EMC TEST REPORT

Report Number: 102734003LAX-001
Project Number: G102734003

Report Issue Date: September 30, 2016

Model(s) Tested: NGP680137

Standards: **FCC CFR47 Part 15 Subpart C, 2016**
Intentional Radiator
§15.247, Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

ISED RSS-247 Issue 1, May 2015
Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHs) and Licence-Exempt Local Area Network (LE-LAN) Devices

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

Client:
Abbott Medical Optics Inc.
1700 E Saint Andrew Place
Santa Ana, CA 92705
USA

Report prepared by

Grace Lin
EMC Staff Engineer

Report reviewed by

Bryan Taylor
EMC Team 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

Test	Rule Section		Results
	US FCC	Canada ISED	
Carrier Frequency Separation	§15.247(a)(1)	§5.1 2 of RSS-247	Complies
Number of Hopping Frequencies	§15.247(a)(1)	§5.1 4 of RSS-247	Complies
Time of Occupancy (Dwell Time)	§15.247(a)(1)	§5.1 4 of RSS-247	Complies
20 dB Bandwidth	§15.247(a)(1)	§5.1 1 of RSS-247	Complies
99% Occupied Bandwidth	-	§4.6.1 of RSS-Gen	(for reporting purpose)
Peak Output Power, conducted	§15.247(b)(1)	§5.4 2 of RSS-247	Complies
Band-edge	§15.247(d)	§5.5 of RSS-247	Complies
Conducted Spurious Emissions	§15.247(d)	§5.5 of RSS-247	Complies
Radiated Spurious Emissions	§15.247(d)	§8.9 of RSS-Gen	Complies
AC Power Line Conducted Emissions	§15.207	§8.8 of RSS-Gen	Complies

3 Client Information

This EUT was tested at the request of:

Client: Abbott Medical Optics Inc.
1700 E Saint Andrew Place
Santa Ana, CA 92705
USA

Contact: Fred Lee
Telephone: (714) 247-8578
Fax:
Email: fred.lee@amo.abbott.com

4 Description of Equipment Under Test and Variant Models

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Remote Control	Abbott Medical Optics Inc.	NGP680137	009

Receive Date:	9/21/2016
Received Condition:	Good
Type:	Production

Dates of Tests:	09/22/2016 – 09/25/2016, 09/30/2016

Description of Equipment Under Test

The equipment under test (EUT) is a device with one Bluetooth transceivers operating in the 2.4 GHz frequency band.

The WHITESTAR Signature Pro Remote Control system consists of the Remote Control Master and Remote Control Slave, the master resides in the WHITESTAR Signature Pro Console NGP680301 and the slave resides in the Remote Control NGP680137. Each device: Master and Slave consists one National Semiconductor's LMX98XX series Bluetooth radios ICs (transceivers), operating in the 2.4 GHz frequency band. This radio subsystem is used to communicate the monitor control signal to the WHITESTAR Signature Pro System for use in cataract surgery.

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
4.8 Vdc	100 mA	N/A	N/A
100-240 Vac (AC Adapter)	0.8 – 0.4 A	47 – 63 Hz	1

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Test Mode – Continuously Transmit
2	Test Mode - Hopping Enabled
3	Charging Mode

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Under test mode, the EUT was programmed to transmit continuously during testing. The EUT was powered by new fully charged batteries during measurement.
2	Under charging mode (for AC power line conducted emission measurement), the EUT did not transmit.

Radio/Receiver Characteristics	
Frequency Range	2402-2480 MHz
Type of Transmission	Frequency Hopping Spread Spectrum
Number of Channel(s)	79
Modulation Type(s)	GFSK
Data Rate	1 Mbps
Maximum Output Power	-3.84 dBm (0.413 mW)
Test Channels	2402 MHz, 2441 MHz, 2480 MHz
Equipment Type	Standalone
Antenna Type and Gain	On-board antenna, 2.5 dBi

5 System Setup and Method

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	None	-	-	-	-

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
None	-	-	-

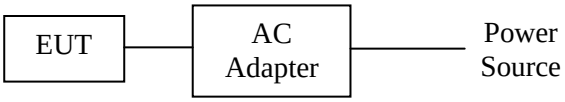
5.1 Method:

Configuration as required by ANSI C63.10-2013.

5.2 EUT Block Diagram:

Test Mode:

Charging Mode:



6 Carrier Frequency Separation

6.1 Requirement(s)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

6.2 Method

The procedure described in Section 7.8.2 of ANSI C63.10-2013 was used.

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	August 2015	August 2018
1140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/22/2016	02/22/2017
1001	Barometer/Humidity	Omega	iBTHX-W	0440775	04/22/2016	04/22/2017

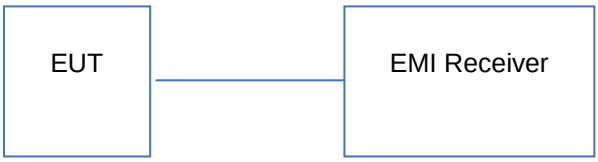
Software Utilized:

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

6.4 Results:

The sample tested was found to comply.

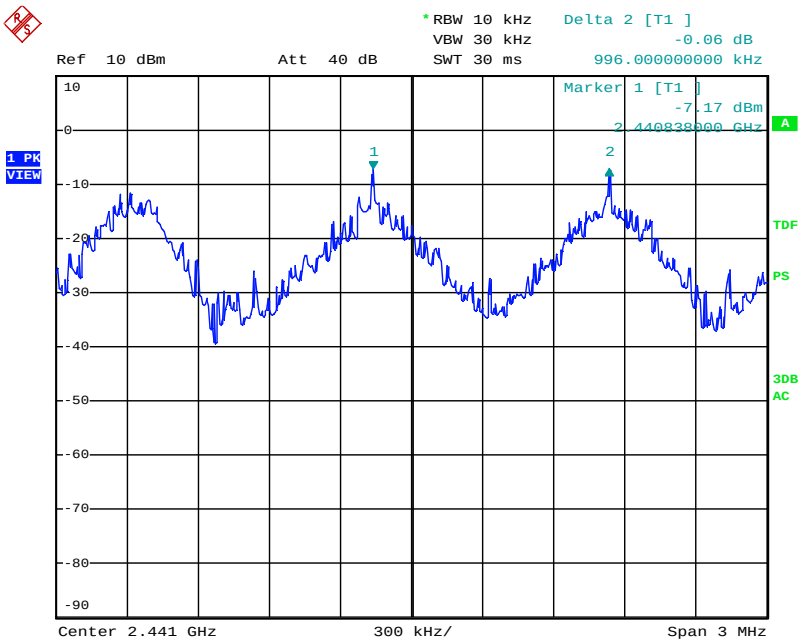
6.5 Setup Diagram:



6.6 Plots/Data:

Test Personnel:	Grace Lin	Test Date:	09/23/2016
Product Standard:	FCC 15.247, IC RSS-247	Limit Applied:	FCC 15.247, IC RSS-247
Input Voltage:	4.8 Vdc (nominal battery voltage)		
Pretest Verification w/ BB Source:	N/A	Ambient Temperature:	21.6 ºC
		Relative Humidity:	51.7 %
		Atmospheric Pressure:	990.8 mbars

Deviations, Additions, or Exclusions: None



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7 Number of Hopping Frequencies

7.1 Requirement(s)

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used

7.2 Method

The procedure described in Section 7.8.3 of ANSI C63.10-2013 was used.

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	August 2015	August 2018
1140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/22/2016	02/22/2017
1001	Barometer/Humidity	Omega	iBTHX-W	0440775	04/22/2016	04/22/2017

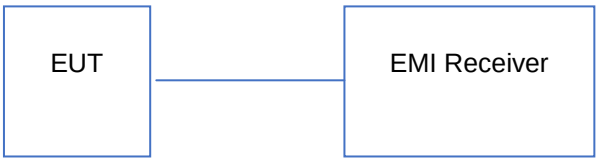
Software Utilized:

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

7.4 Results:

The sample tested was found to comply. The EUT has 79 hopping channels.

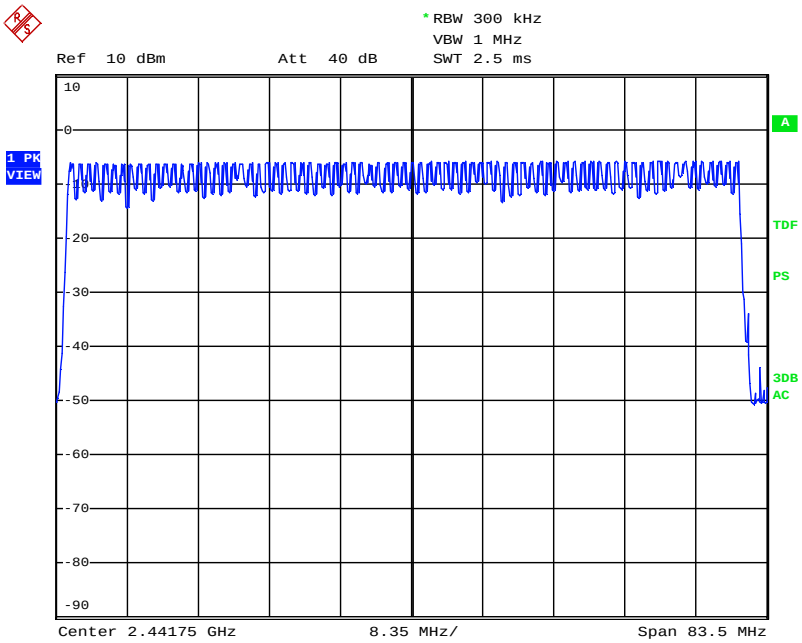
7.5 Setup Diagram:



7.6 Plots/Data:

Test Personnel:	Grace Lin	Test Date:	09/23/2016
Product Standard:	FCC 15.247, IC RSS-247	Limit Applied:	FCC 15.247, IC RSS-247
Input Voltage:	4.8 Vdc (nominal battery voltage)		
Pretest Verification w/		Ambient Temperature:	21.6 ºC
BB Source:	N/A	Relative Humidity:	51.7 %
		Atmospheric Pressure:	990.8 mbars

Deviations, Additions, or Exclusions: None



Date: 23.SEP.2016 17:23:53

Number of Hopping Channels: 79

8 Time of Occupancy (dwell time)

8.1 Requirement(s)

For frequency hopping systems operating in the 2400-2483.5 MHz band, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

8.2 Method

The procedure described in Section 7.8.4 of ANSI C63.10-2013 was used.

Since the radio is employed 79 hopping channels, the Occupancy Time was calculated for the period of 0.4 * 79 = 31.6 sec.

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	August 2015	August 2018
1140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/22/2016	02/22/2017
1001	Barometer/Humidity	Omega	iBTHX-W	0440775	04/22/2016	04/22/2017

Software Utilized:

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

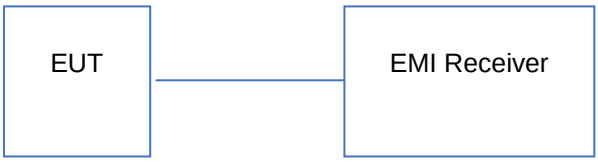
8.4 Results:

The sample tested was found to comply.

Occupancy Time (See plots under Section 8.6):

0.0029*13*10 = 0.377 sec.

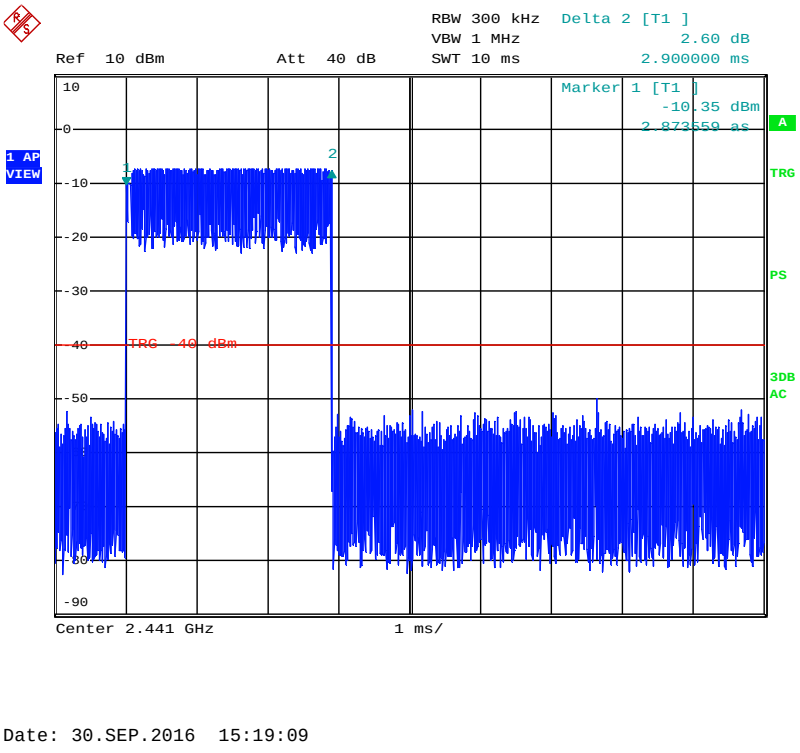
8.5 Setup Diagram:

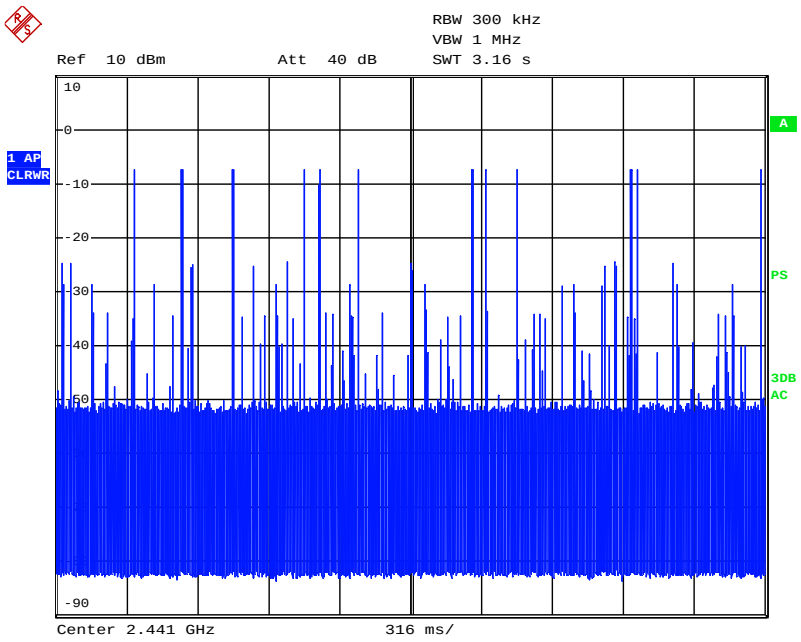


8.6 Plots/Data:

Test Personnel:	Grace Lin	Test Date:	09/30/2016
Product Standard:	FCC 15.247, IC RSS-247	Limit Applied:	FCC 15.247, IC RSS-247
Input Voltage:	4.8 Vdc (nominal battery voltage)		
Pretest Verification w/		Ambient Temperature:	49.0 ºC
BB Source:	N/A	Relative Humidity:	51.7 %
		Atmospheric Pressure:	991 mbars

Deviations, Additions, or Exclusions: None





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9 20 dB Bandwidth

9.1 Requirement(s)

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

9.2 Method

The procedure described in Section 6.9.2 of ANSI C63.10-2013 was used.

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	August 2015	August 2018
1140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/22/2016	02/22/2017
1001	Barometer/Humidity	Omega	iBTHX-W	0440775	04/22/2016	04/22/2017

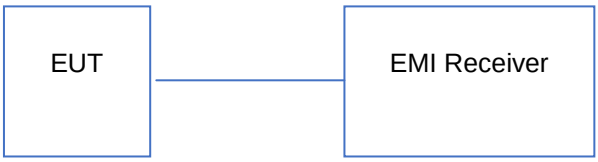
Software Utilized:

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:



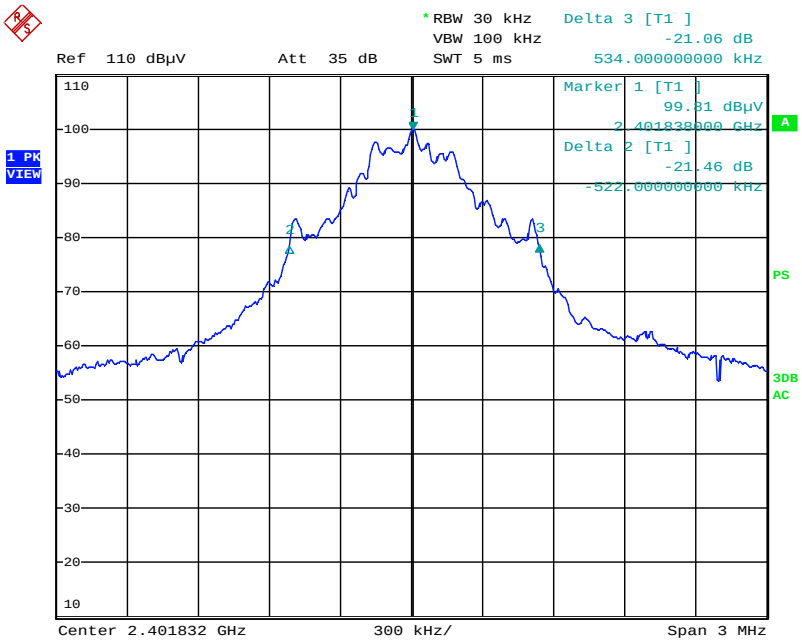
9.6 Plots/Data:

Test Personnel:	Grace Lin	Test Date:	09/23/2016
Product Standard:	FCC 15.247, IC RSS-247	Limit Applied:	FCC 15.247, IC RSS-247
Input Voltage:	4.8 Vdc (nominal battery voltage)		
Pretest Verification w/		Ambient Temperature:	21.6 ºC
BB Source:	N/A	Relative Humidity:	51.7 %
		Atmospheric Pressure:	990.8 mbars

Frequency (MHz)	20 dB Bandwidth (kHz)
2402	1056
2441	1056
2480	1056

Deviations, Additions, or Exclusions: None

Channel 2402 MHz:



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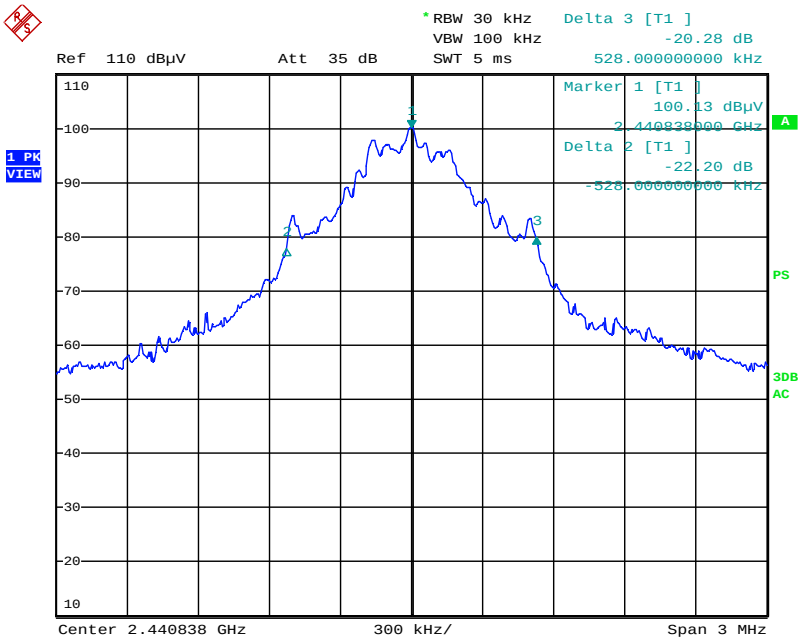
Channel 2441 MHz:



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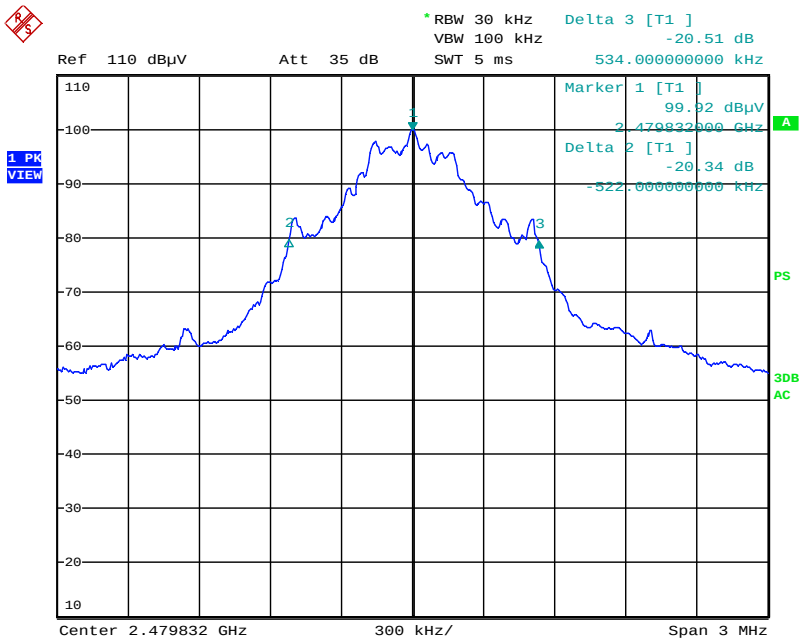
Channel 2480 MHz:



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10 99% Occupied Bandwidth

10.1 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)

10.2 Method

The procedure described in Section 6.9.3 of ANSI C63.10-2013 was used.

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.

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	August 2015	August 2018
1140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/22/2016	02/22/2017
1001	Barometer/Humidity	Omega	iBTHX-W	0440775	04/22/2016	04/22/2017

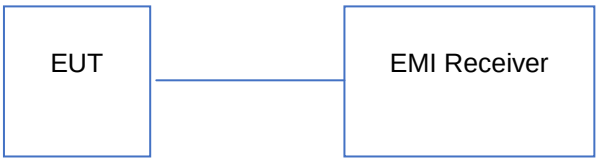
Software Utilized:

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:



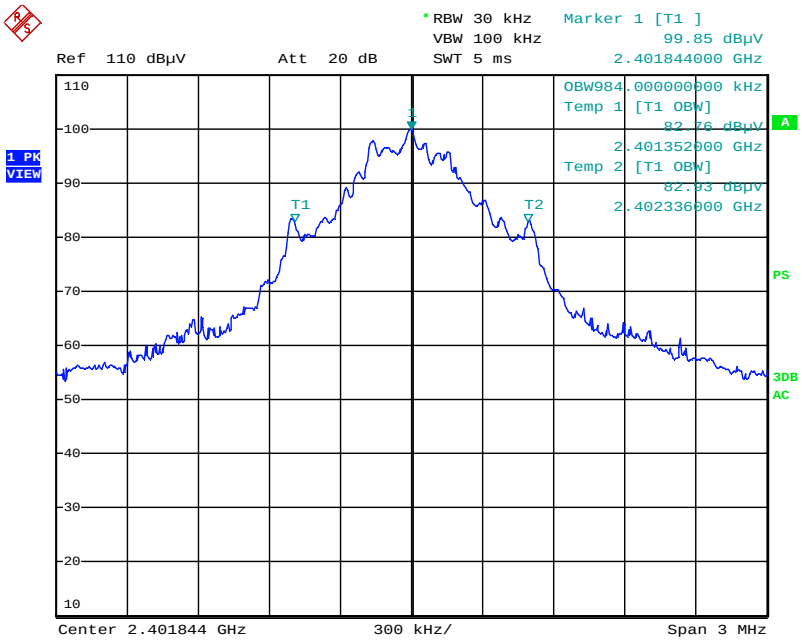
10.6 Plots/Data:

Test Personnel:	Grace Lin	Test Date:	09/23/2016
Product Standard:	FCC 15.247, IC RSS-247	Limit Applied:	FCC 15.247, IC RSS-247
Input Voltage:	4.8 Vdc (nominal battery voltage)		
Pretest Verification w/		Ambient Temperature:	21.6 ºC
BB Source:	N/A	Relative Humidity:	51.7 %
		Atmospheric Pressure:	990.8 mbars

Frequency (MHz)	99% Occupied Bandwidth (kHz)
2402	984
2440	984
2480	978

Deviations, Additions, or Exclusions: None

Channel 2402 MHz:



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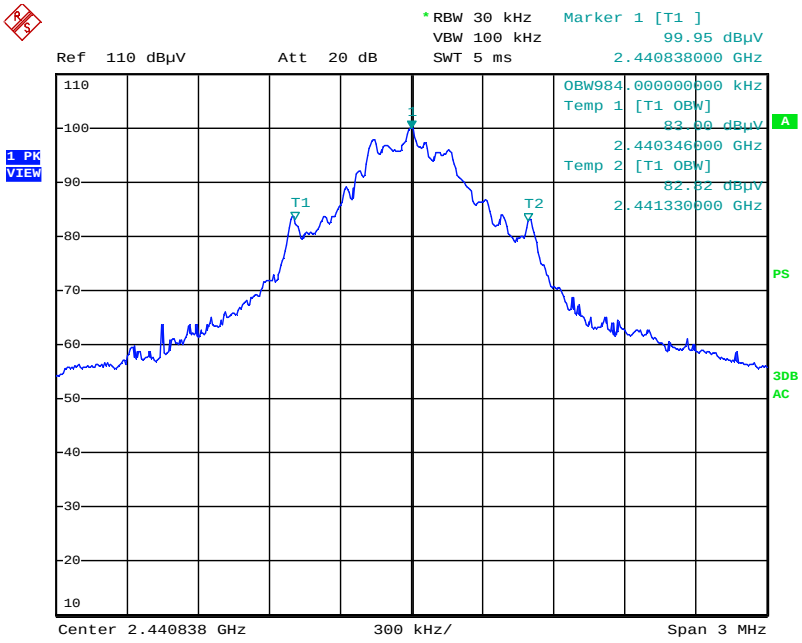
Channel 2441 MHz:



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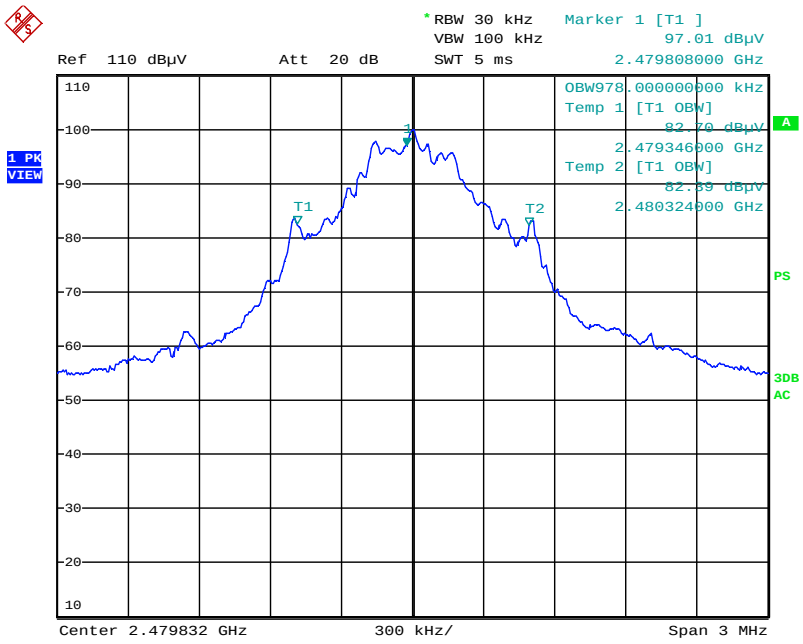
Channel 2480 MHz:



Date: 23.SEP.2016 13:40:13

11 Maximum Peak Conducted Output Power at Antenna Terminals

11.1 Requirement(s)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, the maximum peak output power is 1 watt (30 dBm). For all other frequency hopping systems operating in the 2400-2483.5 MHz band, the maximum peak output power is 0.125 watts.

11.2 Method

The procedure described in Section 7.8.5 of ANSI C63.10-2013 was used.

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.

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	August 2015	August 2018
1140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/22/2016	02/22/2017
1001	Barometer/Humidity	Omega	iBTHX-W	0440775	04/22/2016	04/22/2017

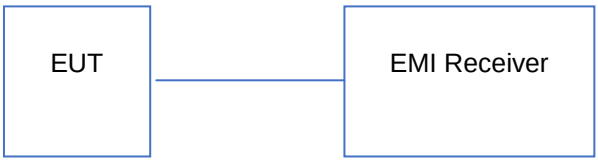
Software Utilized:

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

11.4 Results:

The sample tested was found to comply.

11.5 Setup Diagram:



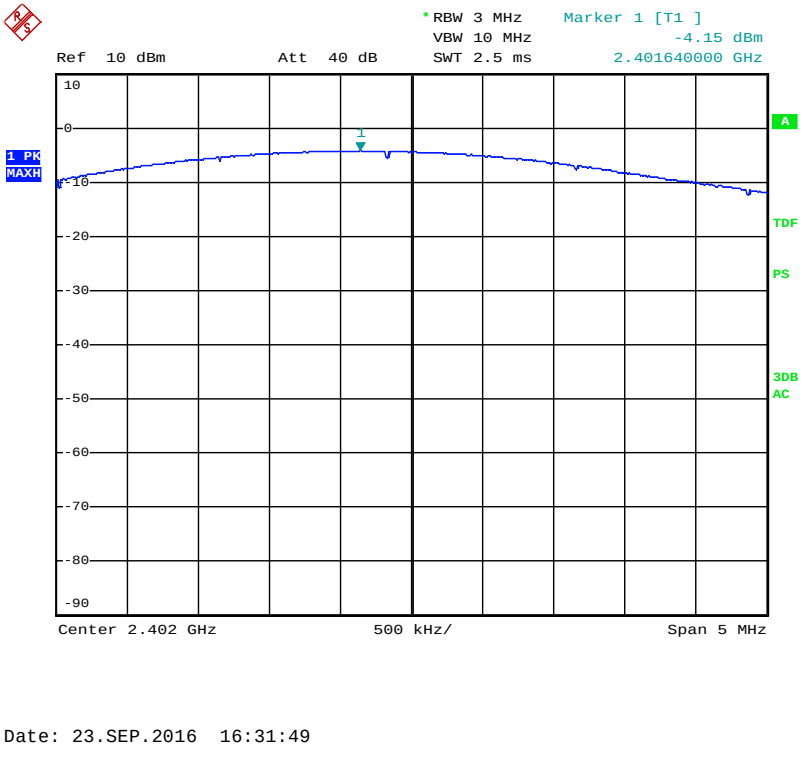
11.6 Plots/Data:

Test Personnel:	Grace Lin	Test Date:	09/23/2016
Product Standard:	FCC 15.247, IC RSS-247	Limit Applied:	FCC 15.247, IC RSS-247
Input Voltage:	4.8 Vdc (nominal battery voltage)		
Pretest Verification w/		Ambient Temperature:	21.6 ºC
BB Source:	N/A	Relative Humidity:	51.7 %
		Atmospheric Pressure:	990.8 mbars

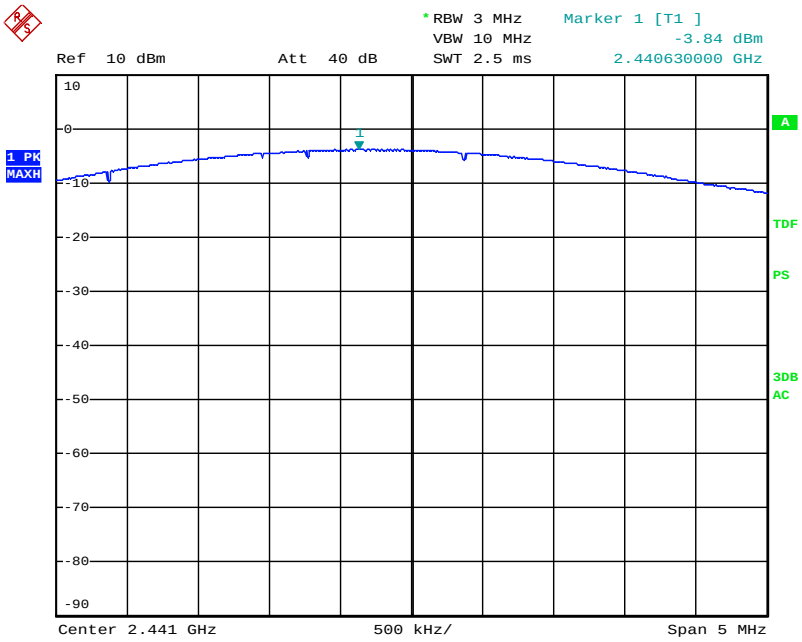
Frequency (MHz)	Output in dBm	Output in mW
2402	-4.15	0.3846
2440	-3.84	0.4130
2480	-5.52	0.2805

Deviations, Additions, or Exclusions: None

Channel 2402 MHz:



Channel 2441 MHz:



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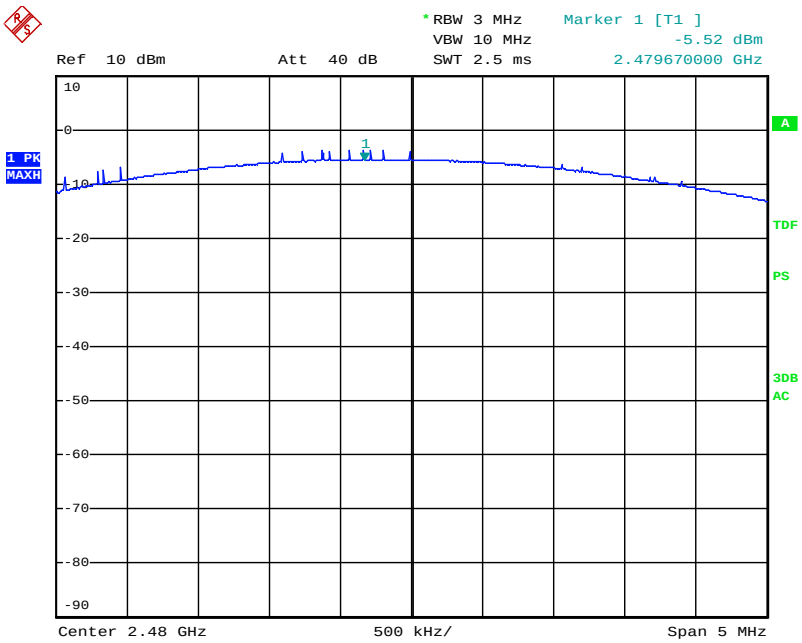
Channel 2480 MHz:



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12 Band-edge

12.1 Requirement(s)

In any 100 kHz bandwidth outside the frequency band, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band.

12.2 Method

The procedure described in Section 7.8.6 of ANSI C63.10-2013 was used.

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.

12.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
637	3m Semi-anechoic Chamber	Panashield	3 meter	25 331-D-Z	August 2015	August 2018
1140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/22/2016	02/22/2017
1001	Barometer/Humidity	Omega	iBTHX-W	0440775	04/22/2016	04/22/2017

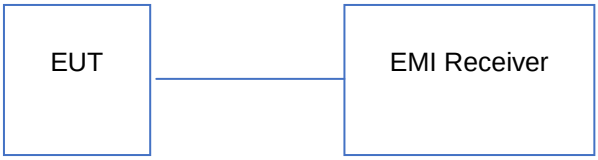
Software Utilized:

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

12.4 Results:

The sample tested was found to comply.

12.5 Setup Diagram:

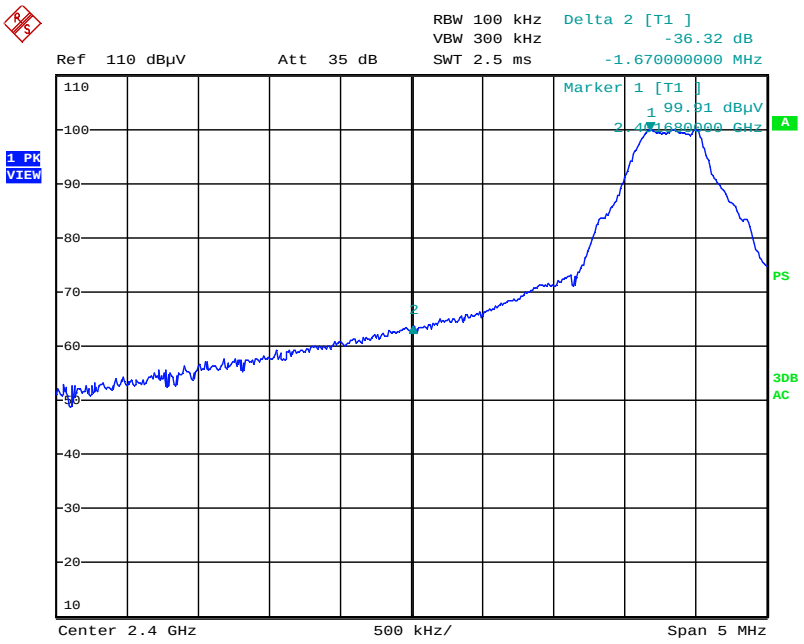


12.6 Plots/Data:

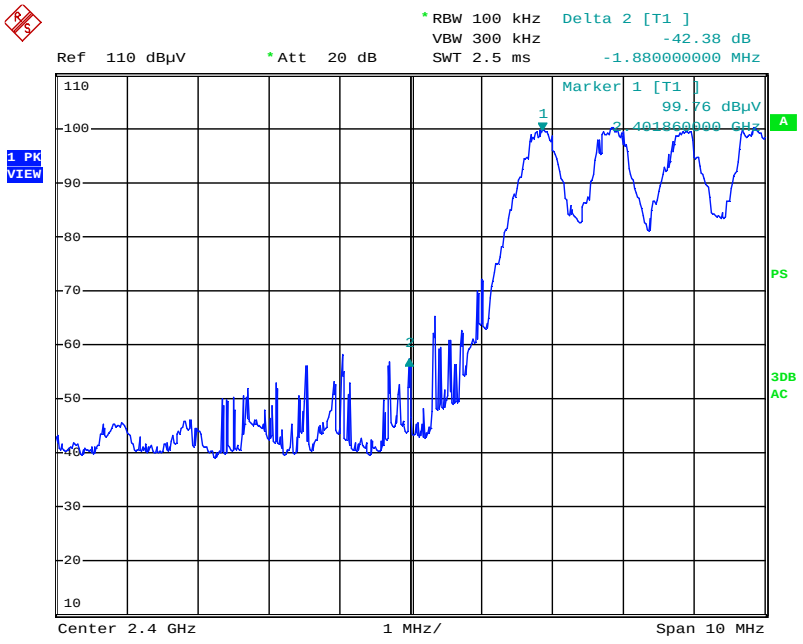
Test Personnel:	Grace Lin	Test Date:	09/23/2016
Product Standard:	FCC 15.247, IC RSS-247	Limit Applied:	FCC 15.247, IC RSS-247
Input Voltage:	4.8 Vdc (nominal battery voltage)		
Pretest Verification w/		Ambient Temperature:	21.6 ºC
BB Source:	N/A	Relative Humidity:	51.7 %
		Atmospheric Pressure:	990.8 mbars

Deviations, Additions, or Exclusions: None

Band-edge at 2400 MHz:

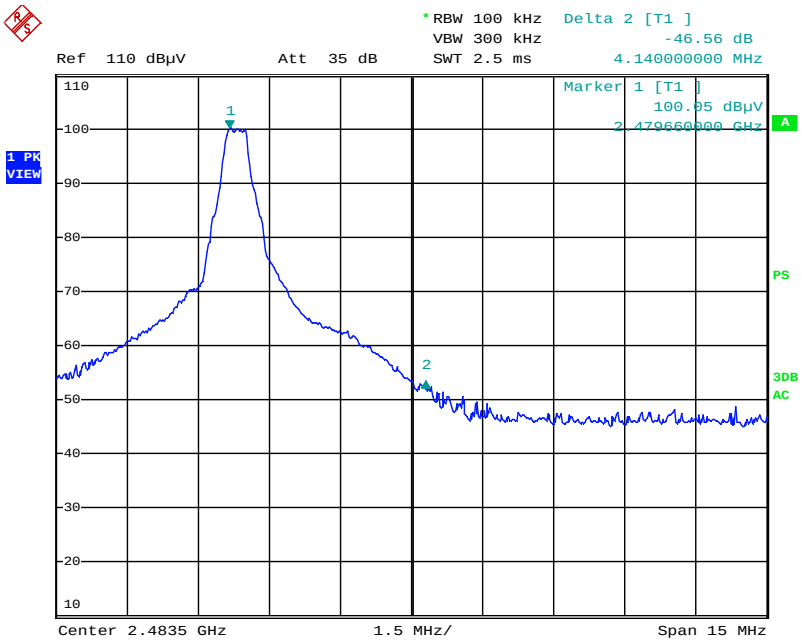


Date: 23.SEP.2016 18:13:00

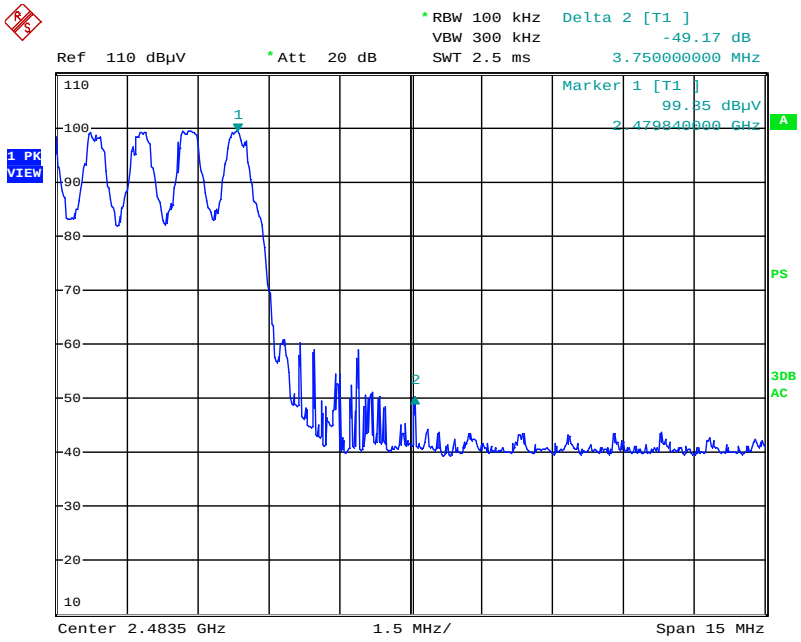


Date: 26.SEP.2016 09:56:48

Band-edge at 2483.5 MHz:



Date: 23.SEP.2016 18:16:32



Date: 26.SEP.2016 10:00:28

13 Conducted Spurious Emissions

13.1 Requirement(s)

In any 100 kHz bandwidth outside the frequency band, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band.

13.2 Method

The procedure described in Section 7.8.8 of ANSI C63.10-2013 was used.

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.

13.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
637	3m Semi-anechoic Chamber	Panashield	3 meter	25 331-D-Z	August 2015	August 2018
1140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/22/2016	02/22/2017
1001	Barometer/Humidity	Omega	iBTHX-W	0440775	04/22/2016	04/22/2017

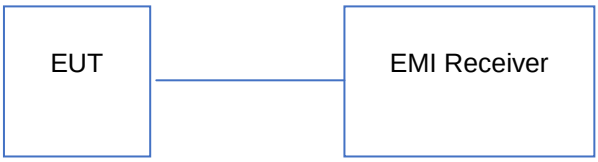
Software Utilized:

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

13.4 Results:

The sample tested was found to comply.

13.5 Setup Diagram:

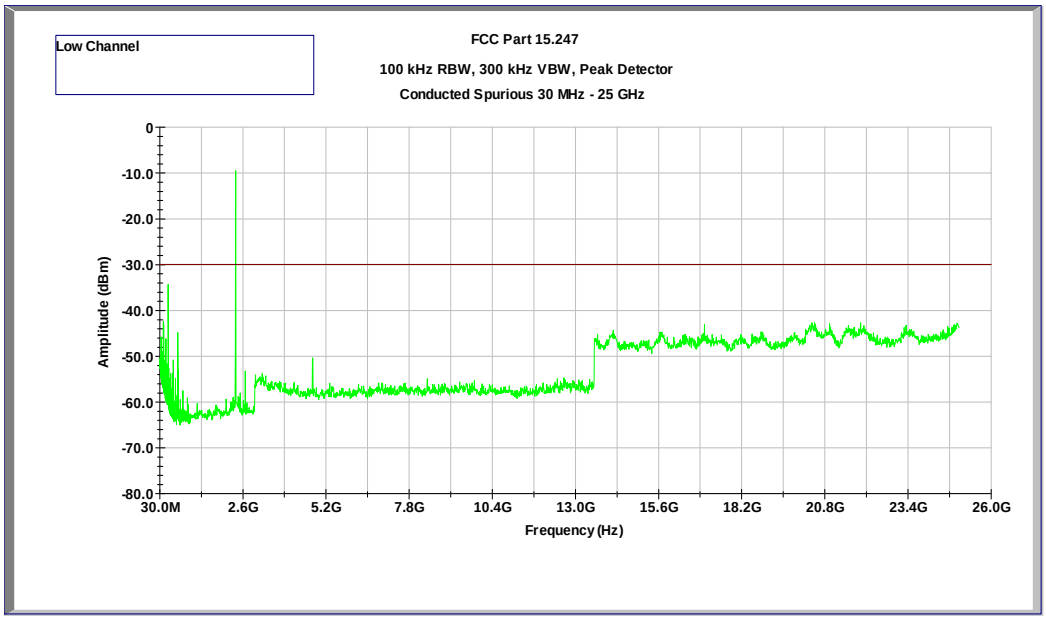


13.6 Plots/Data:

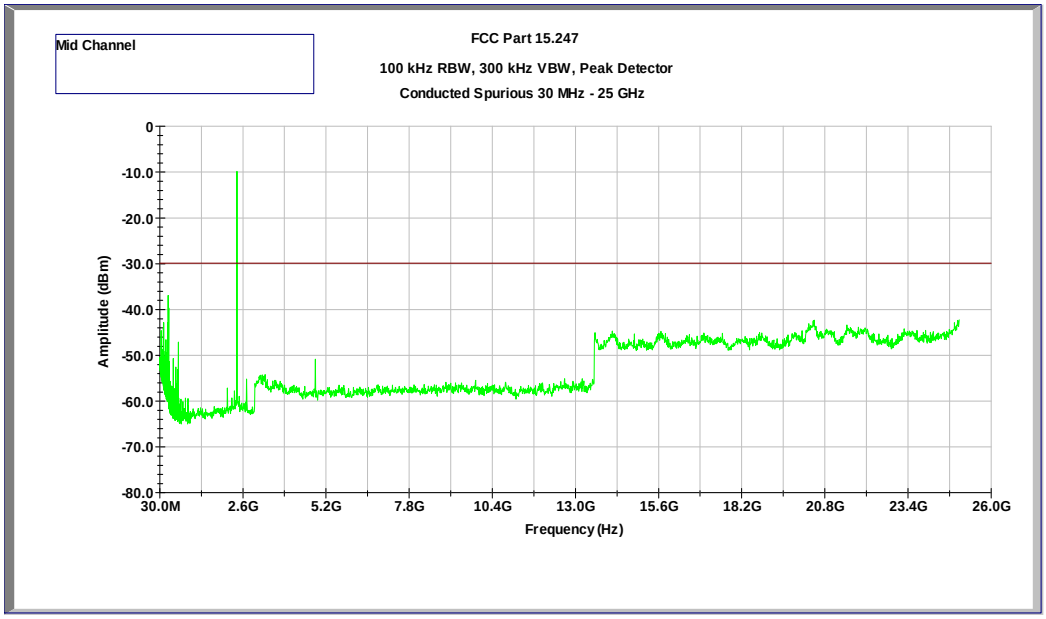
Test Personnel:	Grace Lin	Test Date:	09/23/2016
Product Standard:	FCC 15.247, IC RSS-247	Limit Applied:	FCC 15.247, IC RSS-247
Input Voltage:	4.8 Vdc (nominal battery voltage)		
Pretest Verification w/		Ambient Temperature:	21.6 ºC
BB Source:	N/A	Relative Humidity:	51.7 %
		Atmospheric Pressure:	990.8 mbars

Deviations, Additions, or Exclusions: None

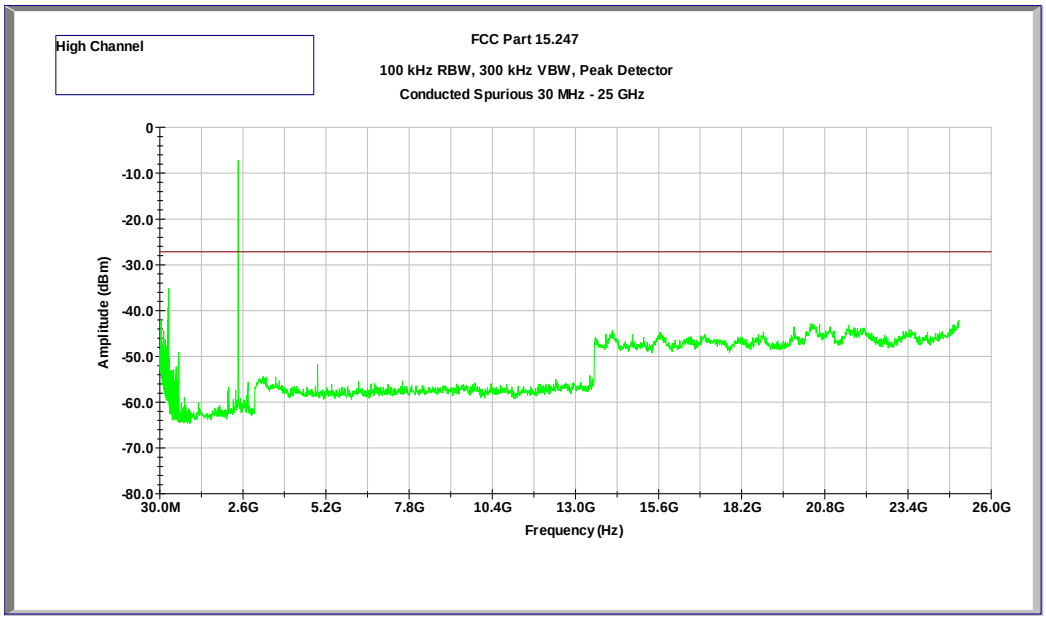
Channel 2402 MHz:



Channel 2441 MHz:



Channel 2480 MHz:



14 Radiated Spurious Emissions

14.1 Requirement(s)

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

In any 100 kHz bandwidth outside the EUT pass-band, the RF power shall be below the maximum in-band 100 kHz emissions by at least 20 dB (if peak power of in-band emission is measured) or 30 dB (if average power of in-band emission is measured).

The field strength of emissions from intentional radiators operated within the frequency band shall comply with the following:

14.2 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. Spectrum analyzer resolution bandwidth is 120 kHz for frequencies 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. The average level of radiated emissions was measured with a resolution bandwidth (RBW) of 1 MHz and a video bandwidth (VBW) of 10 Hz.

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 and 1 meter for frequencies above 18 GHz. Radiated emissions were investigated in three orthogonal axes. Data included is representative of the worst-case configuration (the configuration which resulted in the highest emission levels).

New fully charged batteries were used.

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	5.5	5.2 dB
Radiated Emissions, 1m	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.

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

14.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
637	3m Semi-anechoic Chamber	Panashield	3 meter	25 331-D-Z	August 2015	August 2018
1140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/22/2016	02/22/2017
690	Spectrum Analyzer, 9 KHz - 40 GHz	Rohde & Schwarz	FSP40	100027	01/11/2016	01/11/2017
1147	Bilog Antenna	Teseq	CBL 6112D	32852	10/28/2015	10/28/2016
1515	Horn Antenna	ETS-Lindgren	3115	00161631	11/05/2015	11/05/2016
880	Horn Antenna	ETS-Lindgren	3116C	00153521	11/09/2015	11/09/2016
1135	Preamplifier	Miteq	AMF-6D-00501800-24-10P	1685147	04/15/2016	04/15/2017
1470	Cable	Megaphase	TM18-N1N1-600	-	06/15/2016	06/15/2017
1518	Cable	Rohde & Schwarz	TSPR-B7	101529	07/01/2016	07/01/2017
1564	Cable	Rohde & Schwarz	TSPR-B8	101526	10/14/2015	10/14/2016
1001	Barometer/ Humidity	Omega	iBTHX-W	0440775	04/22/2016	04/22/2017

Software Utilized:

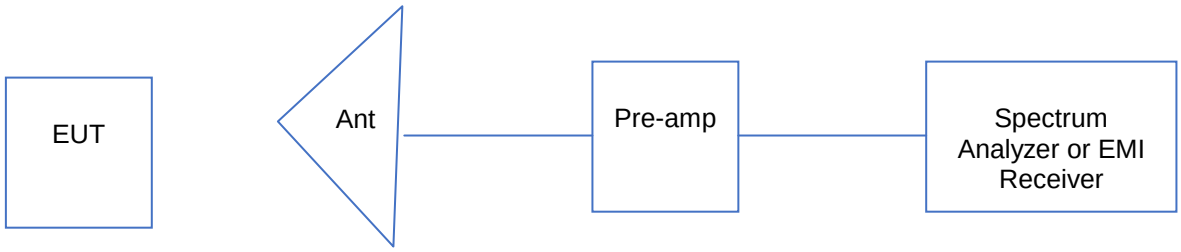
Name	Manufacturer	Version	Profile
Tile	Quantum Change	4.1, 3.4.K.29	• FCC 30 to 1000 • FCC Part 15 FSP 1-18GHz

14.4 Results:

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 25GHz. Peak emissions that were identified were measured to be greater than 20dB below 74dBµV peak limits. No Emissions were identified when scanned from 18-25 GHz.

14.5 Setup Diagram:



14.6 Plots/Data:

Test Personnel:	Grace Lin	Test Date:	09/24/2016 – 09/25/2016
Product Standard:	FCC 15.247, IC RSS-247	Limit Applied:	FCC 15.247, FCC 15.209, IC RSS-247, IC RSS-Gen
Input Voltage:	4.8V (nominal battery voltage)		
Pretest Verification w/		Ambient Temperature:	24.1 ºC
BB Source:	Yes	Relative Humidity:	58.5 %
		Atmospheric Pressure:	993 mbar

Antenna Polarization	Frequency (MHz)	Channel	EUT Orientation	Measured Raw Data (dBuV/m)	Antenna Factor	Cable Loss (dB)	Pre-amp (dB)	Corrected Data	Limit (dBuV/m)	Margin (dB)	Turntable Degree	Antenna Height (cm)	Detector
H	2390	Lo	YZ	43.37	28.15	2.52	44.73	29.31	54	-24.69	234.0	135.0	AVE
H	2390	Lo	YZ	52.47	28.15	2.52	44.73	38.41	74	-35.59	234.0	135.0	PK
H	4804	Lo	YZ	53.62	33.26	3.70	43.41	47.17	54	-6.83	162.0	184.0	AVE
H	4804	Lo	YZ	63.31	33.26	3.70	43.41	56.86	74	-17.14	162.0	184.0	PK
H	12010*	Lo	YZ	38.19	38.74	5.99	45.34	37.58	54	-16.42	0.0	150.0	AVE
H	12010*	Lo	YZ	50.21	38.74	5.99	45.34	49.60	74	-24.40	0.0	150.0	PK
H	4882	Mid	YZ	50.68	33.42	3.74	43.33	44.51	54	-9.49	222.0	149.0	AVE
H	4882	Mid	YZ	60.51	33.42	3.74	43.33	54.34	74	-19.66	222.0	149.0	PK
H	7323	Mid	YZ	37.23	38.25	4.20	42.99	36.69	54	-17.31	233.0	100.0	AVE
H	7323	Mid	YZ	51.59	38.25	4.20	42.99	51.05	74	-22.95	233.0	100.0	PK
H	12205*	Mid	YZ	38.71	38.62	6.16	45.48	38.01	54	-16.00	0.0	100.0	AVE
H	12205*	Mid	YZ	50.70	38.62	6.16	45.48	50.00	74	-24.01	0.0	100.0	PK
H	2483.5	Hi	YZ	52.93	28.46	2.57	44.64	39.32	54	-14.68	230.0	159.0	AVE
H	2483.5	Hi	YZ	72.79	28.46	2.57	44.64	59.18	74	-14.82	230.0	159.0	PK
H	4960	Hi	YZ	51.39	33.55	3.78	43.32	45.40	54	-8.60	232.0	172.0	AVE
H	4960	Hi	YZ	61.86	33.55	3.78	43.32	55.87	74	-18.13	232.0	172.0	PK
H	7440	Hi	YZ	36.80	38.07	4.28	42.70	36.45	54	-17.55	222.0	100.0	AVE
H	7440	Hi	YZ	50.67	38.07	4.28	42.70	50.32	74	-23.68	222.0	100.0	PK
H	12400*	Hi	YZ	38.37	38.85	6.39	45.31	38.30	54	-15.70	0.0	100.0	AVE
H	12400*	Hi	YZ	52.37	38.85	6.39	45.31	52.30	74	-21.70	0.0	100.0	PK

Deviations, Additions, or Exclusions: None

15 AC Power Line Conducted Emissions

15.1 Performance Criterion

Frequency Band MHz	FCC 15.207 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.

15.2 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)	Ucispr
AC Line Conducted Emissions	150 kHz - 30 MHz	2.1 dB	3.4dB
Telco Port Emissions	150 kHz - 30 MHz	2.6 dB	5.0dB

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

15.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
000637	EMC Emission Chamber	Panashield	3m Chamber	250831-D-2	12/21/2015	12/21/2018
001140	EMI Test Receiver	R&S	ESCI7	100825	02/22/2016	02/22/2017
000667	LISN	Teseq	NNB 51	36060	11/11/2015	11/11/2016
001237	Comb Generator	Com Power	CGC-510	311703	VBU 09/22/2016	VBU 09/22/2016
001470	Cable	MegaPhase	TM18-N1N1-600	-	06/15/2016	06/15/2016
001001	Barometer/Humidity	Omega	iBTHX-W	0440775	04/22/2016	04/22/2017

VBU = Verified Before Used

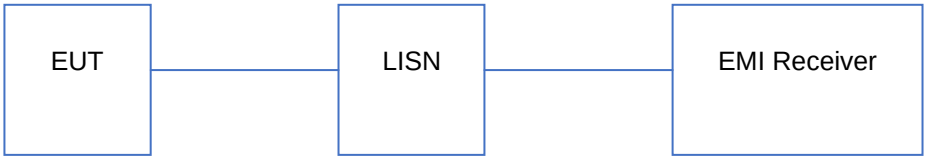
Software Utilized:

Name	Manufacturer	Version	Profile
Tile	Quantum Change	4.1	Master CE FCC

15.4 Results:

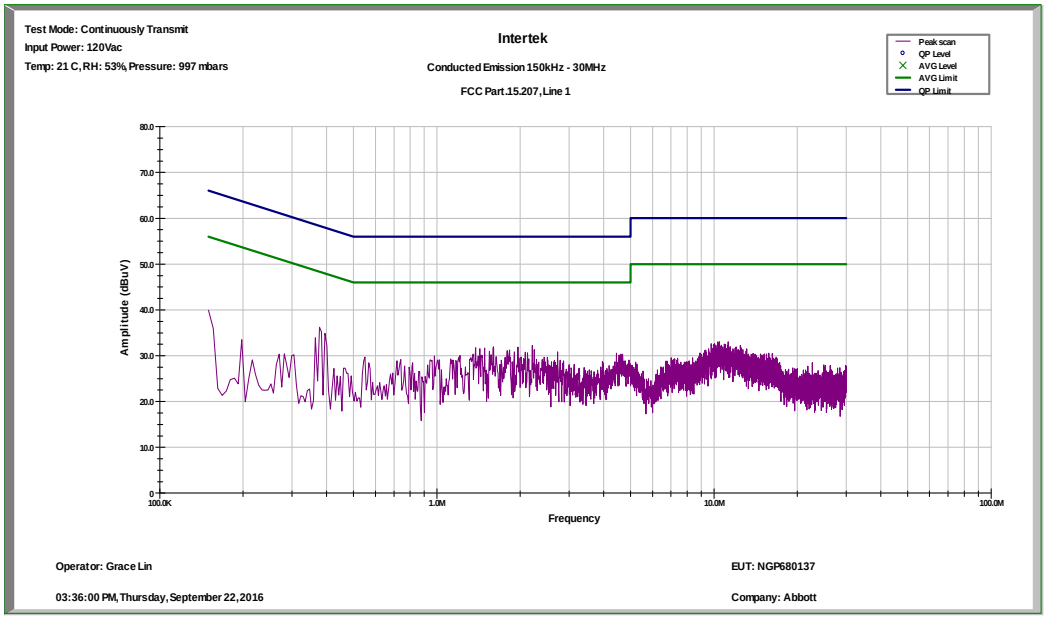
- The sample tested was found to Comply.

15.5 Setup Diagram:

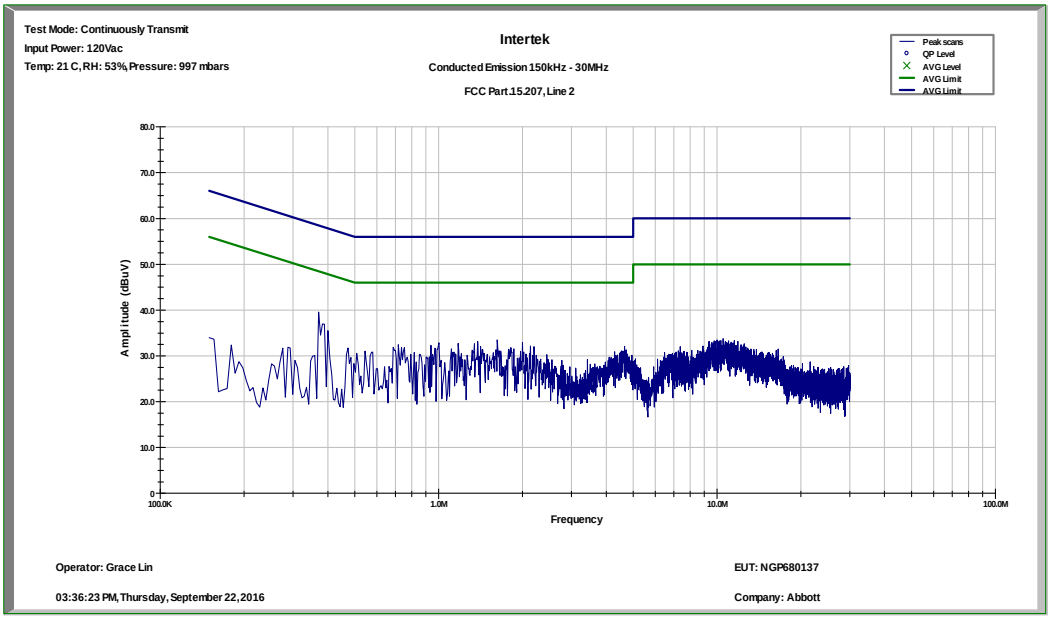


15.6 Plots:

Line 1:



Neutral:



15.7 Data:

Test Personnel:	Grace Lin	Test Date:	09/22/2016
Product Standard:	FCC 15C	Limit Applied:	FCC 15.207
Input Voltage:	120 Vac, 60 Hz		
Pretest Verification w/		Ambient Temperature:	21 ºC
BB Source:	Yes	Relative Humidity:	53 %
		Atmospheric Pressure:	997 mbars

Line 1

Frequency MHz	AV Level (dBuV)	QP Level (dBuV)	AV Limit (dBuV)	QP Limit (dBuV)	AV Margin dB	QP Margin dB
0.387	24.2	33.8	49.2	59.2	-25.0	-25.5

Neutral

Frequency MHz	AV level dBuV	QP Level dBuV	AV Limit dB	QP Limit dB	AV Margin dB	QP Margin dB
0.387	27.2	36.7	49.2	59.2	-22.1	-22.5

Test Result: (*) The **EUT PASSED** Conducted Emission test with -22.1 dB margin at 0.387 MHz

Deviations, Additions, or Exclusions: None

16 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	09/30/2016	102734003LAX-001	GL	BT	Initial Release
1	11/06/2016	102734003LAX-001	GL	BT	Added MU above 18 GHz on Page 33. Correct Antenna Gain on Page 6
2	12/05/2016	102734003LAX-001	GL	KV	Remove some text from EUT description on Page 4