TÜVRheinland®
Precisely Right.

Emissions
Test Report

EUT Name: FreeStyle Libre 3

Model Name: PRT28985-244

CFR 47 Part 15.247: 2020 and RSS 247: 2017

Prepared for:

Abbott Diabetes Care
1360 South Loop Rd
Alameda, CA 94502, U.S.A.

Prepared by:

TUV Rheinland of North America, Inc.
5015 Brandin Ct.
Fremont, CA 94538
Tel: (925) 249-9123
Fax: (925) 249-9124
http://www.tuv.com/

Report/Issue Date: April 6, 2021
Report Number: US21W1NJ 001
Revision Number: 1
Project Number: P00080915

Revisions

Revision No.	Date MM/DD/YYYY	Reason for Change	Author
0	03/23/2021	Original Document	RK
1	04/06/2021	Updated model name	RK

Note: Latest revision report will replace all previous reports.

Statement of Compliance

Manufacturer:	Abbott Diabetes Care 1360 South Loop Rd. Alameda, CA 94502
Requester / Applicant:	Abbott Diabetes Care
Name of Equipment:	FreeStyle Libre 3
Model Name.	PRT28985-244
Type of Equipment:	Intentional Radiator
Application of Regulations:	CFR 47 Part 15.247: 2020 and RSS 247: 2017
Test Dates:	March 15, 2021 to March 18, 2021

Guidance Documents:

Emissions: ANSI C63.10-2013, KDB 558074 D01 DTS Measurement Guidance v05r02

Test Methods:

Emissions: ANSI C63.10-2013, KDB 558074 D01 DTS Measurement Guidance v05r02

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 shall not be reproduced except in full, without the written authorization of TUV Rheinland of North America.

Rachana Khanduri		Richard Decker	
Test Engineer	Date April 6, 2021	Reviewer Signatory	Date April 6, 2021

Testing Cert #3331.02 **US1131** **2932D**

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: 2020 and RSS 247 Issue 2, 2017 based on the results of testing performed from March 15, 2021 through March 18, 2021, on the FreeStyle Libre 3, Model PRT28985-244 manufactured by Abbott Diabetes Care. 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 2402 MHz to 2480 MHz frequency band for Bluetooth, Low Energy is covered in this document.

1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C 63.10 & C63.4	Worse Case (Measured)	Result
Maximum Output Power	CFR47 15.247 (b), RSS 247 Sect. 5.4 (d)	1.25 dBm @ 2402MHz Channel, 1Mbps	**Complied**
DTS Bandwidth (6dB)	CFR47 15.247 (a)(2), RSS 247 Sect. 5.2 (a)	0.601MHz @ all Channel, 1Mbps	**Complied**
Peak Power Spectral Density	CFR47 15.247 (e), RSS 247 Sect. 5.2 (b)	-18.28 dBm/ kHz @ 2480MHz channel, 1Mbps	**Complied**
Out of Band Emissions: Non-Restricted	CFR47 15.247 (d), RSS 247 Sect.5.5	--31.65 dBc @ 2400 MHz, Lower Band Edge	**Complied**
Out of Band Emissions: Restricted	CFR47 15.205, RSS GEN Sect.8.10	-6.10dB margin @ 2483.5 MHz, Peak	**Complied**
Transmitter Spurious Emissions	CFR47 15.209, CFR47 15.247 (d), RSS-GEN Sect.8.9	-10.91dB Margin @ 17563.50 MHz, Average	**Complied**
AC Power Conducted Emission	CFR47 15.207, RSS-GEN Sect.8.8	N/A- EUT is DC powered	**N/A**

Note 1: This test report covers 2400 MHz to 2480 MHz band.

Note 2: Class B limits were applied where applicable.

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 EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5015 Brandin Ct, Fremont, CA. 94538, are 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 (Pleasanton Registration No. US1131, Fremont Registration No. US1131). The laboratory Scopes of Accreditation include Title 47 CFR Parts 15, 18 and 90. The accreditations are updated every three years.

2.1.2 A2LA

TUV Rheinland of North America EMC test facilities are accredited by the American Association for Laboratory Accreditation (A2LA). The laboratories have been assessed and accredited by A2LA in accordance with ISO Standard 17025:2017 (Testing Certificate #3331.02). The Scope of Laboratory Accreditation includes emission and immunity testing. The accreditations are updated annually.

2.1.3 Industry Canada

The Pleasanton 5-meter Semi-Anechoic Chamber, Registration No. 2932M-1, has been accepted by Industry Canada to perform testing to 3 and 5 meters based on the test procedures described in ANSI C63.4-2014. The Fremont 10-meter Semi-Anechoic Chamber, Registration No. 2932D-1, has been accepted by Industry Canada to perform testing to 3 and 10 meters based on the test procedures described in ANSI C63.4-2014.

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5051 Brandin Ct, Fremont, CA. 94538, have been assessed and approved in accordance with the Regulations for Voluntary Control Measures.

VCCI Registration No. for Pleasanton: A-0326

VCCI Registration No. for Fremont: A-0327

2.1.5 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

Test facilities are located at 5015 Brandin Ct, Fremont, California, 94538, USA and 1279 Quarry Lane, Pleasanton, California 94566, USA (Fremont is the Pleasanton Annex).

2.2.1 Emission Test Facility

The Semi-Anechoic Chambers and AC Line Conducted measurement facilities used to collect radiated and conducted emissions data have been constructed in accordance with ANSI C63.7:1992. The Fremont 10 meter semi-anechoic chamber has been measured in accordance with and verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2014 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04), at test distances of 3 and 10 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02). The Pleasanton 5 meter semi-anechoic chamber has been verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2009 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04) at a test distance of 3 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02).

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.

The Expanded Uncertainty defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurement and the fraction may be viewed as the coverage probability or level of confidence of the interval.

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 17025:2017. Equipment calibration records are kept on file at the test facility.

3 Product Information

3.1 Product Description

The Model PRT28985-244, FreeStyle Libre 3, uses a subcutaneously implanted electrochemical sensor, which incorporates ADC's wired enzyme glucose sensing technology to monitor glucose levels in interstitial fluid. The system allows the user to query glucose data from the Sensor though App via BLE or NFC.

Patch uses Bluetooth Low Energy technology in the band 2402 – 2480 MHz

3.2 Equipment Configuration

A description of the equipment configuration is given in the Test Plan Section. 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 a 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 and to place the EUT in the most susceptible state for immunity testing.

3.3 Operating Mode

A description of the operation mode is given in the Test Plan Section. In the case of a EUT that can operate in more than one state, preliminary testing was performed to determine the operating mode that produced maximum radiation.

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 FreeStyle Libre 3 has 1 dipole antenna dedicated Bluetooth antenna that has maximum gain of –13 dBi. The antenna connection is permanent and inside a plastic housing where the user cannot access it.

4 Emissions

Testing was performed in accordance with CFR 47 Part 15.247: 2020 and RSS 247: 2017. 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.

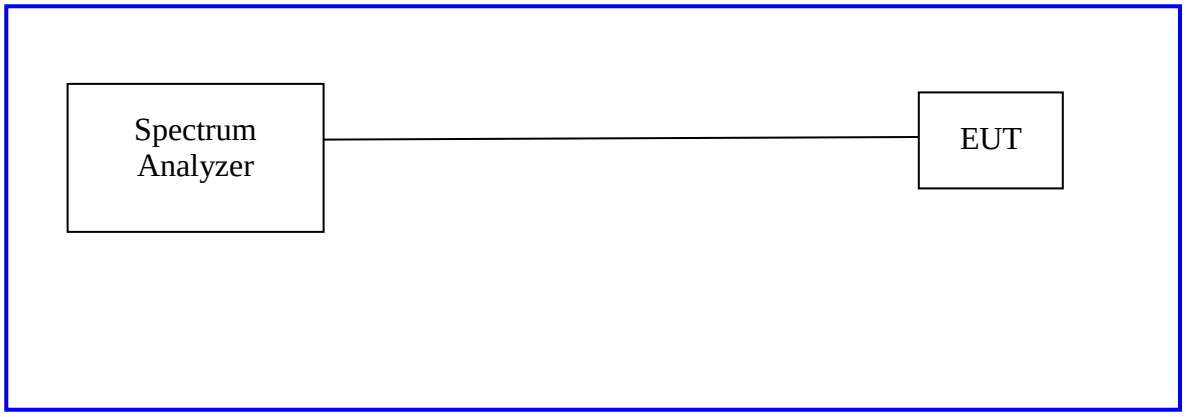
The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b) and RSS 247 Sect. 5.4.(d).

The maximum transmitted power in the frequency band 2400-2483.5 MHz: 1 W

4.1.1 Test Method

Conducted method was used to measure the channel power output. The worst findings were conducted on 3 channels in each operating range per CFR47 Part 15.247(b) and RSS 247 Sect. 5.4(d); 2400 MHz to 2483.5 MHz The worst mode results indicated below.

4.1.2 Test Setup: (Conducted)

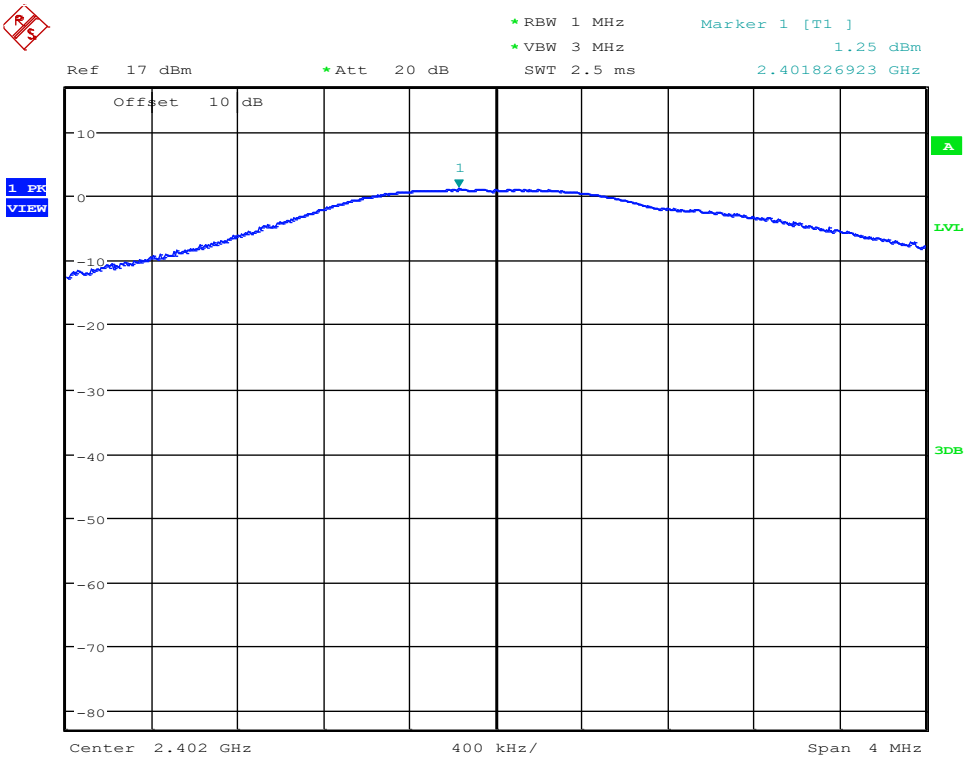


4.1.3 Results

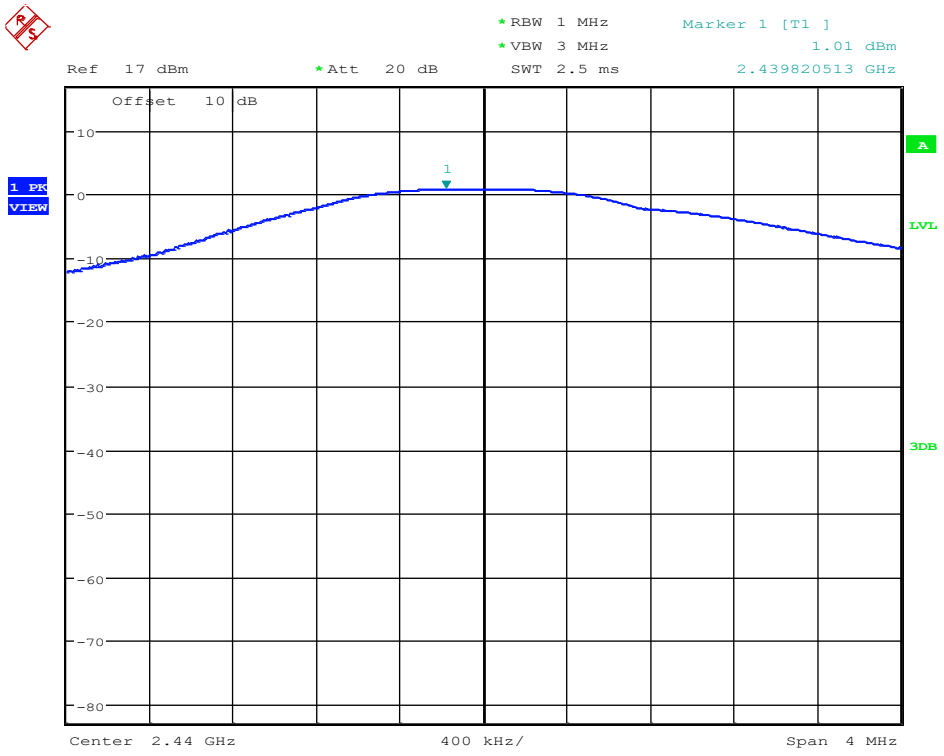
As originally tested, the EUT was found to be compliant to the requirements of the test standard(s). Worse case data for each mode reported below. Plots of highest power included for low, medium, and high channels.

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

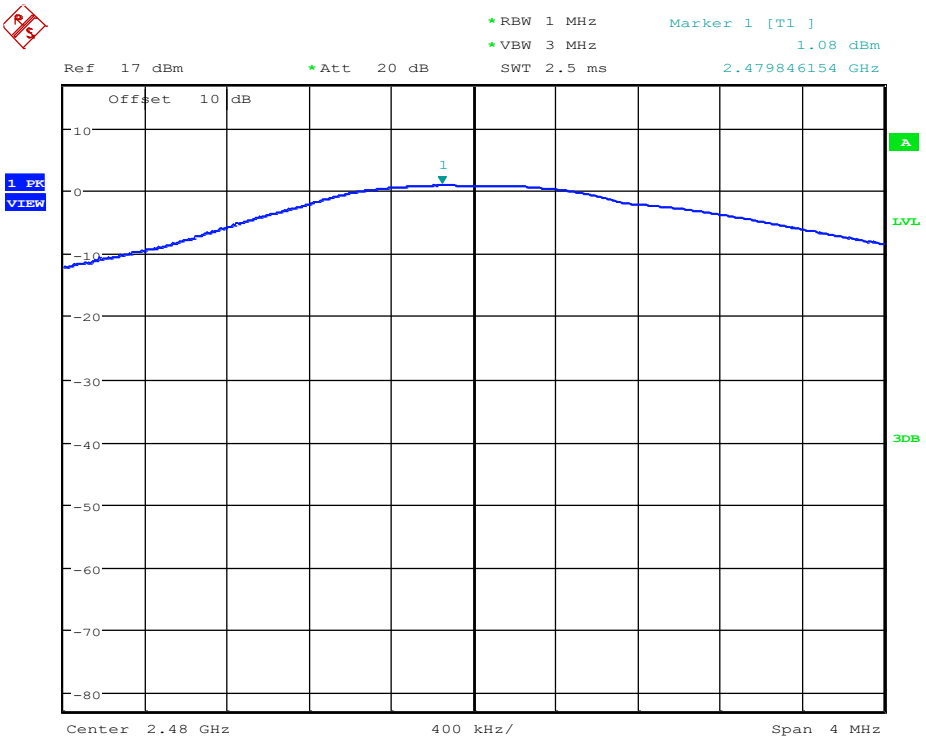
Test Conditions: Conducted Measurement, Normal Temperature			
Antenna Type: Dipole			
Power Setting: Default			
Max. Antenna Gain: -13 dBi			
Test Performed by: Rachana Khanduri			
RF Output Power - BLE			
Operating Channel (MHz)	**Limit [dBm]**	**Measured Peak Power [dBm]**	**Margin [dB]**
2402.00	30.00	1.25	-28.75
2440.00	30.00	1.01	-28.99
2480.00	30.00	1.08	-28.92
Note: All insertion loss corrections are accounted for in the measurement plots.			



Plot 1. Maximum Conducted Power, BLE-2402MHz



Plot 2. Maximum Conducted Power, BLE-2440MHz



Plot 3. Maximum Conducted Power, BLE-2480MHz

4.2 DTS Bandwidth (6dB) and 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.

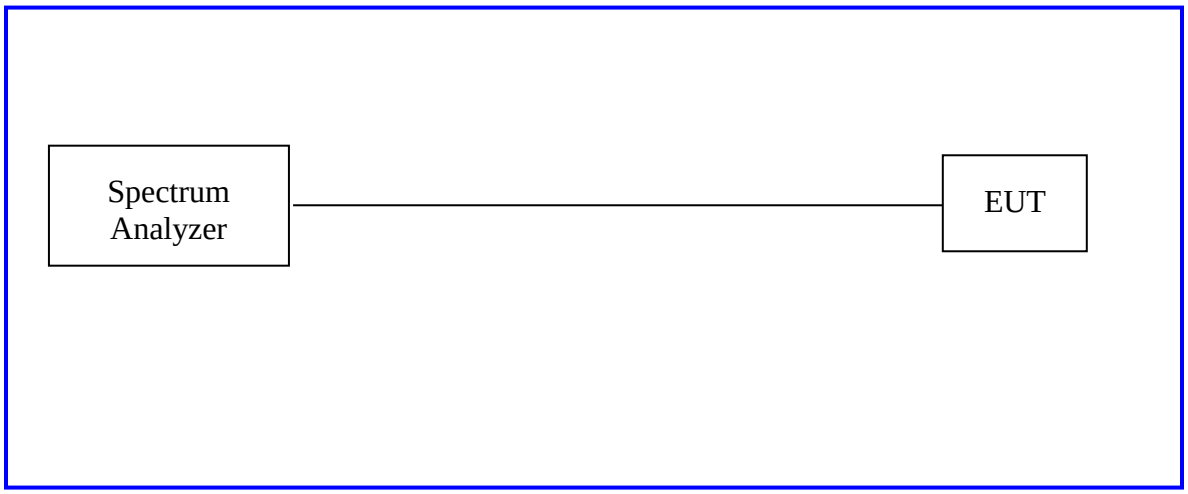
The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.

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 according to ANSI C63.10:2013 Section 11.8. The measurement was performed with modulation per CFR47 15.247 (a) (2) and RSS Gen Sect. 6.6. Measurements were performed on the low, middle and high channels of the operating frequency range; 2400 MHz to 2483.5 MHz.

4.2.2 Test Setup: (Conducted)

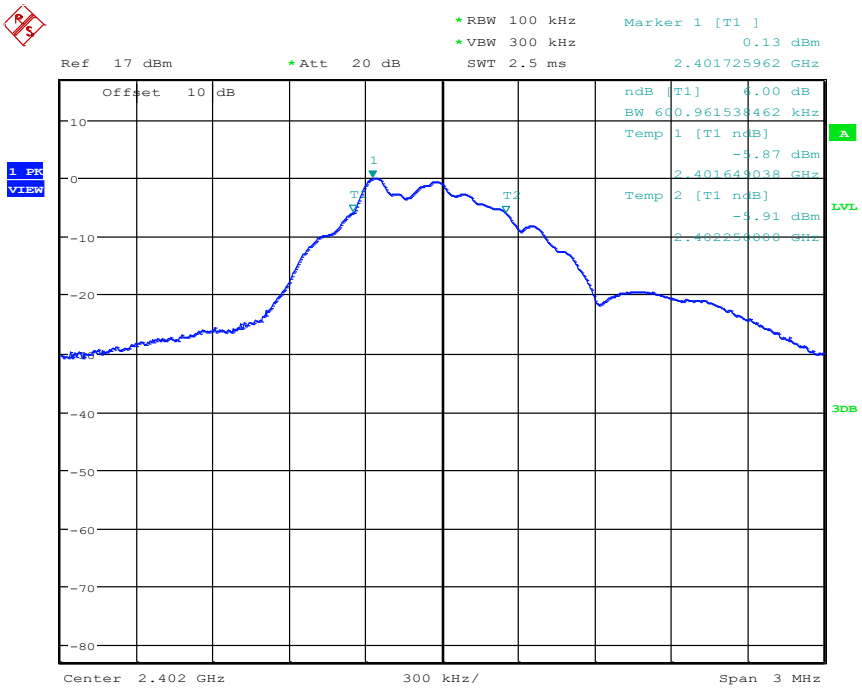


4.2.3 Results

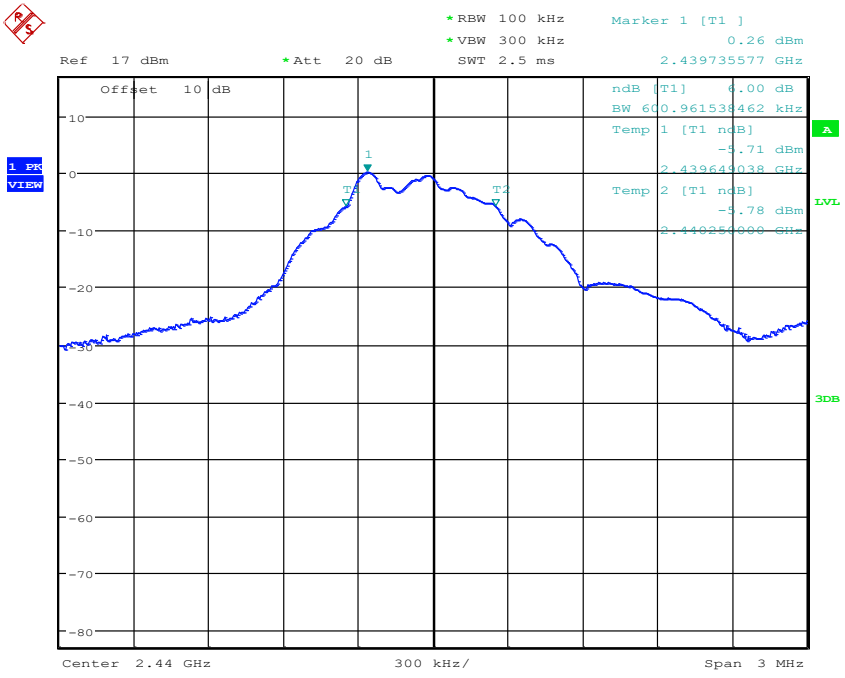
As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 3: Occupied Bandwidth – Test Results

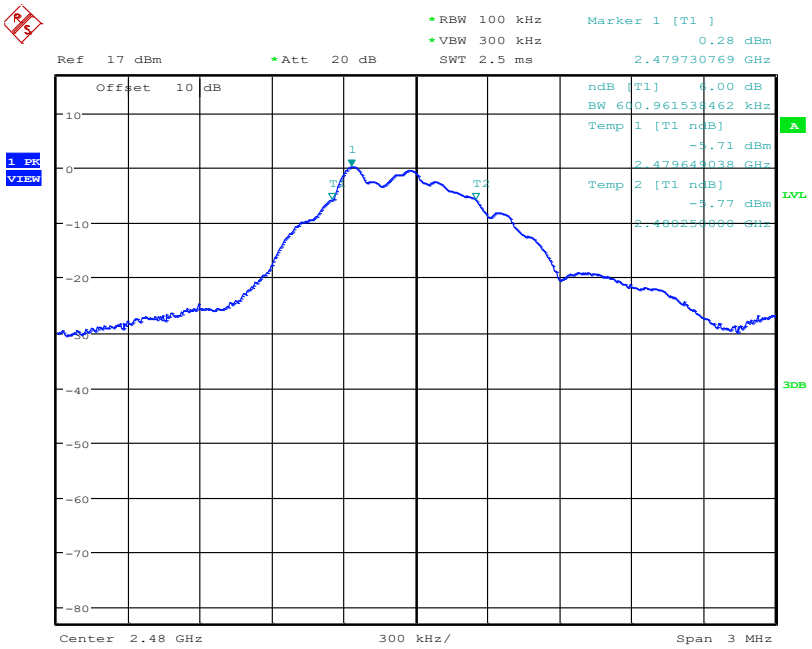
Test Conditions: Conducted Measurement, Normal Temperature		
Antenna Type: Dipole		
Power Setting: Default		
Max. Antenna Gain: -13 dBi		
Test Performed by: Rachana Khanduri		
Operating Channel (MHz)	**99% Bandwidth (MHz)**	**6dB (DTS) Bandwidth (MHz)**
2402.00	1.298	0.601
2440.00	1.216	0.601
2480.00	1.226	0.601



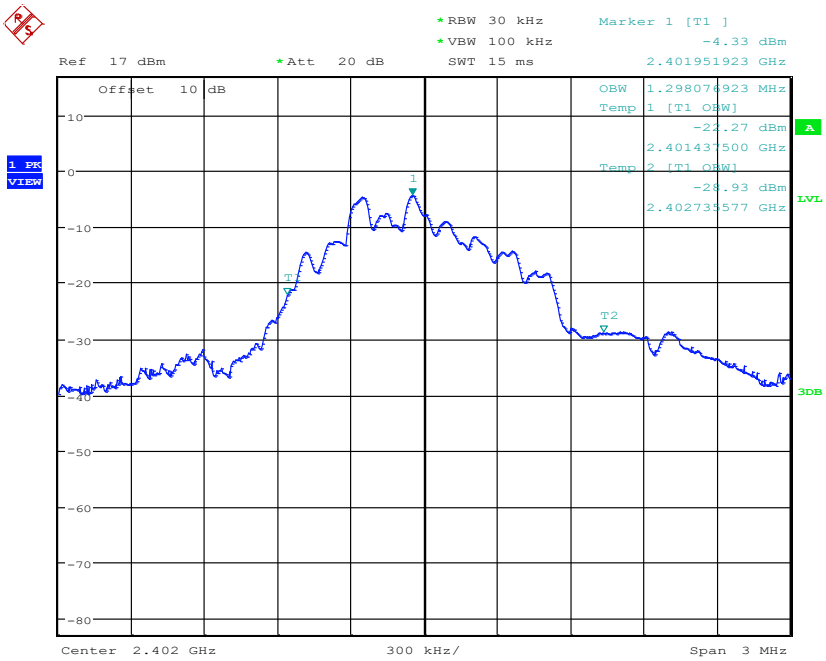
Plot 4. BLE-2402MHz, 6dB Bandwidth



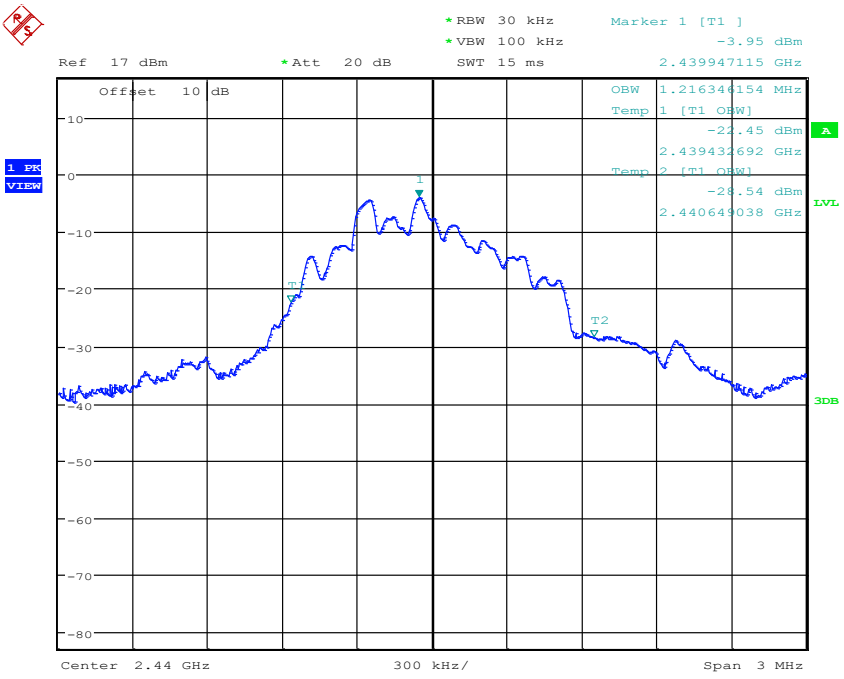
Plot 5. BLE-2440MHz, 6dB Bandwidth



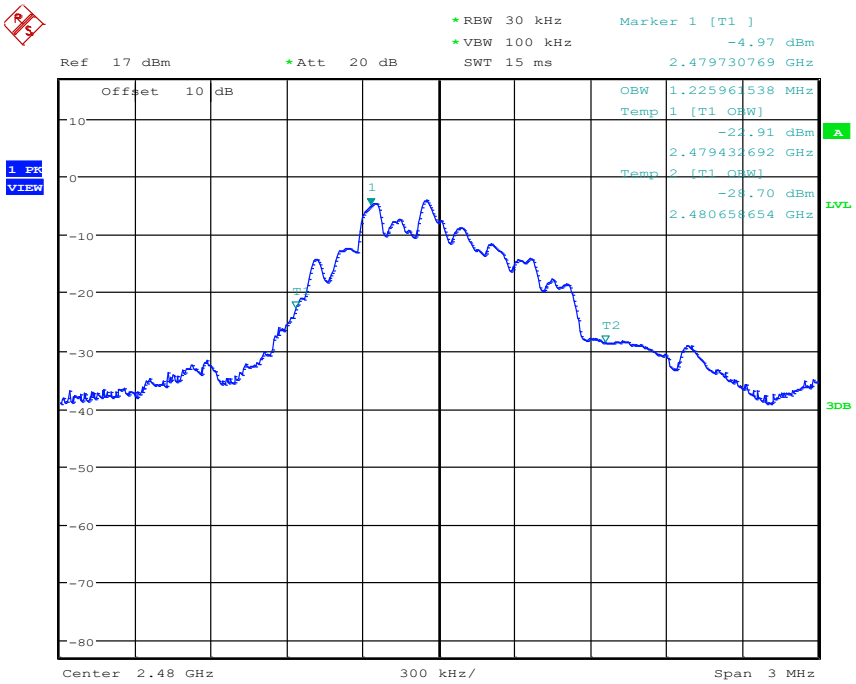
Plot 6. BLE-2480MHz, 6dB Bandwidth



Plot 7. BLE-2402MHz, 99% Bandwidth



Plot 8. BLE-2440MHz, 99% Bandwidth



Plot 9. BLE-2480MHz, 99% Bandwidth

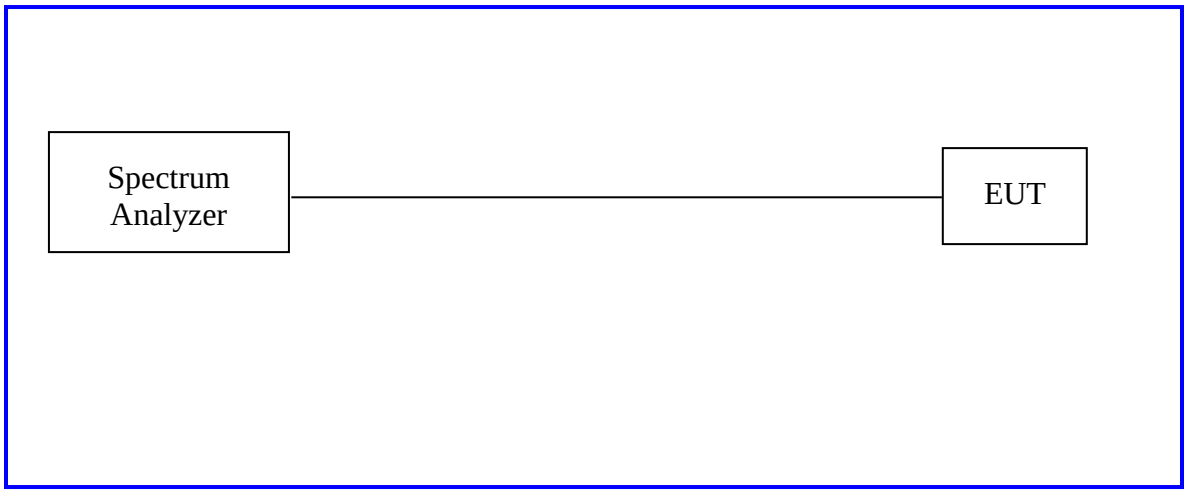
4.3 Peak Power Spectral Density

According to the CFR47 Part 15.247 (e) and RSS 247 Sect.5.2 (b), 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 (b). The worst findings were conducted on 3 channels in each operating frequency range of 2400 MHz to 2483.5 MHz.

4.3.2 Test Setup: (Conducted)



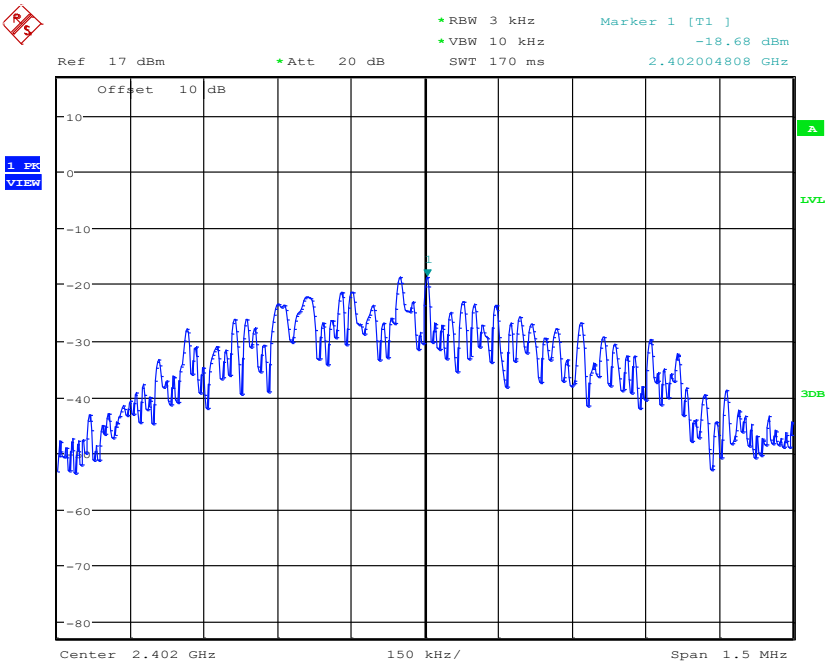
Method PKPSD of "KDB 558074 – DTS Measurement Guidance v04" was used.

4.3.3 Results

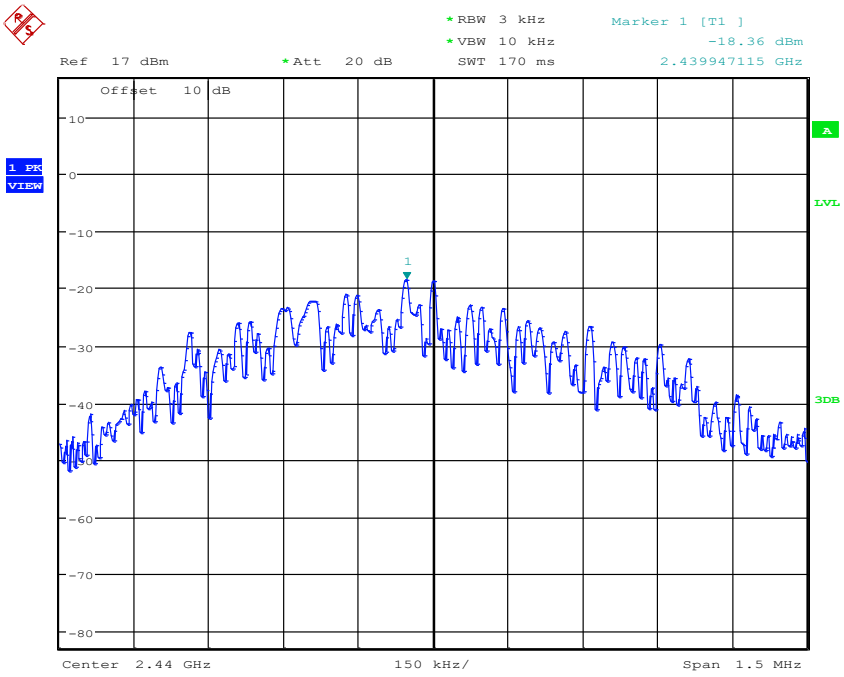
As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 4: Peak Power Spectral Density – Test Results

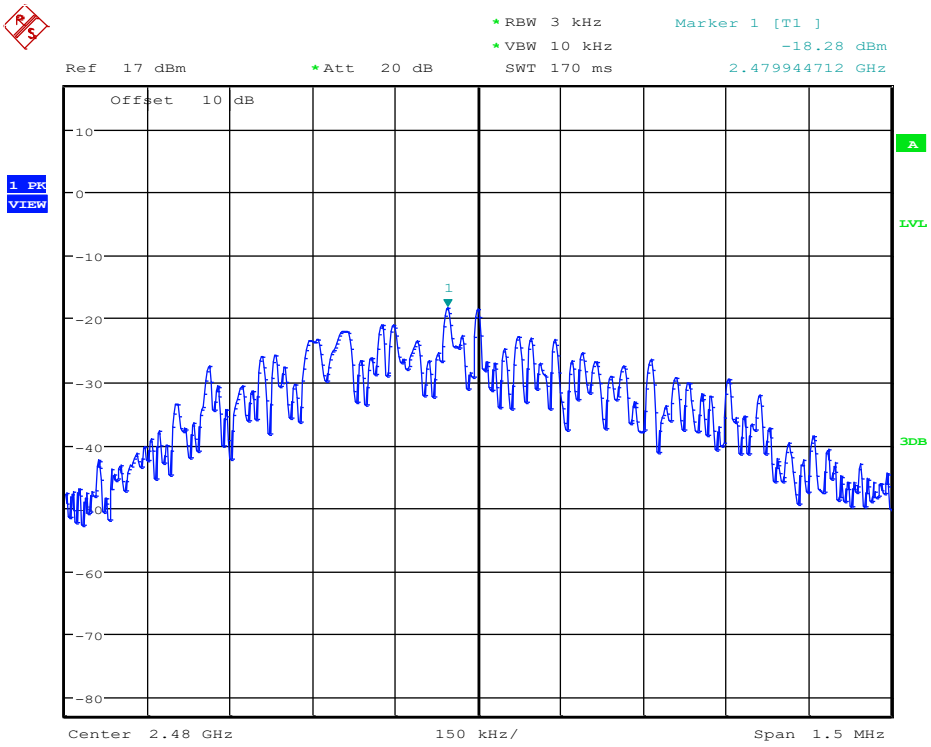
Test Conditions: Conducted Measurement, Normal Temperature			
Antenna Type: Dipole			
Power Setting: Default			
Max. Antenna Gain: -13 dBi			
Test Performed by: Rachana Khanduri			
Operating Channel (MHz)	**Total PSD [dBm/kHz]**	**Limit [dBm/3kHz]**	**Margin [dB]**
2402.00	-18.68	8.0 dBm /3 kHz	-26.68
2440.00	-18.36	8.0 dBm /3 kHz	-26.36
2480.00	-18.28	8.0 dBm /3 kHz	-26.28
Note: All insertion loss corrections are accounted for in the measurement plots.			



Plot 10. BLE-2402MHz PSD



Plot 11. BLE-2440MHz PSD



Plot 12. BLE-2480MHz PSD

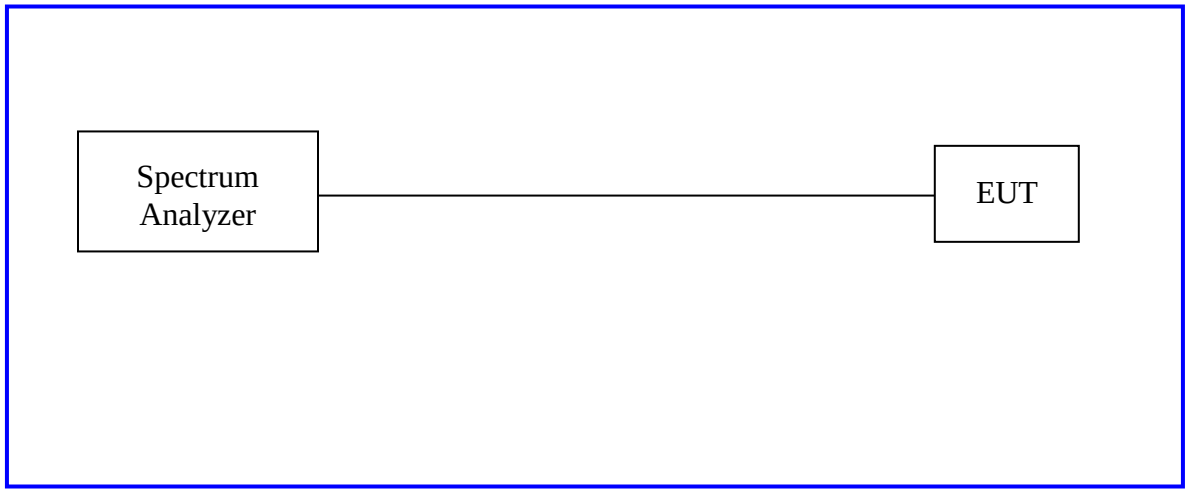
4.4 Out of Band Emissions: Non-Restricted Bands

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), RSS-247 Sect. 5.5, RSS-GEN Sect. 8.9 and 8.10.

4.4.1 Test Method

Conducted measurements per ANSI C63.10-2013 Sections 6.10, 11.11, 14.3.3 were used to measure the undesirable emission requirement in non-restricted bands. The measurement was performed with modulation. The measurement was conducted from 30MHz to 26.5GHz on 3 channels in each mode on the EUT. Band edge tests were conducted on the low and high channel of each mode. The worst case measurement of each mode is recorded in this report.

4.4.2 Test Setup: (Conducted)



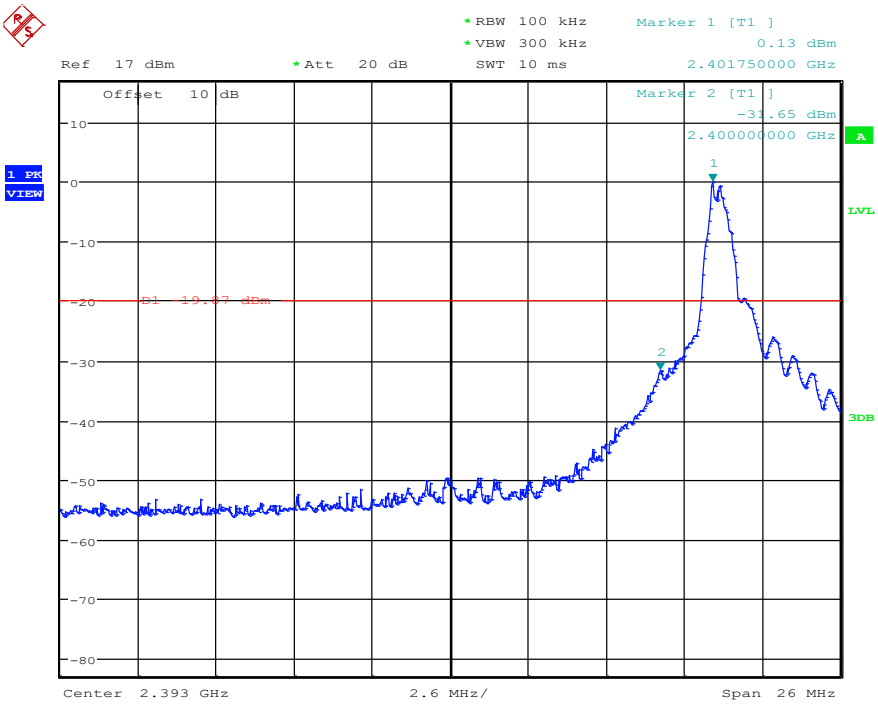
4.4.3 Results

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

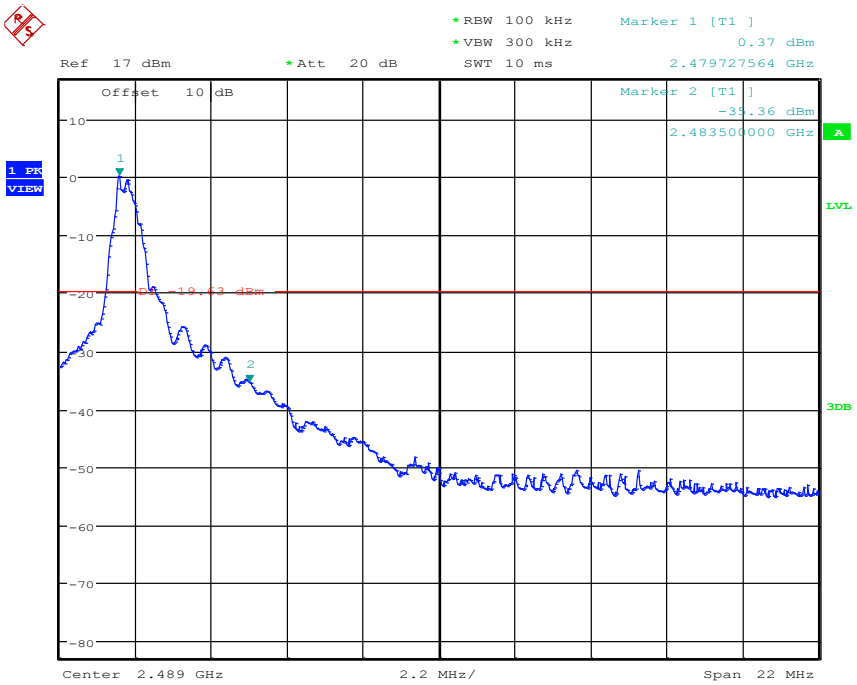
Table 5: Emissions at the Band-Edge – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only					
Antenna Type: Dipole					
Power Setting: Default					
Max. Antenna Gain: -13 dBi					
Test Performed by: Rachana Khanduri					
Non-Restricted Frequency Band Edge Emissions – Worse Case					
Band Edge	**Center Freq (MHz)**	**Measured (dBc)**	**Limit (dBc)**	**Freq (MHz)**	**Results**
Low	2402	-31.65	20	2400.00	Pass
High	2480	-35.36	20	2483.50	Pass
Note: None					

4.4.3.1 Band Edge - Conducted

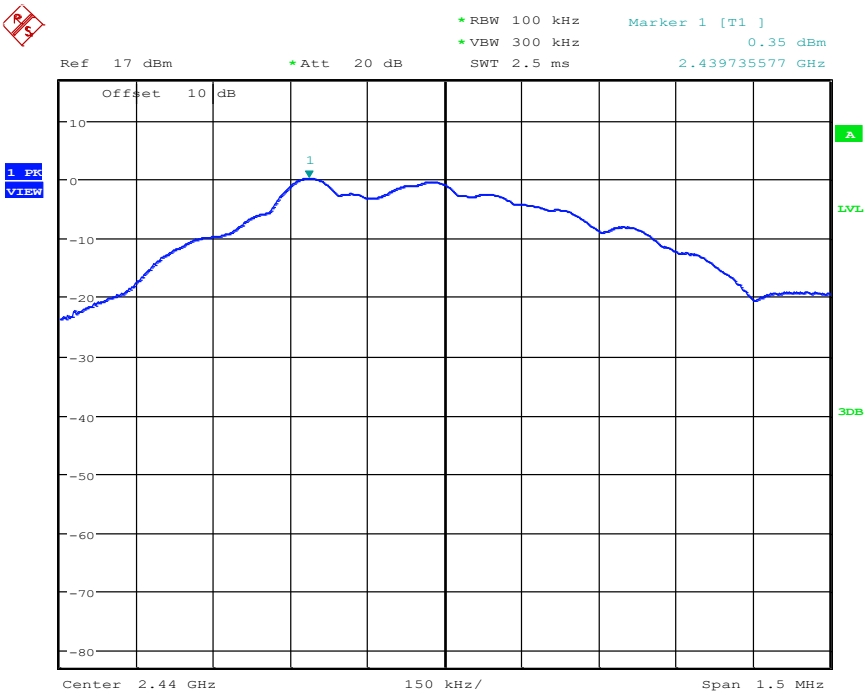


Plot 13. BLE-2402MHz Lower Band Edge

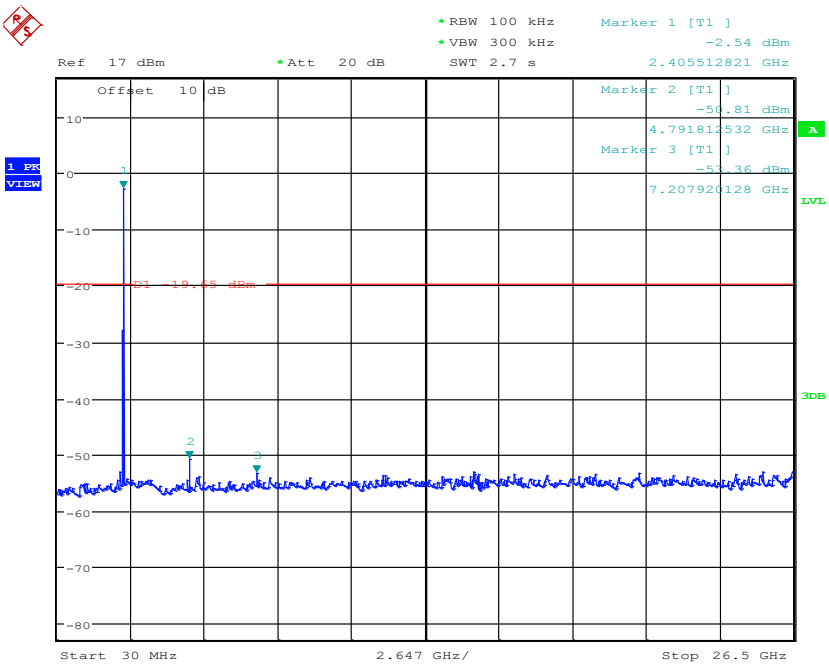


Plot 14. BLE-2480MHz Upper Band Edge

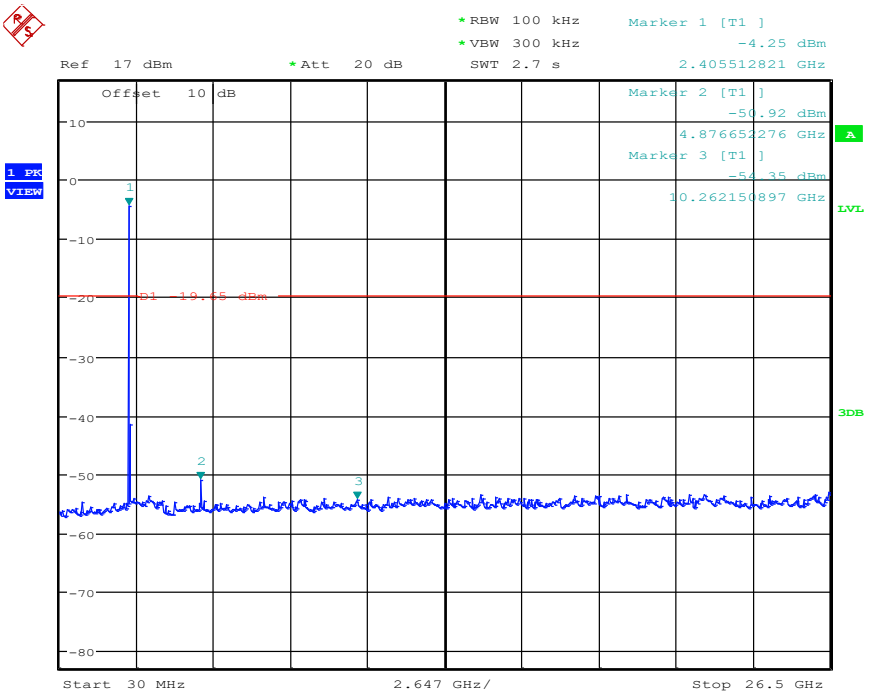
4.4.3.2 Conducted Spurious



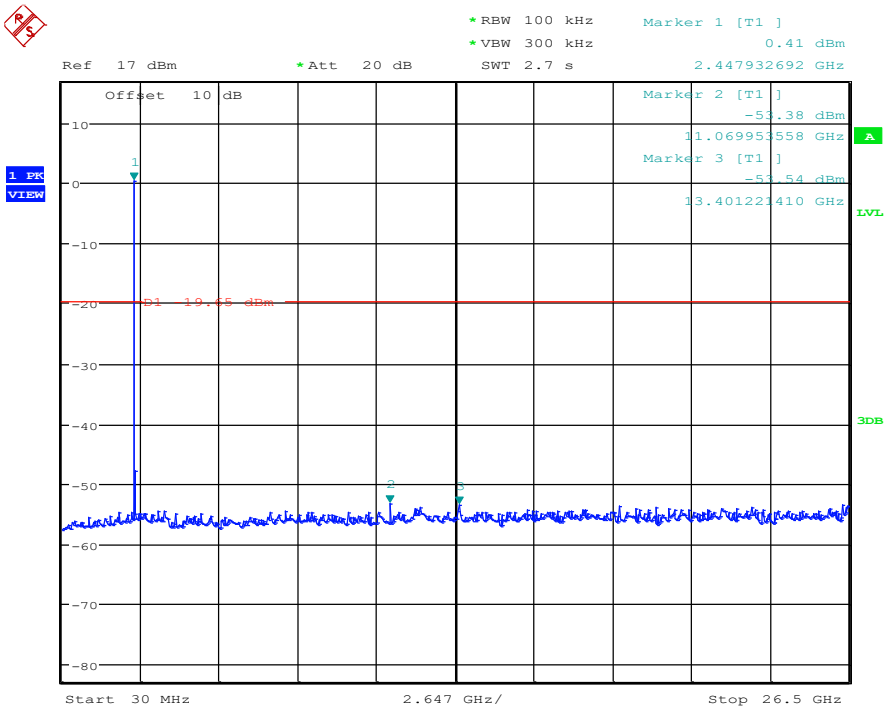
Plot 15. BLE- Reference Measurement, 2440MHz



Plot 16. BLE-2402MHz 30MHz-26.5GHz Spurious



Plot 17. BLE-2440MHz 30MHz-26.5GHz Spurious



Plot 18. BLE-2480MHz 30MHz-26.5GHz Spurious

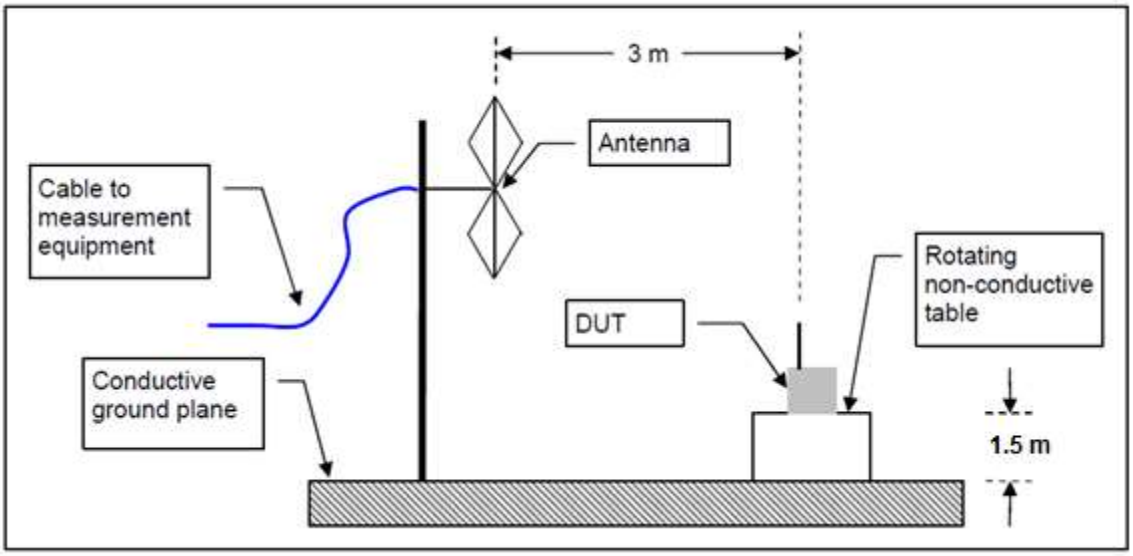
4.5 Out of Band Emissions: Restricted Band Edge

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), RSS-247 Sect. 5.5, RSS-GEN Sect. 8.9 and 8.10.

4.5.1 Test Method

Radiated measurements per ANSI C63.10-2013 Section 6.10.5 were used to measure the undesirable emission requirement in restricted bands. Peak points were found and RMS Average was taken for each point found. The measurement was performed with modulation. This test was conducted on 3 channels in each mode on the EUT. The worst case measurement of each channel is recorded in this report. All channels were tested at highest power settings.

Test Setup



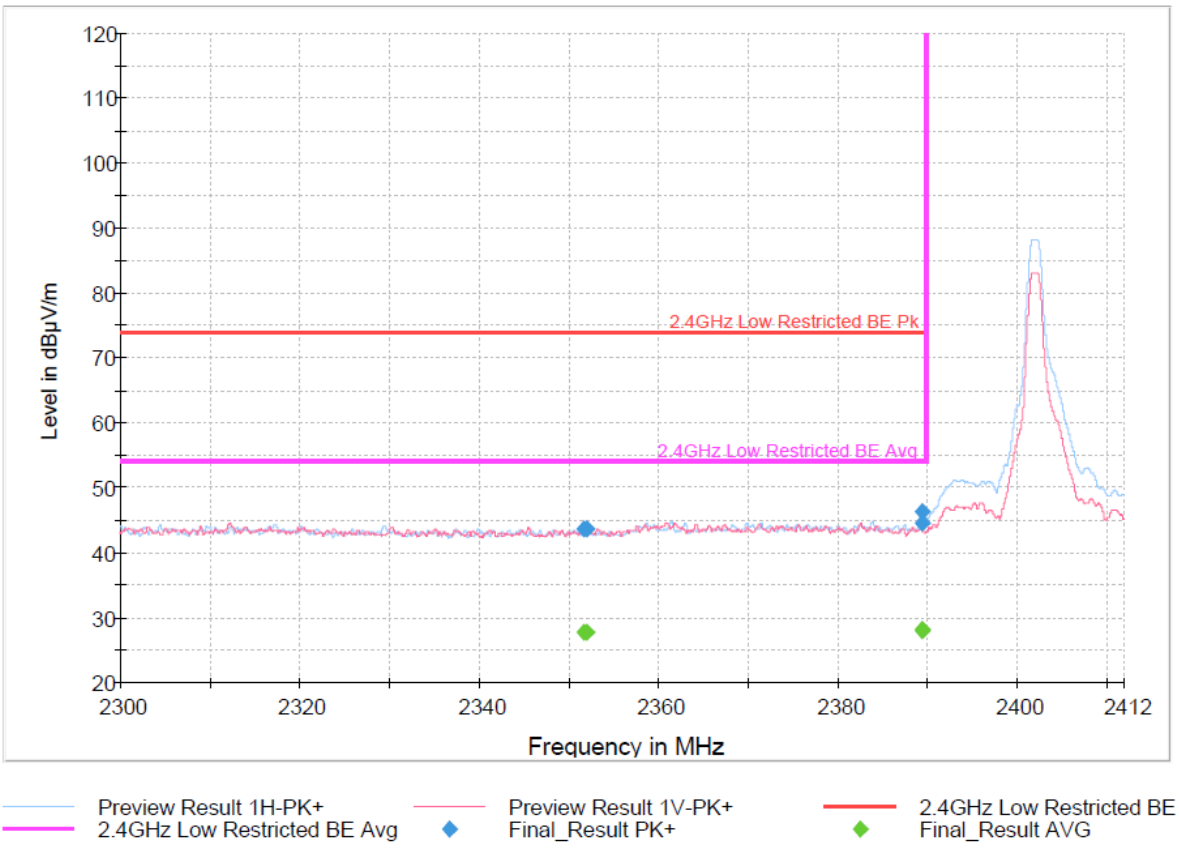
The DUT was stimulated by manufacturer provided test software that is not available to the end user.

4.5.2 Test Results

Test Conditions: Radiated Measurement, Normal Temperature and Voltage
Antenna Type: Dipole
Power Setting: Default
Max. Antenna Gain: -13 dBi
Test Performed by: Rachana Khanduri

Final Result

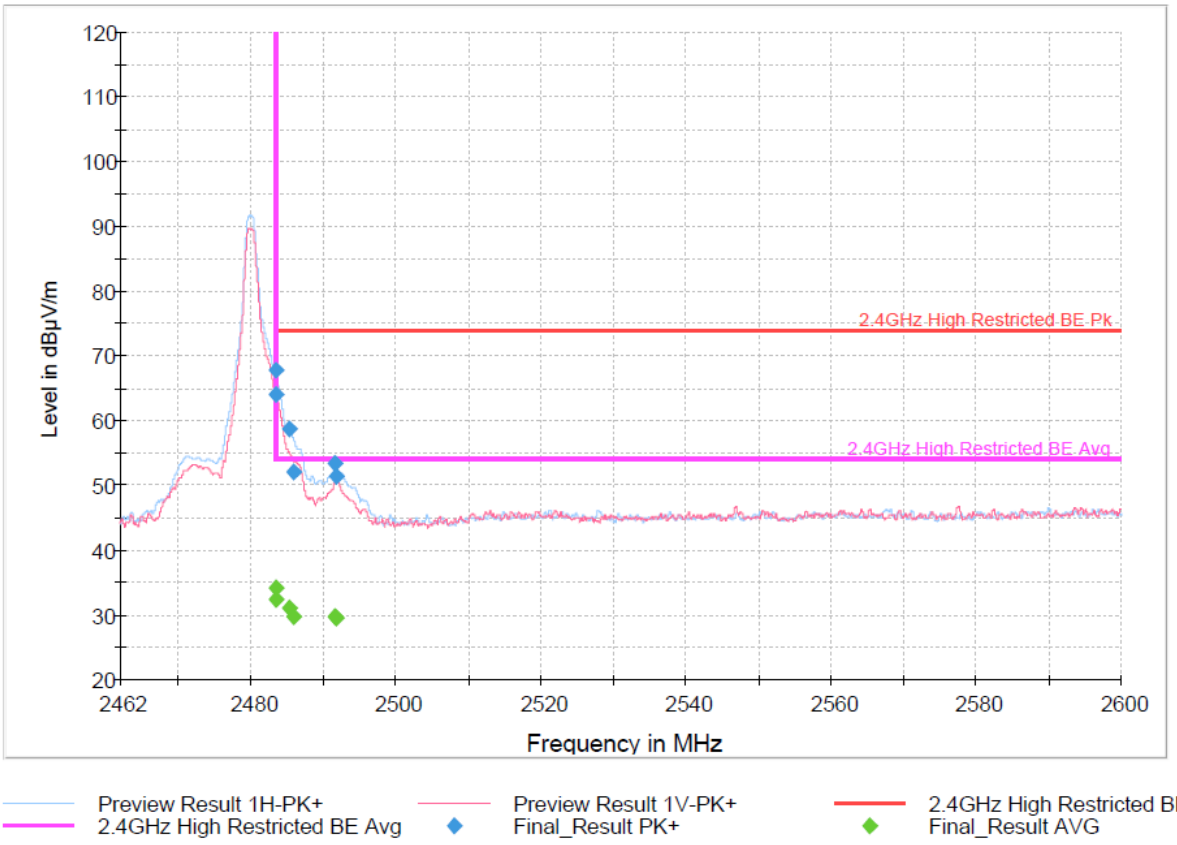
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2351.721600	---	27.82	54.00	26.18	1000.000	218.0	V	16.0	-2.1
2351.721600	43.69	---	74.00	30.31	1000.000	218.0	V	16.0	-2.1
2351.979200	43.71	---	74.00	30.29	1000.000	100.0	H	326.0	-2.1
2351.979200	---	27.85	54.00	26.15	1000.000	100.0	H	326.0	-2.1
2389.420800	44.46	---	74.00	29.54	1000.000	155.0	V	55.0	-2.2
2389.420800	---	28.00	54.00	26.00	1000.000	155.0	V	55.0	-2.2
2389.432000	---	28.28	54.00	25.72	1000.000	167.0	H	5.0	-2.2
2389.432000	46.28	---	74.00	27.72	1000.000	167.0	H	5.0	-2.2



Plot 19. BLE-2402MHz, Lower Band Edge, Restricted

Final Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.500400	---	34.13	54.00	19.87	1000.000	154.0	H	187.0	-1.6
2483.500400	67.90	---	74.00	6.10	1000.000	154.0	H	187.0	-1.6
2483.514200	---	32.31	54.00	21.69	1000.000	295.0	V	121.0	-1.6
2483.514200	64.08	---	74.00	9.92	1000.000	295.0	V	121.0	-1.6
2485.391000	58.78	---	74.00	15.22	1000.000	193.0	H	189.0	-1.6
2485.391000	---	31.15	54.00	22.85	1000.000	193.0	H	189.0	-1.6
2485.956800	---	29.64	54.00	24.36	1000.000	320.0	V	94.0	-1.6
2485.956800	52.11	---	74.00	21.89	1000.000	320.0	V	94.0	-1.6
2491.683800	53.35	---	74.00	20.65	1000.000	195.0	H	192.0	-1.5
2491.683800	---	29.78	54.00	24.22	1000.000	195.0	H	192.0	-1.5
2491.849400	---	29.51	54.00	24.49	1000.000	294.0	V	121.0	-1.5
2491.849400	51.32	---	74.00	22.68	1000.000	294.0	V	121.0	-1.5



Plot 20. BLE-2480MHz, Upper Band Edge, Restricted

4.6 Transmitter 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), RSS 247 Sect.5.5, RSS-GEN Sect. 8.9 and 8.10.

4.6.1 Test Methodology

4.6.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 120 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

Pre-scans were performed to determine the worst data rate / chains.

4.6.1.2 Final Test

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. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

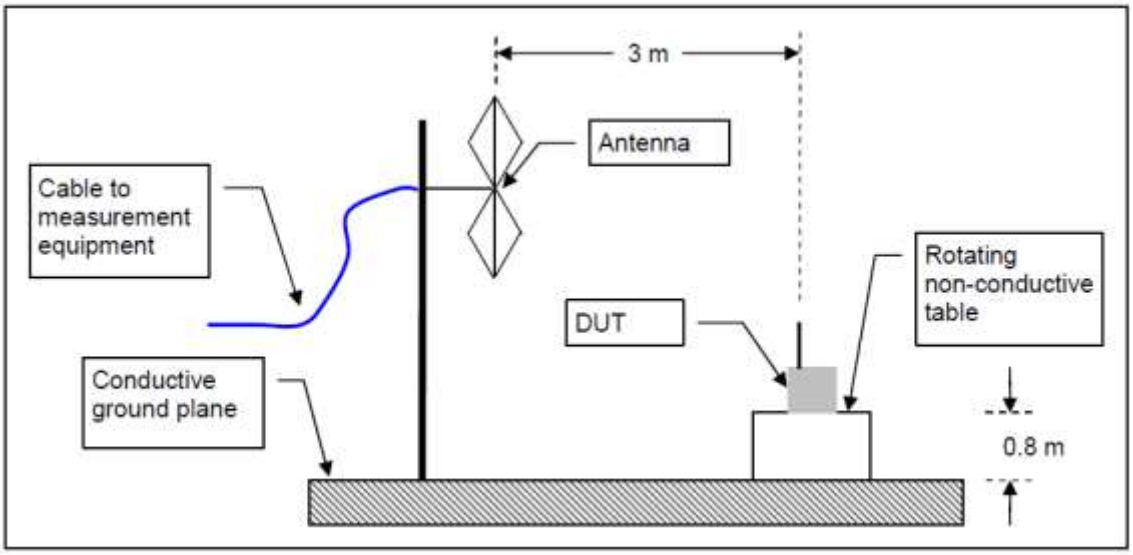
4.6.1.3 Deviations

None.

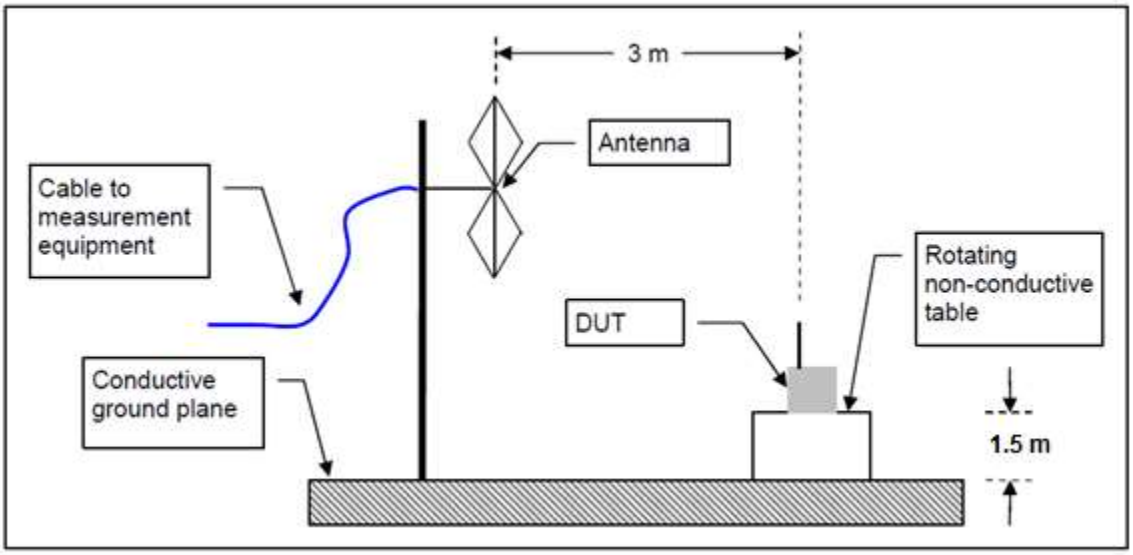
4.6.2 Test Setup:

All tests were conducted at full power on low, middle, and high channels. The DUT was stimulated by manufacturer provided test software that is not available to the end user.

30MHz-1GHz



1-26GHz



4.6.3 Transmitter Spurious Emission Limit

The spurious emissions of the transmitter shall not exceed the values in CFR47 Part 15.205, 15.209: 2015 and RSS Gen Sect. 8.9 and 8.10: 2014.

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

4.6.4 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.

Frequencies below 30MHz were investigated and no emissions were found above the noise floor.

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

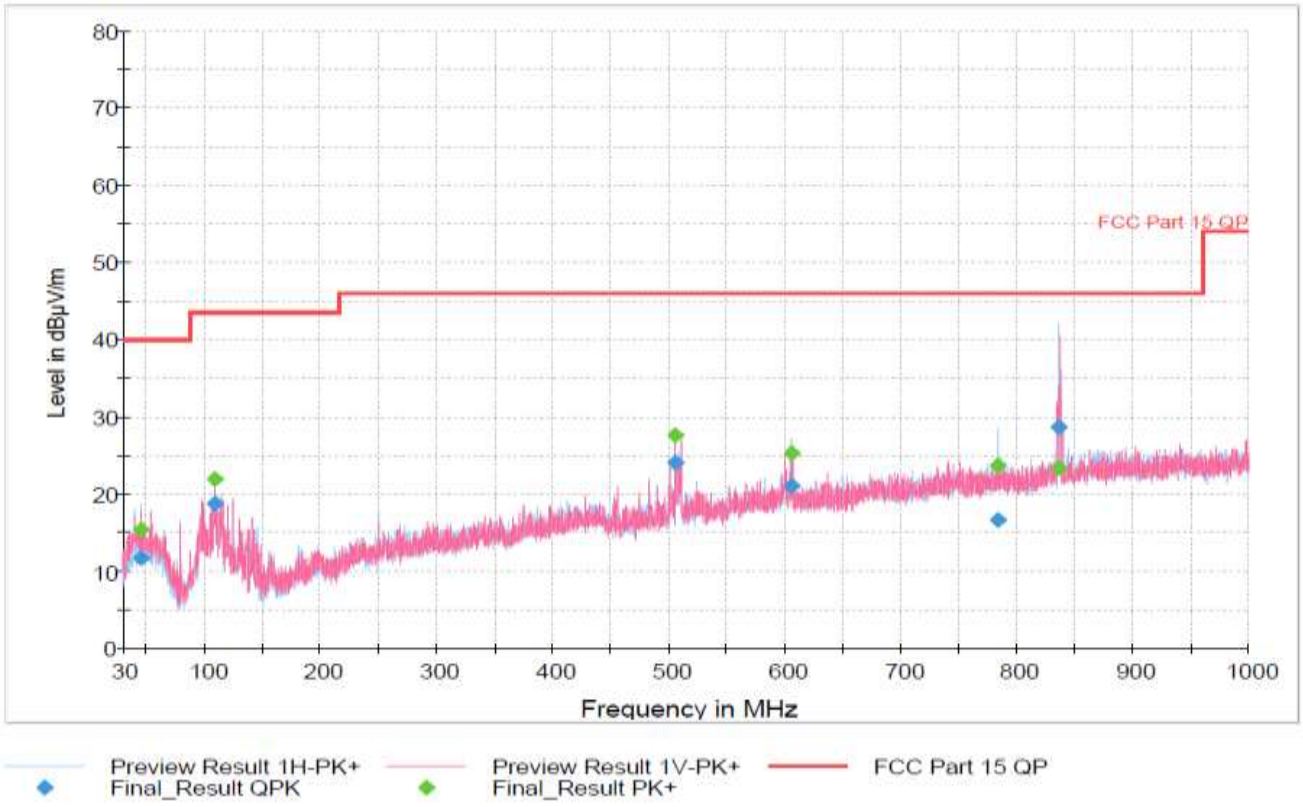
Note: The 2.4 GHz notch filter was used to protect the front end of the pre-amp.

4.6.4.1 Measurement Plots

Test Conditions: Radiated Measurement, Normal Temperature and Voltage
Antenna Type: Dipole
Power Setting: Default
Max. Antenna Gain: -13 dBi
Test Performed by: Rachana Khanduri

Final Result

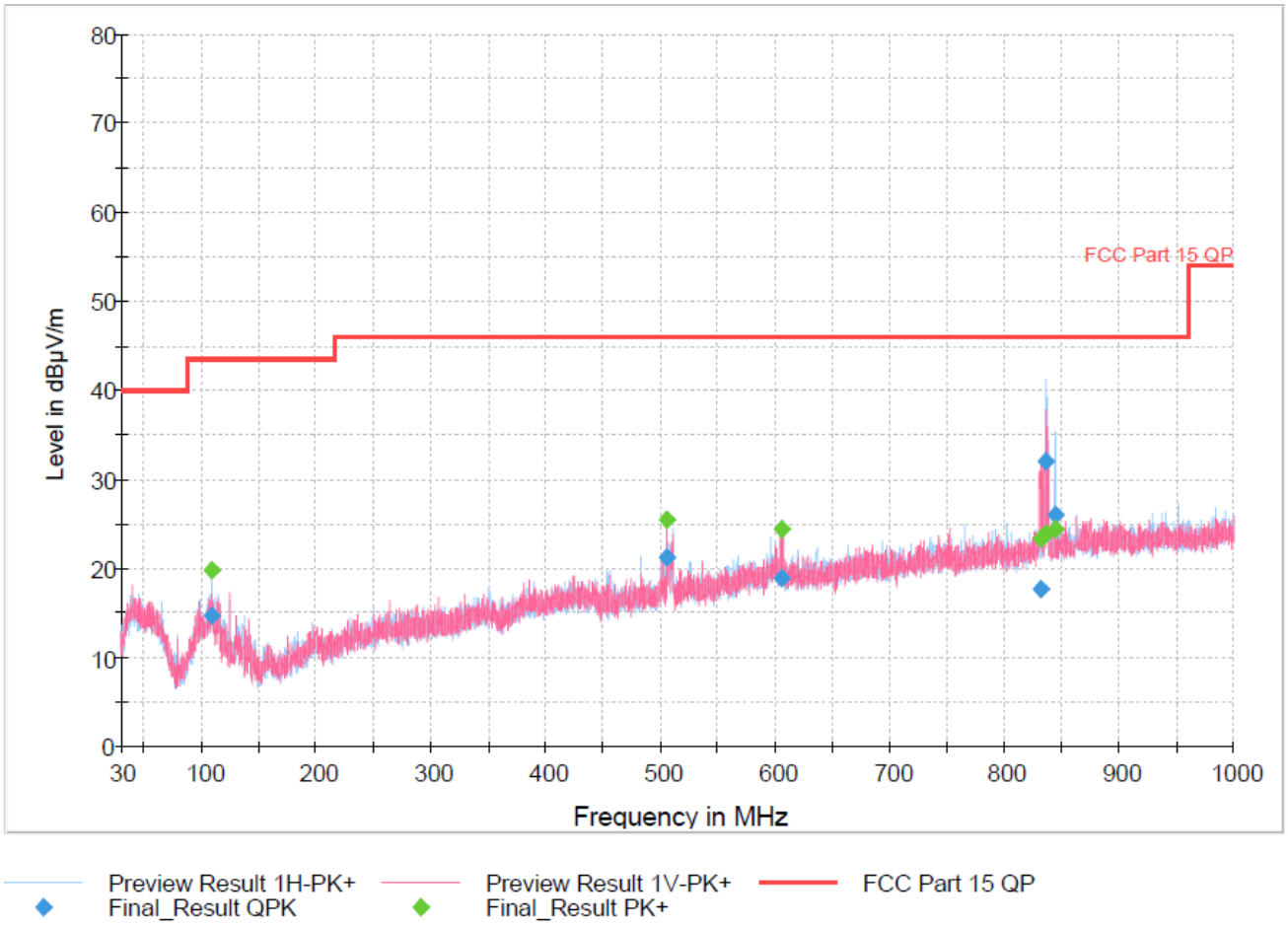
Frequency (MHz)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
44.970580	11.62	---	40.00	28.38	10.0	120.000	117.0	H	256.0	-10.7
44.970580	---	15.46	---	---	10.0	120.000	117.0	H	256.0	-10.7
108.785320	---	21.88	---	---	10.0	120.000	119.0	H	294.0	-13.2
108.785320	18.78	---	43.52	24.74	10.0	120.000	119.0	H	294.0	-13.2
506.307860	24.01	---	46.02	22.01	10.0	120.000	268.0	H	219.0	-7.0
506.307860	---	27.63	---	---	10.0	120.000	268.0	H	219.0	-7.0
606.565080	---	25.36	---	---	10.0	120.000	188.0	H	85.0	-4.9
606.565080	21.09	---	46.02	24.93	10.0	120.000	188.0	H	85.0	-4.9
783.845040	16.62	---	46.02	29.40	10.0	120.000	145.0	H	207.0	-2.4
783.845040	---	23.67	---	---	10.0	120.000	145.0	H	207.0	-2.4
836.558000	28.66	---	46.02	17.36	10.0	120.000	150.0	H	152.0	-1.5
836.558000	---	23.31	---	---	10.0	120.000	150.0	H	152.0	-1.5



Plot 21. 30MHz-1GHz, BLE-2402MHz

Final Result

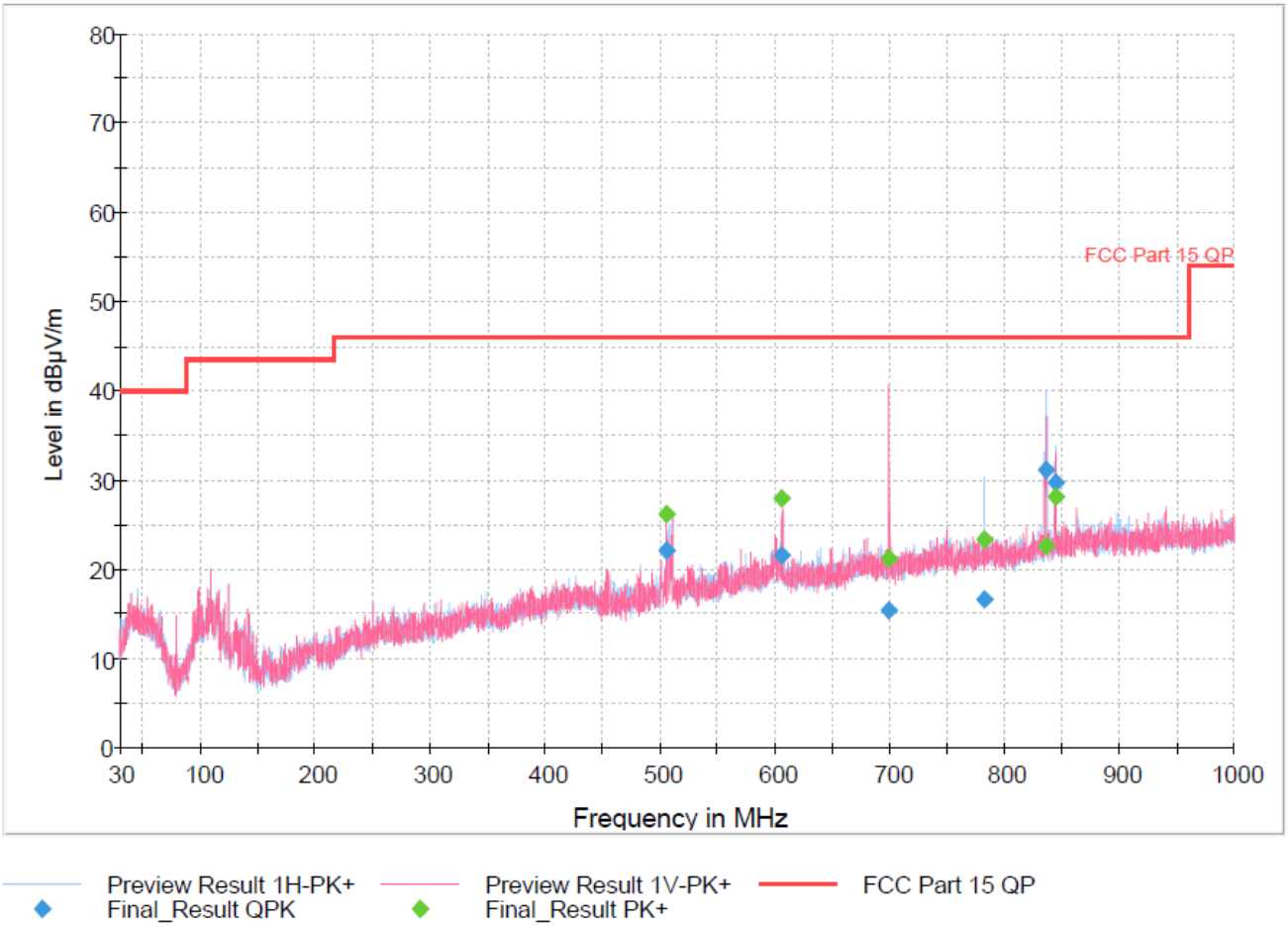
Frequency (MHz)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
108.845320	14.63	---	43.52	28.89	10.0	120.000	195.0	H	172.0	-13.2
108.845320	---	19.74	---	---	10.0	120.000	195.0	H	172.0	-13.2
506.358620	---	25.57	---	---	10.0	120.000	154.0	H	341.0	-7.0
506.358620	21.31	---	46.02	24.71	10.0	120.000	154.0	H	341.0	-7.0
606.257480	18.85	---	46.02	27.17	10.0	120.000	255.0	H	205.0	-4.9
606.257480	---	24.49	---	---	10.0	120.000	255.0	H	205.0	-4.9
832.316580	---	23.39	---	---	10.0	120.000	250.0	V	278.0	-1.7
832.316580	17.69	---	46.02	28.33	10.0	120.000	250.0	V	278.0	-1.7
836.272580	32.08	---	46.02	13.94	10.0	120.000	150.0	H	181.0	-1.5
836.272580	---	23.95	---	---	10.0	120.000	150.0	H	181.0	-1.5
844.100860	26.08	---	46.02	19.94	10.0	120.000	280.0	H	228.0	-1.4
844.100860	---	24.51	---	---	10.0	120.000	280.0	H	228.0	-1.4



Plot 22. 30MHz-1GHz, BLE-2440MHz

Final Result

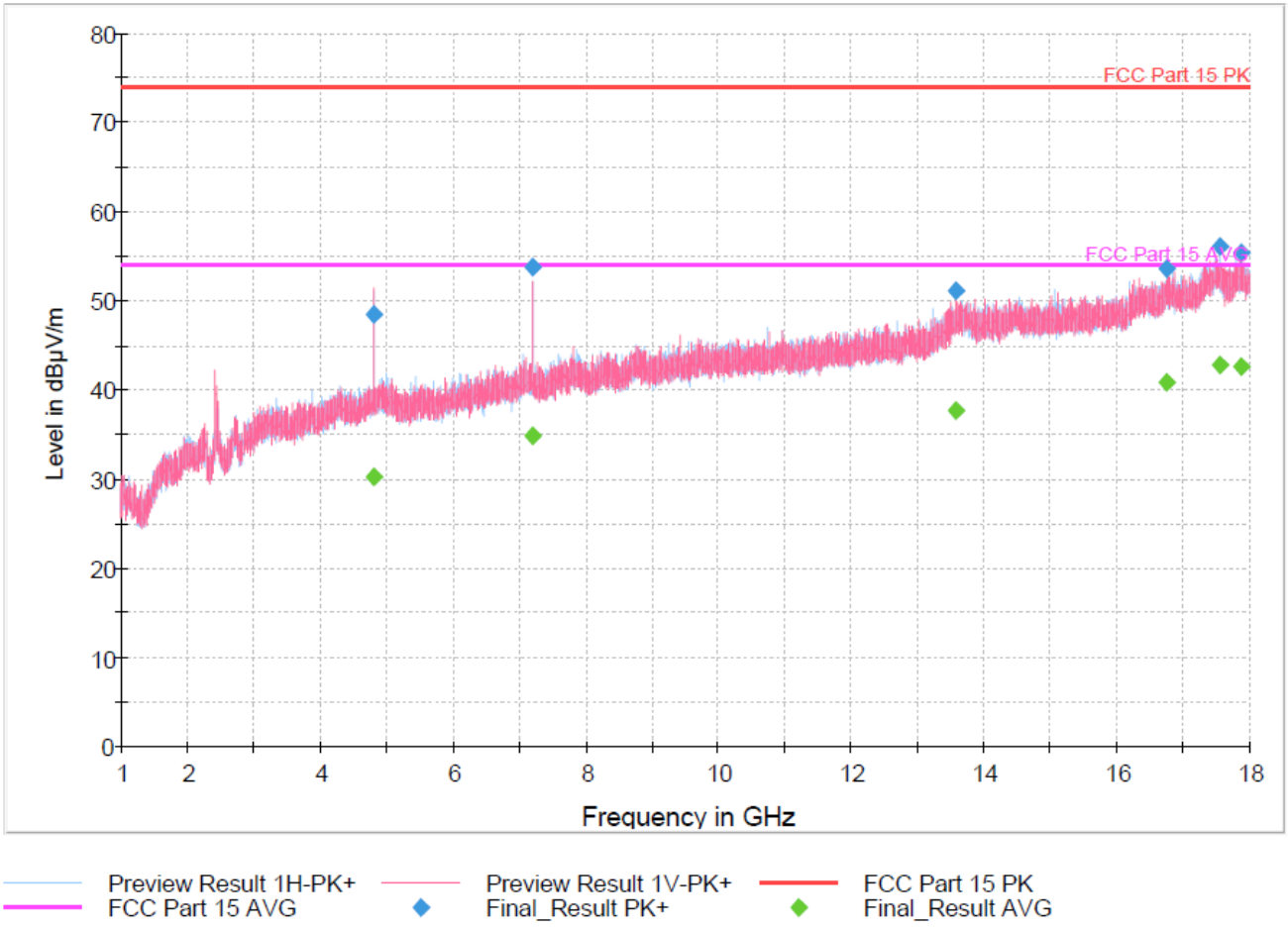
Frequency (MHz)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
506.315780	22.19	---	46.02	23.83	10.0	120.000	250.0	H	102.0	-7.0
506.315780	---	26.12	---	---	10.0	120.000	250.0	H	102.0	-7.0
606.759080	---	27.89	---	---	10.0	120.000	144.0	V	285.0	-4.9
606.759080	21.63	---	46.02	24.39	10.0	120.000	144.0	V	285.0	-4.9
699.690920	---	21.32	---	---	10.0	120.000	105.0	V	168.0	-3.7
699.690920	15.38	---	46.02	30.64	10.0	120.000	105.0	V	168.0	-3.7
782.411020	16.63	---	46.02	29.39	10.0	120.000	166.0	H	89.0	-2.4
782.411020	---	23.35	---	---	10.0	120.000	166.0	H	89.0	-2.4
836.461000	---	22.60	---	---	10.0	120.000	120.0	H	221.0	-1.5
836.461000	31.07	---	46.02	14.95	10.0	120.000	120.0	H	221.0	-1.5
844.274960	---	28.09	---	---	10.0	120.000	250.0	H	10.0	-1.4
844.274960	29.79	---	46.02	16.23	10.0	120.000	250.0	H	10.0	-1.4



Plot 23. 30MHz-1GHz, BLE-2480MHz

Final Result

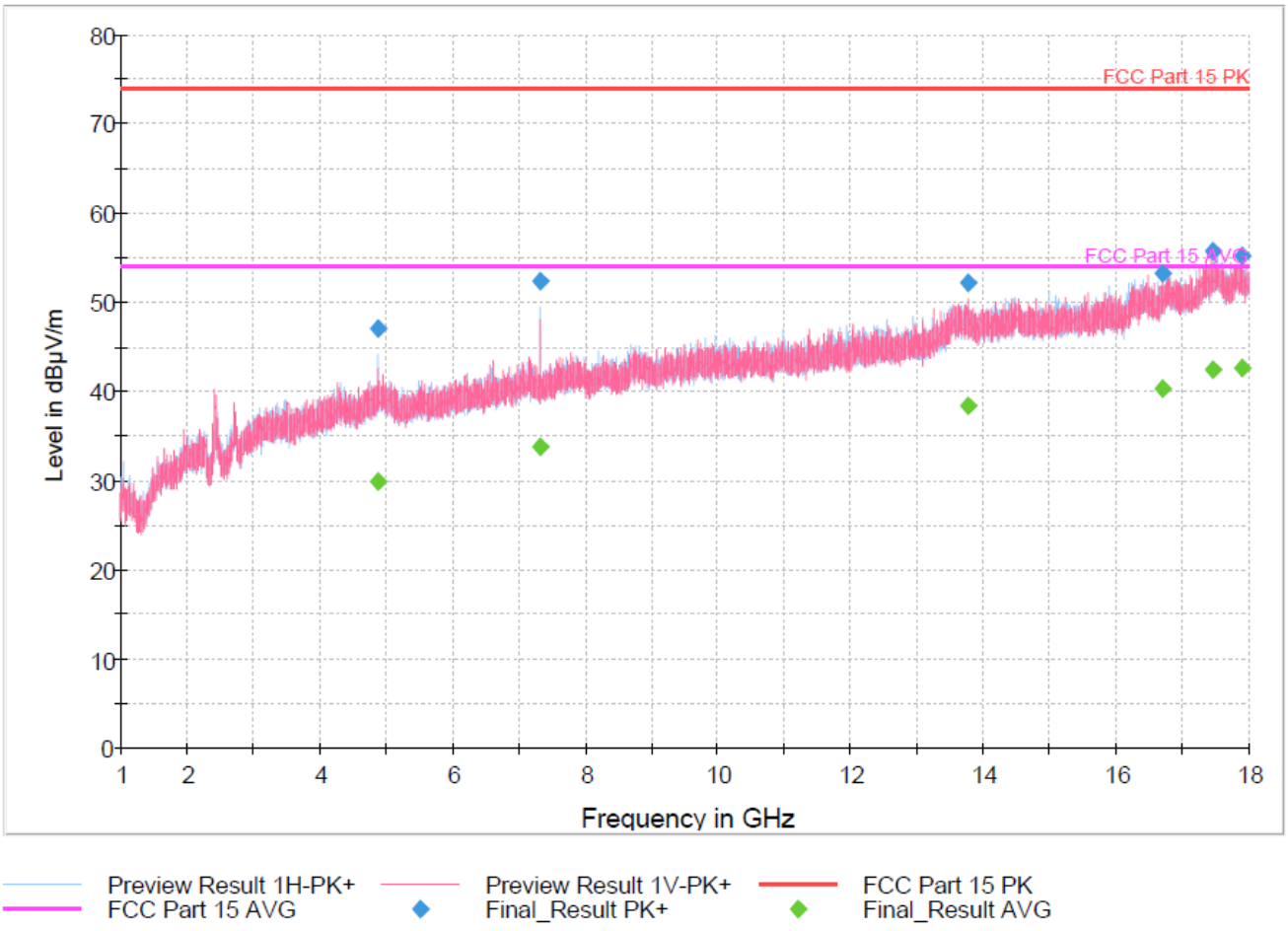
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4804.999029	48.53	---	74.00	25.47	1000.000	103.0	V	329.0	5.7
4804.999029	---	30.20	54.00	23.80	1000.000	103.0	V	329.0	5.7
7205.111000	53.73	---	74.00	20.27	1000.000	100.0	H	344.0	8.4
7205.111000	---	34.95	54.00	19.05	1000.000	100.0	H	344.0	8.4
13581.185000	---	37.74	54.00	16.26	1000.000	166.0	V	161.0	15.1
13581.185000	51.23	---	74.00	22.77	1000.000	166.0	V	161.0	15.1
16761.500971	---	40.95	54.00	13.05	1000.000	309.0	H	186.0	19.2
16761.500971	53.56	---	74.00	20.44	1000.000	309.0	H	186.0	19.2
17568.000000	---	42.79	54.00	11.21	1000.000	196.0	H	216.0	20.3
17568.000000	56.03	---	74.00	17.97	1000.000	196.0	H	216.0	20.3
17874.993000	---	42.70	54.00	11.30	1000.000	119.0	V	95.0	20.6
17874.993000	55.31	---	74.00	18.69	1000.000	119.0	V	95.0	20.6



Plot 24. 1-18GHz, BLE-2402MHz

Final Result

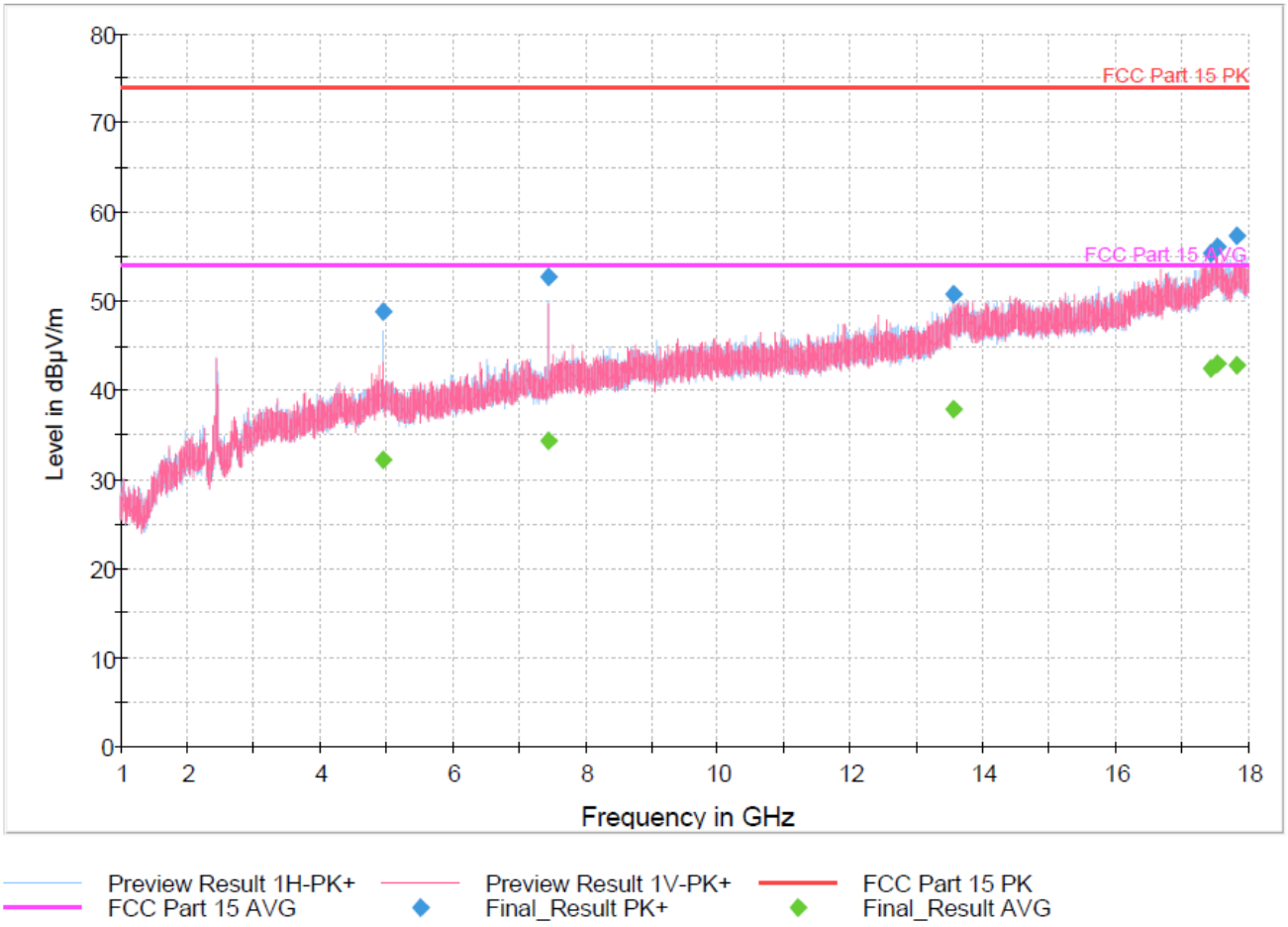
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4880.402000	---	29.97	54.00	24.03	1000.000	150.0	H	168.0	5.8
4880.402000	47.03	---	74.00	26.97	1000.000	150.0	H	168.0	5.8
7319.247000	---	33.87	54.00	20.13	1000.000	154.0	H	158.0	8.0
7319.247000	52.41	---	74.00	21.59	1000.000	154.0	H	158.0	8.0
13763.586000	52.18	---	74.00	21.82	1000.000	154.0	V	296.0	16.5
13763.586000	---	38.32	54.00	15.68	1000.000	154.0	V	296.0	16.5
16696.109971	53.34	---	74.00	20.66	1000.000	220.0	V	-5.0	18.5
16696.109971	---	40.36	54.00	13.64	1000.000	220.0	V	-5.0	18.5
17462.560000	---	42.52	54.00	11.48	1000.000	282.0	H	86.0	19.8
17462.560000	55.82	---	74.00	18.18	1000.000	282.0	H	86.0	19.8
17902.904000	---	42.67	54.00	11.33	1000.000	322.0	H	93.0	20.5
17902.904000	55.26	---	74.00	18.74	1000.000	322.0	H	93.0	20.5



Plot 25. 1-18GHz, BLE-2440MHz

Final Result

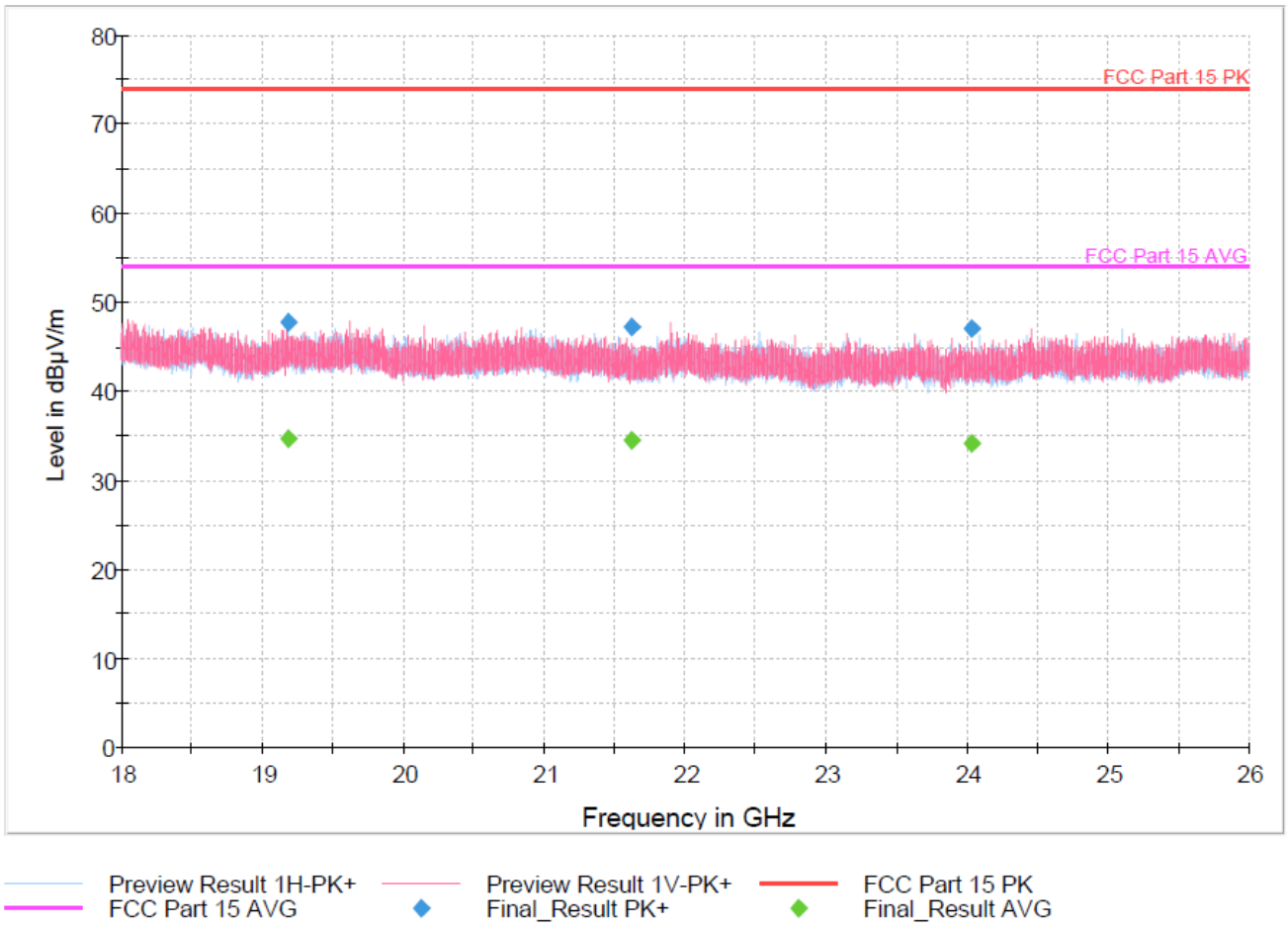
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4959.720971	48.83	---	74.00	25.17	1000.000	106.0	H	346.0	6.2
4959.720971	---	32.28	54.00	21.72	1000.000	106.0	H	346.0	6.2
7439.097971	52.80	---	74.00	21.20	1000.000	119.0	H	247.0	8.5
7439.097971	---	34.39	54.00	19.61	1000.000	119.0	H	247.0	8.5
13546.000000	50.86	---	74.00	23.14	1000.000	144.0	V	74.0	14.7
13546.000000	---	37.86	54.00	16.14	1000.000	144.0	V	74.0	14.7
17434.010000	---	42.40	54.00	11.60	1000.000	350.0	V	20.0	19.7
17434.010000	55.35	---	74.00	18.65	1000.000	350.0	V	20.0	19.7
17543.500971	---	43.09	54.00	10.91	1000.000	150.0	V	241.0	20.4
17543.500971	56.12	---	74.00	17.88	1000.000	150.0	V	241.0	20.4
17828.018000	57.37	---	74.00	16.63	1000.000	169.0	H	90.0	20.6
17828.018000	---	42.78	54.00	11.22	1000.000	169.0	H	90.0	20.6



Plot 26. 1-18GHz, BLE-2480MHz

Final Result

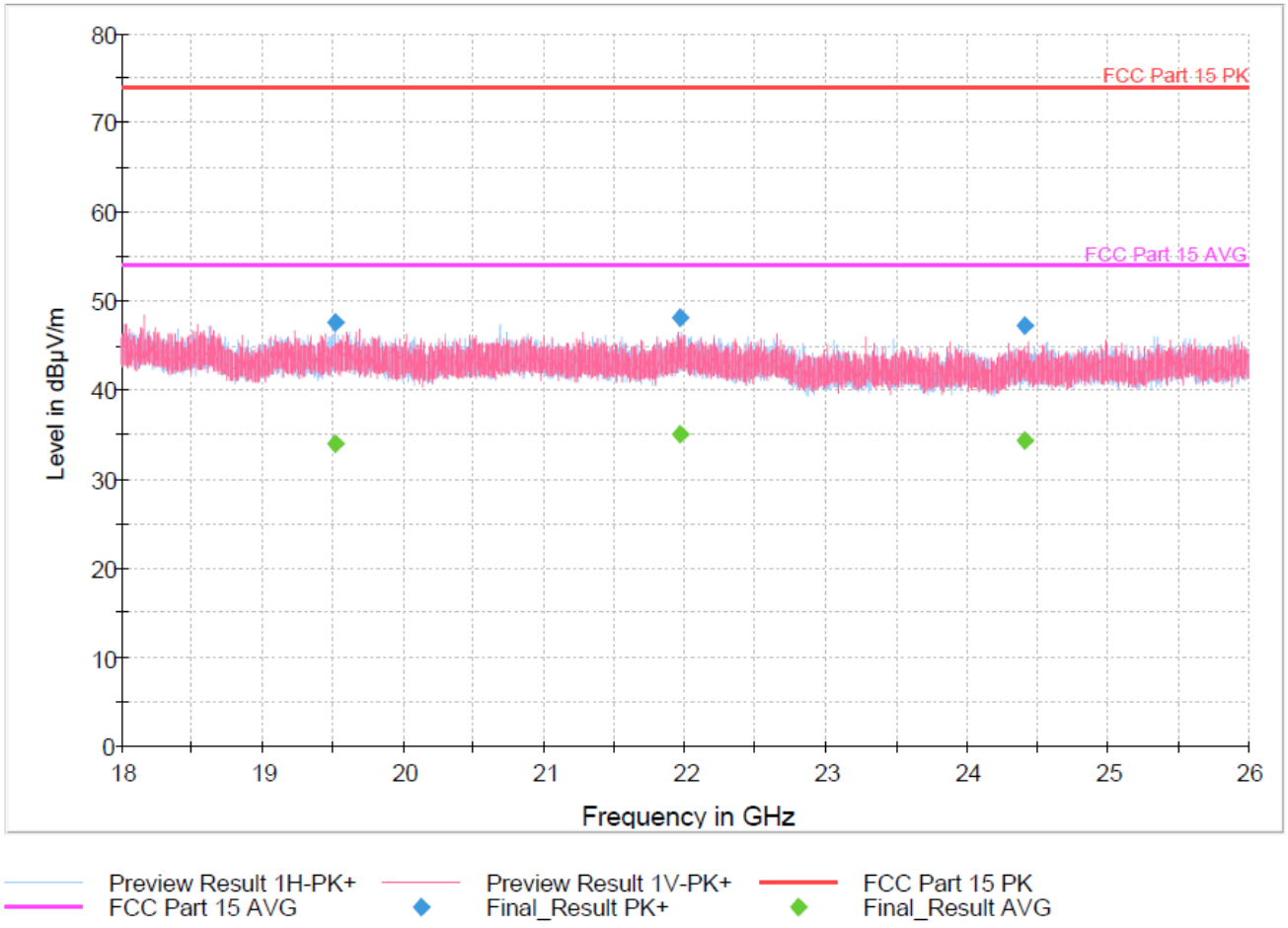
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19185.148030	---	34.61	54.00	19.39	1000.000	179.0	H	137.0	-1.5
19185.148030	47.76	---	74.00	26.24	1000.000	179.0	H	137.0	-1.5
21623.794118	47.22	---	74.00	26.78	1000.000	246.0	V	92.0	0.8
21623.794118	---	34.44	54.00	19.56	1000.000	246.0	V	92.0	0.8
24030.596235	47.02	---	74.00	26.98	1000.000	131.0	V	336.0	1.8
24030.596235	---	34.20	54.00	19.80	1000.000	131.0	V	336.0	1.8



Plot 27. 18-26 GHz, BLE-2402MHz

Final Result

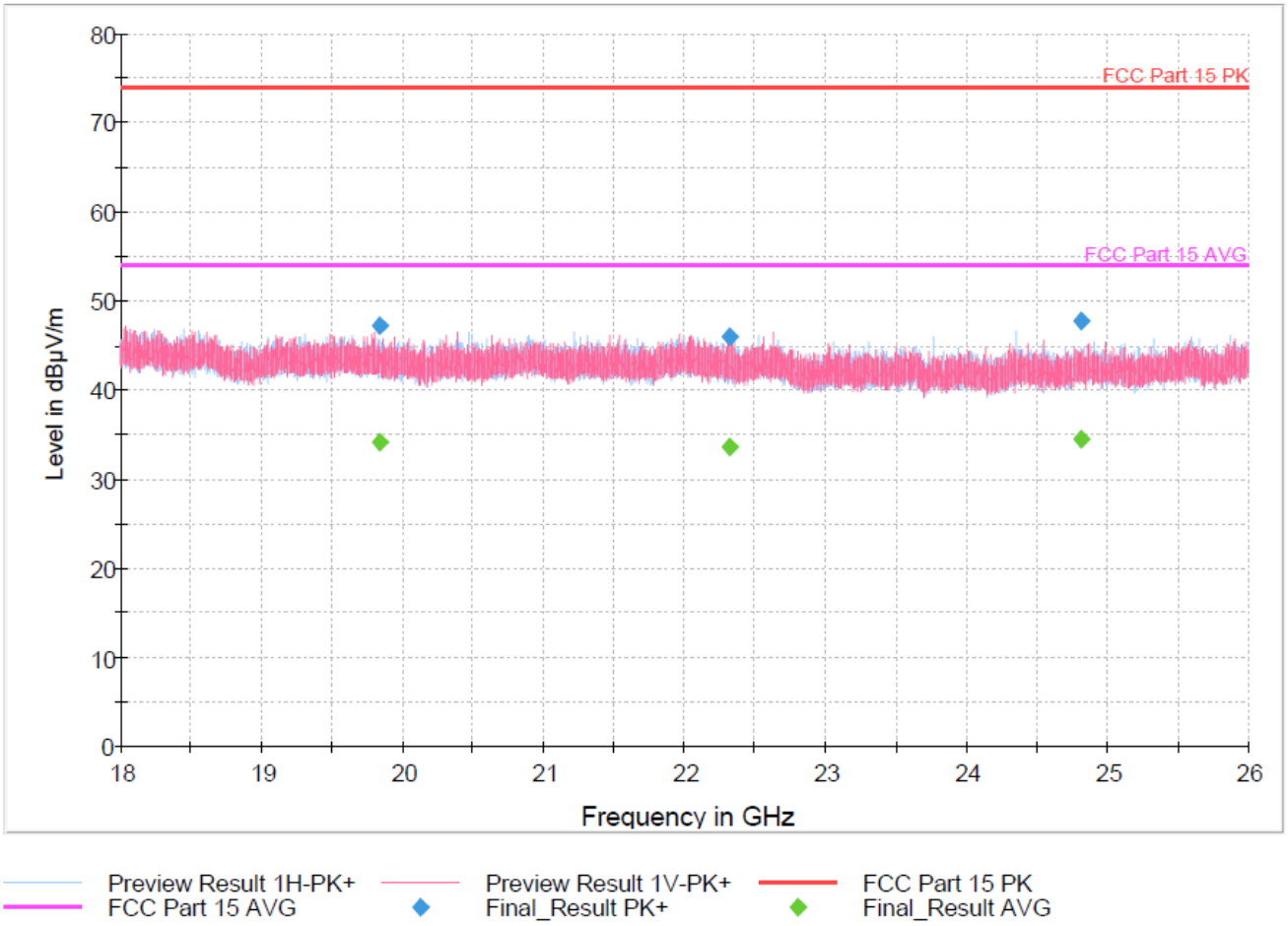
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19517.441176	---	34.03	54.00	19.97	1000.000	150.0	H	292.0	-1.0
19517.441176	47.54	---	74.00	26.46	1000.000	150.0	H	292.0	-1.0
21960.028441	48.10	---	74.00	25.90	1000.000	167.0	V	213.0	0.8
21960.028441	---	35.04	54.00	18.96	1000.000	167.0	V	213.0	0.8
24412.200000	47.25	---	74.00	26.75	1000.000	134.0	V	120.0	2.3
24412.200000	---	34.33	54.00	19.67	1000.000	134.0	V	120.0	2.3



Plot 28. 18-26 GHz, BLE-2440MHz

Final Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19843.736265	---	34.07	54.00	19.93	1000.000	116.0	H	147.0	-0.5
19843.736265	47.31	---	74.00	26.69	1000.000	116.0	H	147.0	-0.5
22323.099529	46.07	---	74.00	27.93	1000.000	100.0	V	181.0	0.8
22323.099529	---	33.69	54.00	20.31	1000.000	100.0	V	181.0	0.8
24811.087264	47.72	---	74.00	26.28	1000.000	234.0	H	-5.0	2.9
24811.087264	---	34.59	54.00	19.41	1000.000	234.0	H	-5.0	2.9



Plot 29. 18-26 GHz, BLE-2480MHz

4.7 AC Conducted Emissions

Testing was performed in accordance with ANSI C63.10: 2013. 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: 2020 and RSS Gen: 2019 Sect. 8.8.

4.7.1 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.

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.

4.7.1.1 Deviations

There were no deviations from this test methodology.

4.7.2 Test Results

Test is not applicable since the EUT is DC powered by a battery.

5 Test Equipment List

5.1 Equipment List

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal mm/dd/yyyy	Next Cal mm/dd/yyyy
Analyzer/EMI Receiver	Rohde & Schwarz	ESW44	101663	08/19/2019	08/19/2021
Bilog Antenna	Schwarzbeck	VULB 9162	100323	07/10/2020	07/10/2020
Preamplifier	Rohde & Schwarz	TS-PR8	102353	08/14/2020	08/14/2021
Filter and Amp Box*	Rohde & Schwarz	SFUNIT-Rx	102143	07/30/2020	07/30/2021
Horn Antenna	Rohde & Schwarz	HF907	102834	07/10/2020	07/10/2021
Switching Unit	Rohde & Schwarz	OSB 230	101431	07/27/2020	07/27/2021
Preamp	Rohde & Schwarz	TS-PR1840	101649	08/14/2020	08/14/2021
Horn Antenna	Narda	180-442-KF	134596-01	04/17/2020	04/17/2021
Spectrum Analyzer	Rohde & Schwarz	FSU26.5	200050	03/05/2021	03/05/2022
Environmental Chamber	Espec	E99D0	0613436	12/20/2019	12/20/2020
EMI Receiver	Agilent	N9038A	MY51210195	07/14/2020	07/14/2022
Signal Generator	Rohde & Schwarz	SMBV100A	257744	09/19/2019	09/19/2021
Note: *SFUNIT-Rx contains 1-18GHz Amplifier, 2.4GHz Notch Filter, 5.5GHz Notch Filter, 3GHz High Pass Filter, 7GHz High Pass Filter and are calibrated as a system.					

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

The information in the following tables is required, as it should appear in the final test report.

Table 6: Customer Information

Company Name	Abbott Diabetes Care
Address	1360 South Loop Rd
City, State, Zip	Alameda, CA 94502
Country	USA

Table 7: Technical Contact Information

Name	William Matievich
E-mail	William.matievich@abbott.com
Phone	+1 (510) 864-4405

6.3 Equipment Under Test (EUT)

The information provided in the following table should be listed as it should appear in the final report. For those products that have only a model name, list the model number as *non-applicable* and vice-versa.

Table 8: EUT Designation

Product Name	FreeStyle Libre 3
Model Name	PRT28985-244
System Name	NA
Product Description	FreeStyle Libre 3 with BLE that operates in the band 2.4 GHz.

6.4 Product Specifications

The information provided in the following table should be listed as it should appear in the final report.

Table 9: EUT Specifications

EUT Specifications	
DC Power Input	1.5 VDC (powered by battery)
Operating Temperature Range:	10°C - 45°C
Multiple Feeds:	☐ Yes and how many ☒ No
Product Marketing Name (PMN)	FreeStyle Libre 3
Hardware Version Identification Number (HVIN)	PRT28985-244 rev. 1
Firmware Version Identification Number (FVIN)	0.1.6.49
Operating Modes	Bluetooth Low Energy
Transmitter Frequency Band	2400 MHz to 2483.5 MHz
Power Setting @ Operating Channel	+4dBm (Default)
Antenna Type	Dipole Antenna
Antenna Gain	-13 dBi
Modulation Type	☐ AM ☐ FM ☐ DSSS ☒ OFDM ☒ Other describe: GFSK
Data Rate	1 Mbps
TX/RX Chain (s)	1
Type of Equipment	☐ Table Top ☐ Wall-mount ☐ Floor standing cabinet ☒ Other: Body worn
Note: EUT will be on / transmitted at all times with the highest power levels and antenna gains per channel.	

Table 10: Antenna Information

Number	Antenna Type	Description	Max Gain (dBi)
1	Dipole antenna	Bluetooth Low Energy	-13

Table 11: 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?
N/A	-	☐ No	☐ Metric:	☐ N/A

Table 12: Accessory Equipment

Equipment	Manufacturer	Model	Serial	Comment
N/A	N/A	N/A	N/A	N/A

Table 13: Ancillary Equipment (used for test purposes only)

Equipment	Manufacturer	Model	Serial	Used for
Laptop	DELL	Lattitude E6430	H97LKX1	Setup EUT operating channels
Reader	Abbott	N/A	N/A	EUT-BLE test commands
Note: None.				

Table 14: Description of Sample used for Testing

Sample Number	Model	Serial Number	Configuration	Used For
1	PRT28985-244	E07A00213EAA3447	Radiated Sample	TX Spurious Emissions, Band edge
2	PRT28985-244	E07A00213EA6356E	Conducted Sample	All other conducted Measurements
Note: None.				

Table 15: Description of Test Configuration used for Radiated Measurement.

Device	Antenna	Mode	Setup Description
PRT28985-244	Dipole	Transmit	EUT positioned vertical, worst case.
Note:			

6.5 Test Specifications

Table 16: Test Specifications

Emissions and Immunity	
Standard	**Requirement**
CFR 47 Part 15.247: 2020	All
RSS 247 Issue 2, 2017	All

END OF REPORT