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EMC TEST REPORT

Report Number: 103017087LEX-023.1
Project Number: G103017087

Report Issue Date: 9/15/2017

Product Name: Wireless Base Station

FCC Standards: FCC Title 47 CFR Part 15 Subpart C
Industry Canada Standards: RSS-210 Issue 9 & RSS-GEN Issue 4

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

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

Report prepared by
Brian Lackey, Project Engineer

Report reviewed by
Bryan Taylor, Team Leader

TABLE OF CONTENTS

1 Introduction and Conclusion

The tests indicated in section 2 were performed on the product constructed as described in section 3. 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 complied with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

The INTERTEK-Lexington is located at 731 Enterprise Drive, Lexington Kentucky, 40510. The radiated emission test site is a 10-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1 and ANSI C63.4. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters. The test site is listed with the FCC under registration number 485103. The test site is listed with Industry Canada under site number IC 2042M-1.

2 Test Summary

Page	Test full name	FCC Reference	IC Reference	Result
6	Occupied Bandwidth	-	RSS-Gen (6.6)	Pass
8	Fundamental Field Strength and Spurious Emissions (Transmitter)	§ 15.249(a)	RSS-210 (B.10(a))	Pass
12	Radiated Spurious Emissions (Receiver)	§ 15.109 § 15.249(d)	RSS-Gen (7.1.2) RSS-210 (B.10(b))	Pass
15	AC Powerline Conducted Emissions	§ 15.107 § 15.207	RSS-Gen (8.8)	Pass
20	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen (8.3)	Pass

3 Description of Equipment under Test:

Equipment Under Test	
Manufacturer	Alcohol Monitoring Systems Inc.
Model Number	BS-400
Serial Number	WB1002W
Receive Date	5/8/2017
Test Start Date	5/8/2017
Test End Date	5/17/2017
Device Received Condition	Good
Test Sample Type	Production
Frequency Band	902MHz-928MHz
Modulation Type	GMFSK
Duty Cycle	100%
Transmission Control	Test Commands
Maximum Output Power	-4.24 dBm
Test Channels	NA[1]
Antenna Type (15.203)	PCB Antenna
Maximum Antenna Gain[2]	0 dBi
Operating Voltage	120Vac 60Hz

Description of Equipment Under Test
The SCRAM CAM bracelet, SCRAM Base Station, and SCRAM Wireless Base Station are part of an alcohol monitoring system and transfers data to a computerized monitoring network. This equipment is intended for use on individuals being monitored by a trained supervising authority.

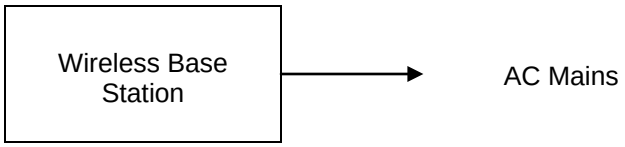
Operating modes of the EUT:

No.	**Descriptions of EUT Exercising**
1	Constant transmission at 916.5MHz with modulation active
2	Receive mode / idle mode

[1] Not applicable, device transmits at a single frequency
[2] From antenna datasheet

3.1 System setup including cable interconnection details, support equipment and simplified block diagram

3.2 EUT Block Diagram:



3.3 Cables:

Cables					
Description	Length	Shielding	Ferrites	Connection	
				From	To
Power Cable	1m	No	No	EUT	AC Mains

3.4 Support Equipment:

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop	HP	EliteBook 8440p	CND046136B

4 Occupied Bandwidth

4.1 Test Limits

RSS-Gen Issue 4 § 6.6:

> When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

4.2 Test Procedure

ANSI C63.10: 2013 and KDB Publication No. 558074 D01 v03r05: Guidance on Measurements for Digital Transmission Systems

4.3 Test Equipment Used:

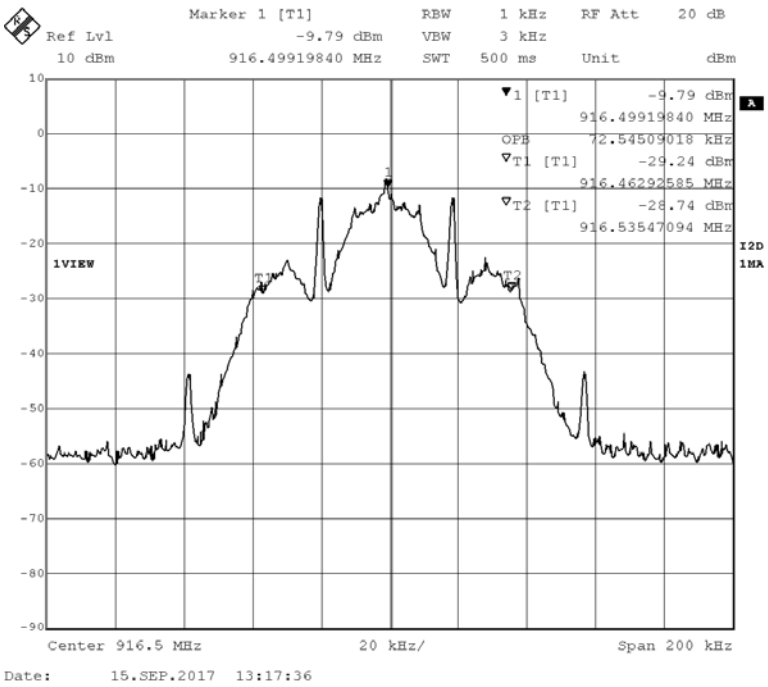
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017

4.4 Results:

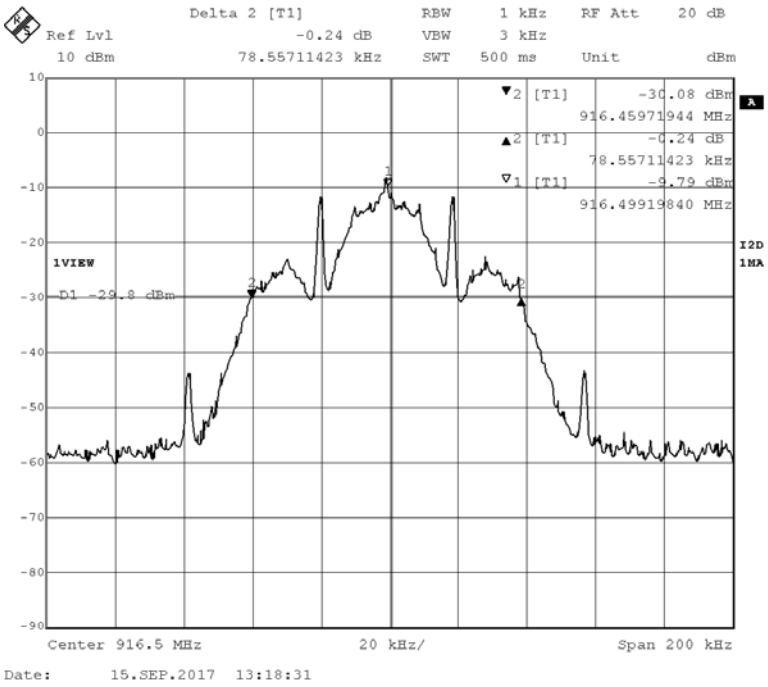
The device was found **to comply**. The 99% power bandwidth was measured to be 72.545kHz.

4.5 Test Data:

Mode	Frequency (MHz)	20dB Bandwidth	99% Power Bandwidth	Result
Normal Modulation	916.5	78.557kHz	72.545kHz	Pass



99% Power Bandwidth



20dB Bandwidth

5 Fundamental Field Strength and Spurious Emissions (Transmitter)

5.1 Test Limits

§ 15.249(a): Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

5.2 Test Procedure

ANSI C63.10: 2013.The peak output power was measured using an EMI receiver.

5.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:
FS = RA + AF + CF

FS = Field Strength in dBμV/m
RA = Receiver Amplitude in dBμV
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dBμV
AF = 18.52 dB
CF = 0.78 dB

FS = 19.48 + 18.52 + 0.78 = 38.78 dBμV/m
Level in μV/m = Common Antilogarithm [(38.78 dBμV/m)/20] = 86.89 μV/m

5.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017
Preamplifier	122005	Rohde&Schwarz	TS-PR18	11/17/2016	11/17/2017
Biconnilog Antenna	00051864	ETS	3142C	4/6/2017	4/6/2018
Horn Antenna	154521	ETS	3117	11/14/2016	11/14/2017
System Controller	121701-1	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
3m Cable Antenna→Preamp	3074			11/17/2016	11/17/2017
3m Cable Preamp→Chamber	2588			11/17/2016	11/17/2017
3m Cable Chamber→Control Room	2593			11/17/2016	11/17/2017
3m Cable Control Room→Receiver	2592			11/17/2016	11/17/2017
10m Cable Antenna→Preamp	3339			11/17/2016	11/17/2017
10m Cable Preamp→Chamber	3172			11/17/2016	11/17/2017
10m Cable Chamber→Control Room	2590			11/17/2016	11/17/2017
10m Cable Control Room→Receiver	2589			11/17/2016	11/17/2017

5.5 Results:

The device was found **to comply**. The fundamental field strength and harmonic field strength were below the limits of 15.249(a).

5.6 Test Data:

Quasi-Peak Measurements below 1000MHz:

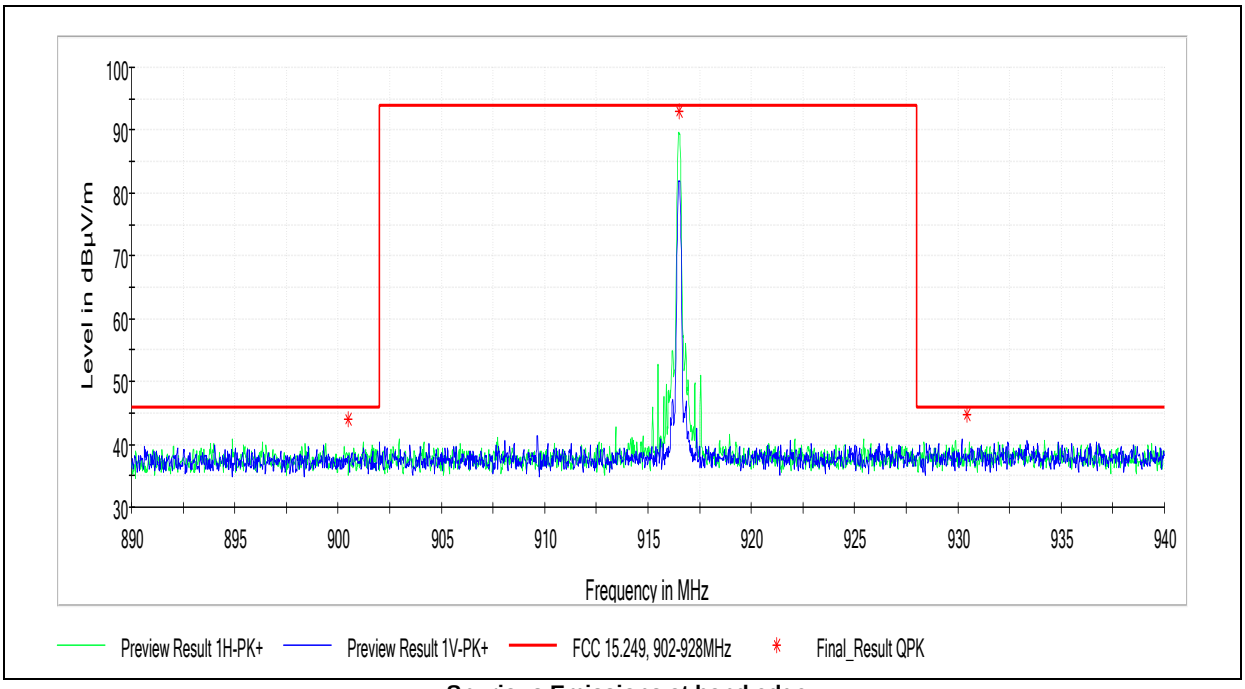
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
916.520000	92.97	94.00	1.03	120.000	146.9	H	198.0	36.1

Peak Measurements above 1000MHz:

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1843.000000	35.83	74.00	38.17	1000.000	410.0	H	121.0	0.7
2750.700000	39.84	74.00	34.16	1000.000	377.0	V	188.0	4.2
3673.600000	40.81	74.00	33.19	1000.000	288.0	V	256.0	5.7
4574.100000	42.22	74.00	31.78	1000.000	379.0	V	162.0	7.7
5498.200000	45.18	74.00	28.82	1000.000	322.0	V	229.0	9.4
6423.100000	44.59	74.00	29.41	1000.000	381.0	V	174.0	10.4
7341.600000	44.06	74.00	29.94	1000.000	272.0	H	146.0	10.5
8241.700000	44.64	74.00	29.36	1000.000	243.0	H	228.0	11.4
9163.400000	45.67	74.00	28.33	1000.000	370.0	H	288.0	12.7

Average Measurements above 1000MHz:

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1843.000000	23.50	54.00	30.50	1000.000	410.0	H	121.0	0.7
2750.700000	26.41	54.00	27.59	1000.000	377.0	V	188.0	4.2
3673.600000	28.13	54.00	25.87	1000.000	288.0	V	256.0	5.7
4574.100000	29.51	54.00	24.49	1000.000	379.0	V	162.0	7.7
5498.200000	33.14	54.00	20.86	1000.000	322.0	V	229.0	9.4
6423.100000	31.50	54.00	22.50	1000.000	381.0	V	174.0	10.4
7341.600000	31.13	54.00	22.87	1000.000	272.0	H	146.0	10.5
8241.700000	32.15	54.00	21.85	1000.000	243.0	H	228.0	11.4
9163.400000	33.22	54.00	20.78	1000.000	370.0	H	288.0	12.7



Spurious Emissions at band edge

Band Edge Spurious Emissions

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
900.480000	44.03	46.00	1.97	120.000	241.5	V	328.0	35.8
916.520000	92.97	94.00	1.03	120.000	146.9	H	198.0	36.1
930.460000	44.72	46.00	1.28	120.000	123.3	V	34.0	36.2

6 Radiated Spurious Emissions (Receiver)

6.1 Test Limits

§ 15.109: Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dBuV/m)
30–88	100	40
88–216	150	43.5
216–960	200	46
Above 960	500	54

6.2 Test Procedure

ANSI C63.4: 2014

6.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:
FS = RA + AF + CF

FS = Field Strength in dBμV/m
RA = Receiver Amplitude in dBμV
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dBμV
AF = 18.52 dB
CF = 0.78 dB

FS = 19.48 + 18.52 + 0.78 = 38.78 dBμV/m
Level in μV/m = Common Antilogarithm [(38.78 dBμV/m)/20] = 86.89 μV/m

6.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017
Preamplifier	122005	Rohde&Schwarz	TS-PR18	11/17/2016	11/17/2017
Biconnilog Antenna	00051864	ETS	3142C	4/6/2017	4/6/2018
Horn Antenna	154521	ETS	3117	11/14/2016	11/14/2017
System Controller	121701-1	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
3m Cable Antenna→Preamp	3074			11/17/2016	11/17/2017
3m Cable Preamp→Chamber	2588			11/17/2016	11/17/2017
3m Cable Chamber→Control Room	2593			11/17/2016	11/17/2017
3m Cable Control Room→Receiver	2592			11/17/2016	11/17/2017
10m Cable Antenna→Preamp	3339			11/17/2016	11/17/2017
10m Cable Preamp→Chamber	3172			11/17/2016	11/17/2017
10m Cable Chamber→Control Room	2590			11/17/2016	11/17/2017
10m Cable Control Room→Receiver	2589			11/17/2016	11/17/2017

6.5 Results:

The device was found **to comply**. All spurious emissions with the test sample in receive mode were below the limits specified in Part 15.109 for a class B digital device.

6.6 Test Data:

Quasi-Peak Measurements below 1000 MHz:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
53.038000	30.68	40.00	9.32	120.000	104.6	V	19.0	15.8
53.324000	30.93	40.00	9.07	120.000	104.8	V	36.0	15.8
53.426000	30.79	40.00	9.21	120.000	105.1	V	309.0	15.8
53.456000	30.54	40.00	9.46	120.000	109.2	V	28.0	15.8
53.720000	30.45	40.00	9.55	120.000	104.5	V	71.0	15.8
79.411000	25.60	40.00	14.4	120.000	110.0	V	229.0	15.6
107.360000	25.75	43.50	17.75	120.000	109.2	V	135.0	16.8
128.980000	28.42	43.50	15.08	120.000	104.5	V	146.0	16.1
687.720000	40.71	46.00	5.29	120.000	224.9	V	236.0	33.1
993.700000	45.65	46.00	0.35	120.000	248.9	V	-2.0	36.6

Peak Measurements above 1000 MHz:

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1218.804500	34.32	74.00	39.68	1000.000	174.0	H	25.0	-1.2
1302.077000	33.98	74.00	40.02	1000.000	143.0	V	50.0	-1.2
2463.577000	47.86	74.00	26.14	1000.000	165.0	V	30.0	3.9
4702.635000	42.67	74.00	31.33	1000.000	148.0	V	36.0	7.7
5497.920000	46.66	74.00	27.34	1000.000	100.0	V	0.0	9.4

Average Measurements above 1000 MHz:

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1218.804500	21.93	54.00	32.07	1000.000	174.0	H	25.0	-1.2
1302.077000	21.69	54.00	32.31	1000.000	143.0	V	50.0	-1.2
2463.577000	27.19	54.00	26.81	1000.000	165.0	V	30.0	3.9
4702.635000	29.89	54.00	24.11	1000.000	148.0	V	36.0	7.7
5497.920000	37.76	54.00	16.24	1000.000	100.0	V	0.0	9.4

7 AC Powerline Conducted Emissions

7.1 Test Limits

§ 15.107(e): Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

7.2 Test Procedure

ANSI C63.4: 2014

7.3 Test Equipment Used:

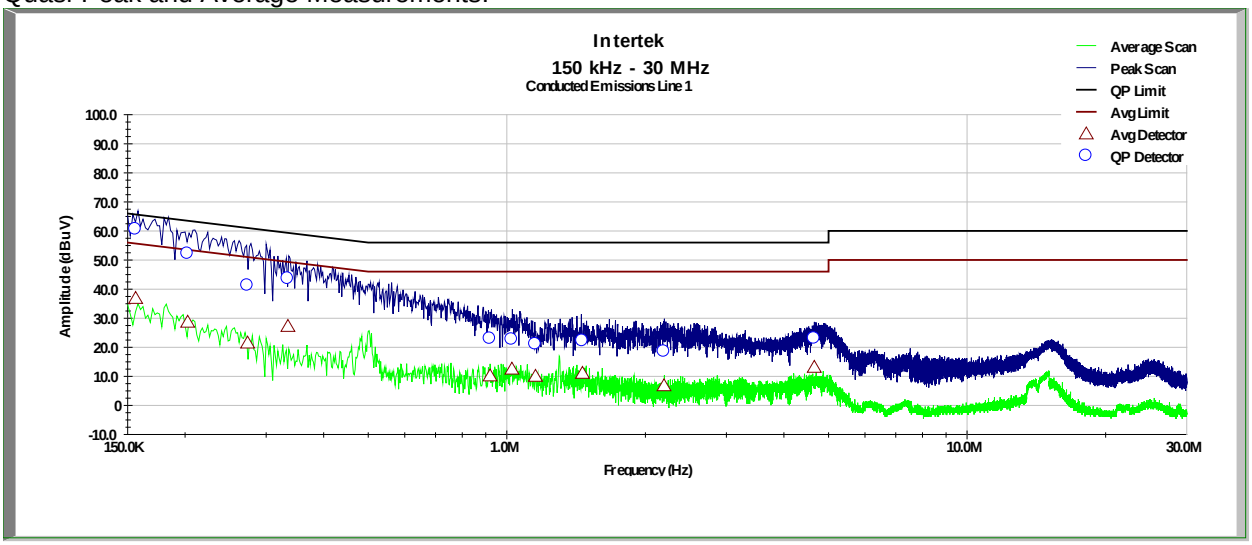
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017
LISN	2509	Fischer Custom Communication	FCC-LISN-50-50-2M	4/6/2017	4/6/2018
Cable	Cond2			11/19/2016	11/19/2017

7.4 Results:

The device was found **to comply**.

7.5 Test Data (Line 1, Transmitting):

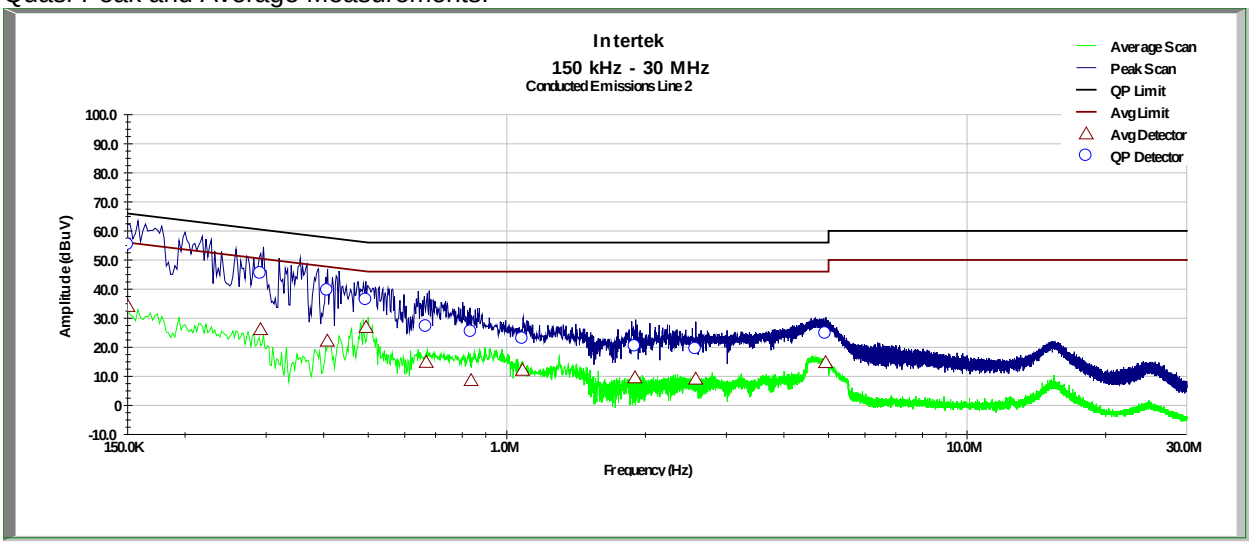
Quasi-Peak and Average Measurements:



Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.1561	60.505	65.826	5.321	36.813	55.826	19.013
0.2026	52.159	64.497	12.338	28.597	54.497	25.900
0.2734	41.176	62.474	21.298	21.450	52.474	31.024
0.3344	43.551	60.731	17.180	27.166	50.731	23.566
0.9194	22.906	56.000	33.094	10.124	46.000	35.876
1.026	22.639	56.000	33.361	12.466	46.000	33.534
1.154	20.975	56.000	35.025	9.999	46.000	36.001
1.460	22.128	56.000	33.872	11.016	46.000	34.984
2.195	18.439	56.000	37.561	6.740	46.000	39.260
4.657	22.955	56.000	33.045	13.087	46.000	32.913

7.6 Test Data (Line 2, Transmitting):

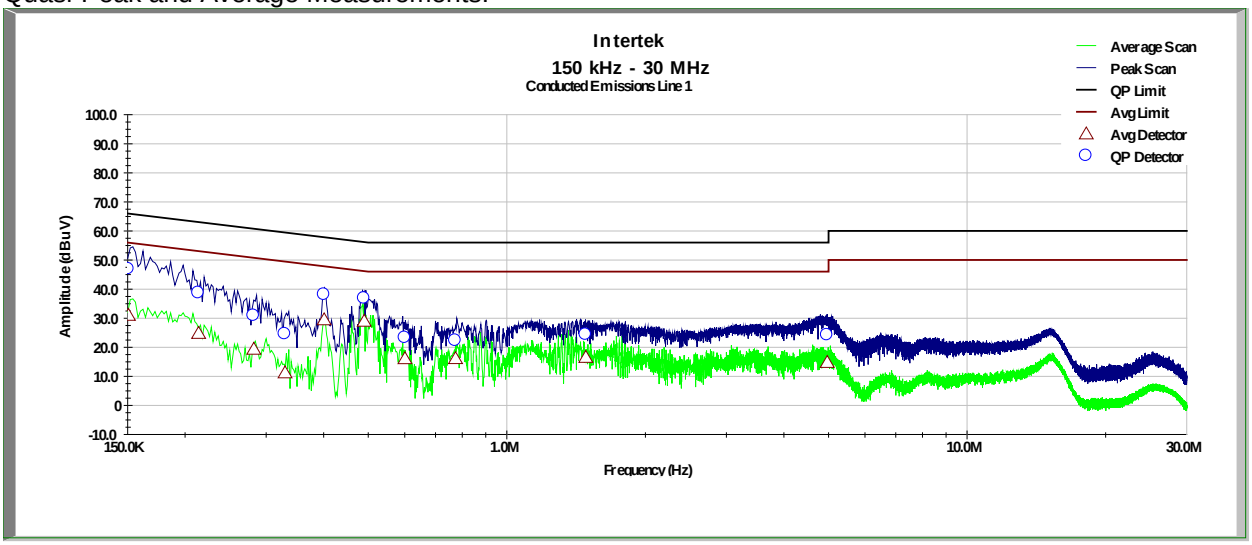
Quasi-Peak and Average Measurements:



Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.1502	55.198	65.994	10.796	34.026	55.994	21.969
0.2916	45.347	61.954	16.607	26.048	51.954	25.906
0.4074	39.542	58.646	19.104	22.107	48.646	26.539
0.4944	36.236	56.160	19.924	26.788	46.160	19.372
0.6682	27.076	56.000	28.924	14.795	46.000	31.205
0.8363	25.291	56.000	30.709	8.529	46.000	37.471
1.082	22.875	56.000	33.125	12.059	46.000	33.941
1.898	20.261	56.000	35.739	9.488	46.000	36.512
2.573	19.326	56.000	36.674	9.018	46.000	36.982
4.927	24.667	56.000	31.333	14.711	46.000	31.289

7.7 Test Data (Line 1, Idle):

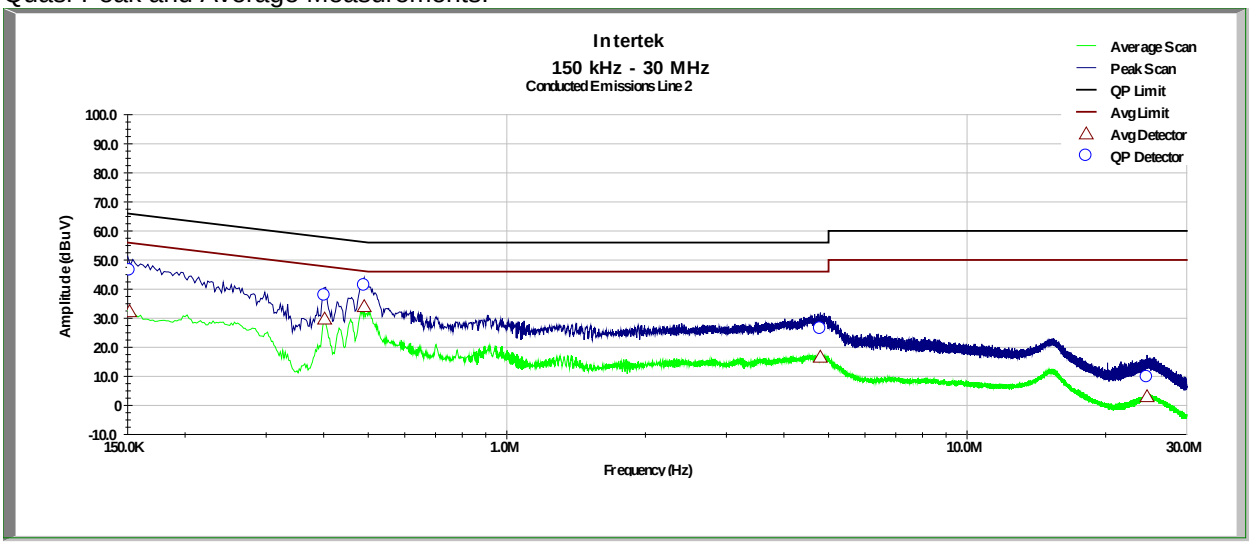
Quasi-Peak and Average Measurements:



Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.1506	46.840	65.983	19.143	30.987	55.983	24.996
0.2139	38.607	64.174	25.567	24.767	54.174	29.407
0.2820	30.823	62.229	31.406	19.311	52.229	32.918
0.3297	24.479	60.866	36.386	11.181	50.866	39.685
0.4010	38.008	58.829	20.821	29.449	48.829	19.379
0.4900	36.748	56.286	19.538	28.956	46.286	17.330
0.6006	23.185	56.000	32.815	16.056	46.000	29.944
0.7736	22.188	56.000	33.812	16.084	46.000	29.916
1.484	24.281	56.000	31.719	16.507	46.000	29.493
4.968	24.150	56.000	31.850	14.763	46.000	31.237

7.8 Test Data (Line 2, Idle):

Quasi-Peak and Average Measurements:



Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.1527	52.730	65.923	13.193	37.166	55.923	18.757
0.2363	37.173	63.534	26.361	21.191	53.534	32.343
0.3244	34.352	61.017	26.665	20.325	51.017	30.692
0.4391	31.896	57.740	25.844	21.558	47.740	26.182
3.429	29.399	56.000	26.601	20.379	46.000	25.621
15.605	32.490	60.000	27.510	26.207	50.000	23.793
17.409	26.837	60.000	33.163	19.266	50.000	30.734
18.496	28.958	60.000	31.042	21.590	50.000	28.410
23.570	25.480	60.000	34.520	19.127	50.000	30.873
25.508	16.832	60.000	43.168	11.181	50.000	38.819

8 Antenna Requirement per FCC Part 15.203

8.1 Test Limits:

§ 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, or §15.221. 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.

8.2 Results:

The sample tested met the antenna requirement. The antenna used was permanently attached and internal to the unit.

9 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of k = 2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty	Notes
Radiated emissions, 30 to 1000 MHz	±3.9dB	
Radiated emissions, 1 to 18 GHz	±4.2dB	
Radiated emissions, 18 to 40 GHz	±4.3dB	
Power Port Conducted emissions, 150kHz to 30 MHz	±2.8dB	

10 Revision History

Revision Level	Date	Report Number	Notes
0	5/31/2017	103017087LEX-023	Original Issue
1	9/15/2017	103017087LEX-023.1	Added occupied bandwidth data and band edge spurious emissions data