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Emissions
Test Report

EUT Name: Wireless Access Point

Model No.: APIN0324 and APIN0325

CFR 47 Part 15.247 2014

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1	07/14/2015	Revised to add additional plots for PSD	SK

Note: Latest revision report will replace all previous reports.

Statement of Compliance

Manufacturer:	Aruba Networks 1344 Crossman Ave. Sunnyvale CA 94089 (408) 990-2557
Requester / Applicant:	Rob Hastings
Name of Equipment:	Wireless Access Point
Model No.	APIN0324 and APIN0325
Type of Equipment:	Intentional Radiator
Application of Regulations:	CFR 47 Part 15.247 2014
Test Dates:	28 Feb 2015 to 04 June 2015

Guidance Documents:

Emissions: ANSI C63.10-2009; KDB 558074 D01 DTS Measurement Guidance v03r03

Test Methods:

Emissions: ANSI C63.10-2009; KDB 558074 D01 DTS Measurement Guidance v03r03

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.

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Test Engineer	Date June 6, 2015	Lab Manager	Date June 30, 2015

Testing Cert #3331.02 **US5254** **2932M-1**

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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 2014 based on the results of testing performed on 28 Feb 2015 to 04 June 2015 on the Wireless Access Point Model APIN0324 and APIN0325 manufactured by Aruba Networks 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 2400MHz to 2483.5MHz frequency band was covered this document.

1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C63.4	Test Parameters (from Standard)	Result
Spurious Emission in Transmitted Mode	CFR47 15.209	Class B	**Complied**
Restricted Bands of Operation	CFR47 15.205	Class B see plots	**Complied**
AC Power Conducted Emission	CFR47 15.207	Class B See plots	**Complied**
Occupied Bandwidth	CFR47 15.247 (a2)	6dB BW≥ 500 kHz Measured: 684KHz (6dB) 1077KHz (99%)	**Complied**
Maximum Transmitted Power	CFR47 15.247 (b3)	Limit: 30dBm Measured 3.81dBm	**Complied**
Peak Power Spectral Density	CFR47 15.247 (e)	Limit: 8dBm/ 3 kHz. Measured:-8.42dBm/3KHz	**Complied**
Bandedge Measurement	CFR47 15.247 (d)	30 dBr, see plots	**Complied**
RF Exposure	CFR47 15.247 (i), 2.1091	General Population	**Complied**

This report covers BLE mode only

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 (US5254). 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-0031

VCCI Registration No. for Santa Clara: A-0032

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 C63.4-2009, 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 C63.4-2009, 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 Aruba AP-320 Series wireless access points support IEEE 802.11ac standard for high-performance WLAN, and is equipped with two dual-band radios, which can provide access and monitor the network simultaneously. Multi-user Multiple-in, Multiple-output (MU-MIMO) technology allows this access point to deliver high-performance 802.11n 2.4 GHz and 802.11ac 5 GHz functionality, while also supporting 802.11a/b/g/n/ac wireless services.

This device has Built-in Bluetooth Low-Energy (BLE) radio. Enables location based services with

BLE-enabled mobile devices receiving signals from multiple Aruba Beacons at the same time.

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.

3.4.1 Results

The Wireless Access Point Model APIN0325/0324 has internal antenna for BLE mode.

4 Emissions

Testing was performed in accordance with CFR 47 Part 15.247: 2014 . 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.

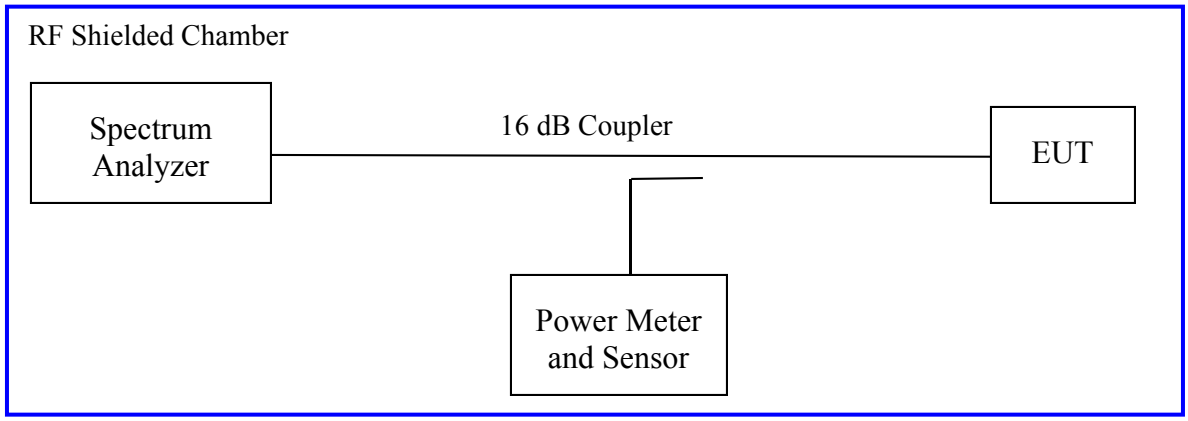
The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b3):2014

The maximum transmitted power is +30 dBm or 1Watt.

4.1.1 Test Method

The ANSI C63.10-2009 Section 6.10.3.1 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 mode on the sample, S/N 428, per CFR47 Part 15.247 (b3):2014; 2400 MHz to 2483.5MHz. The worst mode results indicated below.

Test Setup:



Method AVGSA-1 of "Guidelines for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating under CFR47 Part 15.247"applies since the EUT continuously transmit; where duty cycle is greater than 98%. Sample detector was used.

4.1.2 Results

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

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

Test Conditions: Conducted Measurement, Normal Temperature			
Antenna Type: Internal		**Power Setting:** See test plan	
Max. Directional Gain: -3dBi		**Signal State:** Modulated at 100%.	
Ambient Temp.: 23 °C		**Relative Humidity:**33%	
802.15.1 BLE Mode,			
Operating Channel	**Limit [dBm]**	**Conducted Power antenna port [dBm]**	**Margin [dB]**
2402	30.0	3.81	-26.19
2440	30.0	3.51	-26.49
2480	30.0	3.03	-26.97
Note: 1.The highest output power was observed at 802.11 BLE mode 1Mbps 2. No Beamforming is considered for this mode			

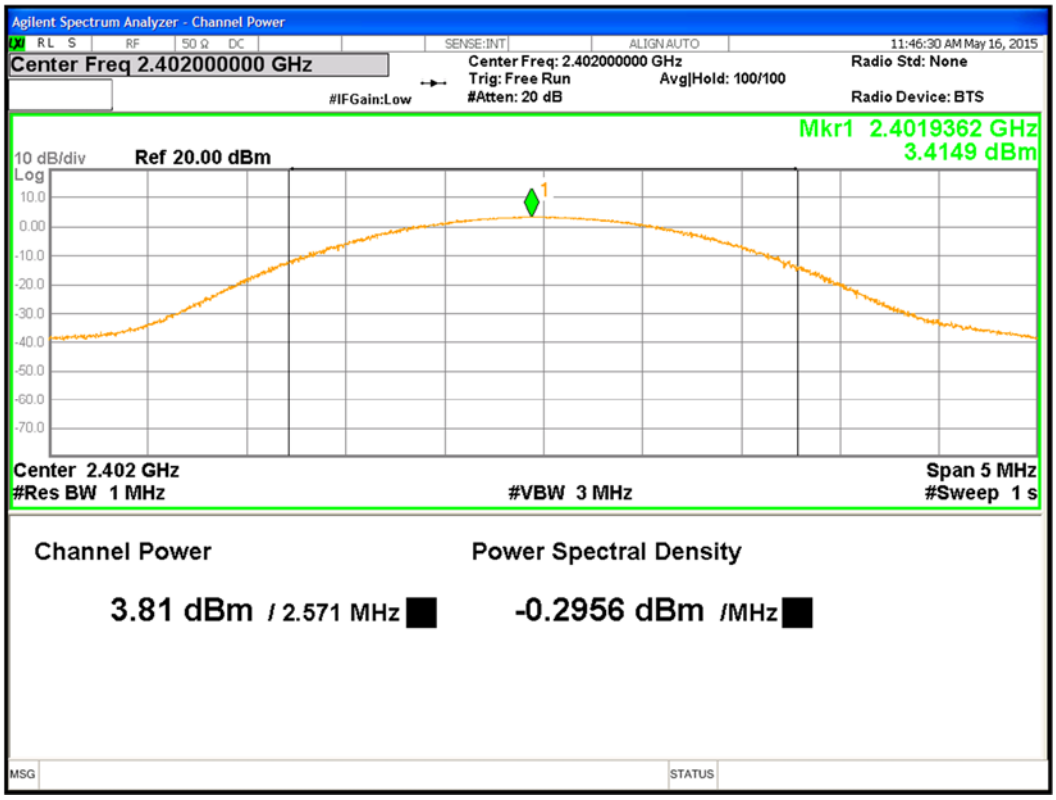


Figure 1: Maximum Transmitted Power, 2402MHz BLE mode at 1Mbps.

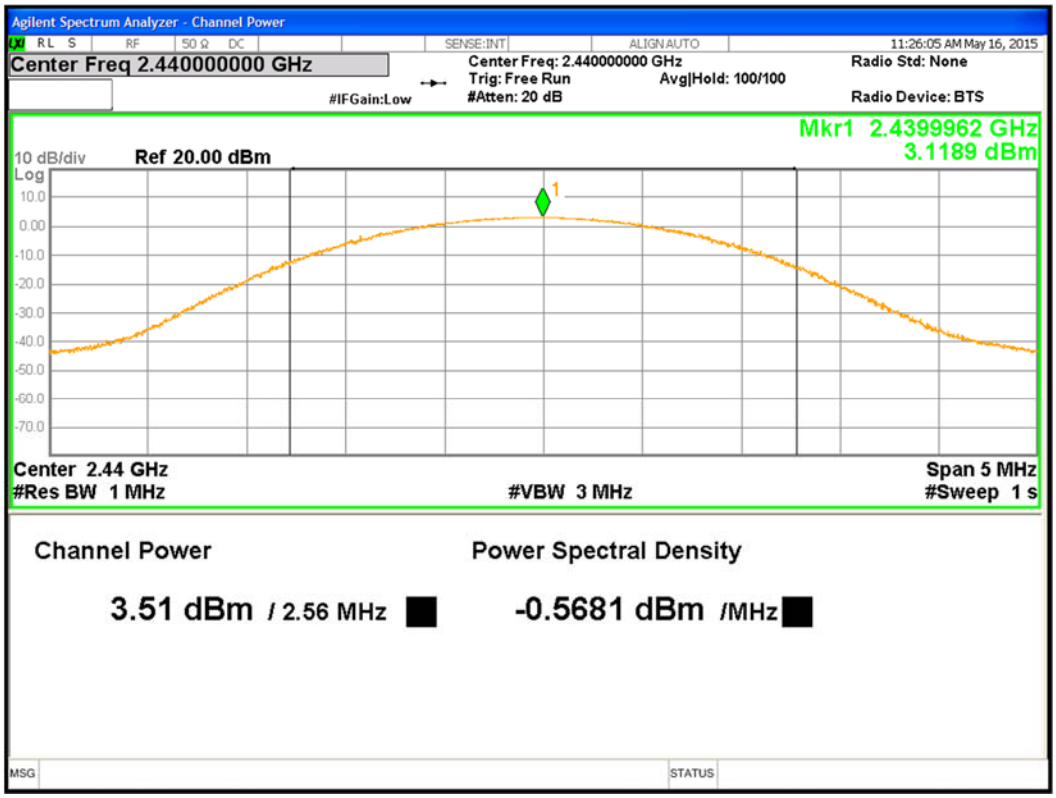


Figure 2: Maximum Transmitted Power, 2440MHz BLE mode at 1Mbps

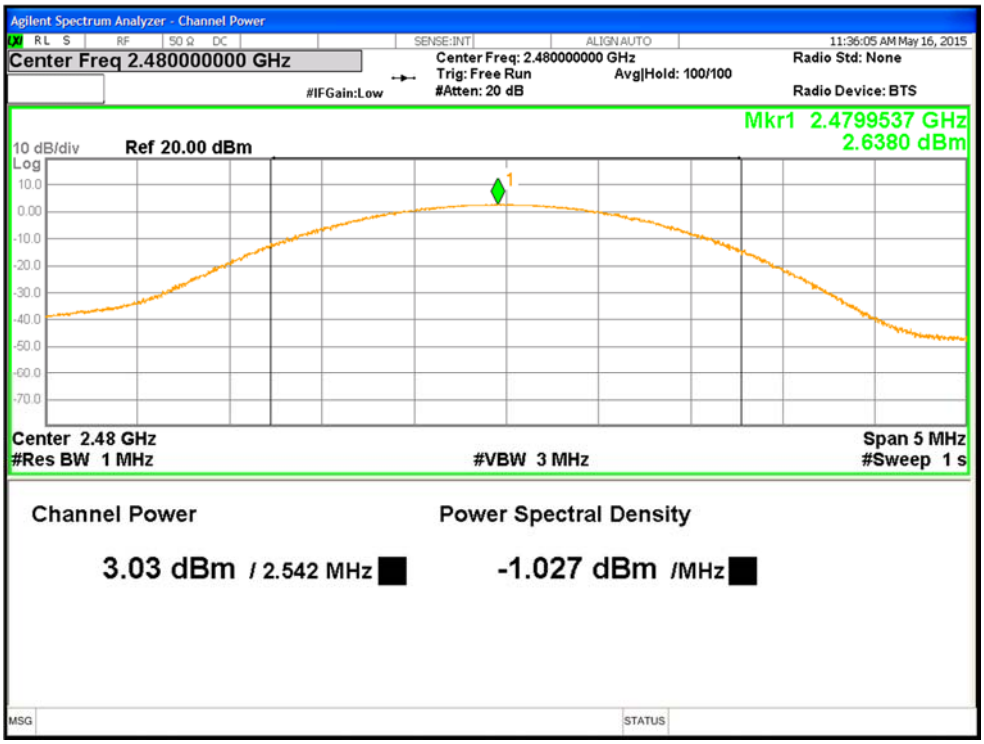


Figure 3: Maximum Transmitted Power, 2480MHz BLE Mode

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.

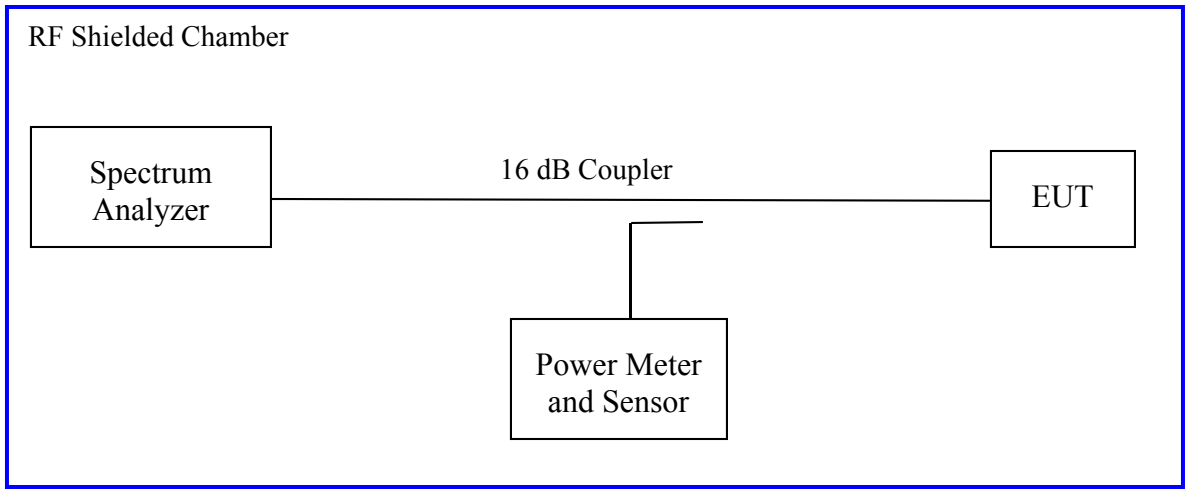
The DTS bandwidth is defined the bandwidth of 6 dBr from highest transmitted level of the fundamental frequency.

The bandwidth shall be at least 500 kHz per Section CFR47 15.247(a2) 2014

4.2.1 Test Method

The conducted method was used to measure the occupied bandwidth. The measurement was performed with modulation per CFR47 15.247(a2) 2014. The preliminary investigation was performed to find the narrowest 6 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 2483.5MHz on the sample, S/N 428. The results indicated below.

Test Setup:



4.2.2 Results

These occupied bandwidth measurements were taken for references only.

Table 3: Occupied Bandwidth – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only					
Antenna Type: Integrated			**Power Setting:** See test plan		
Max. Directional Gain: -3dBi			**Signal State:** Modulated at 100%.		
Ambient Temp.: 22 °C			**Relative Humidity:**30%		
Bandwidth (MHz) for 802.15.1 BLE mode					
Freq. (MHz)	**DTS Bandwidth**		**99% BW**		
	Limit (kHz)	**Measured (KHz)**		**Measured (KHz)**	**Results**
2402	500	685.2		1082	Pass
2440	500	684		1078	Pass
2480	500	678		1077	Pass
Note: The narrowest bandwidth was observed at 802.11BLE mode 1.0Mbps					

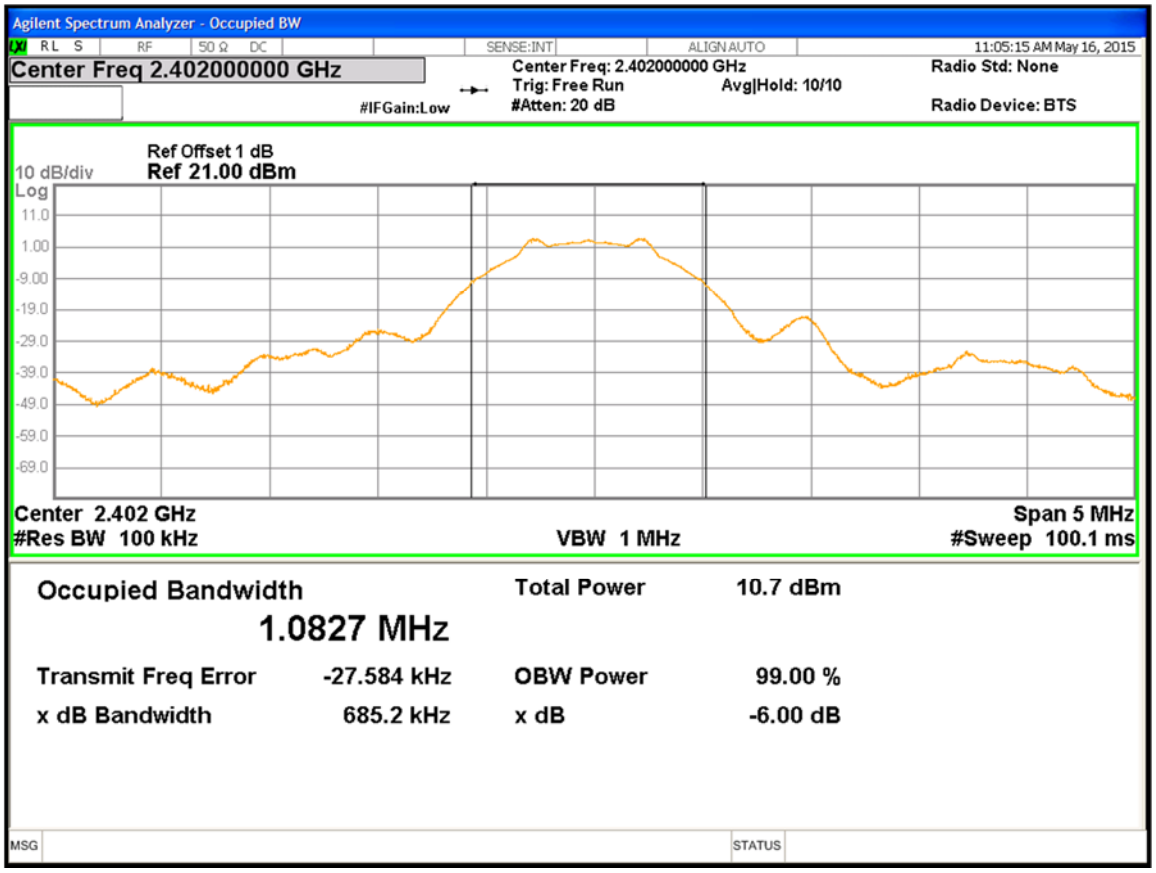


Figure 4: DTS Bandwidth at 2402 MHz

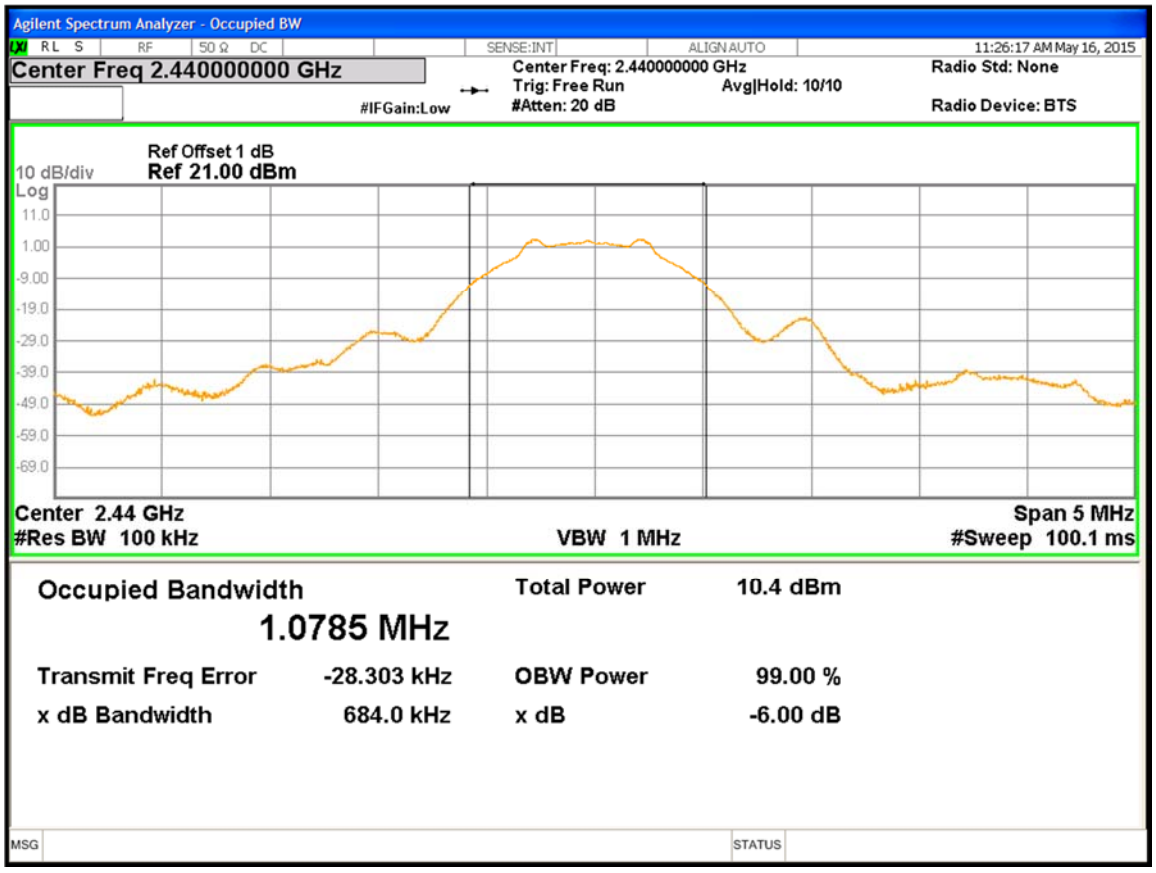


Figure 5: DTS Bandwidth at 2440 MHz

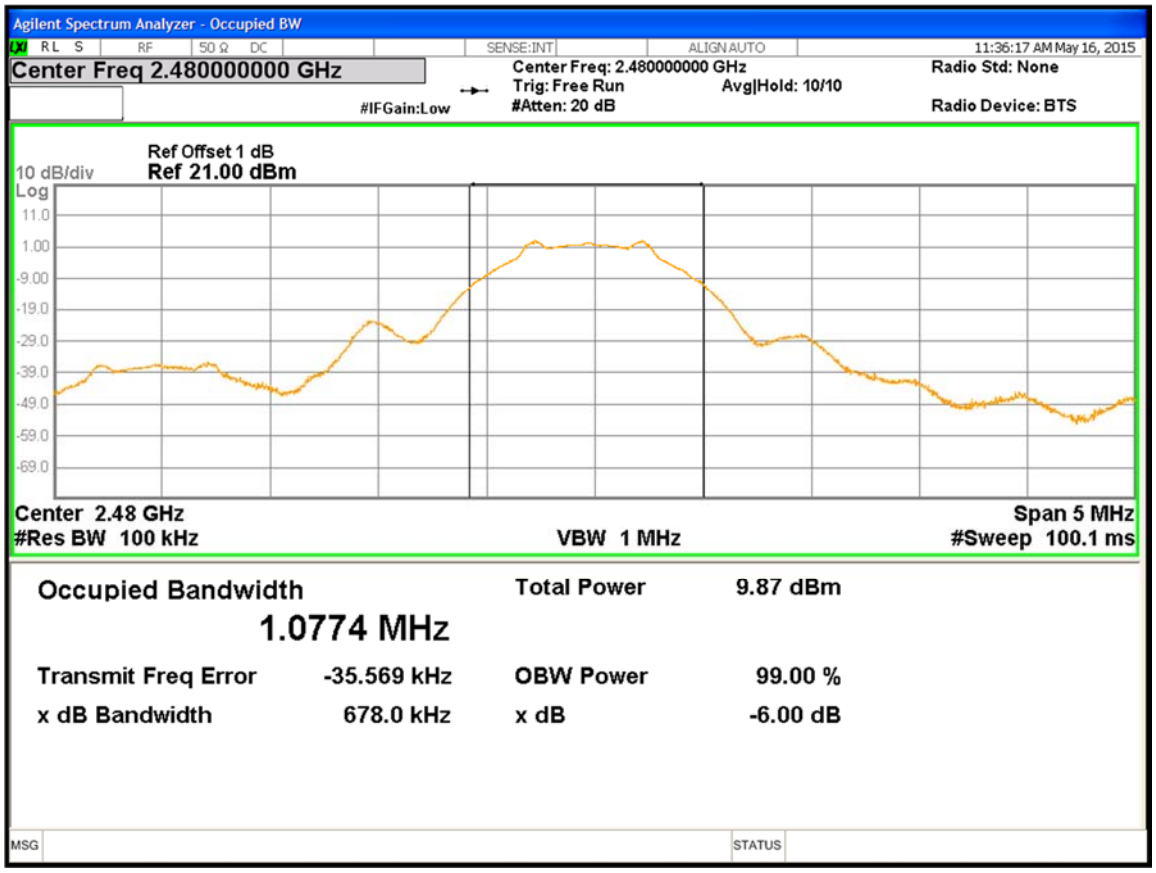


Figure 6: 99% Bandwidth at 2480MHz

4.3 Unwanted Emissions into Non-Restricted Frequency Bands

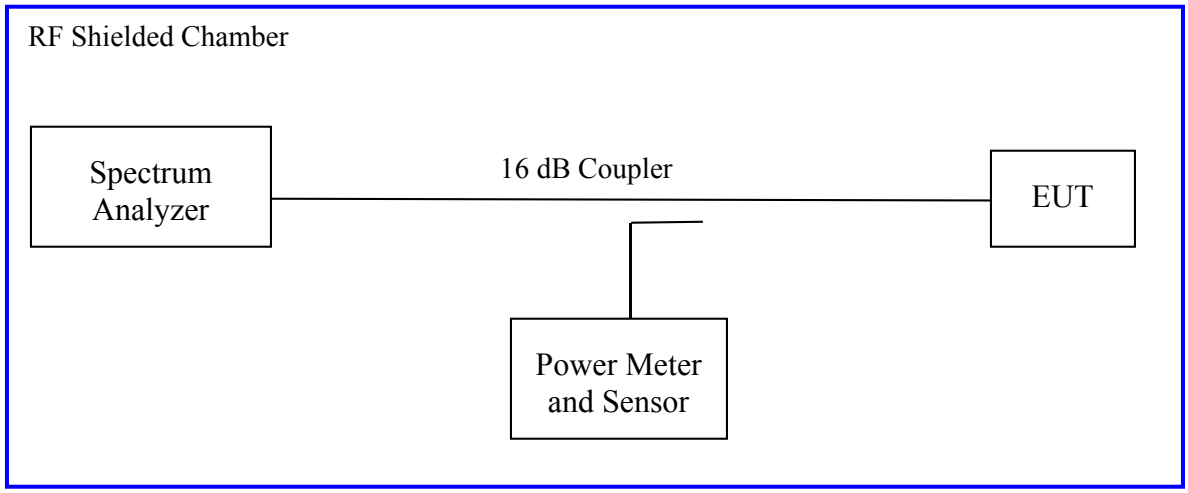
The setup was identical to RF output power measurement. Intentional radiators operating under the alternative provisions to the general emission limits, must be designed to ensure that the 20 dB or 30 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If the frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

Since the transmitter complies with the conducted power limits base on the use of RMS averaging per CFR47 Part 15.247(b)(3), any frequency outside the band of 2400MHz to 2483.5MHz, the power output level must be below 30dB from the in-band transmitting signal; CFR 47 Part 15.215, 15.247(d)

4.3.1 Test Method

The conducted method was used to measure the out-of-band emission requirement. The measurement was performed with modulation per CFR47 15.247(4) (d) 2014. This test was conducted on of Sample in BLE mode on Sample, S/N: 428. The worst sample result indicated below.

Test Setup:



Measurement Procedure AVG2 of KDB 558074

4.3.2 Results

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

Table 4: Emissions at the Band-Edge – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only					
Antenna Type: Integrated			**Power Setting:** See test plan		
Max. Directional Gain: -3dBi			**Signal State:** Modulated at 100%.		
Ambient Temp.: 23 °C			**Relative Humidity:**30%		
Non-Restricted Frequency Band Emission					
Freq. (MHz)	**Mode**	**Measured Value (dBm)**	**Ref. Level (dBm)**	**Plots**	**Results**
2402	1Mbps	-38.12	-26.40	7. 8	Pass
2440	1Mbps	-42.24	-26.48	9, 10	Pass
2480	1Mbps	-42.55	-27.37	11, 12	Pass
Note: All out of band emissions are lower than the 30dBr level. The maximum out of band emission on each individual output put is at least 30 dB below the maximum in-band PSD on that output per KDB 662911.					

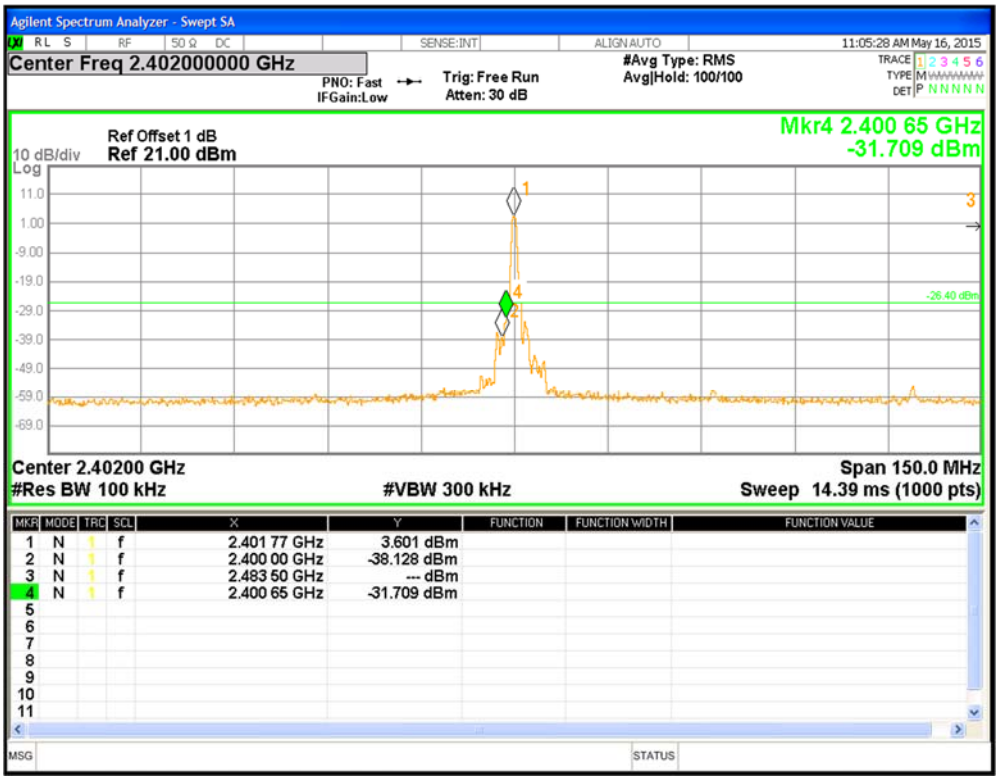


Figure 7: Reference Level for TX at 2402 MHz

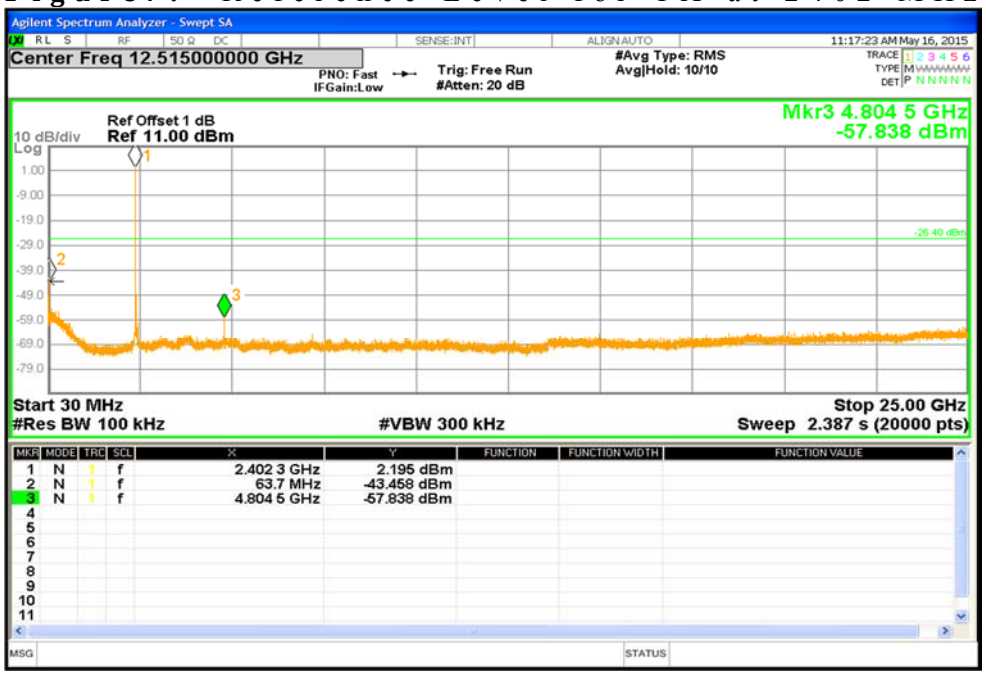


Figure 8: Out of Band Emission for at 2402 MHz

1279 Quarry Lane, Ste. A, Pleasanton, CA 95466
Tel: (925) 249-9123, Fax: (925) 249-9124

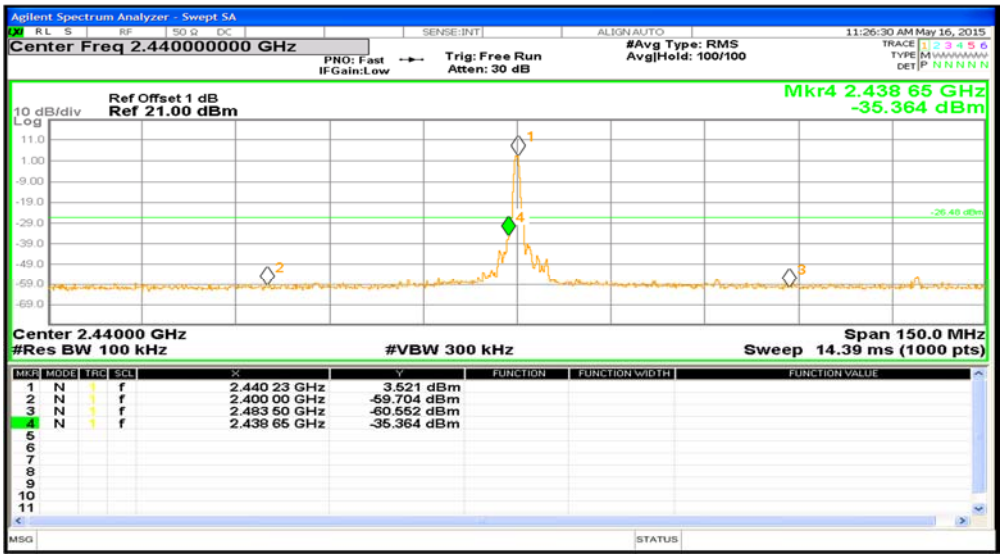


Figure 9: Reference Level for TX at 2440 MHz

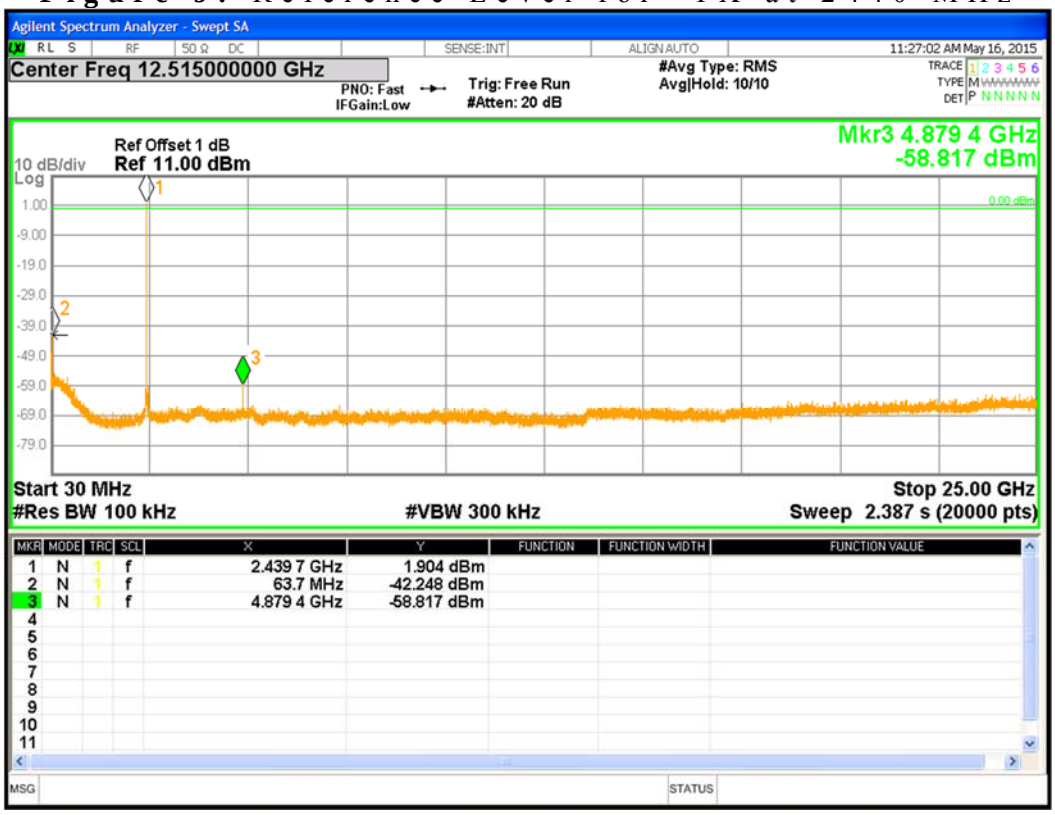


Figure 10: Out of Band Emissions for TX at 2440 MHz

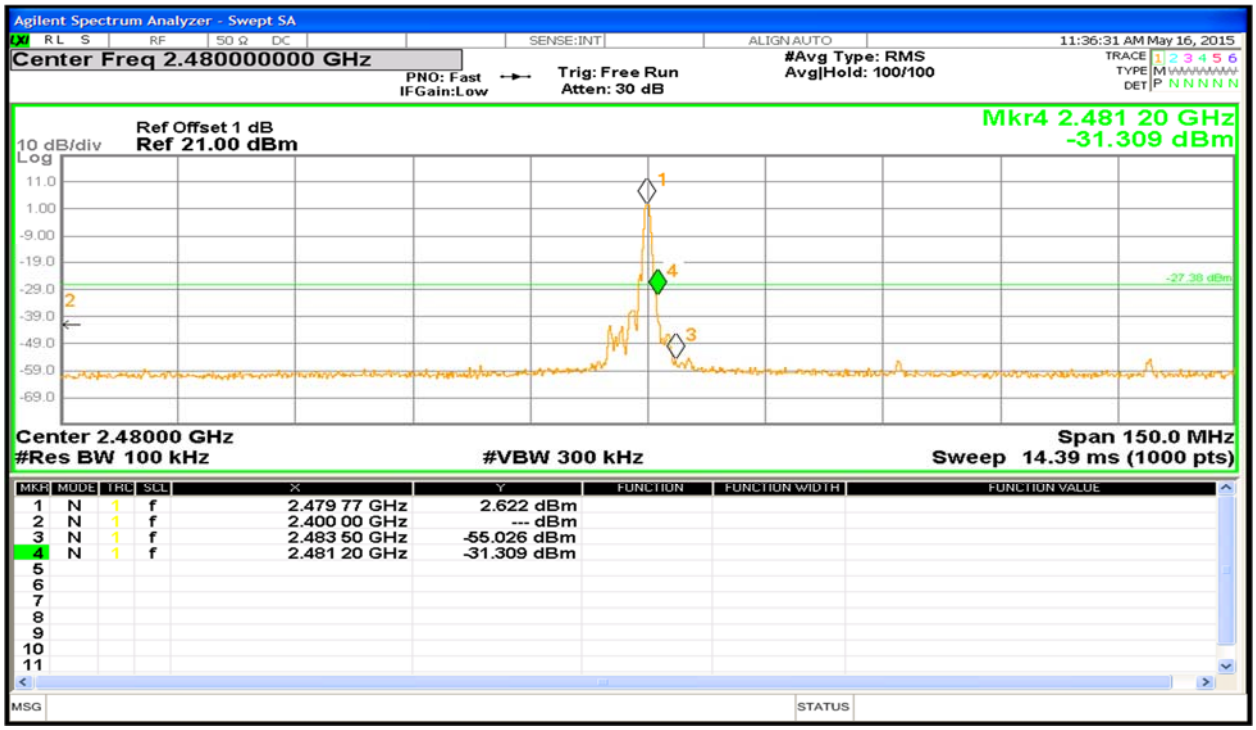


Figure 11: Reference Level for TX at 2480 MHz

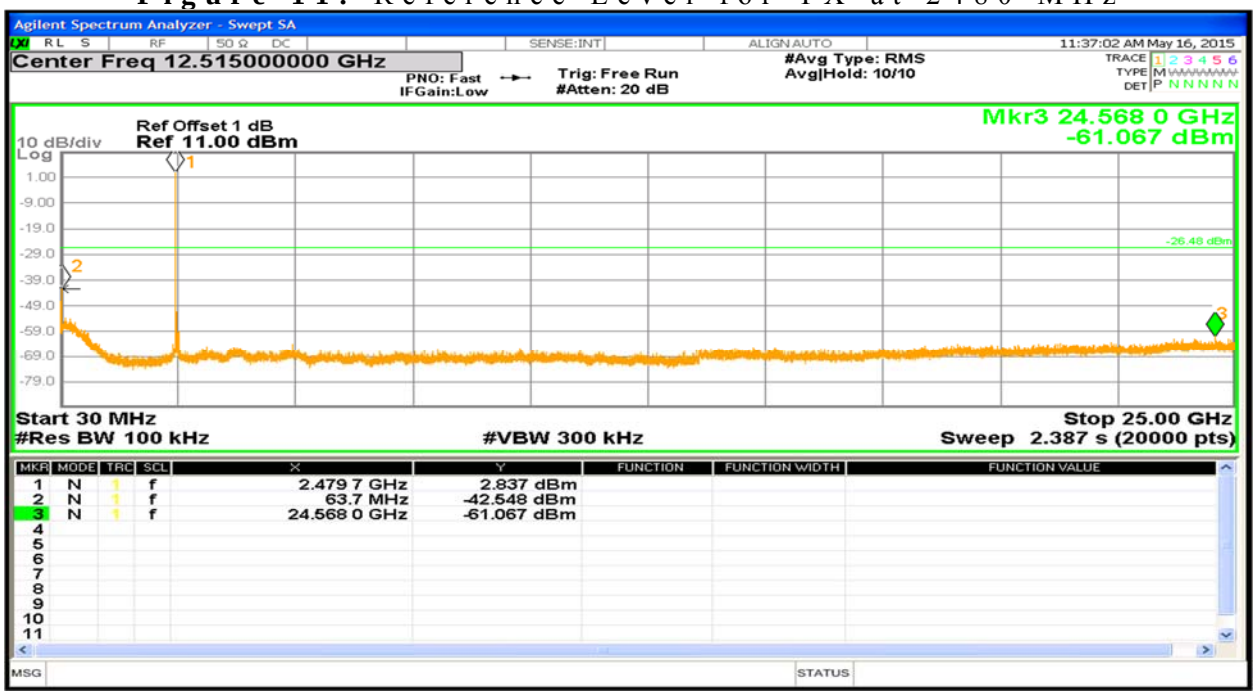


Figure 12: Out of Band Emissions for TX at 2480 MHz

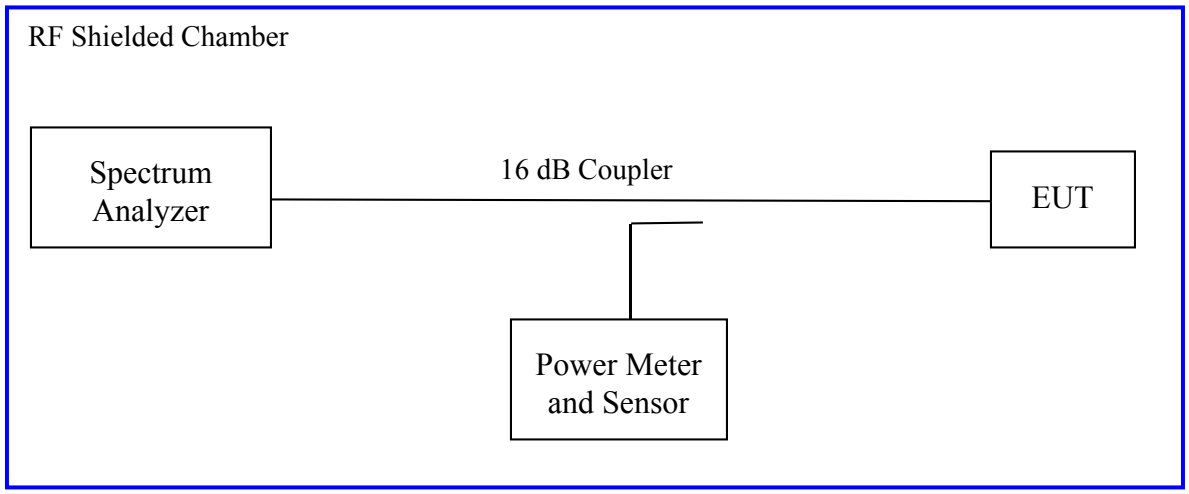
4.4 Peak Power Spectral Density

According to the CFR47 Part 15.247 (e), the spectral power density output of the antenna port shall be less than 8dBm in any 3kHz band during any time interval of continuous transmission.

4.4.1 Test Method

The conducted method was used to measure the channel peak power spectral density per ANSI C63.10-2009 Section 6.11.2. The measurement was performed with modulation per CFR47 Part 15.247 (e) This test was conducted on antenna port of Sample, S/N. 428. The worst findings were conducted on BLE mode of 2400MHz to 2483.5MHz indicated below.

Test Setup:



Measurement procedure AVGPSD-1 of KDB 558074 D01 DTS Meas. Guidance v03r01 was applied.

4.4.2 Results

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

Table 5: Peak Power Spectral Density – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only			
Antenna Type: Integrated		**Power Setting:** See Test plan	
Max. Directional Gain: -3dBi		**Signal State:** Modulated at 100%.	
Ambient Temp.: 23 °C		**Relative Humidity:**32%	
Peak Power Spectral Density			
802.15.1 BLE Mode			
Freq. (MHz)	**Measured PPSD[dBm]**	**Limit [dBm]**	**Margin [dB]**
2402	-7.58	+8dBm	-15.58
2440	-8.06	+8dBm	-16.06
2480	-8.42	+8dBm	-16.42
Note: 1. The highest peak output power was observed at 1Mbps per data stream. Plots are placed in the report			

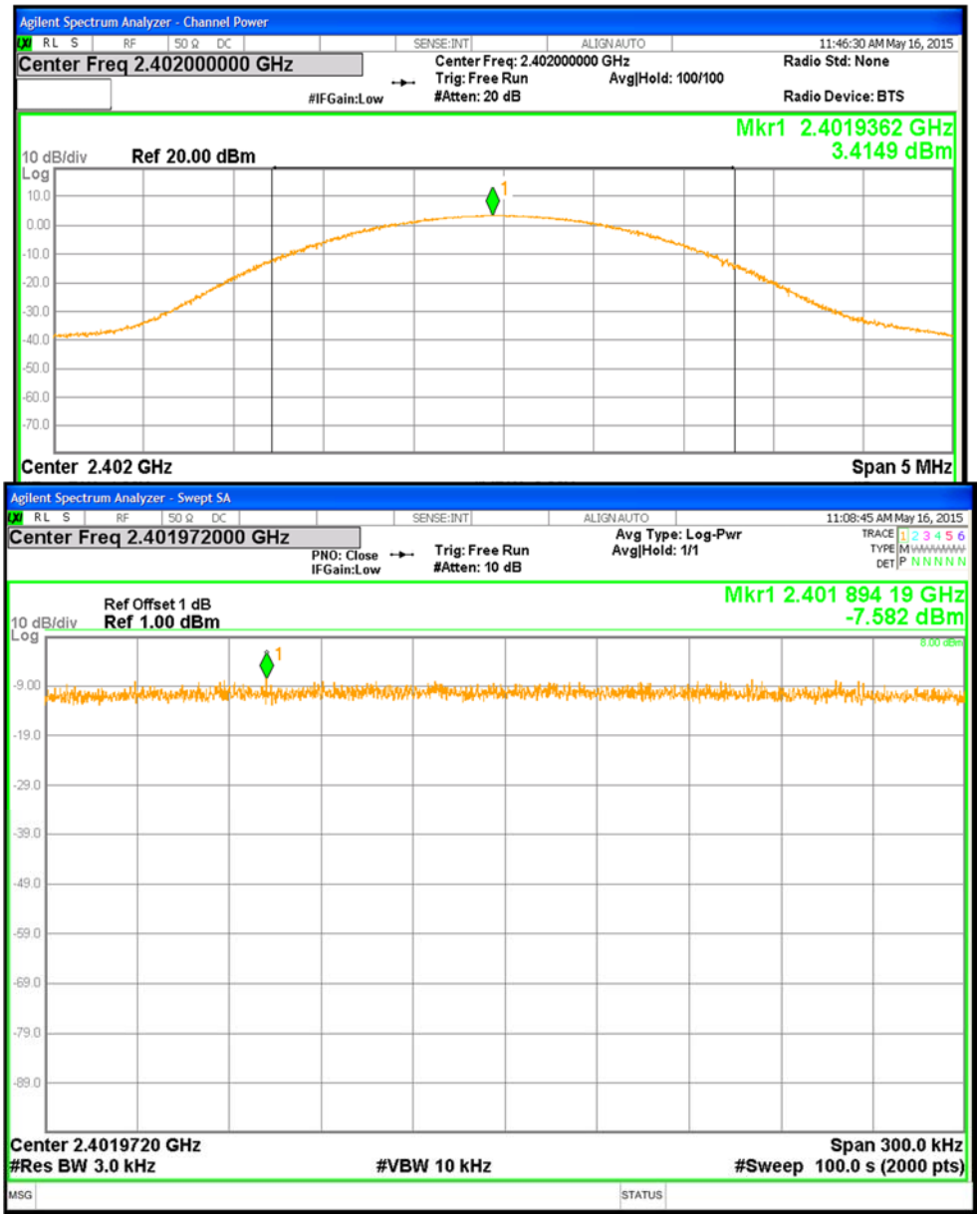


Figure13: PSD,2402MHz, BLE modeat1Mbps (Close up plot)

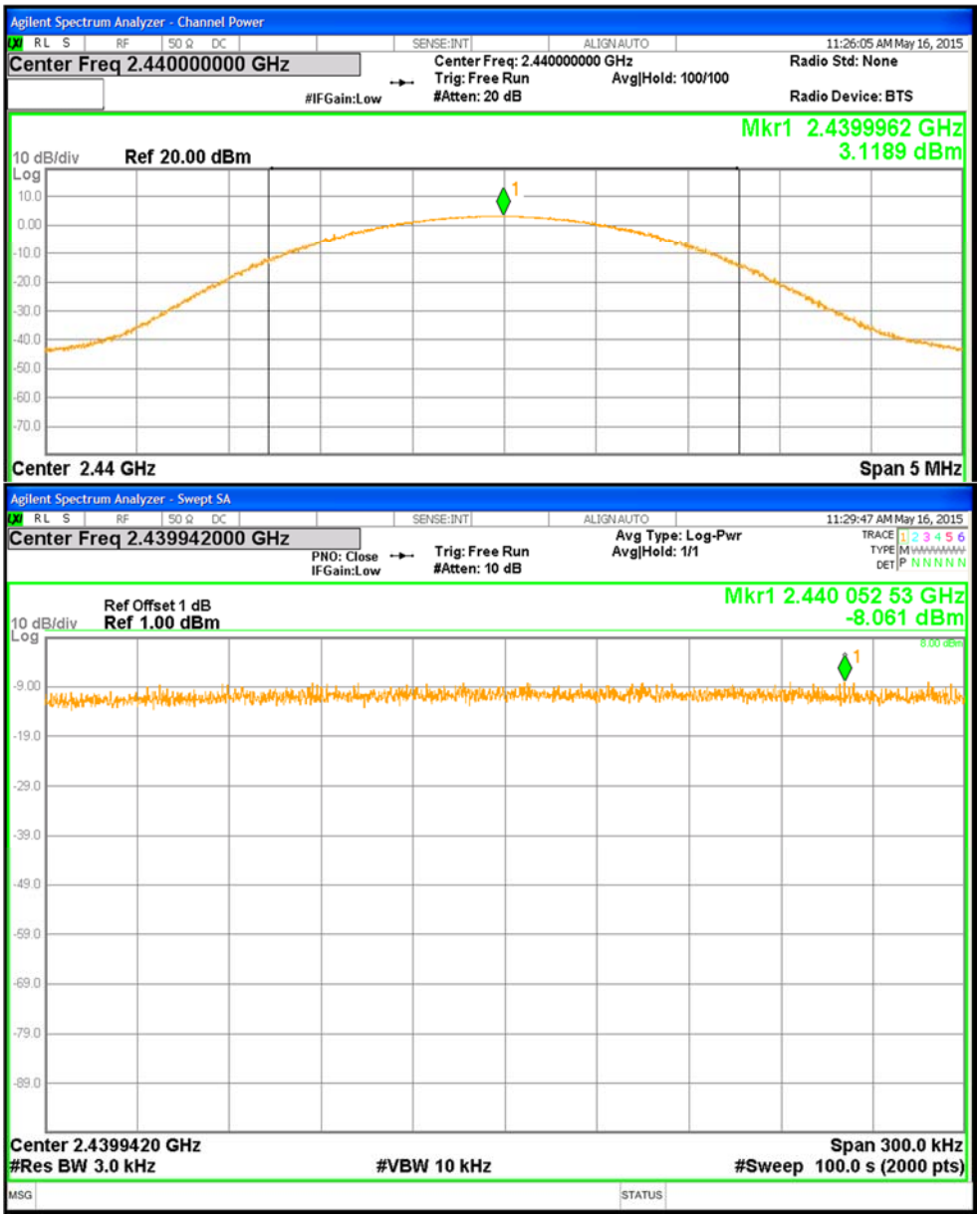


Figure 14: PSD 2440MHz BLE Mode at 1Mbps (close up Plot)

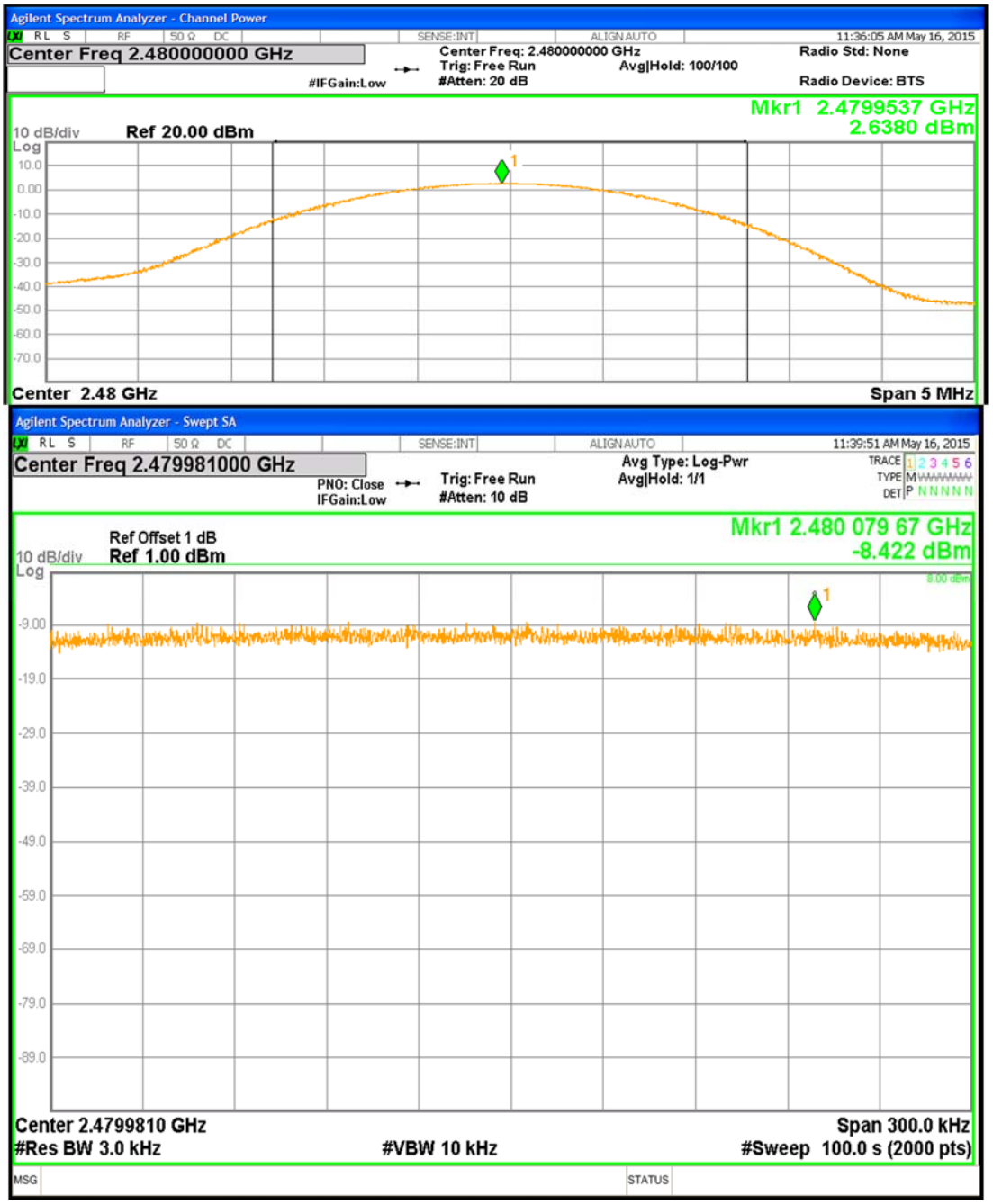


Figure 15: PSD, at 2480 MHz BLE Mode, 1 Mbps

4.5 Transmitter Spurious Emissions

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmit mode; per requirement of CFR47 15.205, 15.209, 15.407(b).

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 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.

Pres-scans were performed to determine the worst axis, 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 above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

The final scans performed on the worst axis, X-Axis, for three operating channels;

1 Mbit/s for 802.11 BLE Mode: 2402 MHz, 2440MHz, 2480 MHz

4.5.1.3 Deviations

None.

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: 2014.

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

4.5.3 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 6: Transmit Spurious Emission at Band-Edge Requirements

Test Conditions: Radiated Measurement, Normal Temperature and Voltage only								
Antenna Type: Internal Antennas				**Power Setting:** See test plan				
Max. Directional Gain: -3dBi				**Signal State:** Modulated at 100%.				
Ambient Temp.: 23 °C				**Relative Humidity:**33%				
Band-Edge Results								
Freq. (MHz)	Level (dBuV/m)	Polarity (H/V)	Limit (dBuV/m)	Margin (dB)	Det.	Table Deg.	Tower (cm)	Note
2389.87	56.18	V	74	−17.81	Pk	350	178	TX on 2402MHz
2389.84	40.85	V	54	−13.14	Avg	350	178	TX on 2402MHz
2389.84	56.38	H	74	−17.62	Pk	105	165	TX on 2402MHz
2389.84	42.66	H	54	−11.34	Avg	105	165	TX on 2402MHz
2483.75	46.29	V	74	−27.71	Pk	32	150	TX on 2480MHz
2483.75	46.29	V	54	−7.71	Avg	32	150	TX on 2480MHz
2484.35	58.03	H	74	−15.97	Pk	47	178	TX on 2480MHz
2483.75	46.29	H	54	−7.71	Avg	47	178	TX on 2480MHz

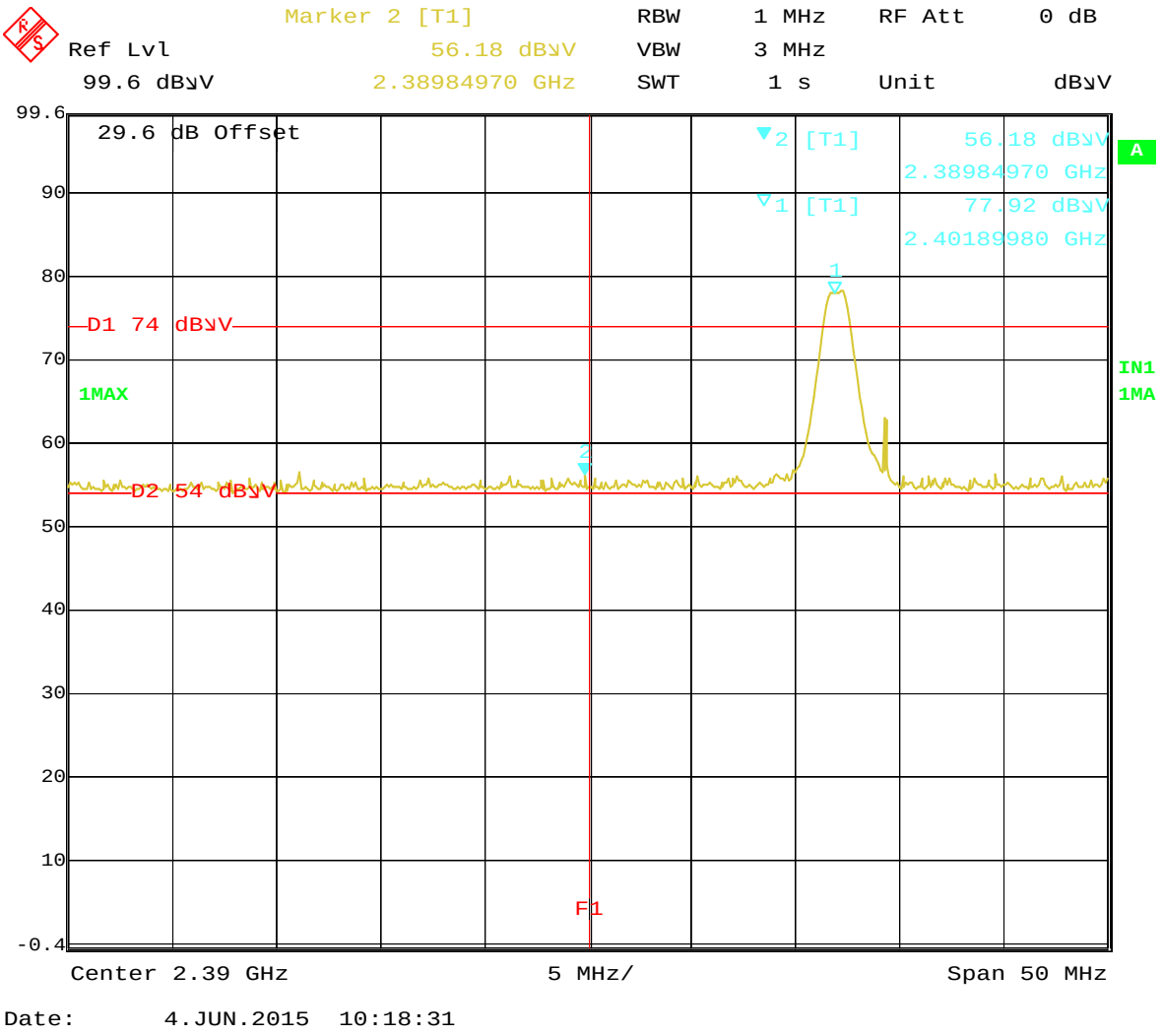


Figure 16: Radiated Emission at the Edge for 2402 MHz –Vert. (Pk)

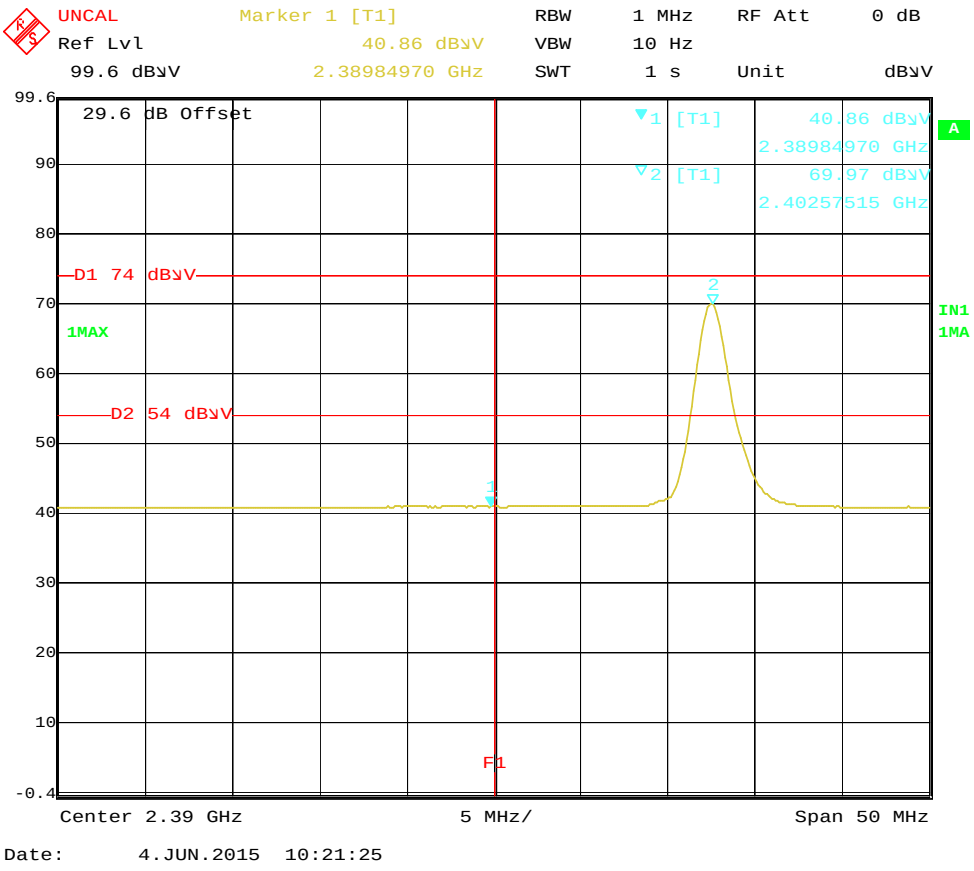


Figure 17: Radiated Emission at the Edge for 2402 MHz – Vert. (Avg)

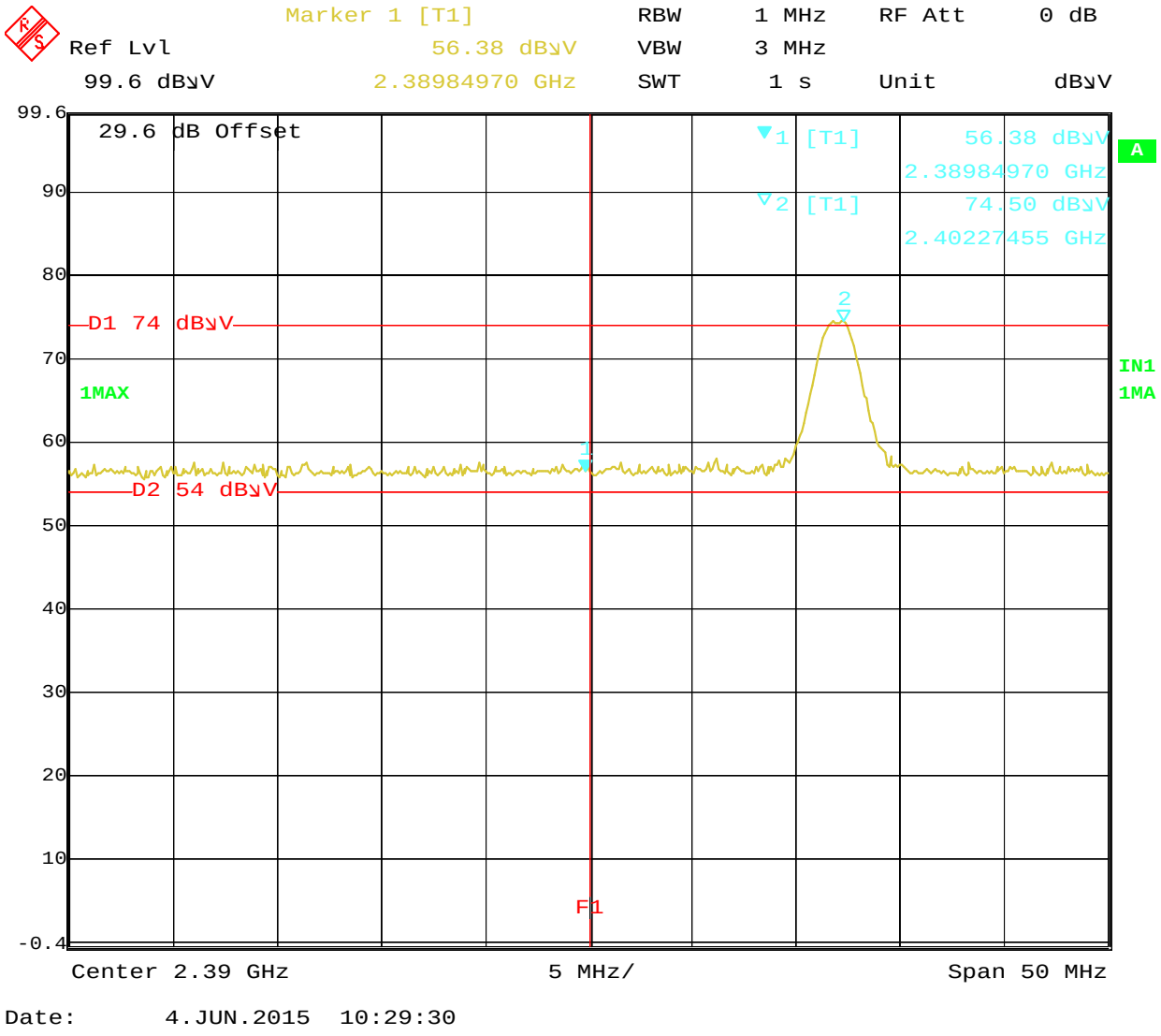


Figure 18: Radiated Emission at the Edge for 2402 MHz – Horz. (PK)

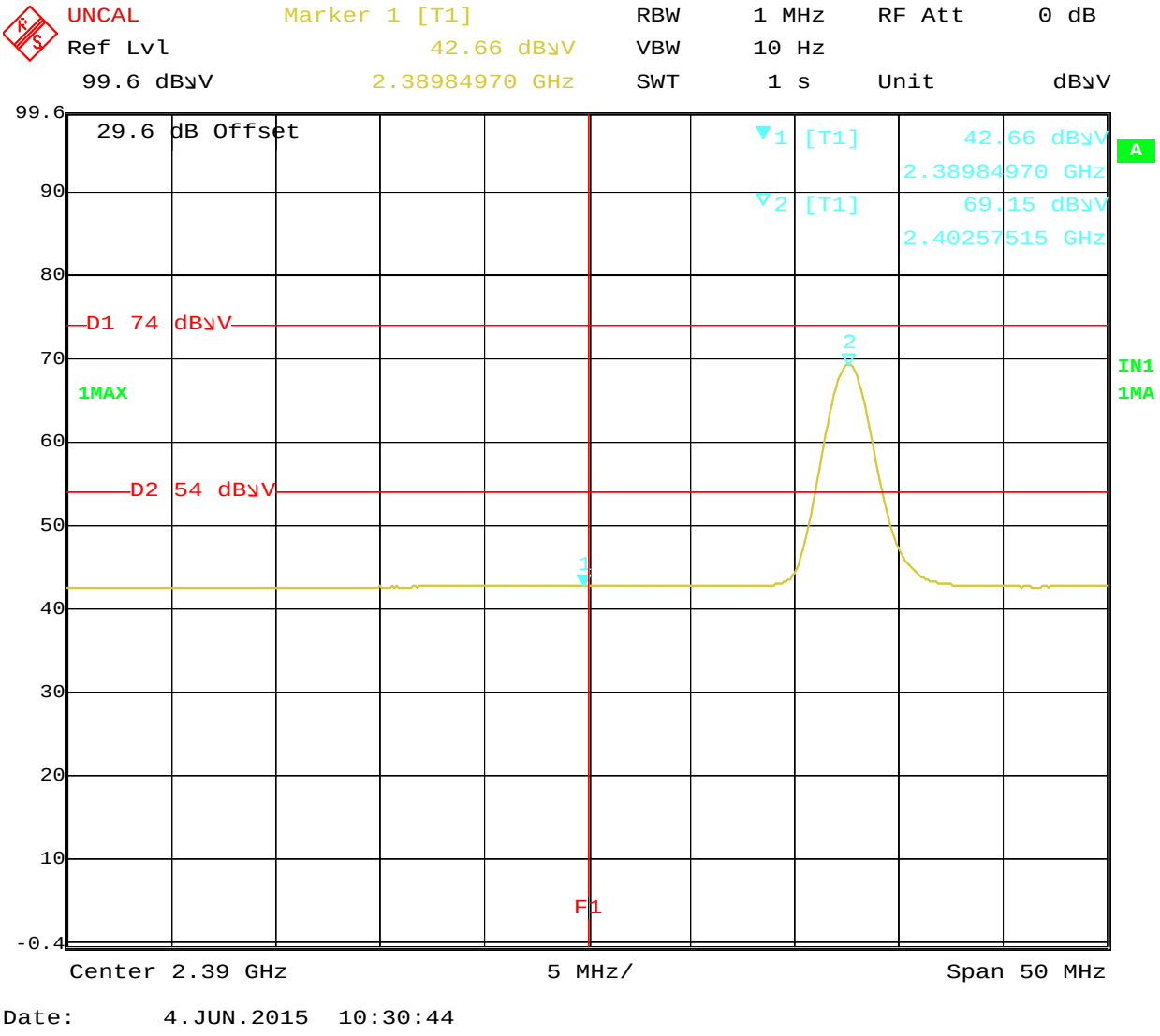


Figure 19: Radiated Emission at the Edge for 2402 MHz – Horz. (Avg)

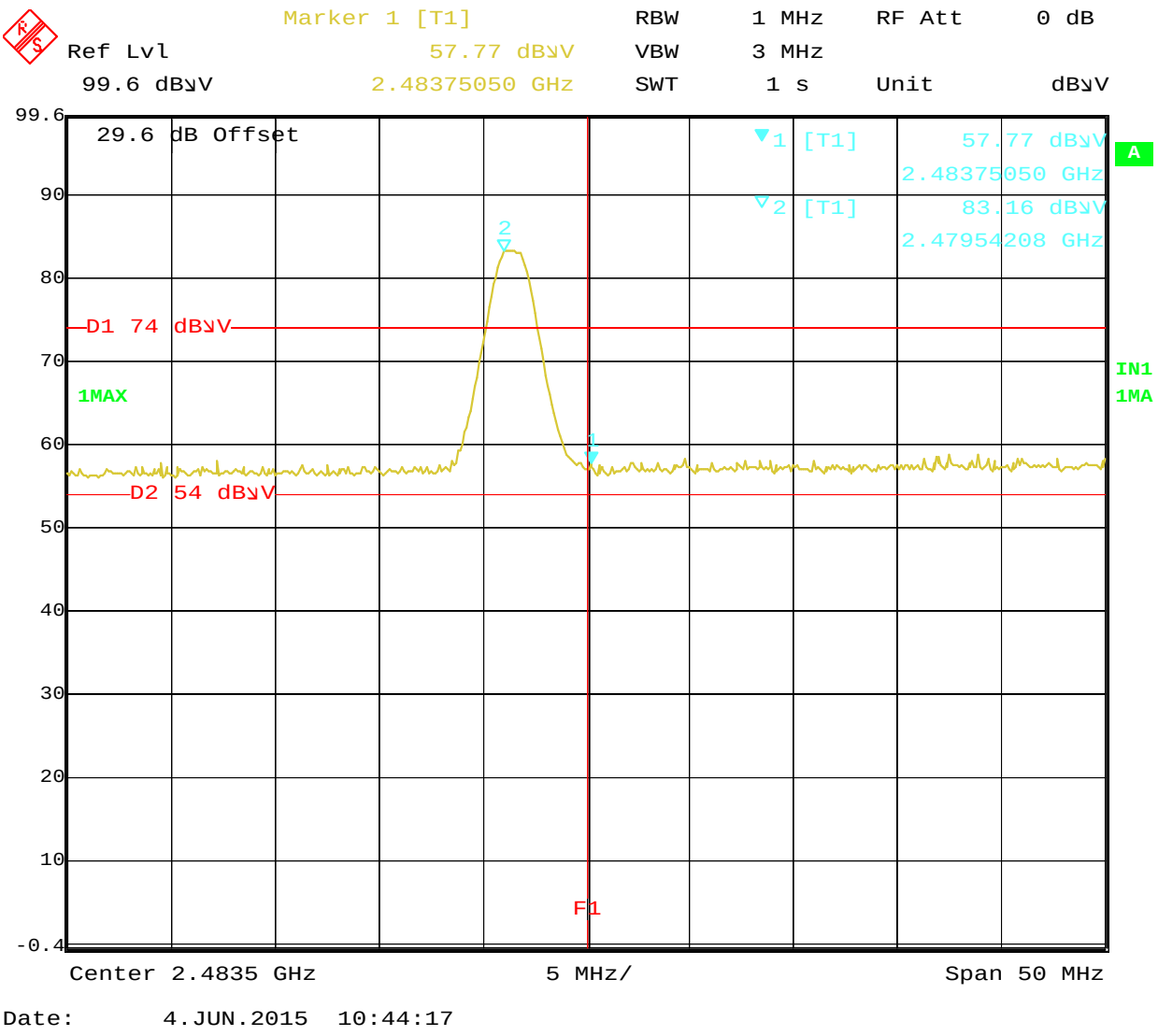


Figure 20: Radiated Emission at the Edge for 2480 MHz – Vert. (Pk)

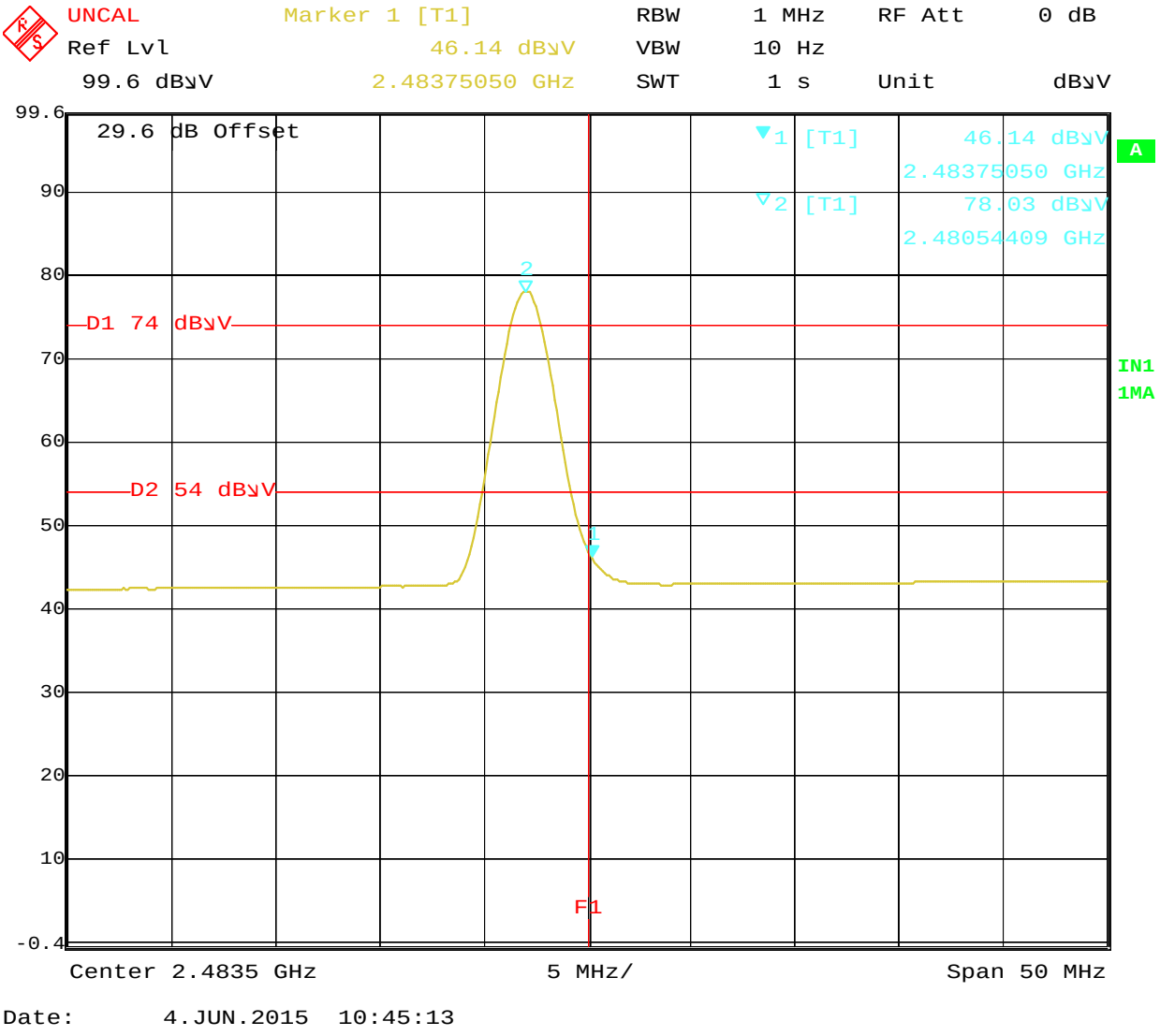


Figure 21: Radiated Emission at the Edge for 2480 MHz – Vert. (Avg)

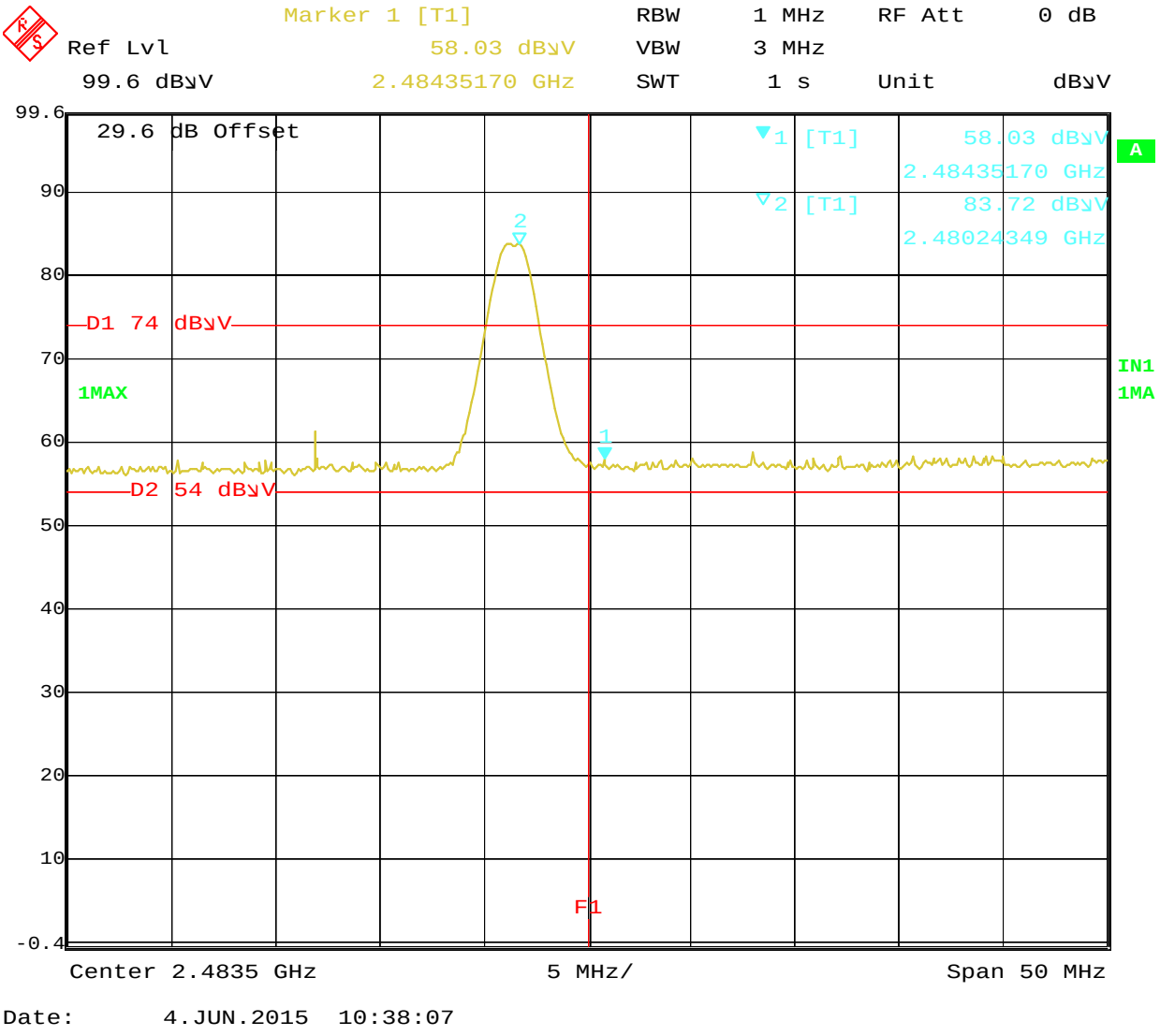


Figure 22: Radiated Emission at the Edge for 2480 MHz – Horz. (Pk)

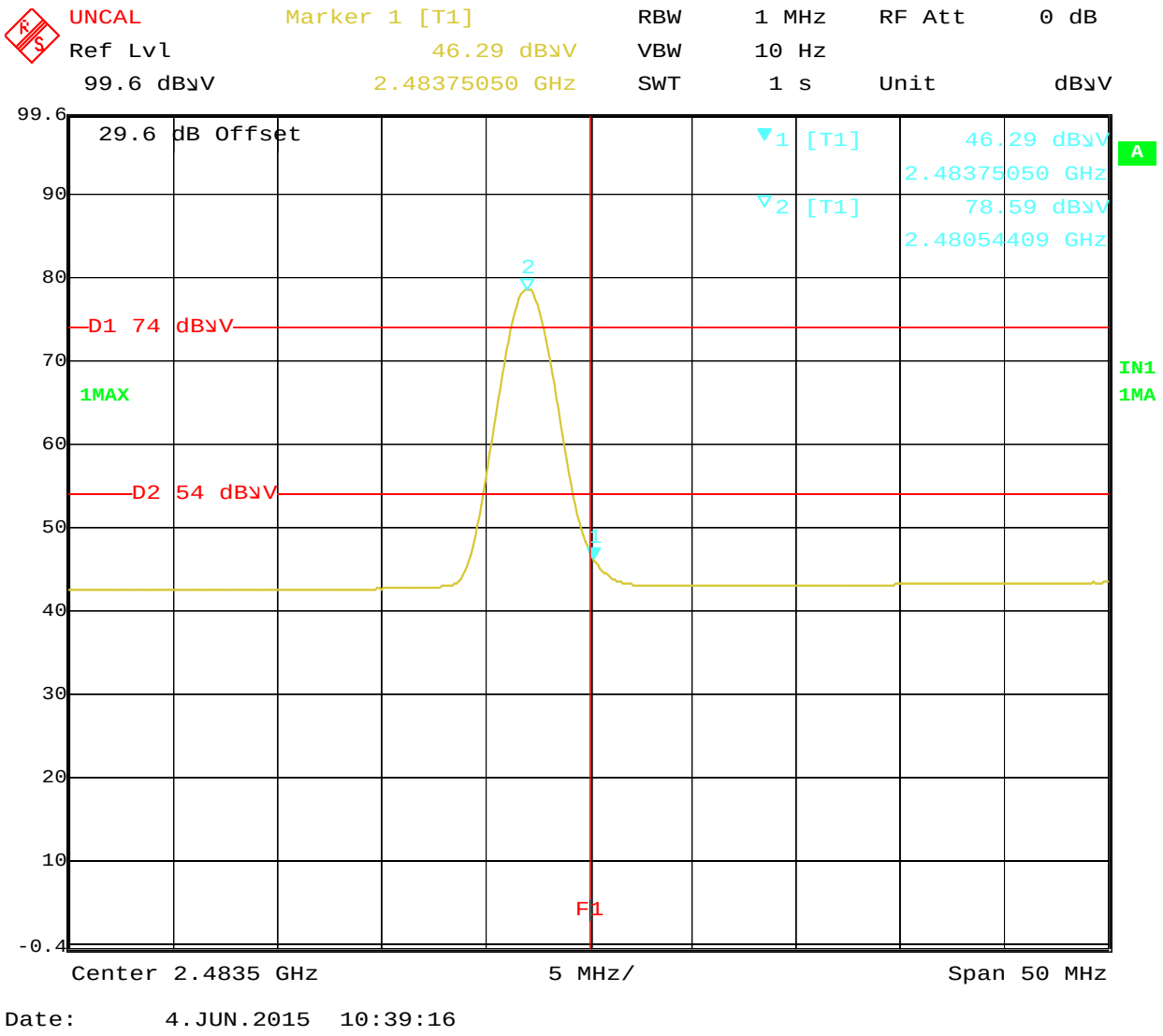


Figure 23: Radiated Emission at the Edge for 2480 MHz – Horz. (Avg)

Radiated Emissions

SOP 1 Radiated Emissions		Tracking # 31561768.001 Page 1 of 10	
EUT Name	Wireless Access Point	**Date**	May 30, 2015
EUT Model	APIN0324 and APIN0325	**Temp / Hum in**	23° C / 28%rh
EUT Serial	DD0000428, with Internal antenna	**Temp / Hum out**	N/A
EUT Config.	X-Axis, 802.11 BLE mode at 1.0 Mbps	**Line AC / Freq**	5V DC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Suresh Kondapalli

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 MHz 1 GHz Transmitted at 802.11 BLE 1Mbps TX On 2402MHz											
178.76	43.67	3.54	-21.14	26.07	QP	H	205	70	43.50	-17.43	Pass
208.00	32.79	3.66	-21.14	15.31	QP	H	244	264	43.50	-28.19	Pass
166.97	42.41	3.48	-20.35	25.53	QP	V	249	334	43.50	-17.97	Pass
172.79	43.54	3.51	-20.83	26.22	QP	V	101	304	43.50	-17.28	Pass
180.25	30.18	3.54	-21.03	12.69	QP	V	203	248	43.50	-30.81	Pass
248.96	33.67	3.84	-20.39	17.11	QP	V	123	-2	46.00	-28.89	Pass
30 MHz 1 GHz Transmitted at 802.11 BLE 1Mbps TX On 2440MHz											
166.97	38.94	3.48	-20.35	22.07	QP	H	263	238	43.50	-21.43	Pass
184.63	35.42	3.57	-20.93	18.06	QP	H	263	16	43.50	-25.44	Pass
249.10	32.02	3.84	-20.39	15.47	QP	H	277	80	46.00	-30.53	Pass
458.27	22.87	4.56	-15.35	12.08	QP	H	180	-2	46.00	-33.92	Pass
178.69	39.56	3.54	-21.14	21.96	QP	V	116	6	43.50	-21.54	Pass
559.61	22.94	4.87	-13.77	14.04	QP	V	158	94	46.00	-31.96	Pass
30 MHz 1 GHz Transmitted at 802.11 BLE 1Mbps TX On 2480MHz											
196.30	34.22	3.61	-19.55	18.29	QP	H	213	92	43.50	-25.22	Pass
213.87	32.59	3.69	-21.22	15.06	QP	H	315	130	43.50	-28.44	Pass
237.33	30.44	3.79	-20.45	13.78	QP	H	334	68	46.00	-32.22	Pass
143.54	23.27	3.36	-19.39	7.25	QP	V	372	92	43.50	-36.26	Pass
207.94	34.48	3.66	-21.13	17.01	QP	V	215	176	43.50	-26.49	Pass
254.87	32.22	3.86	-20.20	15.87	QP	V	248	270	46.00	-30.13	Pass

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

SOP 1 Radiated Emissions

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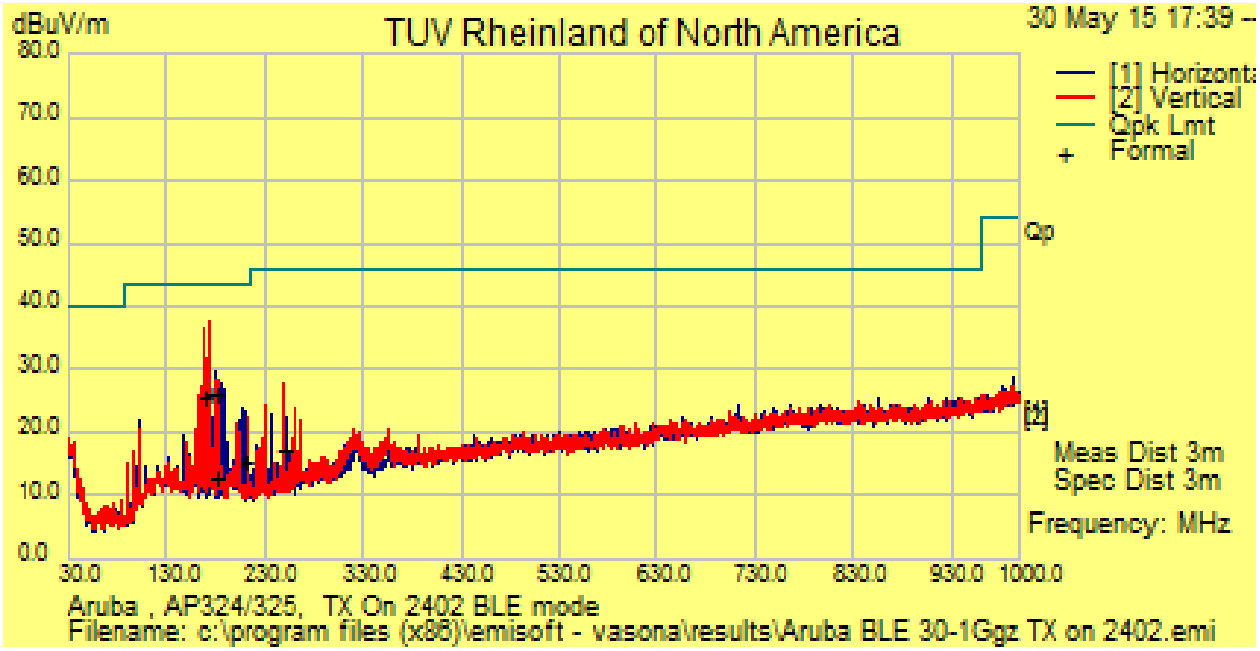
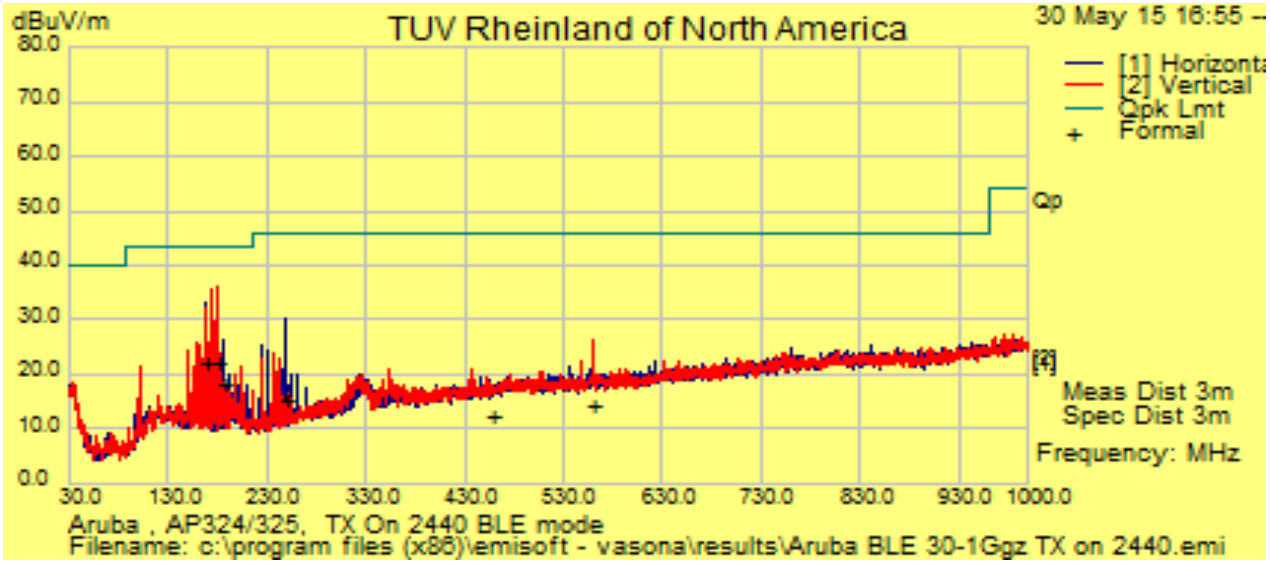
EUT Name	Wireless Access Point	**Date**	May 30, 2015
EUT Model	APIN0324 and APIN0325	**Temp / Hum in**	23°C / 28%rh
EUT Serial	DD0000428, with Internal antennas	**Temp / Hum out**	N/A
EUT Config.	X-Axis, 802.11BLE at 1Mbps/ chain	**Line AC**	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3m – JB3	**Performed by**	Suresh

30MHz to 1 GHz Plot for Transmit BLE Mode at 2402MHz



30MHz to 1 GHz Plot for Transmit BLE Mode at 2440MHz



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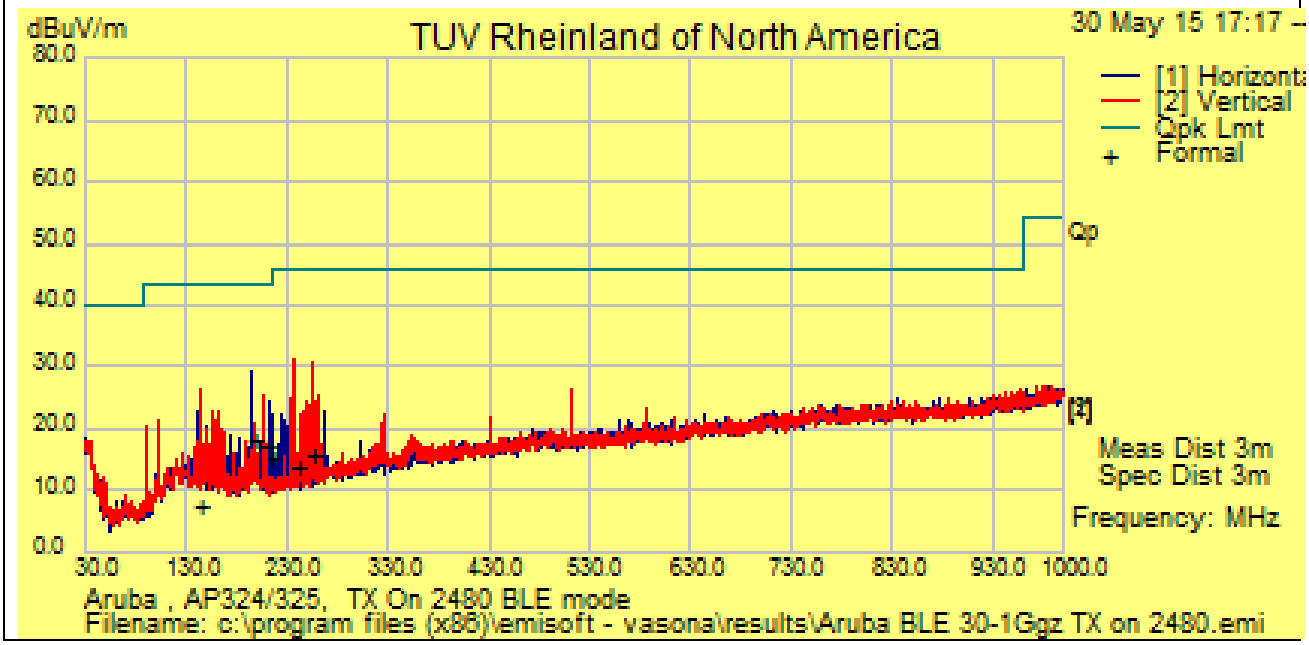
EUT Name	Wireless Access Point	**Date**	May 30, 2015
EUT Model	APIN0324 and APIN0325	**Temp / Hum in**	23°C / 28%rh
EUT Serial	DD0000428, with Internal antennas	**Temp / Hum out**	N/A
EUT Config.	X-Axis, 802.11 BLE at 1Mbps/ chain	**Line AC**	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3m – JB3	**Performed by**	Suresh

30MHz to 1 GHz Plot for Transmit BLE Mode TX on 2480



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EUT Name	Wireless Access Point	**Date**	Jun 04, 2015
EUT Model	APIN0324 and APIN0325	**Temp / Hum in**	23° C / 28%rh
EUT Serial	DD0000428, with Internal antennas	**Temp / Hum out**	N/A
EUT Config.	X-Axis, 802.11BLE mode at 1.0 Mbps/ chain	**Line AC / Freq**	5V DC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Suresh Kondapalli

1 to 18 GHz Transmitted at 802.11 BLE mode TX On 2402-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	
1098.19	47.05	0.81	-25.60	22.26	Avg	V	116	188	54.00	-31.74	Pass
2132.32	42.84	1.15	-22.69	21.30	Avg	V	169	218	54.00	-32.70	Pass
3187.94	44.21	1.44	-19.29	26.35	Avg	V	224	150	54.00	-27.65	Pass
3998.06	40.75	1.64	-16.87	25.53	Avg	V	238	220	54.00	-28.47	Pass
4805.92	55.16	1.87	-16.08	40.96	Avg	V	211	188	54.00	-13.04	Pass
14241.74	39.50	3.22	-7.71	35.02	Avg	V	174	198	54.00	-18.98	Pass
1 to 18 GHz Transmitted at 802.11 BLE mode TX On 2440MHz											
1000.00	44.88	0.78	-26.15	19.51	Avg	V	166	164	54.00	-34.49	Pass
1093.70	44.01	0.81	-25.62	19.19	Avg	V	201	156	54.00	-34.81	Pass
1599.74	43.17	0.98	-25.08	19.07	Avg	V	188	6	54.00	-34.93	Pass
4881.93	57.46	1.88	-15.86	43.49	Avg	V	133	34	54.00	-10.51	Pass
7319.20	38.49	2.29	-11.36	29.42	Avg	V	238	194	54.00	-24.58	Pass
14358.19	39.62	3.29	-7.46	35.46	Avg	V	150	62	54.00	-18.54	Pass
1 to 18 GHz Transmitted at 802.11BLE mode 1Mbps TX On 2480MHz											
4958.01	59.69	1.87	-15.74	45.82	Avg	H	180	158	54.00	-8.18	Pass
14559.75	39.17	3.42	-7.37	35.22	Avg	H	212	156	54.00	-18.78	Pass
1397.91	43.84	0.92	-25.22	19.54	Avg	V	208	178	54.00	-34.46	Pass
1498.42	43.85	0.95	-24.92	19.88	Avg	V	116	196	54.00	-34.13	Pass
7439.16	58.93	2.31	-10.98	50.27	Avg	V	251	190	54.00	-3.73	Pass
12398.66	48.37	3.03	-10.94	40.46	Avg	V	201	355	54.00	-13.54	Pass

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

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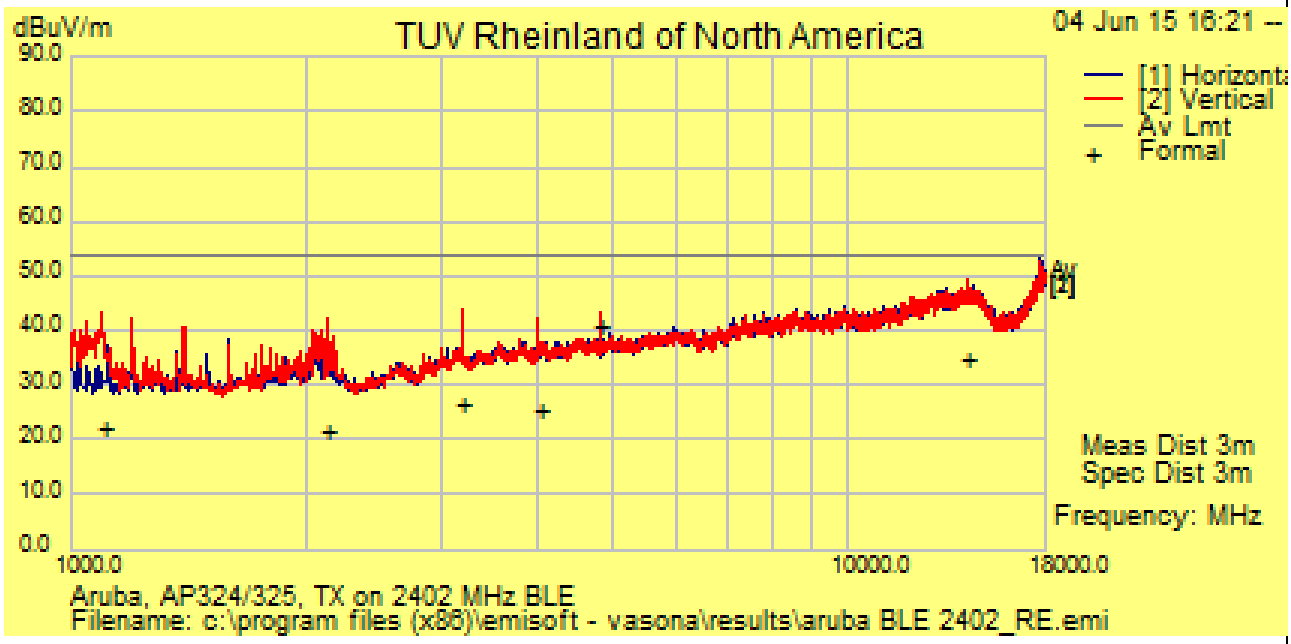
EUT Name	Wireless Access Point	**Date**	Jun 04, 2015
EUT Model	APIN0324 and APIN0325	**Temp / Hum in**	23°C / 33%rh
EUT Serial	DD0000409, with Internal antennas	**Temp / Hum out**	N/A
EUT Config.	x-Axis, 802.11 BLE at 1Mbps	**Line AC**	5V DC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh

1 to 18 GHz Plots for Transmit Mode BLE at 2402MHz



Notes

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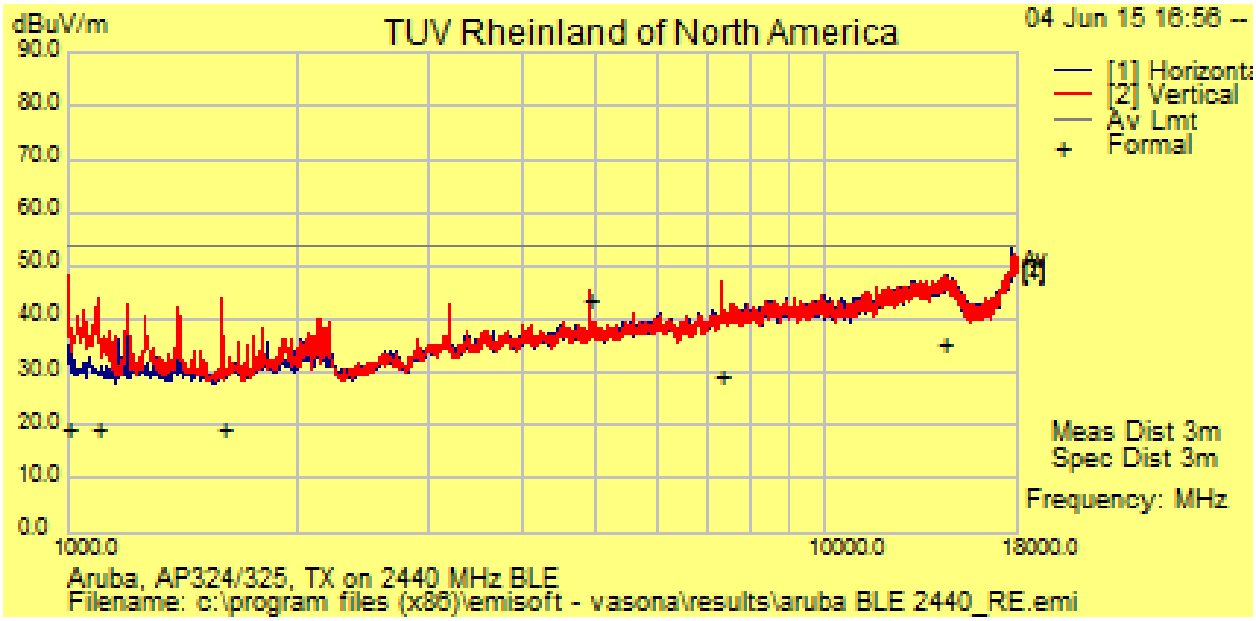
EUT Name	Wireless Access Point	**Date**	Jun 04, 2015
EUT Model	APIN0324 and APIN0325	**Temp / Hum in**	23°C / 33%rh
EUT Serial	DD0000409, with Internal antennas	**Temp / Hum out**	N/A
EUT Config.	X-Axis, 802.11BLE mode	**Line AC**	5V DC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3MHz
Dist/Ant Used	1m - RA42-K-F-4B-C	**Performed by**	Suresh

18 -26GHz Plots for Transmit BLE Mode at 2440 MHz



Notes:

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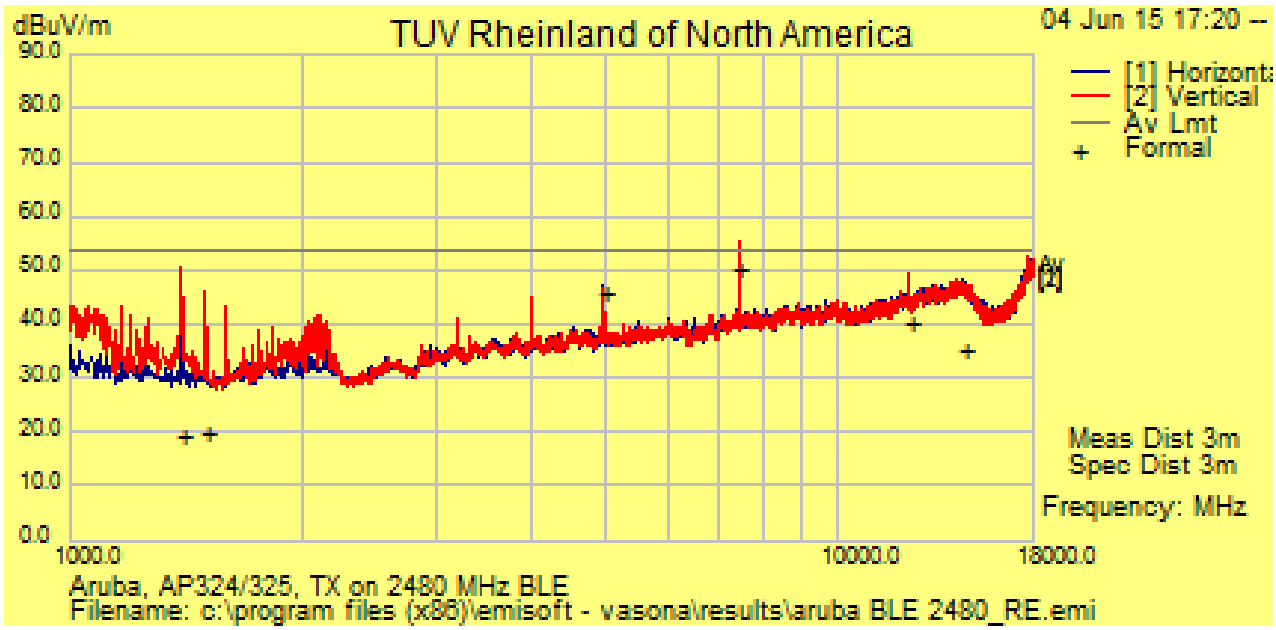
EUT Name	Wireless Access Point	**Date**	Jun 04, 2015
EUT Model	APIN0324 and APIN0325	**Temp / Hum in**	23°C / 33%rh
EUT Serial	DD0000409, with Internal antennas	**Temp / Hum out**	N/A
EUT Config.	X-Axis, 802.11 BLE mode at 1 Mbps	**Line AC**	5V DC
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh K

1-18 GHz Plots for Transmit Mode BLE at 2480 MHz



Notes:

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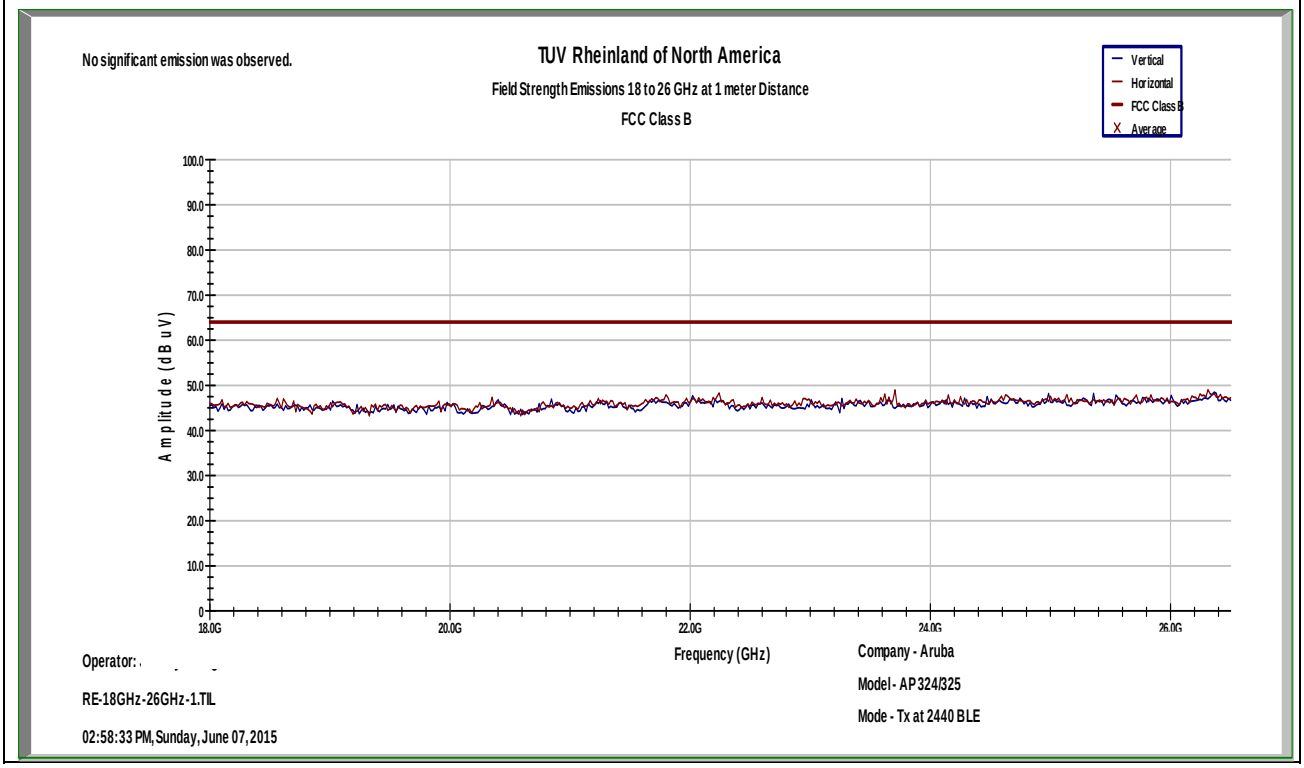
EUT Name	Wireless Access Point	**Date**	Jun 04, 2015
EUT Model	APIN0324 and APIN0325	**Temp / Hum in**	23°C / 28%rh
EUT Serial	DD0000428, with Internal Antenna	**Temp / Hum out**	N/A
EUT Config.	X-Axis, 802.11BLE mode at 1Mbps/ chain	**Line AC**	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3m – JB3	**Performed by**	Suresh

18 GHz to 26 GHz Plot for Transmit Mode BLE Mode at 2440 MHz



Notes: Low, Mid and High channels were evaluated. Mid channel results presented here

4.5.4 Sample Calculation

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:

$$\text{Field Strength (dB}\mu\text{V/m)} = \text{FIM - AMP + CBL + ACF}$$

Where: FIM = Field Intensity Meter (dBμV)
AMP = Amplifier Gain (dB)
CBL = Cable Loss (dB)
ACF = Antenna Correction Factor (dB/m)

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

4.6 AC Conducted Emissions

Testing was performed in accordance with ANSI C63.4: 2010. 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: 2014.

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

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

4.6.1.1 Deviations

There were no deviations from this test methodology.

4.6.2 Test Results

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

Table 7: AC Conducted Emissions – Test Results

Test Conditions: Conducted Measurement at Normal Conditions only		
Antenna Type: Attached	**Power Level:** See Test Plan	
AC Power: 120 Vac/60 Hz	**Configuration:** Tabletop	
Ambient Temperature: 22° C	**Relative Humidity:** 37% 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 # 31561768.001 Page 1 of 4

EUT Name	Wireless Access Point	**Date**	April 20, 2015
EUT Model	APIN0324 and APIN0325	**Temp / Hum in**	23° C / 34% rh
EUT Serial	DD0000501	**Temp / Hum out**	N/A
EUT Config.	External Antenna TX ON 2437MHz HT20	**Line AC / Freq**	120Vac/60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	Lab #2 /Com-Power, Line 1	**Performed by**	Suresh K

Frequency	Raw	Limiter	Ins. Loss	Level	Detector	Line	Limit	Margin	Result
MHz	dBuV	dB	dB	dBuV		Line	dBuV	dB	
0.15	33.56	9.96	-0.10	43.42	QP	Live	66.00	-22.58	Pass
0.15	18.45	9.96	-0.10	28.31	Avg	Live	56.00	-27.69	Pass
0.16	34.04	9.96	-0.10	43.90	QP	Live	66.00	-22.10	Pass
0.16	14.82	9.96	-0.10	24.68	Avg	Live	56.00	-31.32	Pass
0.19	43.13	9.96	-0.08	53.02	QP	Live	63.83	-10.81	Pass
0.19	26.02	9.96	-0.08	35.91	Avg	Live	53.83	-17.93	Pass
0.26	35.90	9.98	-0.06	45.82	QP	Live	61.44	-15.63	Pass
0.26	24.84	9.98	-0.06	34.76	Avg	Live	51.44	-16.69	Pass
0.53	25.06	9.99	-0.04	35.01	QP	Live	56.00	-20.99	Pass
0.53	14.74	9.99	-0.04	24.69	Avg	Live	46.00	-21.31	Pass
16.48	24.56	10.18	0.09	34.84	QP	Live	60.00	-25.16	Pass
16.48	18.43	10.18	0.09	28.71	Avg	Live	50.00	-21.29	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

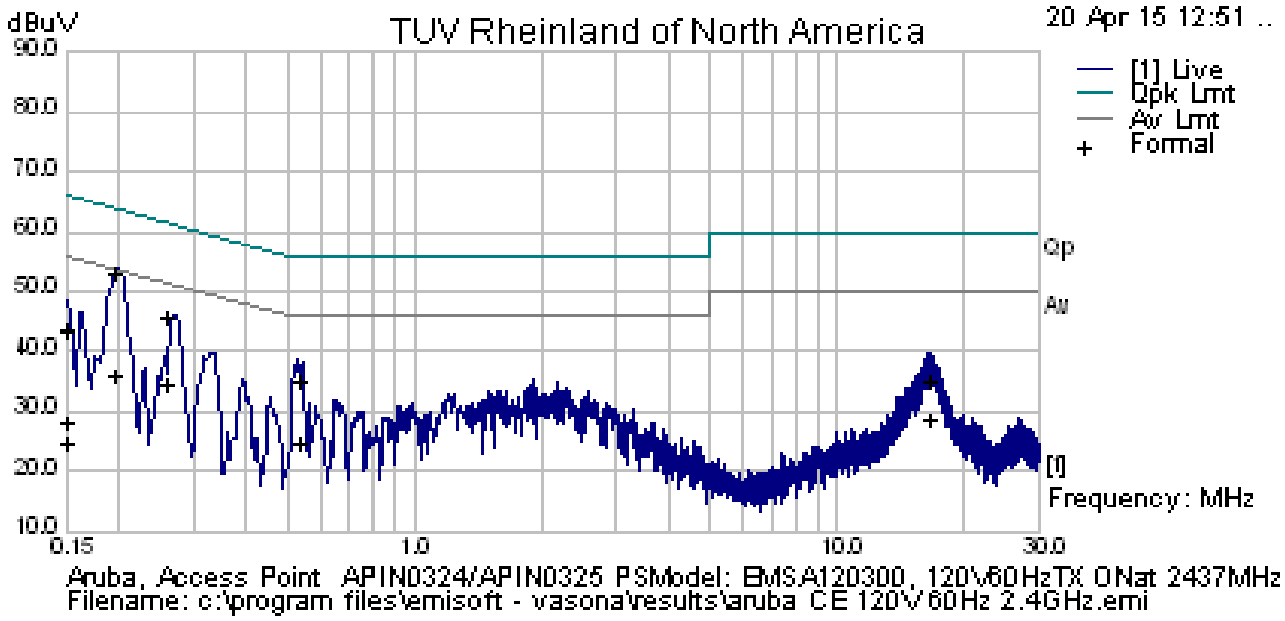
Notes: EUT was setup as table top equipment and transmitted at 2437MHz in HT20 at 6.5Mbps; EUT is a ON BLE mode always ON when EUT is powered on.

SOP 2 Conducted Emissions

Tracking # 31561768.001 Page 2 of 4

EUT Name	Wireless Access Point	**Date**	April 20, 2015
EUT Model	APIN0324 and APIN0325	**Temp / Hum in**	23° C / 34% rh
EUT Serial	DD0000510	**Temp / Hum out**	N/A
EUT Config.	External Antenna TX ON 2437MHz HT20	**Line AC**	120Vac/60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	Lab #2 /Com-Power, Line 1	**Performed by**	Suresh

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



Notes: Meet FCC Class B limit.

SOP 2 Conducted Emissions

Tracking # 31561768.001 Page 3 of 4

EUT Name	Wireless Access Point	**Date**	April 20, 2013
EUT Model	APIN0324 and APIN0325	**Temp / Hum in**	23° C / 34% rh
EUT Serial	DD0000510	**Temp / Hum out**	N/A
EUT Config.	External Antenna TX ON 2437MHz HT20	**Line AC / Freq**	120Vac/60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	Lab #2 /Com-Power, Line 2	**Performed by**	Suresh

Frequency	Raw	Limiter	Ins. Loss	Level	Detector	Line	Limit	Margin	Result
MHz	dBuV	dB	dB	dBuV		Line	dBuV	dB	
0.19	43.04	9.96	-0.08	52.92	QP	Neutral	63.95	-11.03	Pass
0.19	25.70	9.96	-0.08	35.58	Avg	Neutral	53.95	-18.37	Pass
0.19	43.29	9.96	-0.08	53.17	QP	Neutral	63.87	-10.70	Pass
0.19	26.77	9.96	-0.08	36.65	Avg	Neutral	53.87	-17.22	Pass
0.26	35.78	9.98	-0.06	45.70	QP	Neutral	61.51	-15.81	Pass
0.26	25.59	9.98	-0.06	35.51	Avg	Neutral	51.51	-16.00	Pass
0.34	24.37	9.98	-0.05	34.30	QP	Neutral	59.16	-24.86	Pass
0.34	3.34	9.98	-0.05	13.28	Avg	Neutral	49.16	-35.89	Pass
0.58	23.81	10.00	-0.04	33.77	QP	Neutral	56.00	-22.23	Pass
0.58	13.94	10.00	-0.04	23.90	Avg	Neutral	46.00	-22.10	Pass
16.81	29.72	10.19	0.10	40.00	QP	Neutral	60.00	-20.00	Pass
16.81	22.44	10.19	0.10	32.73	Avg	Neutral	50.00	-17.27	Pass

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

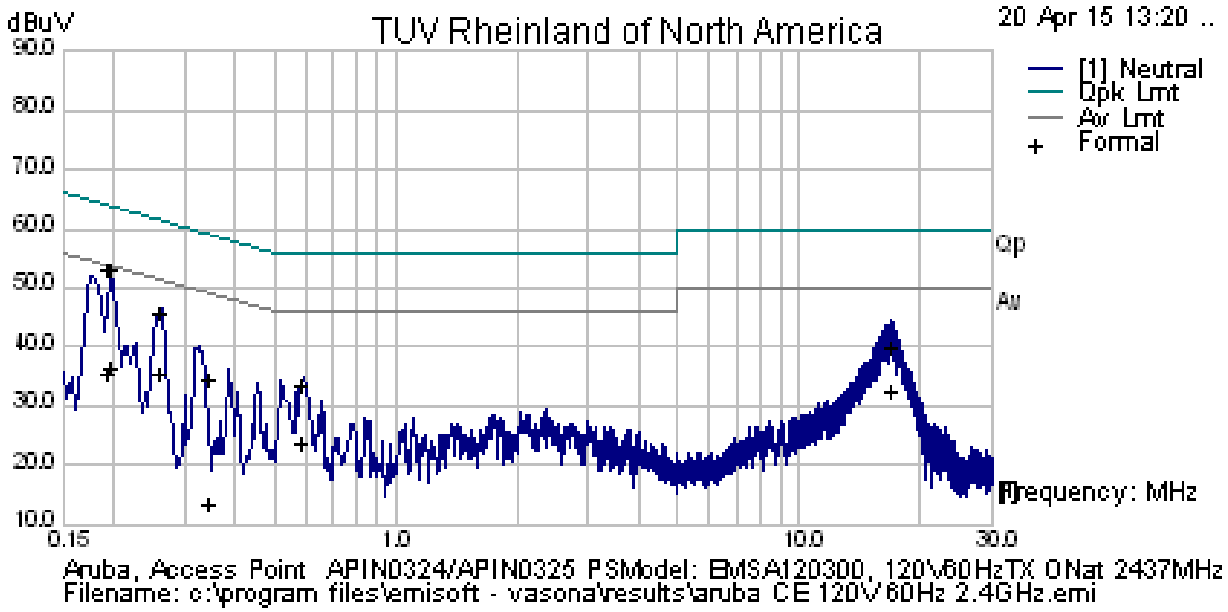
Combined Standard Uncertainty $u_c(y)$ = ± 1.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: EUT was setup as table top equipment and transmitted at 2437 MHz in b mode at 1Mbps

SOP 2 Conducted Emissions — Tracking # 31561768.001 Page 4 of 4

EUT Name	Wireless Access Point	**Date**	April 20, 2013
EUT Model	APIN0324 and APIN0325	**Temp / Hum in**	23° C / 34% RH
EUT Serial	DD0000510	**Temp / Hum out**	N/A
EUT Config.	External Antenna TX ON 2437MHz HT20	**Line AC**	120Vac/60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	Lab #2 /Com-Power, Line 2	**Performed by**	Suresh

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



Note: Meet 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/cm^2)	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**.

4.7.5 Test Results

4.7.5.1 Antenna Gain

The highest directional antenna gain for 2.4 GHz band was +11.5dBi or 14.12(numeric).

The highest directional antenna gain for 2.4 GHz band was +12.0dBi or 15.84(numeric).

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

BLE operates simultaneously with 2.4 GHz band or 5GHz band

a) Simultaneous operation with 2.4GHz DTS mode

DTS power	24.39dBm
BLE mode power	3.81dBm
Simultaneously operation power	0.2752 watts

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 +24.39 dBm or 275mW

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

Pd = (275*14.12) / (1600π) = 0.772 mW/cm2, which is 0. 227 mW/cm2 below to the limit.

b) Simultaneous operation with 5.0GHz UNII band (5150-5250 and 5725-5850MHz Bands)

UNII band power 24.76dBm (From TUV test report 31560848.001)

BLE mode Power 3.81dBm

Simultaneously operation power 0.3012 watts (24.78dBm)

Calculations for this report are based on highest power measurement.

Limit for MPE (from FCC part 1.1310 table1) is 1.0 mW/cm2

The highest measured total power is +24.78dBm or 301mW

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

Pd = (301*15.84) / (1600π) = 0.9485 mW/cm2, which is 0.051mW/cm2 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	07/08/2014	07/08/2016
Bilog Antenna	Sunol Sciences	JB3	A020502	04/30/2015	04/30/2017
Horn Antenna	EMCO	3115	9710-5301	09/04/2013	09/04/2015
Antenna (18-26GHz)	CMT	RA42-K-F-4B-C	020131-004	07/24/2014	07/24/2015
Spectrum Analyzer	Agilent	N9038A	MY51210195	01/12/2015	01/12/2016
Spectrum Analyzer	Agilent	N9030A	MY51380689	01/19/2015	01/19/2016
Spectrum Analyzer	Rohde Schwarz	ESIB	832427/002	01/13/2015	01/13/2016
Amplifier	Sonoma Instruments	310	213221	09/30/2014	09/30/2015
Amplifier	Miteq	TTA1800-30-4G	1842452	01/13/2015	01/13/2016
Amplifier	Rohde & Schwarz	TS-PR26	100011	07/24/2014	07/24/2016
Amplifier	Rohde & Schwarz	TS-PR40	100012	02/21/2015	02/21/2016
Power Meter	Agilent	E4418B	MY45103902	01/15/2015	01/15/2016
Power Sensor	Hewlett Packard	8482A	US37295801	01/15/2015	01/15/2016
DC Power Supply	Agilent	E3634A	MY400004331	01/12/2015	01/12/2016
Notch Filter	Micro-Tronics	BRM50716	003	01/30/2015	01/30/2016
Signal Generator	Anritsu	MG3694A	42803	01/13/2015	01/13/2016

* 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.

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 8: Customer Information

Company Name	Aruba Networks
Address	1344 Crossman Ave.
City, State, Zip	Sunnyvale CA 94089
Country	USA
Phone	(408) 990-2557

Table 9: Technical Contact Information

Name	Rob Hastings
E-mail	rhastings@arubanetworks.com
Phone	(408) 990-2557

6.3 Equipment Under Test (EUT)

Table 10: EUT Specifications

EUT Specifications	
Dimensions	180mm x 180mm x 45mm (W x D x H)
AC Adapter (EMSA120300, S/N:)	Input Voltage: 100-240Vac 50-60Hz Input Current: 1A Output Voltage: 12VDC Output Current: 3.0A Power over Ethernet (PoE): 48 Vdc (nominal)
Environment	Indoor
Operating Temperature Range:	0 to 50 degrees C
Multiple Feeds:	☐ Yes ☒ No BLE mode has one internal Antenna
Hardware Version	3
Part Number	APIN0324 & APIN0325
RF Software Version	Texas Instruments Smart RF Studio 7 QSPR Version 5.0.0 RF Test Image used with QSPR: ipq806xrd_2gpcie11_78hex_5gpcie_50hex.ari
802.11-radio modules	
Operating Modes	802.15.1Bluetooth Low Energy (BLE) Protocol and 802.11a, b, g, nHT 20, HT40, VHT20, VHT40, VHT80
Transmitter Frequency Band	2.4GHz 2400-2483.5MHz; BLE 2400-2483.5MHz 5.15 GHz to 5.25 GHz 5.25GHz to 5.35GHz 5.47GHz to 5.725GHz 5.725 GHz to 5.85 GHz
Max. Rated Power Output	See Channel Planning Table.
Power Setting @ Operating Channel	See Channel Planning Table.
Antenna Type	802.15.1 Bluetooth Low Energy Mode operate with Internal antenna
Antenna Gain	See details below
Modulation Type	☐ AM ☐ FM ☒ DSSS ☐ OFDM ☐ Other describe

EUT Specifications	
Data Rate	802.11 Bluetooth Low Energy Mode 1MBps 802.11b: 1, 2, 5.5, 11 802.11a/g: 6, 9, 12, 18, 24, 36, 48, 54 802.11n: 6.5 to 450 (MCS0 to MCS23) 802.11ac: 6.5 to 1,733 (MCS0 to MCS9, NSS = 1 to 4)
TX/RX Chain (s)	Single PCB antenna for BLE MIMO (4x4)
Directional Gain Type	☐ Correlated ☐ Beam-Forming ☐ Other describe:
Type of Equipment	☐ Table Top ☒ Wall-mount ☐ Floor standing cabinet ☒ Other Ceiling Mounted
Note: 1. All four chains will be on / transmitted at all time. 2.This report only documents the radio characteristics for 2400 – 2483.5MHz band	

Internal Antenna for BLE

Model:	Type	Gain dBi	Frequency MHz	Beam Forming Gain (dBi)
PCB trace	Omni	-3.0	2400 - 2500	N/A

Table 11: Interface Specifications

Interface Type	Cabled with what type of cable?	Is the cable shielded?	Maximum potential length of the cable?	Metallic (M), Coax (C), Fiber (F), or Not Applicable?
RJ45	CAT-5 Ethernet	☐ No	☒ Metric: 10 m	☒ M

Table 12: Supported Equipment

Equipment	Manufacturer	Model	Serial	Used for
Laptop	Dell	PP23LB	9271001233	Setup EUT operating channel
Note: None.				

Table 13: Description of Sample used for Testing

Device	Serial	RF Connection	CFR47 Part 15.247
APIN0325/A PIN0324	DD0000428	Integrated Antenna	Radiated Emissions and Band edges
APIN0325/A PIN0324	DD0000428	Direct via reverse U.FL to SMA connector provided by Aruba	Output Power, Peak Power Spectral Density, Occupied Bandwidth Conducted Spurious Emission

Table 14: Description of Test Configuration used for Radiated Measurement.

Device	Antenna	Mode	Setup Photo (X-Axis)	Setup Photo (Y-Axis)	Setup Photo (Z-Axis)
APIN0325	Integrated	Transmit	 EUT laid flat.	 EUT UP Right	Na.
Note: Pre-scans were performed in 2 supporting axis Wall mounted or Ceiling mounted and X-axis simulating ceiling mounted was worst.					

Table 15: Final Test Mode for 2402 - 2480 BLE mode

Test	802.15.1
Occupied Bandwidth CFR47 15.247 (a2), RSS GEN Sect.4.4.1	2402, 2440, 2480 MHz– 1Mbps
Output Power CFR47 15.247 (b3), RSS 210 Sect. A.8.4	2402, 2440, 2480 MHz– 1Mbps
Peak Power Spectral Density CFR47 15.247 (e), RSS 210 Sect. A.8.2	2402, 2440, 2480 MHz– 1Mbps
Out-of-Band (-30 dBr). CFR47 15.247 (d), RSS 210 Sect. A.8.5	2402, 2440, 2480 MHz– 1Mbps
Band-Edge (Radiated)FCC Part 15.205, 15.209	2402, 2440, 2480 MHz– 1Mbps
Transmitted Spurious Emission (30 MHz – 1GHz) FCC Part 15.205, 15.209	2402, 2440, 2480 MHz– 1Mbps
Transmitted Spurious Emission (Above 1GHz) FCC Part 15.205, 15.209	2402, 2440, 2480 MHz– 1Mbps
AC Conducted Emission FCC Part 15.207	2437 MHz at 4 Data Stream: 6.5Mbp
Note: 1. This device supports Transmission on BLE mode with one internal antenna. 2. All radiated emission performed on X-Axis; worst axis 3. All four chains will be on at all time during the EUT's deployment. 4. All tests were pre-scanned for worst case before final testing.	

6.4 Test Specifications

Testing requirements

Table 16: Test Specifications

Emissions and Immunity	
Standard	**Requirement**
CFR 47 Part 15.407: 2014	All

END OF REPORT