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Honeywell Safety Products USA, Inc.
TEST REPORT

SCOPE OF WORK
FCC 15.247 TESTING – TITAN TELEMETRY

REPORT NUMBER
103680797LAX-001

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December 17, 2019

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Non-Specific Radio Report Shell Rev. December 2017

EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 103680797LAX-001
Project Number: G103680797

Report Issue Date: December 17, 2018
Report Revision Date: December 17, 2019

Model(s) Tested: Titan Telemetry

Standards: **FCC CFR47 Part 15 Subpart C, April 2018**
Intentional Radiator
§15.247, Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

ISED RSS-247 Issue 2, February 2017
Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

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	6 dB Bandwidth and 99% Bandwidth (FCC §15.247(a)(2), ISED RSS-247 §5.2a; ISED RSS-Gen §6.7)	Compliant
7	Maximum Peak Conducted Output Power at Antenna Terminals (FCC §15.247(b)(3), ISED RSS-247 §5.4d)	Compliant
8	Maximum Power Spectral Density (FCC §15.247(e), ISED RSS-247 §5.2b)	Compliant
9	Conducted Spurious Emissions (FCC §15.247(d), ISED RSS-247 §5.5)	Compliant
10	Radiated Spurious Emissions (FCC §15.247(d), §15.209, §15.205, ISED RSS-247 §5.5, ISED RSS-Gen §8.9)	Compliant
11	AC Mains Conducted Emissions (FCC §15.207, ISED RSS-Gen §8.8)	Not Applicable*
12	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	12/06/2018
Received Condition:	Good	Test Ended	12/15/2018
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 BLE 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)	2402 MHz – 2480 MHz
Modulation Type(s)	GFSK
Maximum Output Power	-14.21 dBm (0.038 mW)
Test Channels	2402 MHz, 2440 MHz, 2480 MHz
Occupied Bandwidth	728.9 kHz (6 dB), 1127.9 kHz (99%)
Frequency Hopper: Number of Hopping Channels	Not Applicable
Frequency Hopper: Channel Dwell Time	Not Applicable
Frequency Hopper: Max interval between two instances of use of the same channel	Not Applicable
MIMO Information (# of Transmit and Receive antenna ports)	Not Applicable
Equipment Type	Standalone
Antenna Type and Gain	Permanent attached SMD antenna. Peak Antenna Gain: < 6 dBi

Variant Models:

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

- None

5 System Setup and Method

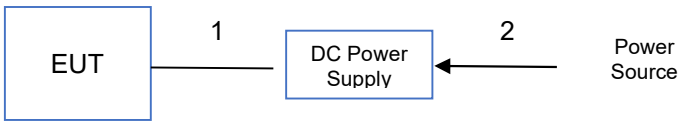
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	Wires (pair)	1.5	No	No	Yes
2	Power Cord	1.8	No	No	Yes

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 Test Setup Block Diagram:



6 DTS (6 dB) Bandwidth and 99% Bandwidth

6.1 Requirement(s)

The minimum DTS (6 dB) bandwidth shall be at least 500 kHz.

6.2 Method

A. The procedure described in ANSI C63.10-2013 and FCC Publication *558074 D01 15.247 Meas Guidance v05*, August 24, 2018 was used to determine the DTS (6 dB) bandwidth. Section *8.2* was used.

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 x RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

B. The following procedure was used for measuring 99% power bandwidth.

a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level.
d) Step a) through step c) might require iteration to adjust within the specified range.
e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
f) Use the 99% power bandwidth function of the instrument and report the measured 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. IC test site registration number is 2042T.

6.3 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
1014	Barometer Temp/Humidity	Omega	IBTHX-W	0480395	12/20/2017	12/20/2018

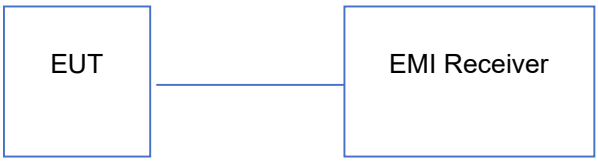
Software Utilized:

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

6.4 Results:

The sample tested was found to Comply.

6.5 Setup Diagram:

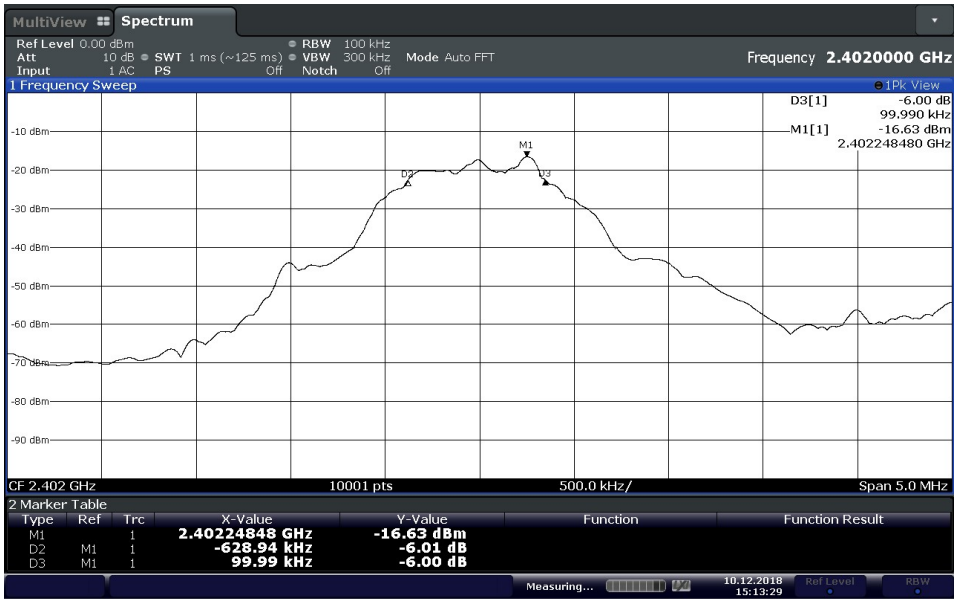


6.6 Plots/Data:

Frequency (MHz)	6 dB Bandwidth (kHz)	99% Bandwidth (kHz)
2402	728.9	1119.9
2440	723.9	1127.9
2480	714.9	1092.9

Note: The RF level in the plots is relative and is not the indication of RF output power.

6 dB Bandwidth, 2402 MHz:

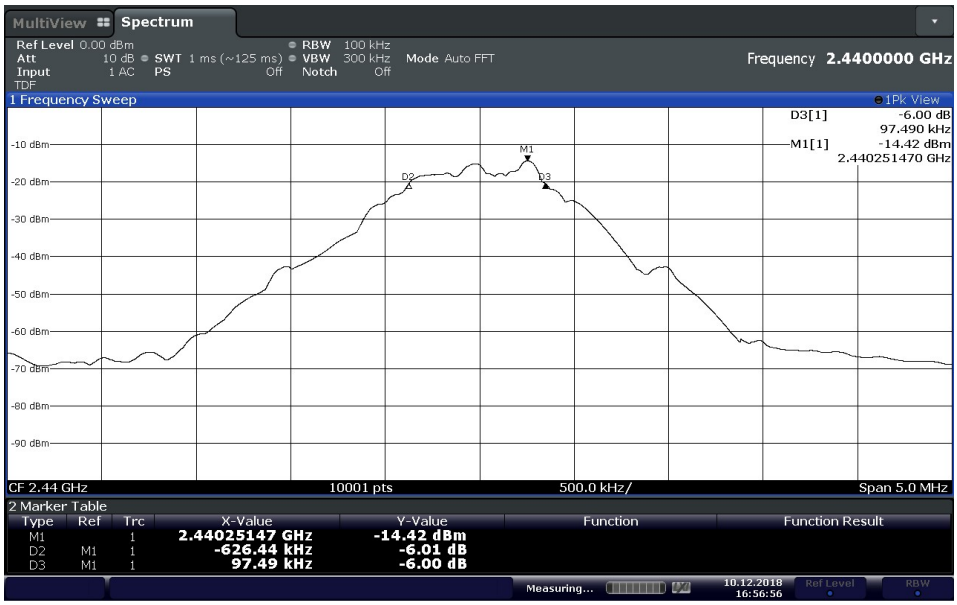


15:13:30 10.12.2018

99% Bandwidth, 2402 MHz:

15:18:24 10.12.2018

6 dB Bandwidth, 2440 MHz:

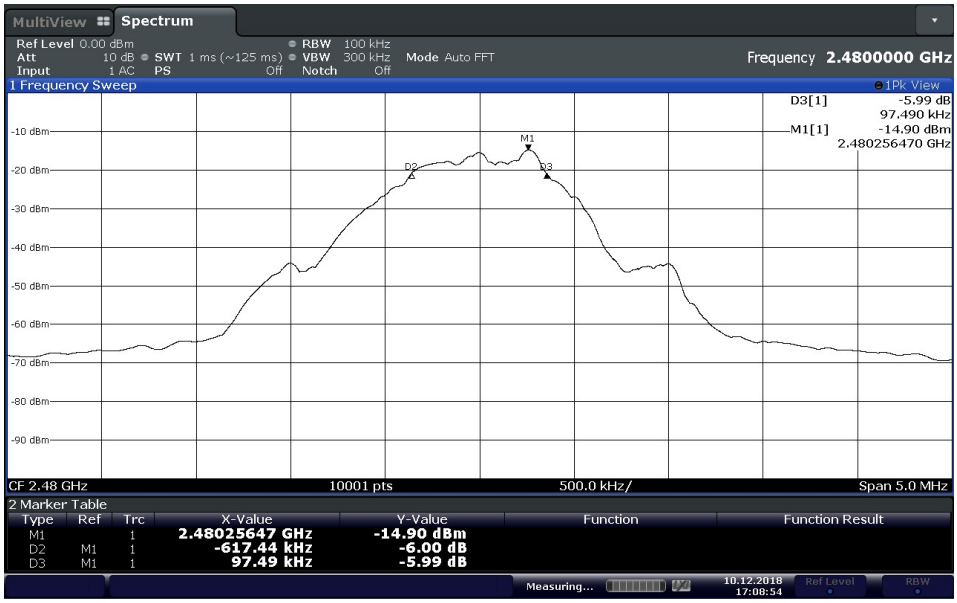


16:56:56 10.12.2018

99% Bandwidth, 2440 MHz:

17:00:16 10.12.2018

6 dB Bandwidth, 2480 MHz:



17:08:55 10.12.2018

99% Bandwidth, 2480 MHz:

17:06:14 10.12.2018

Test Personnel:	Grace Lin	Test Date:	12/10/2018
Product Standard:	FCC §15.247, ISED RSS-247	Limit Applied:	FCC §15.247, ISED RSS-247
Input Voltage:	6 Vdc	Ambient Temperature:	23.6 °C
Pretest Verification w/ BB Source:	N/A	Relative Humidity:	39.2 %
		Atmospheric Pressure:	994.7 mbars

Deviations, Additions, or Exclusions: None

7 Maximum Peak Conducted Output Power at Antenna Terminals

7.1 Requirement(s)

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt or 30 dBm. For antennas with gains greater than 6 dBi, transmitter output level must be decreased appropriately, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.2 Method

The procedure described in ANSI C63.10-2013 and FCC Publication *558074 D01 15.247 Meas Guidance v05*, August 24, 2018 was used. Specifically, Section *8.3.1.1 RBW ≥ DTS bandwidth* was utilized as the spectrum analyzer's resolution bandwidth was greater than the DTS bandwidth.

a) Set the RBW ≥ DTS Bandwidth
b) Set the VBW ≥ 3 x RBW
c) Set the span ≥ 3 x RBW
d) Sweep time = Auto couple
e) Detector = Peak
f) Trace mode = Max Hold
g) Allow trace to fully stabilize
h) Use peak marker function to determine the peak amplitude level.

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.

7.3 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
1014	Barometer Temp/Humidity	Omega	IBTHX-W	0480395	12/20/2017	12/20/2018

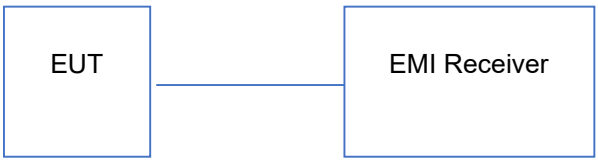
Software Utilized:

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

7.4 Results:

The sample tested was found to Comply.

7.5 Setup Diagram:

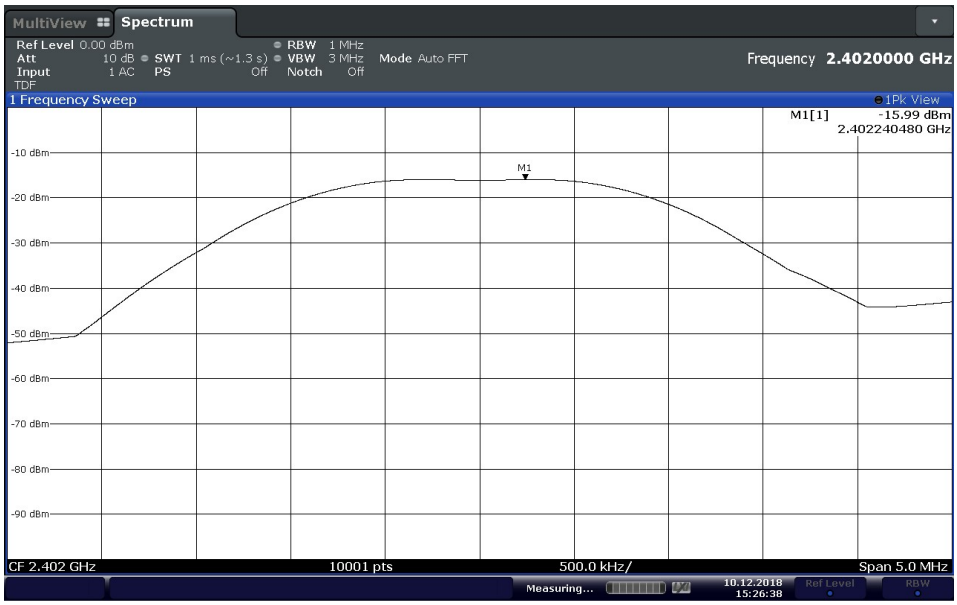


7.6 Plots/Data:

Frequency (MHz)	Peak Conducted Output Power	
	dBm	mW
2402	-15.99	0.025
2440	-14.58	0.035
2480	-14.21	0.038

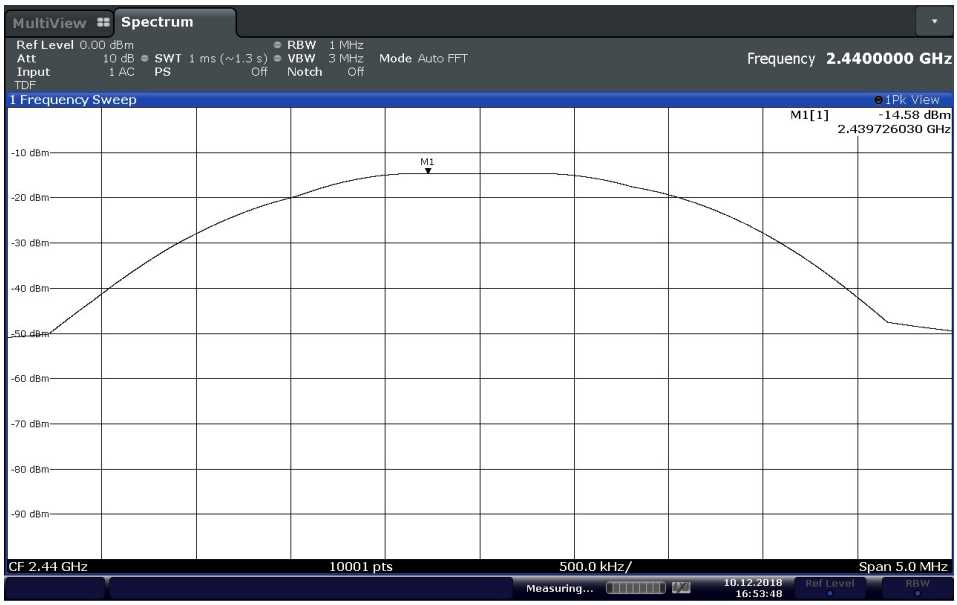
Note: The insertion loss was compensated for in the receiver

Output Power, 2402 MHz:



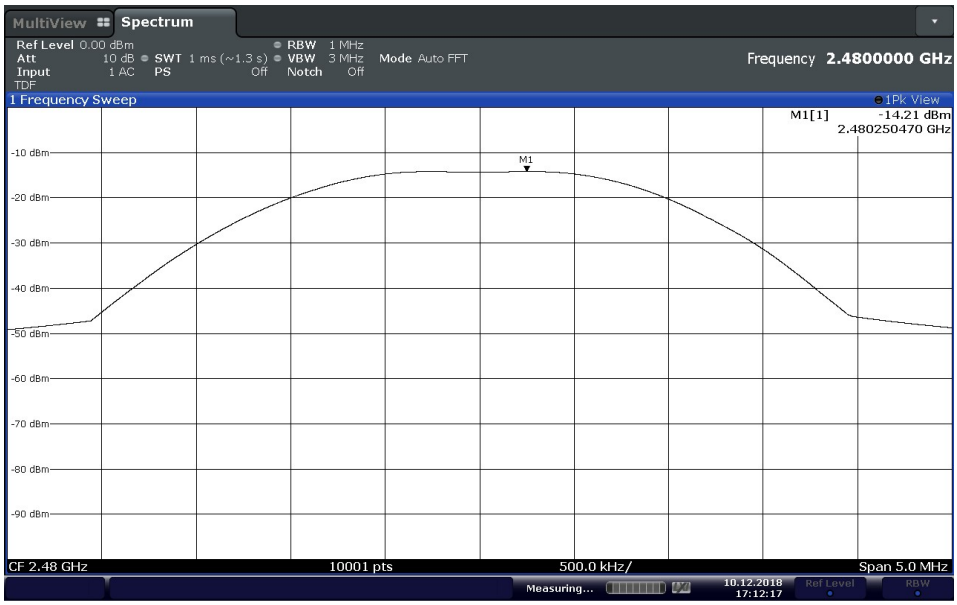
15:26:38 10.12.2018

Output Power, 2440 MHz:



16:53:48 10.12.2018

Output Power, 2480 MHz:



17:12:18 10.12.2018

Test Personnel:	Grace Lin	Test Date:	12/10/2018
Product Standard:	FCC §15.247, ISED RSS-247	Limit Applied:	FCC §15.247, ISED RSS-247
Input Voltage:	6 Vdc	Ambient Temperature:	23.6 °C
Pretest Verification w/ BB Source:	N/A	Relative Humidity:	39.2 %
		Atmospheric Pressure:	994.7 mbars

Deviations, Additions, or Exclusions: None

8 Maximum Power Spectral Density

8.1 Requirement(s)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna should not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.2 Method

The procedure described in ANSI C63.10-2013 and FCC Publication *558074 D01 15.247 Meas Guidance v05*, August 24, 2018, specifically Section 8.4 *DTS maximum power spectral density level in the fundamental emission* was utilized.

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the *DTS bandwidth*.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

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.

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
1014	Barometer Temp/Humidity	Omega	IBTHX-W	0480395	12/20/2017	12/20/2018

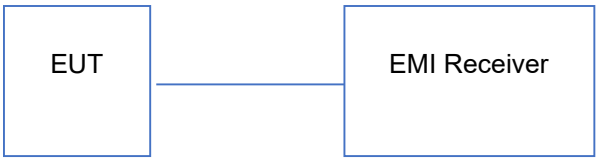
Software Utilized:

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:

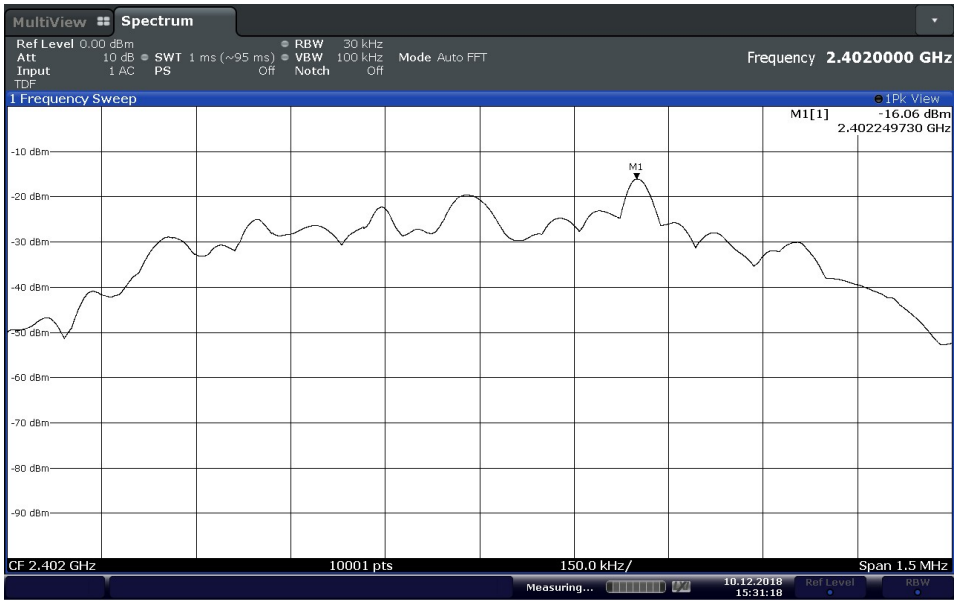


8.6 Plots/Data:

Frequency (MHz)	Maximum Power Spectral Density (dBm)
2402	-16.06
2440	-14.51
2480	-14.27

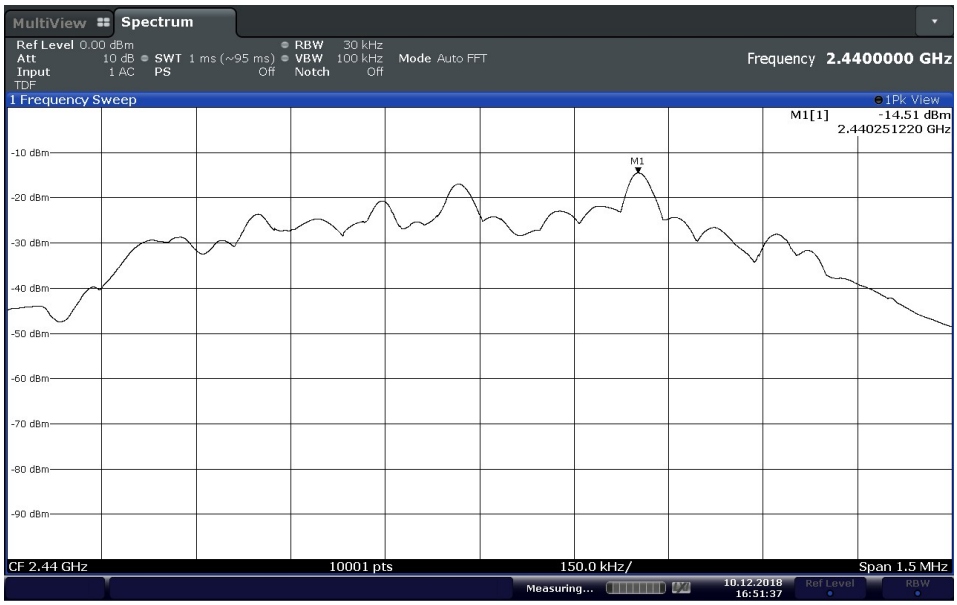
Note: The antenna port of the EUT connected directly to the input of the measuring EMI receiver.

PSD, 2402 MHz:



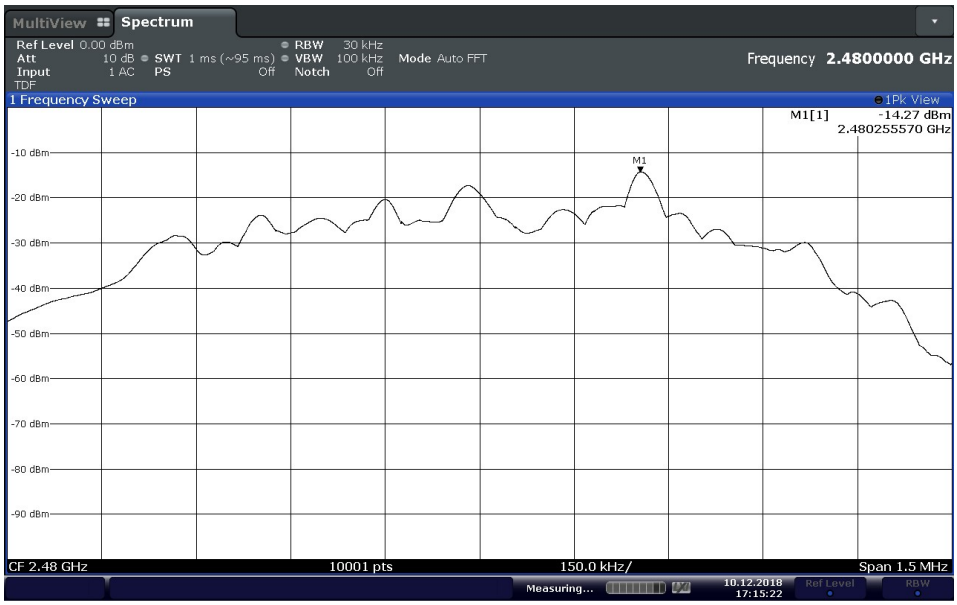
15:31:18 10.12.2018

PSD, 2440 MHz:



16:51:38 10.12.2018

PSD, 2480 MHz:



17:15:23 10.12.2018

Test Personnel:	Grace Lin	Test Date:	12/10/2018
Product Standard:	FCC §15.247, ISED RSS-247	Limit Applied:	FCC §15.247, ISED RSS-247
Input Voltage:	6 Vdc	Ambient Temperature:	23.6 °C
Pretest Verification w/ BB Source:	N/A	Relative Humidity:	39.2 %
		Atmospheric Pressure:	994.7 mbars

Deviations, Additions, or Exclusions: None

9 Conducted Spurious Emissions

9.1 Requirement(s)

In any 100 kHz bandwidth outside the frequency band, the radio frequency power 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, 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 the RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), shall comply with the radiated emission limits specified in § 15.209(a)

9.2 Method

The procedure described in ANSI C63.10-2013 and FCC Publication *558074 D01 15.247 Meas Guidance v05*, August 24, 2018. Specifically, Section *8.5 DTS emissions in non-restricted frequency bands* was utilized.

A spectrum analyzer was connected to the antenna port of the transmitter.

a) Set the RBW = 100 kHz.
b) Set the VBW ≥ 3 x RBW.
c) Detector = peak.
d) Sweep time = auto couple.
e) Trace mode = max hold.
f) Allow trace to fully stabilize.
g) Use the peak marker function to determine the maximum amplitude level.

The unwanted emissions were measured from 30 MHz to 10 GHz. Plots below are corrected for cable loss and then compared to the limits. The RF level in the plots is relative and is not the indication of RF output power.

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.

9.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
690	EMI Test Receiver	R&S	FSP40	100027	02/28/2018	02/28/2019
1669	EMI Test Receiver	R&S	ESW44	101636	08/15/2018	08/15/2019
1014	Barometer Temp/Humidity	Omega	IBTHX-W	0480395	12/20/2017	12/20/2018

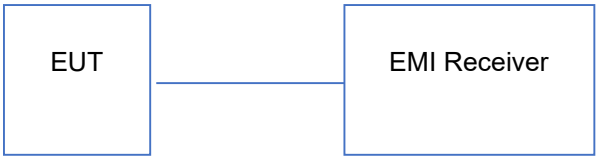
Software Utilized:

Name	Manufacturer	Version	Profile
Tile	Quantum Change	3.4.K.29	Cond_Spur_247

9.4 Results:

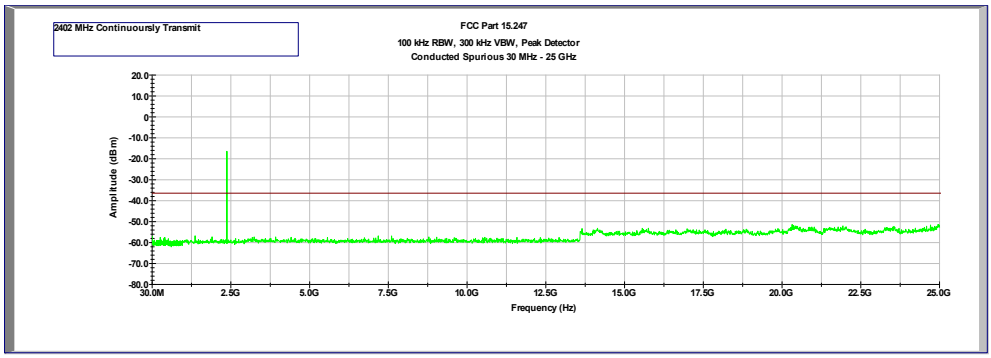
The sample tested was found to Comply. All the emissions outside of the frequency band were at least 20 dB below the carrier power level.

9.5 Setup Diagram:

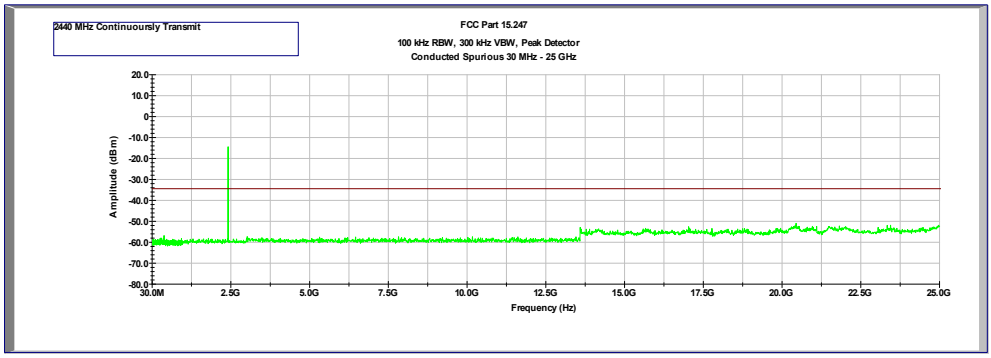


9.6 Plots/Data:

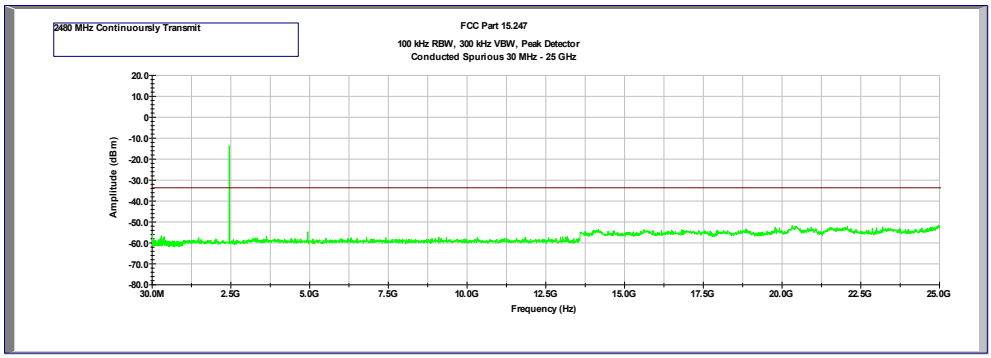
Conducted Spurious Emissions, 2402 MHz:



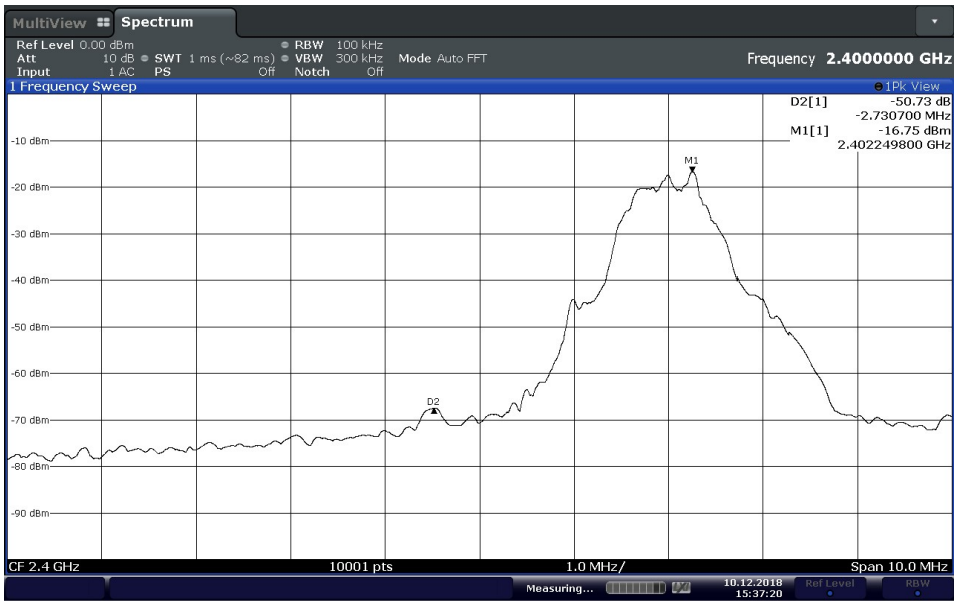
Conducted Spurious Emissions, 2440 MHz:



Conducted Spurious Emissions, 2480 MHz:

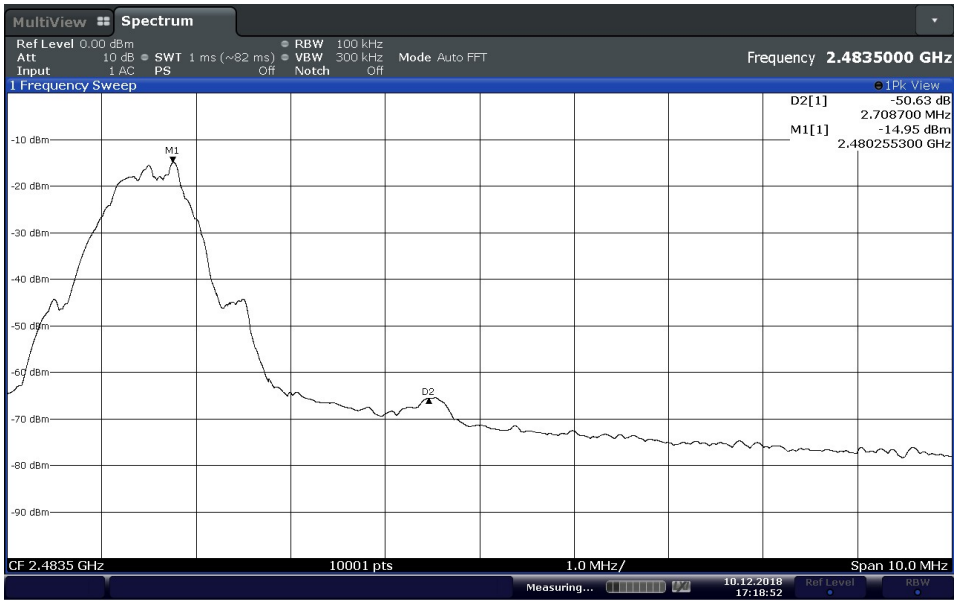


Bandedge, Low Channel:



15:37:20 10.12.2018

Bandedge, High Channel:



17:18:52 10.12.2018

Test Personnel:	Grace Lin	Test Date:	12/10/2018
Product Standard:	FCC §15.247, ISED RSS-247	Limit Applied:	FCC §15.247, ISED RSS-247
Input Voltage:	6 Vdc	Ambient Temperature:	23.6 °C
Pretest Verification w/ BB Source:	N/A	Relative Humidity:	39.2 %
		Atmospheric Pressure:	994.7 mbars

Deviations, Additions, or Exclusions: None

10 Radiated Spurious Emissions

10.1 Requirement(s)

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), shall comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

In any 100 kHz bandwidth outside the frequency band, the radio frequency power 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, 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 the RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

10.2 Method

EUT was configured to transmit continuously. Radiated emission measurements were performed from 30 MHz to 25 GHz according to the procedure described in ANSI C64.10. Resolution bandwidth is 120 kHz for frequencies 30 MHz to 1000 MHz and 1 MHz for frequencies above 1 GHz. Above 1 GHz, both Peak and Average measurements were performed. The Peak level of radiated emissions was measured with a peak detector. The Average level of radiated emissions was measured with an RMS detector with trace averaging.

The EUT is placed on a plastic turntable that is 80 cm in height for frequencies 30 MHz to 1000 MHz, 1.5 meters for frequency above 1000 MHz. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The 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 3 meters for frequencies below 18 GHz. For frequencies above 18 GHz, preliminary scan was performed at 0.1 meter. Final measurement was performed at 1 meter for any emissions detected at 0.1 meter.

EUT was tested at three orientations. Data included is representative of the worst-case configuration (the configuration which resulted in the highest emission levels). Plots below are corrected for distance, cables, preamp, filters and antenna factors then compared to the limits.

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)	Ucispr
Radiated Emissions, 3m	30-1000 MHz	4.3	6.3 dB
Radiated Emissions, 3m	1-18 GHz	4.7	5.2 dB
Radiated Emissions, 3m	18-26.5 GHz	4.5	-

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 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 dBμV 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 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/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 dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

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

10.3 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
1576	Pre-amp	R&S	TS-PR1	102068	07/05/2018	07/05/2019
1515	Horn Antenna	ETS-Lindgren	3115	00161631	03/28/2018	03/28/2019
1556	Pre-amp	R&S	TS-PR18	102144	08/02/2018	08/02/2019
880	Horn Antenna	ETS-Lindgren	3116	00153521	04/18/2018	04/18/2020
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

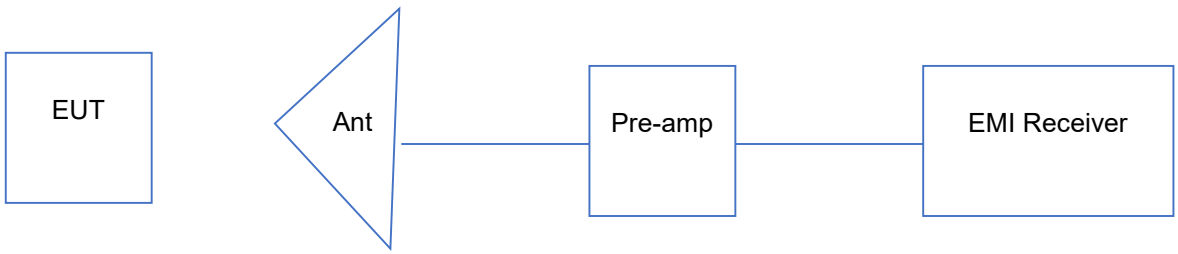
Software Utilized:

Name	Manufacturer	Version	Profile
BAT-EMC	Nexio	3.18.0.16	LAX Intertek Emissions Template 03-30-2018

10.4 Results:

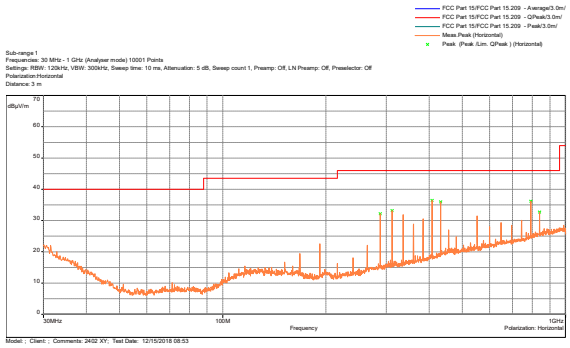
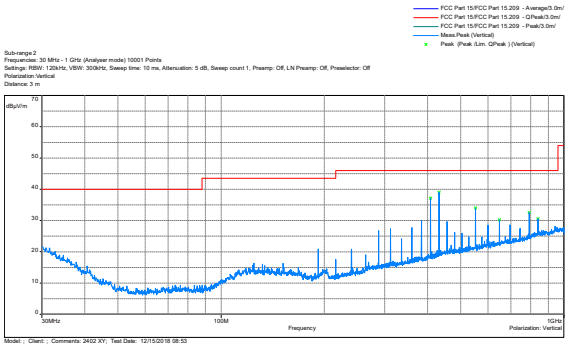
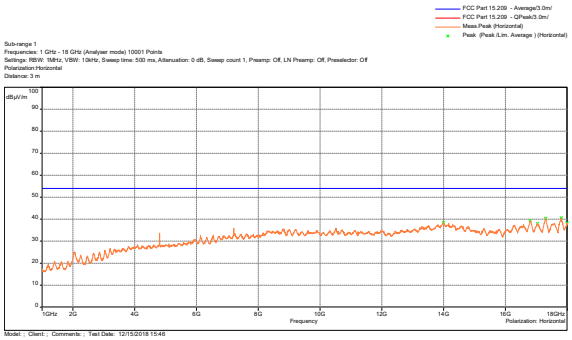
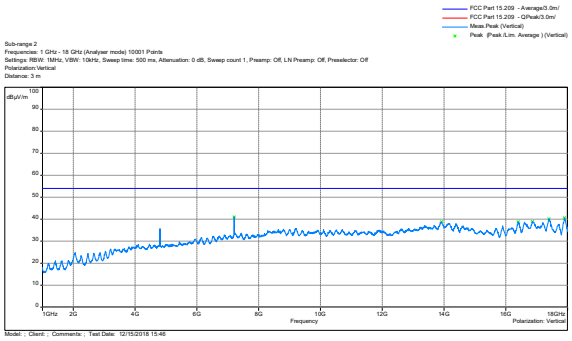
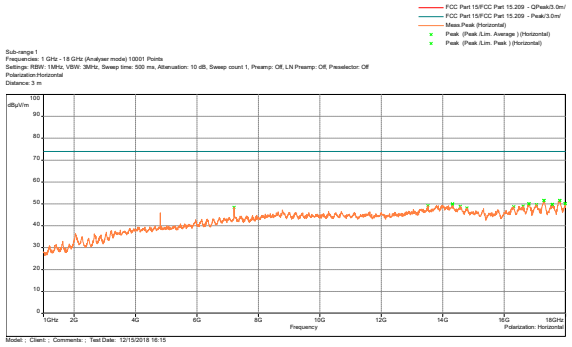
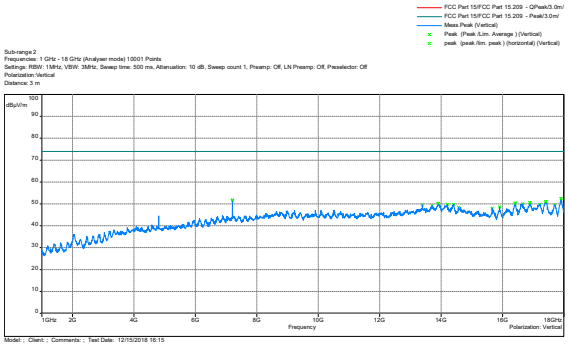
The sample tested was found to Comply.

10.5 Setup Diagram:



10.6 Plots/Data:

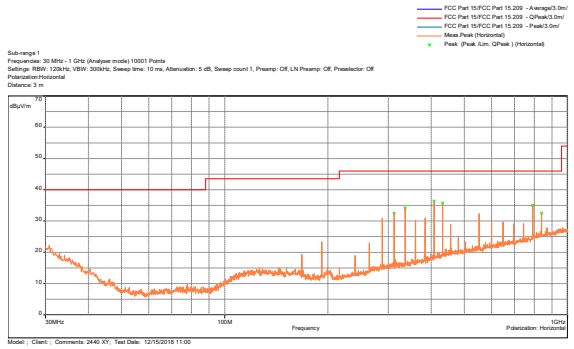
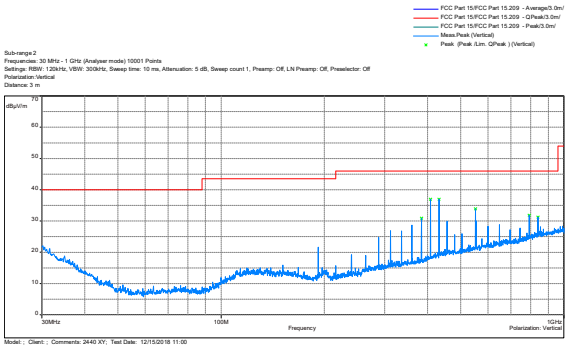
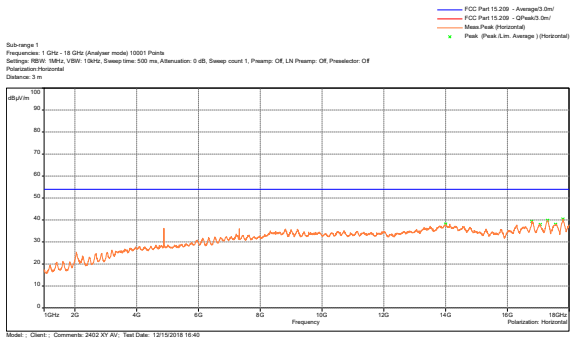
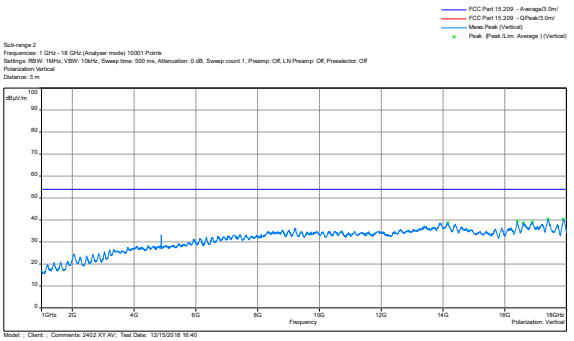
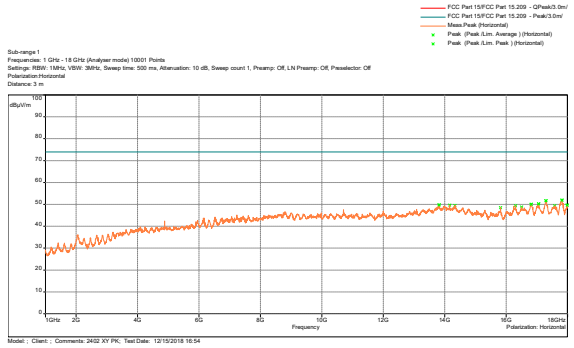
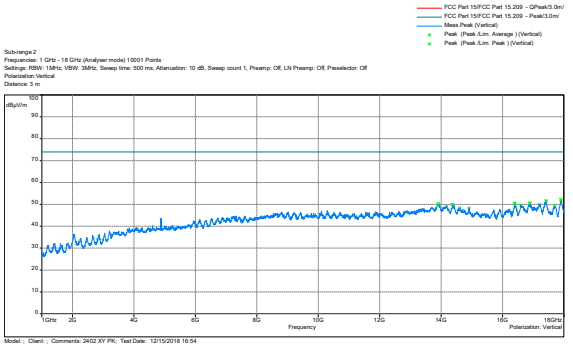
Radiated Spurious Emissions, 2402 MHz

Horizontal	Vertical
30 MHz - 1000 MHz, Peak Scan, Limit Line – QP	30 MHz - 1000 MHz, Peak Scan, Limit Line– QP
	
1- 18 GHz, AVE Scan, Limit Line – AVE	1- 18 GHz, AVE Scan, Limit Line – AVE
	
1- 18 GHz, Peak Scan, Limit Line – Peak	1- 18 GHz, Peak Scan, Limit Line – Peak
	

Note: Radiated spurious emissions measurements were performed from 30 MHz to 25 GHz.

10.6 Plots/Data: *(Continued)*

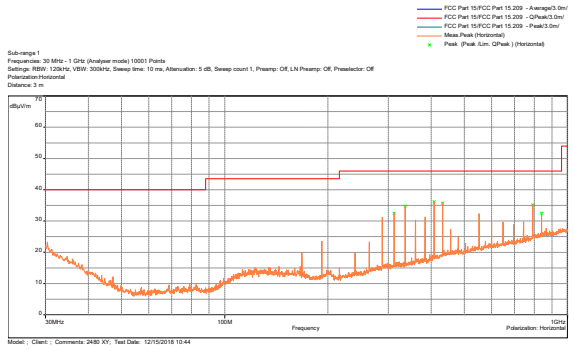
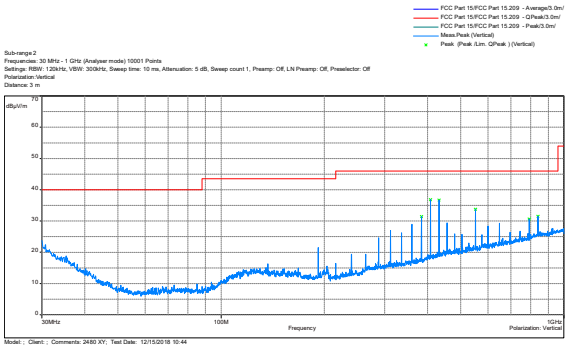
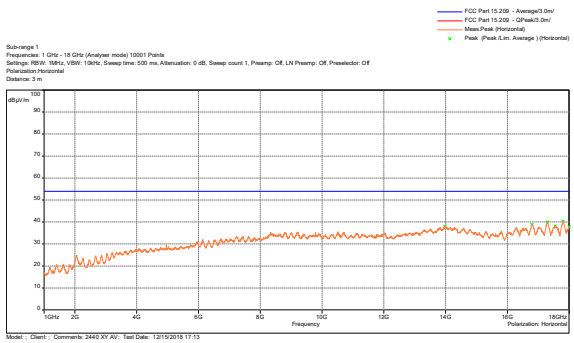
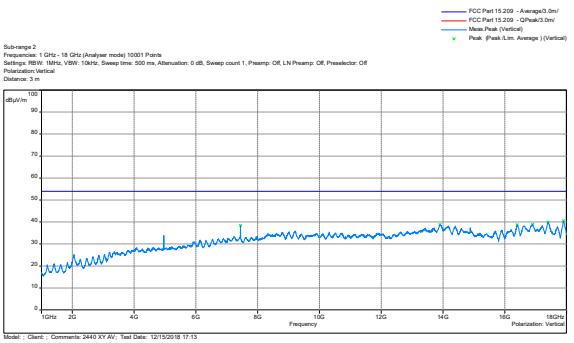
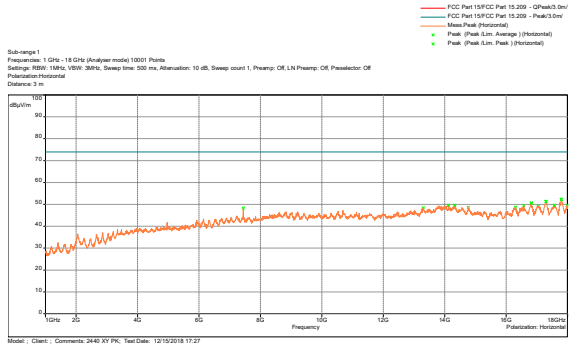
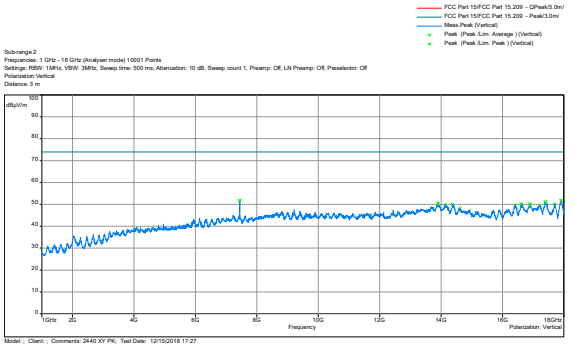
Radiated Spurious Emissions, 2440 MHz

Horizontal	Vertical
30 MHz - 1000 MHz, Peak Scan, Limit Line – QP	30 MHz - 1000 MHz, Peak Scan, Limit Line– QP
	
1- 18 GHz, AVE Scan, Limit Line – AVE	1- 18 GHz, AVE Scan, Limit Line – AVE
	
1- 18 GHz, Peak Scan, Limit Line – Peak	1- 18 GHz, Peak Scan, Limit Line – Peak
	

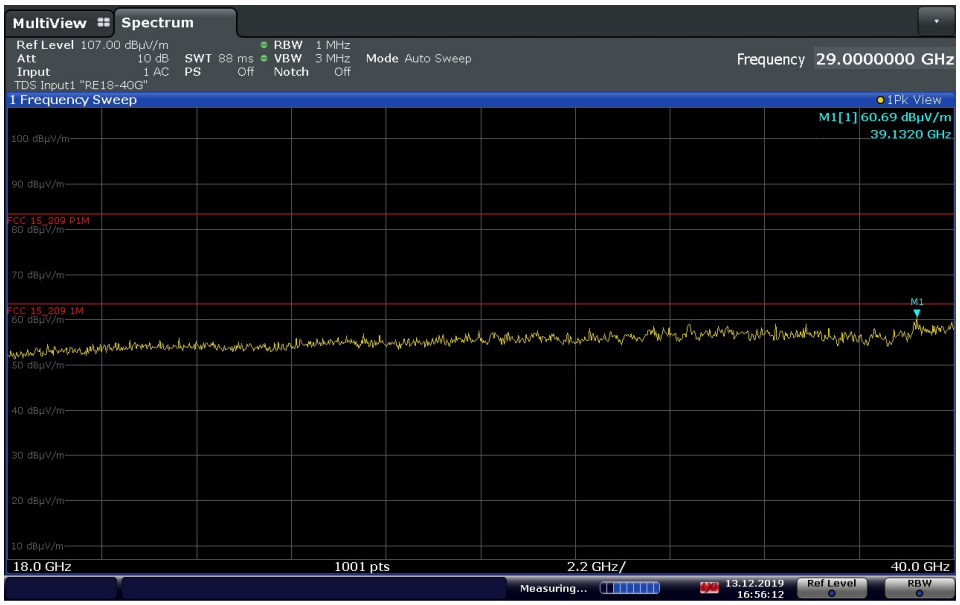
Note: Radiated spurious emissions measurements were performed from 30 MHz to 25 GHz.

10.6 Plots/Data: *(Continued)*

Radiated Spurious Emissions, 2480 MHz

Horizontal	Vertical
30 MHz - 1000 MHz, Peak Scan, Limit Line – QP	30 MHz - 1000 MHz, Peak Scan, Limit Line– QP
	
1- 18 GHz, AVE Scan, Limit Line – AVE	1- 18 GHz, AVE Scan, Limit Line – AVE
	
1- 18 GHz, Peak Scan, Limit Line – Peak	1- 18 GHz, Peak Scan, Limit Line – Peak
	

Note: Radiated spurious emissions measurements were performed from 30 MHz to 25 GHz.



18-40 GHz Noise Floor with reference to limits at 0.1m and 1 m

10.6 Plots/Data: *(Continued)*

Radiated spurious emissions, 30 MHz – 1 GHz:

Frequency (MHz)	Channel Freq. (MHz)	EUT Orientation	PK Field Strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)	Antenna Height (m)	Turntable Angle (°)	Antenna Polarization	Correction (dB)
287.9	2402	YZ	35.2	46	-10.9	1.02	242	Horizontal	-10.19
312.0	2402	YZ	35.5	46	-10.6	1.02	207	Horizontal	-9.63
384.0	2480	XY	31.4	46	-14.6	1.01	219	Vertical	-8.23
408.0	2440	YZ	38.0	46	-8.0	1.01	296	Horizontal	-7.57
432.0	2402	XY	39.0	46	-7.0	1.02	202	Vertical	-6.97
792.0	2402	YZ	38.9	46	-7.1	1.02	27	Horizontal	-1.73

Radiated spurious emissions, above 1 GHz:

Antenna Polarization	Frequency (MHz)	Channel Freq.	EUT Orientation	Field Strength @3m (dBuV/m)	Limit	Margin (dB)	Turtable Degree	Antenna Height (cm)	Detector
H	2390	2402	XY	41.05	74.00	-32.95	283.0	191.0	PK
H	2390	2402	XY	23.15	54.00	-30.85	283.0	191.0	RMS
V	2390	2402	XY	40.28	74.00	-33.72	94.0	161.0	PK
V	2390	2402	XY	23.16	54.00	-30.84	94.0	161.0	RMS
V	7206	2402	XY	53.52	74.00	-20.48	295.0	100.0	PK
V	7206	2402	XY	44.35	54.00	-9.65	295.0	100.0	RMS
V	7320	2440	XY	49.30	74.00	-24.70	294.0	100.0	PK
V	7320	2440	XY	37.78	54.00	-16.22	294.0	100.0	RMS
H	2483.5	2480	XY	47.41	74.00	-26.59	86.0	197.0	PK
H	2483.5	2480	XY	25.27	54.00	-28.73	86.0	197.0	RMS
V	2483.5	2480	XY	47.55	74.00	-26.45	85.0	147.0	PK
V	2483.5	2480	XY	24.56	54.00	-29.44	85.0	147.0	RMS
V	7440	2480	XY	53.09	74.00	-20.91	296.0	100.0	PK
V	7440	2480	XY	43.95	54.00	-10.05	296.0	100.0	RMS

Note: Radiated spurious emissions measurements were performed from 30 MHz to 25 GHz.

Test Personnel:	Grace Lin	Test Date:	12/11/2018, 12/15/2018
Product Standard:	FCC §15.247, ISED RSS-247	Limit Applied:	FCC §15.209, RSS-Gen §8.9
Input Voltage:	6 Vdc	Ambient Temperature:	19.3 °C
Pretest Verification w/ BB Source:	Yes	Relative Humidity:	24.8 %
		Atmospheric Pressure:	993.8 mbars

Deviations, Additions, or Exclusions: None

11 AC Mains Conducted Emissions

11.1 Performance Criterion

Frequency Band MHz	ConductedLimit dB(µV)	
	Quasi-Peak	Average
0.15-0.50	66 to 56 *	56 to 46 *
0.50-5.00	56	46
5.00-30.00	60	50

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

11.2 Method

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

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)	Ucispr
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 dBμV
RF = Reading from receiver in dBμV
LF = LISN or ISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

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

11.3 Test Equipment Used:

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

Software Utilized:

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

11.4 Results:

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

12 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	12/17/2018	103680797LAX-001	GL	SK	Initial Issue
1	12/17/2019	103680797LAX-001	GL	SK	Added ANCI C63.10 to Pages 8, 14, 18, and 22. Corrected frequency on Page 27 (10 GHz -> 25 GHz). Added a noise floor plot to §10.6.