

Honeywell Safety Products USA, Inc. **TEST REPORT**

SCOPE OF WORK

EMC TESTING – TITAN TELEMETRY

REPORT NUMBER

103680797LAX-002

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EMC TEST REPORT
(FULL COMPLIANCE)

Report Number: 103680797LAX-002

Project Number: G103680797

Report Issue Date: December 12, 2018

Report Revised Date: December 17, 2019

Model(s) Tested: Titan Telemetry

Standards: **FCC CFR47 Part 15 Subpart C, September 2018**

Intentional Radiator

§15.225, Operation within the bands 13.110-14.010 MHz

ISED RSS-210 Issue 9, August 2016 (Amendment November 2017)

License-Exempt Radio Apparatus: Category I Equipment

ISED RSS-Gen Issue 5, April 2018

General Requirements for Compliance of Radio Apparatus

Tested by:

Intertek

25791 Commercentre Drive

Lake Forest, CA 92630

USA

Client:

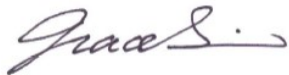
Honeywell Safety Products USA, Inc.

3001 S. Susan Street

Santa Ana, CA 92704

USA

Report prepared by



Grace Lin

EMC Staff Engineer

Report reviewed by



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1 Introduction and Conclusion

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

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

2 Test Summary

Section	Test full name	Result
3	Client Information	-
4	Description of Equipment Under Test and Variant Models	-
5	System Setup and Method	-
6	Field Strength at Fundamental and Radiated Emissions Outside of the band (FCC §15.225(a)(b)(c)(d); ISED RSS-210 §B.6a, b, c, d)	Compliant
7	Frequency Stability (FCC §15.225(e); ISED RSS-210 §B.6)	Compliant
8	Occupied Bandwidth (FCC §15.215(c); ISED RSS-Gen Issue 5 §6.7)	Compliant
9	AC Mains Conducted Emissions (FCC §15.207; ISED RSS-Gen Issue 5 §8.8)	Not Applicable *
10	Revision History	-

*: The EUT is battery powered.

3 Client Information

This EUT was tested at the request of:

Client: Honeywell Safety Products USA, Inc.
3001 S. Susan Street
Santa Ana, CA 92704
USA

Contact: Lance Gifford
Telephone: 714 427 5220
Email: Lance.Giggord@Honeywell.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: Honeywell Safety Products USA, Inc.
3001 S. Susan Street
Santa Ana, CA 92704
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Breathing Apparatus	Honeywell	Titan Telemetry	-
Receive Date:	11/01/2018	Test Started	11/29/2018
Received Condition:	Good	Test Ended	12/04/2018
Type:	Production		

Description of Equipment Under Test (provided by client)

The equipment under test is a self-contained breathing apparatus (SCBA) used by fire fighters, model: Titan Telemetry. SCBA includes a 13.56 MHz RFID transmitter, a Bluetooth Low Energy (BLE) transmitter, and a 900 MHz certified transmitter module. This test report covers for the 13.56 MHz RFID transmitter.



Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
6 Vdc (4 x AA Batteries)	-	-	-

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Test Mode – The EUT transmits continuously. Testing was performed without enclosure (worst-case).

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Under test mode, the EUT was programmed to transmit continuously during testing.

Radio/Receiver Characteristics	
Frequency Band(s)	13.56 MHz – 13.56 MHz
Modulation Type(s)	ASK
Maximum Field Strength at Fundamental	55.2 dBuV/m @ 3m
Test Channels	13.56 MHz
Occupied Bandwidth	324.3 kHz (99%)
Equipment Type	Standalone
Antenna Type and Gain	PCB Trace Antenna

Variant Models: None

5 System Setup and Method

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	Wires (pair)	1.5	No	No	Yes
2	Power Cord	1.8	No	No	Yes

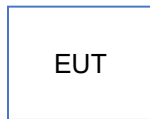
Support Equipment			
Description	Manufacturer	Model Number	Serial Number
DC Power Supply	B&K Precision	1671A	249D15133

5.1 Method:

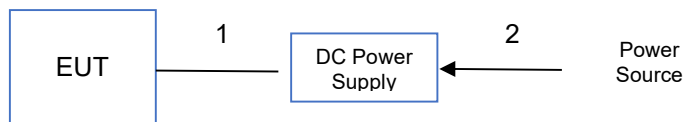
Configuration as required by ANSI C63.10-2013.

5.2 EUT Test Setup Block Diagram:

Radiated spurious emissions test (9 kHz – 1 GHz) and bandwidth tests:



All the other tests:



6 Field Strength at Fundamental and Radiated Emissions Outside the band

6.1 Performance Requirement(s)

The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in FCC §15.209.

6.2 Method

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

Radiated Measurements Below 30 MHz

The measurement antenna is positioned with its plane perpendicular to the ground. The lowest height of the antenna is 1 m above the ground and is positioned at the 3 meters from the EUT. Radiated emissions are taken at three meters unless specified otherwise.

During the test the EUT is rotated 0° to 360° on a turntable and the measuring antenna angles are varied during the search for maximum signal level.

Radiated Measurements Above 30 MHz

During the test the EUT is rotated and the measuring antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at three meters unless specified otherwise. If necessary, a pre-amplifier is used. Radiated emission measurements were performed from 9kHz to 1 GHz, with the following resolution bandwidths:

200Hz or greater	for 9kHz to 150kHz
9 kHz or greater	for 150kHz to 30 MHz
120 kHz or greater	for 30MHz to 1000 MHz

Data includes of the worst-case configuration (the configuration which resulted in the highest emission levels). A sample calculation, test setup diagrams and data tables of the emissions are included.

TEST SITE:

The test is performed in the 3-meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisprr
Radiated Emissions, 3m	30-1000 MHz	4.3	6.3 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, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

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

$$FS = RA + AF + CF - AG$$

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

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

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

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

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

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

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

Example:

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

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

6.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
637	3m Semi-anechoic Chamber	Panashield	3 meter	25 331-D-Z	December 2015	December 2018
1669	EMI Test Receiver	R&S	ESW44	101636	08/15/2018	08/15/2019
1707	Bilog Antenna	sunAR	JB6	A110618	11/20/2018	11/20/2019
590	Loop Antenna	EMCO	6502	9807-3213	08/10/2018	08/10/2019
1568	Pre-amp	Rhode & Schwarz	TS-PR1	102061	01/26/2018	01/26/2019
1517	Cable	R&S	TSPR-B7	101528	08/06/2018	08/06/2019
1518	Cable	R&S	TSPR-B7	101529	08/06/2018	08/06/2019
1014	Barometer Temp/Humidity	Omega	IBTHX-W	0480395	12/20/2017	12/20/2018

Software Utilized:

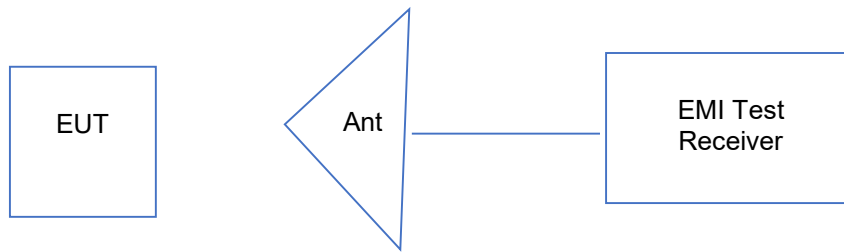
Name	Manufacturer	Version	Profile
TILE	Quantum Change	3.4.K.29	ESCI RE 150kHz-30MHz FCC 15225
BAT-EMC	Nexio	3.18.0.16	LAX Intertek Emissions Template 03-30-2018

6.4 Results:

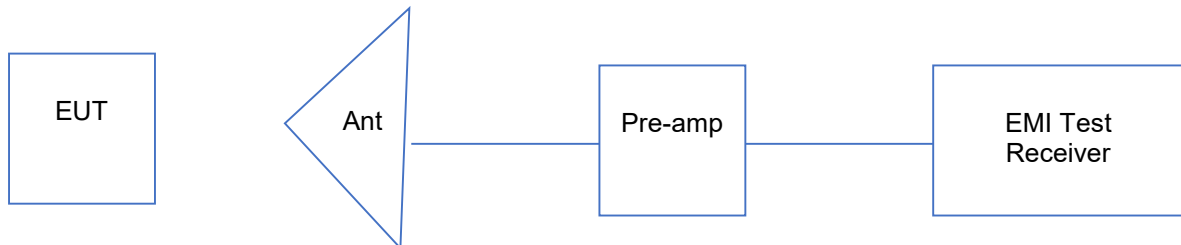
The sample tested was found to Comply.

6.5 Setup Diagram:

Below 30 MHz:

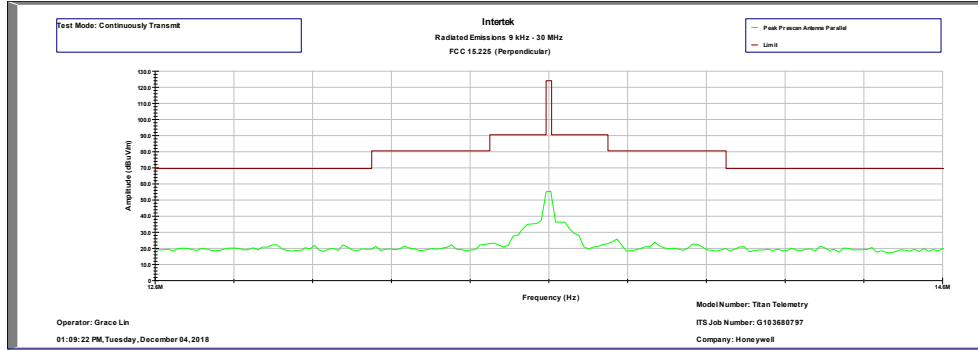


Above 30 MHz:



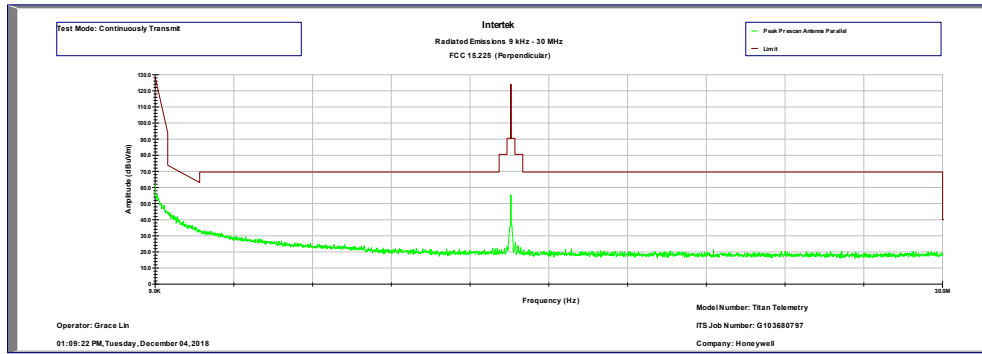
6.6 Plots/Data:

Field Strength at Fundamental:

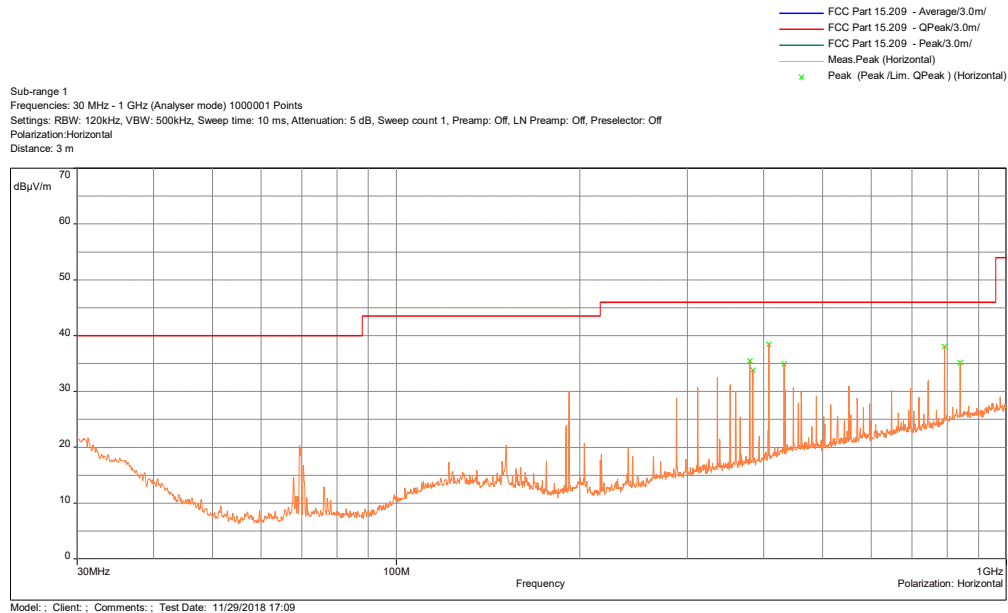


Frequency (MHz)	FS (PK) dB(uV/m)	Limit@3m dB(uV/m)	Margin dB	RA dB(uV)	AF dB(1/m)	CF dB	Turntable (degree)	Ant. Ht. (cm)	Antenna Orientation	EUT Orientation
13.56	55.2	124	-68.8	44.3	10.6	0.3	343	100	Perpendicular	XY

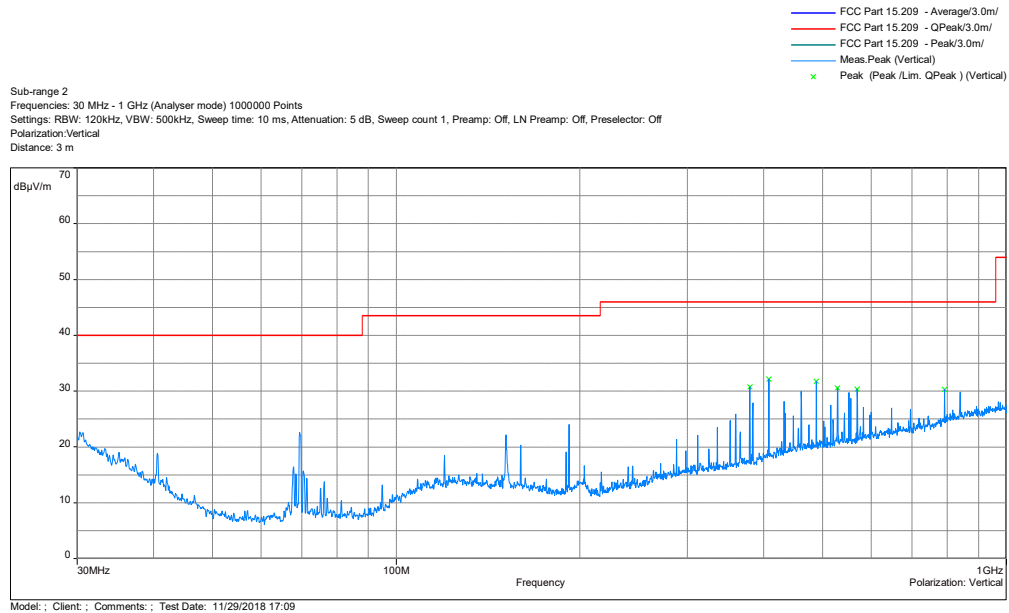
Radiated Emissions Outside the Band:



Radiated Emissions 9 kHz - 30 MHz, Antenna: Perpendicular (Worst case)



Radiated Emissions 30 MHz – 1GHz, Antenna: Horizontal



Radiated Emissions 30 MHz – 1GHz, Antenna: Vertical

Radiated Emissions – Out-of-band

Frequency (MHz)	FS (Pk) (dBµV/m)	Limit (QP) (dBµV/m)	Margin (dB)	Antenna Height (m)	Turntable Angle (°)	Antenna Polarization	Correction (dB)
379.7	35.5	46	-10.5	0.99	2	Horizontal	-8.21
384.0	33.8	46	-12.2	0.99	342	Horizontal	-8.23
408.0	38.5	46	-7.5	0.99	342	Horizontal	-7.56
432.0	34.9	46	-11.1	1.98	277	Horizontal	-6.97
792.0	38.1	46	-7.9	0.99	342	Horizontal	-1.73
840.0	35.2	46	-10.8	0.99	342	Horizontal	-0.42
379.7	30.8	46	-15.2	1.00	79	Vertical	-8.21
408.0	32.1	46	-13.9	1.98	198	Vertical	-7.56
488.1	31.8	46	-14.3	1.00	167	Vertical	-6.08
528.8	30.6	46	-15.4	1.00	79	Vertical	-5.47
569.5	30.4	46	-15.6	1.00	79	Vertical	-4.96
792.0	30.3	46	-15.7	1.98	285	Vertical	-1.73

Test Personnel:	Grace Lin	Test Date:	11/30/2018, 12/04/2018
Product Standard:	FCC 15.225, ISED RSS-210	Limit Applied:	FCC 15.225(a)(b)(c)(d), ISED RSS-210 §B.6a, b, c, d
Input Voltage:	6 Vdc (4 x AA Batteries)	Ambient Temperature:	21.8 °C
Pretest Verification w/ BB Source:	Yes	Relative Humidity:	30 %
		Atmospheric Pressure:	992.6 mbars

Deviations, Additions, or Exclusions: None

7 Frequency Stability

7.1 Performance Requirement(s)

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+ 50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

7.2 Method

Tests are performed in accordance with ANSI C63.10-2013, Sections 6.8.1 and 6.8.2.

The EUT was placed in an environmental test chamber. An EMI receiver was placed outside of the chamber and connected to a loop antenna inside of the chamber. For each temperature, the carrier frequency was recorded. In addition, the carrier frequency was recorded when the power was set to 85% and 115% of the rated voltage.

TEST SITE:

The test is performed in the PV laboratory located at 25791 Commercentre Drive, Lake Forest, California 92630 USA.

7.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
953	Environmental Test Chamber	ESPEC	EWSX376-22CW	1610559A	11/09/2018	11/09/2019
690	Spectrum Analyzer	R&S	FSP40	100027	02/28/2018	02/28/2019
590	Loop Antenna	EMCO	6502	9807-3213	08/10/2018	08/10/2019
1014	Barometer Temp/Humidity	Omega	IBTHX-W	0480395	12/20/2017	12/20/2018

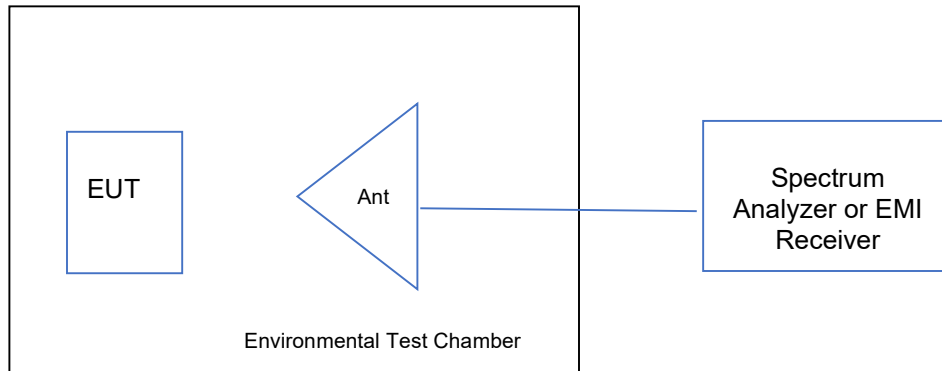
Software Utilized:

Name	Manufacturer	Version	Profile
N/A	N/A	N/A	N/A

7.4 Results:

The sample tested was found to Comply.

7.5 Test Setup Diagram:



7.6 Plots/Data:

Temperature (°C)	Carrier (MHz)	Supply Voltage		Frequency Deviation	
		(Vdc)	(%)	(kHz)	(%)
-30	13.560311000	6	100	0.311	0.0023
-20	13.560326000	6	100	0.326	0.0024
-10	13.560316000	6	100	0.316	0.0023
0	13.560278000	6	100	0.278	0.0021
10	13.560219000	6	100	0.219	0.0016
20	13.560145000	6	100	0.145	0.0011
20	13.560143000	5.1	85	0.143	0.0011
20	13.560146000	6.9	115	0.146	0.0011
30	13.560058000	6	100	0.058	0.0004
40	13.559977000	6	100	0.023	0.0002
50	13,559896000	6	100	0.104	0.0008

Test Personnel: Grace Lin
 Product Standard: FCC §15.225, RSS 210
 Input Voltage: 6 Vdc
 Pretest Verification w/
 BB Source: N/A

Test Date: 12/3/2018
 Limit Applied: FCC §15.225, RSS-210 §B6
 Ambient Temperature: 21.8 °C
 Relative Humidity: 36.6 %
 Atmospheric Pressure: 993.5 mbars

Deviations, Additions, or Exclusions: None

8 Occupied Bandwidth

8.1 Performance Requirement(s)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

8.2 Method

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

The EUT was setup to transmit in normal operating condition. Measurements were made with the loop antenna in close proximity of the EUT. Following the procedures of ANSI 63.10, the 20dB bandwidth measurements were taken. The following plots show Occupied Bandwidth.

TEST SITE:

The test is performed in the wireless laboratory located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. ISED test site registration number is 2042T.

8.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
1669	EMI Test Receiver	R&S	ESW44	101636	08/15/2018	08/15/2019
590	Loop Antenna	EMCO	6502	9807-3213	08/10/2018	08/10/2019
1014	Barometer Temp/Humidity	Omega	IBTHX-W	0480395	12/20/2017	12/20/2018

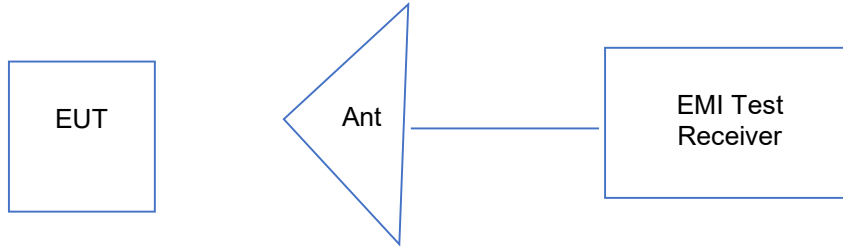
Software Utilized:

Name	Manufacturer	Version	Profile
N/A	N/A	N/A	N/A

8.4 Results:

The sample tested was found to Comply.

8.5 Setup Diagram:



8.6 Plots/Data:

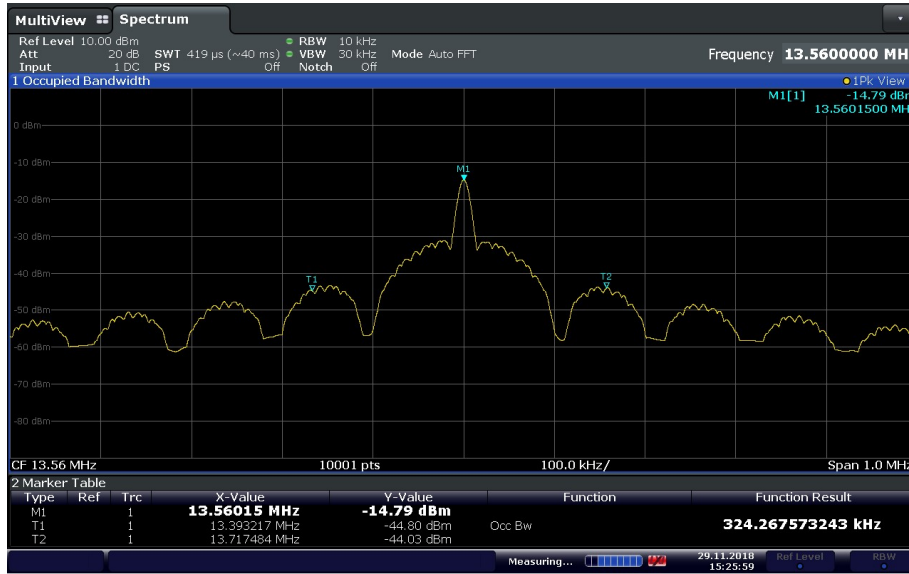
20 dB Bandwidth



15:20:15 29.11.2018

8.6 Plots/Data: (Continue)

99% Bandwidth



15:25:59 29.11.2018

Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
13.56	105.59	324.27

Test Personnel: Grace Lin
 Product Standard: FCC §15.225
 ISED RSS-210
 Input Voltage: 6 Vdc
 Pretest Verification w/
 BB Source: N/A

Test Date: 11/29/2018
 Limit Applied: FCC §15.215(c),
 ISED RSS-Gen i5 §6.7
 Ambient Temperature: 23.3 °C
 Relative Humidity: 52.9 %
 Atmospheric Pressure: 984.8 mbars

Deviations, Additions, or Exclusions: None

9 AC Mains Conducted Emissions

9.1 Performance Criterion

Frequency Band MHz	Class B Limit dB(μV)		Class A Limit dB(μV)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15-0.50	66 to 56 *	56 to 46 *	79	66
0.50-5.00	56	46	73	60
5.00-30.00	60	50	73	60

*Note: *Decreases linearly with the logarithm of the frequency
At the transition frequency the lower limit applies.*

9.2 Method

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.4.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisp
AC Line Conducted Emissions	150 kHz - 30 MHz	2.1 dB	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, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

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:

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

NF = Net Reading in dB μ V

Example:

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

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

9.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
-	-	-	-	-	-	-

Software Utilized:

Name	Manufacturer	Version	Profile
-	-	-	-

9.4 Results:

This test is not applicable as the equipment under test (EUT) is battery powered.

10 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	12/12/2018	103680797LAX-002	GL	SK	Original Issue
1	12/17/2019	103680797LAX-002	GL	SK	Editorial corrections on Pages 7 (30 MHz -> 9 kHz), 18 (6 dB -> 20 dB), and 20 (Vac -> Vdc)