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Emissions
Test Report

EUT Name: Flash

Model No.: FLASHV1

CFR 47 Part 15.247

Prepared for:

KPZ, inc
918 S Horton St, Unit 912
Seattle, WA 98134

Prepared by:

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Revisions

Revision No.	Date MM/DD/YYYY	Reason for Change	Author
0	07/17/2017	Original Document	DA
1	08/30/2017	Corrected A102606 calibration due date	DA

Note: Latest revision report will replace all previous reports.

Statement of Compliance

Manufacturer:	KPZ, inc 918 S Horton St, Unit 912 Seattle, WA 98134
Requester / Applicant:	KPZ, inc
Name of Equipment:	Flash
Model No.	FLASHV1
Type of Equipment:	Intentional Radiator
Application of Regulations:	CFR 47 Part 15.247
Test Dates:	6 July 2017 to 10 July 2017

Guidance Documents:

Emissions: ANSI C63.10-2013

Test Methods:

Emissions: ANSI C63.10-2013

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that the equipment described above has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

This report must not be used to claim product endorsement by A2LA or any agency of the U.S. Government. This report contains data that are not covered by A2LA accreditation. This report shall not be reproduced except in full, without the written authorization of TUV Rheinland of North America.

Douglas Antioco		David Spencer	
Test Engineer	Date August 30, 2017	A2LA Signatory	Date August 30, 2017

Testing Cert #3331.02 **US1131** **2932M-1**

1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR 47 Part 15.247 based on the results of testing performed on 6 July 2017 to 10 July 2017 on the Flash Model FLASHV1 manufactured by *KPZ, inc*. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report. The 2400 MHz to 2483.5 MHz frequency band is covered in this document.

1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C63.4	Test Parameters (Measured)	Result
Spurious Emission in Transmit Mode	CFR47 15.209, RSS-GEN Sect.8.9	Class B	**Complied**
Restricted Bands of Operation	CFR47 15.205, RSS GEN Sect.8.10	Class B	**Complied**
AC Power Conducted Emission	CFR47 15.207, RSS-GEN Sect.8.8	Class B	**Complied**
6dB and 99% Occupied Bandwidth	CFR47 15.247 (a2), RSS 247 Sect. 5.2.1	See plots	**Complied**
Maximum Output Power	CFR47 15.247 (b), RSS 247 Sect. 5.4.4	See plots	**Complied**
Peak Power Spectral Density	CFR47 15.247 (e), RSS 247 Sect. 5.2.2	See plots	**Complied**
Out of Band Emission	CFR47 15.247 (d), RSS 247 Sect.5.5	See plots	**Complied**

1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

1.5 Equipment Modifications

None

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America at 1279 Quarry Ln, Pleasanton, CA 94566 is recognized by the commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (US1131). The laboratory scope of accreditation includes: Title 47 CFR Parts 15, 18, and 90. The accreditation is updated every 3 years.

2.1.2 NIST / A2LA

TUV Rheinland of North America is accredited by the National Voluntary Laboratory Accreditation Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Guide 17025:1999 and ISO 9002 (Lab Code Testing Cert #3331.02). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Acceptance by Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at 1279 Quarry Ln, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / A2LA accreditation will be accepted by each member country.

2.2 Test Facilities

All of the test facilities are located at 1279 Quarry Lane, Pleasanton, California 94566, USA. The 2305 Mission College, Santa Clara, 95054, USA location is considered a Pleasanton annex.

2.2.1 Emission Test Facility

The Semi-Anechoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 and 5 meters. The site is listed with the FCC and accredited by A2LA (Lab Code Testing Cert #3331.02). The 3/5-meter semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 meter and 5 meters. A report detailing this site can be obtained from TUV Rheinland of North America.

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities; it is equal to the positive square root of the sum of the variances or co-variances of these other quantities, weighted according to how the measurement result varies with changes in these quantities. The term *standard uncertainty* is the result of a measurement expressed as a standard deviation.

2.3.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

2.3.2 Measurement Uncertainty

Per CISPR 16-4-2	**U_{lab}**	**U_{cispr}**
Radiated Disturbance @ 10 meters		
30 – 1,000 MHz	2.25 dB	4.51 dB
Radiated Disturbance @ 3 meters		
30 – 1,000 MHz	2.26 dB	4.52 dB
1 – 6 GHz	2.12 dB	4.25 dB
6 – 18 GHz	2.47 dB	4.93 dB

Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.09 dB	2.18 dB
Disturbance Power		
30 MHz – 300 MHz	3.92 dB	4.3 dB

2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

3 Product Information

3.1 Product Description

The Model FLASHV1, Flash, is a smart electric bike consisting of a cellular radio and Bluetooth LE radio. The cellular radio supports WCDMA and LTE technologies.

3.2 Equipment Configuration

A description of the equipment configuration is given in the Test Plan Section (Section 6). The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The EUT was connected to rated power and allowed to reach intended operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of an EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce the worst case radiation for emissions testing.

3.3 Operating Mode

A description of the operation mode is given in the Test Plan Section (Section 6).

The final operating mode was selected to produce the worst case radiation for emissions testing.

3.4 Unique Antenna Connector

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of CFR47 Parts 15.211, 15.213, 15.217, 15.219, or 15.221.

3.4.1 Results

The Flash employs a single integral antenna inaccessible to the end user. The antenna has a declared maximum gain of 0dBi.

Refer to Table 9 for additional antenna information.

4 Emissions

Testing was performed in accordance with CFR 47 Part 15.247. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Procedures described in section 8 of the standard were used.

4.1 Output Power Requirements

The maximum output power requirement is the maximum equivalent isotropic radiated power delivering at the transmitting antenna under specified conditions of measurements in the presence of modulation.

The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b)

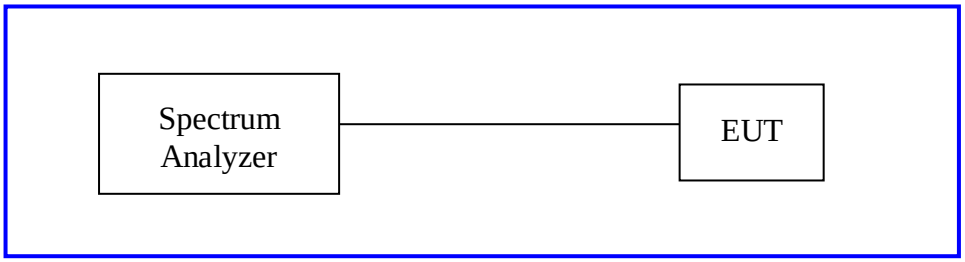
The maximum transmitted powers are:

Band 2400-2483.5 MHz: 1 W

4.1.1 Test Method

The ANSI C63.10-2013 Section 11.9.1.1 conducted method was used to measure the channel power output. The measurements were conducted on 3 channels in each operating range per CFR47 Part 15.247(b); 2400 MHz to 2483.5 MHz

Test Setup:



The method described in ANSI C63.10-2013 Section 11.9.1.1 applies and was used.

4.1.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 2: RF Output Power at the Antenna Port – Test Results – BLE 4.0

Test Conditions: Conducted Measurement, Normal Temperature				
Antenna Type: Custom Integrated			**Power Setting:** See test plan	
Max. Directional Gain: +0 dBi				
Signal State: Modulated				
Ambient Temp.: 24° C			**Relative Humidity:**39%	
RF Output Power – BLE 4.0				
Voltage	**Operating Channel (MHz)**	**Measured Power [dBm]**	**Limit [dBm]**	**Margin [dB]**
Nominal	2402	1.4	30.0	28.6
	2440	1.2	30.0	28.8
	2480	0.8	30.0	29.2
Note: All insertion loss corrections are accounted for in the measurement plots.				

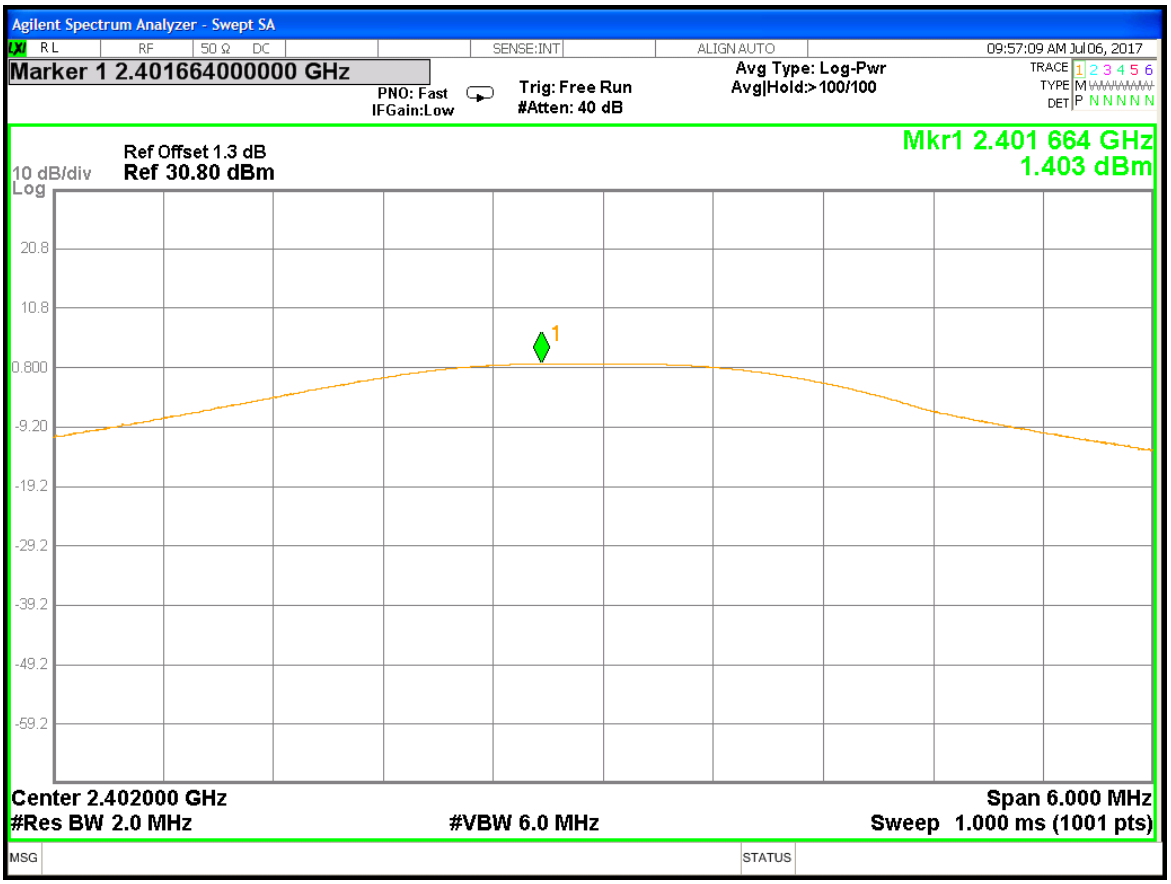


Figure 1 : Maximum peak conducted output power – BLE – 2402MHz

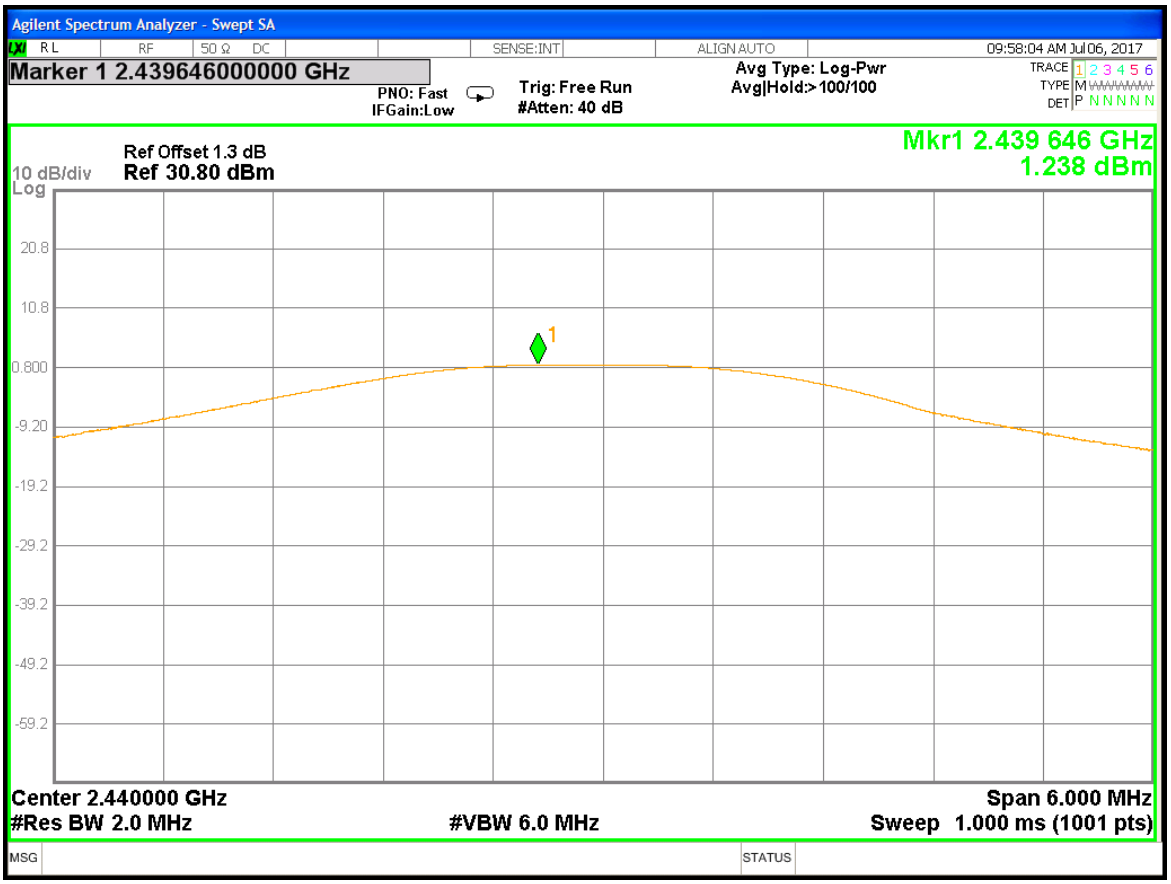


Figure 2 : Maximum peak conducted output power – BLE – 2440MHz

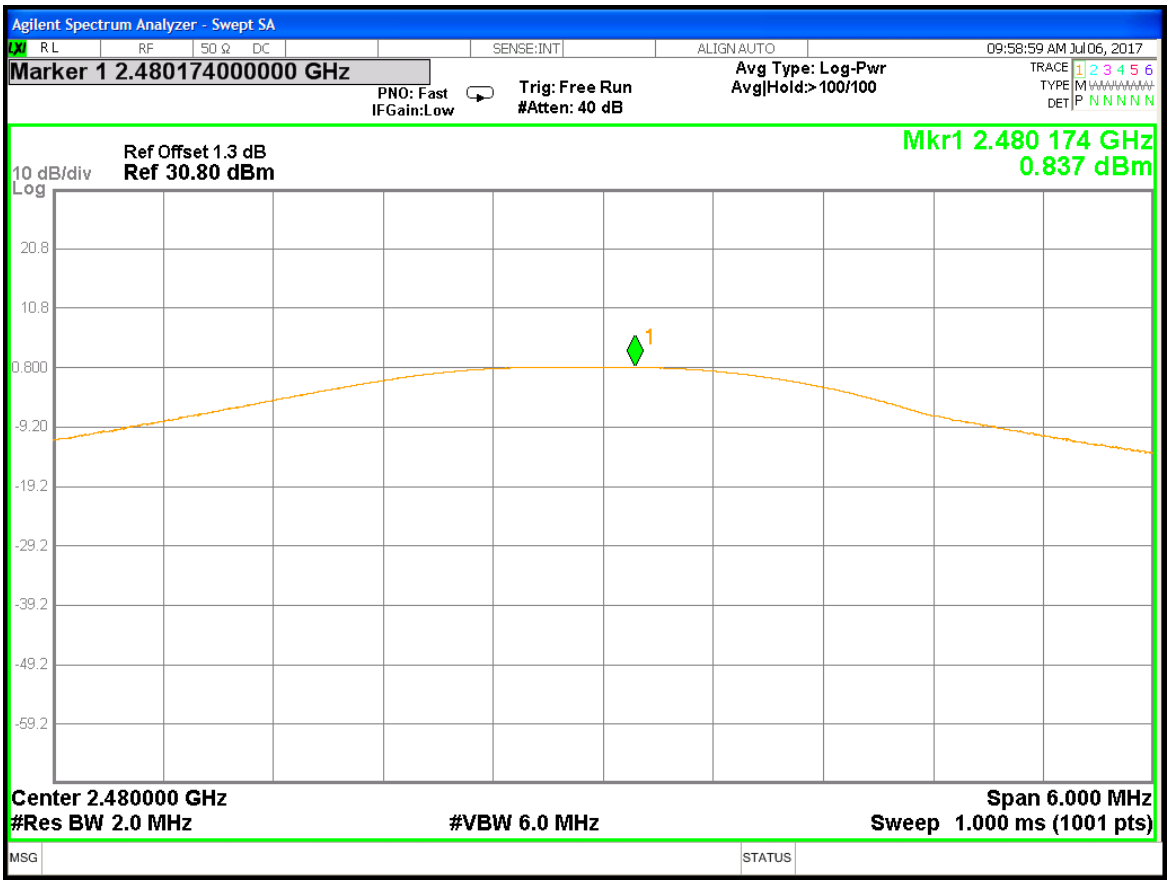


Figure 3 : Maximum peak conducted output power – BLE – 2480MHz

4.2 6 dB and 99% Occupied Bandwidth

The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

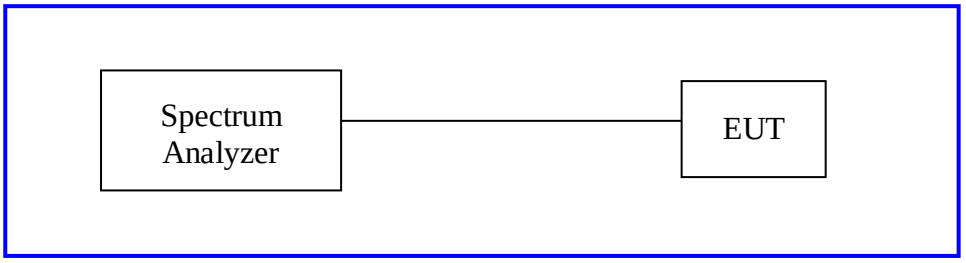
The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.

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

4.2.1 Test Method

The conducted method was used to measure the occupied bandwidth and 6 dB bandwidth according to ANSI C63.10:2013 Section 6.9.3 and 11.8.1, respectively. The measurement was performed with modulation per CFR47 15.247(a) (2). Measurements were performed on 3 channels in each operating frequency range; 2400 MHz to 2483.5 MHz.

Test Setup:



4.2.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 3: Occupied Bandwidth – Test Results – BLE 4.0

Test Conditions: Conducted Measurement, Normal Temperature		
Antenna Type: Custom Integrated		**Power Setting:** See test plan
Max. Directional Gain: +0 dBi		
Signal State: Modulated		
Ambient Temp.: 24° C		**Relative Humidity:**39%
Bandwidth for BLE 4.0		
Freq. (MHz)	**6dB Bandwidth (kHz)**	**99% Bandwidth (MHz)**
2402	0.73	1.06
2442	0.72	1.06
2480	0.72	1.06

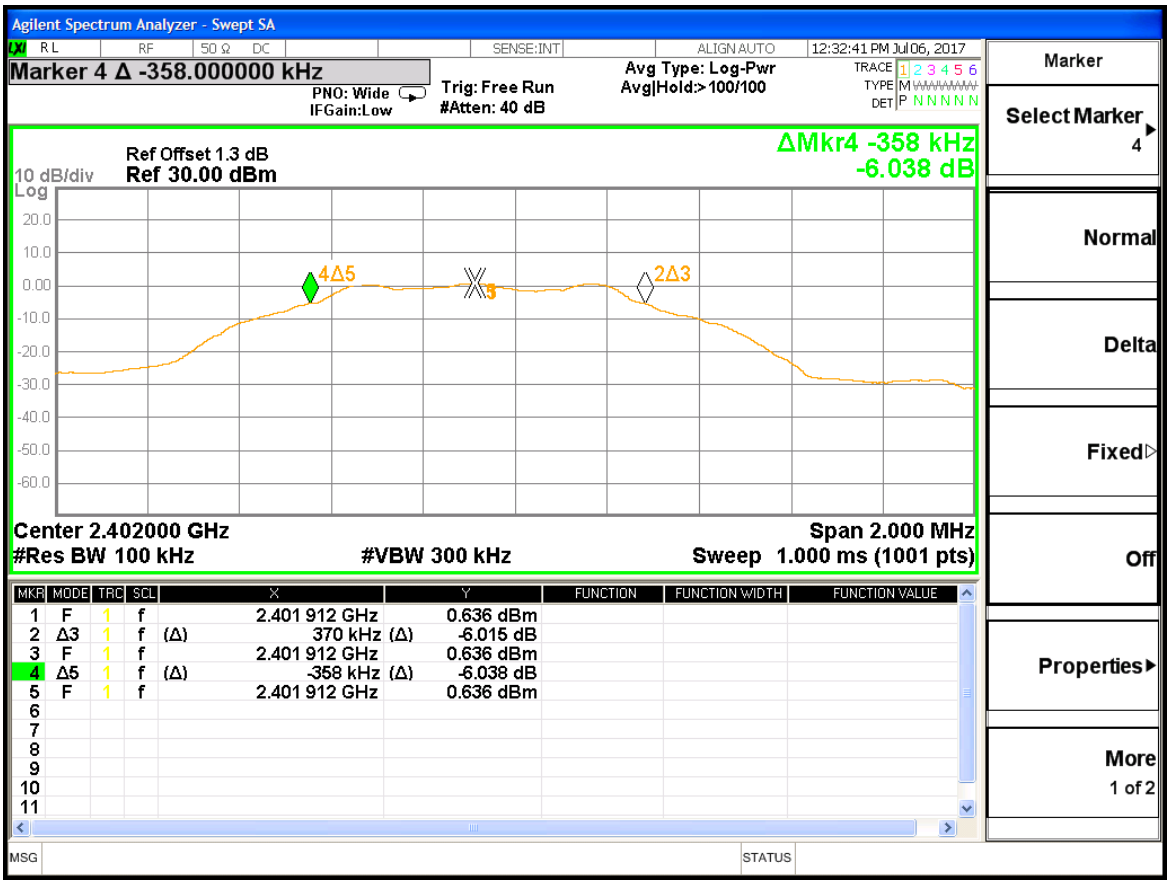


Figure 4 : 6dB Bandwidth – BLE – 2402MHz

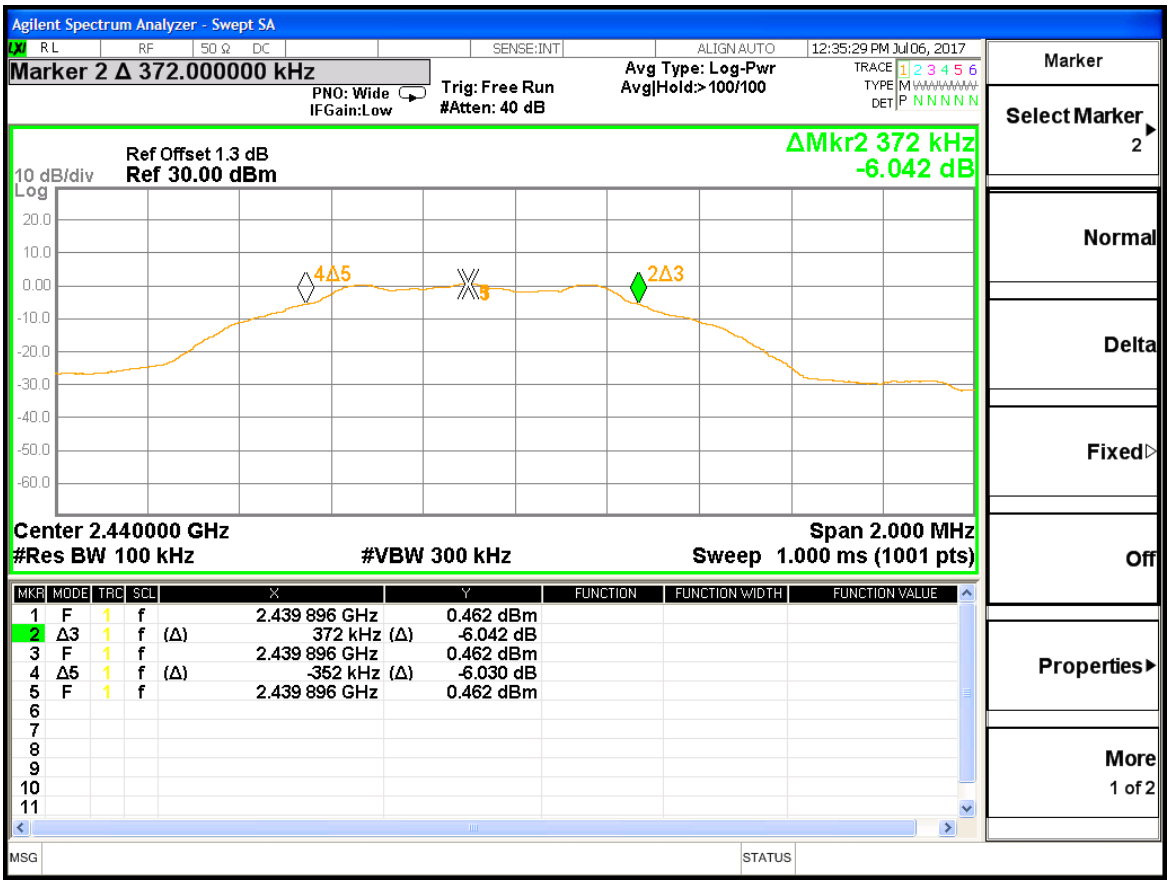


Figure 5 : 6dB Bandwidth – BLE – 2440MHz

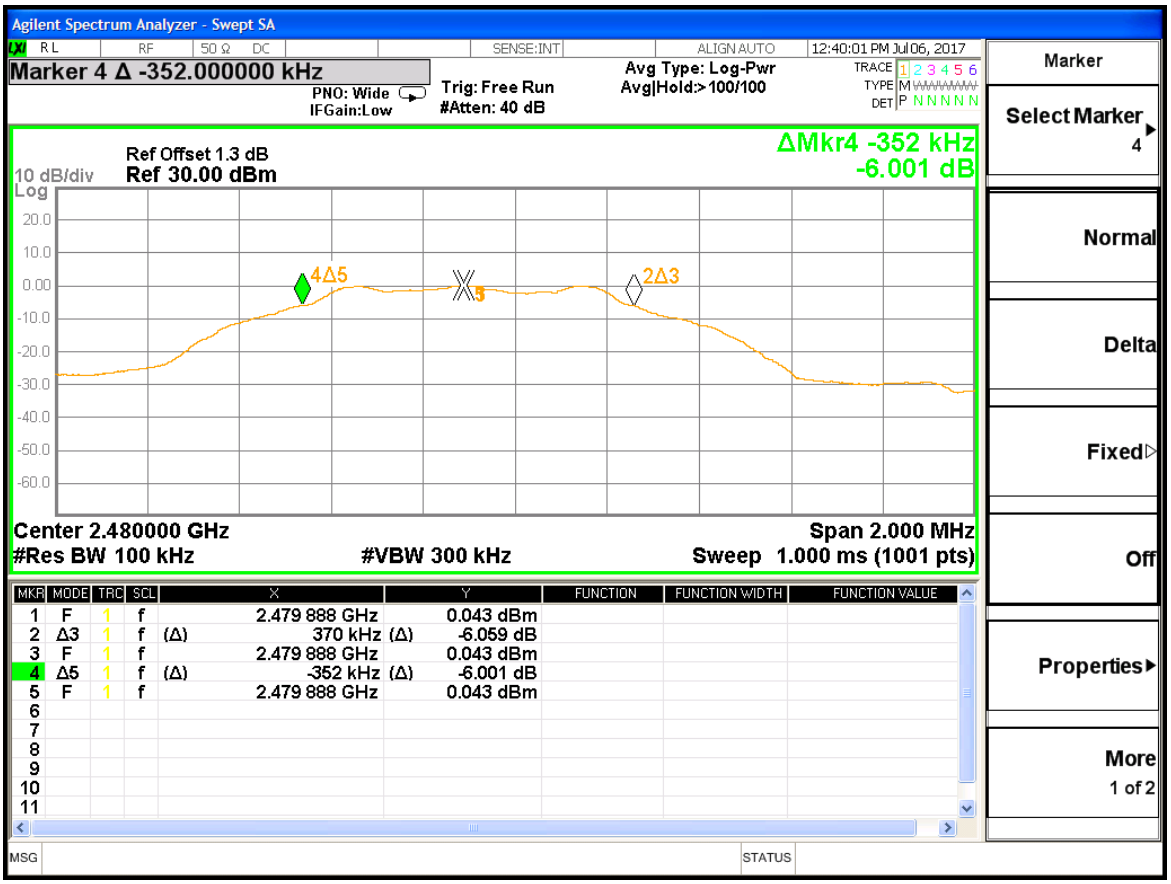


Figure 6 : 6dB Bandwidth – BLE – 2480MHz

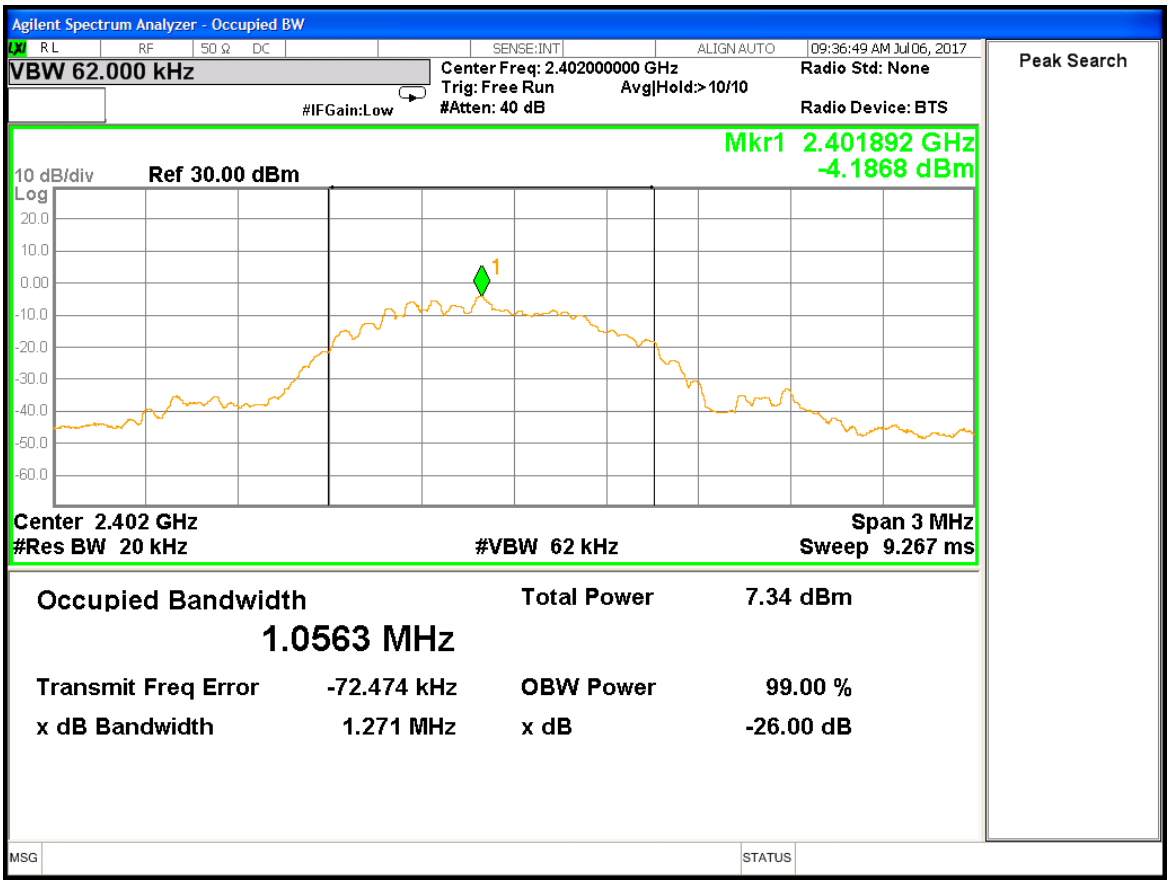


Figure 7 : 99% Occupied Bandwidth – BLE – 2402MHz

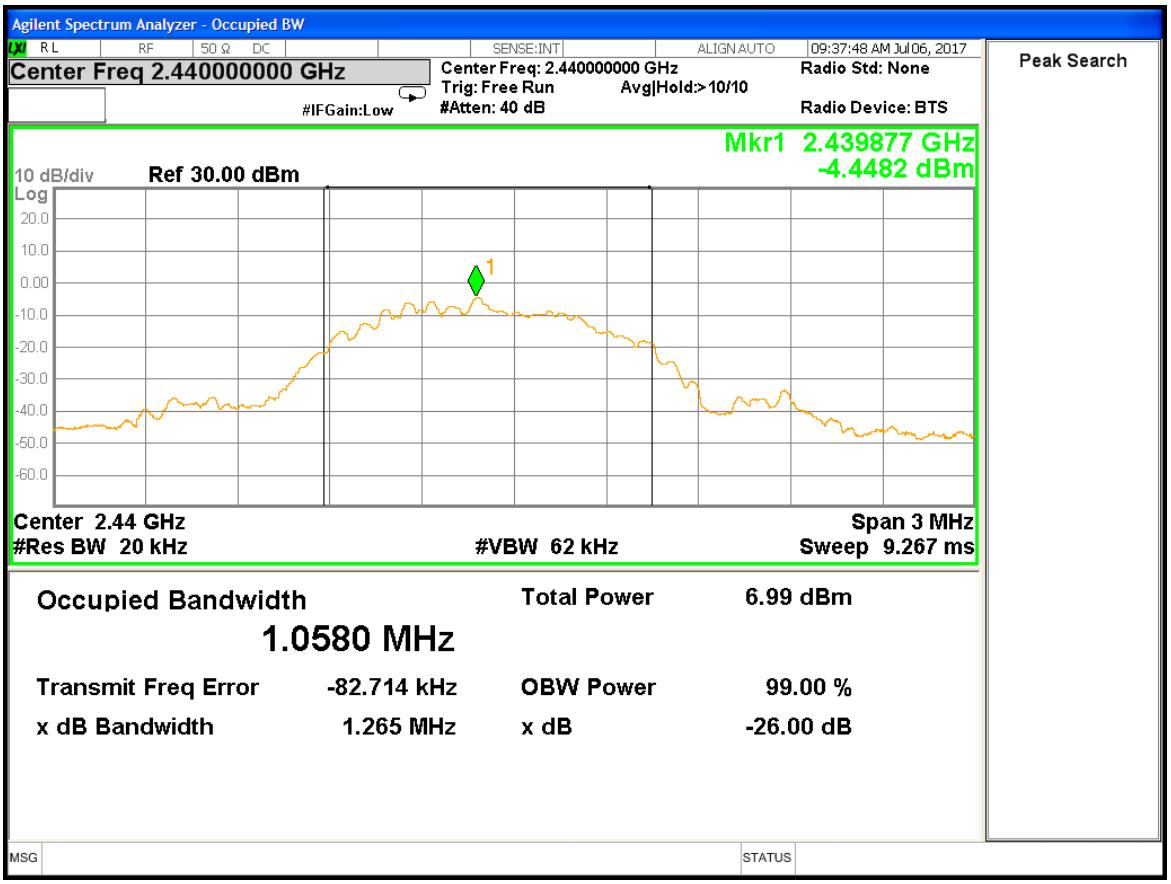


Figure 8 : 99% Occupied Bandwidth – BLE – 2440MHz

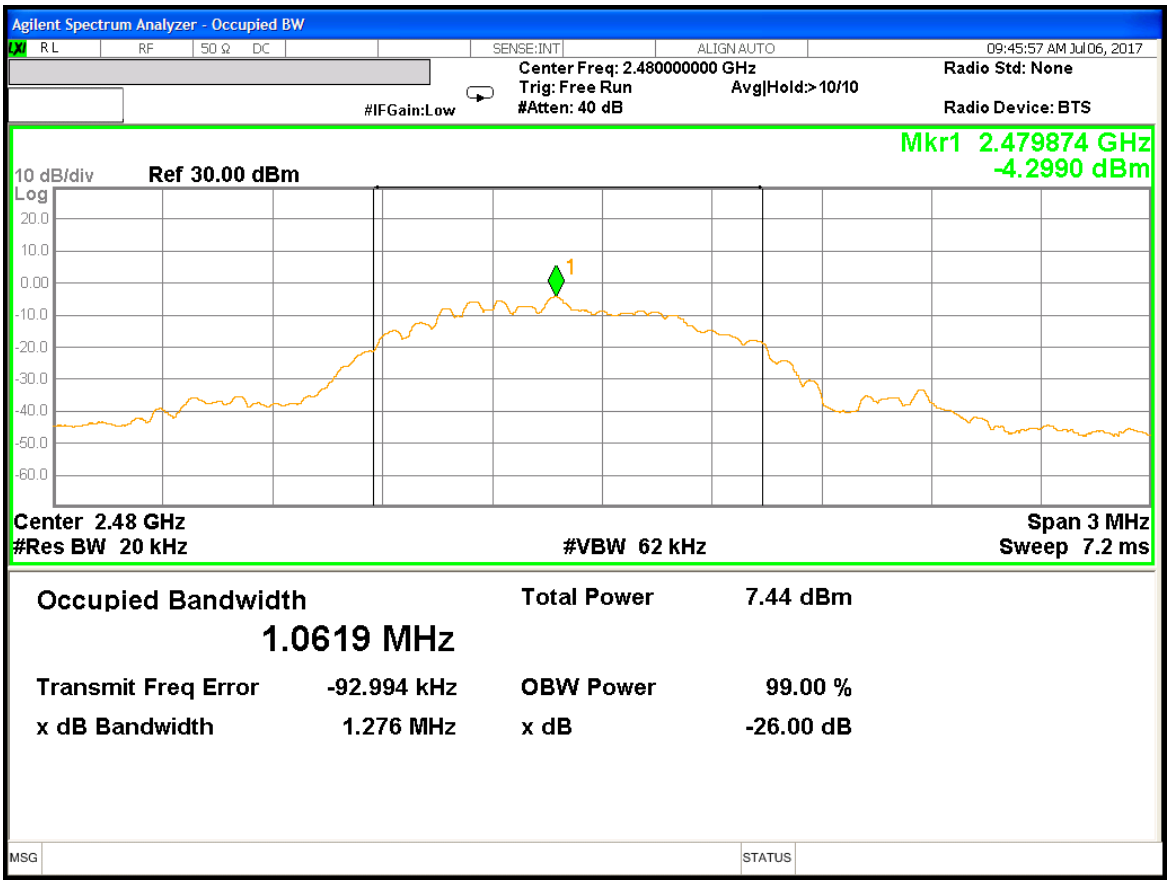


Figure 9 : 99% Occupied Bandwidth – BLE – 2480MHz

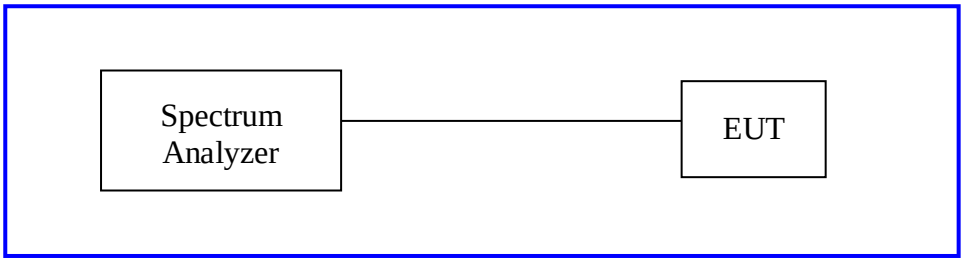
4.3 Peak Power Spectral Density

According to the CFR47 Part 15.247 (e) and RSS 247 Sect.5.2.2, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.3.1 Test Method

The conducted method was used to measure the channel power output per ANSI C63.10-2013 Section 11.10.2. The measurement was performed with modulation per CFR47 Part 15.247 (e) and RSS 247 Sect.5.2.2.

Test Setup:



4.3.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 4: Peak Power Spectral Density – Test Results – BLE 4.0

Test Conditions: Conducted Measurement, Normal Temperature			
Antenna Type: Custom Integrated		**Power Setting:** See test plan	
Max. Directional Gain: +0 dBi			
Signal State: Modulated			
Ambient Temp.: 24° C		**Relative Humidity:**39%	
Peak Power Spectral Density – BLE 4.0			
Freq. (MHz)	**Measured PSD [dBm/3kHz]**	**Limit [dBm/3kHz]**	**Margin [dB]**
2402	-12.9	8	20.9
2440	-13.3	8	21.3
2480	-13.7	8	21.7
Note: All insertion loss corrections are accounted for in the measurement plots.			

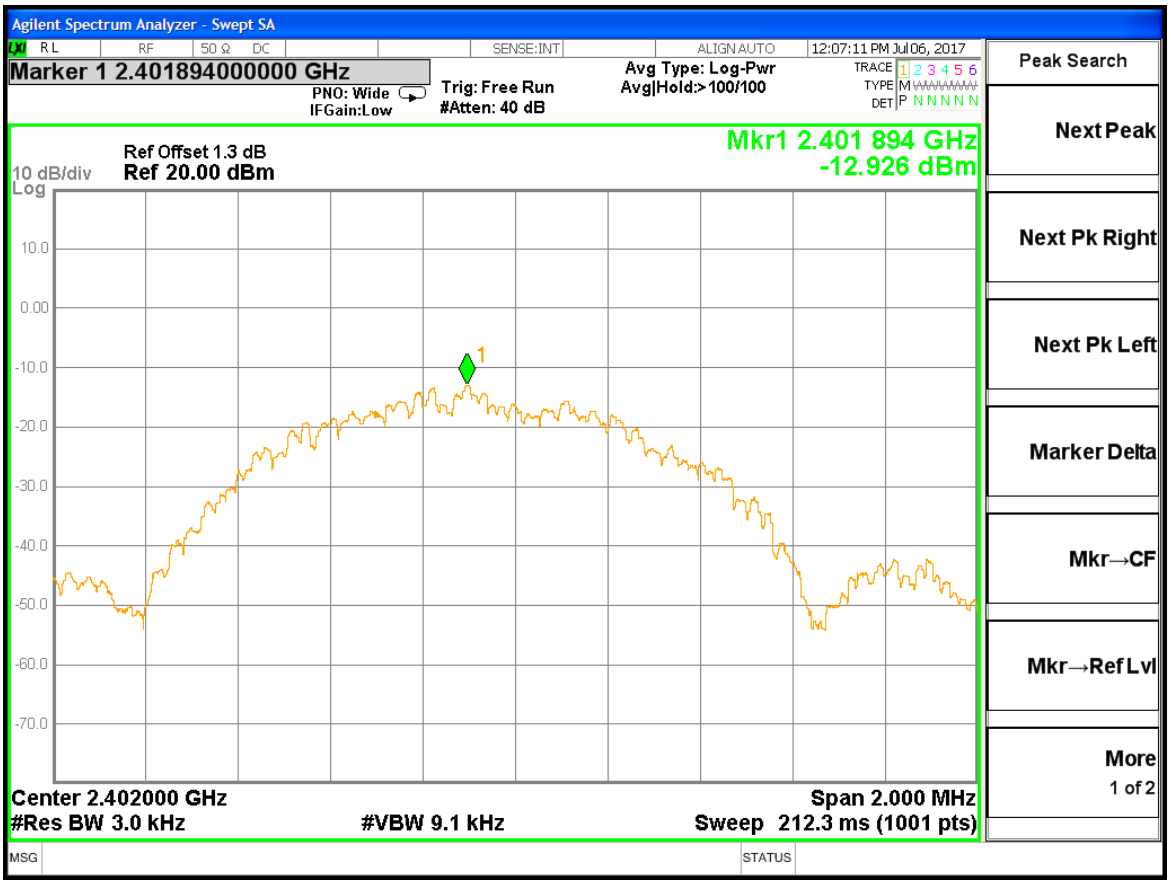


Figure 10: Power Spectral Density – BLE – 2402 MHz

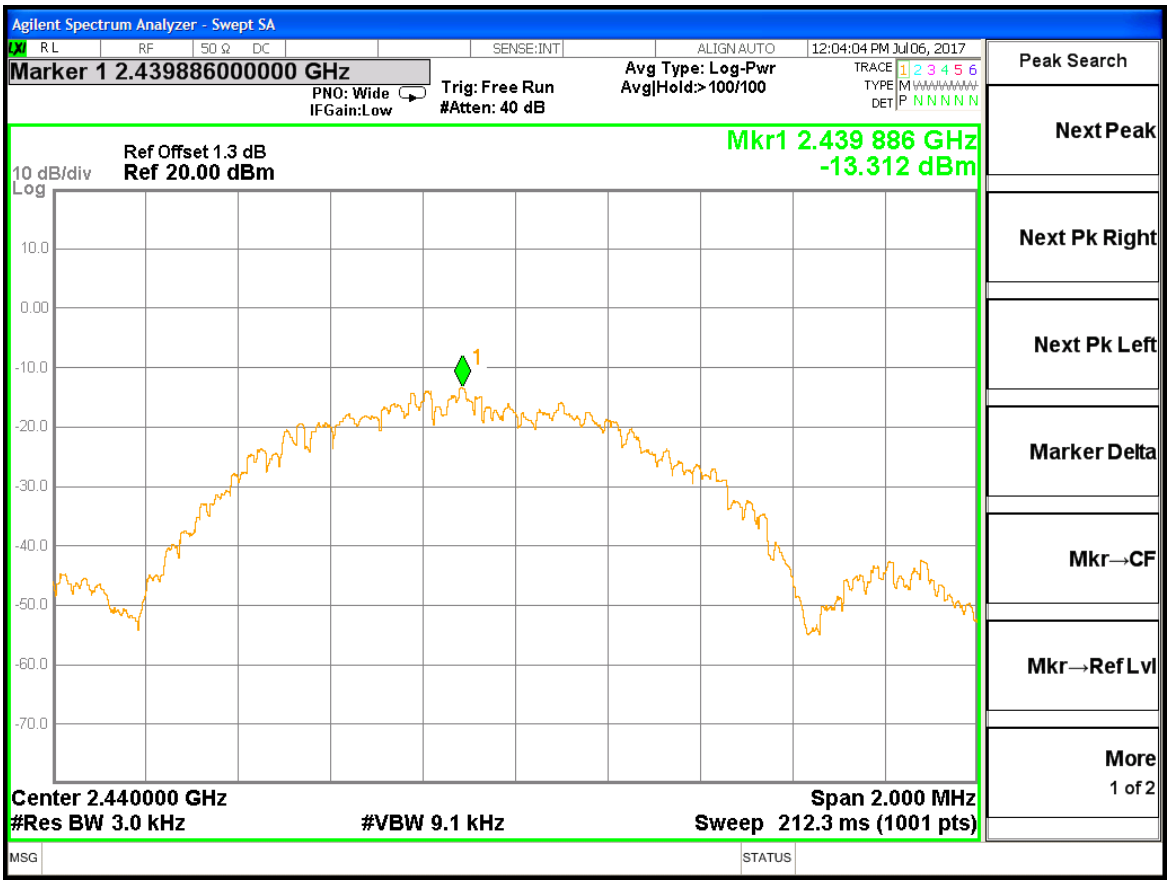


Figure 11: Power Spectral Density – BLE – 2440 MHz

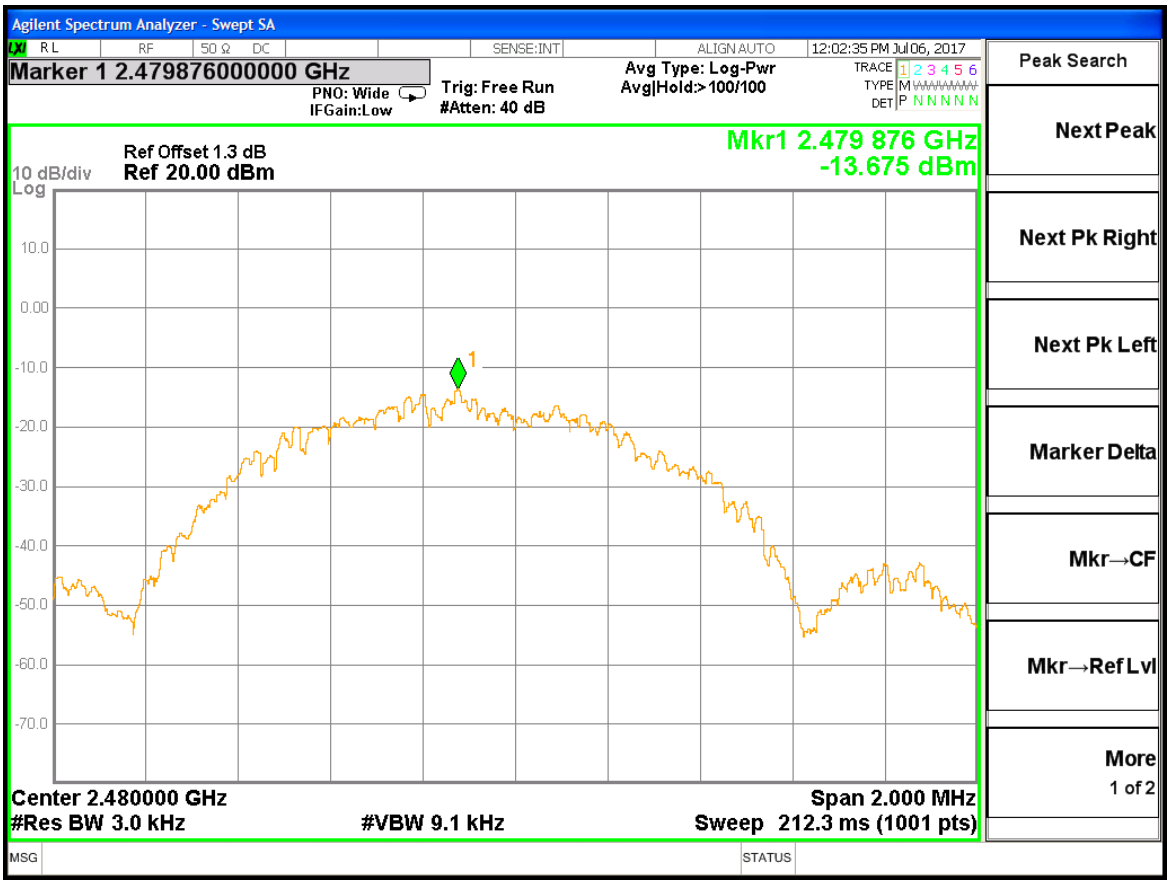


Figure 12: Power Spectral Density – BLE – 2480 MHz

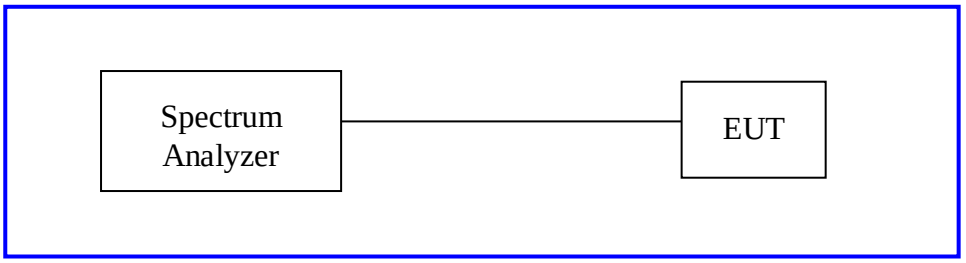
4.4 Out of Band Emissions- Non-Restricted and Restricted Bands

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmitting mode; per requirement of CFR47 15.205, 15.209, 15.247(d).

4.4.1 Test Method

The conducted method was used to measure the undesirable emission requirement. The measurement was performed with modulation. Duty Cycle Measurements were performed according to ANSI 63.10 Section 11.6. Measurements for emissions in nonrestricted frequency bands were performed according to ANSI 63.10-2013 sections 6.10.4 and 11.11. Measurements for emissions in nonrestricted frequency bands were performed according to ANSI 63.10-2013 sections 6.10.5, 11.12.2.4 and 11.12.2.5.2.

Test Setup:



4.4.2 Duty Cycle

The duty cycle of the EUT while operating in each supported mode was measured. Applicable corrections have been applied to emissions measured while operating in modes with a duty cycle less than 98%. Application of the appropriate corrections are in accordance with ANSI 63.10 Section 11.

Mode	Continuous (>98%)	DC Constant?	On Time per period (ms)	Period (ms)	Duty Cycle	Duty Cycle Correction Factor (dB)
BT LE	No	Yes	383	626	61.2%	2.1

4.4.3 Measurement plots

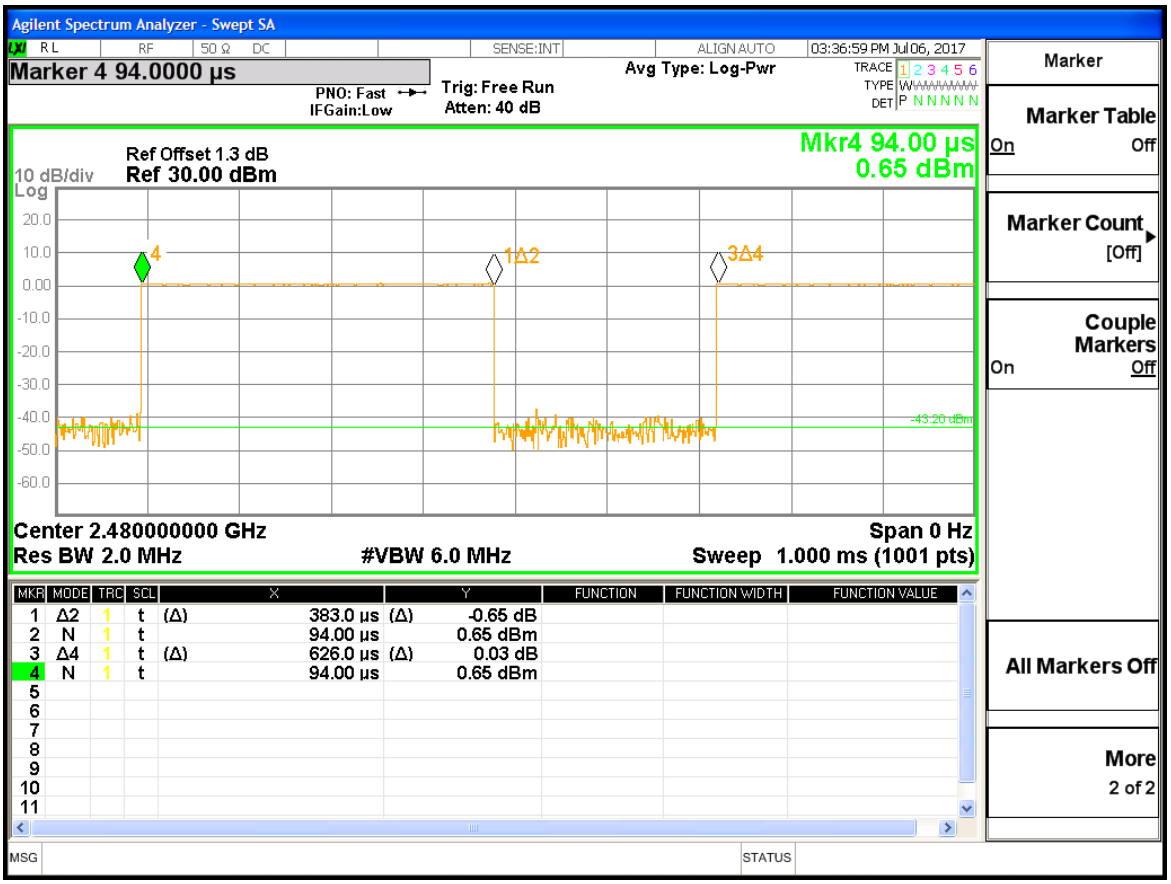


Figure 13: Duty Cycle – BT LE

4.4.4 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 5: Out of Band Emissions including the Band-Edge – Test Results – BT LE

Test Conditions: Conducted Measurement, Normal Temperature					
Antenna Type: Custom Integrated		**Power Setting:** See test plan			
Max. Directional Gain: +0 dBi		**Low Channel Maximum Level in 100kHz BW:** 0.7dBm			
Signal State: Modulated					
Ambient Temp.: 24° C		**Relative Humidity:**39%			
Non-Restricted Frequency Band Emissions – BLE 4.0					
Operating Freq. (MHz)	**Measured Freq. (MHz)**	**Measured (dBm)**	**Limit (dBm)**	**Margin**	**Result**
2402	2400	-35.4	-24.3	11.1	Pass
Note: 1. The stated limits are -20dBc relative to the max output measured in a 100kHz bandwidth					
Restricted Frequency Band Emissions – BLE 4.0					
Operating Freq. (MHz)	**Measured Freq. (MHz)**	**Measured (dBm)**	**Limit (dBm)**	**Margin**	**Result**
2480	2484	-23.9	-21.2	2.7	Pass
2480	2483.5	-43.5	-41.2	2.3	Pass
Note: Unless otherwise specified, corrections for insertion losses are included in the plot					

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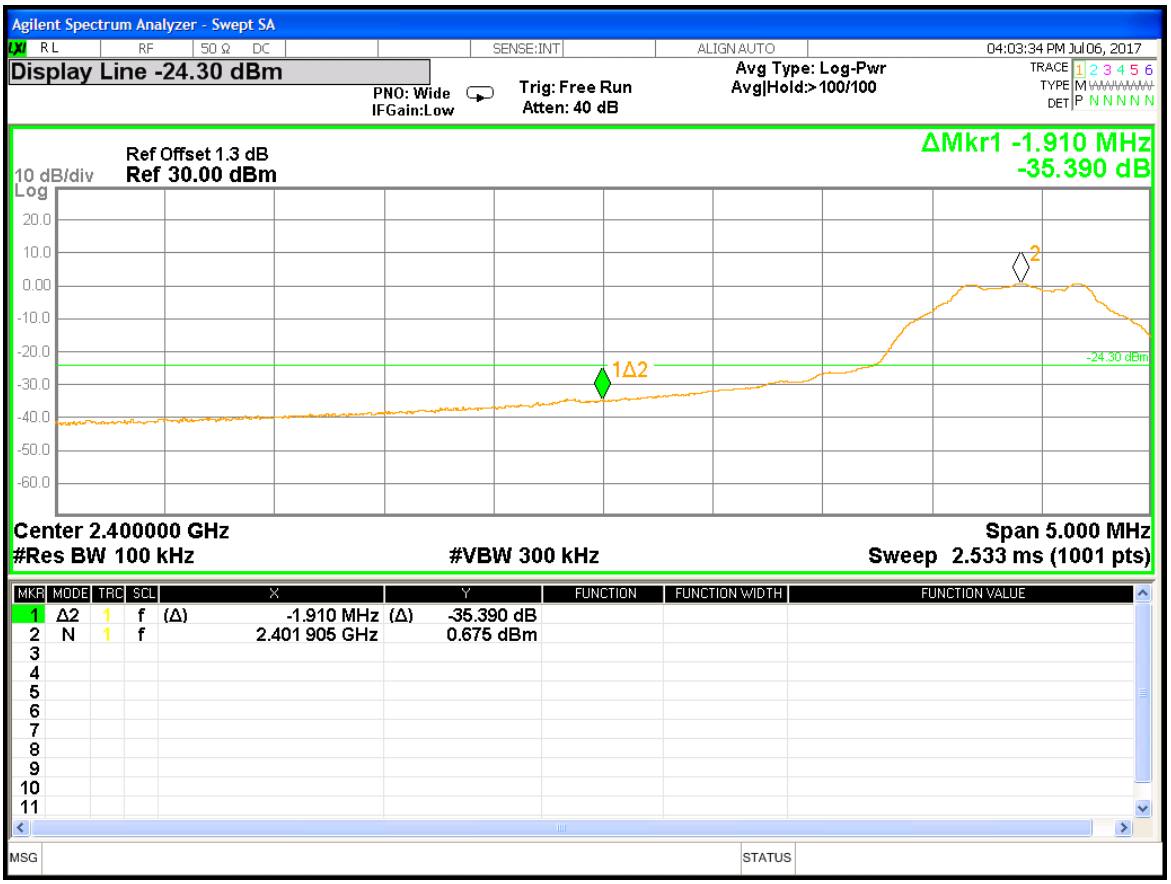

Figure 14: Low Channel Non-Restricted Band Edge– BT LE

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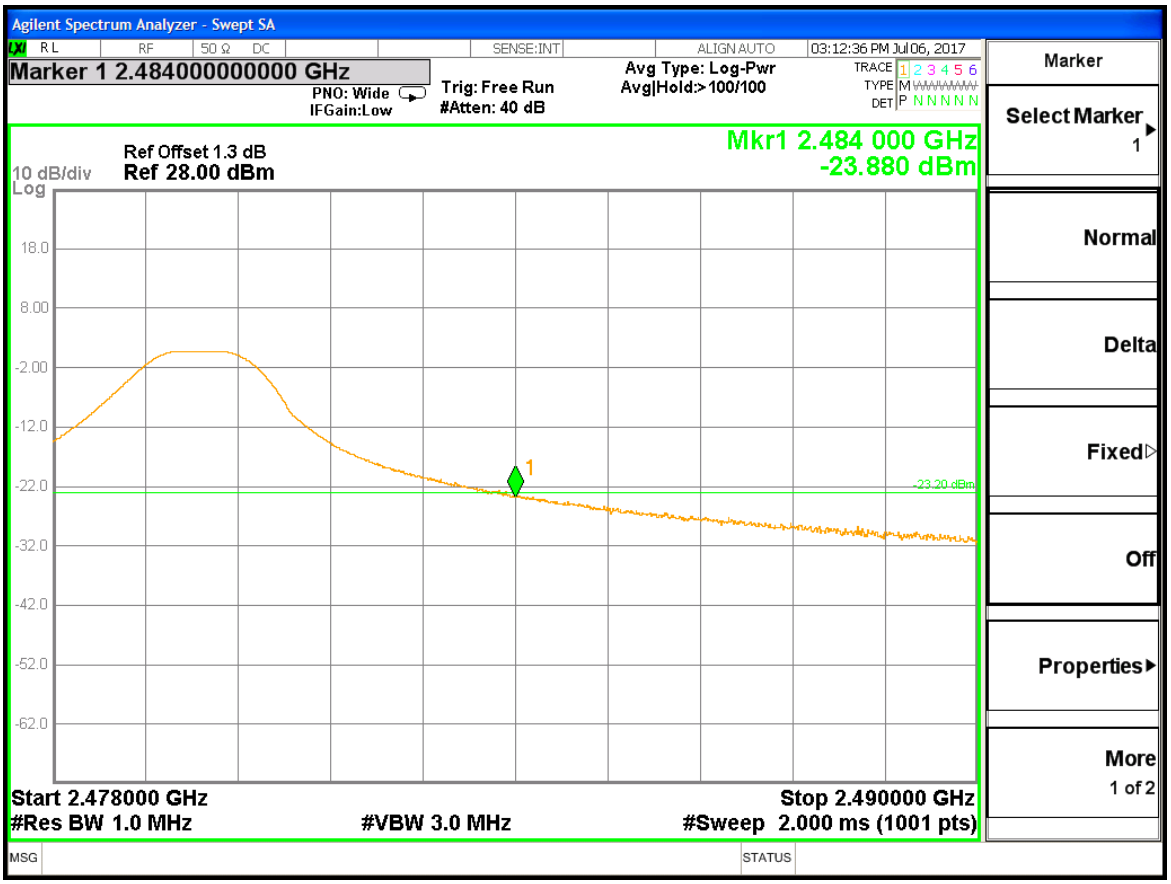

Figure 15: High Channel Restricted Band Edge Peak Detector– BT LE

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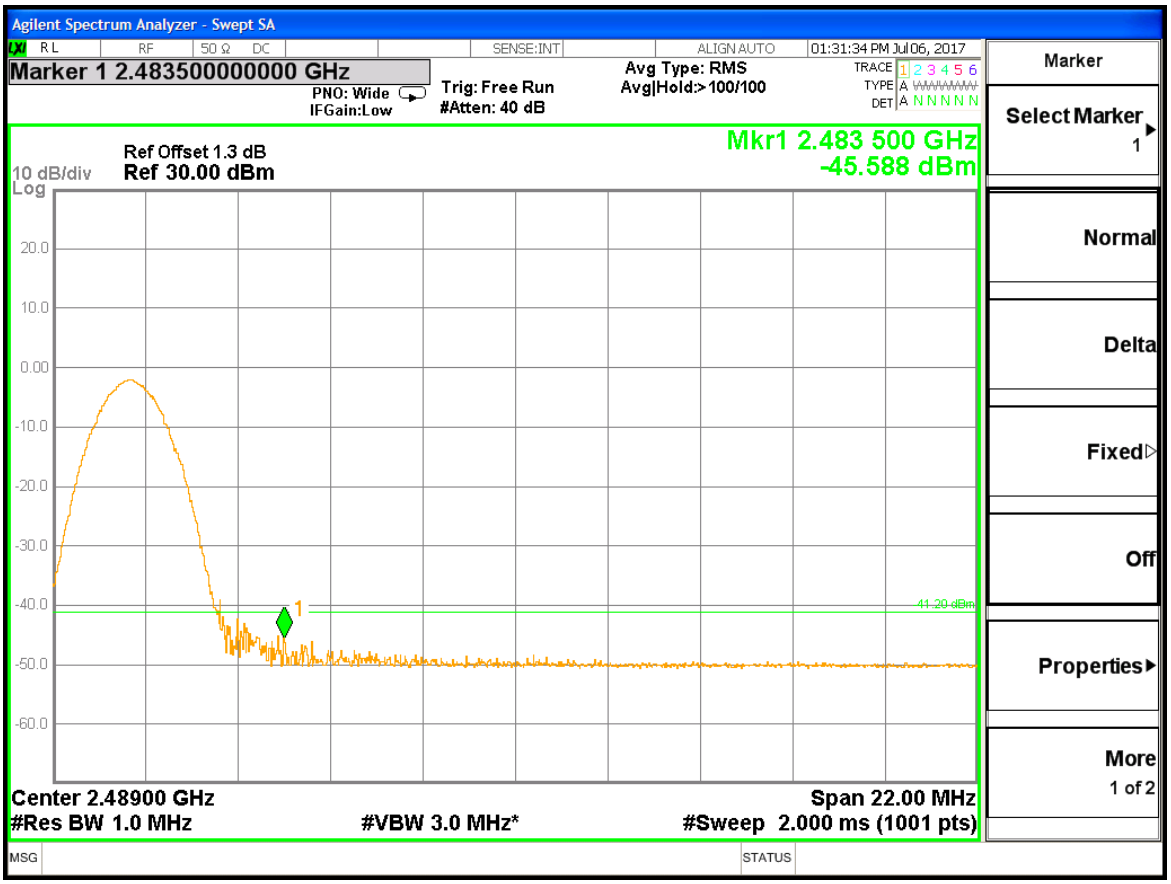


Note: Measurement does not include duty cycle correction factor of 2.1 dB

Figure 16: High Channel Restricted Band Edge RMS Detector– BT LE

4.5 Transmitter Radiated Spurious Emissions

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmit mode; per requirement of CFR47 15.205, 15.209, 15.247(d).

4.5.1 Test Methodology

4.5.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emissions test procedure. The frequency range of interest was divided into sub-ranges. For each sub-range peak emission data was recorded and plotted while the turntable was rotated 360° in 90° steps and the measurement antenna was rotated in horizontal and vertical antenna polarization.

Preliminary emission profile testing was performed inside a semi-anechoic chamber. The EUT was placed on a non-conductive table 80 cm above the floor for emissions less than 1 GHz and 150cm above the floor for emissions greater than 1 GHz. The EUT was positioned as shown in the setup photographs. The measurement antenna was placed at a distance of 3m.

4.5.1.2 Final Test

Final testing was performed on an NSA compliant test site.

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. Emissions within 20 dB of the limit were measured.

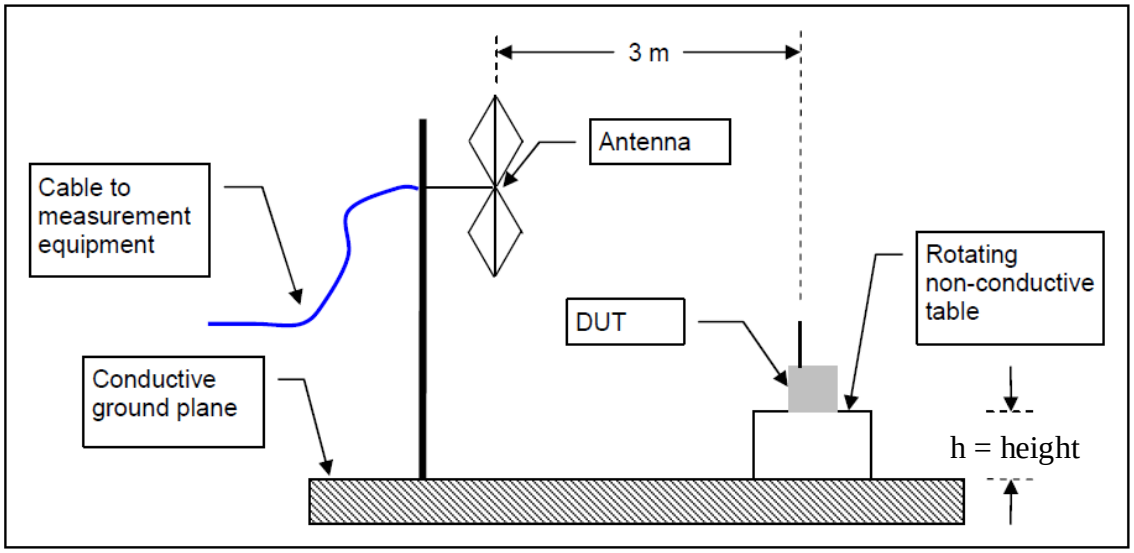
Substitution measurements are done for emissions within 10 dB of the limit.

The final scans were performed on the worst EUT axis for three operating channels in the operating mode with the highest power.

4.5.1.3 Deviations

None.

Test Setup:



Where h = 80cm for <1GHz and 150cm for >1GHz

4.5.2 Transmitter Spurious Emission Limit

The spurious emissions of the transmitter shall not exceed the values in CFR47 Part 15.205, 15.209.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490.....	2400/F(kHz)	300
0.490-1.705.....	24000/F(kHz)	30
1.705-30.0.....	30	30
30-88.....	100 **	3
88-216.....	150 **	3
216-960.....	200 **	3
Above 960.....	500	3

All harmonics and spurious emission which are outside of the restricted band shall be 20dB below the in-band emission.

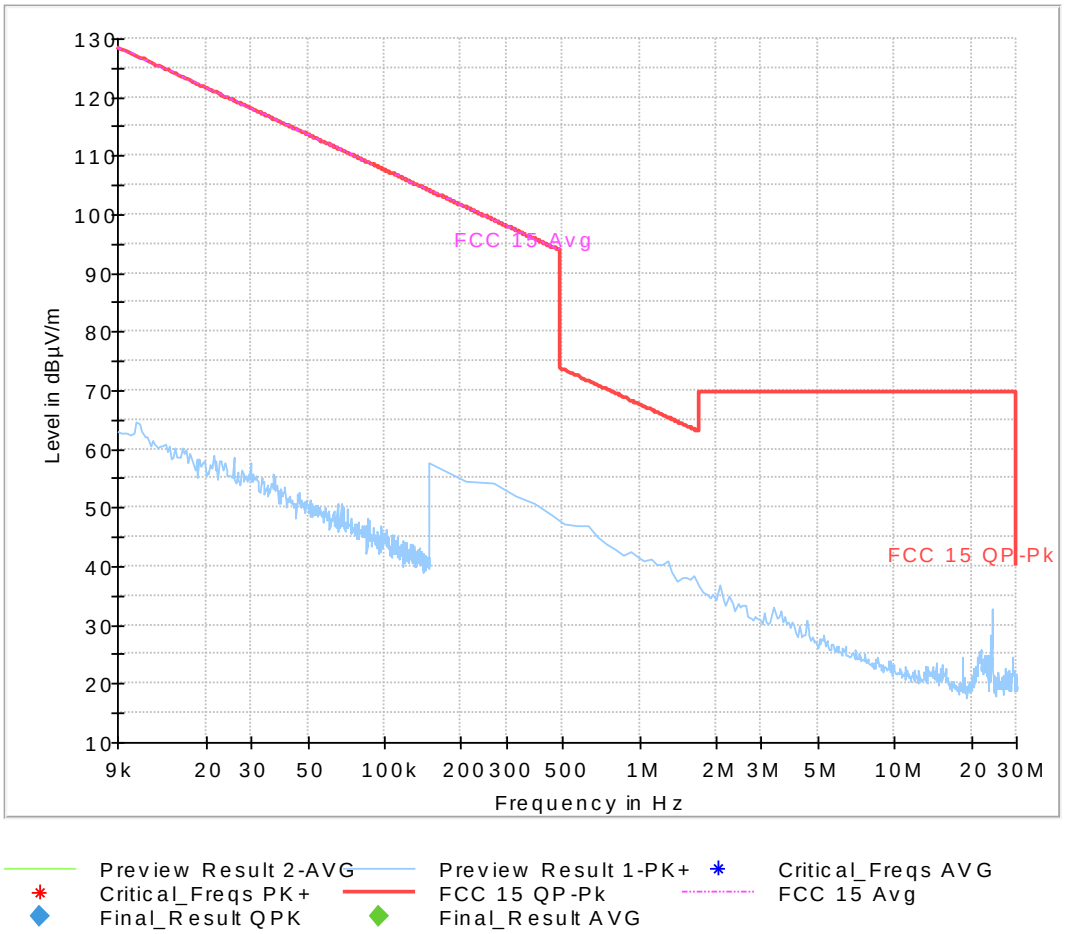
4.5.3 Test Results

The final measurement data was taken under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and test plan.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

SOP 1 Radiated Emissions			Page 1 of 14
EUT Name	Flash	**Date**	July 7, 2017
EUT Model	FLASHV1	**Temp / Hum in**	24° C / 34%rh
EUT Serial	P4 #3	**Temp / Hum out**	N/A
EUT Config.	2440MHz – BT LE	**Line AC / Freq**	120 VAC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	<150KHz: 300Hz/1kHz 150KHz-30MHz: 10KHz/30KHz
Dist/Ant Used	3m / 6502	**Performed by**	Douglas Antioco

9KHz-30MHz Transmit at 2440 MHz (Mid Channel)



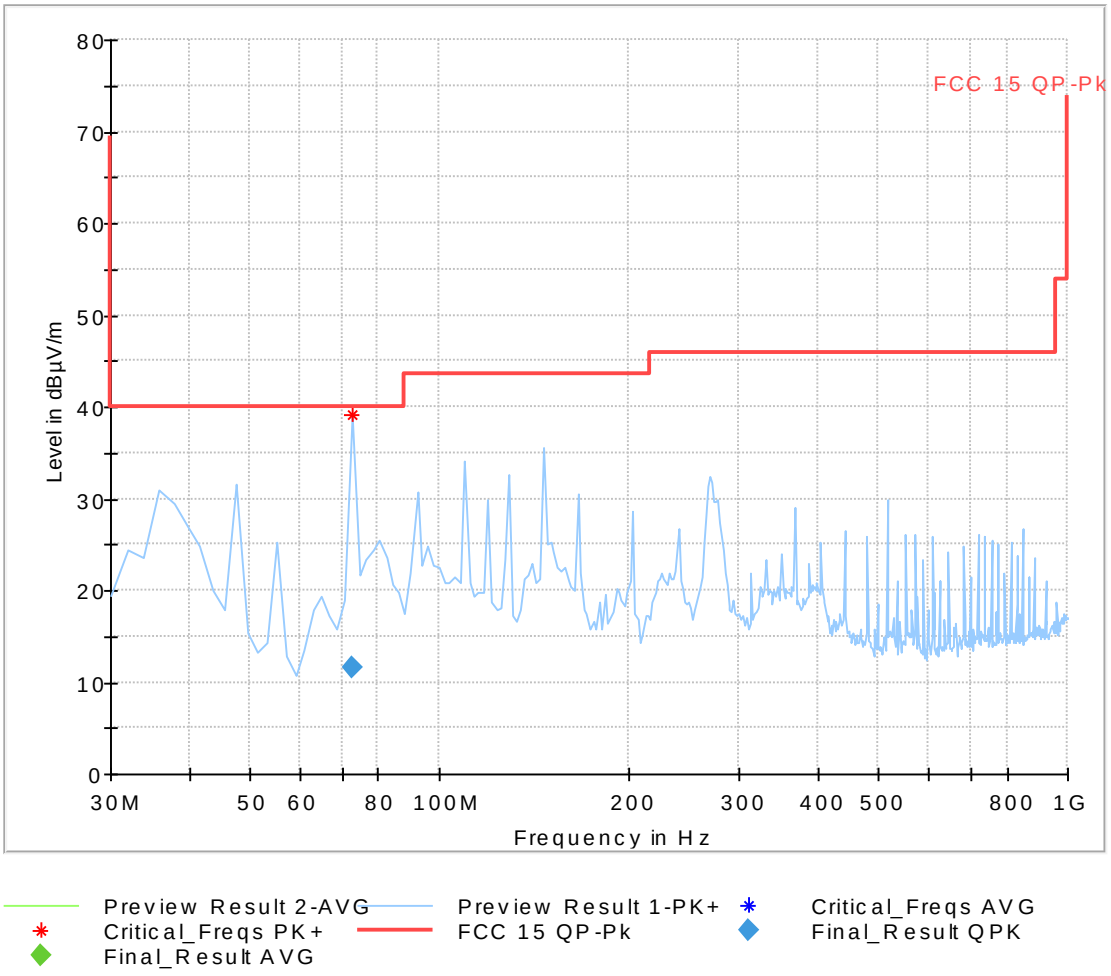
Note:

SOP 1 Radiated Emissions

EUT Name	Flash	**Date**	July 7, 2017
EUT Model	FLASHV1	**Temp / Hum in**	21° C / 37%rh
EUT Serial	P4 #3	**Temp / Hum out**	N/A
EUT Config.	2402MHz - BLE	**Line AC / Freq**	120 VAC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	100KHz/ 300KHz
Dist/Ant Used	3m/ JB3	**Performed by**	Douglas Antioco

30MHz– 1 GHz Transmit at 2402 MHz (Low Channel)

Frequency (MHz)	QuasiPeak (dBµV/m)	Corr. (dB)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
72.5	11.52	-23.5	40.00	28.48	2.0	100.000	100.0	V	182.0



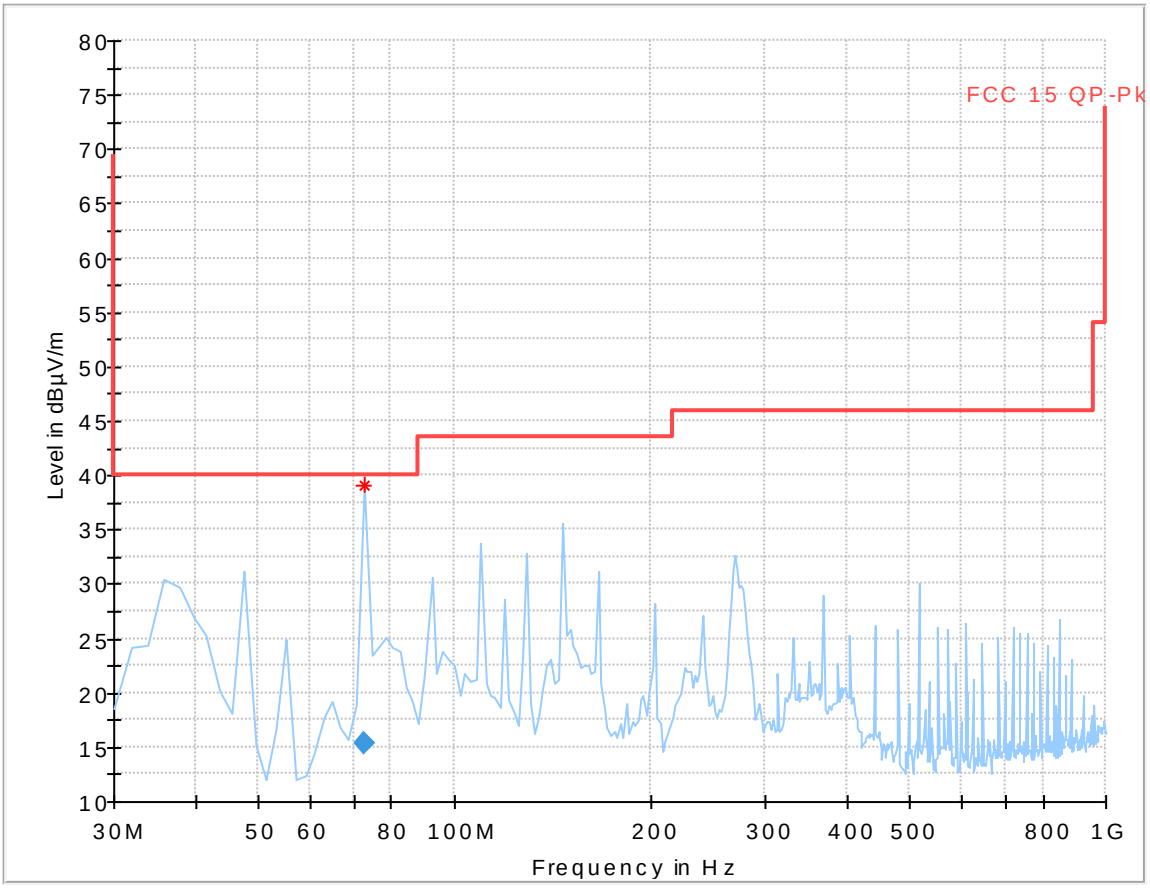
Note:

SOP 1 Radiated Emissions

EUT Name	Flash	**Date**	July 7, 2017
EUT Model	FLASHV1	**Temp / Hum in**	21° C / 37%rh
EUT Serial	P4 #3	**Temp / Hum out**	N/A
EUT Config.	2440MHz - BLE	**Line AC / Freq**	120 VAC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	100KHz/ 300KHz
Dist/Ant Used	3m/ JB3	**Performed by**	Douglas Antioco

30MHz-1GHz Transmit at 2440 MHz (Mid Channel)

Frequency (MHz)	QuasiPeak (dBµV/m)	Corr. (dB)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
72.9	**15.41**	**-23.5**	**40.00**	**24.59**	**2.0**	**100.000**	**100.0**	**V**	**191.0**



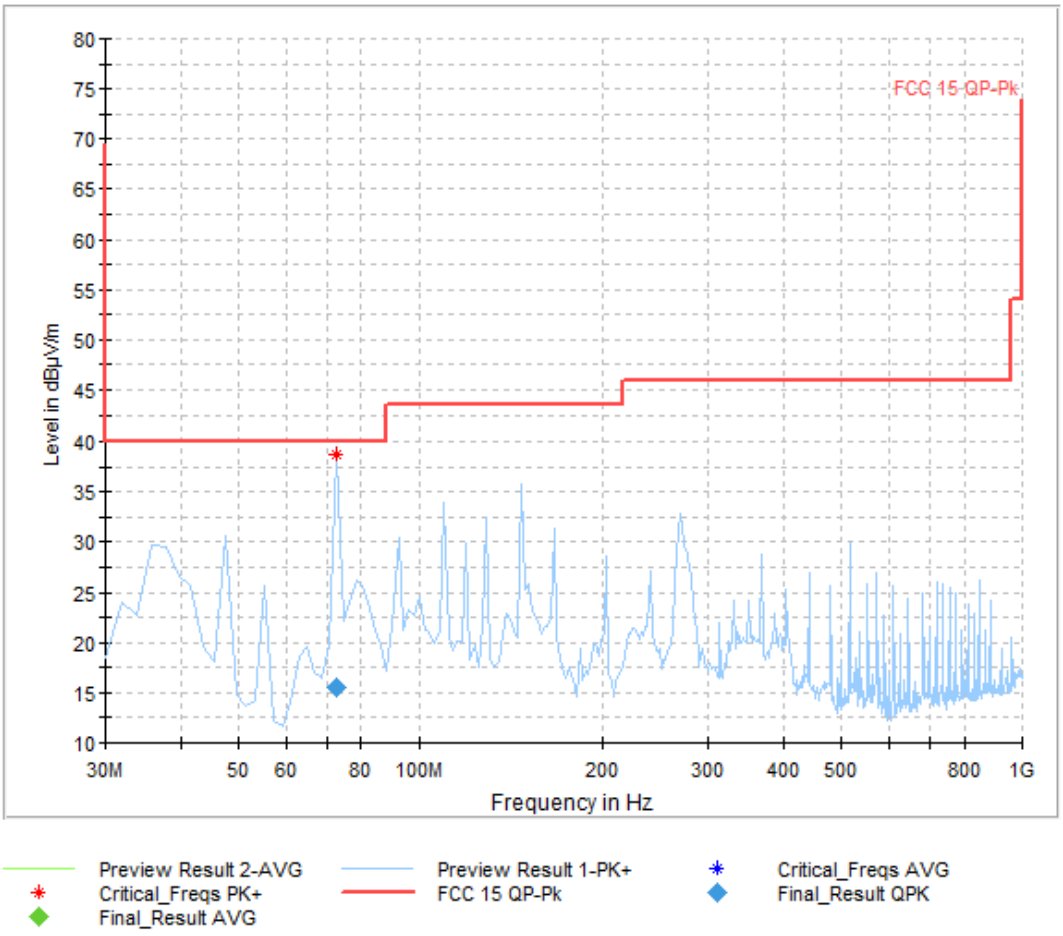
Note:

SOP 1 Radiated Emissions

EUT Name	Flash	**Date**	July 7, 2017
EUT Model	FLASHV1	**Temp / Hum in**	21° C / 37%rh
EUT Serial	P4 #3	**Temp / Hum out**	N/A
EUT Config.	2480MHz - BLE	**Line AC / Freq**	120 VAC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	100KHz/ 300KHz
Dist/Ant Used	3m/ JB3	**Performed by**	Douglas Antioco

30MHz-1GHz Transmit at 2480 MHz (High Channel)

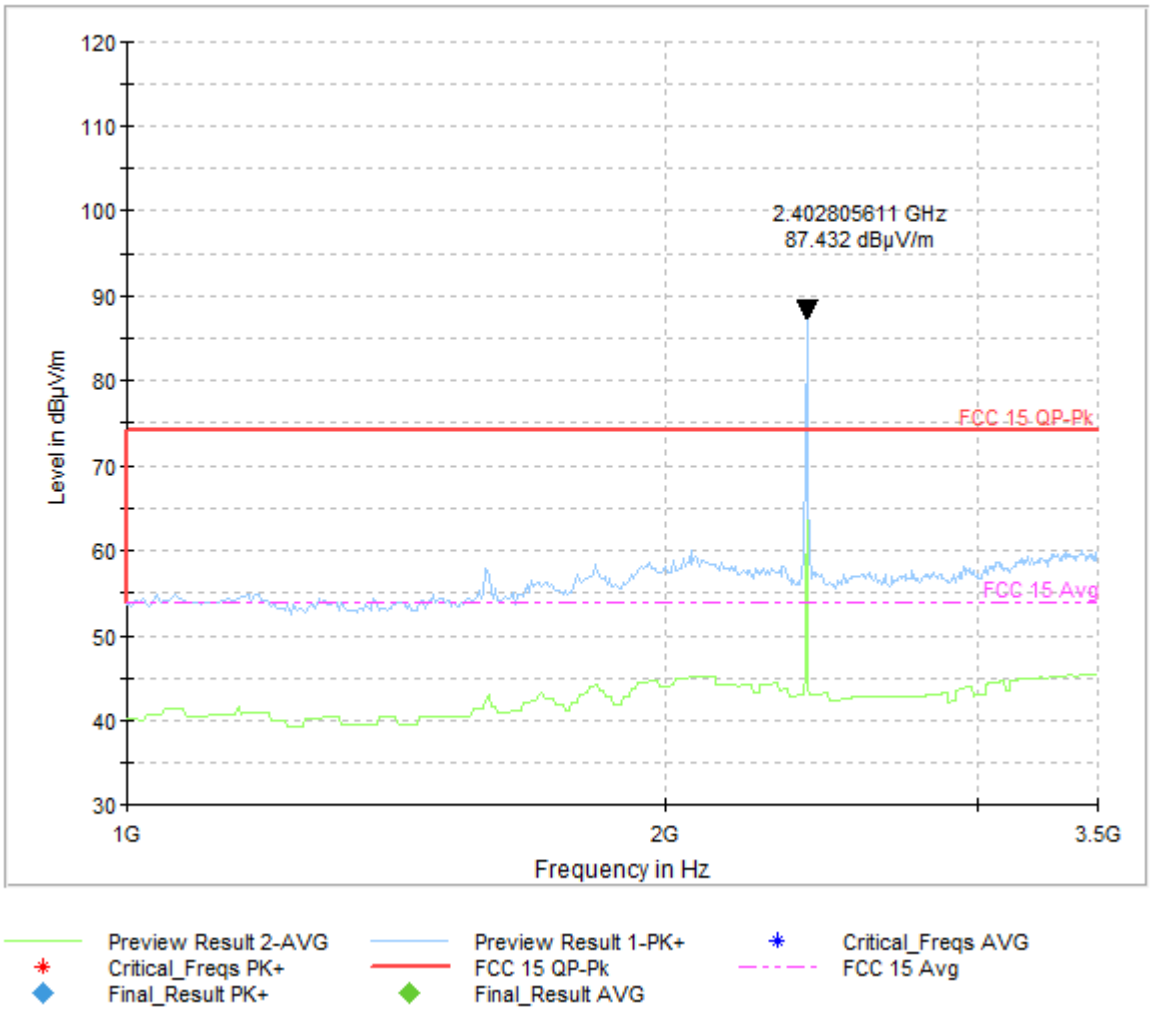
Frequency (MHz)	QuasiPeak (dBµV/m)	Corr. (dB)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
72.9	15.53	-23.5	40.00	24.47	2.0	100.000	100.0	V	204.0



Note:

SOP 1 Radiated Emissions			Page 5 of 14
EUT Name	Flash	**Date**	July 7, 2017
EUT Model	FLASHV1	**Temp / Hum in**	20° C / 34%rh
EUT Serial	P4 #3	**Temp / Hum out**	N/A
EUT Config.	2402MHz - BLE	**Line AC / Freq**	120VAC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m/EMCO3115	**Performed by**	Douglas Antioco

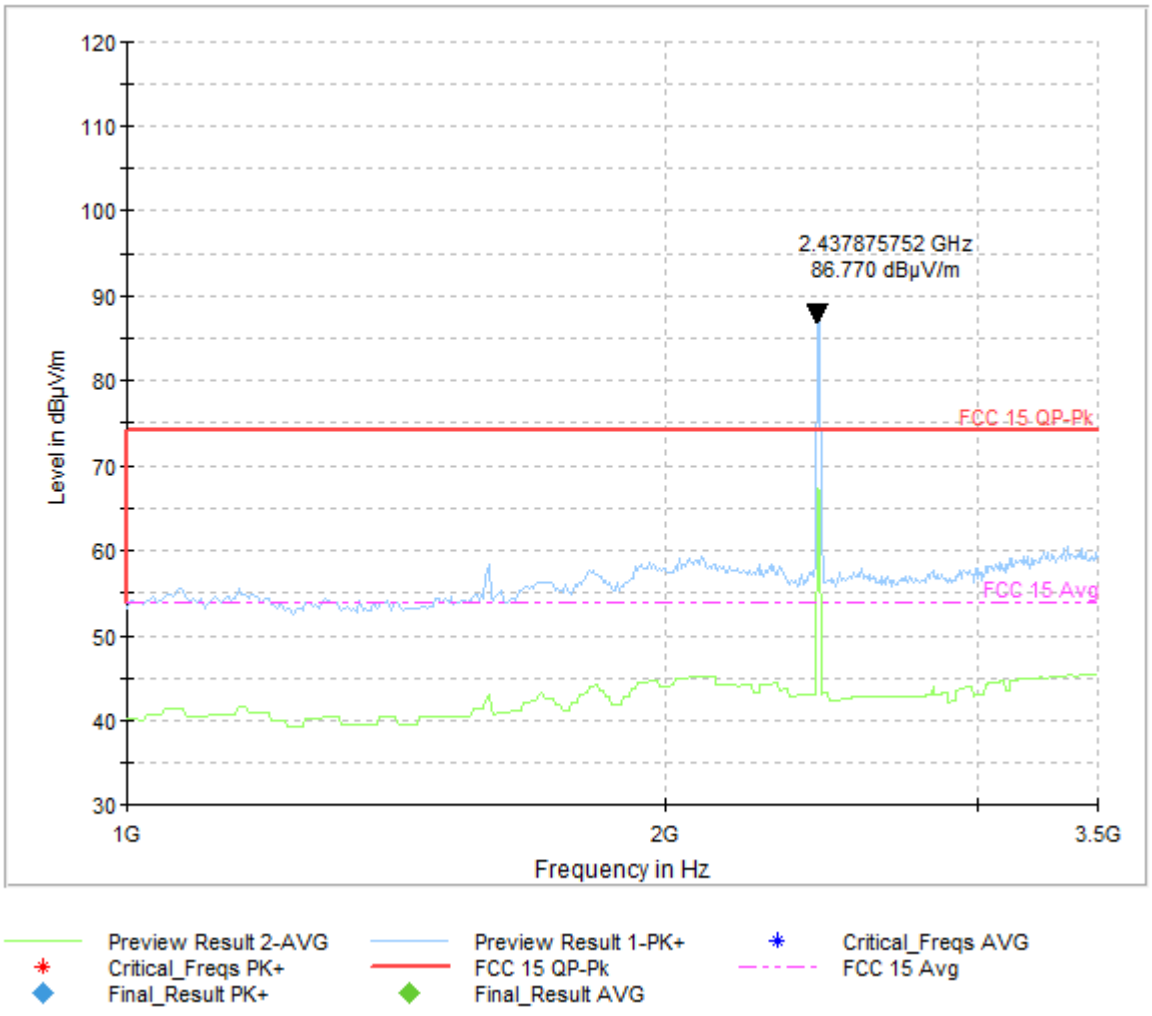
1 – 3.5 GHz Transmit at 2402 MHz (Low Channel)



Note:

SOP 1 Radiated Emissions			Page 6 of 14
EUT Name	Flash	**Date**	July 7, 2017
EUT Model	FLASHV1	**Temp / Hum in**	20° C / 34%rh
EUT Serial	P4 #3	**Temp / Hum out**	N/A
EUT Config.	2440MHz - BLE	**Line AC / Freq**	120VAC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m/EMCO3115	**Performed by**	Douglas Antioco

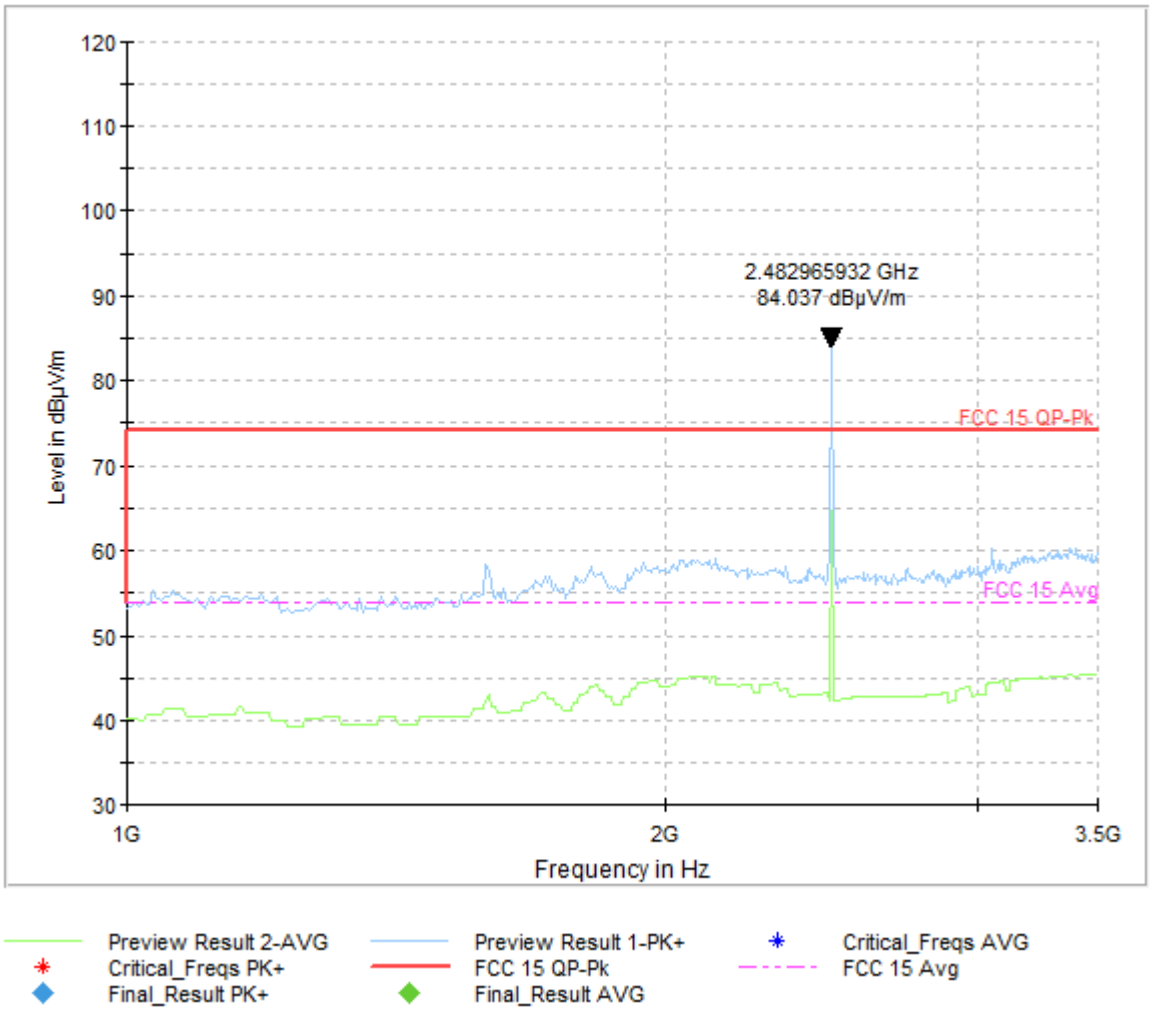
1-3.5 GHz Transmit at 2440 MHz (Mid Channel)



Note:

SOP 1 Radiated Emissions			Page 7 of 14
EUT Name	Flash	**Date**	July 7, 2017
EUT Model	FLASHV1	**Temp / Hum in**	20° C / 34%rh
EUT Serial	P4 #3	**Temp / Hum out**	N/A
EUT Config.	2480MHz - BLE	**Line AC / Freq**	120VAC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m/EMCO3115	**Performed by**	Douglas Antioco

1-3.5 GHz Transmit at 2480 MHz (High Channel)



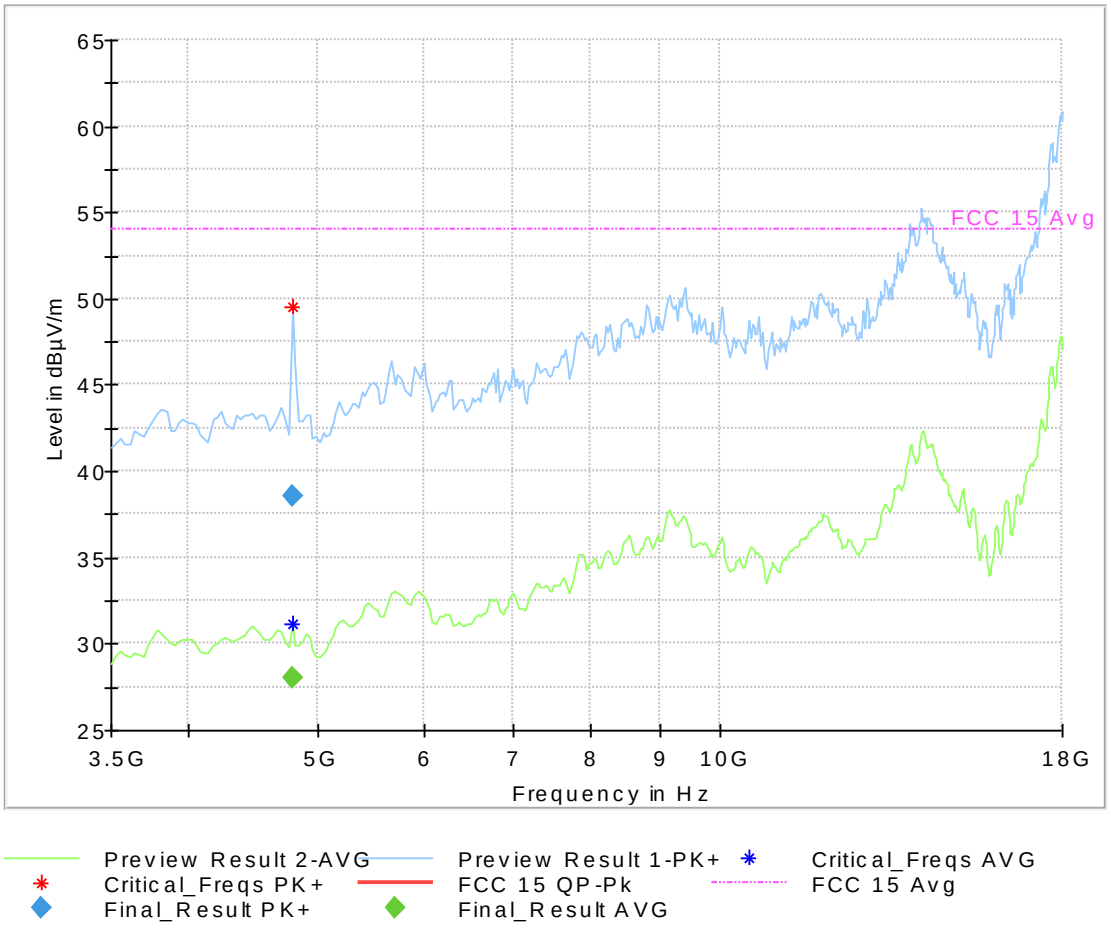
Note:

SOP 1 Radiated Emissions

EUT Name	Flash	**Date**	July 7, 2017
EUT Model	FLASHV1	**Temp / Hum in**	24° C / 34%rh
EUT Serial	P4 #3	**Temp / Hum out**	N/A
EUT Config.	2402MHz – BT LE	**Line AC / Freq**	120VAC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m/EMCO3115	**Performed by**	Douglas Antioco

3.5 – 18 GHz Transmit at 2402MHz

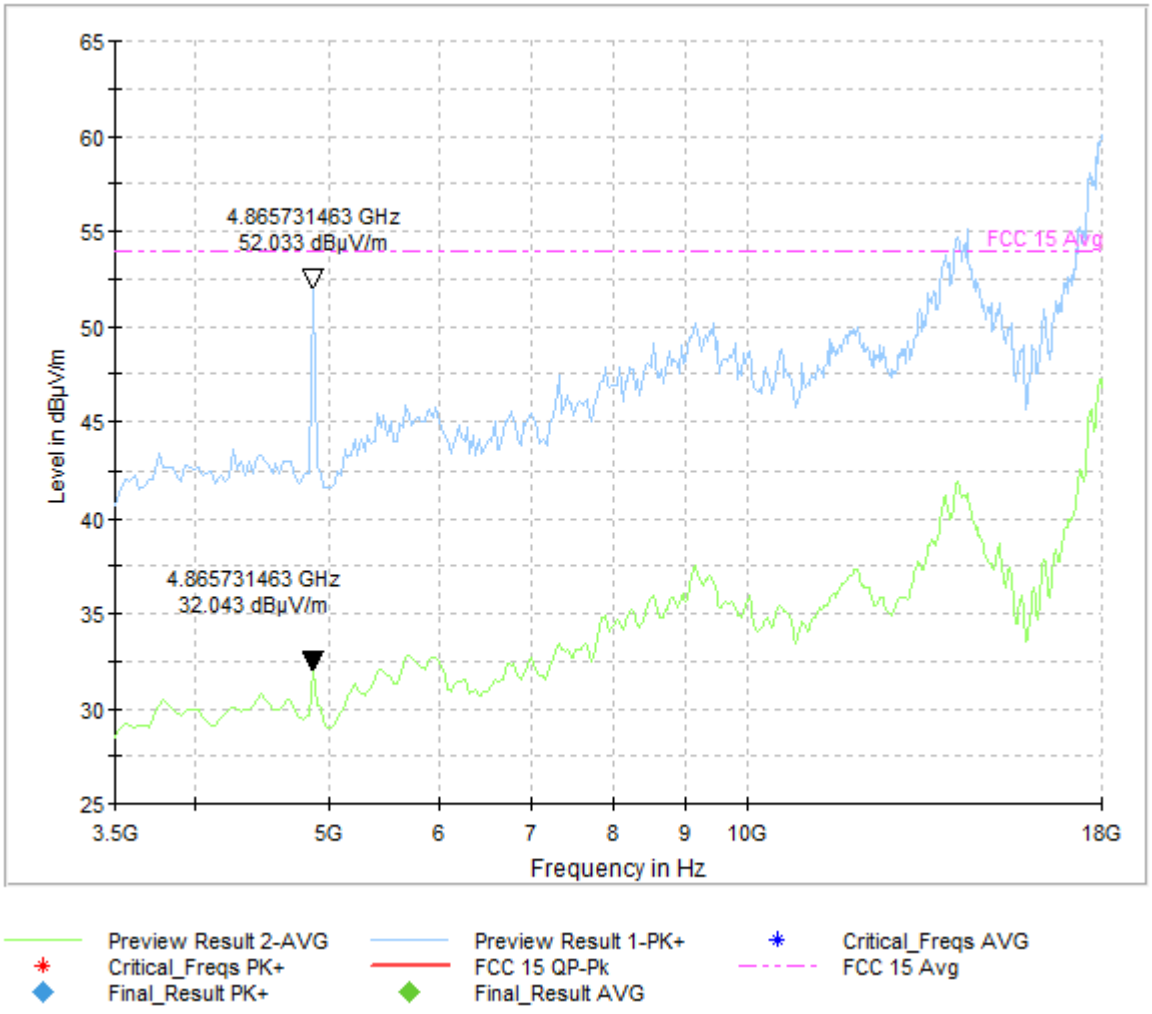
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Corr. (dB)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
4780.8	-	28.04	-15.5	54.00	25.96	2.0	1000.000	269.6	V	240.0
4781.3	38.60	-	-15.5	74.00	35.40	2.0	1000.000	400.3	V	296.0



Note: 1.

SOP 1 Radiated Emissions			Page 9 of 14
EUT Name	Flash	**Date**	July 7, 2017
EUT Model	FLASHV1	**Temp / Hum in**	21° C / 37%rh
EUT Serial	P4 #3	**Temp / Hum out**	N/A
EUT Config.	2440MHz – BT LE	**Line AC / Freq**	120VAC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m/EMCO3115	**Performed by**	Douglas Antioco

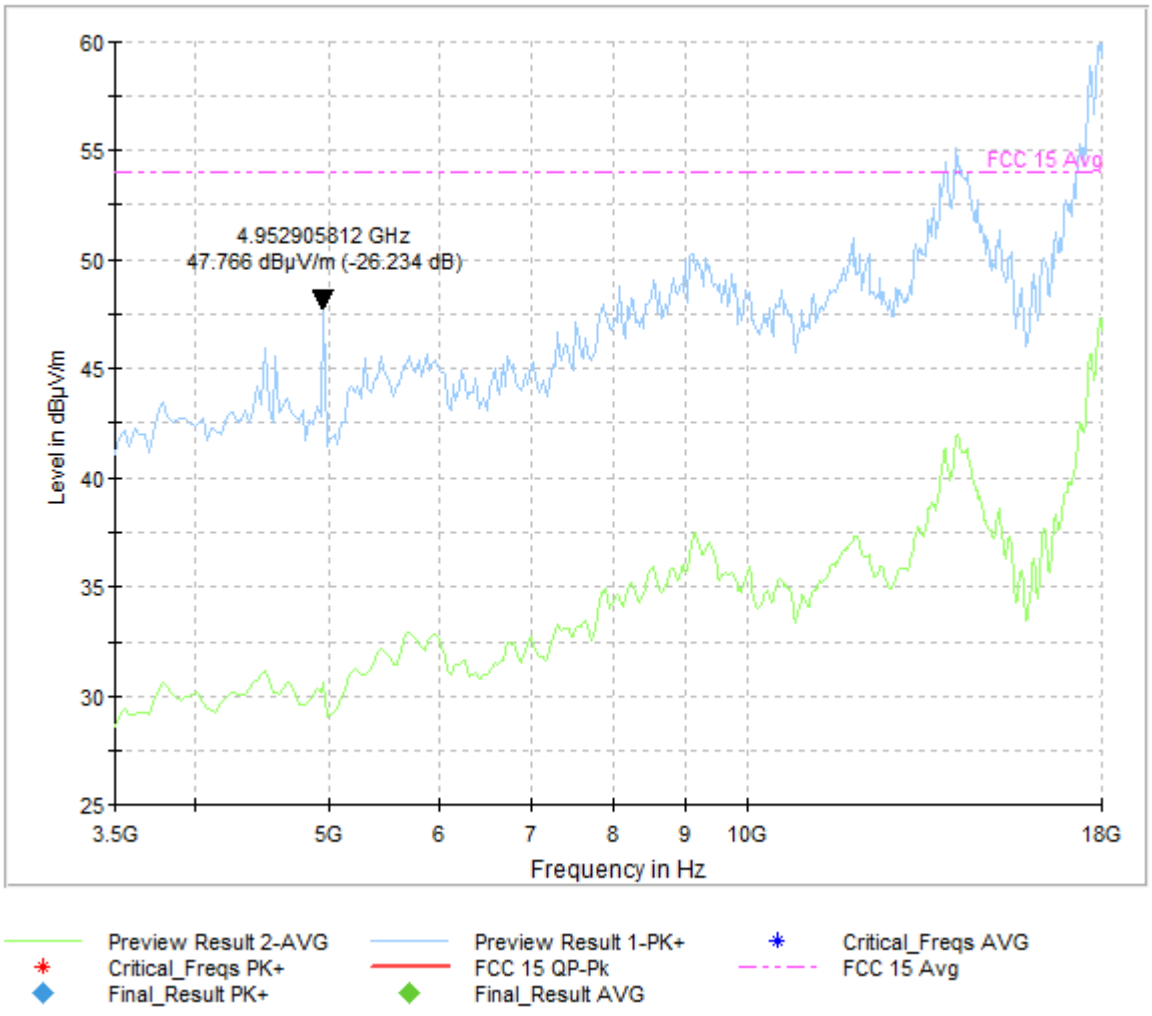
3.5 - 18 GHz Transmit at 2440 MHz (Mid Channel)



Note:

SOP 1 Radiated Emissions			Page 10 of 14
EUT Name	Flash	**Date**	July 7, 2017
EUT Model	FLASHV1	**Temp / Hum in**	21° C / 37%rh
EUT Serial	P4 #3	**Temp / Hum out**	N/A
EUT Config.	2480MHz – BT LE	**Line AC / Freq**	120VAC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m/EMCO3115	**Performed by**	Douglas Antioco

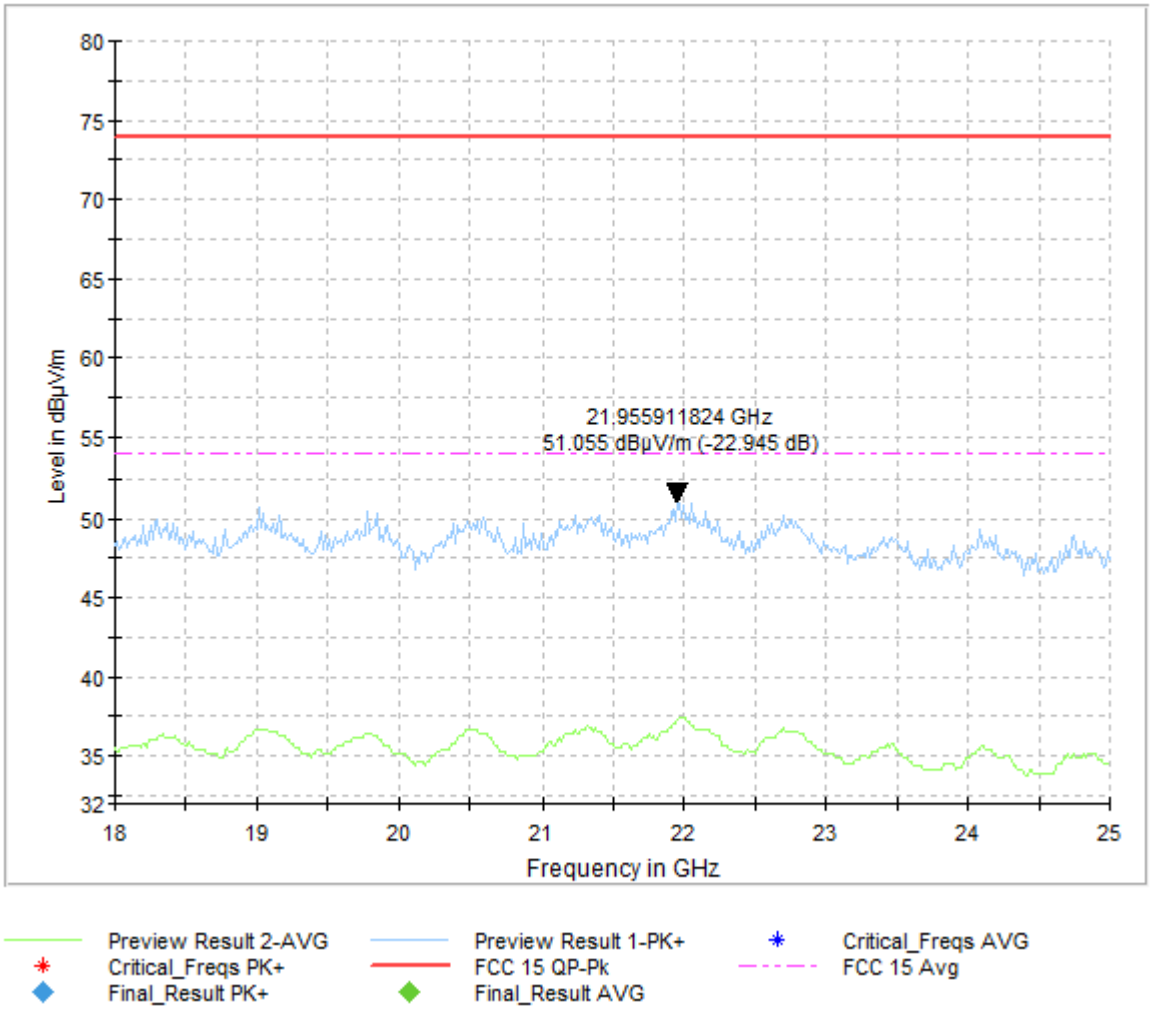
3.5 – 18 GHz Transmit at 2480 MHz (High Channel)



Note:

SOP 1 Radiated Emissions			Page 11 of 14
EUT Name	Flash	**Date**	July 7, 2017
EUT Model	FLASHV1	**Temp / Hum in**	21° C / 37%rh
EUT Serial	P4 #3	**Temp / Hum out**	N/A
EUT Config.	2402MHz – BT LE	**Line AC / Freq**	120VAC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	1m – AHA-840	**Performed by**	Douglas Antioco

18-25 GHz Transmit at 2440 MHz (Mid Channel)



Note:

4.6 AC Conducted Emissions

Testing was performed in accordance with ANSI C63.4: 2014. These test methods are listed under the laboratory's A2LA Scope of Accreditation.

This test measures the levels emanating from the EUT's AC input port, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

The AC conducted emissions of equipment under test shall not exceed the values in CFR47 Part 15.207.

4.6.1 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into sub-ranges such as to yield a frequency resolution of 9 kHz. Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of 50µH / 50Ω LISNs.

Testing is performed in Lab 5. The setup photographs clearly identify which site was used. The vertical ground plane used in the semi-anechoic chamber is a 2m x 2m solid aluminum frame and panel, and it is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN.

4.6.1.1 Deviations

There were no deviations from this test methodology.

4.6.2 Test Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 6: AC Conducted Emissions – Test Results

SOP 2 Conducted Emissions

EUT Name	Flash	**Date**	10 July 2017
EUT Model	FLASHV1	**Temp / Hum in**	23° C / 37% rh
EUT Serial	P4 #3	**Temp / Hum out**	N/A
EUT Config.	Continuous Tx Mid Channel (19)	**Line AC / Freq**	120Vac / 60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9 kHz / 30 kHz
Lab/LISN	Lab #5 /Com-Power	**Performed by**	Douglas Antioco

Neutral									
Frequency	Raw	Limiter	Ins. Loss	Level	Detector	Line	Limit	Margin	Result
MHz	dBuV	dB	dB	dBuV		Line	dBuV	dB	
0.150	37.20	9.82	0.06	47.08	QP	Neutral	66.00	-18.92	Pass
0.150	18.80	9.82	0.06	28.68	Ave	Neutral	56.00	-27.32	Pass
0.232	26.17	9.83	0.04	36.04	QP	Neutral	62.37	-26.32	Pass
0.232	9.43	9.83	0.04	19.30	Ave	Neutral	52.37	-33.07	Pass
0.329	16.55	9.83	0.03	26.41	QP	Neutral	59.46	-33.05	Pass
0.329	3.72	9.83	0.03	13.58	Ave	Neutral	49.46	-35.88	Pass
0.378	12.31	9.84	0.03	22.18	QP	Neutral	58.32	-36.14	Pass
0.378	3.41	9.84	0.03	13.28	Ave	Neutral	48.32	-35.04	Pass
23.891	13.40	10.08	-0.06	23.42	QP	Neutral	60.00	-36.58	Pass
23.891	5.30	10.08	-0.06	15.32	Ave	Neutral	50.00	-34.68	Pass
24.011	17.52	10.08	-0.06	27.54	QP	Neutral	60.00	-32.46	Pass
24.011	15.00	10.08	-0.06	25.02	Ave	Neutral	50.00	-24.98	Pass
Line									
0.157	36.15	9.82	0.05	46.02	QP	Live	65.60	-19.58	Pass
0.157	18.10	9.82	0.05	27.97	Ave	Live	55.60	-27.62	Pass
0.187	31.32	9.82	0.04	41.19	QP	Live	64.15	-22.96	Pass
0.187	16.61	9.82	0.04	26.48	Ave	Live	54.15	-27.67	Pass
0.221	27.76	9.83	0.04	37.63	QP	Live	62.78	-25.15	Pass
0.221	12.85	9.83	0.04	22.72	Ave	Live	52.78	-30.06	Pass
0.326	17.33	9.83	0.03	27.19	QP	Live	59.56	-32.36	Pass
0.326	4.01	9.83	0.03	13.88	Ave	Live	49.56	-35.68	Pass
0.393	11.97	9.84	0.03	21.84	QP	Live	58.00	-36.16	Pass
0.393	1.31	9.84	0.03	11.18	Ave	Live	48.00	-36.82	Pass
24.011	16.89	10.08	-0.06	26.91	QP	Live	60.00	-33.09	Pass
24.011	14.33	10.08	-0.06	24.35	Ave	Live	50.00	-25.65	Pass

Spec Margin = QP./Ave. - Limit, ± Uncertainty

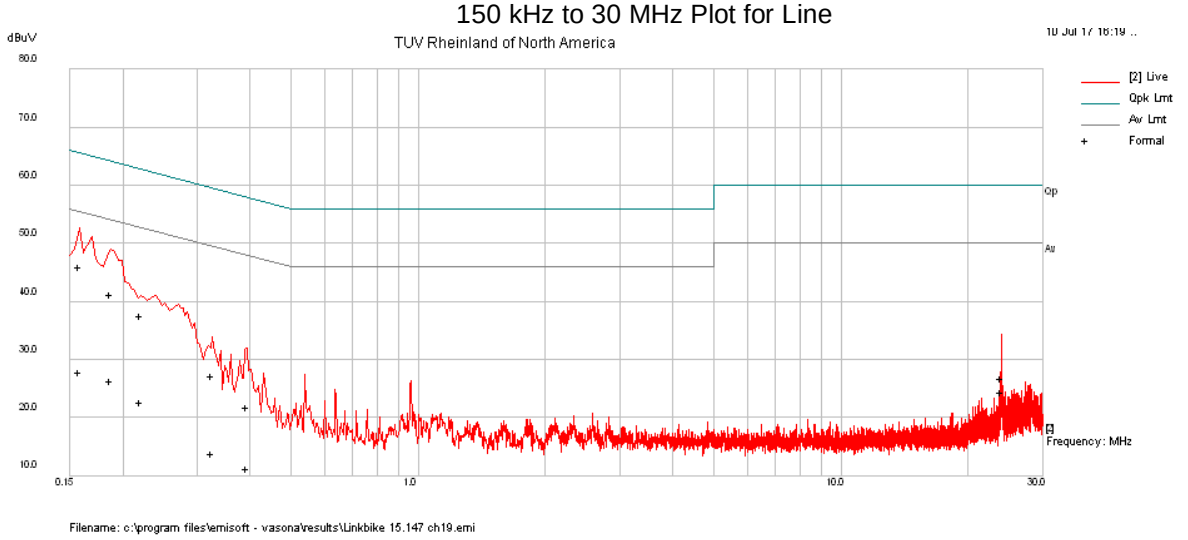
Combined Standard Uncertainty $u_c(y)$ = ± 1.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

SOP 2 Conducted Emissions

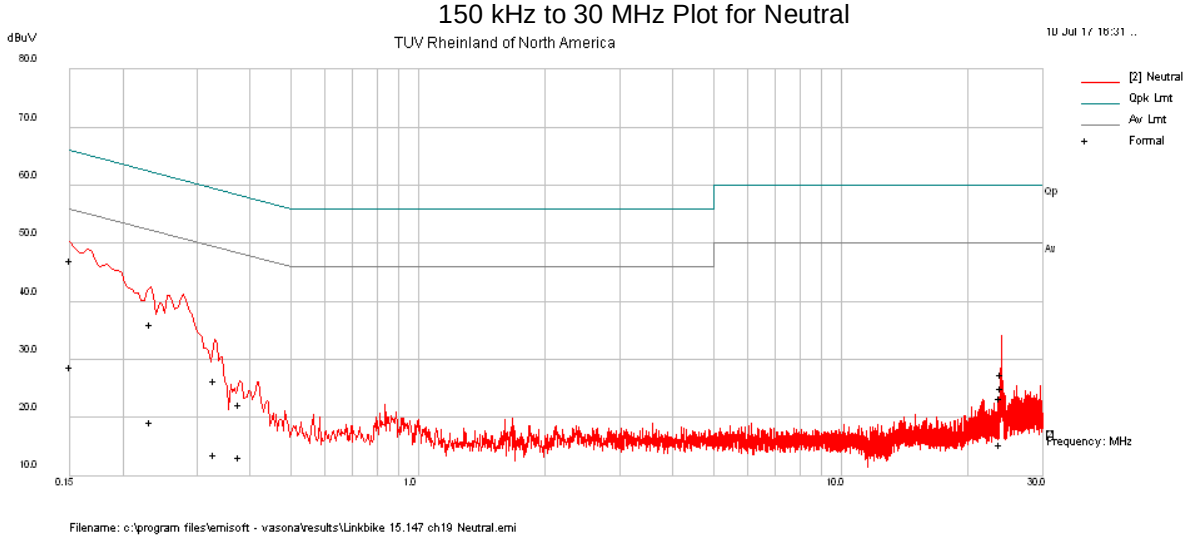
EUT Name	Flash	**Date**	10 July 2017
EUT Model	FLASHV1	**Temp / Hum in**	23° C / 37% rh
EUT Serial	6854F5F8FB30	**Temp / Hum out**	N/A
EUT Config.	Continuous Tx Mid Channel (19)	**Line AC**	120Vac / 60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9 kHz / 30 kHz
Lab/LISN	Lab #5 /Com-Power, Line 1	**Performed by**	Douglas Antioco

150 kHz to 30 MHz Plot for Line



Filename: c:\program files\emisoft - vasona\results\Linkbike 15.147 ch19.emi

150 kHz to 30 MHz Plot for Neutral



Filename: c:\program files\emisoft - vasona\results\Linkbike 15.147 ch19 Neutral.emi

5 Test Equipment List

5.1 Equipment List

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal mm/dd/yyyy	Next Cal mm/dd/yyyy
Bilog Antenna	Sunol Sciences	JB3	A102606	06/15/2016	06/15/2018
Horn Ant. (1-18GHz)	EMCO	3115	9710-5301	10/08/2015	10/08/2017
Antenna (18-40 GHz)	Com-Power	AHA-840	105005	07/08/2015	07/08/2017
Spectrum Analyzer	Agilent	N9030A	US51350291	01/17/2017	01/17/2018
Active Loop Antenna	EMCO	6502	00062531	05/17/2017	05/17/2019
Preamplifier	Sonoma Instruments	310	185516	01/19/2017	01/19/2018
Preamplifier	Miteq	8449B	2020728	11/12/2016	11/12/2017
Notch Filter	Micro-Tronics	BRM50716	037	07/29/2016	07/29/2017
EMI Receiver	Rohde & Schwarz	ESIB 40	100180	04/28/2017	04/28/2018
Transient Limiter	HP	11947A	2820A00154	01/18/2017	01/18/2018
LISN	Com-Power	LI-200	12100	01/16/2017	01/16/2018

6 EMC Test Plan

6.1 Introduction

This section provides a description of the Equipment Under Test (EUT), configurations, operating conditions, and performance acceptance criteria. It is an overview of information provided by the manufacturer so that the test laboratory may perform the requested testing.

6.2 Customer

Table 7: Customer Information

Company Name	KPZ, inc
Address	918 S Horton St, Unit 912
City, State, Zip	Seattle, WA 98134
Country	USA

6.3 Equipment Under Test (EUT)

Table 8: EUT Specifications

EUT Specification	
Power Input	120 VAC
Number of Antenna Feeds:	Transmit: 1 Receive: 1
Hardware Version	1.0
RF Software Version	1.0
Radio Evaluated	Bluetooth Low Energy (LE)
Transmit Frequency Band	2400-2484.5MHz
Max. Power Output for Technology	1.4 dBm (Measured, Conducted)
Antenna Gain	0 dBi
Antenna Type	PCB Trace Antenna
Modulation Type	GFSK
Type of Equipment	☐ Table Top ☐ Wall-mount ☐ Floor standing cabinet ☒ Other: Bicycle

Table 9: Antenna Information

Number	Antenna Type	Description	Max Gain (dBi)
1	Internal	PCB	0.0

Table 10: Interface Specifications

Interface Type	Cabled with what type of cable?	Is the cable shielded?	Maximum potential length of the cable?	Metallic (M), Coax (C), Fiber (F), or Not Applicable?
Serial	RS232	No	Not specified	Not Applicable

Table 11: Support Equipment

Equipment	Manufacturer	Model	Serial	Used for
Laptop	Lenovo	75Y4442	R9-AXV2F 11/01	Configure channel
Note: None.				

Table 12: Description of Sample used for Testing

Device	Serial	RF Connection	CFR47 Part 15.247
FLASHV1	P4 #3	Integrated Antenna, RF connector	Radiated and Conducted Unit

Table 13 Accessory Equipment

Equipment	Manufacturer	Model	Serial Number
Power Supply	Sans Electronic Co, LTD	SSLCO84V42M	SS170201170042

6.4 Testing Notes:

The EUT's BT LE radio was stimulated for continuous transmission on all applicable channels via scripts that were toggled by a laptop through the terminal emulator "Tera Term."

END OF REPORT