ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C AND RSS 247 REQUIREMENT

OF

Product Name:	**Smart Module**
Brand Name:	**N/A**
Model No.:	**SIMT 1502**
Model Difference:	**N/A**
FCC ID:	**UDV-20170406**
IC:	**8460A-20170406**
Report No.:	**ER/2017/50040**
Issue Date:	**Jul. 07, 2017**
FCC Rule Part:	**§15.247, Cat: DTS**
IC Rule:	**RSS-247 issue 2 Feb. 2017**
Prepared for:	**SHANGHAI SIMCOM LIMITED Building A, SIM Technology Building, No.633, Jinzhong Road, Changning District , Shanghai**
Prepared by:	**SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803**

ilac-MRA TAF Testing Laboratory 0513	***Note:*** *This report shall not be reproduced except in full, without the written approval of SGS Taiwan Ltd. This document may be altered or revised by SGS Taiwan Ltd. personnel only, and shall be noted in the revision section of the document.*

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VERIFICATION OF COMPLIANCE

Applicant:	SHANGHAI SIMCOM LIMITED Building A, SIM Technology Building, No.633, Jinzhong Road, Changning District , Shanghai
Product Name:	Smart Module
Brand Name:	N/A
Model No.:	SIMT 1502
Model Difference:	N/A
FCC ID:	UDV-20170406
IC :	8460A-20170406
Report Number:	ER/2017/50040
Date of test:	May 08, 2017 ~ Jul. 04, 2017
Date of EUT Received:	May 08, 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:	Tin Lin	***Date:***	Jul. 07, 2017
	Tin Lin / Engineer		
Prepared By:	Karen Huang	***Date:***	Jul. 07, 2017
	Karen Huang / Clerk		
Approved By:	Jim Chang	***Date:***	Jul. 07, 2017
	Jim Chang / Asst. Manager		

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Revision History

Report Number	Revision	Description	Issue Date
ER/2017/50040	Rev.00	Initial creation of document	Jul. 07, 2017

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1 GENERAL INFORMATION

1.1 Product description

General:

Product Name:	Smart Module
Brand Name:	N/A
Model No.:	SIMT 1502
Model Difference:	N/A
Product SW/HW version:	CB03_8909_V4.4_20160901/ V1.2
Radio SW/HW version:	N/A / N/A
Test SW Version:	N/A
RF power setting in TEST SW:	N/A
Power Supply:	3.8Vdc from DC power Supply

WLAN 2.4GHz:

Wi-Fi	Frequency Range	Channels	Rated Power	Type of Emission 99%	Modulation Technology
11b/g	2412-2462	11	b: 19.75dBm g: 22.42dBm	b:13M7G1D g:16M8D1D	DSSS, OFDM
11n	HT20 2412-2462	11	HT20: 22.41dBm	HT20:17M9D1D	OFDM
Antenna Designation:		External Antenna, Gain: 1.48dBi			
Modulation type:		CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM			
Transition Rate:		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 – 72.2Mbps			

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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

Canada RSS-247 issue 2 Feb. 2017

Canada RSS-Gen issue 4 Nov. 2014

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

Canada Registration Number: 4620A-5.

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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2 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 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.

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 and splitter.

Offset = RF cable loss (dB)+ splitter(dB) =10.9 (dB)

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2.5 Configuration of Tested System

Fig. 2-1 Configuration of Conducted and Radiated Tested System

Fig. 2-2 Conduction

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.	Notebook	Lenovo	L430	R9-YYG88	Shielded	Un-shielded
3.	Test Tool Kit	N/A	N/A	N/A	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	IC Rules	Description Of Test	Result
§15.207(a)	RSS-Gen §8.8	AC Power Line Conducted Emission	Compliant
§15.247(b)(3)	RSS-247 §5.4(4)	Peak Output Power	Compliant
§15.247(a)(2)	RSS-247 §5.2 (1) RSS-Gen §6.6	6dB & 99% Emission Bandwidth	Compliant
§15.247(d)	RSS-247 §5.5	Conducted Band Edge and Spurious Emission	Compliant
§15.247(d)	RSS-247 §5.5	Radiated Band Edge and Spurious Emission	Compliant
§15.247(e)	RSS-247 §5.2(2)	Power Spectral Density	Compliant
§15.203 §15.247(b)	-	Antenna Requirement	Compliant

4 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:

RADIATED EMISSION TEST (BELOW 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
802.11g	1 to 11	1,6,11	OFDM	6

RADIATED EMISSION TEST (ABOVE 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
802.11b	1 to 11	1, 6, 11	DSSS	1
802.11g	1 to 11	1, 6, 11	OFDM	6
802.11n (HT20)	1 to 11	1, 6, 11	OFDM	MCS 0

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 H position was reported.

ANTENNA PORT CONDUCTED MEASUREMENT:

CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
802.11b	1 to 11	1, 6, 11	DSSS	1
802.11g	1 to 11	1, 6, 11	OFDM	6
802.11n (HT20)	1 to 11	1, 6, 11	OFDM	MCS 0

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5 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:

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

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

6.1 Standard Applicable

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

Frequency range MHz	Limits dB(uV)	
	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 TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
EMI Test Receiver	R&S	ESCI7	100760	05/11/2017	05/10/2018
LISN	SCHWARZBECK	NSLK 8127	8127-649	05/22/2016	05/21/2017
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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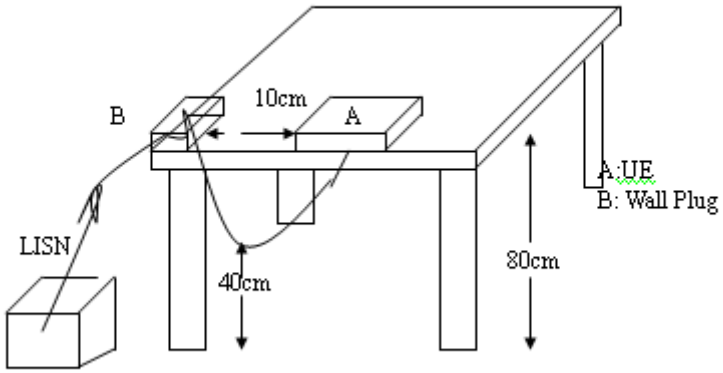
6.4 Test SET-UP (Block Diagram of Configuration)



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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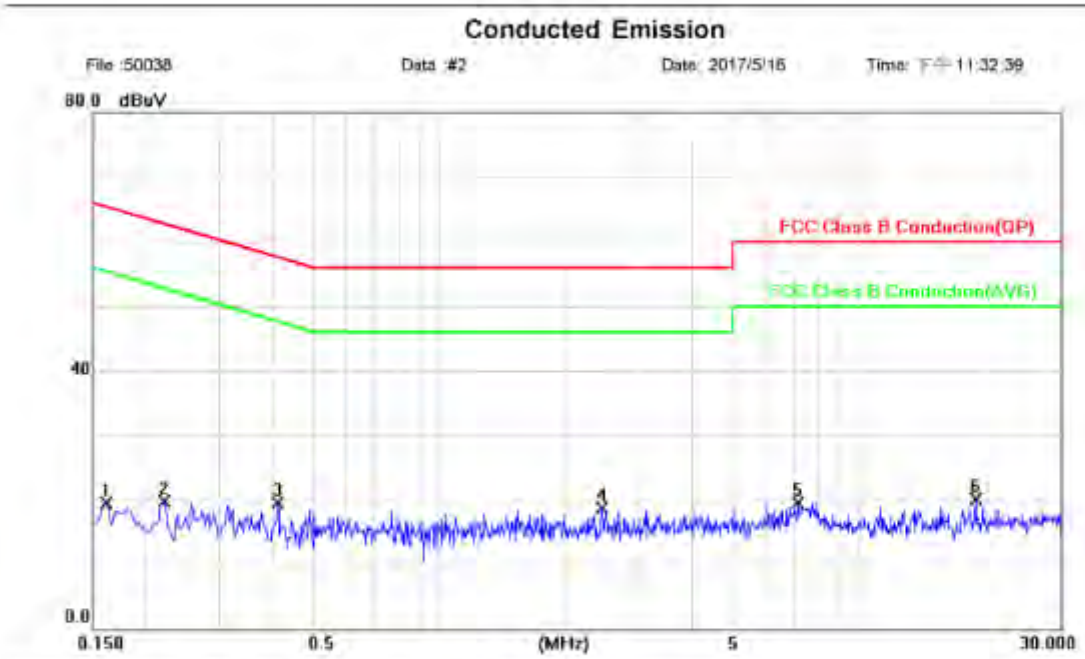
AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode	Test By:	Tin

Site: Conduction Room
Limit: FCC Class B Conduction(QP)
Mode: Operation

Phase: L1
Power: AC 120V/60Hz

Temperature: 20 ℃
Humidity: 56 %



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1620	9.76	9.80	19.56	65.36	-45.80	peak	
2		0.2220	9.89	9.79	19.68	62.74	-43.06	peak	
3		0.4140	9.81	9.79	19.60	57.57	-37.97	peak	
4	*	2.4460	8.97	9.83	18.80	56.00	-37.20	peak	
5		7.1700	9.45	9.99	19.44	60.00	-40.56	peak	
6		18.8780	9.91	10.15	20.06	60.00	-39.94	peak	

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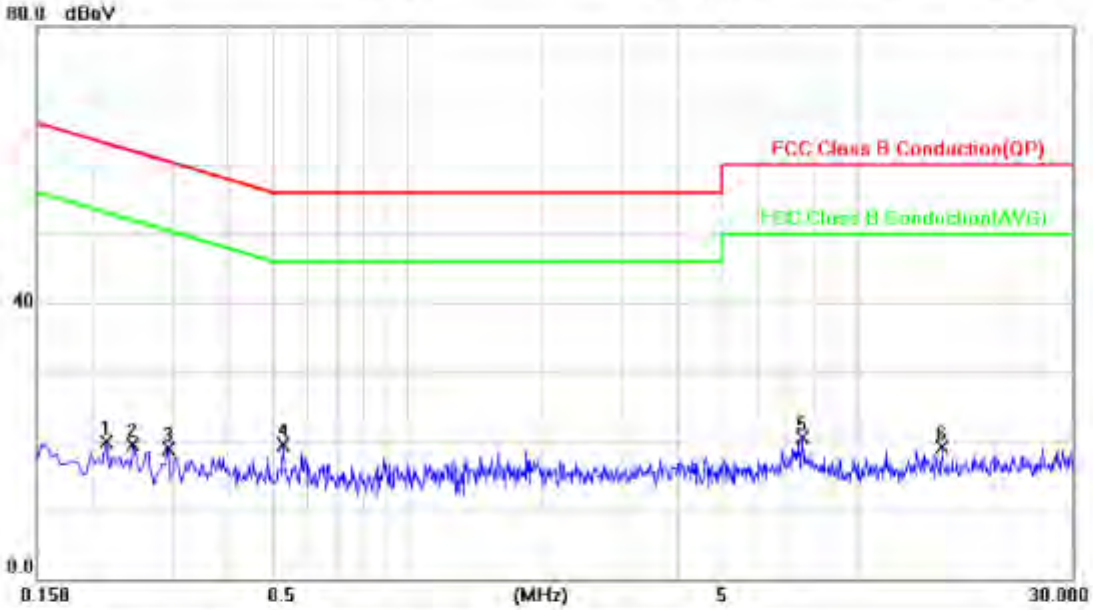
Site: Conduction Room		Phase:	N	Temperature:	20 ℃
Limit: FCC Class B Conduction(QP)		Power:	AC 120V/60Hz	Humidity:	58 %
Mode: Operation					

Conducted Emission

File :50038 Data :#1 Date: 2017/5/16 Time: 下午 11:31:51



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.2140	10.06	9.79	19.85	63.05	-43.20	peak	
2		0.2460	9.76	9.79	19.55	61.89	-42.34	peak	
3		0.2940	9.16	9.79	18.95	60.41	-41.46	peak	
4	*	0.5300	9.67	9.79	19.46	56.00	-36.54	peak	
5		7.5260	10.49	10.00	20.49	60.00	-39.51	peak	
6		15.4340	8.95	10.11	19.06	60.00	-40.94	peak	

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7 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	97.85	0.09
802.11g	87.41	0.58
802.11n_20	86.58	0.63

Duty Cycle Factor: 10 * log(1/0.9785) = 0.09
Duty Cycle Factor: 10 * log(1/0.8741) = 0.58
Duty Cycle Factor: 10 * log(1/0.8658) = 0.63

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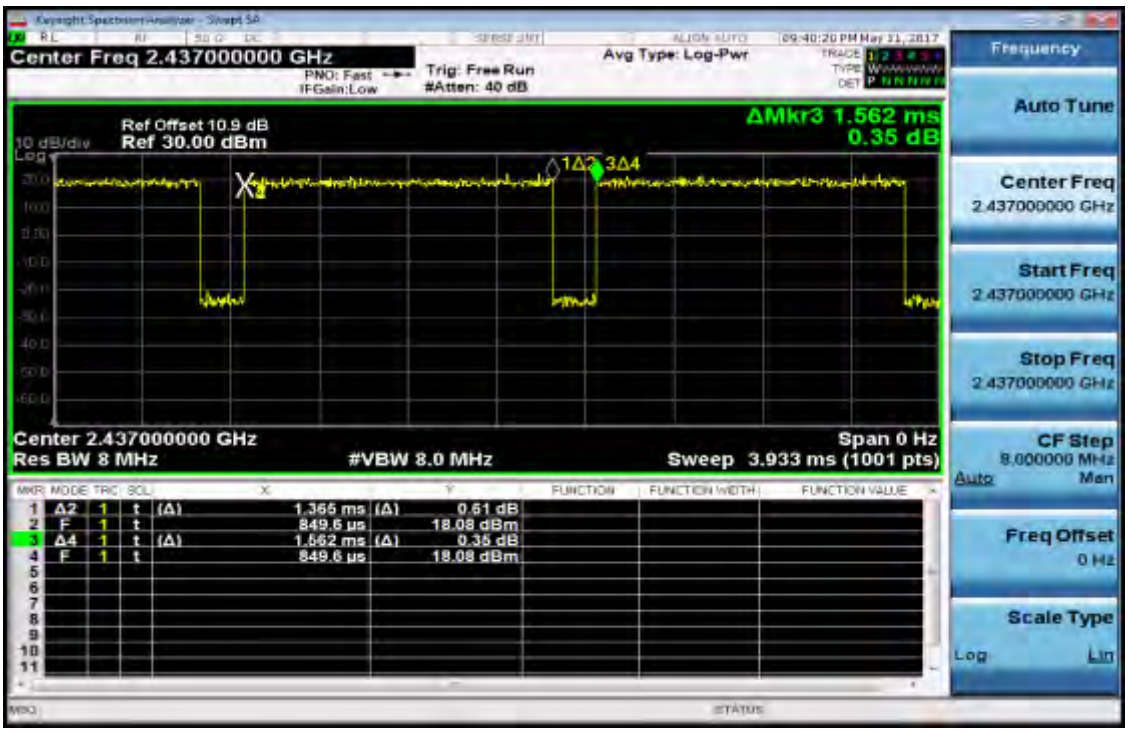
7.1 DUTY CYCLE TEST SIGNAL Measurement Result

802.11 b

802.11 g



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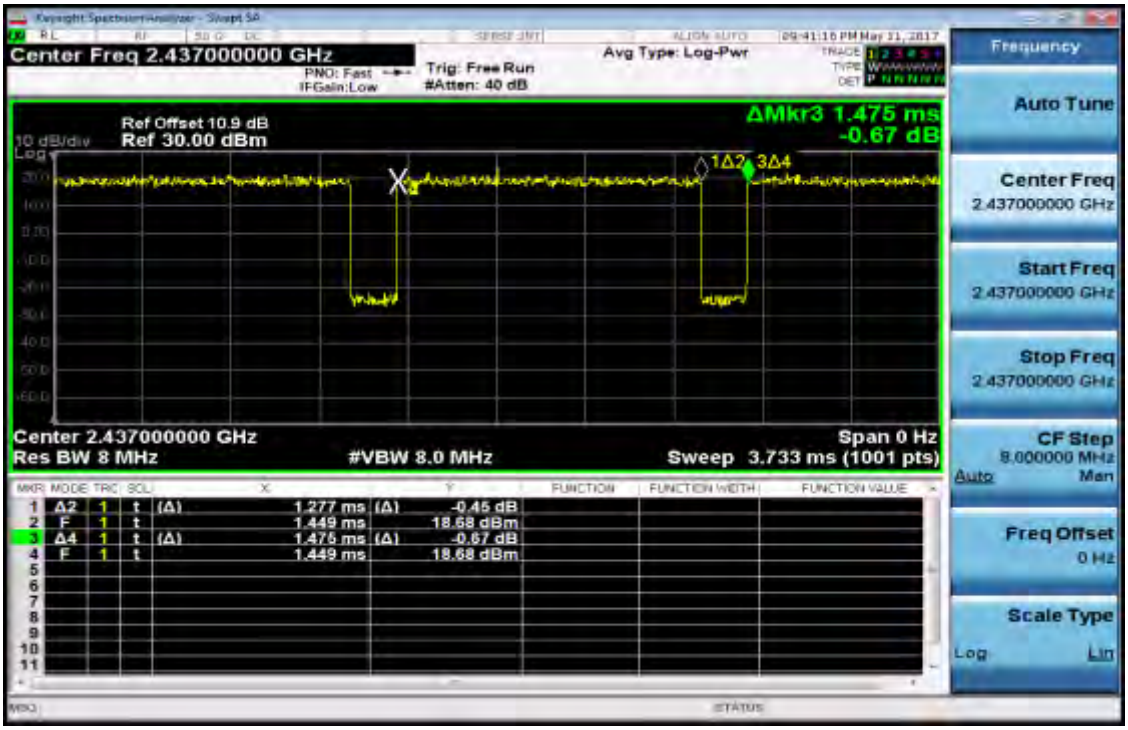
802.11 n_20 MHz



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8 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 TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
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	05/17/2016	05/16/2017

Remark: Please note that the duration to conduct the test took place in the mean time when the calibration for several equipments is due, and therefore extra tables of equipment calibration is constructed to indicate the calibration work is still maintained.

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Temperature Chamber	TERCHY	MHG-120LF	911009	05/19/2017	05/18/2018

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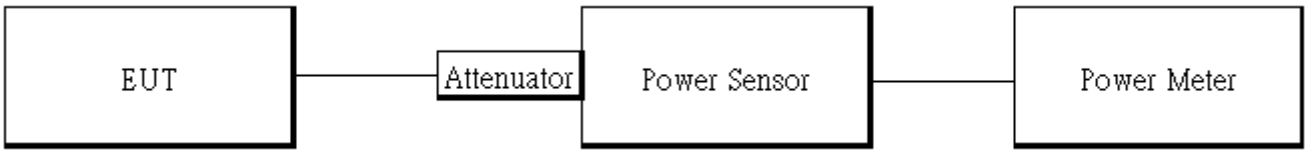
8.3 Test Set-up

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. Guidance .
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.

8.5 Measurement Result

802.11b Main								
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Peak Output Power (mW)	Limit			RESULT
1	2412	1	19.50	89.13	1 Watt =	30.00	dBm	PASS
6	2437	1	19.75	94.41	1 Watt =	30.00	dBm	PASS
11	2462	1	19.67	92.68	1 Watt =	30.00	dBm	PASS
802.11b Main								
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Max. Avg. Output include tune up tolerance Power (mW)	Limit			RESULT
1	2412	1	17.04	50.58	1 Watt =	30.00	dBm	PASS
6	2437	1	17.41	55.08	1 Watt =	30.00	dBm	PASS
11	2462	1	17.24	52.97	1 Watt =	30.00	dBm	PASS

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802.11g Main								
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Peak Output Power (mW)	Limit			RESULT
1	2412	6	21.23	132.74	1 Watt =	30.00	dBm	PASS
6	2437	6	**22.42**	174.58	1 Watt =	30.00	dBm	PASS
11	2462	6	21.06	127.64	1 Watt =	30.00	dBm	PASS
802.11g Main								
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Max. Avg. Output include tune up tolerance Power (mW)	Limit			RESULT
1	2412	6	13.75	23.71	1 Watt =	30.00	dBm	PASS
6	2437	6	**17.14**	51.76	1 Watt =	30.00	dBm	PASS
11	2462	6	13.62	23.01	1 Watt =	30.00	dBm	PASS

802.11n_HT20M Main								
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Peak Output Power (mW)	Limit			RESULT
1	2412	MCS0	20.78	119.67	1 Watt =	30.00	dBm	PASS
6	2437	MCS0	**22.41**	174.18	1 Watt =	30.00	dBm	PASS
11	2462	MCS0	20.61	115.08	1 Watt =	30.00	dBm	PASS
802.11n_HT20M Main								
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Max. Avg. Output include tune up tolerance Power (mW)	Limit			RESULT
1	2412	MCS0	12.86	19.32	1 Watt =	30.00	dBm	PASS
6	2437	MCS0	**17.16**	52.00	1 Watt =	30.00	dBm	PASS
11	2462	MCS0	12.69	18.58	1 Watt =	30.00	dBm	PASS

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

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EIRP

802.11b Main									
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit			RESULT
1	2412	1	17.04	1.48	18.52	4W=	36	dBm	PASS
6	2437	1	17.41	1.48	18.89	4W=	36	dBm	PASS
11	2462	1	17.24	1.48	18.72	4W=	36	dBm	PASS

802.11g Main									
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit			RESULT
1	2412	6	13.75	1.48	15.23	4W=	36	dBm	PASS
6	2437	6	17.14	1.48	18.62	4W=	36	dBm	PASS
11	2462	6	13.62	1.48	15.10	4W=	36	dBm	PASS

802.11n_HT20M Main									
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit			RESULT
1	2412	MCS0	12.86	1.48	14.34	4W=	36	dBm	PASS
6	2437	MCS0	17.16	1.48	18.64	4W=	36	dBm	PASS
11	2462	MCS0	12.69	1.48	14.17	4W=	36	dBm	PASS

*** *Note:*** EIRP = Average Power + Gain

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9 6dB & 99% BANDWIDTH MEASUREMENT

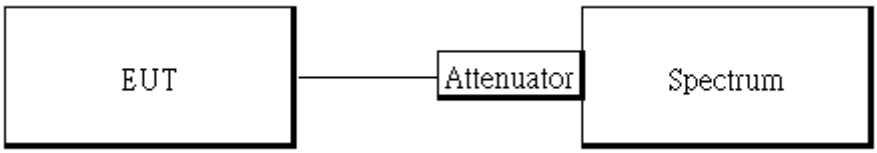
9.1 Standard Applicable

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

9.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
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
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018

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.
4. 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. For 99% Bandwidth:

   Set the spectrum analyzer as RBW=1%, VBW = 3*RBW, Span = 30M/50MHz, Detector=Sample, Sweep=auto.
7. Turn on the 99% bandwidth function, max reading.
8. Repeat above procedures until all frequency of interest measured was complete.

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9.5 Measurement Result

802.11b Main

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	9044	> 500	PASS
2437	9057	> 500	PASS
2462	8595	> 500	PASS

802.11g Main

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	16420	> 500	PASS
2437	16390	> 500	PASS
2462	16380	> 500	PASS

802.11_n_HT20 Main

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	17630	> 500	PASS
2437	17620	> 500	PASS
2462	17580	> 500	PASS

802.11b Main

Freq. (MHz)	99% BW (MHz)
2412	13.709
2437	13.614
2462	13.670

802.11g Main

Freq. (MHz)	99% BW (MHz)
2412	14.967
2437	16.657
2462	16.753

802.11n_HT20M Main

Freq. (MHz)	99% BW (MHz)
2412	17.829
2437	17.703
2462	17.864

Refer to next page for plots

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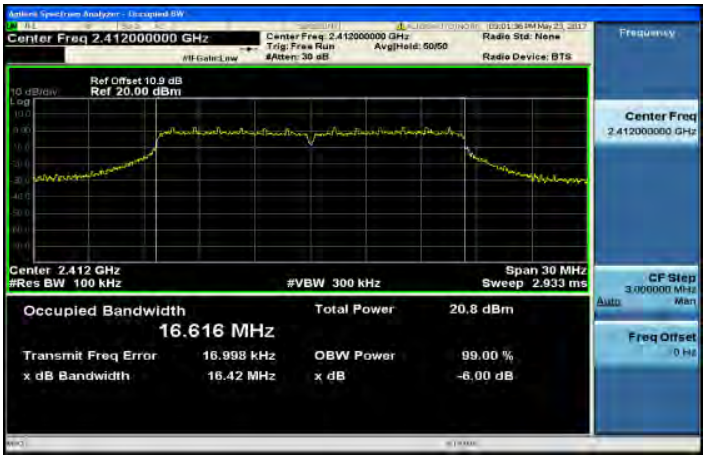
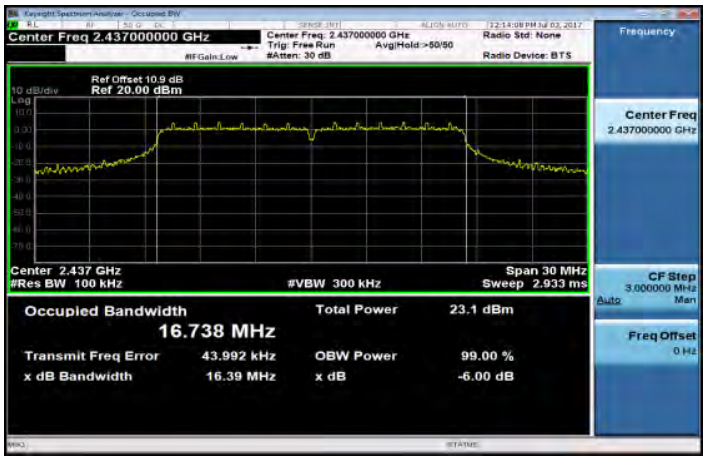
6dB BW 802.11b CH-Low

6dB BW 802.11g CH-Low

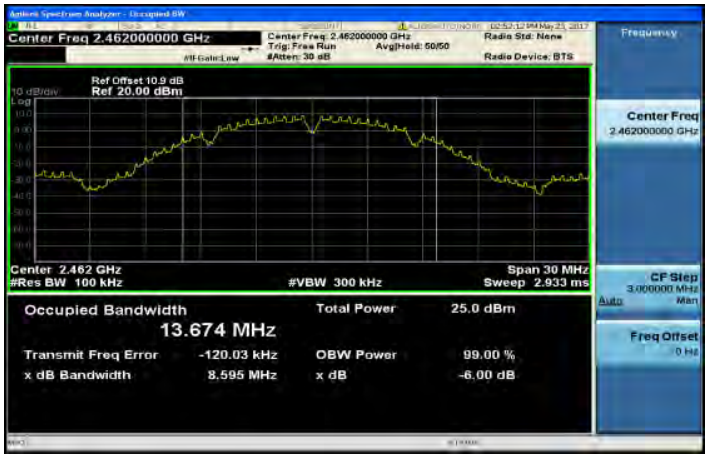


6dB BW 802.11b CH-Mid

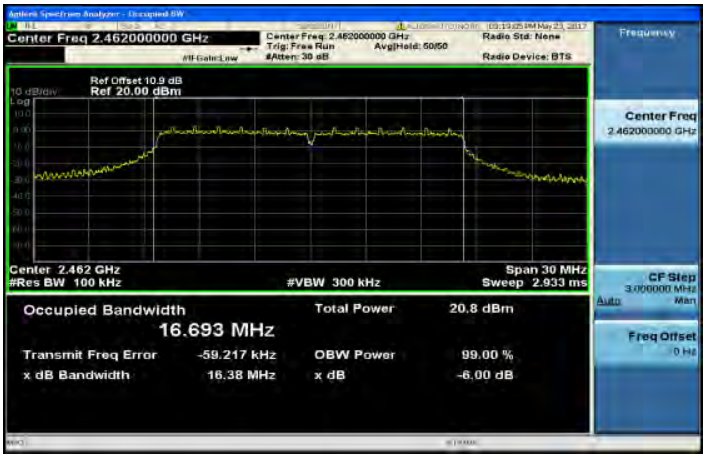
6dB BW 802.11g CH-Mid



6dB BW 802.11b CH-High



6dB BW 802.11g CH-High



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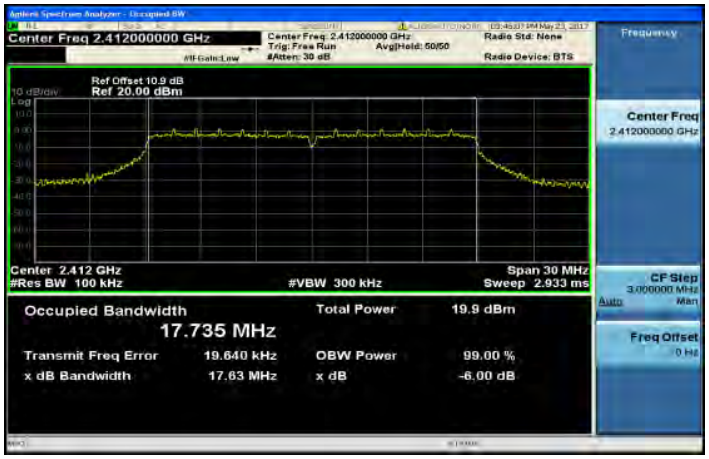
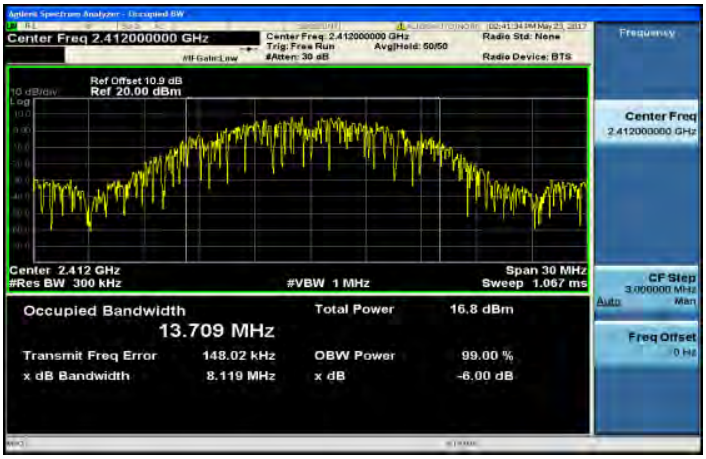
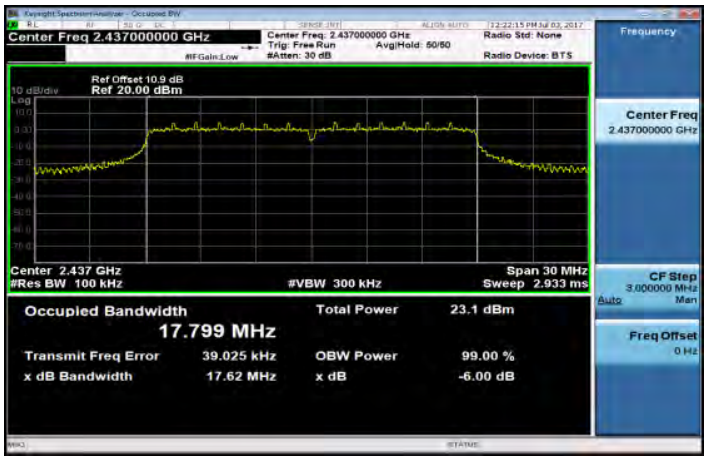
6dB BW 802.11n_HT20M CH-Low



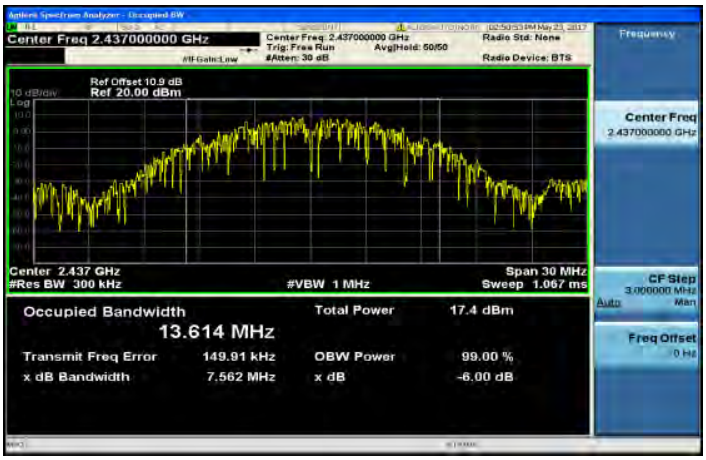
99% BW 802.11b CH-Low



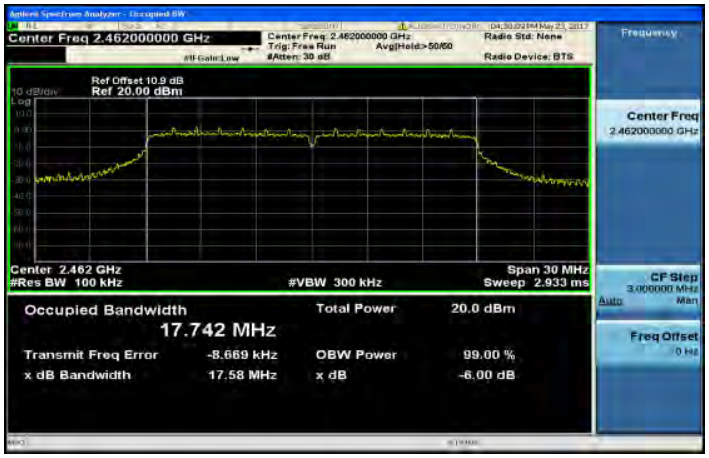
6dB BW 802.11n_HT20M CH-Mid



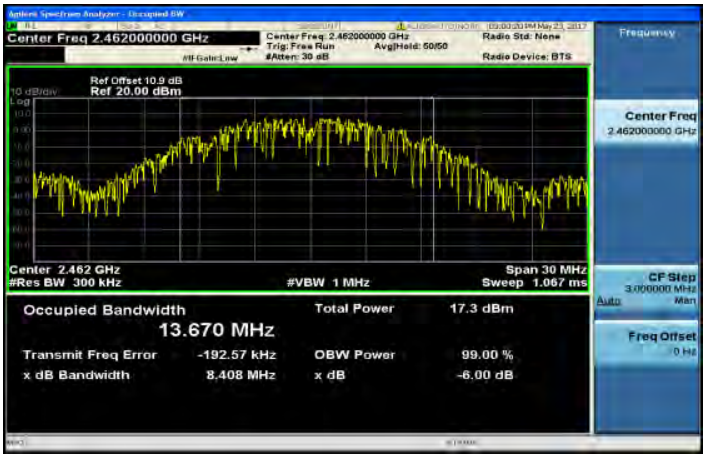
99% BW 802.11b CH-Mid



6dB BW 802.11n_HT20M CH-High



99% BW 802.11b CH-High



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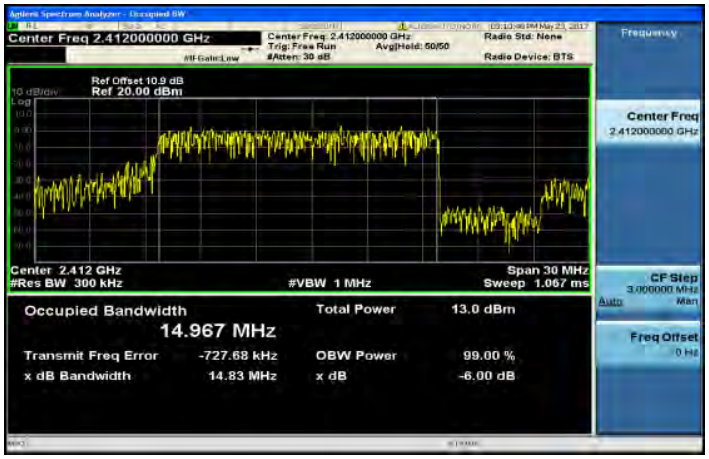
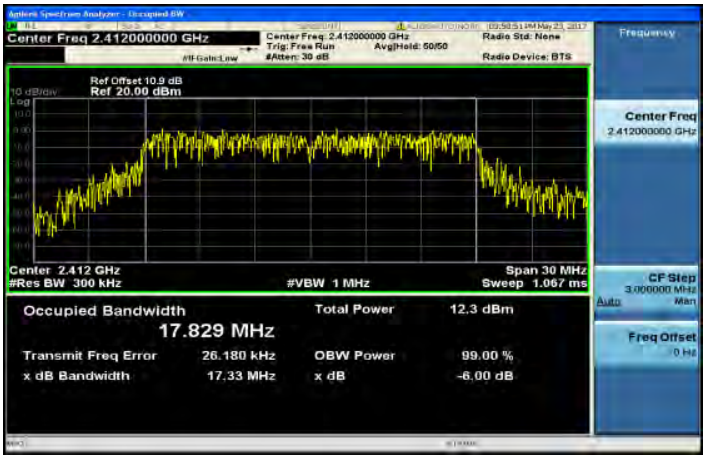
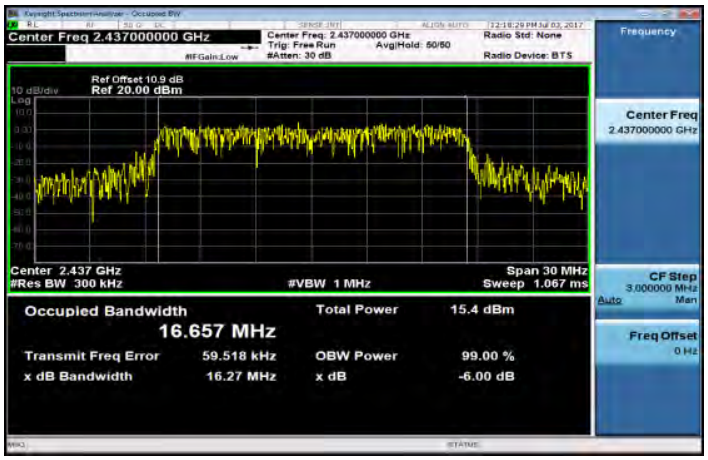
99% BW 802.11g CH-Low



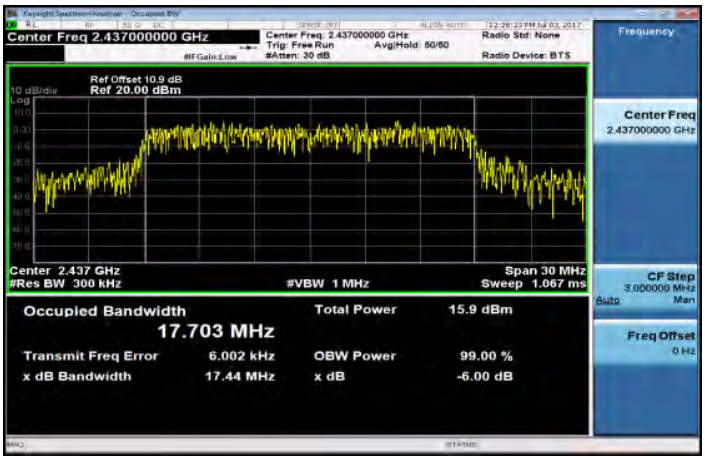
99% BW 802.11n_HT20M CH-Low



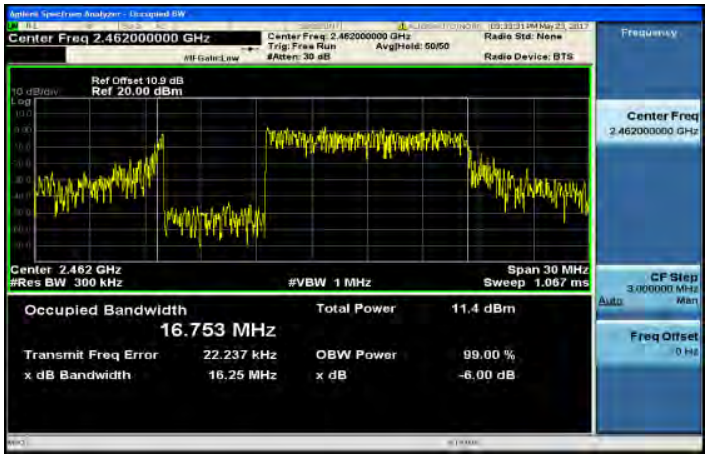
99% BW 802.11g CH-Mid



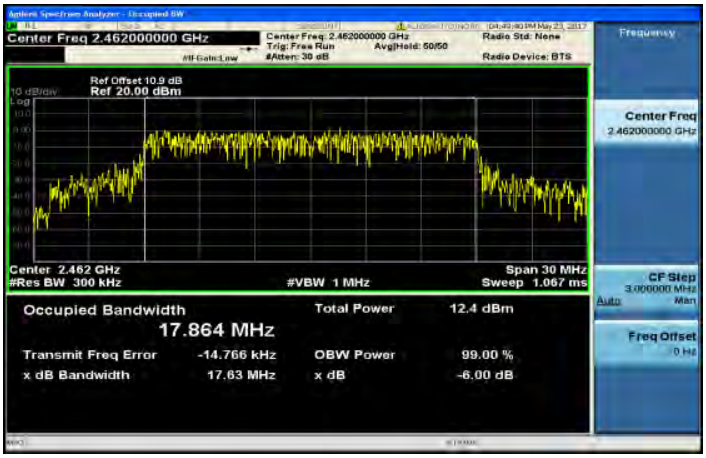
99% BW 802.11n_HT20M CH-Mid



99% BW 802.11g CH-High



99% BW 802.11n_HT20M CH-High



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10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

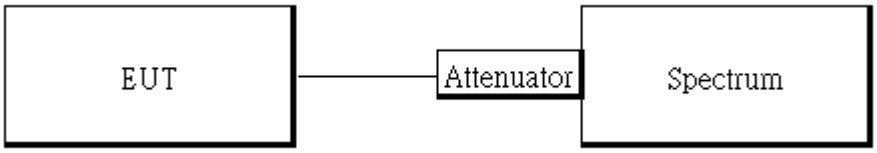
As per KDB 558074 D01 11.1 a)
If the maximum peak conducted output power procedure was used to demonstrate compliance as described in 9.1, then the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc).

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) & RSS-Gen §8.10 Table 6, must also comply with the radiated emission limits specified in §15.209(a) & RSS-Gen §8.9 Table4 &5.

10.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
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
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018

10.3 Test SET-UP



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10.4 Measurement Procedure

Band Edge Limit Calculation:

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 .
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 100kHz & VBW = 300 kHz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.

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 .
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:

1. 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.

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10.5 Measurement Result

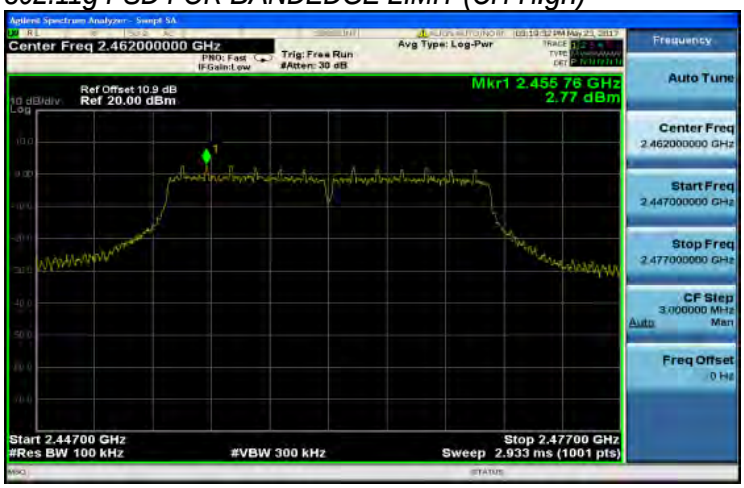
Bandedge Limit 802.11b MODE			Bandedge Limit 802.11g MODE			Bandedge Limit 802.11n20 MODE		
Freq. (MHz)	PSD (dBm)	Bandedge Limit (dBm)	Freq. (MHz)	PSD (dBm)	Bandedge Limit (dBm)	Freq. (MHz)	PSD (dBm)	Bandedge Limit (dBm)
2412	8.80	-11.20	2412	2.40	-17.60	2412	1.35	-18.65
2462	9.15	-10.85	2462	2.76	-17.24	2462	1.91	-18.09

802.11b PSD for Bandedge limit(CH-Low)

802.11g PSD FOR BANDEDGE LIMIT(CH-Low)

802.11b PSD FOR BANDEDGE LIMIT (CH-High)

802.11g PSD FOR BANDEDGE LIMIT (CH-High)



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802.11n_HT20 PSD FOR BANDEDGE LIMIT (CH-Low)

802.11b
Band Edges Test Data CH-Low

802.11n_HT20 PSD FOR BANDEDGE LIMIT (CH-High)

Band Edges Test Data CH-High

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802.11g

Band Edges Test Data CH-Low

802.11n_HT20

Band Edges Test Data CH-Low

Band Edges Test Data CH-High

Band Edges Test Data CH-High

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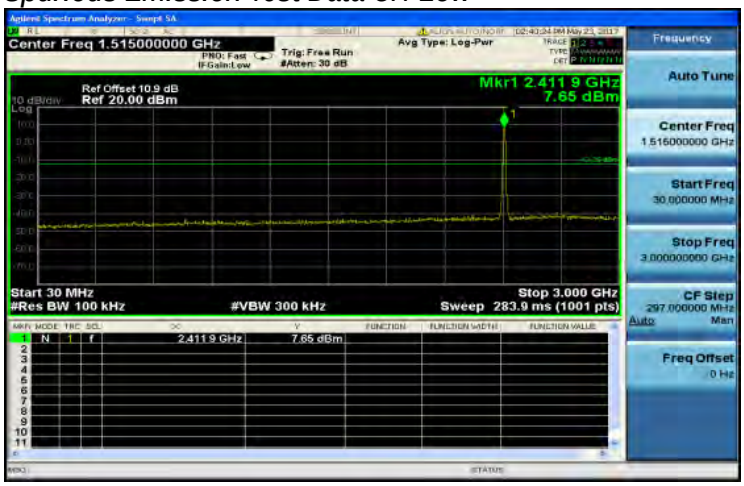
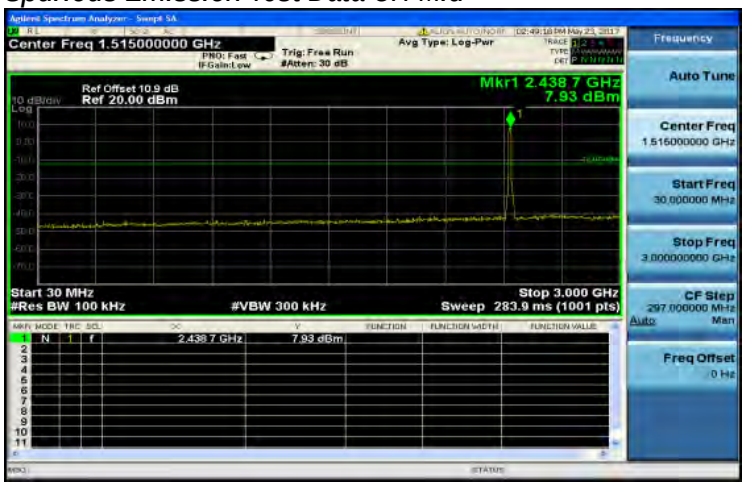
802.11b

Spurious Emission Test Data CH-Low



Spurious Emission Test Data CH-Mid



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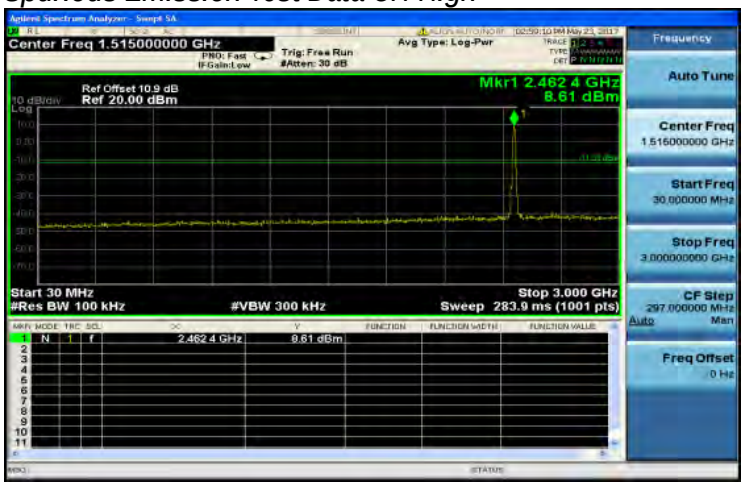
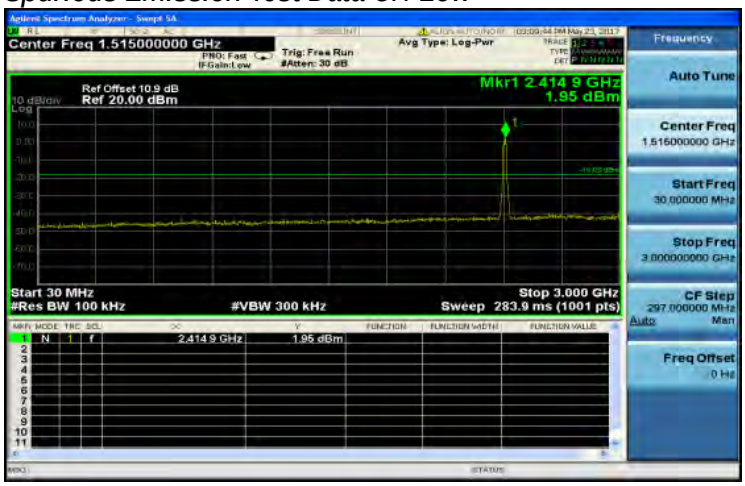
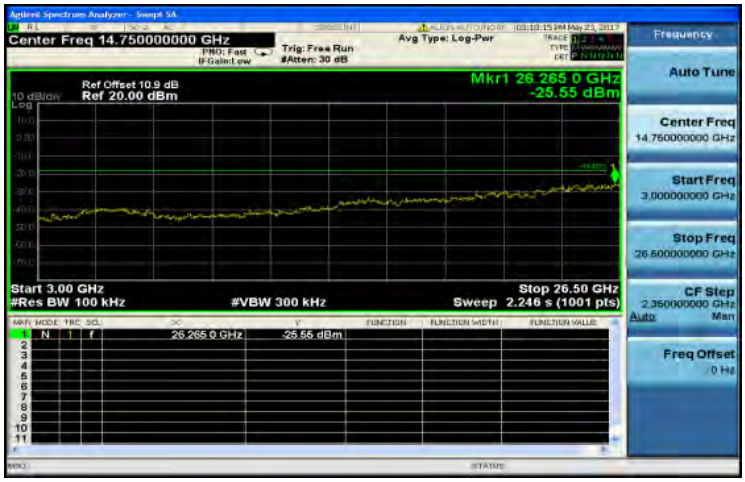
802.11g

Spurious Emission Test Data CH-High



Spurious Emission Test Data CH-Low





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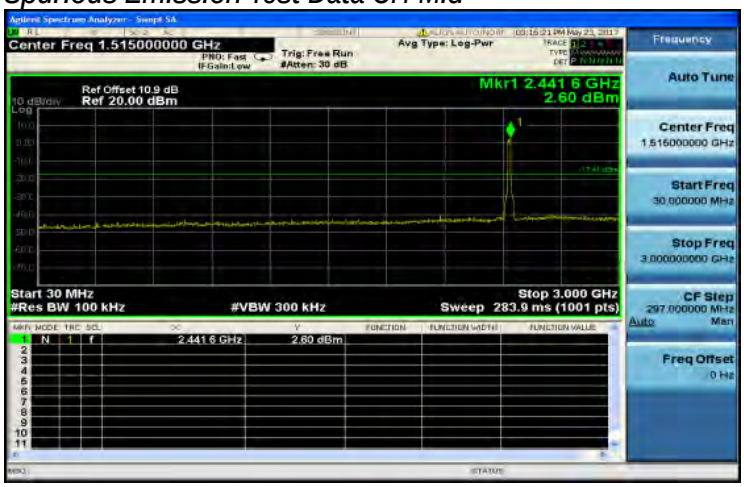
Spurious Emission Test Data CH-Mid



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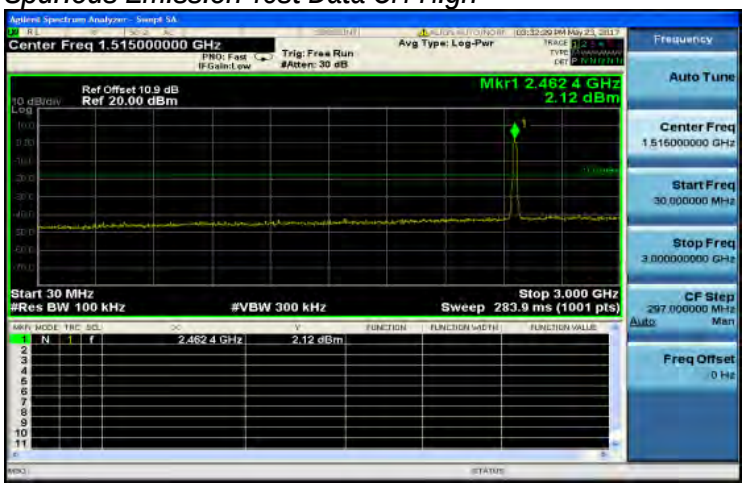

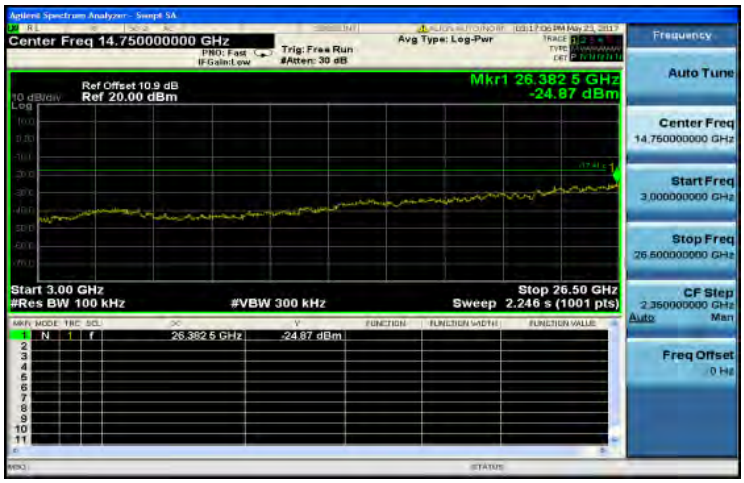

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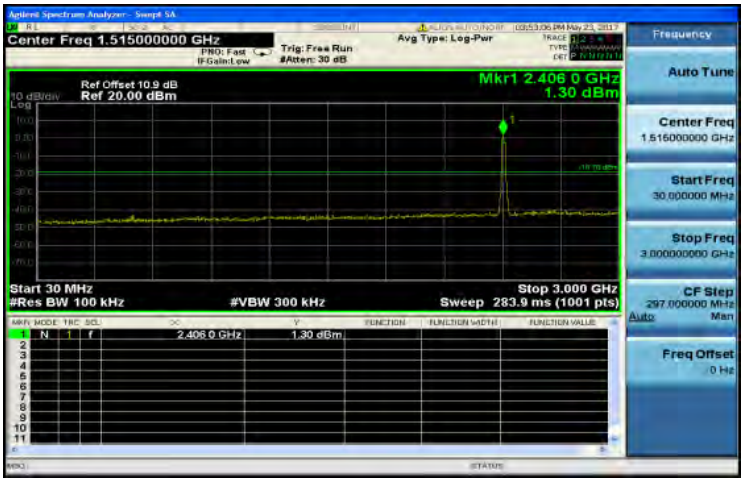
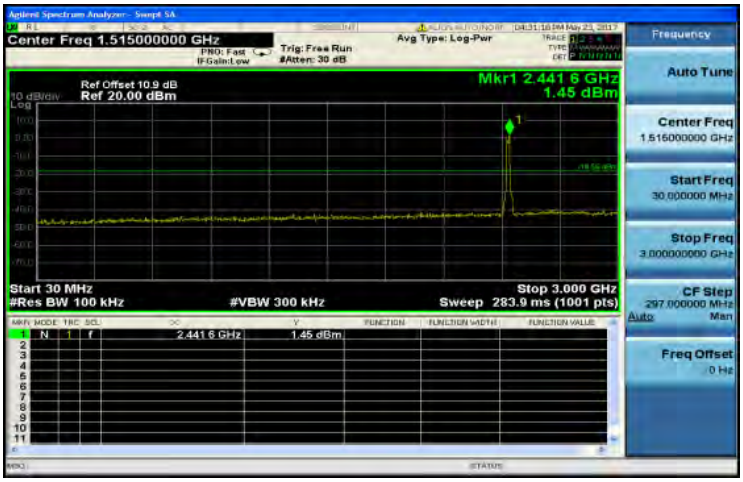
802.11n_HT20

Spurious Emission Test Data CH-Low



Spurious Emission Test Data CH-Mid



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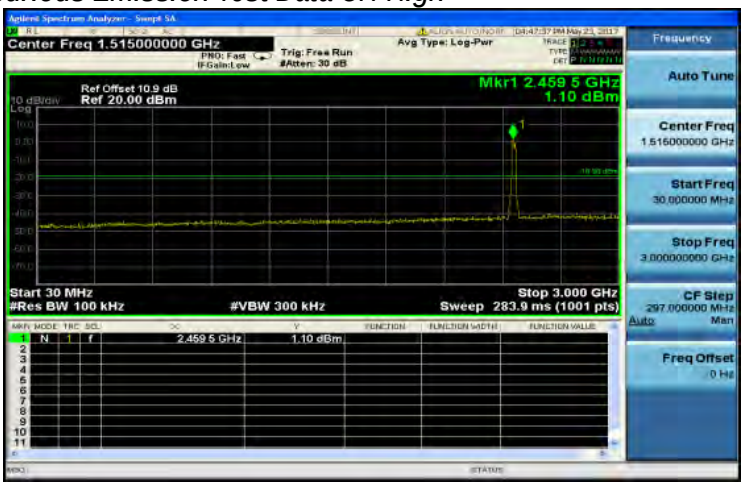
Spurious Emission Test Data CH-High



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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 & RSS-Gen §8.10 Table 6 limit as below.

And according to §15.33(a) (1) & RSS-Gen §8.9 Table 4 & 5, 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 (dBµV/m) = 20 log Emission level (dBµV/m)

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11.2 Measurement Equipment Used:

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL 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 Corp.	EMC0126530	980038	01/05/2017	01/04/2018
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
Pre-Amplifier	EMC Instruments Corp.	EMC184045	980135	01/05/2017	01/04/2018

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

Remark: Please note that the duration to conduct the test took place in the mean time when the calibration for several equipments is due, and therefore extra tables of equipment calibration is constructed to indicate the calibration work is still maintained.

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
3m Site NSA	SGS	966 chamber	N/A	07/01/2017	06/30/2018

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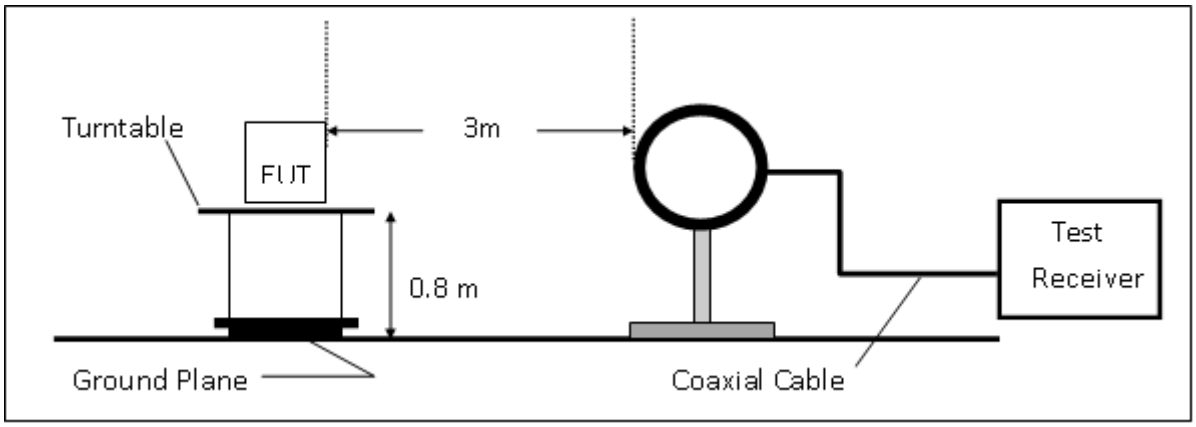
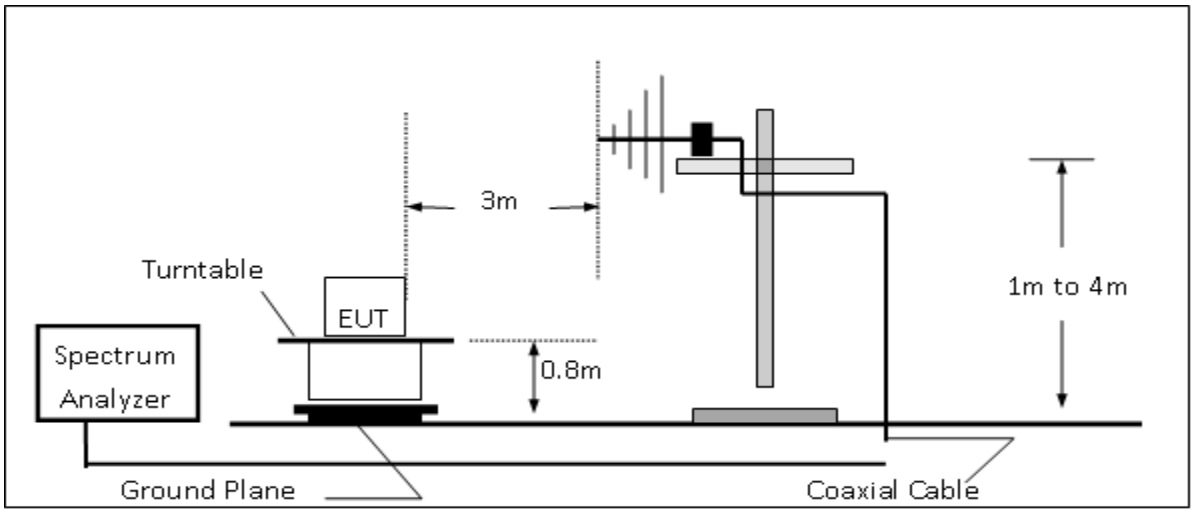
11.3 Test SET-UP

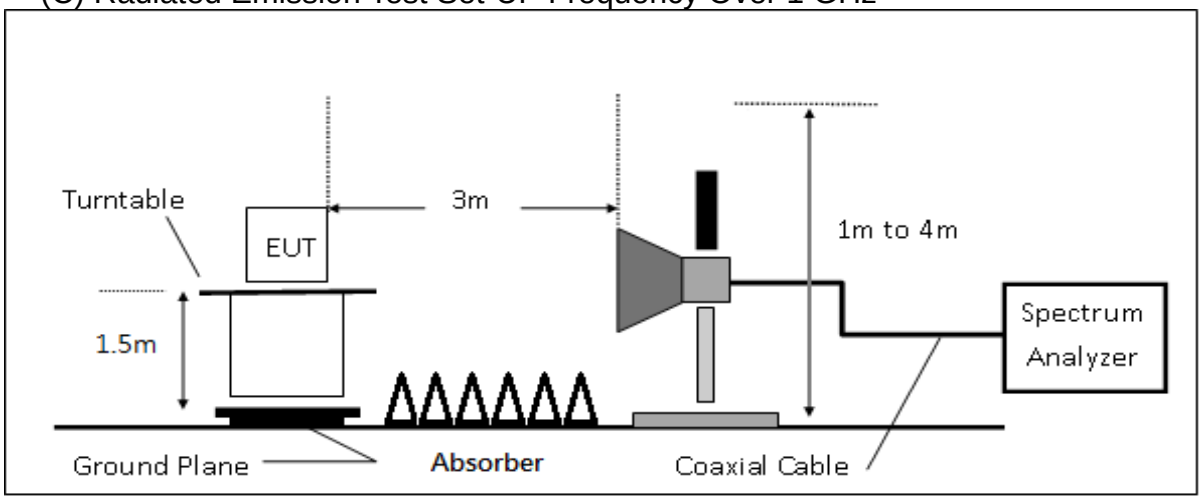
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



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



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



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11.4 Measurement Procedure

1. 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.
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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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 FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/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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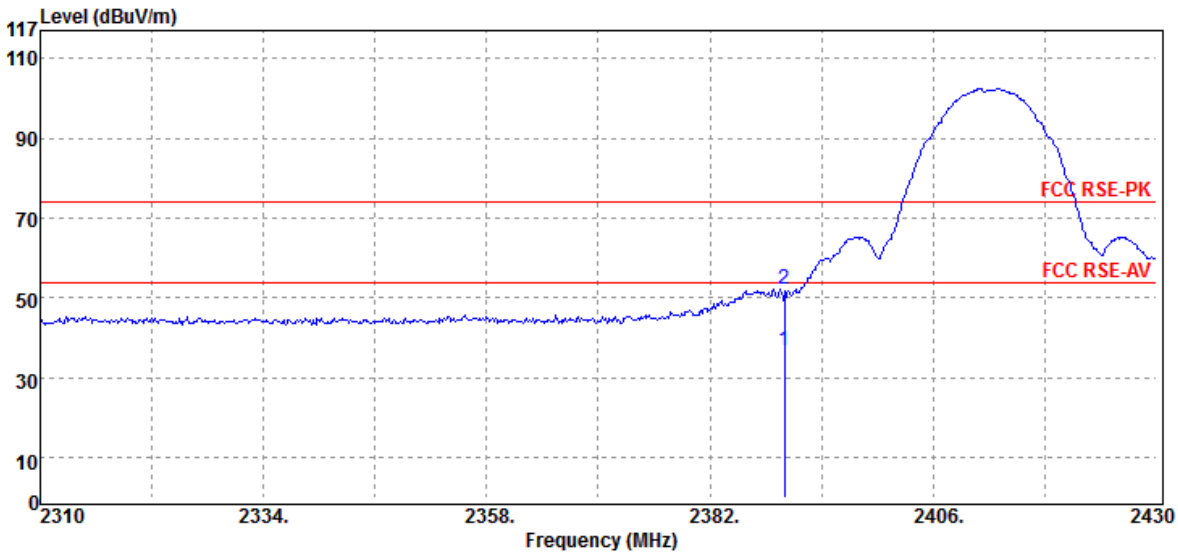
Radiated Band Edge Measurement Result (802.11b)

Operation Band	:802.11b	Test Date	:2017-05-12
Fundamental Frequency	:2412 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Bandedge CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2390.00	E	Average	38.65	-1.74	36.91	54.00	-17.09
2390.00	E	Peak	53.99	-1.74	52.25	74.00	-21.75

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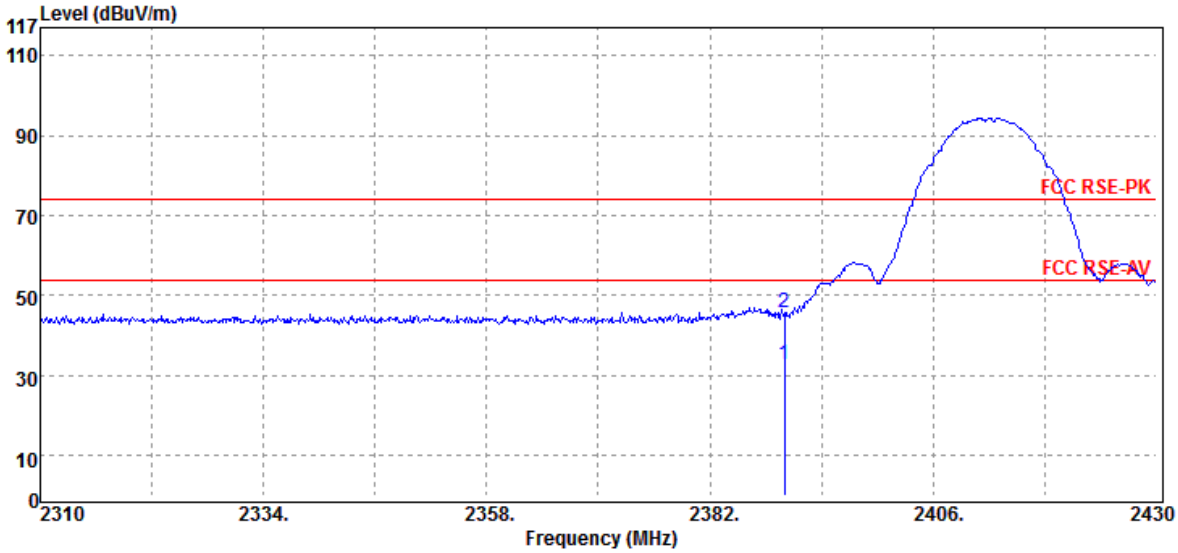
Operation Band	:802.11b	Test Date	:2017-05-12
Fundamental Frequency	:2412 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Bandedge CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2390.00	E	Average	34.69	-1.74	32.95	54.00	-21.05
2390.00	E	Peak	47.40	-1.74	45.66	74.00	-28.34

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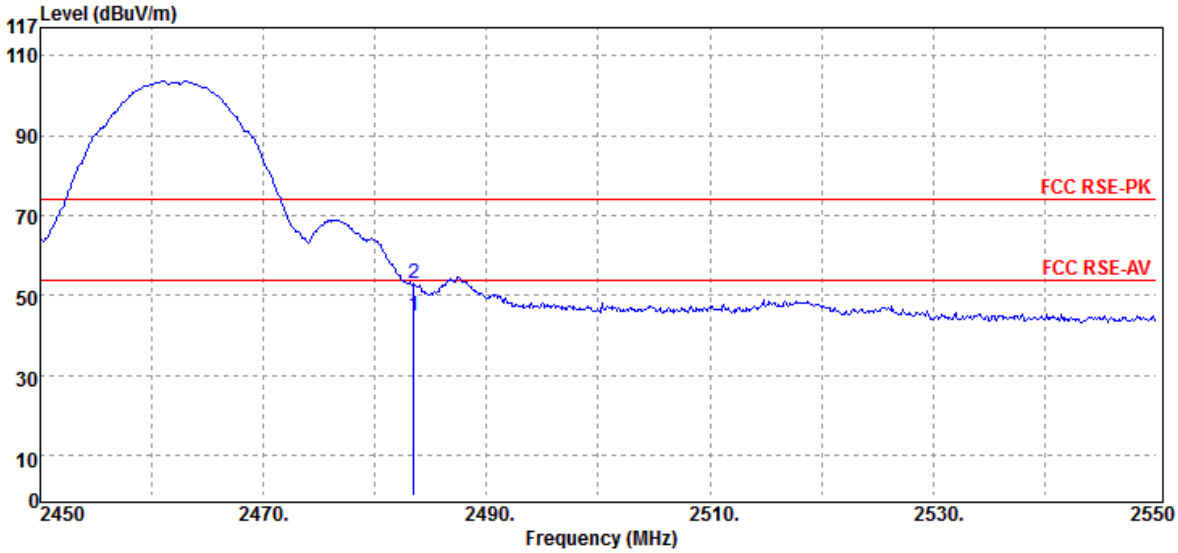
Operation Band	:802.11b	Test Date	:2017-05-12
Fundamental Frequency	:2462 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Bandedge CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2483.50	E	Average	46.40	-1.62	44.78	54.00	-9.22
2483.50	E	Peak	54.53	-1.62	52.91	74.00	-21.09

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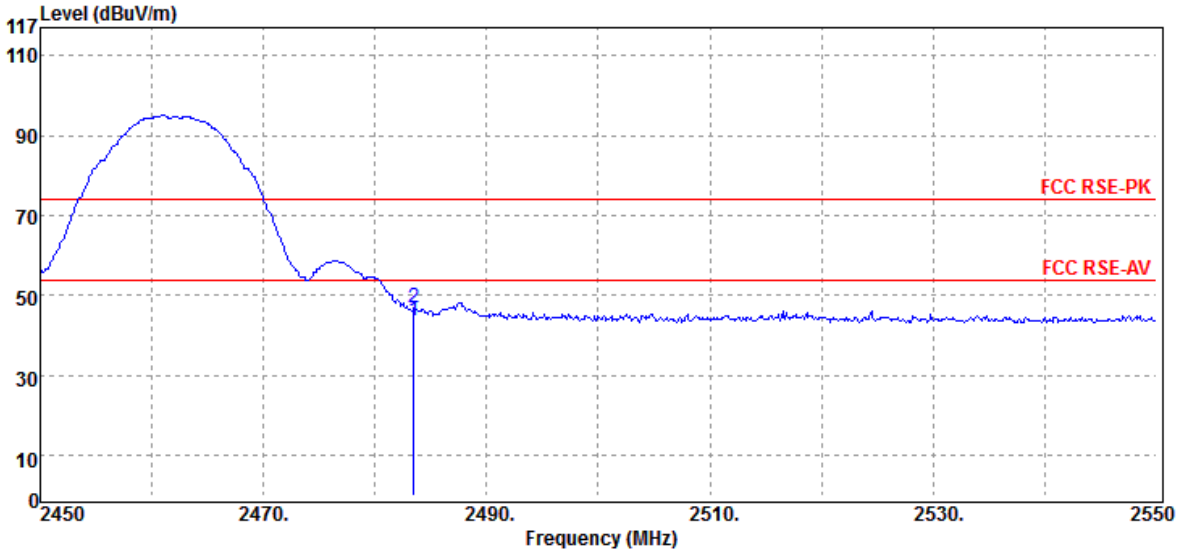
Operation Band	:802.11b	Test Date	:2017-05-12
Fundamental Frequency	:2462 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Bandedge CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2483.50	E	Average	45.36	-1.62	43.74	54.00	-10.26
2483.50	E	Peak	48.41	-1.62	46.79	74.00	-27.21

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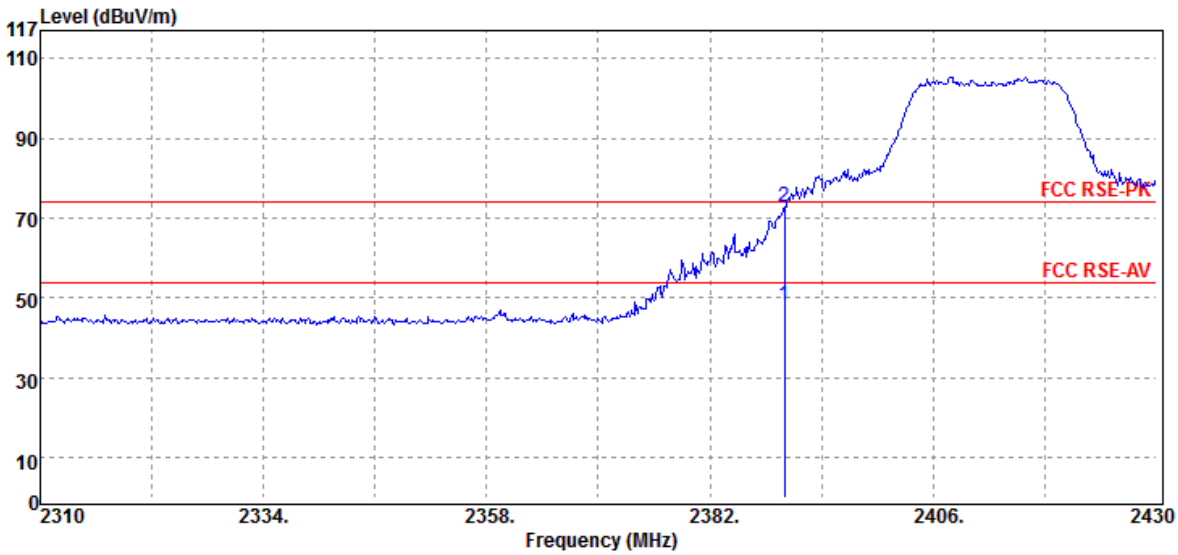
Radiated Band Edge Measurement Result (802.11g)

Operation Band	:802.11g	Test Date	:2017-05-12
Fundamental Frequency	:2412 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Bandedge CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2390.00	E	Average	49.97	-1.74	48.23	54.00	-5.77
2390.00	E	Peak	74.79	-1.74	73.05	74.00	-0.95

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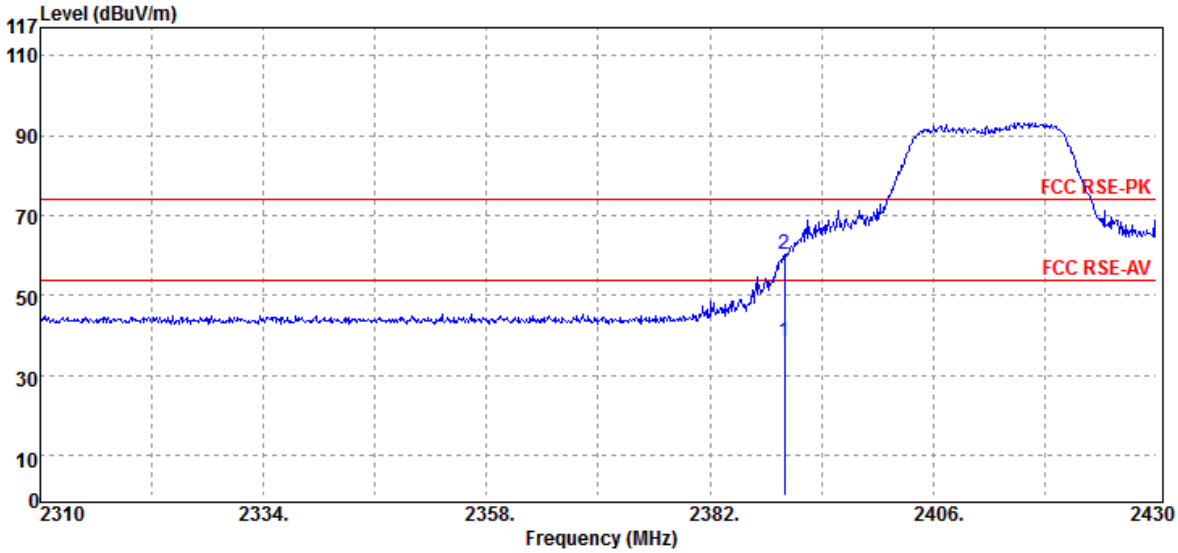
Operation Band	:802.11g	Test Date	:2017-05-12
Fundamental Frequency	:2412 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Bandedge CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2390.00	E	Average	40.26	-1.74	38.52	54.00	-15.48
2390.00	E	Peak	62.01	-1.74	60.27	74.00	-13.73

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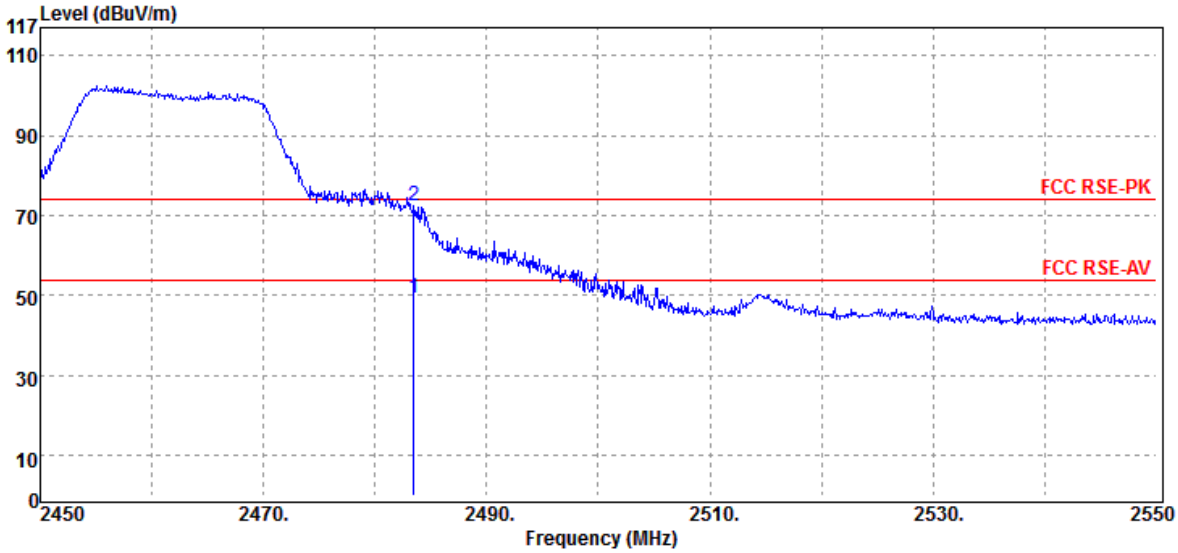
Operation Band	:802.11g	Test Date	:2017-05-12
Fundamental Frequency	:2462 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Bandedge CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2483.50	E	Average	51.01	-1.62	49.39	54.00	-4.61
2483.50	E	Peak	74.26	-1.62	72.64	74.00	-1.36

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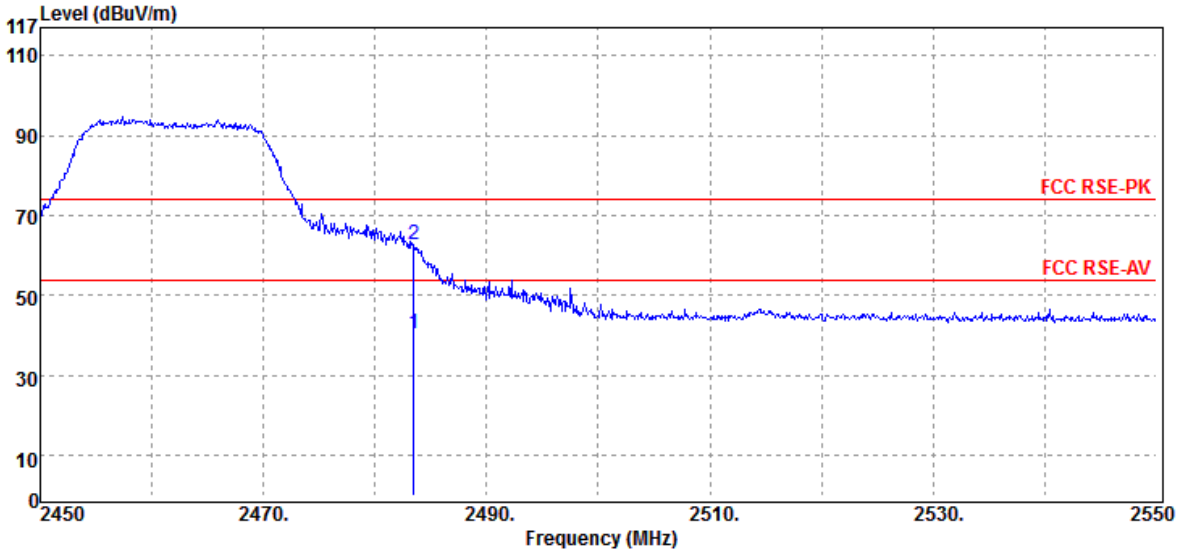
Operation Band	:802.11g	Test Date	:2017-05-12
Fundamental Frequency	:2462 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Bandedge CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2483.50	E	Average	42.21	-1.62	40.59	54.00	-13.41
2483.50	E	Peak	64.29	-1.62	62.67	74.00	-11.33

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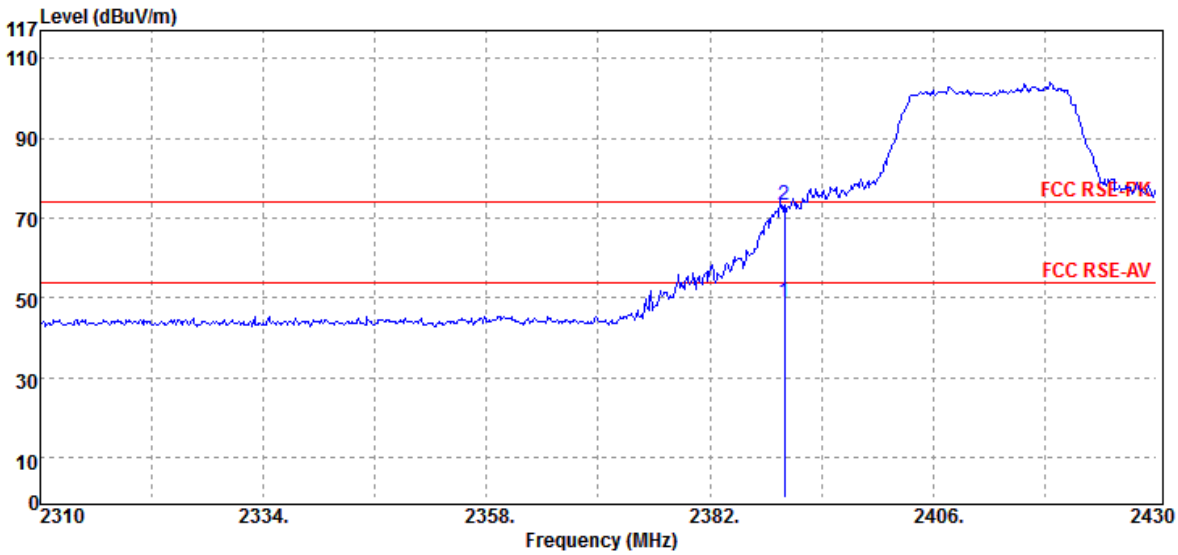
Radiated Band Edge Measurement Result (802.11_HT20)

Operation Band	:802.11n20	Test Date	:2017-05-12
Fundamental Frequency	:2412 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Bandedge CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2390.00	E	Average	50.87	-1.74	49.13	54.00	-4.87
2390.00	E	Peak	74.86	-1.74	73.12	74.00	-0.88

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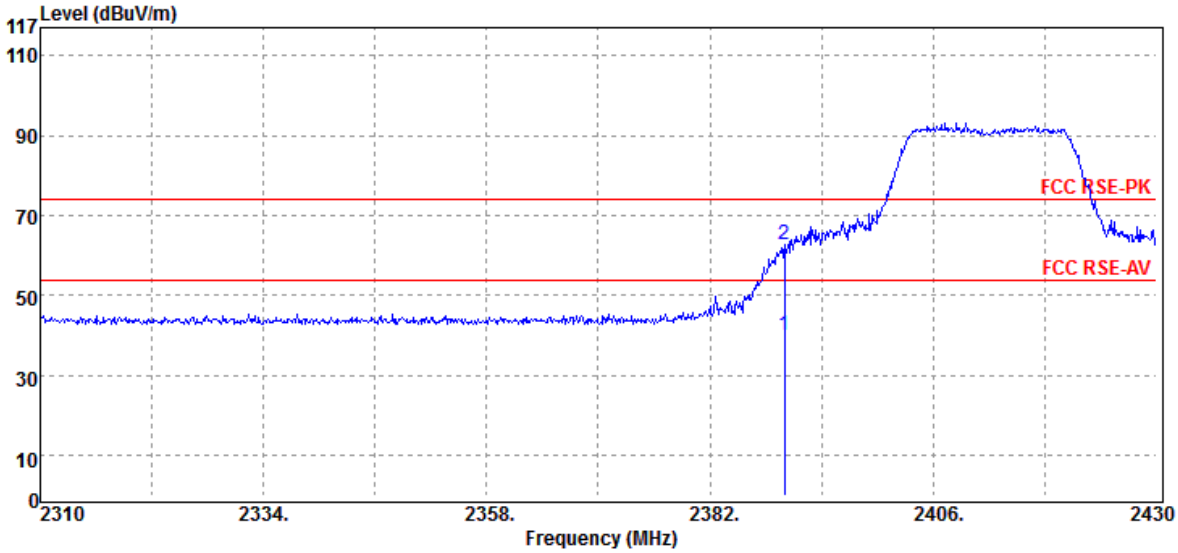
Operation Band	:802.11n20	Test Date	:2017-05-12
Fundamental Frequency	:2412 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Bandedge CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2390.00	E	Average	41.86	-1.74	40.12	54.00	-13.88
2390.00	E	Peak	64.56	-1.74	62.82	74.00	-11.18

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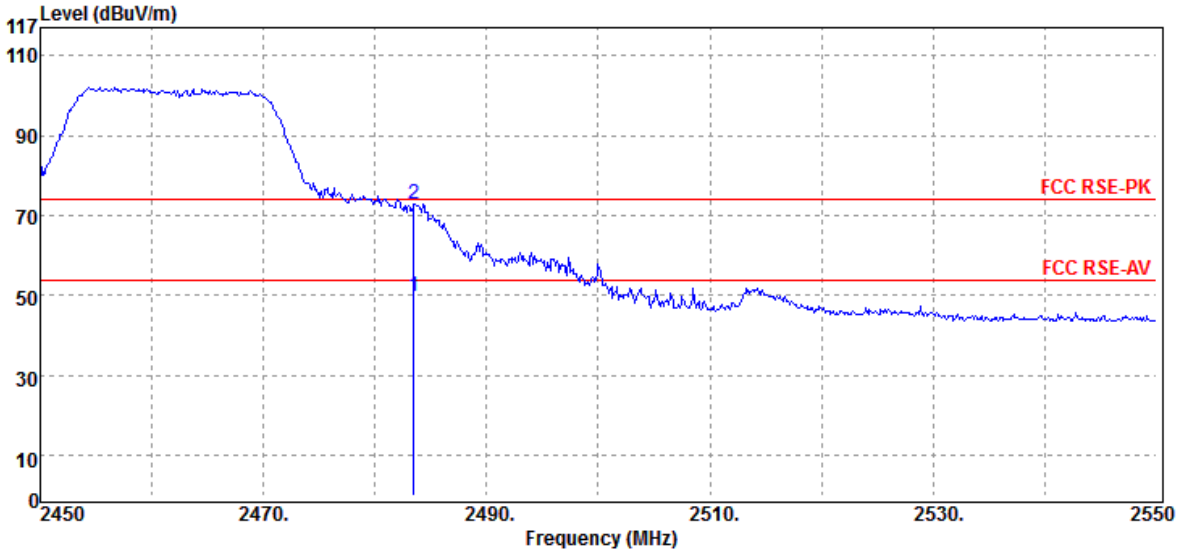
Operation Band	:802.11n20	Test Date	:2017-05-12
Fundamental Frequency	:2462 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Bandedge CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2483.50	E	Average	51.36	-1.62	49.74	54.00	-4.26
2483.50	E	Peak	74.42	-1.62	72.80	74.00	-1.20

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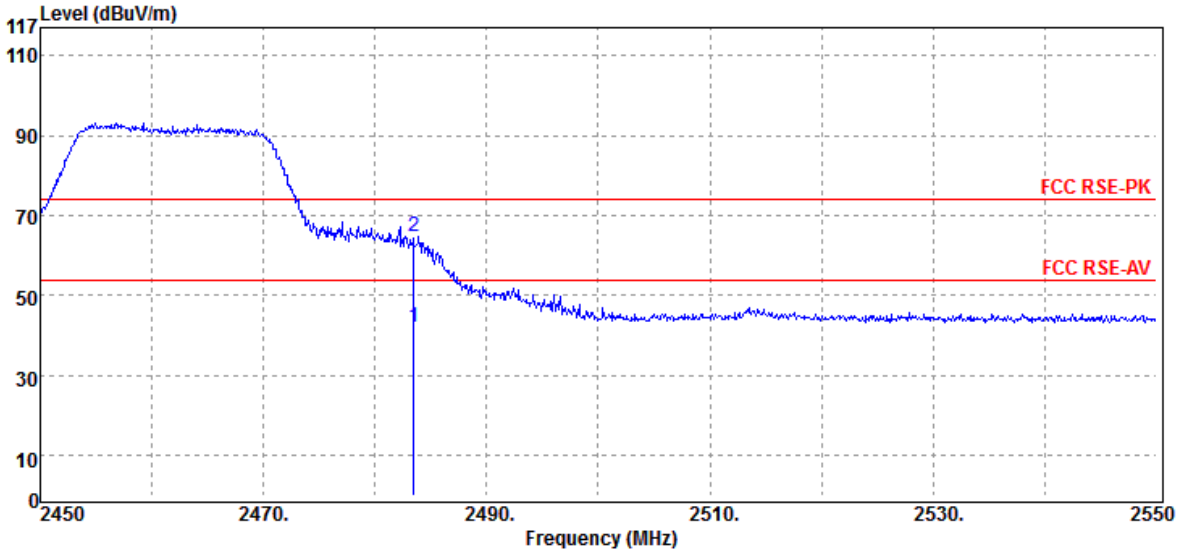
Operation Band	:802.11n20	Test Date	:2017-05-12
Fundamental Frequency	:2462 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Bandedge CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2483.50	E	Average	43.72	-1.62	42.10	54.00	-11.90
2483.50	E	Peak	66.26	-1.62	64.64	74.00	-9.36

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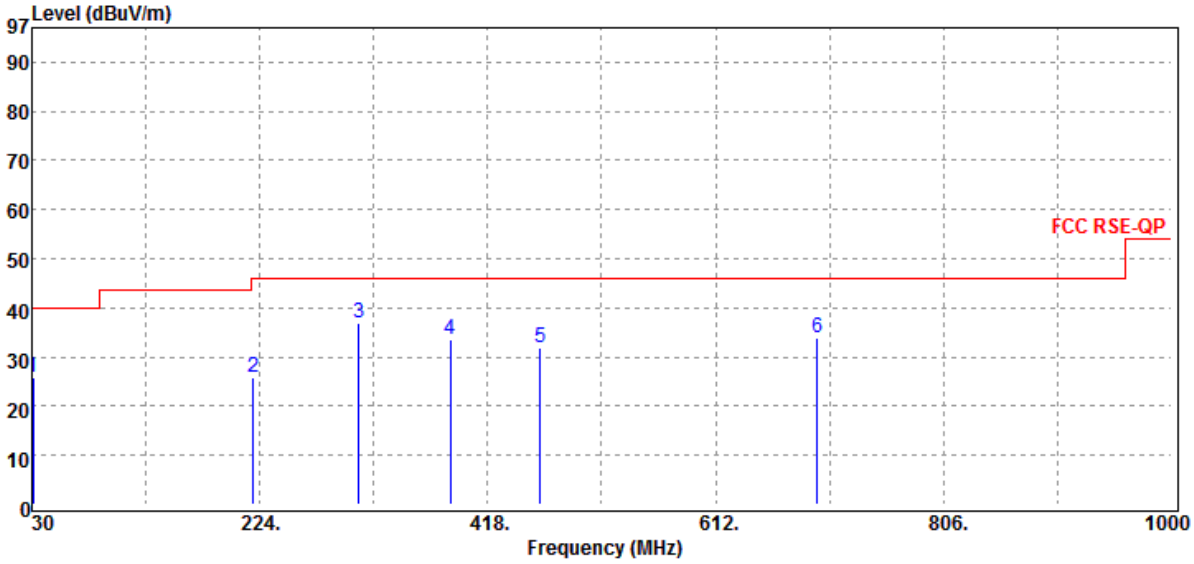
Below 1GHz Worst-Case Data:

Radiated Spurious Emission Measurement Result (802.11 g)

Operation Band	:802.11 g	Test Date	:2017-05-16
Fundamental Frequency	:2412 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
30.97	S	Peak	34.90	-9.15	25.75	40.00	-14.25
218.18	S	Peak	35.10	-9.33	25.77	46.00	-20.23
308.39	S	Peak	42.61	-5.57	37.04	46.00	-8.96
385.99	S	Peak	37.91	-4.31	33.60	46.00	-12.40
462.62	S	Peak	34.45	-2.56	31.89	46.00	-14.11
698.33	S	Peak	32.35	1.40	33.75	46.00	-12.25

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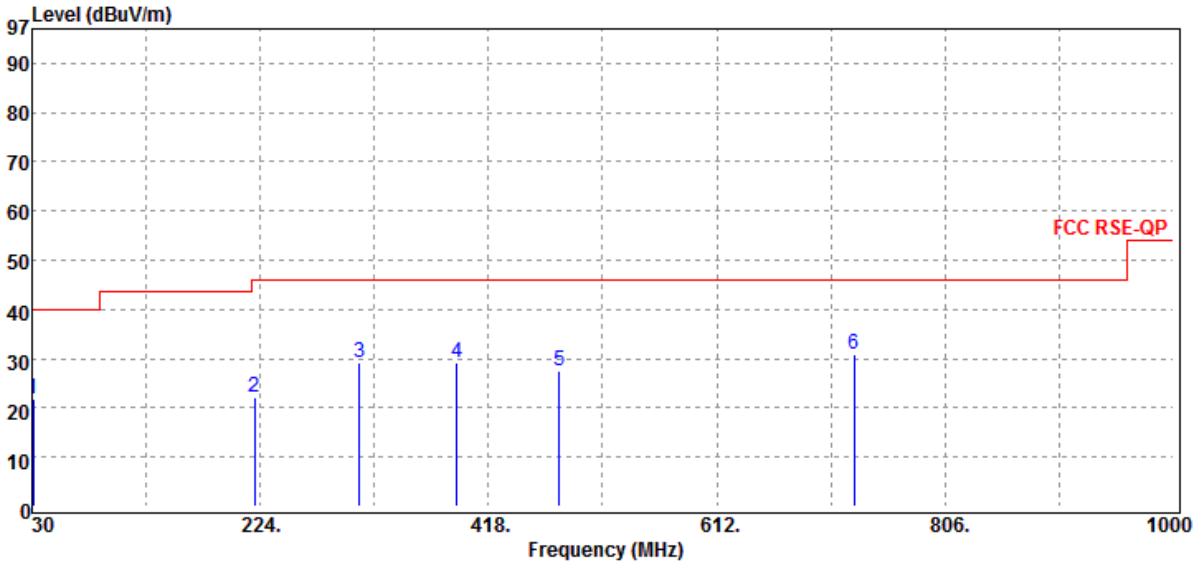
Operation Band	:802.11 g	Test Date	:2017-05-16
Fundamental Frequency	:2412 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
30.97	S	Peak	31.13	-9.15	21.98	40.00	-18.02
219.15	S	Peak	31.45	-9.28	22.17	46.00	-23.83
308.39	S	Peak	34.72	-5.57	29.15	46.00	-16.85
390.84	S	Peak	33.49	-4.18	29.31	46.00	-16.69
478.14	S	Peak	29.93	-2.43	27.50	46.00	-18.50
728.40	S	Peak	29.28	1.65	30.93	46.00	-15.07

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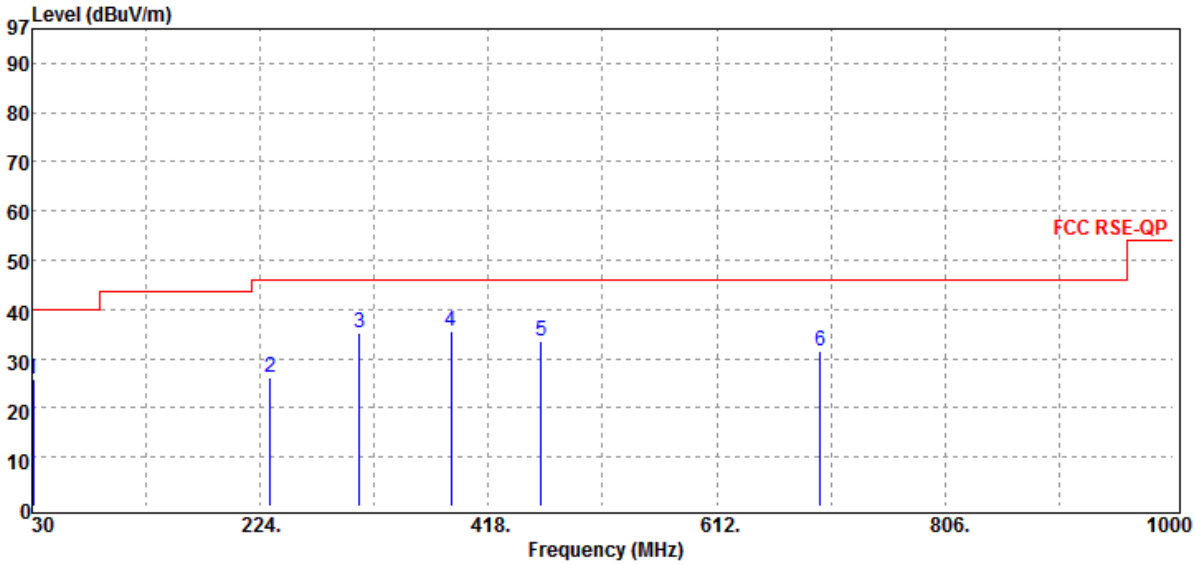
Operation Band	:802.11 g	Test Date	:2017-07-04
Fundamental Frequency	:2437 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
30.97	S	Peak	34.95	-9.15	25.80	40.00	-14.20
232.73	S	Peak	34.80	-8.73	26.07	46.00	-19.93
308.39	S	Peak	40.67	-5.57	35.10	46.00	-10.90
385.99	S	Peak	39.79	-4.31	35.48	46.00	-10.52
462.62	S	Peak	35.98	-2.56	33.42	46.00	-12.58
700.27	S	Peak	30.03	1.44	31.47	46.00	-14.53

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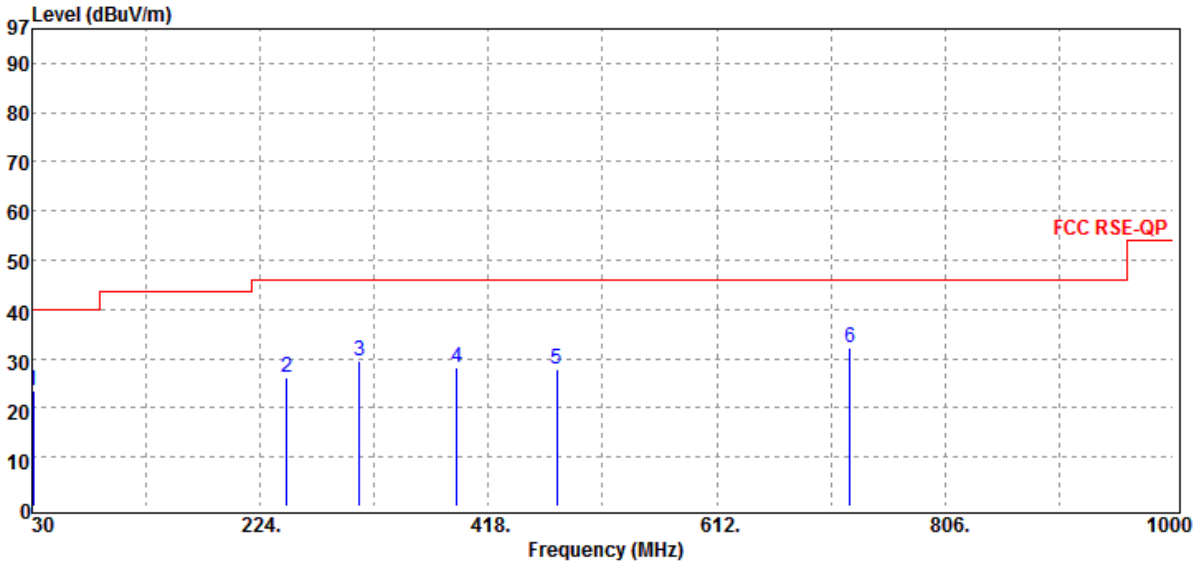
Operation Band	:802.11 g	Test Date	:2017-07-04
Fundamental Frequency	:2437 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
30.97	S	Peak	32.64	-9.15	23.49	40.00	-16.51
246.31	S	Peak	34.23	-8.01	26.22	46.00	-19.78
308.39	S	Peak	35.17	-5.57	29.60	46.00	-16.40
390.84	S	Peak	32.36	-4.18	28.18	46.00	-17.82
476.20	S	Peak	30.22	-2.45	27.77	46.00	-18.23
725.49	S	Peak	30.36	1.74	32.10	46.00	-13.90

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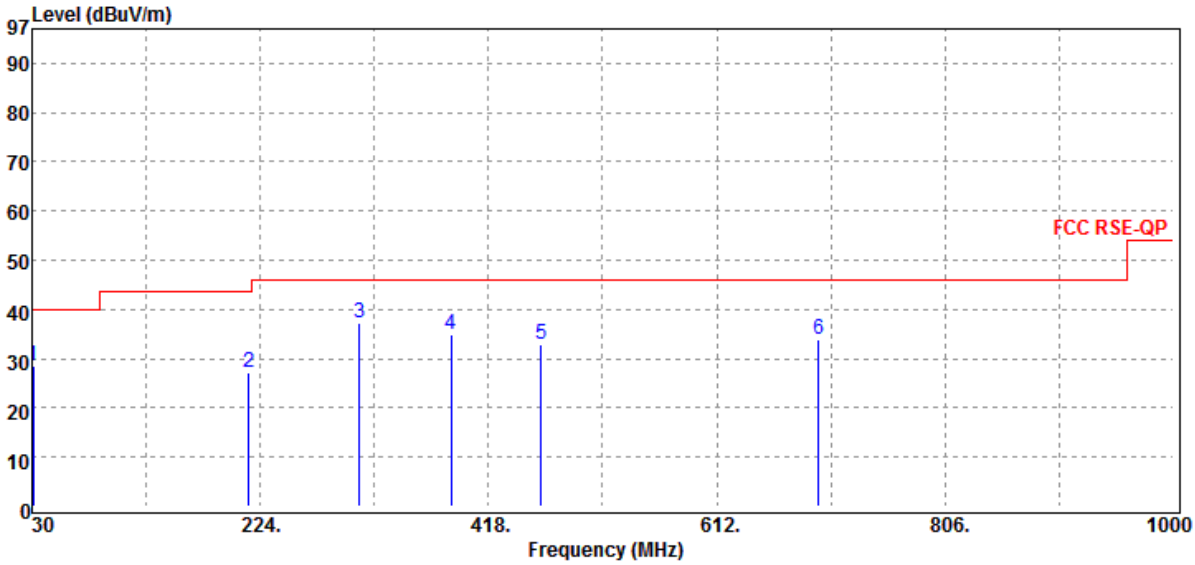
Operation Band	:802.11 g	Test Date	:2017-05-16
Fundamental Frequency	:2462 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
30.97	S	Peak	37.61	-9.15	28.46	40.00	-11.54
214.30	S	Peak	36.69	-9.55	27.14	43.50	-16.36
308.39	S	Peak	42.77	-5.57	37.20	46.00	-8.80
385.99	S	Peak	39.16	-4.31	34.85	46.00	-11.15
462.62	S	Peak	35.29	-2.56	32.73	46.00	-13.27
698.33	S	Peak	32.37	1.40	33.77	46.00	-12.23

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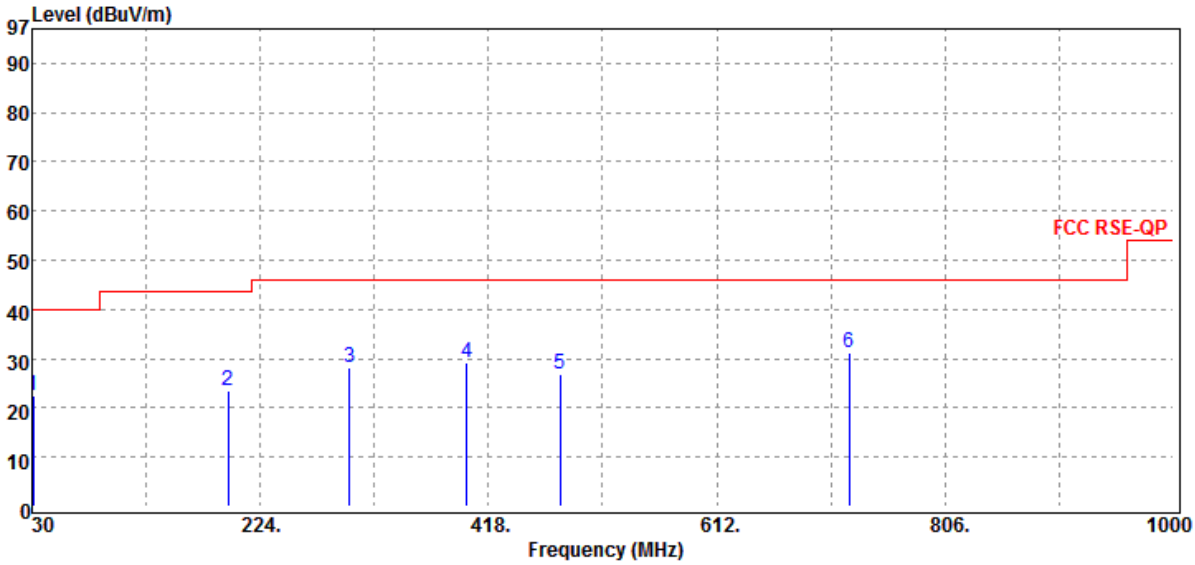
Operation Band	:802.11 g	Test Date	:2017-05-16
Fundamental Frequency	:2462 MHz	Temp./Humi.	:22 deg_C / 61 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
30.97	S	Peak	31.59	-9.15	22.44	40.00	-17.56
196.84	S	Peak	32.99	-9.56	23.43	43.50	-20.07
299.66	S	Peak	33.99	-5.93	28.06	46.00	-17.94
399.57	S	Peak	33.07	-3.92	29.15	46.00	-16.85
479.11	S	Peak	29.27	-2.39	26.88	46.00	-19.12
724.52	S	Peak	29.39	1.69	31.08	46.00	-14.92

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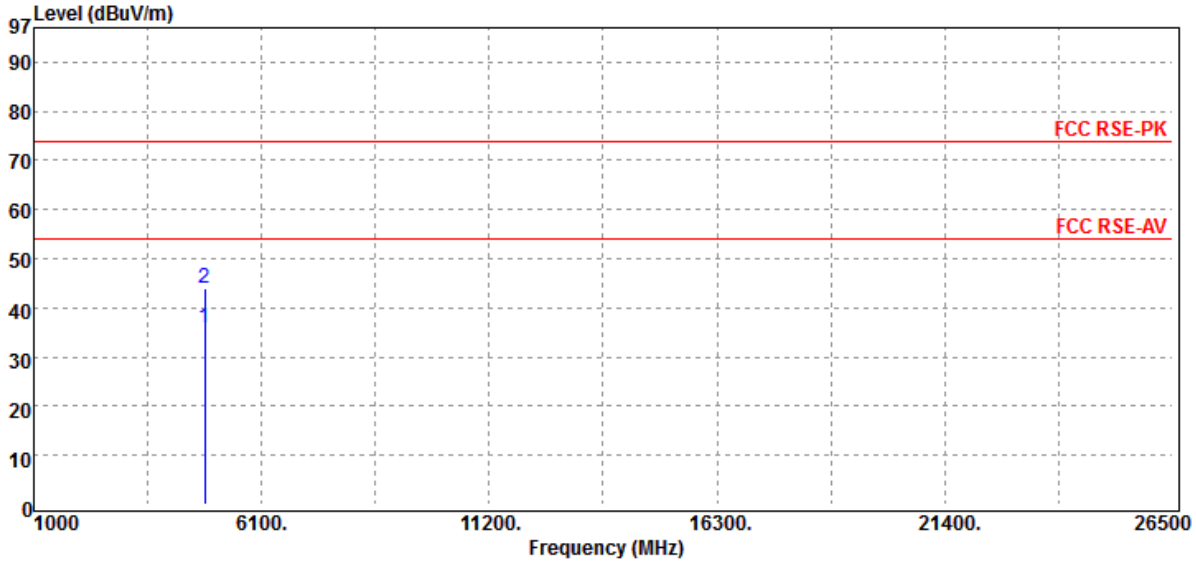
Above 1GHz Data:

Radiated Spurious Emission Measurement Result (802.11 b)

Operation Band	:802.11b	Test Date	:2017-07-03
Fundamental Frequency	:2412 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4824.00	H	Average	31.06	4.93	35.99	54.00	-18.01
4824.00	H	Peak	39.06	4.93	43.99	74.00	-30.01

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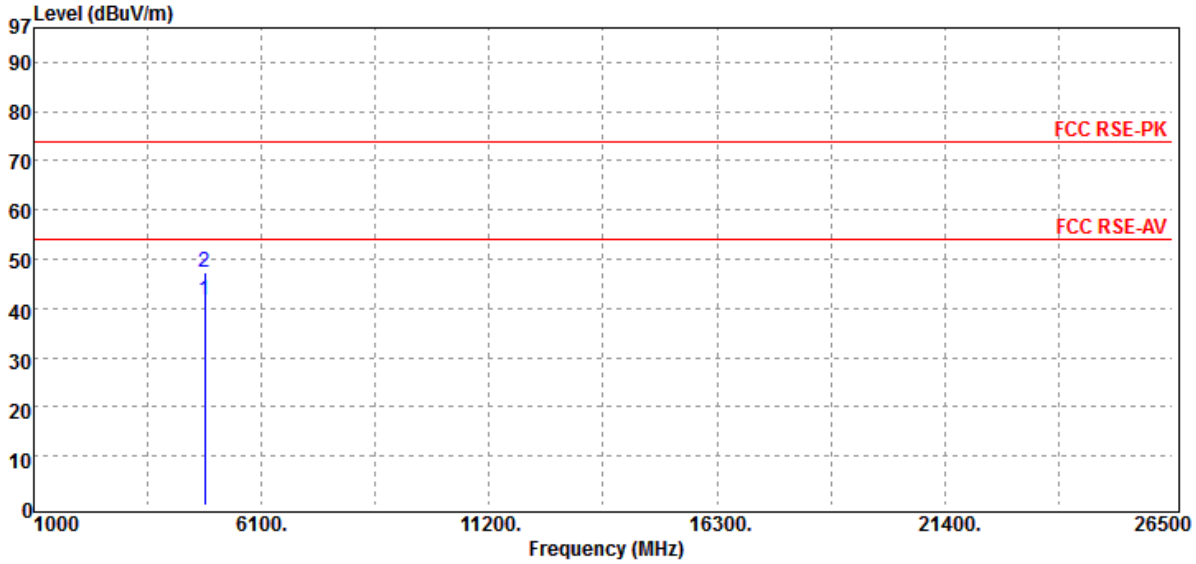
Operation Band	:802.11b	Test Date	:2017-07-03
Fundamental Frequency	:2412 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4824.00	H	Average	36.56	4.93	41.49	54.00	-12.51
4824.00	H	Peak	42.33	4.93	47.26	74.00	-26.74

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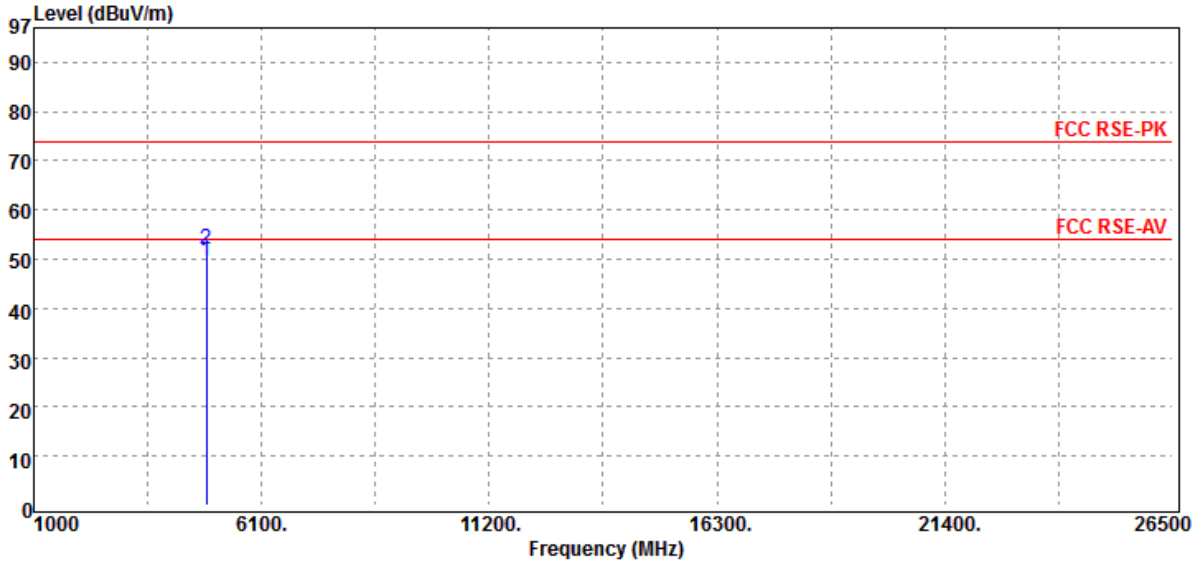
Operation Band	:802.11b	Test Date	:2017-07-03
Fundamental Frequency	:2437 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4874.00	H	Average	44.59	5.13	49.72	54.00	-4.28
4874.00	H	Peak	46.94	5.13	52.07	74.00	-21.93

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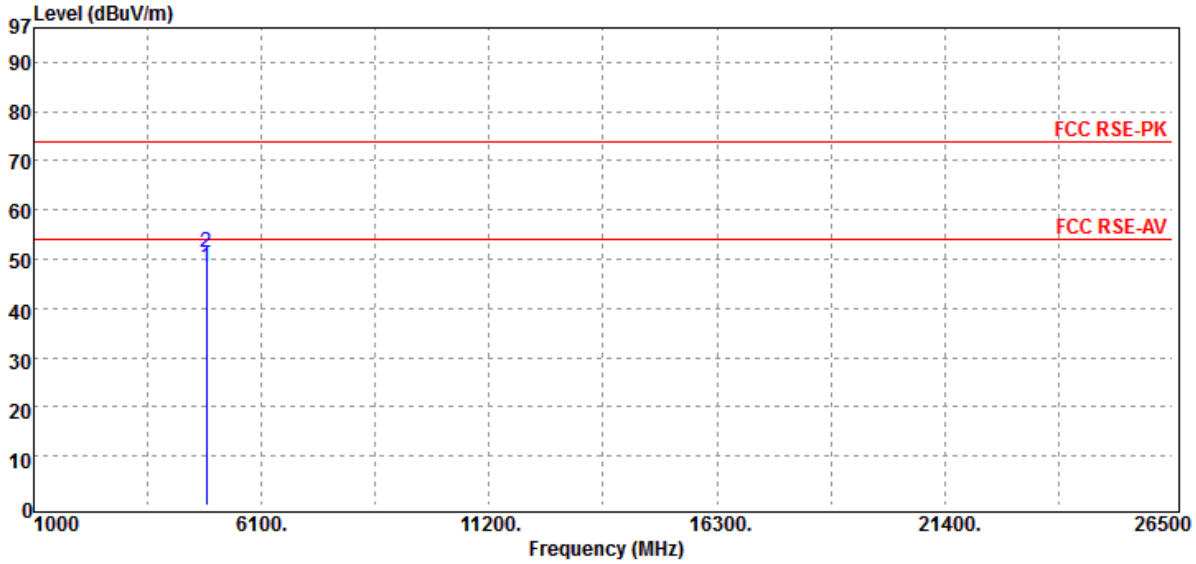
Operation Band	:802.11b	Test Date	:2017-07-03
Fundamental Frequency	:2437 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4874.00	H	Average	43.12	5.13	48.25	54.00	-5.75
4874.00	H	Peak	46.32	5.13	51.45	74.00	-22.55

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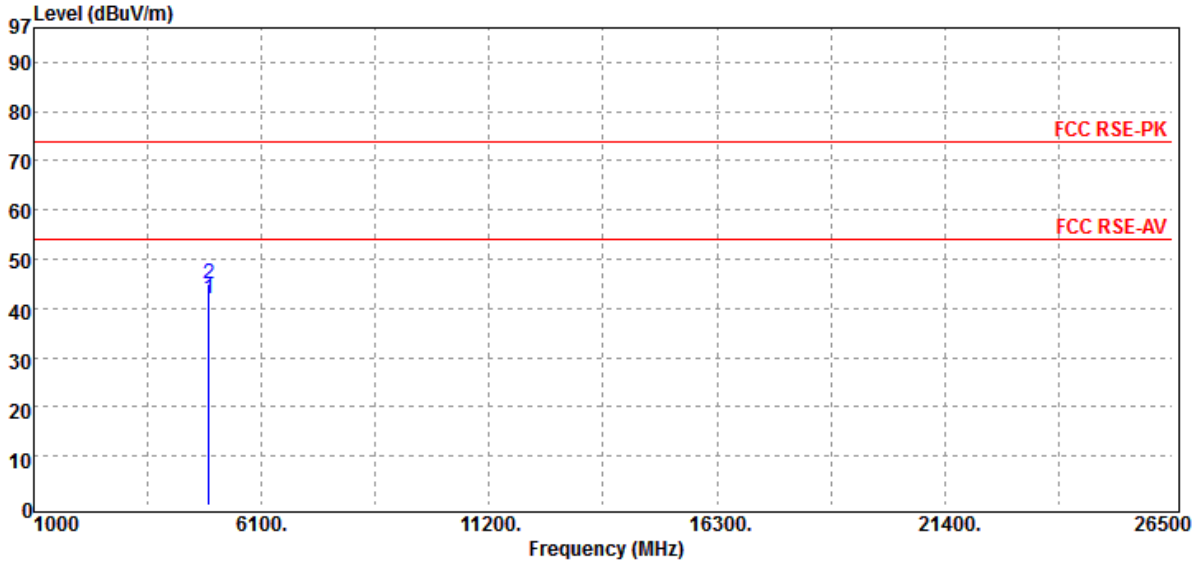
Operation Band	:802.11b	Test Date	:2017-07-03
Fundamental Frequency	:2462 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4924.00	H	Average	36.54	5.25	41.79	54.00	-12.21
4924.00	H	Peak	39.76	5.25	45.01	74.00	-28.99

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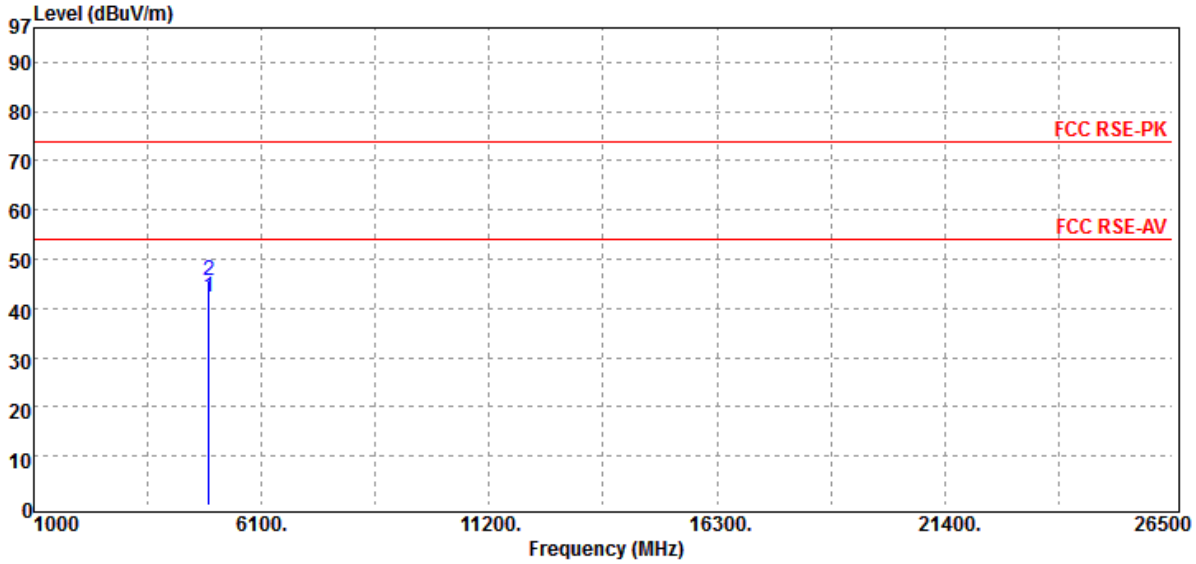
Operation Band	:802.11b	Test Date	:2017-07-03
Fundamental Frequency	:2462 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4924.00	H	Average	37.20	5.25	42.45	54.00	-11.55
4924.00	H	Peak	40.29	5.25	45.54	74.00	-28.46

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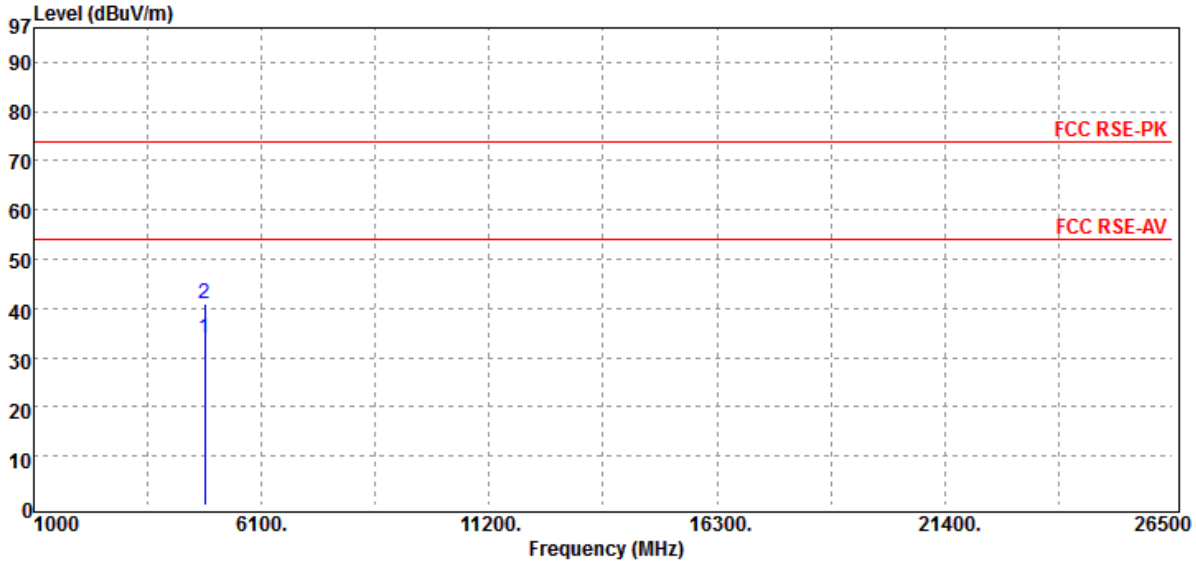
Radiated Spurious Emission Measurement Result (802.11 g)

Operation Band	:802.11g	Test Date	:2017-07-03
Fundamental Frequency	:2412 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4824.00	H	Average	28.90	4.93	33.83	54.00	-20.17
4824.00	H	Peak	36.08	4.93	41.01	74.00	-32.99

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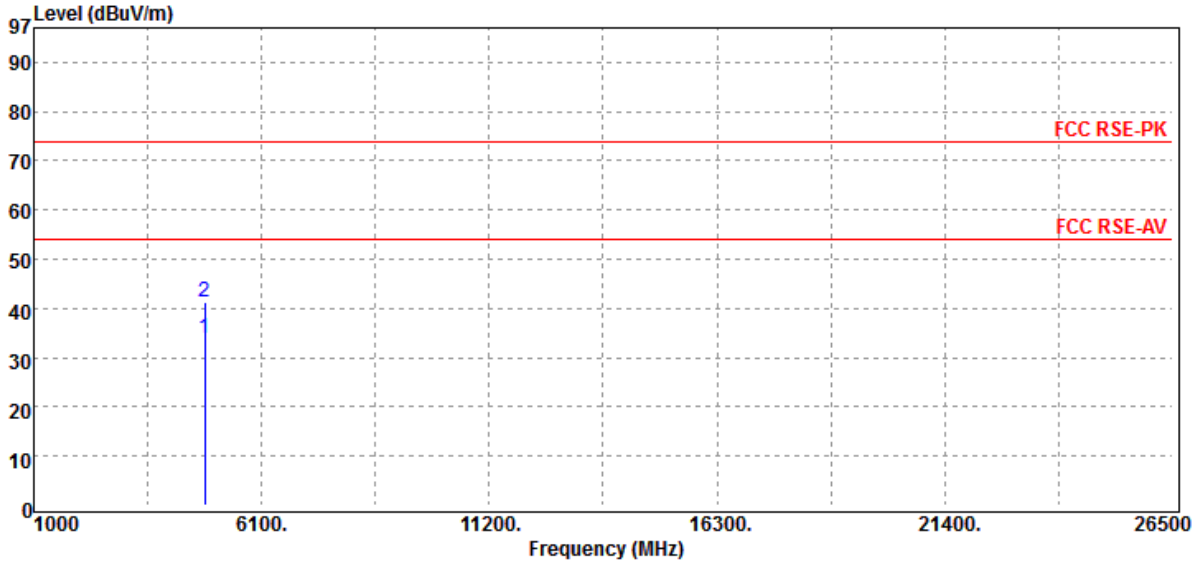
Operation Band	:802.11g	Test Date	:2017-07-03
Fundamental Frequency	:2412 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4824.00	H	Average	28.91	4.93	33.84	54.00	-20.16
4824.00	H	Peak	36.41	4.93	41.34	74.00	-32.66

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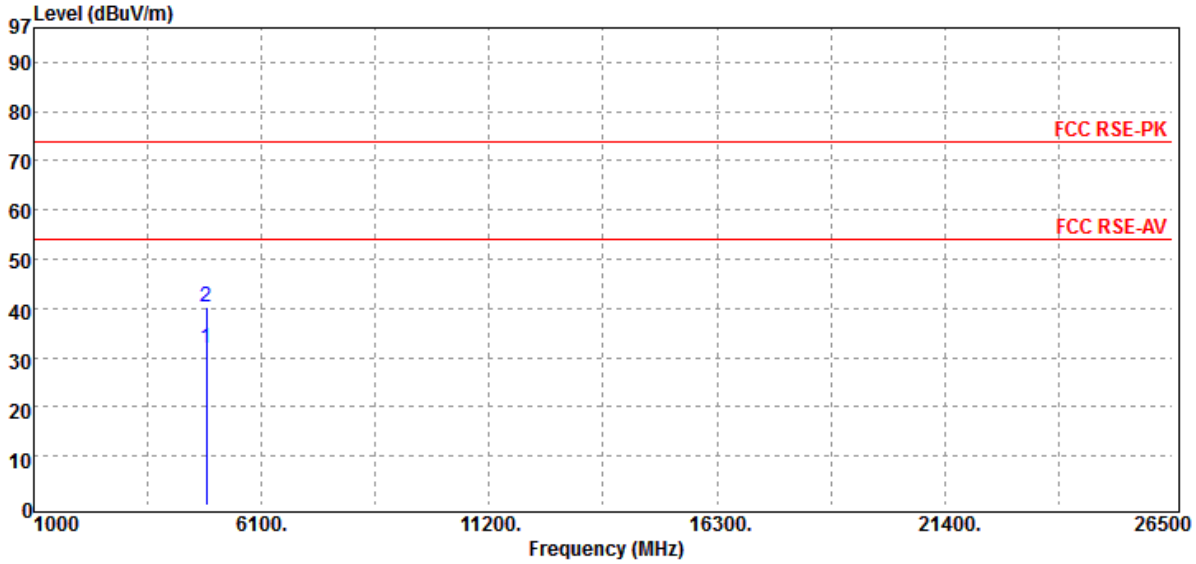
Operation Band	:802.11g	Test Date	:2017-07-03
Fundamental Frequency	:2437 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4874.00	H	Average	26.66	5.13	31.79	54.00	-22.21
4874.00	H	Peak	35.26	5.13	40.39	74.00	-33.61

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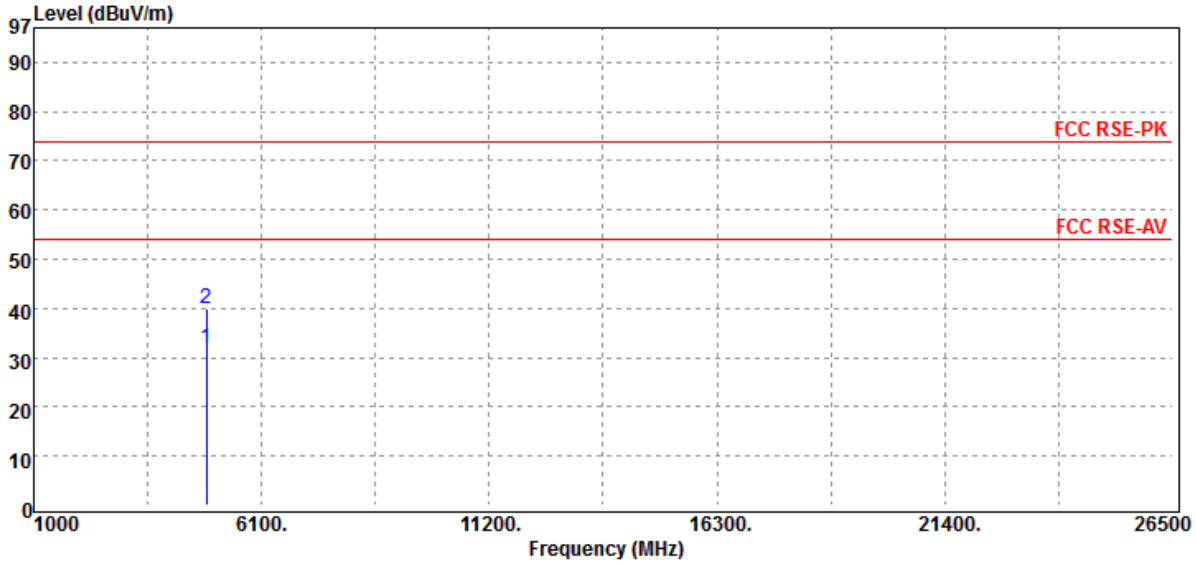
Operation Band	:802.11g	Test Date	:2017-07-03
Fundamental Frequency	:2437 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4874.00	H	Average	26.72	5.13	31.85	54.00	-22.15
4874.00	H	Peak	34.91	5.13	40.04	74.00	-33.96

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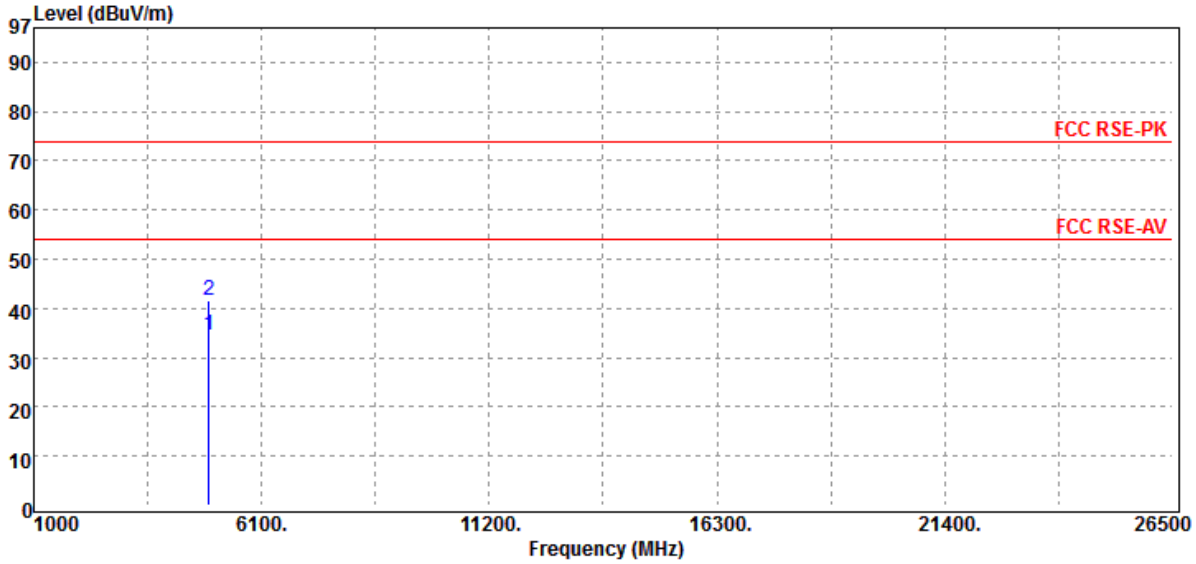
Operation Band	:802.11g	Test Date	:2017-07-03
Fundamental Frequency	:2462 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4924.00	H	Average	29.41	5.25	34.66	54.00	-19.34
4924.00	H	Peak	36.32	5.25	41.57	74.00	-32.43

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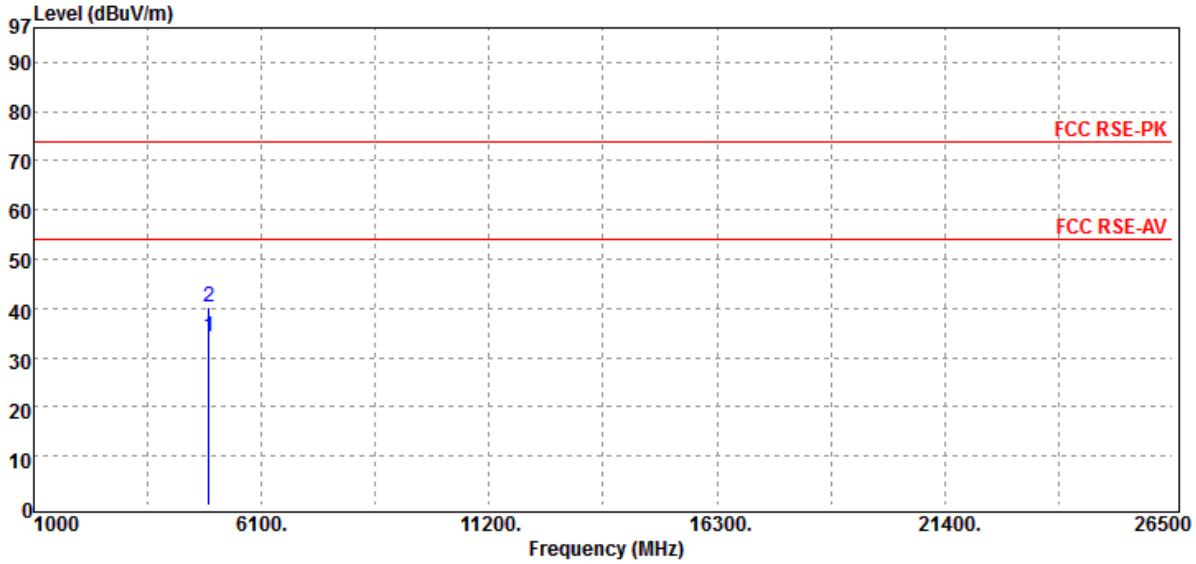
Operation Band	:802.11g	Test Date	:2017-07-03
Fundamental Frequency	:2462 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4924.00	H	Average	29.14	5.25	34.39	54.00	-19.61
4924.00	H	Peak	35.15	5.25	40.40	74.00	-33.60

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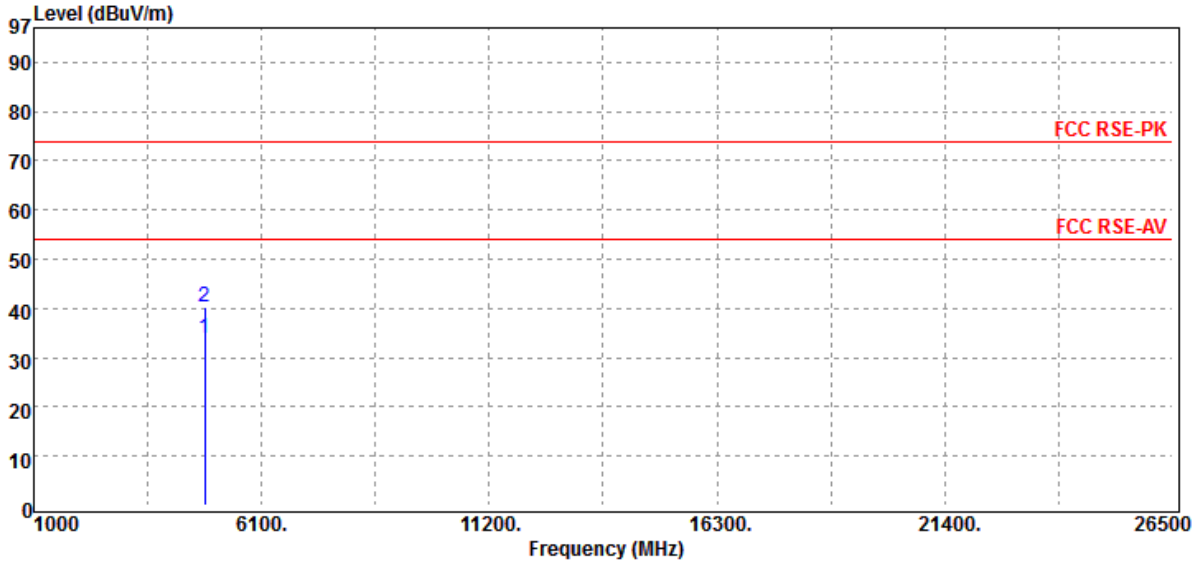
Radiated Spurious Emission Measurement Result (802.11_HT20)

Operation Band	:802.11n20	Test Date	:2017-07-03
Fundamental Frequency	:2412 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4824.00	H	Average	28.88	4.93	33.81	54.00	-20.19
4824.00	H	Peak	35.34	4.93	40.27	74.00	-33.73

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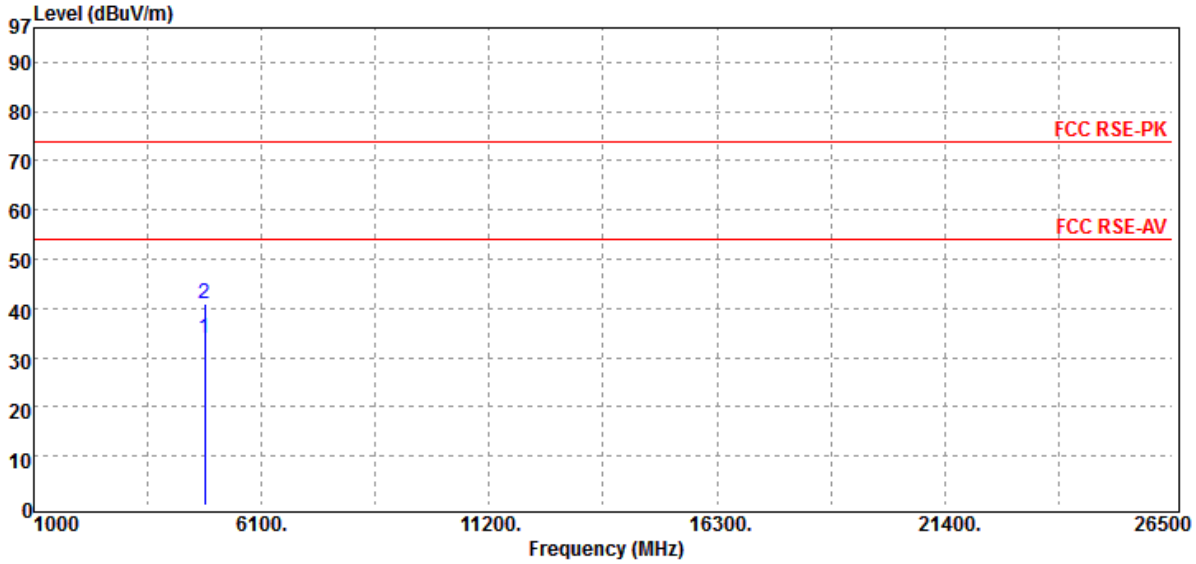
Operation Band	:802.11n20	Test Date	:2017-07-03
Fundamental Frequency	:2412 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4824.00	H	Average	28.88	4.93	33.81	54.00	-20.19
4824.00	H	Peak	35.90	4.93	40.83	74.00	-33.17

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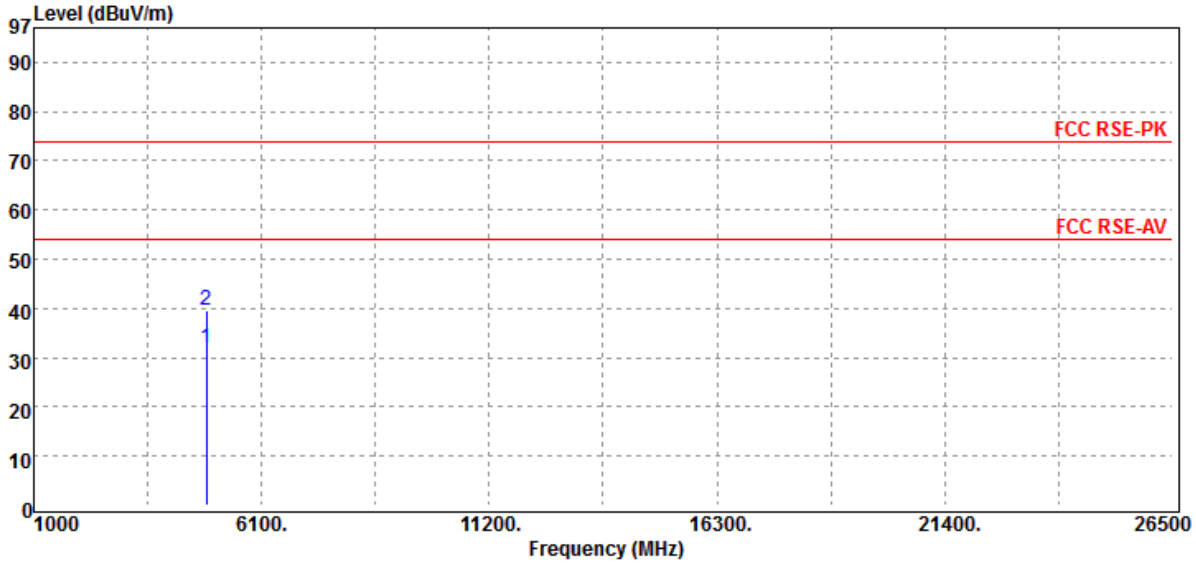
Operation Band	:802.11n20	Test Date	:2017-07-03
Fundamental Frequency	:2437 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4874.00	H	Average	26.60	5.13	31.73	54.00	-22.27
4874.00	H	Peak	34.49	5.13	39.62	74.00	-34.38

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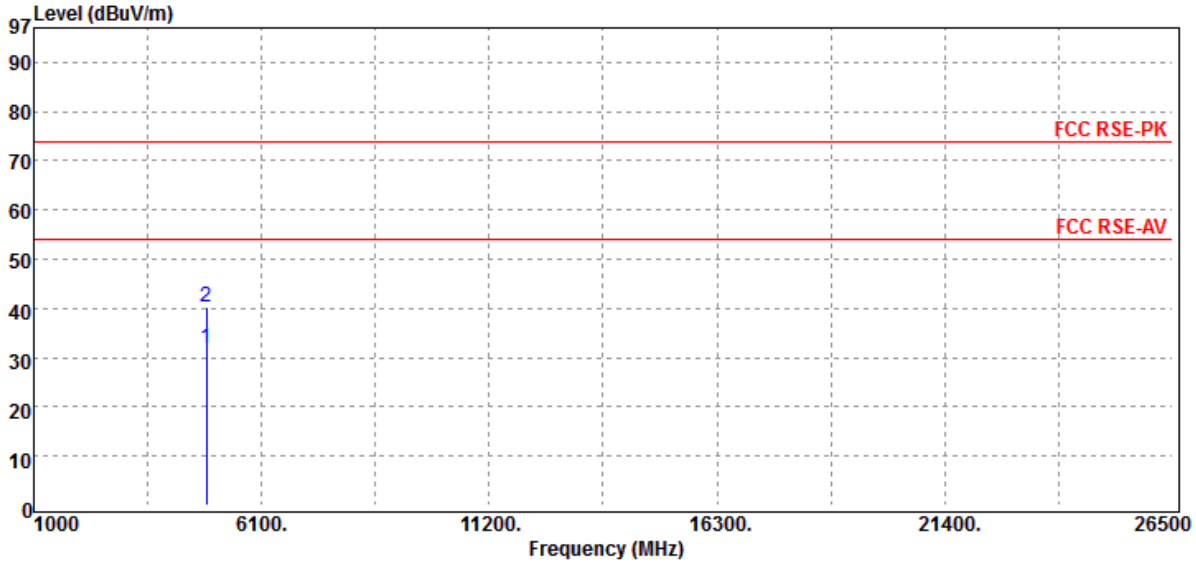
Operation Band	:802.11n20	Test Date	:2017-07-03
Fundamental Frequency	:2437 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4874.00	H	Average	26.62	5.13	31.75	54.00	-22.25
4874.00	H	Peak	35.22	5.13	40.35	74.00	-33.65

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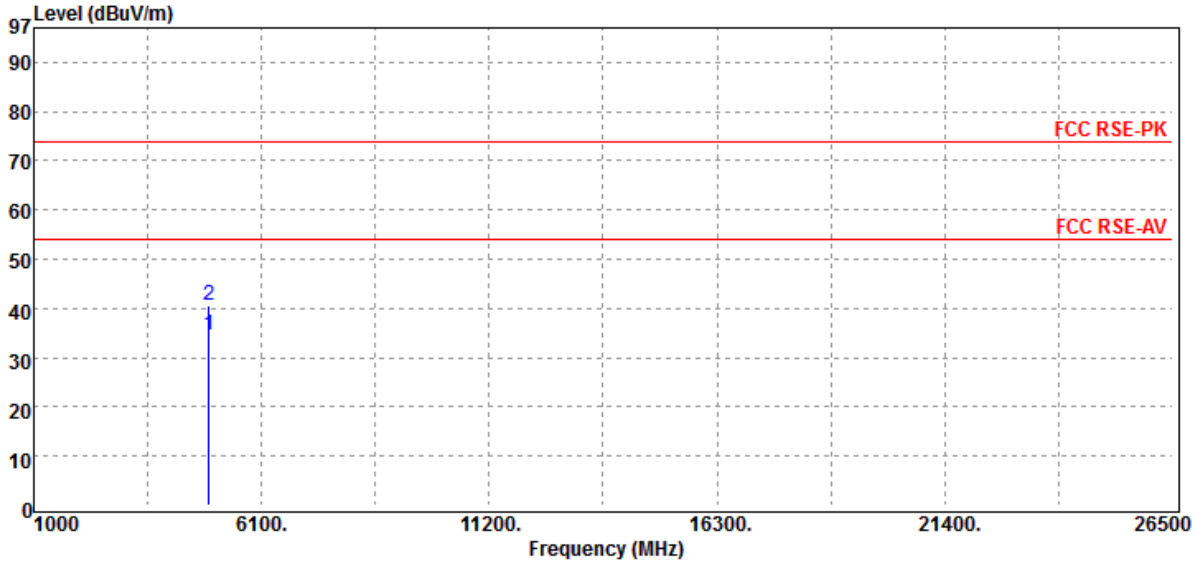
Operation Band	:802.11n20	Test Date	:2017-07-03
Fundamental Frequency	:2462 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4924.00	H	Average	29.17	5.25	34.42	54.00	-19.58
4924.00	H	Peak	35.51	5.25	40.76	74.00	-33.24

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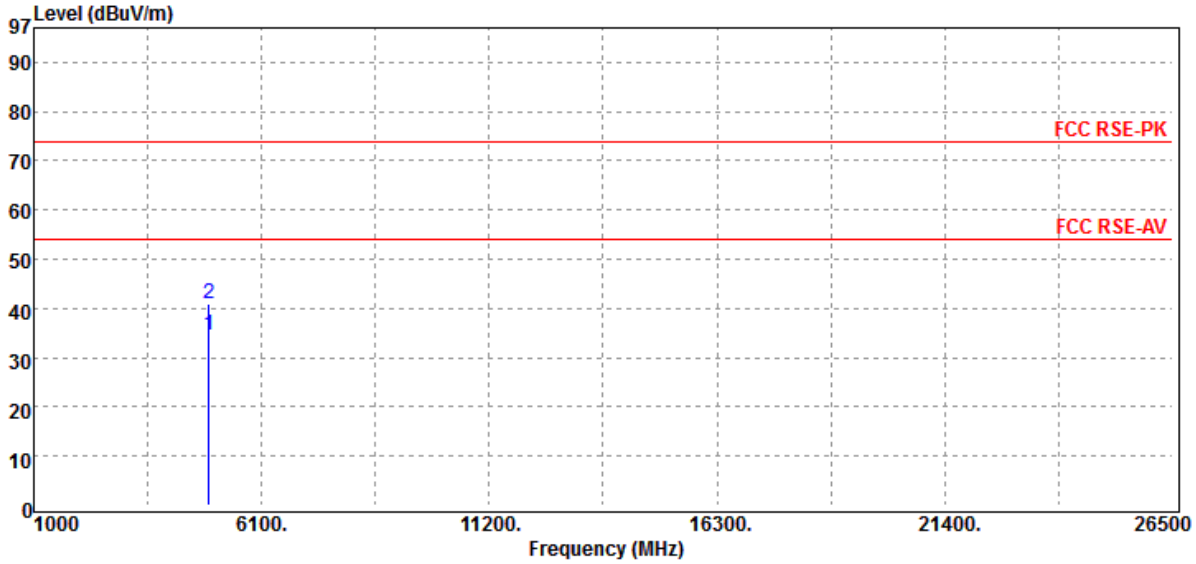
Fundamental Frequency	:2462 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Safe Margin dB
4924.00	H	Average	29.23	5.25	34.48	54.00	-19.52
4924.00	H	Peak	35.72	5.25	40.97	74.00	-33.03

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12 PEAK POWER SPECTRAL DENSITY

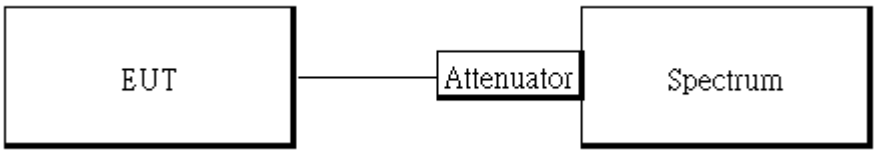
12.1 Standard Applicable

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

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
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
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018

12.3 Test Set-up



12.4 Measurement Procedure

10. Set analyzer center frequency to DTS channel center frequency.
11. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
12. Set the span to 1.5 times the DTS channel bandwidth.
13. Set the RBW = 3 kHz & VBW = 10 kHz.
14. For defining Restricted Band Edge Limit:
    Set the RBW = 100kHz & VBW = 300 kHz
15. Detector = peak.
16. Sweep time = auto couple.
17. Trace mode = max hold.
18. Allow trace to fully stabilize.
19. Use the peak marker function to determine the maximum amplitude level.

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12.5 Measurement Result

POWER DENSITY 802.11b MODE			
Freq. (MHz)	PSD (dBm)	Limit (dBm)	Result
2412	-5.11	8.00	PASS
2437	-5.49	8.00	PASS
2462	-3.80	8.00	PASS

POWER DENSITY 802.11g MODE			
Freq. (MHz)	PSD (dBm)	Limit (dBm)	Result
2412	-12.00	8.00	PASS
2437	-10.44	8.00	PASS
2462	-12.18	8.00	PASS

POWER DENSITY 802.11n HT20 MODE			
Freq. (MHz)	PSD (dBm)	Limit (dBm)	Result
2412	-12.74	8.00	PASS
2437	-9.89	8.00	PASS
2462	-13.39	8.00	PASS

Refer to next page for plots

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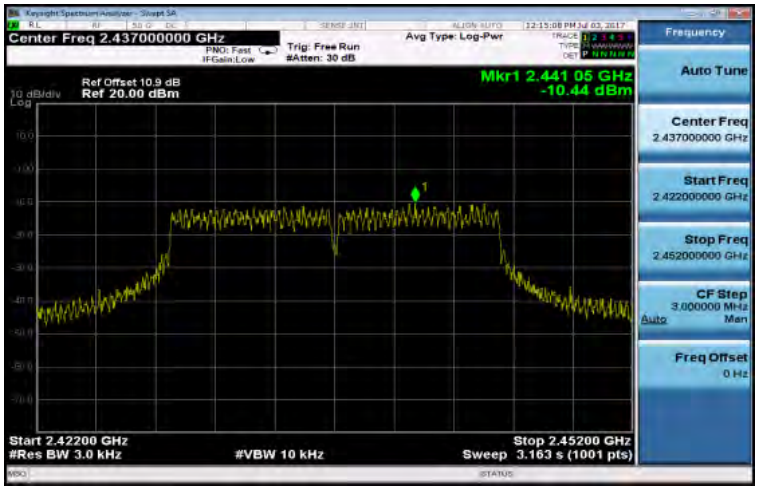
802.11b CH-Low

802.11g CH-Low

802.11b CH-Mid

802.11g CH-Mid



802.11b CH-High

802.11g CH-High

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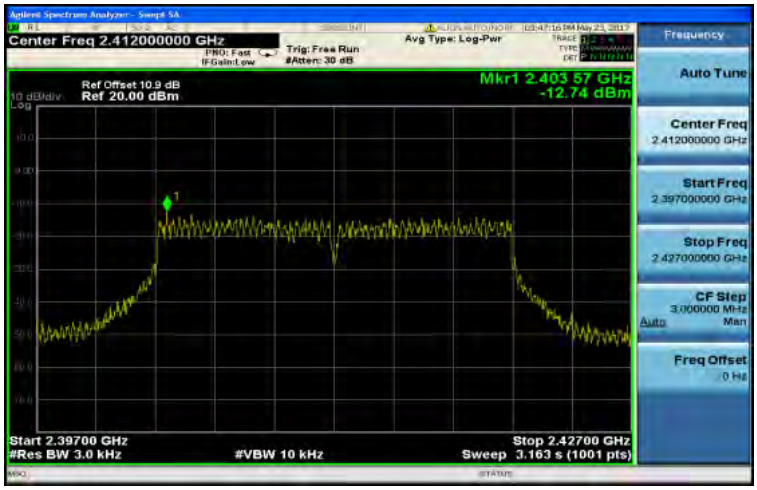
802.11n_20 CH-Low



802.11n_20 CH-Mid

802.11n_20 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.

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14 MAXIMUM PERMISSIBLE EXPOSURE (MPE)

14.1 Standard Applicable

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

This is a Mobile device, the MPE is required.

According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for Maximum Permissive Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	F/1500	30
1500-15000	/	/	1.0	30

F = frequency in MHz

* = Plane-wave equipment power density

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14.2 Maximum Permissible Exposure (MPE) Evaluation (Worst Case)

802.11b Main								
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Peak Output Power (mW)	Limit			RESULT
1	2412	1	19.50	89.13	1 Watt =	30.00	dBm	PASS
6	2437	1	19.75	94.41	1 Watt =	30.00	dBm	PASS
11	2462	1	19.67	92.68	1 Watt =	30.00	dBm	PASS
802.11b Main								
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Max. Avg. Output include tune up tolerance Power (mW)	Limit			RESULT
1	2412	1	17.04	50.58	1 Watt =	30.00	dBm	PASS
6	2437	1	17.41	55.08	1 Watt =	30.00	dBm	PASS
11	2462	1	17.24	52.97	1 Watt =	30.00	dBm	PASS

MPE Prediction (802.11b 2412~2462)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

Max. output power including tune-up tolerancel:	17.41	(dBm)
Max. output power including tune-up tolerancel:	55.08077	(mW)
Duty cycle:	97.85	(%)
Maximum Pav :	53.896533	(mW)
Peak Antenna gain (Maximum):	1.48	(dBi)
Peak Antenna gain (linear):	1.4060475	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2437	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.015	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.015 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 2437MHz.

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15 MAXIMUM PERMISSIBLE EXPOSURE (MPE)

15.1 Standard Applicable

According to RSS 102 March 19,2015 issue 5 §2.5.2 RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

below 20 MHz[6] and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);

at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $22.48/f^{0.5}$W (adjusted for tune-up tolerance), where f is in MHz;

at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);

at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;

This is a Mobile device, at which separation distance between the user and the device's antenna is 20cm. Therefore, section 2.5.2 shall be complied with.

15.2 Maximum Permissible Exposure (MPE) Exemption (Worst Case)

802.11 b:

Max. output power including tune-up tolerance:	17.41	(dBm)
Max. output power including tune-up tolerance:	55.08077	(mW)
Antenna gain (Peak):	1.48	(dBi)
Maximum antenna gain:	1.4060475	(numeric)
Frenquency	2437	MHz
Limit	**2.7030**	W
EIRP	**0.0774**	W

Evaluation Result

The radiated power is 17.41 + 1.48 = 18.89 dBm(EIRP) =77.446mW =0.077446W that is less than or equal to 2.703W. Hence, following section 2.5.2 of RSS102 issue 5, RF exposure evaluation is no longer required.

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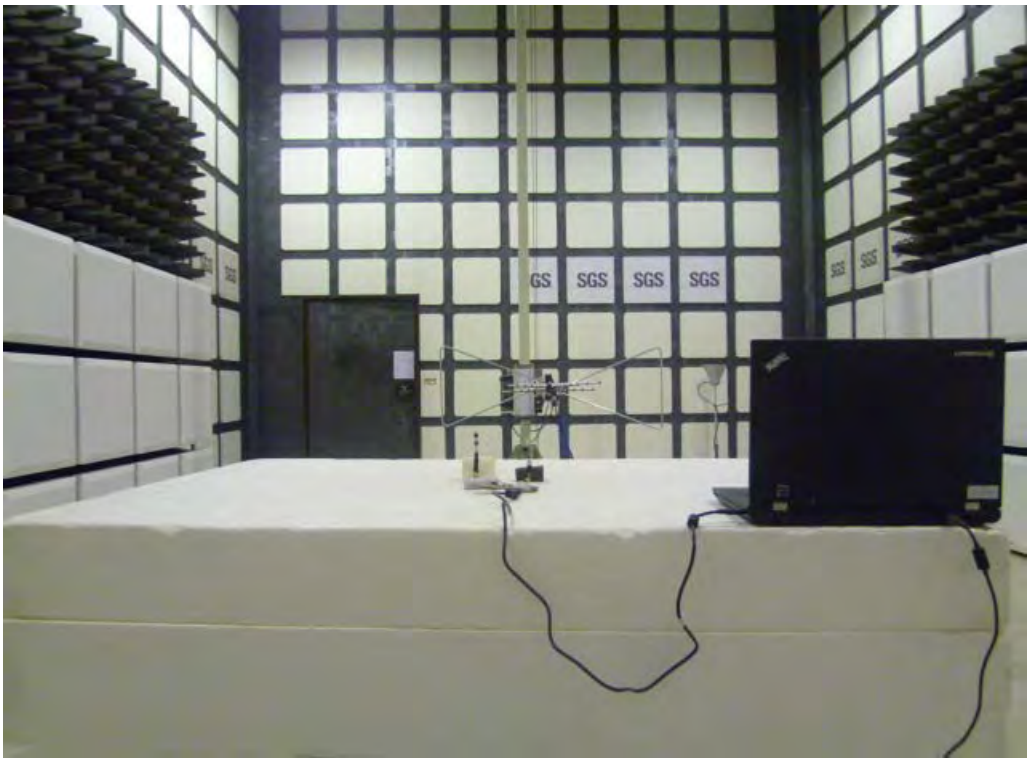
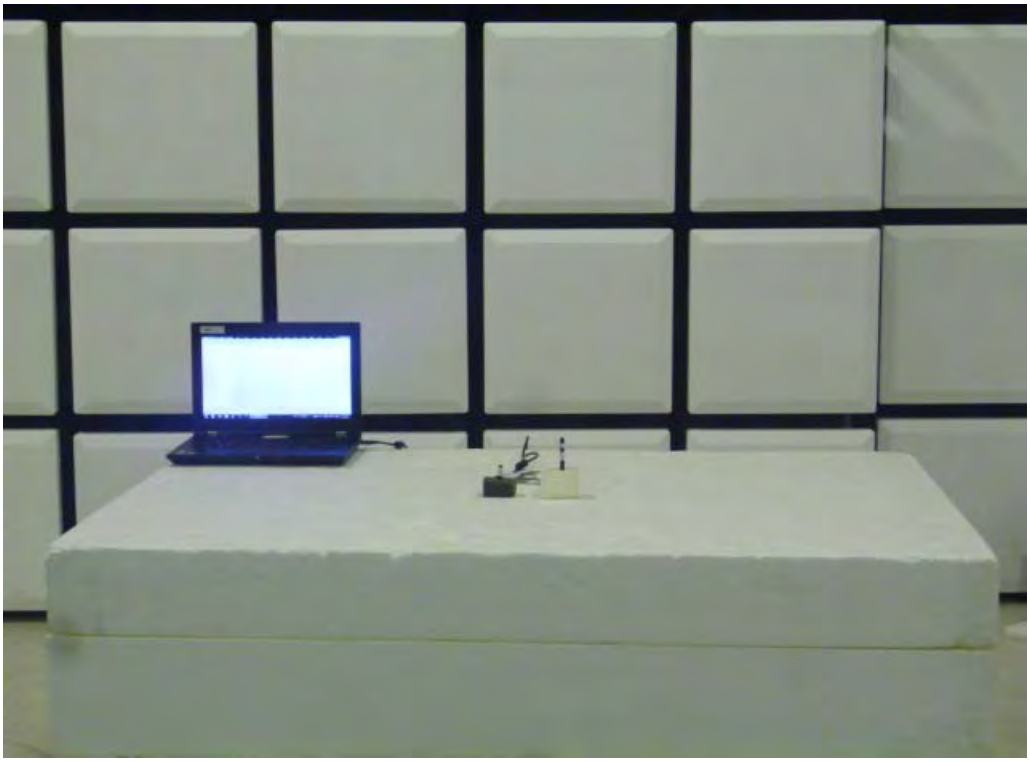
PHOTOGRAPHS OF SET UP

Radiated Emission Set up Photos (Below 1GHz)





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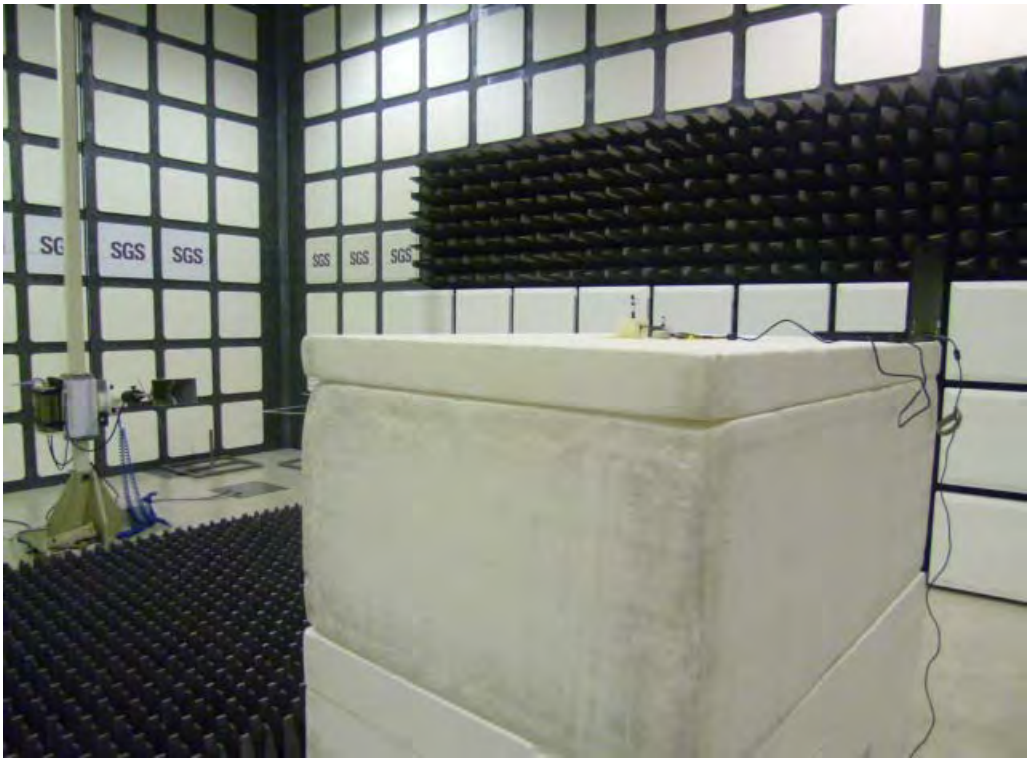
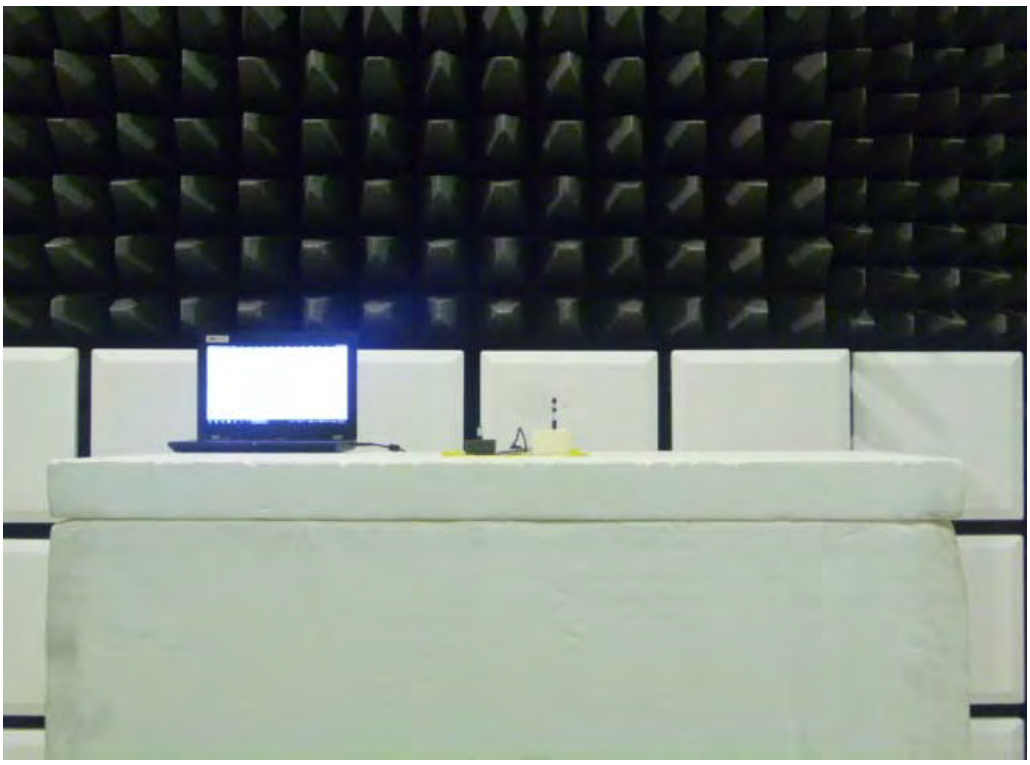
Radiated Emission Set up Photos (Above 1GHz)





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AC Power-line Conducted Emission Set up Photo

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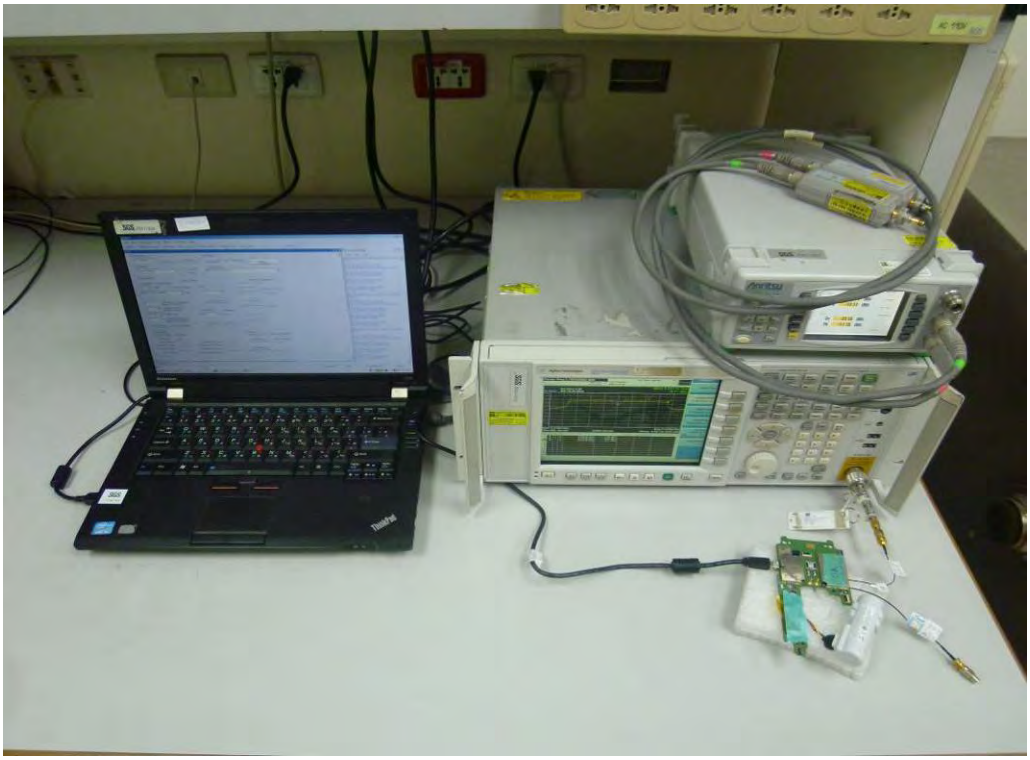
Conducted Setup Photo (Measurement at Antenna Port)



PHOTOGRAPHS OF EUT

Please refer to the attached file(EUT Photo)

~ End of Report ~

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