

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

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

Product Name: Clover Flex

Brand Name: clover

Model No.: C403

Model Difference: N/A

Report Number: E2/2020/50043

FCC ID: HFS-C403V

FCC Rule Part: §15.247, Cat: DTS

Issue Date: Jun. 16, 2020

Date of Test: May 14, 2020 ~ Jun. 10, 2020

**Date of EUT Re-
ceived:** May 14, 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
E2/2020/50043	Rev.00	Original.	Jun. 16, 2020	Revised By: Karen Huang

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:	Clover Flex	
Brand Name:	clover	
Model No.:	C403	
Model Difference:	N/A	
Hardware Version:	4.01	
Software Version:	N/A	
Micro Hub:	Model No.: H400, Supplier: clover	
Docking:	Model No.: K400, Supplier: clover	
Power Supply:	7.6V from Li-ion Polymer rechargeable battery or 12V from Adapter	
	Battery:	Model No.: CA355772HV_POS5, Supplier: Zhuhai CosMX Battery Co., Ltd.
	Adapter:	Model No.: FSP040-RHBN3, Supplier: FSP

Wi-Fi 802.11	Frequency Range	Channels	Rated Power (dBm)	Modulation Technology
b	2412-2462	11	19.88	DSSS,
g			20.85	OFDM
n_HT20			21.88	
n_HT40	2422-2452	7	22.76	
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		

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1.2 Antenna Designation

Antenna Type	Supplier	Antenna Part No.	Freq.	Peak Antenna Gain (dBi)	Worst Antenna Gain
PIFA	SAA	DQ60AYF0002	2.4GHz	-1.47	-

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

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 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 & Conducted (Antenna Port) Emission Configuration

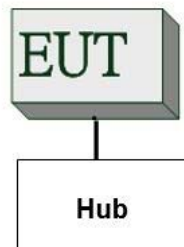


Fig 2-2 Conduction (AC Power Line) Emission

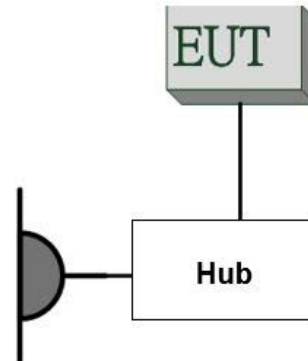


Table 2-1 Equipment Used in Tested System

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	Hub	clover	H400	N/A	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
☒ 802.11 b	☒ Ch0	☐ Ch1	☐ Ch2	☐ Ch3	☐ 2TX
☒ 802.11 g	☒ Ch0	☐ Ch1	☐ Ch2	☐ Ch3	☐ 2TX
☒ 802.11 n	☒ Ch0	☐ Ch1	☐ Ch2	☐ Ch3	☐ MIMO
☐ 802.11 ax	☐ Ch0	☐ Ch1	☐ Ch2	☐ Ch3	☐ 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

6.3 EUT Setup

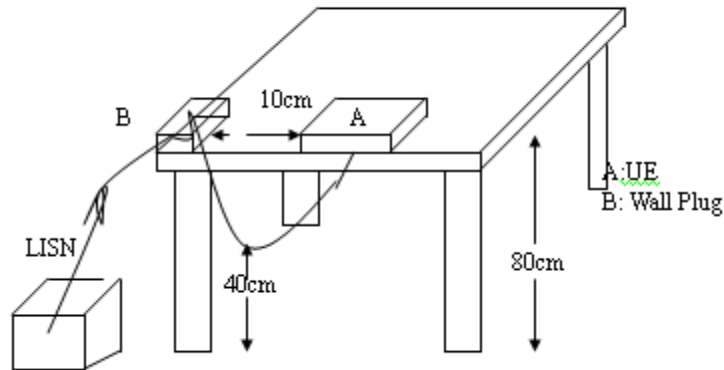
1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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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.

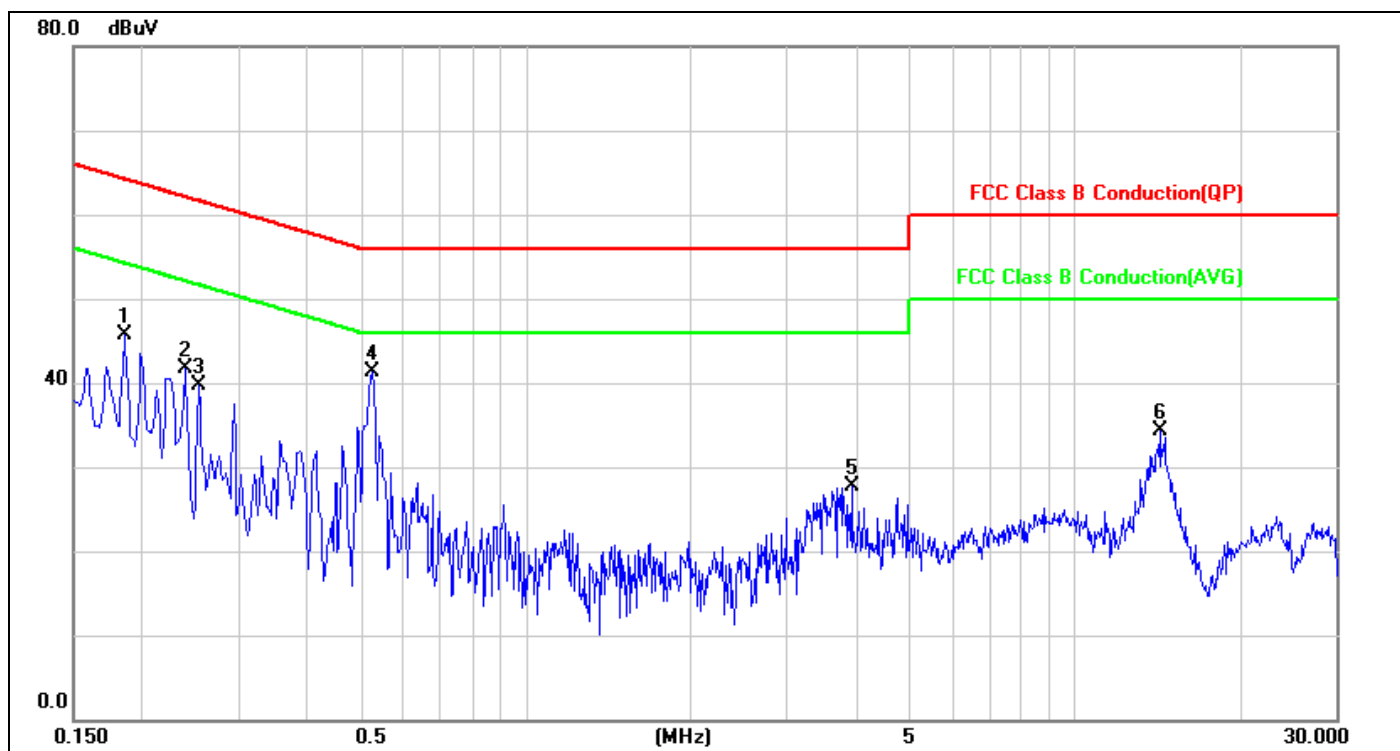
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Site:	: Conduction Room C	Date:	2020/5/29	Time:	PM 03:08:11
Limit:	FCC Class B Conduction(QP)	Probe:	L1	Temperature:	23.7 °C
Mode:	WLAN 2.4G	Power:	AC120/60Hz	Humidity:	69 %RH
Re-	E2-2020-50043			Air Pressure:	1010
port:				hpa	
Tester:	Kailin				
Note:	EUT_Adaptador:FSP040-RHBN3				



No.	Mk.	Freq.	Reading	Factor	Measure- ment	Limit	Over	Detector	Comment
		(MHz)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dB)		
1		0.1860	35.41	10.22	45.63	64.21	-18.58	peak	
2		0.2400	31.49	10.22	41.71	62.10	-20.39	peak	
3		0.2535	29.43	10.22	39.65	61.64	-21.99	peak	
4	*	0.5280	31.14	10.24	41.38	56.00	-14.62	peak	
5		3.9255	17.18	10.48	27.66	56.00	-28.34	peak	
6		14.3115	23.45	10.76	34.21	60.00	-25.79	peak	

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Site: : Conduction Room C

Date: 2020/5/29

Time: PM 03:08:48

Limit: FCC Class B Conduction(QP)

Probe: N

Temperature: 23.7 °C

Mode: WLAN 2.4G

Power: AC120/60Hz

Humidity: 69 %RH

Re- E2-2020-50043

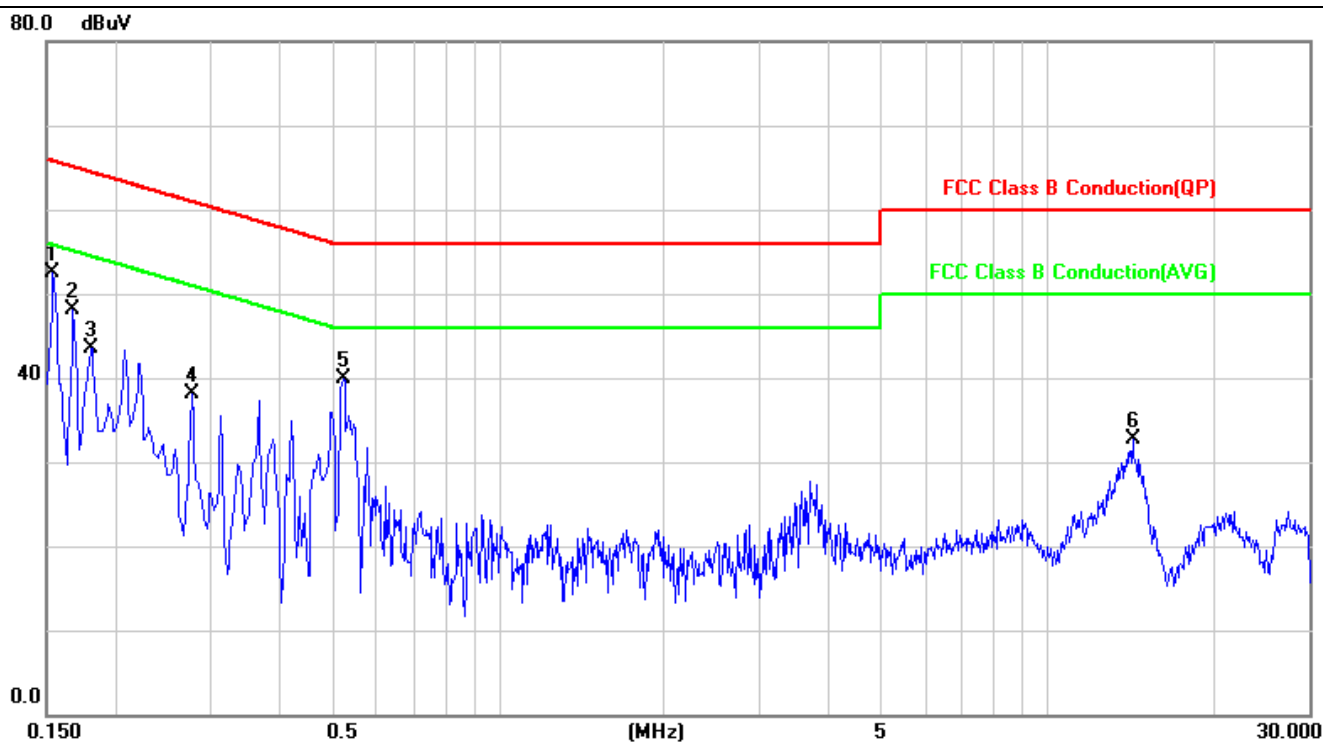
port:

Air Pressure: 1010

hpa

Tester: Kailin

Note: EUT_Adaptador:FSP040-RHBN3



No.	Mk.	Freq.	Reading	Factor	Measure- ment	Limit	Over	Detector	Comment
		(MHz)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dB)		
1	*	0.1545	42.20	10.21	52.41	65.75	-13.34	peak	
2		0.1680	37.98	10.21	48.19	65.06	-16.87	peak	
3		0.1815	33.32	10.21	43.53	64.42	-20.89	peak	
4		0.2760	27.99	10.21	38.20	60.94	-22.74	peak	
5		0.5235	29.76	10.22	39.98	56.00	-16.02	peak	
6		14.3340	21.84	10.78	32.62	60.00	-27.38	peak	

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7 DUTY CYCLE OF TEST SIGNAL

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle. All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

7.1 Measurement Procedure:

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

7.2 Duty Cycle:

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
802.11b	99.28	0.03	0.08	0.01
802.11g	94.93	0.23	0.49	1.00
802.11n_20	95.07	0.22	0.52	1.00
802.11n_40	90.48	0.43	1.05	2.00

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

Duty Cycle Factor: $10 * \log(1/0.9493) = 0.23$

Duty Cycle Factor: $10 * \log(1/0.9507) = 0.22$

Duty Cycle Factor: $10 * \log(1/0.9048) = 0.43$

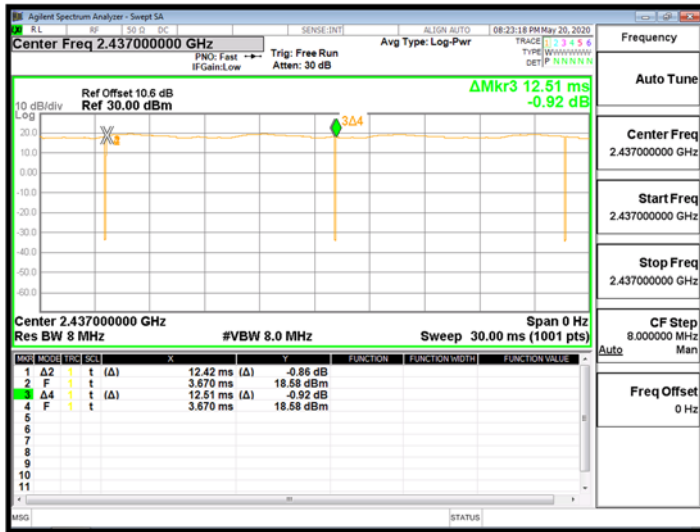
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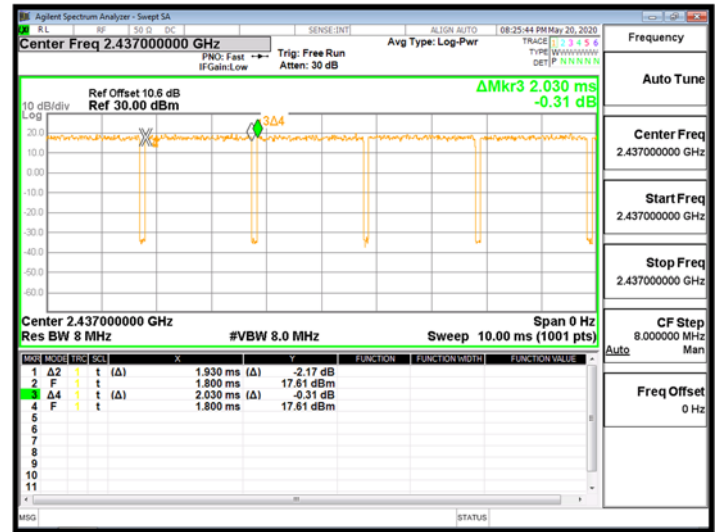
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7.3 Duty Cycle test plots

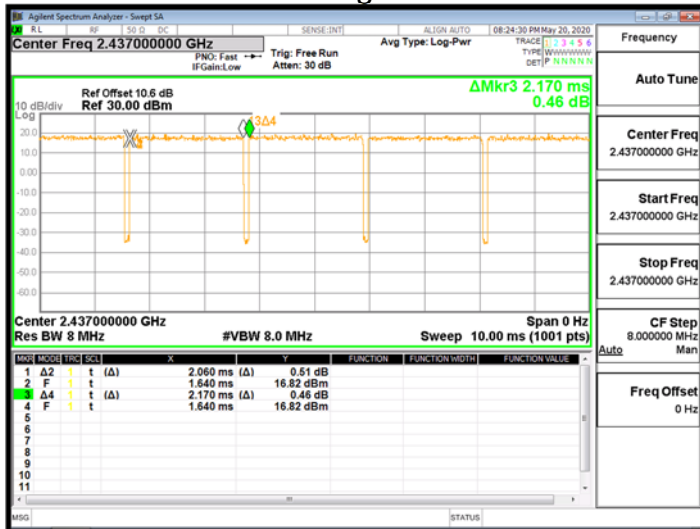
802.11 b mode



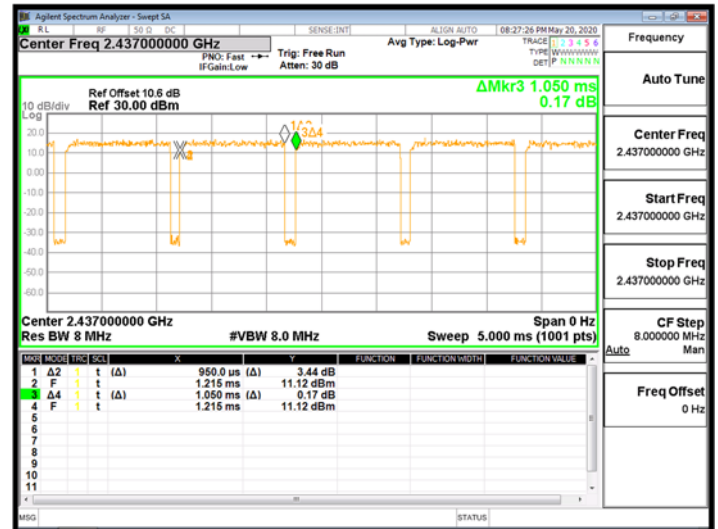
802.11 n HT20 mode



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 form the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

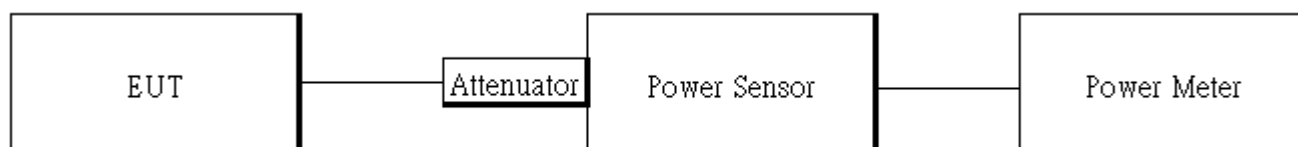
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

8.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	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
Spectrum Analyzer	KEYSIGHT	N9010B	MY59070240	04/14/2019	04/14/2021
DC Block	PASTERNAK	PE8210	RF29	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:



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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	19.79	30.00	PASS
6	2437	1	19.83	30.00	PASS
11	2462	1	19.88	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	17.15	30.00	PASS
6	2437	1	17.19	30.00	PASS
11	2462	1	17.33	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	20.85	30.00	PASS
6	2437	6	20.61	30.00	PASS
11	2462	6	20.55	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	16.19	30.00	PASS
6	2437	6	16.15	30.00	PASS
11	2462	6	16.18	30.00	PASS

802.11n_HT20M Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	21.79	30.00	PASS
6	2437	MCS0	21.88	30.00	PASS
11	2462	MCS0	21.27	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	16.95	30.00	PASS
6	2437	MCS0	16.91	30.00	PASS
11	2462	MCS0	16.61	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	22.48	30.00	PASS
6	2437	MCS0	22.76	30.00	PASS
9	2452	MCS0	22.48	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	15.85	30.00	PASS
6	2437	MCS0	15.98	30.00	PASS
9	2452	MCS0	15.75	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

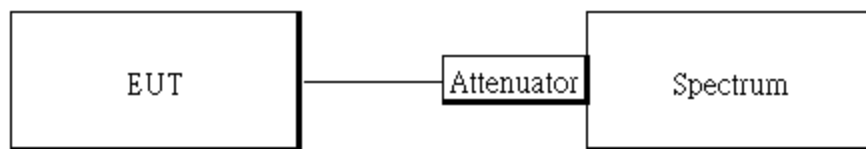
9.1 Standard Applicable

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	MY59070240	04/14/2019	04/14/2021
DC Block	PASTERNAK	PE8210	RF29	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. 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	8058.00	> 500	PASS
2437	8056.00	> 500	PASS
2462	7525.00	> 500	PASS

802.11g Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	15170.00	> 500	PASS
2437	15380.00	> 500	PASS
2462	15940.00	> 500	PASS

802.11_n_HT20 Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	15160.00	> 500	PASS
2437	15670.00	> 500	PASS
2462	16260.00	> 500	PASS

802.11_n_HT40 Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2422	35680.00	> 500	PASS
2437	35190.00	> 500	PASS
2452	35170.00	> 500	PASS

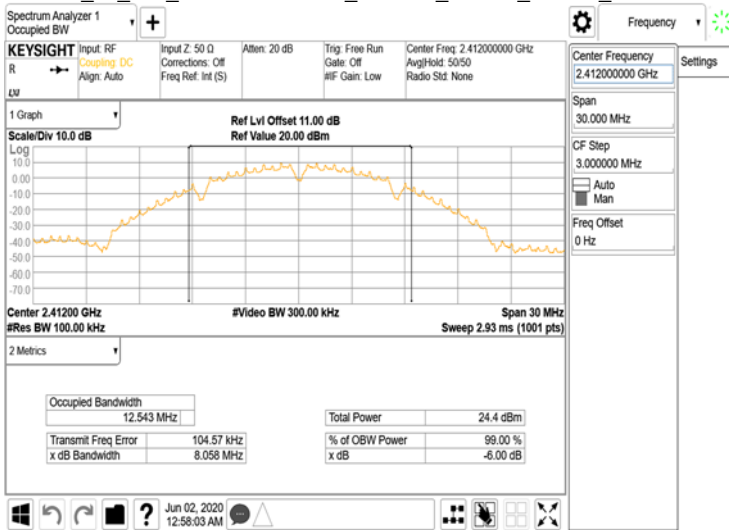
**Refer to next page for plots*

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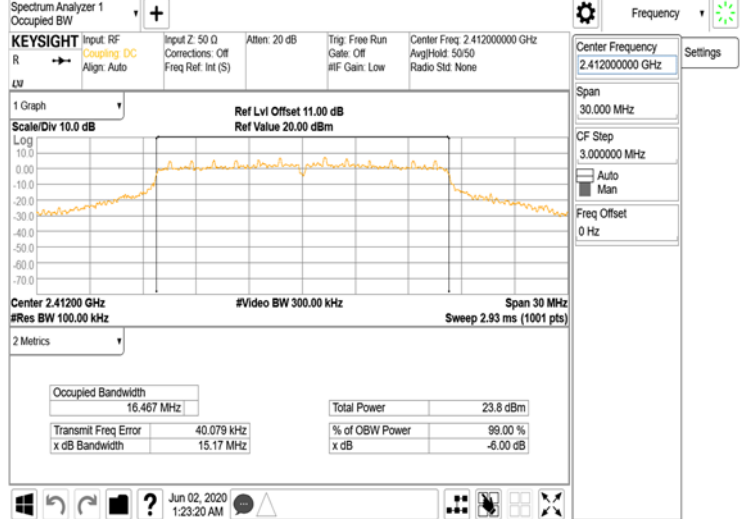
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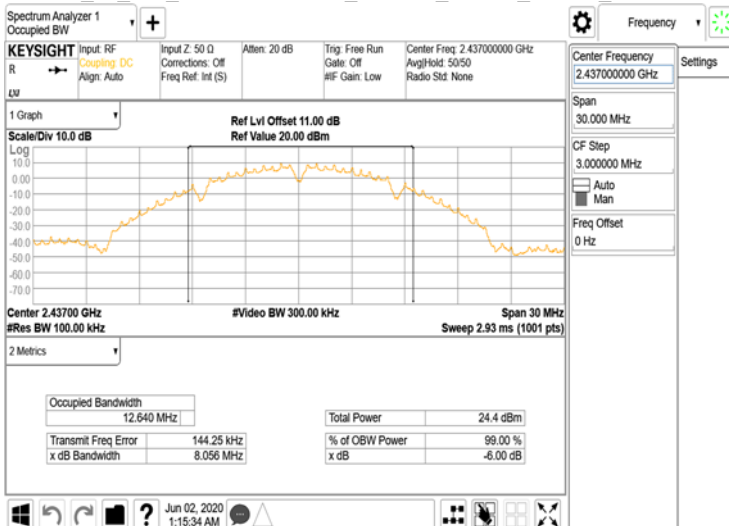
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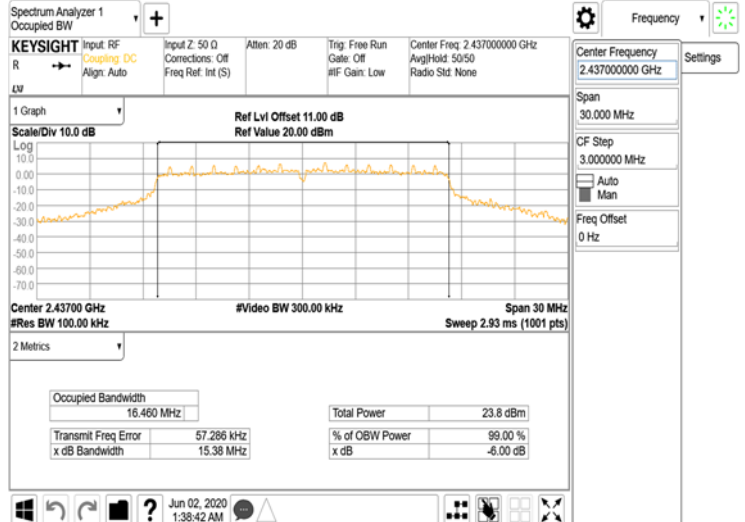
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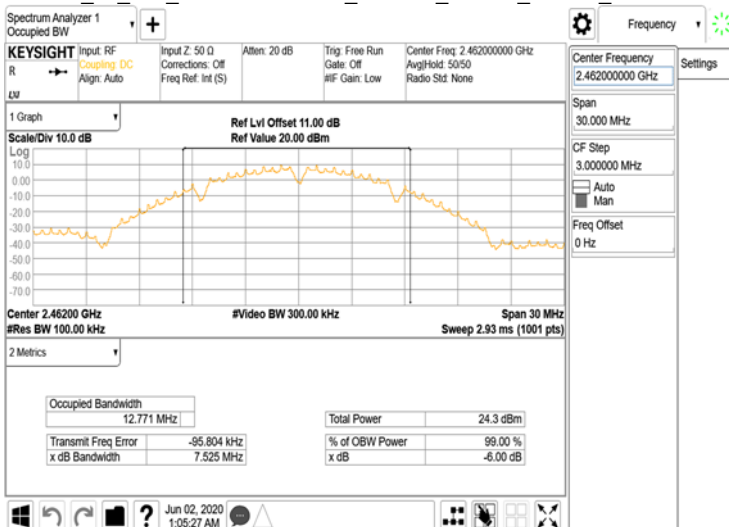
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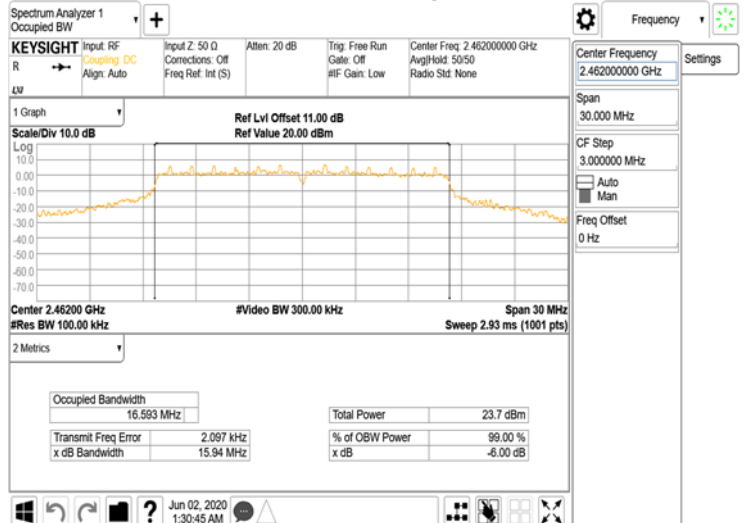
FCC_15_247_WLAN\OBW 6dB_802.11g_20MHz_Chain0_2437MHz



FCC_15_247_WLAN\OBW 6dB_802.11b_20MHz_Chain0_2462MHz



FCC_15_247_WLAN\OBW 6dB_802.11g_20MHz_Chain0_2462MHz

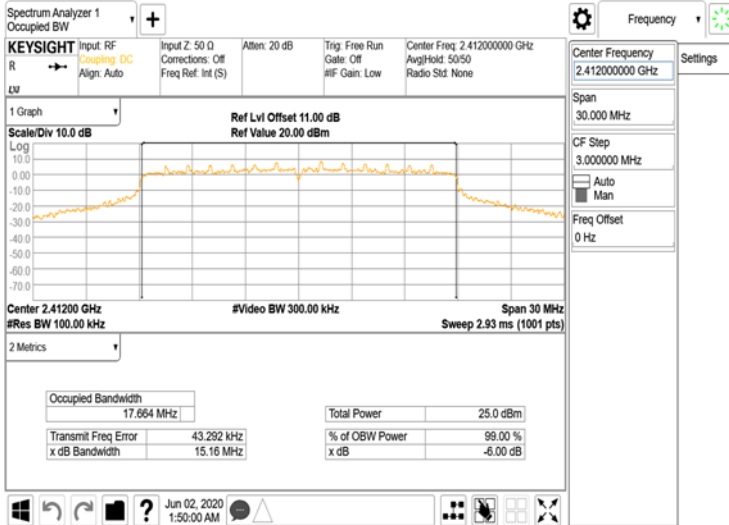


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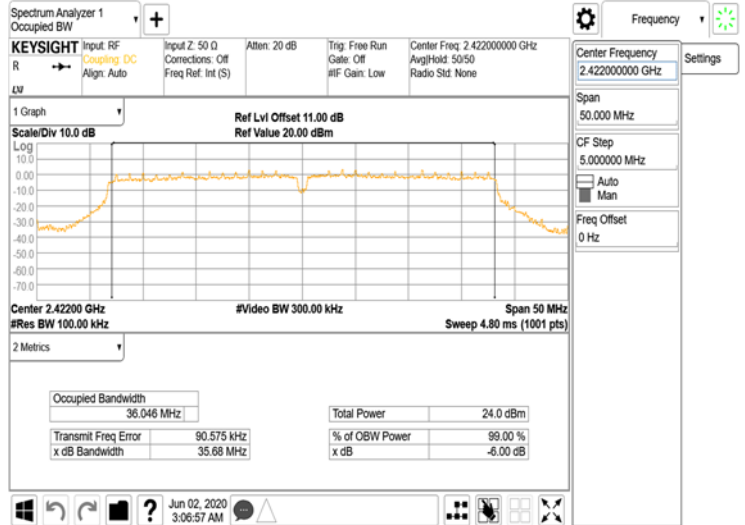
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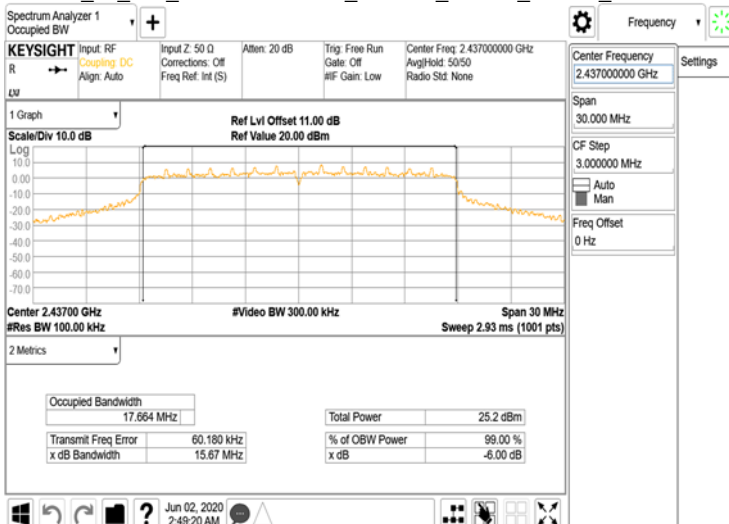
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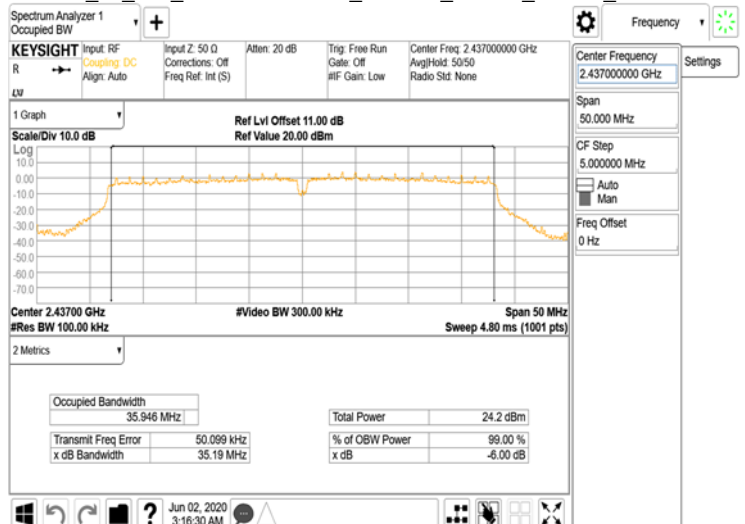
FCC 15 247 WLAN\OBW 6dB 802.11n 40MHz Chain0 2422MHz



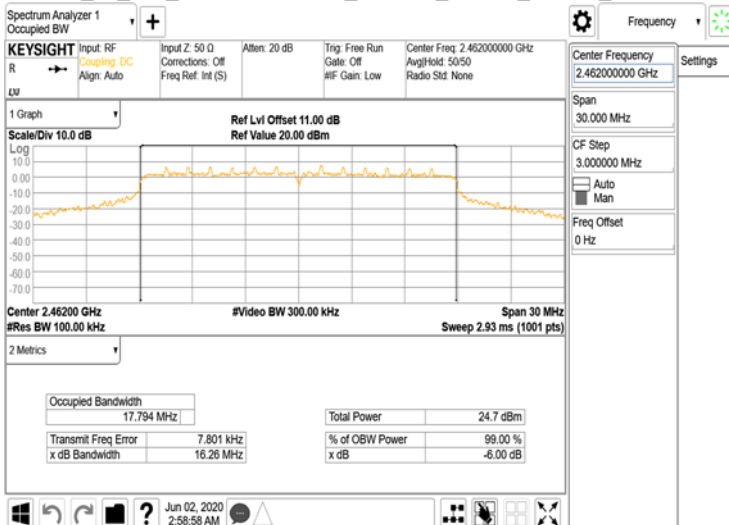
FCC 15 247 WLAN\OBW 6dB 802.11n 20MHz Chain0 2437MHz



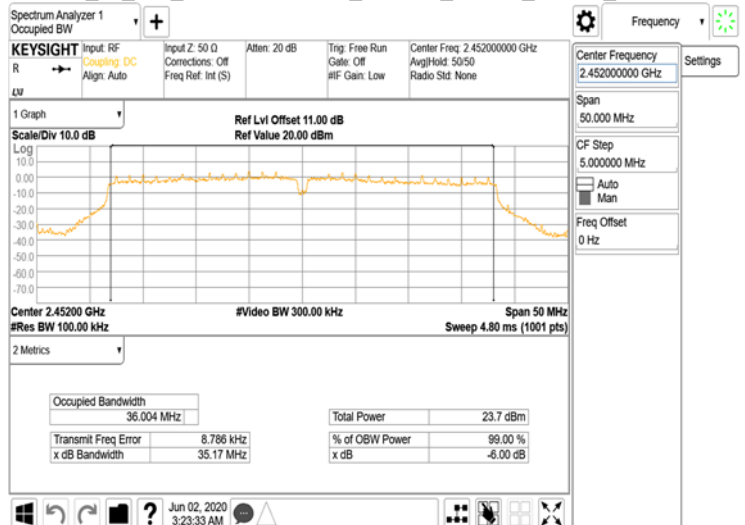
FCC 15 247 WLAN\OBW 6dB 802.11n 40MHz Chain0 2437MHz



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

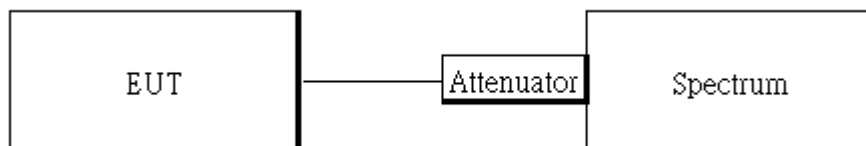
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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	MY59070240	04/14/2019	04/14/2021
DC Block	PASTERNAK	PE8210	RF29	11/20/2019	11/19/2020
Attenuator	Marvelous	WATT-218FS-10	RF245	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		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	9.65	-10.35
2437	9.54	-10.46
2462	9.64	-10.36

Reference Level of Limit 802.11g mode		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	7.14	-12.86
2437	6.86	-13.14
2462	6.85	-13.15

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Reference Level of Limit 802.11n20 mode		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	8.21	-11.79
2437	8.22	-11.78
2462	7.41	-12.59

Reference Level of Limit 802.11n40 MODE		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2422	3.23	-16.77
2437	3.71	-16.29
2452	3.51	-16.49

Note

Cable Loss 11.00 dB

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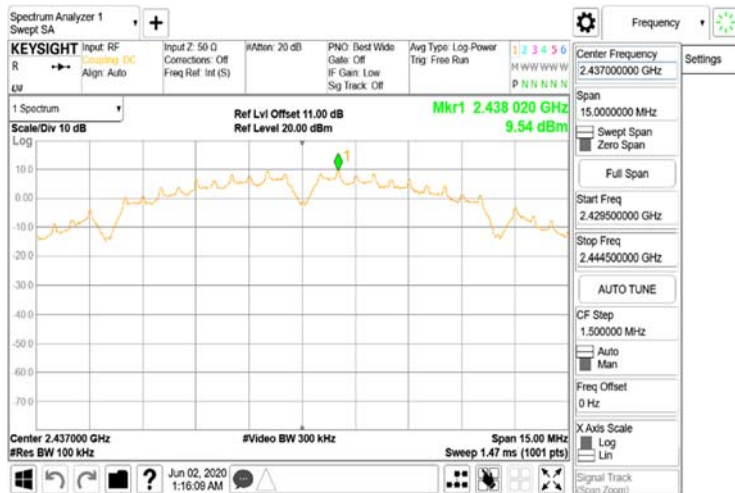
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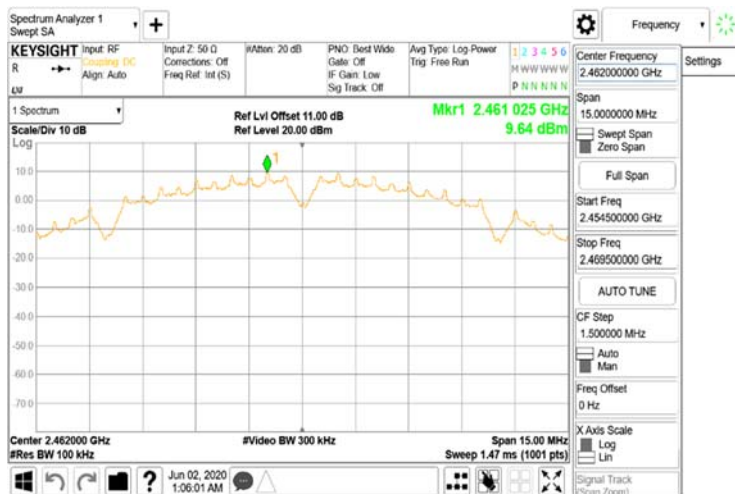
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FCC_15_247_WLAN\Reference Level_802.11g_20MHz_Chain0_2437MHz



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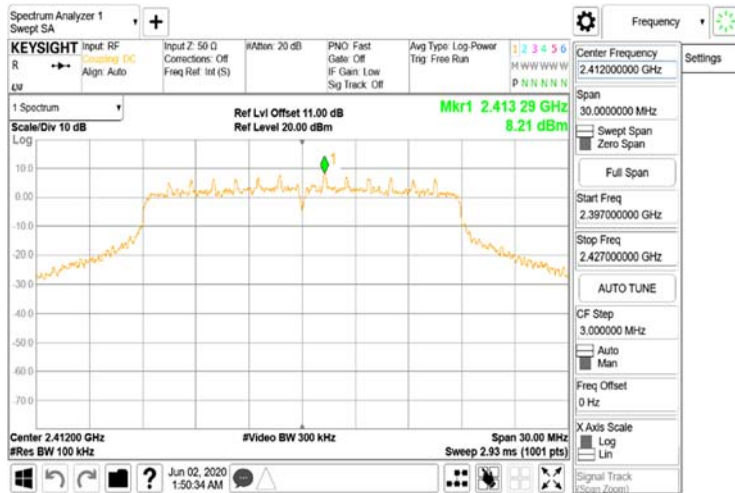


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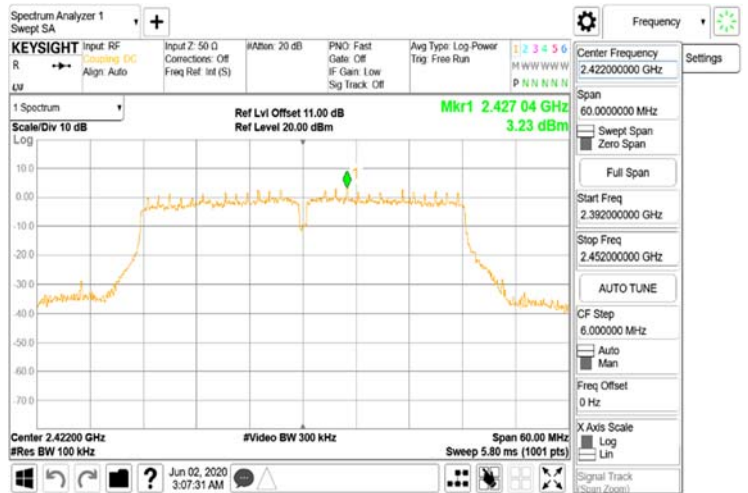
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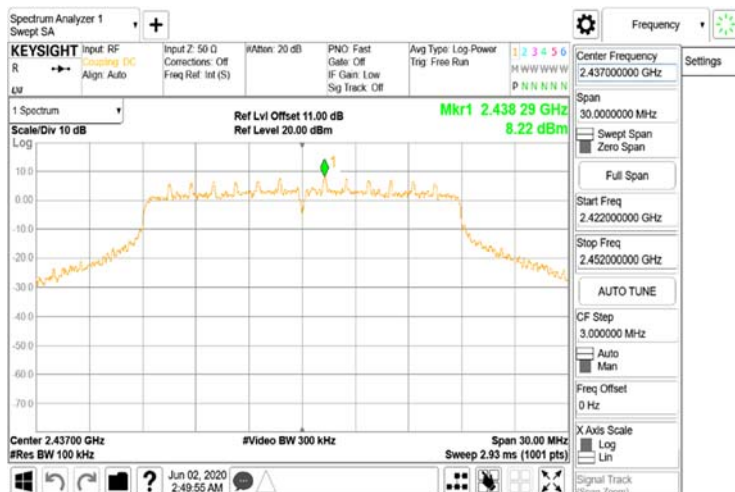
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FCC_15_247_WLAN\Reference Level_802.11n_40MHz_Chain0_2422MHz



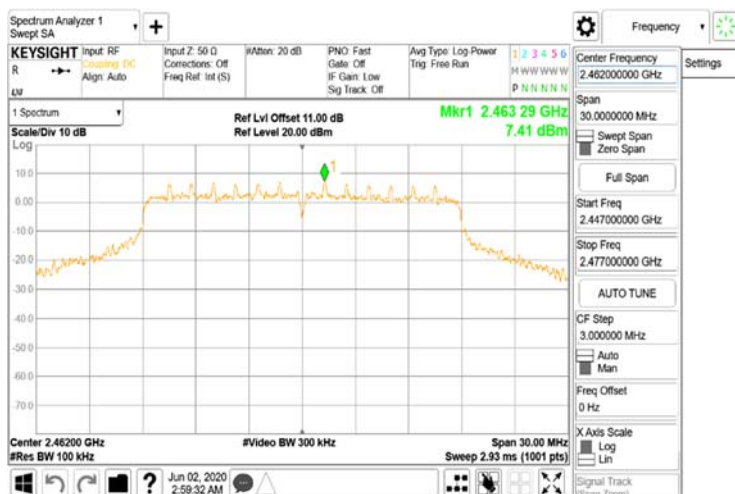
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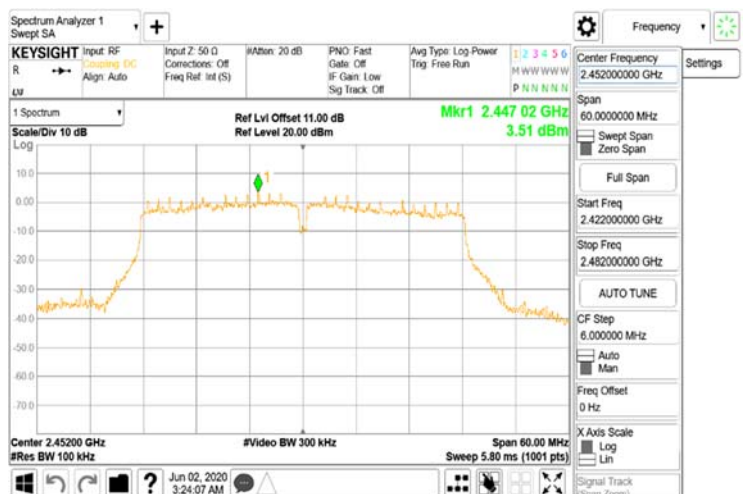
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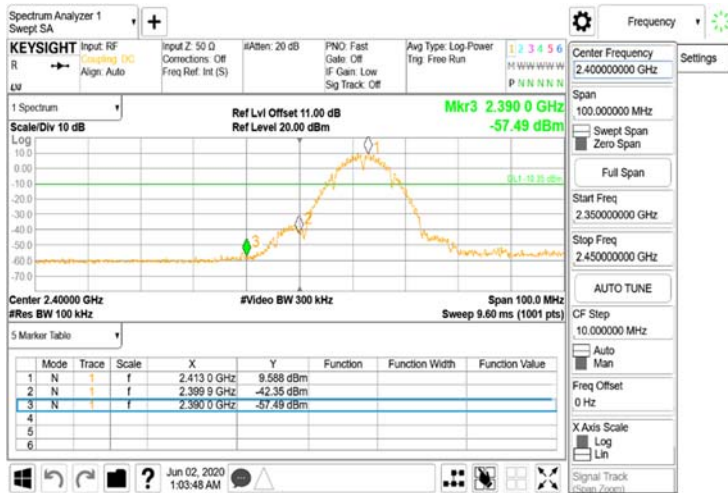
FCC_15_247_WLAN\Reference Level_802.11n_40MHz_Chain0_2452MHz



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FCC_15_247_WLAN\Band Edge_802.11b_20MHz_Chain0_2412MHz



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FCC_15_247_WLAN\Band Edge_802.11b_20MHz_Chain0_2462MHz



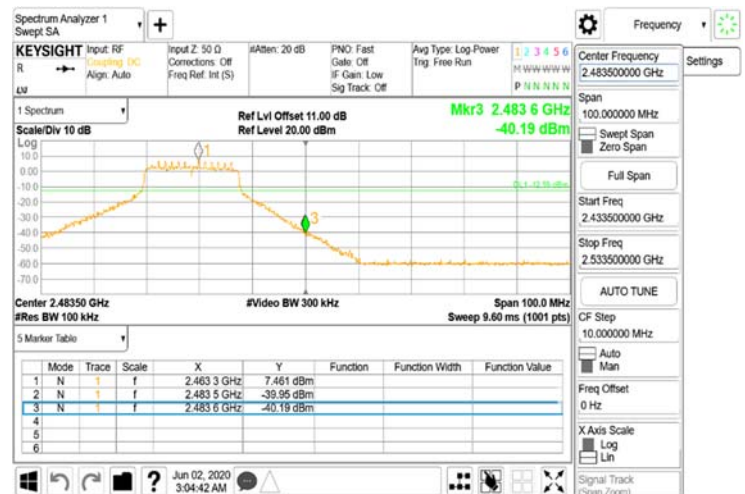
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FCC_15_247_WLAN\Band Edge_802.11n_20MHz_Chain0_2462MHz

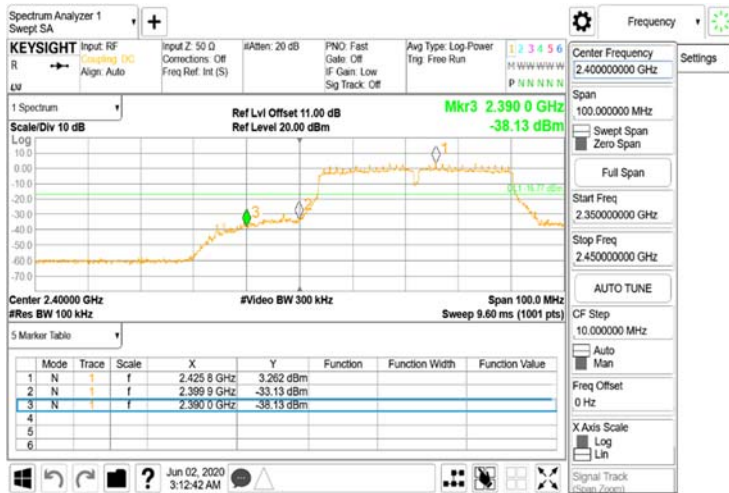


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FCC_15_247_WLAN\Band_Edge_802.11n_40MHz_Chain0_2422MHz



FCC_15_247_WLAN\Band_Edge_802.11n_40MHz_Chain0_2452MHz



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FCC 15 247 WLAN\Spurious Emission_802.11b_20MHz_Chain0_2412MHz



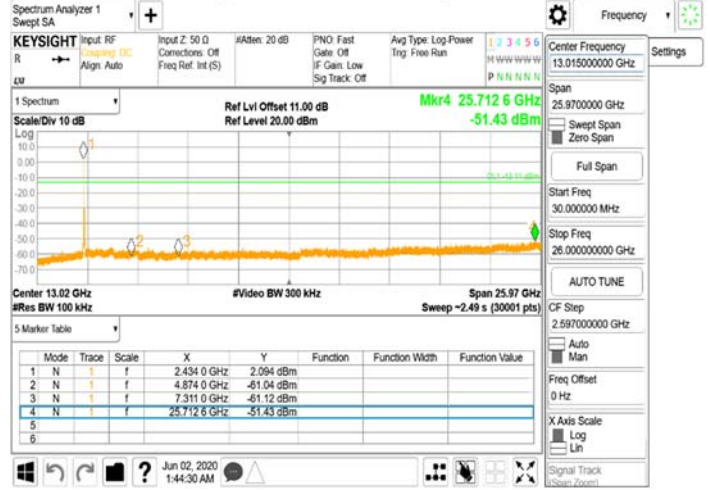
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FCC 15 247 WLAN\Spurious Emission_802.11b_20MHz_Chain0_2437MHz



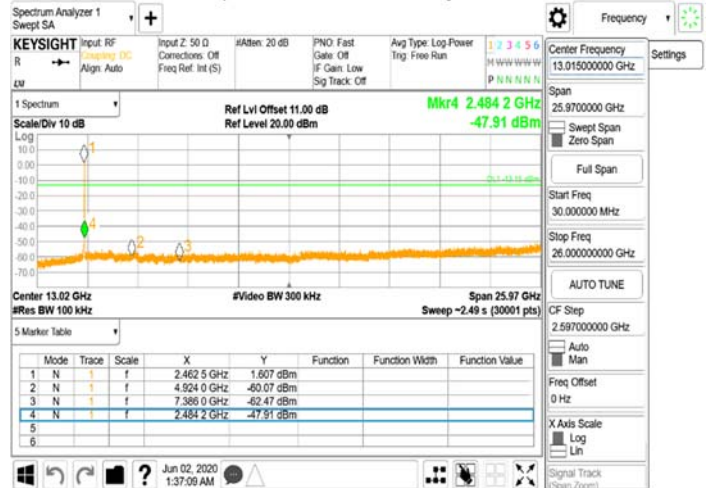
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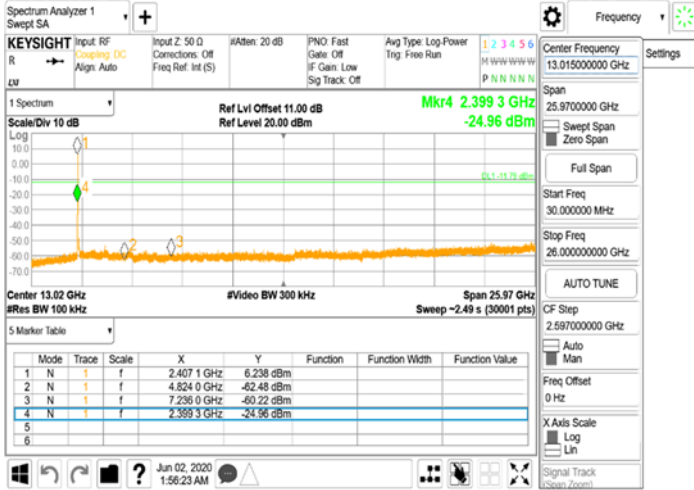


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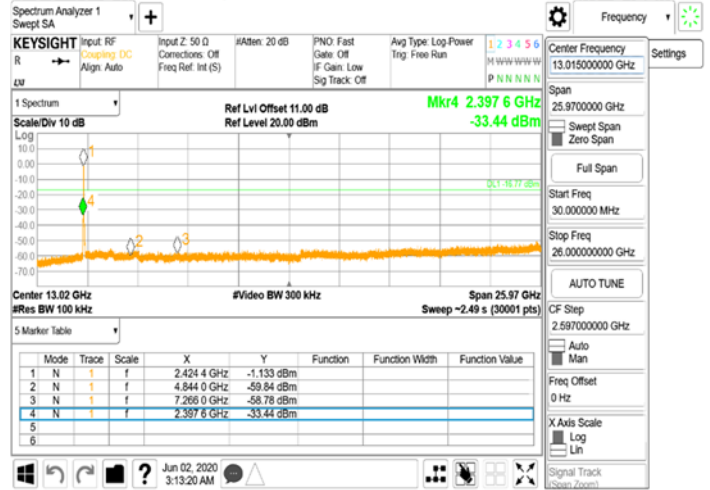
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FCC 15 247 WLAN\Spurious Emission 802.11n 20MHz Chain0 2412MHz



FCC 15 247 WLAN\Spurious Emission 802.11n 40MHz Chain0 2422MHz



FCC 15 247 WLAN\Spurious Emission 802.11n 20MHz Chain0 2437MHz



FCC 15 247 WLAN\Spurious Emission 802.11n 40MHz Chain0 2437MHz



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	185	08/07/2019	08/06/2020
Horn Antenna	Schwarzbeck	BBHA9120D	1341	06/12/2019	06/11/2020
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

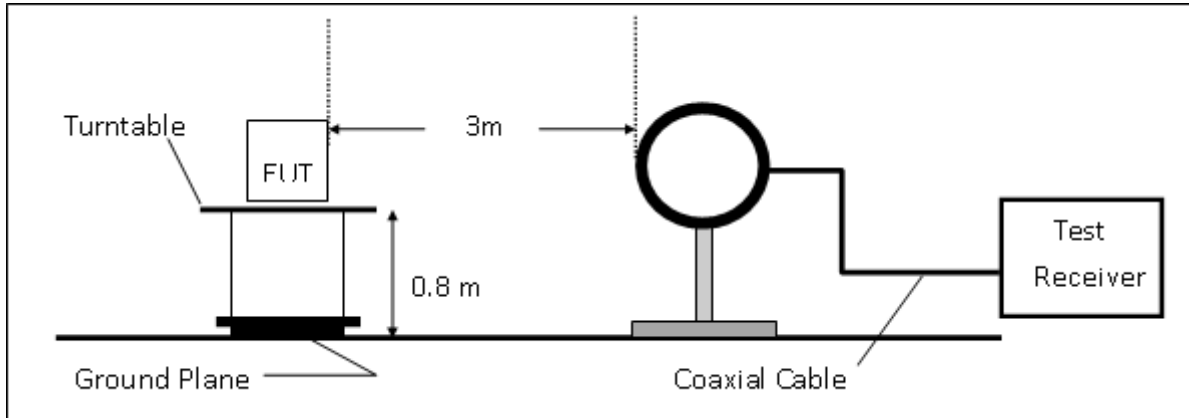
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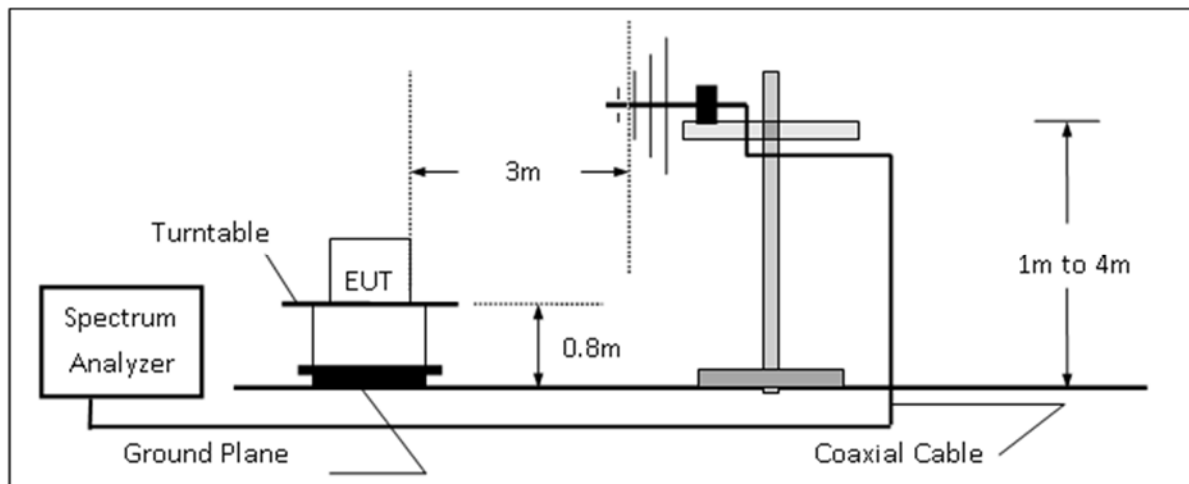
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11.3 Test SET-UP

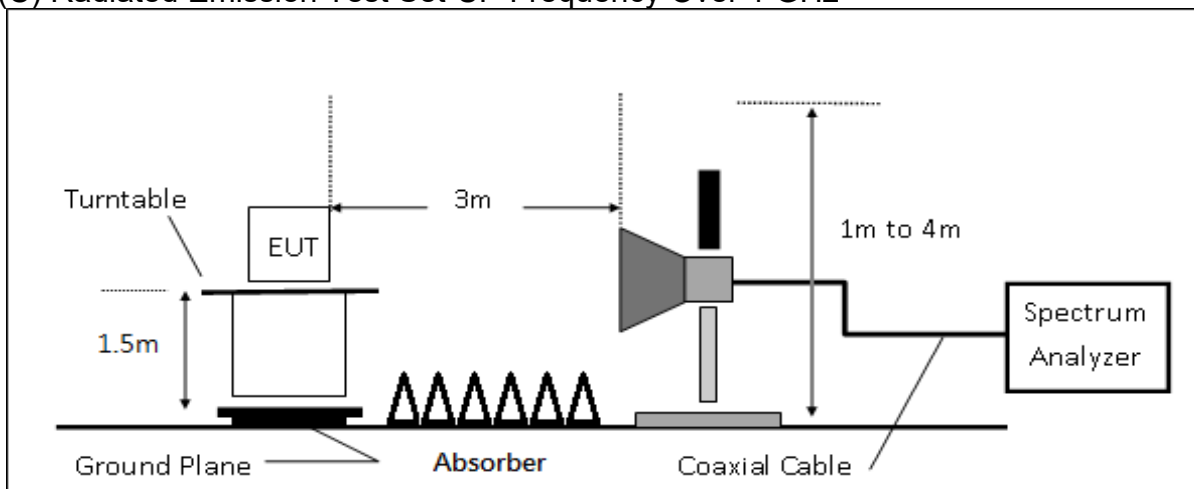
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(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 $20 \cdot \log(\mu V/m)$

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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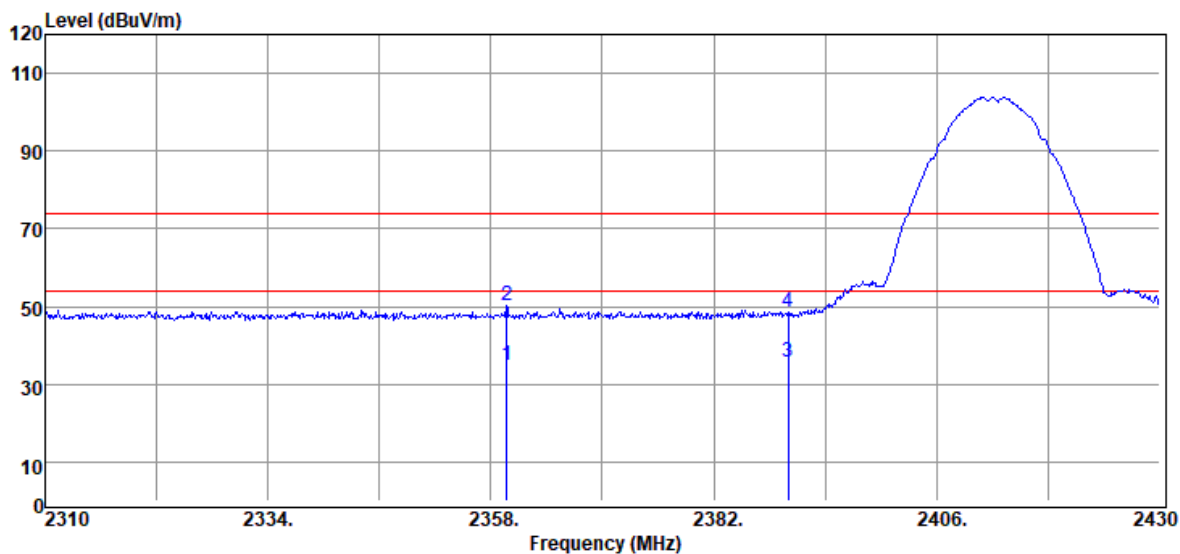
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11.7.1 Radiated Band Edge Measurement Result

Report Number :E2/2020/50043
Operation Mode :802.11b
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/67
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
2359.68	Average	40.34	-5.66	34.68	54.00	-19.32
2359.68	Peak	56.02	-5.66	50.36	74.00	-23.64
2390.00	Average	41.40	-5.52	35.88	54.00	-18.12
2390.00	Peak	54.22	-5.52	48.70	74.00	-25.30

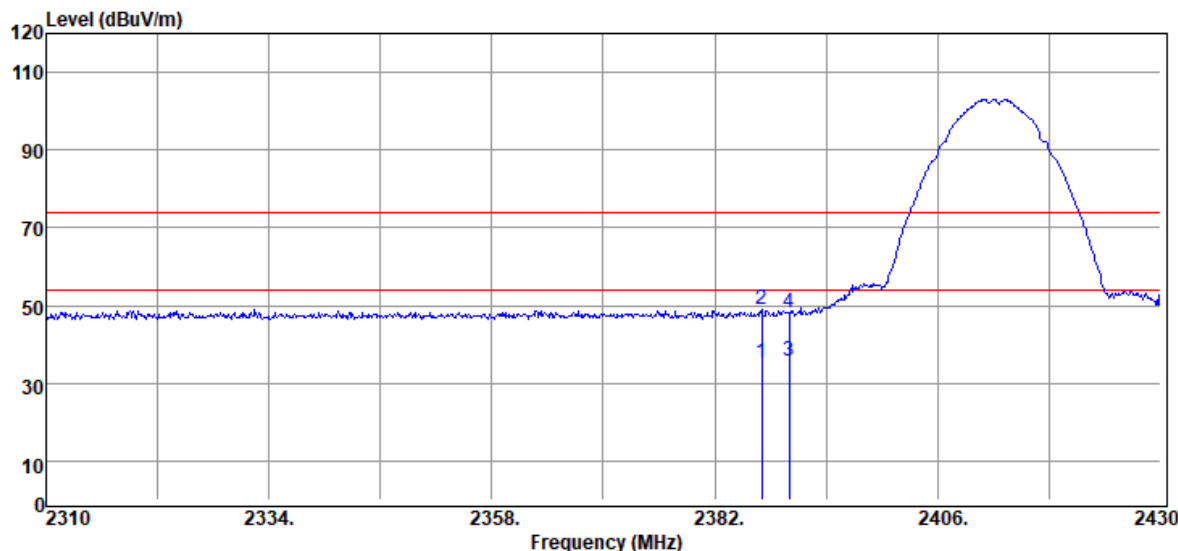
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Report Number :E2/2020/50043
Operation Mode :802.11b
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/67
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
2387.04	Average	40.63	-5.52	35.11	54.00	-18.89
2387.04	Peak	54.41	-5.52	48.89	74.00	-25.11
2390.00	Average	41.23	-5.52	35.71	54.00	-18.29
2390.00	Peak	53.61	-5.52	48.09	74.00	-25.91

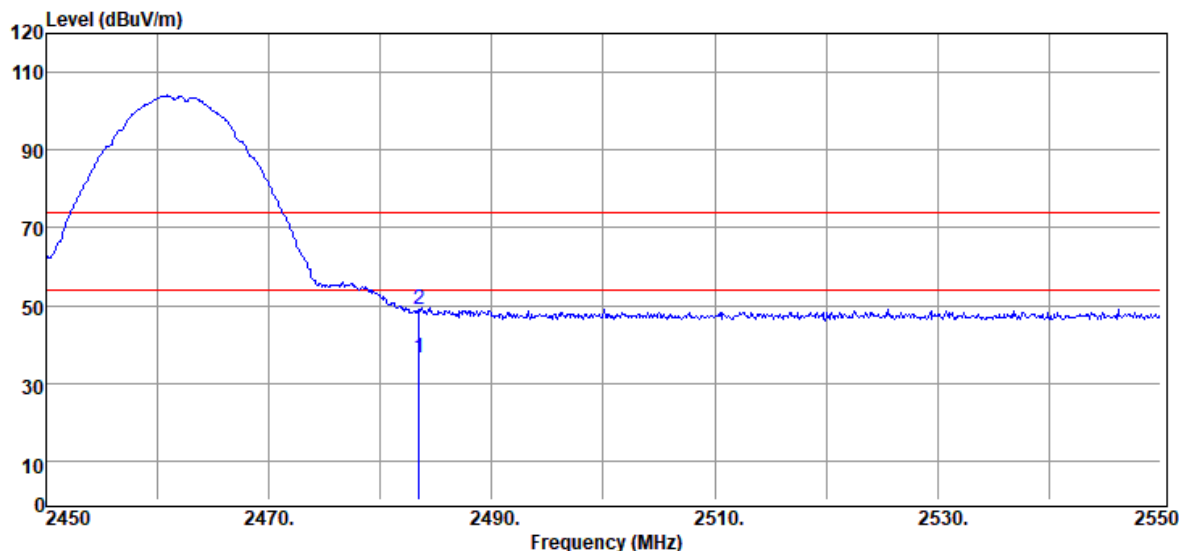
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Report Number :E2/2020/50043
Operation Mode :802.11b
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/67
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	41.88	-5.42	36.46	54.00	-17.54
2483.50	Peak	54.59	-5.42	49.17	74.00	-24.83

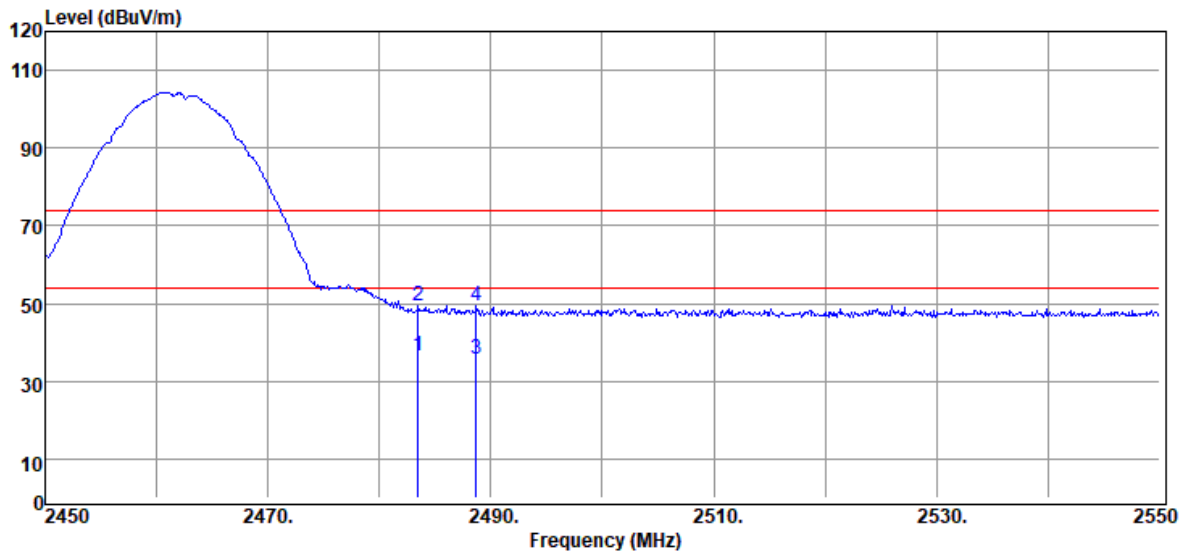
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Operation Mode :802.11b
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/67
Antenna Pol. :HORIZONTAL
Engineer :Kailin

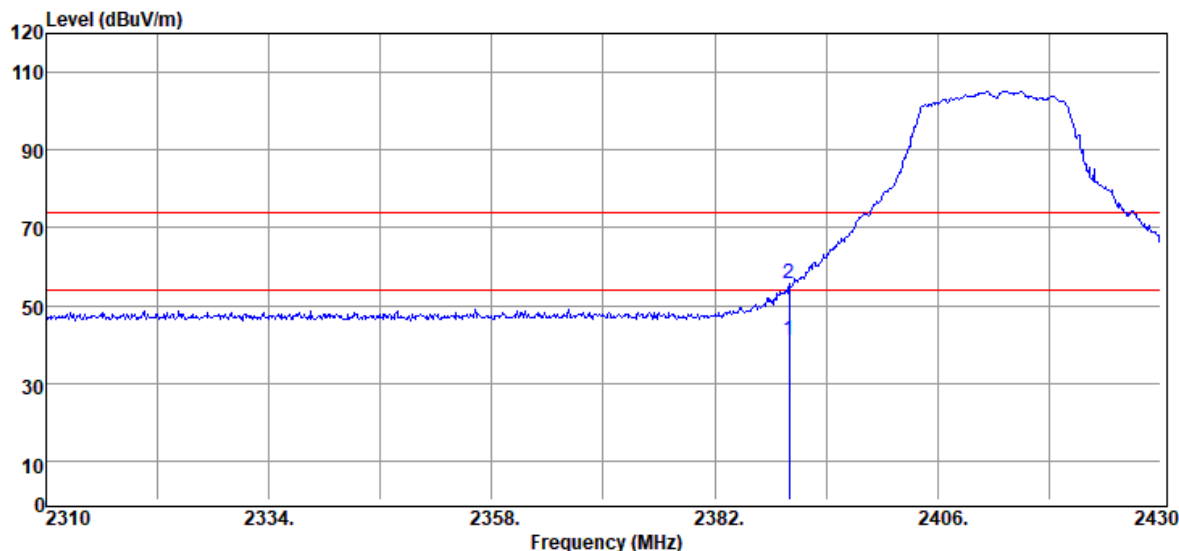


Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	Average	41.88	-5.42	36.46	54.00	-17.54
2483.50	Peak	54.72	-5.42	49.30	74.00	-24.70
2488.70	Average	40.99	-5.41	35.58	54.00	-18.42
2488.70	Peak	54.96	-5.41	49.55	74.00	-24.45

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Report Number :E2/2020/50043
Operation Mode :802.11g
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/66
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	46.60	-5.52	41.08	54.00	-12.92
2390.00	Peak	61.24	-5.52	55.72	74.00	-18.28

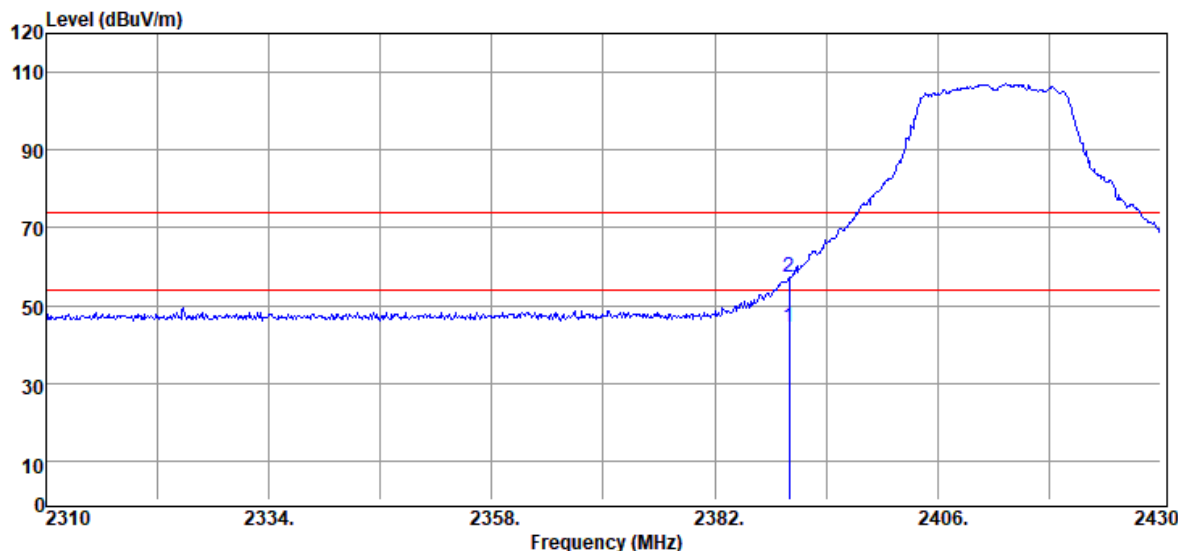
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Operation Mode :802.11g
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/66
Antenna Pol. :HORIZONTAL
Engineer :Kailin



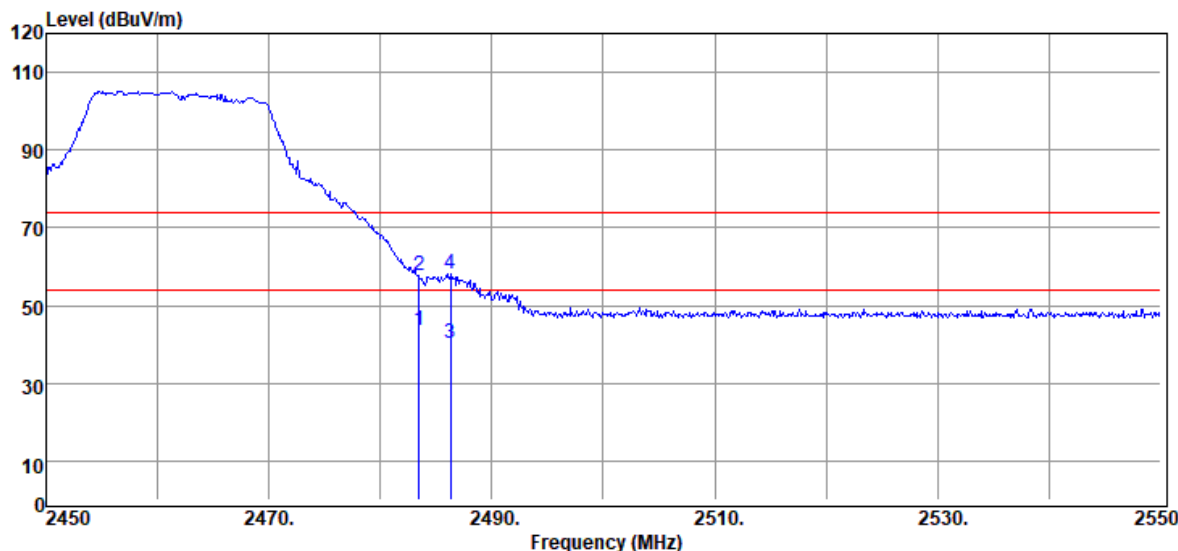
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2390.00	Average	49.89	-5.52	44.37	54.00	-9.63
2390.00	Peak	62.86	-5.52	57.34	74.00	-16.66

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Report Number :E2/2020/50043
Operation Mode :802.11g
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.6/66
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	49.20	-5.42	43.78	54.00	-10.22
2483.50	Peak	63.03	-5.42	57.61	74.00	-16.39
2486.30	Average	45.88	-5.42	40.46	54.00	-13.54
2486.30	Peak	63.45	-5.42	58.03	74.00	-15.97

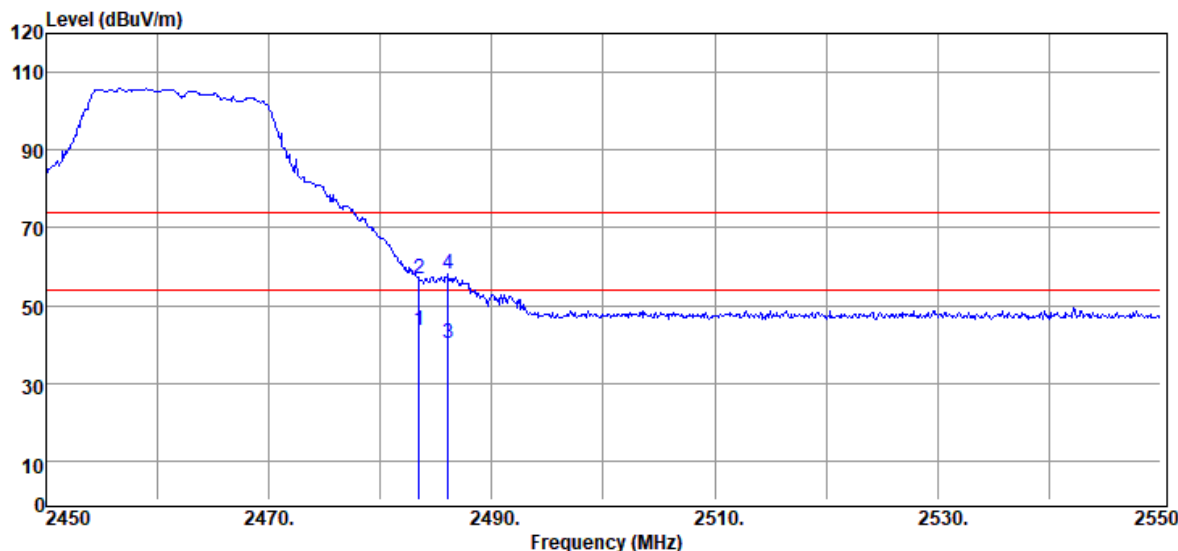
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Report Number :E2/2020/50043
Operation Mode :802.11g
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.6/66
Antenna Pol. :HORIZONTAL
Engineer :Kailin



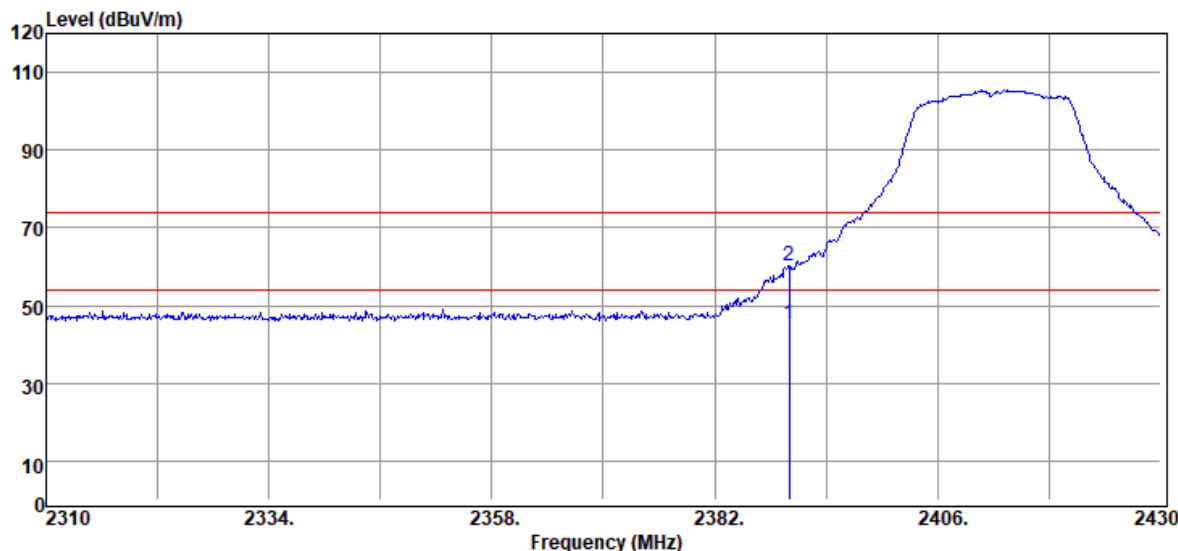
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	Average	48.95	-5.42	43.53	54.00	-10.47
2483.50	Peak	62.20	-5.42	56.78	74.00	-17.22
2486.10	Average	45.76	-5.42	40.34	54.00	-13.66
2486.10	Peak	63.36	-5.42	57.94	74.00	-16.06

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Report Number :E2/2020/50043
Operation Mode :802.11n20
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.6/66
Antenna Pol. :VERTICAL
Engineer :Kailin


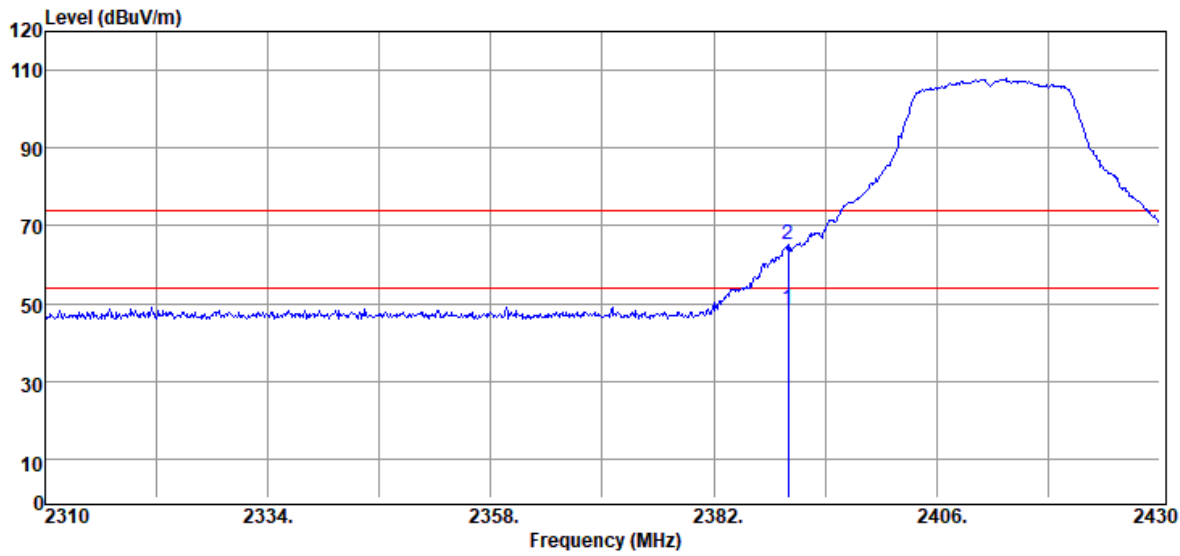
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2390.00	Average	50.85	-5.52	45.33	54.00	-8.67
2390.00	Peak	65.70	-5.52	60.18	74.00	-13.82

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Report Number :E2/2020/50043
Operation Mode :802.11n20
Test Frequency :2412 MHz
Test Mode :BE CH LOW
EUT Pol :H Plan

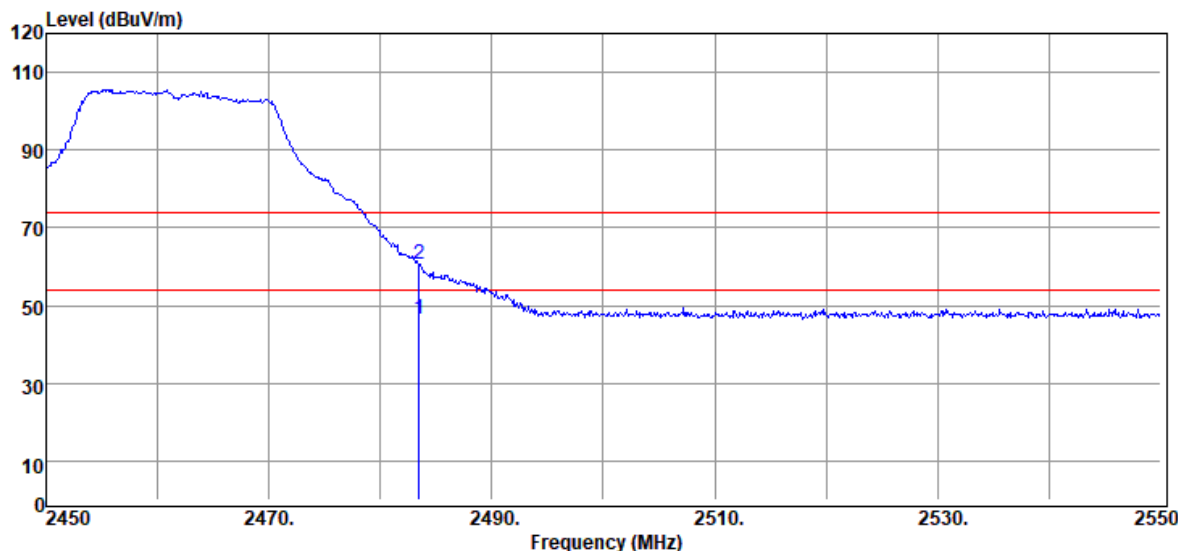
Test Date :2020-06-02
Temp./Humi. :21.6/66
Antenna Pol. :HORIZONTAL
Engineer :Kailin


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
2390.00	Average	53.97	-5.52	48.45	54.00	-5.55
2390.00	Peak	70.74	-5.52	65.22	74.00	-8.78

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Report Number :E2/2020/50043
Operation Mode :802.11n20
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.6/66
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	51.89	-5.42	46.47	54.00	-7.53
2483.50	Peak	65.98	-5.42	60.56	74.00	-13.44

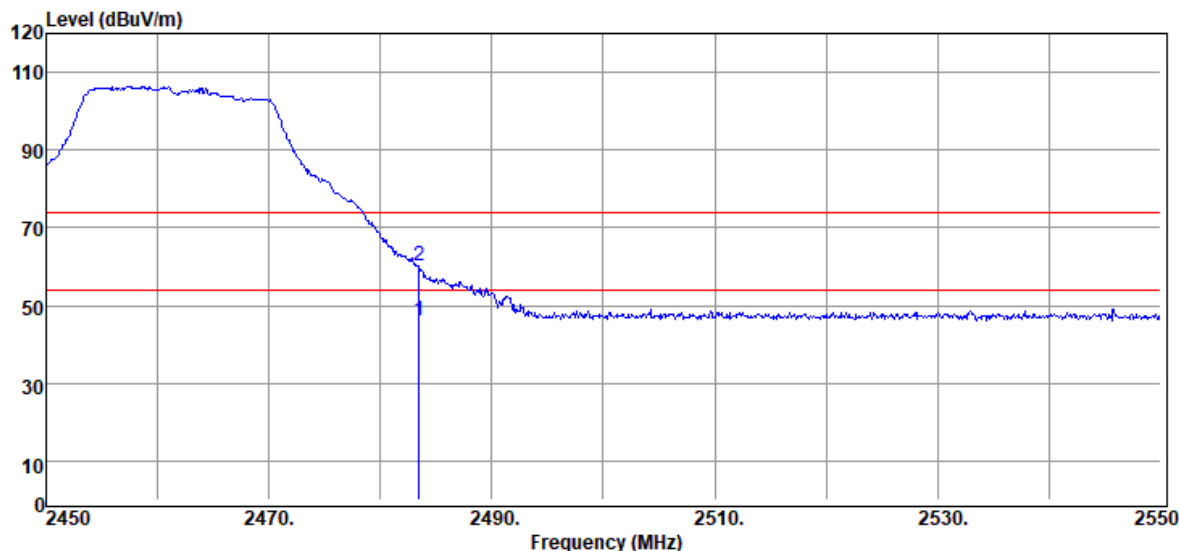
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Report Number :E2/2020/50043
Operation Mode :802.11n20
Test Frequency :2462 MHz
Test Mode :BE CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.6/66
Antenna Pol. :HORIZONTAL
Engineer :Kailin



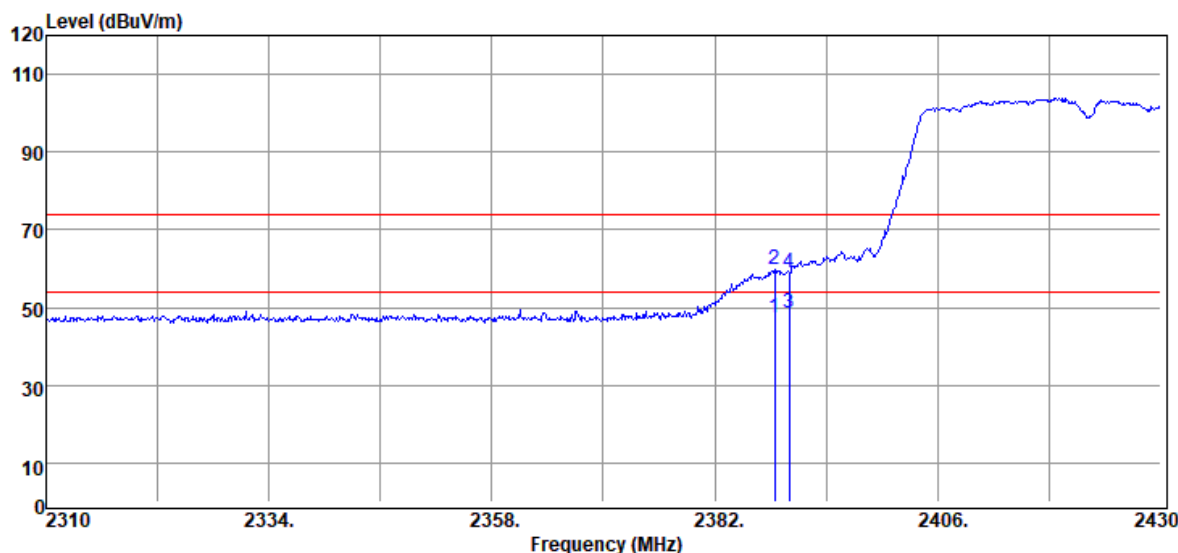
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	Average	51.42	-5.42	46.00	54.00	-8.00
2483.50	Peak	65.68	-5.42	60.26	74.00	-13.74

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Report Number :E2/2020/50043
Operation Mode :802.11n40
Test Frequency :2422 MHz
Test Mode :BE CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.6/67
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
2388.48	Average	52.98	-5.53	47.45	54.00	-6.55
2388.48	Peak	65.18	-5.53	59.65	74.00	-14.35
2390.00	Average	53.93	-5.52	48.41	54.00	-5.59
2390.00	Peak	64.55	-5.52	59.03	74.00	-14.97

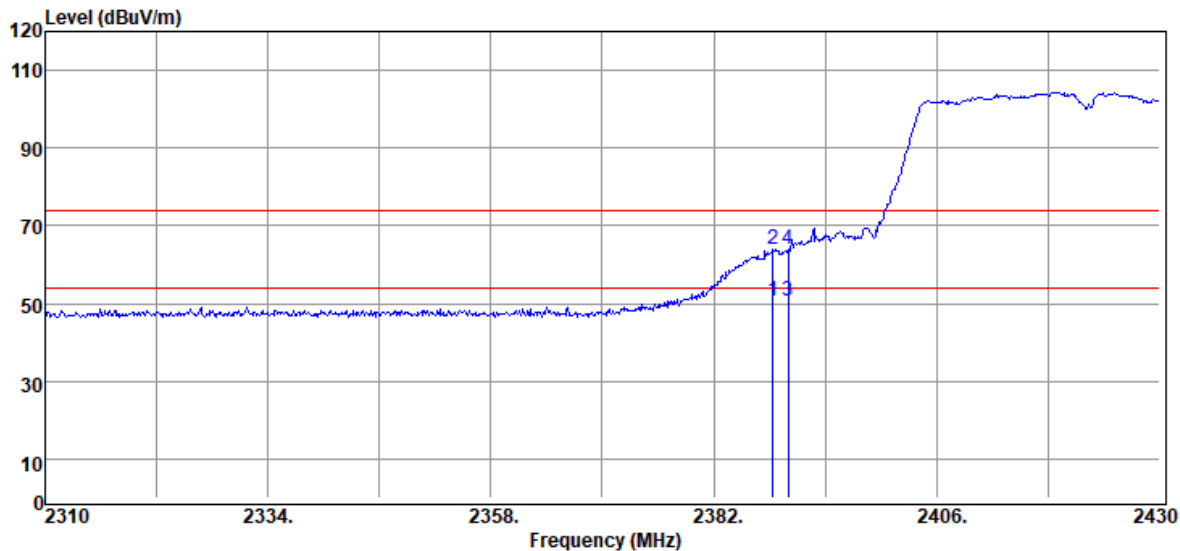
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Report Number :E2/2020/50043
Operation Mode :802.11n40
Test Frequency :2422 MHz
Test Mode :BE CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.6/67
Antenna Pol. :HORIZONTAL
Engineer :Kailin

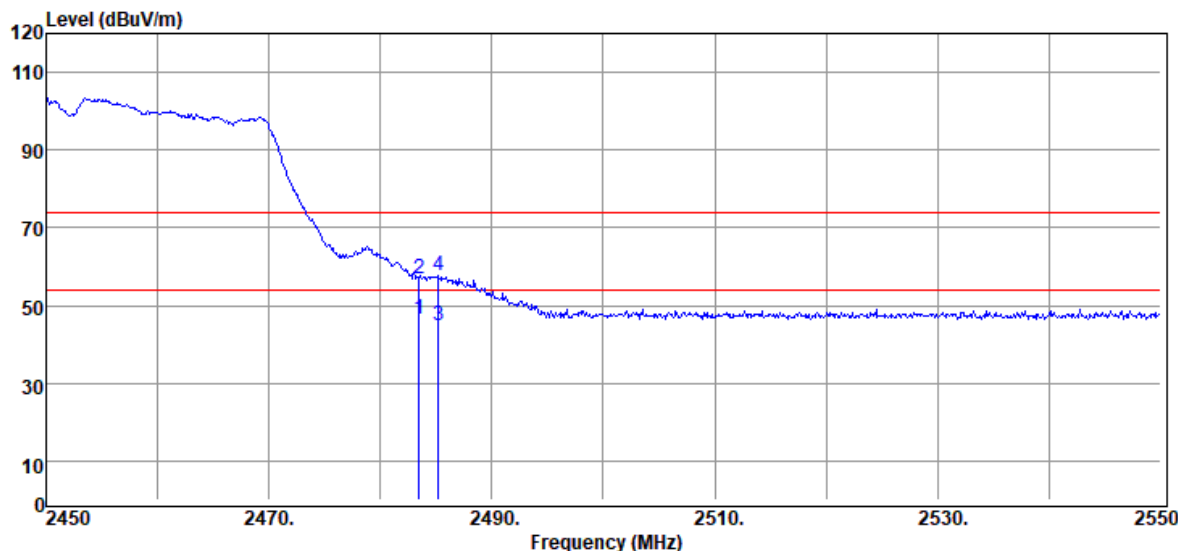


Freq. MHz	Detector Mode	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2388.36	Average	56.27	-5.53	50.74	54.00	-3.26
2388.36	Peak	69.30	-5.53	63.77	74.00	-10.23
2390.00	Average	55.98	-5.52	50.46	54.00	-3.54
2390.00	Peak	69.30	-5.52	63.78	74.00	-10.22

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Report Number :E2/2020/50043
Operation Mode :802.11n40
Test Frequency :2452 MHz
Test Mode :BE CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/67
Antenna Pol. :VERTICAL
Engineer :Kailin


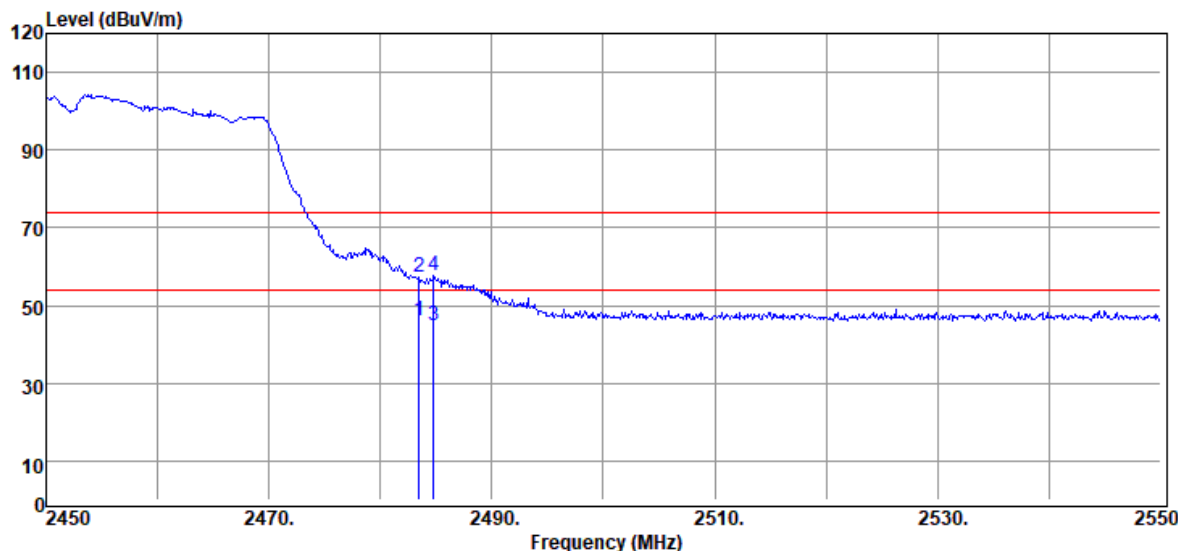
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	Average	51.74	-5.42	46.32	54.00	-7.68
2483.50	Peak	62.40	-5.42	56.98	74.00	-17.02
2485.20	Average	50.36	-5.42	44.94	54.00	-9.06
2485.20	Peak	63.25	-5.42	57.83	74.00	-16.17

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Report Number :E2/2020/50043
Operation Mode :802.11n40
Test Frequency :2452 MHz
Test Mode :BE CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/67
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
2483.50	Average	51.41	-5.42	45.99	54.00	-8.01
2483.50	Peak	62.66	-5.42	57.24	74.00	-16.76
2484.80	Average	50.33	-5.42	44.91	54.00	-9.09
2484.80	Peak	63.22	-5.42	57.80	74.00	-16.20

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.

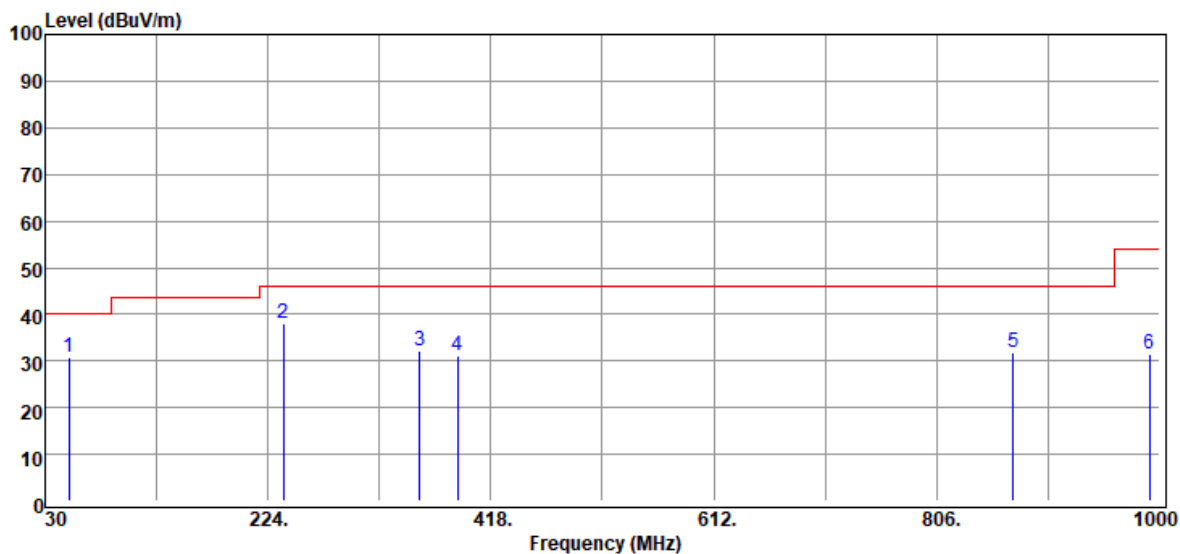
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11.7.2 Below 1GHz Worst-Case Emission:

Report Number :E2/2020/50043
Operation Mode :802.11g
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/69
Antenna Pol. :VERTICAL
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
50.37	Peak	47.80	-16.87	30.93	40.00	-9.07
237.58	Peak	55.05	-17.12	37.93	46.00	-8.07
355.92	Peak	46.09	-14.01	32.08	46.00	-13.92
388.90	Peak	44.23	-12.94	31.29	46.00	-14.71
872.93	Peak	37.76	-5.80	31.96	46.00	-14.04
991.27	Peak	35.44	-4.07	31.37	54.00	-22.63

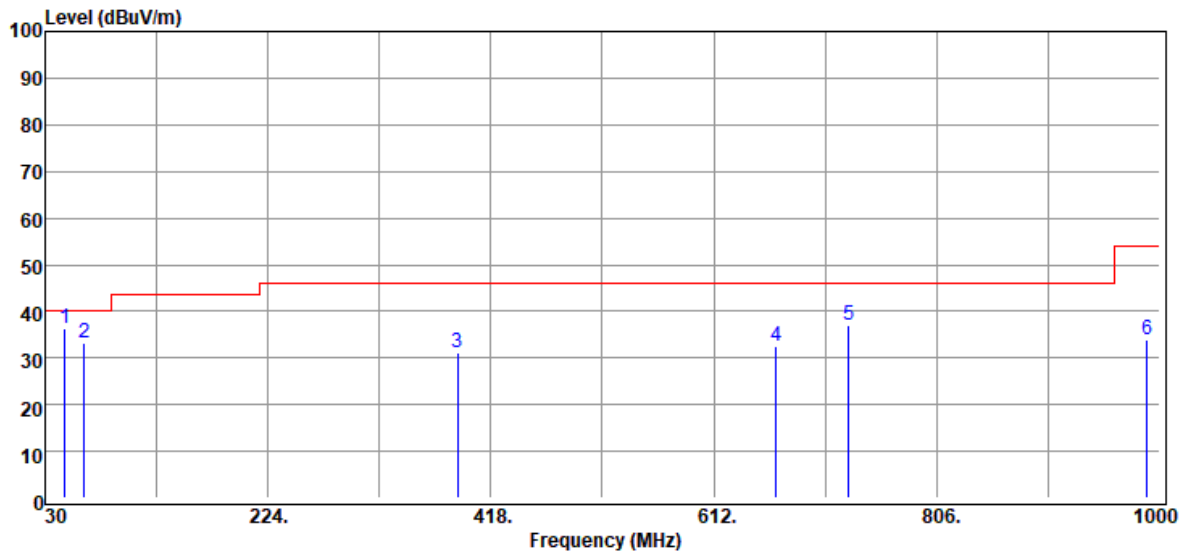
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Report Number :E2/2020/50043
Operation Mode :802.11g
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/69
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
47.46	Peak	53.23	-16.87	36.36	40.00	-3.64
63.95	Peak	51.18	-18.09	33.09	40.00	-6.91
388.90	Peak	44.21	-12.94	31.27	46.00	-14.73
666.32	Peak	40.90	-8.54	32.36	46.00	-13.64
729.37	Peak	44.21	-7.15	37.06	46.00	-8.94
989.33	Peak	38.06	-4.06	34.00	54.00	-20.00

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.

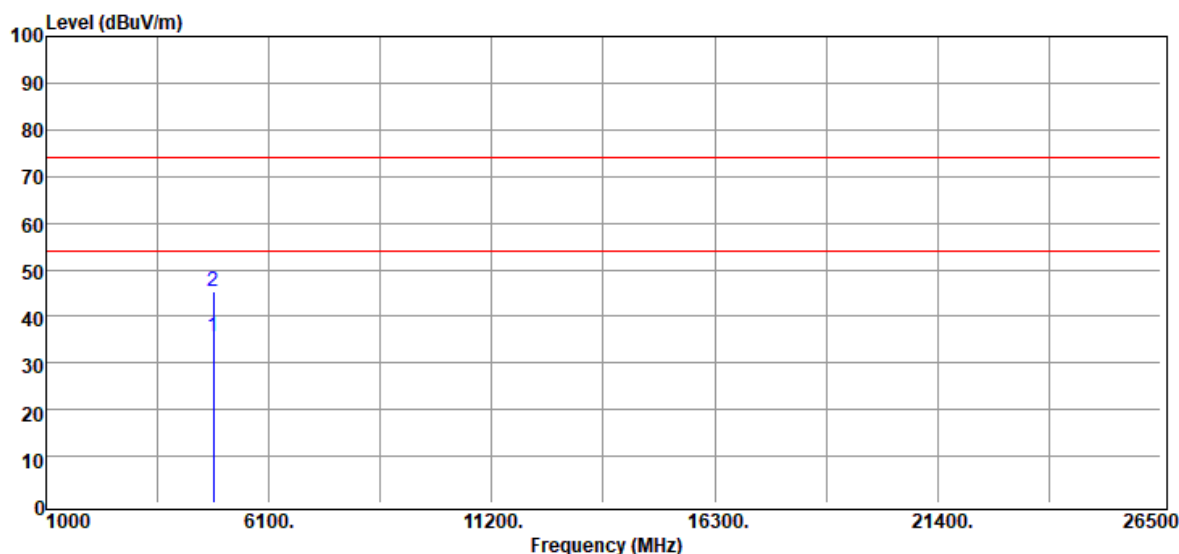
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11.7.3 Above 1GHz Emission:

Report Number :E2/2020/50043
Operation Mode :802.11b
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/69
Antenna Pol. :VERTICAL
Engineer :Kailin



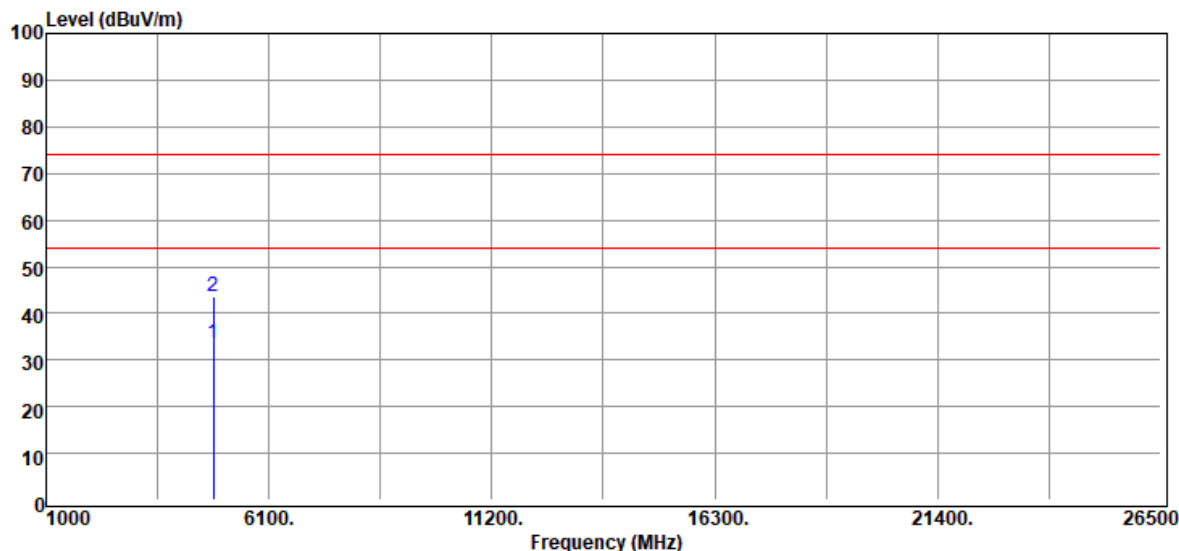
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4824.00	Average	36.09	-0.34	35.75	54.00	-18.25
4824.00	Peak	45.55	-0.34	45.21	74.00	-28.79

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Report Number :E2/2020/50043
Operation Mode :802.11b
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/69
Antenna Pol. :HORIZONTAL
Engineer :Kailin


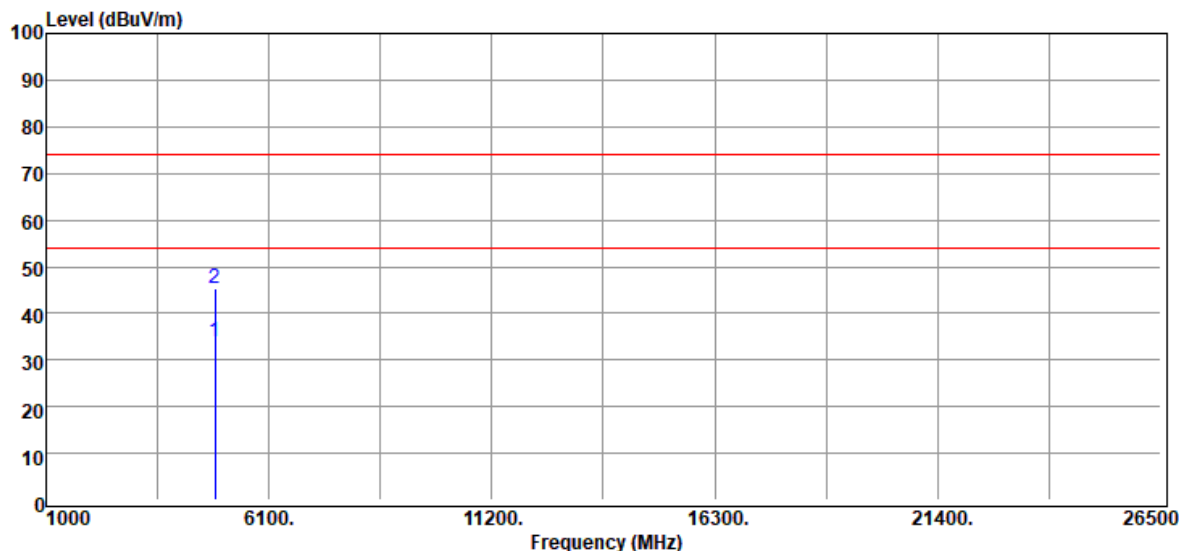
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4824.00	Average	33.80	-0.34	33.46	54.00	-20.54
4824.00	Peak	43.87	-0.34	43.53	74.00	-30.47

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Report Number :E2/2020/50043
Operation Mode :802.11b
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/69
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
4874.00	Average	34.19	-0.42	33.77	54.00	-20.23
4874.00	Peak	45.86	-0.42	45.44	74.00	-28.56

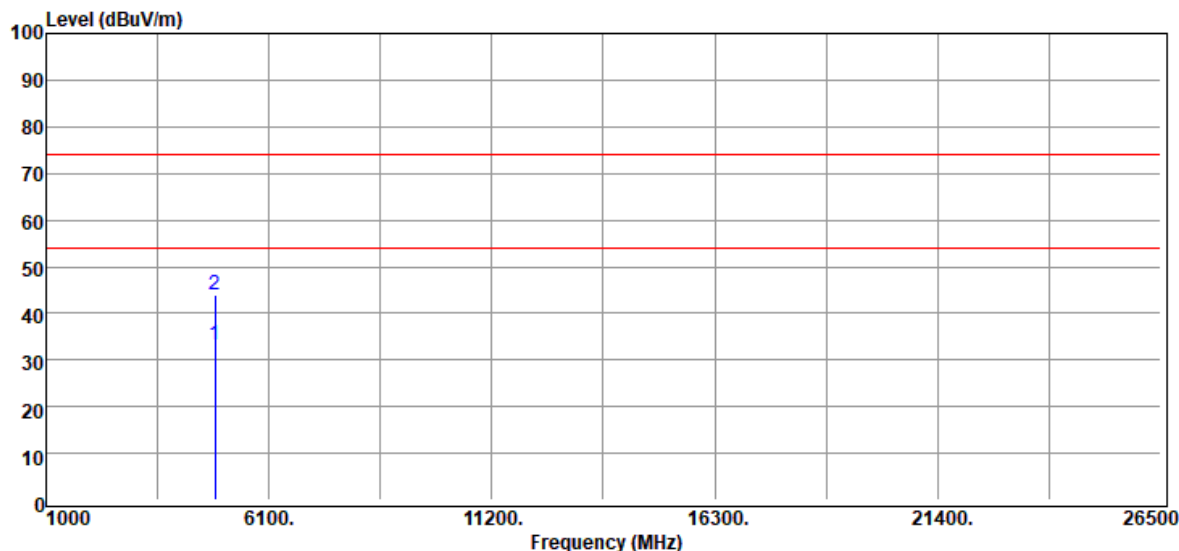
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Report Number :E2/2020/50043
Operation Mode :802.11b
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/69
Antenna Pol. :HORIZONTAL
Engineer :Kailin



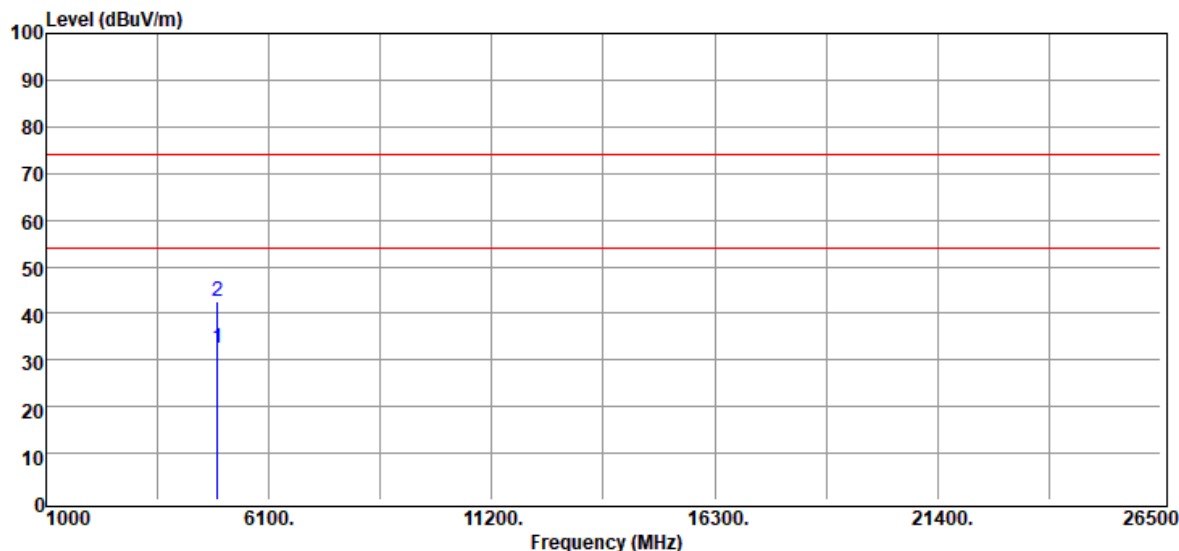
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4874.00	Average	33.75	-0.42	33.33	54.00	-20.67
4874.00	Peak	44.26	-0.42	43.84	74.00	-30.16

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Report Number :E2/2020/50043
Operation Mode :802.11b
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/69
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
4924.00	Average	33.15	-0.61	32.54	54.00	-21.46
4924.00	Peak	43.22	-0.61	42.61	74.00	-31.39

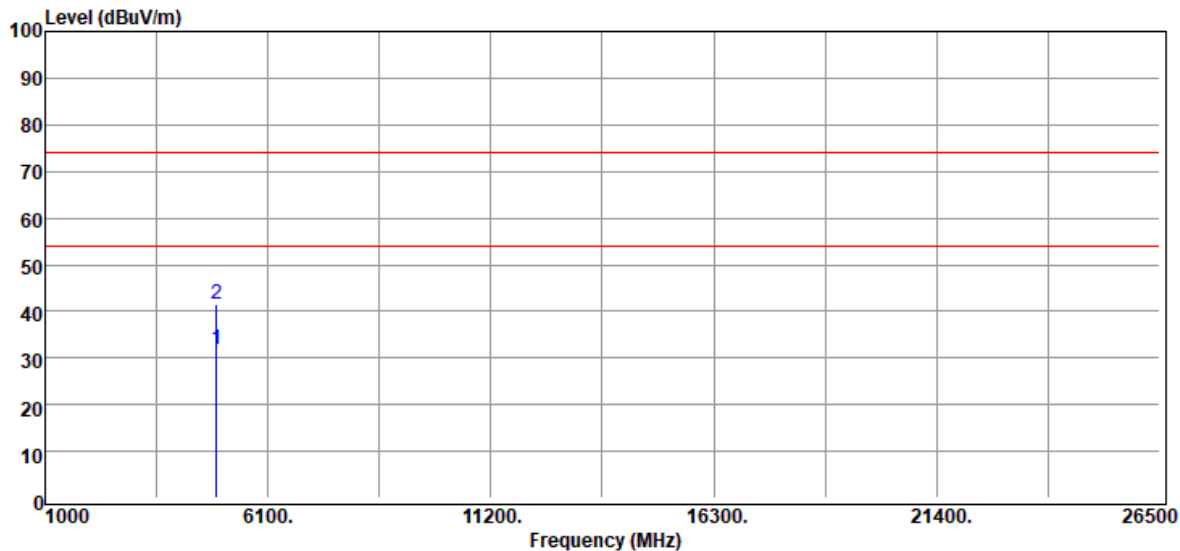
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Report Number :E2/2020/50043
Operation Mode :802.11b
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/69
Antenna Pol. :HORIZONTAL
Engineer :Kailin



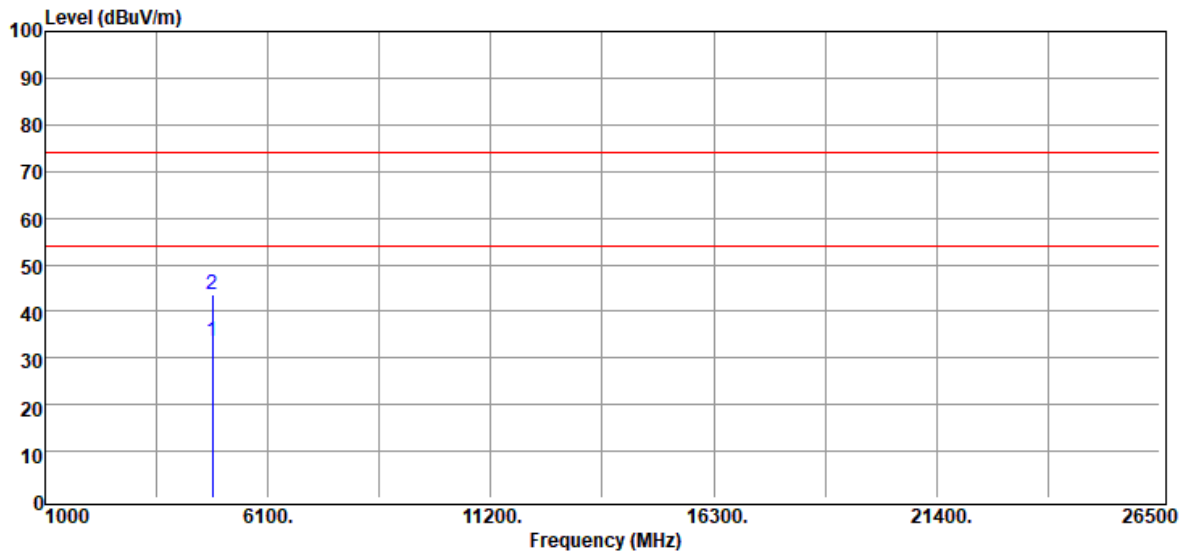
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4924.00	Average	32.37	-0.61	31.76	54.00	-22.24
4924.00	Peak	42.10	-0.61	41.49	74.00	-32.51

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Report Number :E2/2020/50043
Operation Mode :802.11g
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/68
Antenna Pol. :VERTICAL
Engineer :Kailin



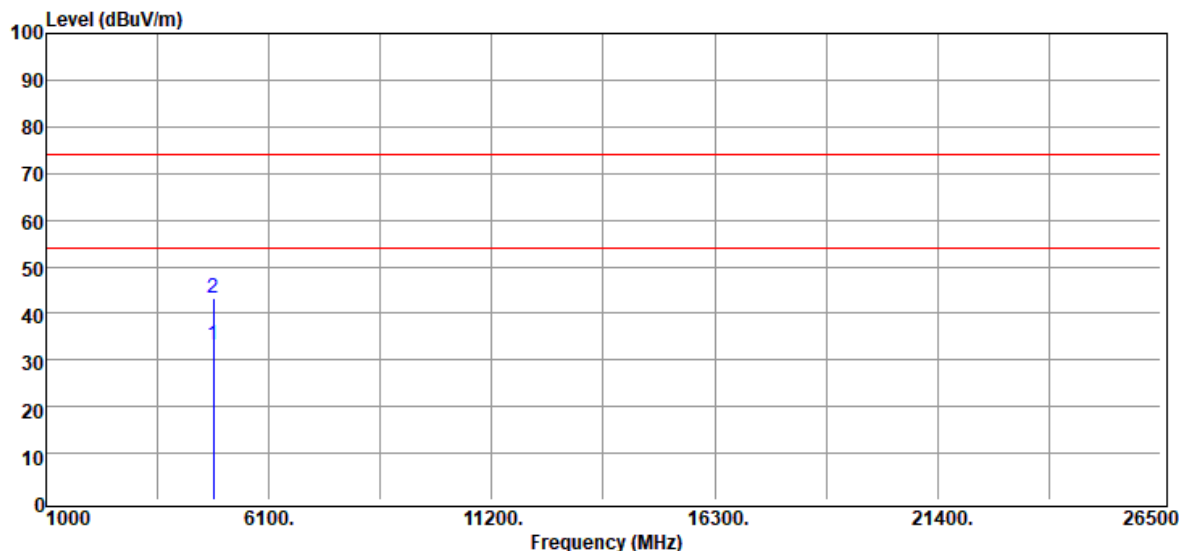
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4824.00	Average	34.01	-0.34	33.67	54.00	-20.33
4824.00	Peak	43.98	-0.34	43.64	74.00	-30.36

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Report Number :E2/2020/50043
Operation Mode :802.11g
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/68
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
4824.00	Average	33.71	-0.34	33.37	54.00	-20.63
4824.00	Peak	43.52	-0.34	43.18	74.00	-30.82

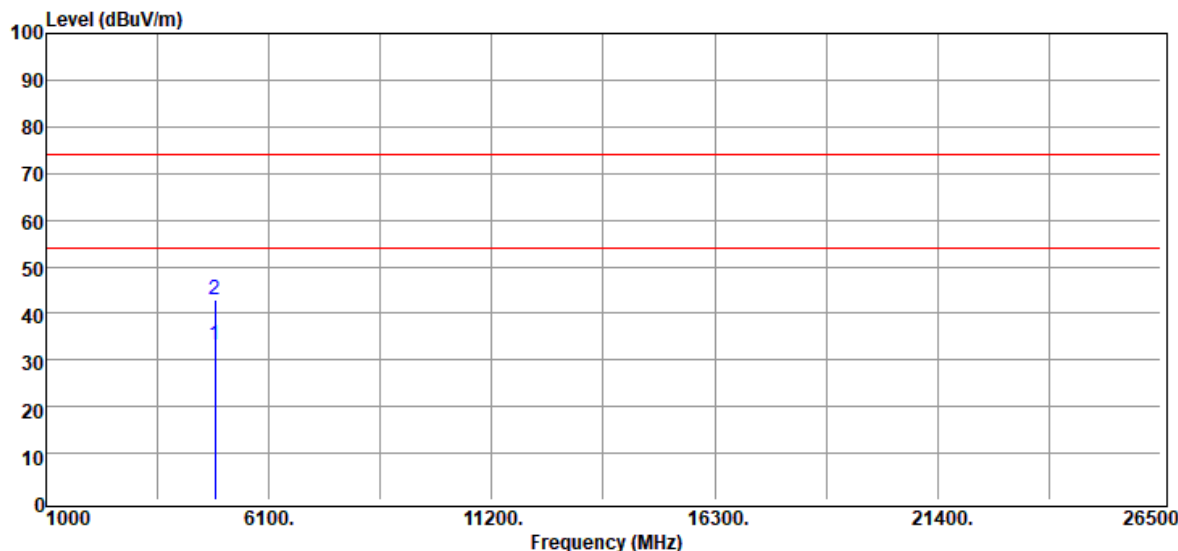
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Report Number :E2/2020/50043
Operation Mode :802.11g
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/67
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	33.75	-0.42	33.33	54.00	-20.67
4874.00	Peak	43.27	-0.42	42.85	74.00	-31.15

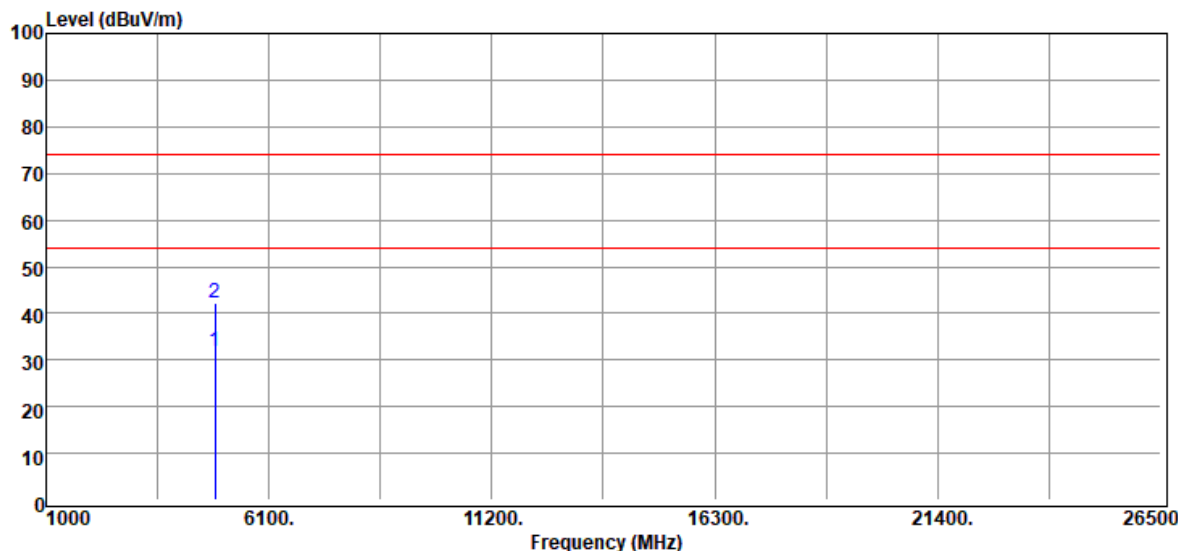
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Report Number :E2/2020/50043
Operation Mode :802.11g
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/67
Antenna Pol. :HORIZONTAL
Engineer :Kailin



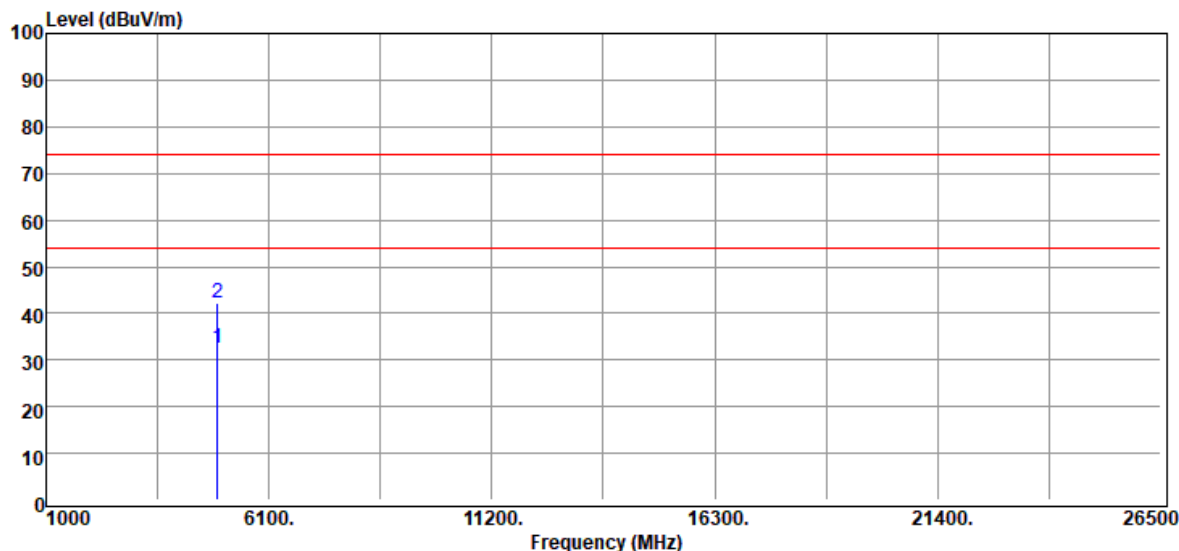
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4874.00	Average	32.16	-0.42	31.74	54.00	-22.26
4874.00	Peak	42.79	-0.42	42.37	74.00	-31.63

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Report Number :E2/2020/50043
Operation Mode :802.11g
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/67
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
4924.00	Average	33.09	-0.61	32.48	54.00	-21.52
4924.00	Peak	42.71	-0.61	42.10	74.00	-31.90

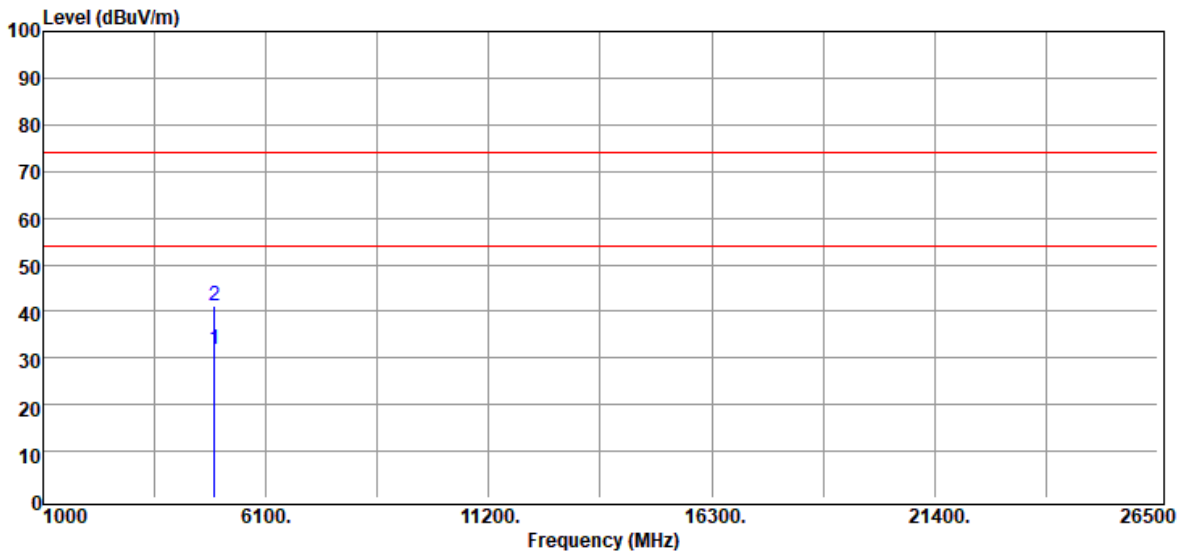
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Report Number :E2/2020/50043
Operation Mode :802.11g
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/67
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
4924.00	Average	32.60	-0.61	31.99	54.00	-22.01
4924.00	Peak	41.62	-0.61	41.01	74.00	-32.99

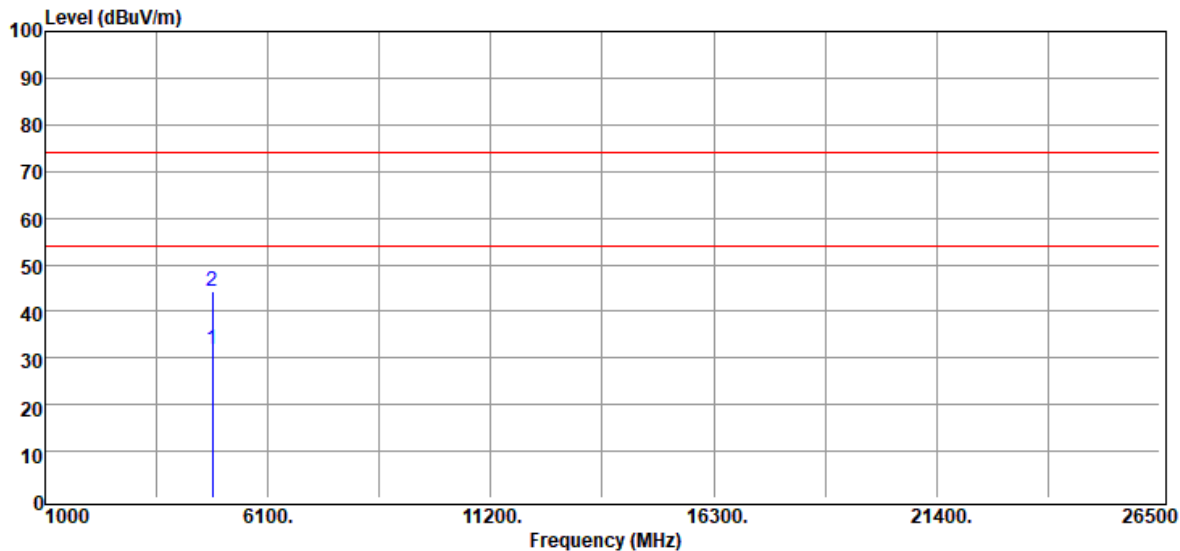
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Report Number :E2/2020/50043
Operation Mode :802.11n20
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/67
Antenna Pol. :VERTICAL
Engineer :Kailin



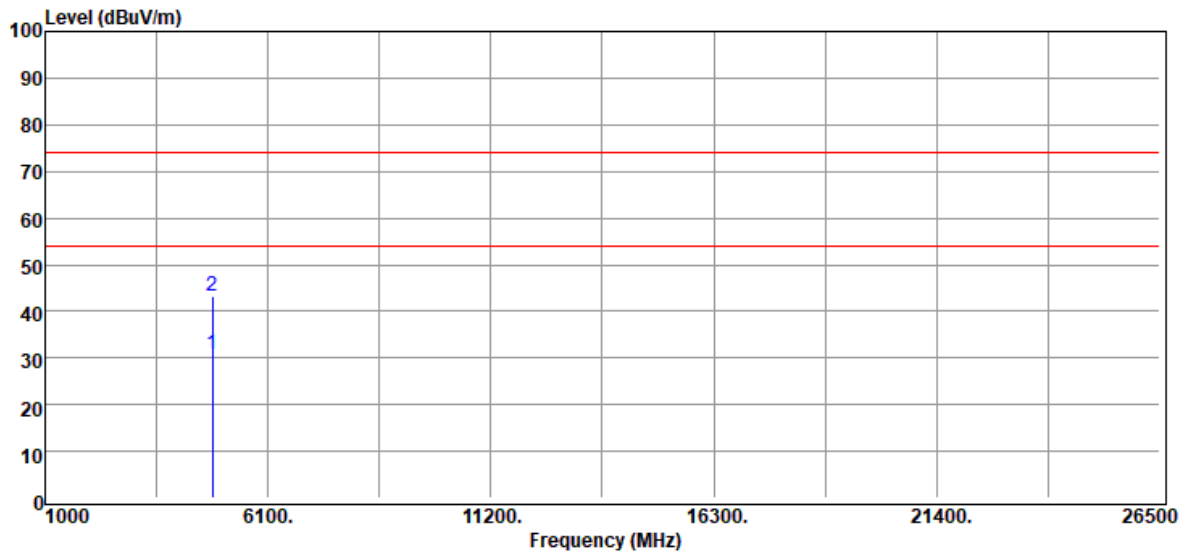
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4824.00	Average	32.07	-0.34	31.73	54.00	-22.27
4824.00	Peak	44.65	-0.34	44.31	74.00	-29.69

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Report Number :E2/2020/50043
Operation Mode :802.11n20
Test Frequency :2412 MHz
Test Mode :TX CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/67
Antenna Pol. :HORIZONTAL
Engineer :Kailin



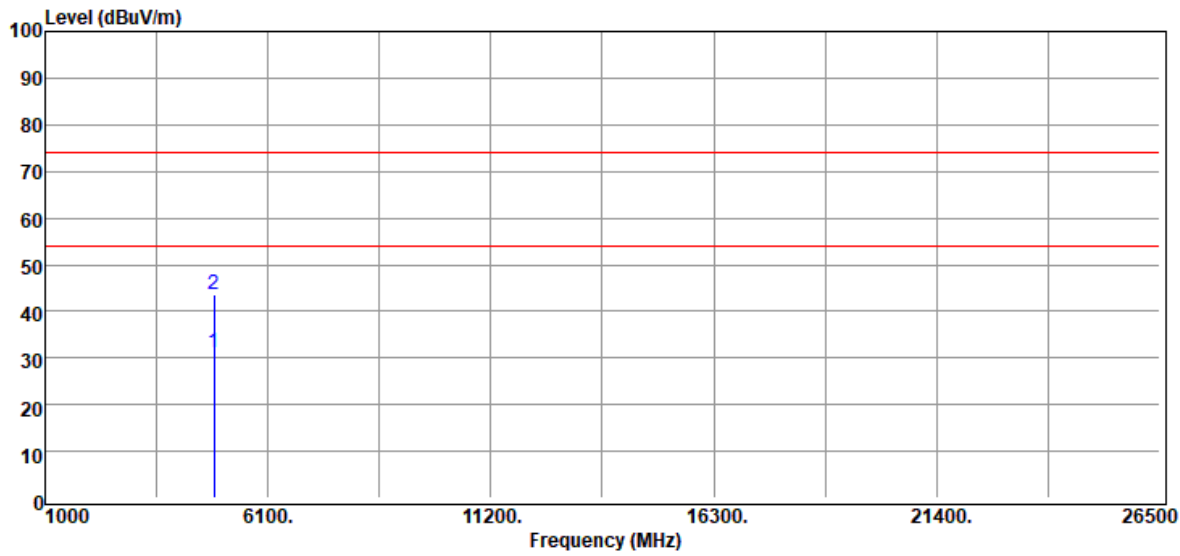
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4824.00	Average	31.05	-0.34	30.71	54.00	-23.29
4824.00	Peak	43.59	-0.34	43.25	74.00	-30.75

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Report Number :E2/2020/50043
Operation Mode :802.11n20
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/68
Antenna Pol. :VERTICAL
Engineer :Kailin



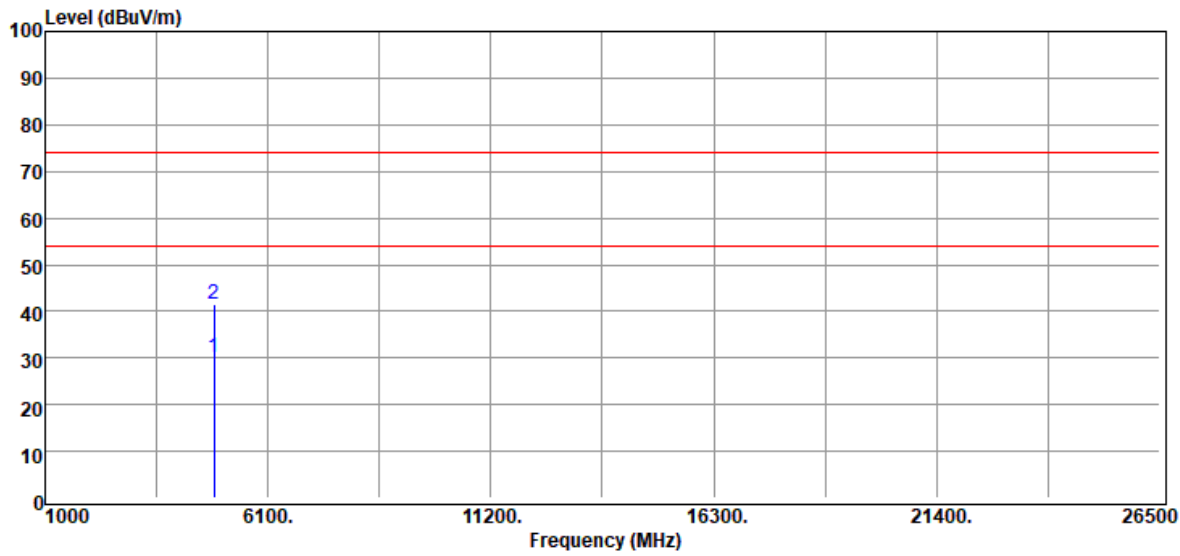
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4874.00	Average	31.72	-0.42	31.30	54.00	-22.70
4874.00	Peak	43.99	-0.42	43.57	74.00	-30.43

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Report Number :E2/2020/50043
Operation Mode :802.11n20
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/68
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
4874.00	Average	30.55	-0.42	30.13	54.00	-23.87
4874.00	Peak	42.02	-0.42	41.60	74.00	-32.40

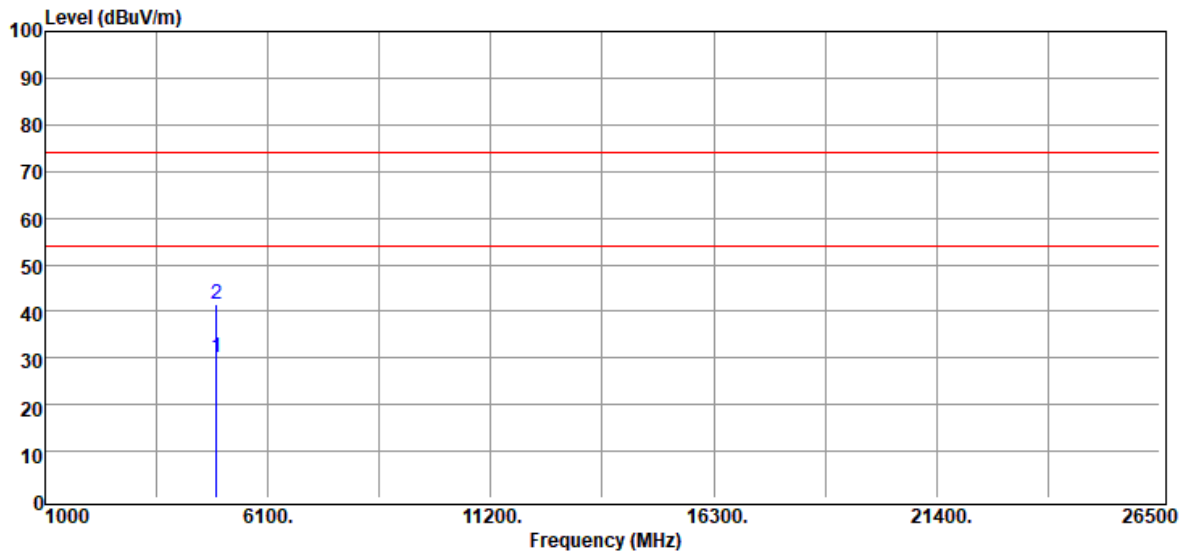
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Report Number :E2/2020/50043
Operation Mode :802.11n20
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/69
Antenna Pol. :VERTICAL
Engineer :Kailin



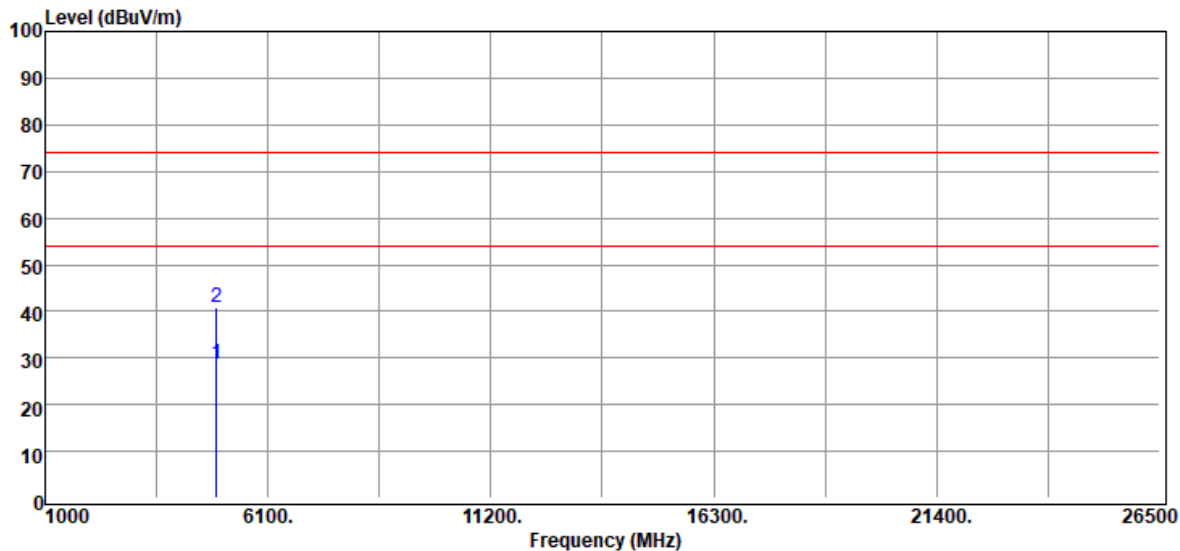
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4924.00	Average	30.71	-0.61	30.10	54.00	-23.90
4924.00	Peak	42.11	-0.61	41.50	74.00	-32.50

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Report Number :E2/2020/50043
Operation Mode :802.11n20
Test Frequency :2462 MHz
Test Mode :TX CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/69
Antenna Pol. :HORIZONTAL
Engineer :Kailin



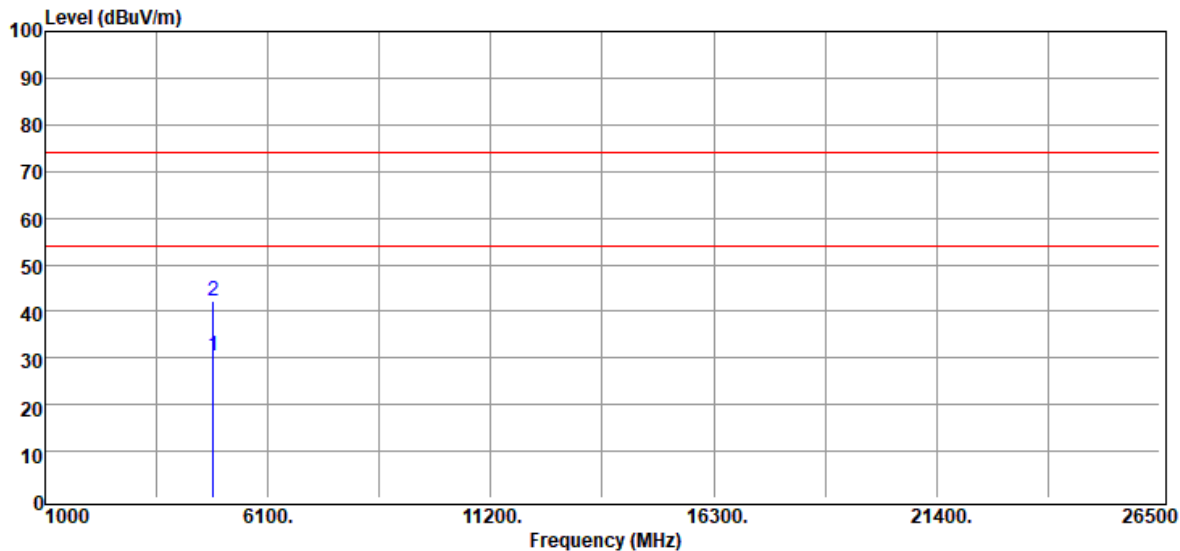
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4924.00	Average	29.41	-0.61	28.80	54.00	-25.20
4924.00	Peak	41.35	-0.61	40.74	74.00	-33.26

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Report Number :E2/2020/50043
Operation Mode :802.11n40
Test Frequency :2422 MHz
Test Mode :TX CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/69
Antenna Pol. :VERTICAL
Engineer :Kailin



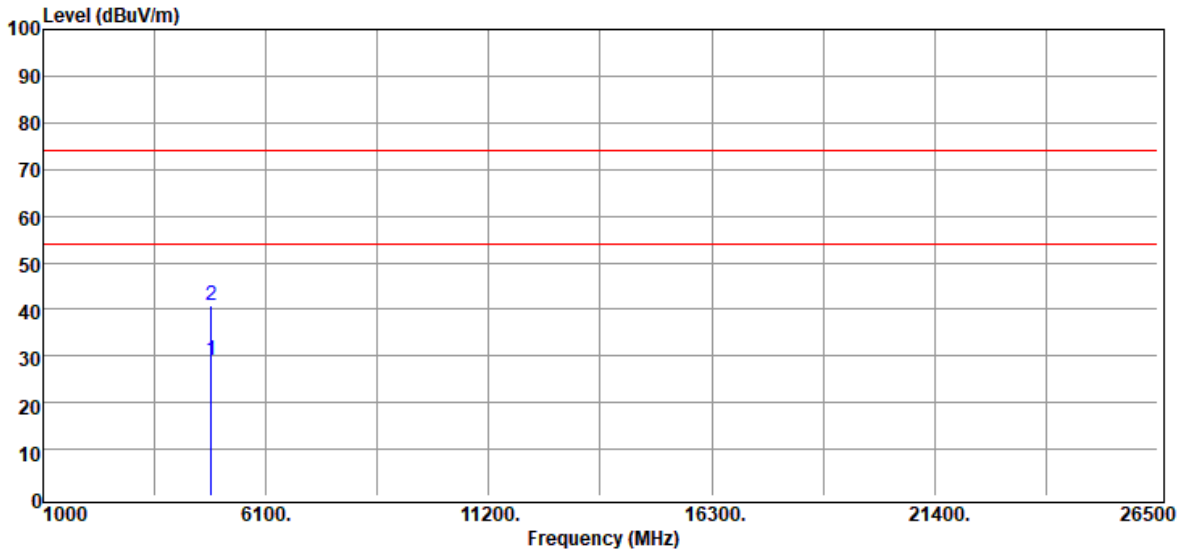
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4844.00	Average	30.62	-0.33	30.29	54.00	-23.71
4844.00	Peak	42.45	-0.33	42.12	74.00	-31.88

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Report Number :E2/2020/50043
Operation Mode :802.11n40
Test Frequency :2422 MHz
Test Mode :TX CH LOW
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/69
Antenna Pol. :HORIZONTAL
Engineer :Kailin



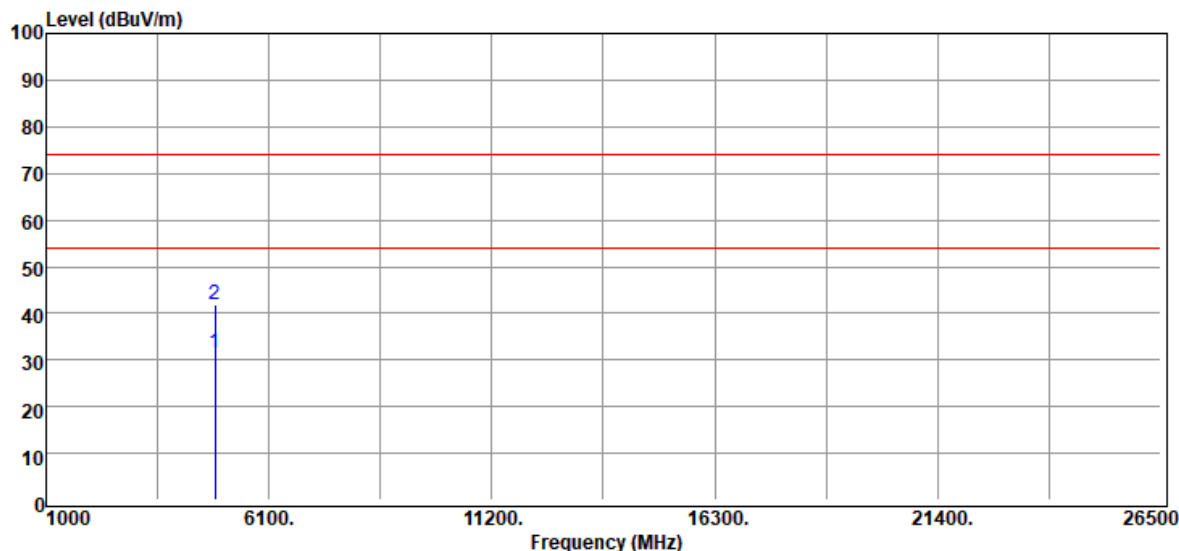
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4844.00	Average	29.32	-0.33	28.99	54.00	-25.01
4844.00	Peak	41.30	-0.33	40.97	74.00	-33.03

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Report Number :E2/2020/50043
Operation Mode :802.11n40
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/69
Antenna Pol. :VERTICAL
Engineer :Kailin


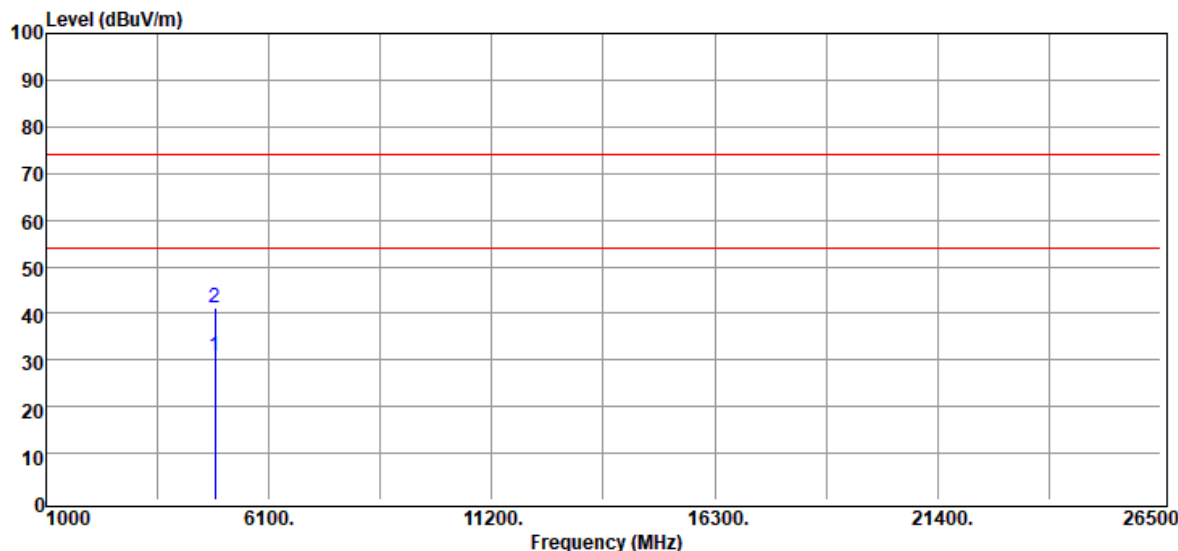
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4874.00	Average	31.99	-0.42	31.57	54.00	-22.43
4874.00	Peak	42.16	-0.42	41.74	74.00	-32.26

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Report Number :E2/2020/50043
Operation Mode :802.11n40
Test Frequency :2437 MHz
Test Mode :TX CH MID
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.8/69
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
4874.00	Average	31.27	-0.42	30.85	54.00	-23.15
4874.00	Peak	41.56	-0.42	41.14	74.00	-32.86

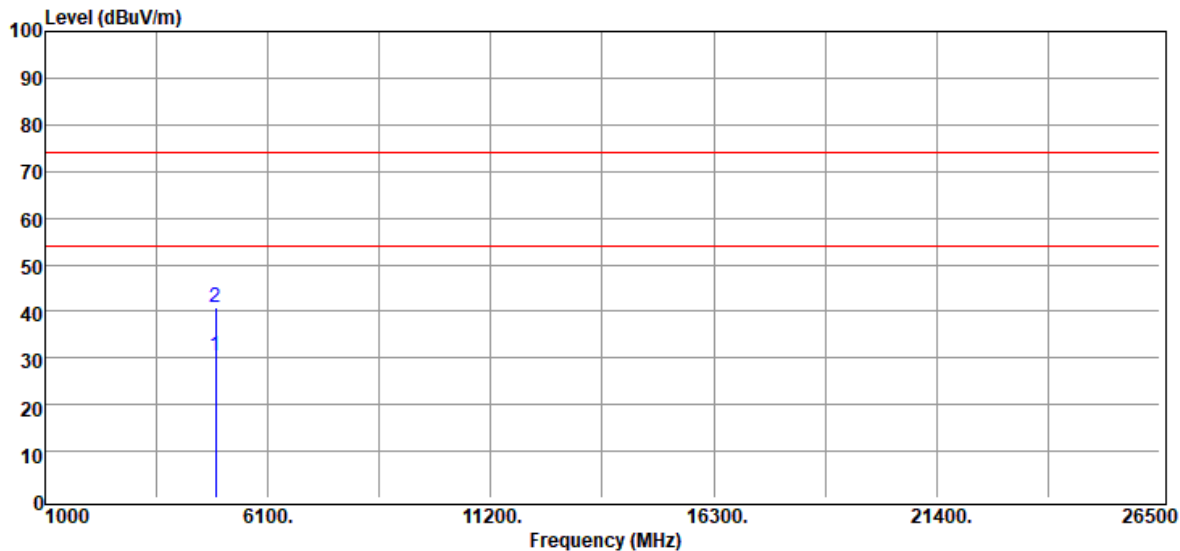
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Report Number :E2/2020/50043
Operation Mode :802.11n40
Test Frequency :2452 MHz
Test Mode :TX CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/68
Antenna Pol. :VERTICAL
Engineer :Kailin



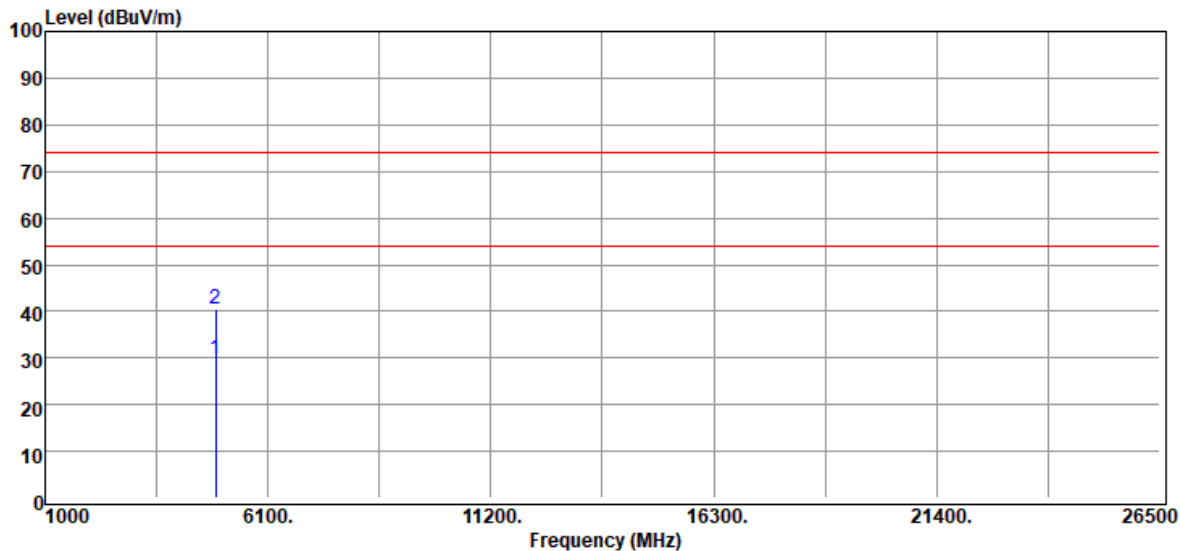
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4904.00	Average	31.06	-0.51	30.55	54.00	-23.45
4904.00	Peak	41.27	-0.51	40.76	74.00	-33.24

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Report Number :E2/2020/50043
Operation Mode :802.11n40
Test Frequency :2452 MHz
Test Mode :TX CH HIGH
EUT Pol :H Plan

Test Date :2020-06-02
Temp./Humi. :21.7/68
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
4904.00	Average	30.10	-0.51	29.59	54.00	-24.41
4904.00	Peak	40.90	-0.51	40.39	74.00	-33.61

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12 POWER SPECTRAL DENSITY

12.1 Standard Applicable

Per Part 15.247 (e)

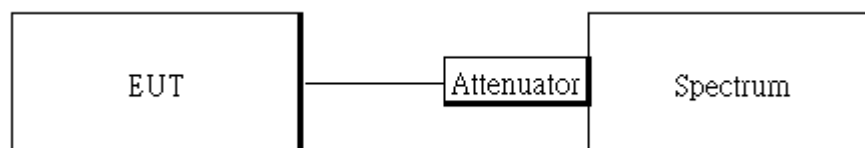
The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

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	MY59070240	04/14/2019	04/14/2021
DC Block	PASTERNAK	PE8210	RF29	11/20/2019	11/19/2020
Attenuator	Marvelous	WATT-218FS-10	RF245	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	-6.64	11.00	8.00	PASS
2437	-8.23	11.00	8.00	PASS
2462	-7.36	11.00	8.00	PASS

POWER DENSITY 802.11g				
Freq. (MHz)	PSD (dBm/3kHz)	Offset	Limit (dBm/3kHz)	Result
2412	-11.07	11.00	8.00	PASS
2437	-11.35	11.00	8.00	PASS
2462	-11.06	11.00	8.00	PASS

POWER DENSITY 802.11n HT20				
Freq. (MHz)	PSD (dBm/3kHz)	Offset	Limit (dBm/3kHz)	Result
2412	-10.57	11.00	8.00	PASS
2437	-9.19	11.00	8.00	PASS
2462	-10.34	11.00	8.00	PASS

POWER DENSITY 802.11n HT40				
Freq. (MHz)	PSD (dBm/3kHz)	Offset	Limit (dBm/3kHz)	Result
2422	-14.66	11.00	8.00	PASS
2437	-13.80	11.00	8.00	PASS
2452	-13.55	11.00	8.00	PASS

Note

Cable Loss 11.00 dB

*Refer to next page for plots

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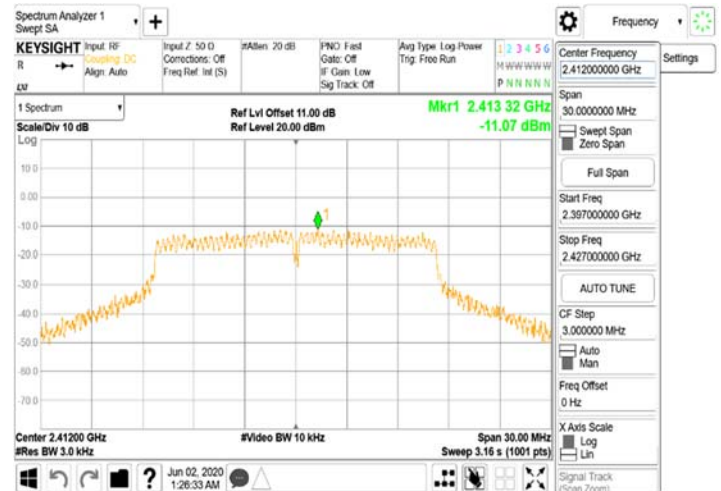
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FCC_15_247_WLANPower Density_802.11b_20MHz_Chain0_2412MHz



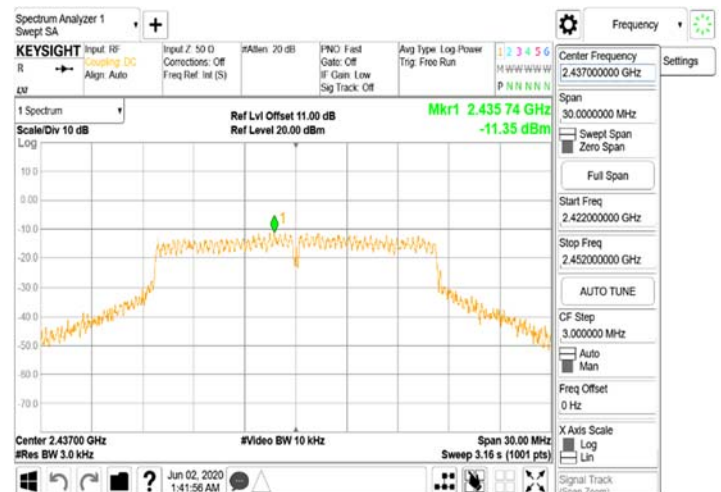
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FCC_15_247_WLANPower Density_802.11b_20MHz_Chain0_2437MHz



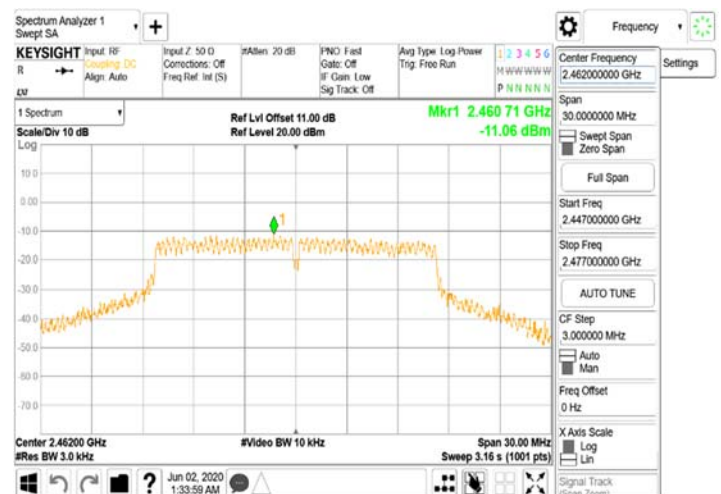
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FCC_15_247_WLANPower Density_802.11b_20MHz_Chain0_2462MHz



FCC_15_247_WLANPower Density_802.11g_20MHz_Chain0_2462MHz



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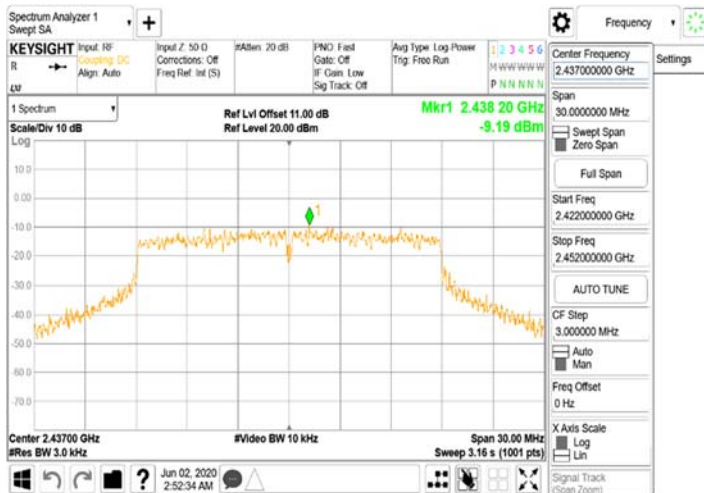
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FCC_15_247_WLANPower Density_802.11n_40MHz_Chain0_2422MHz



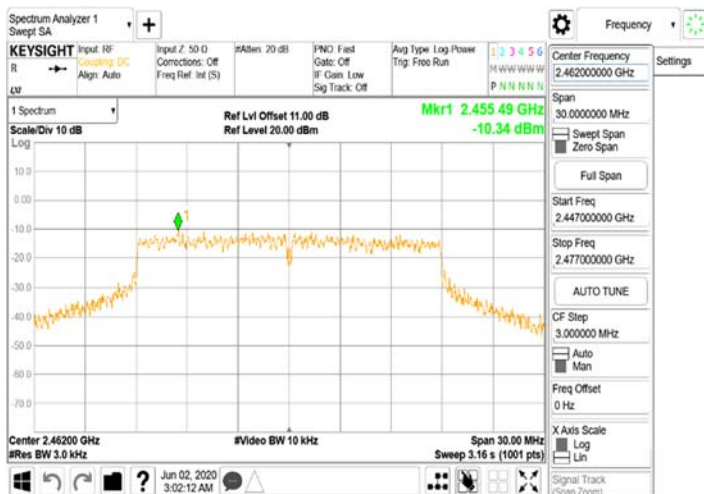
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FCC_15_247_WLANPower Density_802.11n_40MHz_Chain0_2437MHz



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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