

## ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

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

OF

**Applicant:** Sharp Corporation, Mobile Communication B.U.  
2-13-1, Hachihonmatsu-lida, Higashi-hiroshima-shi,  
Hiroshima 739-0192, Japan

**Manufacturer:** Sharp Corporation  
1 Takumi-cho, Sakai-ku, Sakai City, Osaka 590-8522, Japan

**Product Name:** Smart Phone

**Report Number:** ER/2019/A0106

**FCC ID:** APYHRO00280

**FCC Rule Part:** §15.247, Cat: DTS

**Issue Date:** Dec. 06, 2019

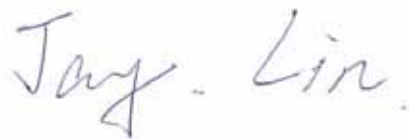
**Date of Test:** Oct. 22, 2019 ~ Nov. 25, 2019

**Date of EUT Received:** Oct. 22, 2019

**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.

Approved By: \_\_\_\_\_



Jay Lin / Asst. Supervisor



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Revision History			
Revision	Description	Issue Date	Remark
Rev.00	Original.	Nov. 28, 2019	Revised By: Karen Huang
Rev.01	Updated information on section 1.2	Dec. 06, 2019	Revised By: Karen Huang

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# 1 GENERAL INFORMATION

## 1.1 Product description

Product Name:	Smart Phone
Hardware Version:	DVT
Software Version:	N/A
Power Supply:	3.85V from Rechargeable Li-ion Battery

Wi-Fi 802.11	Frequency Range	Channels	Rated Power	Modulation Technology
b	2412-2462	11	19.33dBm	DSSS
g			26.09dBm	OFDM
n_HT20			25.67dBm	
Modulation Type:	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM			
Antenna Designation:	Inverted-F Antenna, Gain: -2.7dBi (ANT0) / -4.2dBi (ANT1)			
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 – 144.4 Mbps			

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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 v05r02

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

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 Designation number: TW0001

## 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.

## 1.6 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m\*9m\*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

## 1.7 Test data is reference from cross authorization

Conducted measurement results in the original test report ER/2019/A0073 under FCC ID: APYHRO00279 are fully leveraged in this test report with spot check to demonstrate compliance.

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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 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

#### 2.3.3 Radiated Emissions

The EUT is a placed on a 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.

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## 2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission



Fig. 2-2 Conducted (Antenna Port) Emission

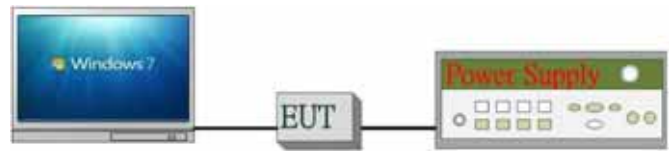


Fig. 2-2 AC Power Line Conducted Emission

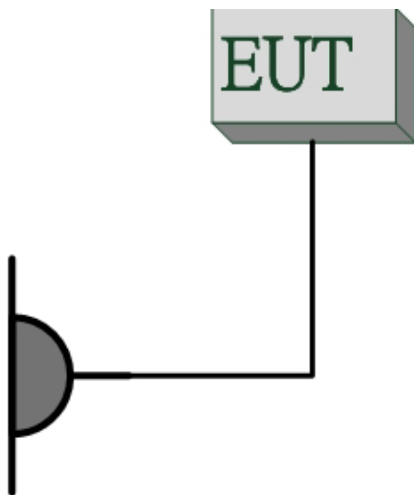


Table 2-1 Equipment Used in Tested System

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	MY52410006	N/A	N/A
3.	Notebook	Lenovo	L430	R9-XFG0X	N/A	N/A
4.	Notebook	Lenovo	L430	R9-X11BG	N/A	N/A

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### 3 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
§15.205 §15.209 §15.247(d)	Conducted Band Edge and Spurious Emission	Compliant
§15.205 §15.209 §15.247(d)	Radiated Band Edge and Spurious Emission	Compliant
§15.247(e)	Power Spectral Density	Compliant
§15.203 §15.247(b)	Antenna Requirement	Compliant

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## 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	8	2447 MHz
2	2417 MHz	9	2452 MHz
3	2422 MHz	10	2457 MHz
4	2427 MHz	11	2462 MHz
5	2432 MHz		
6	2437 MHz		
7	2442 MHz		

### 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. The given UE is pre-scanned among below modes.

Modulation	Transmission Chain				Multiple Transmission Spatial
	Ch0	Ch1	Ch2	Ch3	
<input checked="" type="checkbox"/> 802.11 b	<input checked="" type="checkbox"/> Ch0	<input checked="" type="checkbox"/> Ch1	<input type="checkbox"/> Ch2	<input type="checkbox"/> Ch3	<input checked="" type="checkbox"/> 2TX
<input checked="" type="checkbox"/> 802.11 g	<input checked="" type="checkbox"/> Ch0	<input checked="" type="checkbox"/> Ch1	<input type="checkbox"/> Ch2	<input type="checkbox"/> Ch3	<input checked="" type="checkbox"/> 2TX
<input checked="" type="checkbox"/> 802.11 n	<input checked="" type="checkbox"/> Ch0	<input checked="" type="checkbox"/> Ch1	<input type="checkbox"/> Ch2	<input type="checkbox"/> Ch3	<input checked="" type="checkbox"/> MIMO
<input type="checkbox"/> 802.11 ax	<input type="checkbox"/> Ch0	<input type="checkbox"/> Ch1	<input type="checkbox"/> Ch2	<input type="checkbox"/> Ch3	<input type="checkbox"/> MIMO

4. Therefore, below summary is the modes of test configuration that yield the highest reading and generate the highest emission chosen to carry out the relevantly mandatory test items.

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**RADIATED EMISSION TEST:**

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
<b>RADIATED EMISSION TEST (BELOW 1 GHz)</b>					
802.11g	1 to 11	6	OFDM	6	2TX
802.11n (HT20)	1 to 11	6	OFDM	MCS 8	MIMO
<b>RADIATED EMISSION TEST (ABOVE 1 GHz)</b>					
802.11b	1 to 11	1, 6, 11	DSSS	1	2TX
802.11g	1 to 11	1, 6, 11	OFDM	6	2TX
802.11n (HT20)	1 to 11	1, 6, 11	OFDM	MCS 8	MIMO

**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:**

<b>CONDUCTED TEST</b>					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11b	1 to 11	1, 6, 11	DSSS	1	2TX
802.11g	1 to 11	1, 6, 11	OFDM	6	2TX
802.11n (HT20)	1 to 11	1, 6, 11	OFDM	MCS 8	MIMO

**Spot Check**

<b>ANTENNA PORT CONDUCTED MEASUREMENT</b>					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
<b>Peak Output Power</b>					
802.11b	1 to 11	1, 6, 11	DSSS	1	2TX
802.11g	1 to 11	1, 6, 11	OFDM	6	2TX
802.11n (HT20)	1 to 11	1, 6, 11	OFDM	MCS 8	MIMO

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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	
<b>Polarization: Vertical</b>	9kHz~30MHz: +-2.3dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB
<b>Polarization: Horizontal</b>	9kHz~30MHz: +-2.3dB
	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

**Note:**

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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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(μV)	
	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

- The lower limit shall apply at the transition frequencies
- 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	ESCI 3	100335	02/12/2019	02/11/2020
Coaxial Cables	N/A	WK CE Cable	N/A	11/26/2018	11/25/2019
LISN	SCHWARZBECK	NSLK 8127	8127-649	04/02/2019	04/01/2020
Test Software	Farad	EZ-EMC	Ver. SGS-03A2	N.C.R	N.C.R

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

### 6.3 EUT Setup

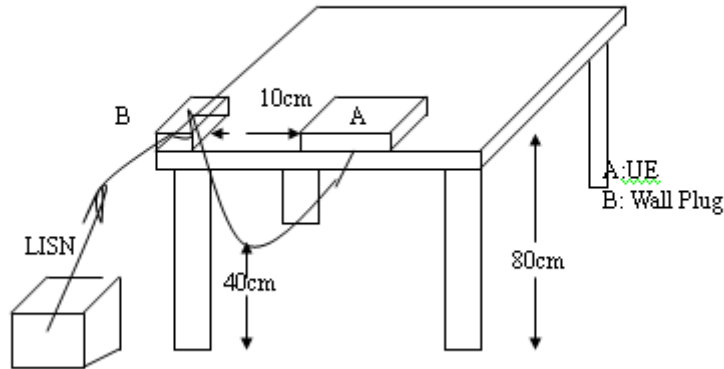
- The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
- The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
- The LISN was connected with 120Vac/60Hz power source.

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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.

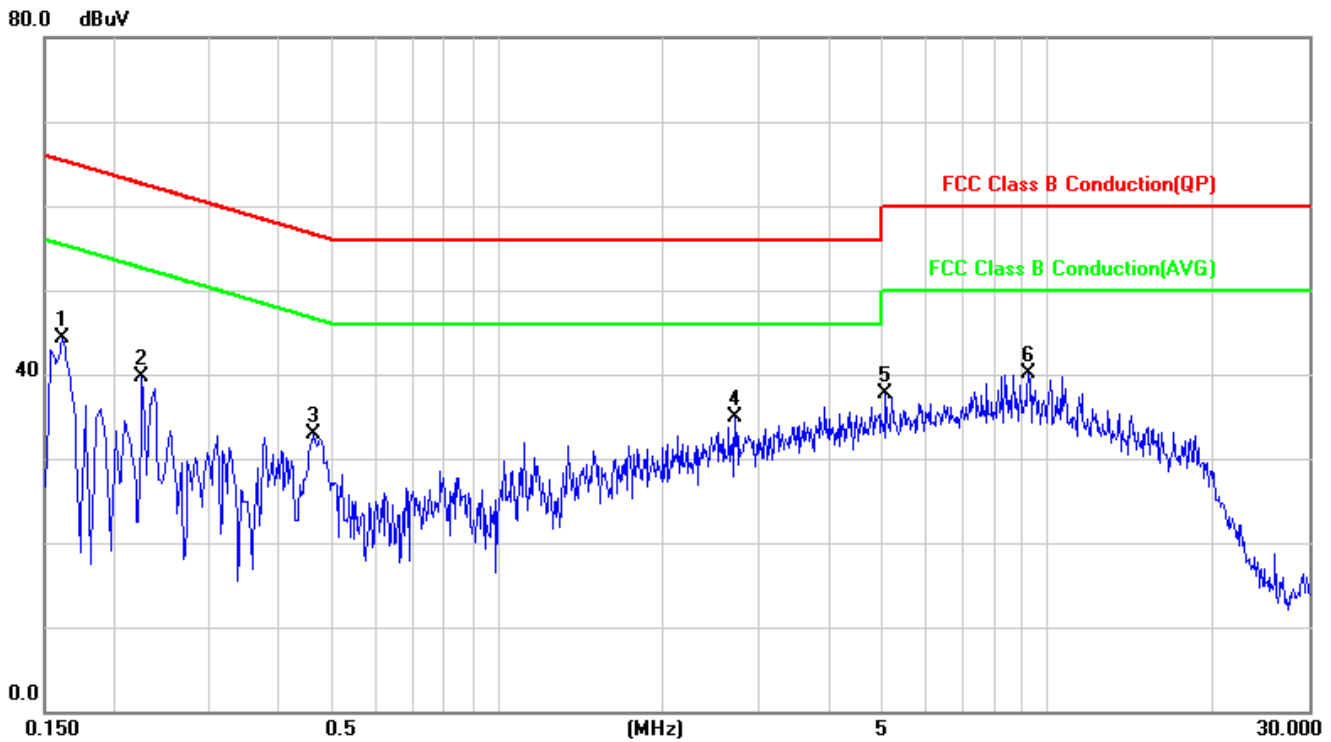
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### AC POWER LINE CONDUCTED EMISSION TEST DATA

Description:	Operation	Date:	2019/11/11
Line:	L1	Temp.( )/Hum.(%):	24.1( )/64%
Test Voltage:	AC 120V/60Hz	Test By:	Kane



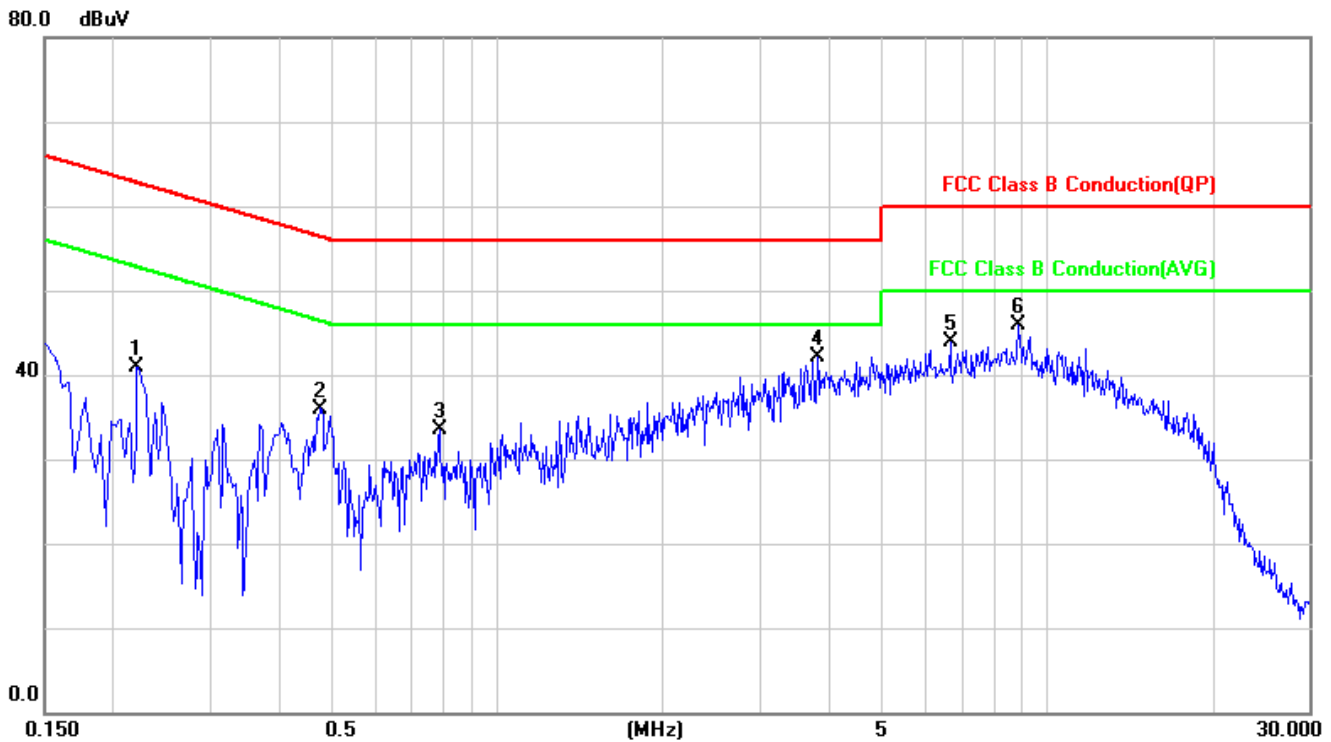
No.	Mk.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Measurement (dBuV)	Limit (dBuV)	Over (dB)	Detector	Comment
1		0.1620	44.37	0.00	44.37	65.36	-20.99	peak	
2		0.2260	39.78	0.01	39.79	62.60	-22.81	peak	
3		0.4620	32.95	0.01	32.96	56.66	-23.70	peak	
4		2.7100	34.74	0.15	34.89	56.00	-21.11	peak	
5		5.1020	37.45	0.19	37.64	60.00	-22.36	peak	
6	*	9.2620	39.76	0.27	40.03	60.00	-19.97	peak	

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Description:	Operation	Date:	2019/11/11
Line:	N	Temp.( )/Hum.(%):	24.1( )/64%
Test Voltage:	AC 120V/60Hz	Test By:	Kane



No.	Mk.	Freq. (MHz)	Reading dBuV	Factor (dB)	Measurement (dBuV)	Limit (dBuV)	Over (dB)	Detector	Comment
1		0.2220	40.80	0.03	40.83	62.74	-21.91	peak	
2		0.4780	35.97	0.03	36.00	56.37	-20.37	peak	
3		0.7860	33.47	0.04	33.51	56.00	-22.49	peak	
4	*	3.8220	41.98	0.18	42.16	56.00	-13.84	peak	
5		6.6780	43.69	0.23	43.92	60.00	-16.08	peak	
6		8.8740	45.62	0.27	45.89	60.00	-14.11	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.

### 7.1 Measurement Procedure:

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

### 7.2 Duty Cycle:

#### Formula:

$$\text{Duty Cycle} = \text{Ton} / (\text{Ton} + \text{Toff})$$

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) = 10*log ( 1/Duty Cycle )	1/T (kHz)	VBW setting (kHz)
802.11b	99.28	0.03	0.08	0.01
802.11g	98.26	0.08	0.49	0.01
802.11n_20	98.08	0.08	0.53	0.01

$$b = 99.28\%, g = 98.26\%, n\_ht\_20 = 98.08\%, n\_ht\_40 = 99\%$$

$$\text{Duty Cycle Factor: } 10 * \log(1/0.9928) = 0.03$$

$$\text{Duty Cycle Factor: } 10 * \log(1/0.9826) = 0.08$$

$$\text{Duty Cycle Factor: } 10 * \log(1/0.9808) = 0.08$$

$$\text{Duty Cycle Factor: } 10 * \log(1/0.99) = 0.04$$

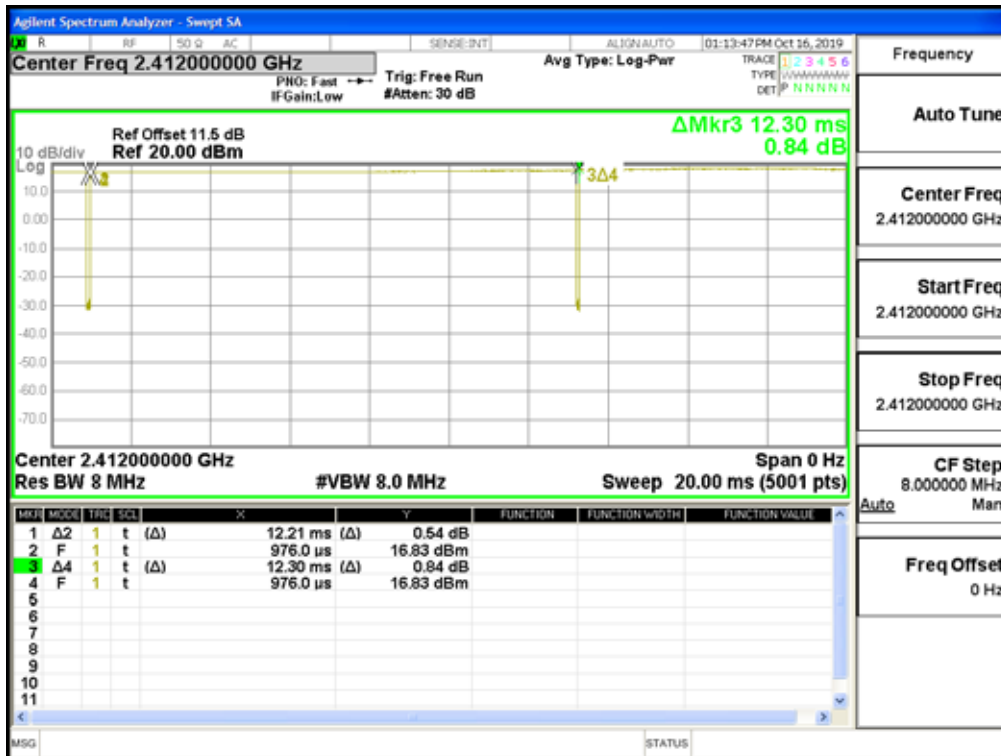
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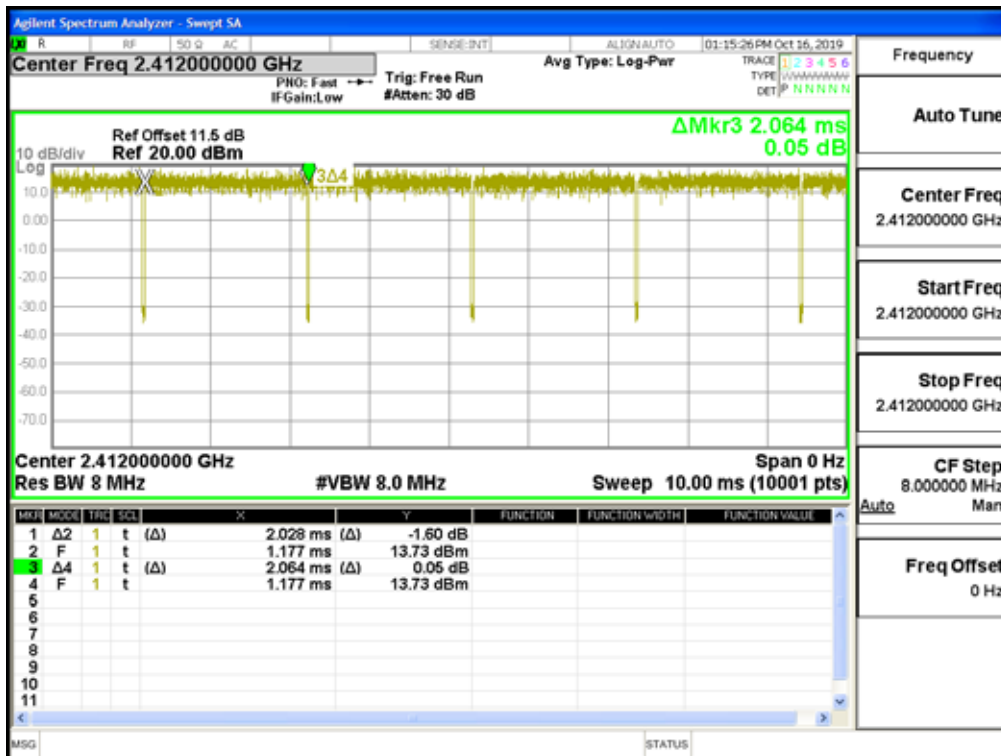
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7.3 Duty Cycle Test Plots  
802.11 b



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 from 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.

#### Note:

As per FCC KDB 662911 D01

Unequal antenna gains, with equal transmit powers. For antenna gains given by G1, G2, ..., GN dBi.

(i) If transmit signals are correlated, then Directional gain

$$= 10 \log \left[ \left( 10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20} \right)^2 / N_{ANT} \right] \text{ dBi}$$

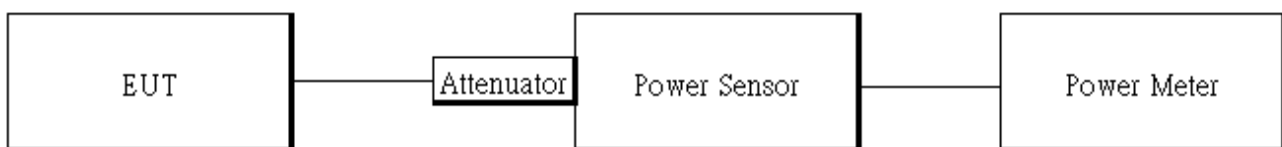
[Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

The antenna gain is not greater than 6 dBi. Therefore, reduction of power is not required.

### 8.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1804001	02/13/2019	02/12/2020
Power Sensor	Anritsu	MA2411B	1726104	02/13/2019	02/12/2020
Power Sensor	Anritsu	MA2411B	1726107	02/13/2019	02/12/2020
DC Power Supply	Agilent	E3640A	MY52410006	12/04/2018	12/03/2019
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2019	01/01/2020

### 8.3 Test Set-up



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### 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_2TX							
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
			CH 0	CH 1			
1	2412	1	16.65	15.96	19.33	30.00	PASS
6	2437	1	16.57	15.87	19.24	30.00	PASS
11	2462	1	16.61	15.86	19.26	30.00	PASS
802.11b_2TX							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)		Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
			CH 0	CH 1			
1	2412	1	14.38	13.45	16.98	30.00	PASS
6	2437	1	14.26	13.46	16.92	30.00	PASS
11	2462	1	14.36	13.43	16.96	30.00	PASS

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802.11g_2TX							
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
			CH 0	CH 1			
1	2412	6	23.11	22.68	25.91	30.00	PASS
6	2437	6	22.91	22.65	25.79	30.00	PASS
11	2462	6	23.56	22.55	26.09	30.00	PASS

802.11g_2TX							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)		Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
			CH 0	CH 1			
1	2412	6	14.21	13.51	16.96	30.00	PASS
6	2437	6	14.16	13.49	16.92	30.00	PASS
11	2462	6	14.26	13.47	16.97	30.00	PASS

802.11n_HT20M MIMO							
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
			CH 0	CH 1			
1	2412	MCS8	21.16	20.78	23.98	30.00	PASS
6	2437	MCS8	22.97	22.33	25.67	30.00	PASS
11	2462	MCS8	21.45	21.35	24.41	30.00	PASS

802.11n_HT20M MIMO							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)		Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
			CH 0	CH 1			
1	2412	MCS8	11.98	11.71	14.94	30.00	PASS
6	2437	MCS8	14.35	13.27	16.94	30.00	PASS
11	2462	MCS8	12.02	11.76	14.99	30.00	PASS

Note

Cable Loss 11.50 dB

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

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Spot Check Data:

802.11b		Peak Power Output(dBm)		
CH	Frequency (MHz)	Data Rate (Mbps)		
		1		
		ch 0	ch 1	ch 0+1
1	2412	16.61	15.94	19.30
6	2437	16.54	15.82	19.21
11	2462	16.58	15.83	19.23

802.11g		Peak Power Output(dBm)		
CH	Frequency (MHz)	Data Rate (Mbps)		
		6		
		ch 0	ch 1	ch 0+1
1	2412	23.08	22.65	25.88
6	2437	22.86	22.60	25.74
11	2462	23.53	22.51	26.06

802.11 n (20M)		Peak Power Output(dBm)		
CH	Frequency (MHz)	Data Rate (Mbps)		
		mcs 8		
		ch 0	ch 1	ch 0+1
1	2412	21.12	20.74	23.94
2	2417	22.98	22.37	25.70
6	2437	22.89	22.30	25.62
10	2457	23.01	22.34	25.70
11	2462	21.38	21.29	24.35

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## 9 6DB BANDWIDTH MEASUREMENT

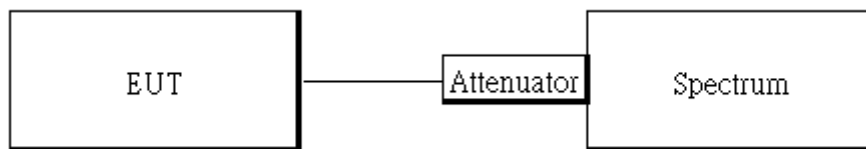
### 9.1 Standard Applicable

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

### 9.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	05/02/2019	05/01/2020
DC Power Supply	Agilent	E3640A	MY52410006	12/04/2018	12/03/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2019	01/01/2020
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2019	01/01/2020

### 9.3 Test Set-up



### 9.4 Measurement Procedure

- Place the EUT on the table and set it in transmitting mode.
- The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 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.
- Mark the peak frequency and -6dB (upper and lower) frequency.
- Repeat above procedures until all frequency of interest measured was complete.

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## 9.5 Measurement Result

802.11b Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	8599.00	> 500	PASS
2437	8565.00	> 500	PASS
2462	8579.00	> 500	PASS

802.11b Ch1

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	9075.00	> 500	PASS
2437	9082.00	> 500	PASS
2462	8598.00	> 500	PASS

802.11g Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	16400.00	> 500	PASS
2437	16390.00	> 500	PASS
2462	16370.00	> 500	PASS

802.11g Ch1

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	16400.00	> 500	PASS
2437	16410.00	> 500	PASS
2462	16390.00	> 500	PASS

802.11\_n\_HT20 Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	17620.00	> 500	PASS
2437	17320.00	> 500	PASS
2462	17600.00	> 500	PASS

802.11\_n\_HT20 Ch1

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	17630.00	> 500	PASS
2437	17660.00	> 500	PASS
2462	17340.00	> 500	PASS

*\*Refer to next page for plots*

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OBW 6dB\_802.11b\_20MHz\_Chain0\_2412MHz



OBW 6dB\_802.11b\_20MHz\_Chain1\_2412MHz



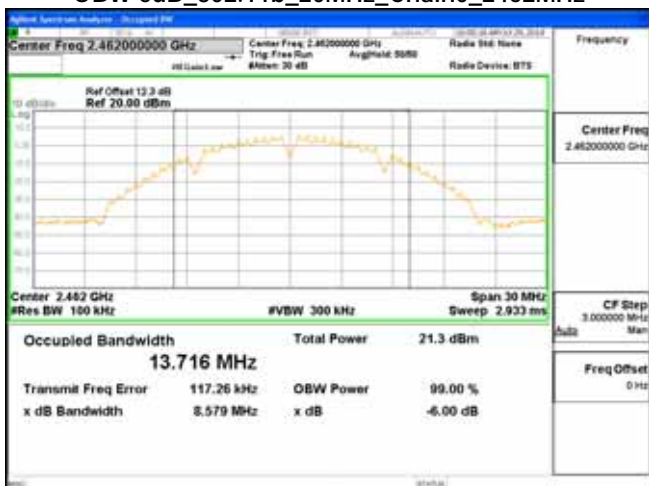
OBW 6dB\_802.11b\_20MHz\_Chain0\_2437MHz



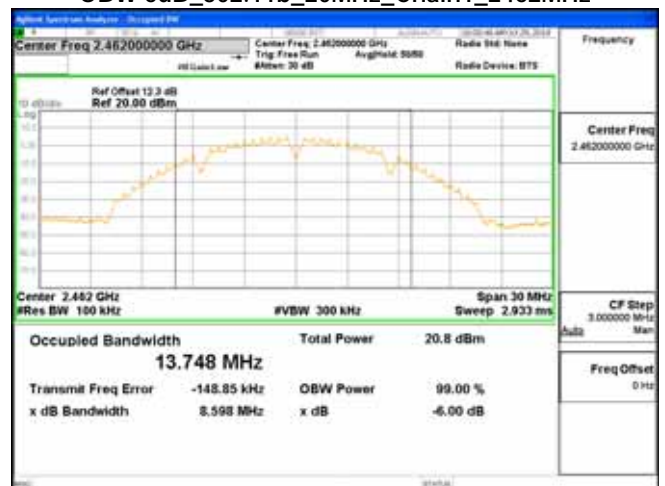
OBW 6dB\_802.11b\_20MHz\_Chain1\_2437MHz



OBW 6dB\_802.11b\_20MHz\_Chain0\_2462MHz



OBW 6dB\_802.11b\_20MHz\_Chain1\_2462MHz



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OBW 6dB\_802.11g\_20MHz\_Chain0\_2412MHz



OBW 6dB\_802.11g\_20MHz\_Chain1\_2412MHz



OBW 6dB\_802.11g\_20MHz\_Chain0\_2437MHz



OBW 6dB\_802.11g\_20MHz\_Chain1\_2437MHz



OBW 6dB\_802.11g\_20MHz\_Chain0\_2462MHz



OBW 6dB\_802.11g\_20MHz\_Chain1\_2462MHz



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OBW 6dB\_802.11n\_20MHz\_Chain0\_2412MHz



OBW 6dB\_802.11n\_20MHz\_Chain1\_2412MHz



OBW 6dB\_802.11n\_20MHz\_Chain0\_2437MHz



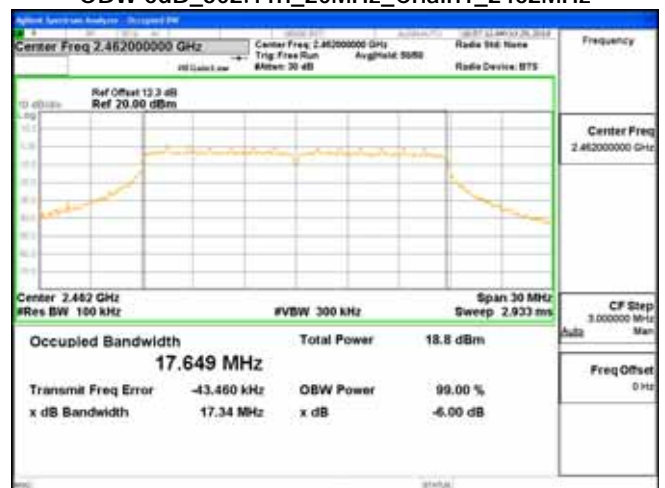
OBW 6dB\_802.11n\_20MHz\_Chain1\_2437MHz



OBW 6dB\_802.11n\_20MHz\_Chain0\_2462MHz



OBW 6dB\_802.11n\_20MHz\_Chain1\_2462MHz



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## 10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

### 10.1 Standard Applicable

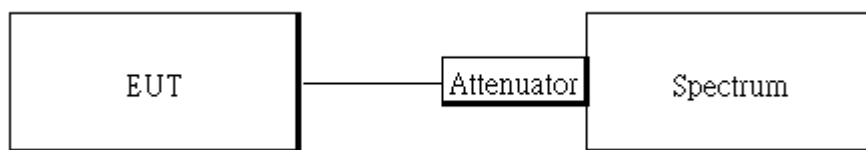
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the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

### 10.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	05/02/2019	05/01/2020
DC Power Supply	Agilent	E3640A	MY52410006	12/04/2018	12/03/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2019	01/01/2020
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2019	01/01/2020

### 10.3 Test SET-UP



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## 10.4 Measurement Procedure

### Reference Level of Emission 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.  
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:

Reference Level of Limit 802.11b mode			Reference Level of Limit 802.11g mode		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)	Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	8.94	-11.06	2412	6.28	-13.72
2437	8.88	-11.12	2437	6.59	-13.41
2462	8.91	-11.09	2462	6.58	-13.42

Reference Level of Limit 802.11n20 mode		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	4.02	-15.98
2437	6.75	-13.25
2462	3.61	-16.39

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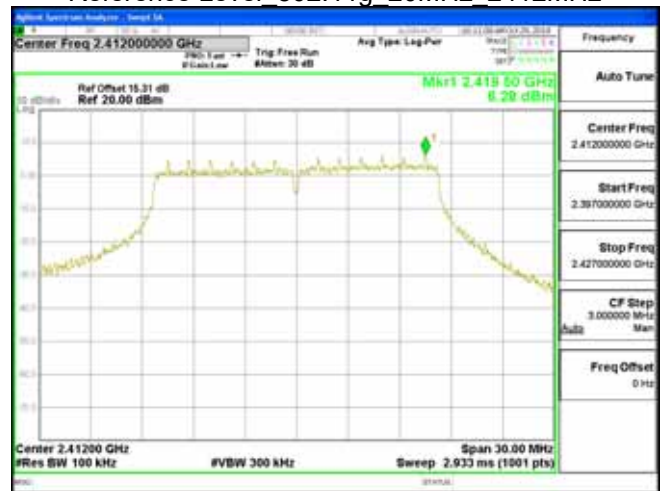
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Reference Level 802.11b 20MHz 2412MHz



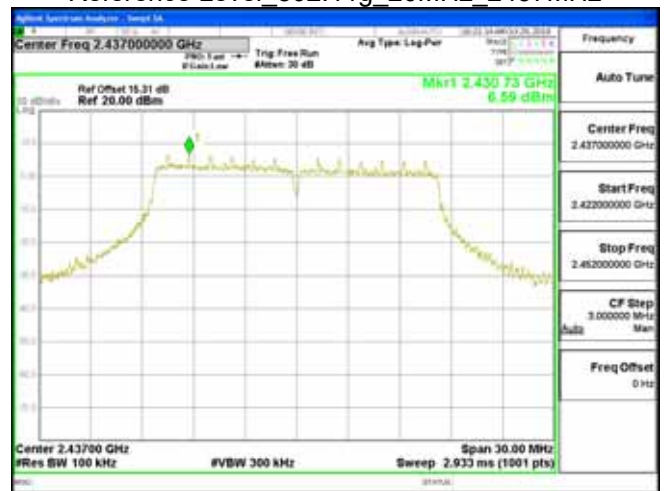
Reference Level 802.11g 20MHz 2412MHz



Reference Level 802.11b 20MHz 2437MHz



Reference Level 802.11g 20MHz 2437MHz



Reference Level 802.11b 20MHz 2462MHz



Reference Level 802.11g 20MHz 2462MHz



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Reference Level 802.11n 20MHz 2412MHz



Reference Level 802.11n 20MHz 2437MHz



Reference Level 802.11n 20MHz 2462MHz



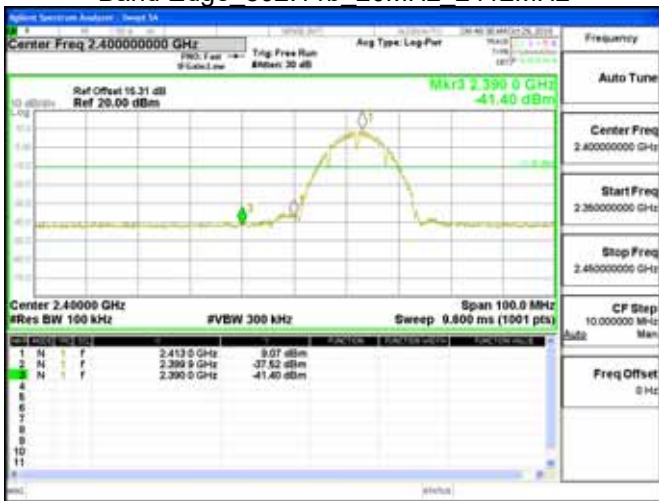
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Band Edge 802.11b 20MHz 2412MHz



Band Edge 802.11g 20MHz 2462MHz



Band Edge 802.11b 20MHz 2462MHz



Band Edge 802.11n 20MHz 2412MHz



Band Edge 802.11g 20MHz 2412MHz



Band Edge 802.11n 20MHz 2462MHz



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Spurious Emission 802.11b 20MHz 2412MHz



Spurious Emission 802.11g 20MHz 2412MHz



Spurious Emission 802.11b 20MHz 2437MHz



Spurious Emission 802.11g 20MHz 2437MHz



Spurious Emission 802.11b 20MHz 2462MHz



Spurious Emission 802.11g 20MHz 2462MHz



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Spurious Emission 802.11n 20MHz 2412MHz



Spurious Emission 802.11n 20MHz 2437MHz



Spurious Emission 802.11n 20MHz 2462MHz



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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.
2. Emission level (dBµV/m) = 20 log Emission level (dBµV/m)

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## 11.2 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Bi-log Antenna	SCHWAZBECK	VULB9168	378	01/04/2019	01/03/2020
Horn Antenna	Schwarzbeck	BBHA9120D	1441	08/20/2019	08/19/2020
Horn Antenna	Schwarzbeck	BBHA9170	184	12/27/2018	12/26/2019
3m Site NSA	SGS	966 chamber	N/A	01/02/2019	01/01/2020
Loop Antenna	ETS.LINDGREN	6502	148045	10/15/2019	10/14/2020
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/22/2019	04/21/2020
EMI Test Receiver	R&S	ESCI 3	100335	02/12/2019	02/11/2020
Pre-Amplifier	HP	8449B	3008A00578	01/02/2019	01/01/2020
Pre-Amplifier	HP	8447D	2944A07676	01/02/2019	01/01/2020
Pre-Amplifier	EMC Instruments	EMC184045B	980135	01/02/2019	01/01/2020
Attenuator	Mini-Circuit	BW-S10W2+	4	01/02/2019	01/01/2020
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M1	01/02/2019	01/01/2020
High Pass Filter	WI	WHKX4.0/18G-10SS	22	01/01/2019	01/02/2020
Low Loss Cable	Huber Suhner	966_RX	9	01/02/2019	01/01/2020

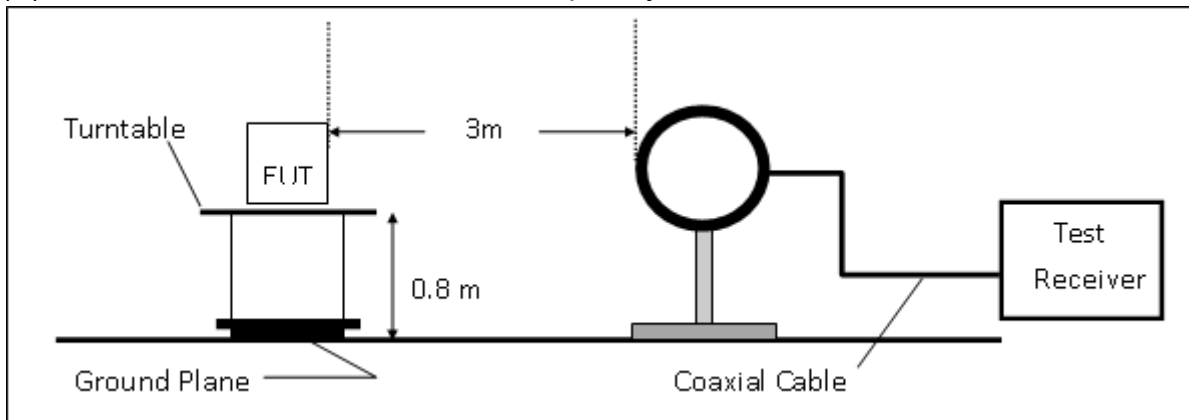
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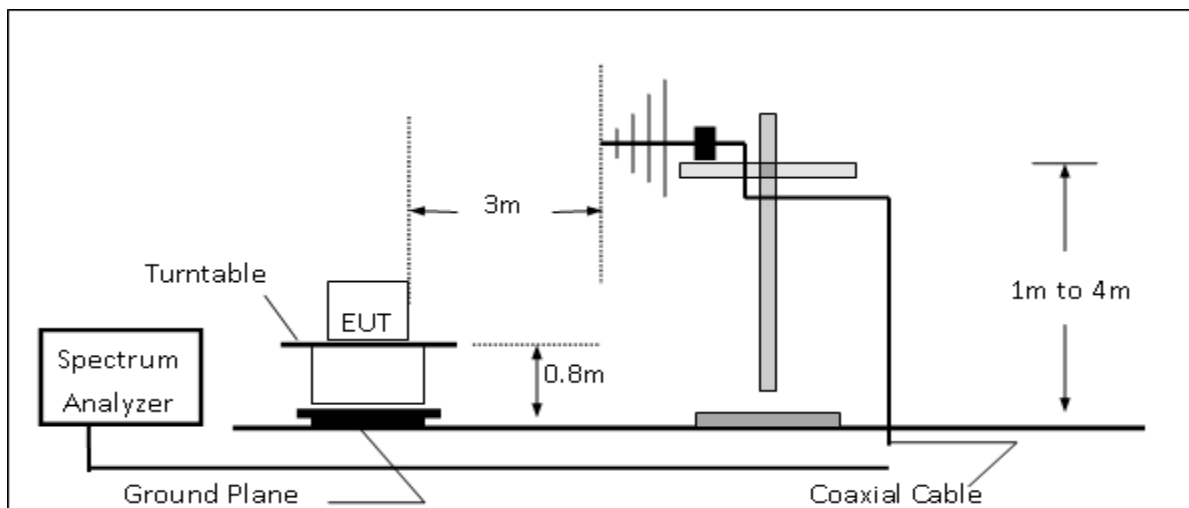
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### 11.3 Test SET-UP

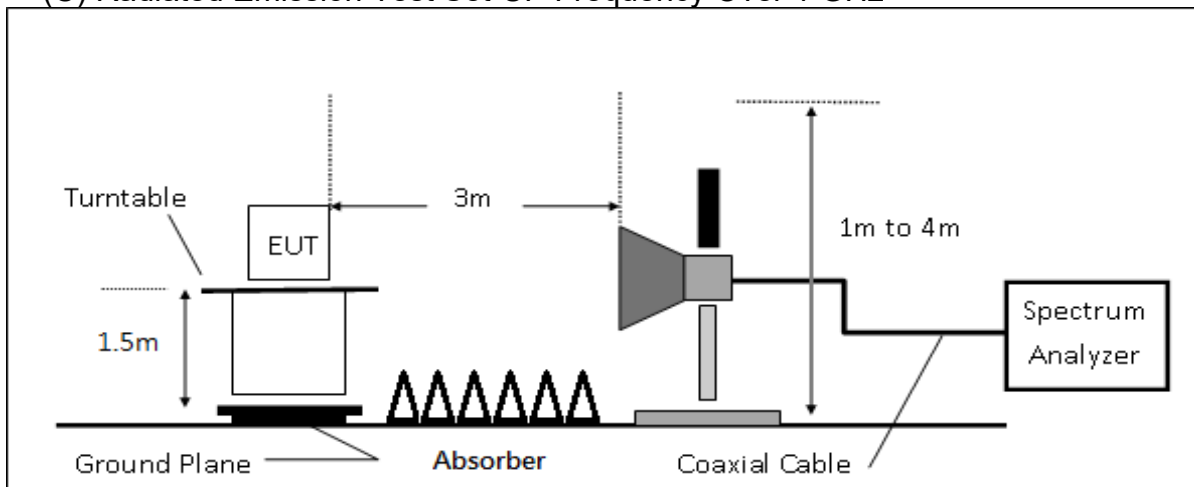
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



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



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



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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*

*The limit of the emission level is expressed in dBuV/m, which converts  $20 \cdot \log(uV/m)$*

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

*Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre\_Amplifier Gain(dB)*

## 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

1. *Refer to next page spectrum analyzer data chart and tabular data sheets.*
2. *Measurements are completed at peak and average level, the mark of average is the highest emission in restricted bands*

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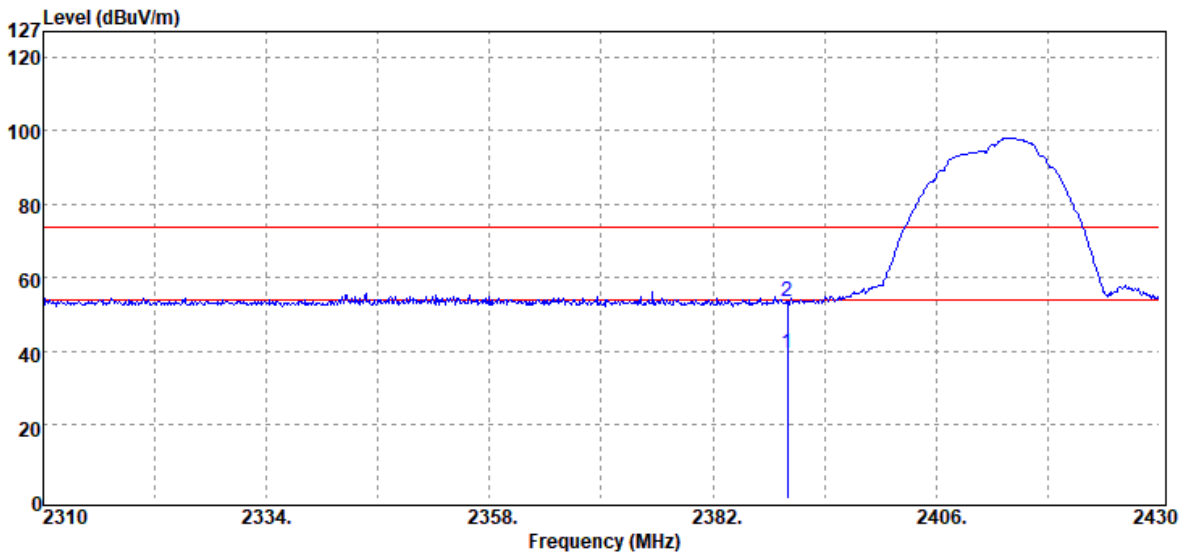
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### Radiated Band Edge Measurement Result

Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11b	Temp./Humi.	:24.6/66
Test Channel	:2412 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH Low	Engineer	:Kane
EUT Pol	:E1 Plane		



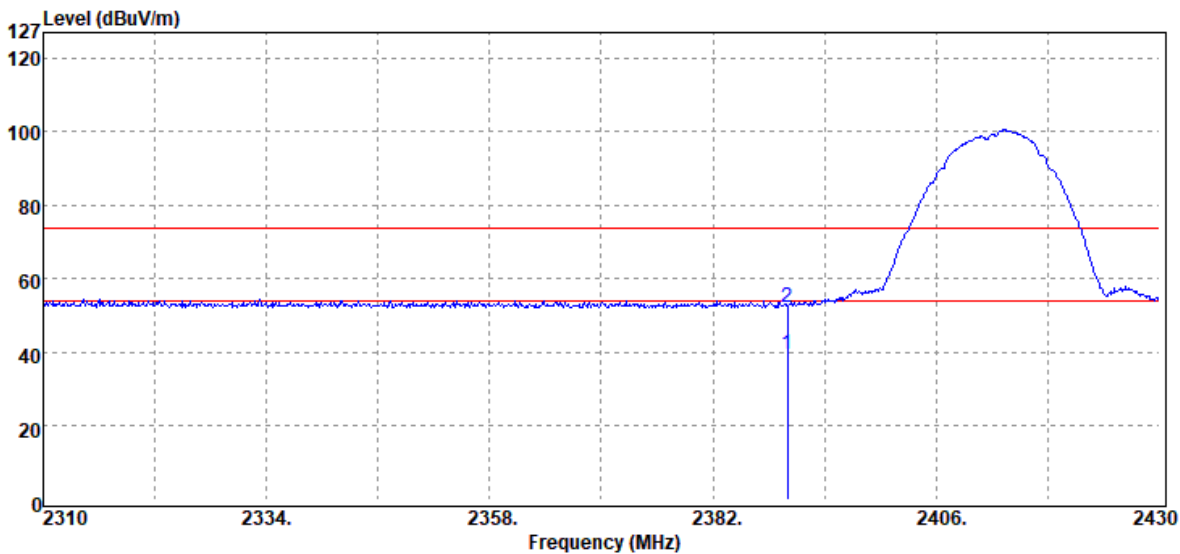
Freq. MHz	Detector Mode	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2390.00	Average	39.46	0.24	39.70	54.00	-14.30
2390.00	Peak	53.17	0.24	53.41	74.00	-20.59

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11b	Temp./Humi.	:24.6/66
Test Channel	:2412 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH Low	Engineer	:Kane
EUT Pol	:E1 Plane		



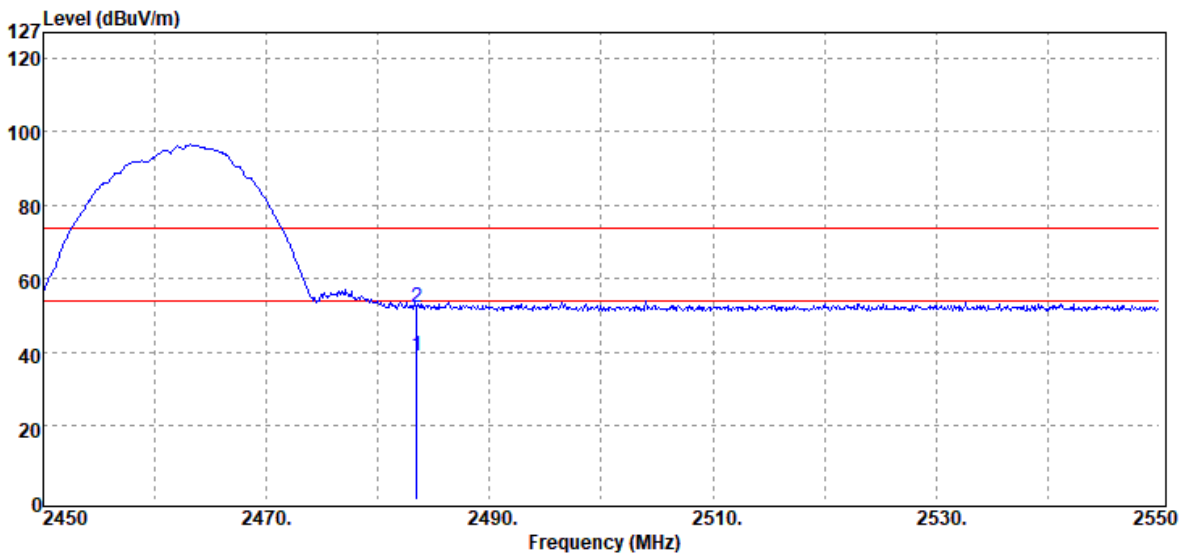
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2390.00	Average	39.46	0.24	39.70	54.00	-14.30
2390.00	Peak	52.16	0.24	52.40	74.00	-21.60

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11b	Temp./Humi.	:24.6/66
Test Channel	:2462 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH High	Engineer	:Kane
EUT Pol	:E1 Plane		



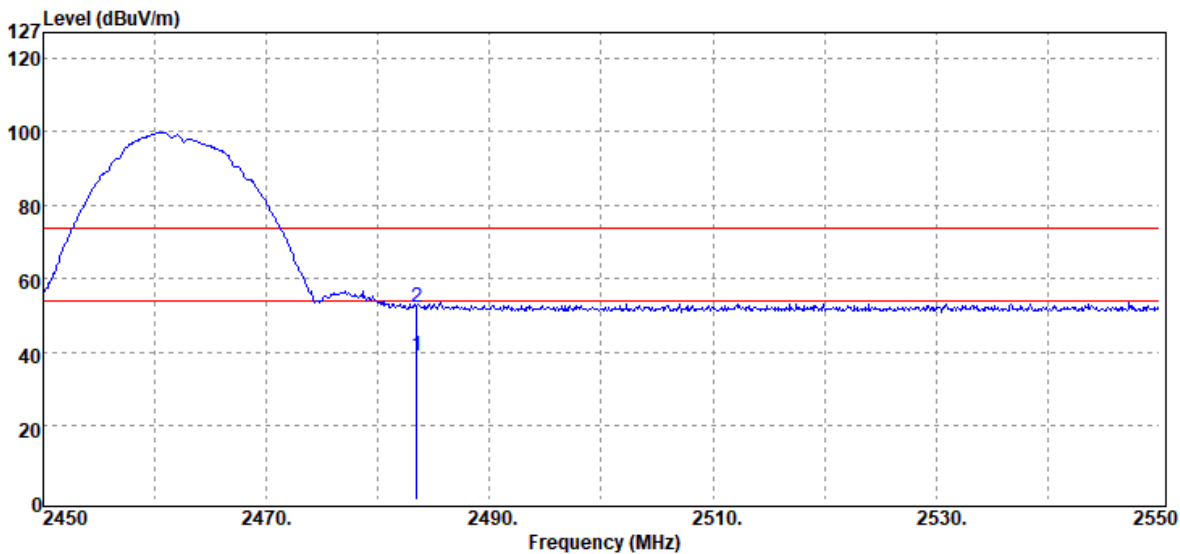
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2483.50	Average	39.29	-0.17	39.12	54.00	-14.88
2483.50	Peak	52.28	-0.17	52.11	74.00	-21.89

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Operation Mode	:802.11b	Temp./Humi.	:24.6/66
Test Channel	:2462 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH High	Engineer	:Kane
EUT Pol	:E1 Plane		



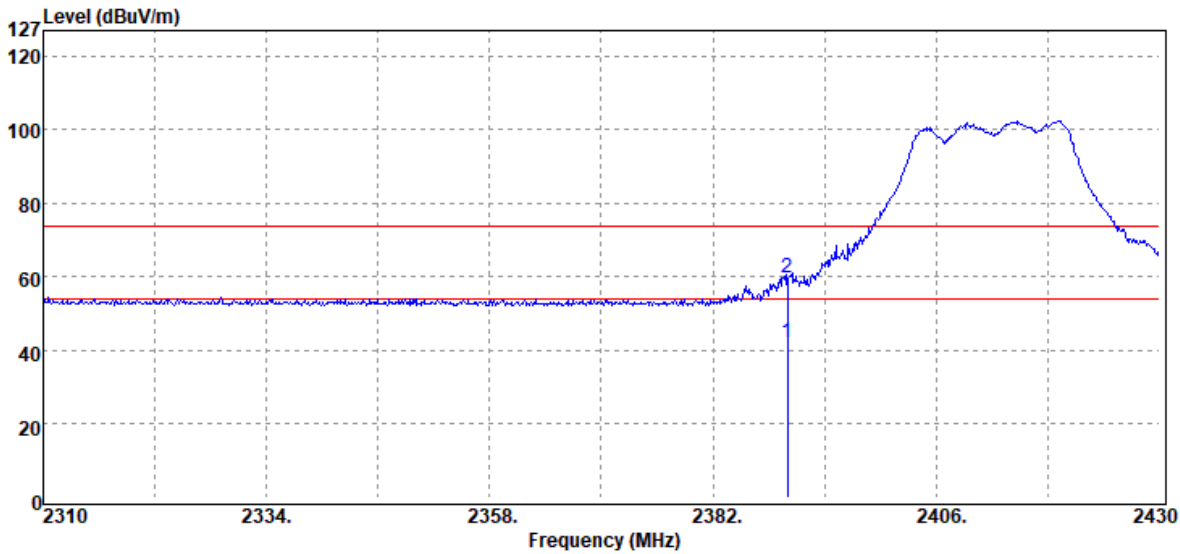
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dB $\mu$ V		dB $\mu$ V/m	dB $\mu$ V/m	
2483.50	Average	39.43	-0.17	39.26	54.00	-14.74
2483.50	Peak	52.30	-0.17	52.13	74.00	-21.87

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11g	Temp./Humi.	:24.6/66
Test Channel	:2412 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH Low	Engineer	:Kane
EUT Pol	:E1 Plane		



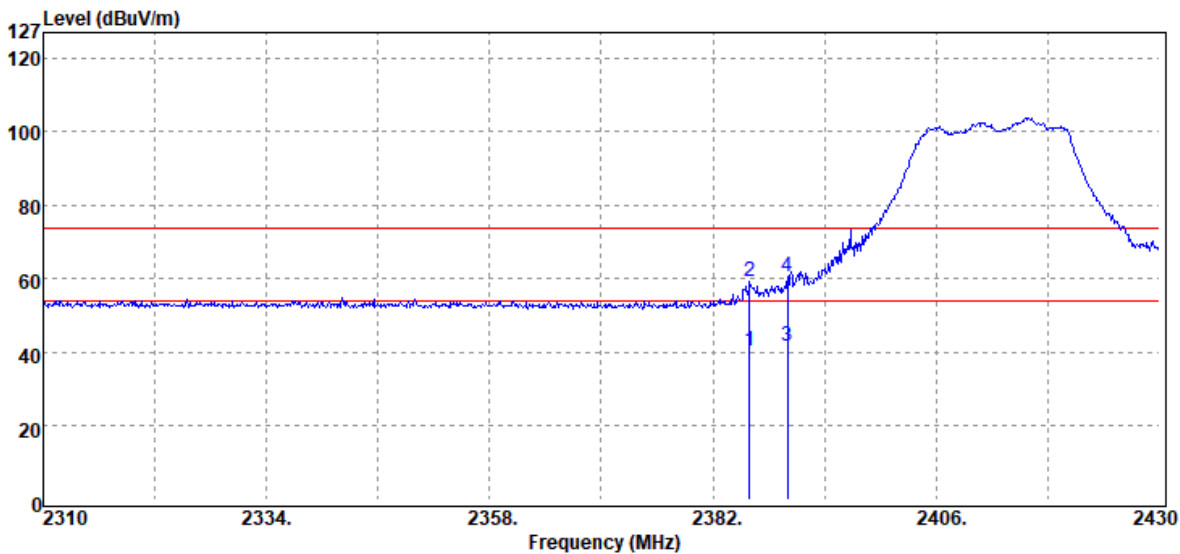
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2390.00	Average	41.80	0.24	42.04	54.00	-11.96
2390.00	Peak	59.40	0.24	59.64	74.00	-14.36

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Test Mode	:Bandedge CH Low	Engineer	:Kane
EUT Pol	:E1 Plane		



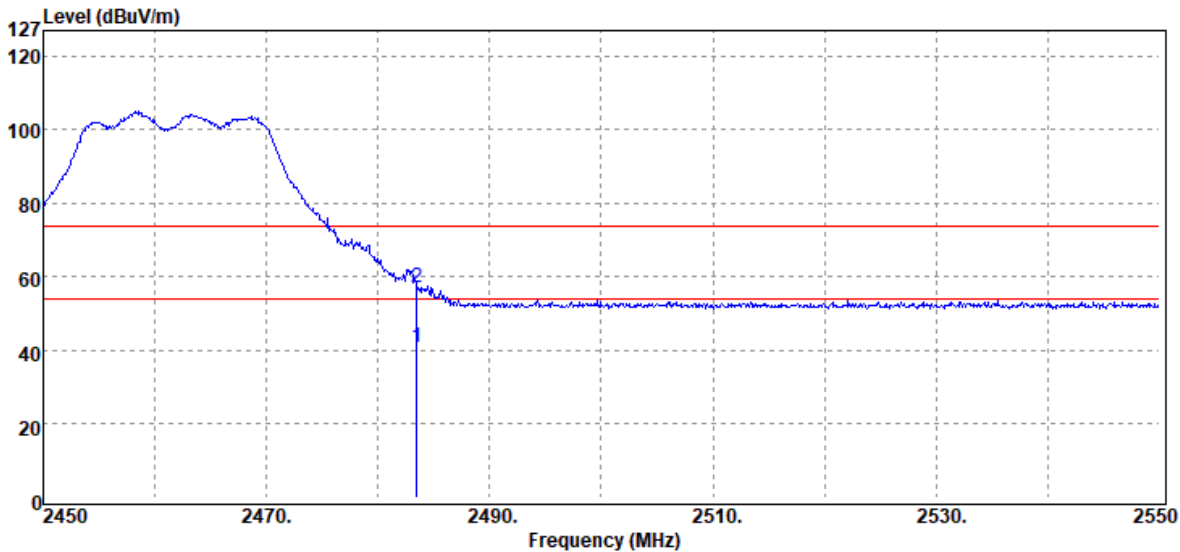
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2385.96	Average	40.11	0.26	40.37	54.00	-13.63
2385.96	Peak	59.28	0.26	59.54	74.00	-14.46
2390.00	Average	41.66	0.24	41.90	54.00	-12.10
2390.00	Peak	60.45	0.24	60.69	74.00	-13.31

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11g	Temp./Humi.	:24.6/66
Test Channel	:2462 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH High	Engineer	:Kane
EUT Pol	:E1 Plane		



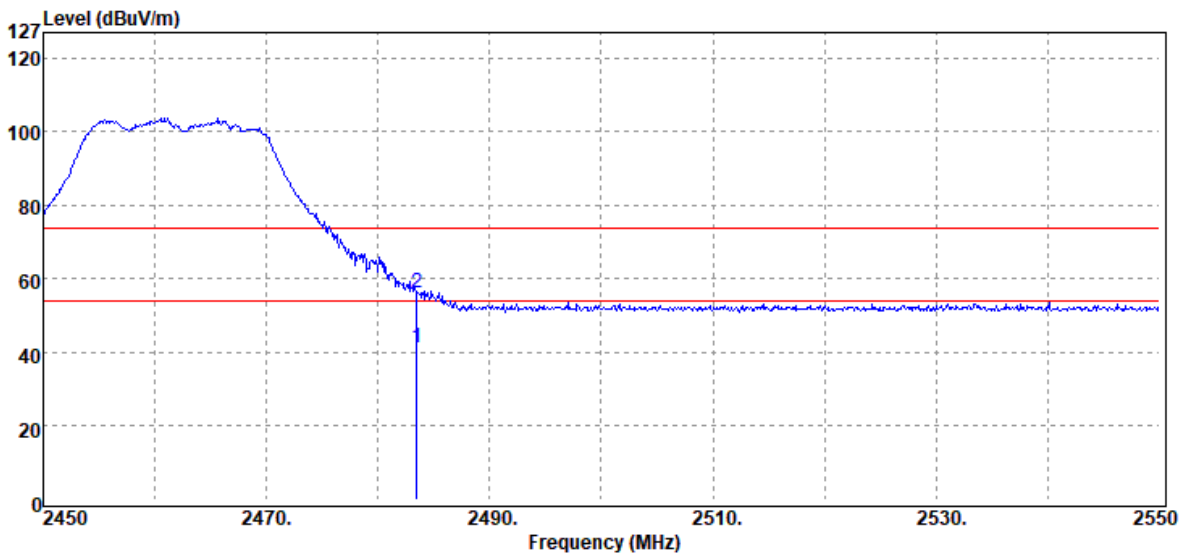
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2483.50	Average	41.25	-0.17	41.08	54.00	-12.92
2483.50	Peak	57.49	-0.17	57.32	74.00	-16.68

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11g	Temp./Humi.	:24.6/66
Test Channel	:2462 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH High	Engineer	:Kane
EUT Pol	:E1 Plane		



Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2483.50	Average	41.33	-0.17	41.16	54.00	-12.84
2483.50	Peak	56.48	-0.17	56.31	74.00	-17.69

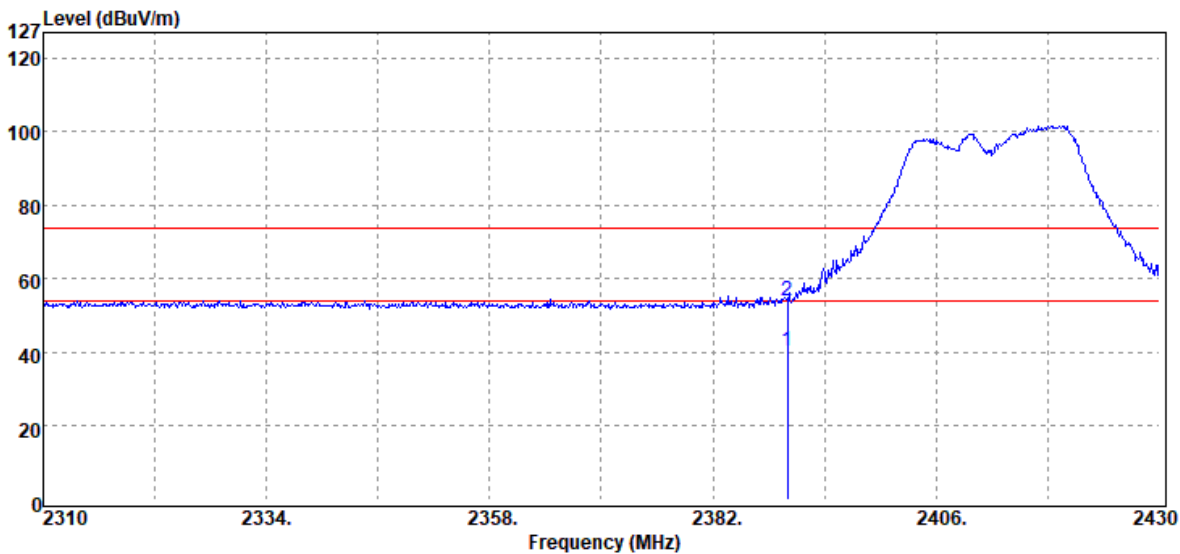
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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2412 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH Low	Engineer	:Kane
EUT Pol	:E1 Plane		



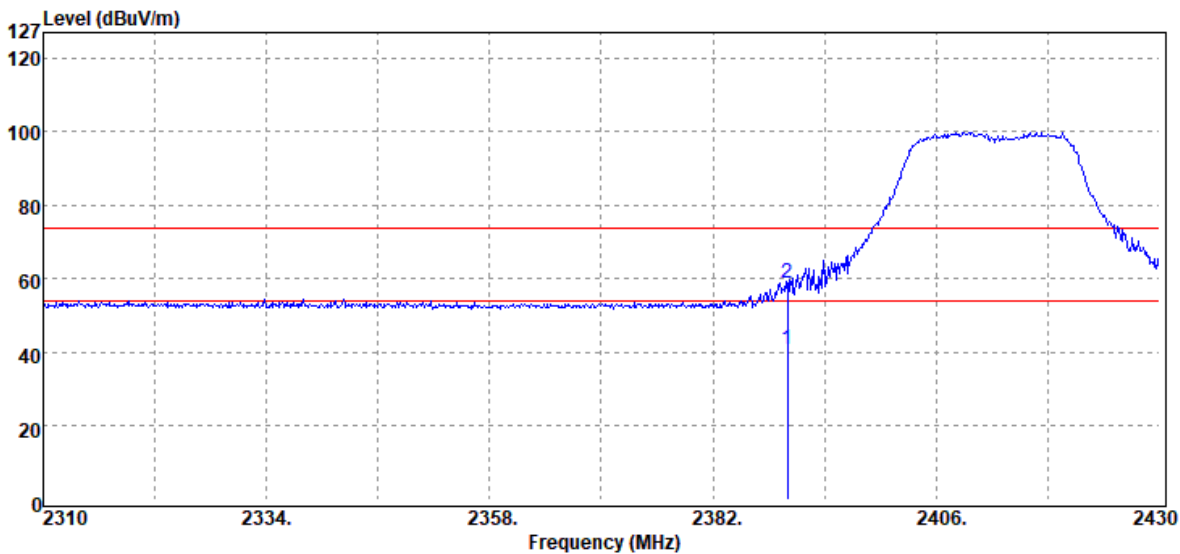
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2390.00	Average	40.05	0.24	40.29	54.00	-13.71
2390.00	Peak	53.89	0.24	54.13	74.00	-19.87

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2412 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH Low	Engineer	:Kane
EUT Pol	:E1 Plane		



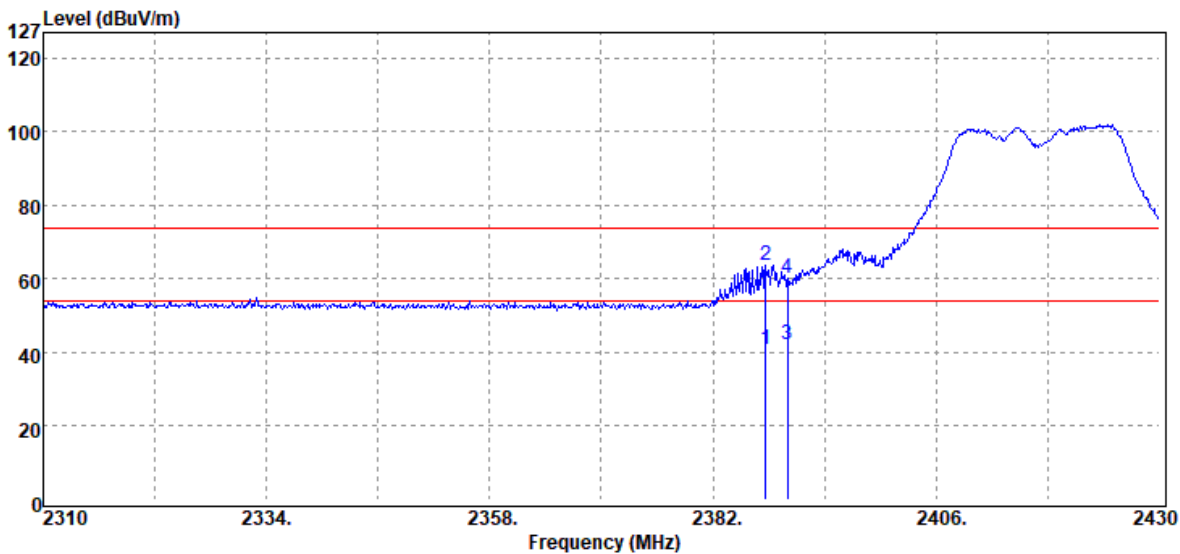
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2390.00	Average	40.66	0.24	40.90	54.00	-13.10
2390.00	Peak	58.67	0.24	58.91	74.00	-15.09

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2417 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH Low	Engineer	:Kane
EUT Pol	:E1 Plane		



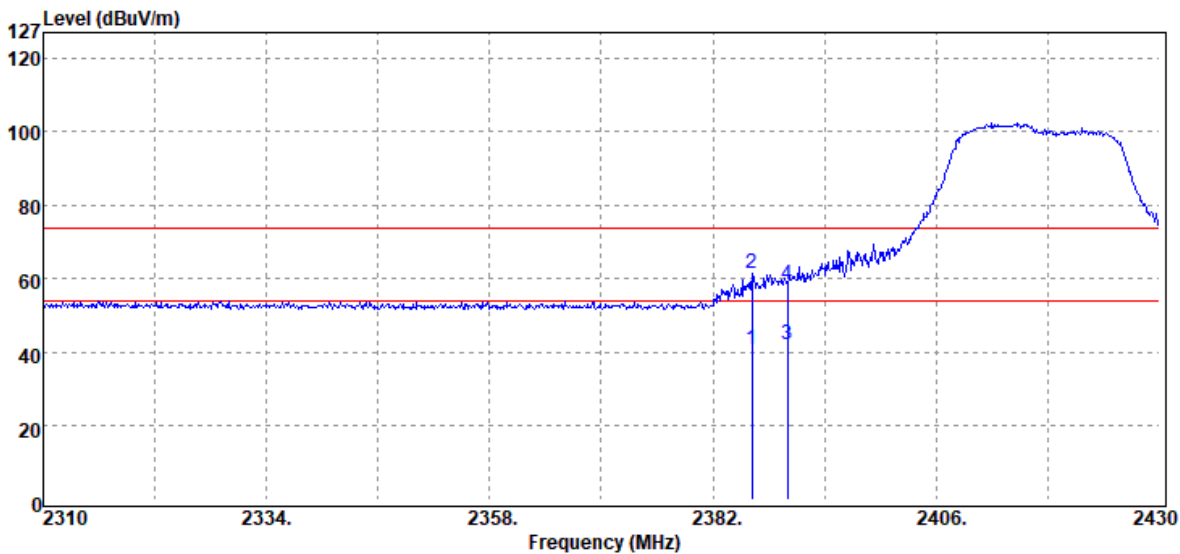
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2387.64	Average	40.77	0.25	41.02	54.00	-12.98
2387.64	Peak	63.49	0.25	63.74	74.00	-10.26
2390.00	Average	41.76	0.24	42.00	54.00	-12.00
2390.00	Peak	59.97	0.24	60.21	74.00	-13.79

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2417 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH Low	Engineer	:Kane
EUT Pol	:E1 Plane		



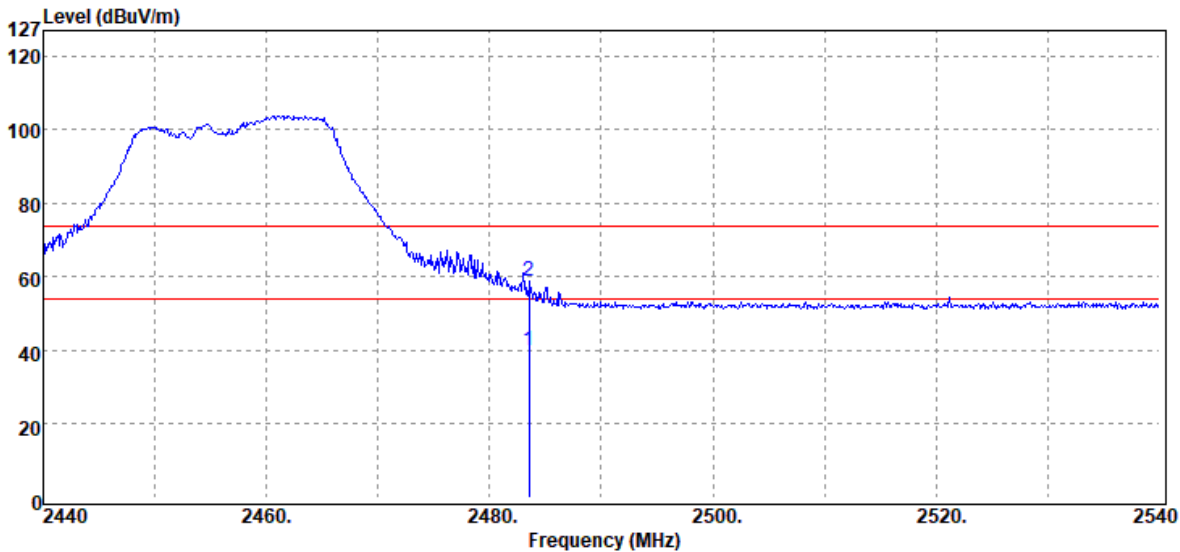
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2386.20	Average	40.40	0.25	40.65	54.00	-13.35
2386.20	Peak	61.47	0.25	61.72	74.00	-12.28
2390.00	Average	41.97	0.24	42.21	54.00	-11.79
2390.00	Peak	58.06	0.24	58.30	74.00	-15.70

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2457 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH High	Engineer	:Kane
EUT Pol	:E1 Plane		



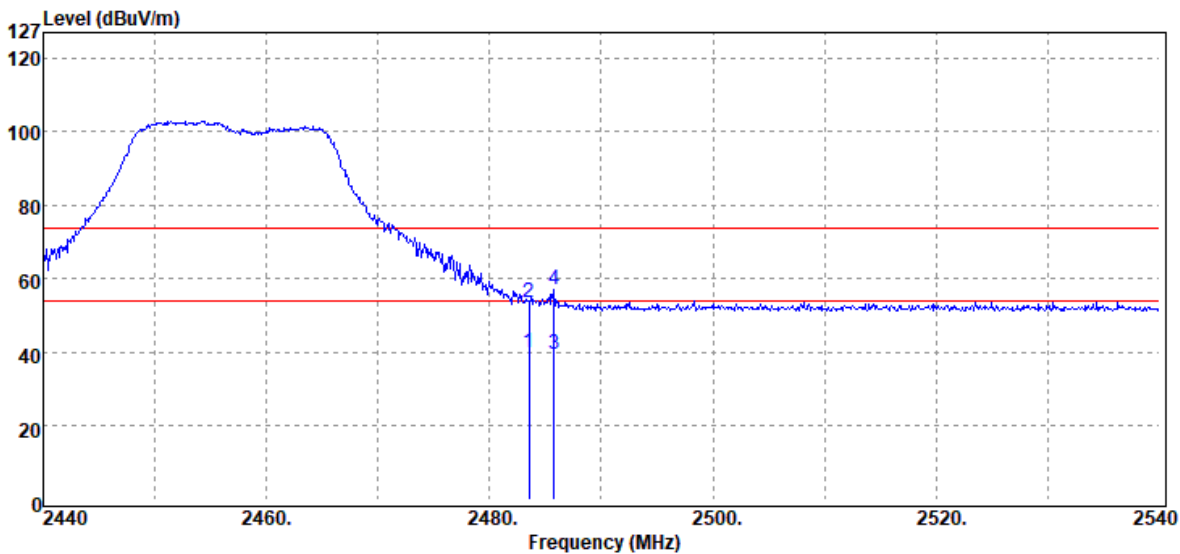
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dB $\mu$ V		dB $\mu$ V/m	dB $\mu$ V/m	
2483.50	Average	40.34	-0.17	40.17	54.00	-13.83
2483.50	Peak	59.25	-0.17	59.08	74.00	-14.92

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2457 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH High	Engineer	:Kane
EUT Pol	:E1 Plane		



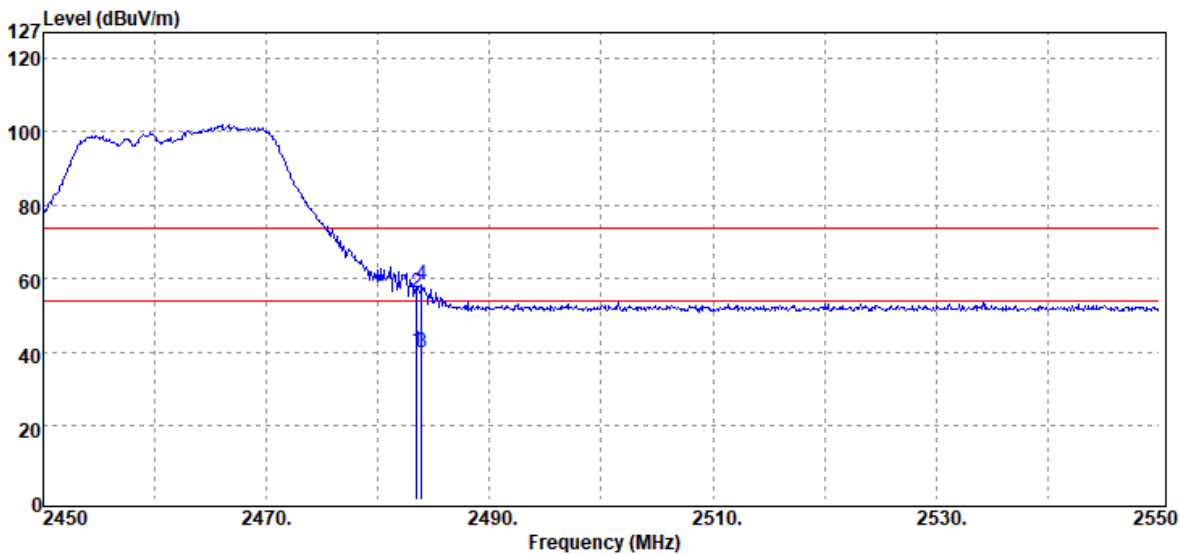
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2483.50	Average	40.18	-0.17	40.01	54.00	-13.99
2483.50	Peak	53.78	-0.17	53.61	74.00	-20.39
2485.80	Average	39.58	-0.18	39.40	54.00	-14.60
2485.80	Peak	57.18	-0.18	57.00	74.00	-17.00

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2462 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH High	Engineer	:Kane
EUT Pol	:E1 Plane		



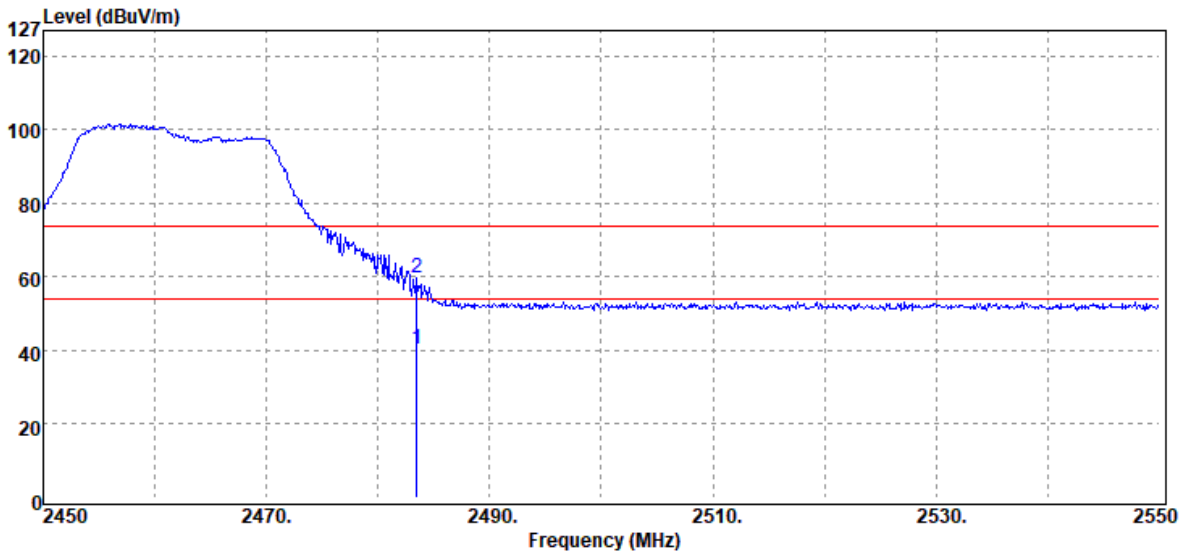
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2483.50	Average	40.43	-0.17	40.26	54.00	-13.74
2483.50	Peak	56.42	-0.17	56.25	74.00	-17.75
2483.90	Average	40.31	-0.18	40.13	54.00	-13.87
2483.90	Peak	58.46	-0.18	58.28	74.00	-15.72

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2462 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH High	Engineer	:Kane
EUT Pol	:E1 Plane		



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dB $\mu$ V		dB $\mu$ V/m	dB $\mu$ V/m	
2483.50	Average	40.73	-0.17	40.56	54.00	-13.44
2483.50	Peak	59.81	-0.17	59.64	74.00	-14.36

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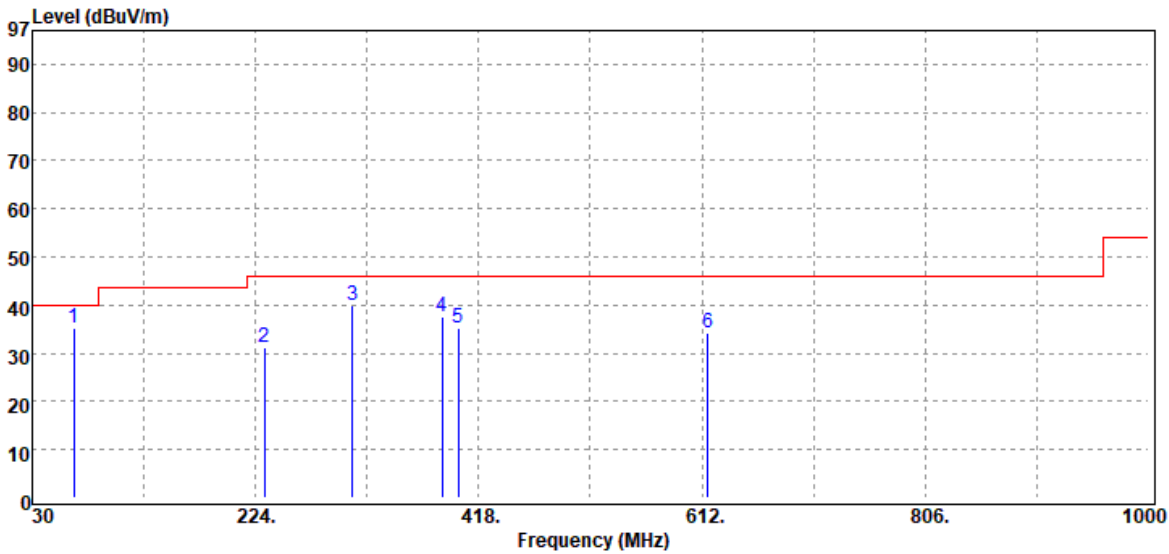
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### Radiated Spurious Emission Measurement Result:

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

Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11g	Temp./Humi.	:24.6/66
Test Channel	:2437 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol	:E1 Plane		



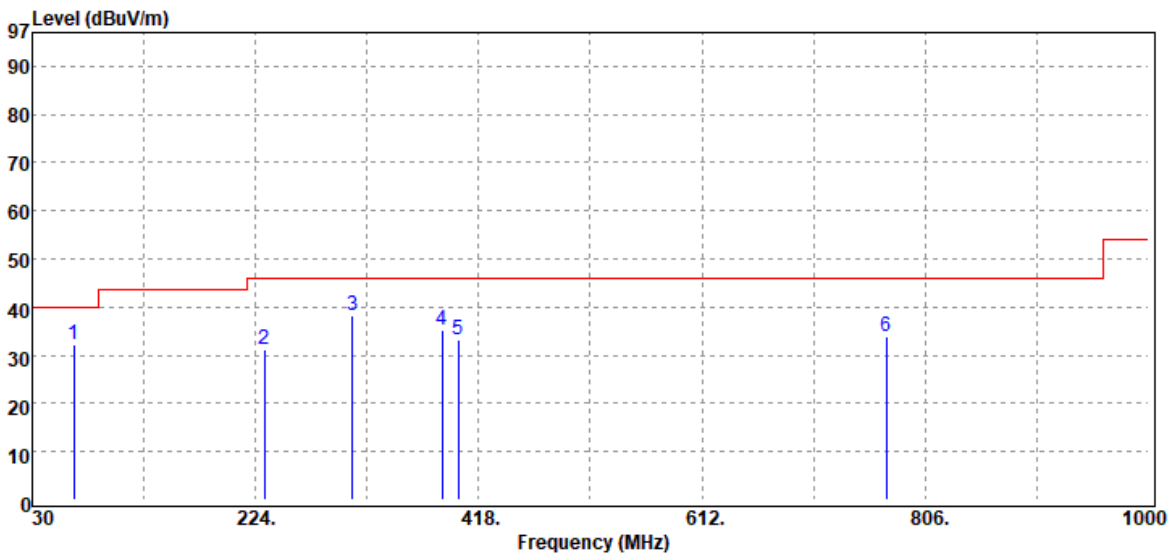
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
65.89	Peak	44.52	-9.31	35.21	40.00	-4.79
231.76	Peak	39.82	-8.68	31.14	46.00	-14.86
308.39	Peak	45.95	-5.93	40.02	46.00	-5.98
385.99	Peak	41.92	-4.26	37.66	46.00	-8.34
400.54	Peak	39.08	-3.87	35.21	46.00	-10.79
616.85	Peak	34.59	-0.51	34.08	46.00	-11.92

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11g	Temp./Humi.	:24.6/66
Test Channel	:2437 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol	:E1 Plane		



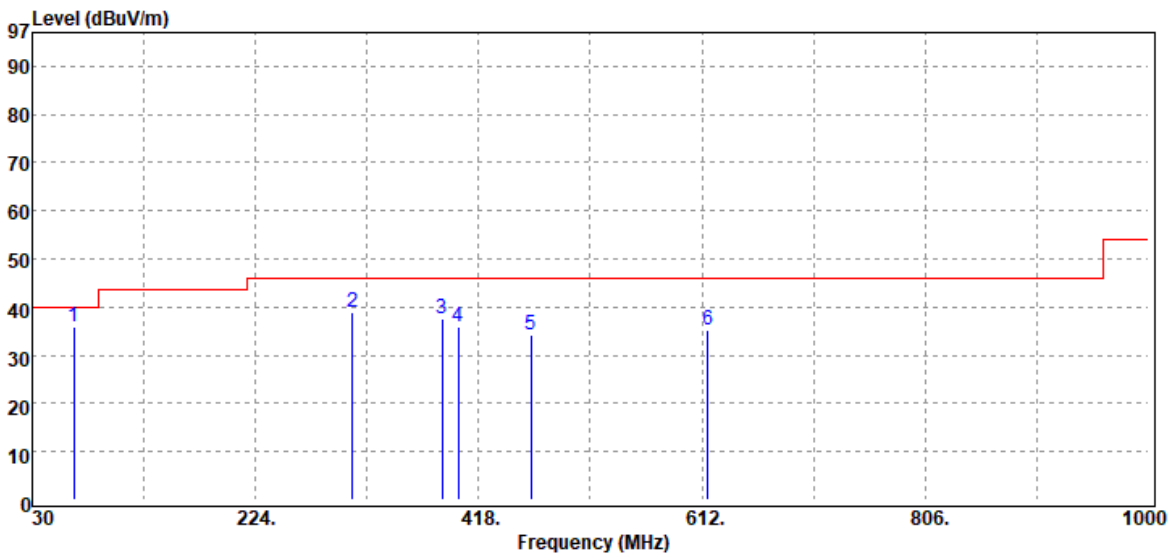
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
65.89	Peak	41.37	-9.31	32.06	40.00	-7.94
231.76	Peak	39.79	-8.68	31.11	46.00	-14.89
308.39	Peak	44.18	-5.93	38.25	46.00	-7.75
385.99	Peak	39.58	-4.26	35.32	46.00	-10.68
400.54	Peak	37.15	-3.87	33.28	46.00	-12.72
772.05	Peak	31.72	2.24	33.96	46.00	-12.04

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2437 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol	:E1 Plane		



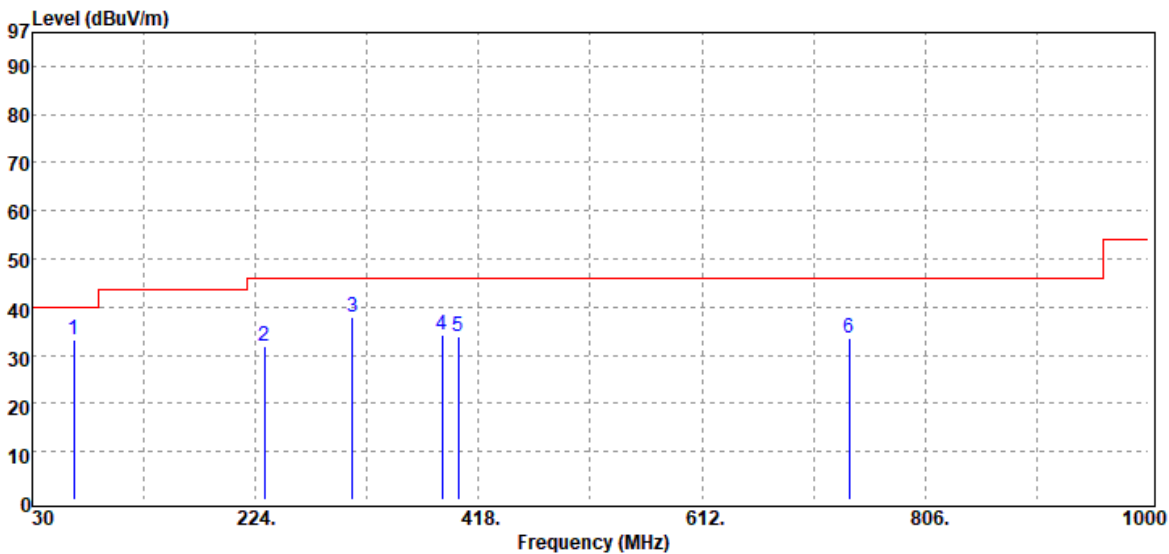
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
65.89	Peak	45.07	-9.31	35.76	40.00	-4.24
308.39	Peak	44.81	-5.93	38.88	46.00	-7.12
385.99	Peak	41.99	-4.26	37.73	46.00	-8.27
400.54	Peak	39.84	-3.87	35.97	46.00	-10.03
463.59	Peak	37.25	-3.14	34.11	46.00	-11.89
616.85	Peak	35.71	-0.51	35.20	46.00	-10.80

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2437 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol	:E1 Plane		



Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
65.89	Peak	42.37	-9.31	33.06	40.00	-6.94
231.76	Peak	40.63	-8.68	31.95	46.00	-14.05
308.39	Peak	43.91	-5.93	37.98	46.00	-8.02
385.99	Peak	38.51	-4.26	34.25	46.00	-11.75
400.54	Peak	37.83	-3.87	33.96	46.00	-12.04
740.04	Peak	31.70	1.91	33.61	46.00	-12.39

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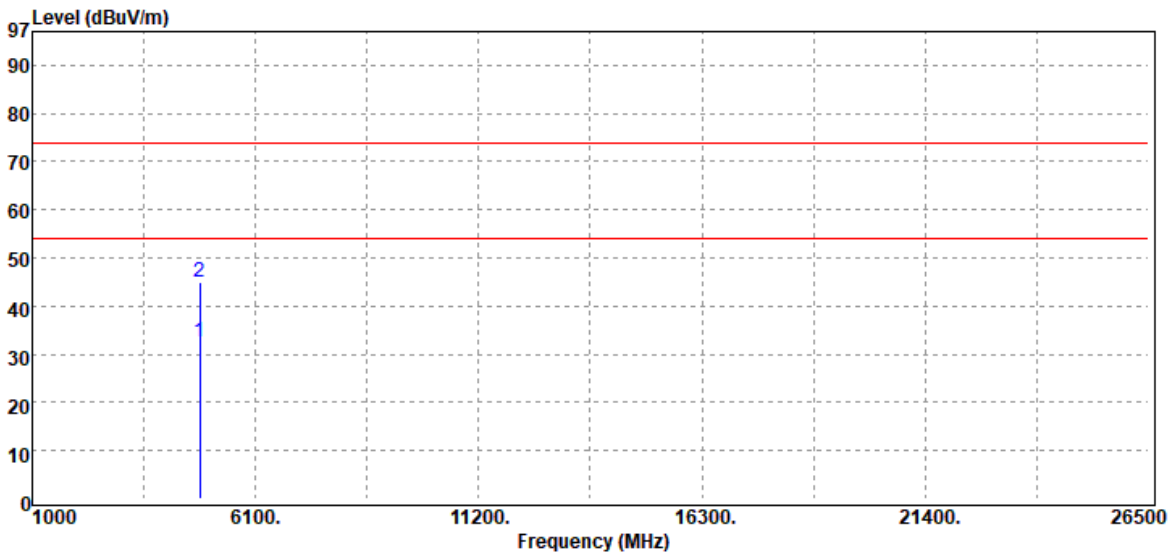
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### Radiated Spurious Emission Measurement Result:

#### Above 1GHz Data:

Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11b	Temp./Humi.	:24.6/66
Test Channel	:2412 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH Low	Engineer	:Kane
EUT Pol	:E1 Plane		



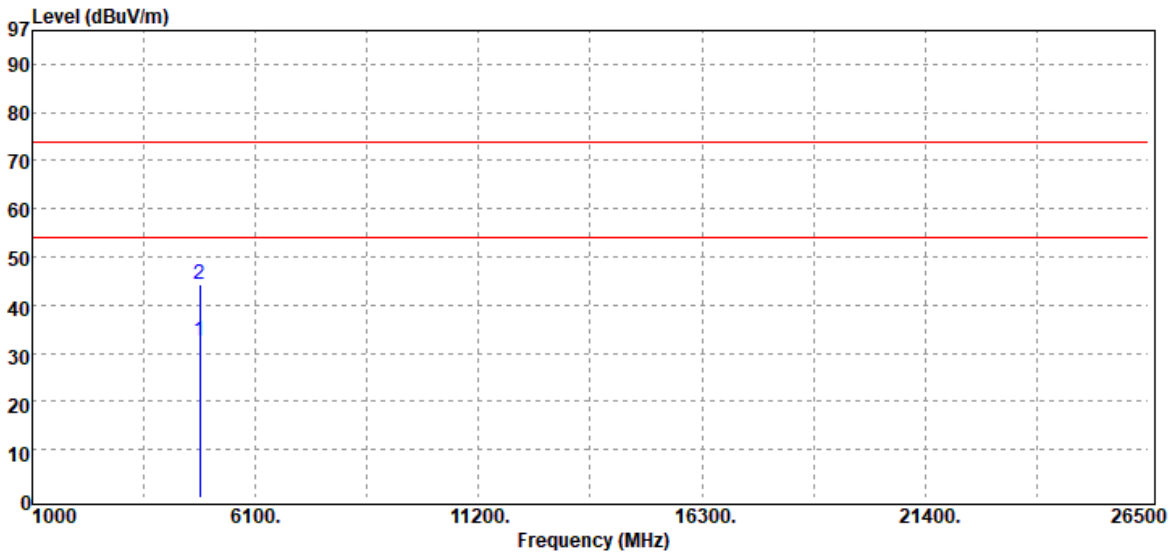
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4824.00	Average	26.13	6.53	32.66	54.00	-21.34
4824.00	Peak	38.39	6.53	44.92	74.00	-29.08

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11b	Temp./Humi.	:24.6/66
Test Channel	:2412 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Low	Engineer	:Kane
EUT Pol	:E1 Plane		



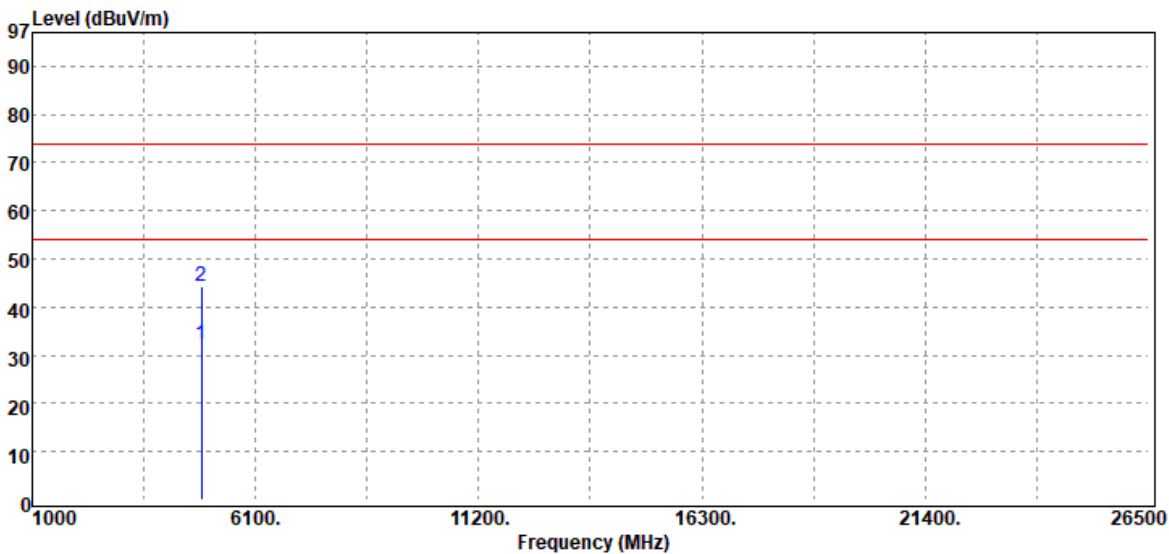
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dB $\mu$ V		dB $\mu$ V/m	dB $\mu$ V/m	
4824.00	Average	26.09	6.53	32.62	54.00	-21.38
4824.00	Peak	37.79	6.53	44.32	74.00	-29.68

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11b	Temp./Humi.	:24.6/66
Test Channel	:2437 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol	:E1 Plane		



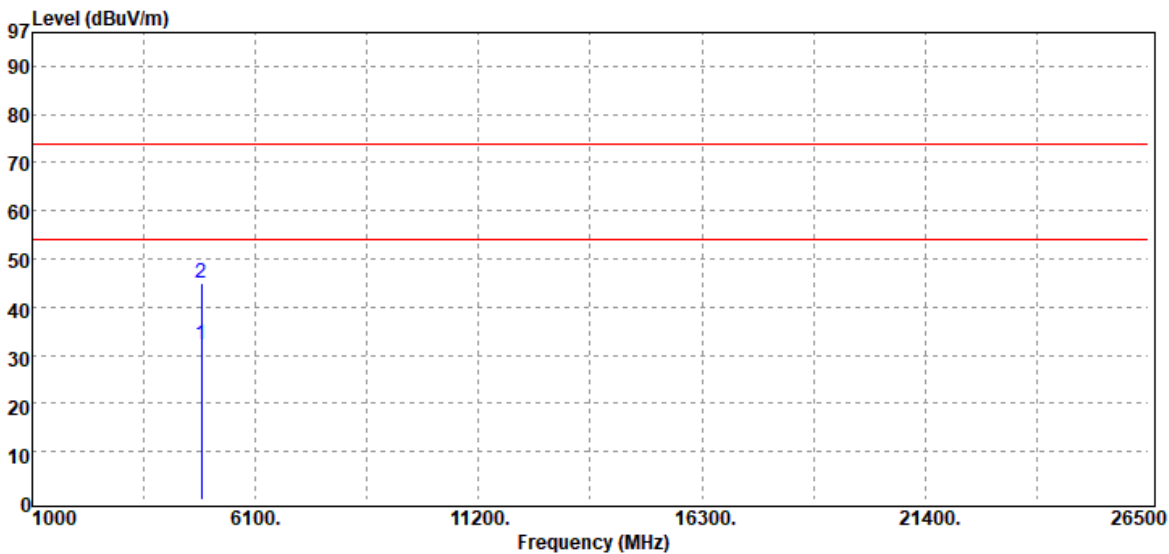
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4874.00	Average	25.54	6.69	32.23	54.00	-21.77
4874.00	Peak	37.49	6.69	44.18	74.00	-29.82

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11b	Temp./Humi.	:24.6/66
Test Channel	:2437 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol	:E1 Plane		



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dB $\mu$ V		dB $\mu$ V/m	dB $\mu$ V/m	
4874.00	Average	25.62	6.69	32.31	54.00	-21.69
4874.00	Peak	38.23	6.69	44.92	74.00	-29.08

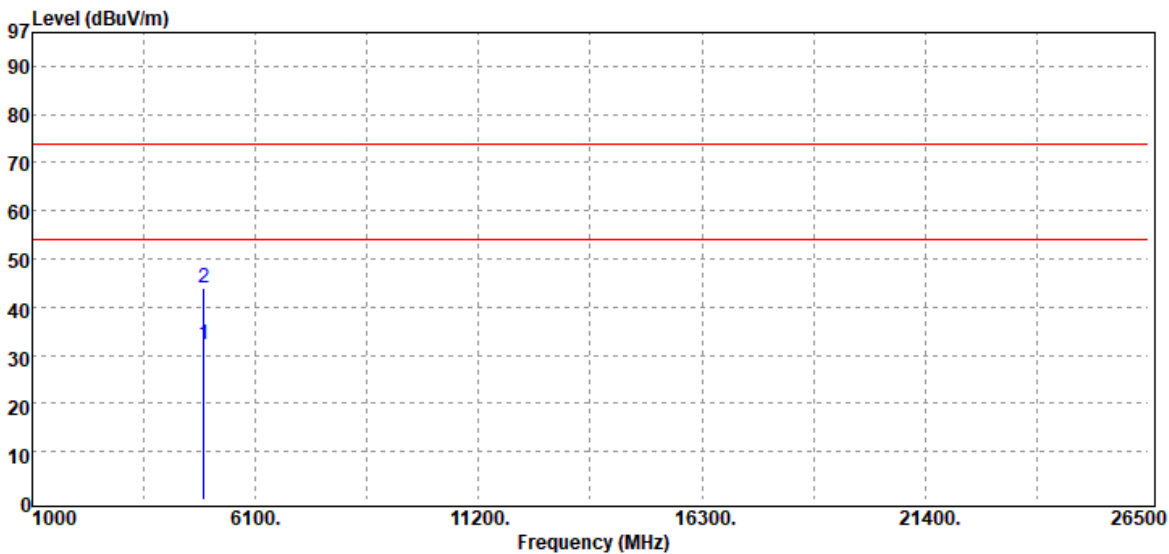
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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11b	Temp./Humi.	:24.6/66
Test Channel	:2462 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH High	Engineer	:Kane
EUT Pol	:E1 Plane		



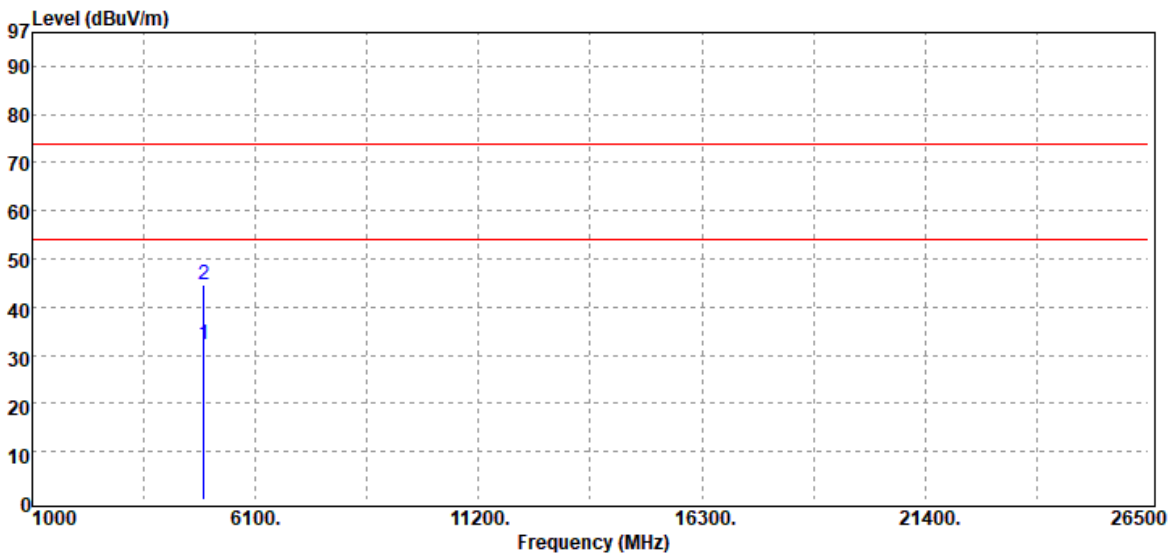
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4924.00	Average	25.40	6.85	32.25	54.00	-21.75
4924.00	Peak	37.03	6.85	43.88	74.00	-30.12

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11b	Temp./Humi.	:24.6/66
Test Channel	:2462 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH High	Engineer	:Kane
EUT Pol	:E1 Plane		



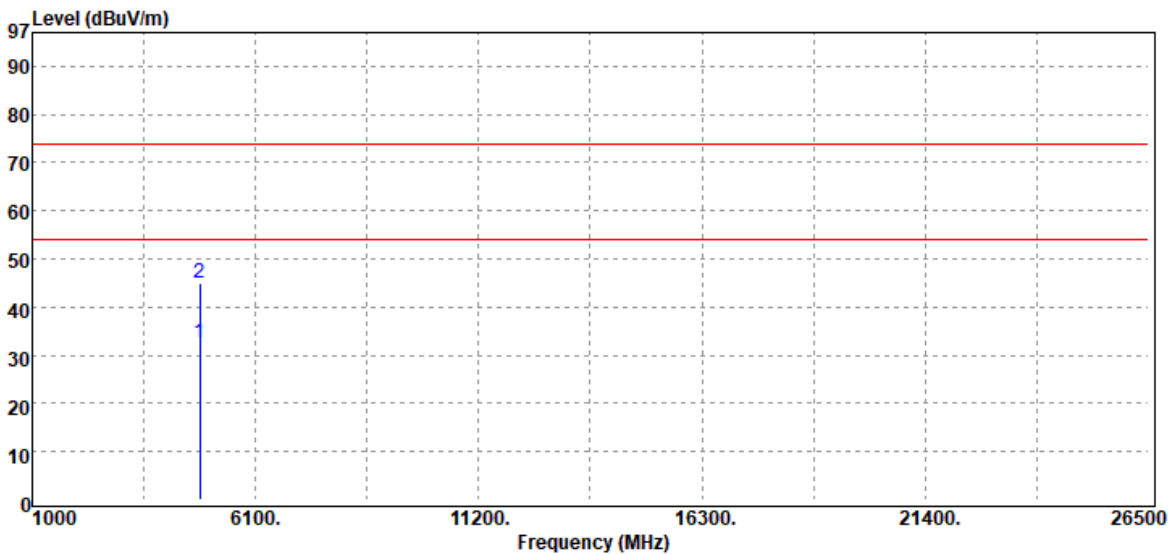
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4924.00	Average	25.32	6.85	32.17	54.00	-21.83
4924.00	Peak	37.73	6.85	44.58	74.00	-29.42

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11g	Temp./Humi.	:24.6/66
Test Channel	:2412 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH Low	Engineer	:Kane
EUT Pol	:E1 Plane		



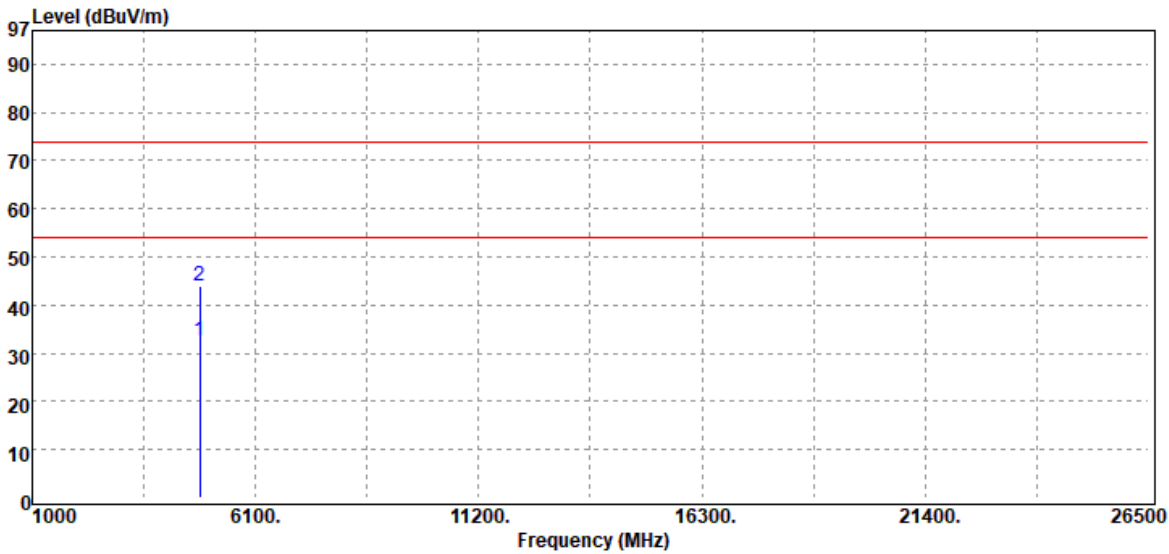
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4824.00	Average	25.90	6.53	32.43	54.00	-21.57
4824.00	Peak	38.49	6.53	45.02	74.00	-28.98

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11g	Temp./Humi.	:24.6/66
Test Channel	:2412 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Low	Engineer	:Kane
EUT Pol	:E1 Plane		



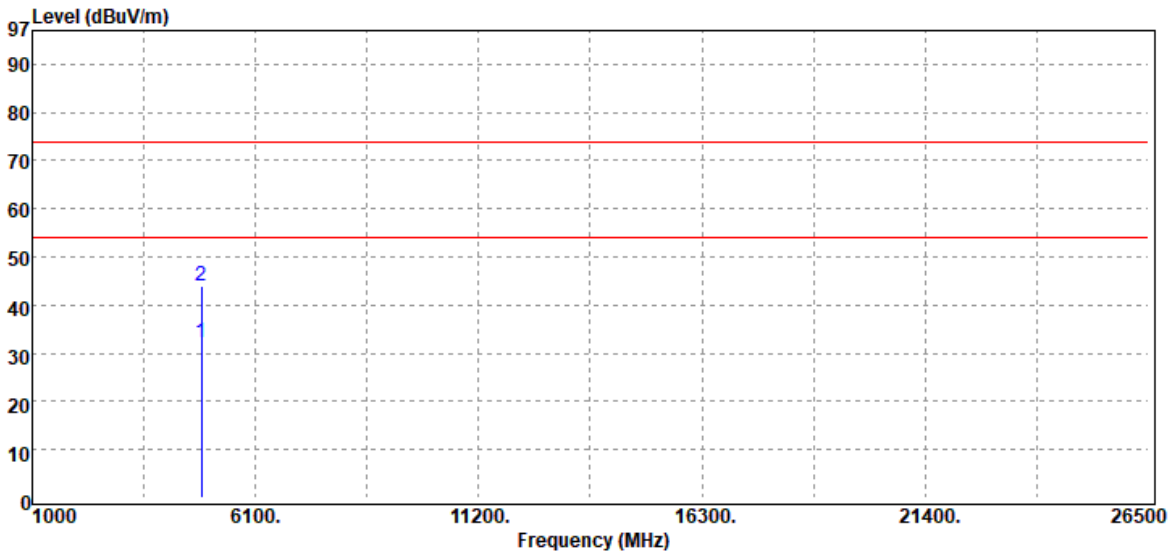
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4824.00	Average	25.95	6.53	32.48	54.00	-21.52
4824.00	Peak	37.56	6.53	44.09	74.00	-29.91

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11g	Temp./Humi.	:24.6/66
Test Channel	:2437 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol	:E1 Plane		



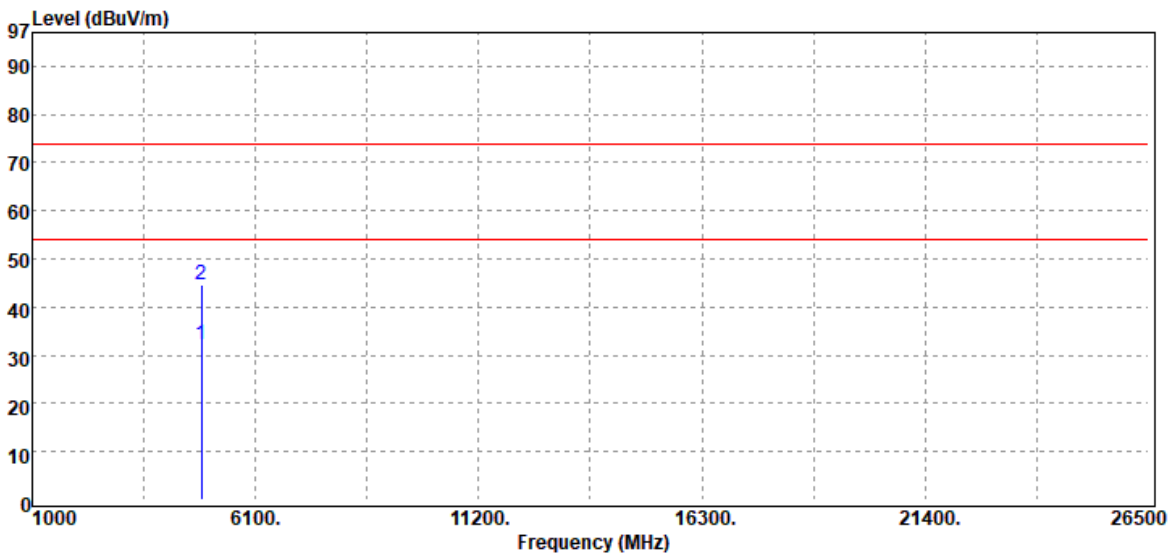
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4874.00	Average	25.42	6.69	32.11	54.00	-21.89
4874.00	Peak	37.38	6.69	44.07	74.00	-29.93

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11g	Temp./Humi.	:24.6/66
Test Channel	:2437 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol	:E1 Plane		



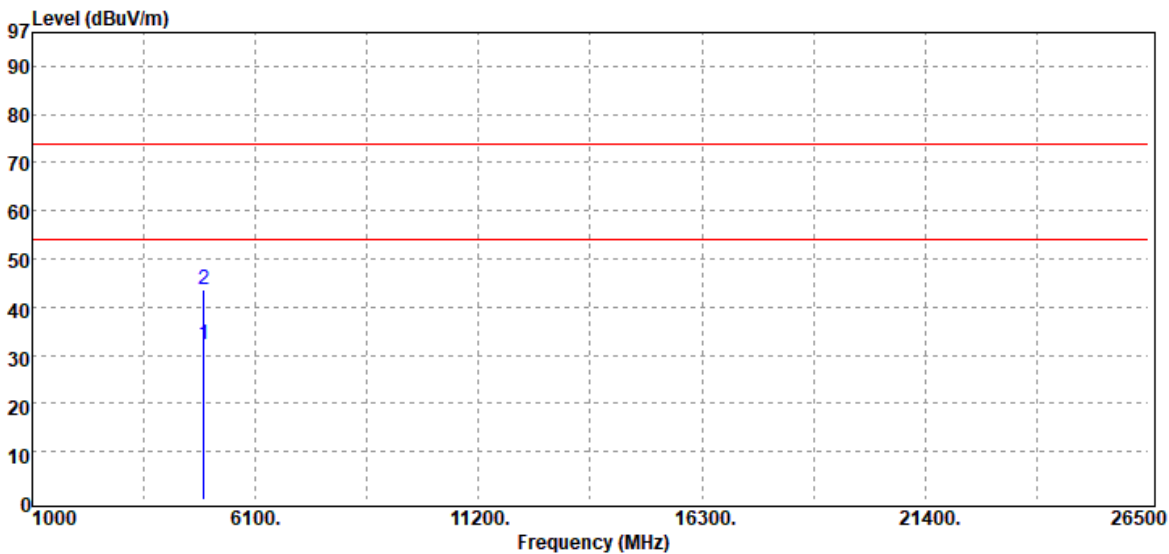
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dB $\mu$ V		dB $\mu$ V/m	dB $\mu$ V/m	
4874.00	Average	25.37	6.69	32.06	54.00	-21.94
4874.00	Peak	38.01	6.69	44.70	74.00	-29.30

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11g	Temp./Humi.	:24.6/66
Test Channel	:2462 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH High	Engineer	:Kane
EUT Pol	:E1 Plane		



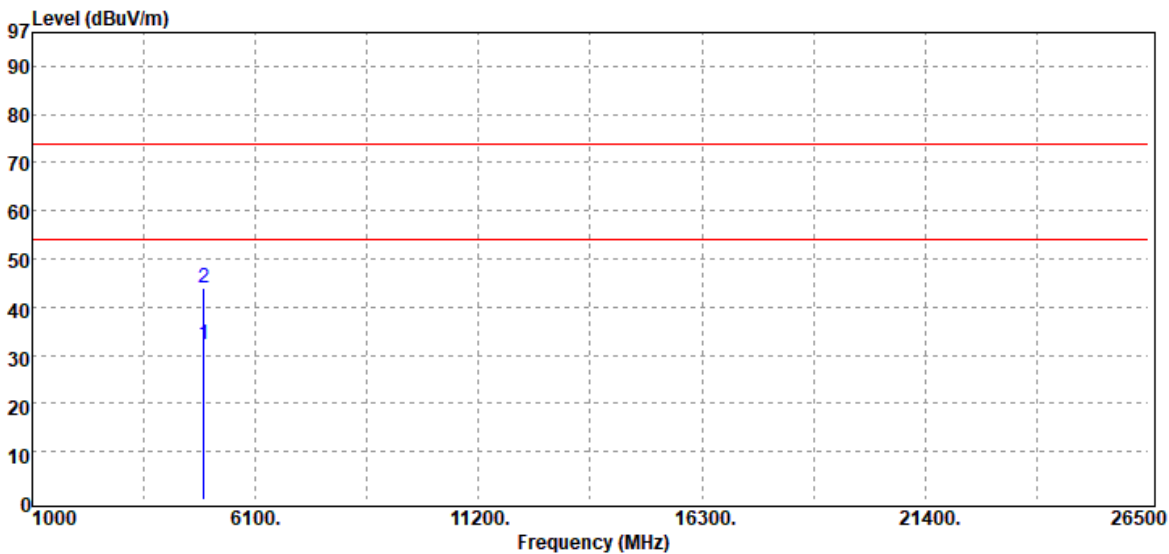
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4924.00	Average	25.22	6.85	32.07	54.00	-21.93
4924.00	Peak	36.87	6.85	43.72	74.00	-30.28

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11g	Temp./Humi.	:24.6/66
Test Channel	:2462 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH High	Engineer	:Kane
EUT Pol	:E1 Plane		



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dB $\mu$ V		dB $\mu$ V/m	dB $\mu$ V/m	
4924.00	Average	25.28	6.85	32.13	54.00	-21.87
4924.00	Peak	37.15	6.85	44.00	74.00	-30.00

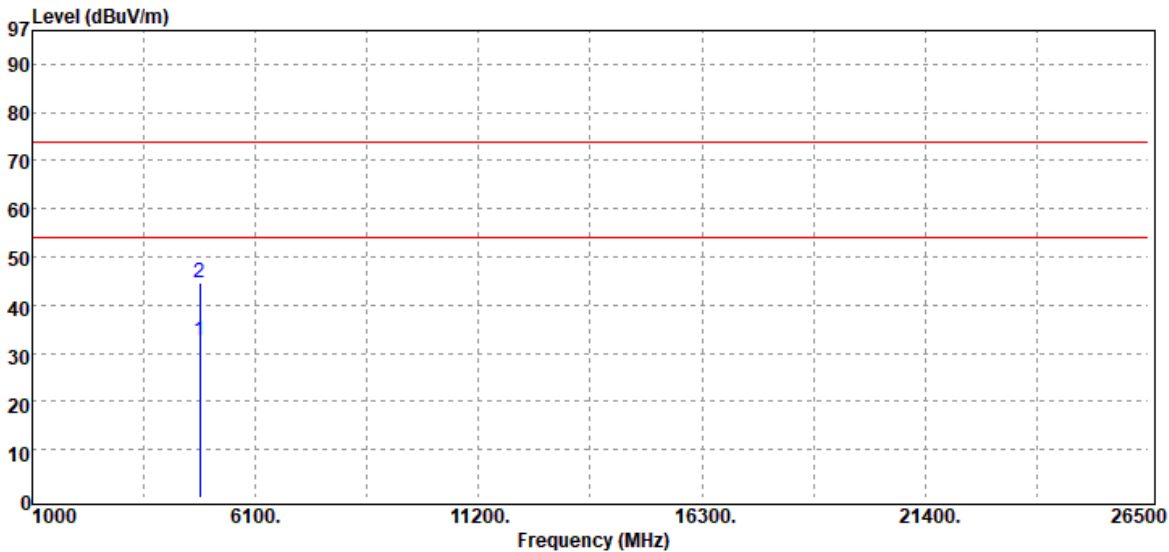
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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2412 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH Low	Engineer	:Kane
EUT Pol	:E1 Plane		



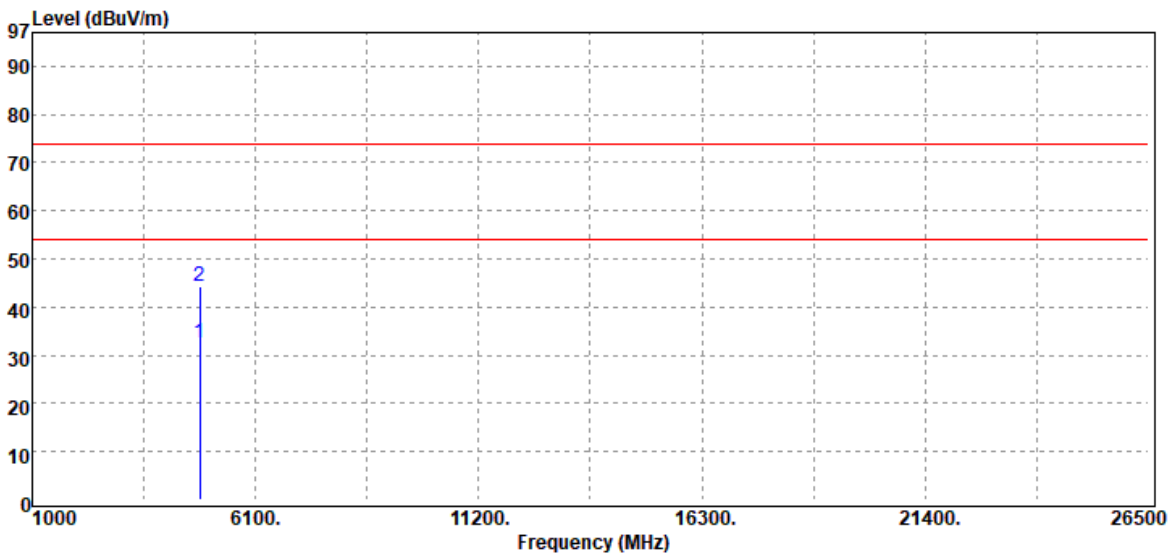
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dB $\mu$ V		dB $\mu$ V/m	dB $\mu$ V/m	
4824.00	Average	26.02	6.53	32.55	54.00	-21.45
4824.00	Peak	38.20	6.53	44.73	74.00	-29.27

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2412 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Low	Engineer	:Kane
EUT Pol	:E1 Plane		



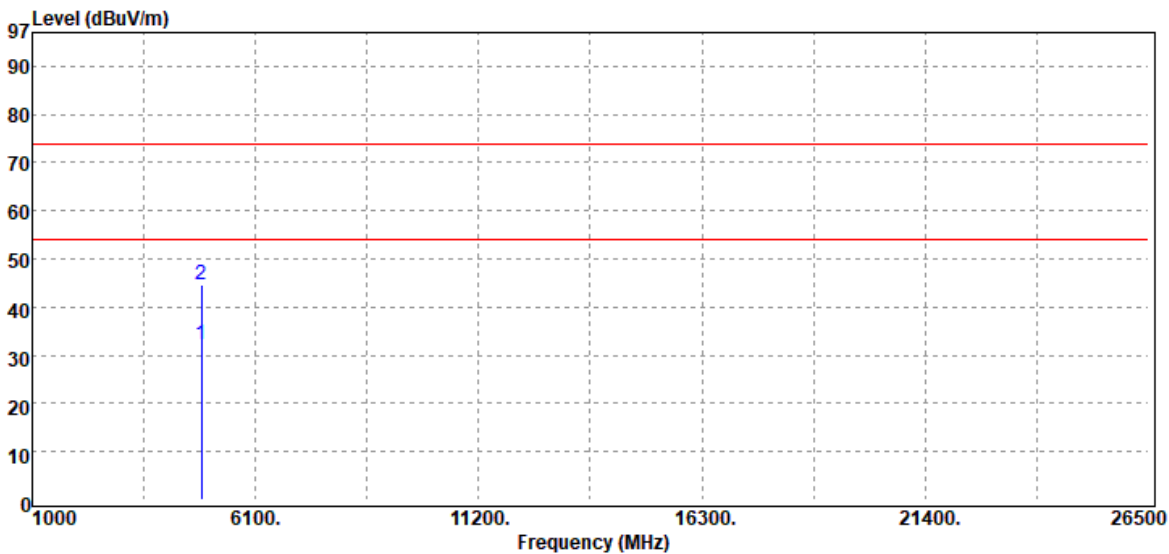
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dB $\mu$ V		dB $\mu$ V/m	dB $\mu$ V/m	
4824.00	Average	25.95	6.53	32.48	54.00	-21.52
4824.00	Peak	37.93	6.53	44.46	74.00	-29.54

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2437 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol	:E1 Plane		



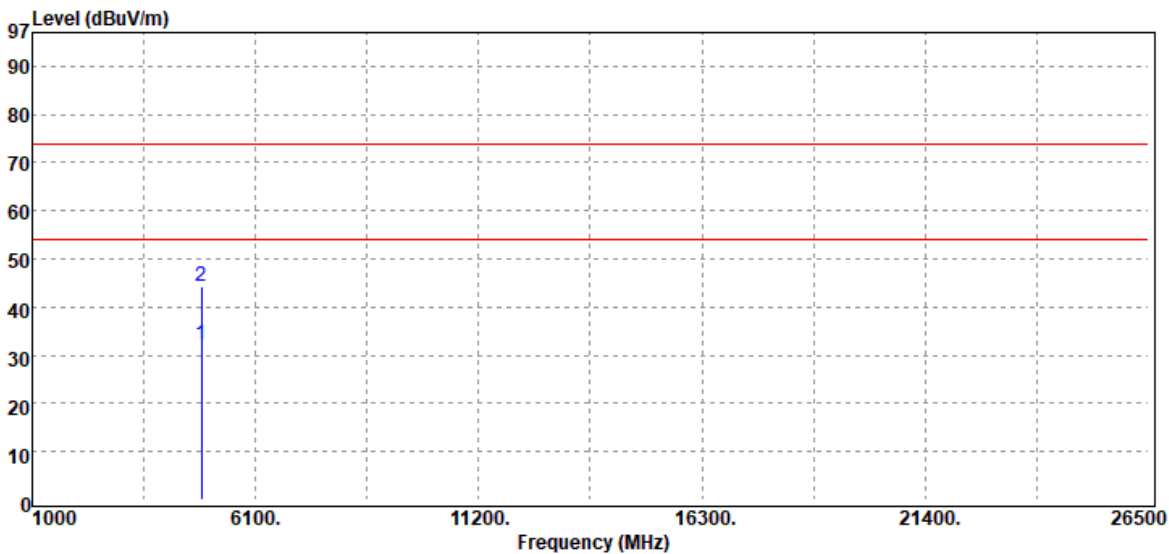
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4874.00	Average	25.44	6.69	32.13	54.00	-21.87
4874.00	Peak	37.86	6.69	44.55	74.00	-29.45

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2437 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol	:E1 Plane		



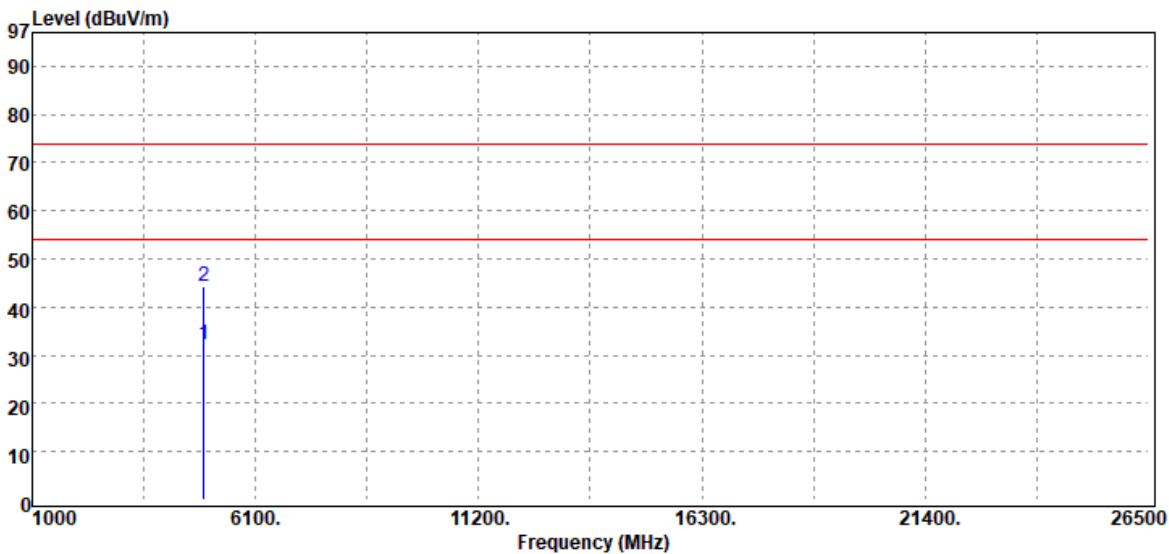
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4874.00	Average	25.41	6.69	32.10	54.00	-21.90
4874.00	Peak	37.56	6.69	44.25	74.00	-29.75

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2462 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH High	Engineer	:Kane
EUT Pol	:E1 Plane		



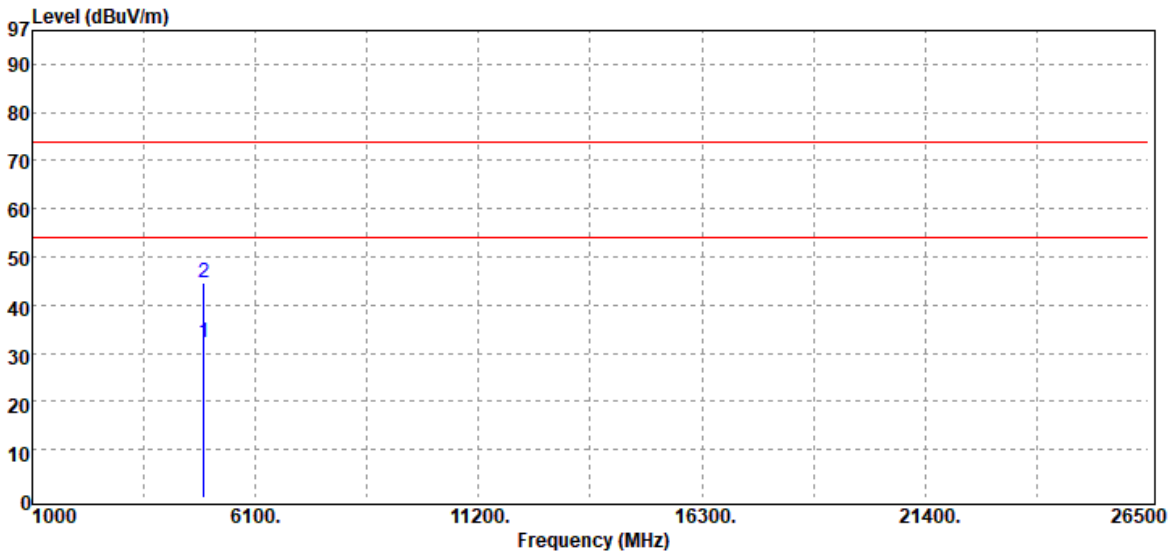
Freq. MHz	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4924.00	Average	25.38	6.85	32.23	54.00	-21.77
4924.00	Peak	37.60	6.85	44.45	74.00	-29.55

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Report Number	:ER/2019/A0106	Test Date	:2019-11-14
Operation Mode	:802.11n20	Temp./Humi.	:24.6/66
Test Channel	:2462 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH High	Engineer	:Kane
EUT Pol	:E1 Plane		



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dB $\mu$ V		dB $\mu$ V/m	dB $\mu$ V/m	
4924.00	Average	25.30	6.85	32.15	54.00	-21.85
4924.00	Peak	37.87	6.85	44.72	74.00	-29.28

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## 12 PEAK POWER SPECTRAL DENSITY

### 12.1 Standard Applicable

Per Part 15.247 (e)

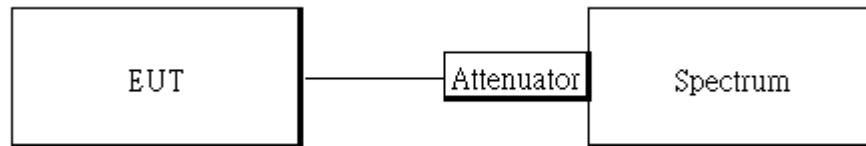
The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

### 12.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	05/02/2019	05/01/2020
DC Power Supply	Agilent	E3640A	MY52410006	12/04/2018	12/03/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2019	01/01/2020
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2019	01/01/2020

### 12.3 Test Set-up



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## 12.4 Measurement Procedure

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
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.
11. 802.11n MIMO mode: offset is set following “measure and add 10 Log (N)” on spectrum to measure the PSD for MIMO mode. Offset = cable loss + 10 log (N), where N is number of transmitting antenna. N=2 for this given application.

### Note:

*For the test of PSD at MIMO mode, the highest emission of worst case employing Measure and add 10 log (N) technical is reported on this report after the comparison between Main Antenna at single transmitting mode and Aux that yields the higher value. The MIMO transmitting mode produces higher value of outcome*

1. As per FCC KDB 662911 D01

Unequal antenna gains, with equal transmit powers. For antenna gains given by G1, G2, ..., GN dBi.

(i) If transmit signals are correlated, then Directional gain

$$= 10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / N_{ANT}] \text{ dBi}$$

[Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

The antenna gain is not greater than 6 dBi. Therefore, reduction of power is not required.

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## 12.5 Measurement Result

POWER DENSITY 802.11b_2TX				POWER DENSITY 802.11g_MIMO			
Freq. (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result	Freq. (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-5.26	8.00	PASS	2412	-8.12	8.00	PASS
2437	-3.94	8.00	PASS	2437	-5.84	8.00	PASS
2462	-6.32	8.00	PASS	2462	-7.82	8.00	PASS

POWER DENSITY 802.11n HT20_MIMO			
Freq. (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-9.46	8.00	PASS
2437	-8.26	8.00	PASS
2462	-10.34	8.00	PASS

### Note

Cable Loss 11.50 dB

\*Refer to next page for plots.

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Power Density 802.11b 20MHz Chain0 2412MHz



Power Density 802.11g 20MHz Chain0 2412MHz



Power Density 802.11b 20MHz Chain0 2437MHz



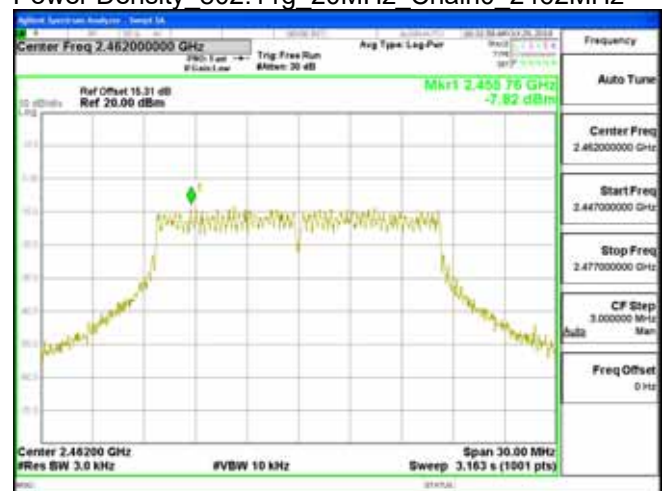
Power Density 802.11g 20MHz Chain0 2437MHz



Power Density 802.11b 20MHz Chain0 2462MHz



Power Density 802.11g 20MHz Chain0 2462MHz

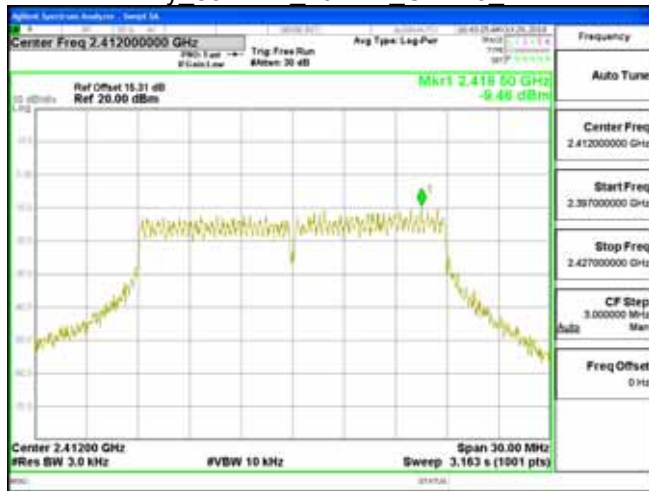


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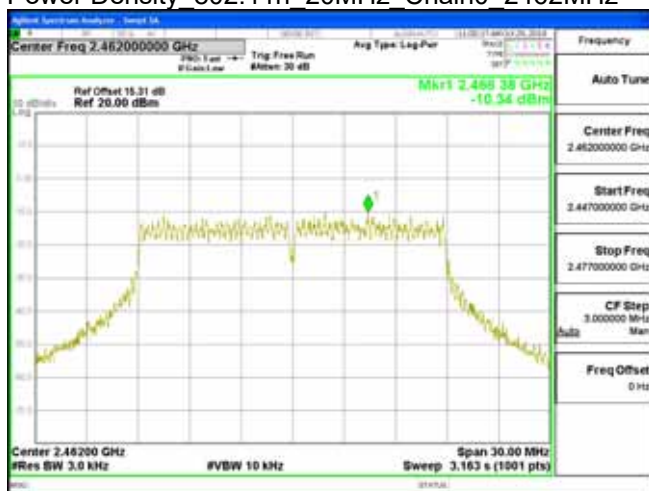
Power Density 802.11n 20MHz Chain0 2412MHz



Power Density 802.11n 20MHz Chain0 2437MHz



Power Density 802.11n 20MHz Chain0 2462MHz



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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

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo for details.

*~ End of Report ~*

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