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# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

# INTENTIONAL RADIATOR CERTIFICATION TO **FCC PART 15 SUBPART C REQUIREMENT**

OF

**Product Name: Smart Phone** 

**Brand Name:** Nokia

Model No.: TA-1029

**Model Difference:** N/A

FCC ID: **2AJOTTA-1029** 

**Report No.:** ER/2017/60105

Jul. 17, 2017 Issue Date:

**FCC Rule Part:** §15.247, Cat: DTS

**HMD Global Oy** 

**Prepared for:** Karaportti 2, 02610 Espoo, Finland

SGS Taiwan Ltd.

**Electronics & Communication Laboratory** 

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

Park, Wuku District, New Taipei City, Taiwan

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## VERIFICATION OF COMPLIANCE

HMD Global Oy **Applicant:** 

Karaportti 2, 02610 Espoo, Finland

**Product Name: Smart Phone** 

**Brand Name:** Nokia

Model No.: TA-1029

**Model Difference:** N/A

FCC ID: 2AJOTTA-1029 **File Number:** ER/2017/60105

Date of Test: Jun. 24, 2017 ~ Jul. 07, 2017

Date of EUT Received: Jun. 24, 2017

## 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 C63.10:2013 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:	(on Li	Date:	Jul. 17, 2017
Prepared By:	Tin Lin / Engineer Karen Huang	Date:	Jul. 17, 2017
Approved By:	Karen Huang / Clerk  Jim Chang / Asst. Manager	Date:	Jul. 17, 2017

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# **Revision History**

Report Number	Revision	Description	Issue Date
ER/2017/60105	Rev.00	Initial creation of document	Jul. 17, 2017

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### **GENERAL INFORMATION**

## 1.1 Product description

#### General:

Product Name:	Smart Phone		
Brand Name:	Nokia		
Model No.:	TA-1029		
Model Difference:	N/A		
Hardware Version:	860		
Software Version:	V0.140		
USB Cable:	Model No.: CUBB01M-FA010-DH, Supplier: Nokia		
Headset:	Model No.: WH-108, Supplier: Nokia		
	3.85Vdc from Rechargeable Li-ion Polymer Battery or 5V from AC/DC Adapter		
Power Supply:	Battery:	Model No.: HE338, Supplier: Nokia	
	Adapter: Model No.: FC0102, Supplier: Nokia		

# WLAN 2.4GHz:

Wi-Fi	Frequency Range	Channels	Rated Power	Modulation Technology		
11b/g	2412-2462	11	b: 19.85dBm g: 21.34dBm	DSSS, OFDM		
11n	HT20 2412-2462	11	20.58dBm	OFDM		
Antenna Designation:		PIFA Antenna, Gain: -1.84dBi				
Modulation type:		CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM				
Transition Rate:		802.11 g: 6	802.11 b: 1/2/5.5/11 Mbps 802.11 g: 6/9/12/18/24/36/48/54 Mbps 802.11 n_20MHz: 6.5 – 65Mbps			

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## 1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 DTS Meas. Guidance

ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards.

### 1.3 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803

(TAF code 0513)

FCC Registration Numbers are: 509634

### 1.4 Special Accessories

There are no special accessories used while test was conducted.

### 1.5 Equipment Modifications

There was no modification incorporated into the EUT.

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### 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 Quasi-Peak and Average detector mode is employed according to §15.207. 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 1.5 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 one orthogonal axe 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.

### 2.4 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) dB =11dB

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# 2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission Configuration

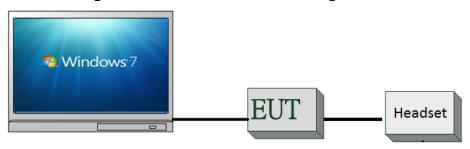


Fig. 2-2 AC Power Line Conducted Emission Configuration

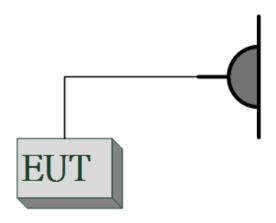


Fig. 2-3 Conducted Emission Configuration

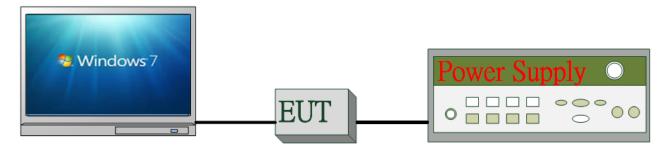


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	WLAN Test Software	N/A	N/A	N/A	N/A	N/A
2.	DC Power Supply	Agilent	E3640A	KR93300208	N/A	Un-shield
3.	Notebook	Lenovo	L420	LR-7HXZA	N/A	Un-shield
4.	Headset	Nokia	WH-108	N/A	N/A	N/A

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### **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 Emission 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

### **DESCRIPTION OF TEST MODES**

### 4.1 Operated in 2400 ~ 2483.5MHz Band

11 channels are provided for 802.11b, 802.11g and 802.11n\_HT20

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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### 4.2 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 programmed.
- 3. Investigation has been done on all the possible configurations for searching the worst case.

#### **RADIATED EMISSION TEST:**

IN ADIATION CONTRACTOR	RADIATED EMILOGION TEOT.					
	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 TEST (ABOVE 1 GHz)					
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	MCS 0	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

AITI EITITA I OITI I	MILINIA I OKI OONDOOTED MEAOOKEMENT.				
		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	MCS 0	MAIN

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### **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:

	9kHz-30MHz: +/-2.87dB
	30MHz - 180MHz: +/- 3.37dB
Measurement uncertainty	180MHz -417MHz: +/- 3.19dB
(Polarization : Vertical)	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

	9kHz-30MHz: +/-2.87dB
	30MHz - 167MHz: +/- 4.22dB
Measurement uncertainty	167MHz -500MHz: +/- 3.44dB
(Polarization : Horizontal)	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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### **CONDUCTED EMISSION TEST**

### 6.1 Standard Applicable

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range	Limits 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.

## 6.2 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	05/11/2017	05/10/2018		
LISN	SCHWARZBECK	NSLK 8127	8127-649	05/22/2017	05/21/2018		
LISN	MESS TEC	FCC-LISN-50/250- 25-2-01	4034	03/19/2017	03/18/2018		
Coaxial Cables	N/A	WK CE Cable	N/A	11/26/2016	11/25/2017		

### 6.3 EUT Setup

- 1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
- 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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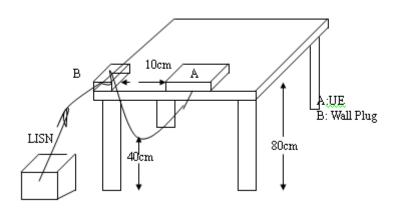
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## 6.4 Test SET-UP (Block Diagram of Configuration)



### **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

#### 6.6 Measurement Result

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

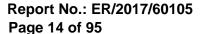
Note2: The \* reveals the worst-case results that closet to the limit.

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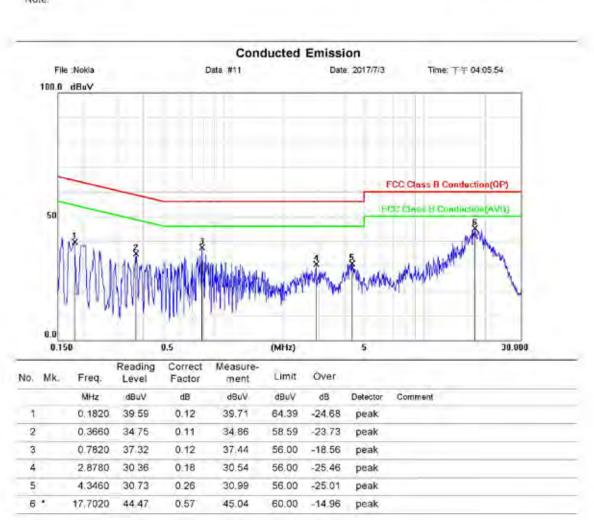




AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode		Test Date:	Jul. 03, 2017	
Temperature:	20	Humidity:	58 %	Test By:	Tin
				Phase:	L1 / N

20 ℃ Temperature: Site Conduction Room Phase: 11 Limit: FCC Class B Conduction(QP) Power AC 120V/60Hz Humidity: Mode: Operation mode Note:



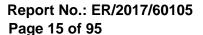
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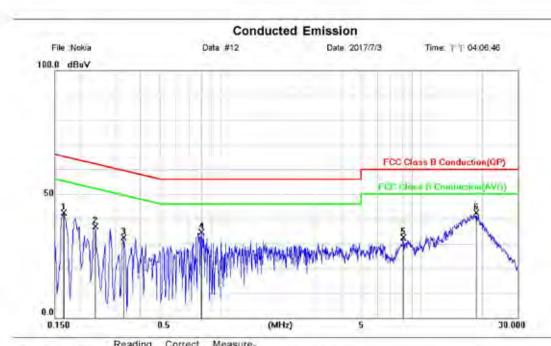
Site Conduction Room Limit FCC Class B Conduction(QP)

Mode: Operation mode

Phase: Power AC 120V/60Hz

20 T Temperature

Humidity:



No.	Mk.	Freq	Level	Factor	ment	Limit	Over			
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment	
1		0.1660	42.29	0.07	42.36	65.16	-22.80	peak		
2		0.2380	36.91	0.07	36.98	62.17	-25.19	peak		
3		0.3300	32.35	0.08	32.43	59.45	-27.02	peak		
4		0.8020	34.60	0.09	34.69	56.00	-21.31	peak		
5		8.0900	31.99	0.31	32.30	60.00	-27.70	peak		
6	•	18.5620	42.01	0.48	42.49	60.00	-17.51	peak		

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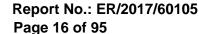
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**DUTY CYCLE OF TEST SIGNAL** 

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:**

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

### **Duty Cycle:**

	Duty Cycle (%)	Duty Factor (dB)
802.11b	97.74	0.10
802.11g	87.24	0.59
802.11n_20	86.64	0.62

b = 97.74%, g = 87.24%, $n_ht_20 = 86.64\%$ 

Duty Cycle Factor:  $10 * \log(1/0.9774) = 0.1$ Duty Cycle Factor: 10 \* log(1/0.8724) = 0.59Duty Cycle Factor:  $10 * \log(1/0.8664) = 0.62$ 

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# 7.1 DUTY CYCLE TEST SIGNAL Measurement Result 802.11 b



### 802.11 g



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### 802.11 n\_20 MHz



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### 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.

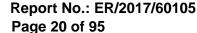
## 8.2 Measurement Equipment Used

	SGS Conducted Room							
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.			
TYPE		NUMBER	NUMBER	CAL.				
Power Meter	Anritsu	ML2495A	1005007	12/15/2016	12/14/2017			
Power Sensor	Anritsu	MA2411B	917032	12/15/2016	12/14/2017			
EXA Spectrum	A a:: La .a.t	NICOCOA	NAVE2420700	00/04/0047	00/00/0040			
Analyzer	Agilent	N9030A	MY53120760	03/21/2017	03/20/2018			
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2017	01/04/2018			
Coaxial Cable	HUBER+SUHNER	SUCOFLEX 102	23670/2	01/05/2017	01/04/2018			
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018			
Splitter	Agilent	11636B	N/A	01/05/2017	01/04/2018			
DC Power Supply	Agilent	E3640A	MY52410006	11/21/2016	11/20/2017			
Temperature	TERCHY	MHG-120LF	911009	05/19/2017	05/18/2018			
Chamber	TEROITI	WII IO-120LI	311009	03/13/2017	03/10/2010			

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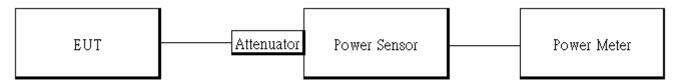
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## 8.3 Test Set-up

**Power Meter:** 



#### 8.4 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. Guid-
- 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:**

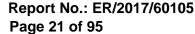
It is used as the auxiliary test equipment to conduct the output power measurement.

4. Record the max. Reading as observed from Spectrum or Power Meter.

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8.5 Measurement Result

802.	11b Ma	in					
СН	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Peak Output Power (mW)	Limit	RESULT	
1	2412	1	19.85	96.61	1 Watt = 30.00 dBm	PASS	
6	2437	1	19.82	95.94	1 Watt = 30.00 dBm	PASS	
11	2462	1	19.74	94.19	1 Watt = $30.00 \text{ dBm}$	PASS	
802.	802.11b Main						
СН	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)	Avg. Output Power (mW)	Limit	RESULT	
1	2412	1	17.23	52.84	1 Watt = 30.00 dBm	PASS	
6	2437	1	17.15	51.88	1 Watt = 30.00 dBm	PASS	
11	2462	1	17.11	51.40	1 Watt = 30.00 dBm	PASS	

802.	02.11g Main						
СН	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Peak Output Power (mW)	Limit	RESULT	
1	2412	6	21.02	126.47	1 Watt = 30.00 dBm	PASS	
6	2437	6	21.34	136.14	1 Watt = 30.00 dBm	PASS	
11	2462	6	21.25	133.35	1 Watt = 30.00 dBm	PASS	
802.	302.11g Main						
СН	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)	Avg. Output Power (mW)	Limit	RESULT	
1	2412	6	12.32	17.06	1 Watt = 30.00 dBm	PASS	
6	2437	6	12.36	17.22	1 Watt = 30.00 dBm	PASS	
11	2462	6	12.1	16.22	1 Watt = 30.00 dBm	PASS	

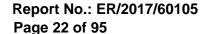
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**PASS** 

**PASS** 

**PASS** 



1

6

11

2412

2437

2462

MCS0

MCS<sub>0</sub>

MCS<sub>0</sub>

10.28

10.35

10.25

802.11n\_HT20M Main **Peak Output Peak Output** Freq. **Data** CH **Power** Power Limit **RESULT** (MHz) Rate (dBm) (mW) MCS<sub>0</sub> 114.29 1 Watt = 1 2412 20.58 30.00 dBm **PASS** 6 2437 MCS0 20.11 102.57 1 Watt = 30.00 dBm **PASS** 2462 MCS0 97.72 11 19.9 1 Watt = 30.00 dBm **PASS** 802.11n HT20M Main Avg. Output Avg. Output Data Freq. CH **Power** Power Limit **RESULT** (MHz) Rate (dBm) (mW)

10.67

10.84

10.59

1 Watt =

1 Watt =

1 Watt =

30.00

30.00

30.00

dBm

dBm

dBm

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



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### **6DB BANDWIDTH MEASUREMENT**

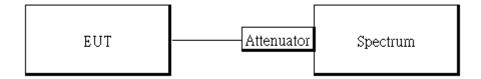
### 9.1 Standard Applicable

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

## 9.2 Measurement Equipment Used

	SGS Conducted Room							
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.			
TYPE		NUMBER	NUMBER	CAL.				
Power Meter	Anritsu	ML2495A	1005007	12/15/2016	12/14/2017			
Power Sensor	Anritsu	MA2411B	917032	12/15/2016	12/14/2017			
EXA Spectrum	A 11	Nacca	I I) (50 400 700	00/04/0047	00/00/0040			
Analyzer	Agilent	N9030A	MY53120760	03/21/2017	03/20/2018			
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2017	01/04/2018			
Coaxial Cable	HUBER+SUHNER	SUCOFLEX 102	23670/2	01/05/2017	01/04/2018			
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018			
Splitter	Agilent	11636B	N/A	01/05/2017	01/04/2018			
DC Power Supply	Agilent	E3640A	MY52410006	11/21/2016	11/20/2017			
Temperature	TERCHY	MHG-120LF	911009	05/19/2017	05/18/2018			
Chamber	ILIXOITI	WII IO-120LI	311003	00/10/2017	00/10/2010			

#### 9.3 Test Set-up



#### 9.4 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.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- For 6dB Bandwidth:
  - Set the spectrum analyzer as RBW = 100 kHz, VBW = 3\*RBW, Span = 30M/50MHz, Detector=peak, Sweep=auto.
- 5. Mark the peak frequency and –6dB (upper and lower) frequency.
- 6. Repeat above procedures until all frequency of interest measured was complete.

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# 9.5 Measurement Result 6dB Bandwidth

#### 802.11b Main

Freq.	6dB BW	Limit	Result
(MHz)	(kHz)	(kHz)	ixesuit
2412	8582	> 500	PASS
2437	8576	> 500	PASS
2462	8096	> 500	PASS

### 802.11g Main

Freq.	6dB BW	Limit	Result
(MHz)	(kHz)	(kHz)	Result
2412	16400	> 500	PASS
2437	16390	> 500	PASS
2462	16420	> 500	PASS

### 802.11 n HT20 Main

Freq.	6dB BW	Limit	Result	
(MHz)	(kHz)	(kHz)		
2412	17610	> 500	PASS	
2437	17590	> 500	PASS	
2462	17630	> 500	PASS	

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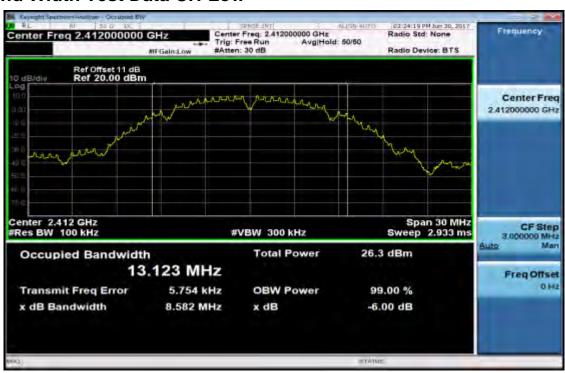
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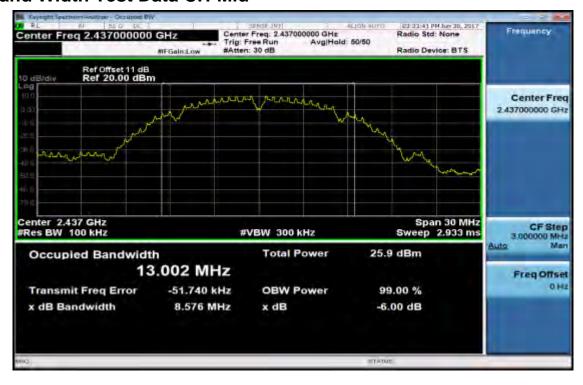
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# 802.11b (Main) 6dB Band Width Test Data CH-Low



### 6dB Band Width Test Data CH-Mid

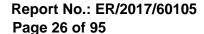


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# 6dB Band Width Test Data CH-High



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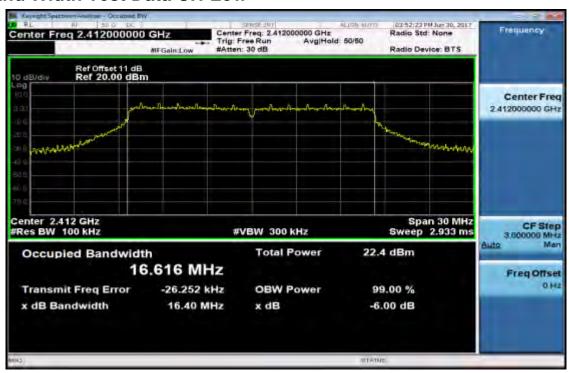
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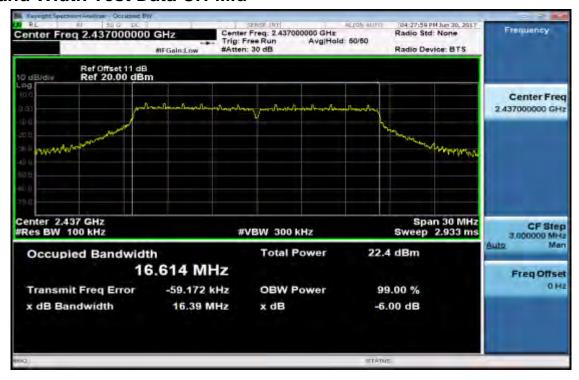
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# 802.11g (Main) 6dB Band Width Test Data CH-Low



## 6dB Band Width Test Data CH-Mid



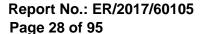
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# 6dB Band Width Test Data CH-High



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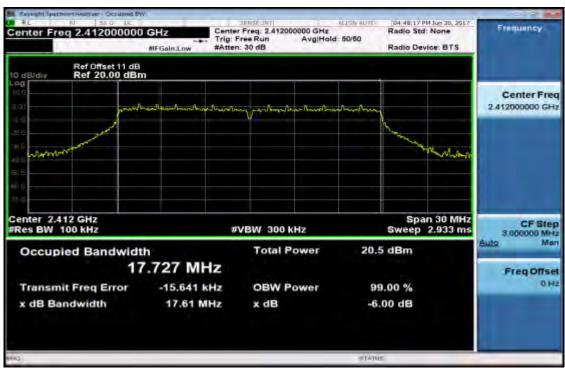
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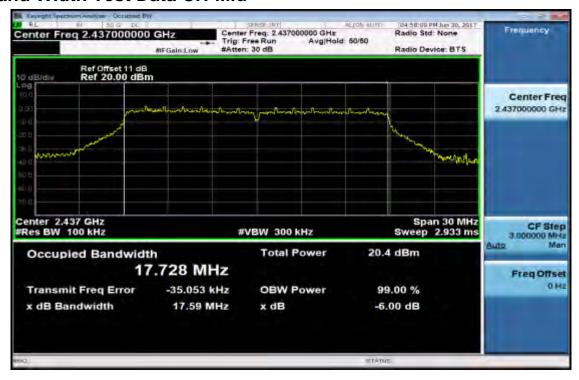
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# 802.11n\_20M (Main) 6dB Band Width Test Data CH-Low



## 6dB Band Width Test Data CH-Mid



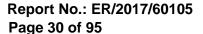
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# 6dB Band Width Test Data CH-High



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### 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).

If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB.

10.2 Measurement Equipment Used

SGS Conducted Room								
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.			
TYPE		NUMBER	NUMBER	CAL.				
Power Meter	Anritsu	ML2495A	1005007	12/15/2016	12/14/2017			
Power Sensor	Anritsu	MA2411B	917032	12/15/2016	12/14/2017			
EXA Spectrum	A '1 4	N9030A	MY53120760	03/21/2017	03/20/2018			
Analyzer	Agilent							
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2017	01/04/2018			
Coaxial Cable	HUBER+SUHNER	SUCOFLEX 102	23670/2	01/05/2017	01/04/2018			
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018			
Splitter	Agilent	11636B	N/A	01/05/2017	01/04/2018			
DC Power Supply	Agilent	E3640A	MY52410006	11/21/2016	11/20/2017			
Temperature	TERCHY	MHG-120LF	911009	05/19/2017	05/40/0040			
Chamber					05/18/2018			

#### 10.3 Test SET-UP



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### 10.4 Measurement Procedure

### **Conducted Band Edge:**

- To connect Antenna Port of EUT to Spectrum.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 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=100 kHz, VBW=300 kHz, 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:**

- To connect Antenna Port of EUT to Spectrum
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 3. Set RBW = 100 kHz & VBW= 300 kHz, 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.

#### 10.5 Measurement Result

- Refer to next page spectrum analyzer data chart and tabular data sheets.
- 2. For restricted Band Edge Limit, please refer to section 12.5 of this report for measurement result.

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



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



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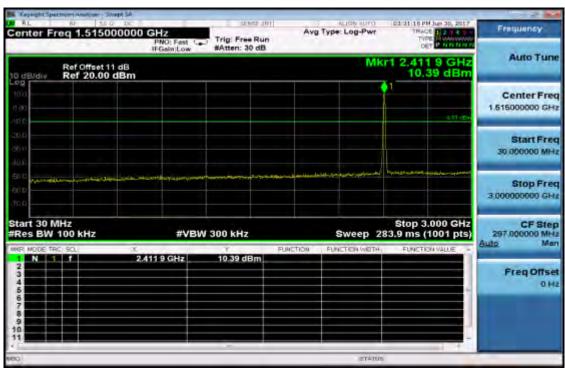
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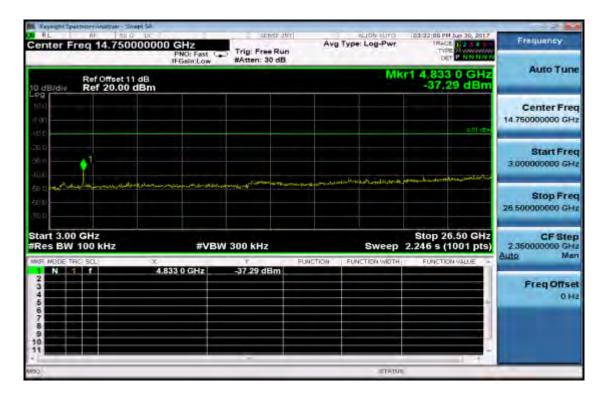
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### 802.11b

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





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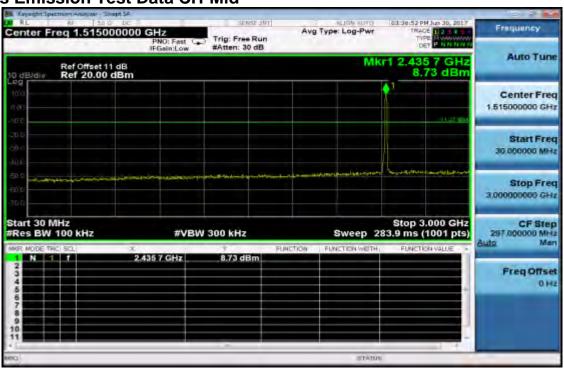
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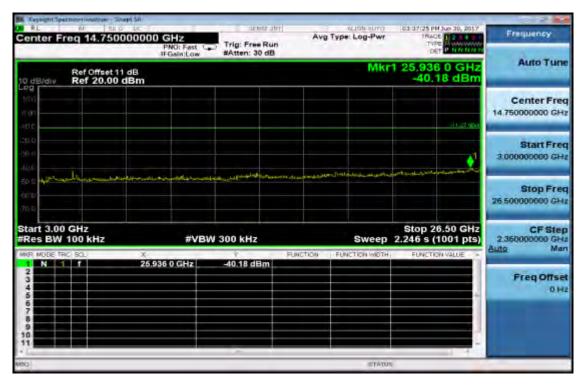
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**Spurious Emission Test Data CH-Mid** 





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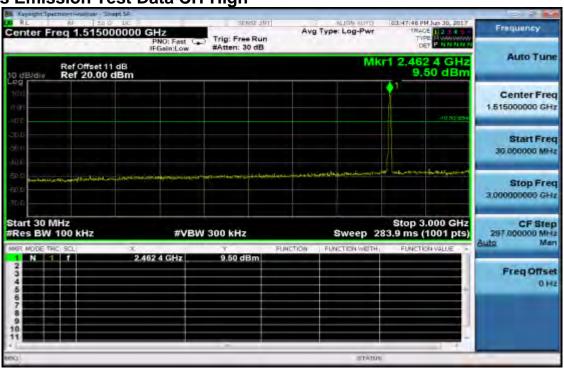
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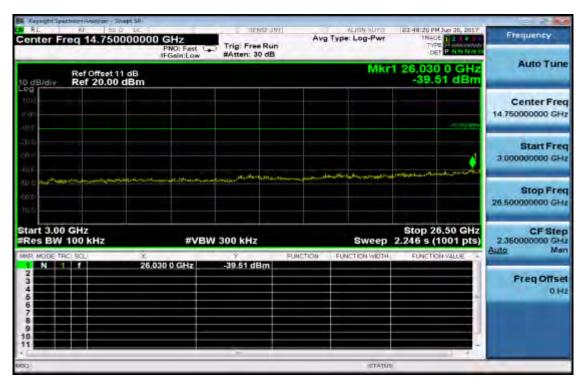
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Spurious Emission Test Data CH-High





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



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



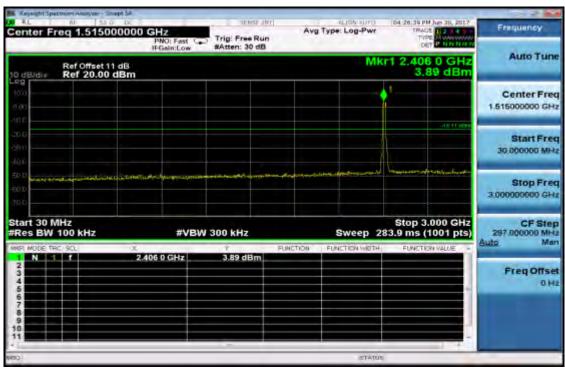
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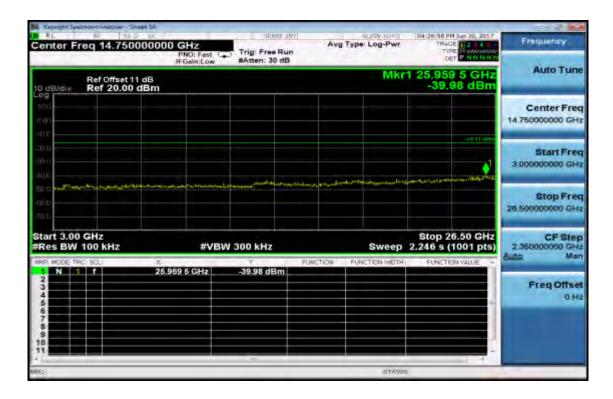
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## 802.11g

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





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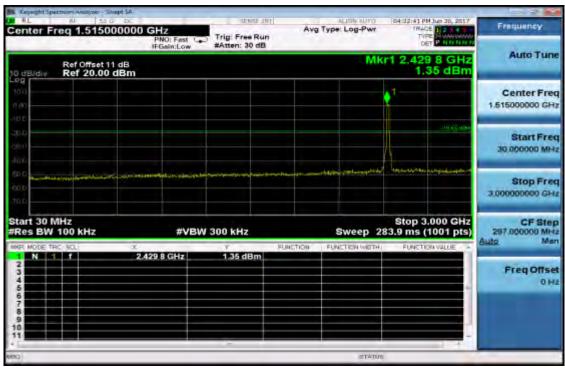
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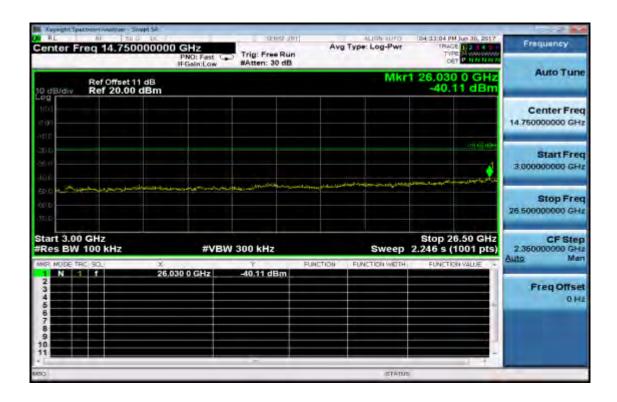
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## **Spurious Emission Test Data CH-Mid**





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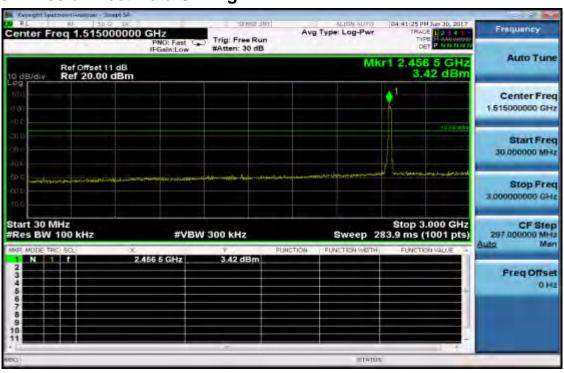
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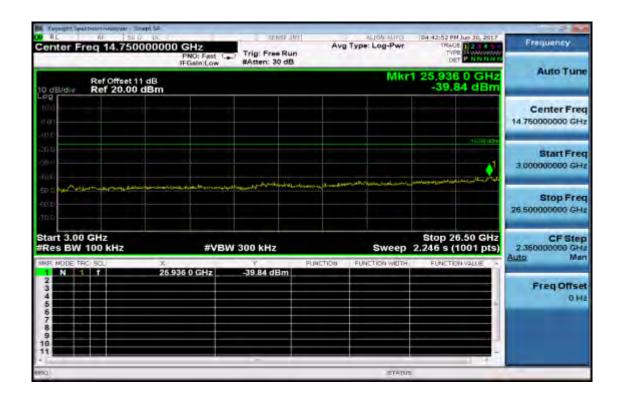
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# **Spurious Emission Test Data CH-High**





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# 802.11n\_HT20 **Band Edges Test Data CH-Low**



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



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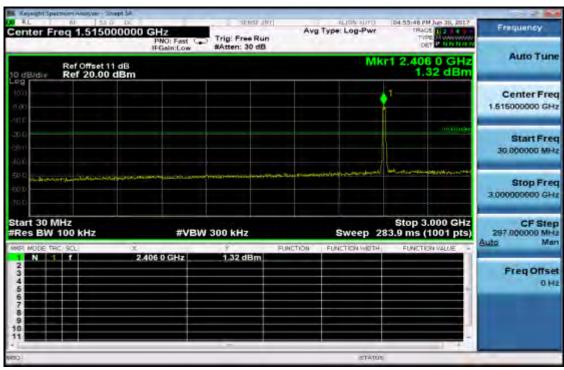
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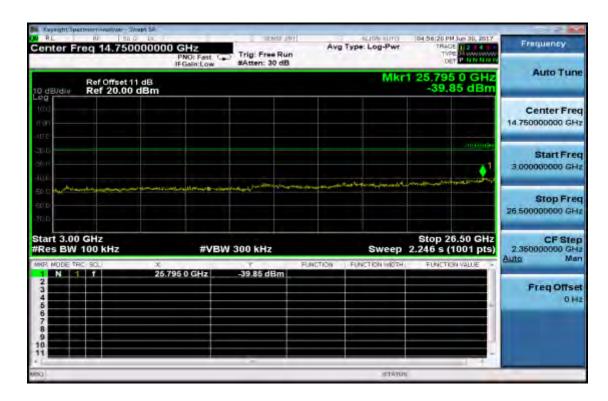
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## 802.11n HT20

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



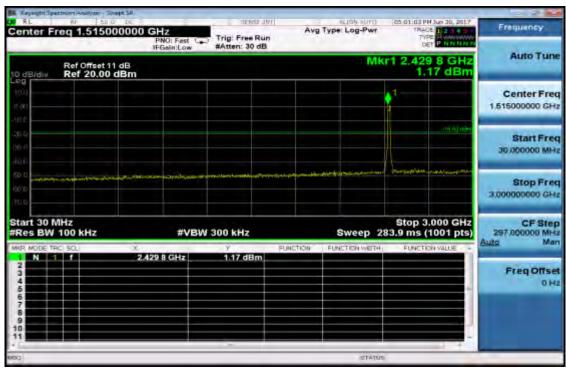


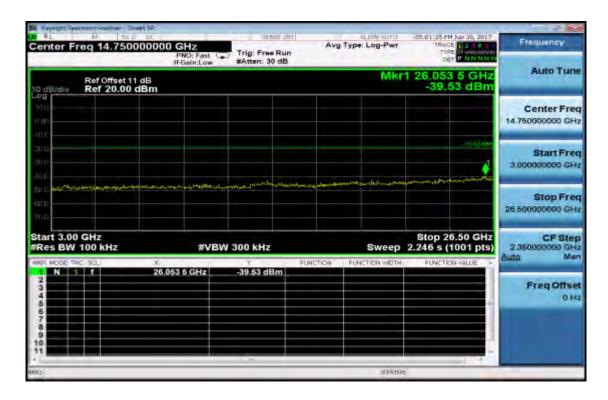
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### **Spurious Emission Test Data CH-Mid**





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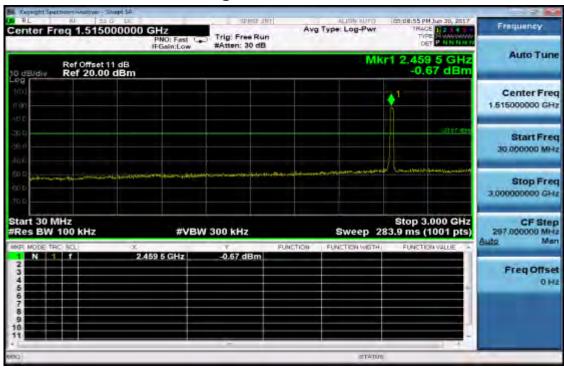
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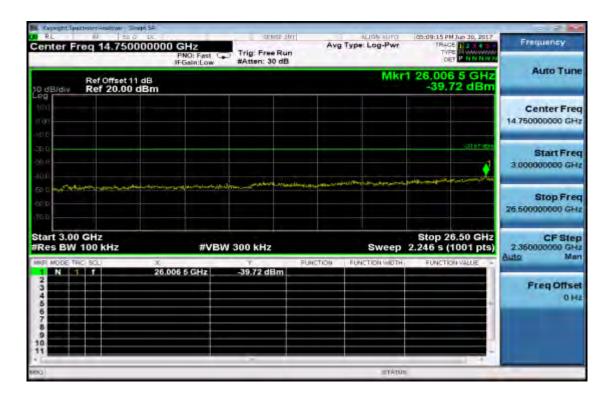
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# **Spurious Emission Test Data CH-High**





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#### 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.
- Emission level (dBµV/m) = 20 log Emission level (dBµV/m)

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## 11.2 Measurement Equipment Used:

	SGS SAC-III										
Name of	Manufacturer	Model	Serial Num-	Calibra-	Calibra-						
Equipment			ber	tion Date	tion Due						
EMI Test Receiver	R&S	ESCI7	100760	05/11/2017	05/10/2018						
Spectrum Analyzer	Agilent	E4446A	MY51100003	04/25/2017	04/24/2018						
Loop Antenna	ETS-Lindgren	6502	148045	09/20/2016	09/19/2017						
Bilog Antenna	SCHWAZBECK	VULB9168	378	12/19/2016	12/18/2017						
Horn Antenna	Schwarzbeck	BBHA9120D	1441	08/01/2016	07/31/2017						
Pre-Amplifier	Agilent	8447D	2944A07676	01/05/2017	01/04/2018						
Pre-Amplifier	EMC Instruments	EMC0126530	980038	01/05/2017	01/04/2018						
	Corp.	211100120000		01/00/2017	01/01/2010						
Turn Table	HD	DT420	N/A	N.C.R	N.C.R						
Antenna Tower	ChamPro	AM-BS-4500-B	060776-ABS	N.C.R	N.C.R						
Controller	ChamPro	EM1000	60776	N.C.R	N.C.R						
Low Loss Cable	Huber Suhner	966_RX	9	01/05/2017	01/04/2018						
3m Site NSA	SGS	966 chamber	N/A	07/01/2016	06/30/2017						
Low Loss Cable	Huber Suhner	966 TX	1	01/05/2017	01/04/2018						
Horn Antenna	Schwarzbeck	BBHA9170	184	12/12/2016	12/11/2017						
Dro Amenlifian	EMC Instruments	EMC40404E	000425	04/05/2047	04/04/0040						
Pre-Amplifier	Corp.	EMC184045	980135	01/05/2017	01/04/2018						

Note: N.C.R refers to Not Calibrated Required.

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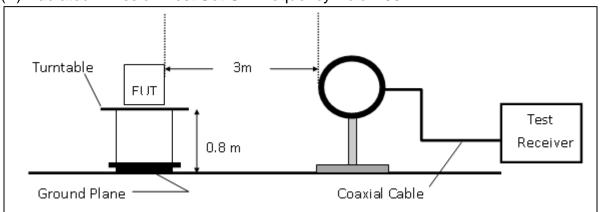
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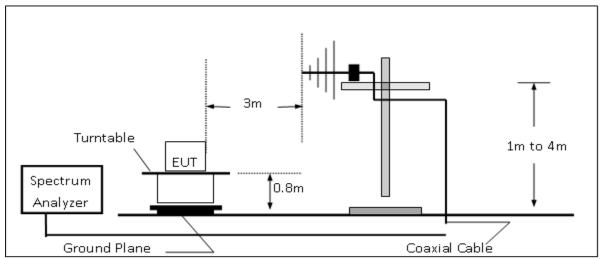
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#### 11.3 Test SET-UP

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



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



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz Turntable Зт 1m to 4m **EUT** Spectrum 1.5m Analyzer Ground Plane Absorber Coaxial Cable

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#### 11.4 Measurement Procedure

- The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 1.5m 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.
- 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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#### 11.5 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	S S	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.

#### 11.6 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.

#### 11.7 Measurement Result

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

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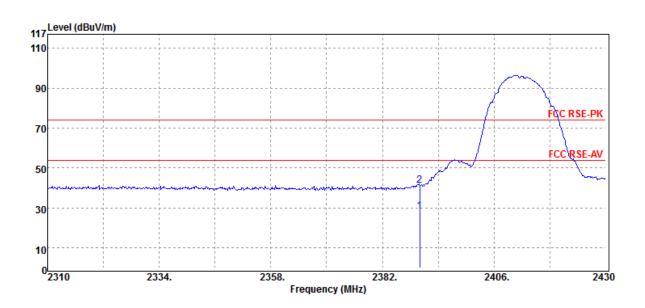
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### Radiated Band Edge Measurement Result (802.11b)

**Operation Band** :802.11b **Test Date** :2017-06-29

Fundamental Frequency :2412 MHz Temp./Humi. :21 deg\_C / 62 RH **Operation Mode** :Bandedge CH LOW Engineer :Mike

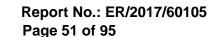
EUT Pol. :E2 Plane :VERTICAL Measurement Antenna Pol.



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
2390.00	E	Average	29.90	-1.74	28.16	54.00	-25.84
2390.00	Е	Peak	43.11	-1.74	41.37	74.00	-32.63

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:802.11b :2412 MHz

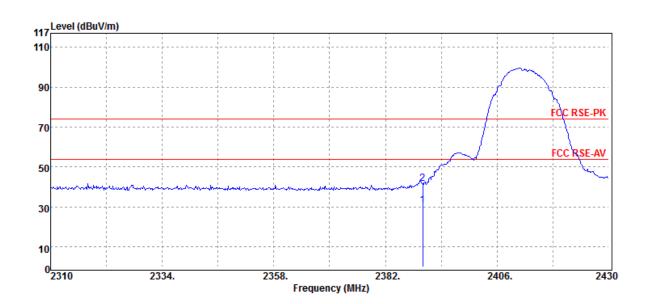
:Bandedge CH LOW

EUT Pol. :E2 Plane **Test Date** :2017-06-29

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

: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	
	2390.00	E	Average	32.32	-1.74	30.58	54.00	-23.42	
	2390.00	Е	Peak	43.43	-1.74	41.69	74.00	-32.31	

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**Operation Band** Fundamental Frequency **Operation Mode** 

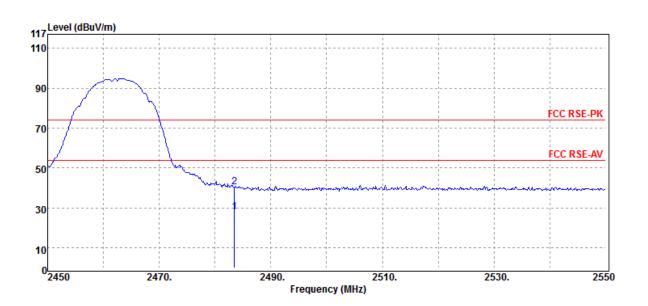
:802.11b :2462 MHz

:Bandedge CH HIGH

EUT Pol. :E2 Plane **Test Date** :2017-06-29

Temp./Humi. :21 deg\_C / 62 RH Engineer :Mike

: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	29.48	-1.62	27.86	54.00	-26.14
2483.50	Е	Peak	41.99	-1.62	40.37	74.00	-33.63

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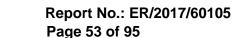
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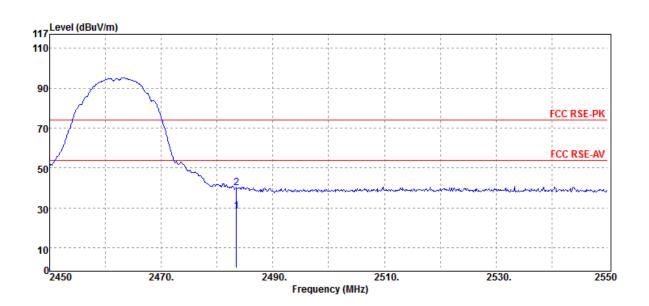
:802.11b :2462 MHz

:Bandedge CH HIGH

EUT Pol. :E2 Plane **Test Date** :2017-06-29 :21 deg\_C / 62 RH

Temp./Humi. Engineer :Mike

: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
	2483.50	E	Average	29.89	-1.62	28.27	54.00	-25.73
	2483.50	Е	Peak	41.78	-1.62	40.16	74.00	-33.84

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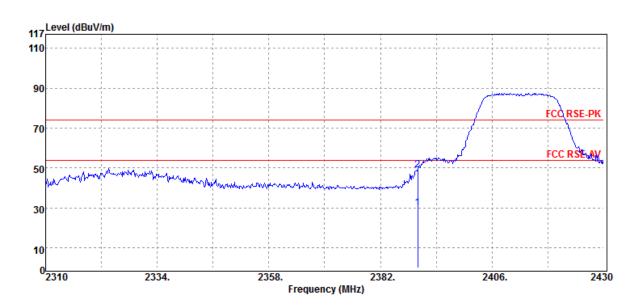
### Radiated Band Edge Measurement Result (802.11g)

**Operation Band** :802.11g Test Date :2017-06-29

Fundamental Frequency :2412 MHz Temp./Humi. :21 deg\_C / 62 RH

**Operation Mode** :Bandedge CH LOW Engineer :Mike

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



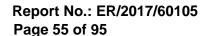
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
2390.00	E	Average	31.59	-1.74	29.85	54.00	-24.15
2390.00	Е	Peak	50.92	-1.74	49.18	74.00	-24.82
	MHz 2390.00	MHz F/H/E/S 2390.00 E	Mode           MHz         F/H/E/S         PK/QP/AV           2390.00         E         Average	Mode Reading Level  MHz F/H/E/S PK/QP/AV dBμV  2390.00 E Average 31.59	Mode         Reading Level           MHz         F/H/E/S         PK/QP/AV         dBμV         dB           2390.00         E         Average         31.59         -1.74	Mode         Reading Level         FS           MHz         F/H/E/S         PK/QP/AV         dBμV         dB         dBμV/m           2390.00         E         Average         31.59         -1.74         29.85	Mode         Reading Level         FS         @3m           MHz         F/H/E/S         PK/QP/AV         dBμV         dB         dBμV/m         dBμV/m           2390.00         E         Average         31.59         -1.74         29.85         54.00

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:802.11g :2412 MHz

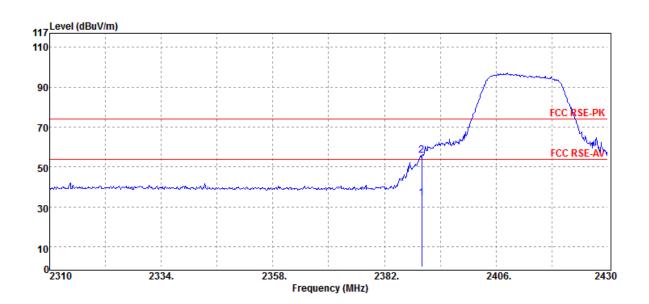
:Bandedge CH LOW

EUT Pol. :E2 Plane **Test Date** :2017-06-29

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

: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	
	2390.00	E	Average	36.12	-1.74	34.38	54.00	-19.62	
	2390.00	Е	Peak	57.46	-1.74	55.72	74.00	-18.28	

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**Operation Band** Fundamental Frequency **Operation Mode** 

:802.11g :2462 MHz

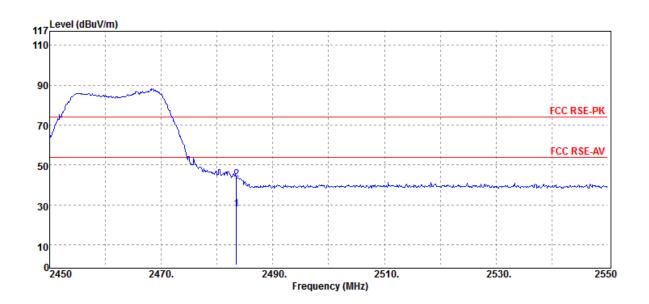
:Bandedge CH HIGH

EUT Pol. :E2 Plane **Test Date** :2017-06-29

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

: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	29.45	-1.62	27.83	54.00	-26.17
	2483.50	Е	Peak	44.69	-1.62	43.07	74.00	-30.93

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**Operation Band** Fundamental Frequency **Operation Mode** 

:802.11g :2462 MHz

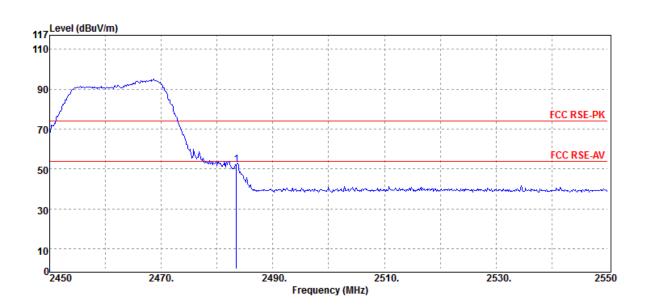
:Bandedge CH HIGH

EUT Pol. :E2 Plane **Test Date** :2017-06-29

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

: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
2483.50	Е	Average	33.67	-1.62	32.05	54.00	-21.95
2483.50	Е	Peak	53.67	-1.62	52.05	74.00	-21.95

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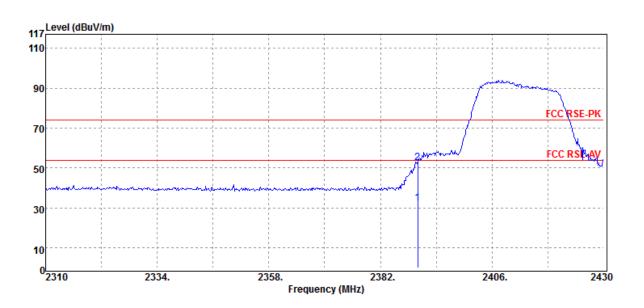
### Radiated Band Edge Measurement Result (802.11\_HT20)

**Operation Band** :802.11n20 **Test Date** :2017-06-29

Fundamental Frequency :2412 MHz Temp./Humi. :21 deg\_C / 62 RH

**Operation Mode** :Bandedge CH LOW Engineer :Mike

EUT Pol. :E2 Plane :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	dΒμV/m	dBμV/m	dB	
2390.00	E	Average	34.21	-1.74	32.47	54.00	-21.53	
2390.00	Е	Peak	54.22	-1.74	52.48	74.00	-21.52	

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**Operation Band** Fundamental Frequency **Operation Mode** 

:802.11n20 :2462 MHz

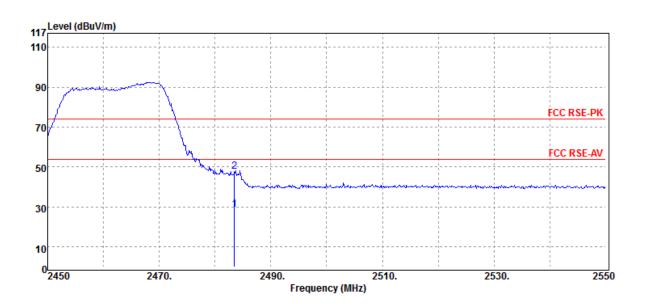
:Bandedge CH HIGH

EUT Pol. :E2 Plane **Test Date** :2017-06-29

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:VERTICAL Measurement Antenna Pol.



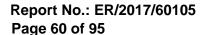
	Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
			Mode	Reading Level		FS	@3m	
_	MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
	2483.50	E	Average	30.18	-1.62	28.56	54.00	-25.44
	2483.50	Е	Peak	49.21	-1.62	47.59	74.00	-26.41

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:802.11n20 :2462 MHz

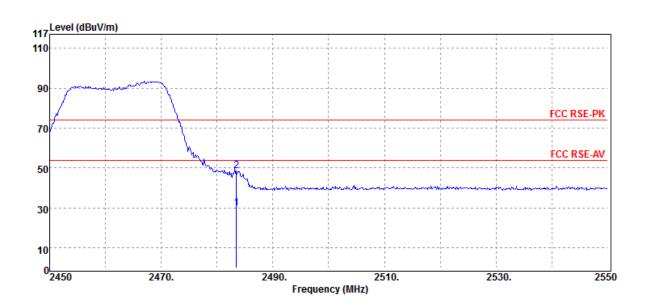
:Bandedge CH HIGH

EUT Pol. :E2 Plane **Test Date** :2017-06-29

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

: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
2483.50	E	Average	31.48	-1.62	29.86	54.00	-24.14
2483.50	Е	Peak	50.21	-1.62	48.59	74.00	-25.41

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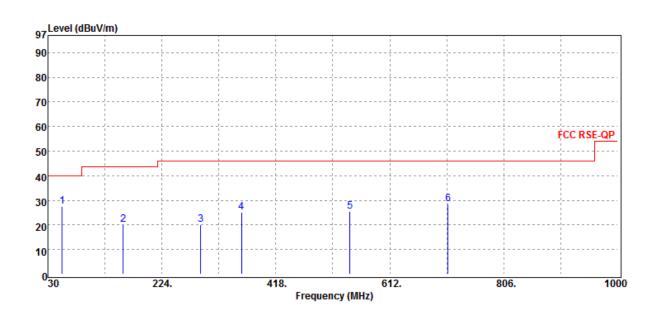
### **Below 1GHz Worst-Case Data:**

Radiated Spurious Emission Measurement Result (802.11 g)

Test Date **Operation Band** :802.11g :2017-06-30

Temp./Humi. **Fundamental Frequency** :2412 MHz :21 deg\_C / 62 RH **Operation Mode** :Tx CH LOW Engineer :Mike

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



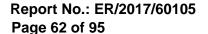
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
54.25	S	Peak	35.46	-7.82	27.64	40.00	-12.36
158.04	S	Peak	27.47	-7.45	20.02	43.50	-23.48
289.96	S	Peak	26.22	-6.07	20.15	46.00	-25.85
359.80	S	Peak	30.00	-4.79	25.21	46.00	-20.79
544.10	S	Peak	27.18	-1.59	25.59	46.00	-20.41
710.94	S	Peak	27.31	1.33	28.64	46.00	-17.36

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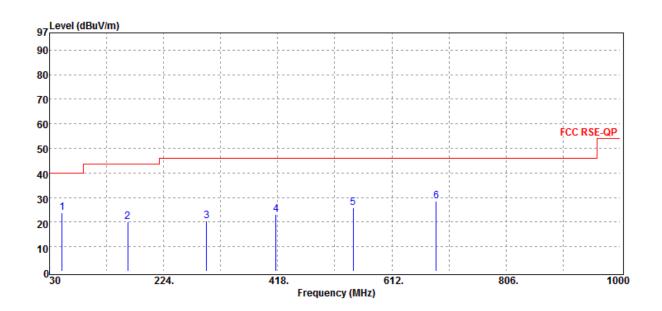
**Operation Band** :802.11g **Fundamental Frequency** :2412 MHz **Operation Mode** :Tx CH LOW

EUT Pol. :E2 Plane **Test Date** :2017-06-30

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



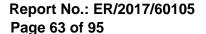
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
51.34	S	Peak	31.51	-7.75	23.76	40.00	-16.24
162.89	S	Peak	27.59	-7.48	20.11	43.50	-23.39
296.75	S	Peak	26.53	-5.98	20.55	46.00	-25.45
415.09	S	Peak	26.40	-3.21	23.19	46.00	-22.81
546.04	S	Peak	27.40	-1.55	25.85	46.00	-20.15
687.66	S	Peak	27.17	1.20	28.37	46.00	-17.63

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EUT Pol.

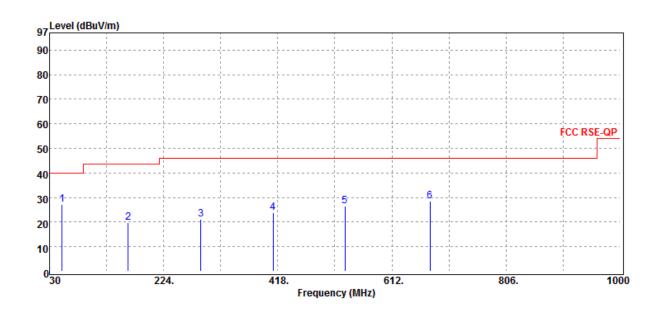
:802.11g :2437 MHz :Tx CH MID :E2 Plane

**Test Date** :2017-06-30

:21 deg\_C / 62 RH Temp./Humi.

Engineer :Mike

:VERTICAL Measurement Antenna Pol.



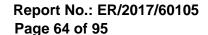
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
51.34	S	Peak	35.00	-7.75	27.25	40.00	-12.75
163.86	S	Peak	27.28	-7.45	19.83	43.50	-23.67
287.05	S	Peak	27.20	-6.19	21.01	46.00	-24.99
410.24	S	Peak	27.29	-3.62	23.67	46.00	-22.33
532.46	S	Peak	28.32	-1.68	26.64	46.00	-19.36
676.99	S	Peak	27.54	0.84	28.38	46.00	-17.62

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**Operation Band** :802.11g **Fundamental Frequency** :2437 MHz **Operation Mode** 

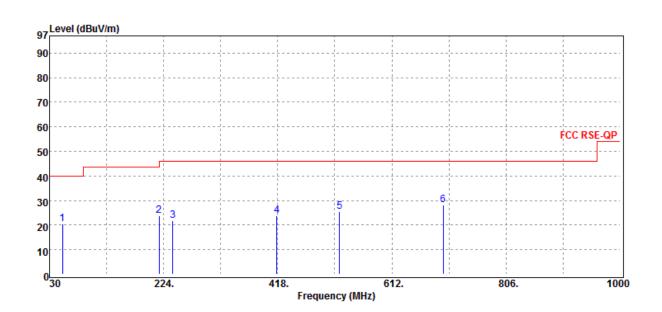
:Tx CH MID EUT Pol. :E2 Plane

**Test Date** :2017-06-30

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



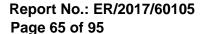
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
52.31	S	Peak	28.07	-7.76	20.31	40.00	-19.69
216.24	S	Peak	33.12	-9.43	23.69	46.00	-22.31
239.52	S	Peak	29.80	-8.12	21.68	46.00	-24.32
416.06	S	Peak	26.95	-3.27	23.68	46.00	-22.32
522.76	S	Peak	27.21	-1.66	25.55	46.00	-20.45
699.30	S	Peak	26.89	1.44	28.33	46.00	-17.67

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EUT Pol.

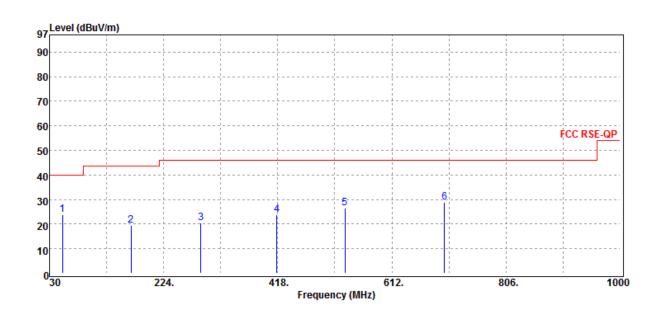
:802.11g :2462 MHz :Tx CH HIGH :E2 Plane

**Test Date** :2017-06-30

:21 deg\_C / 62 RH Temp./Humi.

Engineer :Mike :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
52.31	S	Peak	31.50	-7.76	23.74	40.00	-16.26
168.71	S	Peak	26.88	-7.52	19.36	43.50	-24.14
287.05	S	Peak	26.80	-6.19	20.61	46.00	-25.39
416.06	S	Peak	27.18	-3.27	23.91	46.00	-22.09
532.46	S	Peak	28.07	-1.68	26.39	46.00	-19.61
701.24	S	Peak	27.35	1.44	28.79	46.00	-17.21

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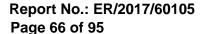
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EUT Pol.

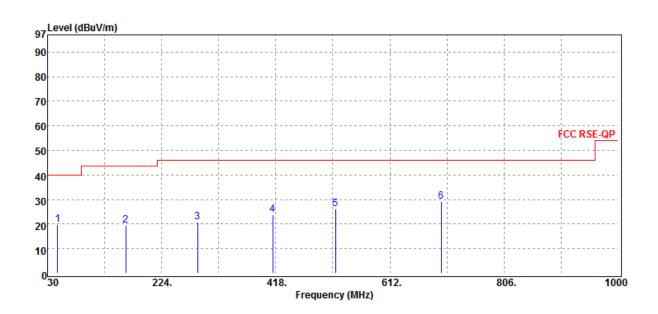
:802.11g :2462 MHz :Tx CH HIGH :E2 Plane

**Test Date** :2017-06-30

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

: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
47.46	S	Peak	27.62	-7.85	19.77	40.00	-20.23
162.89	S	Peak	26.79	-7.48	19.31	43.50	-24.19
285.11	S	Peak	26.89	-6.24	20.65	46.00	-25.35
413.15	S	Peak	27.27	-3.38	23.89	46.00	-22.11
519.85	S	Peak	27.89	-1.62	26.27	46.00	-19.73
699.30	S	Peak	27.89	1.44	29.33	46.00	-16.67

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#### **Above 1GHz Data:**

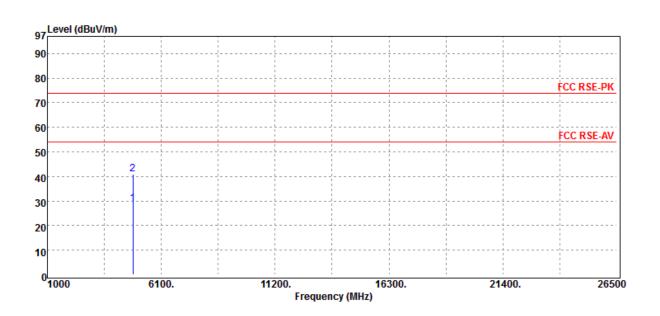
### Radiated Spurious Emission Measurement Result (802.11 b)

**Operation Band** :802.11b **Test Date** :2017-06-30

Fundamental Frequency :2412 MHz Temp./Humi. :21 deg\_C / 62 RH

**Operation Mode** :Tx CH LOW Engineer :Mike

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



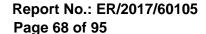
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4824.00	Н	Average	23.91	4.93	28.84	54.00	-25.16
4824.00	Н	Peak	35.96	4.93	40.89	74.00	-33.11

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EUT Pol.

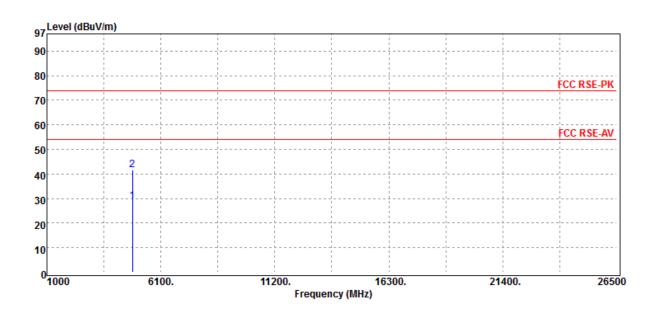
:802.11b :2412 MHz :Tx CH LOW :E2 Plane

**Test Date** :2017-06-30

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4824.00	Н	Average	23.96	4.93	28.89	54.00	-25.11
4824.00	Н	Peak	36.55	4.93	41.48	74.00	-32.52

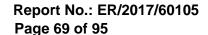
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EUT Pol.

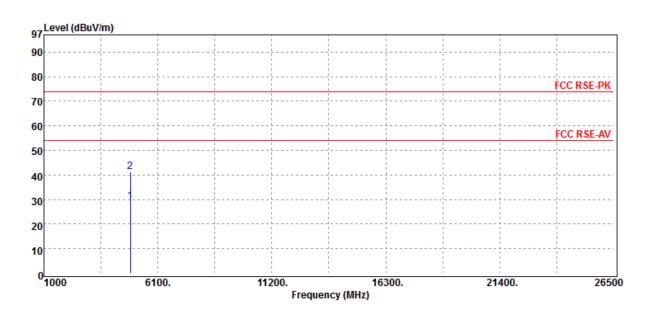
:802.11b :2437 MHz :Tx CH MID :E2 Plane

:2017-06-29 **Test Date** 

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4874.00	Н	Average	23.97	5.13	29.10	54.00	-24.90
4874.00	Н	Peak	36.00	5.13	41.13	74.00	-32.87

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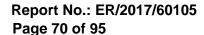
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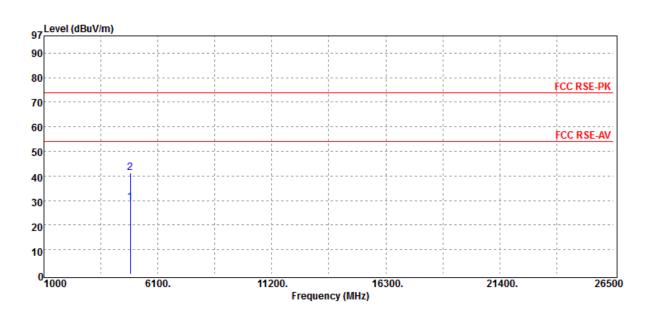


:802.11b :2437 MHz :Tx CH MID :E2 Plane

**Test Date** :2017-06-29 Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4874.00	Н	Average	24.02	5.13	29.15	54.00	-24.85
4874.00	Н	Peak	36.11	5.13	41.24	74.00	-32.76

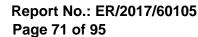
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**Operation Band** Fundamental Frequency

**Operation Mode** EUT Pol.

:802.11b :2462 MHz :Tx CH HIGH

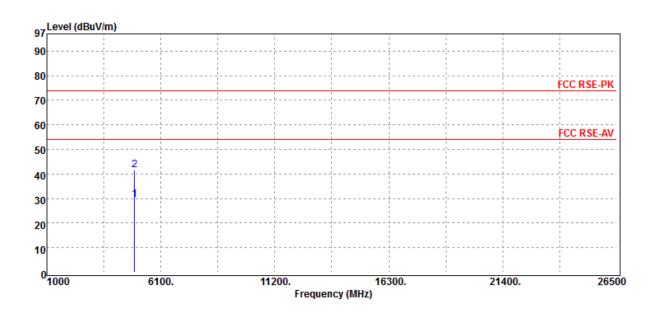
:E2 Plane

:2017-06-29 **Test Date** 

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:VERTICAL Measurement Antenna Pol.



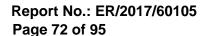
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4924.00	Н	Average	24.35	5.25	29.60	54.00	-24.40
4924.00	Н	Peak	36.46	5.25	41.71	74.00	-32.29

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EUT Pol.

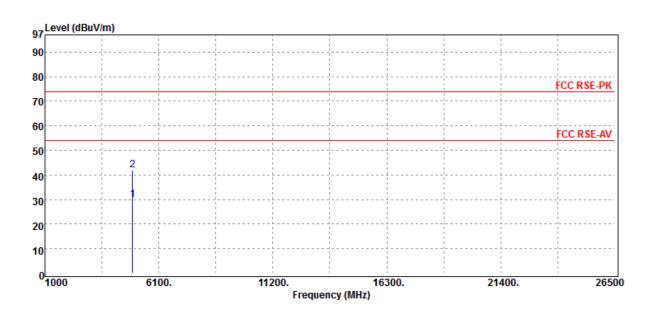
:802.11b :2462 MHz :Tx CH HIGH :E2 Plane

**Test Date** :2017-06-29

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4924.00	Н	Average	24.48	5.25	29.73	54.00	-24.27
4924.00	Н	Peak	36.72	5.25	41.97	74.00	-32.03

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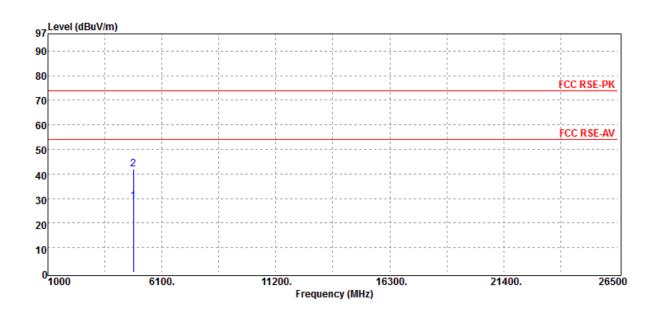
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## Radiated Spurious Emission Measurement Result (802.11 g)

Test Date **Operation Band** :2017-06-29 :802.11g Fundamental Frequency :2412 MHz Temp./Humi. :21 deg\_C / 62 RH

:Tx CH LOW **Operation Mode** Engineer :Mike

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



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4824.00	Н	Average	24.04	4.93	28.97	54.00	-25.03
4824.00	Н	Peak	36.96	4.93	41.89	74.00	-32.11

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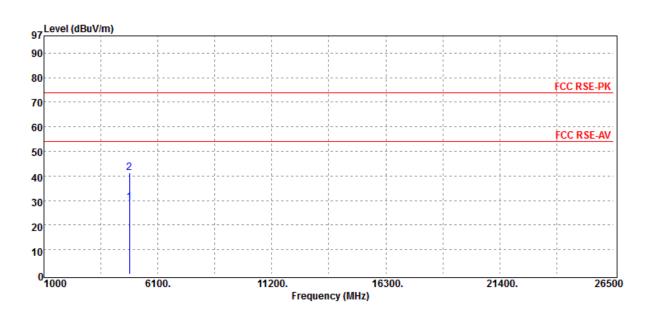
**Operation Band** Fundamental Frequency **Operation Mode** EUT Pol.

:802.11g :2412 MHz :Tx CH LOW :E2 Plane

**Test Date** :2017-06-29 Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe	
		Mode	Reading Level		FS	@3m	Margin	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB	
4824.00	Н	Average	24.12	4.93	29.05	54.00	-24.95	
4824.00	Н	Peak	36.36	4.93	41.29	74.00	-32.71	

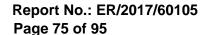
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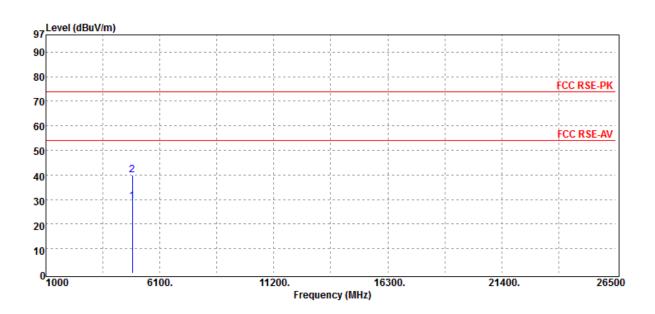
EUT Pol.

:802.11g :2437 MHz :Tx CH MID :E2 Plane

:2017-06-29 **Test Date** :21 deg\_C / 62 RH Temp./Humi.

Engineer :Mike

:VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4874.00	Н	Average	24.06	5.13	29.19	54.00	-24.81
4874.00	Н	Peak	34.93	5.13	40.06	74.00	-33.94

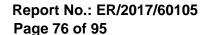
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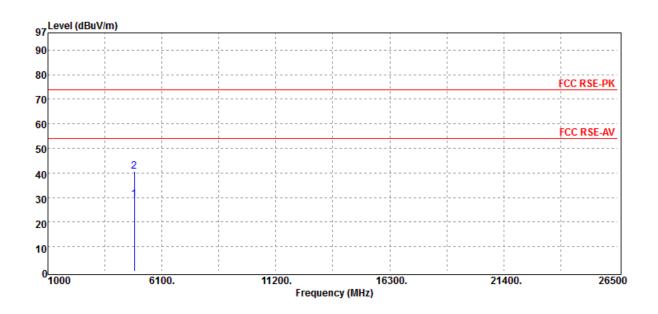


:802.11g :2437 MHz :Tx CH MID :E2 Plane

**Test Date** :2017-06-29 Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe	
		Mode	Reading Level		FS	@3m	Margin	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB	
4874.00	Н	Average	24.09	5.13	29.22	54.00	-24.78	
4874.00	Н	Peak	35.64	5.13	40.77	74.00	-33.23	

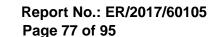
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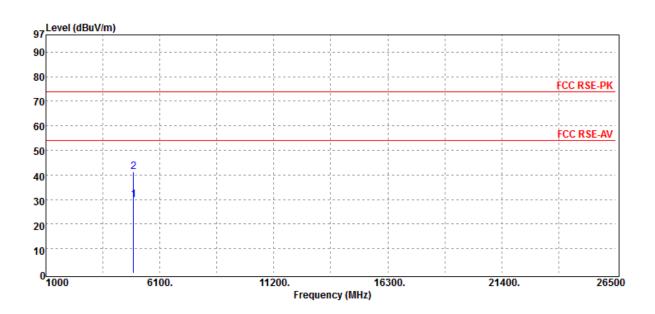
:802.11g :2462 MHz :Tx CH HIGH :E2 Plane

:2017-06-29 **Test Date** 

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4924.00	Н	Average	24.49	5.25	29.74	54.00	-24.26
4924.00	Н	Peak	36.04	5.25	41.29	74.00	-32.71

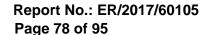
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EUT Pol.

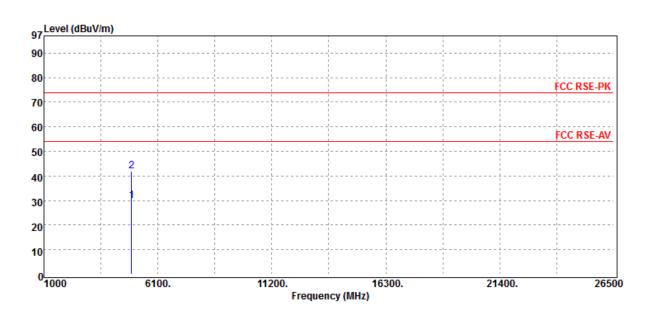
:802.11g :2462 MHz :Tx CH HIGH :E2 Plane

**Test Date** Temp./Humi. :2017-06-29

:21 deg\_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe	
		Mode	Reading Level		FS	@3m	Margin	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB	
4924.00	Н	Average	24.53	5.25	29.78	54.00	-24.22	
4924.00	Н	Peak	36.60	5.25	41.85	74.00	-32.15	

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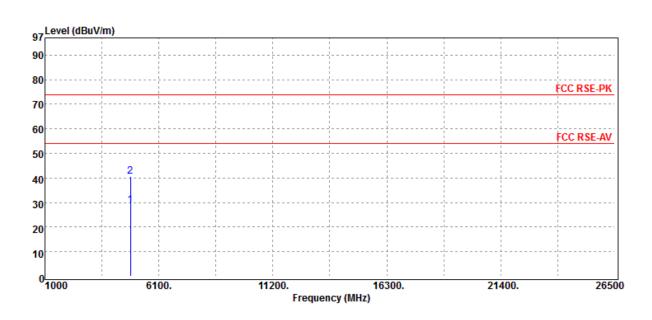
Page 79 of 95

### Radiated Spurious Emission Measurement Result (802.11\_HT20)

**Operation Band Test Date** :802.11n20 :2017-06-29 Fundamental Frequency :2412 MHz Temp./Humi. :21 deg\_C / 62 RH

:Tx CH LOW **Operation Mode** Engineer :Mike

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

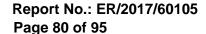


Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4824.00	Н	Average	24.07	4.93	29.00	54.00	-25.00
4824.00	Н	Peak	35.63	4.93	40.56	74.00	-33.44

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26500



**Operation Band** Fundamental Frequency **Operation Mode** 

0<mark>1000</mark>

EUT Pol.

:802.11n20 :2412 MHz :Tx CH LOW :E2 Plane

6100.

**Test Date** :2017-06-29 Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.

21400.



11200.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4824.00	Н	Average	24.16	4.93	29.09	54.00	-24.91
4824.00	Н	Peak	35.80	4.93	40.73	74.00	-33.27

Frequency (MHz)

16300.

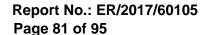
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EUT Pol.

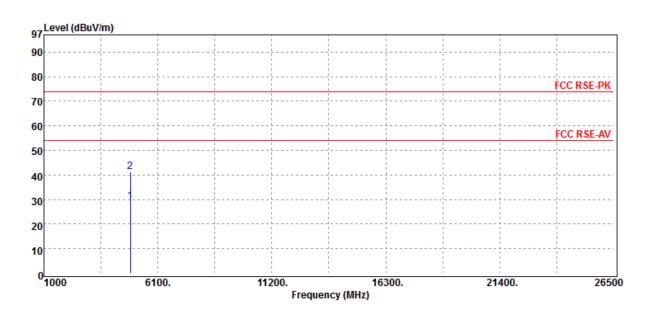
:802.11n20 :2437 MHz :Tx CH MID :E2 Plane

:2017-06-29 **Test Date** 

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe	
		Mode	Reading Level		FS	@3m	Margin	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB	
4874.00	Н	Average	24.19	5.13	29.32	54.00	-24.68	
4874.00	Н	Peak	36.21	5.13	41.34	74.00	-32.66	

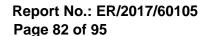
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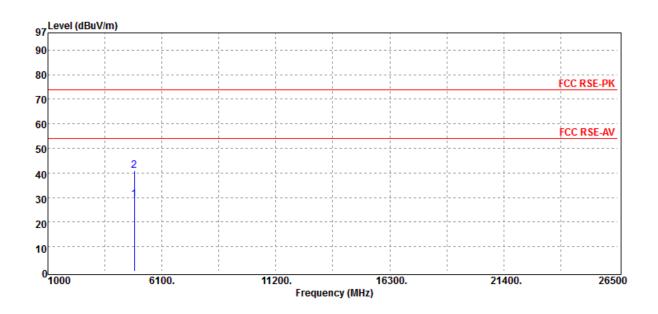


:802.11n20 :2437 MHz :Tx CH MID :E2 Plane

**Test Date** :2017-06-29 Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4874.00	Н	Average	24.21	5.13	29.34	54.00	-24.66
4874.00	Н	Peak	35.75	5.13	40.88	74.00	-33.12

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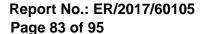
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:2462 MHz :Tx CH HIGH EUT Pol. :E2 Plane

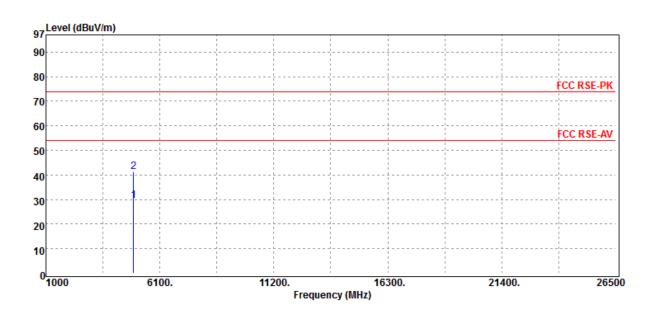
:802.11n20

:2017-06-29 **Test Date** 

Temp./Humi. :21 deg\_C / 62 RH

Engineer :Mike

:VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe	
		Mode	Reading Level		FS	@3m	Margin	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB	
4924.00	Н	Average	24.43	5.25	29.68	54.00	-24.32	
4924.00	Н	Peak	36.02	5.25	41.27	74.00	-32.73	

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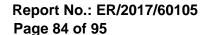
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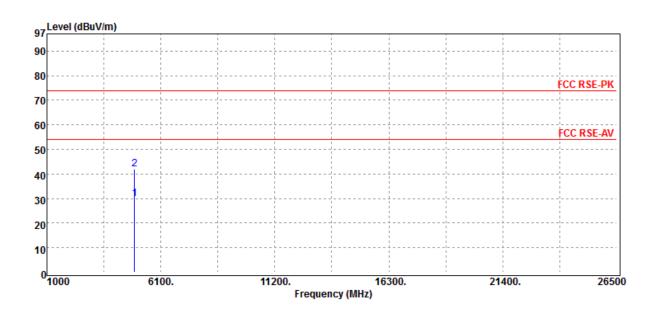
EUT Pol.

:802.11n20 :2462 MHz :Tx CH HIGH :E2 Plane

**Test Date** :2017-06-29 :21 deg\_C / 62 RH

Temp./Humi. Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4924.00	Н	Average	24.50	5.25	29.75	54.00	-24.25
4924.00	Н	Peak	36.65	5.25	41.90	74.00	-32.10

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#### 12 PEAK POWER SPECTRAL DENSITY

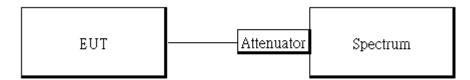
## 12.1 Standard Applicable

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

	Measurement Equipment Oseu				
SGS Conducted Room					
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.
TYPE		NUMBER	NUMBER	CAL.	
Power Meter	Anritsu	ML2495A	1005007	12/15/2016	12/14/2017
Power Sensor	Anritsu	MA2411B	917032	12/15/2016	12/14/2017
EXA Spectrum  Analyzer	Agilent	N9030A	MY53120760	03/21/2017	03/20/2018
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2017	01/04/2018
Coaxial Cable	HUBER+SUHNER	SUCOFLEX 102	23670/2	01/05/2017	01/04/2018
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018
Splitter	Agilent	11636B	N/A	01/05/2017	01/04/2018
DC Power Supply	Agilent	E3640A	MY52410006	11/21/2016	11/20/2017
Temperature Chamber	TERCHY	MHG-120LF	911009	05/19/2017	05/18/2018

#### 12.3 Test Set-up



#### 12.4 Measurement Procedure

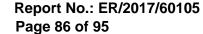
- 1. Set analyzer center frequency to DTS channel center frequency.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas.
- 3. Set the span to 1.5 times the DTS channel bandwidth.
- 4. Set the RBW = 3 kHz & VBW = 10 kHz.
- 5. For defining Restricted Band Edge Limit: Set the RBW = 100kHz & VBW = 300 kHz.
- 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.

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12.5 Measurement Result

POWER DENSITY 802.11b			
Freq. (MHz)	PSD (dBm)	Limit (dBm)	Result
2412	-4.07	8.00	PASS
2437	-3.92	8.00	PASS
2462	-4.82	8.00	PASS

POWER DENSITY 802.11g			
Freq. (MHz)	PSD (dBm)	Limit (dBm)	Result
2412	-10.26	8.00	PASS
2437	-10.25	8.00	PASS
2462	-10.82	8.00	PASS

POWER DENSITY 802.11n HT20			
Freq. (MHz)	PSD (dBm)	Limit (dBm)	Result
2412	-12.35	8.00	PASS
2437	-11.63	8.00	PASS
2462	-12.85	8.00	PASS

Bandedge Limit 802.11b MODE		
Freq. (MHz)	PSD (dBm)	Bandedge Limit (dBm)
2412	10.62	-9.38
2462	9.81	-10.19

Bandedge Limit 802.11g MODE		
Freq. (MHz)	PSD (dBm)	Bandedge Limit (dBm)
2412	4.31	-15.69
2462	3.57	-16.43

Bandedge Limit 802.11n20 MODI		
Freq. (MHz)	PSD (dBm)	Bandedge Limit (dBm)
2412	2.27	-17.73
2462	1.62	-18.38

\*Refer to next page for plots

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#### 802.11b

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



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



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



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



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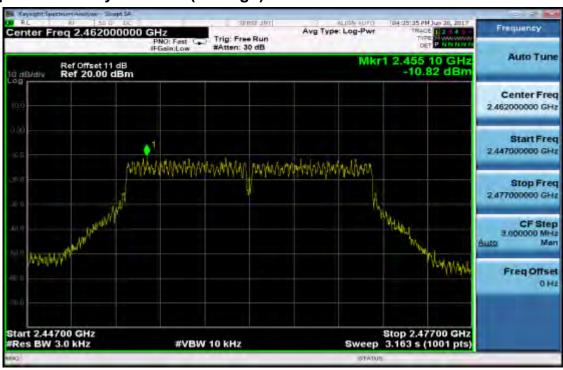
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## **Power Spectral Density Test Plot (CH-Mid)**



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



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#### 802.11n HT20

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



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



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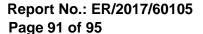
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# **Power Spectral Density Test Plot (CH-High)**



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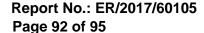
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802.11b PSD for Band edge Limit (CH-Low)



802.11b PSD for Bandedge Limit(CH-High)



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802.11g PSD for Bandedge Limit(CH-Low)



802.11g PSD for Bandedge Limit(CH-High)



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802.11n\_HT20 PSD for Bandedge Limit(CH-Low)



802.11n\_HT20 PSD for Bandedge Limit(CH-High)



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#### 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.

#### 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.

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