



Total Quality. Assured.

Intertek
731 Enterprise Drive
Lexington, KY 40510

Tel 859 226 1000
Fax 859 226 1040

www.intertek.com

Alcohol Monitoring Systems, Inc. TEST REPORT

SCOPE OF WORK

FCC PART 15.247 / RSS-247 TESTING – US BASE STATION

REPORT NUMBER

103705988LEX-001

ISSUE DATE

3/19/2019

PAGES

44

DOCUMENT CONTROL NUMBER

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



EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 103705988LEX-001

Project Number: G103705988

Report Issue Date: 3/19/2019

Model(s) Tested: US Base Station
BS600

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

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

Client:
Alcohol Monitoring Systems, Inc.
1241 W Mineral Ave
Suite 200
Littleton, CO 80120
USA

Report prepared by



Brian Lackey, Project Engineer

Report reviewed by



Bryan Taylor, Team Leader

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



Table of Contents

1	<i>Introduction and Conclusion.....</i>	4
2	<i>Test Summary</i>	4
3	<i>Client Information</i>	5
4	<i>Description of Equipment under Test and Variant Models.....</i>	6
5	<i>System Setup and Method</i>	7
6	<i>Receiver Spurious Emissions.....</i>	10
7	<i>Transmitter Spurious Emissions.....</i>	15
8	<i>Conducted Spurious Emissions.....</i>	21
9	<i>Output Power.....</i>	24
10	<i>Occupied Bandwidth</i>	26
11	<i>Channel Separation</i>	29
12	<i>Number of Hopping Channels.....</i>	32
13	<i>Time of Occupancy</i>	34
14	<i>Antenna Requirement</i>	37
15	<i>Conducted Emissions</i>	38
16	<i>Revision History.....</i>	44



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	Conducted Spurious Emissions (FCC Part 15.247(d), RSS-247 Issue 2 § 5.5)	Pass
9	Output Power (FCC Part 15.247(b)(1), RSS-247 Issue 2 § 5.4(b))	Pass
10	Occupied Bandwidth (FCC Part 15.247(a)(1)(i), RSS-247 Issue 2 § 5.1(c))	Pass
11	Channel Separation (FCC Part 15.247(a)(1), RSS-247 Issue 2 § 5.1(b))	Pass
12	Number of Hopping Channels (FCC Part 15.247(a)(1)(iii), RSS-247 Issue 2 § 5.1(d))	Pass
13	Time of Occupancy (FCC Part 15.247(a)(1)(iii), RSS-247 Issue 2 § 5.1(d))	Pass
14	Antenna Requirement (FCC Part 15.203, RSS-Gen Issue 4 § 8.3)	Pass
15	Conducted Emissions (ANSI C63.4:2014)	Pass



3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	Alcohol Monitoring Systems, Inc.
Address:	1241 W Mineral Ave Suite 200 Littleton, CO 80120 USA
Contact:	John Chabon
Telephone:	+1 (303) 483-0543
Email:	jchabon@alcoholmonitoring.com
Manufacturer Information	
Manufacturer Name:	Alcohol Monitoring Systems, Inc.
Manufacturer Address:	1241 W Mineral Ave Suite 200 Littleton, CO 80120 USA



4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	US Base Station
Model Number	BS600
Serial Number	1078574
Receive Date	1/22/2019
Test Start Date	1/22/2019
Test End Date	3/11/2019
Device Received Condition	Good
Test Sample Type	Production
Input Ratings	10VDC/650mA via 120V/60Hz AC/DC adapter 7.4VDC/2250mAh battery
Software Used By EUT	1.00.3401
Frequency Band	902-928MHz
Maximum Output Power (dBm)	7.52dBm
Maximum Antenna Gain (dBi)	-0.5dBi
Test Channels	7 (903.3MHz), 61 (914.2MHz), 121 (926.2MHz)
Description of Equipment Under Test (provided by client)	
Base Station works as a communication hub for bracelets.	

4.1 Variant Models:

There were no variant models covered by this evaluation.



5 System Setup and Method

5.1 Method:

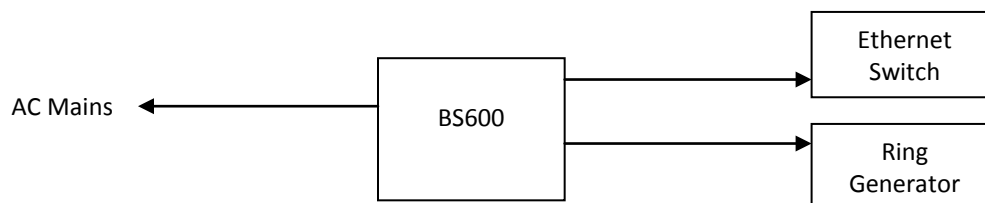
Configuration as required by ANSI C63.4: 2014 and ANSI C63.10:2013

No.	Descriptions of EUT Exercising
1	Transmitting a signal on low, middle, or high channel
2	Radios idle

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	AC Mains	1	No	No	Plug
2	Ethernet	1	Yes	Yes	RJ45
3	Phone	1	No	No	RJ11

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Ethernet Switch	Cisco	-	-
Ring Generator	Skutch	-	-

5.2 EUT Block Diagram:





5.3 EUT Photo (Front):





5.4 EUT Photo (Back):





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)	Ucisp
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 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 = Net Reading in dB μ V

Example:

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



6.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	9/18/2018	9/18/2019
Bilog Antenna	7088	SunAR	JB6	7/24/2018	7/24/2019
Horn Antenna	3780	ETS Lindgren	3117	6/11/2018	6/11/2019
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
3m Cable Antenna→Preamp	3074			11/26/2018	11/26/2019
3m Cable Preamplifier	3918	Rohde & Schwarz	TS-PR18	11/26/2018	11/26/2019
3m Cable Preamp→Chamber	2588			11/26/2018	11/26/2019
3m Cable Chamber→Control Room	2593			11/26/2018	11/26/2019
3m Cable Control Room→Receiver	2592			11/26/2018	11/26/2019

6.4 Software Utilized

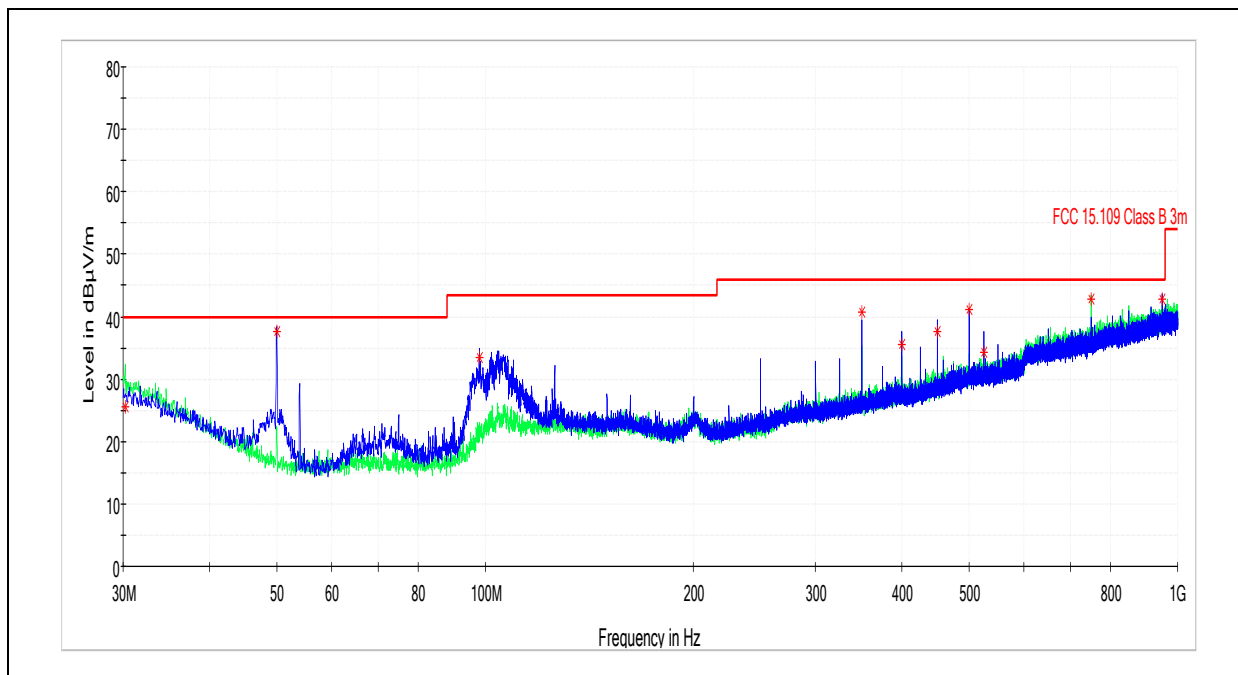
Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 9.15.02

6.5 Test Results

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

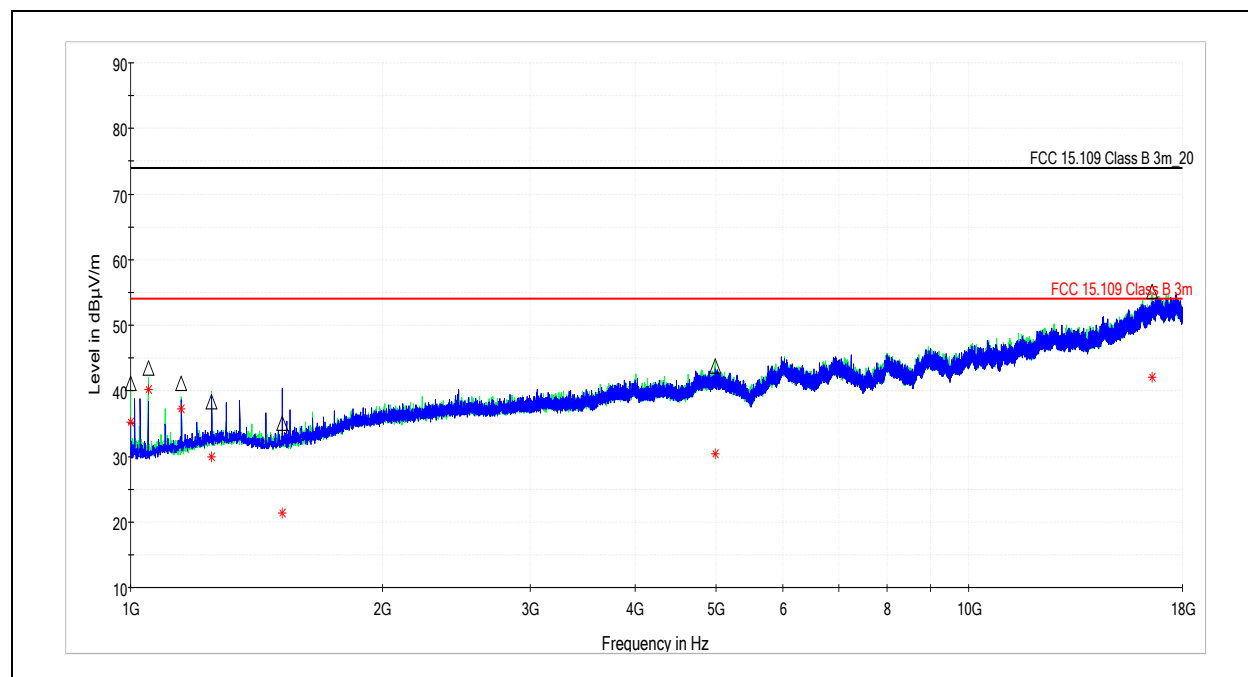
6.6 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	1/23/2019
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	See Above
Product Standard:	FCC Part 15.247	Ambient Temperature:	22.6C
Input Voltage:	RSS-247 Issue 2	Relative Humidity:	26.5%
Pretest Verification w / Ambient Signals or BB Source:	120V/60Hz to 10Vdc	Atmospheric Pressure:	982.0mbar
	Yes		

**6.7 Test Data: 30MHz – 1GHz**

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.215556	25.57	40.00	14.43	120.000	400.0	H	110.0	28.0
49.992778	37.55	40.00	2.45	120.000	100.3	V	156.0	15.3
98.115556	33.55	43.52	9.97	120.000	105.3	V	172.0	18.7
349.992222	40.66	46.02	5.36	120.000	153.7	V	338.0	24.5
400.001111	35.63	46.02	10.39	120.000	107.5	V	284.0	25.9
450.010000	37.63	46.02	8.39	120.000	100.3	V	73.0	27.2
500.018889	41.06	46.02	4.96	120.000	107.5	V	236.0	28.3
525.023333	34.34	46.02	11.68	120.000	102.2	V	117.0	28.7
750.009444	42.71	46.02	3.31	120.000	165.3	H	130.0	32.8
949.991111	42.72	46.02	3.30	120.000	100.3	V	130.0	35.3

Deviations, Additions, or Exclusions: None

**6.8 Test Data: 1GHz – 18GHz**

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1000.000000	41.07	74.00	32.93	1000.000	312.0	H	14.0	-3.0
1050.000000	43.41	74.00	30.59	1000.000	282.0	H	11.0	-3.8
1150.000000	41.20	74.00	32.80	1000.000	269.0	H	1.0	-3.0
1249.500000	38.36	74.00	35.64	1000.000	307.0	H	265.0	-1.4
1516.500000	34.99	74.00	39.01	1000.000	203.0	V	347.0	-1.9
4983.500000	43.72	74.00	30.28	1000.000	410.0	H	212.0	7.9
16561.000000	55.08	74.00	18.92	1000.000	314.0	H	1.0	23.0

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1000.000000	35.14	54.00	18.86	1000.000	312.0	H	14.0	-3.0
1050.000000	40.14	54.00	13.86	1000.000	282.0	H	11.0	-3.8
1150.000000	37.25	54.00	16.75	1000.000	269.0	H	1.0	-3.0
1249.500000	30.00	54.00	24.00	1000.000	307.0	H	265.0	-1.4
1516.500000	21.34	54.00	32.66	1000.000	203.0	V	347.0	-1.9
4983.500000	30.45	54.00	23.55	1000.000	410.0	H	212.0	7.9
16561.000000	42.05	54.00	11.95	1000.000	314.0	H	1.0	23.0

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 § 6.6. The sample was tested in three orthogonal axes. The fundamental emission was suppressed with a filter.



7.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	9/18/2018	9/18/2019
Bilog Antenna	7088	SunAR	JB6	7/24/2018	7/24/2019
Horn Antenna	3780	ETS Lindgren	3117	6/11/2018	6/11/2019
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
3m Cable Antenna→Preamp	3074			11/26/2018	11/26/2019
3m Cable Preamplifier	3918	Rohde & Schwarz	TS-PR18	11/26/2018	11/26/2019
3m Cable Preamp→Chamber	2588			11/26/2018	11/26/2019
3m Cable Chamber→Control Room	2593			11/26/2018	11/26/2019
3m Cable Control Room→Receiver	2592			11/26/2018	11/26/2019

7.4 Software Utilized

Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 9.15.02

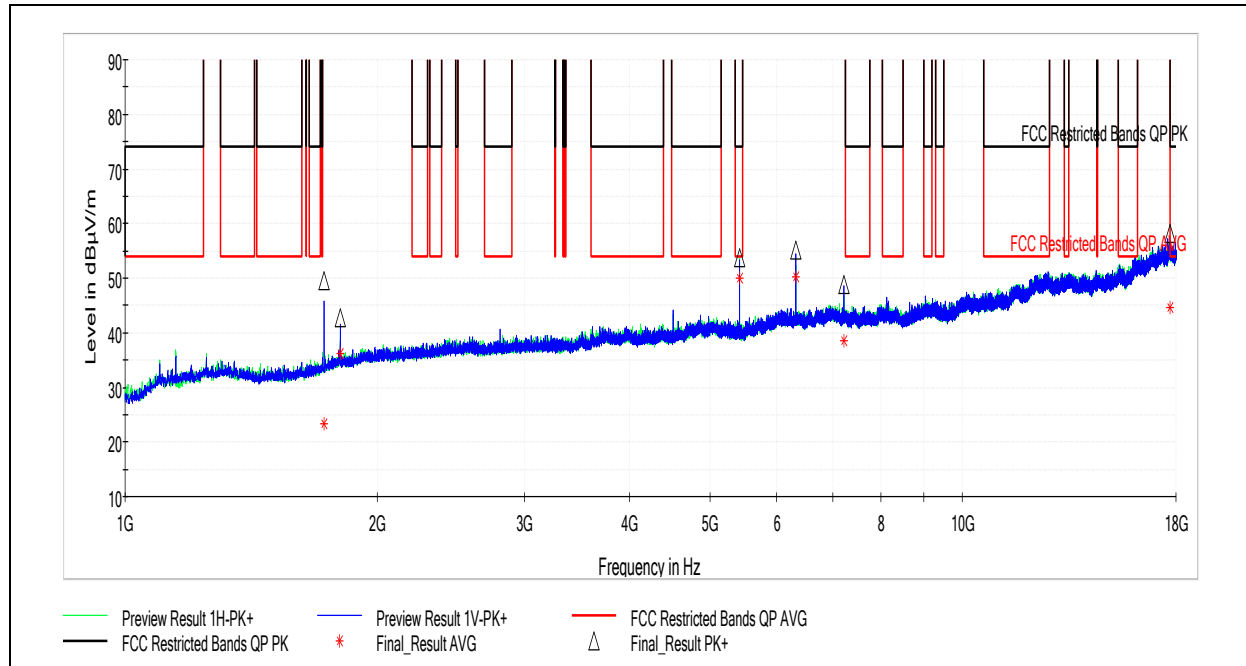
7.5 Test Results

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



7.6 Test Data

7.6.1 Channel 7 (903.4MHz) Spurious Emissions, 1GHz-18GHz



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1728.500000	49.59	1000.00	950.41	1000.000	354.0	V	62.0	-0.6
1806.500000	42.67	1000.00	957.33	1000.000	158.0	V	198.0	0.5
5420.500000	53.64	73.98	20.34	1000.000	410.0	H	263.0	8.1
6324.000000	55.08	1000.00	944.92	1000.000	100.0	V	224.0	9.9
7227.000000	48.82	1000.00	951.18	1000.000	100.0	V	216.0	11.2
17713.000000	58.11	73.98	15.87	1000.000	377.0	V	327.0	25.2

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1728.500000	23.25	1000.00	976.75	1000.000	354.0	V	62.0	-0.6
1806.500000	36.20	1000.00	963.80	1000.000	158.0	V	198.0	0.5
5420.500000	50.00	53.98	3.98	1000.000	410.0	H	263.0	8.1
6324.000000	50.21	1000.00	949.79	1000.000	100.0	V	224.0	9.9
7227.000000	38.52	1000.00	961.48	1000.000	100.0	V	216.0	11.2
17713.000000	44.53	53.98	9.45	1000.000	377.0	V	327.0	25.2

Test Personnel: Brian Lackey

Supervising/Reviewing Engineer: NA
(Where Applicable) FCC Part 15.247

Product Standard: RSS-247 Issue 2

Input Voltage: 120V/60Hz to 10Vdc

Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 2/6/2019

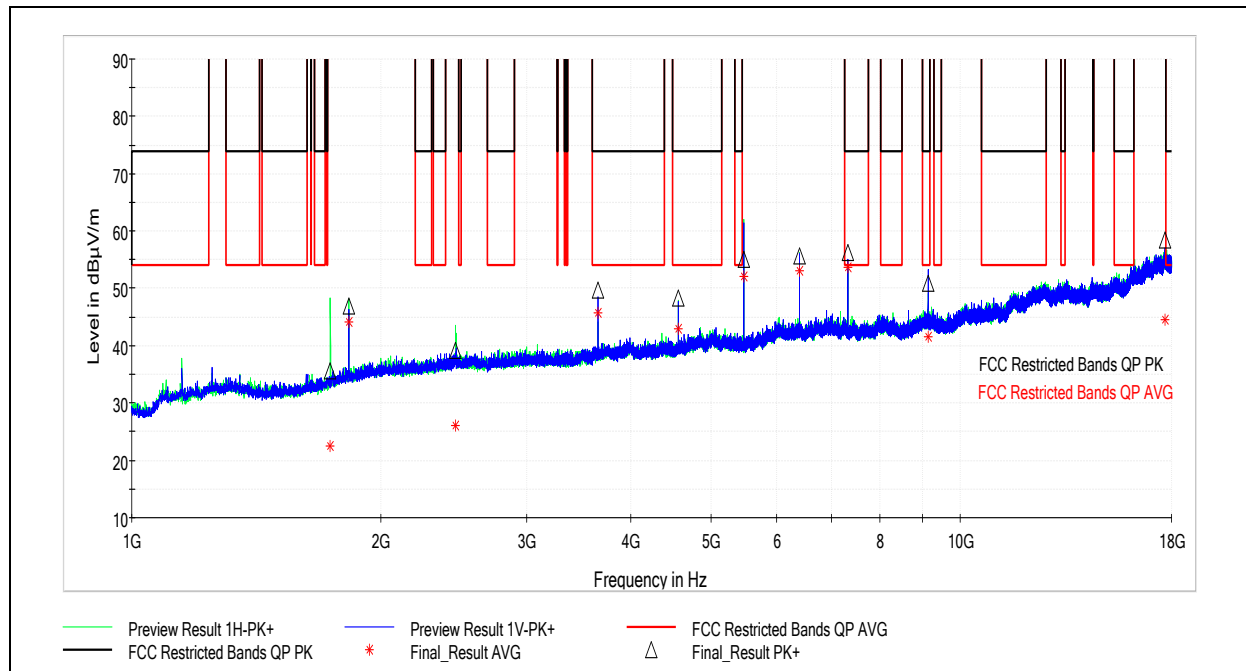
Limit Applied: See Above

Ambient Temperature: 22.7C

Relative Humidity: 42.0%

Atmospheric Pressure: 982.0mbar

Deviations, Additions, or Exclusions: Tested at a reduced power setting of '7'.

**7.6.2 Channel 61 (914.2MHz) Spurious Emissions, 1GHz-18GHz**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1736.000000	35.67	74.00	38.33	1000.000	161.0	H	309.0	-0.6
1828.000000	47.02	74.00	26.98	1000.000	280.0	H	280.0	0.7
2459.000000	39.12	74.00	34.88	1000.000	364.0	H	98.0	3.3
3657.000000	49.70	74.00	24.30	1000.000	321.0	V	182.0	5.2
4571.000000	48.35	74.00	25.65	1000.000	345.0	H	83.0	7.1
5485.500000	55.05	74.00	18.95	1000.000	307.0	H	133.0	8.1
6399.500000	55.75	74.00	18.25	1000.000	100.0	H	180.0	10.2
7313.500000	56.34	74.00	17.66	1000.000	100.0	V	252.0	10.9
9141.500000	50.88	74.00	23.12	1000.000	321.0	V	0.0	12.6
17682.500000	58.46	74.00	15.54	1000.000	100.0	V	42.0	25.2

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1736.000000	22.47	54.00	31.53	1000.000	161.0	H	309.0	-0.6
1828.000000	44.12	54.00	9.88	1000.000	280.0	H	280.0	0.7
2459.000000	26.08	54.00	27.92	1000.000	364.0	H	98.0	3.3
3657.000000	45.68	54.00	8.32	1000.000	321.0	V	182.0	5.2
4571.000000	42.97	54.00	11.03	1000.000	345.0	H	83.0	7.1
5485.500000	52.16	54.00	1.84	1000.000	307.0	H	133.0	8.1
6399.500000	53.05	54.00	0.95	1000.000	100.0	H	180.0	10.2
7313.500000	53.60	54.00	0.40	1000.000	100.0	V	252.0	10.9
9141.500000	41.58	54.00	12.42	1000.000	321.0	V	0.0	12.6
17682.500000	44.55	54.00	9.45	1000.000	100.0	V	42.0	25.2

Test Personnel: Brian Lackey

Supervising/Reviewing Engineer: NA

(Where Applicable) FCC Part 15.247

Product Standard: RSS-247 Issue 2

Input Voltage: 120V/60Hz to 10Vdc

Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 2/5/2019

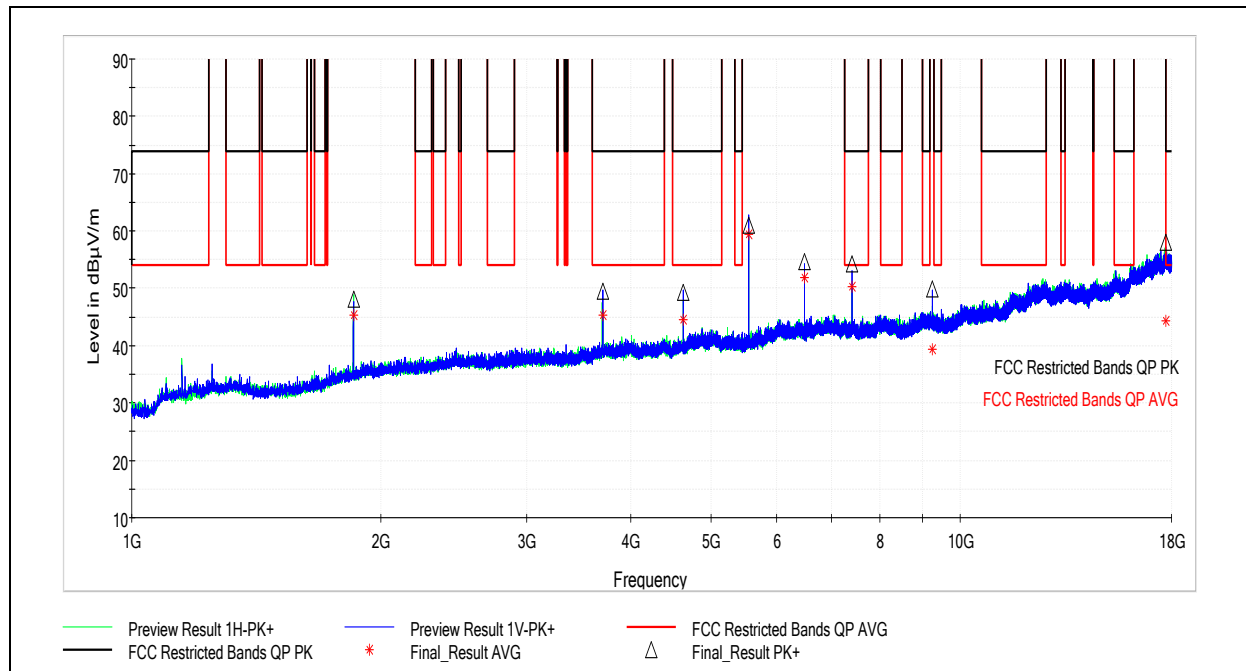
Limit Applied: See Above

Ambient Temperature: 22.8C

Relative Humidity: 41.8%

Atmospheric Pressure: 985.4mbar

Deviations, Additions, or Exclusions: None

**7.6.3 Channel 121 (926.2MHz) Spurious Emissions, 1GHz-18GHz**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1852.000000	48.12	74.00	25.88	1000.000	271.0	H	284.0	0.8
3704.500000	49.50	74.00	24.50	1000.000	293.0	V	186.0	5.4
4631.000000	49.32	74.00	24.68	1000.000	292.0	V	37.0	7.1
5557.000000	61.03	74.00	12.97	1000.000	100.0	V	273.0	8.2
6483.500000	54.75	74.00	19.25	1000.000	100.0	H	180.0	10.2
7409.500000	54.32	74.00	19.68	1000.000	100.0	V	112.0	11.0
9261.500000	49.83	74.00	24.17	1000.000	324.0	V	0.0	12.9
17709.500000	57.95	74.00	16.05	1000.000	410.0	V	0.0	25.2

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1852.000000	45.40	54.00	8.60	1000.000	271.0	H	284.0	0.8
3704.500000	45.41	54.00	8.59	1000.000	293.0	V	186.0	5.4
4631.000000	44.61	54.00	9.39	1000.000	292.0	V	37.0	7.1
5557.000000	59.51	54.00	-5.51	1000.000	100.0	V	273.0	8.2
6483.500000	51.80	54.00	2.20	1000.000	100.0	H	180.0	10.2
7409.500000	50.24	54.00	3.76	1000.000	100.0	V	112.0	11.0
9261.500000	39.32	54.00	14.68	1000.000	324.0	V	0.0	12.9
17709.500000	44.27	54.00	9.73	1000.000	410.0	V	0.0	25.2

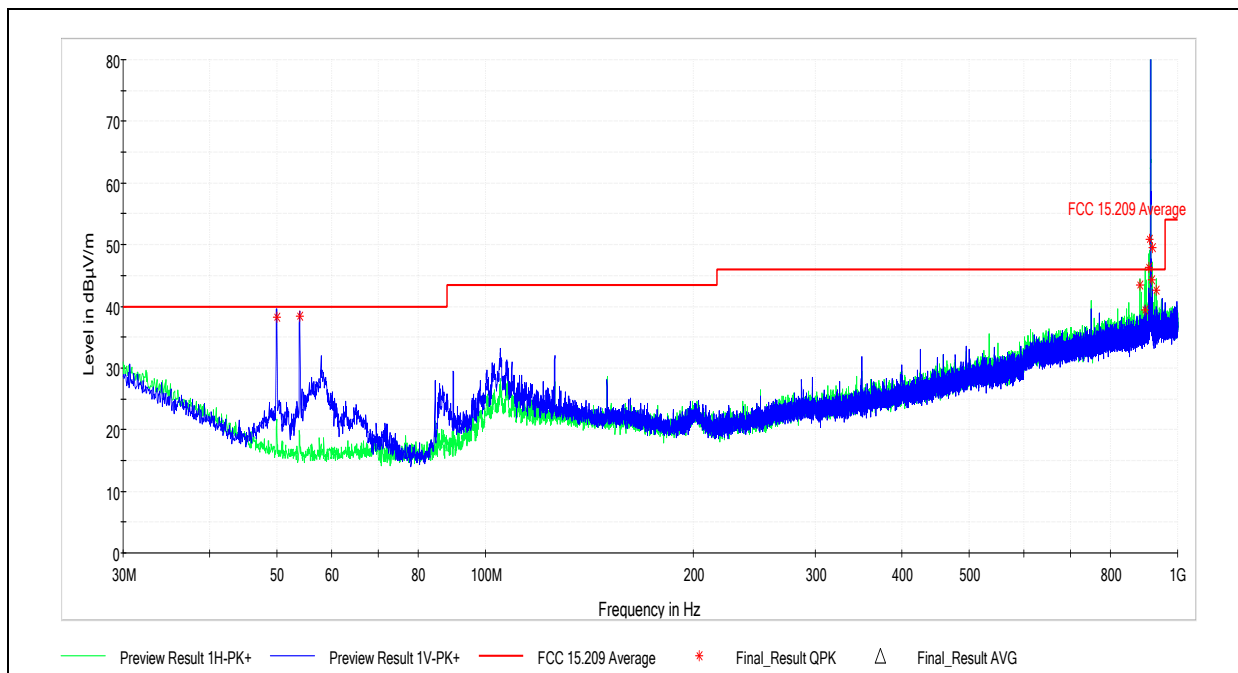
Test Personnel: Brian Lackey
Supervising/Reviewing Engineer: (Where Applicable) NA
Product Standard: FCC Part 15.247
Input Voltage: RSS-247 Issue 2
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 2/5/2019
Limit Applied: See Above
Ambient Temperature: 22.8C
Relative Humidity: 41.8%
Atmospheric Pressure: 985.4mbar

Deviations, Additions, or Exclusions: None



7.6.4 Spurious Emissions, 30MHz-1GHz



Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
49.992778	38.15	40.00	1.85	120.000	105.2	V	92.0	15.2
53.980556	38.34	40.00	1.66	120.000	100.1	V	117.0	14.5
882.198889	43.39	46.02	2.63	120.000	99.7	H	163.0	34.1
898.311667	39.45	46.02	6.57	120.000	117.6	H	38.0	34.2
908.281111 ¹	46.33	46.02	-0.31	120.000	165.9	H	155.0	34.4
910.221111 ¹	50.84	46.02	-4.82	120.000	169.3	H	157.0	34.3
914.262778 ²	98.44	46.02	-52.42	120.000	100.1	H	264.0	34.2
918.304444	44.30	46.02	1.72	120.000	166.0	H	154.0	34.3
920.244444 ¹	49.59	46.02	-3.57	120.000	166.1	H	164.0	34.3
930.267778	42.54	46.02	3.48	120.000	153.8	H	156.0	34.5

Test Personnel: Brian Lackey
Supervising/Reviewing Engineer: NA
(Where Applicable) FCC Part 15.247
Product Standard: RSS-247 Issue 2
Input Voltage: 120V/60Hz to 10Vdc
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 2/5/2019
Limit Applied: See Above
Ambient Temperature: 22.8C
Relative Humidity: 41.8%
Atmospheric Pressure: 985.4mbar

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

¹ Frequency does not fall in a restricted band of operation; excluded from compliance for this test

² Fundamental emission, excluded from compliance for this test



8 Conducted Spurious Emissions

8.1 Test Limits

FCC Part 15.247(d):

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

RSS-247 Issue 2 § 5.5:

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 § 7.8.8.

8.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ES126	9/21/2018	9/20/2019

8.4 Test Results

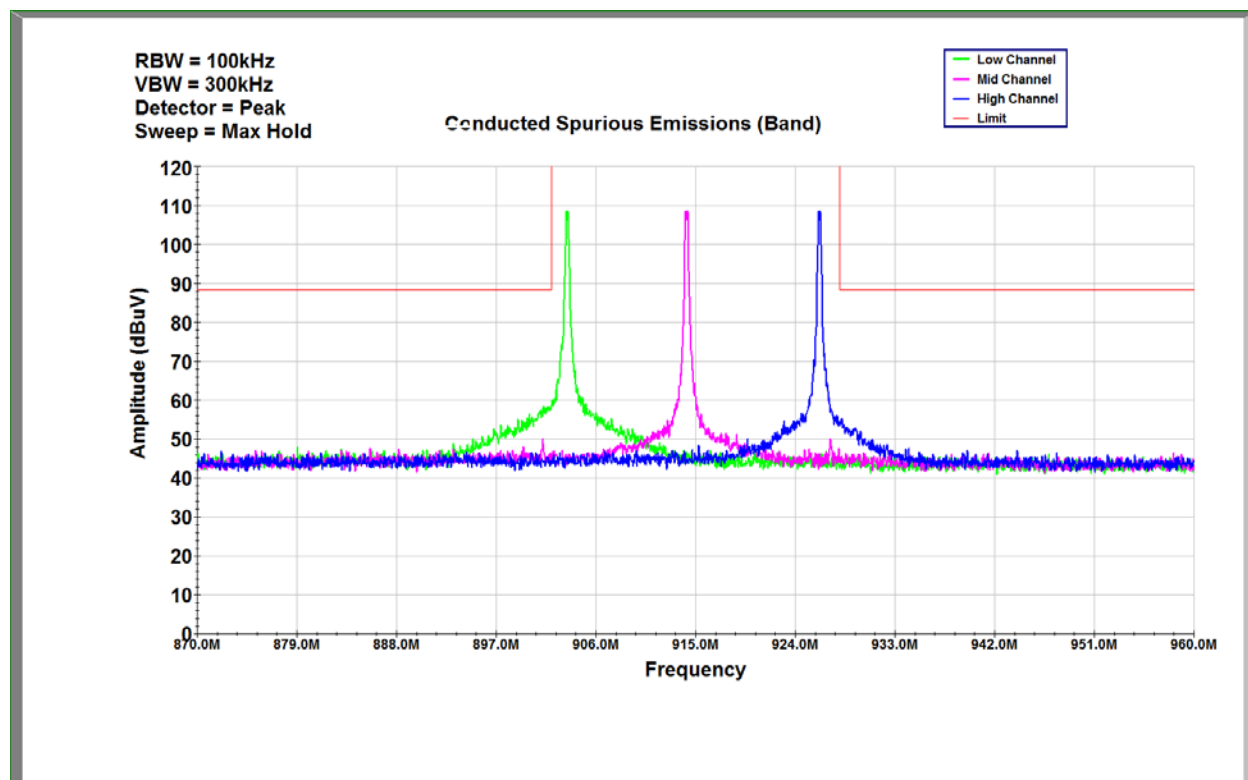
The device was found to be **compliant**. All spurious emissions were attenuated at least 20dB below the level of the highest fundamental emission.

8.5 Test Conditions

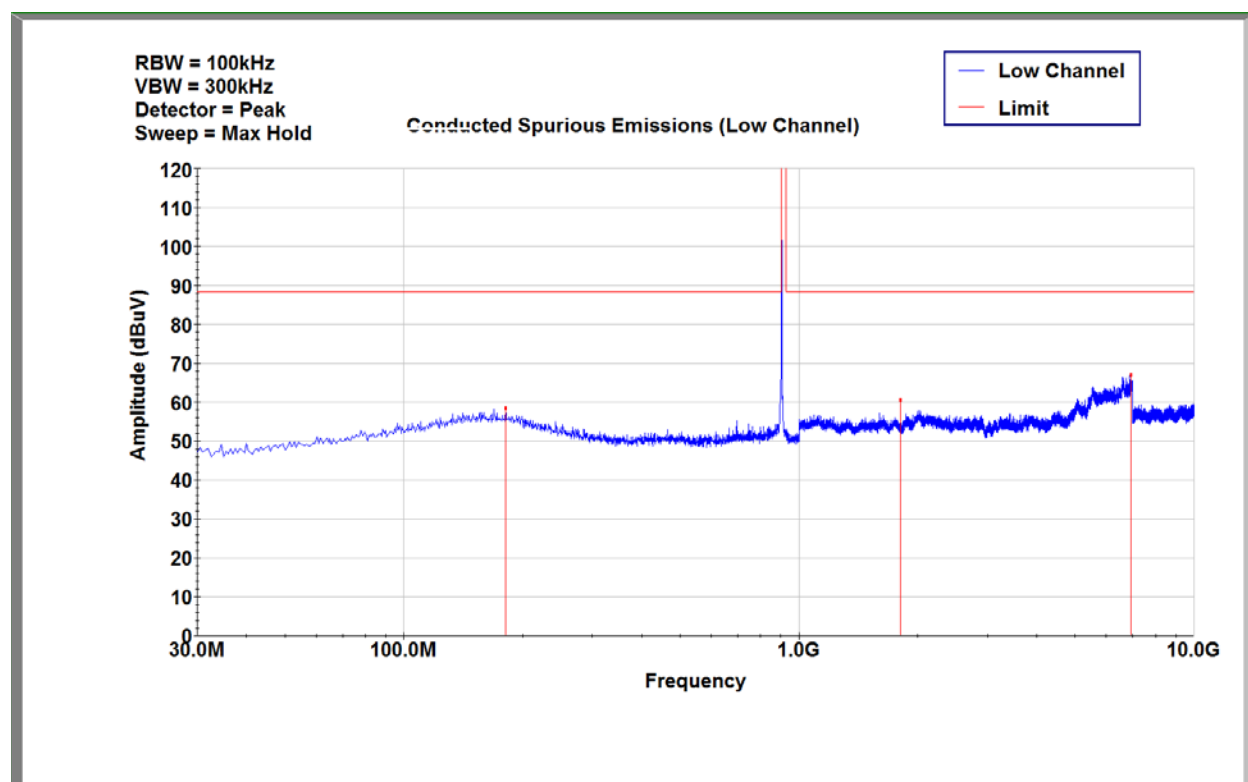
Test Personnel:	Brian Lackey	Test Date:	2/7/2019
Supervising/Reviewing Engineer:		Limit Applied:	See Above
(Where Applicable)	NA	Ambient Temperature:	23.0V
Product Standard:	FCC Part 15.247	Relative Humidity:	49.3%
Input Voltage:	RSS-247 Issue 2	Atmospheric Pressure:	982.0mbar
Pretest Verification w / Ambient	120V/60Hz to 10Vdc		
Signals or BB Source:	Yes		



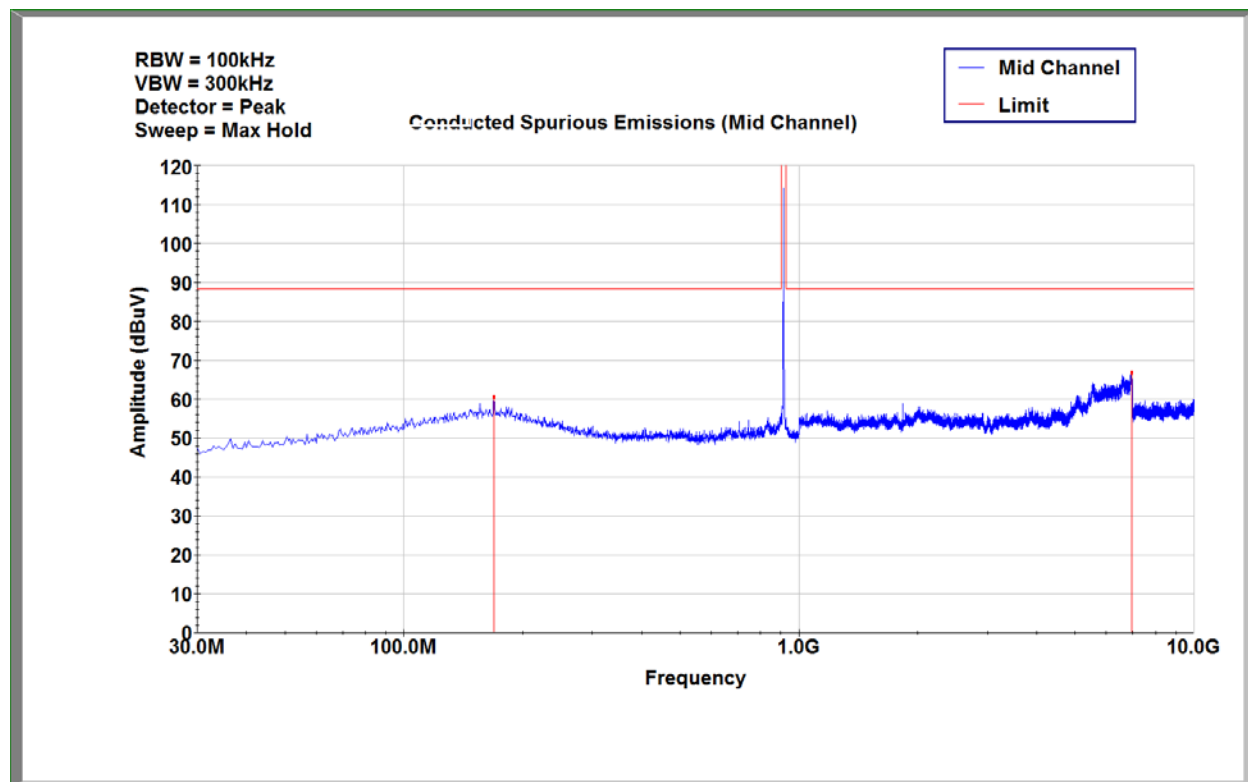
8.6 Test Data



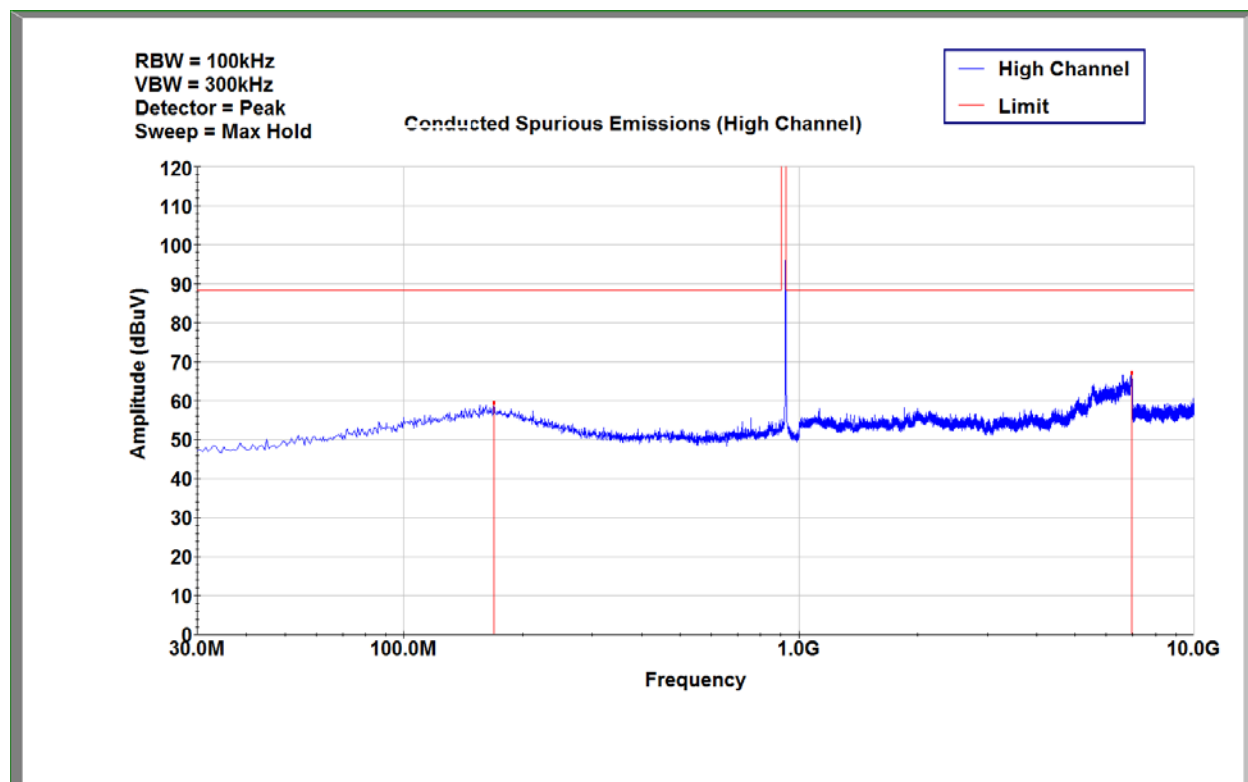
Conducted Spurious Emissions (Band)



Conducted Spurious Emissions, Channel 7 (903.4MHz)



Conducted Spurious Emissions, Channel 61 (914.2MHz)



Conducted Spurious Emissions, Channel 121 (926.2MHz)



9 Output Power

9.1 Test Limits

FCC Part 15.247(b)(1):

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-247 Issue 2 § 5.4(b):

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

9.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 7.8.5.

9.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
Wideband Power Sensor	4022	Rohde&Schwarz	NRP-Z81	9/21/2018	9/21/2019



9.4 Test Results

The device was found to be **compliant**. The output power of all modes of operation was less than 1W.

9.5 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	8/6/2018
Supervising/Reviewing Engineer:			
(Where Applicable)	NA	Limit Applied:	See Above
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	24.6C
Input Voltage:	Battery	Relative Humidity:	50.8%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

9.6 Test Data

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (mW)	Limit (mW)	Result
7	903.4	7.52	5.65	1000	Pass
61	914.2	6.89	4.89	1000	Pass
121	926.2	6.15	4.12	1000	Pass

Deviations, Additions, or Exclusions: None



10 Occupied Bandwidth

10.1 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 6.9.2.

10.2 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ES126	9/21/2018	9/21/2019

10.3 Test Results

The 20dB and 99% occupied power bandwidth are reported in section 10.5.

10.4 Test Conditions

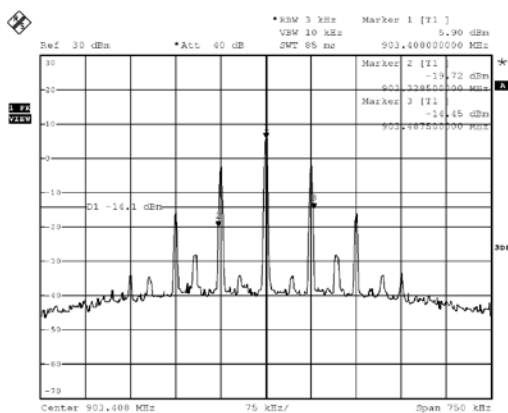
Test Personnel:	B. Lackey	Test Date:	2/7/2019
Supervising/Reviewing Engineer:		Limit Applied:	See Above
(Where Applicable)	NA	Ambient Temperature:	23.0V
Product Standard:	FCC Part 15.247	Relative Humidity:	49.3%
Input Voltage:	RSS-247 Issue 2	Atmospheric Pressure:	982.0mbar
Pretest Verification w / Ambient	120V/60Hz to 10Vdc		
Signals or BB Source:	Yes		

**10.5 Test Data**

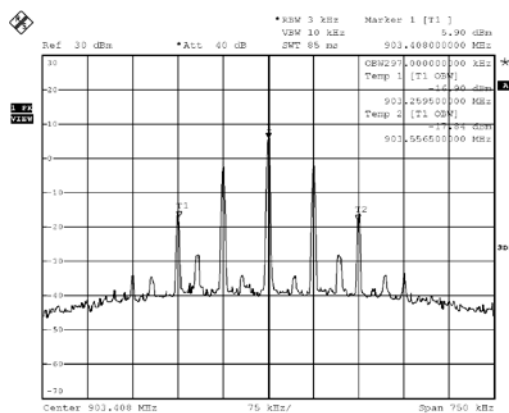
Channel	Frequency (MHz)	20dB BW (kHz)	99% OBW (kHz)
7	903.4	159	297
61	914.2	159	300
121	926.2	159	297



10.5.1 Bandwidth Plots

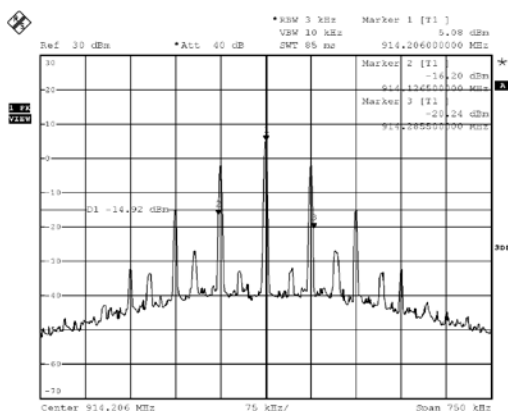


Date: 7.FEB.2019 13:05:17

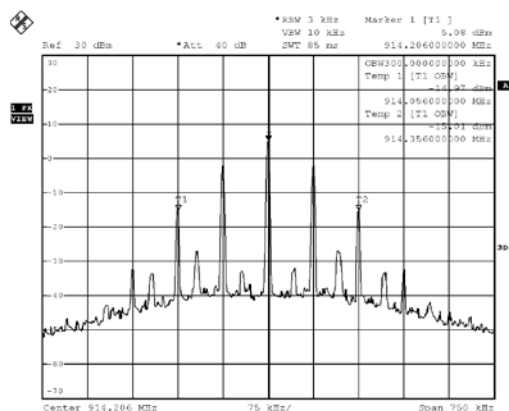


Date: 7.FEB.2019 13:07:22

Ch7 (903.4MHz) Occupied Bandwidth, 20dB (left), 99% (right)

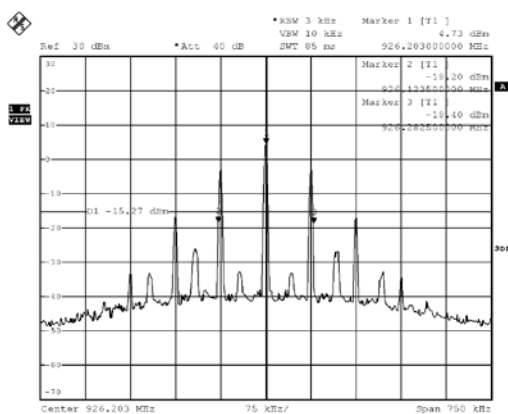


Date: 7.FEB.2019 13:09:34

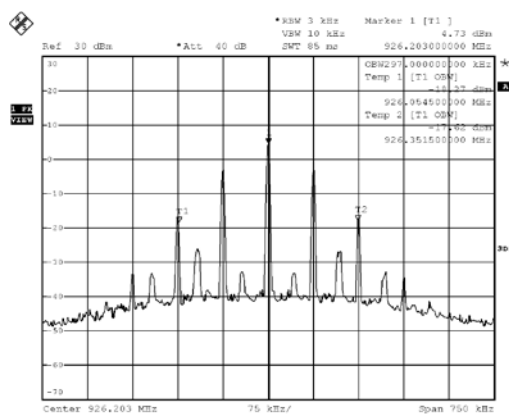


Date: 7.FEB.2019 13:08:44

Ch61 (914.2MHz) Occupied Bandwidth, 20dB (left), 99% (right)



Date: 7.FEB.2019 13:11:22



Date: 7.FEB.2019 13:12:18

Ch121 (926.2MHz) Occupied Bandwidth, 20dB (left), 99% (right)

Deviations, Additions, or Exclusions: None



11 Channel Separation

11.1 Test Limits

FCC Part 15.247(a)(1):

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

RSS-247 Issue 2 § 5.1(b):

FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

11.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 7.8.2.

11.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ES126	9/21/2018	9/21/2019

11.4 Test Results

The device was found to be **compliant**. Adjacent channels were separated by at least the two thirds of the 20dB bandwidth of the hopping channel.

11.5 Test Conditions

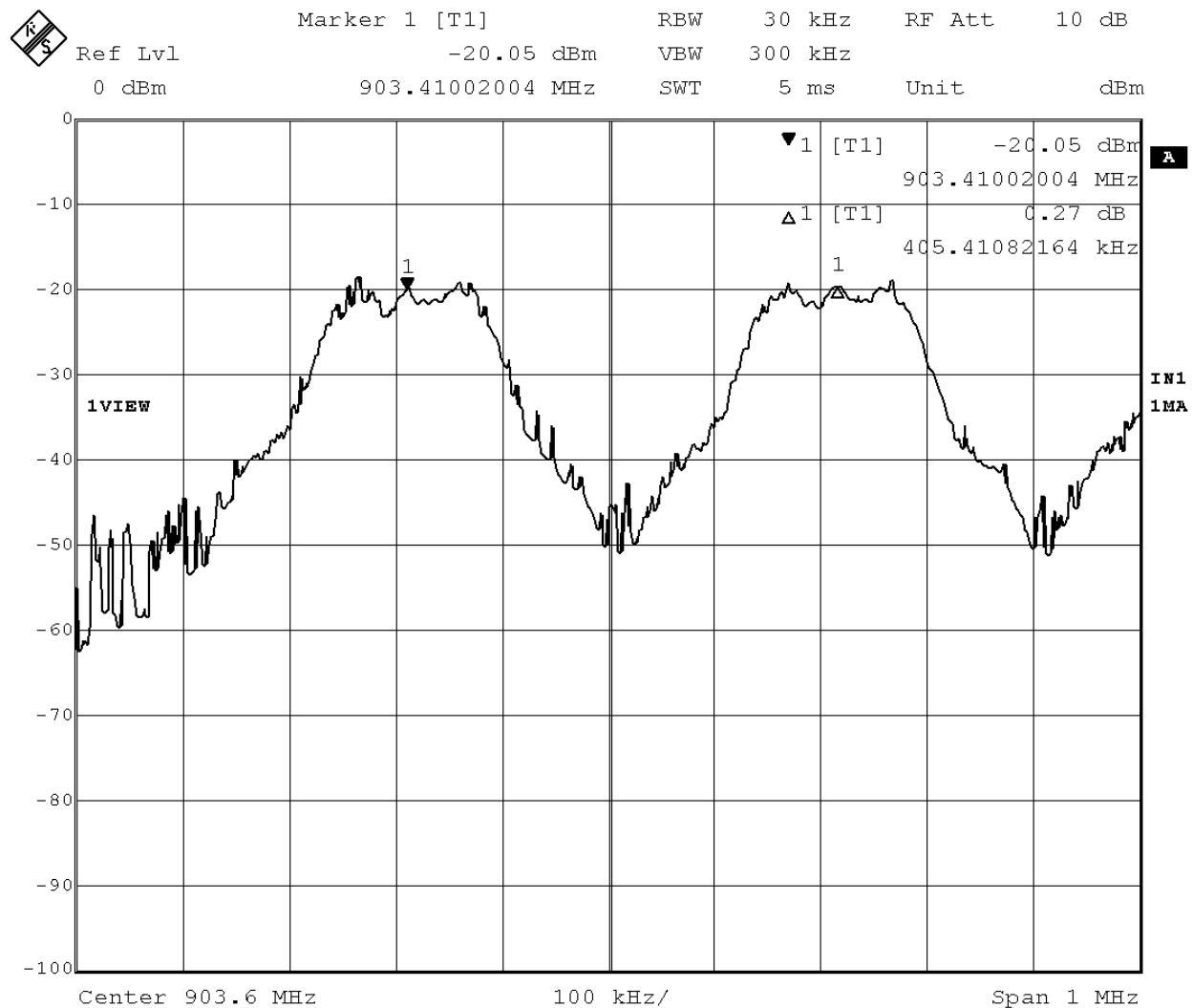
Test Personnel:	Brian Lackey	Test Date:	1/22/2019
Supervising/Reviewing Engineer:		Limit Applied:	See Above
(Where Applicable)	NA	Ambient Temperature:	22.1C
Product Standard:	FCC Part 15.247	Relative Humidity:	25.1%
Input Voltage:	RSS-247 Issue 2	Atmospheric Pressure:	988.8mbar
Pretest Verification w / Ambient	120V/60Hz to 10Vdc		
Signals or BB Source:	Yes		

**11.6 Test Data**

20dB BW (kHz)	2/3 of 20dB BW (kHz)	Channel Separation (kHz)	Result
159	106	200	Pass



11.6.1 Channel Separation



Date: 22.JAN.2019 14:15:47

Deviations, Additions, or Exclusions: None



12 Number of Hopping Channels

12.1 Test Limits

FCC Part 15.247(a)(1)(iii):

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

RSS-247 Issue 2 § 5.1(d):

FHSS operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

12.2 Test Method

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

12.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ES126	9/21/2018	9/21/2019

12.4 Test Results

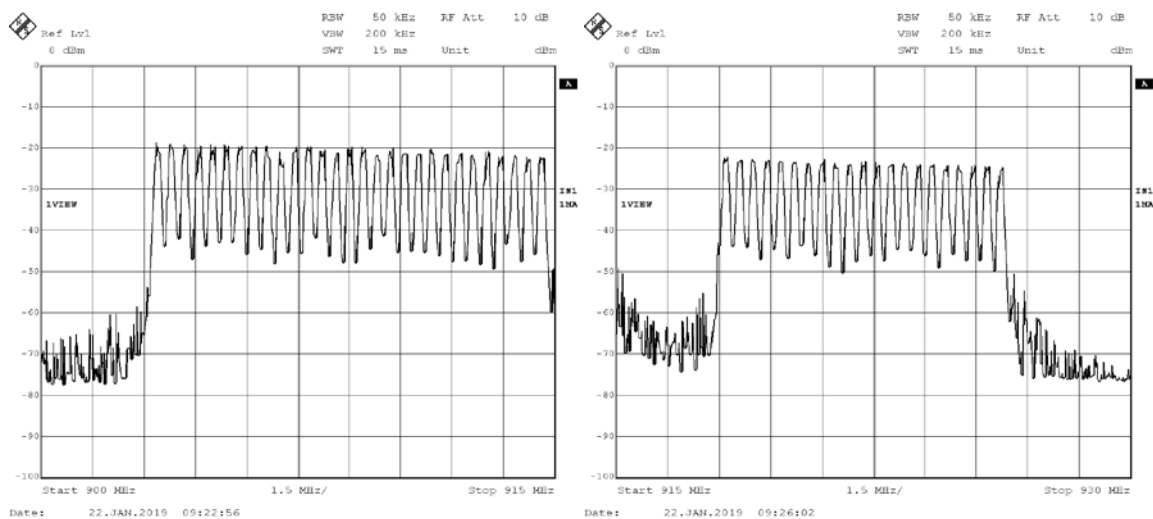
The device was found to be **compliant**. The device used at least 15 hopping channels.

12.5 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	1/22/2019
Supervising/Reviewing Engineer:		Limit Applied:	See Above
(Where Applicable)	NA	Ambient Temperature:	22.1C
Product Standard:	FCC Part 15.247	Relative Humidity:	25.1%
Input Voltage:	RSS-247 Issue 2	Atmospheric Pressure:	988.8mbar
Pretest Verification w / Ambient	120V/60Hz to 10Vdc		
Signals or BB Source:	Yes		



12.6 Test Data



Number of hopping channels, 900-915MHz (left), 915-930MHz (right)

Frequency Range	Number of Channels
900-915MHz	26
915-930MHz	21
Total	50



13 Time of Occupancy

13.1 Test Limits

FCC Part 15.247(a)(1)(iii):

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

RSS-247 Issue 2 § 5.1(d):

FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

13.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 7.8.4.

13.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ESI26	9/21/2018	9/21/2019

13.4 Test Results

The device was found to be **compliant**. The total time of occupancy per channel was less than 0.4 seconds in a period of 20 seconds (0.4 seconds x 50 hopping channels).

13.5 Test Conditions

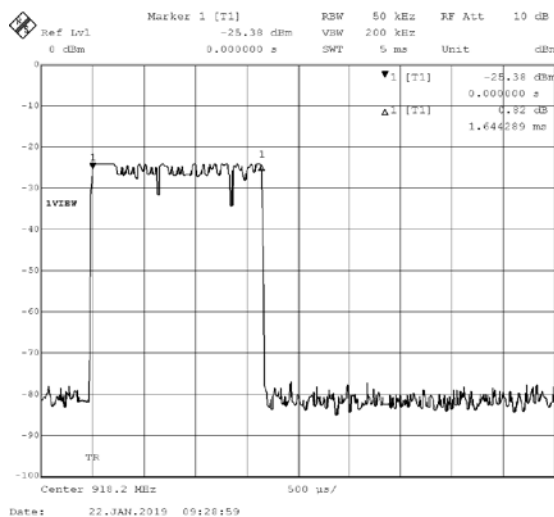
Test Personnel:	Brian Lackey	Test Date:	1/22/2019
Supervising/Reviewing Engineer:		Limit Applied:	See Above
(Where Applicable)	NA	Ambient Temperature:	22.1C
Product Standard:	FCC Part 15.247	Relative Humidity:	25.1%
Input Voltage:	RSS-247 Issue 2	Atmospheric Pressure:	988.8mbar
Pretest Verification w / Ambient	120V/60Hz to 10Vdc		
Signals or BB Source:	Yes		

**13.6 Test Data**

Time of Single Occupancy (ms)	Number of Occupancies Per Burst	Number of Bursts in 20s	Total Time of Occupancy (ms)	Limit (ms)	Result
1.644	25	1	41.6	400	Pass

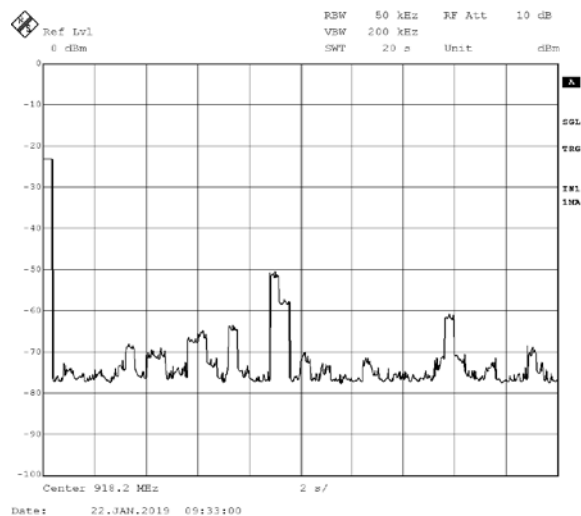
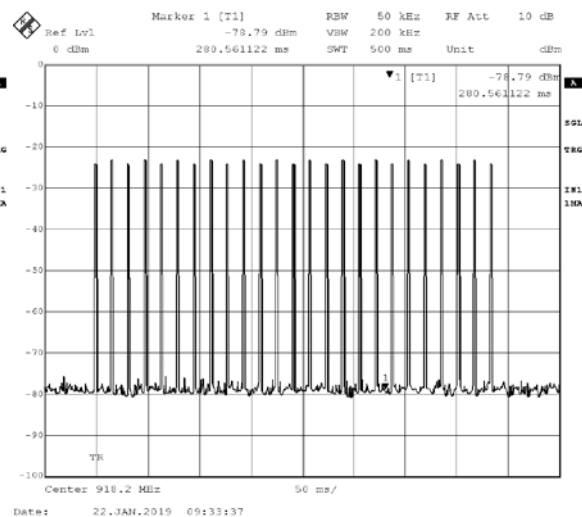


13.6.1 Time of Occupancy Plots



Time of single occupancy = 1.644ms (left)

Number of occupancies per burst = 25 (right)



Number of Bursts in 20s = 1

Deviations, Additions, or Exclusions: None



14 Antenna Requirement

14.1 Test Limits

FCC Part 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

RSS-Gen Issue 4 § 8.3:

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

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

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

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

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

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

14.2 Test Results

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



15 Conducted Emissions

15.1 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)	Ucisp
AC 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.

15.2 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:

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

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

**15.3 Test Equipment Used:**

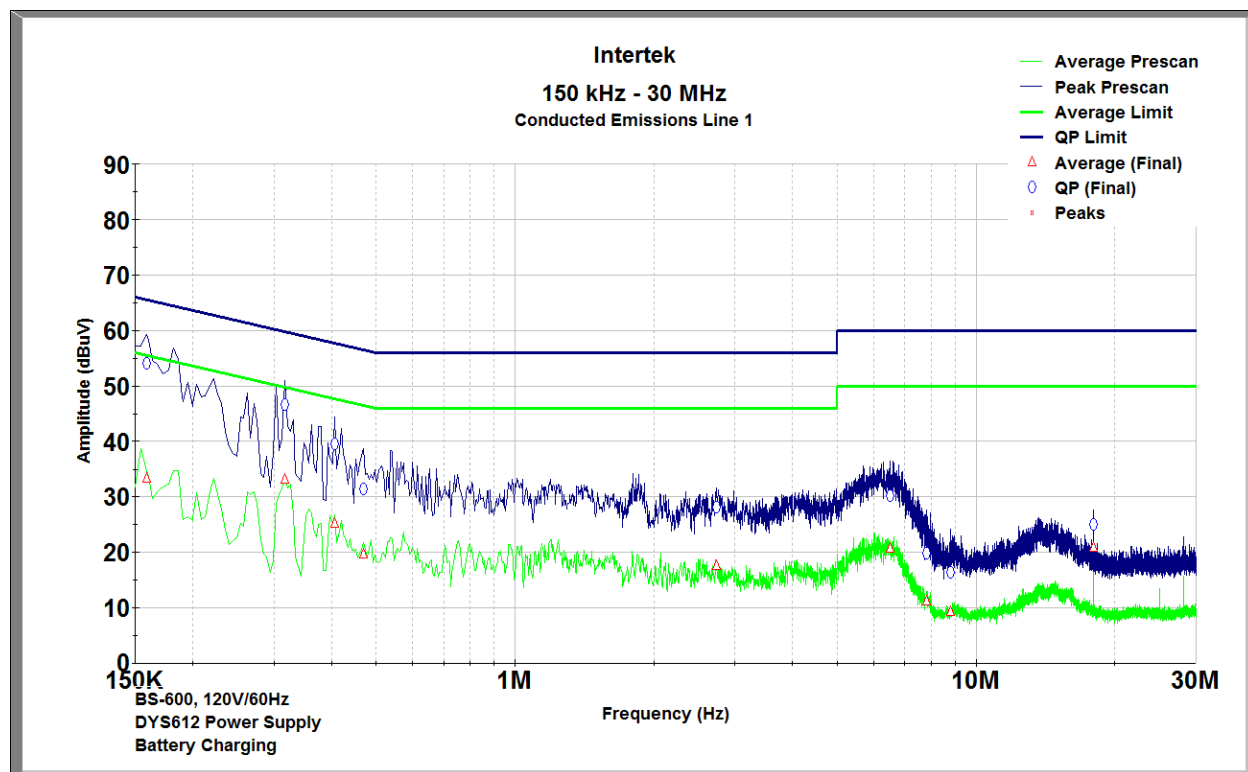
Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ESi26	9/21/2018	9/21/2019
LISN	2509	Fischer Custom Communication	FCC-LISN-50-50-2M	4/10/2018	4/10/2019
Coaxial Cable (COND 2)	5025			11/26/2018	11/26/2019

15.4 Software Utilized:

Name	Manufacturer	Version
TILE	ETS Lindgren	V7.0.6.545

15.5 Results:

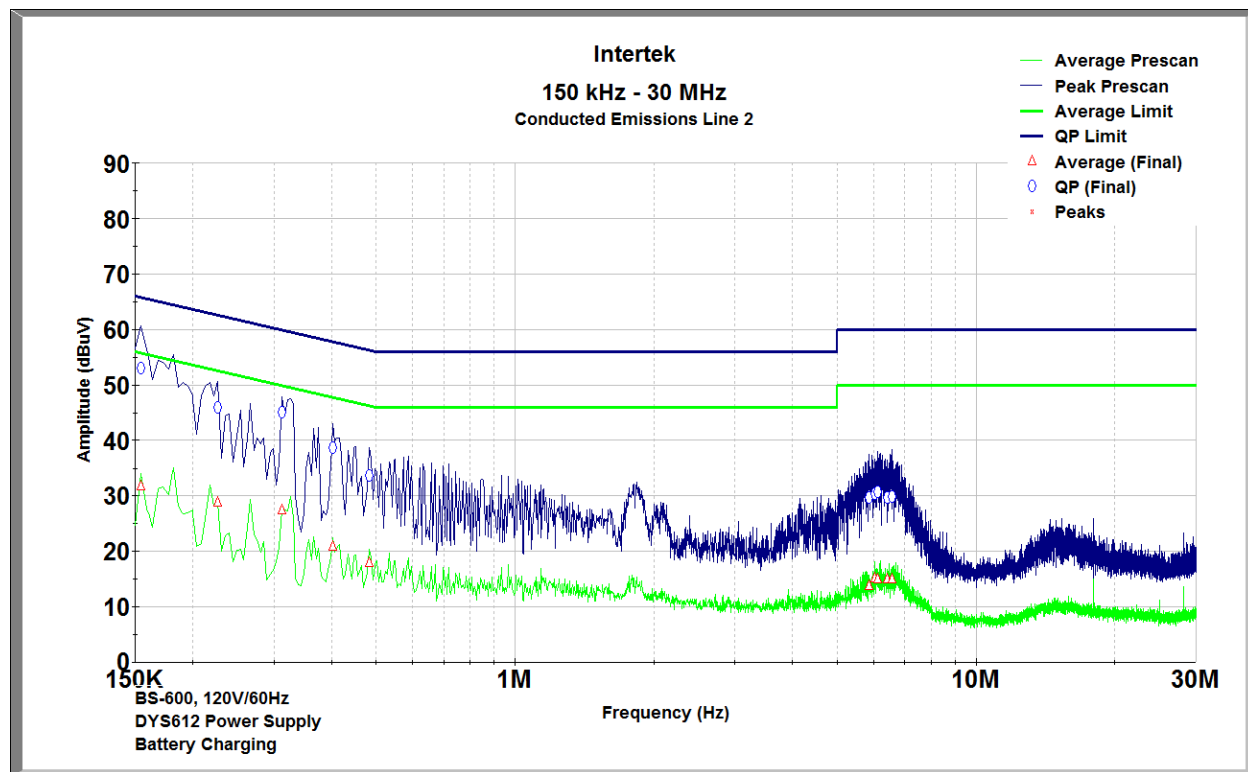
The sample tested was found to Comply.

**15.6 Plots/Data: Conducted Emissions (Idle)**

Line

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.159	54.043	65.743	11.700	33.301	55.743	22.442
0.317	46.613	61.243	14.630	33.074	51.243	18.168
0.406	39.505	58.671	19.166	25.230	48.671	23.441
0.469	31.386	56.871	25.485	19.668	46.871	27.203
2.733	28.222	56.000	27.778	17.551	46.000	28.449
6.518	30.214	60.000	29.786	20.750	50.000	29.250
7.801	19.801	60.000	40.199	11.128	50.000	38.872
8.805	16.363	60.000	43.637	9.341	50.000	40.659
18.000	24.981	60.000	35.019	20.833	50.000	29.167

Line



Neutral

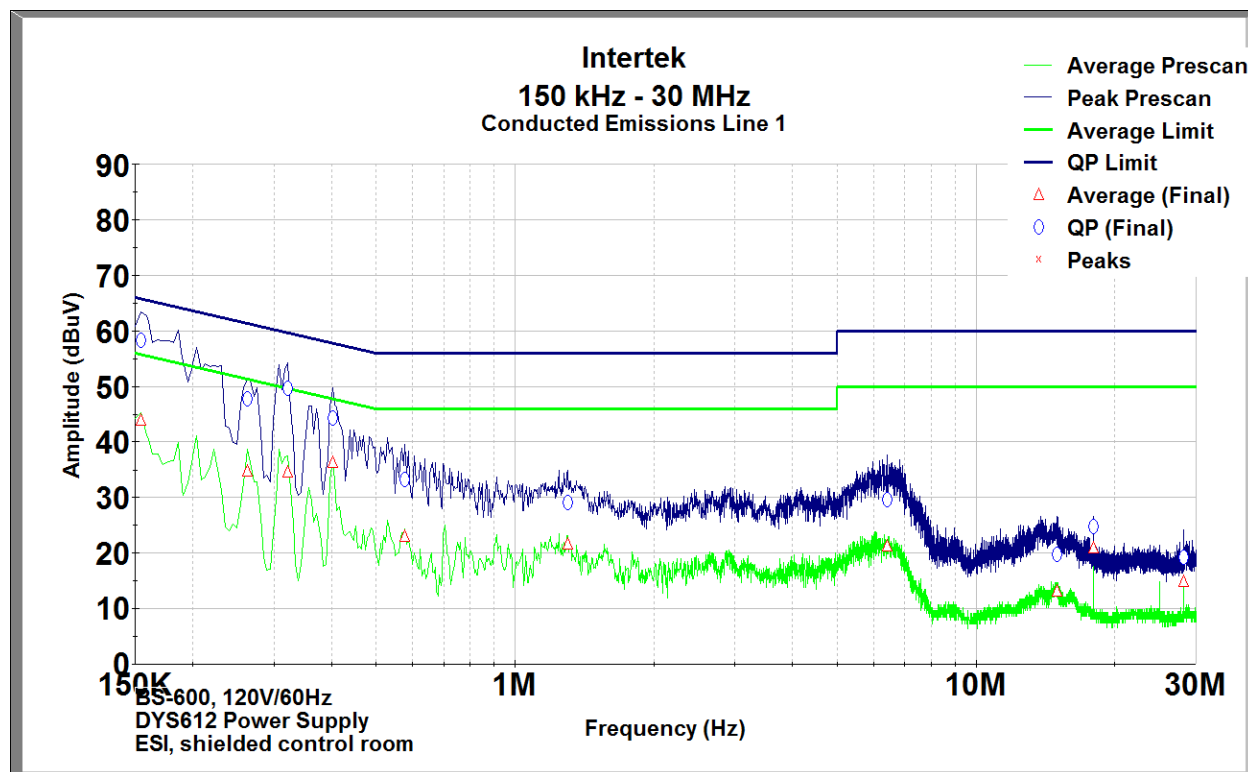
Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.155	53.020	65.871	12.851	31.777	55.871	24.094
0.227	46.017	63.814	17.797	28.822	53.814	24.993
0.312	45.150	61.371	16.222	27.477	51.371	23.894
0.402	38.682	58.800	20.118	20.901	48.800	27.899
0.483	33.631	56.486	22.855	17.891	46.486	28.595
5.856	29.660	60.000	30.340	13.848	50.000	36.152
6.018	30.363	60.000	29.637	15.074	50.000	34.926
6.126	30.671	60.000	29.329	14.948	50.000	35.052
6.423	29.657	60.000	30.343	14.965	50.000	35.035
6.572	29.831	60.000	30.169	15.022	50.000	34.978

Neutral

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

Test Date: 3/11/2019
Limit Applied: Class B
Ambient Temperature: 23.1C
Relative Humidity: 24.%
Atmospheric Pressure: 988.8mbar

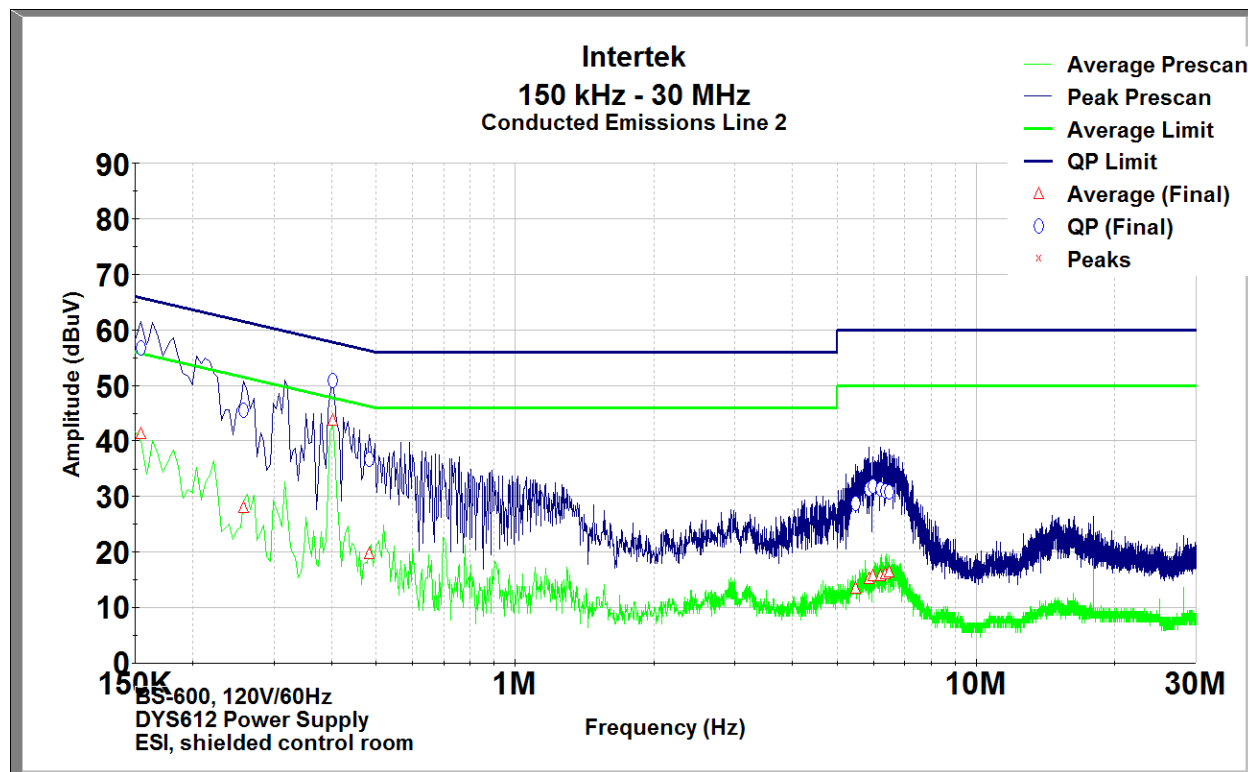
Deviations, Additions, or Exclusions: None

**15.7 Plots/Data: Conducted Emissions (Transmitting)**

Line

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.155	57.823	65.871	8.048	43.293	55.871	12.579
0.263	47.213	62.786	15.573	34.216	52.786	18.570
0.321	49.133	61.114	11.982	34.020	51.114	17.094
0.402	43.907	58.800	14.893	35.696	48.800	13.104
0.578	32.859	56.000	23.210	22.375	46.000	23.694
1.302	28.650	56.000	28.063	21.075	46.000	25.638
6.423	29.061	60.000	27.167	20.711	50.000	25.516
14.948	19.257	60.000	38.335	12.632	50.000	34.960
18.000	24.398	60.000	33.682	20.419	50.000	27.661
28.226	18.838	60.000	40.878	14.448	50.000	35.268

Line



Neutral

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.155	56.270	65.871	9.602	40.761	55.871	15.110
0.258	44.980	62.914	17.934	27.454	52.914	25.460
0.402	50.388	58.800	8.412	43.157	48.800	5.643
0.483	36.193	56.486	20.293	19.170	46.486	27.316
5.478	28.246	60.000	27.830	12.879	50.000	33.198
5.870	30.901	60.000	25.239	14.565	50.000	31.575
5.968	31.331	60.000	24.824	15.069	50.000	31.086
6.194	30.947	60.000	25.244	15.157	50.000	31.034
6.360	30.499	60.000	25.718	15.423	50.000	30.795
6.473	30.407	60.000	25.829	15.775	50.000	30.460

Neutral

Test Personnel: Brian Lackey

Supervising/Reviewing Engineer: NA
(Where Applicable) FCC Part 15B

Product Standard: ICES-003 Issue 6

Input Voltage: 120V/60Hz

Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 3/11/2019

Limit Applied: 15.207

Ambient Temperature: 23.1C

Relative Humidity: 24.0%

Atmospheric Pressure: 988.8mbar

Deviations, Additions, or Exclusions: None

**16 Revision History**

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	3/19/2019	103705988LEX-001	BZ	BCT	Original Issue