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Alcohol Monitoring Systems, Inc. TEST REPORT

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

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EMC TEST REPORT

(FULL COMPLIANCE)

Report Number:103705988LEX-001Project Number:G103705988Report Issue Date:3/19/2019Model(s) Tested:US Base Station
BS600Standards: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

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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
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 or low, middle, or high channel
2	Radios idle

	Cables							
п	Description	Longth (m)	Shielding	Forritos	Termination			
שו	Description	Length (m)	Silleluling	Ferrices	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)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	3.9dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.0dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.7dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.7dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.7dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.7dB	5.5 dB

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



6.2 Sample Calculation

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

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

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

Assume a receiver reading of 52.0 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 dBμV AF = 7.4 dB/m CF = 1.6 dB AG = 29.0 dB FS = 32 dBμV/m

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

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

Example:

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



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	Verify at
				Time of Use	Time of Use
System Controller	3957	Sunol Sciences	SC99V	Verify at	Verify at
				Time of Use	Time of Use
3m Cable	3074			11/26/2018	11/26/2019
Antenna→Preamp					
3m Cable	3918	Rohde & Schwarz	TS-PR18	11/26/2018	11/26/2019
Preamplifier					
3m Cable	2588			11/26/2018	11/26/2019
Preamp→Chamber					
3m Cable	2593			11/26/2018	11/26/2019
Chamber→Control Room					
3m Cable	2592			11/26/2018	11/26/2019
Control Room→Receiver					

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
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	22.6C
Input Voltage:	120V/60Hz to 10Vdc	Relative Humidity:	26.5%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	982.0mbar



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	н	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	н	130.0	32.8
949.991111	42.72	46.02	3.30	120.000	100.3	v	130.0	35.3



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	н	14.0	-3.0
1050.000000	43.41	74.00	30.59	1000.000	282.0	н	11.0	-3.8
1150.000000	41.20	74.00	32.80	1000.000	269.0	н	1.0	-3.0
1249.500000	38.36	74.00	35.64	1000.000	307.0	н	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	н	212.0	7.9
16561.000000	55.08	74.00	18.92	1000.000	314.0	Н	1.0	23.0

Frequency	Average	Limit	Margin	Bandwidth	Height	Pol	Azimuth	Corr.
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(kHz)	(cm)		(deg)	(dB)
1000.000000	35.14	54.00	18.86	1000.000	312.0	н	14.0	-3.0
1050.000000	40.14	54.00	13.86	1000.000	282.0	н	11.0	-3.8
1150.000000	37.25	54.00	16.75	1000.000	269.0	н	1.0	-3.0
1249.500000	30.00	54.00	24.00	1000.000	307.0	н	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	н	212.0	7.9
16561.000000	42.05	54.00	11.95	1000.000	314.0	н	1.0	23.0



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	Verify at
				Time of Use	Time of Use
System Controller	3957	Sunol Sciences	SC99V	Verify at	Verify at
				Time of Use	Time of Use
3m Cable	3074			11/26/2018	11/26/2019
Antenna→Preamp					
3m Cable	3918	Rohde & Schwarz	TS-PR18	11/26/2018	11/26/2019
Preamplifier					
3m Cable	2588			11/26/2018	11/26/2019
Preamp→Chamber					
3m Cable	2593			11/26/2018	11/26/2019
Chamber→Control Room					
3m Cable	2592			11/26/2018	11/26/2019
Control Room→Receiver					

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	н	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	Average	Limit	Margin	Bandwidth	Height	Pol	Azimuth	Corr.
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(kHz)	(cm)		(deg)	(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	н	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	Test Date:	2/6/2019
Supervising/Reviewing Engineer:			
(Where Applicable)	NA	Limit Applied:	See Above
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	22.7C
Input Voltage:	120V/60Hz to 10Vdc	Relative Humidity:	42.0%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	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	MaxPeak	Limit	Margin	Bandwidth	Height	Pol	Azimuth	Corr.
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(kHz)	(cm)		(deg)	(dB)
1736.000000	35.67	74.00	38.33	1000.000	161.0	Н	309.0	-0.6
1828.000000	47.02	74.00	26.98	1000.000	280.0	Н	280.0	0.7
2459.000000	39.12	74.00	34.88	1000.000	364.0	Н	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	н	83.0	7.1
5485.500000	55.05	74.00	18.95	1000.000	307.0	н	133.0	8.1
6399.500000	55.75	74.00	18.25	1000.000	100.0	Н	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	Average	Limit	Margin	Bandwidth	Height	Pol	Azimuth	Corr.
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(kHz)	(cm)		(deg)	(dB)
1736.000000	22.47	54.00	31.53	1000.000	161.0	н	309.0	-0.6
1828.000000	44.12	54.00	9.88	1000.000	280.0	н	280.0	0.7
2459.000000	26.08	54.00	27.92	1000.000	364.0	н	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	н	83.0	7.1
5485.500000	52.16	54.00	1.84	1000.000	307.0	н	133.0	8.1
6399.500000	53.05	54.00	0.95	1000.000	100.0	н	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	Test Date:	2/5/2019
Supervising/Reviewing Engineer:			
(Where Applicable)	NA	Limit Applied:	See Above
	FCC Part 15.247	_	
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	22.8C
Input Voltage:	120V/60Hz to 10Vdc	Relative Humidity:	41.8%
Pretest Verification w / Ambient		_	
Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar





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	Н	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	н	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	н	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	н	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	Test Date:	2/5/2019
Supervising/Reviewing Engineer:			
(Where Applicable)	NA	Limit Applied:	See Above
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	22.8C
Input Voltage:	120V/60Hz to 10Vdc	Relative Humidity:	41.8%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar



7.6.4 Spurious Emissions, 30MHz-1GHz



Frequency	QuasiPeak	Limit	Margin	Bandwidth	Height	Pol	Azimuth	Corr.
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(kHz)	(cm)		(deg)	(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	н	163.0	34.1
898.311667	39.45	46.02	6.57	120.000	117.6	н	38.0	34.2
908.281111 ¹	46.33	46.02	-0.31	120.000	165.9	н	155.0	34.4
910.221111 ¹	50.84	46.02	-4.82	120.000	169.3	н	157.0	34.3
914.262778 ²	98.44	46.02	-52.42	120.000	100.1	н	264.0	34.2
918.304444	44.30	46.02	1.72	120.000	166.0	н	154.0	34.3
920.244444 ¹	49.59	46.02	-3.57	120.000	166.1	н	164.0	34.3
930.267778	42.54	46.02	3.48	120.000	153.8	н	156.0	34.5

Test Personnel:	Brian Lackey	Test Date:	2/5/2019
Supervising/Reviewing Engineer:			
(Where Applicable)	NA	Limit Applied:	See Above
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	22.8C
Input Voltage:	120V/60Hz to 10Vdc	Relative Humidity:	41.8%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

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

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 §15.205(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	ESI26	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:			
(Where Applicable)	NA	Limit Applied:	See Above
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	23.0V
Input Voltage:	120V/60Hz to 10Vdc	Relative Humidity:	49.3%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	982.0mbar



8.6 Test Data







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 nonoverlapping 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

Brian Lackey	Test Date:	8/6/2018
NA	Limit Applied:	See Above
FCC Part 15.247		
RSS-247 Issue 2	Ambient Temperature:	24.6C
Battery	Relative Humidity:	50.8%
Yes	Atmospheric Pressure:	985.4mbar
	Brian Lackey NA FCC Part 15.247 RSS-247 Issue 2 Battery Yes	Brian LackeyTest Date:NALimit Applied:FCC Part 15.247Ambient Temperature:BatteryRelative Humidity:YesAtmospheric Pressure:

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



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	ESI26	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:			
(Where Applicable)	NA	Limit Applied:	See Above
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	23.0V
Input Voltage:	120V/60Hz to 10Vdc	Relative Humidity:	49.3%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	982.0mbar

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)



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	ESI26	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:			
(Where Applicable)	NA	Limit Applied:	See Above
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	22.1C
Input Voltage:	120V/60Hz to 10Vdc	Relative Humidity:	25.1%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	988.8mbar



11.6 Test Data

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

11.6.1 Channel Separation

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	ESI26	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:			
(Where Applicable)	NA	Limit Applied:	See Above
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	22.1C
Input Voltage:	120V/60Hz to 10Vdc	Relative Humidity:	25.1%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	988.8mbar

12.6 Test Data

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

13.6 Test Data

Time of Single	Number of		Total Time of		
Occupancy	Occupancies Per	Number of Bursts in	Occupancy	Limit	
(ms)	Burst	20 s	(ms)	(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)

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)	Ucispr
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 $NF = Net Reading in dB\mu V$

RF = Reading from receiver in $dB\mu V$

LF = LISN or ISN Correction Factor in dB

- CF = Cable Correction Factor in dB
- AF = Attenuator Loss Factor in dB

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

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

Example:

$$\begin{split} NF &= RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 \ dB\mu V \\ UF &= 10^{(49.1 \ dB\mu V \ / \ 20)} = 285.1 \ \mu V/m \end{split}$$

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	FCC-LISN-50-	4/10/2018	4/10/2019
		Communication	50-2M		
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	Quasi-Peak	Quasi-Peak	Quasi-Peak	Average	Average	Average
(MHz)	(dBuV)	Limit (dBuV)	Margin (dB)	(dBuV)	Limit (dBuV)	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	Test Date:	3/11/2019
Supervising/Reviewing Engineer:			
(Where Applicable)	NA	Limit Applied:	Class B
	FCC Part 15B		
Product Standard:	ICES-003 Issue 6	Ambient Temperature:	23.1C
Input Voltage:	120V/60Hz	Relative Humidity:	24.%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	988.8mbar

15.7 Plots/Data: Conducted Emissions (Transmitting)

Line

Frequency	Quasi-Peak	Quasi-Peak	Quasi-Peak	Average	Average	Average
(MHz)	(dBuV)	Limit (dBuV)	Margin (dB)	(dBuV)	Limit (dBuV)	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	Quasi-Peak	Quasi-Peak	Quasi-Peak	Average	Average	Average
(MHz)	(dBuV)	Limit (dBuV)	Margin (dB)	(dBuV)	Limit (dBuV)	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	Test Date:	3/11/2019
Supervising/Reviewing Engineer:			
(Where Applicable)	NA	Limit Applied:	15.207
	FCC Part 15B		
Product Standard:	ICES-003 Issue 6	Ambient Temperature:	23.1C
Input Voltage:	120V/60Hz	Relative Humidity:	24.%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	988.8mbar

16 Revision History

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