Emissions
Test Report

EUT Name: Wi-Fi Router

Model No.: D010001 (USA), D010002 (IC)

CFR 47 Part 15.247: 2016 and RSS 247: 2017

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Report/Issue Date: May 05, 2017
Job # 0000146054
Report Number: 31760707.001

Revisions

Revision No.	Date MM/DD/YYYY	Reason for Change	Author
0	05/05/2017	Original Document	N/A

Note: Latest revision report will replace all previous reports.

Statement of Compliance

Manufacturer:	eero inc. 500 Howard Street, Suite 900 San Francisco, CA 94105 (415) 738-7972
Requester / Applicant:	Clifford Clarke
Name of Equipment:	Wi-Fi Router
Model No.	D010001 (USA), D010002 (IC)
Type of Equipment:	Intentional Radiator
Application of Regulations:	CFR 47 Part 15.247: 2016 and RSS 247: 2017
Test Dates:	17 Feb 2017 to 04 May 2017

Guidance Documents:

Emissions: ANSI C63.10-2013, KDB 558074 D01 DTS Measurement Guidance v03r05, KDB 662911 D01 Multiple Transmitter Output v02r01

Test Methods:

Emissions: ANSI C63.10-2013, KDB 558074 D01 DTS Measurement Guidance v03r05, KDB 662911 D01 Multiple Transmitter Output v02r01

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.

Kerwinn Corpuz	David Spencer
Test Engineer Date May 05, 2017	A2LA Signatory Date May 05, 2017

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

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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: 2016 and RSS 247: 2017 based on the results of testing performed on 17 Feb 2017 to 04 May 2017 on the Wi-Fi Router Model D010001 (USA), D010002 (IC) manufactured by eero 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 2402 MHz to 2480 MHz frequency band for Bluetooth LE, 2405 MHz to 2475 MHz frequency band for Thread (Zigbee) and 2412 MHz to 2462 MHz frequency band for WiFi are 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 Transmitted 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**
Occupied Bandwidth	CFR47 15.247 (a1), RSS GEN Sect.6.6	See plots	**Complied**
Maximum Output Power	CFR47 15.247 (b), RSS 247 Sect. 5.4 (d)	*28.85 dBm (802.11g) *28.79 dBm (HT 20) *28.86 dBm (HT 40) 12.78 dBm (BLE)	**Complied**
Peak Power Spectral Density	CFR47 15.247 (e), RSS 247 Sect. 5.2 (b)	< 8 dBm/3kHz	**Complied**
Out of Band Emission	CFR47 15.247 (d), RSS 247 Sect.5.5	30 MHz - 26 GHz < 20 dBm/100kHz	**Complied**
RF Exposure	CFR47 15.247 (i), 2.1093 RSS-102 Issue 5	General Population	**Complied**

Note: This test report covers 2400 MHz to 2483.5 MHz band. * = summed power.

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 Canada – Industry Canada

TUV Rheinland of North America at the 1279 Quarry Ln, Pleasanton, CA 94566 address is accredited by Industry Canada for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by Industry Canada (File Number 2932M). This reference number is the indication to the Industry Canada Certification Officers that the site meets the requirements of RSS 212, Issue 1 (Provisional). The accreditation is updated every 3 years.

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 at 1279 Quarry Ln, Pleasanton, CA 94566 has been assessed and approved in accordance with the Regulations for Voluntary Control Measures.

VCCI Registration No. for Pleasanton: A-0261

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

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.

2.2.2 Immunity Test Facility

ESD, EFT, Surge, PQF: These tests are performed in an environmentally controlled room with a 3.7 m x 4.8 m x 3.175 mm thick aluminum floor connected to PE ground.

For ESD testing, tabletop equipment is placed on an insulated mat with a surface resistivity of 10^9 Ohms/square on a 1.6 m x 0.8 m x 0.8 m high non-conductive table with a 3.175 mm aluminum top (Horizontal Coupling Plane). The HCP is connected to the main ground plane via a low impedance ground strap through two 470-kΩ resistors. The Vertical Coupling Plane consists of an aluminum plate 50 cm x 50 cm x 3.175 mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470-kΩ resistors.

For EFT, Surge, PQF, the HCP and VCP are removed.

RF Field Immunity testing is performed in a 7.3m x 4.3m x 4.1m anechoic chamber.

RF Conducted and Magnetic Field Immunity testing is performed on a 4.8m x 3.7m x 3.175mm thick aluminum ground plane.

All test areas allow a minimum distance of 1 meter from the EUT to walls or conducting objects.

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

Voltech PM6000A

The estimated combined standard uncertainty for harmonic current and flicker measurements is ± 5.0%.	Per CISPR 16-4-2 Methods

2.3.3 Measurement Uncertainty Immunity

The estimated combined standard uncertainty for ESD immunity measurements is ± 8.2%.	Per IEC 61000-4-2
The estimated combined standard uncertainty for radiated immunity measurements is ± 4.10 dB.	Per IEC 61000-4-3
The estimated combined standard uncertainty for conducted immunity measurements with CDN is ± 3.66 dB	Per IEC 61000-4-6
The estimated combined standard uncertainty for power frequency magnetic field immunity is ± 2.9%.	Per IEC 61000-4-8

Thermo KeyTek EMC Pro

The estimated combined standard uncertainty for EFT fast transient immunity measurements is ± 2.6%.
The estimated combined standard uncertainty for surge immunity measurements is ± 2.6%.
The estimated combined standard uncertainty for voltage variation and interruption measurements is ± 1.74%.

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

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 D010001 (USA), D010002 (IC), Wi-Fi Router, is a Wi-Fi router for the home capable of operating in the 2.4 GHz and 5 GHz frequency bands over 20 MHz, 40 MHz and 80 MHz channels.

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 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 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 an 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 and to place the EUT in the most susceptible state for immunity 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 Wi-Fi Router has five FPCB antennas. The 2.4GHz band uses Flex Printed Circuit Board (FPCB) dipole antennas (Antenna 3, Antenna 4 and Antenna 5) and has maximum gain +4.08 dBi for WiFi and +4.14 dBi for BLE and Thread (Zigbee). Antenna 5 is used independently for Bluetooth LE / Thread (Zigbee) and has no beam forming capability.

Refer to Table 18 for additional antenna information.

There is no additional antenna available.

4 Emissions

Testing was performed in accordance with CFR 47 Part 15.247: 2016 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.

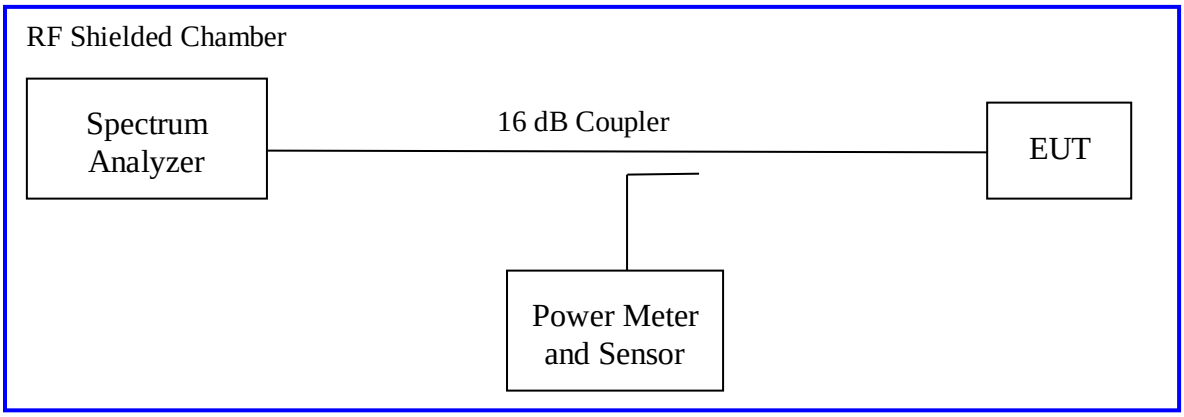
The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b):2016 and RSS 247: 2017 Sect. 5.4 (d).

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

4.1.1 Test Method

The ANSI C63.10-2013 Section 11.9.2.2.2. Conducted method was used to measure the channel power output. The preliminary investigation was performed at different data rate / chain to determine the highest power output for each mode. 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.

Test Setup:



Method AVGSA-1 of "KDB 558074 – DTS Measurement Guidance v03r05" applies since the EUT continuously transmits with duty cycle greater than 98%. Sample detector was used.

Each chain was measured individually and applied the measure-and-sum approach per KDB662911.

The total directional gain (6.87 dBi) was calculated by summing Antenna 3 (4.08 dBi) and Antenna 4 (3.64 dBi).

The duty cycle, CF = 10Log(1/duty cycle), was applied for BLE.

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 – Non Beamforming

Test Conditions: Conducted Measurement, Normal Temperature

Antenna Type: FPCB **Power Setting:** See test plan

Max. Directional Gain: Antenna 3 = + 4.08 dBi (WiFi); Antenna 4 = + 3.64 dBi (WiFi); Antenna 5 = + 4.14 dBi (BLE and Thread)

Signal State: Modulated at 100%.

Ambient Temp.: 22° C **Relative Humidity:**39%

802.11g

Operating Channel (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Total Power [dBm]	Margin [dB]
2412.00	30.00	24.18	23.67	26.94	-2.19
2437.00	30.00	26.97	26.79	29.89	-0.11
2462.00	30.00	26.86	26.47	29.68	-0.32

Note: 1.The highest output power was observed at 802.11g mode, 6.0 Mbps, 1 Data Streams.
2. The sum of Ch0 and Ch1 = Total Power.
3. Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.

802.11n

Operating Channel (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Total Power [dBm]	Margin [dB]
2412.00	30.00	24.20	23.77	27.00	-2.13
2437.00	30.00	26.91	26.75	29.84	-0.16
2462.00	30.00	26.75	26.80	29.79	-0.21

Note: 1. The highest output power was observed at HT20 MCS0, 1 Data Streams.
2. The sum of Ch0 and Ch1 = Total Power.
3. Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.

Table 3: RF Output Power at the Antenna Port – Test Results – Non Beamforming Continued

Test Conditions: Conducted Measurement, Normal Temperature

Antenna Type: FPCB **Power Setting:** See test plan

Max. Directional Gain: Antenna 3 = + 4.08 dBi (WiFi); Antenna 4 = + 3.64 dBi (WiFi); Antenna 5 = + 4.14 dBi (BLE and Thread)

Signal State: Modulated at 100%.

Ambient Temp.: 22° C **Relative Humidity:**39%

802.11n

Operating Channel (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Total Power [dBm]	Margin [dB]
2422.00	30.00	21.66	21.32	24.50	-4.63
2437.00	30.00	26.78	26.51	29.66	-0.34
2452.00	30.00	22.04	21.70	24.88	-4.25

Note: 1. The highest output power was observed at HT40 MCS0, 1 Data Streams.
2. The sum of Ch0 and Ch1 = Total Power.
3. Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.

802.15.1

Operating Channel (MHz)	Packet	Limit [dBm]	Max. Power [dBm]	Margin [dB]
2402.00	BLE	30.00	12.78	-17.22
2442.00	BLE	30.00	12.45	-17.55
2480.00	BLE	30.00	12.00	-18.00

Note: 1. The highest output power was observed at Bluetooth LE, 1 Data Streams.
2. The TX measured duty cycle is 61%. A 2.1 dB Correction Factor was applied to the measured power.
3. Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.

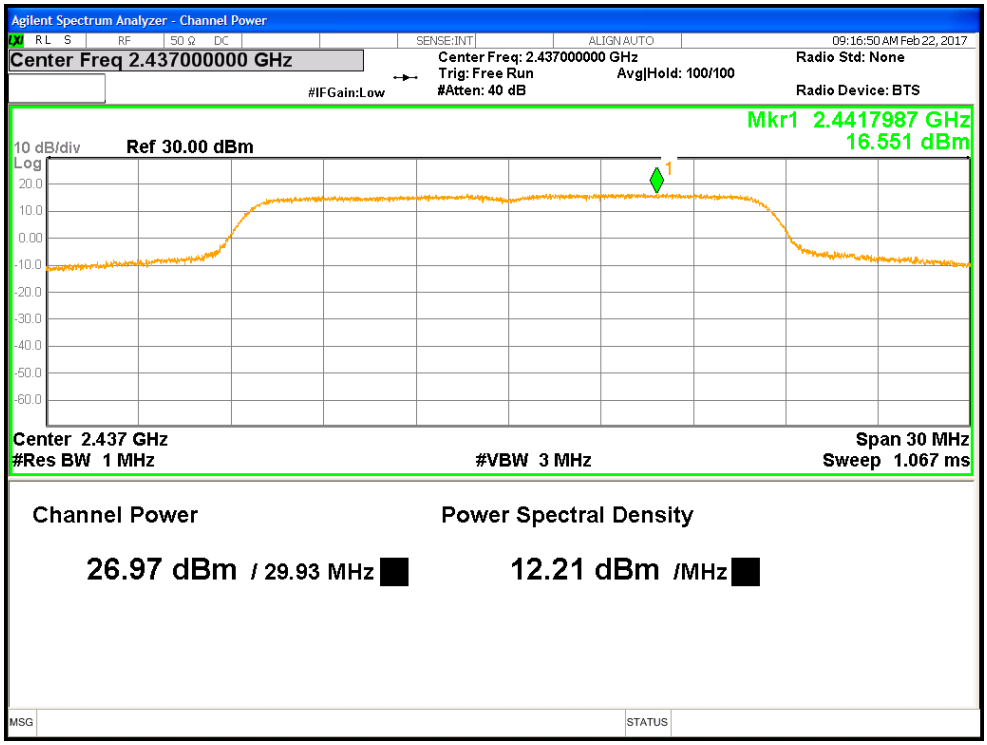


Figure 1: Maximum Transmitted Power, 2437 MHz at 11g 6Mbps, Chain 0

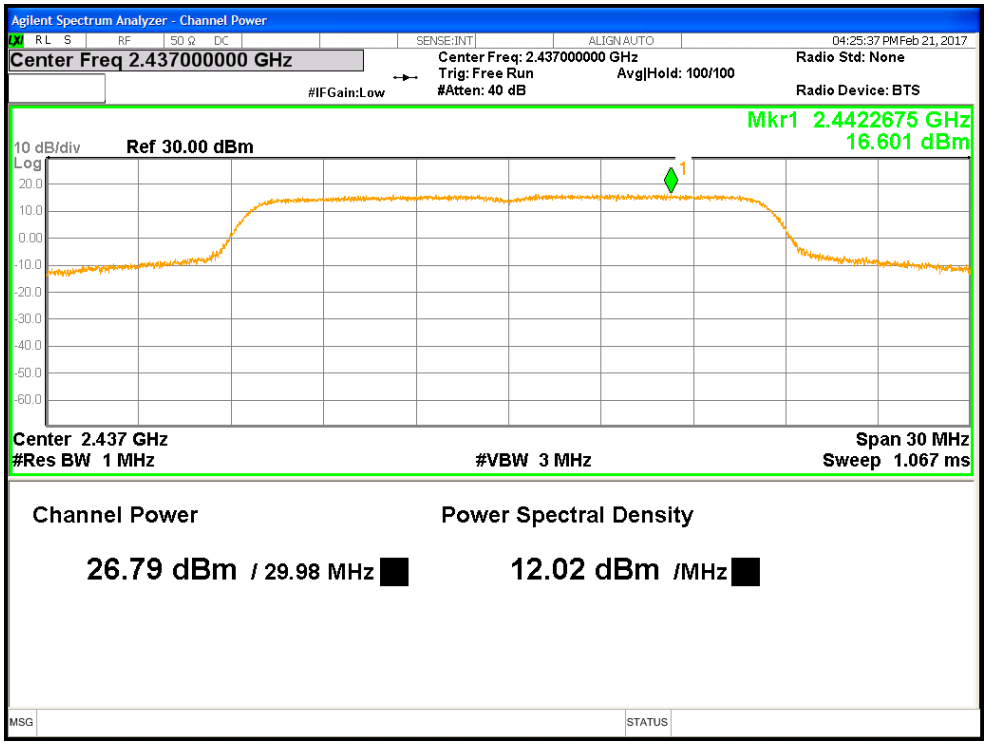


Figure 2: Maximum Transmitted Power, 2437 MHz at 11g 6Mbps, Chain 1

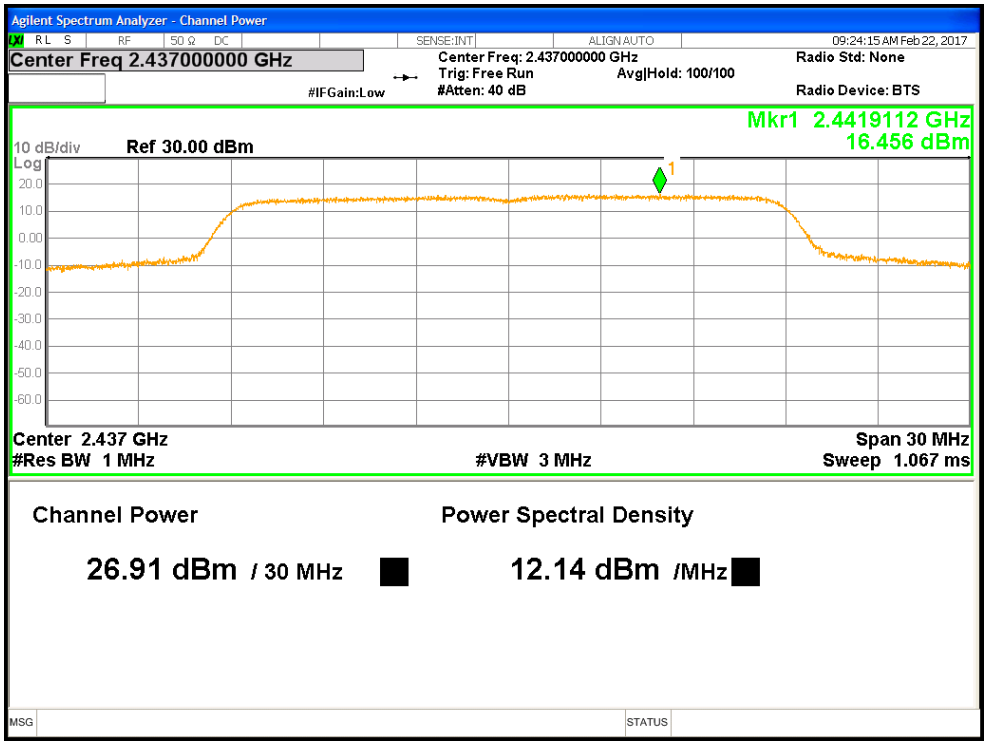


Figure 3: Maximum Transmitted Power, 2437 MHz at HT20 MCS0, Chain 0

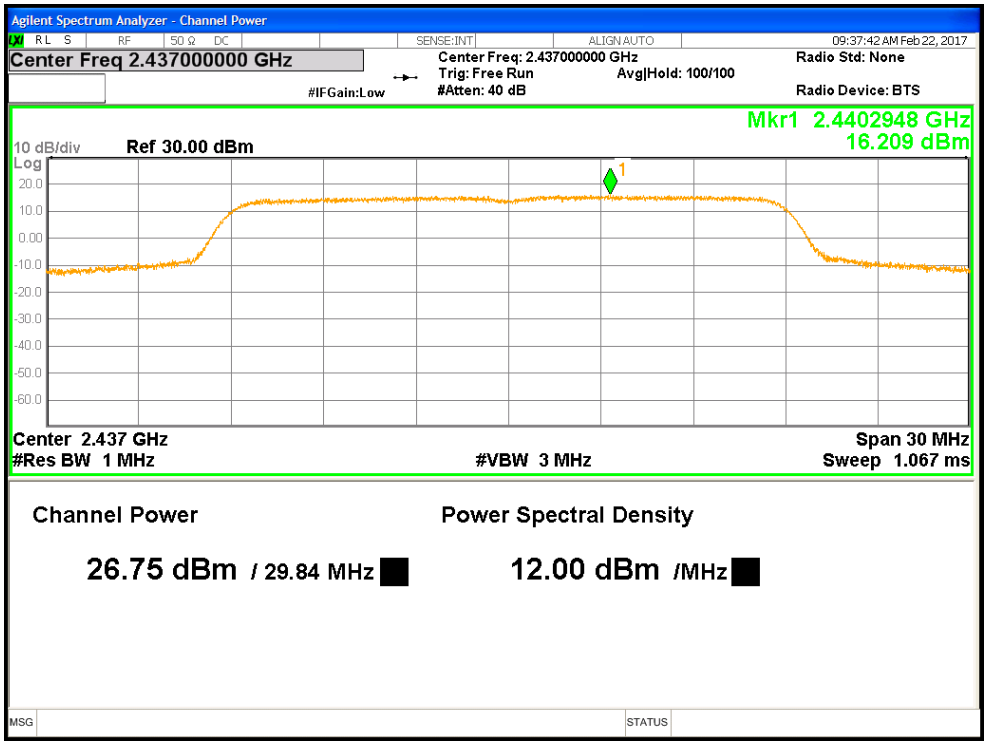


Figure 4: Maximum Transmitted Power, 2437 MHz at HT20 MCS0, Chain 1

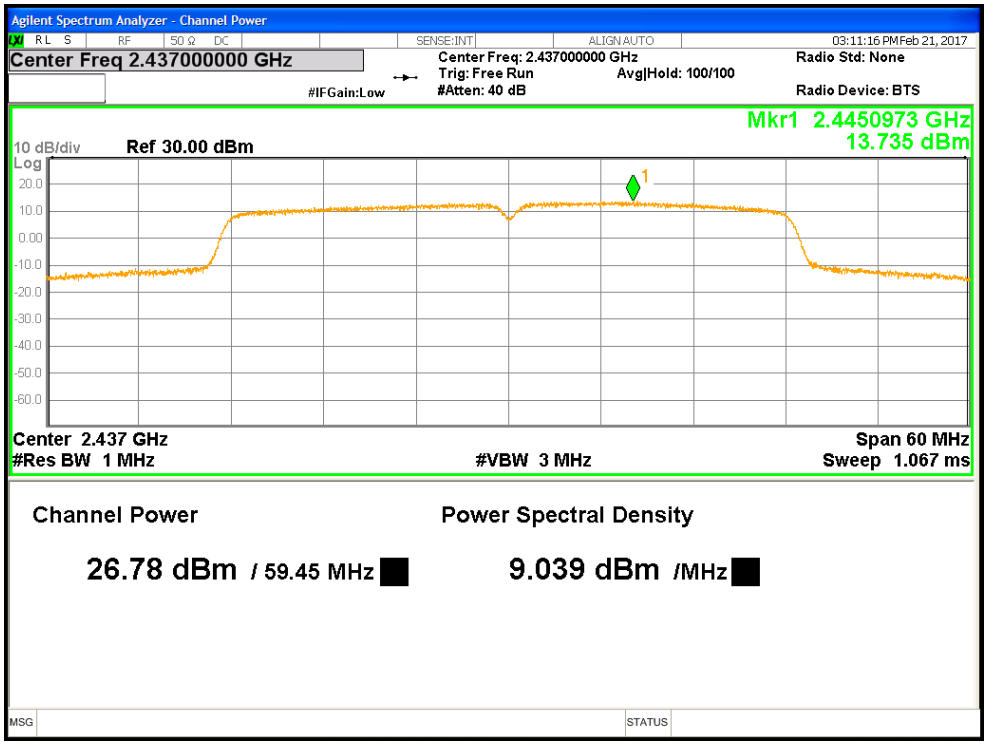


Figure 5: Maximum Transmitted Power, 2437 MHz at HT40 MCS0, Chain 0

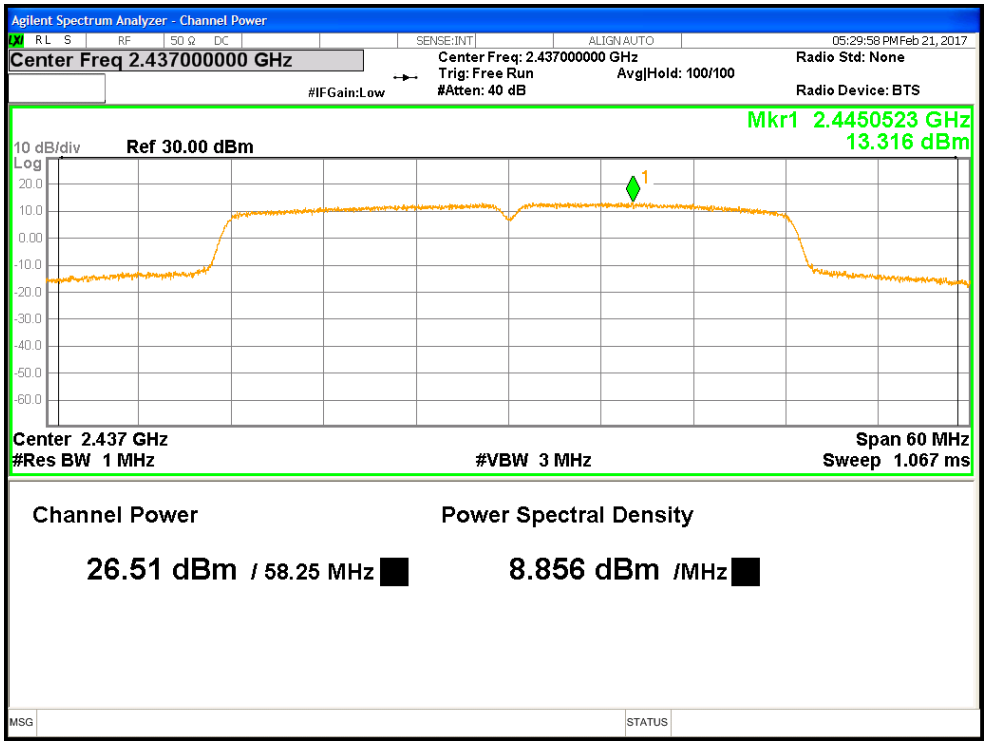


Figure 6: Maximum Transmitted Power, 2437 MHz at HT40 MCS0, Chain 1

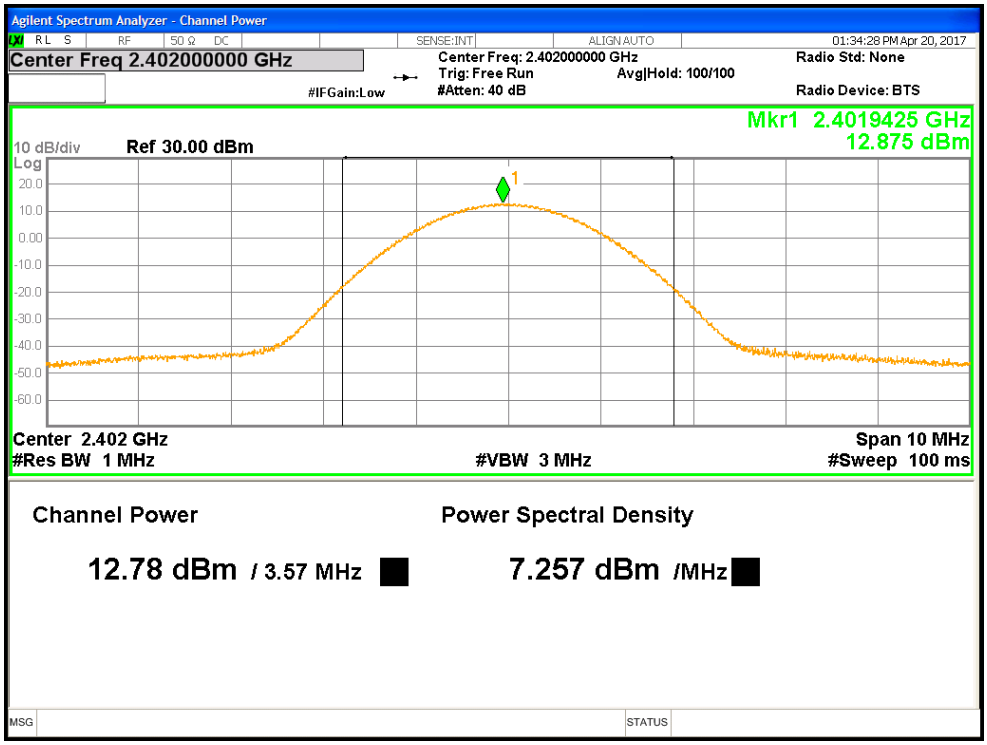


Figure 7: Maximum Transmitted Power, 2402 MHz for BLE

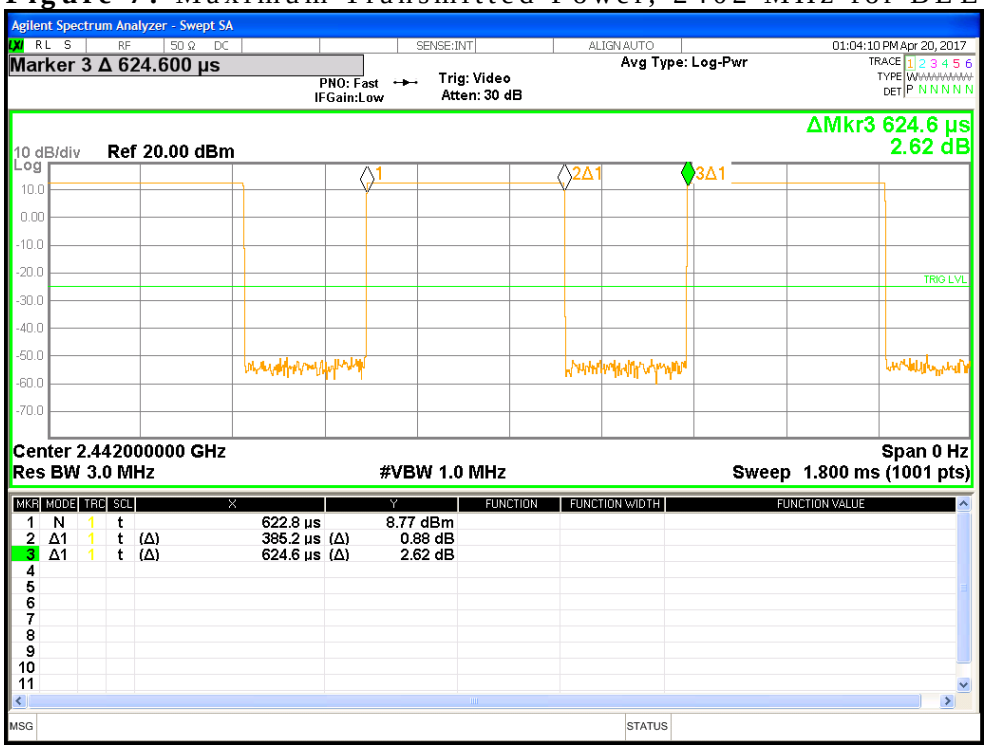


Figure 8: Duty Cycle measurement for Bluetooth LE

Table 4: RF Output Power at the Antenna Port – Test Results – Beamforming

Test Conditions: Conducted Measurement, Normal Temperature

Antenna Type: FPCB **Power Setting:** See test plan

Total Directional Gain: + 6.87 dBi (WiFi)

Signal State: Modulated at 100%.

Ambient Temp.: 22° C **Relative Humidity:**39%

802.11g

Operating Channel (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Total Power [dBm]	Margin [dB]
2412.00	29.13	24.18	23.67	26.94	-2.19
2437.00	29.13	25.94	25.74	28.85	-0.28
2462.00	29.13	25.72	25.51	28.63	-0.50

Note: 1.The highest output power was observed at 802.11g mode, 6.0 Mbps, 1 Data Streams.
2. The sum of Ch0 and Ch1 = Total Power.
3. 0.87 dBi – 30 dBm = Limit [dBm].
4. Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.

802.11n

Operating Channel (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Total Power [dBm]	Margin [dB]
2412.00	29.13	24.20	23.77	27.00	-2.13
2437.00	29.13	25.91	25.65	28.79	-0.34
2462.00	29.13	25.47	25.74	28.62	-0.51

Note: 1. The highest output power was observed at HT20 MCS0, 1 Data Streams.
2. The sum of Ch0 and Ch1 = Total Power.
3. 0.87 dBi – 30 dBm = Limit [dBm].
4. Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.

Table 5: RF Output Power at the Antenna Port – Test Results – Beamforming Continued

Test Conditions: Conducted Measurement, Normal Temperature					
Antenna Type: FPCB			**Power Setting:** See test plan		
Total Directional Gain: + 6.87 dBi (WiFi)					
Signal State: Modulated at 100%.					
Ambient Temp.: 22° C			**Relative Humidity:**39%		
802.11n					
Operating Channel (MHz)	**Limit [dBm]**	**Ch0 [dBm]**	**Ch1 [dBm]**	**Total Power [dBm]**	**Margin [dB]**
2422.00	29.13	21.66	21.32	24.50	-4.63
2437.00	29.13	26.09	25.6	28.86	-0.27
2452.00	29.13	22.04	21.70	24.88	-4.25

Note: 1. The highest output power was observed at HT40 MCS0, 1 Data Streams.
2. The sum of Ch0 and Ch1 = Total Power.
3. 0.87 dBi – 30 dBm = Limit [dBm].
4. Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.

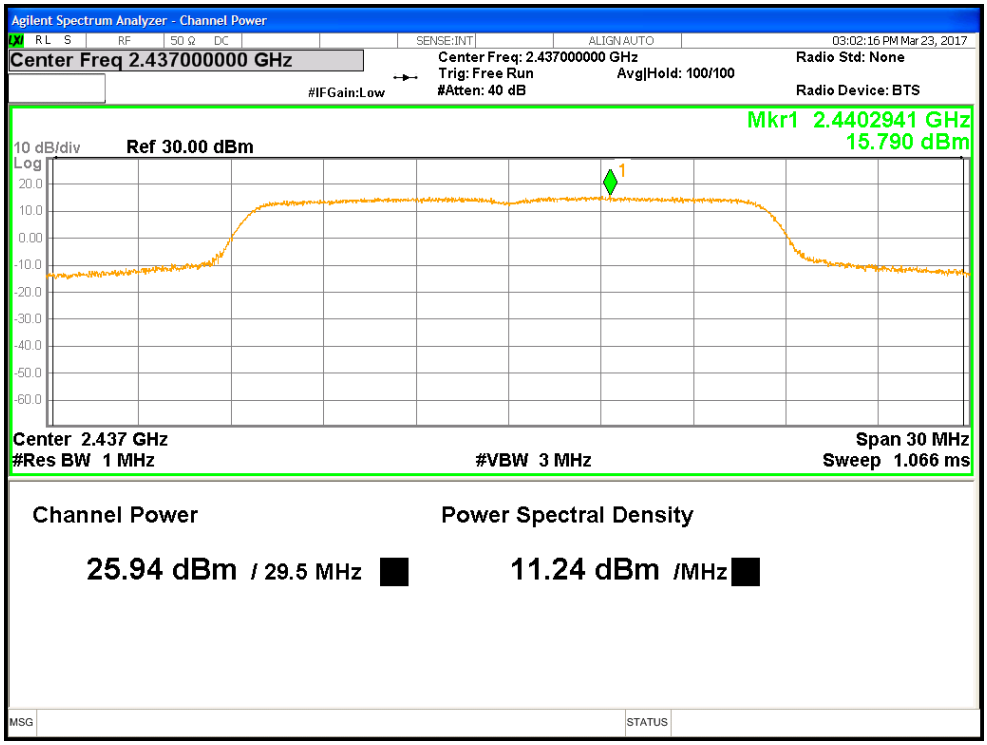


Figure 9: Maximum Transmitted Power, 2437 MHz at 11g 6Mbps, Chain 0

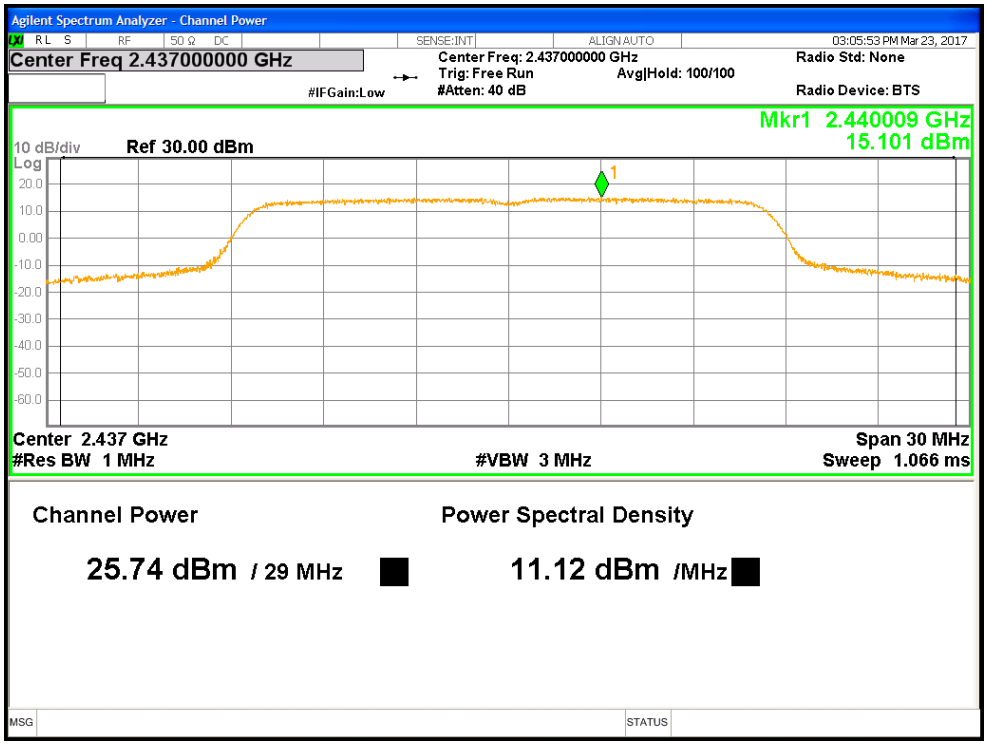


Figure 10: Maximum Transmitted Power, 2437 MHz at 11g 6Mbps, Chain 1

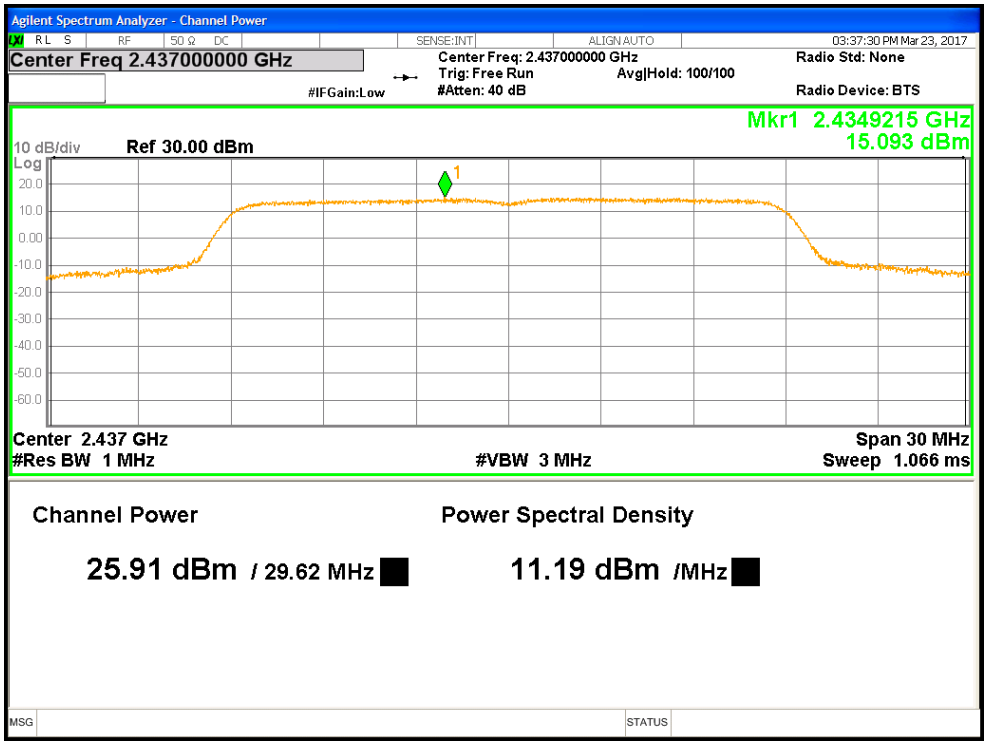


Figure 11: Maximum Transmitted Power, 2437 MHz at HT20 MCS0, Chain 0

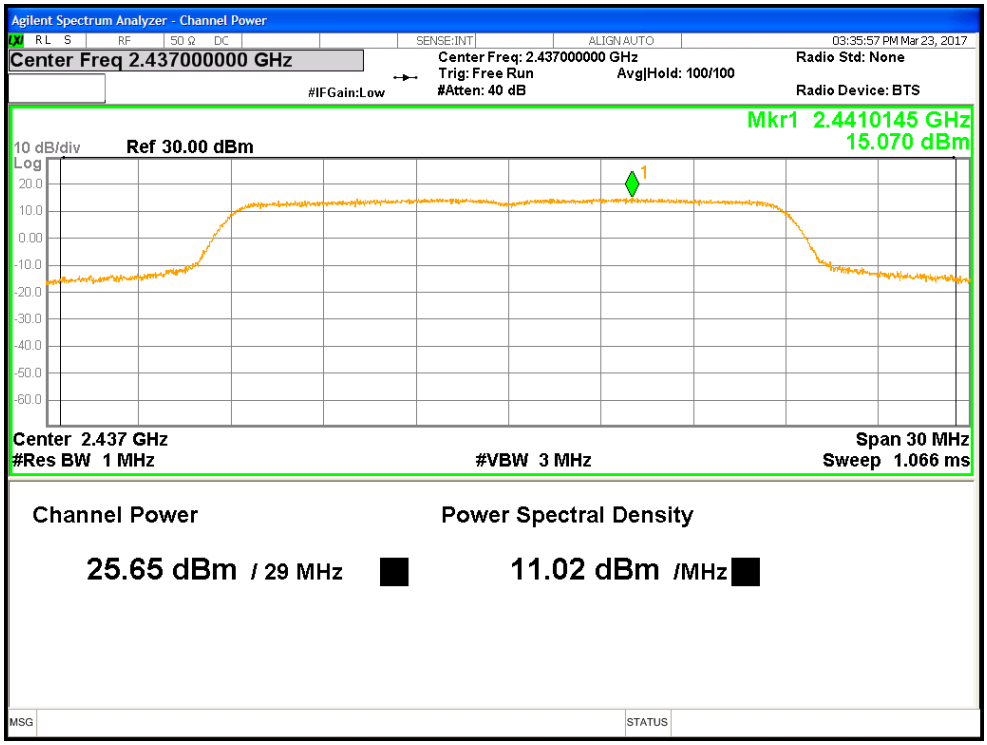


Figure 12: Maximum Transmitted Power, 2437 MHz at HT20 MCS0, Chain 1

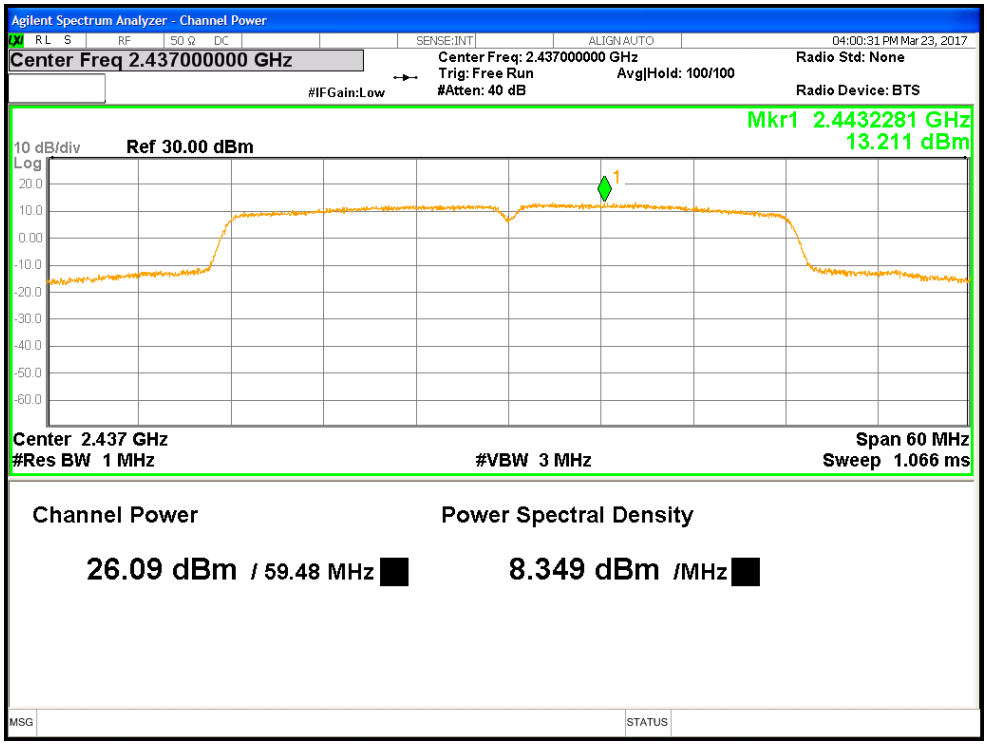


Figure 13: Maximum Transmitted Power, 2437 MHz at HT40 MCS0, Chain 0

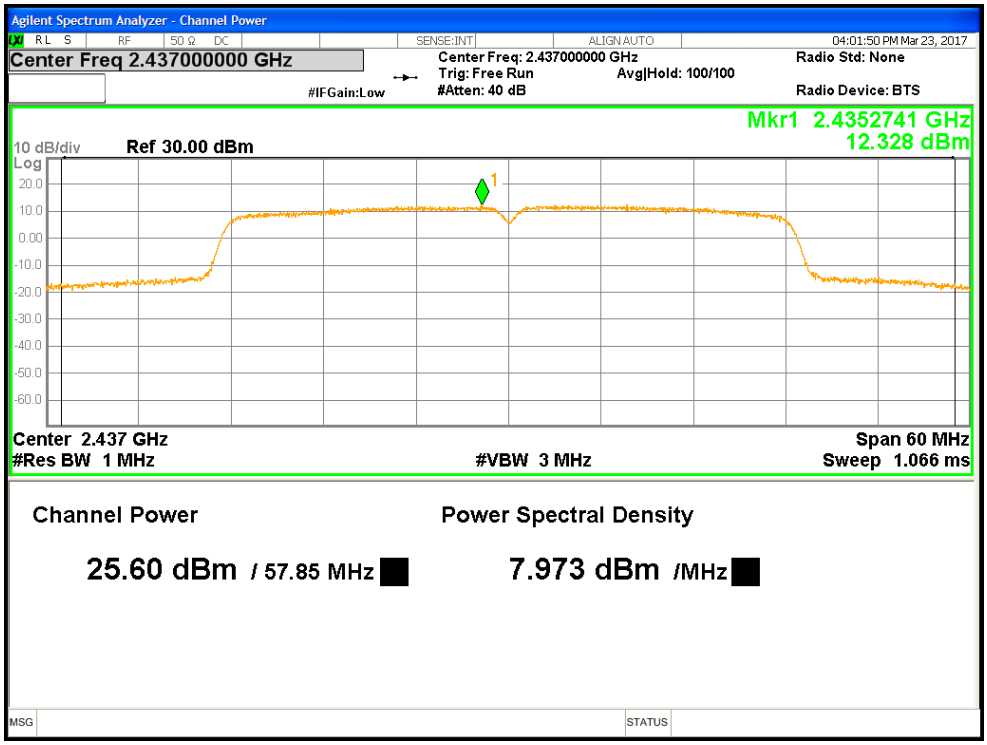


Figure 14: Maximum Transmitted Power, 2437 MHz at HT40 MCS0, Chain 1

4.2 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.

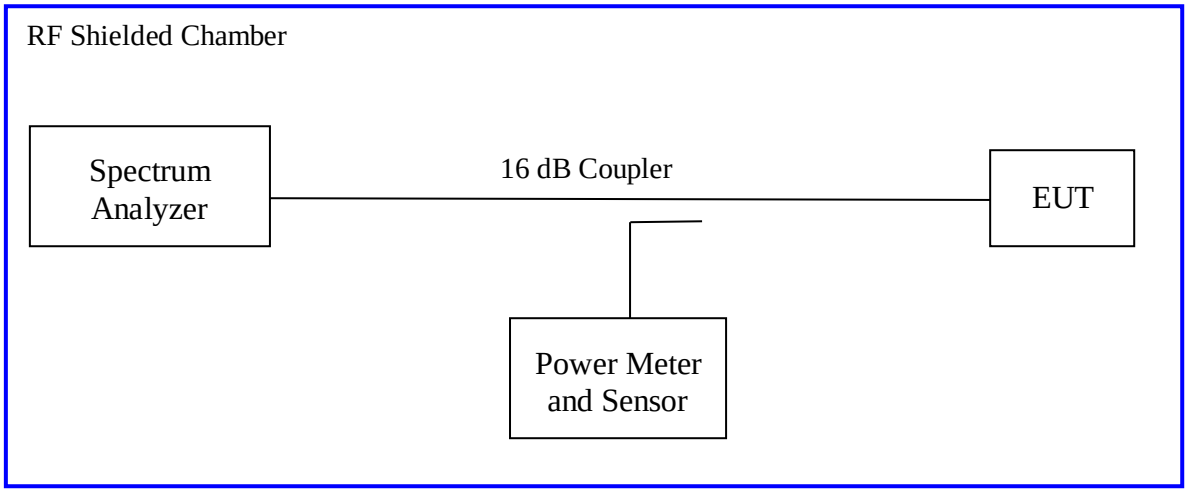
The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.

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) 2016 and RSS Gen Sect. 6.6 2014. The preliminary investigation was performed to find the narrowest 26 dB bandwidth for each operational mode at different data rates. This worst finding was performed on 3 channels in each operating frequency range; 2400 MHz to 2483.5 MHz, a 6 dB bandwidth was used. The worst results indicated below.

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 6: Occupied Bandwidth – Test Results

Test Conditions: Conducted Measurement, Normal Temperature

Antenna Type: FPCB **Power Setting:** See test plan

Total Directional Gain: + 6.87 dBi (WiFi)
Max. Directional Gain: Antenna 3 = + 4.08 dBi (WiFi); Antenna 4 = + 3.64 dBi (WiFi); Antenna 5 = + 4.14 dBi (BLE and Thread)

Signal State: Modulated at 100%.

Ambient Temp.: 22° C **Relative Humidity:**39%

Bandwidth (MHz) for 802.11g

Freq. (MHz)	6dB Bandwidth (MHz)		99% Bandwidth (MHz)	
	Ch0	Ch1	Ch0	Ch1
2412	16.334	16.344	16.338	16.335
2437	16.346	16.308	16.981	16.546
2462	16.356	16.356	17.863	17.023

Note: 1. The bandwidth was measured at 6.0 Mbps.
2. Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.

Bandwidth (MHz) for 802.11n

Freq. (MHz)	6dB Bandwidth (MHz)		99% Bandwidth (MHz)	
	Ch0	Ch1	Ch0	Ch1
2412	17.561	17.536	17.558	17.541
2437	17.305	17.327	17.854	17.734
2462	17.547	17.578	18.326	17.925

Note: 1. The bandwidth was measured at HT20 MCS0, 1 Data Streams.
2. Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.

Table 7: Occupied Bandwidth – Test Results Continued

Test Conditions: Conducted Measurement, Normal Temperature

Antenna Type: FPCB **Power Setting:** See test plan

Total Directional Gain: + 6.87 dBi (WiFi)
Max. Directional Gain: Antenna 3 = + 4.08 dBi (WiFi); Antenna 4 = + 3.64 dBi (WiFi); Antenna 5 = + 4.14 dBi (BLE and Thread)

Signal State: Modulated at 100%.

Ambient Temp.: 22° C **Relative Humidity:**39%

Bandwidth (MHz) for 802.11n

Freq. (MHz)	6dB Bandwidth (MHz)		99% Bandwidth (MHz)	
	Ch0	Ch1	Ch0	Ch1
2422	35.302	35.350	35.866	36.095
2437	35.066	35.107	36.095	36.026
2452	35.117	35.093	35.743	35.763

Note: 1. The bandwidth was measured at HT40 MCS0, 1 Data Streams.
2. Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.

Bandwidth (MHz) for 802.15.1

Freq. (MHz)	Packet	6dB Bandwidth (MHz)	99% Bandwidth (MHz)
2402	BLE	0.7115	1.1304
2442	BLE	0.7132	1.1291
2480	BLE	0.7145	1.1302

Note: 1. The bandwidth was measured at Bluetooth LE, 1 Data Streams.
2. Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.

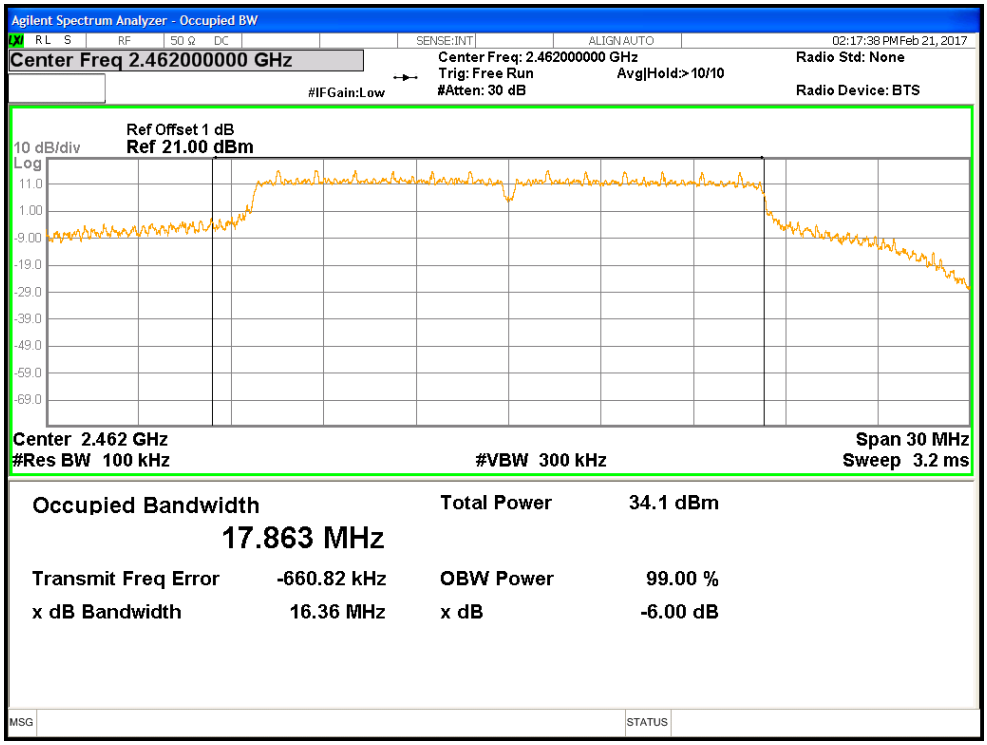


Figure 15: 6dB & 99% Occupied Bandwidth, 2462 MHz at 802.11g, Chain 0

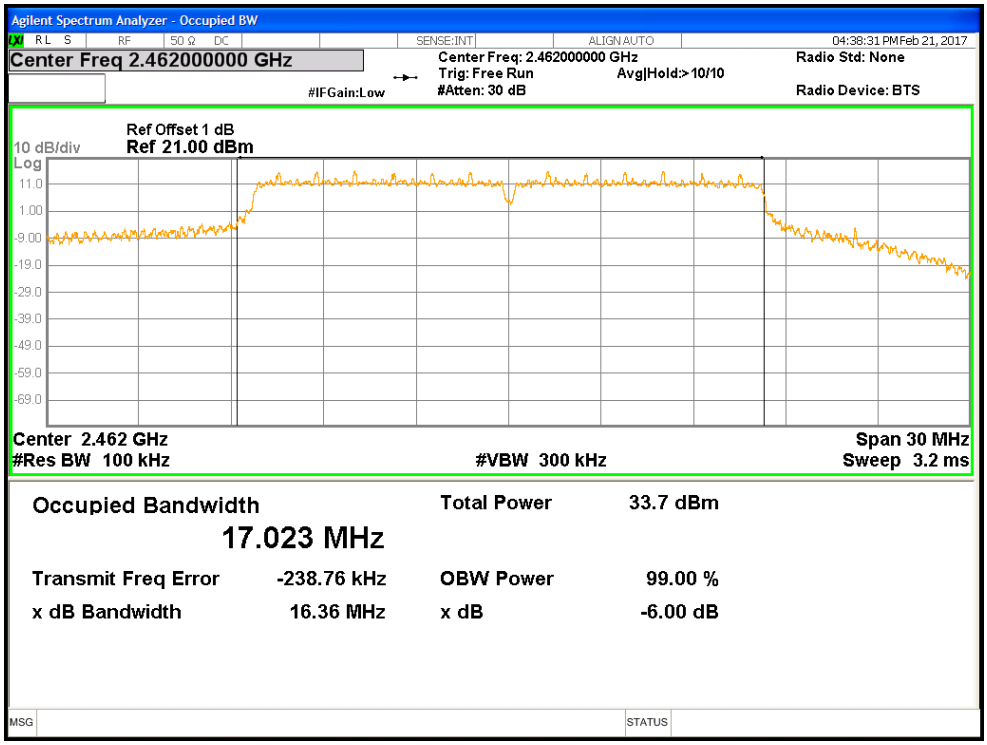


Figure 16: 6dB & 99% Occupied Bandwidth, 2462 MHz at 802.11g, Chain 1

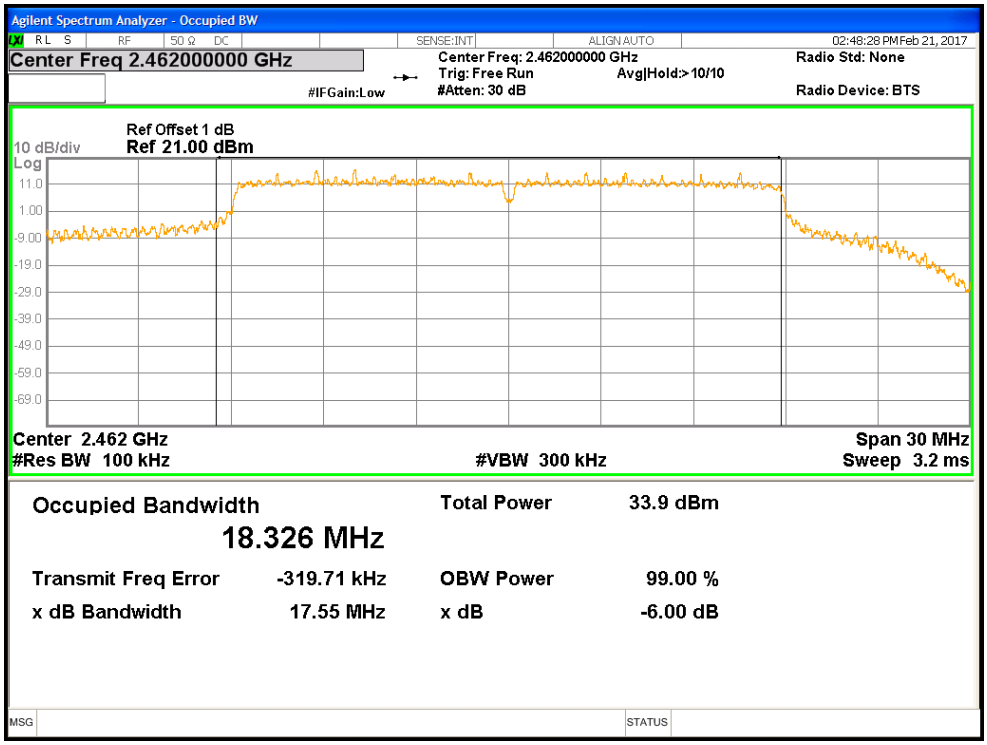


Figure 17: 6dB & 99% Occupied Bandwidth, 2462 MHz at HT20, Chain 0

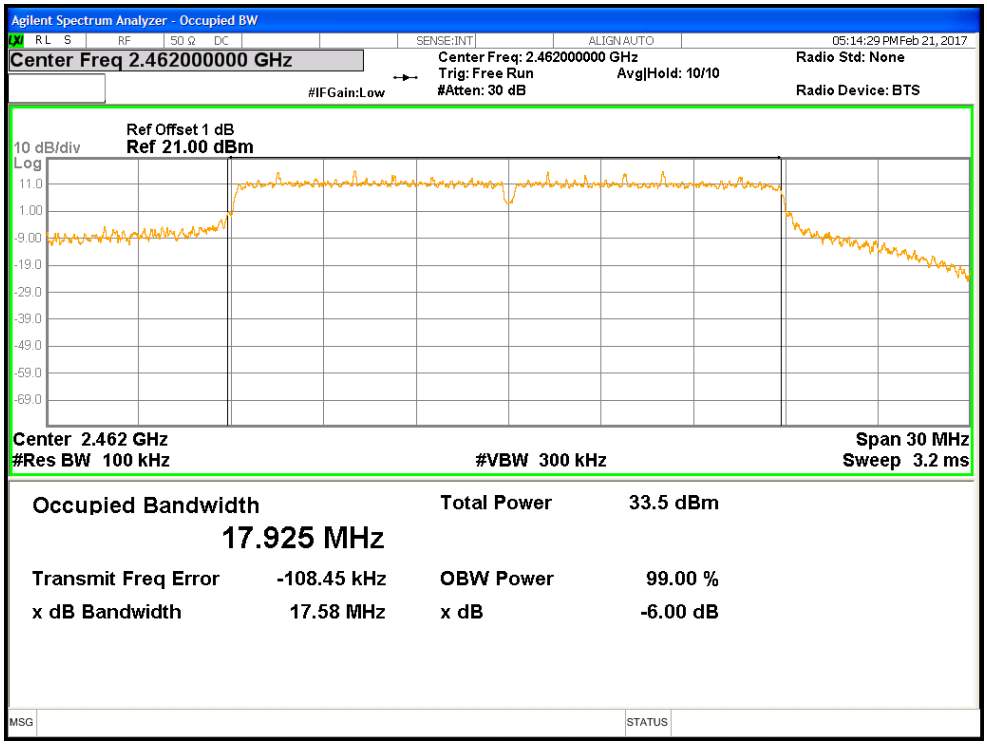


Figure 18: 6dB & 99% Occupied Bandwidth, 2462 MHz at HT20, Chain 1

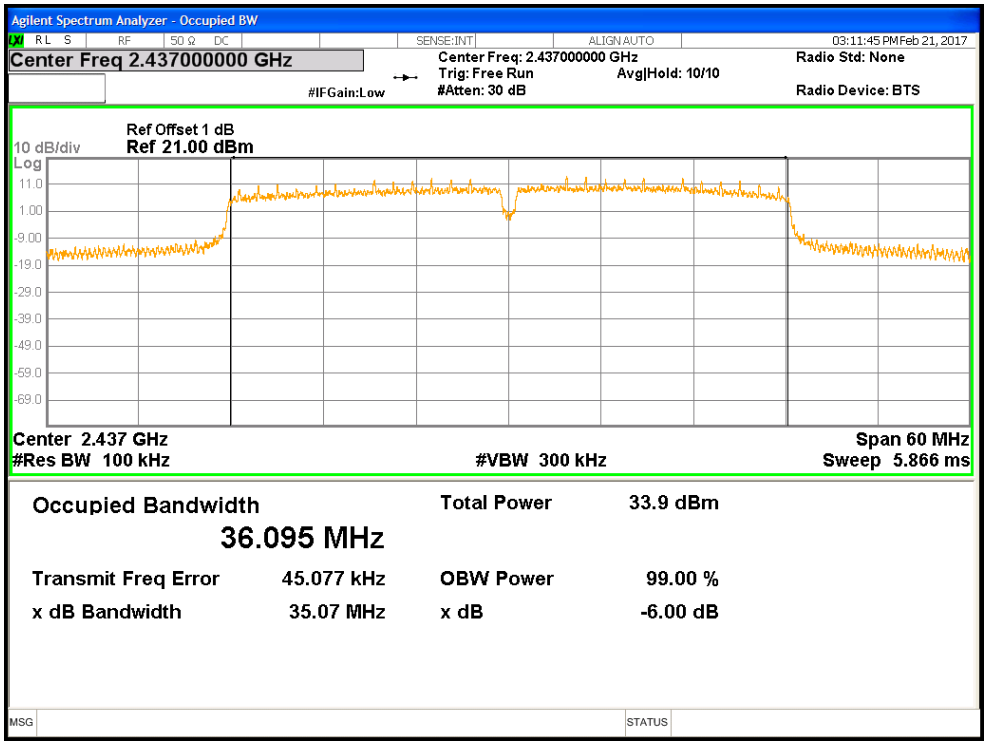


Figure 19: 6dB & 99% Occupied Bandwidth, 2437 MHz at HT40, Chain 0

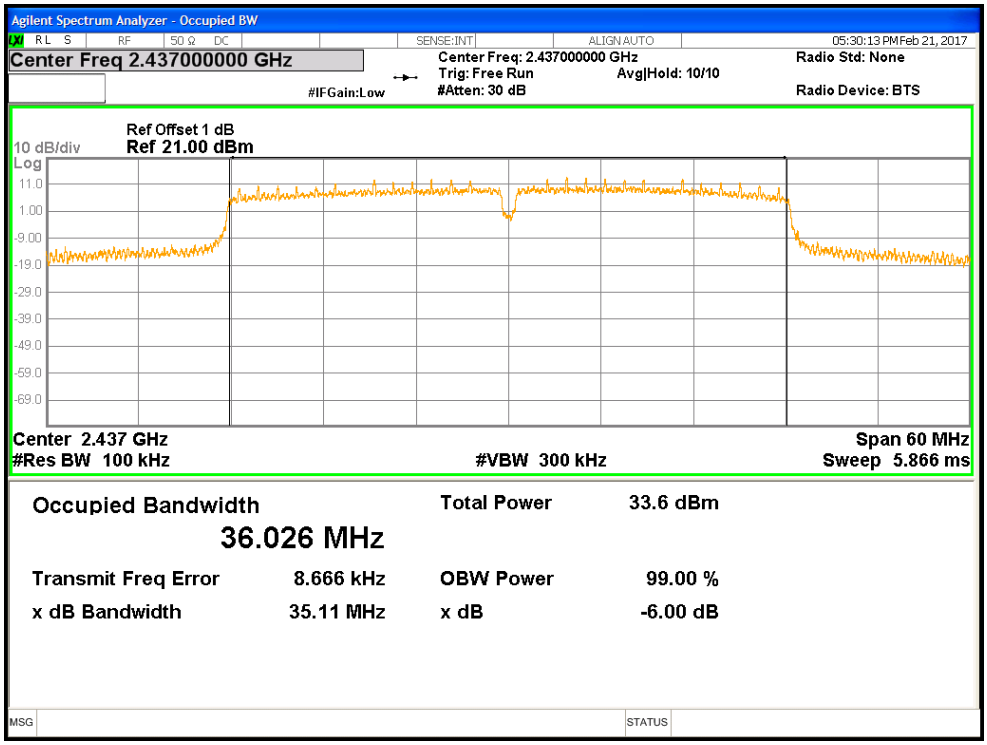


Figure 20: 6dB & 99% Occupied Bandwidth, 2437 MHz at HT40, Chain 1

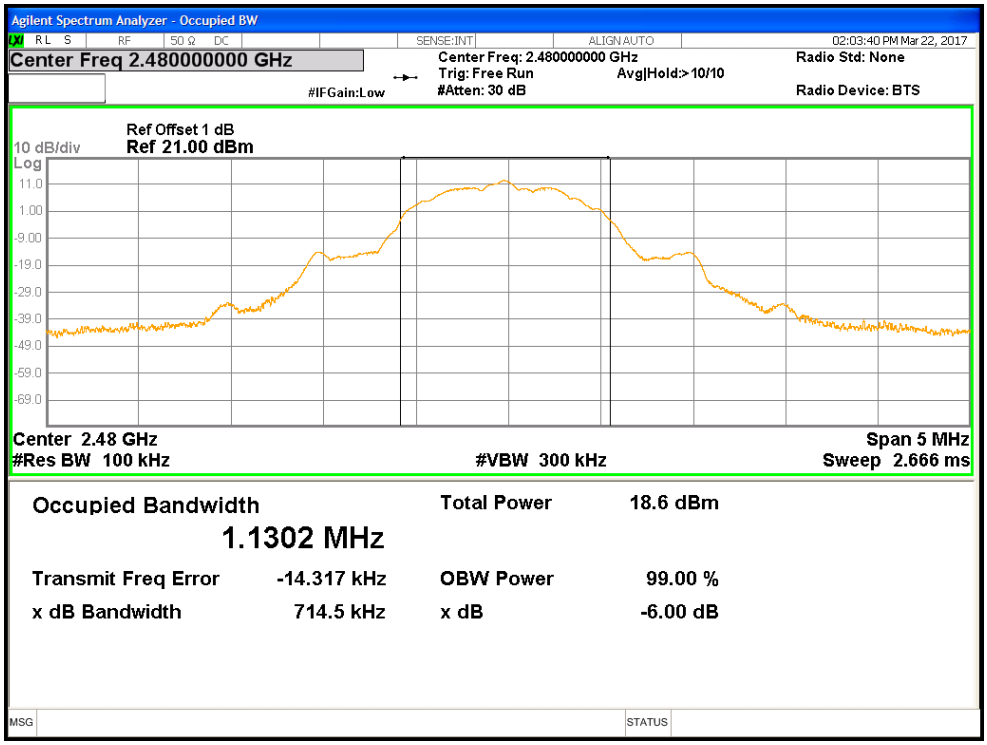


Figure 21: 6dB & 99% Occupied Bandwidth, 2480 MHz for BLE

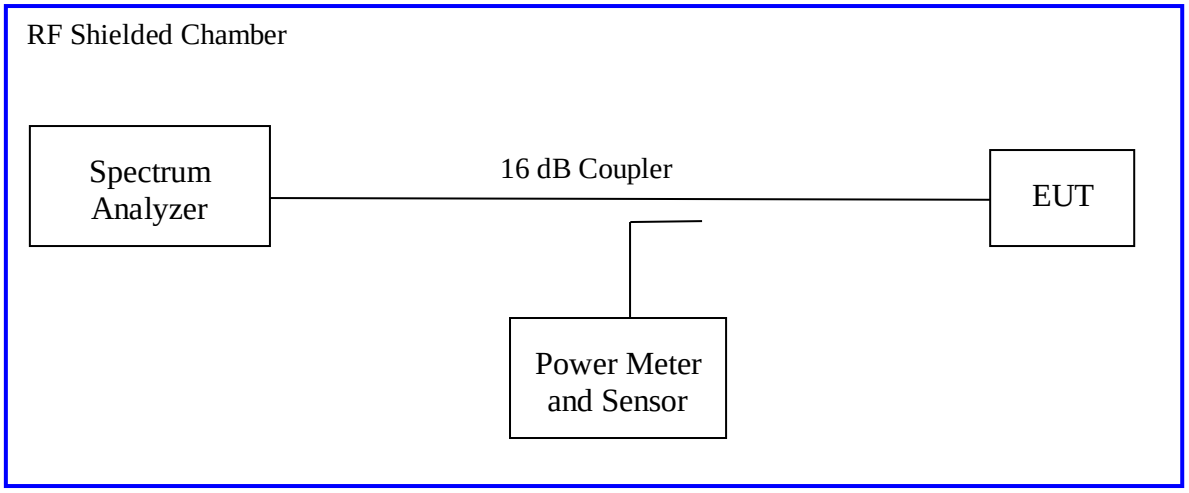
4.3 Peak Power Spectral Density

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 11.10.3. The measurement was performed with modulation per CFR47 Part 15.247 (e) and RSS 247 Sect.5.2 (b). The pre-evaluation was performed to find the worst modes. The worst findings were conducted on 3 channels in each operating frequency range of 2400 MHz to 2483.5 MHz. The worst sample result indicated below.

Test Setup:



Method AVGSA-1 of "KDB 558074 – DTS Measurement Guidance v03r05" applies since the EUT continuously transmits with duty cycle greater than 98%. Sample detector was used.

Each chain was measured individually and applied the measure-and-sum approach per KDB662911.

The total directional gain (6.87 dBi) was calculated by summing Antenna 3 (4.08 dBi) and Antenna 4 (3.64 dBi).

The duty cycle, CF = 10Log(1/duty cycle), was applied for BLE.

4.3.2 Results

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

Table 8: Peak Power Spectral Density – Test Results – Non Beamforming

Test Conditions: Conducted Measurement, Normal Temperature

Antenna Type: FPCB **Power Setting:** See test plan

Max. Directional Gain: Antenna 3 = + 4.08 dBi (WiFi); Antenna 4 = + 3.64 dBi (WiFi); Antenna 5 = + 4.14 dBi (BLE and Thread)

Signal State: Modulated at 100%.

Ambient Temp.: 22° C **Relative Humidity:**39%

Peak Power Spectral Density

802.11g

Freq. (MHz)	Ch0 [dBm]	Ch1 [dBm]	Max [dBm]	Total PSD [dBm]	Limit [dBm]	Margin [dB]
2412	-10.107	-10.412	-10.107	-7.247	8.000	-15.247
2437	-7.360	-7.679	-7.360	-4.506	8.000	-12.506
2462	-7.596	-7.880	-7.596	-4.725	8.000	-12.725

Note: 1. The highest peak output power was observed at **11g 6Mbps** per data stream.
2. The sum of Ch0 and Ch1 = Total PSD.
3. Limited number of plots are placed in the report.

802.11n

Freq. (MHz)	Ch0 [dBm]	Ch1 [dBm]	Max [dBm]	Total PSD [dBm]	Limit [dBm]	Margin [dB]
2412	-10.500	-10.628	-10.500	-7.553	8.000	-15.553
2437	-7.306	-7.864	-7.306	-4.566	8.000	-12.566
2462	-8.041	-8.544	-8.041	-5.275	8.000	-13.275

Note: 1. The highest peak output power was observed at **HT20 MCS0** per data stream.
2. The sum of Ch0 and Ch1 = Total PSD.
3. Limited number of plots are placed in the report.

Table 9: Peak Power Spectral Density – Test Results – Non Beamforming Continued

Test Conditions: Conducted Measurement, Normal Temperature

Antenna Type: FPCB **Power Setting:** See test plan

Max. Directional Gain: Antenna 3 = + 4.08 dBi (WiFi); Antenna 4 = + 3.64 dBi (WiFi); Antenna 5 = + 4.14 dBi (BLE and Thread)

Signal State: Modulated at 100%.

Ambient Temp.: 22° C **Relative Humidity:**39%

Peak Power Spectral Density

802.11n

Freq. (MHz)	Ch0 [dBm]	Ch1 [dBm]	Max [dBm]	Total PSD [dBm]	Limit [dBm]	Margin [dB]
2422	-16.258	-16.575	-16.258	-13.403	8.000	-21.403
2437	-10.424	-10.905	-10.424	-7.648	8.000	-15.648
2452	-15.095	-15.216	-15.095	-12.145	8.000	-20.145

Note: 1. The highest peak output power was observed at **HT40 MCS0** per data stream.
2. The sum of Ch0 and Ch1 = Total PSD.
3. Limited number of plots are placed in the report.

802.15.1

Freq. (MHz)	Packet	Max. PSD [dBm]	Limit [dBm]	Margin [dB]
2402	BLE	6.575	8.000	-1.425
2442	BLE	6.471	8.000	-1.529
2480	BLE	5.763	8.000	-2.237

Note: 1. The highest peak output power was observed at **Bluetooth LE** per data stream.
2. The TX measured duty cycle is 61%. A 2.1 dB Correction Factor was applied to the measured power.
3. Limited number of plots are placed in the report.

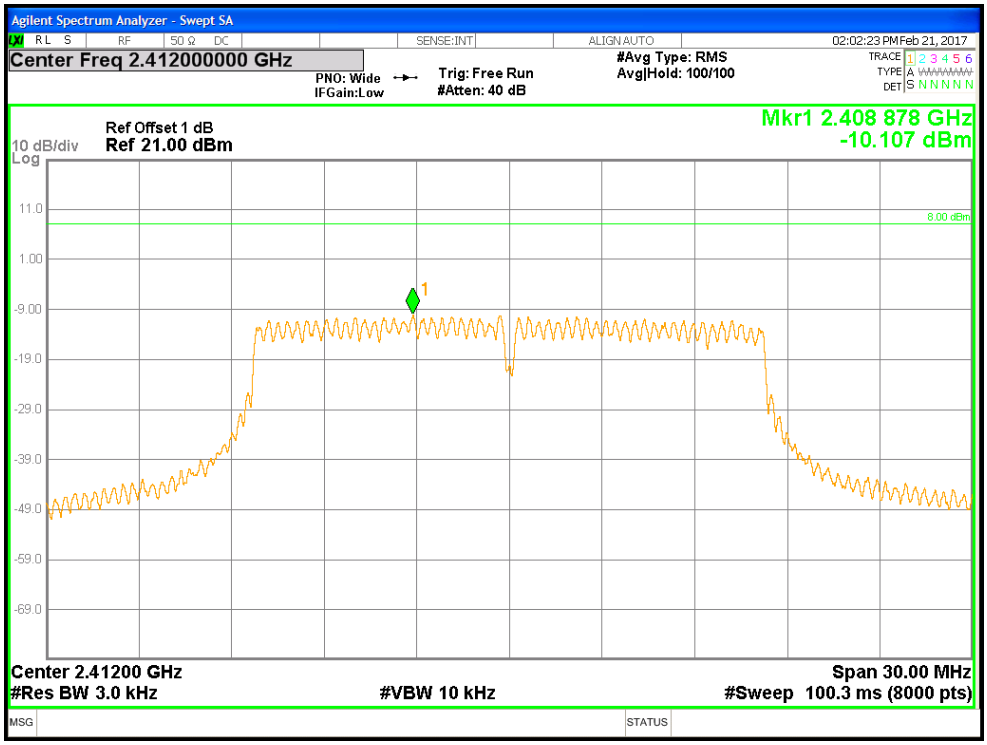


Figure 22: Power Spectral Density, 2437 MHz at 802.11g 6Mbps, Chain 0

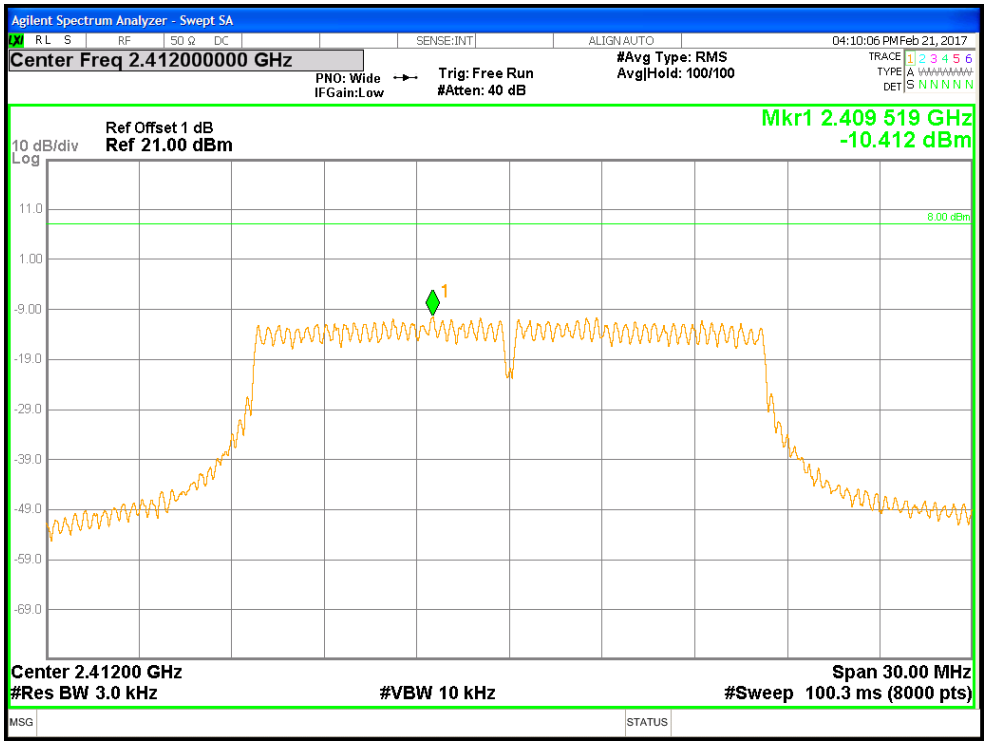


Figure 23: Power Spectral Density, 2437 MHz at 802.11g 6Mbps, Chain 1

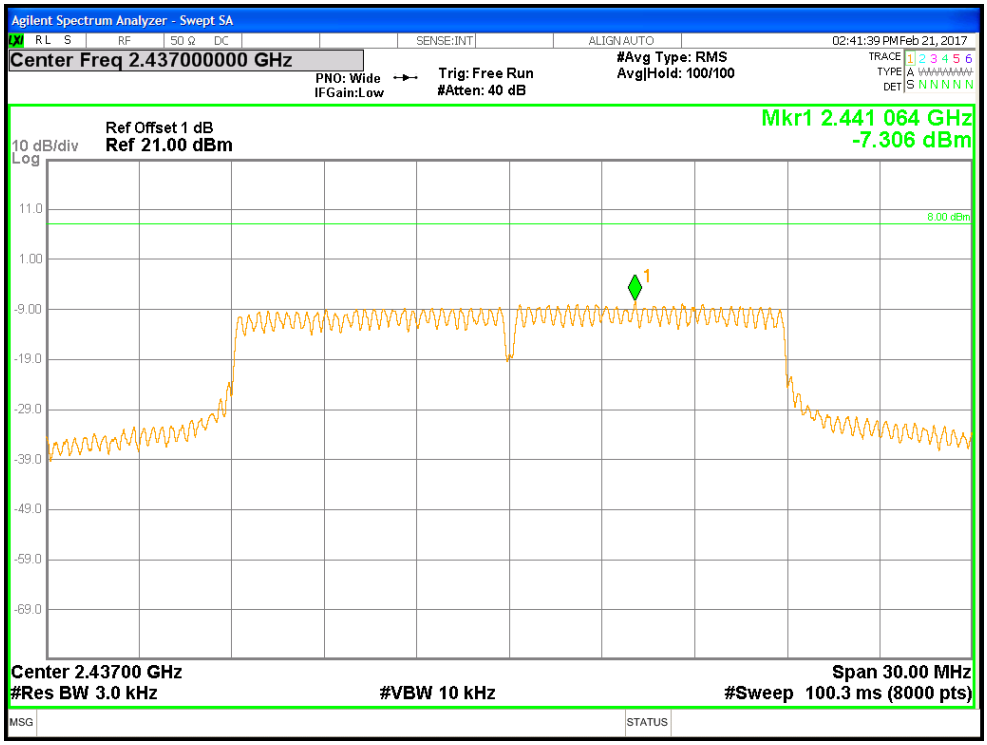


Figure 24: Power Spectral Density, 2437 MHz at HT20 MCS0, Chain 0

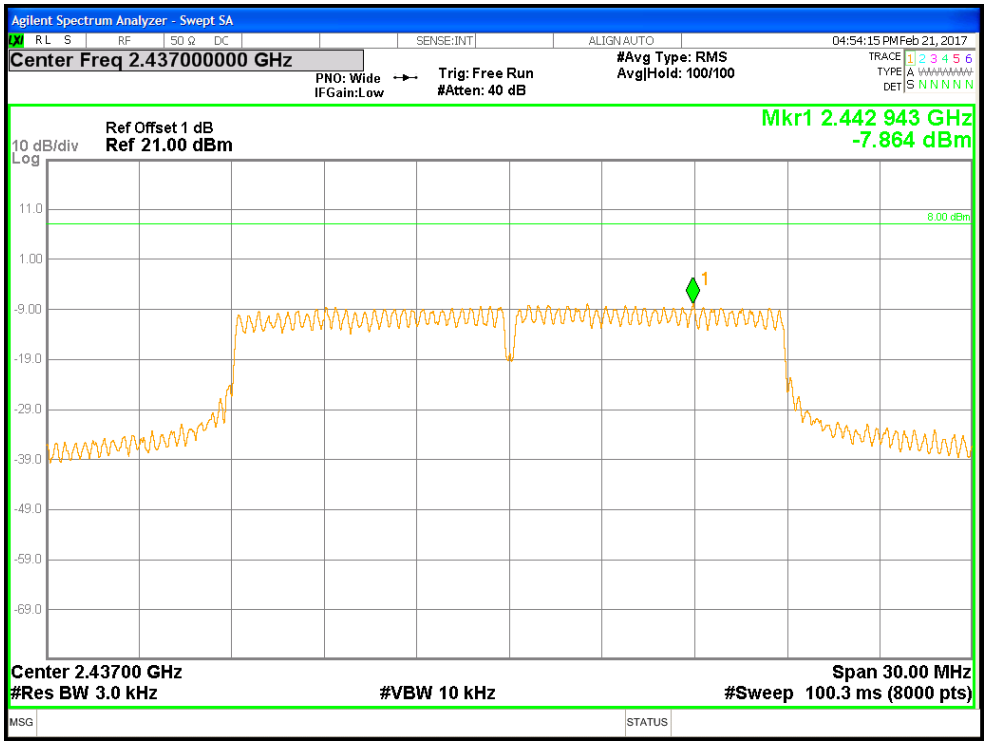


Figure 25: Power Spectral Density, 2437 MHz at HT20 MCS0, Chain 1

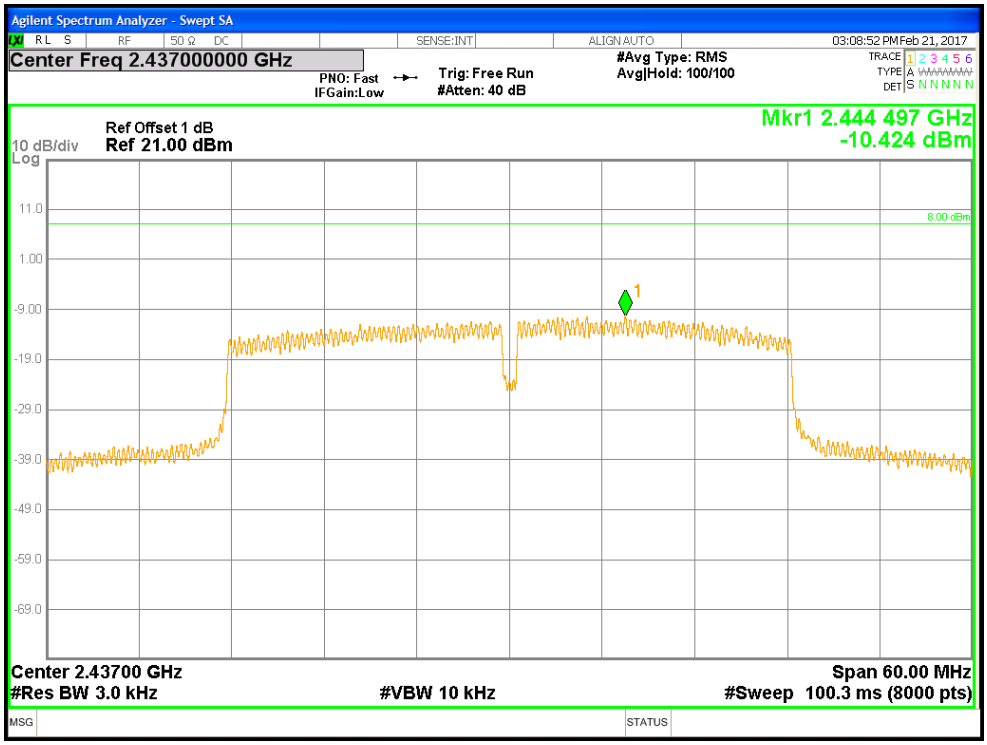


Figure 26: Power Spectral Density, 2437 MHz at HT40 MCS0, Chain 0

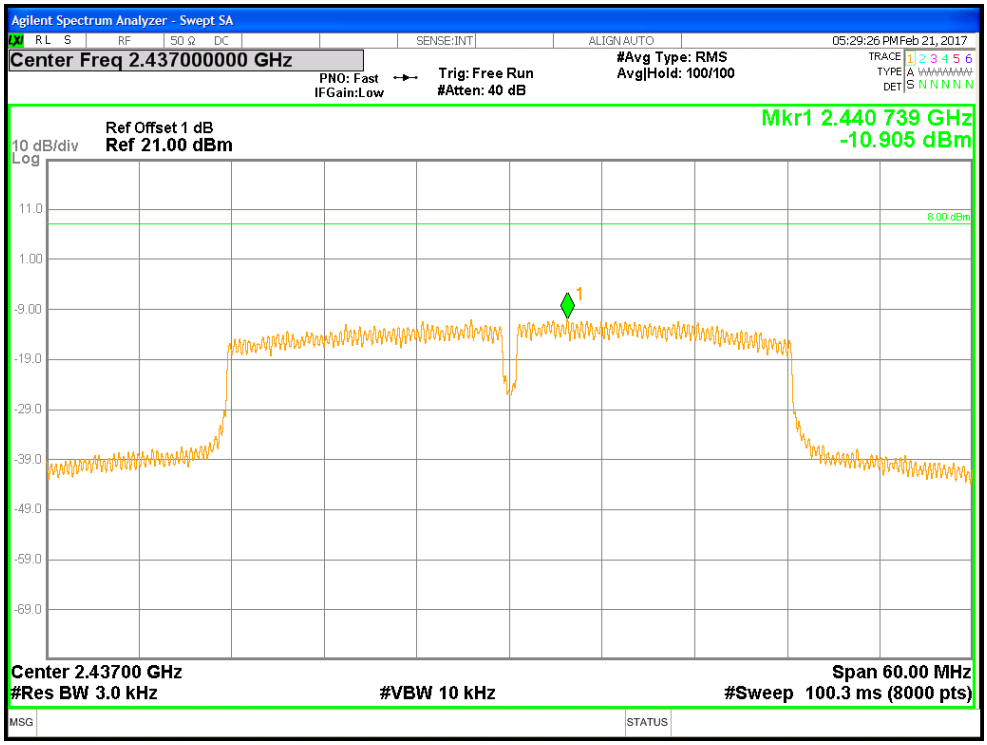


Figure 27: Power Spectral Density, 2437 MHz at HT40 MCS0, Chain 1

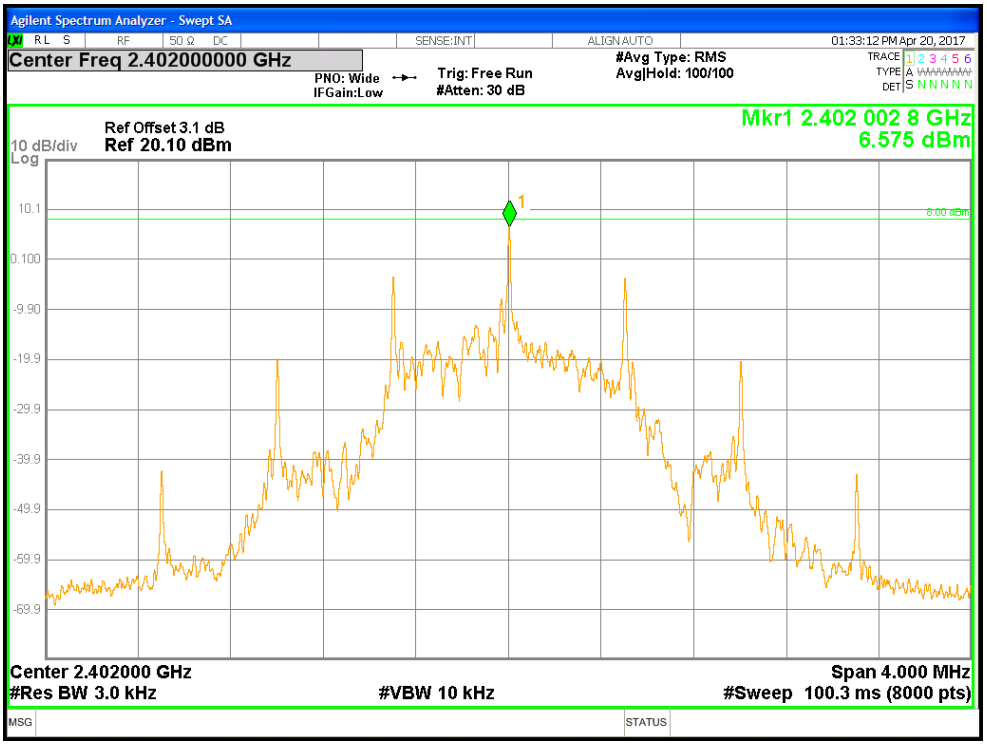


Figure 28: Power Spectral Density, 2402 MHz for BLE

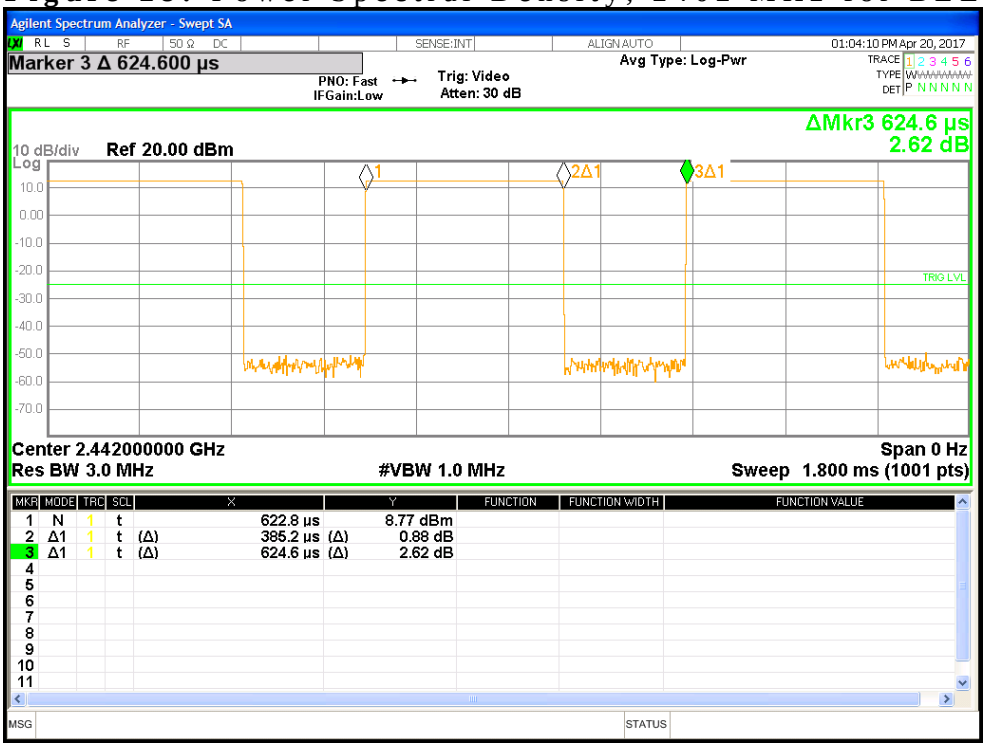


Figure 29: Duty Cycle measurement for Bluetooth LE

Table 10: Peak Power Spectral Density – Test Results – Beamforming

Test Conditions: Conducted Measurement, Normal Temperature					
Antenna Type: FPCB				**Power Setting:** See test plan	
Total Directional Gain: + 6.87 dBi (WiFi)					
Signal State: Modulated at 100%.					
Ambient Temp.: 22° C				**Relative Humidity:**39%	
Peak Power Spectral Density					
802.11g					
Freq. (MHz)	**Ch0 [dBm]**	**Ch1 [dBm]**	**Total PSD [dBm]**	**Limit [dBm]**	**Margin [dB]**
2412	-10.407	-11.169	-7.760	7.130	-14.890
2437	-8.353	-8.508	-5.420	7.130	-12.550
2462	-8.737	-9.212	-5.960	7.130	-13.090
Note: 1. The highest peak output power was observed at **11g 6Mbps** per data stream. 2. The sum of Ch0 and Ch1 = Total PSD. 3. 0.87 dBi – 8 dBm = Limit [dBm]. 4. Limited number of plots are placed in the report.					
802.11n					
Freq. (MHz)	**Ch0 [dBm]**	**Ch1 [dBm]**	**Total PSD [dBm]**	**Limit [dBm]**	**Margin [dB]**
2412	-10.336	-11.224	-7.750	7.130	-14.880
2437	-8.725	-8.529	-5.620	7.130	-12.750
2462	-9.074	-9.361	-6.200	7.130	-13.330
Note: 1. The highest peak output power was observed at **HT20 MCS0** per data stream. 2. The sum of Ch0 and Ch1 = Total PSD. 3. 0.87 dBi – 8 dBm = Limit [dBm]. 4. Limited number of plots are placed in the report.					

Table 11: Peak Power Spectral Density – Test Results – Beamforming Continued

Test Conditions: Conducted Measurement, Normal Temperature					
Antenna Type: FPCB				**Power Setting:** See test plan	
Total Directional Gain: + 6.87 dBi (WiFi)					
Signal State: Modulated at 100%.					
Ambient Temp.: 22° C				**Relative Humidity:**39%	
Peak Power Spectral Density					
802.11n					
Freq. (MHz)	**Ch0 [dBm]**	**Ch1 [dBm]**	**Total PSD [dBm]**	**Limit [dBm]**	**Margin [dB]**
2422	-16.092	-16.793	-13.420	7.130	-20.550
2437	-11.170	-11.777	-8.450	7.130	-15.580
2452	-15.493	-15.853	-12.660	7.130	-19.790
Note: 1. The highest peak output power was observed at **HT40 MCS0** per data stream. 2. The sum of Ch0 and Ch1 = Total PSD. 3. 0.87 dBi – 8 dBm = Limit [dBm]. 4. Limited number of plots are placed in the report.					

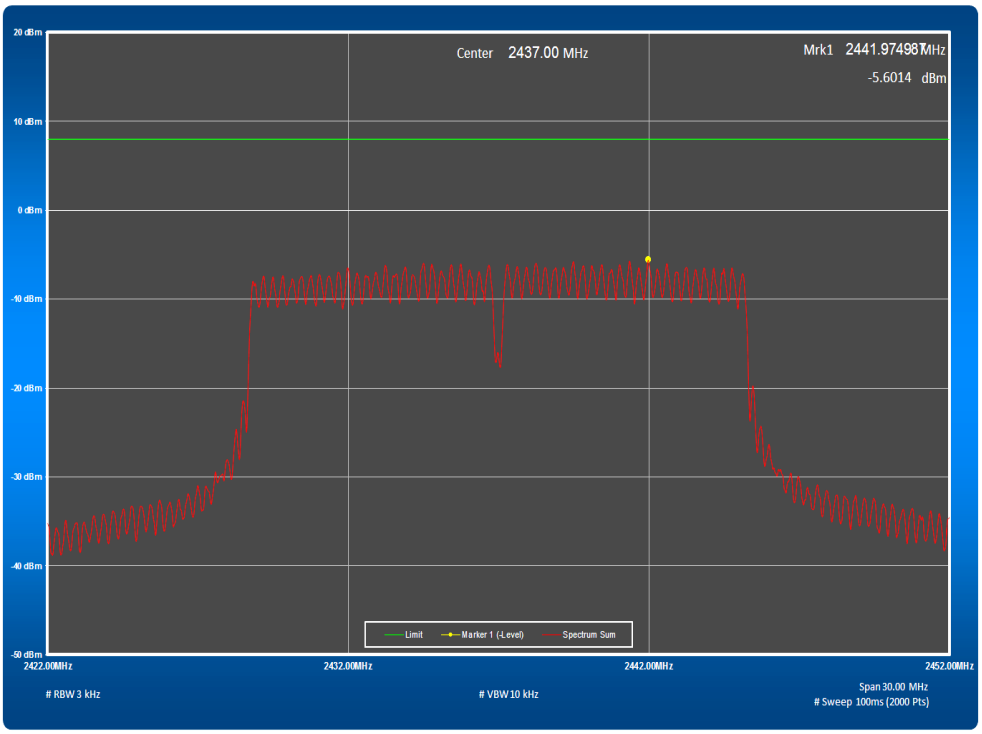


Figure 30: Power Spectral Density, 2437 MHz at 802.11g 6Mbps, Chain 0 & 1

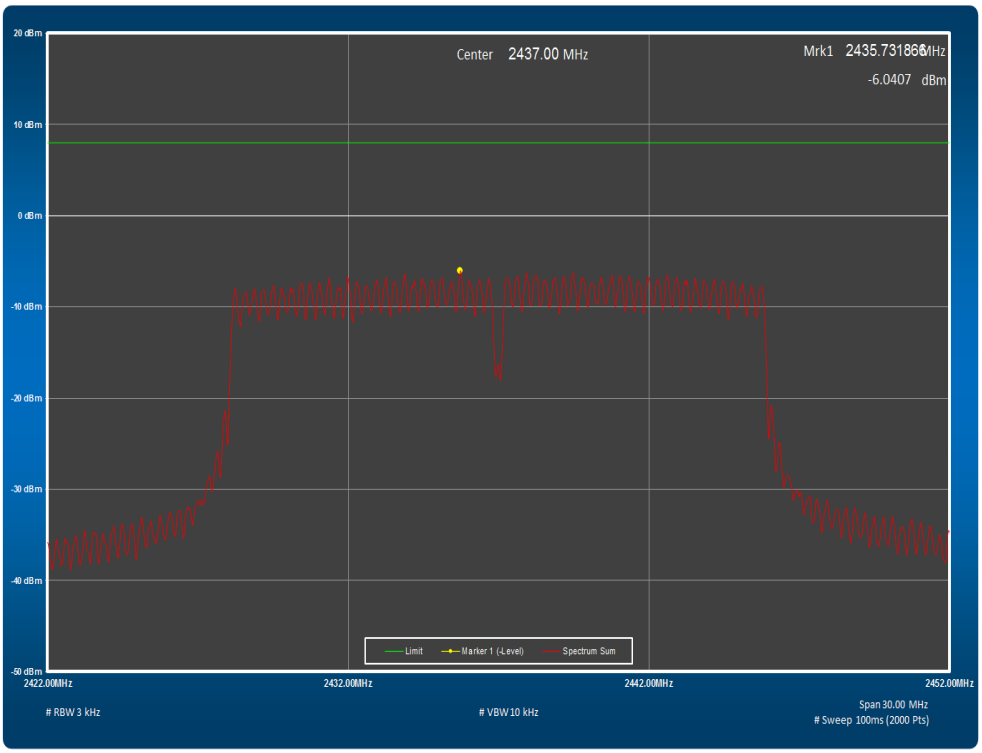


Figure 31: Power Spectral Density, 2437 MHz at HT20 MCS0, Chain 0 & 1

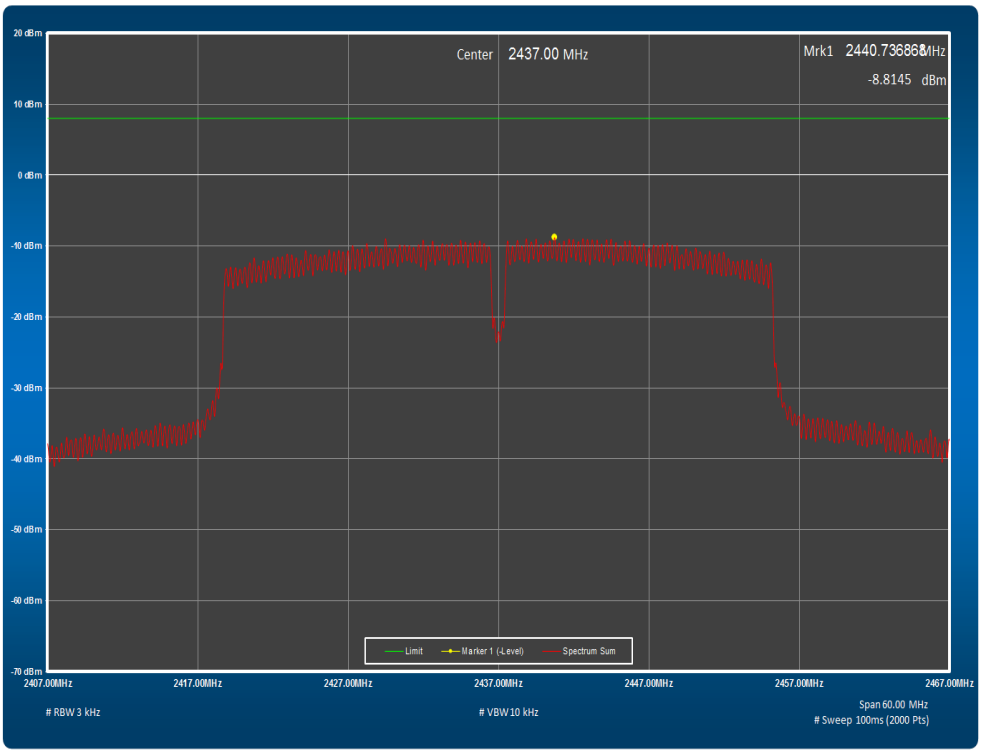


Figure 32: Power Spectral Density, 2437 MHz at HT40 MCS0, Chain 0 & 1

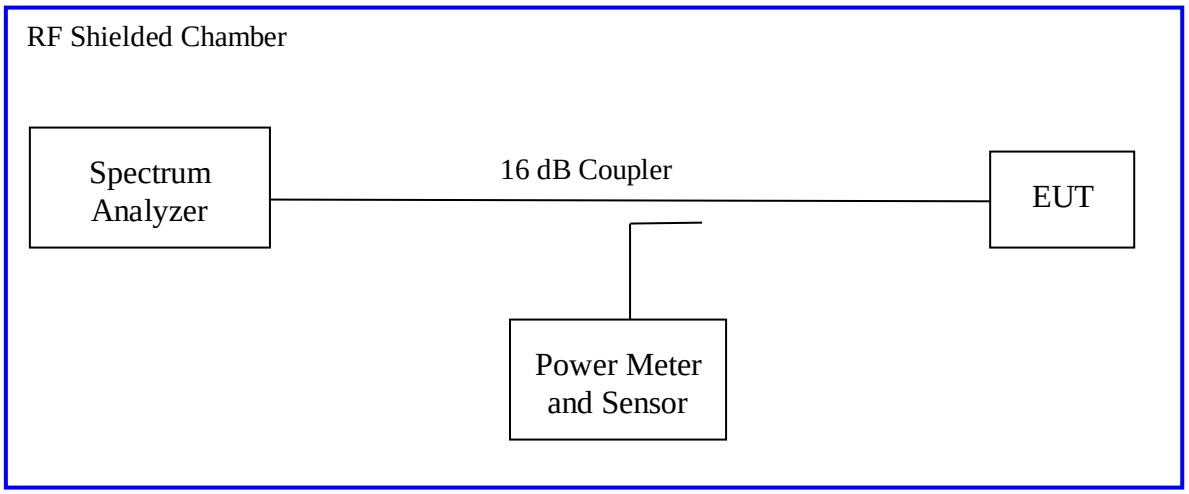
4.4 Out of Band Emissions

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

The conducted method was used to measure the undesirable emission requirement. The measurement was performed with modulation. This test was conducted on 3 channels of Sample in each mode on Sample. The worst sample result indicated below.

Test Setup:



Measurement Procedure AVG2 of KDB 662911

4.4.2 Results

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

Table 12: Emissions at the Band-Edge – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only						
Antenna Type: FPCB				**Power Setting:** See test plan		
Total Directional Gain: + 6.87 dBi (WiFi) **Max. Directional Gain:** Antenna 3 = + 4.08 dBi (WiFi); Antenna 4 = + 3.64 dBi (WiFi); Antenna 5 = + 4.14 dBi (BLE and Thread)						
Signal State: Modulated at 100%.						
Ambient Temp.: 22° C				**Relative Humidity:**39%		
Non-Restricted Frequency Band Emissions						
Freq. (MHz)	**Mode**	**Chain**	**Measured (dBm)**	**Limit (dBm)**	**Plots**	**Results**
2400	11g-6Mbps	0	-20.60	-17.19	Fig. 33, 34	Pass
2400	11g-6Mbps	1	-21.92	-17.67	Fig. 35, 36	Pass
2483.5	11g-6Mbps	0	-42.28	-13.69	Fig. 37, 38	Pass
2483.5	11g-6Mbps	1	-41.86	-14.78	Fig. 39, 40	Pass
2400	HT20-MCS0	0	-19.56	-17.32	Fig. 41, 42	Pass
2400	HT20-MCS0	1	-22.26	-17.71	Fig. 43, 44	Pass
2483.5	HT20-MCS0	0	-39.77	-15.60	Fig. 45,46	Pass
2483.5	HT20-MCS0	1	-43.05	-14.99	Fig. 47, 48	Pass
2400	HT40-MCS0	0	-30.36	-22.67	Fig. 49, 50	Pass
2400	HT40-MCS0	1	-30.75	-22.83	Fig. 51, 52	Pass
2483.5	HT40-MCS0	0	-58.12	-21.27	Fig. 53, 54	Pass
2483.5	HT40-MCS0	1	-58.87	-21.62	Fig. 55, 56	Pass
2400	BLE	0	-41.08	-16.87	Fig. 57, 58	Pass
2483.5	BLE	0	-47.45	-17.61	Fig. 59, 60	Pass
Note: 1. The stated limits for 30 dBr are relative to each individual output per KDB 662911 Method. 2. The worst case of each data rate is recorded.						

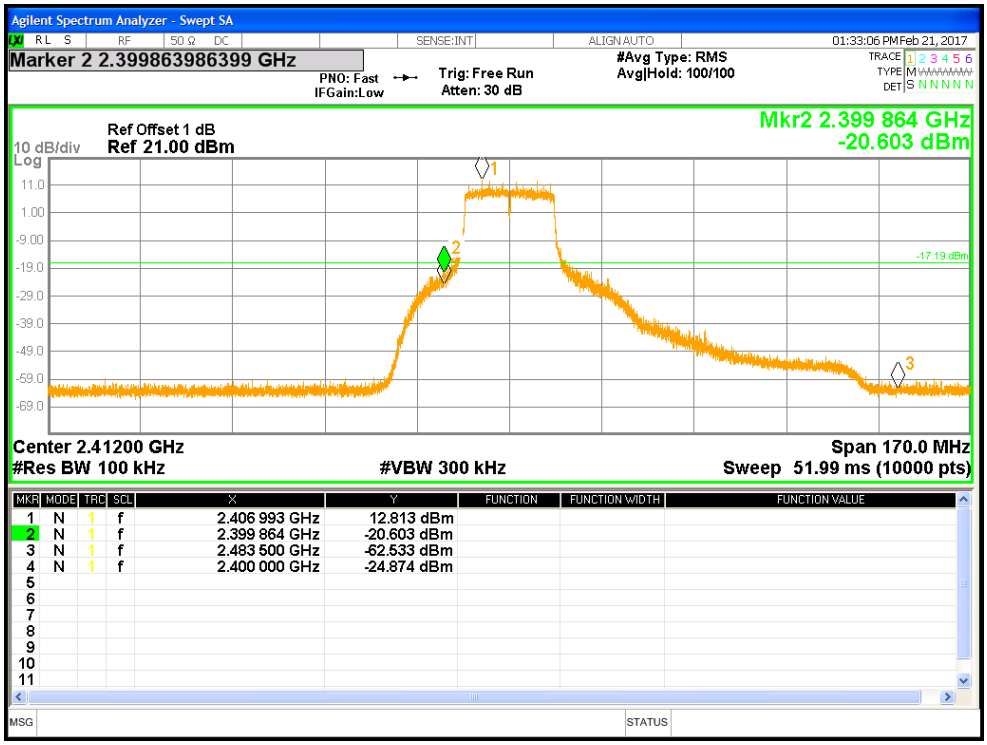


Figure 33: Measured Bandedge for 802.11g-6Mbps at 2412 MHz, Chain 0

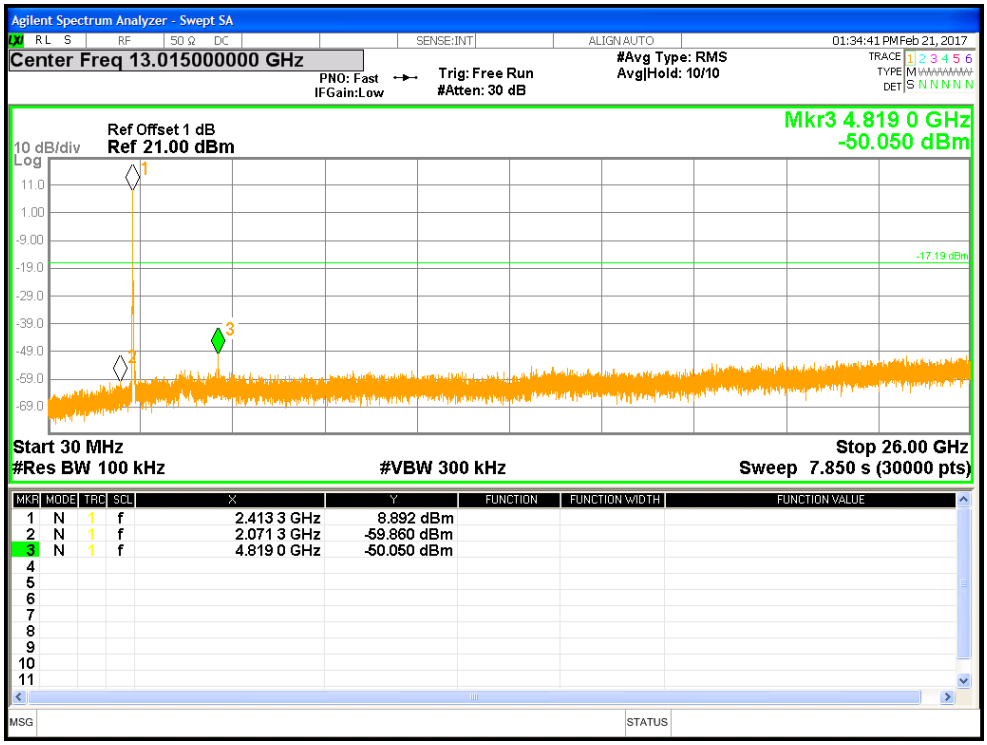


Figure 34: Out of Band Emissions for 802.11g-6Mbps at 2412 MHz, Chain 0

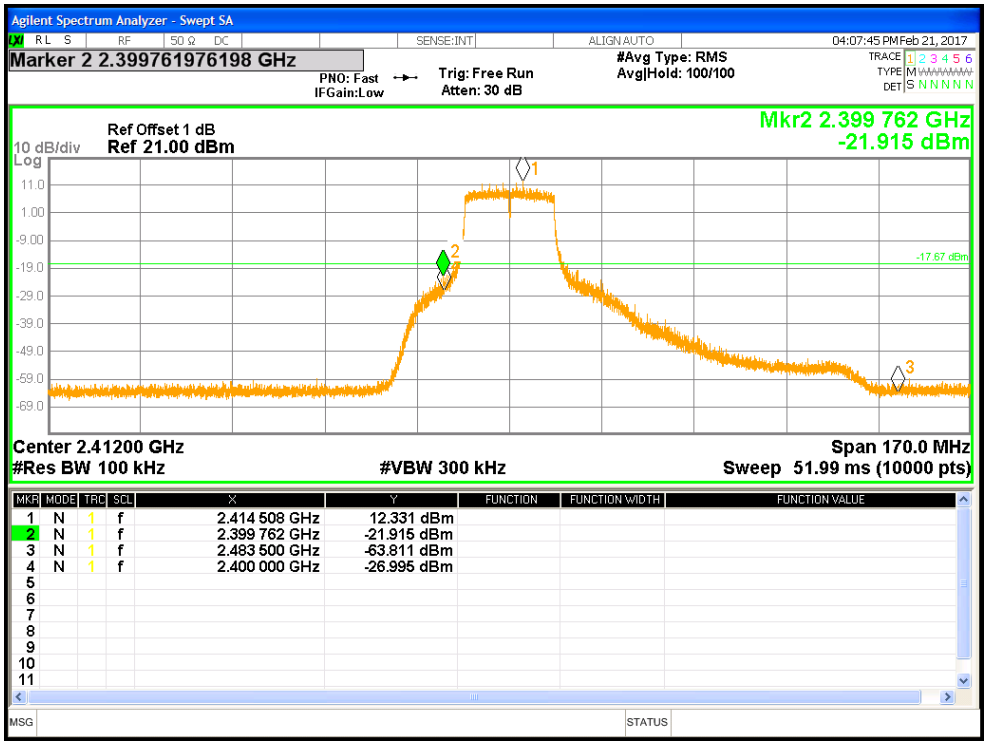


Figure 35: Measured Bandedge for 802.11g-6Mbps at 2412 MHz, Chain 1

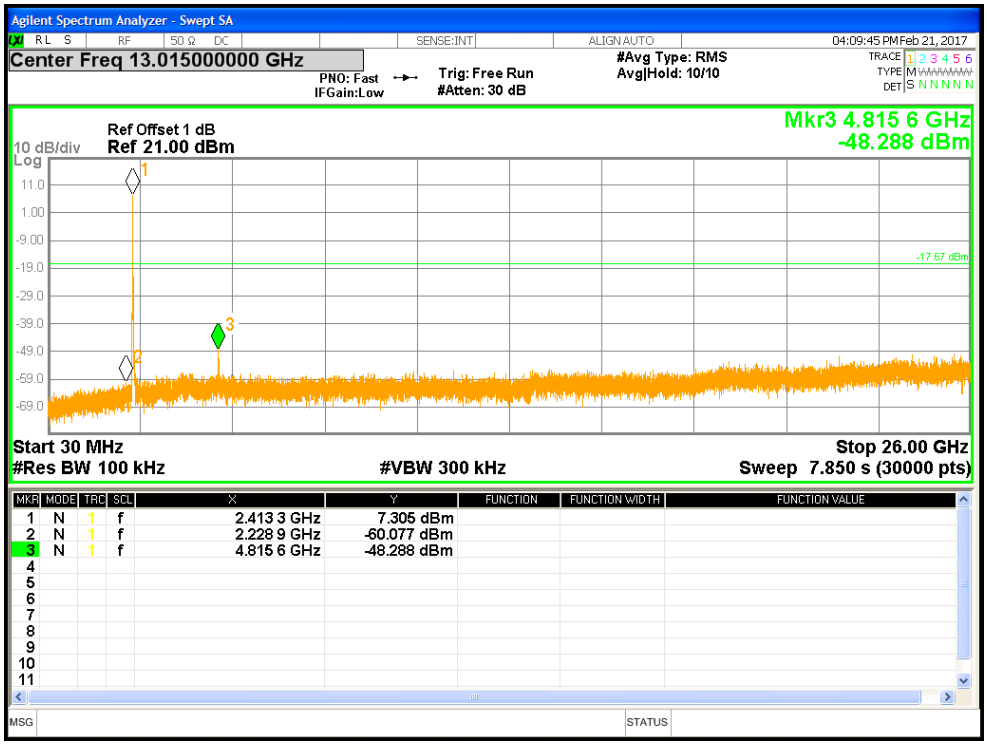


Figure 36: Out of Band Emissions for 802.11g-6Mbps at 2412 MHz, Chain 1

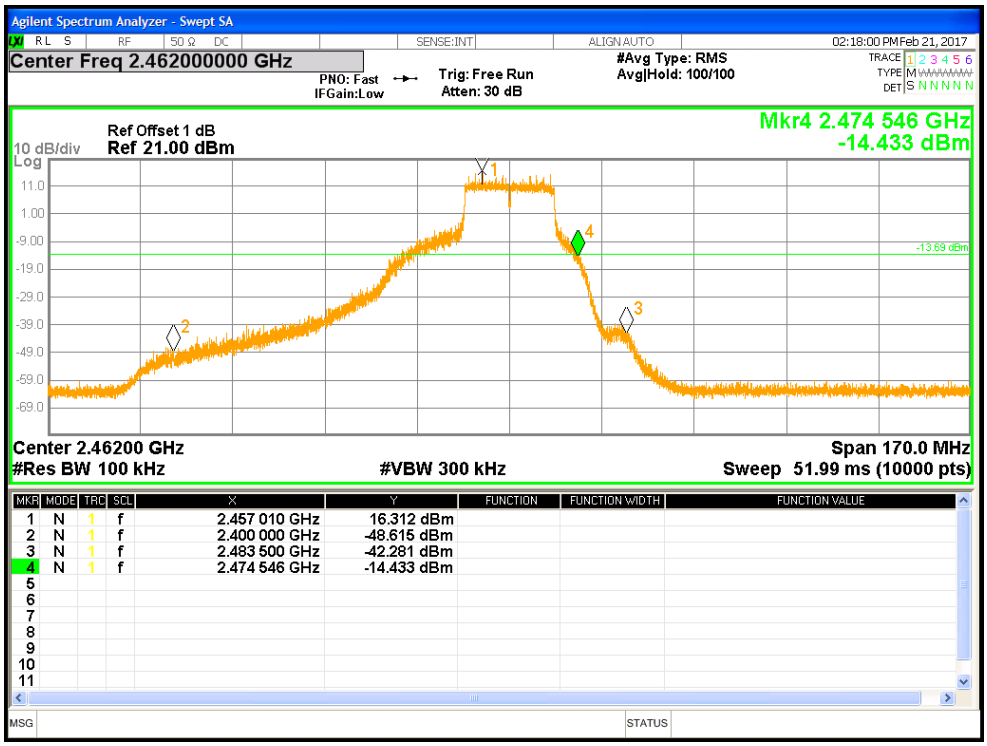


Figure 37: Measured Bandedge for 802.11g-6Mbps at 2462MHz, Chain 0

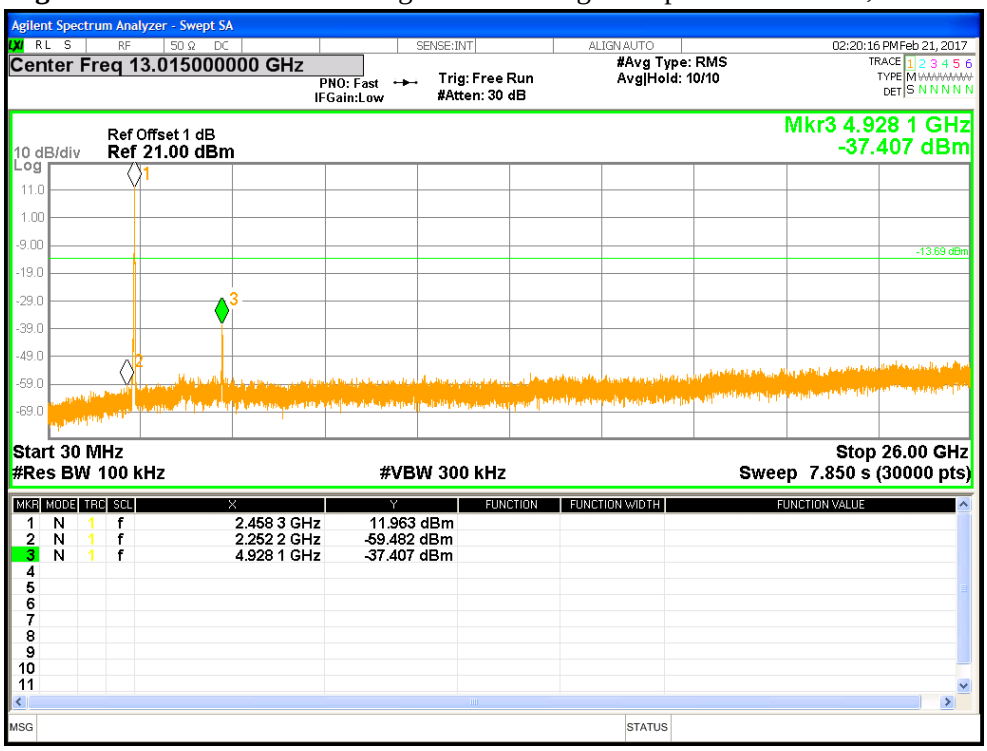


Figure 38: Out of Band Emissions for 802.11g-6Mbps at 2462MHz, Chain 0

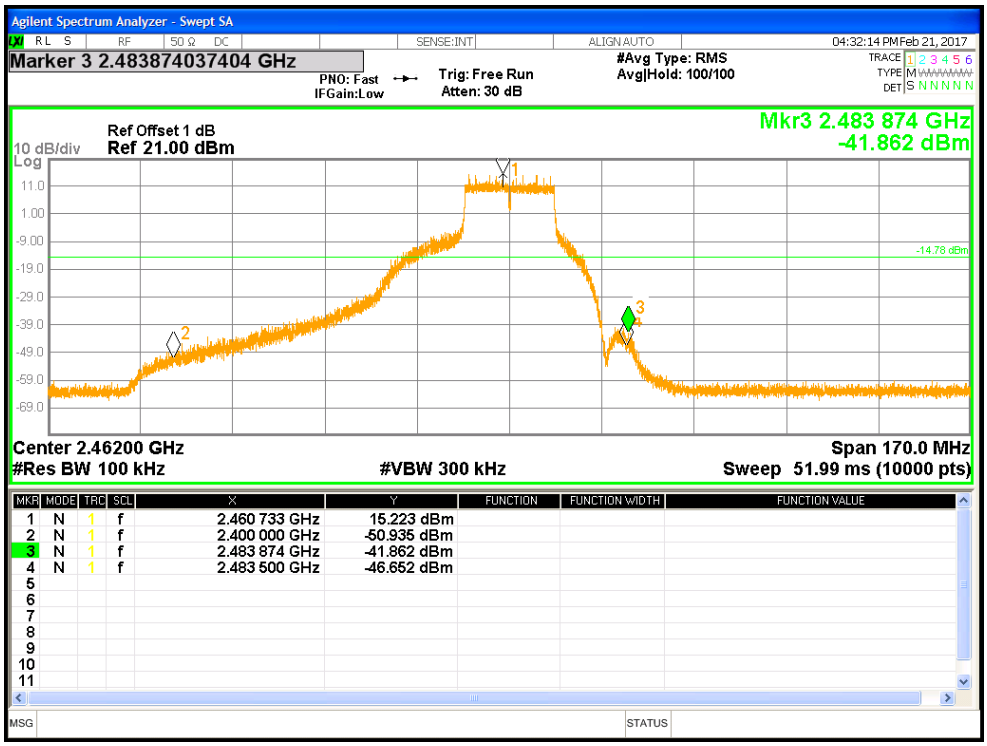


Figure 39: Measured Bandedge for 802.11g-6Mbps at 2462MHz, Chain 1

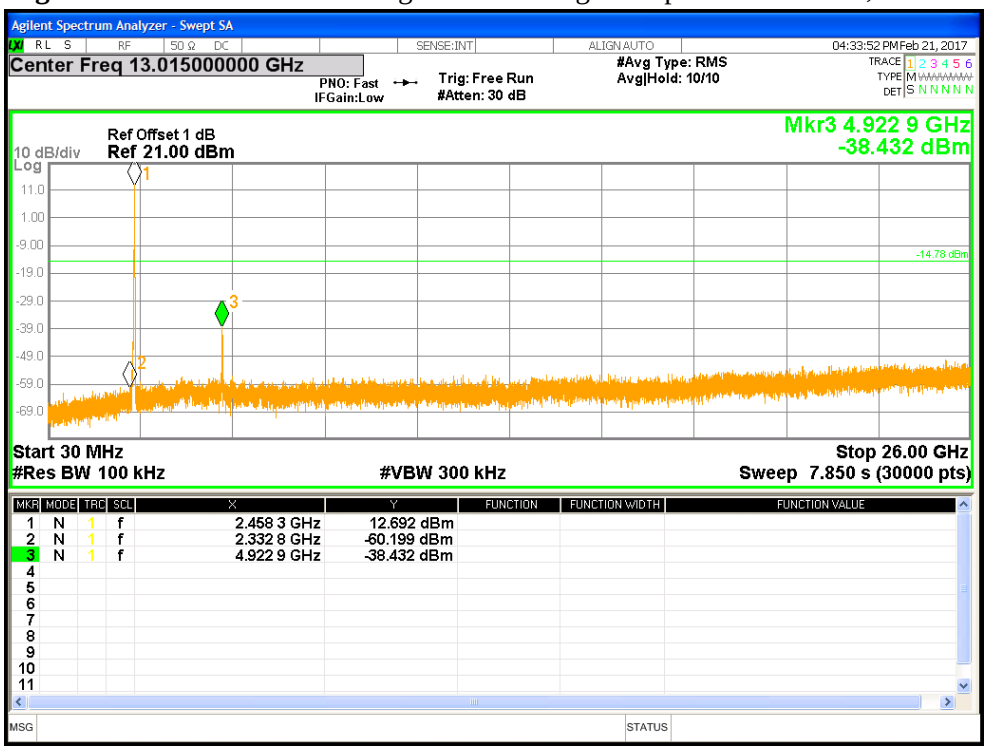


Figure 40: Out of Band Emissions for 802.11g-6Mbps at 2462MHz, Chain 1

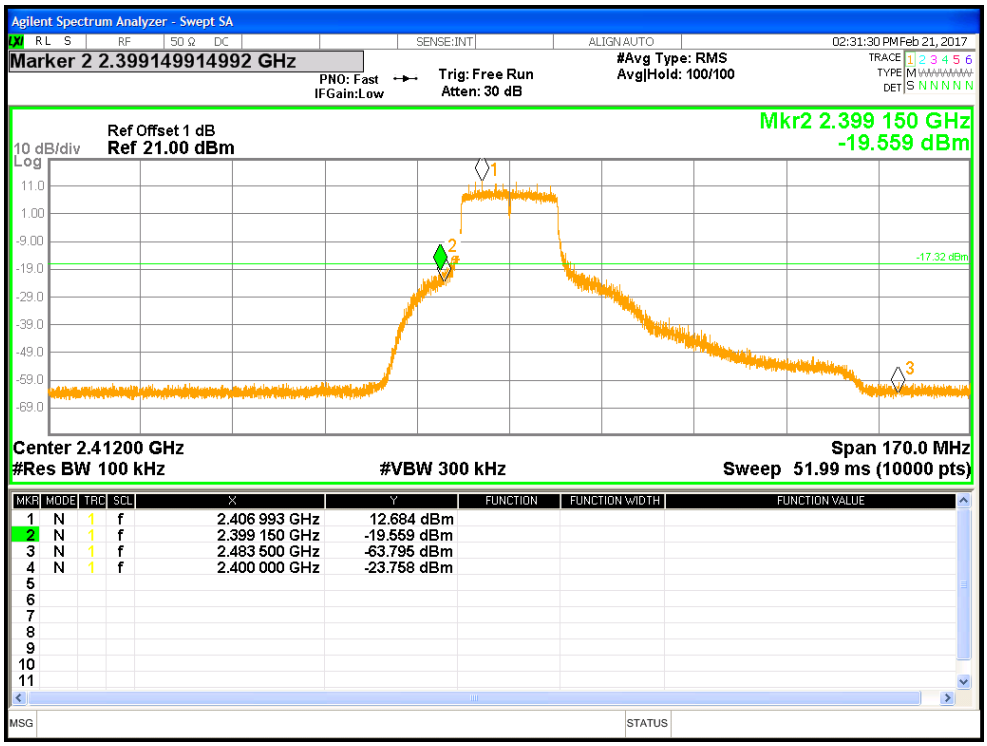


Figure 41: Measured Bandedge for HT20-MCS0 at 2412 MHz, Chain 0

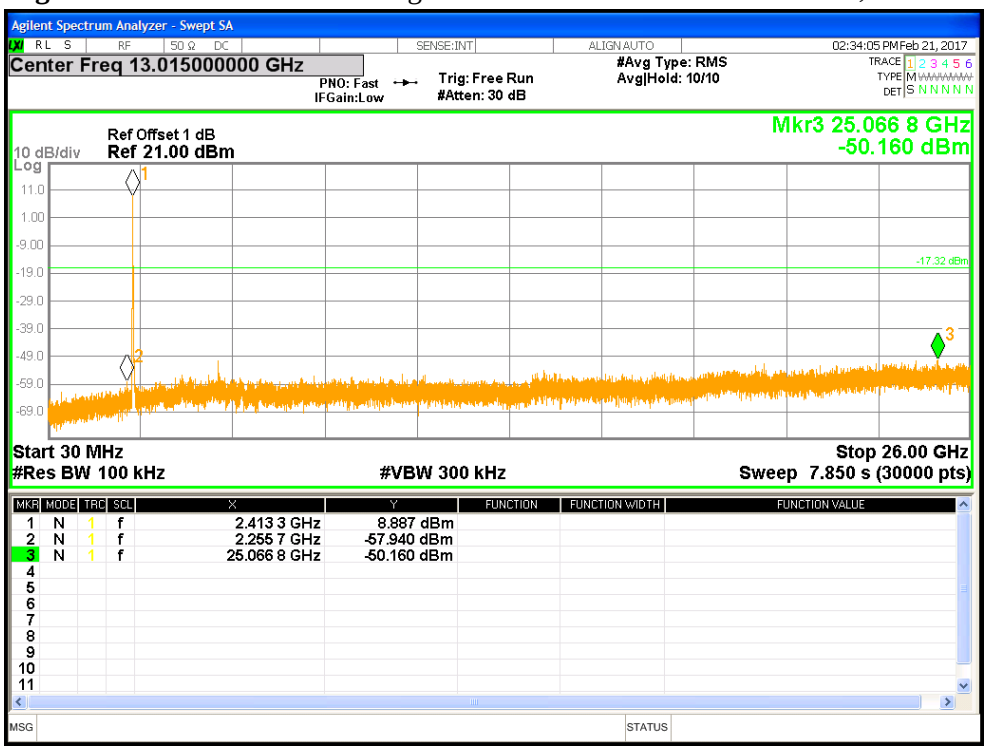


Figure 42: Out of Band Emissions for HT20-MCS0 at 2412 MHz, Chain 0

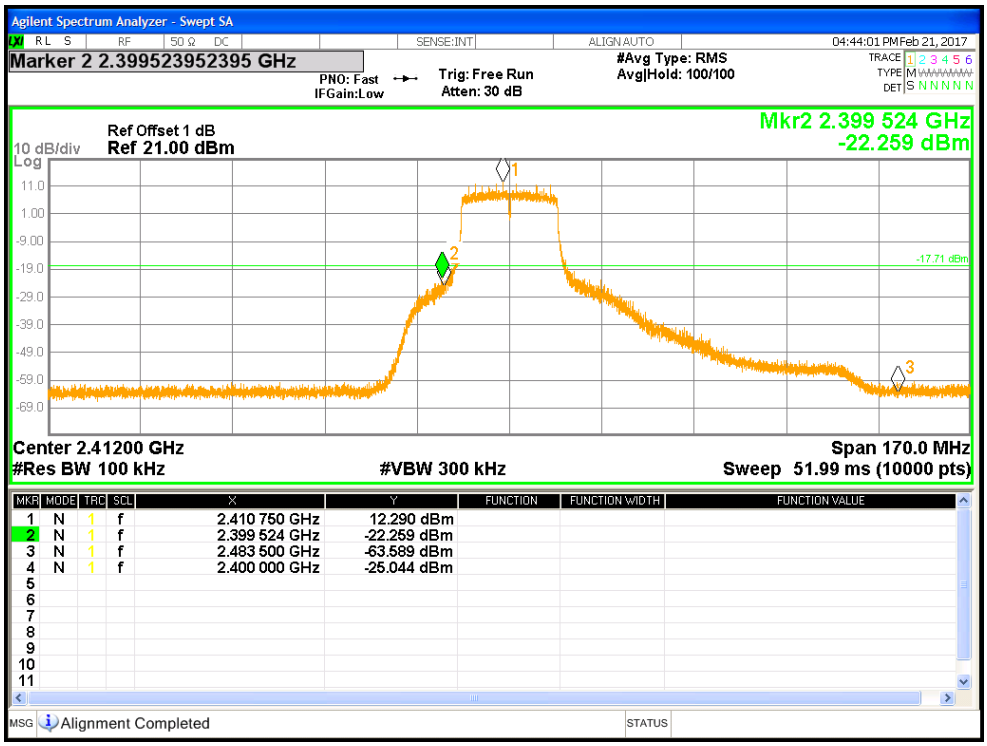


Figure 43: Measured Bandedge for HT20-MCS0 at 2412 MHz, Chain 1

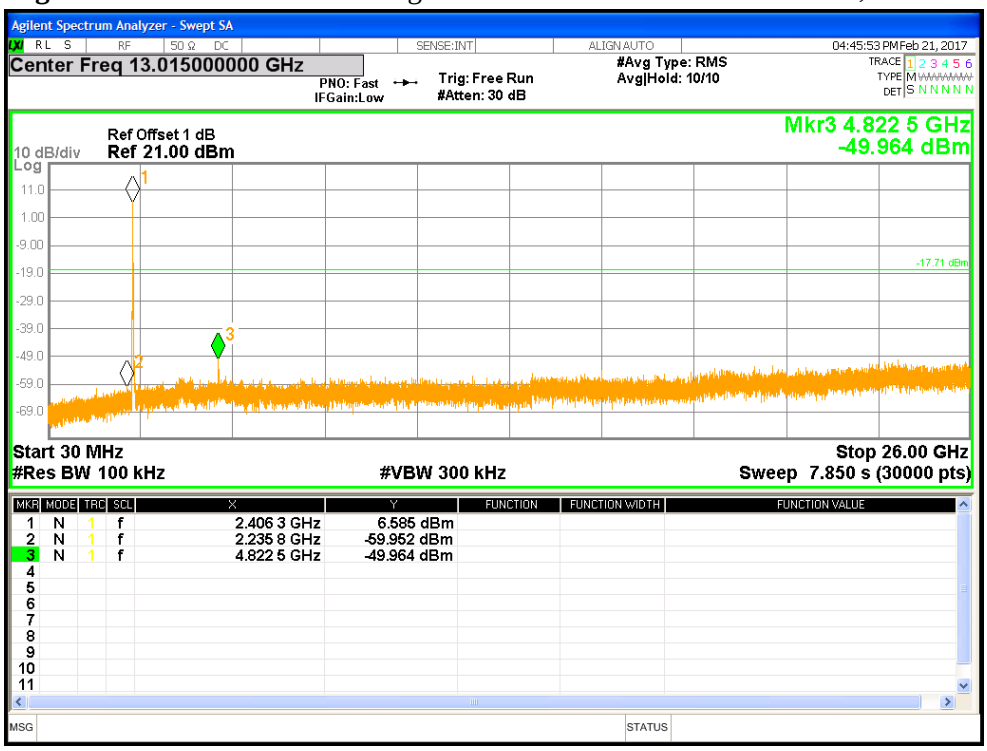


Figure 44: Out of Band Emissions for HT20-MCS0 at 2412 MHz, Chain 1

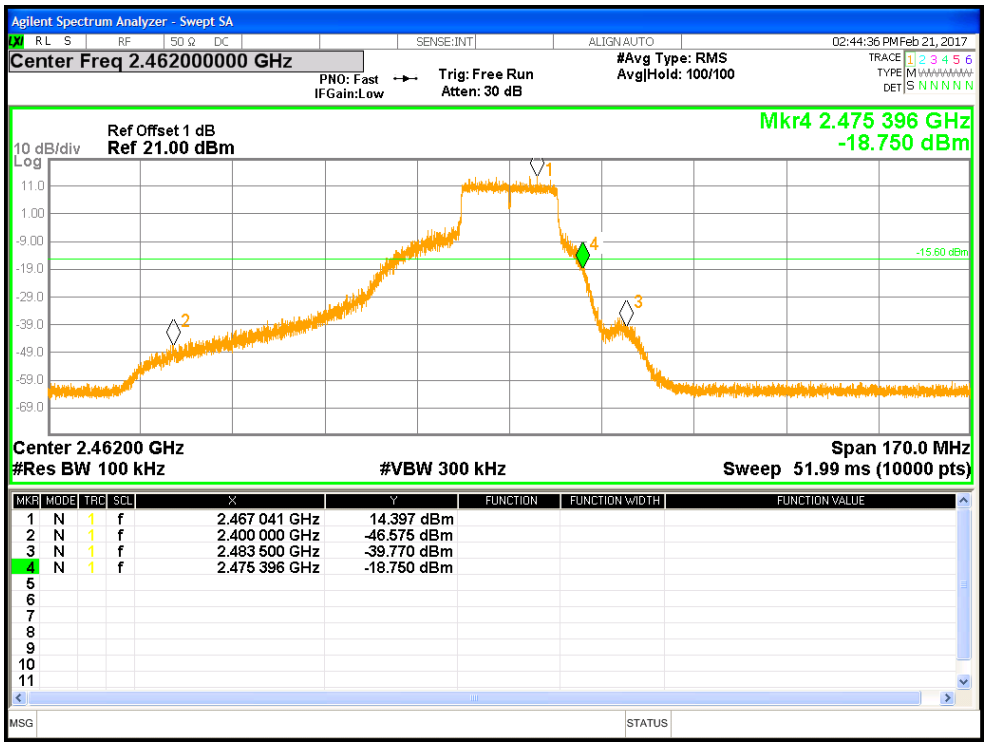


Figure 45: Measured Bandedge for HT20-MCS0 at 2462MHz, Chain 0

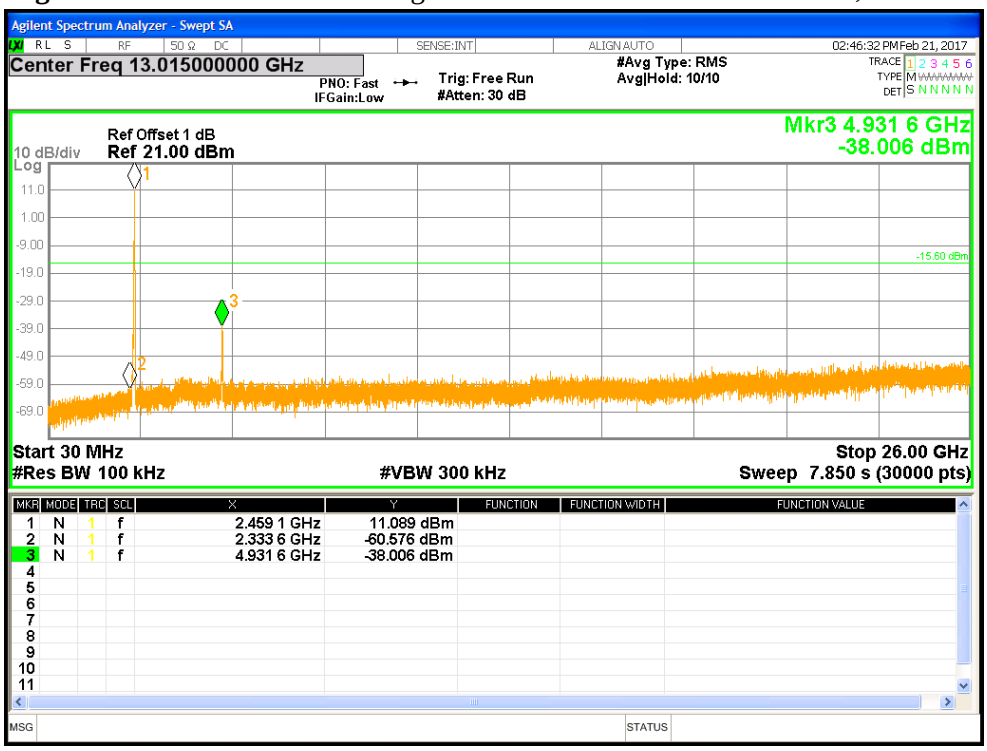


Figure 46: Out of Band Emissions for HT20-MCS0 at 2462MHz, Chain 0

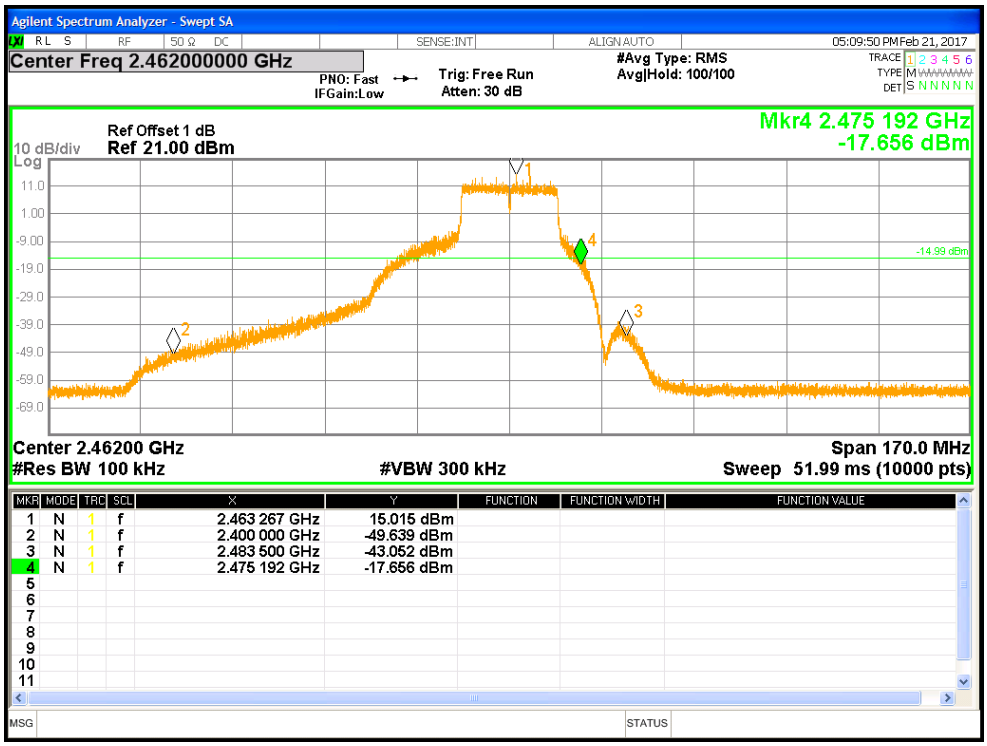


Figure 47: Measured Bandedge for HT20-MCS0 at 2462 MHz, Chain 1

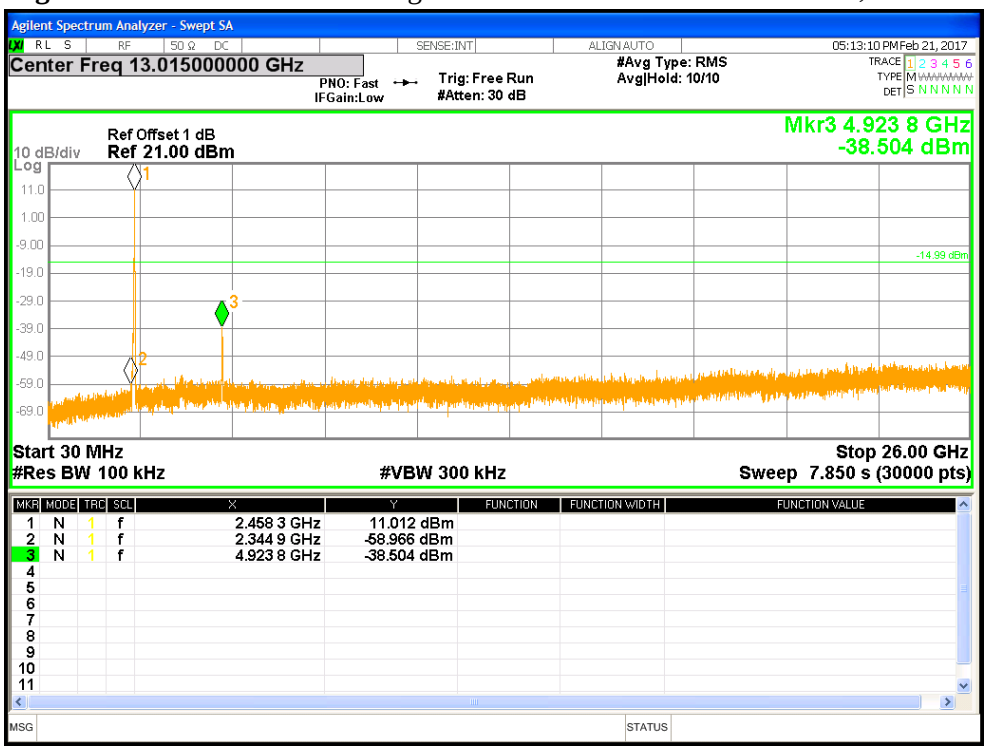


Figure 48: Out of Band Emissions for HT20-MCS0 at 2462 MHz, Chain 1

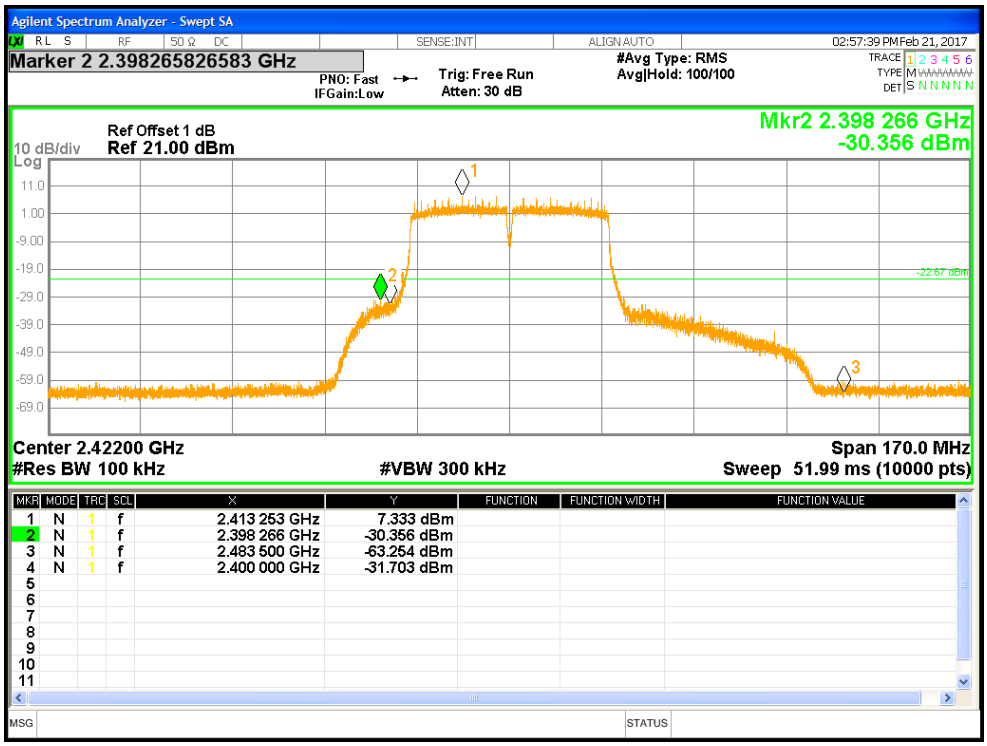


Figure 49: Measured Bandedge for HT40-MCS0 at 2422 MHz, Chain 0

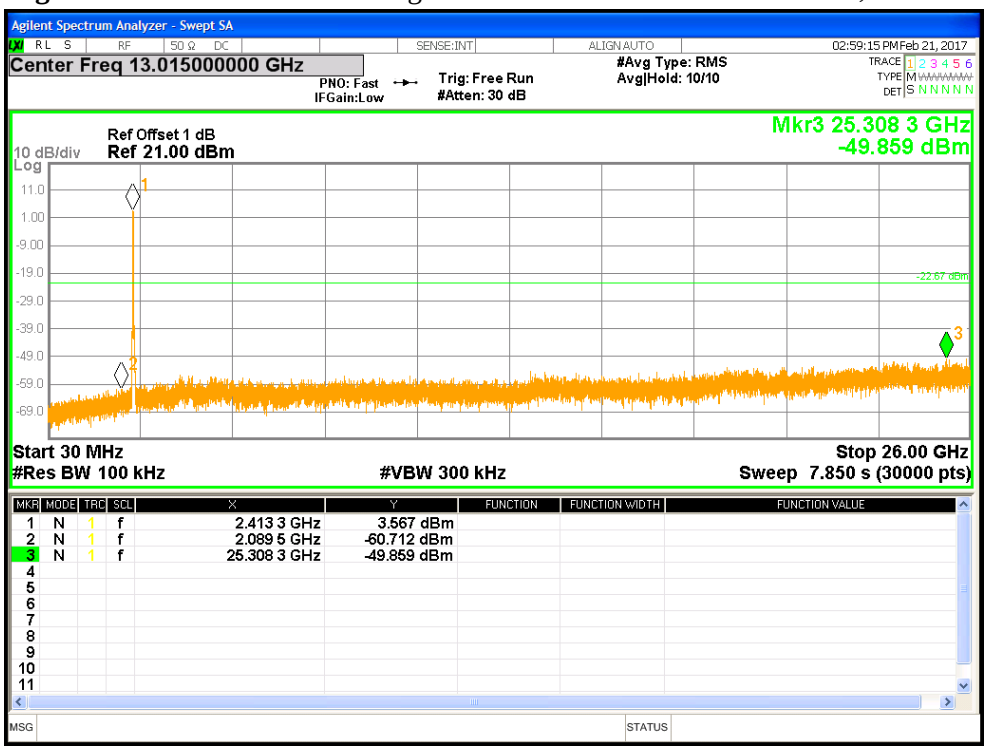


Figure 50: Out of Band Emissions for HT40-MCS0 at 2422 MHz, Chain 0

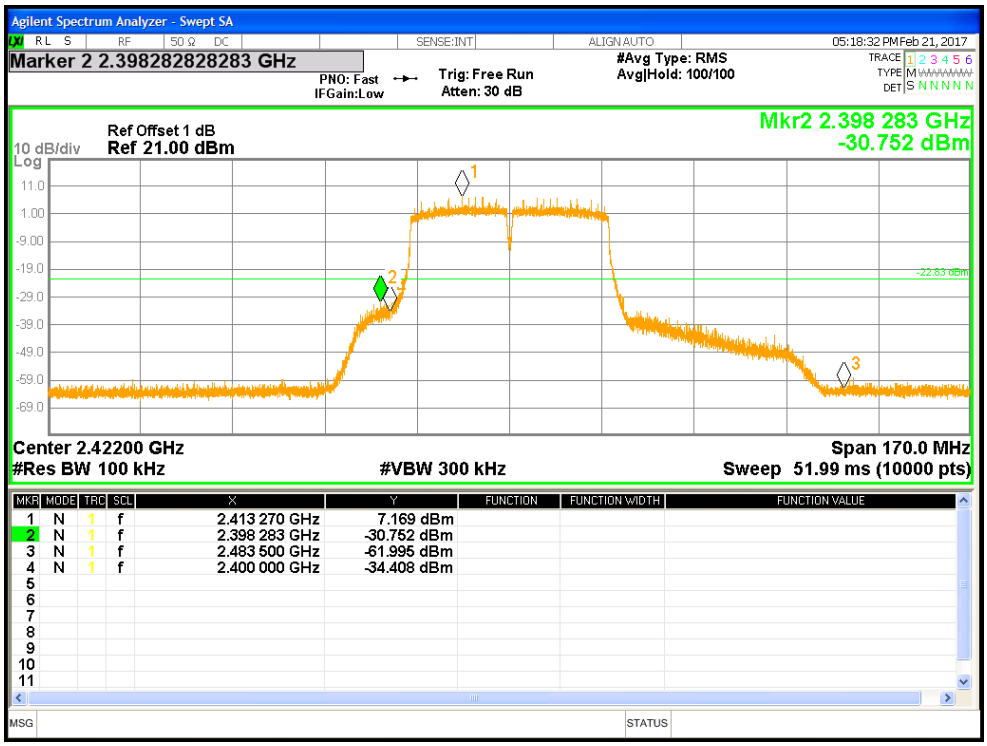


Figure 51: Measured Bandedge for HT40-MCS0 at 2422 MHz, Chain 1

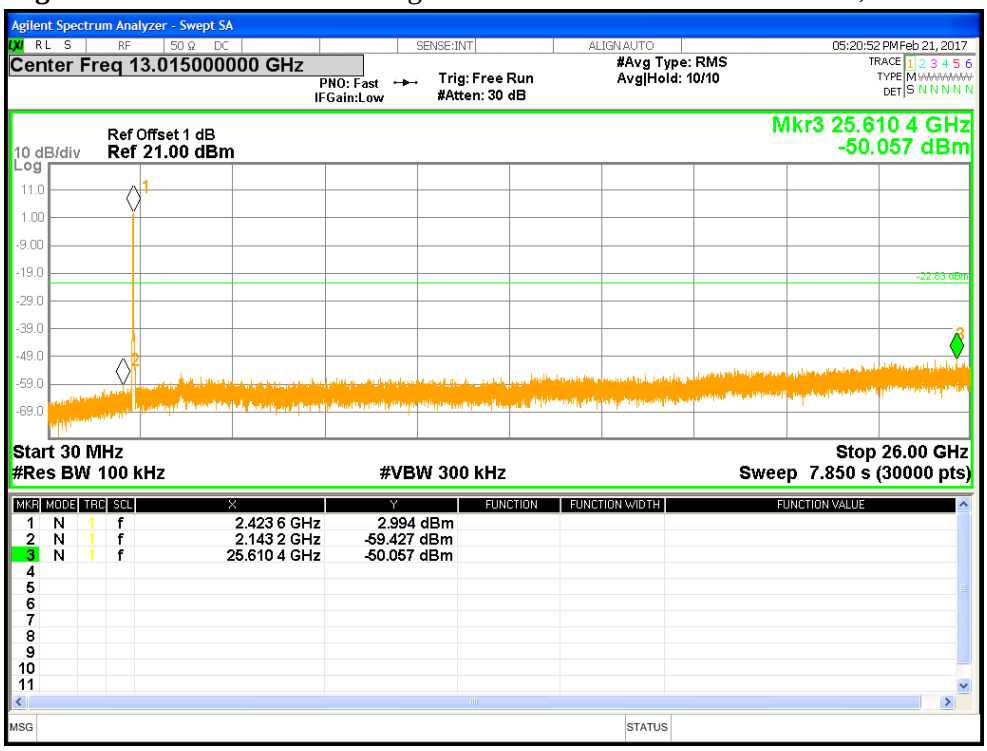


Figure 52: Out of Band Emissions for HT40-MCS0 at 2422 MHz, Chain 1

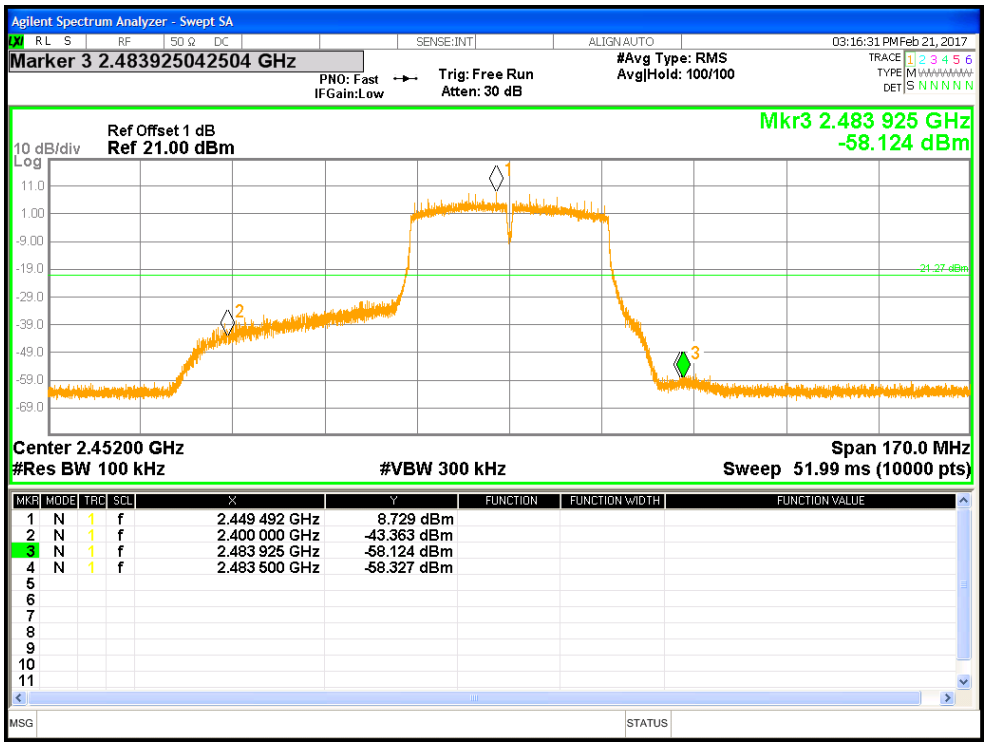


Figure 53: Measured Bandedge for HT40-MCS0 at 2452 MHz, Chain 0

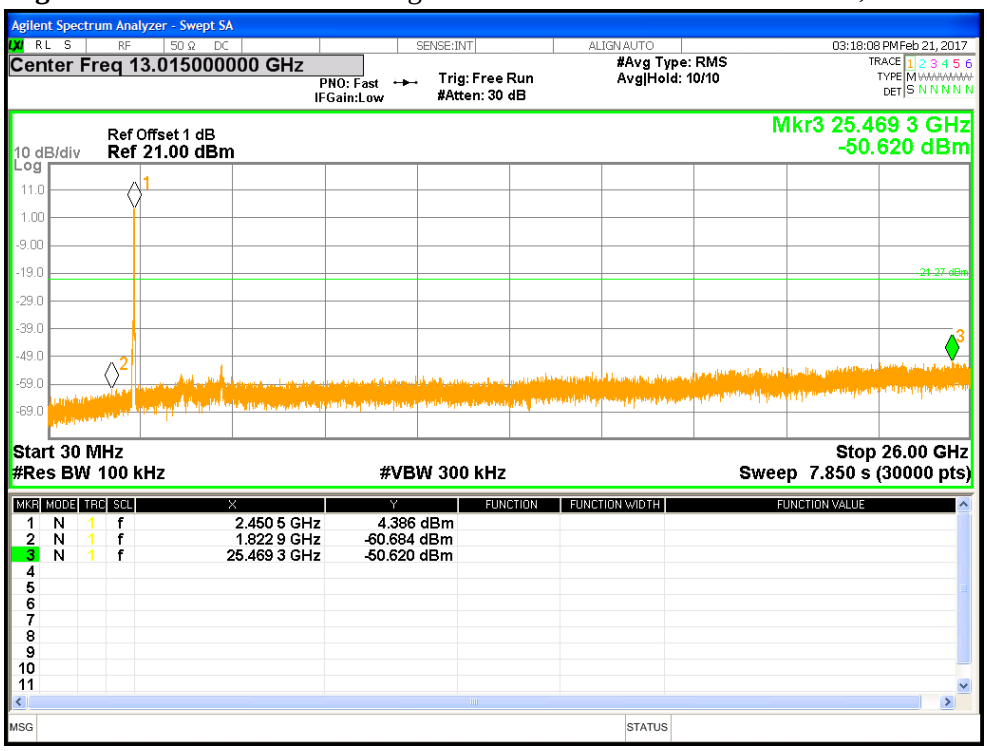


Figure 54: Out of Band Emissions for HT40-MCS0 at 2452 MHz, Chain 0

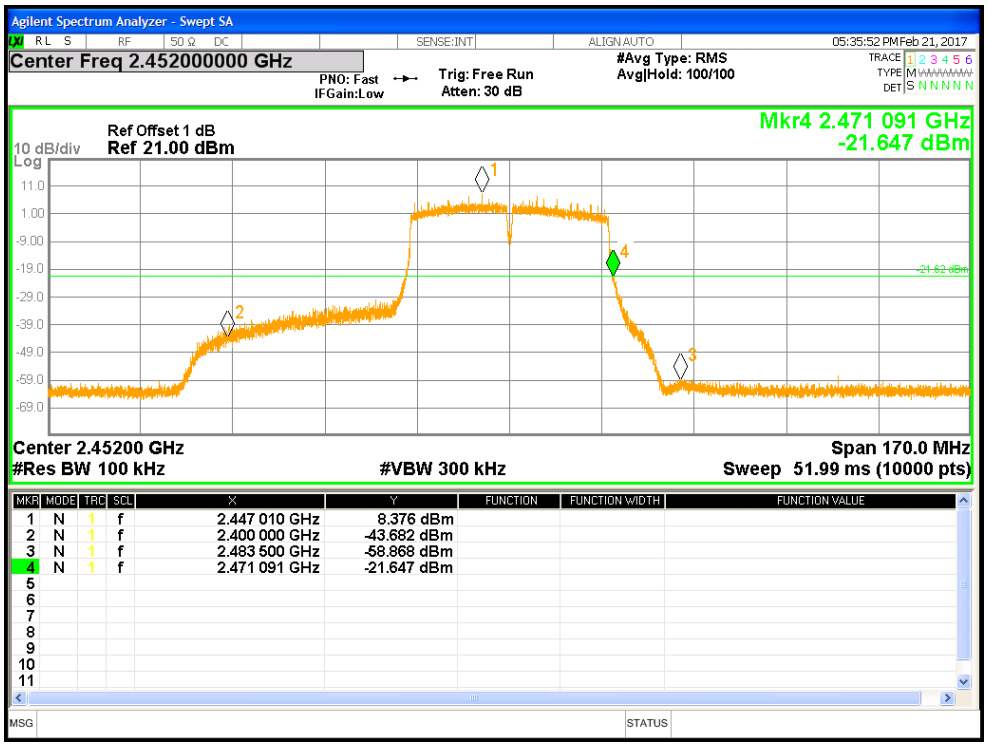


Figure 55: Measured Bandedge for HT40-MCS0 at 2452 MHz, Chain 1

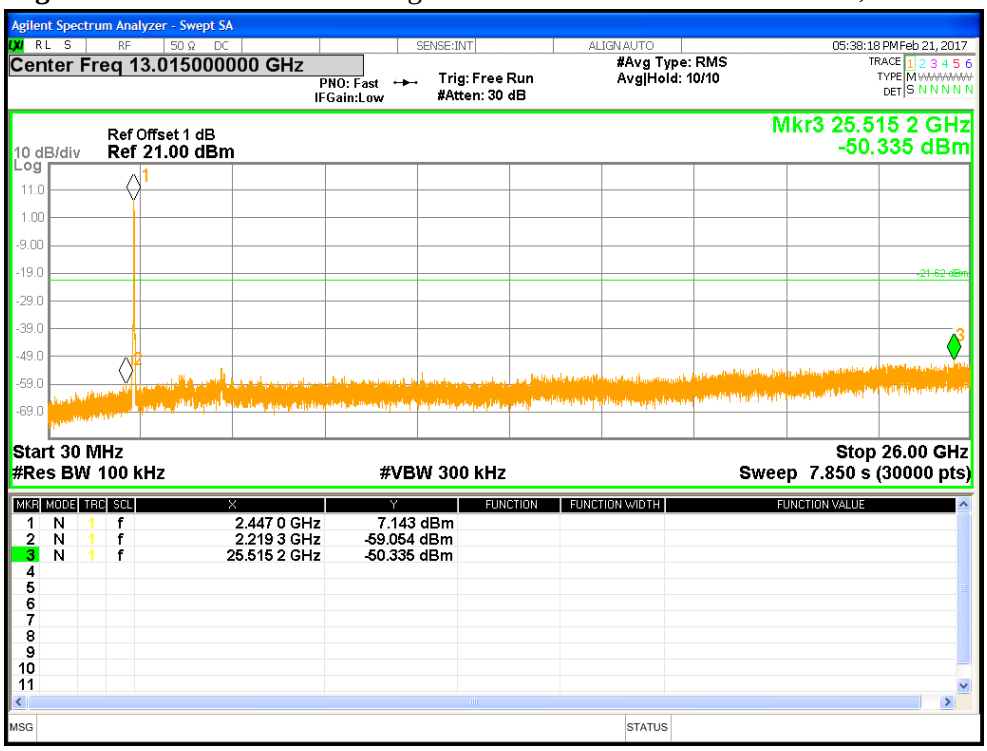


Figure 56: Out of Band Emissions for HT40-MCS0 at 2452 MHz, Chain 1

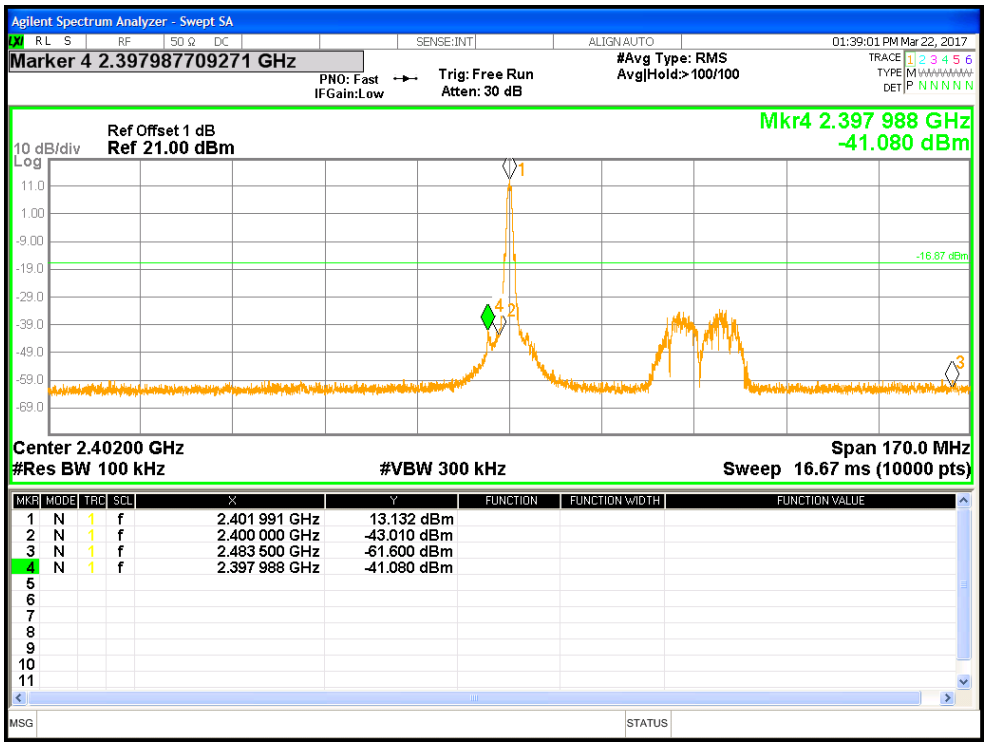


Figure 57: Measured Bandedge for BLE at 2402 MHz

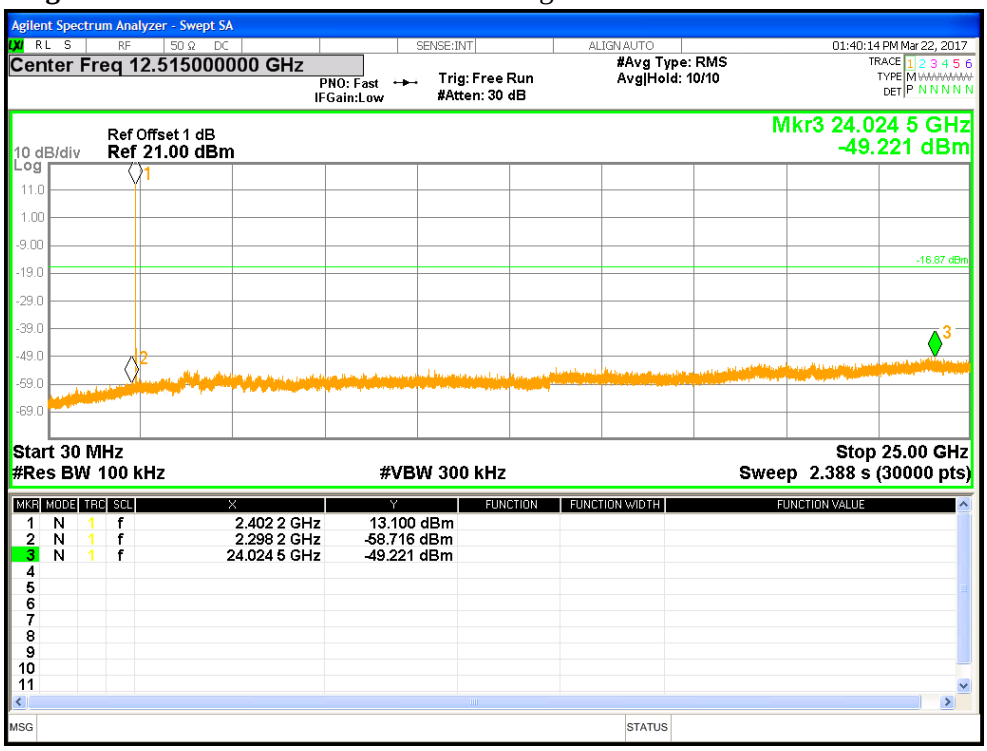


Figure 58: Out of Band Emissions for BLE at 2402 MHz

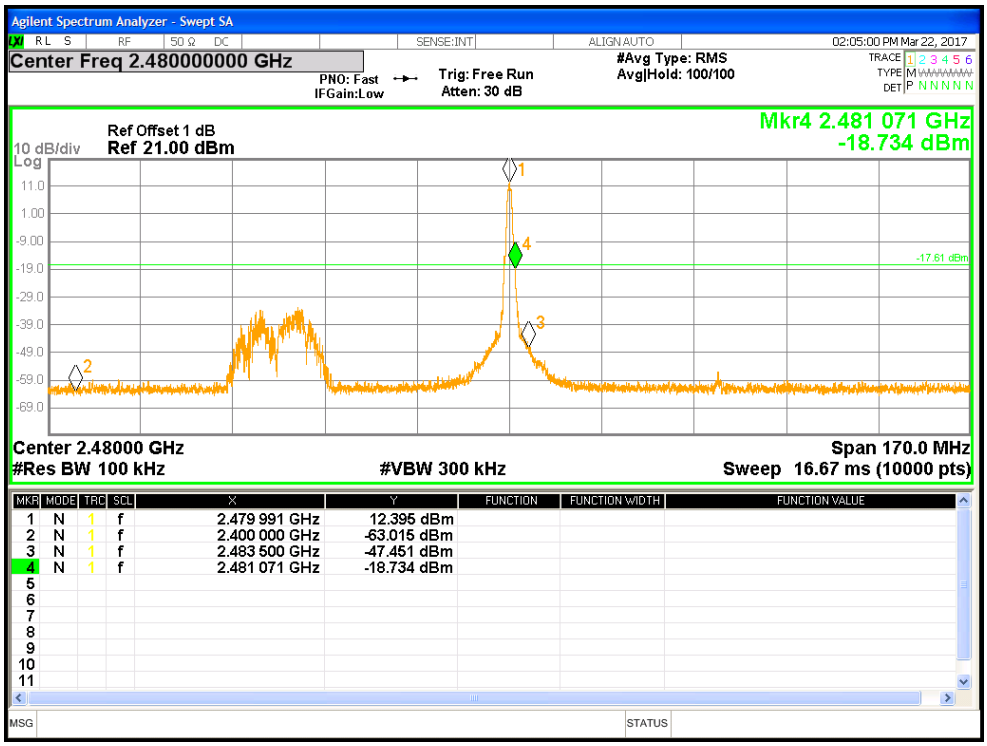


Figure 59: Measured Bandedge for BLE at 2480 MHz

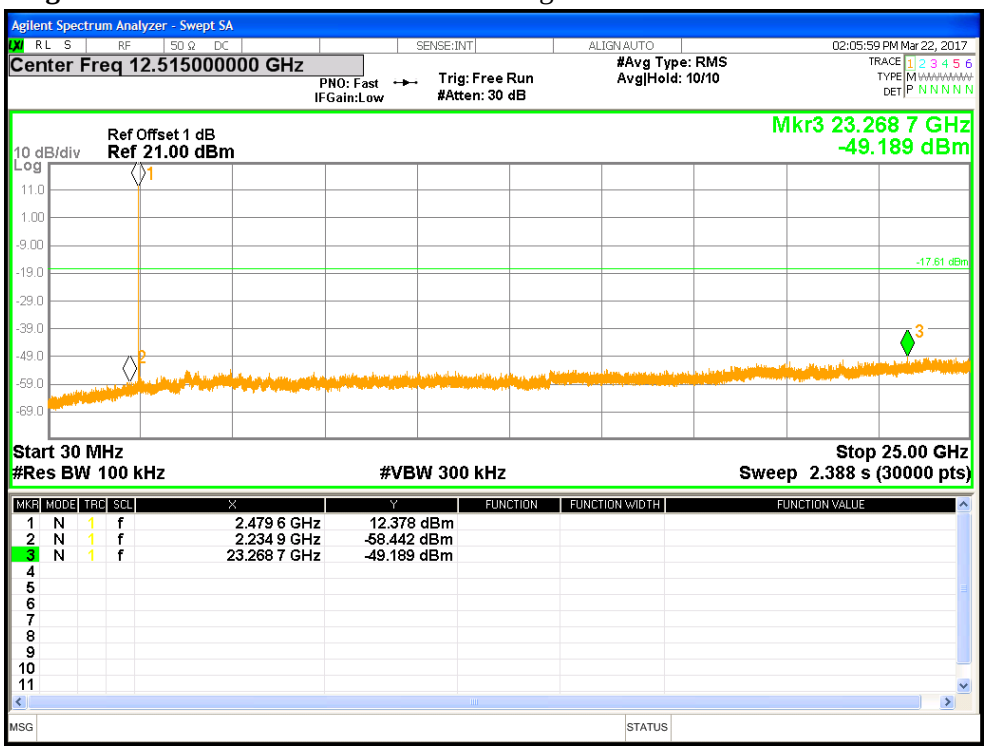


Figure 60: Out of Band Emissions for BLE at 2480 MHz

4.5 Transmit 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.

4.5.1 Test Methodology

4.5.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF 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.

4.5.1.2 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.

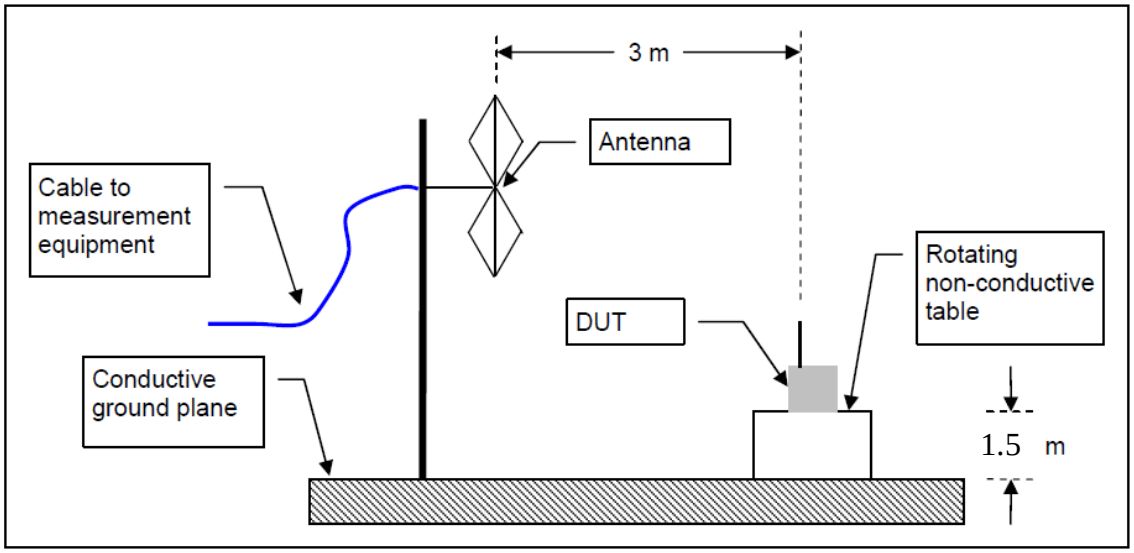
Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

Final results are: 802.11g (Chain 0 and Chain 1) and HT40 (Chain 0 and Chain 1). 20MHz channel BW worse case is 802.11g and covers HT20.

4.5.1.3 Deviations

None.

Test Setup:



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: 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

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).

Table 13: Transmit Spurious Emission at Band-Edge Requirements

Test Conditions: Radiated Measurement, Normal Temperature and Voltage only

Antenna Type: FPCB **Power Setting:** See test plan

Total Directional Gain: + 6.87 dBi (WiFi)
Max. Directional Gain: Antenna 3 = + 4.08 dBi (WiFi); Antenna 4 = + 3.64 dBi (WiFi); Antenna 5 = + 4.14 dBi (BLE and Thread)

Signal State: Modulated at 100%.

Ambient Temp.: 21° C **Relative Humidity:**44%

Band-Edge Results

Freq. (MHz)	Level (dBuV/m)	Pol. (H/V)	Limit (dBuV/m)	Margin (dB)	Det.	Table Deg.	Tower (cm)	Note
2390	69.93	V	74	-4.07	Pk	14	106	PLOT 61: 11g-6Mbps-2412MHz-TP25-Ch0-Ch1
2390	52.51	V	54	-1.49	Ave	14	106	PLOT 62: 11g-6Mbps-2412MHz-TP25-Ch0-Ch1
2390	67.29	H	74	-6.71	Pk	18	108	PLOT 63: 11g-6Mbps-2412MHz-TP25-Ch0-Ch1
2390	49.71	H	54	-4.29	Ave	18	108	PLOT 64: 11g-6Mbps-2412MHz-TP25-Ch0-Ch1
2483.7	72.54	V	74	-1.46	Pk	24	145	PLOT 65: 11g-6Mbps-2462MHz-TP27-Ch0-Ch1
2483.5	53.41	V	54	-0.59	Ave	24	145	PLOT 66: 11g-6Mbps-2462MHz-TP27-Ch0-Ch1
2484.0	71.75	H	74	-2.25	Pk	8	115	PLOT 67: 11g-6Mbps-2462MHz-TP27-Ch0-Ch1
2483.5	52.64	H	54	-1.36	Ave	8	115	PLOT 68: 11g-6Mbps-2462MHz-TP27-Ch0-Ch1
2390	70.24	V	74	-3.76	Pk	298	147	PLOT 69: HT20-MCS0-2412MHz-TP24-Ch0-Ch1
2390	53.11	V	54	-0.89	Ave	298	147	PLOT 70: HT20-MCS0-2412MHz-TP24-Ch0-Ch1
2389	66.92	H	74	-7.08	Pk	16	111	PLOT 71: HT20-MCS0-2412MHz-TP24-Ch0-Ch1
2390	50.87	H	54	-3.13	Ave	16	111	PLOT 72: HT20-MCS0-2412MHz-TP24-Ch0-Ch1
2484.2	72.39	V	74	-1.61	Pk	31	142	PLOT 73: HT20-MCS0-2462MHz-TP27-Ch0-Ch1
2483.5	53.72	V	54	-0.28	Ave	31	142	PLOT 74: HT20-MCS0-2462MHz-TP27-Ch0-Ch1
2484.0	70.63	H	74	-3.37	Pk	10	118	PLOT 75: HT20-MCS0-2462MHz-TP27-Ch0-Ch1
2483.5	53.90	H	54	-0.10	Ave	10	118	PLOT 76: HT20-MCS0-2462MHz-TP27-Ch0-Ch1

Note: 1. The emissions were measured at the adjacent restricted band of the fundamental signal.
2. All the band-edge measurements met the restricted band requirements of CFR47 15.205.

Band-Edge Results, Continued

Freq. (MHz)	Level (dBuV/m)	Pol. (H/V)	Limit (dBuV/m)	Margin (dB)	Det.	Table Deg.	Tower (cm)	Note
2390	65.33	V	74	-8.67	Pk	347	146	PLOT 77: HT40-MCS0-2422MHz-TP21-Ch0-Ch1
2390	51.29	V	54	-2.71	Ave	347	146	PLOT 78: HT40-MCS0-2422MHz-TP21-Ch0-Ch1
2385	65.56	H	74	-8.44	Pk	14	110	PLOT 79: HT40-MCS0-2422MHz-TP21-Ch0-Ch1
2390	49.78	H	54	-4.22	Ave	14	110	PLOT 80: HT40-MCS0-2422MHz-TP21-Ch0-Ch1
2487.9	67.38	V	74	-6.62	Pk	338	122	PLOT 81: HT40-MCS0-2452MHz-TP21-Ch0-Ch1
2487.3	48.44	V	54	-5.56	Ave	338	122	PLOT 82: HT40-MCS0-2452MHz-TP21-Ch0-Ch1
2485.1	70.36	H	74	-3.64	Pk	13	168	PLOT 83: HT40-MCS0-2452MHz-TP21-Ch0-Ch1
2483.5	52.99	H	54	-1.01	Ave	13	168	PLOT 84: HT40-MCS0-2452MHz-TP21-Ch0-Ch1
2364.0	57.12	H	74	-16.88	Pk	358	118	PLOT 85: BLE-2402MHz-TP19
2390.0	43.35	H	54	-10.65	Ave	358	118	PLOT 86: BLE-2402MHz-TP19
2382.6	57.35	V	74	-16.65	Pk	8	175	PLOT 87: BLE-2402MHz-TP19
2390.0	42.92	V	54	-11.08	Ave	8	175	PLOT 88: BLE-2402MHz-TP19
2483.6	58.90	V	74	-15.10	Pk	47	142	PLOT 89: BLE-2480MHz-TP19
2483.5	44.08	V	54	-9.92	Ave	47	142	PLOT 90: BLE-2480MHz-TP19
2483.5	69.40	H	74	-4.60	Pk	16	174	PLOT 91: BLE-2480MHz-TP19
2483.5	49.93	H	54	-4.07	Ave	16	174	PLOT 92: BLE-2480MHz-TP19

Note: 1. The emissions were measured at the adjacent restricted band of the fundamental signal.
2. All the band-edge measurements met the restricted band requirements of CFR47 15.205.

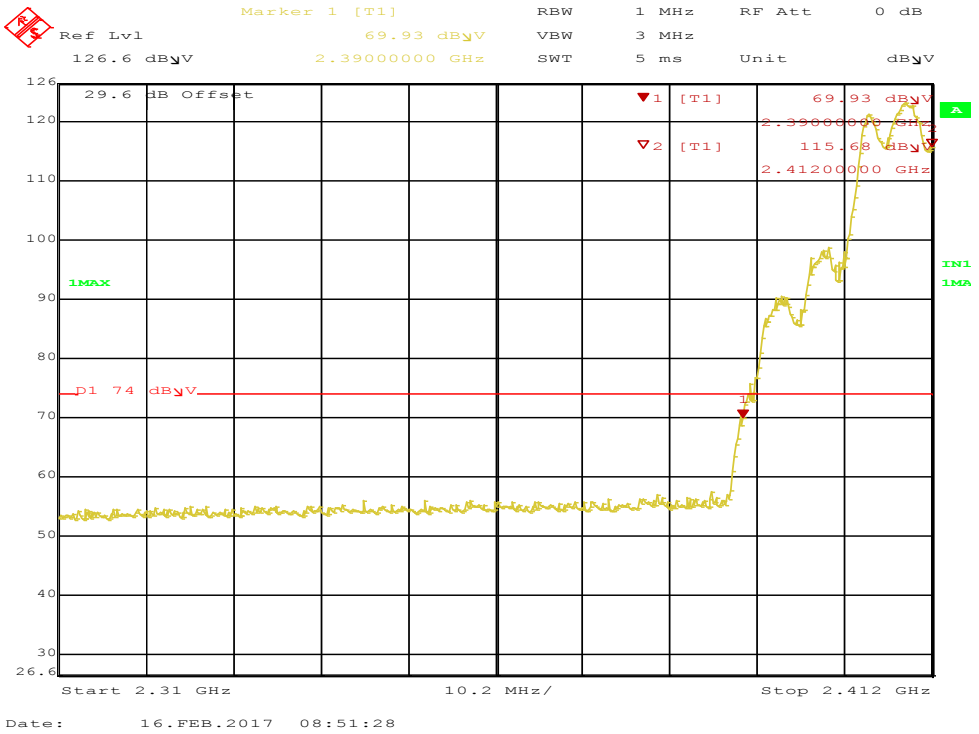


Figure 61: 11g Radiated Emission at the Edge for 2390 MHz – Vert. (Pk)

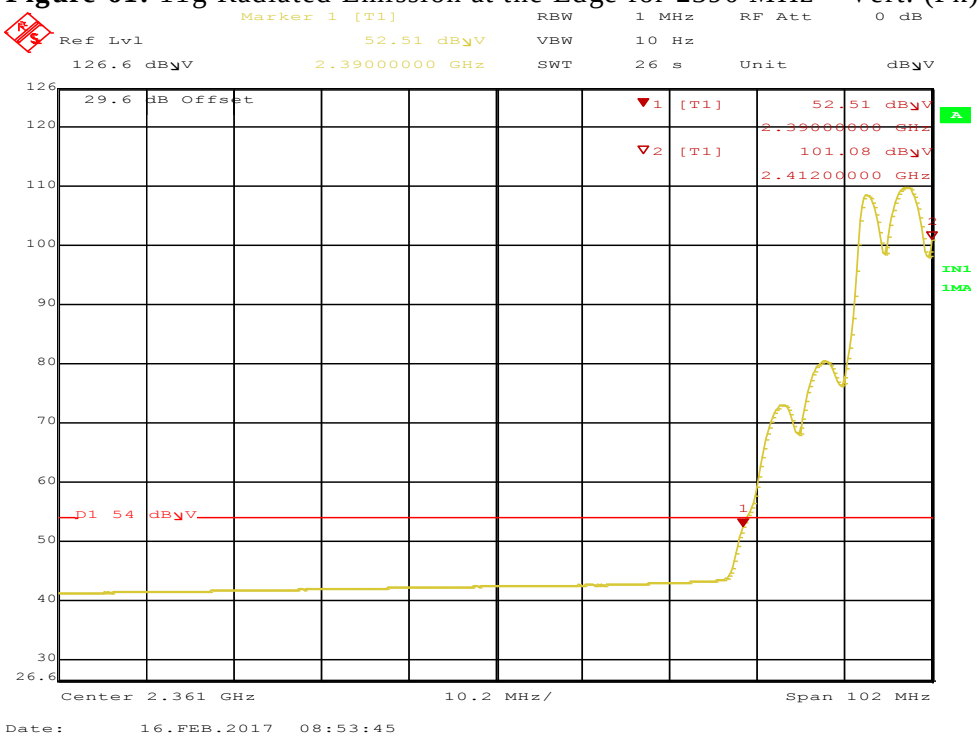


Figure 62: 11g Radiated Emission at the Edge for 2390 MHz – Vert. (Ave)

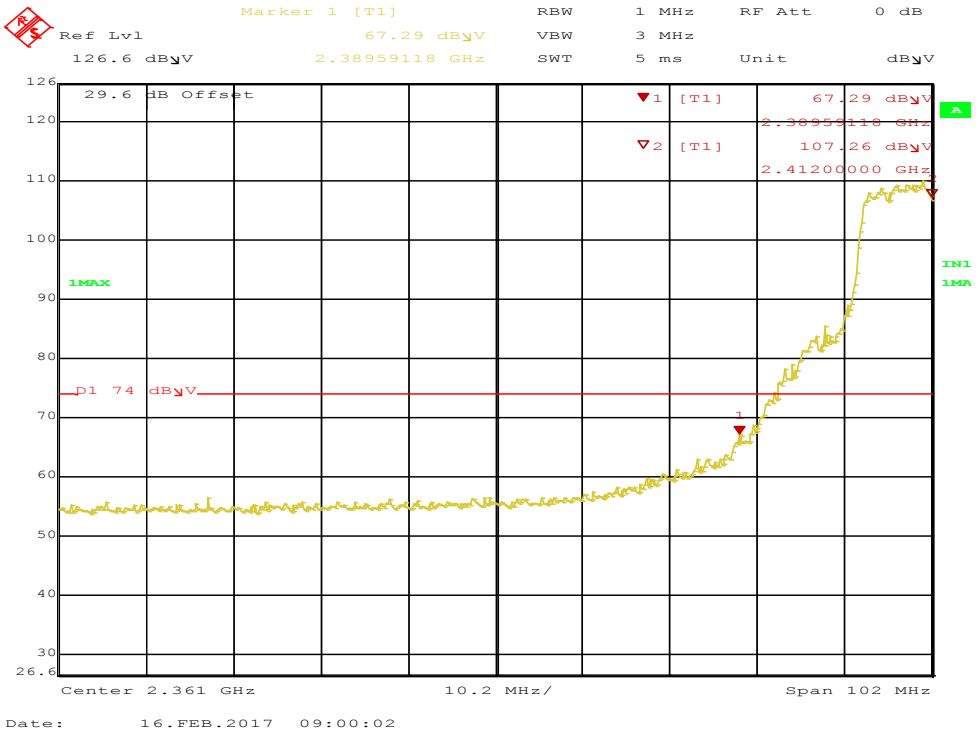


Figure 63: 11g Radiated Emission at the Edge for 2390 MHz – Horz. (Pk)

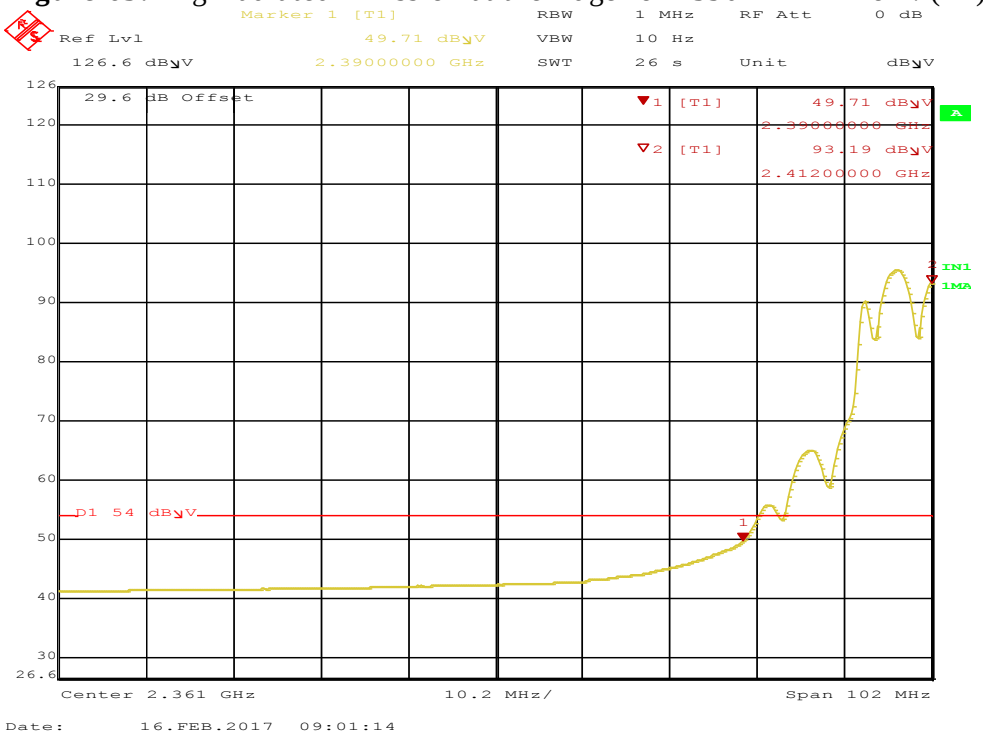


Figure 64: 11g Radiated Emission at the Edge for 2390 MHz – Horz. (Ave)

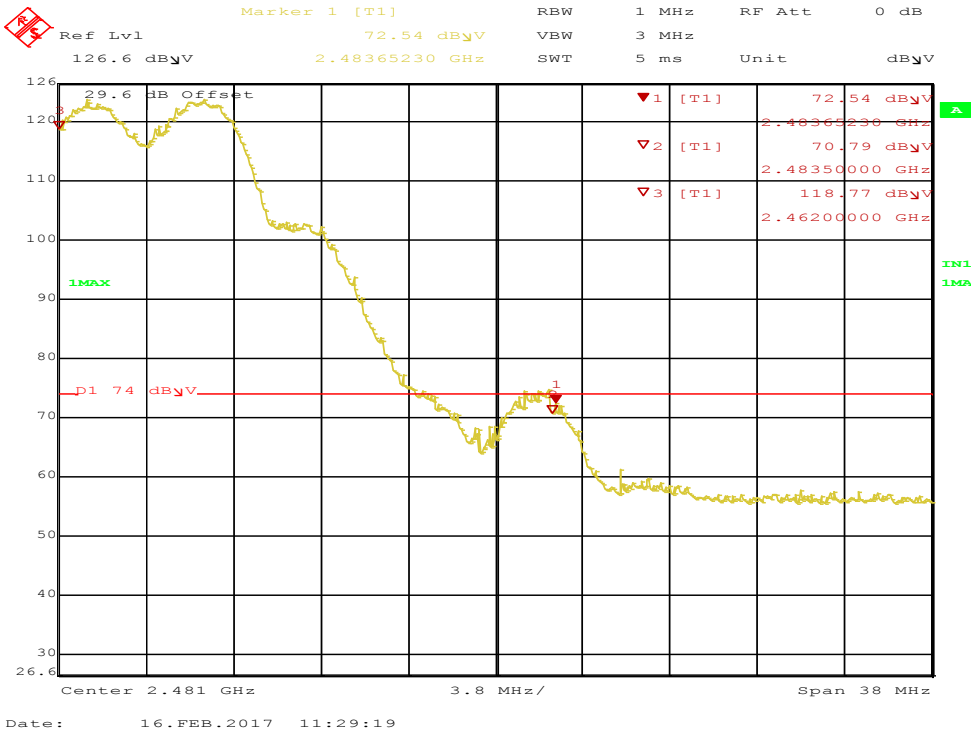


Figure 65: 11g Radiated Emission at the Edge for 2483.7 MHz – Vert. (Pk)

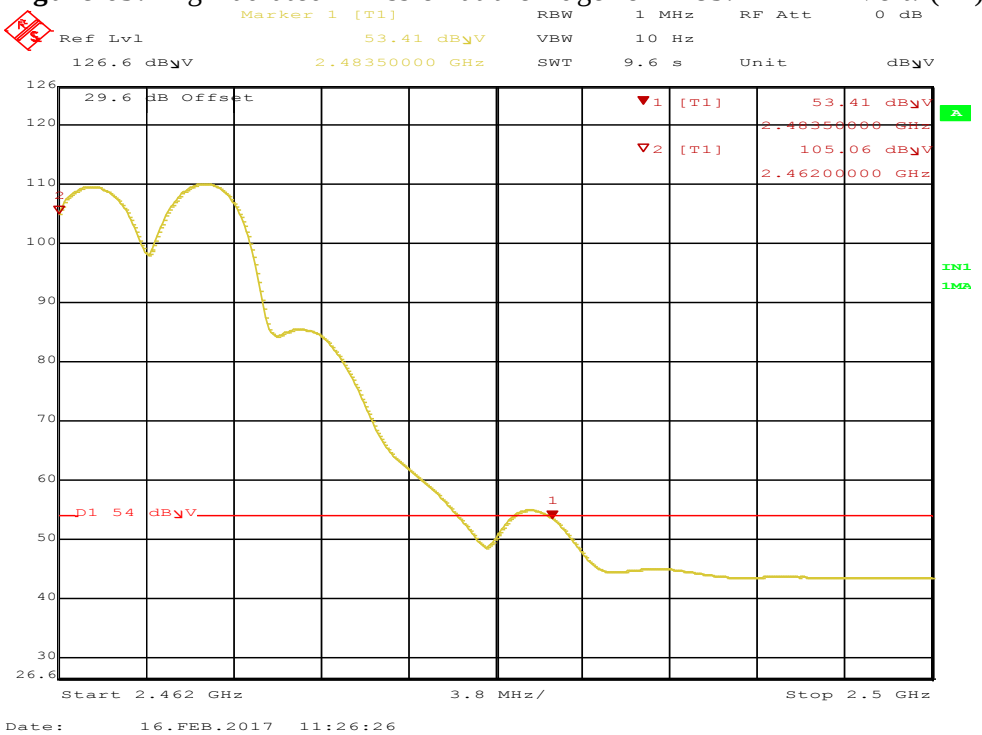


Figure 66: 11g Radiated Emission at the Edge for 2483.5 MHz – Vert. (Ave)

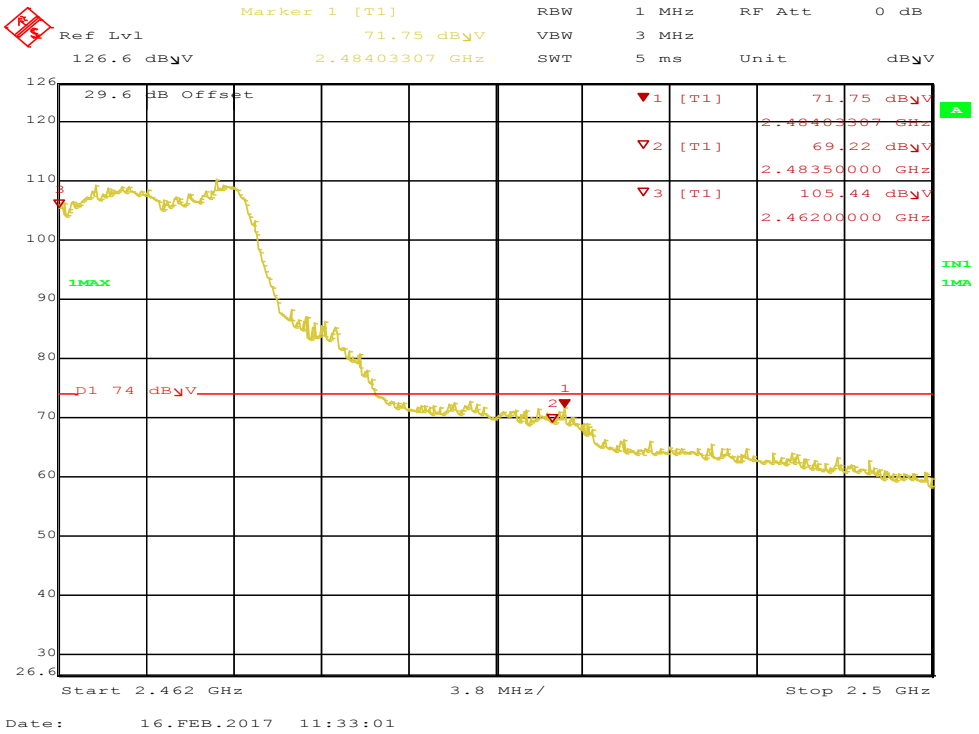


Figure 67: 11g Radiated Emission at the Edge for 2484.0 MHz – Horz. (Pk)

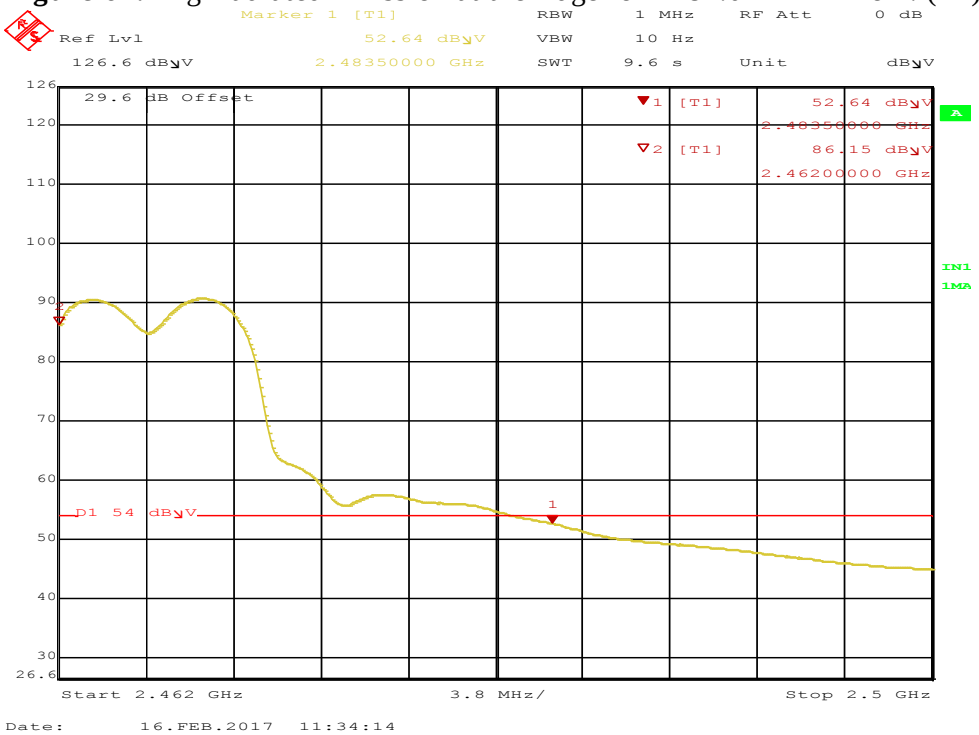


Figure 68: 11g Radiated Emission at the Edge for 2483.5 MHz – Horz. (Ave)

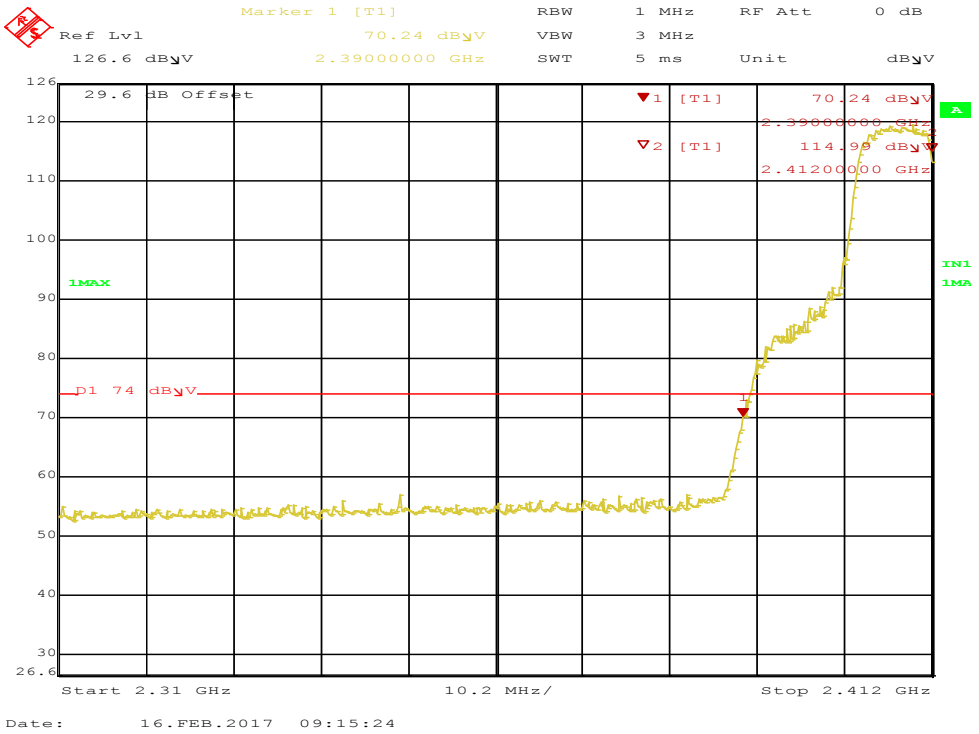


Figure 69: HT20 Radiated Emission at the Edge for 2390 MHz – Vert. (Pk)

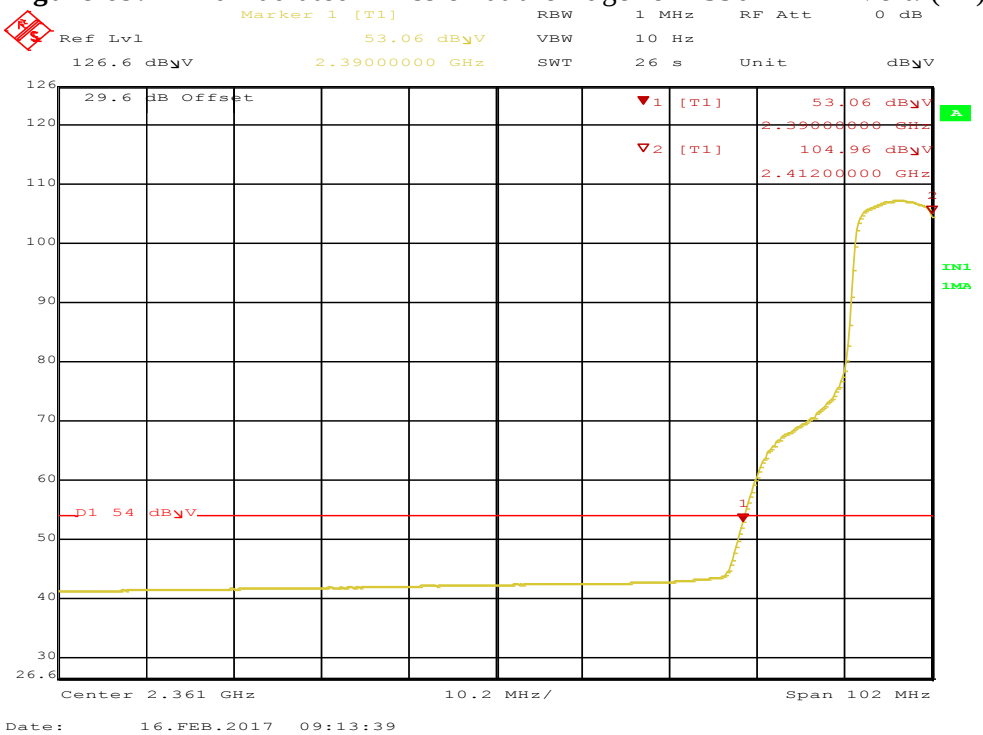


Figure 70: HT20 Radiated Emission at the Edge for 2390 MHz – Vert. (Ave)

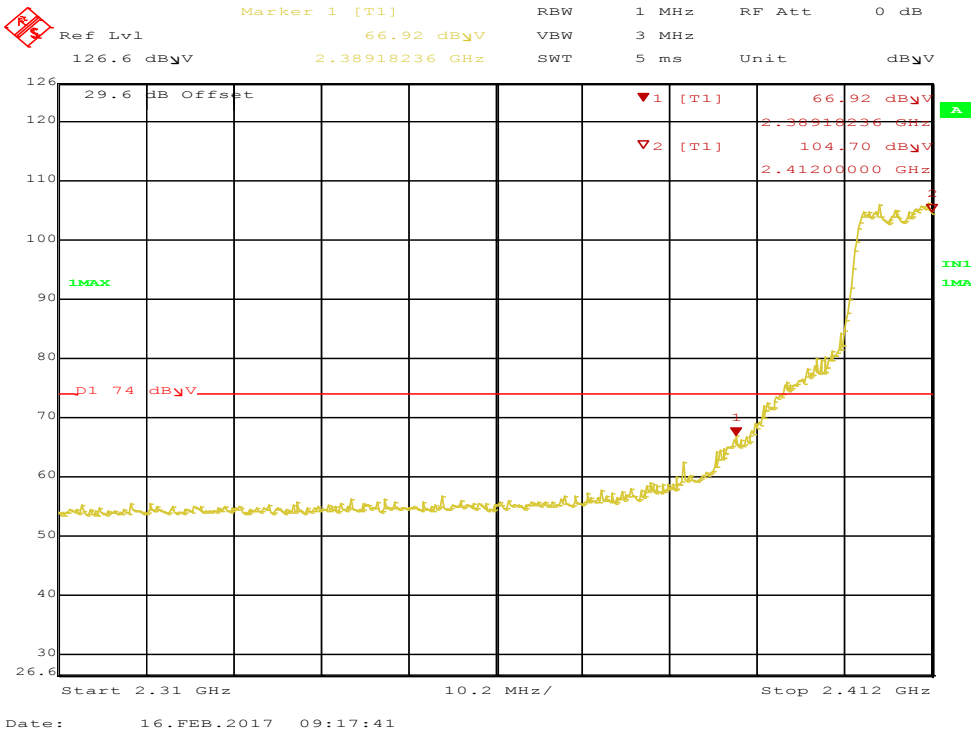


Figure 71: HT20 Radiated Emission at the Edge for 2389 MHz – Horz. (Pk)

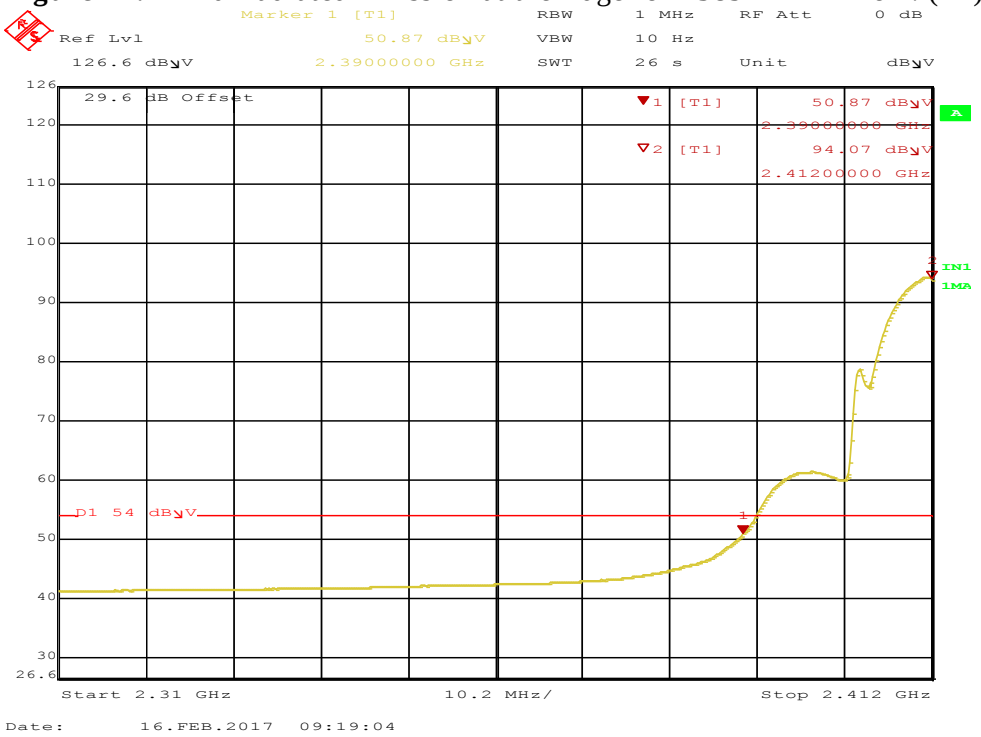


Figure 72: HT20 Radiated Emission at the Edge for 2390 MHz – Horz. (Ave)

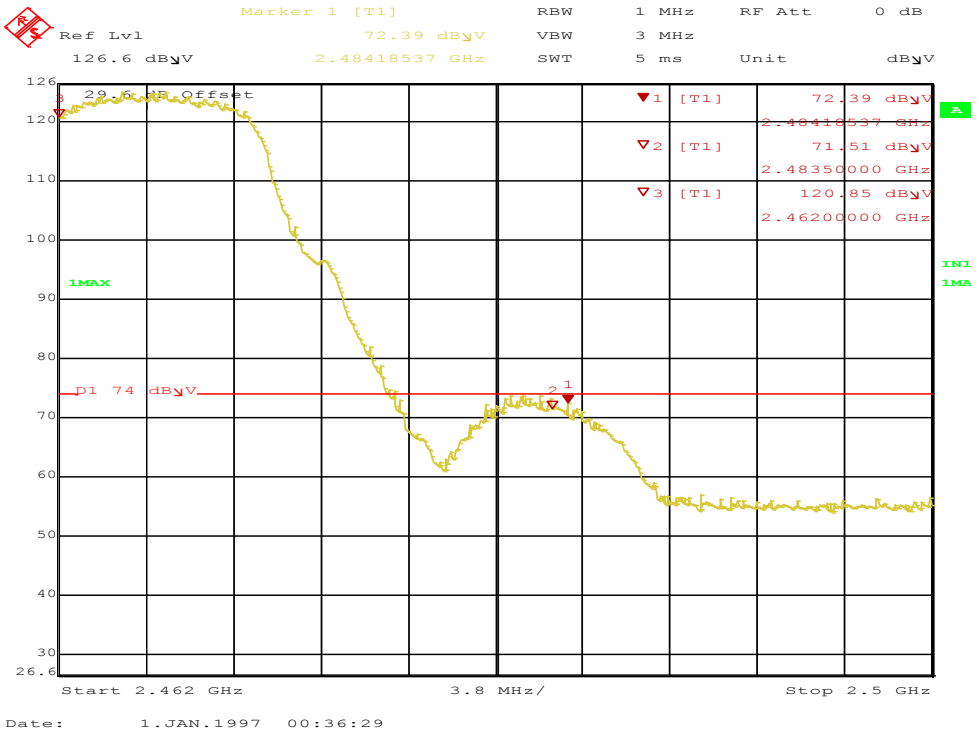


Figure 73: HT20 Radiated Emission at the Edge for 2484.2 MHz – Vert. (Pk)

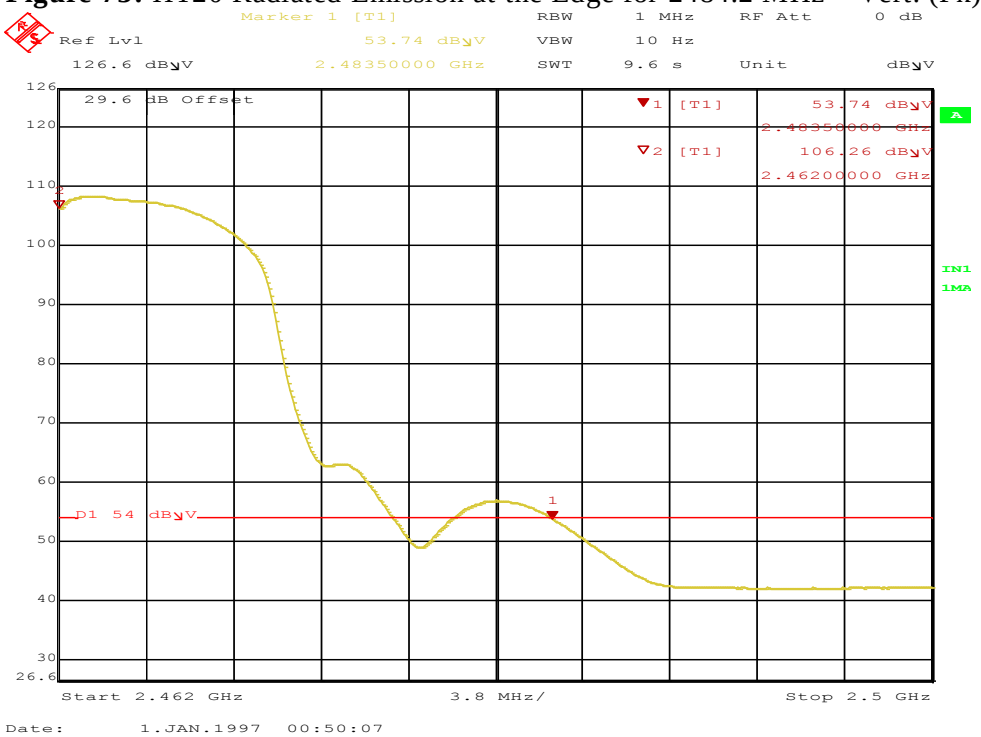


Figure 74: HT20 Radiated Emission at the Edge for 2483.5 MHz – Vert. (Ave)

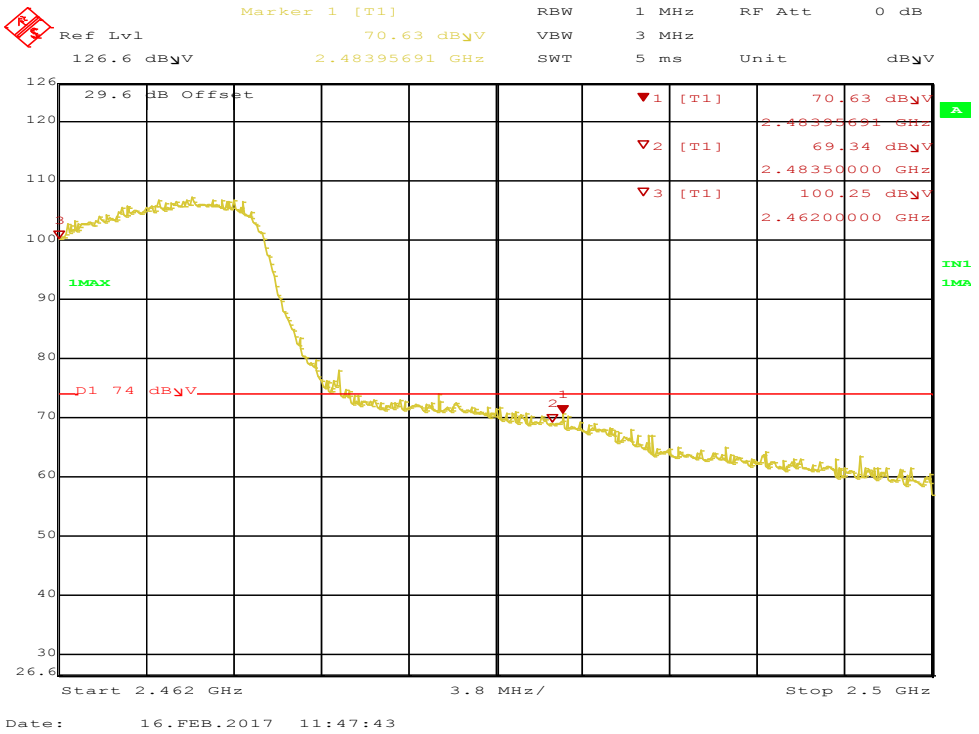


Figure 75: HT20 Radiated Emission at the Edge for 2484.0 MHz – Horz. (Pk)

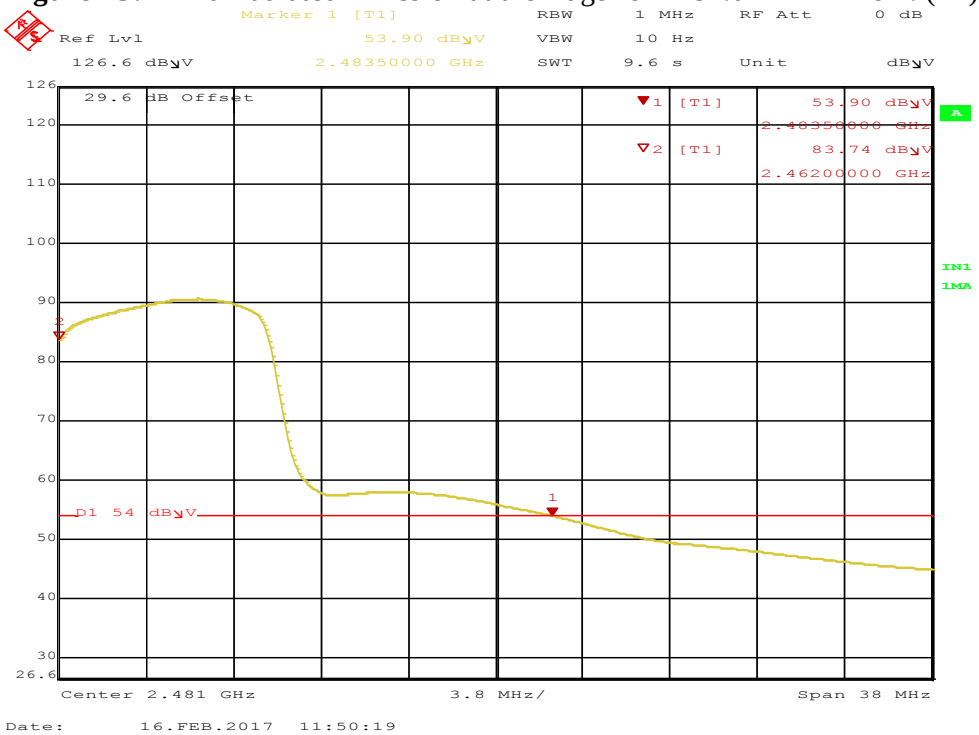


Figure 76: HT20 Radiated Emission at the Edge for 2483.5 MHz – Horz. (Ave)

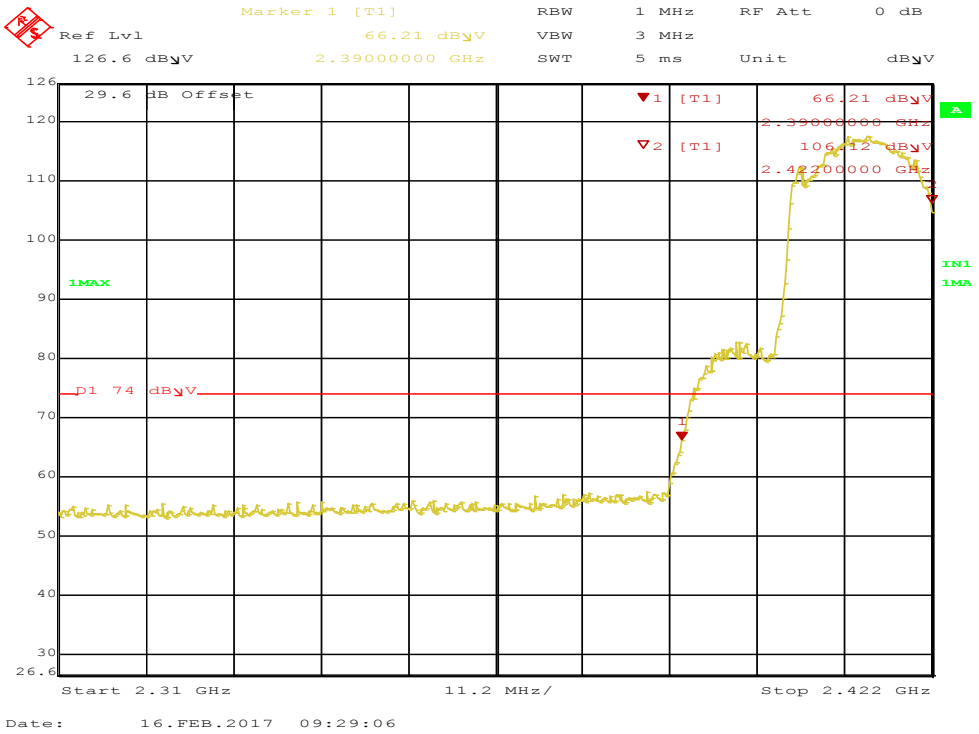


Figure 77: HT40 Radiated Emission at the Edge for 2390 MHz – Vert. (Pk)

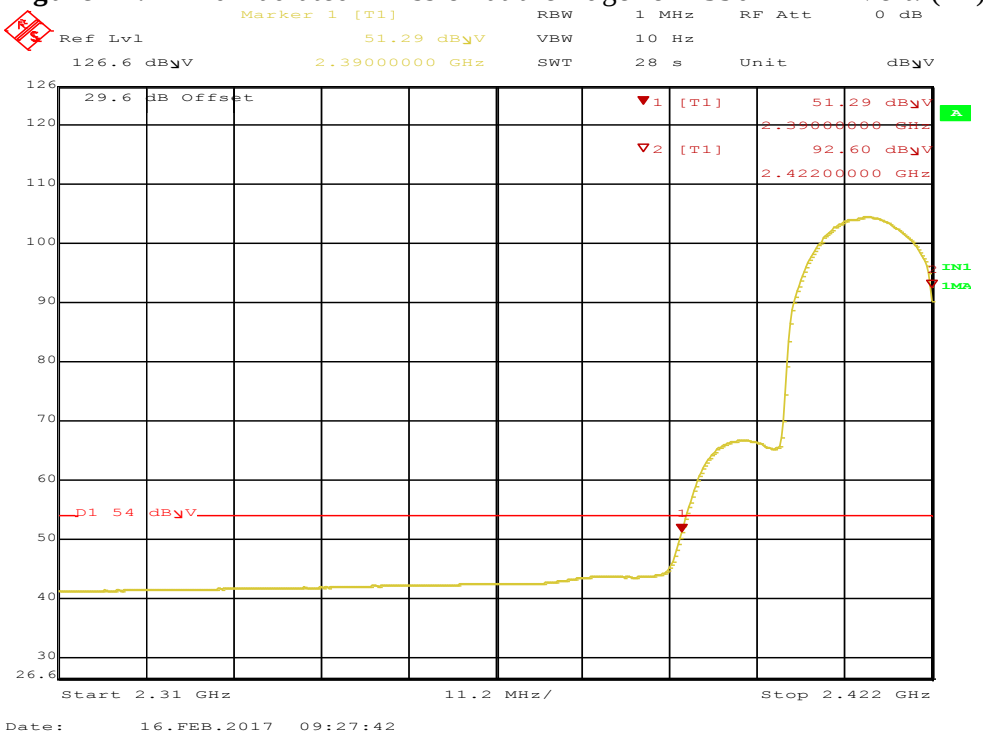


Figure 78: HT40 Radiated Emission at the Edge for 2390 MHz – Vert. (Ave)

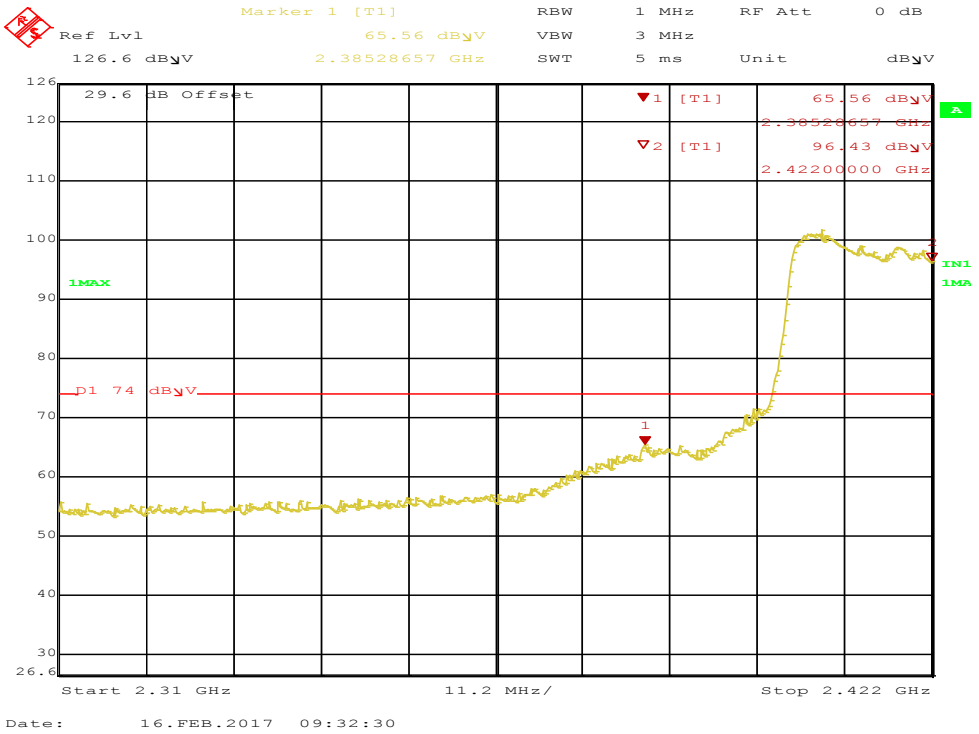


Figure 79: HT40 Radiated Emission at the Edge for 2385 MHz – Horz. (Pk)

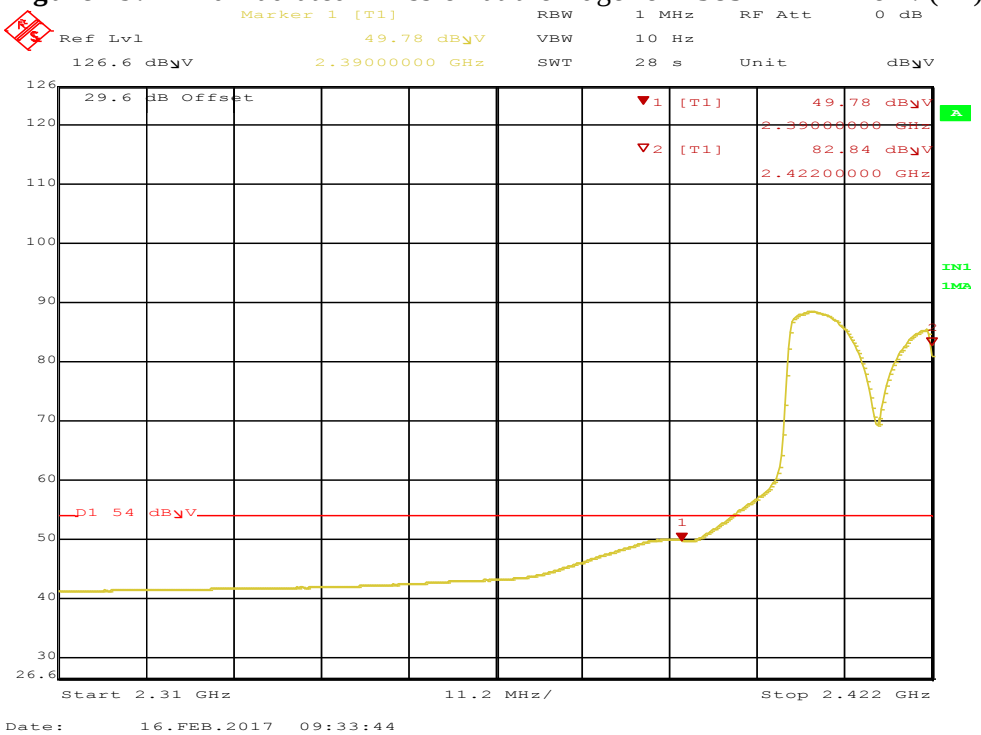


Figure 80: HT40 Radiated Emission at the Edge for 2390 MHz – Horz. (Ave)

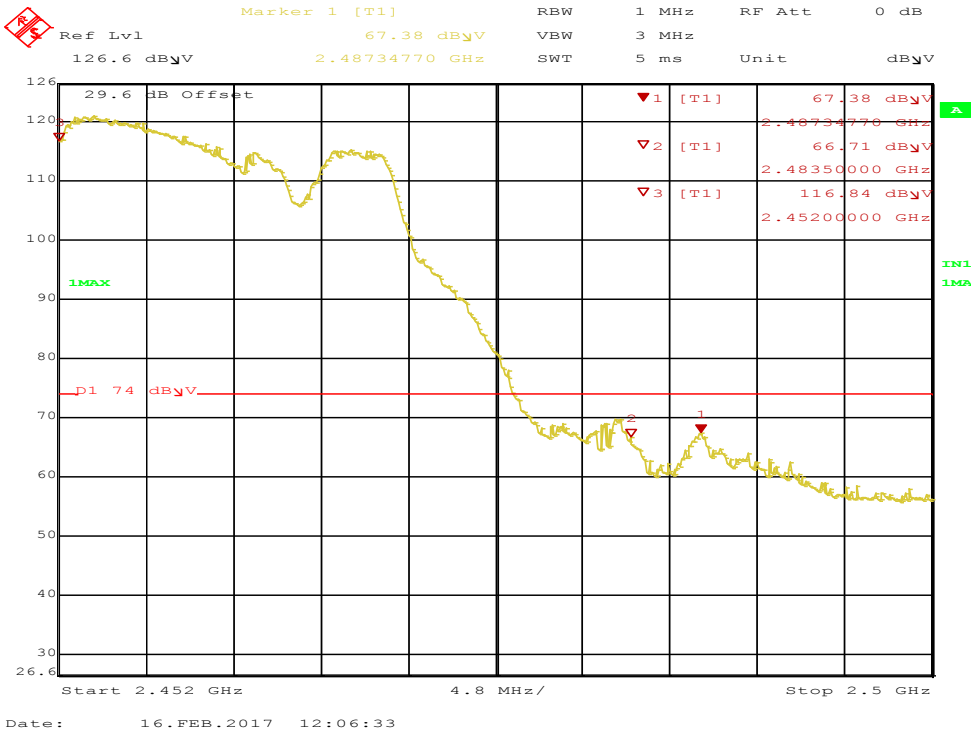


Figure 81: HT40 Radiated Emission at the Edge for 2487.9 MHz – Vert. (Pk)

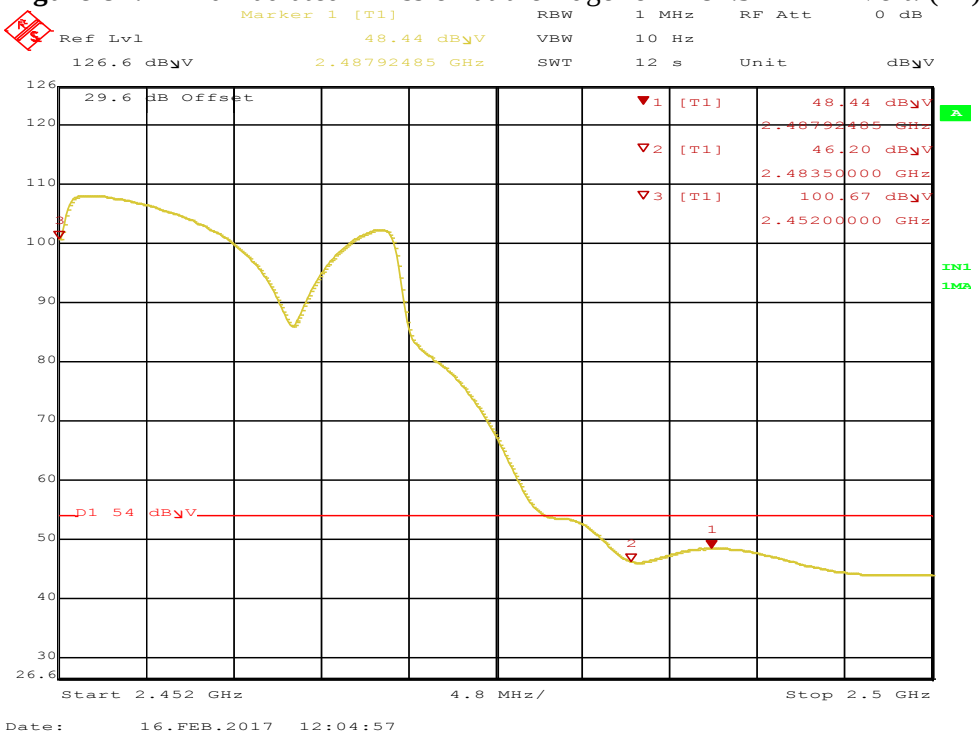


Figure 82: HT40 Radiated Emission at the Edge for 2487.3 MHz – Vert. (Ave)

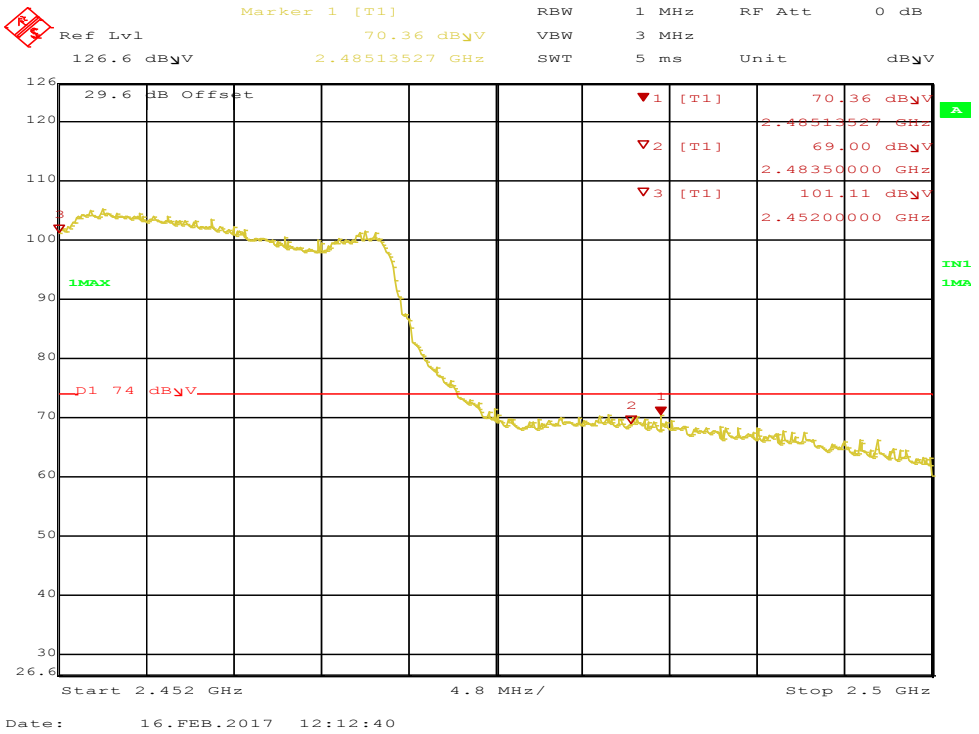


Figure 83: HT40 Radiated Emission at the Edge for 2485.1 MHz – Horz. (Pk)

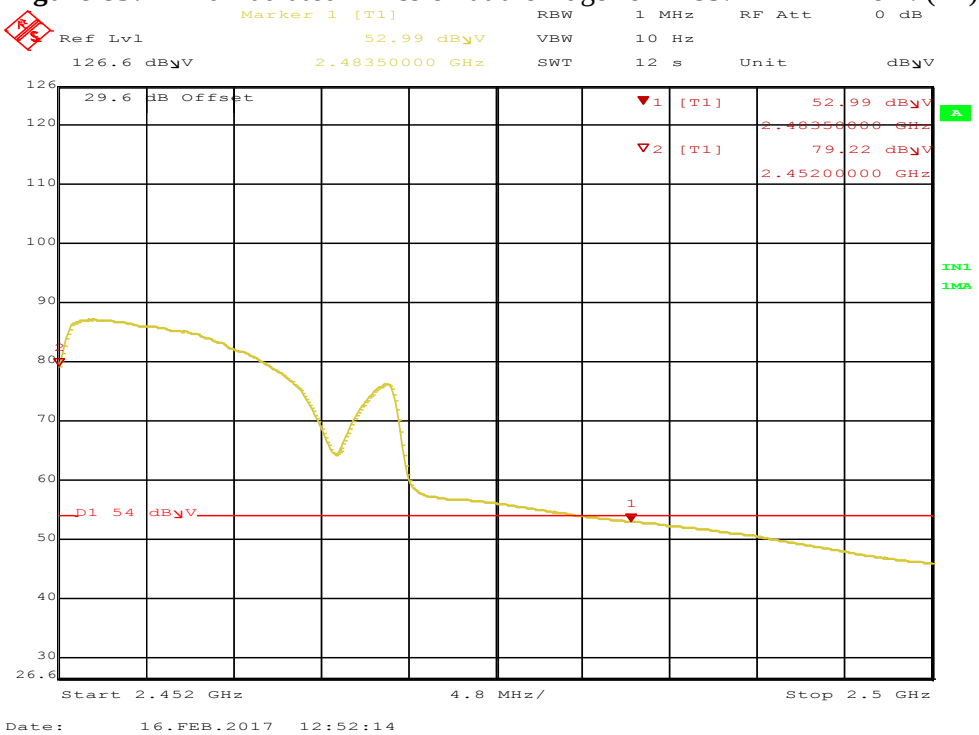


Figure 84: HT40 Radiated Emission at the Edge for 2483.5 MHz – Horz. (Ave)

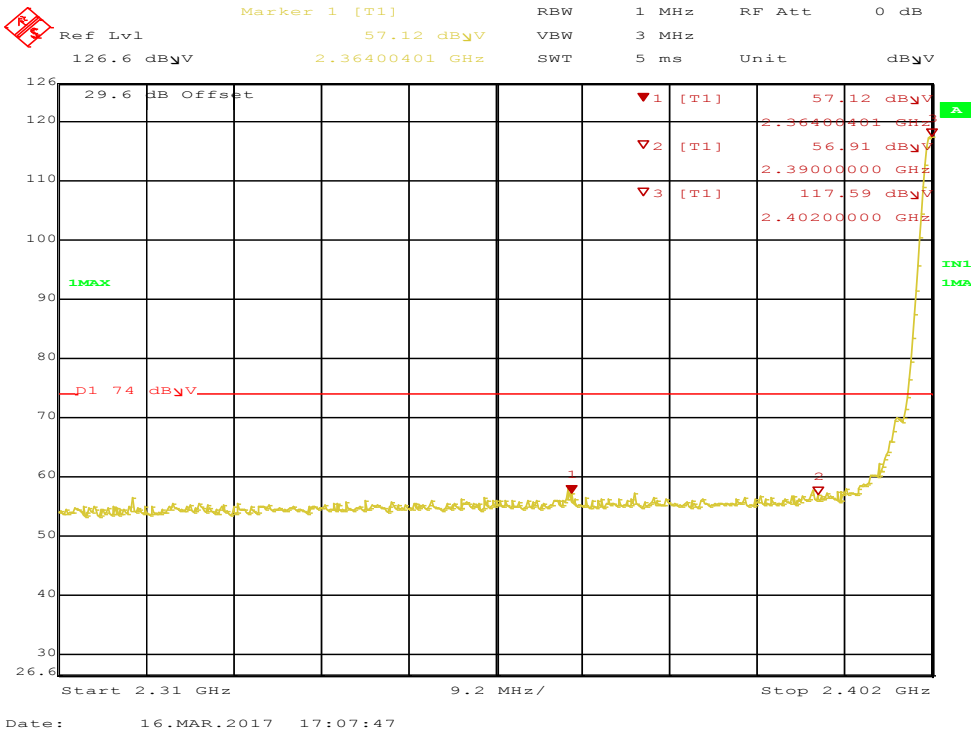


Figure 85: BLE Radiated Emission at the Edge for 2364.0 MHz – Horz. (Pk)

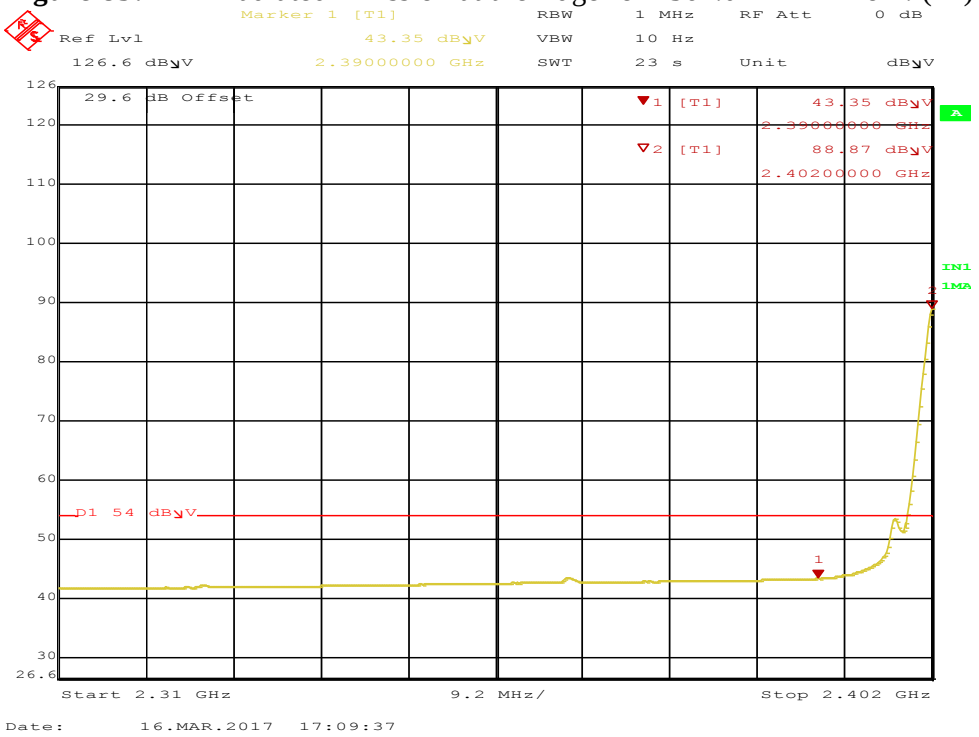


Figure 86: BLE Radiated Emission at the Edge for 2390.0 MHz – Horz. (Ave)

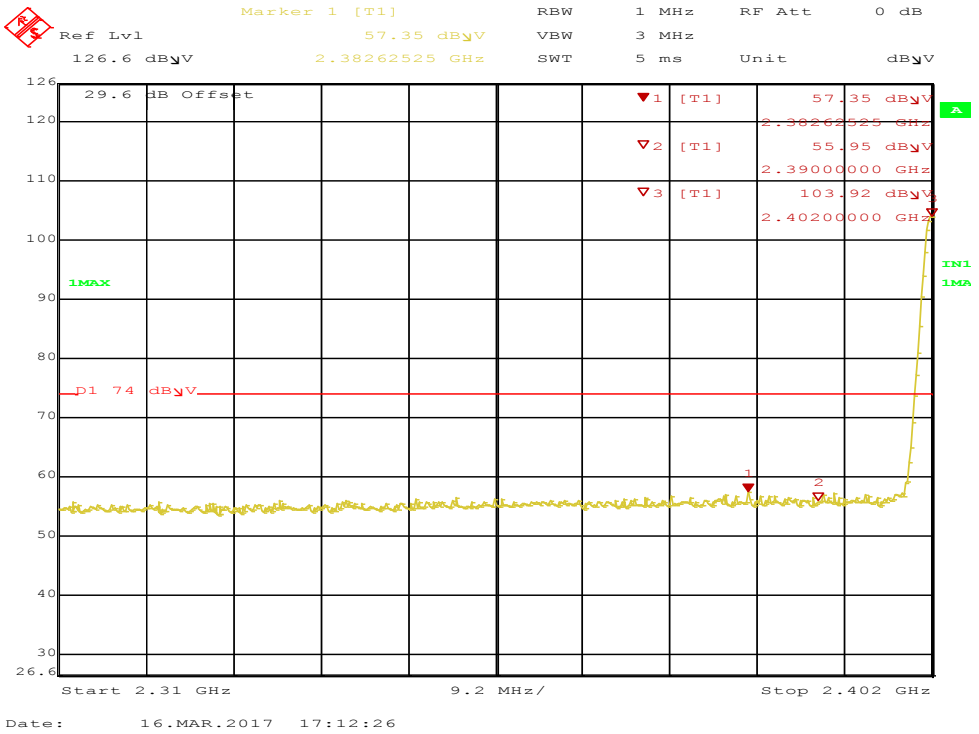


Figure 87: BLE Radiated Emission at the Edge for 2382.6 MHz – Vert. (Pk)

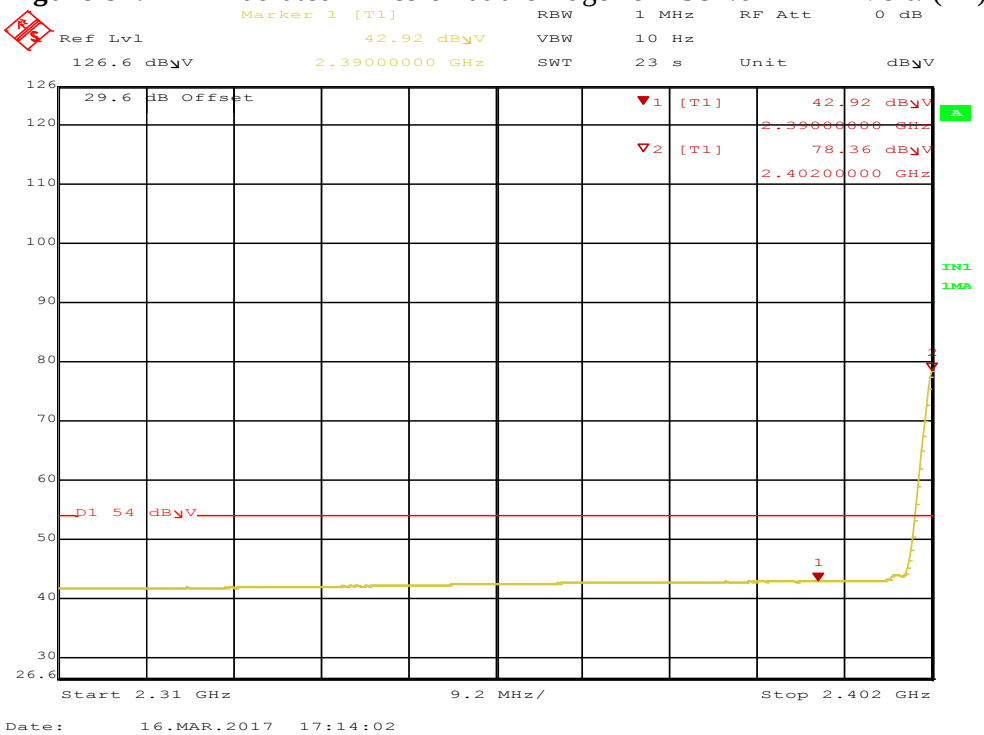


Figure 88: BLE Radiated Emission at the Edge for 2390.0 MHz – Vert. (Ave)

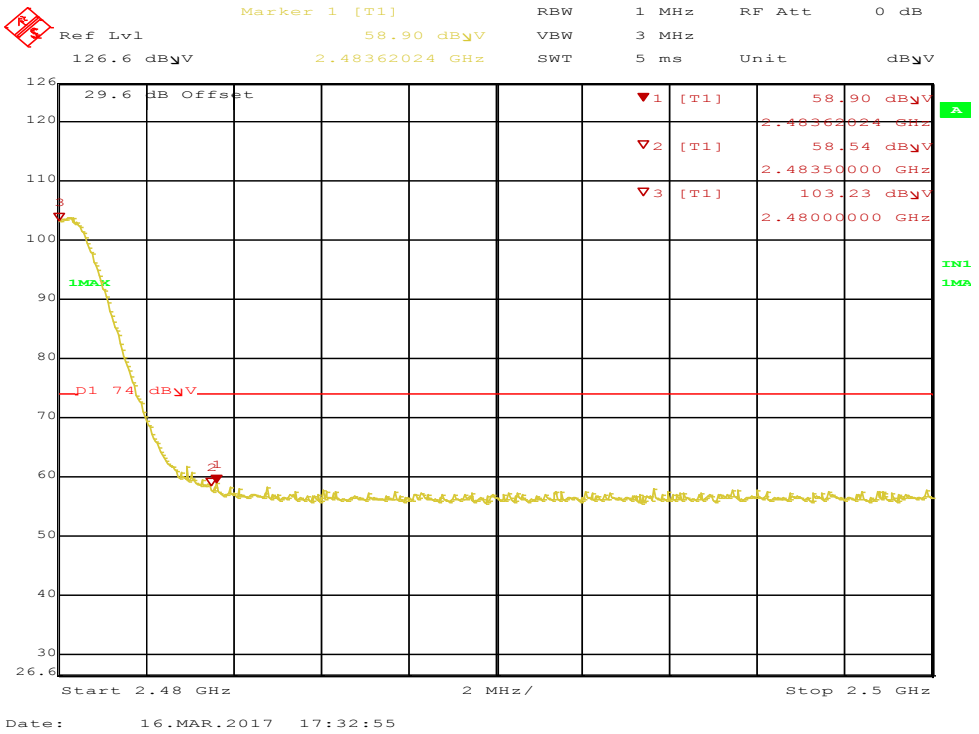


Figure 89: BLE Radiated Emission at the Edge for 2483.6 MHz – Vert. (Pk)

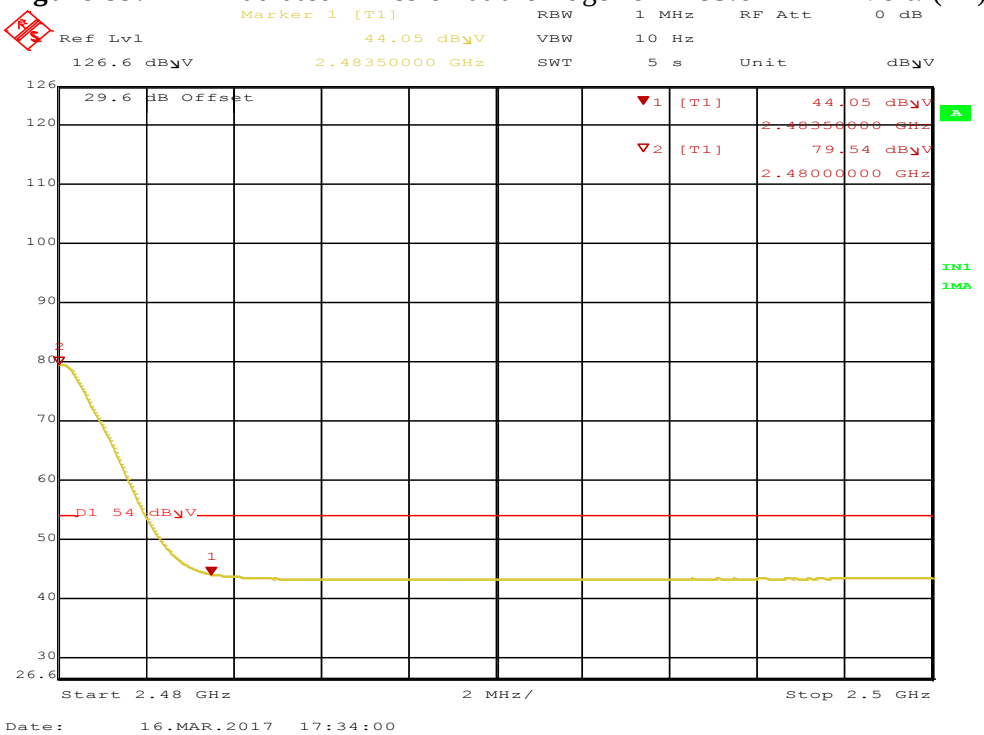


Figure 90: BLE Radiated Emission at the Edge for 2483.5 MHz – Vert. (Ave)

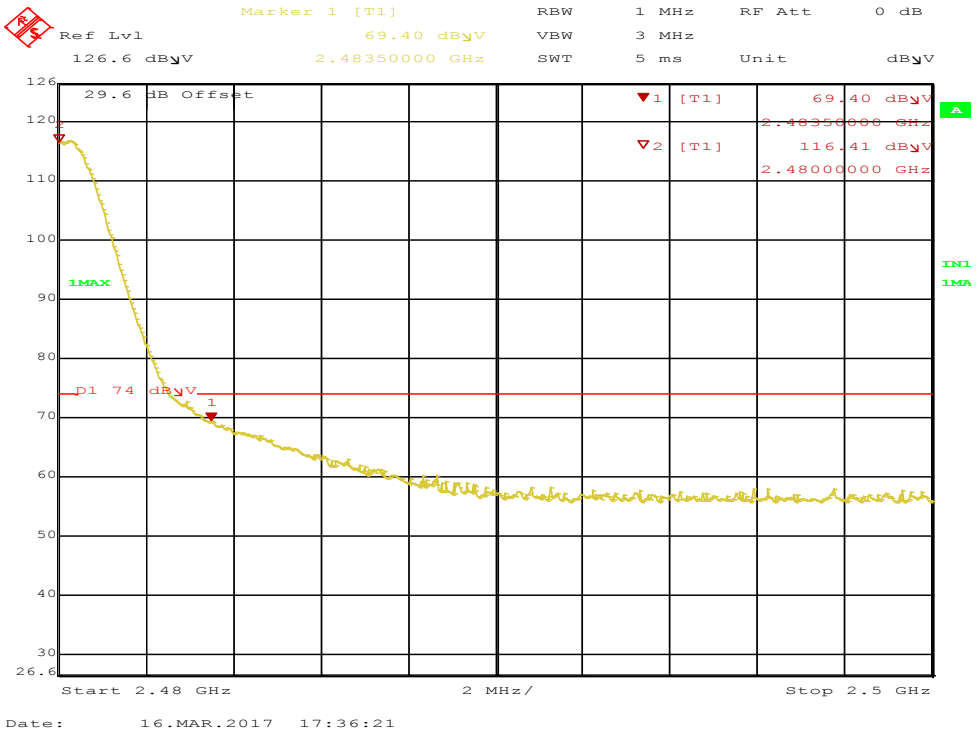


Figure 91: BLE Radiated Emission at the Edge for 2483.5 MHz – Horz. (Pk)

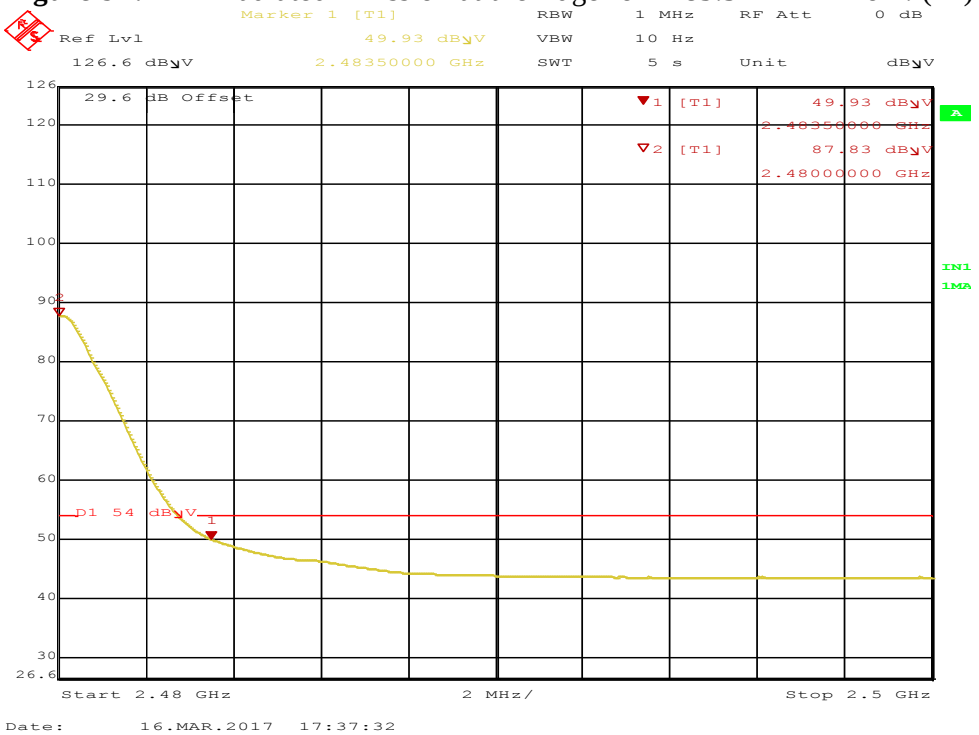
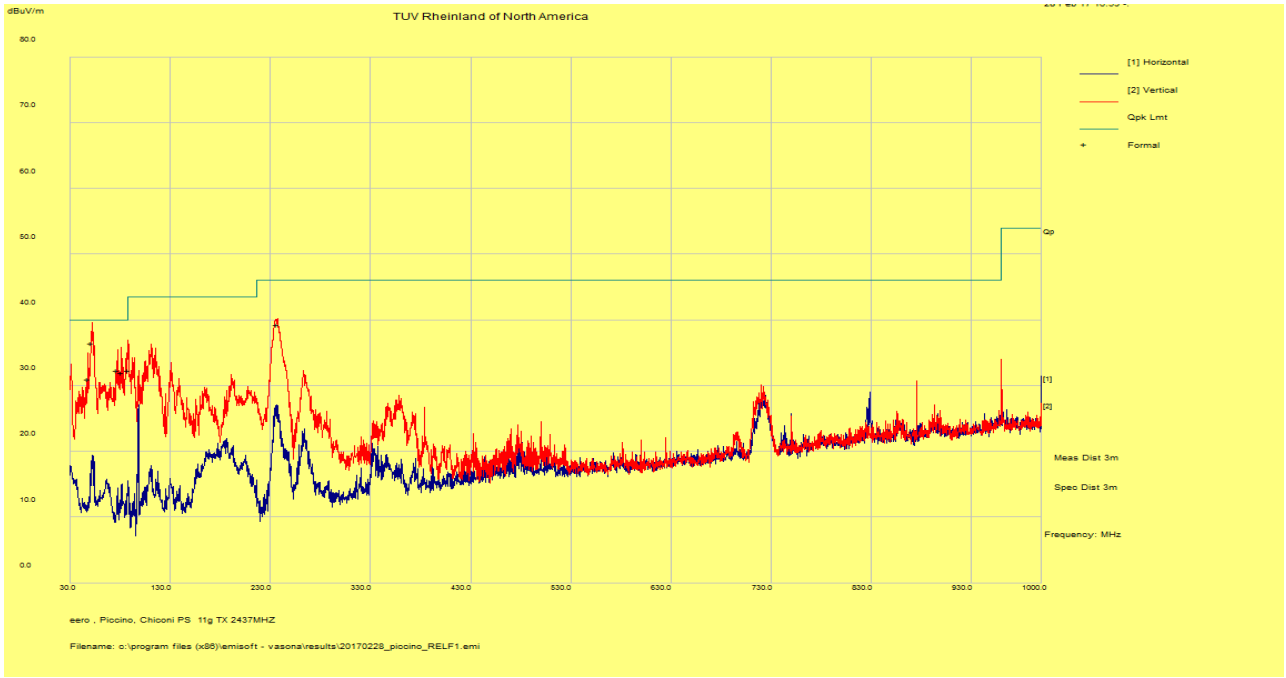


Figure 92: BLE Radiated Emission at the Edge for 2483.5 MHz – Horz. (Ave)

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 1 of 23	
EUT Name	Wi-Fi Router	**Date**	Feb 28, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	21° C / 38%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11g at 6Mbps (chain 0 & 1) / Chicony PSU	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Richard Decker

30 MHz – 1 GHz Transmit at 2437 MHz

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
51.79	58.88	1.71	-24.09	36.51	QP	V	101	240	40.00	-3.49
87.82	55.13	1.92	-24.73	32.31	QP	V	133	292	40.00	-7.69
81.22	54.53	1.88	-24.45	31.96	QP	V	180	360	40.00	-8.04
77.21	54.54	1.86	-24.05	32.35	QP	V	180	158	40.00	-7.65
47.80	52.03	1.69	-22.65	31.06	QP	V	175	290	40.00	-8.94
236.90	56.70	2.50	-19.95	39.25	QP	V	237	361	46.00	-6.75



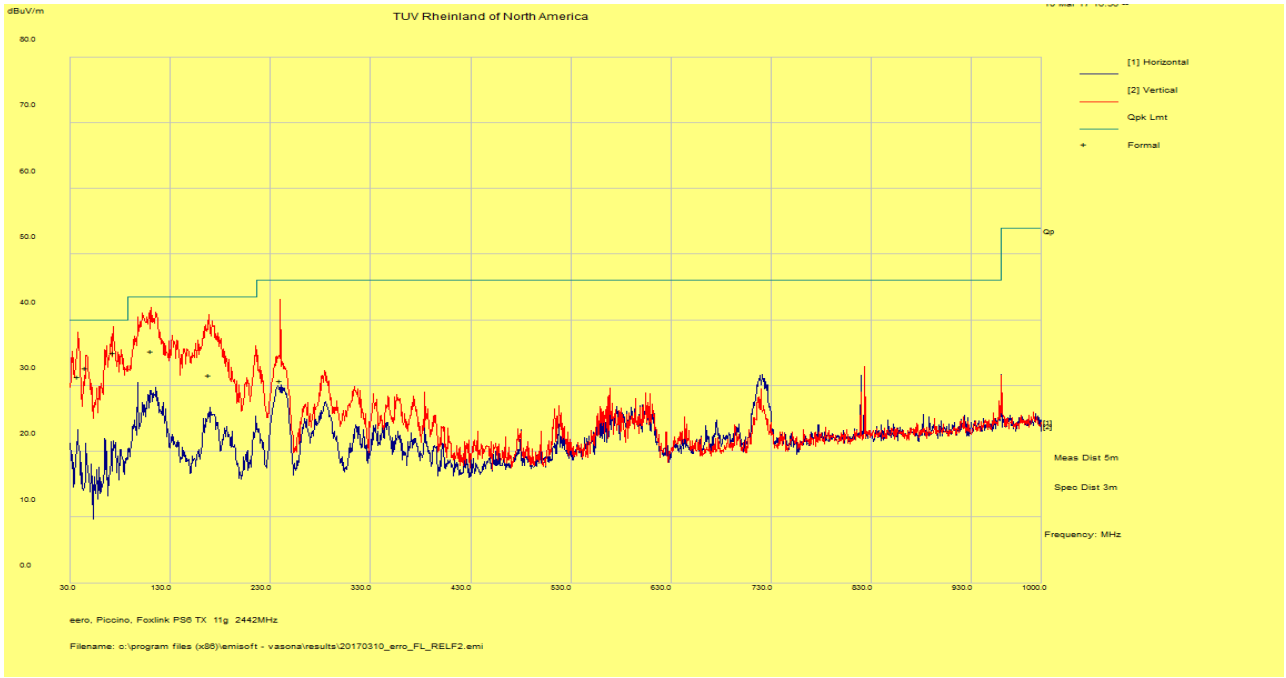
Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: 1. Worst case was observed on Mid channel of 802.11g 6Mbps mode for 20MHz channel BW.
2. Modes tested are 802.11g and HT20 (low, mid & high channel).
3. No significant emission was observed below 30MHz.
4. To reduce complexity and bulkiness of the report Worst case Plots is placed in the report.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 2 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 10, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 43%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11g at 6Mbps (chain 0 & 1) / FoxLink PSU	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Richard Decker

30 MHz – 1 GHz Transmit at 2437 MHz

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
73.18	54.35	0.86	-20.13	35.08	QP	V	137	0	40.00	-4.92
111.37	49.55	1.05	-15.34	35.25	QP	V	112	54	43.50	-8.25
38.04	43.47	0.64	-12.67	31.43	QP	V	102	158	40.00	-8.57
168.67	46.58	1.27	-16.16	31.69	QP	V	162	334	43.50	-11.81
239.95	45.36	1.49	-16.08	30.77	QP	V	204	280	46.00	-15.23
45.79	49.83	0.71	-17.82	32.72	QP	V	102	30	40.00	-7.28



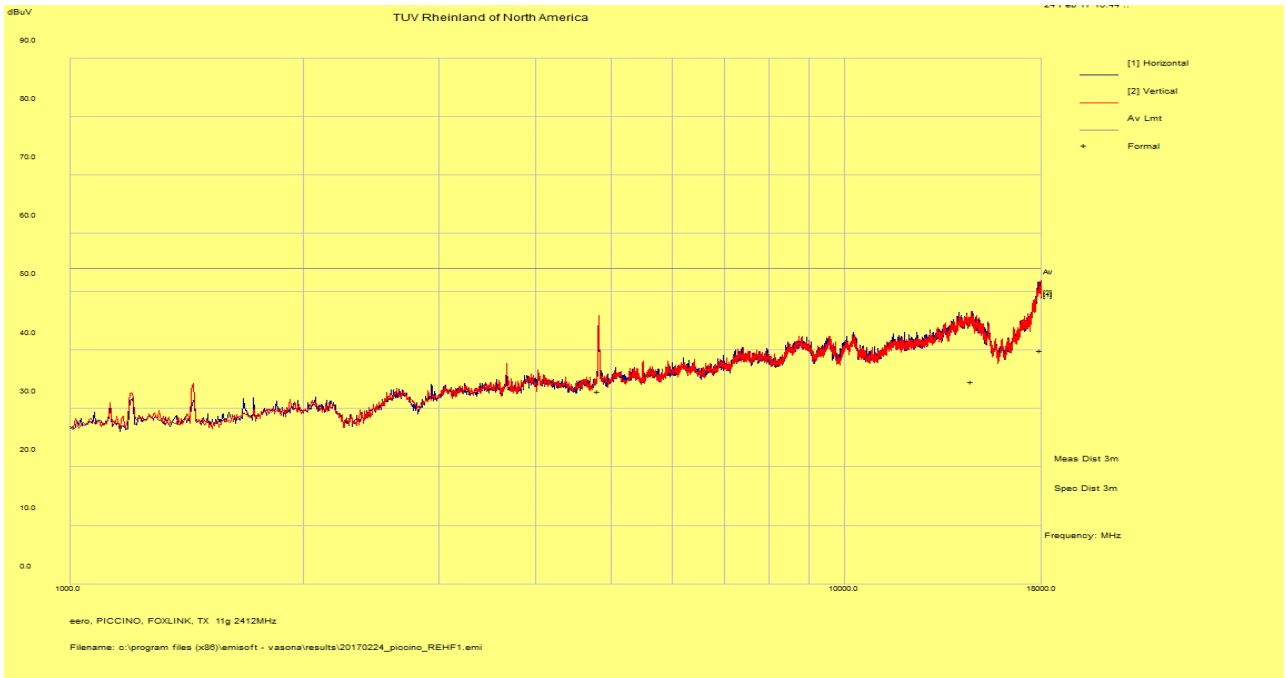
Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: 1. Worst case was observed on Mid channel of 802.11g 6Mbps mode for 20MHz channel BW.
2. Modes tested are 802.11g and HT20 (low, mid & high channel).
3. No significant emission was observed below 30MHz.
4. To reduce complexity and bulkiness of the report Worst case Plots is placed in the report.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 3 of 23	
EUT Name	Wi-Fi Router	**Date**	Feb 24, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	21° C / 40%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11g at 6Mbps / chain 0 & 1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

1 – 18 GHz Transmit at 2412 MHz (Low Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
17946.08	39.37	3.75	-3.13	40.00	Ave	V	159	260	54.00	-14.00
14607.25	40.07	3.31	-8.81	34.57	Ave	V	236	88	54.00	-19.43
4819.72	51.36	1.75	-20.12	32.99	Ave	H	203	266	54.00	-21.01



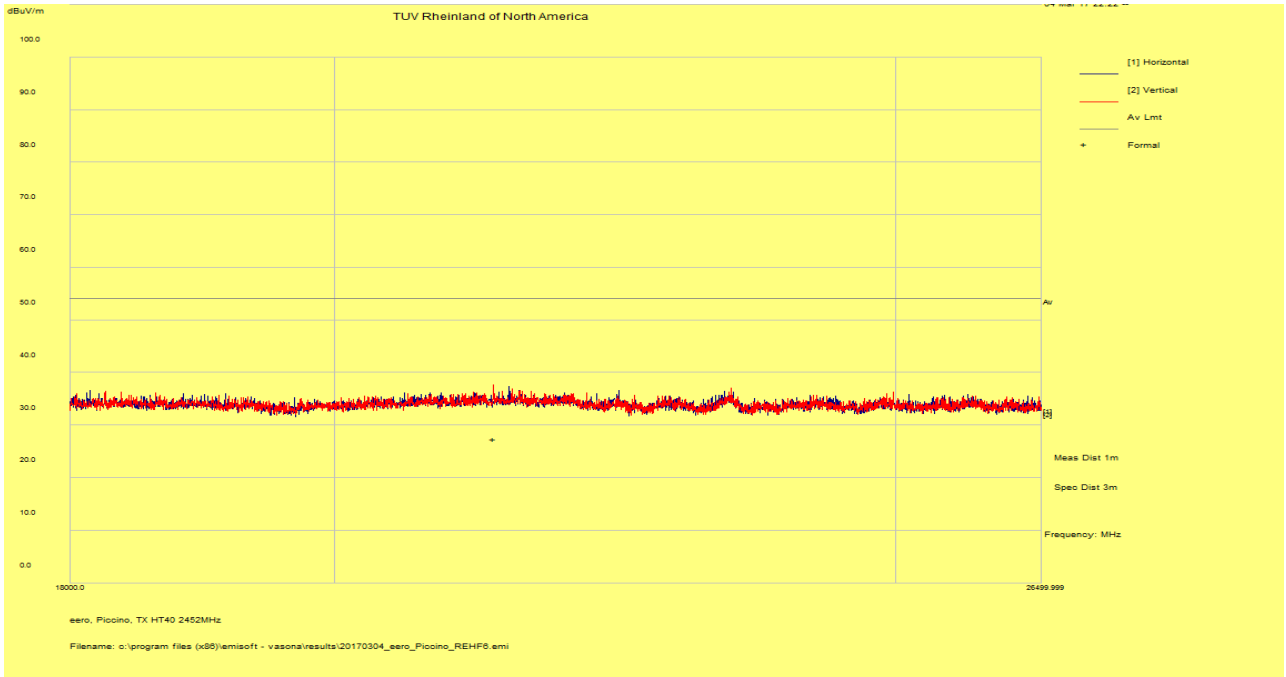
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on 802.11g 6Mbps for 20 MHz channel BW.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 4 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 4, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 41%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11g at 6Mbps / chain 0 & 1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

18 – 26.5 GHz Transmit at 2412 MHz (Low Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
21308.20	29.34	7.54	-9.44	27.44	Ave	V	130	122	54.00	-26.56



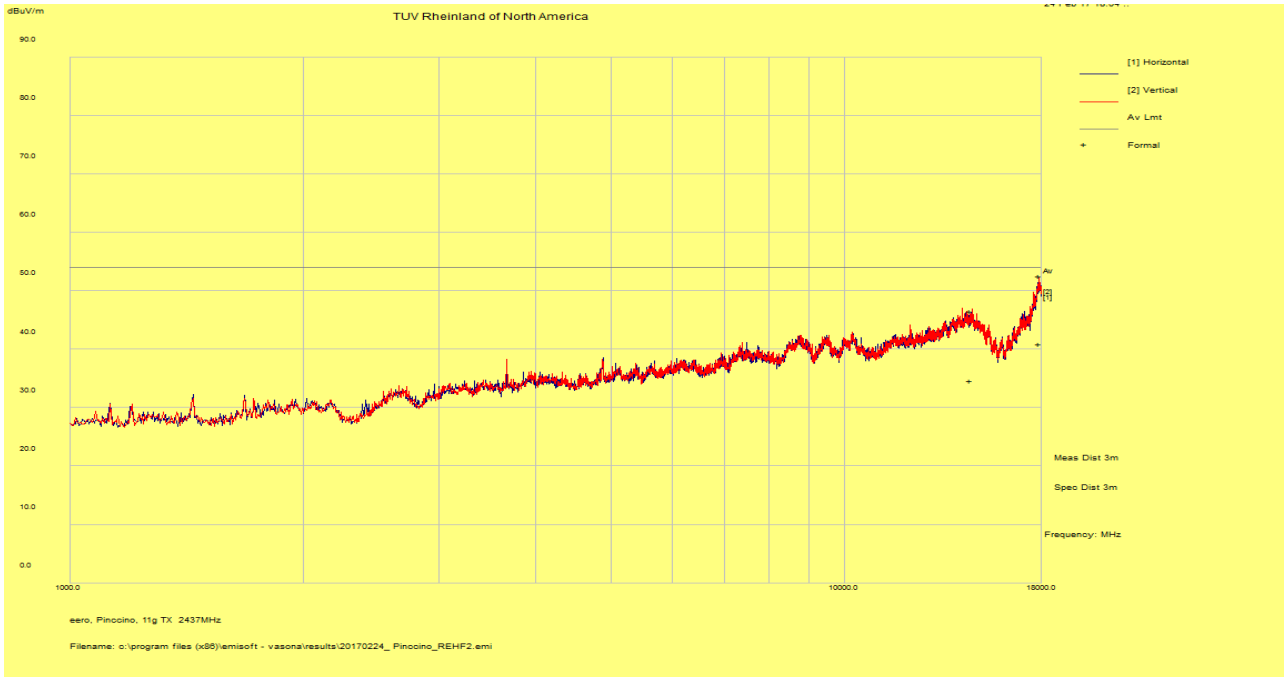
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on 802.11g 6Mbps for 20 MHz channel BW.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 5 of 23	
EUT Name	Wi-Fi Router	**Date**	Feb 24, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	21° C / 40%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11g at 6Mbps / chain 0 & 1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

1 – 18 GHz Transmit at 2437 MHz (Mid Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
17888.20	40.66	3.72	-3.43	40.94	Ave	V	401	254	54.00	-13.06
14553.33	40.13	3.23	-8.67	34.69	Ave	V	401	142	54.00	-19.31



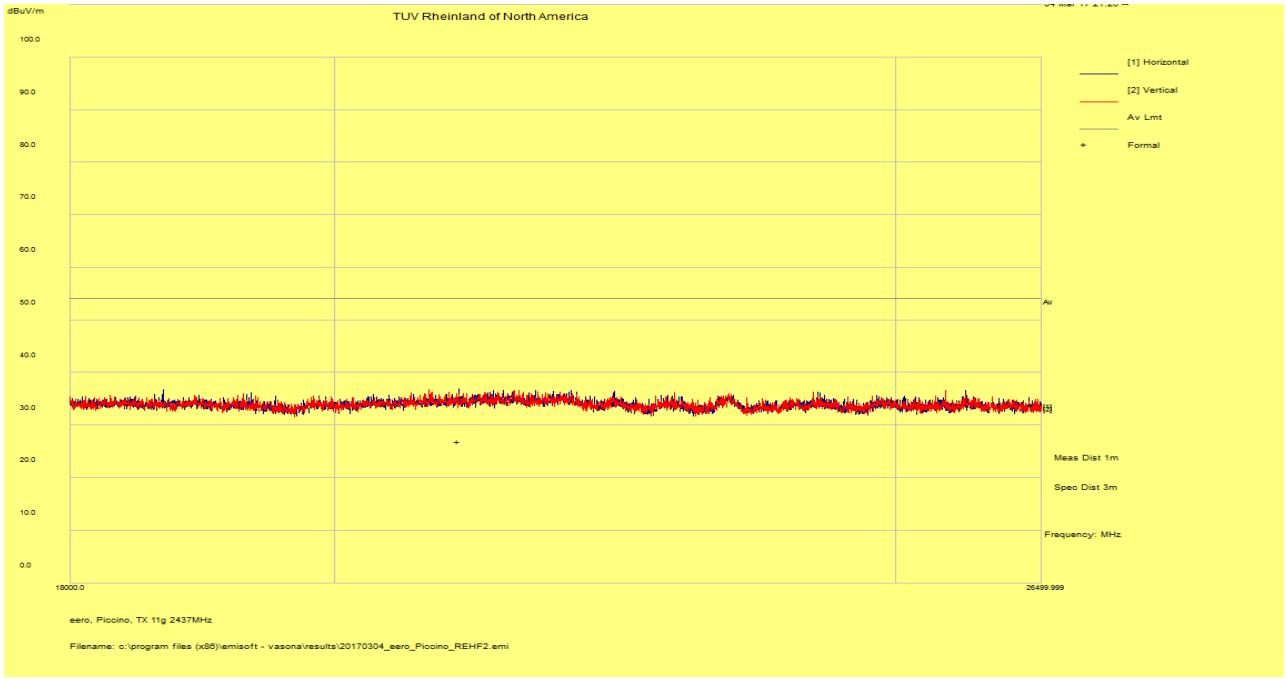
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on 802.11g 6Mbps for 20 MHz channel BW.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 6 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 4, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 41%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11g at 6Mbps / chain 0 & 1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

18 – 26.5 GHz Transmit at 2437 MHz (Mid Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
21006.56	28.7	7.5	-9.23	26.97	Ave	H	115	32	54.00	-27.03



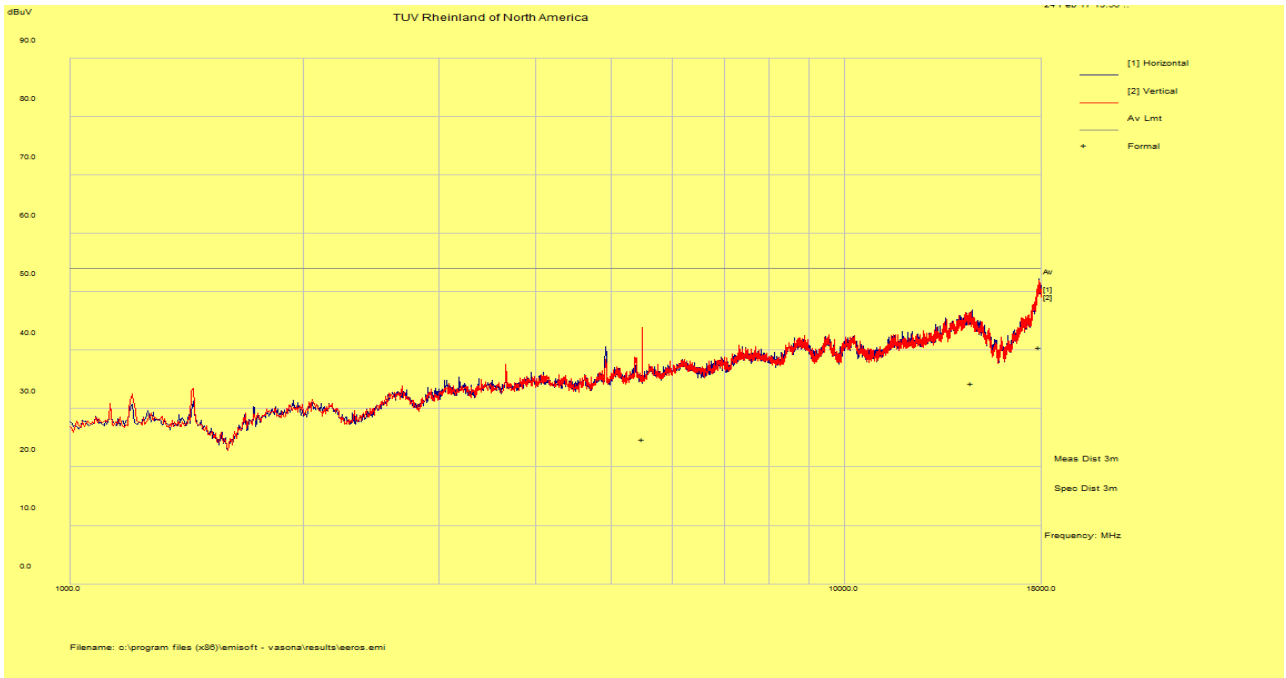
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on 802.11g 6Mbps for 20 MHz channel BW.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 7 of 23	
EUT Name	Wi-Fi Router	**Date**	Feb 24, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	21° C / 40%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11g at 6Mbps / chain 0 & 1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

1 – 18 GHz Transmit at 2462 MHz (High Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
17883.13	40.30	3.71	-3.46	40.55	Ave	H	244	170	54.00	-13.45
14633.26	40.00	3.29	-8.90	34.40	Ave	H	209	208	54.00	-19.60
5490.71	41.94	1.88	-19.06	24.76	Ave	V	232	322	54.00	-29.24



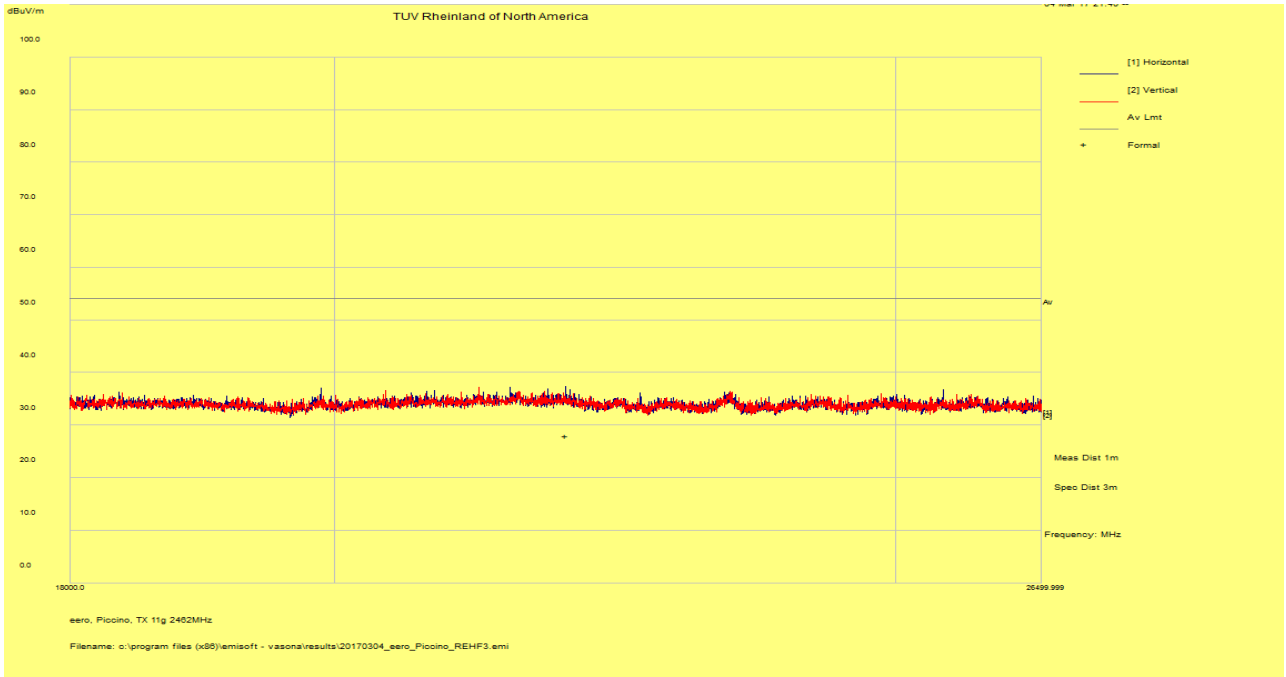
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on 802.11g 6Mbps for 20 MHz channel BW.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 8 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 4, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 41%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11g at 6Mbps / chain 0 & 1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

18 – 26.5 GHz Transmit at 2462 MHz (High Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
21927.09	30.47	7.62	-10.09	28.00	Ave	H	109	304	54.00	-26.00



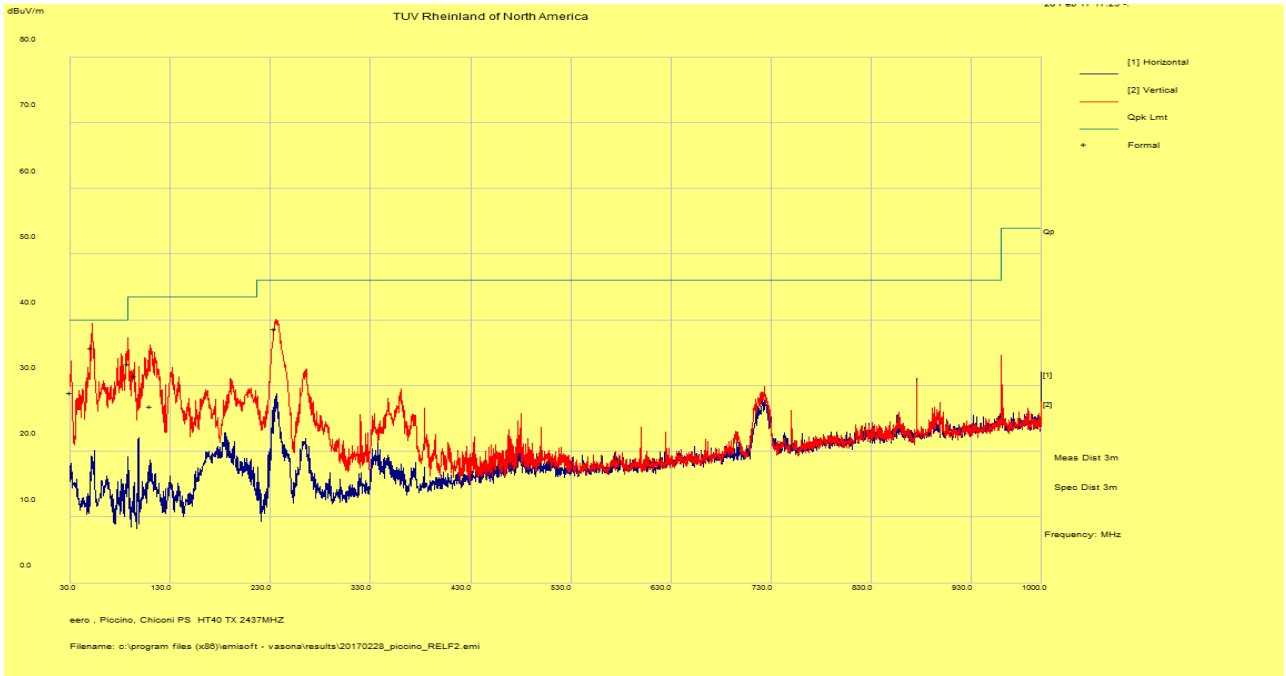
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on 802.11g 6Mbps for 20 MHz channel BW.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 9 of 23	
EUT Name	Wi-Fi Router	**Date**	Feb 28, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	21° C / 38%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11n HT40 (chain 0 & 1) / Chicony PSU	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Richard Decker

30 MHz – 1 GHz Transmit at 2437 MHz

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
51.78	58.19	1.71	-24.08	35.82	QP	V	109	284	40.00	-4.18
87.60	56.11	1.92	-24.73	33.29	QP	V	108	316	40.00	-6.71
235.01	56.28	2.49	-20.03	38.74	QP	V	208	361	46.00	-7.26
30.68	39.06	1.57	-11.67	28.96	QP	V	151	284	40.00	-11.04
109.88	44.23	2.02	-19.34	26.91	QP	V	169	222	43.50	-16.59
94.37	53.17	1.95	-23.62	31.50	QP	V	133	300	43.50	-12.00



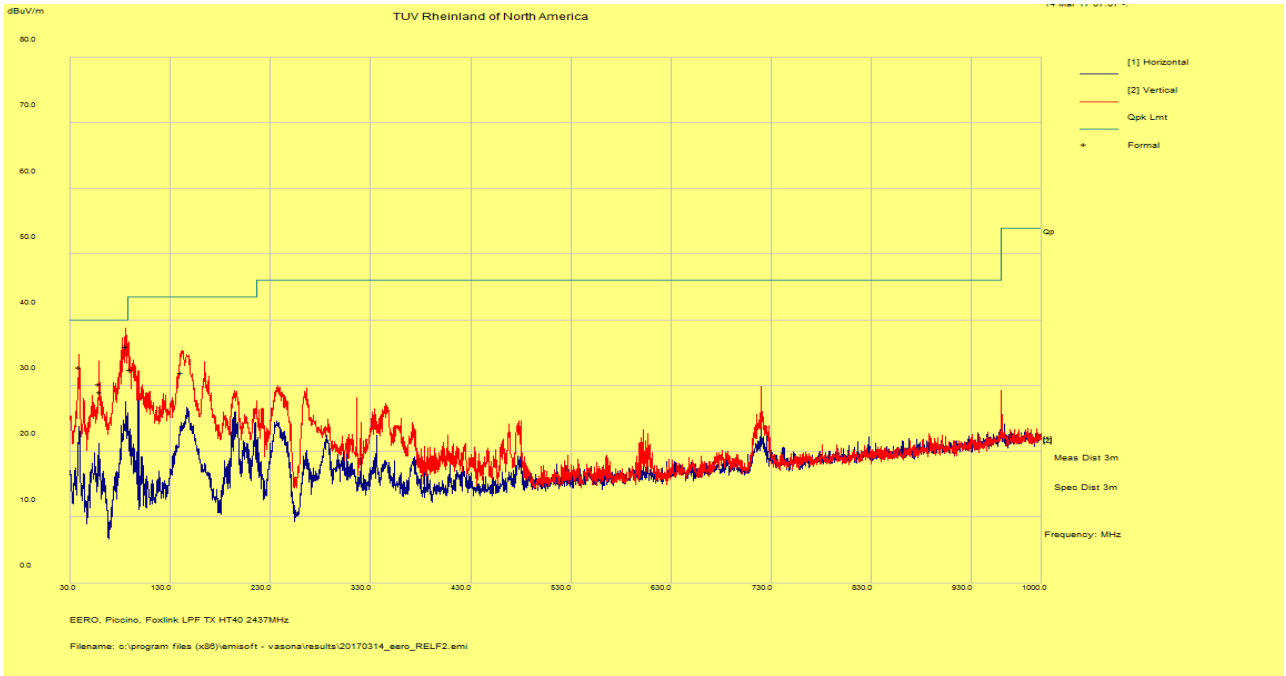
Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: 1. Worst case was observed on Mid channel of 802.11n HT40 MCS0 mode.
2. No significant emission was observed below 30MHz.
3. To reduce complexity and bulkiness of the report Worst case Plots is placed in the report.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 10 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 10, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 43%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11n HT40 (chain 0 & 1) / FoxLink PSU	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Richard Decker

30 MHz – 1 GHz Transmit at 2437 MHz

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
85.52	60.50	0.93	-25.36	36.07	QP	V	120	132	40.00	-3.93
58.72	54.74	0.78	-25.20	30.32	QP	V	133	193	40.00	-9.68
141.45	50.51	1.17	-19.69	31.99	QP	V	105	274	43.50	-11.51
90.38	56.66	0.96	-25.12	32.50	QP	V	109	342	43.50	-11.00
60.22	53.44	0.79	-25.15	29.08	QP	V	102	347	40.00	-10.92
38.97	49.92	0.66	-17.76	32.83	QP	V	125	356	40.00	-7.17



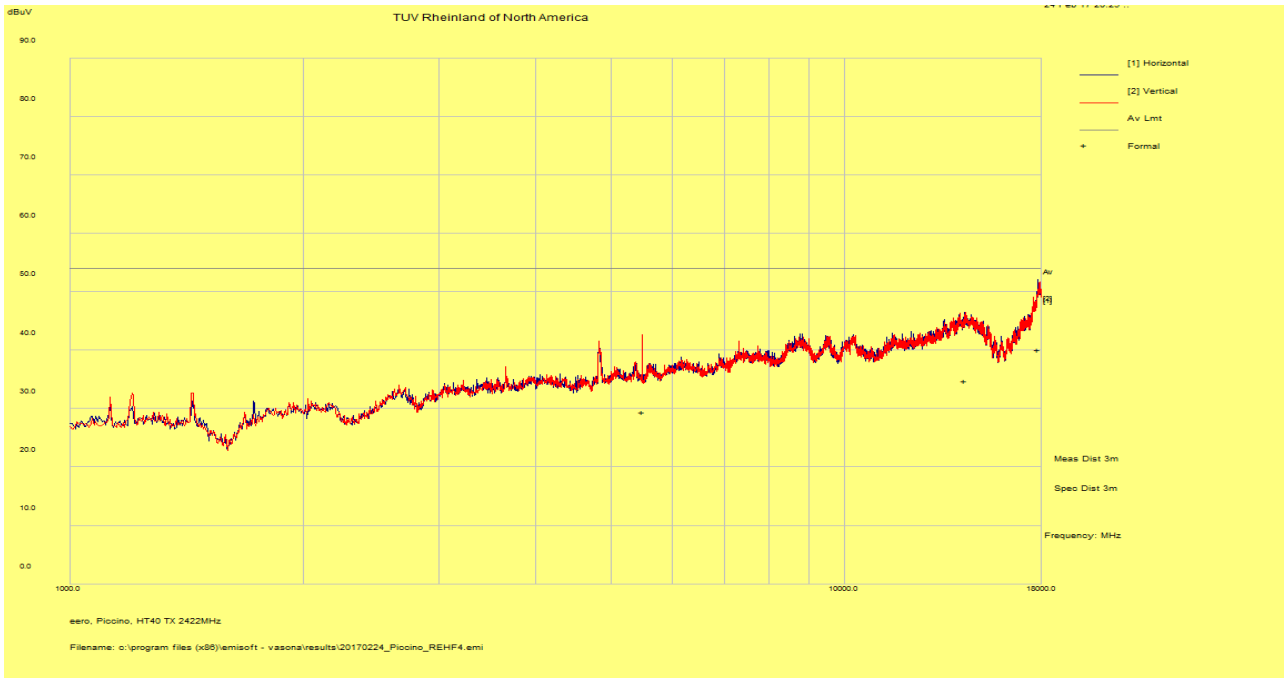
Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: 1. Worst case was observed on Mid channel of 802.11n HT40 mode.
2. No significant emission was observed below 30MHz.
3. To reduce complexity and bulkiness of the report Worst case Plots is placed in the report.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 11 of 23	
EUT Name	Wi-Fi Router	**Date**	Feb 24, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	21° C / 40%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11n at HT40 MCS0 / chain 0 & 1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

1 – 18 GHz Transmit at 2422 MHz (Low Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
17799.33	40.42	3.64	-3.93	40.14	Ave	H	241	118	54.00	-13.86
14327.60	39.81	3.20	-8.27	34.74	Ave	H	153	361	54.00	-19.26
5485.73	46.64	1.87	-19.06	29.46	Ave	V	162	234	54.00	-24.55



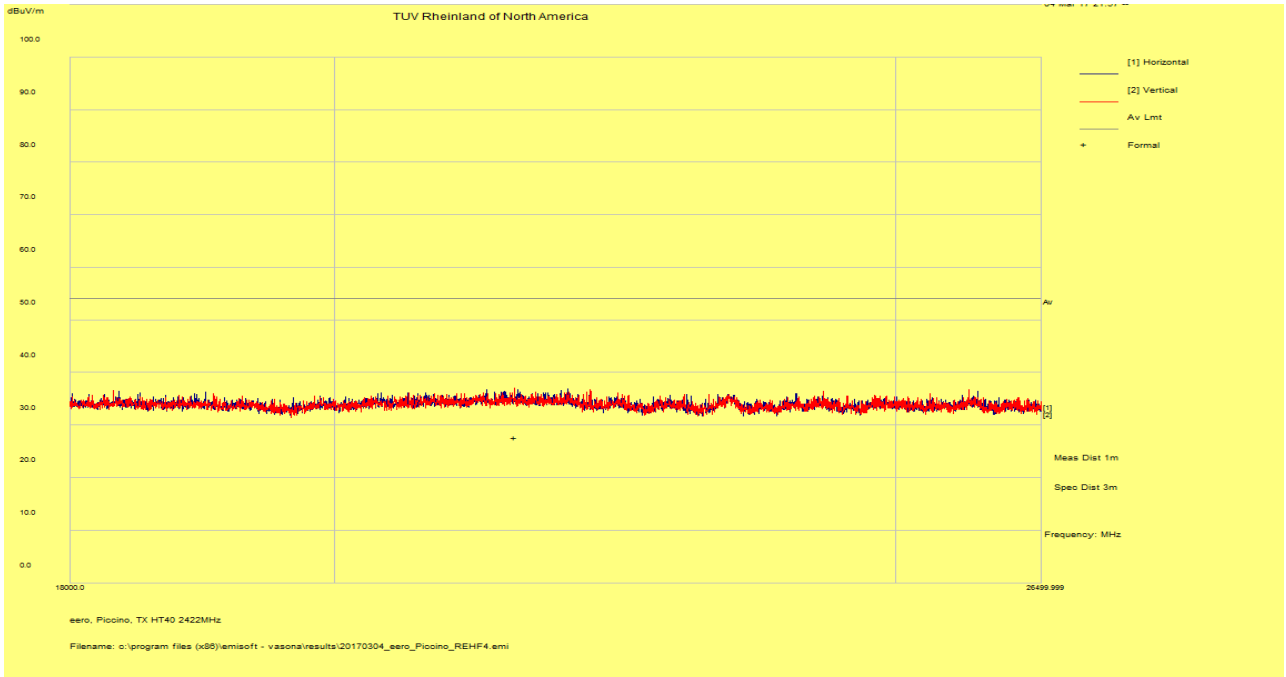
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on HT40 MCS0.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 12 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 4, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 41%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11n at HT40 MCS0 / chain 0 & 1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

18 – 26.5 GHz Transmit at 2422 MHz (Low Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
21483.79	29.65	7.59	-9.55	27.69	Ave	V	125	136	54.00	-26.31



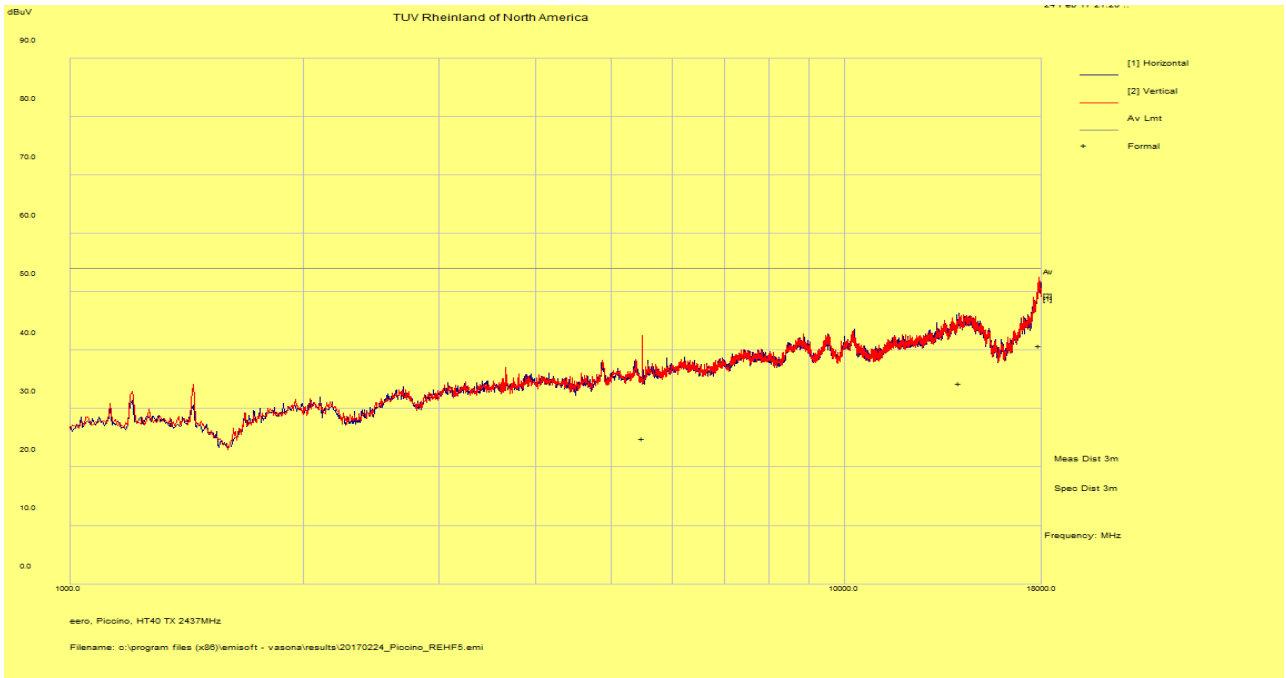
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on HT40 MCS0.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 13 of 23	
EUT Name	Wi-Fi Router	**Date**	Feb 24, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	21° C / 40%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11n at HT40 MCS0 / chain 0 & 1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

1 – 18 GHz Transmit at 2437 MHz (Mid Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
17871.10	40.60	3.71	-3.53	40.78	Ave	V	237	350	54.00	-13.22
14079.27	39.79	3.22	-8.60	34.41	Ave	H	179	64	54.00	-19.59
5488.25	42.08	1.88	-19.06	24.89	Ave	V	177	312	54.00	-29.11



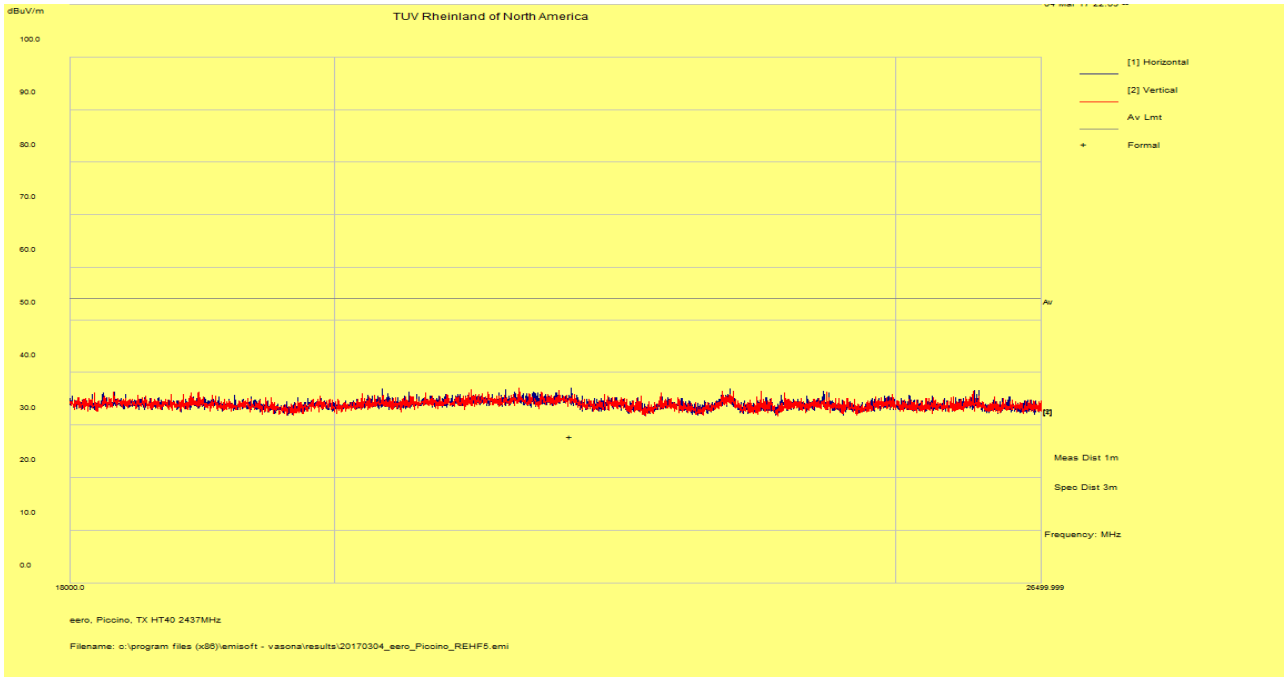
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on HT40 MCS0.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 14 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 4, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 41%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11n at HT40 MCS0 / chain 0 & 1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

18 – 26.5 GHz Transmit at 2437 MHz (Mid Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
21970.91	30.41	7.63	-10.14	27.90	Ave	V	105	250	54.00	-26.10



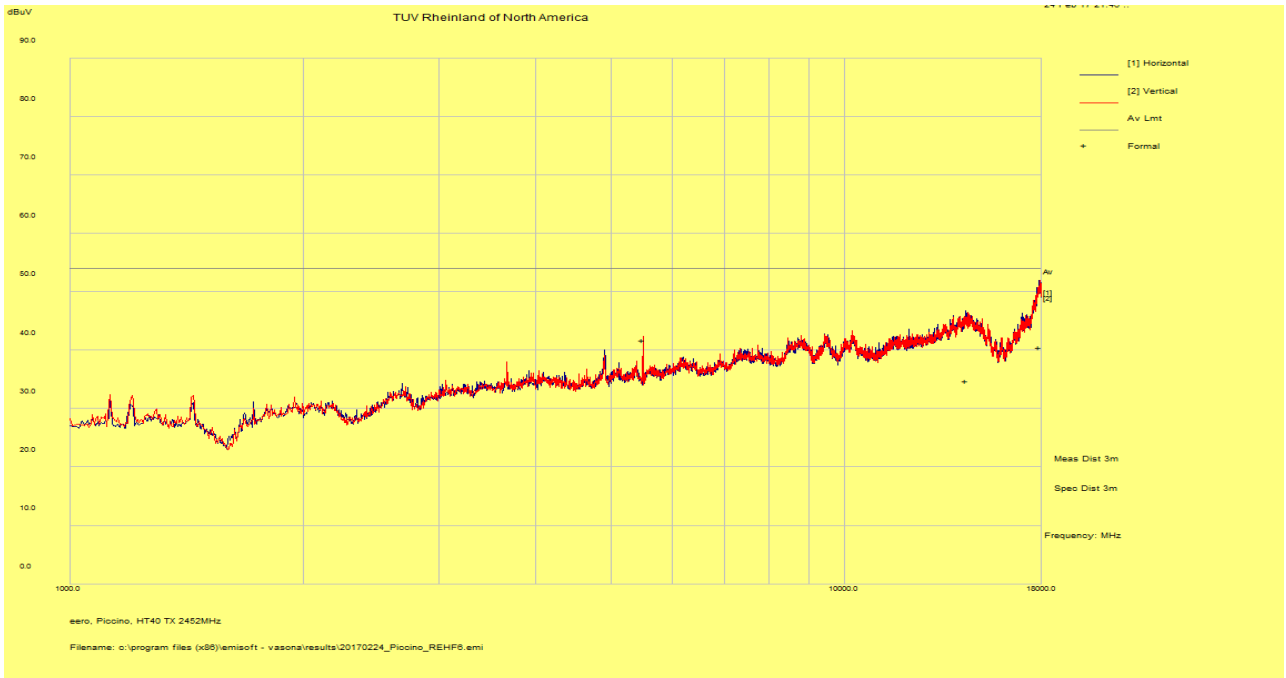
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on HT40 MCS0.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 15 of 23	
EUT Name	Wi-Fi Router	**Date**	Feb 24, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	21° C / 40%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11n at HT40 MCS0 / chain 0 & 1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

1 – 18 GHz Transmit at 2452 MHz (Hi Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
17876.81	40.34	3.71	-3.50	40.55	Ave	H	241	156	54.00	-13.45
14378.00	39.91	3.20	-8.38	34.73	Ave	H	167	38	54.00	-19.27
5500.14	58.96	1.88	-19.06	41.78	Ave	V	126	232	54.00	-12.22



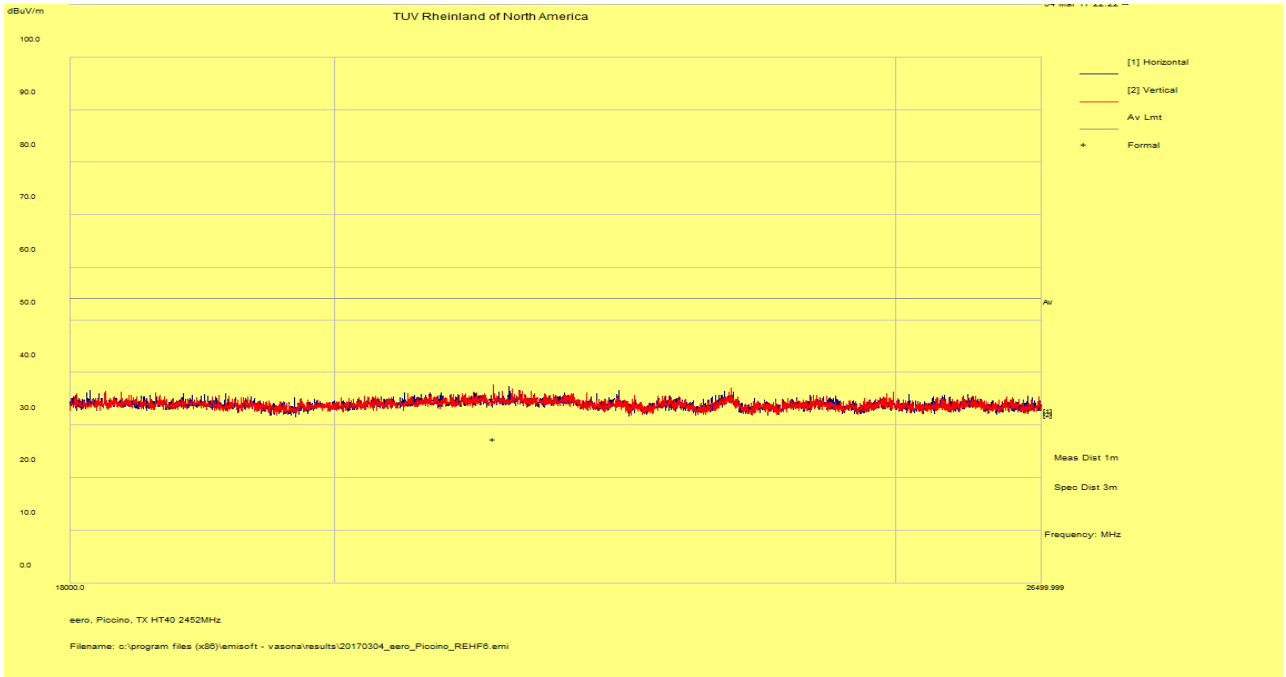
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on HT40 MCS0.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 16 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 4, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 41%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.11n at HT40 MCS0 / chain 0 & 1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

18 – 26.5 GHz Transmit at 2452 MHz (Hi Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
21308.20	29.34	7.54	-9.44	27.44	Ave	V	130	122	54.00	-26.56



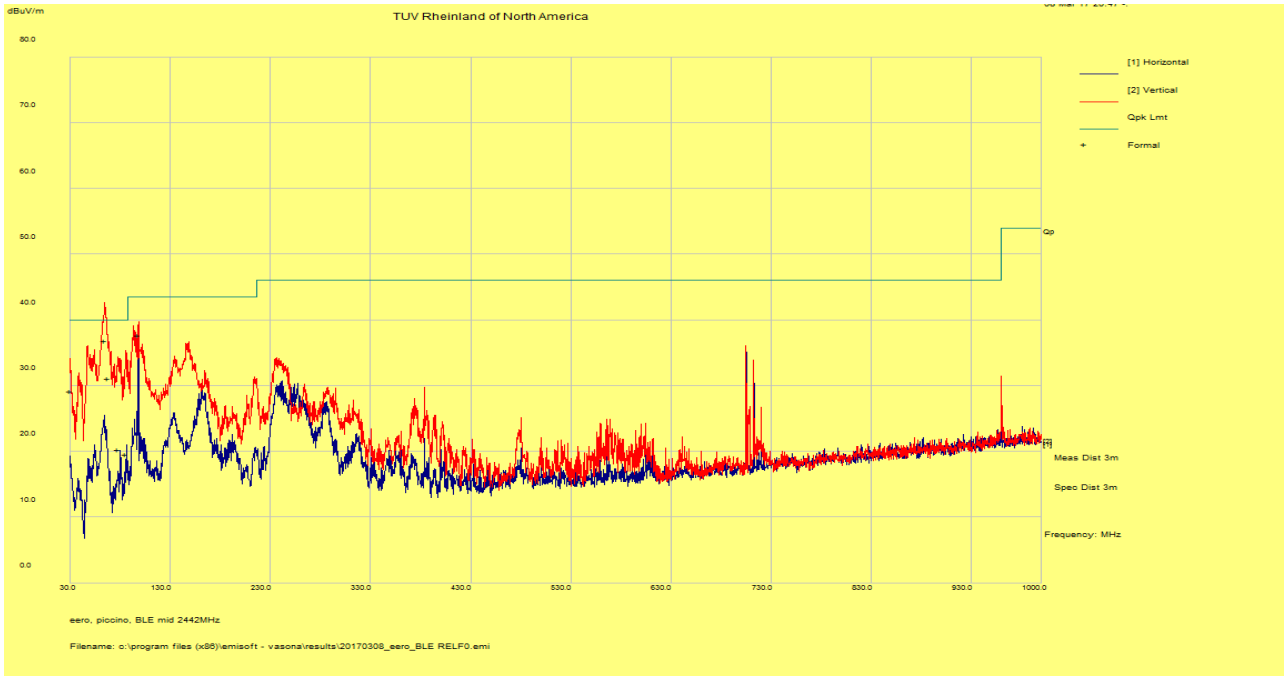
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on HT40 MCS0.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 17 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 8, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 40%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.15.1 BLE / Chicony PSU	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Richard Decker

30 MHz – 1 GHz Transmit at 2442 MHz

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
30.00	40.44	0.58	-11.88	29.14	QP	V	148	124	40.00	-10.86
68.57	54.93	0.84	-24.61	31.16	QP	V	128	170	40.00	-8.84
77.58	44.13	0.89	-24.73	20.29	QP	V	183	206	40.00	-19.71
98.08	59.87	0.99	-23.13	37.73	QP	V	150	214	43.50	-5.77
65.08	60.90	0.82	-24.86	36.86	QP	V	108	214	40.00	-3.14
85.40	44.02	0.93	-25.36	19.59	QP	V	114	232	40.00	-20.42



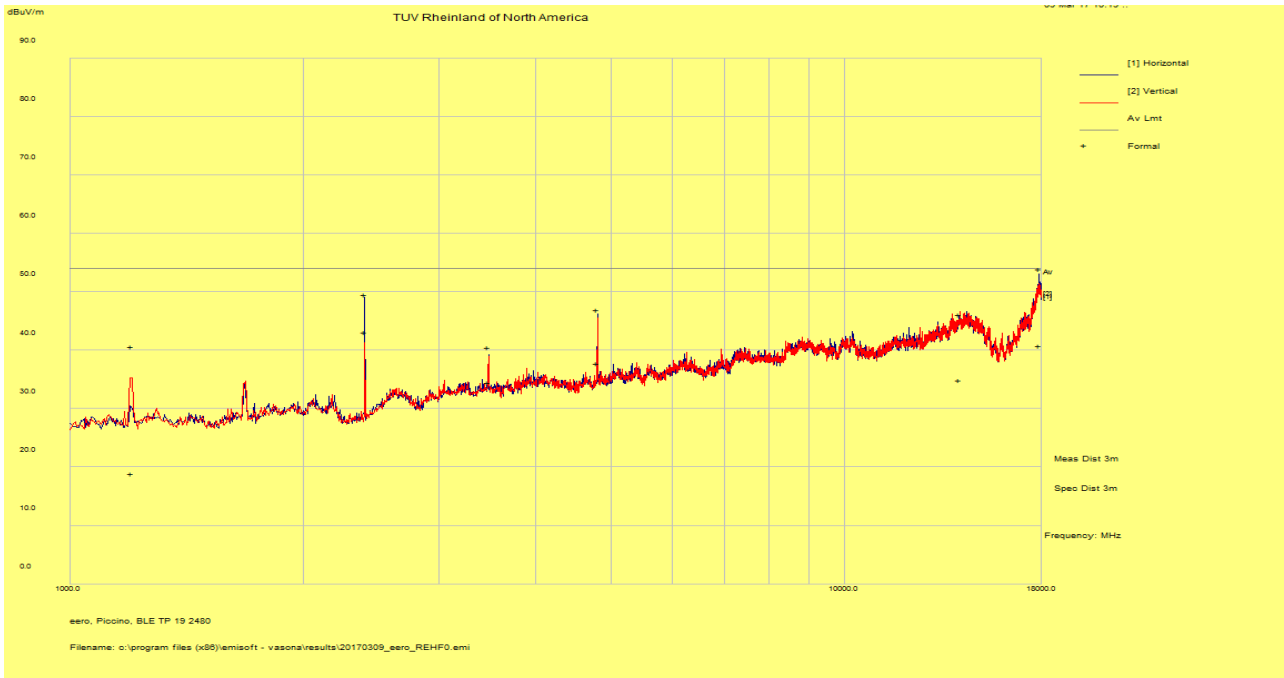
Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: 1. Worst case was observed on Mid channel of Bluetooth LE mode.
2. No significant emission was observed below 30MHz.
3. To reduce complexity and bulkiness of the report Worst case Plots is placed in the report.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 18 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 9, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 42%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.15.1 BLE	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

1 – 18 GHz Transmit at 2402 MHz (Low Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
2402.20	66.62	1.22	-24.74	43.10	Ave	H	103	0	54.00	-10.90
17865.55	40.67	3.71	-3.56	40.82	Ave	H	150	361	54.00	-13.18
4804.06	56.20	1.75	-20.11	37.84	Ave	H	119	276	54.00	-16.16
14098.99	40.15	3.21	-8.52	34.84	Ave	H	239	126	54.00	-19.16
3473.65	54.76	1.46	-21.78	34.44	Ave	H	109	286	54.00	-19.56



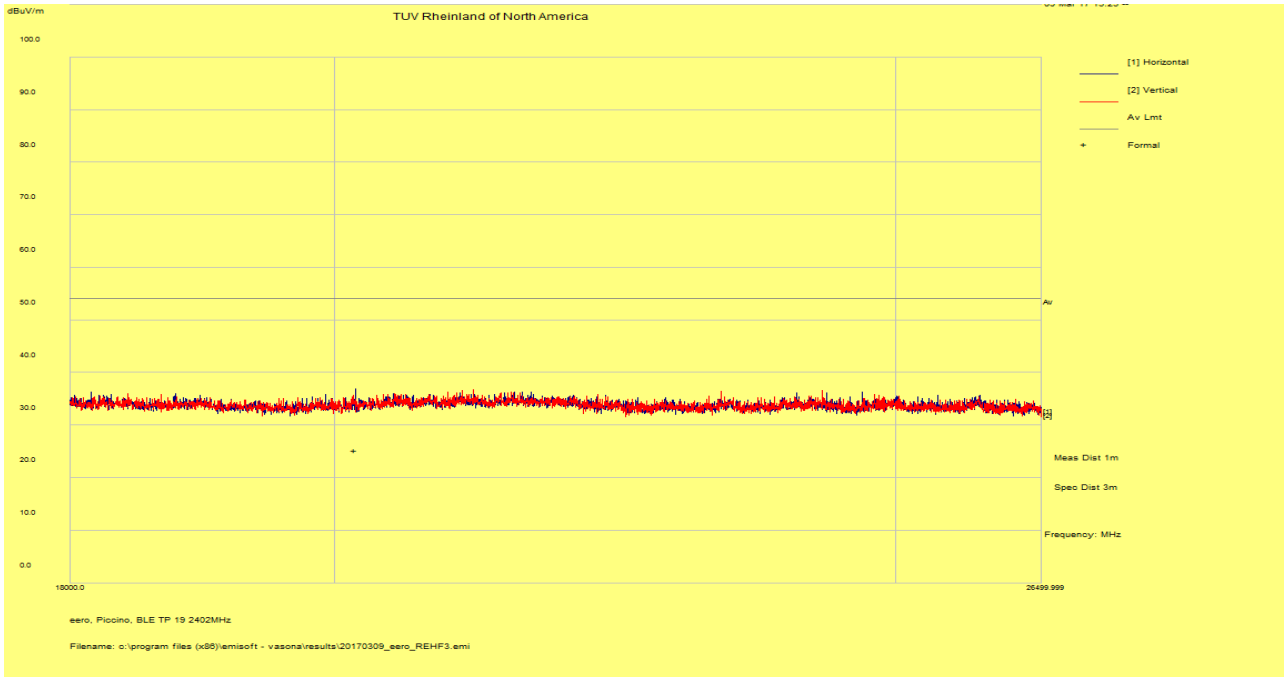
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on BLE.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 19 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 9, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 42%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.15.1 BLE	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

18 – 26.5 GHz Transmit at 2402 MHz (Low Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
20165.39	27.08	7.28	-9.10	25.26	Ave	V	118	128	54.00	-28.74



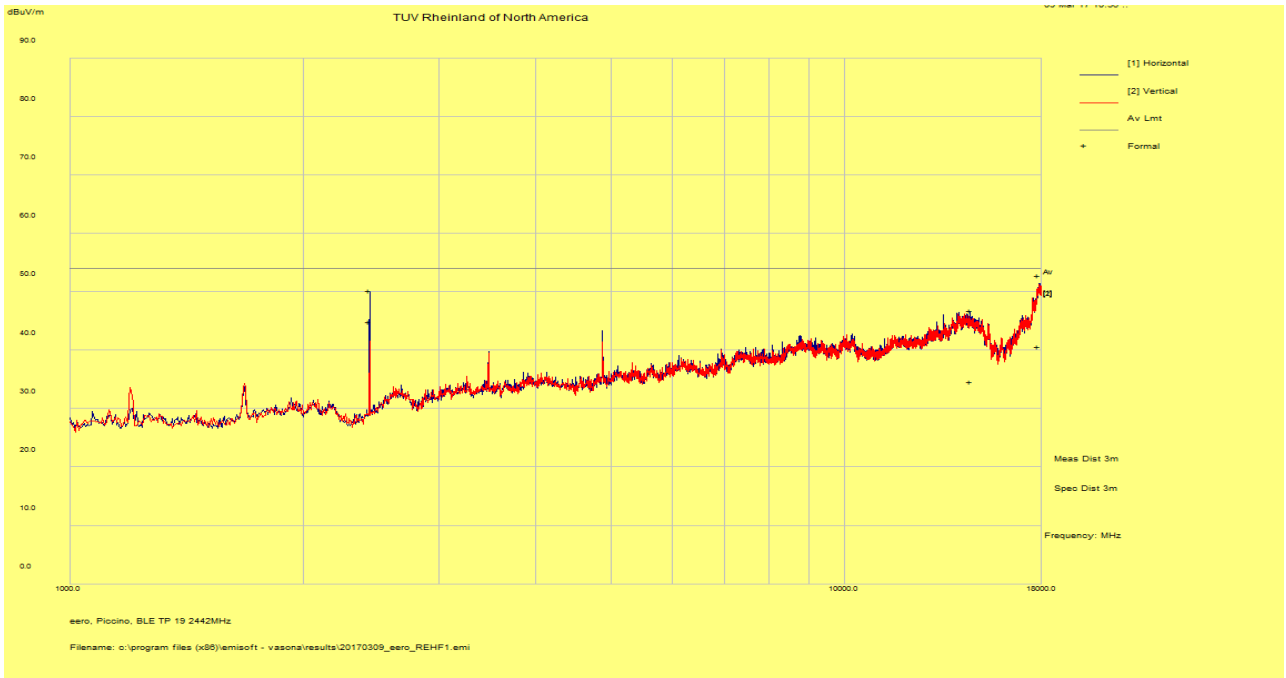
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on BLE.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 20 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 9, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 42%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.15.1 BLE	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

1 – 18 GHz Transmit at 2442 MHz (Mid Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
17844.66	40.62	3.71	-3.68	40.66	Ave	H	219	36	54.00	-13.35
2437.91	68.39	1.22	-24.74	44.87	Ave	H	101	2	54.00	-9.14
14556.00	40.12	3.25	-8.67	34.70	Ave	H	148	146	54.00	-19.30



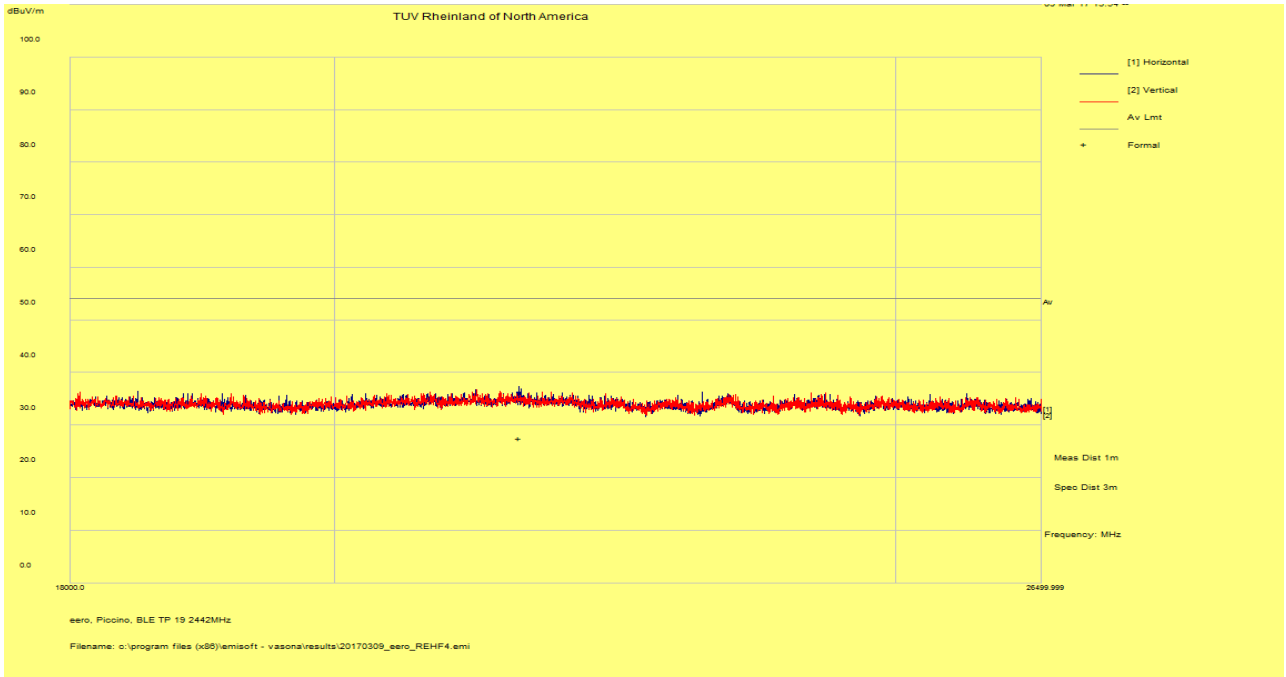
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on BLE.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 21 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 9, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 42%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.15.1 BLE	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

18 – 26.5 GHz Transmit at 2442 MHz (Mid Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
21524.95	29.46	7.60	-9.59	27.47	Ave	H	100	348	54.00	-26.53



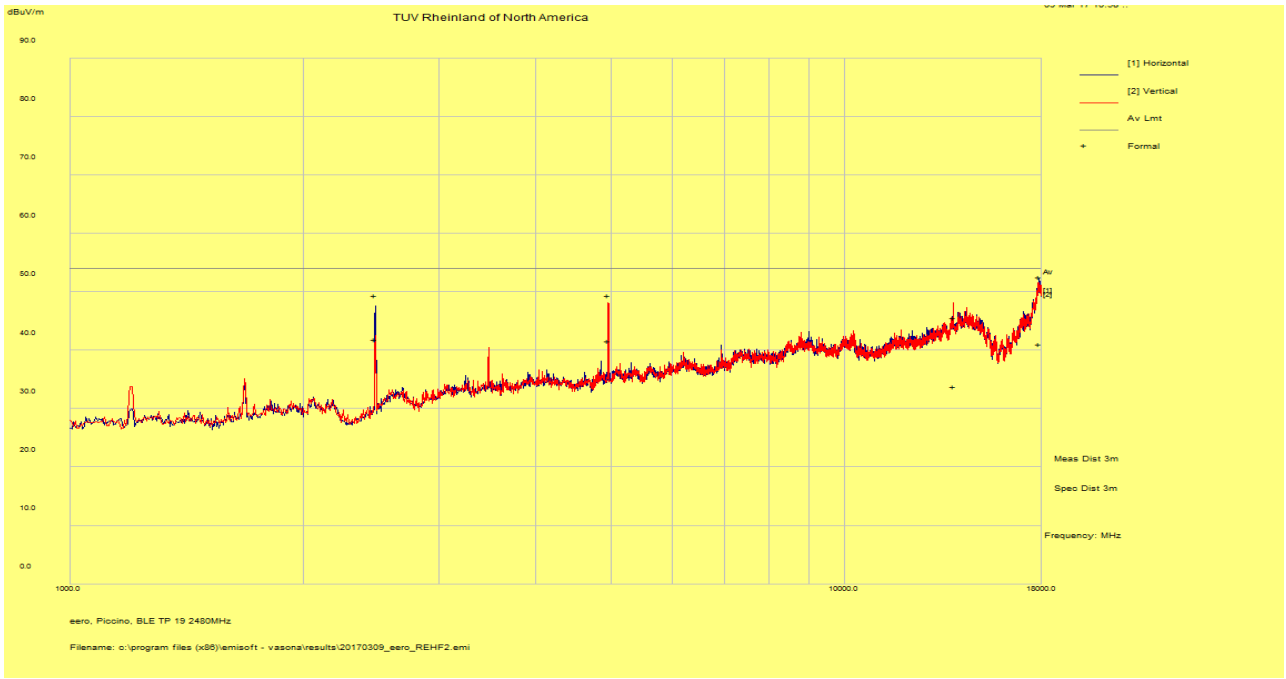
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on BLE.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 22 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 9, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 42%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.15.1 BLE	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

1 – 18 GHz Transmit at 2480 MHz (Hi Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
17861.20	40.90	3.72	-3.59	41.03	Ave	H	104	28	54.00	-12.97
4959.76	59.98	1.79	-20.16	41.61	Ave	V	248	2	54.00	-12.40
13857.34	40.10	3.17	-9.44	33.83	Ave	V	100	334	54.00	-20.17
2480.28	65.25	1.23	-24.60	41.88	Ave	H	149	2	54.00	-12.12



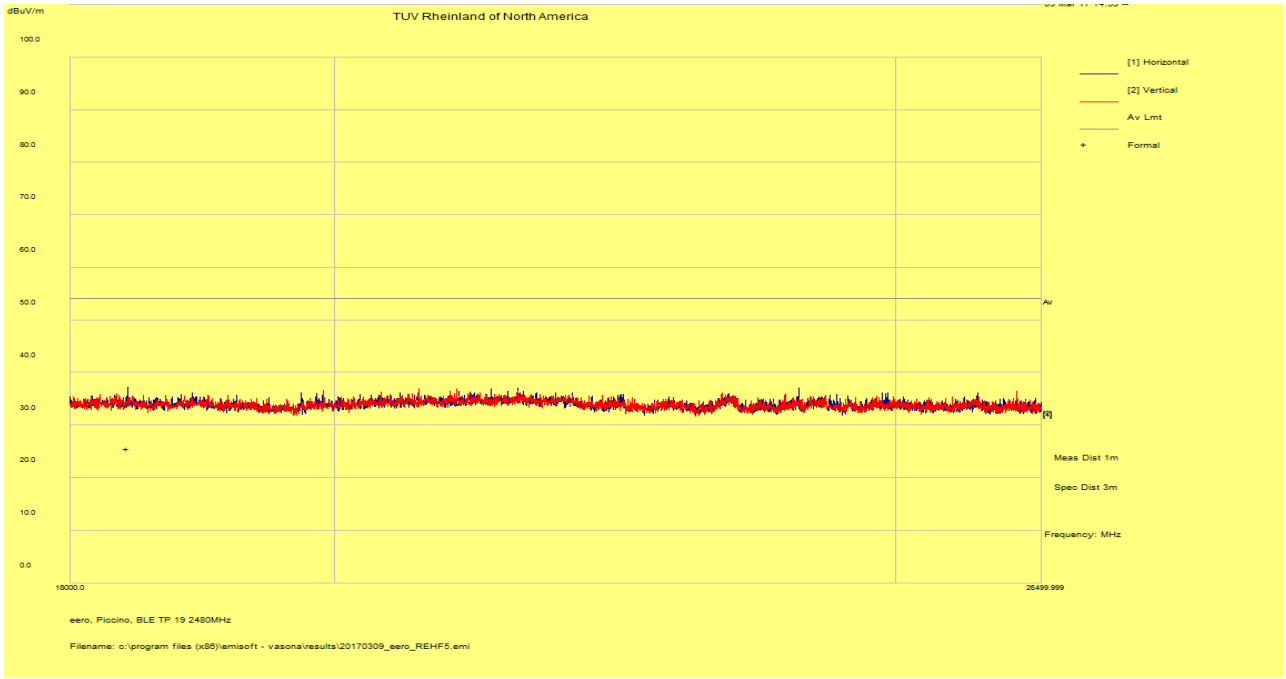
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on BLE.

SOP 1 Radiated Emissions		Tracking # 31760707.001 Page 23 of 23	
EUT Name	Wi-Fi Router	**Date**	Mar 9, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 42%rh
EUT Serial	MF701114110316	**Temp / Hum out**	N/A
EUT Config.	802.15.1 BLE	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Richard Decker

18 – 26.5 GHz Transmit at 2480 MHz (Hi Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
18417.16	26.45	7.01	-7.94	25.52	Ave	V	118	268	54.00	-28.48



Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on BLE.

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 and RSS-GEN. Sect. 8.8.

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.

Preliminary test were performed: 802.11g, 802.11n, BLE and Thread (Zigbee).

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 14: AC Conducted Emissions – Test Results

Test Conditions: Conducted Measurement at Normal Conditions only		
Antenna Type: FPCB	**Power Level:** See Test Plan	
AC Power: 120 Vac/60 Hz	**Configuration:** Tabletop	
Ambient Temperature: 22° C	**Relative Humidity:** 44% RH	
Configuration	**Frequency Range**	**Test Result**
Line 1 (Hot)	0.15 to 30 MHz	Pass
Line 2 (Neutral)	0.15 to 30 MHz	Pass

SOP 2 Conducted Emissions — Tracking # 31760707.001 Page 1 of 8

EUT Name	Wi-Fi Router	**Date**	Mar 16, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 44% rh
EUT Serial	F719-0354-25CT-KJ8T	**Temp / Hum out**	N/A
EUT Config.	TX mode (chain 0 & 1) / Chicony PSU	**Line AC / Freq**	120Vac / 60Hz
Standard	CFR47 Part 15.207 and RSS Gen	**RBW / VBW**	9 kHz / 30 kHz
Lab/LISN	Lab #5 /Com-Power, Line 1	**Performed by**	Kerwinn Corpuz

Frequency	Raw	Limiter	Ins. Loss	Level	Detector	Line	Limit	Margin	Result
MHz	dBuV	dB	dB	dBuV			dBuV	dB	
0.160	49.19	9.98	0.23	59.40	QP	Live	65.44	-6.05	Pass
0.160	22.00	9.98	0.23	32.21	Avg	Live	55.44	-23.24	Pass
0.186	45.47	9.98	0.20	55.65	QP	Live	64.22	-8.57	Pass
0.186	21.84	9.98	0.20	32.02	Avg	Live	54.22	-22.20	Pass
0.246	40.54	9.99	0.15	50.68	QP	Live	61.88	-11.20	Pass
0.246	18.55	9.99	0.15	28.69	Avg	Live	51.88	-23.19	Pass
0.306	38.86	9.99	0.13	48.98	QP	Live	60.07	-11.09	Pass
0.306	15.70	9.99	0.13	25.82	Avg	Live	50.07	-24.25	Pass
0.358	33.98	10.00	0.12	44.10	QP	Live	58.77	-14.66	Pass
0.358	12.59	10.00	0.12	22.71	Avg	Live	48.77	-26.06	Pass
0.391	31.76	10.01	0.11	41.88	QP	Live	58.05	-16.17	Pass
0.391	11.86	10.01	0.11	21.98	Avg	Live	48.05	-26.07	Pass
0.422	32.69	10.01	0.11	42.81	QP	Live	57.41	-14.60	Pass
0.422	10.61	10.01	0.11	20.73	Avg	Live	47.41	-26.68	Pass
0.482	29.30	10.02	0.10	39.42	QP	Live	56.31	-16.90	Pass
0.482	12.84	10.02	0.10	22.96	Avg	Live	46.31	-23.35	Pass
0.493	29.45	10.02	0.10	39.57	QP	Live	56.12	-16.55	Pass
0.493	13.56	10.02	0.10	23.68	Avg	Live	46.12	-22.44	Pass
0.553	25.31	10.03	0.09	35.42	QP	Live	56.00	-20.58	Pass
0.553	11.73	10.03	0.09	21.85	Avg	Live	46.00	-24.15	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: EUT was setup as table top equipment and transmitted at 2437 MHz in 802.11g at 6Mbps (worse case).

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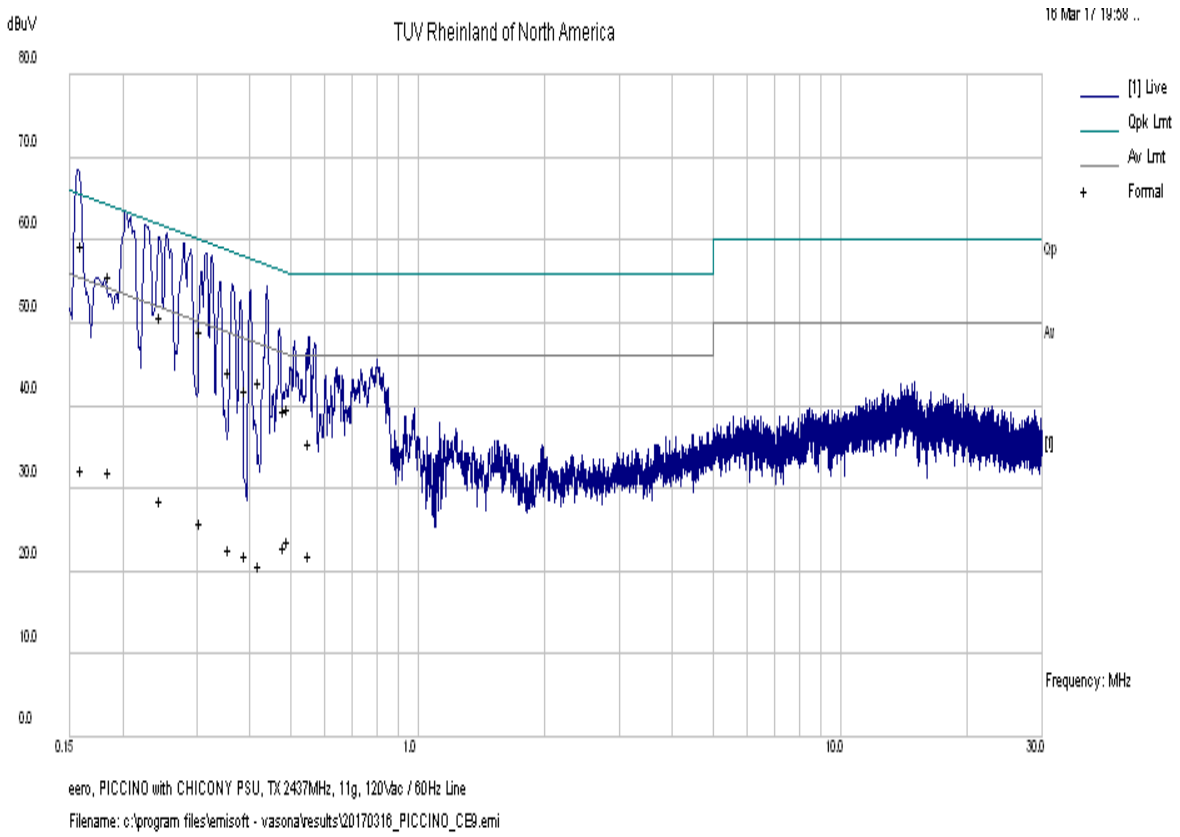
EUT Name	Wi-Fi Router	**Date**	Mar 16, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 44% rh
EUT Serial	F719-0354-25CT-KJ8T	**Temp / Hum out**	N/A
EUT Config.	TX mode (chain 0 & 1) / Chicony PSU	**Line AC**	120Vac / 60Hz
Standard	CFR47 Part 15.207 and RSS Gen	**RBW / VBW**	9 kHz / 30 kHz
Lab/LISN	Lab #5 /Com-Power, Line 1	**Performed by**	Kerwinn Corpuz

150 kHz to 30 MHz Plot for Line 1 (Live)



Note: Met FCC Class B limit.

SOP 2 Conducted Emissions

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EUT Name	Wi-Fi Router	**Date**	Mar 16, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 44% rh
EUT Serial	F719-0354-25CT-KJ8T	**Temp / Hum out**	N/A
EUT Config.	TX mode (chain 0 & 1) / Chicony PSU	**Line AC / Freq**	120Vac / 60Hz
Standard	CFR47 Part 15.207 and RSS Gen	**RBW / VBW**	9 kHz / 30 kHz
Lab/LISN	Lab #5 /Com-Power, Line 2	**Performed by**	Kerwinn Corpuz

Frequency	Raw	Limiter	Ins. Loss	Level	Detector	Line	Limit	Margin	Result
MHz	dBuV	dB	dB	dBuV			dBuV	dB	
0.163	47.12	9.98	0.23	57.33	QP	Neutral	65.30	-7.97	Pass
0.163	21.11	9.98	0.23	31.32	Avg	Neutral	55.30	-23.98	Pass
0.174	46.75	9.97	0.22	56.94	QP	Neutral	64.76	-7.82	Pass
0.174	21.73	9.97	0.22	31.91	Avg	Neutral	54.76	-22.85	Pass
0.193	45.03	9.98	0.20	55.21	QP	Neutral	63.91	-8.70	Pass
0.193	18.82	9.98	0.20	29.00	Avg	Neutral	53.91	-24.91	Pass
0.256	39.95	9.99	0.15	50.08	QP	Neutral	61.57	-11.49	Pass
0.256	17.26	9.99	0.15	27.39	Avg	Neutral	51.57	-24.18	Pass
0.327	34.77	10.00	0.12	44.89	QP	Neutral	59.53	-14.63	Pass
0.327	13.56	10.00	0.12	23.68	Avg	Neutral	49.53	-25.85	Pass
0.386	30.72	10.01	0.11	40.84	QP	Neutral	58.14	-17.30	Pass
0.386	10.95	10.01	0.11	21.07	Avg	Neutral	48.14	-27.07	Pass
0.388	32.14	10.01	0.11	42.26	QP	Neutral	58.10	-15.84	Pass
0.388	11.04	10.01	0.11	21.16	Avg	Neutral	48.10	-26.94	Pass
0.446	26.10	10.01	0.10	36.21	QP	Neutral	56.95	-20.74	Pass
0.446	13.23	10.01	0.10	23.35	Avg	Neutral	46.95	-23.61	Pass
0.532	27.16	10.02	0.09	37.28	QP	Neutral	56.00	-18.72	Pass
0.532	14.46	10.02	0.09	24.58	Avg	Neutral	46.00	-21.42	Pass
0.617	23.33	10.03	0.09	33.45	QP	Neutral	56.00	-22.55	Pass
0.617	14.12	10.03	0.09	24.24	Avg	Neutral	46.00	-21.76	Pass

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

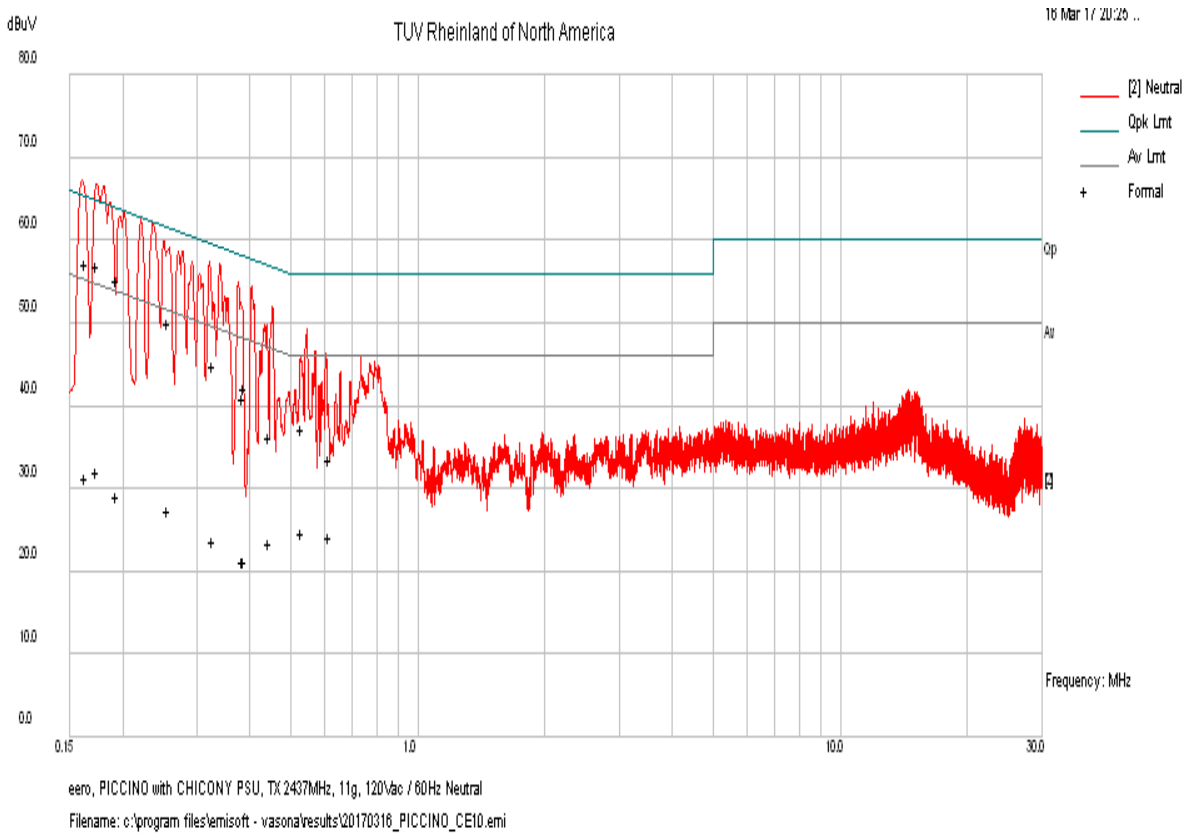
Combined Standard Uncertainty $u_c(y)$ = ± 1.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: EUT was setup as table top equipment and transmitted at 2437 MHz in 802.11g at 6Mbps (worse case).

SOP 2 Conducted Emissions — Tracking # 31760707.001 Page 4 of 8

EUT Name	Wi-Fi Router	**Date**	Mar 16, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 44% rh
EUT Serial	F719-0354-25CT-KJ8T	**Temp / Hum out**	N/A
EUT Config.	TX mode (chain 0 & 1) / Chicony PSU	**Line AC**	120Vac / 60Hz
Standard	CFR47 Part 15.207 and RSS Gen	**RBW / VBW**	9 kHz / 30 kHz
Lab/LISN	Lab #5 /Com-Power, Line 2	**Performed by**	Kerwinn Corpuz

150 kHz to 30 MHz Plot for Line 2 (Neutral)



Note: Met FCC Class B Limit.

SOP 2 Conducted Emissions

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EUT Name	Wi-Fi Router	**Date**	Mar 16, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 44% rh
EUT Serial	XF0113M120094	**Temp / Hum out**	N/A
EUT Config.	TX mode (chain 0 & 1) / FoxLink PSU	**Line AC / Freq**	120Vac / 60Hz
Standard	CFR47 Part 15.207 and RSS Gen	**RBW / VBW**	9 kHz / 30 kHz
Lab/LISN	Lab #5 /Com-Power, Line 1	**Performed by**	Kerwinn Corpuz

Frequency	Raw	Limiter	Ins. Loss	Level	Detector	Line	Limit	Margin	Result
MHz	dBuV	dB	dB	dBuV			dBuV	dB	
0.150	51.40	9.97	0.25	61.62	QP	Live	66.00	-4.38	Pass
0.150	26.39	9.97	0.25	36.61	Avg	Live	56.00	-19.39	Pass
0.193	48.60	9.98	0.20	58.77	QP	Live	63.91	-5.14	Pass
0.193	21.88	9.98	0.20	32.06	Avg	Live	53.91	-21.86	Pass
0.219	47.53	9.98	0.17	57.69	QP	Live	62.86	-5.17	Pass
0.219	20.46	9.98	0.17	30.62	Avg	Live	52.86	-22.24	Pass
0.260	44.31	9.99	0.15	54.44	QP	Live	61.43	-6.99	Pass
0.260	25.28	9.99	0.15	35.42	Avg	Live	51.43	-16.01	Pass
0.303	42.58	9.99	0.13	52.70	QP	Live	60.16	-7.46	Pass
0.303	20.82	9.99	0.13	30.94	Avg	Live	50.16	-19.22	Pass
0.403	38.28	10.01	0.11	48.40	QP	Live	57.78	-9.39	Pass
0.403	16.83	10.01	0.11	26.95	Avg	Live	47.78	-20.84	Pass
0.537	34.45	10.02	0.09	44.57	QP	Live	56.00	-11.43	Pass
0.537	24.25	10.02	0.09	34.36	Avg	Live	46.00	-11.64	Pass
0.652	29.43	10.03	0.08	39.54	QP	Live	56.00	-16.46	Pass
0.652	13.51	10.03	0.08	23.62	Avg	Live	46.00	-22.38	Pass
0.719	27.97	10.03	0.08	38.09	QP	Live	56.00	-17.91	Pass
0.719	12.15	10.03	0.08	22.26	Avg	Live	46.00	-23.74	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: The EUT was set horizontally on the table top and transmitted at 2437 MHz in 802.11g at 6Mbps (worse case).

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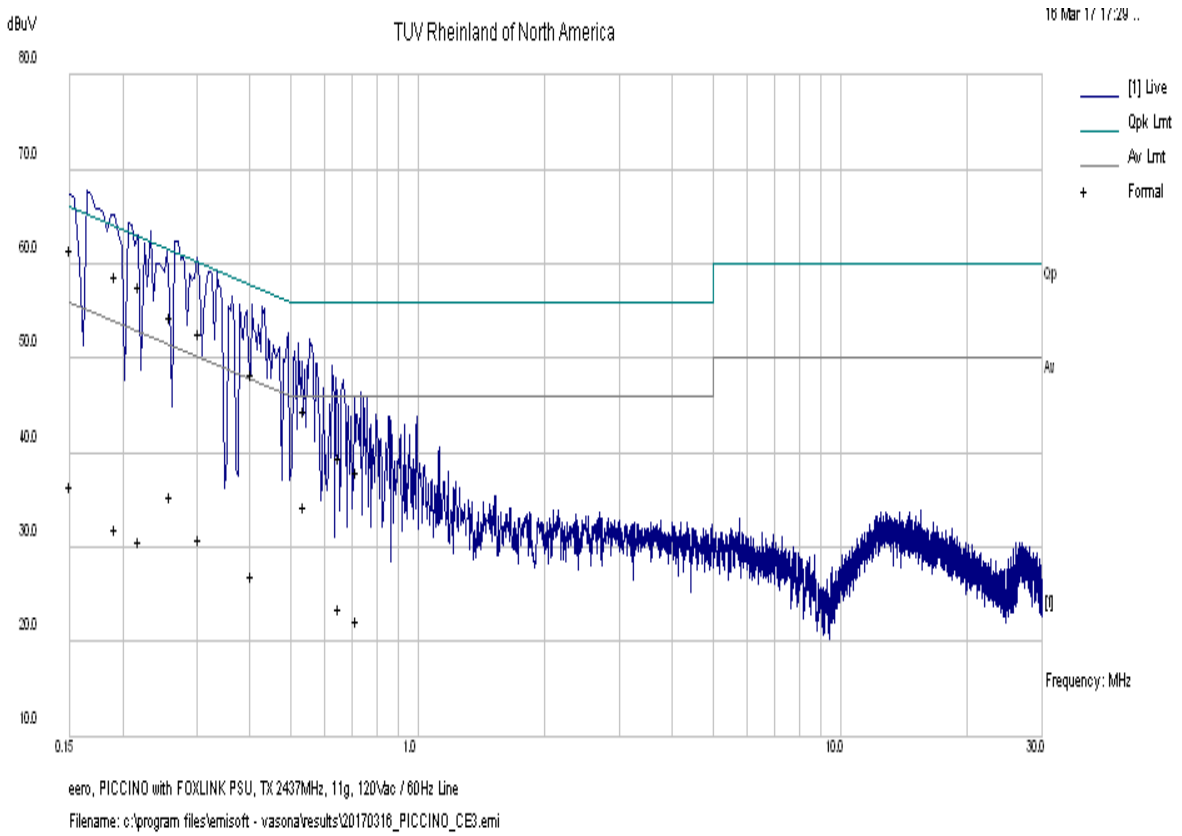
EUT Name	Wi-Fi Router	**Date**	Mar 16, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 44% rh
EUT Serial	XF0113M120094	**Temp / Hum out**	N/A
EUT Config.	TX mode (chain 0 & 1) / FoxLink PSU	**Line AC**	120Vac / 60Hz
Standard	CFR47 Part 15.207 and RSS Gen	**RBW / VBW**	9 kHz / 30 kHz
Lab/LISN	Lab #5 /Com-Power, Line 1	**Performed by**	Kerwinn Corpuz

150 kHz to 30 MHz Plot for Line 1 (Live)



Note: Met FCC Class B limit.

SOP 2 Conducted Emissions

Tracking # 31760707.001 Page 7 of 8

EUT Name	Wi-Fi Router	**Date**	Mar 16, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 44% rh
EUT Serial	XF0113M120094	**Temp / Hum out**	N/A
EUT Config.	TX mode (chain 0 & 1) / FoxLink PSU	**Line AC / Freq**	120Vac / 60Hz
Standard	CFR47 Part 15.207 and RSS Gen	**RBW / VBW**	9 kHz / 30 kHz
Lab/LISN	Lab #5 /Com-Power, Line 2	**Performed by**	Kerwinn Corpuz

Frequency	Raw	Limiter	Ins. Loss	Level	Detector	Line	Limit	Margin	Result
MHz	dBuV	dB	dB	dBuV			dBuV	dB	
0.150	51.84	9.97	0.25	62.06	QP	Neutral	66.00	-3.94	Pass
0.150	13.00	9.97	0.25	23.22	Avg	Neutral	56.00	-32.78	Pass
0.201	48.17	9.98	0.19	58.34	QP	Neutral	63.55	-5.21	Pass
0.201	19.18	9.98	0.19	29.34	Avg	Neutral	53.55	-24.21	Pass
0.242	44.98	9.98	0.16	55.12	QP	Neutral	62.02	-6.90	Pass
0.242	18.21	9.98	0.16	28.35	Avg	Neutral	52.02	-23.67	Pass
0.301	41.14	9.99	0.13	51.26	QP	Neutral	60.20	-8.94	Pass
0.301	12.80	9.99	0.13	22.92	Avg	Neutral	50.20	-27.29	Pass
0.378	38.16	10.01	0.11	48.29	QP	Neutral	58.31	-10.03	Pass
0.378	13.20	10.01	0.11	23.33	Avg	Neutral	48.31	-24.99	Pass
0.469	34.26	10.02	0.10	44.38	QP	Neutral	56.54	-12.16	Pass
0.469	14.42	10.02	0.10	24.53	Avg	Neutral	46.54	-22.00	Pass
0.515	24.46	10.02	0.10	34.58	QP	Neutral	56.00	-21.42	Pass
0.515	20.98	10.02	0.10	31.10	Avg	Neutral	46.00	-14.90	Pass
0.547	30.76	10.02	0.09	40.87	QP	Neutral	56.00	-15.13	Pass
0.547	20.35	10.02	0.09	30.47	Avg	Neutral	46.00	-15.53	Pass
0.618	29.72	10.03	0.09	39.83	QP	Neutral	56.00	-16.17	Pass
0.618	15.17	10.03	0.09	25.28	Avg	Neutral	46.00	-20.72	Pass

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

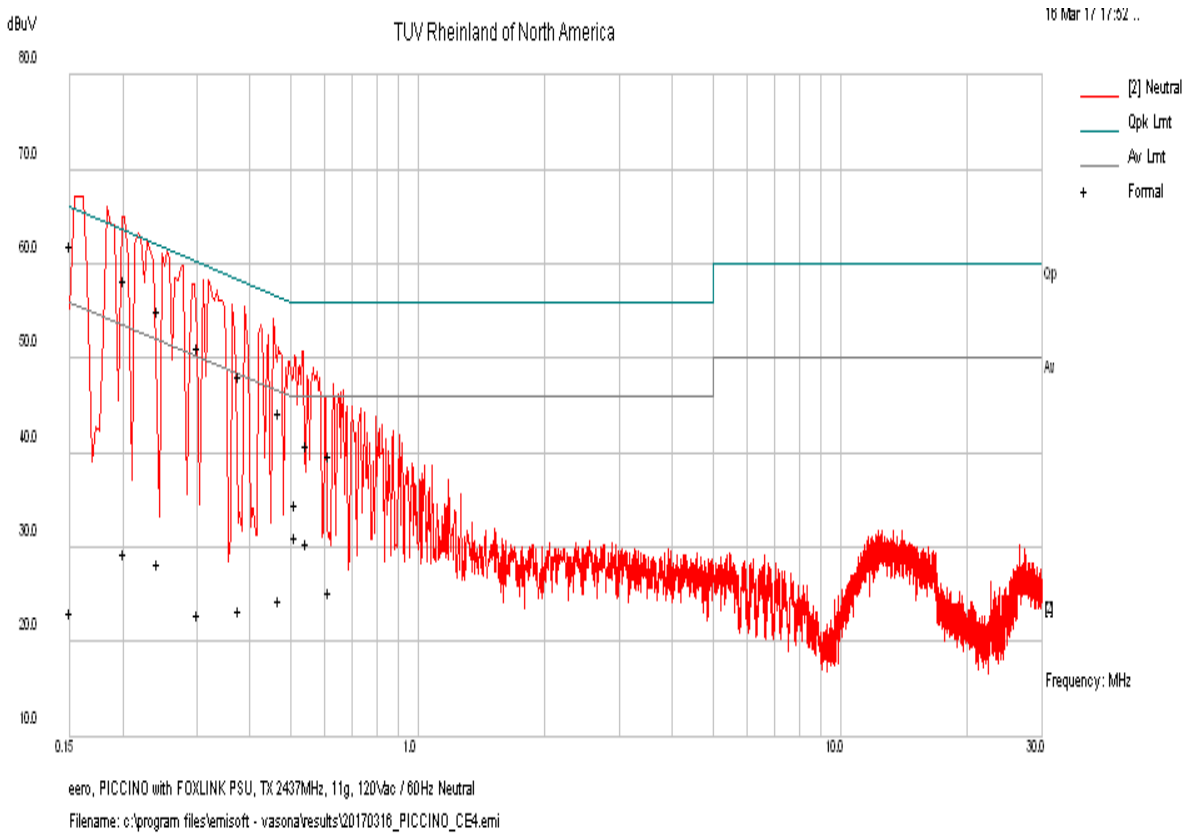
Combined Standard Uncertainty $u_c(y)$ = ± 1.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: The EUT was set horizontally on the table top and transmitted at 2437 MHz in 802.11g at 6Mbps (worse case).

SOP 2 Conducted Emissions — Tracking # 31760707.001 Page 8 of 8

EUT Name	Wi-Fi Router	**Date**	Mar 16, 2017
EUT Model	D010001 (USA), D010002 (IC)	**Temp / Hum in**	22° C / 44% rh
EUT Serial	XF0113M120094	**Temp / Hum out**	N/A
EUT Config.	TX mode (chain 0 & 1) / FoxLink PSU	**Line AC**	120Vac / 60Hz
Standard	CFR47 Part 15.207 and RSS Gen	**RBW / VBW**	9 kHz / 30 kHz
Lab/LISN	Lab #5 /Com-Power, Line 2	**Performed by**	Kerwinn Corpuz

150 kHz to 30 MHz Plot for Line 2 (Neutral)



Note: Met FCC Class B Limit.

4.7 Maximum Permissible Exposure

4.7.1 Test Methodology

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The Gain of the antenna used in this calculation is declared by the manufacturer, and the maximum total power input to the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

4.7.2 RF Exposure Limit

According to FCC 1.1310 table 1: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm2)	Average Time (minutes)
(A)Limits For Occupational / Control Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f^2)	6
30–300	…	…	1.0	6
300 - 1500	…	…	f/300	6
1500 - 100,000	…	…	5	6
(B)Limits For General Population / Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/ f^2)	30
30–300	27.5	0.037	0.2	30
300 - 1500	…	…	f/1500	30
1500 - 100,000	…	…	1.0	30

F = Frequency in MHz
* = Plane-wave equivalent power density

4.7.3 EUT Operating Condition

The software provided by Manufacturer enabled the EUT to transmit data at lowest, middle and highest channel individually.

4.7.4 Classification

The antenna of the product, under normal use condition, is at least 20cm away from the body of the user. Warning statement to the user for keeping at least 20cm or more separation distance with the antenna should be included in user's manual. So, this device is classified as a **Mobile Device**.

See below calculation for 2.437 GHz RF Exposure at a distance of 20cm.

4.7.5 Test Results

4.7.5.1 Antenna Gain

The 2.437 GHz transmitting total antenna gain (beamforming) is +6.87 dBi or 4.86 (numeric).

4.7.5.2 Output Power into Antenna & RF Exposure value at distance 20cm:

Calculations for this report are based on highest power measurement.

Limit for MPE (from FCC part 1.1310 table1) is 1.0 mW/cm^2

The highest measured total power is +28.86 dBm or 769.13 mW (summed 2 chains).

Using the Friss transmission formula, the EIRP is Pout*G, and R is 20cm.

Pd = (769.13*4.86) / (1600π) = 0.7436 mW/cm^2, which is 0.2564 mW/cm^2 below to the limit.

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

4.7.6 Sample Calculation

The Friss transmission formula: $Pd = (Pout*G) / (4*\pi*R^2)$

Where;

Pd = power density in mW/cm^2
Pout = output power to antenna in mW
G = gain of antenna in linear scale
$\pi \approx 3.1416$
R = distance between observation point and center of the radiator in cm

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq. (11-133).

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 Antenna	Sunol Sciences	3115	9710-5301	10/08/2015	10/08/2017
Antenna (18-40 GHz)	Com-Power	AHA-840	105005	07/08/2015	07/08/2017
Loop Antenna	EMCO	6502	9110-2683	06/13/2016	06/13/2017
Spectrum Analyzer	Rohde & Schwarz	FSL6	100169	01/13/2017	01/13/2018
Spectrum Analyzer	Agilent	N9038A	MY552260210	01/16/2017	01/16/2018
Spectrum Analyzer	Agilent	N9030A	MY52350885	05/17/2016	05/17/2017
Spectrum Analyzer	Rohde Schwarz	ESIB40	832427/002	01/16/2017	01/16/2018
Spectrum Analyzer	Rohde Schwarz	FSV40	1321.3008K40	08/30/2016	08/30/2017
Amplifier	Sonoma Instruments	310	165516	01/19/2017	01/19/2018
Amplifier	Miteq	TTA1800-30-HG	2020728	11/12/2016	11/12/2017
Amplifier	Rohde & Schwarz	TS-PR26	100011	11/04/2017	11/04/2018
Amplifier	Rohde & Schwarz	TS-PR40	100012	08/02/2017	08/02/2017
Power Meter	Agilent	E4418B	MY45103902	01/11/2017	01/11/2018
Power Sensor	Hewlett Packard	8482A	1925A04647	01/01/2017	01/01/2018
Thermometer	Fluke	52II	88650033	11/04/2016	11/04/2017
Thermo Chamber	Espec	BTZ-133	0613436	NCR	NCR
Multimeter	Fluke	177	92780312	01/11/2017	01/11/2018
DC Power Supply	Agilent	E3634A	MY400004331	01/12/2017	01/12/2018
Notch Filter	Micro-Tronics	BRM50702	037	07/18/2016	07/18/2017
Signal Generator	Anritsu	MG3694A	42803	01/13/2017	01/13/2018
Signal Generator	Rohde & Schwarz	SMF100A	1167.0000K02	09/06/2016	09/06/2017
Signal Generator	Rohde & Schwarz	SMBV100A	1407.6004K02	09/06/2016	09/06/2017
Power Sensors	Rohde & Schwarz	OSP120	1520.9010.02	09/06/2016	09/06/2017

* Calibration of equipment past due for re-calibration will be performed expeditiously. If any equipment is found to be out of tolerance at that time, affected customers will be notified accordingly.

NCR = No Calibration Required

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 15: Customer Information

Company Name	eero inc.
Address	500 Howard Street, Suite 900
City, State, Zip	San Francisco, CA 94105
Country	USA
Phone	(415) 738-7972
Fax	

Table 16: Technical Contact Information

Name	Clifford Clarke
E-mail	cliff@eero.com
Phone	(415) 738-7972
Fax	

6.3 Equipment Under Test (EUT)

Table 17: EUT Specifications

EUT Specifications	
Dimensions	W: 2.875in (73mm) x D: 4.750in (121mm) x H: 1.188in (30mm)
AC Input	100-240V AC, 50 – 60 Hz
Environment	Indoor
Operating Temperature Range:	0 to 35 degrees C
Multiple Feeds:	☐ Yes and how many ☒ No
Product Marketing Name (PMN)	D010001 (USA), D010002 (IC)
Hardware Version Identification Number (HVIN)	D010001 (USA), D010002 (IC)
Firmware Version Identification Number (FVIN)	3.0.0
802.11-radio modules	
Operating Mode	802.15.1, 802.15.4, 802.11g, 802.11n (HT20 and HT40)
Transmitter Frequency Band	2.4 GHz – 2.4835 GHz
Max. Rated Power Output	See Channel Planning Table.
Power Setting @ Operating Channel	See Channel Planning Table.
Antenna Type	Qty 5 – 3 custom antennas at 2.4GHz. See Table 18 for details
Antenna Gain	Antenna 3 = +4.08 dBi, Antenna 4 = +3.64 dBi, Antenna 5 = +4.14 dBi
Modulation Type	☒ Thread (Zigbee) ☒ BLE ☒ DSSS ☒ OFDM ☒ Other describe: 16QAM and 64 QAM
Data Rate	Thread (Zigbee): 250 kbps BLE: 1-2 Mbps 802.11g: 2 Spatial Streams: 6, 9, 12, 18, 24, 36, 48, 54 Mbps 802.11n HT20: 2 Spatial Streams: 13, 26, 39, 52, 78, 104, 117, 130 /156 Mbps (LGI) 802.11n HT40: 2 Spatial Streams: 27, 54, 81, 108, 162, 216, 243, 270 / 324, 370 Mbps (LGI)
TX/RX Chain (s)	MIMO (2x2); single for BLE and Thread (Zigbee)

EUT Specifications	
Directional Gain Type	☐ Correlated ☒ Beam-Forming ☐ Other describe:
Type of Equipment	☐ Table Top ☐ Wall-mount ☐ Floor standing cabinet ☒ Other: Wall-mount at AC outlet
Note: All 2 chains will be on / transmitted at all time.	

Table 18: Antenna Information

Number	Antenna Type	Description	Max Gain (dBi)
Antenna 1	Flex PCB	5 GHz Wi-Fi U-NII-1 Band, Chain 0	6.29
Antenna 2	Flex PCB	5 GHz Wi-Fi U-NII-1 Band, Chain 1	4.97
Antenna 1	Flex PCB	5 GHz Wi-Fi U-NII-2A Band, Chain 0	5.96
Antenna 2	Flex PCB	5 GHz Wi-Fi U-NII-2A Band, Chain 1	4.86
Antenna 1	Flex PCB	5 GHz Wi-Fi U-NII-2C Band, Chain 0	4.74
Antenna 2	Flex PCB	5 GHz Wi-Fi U-NII-2C Band, Chain 1	5.13
Antenna 1	Flex PCB	5 GHz Wi-Fi U-NII-3 Band, Chain 0	4.94
Antenna 2	Flex PCB	5 GHz Wi-Fi U-NII-3 Band, Chain 1	5.22
Antenna 3	Flex PCB	2.4 GHz Wi-Fi Chain 0	4.08
Antenna 4	Flex PCB	2.4 GHz Wi-Fi Chain 1	3.64
Antenna 5	Flex PCB	Bluetooth LE or Thread (Zigbee)	4.14

Table 19: EUT Channel Power Specifications

Total Power (Summed 2 Chains) for Non-Beamforming Mode

No.	Frequency (MHz)	Target Power Value dBm					
		802.11g	802.11n HT20	802.11n HT40	BLE	Thread (Zigbee)	
1	2412	26.94**	27.00**				
3	2422			24.50*			
5	2432						
6	2437	29.89****	29.84****	29.66***			
9	2452			24.88*			
11	2462	28.63****	28.62****				
0	2402				12.78*****		
20	2442				12.45*****		
39	2480				12.00*****		
11	2405					18.65******	
18	2440					18.49******	
25	2475					17.26******	

Note: 1. The adjusted power target values are updated at the evaluated frequencies.
2. TP setting: * = 21, ** = 24, *** = 26, **** = 27, ***** = 14, ****** = 19.
3. BLE and Thread (Zigbee) are Max Power measured.

Total Power (Summed 2 Chains) for Beamforming Mode

No.	Frequency (MHz)	Target Power Value dBm					
		802.11b	802.11g	802.11n HT20	802.11n HT40		
1	2412		26.94**	27.00**			
3	2422				24.50*		
5	2432						
6	2437		28.85****	28.79****	28.86***		
9	2452				24.88*		
11	2462		28.63****	28.62****			

Note: 1. The adjusted power target values are updated at the evaluated frequencies.
2. TP setting: * = 21, ** = 24, *** = 25.5, **** = 26, ***** = 15.

Table 20: 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?
Ethernet	RJ45	☒ No	☒ Metric: 2 m	☐ N/A

Table 21: Supported Equipment

Equipment	Manufacturer	Model	Serial	Used for
Laptop	Dell	Latitude	35521341769	Setup EUT operating channel
Note: None.				

Table 22: Description of Sample used for Testing

Device	Serial	RF Connection	CFR47 Part 15.247
Wi-Fi Router	MF701114110316 (Piccino) & SPE28JY (Unico)	FPCB Antenna	TX Emissions, AC Conducted Emission
		Direct Connection	Peak Transmit Power, Peak Power Spectral Density, Occupied Bandwidth Band-Edge Out-of-Band Emission
Note: 1. Chicony PSU S/N: F719-0354-25CT-KJ8T, FoxLink PSU S/N: XF70113M120094			

Table 23: Description of Test Configuration used for Radiated Measurement.

Device	Antenna	Mode	Setup Photo (X-Axis)	Setup Photo (Y-Axis)	Setup Photo (Z-Axis)
Wi-Fi Router	FPCB	Transmit	N/A	EUT standing up	N/A
Note: N/A.					

6.4 Test Specifications

Table 24: Test Specifications

Emissions and Immunity	
Standard	**Requirement**
CFR 47 Part 15.247: 2016	All
RSS 247 Issue 2, 2017	All

END OF REPORT