

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant: Murata Manufacturing Co., Ltd.
1-10-1, Higashikotari, Nagaokakyo-shi, Kyoto 617-8555 Japan

Product Name: Communication Module

Brand Name: muRata

Model No.: LBEE5XV1YM

Model Difference: N/A

Report Number: ER/2020/C0064

FCC ID: VPYLB1YM

IC: 772C-LB1YM

FCC Rule Part: §15.247, Cat: DTS

IC RSS: RSS-247 issue 2 Feb 2017

Issue Date: Dec. 30, 2020

Date of Test: Aug. 19, 2020 ~ Oct. 08, 2020

Date of EUT Received: Aug. 19, 2020

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab. 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

Jay Lin / Asst. Supervisor



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Revision History

Report Number	Revision	Description	Issue Date	Remark
ER/2020/C0064	Rev.00	Original.	Dec. 30, 2020	Revised By: Elle Chang

Note:

1、Disclaimer

Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

2、Measurement results in the original test report ER/2020/80121 are fully leveraged in this test report without further verification test.

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Table of Contents

1	GENERAL INFORMATION.....	4
2	SYSTEM TEST CONFIGURATION	7
3	SUMMARY OF TEST RESULTS	10
4	DESCRIPTION OF TEST MODES.....	11
5	MEASUREMENT UNCERTAINTY.....	14
6	CONDUCTED EMISSION TEST	15
7	DUTY CYCLE OF TEST SIGNAL.....	19
8	PEAK OUTPUT POWER MEASUREMENT	21
9	6dB & 99% BANDWIDTH MEASUREMENT	33
10	CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT	42
11	RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT.....	51
12	POWER SPECTRAL DENSITY	100
13	ANTENNA REQUIREMENT.....	106

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1 GENERAL INFORMATION

1.1 Product description

Product Name:	Communication Module
Brand Name:	muRata
Model No.:	LBEE5XV1YM
Model Difference:	N/A
Hardware Version:	1.0
Software Version:	1.0
Power Supply:	3.3Vdc

Wi-Fi 802.11	Frequency Range	Channels	Rated Power (dBm)	Modulation Technology
b	2412-2462	11	20.19	DSSS
g			28.05	OFDM
n_HT20 ac_VHT20			HT: 28.14	
Modulation type:		CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM 256QAM for OFDM in 802.11ac only		
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 – 144.4Mbps 802.11 ac_20MHz: 6.5 – 173.3Mbps		

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1.2 Antenna Designation

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)	Worst Antenna Gain
Dipole	Molex	146153	2412-2472	3.2	
	Molex	146187	2412-2472	3.4	V

Note: Pre-scanned was done on the above 2 antennas, the peak gain 3.4dBi results higher emission at 2.4GHz. Therefore, the completed set of measurement was done on the antenna to be presented on this test report.

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1.3 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247
FCC KDB 558074 D01 15.247 Meas Guidance v05r02
FCC KDB 662911 D01 Multiple Transmitter Output v02r01
RSS-247 issue 2 Feb. 2017
RSS-Gen. issue 5, Amendment 1, March 2019
ANSI C63.10:2013

1.4 Test Facility

SGS Taiwan Ltd. Central RF Lab (TAF code 3702)
No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333

FCC Designation number: TW0028

ISED CAB identifier: TW3702

1.5 Special Accessories

There are no special accessories used while test was conducted.

1.6 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 placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50 μ H/50 ohm 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 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.

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2.4 Measurement Results Explanation Example

2.4.1 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.

2.4.2 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.

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2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission configuration

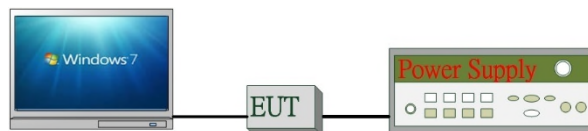


Fig. 2-2 Conducted (Antenna Port) Configuration Emission

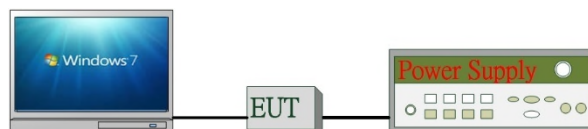


Fig. 2-3 Conducted (AC powerline) Emission Configuration

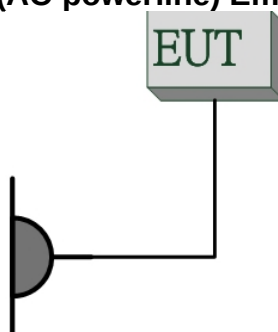


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	WLAN Test Software	N/A	N/A	N/A	N/A	N/A
2.	Notebook	Lenovo	L420	S0011721	N/A	N/A
3.	DC Power Supply	DHA	DPS-3003	9411005787	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 d	Peak Output Power	Compliant
§15.247(a)(2)	RSS-247 §5.2 a RSS-Gen §6.7	6dB & 99% Emission Bandwidth	Compliant
§15.205 §15.209 §15.247(d)	RSS-247 §5.5 RSS-Gen §8.10	Conducted Band Edge and Spurious Emission	Compliant
§15.205 §15.209 §15.247(d)	RSS-247 §5.5 RSS-Gen §8.9 RSS-Gen §8.10 RSS-Gen §6.13	Radiated Band Edge and Spurious Emission	Compliant
§15.247(e)	RSS-247 §5.2 b	Power Spectral Density	Compliant
§15.203 §15.247(b)	RSS- Gen §6.8	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/g/n/ac
20M.

CHANNEL	FREQUENCY (MHz)
1	2412
2	2417
3	2422
4	2427
5	2432
6	2437
7	2442
8	2447
9	2452
10	2457
11	2462

Note: EUT serial number is 1617633250 and sample number is DUT No. 20.

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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.

The given UE is pre-scanned among below modes.

Modulation	Transmission Chain				Single Transmission Spatial	Multiple Transmission Spatial
☒ 802.11 b	☒ Ch0	☒ Ch1	☐ Ch2	☐ Ch3	☐ 1TX	☒ 2TX
☒ 802.11 g	☒ Ch0	☒ Ch1	☐ Ch2	☐ Ch3	☐ 1TX	☒ 2TX
☒ 802.11 n	☒ Ch0	☒ Ch1	☐ Ch2	☐ Ch3	☐ SISO	☒ MIMO
☒ 802.11 ac	☒ Ch0	☒ Ch1	☐ Ch2	☐ Ch3	☐ SISO	☒ 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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4.3 Radiated Emission Test:

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
RADIATED EMISSION TEST (BELOW 1 GHz)					
802.11g	1 to 11	6	OFDM	6	2TX
RADIATED EMISSION TEST (ABOVE 1 GHz)					
802.11b	1 to 11	1, 2, 6, 10, 11	DSSS	1	2TX
802.11g	1 to 11	1, 3, 6, 9, 11	OFDM	6	2TX
802.11n_HT20	1 to 11	1, 3, 6, 9, 11	OFDM	MCS 0	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.

4.4 Antenna Port Conducted Measurement:

CONDUCTED TEST					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11b	1 to 11	1, 2, 6, 10, 11	DSSS	1	2TX
802.11g	1 to 11	1, 3, 6, 9, 11	OFDM	6	2TX
802.11n_HT20	1 to 11	1, 3, 6, 9, 11	OFDM	MCS 0	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	
Polarization: Vertical	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
Polarization: Horizontal	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 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/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LISN	SCHWARZBECK Mess-Elektronik	NSLK8127	974	03/25/2020	03/24/2021
EMI Test Receiver	R&S	ESCI	101342	04/28/2020	04/27/2021
Test Software	audix	e3	Ver. 6.11- 20180419c	N.C.R	N.C.R

6.3 EUT Setup

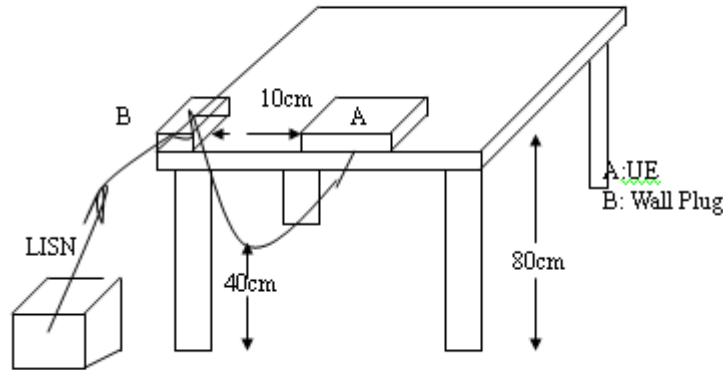
1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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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.

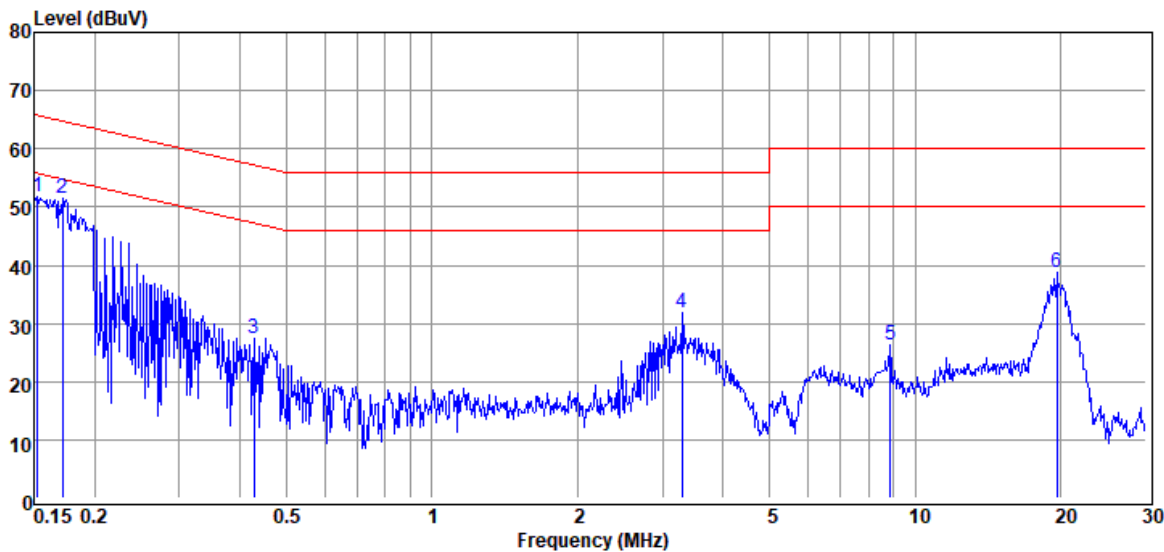
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number	:ER/2020/80121	Test Site	:Conduction Room C
Test Mode	:WLAN 2.4G	Test Date	:2020-09-04
Power	:120V/60Hz	Temp./Humi.	:25.1/68
Probe	:L1	Engineer	:Kailin Lee
Note:	: Adapter: FSP065-REB		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.15	Peak	41.63	10.22	51.85	65.87	-14.02
0.17	Peak	41.24	10.22	51.46	64.86	-13.40
0.43	Peak	17.26	10.22	27.48	57.29	-29.81
3.29	Peak	21.38	10.47	31.85	56.00	-24.15
8.87	Peak	15.57	10.66	26.23	60.00	-33.77
19.64	Peak	27.89	10.85	38.74	60.00	-21.26

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Report Number :ER/2020/80121

Test Site :Conduction Room C

Test Mode :WLAN 2.4G

Test Date :2020-09-04

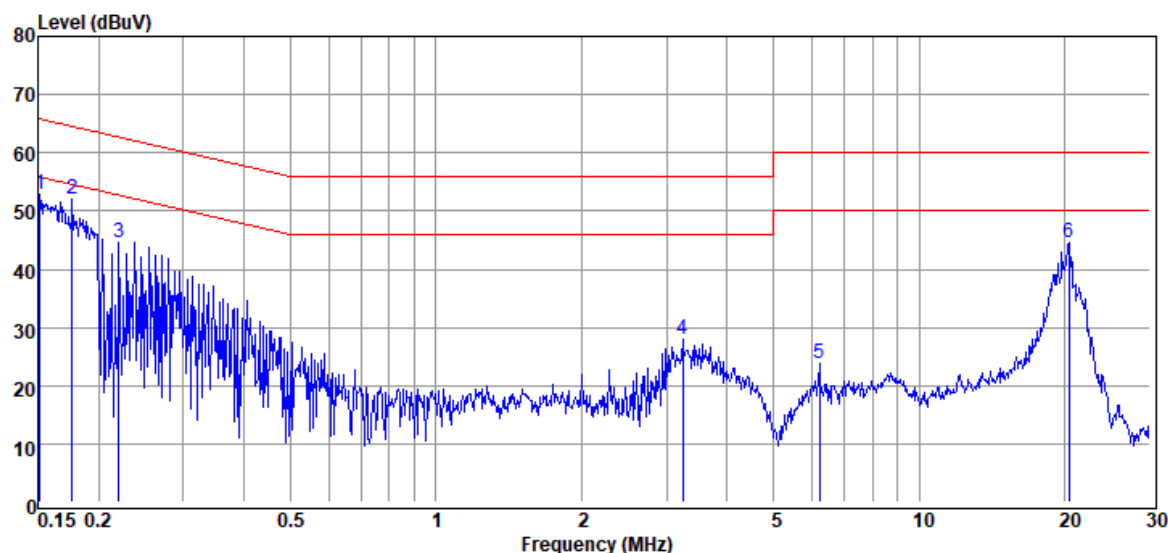
Power :120V/60Hz

Temp./Humi. :25.1/68

Probe :N

Engineer :Kailin Lee

Note: : Adapter: FSP065-REB



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS		
	PK/QP/AV	dBμV	dB	dBμV	dBμV	dB
0.15	Peak	42.69	10.21	52.90	65.91	-13.01
0.18	Peak	41.88	10.21	52.09	64.64	-12.55
0.22	Peak	34.32	10.21	44.53	62.79	-18.26
3.24	Peak	17.40	10.48	27.88	56.00	-28.12
6.22	Peak	13.34	10.58	23.92	60.00	-36.08
20.38	Peak	33.69	10.87	44.56	60.00	-15.44

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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:

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) = 10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
802.11b	98.68	0.06	0.12	0.01
802.11g	96.82	0.14	0.32	1.00
802.11n_20	97.70	0.10	0.21	1.00
802.11ac_20	97.76	0.10	0.21	1.00

$b = 98.68\%$, $g = 96.82\%$, $n_ht_20 = 97.7\%$

Duty Cycle Factor: $10 * \log(1/0.9868) = 0.06$

Duty Cycle Factor: $10 * \log(1/0.9682) = 0.14$

Duty Cycle Factor: $10 * \log(1/0.977) = 0.1$

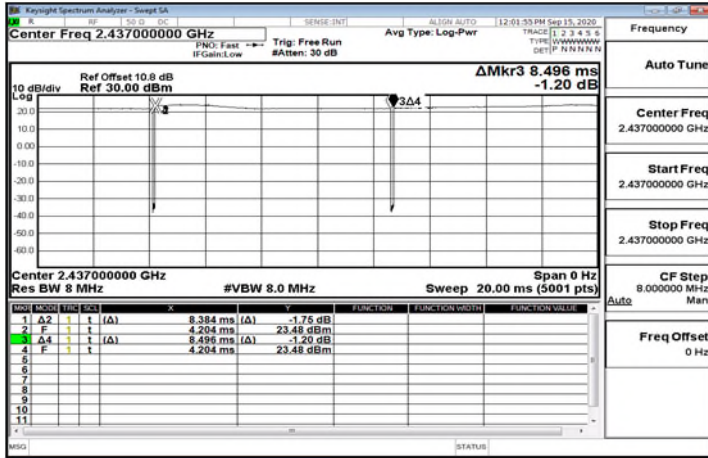
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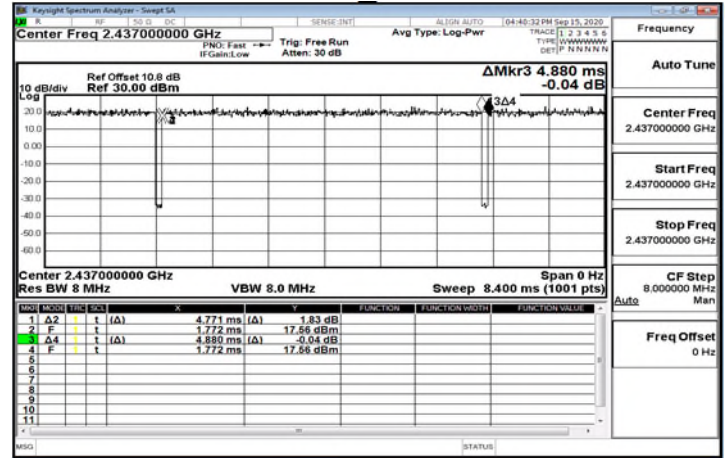
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7.3 Duty Cycle test plots

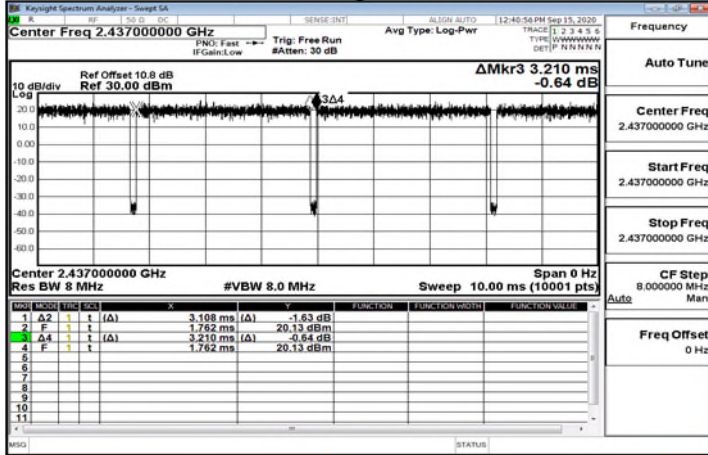
802.11b mode



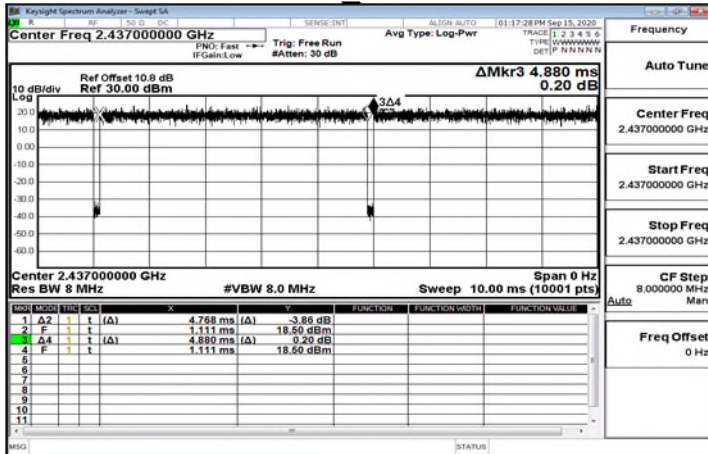
802.11ac 20 mode



802.11g mode



802.11n 20 mode



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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 section F. 2). e). (ii) of FCC KDB 662911 D01

If antenna gains are not equal and each transmit antenna is driven by only one spatial stream, directional gain may be calculated by either of the following formulas.

$$\bullet \quad DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

where

Each antenna is driven by no more than one spatial stream;

NSS = the number of independent spatial streams of data;

NANT = the total number of antennas

$g_{j,k}$ = / 20 10Gk if the kth antenna is being fed by spatial stream j, or zero if it is not;

G_k is the gain in dBi of the kth antenna.

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

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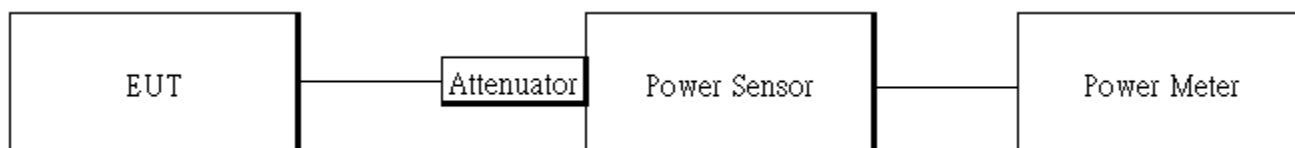
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8.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
DC Power Supply	DHA	DPS-3003	9411005787	08/19/2020	08/18/2021
Power Meter	Anritsu	ML2496A	1804002	04/06/2020	04/05/2021
Power Sensor	Anritsu	MA2411B	1726105	04/06/2020	04/05/2021
Power Sensor	Anritsu	MA2411B	1726106	04/06/2020	04/05/2021
Attenuator	Marvelous	MVE2213-10	RF80	11/20/2019	11/19/2020
Attenuator	Marvelous	WATT-218FS-10	RF245	11/20/2019	11/19/2020

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.

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

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8.5 Measurement Result

802.11b Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	17.24	30.00	PASS
6	2437	1	17.23	30.00	PASS
11	2462	1	17.28	30.00	PASS
802.11b Ch0					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	1	14.65	30.00	PASS
6	2437	1	14.66	30.00	PASS
11	2462	1	14.63	30.00	PASS

802.11b Ch1					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	16.98	30.00	PASS
6	2437	1	17.02	30.00	PASS
11	2462	1	17.16	30.00	PASS
802.11b Ch1					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	1	14.58	30.00	PASS
6	2437	1	14.56	30.00	PASS
11	2462	1	14.56	30.00	PASS

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802.11b_2TX					
CH	Freq. (MHz)	Data Rate	Total Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	20.09	29.59	PASS
6	2437	1	20.15	29.59	PASS
11	2462	1	20.19	29.59	PASS
802.11b_2TX					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	1	17.56	29.59	PASS
6	2437	1	17.59	29.59	PASS
11	2462	1	17.55	29.59	PASS

802.11g Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	21.37	30.00	PASS
3	2422	6	25.37	30.00	PASS
6	2437	6	25.32	30.00	PASS
9	2452	6	25.41	30.00	PASS
11	2462	6	21.54	30.00	PASS
802.11g Ch0					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	6	11.63	30.00	PASS
3	2422	6	17.97	30.00	PASS
6	2437	6	17.59	30.00	PASS
9	2452	6	17.98	30.00	PASS
11	2462	6	11.61	30.00	PASS

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802.11g Ch1					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	21.79	30.00	PASS
3	2422	6	25.38	30.00	PASS
6	2437	6	25.31	30.00	PASS
9	2452	6	25.33	30.00	PASS
11	2462	6	21.80	30.00	PASS
802.11g Ch1					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	6	11.61	30.00	PASS
3	2422	6	17.52	30.00	PASS
6	2437	6	17.43	30.00	PASS
9	2452	6	17.54	30.00	PASS
11	2462	6	11.66	30.00	PASS

802.11g_2TX					
CH	Freq. (MHz)	Data Rate	Total Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	25.11	29.59	PASS
3	2422	6	28.05	29.59	PASS
6	2437	6	28.05	29.59	PASS
9	2452	6	28.03	29.59	PASS
11	2462	6	25.02	29.59	PASS
802.11g_2TX					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	6	14.69	29.59	PASS
3	2422	6	20.70	29.59	PASS
6	2437	6	20.65	29.59	PASS
9	2452	6	20.73	29.59	PASS
11	2462	6	14.88	29.59	PASS

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802.11n_HT20M Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	21.54	30.00	PASS
3	2422	MCS0	25.41	30.00	PASS
6	2437	MCS0	25.44	30.00	PASS
9	2452	MCS0	25.39	30.00	PASS
11	2462	MCS0	21.65	30.00	PASS
802.11n_HT20M Ch0					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	11.64	30.00	PASS
3	2422	MCS0	16.57	30.00	PASS
6	2437	MCS0	16.69	30.00	PASS
9	2452	MCS0	16.62	30.00	PASS
11	2462	MCS0	11.68	30.00	PASS

802.11n_HT20M Ch1					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	22.13	30.00	PASS
3	2422	MCS0	25.35	30.00	PASS
6	2437	MCS0	25.30	30.00	PASS
9	2452	MCS0	25.33	30.00	PASS
11	2462	MCS0	22.18	30.00	PASS
802.11n_HT20M Ch1					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	11.54	30.00	PASS
3	2422	MCS0	16.52	30.00	PASS
6	2437	MCS0	16.56	30.00	PASS
9	2452	MCS0	16.55	30.00	PASS
11	2462	MCS0	11.74	30.00	PASS

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802.11n_HT20M MIMO					
CH	Freq. (MHz)	Data Rate	Total Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	25.37	29.59	PASS
3	2422	MCS0	28.09	29.59	PASS
6	2437	MCS0	28.14	29.59	PASS
9	2452	MCS0	28.09	29.59	PASS
11	2462	MCS0	25.35	29.59	PASS
802.11n_HT20M MIMO					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	14.89	29.59	PASS
3	2422	MCS0	19.81	29.59	PASS
6	2437	MCS0	19.83	29.59	PASS
9	2452	MCS0	19.85	29.59	PASS
11	2462	MCS0	14.98	29.59	PASS
802.11ac_VHT20M Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	21.50	30.00	PASS
3	2422	MCS0	25.34	30.00	PASS
6	2437	MCS0	25.40	30.00	PASS
9	2452	MCS0	25.36	30.00	PASS
11	2462	MCS0	21.58	30.00	PASS
802.11ac_VHT20M Ch0					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	11.63	30.00	PASS
3	2422	MCS0	16.76	30.00	PASS
6	2437	MCS0	16.83	30.00	PASS
9	2452	MCS0	16.74	30.00	PASS
11	2462	MCS0	11.65	30.00	PASS

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802.11ac_VHT20M Ch1					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	22.10	30.00	PASS
3	2422	MCS0	25.33	30.00	PASS
6	2437	MCS0	25.31	30.00	PASS
9	2452	MCS0	25.32	30.00	PASS
11	2462	MCS0	22.08	30.00	PASS
802.11ac_VHT20M Ch1					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	11.56	30.00	PASS
3	2422	MCS0	16.51	30.00	PASS
6	2437	MCS0	16.60	30.00	PASS
9	2452	MCS0	16.62	30.00	PASS
11	2462	MCS0	11.57	30.00	PASS

802.11ac_VHT20M MIMO					
CH	Freq. (MHz)	Data Rate	Total Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	25.30	29.59	PASS
3	2422	MCS0	28.08	29.59	PASS
6	2437	MCS0	28.13	29.59	PASS
9	2452	MCS0	28.08	29.59	PASS
11	2462	MCS0	25.30	29.59	PASS
802.11ac_VHT20M MIMO					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	14.85	29.59	PASS
3	2422	MCS0	19.80	29.59	PASS
6	2437	MCS0	19.81	29.59	PASS
9	2452	MCS0	19.84	29.59	PASS
11	2462	MCS0	14.98	29.59	PASS

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

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EIRP

802.11b Ch0							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	RESULT
1	2412	1	14.65	3.40	18.05	36	PASS
6	2437	1	14.66	3.40	18.06	36	PASS
11	2462	1	14.63	3.40	18.03	36	PASS

802.11b Ch1							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	RESULT
1	2412	1	14.58	3.40	17.98	36	PASS
6	2437	1	14.56	3.40	17.96	36	PASS
11	2462	1	14.56	3.40	17.96	36	PASS

802.11b_2TX							
CH	Freq. (MHz)	Data Rate	Total Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	RESULT
1	2412	1	17.56	6.41	23.97	36	PASS
6	2437	1	17.59	6.41	24.00	36	PASS
11	2462	1	17.55	6.41	23.96	36	PASS

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802.11g Ch0							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	RESULT
1	2412	6	11.63	3.40	15.03	36	PASS
3	2422	6	17.97	3.40	21.37	36	PASS
6	2437	6	17.59	3.40	20.99	36	PASS
9	2452	6	17.98	3.40	21.38	36	PASS
11	2462	6	11.61	3.40	15.01	36	PASS

802.11g Ch1							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	RESULT
1	2412	6	11.61	3.40	15.01	36	PASS
3	2422	6	17.52	3.40	20.92	36	PASS
6	2437	6	17.43	3.40	20.83	36	PASS
9	2452	6	17.54	3.40	20.94	36	PASS
11	2462	6	11.66	3.40	15.06	36	PASS

802.11g_2TX							
CH	Freq. (MHz)	Data Rate	Total Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	RESULT
1	2412	6	14.69	6.41	21.10	36	PASS
3	2422	6	20.70	6.41	27.11	36	PASS
6	2437	6	20.65	6.41	27.06	36	PASS
9	2452	6	20.73	6.41	27.14	36	PASS
11	2462	6	14.88	6.41	21.29	36	PASS

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802.11n_HT20M Ch0							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	11.64	3.40	15.04	36	PASS
3	2422	MCS0	16.57	3.40	19.97	36	PASS
6	2437	MCS0	16.69	3.40	20.09	36	PASS
9	2452	MCS0	16.62	3.40	20.02	36	PASS
11	2462	MCS0	11.68	3.40	15.08	36	PASS

802.11n_HT20M Ch1							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	11.54	3.40	14.94	36	PASS
3	2422	MCS0	16.52	3.40	19.92	36	PASS
6	2437	MCS0	16.56	3.40	19.96	36	PASS
9	2452	MCS0	16.55	3.40	19.95	36	PASS
11	2462	MCS0	11.74	3.40	15.14	36	PASS

802.11n_HT20M MIMO							
CH	Freq. (MHz)	Data Rate	Total Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	14.89	6.41	21.30	36	PASS
3	2422	MCS0	19.81	6.41	26.22	36	PASS
6	2437	MCS0	19.83	6.41	26.24	36	PASS
9	2452	MCS0	19.85	6.41	26.26	36	PASS
11	2462	MCS0	14.98	6.41	21.39	36	PASS

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802.11ac_20M Ch0							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	11.63	3.40	15.03	36	PASS
3	2422	MCS0	16.76	3.40	20.16	36	PASS
6	2437	MCS0	16.83	3.40	20.23	36	PASS
9	2452	MCS0	16.74	3.40	20.14	36	PASS
11	2462	MCS0	11.65	3.40	15.05	36	PASS

802.11ac_20M Ch1							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	11.56	3.40	14.96	36	PASS
3	2422	MCS0	16.51	3.40	19.91	36	PASS
6	2437	MCS0	16.60	3.40	20.00	36	PASS
9	2452	MCS0	16.62	3.40	20.02	36	PASS
11	2462	MCS0	11.57	3.40	14.97	36	PASS

802.11ac_20M MIMO							
CH	Freq. (MHz)	Data Rate	Total Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	14.85	6.41	21.26	36	PASS
3	2422	MCS0	19.80	6.41	26.21	36	PASS
6	2437	MCS0	19.81	6.41	26.22	36	PASS
9	2452	MCS0	19.84	6.41	26.25	36	PASS
11	2462	MCS0	14.98	6.41	21.39	36	PASS

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9 6DB & 99% BANDWIDTH MEASUREMENT

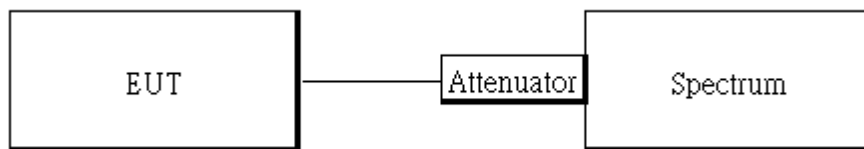
9.1 Standard Applicable

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

9.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/17/2020	03/16/2021
DC Power Supply	DHA	DPS-3003	9411005787	08/19/2020	08/18/2021
DC Block	PASTERNAK	PE8210	RF256	11/20/2019	11/19/2020
Attenuator	Marvelous	WATT-218FS-10	RF245	11/20/2019	11/19/2020

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. Set the spectrum analyzer as
 RBW= 1 % to 5% of OBW ,
 VBW = 3 X RBW,
 Span= 2 to 5 times of the OBW,
 Sweep=auto,
 Detector = Peak, and Max hold for 20dB Bandwidth test.
5. Mark the peak frequency and –20dB (upper and lower) frequency
6. Set the spectrum analyzer as
 RBW= 1 % to 5% of 99% Bandwidth ,
 VBW ≥ 3 X RBW,
 Span= large enough to capture all products of the modulation process,
 Sweep=auto,
 Detector = Peak, and Max hold for 99% Bandwidth test.
7. Turn on the 99% bandwidth function, max reading.
8. Repeat above procedures until all test default channel is completed

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9.5 6dB Bandwidth

802.11b Ch0				802.11b Ch1			
Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result	Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	10100.00	> 500	PASS	2412	10110.00	> 500	PASS
2437	10110.00	> 500	PASS	2437	10100.00	> 500	PASS
2462	10110.00	> 500	PASS	2462	10110.00	> 500	PASS

802.11g Ch0				802.11g Ch1			
Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result	Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	16400.00	> 500	PASS	2412	16410.00	> 500	PASS
2437	16410.00	> 500	PASS	2437	16410.00	> 500	PASS
2462	16410.00	> 500	PASS	2462	16400.00	> 500	PASS

802.11_n_HT20 Ch0				802.11_n_HT20 Ch1			
Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result	Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	17600.00	> 500	PASS	2412	17590.00	> 500	PASS
2437	17590.00	> 500	PASS	2437	17590.00	> 500	PASS
2462	17590.00	> 500	PASS	2462	17580.00	> 500	PASS

*Refer to next page for plots

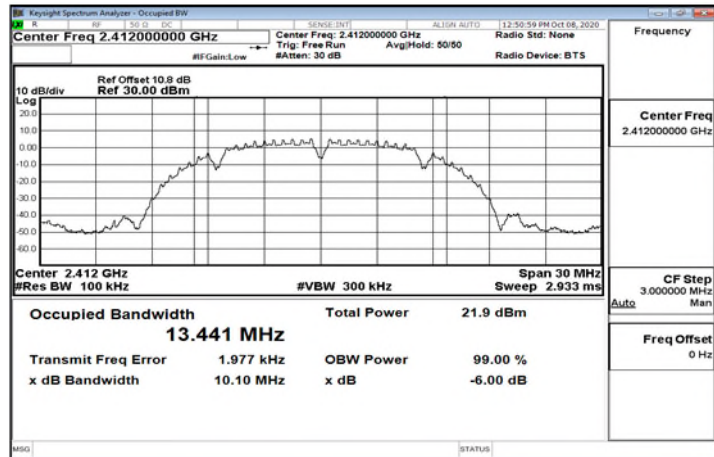
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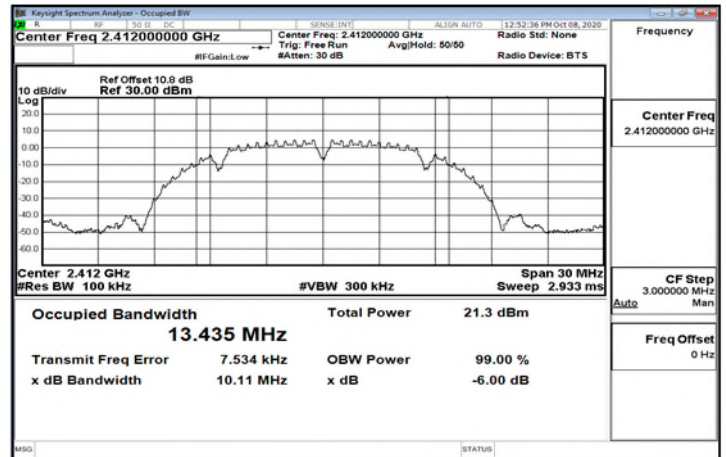
802.11b (CH0)

6dB Band Width Test Data CH-2412MHz

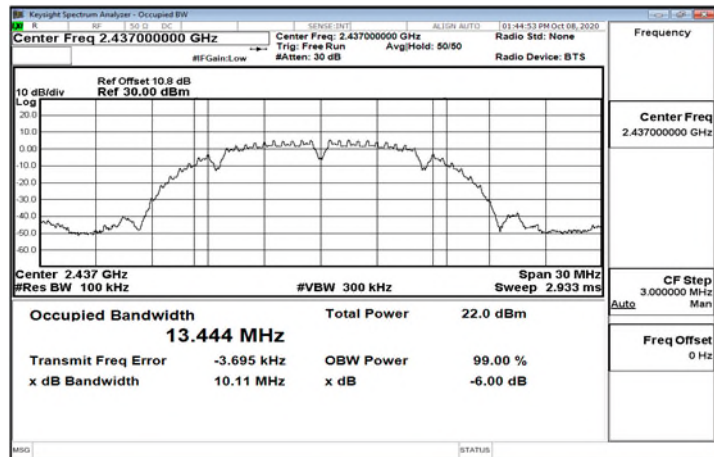


802.11b (CH1)

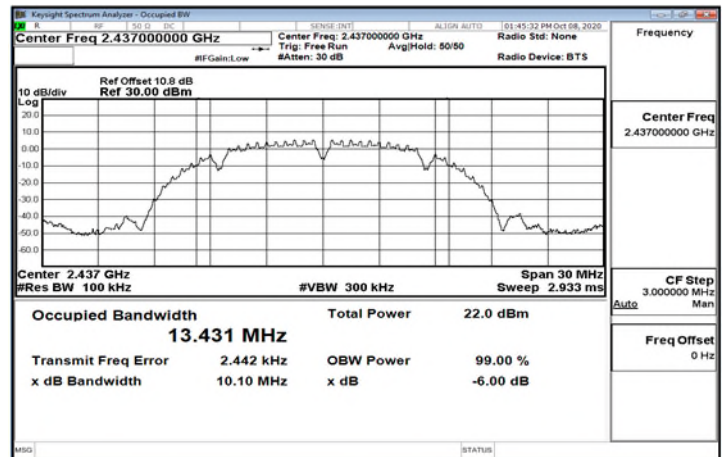
6dB Band Width Test Data CH-2412MHz



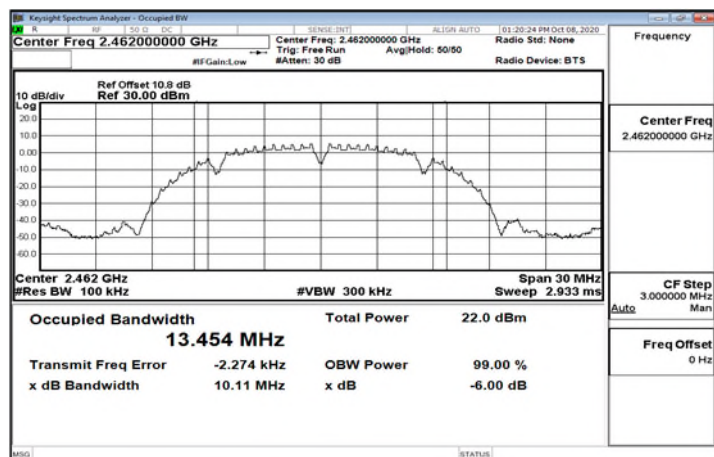
6dB Band Width Test Data CH-2437MHz



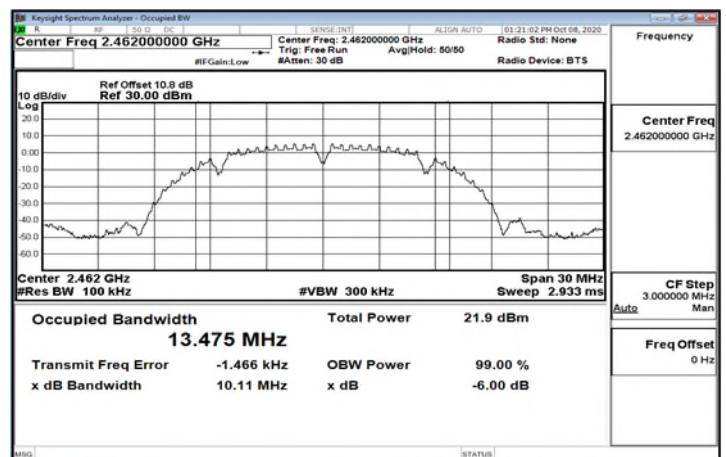
6dB Band Width Test Data CH-2437MHz



6dB Band Width Test Data CH-2462MHz



6dB Band Width Test Data CH-2462MHz



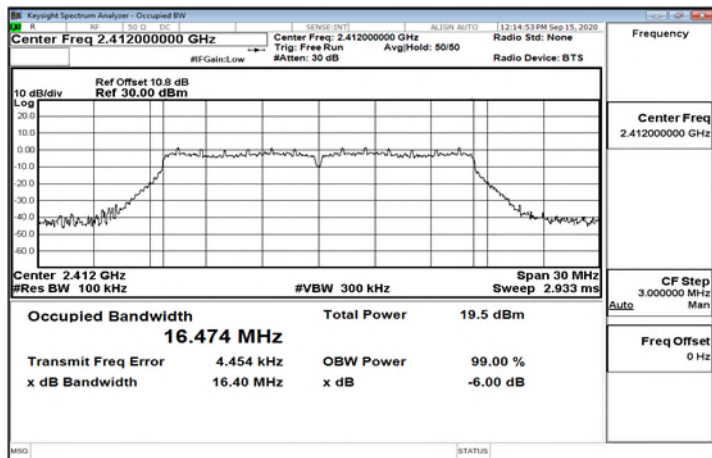
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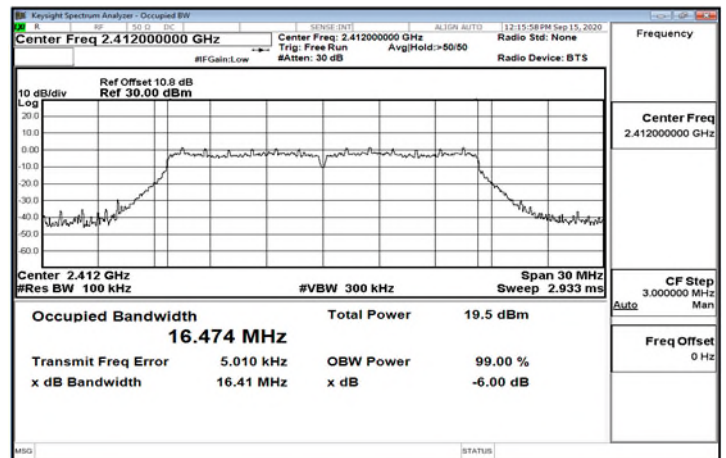
802.11g (CH0)

6dB Band Width Test Data CH-2412MHz

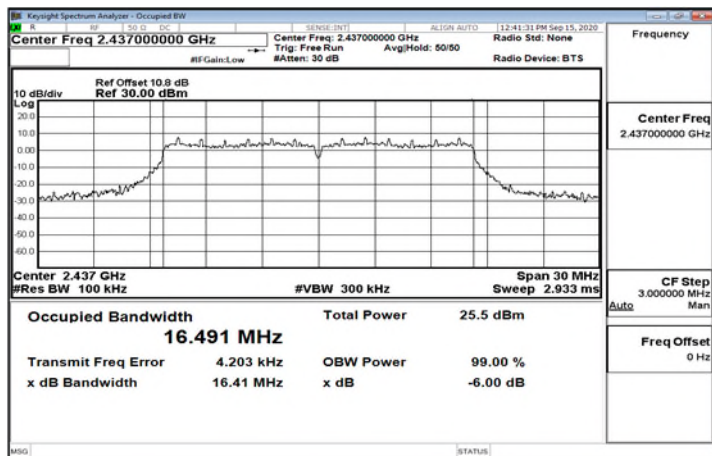


802.11g (CH1)

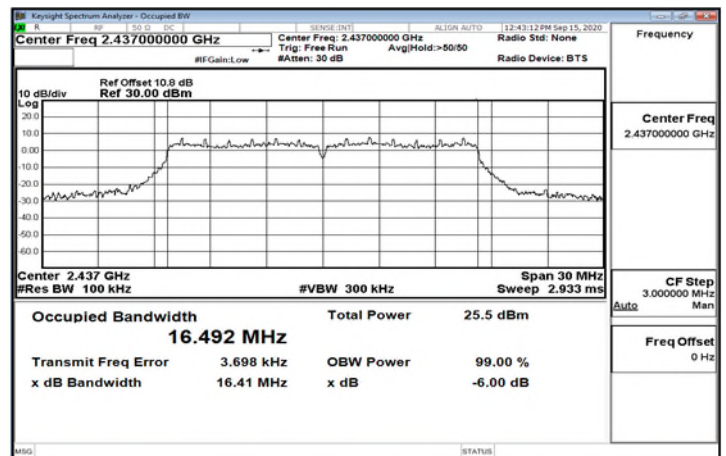
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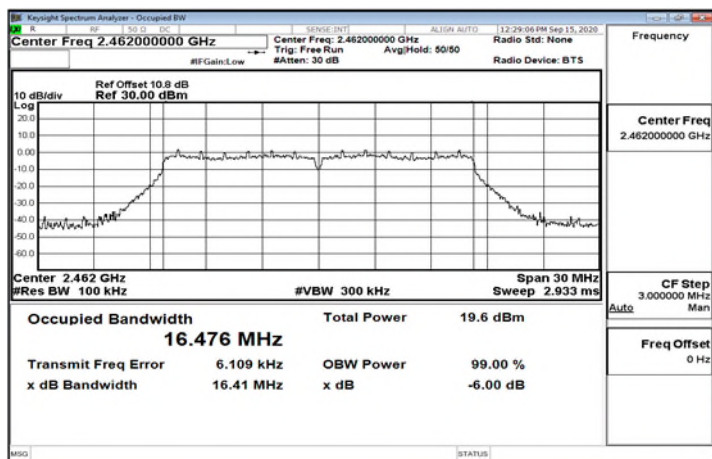
6dB Band Width Test Data CH-2437MHz



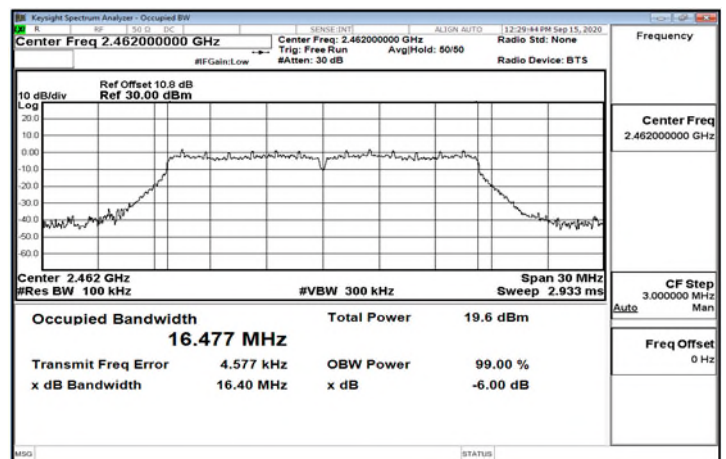
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6dB Band Width Test Data CH-2462MHz



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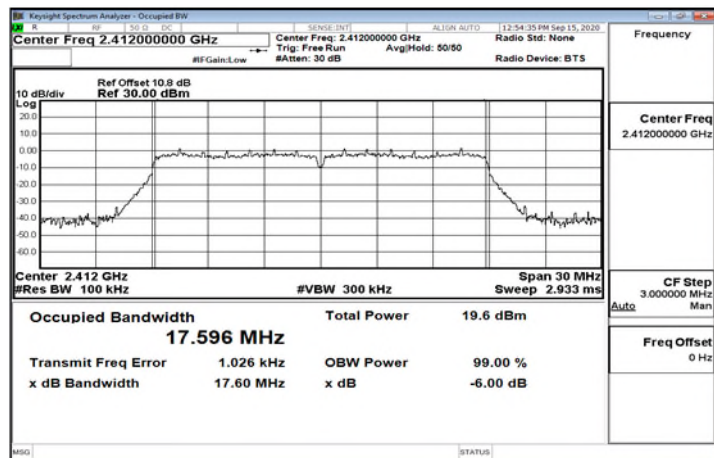


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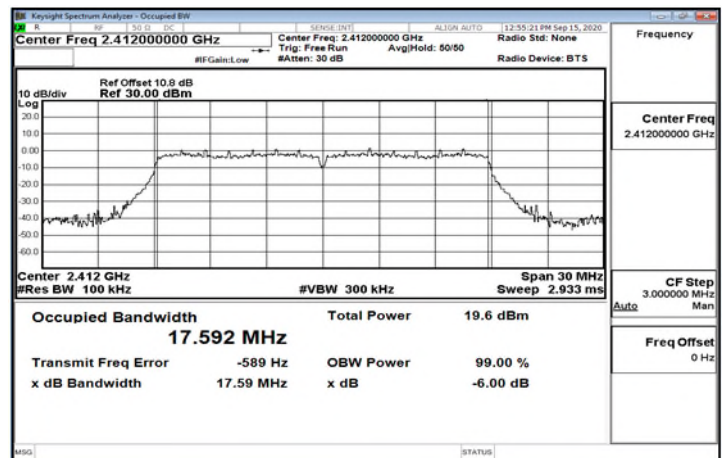
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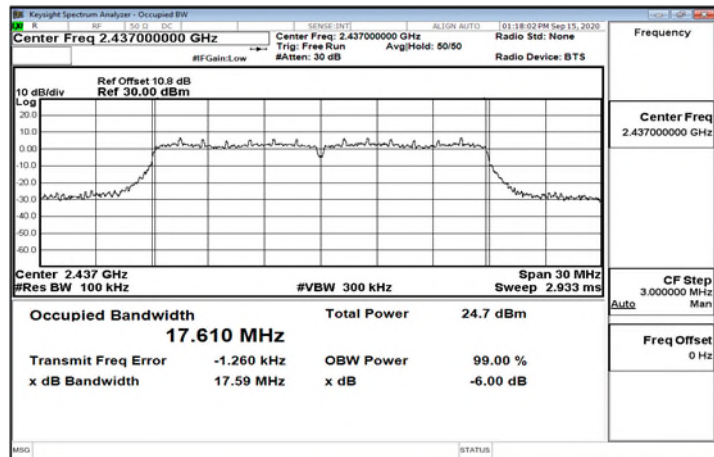
802.11n_20M (CH0) 6dB Band Width Test Data CH-2412MHz



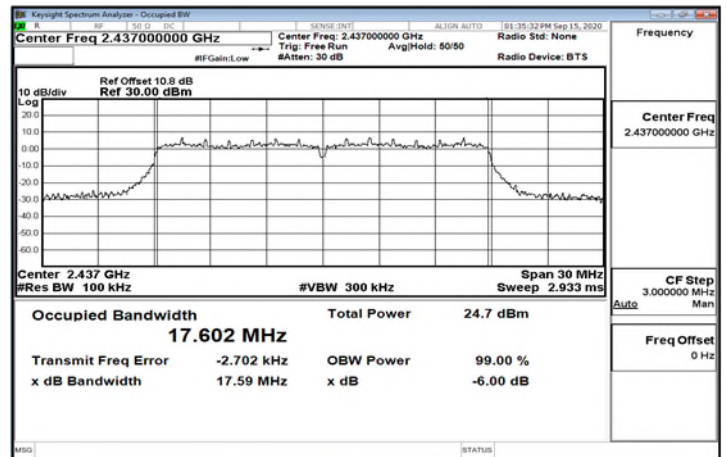
802.11n_20M (CH1) 6dB Band Width Test Data CH-2412MHz



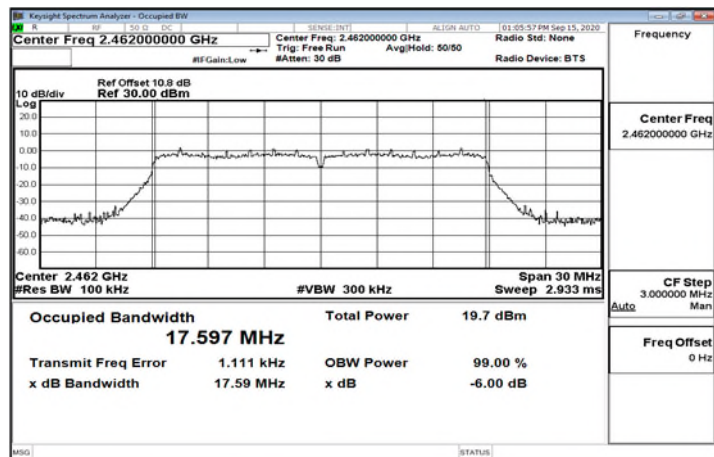
6dB Band Width Test Data CH-2437MHz



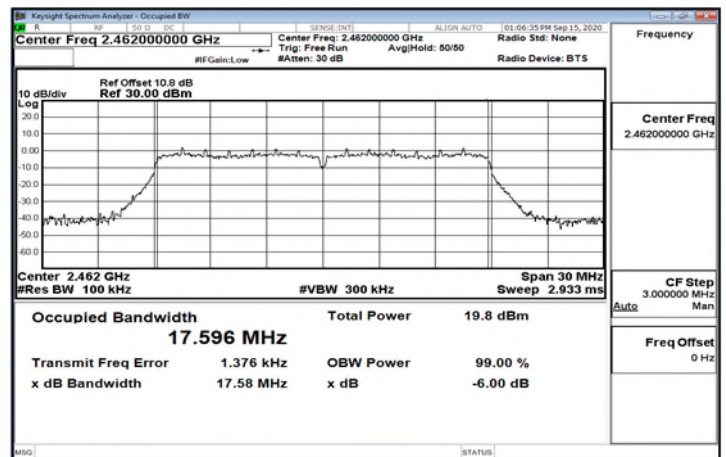
6dB Band Width Test Data CH-2437MHz



6dB Band Width Test Data CH-2462MHz



6dB Band Width Test Data CH-2462MHz



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9.6 99% Bandwidth

802.11b Ch0		802.11b Ch1	
Freq. (MHz)	99% BW (MHz)	Freq. (MHz)	99% BW (MHz)
2412	13.46	2412	13.457
2437	13.448	2437	13.446
2462	13.48	2462	13.478

802.11g Ch0		802.11g Ch1	
Freq. (MHz)	99% BW (MHz)	Freq. (MHz)	99% BW (MHz)
2412	16.806	2412	16.791
2437	16.831	2437	16.869
2462	16.791	2462	16.795

802.11n_HT20M Ch0		802.11n_HT20M Ch1	
Freq. (MHz)	99% BW (MHz)	Freq. (MHz)	99% BW (MHz)
2412	17.707	2412	17.7
2437	17.745	2437	17.759
2462	17.717	2462	17.707

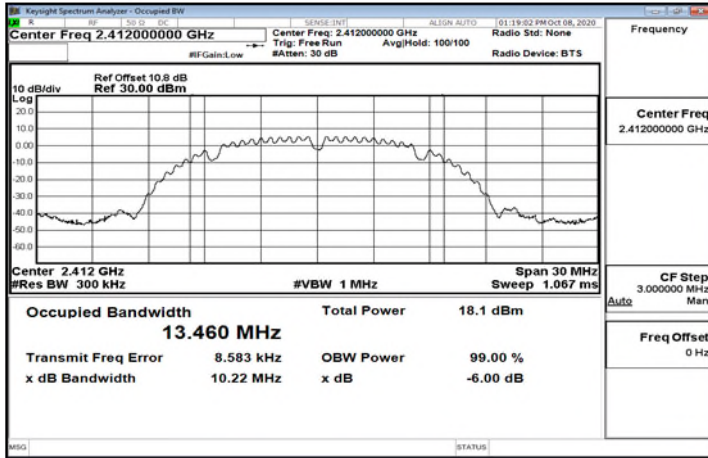
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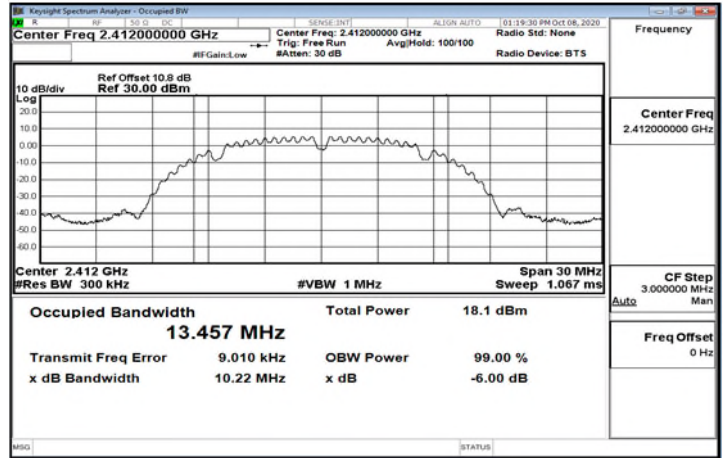
802.11b (CH0)

99% Band Width Test Data CH-2412MHz

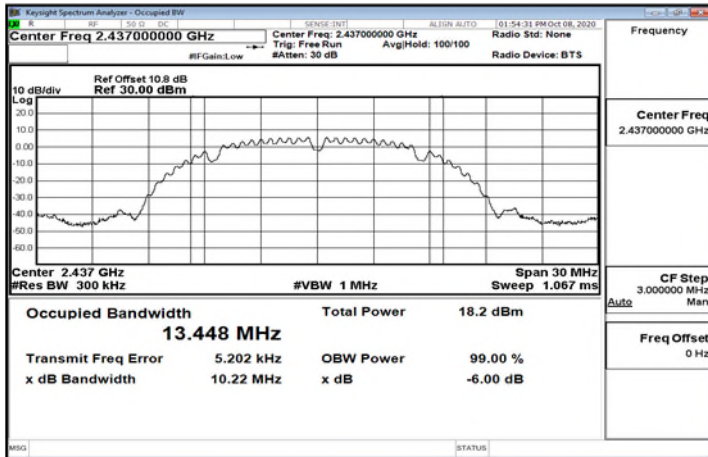


802.11b (CH1)

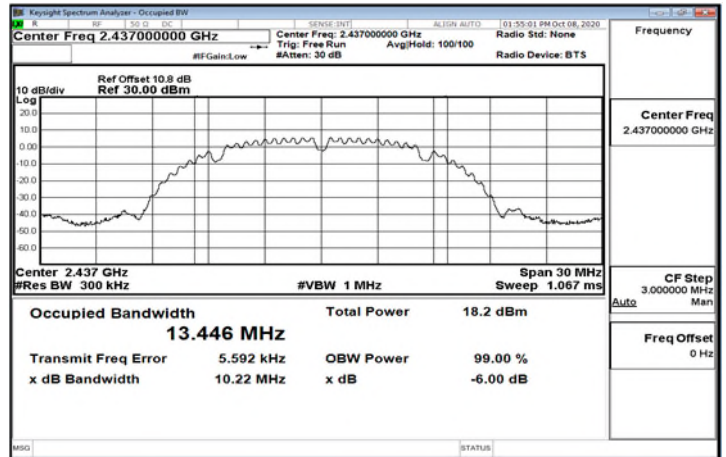
99% Band Width Test Data CH-2412MHz



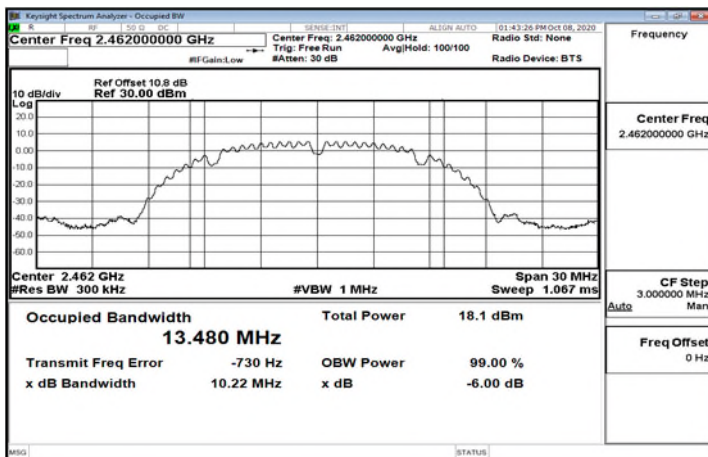
99% Band Width Test Data CH-2437MHz



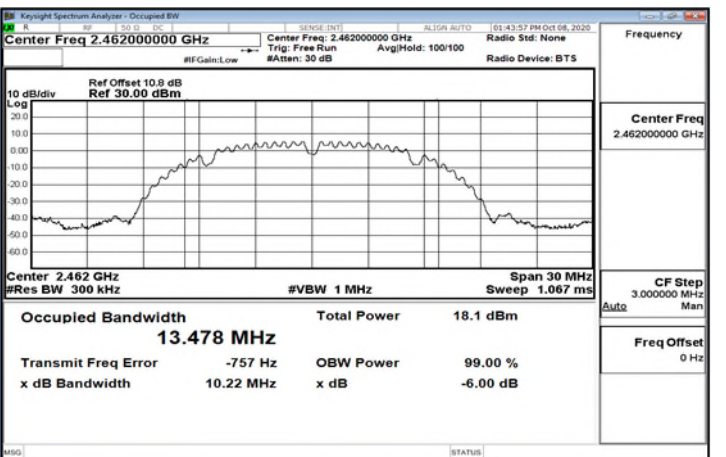
99% Band Width Test Data CH-2437MHz



99% Band Width Test Data CH-2462MHz



99% Band Width Test Data CH-2462MHz



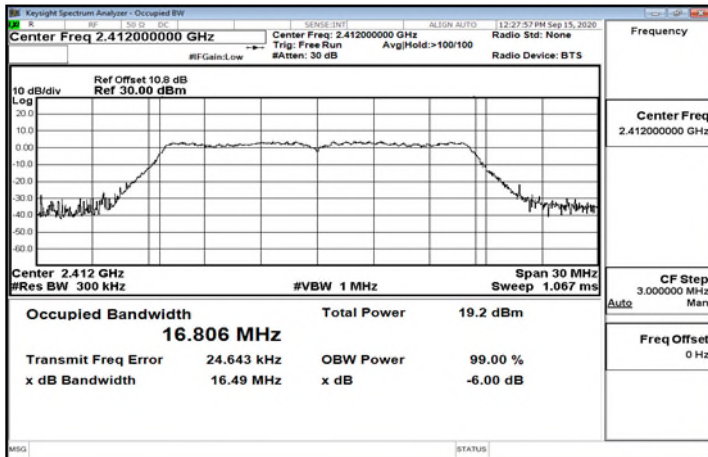
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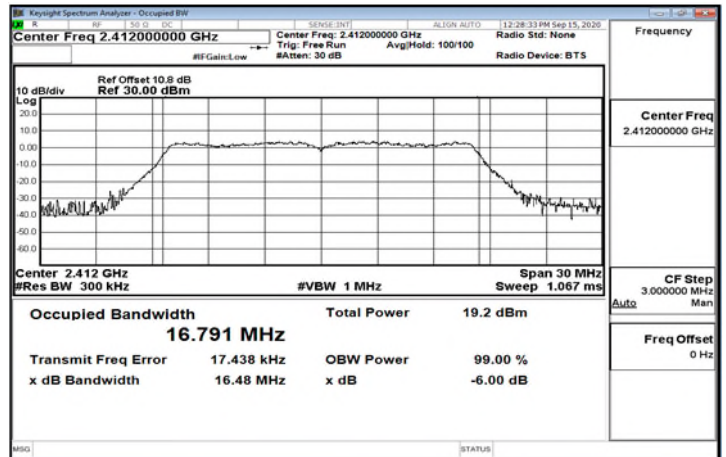
802.11g (CH0)

99% Band Width Test Data CH-2412MHz

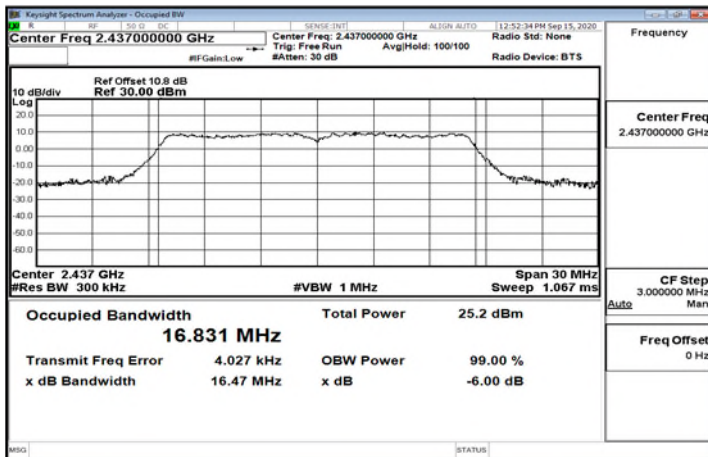


802.11g (CH1)

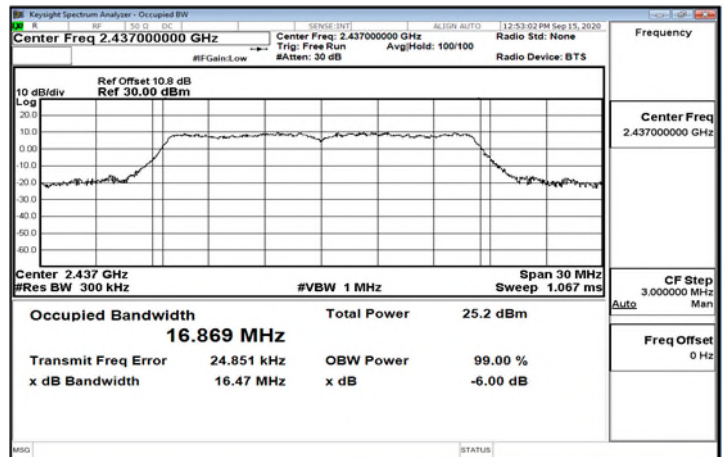
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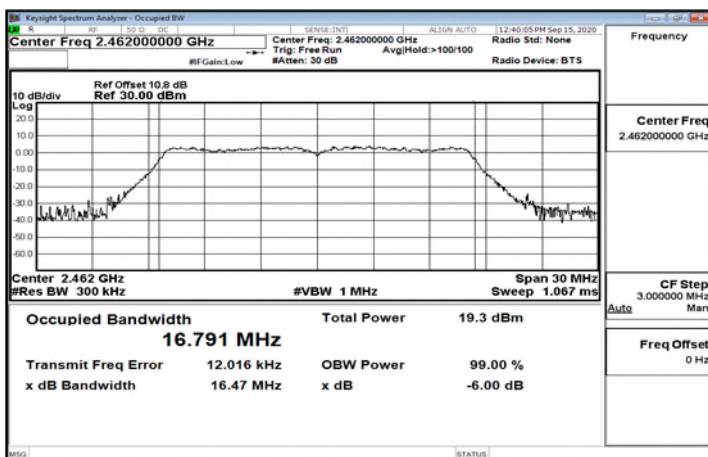
99% Band Width Test Data CH-2437MHz



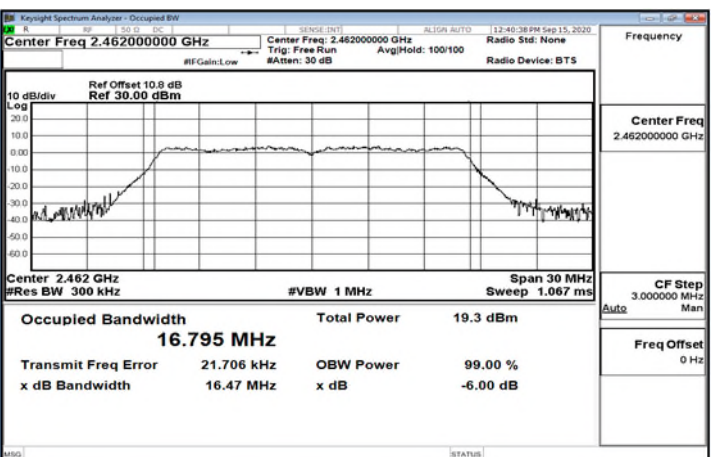
99% Band Width Test Data CH-2437MHz



99% Band Width Test Data CH-2462MHz



99% Band Width Test Data CH-2462MHz

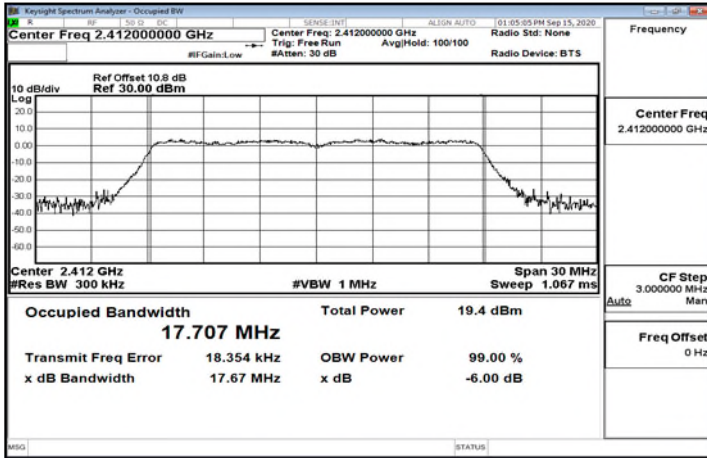


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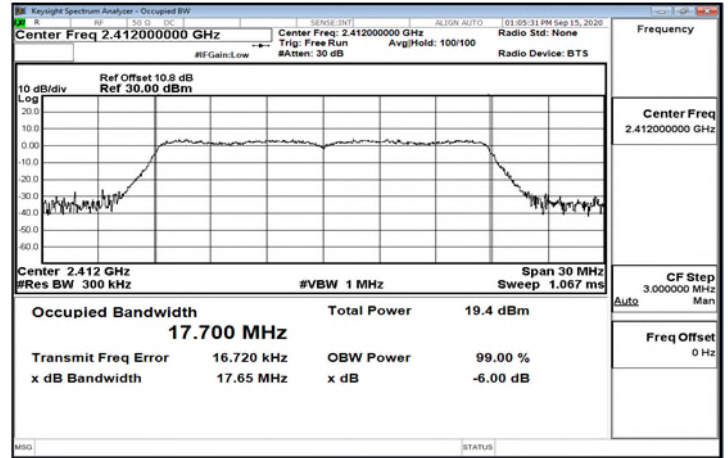
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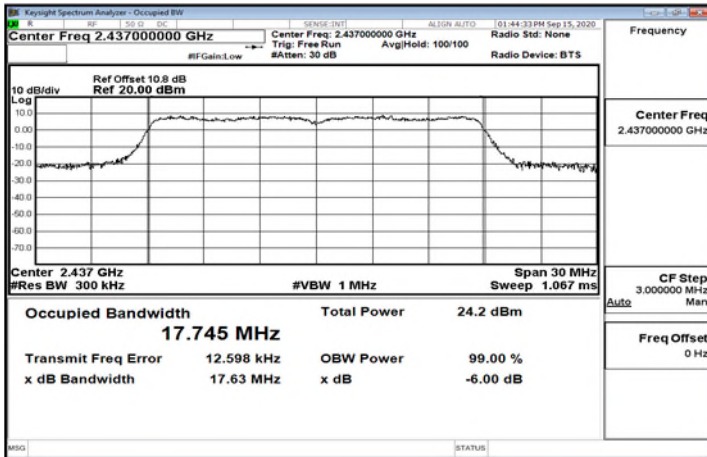
802.11n_20M (CH0)
99% Band Width Test Data CH-2412MHz



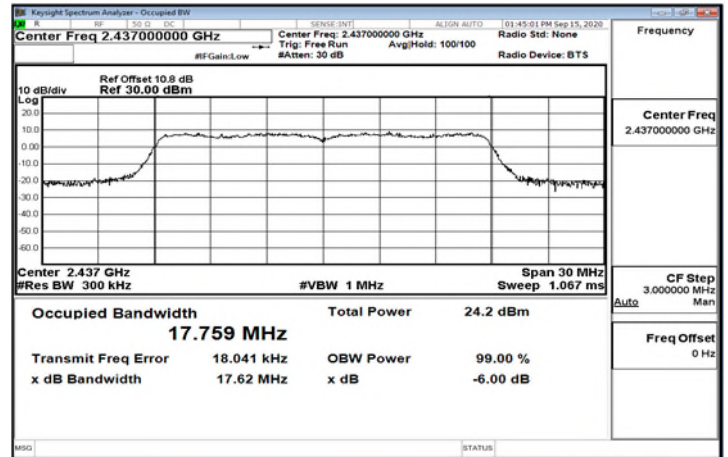
802.11n_20M (CH1)
99% Band Width Test Data CH-2412MHz



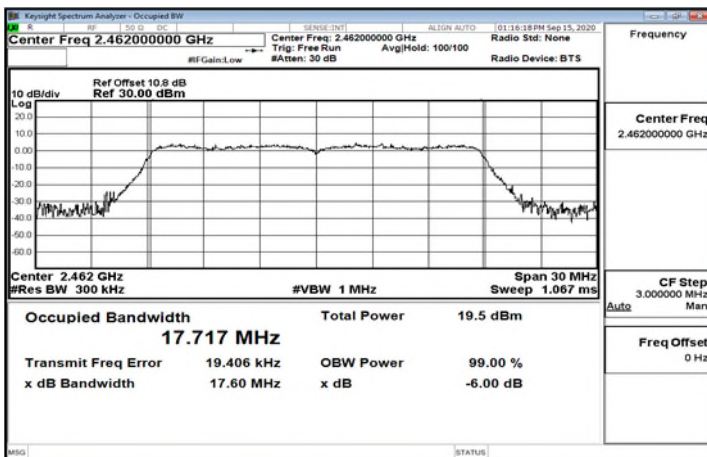
99% Band Width Test Data CH-2437MHz



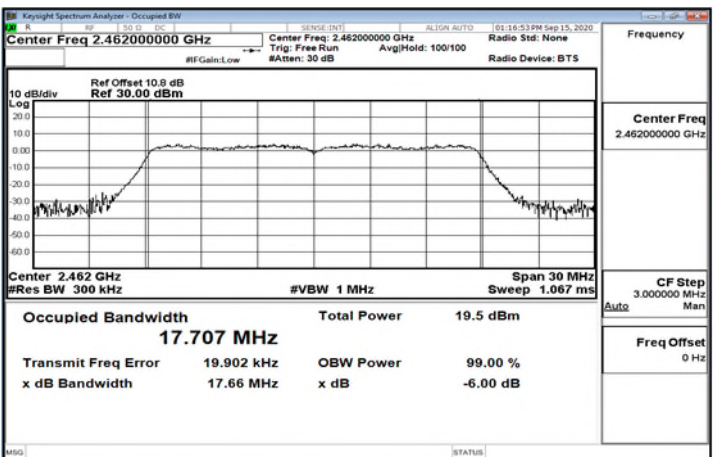
99% Band Width Test Data CH-2437MHz



99% Band Width Test Data CH-2462MHz



99% Band Width Test Data CH-2462MHz



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10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

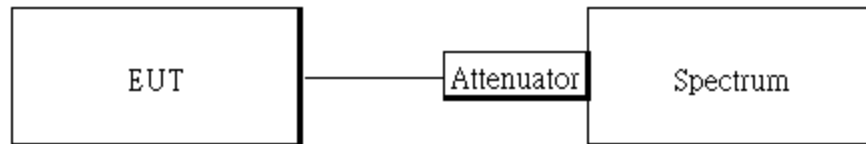
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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) & RSS-Gen §8.10, must also comply with the radiated emission limits specified in §15.209(a) & RSS-Gen §8.9.

10.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/17/2020	03/16/2021
DC Power Supply	DHA	DPS-3003	9411005787	08/19/2020	08/18/2021
DC Block	PASTERNAK	PE8210	RF256	11/20/2019	11/19/2020
Attenuator	Marvelous	WATT-218FS-10	RF245	11/20/2019	11/19/2020

10.3 Test SET-UP



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10.4 Measurement Procedure

Reference Level of Emission Limit:

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.
10. MIMO mode: offset is set following “measure and add 10 Log (N)” on spectrum to measure for MIMO mode. Offset = cable loss + 10 log (N), where N is number of transmitting antenna.

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.
10. MIMO mode: offset is set following “measure and add 10 Log (N)” on spectrum to measure for MIMO mode. Offset = cable loss + 10 log (N), where N is number of transmitting antenna.

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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.
7. MIMO mode: offset is set following “measure and add 10 Log (N)” on spectrum to measure for MIMO mode. Offset = cable loss + 10 log (N), where N is number of transmitting antenna.

Note:

For test of 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.

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	8.19	-11.81	2412	4.60	-15.40
2437	8.29	-11.71	2437	10.52	-9.48
2462	8.26	-11.74	2462	4.72	-15.28

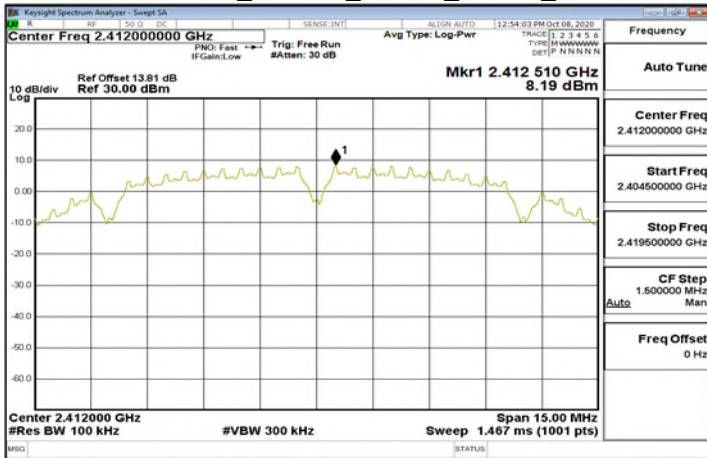
Reference Level of Limit 802.11n20 mode		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	4.57	-15.43
2437	9.40	-10.60
2462	4.57	-15.43

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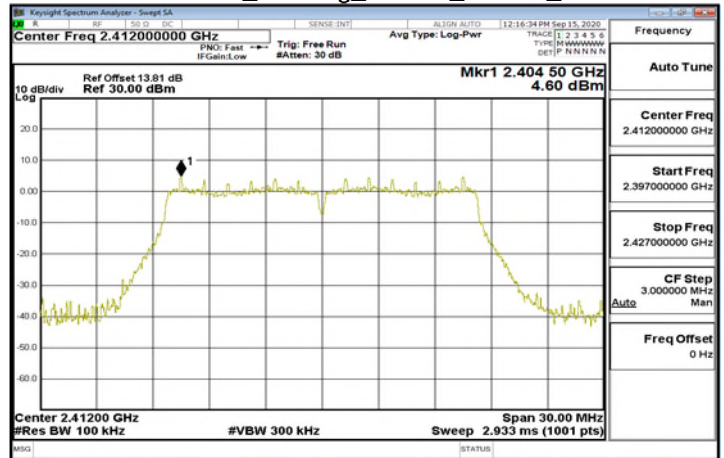
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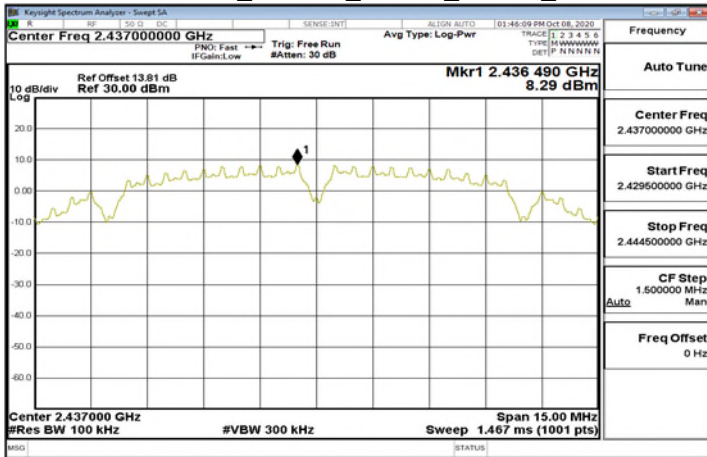
Reference Level_802.11b_20MHz_Chain0_2412MHz



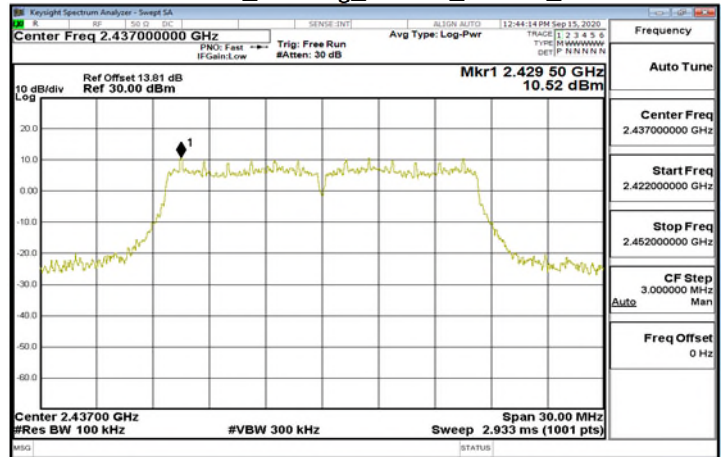
Reference Level_802.11g_20MHz_Chain0_2412MHz



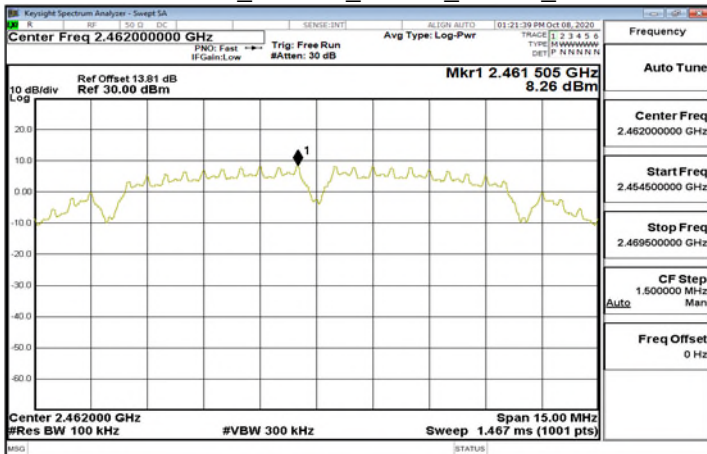
Reference Level_802.11b_20MHz_Chain0_2437MHz



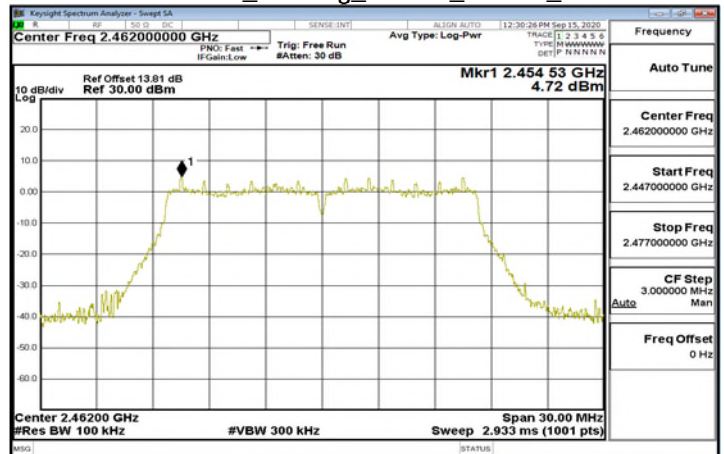
Reference Level_802.11g_20MHz_Chain0_2437MHz



Reference Level_802.11b_20MHz_Chain0_2462MHz



Reference Level_802.11g_20MHz_Chain0_2462MHz

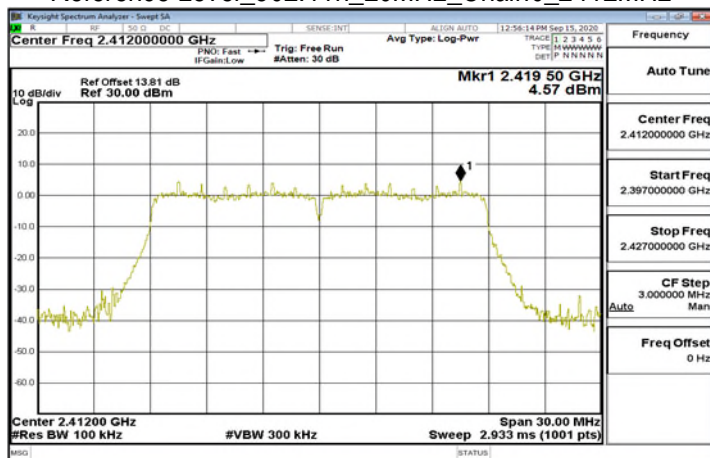


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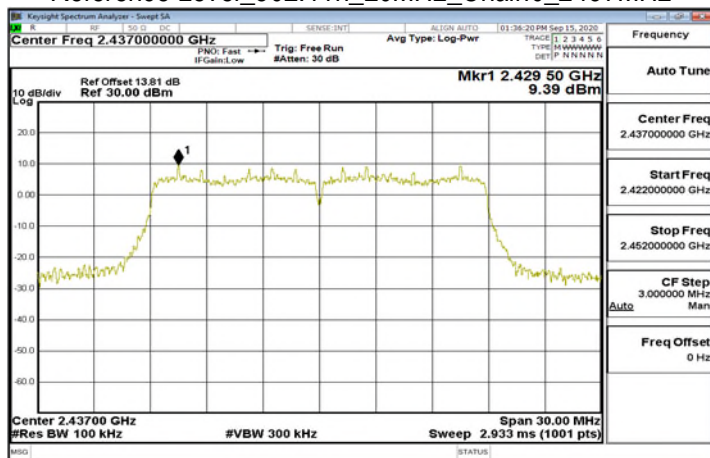
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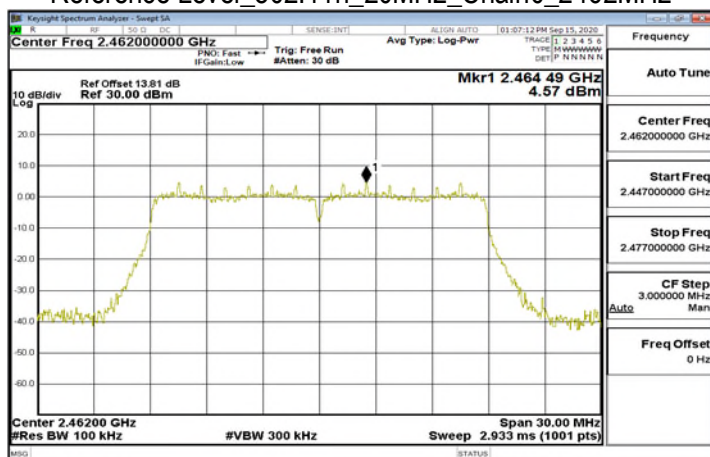
Reference Level_802.11n_20MHz_Chain0_2412MHz



Reference Level_802.11n_20MHz_Chain0_2437MHz



Reference Level_802.11n_20MHz_Chain0_2462MHz

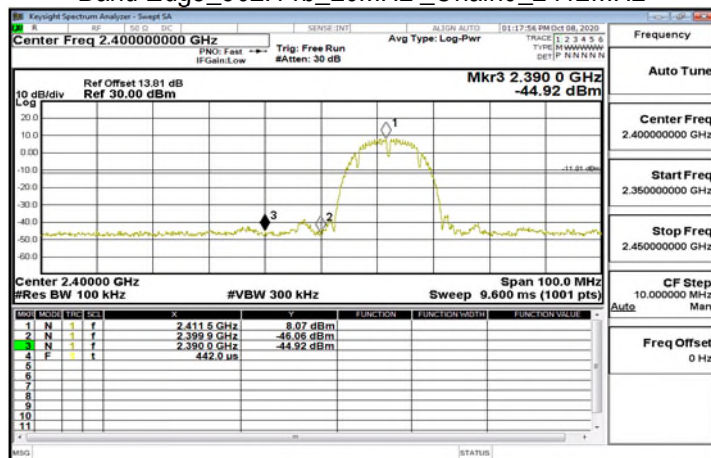


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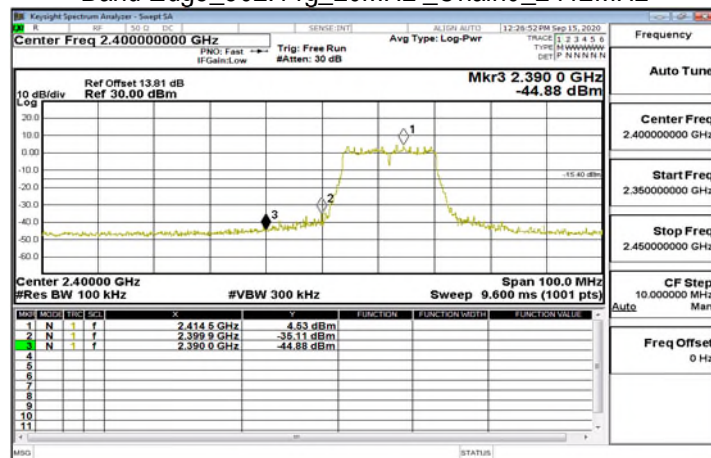
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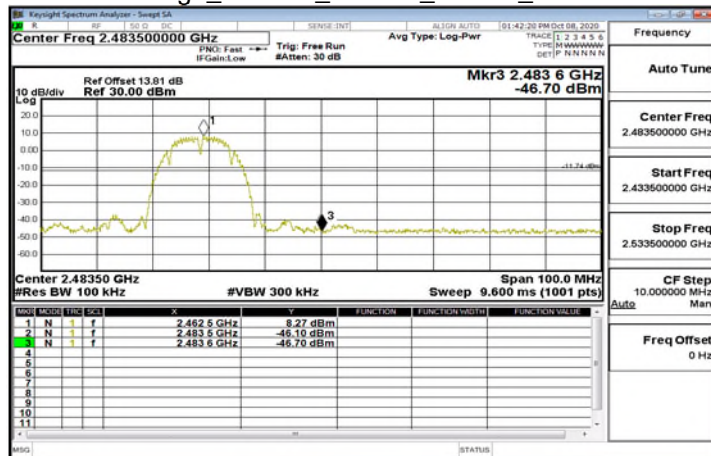
Band Edge_802.11b_20MHz_Chain0_2412MHz



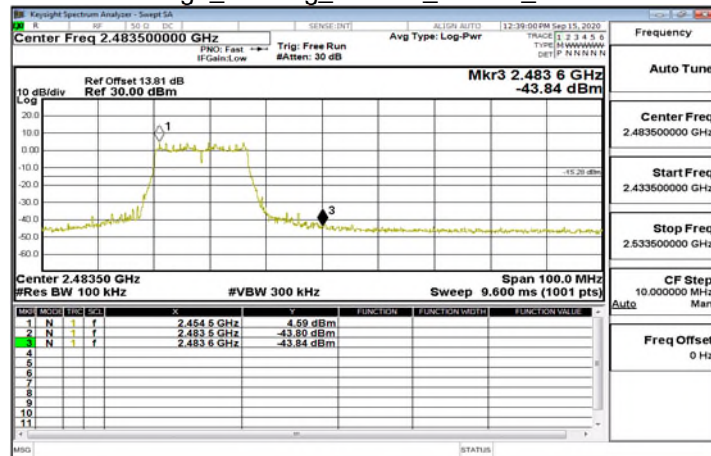
Band Edge_802.11g_20MHz_Chain0_2412MHz



Band Edge_802.11b_20MHz_Chain0_2462MHz



Band Edge_802.11g_20MHz_Chain0_2462MHz

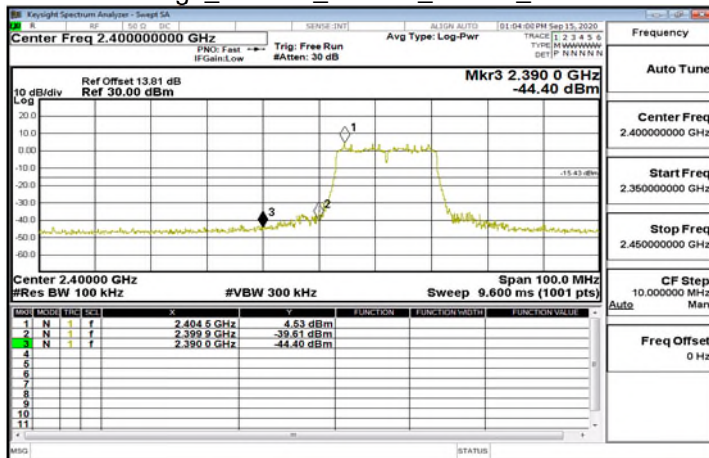


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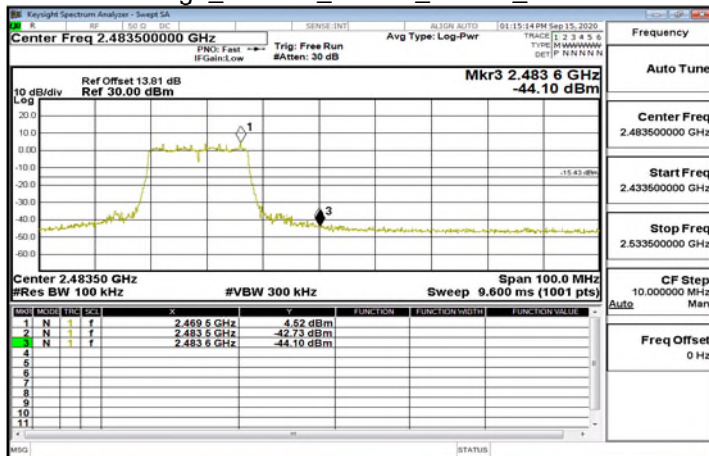
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Band Edge_802.11n_20MHz_Chain0_2412MHz



Band Edge_802.11n_20MHz_Chain0_2462MHz

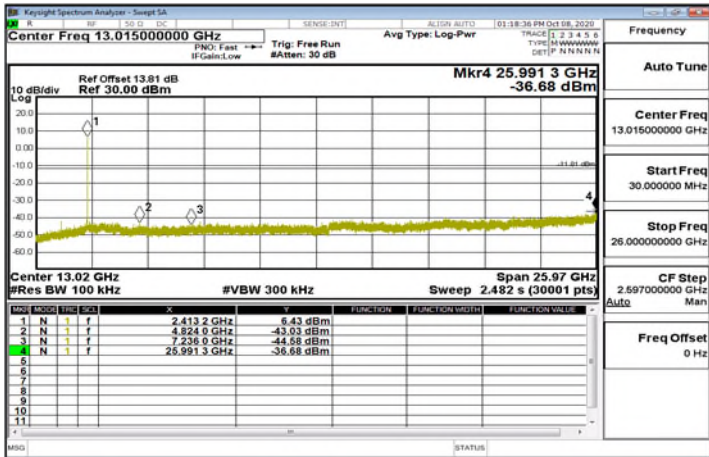


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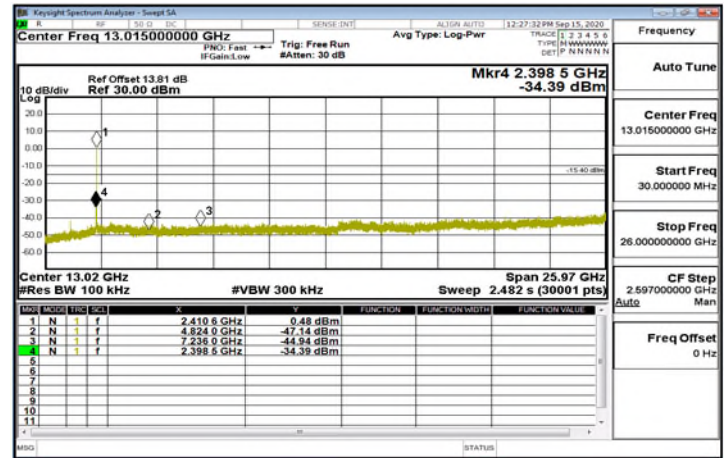
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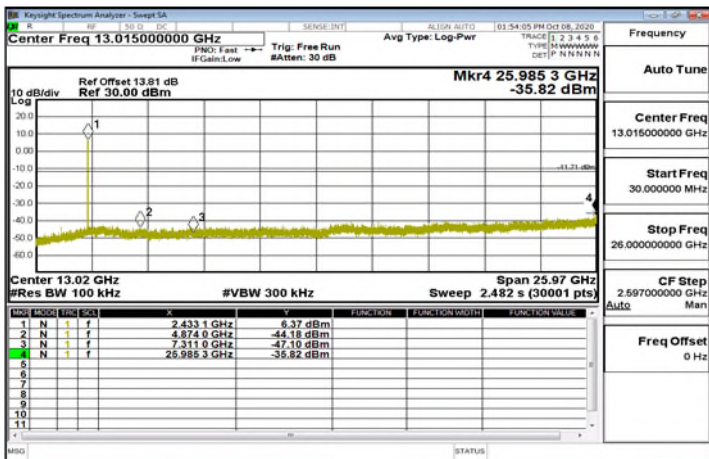
Spurious Emission_802.11b_20MHz_Chain0_2412MHz



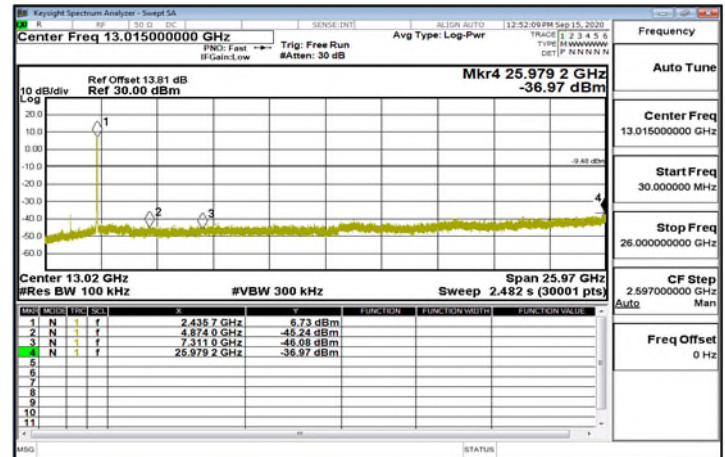
Spurious Emission_802.11g_20MHz_Chain0_2412MHz



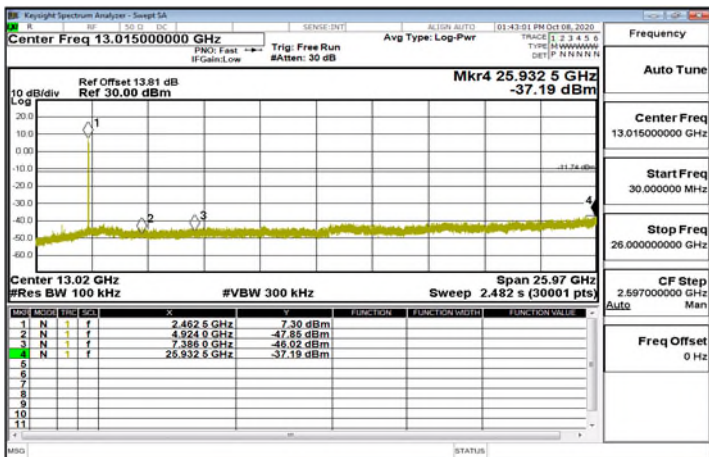
Spurious Emission_802.11b_20MHz_Chain0_2437MHz



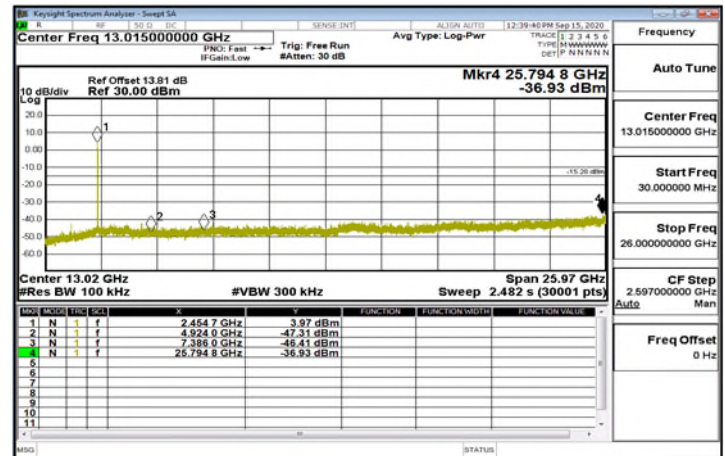
Spurious Emission_802.11g_20MHz_Chain0_2437MHz



Spurious Emission_802.11b_20MHz_Chain0_2462MHz



Spurious Emission_802.11g_20MHz_Chain0_2462MHz

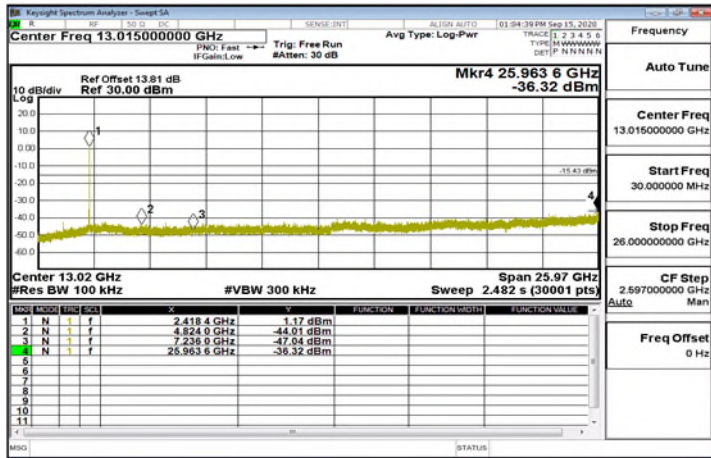


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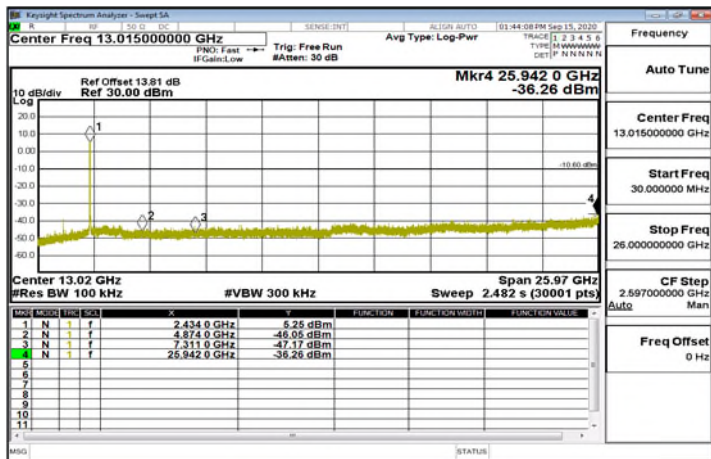
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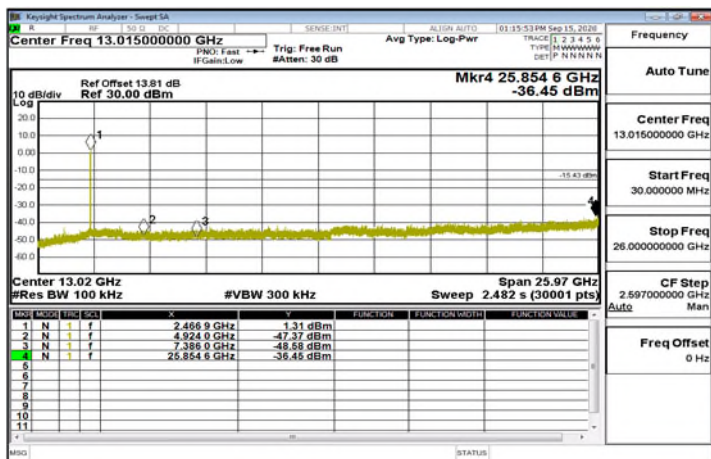
Spurious Emission_802.11n_20MHz_Chain0_2412MHz



Spurious Emission_802.11n_20MHz_Chain0_2437MHz



Spurious Emission_802.11n_20MHz_Chain0_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 and RSS-Gen §8.9 Table 5 and 6 limit as below. And according to §15.33(a) (1) & RSS-Gen §6.13.2.a, 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 (μV/m)

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11.2 Measurement Equipment Used:

966 Chamber					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	SCHWAZBECK	VULB 9168	9168-617	11/04/2019	11/03/2020
Horn Antenna	Schwarzbeck	BBHA9170	184	12/25/2019	12/24/2020
Horn Antenna	Schwarzbeck	BBHA9120D	1341	06/22/2020	06/21/2021
Loop Antenna	ETS.LINDGREN	6502	143303	04/28/2020	04/27/2021
3m Site NSA	SGS	966 chamber D	N/A	07/12/2020	07/11/2021
Spectrum Analyzer	KEYSIGHT	N9010A	MY54510568	07/08/2020	07/07/2021
Pre-Amplifier	EMC Instruments	EMC184045B	980135	11/20/2019	11/19/2020
Pre-Amplifier	EMC Instruments	EMC9135	980234	11/20/2019	11/19/2020
Pre-Amplifier	EMC Instruments	EMC12630SE	980271	11/20/2019	11/19/2020
Attenuator	Woken	WATT-218FS-10	RF25	11/20/2019	11/19/2020
High Pass Filter	R&S	F13 HPF 3GHz	RF64	11/20/2019	11/19/2020
Low Pass Filter	EWT	EWT-56-0019	RF46	11/20/2019	11/19/2020
Notch Filter	EWT	EWT-54-0038	RF55	11/20/2019	11/19/2020
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17388/4	11/20/2019	11/19/2020
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	11/20/2019	11/19/2020
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17413/4	11/20/2019	11/19/2020

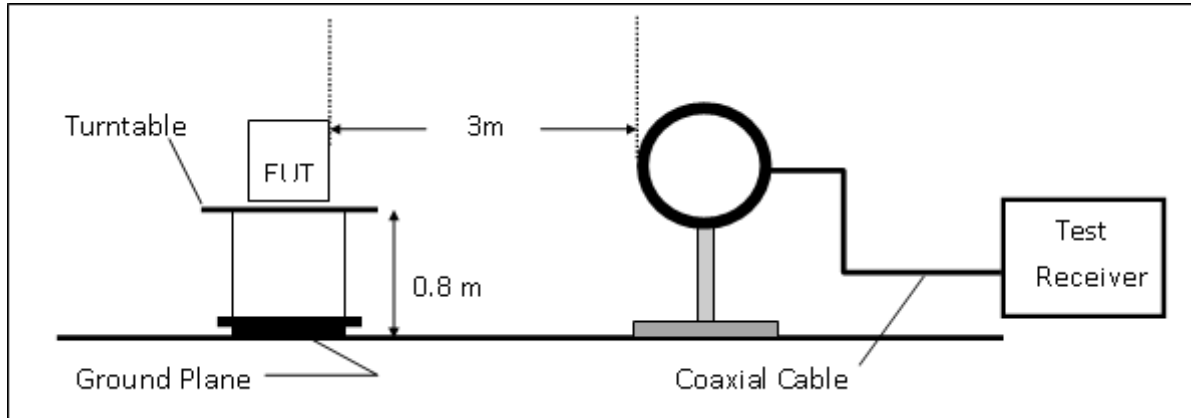
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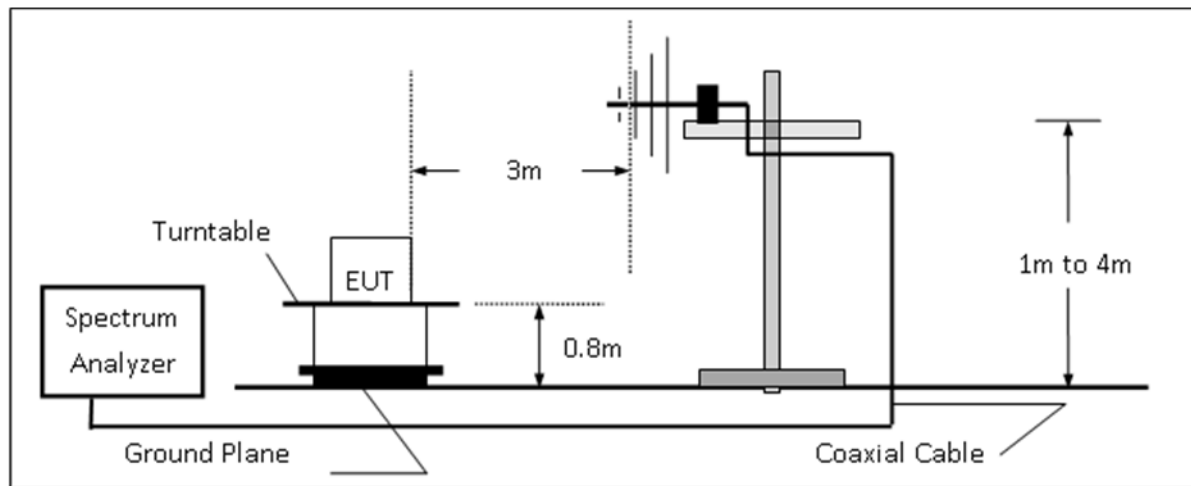
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11.3 Test SET-UP

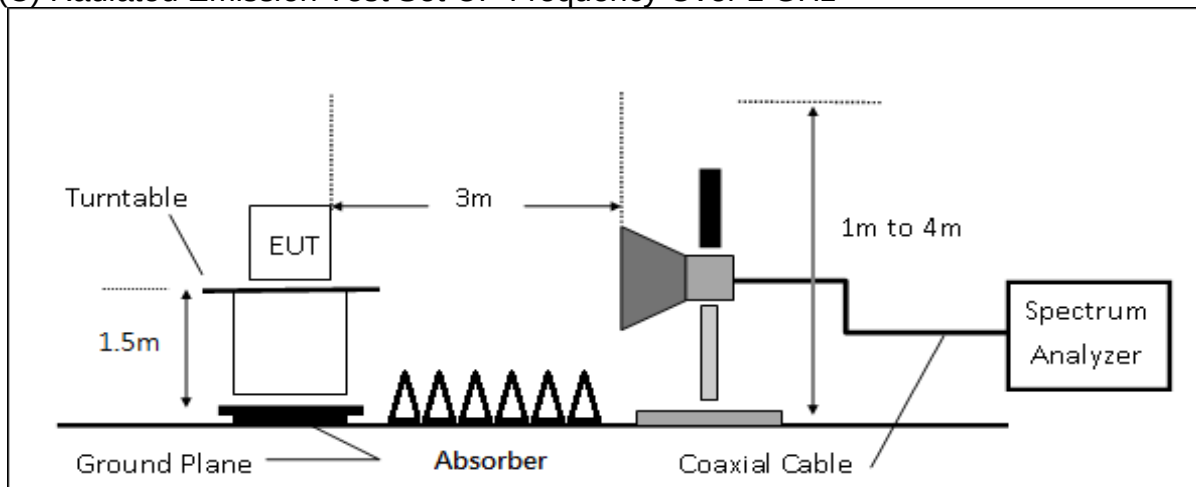
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(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 $\geq 1/T$ (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 $20 \cdot \log(\mu V/m)$

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) & RSS-GEN §6.13.2 was not reported.

11.7 Measurement Result

Note:

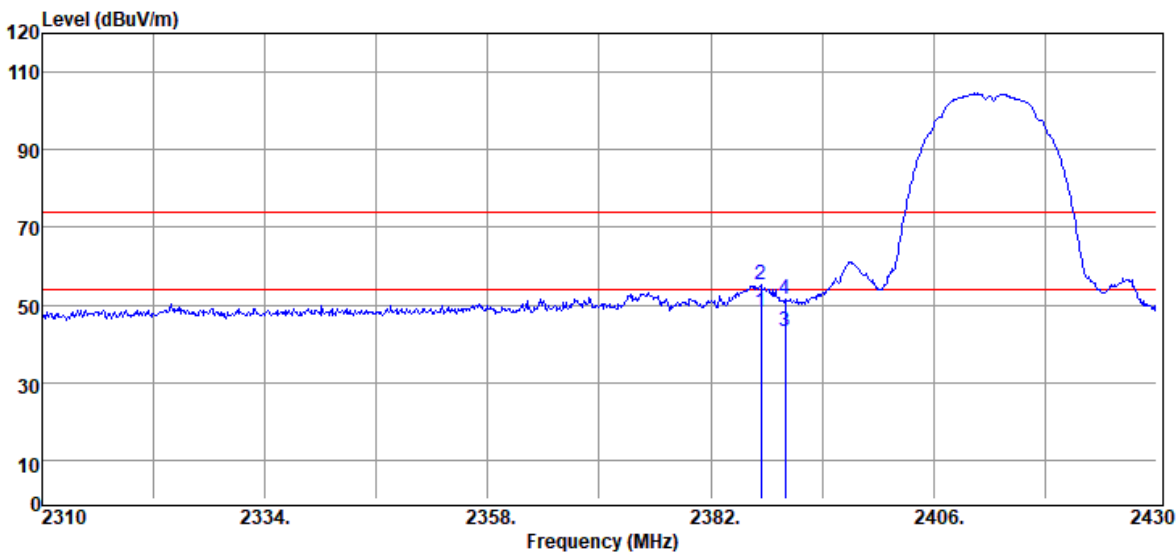
1. Refer to next page spectrum analyzer data chart and tabular data sheets.
2. Measurements are completed at peak and average level, the mark of average is the highest emission in restricted bands

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

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11.7.1 Radiated Band Edge Measurement Result

Report Number	:ER/2020/80121	Test Site	:966 Chamber D
Operation Mode	:802.11b	Test Date	:2020-09-01
Test Frequency	:2412 MHz	Temp./Humi.	:24.6/64
Test Mode	:BE CH LOW	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plan	Engineer	:Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
2387.40	Average	53.62	-5.50	48.12	54.00	-5.88
2387.40	Peak	60.92	-5.50	55.42	74.00	-18.58
2390.00	Average	48.71	-5.50	43.21	54.00	-10.79
2390.00	Peak	56.88	-5.50	51.38	74.00	-22.62

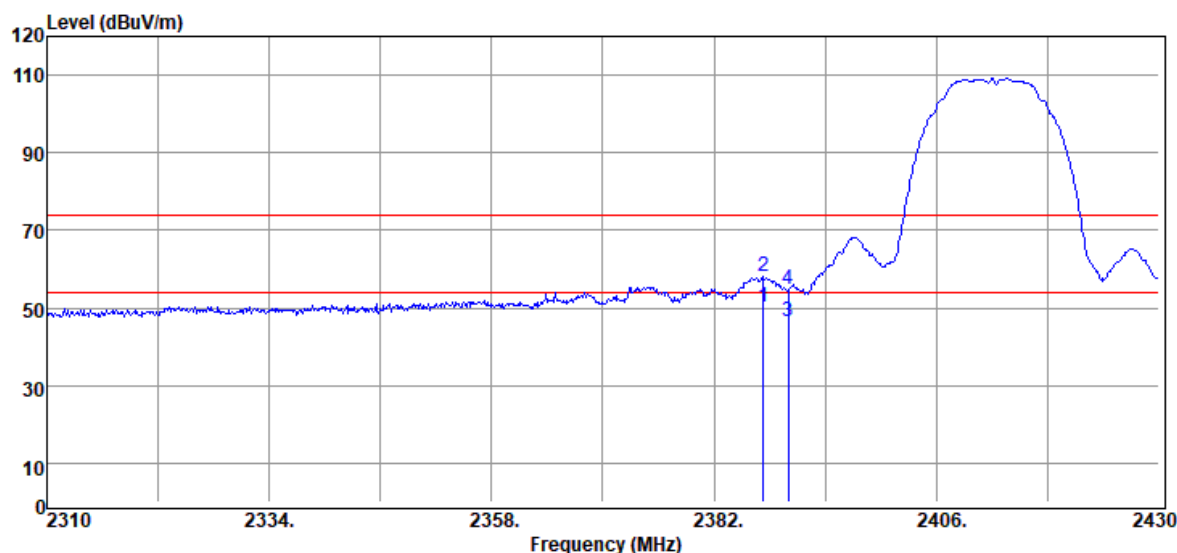
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Report Number :ER/2020/80121
Operation Mode :802.11b
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.6/64
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



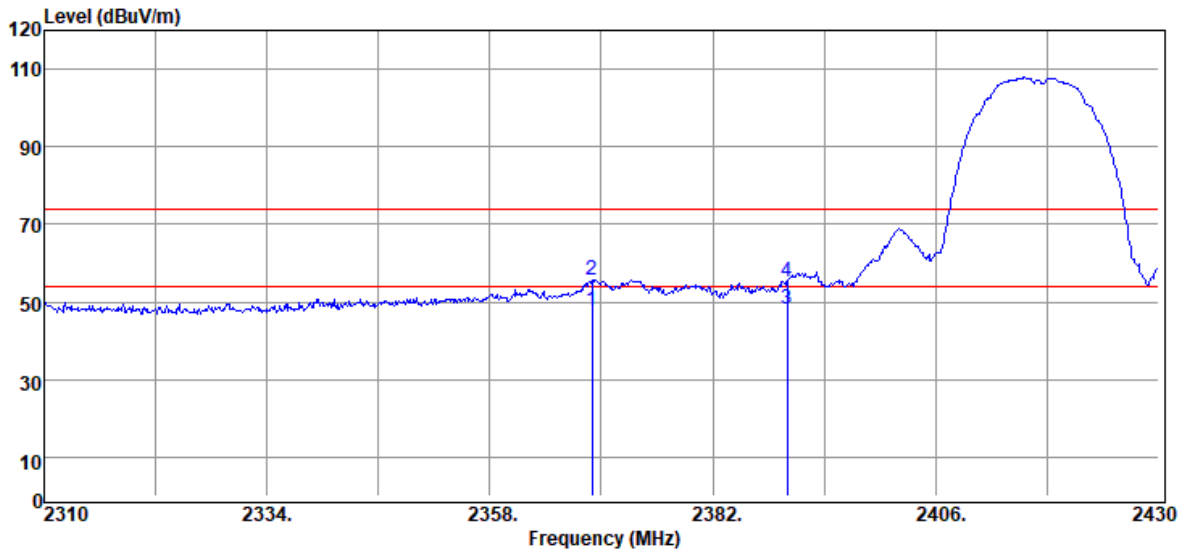
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2387.28	Average	55.72	-5.50	50.22	54.00	-3.78
2387.28	Peak	63.45	-5.50	57.95	74.00	-16.05
2390.00	Average	51.89	-5.50	46.39	54.00	-7.61
2390.00	Peak	60.30	-5.50	54.80	74.00	-19.20

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Report Number :ER/2020/80121
Operation Mode :802.11b
Test Frequency :2417 MHz
Test Mode :BE CH 2
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-22
Temp./Humi. :22.4/62
Antenna Pol. :VERTICAL
Engineer : Kailin Lee


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
2369.04	Average	53.49	-5.56	47.93	54.00	-6.07
2369.04	Peak	61.22	-5.56	55.66	74.00	-18.34
2390.00	Average	53.84	-5.50	48.34	54.00	-5.66
2390.00	Peak	60.59	-5.50	55.09	74.00	-18.91

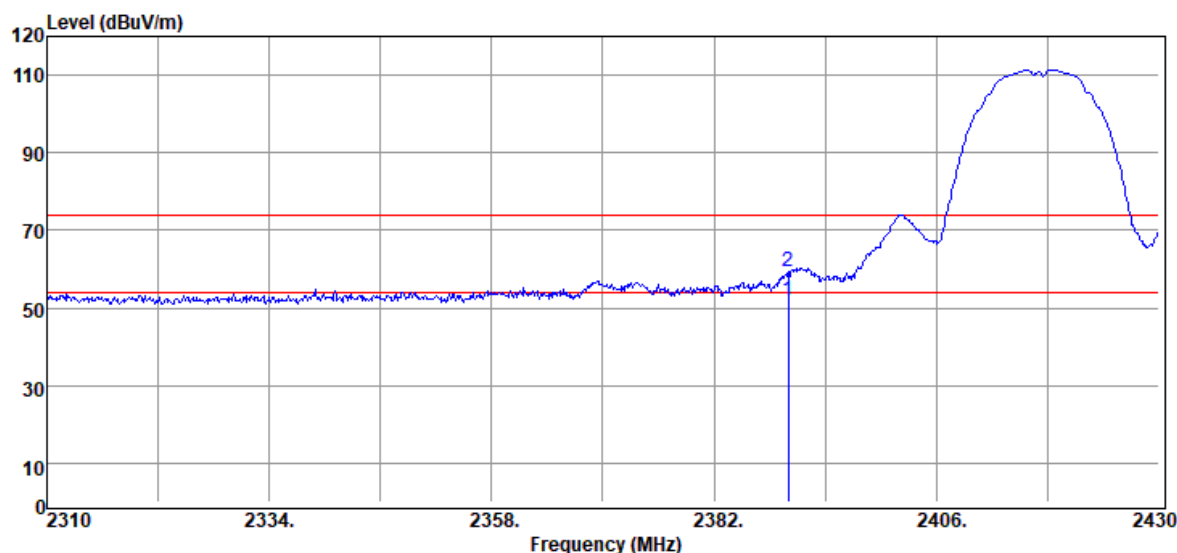
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Report Number :ER/2020/80121
Operation Mode :802.11b
Test Frequency :2417 MHz
Test Mode :BE CH 2
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-22
Temp./Humi. :22.4/62
Antenna Pol. :HORIZONTAL
Engineer : Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	Average	57.54	-5.50	52.04	54.00	-1.96
2390.00	Peak	64.78	-5.50	59.28	74.00	-14.72

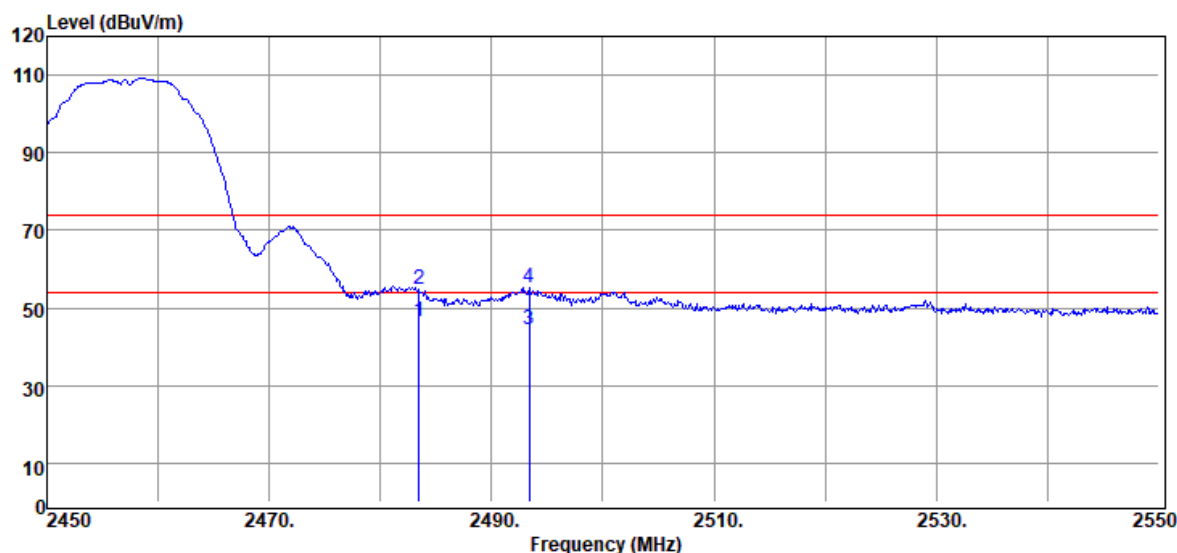
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Report Number :ER/2020/80121
Operation Mode :802.11b
Test Frequency :2457 MHz
Test Mode :BE CH 10
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-22
Temp./Humi. :22.4/62
Antenna Pol. :VERTICAL
Engineer : Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
2483.50	Average	52.05	-5.56	46.49	54.00	-7.51
2483.50	Peak	60.50	-5.56	54.94	74.00	-19.06
2493.40	Average	50.01	-5.57	44.44	54.00	-9.56
2493.40	Peak	60.87	-5.57	55.30	74.00	-18.70

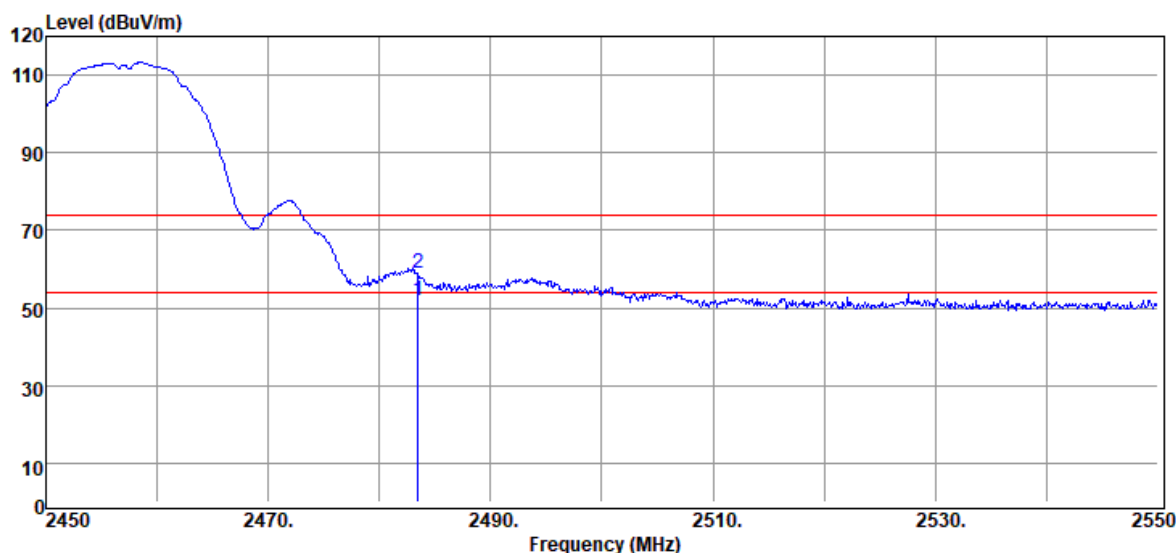
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Report Number :ER/2020/80121
Operation Mode :802.11b
Test Frequency :2457 MHz
Test Mode :BE CH 10
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-22
Temp./Humi. :22.4/62
Antenna Pol. :HORIZONTAL
Engineer : Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Average	57.45	-5.56	51.89	54.00	-2.11
2483.50	Peak	64.35	-5.56	58.79	74.00	-15.21

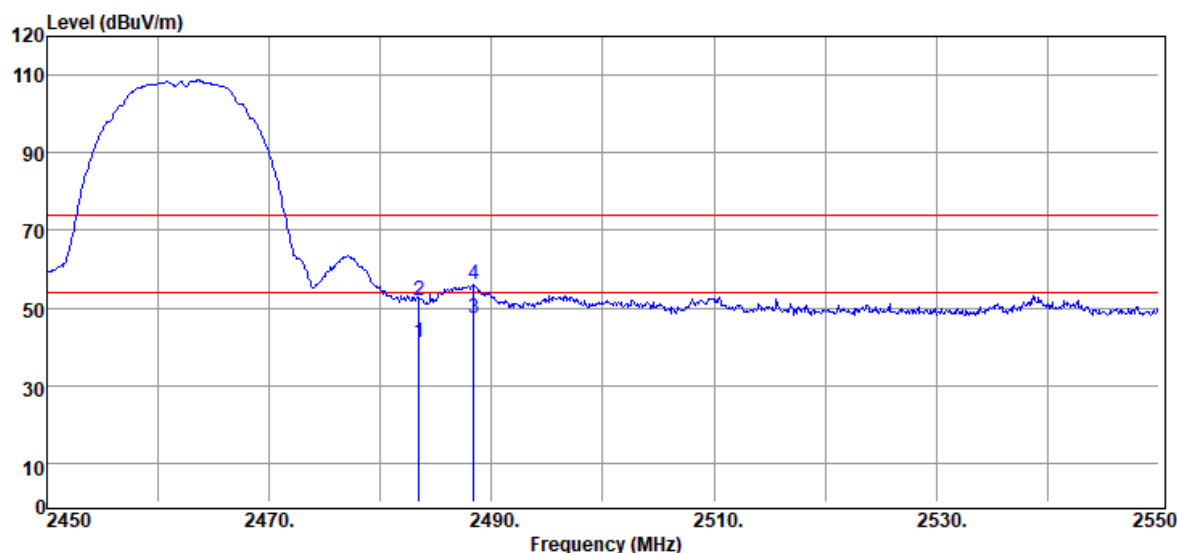
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Report Number :ER/2020/80121
 Operation Mode :802.11b
 Test Frequency :2462 MHz
 Test Mode :BE CH HIGH
 EUT Pol :E2 Plan

Test Site :966 Chamber D
 Test Date :2020-09-01
 Temp./Humi. :24.6/64
 Antenna Pol. :VERTICAL
 Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
2483.50	Average	46.58	-5.56	41.02	54.00	-12.98
2483.50	Peak	57.36	-5.56	51.80	74.00	-22.20
2488.40	Average	52.98	-5.57	47.41	54.00	-6.59
2488.40	Peak	61.62	-5.57	56.05	74.00	-17.95

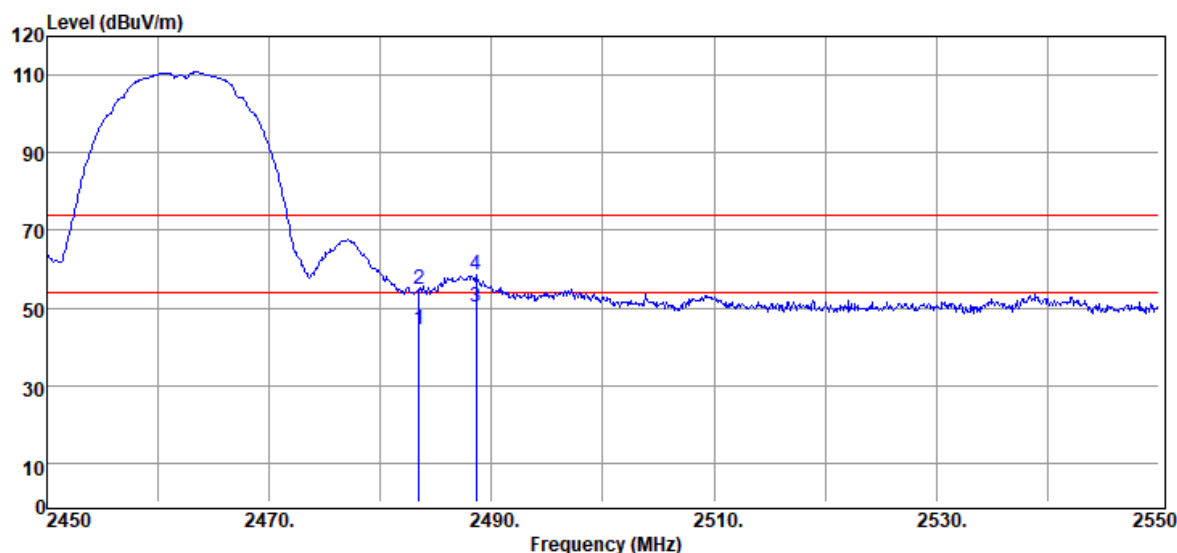
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Report Number :ER/2020/80121
Operation Mode :802.11b
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.6/64
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Average	49.85	-5.56	44.29	54.00	-9.71
2483.50	Peak	60.26	-5.56	54.70	74.00	-19.30
2488.60	Average	55.68	-5.57	50.11	54.00	-3.89
2488.60	Peak	64.16	-5.57	58.59	74.00	-15.41

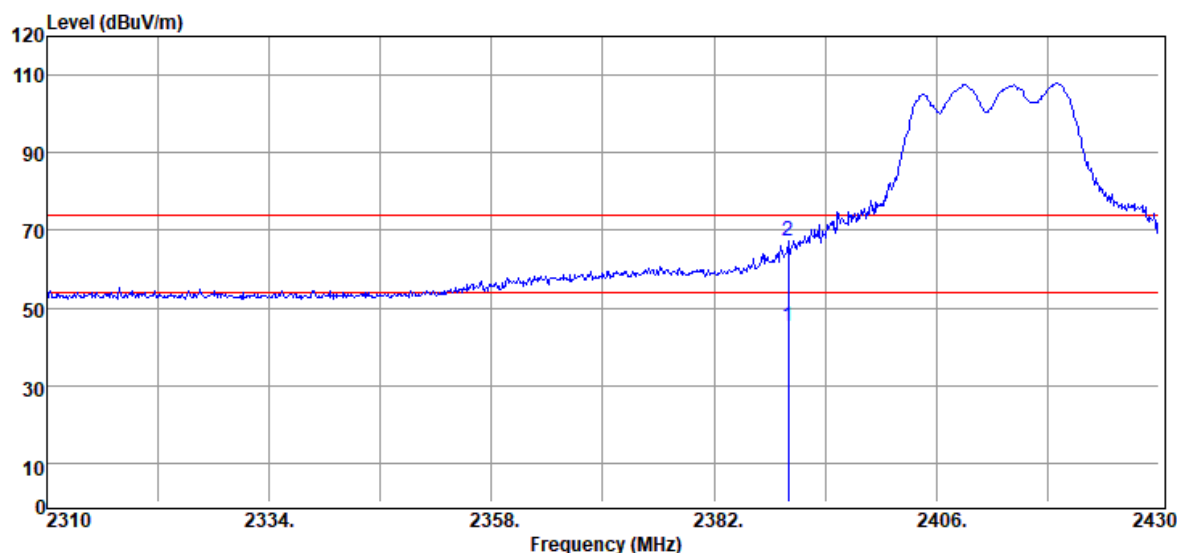
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Report Number :ER/2020/80121
Operation Mode :802.11g
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.6/64
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	Average	50.62	-5.50	45.12	54.00	-8.88
2390.00	Peak	72.79	-5.50	67.29	74.00	-6.71

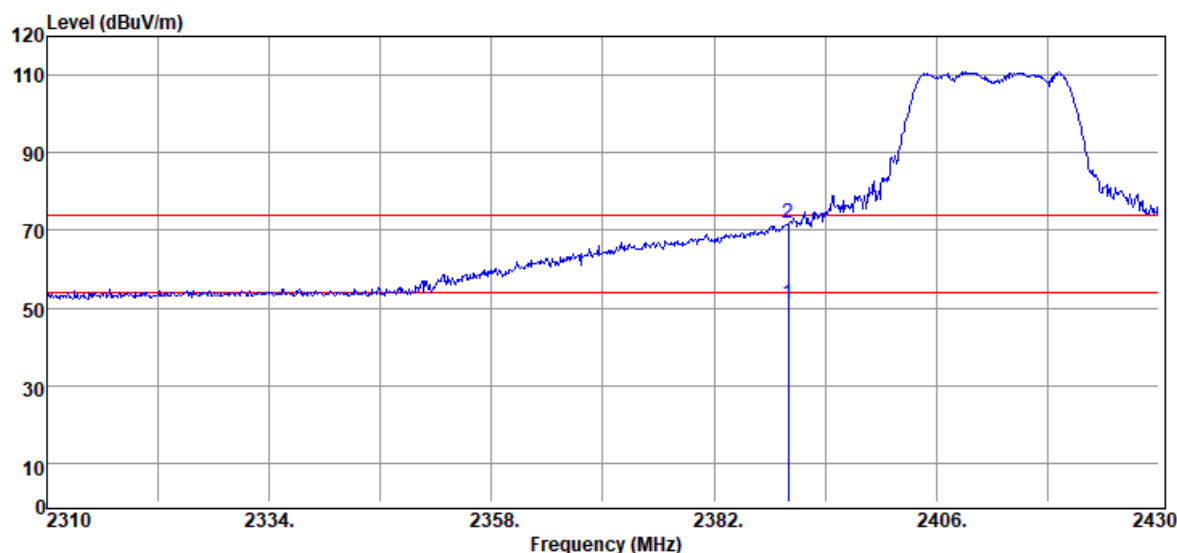
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Report Number :ER/2020/80121
Operation Mode :802.11g
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.6/64
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	Average	56.62	-5.50	51.12	54.00	-2.88
2390.00	Peak	77.37	-5.50	71.87	74.00	-2.13

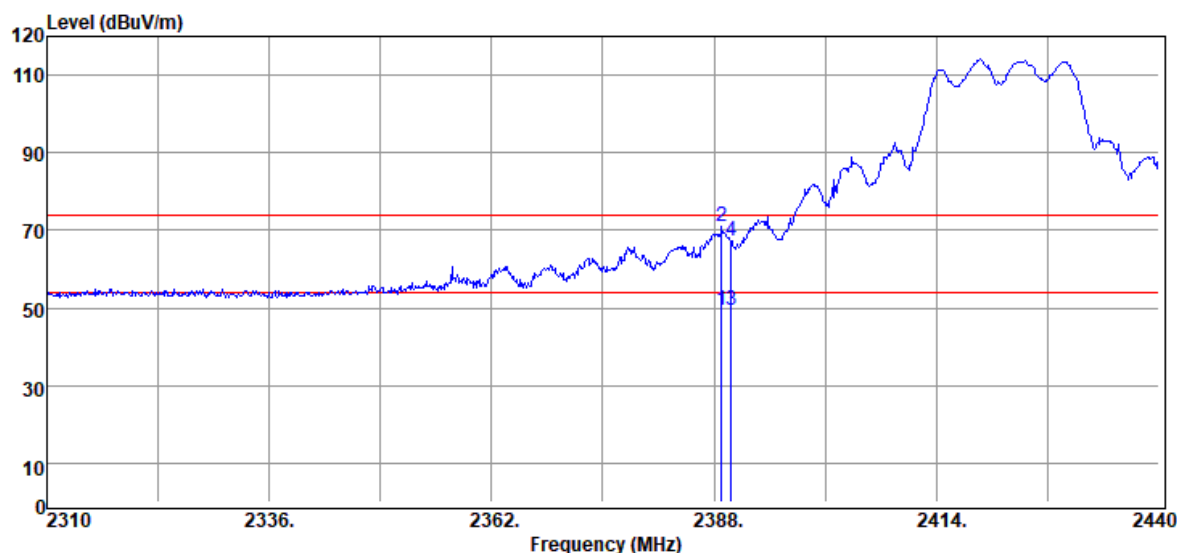
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Report Number :ER/2020/80121
Operation Mode :802.11g
Test Frequency :2422 MHz
Test Mode :BE CH 3
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.6/64
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
2388.91	Average	54.95	-5.50	49.45	54.00	-4.55
2388.91	Peak	76.49	-5.50	70.99	74.00	-3.01
2390.00	Average	54.74	-5.50	49.24	54.00	-4.76
2390.00	Peak	72.85	-5.50	67.35	74.00	-6.65

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Report Number :ER/2020/80121

Test Site :966 Chamber D

Operation Mode :802.11g

Test Date :2020-09-01

Test Frequency :2422 MHz

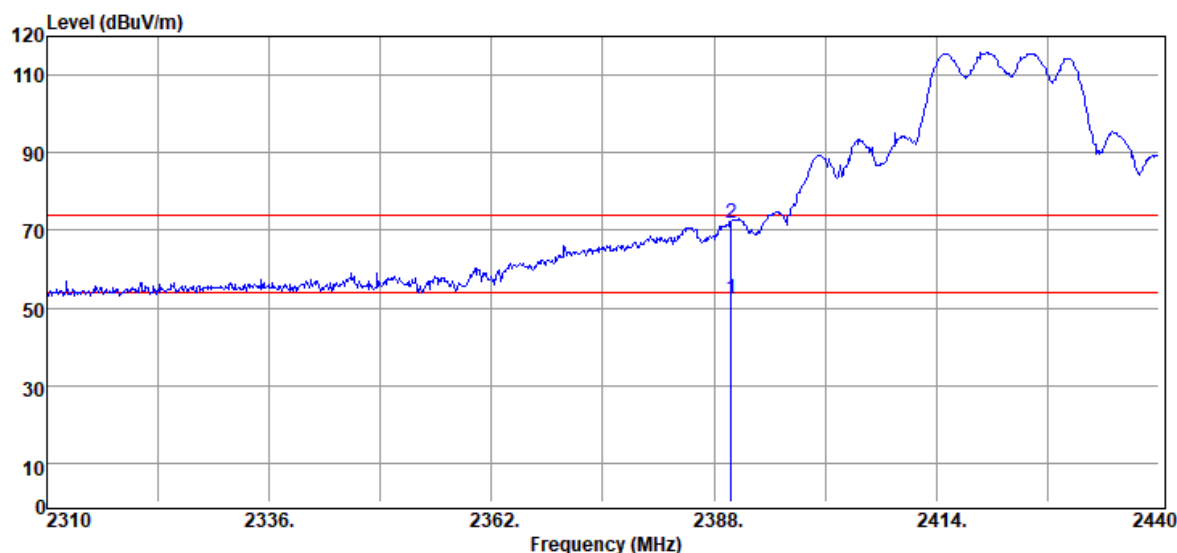
Temp./Humi. :24.6/64

Test Mode :BE CH 3

Antenna Pol. :HORIZONTAL

EUT Pol :E2 Plan

Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	Average	57.98	-5.50	52.48	54.00	-1.52
2390.00	Peak	77.52	-5.50	72.02	74.00	-1.98

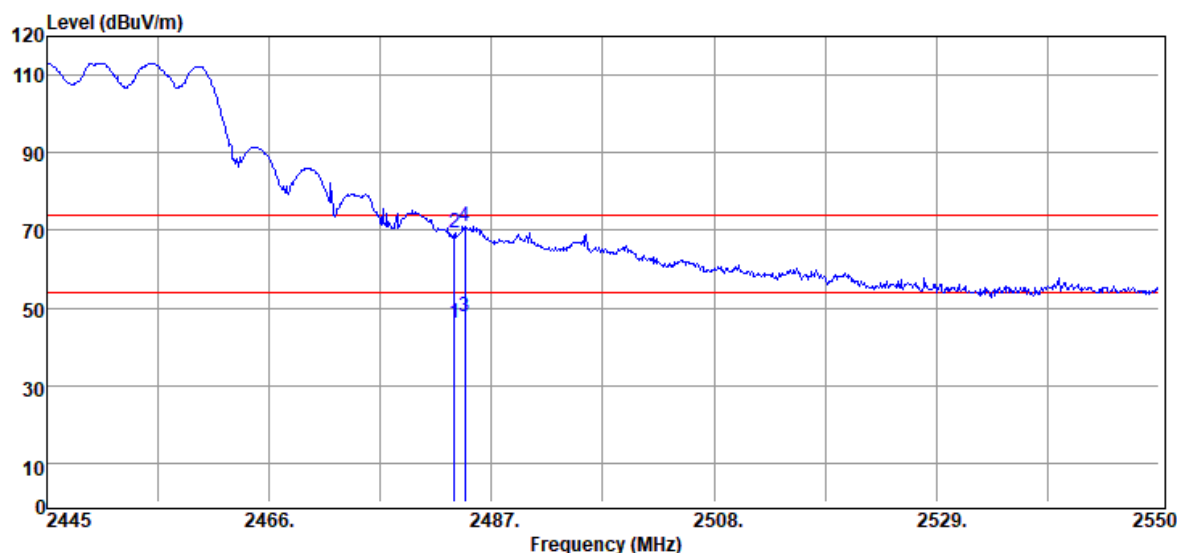
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Report Number :ER/2020/80121
Operation Mode :802.11g
Test Frequency :2452 MHz
Test Mode :BE CH 9
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.6/64
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBUV	Factor dB	Actual FS dBUV/m	Limit @3m dBUV/m	Margin dB
2483.50	Average	51.77	-5.56	46.21	54.00	-7.79
2483.50	Peak	75.06	-5.56	69.50	74.00	-4.50
2484.48	Average	53.41	-5.56	47.85	54.00	-6.15
2484.48	Peak	76.47	-5.56	70.91	74.00	-3.09

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Report Number :ER/2020/80121

Test Site :966 Chamber D

Operation Mode :802.11g

Test Date :2020-09-01

Test Frequency :2452 MHz

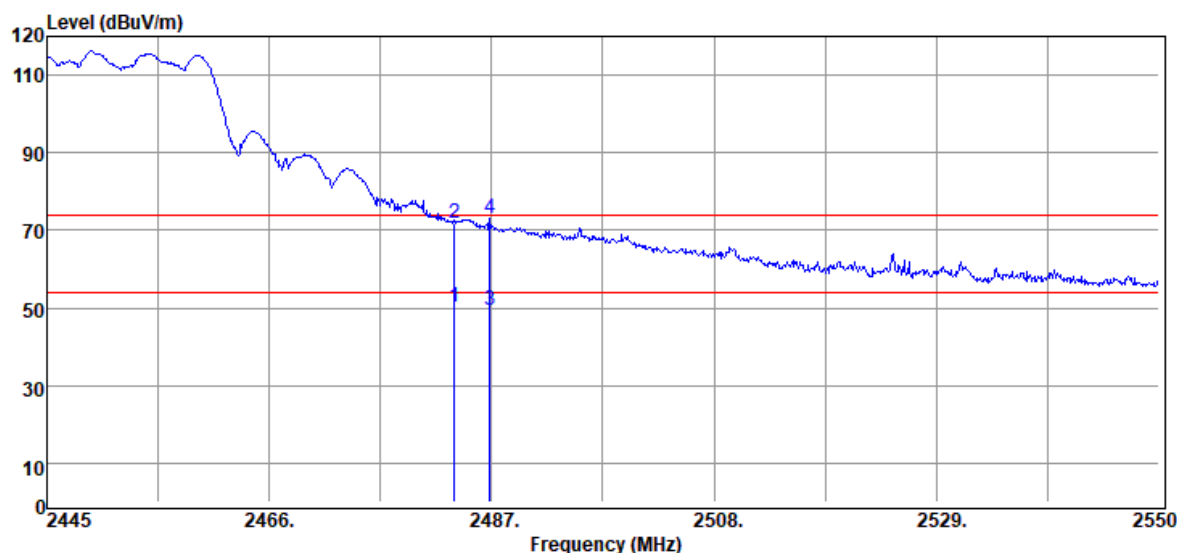
Temp./Humi. :24.6/64

Test Mode :BE CH 9

Antenna Pol. :HORIZONTAL

EUT Pol :E2 Plan

Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Average	55.66	-5.56	50.10	54.00	-3.90
2483.50	Peak	77.57	-5.56	72.01	74.00	-1.99
2486.79	Average	54.86	-5.56	49.30	54.00	-4.70
2486.79	Peak	78.44	-5.56	72.88	74.00	-1.12

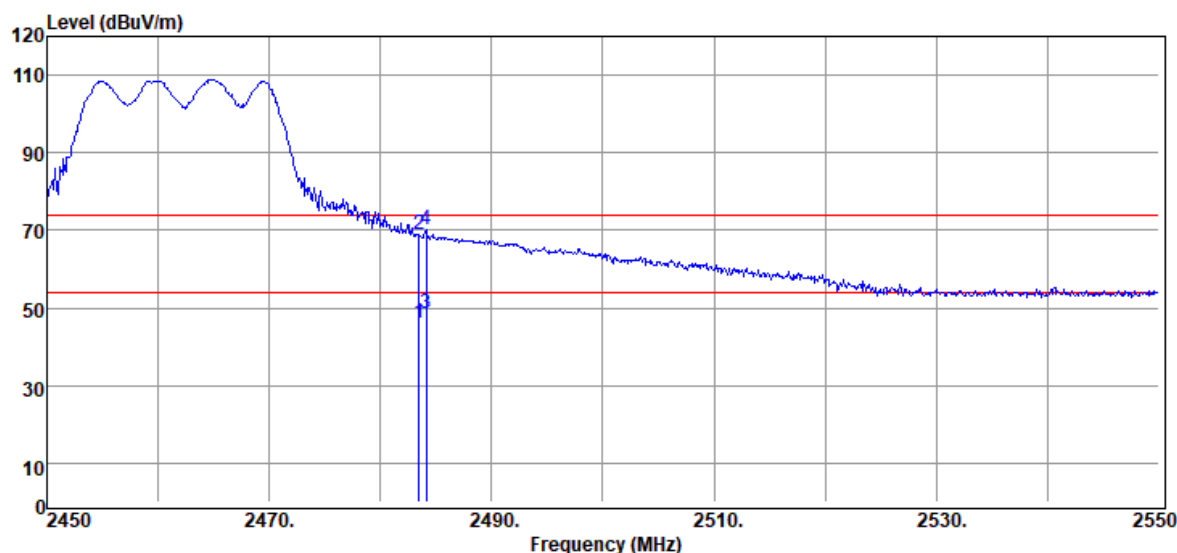
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Report Number :ER/2020/80121
Operation Mode :802.11g
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.6/64
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Average	51.62	-5.56	46.06	54.00	-7.94
2483.50	Peak	74.55	-5.56	68.99	74.00	-5.01
2484.10	Average	53.98	-5.56	48.42	54.00	-5.58
2484.10	Peak	75.88	-5.56	70.32	74.00	-3.68

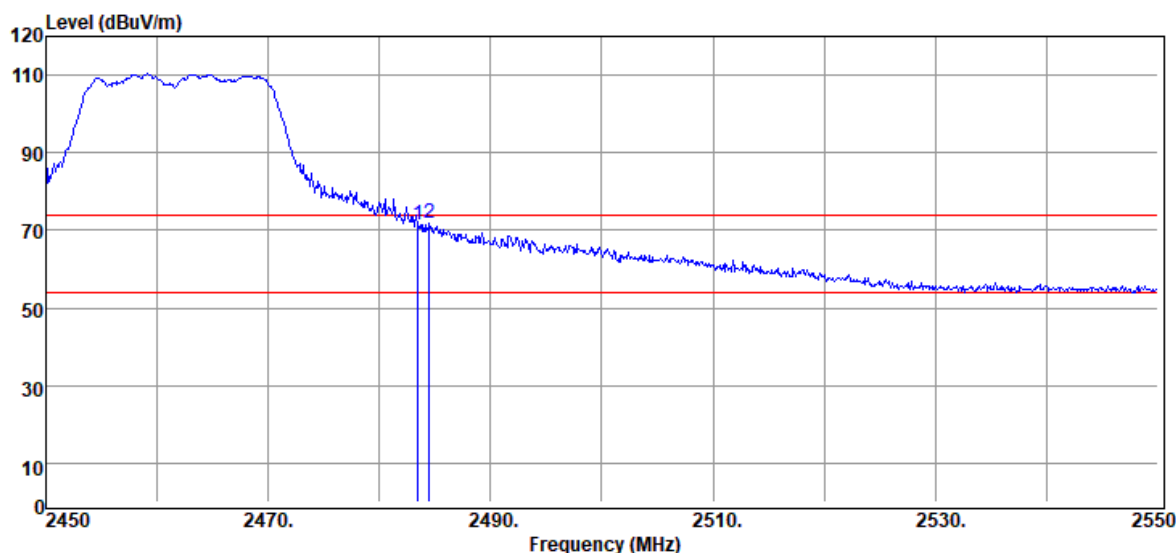
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Report Number :ER/2020/80121
Operation Mode :802.11g
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.6/64
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Peak	77.09	-5.56	71.53	74.00	-2.47
2484.50	Peak	77.26	-5.56	71.70	74.00	-2.30

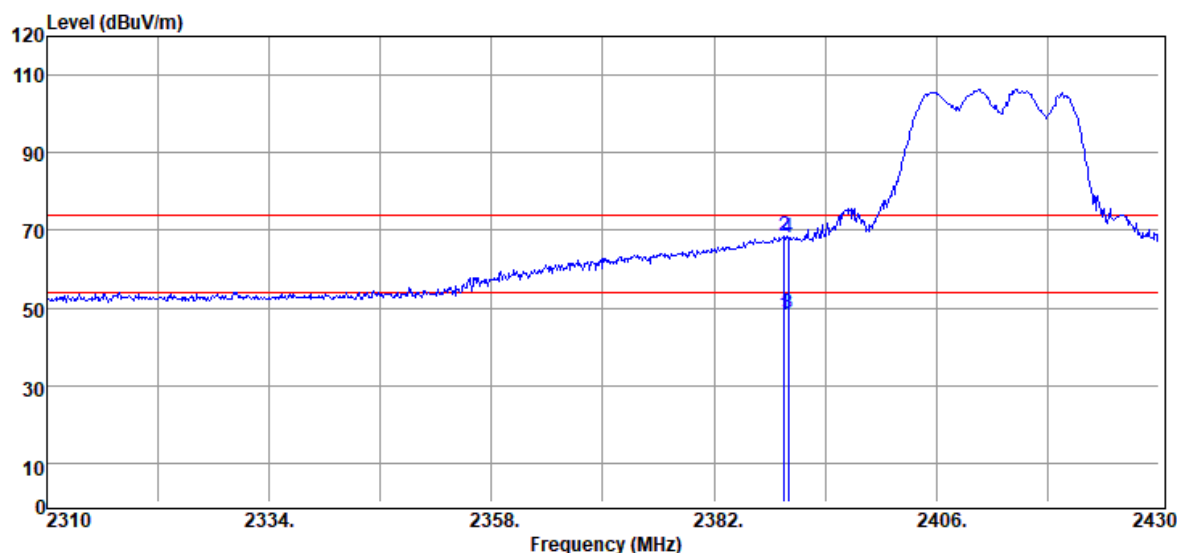
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Report Number :ER/2020/80121
Operation Mode :802.11n20
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-07
Temp./Humi. :23.4/57
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
2389.56	Average	53.68	-5.50	48.18	54.00	-5.82
2389.56	Peak	73.86	-5.50	68.36	74.00	-5.64
2390.00	Average	53.98	-5.50	48.48	54.00	-5.52
2390.00	Peak	73.65	-5.50	68.15	74.00	-5.85

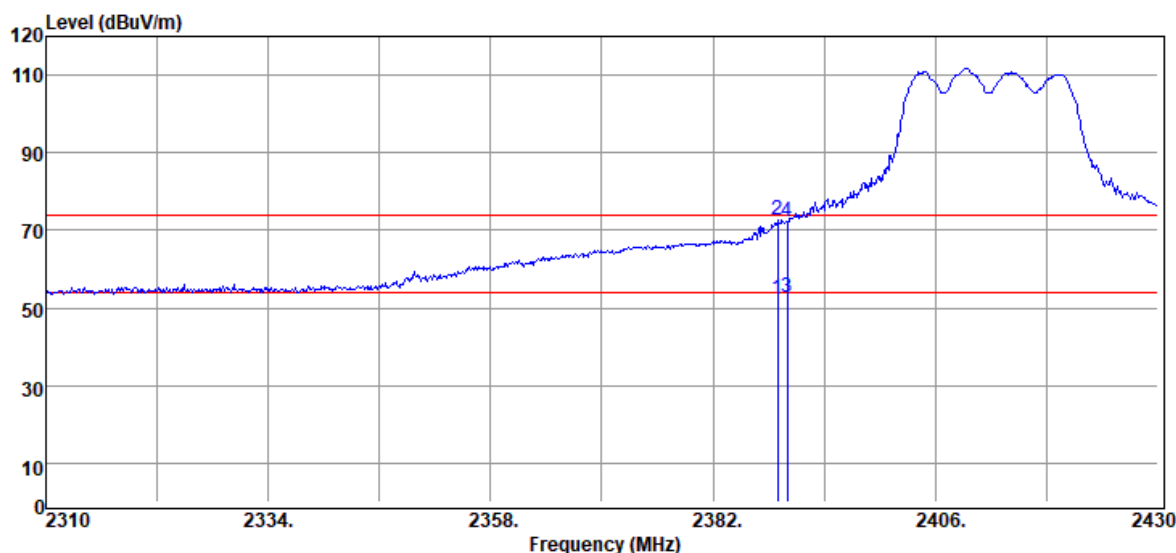
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Report Number :ER/2020/80121
Operation Mode :802.11n20
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-07
Temp./Humi. :23.4/57
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2388.96	Average	57.98	-5.50	52.48	54.00	-1.52
2388.96	Peak	78.13	-5.50	72.63	74.00	-1.37
2390.00	Average	58.11	-5.50	52.61	54.00	-1.39
2390.00	Peak	77.67	-5.50	72.17	74.00	-1.83

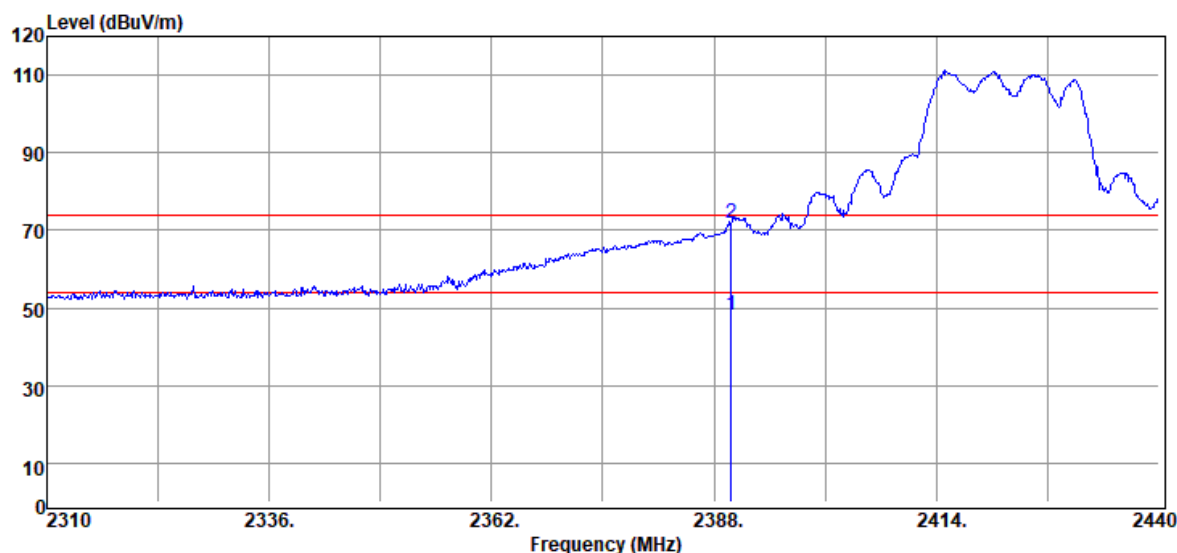
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Report Number :ER/2020/80121
Operation Mode :802.11n20
Test Frequency :2422 MHz
Test Mode :BE CH 3
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-07
Temp./Humi. :24.3/57
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	Average	53.48	-5.50	47.98	54.00	-6.02
2390.00	Peak	77.25	-5.50	71.75	74.00	-2.25

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Report Number :ER/2020/80121

Test Site :966 Chamber D

Operation Mode :802.11n20

Test Date :2020-09-07

Test Frequency :2422 MHz

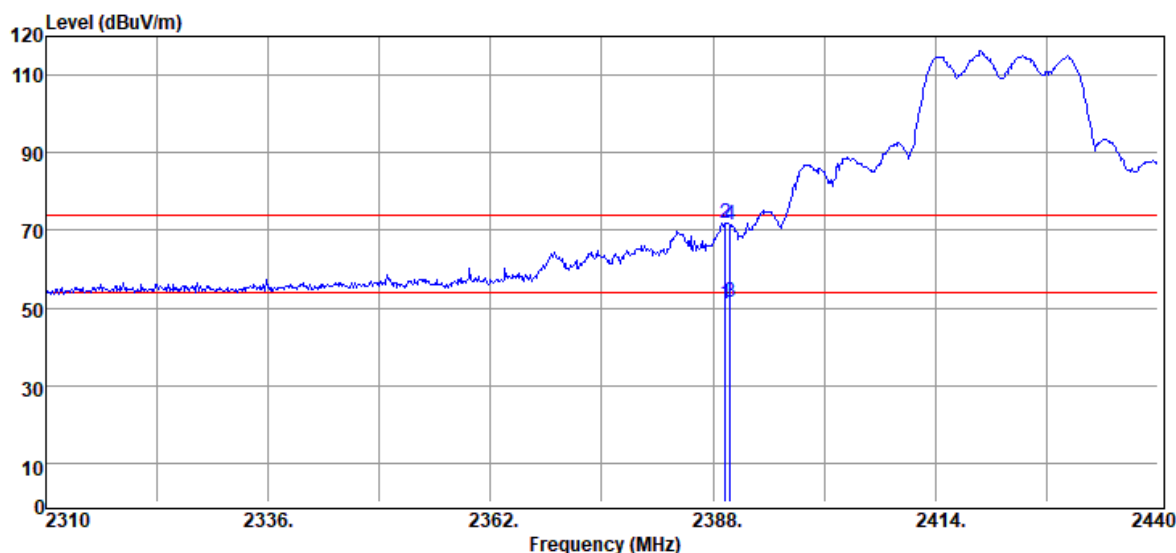
Temp./Humi. :24.3/57

Test Mode :BE CH 3

Antenna Pol. :HORIZONTAL

EUT Pol :E2 Plan

Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2389.43	Average	56.71	-5.50	51.21	54.00	-2.79
2389.43	Peak	77.48	-5.50	71.98	74.00	-2.02
2390.00	Average	56.89	-5.50	51.39	54.00	-2.61
2390.00	Peak	77.07	-5.50	71.57	74.00	-2.43

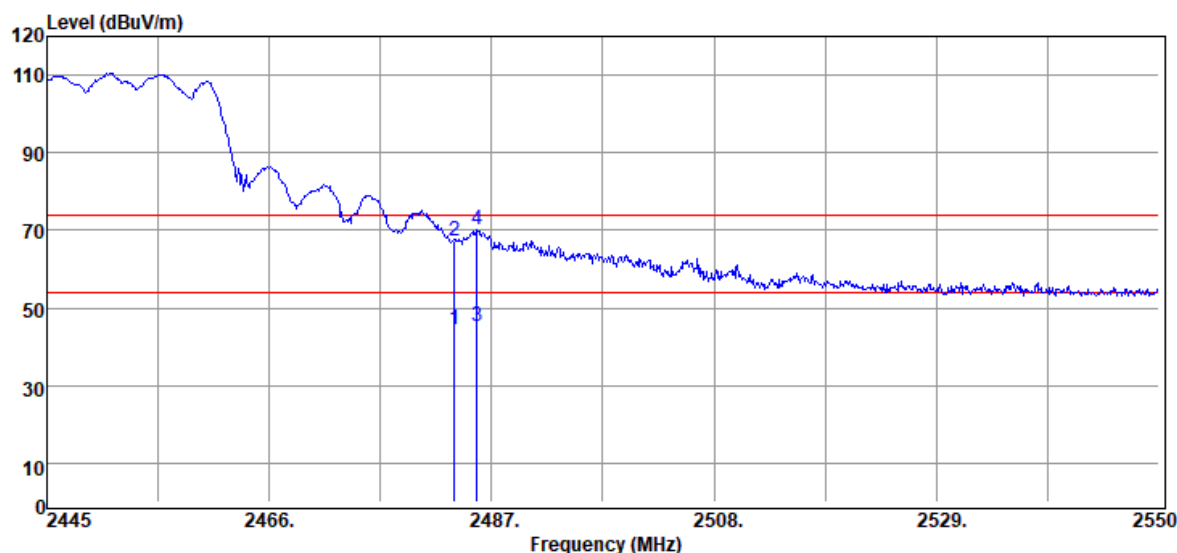
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Report Number :ER/2020/80121
Operation Mode :802.11n20
Test Frequency :2452 MHz
Test Mode :BE CH 9
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-07
Temp./Humi. :24.2/58
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
2483.50	Average	50.15	-5.56	44.59	54.00	-9.41
2483.50	Peak	72.67	-5.56	67.11	74.00	-6.89
2485.64	Average	51.02	-5.56	45.46	54.00	-8.54
2485.64	Peak	75.76	-5.56	70.20	74.00	-3.80

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Report Number :ER/2020/80121

Test Site :966 Chamber D

Operation Mode :802.11n20

Test Date :2020-09-07

Test Frequency :2452 MHz

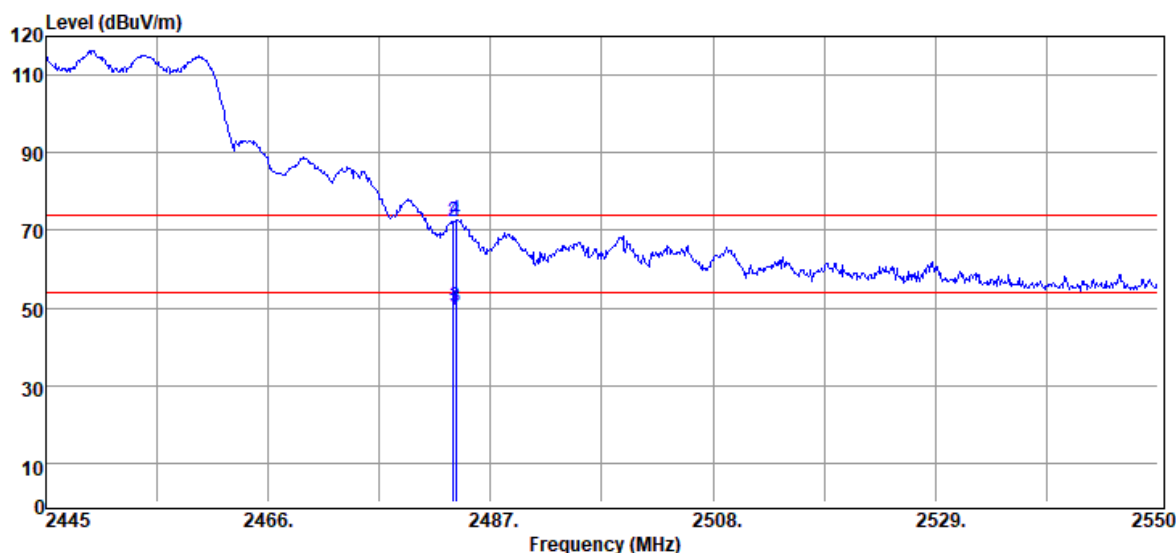
Temp./Humi. :24.2/58

Test Mode :BE CH 9

Antenna Pol. :HORIZONTAL

EUT Pol :E2 Plan

Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Average	54.84	-5.56	49.28	54.00	-4.72
2483.50	Peak	77.76	-5.56	72.20	74.00	-1.80
2483.75	Average	55.95	-5.56	50.39	54.00	-3.61
2483.75	Peak	78.42	-5.56	72.86	74.00	-1.14

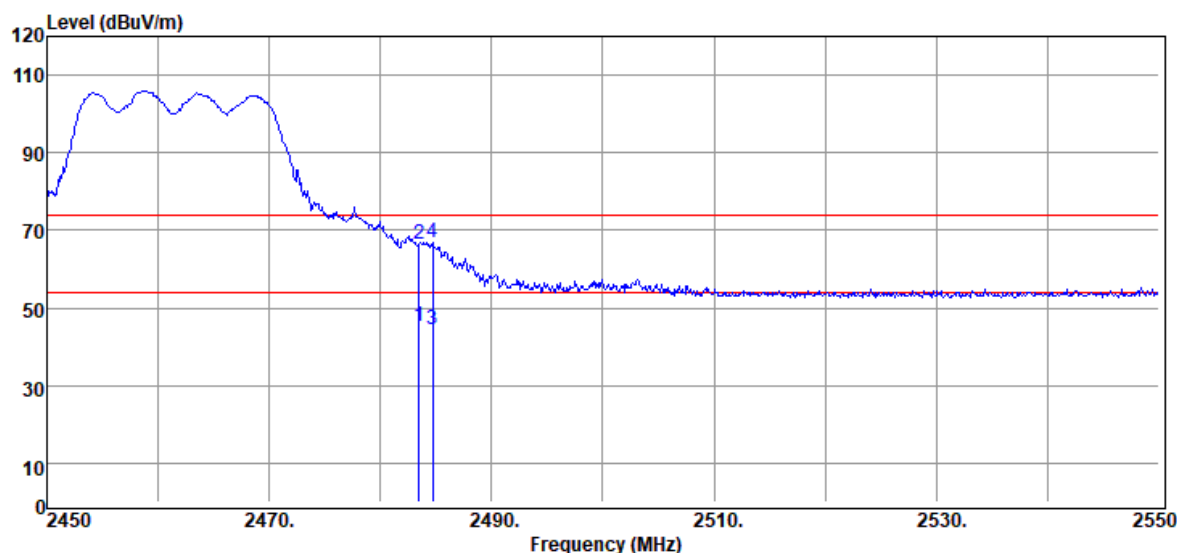
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Report Number :ER/2020/80121
Operation Mode :802.11n20
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-07
Temp./Humi. :24.2/57
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



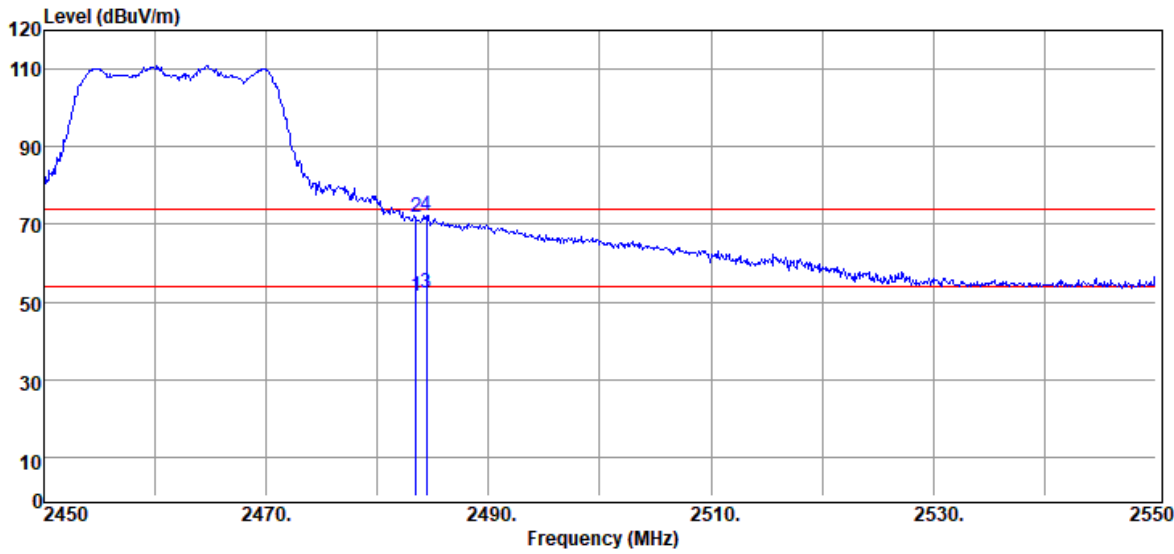
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
2483.50	Average	50.78	-5.56	45.22	54.00	-8.78
2483.50	Peak	71.84	-5.56	66.28	74.00	-7.72
2484.70	Average	49.87	-5.56	44.31	54.00	-9.69
2484.70	Peak	72.42	-5.56	66.86	74.00	-7.14

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Report Number :ER/2020/80121
Operation Mode :802.11n20
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-07
Temp./Humi. :24.2/57
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Average	56.98	-5.56	51.42	54.00	-2.58
2483.50	Peak	77.34	-5.56	71.78	74.00	-2.22
2484.40	Average	57.68	-5.56	52.12	54.00	-1.88
2484.40	Peak	77.89	-5.56	72.33	74.00	-1.67

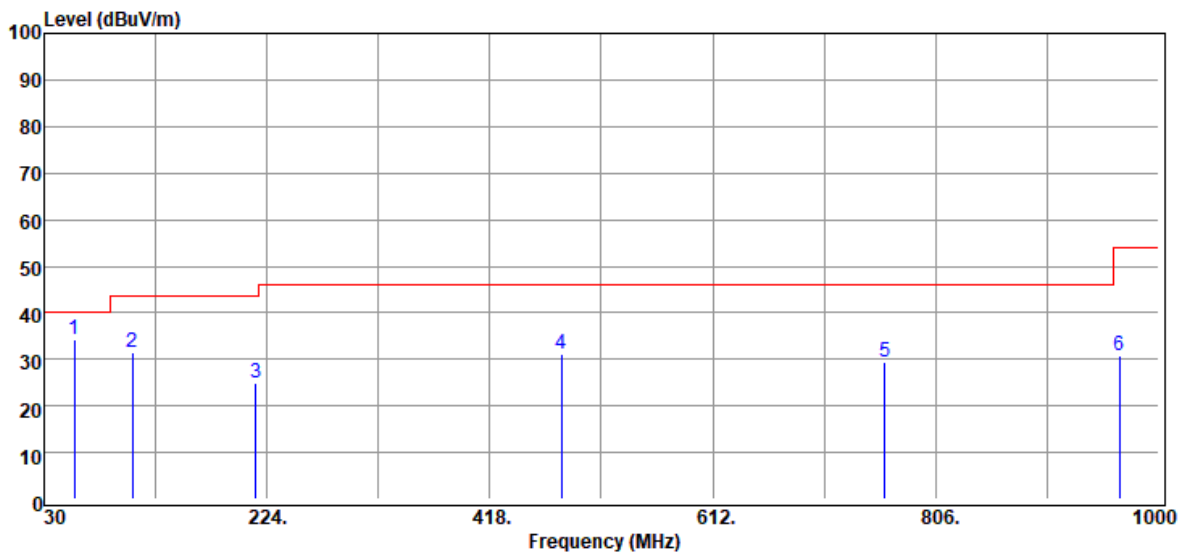
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11.7.2 Below 1GHz Worst-Case Emission:

Report Number	:ER/2020/80121	Test Site	:966 Chamber D
Operation Mode	:802.11g	Test Date	:2020-08-31
Test Frequency	:2437 MHz	Temp./Humi.	:24.7/68
Test Mode	:TX CH MID	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plan	Engineer	:Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
56.19	Peak	51.47	-17.13	34.34	40.00	-5.66
106.63	Peak	51.66	-20.07	31.59	43.50	-11.91
214.30	Peak	43.67	-18.64	25.03	43.50	-18.47
480.08	Peak	42.36	-11.23	31.13	46.00	-14.87
761.38	Peak	36.16	-6.69	29.47	46.00	-16.53
966.05	Peak	34.94	-4.18	30.76	54.00	-23.24

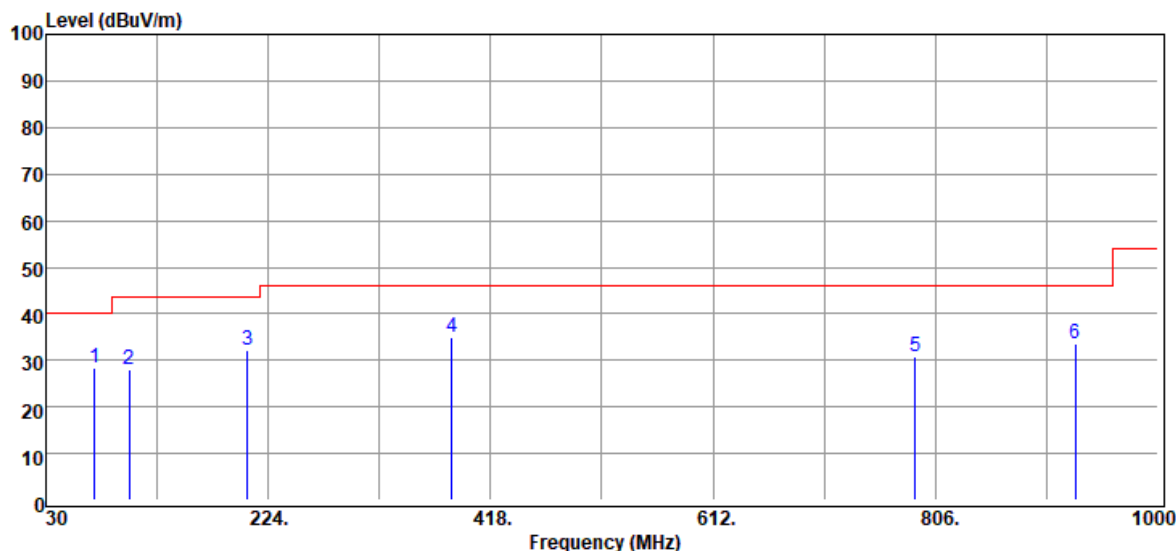
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Report Number :ER/2020/80121
Operation Mode :802.11g
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-31
Temp./Humi. :24.7/68
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
72.68	Peak	48.25	-19.83	28.42	40.00	-11.58
102.75	Peak	48.86	-20.89	27.97	43.50	-15.53
205.57	Peak	50.86	-18.61	32.25	43.50	-11.25
384.05	Peak	47.85	-13.06	34.79	46.00	-11.21
788.54	Peak	37.04	-6.15	30.89	46.00	-15.11
928.22	Peak	38.35	-4.80	33.55	46.00	-12.45

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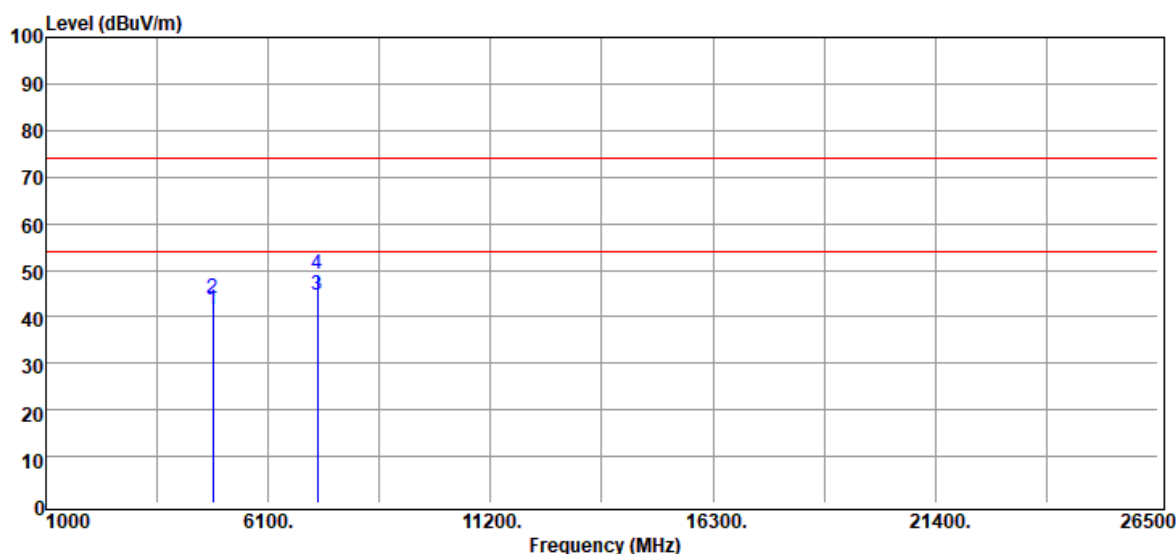
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11.7.3 Above 1GHz Emission:

Report Number :ER/2020/80121
 Operation Mode :802.11b
 Test Frequency :2412 MHz
 Test Mode :TX CH LOW
 EUT Pol :E2 Plan

Test Site :966 Chamber D
 Test Date :2020-09-01
 Temp./Humi. :24.3/65
 Antenna Pol. :VERTICAL
 Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
4824.00	Average	42.01	-0.34	41.67	54.00	-12.33
4824.00	Peak	44.26	-0.34	43.92	74.00	-30.08
7236.00	Average	38.95	5.52	44.47	54.00	-9.53
7236.00	Peak	43.62	5.52	49.14	74.00	-24.86

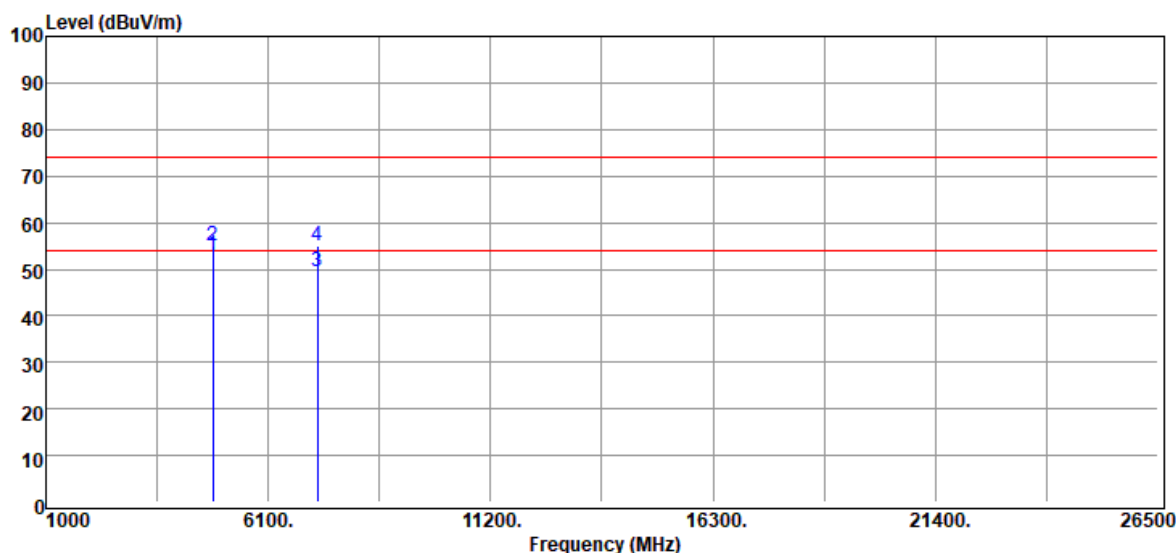
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Report Number :ER/2020/80121
Operation Mode :802.11b
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.3/65
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4824.00	Average	53.12	-0.34	52.78	54.00	-1.22
4824.00	Peak	55.24	-0.34	54.90	74.00	-19.10
7236.00	Average	44.06	5.52	49.58	54.00	-4.42
7236.00	Peak	49.35	5.52	54.87	74.00	-19.13

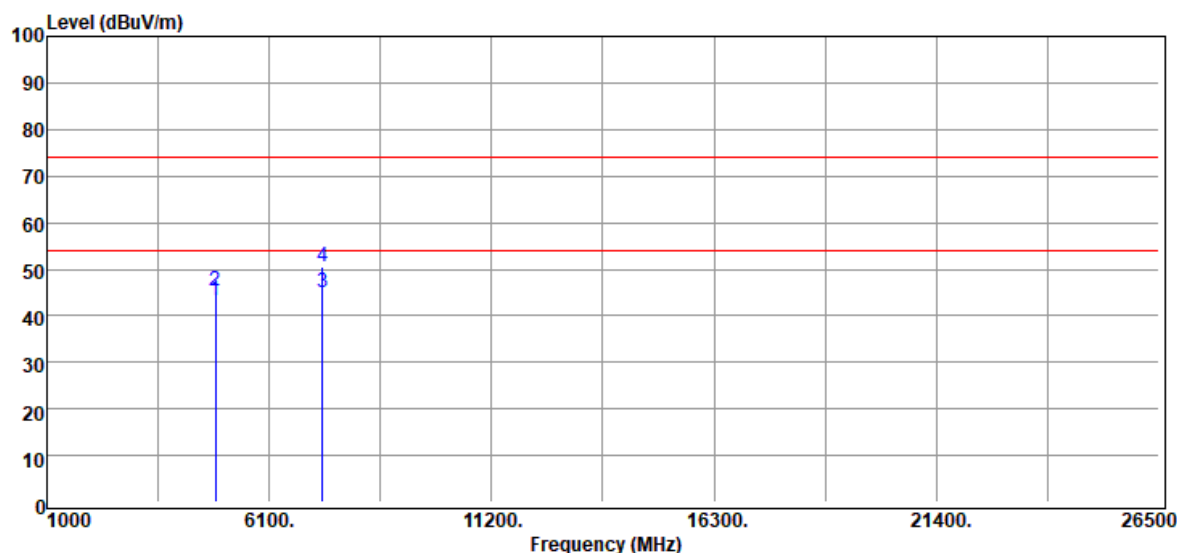
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Report Number :ER/2020/80121
Operation Mode :802.11b
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.3/65
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
4874.00	Average	43.66	-0.42	43.24	54.00	-10.76
4874.00	Peak	45.63	-0.42	45.21	74.00	-28.79
7311.00	Average	39.15	5.85	45.00	54.00	-9.00
7311.00	Peak	44.71	5.85	50.56	74.00	-23.44

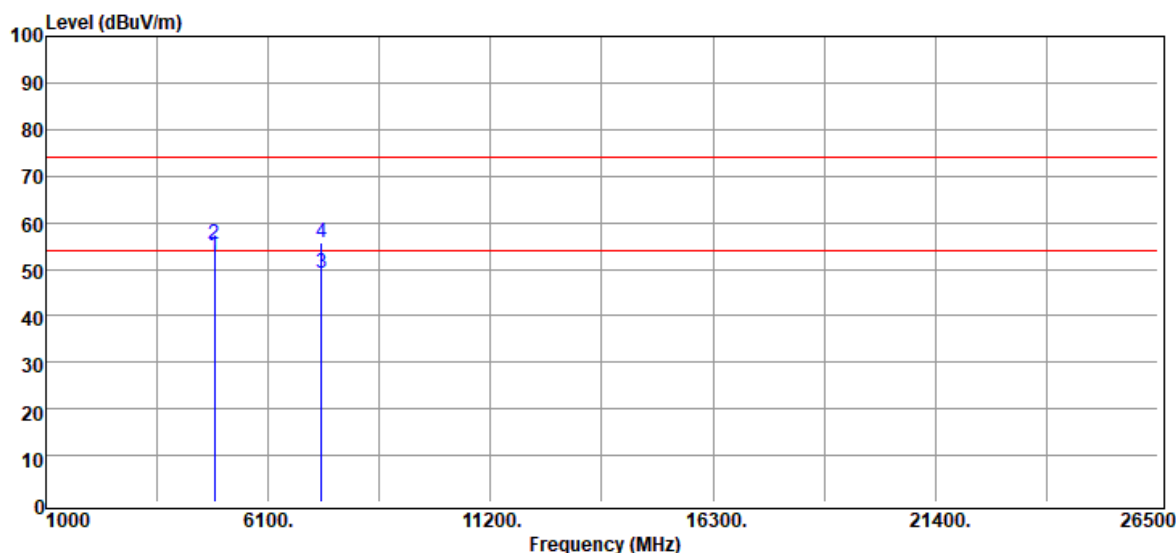
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Report Number :ER/2020/80121
Operation Mode :802.11b
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.3/65
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBUV	Factor dB	Actual FS dBUV/m	Limit @3m dBUV/m	Margin dB
4874.00	Average	53.27	-0.42	52.85	54.00	-1.15
4874.00	Peak	55.85	-0.42	55.43	74.00	-18.57
7311.00	Average	43.15	5.85	49.00	54.00	-5.00
7311.00	Peak	49.86	5.85	55.71	74.00	-18.29

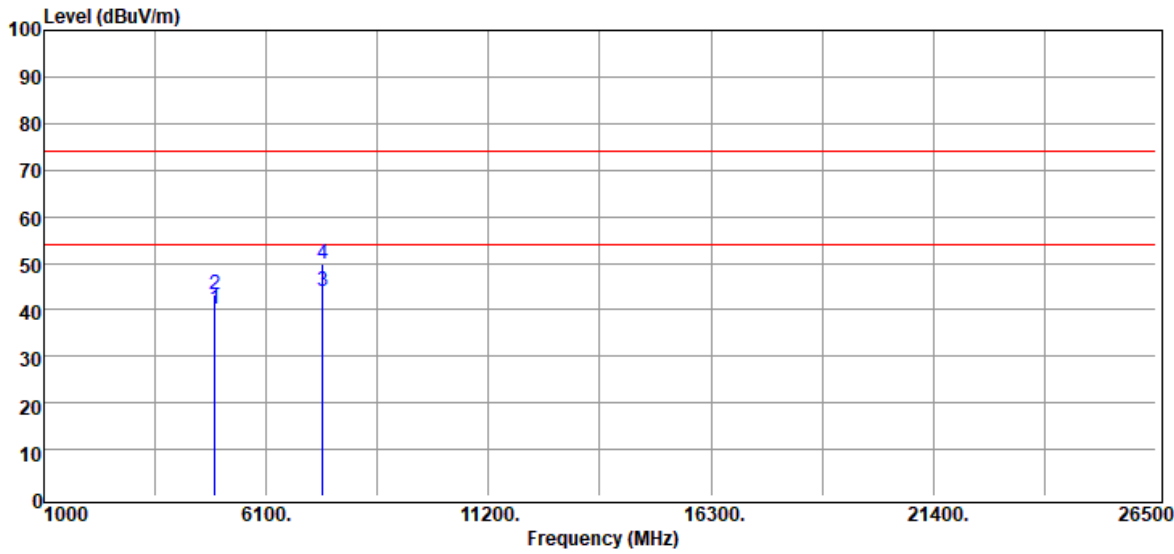
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Report Number :ER/2020/80121
Operation Mode :802.11b
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.7/68
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4924.00	Average	40.62	-0.61	40.01	54.00	-13.99
4924.00	Peak	43.87	-0.61	43.26	74.00	-30.74
7386.00	Average	38.78	5.08	43.86	54.00	-10.14
7386.00	Peak	44.71	5.08	49.79	74.00	-24.21

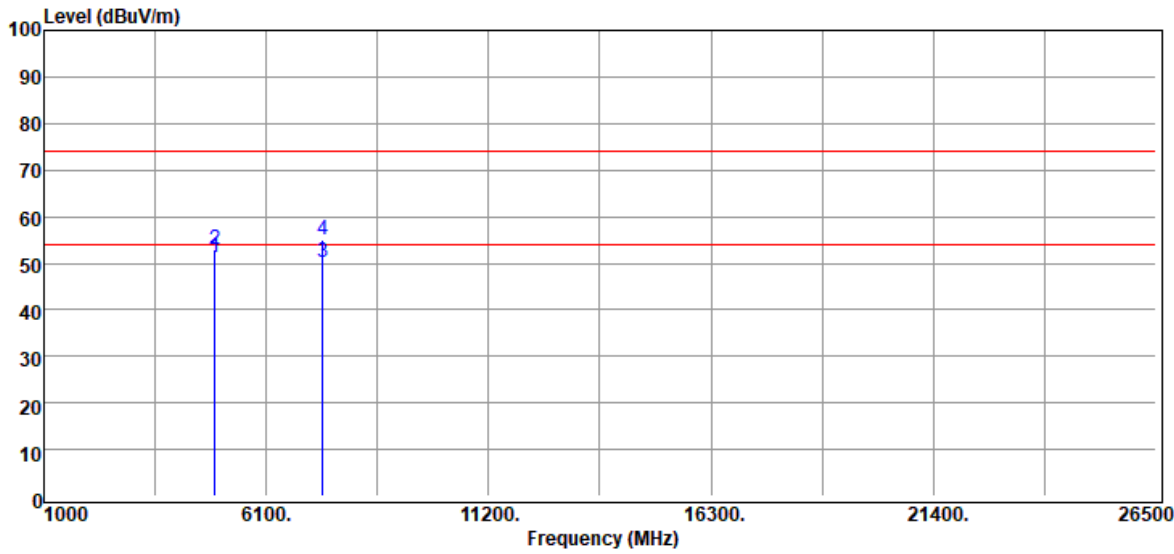
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Report Number :ER/2020/80121
Operation Mode :802.11b
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.7/68
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4924.00	Average	51.68	-0.61	51.07	54.00	-2.93
4924.00	Peak	53.62	-0.61	53.01	74.00	-20.99
7386.00	Average	44.95	5.08	50.03	54.00	-3.97
7386.00	Peak	49.98	5.08	55.06	74.00	-18.94

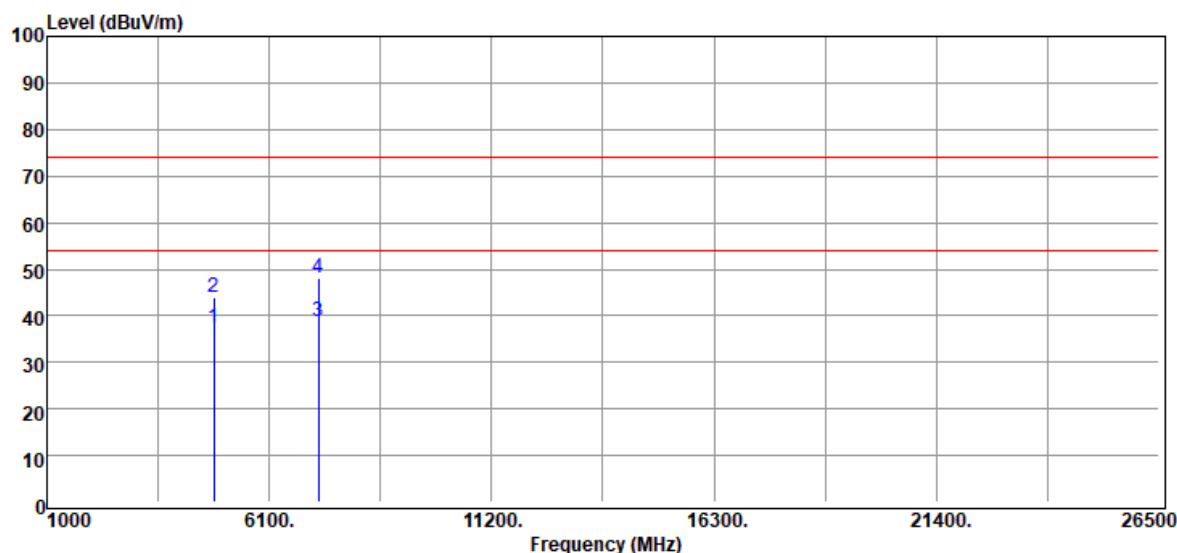
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Report Number :ER/2020/80121
Operation Mode :802.11g
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.7/68
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4824.00	Average	37.64	-0.34	37.30	54.00	-16.70
4824.00	Peak	44.16	-0.34	43.82	74.00	-30.18
7236.00	Average	33.24	5.52	38.76	54.00	-15.24
7236.00	Peak	42.63	5.52	48.15	74.00	-25.85

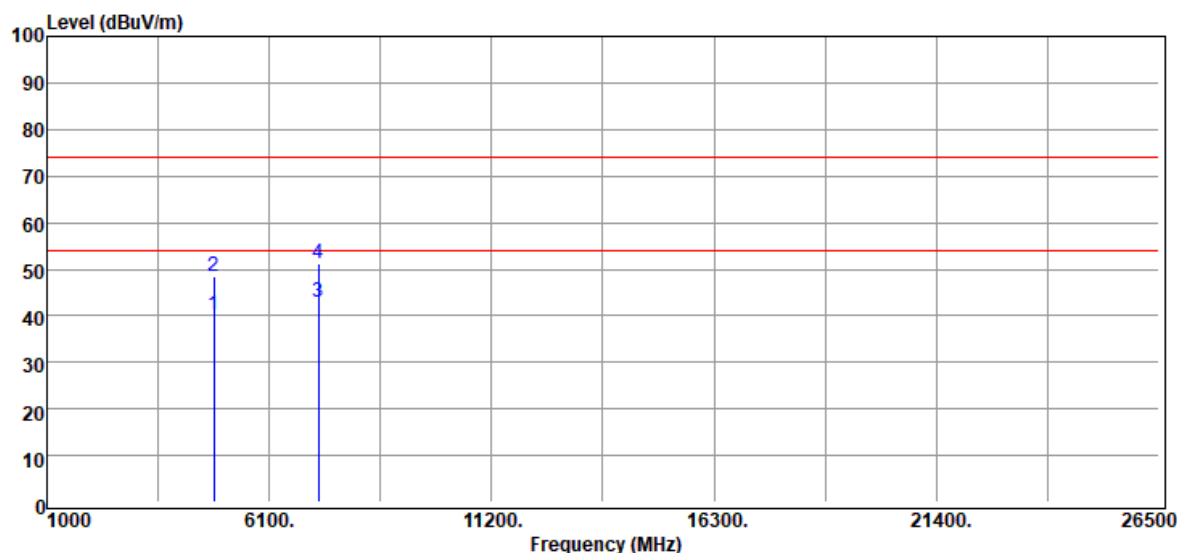
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Report Number :ER/2020/80121
Operation Mode :802.11g
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.7/68
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4824.00	Average	40.38	-0.34	40.04	54.00	-13.96
4824.00	Peak	48.73	-0.34	48.39	74.00	-25.61
7236.00	Average	37.31	5.52	42.83	54.00	-11.17
7236.00	Peak	45.83	5.52	51.35	74.00	-22.65

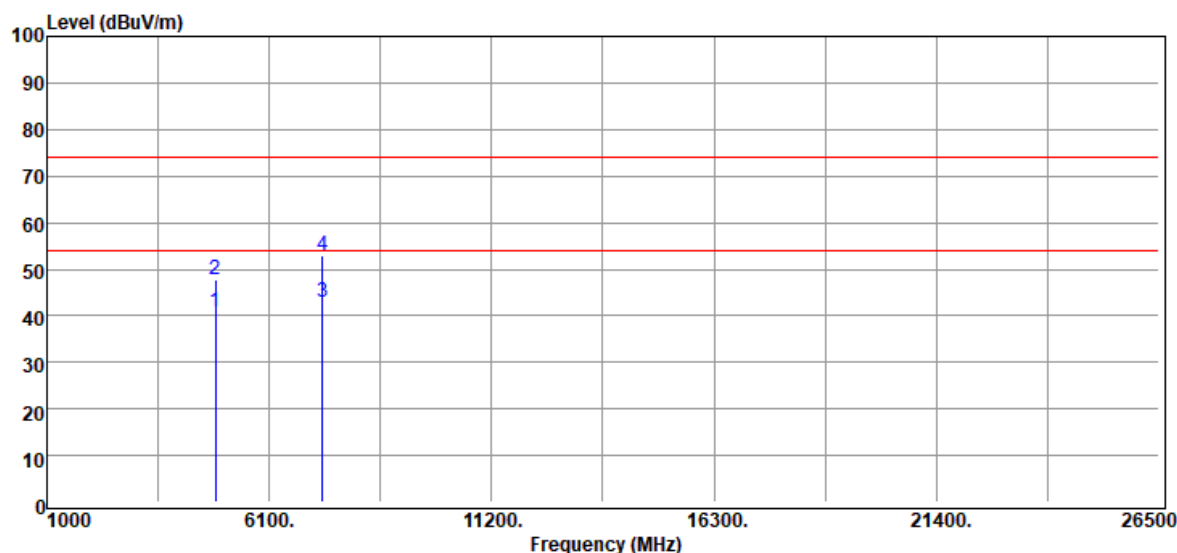
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Report Number :ER/2020/80121
Operation Mode :802.11g
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.7/68
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
4874.00	Average	41.22	-0.42	40.80	54.00	-13.20
4874.00	Peak	48.03	-0.42	47.61	74.00	-26.39
7311.00	Average	37.11	5.85	42.96	54.00	-11.04
7311.00	Peak	47.13	5.85	52.98	74.00	-21.02

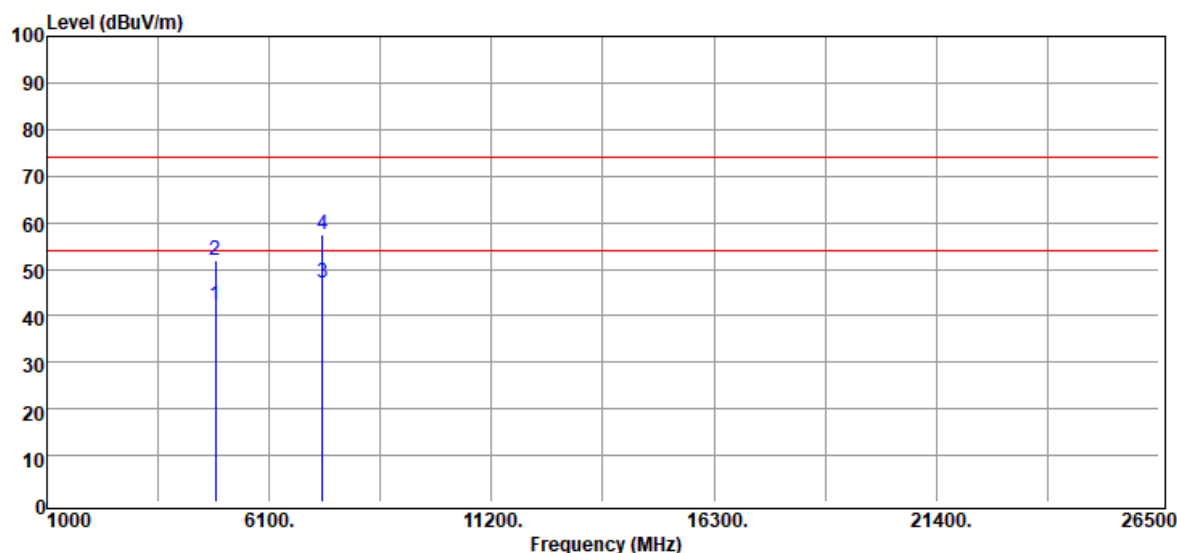
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Report Number :ER/2020/80121
Operation Mode :802.11g
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.7/68
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4874.00	Average	42.79	-0.42	42.37	54.00	-11.63
4874.00	Peak	52.42	-0.42	52.00	74.00	-22.00
7311.00	Average	41.33	5.85	47.18	54.00	-6.82
7311.00	Peak	51.70	5.85	57.55	74.00	-16.45

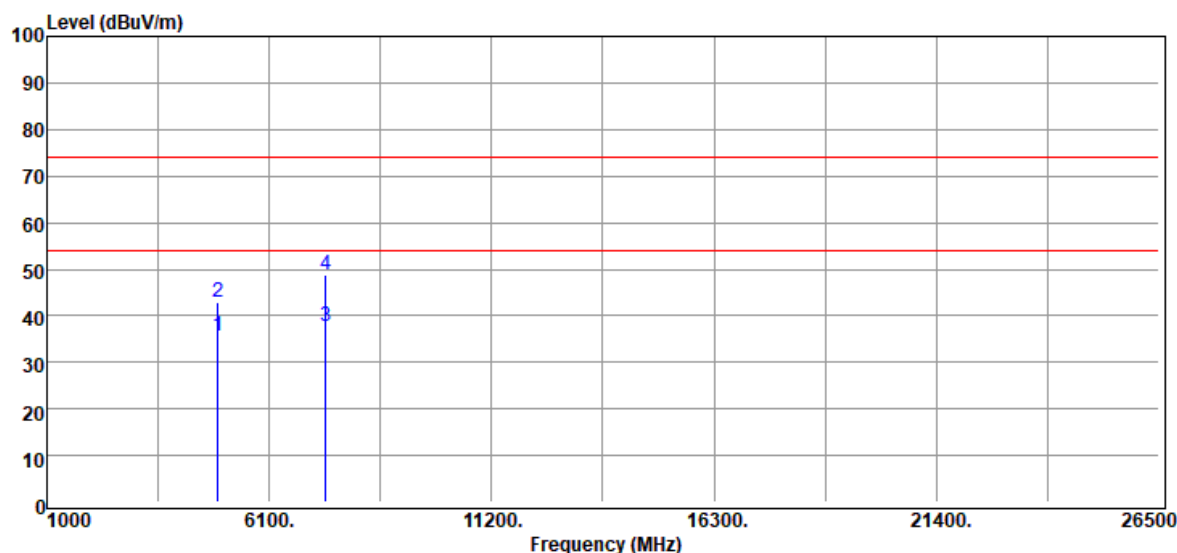
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Report Number :ER/2020/80121
Operation Mode :802.11g
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.7/68
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4924.00	Average	36.20	-0.61	35.59	54.00	-18.41
4924.00	Peak	43.51	-0.61	42.90	74.00	-31.10
7386.00	Average	32.72	5.08	37.80	54.00	-16.20
7386.00	Peak	43.79	5.08	48.87	74.00	-25.13

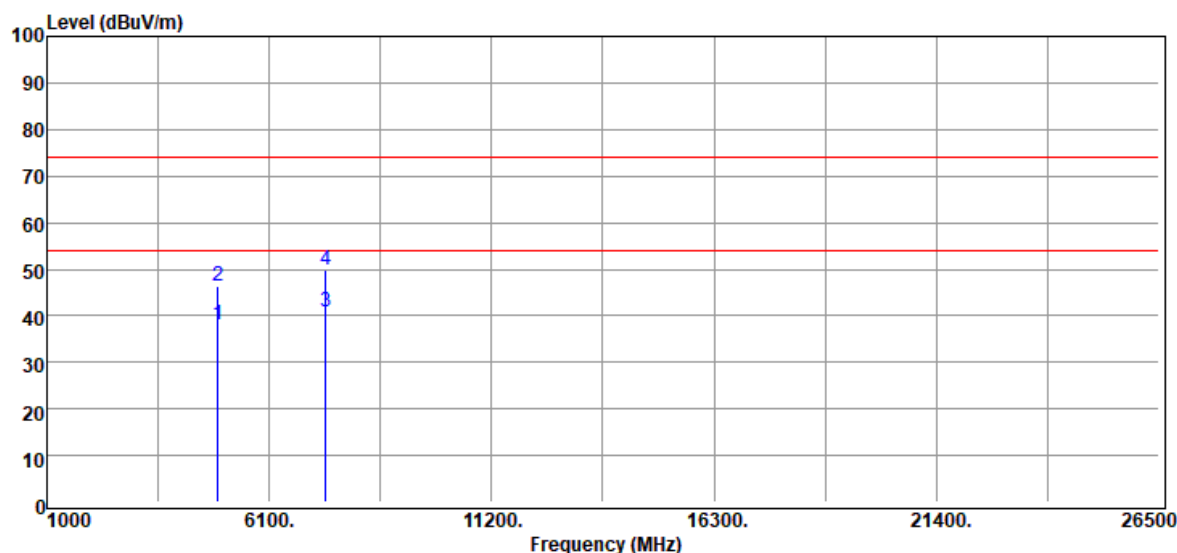
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Report Number :ER/2020/80121
Operation Mode :802.11g
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.7/68
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4924.00	Average	38.74	-0.61	38.13	54.00	-15.87
4924.00	Peak	46.91	-0.61	46.30	74.00	-27.70
7386.00	Average	35.86	5.08	40.94	54.00	-13.06
7386.00	Peak	44.68	5.08	49.76	74.00	-24.24

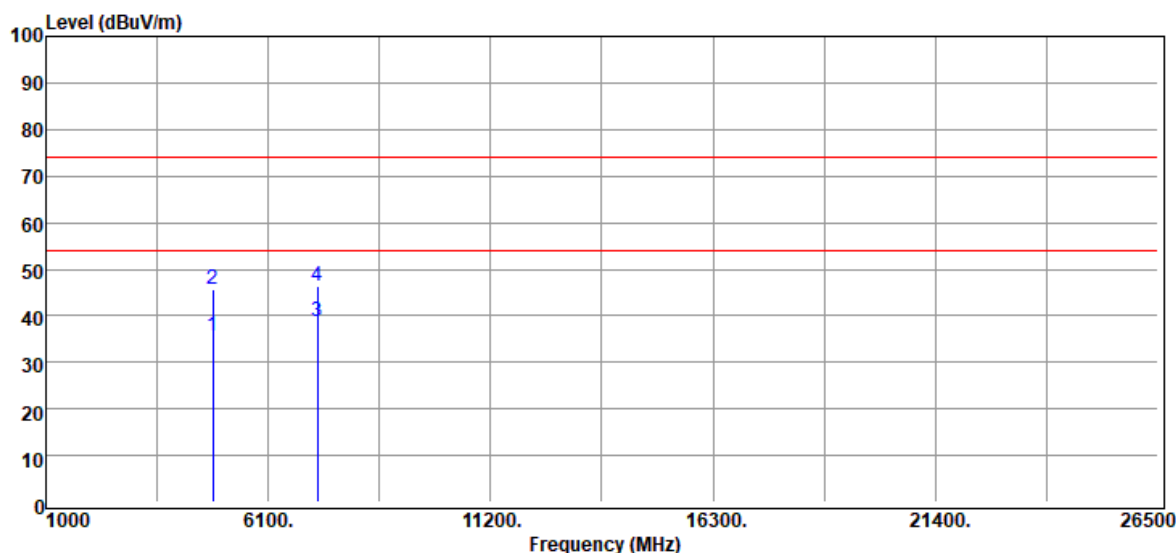
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Report Number :ER/2020/80121
Operation Mode :802.11n20
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.7/68
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4824.00	Average	36.12	-0.34	35.78	54.00	-18.22
4824.00	Peak	45.88	-0.34	45.54	74.00	-28.46
7236.00	Average	33.18	5.52	38.70	54.00	-15.30
7236.00	Peak	41.02	5.52	46.54	74.00	-27.46

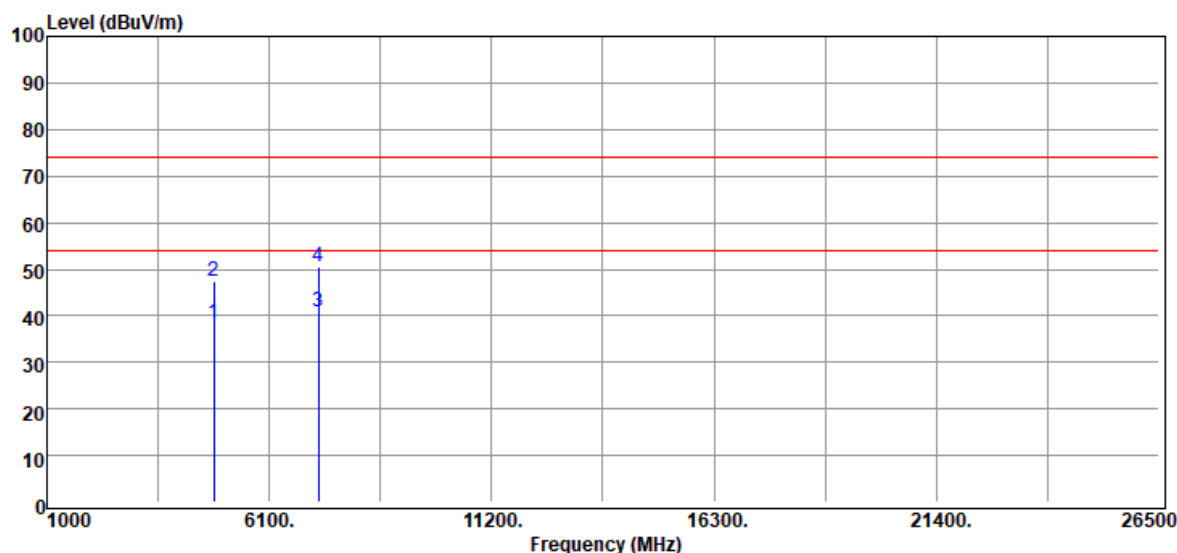
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Report Number :ER/2020/80121
Operation Mode :802.11n20
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.7/68
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4824.00	Average	38.62	-0.34	38.28	54.00	-15.72
4824.00	Peak	47.68	-0.34	47.34	74.00	-26.66
7236.00	Average	35.39	5.52	40.91	54.00	-13.09
7236.00	Peak	44.87	5.52	50.39	74.00	-23.61

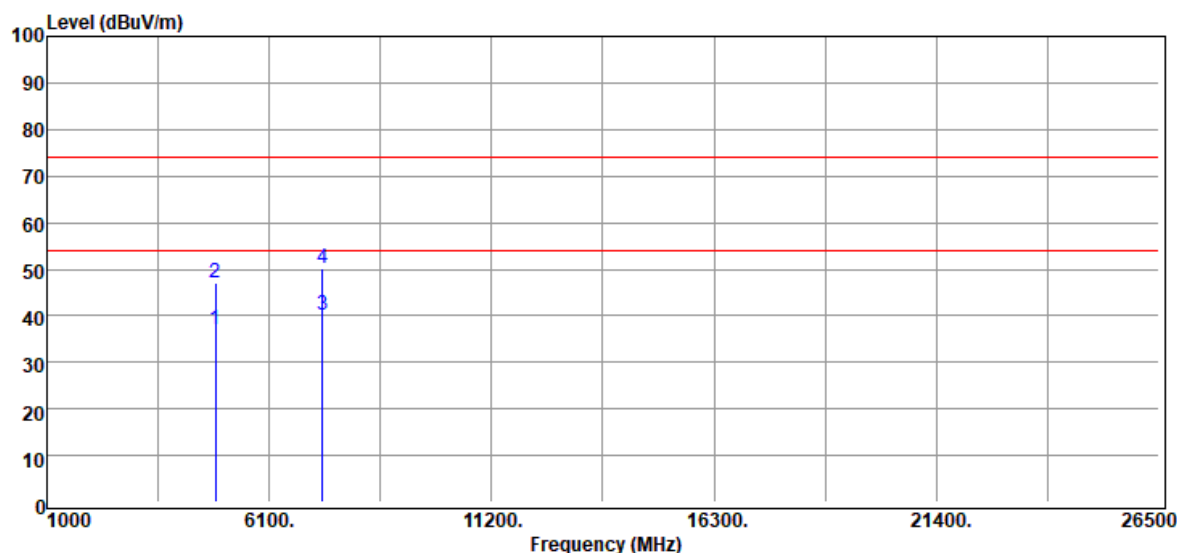
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Report Number :ER/2020/80121
Operation Mode :802.11n20
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.7/68
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4874.00	Average	37.46	-0.42	37.04	54.00	-16.96
4874.00	Peak	47.43	-0.42	47.01	74.00	-26.99
7311.00	Average	34.40	5.85	40.25	54.00	-13.75
7311.00	Peak	44.23	5.85	50.08	74.00	-23.92

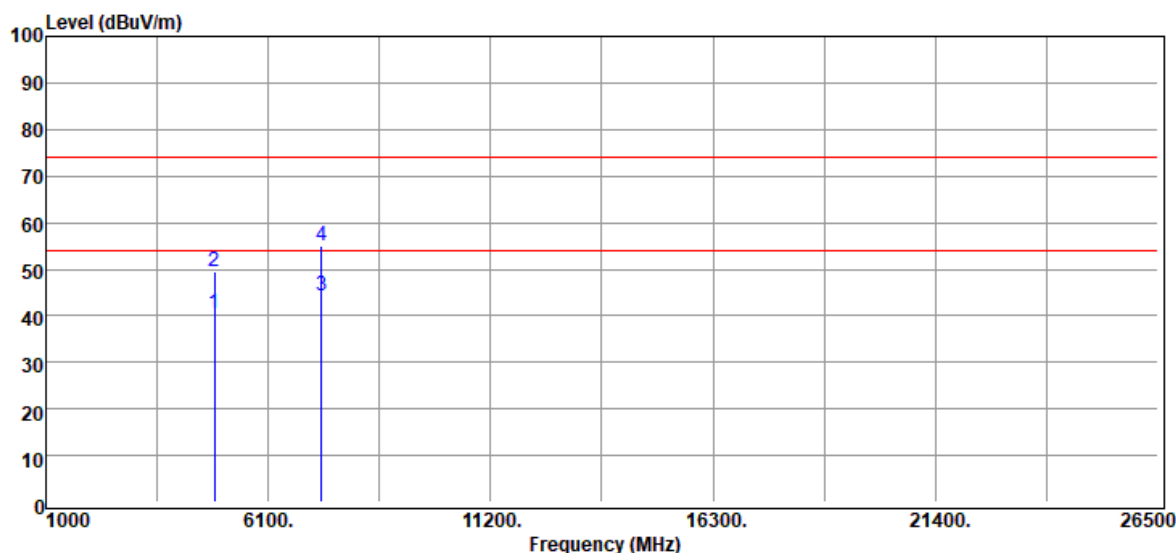
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Report Number :ER/2020/80121
Operation Mode :802.11n20
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.7/68
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4874.00	Average	40.76	-0.42	40.34	54.00	-13.66
4874.00	Peak	50.01	-0.42	49.59	74.00	-24.41
7311.00	Average	38.50	5.85	44.35	54.00	-9.65
7311.00	Peak	49.10	5.85	54.95	74.00	-19.05

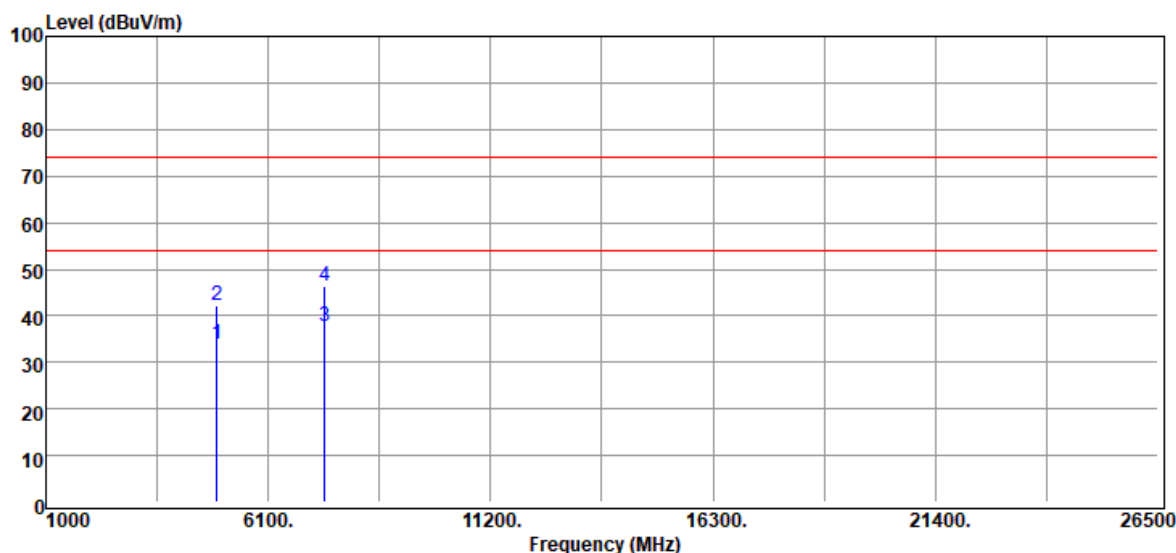
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Report Number :ER/2020/80121
Operation Mode :802.11n20
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.7/68
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
4924.00	Average	34.60	-0.61	33.99	54.00	-20.01
4924.00	Peak	42.81	-0.61	42.20	74.00	-31.80
7386.00	Average	32.79	5.08	37.87	54.00	-16.13
7386.00	Peak	41.14	5.08	46.22	74.00	-27.78

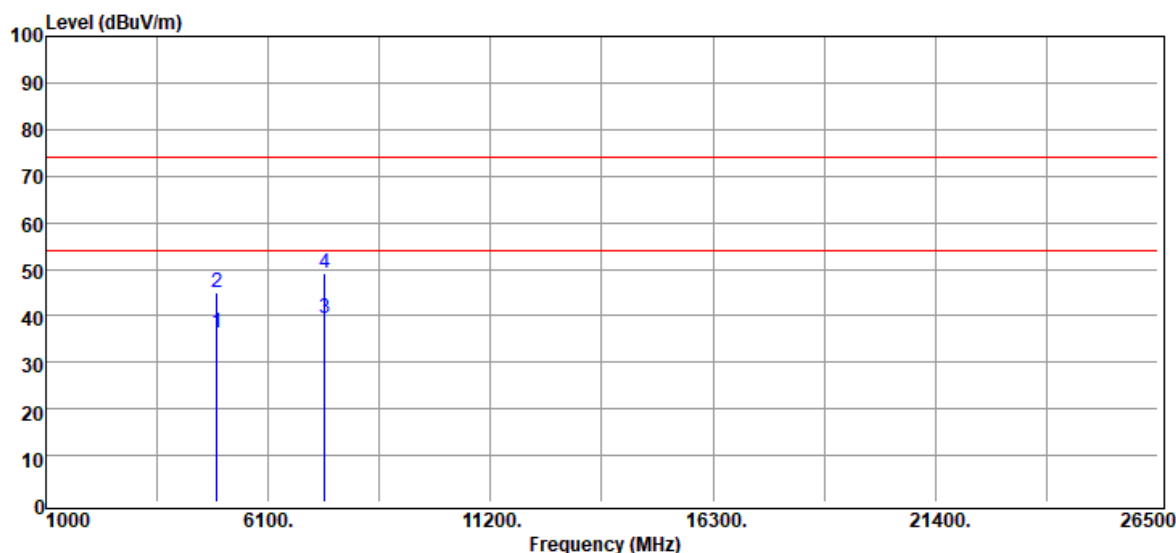
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Operation Mode :802.11n20
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-09-01
Temp./Humi. :24.7/68
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4924.00	Average	36.87	-0.61	36.26	54.00	-17.74
4924.00	Peak	45.58	-0.61	44.97	74.00	-29.03
7386.00	Average	34.34	5.08	39.42	54.00	-14.58
7386.00	Peak	44.18	5.08	49.26	74.00	-24.74

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12 POWER SPECTRAL DENSITY

12.1 Standard Applicable

Per Part 15.247 (e)

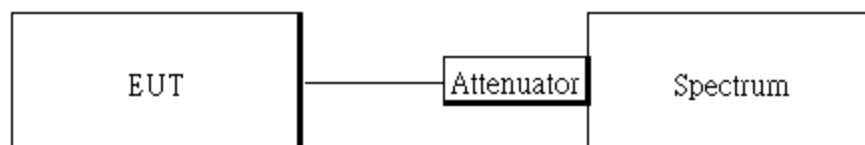
The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

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

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/17/2020	03/16/2021
DC Power Supply	DHA	DPS-3003	9411005787	08/19/2020	08/18/2021
DC Block	PASTERNAK	PE8210	RF256	11/20/2019	11/19/2020
Attenuator	Marvelous	WATT-218FS-10	RF245	11/20/2019	11/19/2020

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. 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.
10. 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.

Note:

For the test of 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.

12.5 As per FCC KDB 662911 D01

As per section F. 2). e). (ii) of FCC KDB 662911 D01

If antenna gains are not equal and each transmit antenna is driven by only one spatial stream, directional gain may be calculated by either of the following formulas.

$$\bullet \quad DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

where

Each antenna is driven by no more than one spatial stream;

NSS = the number of independent spatial streams of data;

NANT = the total number of antennas

$g_{j,k}$ = / 20 10Gk if the kth antenna is being fed by spatial stream j, or zero if it is not;

G_k is the gain in dBi of the kth antenna.

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

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12.6 Power spectral density

POWER DENSITY 802.11b					
Freq. (MHz)	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-5.68	-6.35	-2.99	7.59	PASS
2437	-6.34	-6.55	-3.43	7.59	PASS
2462	-5.85	-4.85	-2.31	7.59	PASS

POWER DENSITY 802.11g					
Freq. (MHz)	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-13.77	-13.83	-10.79	7.59	PASS
2437	-7.91	-8.19	-5.04	7.59	PASS
2462	-14.5	-14.25	-11.36	7.59	PASS

POWER DENSITY 802.11n HT20					
Freq. (MHz)	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-13.69	-13.38	-10.52	7.59	PASS
2437	-8.38	-8.57	-5.46	7.59	PASS
2462	-13.27	-13.15	-10.20	7.59	PASS

*Refer to next page for plots

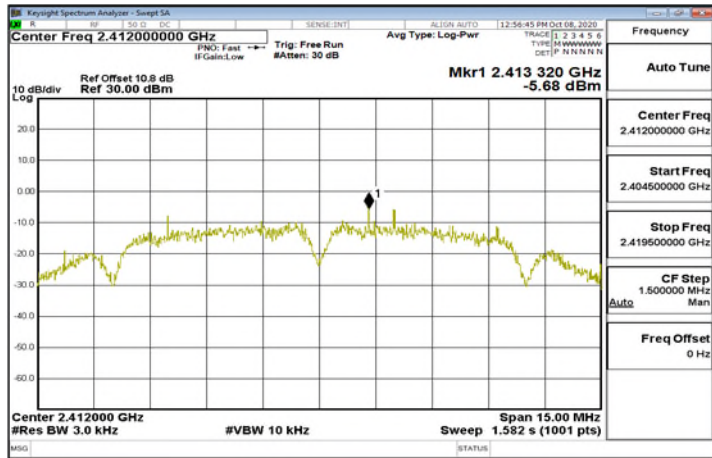
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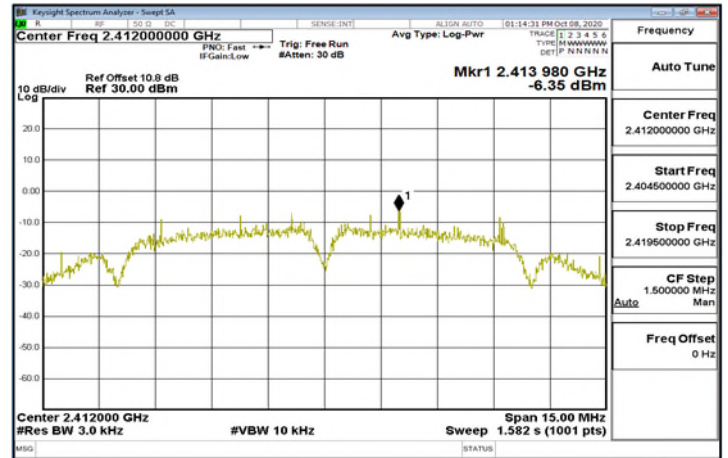
802.11b (CH0)

Power Spectral Density Test Plot-2412MHz

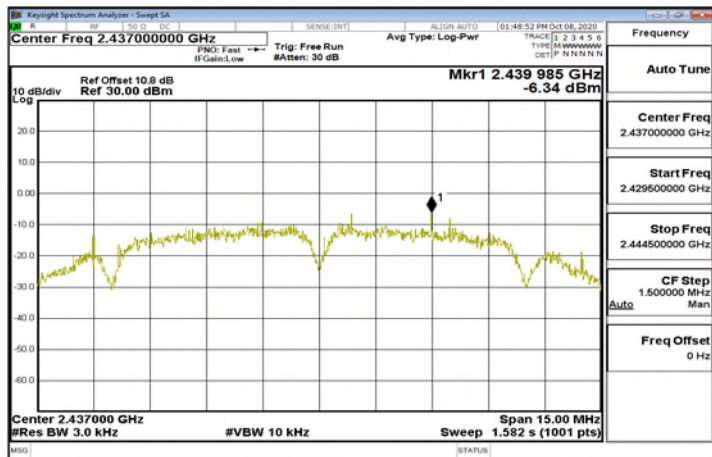


802.11b (CH1)

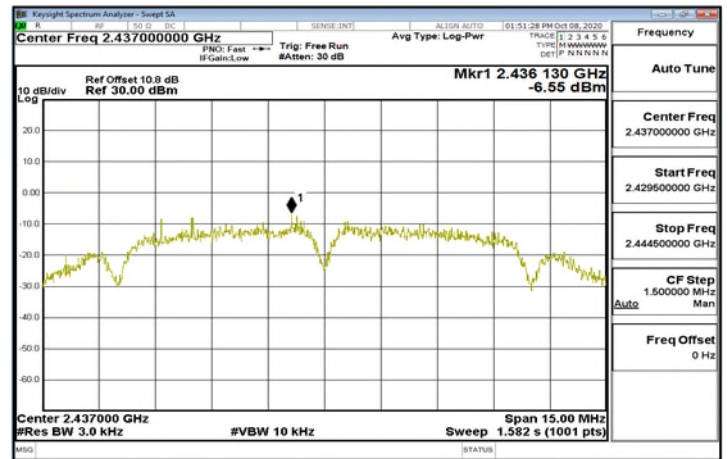
Power Spectral Density Test Plot-2412MHz



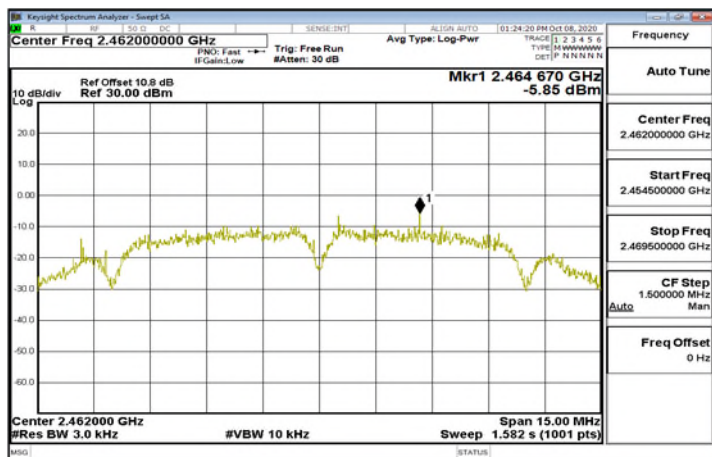
Power Spectral Density Test Plot-2437MHz



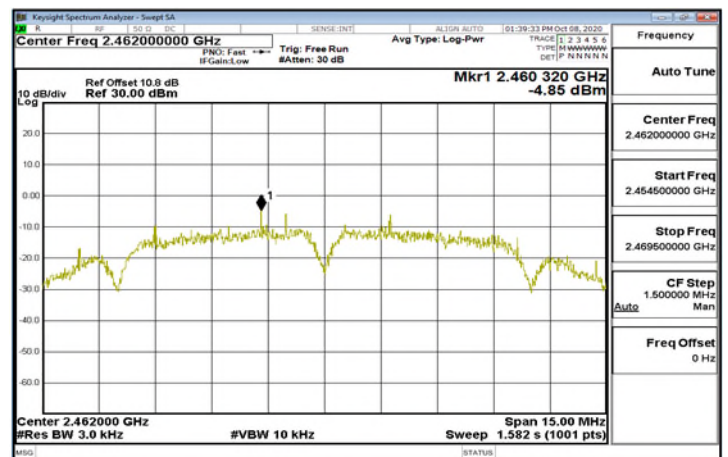
Power Spectral Density Test Plot-2437MHz



Power Spectral Density Test Plot-2462MHz



Power Spectral Density Test Plot-2462MHz

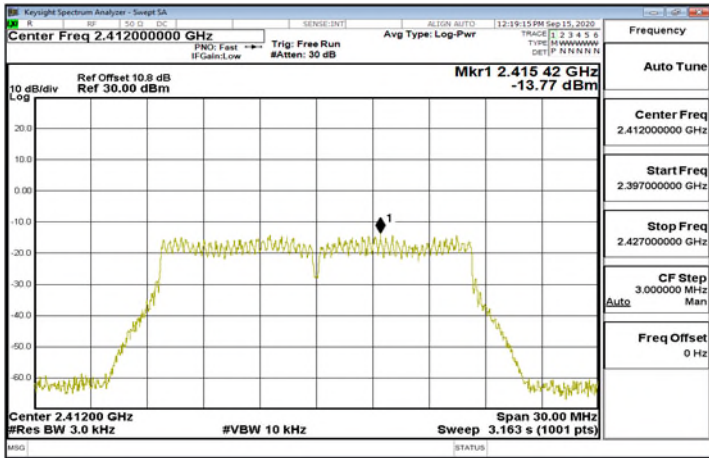


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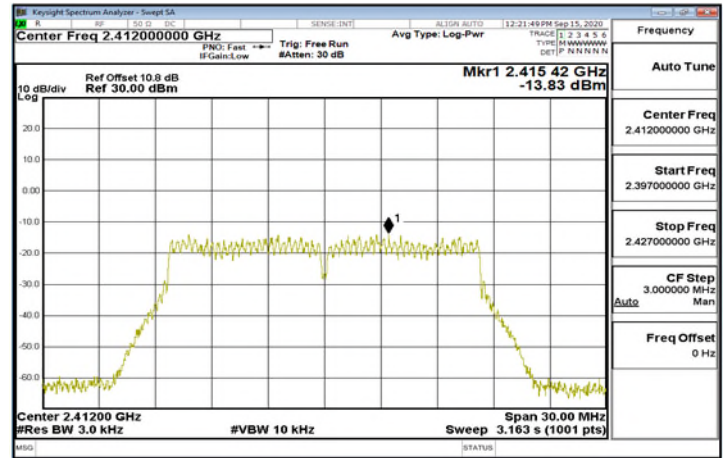
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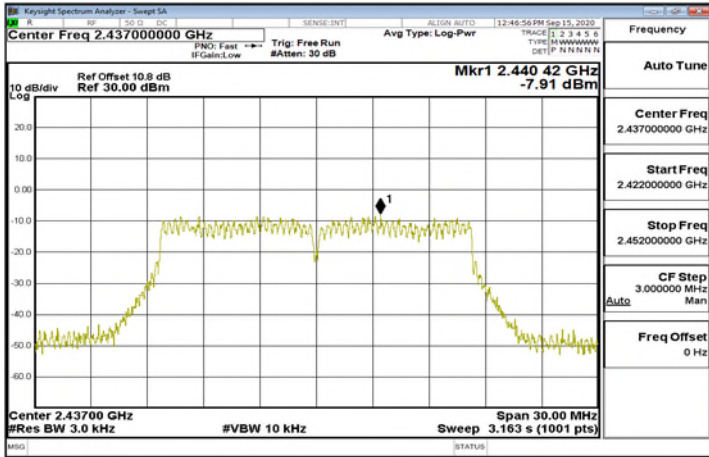
802.11g (CH0) Power Spectral Density Test Plot-2412MHz



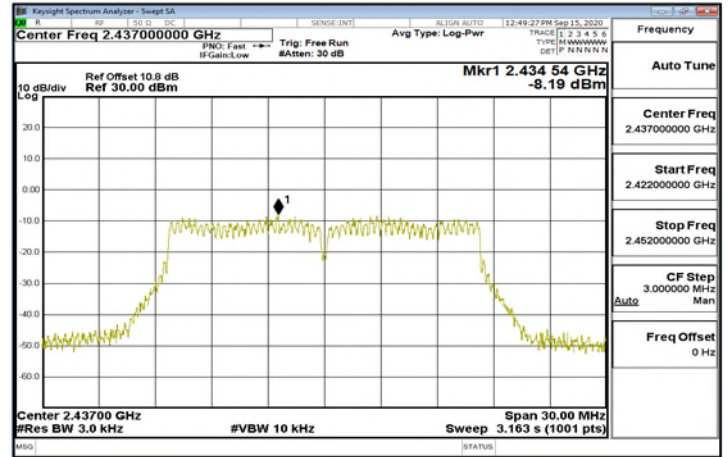
802.11g (CH1) Power Spectral Density Test Plot-2412MHz



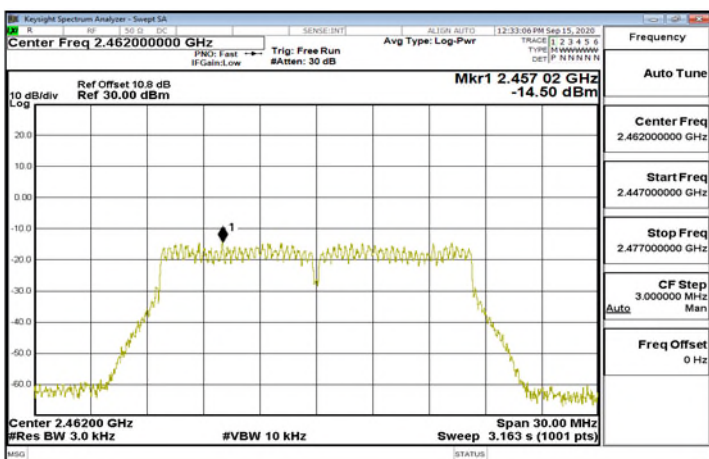
Power Spectral Density Test Plot-2437MHz



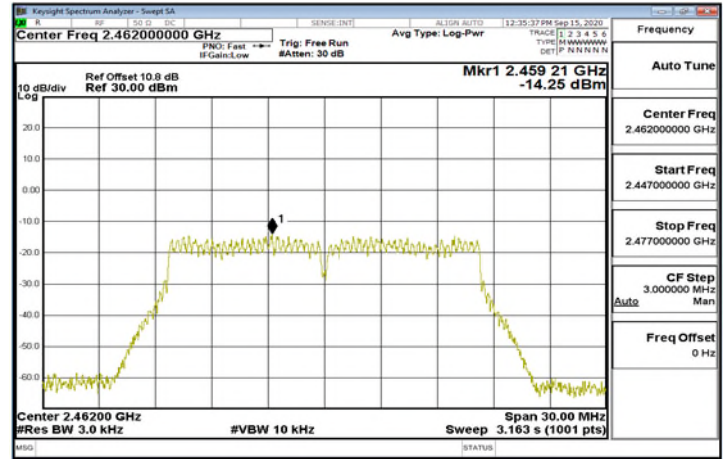
Power Spectral Density Test Plot-2437MHz



Power Spectral Density Test Plot-2462MHz



Power Spectral Density Test Plot-2462MHz

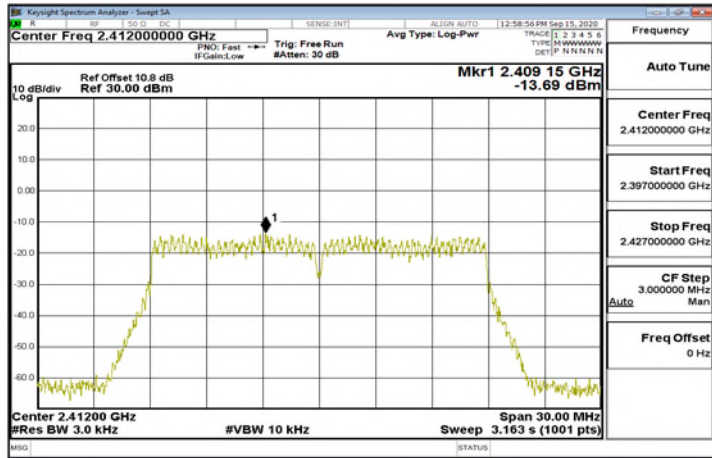


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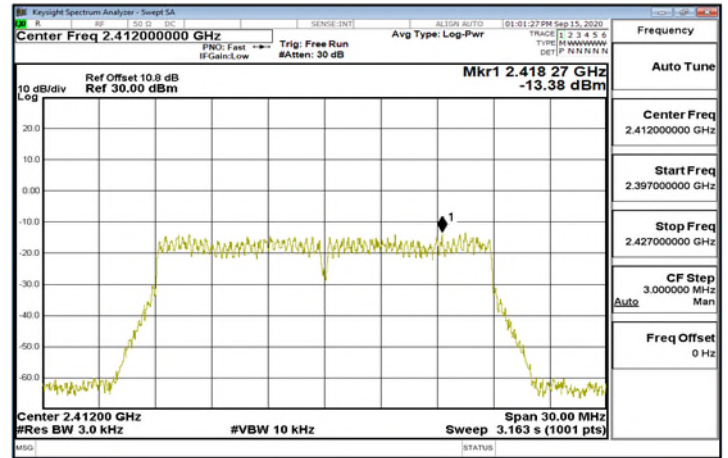
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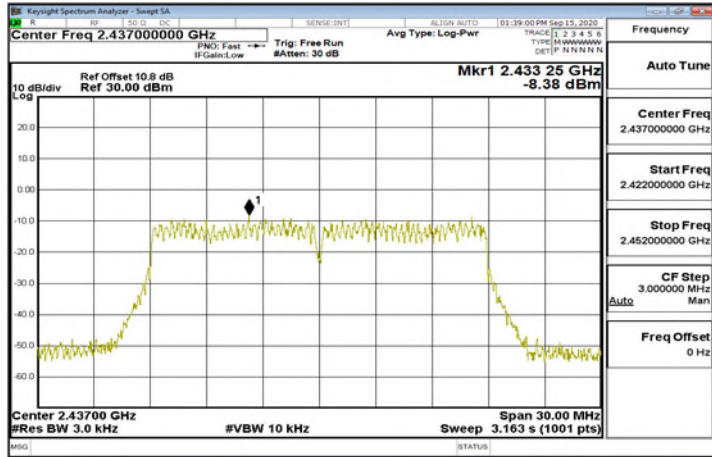
802.11n_HT20 (CH0) Power Spectral Density Test Plot-2412MHz



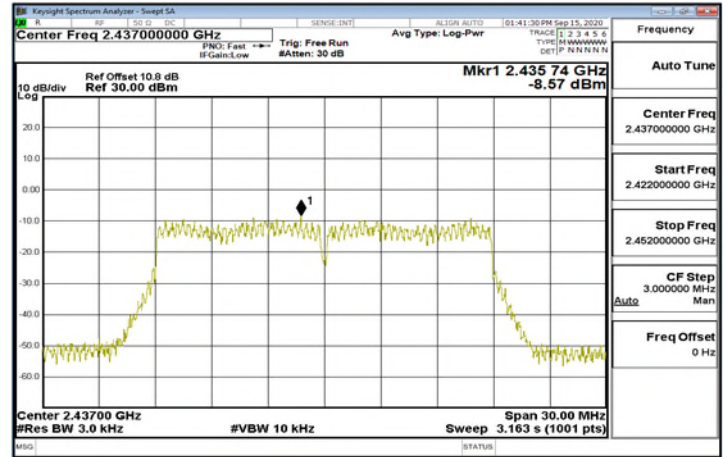
802.11n_HT20 (CH1) Power Spectral Density Test Plot-2412MHz



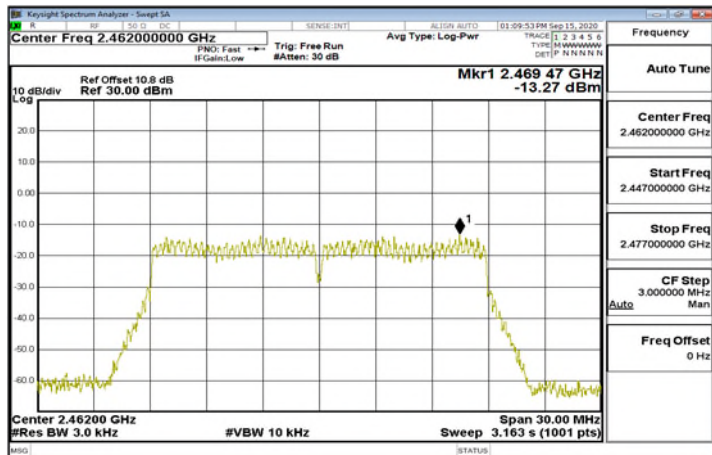
Power Spectral Density Test Plot-2437MHz



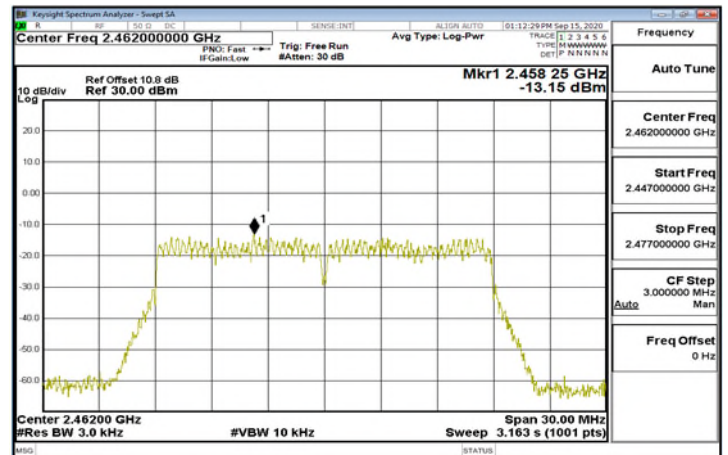
Power Spectral Density Test Plot-2437MHz



Power Spectral Density Test Plot-2462MHz



Power Spectral Density Test Plot-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 with unique RF connector and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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