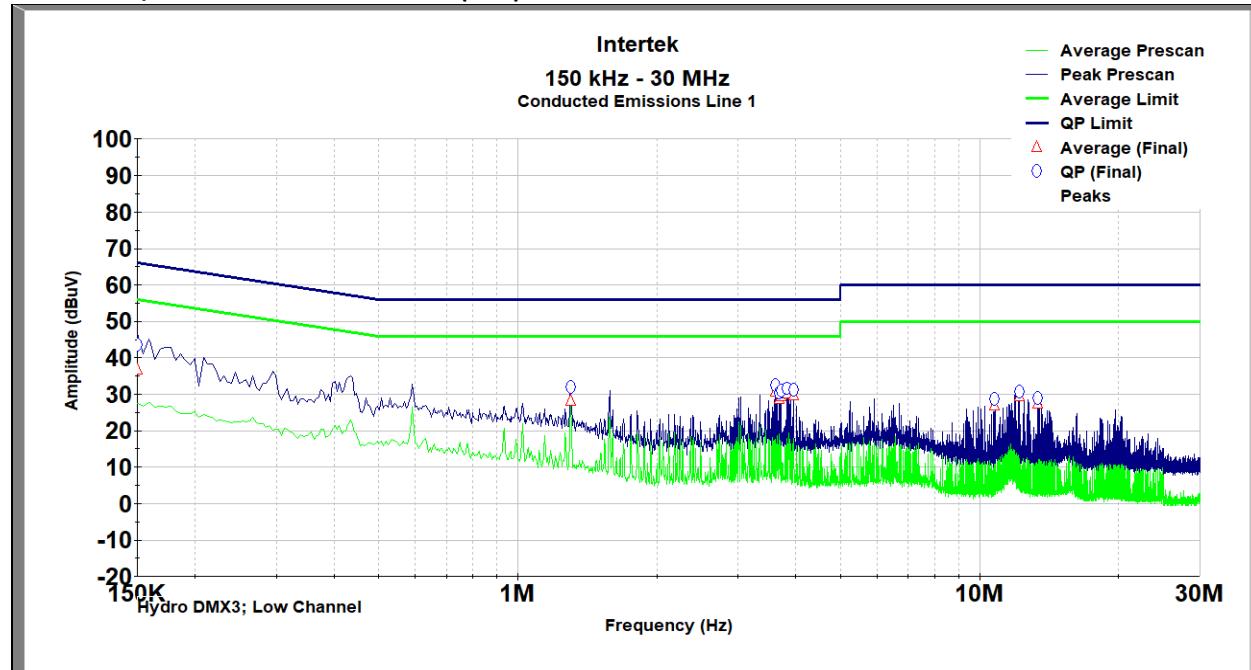
Name	Manufacturer	Version
TILE	ETS Lindgren	V7.0.6.545

12.5 Results:

The sample tested was found to Comply.



12.6 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)
0.150	43.525	66.000	22.475	36.677	56.000	19.323
1.302	31.931	56.000	24.069	28.166	46.000	17.834
3.616	32.467	56.000	23.533	30.715	46.000	15.285
3.680	30.421	56.000	25.579	28.667	46.000	17.333
3.711	31.074	56.000	24.926	29.437	46.000	16.563
3.833	31.682	56.000	24.318	30.297	46.000	15.703
3.954	31.281	56.000	24.719	29.824	46.000	16.176
10.793	28.601	60.000	31.399	27.072	50.000	22.928
12.198	30.718	60.000	29.282	29.397	50.000	20.603
13.359	28.980	60.000	31.020	27.393	50.000	22.607

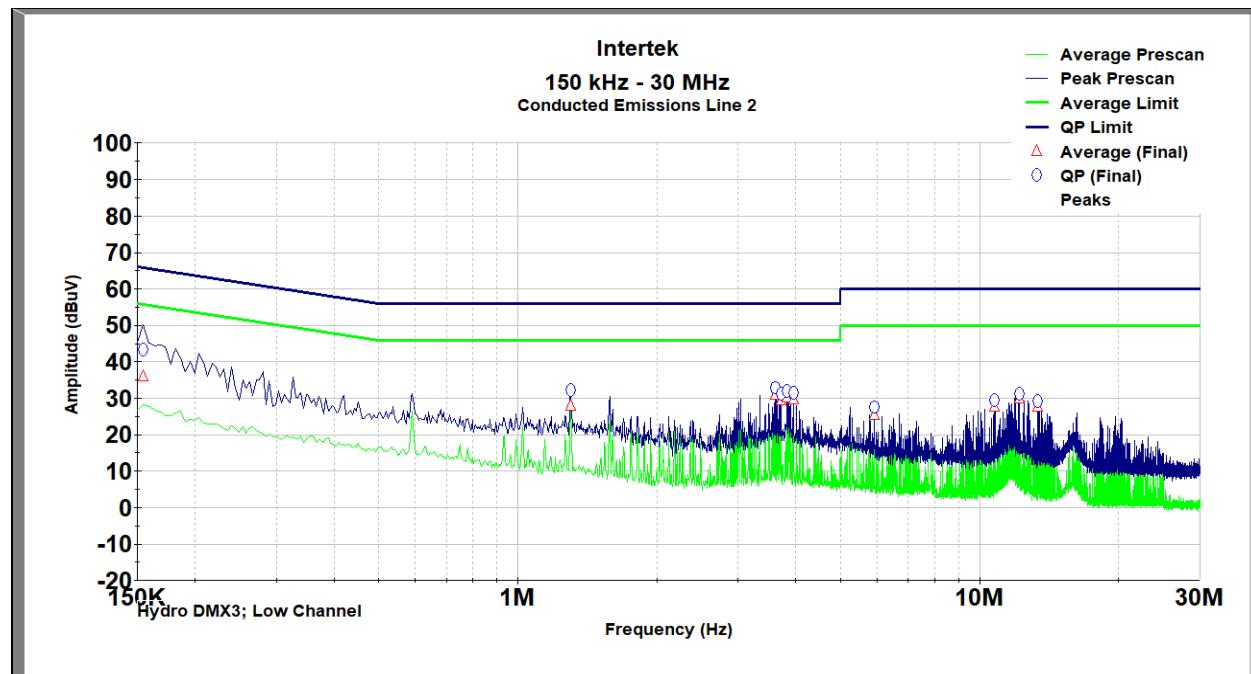
Test Personnel: Bryan Taylor
Supervising/Reviewing Engineer: _____
(Where Applicable) NA
Product Standard: FCC Part 15C, RSS-247
Input Voltage: 120VAC / 60Hz
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 7/13/2021
Limit Applied: 15.207
Ambient Temperature: 22.2 °C
Relative Humidity: 48.4%
Atmospheric Pressure: 991.2 mbar

Deviations, Additions, or Exclusions: None



12.7 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)
0.155	43.261	65.871	22.611	35.991	55.871	19.880
1.302	32.333	56.000	23.667	27.997	46.000	18.003
3.616	32.952	56.000	23.048	30.909	46.000	15.091
3.711	31.192	56.000	24.808	29.548	46.000	16.452
3.833	31.873	56.000	24.127	30.326	46.000	15.674
3.954	31.402	56.000	24.598	29.779	46.000	16.221
5.907	27.655	60.000	32.345	25.330	50.000	24.670
10.793	29.341	60.000	30.659	27.759	50.000	22.241
12.198	31.228	60.000	28.772	29.999	50.000	20.001
13.359	29.228	60.000	30.772	27.791	50.000	22.209

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

Test Date: 7/13/2021
Limit Applied: 15.207
Ambient Temperature: 22.2 °C
Relative Humidity: 48.4%
Atmospheric Pressure: 991.2 mbar

Deviations, Additions, or Exclusions: None



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 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	8/11/2021	104460717LEX-001	BCT	BZ	Original Issue