EMC TEST REPORT

Report Number: 103083191LAX-001
Project Number: G103083191

Report Issue Date: June 13, 2017

Model(s) Tested: 03089702

Standards: **FCC CFR47 Part 15 Subpart C, 2017**
Intentional Radiator
§15.247, Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

FCC CFR47 Part 15 Subpart B, 2017
Unintentional Radiator

ISED RSS-Gen Issue 4, 2014

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

ISED ICES-003 Issue 6, Updated April 2017
Information Technology Equipment (ITE) - Limits and methods of measurement

Tested by:
Intertek
25791 Commercentre Drive
Lake Forest, CA 92630
USA

Client:
Walter Kidde Portable Equipment, Inc.
4820 Centennial Blvd., Suite 145
Colorado Spring, CO 80919-3319
USA

Report prepared by

Grace Lin
EMC Staff Engineer

Report reviewed by

Krishna Vemuri
EngineeringTeam Leader

Table of Contents

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 comply 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	6 dB Bandwidth (FCC §15.247(a)(2), ISED RSS-247§5.2(a))	Compliant
7	Occupied Bandwidth (ISED RSS-Gen Issue 4 §6.6)	Compliant
8	Maximum Peak Conducted Output Power at Antenna Terminals (FCC §15.247(b)(3), ISED RSS-247§5.4(d))	Compliant
9	Maximum Power Spectral Density (FCC §15.247(e), ISED RSS-247§5.2(b))	Compliant
10	Unwanted Conducted Emissions (FCC §15.247(d), ISED RSS-247§5.5)	Compliant
11	Transmitter Radiated Spurious Emissions ((FCC §15.247(d), §15.209, §15.205; ISED RSS-247§5.5)	Compliant
12	Radiated Emissions (FCC §15.109; ISED ICES-003 Issue §6.2)	Compliant
13	AC Mains Conducted Emissions (FCC §15.207; ISED RSS-Gen Issue 4 §8.8) (FCC §15.107; ISED ICES-003 Issue 6 §6.1)	Compliant

3 Client Information

This EUT was tested at the request of:

Client: Walter Kidde Portable Equipment, Inc.
4820 Centennial Blvd., Suite 145
Colorado Springs, CO 80919-3319
USA

Contact: Rick Mantz
Telephone: (719) 533-2305
Fax:
Email: rick.mantz@kiddeus.com

4 Description of Equipment Under Test and Variant Models

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Transmitter Module	Walter Kidde Portable Equipment, Inc.	03089702	2A (Conducted), 1A (Radiated) 3A (Normal Mode)

Receive Date:	6/01/2017	Test Started:	6/03/2017
Received Condition:	Good	Test Completed:	6/08/2017
Type:	Production		

Description of Equipment Under Test

The equipment under test (EUT) is a transmitter module operating at 925.7 ± 0.2 MHz. The EUT is powered by 3Vdc. The antenna is permanently attached with antenna gain less than 6 dBi.

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
3VDC	N/A	N/A	N/A

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Test Mode – Continuously Transmitting
2	Normal Operation

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Under test mode, the EUT was programmed to transmit continuously during testing.
2	Under normal operation, the EUT was programmed to operate as an end user would normally use.

Radio/Receiver Characteristics	
Frequency Band(s)	902 - 928 MHz
Modulation Type(s)	FSK
Maximum Output Power	8.83 dBm (7.6384 mW)
Test Channels	925.7 MHz
Occupied Bandwidth	840 kHz
Equipment Type	Standalone
Antenna Type and Gain	Permanently attached antenna, 1 dBi

5 System Setup and Method

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	Minigrabber Patch Cord	0.9	No	No	Yes
2	Minigrabber - Banana Plug Cable	0.9	No	No	Yes

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Power supply	BK Precision	1671A	249D15133

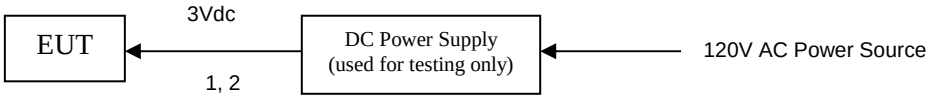
5.1 Measurement Procedures:

ANSI C63.10-2013
American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

FCC publication 558074 D01, April 5, 2017
Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247

ANSI C63.4-2014
American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

5.2 EUT Block Diagram:



6 6 dB Bandwidth

6.1 Requirement(s)

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

6.2 Method

The procedure described in the FCC publication 558074 D01 DTS Meas Guidance v04 April 5, 2017 was used to determine the 6 dB bandwidth. Section 8.1 Option 1 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.

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.

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	08/2015	08/2018
1140	EMI Test Receiver	R&S	ESCI7	100825	02/21/2017	02/21/2018
1536	Barometer/ Humidity	Omega	iBTHX-W	1541000	01/09/2017	01/09/2018

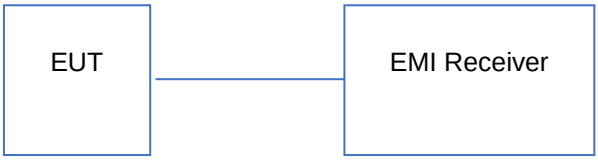
Software Utilized:

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

6.4 Results:

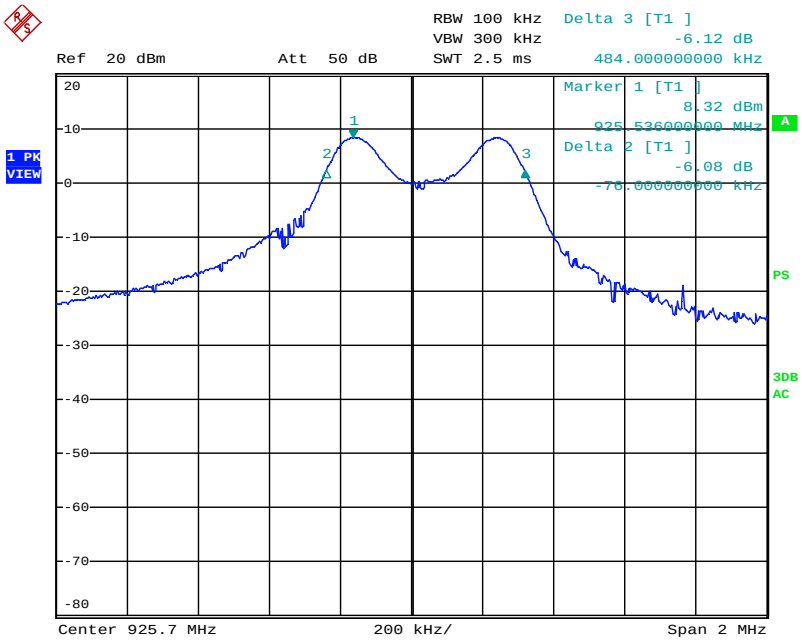
The sample tested was found to comply.

6.5 Setup Diagram:



6.6 Plots/Data:

Frequency (MHz)	6 dB Bandwidth (kHz)
925.7	560



Date: 3.JUN.2017 19:54:42

Test Personnel:	Grace Lin	Test Date:	6/03/2017
Product Standard:	FCC 15.247, ISED RSS-247	Limit Applied:	FCC 15.247, ISED RSS-247
Input Voltage:	3Vdc DC Power	Ambient Temperature:	23.9 ºC
Pretest Verification w/ Ambient Signals or BB Source:	Yes	Relative Humidity:	55.5 %
		Atmospheric Pressure:	989.1 mBar

Deviations, Additions, or Exclusions: None

7 Occupied Bandwidth

7.1 Requirement(s)

The transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured. (ISED RSS-Gen Issue 4 §6.6)

7.2 Method

The bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer. The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth shall be set to approximately 3 x RBW. Video averaging is not permitted.

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
637	3m Semi-anechoic Chamber	Panashield	3 meter	25 331-D-Z	08/2015	08/2018
1140	EMI Test Receiver	R&S	ESCI7	100825	02/21/2017	02/21/2018
1536	Barometer/ Humidity	Omega	iBTHX-W	1541000	01/09/2017	01/09/2018

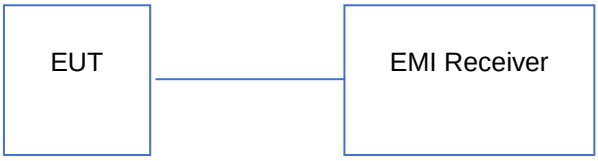
Software Utilized:

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

7.4 Results:

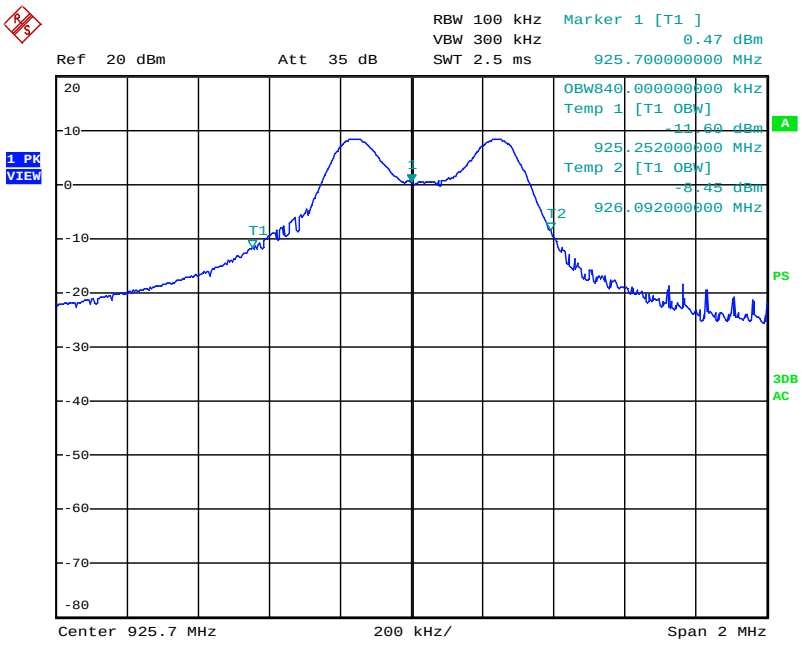
The sample tested was found to comply.

7.5 Setup Diagram:



7.6 Plots/Data:

Frequency (MHz)	Occupied Bandwidth (kHz)
925.7	840



Date: 3.JUN.2017 19:52:34

Test Personnel:	Grace Lin	Test Date:	6/03/2017
Product Standard:	FCC 15.247, ISED RSS-247	Limit Applied:	FCC 15.247, ISED RSS-247
Input Voltage:	3Vdc DC Power	Ambient Temperature:	23.9 ºC
Pretest Verification w/ Ambient Signals or		Relative Humidity:	55.5 %
BB Source:	Yes	Atmospheric Pressure:	989.1 mBar

Deviations, Additions, or Exclusions: None

8 Maximum Peak Conducted Output Power at Antenna Terminals

8.1 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.

8.2 Method

The procedure described in FCC Publication 558074 D01 DTS Meas Guidance v04 April 5, 2017 was used. Specifically, section 9.1.1 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.

8.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
637	3m Semi-anechoic Chamber	Panashield	3 meter	25 331-D-Z	08/2015	08/2018
1140	EMI Test Receiver	R&S	ESCI7	100825	02/21/2017	02/21/2018
1536	Barometer/ Humidity	Omega	iBTHX-W	1541000	01/09/2017	01/09/2018

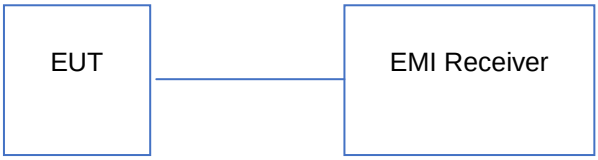
Software Utilized:

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

8.4 Results:

The sample tested was found to comply.

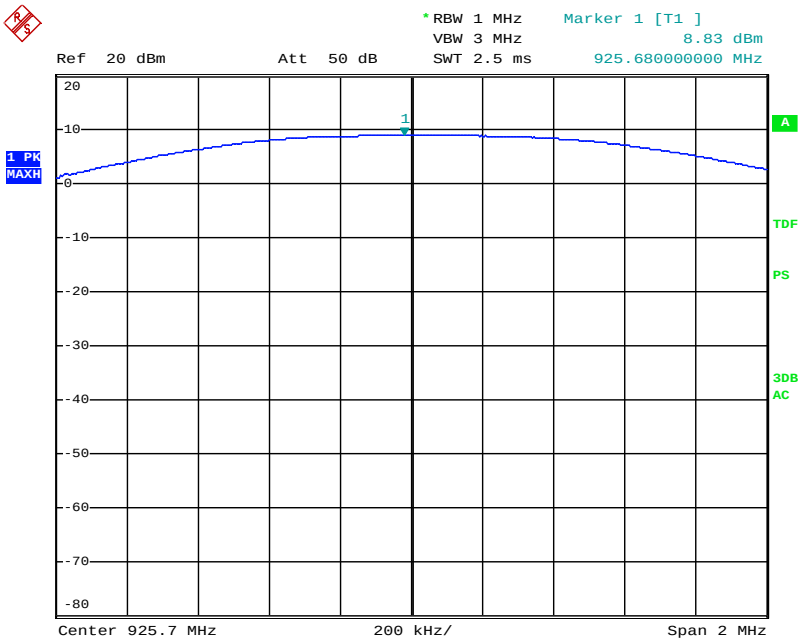
8.5 Setup Diagram:



8.6 Plots/Data:

Frequency (MHz)	Peak Conducted Output Power	
	dBm	mW
925.7	8.83	7.6384

Note: The insertion loss was compensated for in the receiver.



Test Personnel:	Grace Lin	Test Date:	6/03/2017
Product Standard:	FCC 15.247, ISED RSS-247	Limit Applied:	FCC 15.247, ISED RSS-247
Input Voltage:	3Vdc DC Power	Ambient Temperature:	23.9 ºC
Pretest Verification w/ Ambient Signals or BB Source:	Yes	Relative Humidity:	55.5 %
		Atmospheric Pressure:	989.1 mBar

Deviations, Additions, or Exclusions: None

9 Maximum Power Spectral Density

9.1 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.

9.2 Method

The procedure described in FCC Publication 558074 D01 DTS Meas Guidance v04 April 5, 2017, specifically Section 10.2 Method PKPSD (peak PSD).

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 x *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.

9.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
637	3m Semi-anechoic Chamber	Panashield	3 meter	25 331-D-Z	08/2015	08/2018
1140	EMI Test Receiver	R&S	ESCI7	100825	02/21/2017	02/21/2018
1536	Barometer/ Humidity	Omega	iBTHX-W	1541000	01/09/2017	01/09/2018

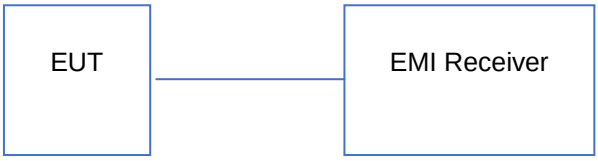
Software Utilized:

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

9.4 Results:

The sample tested was found to comply.

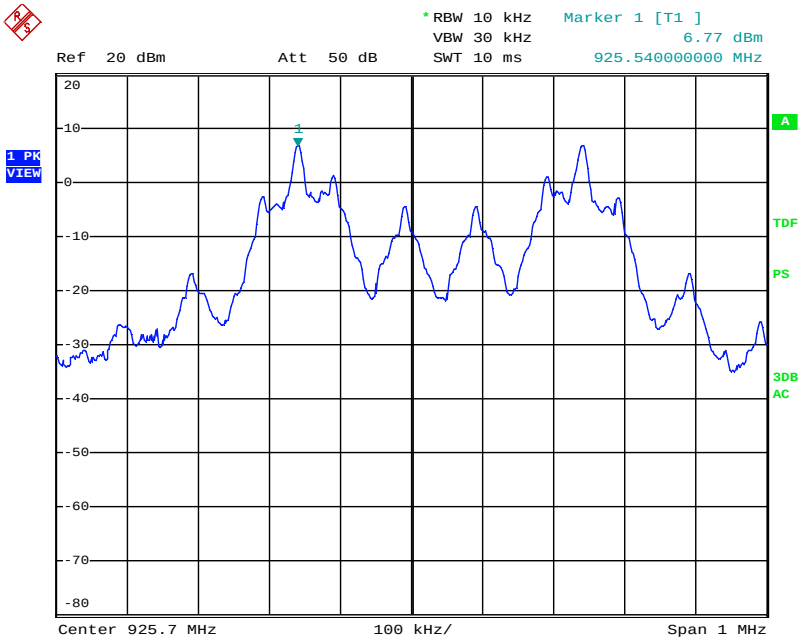
9.5 Setup Diagram:



9.6 Plots/Data:

Frequency (MHz)	Maximum Power Spectral Density (dBm)
925.7	6.77

Note: The insertion loss was compensated for in the receiver.



Date: 4.JUN.2017 11:04:53

Test Personnel:	Grace Lin	Test Date:	6/04/2017
Product Standard:	FCC 15.247, ISED RSS-247	Limit Applied:	FCC 15.247, ISED RSS-247
Input Voltage:	3Vdc DC Power	Ambient Temperature:	24.4 ºC
Pretest Verification w/ Ambient Signals or BB Source:	Yes	Relative Humidity:	51.2 %
		Atmospheric Pressure:	988.5 mBar

Deviations, Additions, or Exclusions: None

10 Unwanted Conducted Emissions

10.1 Requirement(s)

If the maximum peak conducted output power procedure was used to determine compliance, the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc).

If maximum conducted (average) output power was used to determine compliance, the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc).

10.2 Method

The procedure described in FCC Publication 558074 D01 DTS Meas Guidance v04 April 5, 2017, specifically Section 11.0 Emissions in non-restricted frequency bands.

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

a) Set instrument center frequency to DTS channel center frequency.
b) Set the sapn to ≥ 1.5 x DTS bandwidth.
c) Set the 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.

The unwanted emissions were measured from 30 MHz to the 10th harmonics of the carrier frequency. Plots below are corrected for cable loss and 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. ISED test site registration number is 2042T.

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	08/2015	08/2018
690	Spectrum Analyzer	R&S	FSP	100027	01/24/2017	01/24/2018
1536	Barometer/ Humidity	Omega	iBTHX-W	1541000	01/09/2017	01/09/2018

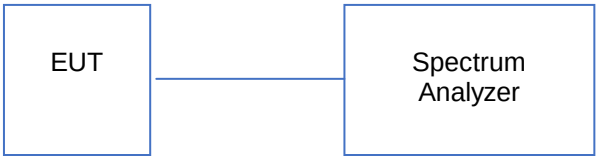
Software Utilized:

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

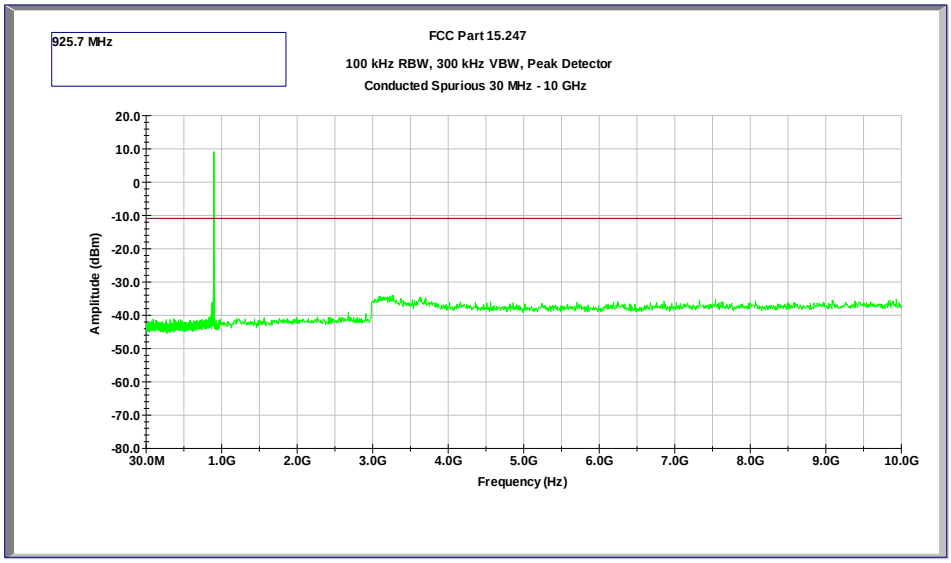
10.4 Results:

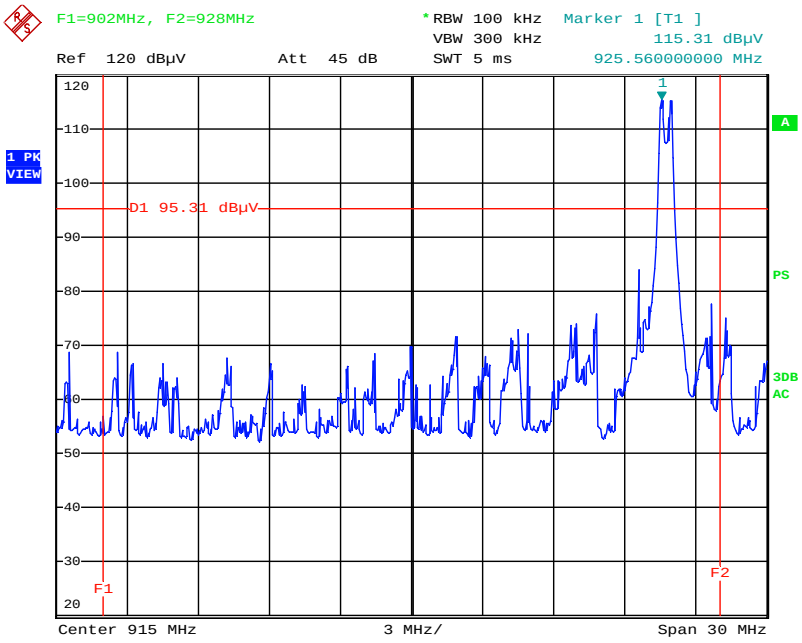
The sample tested was found to comply.

10.5 Setup Diagram:



10.6 Plots/Data:





Date: 13.JUN.2017 08:12:09

Test Personnel:	Grace Lin	Test Date:	6/03/2017, 6/13/2017
Product Standard:	FCC 15.247, ISED RSS-247	Limit Applied:	FCC 15.247, ISED RSS-247
Input Voltage:	3Vdc DC Power	Ambient Temperature:	23.9 ºC, 21.3 ºC
Pretest Verification w/ Ambient Signals or BB Source:	Yes	Relative Humidity:	55.5 %, 39.7 %
		Atmospheric Pressure:	989.1 mBar, 989.0 mBar

Deviations, Additions, or Exclusions: None

11 Transmitter Radiated Spurious Emissions

11.1 Requirement(s)

Radiated emissions which fall in the restricted bands, as defined in FCC §15.205(a) and ISED RSS-Gen §8.10, must comply with the radiated emission limits specified in FCC §15.209(a) and ISED RSS-Gen §8.9.

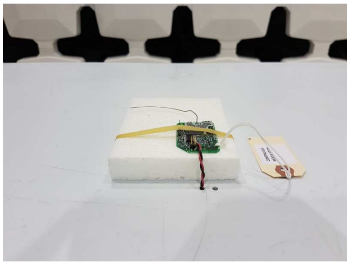
11.2 Method

EUT was configured to transmit continuously. Radiated emission measurements were performed from 30 MHz to the 10th harmonics of the carrier frequency according to the procedure described in ANSI C63.10. Spectrum analyzer resolution bandwidth is 120 kHz for frequencies from 30 MHz to 1000 MHz. Above 1 GHz, both Peak and Average measurements were performed. The peak level of radiated emissions was measured with a resolution bandwidth (RBW) of 1 MHz and a video bandwidth (VBW) of 3 MHz, using a peak detector. The average level of radiated emissions was measured with a resolution bandwidth (RBW) of 1 MHz and a video bandwidth (VBW) of 3 MHz, using an RMS detector.

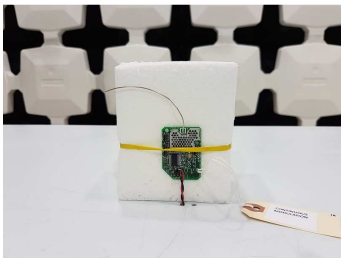
The EUT is placed on a plastic turntable that is 80 cm in height for frequencies from 30 MHz to 1000 MHz, 1.5 meters for frequency above 1000 MHz. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case 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 and 1 meter for frequencies above 18 GHz.

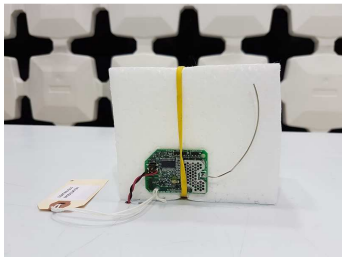
Plots below are corrected for distance, cables, preamp, filters and antenna factors then compared to the limits. EUT was tested in three orthogonal orientations (XY, YZ, and ZX planes). The worst-case data taken in XY orientation were recorded in this report.



EUT = XY



EUT = YZ



EUT = ZX

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	1-10 GHz	4.7	5.2 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.

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

11.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
637	3m Semi-anechoic Chamber	Panashield	3 meter	25 331-D-Z	08/2015	08/2018
1140	EMI Test Receiver	R&S	ESCI7	100825	02/21/2017	02/21/2018
690	Spectrum Analyzer	R&S	FSP	100027	01/24/2017	01/24/2018
1147	Bilog Antenna	TESEQ Gmbh	CBL 6112D	32852	11/03/2016	11/03/2017
1515	Horn Antenna	ETS-Lindgren	3115	00161631	03/15/2017	03/15/2018
1576	Preamplifier	R&S	TS-PR1	9037.6616.02	07/01/2016	07/01/2017
1135	Preamplifier	Miteq	AMF-6D-00501800-24-10P	1685147	05/04/2017	05/04/2018
698	Cable	Insulated Wire Inc	KPS-1503-1080-KPS	-	03/14/2017	03/14/2018
1517	Cable	R&S	TSPR-B7	101528	07/01/2016	07/01/2017
1518	Cable	R&S	TSPR-B7	101529	07/01/2016	07/01/2017
1536	Barometer/ Humidity	Omega	iBTHX-W	1541000	01/09/2017	01/09/2018

Software Utilized:

Name	Manufacturer	Version	Profile
Tile	Quantum Change	4.1	FCC 30 to 1000 FCC Part 15 FSP 1-10GHz

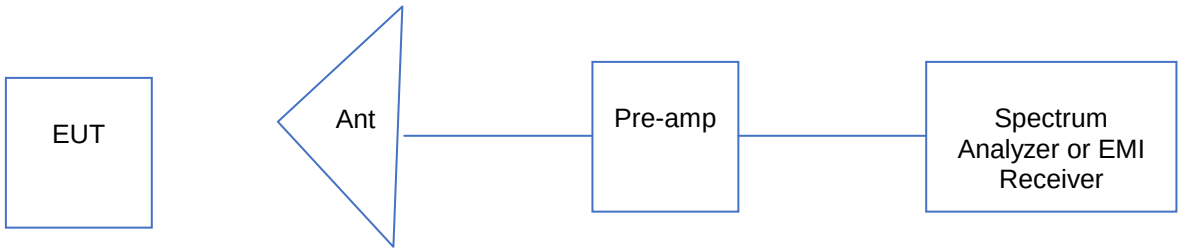
11.4 Results:

The sample tested was found to Comply.

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

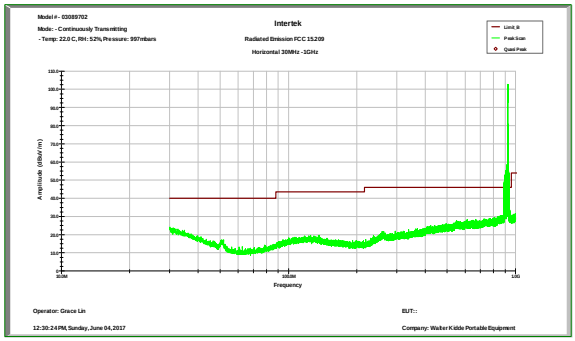
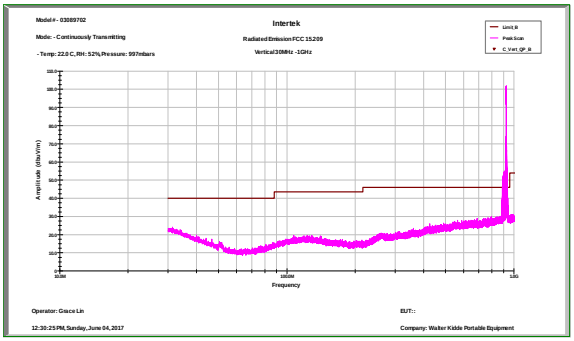
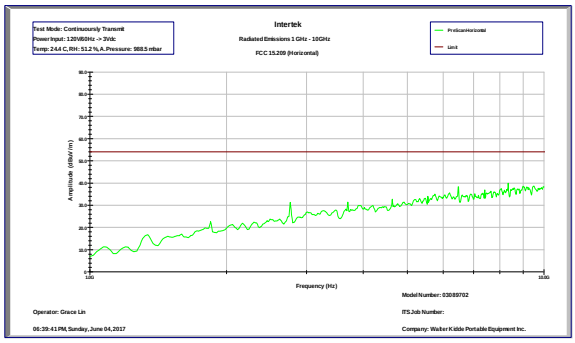
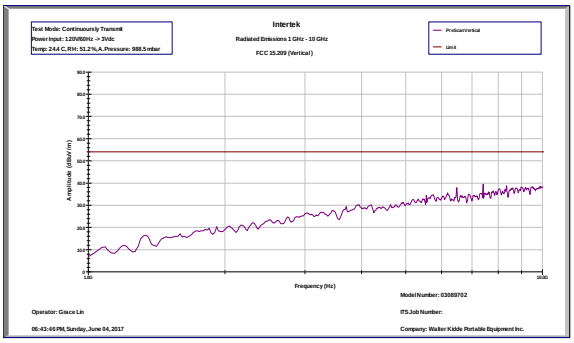
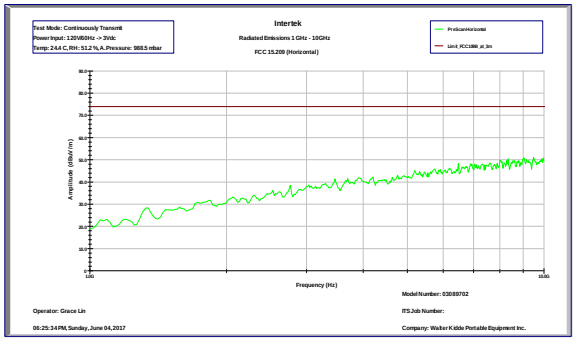
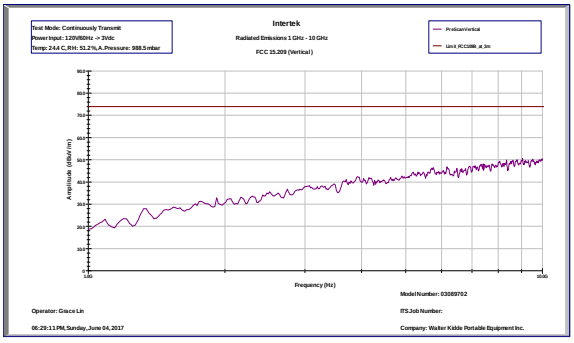
Radiated emission measurements were performed up to 10GHz. Peak emissions that were identified were measured to be greater than 20dB below 74dBµV peak limits.

11.5 Setup Diagram:



11.6 Plots/Data:

Transmitter Radiated Spurious Emissions 925.7 MHz

Horizontal	Vertical
30 MHz - 1000 MHz, Peak Scan, Limit Line – QP	30 MHz - 1000 MHz, Peak Scan, Limit Line– QP
	
1- 10 GHz, AVE Scan, Limit Line – AVE	1- 10 GHz, AVE Scan, Limit Line – AVE
	
1- 10 GHz, Peak Scan, Limit Line – Peak	1- 10 GHz, Peak Scan, Limit Line – Peak
	

Test Personnel:	Grace Lin	Test Date:	06/04/2017
Product Standard:	FCC 15.247, ISED RSS-247	Limit Applied:	FCC 15.209; ISED RSS-Gen
Input Voltage:	3Vdc	Ambient Temperature:	24.4 ºC
Pretest Verification w/ Ambient Signals or BB Source:	Yes	Relative Humidity:	51.2 %
		Atmospheric Pressure:	988.5 mBar

TX Radiated Spurious Emissions, 925.7 MHz

Antenna Polarization	Frequency (MHz)	EUT Orientation	Measured Data (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Turntable Degree	Antenna Height (cm)	Detector
H	2777.79	XY	38.14	54	-15.86	107.0	145.0	RMS
H	2777.79	XY	40.76	74	-33.24	107.0	145.0	PK
H	3703.72	XY	37.10	54	-16.90	111.0	140.0	RMS
H	3703.72	XY	41.87	74	-32.13	111.0	140.0	PK
H	4629.65	XY	36.59	54	-17.42	105.0	110.0	RMS
H	4629.65	XY	44.76	74	-29.25	105.0	110.0	PK
V	6481.51	XY	45.80	54	-8.20	85.0	251.0	RMS
V	6481.51	XY	51.73	74	-22.27	85.0	251.0	PK
V	7407.44	XY	46.80	54	-7.20	259.0	183.0	RMS
V	7407.44	XY	52.51	74	-21.49	259.0	183.0	PK

Deviations, Additions, or Exclusions: None

12 Radiated Emissions

12.1 Method

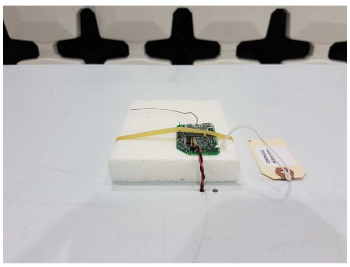
Tests are performed in accordance with ANSI C63.4-2014.

EUT was configured to transmit continuously. Radiated emission measurements were performed from 30 MHz to the 5th harmonics of the carrier frequency according to the procedure described in ANSI C63.4. Spectrum analyzer resolution bandwidth is 120 kHz for frequencies from 30 MHz to 1000 MHz. Above 1 GHz, both Peak and Average measurements were performed. The peak level of radiated emissions was measured with a resolution bandwidth (RBW) of 1 MHz and a video bandwidth (VBW) of 3 MHz, using a peak detector. The average level of radiated emissions was measured with a resolution bandwidth (RBW) of 1 MHz and a video bandwidth (VBW) of 3 MHz, using an RMS detector.

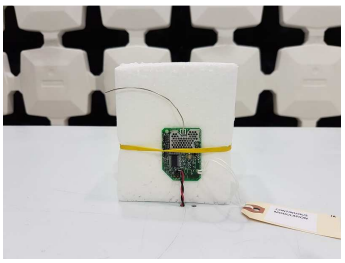
The EUT is placed on a plastic turntable that is 80 cm in height. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The antenna height 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 and 1 meter for frequencies above 18 GHz.

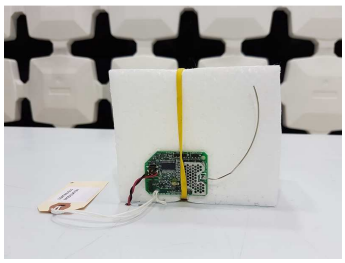
Plots below are corrected for distance, cables, preamp, filters and antenna factors then compared to the limits. EUT was tested in three orthogonal orientations (XY, YZ, and ZX planes). The worst-case data taken in XY orientation were recorded in this report.



EUT = XY



EUT = YZ



EUT = ZX

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	4.5	6.3 dB
Radiated Emissions, 3m	1-10 GHz	4.7	5.2 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.

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

12.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
637	3m Semi-anechoic Chamber	Panashield	3 meter	25 331-D-Z	08/2015	08/2018
1140	EMI Test Receiver	R&S	ESCI7	100825	02/21/2017	02/21/2018
690	Spectrum Analyzer	R&S	FSP	100027	01/24/2017	01/24/2018
1147	Bilog Antenna	TESEQ Gmbh	CBL 6112D	32852	11/03/2016	11/03/2017
1515	Horn Antenna	ETS-Lindgren	3115	00161631	03/15/2017	03/15/2018
1576	Preamplifier	R&S	TS-PR1	9037.6616.02	07/01/2016	07/01/2017
1135	Preamplifier	Miteq	AMF-6D-00501800-24-10P	1685147	05/04/2017	05/04/2018
698	Cable	Insulated Wire Inc	KPS-1503-1080-KPS	-	03/14/2017	03/14/2018
1517	Cable	R&S	TSPR-B7	101528	07/01/2016	07/01/2017
1518	Cable	R&S	TSPR-B7	101529	07/01/2016	07/01/2017
1536	Barometer/ Humidity	Omega	iBTHX-W	1541000	01/09/2017	01/09/2018

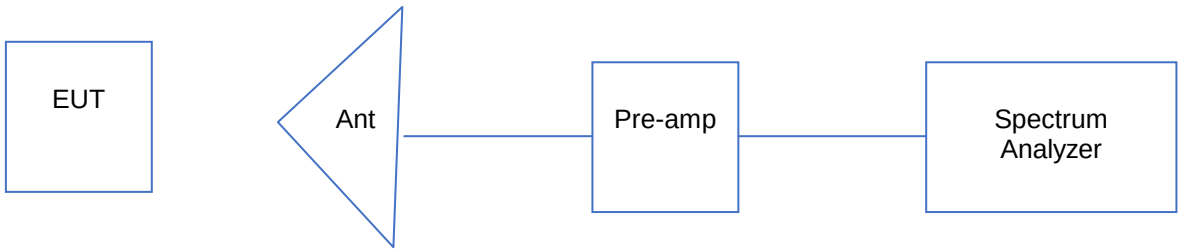
Software Utilized:

Name	Manufacturer	Version	Profile
Tile	Quantum Change	4.1	FCC 30 to 1000 FCC Part 15 FSP 1-10GHz

12.3 Results:

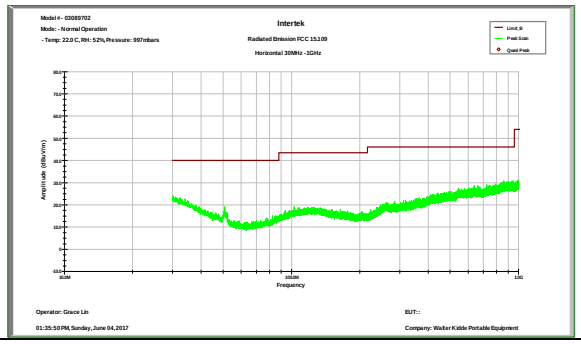
The sample tested was found to Comply.

12.4 Setup Diagram:

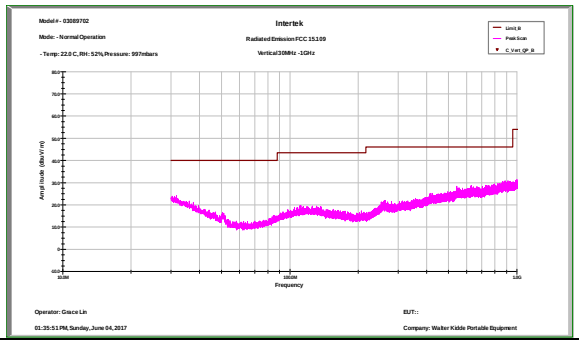


12.5 Plots/Data:

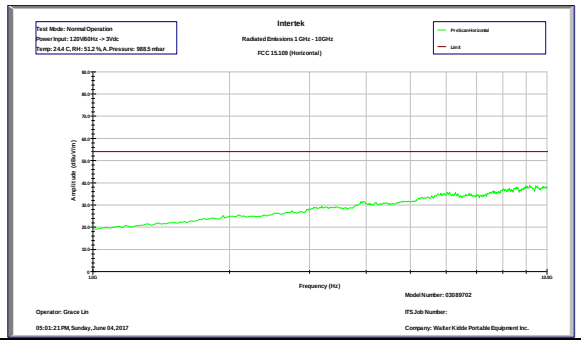
30 – 1000 MHz, Peak Scan – QP Limit, Horizontal



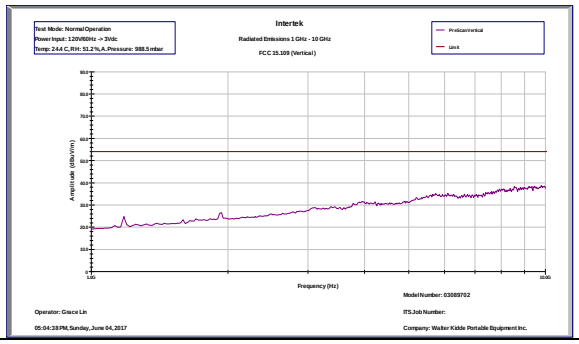
30 – 1000 MHz, Peak Scan – QP Limit, Vertical



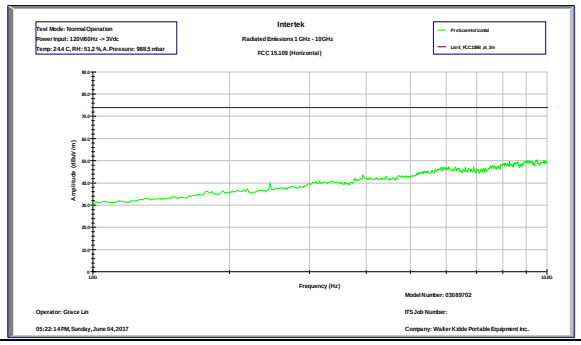
1 – 10 GHz, Average, Horizontal



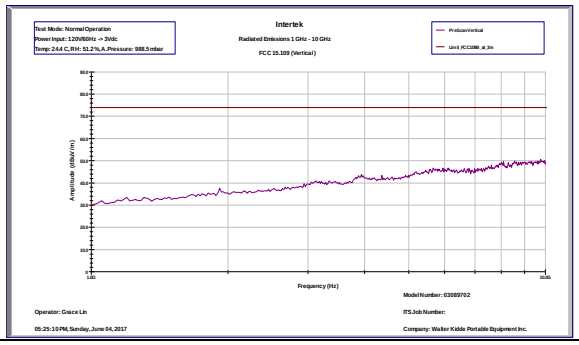
1 – 10 GHz, Average, Vertical



1 – 10 GHz, Peak, Horizontal



1 – 10 GHz, Peak, Vertical



All emissions were at least 20 dB below the applicable limits.

Test Personnel:	Grace Lin	Test Date:	06/04/2017
Product Standard:	FCC 15B; ISED ICES-003	Limit Applied:	FCC 15.109; ISED ICES-003
Input Voltage:	3Vdc	Ambient Temperature:	24.4 ºC
Pretest Verification w/ Ambient Signals or BB Source:	Yes	Relative Humidity:	51.2 %
		Atmospheric Pressure:	988.5 mBar

Deviations, Additions, or Exclusions: None

13 AC Mains Conducted Emissions

13.1 Requirements

Frequency Band MHz	Class B Limit 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.

13.2 Method

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. A LISN 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. A LISN 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 LISN 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 emissions are 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.

Equipment setup for conducted emissions 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	2.6 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.

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

13.1 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
637	3m Semi-anechoic Chamber	Panashield	3 meter	25 331-D-Z	12/21/2015	12/21/2018
1140	EMI Test Receiver	R&S	ESCI7	100825	02/21/2017	02/21/2018
666	LISN	Teseq	NNB 51	36058	08/26/2016	08/26/2017
1470	Cable	MegaPhase	TM18-N1N1-600	-	06/15/2016	06/15/2017
1536	Barometer/ Humidity	Omega	iBTHX-W	1541000	01/09/2017	01/09/2018

Software Utilized:

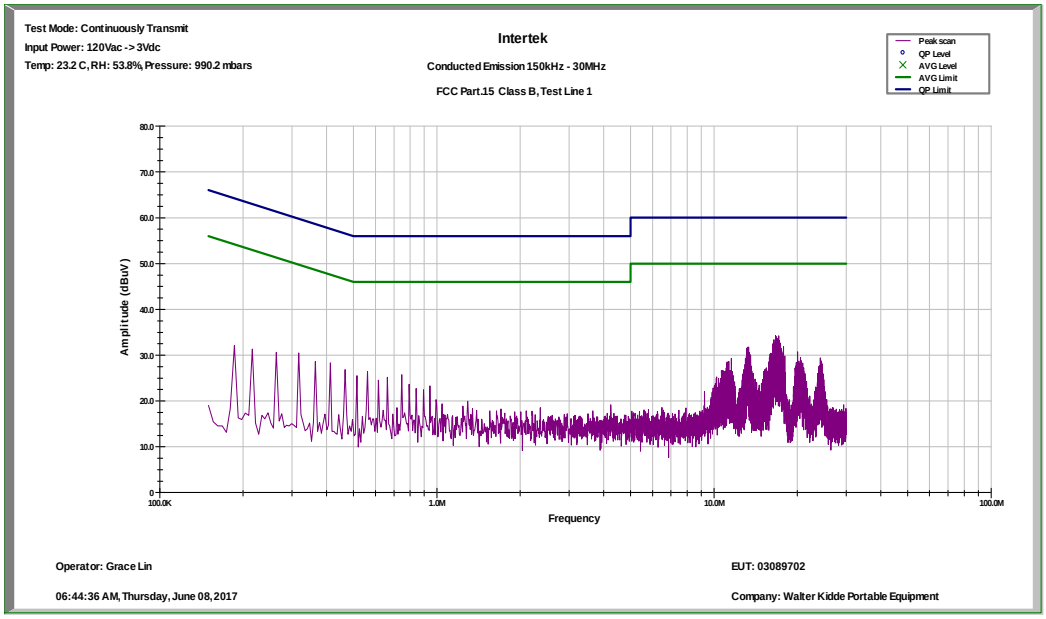
Name	Manufacturer	Version	Profile
Tile	Quantum Change	4.1	Master CE CISPR 11

13.2 Results:

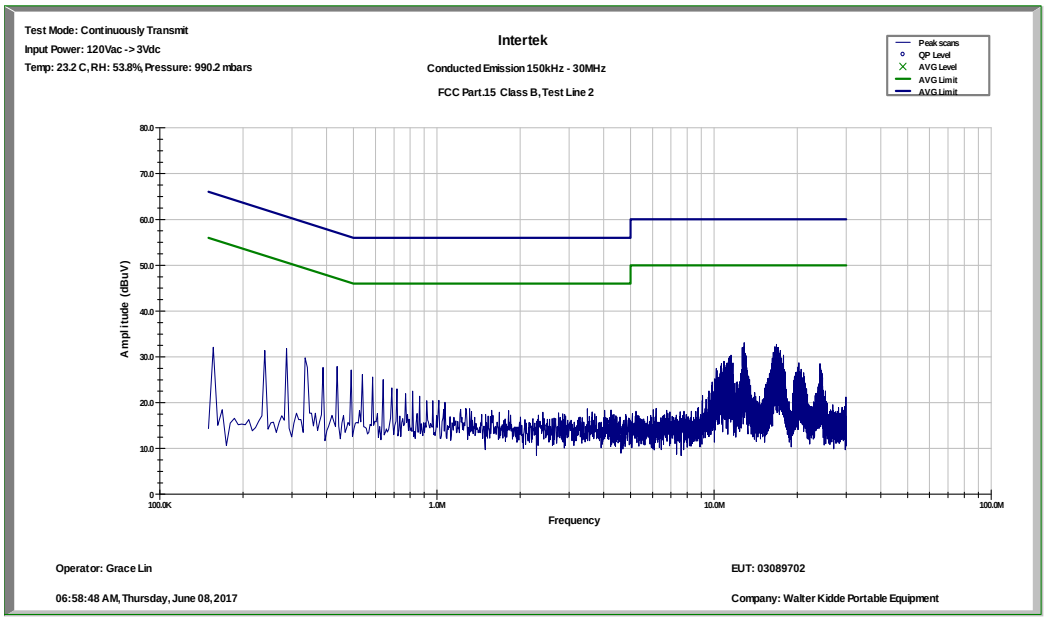
The sample tested was found to Comply.

13.1 Setup Diagram:

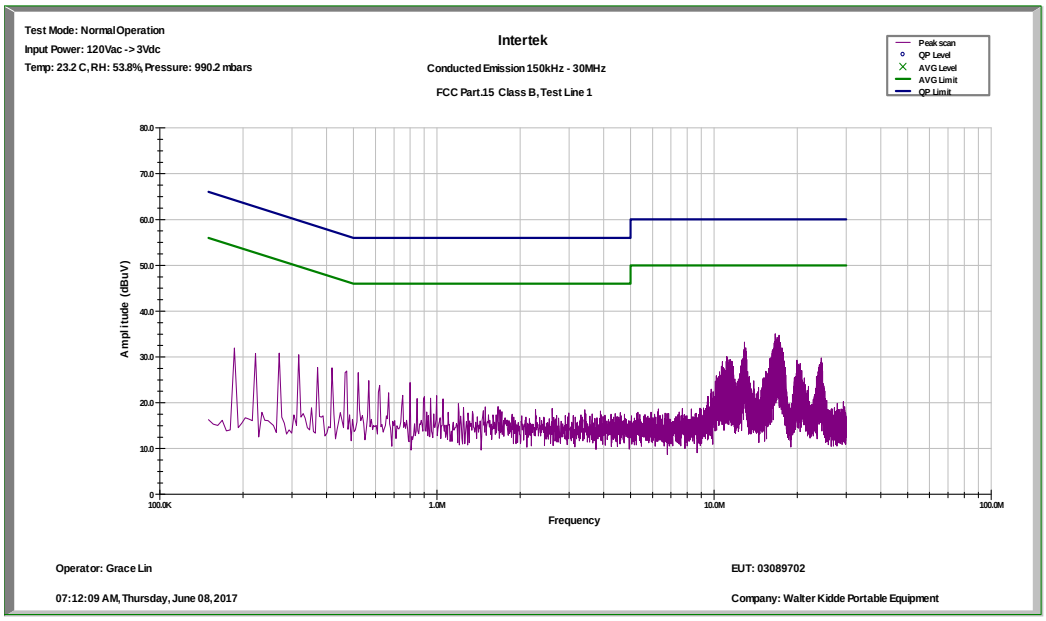
13.2 Plots/Data:



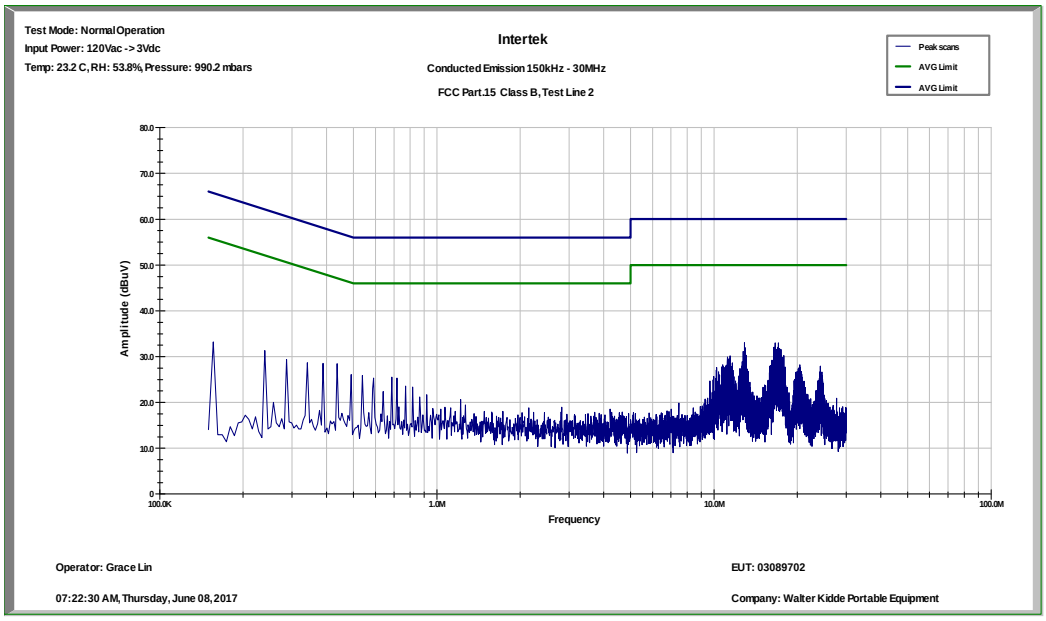
Conducted Emissions Line 1, Continuously Transmit



Conducted Emissions Line 2, Continuously Transmit



Conducted Emissions Line 1, Normal Operation



Conducted Emissions Line 2, Normal Operation

13.3 Data:

All emissions were at least 20 dB below the applicable limits. Please refer to plots shown in Section 13.2.

Test Personnel:	Grace Lin	Test Date:	06/08/2017
Product Standard:	FCC 15C, FCC 15B; ISED RSS-Gen, ISED ICES-003	Limit Applied:	FCC 15.207, FCC 15.107; ISED RSS-Gen, ISED ICES-003
Input Voltage:	3Vdc	Ambient Temperature:	23.2 ºC
Pretest Verification w/ Ambient Signals or BB Source:	Yes	Relative Humidity:	53.8 %
		Atmospheric Pressure:	990.2 mBar

Deviations, Additions, or Exclusions: None

14 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	June 13, 2017	103083191LAX-001	GL	KV	Initial Release