

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant: Quanta Computer Inc.
No. 188, Wenhua 2nd Road, Guishan District, Taoyuan City
33377, Taiwan

Product Name: Dev Board Mini

Brand Name: Google

Model No.: KA1

Model Difference: N/A

Report Number: E2/2020/50130

FCC ID: HFS-NX2KA1

FCC Rule Part: §15.247, Cat: DTS

Issue Date: Aug. 11, 2020

Date of Test: May 27, 2020 ~ Jun. 30, 2020

Date of EUT Received: May 27, 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: _____

Jim Chang / Manager



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Revision History

Report Number	Revision	Description	Issue Date	Remark
E2/2020/50130	Rev.00	Original.	Aug. 11, 2020	Revised By: Stefanie Yu

Note:

1、Disclaimer

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

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1 GENERAL INFORMATION

1.1 Product description

Product Name:	Dev Board Mini
Brand Name:	Google
Model No.:	KA1
Model Difference:	N/A
Hardware Version:	N/A
Software Version:	N/A
Power Supply:	5Vdc from Host

Wi-Fi 802.11	Frequency Range	Channels	Rated Power (dBm)	Modulation Technology
b	2412-2462	11	18.49	DSSS,
g			22.71	OFDM
n_HT20			21.67	
n_HT40	2422-2452	7	21.63	
Modulation type:	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM			
Transistion 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_HT20MHz: 6.5 – 72.2 Mbps 802.11 n_HT40MHz: 13.5 - 150.0 Mbps			

1.2 Antenna Designation

Antenna Type	Supplier	Antenna Part No.	Freq.	Peak Antenna Gain (dBi)	Worst Antenna Gain
Chip	TDK	N/A	2.4GHz	0.9	-

1.3 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

ANSI C63.10:2013

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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

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 30MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50uH/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 & Conducted (Antenna Port) Emission Configuration

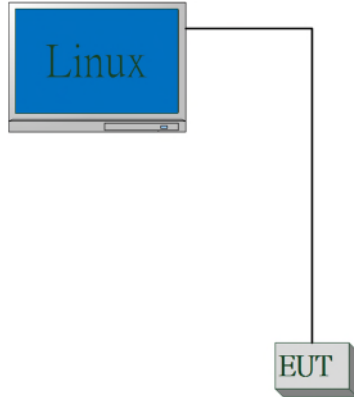


Fig 2-2 Conduction (AC Power Line) Emission

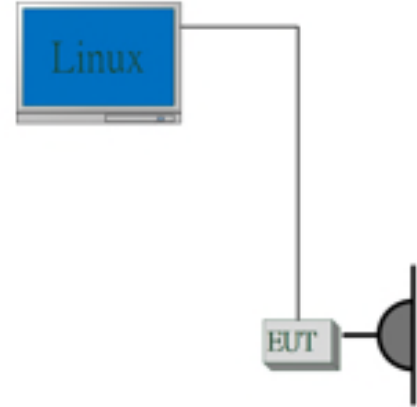


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1	WLAN Test Software	N/A	N/A	N/A	N/A	N/A
2	Notebook	Dell	P66F	28241894594	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	Peak Output Power	Compliant
§15.247(a)(2)	6dB Emission Bandwidth	Compliant
§15.205 §15.209 §15.247(d)	Conducted Band Edge and Spurious Emission	Compliant
§15.205 §15.209 §15.247(d)	Radiated Band Edge and Spurious Emission	Compliant
§15.247(e)	Power Spectral Density	Compliant
§15.203 §15.247(b)	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operated in 2400 ~ 2483.5MHz Band

11 channels are provided for 802.11b/g/n 20M.

7 channels are provided for 802.11n 40M

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

CHANNEL	FREQUENCY (MHz)
3	2422
4	2427
5	2432
6	2437
7	2442
8	2447
9	2452

4.2 The Worst Test Modes and Channel Details

- The EUT has been tested under operating condition.
- aTest program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
- Investigation has been done on all the possible configurations for searching the worst case.
The given UE is pre-scanned among below modes.

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

- 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	Ch0
RADIATED EMISSION TEST (ABOVE 1 GHz)					
802.11b	1 to 11	1, 6, 11	DSSS	1	Ch0
802.11g	1 to 11	1, 6, 11	OFDM	6	Ch0
802.11n 20M	1 to 11	1, 6, 11	OFDM	MCS 0	SISO
802.11n 40M	3 to 9	3, 6, 9	OFDM	MCS 0	SISO

Note:

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

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, 6, 11	DSSS	1	Ch0
802.11g	1 to 11	1, 6, 11	OFDM	6	Ch0
802.11n 20M	1 to 11	1, 6, 11	OFDM	MCS 0	SISO
802.11n 40M	3 to 9	3, 6, 9	OFDM	MCS 0	SISO

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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(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

6.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
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
Notebook	Lenovo	T470	P0001293	N/A	N/A
Cable	I Max	USB-C1200	USB to Type-c	N/A	N/A

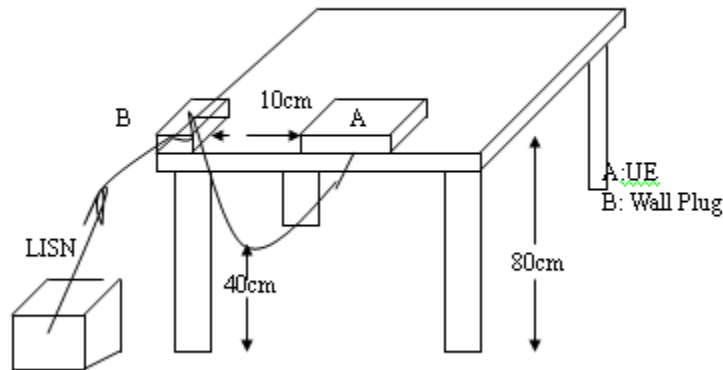
6.3 EUT Setup

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 :E2/2020/50130

Test Date :2020-06-19

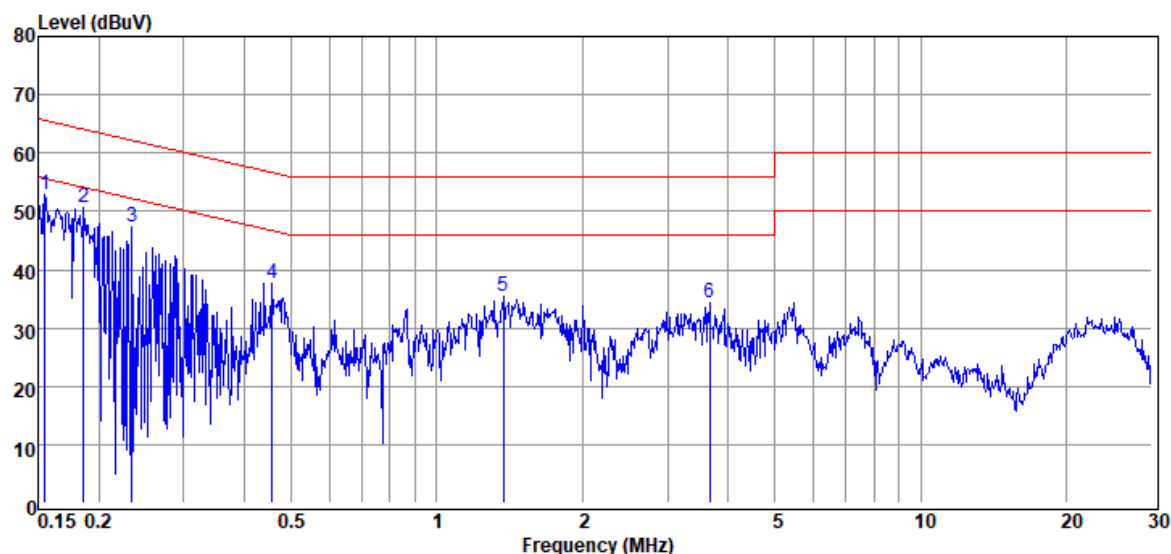
Test Mode :WLAN 2.4G

Temp./Humi. :25.2/59

Power :120V/60Hz

Engineer :Kailin

Probe :L1



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
Mode		Reading Level		FS		
MHz	PK/QP/AV	dBμV	dB	dBμV	dBμV	dB
0.15	Peak	42.62	10.22	52.84	65.74	-12.90
0.19	Peak	40.46	10.22	50.68	64.20	-13.52
0.23	Peak	37.24	10.22	47.46	62.30	-14.84
0.46	Peak	27.44	10.22	37.66	56.76	-19.10
1.37	Peak	25.12	10.44	35.56	56.00	-20.44
3.66	Peak	23.91	10.48	34.39	56.00	-21.61

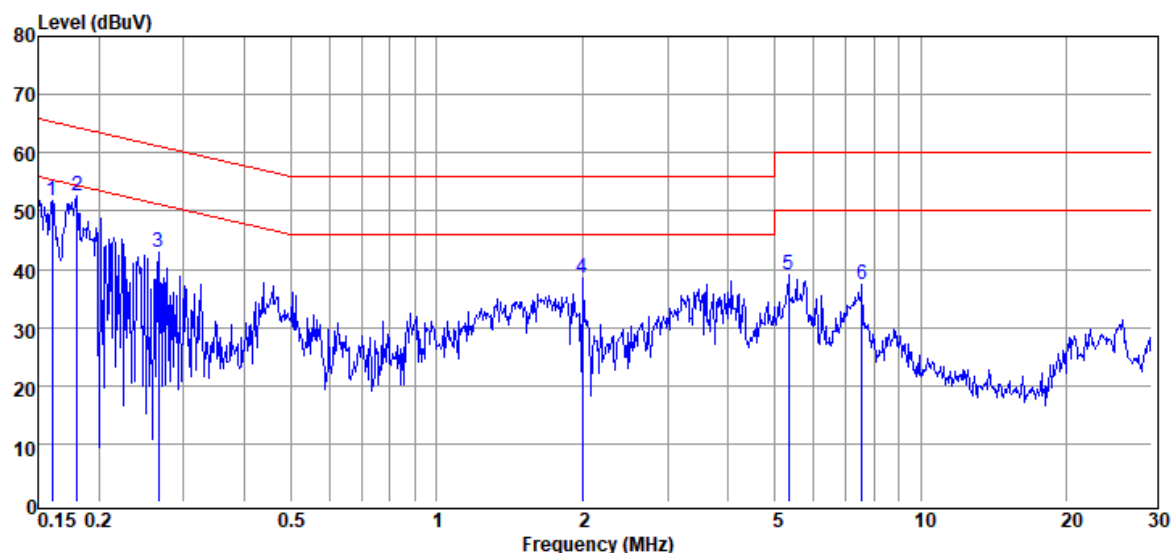
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Report Number :E2/2020/50130
Test Mode :WLAN 2.4G
Power :120V/60Hz
Probe :N

Test Date :2020-06-19
Temp./Humi. :25.2/59
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS		
MHz	PK/QP/AV	dBμV	dB	dBμV	dBμV	dB
0.16	Peak	41.50	10.21	51.71	65.43	-13.72
0.18	Peak	42.32	10.21	52.53	64.46	-11.93
0.27	Peak	32.75	10.21	42.96	61.25	-18.29
2.00	Peak	27.91	10.45	38.36	56.00	-17.64
5.33	Peak	28.43	10.54	38.97	60.00	-21.03
7.57	Peak	26.79	10.63	37.42	60.00	-22.58

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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	98.91	0.05	0.12	0.01
802.11g	93.36	0.30	0.72	1.00
802.11n_20	92.92	0.32	0.77	1.00
802.11n_40	86.86	0.61	1.54	2.00

$$b = 98.91\%, g = 93.36\%, n_{ht_20} = 92.92\%, n_{ht_40} = 86.86\%$$

$$\text{Duty Cycle Factor: } 10 * \log(1/0.9891) = 0.05$$

$$\text{Duty Cycle Factor: } 10 * \log(1/0.9336) = 0.3$$

$$\text{Duty Cycle Factor: } 10 * \log(1/0.9292) = 0.32$$

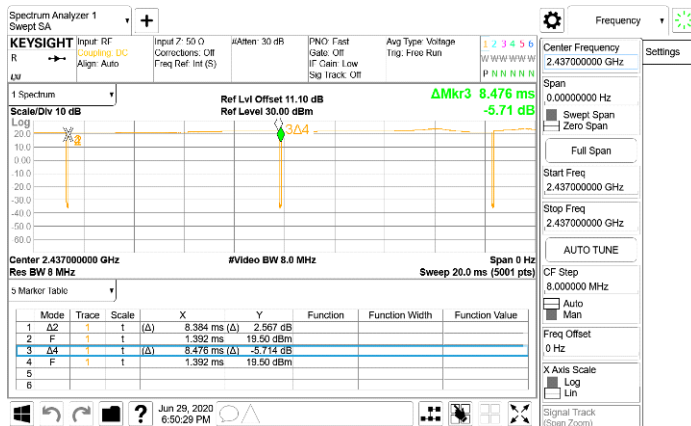
$$\text{Duty Cycle Factor: } 10 * \log(1/0.8686) = 0.61$$

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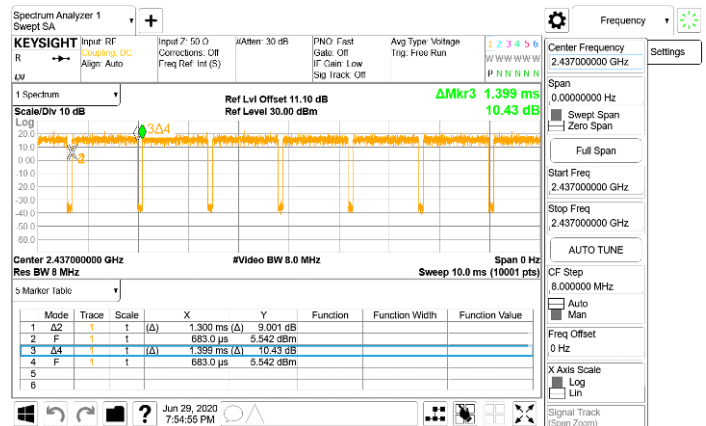
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7.3 Duty Cycle test plots

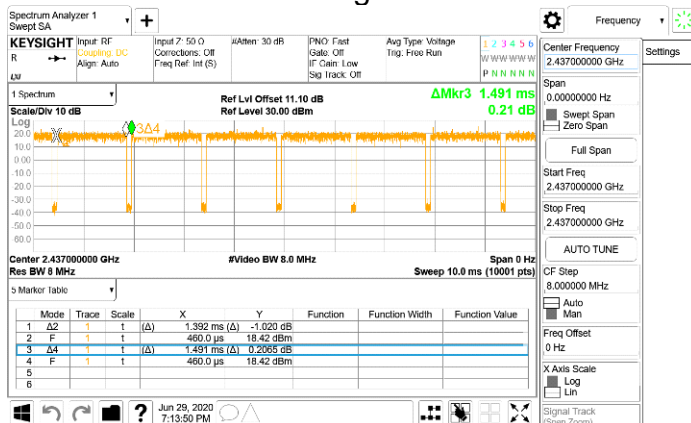
802.11 b mode



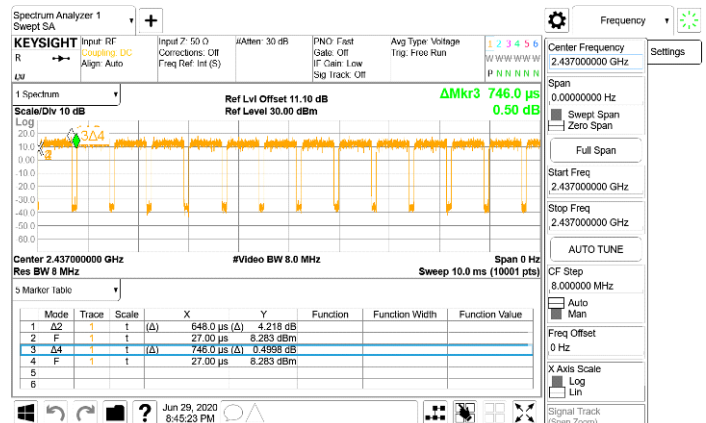
802.11 n HT20 mode



802.11 g mode



802.11 n HT40 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.

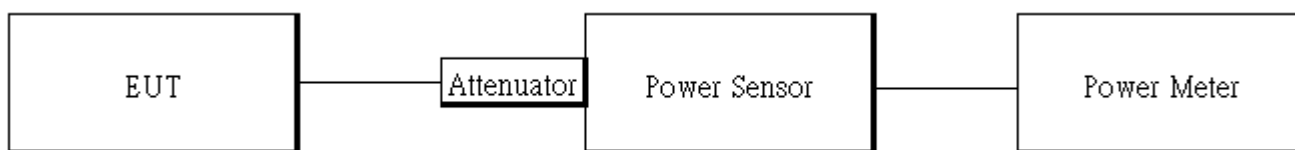
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

8.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1326001	08/05/2019	08/04/2020
Power Sensor	Anritsu	MA2411B	1315048	08/05/2019	08/04/2020
Power Sensor	Anritsu	MA2411B	1315049	08/05/2019	08/04/2020
Attenuator	Marvelous	MVE2213-10	RF80	11/20/2019	11/19/2020

8.3 Test Set-up

Power Meter:



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8.4 Measurement Procedure

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

Power Meter:

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

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

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

8.5 Measurement Result

802.11b Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	18.46	30.00	PASS
6	2437	1	18.49	30.00	PASS
11	2462	1	18.42	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	16.87	30.00	PASS
6	2437	1	16.90	30.00	PASS
11	2462	1	17.03	30.00	PASS

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802.11g Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	22.67	30.00	PASS
6	2437	6	22.64	30.00	PASS
11	2462	6	22.71	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	15.08	30.00	PASS
6	2437	6	15.12	30.00	PASS
11	2462	6	14.89	30.00	PASS

802.11n_HT20M Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	21.58	30.00	PASS
6	2437	MCS0	21.67	30.00	PASS
11	2462	MCS0	21.62	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	11.95	30.00	PASS
6	2437	MCS0	12.30	30.00	PASS
11	2462	MCS0	11.89	30.00	PASS

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802.11n_HT40M Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
3	2422	MCS0	21.59	30.00	PASS
6	2437	MCS0	21.63	30.00	PASS
9	2452	MCS0	21.55	30.00	PASS
802.11n_HT40M Ch0					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
3	2422	MCS0	12.55	30.00	PASS
6	2437	MCS0	12.58	30.00	PASS
9	2452	MCS0	12.61	30.00	PASS

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

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9 6DB BANDWIDTH MEASUREMENT

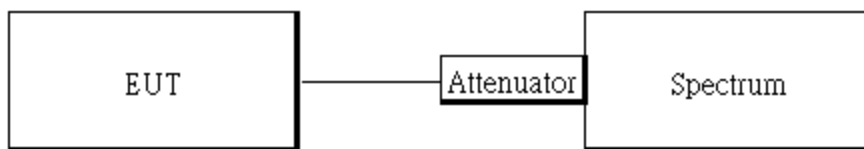
9.1 Standard Applicable

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

9.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010B	MY59070196	03/22/2019	03/21/2021
DC Block	PASTERNAK	PE8210	RF256	11/20/2019	11/19/2020
Attenuator	Marvelous	MVE2213-10	RF80	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. For 6dB Bandwidth:
Set the spectrum analyzer as RBW = 100 kHz, VBW = 3*RBW, Span = large enough to capture all products of the modulation process, Detector=peak, Sweep=auto.
5. Mark the peak frequency and -6dB (upper and lower) frequency.
6. Repeat above procedures until all frequency of interest measured was complete.

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9.5 6dB Bandwidth

802.11b Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	8108.00	> 500	PASS
2437	9108.00	> 500	PASS
2462	9105.00	> 500	PASS

802.11g Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	15150.00	> 500	PASS
2437	15140.00	> 500	PASS
2462	15150.00	> 500	PASS

802.11_n_HT20 Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	15150.00	> 500	PASS
2437	15150.00	> 500	PASS
2462	15140.00	> 500	PASS

802.11_n_HT40 Ch0

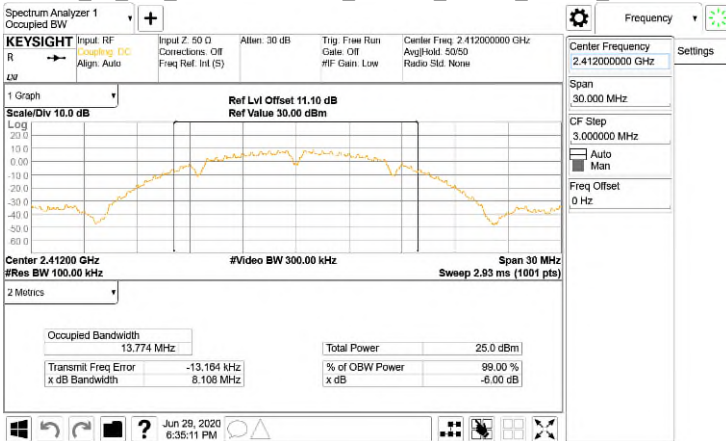
Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2422	35170.00	> 500	PASS
2437	35170.00	> 500	PASS
2452	35170.00	> 500	PASS

*Refer to next page for plots

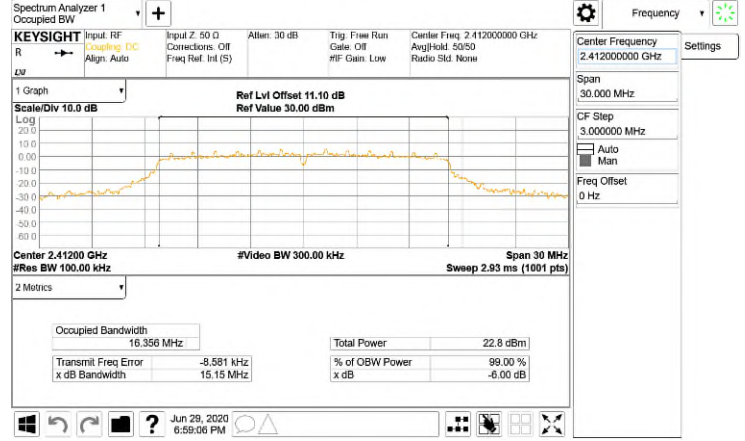
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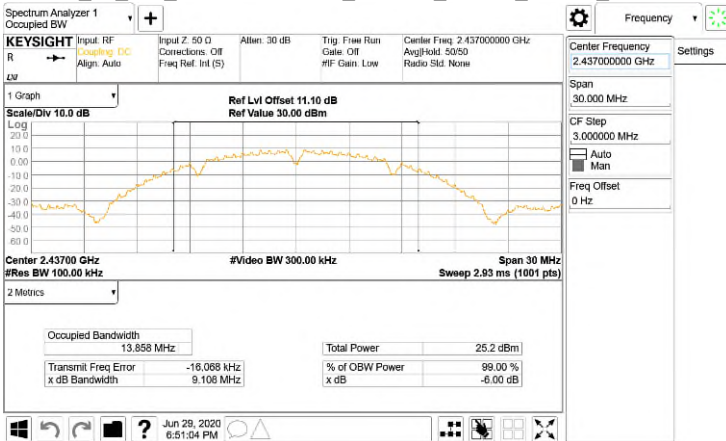
FCC_15_247_WLAN\OBW 6dB_802.11b_20MHz_Chain0_2412MHz



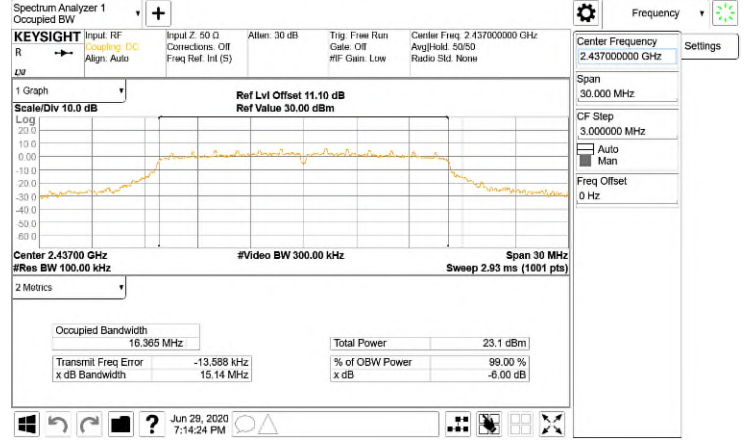
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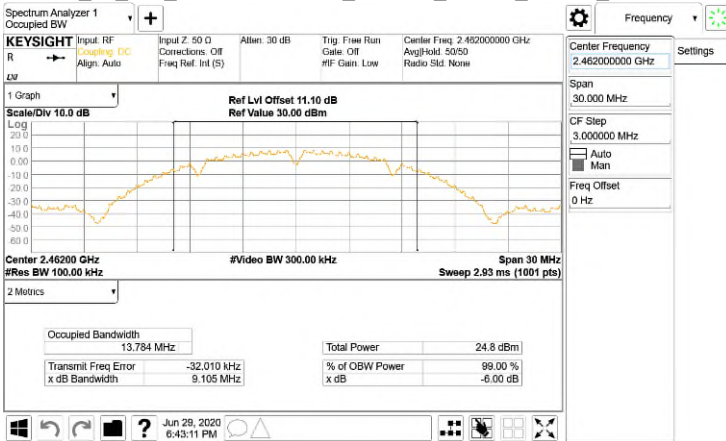
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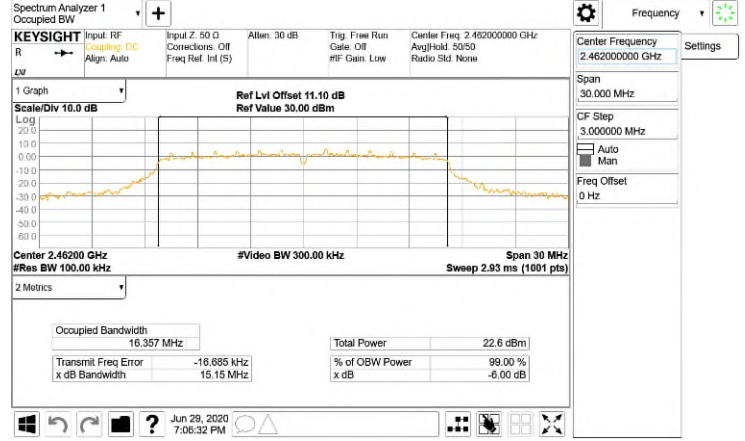
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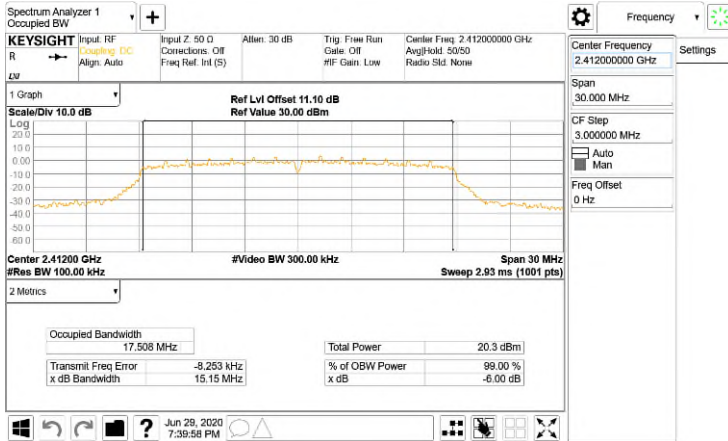


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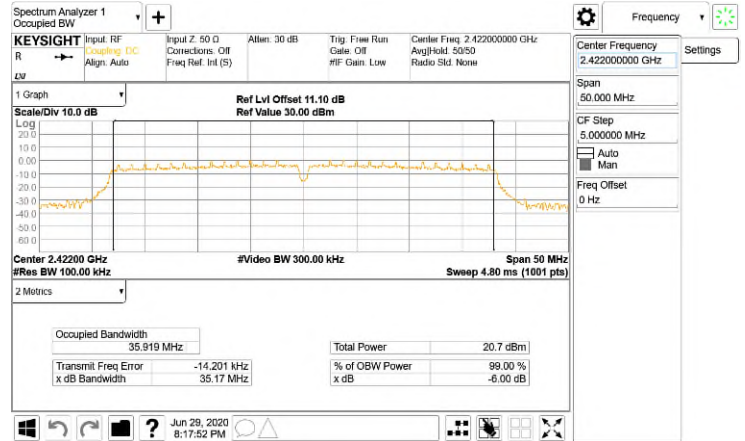
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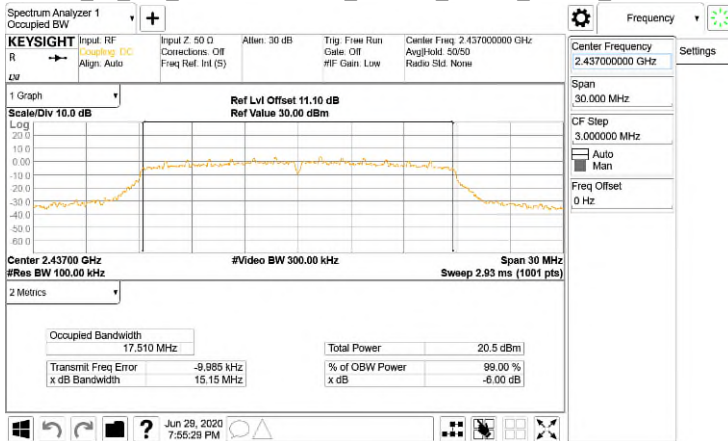
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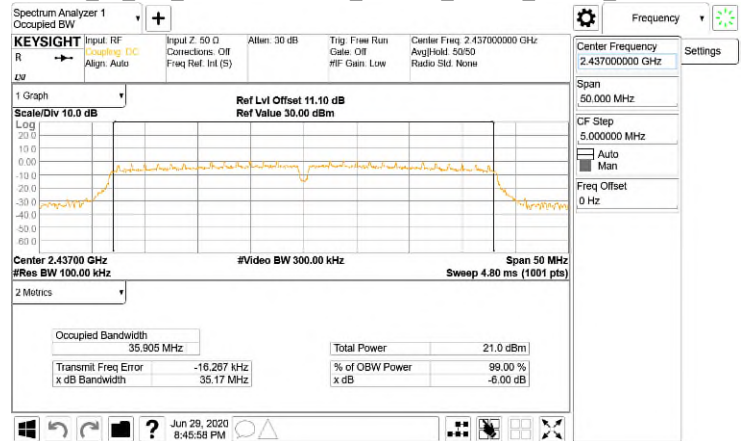
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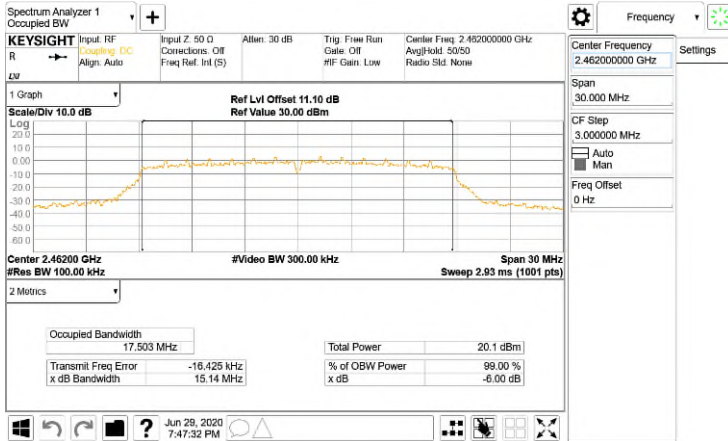
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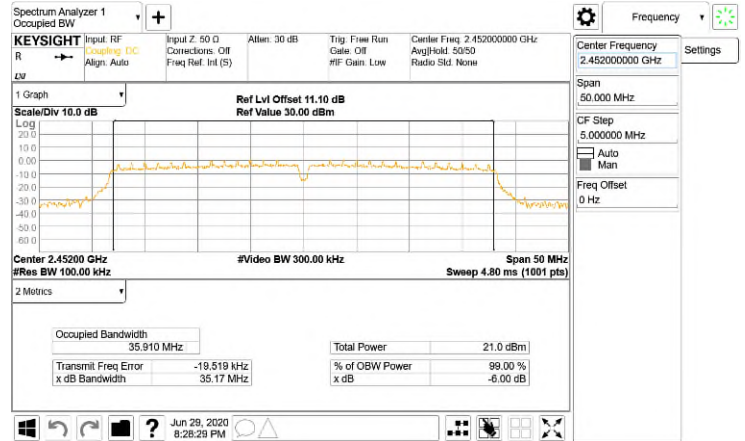
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FCC_15_247_WLAN\OBW 6dB_802.11n_20MHz_Chain0_2462MHz



FCC_15_247_WLAN\OBW 6dB_802.11n_40MHz_Chain0_2452MHz



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10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

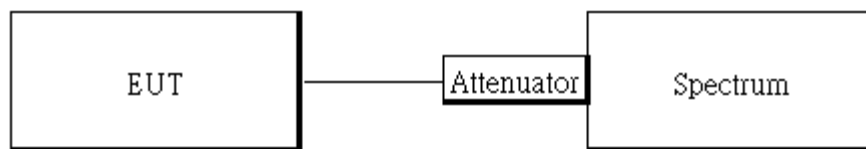
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

10.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010B	MY59070196	03/22/2019	03/21/2021
DC Block	PASTERNAK	PE8210	RF256	11/20/2019	11/19/2020
Attenuator	Marvelous	MVE2213-10	RF80	11/20/2019	11/19/2020

10.3 Test SET-UP



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.

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Conducted Band Edge:

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

Conducted Spurious Emission:

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

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	8.47	-11.53	2412	5.95	-14.05
2437	8.73	-11.27	2437	6.23	-13.77
2462	8.31	-11.69	2462	5.65	-14.35

Reference Level of Limit 802.11n20 mode			Reference Level of Limit 802.11n40 MODE		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)	Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	3.42	-16.58	2422	0.11	-19.89
2437	3.70	-16.30	2437	0.49	-19.51
2462	3.23	-16.77	2452	0.4	-19.60

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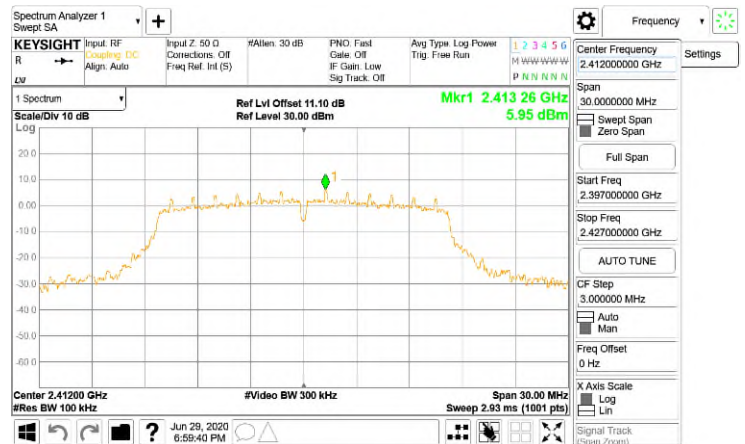
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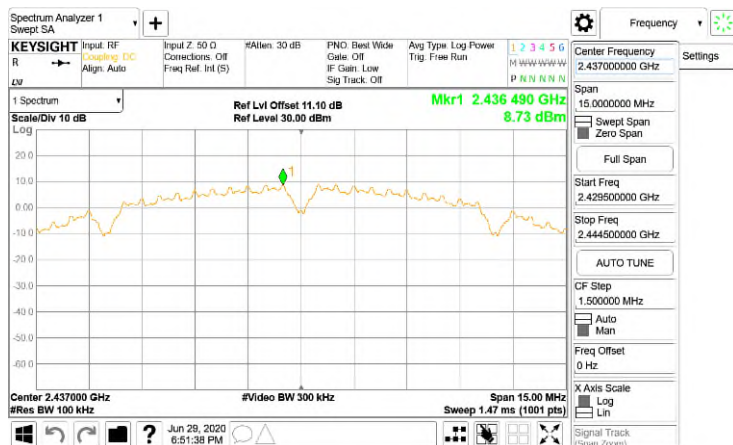
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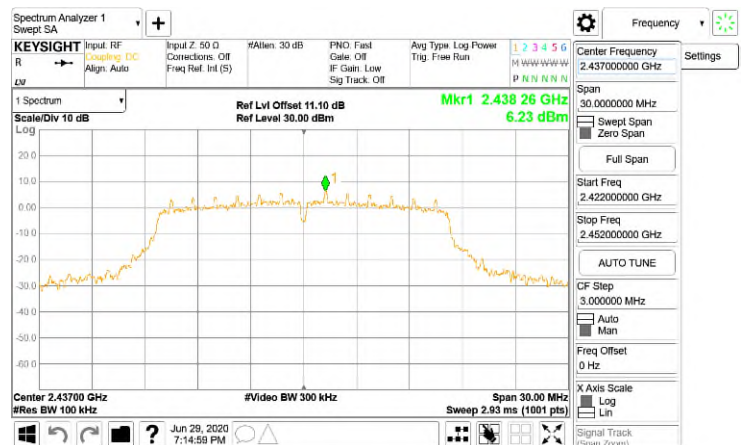
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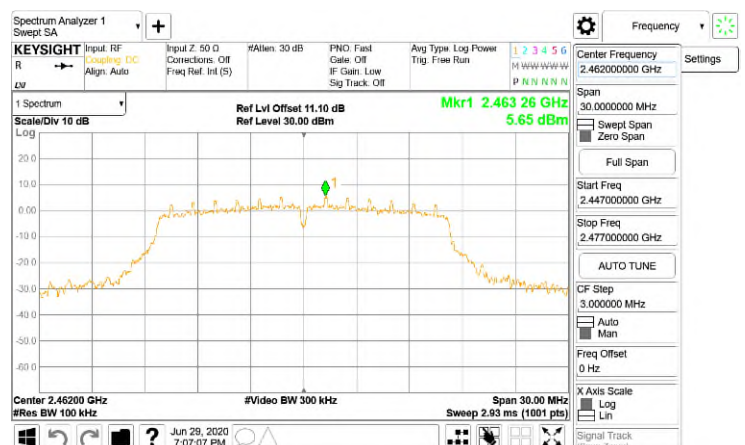
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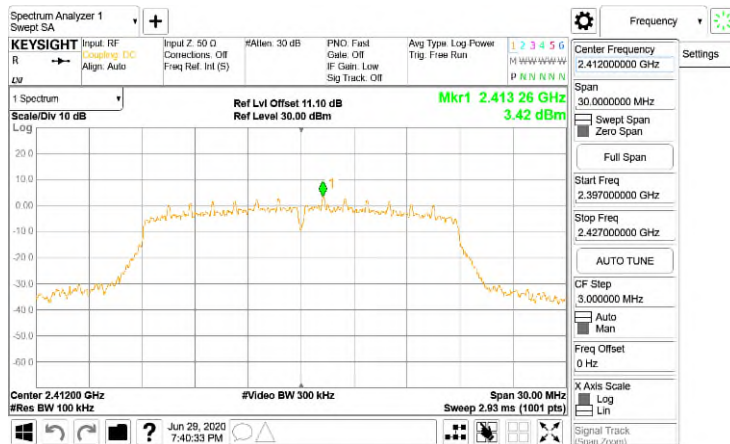


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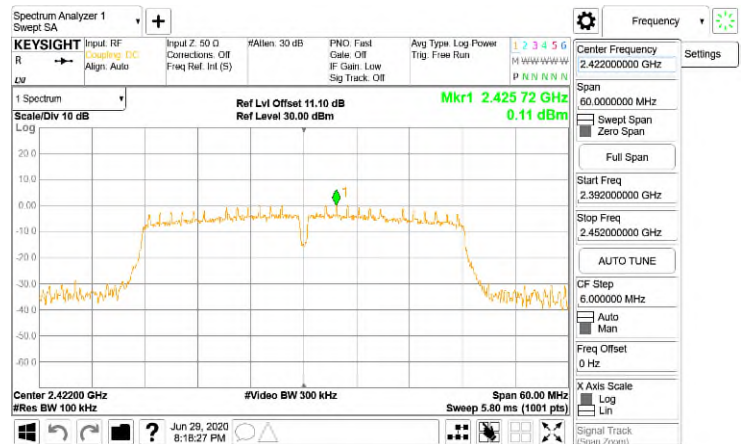
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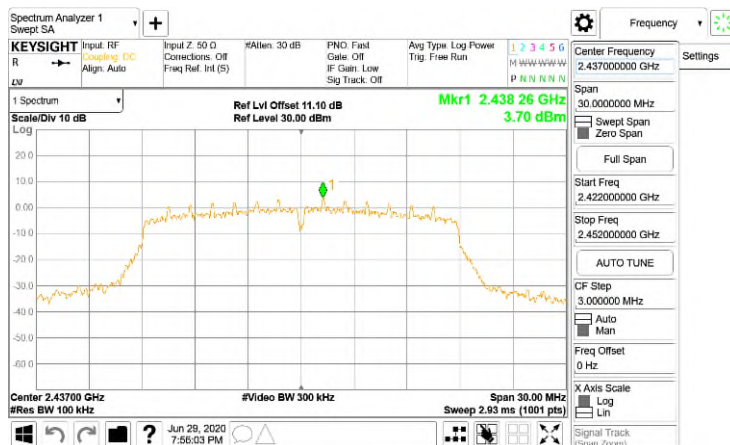
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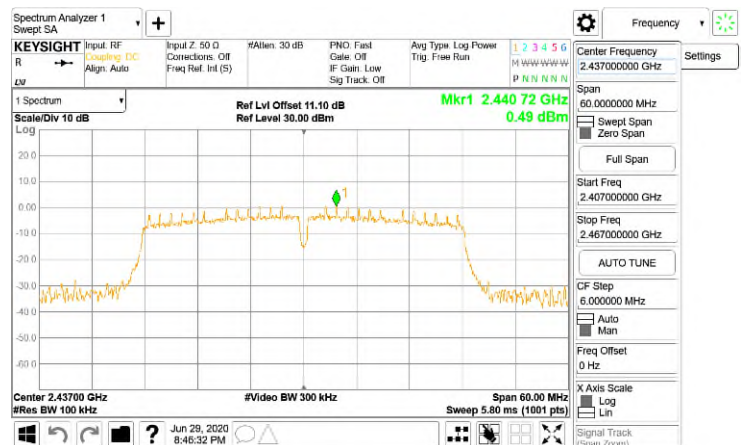
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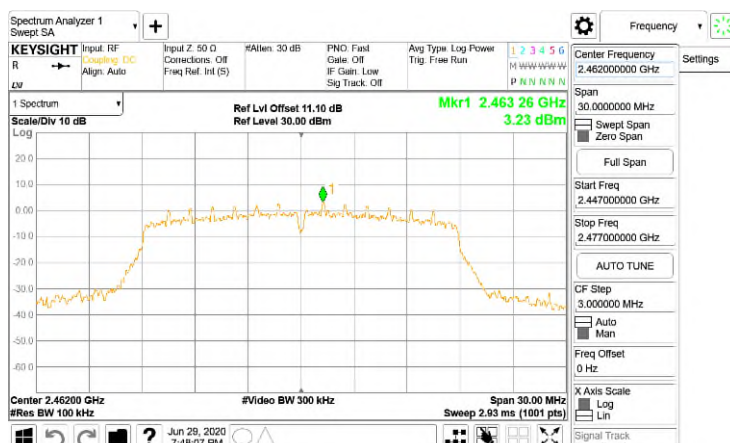
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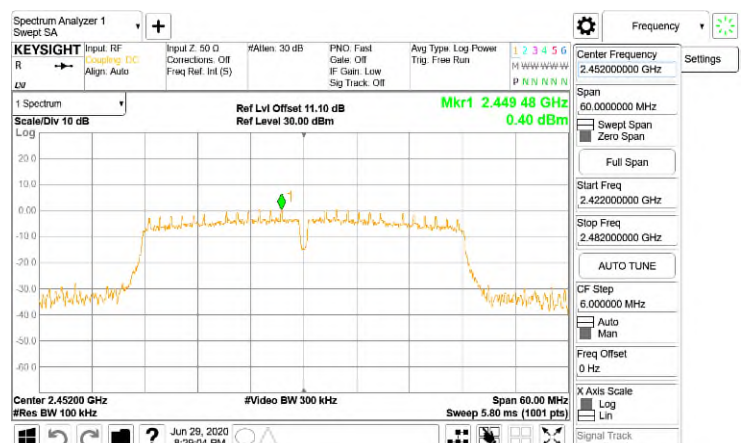
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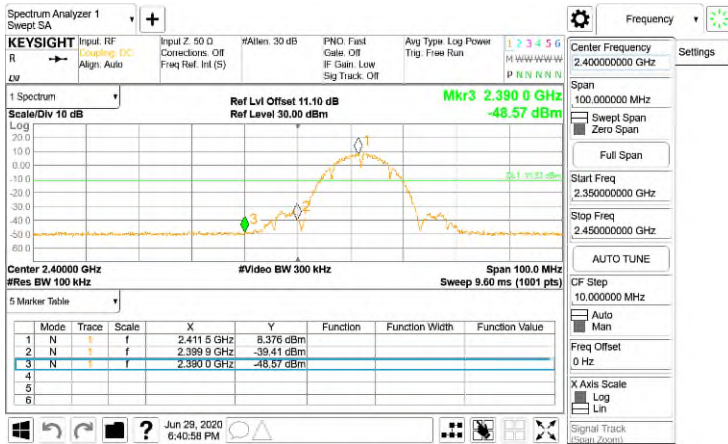


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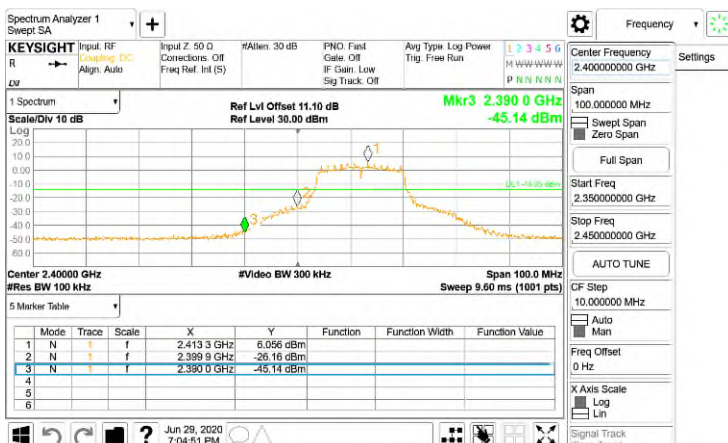
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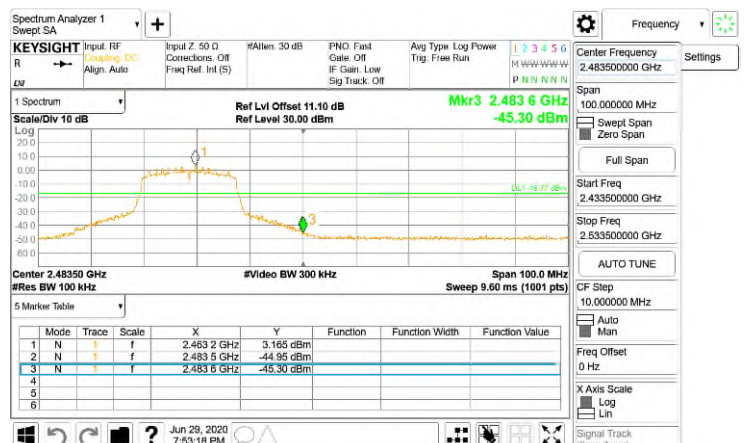
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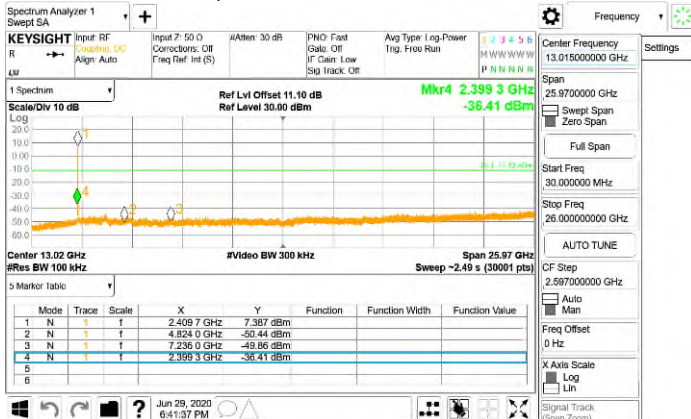


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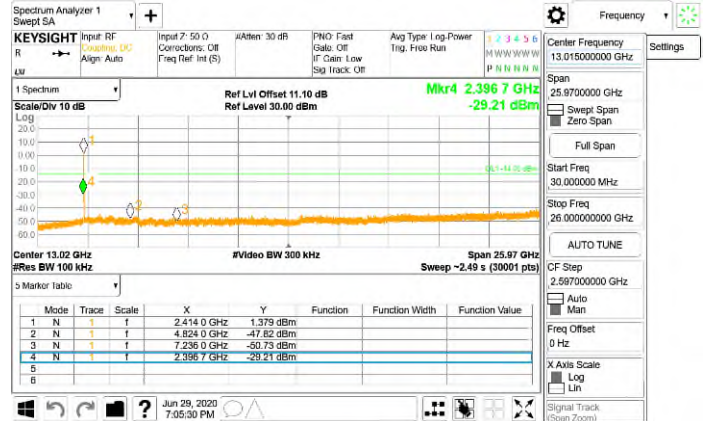
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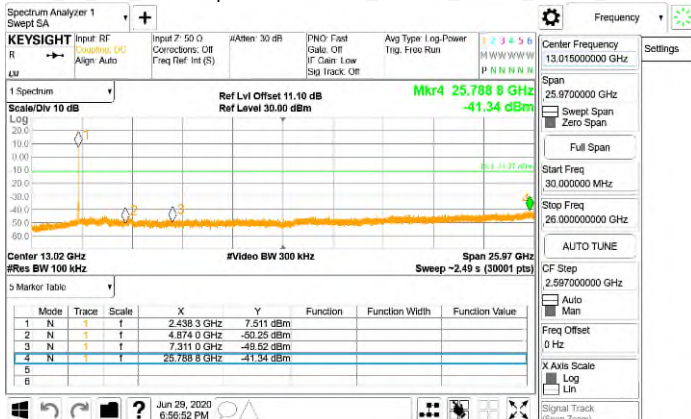
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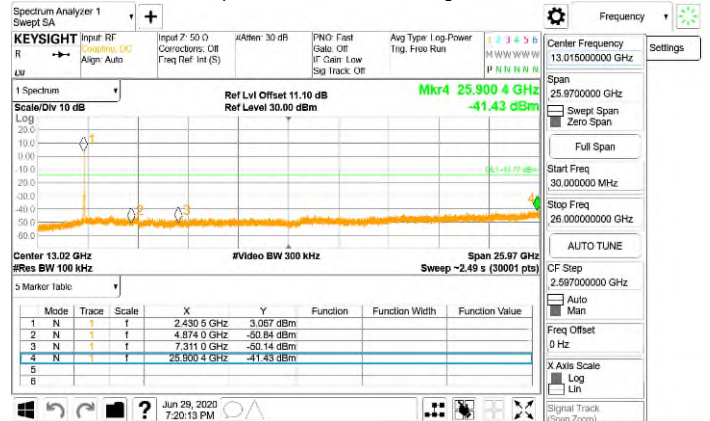
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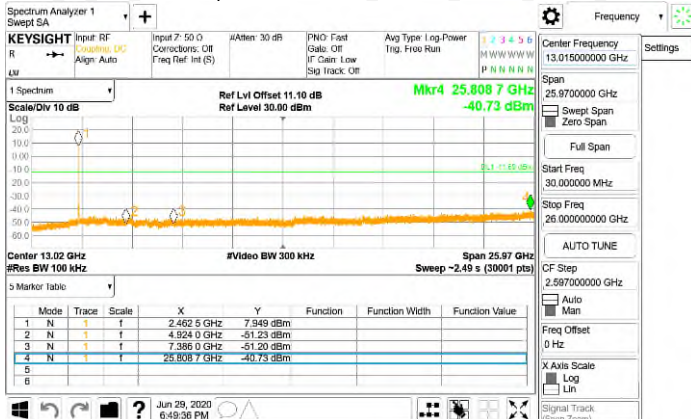
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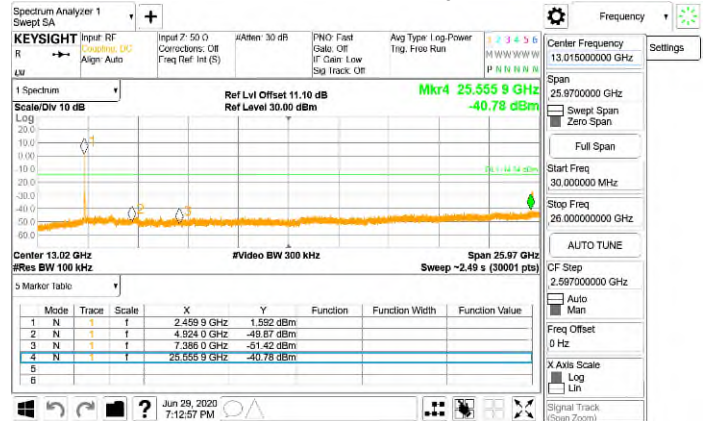
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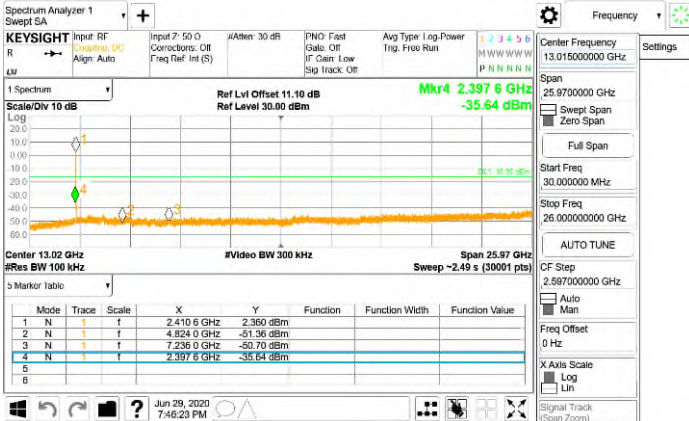


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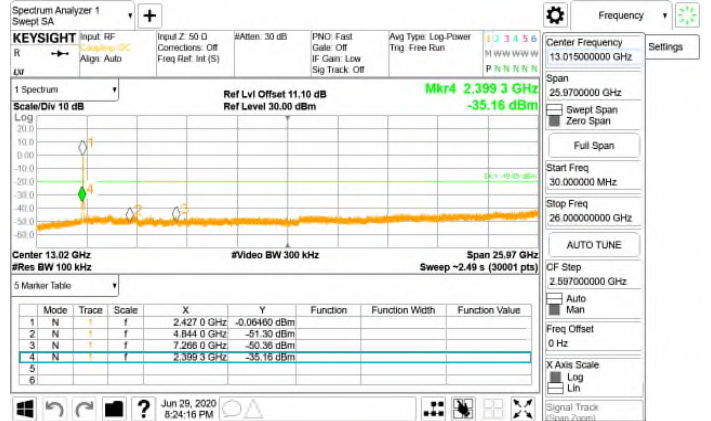
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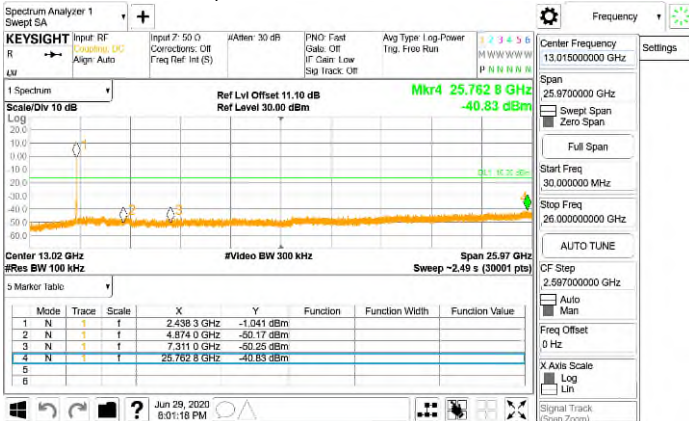
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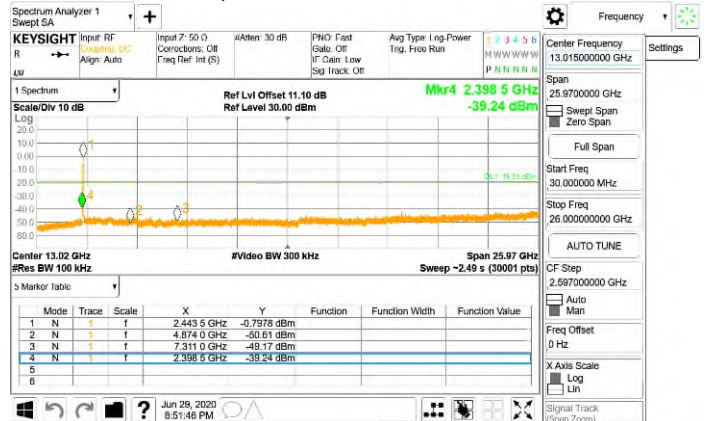
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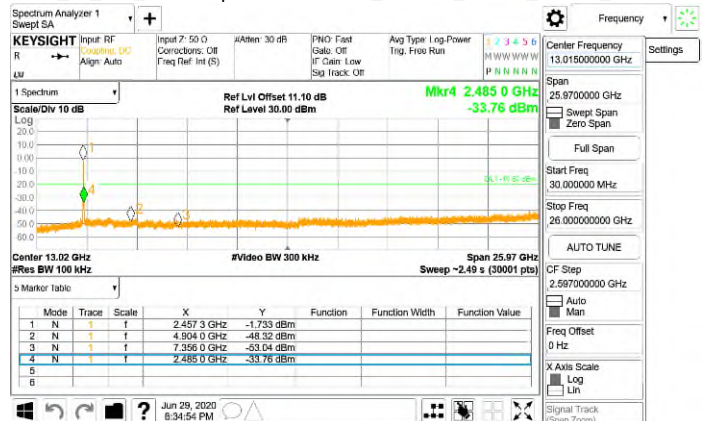
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FCC_15_247_WLAN\Spurious Emission_802.11n_20MHz_Chain0_2462MHz



FCC_15_247_WLAN\Spurious Emission_802.11n_40MHz_Chain0_2452MHz



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11 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

11.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 limit as below.

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

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

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (μV/m)

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11.2 Measurement Equipment Used:

966 Chamber					
EQUIPMENT TYPE	MFR	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	1187	01/10/2020	01/09/2021
Loop Antenna	ETS.LINDGREN	6502	143303	04/28/2020	04/27/2021
3m Site NSA	SGS	966 chamber D	N/A	07/12/2019	07/11/2020
Spectrum Analyzer	KEYSIGHT	N9010A	MY51440113	07/15/2019	07/14/2020
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

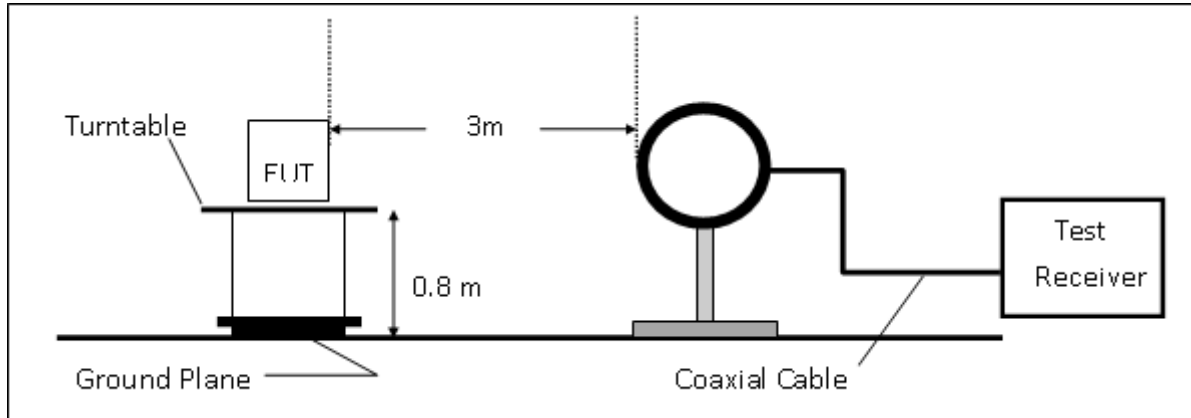
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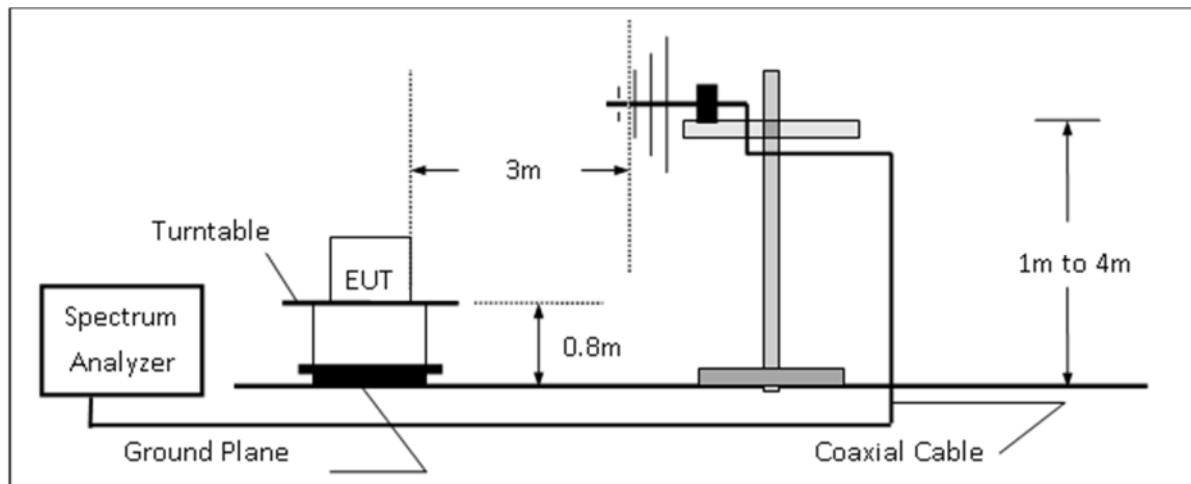
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11.3 Test SET-UP

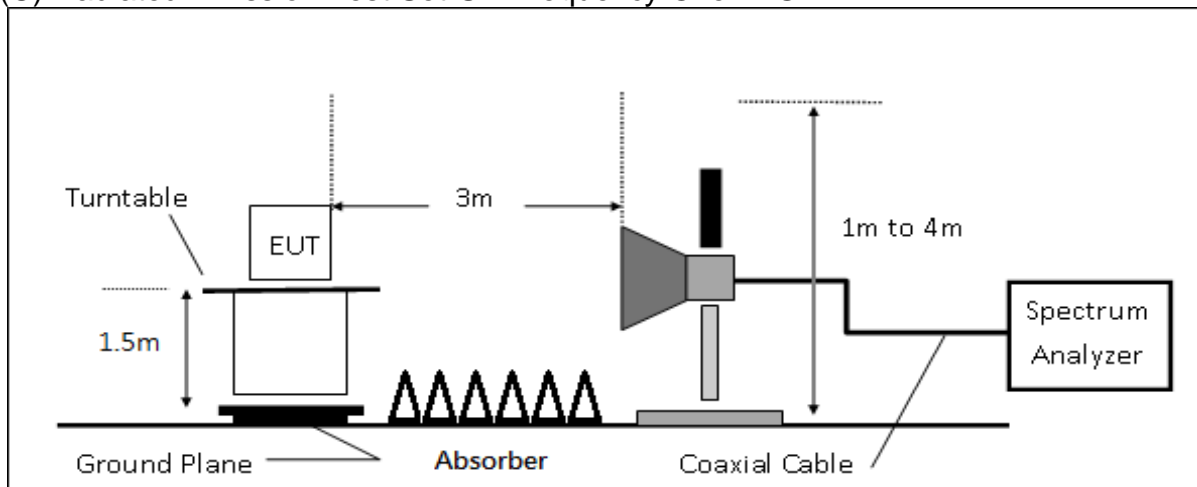
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(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 $20 \cdot \log(uV/m)$

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

Factor(dB) = Antenna Factor(dBuV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

11.6 Test Results of Radiated Spurious Emissions form 9 kHz to 30 MHz

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

11.7 Measurement Result

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

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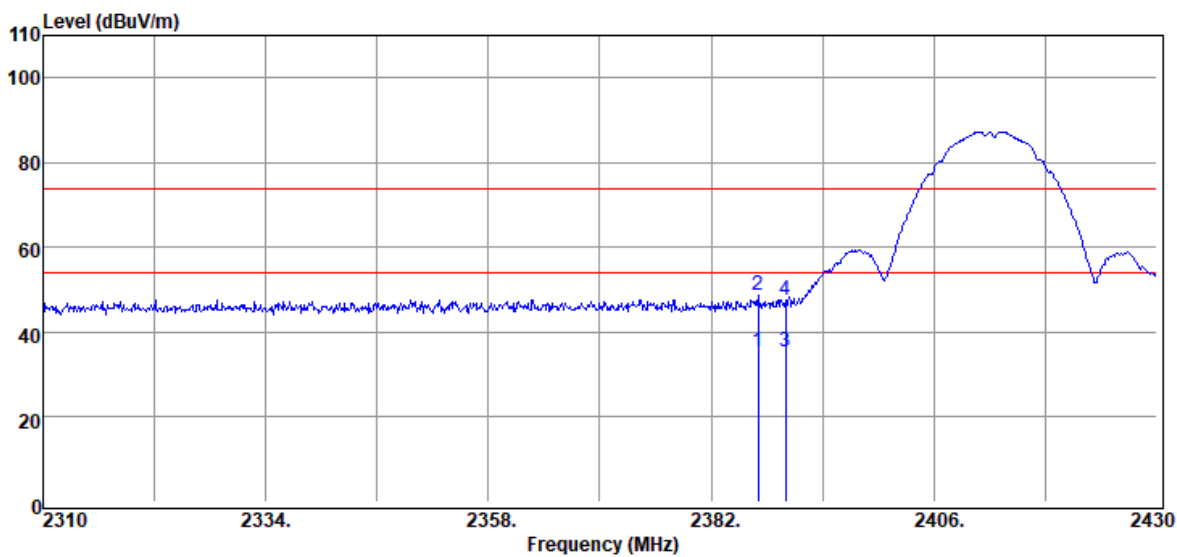
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11.7.1 Radiated Band Edge Measurement Result

Report Number :E2/2020/50130
Operation Mode :802.11b
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/63
Antenna Pol. :VERTICAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBuV	dB	dBuV/m	dBuV/m	dB
2387.04	Average	40.83	-5.52	35.31	54.00	-18.69
2387.04	Peak	54.23	-5.52	48.71	74.00	-25.29
2390.00	Average	41.06	-5.52	35.54	54.00	-18.46
2390.00	Peak	52.98	-5.52	47.46	74.00	-26.54

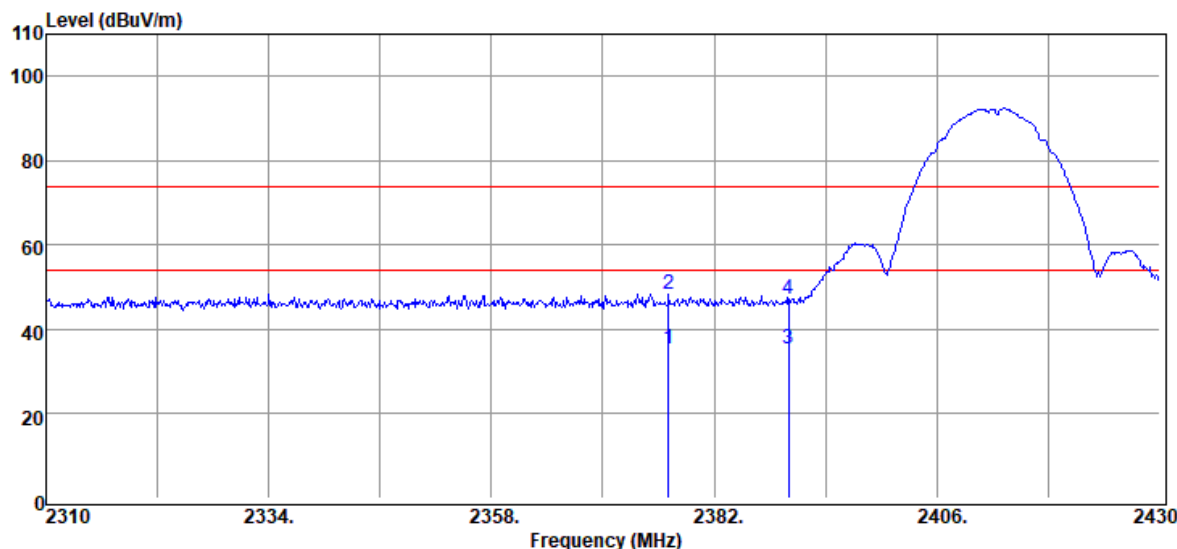
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Report Number :E2/2020/50130
Operation Mode :802.11b
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/63
Antenna Pol. :HORIZONTAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2377.08	Average	40.94	-5.57	35.37	54.00	-18.63
2377.08	Peak	53.99	-5.57	48.42	74.00	-25.58
2390.00	Average	41.07	-5.52	35.55	54.00	-18.45
2390.00	Peak	52.70	-5.52	47.18	74.00	-26.82

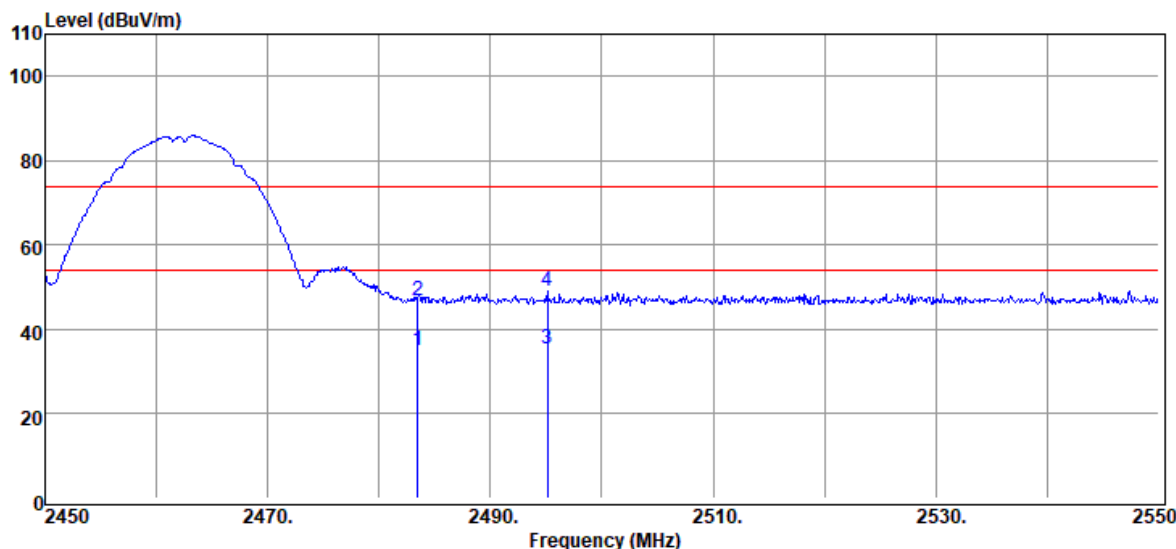
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Report Number :E2/2020/50130
Operation Mode :802.11b
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/63
Antenna Pol. :VERTICAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	Average	40.61	-5.42	35.19	54.00	-18.81
2483.50	Peak	52.42	-5.42	47.00	74.00	-27.00
2495.10	Average	40.71	-5.39	35.32	54.00	-18.68
2495.10	Peak	54.65	-5.39	49.26	74.00	-24.74

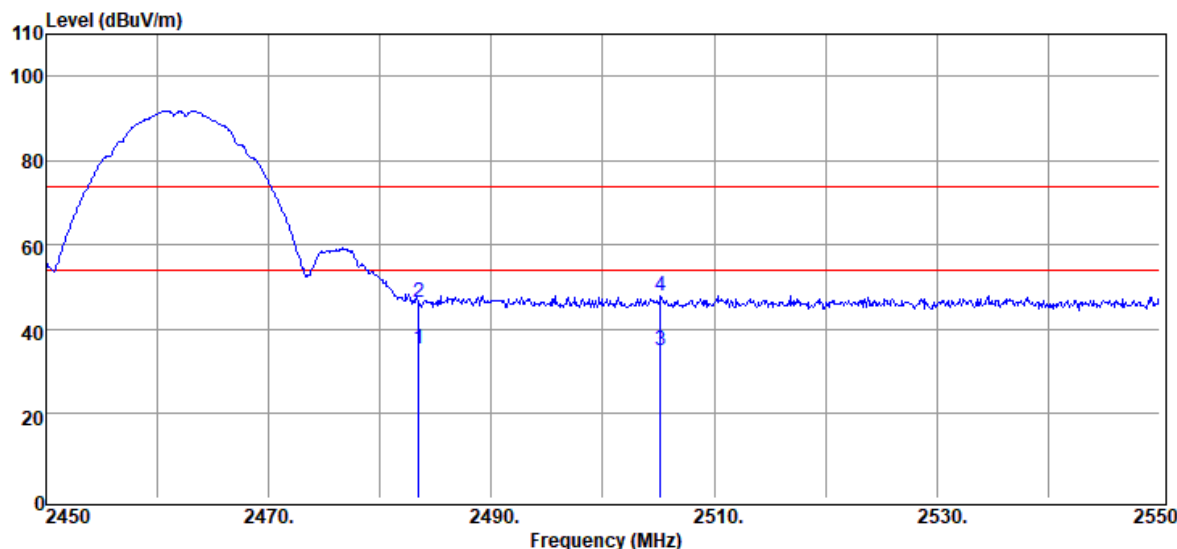
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Report Number :E2/2020/50130
Operation Mode :802.11b
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/63
Antenna Pol. :HORIZONTAL
Engineer :Kailin



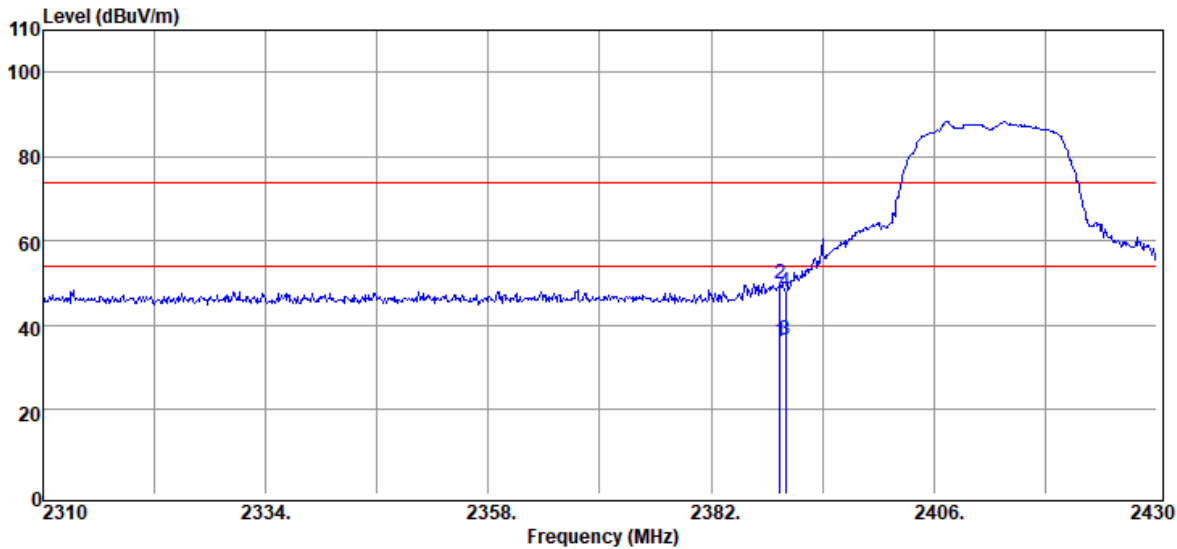
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	Average	40.98	-5.42	35.56	54.00	-18.44
2483.50	Peak	51.97	-5.42	46.55	74.00	-27.45
2505.20	Average	40.40	-5.39	35.01	54.00	-18.99
2505.20	Peak	53.51	-5.39	48.12	74.00	-25.88

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Report Number :E2/2020/50130
Operation Mode :802.11g
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/63
Antenna Pol. :VERTICAL
Engineer :Kailin


Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2389.44	Average	41.58	-5.52	36.06	54.00	-17.94
2389.44	Peak	55.41	-5.52	49.89	74.00	-24.11
2390.00	Average	41.96	-5.52	36.44	54.00	-17.56
2390.00	Peak	53.44	-5.52	47.92	74.00	-26.08

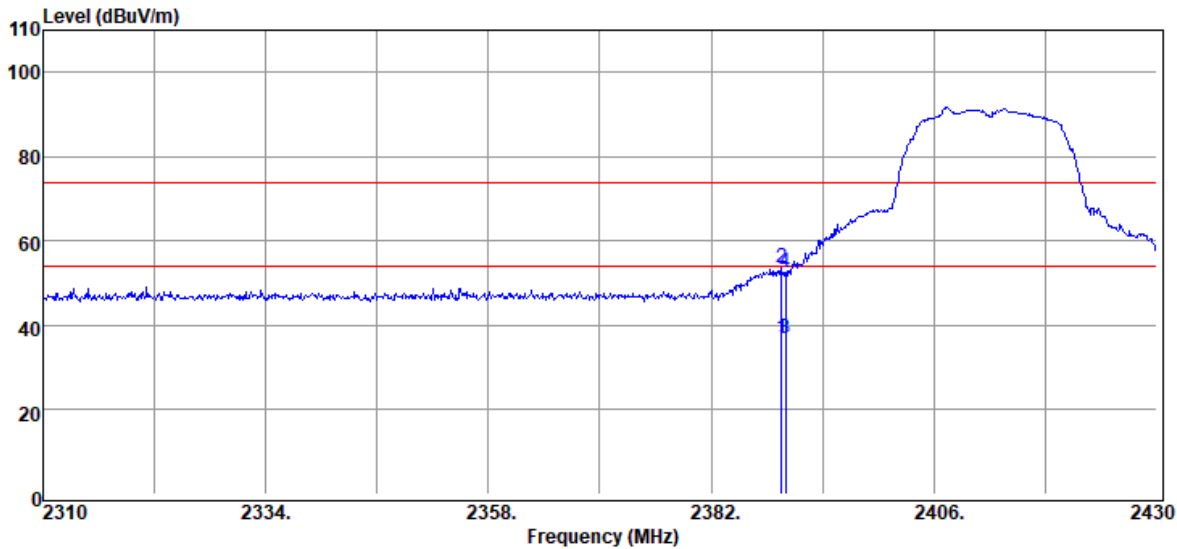
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Report Number :E2/2020/50130
Operation Mode :802.11g
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/63
Antenna Pol. :HORIZONTAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2389.56	Average	42.60	-5.52	37.08	54.00	-16.92
2389.56	Peak	59.05	-5.52	53.53	74.00	-20.47
2390.00	Average	42.52	-5.52	37.00	54.00	-17.00
2390.00	Peak	57.87	-5.52	52.35	74.00	-21.65

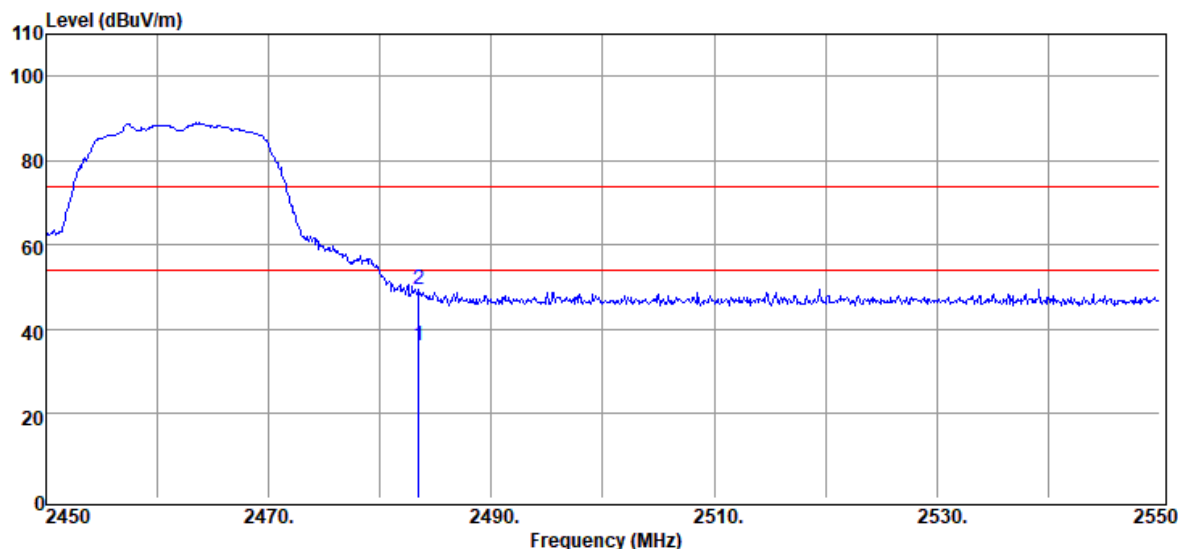
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Report Number :E2/2020/50130
Operation Mode :802.11g
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/63
Antenna Pol. :VERTICAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	Average	41.70	-5.42	36.28	54.00	-17.72
2483.50	Peak	54.83	-5.42	49.41	74.00	-24.59

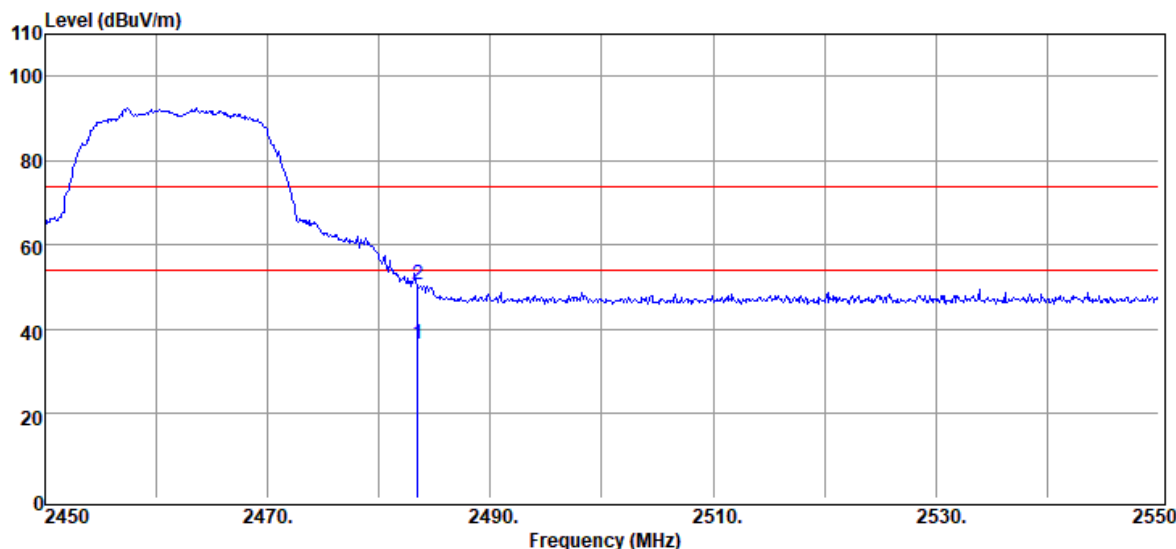
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Report Number :E2/2020/50130
Operation Mode :802.11g
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/63
Antenna Pol. :HORIZONTAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	Average	41.85	-5.42	36.43	54.00	-17.57
2483.50	Peak	55.99	-5.42	50.57	74.00	-23.43

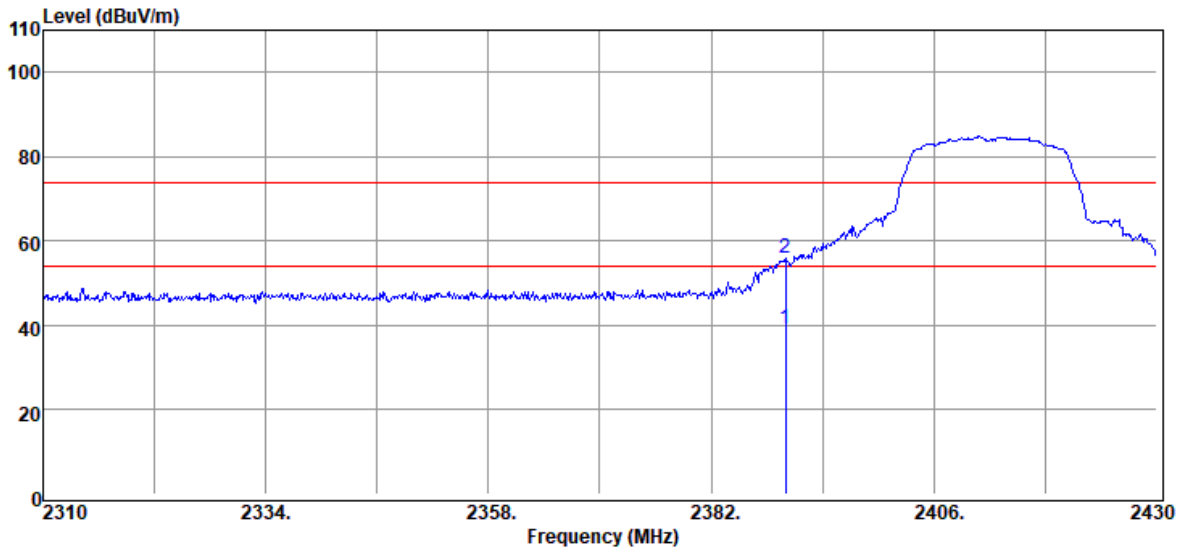
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Report Number :E2/2020/50130
Operation Mode :802.11n20
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.2/62
Antenna Pol. :VERTICAL
Engineer :Kailin



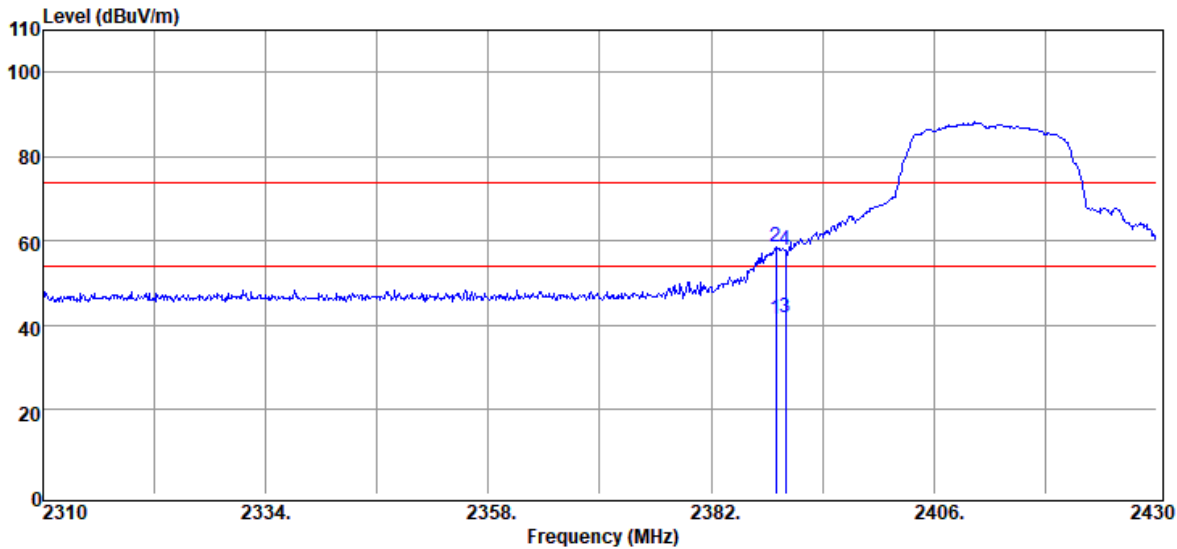
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2390.00	Average	44.78	-5.52	39.26	54.00	-14.74
2390.00	Peak	61.35	-5.52	55.83	74.00	-18.17

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Report Number :E2/2020/50130
Operation Mode :802.11n20
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.2/62
Antenna Pol. :HORIZONTAL
Engineer :Kailin


Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
2388.96	Average	47.02	-5.52	41.50	54.00	-12.50
2388.96	Peak	64.05	-5.52	58.53	74.00	-15.47
2390.00	Average	47.55	-5.52	42.03	54.00	-11.97
2390.00	Peak	63.21	-5.52	57.69	74.00	-16.31

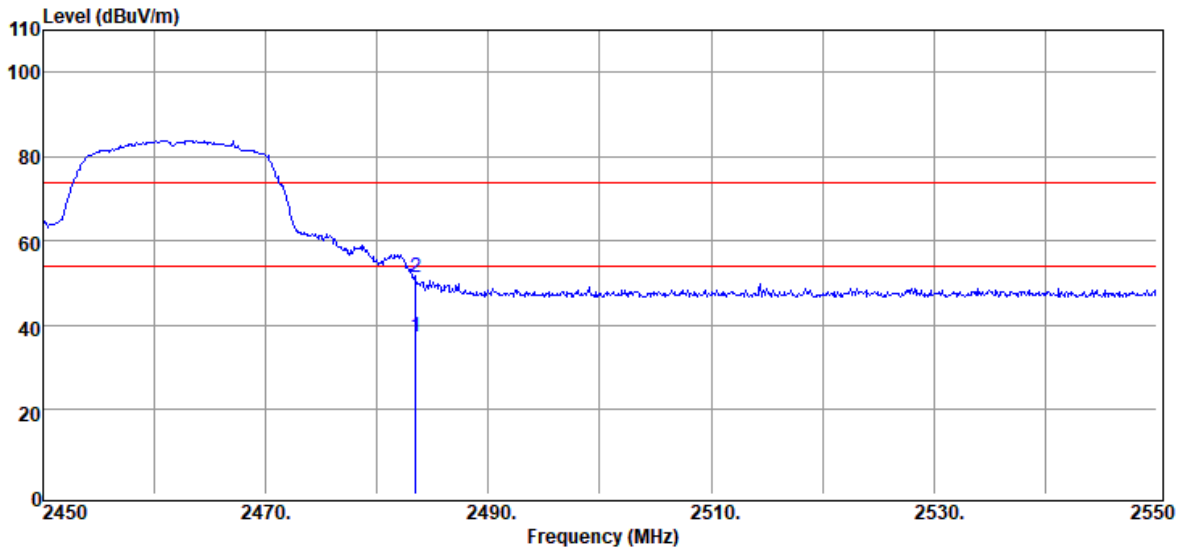
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Report Number :E2/2020/50130
Operation Mode :802.11n20
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.2/62
Antenna Pol. :VERTICAL
Engineer :Kailin



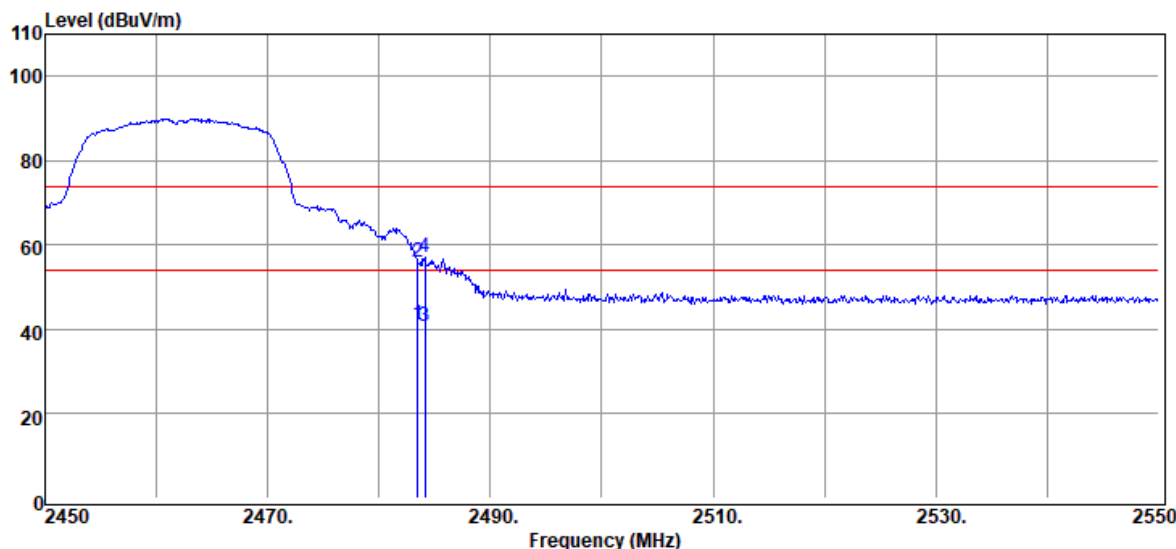
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	Average	42.58	-5.42	37.16	54.00	-16.84
2483.50	Peak	56.90	-5.42	51.48	74.00	-22.52

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Report Number :E2/2020/50130
Operation Mode :802.11n20
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.2/62
Antenna Pol. :HORIZONTAL
Engineer :Kailin


Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
2483.50	Average	46.46	-5.42	41.04	54.00	-12.96
2483.50	Peak	61.38	-5.42	55.96	74.00	-18.04
2484.10	Average	45.96	-5.42	40.54	54.00	-13.46
2484.10	Peak	62.63	-5.42	57.21	74.00	-16.79

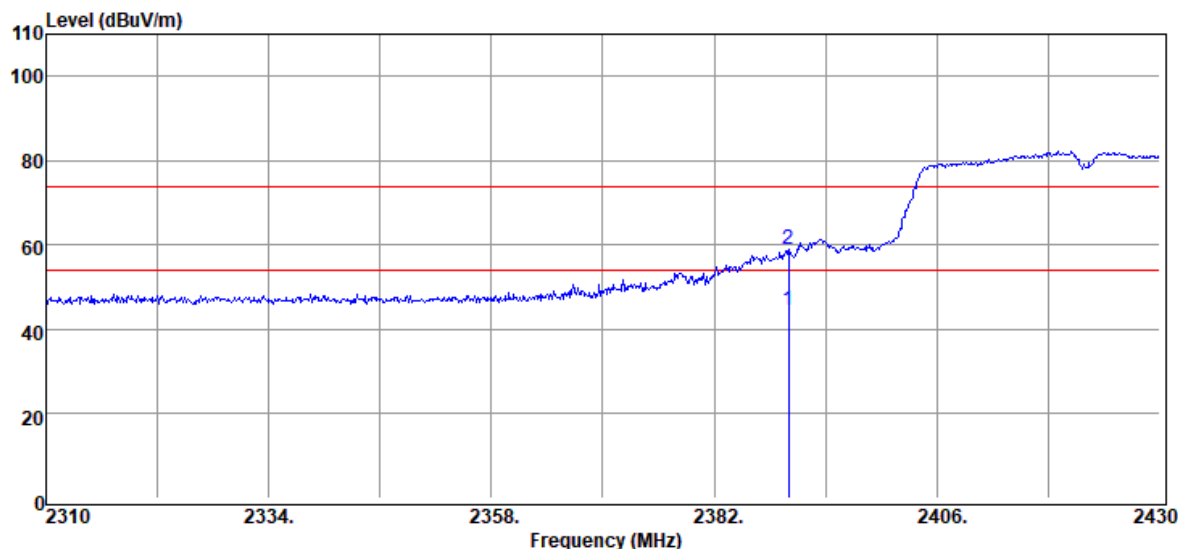
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Report Number :E2/2020/50130
Operation Mode :802.11n40
Test Frequency :2422 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/62
Antenna Pol. :VERTICAL
Engineer :Kailin



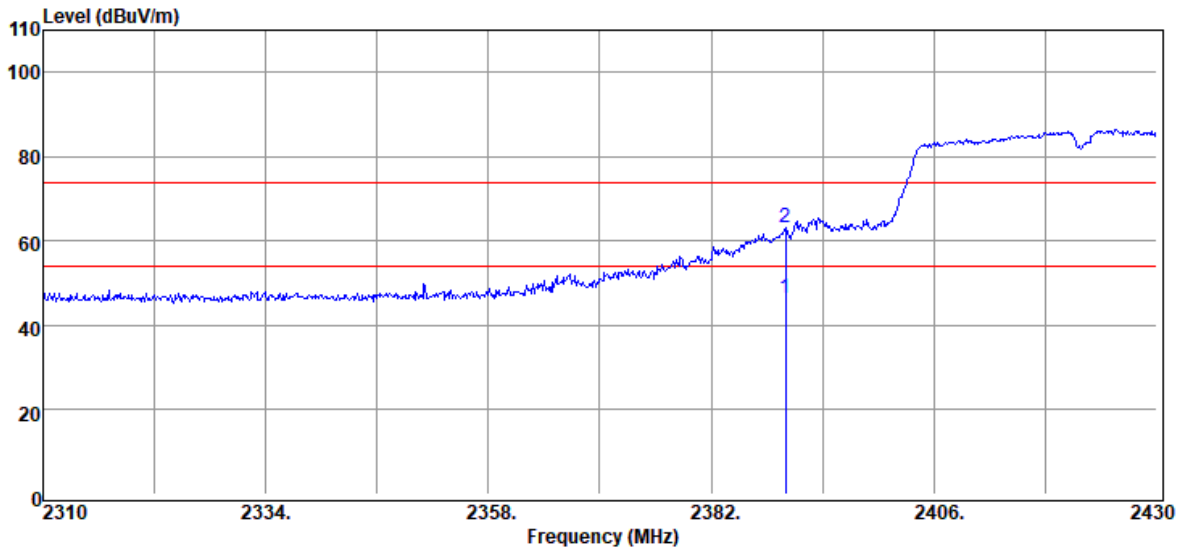
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
Mode	Reading Level			FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2390.00	Average	49.88	-5.52	44.36	54.00	-9.64
2390.00	Peak	64.59	-5.52	59.07	74.00	-14.93

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Report Number :E2/2020/50130
Operation Mode :802.11n40
Test Frequency :2422 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/62
Antenna Pol. :HORIZONTAL
Engineer :Kailin


Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2390.00	Average	51.89	-5.52	46.37	54.00	-7.63
2390.00	Peak	68.60	-5.52	63.08	74.00	-10.92

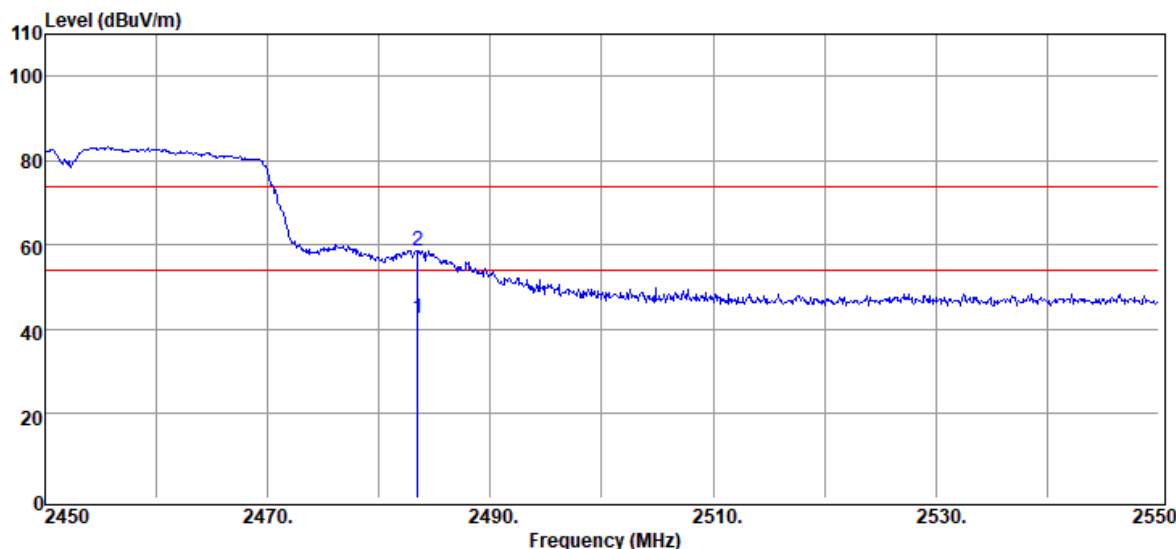
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Report Number :E2/2020/50130
Operation Mode :802.11n40
Test Frequency :2452 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/62
Antenna Pol. :VERTICAL
Engineer :Kailin



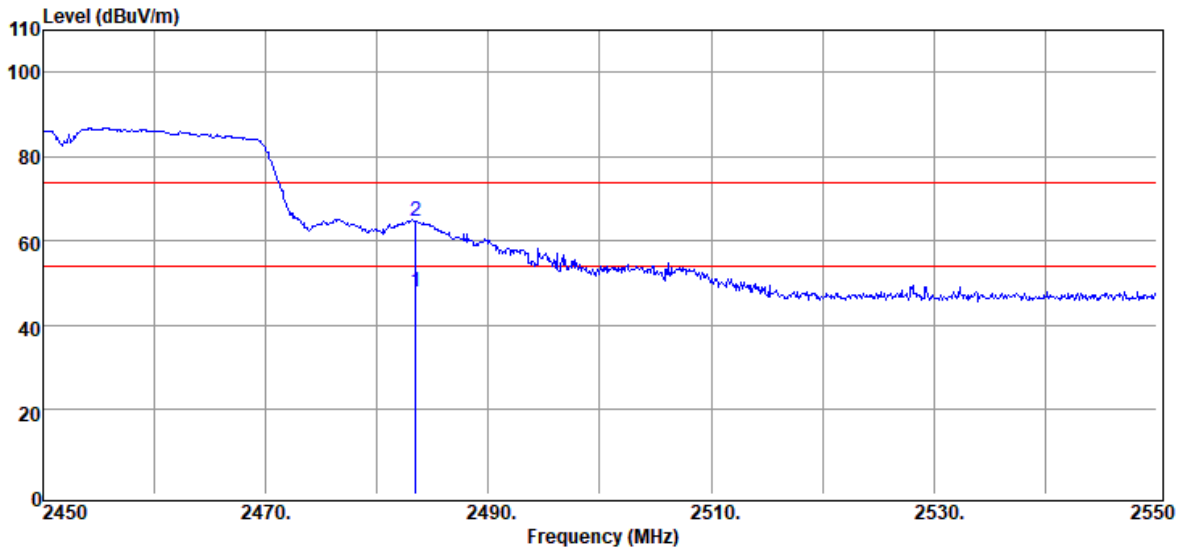
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	Average	47.88	-5.42	42.46	54.00	-11.54
2483.50	Peak	63.92	-5.42	58.50	74.00	-15.50

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Report Number :E2/2020/50130
Operation Mode :802.11n40
Test Frequency :2452 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/62
Antenna Pol. :HORIZONTAL
Engineer :Kailin


Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	Average	53.55	-5.42	48.13	54.00	-5.87
2483.50	Peak	69.98	-5.42	64.56	74.00	-9.44

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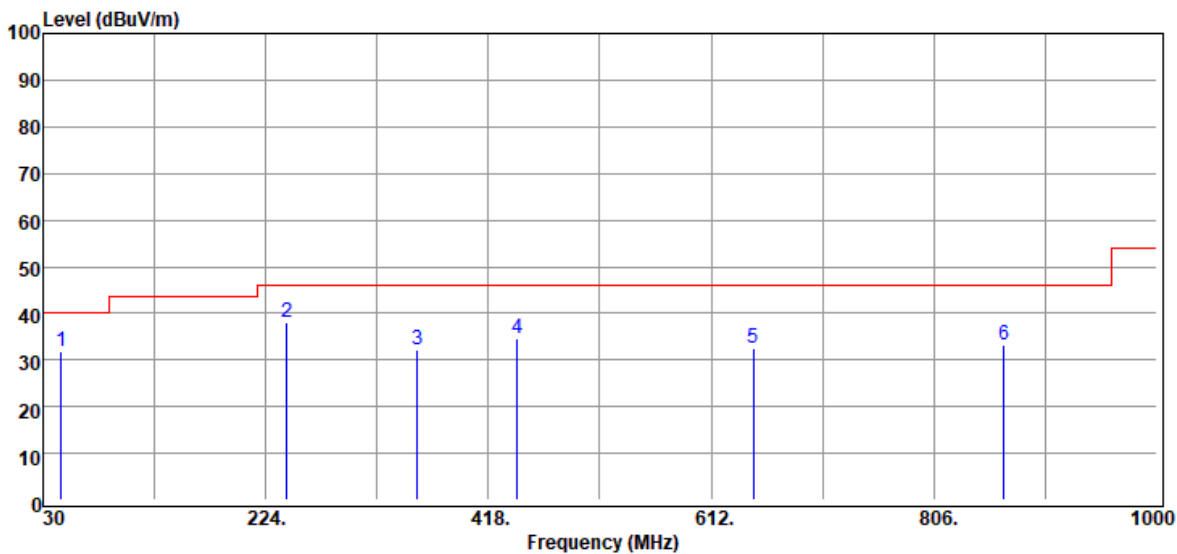
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11.7.2 Below 1GHz Worst-Case Emission:

Report Number :E2/2020/50130
Operation Mode :802.11g
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/62
Antenna Pol. :VERTICAL
Engineer :Kailin



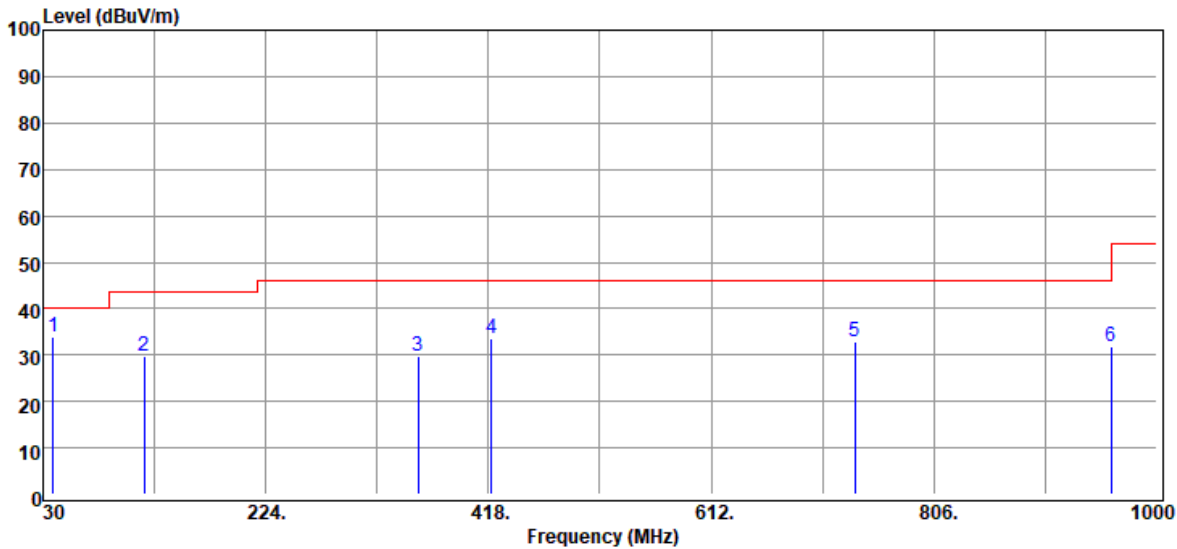
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
45.52	Peak	48.95	-16.95	32.00	40.00	-8.00
242.43	Peak	55.06	-16.96	38.10	46.00	-7.90
355.92	Peak	46.09	-14.01	32.08	46.00	-13.92
443.22	Peak	46.17	-11.69	34.48	46.00	-11.52
648.86	Peak	40.83	-8.37	32.46	46.00	-13.54
867.11	Peak	39.23	-5.95	33.28	46.00	-12.72

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Report Number :E2/2020/50130
Operation Mode :802.11g
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/62
Antenna Pol. :HORIZONTAL
Engineer :Kailin


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
38.73	Peak	51.42	-17.62	33.80	40.00	-6.20
118.27	Peak	48.62	-18.88	29.74	43.50	-13.76
356.89	Peak	43.87	-13.99	29.88	46.00	-16.12
420.91	Peak	46.26	-12.84	33.42	46.00	-12.58
737.13	Peak	39.84	-7.13	32.71	46.00	-13.29
960.23	Peak	36.15	-4.32	31.83	54.00	-22.17

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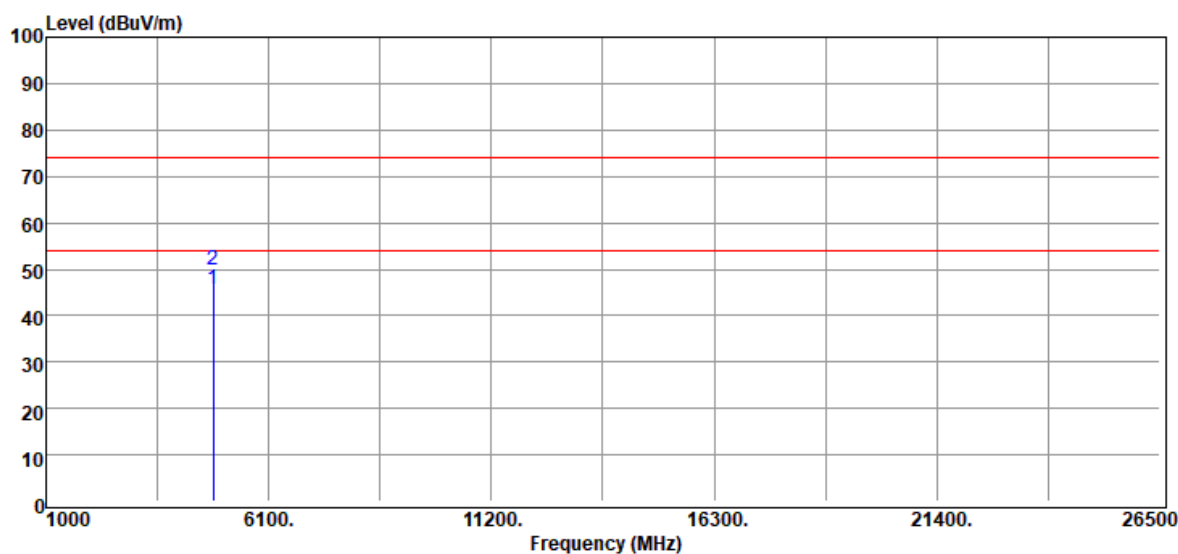
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11.7.3 Above 1GHz Emission:

Report Number :E2/2020/50130
Operation Mode :802.11b
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.0/63
Antenna Pol. :VERTICAL
Engineer :Kailin



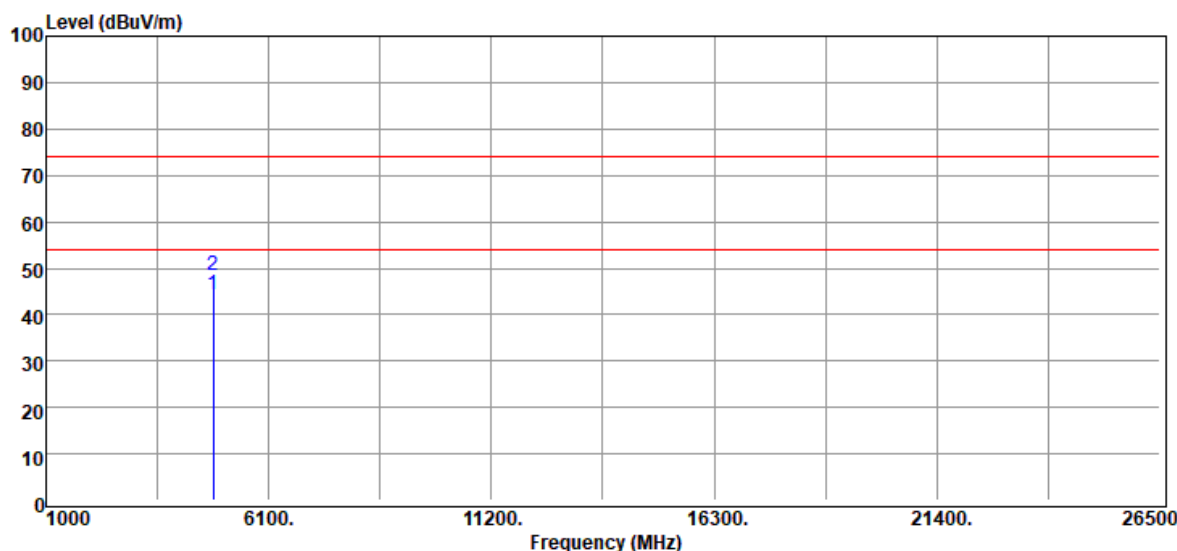
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBuV	dB	dBuV/m	dBuV/m	dB
4824.00	Average	46.11	-0.34	45.77	54.00	-8.23
4824.00	Peak	50.08	-0.34	49.74	74.00	-24.26

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Report Number :E2/2020/50130
Operation Mode :802.11b
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.0/63
Antenna Pol. :HORIZONTAL
Engineer :Kailin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
4824.00	Average	44.80	-0.34	44.46	54.00	-9.54
4824.00	Peak	48.71	-0.34	48.37	74.00	-25.63

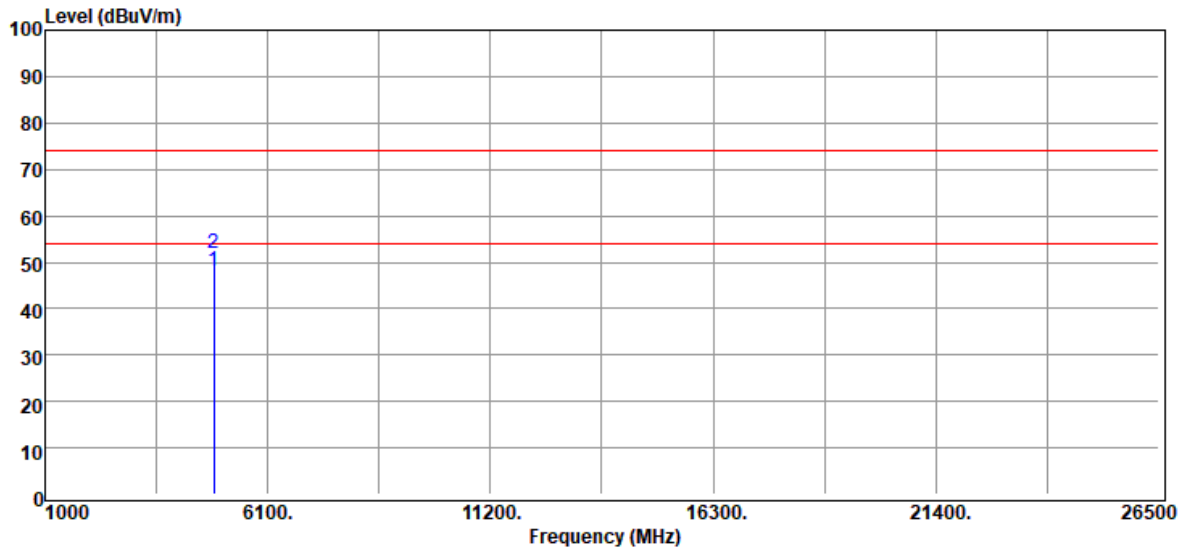
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Report Number :E2/2020/50130
Operation Mode :802.11b
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.0/63
Antenna Pol. :VERTICAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
4874.00	Average	48.55	-0.42	48.13	54.00	-5.87
4874.00	Peak	52.42	-0.42	52.00	74.00	-22.00

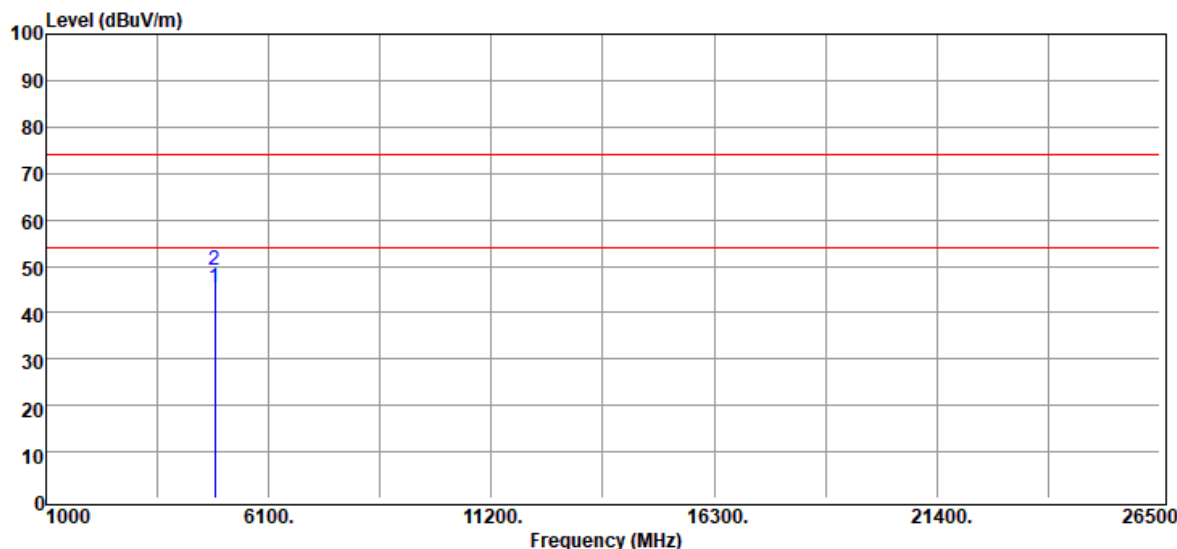
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Report Number :E2/2020/50130
Operation Mode :802.11b
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.0/63
Antenna Pol. :HORIZONTAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4874.00	Average	45.75	-0.42	45.33	54.00	-8.67
4874.00	Peak	49.68	-0.42	49.26	74.00	-24.74

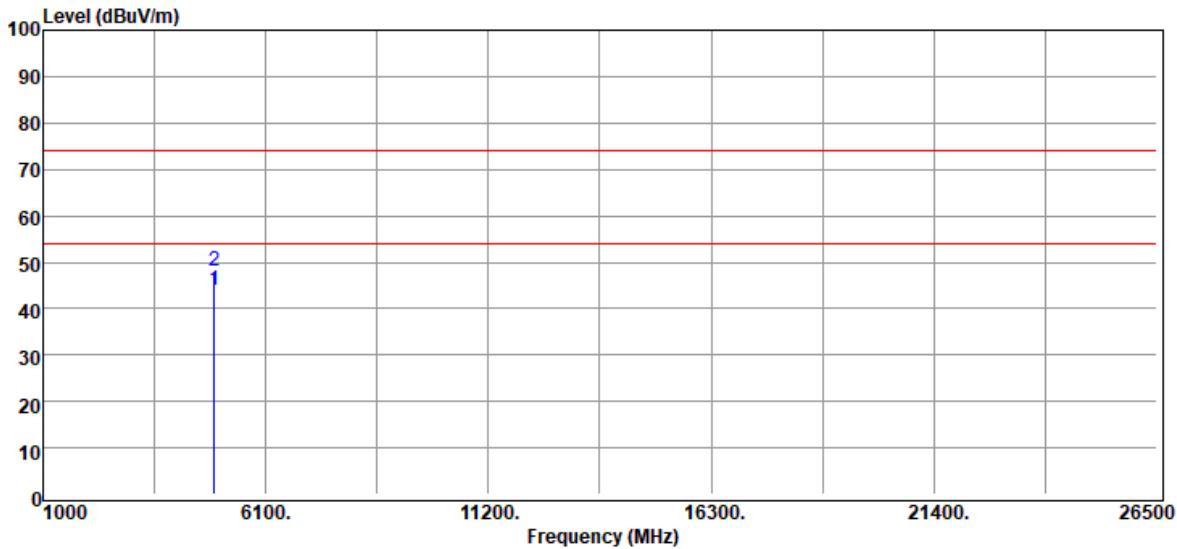
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Report Number :E2/2020/50130
Operation Mode :802.11b
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.0/62
Antenna Pol. :VERTICAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
4924.00	Average	44.55	-0.61	43.94	54.00	-10.06
4924.00	Peak	48.65	-0.61	48.04	74.00	-25.96

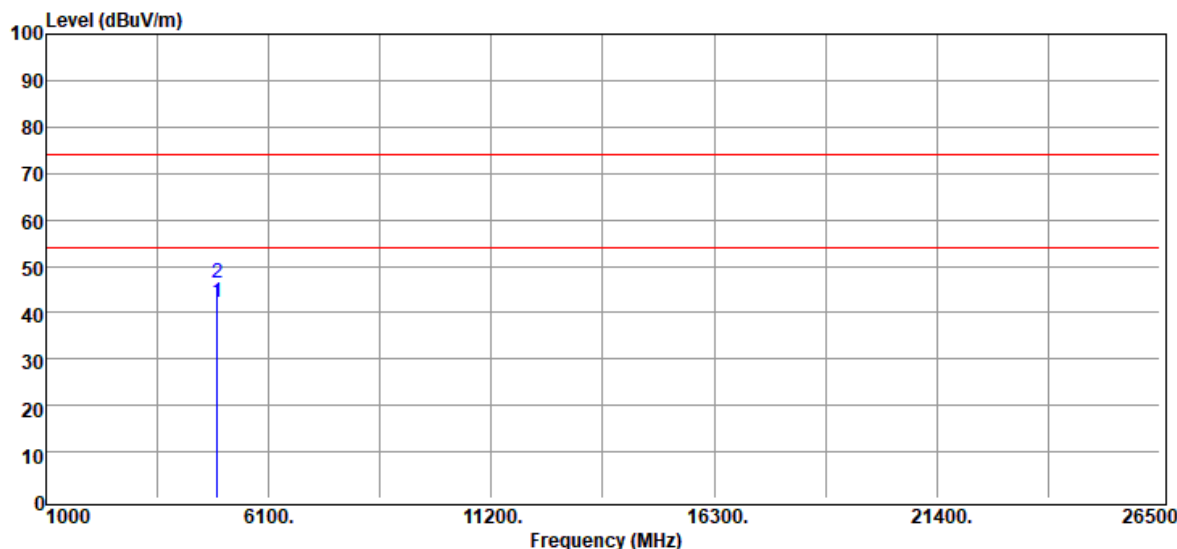
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Report Number :E2/2020/50130
Operation Mode :802.11b
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.0/62
Antenna Pol. :HORIZONTAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4924.00	Average	42.71	-0.61	42.10	54.00	-11.90
4924.00	Peak	46.81	-0.61	46.20	74.00	-27.80

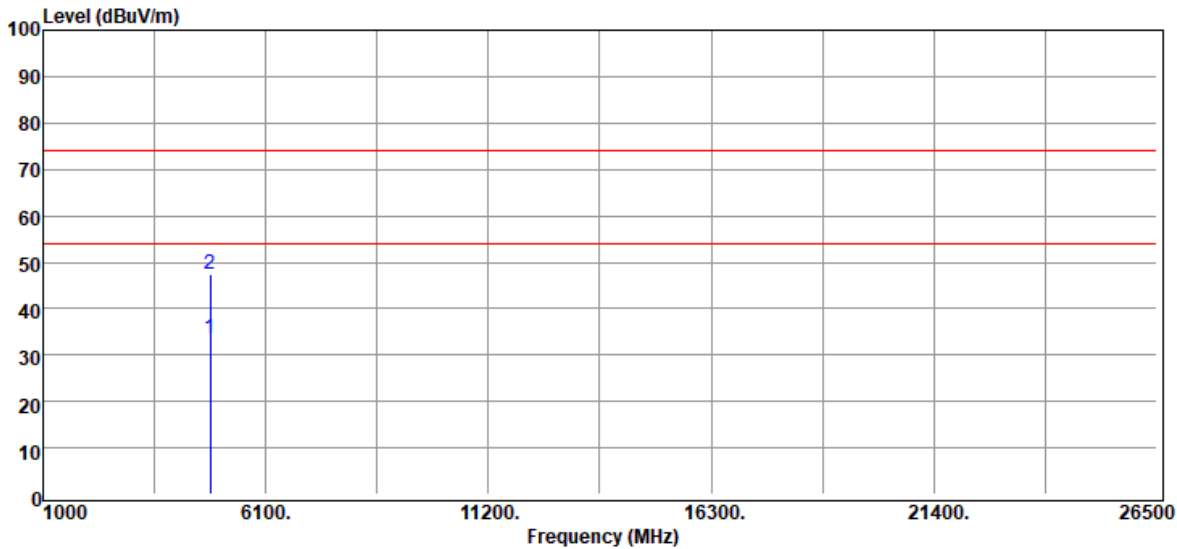
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Report Number :E2/2020/50130
Operation Mode :802.11g
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.0/62
Antenna Pol. :VERTICAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4824.00	Average	33.84	-0.34	33.50	54.00	-20.50
4824.00	Peak	47.85	-0.34	47.51	74.00	-26.49

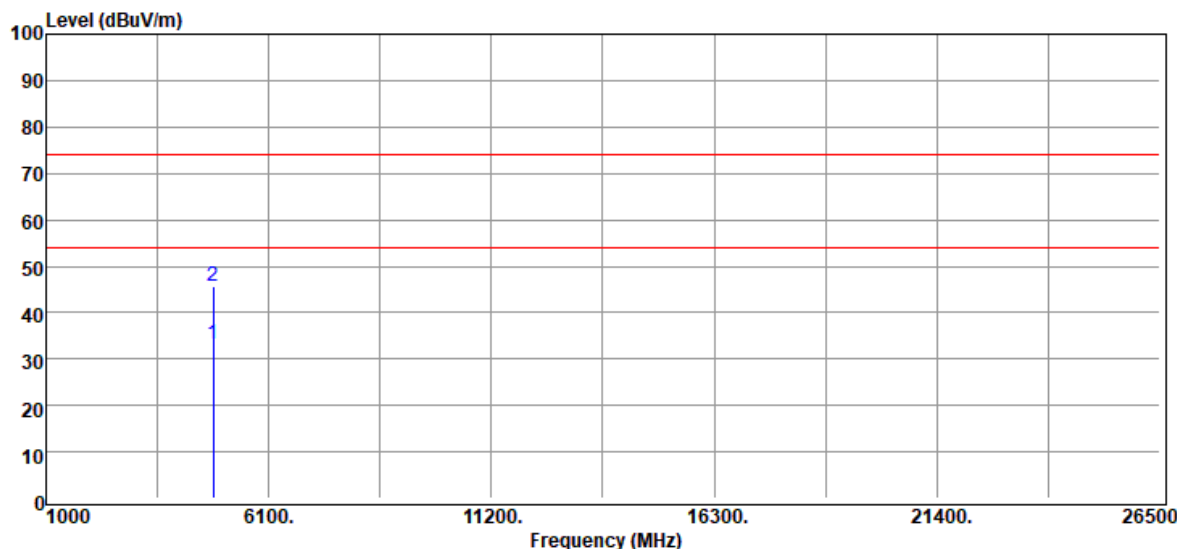
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Report Number :E2/2020/50130
Operation Mode :802.11g
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.0/62
Antenna Pol. :HORIZONTAL
Engineer :Kailin



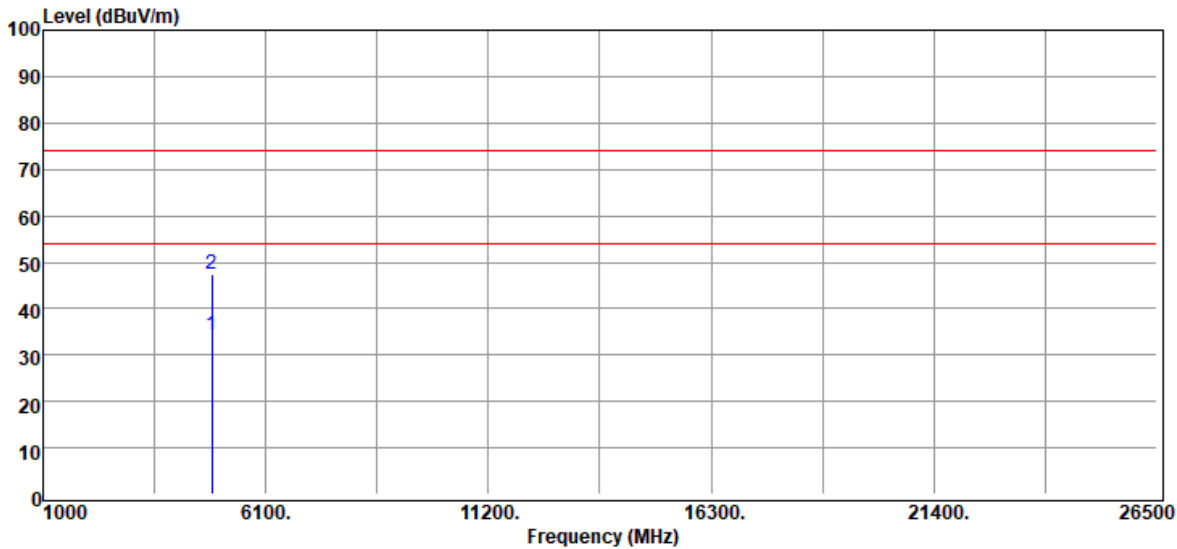
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4824.00	Average	33.62	-0.34	33.28	54.00	-20.72
4824.00	Peak	45.93	-0.34	45.59	74.00	-28.41

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Report Number :E2/2020/50130
Operation Mode :802.11g
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.0/62
Antenna Pol. :VERTICAL
Engineer :Kailin


Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4874.00	Average	34.52	-0.42	34.10	54.00	-19.90
4874.00	Peak	47.82	-0.42	47.40	74.00	-26.60

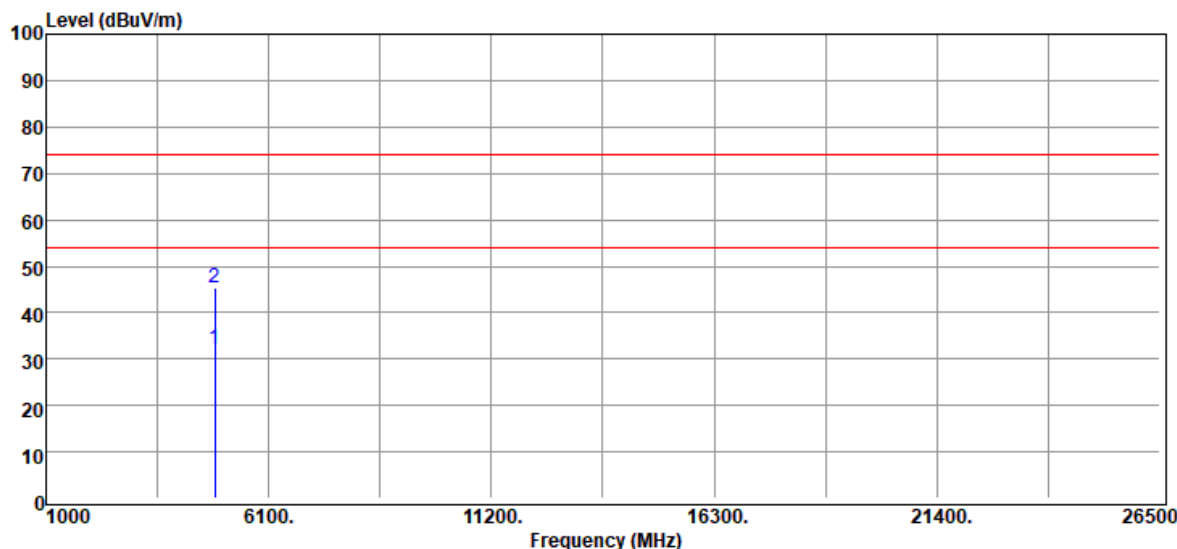
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Report Number :E2/2020/50130
Operation Mode :802.11g
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.0/62
Antenna Pol. :HORIZONTAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4874.00	Average	32.46	-0.42	32.04	54.00	-21.96
4874.00	Peak	45.63	-0.42	45.21	74.00	-28.79

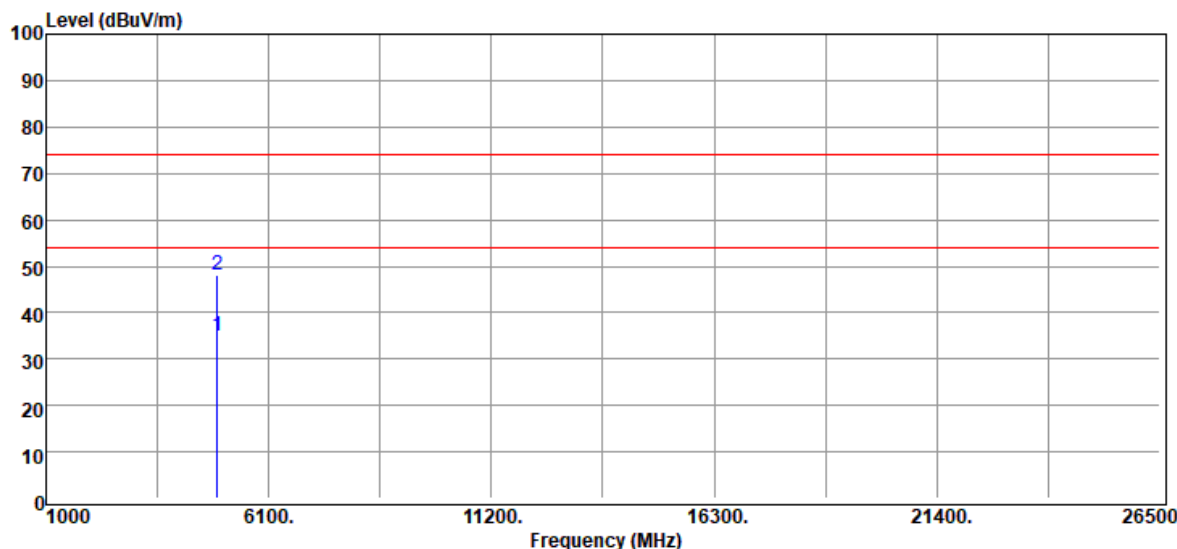
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Report Number :E2/2020/50130
Operation Mode :802.11g
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.0/62
Antenna Pol. :VERTICAL
Engineer :Kailin



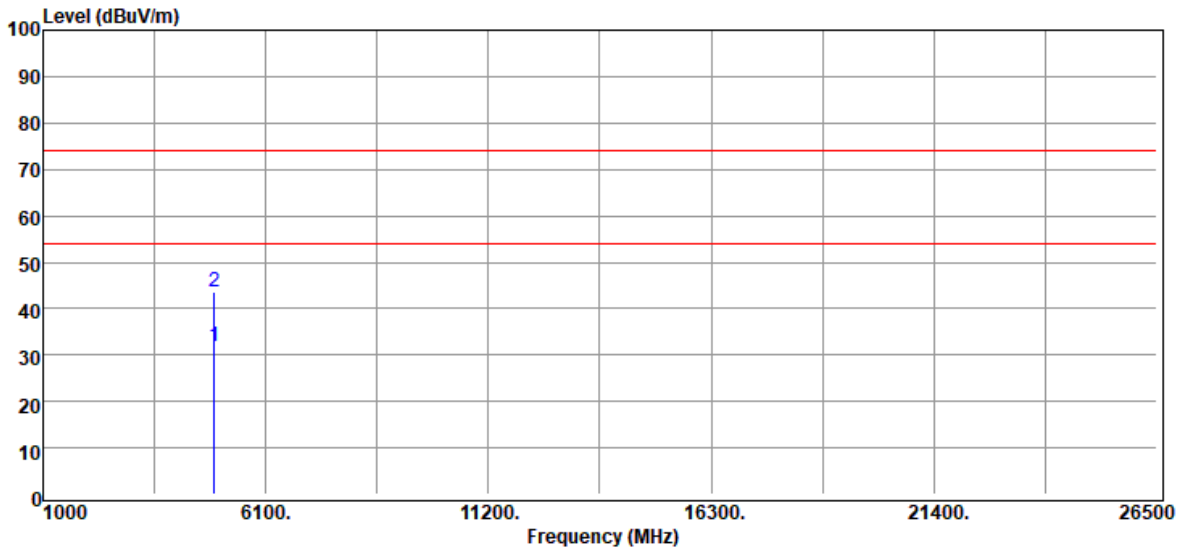
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
4924.00	Average	35.66	-0.61	35.05	54.00	-18.95
4924.00	Peak	48.55	-0.61	47.94	74.00	-26.06

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Report Number :E2/2020/50130
Operation Mode :802.11g
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.0/62
Antenna Pol. :HORIZONTAL
Engineer :Kailin


Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBuV	dB	dBuV/m	dBuV/m	dB
4924.00	Average	32.44	-0.61	31.83	54.00	-22.17
4924.00	Peak	44.15	-0.61	43.54	74.00	-30.46

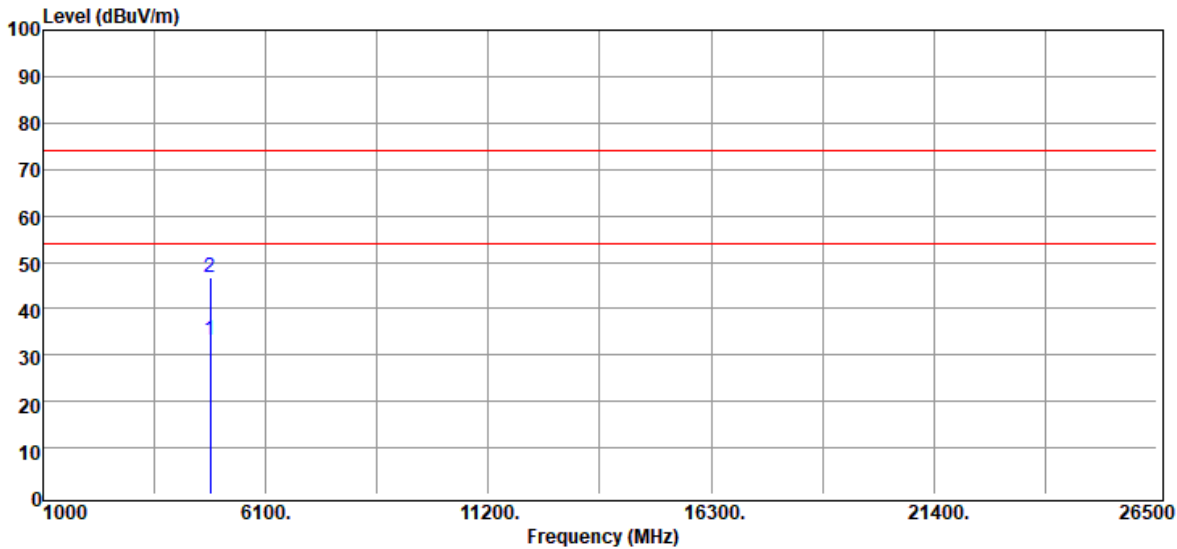
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Report Number :E2/2020/50130
Operation Mode :802.11n20
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/61
Antenna Pol. :VERTICAL
Engineer :Kailin



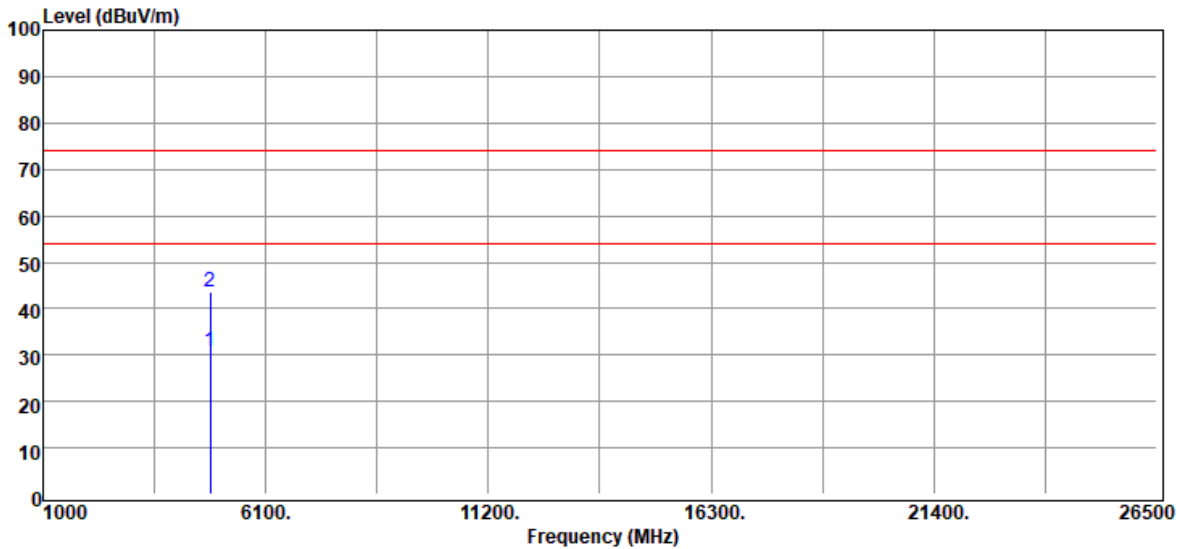
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
4824.00	Average	33.47	-0.34	33.13	54.00	-20.87
4824.00	Peak	47.11	-0.34	46.77	74.00	-27.23

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Report Number :E2/2020/50130
Operation Mode :802.11n20
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/61
Antenna Pol. :HORIZONTAL
Engineer :Kailin


Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBuV	dB	dBuV/m	dBuV/m	dB
4824.00	Average	30.99	-0.34	30.65	54.00	-23.35
4824.00	Peak	43.95	-0.34	43.61	74.00	-30.39

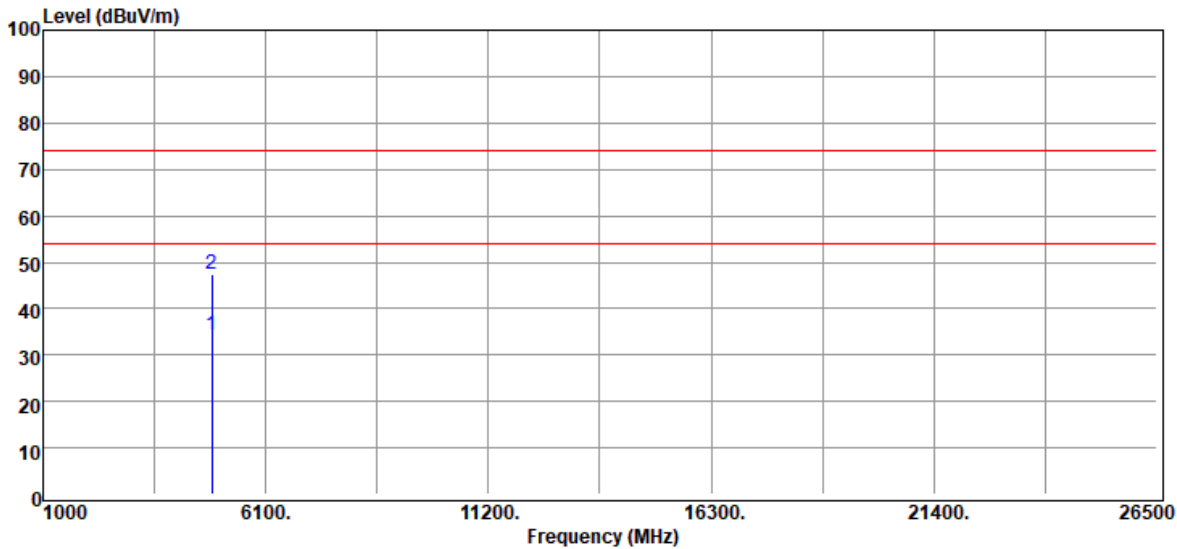
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Report Number :E2/2020/50130
Operation Mode :802.11n20
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/61
Antenna Pol. :VERTICAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
4874.00	Average	34.66	-0.42	34.24	54.00	-19.76
4874.00	Peak	47.69	-0.42	47.27	74.00	-26.73

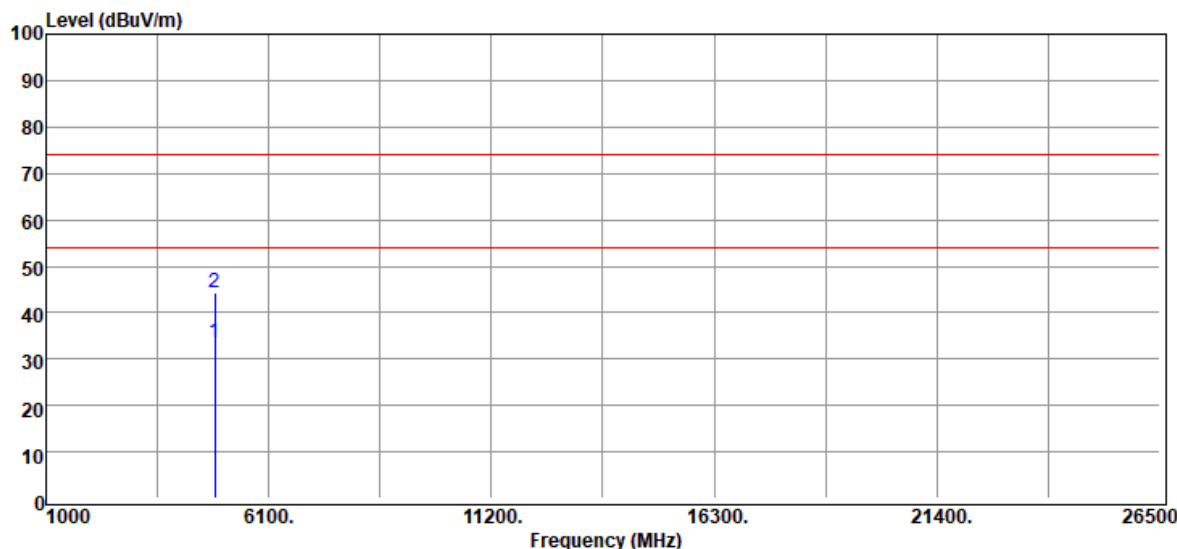
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Report Number :E2/2020/50130
Operation Mode :802.11n20
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/61
Antenna Pol. :HORIZONTAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4874.00	Average	33.96	-0.42	33.54	54.00	-20.46
4874.00	Peak	44.82	-0.42	44.40	74.00	-29.60

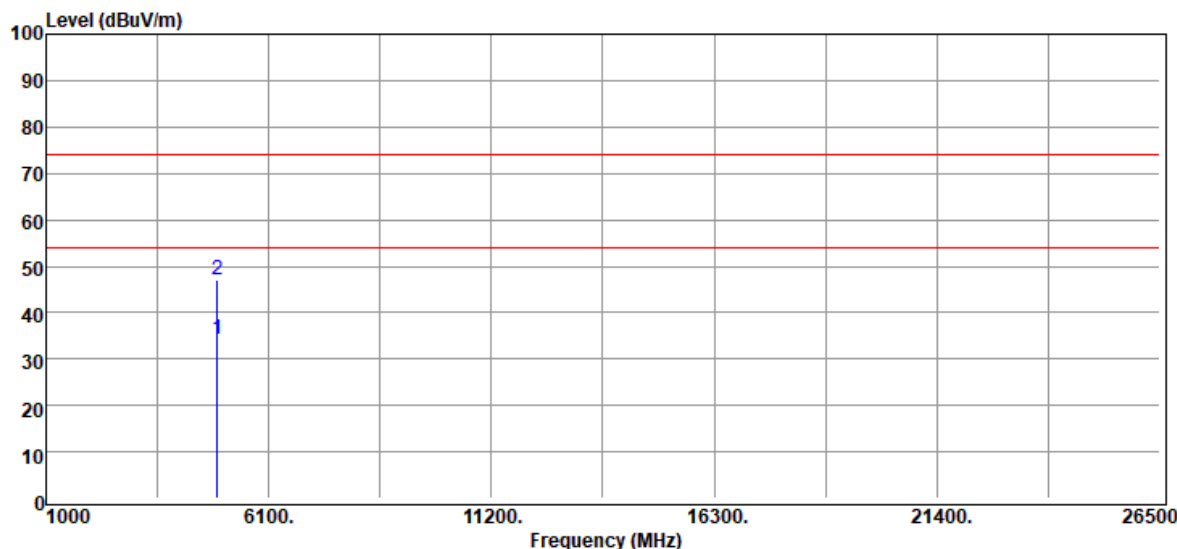
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Report Number :E2/2020/50130
Operation Mode :802.11n20
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/61
Antenna Pol. :VERTICAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
4924.00	Average	34.89	-0.61	34.28	54.00	-19.72
4924.00	Peak	47.80	-0.61	47.19	74.00	-26.81

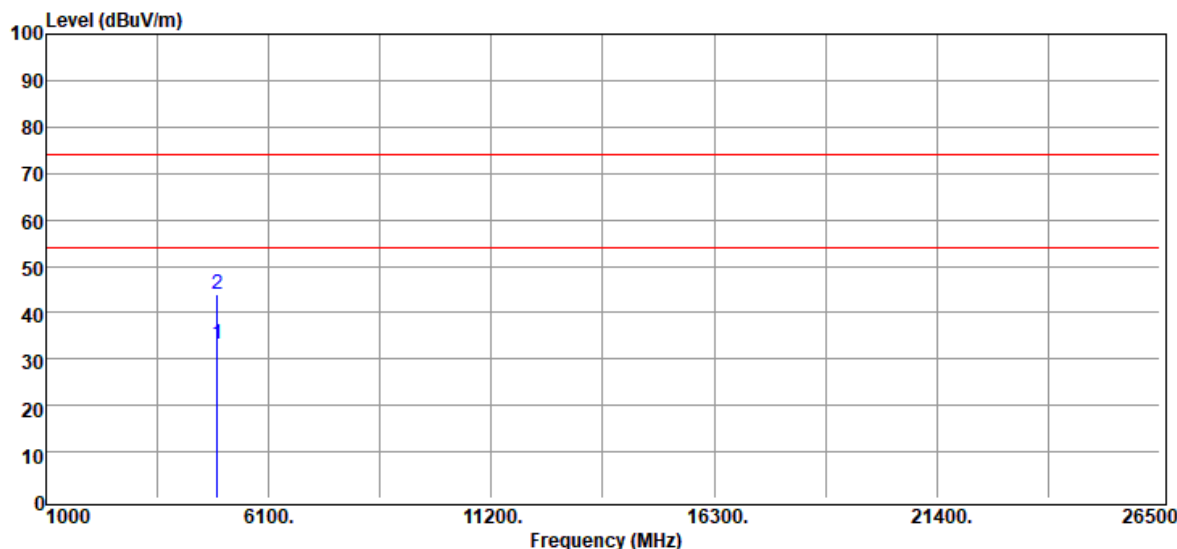
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Report Number :E2/2020/50130
Operation Mode :802.11n20
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/61
Antenna Pol. :HORIZONTAL
Engineer :Kailin



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	33.71	-0.61	33.10	54.00	-20.90
4924.00	Peak	44.68	-0.61	44.07	74.00	-29.93

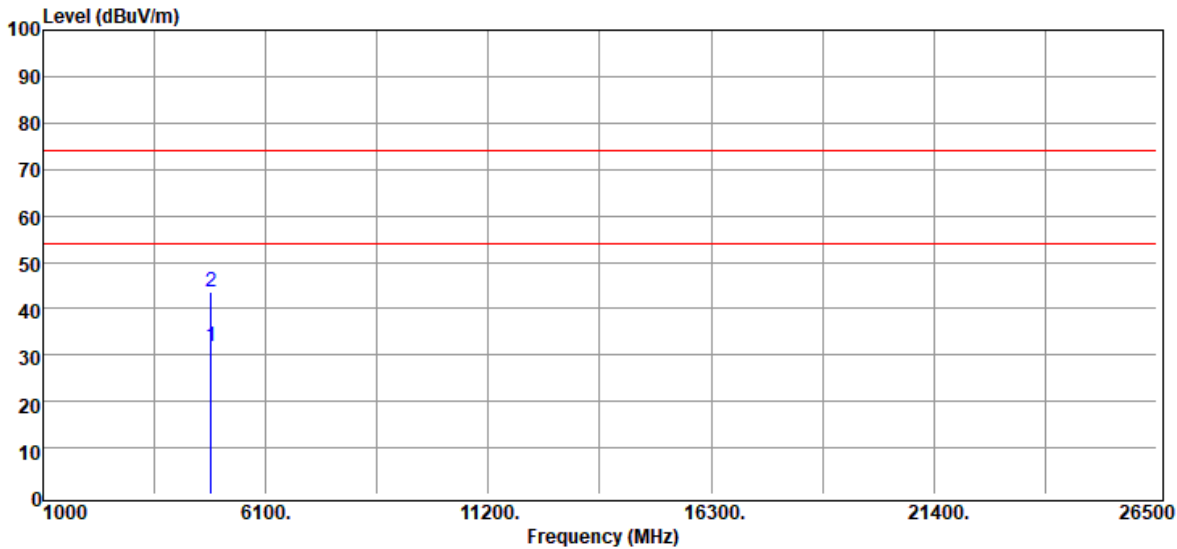
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Report Number :E2/2020/50130
Operation Mode :802.11n40
Test Frequency :2422 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/61
Antenna Pol. :VERTICAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4844.00	Average	32.21	-0.33	31.88	54.00	-22.12
4844.00	Peak	43.84	-0.33	43.51	74.00	-30.49

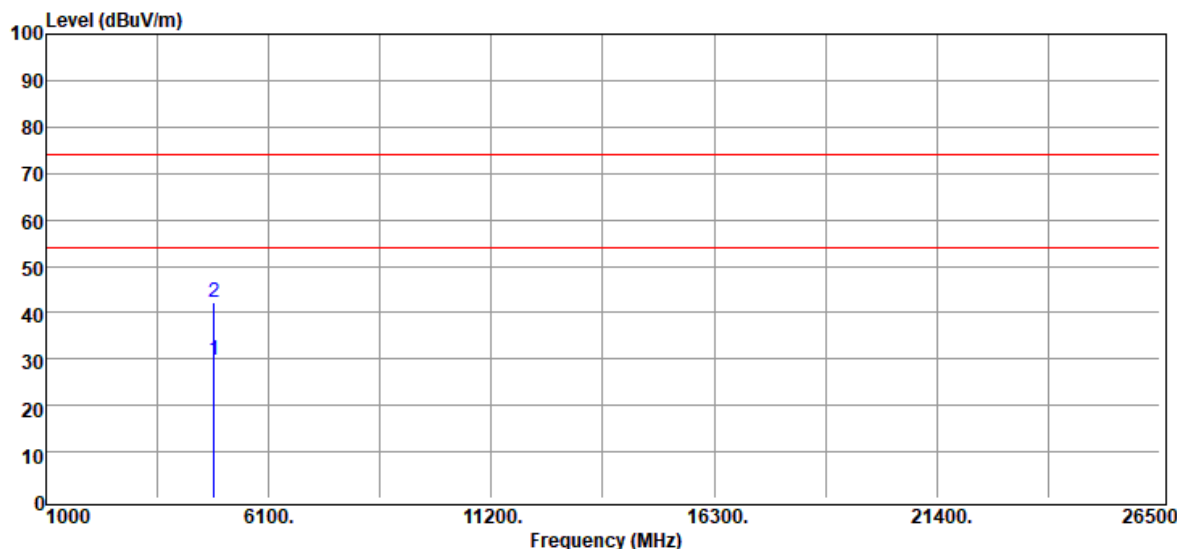
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Report Number :E2/2020/50130
Operation Mode :802.11n40
Test Frequency :2422 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.1/61
Antenna Pol. :HORIZONTAL
Engineer :Kailin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
4844.00	Average	30.11	-0.33	29.78	54.00	-24.22
4844.00	Peak	42.65	-0.33	42.32	74.00	-31.68

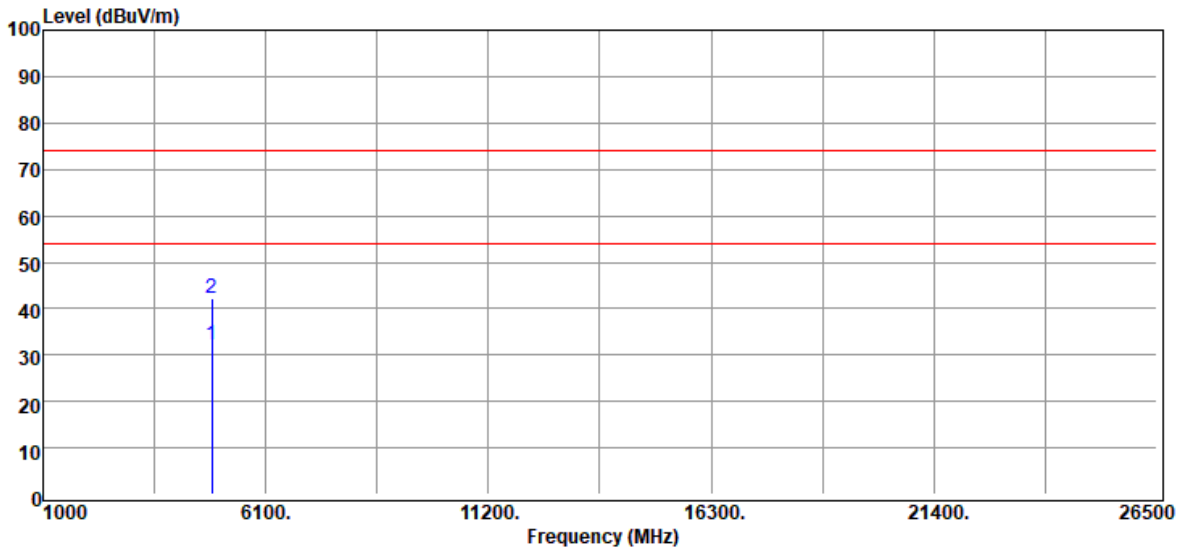
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Report Number :E2/2020/50130
Operation Mode :802.11n40
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.2/61
Antenna Pol. :VERTICAL
Engineer :Kailin



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
4874.00	Average	32.66	-0.42	32.24	54.00	-21.76
4874.00	Peak	42.72	-0.42	42.30	74.00	-31.70

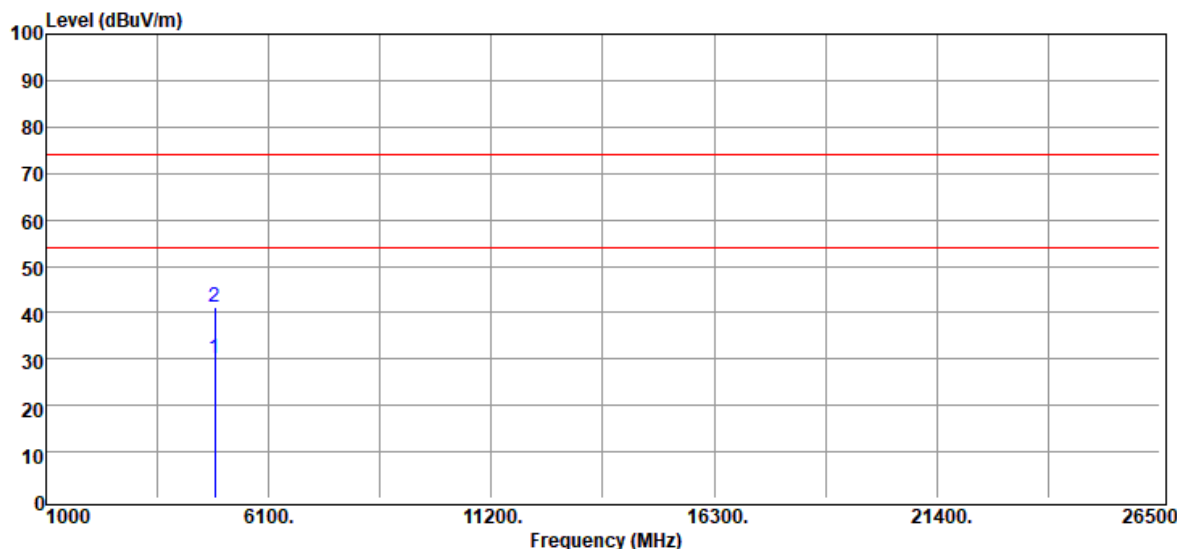
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Report Number :E2/2020/50130
Operation Mode :802.11n40
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.2/61
Antenna Pol. :HORIZONTAL
Engineer :Kailin



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	30.41	-0.42	29.99	54.00	-24.01
4874.00	Peak	41.63	-0.42	41.21	74.00	-32.79

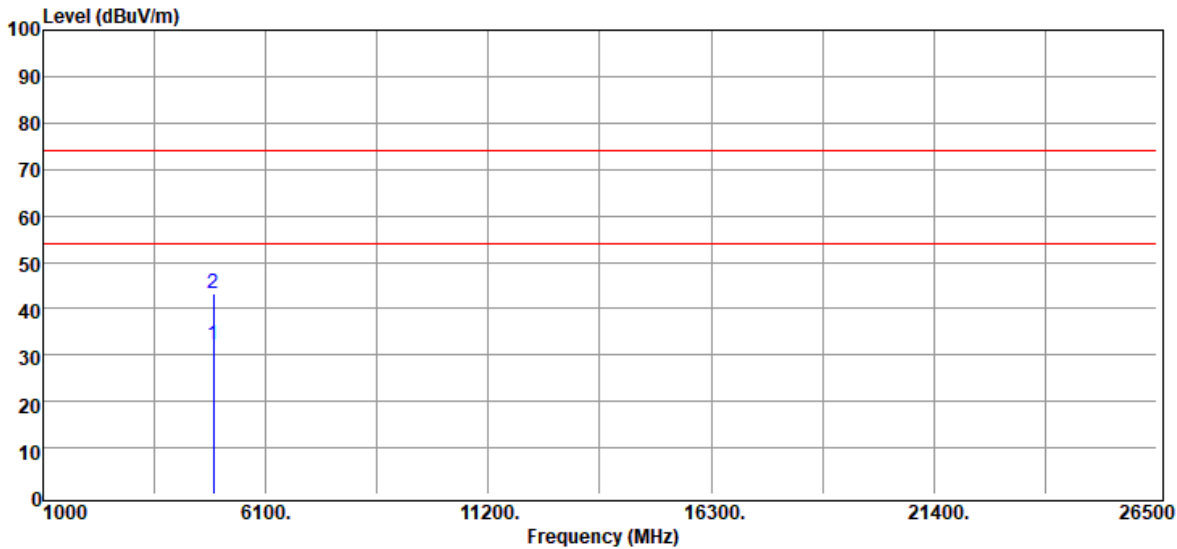
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Report Number :E2/2020/50130
Operation Mode :802.11n40
Test Frequency :2452 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.2/61
Antenna Pol. :VERTICAL
Engineer :Kailin



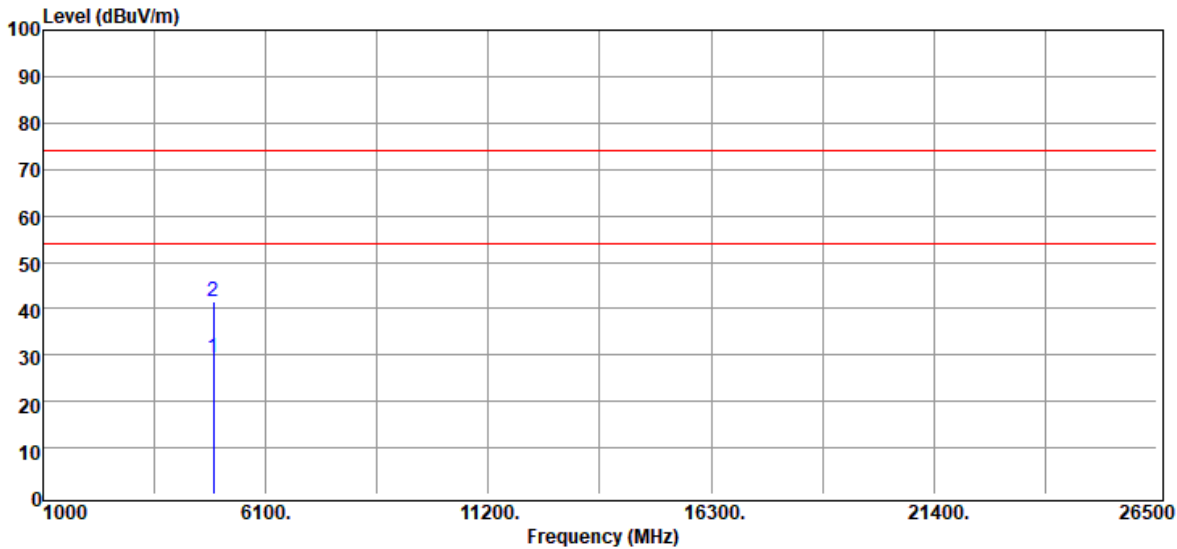
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4904.00	Average	32.76	-0.51	32.25	54.00	-21.75
4904.00	Peak	43.62	-0.51	43.11	74.00	-30.89

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Report Number :E2/2020/50130
Operation Mode :802.11n40
Test Frequency :2452 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-06-20
Temp./Humi. :21.2/61
Antenna Pol. :HORIZONTAL
Engineer :Kailin


Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4904.00	Average	29.87	-0.51	29.36	54.00	-24.64
4904.00	Peak	41.88	-0.51	41.37	74.00	-32.63

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12 POWER SPECTRAL DENSITY

12.1 Standard Applicable

Per Part 15.247 (e)

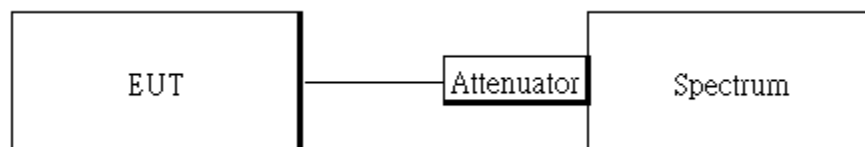
The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

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	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010B	MY59070196	03/22/2019	03/21/2021
DC Block	PASTERNAK	PE8210	RF256	11/20/2019	11/19/2020
Attenuator	Marvelous	MVE2213-10	RF80	11/20/2019	11/19/2020

12.3 Test Set-up



12.4 Measurement Procedure

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 3 kHz & VBW = 10 kHz.
5. For defining Restricted Band Edge Limit:
Set the RBW = 100kHz & VBW = 300 kHz
6. Detector = peak.
7. Sweep time = auto couple.
8. Trace mode = max hold.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum amplitude level.

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12.5 Power spectral density

POWER DENSITY 802.11b				
Freq. (MHz)	PSD (dBm/3kHz)	Offset	Limit (dBm/3kHz)	Result
2412	-7.34	11.10	8.00	PASS
2437	-7.26	11.10	8.00	PASS
2462	-7.43	11.10	8.00	PASS

POWER DENSITY 802.11g				
Freq. (MHz)	PSD (dBm/3kHz)	Offset	Limit (dBm/3kHz)	Result
2412	-10.87	11.10	8.00	PASS
2437	-10.24	11.10	8.00	PASS
2462	-11.45	11.10	8.00	PASS

POWER DENSITY 802.11n HT20				
Freq. (MHz)	PSD (dBm/3kHz)	Offset	Limit (dBm/3kHz)	Result
2412	-12.71	11.10	8.00	PASS
2437	-14.05	11.10	8.00	PASS
2462	-13.77	11.10	8.00	PASS

POWER DENSITY 802.11n HT40				
Freq. (MHz)	PSD (dBm/3kHz)	Offset	Limit (dBm/3kHz)	Result
2422	-15.99	11.10	8.00	PASS
2437	-15.91	11.10	8.00	PASS
2452	-15.98	11.10	8.00	PASS

Note

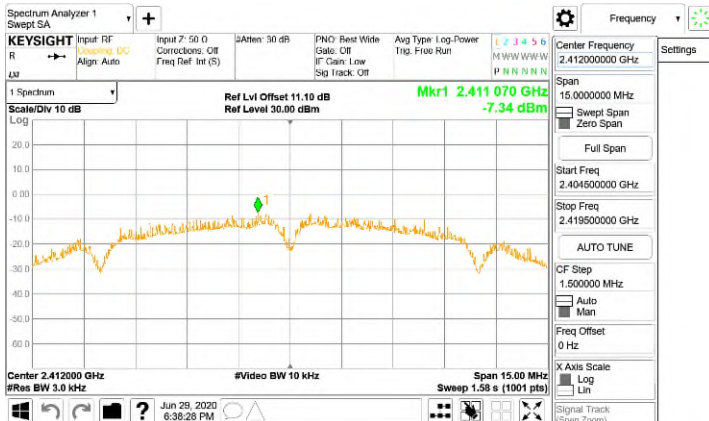
Cable Loss 11.10 dB

*Refer to next page for plots

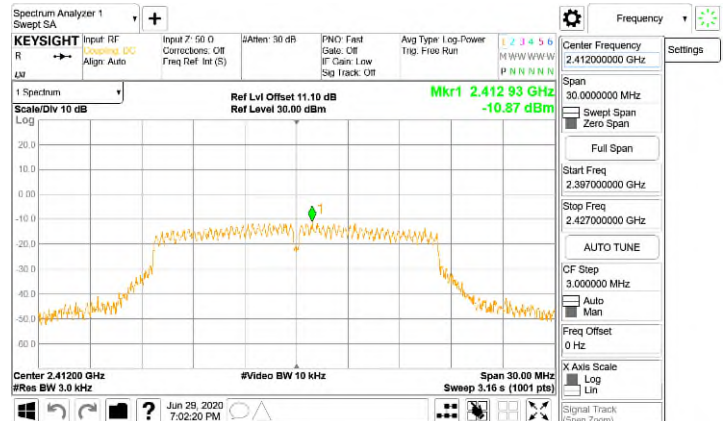
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FCC_15_247_WLANPower Density_802.11b_20MHz_Chain0_2412MHz



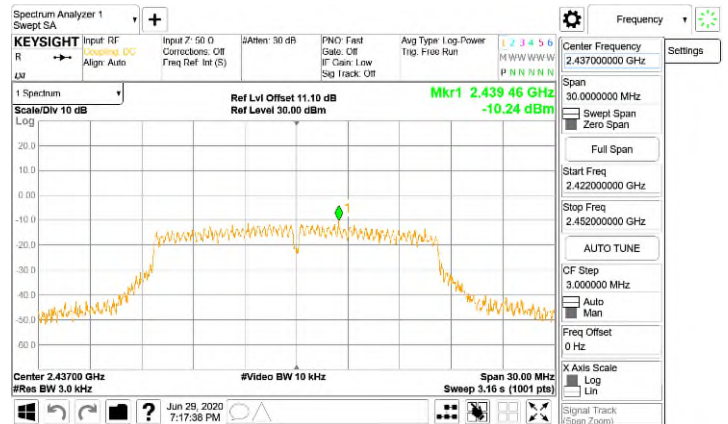
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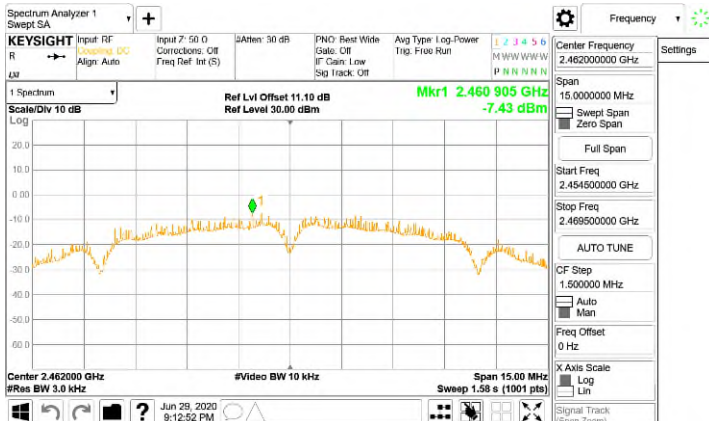
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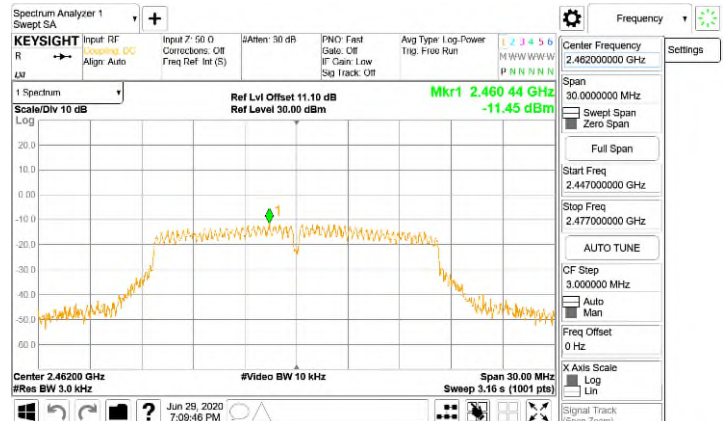
FCC_15_247_WLANPower Density_802.11g_20MHz_Chain0_2437MHz



FCC_15_247_WLANPower Density_802.11b_20MHz_Chain0_2462MHz



FCC_15_247_WLANPower Density_802.11g_20MHz_Chain0_2462MHz

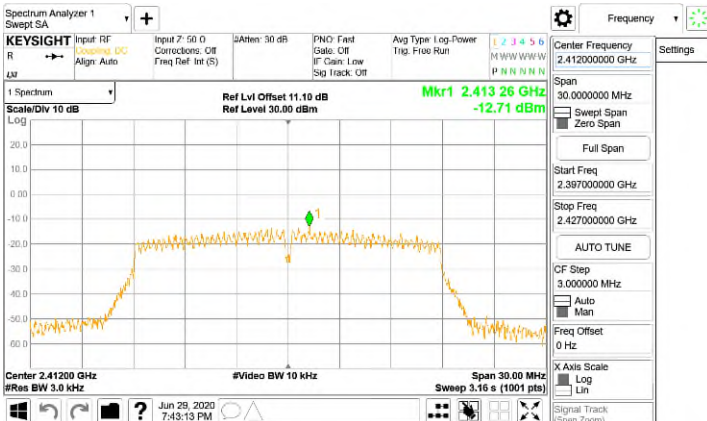


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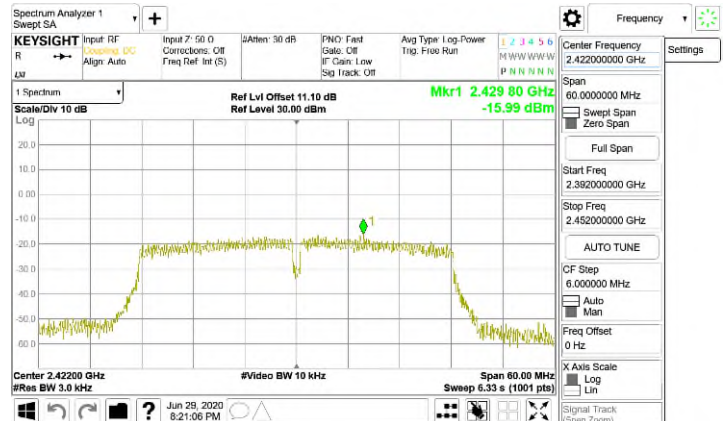
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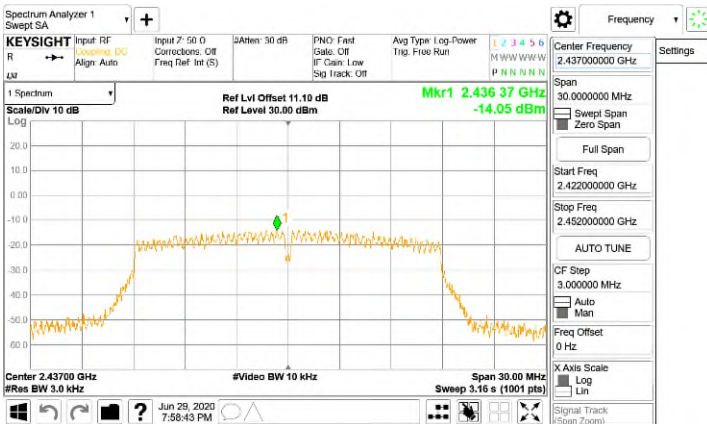
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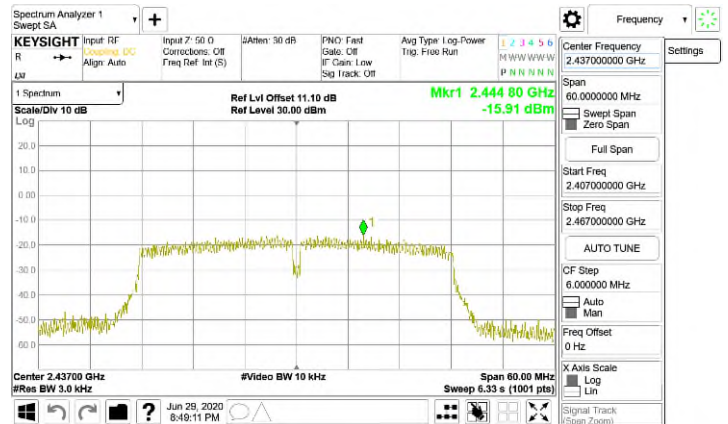
FCC_15_247_WLANPower Density_802.11n_40MHz_Chain0_2422MHz



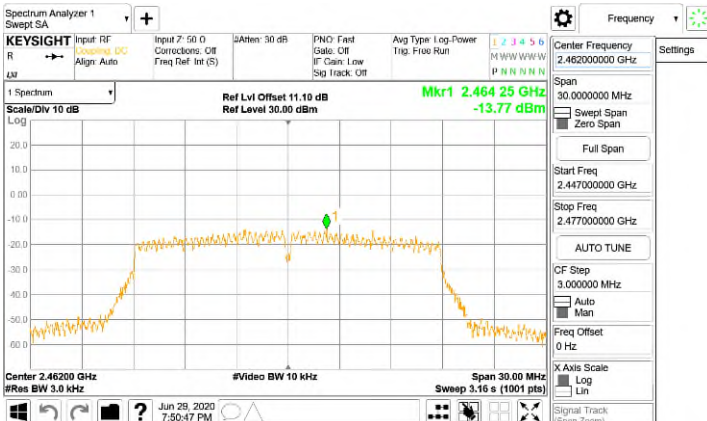
FCC_15_247_WLANPower Density_802.11n_20MHz_Chain0_2437MHz



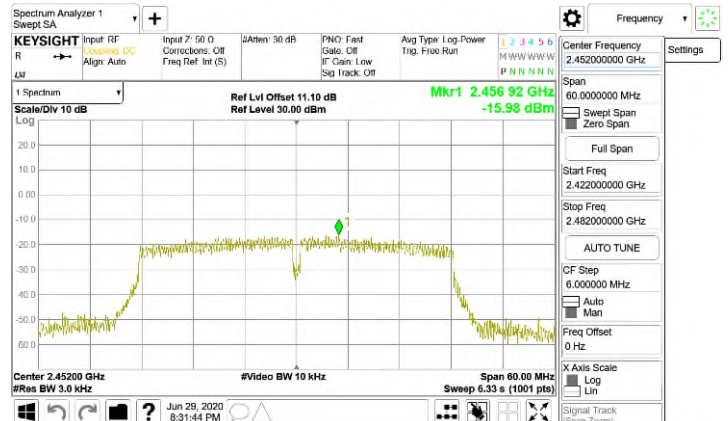
FCC_15_247_WLANPower Density_802.11n_40MHz_Chain0_2437MHz



FCC_15_247_WLANPower Density_802.11n_20MHz_Chain0_2462MHz



FCC_15_247_WLANPower Density_802.11n_40MHz_Chain0_2452MHz



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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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