

Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 1 of 88

# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

# INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

*OF* 

**Product Name: Juno T41/5** 

**Trimble Brand Name:** 

RH42G **Marketing Name:** 

**Model No.:** JUNO/T41/5-BWC2RFG

**Model Difference:** N/A

FCC ID: S9E-JUNO41WN

**Report No.:** ER/2015/60002

**Issue Date:** Jun. 26, 2015

**FCC Rule Part:** §15.247, Cat: DTS

**Trimble Navigation Limited** Prepared for:

345 SW Avery Avenue, Corvallis, OR 97333

SGS Taiwan Ltd.

**Electronics & Communication Laboratory** 

Prepared by: No.134, Wu Kung Road, New Taipei Industrial

Park, Wuku District, New Taipei City, Taiwan

24803





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Page: 2 of 88

# VERIFICATION OF COMPLIANCE

Trimble Navigation Limited **Applicant:** 

345 SW Avery Avenue, Corvallis, OR 97333

**Product Name:** Juno T41/5

**Brand Name:** Trimble

RH42G **Marketing Name:** 

Model No.: JUNO/T41/5-BWC2RFG

**Model Difference:** N/A

FCC ID: S9E-JUNO41WN

**Report Number:** ER/2015/60002

Date of test: Jun. 03, 2015 ~ Jun. 18, 2015

**Date of EUT Received:** Jun. 03, 2015

# We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2009 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

Test By:	Curry Chen	Date	Jun. 26, 2015
Prepared By:	Curry Chen/Engineer Utoletta Tang	Date	Jun. 26, 2015
Approved By:	Violetta Tang / Clerk  Jim Chang / Asst. Manager	Date	Jun. 26, 2015

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 3 of 88

# **Revision History**

Report Number	Revision	Description	Issue Date
ER/2015/60002	Rev.00	Initial creation of document	Jun. 26, 2015

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 4 of 88

# **Table of Contents**

1	GEN	VERAL INFORMATION	6
	1.1	Product description.	6
	1.2	Product Feature of Equipment Under Test	7
	1.3	Test Methodology of Applied Standards	8
	1.4	Test Facility	8
	1.5	Special Accessories	8
	1.6	Equipment Modifications	8
2	SYS	TEM TEST CONFIGURATION	9
	2.1	EUT Configuration	9
	2.2	EUT Exercise	9
	2.3	Test Procedure	9
	2.4	Measurement Results Explanation Example	9
	2.5	Configuration of Tested System	10
3	SUM	IMARY OF TEST RESULTS	11
4	DES	CRIPTION OF TEST MODES	12
	4.1	Operated in 2400 ~ 2483.5MHz Band	12
	4.2	The Worst Test Modes and Channel Details	13
5	MEA	ASUREMENT UNCERTAINTY	14
6	CON	NDUCTED EMISSION TEST	15
	6.1	Standard Applicable	15
	6.2	Measurement Equipment Used	15
	6.3	EUT Setup	15
	6.4	Test SET-UP (Block Diagram of Configuration)	16
	6.5	Measurement Procedure	16
	6.6	Measurement Result	16
7	DUT	TY CYCLE OF TEST SIGNAL	19
	7.1	DUTY CYCLE TEST SIGNAL Measurement Result	20
8	PEA	K OUTPUT POWER MEASUREMENT	22
	8.1	Standard Applicable	22
	8.2	Measurement Equipment Used	22
	8.3	Test Set-up	22
	8.4	Measurement Procedure	23
	8.5	Measurement Result	23

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 5 of 88

9	6dB I	BANDWIDTH	25
	9.1	Standard Applicable	25
	9.2	Measurement Equipment Used	25
	9.3	Test Set-up.	25
	9.4	Measurement Procedure	25
	9.5	Measurement Result	26
10	CON	DUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT	32
	10.1	Standard Applicable	32
	10.2	Measurement Equipment Used	32
	10.3	Test SET-UP	32
	10.4	Measurement Result	33
11	RAD	ATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT	46
	11.1	Standard Applicable	46
	11.2	Measurement Equipment Used:	47
	11.3	Test SET-UP	47
	11.5	Test Results of Radiated Spurious Emissions form 9 KHz to 30 MHz	50
	11.6	Measurement Result	50
12	PEAL	K POWER SPECTRAL DENSITY	81
	12.1	Standard Applicable	81
	12.2	Measurement Equipment Used	81
	12.3	Test Set-up	81
	12.4	Measurement Procedure	81
	12.5	Measurement Result	82
13	ANT	ENNA REQUIREMENT	88
	13.1	Standard Applicable	88
	13.2	Antenna Connected Construction	88

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 6 of 88

# **GENERAL INFORMATION**

# **Product description**

# General:

Product Name:	Juno T41/5				
Brand Name:	Trimble				
Marketing Name:	RH42G				
Model No.:	JUNO/T41	/5-BWC2RFG			
Model Difference:	N/A				
Hardware Version:	V9				
Software Version:	1.0.8(Build 396)				
Data Cable (USB):	Model No.: A9136939, Supplier: Sinbon				
	3.7Vdc Rechargeable Li-ion Battery or 5Vdc from AC/DC Adapter				
Power Supply:	Battery:	Model No.: S11GD103A, Supplier: LICO			
Tomer Suppry.	Adapter:	Model No.: PSA10F-050Q, Supplier: PHIHONG TECHNOLOGY CO.,			

### WLAN 2.4GHz:

Wi-Fi	Frequency Range	Channels	Rated Power	Modulation Technology	
11b/g	2412-2462	11	b: 19.48dBm g: 21.87dBm	DSSS, OFDM	
11n	HT20 2412-2462	11	HT20: 21.76dBm	OFDM	
Antenna De	esignation:	PIFA Antenna, Gain: 2.9dBi			
Modulation type:		CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM			
Transition Rate:		802.11 b: up to 11 Mbps; 802.11 g: up to 54 Mbps 802.11 n_20MHz: up to 72.2Mbps			

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 7 of 88

## **Product Feature of Equipment Under Test**

The equipment under Test (Hereafter Called: EUT) is Juno T41/5 supporting, GSM / WCDMA / CDMA,

Wi-Fi 802 11bgn Bluetooth with RFID features and below is details of information

	Product Feature
Product Name:	Juno T41/5
Brand Name:	Trimble
Marketing Name:	RH42G
Model No.:	JUNO/T41/5-BWC2RFG
Model Difference:	N/A
FCC ID	S9E-JUNO41WN
GSM Operating Band(s)	GSM 850 / 1900MHz
GPRS / EGPRS Multi Slot Class	Class 12
WCDMA Operating Band(s)	FDD Band II / V
CDMA / EVDO Operating Band(s)	BC0 / BC1 / BC10
Wi-Fi Specification	802.11b/g/n
Bluetooth Version	V2.1+EDR
RFID Specification	RFID

**Note:** The above EUT information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

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Page: 8 of 88

#### 1.3 **Test Methodology of Applied Standards**

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 DTS Meas. Guidance V03r03

ANSI C63.10:2009

### Note:

- All test items have been performed and record as per the above standards. 1.
- The composite system is compliance with FCC Subpart B is authorized under the certi-2. fication procedure.
- The EUT was placed 0.8m height for frequency above 1GHz in accordance with ANSI C63. 10:2009

#### **Test Facility** 1.4

SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan. (TAF code 0513)

FCC Registration Numbers are: 990257 (Wuku)

Canada Registration Number: 4620A-5.

#### **Special Accessories** 1.5

There are no special accessories used while test was conducted.

#### **Equipment Modifications** 1.6

There was no modification incorporated into the EUT.

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Page: 9 of 88

## SYSTEM TEST CONFIGURATION

#### 2.1 **EUT Configuration**

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

#### 2.2 **EUT Exercise**

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

#### 2.3 **Test Procedure**

#### 2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz,. The CISPR Ouasi-Peak and Average detector mode is employed according to \$15.107. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

#### 2.3.2 Radiated Emissions

The EUT is a placed on as turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 0.8 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m 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 max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

### **Measurement Results Explanation Example**

### For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

#### Note:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Following shows an offset computation example with cable loss 1dB and 10dB attenuator.

Offset = RF cable loss (dB)+ attenuation factor(dB) = 1+10=11(dB)

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 10 of 88

# **Configuration of Tested System**

Fig. 2-1 Radiated Emission

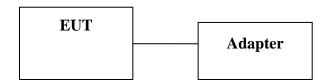


Fig. 2-2 Conducted (Antenna Port) Configuration

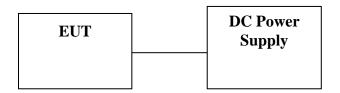
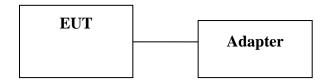


Fig. 2-3 AC Power Line Conducted Emission



**Table 2-1 Equipment Used in Tested System** 

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	<b>Power Cord</b>
1.	WLAN Test Software	N/A	N/A	N/A	N/A	N/A
2.	DC Power Supply	НР	E3640A	KR93300208	N/A	N/A

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 11 of 88

# SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	Peak Output Power	Compliant
§15.247(a)(2)	6dB Bandwidth	Compliant
§15.247(d)	Conducted Band Edge and Spurious Emission	Compliant
§15.247(d)	Radiated Band Edge and Spurious Emission	Compliant
§15.247(e)	Power Spectral Density	Compliant
§15.203 §15.247(b)	Antenna Requirement	Compliant

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 12 of 88

# **DESCRIPTION OF TEST MODES**

# Operated in 2400 ~ 2483.5MHz Band

11 channels are provided for 802.11b, 802.11g and 802.11n HT20

Ovided 101 802.110, 802.11g and 802.1111_11120								
CHANNEL	FREQUENCY	CHANNEL	FREQUENCY					
1	2412 MHz	7	2442 MHz					
2	2417 MHz	8	2447 MHz					
3	2422 MHz	9	2452 MHz					
4	2427 MHz	10	2457 MHz					
5	2432 MHz	11	2462 MHz					
6	2437 MHz							

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 13 of 88

## The Worst Test Modes and Channel Details

- 1. The EUT has been tested under operating condition.
- 2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is
- 3. Investigation has been done on all the possible configurations for searching the worst case.

### **RADIATED EMISSION TEST:**

ADIATED EMISSION TEST:								
RADIATED EMISSION TEST (BELOW 1 GHz)								
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT			
802.11g	1 to 11	1,6,11	OFDM	6	MAIN			
	RADIATED	EMISSION TE	ST (ABOVE 1 GH	( <b>z</b> )				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT			
802.11b	1 to 11	1, 6, 11	DSSS	1	MAIN			
802.11g	1 to 11	1, 6, 11	OFDM	6	MAIN			
802.11n (HT20)	1 to 11	1, 6, 11	OFDM	6.5	MAIN			

### Note:

The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for 802.11b/g/n WLAN Transmitter for channel Low, Mid and High, the worst case E2 position was reported.

### ANTENNA PORT CONDUCTED MEASUREMENT:

	CONDUCTED TEST							
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT			
802.11b	1 to 11	1, 6, 11	DSSS	1	MAIN			
802.11g	1 to 11	1, 6, 11	OFDM	6	MAIN			
802.11n (HT20)	1 to 11	1, 6, 11	OFDM	6.5	MAIN			

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 14 of 88

# **MEASUREMENT UNCERTAINTY**

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 0.84 dB
6dB Bandwidth	+/- 51.33 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 0.84 dB
Peak Power Density	+/- 1.3 dB
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

# Radiated Spurious Emission:

Management	30MHz - 180MHz: +/- 3.37dB		
	180MHz -417MHz: +/- 3.19dB		
Measurement uncertainty (Polarization : <b>Vertical</b> )	0.417GHz-1GHz: +/- 3.19dB		
(Foldifization : Vertical)	1GHz - 18GHz: +/- 4.04dB		
	18GHz - 40GHz: +/- 4.04dB		
	30MHz - 167MHz: +/- 4.22dB		
Measurement uncertainty	167MHz -500MHz: +/- 3.44dB		
(Polarization : <b>Horizontal</b> )	0.5GHz-1GHz: +/- 3.39dB		
	1GHz - 18GHz: +/- 4.08dB		
	18GHz - 40GHz: +/- 4.08dB		

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 15 of 88

# **CONDUCTED EMISSION TEST**

#### 6.1 **Standard Applicable**

According to §15.207, frequency range within 150kHz to 30MHz shall not exceed the limit table as below.

	Limits			
Frequency range	dB(	(uV)		
MHz	Quasi-peak	Average		
0.15 to 0.50	66 to 56	56 to 46		
0.50 to 5	56	46		
5 to 30	60	50		

#### Note

- 1. The lower limit shall apply at the transition frequencies
- 2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

**Measurement Equipment Used** 

Conducted Emission Test Site								
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.			
TYPE		NUMBER	NUMBER	CAL.				
EMI Test Receiver	R&S	ESCI7	100760	05/04/2015	05/03/2016			
LISN	SCHWARZBECK	NSLK 8127	8127-649	05/15/2015	05/14/2016			
LISN	FCC	FCC-LISN-50/250 -25-2-01	04034	03/13/2015	03/12/2016			
Coaxial Cables	N/A	WK CE Cable	N/A	11/26/2014	11/25/2015			

## 6.3 EUT Setup

- 1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2009.
- 2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
- 3. The LISN was connected with 120Vac/60Hz power source.

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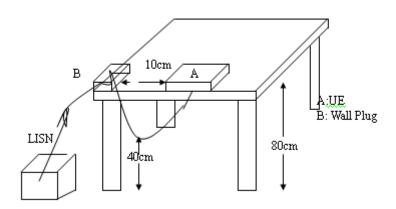
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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 16 of 88

# 6.4 Test SET-UP (Block Diagram of Configuration)



#### 6.5 **Measurement Procedure**

- 1. The EUT was placed on a table which is 0.8m above ground plane.
- 2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 3. Repeat above procedures until all phases of power being supplied by given UE are completed

#### **Measurement Result** 6.6

Note: Refer to next page for measurement data and plots.

Note2: The \* reveals the worst-case results that closet to the limit

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 17 of 88

# AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode			Test Date:	Jun. 18, 2015
Temperature:	24	Humidity:	66 %	Test By:	Marcus
				Phase:	L1

Site ConductionRoom

Limit: FCC Class B Conduction(QP)

Mode: Operation

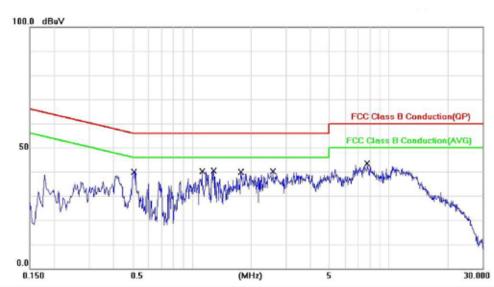
Note:

Phase: L1 AC 120V/60Hz Power:

Temperature:

Humidity:

#### **Conducted Emission**



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		
		MHz	dBuV	dΒ	dBuV	dBuV	dΒ	Detector	Comment
1		0.5073	37.30	0.04	37.34	56.00	-18.66	QP	
2		0.5073	29.30	0.04	29.34	46.00	-16.66	AVG	
3		1.1260	32.00	0.05	32.05	56.00	-23.95	QP	
4		1.1260	21.10	0.05	21.15	46.00	-24.85	AVG	
5		1.2904	36.00	0.06	36.06	56.00	-19.94	QΡ	
6		1.2904	24.40	0.06	24.46	46.00	-21.54	AVG	
7		1.7730	33.80	0.07	33.87	56.00	-22.13	QP	
8		1.7730	23.80	0.07	23.87	46.00	-22.13	AVG	
9		2.5580	34.10	0.09	34.19	56.00	-21.81	QP	
10		2.5580	23.00	0.09	23.09	46.00	-22.91	AVG	
11		7.7400	35.70	0.24	35.94	60.00	-24.06	QP	
12		7.7400	23.70	0.24	23.94	50.00	-26.06	AVG	

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 18 of 88

Temperature:

Humidity: 66%

24 °C

30.000

Operation Mode:	Operation mode			Test Date:	Jun. 18, 2015
Temperature:	24	Humidity:	66 %	Test By:	Marcus
				Phase:	N

Phase:

Site ConductionRoom

Limit: FCC Class B Conduction(QP)

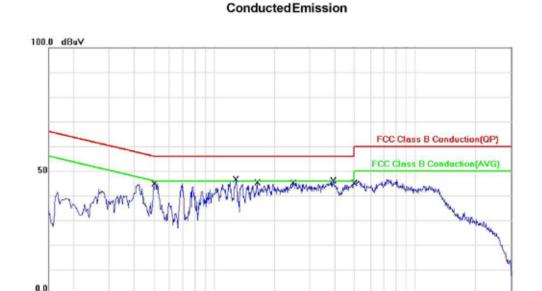
Mode: Operation

0.150

Note:

Power: AC 120V/60Hz

N



(MHz)

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		
		MHz	dBuV	dΒ	dBuV	dBuV	dΒ	Detector	Comment
1		0.5070	42.30	0.06	42.36	56.00	-13.64	QP	
2	*	0.5070	34.20	0.06	34.26	46.00	-11.74	AVG	
3		1.2857	41.90	80.0	41.98	56.00	-14.02	QP.	
4		1.2857	31.70	80.0	31.78	46.00	-14.22	AVG	
5		1.6290	38.20	80.0	38.28	56.00	-17.72	QΡ	
6		1.6290	27.00	80.0	27.08	46.00	-18.92	AVG	
7		2.4645	39.60	0.11	39.71	56.00	-16.29	QP	
8		2.4645	28.60	0.11	28.71	46.00	-17.29	AVG	
9		3.8870	39.80	0.13	39.93	56.00	-16.07	QΡ	
10		3.8870	27.90	0.13	28.03	46.00	-17.97	AVG	
11		4.9854	39.40	0.16	39.56	56.00	-16.44	QP	
12		4.9854	27.10	0.16	27.26	46.00	-18.74	AVG	

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 19 of 88

# **DUTY CYCLE OF TEST SIGNAL**

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle. All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

### Formula:

Duty Cycle = Ton / (Ton+Toff)

#### **Measurement Procedure:**

- Set span = Zero
- 2. RBW = 8MHz
- 3. VBW = 8MHz,
- 4. Detector = Peak

# **Duty Cycle:**

	<b>Duty Cycle</b>	Duty Factor (dB)
802.11b	99.20%	0.03
802.11g	93.82%	0.28
802.11n_20	93.83%	0.28

Duty Cycle Factor:  $10 * \log (1/0.992) = 0.03$ Duty Cycle Factor:  $10 * \log (1/0.938) = 0.28$ Duty Cycle Factor:  $10 * \log (1/0.938) = 0.28$ 

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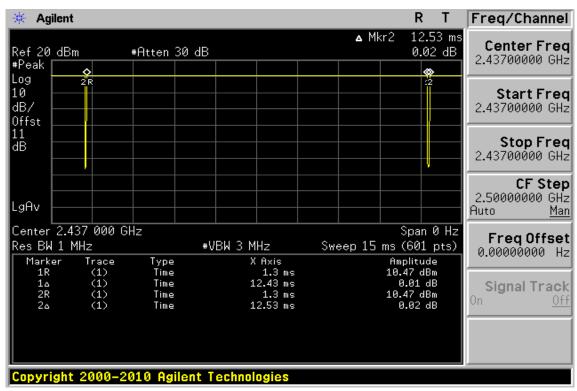
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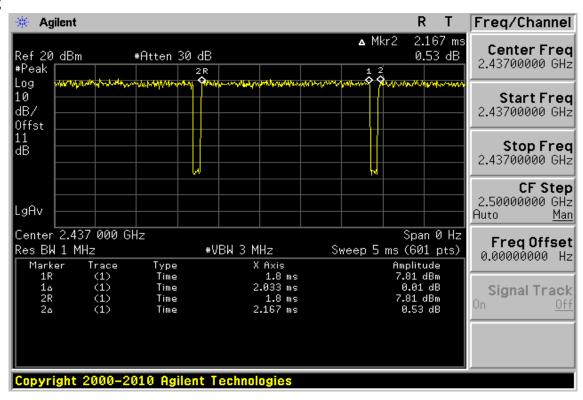
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# 7.1 DUTY CYCLE TEST SIGNAL Measurement Result

### 802.11 b



### 802.11 g



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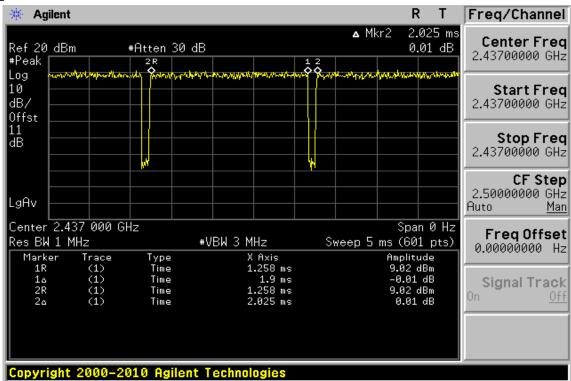
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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 21 of 88

### 802.11 n 20 MHz



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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 22 of 88

# PEAK OUTPUT POWER MEASUREMENT

#### 8.1 **Standard Applicable**

For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt.

If the transmitting antenna of directional gain greater than 6dBi are used the peak output power form the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

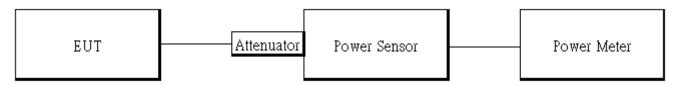
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

#### 8.2 **Measurement Equipment Used**

	Conducted Emission Test Site								
EQUIPMENT	LAST	CAL DUE.							
TYPE		NUMBER	NUMBER	CAL.					
Power Meter	Anritsu	ML2495A	1005007	12/20/2014	12/19/2015				
Power Sensor	Anritsu	MA2411B	917032	12/20/2014	12/19/2015				
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2015	01/01/2016				
Attenuator	Mini-Circuit	BW-S10W2+	002	01/02/2015	01/01/2016				

# **Test Set-up**

Power Meter:



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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 23 of 88

## **Measurement Procedure**

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance V03r03.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.

### **Power Meter:**

It is used as the auxiliary test equipment to conduct the output power measurement.

- 4. Record the max. Reading as observed from Spectrum or Power Meter.
- 5. Repeat above procedures until all frequency of interest measured was complete.

#### **Measurement Result** 8.5

### 802.11b

СН	Frequency (MHz)	Data Rate	Peak Output Power (dBm)	Peak Output Power (mW)	Limit
1	2412	1	19.48	88.72	1  Watt = 30  dBm
6	2437	1	19.41	87.30	1  Watt = 30  dBm
11	2462	1	19.38	86.70	1  Watt = 30  dBm

СН	Frequency (MHz)	Data Rate	Avg. Output Power (dBm)	Avg. Output Power (mW)	Limit
1	2412	1	16.20	41.69	1  Watt = 30  dBm
6	2437	1	16.27	42.36	1  Watt = 30  dBm
11	2462	1	16.24	42.07	1  Watt = 30  dBm

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 24 of 88

## 802.11g

СН	Frequency (MHz)	- "I Data Rate I		Peak Output Power (mW)	Limit	
1	2412	6	21.87	153.82	1  Watt = 30  dBm	
6	2437	6	21.55	142.89	1  Watt = 30  dBm	
11	2462	6	21.81	151.71	1  Watt = 30  dBm	

СН	Frequency (MHz)	Data Rate	Avg. Output Power (dBm)	Avg. Output Power (mW)	Limit	
1	2412	6	12.15	16.41	1  Watt = 30  dBm	
6	2437	6	14.23	26.49	1  Watt = 30  dBm	
11	2462	6	11.82	15.21	1  Watt = 30  dBm	

## 802.11n\_HT20

СН	Frequency (MHz)	Data Rate	Peak Output Power (dBm)	Peak Output Power (mW)	Limit	
1	2412	MCS0	21.76	149.97	1  Watt = 30  dBm	
6	2437	MCS0	21.59	144.21	1  Watt = 30  dBm	
11	2462	MCS0	21.32	135.52	1  Watt = 30  dBm	

СН	Frequency (MHz)	Data Rate	Avg. Output Power (dBm)	Avg. Output Power (mW)	Limit
1	2412	MCS0	12.14	16.37	1  Watt = 30  dBm
6	2437	MCS0	14.46	27.93	1  Watt = 30  dBm
11	2462	MCS0	11.13	12.97	1  Watt = 30  dBm

\* Note: The duty cycle factor is compensated to obtain the maximum value of measurement in average.

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 25 of 88

## 6dB BANDWIDTH

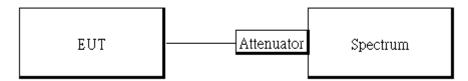
# **Standard Applicable**

The minimum 6 dB bandwidth shall be at least 500 kHz.

9.2 **Measurement Equipment Used** 

Conducted Emission Test Site								
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.			
TYPE		NUMBER	NUMBER	CAL.				
Spectrum Analyzer	Agilent	E4446A	MY51100003	01/29/2015	01/28/2016			
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2015	01/01/2016			
Attenuator	Mini-Circuit	BW-S10W2+	002	01/02/2015	01/01/2016			

#### 9.3 **Test Set-up**



### **Measurement Procedure**

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance V03r03.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 3. Set the spectrum analyzer as RBW = 100 kHz, VBW = 3\*RBW, Span = 30M/50MHz, Detector=Peak, Sweep=auto.
- 4. Mark the peak frequency and –6dB (upper and lower) frequency.
- 5. Repeat above procedures until all frequency of interest measured was complete.

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 26 of 88

### **Measurement Result**

Frequency (MHz)	- •		Result					
802.11b								
2412	9076	> 500	PASS					
2437	9071	> 500	PASS					
2462	8590	> 500	PASS					
	802.11g							
2412	15197	> 500	PASS					
2437	13848	> 500	PASS					
2462	15174	> 500	PASS					
	802.11n_HT20							
2412	15010	> 500	PASS					
2437	15173	> 500	PASS					
2462	15131	> 500	PASS					

<sup>\*</sup> Note: The arrow "->" reveals X decibel level

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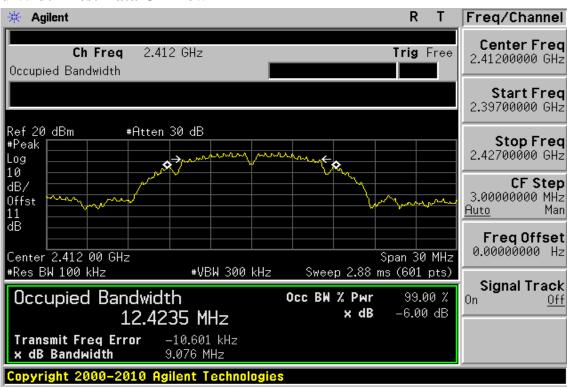
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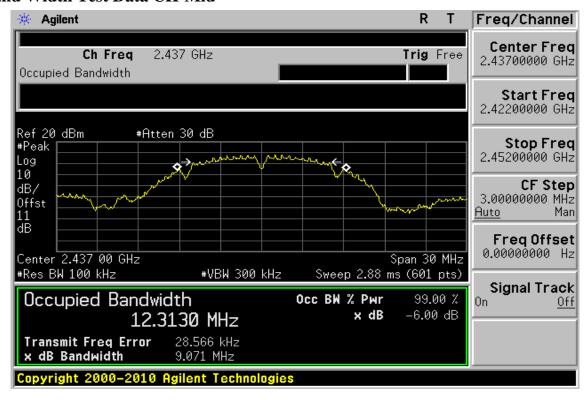
<sup>\*</sup>Refer to next page for plots

Page: 27 of 88

# 802.11b 6dB Band Width Test Data CH-Low



## 6dB Band Width Test Data CH-Mid



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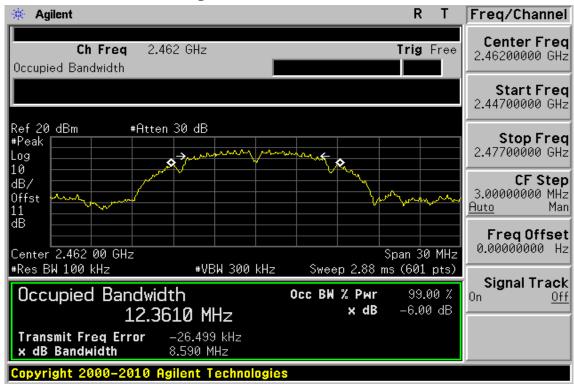
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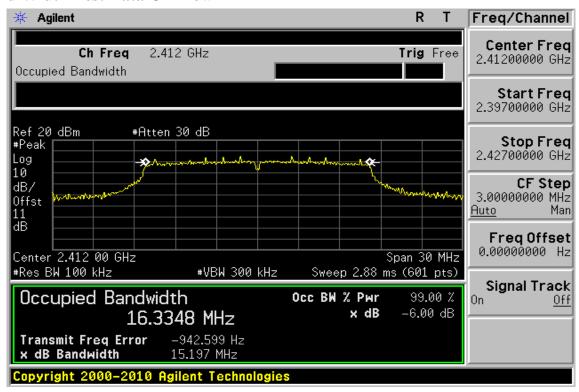
Page: 28 of 88

# 6dB Band Width Test Data CH-High



# 802.11g

## 6dB Band Width Test Data CH-Low



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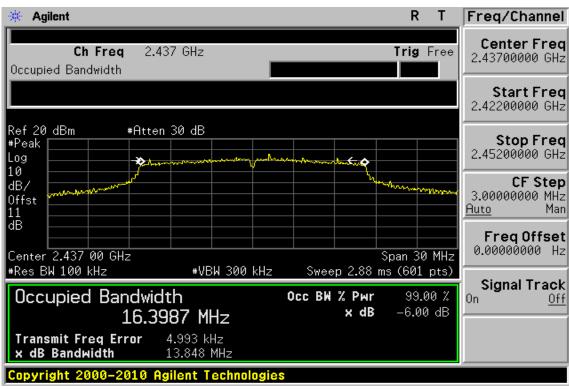
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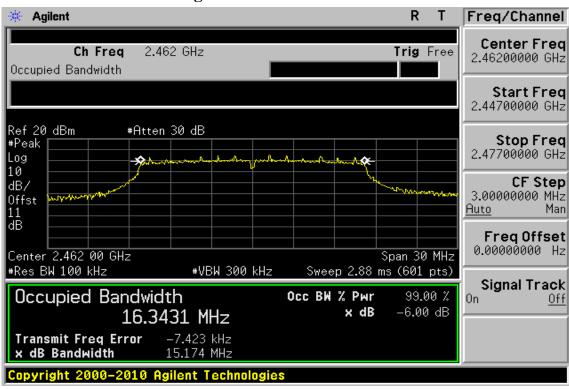


Page: 29 of 88

## 6dB Band Width Test Data CH-Mid



# 6dB Band Width Test Data CH-High



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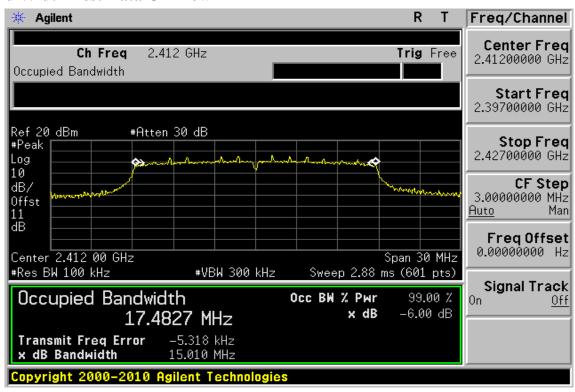
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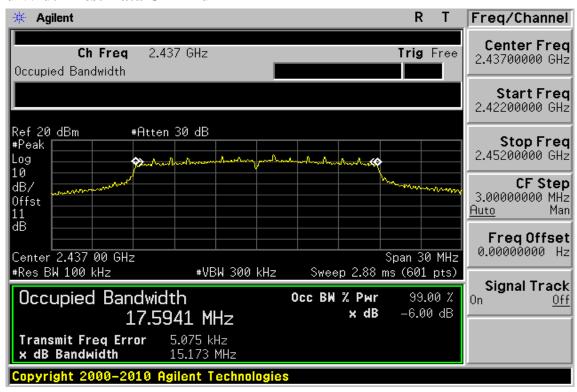
Page: 30 of 88

# 802.11n 20M

## 6dB Band Width Test Data CH-Low



## 6dB Band Width Test Data CH-Mid



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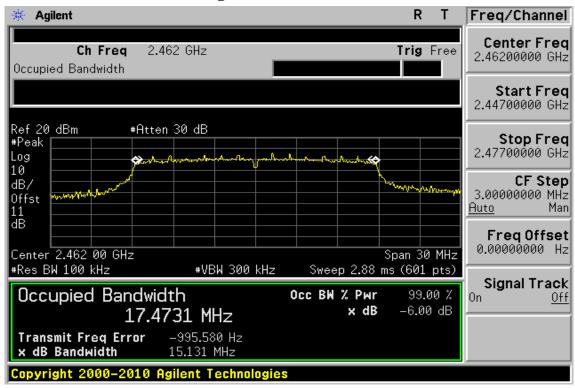
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Page: 31 of 88

# 6dB Band Width Test Data CH-High



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Page: 32 of 88

# 10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

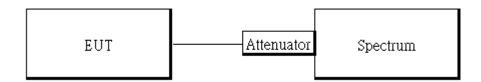
## 10.1 Standard Applicable

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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

10.2 Measurement Equipment Used

Conducted Emission Test Site								
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.			
TYPE		NUMBER	NUMBER	CAL.				
Spectrum Analyzer	Agilent	E4446A	MY51100003	01/29/2015	01/28/2016			
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2015	01/01/2016			
Attenuator	Mini-Circuit	BW-S10W2+	002	01/02/2015	01/01/2016			

## 10.3 Test SET-UP



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Report No.: ER/2015/60002 **Issue Date: Jun. 26, 2015** 

Page: 33 of 88

#### 10.3.1 Measurement Procedure

# **Conducted Band Edge:**

- 1. To connect Antenna Port of EUT to Spectrum.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance V03r03.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
- 5. Set the spectrum analyzer as RBW, VBW=300KHz, Detector = Peak, Sweep = auto
- 6. Mark the highest reading of the emission as the reference level measurement.
- 7. Set DL as the limit = reading on marker 1 20dBm
- 8. Marker on frequency, 2.3999GHz and 2.4836GHz, and examine shall 100 KHz immediately outside the authorized (2400~2483.5) be attenuated by 20dB at least relative to the maximum emission of power.
- 9. Repeat above procedures until all default test channel (low, middle, and high) was complete.

## **Conducted Spurious Emission:**

- 1. To connect Antenna Port of EUT to Spectrum
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance V03r03.
- 3. Set RBW =  $100K \& VBW \ge 300K$ , Detector = Peak, Sweep = Auto.
- 4. Allow trace to fully stabilize.
- 5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
- 6. Repeat above procedures until all default test channel measured were complete.

#### 10.4 Measurement Result

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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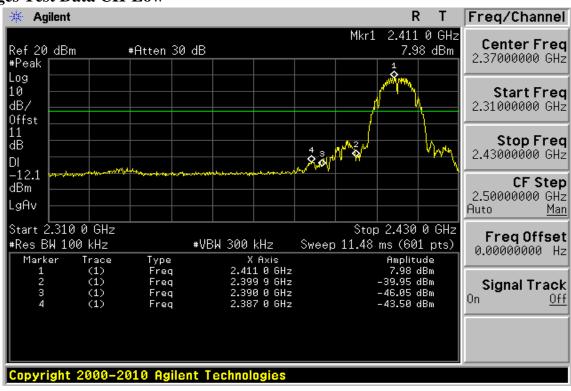
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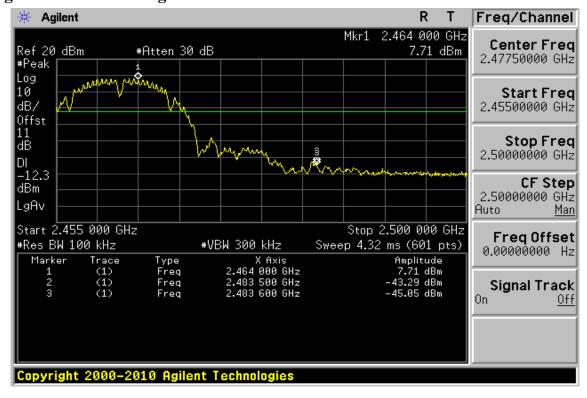
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Page: 34 of 88

802.11b **Band Edges Test Data CH-Low** 



# **Band Edges Test Data CH-High**



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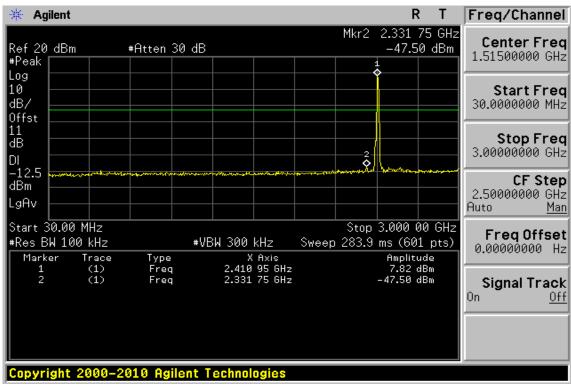
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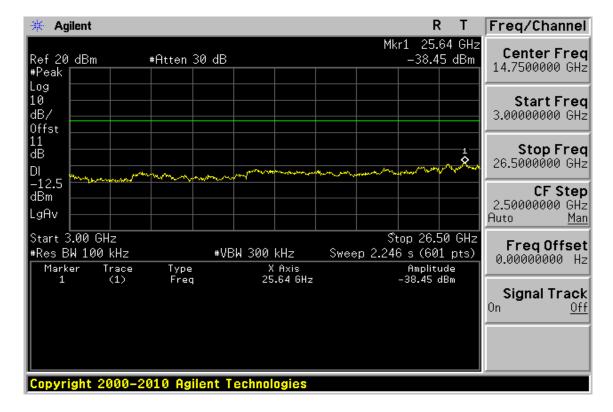
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Page: 35 of 88

802.11b **Spurious Emission Test Data CH-Low** 





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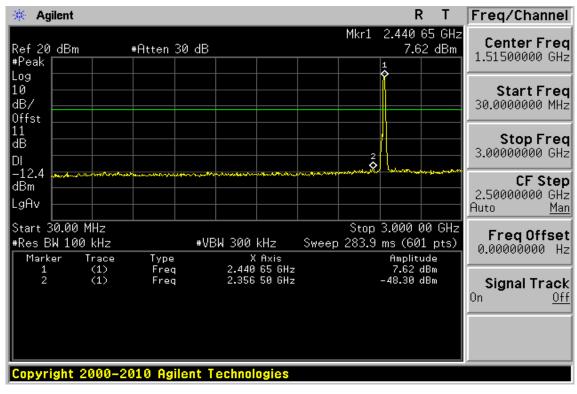
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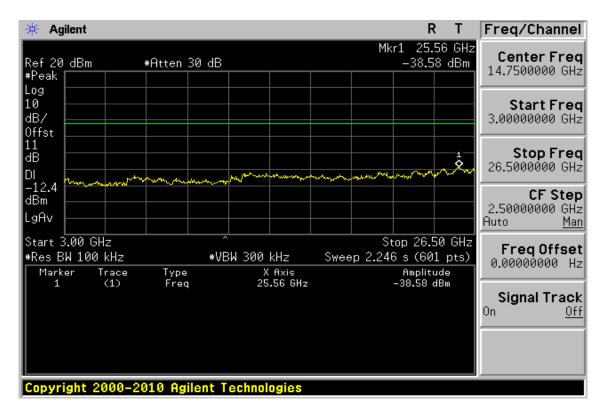
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Page: 36 of 88

# **Spurious Emission Test Data CH-Mid**





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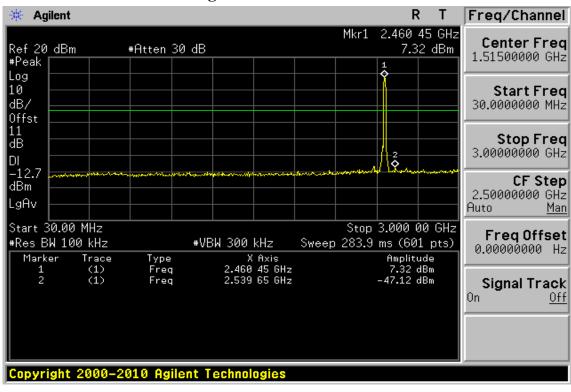
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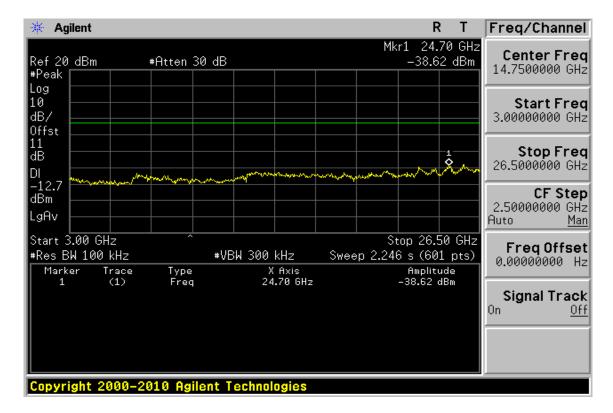
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Page: 37 of 88

## **Spurious Emission Test Data CH-High**





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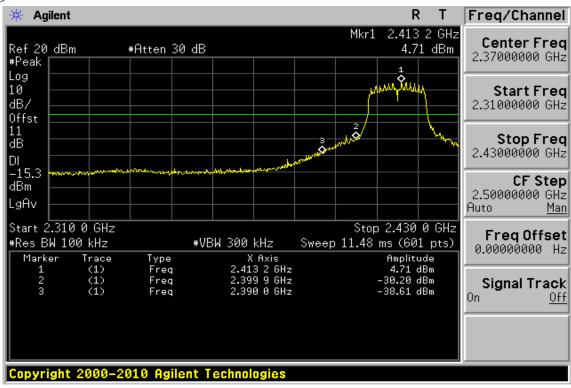
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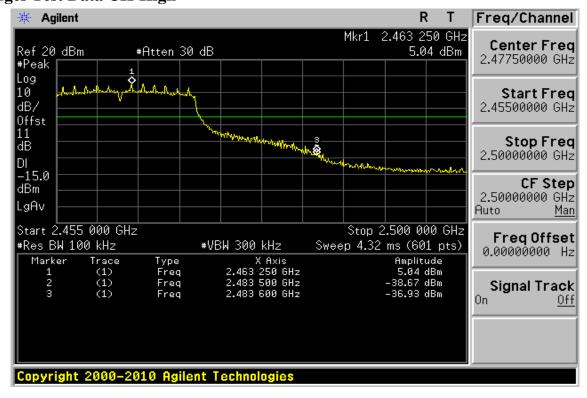
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Page: 38 of 88

802.11g **Band Edges Test Data CH-Low** 



## **Band Edges Test Data CH-High**



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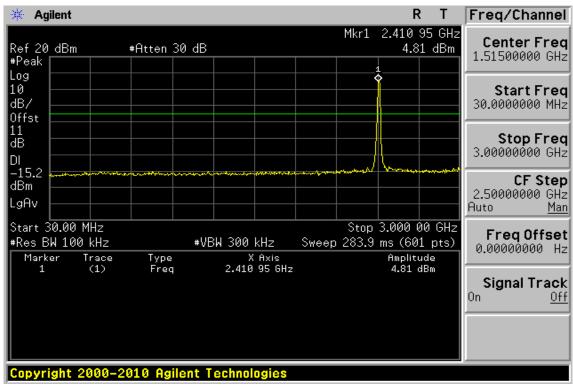
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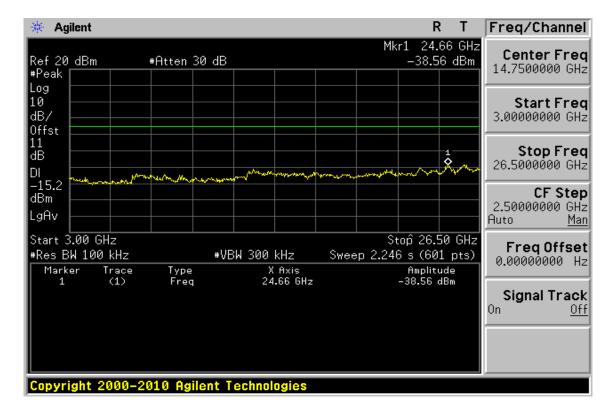
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Page: 39 of 88

802.11g **Spurious Emission Test Data CH-Low** 





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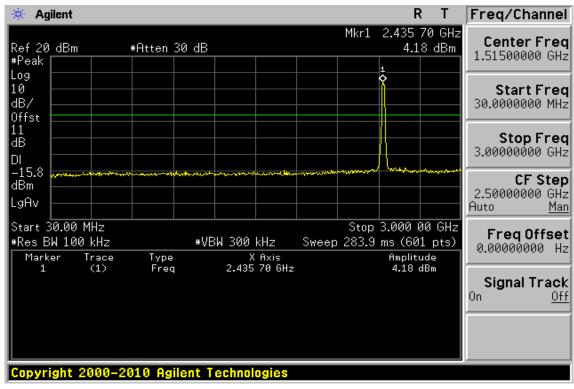
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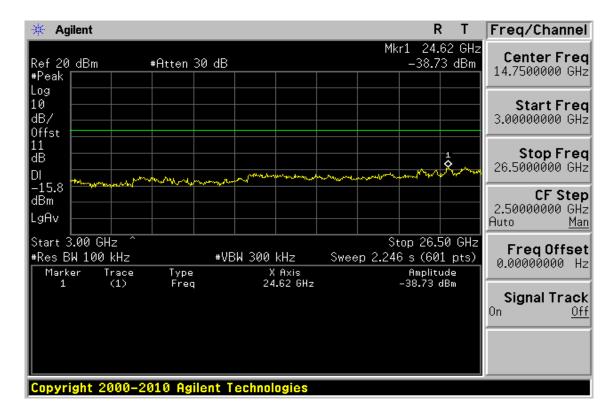
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Page: 40 of 88

# **Spurious Emission Test Data CH-Mid**





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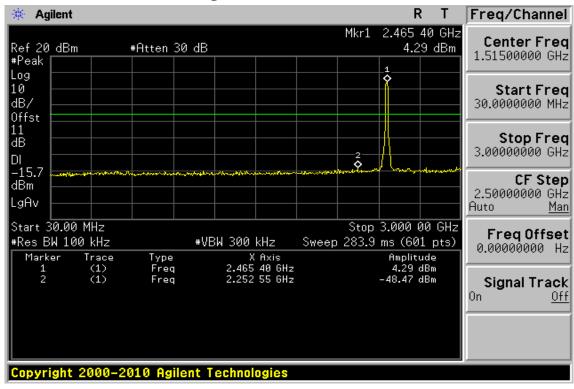
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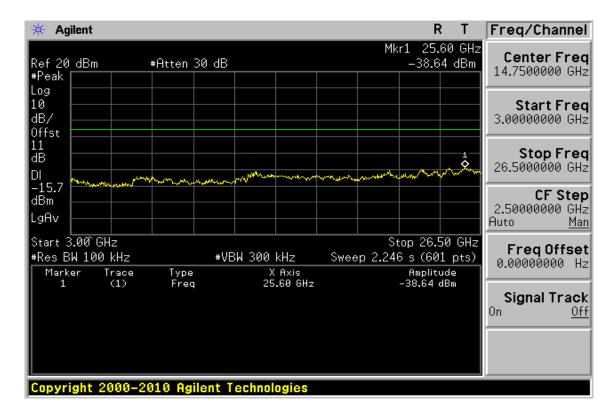
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Page: 41 of 88

# **Spurious Emission Test Data CH-High**





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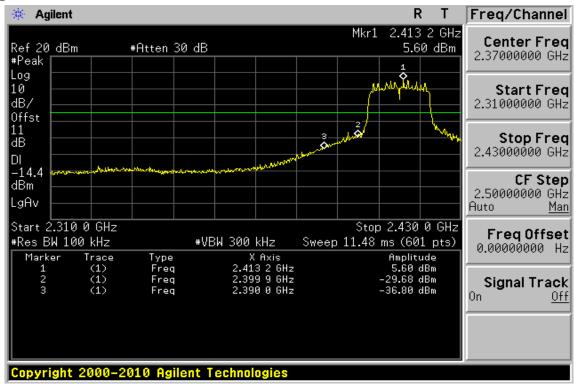
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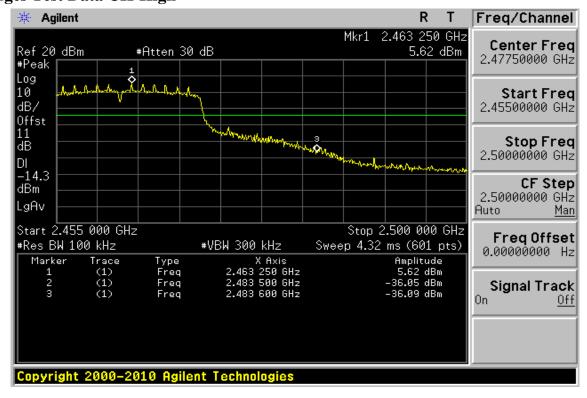
Page: 42 of 88

## 802.11n HT20

# **Band Edges Test Data CH-Low**



## **Band Edges Test Data CH-High**



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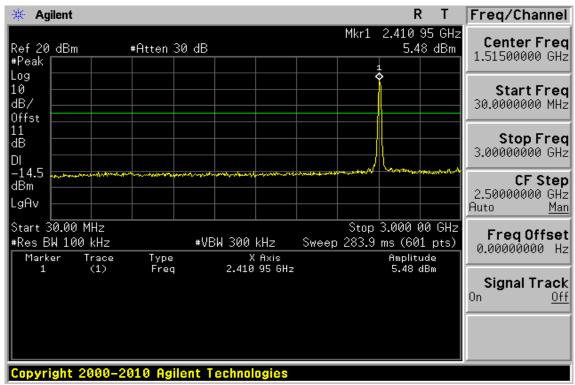
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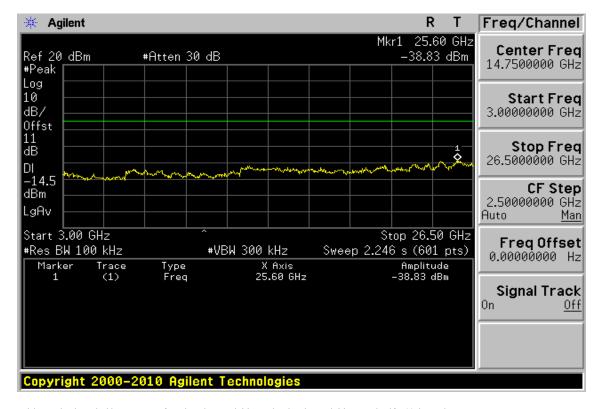


Page: 43 of 88

## 802.11n HT20

# **Spurious Emission Test Data CH-Low**





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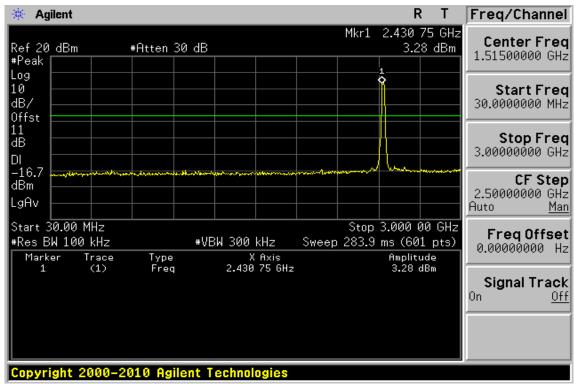
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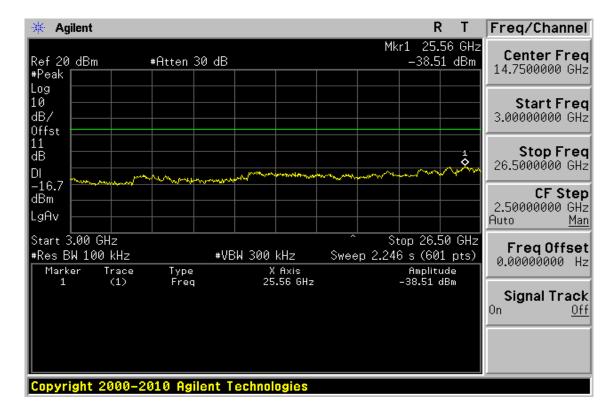
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Page: 44 of 88

# **Spurious Emission Test Data CH-Mid**





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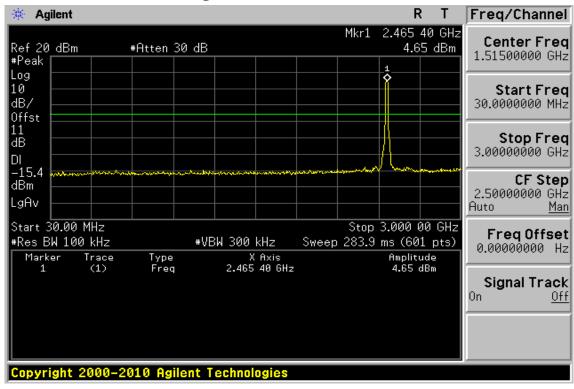
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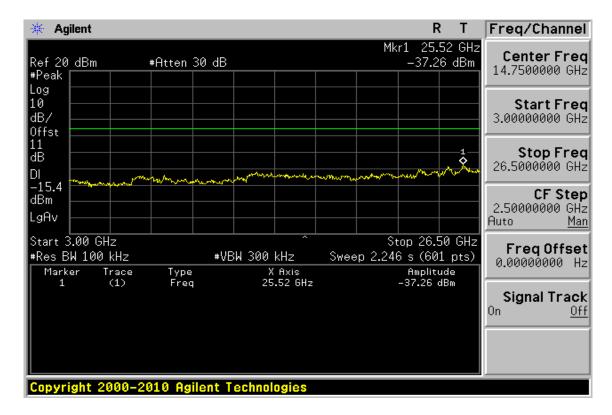
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# **Spurious Emission Test Data CH-High**





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Page: 46 of 88

## 11 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

## 11.1 Standard Applicable

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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 limit as below.

And according to §15.33(a) (1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

Frequency (MHz)	Field strength (microvolts/meter)	Distance (meters)
0.009-0.490	2400/F(KHz)	300
0.490-1.705	24000/F(KHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

#### Note:

- 1. The lower limit shall apply at the transition frequencies.
- 2. Emission level  $(dB\mu V/m) = 20 \log Emission level (dB\mu V/m)$

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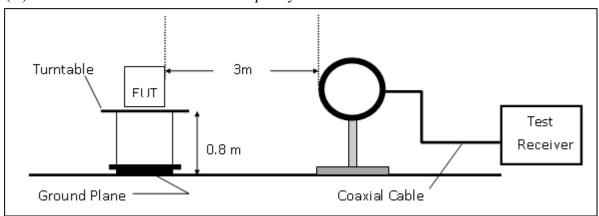
Page: 47 of 88

## 11.2 Measurement Equipment Used:

966 Chamber										
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.					
TYPE		NUMBER	NUMBER	CAL.						
EMI Test Receiver	R&S	ESCI7	100760	05/04/2015	05/03/2016					
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	12/22/2014	12/21/2015					
Spectrum Analyzer	R&S	FSV-30	101398	10/07/2014	10/06/2015					
Loop Antenna	ETS.LINDGREN	6502	00148045	07/03/2014	07/02/2015					
Bilog Antenna	SCHWAZBECK	VULB9168	378	12/23/2014	12/22/2015					
Horn antenna	ETS.LINDGREN	3117	123995	05/05/2015	05/04/2016					
Horn Antenna	Horn Antenna Schwarzbeck		184	12/25/2014	12/24/2015					
Pre-Amplifier	Agilent	8447D	2944A07676	01/02/2015	01/01/2016					
Pre-Amplifier	Agilent	8449B	3008A00578	01/02/2015	01/01/2016					
Pre-Amplifier	EMC Instruments Corp.	EMC184045	980135	01/02/2015	01/01/2016					
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M2	01/02/2015	01/01/2016					
Attenuator	Mini-Circuit	BW-S10W2+	004	01/02/2015	01/01/2016					
Turn Table	HD	DT420	N/A	N.C.R	N.C.R					
Antenna Tower	HD	MA240-N	240/657	N.C.R	N.C.R					
Controller	HD	HD100	N/A	N.C.R	N.C.R					
Low Loss Cable	Huber Suhner	966_Rx	9	01/02/2015	01/01/2016					

## 11.3 Test SET-UP

(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



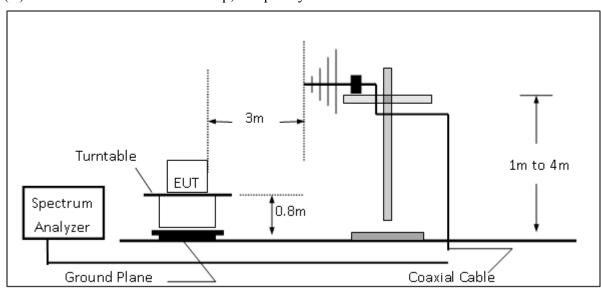
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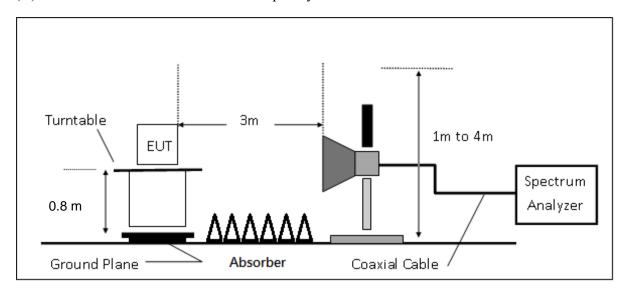
Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 48 of 88

## (B) Radiated Emission Test Set-Up, Frequency form 30MHz to 1000MHz



## (C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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Report No.: ER/2015/60002 **Issue Date: Jun. 26, 2015** 

Page: 49 of 88

### 11.3.1 Measurement Procedure

- 1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance V03r03.
- 2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 0.8m for frequency> 1GHz above ground plane.
- 3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
- 4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
- 5. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.
- 6. Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
- 7. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
- 8. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
- 9. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- 10. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 11. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
- 12. Repeat above procedures until all default test channel measured were complete.

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 50 of 88

### 11.4 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

Actual FS( $dB\mu V/m$ ) = SPA. Reading level( $dB\mu V$ ) + Factor(dB)

Factor(dB) = Antenna Factor(dB $\mu$ V/m) + Cable Loss(dB) – Pre Amplifier Gain(dB)

### Note:

"F": denotes Fundamental Frequency.; "H": denotes Harmonic Frequency.

"E": denotes Band Edge Frequency.; "S": denotes Spurious Frequency.

## 11.5 Test Results of Radiated Spurious Emissions form 9 KHz to 30 MHz

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

### 11.6 Measurement Result

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 51 of 88

## Radiated Band Edge Measurement Result (802.11b)

Operation Band :802.11 b Test Date :2015-06-16 Fundamental Frequency :2412 MHz :21 deg C / 61 RH

Temp./Humi. Operation Mode :Bandedge LOW Engineer :Tin

EUT Pol. :VERTICAL :E2 Plane Measurement Antenna Pol.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
2390.00	E	Average	37.33	5.16	42.49	54.00	-11.51
2390.00	Е	Peak	47.19	5.16	52.35	74.00	-21.65

Operation Band :802.11 b Test Date :2015-06-16

Fundamental Frequency :2412 MHz Temp./Humi. :21 deg C / 61 RH

Operation Mode :Bandedge LOW Engineer :Tin

EUT Pol. :E2 Plane Measurement Antenna Pol. :HORIZONTAL

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
2390.00	E	Average	47.02	5.16	52.18	54.00	-1.82
2390.00	E	Peak	54.85	5.16	60.01	74.00	-13.99

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 52 of 88

Operation Band :802.11 b Test Date :2015-06-15

Fundamental Frequency :2462 MHz Temp./Humi. :21 deg C / 61 RH

Operation Mode Engineer :Bandedge HIGH :Tin

**EUT Pol.** :E2 Plane :VERTICAL Measurement Antenna Pol.

	Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
			Mode	Reading Level		FS	@3m	
_	MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
	2483.50	E	Average	39.12	6.01	45.13	54.00	-8.87
	2483.50	E	Peak	47.27	6.01	53.28	74.00	-20.72

Operation Band Test Date :2015-06-15 :802.11 b

Fundamental Frequency Temp./Humi. :21 deg C / 61 RH :2462 MHz

Operation Mode :Bandedge HIGH Engineer :Tin

EUT Pol. :HORIZONTAL :E2 Plane Measurement Antenna Pol.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
2483.50	E	Average	45.73	6.01	51.74	54.00	-2.26
2483.50	E	Peak	52.79	6.01	58.80	74.00	-15.20

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

:21 deg C / 61 RH

Page: 53 of 88

Radiated Band Edge Measurement Result (802.11g)

Operation Band :802.11 g Test Date :2015-06-16 Fundamental Frequency :2412 MHz

Temp./Humi.

Operation Mode :Bandedge LOW Engineer :Tin

EUT Pol. :VERTICAL :E2 Plane Measurement Antenna Pol.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
2390.00	E	Average	39.56	5.16	44.72	54.00	-9.28
2390.00	Е	Peak	57.98	5.16	63.14	74.00	-10.86

Operation Band :802.11 g Test Date :2015-06-16

Fundamental Frequency :2412 MHz Temp./Humi. :21 deg C / 61 RH

Operation Mode :Bandedge LOW Engineer :Tin

EUT Pol. :E2 Plane Measurement Antenna Pol. :HORIZONTAL

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	$\mathrm{d} B \mu V$	dB	dBμV/m	dBμV/m	dB
2390.00	E	Average	47.19	5.16	52.35	54.00	-1.65
2390.00	E	Peak	67.07	5.16	72.23	74.00	-1.77

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 54 of 88

Operation Band :802.11 g Test Date :2015-06-16

Fundamental Frequency :2462 MHz Temp./Humi. :21 deg C / 61 RH Operation Mode Engineer :Bandedge HIGH :Tin

**EUT Pol.** :E2 Plane :VERTICAL Measurement Antenna Pol.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
2483.50	E	Average	36.38	6.01	42.39	54.00	-11.61
2483.50	E	Peak	58.38	6.01	64.39	74.00	-9.61

Operation Band Test Date :2015-06-16 :802.11 g

Fundamental Frequency Temp./Humi. :21 deg C / 61 RH :2462 MHz

Operation Mode :Bandedge HIGH Engineer :Tin

EUT Pol. :HORIZONTAL :E2 Plane Measurement Antenna Pol.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
2483.50	E	Average	42.17	6.01	48.18	54.00	-5.82
2483.50	E	Peak	65.70	6.01	71.71	74.00	-2.29

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 55 of 88

## Radiated Band Edge Measurement Result (802.11\_HT20)

Operation Band :802.11 n20M :2015-06-16 Test Date :2412 MHz Fundamental Frequency Temp./Humi. :21 deg C / 61 RH

Operation Mode :Bandedge LOW Engineer :Tin

EUT Pol. :VERTICAL :E2 Plane Measurement Antenna Pol.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
2390.00	E	Average	41.18	5.16	46.34	54.00	-7.66
2390.00	E	Peak	59.08	5.16	64.24	74.00	-9.76

Operation Band :802.11 n20M Test Date :2015-06-16

Fundamental Frequency Temp./Humi. :21 deg C / 61 RH :2412 MHz

Operation Mode :Bandedge LOW Engineer :Tin

EUT Pol. :E2 Plane Measurement Antenna Pol. :HORIZONTAL

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
2390.00	E	Average	48.45	5.16	53.61	54.00	-0.39
2390.00	E	Peak	67.97	5.16	73.13	74.00	-0.87

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 56 of 88

Operation Band :802.11 n20M Test Date :2015-06-16

Fundamental Frequency :2462 MHz Temp./Humi. :21 deg C / 61 RH Operation Mode Engineer :Bandedge HIGH :Tin

**EUT Pol.** :E2 Plane :VERTICAL Measurement Antenna Pol.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
2483.50	E	Average	35.07	6.01	41.08	54.00	-12.92
2483.50	E	Peak	56.04	6.01	62.05	74.00	-11.95

:802.11 n20M Operation Band Test Date :2015-06-16

Fundamental Frequency Temp./Humi. :21 deg C / 61 RH :2462 MHz

Operation Mode :Bandedge HIGH Engineer :Tin

EUT Pol. :HORIZONTAL :E2 Plane Measurement Antenna Pol.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
2483.50	E	Average	43.23	6.01	49.24	54.00	-4.76
2483.50	E	Peak	66.43	6.01	72.44	74.00	-1.56

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 57 of 88

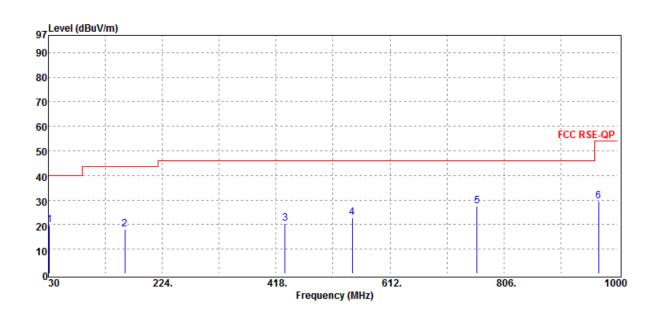
## **Radiated Spurious Emission Measurement Result**

## **Below 1GHz Worst-Case Data:**

**Operation Band** :802.11 g Test Date :2015-06-15 Fundamental Frequency :2412 MHz Temp./Humi. :21 deg C / 61 RH

Operation Mode :TX LOW Engineer :Tin

EUT Pol. :E2 Plane Measurement Antenna Pol. :VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
31.94	S	Peak	30.08	-10.22	19.86	40.00	-20.14
159.98	S	Peak	27.08	-8.81	18.27	43.50	-25.23
433.52	S	Peak	26.25	-5.82	20.43	46.00	-25.57
547.98	S	Peak	26.84	-4.04	22.80	46.00	-23.20
760.41	S	Peak	26.38	1.11	27.49	46.00	-18.51
967.02	S	Peak	25.97	3.67	29.64	54.00	-24.36

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 58 of 88

Operation Band Fundamental Frequency Operation Mode

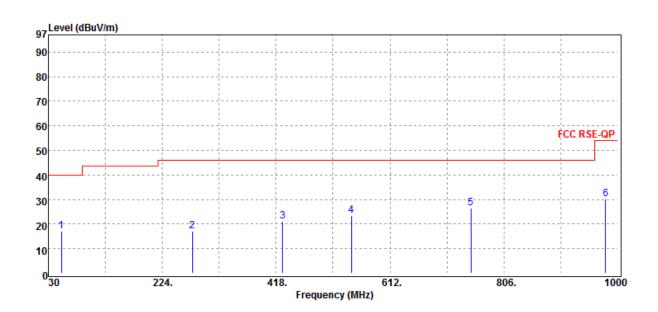
EUT Pol.

:802.11 g :2412 MHz :TX LOW :E2 Plane

Test Date Temp./Humi. :2015-06-15 :21 deg C / 61 RH

Engineer

:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
52.31	S	Peak	26.60	-9.57	17.03	40.00	-22.97
275.41	S	Peak	25.64	-8.66	16.98	46.00	-29.02
428.67	S	Peak	26.75	-5.75	21.00	46.00	-25.00
546.04	S	Peak	27.46	-4.02	23.44	46.00	-22.56
749.74	S	Peak	26.39	0.27	26.66	46.00	-19.34
979.63	S	Peak	26.75	3.42	30.17	54.00	-23.83

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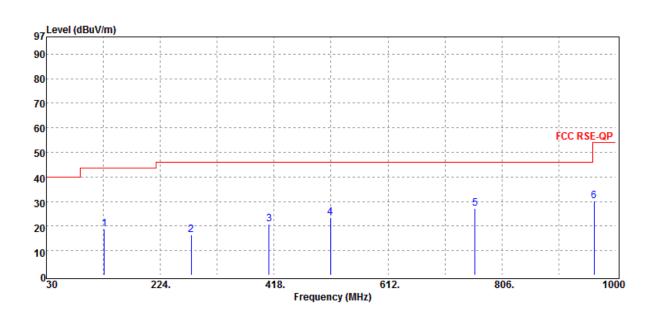
:2015-06-15

Page: 59 of 88

Operation Band Test Date :802.11 g

Fundamental Frequency :2437 MHz Temp./Humi. :21 deg C / 61 RH Operation Mode :TX MID Engineer :Tin

EUT Pol. :E2 Plane :VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
128.94	S	Peak	29.35	-10.59	18.76	43.50	-24.74
276.38	S	Peak	25.19	-8.60	16.59	46.00	-29.41
409.27	S	Peak	26.56	-5.87	20.69	46.00	-25.31
514.03	S	Peak	28.03	-4.52	23.51	46.00	-22.49
760.41	S	Peak	26.09	1.11	27.20	46.00	-18.80
963.14	S	Peak	26.66	3.70	30.36	54.00	-23.64

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 60 of 88

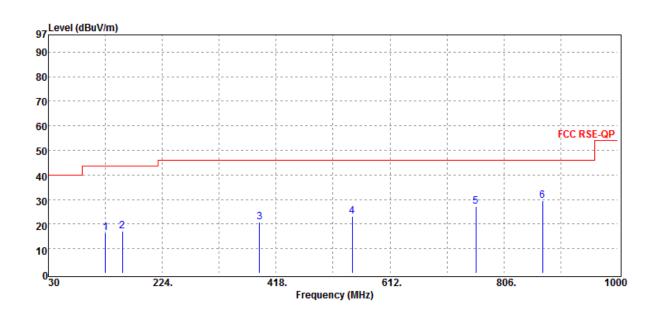
Operation Band Fundamental Frequency Operation Mode EUT Pol.

:802.11 g :2437 MHz :TX MID :E2 Plane

Test Date Temp./Humi. Engineer

:2015-06-15 :21 deg C / 61 RH

:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
127.00	S	Peak	27.15	-10.73	16.42	43.50	-27.08
156.10	S	Peak	26.19	-8.98	17.21	43.50	-26.29
389.87	S	Peak	27.05	-6.15	20.90	46.00	-25.10
547.98	S	Peak	27.13	-4.04	23.09	46.00	-22.91
758.47	S	Peak	26.02	1.02	27.04	46.00	-18.96
871.96	S	Peak	27.19	2.51	29.70	46.00	-16.30

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 61 of 88

Operation Band Fundamental Frequency Operation Mode EUT Pol.

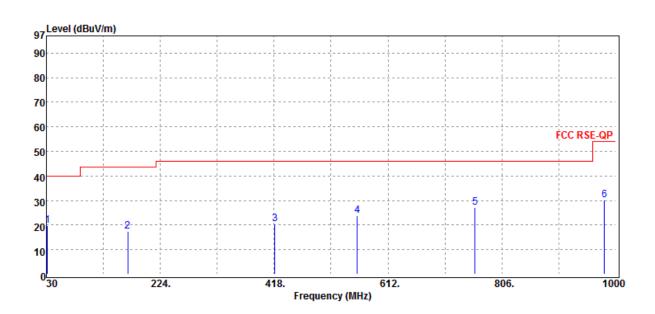
:802.11 g :2462 MHz :TX HIGH :E2 Plane

Test Date Temp./Humi. Engineer

:2015-06-15

:21 deg C / 61 RH :Tin

:VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
31.94	S	Peak	30.14	-10.22	19.92	40.00	-20.08
168.71	S	Peak	26.44	-9.14	17.30	43.50	-26.20
418.97	S	Peak	26.22	-5.68	20.54	46.00	-25.46
559.62	S	Peak	27.75	-3.82	23.93	46.00	-22.07
760.41	S	Peak	25.92	1.11	27.03	46.00	-18.97
980.60	S	Peak	26.70	3.41	30.11	54.00	-23.89

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 62 of 88

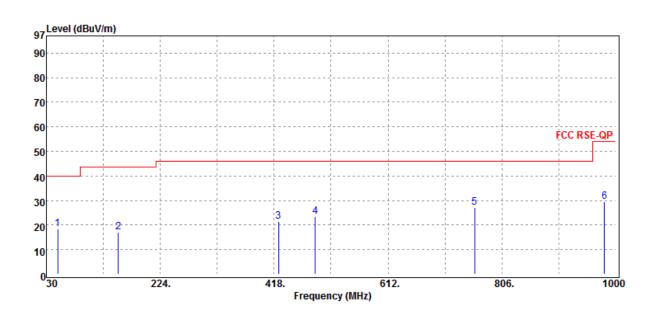
Operation Band Fundamental Frequency Operation Mode EUT Pol.

:802.11 g :2462 MHz :TX HIGH :E2 Plane

Test Date Temp./Humi. :2015-06-15 :21 deg C / 61 RH

Engineer

:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	$\mathrm{d} B \mu V$	dB	dBμV/m	dBμV/m	dB
49.40	S	Peak	27.74	-9.37	18.37	40.00	-21.63
152.22	S	Peak	26.36	-9.18	17.18	43.50	-26.32
425.76	S	Peak	27.19	-5.72	21.47	46.00	-24.53
487.84	S	Peak	27.94	-4.34	23.60	46.00	-22.40
759.44	S	Peak	26.15	1.07	27.22	46.00	-18.78
980.60	S	Peak	26.22	3.41	29.63	54.00	-24.37

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 63 of 88

## **Radiated Spurious Emission Measurement Result**

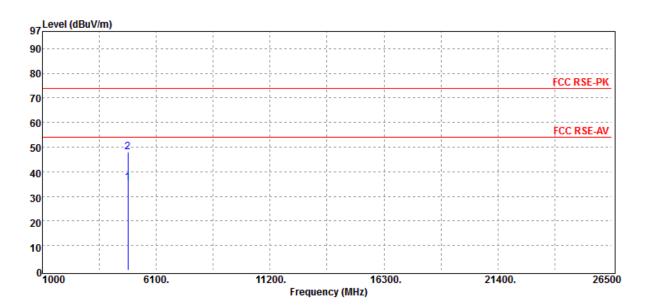
## **Above 1GHz Worst-Case Data:**

**Operation Band** :802.11 b Test Date :2015-06-15

Fundamental Frequency :2412 MHz Temp./Humi. :21 deg C / 61 RH

Operation Mode :TX LOW Engineer :Tin

EUT Pol. :E2 Plane Measurement Antenna Pol. :VERTICAL



	Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin	
			Mode	Reading Level		FS	@3m		
_	MHz	F/H/E/S	PK/QP/AV	$\mathrm{d} B \mu V$	dB	dBμV/m	dBμV/m	dB	
	4824.00	Н	Average	25.88	9.63	35.51	54.00	-18.49	
	4824.00	Н	Peak	38.33	9.63	47.96	74.00	-26.04	

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 64 of 88

Operation Band Fundamental Frequency

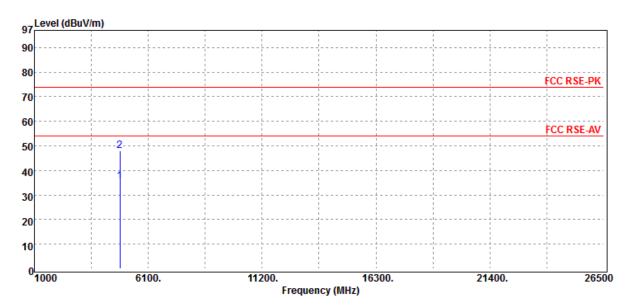
:802.11 b :2412 MHz Operation Mode :TX LOW EUT Pol. :E2 Plane

Test Date Temp./Humi. :2015-06-15 :21 deg\_C / 61 RH

Engineer

Measurement Antenna Pol.

:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	${ m d} B \mu V$	dB	dBμV/m	dBμV/m	dB
4824.00	Н	Average	25.96	9.63	35.59	54.00	-18.41
4824.00	Н	Peak	38.42	9.63	48.05	74.00	-25.95

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 65 of 88

Operation Band Fundamental Frequency Operation Mode

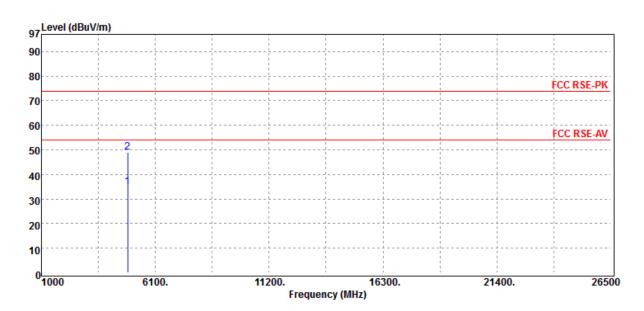
EUT Pol.

:802.11 b :2437 MHz :TX MID :E2 Plane

Test Date Temp./Humi. :2015-06-15 :21 deg\_C / 61 RH

Engineer

Measurement Antenna Pol. :VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	$\mathrm{d} B \mu V$	dB	dBμV/m	$dB\mu V/m$	dB
4874.00	Н	Average	25.22	9.85	35.07	54.00	-18.93
4874.00	Н	Peak	39.29	9.85	49.14	74.00	-24.86
	4874.00	MHz F/H/E/S 4874.00 H	Mode MHz F/H/E/S PK/QP/AV  4874.00 H Average	MHz F/H/E/S PK/QP/AV dBμV  4874.00 H Average 25.22	Mode Reading Level  MHz F/H/E/S PK/QP/AV dBμV dB  4874.00 H Average 25.22 9.85	Mode Reading Level FS MHz F/H/E/S PK/QP/AV dBμV dB dBμV/m  4874.00 H Average 25.22 9.85 35.07	MHz         Mode PK/QP/AV         Reading Level dBμV         FS         @3m dBμV/m           4874.00         H         Average         25.22         9.85         35.07         54.00

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 66 of 88

Operation Band Fundamental Frequency Operation Mode

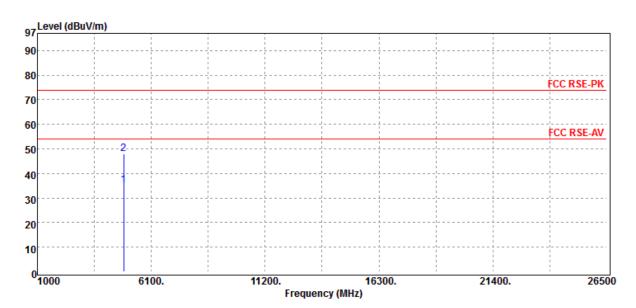
EUT Pol.

:802.11 b :2437 MHz :TX MID :E2 Plane

Test Date Temp./Humi. :2015-06-15 :21 deg\_C / 61 RH

Engineer

Measurement Antenna Pol. :HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	${ m d} B \mu V$	dB	dBμV/m	dBμV/m	dB
4874.00	Н	Average	25.45	9.85	35.30	54.00	-18.70
4874.00	Н	Peak	38.03	9.85	47.88	74.00	-26.12

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 67 of 88

Operation Band Fundamental Frequency Operation Mode

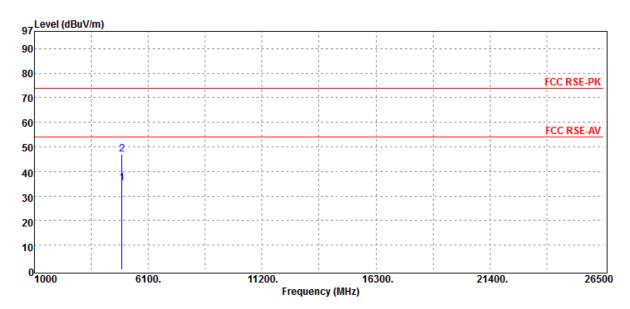
EUT Pol.

:802.11 b :2462 MHz :TX HIGH :E2 Plane

Test Date Temp./Humi. :2015-06-15 :21 deg\_C / 61 RH

Engineer

Measurement Antenna Pol. :VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	${ m d} B \mu V$	dB	dBμV/m	dBμV/m	dB
4924.00	Н	Average	25.32	9.86	35.18	54.00	-18.82
4924.00	Н	Peak	37.03	9.86	46.89	74.00	-27.11

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 68 of 88

Operation Band Fundamental Frequency Operation Mode

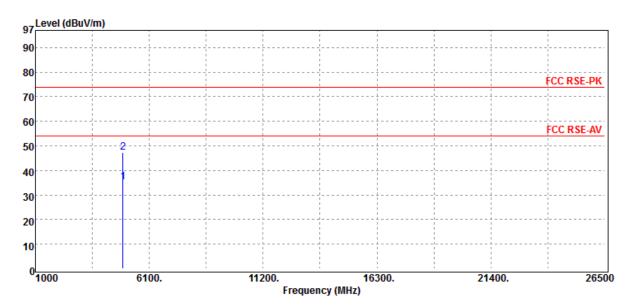
EUT Pol.

:802.11 b :2462 MHz :TX HIGH :E2 Plane

Test Date Temp./Humi. Engineer

:2015-06-15 :21 deg\_C / 61 RH

Measurement Antenna Pol. :HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	${ m d} B \mu V$	dB	dBμV/m	dBμV/m	dB
4924.00	Н	Average	25.46	9.86	35.32	54.00	-18.68
4924.00	Н	Peak	37.61	9.86	47.47	74.00	-26.53

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 69 of 88

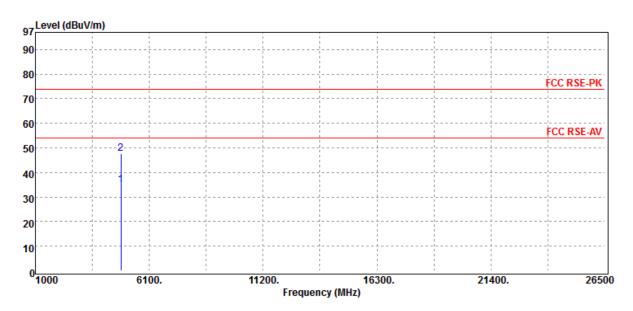
## Radiated Spurious Emission Measurement Result (802.11 g)

:2015-06-15 Operation Band :802.11 g Test Date

Fundamental Frequency :21 deg C / 61 RH :2412 MHz Temp./Humi.

:Tin Operation Mode :TX LOW Engineer

EUT Pol. :E2 Plane Measurement Antenna Pol. :VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	$\mathrm{d} B \mu V$	dB	$dB\mu V/m$	dBμV/m	dB
4824.00	Н	Average	25.14	9.63	34.77	54.00	-19.23
4824.00	Н	Peak	38.13	9.63	47.76	74.00	-26.24

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 70 of 88

Operation Band Fundamental Frequency Operation Mode

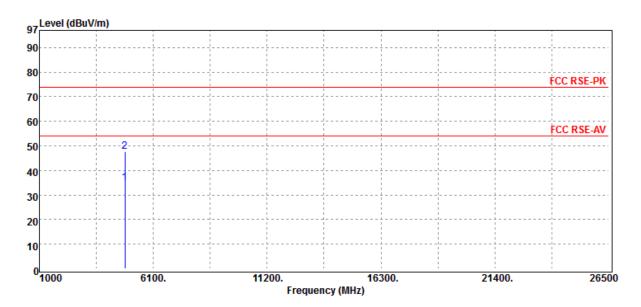
EUT Pol.

:802.11 g :2412 MHz :TX LOW :E2 Plane

Test Date Temp./Humi. Engineer

:2015-06-15 :21 deg\_C / 61 RH

Measurement Antenna Pol. :HORIZONTAL



Freq.	Actual Limit	Note Detector Spectrum Fact	Margin
	FS @3m	Mode Reading Level	
MHz	$dB\mu V/m$ $dB\mu V/m$	$F/H/E/S$ $PK/QP/AV$ $dB\mu V$ $dE$	dB
4824.00	34.96 54.00	H Average 25.33 9.6	-19.04
4824.00	47.57 74.00	H Peak 37.94 9.6	-26.43
		č	

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Page: 71 of 88

Operation Band Fundamental Frequency Operation Mode

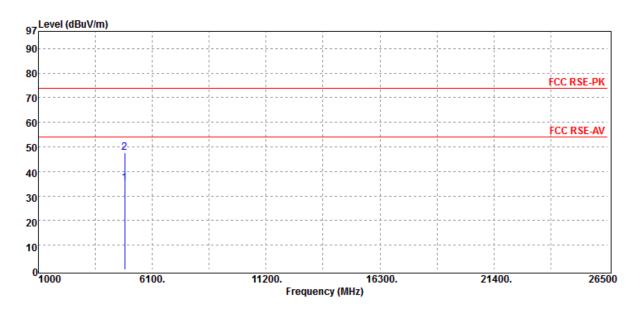
EUT Pol.

:802.11 g :2437 MHz :TX MID :E2 Plane

Test Date Temp./Humi. :2015-06-15 :21 deg\_C / 61 RH

Engineer

Measurement Antenna Pol. :VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin	
		Mode	Reading Level		FS	@3m		
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB	
4874.00	Н	Average	25.47	9.85	35.32	54.00	-18.68	
4874.00	Н	Peak	37.92	9.85	47.77	74.00	-26.23	
		Č						

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 72 of 88

Operation Band Fundamental Frequency Operation Mode

EUT Pol.

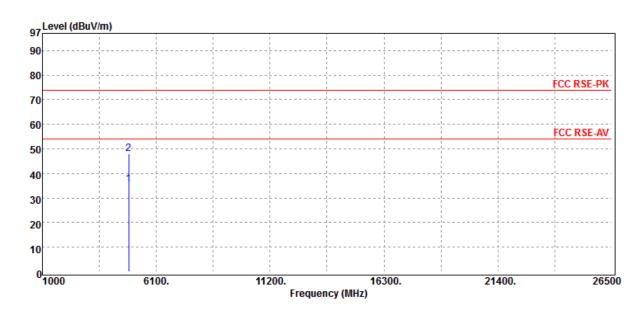
:802.11 g :2437 MHz :TX MID :E2 Plane

Test Date Temp./Humi. :2015-06-15 :21 deg\_C / 61 RH

Engineer

Measurement Antenna Pol.

:HORIZONTAL



	Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin	
			Mode	Reading Level		FS	@3m		
_	MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB	
	4874.00	Н	Average	25.62	9.85	35.47	54.00	-18.53	
	4874.00	Н	Peak	38.13	9.85	47.98	74.00	-26.02	

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 73 of 88

Operation Band Fundamental Frequency Operation Mode

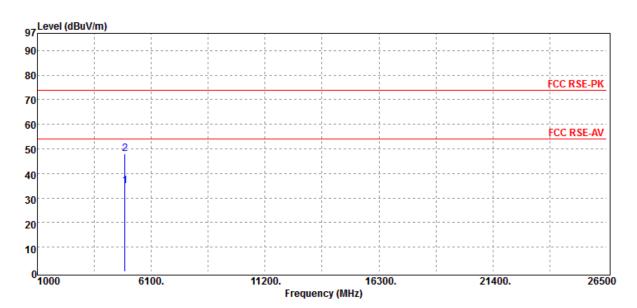
EUT Pol.

:802.11 g :2462 MHz :TX HIGH :E2 Plane

Test Date Temp./Humi. :2015-06-15 :21 deg\_C / 61 RH

Engineer

Measurement Antenna Pol. :VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	${ m d} B \mu V$	dB	dBμV/m	dBμV/m	dB
4924.00	Н	Average	25.19	9.86	35.05	54.00	-18.95
4924.00	Н	Peak	38.00	9.86	47.86	74.00	-26.14

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 74 of 88

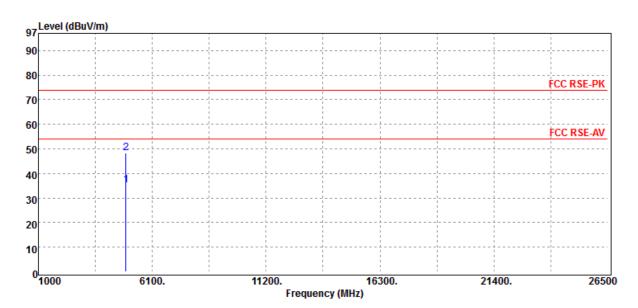
Operation Band Fundamental Frequency Operation Mode EUT Pol.

:802.11 g :2462 MHz :TX HIGH :E2 Plane

Test Date Temp./Humi. :2015-06-15 :21 deg\_C / 61 RH

Engineer

Measurement Antenna Pol. :HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	$\mathrm{d} B \mu V$	dB	dBμV/m	dBμV/m	dB
4924.00	Н	Average	25.36	9.86	35.22	54.00	-18.78
4924.00	Н	Peak	38.53	9.86	48.39	74.00	-25.61

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EUT Pol.

## FCC ID: S9E-JUNO41WN

Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

:VERTICAL

Page: 75 of 88

# Radiated Spurious Emission Measurement Result (802.11\_HT20)

:E2 Plane

:2015-06-15 Operation Band :802.11 n20M Test Date

Fundamental Frequency :21 deg C / 61 RH :2412 MHz Temp./Humi.

Measurement Antenna Pol.

Operation Mode :TX LOW Engineer :Tin



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	$\mathrm{dB}\mu\mathrm{V}$	dB	dBμV/m	dBμV/m	dB
4824.00	Н	Average	25.83	9.63	35.46	54.00	-18.54
4824.00	Н	Peak	38.22	9.63	47.85	74.00	-26.15

Frequency (MHz)

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 76 of 88

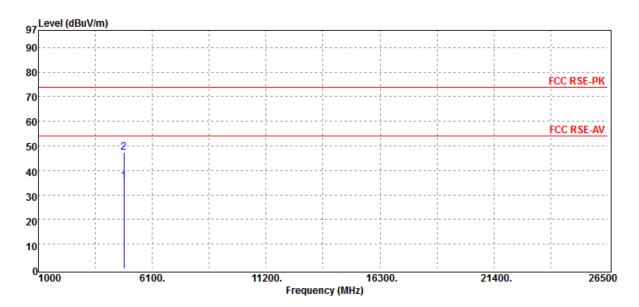
Operation Band Fundamental Frequency Operation Mode EUT Pol.

:802.11 n20M :2412 MHz :TX LOW :E2 Plane

Test Date Temp./Humi. Engineer

:2015-06-15 :21 deg\_C / 61 RH

Measurement Antenna Pol. :HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin	
		Mode	Reading Level		FS	@3m		
MHz	F/H/E/S	PK/QP/AV	$\mathrm{d} B \mu V$	dB	dBμV/m	dBμV/m	dB	
4824.00	Н	Average	25.91	9.63	35.54	54.00	-18.46	
4824.00	Н	Peak	37.67	9.63	47.30	74.00	-26.70	
		Č						

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 77 of 88

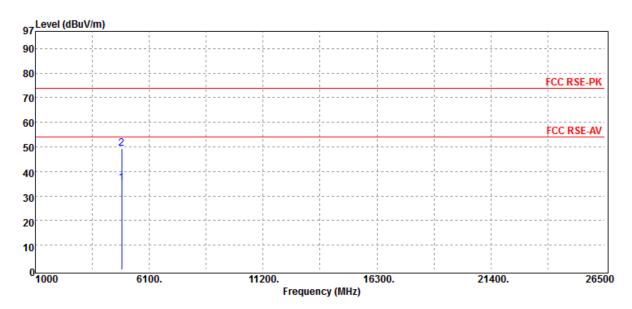
Operation Band Fundamental Frequency Operation Mode EUT Pol.

:802.11 n20M :2437 MHz :TX MID :E2 Plane

Test Date Temp./Humi. Engineer

:2015-06-15 :21 deg\_C / 61 RH

Measurement Antenna Pol. :VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	${ m d} B \mu V$	dB	dBμV/m	dBμV/m	dB
4874.00	Н	Average	25.55	9.85	35.40	54.00	-18.60
4874.00	Н	Peak	39.37	9.85	49.22	74.00	-24.78

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Page: 78 of 88

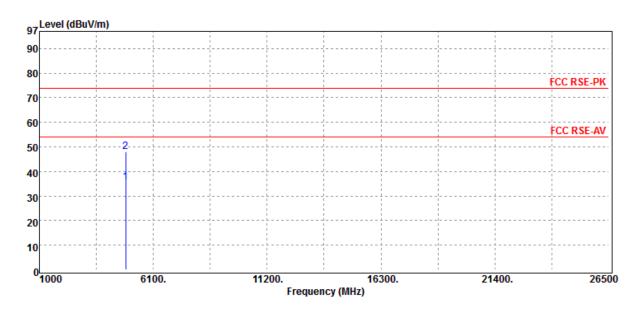
Operation Band Fundamental Frequency Operation Mode EUT Pol.

:802.11 n20M :2437 MHz :TX MID :E2 Plane

Test Date Temp./Humi. :2015-06-15 :21 deg\_C / 61 RH

Engineer

Measurement Antenna Pol. :HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin	
		Mode	Reading Level		FS	@3m		
MHz	F/H/E/S	PK/QP/AV	$\mathrm{d} B \mu V$	dB	dBμV/m	$dB\mu V/m$	dB	
874.00	Н	Average	25.62	9.85	35.47	54.00	-18.53	
874.00	Н	Peak	38.24	9.85	48.09	74.00	-25.91	
	Freq.  MHz  874.00 874.00	MHz F/H/E/S 874.00 H	Mode  MHz F/H/E/S PK/QP/AV  874.00 H Average	Mode Reading Level  MHz F/H/E/S PK/QP/AV dBμV  874.00 H Average 25.62	Mode         Reading Level           MHz         F/H/E/S         PK/QP/AV         dBμV         dB           874.00         H         Average         25.62         9.85	Mode         Reading Level         FS           MHz         F/H/E/S         PK/QP/AV         dBμV         dB         dBμV/m           874.00         H         Average         25.62         9.85         35.47	Mode         Reading Level         FS         @3m           MHz         F/H/E/S         PK/QP/AV         dBμV         dB         dBμV/m         dBμV/m           874.00         H         Average         25.62         9.85         35.47         54.00	Mode         Reading Level         FS         @3m           MHz         F/H/E/S         PK/QP/AV         dBμV         dB         dBμV/m         dBμV/m         dB           874.00         H         Average         25.62         9.85         35.47         54.00         -18.53

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Page: 79 of 88

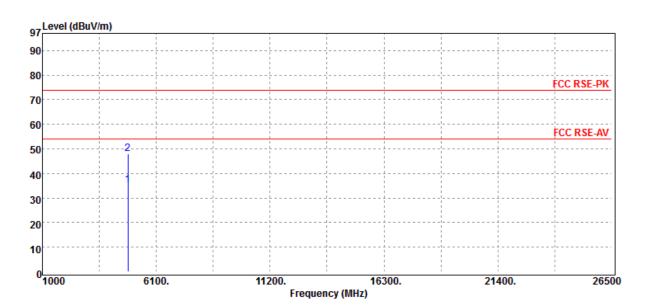
Operation Band Fundamental Frequency Operation Mode EUT Pol.

:802.11 n20M :2462 MHz :TX HIGH :E2 Plane

Test Date Temp./Humi. :2015-06-15 :21 deg\_C / 61 RH

Engineer

Measurement Antenna Pol. :VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
МНz	F/H/E/S	PK/QP/AV	$\mathrm{d} B \mu V$	dB	dBμV/m	dBμV/m	dB
24.00	Н	Average	25.72	9.63	35.35	54.00	-18.65
324.00	Н	Peak	38.32	9.63	47.95	74.00	-26.05
	MHz 24.00	MHz F/H/E/S 24.00 H	Mode  MHz F/H/E/S PK/QP/AV  24.00 H Average	Mode Reading Level  MHz F/H/E/S PK/QP/AV dBμV  24.00 H Average 25.72	Mode Reading Level  MHz F/H/E/S PK/QP/AV dBμV dB  24.00 H Average 25.72 9.63	Mode Reading Level FS MHz F/H/E/S PK/QP/AV dBμV dB dBμV/m  24.00 H Average 25.72 9.63 35.35	Mode         Reading Level         FS         @3m           MHz         F/H/E/S         PK/QP/AV         dBμV         dB         dBμV/m         dBμV/m           24.00         H         Average         25.72         9.63         35.35         54.00

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Page: 80 of 88

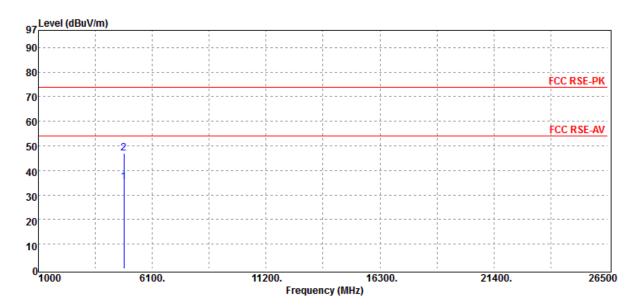
Operation Band Fundamental Frequency Operation Mode EUT Pol.

:802.11 n20M :2462 MHz :TX HIGH :E2 Plane

Test Date Temp./Humi. :2015-06-15 :21 deg\_C / 61 RH

Engineer

Measurement Antenna Pol. :HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin	
		Mode	Reading Level		FS	@3m		
MHz	F/H/E/S	PK/QP/AV	$\mathrm{d} B \mu V$	dB	dBμV/m	dBμV/m	dB	
4824.00	Н	Average	25.73	9.63	35.36	54.00	-18.64	
4824.00	Н	Peak	37.25	9.63	46.88	74.00	-27.12	
	MHz 4824.00	MHz F/H/E/S 4824.00 H	Mode MHz F/H/E/S PK/QP/AV  4824.00 H Average	Mode Reading Level MHz F/H/E/S PK/QP/AV dBμV  4824.00 H Average 25.73	Mode Reading Level  MHz F/H/E/S PK/QP/AV dBμV dB  4824.00 H Average 25.73 9.63	Mode         Reading Level         FS           MHz         F/H/E/S         PK/QP/AV         dBμV         dB         dBμV/m           4824.00         H         Average         25.73         9.63         35.36	Mode Mode Meading Level         FS         @3m           MHz         F/H/E/S         PK/QP/AV         dBμV         dB         dBμV/m         dBμV/m           4824.00         H         Average         25.73         9.63         35.36         54.00	Mode Mode Meading Level         FS         @3m           MHz         F/H/E/S         PK/QP/AV         dBμV         dB         dBμV/m         dBμV/m         dB           4824.00         H         Average         25.73         9.63         35.36         54.00         -18.64

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Page: 81 of 88

## 12 PEAK POWER SPECTRAL DENSITY

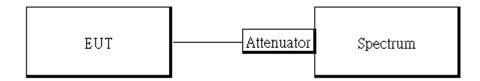
## 12.1 Standard Applicable

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

12.2 Measurement Equipment Used

Conducted Emission Test Site							
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.		
TYPE		NUMBER	NUMBER	CAL.			
Spectrum Analyzer	Agilent	E4446A	MY51100003	01/29/2015	01/28/2016		
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2015	01/01/2016		
Attenuator	Mini-Circuit	BW-S10W2+	002	01/02/2015	01/01/2016		

## 12.3 Test Set-up



## 12.4 Measurement Procedure

- 1. Set analyzer center frequency to DTS channel center frequency.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance V03r03.
- 3. Set the span to 1.5 times the DTS channel bandwidth.
- 4. Set the RBW  $\geq$  3 kHz.
- 5. Set the VBW  $\geq$  3 x RBW.
- 6. Detector = peak.
- 7. Sweep time = auto couple.
- 8. Trace mode = max hold.
- 9. Allow trace to fully stabilize.
- 10. Use the peak marker function to determine the maximum amplitude level.
- 11. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 82 of 88

## 12.5 Measurement Result

Frequency	<b>RF Power Density</b>	Maximum Limit	Result
(MHz)	(dBm)	(dBm)	
	802.11	b	
2412	-6.01	8	PASS
2437	-6.47	8	PASS
2462	-6.67	8	PASS
	802.11	g	
2412	-10.36	8	PASS
2437	-9.27	8	PASS
2462	-11.38	8	PASS
	802.11n_H	IT20	
2412	-10.08	8	PASS
2437	-9.88	8	PASS
2462	-10.49	8	PASS

<sup>\*</sup>Refer to next page for plots

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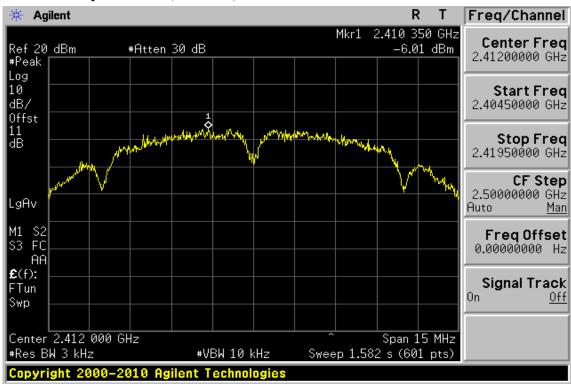
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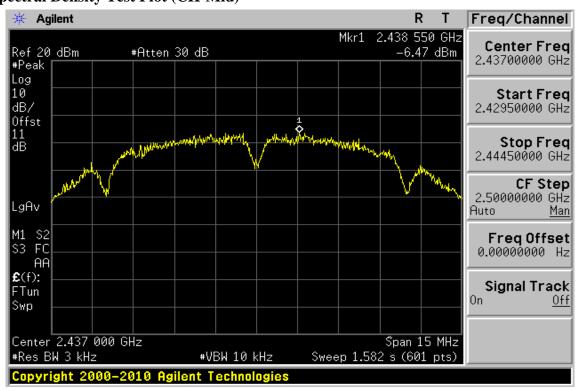
Report No.: ER/2015/60002 FCC ID: S9E-JUNO41WN Issue Date: Jun. 26, 2015

Page: 83 of 88

802.11b **Power Spectral Density Test Plot (CH-Low)** 



# **Power Spectral Density Test Plot (CH-Mid)**



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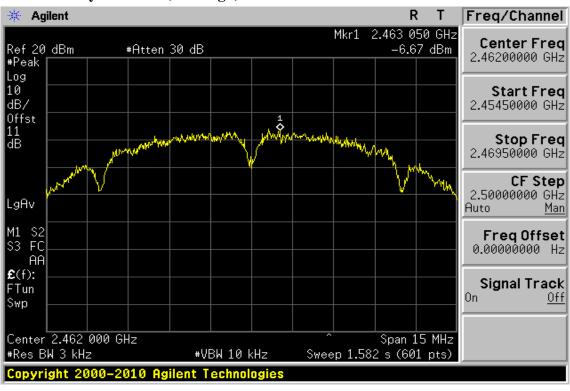
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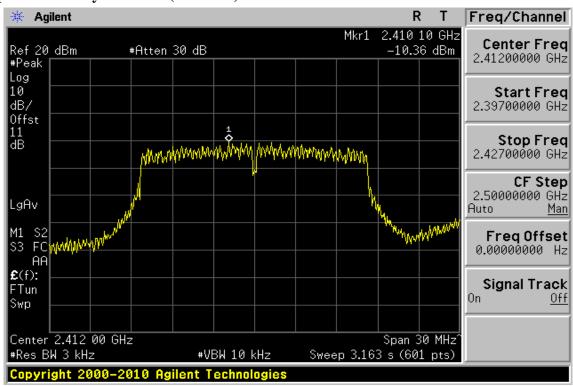
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Page: 84 of 88

## **Power Spectral Density Test Plot (CH-High)**



802.11g **Power Spectral Density Test Plot (CH-Low)** 



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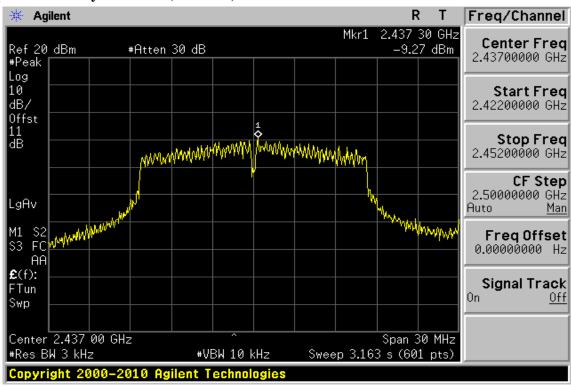
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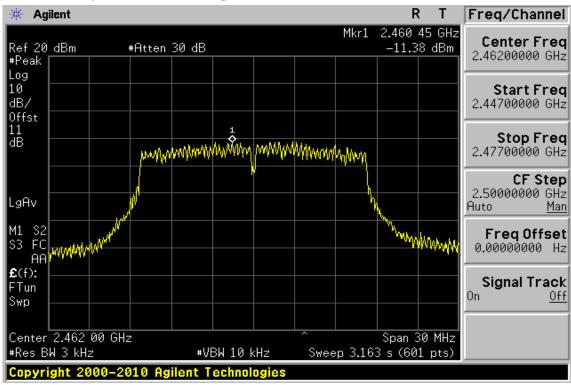
Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 85 of 88

## **Power Spectral Density Test Plot (CH-Mid)**



## **Power Spectral Density Test Plot (CH-High)**



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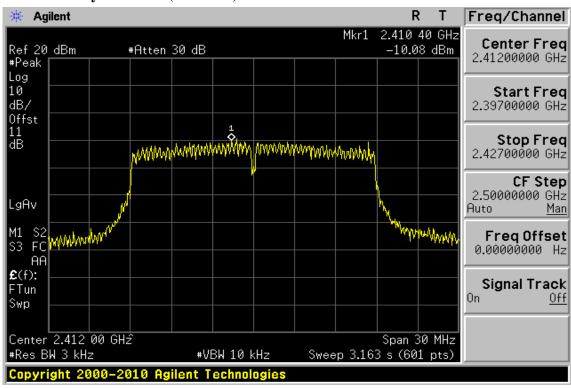
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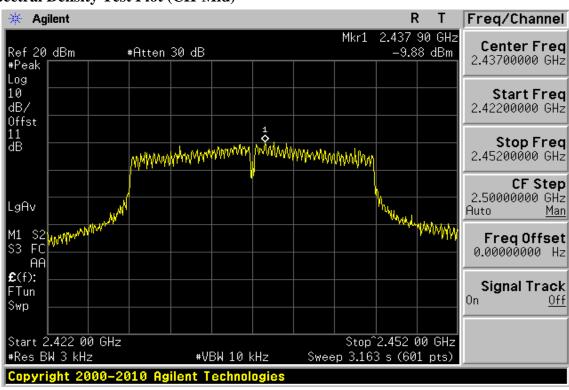
Page: 86 of 88

# 802.11n HT20

# **Power Spectral Density Test Plot (CH-Low)**



# **Power Spectral Density Test Plot (CH-Mid)**



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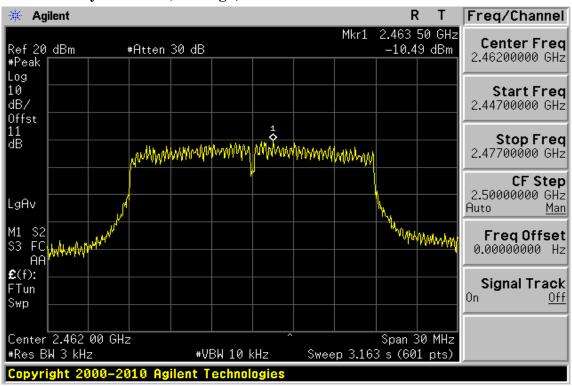
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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 87 of 88

## **Power Spectral Density Test Plot (CH-High)**



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Report No.: ER/2015/60002 Issue Date: Jun. 26, 2015

Page: 88 of 88

# 13 ANTENNA REQUIREMENT

# 13.1 Standard Applicable

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

In case of point-to-point operation, the power shall be reduced by the one dB for every 3 dB that the directional gain of antenna exceeds 6dBi.

## 13.2 Antenna Connected Construction

An embedded-in antenna design is used.

The antenna connector is designed with unique type RF connector and no consideration of replacement. Please see EUT photo and antenna spec. for details.

The antenna gain is less than 6dBi. Therefore, it is not necessary to reduce maximum output power limit.

~ End of Report ~

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only

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