# **TEST REPORT**

DT&C Co., Ltd.

500		DT&C Co., Ltd.
	Dt&C	42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042 Tel : 031-321-2664, Fax : 031-321-1664
1. Report	No: DRTFCC1803-004	6
2. Custom	ner	
• Name	: Sena Technologies,Ind	2.
• Addre	ess : 19, Heolleung-ro 569	9-gil, Gangnam-gu, Seoul, South Korea
3. Use of	Report : FCC & IC Origin	al Grant
4. Product	Name / Model Name : P	rism Tube Wifi / SP53
FCC ID	: S7A-SP53 / IC: 8154A-S	SP53
5. Test Me	ethod Used : KDB 558074	4 D01 v04
Test Sp	ecification : FCC Part 15	Subpart C.247
	RSS-247 lss	ue 2 (2017-02), RSS-GEN Issue 4 (2014-11)
6. Date of	Test : 2018.01.16 ~ 2018	3.01.26
7. Testing	Environment : See appe	nded test report.
8. Test Re	sult : Refer to the attache	ed test result.
Affine ation	Tested by	Reviewed by
Affirmation	Name : JungWoo Kim	Sitter Name : GeunKi Son (Signature)
		est report are limited only to the sample supplied by applicant and
the use of t		her than its purpose. This test report shall not be reproduced except in
		ut the written approval of DT&C Co., Ltd.
		2018.03.08.
		DT&C Co., Ltd.

# **Test Report Version**

Test Report No.	Date	Description
DRTFCC1803-0046	Mar. 08, 2018	Initial issue



# **Table of Contents**

1. GENERAL INFORMATION 4
1.1 Testing Laboratory4
1.2 Test Environment4
1.3 Measurement Uncertainty4
1.4 Details of Applicant5
1.5 Description of EUT5
2. SUMMARY OF TESTS 6
3. TEST METHODOLOGY7
3.1 EUT CONFIGURATION
3.2 EUT EXERCISE
3.3 GENERAL TEST PROCEDURES7
3.4 DESCRIPTION OF TEST MODES7
4. INSTRUMENT CALIBRATION 8
5. ANTENNA REQUIREMENTS 8
6. TEST RESULT
6.1 6 dB Bandwidth9
6.2 Maximum Peak Conducted Output Power16
6.3 Maximum Power Spectral Density18
6.4 Out of Band Emissions at the Band Edge / Conducted Spurious Emissions
6.5 Radiated Spurious Emissions50
6.6 Power-line conducted emissions55
6.7 Occupied Bandwidth58
7. LIST OF TEST EQUIPMENT 65
APPENDIX I
APPENDIX II
APPENDIX III

# **1. GENERAL INFORMATION**

# **1.1 Testing Laboratory**

# DT&C Co., Ltd.

The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The site is constructed in conformance with the requirements.

### - FCC MRA Accredited Test Firm No. : KR0034

- IC Test site	No. :	5740A-4
www.dtnc.net		
Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

# **1.2 Test Environment**

Ambient Condition					
Temperature	+21 ~ +23 ℃				
<ul> <li>Relative Humidity</li> </ul>	40 % ~ 41 %				

# **1.3 Measurement Uncertainty**

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C 63.4-2014 and ANSI C 63.10-2013. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence.

Test items	Measurement uncertainty
Transmitter Output Power	0.7 dB (The confidence level is about 95 %, $k = 2$ )
Conducted spurious emission	1.0 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz Below)	5.1 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz ~ 18 GHz)	5.4 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (18 GHz Above)	5.3 dB (The confidence level is about 95 %, $k = 2$ )



# **1.4 Details of Applicant**

Applicant	:	Sena Technologies,Inc.
Address	:	19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, South Korea
Contact person	:	Seunghyun Kim

# 1.5 Description of EUT

EUT	Prism Tube Wifi
Model Name	SP53
Add Model Name	NA
Power Supply	DC 3.7 V
Hardware version	1.0
Software version	1.0
Frequency Range	2.4GHz Band • 802.11b/g/n(HT20) : 2412 MHz ~ 2462 MHz
Max. RF Output Power	2.4GHz Band • 802.11b : 11.21 dBm • 802.11g : 17.97 dBm • 802.11n (HT20) : 17.73 dBm
Modulation Type	802.11b : DSSS/CCK 802.11g/n : OFDM
Antenna Specification	Internal Antenna • 2.4GHz Band Max. peak gain : -1.15 dBi

# 2. SUMMARY OF TESTS

FCC Part	RSS Std.	Parameter	Limit	Test Condition	Status Note 1				
15.247(a)	RSS-247 [5.2]	6 dB Bandwidth	> 500 kHz		С				
15.247(b)	RSS-247 [5.4]	Transmitter Output Power	< 1 Watt		С				
15.247(d)	RSS-247 [5.5]	Out of Band Emissions / Band Edge	20 dBc in any 100 kHz BW	Conducted	с				
15.247(e)	RSS-247 [5.2]	Transmitter Power Spectral Density	< 8 dBm/3 kHz		С				
-	RSS-Gen [6.6]	Occupied Bandwidth (99 %)	RSS-Gen(6.6)		С				
15.247(d) 15.205 15.209	RSS-247 [5.5] RSS-GEN [8.9] RSS-GEN [8.10]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	FCC 15.209 limits	Radiated	C Note 2,3				
15.207	RSS-Gen [8.8]	AC Line Conducted Emissions	FCC 15.207 limits	AC Line Conducted	С				
15.203	RSS-Gen [8.3]	Antenna Requirements	FCC 15.203	-	С				
Note 2 : For	Note 1: C=Comply       NC=Not Comply       NT=Not Tested       NA=Not Applicable         Note 2 : For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated with OATS.       OATS.								

Note 3 : This test item was performed in each axis and the worst case data was reported.



# 3. TEST METHODOLOGY

Generally the tests were performed according to the KDB558074 D01 v04. And ANSI C63.10-2013 was used to reference appropriate EUT setup and maximizing procedures of radiated spurious emission and AC line conducted emission testing.

# **3.1 EUT CONFIGURATION**

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

# **3.2 EUT EXERCISE**

The EUT was operated in the test mode to fix the TX frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

# **3.3 GENERAL TEST PROCEDURES**

#### **Conducted Emissions**

The power-line conducted emission test procedure is not described on the KDB558074 D01v04.

So this test was fulfilled with the requirements in Section 6.2 of ANSI C63.10-2013.

The EUT is placed on the wooden table, which is 0.8 m above ground plane and the conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and Average detector.

#### **Radiated Emissions**

Basically the radiated tests were performed with KDB558074 D01v04. But some requirements and procedures like test site requirements, EUT setup and maximizing procedure were fulfilled with the requirements in Section 5 and 6 of the ANSI C63.10-2013 as stated on section 12.1 of the KDB558074 D01v04.

The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the highest emission, the relative positions of the EUT were rotated through three orthogonal axes.

# **3.4 DESCRIPTION OF TEST MODES**

The EUT has been tested with all modes of operating conditions to determine the worst case emission characteristics. A test program is used to control the EUT for staying in continuous transmitting mode.



# 4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

# 5. ANTENNA REQUIREMENTS

# 5.1 According to FCC 47 CFR §15. 203

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 antenna is Permanently attached. (Refer to Internal Photo file.) Therefore this E.U.T Complies with the requirement of §15.203.



# 6. TEST RESULT

# 6.1 6 dB Bandwidth

# Test Requirements and limit, §15.247(a) & RSS-247 [5.2]

The bandwidth at 6 dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

# The minimum permissible 6 dB bandwidth is 500 kHz.

# **TEST CONFIGURATION**

Refer to the APPENDIX I.

# TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer and used following test procedure of KDB558074 D01v04

- 1. Set resolution bandwidth (RBW) = 100 kHz.
- 2. Set the video bandwidth (VBW) ≥ 3 x RBW. (RBW : 100 kHz / VBW : 300 kHz)
- 3. Detector = Peak.
- 4. Trace mode = **Max hold**.
- 5. Sweep = Auto couple.
- 6. Allow the trace to stabilize.
- 7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

# TEST RESULTS: Comply

Test Mode	Data Rate	Frequency [MHz]	Test Results [MHz]
		2412	8.04
802.11b	1 Mbps	2437	8.06
		2462	7.58
		2412	15.16
802.11g	6 Mbps	2437	15.13
		2462	15.13
		2412	15.15
802.11n (HT20)	MCS 0	2437	15.13
(11120)		2462	15.14

## RESULT PLOTS

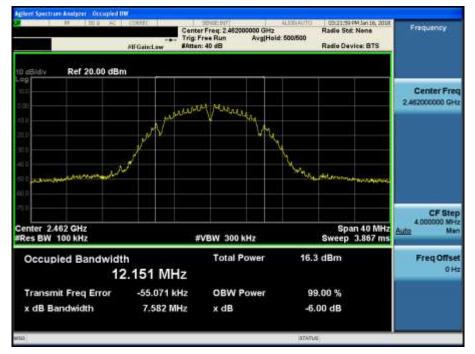
#### 6 dB Bandwidth Test Mode: 802.11b & 1 Mbps & 2412 MHz Center Freq: 2.41200000 GHz Trig: Free Run Avg|Hold: 500/500 Alf Geint.aw Aften: 40 dB Radio Std. None Frequency Radio Device: BTS Ref 20.00 dBm Center Freq 2.412000000 GHt and Manua CF Step 4.0 Span 40 MHz Sweep 3.867 ms Center 2.412 GHz #Res BW 100 kHz Ma Auto #VBW 300 kHz Occupied Bandwidth Total Power 16.2 dBm Freq Offset OH 12.260 MHz Transmit Freq Error -40.486 kHz **OBW Power** 99.00 % x dB Bandwidth 8.043 MHz x dB -6.00 dB

#### 6 dB Bandwidth

Test Mode: 802.11b & 1 Mbps & 2437 MHz



#### Test Mode: 802.11b & 1 Mbps & 2462 MHz



#### Test Mode: 802.11g & 6 Mbps & 2412 MHz

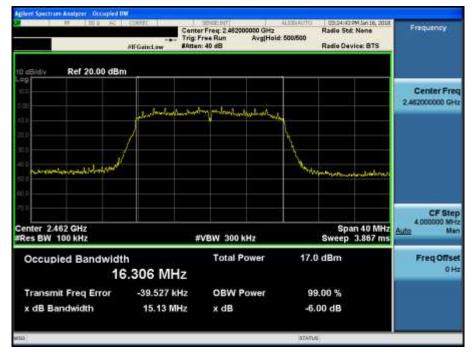


#### 6 dB Bandwidth

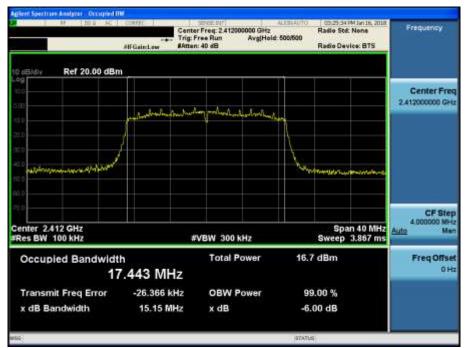
### Test Mode: 802.11g & 6 Mbps & 2437 MHz



#### Test Mode: 802.11g & 6 Mbps & 2462 MHz



#### Test Mode: 802.11n(HT20) & MCS 0 & 2412 MHz

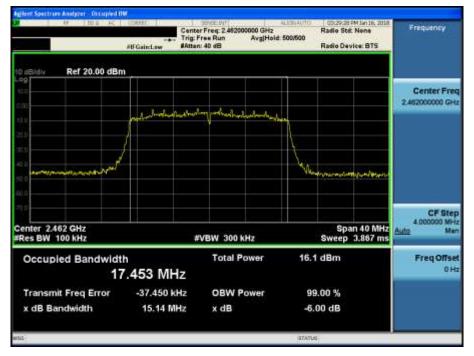


#### 6 dB Bandwidth

Test Mode: 802.11n(HT20) & MCS 0 & 2437 MHz



#### Test Mode: 802.11n(HT20) & MCS 0 & 2462 MHz



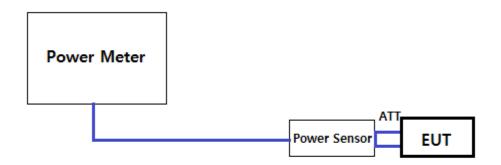


# 6.2 Maximum Peak Conducted Output Power

# Test Requirements and limit, §15.247(b) & RSS-247 [5.4]

The maximum permissible conducted output power is 1 Watt.

# TEST CONFIGURATION



#### TEST PROCEDURE

### 1. PKPM1 Peak power meter method of KDB558074 D01v04

The maximum conducted output powers were measured using a broadband peak RF power meter which has greater video bandwidth than DUT's DTS bandwidth and utilize a fast-responding diode detector.

### 2. Method AVGPM-G (Measurement using a gated RF average power meter) of KDB558074 D01v04

The average conducted output powers were measured using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.

# TEST RESULTS: Comply

#### - Test Results

Mode	Channel	Frequency [MHz]		Test Result [dBm]								
			Detector	DATA RATE [Mbps]								
				1	2	5.5	11	NA	NA	NA	NA	
	1	2412	PK	11.12	11.08	11.05	11.02	-	-	-	-	
			AV	8.32	8.29	8.25	8.26	-	-	-	-	
802.11b		2437	PK	11.21	11.18	11.15	11.13	-	-	-	-	
002.110	6		AV	8.38	8.36	8.32	8.29	-	-	-	-	
	11		PK	11.14	11.13	11.11	11.05	-	-	-	-	
		2462	AV	8.34	8.32	8.29	8.25	-	-	-	-	

Mode	Channel	Frequency [MHz]		Test Result [dBm]								
			Detector	DATA RATE [Mbps]								
				6	9	12	18	24	36	48	54	
	4	2412	PK	17.55	17.49	17.51	17.52	17.49	17.48	17.45	17.46	
1	I		AV	8.68	8.66	8.61	8.63	8.62	8.58	8.60	8.59	
000 11 -	6	2437	PK	17.77	17.75	17.72	17.69	17.68	17.62	17.59	17.58	
802.11g	802.11g 6		AV	8.72	8.69	8.70	8.68	8.66	8.68	8.66	8.62	
	44		PK	17.97	17.95	17.88	17.91	17.88	17.90	17.89	17.91	
	11	2462	AV	8.43	8.42	8.38	8.40	8.35	8.32	8.31	8.32	

Mode Channe				Test Result [dBm]							
	Channel	Frequency [MHz]	Detector			[	DATA RA	TE [MCS	]		
				0	1	2	3	4	5	6	7
	4	2442	PK	17.45	17.42	17.39	17.36	17.32	17.29	17.25	17.24
	1	2412	AV	8.56	8.55	8.52	8.54	8.51	8.48	8.52	8.49
802.11n	6	0.407	РК	17.73	17.72	17.69	17.68	17.70	17.65	17.62	17.63
(HT20)	6	2437	AV	8.51	8.48	8.50	8.46	46 8.44 8.45 8.4	8.46	8.44	
	11	2462	PK	17.59	17.55	17.53	17.52	17.46	17.42	17.38	17.36
		2462	AV	8.41	8.39	8.37	8.36	8.36	8.32	8.35	8.32



# 6.3 Maximum Power Spectral Density

# Test requirements and limit, §15.247(e) & RSS-247 [5.2]

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

#### **TEST CONFIGURATION**

Refer to the APPENDIX I.

#### Test Procedure

Method PKPSD of KDB558074 is used.

- 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 kHz** ≤ RBW ≤ **100 kHz**
- 4. Set the VBW  $\ge$  3 x 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.

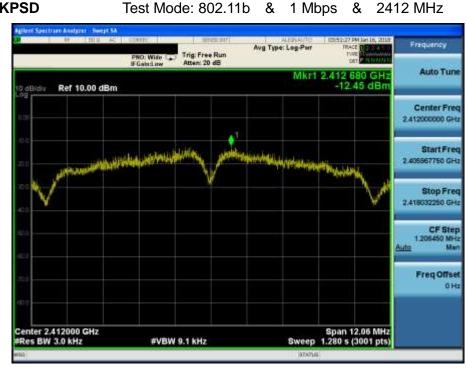
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Test Mode	Data Rate	Frequency [MHz]	RBW	PKPSD [dBm]
		2412	3 kHz	-12.45
802.11b	1 Mbps	2437	3 kHz	-13.51
		2462	3 kHz	-11.76
	6 Mbps	2412	3 kHz	-14.27
802.11g		2437	3 kHz	-14.72
		2462	3 kHz	-14.22
		2412	3 kHz	-14.03
802.11n HT20	MCS 0	2437	3 kHz	-14.46
		2462	3 kHz	-15.38

### TEST RESULTS: Comply

## RESULT PLOTS

Maximum PKPSD



#### **Maximum PKPSD**

Test Mode: 802.11b & 1 Mbps & 2437 MHz



Test Mode: 802.11b & 1 Mbps & 2462 MHz



#### Test Mode: 802.11g & 6 Mbps & 2412 MHz

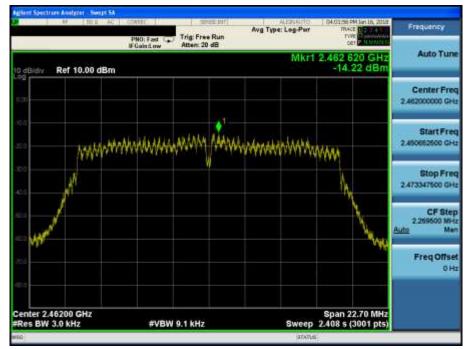


### Maximum PKPSD

Test Mode: 802.11g & 6 Mbps & 2437 MHz



Test Mode: 802.11g & 6 Mbps & 2462 MHz





#### Test Mode: 802.11n(HT20) & MCS 0 & 2412 MHz



## Maximum PKPSD

Test Mode: 802.11n(HT20) & MCS 0 & 2437 MHz



#### Test Mode: 802.11n(HT20) & MCS 0 & 2462 MHz





# 6.4 Out of Band Emissions at the Band Edge / Conducted Spurious Emissions

# Test requirements and limit, §15.247(d) & RSS-247 [5.5]

**§15.247(d)** specifies that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions :

If the peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to **15.247(b)(3)** requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level.

If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to **15.247(b)(3)** requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured in-band average PSD level.

In either case, attenuation to levels below the general emission limits specified in §15.209(a) is not required.

## TEST CONFIGURATION

Refer to the APPENDIX I.

# TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer.

#### - Measurement Procedure 1 – Reference Level

- 1. Set instrument center frequency to DTS channel center frequency.
- 2. Set the span to  $\geq$  1.5 times the DTS bandwidth.
- 3. Set the RBW = **100 kHz.**
- 4. Set the VBW  $\geq$  3 x 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 PSD level.

#### - Measurement Procedure 2 - Unwanted Emissions

- 1. Set the center frequency and span to encompass frequency range to be measured.
- 2. Set the RBW = 100 kHz. (Actual 1 MHz , See below note)
- 3. Set the VBW  $\geq$  3 x RBW. (Actual 3 MHz, See below note)
- 4. Detector = **Peak**.
- 5. Ensure that the number of measurement points  $\geq$  Span / RBW.
- 6. Sweep time = Auto couple.
- 7. Trace mode = **Max hold**.
- 8. Allow the trace to stabilize. (this may take some time, depending on the extent of the span)
- 9. Use the peak marker function to determine the maximum amplitude level.

**Note:** The conducted spurious emission was tested with below settings.

Frequency range: 9 kHz ~ 30 MHz

RBW = 100 kHz, VBW = 300 kHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40001

Frequency range: 30 MHz ~ 10 GHz, 10 GHz ~25 GHz RBW = 1 MHz, VBW = 3 MHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40001

#### LIMIT LINE = 20 dB below of the reference level of above measurement procedure Step 2. (RBW = 100 kHz, VBW = 300 kHz)

If the emission level with above setting was close to the limit (ie, less than 3 dB margin) then zoom scan is required using RBW = 100 kHz, VBW = 300 kHz, SPAN = 100 MHz and BINS = 2001 to get accurate emission level within 100 kHz BW.

Also the path loss for conducted measurement setup was used as described on the Appendix I of this test report.



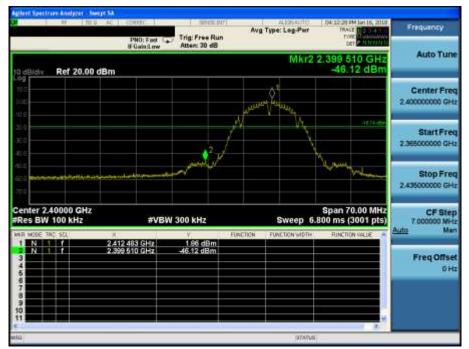
# RESULT PLOTS

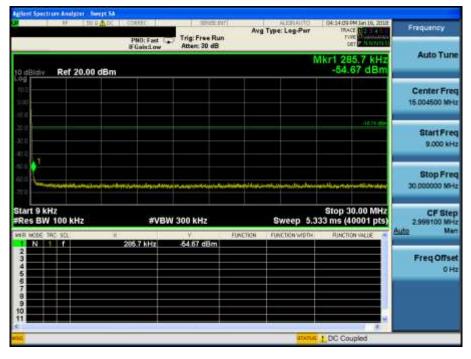
## 802.11b & 1 Mbps & 2412 MHz

lan 16 Frequency Avg Type: Log-Pur PNO: Wide Trig: Free Run Figain:Low Atten: 30 dB Auto Tune Mkr1 2.411 473 GHz 1.26 dBm Ref 20.00 dBm Center Freq 2.412000000 GHz MALAN nu Start Freq 2,405967750 GHz Stop Freq 2.418032250 GHz CF Step 1.206450 MHz ..... Freq Offset OH Center 2.412000 GHz #Res BW 100 kHz Span 12.06 MHz Sweep 1.200 ms (3001 pts) #VBW 300 kHz

Reference

Low Band-edge

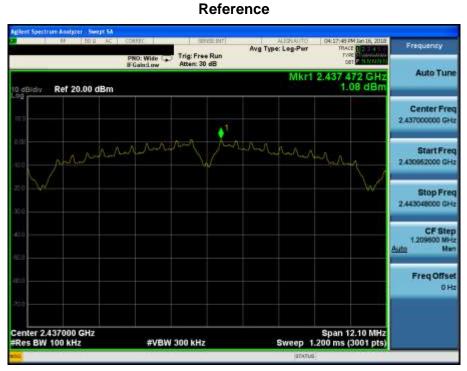


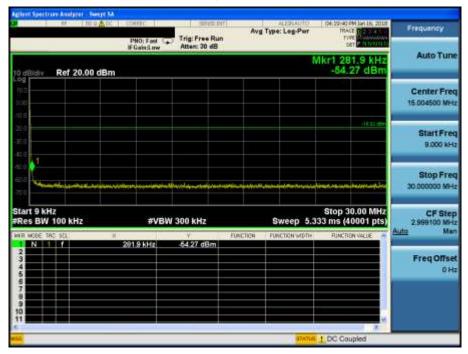


04 15:31 PM Jan 16, 2018 TRACE T 2014 TYPE DET 2 N 10/2/11	ALEXANTO Type: Log-Pwr	21 S	Trig: Free Ru Atten: 30 dB	PNO: Fast		10 [10
46.53 dBm	Mkr5				dBm	Bidly Ref 20.0
					¢1	
AE74 dB		() <sup>4</sup>		<b>6</b> <sup>5</sup> Q <sup>2</sup>	¢ª	2 0 0 1
top 10.000 GHz 'ms (40001 pts)	state of the local division of the local div		3.0 MHz	#VBW		art 30 MHz es BW 1.0 MHz
RUNCTION VALUE	FUNCTION WIDTH	EIAEDO	487 dBm 4043 dBm 4372 dBm 4571 dBm 4653 dBm	96 GHz	2,412 3,617 2,207 6,777	NOTE TROUGHT
151 36 GHz -46.53 dBm	Type: Leg Pur Mkr5	21 S	Trig: Free Ru Atten: 30 dB 3.0 MHz 4.013 dBm 4.3.72 dBm 4.3.72 dBm	HOTFact		24120 3.617 9 2.217 1



# 802.11b & 1 Mbps & 2437 MHz







89 (50 G )	PNO: Fast G	Trig: Free Run Atten: 30 dB	Avg Type: Log Pu		Frequency
o dBidiv Ref 20.00 dB	m		MI	r2 21.819 8 GHz -40.89 dBm	Auto Tune
eg 100					Center Free 18.25000000 GH
810 810 810					Start Fred 10.00000000 GH3
910 ©)2 700					Stop Free 26.60000000 GH
Start 10.000 GHz Res BW 1.0 MHz	#VBV	V 3.0 MHz	Sweep	Stop 26.500 GHz 12.67 ms (40001 pts)	CF Step 1.65000000 GH
WER WODE THE SEL	8 25 151 1 GH2	V E -37.89 dBm	INCTION FUNCTION WID	N+ RUNCTION VALUE	Auto Mer
3 4 5	21.819 8 GHz	-40.89 dBm			Freq Offse 0 H
6 7 8 9 9					
ii <b></b>			10		
4			97.6	nus -	

# 802.11b & 1 Mbps & 2462 MHz



#### Reference

#### **High Band-edge**



Frequency	TRACE DE DA	Type: Log-Pwr	Avı	Trig: Free Run Atten: 30 dB	NO: Fast 😱	P B B		
Auto Tuni	r1 293.9 kHz -55.31 dBm	N				dBm	Ref 20.00	dBidiv R
Center Fred 15.004500 MHz								4 (c) (c)
Start Free 9,000 kH	-4621 dhe							
Stop Free 30.000000 MH	Kennele, Autor Market Market	eletra jerret dan Sirja i je	iseriyainintaa	وريتين عووريانونوا	here in the second state	an ini ini ya mani	20000000	
CF Step 2.999100 MH Auto Mar	Stop 30.00 MHz ms (40001 pts)		E000 (200 (201	300 kHz	#VBW		00 kHz	art 9 kHz tes BW 10
and the second se	PDA, TON VALUE	FUNCTION SUDIFIC	LUNLICH	65.31 dBm	9 kHz			
Freq Offse 0 H	RINCTION VALUE *	FUNCTION WEDTH	EINETICH	y 531 dBm	-64	9 kHz -54	9 293.9 kHz 54	

1 100	AC COMMC PNO: Fast ( Ef Gain Low	10 A 10 A 10 A	Aug Type: Leg.Pwr	GH(25)40 PM Jan 16, 2018 TRACE D 2 0 4 Type Det P N NY1711	Frequency
dBidiv Ref 20.00 d			Mkr	5 2.883 66 GHz -46.33 dBm	Auto Tune
99 101 201	\$ <sup>1</sup>				Center Free 5.015000000 GH
	Q <sup>3</sup> 5.4 Q	2		-4121 day	Start Free 30.000000 MH
10 Na To	Manada				Stop Free 10.000000000 GH
art 30 MHz Res BW 1.0 MHz	#VB	W 3.0 MHz		Stop 10.000 GHz 67 ms (40001 pts)	997.000000 MH
	2,461 93 GHz 3,692 96 GHz 2,160 34 GHz 3,153 10 GHz 2,663 66 GHz	4.92 dBm -39.57 dBm -43.83 dBm -46.22 dBm -46.33 dBm			
	8 2.461 93 GHz 3.692 96 GHz 2.160 34 GHz 3.153 10 GHz	V EU 4.92 dBm -39.57 dBm -43.83 dBm -46.22 dBm	Sweep 18.		CF Step 997 200000 MHz <u>Auto</u> Man Freq Offset 0 Hz



# 802.11g & 6 Mbps & 2412 MHz



#### Reference

Low Band-edge



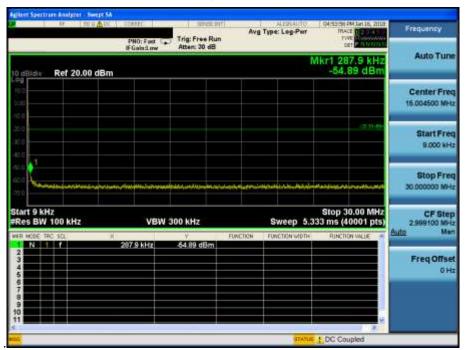
Frequency	e PM Jan 16, 2018 NACE DECIMAND TYPE DET ANNOUNCE	1.04149	Type: Log-Pur	Avg	Trig: Free Run Atten: 30 dB	WO: Fast G		1 10
Auto Tun	81.9 kHz .46 dBm						00 dBm	
Center Fre 15.004500 MH								
Start Fre 9.000 kH	57,11,456							
Stop Fre 30.000000 MH	ne 10,0400-031-0-0	ingen frigeting	uji ja dingena aya	البوانية الياحية الانداد	*		eksinelista eyenselekenseskan	
CF Ste 2.999100 MH Auto Me	30.00 MHz (40001 pts)	.333 ms	Sweep 5.	FUNCTION	00 kHz	VBW 3	8	rt 9 kHz es BW 100 kHz
Freq Offse OH				LONGIAN	54.46 dBm	1.9 kHz		

88 (50.0 AC)	PHO: Fast	Trig: Free Run Atten: 30 dB	Avg Type: Log Pur	THACE DO NOT THE STORE	Frequency
0 dBidiv Ref 20.00 dBm			Mkr	4 5.576 56 GHz -46.24 dBm	Auto Tune
					Center Free 5.015000000 GH
ие 200 иса — — — — — — — — — — — — — — — — — — —	$\langle \rangle^2$	¥		-3.045	Start Free 30.000000 MH
51.0 <b></b>				يستخصر وتشريهم مراكمهم	Stop Free 10.00000000 GH
Start 30 MHz Res BW 1.0 MHz	VBW 3	.0 MHz		Stop 10.000 GHz .67 ms (40001 pts)	CF Step 997.000000 MH Auto Me
2 N f 3.6 3 N f 2.1 N f 6.5 5 6	11 09 GHz 18 45 GHz 57 60 GHz 76 66 GHz	7,25 dBm 40.10 dBm 43.48 dBm 46.24 dBm	INCTION FUNCTION WOTH	RUNCTION VALUE =	Freq Offse 0H
8 9 10 11			arxne	*	



### 802.11g & 6 Mbps & 2437 MHz







1000 A.	PNO: Fast C #Gain:Low	Trig: Free Run Atten: 30 dB	Avg Type: Log-Pwr	THEST AD PM Jan 16, 2018 MALE DE 204 TYPE DISCOMPLICATION COLT DISCOMPLICATION	Frequency
dBidiv Ref 20.00 dBm			Mkr	2 24.962 2 GHz -39.12 dBm	Auto Tune
					Center Fred 18.25000000 GHz
20 00 00				⊘ <sup>1</sup> ↓ <sup>2</sup>	Start Free 10.00000000 GHz
					Stop Free 26.60000000 GH
tart 10.000 GHz Res BW 1.0 MHz	VBW	1 3.0 MHz	Sweep 42	Stop 26.500 GHz .67 ms (40001 pts)	CF Step 1.65000000 GH
R MODE TRO SOL R	353 4 GHz	-39.10 dBm	FUNCTION FUNCTION WIDTH	RUNCTION VALUE	Auto Mer
	.952 2 GHz	-39.12 dBm			Freq Offset 0 Hz
7					

#### 802.11g & 6 Mbps & 2462 MHz



#### Reference

#### **High Band-edge**



Frequency	THACE DECAMENTS		ALISHU Type: Log-F	Ave	g: Free Run tem: 30 dB	Trig	WO: Fast	P B B	11 [10]	
Auto Tune	282.7 kHz 5.24 dBm	Mkr						dBm	Ref 20.00	dBidiy .
Center Fred 15.004500 MHz										6
Start Free 9,000 kHz	atida									а а а
Stop Free 30.000000 MHz				u.Biquelloc.coA			المعرفين والمعالم	ومعياديديون	nidentoisette	a landerman
CF Step 2.999100 MH: Auto Mar	p 30.00 MHz s (40001 pts)		Sweep		kHz	300 k	VBW		00 kHz	es BW 10
Auto Mer Freq Offse 0 Hi	NCTRON VALUE	vf⊅T+	FUNCTION W	EUNETICH	.24 dBm	-65	2.7 KHz	8 282		
	7	10							-16	

Frequency	AM Jan 16, 2018 AZ DEPENDENT AZ DEPENDENT AZ DEPENDENT	TRA T	e: Log Pur		e Run 0 dB	Service 7	HO: Fast		4 [B
Auto Tur	32 GHz 11 dBm		Mkr					dBm	Bidly Ref 20.0
Center Fro 5.015000000 Gi								\   	
Start Fre 30.000000 MP	an ti dhe						Q <sup>2</sup>	Q <sup>3</sup>	
Stop Fre 10.00000000 G								- New York	
CF Ste 997.000000 Mi Auto Mi		.67 ms (4	Weep 18.	FUNCTION		3.0 MHz	VBW 3		t 30 MHz s BW 1.0 MHz
Freq Offs 01				040364	Bm Bm	7.46 dl -39.17 dt -42.09 df -46.11 dt	3 GHz 9 GHz	2,463 ( 3,693 / 2,177 6,405 (	
		6	9757145						



# 802.11n(HT20) & MCS 0 & 2412 MHz



#### Reference

Low Band-edge



COMPANY OF A DESCRIPTION OF A DESCRIPTIO				#Gain:Low		
Akr1 281.9 k -55.46 di					Ref 20.00 dBm	dBldiv
						0.0 100
an desigen of second	allassariananak		ط	بورتندر ولاالا وجودور	ha marana di sa	and Mental and
	Sweep 5.		00 kHz	VBW 3	00 kHz	tart 9 kHz Res BW 1
RUNCTION VALUE	FUNCTION WEPTH	FUNCTION	65.48 dBm	1919 kHz		ER MODE TRC 2 3 4 4 5 5 7 8 9 9 0
00 N	Stop 30. 333 ms (40	Stop 30. Sweep 5.333 ms (40	Stop 30. Sweep 5.333 ms (40	Stop 30. Sweep 5.333 ms (40 V Electren Function windth Rijkstren	Stop 30. VBW 300 KHz Sweep 5,333 ms (40 V ENICTION FUNCTION MODIL RINCTION	Stop 30.           00 kHz         VBW 300 kHz         Sweep 5.333 ms (40)           SEL         X         Y         FUNCTION HIDTH         RUNCTION

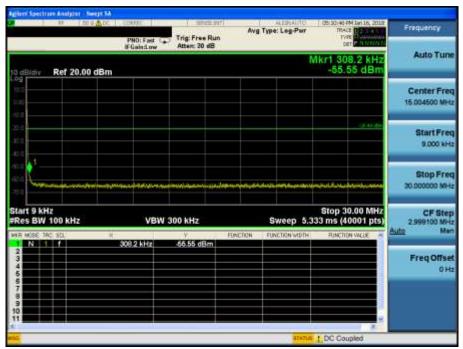
W 193 A	PNO: Fast FGaind ow	Trig: Free Run Atten: 30 dB	Avg Type: Log Pur	DECEMBER OF LANSE, 2010 TRACE 1 2 204 TYPE 2 204 Cet 2 N MOUNT	Frequency
dBidiy Ref 20.00 dBr	n		Mkr	4 5.355 23 GHz -45.92 dBm	Auto Tune
99 000 100	¢'				Center Fre 5.015000000 GH
				33.65	Start Fre 30.000000 MH
111 <b></b>	-				Stop Fre 10.00000000 GH
tart 30 MHz Res BW 1.0 MHz R MORE TRC SCI	VBV	V 3.0 MHz	Sweep 18	Stop 10.000 GHz .67 ms (40001 pts)	CF Ste 997.000000 Mi- Auto Ma
1 N 1 f 2 N f 3 N f 5 N f 5 5 5 7	2,410,84 GHz 3,617,96 GHz 2,217,17 GHz 5,366,23 GHz	7 00 dBm 40 22 dBm 43 53 dBm 46 92 dBm			Freq Offse OH
9			974745		



# 802.11n(HT20) & MCS 0 & 2437 MHz



#### Reference





	PNO: Fast C			ALISANTO (pe: Log Pwr	DELECTION AND AND AND AND AND AND AND AND AND AN	Frequency
o dBidiv Ref 20.00 dBm				Mkr2	22.291 3 GHz -40.82 dBm	Auto Tune
69 100						Center Frei 18.25000000 GH
60 60 60				<b>→</b> <sup>2</sup>	2000 Q <sup>1</sup>	Start Free 10.00000000 GH
11.0 <b>hani di senara di si dan</b> a 200 <b></b>						Stop Fre 26.50000000 GH
tart 10.000 GHz Res BW 1.0 MHz	VBW	/ 3.0 MHz		Sweep 42.	Stop 26.500 GHz 67 ms (40001 pts)	CF Step 1.65000000 GH Auto Me
RR MODE TRO SOL R	507 9 GHz	-39.02 dBm	FUNCTION	FUNCTION WIDTH	RINCTION VALUE	Auto Mer
	291 3 GHz	-40.82 dBm				Freq Offse 0H
9 9 0						

# 802.11n(HT20) & MCS 0 & 2462 MHz



#### Reference

#### **High Band-edge**



Frequency	PM Jan 16, 2018 CE DECIMANT RECENTION	mai Fa	ntestanto pe: Log Pwr		re Run 0 dB	Sec. 19	WO: Fast G	¢≜bt   ci		
Auto Tun	1.9 kHz 67 dBm							) dBm	Ref 20.0	dBidiv
Center Fre 15:004500 MH										9 0 0
Start Fre 9.000 kH	-2.0.00									
Stop Fre 30.000000 MH	d an de Paris de seu lla		*****	la Antonio a la M	Nakideu	an a	etter Lastic Listeria	ور بر امریک ا	Augustan	
CF Step 2.999100 MH Auto Ma		33 ms (4	Sweep 5.3			300 kHz	VBW		100 kHz	art 9 kHz es BW 1
Freq Offse OH	ON VALUE +	RUNCE	UNICTION WETH	FUNETION	:8m	65.87 d	.9 kHz	R R		N MODE TRO

Frequency	CECERCE PM Jan 16, 2018 MACE 11 2004 Type 12 2004 Cent 12 Structure 1	Type: Log Pwr	12	Trig: Free Atten: 30 c	D:Fast ()	p	0 0 . AC	W [3
Auto Tuni	3.140 64 GHz -46.19 dBm	Mkr5					0 dBm	Bidiv Ref 20.0
Center Fre 5.015000000 GH						∧ <sup>1</sup> .	- 4	
Start Free	-1.0 <del>(1</del> .				- 02			
Stop Free 10.00000000 GH					5	-	<u> </u>	and the second second
CF Ste 997.00000 Mi- Auto Ma	Stop 10.000 GHz 57 ms (40001 pts)			.0 MHz	VBW 3			t 30 MHz s BW 1.0 MHz
Freq Offse 0H	RUNCTION VALUE -	FUNCTION WIDTH	FUNCTI	6.30 dB -39.22 dB -42.52 dB -42.54 dB -46.19 dB	GHz GHz GHz	461 1 693 4 173 0 202 7 140 6	3.2.2.2	NOE TRO SCL N T T N T T N T T N T T N T T
		STATLS						





# 6.5 Radiated Spurious Emissions

#### Test Requirements and limit,

#### §15.247(d), §15.205, §15.209 & RSS-247 [5.5], RSS-Gen [8.9], RSS-Gen [8.10]

In any 100 kHz bandwidth outside the operating frequency band, 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. In case the emission fall within the restricted band specified on 15.205(a) and (b), then the 15.209(a) limit in the table below has to be followed.

#### • FCC Part 15.209(a) and (b)

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
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 15.209(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. 15.231 and 15.241.

• FCC Part 15.205 (a): Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~	149.9 ~ 150.05	1645.5 ~ 1646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.52025	156.52475 ~	1660 ~ 1710	8.025 ~ 8.5	22.01 ~ 23.12
4.17725 ~ 4.17775	12.57675 ~	156.52525	1718.8 ~ 1722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.20725 ~ 4.20775	12.57725	156.7 ~ 156.9	2200 ~ 2300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	13.36 ~ 13.41	162.0125 ~ 167.17	2310 ~ 2390	10.6 ~ 12.7	36.43 ~ 36.5
6.26775 ~ 6.26825	16.42 ~ 16.423	167.72 ~ 173.2	2483.5 ~ 2500	13.25 ~ 13.4	Above 38.6
6.31175 ~ 6.31225	16.69475 ~	240 ~ 285	2655 ~ 2900		
8.291 ~ 8.294	16.69525	322 ~ 335.4	3260 ~ 3267		
8.362 ~ 8.366	16.80425 ~	399.90 ~ 410	3332 ~ 3339		
8.37625 ~ 8.38675	16.80475	608 ~ 614	3345.8 ~ 3358		
	25.5 ~ 25.67	960 ~ 1240	3600 ~ 4400		
	37.5 ~ 38.25				
	73 ~ 74.6				
	74.8 ~ 75.2				

• FCC Part 15.205(b): The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.



#### **TEST CONFIGURATION**

Refer to the APPENDIX I.

### TEST PROCEDURE

- 1. The EUT is placed on a non-conductive table, emission measurements at below 1 GHz, the table height is 80 cm and above 1 GHz, the table height is 1.5 m.
- 2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
- 3. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
- 4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 6. Repeat above procedures until the measurements for all frequencies are complete.

#### Measurement Instrument Setting for Radiated Emission Measurements.

The radiated emission was tested according to the section 6.3, 6.4, 6.5 and 6.6 of the ANSI C63.10-2013 with following settings.

#### Peak Measurement:

RBW = As specified in below table , VBW ≥ 3 x RBW, Sweep = Auto, Detector = Peak, Trace mode = Max Hold until the trace stabilizes.

Frequency	RBW
9 - 150 kHz	200 - 300 Hz
0.15 - 30 MHz	9 - 10 kHz
30 - 1000 MHz	100 - 120 kHz
> 1000 MHz	1 MHz

#### Average Measurement:

- 1. RBW = 1 MHz (unless otherwise specified).
- 2. VBW ≥ 3 x RBW.
- 3. Detector = RMS (Number of points  $\geq$  2 x Span / RBW)
- 4. Averaging type = power. (i.e., RMS)
- 5. Sweep time = auto.
- 6. Perform a trace average of at least 100 traces.
- 7. A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
- 1) If power averaging (RMS) mode was used in step 4, then the applicable correction factor is 10 log(1/x), where x is the duty cycle.
- 2) If linear voltage averaging mode was used in step 4, then the applicable correction factor is 20 log(1/x), where x is the duty cycle.
- 3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

#### Duty Cycle Corrections (Refer to appendix II for duty cycle measurement procedure and plots)

Band	Duty Cycle (%)	T <sub>on</sub> (ms)	T <sub>on</sub> + T <sub>off</sub> (ms)	DCF = 10log(1 / Duty) (dB)
802.11b	99.53	8.413	8.453	0.02
802.11g	97.08	1.395	1.437	0.13
802.11n(HT20)	97.03	1.309	1.349	0.13
-	-	-	-	-

# 9 kHz~ 25 GHz Data (802.11b & 1 Mbps)

#### • 2412 MHz

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCF (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2320.18	Н	Z	PK	53.34	0.42	N/A	N/A	53.76	74.00	20.24
2319.96	Н	Z	AV	44.51	0.42	0.02	N/A	44.95	54.00	9.05
4822.74	Н	Z	PK	44.96	4.85	N/A	N/A	49.81	74.00	24.19
4824.23	Н	Z	AV	33.91	4.86	0.02	N/A	38.79	54.00	15.21

#### • 2437 MHz

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCF (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4875.72	Н	Z	PK	44.18	5.08	N/A	N/A	49.26	74.00	24.74
4873.32	Н	Z	AV	33.64	5.07	0.02	N/A	38.73	54.00	15.27

#### • 2462 MHz

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCF (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2484.15	Н	Z	PK	49.44	0.94	N/A	N/A	50.38	74.00	23.62
2483.93	Н	Z	AV	39.07	0.94	0.02	N/A	40.03	54.00	13.97
4923.61	Н	Z	PK	46.10	5.23	N/A	N/A	51.33	74.00	22.67
4924.13	Н	Z	AV	33.87	5.23	0.02	N/A	39.12	54.00	14.88

#### Note.

1. Measurement Distance = 3 m for below 10 GHz, Measurement Distance = 1 m for above 10 GHz. So Distance Correction Factor : -  $9.54 \text{ dB} = 20^{*}\log(1 \text{ m} / 3 \text{ m})$ 

2. The radiated emissions were investigated up to 25GHz. And no other spurious and harmonic emissions were found above listed frequencies.

3. The band edge test has performed between 2310-2390 MHz and 2483.5-2500 MHz. The worst results were reported in the table.

4. Sample Calculation.

Margin = Limit – Result / Result = Reading + T.F+ DCF + Distance Factor / T.F = AF + CL – AG Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain, DCF = Duty Cycle Correction Factor.



IC: 8154A-SP53

# 9 kHz~ 25 GHz Data (802.11g & 6 Mbps)

#### • 2412 MHz

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCF (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2389.23	Н	Z	PK	59.63	0.70	N/A	N/A	60.33	74.00	13.67
2389.86	Н	Z	AV	48.38	0.70	0.13	N/A	49.21	54.00	4.79
4824.03	Н	Z	PK	44.73	4.86	N/A	N/A	49.59	74.00	24.41
4822.84	Н	Z	AV	33.86	4.85	0.13	N/A	38.84	54.00	15.16

#### • 2437 MHz

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCF (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4873.11	Н	Z	PK	44.43	5.07	N/A	N/A	49.50	74.00	24.50
4872.70	Н	Z	AV	33.49	5.07	0.13	N/A	38.69	54.00	15.31

#### • 2462 MHz

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCF (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.73	Н	Z	PK	54.61	0.94	N/A	N/A	55.55	74.00	18.45
2483.60	Н	Z	AV	41.49	0.94	0.13	N/A	42.56	54.00	11.44
4922.44	Н	Z	PK	44.75	5.23	N/A	N/A	49.98	74.00	24.02
4924.16	Н	Z	AV	33.80	5.23	0.13	N/A	39.16	54.00	14.84

#### Note.

1. Measurement Distance = 3 m for below 10 GHz, Measurement Distance = 1 m for above 10 GHz. So Distance Correction Factor : -  $9.54 \text{ dB} = 20^{*}\log(1 \text{ m} / 3 \text{ m})$ 

2. The radiated emissions were investigated up to 25GHz. And no other spurious and harmonic emissions were found above listed frequencies.

3. The band edge test has performed between 2310-2390 MHz and 2483.5-2500 MHz. The worst results were reported in the table.

4. Sample Calculation.

Margin = Limit – Result / Result = Reading + T.F+ DCF + Distance Factor / T.F = AF + CL – AG Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain, DCF = Duty Cycle Correction Factor.



# 9 kHz~ 25 GHz Data (802.11n HT20 & MCS 0)

#### • 2412 MHz

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCF (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2389.89	Н	Z	PK	63.31	0.70	N/A	N/A	64.01	74.00	9.99
2389.89	Н	Z	AV	49.70	0.70	0.13	N/A	50.53	54.00	3.47
4825.24	Н	Z	PK	44.38	4.86	N/A	N/A	49.24	74.00	24.76
4824.54	Н	Z	AV	33.85	4.86	0.13	N/A	38.84	54.00	15.16

#### • 2437 MHz

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCF (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4872.91	Н	Z	PK	44.35	5.07	N/A	N/A	49.42	74.00	24.58
4872.94	Н	Z	AV	33.49	5.07	0.13	N/A	38.69	54.00	15.31

#### • 2462 MHz

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCF (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.85	Н	Z	PK	55.99	0.94	N/A	N/A	56.93	74.00	17.07
2483.78	Н	Z	AV	44.31	0.94	0.13	N/A	45.38	54.00	8.62
4925.47	Н	Z	PK	44.93	5.24	N/A	N/A	50.17	74.00	23.83
4923.31	Н	Z	AV	33.82	5.23	0.13	N/A	39.18	54.00	14.82

#### Note.

1. Measurement Distance = 3 m for below 10 GHz, Measurement Distance = 1 m for above 10 GHz. So Distance Correction Factor : - 9.54 dB = 20\*log(1 m / 3 m)

2. The radiated emissions were investigated up to 25GHz. And no other spurious and harmonic emissions were found above listed frequencies.

3. The band edge test has performed between 2310-2390 MHz and 2483.5-2500 MHz. The worst results were reported in the table.

4. Sample Calculation.

Margin = Limit – Result / Result = Reading + T.F+ DCF + Distance Factor / T.F = AF + CL – AG Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain, DCF = Duty Cycle Correction Factor.



# 6.6 Power-line conducted emissions

# Test Requirements and limit, §15.207 & RSS-Gen [8.8]

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 uH/50 ohm line impedance stabilization network(LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency Range	Conducted Limit (dBuV)					
(MHz)	Quasi-Peak	Average				
0.15 ~ 0.5	66 to 56 *	56 to 46 *				
0.5 ~ 5	56	46				
5 ~ 30	60	50				

\* Decreases with the logarithm of the frequency

# **TEST CONFIGURATION:**

See test photographs for the actual connections between EUT and support equipment.

# TEST PROCEDURE

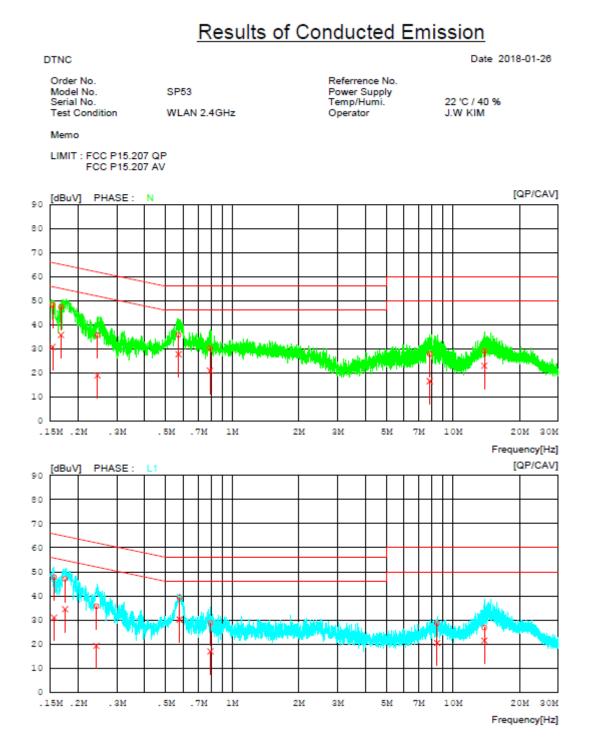
- 1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
- 2. The EUT is connected via LISN to the test power supply.
- 3. The measurement results are obtained as described below:
- 4. Detectors Quasi Peak and Average Detector.

# Test Results: Comply



#### RESULT PLOTS

# AC Line Conducted Emissions (Graph)



# AC Line Conducted Emissions (List)

# Results of Conducted Emission

Date 2018-01-26

Order No. Model No. SP53 Serial No. Test Condition WLAN 2.4GHz	Referrence No. Power Supply Temp/Humi. Operator	22 'C / 40 % J.W KIM
---	--	-------------------------

Memo

\_

DTNC

#### LIMIT : FCC P15.207 QP FCC P15.207 AV

NC	FREQ	READING QP CAV [dBuV][dBuV]	C.FACTOR [ [dB]	RESULT QP CAV [dBuV] [dBuV]	QP	MIT CAV ][dBuV]	QP CAV	PHASE
1	0.15337	38.33 21.00	9.89	48.22 30.89	65.82	55.82	17.60 24.93	N
2	0.16750	37.4925.99	9.89	47.38 35.88	65.08	55.08	17.70 19.20	N
3	0.24506	25.83 9.15	9.90	35.7319.05	61.92	51.92	26.19 32.87	N
4	0.57018	25.9617.89	9.91	35.87 27.80	56.00	46.00	20.1318.20	N
5	0.79243	20.38 11.05	9.92	30.30 20.97	56.00	46.00	25.70 25.03	N
6	7.85560	17.82 6.59	10.08	27.90 16.67	60.00	50.00	32.10 33.33	N
7	13.85920	18.9312.82	10.20	29.1323.02	60.00	50.00	30.87 26.98	N
8	0.15599	37.85 21.00	9.89	47.74 30.89	65.67	55.67	17.9324.78	L1
9	0.17456	37.0924.55	9.89	46.98 34.44	64.74	54.74	17.7620.30	L1
10	0.24224	25.69 9.30	9.90	35.5919.20	62.02	52.02	26.43 32.82	L1
11	0.57727	29.22 20.24	9.91	39.13 30.15	56.00	46.00	16.87 15.85	L1
12	0.79646	18.83 7.05	9.92	28.7516.97	56.00	46.00	27.25 29.03	L1
13	8.46760	18.5310.33	10.10	28.6320.43	60.00	50.00	31.37 29.57	L1
14	13.86900	16.60 11.25	10.20	26.80 21.45	60.00	50.00	33.20 28.55	L1



# Test Requirements, RSS-Gen [6.6]

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99 % emission bandwidth, as calculated or measured.

# **TEST CONFIGURATION**

Refer to the APPENDIX I.

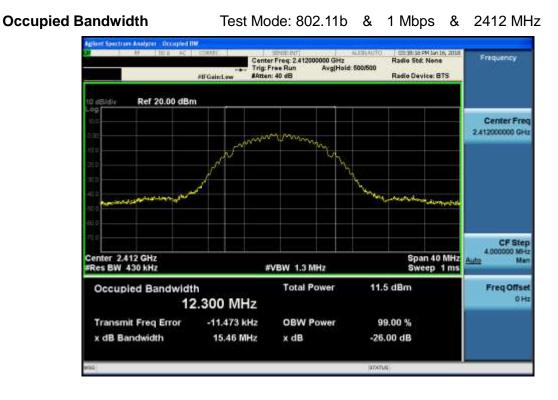
# TEST PROCEDURE

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

# TEST RESULTS: Comply

Test Mode	Data Rate	Frequency [MHz]	Test Results [MHz]
	1 Mbps	2412	12.30
802.11b		2437	12.26
		2462	12.30
802.11g	6 Mbps	2412	16.57
		2437	16.57
		2462	16.58
		2412	17.53
802.11n (HT20)	MCS 0	2437	17.53
		2462	17.54

#### RESULT PLOTS



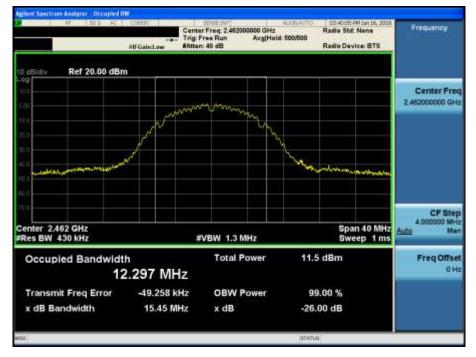
#### **Occupied Bandwidth**

#### Test Mode: 802.11b & 1 Mbps & 2437 MHz



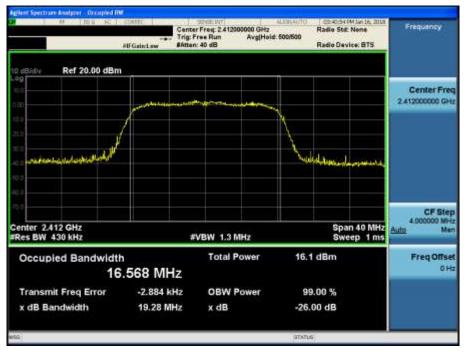


#### Test Mode: 802.11b & 1 Mbps & 2462 MHz



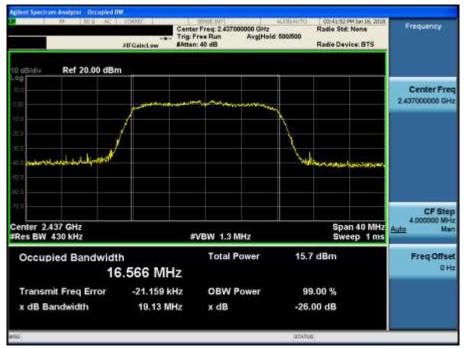


#### Test Mode: 802.11g & 6 Mbps & 2412 MHz



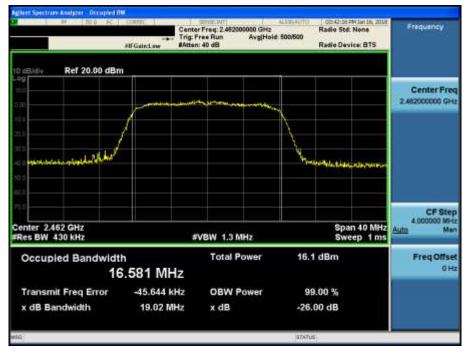
#### **Occupied Bandwidth**

#### Test Mode: 802.11g & 6 Mbps & 2437 MHz





#### Test Mode: 802.11g & 6 Mbps & 2462 MHz



#### Test Mode: 802.11n(HT20) & MCS 0 & 2412 MHz

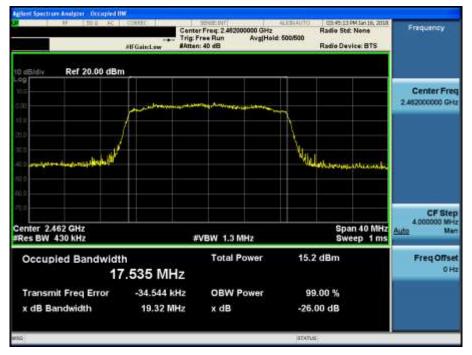


#### **Occupied Bandwidth**

#### Test Mode: 802.11n(HT20) & MCS 0 & 2437 MHz



#### Test Mode: 802.11n(HT20) & MCS 0 & 2462 MHz



# 7. LIST OF TEST EQUIPMENT

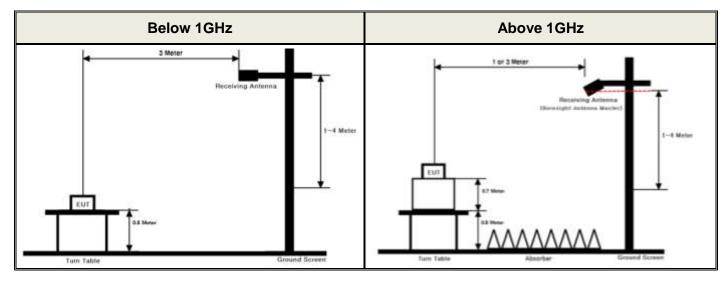
Туре	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	17/09/06	18/09/06	MY50200834
Spectrum Analyzer	Agilent Technologies	N9020A	17/09/05	18/09/05	MY46471251
Multimeter	FLUKE	17B	17/12/26	18/12/26	26030065WS
DC Power Supply	Agilent	66332A	17/09/05	18/09/05	MY43000394
Signal Generator	Rohde Schwarz	SMBV100A	17/12/27	18/12/27	255571
Signal Generator	Rohde Schwarz	SMF100A	17/12/27	18/12/27	102341
Thermohygrometer	BODYCOM	BJ5478	18/01/03	19/01/03	120612-2
Attenuator(10dB)	SMAJK	SMAJK-50-10	17/09/06	18/09/06	2-50-10
Loop Antenna	ELF-Lindgren	6502	17/08/08	19/08/08	00203480
BILOG ANTENNA	Schwarzbeck	VULB 9160	16/08/05	18/08/05	9160-3362
Horn Antenna	ETS-LINDGREN	3117	16/05/03	18/05/03	00140394
Horn Antenna	A.H.Systems Inc.	SAS-574	17/07/31	19/07/31	155
PreAmplifier	Agilent	8449B	17/09/05	18/09/05	3008A02108
PreAmplifier	TSJ	MLA-010K01- B01-27	17/03/06	18/03/06	1844539
EMI Test Receiver	Rohde Schwarz	ESR7	17/02/16	18/02/16	101061
High-pass filter	Wainwright	WHKX12-2580- 3000-18000- 80SS	17/09/05	18/09/05	3
High-pass filter	Wainwright	WHNX6-6320- 8000-26500- 40CC	17/09/05	18/09/05	1
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2495A MA2490A	17/12/27	18/12/27	1306007 1249001
EMI Test Receiver	R&S	ESCI7	17/02/16	18/02/16	100910
LISN	SCHWARZBECK	NNLK 8121	17/04/03	18/04/03	06183
PULSE LIMITER	ROHDE&SCHWARZ	ESH3-Z2	17/09/29	18/09/29	101333

Note: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017

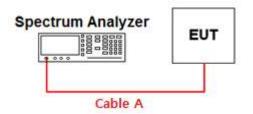
# **APPENDIX I**

#### Test set up diagrams

#### Radiated Measurement



#### Conducted Measurement



#### Path loss information

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	0.01	15	0.82
1	0.23	20	0.94
2.412 & 2.437 & 2.462	0.34	25	1.04
5	0.50	-	-
10	0.78	-	-

Note 1: The path loss from EUT to Spectrum analyzer was measured and used for test. Path loss (S/A's correction factor) = Cable A (Attenuator, Applied only when it was used externally)



# **APPENDIX II**

# **Duty cycle plots**

#### TEST PROCEDURE

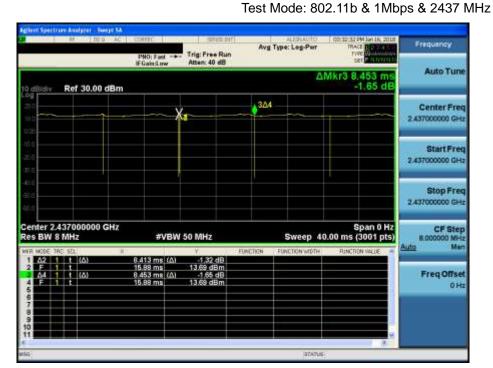
#### Duty Cycle measured using section 6.0 b) of KDB558074 D01v04 :

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal.

Set the center frequency of the instrument to the center frequency of the transmission. Set RBW  $\geq$  OBW if possible; otherwise, set RBW to the largest available value. Set VBW  $\geq$  RBW. Set detector = peak or average.

The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T  $\leq$  16.7 microseconds.)

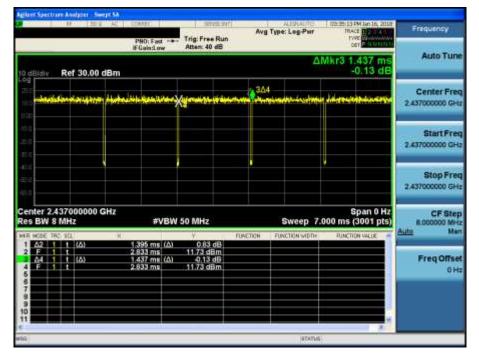
#### Test Plots :



#### **Duty Cycle**

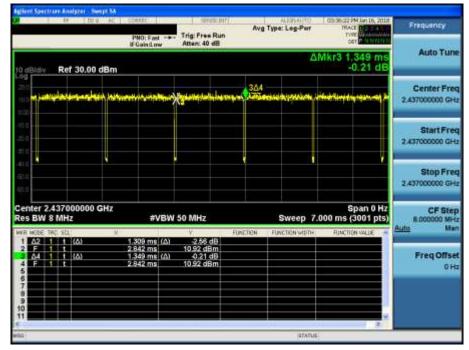
#### **Duty Cycle**

#### Test Mode: 802.11g & 6Mbps & 2437 MHz



# Duty Cycle

# Test Mode: 802.11n(HT20) & MCS 0 & 2437 MHz

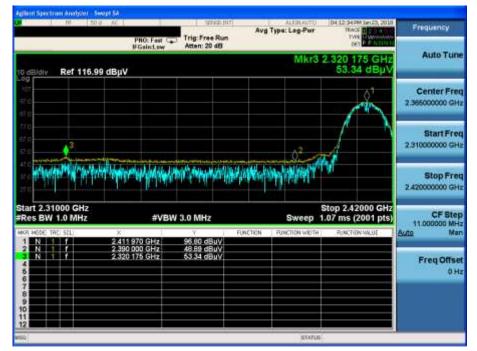


**Detector Mode : PK** 

# **APPENDIX III**

# **Unwanted Emissions (Radiated) Test Plot**

#### 802.11b & Lowest & Z & Hor

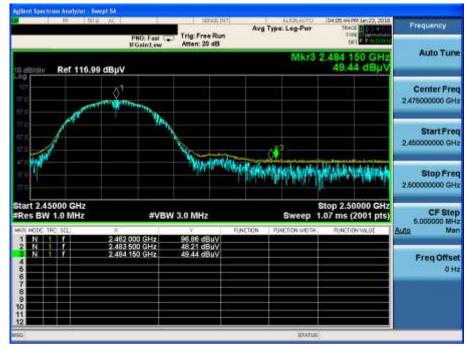


#### 802.11b & Lowest & Z & Hor

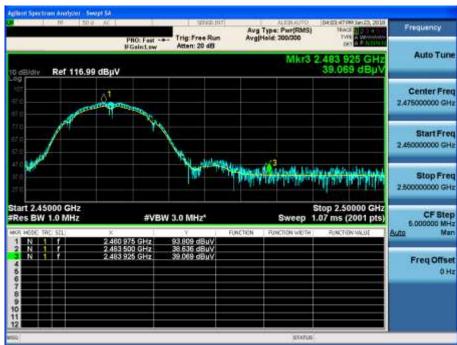
#### Frequency Avg Type: Per(RMS) Avg/Held: 300/300 Trig: Free Ru Atten: 20 dB PNO: Fest FGainLow Auto Ture Mkr3 2.319 955 GHz 44.510 dBpV Ref 116.99 dBµV Center Freq 2.36500000 GH Start Freq 2,310000000 GHz 84 B 1 A MARINE MARK Stop Freq 2 420000000 GHz Start 2.31000 GHz #Res BW 1.0 MHz Stop 2.42000 GHz 1.07 ms (2001 pts) CF Step 11.000000 MH #VBW 3.0 MHz\* Sweep Ma unto Freq Offse OH



# 802.11b & Highest & Z & Hor



#### 802.11b & Highest & Z & Hor



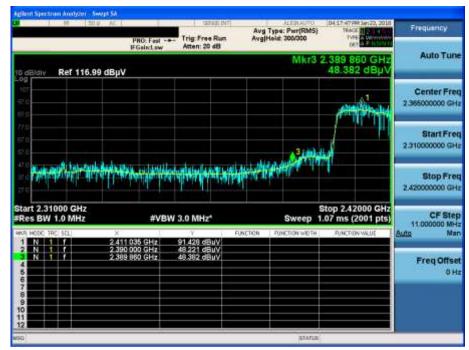


# 802.11g & Lowest & Z & Hor

#### **Detector Mode : PK**



#### 802.11g & Lowest & Z & Hor



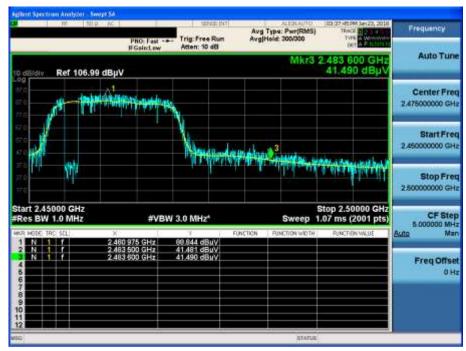


**Detector Mode : PK** 

# 802.11g & Highest & Z & Hor



#### 802.11g & Highest & Z & Hor



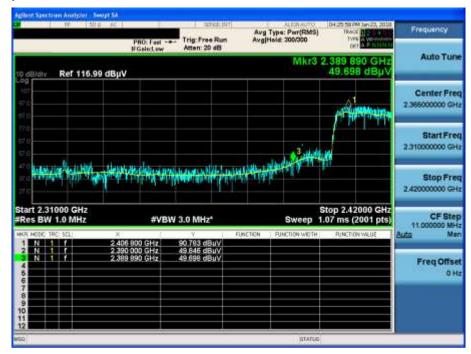


#### 802.11n(HT20) & Lowest & Z & Hor

#### **Detector Mode : PK**

M 50.0	PNO: Fest C	Trig: Free Run Atten: 20 dB		Type: Log-Pwr	04:27:22:9M Jan 20, 2018 TRACE D C C C C C C C C C C C C C C C C C C	Frequency
ID dBldly Ref 116.99	IFGalet.ew	Attent 20 dis		Mkr3	2.389 890 GHz 63.31 dBµV	Auto Tune
-09 107 77 (2 07 (2					ATT A	Center Freq 2.365000000 GHz
77.0 67.0 57.0	a strandbarger (see and see		للقيصيد	A ANNIA		Start Freq 2.310000000 GHz
	with million in the	him manager fi	(Herly Herl	ANNIEL II	n syr	Stop Freq 2.42000000 GHz
					Stop 2.42000 GHz	
Start 2.31000 GHz #Res BW 1.0 MHz	#VB	W 3.0 MHz		Sweep 1	1.07 ms (2001 pts)	CF Step 11.000000 MHz
Res BW 1.0 MHz	× 2.412 135 GHz	99.19 dBuV	FUNCTION			CF Step
Res BW 1.0 MHz	<b>8</b> 2	(X I)	FUNCTION	Sweep 1	1.07 ms (2001 pts)	CF Step 11.000000 MHz
Res BW 1.0 MHz           MRR MODE, TRC, SCL,           1         N           2         N           3         N           4           6	X 2.412 135 GHz 2.390 000 GHz	99.19 dBuV 60.29 dBuV	FUNCTION	Sweep 1	1.07 ms (2001 pts)	CF Step 11.000000 MHz Audo: Man Freq Offset

802.11n(HT20) & Lowest & Z & Hor



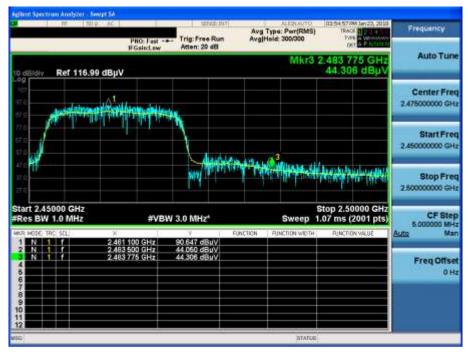


### 802.11n(HT20) & Highest & Z & Hor

#### **Detector Mode : PK**

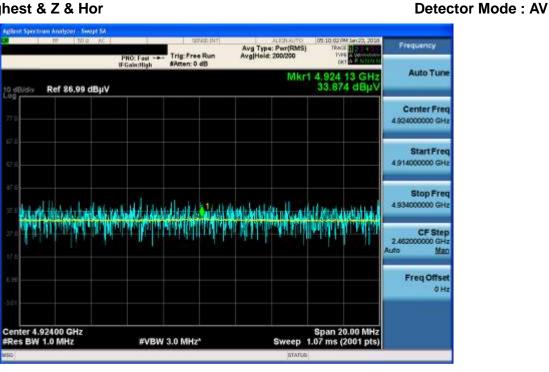


#### 802.11n(HT20) & Highest & Z & Hor





# 802.11b & Highest & Z & Hor



#### 802.11g & Highest & Z & Hor







# 802.11n(HT20) & Highest & Z & Hor

