

## RF Test Report

Applicant : Iconnect

Product Type : 802.11ac WiFi Dual-Band AP/Bridge

Trade Name : ALFA

Model Number : MatrixPro 2, Matrix 2X, Matrix 2, Matrix 2-EX, AP120C-AC, N52Q, APAC-5824, IWA-AP102, WA512G, AP120CU-AC PCBA, AP120C-AC PCBA, Range-ACX, Range-AC

Applicable Standard : FCC 47 CFR PART 15 SUBPART C  
ANSI C63.10:2013

Receive Date : Mar. 22, 2019

Test Period : Jul. 22 ~ Jul. 30, 2019

Issue Date : Aug. 28, 2019

### Issue by

A Test Lab Techno Corp.  
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Taiwan Accreditation Foundation accreditation number: 1330

Test Firm MRA designation number: TW0010

#### **Note:**

- 1.The test results are valid only for samples provided by customers and under the test conditions described in this report.
- 2.This report shall not be reproduced except in full, without the written approval of A Test Lab Technology Corporation.
- 3.The relevant information is provided by customers in this test report. According to the correctness, appropriateness or completeness of the information provided by the customer, if there is any doubt or error in the information which affects the validity of the test results, the laboratory does not take the responsibility.



### **Revision History**

Rev.	Issue Date	Revisions	Revised By
00	Aug. 13, 2019	Initial Issue	Tobey Cheng
01	Aug. 27, 2019	IEEE 802.11b/g/n 2.4 GHz 20 MHz deletes channel 13 data and information. IEEE 802.11n 2.4 GHz 40 MHz deletes channel 11 data and information.	Tobey Cheng
02	Aug. 28, 2019	Page 1 & 3 & 7 Revised Model Number.	Tobey Cheng

## Verification of Compliance

Issued Date: Aug. 28, 2019

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FCC ID : 2AB874018  
EUT Rated Voltage : DC 48 V, 500 mA  
Test Voltage : 120 Vac / 60 Hz  
Applicable Standard : FCC 47 CFR PART 15 SUBPART C  
ANSI C63.10:2013  
Test Result : Complied

Performing Lab. : A Test Lab Techno Corp.  
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Taiwan Accreditation Foundation accreditation number: 1330  
<http://www.atl-lab.com.tw/e-index.htm>

A Test Lab Techno Corp. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by A Test Lab Techno Corp. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Approved By  
(Manager)

: Fly Lu  
(Fly Lu)

Reviewed By

(Testing Engineer)

: Ken Yang  
(Ken Yang)

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## 1 General Information

### 1.1. Summary of Test Result

Standard	Item	Result	Remark
15.207	AC Power Conducted Emission	PASS	-----
15.247(d)	Transmitter Radiated Emissions	PASS	-----
15.247(b)(3)	Max. Output Power	PASS	-----
15.247(a)(2)	6 dB RF Bandwidth	PASS	-----
15.247(e)	Maximum Power Spectral Density	PASS	-----
15.247(d)	Out of Band Conducted Spurious Emission	PASS	-----
15.203	Antenna Requirement	PASS	Note

Note: This device must be professionally installed.

Standard	Description
CFR47, Part 15, Subpart C	Intentional Radiators
ANSI C63. 10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
KDB 558074 D01 15.247 Meas Guidance v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES

## 1.2. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty (dB)
Conducted Emission	150 kHz ~ 30 MHz	2.8
Radiated Emission	9 kHz ~ 30 MHz	1.7
	30 MHz ~ 1000 MHz	5.7
	1000 MHz ~ 18000 MHz	5.6
	18000 MHz ~ 26500 MHz	4.9
	26500 MHz ~ 40000 MHz	4.8
Conducted Output Power	+0.27 dB / -0.28 dB	
RF Bandwidth	4.96 %	
Power Spectral Density	+0.71 dB / -0.77 dB	

Decision Rule

- ☒ Uncertainty is not included.
- ☐ Uncertainty is included.

## 2 EUT Description

Applicant	Iconnect No.9, Aly. 58, Ln. 112, Ruiguang Rd., Neihu Dist.,Taipei City, 114 ,Taiwan				
Manufacturer	Iconnect No.9, Aly. 58, Ln. 112, Ruiguang Rd., Neihu Dist.,Taipei City, 114 ,Taiwan				
Product Type	802.11ac WiFi Dual-Band AP/Bridge				
Trade Name	ALFA				
Model Number	MatrixPro 2, Matrix 2X, Matrix 2, Matrix 2-EX, AP120C-AC, N52Q, APAC-5824, IWA-AP102, WA512G, AP120CU-AC PCBA, AP120C-AC PCBA, Range-ACX, Range-AC				
Models different description	<p>The different lies in the appearance of the material, as follows :</p> <p>Iron shell : MatrixPro 2 Plastic shell : Matrix 2X Iron shell / Plastic shell : Matrix 2, Matrix 2-EX, AP120C-AC, N52Q, APAC-5824, IWA-AP102, WA512G, AP120CU-AC PCBA, AP120C-AC PCBA, Range-ACX, Range-AC</p> <p>Due to market demand, several series models are added. rest of the spare parts such as circuit design and printed circuit boards remain the same.</p>				
FCC ID	2AB874018				
Operate Freq. Band	Frequency Range (MHz)	Modulation	Channel Bandwidth	Data Rate 400 / 800 GI (ns)	
IEEE 802.11b	2412 ~ 2462	DSSS	20 MHz	Up to 11 Mbps	
IEEE 802.11g	2412 ~ 2462	OFDM	20 MHz	Up to 54 Mbps	
IEEE 802.11n 2.4 GHz 20 MHz	2412 ~ 2462	OFDM	20 MHz	Up to 173.4 Mbps	
IEEE 802.11n 2.4 GHz 40 MHz	2422 ~ 2452	OFDM	40 MHz	Up to 400 Mbps	
Antenna information	ANT	Manufacturer	Model Number	Type	Max. Gain (dBi)
	ANT-0 / ANT-1	Alfa Networks Inc.	AOA-2458-59-TM	External antenna (N Type)	5.00
	Note: Antenna connector is N type and this device must be professionally installed.				
Antenna Delivery	See section 3.1				
Operate Temp. Range	-40 ~ 40 ℃				

Frequency Band	Max. RF Output Power (W)
IEEE 802.11b	0.353
IEEE 802.11g	0.689
IEEE 802.11n 2.4 GHz 20 MHz	0.541
IEEE 802.11n 2.4 GHz 40 MHz	0.366

### 3 Test Methodology

#### 3.1. Mode of Operation

Decision of Test ATL has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1: Transmit mode
Mode 2: IEEE 802.11b Continuous TX mode
Mode 3: IEEE 802.11g Continuous TX mode
Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode
Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode

Software used to control the EUT for staying in continuous transmitting mode was programmed.

After verification, all tests were carried out with the worst case test modes.

Test Mode	ANT-0	ANT-1	ANT-0+1
Mode 2	V	V	V
Mode 3	V	V	V
Mode 4	V	V	V
Mode 5	V	V	V

Test Mode	Antenna Delivery	Data Rate (Mbps)	Test Channel
Mode 2	2TX (CDD)	1	1, 6, 11
Mode 3	2TX (CDD)	6	1, 6, 11
Mode 4	2TX (MIMO)	13	1, 6, 11
Mode 5	2TX (MIMO)	27	3, 6, 9

#### Duty cycle

Test Mode	Frequency (MHz)	on time (ms)	on+off time (ms)	Duty cycle	Duty Factor (dB)	1/T Minimum VBW (kHz)
Mode 2	2412.0	10.000	10.000	1.000	0.000	0.010
Mode 3	2412.0	2.080	2.140	0.972	0.124	0.481
Mode 4	2412.0	5.025	5.085	0.988	0.052	0.010
Mode 5	2422.0	2.440	2.510	0.972	0.123	0.410



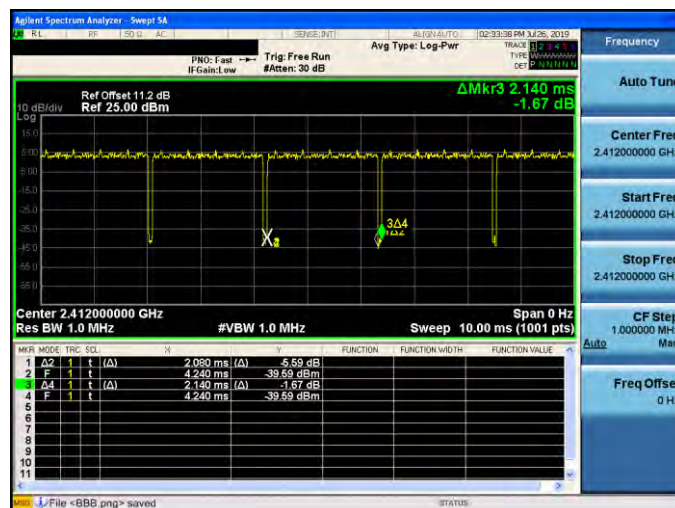


## Duty Cycle Graphs

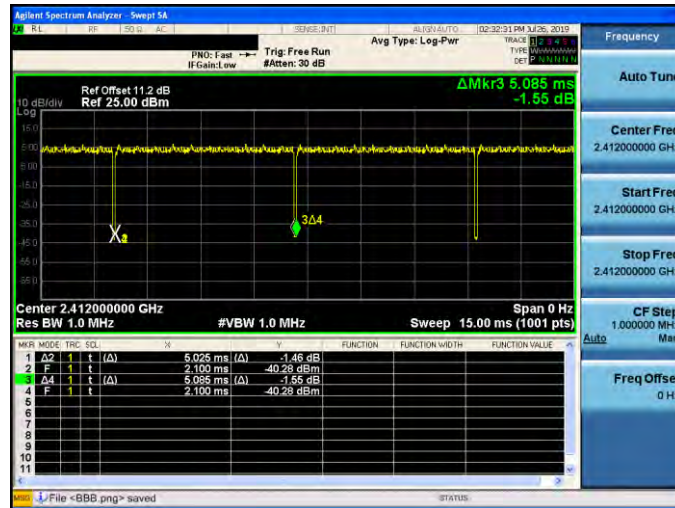
### Mode 2: IEEE 802.11b Continuous TX mode



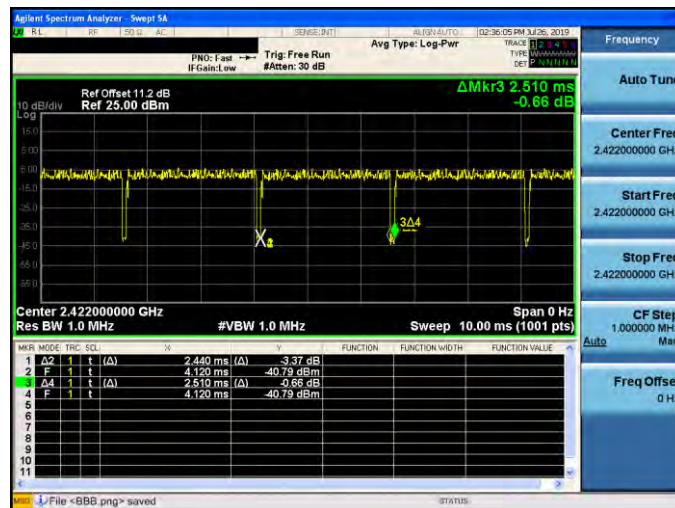
### Mode 3: IEEE 802.11g Continuous TX mode



Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode



Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode



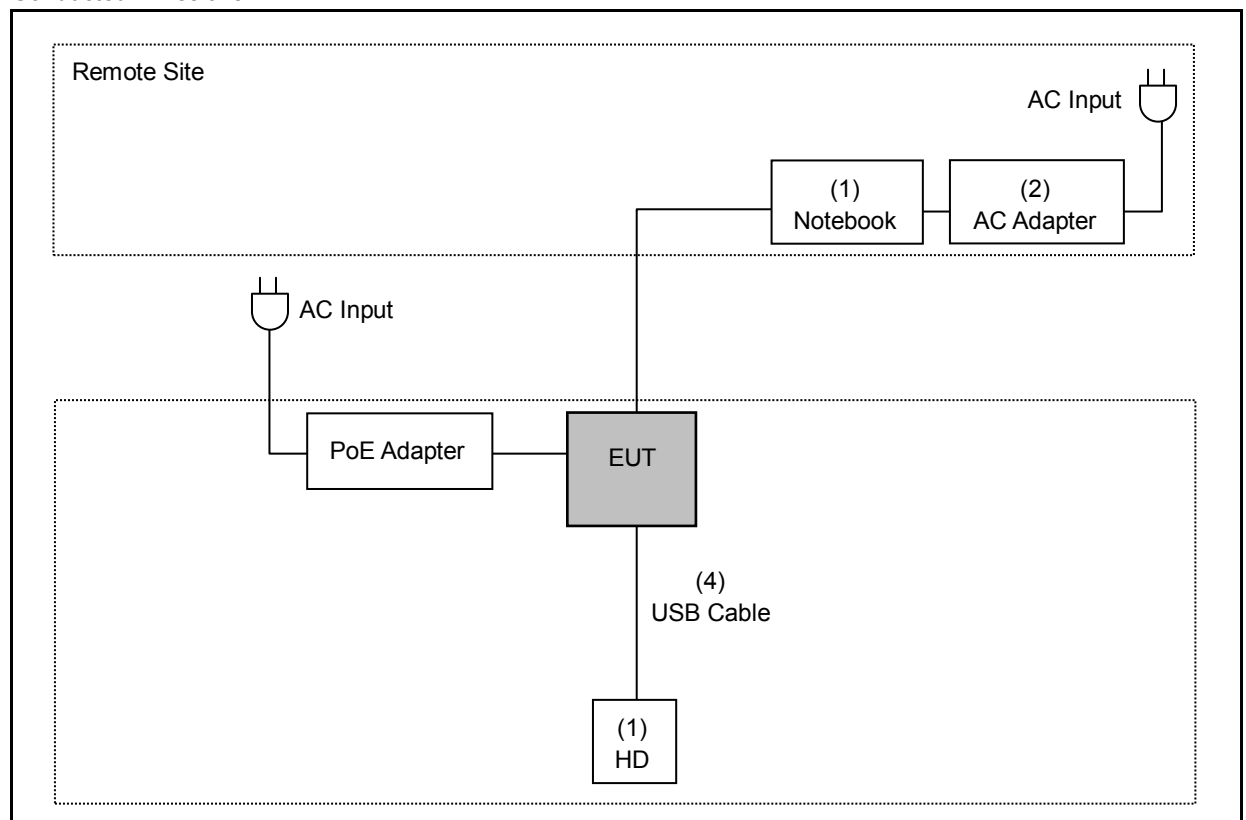
### 3.2. EUT Test Step

1.	Setup the EUT shown on “Configuration of Test System Details”.
2.	Turn on the power of all equipment.
3.	Turn Wi-Fi function link to Notebook.
4.	EUT run test program.

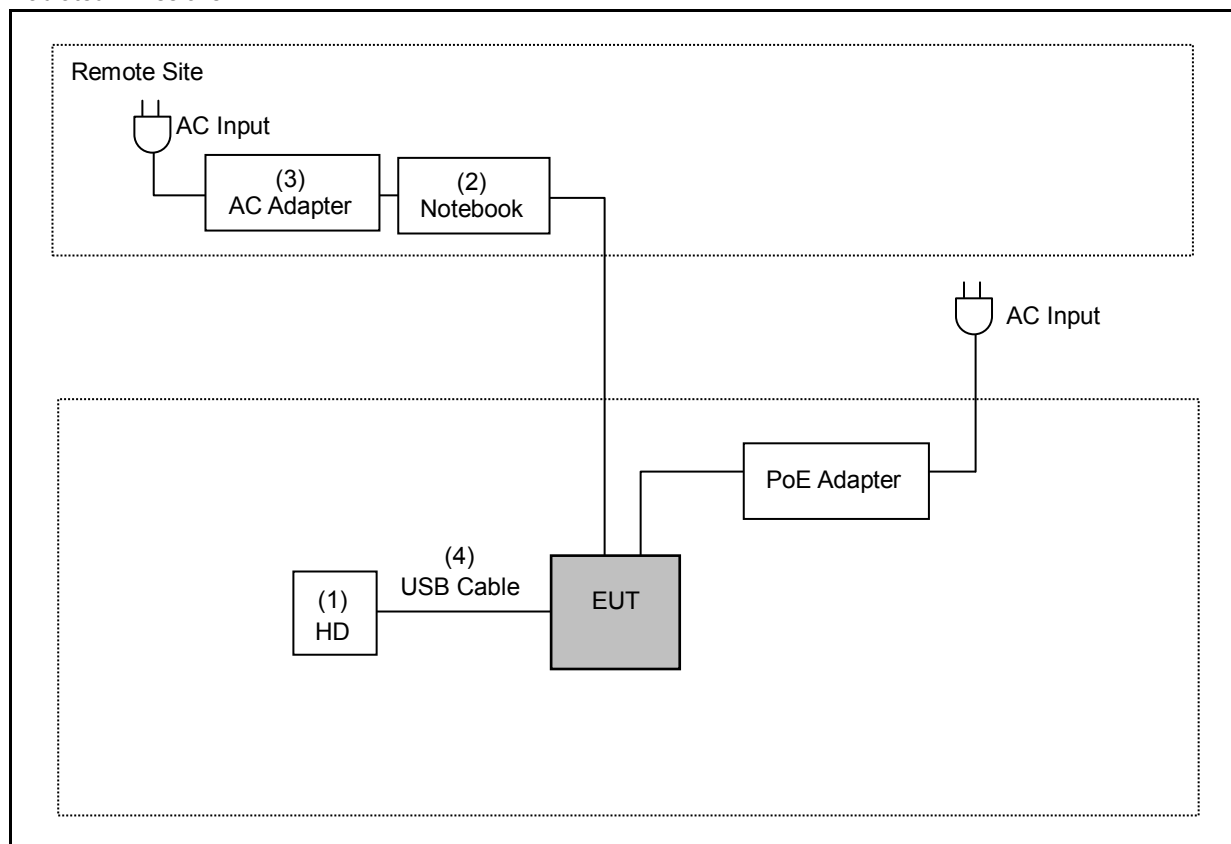
Measurement Software			
No.	Description	Software	Version
1	Conducted Emission	EZ EMC	1.1.4.3
2	Radiated Emission	EZ EMC	1.1.4.4

### 3.3. Configuration of Test System Details

#### Conducted Emissions



# Radiated Emissions



Devices Description					
	Product	Manufacturer	Model Number	Serial Number	Power Cord
(1)	HD	Transend	TS1TSJ25A3K-RU	D72654-0611	Shielded, 0.46 m
(2)	Notebook	DELL	LATITUDE E6440	5HZBD72	---
(3)	AC Adapter	DELL	HA65NM130	---	Non-Shielded, 0.8 m
(4)	USB Cable	Transend	---	---	---



### 3.4. Test Instruments

For Conducted Emission

Test Period: Jul. 30, 2019

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
Test Receiver	R&S	ESCI	100367	05/23/2019	1 year
LISN	R&S	ENV216	101040	04/03/2019	1 year
RF Cable	Woken	00100D1380194M	TE-02-03	05/23/2019	1 year

For Radiated Emissions

Test Period: Jul. 22 ~ Jul. 23, 2019

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
Spectrum Analyzer (10 Hz~44 GHz)	Keysight	N9010A	MY52221312	01/14/2019	1 year
Pre Amplifier (1~26.5 GHz)	Agilent	8449B	3008A02237	10/16/2018	1 year
Pre Amplifier (100 kHz~1.3 GHz)	Agilent	8447D	2944A11119	01/14/2019	1 year
Broadband Antenna	Schwarzbeck	VULB9168	416	10/19/2018	1 year
Horn Antenna (1~18 GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA9120D	9120D-550	08/23/2018	1 year
Horn Antenna (18~40 GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA9170	9170-320	08/07/2018	1 year
Loop Antenna	COM-POWER CORPORATION	AL-130	121014	03/29/2019	1 year
RF Cable	EMCI	EMC104-N-N-6000	TE01-1	02/20/2019	1 year
Microwave Cable	EMCI	EMC104-SM -SM-13000	170814	10/30/2018	1 year
Microwave Cable	EMCI	EMC102-KM -KM-14000	151001	02/20/2019	1 year

Note: N.C.R. = No Calibration Request.



For Conducted

Test Period: Jul. 26 ~ Jul. 30, 2019

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
Spectrum Analyzer (20 Hz~26.5 GHz)	Agilent	N9020A	US47520902	09/25/2018	1 year
Power Sensor	Anritsu	MA2411B	1126022	08/29/2018	1 year
Power Meter	Anritsu	ML2495A	1135009	08/29/2018	1 year

Note: N.C.R. = No Calibration Request.

### 3.5. Test Site Environment

Items	Required (IEC 60068-1)	Actual
Temperature (°C)	15-35	26
Humidity (%RH)	25-75	60
Barometric pressure (mbar)	860-1060	990

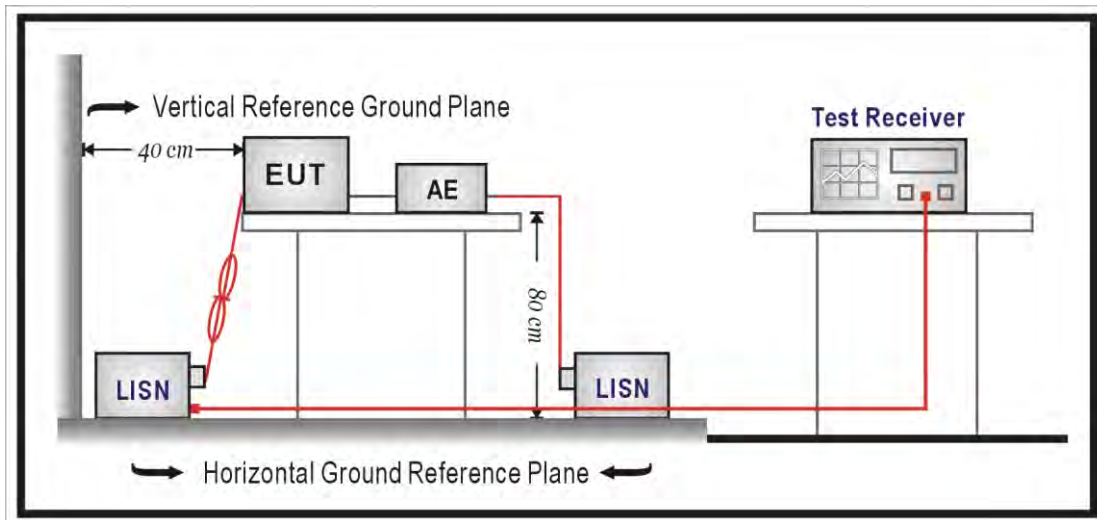
## 4 Measurement Procedure

### 4.1. AC Power Line Conducted Emission Measurement

#### ■ Limit

Frequency (MHz)	Quasi-peak	Average
0.15 - 0.5	66 to 56	56 to 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

#### ■ Test Setup



### ■ Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a  $50\ \Omega // 50\ \mu\text{H}$  coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a  $50\ \Omega // 50\ \mu\text{H}$  coupling impedance with 50 ohm termination.

Tabletop device shall be placed on a non-conducting platform, of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The wall of screened room shall be located 40 cm to the rear of the EUT. Other surfaces of tabletop or floor standing EUT shall be at least 80 cm from any other ground conducting surface including one or more LISNs. For floor-standing device shall be placed under the EUT with a 12 mm insulating material.

Conducted emissions were investigated over the frequency range from 0.15 MHz to 30 MHz using a resolution bandwidth of 9 kHz. The equipment under test (EUT) shall be meet the limits in section 4.1, as applicable, including the average limit and the quasi-peak limit when using respectively, an average detector and quasi-peak detector measured in accordance with the methods described of related standard. When all of peak value were complied with quasi-peak and average limit from 150 kHz to 30 MHz then quasi-peak and average measurement was unnecessary.

The AMN shall be placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for AMNs mounted on top of the ground reference plane. This distance is between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8 m from the AMN. If the mains power cable is longer than 1 m then the cable shall be folded back and forth at the centre of the lead to form a bundle no longer than 0.4 m. All of interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long. All of EUT and AE shall be separate place more than 0.1 m. All  $50\ \Omega$  ports of the LISN shall be resistively terminated into  $50\ \Omega$  loads when not connected to the measuring instrument.

If the reading of the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the higher reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.



## 4.2. Radiated Emission Measurement

### ■ Limit

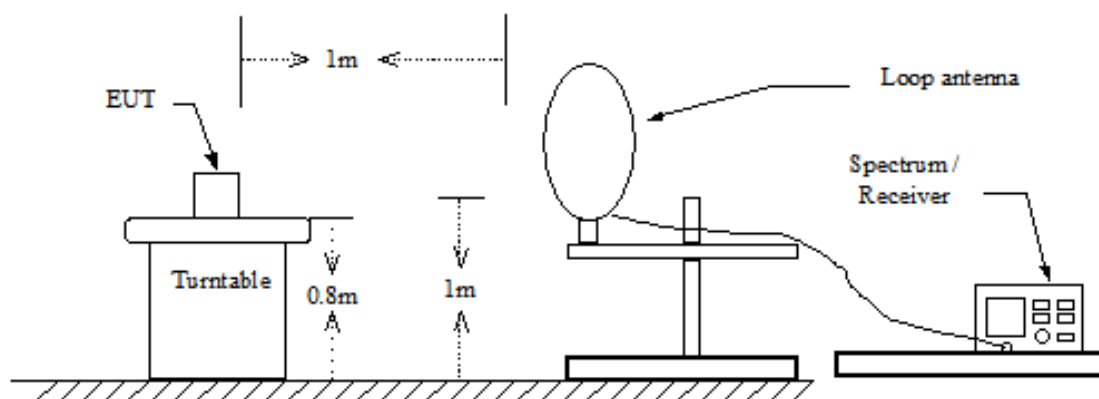
According to §15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ at 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

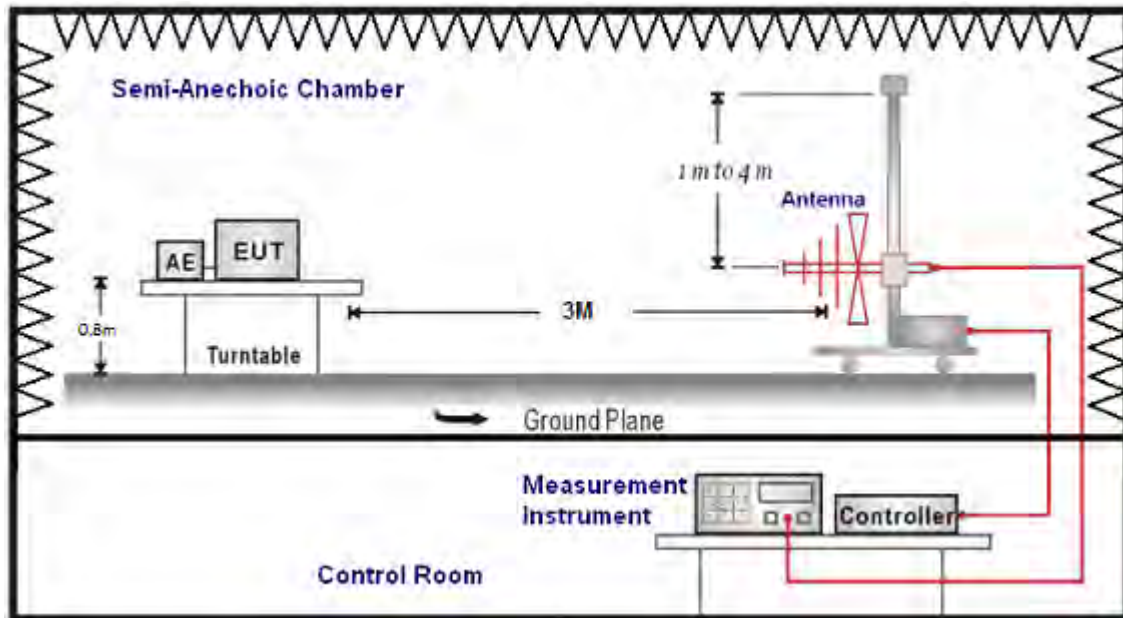
\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

### ■ Setup

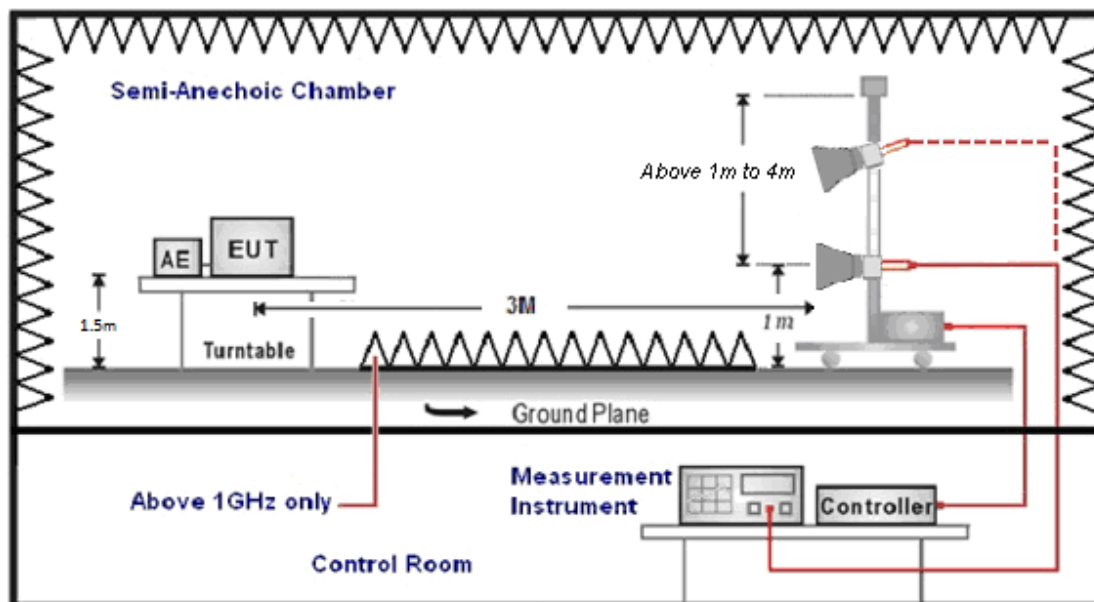
9 kHz ~ 30 MHz



Below 1 GHz



Above 1 GHz



## ■ Test Procedure

Final radiation measurements were made on a three-meter, Semi Anechoic Chamber. The EUT system was placed on a nonconductive turntable which is 0.8 or 1.5 meters height, top surface 1.0 x 1.5 meter. The spectrum was examined from 250 MHz to 2.5 GHz in order to cover the whole spectrum below 10th harmonic which could generate from the EUT. During the test, EUT was set to transmit continuously & Measurements spectrum range from 9 kHz to 26.5 GHz is investigated.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 3 MHz for peak measurements and 10 Hz for average measurements when Duty cycle  $>0.98$  /  $1/T$  for average measurements when Duty cycle  $<0.98$ . A nonconductive material surrounded the EUT to supporting the EUT for standing on three orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

SCHWARZBECK MESS-ELEKTRONIK Biconilog Antenna at 3 Meter and the SCHWARZBECK Double Ridged Guide Antenna was used in frequencies 1 –26.5 GHz at a distance of 3 meter. The antenna at an angle toward the source of the emission. All test results were extrapolated to equivalent signal at 3 meters utilizing an inverse linear distance extrapolation Factor (20 dB/decade).

For testing above 1 GHz, the emission level of the EUT in peak mode was 20 dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer's 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtracting the duty cycle correction factor from the peak readings.

The following procedures were used to convert the emission levels measured in decibels referenced to 1 microvolt (dBuV) into field intensity in micro volts per meter (uV/m).

The actual field intensity in decibels referenced to 1 microvolt in to field intensity in micro volts per meter (dBuV/m).

The actual field is intensity in referenced to 1 microvolt per meter (dBuV/m) is determined by algebraically adding the measured reading in dBuV, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.

$$(1) \text{ Amplitude (dBuV/m) = FI (dBuV) + AF (dBuV) + CL (dBuV) - Gain (dB)}$$

FI= Reading of the field intensity.

AF= Antenna factor.

CL= Cable loss.

P.S Amplitude is auto calculate in spectrum analyzer.

$$(2) \text{ Actual Amplitude (dBuV/m) = Amplitude (dBuV) - Dis(dB)}$$

The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:

(a) For fundamental frequency : Transmitter Output < +30 dBm

(b) For spurious frequency : Spurious emission limits = fundamental emission limit /10

Data of measurement within this frequency range without mark in the table above means the reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.

### 4.3. Maximum Conducted Output Power Measurement

#### ■ Limit

For systems using digital modulation in the 2400-2483.5 MHz, the limit for maximum output power is 30 dBm.

And According to 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

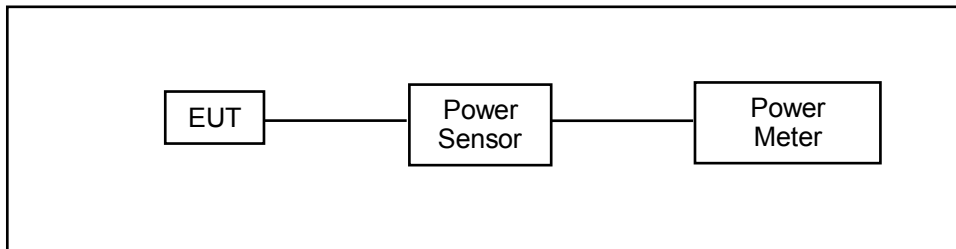
IEEE 802.11b / IEEE 802.11g

- \* Directional Gain =  $10 \cdot \log\{[10^{(G1/10)} + 10^{(G2/10)} + \dots + 10^{(Gn/10)}] / N_{ANT}\} = 5 \text{ dBi} < 6 \text{ dBi}$
- \* Power Limit = 30 dBm

IEEE 802.11n 2.4 GHz 20 MHz / IEEE 802.11n 2.4 GHz 40 MHz

- \* Directional Gain =  $10 \cdot \log\{[10^{(G1/20)} + 10^{(G2/20)} + \dots + 10^{(Gn/20)}]^2 / N_{ANT}\} = 8.01 \text{ dBi} > 6 \text{ dBi}$
- \* Power Limit = 30 = 27.99 dBm

#### ■ Test Setup



#### ■ Test Procedure

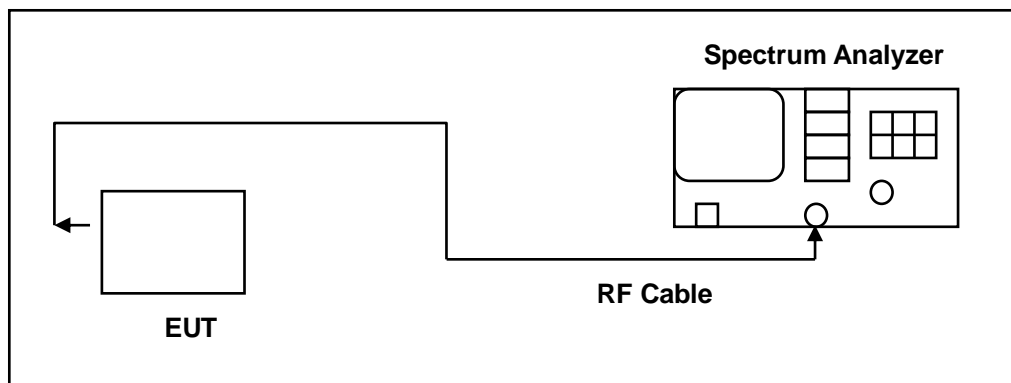
The tests below are run with the EUT's transmitter set at high power in TX mode. The EUT is needed to force selection of output power level and channel number. While testing, EUT was set to transmit continuously. Remove the Subjective device's antenna and connect the RF output port to power sensor.

#### 4.4. 6 dB RF Bandwidth Measurement

##### ■ Limit

6 dB RF Bandwidth: Systems using digital modulation techniques may operate in the 2400–2483.5 MHz bands. The minimum 6 dB band-width shall be at least 500 kHz.

##### ■ Test Setup



##### ■ Test Procedure

The EUT tested to DTS test procedure of ANSI C63.10:2013 section 11.8.2 option2 for compliance to FCC 47CFR 15.247 requirements.

6 dB RF Bandwidth: The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW was set to 100 kHz. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A peak output reading was taken, a DISPLAY line was drawn 6 dB lower than peak level. The 6 dB bandwidth was determined from where the channel output spectrum intersected the display line.

The test was performed at 3 channels (Channel low, middle, high)

## 4.5. Maximum Power Density Measurement

### ■ Limit

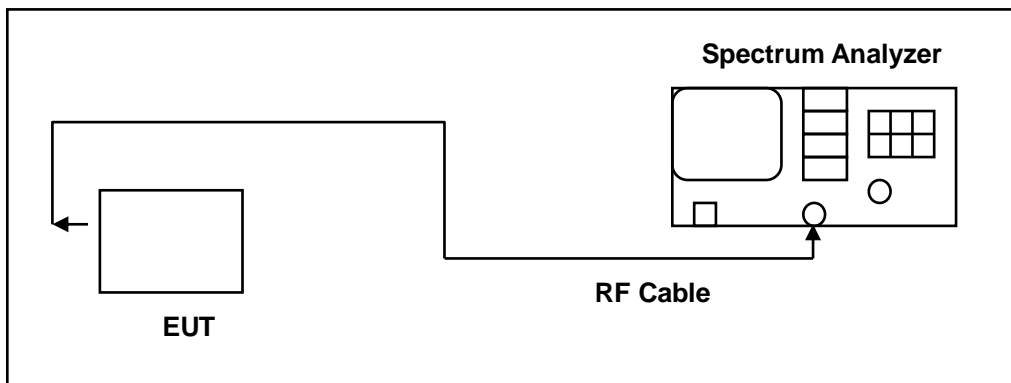
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

IEEE 802.11b / IEEE 802.11g / IEEE 802.11n 2.4 GHz 20 MHz / IEEE 802.11n 2.4 GHz 40 MHz

\* Directional Gain =  $10 \cdot \log\{[10^{(G1/20)} + 10^{(G2/20)} + \dots + 10^{(Gn/20)}]^2 / NANT\}$  = 8.01 dBi > 6dBi

\* Conducted Power Spectral Density Limit = 8 - 2.01 = 5.99 dBm/MHz

### ■ Test Setup





■ **Test Procedure**

The EUT tested to DTS test procedure of ANSI C63.10:2013 section 11.10.2 for compliance to FCC 47CFR 15.247 requirements.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
4. Set the VBW  $\geq 3 \times \text{RBW}$ .
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

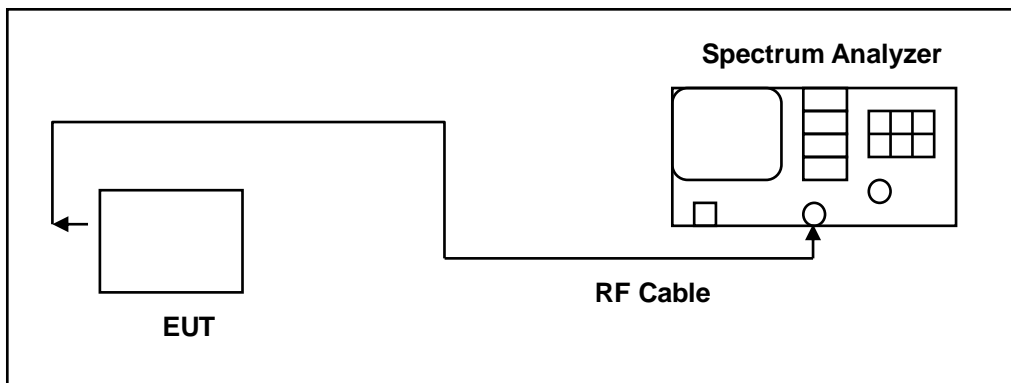


## 4.6. Out of Band Conducted Emissions Measurement

### ■ Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

### ■ Test Setup



### ■ Test Procedure

In any 100 kHz bandwidth outside the EUT pass band, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function. All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the pass band. The test was performed at 3 channels.



## 4.7. Antenna Measurement

### ■ Limit

For intentional device, according to 15.203, 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.

And According to 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### ■ Antenna Description

See section 2 – antenna information.

### ■ Antenna Connector Construction

KDB 353028 D01 Antennas Part 15 Transmitters v01

II. BASIC RULE AND POLICY REQUIREMENTS FOR ANTENNAS USED WITH PART 15 TRANSMITTERS A.  
ANTENNA REQUIREMENTS—Section 15.203

2) The following describes the three ways that can be used to demonstrate compliance to Section 15.203:

c) Professional installation

### ■ Directional Gain Calculated

#### For Maximum Conducted Output Power

Operate Freq. Band	Directional Gain (dBi)
IEEE 802.11b	5.00
IEEE 802.11g	5.00
IEEE 802.11n 2.4 GHz 20 MHz	8.01
IEEE 802.11n 2.4 GHz 40 MHz	8.01

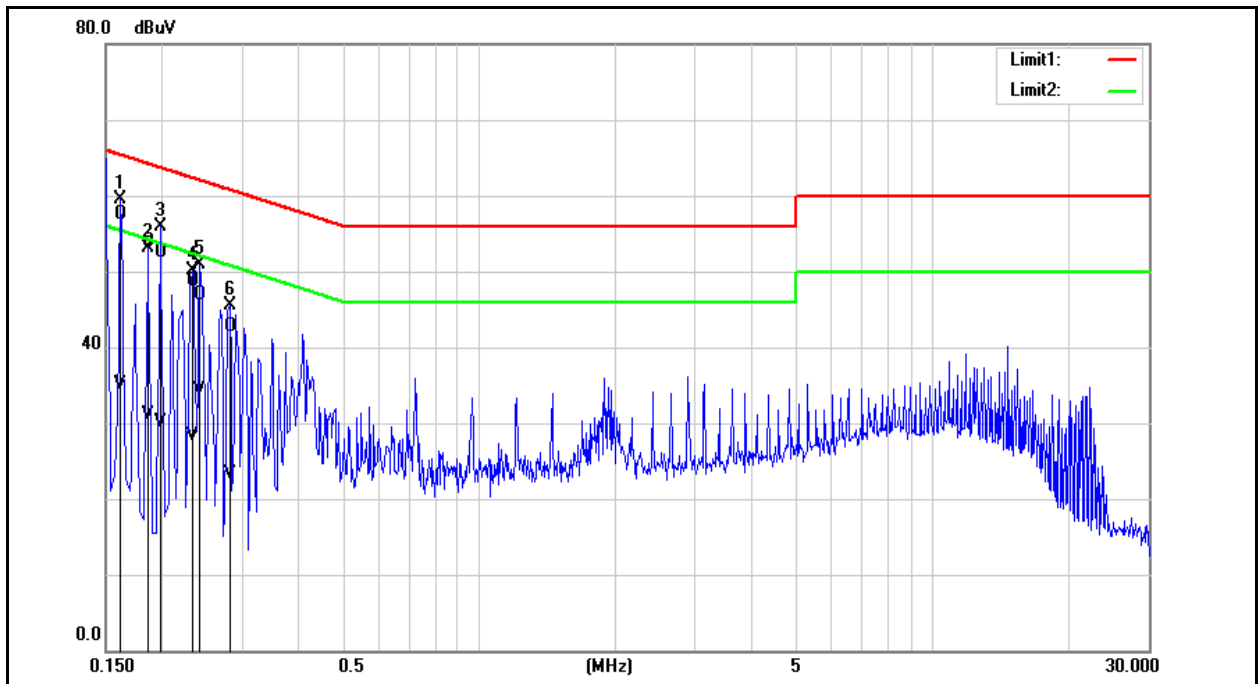
#### For Maximum Power Density

Operate Freq. Band	Directional Gain (dBi)
IEEE 802.11b	8.01
IEEE 802.11g	8.01
IEEE 802.11n 2.4 GHz 20 MHz	8.01
IEEE 802.11n 2.4 GHz 40 MHz	8.01

## 5 Test Results

### Annex A. Conducted Emission

Standard:	FCC Part 15.247	Line:	L1
Test item:	Conducted Emission	Power:	AC 120 V/60 Hz
Mode:	Mode 1	Temp.(°C)/Hum.(%RH):	26(°C)/60 %RH
Description:			

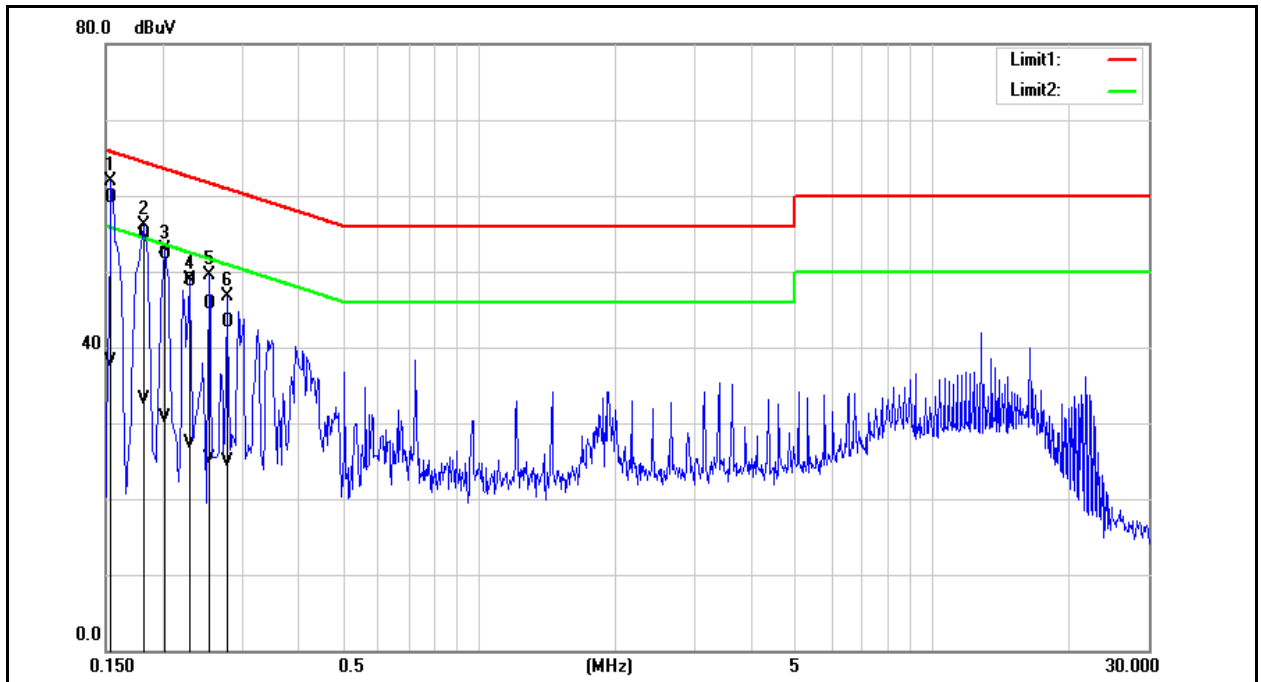


No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	AVG result (dBuV)	QP limit (dBuV)	AVG limit (dBuV)	QP margin (dB)	AVG margin (dB)	Remark
1	0.1620	47.89	25.53	9.65	57.54	35.18	65.36	55.36	-7.82	-20.18	Pass
2	0.1860	44.17	21.53	9.64	53.81	31.17	64.21	54.21	-10.40	-23.04	Pass
3	0.1980	42.78	20.37	9.64	52.42	30.01	63.69	53.69	-11.27	-23.68	Pass
4	0.2340	38.99	18.59	9.64	48.63	28.23	62.31	52.31	-13.68	-24.08	Pass
5	0.2420	37.17	24.72	9.64	46.81	34.36	62.03	52.03	-15.22	-17.67	Pass
6	0.2820	33.04	13.66	9.65	42.69	23.31	60.76	50.76	-18.07	-27.45	Pass

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

Standard:	FCC Part 15.247	Line:	N
Test item:	Conducted Emission	Power:	AC 120 V/60 Hz
Mode:	Mode 1	Temp.(°C)/Hum.(%RH):	26(°C)/60 %RH
Description:			



No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	AVG result (dBuV)	QP limit (dBuV)	AVG limit (dBuV)	QP margin (dB)	AVG margin (dB)	Remark
1	0.1540	50.00	28.52	9.68	59.68	38.20	65.78	55.78	-6.10	-17.58	Pass
2	0.1820	45.18	23.34	9.67	54.85	33.01	64.39	54.39	-9.54	-21.38	Pass
3	0.2020	42.72	21.09	9.67	52.39	30.76	63.53	53.53	-11.14	-22.77	Pass
4	0.2300	38.99	17.68	9.67	48.66	27.35	62.45	52.45	-13.79	-25.10	Pass
5	0.2540	36.03	15.71	9.67	45.70	25.38	61.63	51.63	-15.93	-26.25	Pass
6	0.2780	33.62	15.30	9.68	43.30	24.98	60.88	50.88	-17.58	-25.90	Pass

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).  
2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

## Annex B. Conducted Test Results

### Maximum Conducted Output Power Measurement

Test Mode	Frequency (MHz)	Data Rate	Average Output Power				Peak Output Power				Limit
			ANT-0		ANT-1		ANT-0		ANT-1		
			(dBm)	(W)	dBm	(W)	(dBm)	(W)	dBm	(W)	dBm
Mode 2	2412	1 M	19.28	0.085	19.79	0.095	21.53	0.142	22.04	0.160	≤ 30.00
	2437		20.47	0.111	20.17	0.104	22.61	0.182	22.33	0.171	≤ 30.00
	2462		19.22	0.084	18.72	0.074	21.47	0.140	20.98	0.125	≤ 30.00
Mode 3	2412	6 M	12.74	0.019	13.06	0.020	20.37	0.109	21.62	0.145	≤ 30.00
	2437		17.37	0.055	17.41	0.055	25.53	0.357	25.21	0.332	≤ 30.00
	2462		11.97	0.016	12.71	0.019	20.29	0.107	21.71	0.148	≤ 30.00
Mode 4	2412	13 M	12.67	0.018	13.07	0.020	20.97	0.125	20.74	0.119	≤ 27.99
	2437		16.53	0.045	16.77	0.048	24.31	0.270	24.34	0.272	≤ 27.99
	2462		12.11	0.016	12.77	0.019	20.97	0.125	20.97	0.125	≤ 27.99
Mode 5	2422	27 M	8.08	0.006	8.88	0.008	16.54	0.045	17.19	0.052	≤ 27.99
	2437		14.13	0.026	14.61	0.029	22.88	0.194	22.36	0.172	≤ 27.99
	2452		8.23	0.007	8.61	0.007	16.36	0.043	16.61	0.046	≤ 27.99

Note: The relevant measured result has the offset with cable loss already.

Test Mode	Frequency (MHz)	Data Rate	Average Output Power		Peak Output Power		Limit
			ANT-0+1		ANT-0+1		
			(dBm)	(W)	(dBm)	(W)	dBm
Mode 2	2412	1 M	22.55	0.180	24.80	0.302	≤ 30.00
	2437		23.33	0.215	<b>25.48</b>	<b>0.353</b>	≤ 30.00
	2462		21.99	0.158	24.24	0.266	≤ 30.00
Mode 3	2412	6 M	15.91	0.039	24.05	0.254	≤ 30.00
	2437		20.40	0.110	<b>28.38</b>	<b>0.689</b>	≤ 30.00
	2462		15.37	0.034	24.07	0.255	≤ 30.00
Mode 4	2412	13 M	15.88	0.039	23.87	0.244	≤ 27.99
	2437		19.66	0.093	<b>27.34</b>	<b>0.541</b>	≤ 27.99
	2462		15.46	0.035	23.98	0.250	≤ 27.99
Mode 5	2422	27 M	11.51	0.014	19.89	0.097	≤ 27.99
	2437		17.39	0.055	<b>25.64</b>	<b>0.366</b>	≤ 27.99
	2452		11.43	0.014	19.50	0.089	≤ 27.99

Note: The relevant measured result has the offset with cable loss already.



#### 6 dB RF Bandwidth Measurement

Test Mode	Frequency (MHz)	Measurement (kHz)		Limit (kHz)
		ANT-0	ANT-1	
Mode 2	2412	8108	8103	≥ 500
	2437	8107	8104	≥ 500
	2462	8103	8102	≥ 500
Mode 3	2412	16360	16390	≥ 500
	2437	16390	16390	≥ 500
	2462	16340	16390	≥ 500
Mode 4	2412	17590	17580	≥ 500
	2437	17620	17610	≥ 500
	2462	17570	17610	≥ 500
Mode 5	2422	35310	35180	≥ 500
	2437	35190	35150	≥ 500
	2452	35460	35160	≥ 500



## Test Graphs

Mode 2: IEEE 802.11b Continuous TX mode\_ANT-0

2412 MHz



2437 MHz



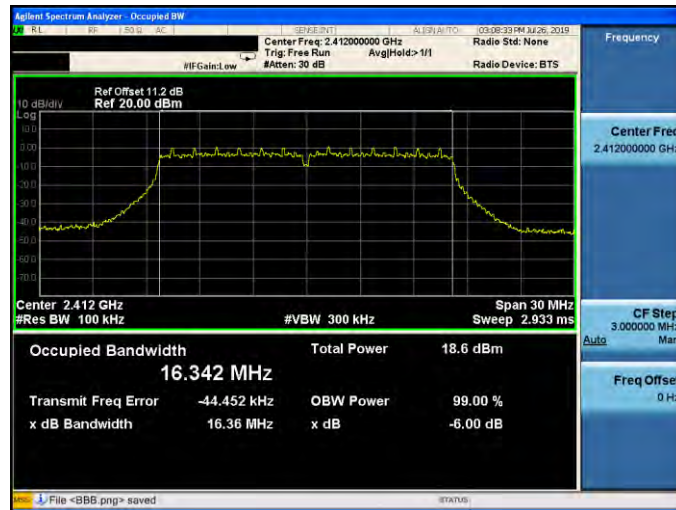
2462 MHz





Mode 3: IEEE 802.11g Continuous TX mode\_ANT-0

2412 MHz



2437 MHz



2462 MHz





Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode \_ANT-0

2412 MHz



2437 MHz



2462 MHz





Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode \_ANT-0

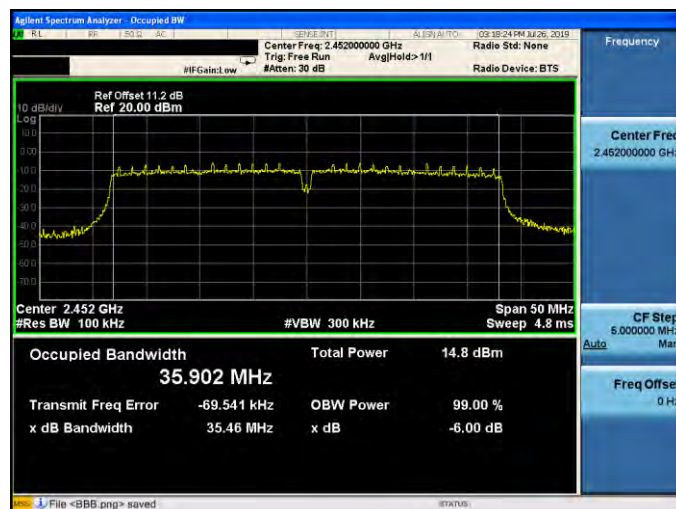
2422 MHz



2437 MHz



2452 MHz







Mode 2: IEEE 802.11b Continuous TX mode\_ANT-1

2412 MHz



2437 MHz



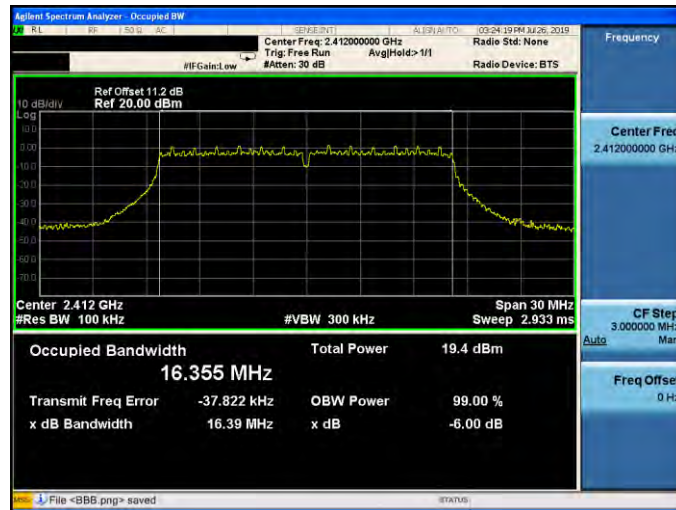
2462 MHz





Mode 3: IEEE 802.11g Continuous TX mode\_ANT-1

2412 MHz



2437 MHz



2462 MHz





Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode \_ANT-1

2412 MHz



2437 MHz



2462 MHz





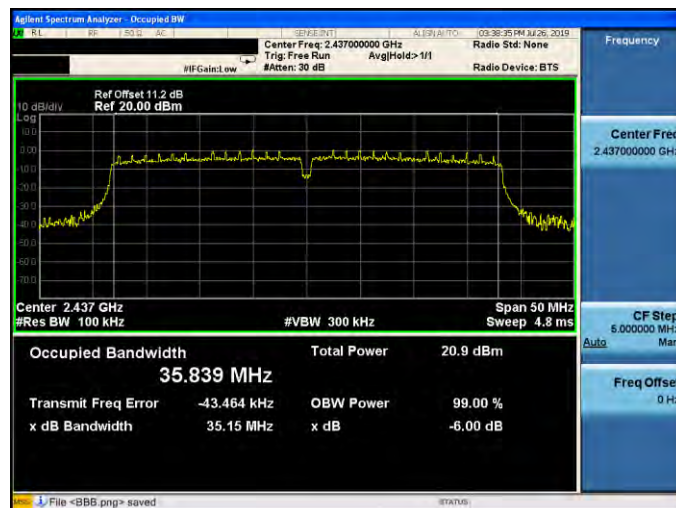


Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode \_ANT-1

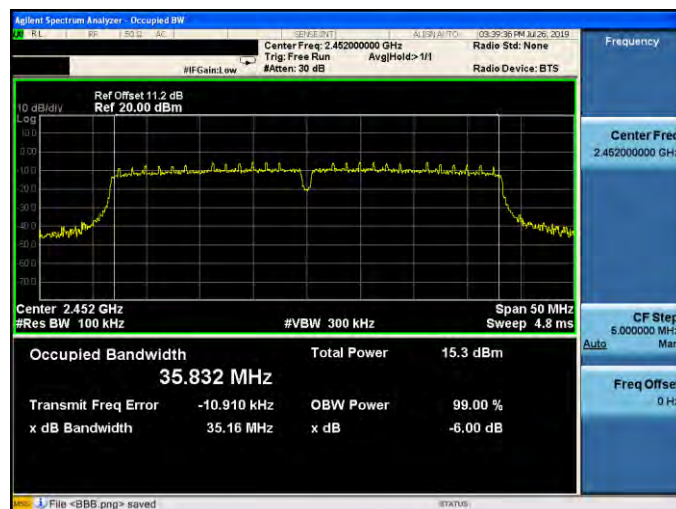
2422 MHz



2437 MHz



2452 MHz





### Maximum Power Density Measurement

Test Mode	Frequency (MHz)	Measurement (dBm/3 kHz)			Limit (dBm/3 kHz)
		ANT-0	ANT-1	ANT-0+1	
Mode 2	2412	-5.599	-5.068	-2.315	≤ 5.99
	2437	-4.990	-4.899	-1.934	≤ 5.99
	2462	-5.873	-6.228	-3.037	≤ 5.99
Mode 3	2412	-14.259	-14.849	-11.534	≤ 5.99
	2437	-10.003	-10.613	-7.287	≤ 5.99
	2462	-15.127	-15.391	-12.247	≤ 5.99
Mode 4	2412	-14.844	-14.321	-11.564	≤ 5.99
	2437	-10.882	-10.668	-7.763	≤ 5.99
	2462	-15.321	-14.183	-11.705	≤ 5.99
Mode 5	2422	-21.226	-20.953	-18.077	≤ 5.99
	2437	-16.171	-15.437	-12.778	≤ 5.99
	2452	-21.226	-21.322	-18.263	≤ 5.99





■ Test Graphs

Mode 2: IEEE 802.11b Continuous TX mode\_ANT-0

2412 MHz



2437 MHz



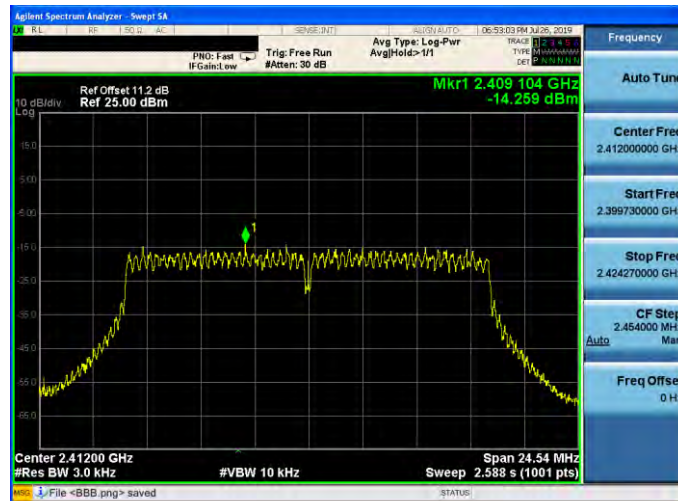
2462 MHz



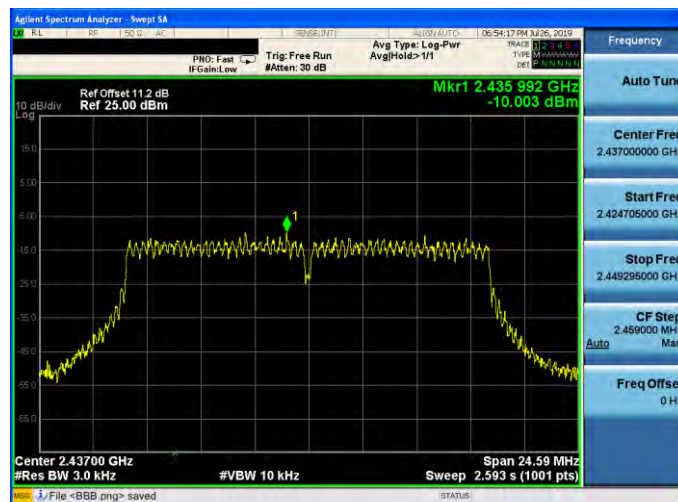


Mode 3: IEEE 802.11g Continuous TX mode\_ANT-0

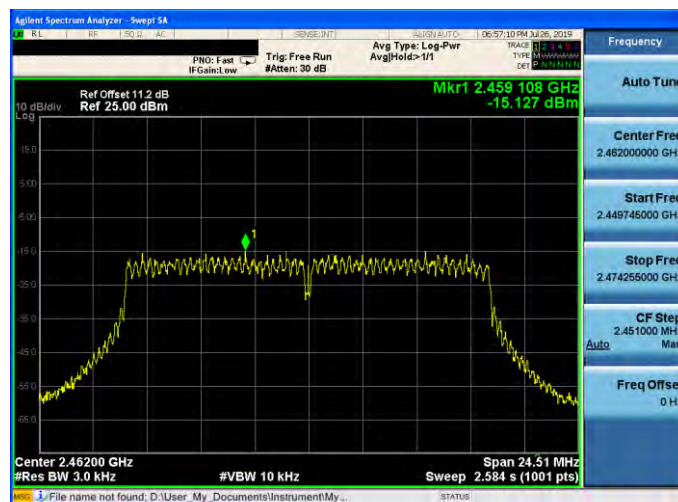
2412 MHz



2437 MHz



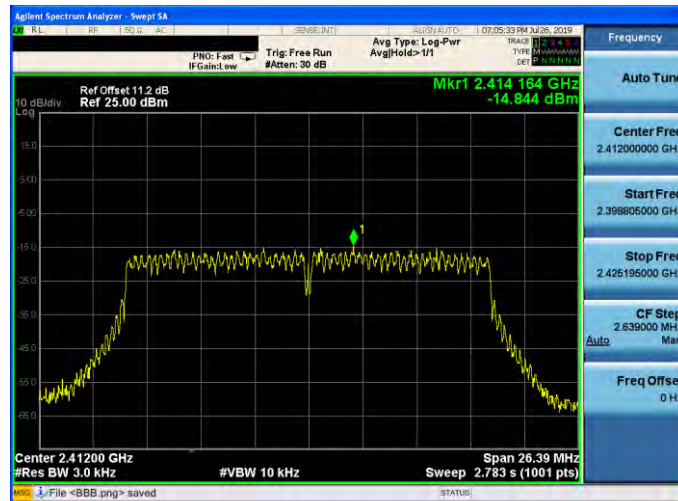
2462 MHz



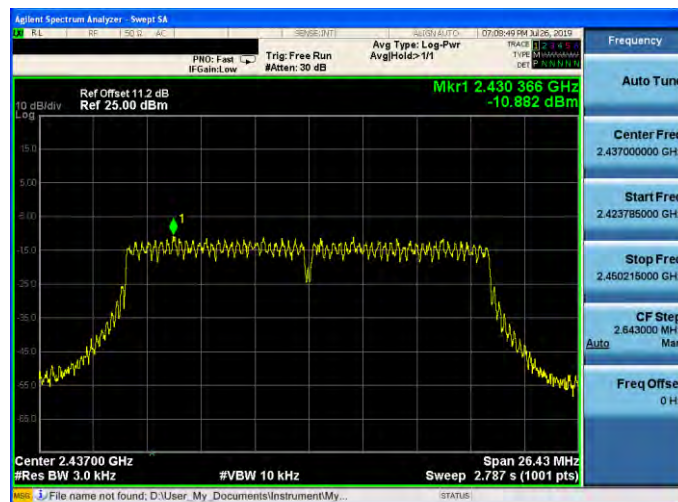


Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode \_ANT-0

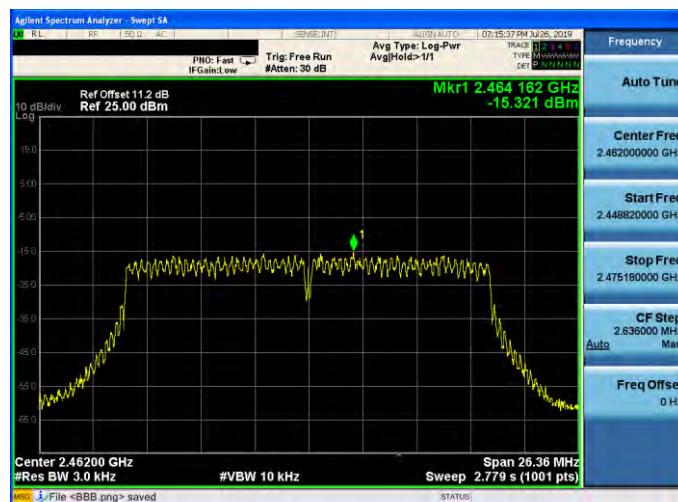
2412 MHz



2437 MHz



2462 MHz

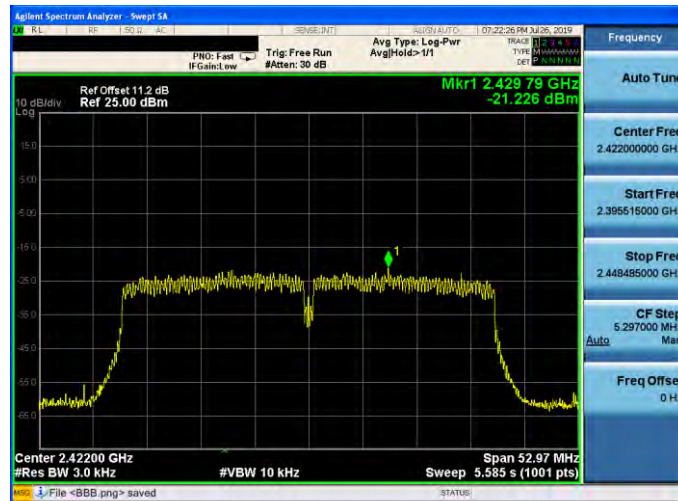




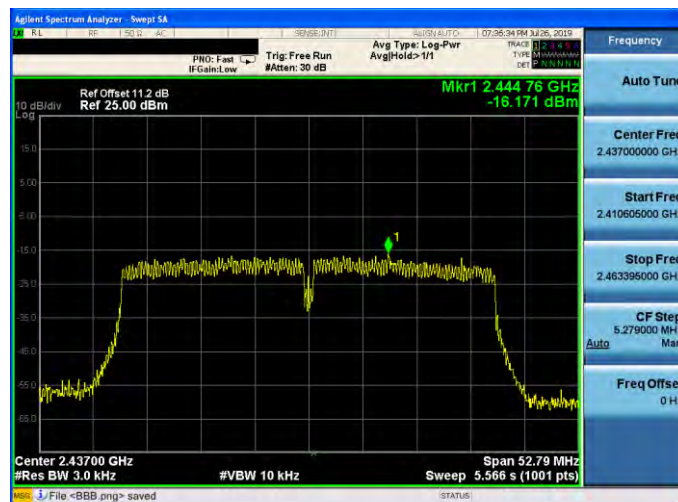


Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode \_ANT-0

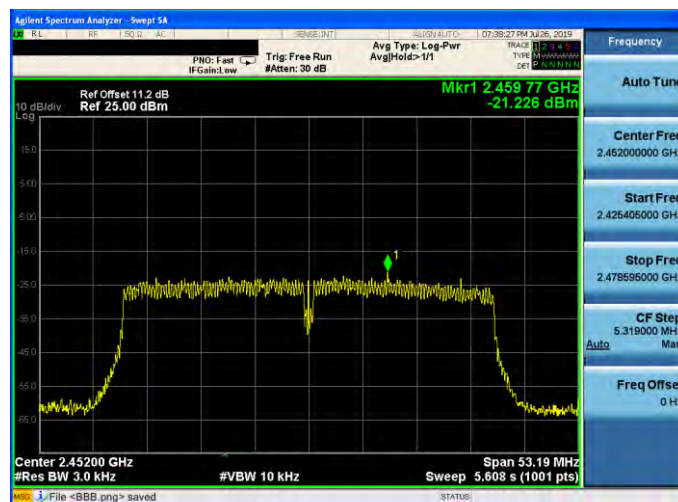
2422 MHz



2437 MHz



2452 MHz





Mode 2: IEEE 802.11b Continuous TX mode\_ANT-1

2412 MHz



2437 MHz



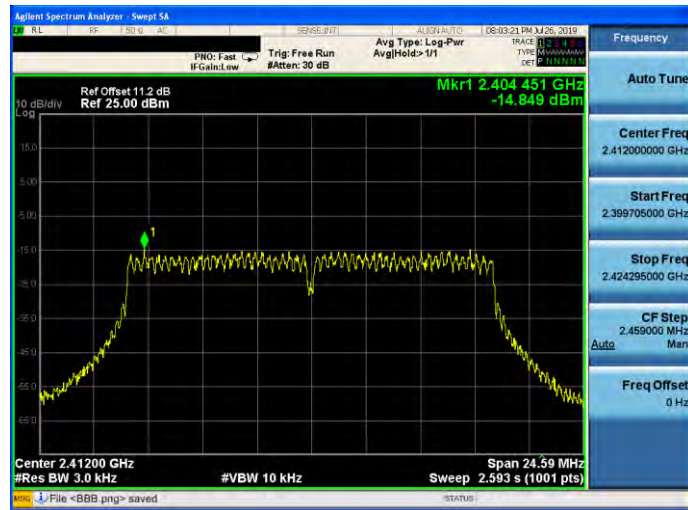
2462 MHz



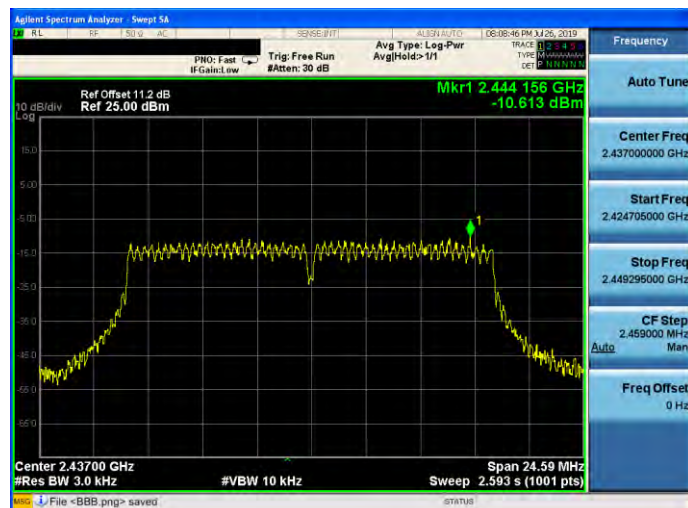


Mode 3: IEEE 802.11g Continuous TX mode\_ANT-1

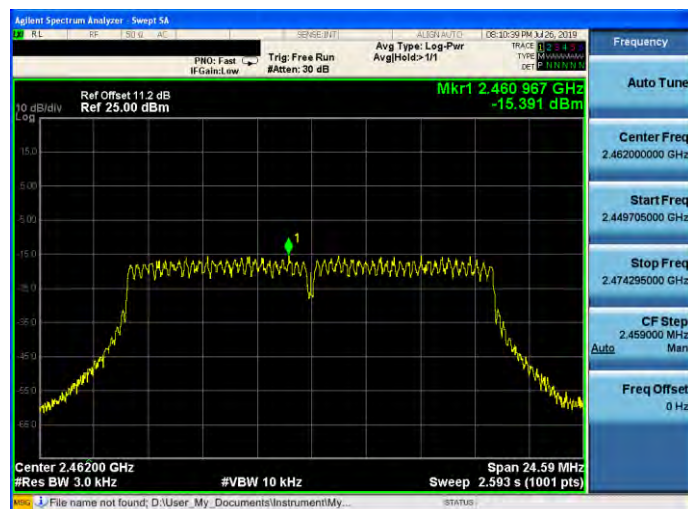
2412 MHz



2437 MHz



2462 MHz

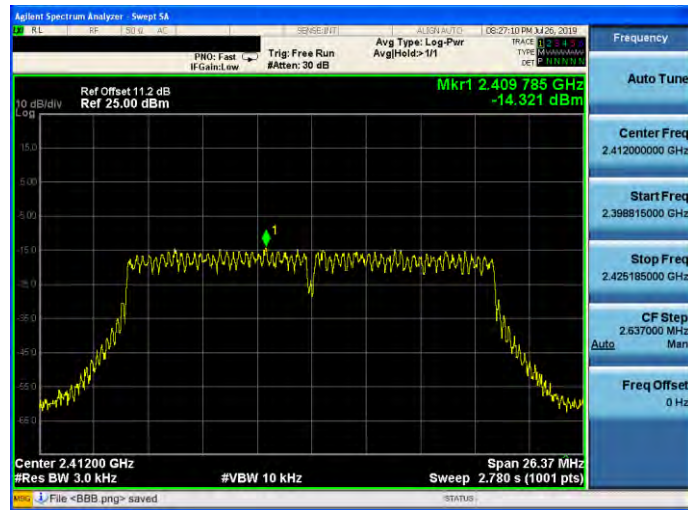




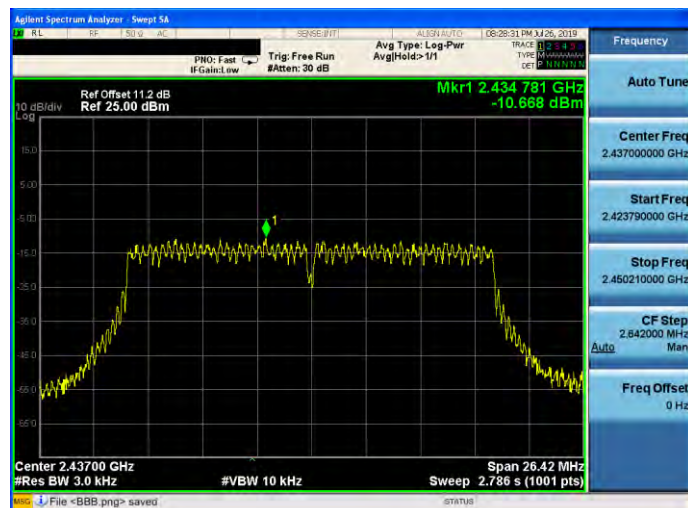


Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode \_ANT-1

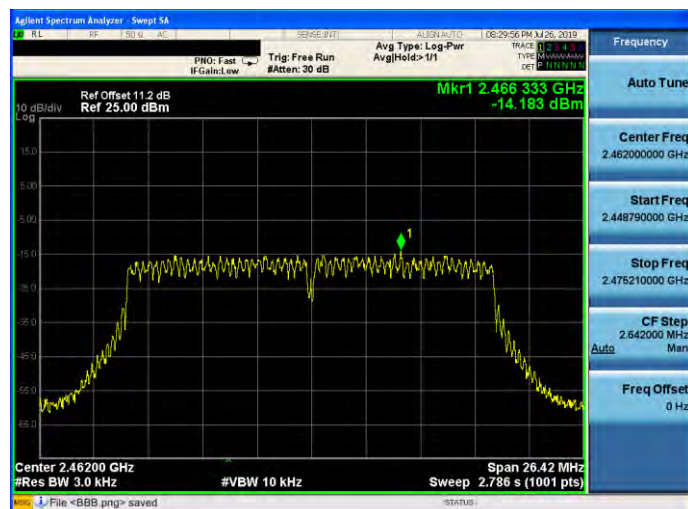
2412 MHz



2437 MHz

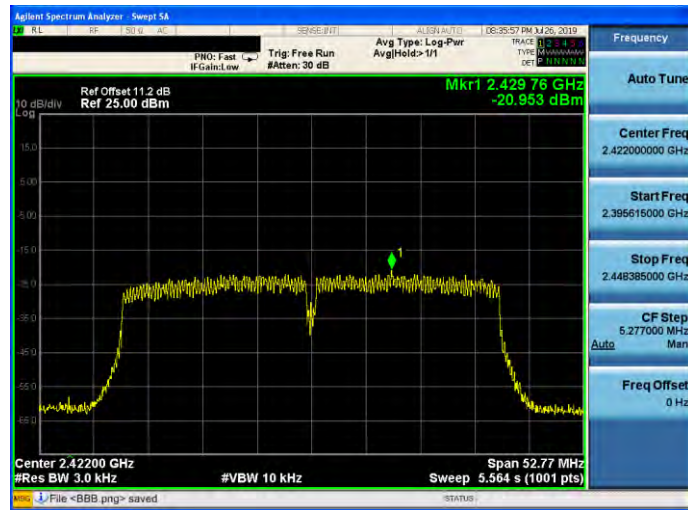


2462 MHz

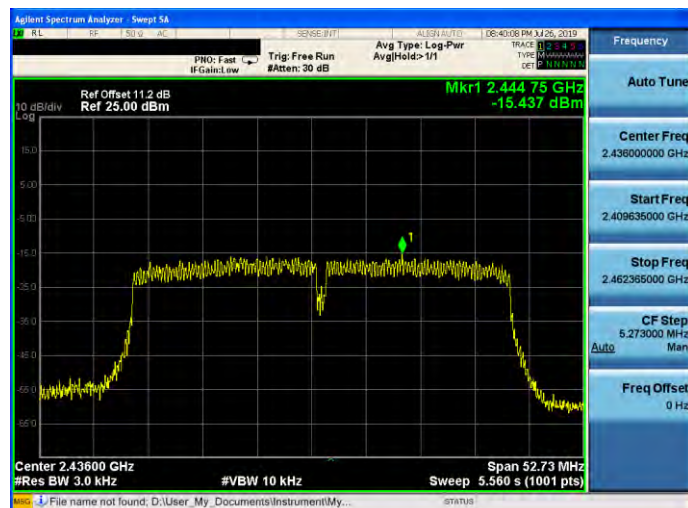


Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode \_ANT-1

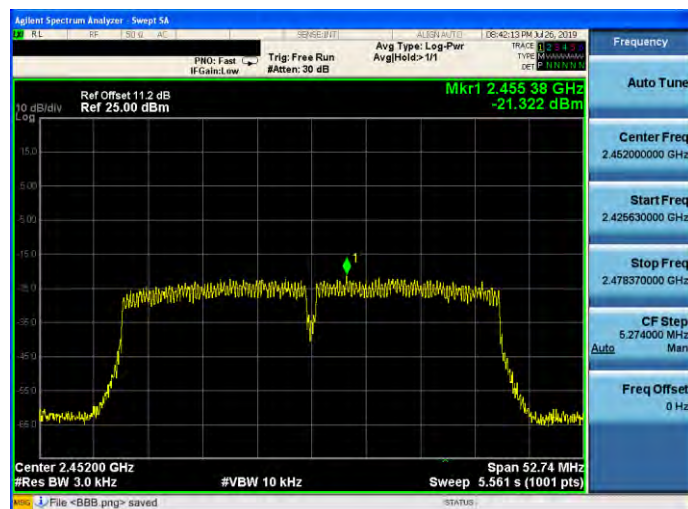
2422 MHz



2437 MHz



2452 MHz





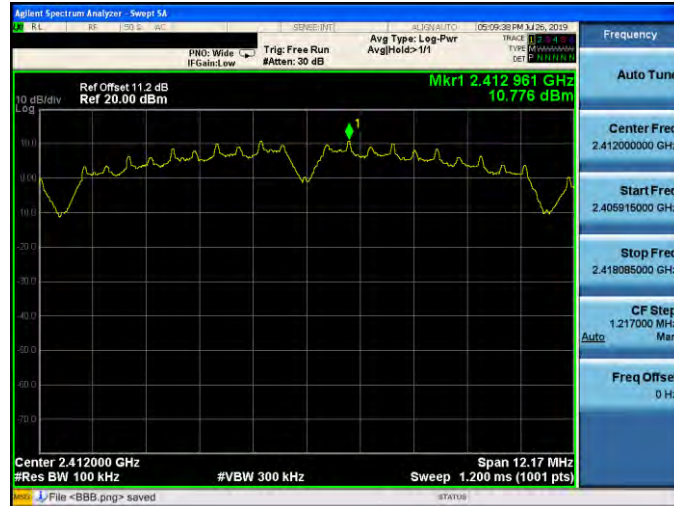
## Out of Band Conducted Emissions Measurement

### ■ Test Graphs

#### Reference level

Mode 2: IEEE 802.11b Continuous TX mode\_ANT-0

2412 MHz



2437 MHz



2462 MHz



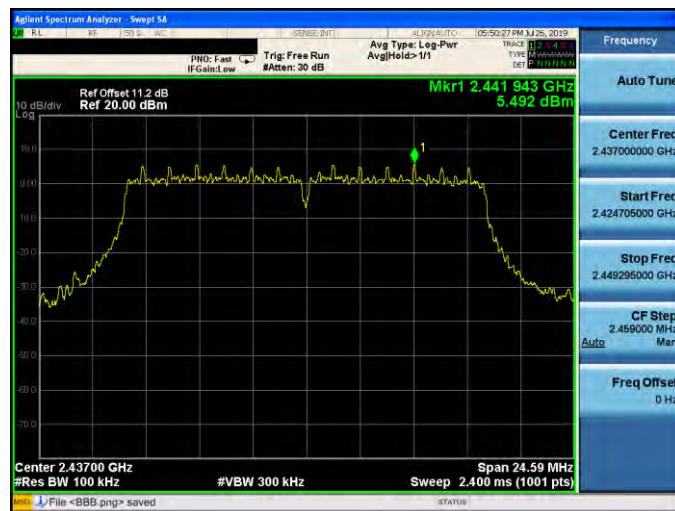


Mode 3: IEEE 802.11g Continuous TX mode\_ANT-0

2412 MHz



2437 MHz



2462 MHz



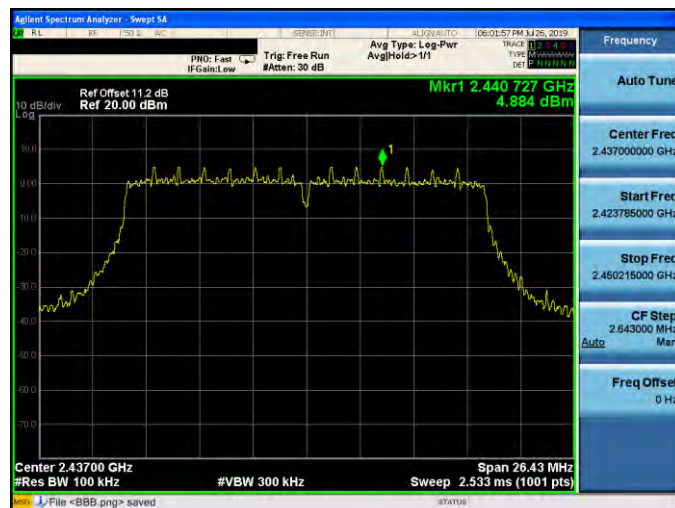


Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode \_ANT-0

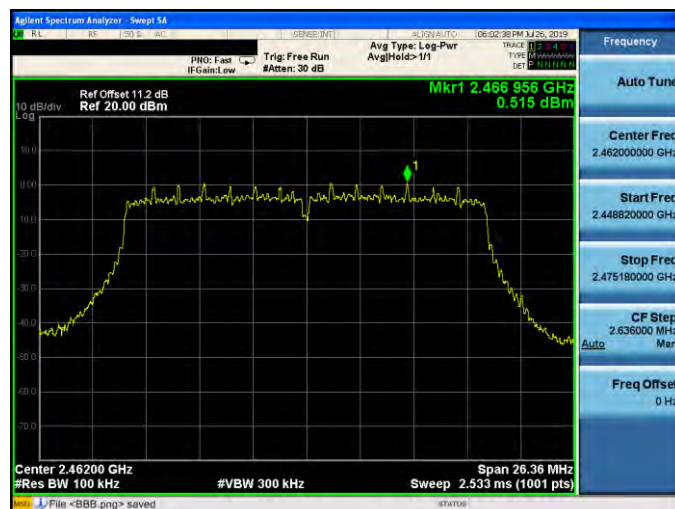
2412 MHz



2437 MHz



2462 MHz







Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode \_ANT-0

2422 MHz



2437 MHz



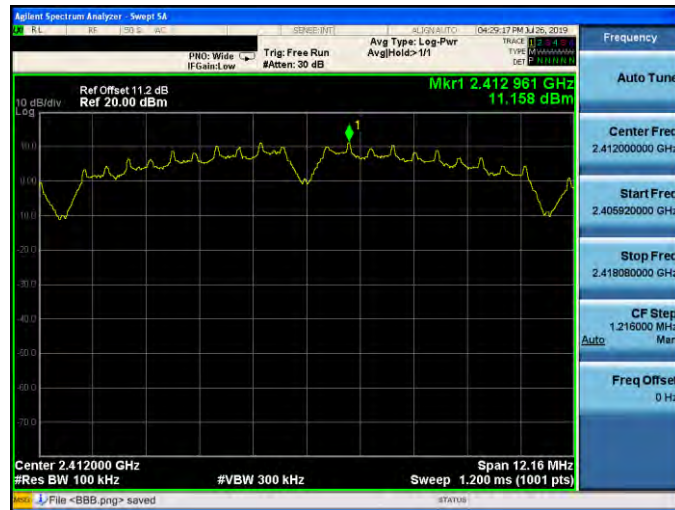
2452 MHz





Mode 2: IEEE 802.11b Continuous TX mode\_ANT-1

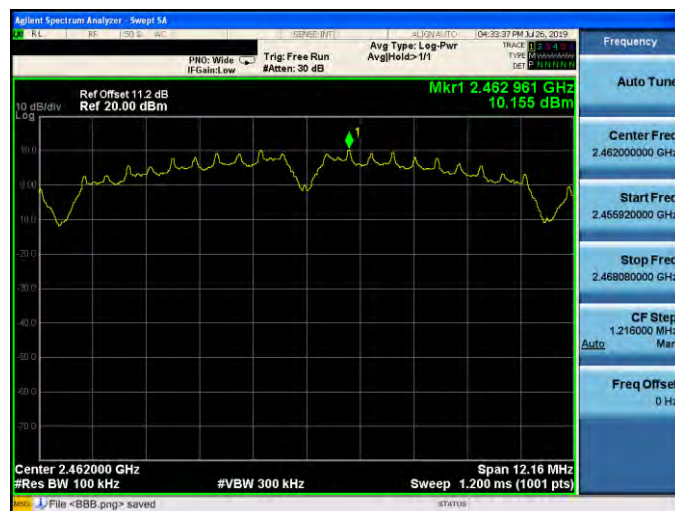
2412 MHz



2437 MHz

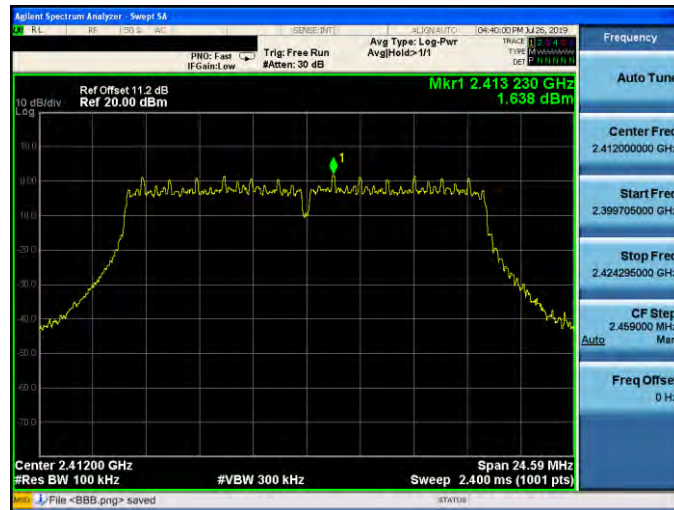


2462 MHz



Mode 3: IEEE 802.11g Continuous TX mode\_ANT-1

2412 MHz



2437 MHz



2462 MHz







Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode \_ANT-1

2412 MHz



2437 MHz



2462 MHz





Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode \_ANT-1

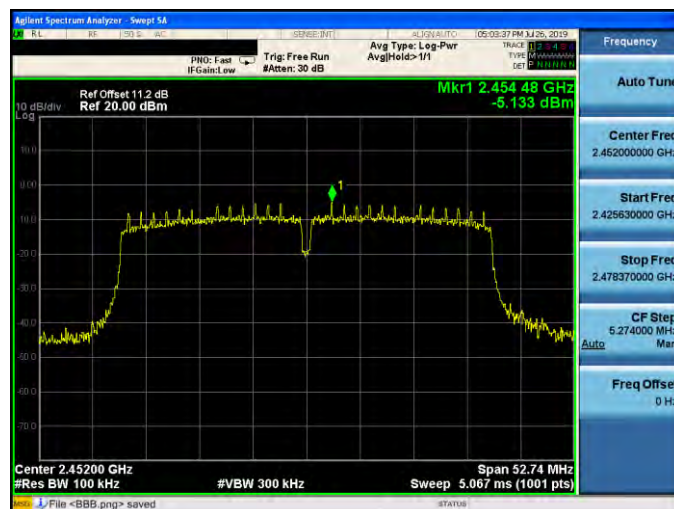
2422 MHz



2437 MHz



2452 MHz



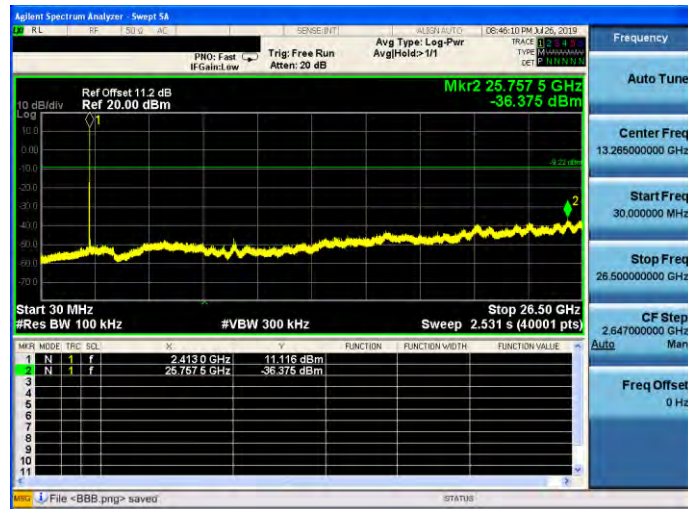




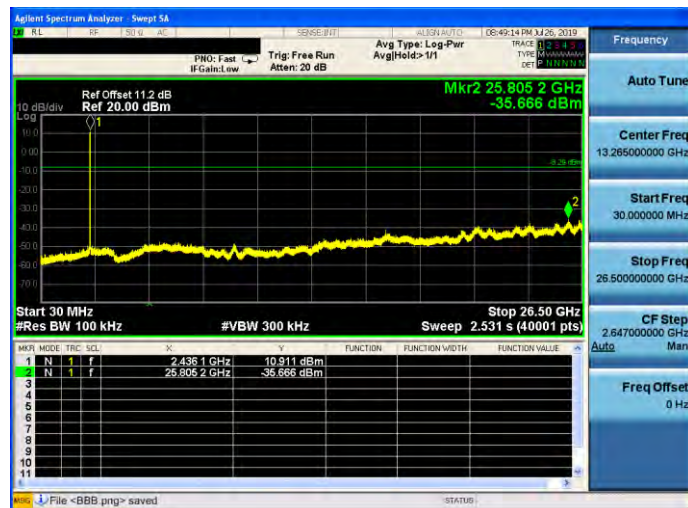
## Out of Band Conducted Emissions

Mode 2: IEEE 802.11b Continuous TX mode\_ANT-0

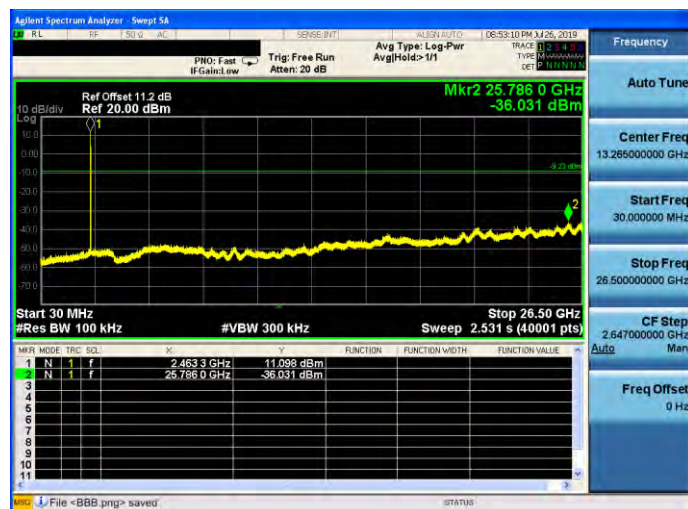
2412 MHz



2437 MHz



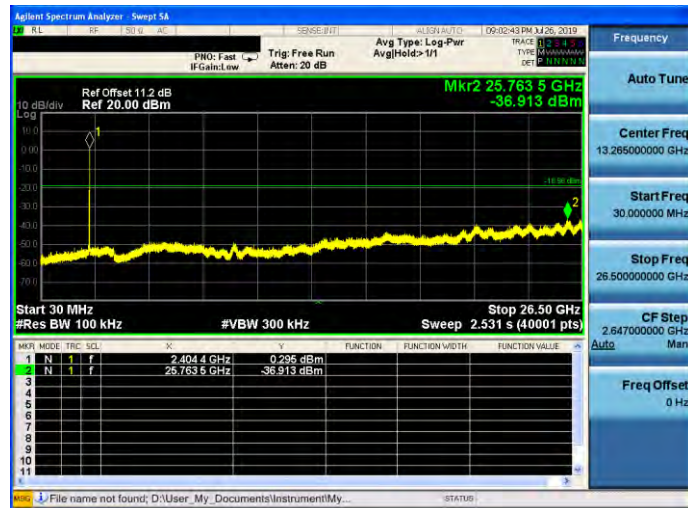
2462 MHz



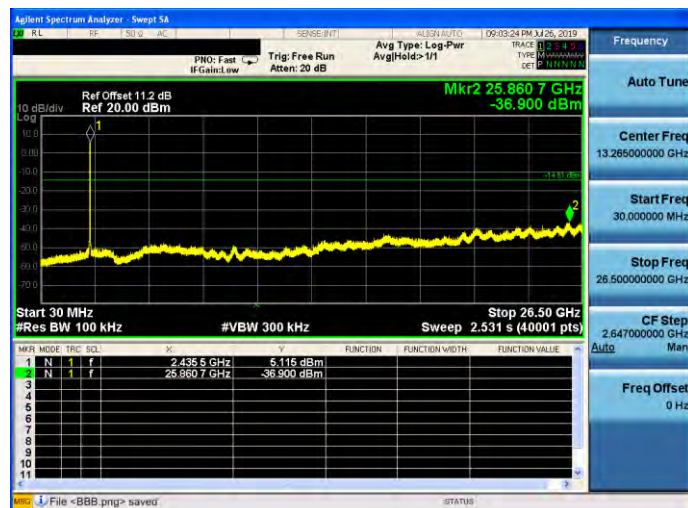


Mode 3: IEEE 802.11g Continuous TX mode\_ANT-0

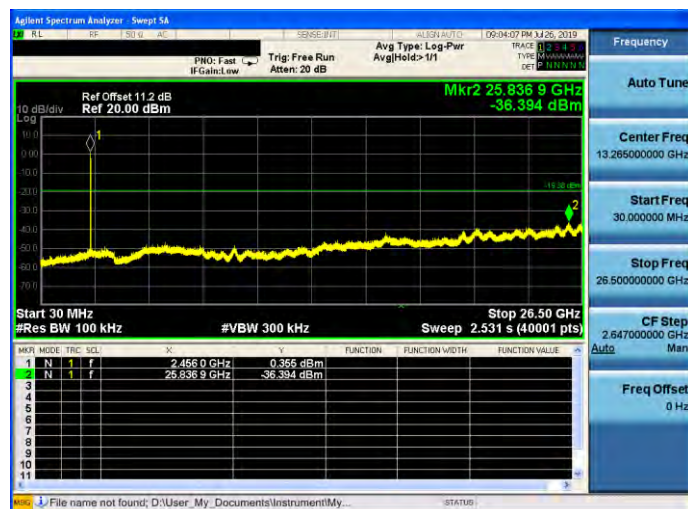
2412 MHz



2437 MHz



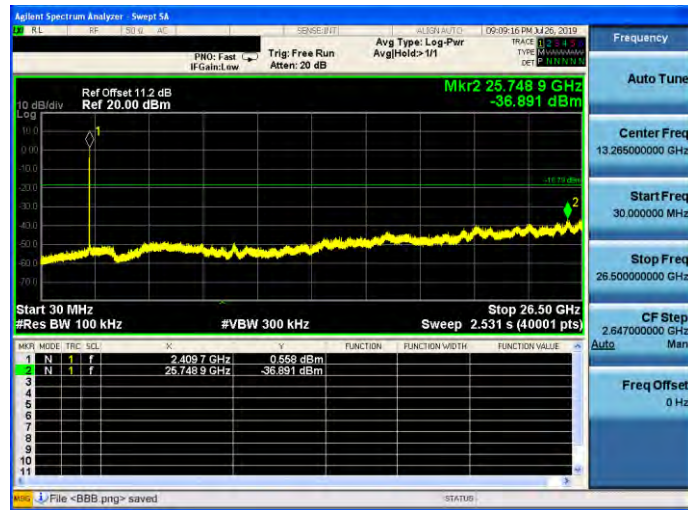
2462 MHz



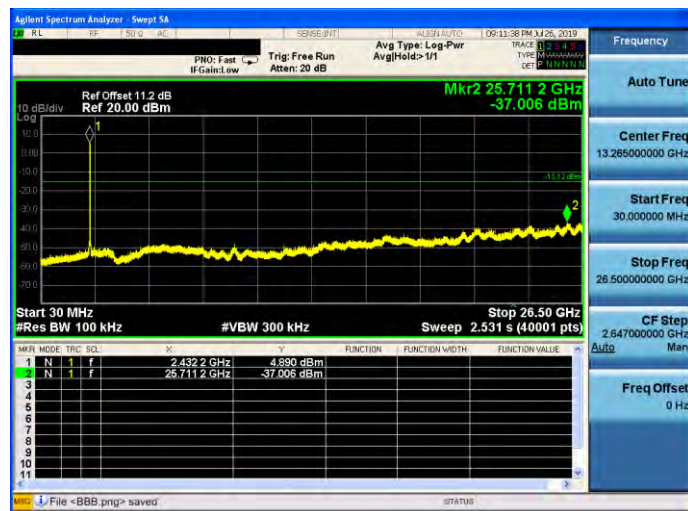


Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode \_ANT-0

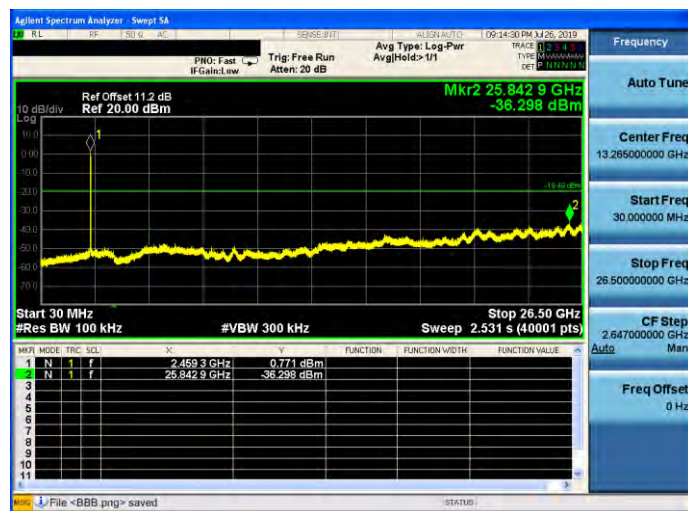
2412 MHz



2437 MHz



2462 MHz







Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode \_ANT-0

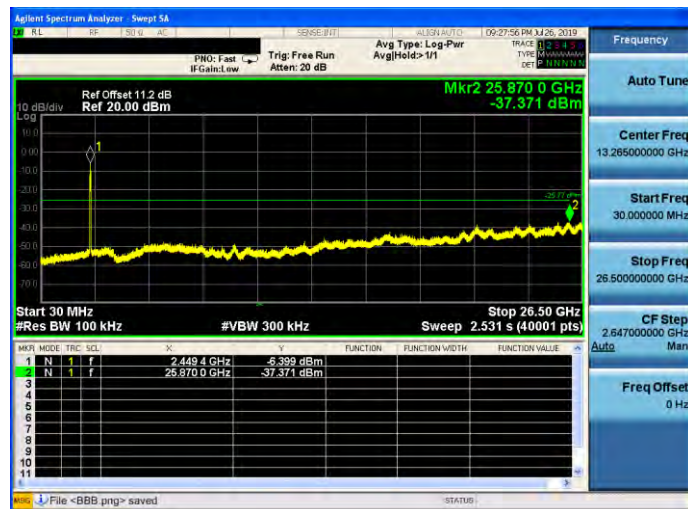
2422 MHz



2437 MHz



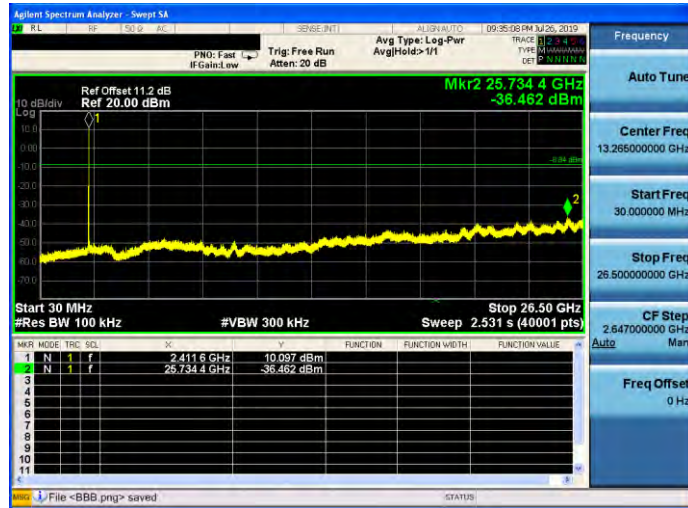
2452 MHz



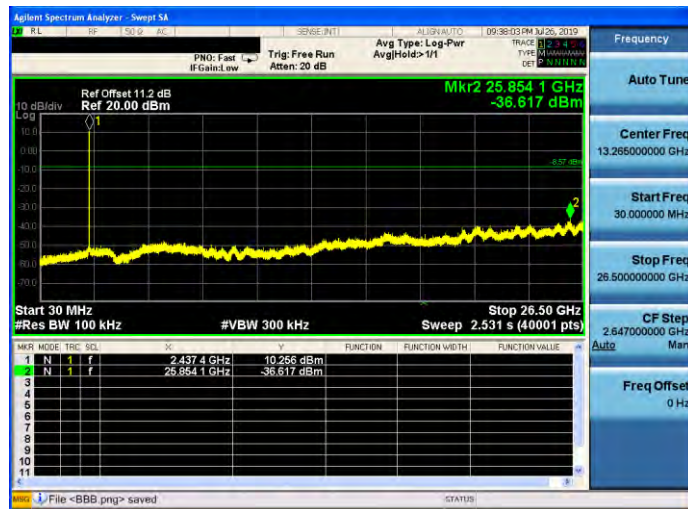


Mode 2: IEEE 802.11b Continuous TX mode\_ANT-1

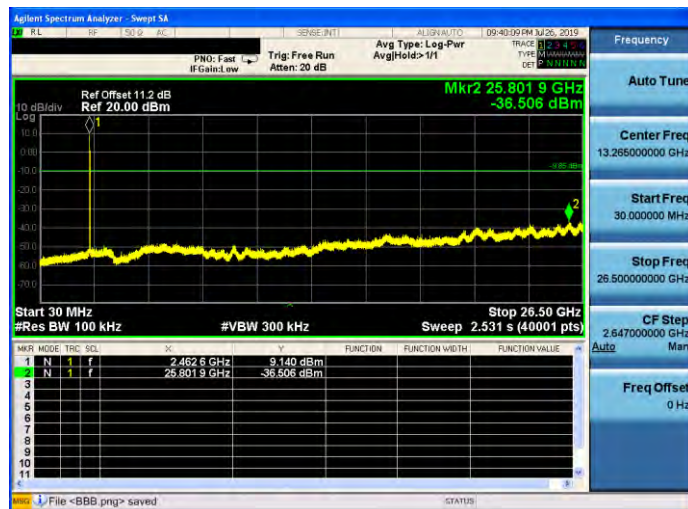
2412 MHz



2437 MHz



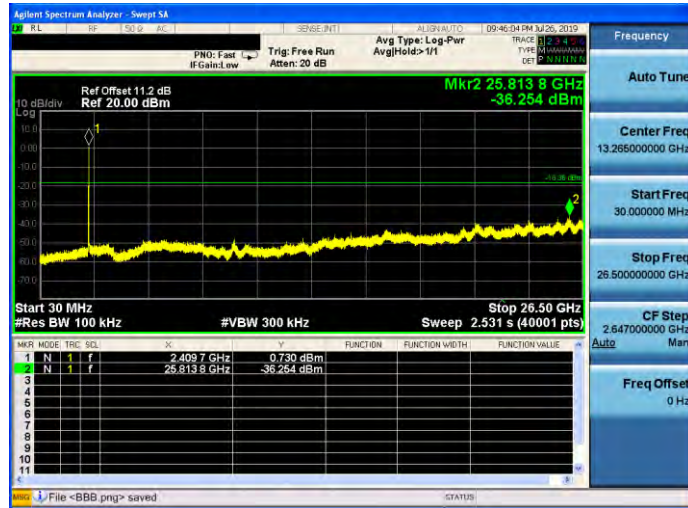
2462 MHz



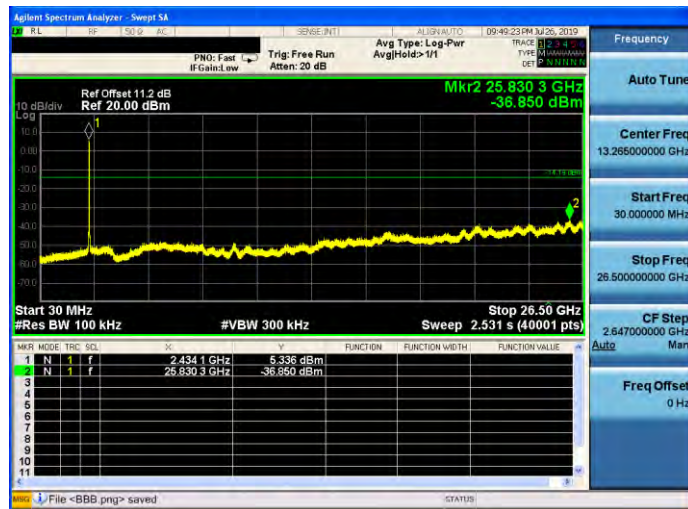


Mode 3: IEEE 802.11g Continuous TX mode\_ANT-1

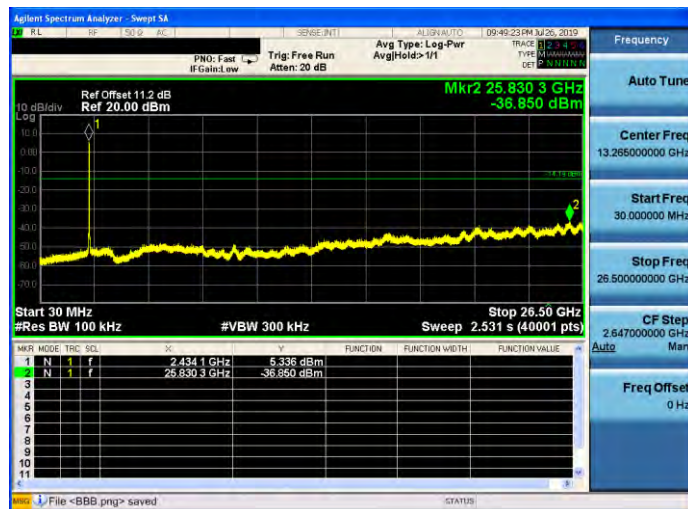
2412 MHz



2437 MHz



2462 MHz

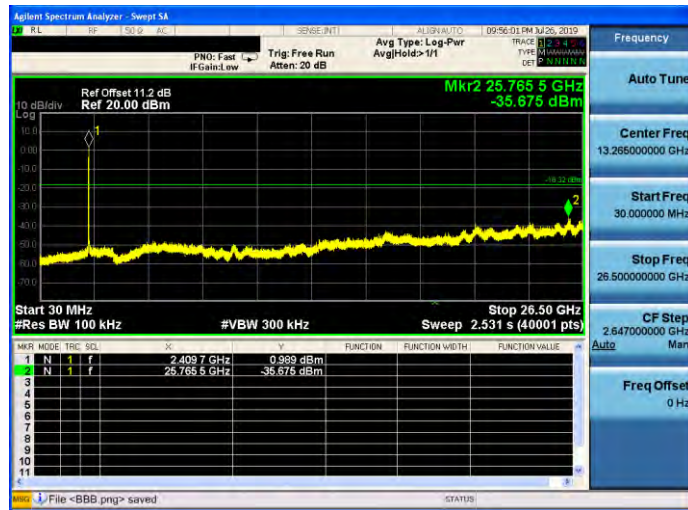




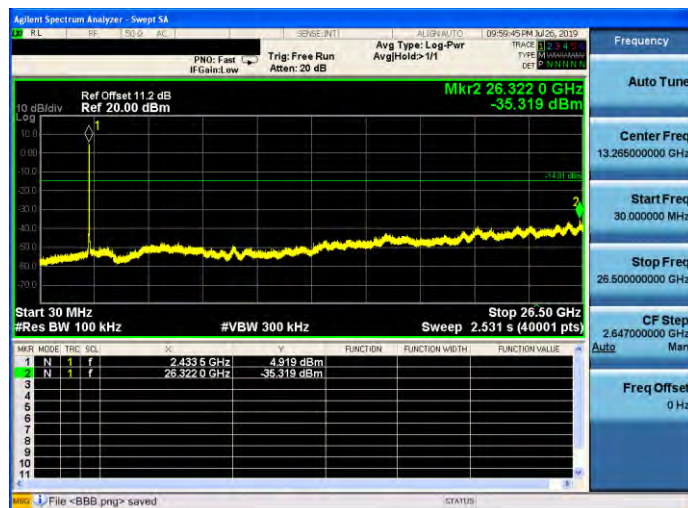


Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode \_ANT-1

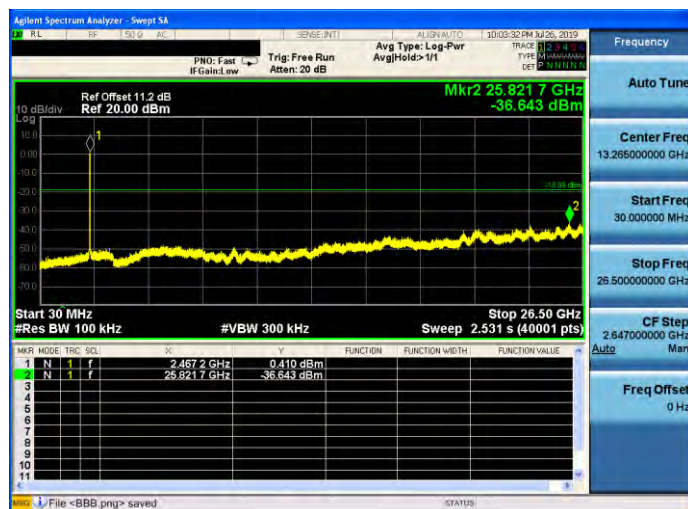
2412 MHz



2437 MHz



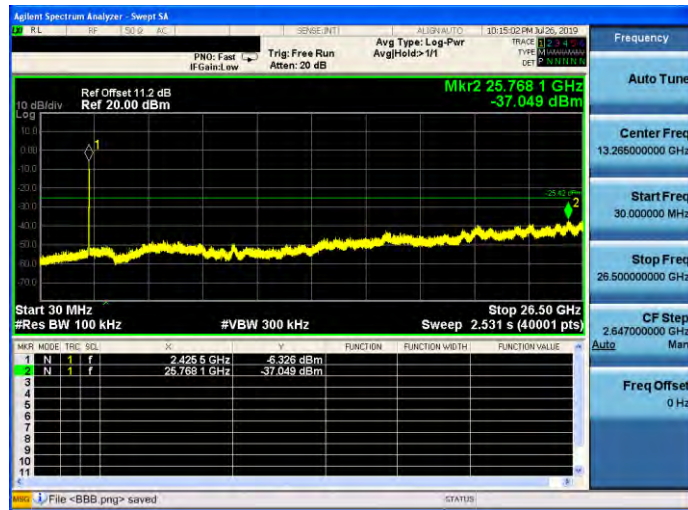
2462 MHz



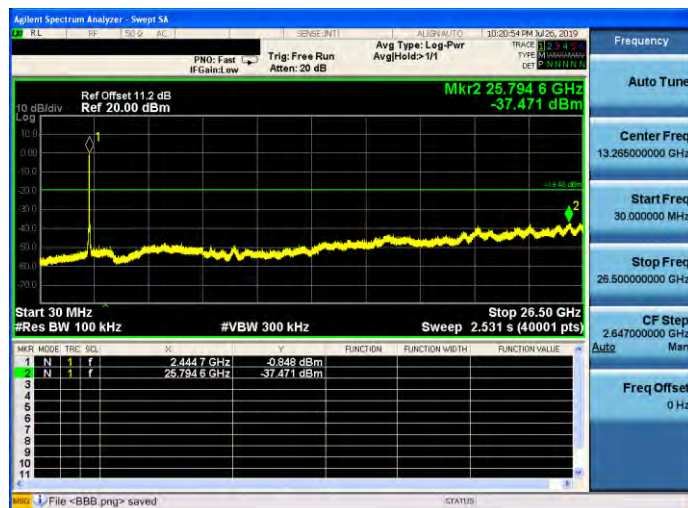


Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode \_ANT-1

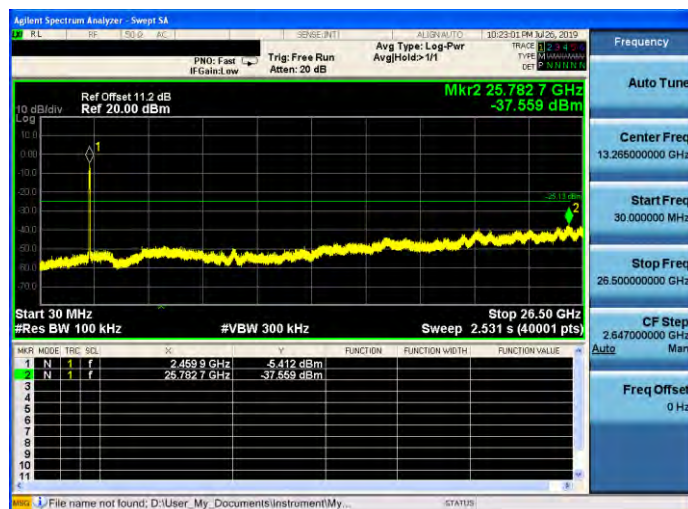
2422 MHz



2437 MHz



2452 MHz



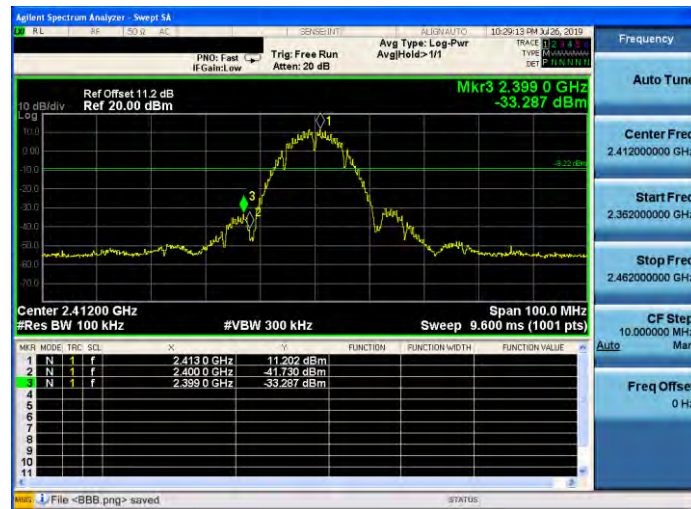




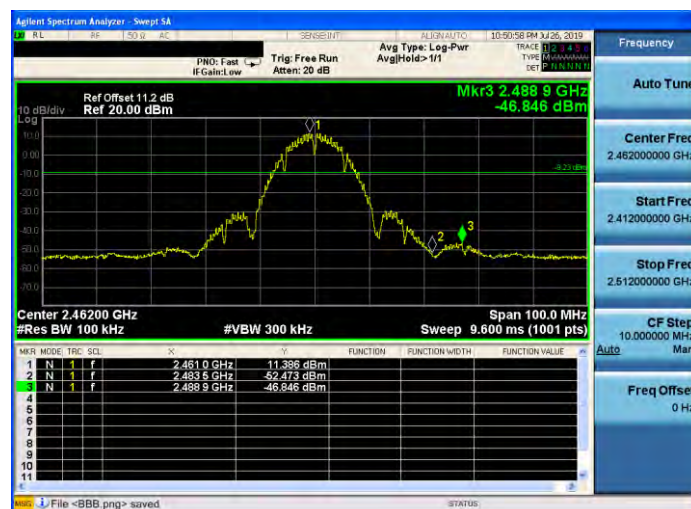
## Conducted Band Edge

Mode 2: IEEE 802.11b Continuous TX mode\_ANT-0

2412 MHz



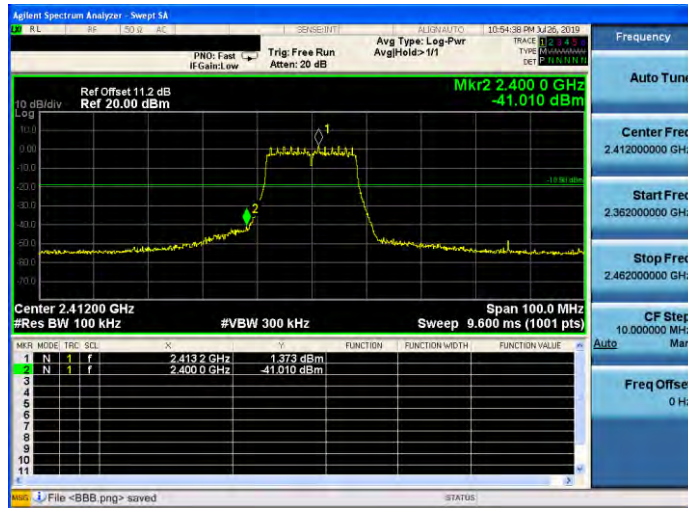
2462 MHz



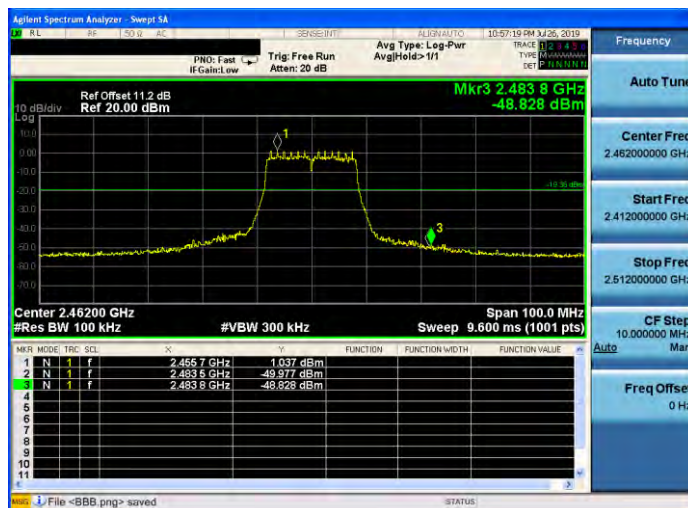


Mode 3: IEEE 802.11g Continuous TX mode\_ANT-0

2412 MHz



2462 MHz



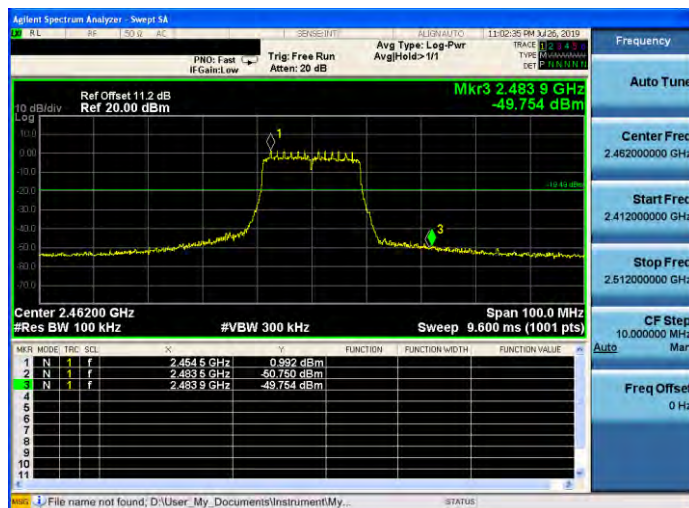


Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode \_ANT-0

2412 MHz



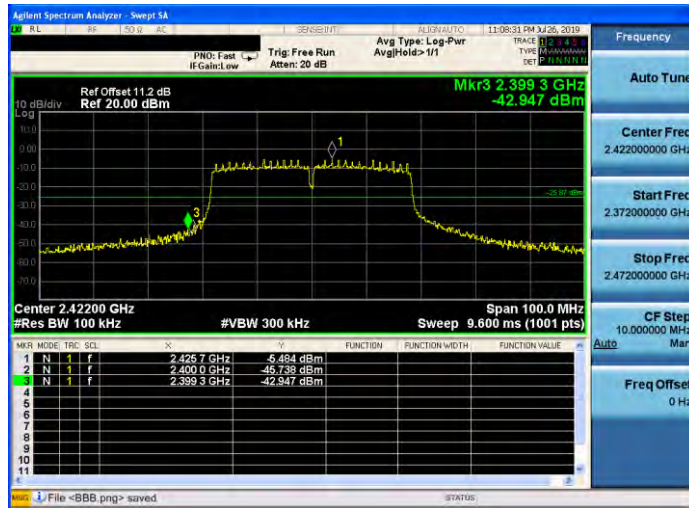
2462 MHz



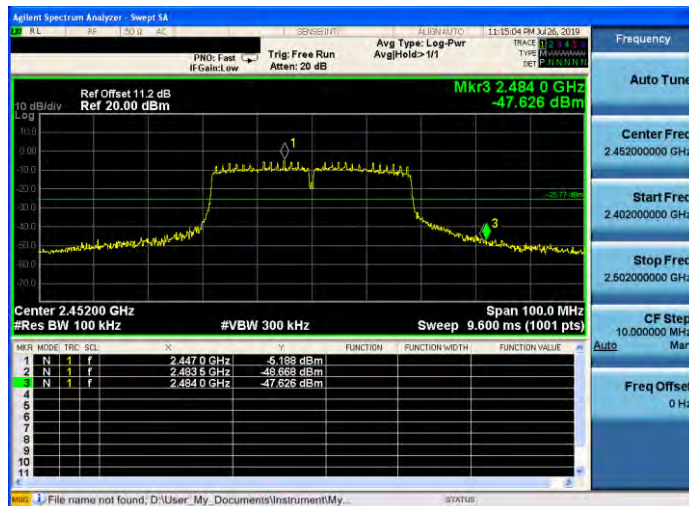


Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode \_ANT-0

2422 MHz



2452 MHz

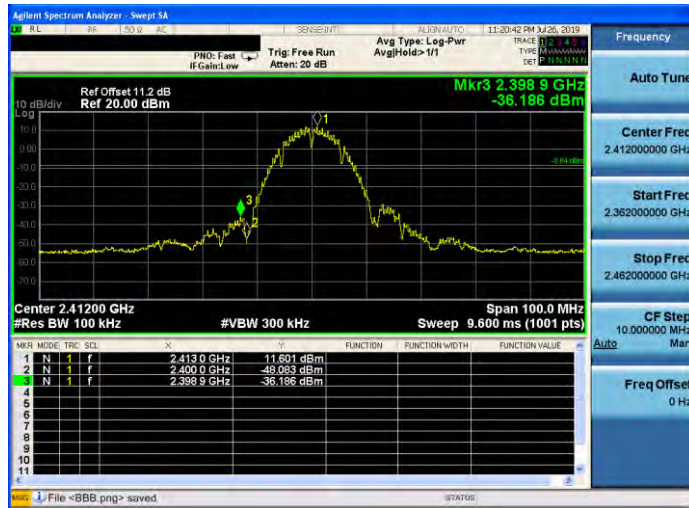




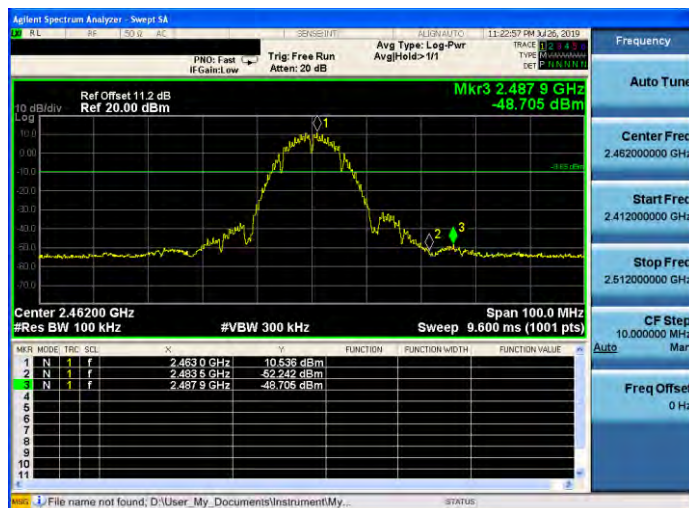


Mode 2: IEEE 802.11b Continuous TX mode\_ANT-1

2412 MHz



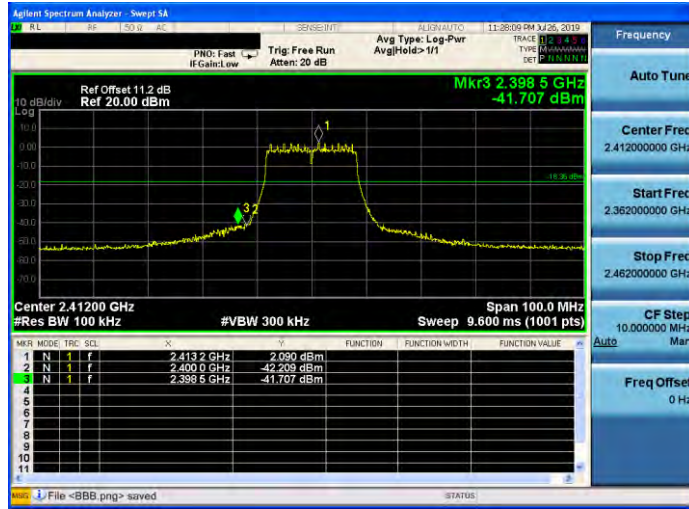
2462 MHz



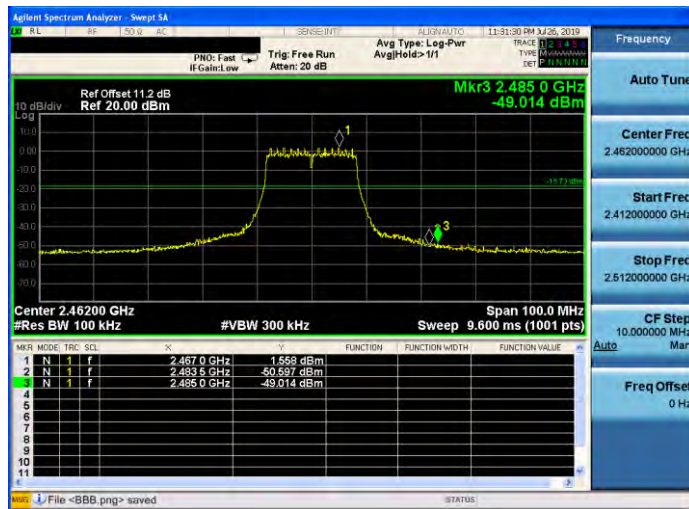


Mode 3: IEEE 802.11g Continuous TX mode\_ANT-1

2412 MHz



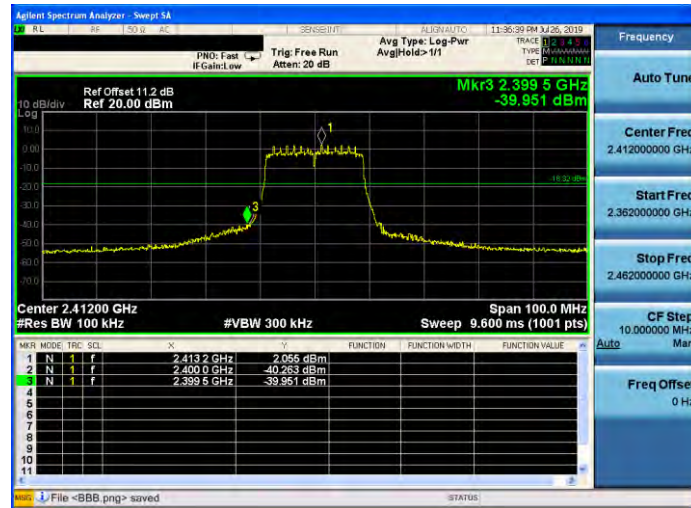
2462 MHz



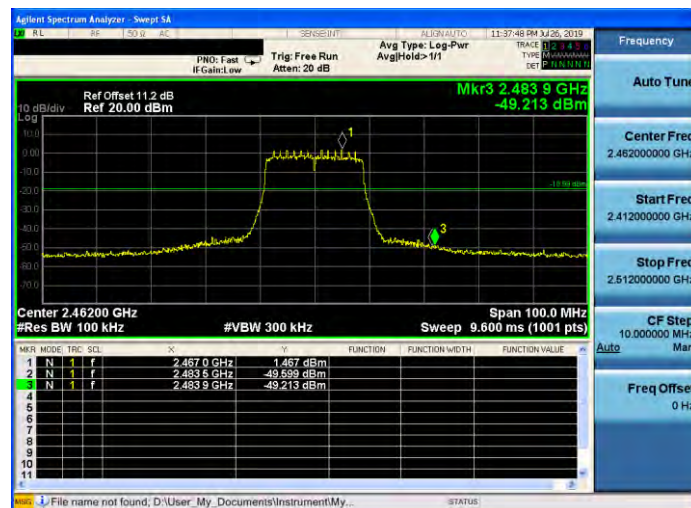


Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode \_ANT-1

2412 MHz



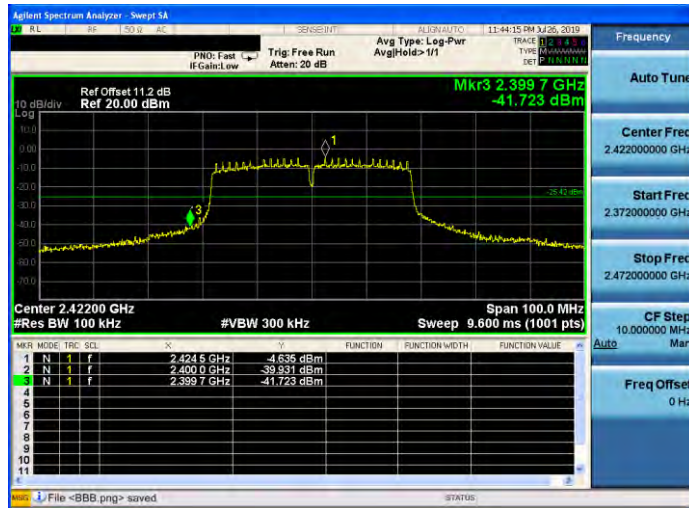
2462 MHz





Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode \_ANT-1

2422 MHz



2452 MHz

