TEST REPORT

Report Number: 102780674MPK-001
Project Number: G102780674
November 17, 2016

Testing performed on the
GoTenna Mesh
Model: 80085
FCC ID: 2ABVK80085
IC: 21842-GTISM01

To

FCC Part 15 Subpart C (15.247)
Industry Canada RSS-247 Issue 1

For

goTenna Inc.

Test Performed by:	Test Authorized by:
Intertek	goTenna Inc.
1365 Adams Court	81 Willoughby Street, Suite 302
Menlo Park, CA 94025 USA	Brooklyn, NY 11201

Prepared by: _____ **Date:** November 17, 2016
Minh Ly

Reviewed by: _____ **Date:** November 17, 2016
Krishna K Vemuri

Report No. 102780674MPK-001

Equipment Under Test:	GoTenna Mesh
Trade Name:	GoTenna Mesh
Model Number:	80085
Serial Number:	MPK1610261216-002 MPK1611071303-001 MPK1611071303-002
Applicant:	goTenna Inc.
Contact:	Mick Tinker
Address:	goTenna Inc. 81 Willoughby Street, Suite 302 Brooklyn, NY 19805
Country	USA
Tel. Number:	(302) 540-2246
Email:	mick@gotenna.com
Applicable Regulation:	FCC Part 15 Subpart C (15.247) Industry Canada RSS-247 Issue 1
Date of Test:	October 24 – November 10, 2016

We attest to the accuracy of this report:

Minh Ly	Krishna K Vemuri
EMC Project Engineer	Engineering Team Lead

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1.0 Introduction

The Equipment Under Test (EUT) is the GoTenna Mesh, model number 80085, consisting one 900MHz FHSS radio (902MHz – 928MHz band) and one Bluetooth Low Energy radio (2402MHz – 2480MHz). This test report covers only the FHSS radio. A separate test report, report #102780674MPK-002, covers the Bluetooth radio.

1.1 Summary of Tests

TEST	REFERENCE FCC Part 15 Subpart C (15.247)	REFERENCE RSS-247	RESULTS
RF Output Power	15.247(b)	5.4.2	Complies
20-dB Bandwidth	15.247(a)(1)	5.1.1	Complies
Channel Separation	15.247(a)(1)	5.1.2	Complies
Number of Hopping Channels	15.247(a)(1)	5.14	Complies
Average Channel Occupancy Time	15.247(a)(1)	5.14	Complies
Out-of-Band Antenna Conducted Emission	15.247(d)	5.5	Complies
Transmitter Radiated Emissions	15.247(d), 15.209, 15.205	RSS-GEN	Complies
AC Line Conducted Emission	15.207	RSS-GEN	Complies
Antenna Requirement	15.203	RSS-GEN	Complies. The EUT utilizes internal antenna.

2.0 General Description

2.1 Product Description

GoTenna is a device that pair with the smart phone and use the goTenna app to communicate off-grid. The unit is battery powered and it charged through USB port.

Overview of the EUT

Applicant	goTenna Inc.
Trade Name	goTenna Inc.
Model Number	80085
FCC Identifier	2ABVK80085
IC Identifier	21842-GTISM01
Type of Transmission	Frequency Hopping Spread Spectrum
Rated RF Output	29.14 dBm, 0.822 W
Frequency Range	902.5 – 927.5 MHz
Number of Channel(s)	51
Modulation Type	2GFSK
Data Rate	100 kbps
Antenna(s) type & Gain	Internal Antenna, 1.0 dBi peak gain
Manufacturer name & address	goTenna Inc. 81 Willoughby Street, Suite 302 Brooklyn, NY 19805 USA

EUT receive date: October 24, 2016
EUT receive condition: The pre-production version of the EUT was received in good condition with no apparent damage. As declared by the Applicant, it is identical to the production units.
Test start date: October 24, 2016
Test completion date: November 10, 2016
The test results in this report pertain only to the item tested.

2.2 Related Submittal(s) Grants

None.

2.3 Test Methodology

Antenna conducted measurements were performed according to the procedure DA 00-705 Released March 30, 2000 “Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.”

Both AC mains line-conducted and radiated emissions measurements were performed according to the procedures in ANSI C63.10-2013. Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the **"Data Sheet"** of this Application.

All other measurements were made in accordance with the procedures in part 2 of CFR 47.

2.4 Test Facility

The test site used to collect the radiated data is site 1 (10-m semi-anechoic chamber). This test facility and site measurement data have been fully placed on file with the FCC, IC and A2LA accredited.

2.5 Measurement Uncertainty

Compliance with the limits was based on the results of the measurements and doesn’t take into account the measurement uncertainty.

Estimated Measurement Uncertainty

Measurement	Expanded Uncertainty (k=2)		
	0.15 MHz – 1 GHz	1 GHz – 2.5 GHz	> 2.5 GHz
RF Power and Power Density – antenna conducted	-	0.7 dB	-
Unwanted emissions - antenna conducted	1.1 dB	1.3 dB	1.9 dB
Bandwidth – antenna conducted	-	30 Hz	-

Measurement	Expanded Uncertainty (k=2)		
	0.15 MHz – 30MHz	30 MHz – 1 GHz	1 GHz – 18 GHz
Radiated emissions	-	4.5	5.9 dB
AC mains conducted emissions	2.1 dB	-	-

3.0 System Test Configuration

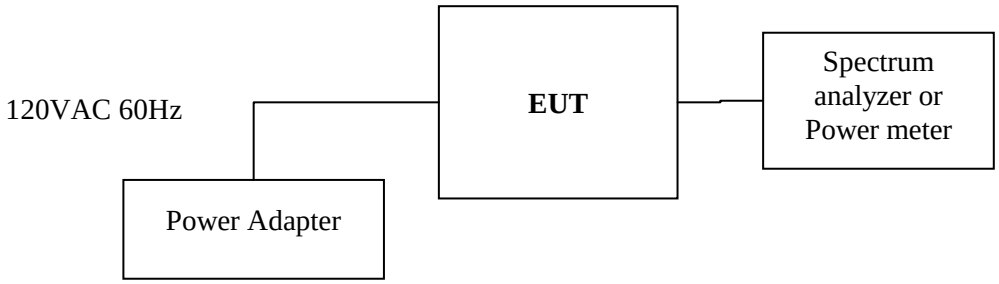
3.1 Support Equipment

Description	Manufacturer	Model No./ Part No.
Power Adapter	Pantech	PTA-5010MU1US

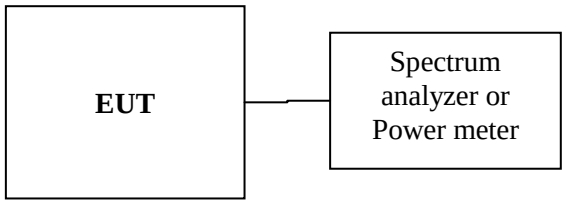
3.2 Block Diagram of Test Setup

Charging Mode:

Antenna was removed and co-axial connector with a cable was installed for Conducted Measurements.



Battery Mode:



S = Shielded **U** = Unshielded	**F** = With Ferrite **m** = Length in Meters

3.3 Justification

For radiated emission measurements the EUT is placed on a non-conductive table. The EUT is programmed to transmit full power. Both 900MHz radio and BLE radio were active to ensure there were no adverse effects when both radios were simultaneously transmitting. Radiated Emission was investigated up to 26GHz.

3.4 Mode of Operation During Test

During transmitter testing, the transmitter was setup to transmit continuously at maximum RF power on the low channel, middle channel, high channel and with hopping channels enabled.

3.5 Modifications Required for Compliance

Intertek installed no modifications during compliance testing in order to bring the product into compliance.

3.6 Additions, Deviations and Exclusions from Standards

No additions, deviations or exclusions from the standard were made.

4.0 Transmitter Emissions Measurement Results

4.1 20dB Bandwidth, and 99% Occupied Bandwidth
FCC Rule 15.247(a)(1)

4.1.1 Procedure

The Procedure described in the FCC Publication DA 00-705 Released March 30, 2000 “Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems” was used to determine the 20dB bandwidth.

- Span = Approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
- RBW = 1% of the 20 dB bandwidth
- VBW = 3 x RBW
- Sweep = Auto
- Detector function = Peak
- Trace = Max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the markerdelta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

For 99% power bandwidth measurement, the bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer.

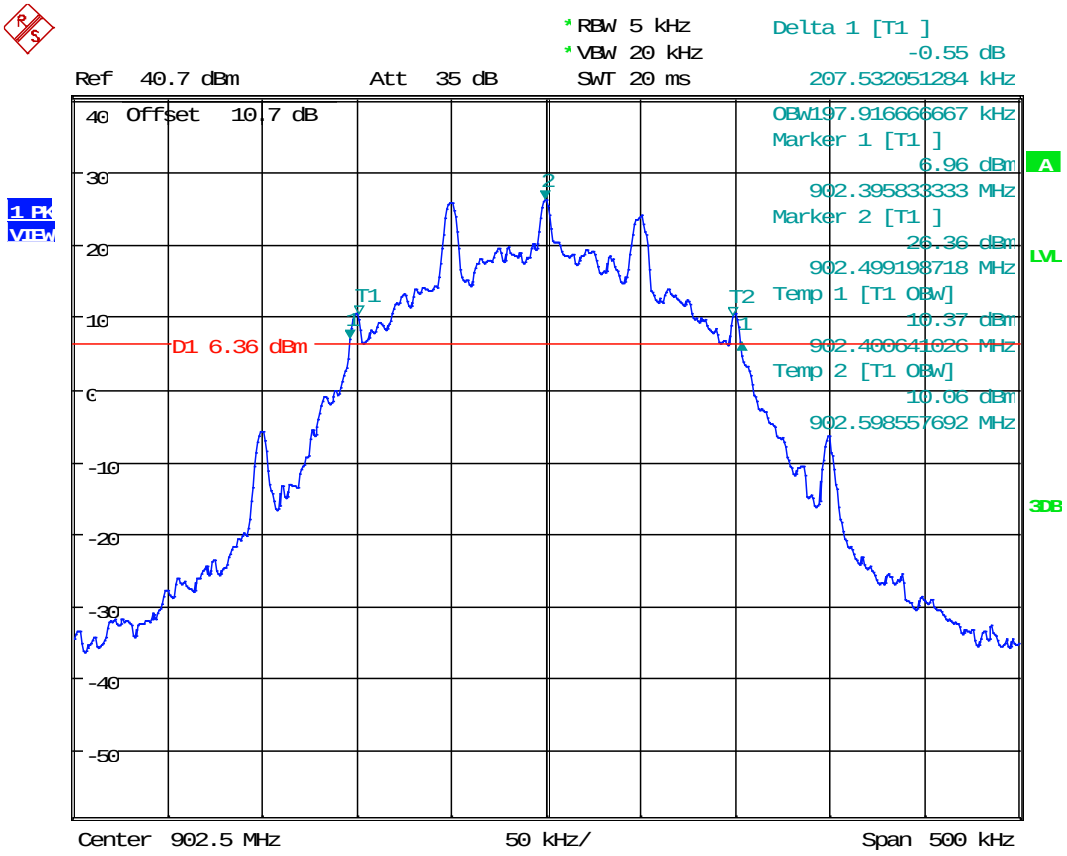
The antenna port of the EUT was connected to the input of a spectrum analyzer (SA). For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A Peak output reading was taken, a Display line was drawn for 20dB lower than Peak level. The 20dB bandwidth was determined from where the channel output spectrum intersected the display line.

Tested By:	Minh Ly
Test Date:	October 24, 2016

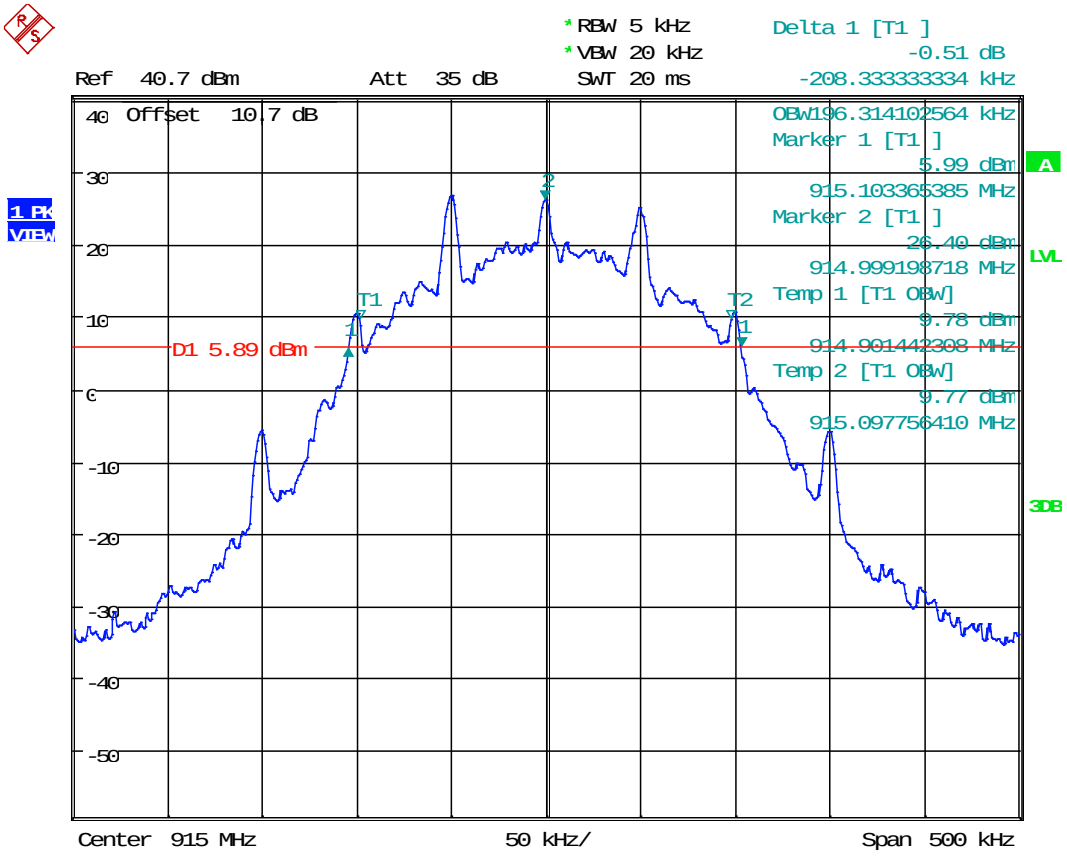
4.1.2 Test Result

Frequency (MHz)	20 dB FCC Bandwidth, MHz	99% Bandwidth, MHz	Plot
902.5	0.207	0.197	1.1
915.0	0.208	0.196	1.2
927.5	0.207	0.196	1.3

Plot 1. 1 – Low Channel

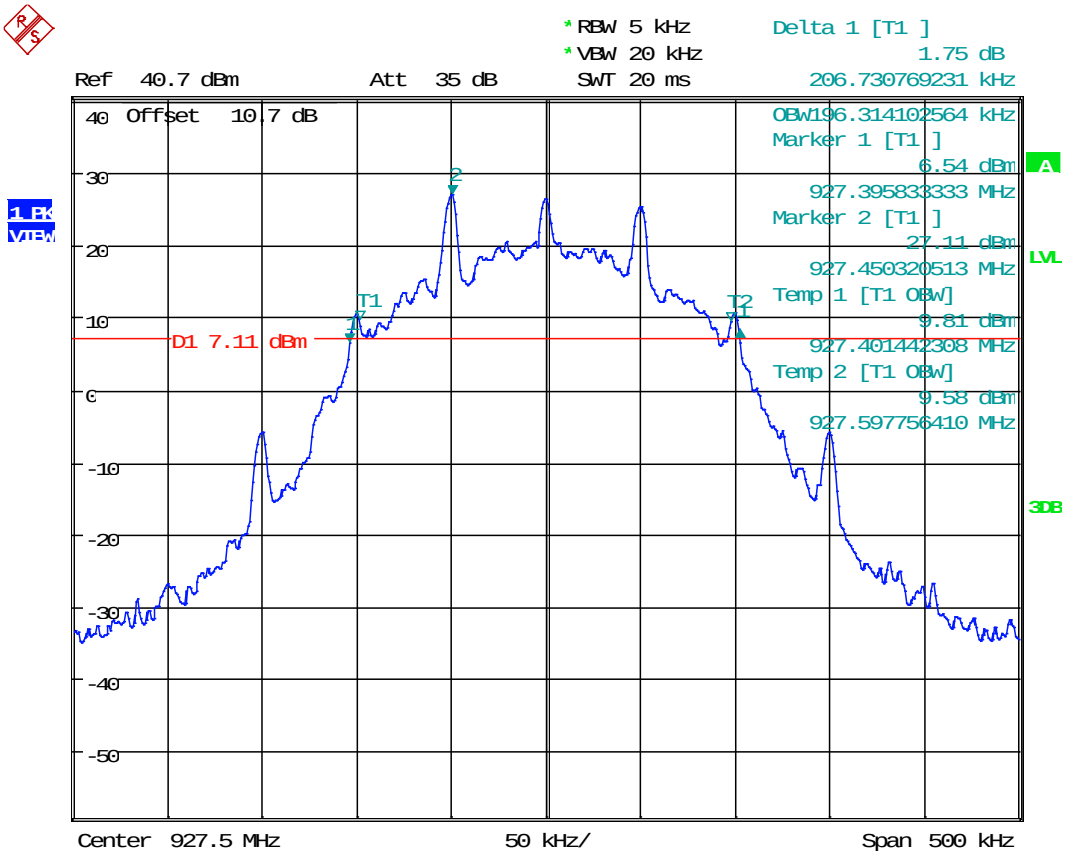


Plot 1. 2 – Middle Channel



Date: 24.OCT.2016 13:46:22

Plot 1. 3 – High Channel



Date: 24.OCT.2016 13:47:18

4.2 Conducted Output Power at Antenna Terminals
FCC Rule 15.247(b)(1)

4.2.1 Requirement

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph 15.247(a)(1)(i) of the section.

4.2.2 Procedure

The Procedure described in the FCC Publication DA 00-705 Released March 30, 2000 “Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems” was used to determine the RF Output Power.

- Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
- RBW > the 20 dB bandwidth of the emission being measured
- VBW = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power (see the NOTE above regarding external attenuation and cable loss). The limit is specified in one of the subparagraphs of this Section. Submit this plot.

The antenna port of the EUT was connected to the input of a spectrum analyzer. Power was read directly from the spectrum analyzer and cable loss correction was added to the reading to obtain the power at the antenna terminals.

Tested By:	Minh Ly
Test Date:	November 02, 2016

4.3.3 Test Result

Refer to the following plots for the test result:

Charging Mode:

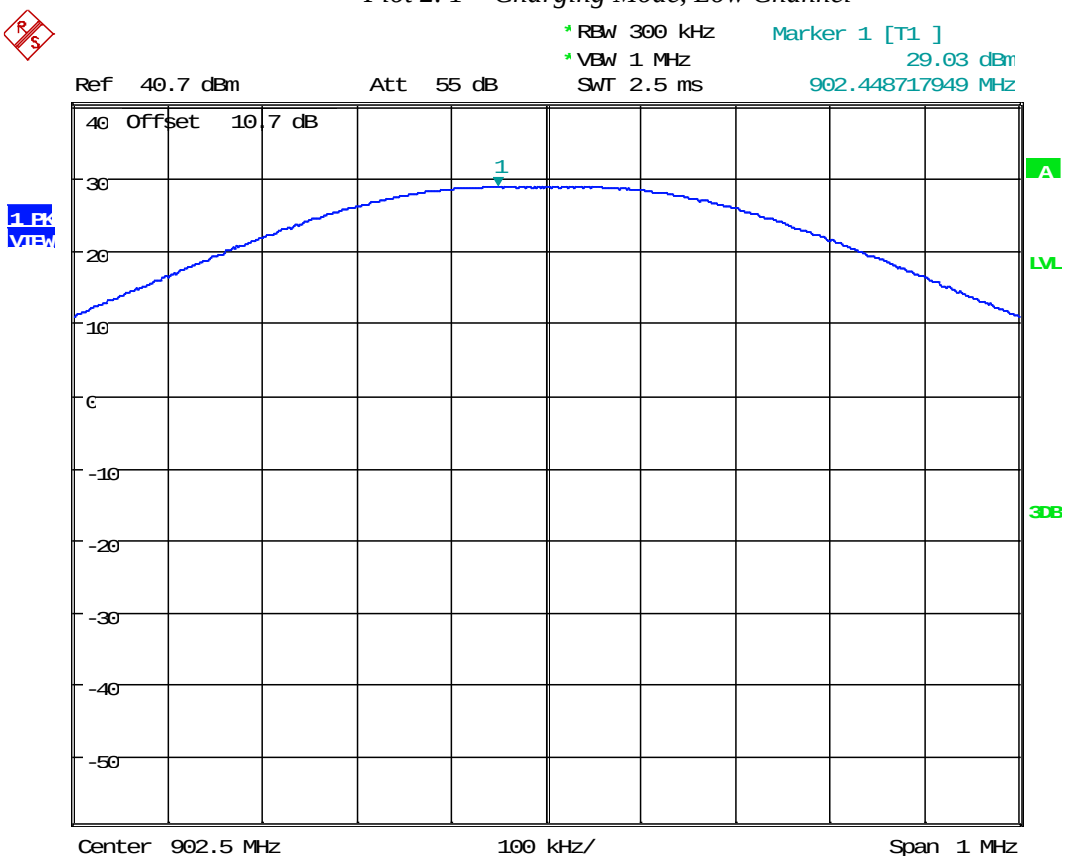
Frequency, MHz	Conducted Power (peak), dBm	Conducted Power (peak), W	Plot
902.5	29.03	0.801	2.1
915.0	29.00	0.796	2.2
927.5	29.14	0.822	2.3

Battery Mode:

Frequency, MHz	Conducted Power (peak), dBm	Conducted Power (peak), W	Plot
902.5	29.01	0.798	2.4
915.0	28.94	0.785	2.5
927.5	29.08	0.811	2.6

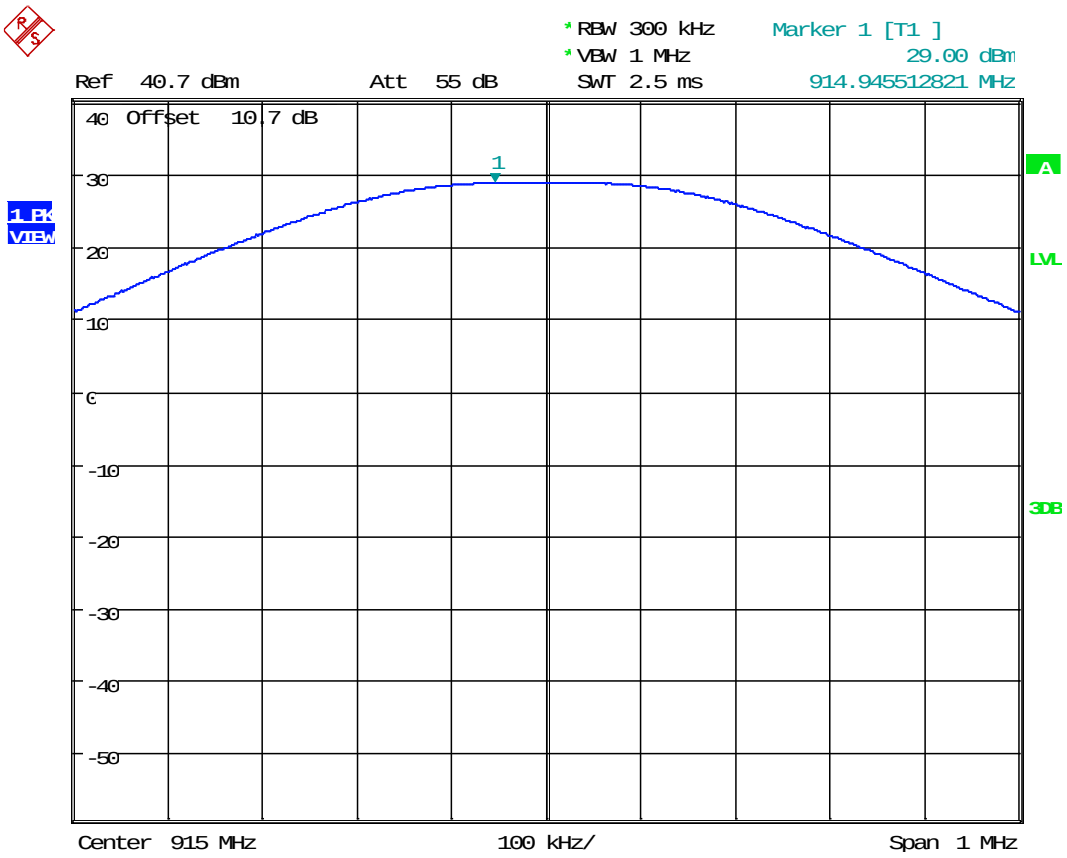
Results	Complies

Plot 2. 1 – Charging Mode, Low Channel

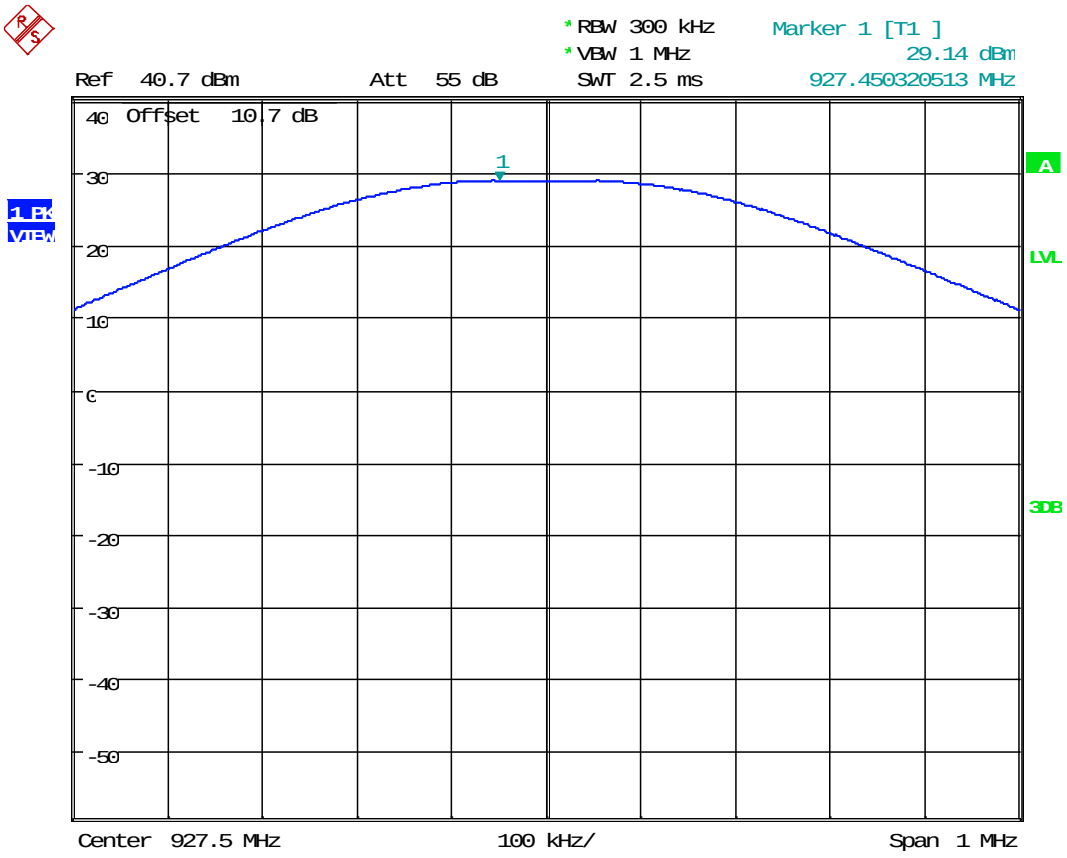


Date: 24.OCT.2016 13:52:17

Plot 2. 2 – Charging Mode, Mid Channel

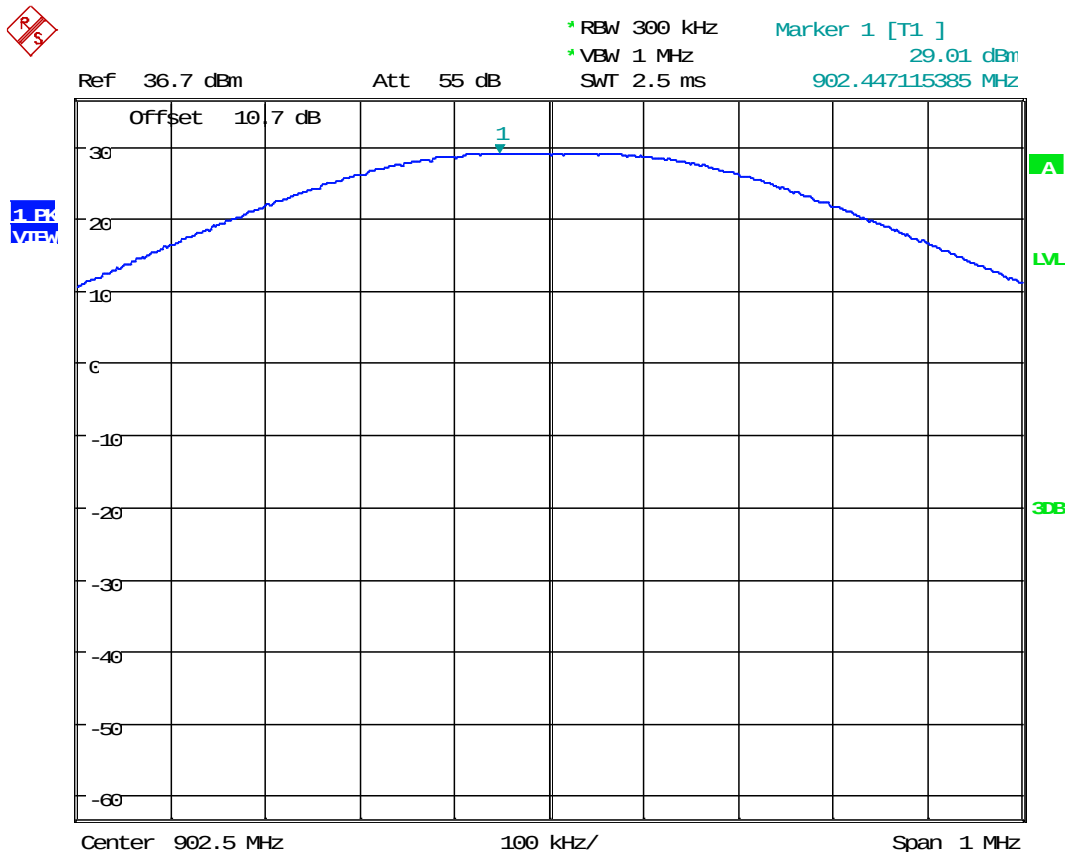


Plot 2. 3 – Charging Mode, High Channel



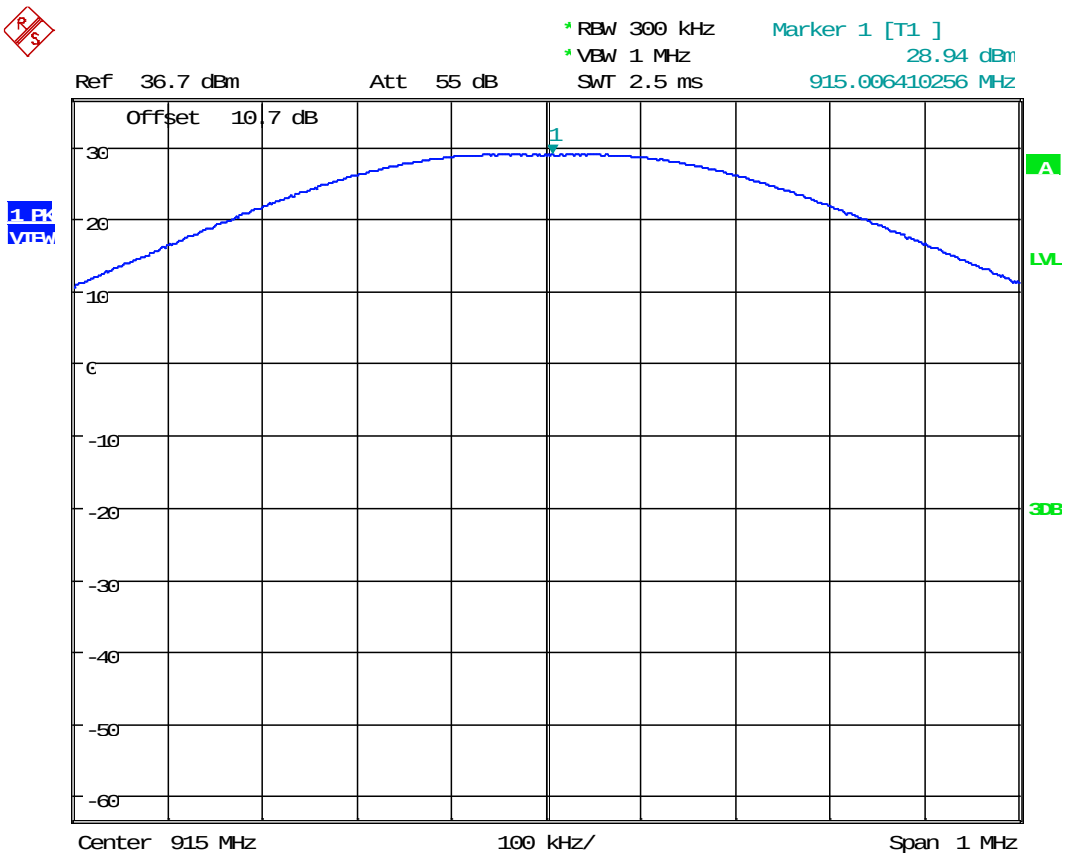
Date: 24.OCT.2016 13:49:28

Plot 2. 4 – Battery Mode, Low Channel



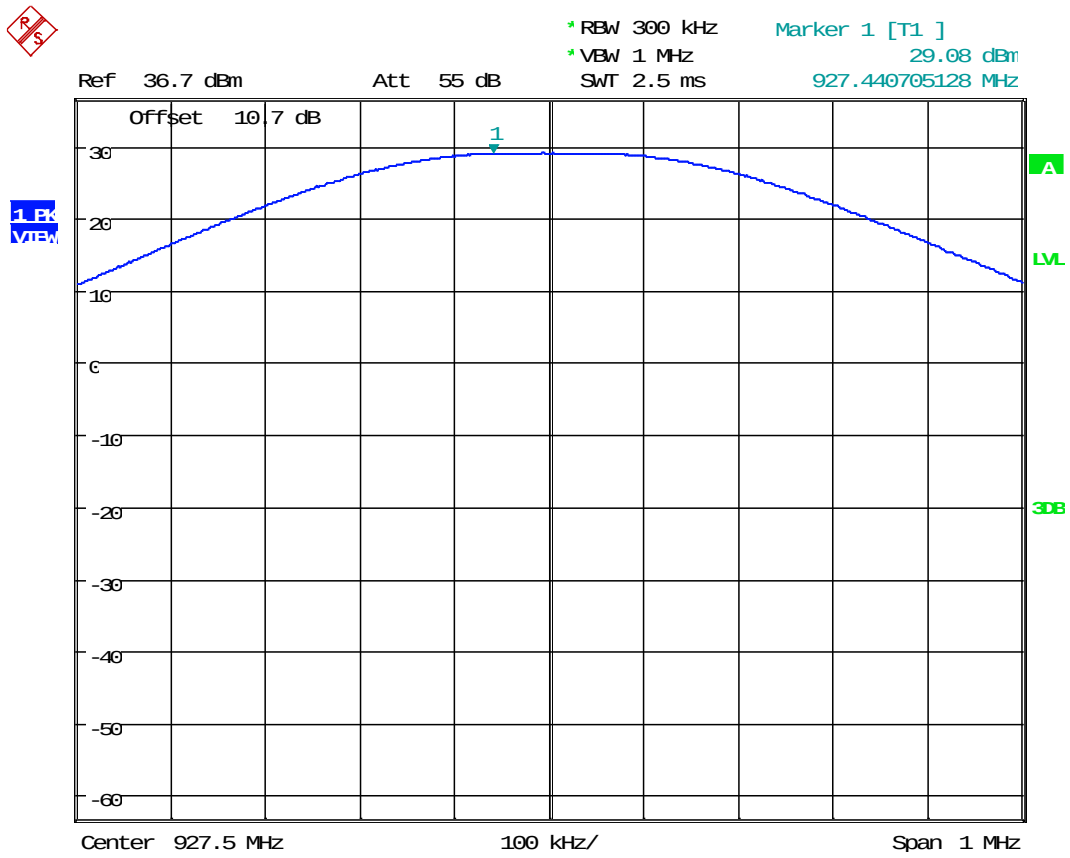
Date: 2.NOV.2016 13:26:38

Plot 2. 5 – Battery Mode, Mid Channel



Date: 2.NOV.2016 13:27:26

Plot 2. 6 – Battery Mode, High Channel



Date: 2.NOV.2016 13:27:56

4.3 Carrier Frequency Separation
FCC 15.247 (a)(1)

4.3.1 Requirement

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.

4.3.2 Procedure

The Procedure described in the FCC Publication DA 00-705 Released March 30, 2000 "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems" was used to determine the Carrier Frequency Separation.

- The EUT must have its hopping function enabled
- Span = wide enough to capture the peaks of two adjacent channels
- Resolution (or IF) Bandwidth (RBW) = 1% of the span
- Video (or Average) Bandwidth (VBW) = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

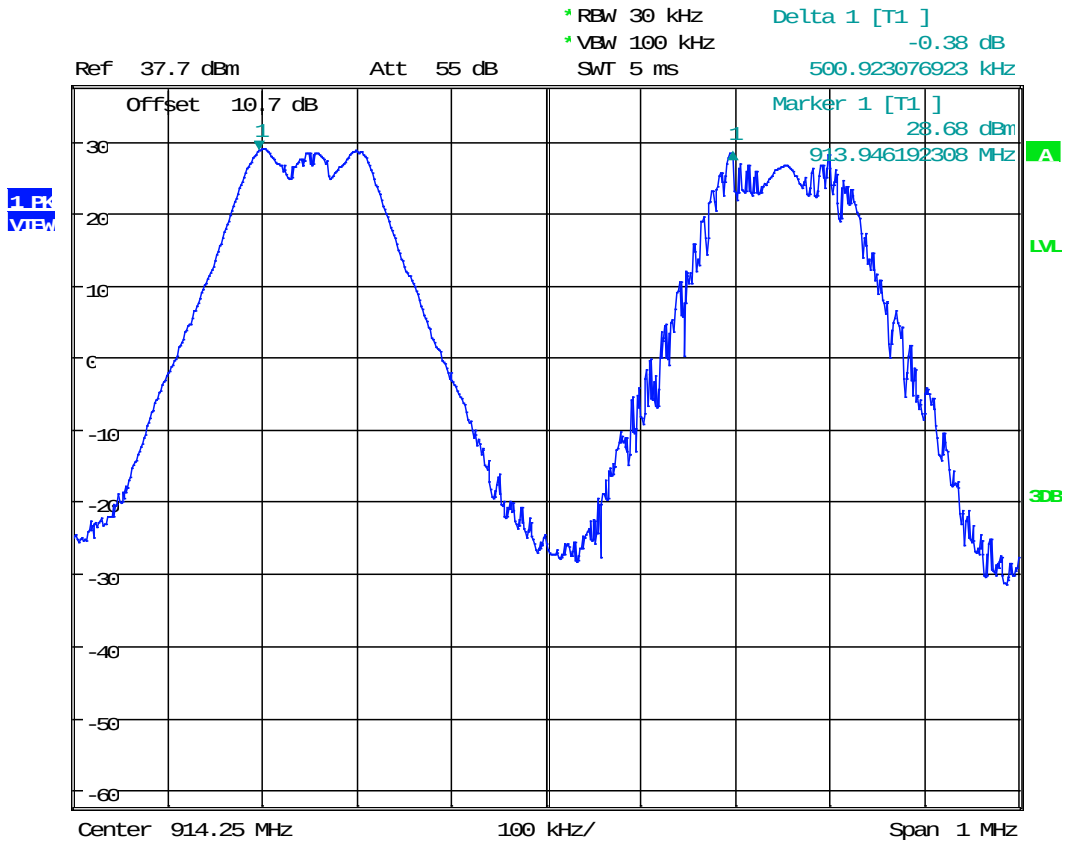
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

Tested By:	Minh Ly
Test Date:	November 10, 2016

4.3.3 Test Result

The worst case 20dB Bandwidth is 0.208 MHz, therefor this bandwidth was used as a minimum requirement for Carrier Frequency Separation.

Plot 3.1– Channel Separation



The Carrier Frequency Separation is **500 kHz**, therefore meets the minimum requirement.

Results	**Complies**

4.4 Number of Channels
FCC 15.247 (a)(1)(iii)

4.4.1 Requirement

For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.

4.4.2 Procedure

The Procedure described in the FCC Publication DA 00-705 Released March 30, 2000 "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems" was used to determine the Number of Channels.

- The EUT must have its hopping function enabled.
- Span = the frequency band of operation
- RBW = 1% of the span
- VBW = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies.

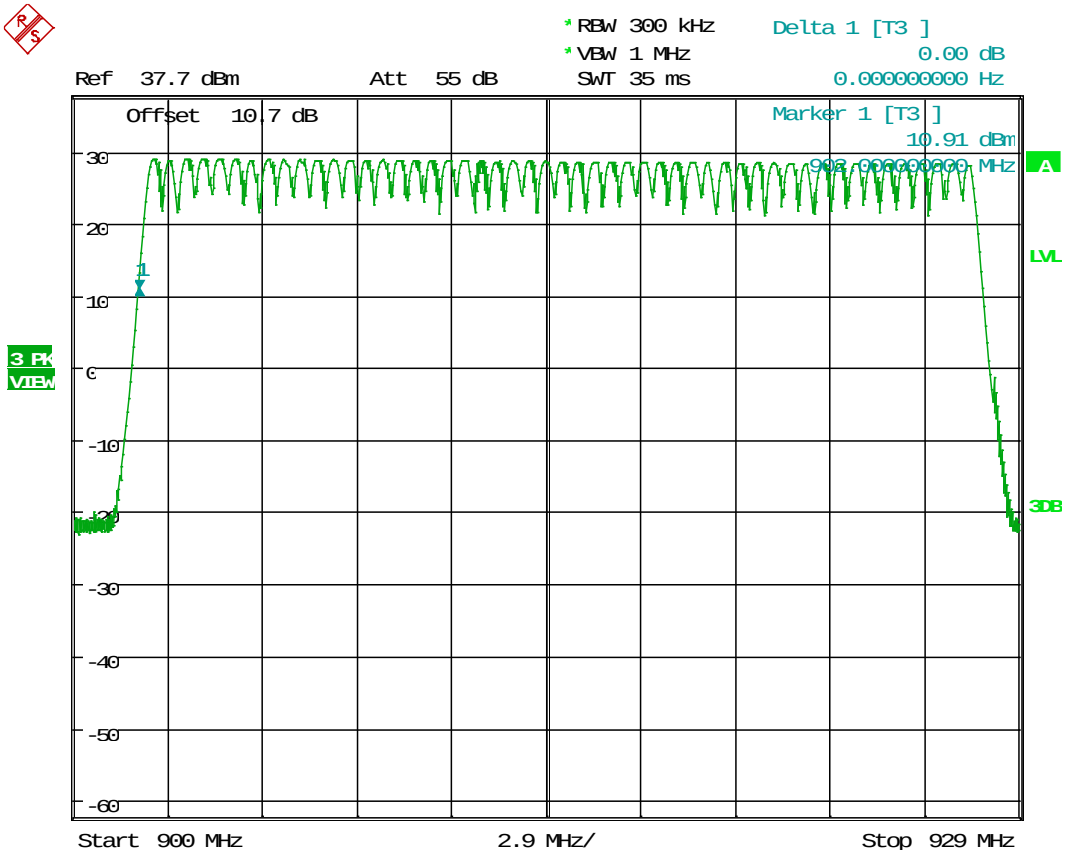
With the analyzer set to MAX HOLD, readings were taken once channels were filled in. The channel peaks were recorded and compared to the minimum number of channels required in the regulation.

Tested By:	Minh Ly
Test Date:	November 02, 2016

4.4.3 Test Result

Results	51 Channels -Complies

Plot 4.1 – Number of Channels



4.5 Average Channel Occupancy Time
FCC 15.247(a)(1)

4.5.1 Requirement

For systems operating in the 902-928 MHz band, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

4.5.2 Procedure

The Procedure described in the FCC Publication DA 00-705 Released March 30, 2000 “Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems” was used to determine the Average Channel Occupancy Time.

- The EUT must have its hopping function enabled.
- Span = zero span, centered on a hopping channel
- RBW = 1 MHz
- VBW = 3 x RBW
- Sweep = as necessary to capture the entire dwell time per hopping channel
- Detector function = peak
- Trace = max hold

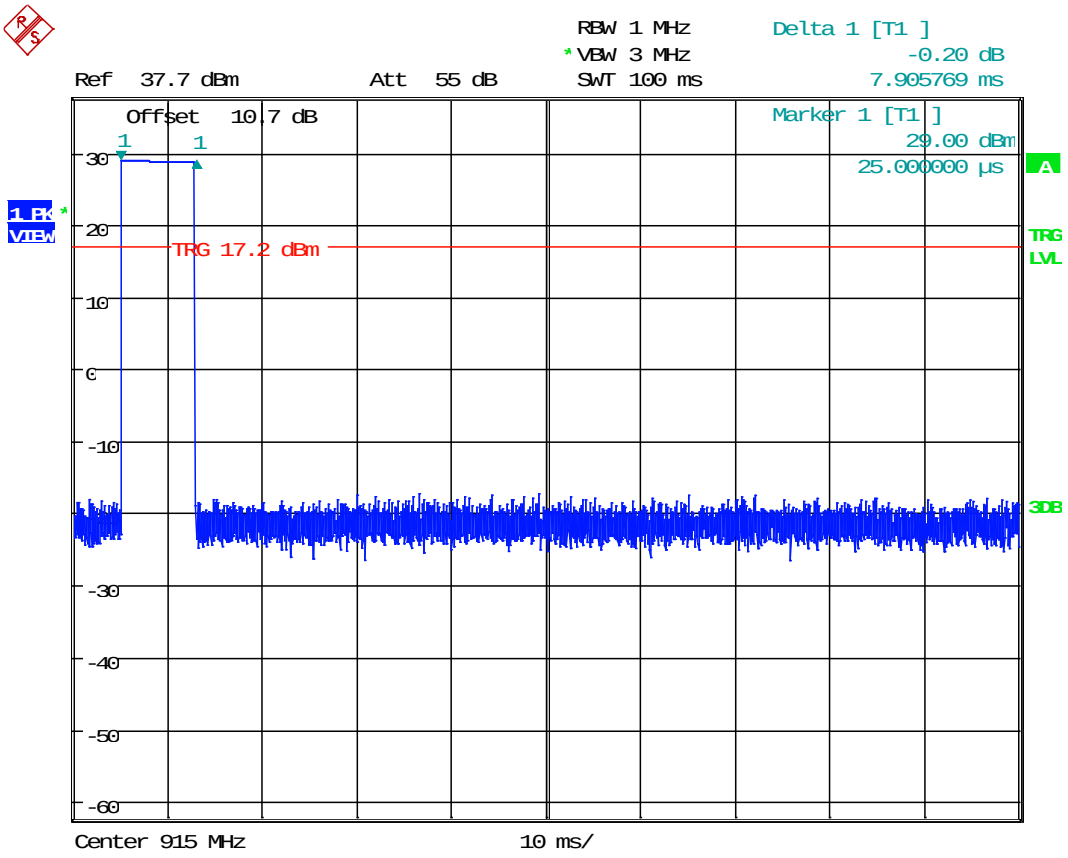
If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. An oscilloscope may be used instead of a spectrum analyzer.

The spectrum analyzer center frequency was set to one of the known hopping channels, the SPAN was set to ZERO SPANS, and the TRIGGER was set to VIDEO. The time duration of the transmission so captured was measured with the MARKER DELTA function.

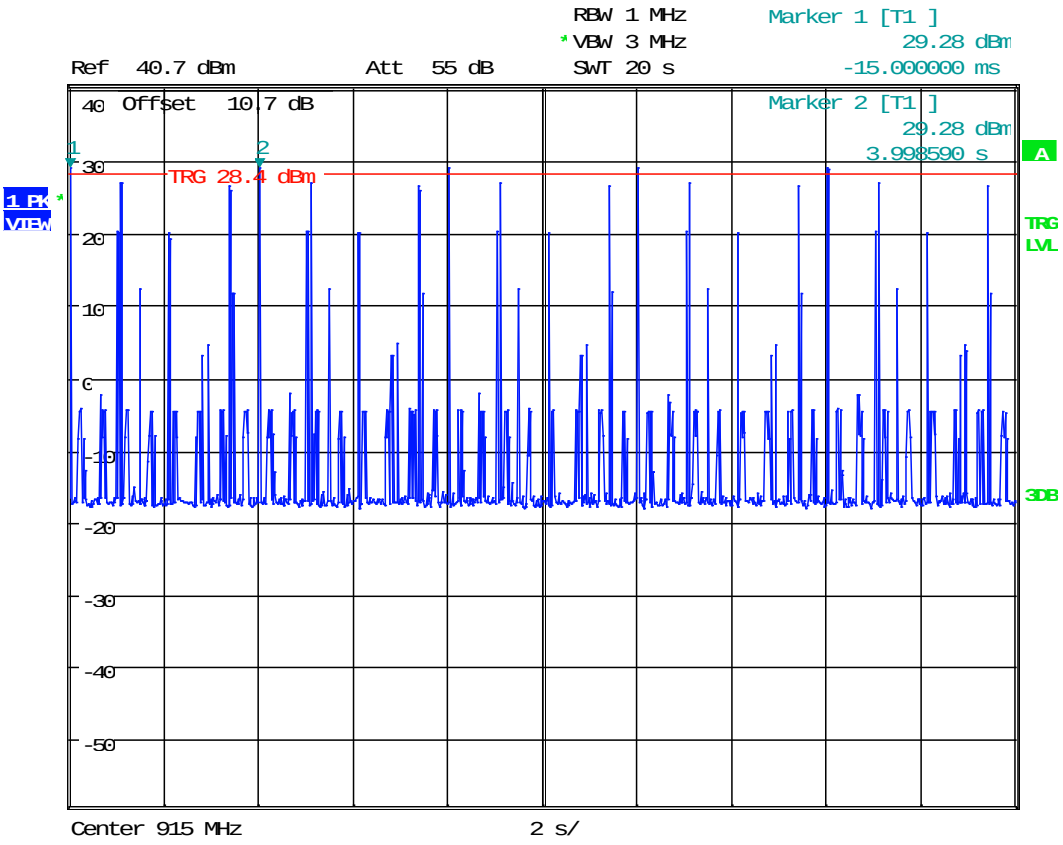
Tested By:	Minh Ly
Test Date:	November 07 – November 10, 2016

4.5.3 Test Results

No. of Burst in 20s	Burst On Time (ms)	Dwell Time (ms)	Dwell Time limit (ms)
6	7.91	47.46	400



Date: 2.NOV.2016 09:34:56



Date: 10.NOV.2016 10:33:37

Results	Complies

4.6 Out-of-Band Conducted Emissions
FCC 15.247(d)

4.6.1 Requirement

In any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

4.6.2 Procedure

The Procedure described in the FCC Publication DA 00-705 Released March 30, 2000 “Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems” was used to determine the Out-of-Band Conducted Emissions.

- Span = wide enough to capture the peak level of the in-band emission and all spurious
- emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the
- 10th harmonic. Typically, several plots are required to cover this entire span.
- RBW = 100 kHz
- VBW = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this Section.

A spectrum analyzer was connected to the antenna port of the transmitter. Analyzer Resolution Bandwidth was set to 100 kHz. For each channel investigated, the in-band and out-of-band emission measurements were performed. The out-of-band emissions were measured from 30 MHz to 10 GHz.

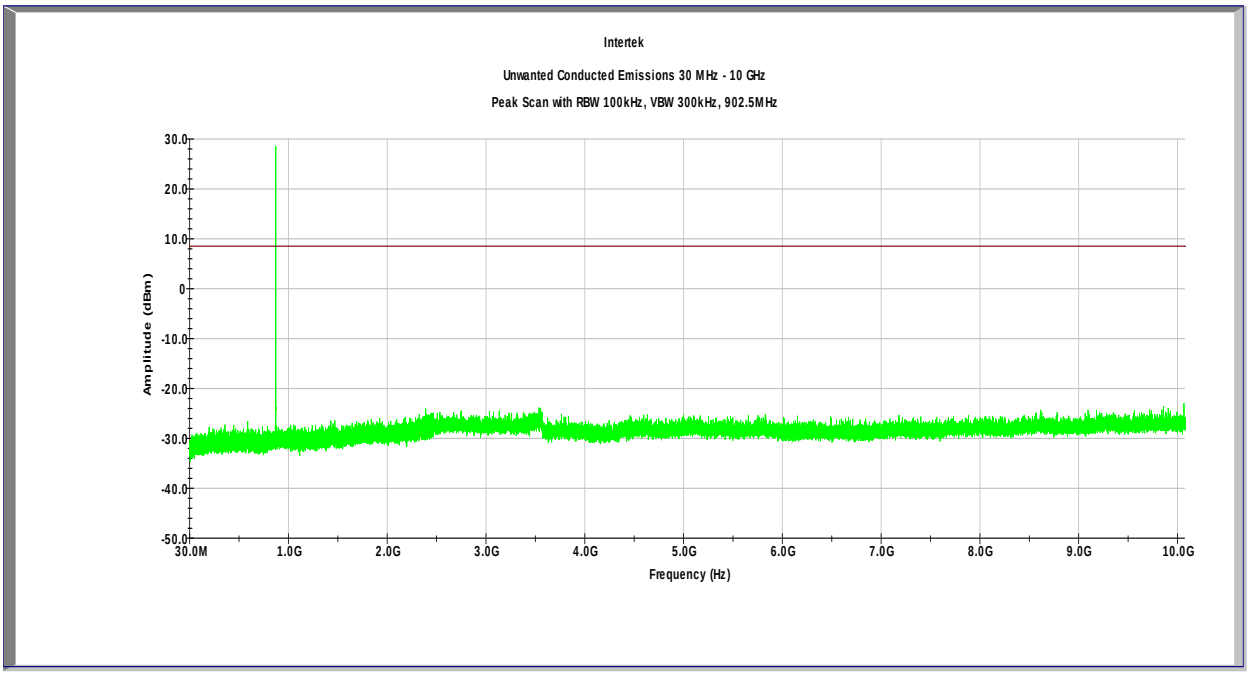
Tested By:	Minh Ly
Test Date:	October 24, 2016

4.6.3 Test Result

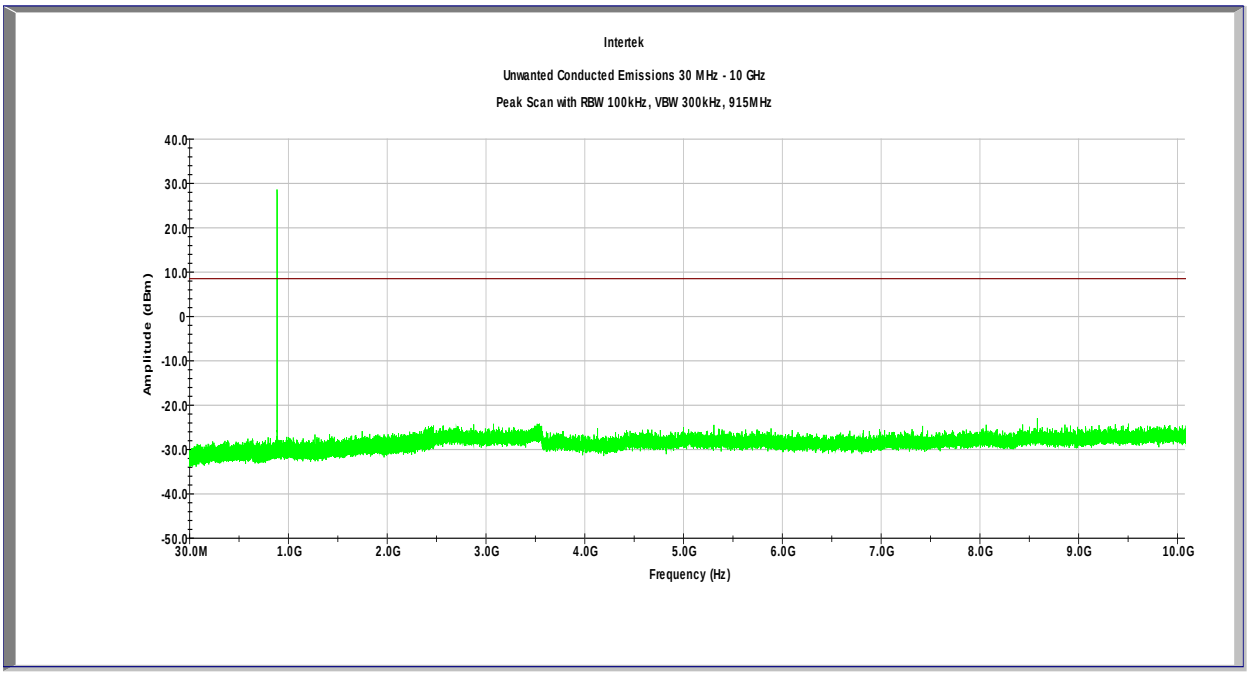
Refer to the following plots and out-of-band conducted spurious emissions at the Band-Edge for the test result.

Results	Complies

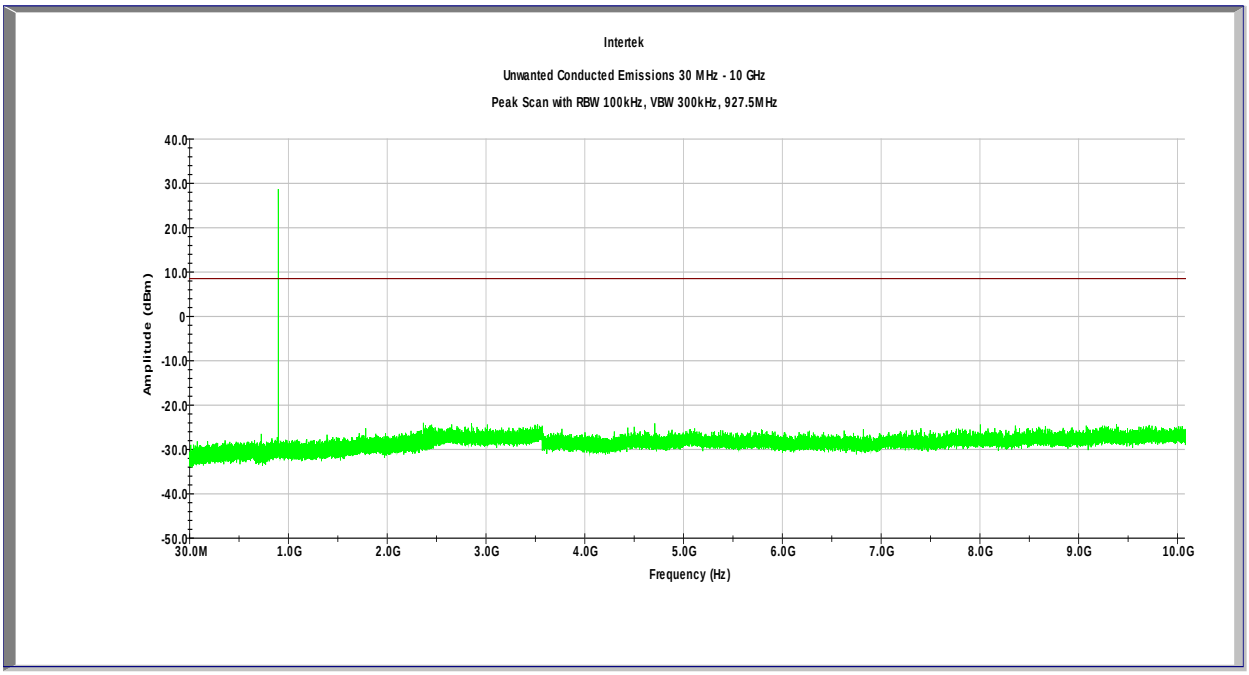
Plot 4.1
Transmitter Spurious, Low Channel



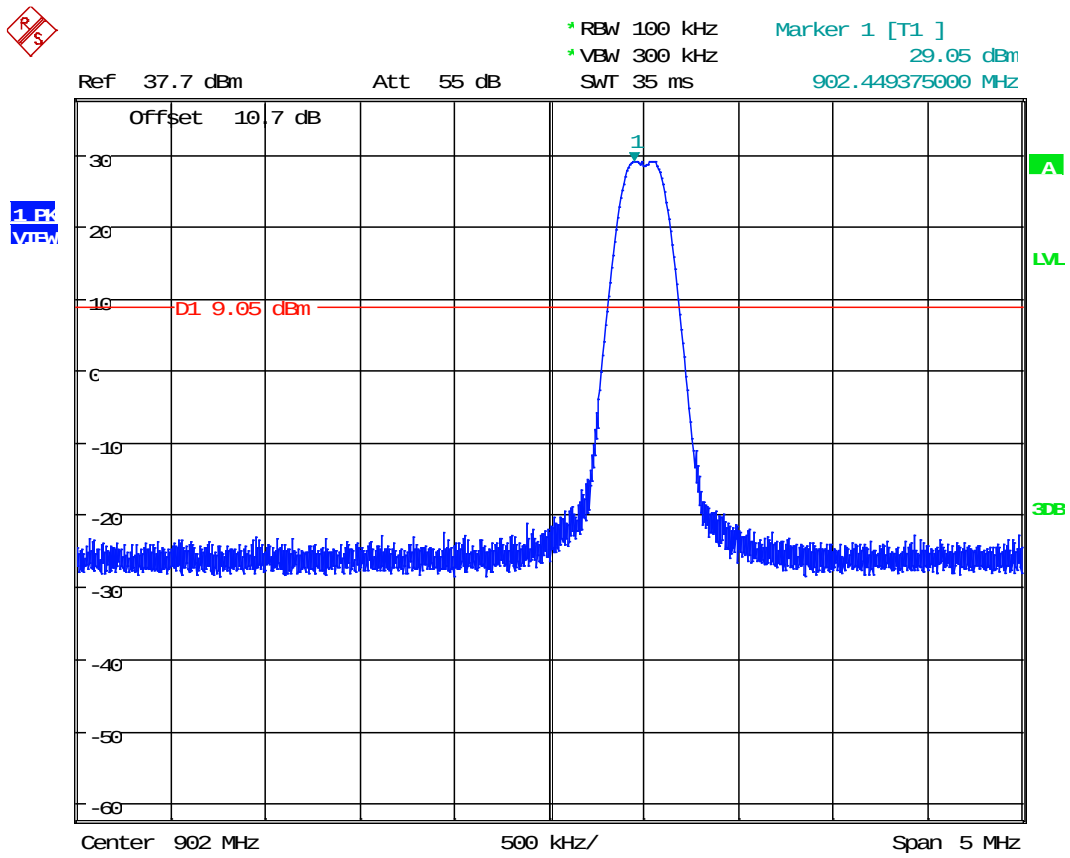
Plot 4.2
Transmitter Spurious, Middle Channel



Plot 4.3
Transmitter Spurious, High Channel

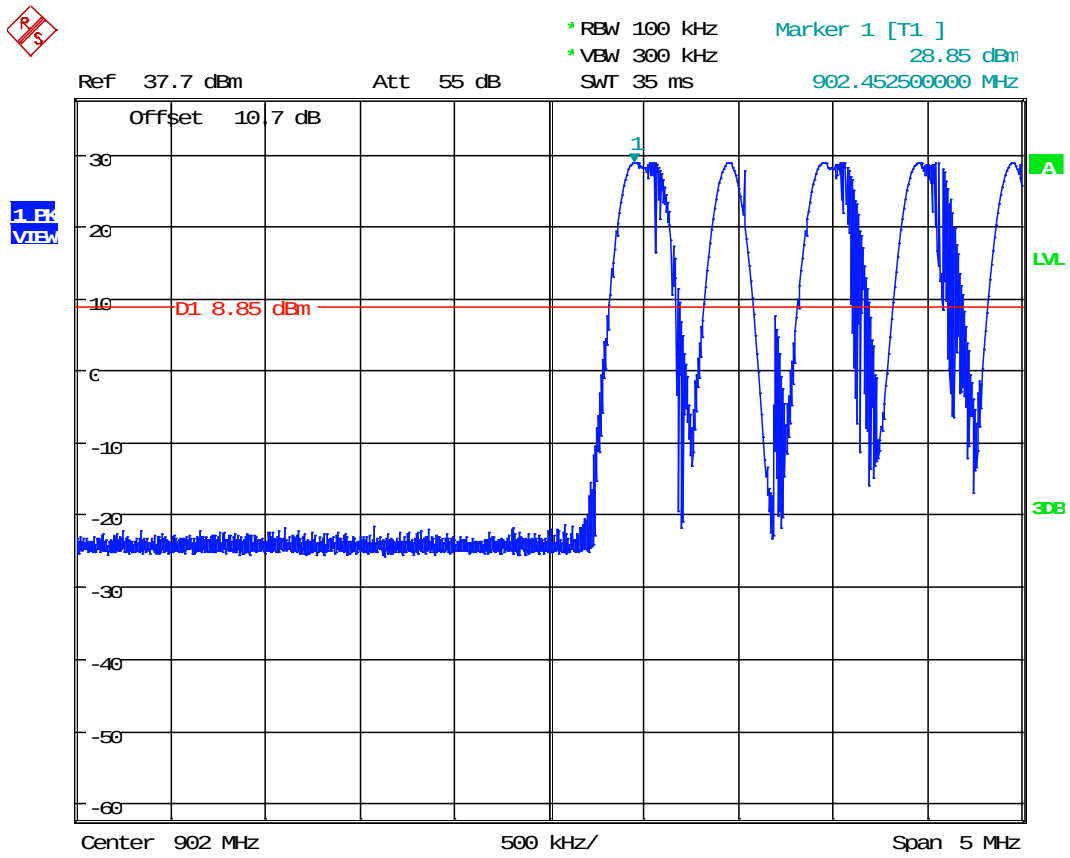


Plot 4.4
Conducted Band Edge, Low Channel



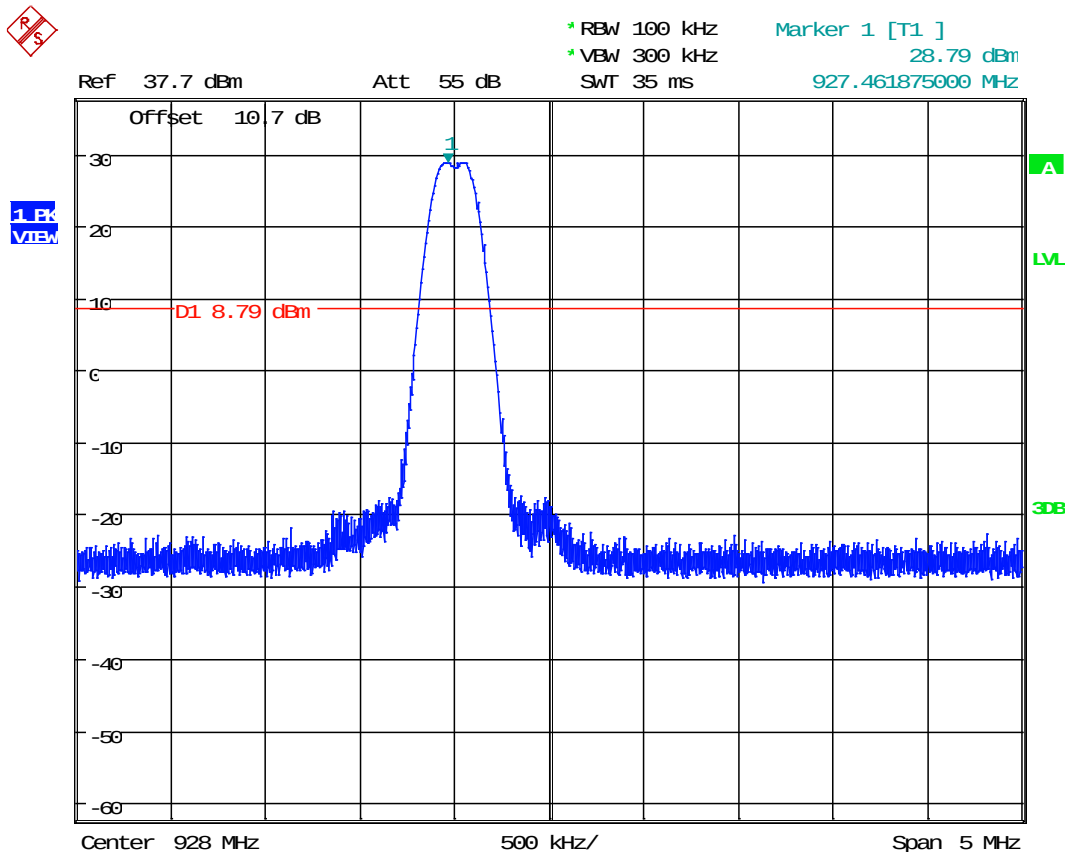
Date: 2.NOV.2016 11:05:11

Plot 4.5
Conducted Band Edge (Hopping)



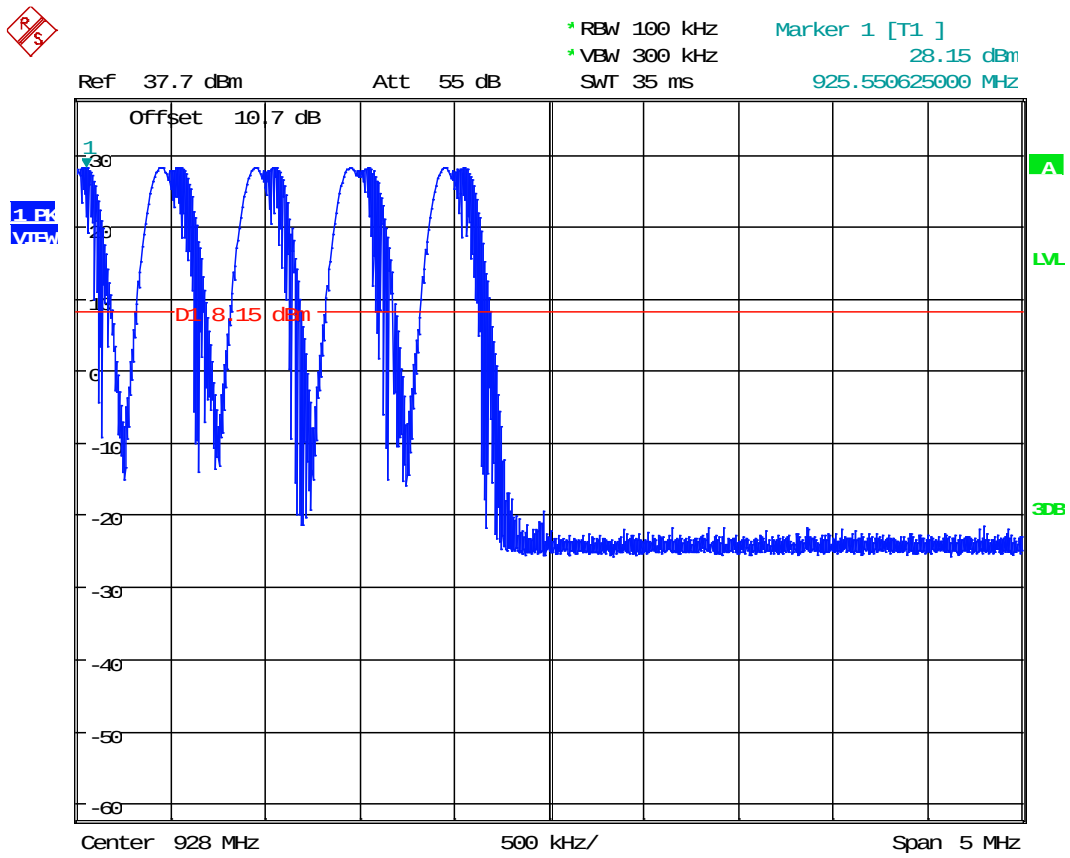
Date: 2.NOV.2016 10:54:03

Plot 4.6
Conducted Band Edge, High Channel



Date: 2.NOV.2016 11:05:53

Plot 4.7
Conducted Band Edge (Hopping)



Date: 2.NOV.2016 11:02:49

4.7 Transmitter Radiated Emissions
FCC Rule 15.247(d), 15.209, 15.205

4.7.1 Requirement

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

For out of band radiated emissions (except for frequencies in restricted bands), in any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

4.7.2 Procedure

Radiated emission measurements were performed from 30 MHz to 26,000 MHz. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz for frequencies above 1000 MHz.

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

A preamp and a 902-928MHz notch filter were used during the scans.

Data is included of the worst-case configuration (the configuration which resulted in the highest emission levels).

EUT was tested with Internal Antenna, 1.0 dBi peak gain

4.7.3 Field Strength Calculation

Field Strength 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; if measurement is performed at a distance other than specified in the rule, a Distance Correction Factor (DCF) shall be added.

Where FS = Field Strength in dB(μV/m)
RA = Receiver Amplitude (including preamplifier) in dB(μV); AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB; AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dB(μV) is obtained. The antennas factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of 32 dB(μV/m). This value in dB(μV/m) was converted to its corresponding level in μV/m.
RA = 52.0 dB(μV)
AF = 7.4 dB(1/m)
CF = 1.6 dB
AG = 29.0 dB
FS = 52.0+7.4+1.6-29.0 = 32 dB(μV/m).
Level in μV/m = Common Antilogarithm [(32 dBμV/m)/20] = 39.8 μV/m.

4.7.4 Test Results

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

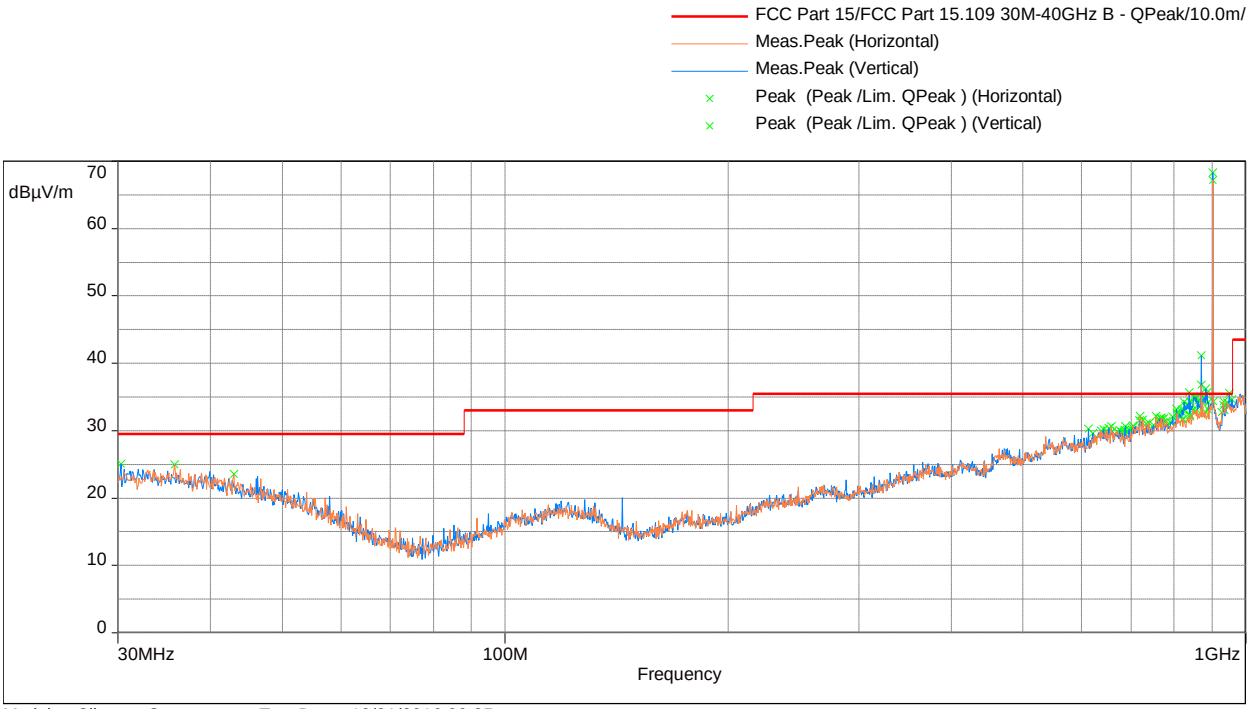
Radiated emission measurements were performed up to 26GHz. No other emissions were detected above the noise floor which is at least 10 dB below the limit.

Tested By:	Minh Ly
Test Date:	October 25 to November 01, 2016

4.7.4 **Test Results:**

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 902.5MHz

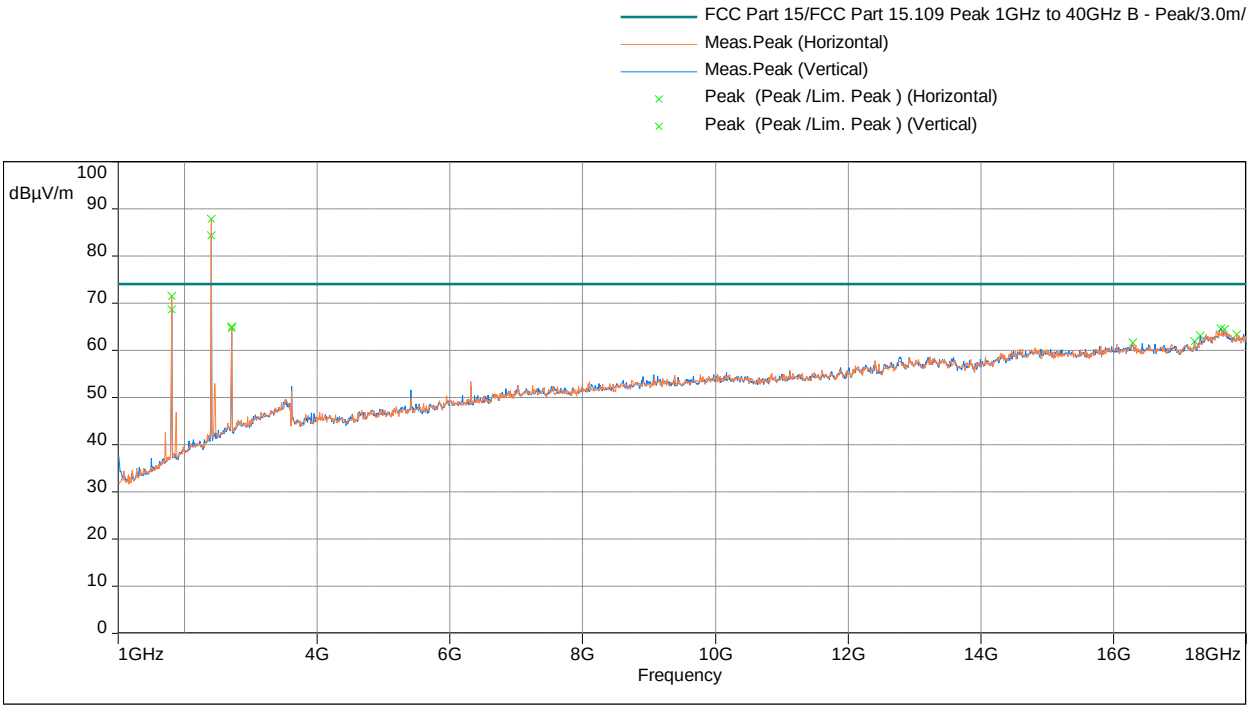
Radiated Spurious Emissions 30 MHz - 1000 MHz, Charging Mode



Model: ; Client: ; Comments: ; Test Date: 10/31/2016 09:25

Note: 870.6MHz, 882.7MHz, 887.0MHz, 949MHz are not in restricted band (FCC 15.205) and complied with 20dBc requirement. Therefore, they are compliant.

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan, Charging Mode

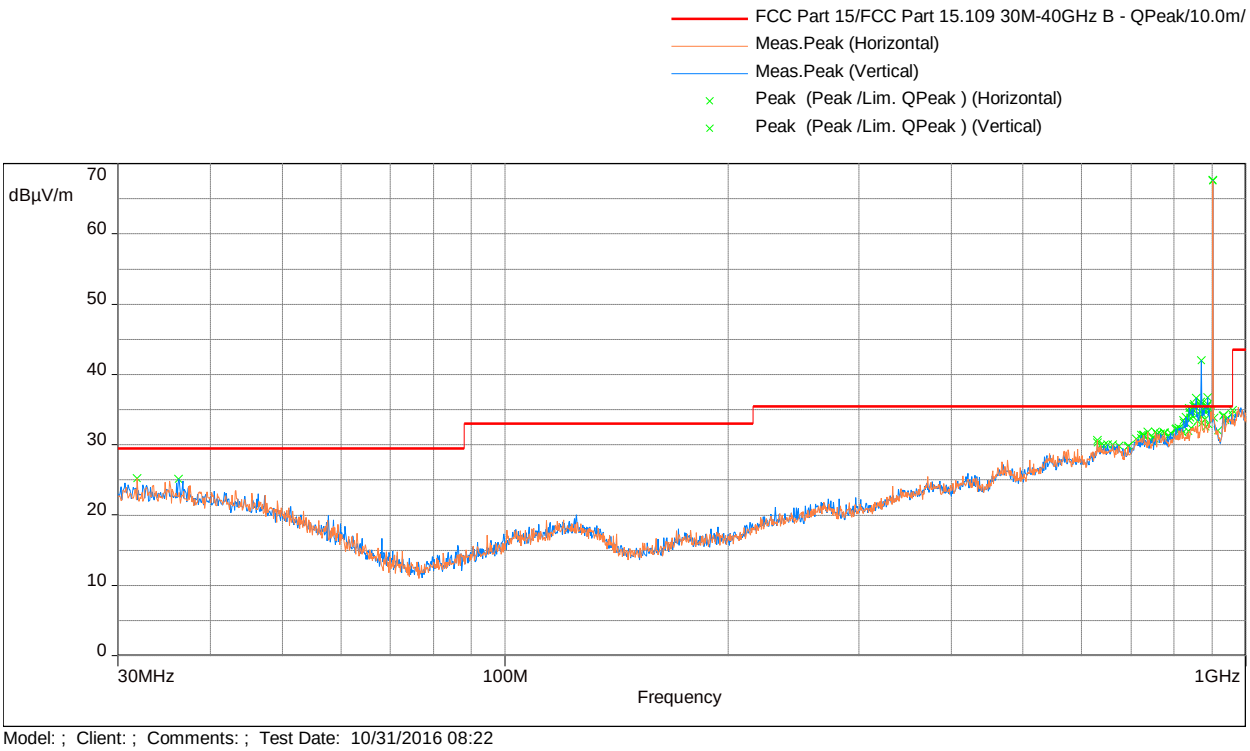


Model: ; Client: ; Comments: ; Test Date: 10/27/2016 12:20

Frequency (MHz)	Peak (dBµV/m)	Lim. Peak (dBµV/m)	Margin (dB)	Height (m)	Angle (°)	Comment	Correction (dB)
1804.1	71.46	74	-2.54	1.98	247.25	Horizontal polarization	-2.63
2706.8	64.99	74	-9.01	1.98	359.75	Horizontal polarization	1.05

Note:
- The highest level, showed on this Graph is the 2402MHz fundamental signal from the BLE radio which must be ignored for this test.
- The peaks showed are compliant with 15.209 Average limit (54dBuV/m) by applying Duty Cycle Correction Factor of 20dB (See Annex A for Duty Cycle calculation).
- Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz

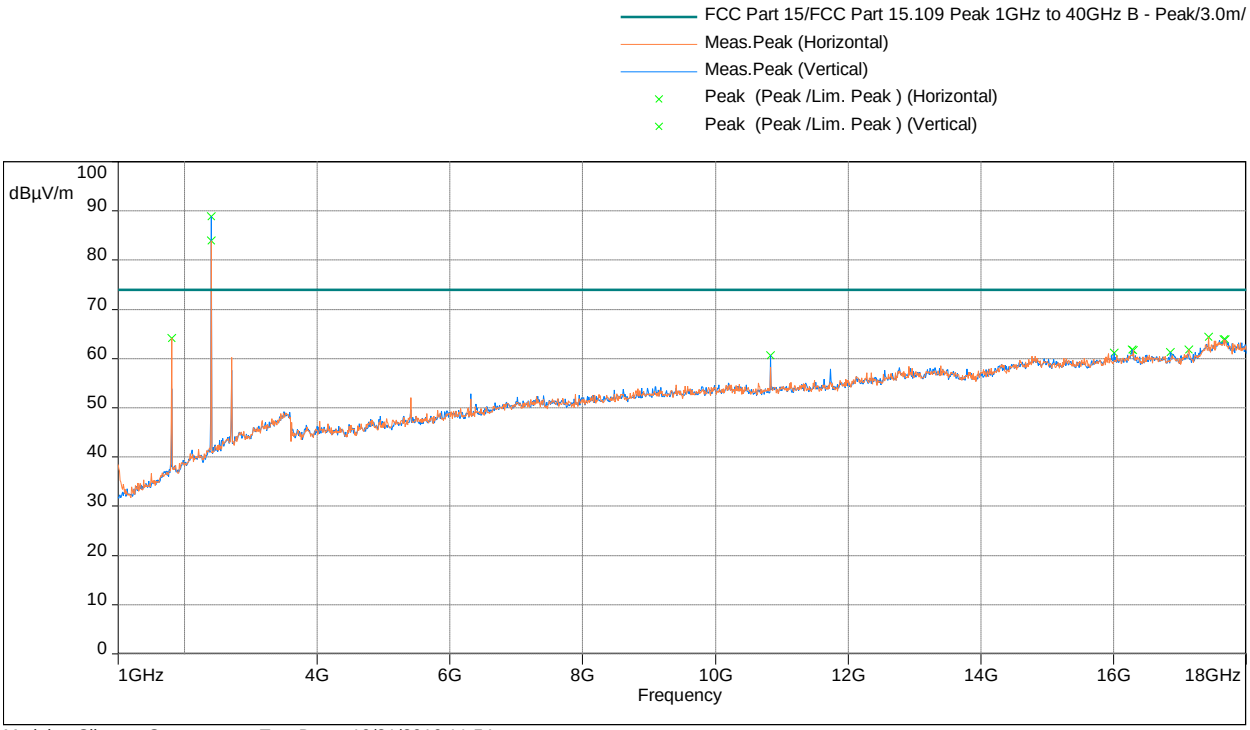
Radiated Spurious Emissions 30 MHz - 1000 MHz, Battery Mode



Model: ; Client: ; Comments: ; Test Date: 10/31/2016 08:22

Note: 866.5MHz, 868.2MHz, 870.6MHz, 884.7MHz, 887.9MHz are not in restricted band (FCC 15.205) and complied with 20dBc requirement. Therefore, they are compliant.

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan, Battery Mode

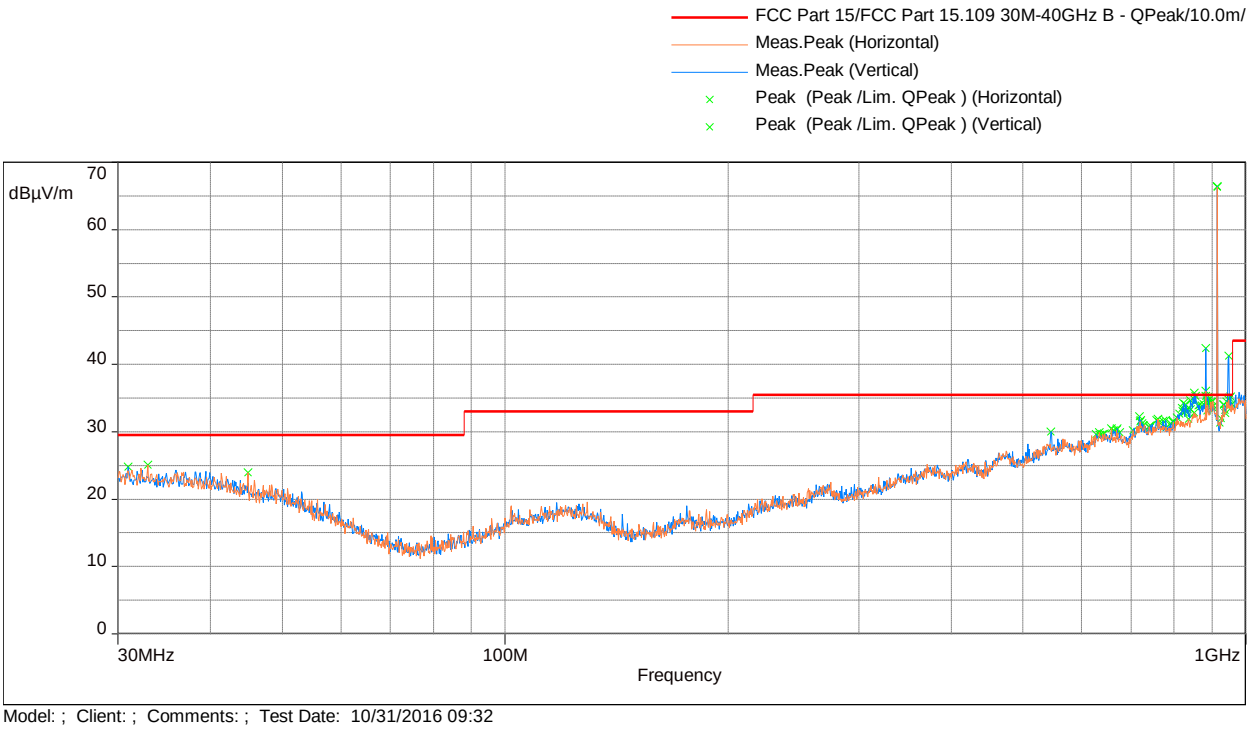


Model: ; Client: ; Comments: ; Test Date: 10/31/2016 11:54

Note:
- The highest level, showed on the Graph, is the 2402MHz fundamental signal from the BLE radio which must be ignored for this test.
- The peaks showed are compliant with 15.209 Average limit (54dBuV/m) by applying Duty Cycle Correction Factor of 20dB (See Annex A for Duty Cycle calculation).
- Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 915.0MHz

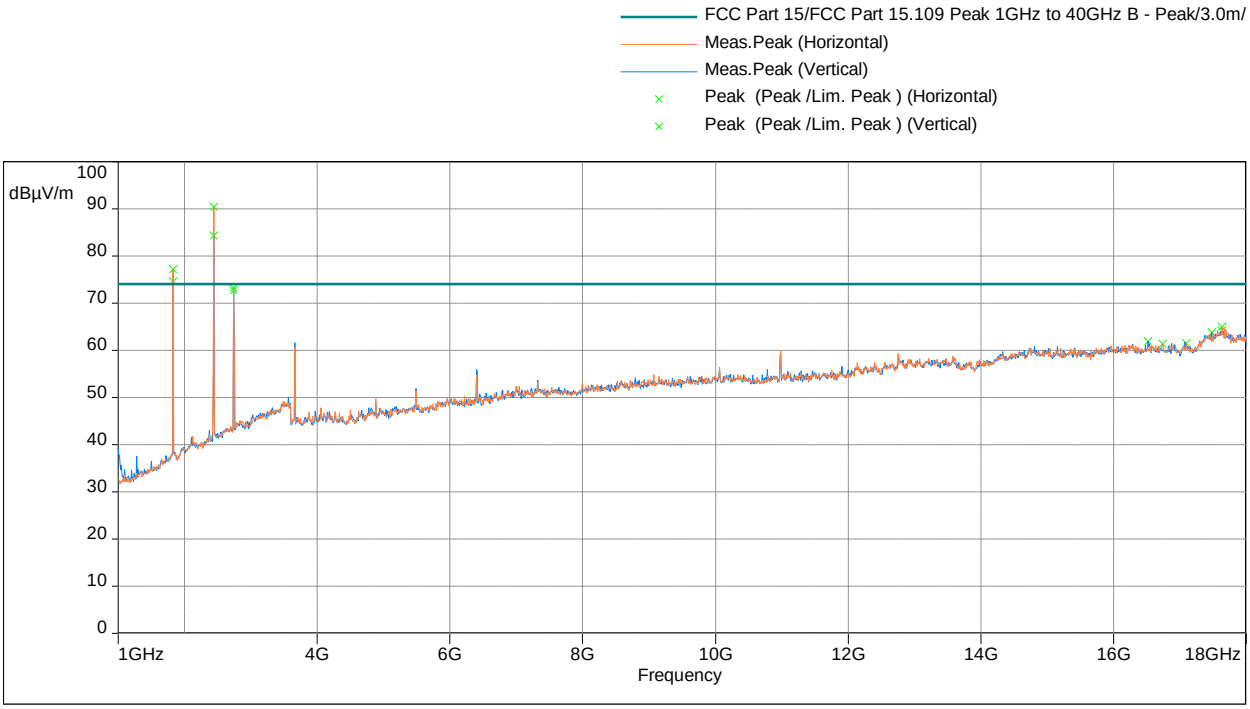
Radiated Spurious Emissions 30 MHz - 1000 MHz, Charging Mode



Model: ; Client: ; Comments: ; Test Date: 10/31/2016 09:32

Note: 851MHz, 883.1MHz, 947MHz are not in restricted band (FCC 15.205) and complied with 20dBc requirement. Therefore, they are compliant.

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan, Charging Mode

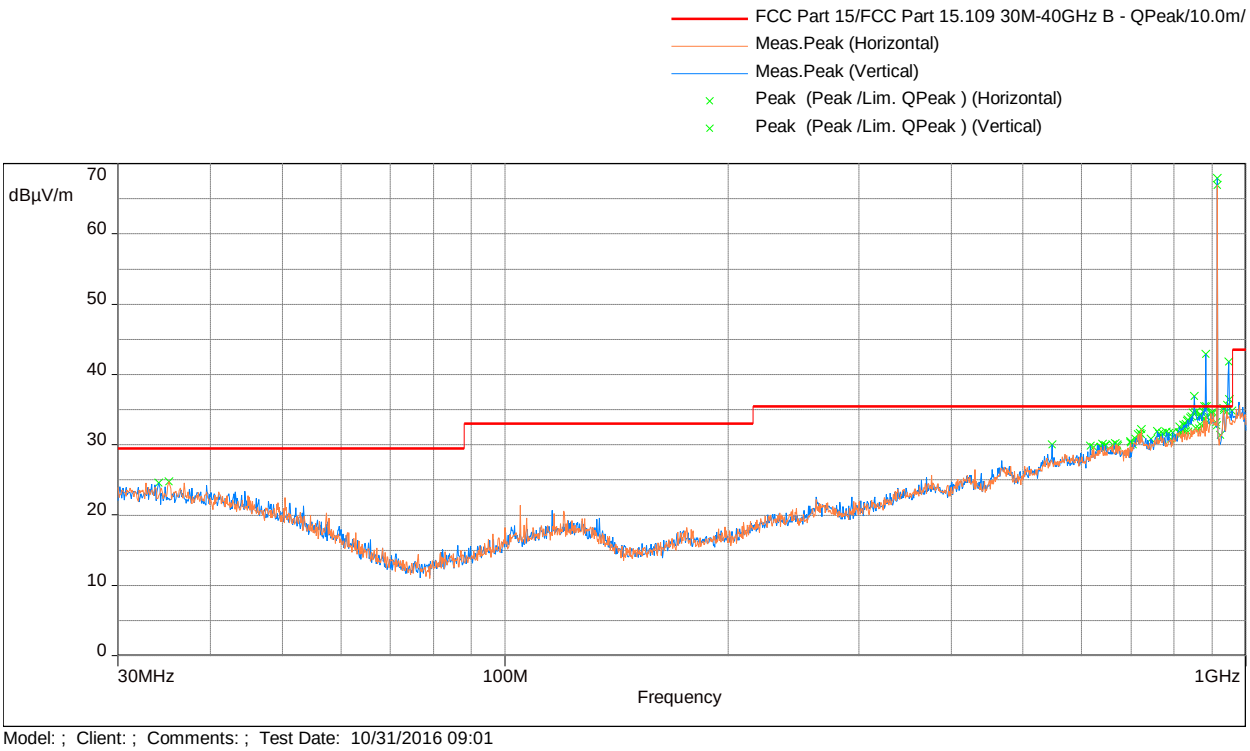


Model: ; Client: ; Comments: ; Test Date: 10/27/2016 16:38

Frequency (MHz)	Peak (dBµV/m)	Lim. Peak (dBµV/m)	Margin (dB)	Height (m)	Angle (°)	Comment	Correction (dB)
2744.2	73.24	74	-0.76	1.98	340	Horizontal polarization	1.08

Note:
- The highest level, showed on the Graph, is the 2440MHz fundamental signal from the BLE radio which must be ignored for this test.
- 1829.6MHz is not in restricted band (FCC 15.205) and complied with 20dBc requirement.
- The peaks showed are compliant with 15.209 Average limit (54dBuV/m) by applying Duty Cycle Correction Factor of 20dB (See Annex A for Duty Cycle calculation).
- Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz

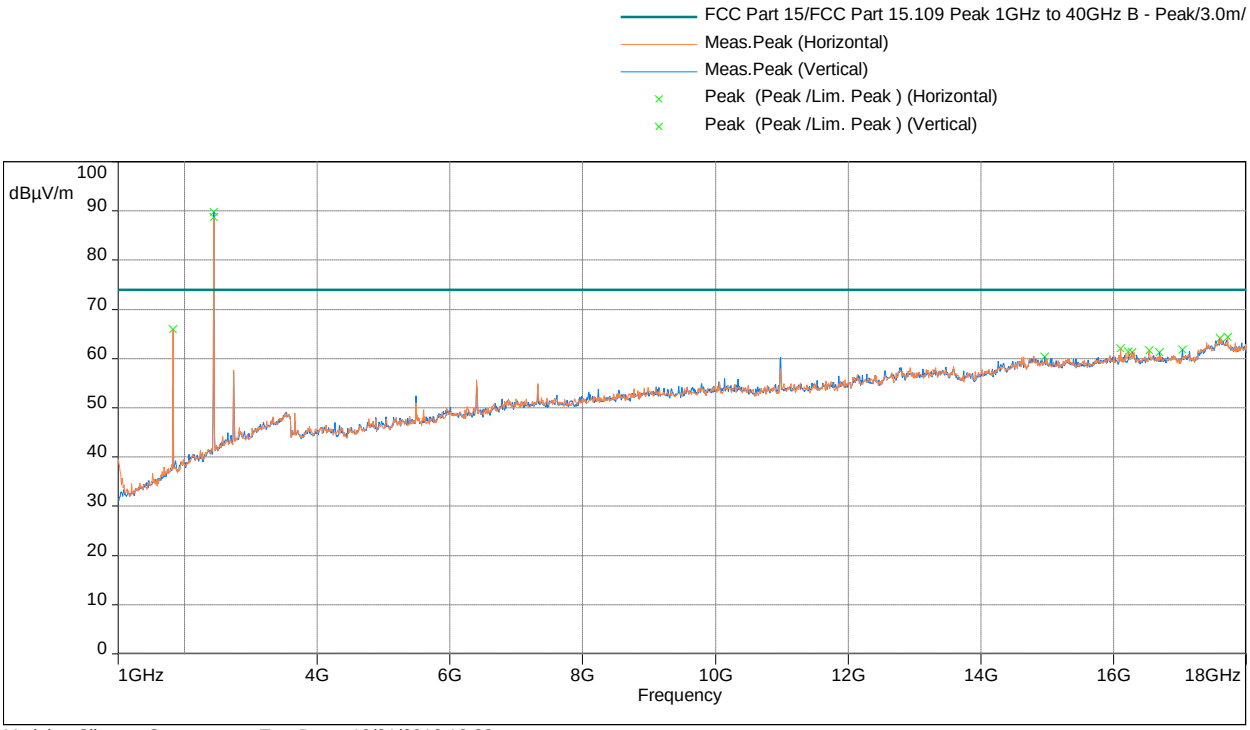
Radiated Spurious Emissions 30 MHz - 1000 MHz, Battery Mode



Model: ; Client: ; Comments: ; Test Date: 10/31/2016 09:01

Note: 851MHz, 883MHz, 943MHz, 947MHz, 950MHz are not in restricted band (FCC 15.205) and complied with 20dBc requirement. Therefore, they are compliant.

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan, Battery Mode

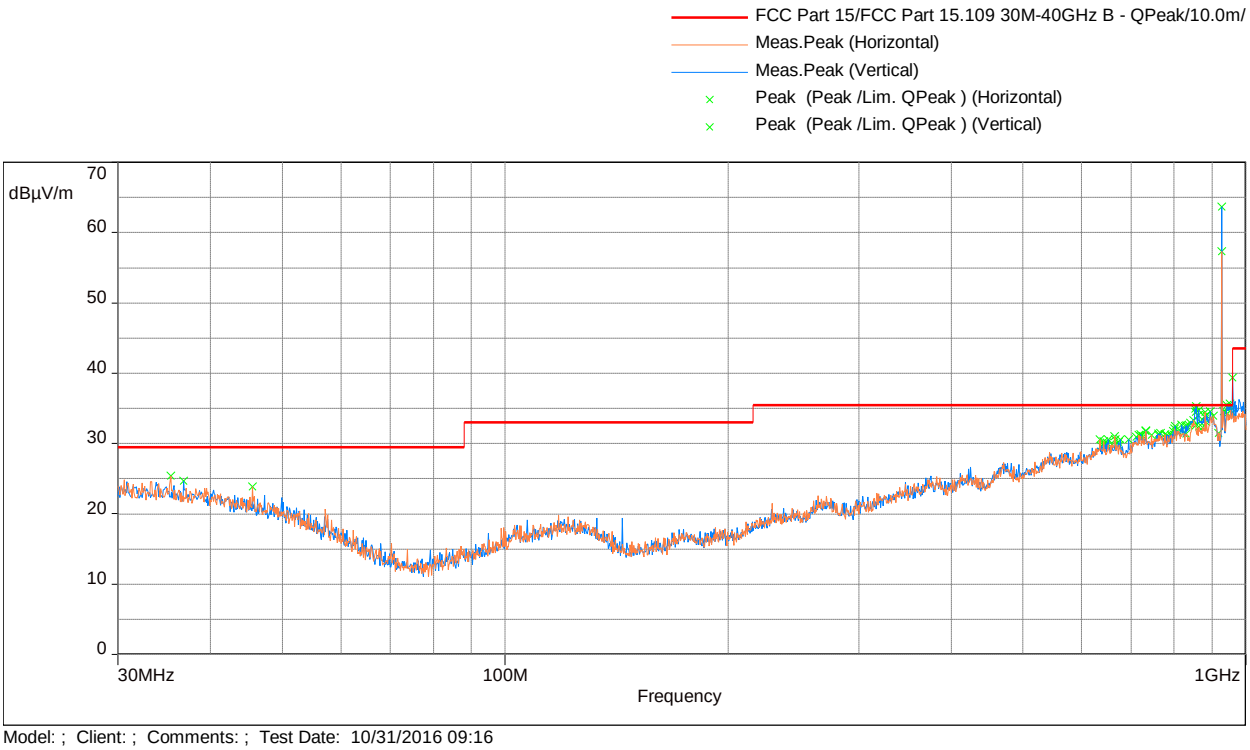


Model: ; Client: ; Comments: ; Test Date: 10/31/2016 12:22

Note:
- The highest level, showed on the Graph, is the 2440MHz fundamental signal from the BLE radio which must be ignored for this test.
- The peaks showed are compliant with 15.209 Average limit (54dBuV/m) by applying Duty Cycle Correction Factor of 20dB (See Annex A for Duty Cycle calculation).
- Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 927.5MHz

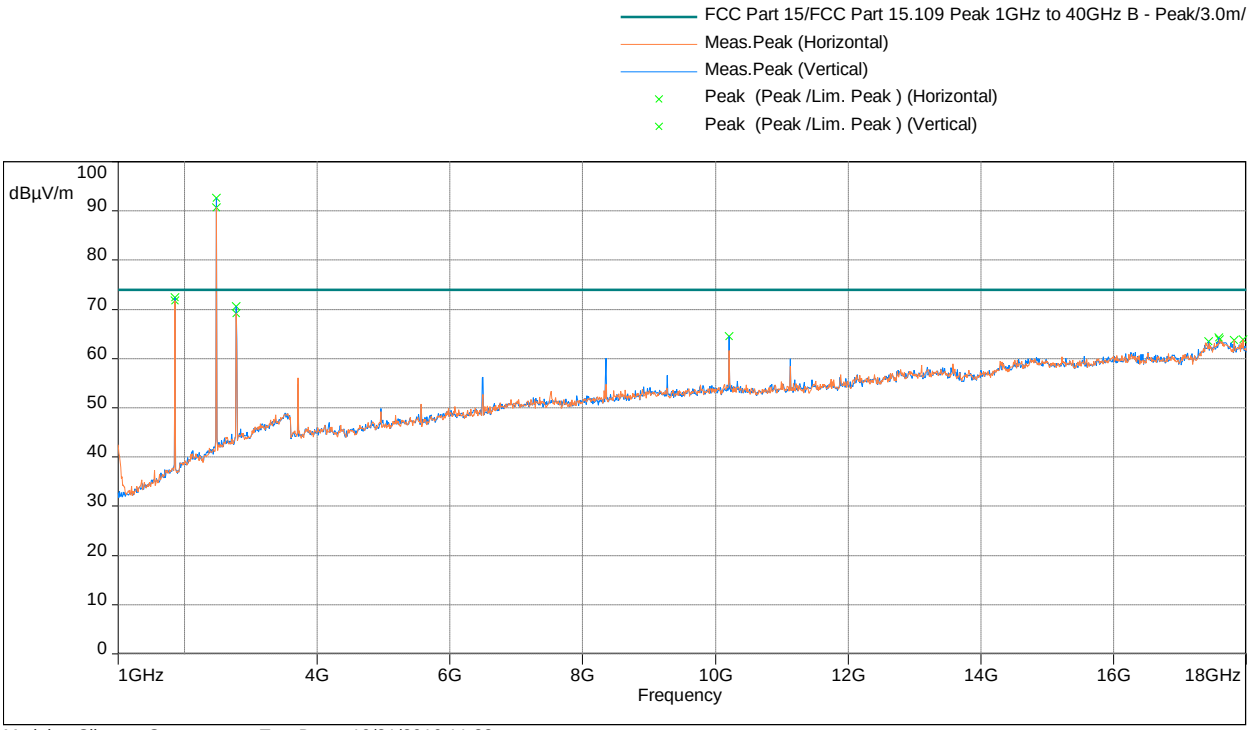
Radiated Spurious Emissions 30 MHz - 1000 MHz, Charging Mode



Model: ; Client: ; Comments: ; Test Date: 10/31/2016 09:16

Note: 952.47MHz and 959.5MHz are not in restricted band (FCC 15.205) and complied with 20dBc requirement. Therefore, they are compliant.

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan, Charging Mode

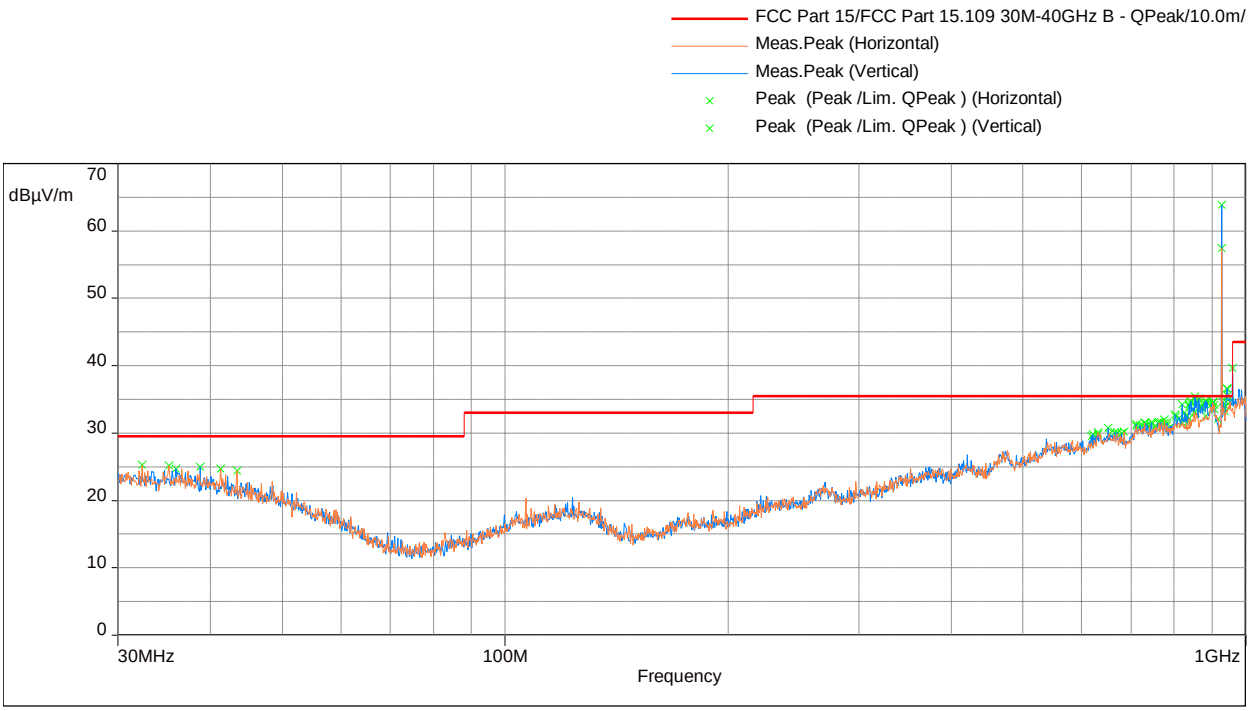


Model: ; Client: ; Comments: ; Test Date: 10/31/2016 11:38

Frequency (MHz)	Peak (dBµV/m)	Lim. Peak (dBµV/m)	Margin (dB)	Height (m)	Angle (°)	Comment	Correction (dB)
2781.6	70.66	74	-3.34	1.98	0	Vertical polarization	1.1

Note:
- The highest level, showed on the Graph, is the 2480MHz fundamental signal from the BLE radio which must be ignored for this test.
- The peaks showed are compliant with 15.209 Average limit (54dBuV/m) by applying Duty Cycle Correction Factor of 20dB (See Annex A for Duty Cycle calculation).
- Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz

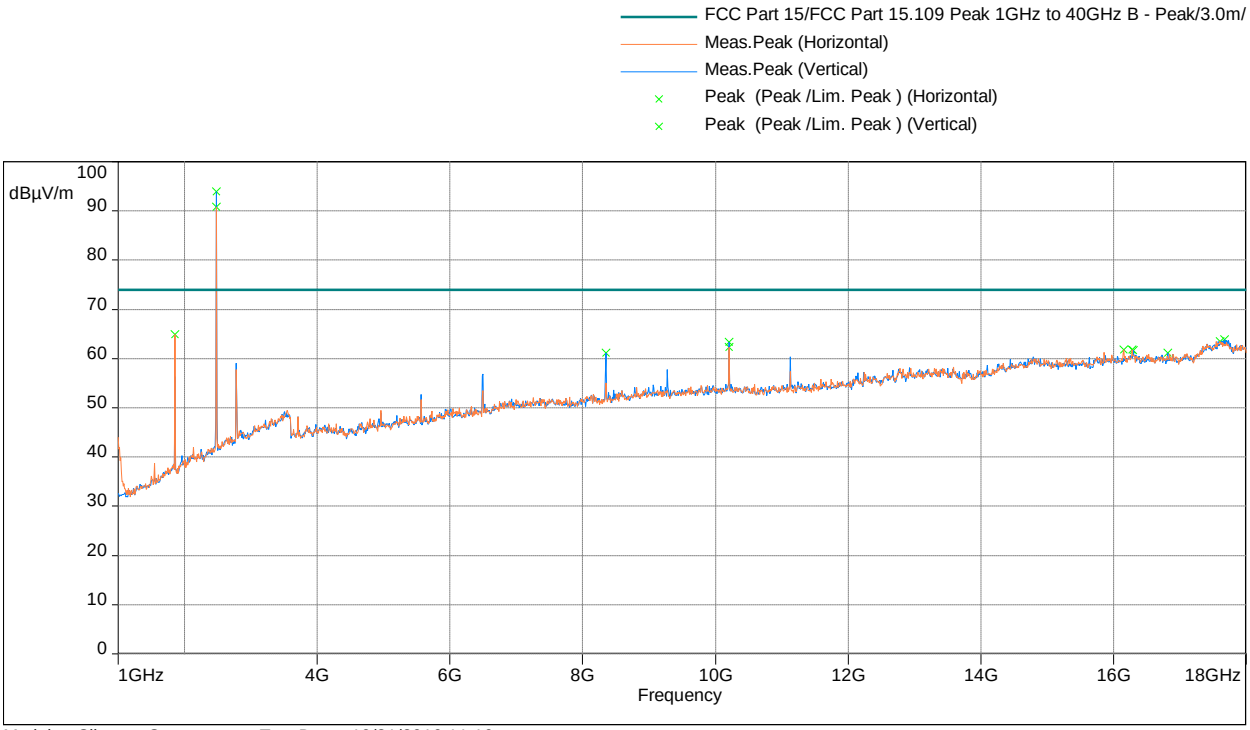
Radiated Spurious Emissions 30 MHz - 1000 MHz, Battery Mode



Model: ; Client: ; Comments: ; Test Date: 10/31/2016 09:08

Note: 942.7MHz, 943.8MHz, 944.7MHz, 959.5MHz are not in restricted band (FCC 15.205) and complied with 20dBc requirement. Therefore, they are compliant.

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan, Battery Mode



Model: ; Client: ; Comments: ; Test Date: 10/31/2016 11:16

Note:
- The highest level, showed on the Graph, is the 2480MHz fundamental signal from the BLE radio which must be ignored for this test.
- The peaks showed are compliant with 15.209 Average limit (54dBuV/m) by applying Duty Cycle Correction Factor of 20dB (See Annex A for Duty Cycle calculation).
- Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz

Results	**Complies**

4.7.5 Test Setup Photographs

The following photographs show the testing configurations used for charging mode

4.7.5 Test Setup Photographs (Continued)

4.8 AC Line Conducted Emission
FCC: 15.207; RSS-GEN

4.8.1 Requirement

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

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

4.6.2 Procedure

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.

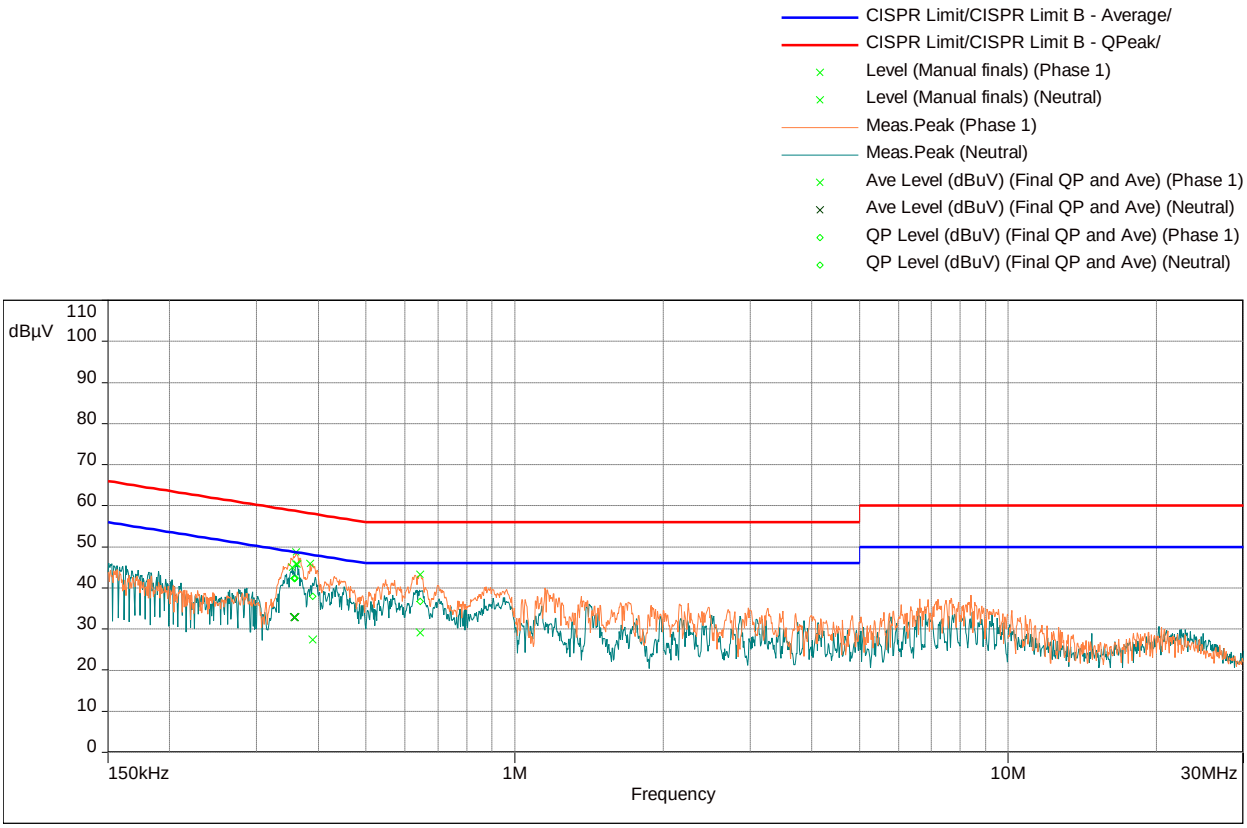
Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.10-2013.

4.8.3 Test Result

Date of Test:	October 25, 2016
Results	**Complies**

AC Line Conducted Emission Data

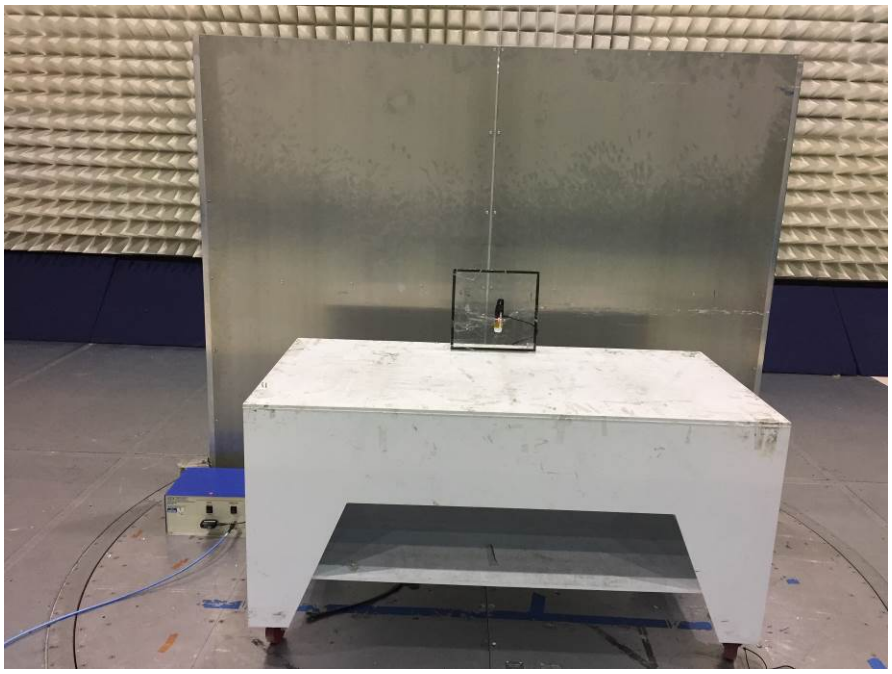


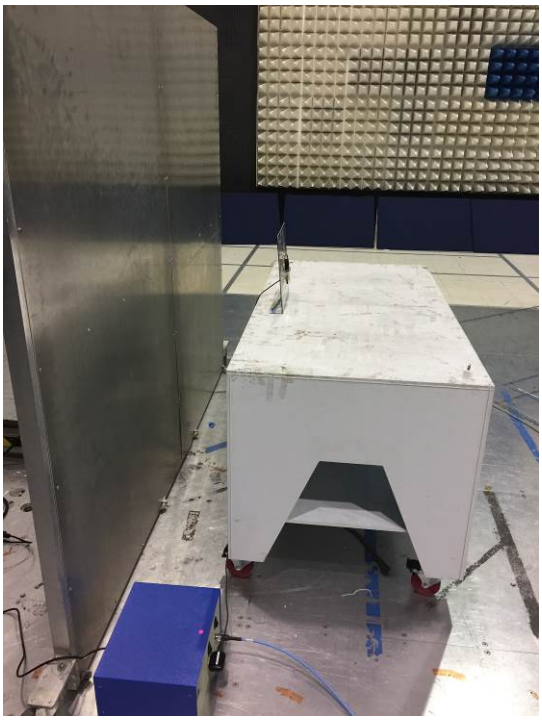
Model: ; Client: ; Comments: ; Test Date: 10/25/2016 13:47

Frequency (MHz)	Ave Level (dBuV)	QP Level (dBuV)	Ave Limit (dBuV)	QP Limit (dBuV)	Ave Margin (dB)	QP Margin (dB)	Line	Correction (dB)
0.358909	32.8	42.4	48.8	58.8	-15.9	-16.4	Phase 1	11.0
0.389403	27.5	38.0	48.1	58.1	-20.6	-20.1	Phase 1	11.0
0.644243	29.1	36.8	46.0	56.0	-16.9	-19.2	Phase 1	11.0
0.358119	32.8	42.3	48.8	58.8	-16.0	-16.5	Neutral	11.0
0.358547	32.9	42.4	48.8	58.8	-15.9	-16.4	Neutral	11.0
0.359130	32.9	42.4	48.8	58.8	-15.9	-16.3	Neutral	11.0

4.8.4 Test Configuration Photographs

The following photographs show the testing configurations used.





AC Mains Line-Conducted Disturbance Setup Photograph

5.0 List of Test Equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Asset #	Cal Int	Cal Due
Spectrum Analyzer	Rohde and Schwarz	FSU	ITS00913	12	01/05/17
EMI Receiver	Rohde and Schwarz	ESU	ITS 00961	12	12/11/16
Pre-Amplifier	Sonoma Instrument	310N	ITS 00942	12	01/07/17
Pre-Amplifier (18-40GHz)	Miteq	TTA1840-35-S-M	ITS 01393	12	04/13/17
BI-Log Antenna	Antenna Research	LPB-2513	ITS 00355	12	09/09/17
Pyramidal Horn Antenna	EMCO	3160-09	ITS 00571	#	#
Horn Antenna & Pre-Amplifier	ETS-Lindgren	3117 & 3117-PA	ITS 01365	12	08/09/17
LISN	Com-Power	LIN-115A	ITS 01288	12	06/25/16

No Calibration required

Software used for emission compliance testing utilized the following:

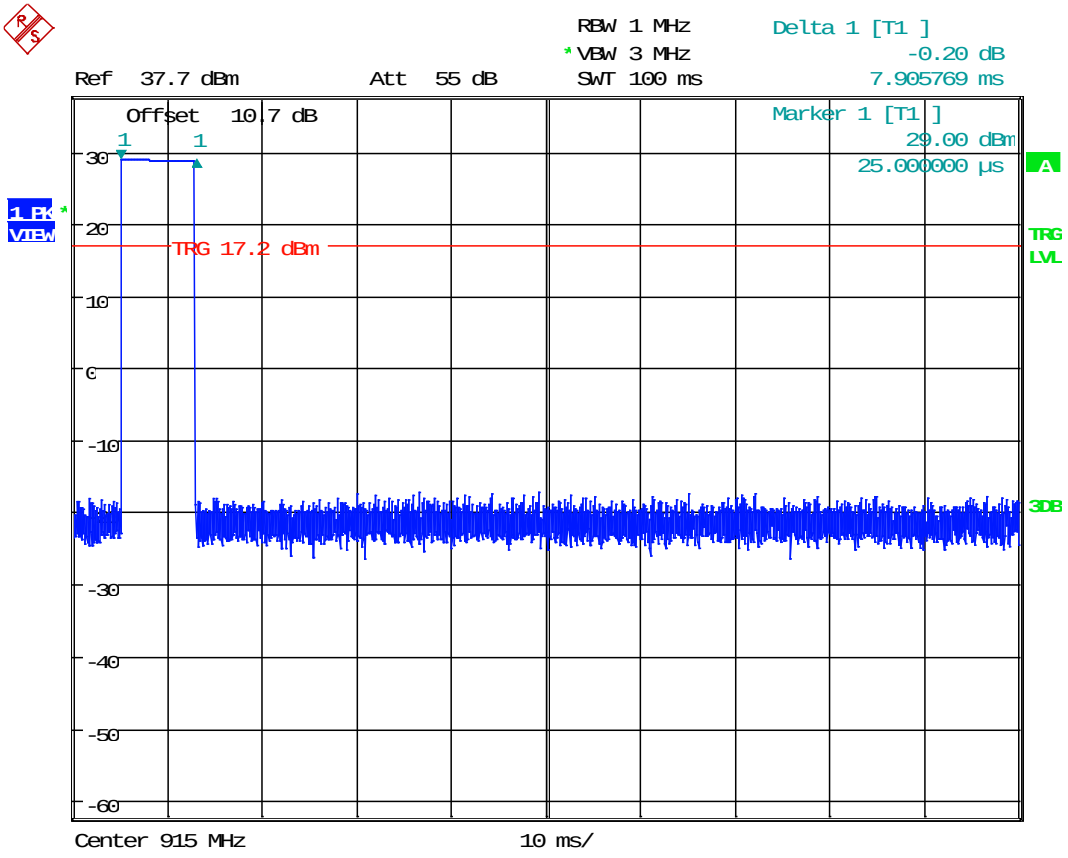
Name	Manufacturer	Version	Template/Profile
Tile	Quantum Change	3.4.K.22	Conducted Spurious_30M-26GHz
BAT-EMC	Nexio	3.16.0.44	Gotenna 10-25-16_ML.bpp
RS Commander	Rohde Schwarz	1.6.4	Not Applicable (Screen grabber)

6.0 Document History

Revision/ Job Number	Writer Initials	Reviewers Initials	Date	Change
1.0 / G102780674	ML	KV	November 17, 2016	Original document

Annex A - Duty Cycle Measurement

Date of Test:	November 02, 2016



Date: 2.NOV.2016 09:34:56

*****Duty Cycle Correction Factor (DA 00-705, Spurious Radiated Emissions):***

*20log(dwell time/100ms) = 20*log(8ms/100ms)= 21.9*

Maximum duty cycle factor of 20dB was used for average calculations.