ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant:	FUJITSU CONNECTED TECHNOLOGIES Ltd. Chuorinkan 7-10-1 Yamato, Kanagawa 242-0007, Japan
Product Name:	Smart Phone
Brand Name:	FUJITSU
Model No.:	F-52A
Model Difference:	N/A
Report Number:	ER/2020/90018
FCC ID:	2AQYEFMP180
FCC Rule Part:	§15.247, Cat: DTS
Issue Date:	Sep. 30th, 2020
Date of Test:	Sep. 14th, 2020 ~ Sep. 23nd, 2020
Date of EUT Received:	Sep. 14th, 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: _____

Blue Yang / Asst. Manager

Testing Laboratory
3702

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Revision History				
Report Number	**Revision**	**Description**	**Issue Date**	**Remark**
ER/2020/90018	Rev.00	Original.	Sep. 30th, 2020	Revised By: Tiffany Kao

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:	Smart Phone	
Brand Name:	FUJITSU	
Model No.:	F-52A	
Model Difference:	N/A	
Hardware Version:	V2.0.0	
Software Version:	V02R021B-UD	
Power Supply:	3.85Vdc from Rechargeable Li-ion Battery	
	Battery:	Model No.:CA54310-0081 Supplier: FUJITSU CONNECTED TECHNOLOGIES LIMITED

Wi-Fi 802.11	Frequency Range	Channels	Rated Power (dBm)	Modulation Technology
b	2412-2462	11	18.07	DSSS
g			21.97	OFDM
n_HT20			21.95	
Modulation type:	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM			
Antenna Designation:	λ/4 Monopole Antenna, Peak Gain: -6.5dBi (WLAN#1), -6.0dBi(WLAN#2)			
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_20MHz: 6.5 – 144.4Mbps			

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1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247
FCC KDB 558074 D01 15.247 Meas Guidance v05r02
FCC KDB 662911 D01 Multiple Transmitter Output v02r01
ANSI C63.10:2013

1.3 Test Facility

SGS Taiwan Ltd. Central RF Lab (TAF code 3702)
No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803

FCC Designation number: TW0027

1.4 Special Accessories

There are no special accessories used while test was conducted.

1.5 Equipment Modifications

There was no modification incorporated into the EUT.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on 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 a placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.

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2.4 Measurement Results Explanation Example

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

Radiated emission below 30MHz is measured in a 9m*9m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.
There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

2.4.2 For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission configuration

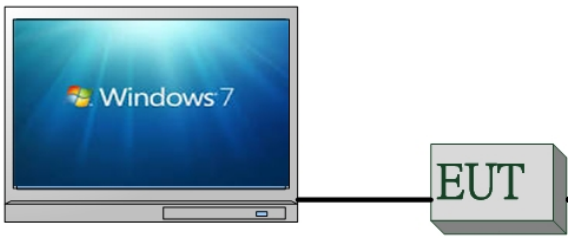

Fig. 2-2 Conducted (Antenna Port) Configuration Emission

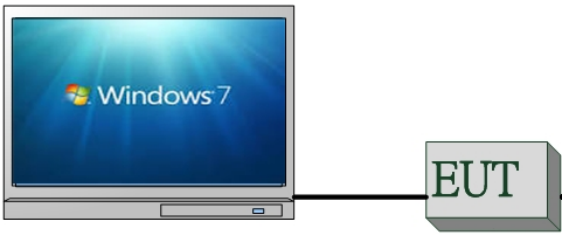

Fig 2-3 Conduction (AC Power Line) Radiated Emission

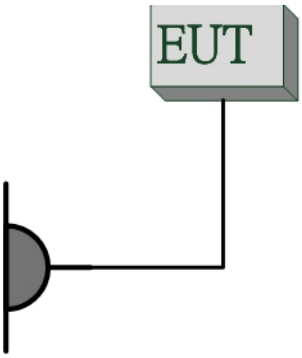

Table 2-1 Equipment Used in Tested System

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
3	Notebook	Lenovo	T440P	PC-014TAK	Shielded	Unshielded

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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.

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

4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. aTest program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3. Investigation has been done on all the possible configurations for searching the worst case.

The gevin 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

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

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4.3 Radiated Emission Test:

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
RADIATED EMISSION TEST (BELOW 1 GHz)					
802.11g	1 to 11	6	OFDM	6	2TX
RADIATED EMISSION TEST (ABOVE 1 GHz)					
802.11b	1 to 11	1, 6, 11	DSSS	1	2TX
802.11g	1 to 11	1, 6, 11	OFDM	6	2TX
802.11n20M	1 to 11	1, 6, 11	OFDM	MCS 8	MIMO

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

4.4 Antenna Port Conducted Mesurement:

CONDUCTED TEST					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11b	1 to 11	1, 6, 11	DSSS	1	2TX
802.11g	1 to 11	1, 6, 11	OFDM	6	2TX
802.11n 20M	1 to 11	1, 6, 11	OFDM	MCS 0	MIMO

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 0.84 dB
6dB Bandwidth	+/- 51.33 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 0.84 dB
Peak Power Density	+/- 1.3 dB
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

Radiated Spurious Emission Measurement Uncertainty	
Polarization: Vertical	9kHz~30MHz: +-2.3dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB
Polarization: Horizontal	9kHz~30MHz: +-2.3dB
	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

Note:

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

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6 CONDUCTED EMISSION TEST

6.1 Standard Applicable

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

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Note
1.The lower limit shall apply at the transition frequencies
2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

6.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
EMI Test Receiver	R&S	ESCI 7	100759	Jul. 13th, 2020	Jul. 12nd, 2021
LISN	SCHWARZBECK	NSLK 8127	8127-465	Apr. 9th, 2020	Apr. 8th, 2021
Coaxial Cables	N/A	Coaxial Cable	161207	Dec, 7th, 2019	Dec. 6th, 2020
Test Software	audix	e3	Ver. 6.11-20180413	N.C.R	N.C.R

6.3 EUT Setup

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

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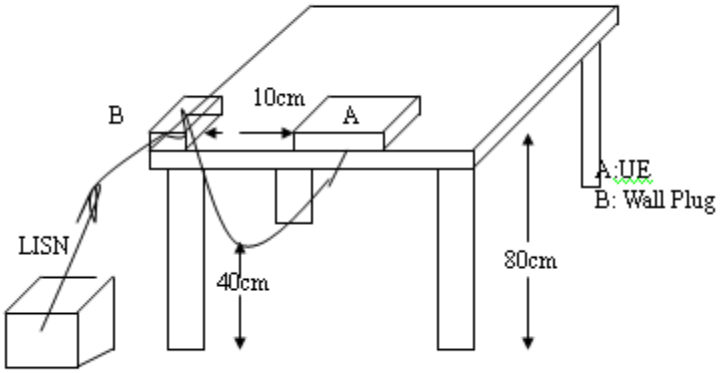
6.4 Test SET-UP (Block Diagram of Configuration)



6.5 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

6.6 Measurement Result

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit.

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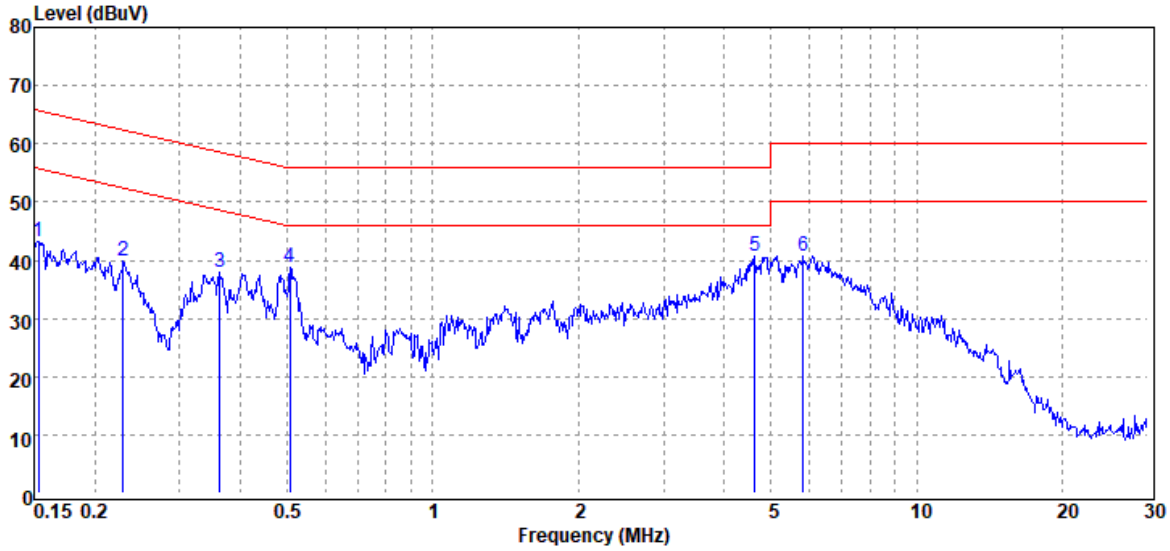
AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number	:ER-2020-90018	Test Site	:Conduction 6F
Test Mode	:WLAN2.4G	Test Date	:2020-09-14
Power	:AC 120V/60Hz	Temp./Humi.	:25.2/57
Probe	:L	Engineer	:Nick
Note:	:		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV	Limit dBµV	Margin dB
0.15	Peak	40.93	2.14	43.07	65.82	-22.75
0.23	Peak	37.66	2.14	39.80	62.48	-22.68
0.36	Peak	35.87	2.15	38.02	58.65	-20.63
0.51	Peak	36.55	2.16	38.71	56.00	-17.29
4.62	Peak	38.13	2.51	40.64	56.00	-15.36
5.84	Peak	38.01	2.61	40.62	60.00	-19.38

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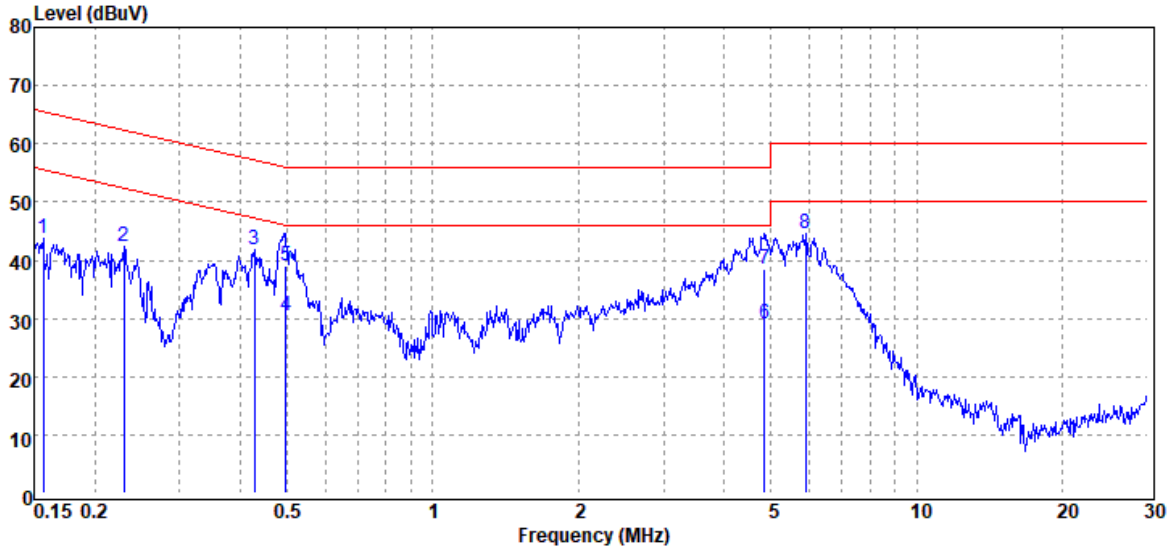
Report Number	:ER-2020-90018	Test Site	:Conduction 6F
Test Mode	:WLAN2.4G	Test Date	:2020-09-14
Power	:AC 120V/60Hz	Temp./Humi.	:25.2/57
Probe	:N	Engineer	:Nick
Note:	:		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.16	Peak	41.48	2.21	43.69	65.65	-21.96
0.23	Peak	40.09	2.21	42.30	62.44	-20.14
0.43	Peak	39.69	2.21	41.90	57.29	-15.39
0.50	Average	28.18	2.22	30.40	46.05	-15.65
0.50	QP	36.77	2.22	38.99	56.05	-17.06
4.85	Average	26.50	2.46	28.96	46.00	-17.04
4.85	QP	35.88	2.46	38.34	56.00	-17.66
5.90	Peak	41.92	2.53	44.45	60.00	-15.55

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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	99.35	0.03	0.08	0.01
802.11g	98.21	0.08	0.49	0.01
802.11n_20	97.93	0.09	0.59	1.00

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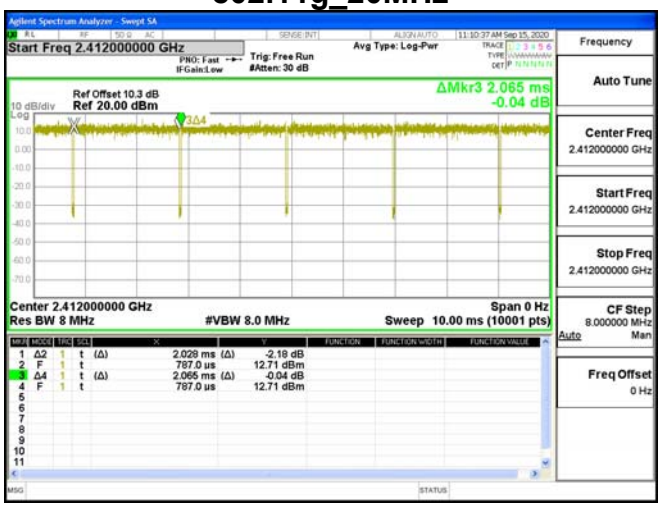
7.3 Duty Cycle test plots

802.11b_20MHz

802.11g_20MHz



802.11n_20MHz

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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.

Note:

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

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

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

where

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

NSS = the number of independent spatial streams of data;

NANT = the total number of antennas

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

G_k is the gain in dBi of the kth antenna.

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

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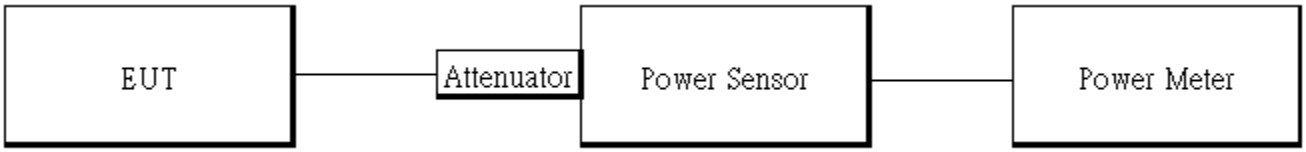
8.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1804001	Feb. 20th, 2020	Feb. 19th, 2021
Power Sensor	Anritsu	MA2411B	1726104	Feb. 20th, 2020	Feb. 19th, 2021
Power Sensor	Anritsu	MA2411B	1726107	Feb. 20th, 2020	Feb. 19th, 2021
Attenuator	Mini-Circuit	BW-S10W2+	2	Jan. 2nd, 2020	Jan. 1st, 2021

8.3 Test Set-up

Power Meter:



8.4 Measurement Procedure

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

   Power Meter:

   It is used as the auxiliary test equipment to conduct the output power measurement.
4. Record the max. Reading as observed from Spectrum or Power Meter.

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

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8.5 Measurement Result

802.11b Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	15.21	30.00	PASS
6	2437	1	15.40	30.00	PASS
11	2462	1	15.11	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	12.94	30.00	PASS
6	2437	1	12.86	30.00	PASS
11	2462	1	12.92	30.00	PASS

802.11b Ch1					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	15.08	30.00	PASS
6	2437	1	15.18	30.00	PASS
11	2462	1	15.36	30.00	PASS
802.11b Ch1					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	1	12.89	30.00	PASS
6	2437	1	12.78	30.00	PASS
11	2462	1	12.89	30.00	PASS

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802.11b_2TX							
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
			CH 0	CH 1			
1	2412	1	15.17	14.94	18.07	30.00	PASS
6	2437	1	15.02	14.97	18.01	30.00	PASS
11	2462	1	15.15	14.69	17.94	30.00	PASS
802.11b_2TX							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)		Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
			CH 0	CH 1			
1	2412	1	12.86	12.81	15.87	30.00	PASS
6	2437	1	12.68	12.64	15.70	30.00	PASS
11	2462	1	12.76	12.62	15.73	30.00	PASS

802.11g Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	18.44	30.00	PASS
6	2437	6	18.61	30.00	PASS
11	2462	6	18.38	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	13.79	30.00	PASS
6	2437	6	13.72	30.00	PASS
11	2462	6	13.92	30.00	PASS

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802.11g Ch1					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	18.73	30.00	PASS
6	2437	6	18.54	30.00	PASS
11	2462	6	18.51	30.00	PASS
802.11g Ch1					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	6	13.76	30.00	PASS
6	2437	6	13.61	30.00	PASS
11	2462	6	13.71	30.00	PASS

802.11g_2TX							
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
			CH 0	CH 1			
1	2412	6	19.18	18.73	21.97	30.00	PASS
6	2437	6	18.97	18.56	21.78	30.00	PASS
11	2462	6	19.10	18.69	21.91	30.00	PASS
802.11g_2TX							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)		Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
			CH 0	CH 1			
1	2412	6	13.91	13.86	16.97	30.00	PASS
6	2437	6	13.86	13.79	16.91	30.00	PASS
11	2462	6	13.90	13.85	16.96	30.00	PASS

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802.11n_HT20M Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	18.89	30.00	PASS
6	2437	MCS0	18.60	30.00	PASS
11	2462	MCS0	18.77	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	13.97	30.00	PASS
6	2437	MCS0	13.88	30.00	PASS
11	2462	MCS0	13.93	30.00	PASS

802.11n_HT20M Ch1					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	19.15	30.00	PASS
6	2437	MCS0	19.05	30.00	PASS
11	2462	MCS0	19.06	30.00	PASS
802.11n_HT20M Ch1					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	13.95	30.00	PASS
6	2437	MCS0	13.77	30.00	PASS
11	2462	MCS0	13.90	30.00	PASS

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802.11n_HT20M MIMO							
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
			CH 0	CH 1			
1	2412	MCS8	19.19	18.68	21.95	30.00	PASS
6	2437	MCS8	18.98	18.61	21.81	30.00	PASS
11	2462	MCS8	19.01	18.68	21.86	30.00	PASS
802.11n_HT20M MIMO							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)		Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
			CH 0	CH 1			
1	2412	MCS8	13.97	13.76	16.97	30.00	PASS
6	2437	MCS8	13.87	13.65	16.86	30.00	PASS
11	2462	MCS8	13.84	13.76	16.90	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

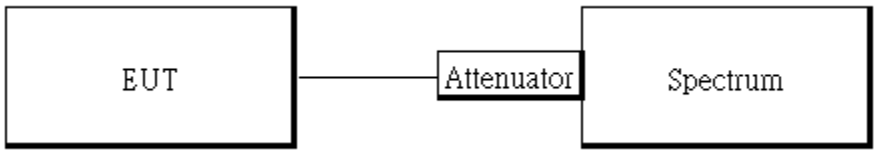
9.1 Standard Applicable

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.
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	May 6th, 2020	May 5th, 2021
DC Block	Mini-Circuits	BLK-18-S+	1	Jan. 2nd, 2020	Jan. 1st, 2021
Attenuator	Mini-Circuit	BW-S10W2+	2	Jan. 2nd, 2020	Jan. 1st, 2021

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.

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9.5 6dB Bandwidth

802.11b Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	8590.00	> 500	PASS
2437	8551.00	> 500	PASS
2462	**8597.00**	> 500	PASS

802.11b Ch1

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	**9064.00**	> 500	PASS
2437	9048.00	> 500	PASS
2462	8115.00	> 500	PASS

802.11g Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	**15360.00**	> 500	PASS
2437	15320.00	> 500	PASS
2462	15340.00	> 500	PASS

802.11g Ch1

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	15170.00	> 500	PASS
2437	**15910.00**	> 500	PASS
2462	15730.00	> 500	PASS

802.11_n_HT20 Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	15380.00	> 500	PASS
2437	**16090.00**	> 500	PASS
2462	15170.00	> 500	PASS

802.11_n_HT20 Ch1

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	15190.00	> 500	PASS
2437	**16420.00**	> 500	PASS
2462	15830.00	> 500	PASS

**Refer to next page for plots*

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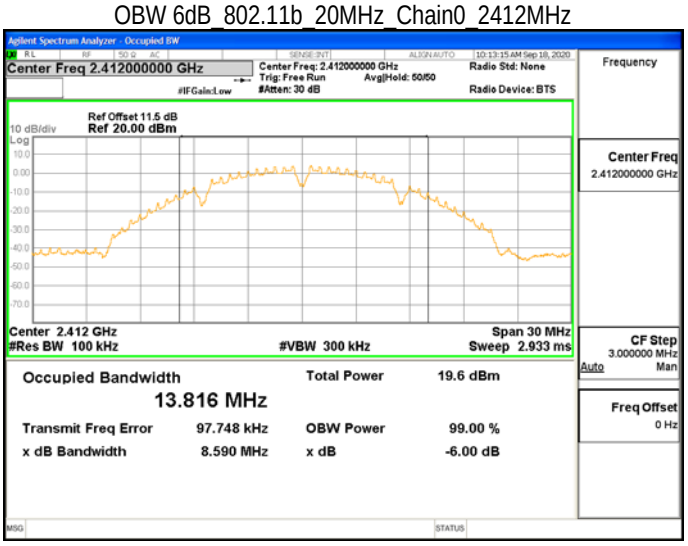
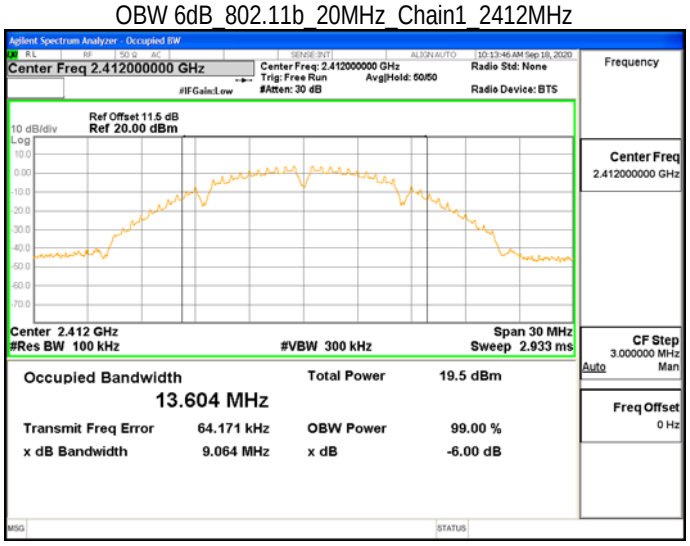
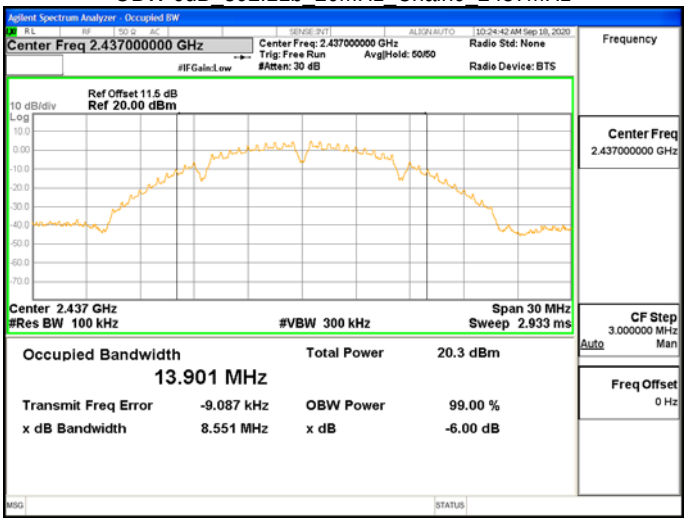
OBW 6dB_802.11b_20MHz_Chain0_2412MHz



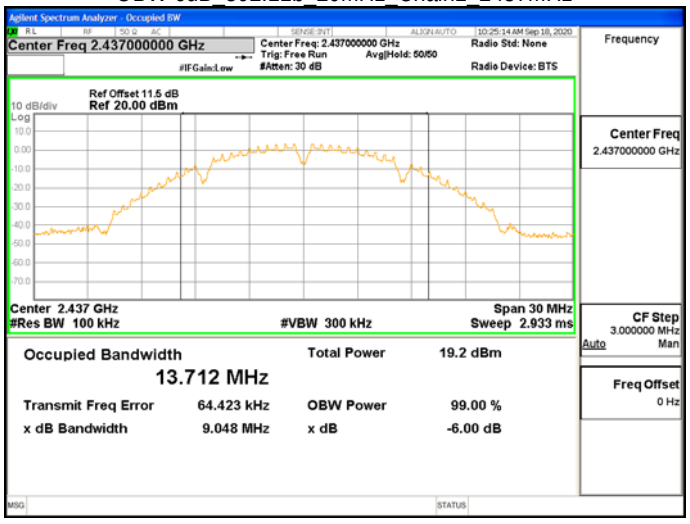
OBW 6dB_802.11b_20MHz_Chain1_2412MHz



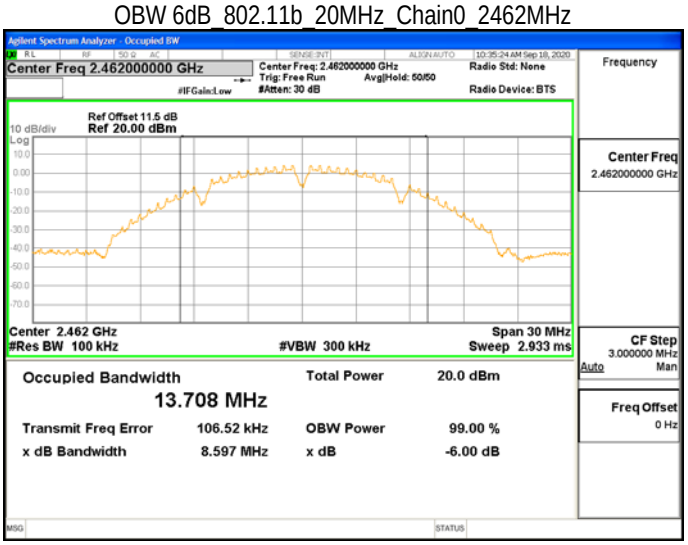
OBW 6dB_802.11b_20MHz_Chain0_2437MHz



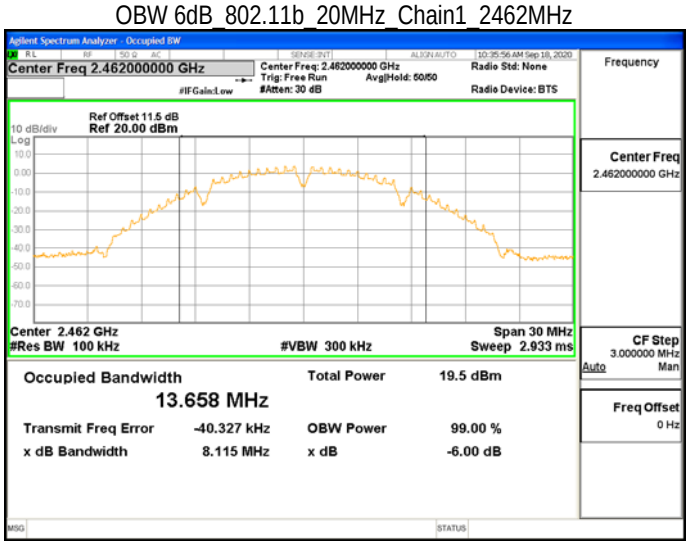
OBW 6dB_802.11b_20MHz_Chain1_2437MHz



OBW 6dB_802.11b_20MHz_Chain0_2462MHz



OBW 6dB_802.11b_20MHz_Chain1_2462MHz



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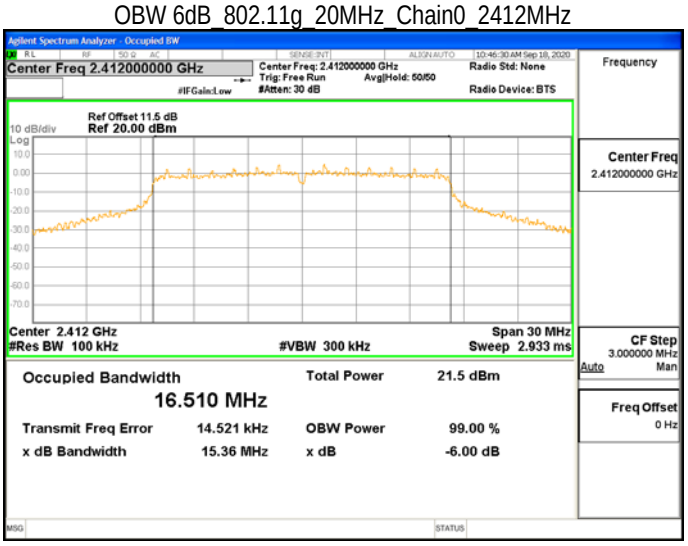
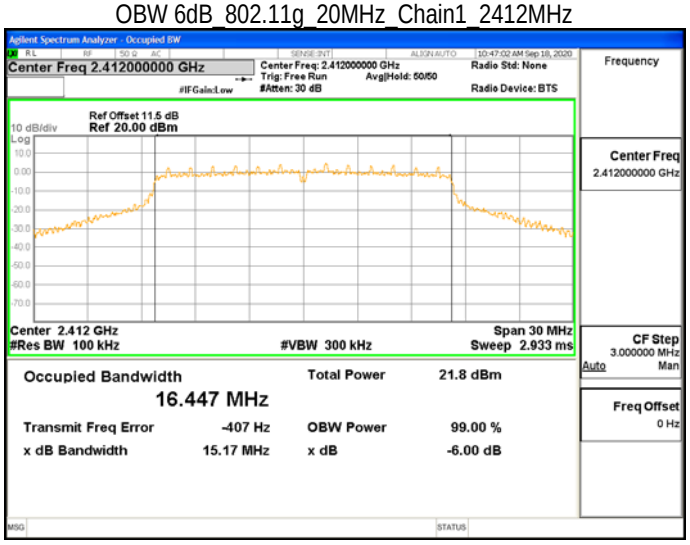
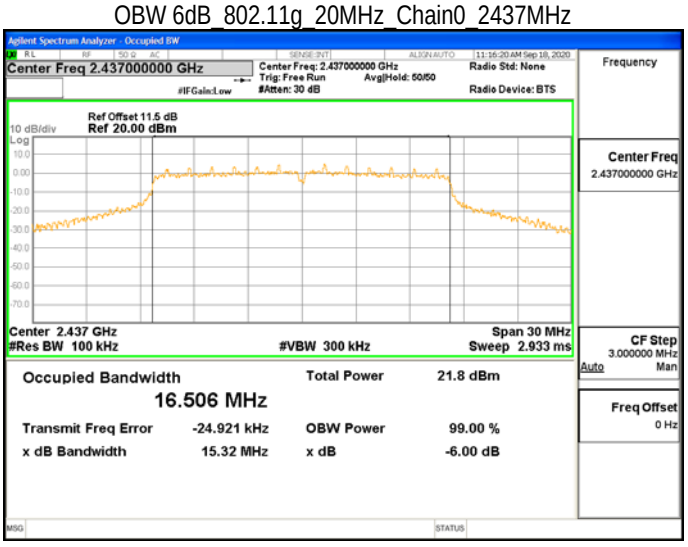
OBW 6dB_802.11g_20MHz_Chain0_2412MHz



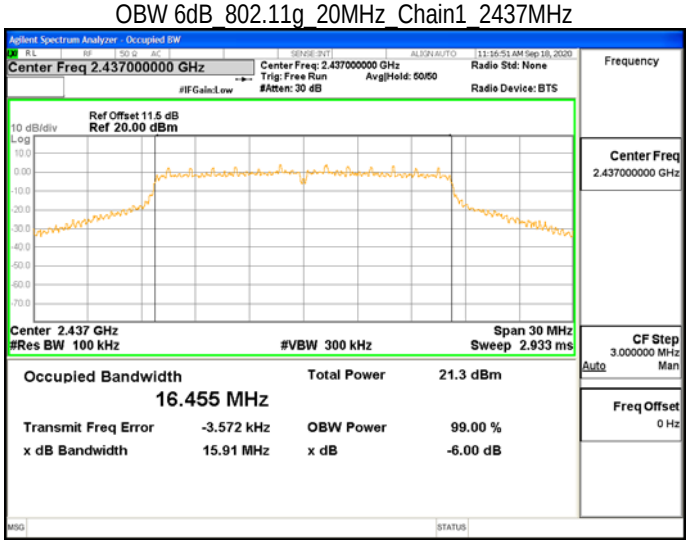
OBW 6dB_802.11g_20MHz_Chain1_2412MHz



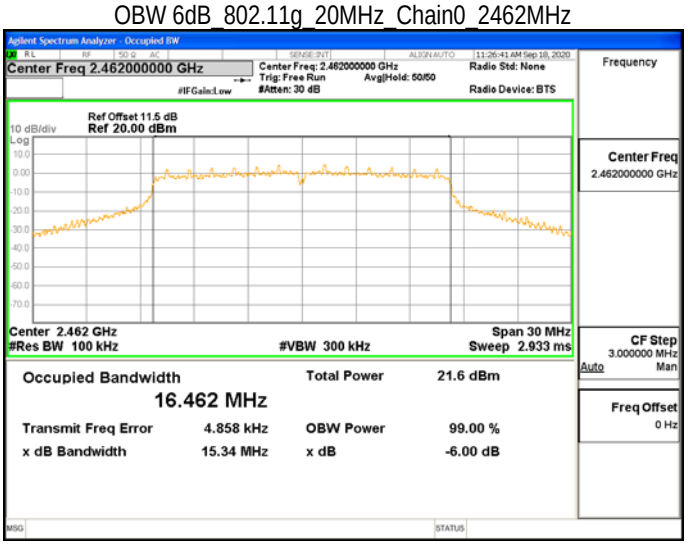
OBW 6dB_802.11g_20MHz_Chain0_2437MHz



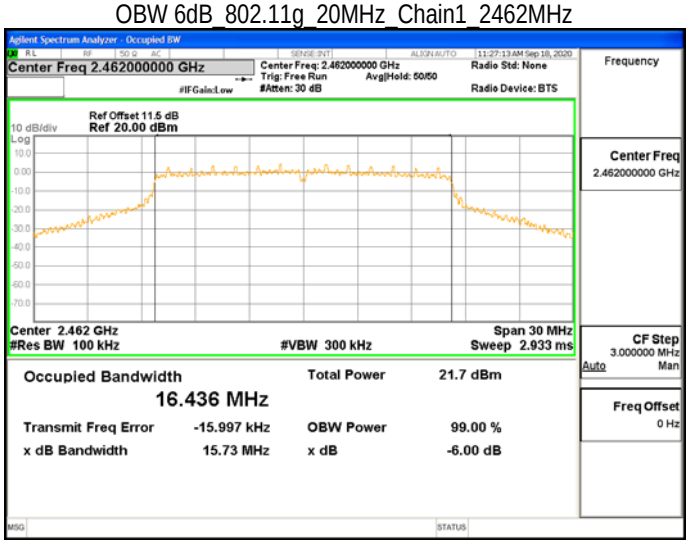
OBW 6dB_802.11g_20MHz_Chain1_2437MHz



OBW 6dB_802.11g_20MHz_Chain0_2462MHz



OBW 6dB_802.11g_20MHz_Chain1_2462MHz



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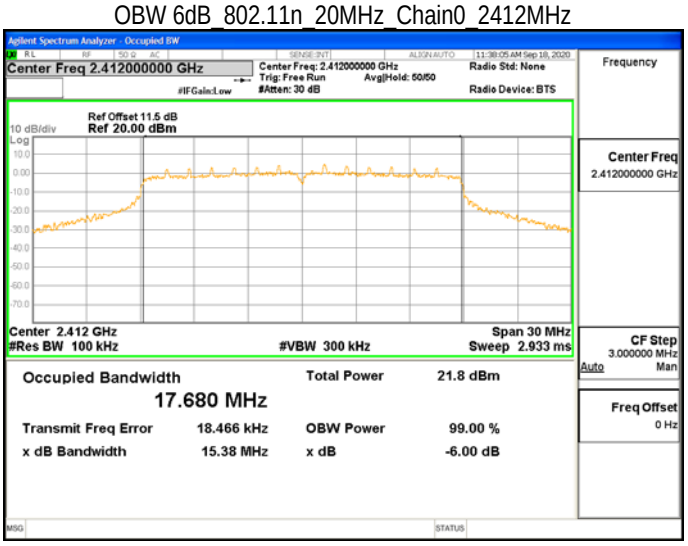
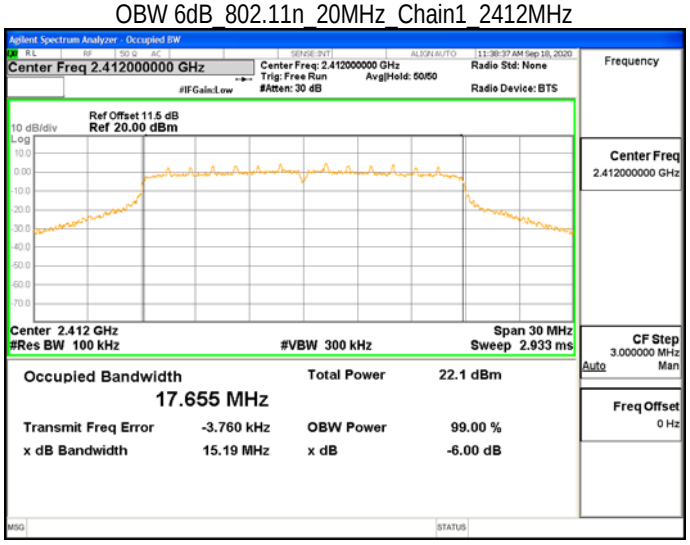
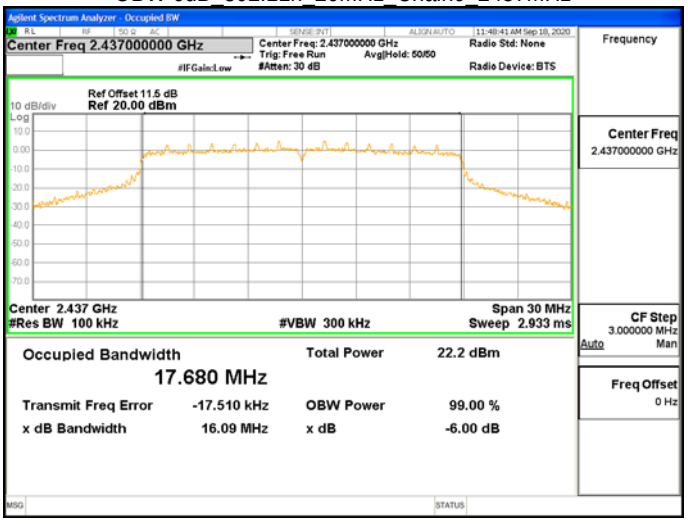
OBW 6dB_802.11n_20MHz_Chain0_2412MHz



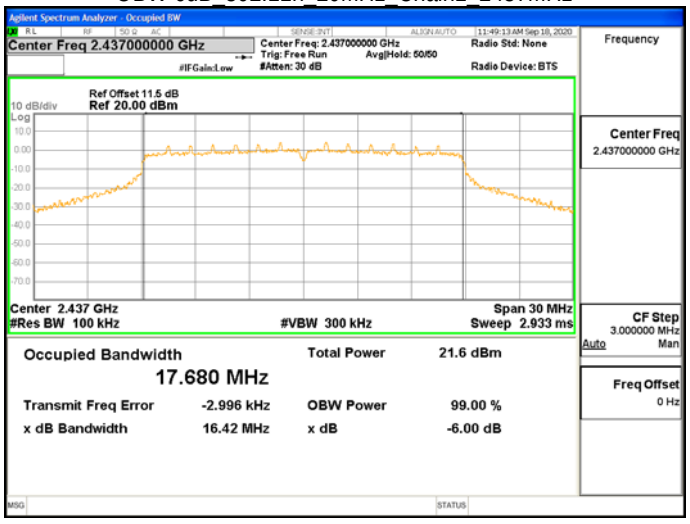
OBW 6dB_802.11n_20MHz_Chain1_2412MHz



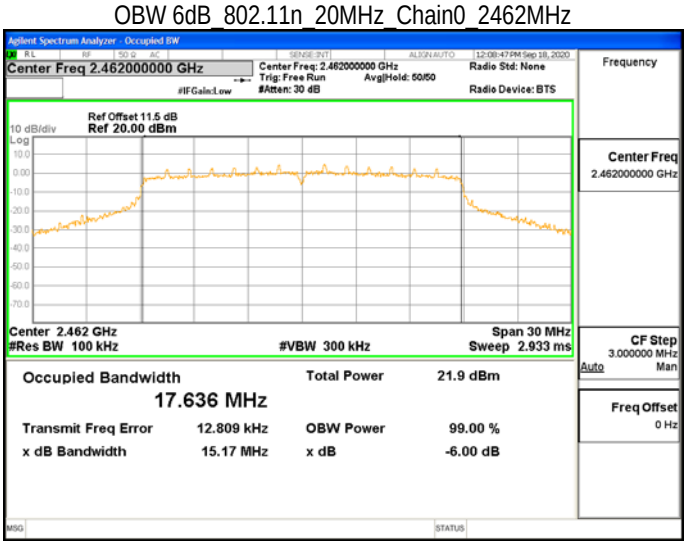
OBW 6dB_802.11n_20MHz_Chain0_2437MHz



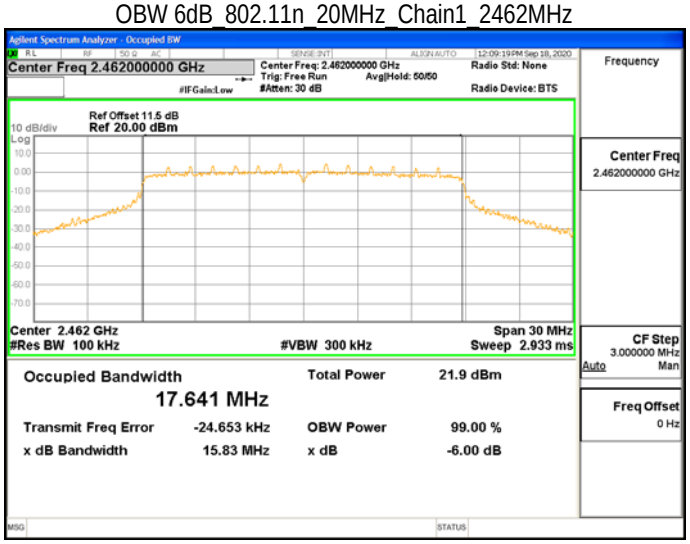
OBW 6dB_802.11n_20MHz_Chain1_2437MHz



OBW 6dB_802.11n_20MHz_Chain0_2462MHz



OBW 6dB_802.11n_20MHz_Chain1_2462MHz



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10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

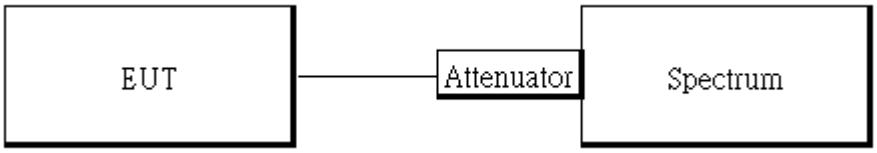
10.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.
In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

10.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	May 6th, 2020	May 5th, 2021
DC Block	Mini-Circuits	BLK-18-S+	1	Jan. 2nd, 2020	Jan. 1st, 2021
Attenuator	Mini-Circuit	BW-S10W2+	2	Jan. 2nd, 2020	Jan. 1st, 2021

10.3 Test SET-UP



10.4 Measurement Procedure

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Reference Level of Emission Limit:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 100kHz & VBW = 300 kHz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.
10. MIMO mode: offset is set following “measure and add 10 Log (N)” on spectrum to measure for MIMO mode. Offset = cable loss + 10 log (N), where N is number of transmitting antenna.

Conducted Band Edge:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Detector = Peak, Sweep = auto
6. Mark the highest reading of the emission as the reference level measurement.
7. Set DL as the limit = reading on marker 1 – 20dBm
8. Marker on frequency, 2.3999GHz and 2.4836GHz, and examine shall 100 kHz immediately outside the authorized (2400~2483.5) be attenuated by 20dB at least relative to the maximum emission of power.
9. Repeat above procedures until all default test channel (low, middle, and high) was complete.
10. MIMO mode: offset is set following “measure and add 10 Log (N)” on spectrum to measure for MIMO mode. Offset = cable loss + 10 log (N), where N is number of transmitting antenna.

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Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Set RBW = 100 kHz & VBW= 300 kHz, Detector =Peak, Sweep = Auto.
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Repeat above procedures until all default test channel measured were complete.
7. MIMO mode: offset is set following "measure and add 10 Log (N)" on spectrum to measure for MIMO mode. Offset = cable loss + 10 log (N), where N is number of transmitting antenna

Note:

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

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10.5 Measurement Result

Reference Level of Limit 802.11b mode		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	6.96	-13.04
2437	7.59	-12.41
2462	7.28	-12.72

Reference Level of Limit 802.11g mode		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	7.27	-12.73
2437	8.01	-11.99
2462	7.69	-12.31

Reference Level of Limit 802.11n20 mode		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	7.84	-12.16
2437	8.06	-11.94
2462	7.87	-12.13

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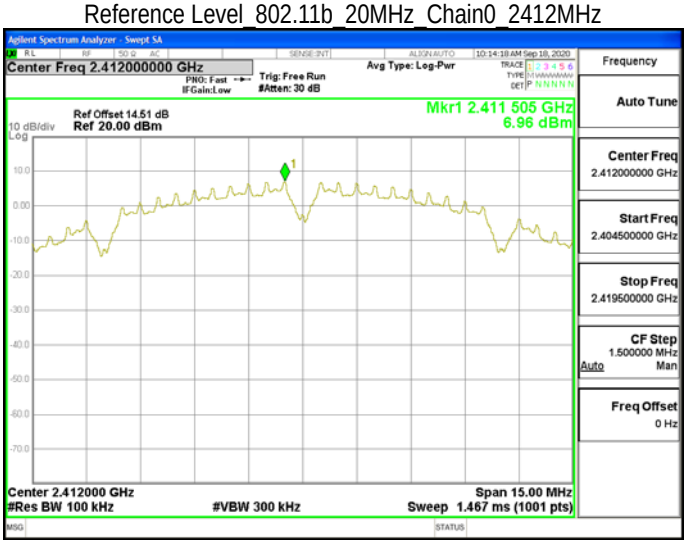
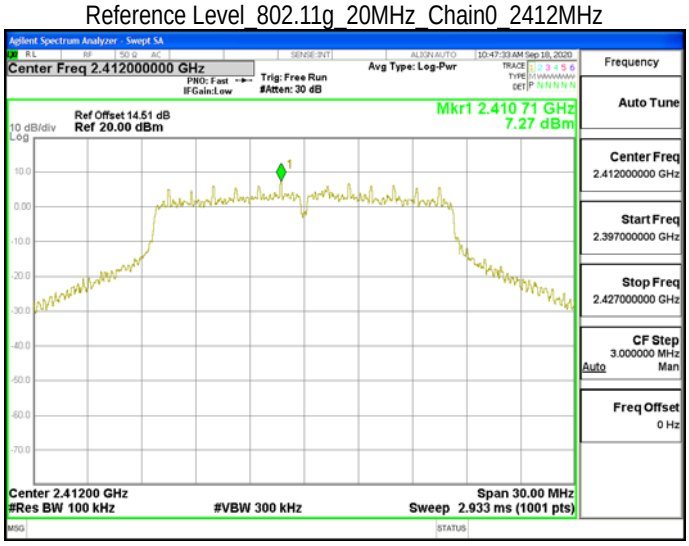
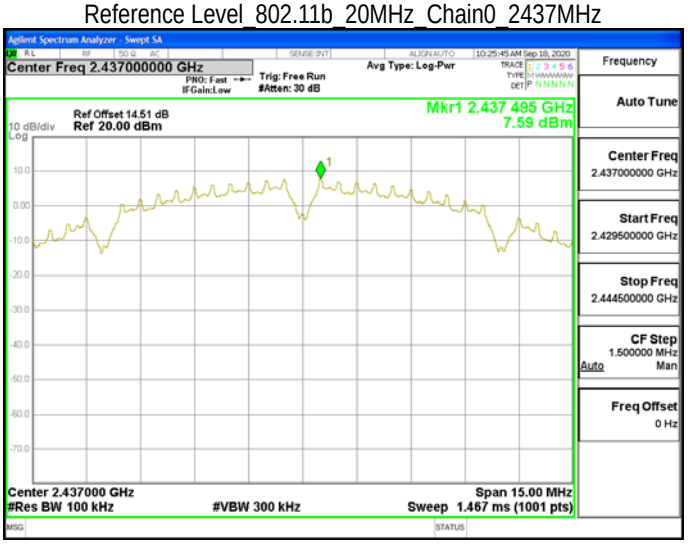
Reference Level_802.11b_20MHz_Chain0_2412MHz



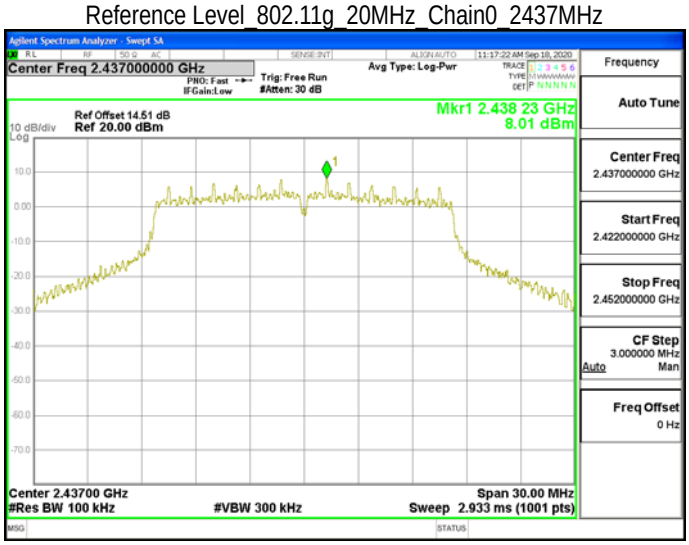
Reference Level_802.11g_20MHz_Chain0_2412MHz



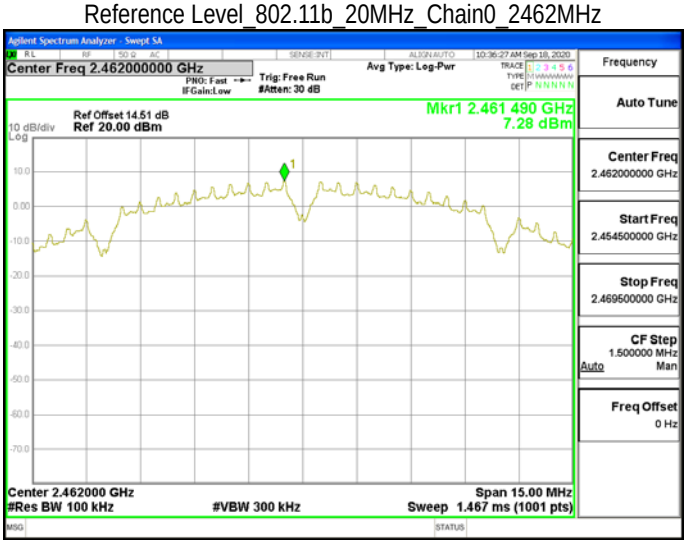
Reference Level_802.11b_20MHz_Chain0_2437MHz



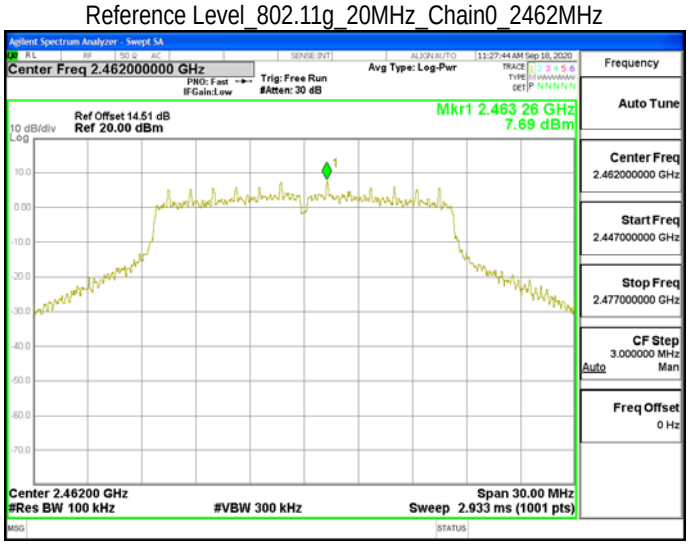
Reference Level_802.11g_20MHz_Chain0_2437MHz



Reference Level_802.11b_20MHz_Chain0_2462MHz



Reference Level_802.11g_20MHz_Chain0_2462MHz



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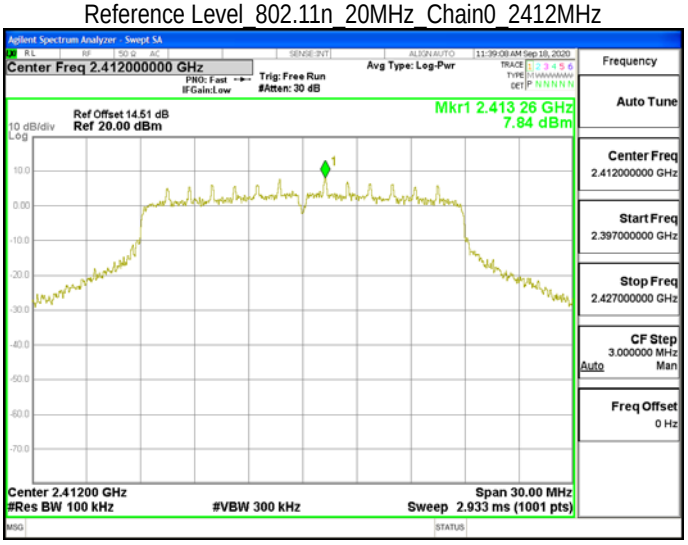
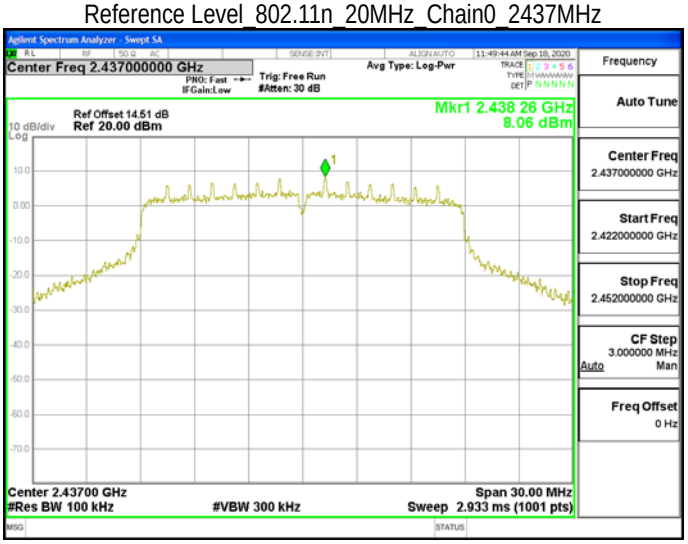
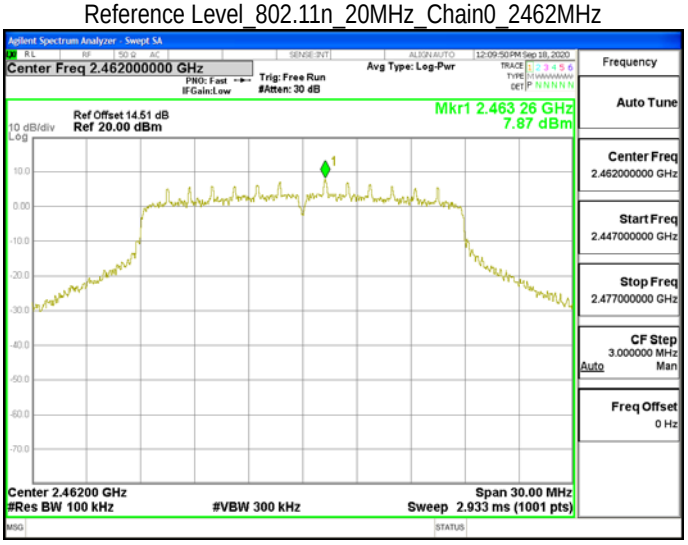
Reference Level_802.11n_20MHz_Chain0_2412MHz



Reference Level_802.11n_20MHz_Chain0_2437MHz



Reference Level_802.11n_20MHz_Chain0_2462MHz



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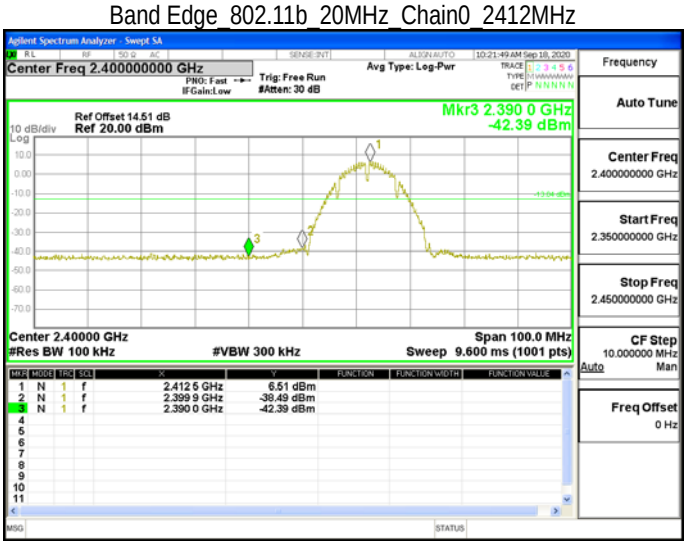
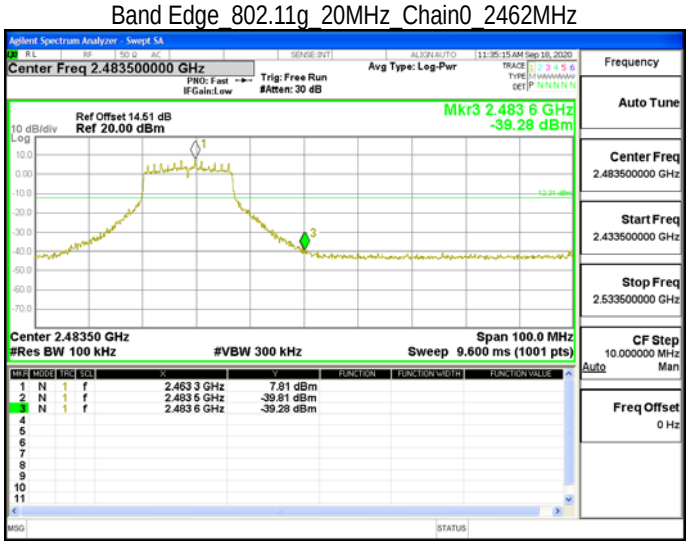
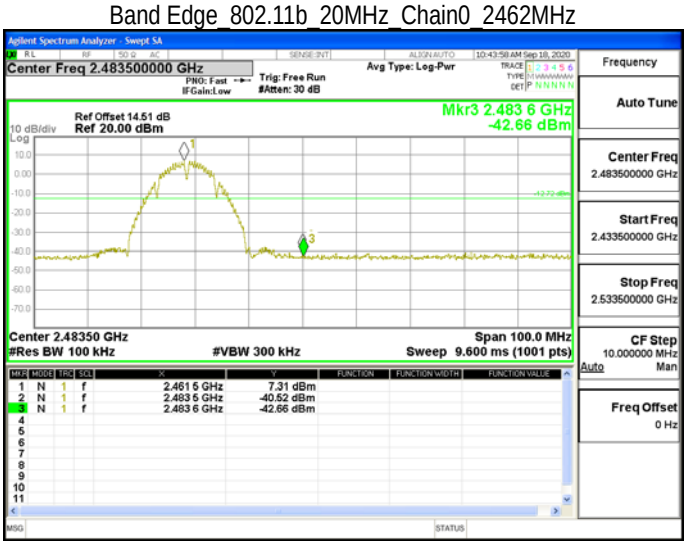
Band Edge_802.11b_20MHz_Chain0_2412MHz



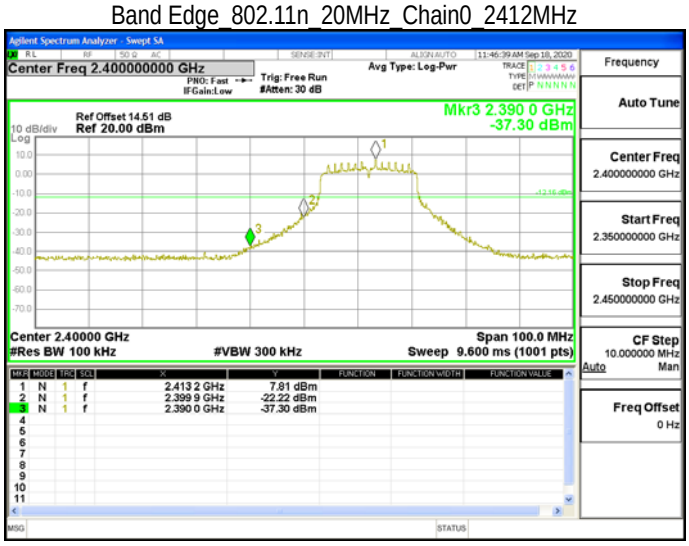
Band Edge_802.11g_20MHz_Chain0_2462MHz



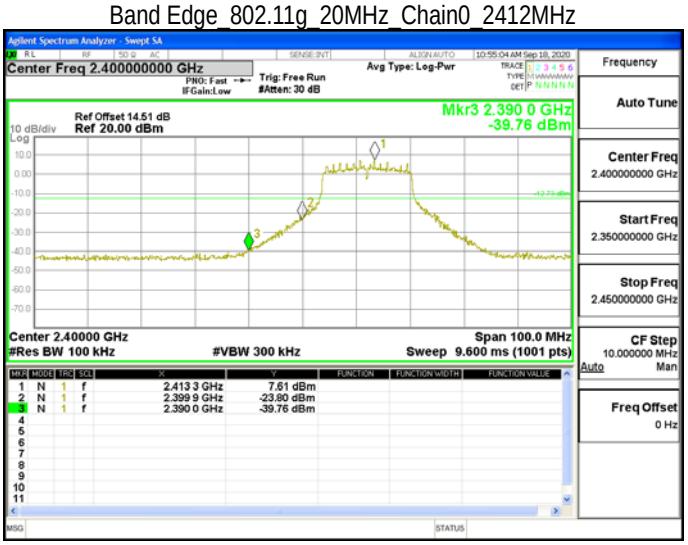
Band Edge_802.11b_20MHz_Chain0_2462MHz



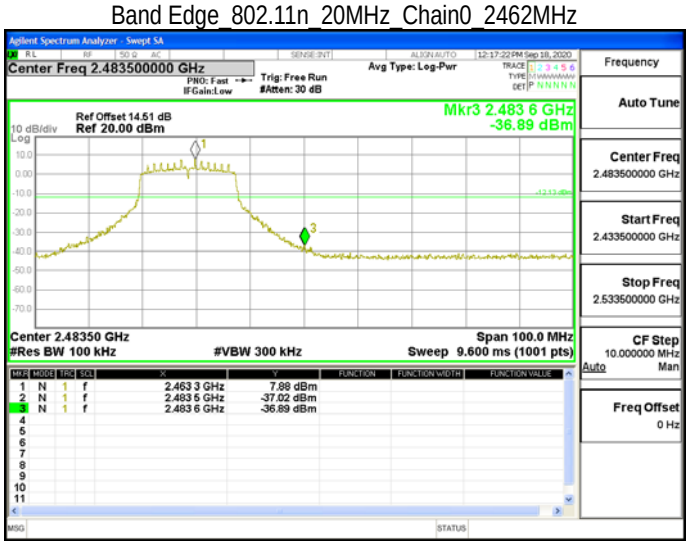
Band Edge_802.11n_20MHz_Chain0_2412MHz



Band Edge_802.11g_20MHz_Chain0_2412MHz



Band Edge_802.11n_20MHz_Chain0_2462MHz



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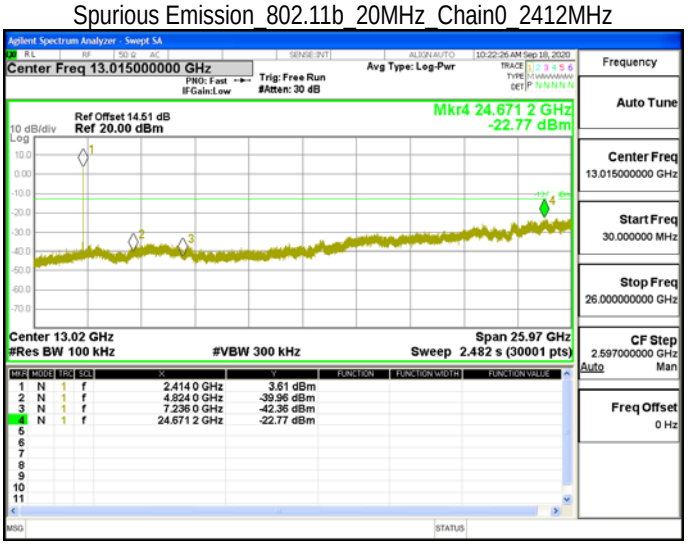
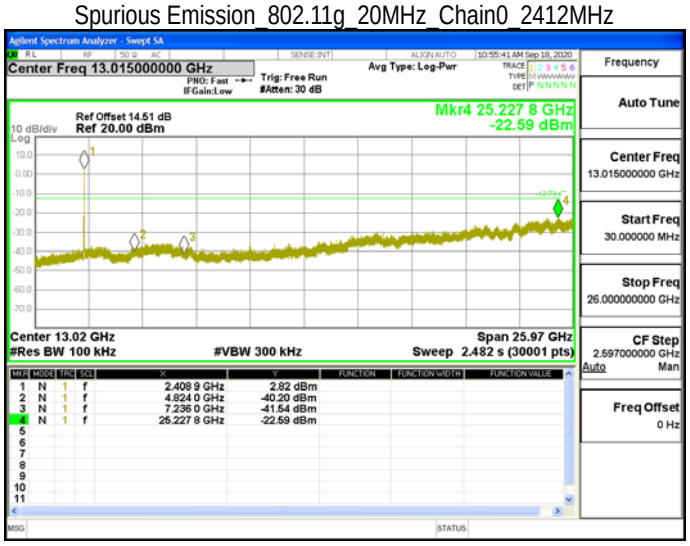
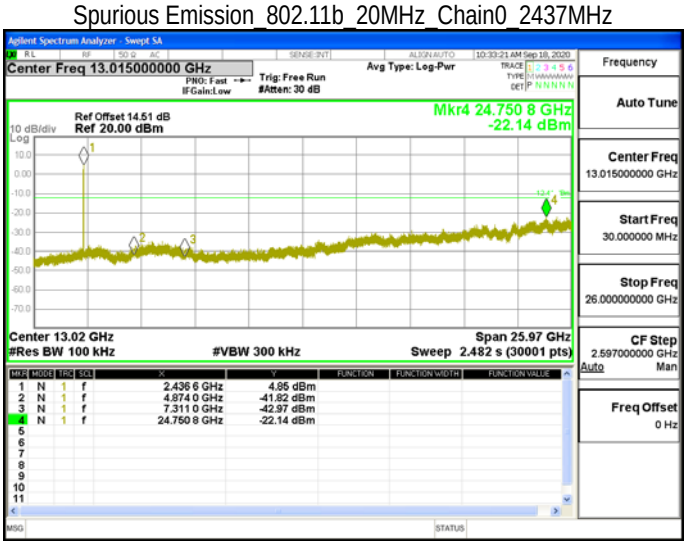
Spurious Emission_802.11b_20MHz_Chain0_2412MHz



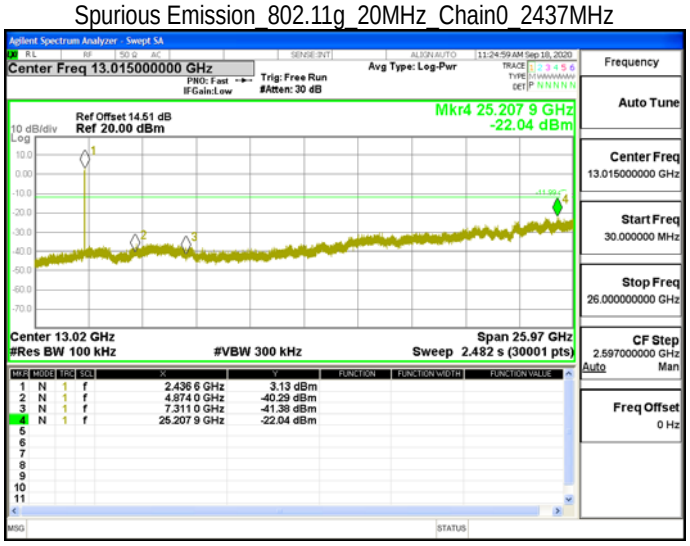
Spurious Emission_802.11g_20MHz_Chain0_2412MHz



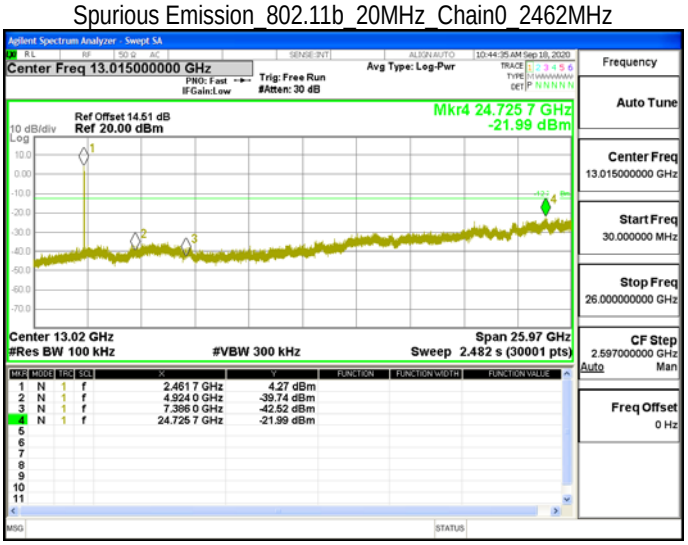
Spurious Emission_802.11b_20MHz_Chain0_2437MHz



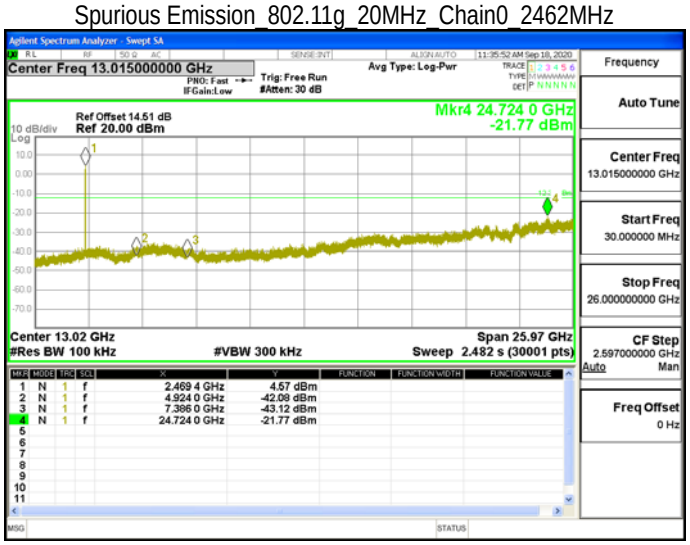
Spurious Emission_802.11g_20MHz_Chain0_2437MHz



Spurious Emission_802.11b_20MHz_Chain0_2462MHz



Spurious Emission_802.11g_20MHz_Chain0_2462MHz



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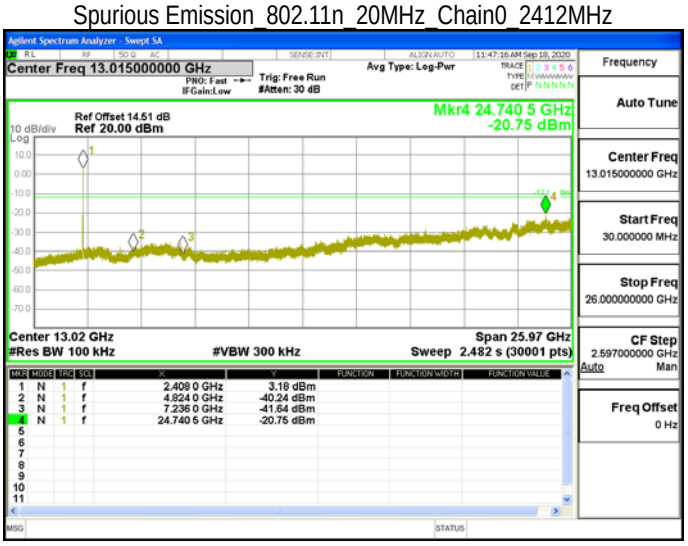
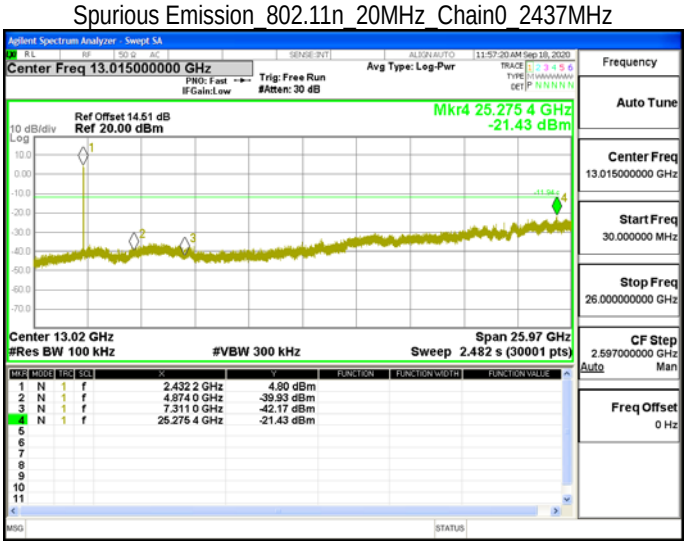
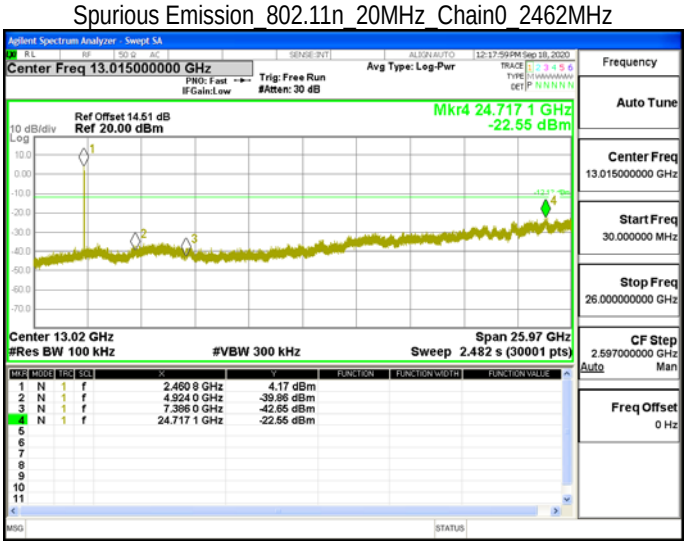
Spurious Emission_802.11n_20MHz_Chain0_2412MHz



Spurious Emission_802.11n_20MHz_Chain0_2437MHz



Spurious Emission_802.11n_20MHz_Chain0_2462MHz



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11 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

11.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 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.
Horn Antenna	Schwarzbeck	BBHA9170	184	Dec. 25th, 2019	Dec. 24th, 2020
Horn Antenna	Schwarzbeck	BBHA9120D	603	Apr. 29th, 2020	Apr. 28th, 2021
Bi-log Antenna	SCHWAZBECK	VULB9168	378	Aug. 6th, 2020	Aug. 5th, 2021
Loop Antenna	ETS.LINDGREN	6502	148045	Oct. 15th, 2019	Oct. 14th, 2020
3m Site NSA	SGS	966 chamber	N/A	Jan. 2nd, 2020	Jan. 1st, 2021
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	Apr. 21st, 2020	Apr. 20th, 2021
EMI Test Receiver	R&S	ESCI 7	100759	Jul. 13th, 2020	Jul. 12nd, 2021
Pre-Amplifier	EMC Instruments	EMC184045B	980135	Jan. 2nd, 2020	Jan. 1st, 2021
Pre-Amplifier	HP	8447D	2944A09469	Jan. 2nd, 2020	Jan. 1st, 2021
Attenuator	Mini-Circuit	BW-S10W2+	4	Jan. 2nd, 2020	Jan. 1st, 2021
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M1	Jan. 2nd, 2020	Jan. 1st, 2021
High Pass Filter	WI	WHKX4.0/18G-10SS	22	Jan. 2nd, 2020	Jan. 1st, 2021
Coaxial Cable	Huber Suhner	succoflex 102	MY2622/2	Jan. 2nd, 2020	Jan. 1st, 2021
Coaxial Cable	Huber Suhner	succoflex 104A	800086/4a	Jan. 2nd, 2020	Jan. 1st, 2021
Coaxial Cable	Huber Suhner	EMC 104-SM-SM-2000	160123	Jan. 2nd, 2020	Jan. 1st, 2021
Test Software	audix	e3	Ver. 6.11-20180413	N.C.R	N.C.R

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

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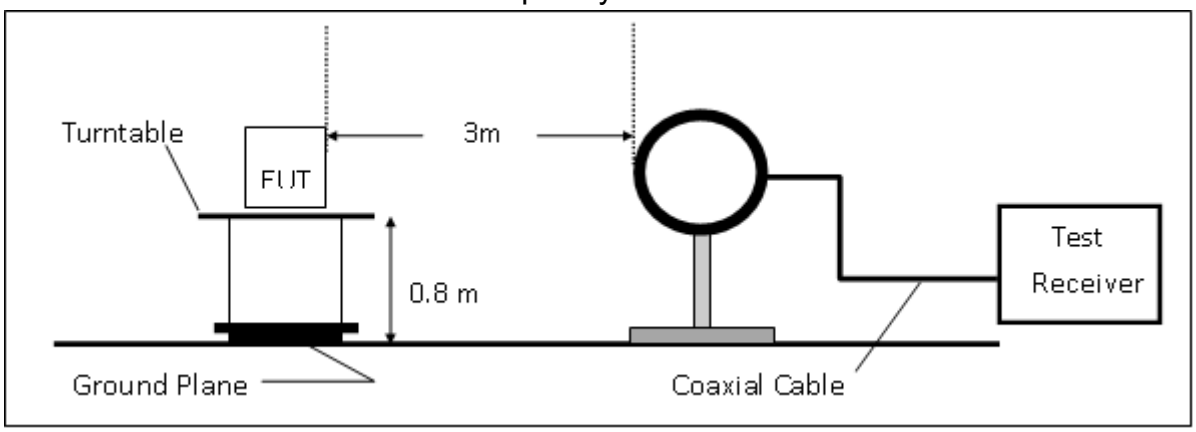
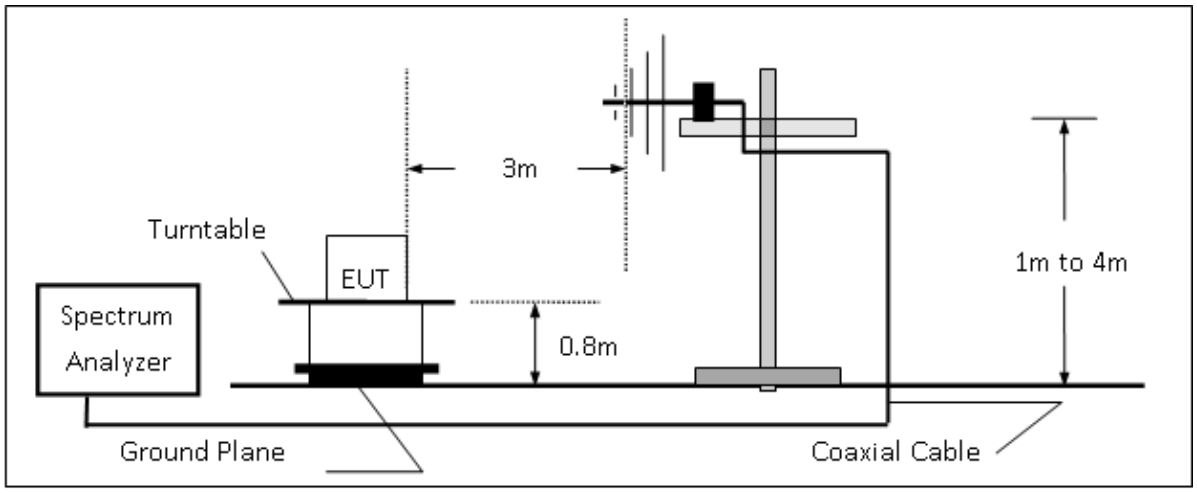
11.3 Test SET-UP

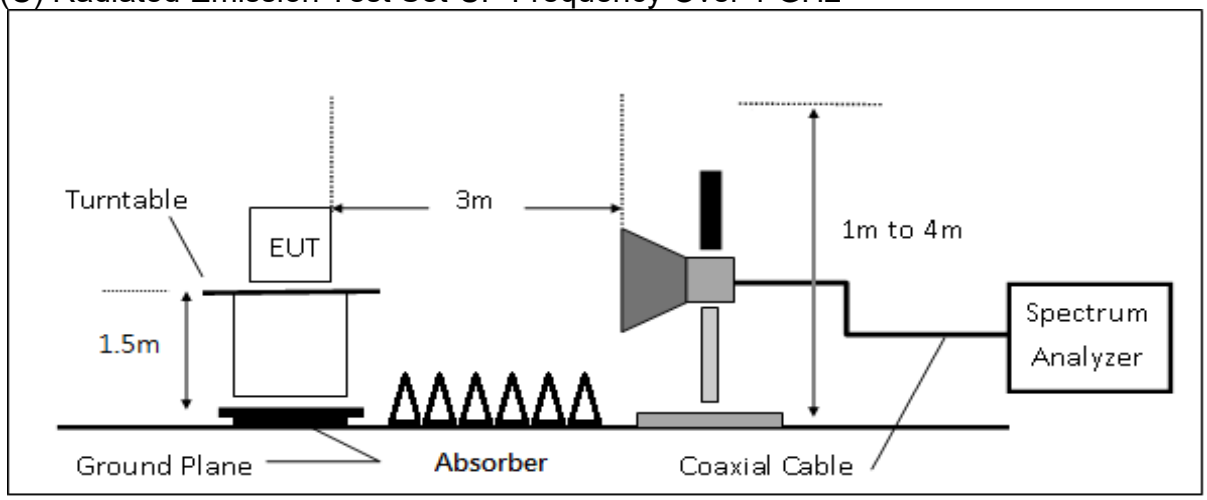
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



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



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



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11.4 Measurement Procedure

1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 1.5m for frequency> 1GHz above ground plane.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.
6. Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
7. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
8. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
9. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
10. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
11. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
12. Repeat above procedures until all default test channel measured were complete.

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11.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where *FS = Field Strength* *CL = Cable Attenuation Factor (Cable Loss)*

RA = Reading Amplitude *AG = Amplifier Gain*

AF = Antenna Factor

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

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

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

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

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

11.7 Measurement Result

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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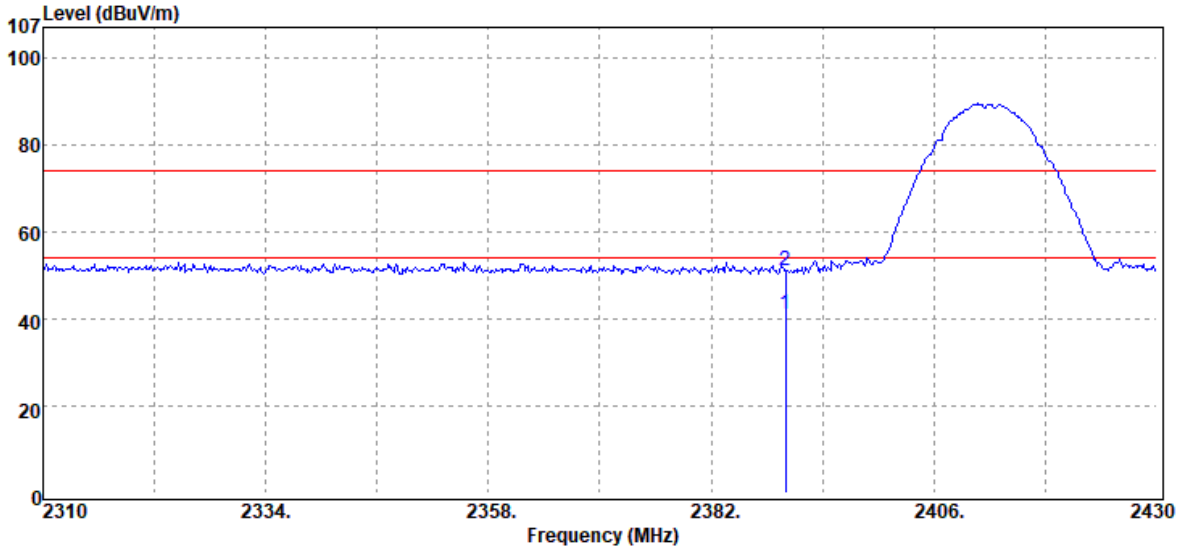
11.7.1 Radiated Band Edge Measurement Result

Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11b	Test Date	:2020-09-16
Test Frequency	:2412 MHz	Temp./Humi.	:25.1/61
Test Mode	:Bandedge CH Low	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	Average	40.23	0.92	41.15	54.00	-12.85
2390.00	Peak	50.00	0.92	50.92	74.00	-23.08

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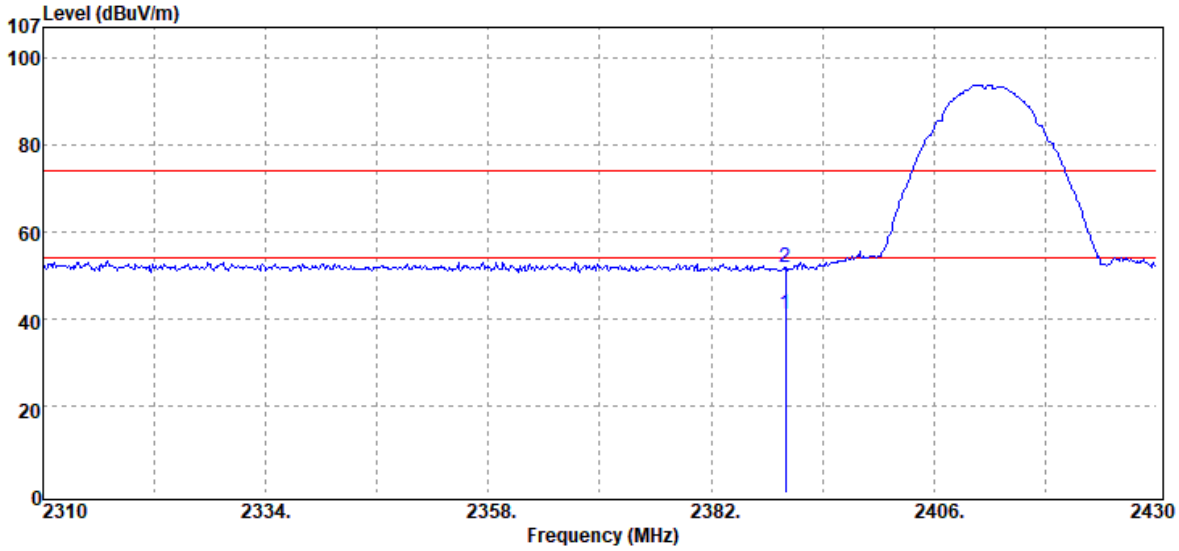
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11b	Test Date	:2020-09-16
Test Frequency	:2412 MHz	Temp./Humi.	:25.1/61
Test Mode	:Bandedge CH Low	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2390.00	Average	40.18	0.92	41.10	54.00	-12.90
2390.00	Peak	50.99	0.92	51.91	74.00	-22.09

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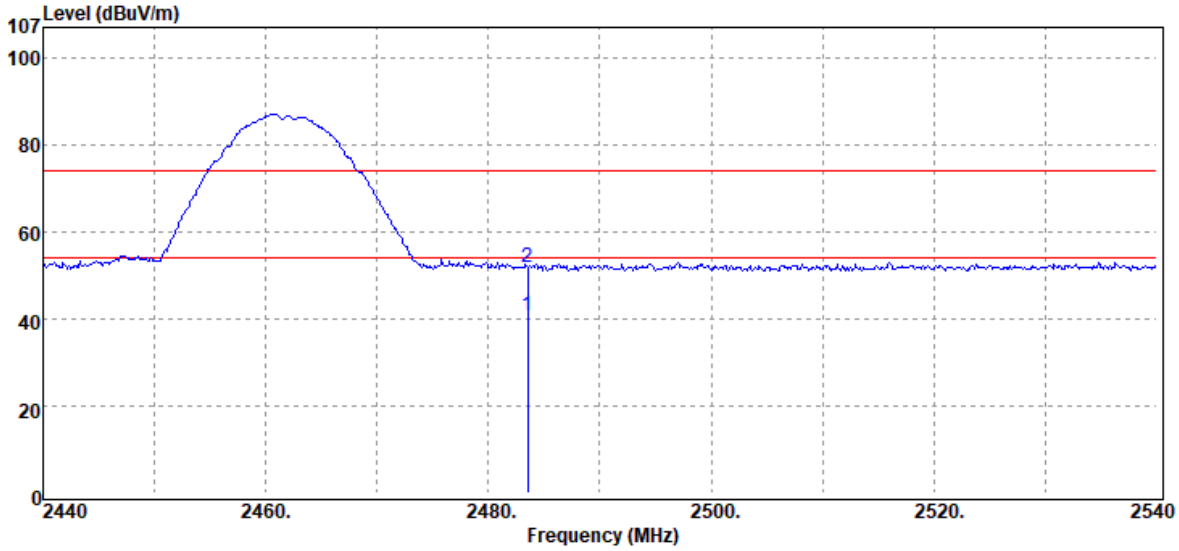
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11b	Test Date	:2020-09-16
Test Frequency	:2462 MHz	Temp./Humi.	:25.1/61
Test Mode	:Bandedge CH High	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2483.50	Average	40.09	0.67	40.76	54.00	-13.24
2483.50	Peak	51.22	0.67	51.89	74.00	-22.11

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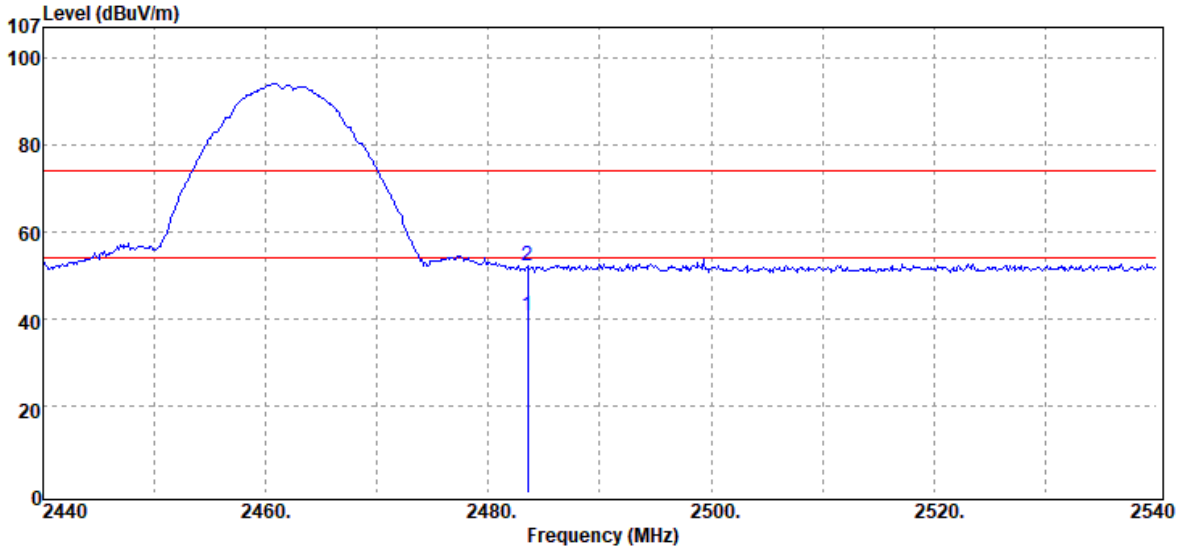
Operation Mode	:802.11b	Test Date	:2020-09-16
Test Frequency	:2462 MHz	Temp./Humi.	:25.1/61
Test Mode	:Bandedge CH High	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2483.50	Average	40.21	0.67	40.88	54.00	-13.12
2483.50	Peak	51.56	0.67	52.23	74.00	-21.77

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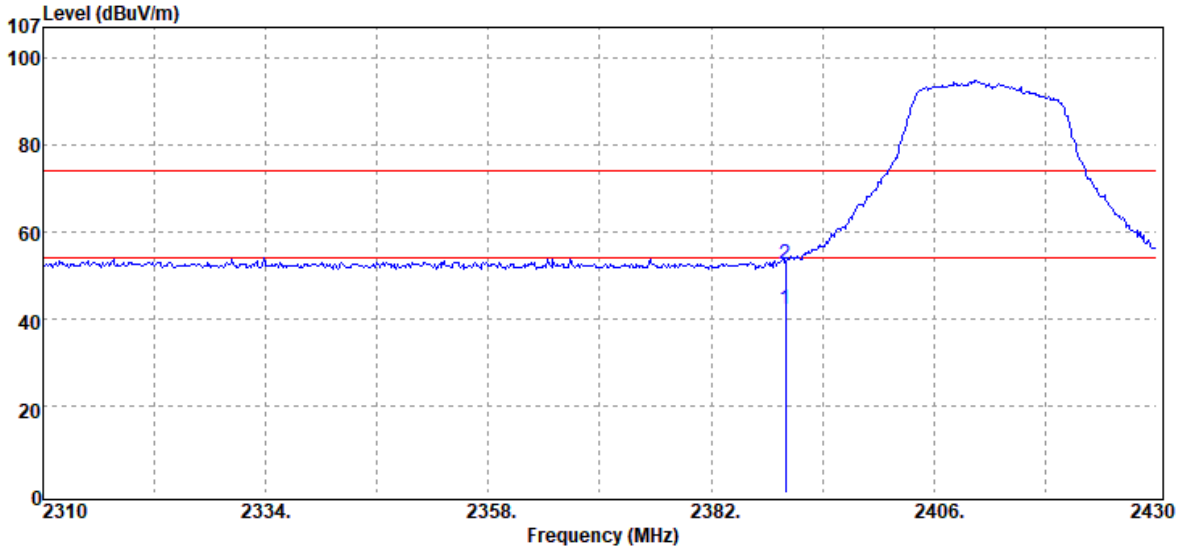
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11g	Test Date	:2020-09-16
Test Frequency	:2412 MHz	Temp./Humi.	:25.1/61
Test Mode	:Bandedge CH Low	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2390.00	Average	41.34	0.92	42.26	54.00	-11.74
2390.00	Peak	51.78	0.92	52.70	74.00	-21.30

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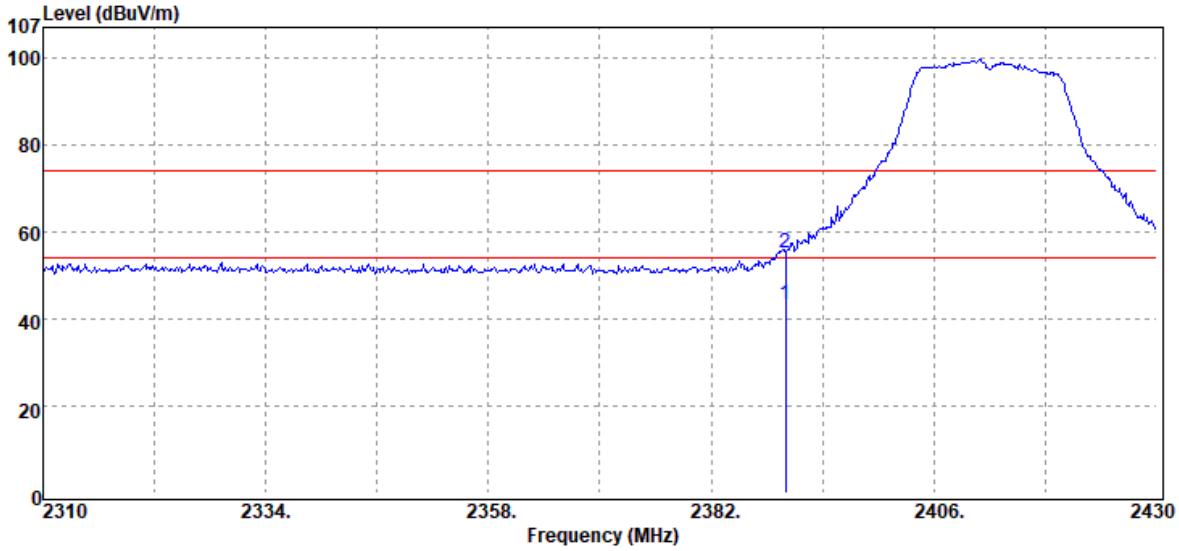
Operation Mode	:802.11g	Test Date	:2020-09-16
Test Frequency	:2412 MHz	Temp./Humi.	:25.1/61
Test Mode	:Bandedge CH Low	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2390.00	Average	42.33	0.92	43.25	54.00	-10.75
2390.00	Peak	54.14	0.92	55.06	74.00	-18.94

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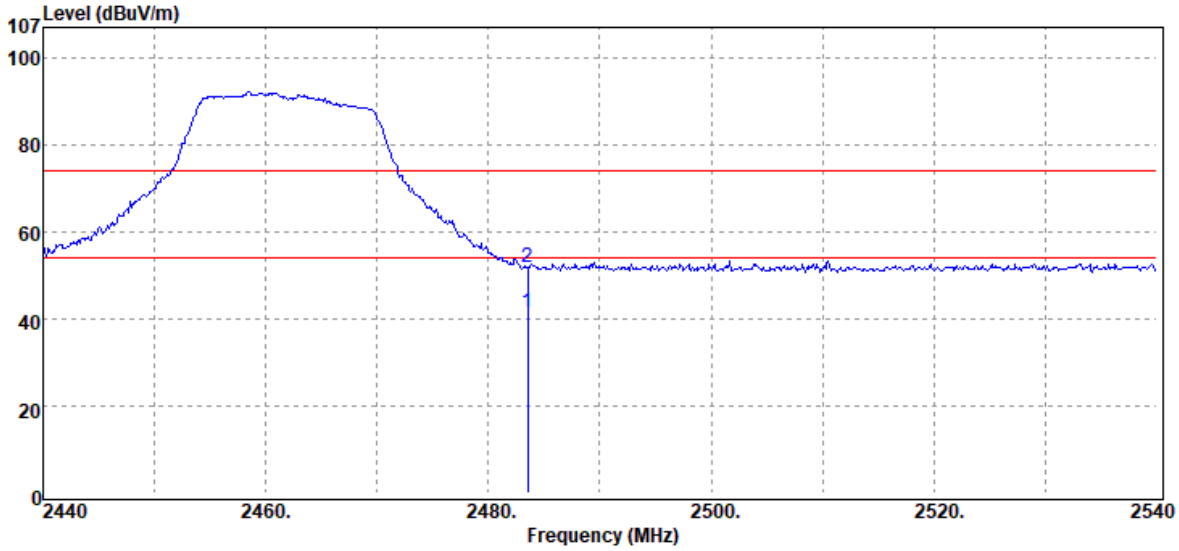
Operation Mode	:802.11g	Test Date	:2020-09-16
Test Frequency	:2462 MHz	Temp./Humi.	:25.1/61
Test Mode	:Bandedge CH High	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2483.50	Average	40.67	0.67	41.34	54.00	-12.66
2483.50	Peak	51.20	0.67	51.87	74.00	-22.13

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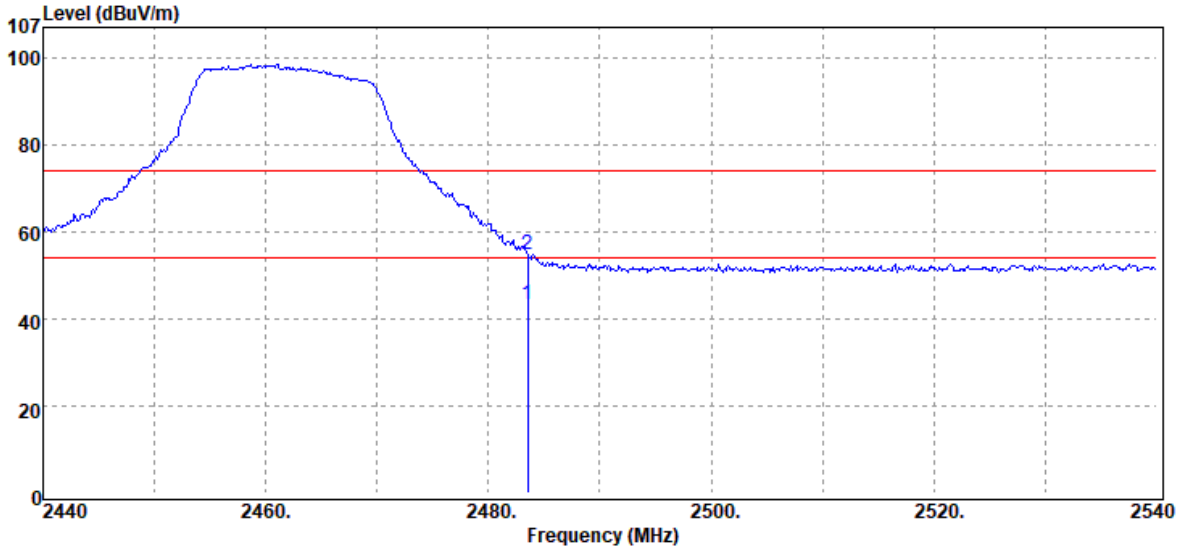
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11g	Test Date	:2020-09-16
Test Frequency	:2462 MHz	Temp./Humi.	:25.1/61
Test Mode	:Bandedge CH High	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2483.50	Average	42.49	0.67	43.16	54.00	-10.84
2483.50	Peak	54.22	0.67	54.89	74.00	-19.11

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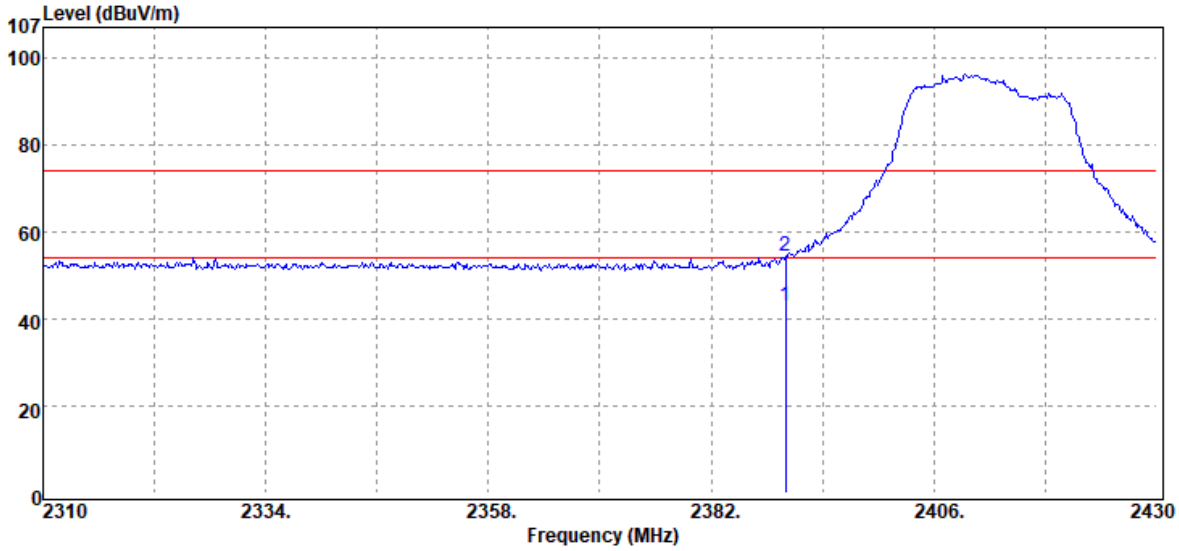
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11n20	Test Date	:2020-09-16
Test Frequency	:2412 MHz	Temp./Humi.	:25.1/61
Test Mode	:Bandedge CH Low	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2390.00	Average	41.99	0.92	42.91	54.00	-11.09
2390.00	Peak	53.47	0.92	54.39	74.00	-19.61

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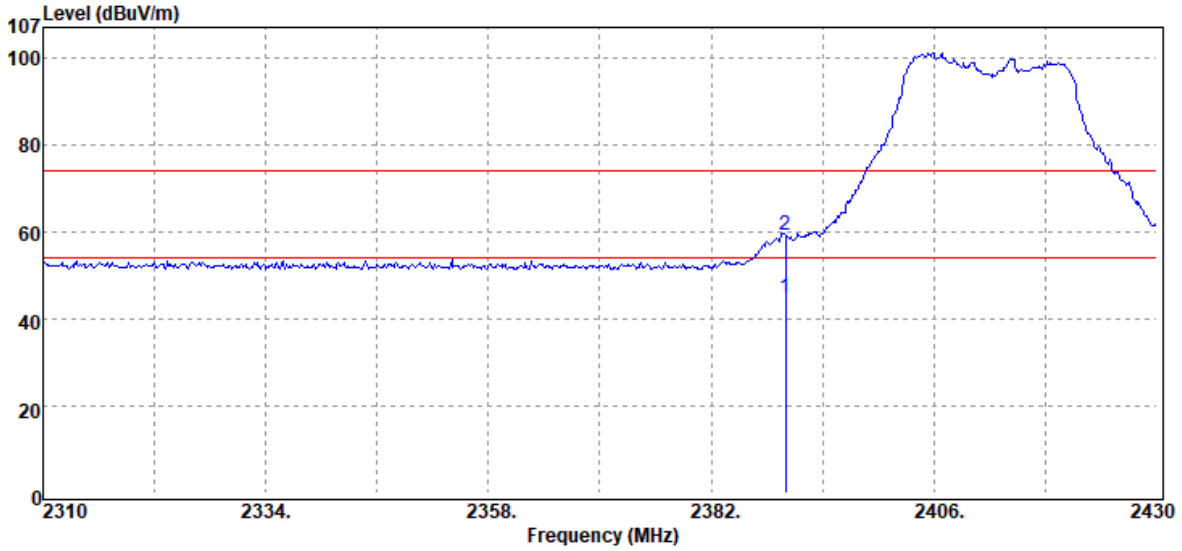
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11n20	Test Date	:2020-09-16
Test Frequency	:2412 MHz	Temp./Humi.	:25.1/61
Test Mode	:Bandedge CH Low	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2390.00	Average	43.88	0.92	44.80	54.00	-9.20
2390.00	Peak	58.50	0.92	59.42	74.00	-14.58

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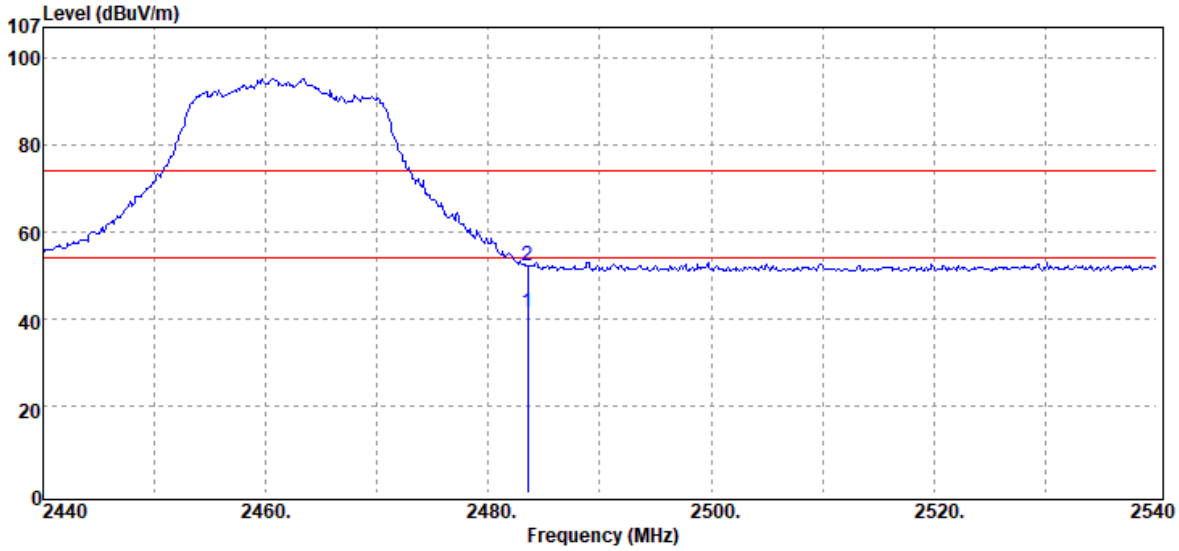
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11n20	Test Date	:2020-09-16
Test Frequency	:2462 MHz	Temp./Humi.	:25.1/61
Test Mode	:Bandedge CH High	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2483.50	Average	40.98	0.67	41.65	54.00	-12.35
2483.50	Peak	51.63	0.67	52.30	74.00	-21.70

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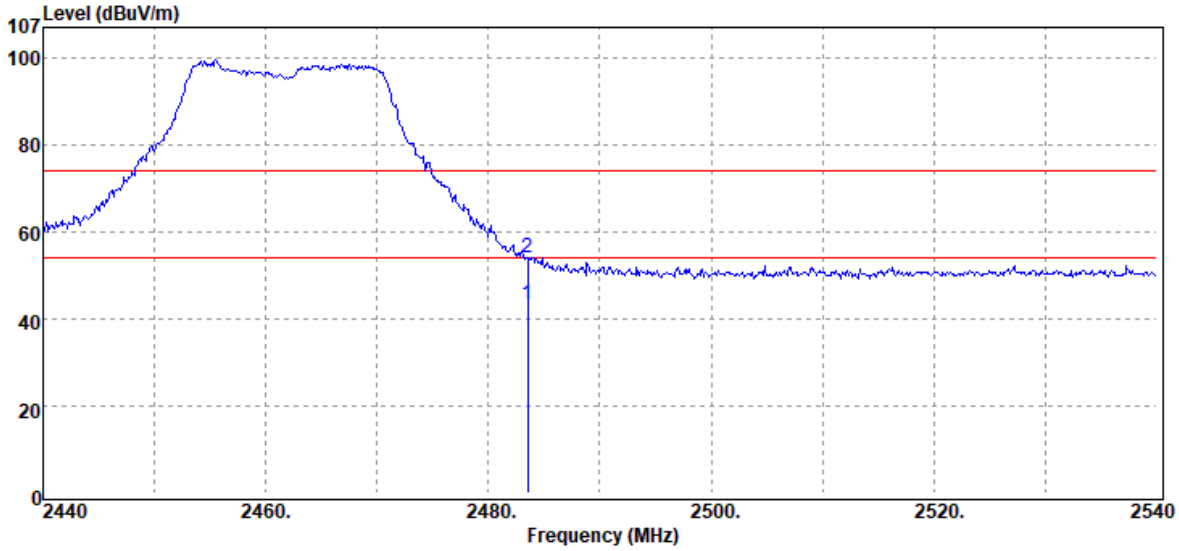
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11n20	Test Date	:2020-09-16
Test Frequency	:2462 MHz	Temp./Humi.	:25.1/61
Test Mode	:Bandedge CH High	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2483.50	Average	42.75	0.67	43.42	54.00	-10.58
2483.50	Peak	53.49	0.67	54.16	74.00	-19.84

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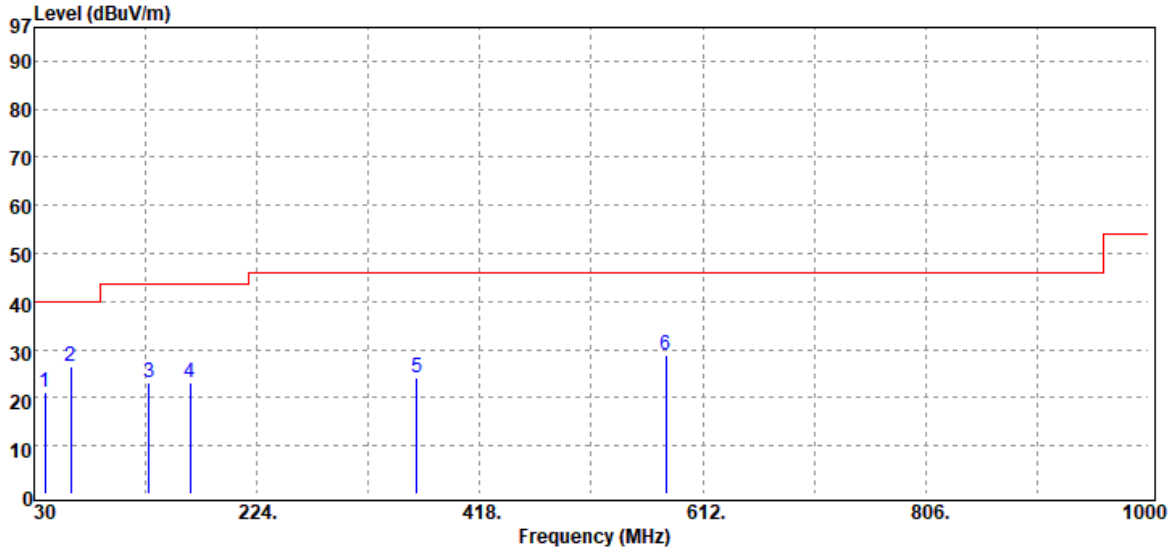
11.7.2 Below 1GHz Worst-Case Emission:

Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11g	Test Date	:2020-09-16
Test Frequency	:2437 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH Mid	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
39.70	Peak	29.77	-8.53	21.24	40.00	-18.76
62.01	Peak	35.44	-9.06	26.38	40.00	-13.62
129.91	Peak	31.79	-8.55	23.24	43.50	-20.26
165.80	Peak	30.55	-7.50	23.05	43.50	-20.45
362.71	Peak	29.01	-4.82	24.19	46.00	-21.81
579.99	Peak	29.07	-0.19	28.88	46.00	-17.12

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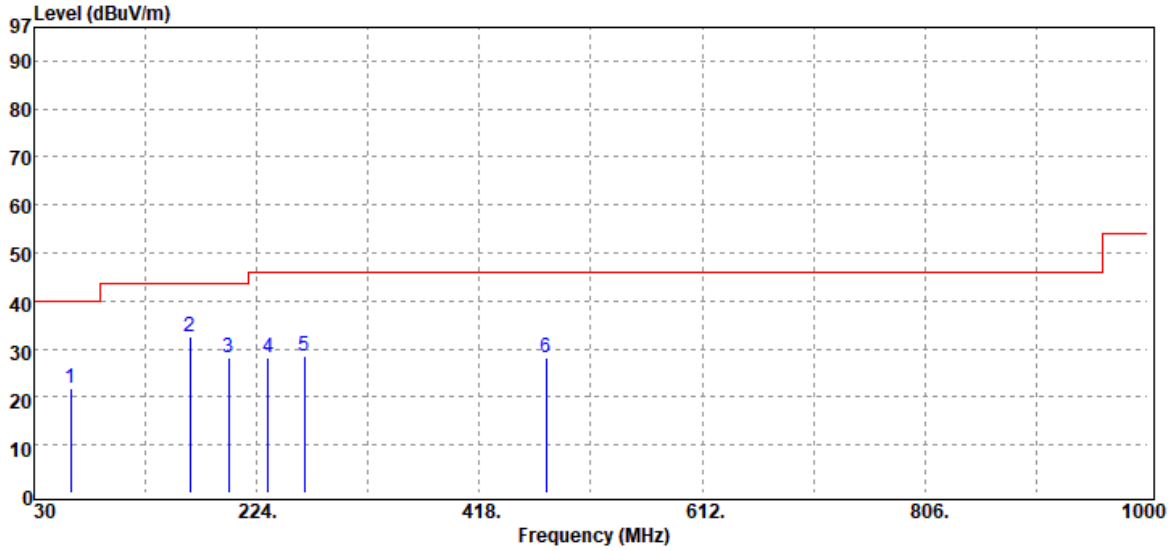
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11g	Test Date	:2020-09-16
Test Frequency	:2437 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH Mid	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
62.01	Peak	30.84	-9.06	21.78	40.00	-18.22
165.80	Peak	39.98	-7.50	32.48	43.50	-11.02
199.75	Peak	37.93	-9.64	28.29	43.50	-15.21
233.70	Peak	36.85	-8.62	28.23	46.00	-17.77
265.71	Peak	35.68	-7.25	28.43	46.00	-17.57
476.20	Peak	30.60	-2.41	28.19	46.00	-17.81

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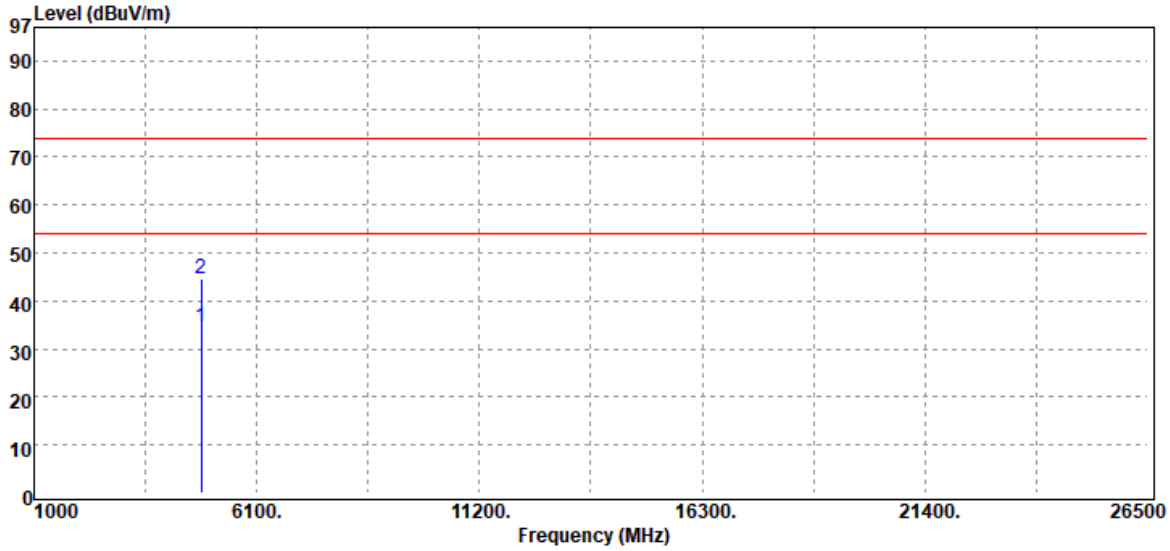
11.7.3 Above 1GHz Emission:

Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11b	Test Date	:2020-09-16
Test Frequency	:2412 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH Low	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4824.00	Average	27.28	7.13	34.41	54.00	-19.59
4824.00	Peak	37.41	7.13	44.54	74.00	-29.46

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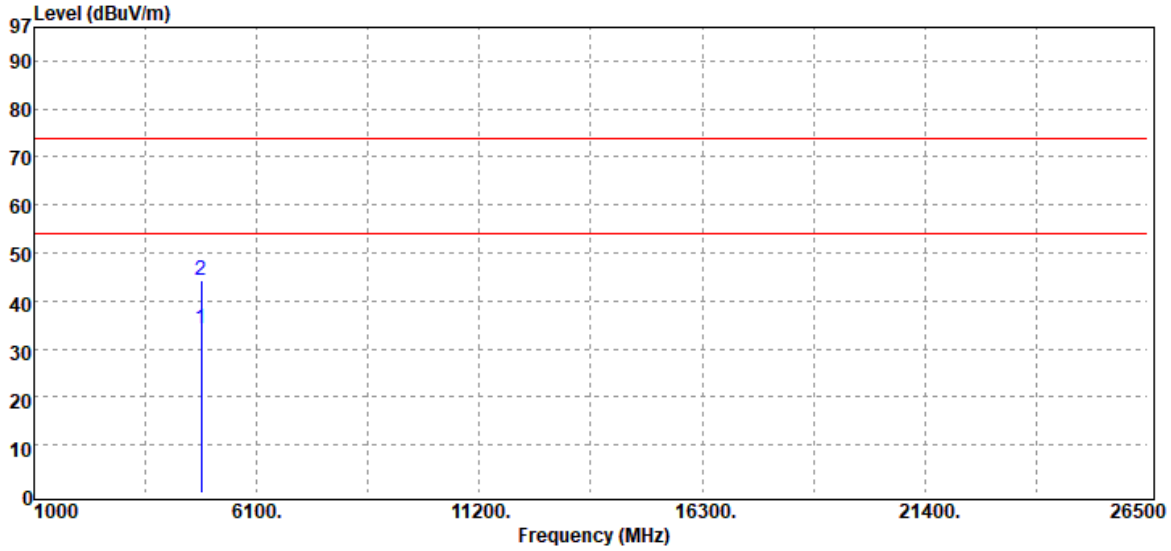
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11b	Test Date	:2020-09-16
Test Frequency	:2412 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH Low	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
4824.00	Average	27.24	7.13	34.37	54.00	-19.63
4824.00	Peak	37.17	7.13	44.30	74.00	-29.70

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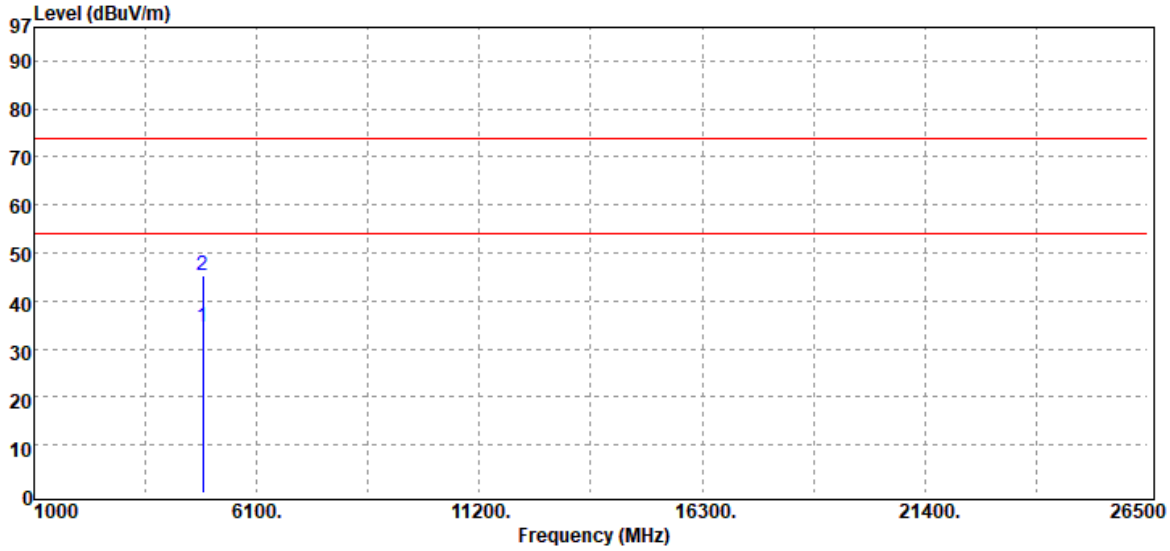
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11b	Test Date	:2020-09-16
Test Frequency	:2437 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH Mid	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



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	27.14	7.51	34.65	54.00	-19.35
4874.00	Peak	37.84	7.51	45.35	74.00	-28.65

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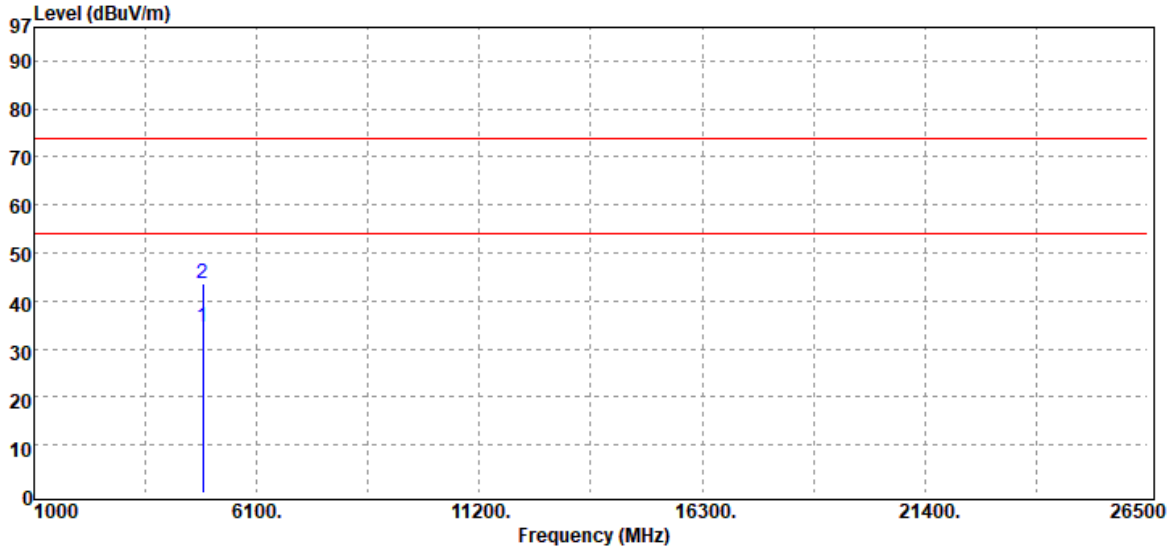
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11b	Test Date	:2020-09-16
Test Frequency	:2437 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH Mid	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



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	27.09	7.51	34.60	54.00	-19.40
4874.00	Peak	36.15	7.51	43.66	74.00	-30.34

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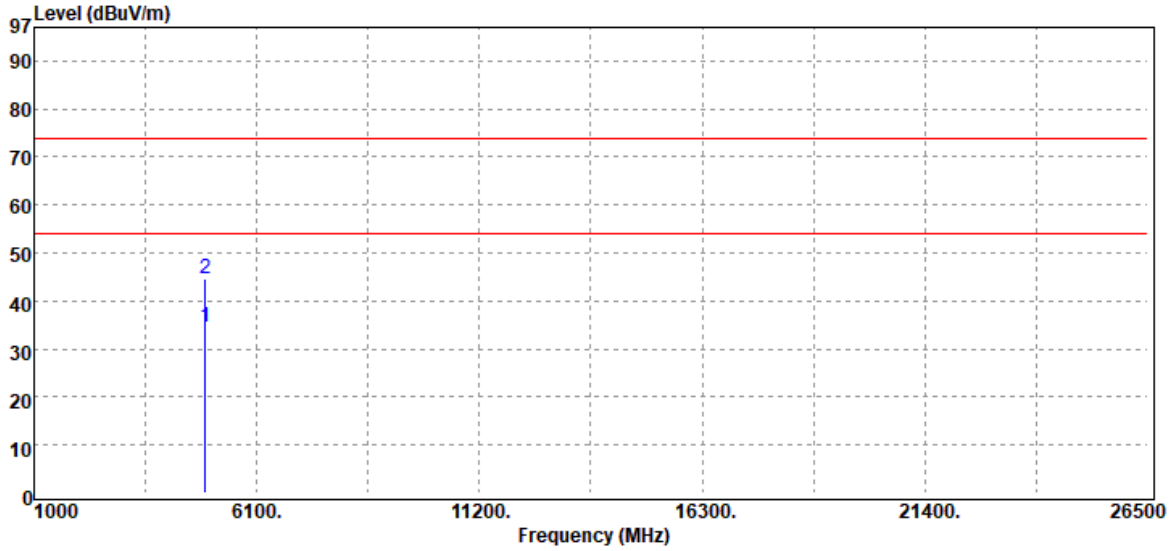
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11b	Test Date	:2020-09-16
Test Frequency	:2462 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH High	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



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	26.77	7.84	34.61	54.00	-19.39
4924.00	Peak	36.91	7.84	44.75	74.00	-29.25

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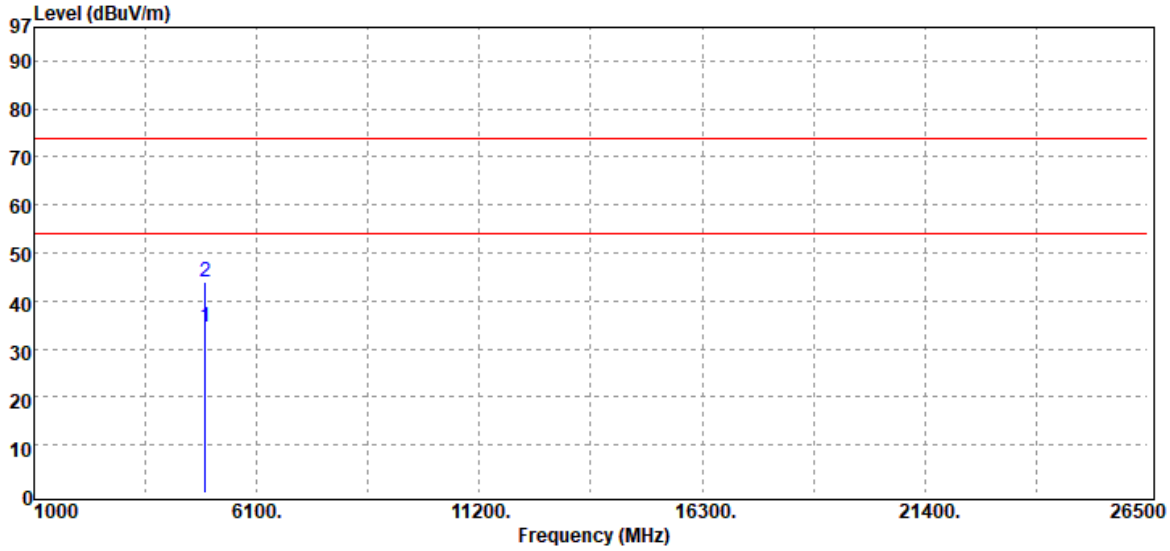
Operation Mode	:802.11b	Test Date	:2020-09-16
Test Frequency	:2462 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH High	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



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	26.83	7.84	34.67	54.00	-19.33
4924.00	Peak	36.19	7.84	44.03	74.00	-29.97

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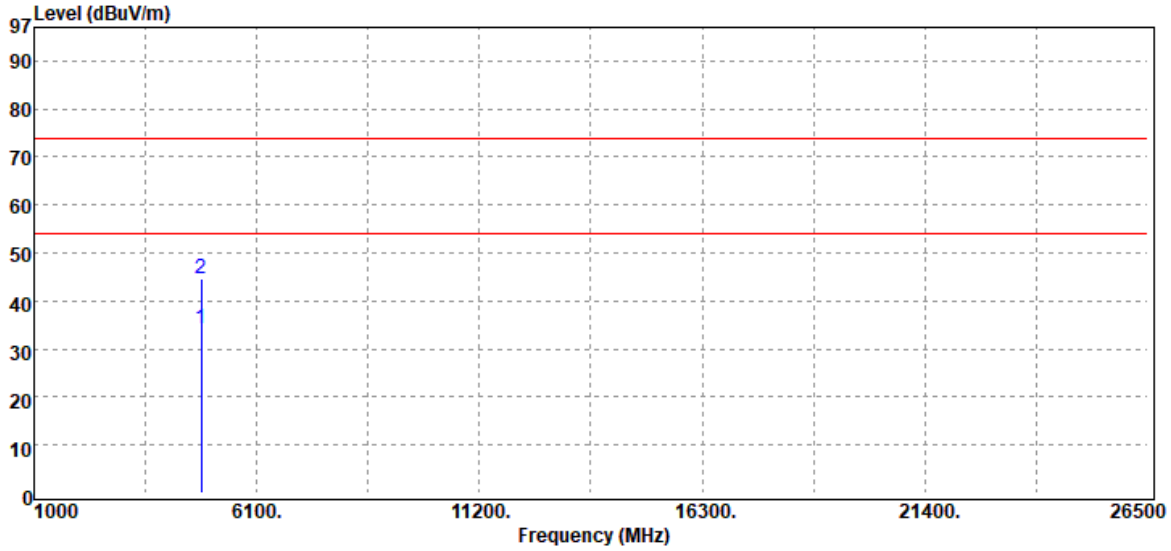
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11g	Test Date	:2020-09-16
Test Frequency	:2412 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH Low	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4824.00	Average	27.25	7.13	34.38	54.00	-19.62
4824.00	Peak	37.44	7.13	44.57	74.00	-29.43

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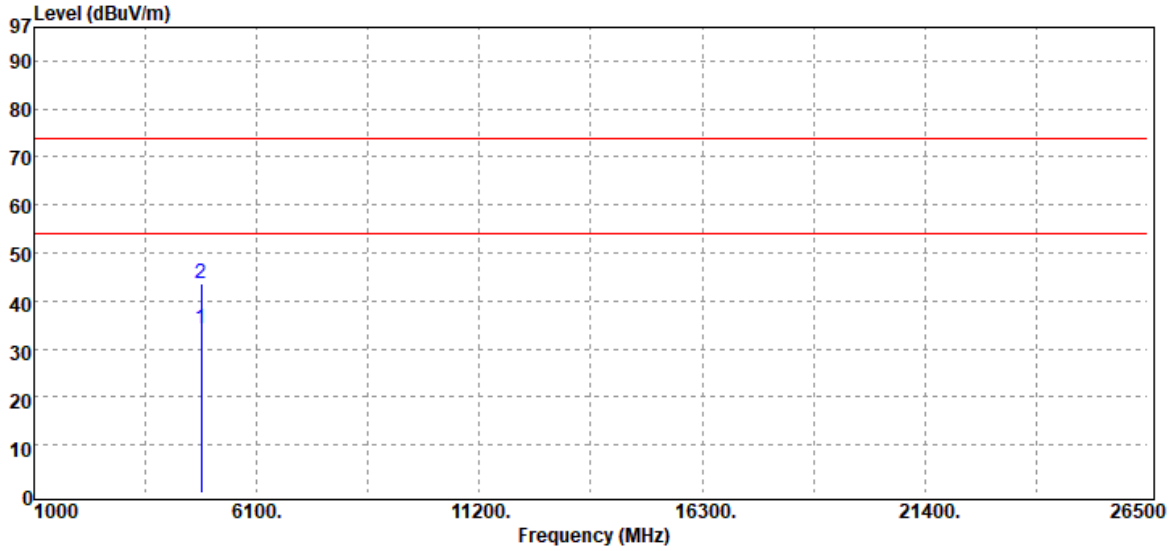
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11g	Test Date	:2020-09-16
Test Frequency	:2412 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH Low	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
4824.00	Average	27.19	7.13	34.32	54.00	-19.68
4824.00	Peak	36.62	7.13	43.75	74.00	-30.25

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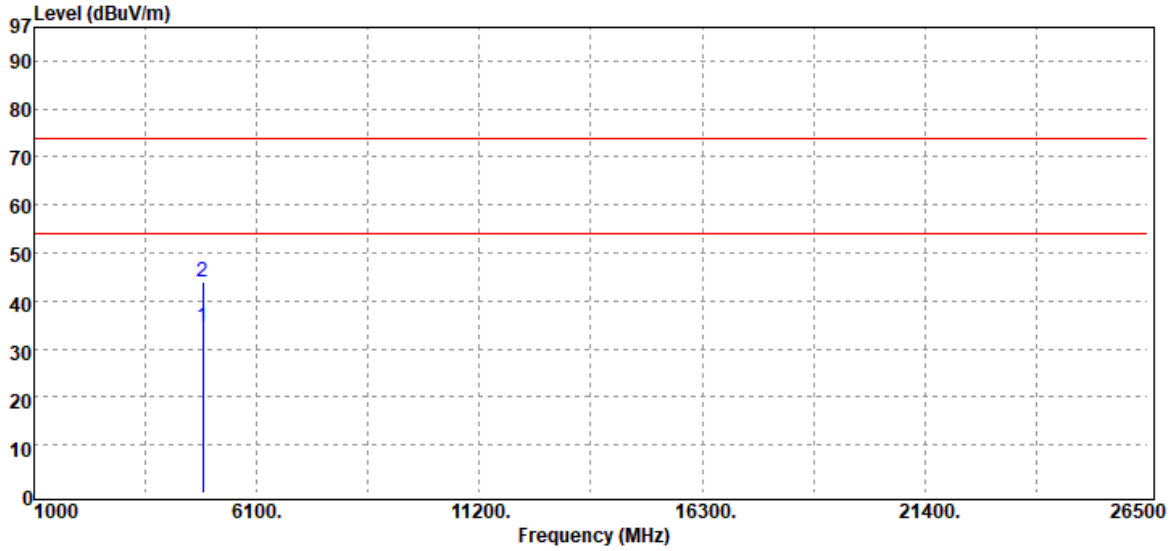
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11g	Test Date	:2020-09-16
Test Frequency	:2437 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH Mid	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



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	27.11	7.51	34.62	54.00	-19.38
4874.00	Peak	36.57	7.51	44.08	74.00	-29.92

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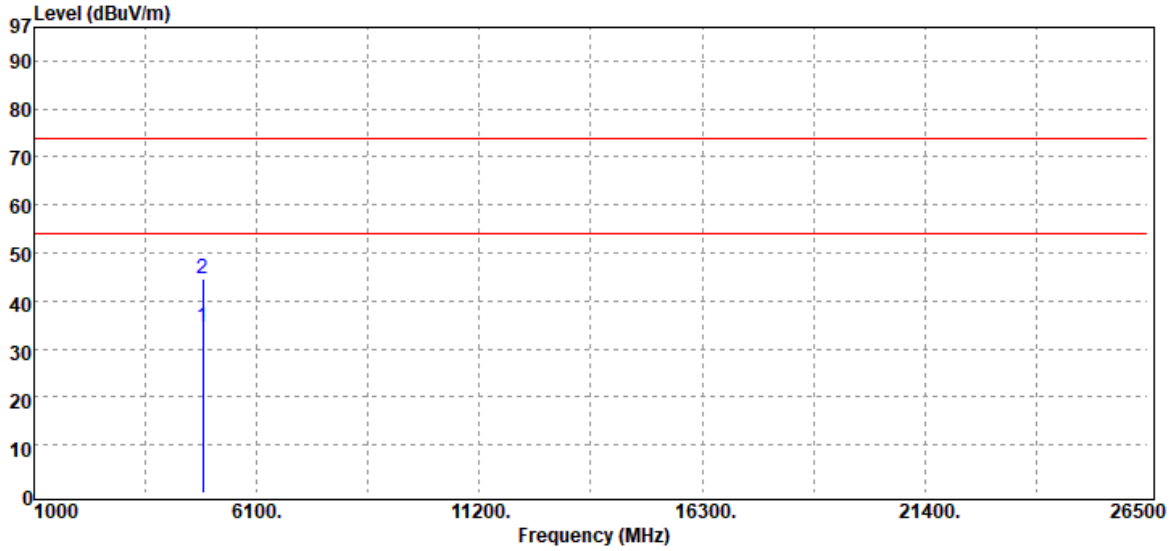
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11g	Test Date	:2020-09-16
Test Frequency	:2437 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH Mid	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



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	27.08	7.51	34.59	54.00	-19.41
4874.00	Peak	37.08	7.51	44.59	74.00	-29.41

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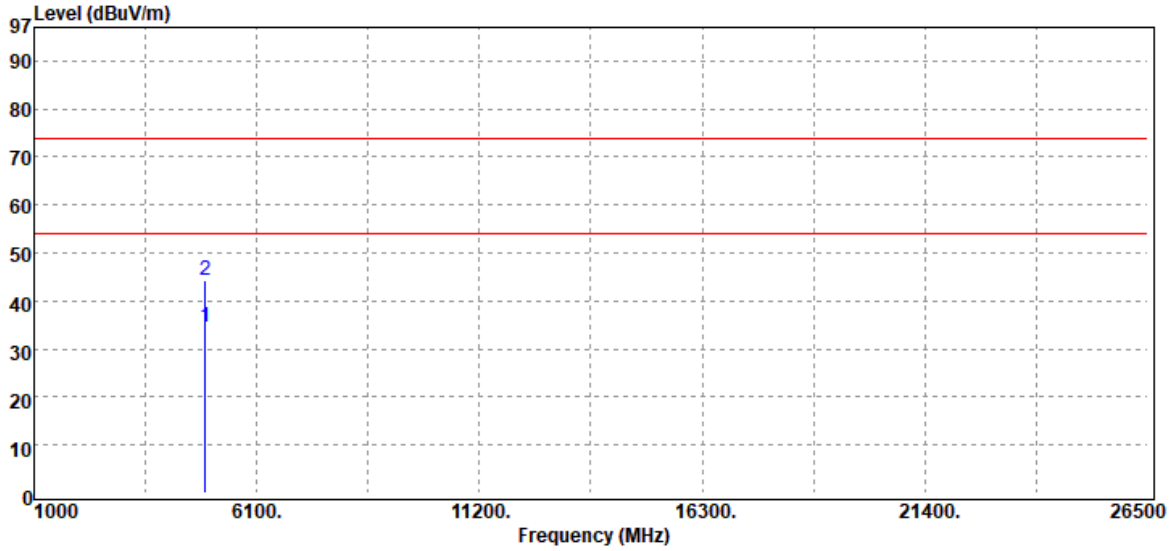
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11g	Test Date	:2020-09-16
Test Frequency	:2462 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH High	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



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	26.75	7.84	34.59	54.00	-19.41
4924.00	Peak	36.38	7.84	44.22	74.00	-29.78

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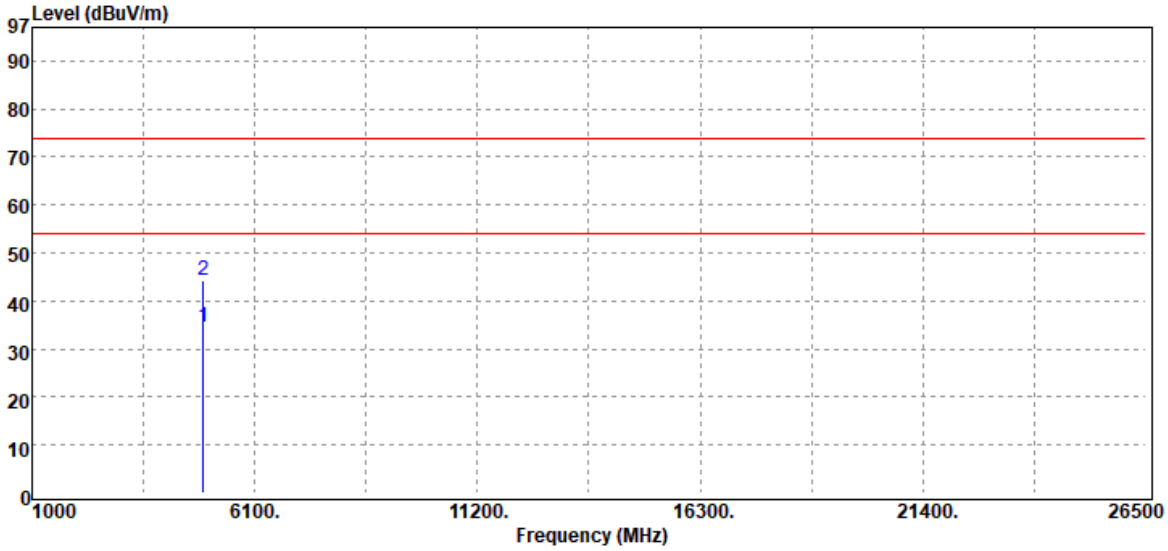
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11g	Test Date	:2020-09-16
Test Frequency	:2462 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH High	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



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	26.76	7.84	34.60	54.00	-19.40
4924.00	Peak	36.50	7.84	44.34	74.00	-29.66

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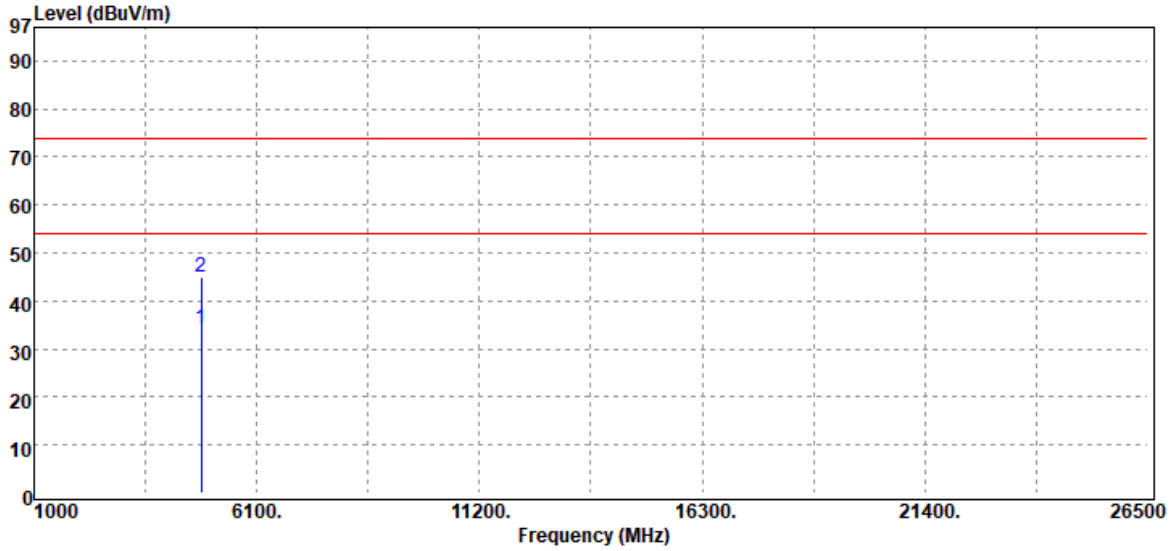
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11n20	Test Date	:2020-09-16
Test Frequency	:2412 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH Low	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4824.00	Average	27.22	7.13	34.35	54.00	-19.65
4824.00	Peak	37.83	7.13	44.96	74.00	-29.04

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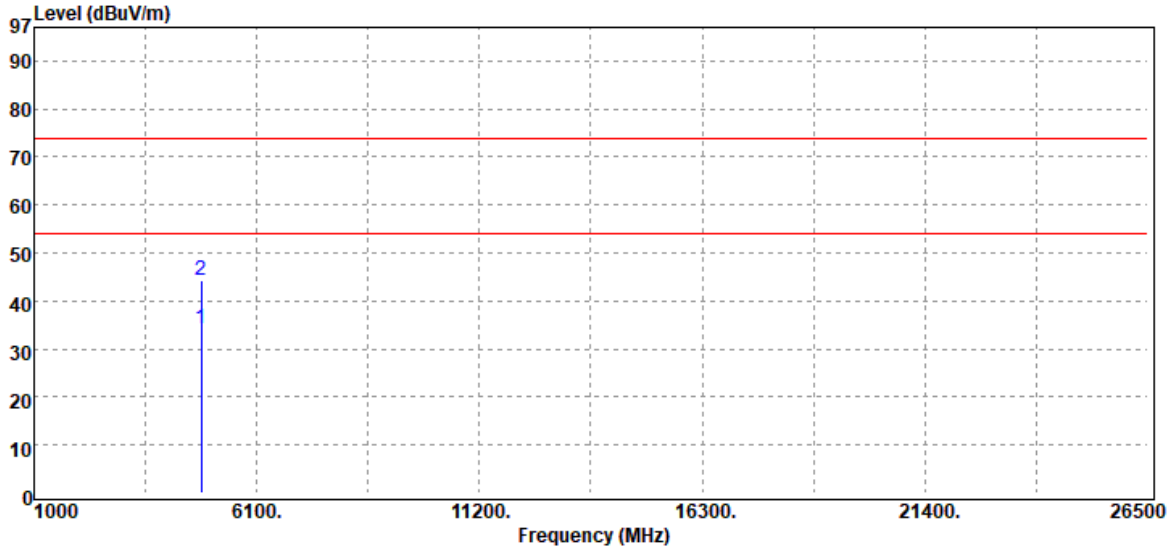
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11n20	Test Date	:2020-09-16
Test Frequency	:2412 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH Low	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4824.00	Average	27.20	7.13	34.33	54.00	-19.67
4824.00	Peak	37.08	7.13	44.21	74.00	-29.79

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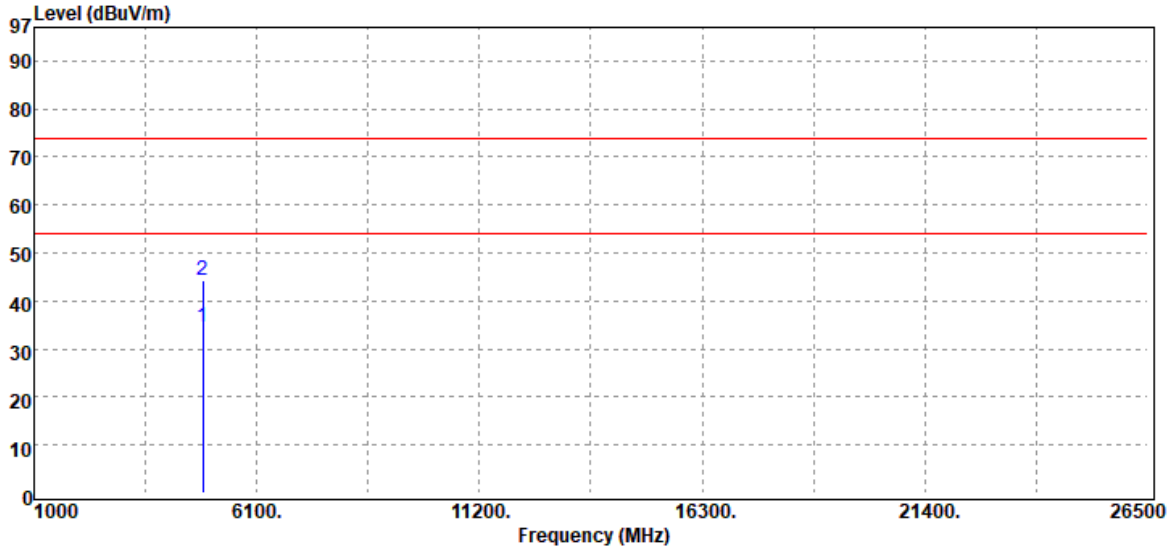
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11n20	Test Date	:2020-09-16
Test Frequency	:2437 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH Mid	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



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	27.10	7.51	34.61	54.00	-19.39
4874.00	Peak	36.66	7.51	44.17	74.00	-29.83

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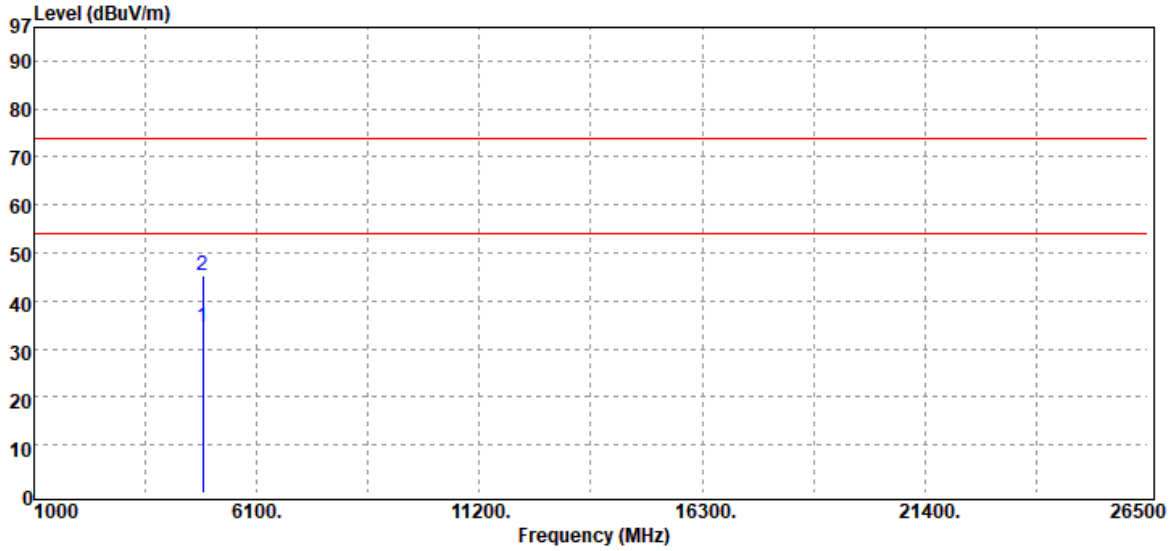
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11n20	Test Date	:2020-09-16
Test Frequency	:2437 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH Mid	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



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	27.06	7.51	34.57	54.00	-19.43
4874.00	Peak	37.68	7.51	45.19	74.00	-28.81

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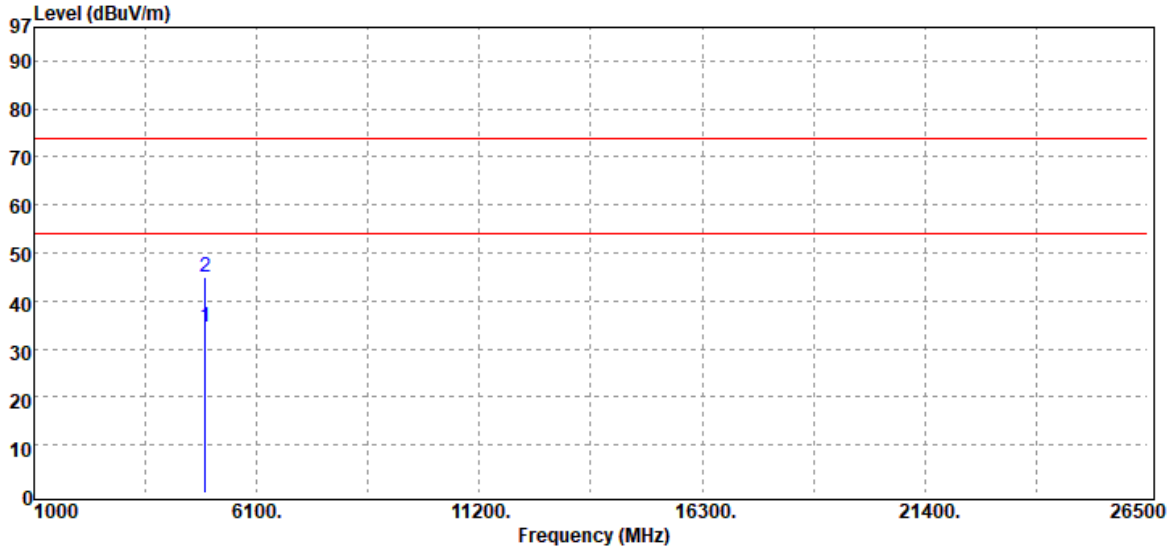
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11n20	Test Date	:2020-09-16
Test Frequency	:2462 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH High	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick



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	26.74	7.84	34.58	54.00	-19.42
4924.00	Peak	37.06	7.84	44.90	74.00	-29.10

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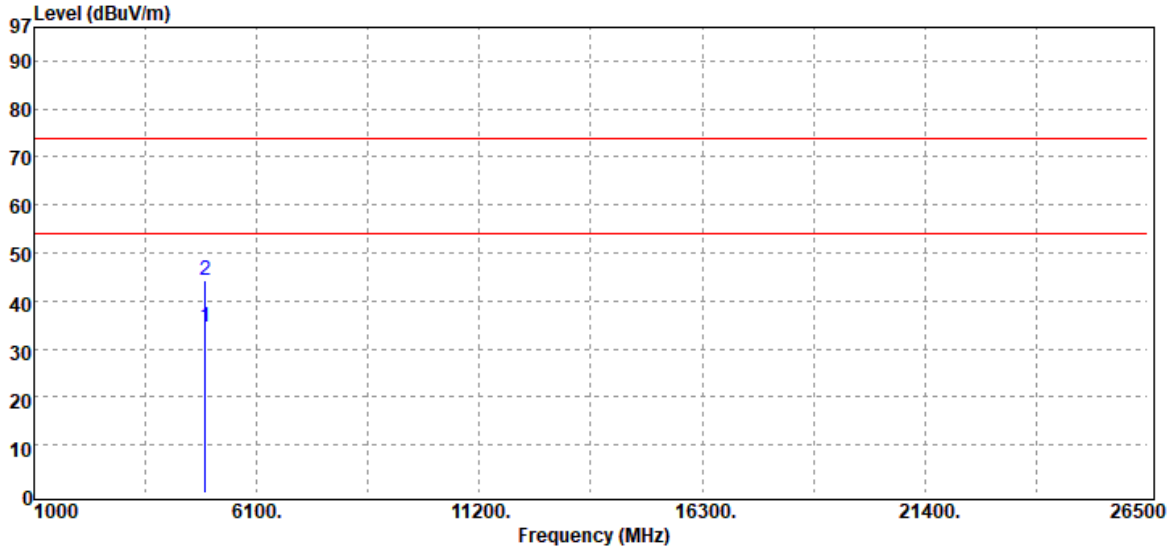
Report Number	:ER-2020-90018	Test Site	:SAC III Chamber
Operation Mode	:802.11n20	Test Date	:2020-09-16
Test Frequency	:2462 MHz	Temp./Humi.	:25.1/61
Test Mode	:Tx CH High	Antenna Pol.	:HORIZONTAL
EUT Pol	:E2 Plane	Engineer	:Nick



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	26.76	7.84	34.60	54.00	-19.40
4924.00	Peak	36.48	7.84	44.32	74.00	-29.68

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12 POWER SPECTRAL DENSITY

12.1 Standard Applicable

Per Part 15.247 (e)

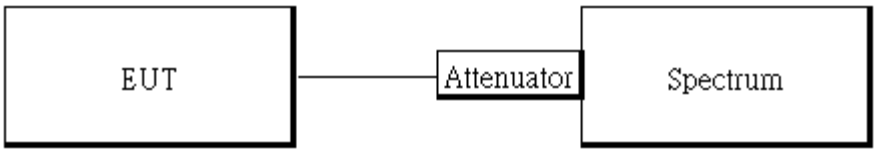
The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

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.
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	May 6th, 2020	May 5th, 2021
DC Block	Mini-Circuits	BLK-18-S+	1	Jan. 2nd, 2020	Jan. 1st, 2021
Attenuator	Mini-Circuit	BW-S10W2+	2	Jan. 2nd, 2020	Jan. 1st, 2021

12.3 Test Set-up



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12.4 Measurement Procedure

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 3 kHz & VBW = 10 kHz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.
10. MIMO mode: offset is set following “measure and add 10 Log (N)” on spectrum to measure the PSD for MIMO mode. Offset = cable loss + 10 log (N), where N is number of transmitting antenna.

Note:

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

12.5 As per FCC KDB 662911 D01

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

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

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

where

Each antenna is driven by no more than one spatial stream;
NSS = the number of independent spatial streams of data;
NANT = the total number of antennas
$g_{j,k}$ = / 20 10Gk if the kth antenna is being fed by spatial stream j, or zero if it is not;
G_k is the gain in dBi of the kth antenna.
The antenna gain is not grater than 6 dBi. Therefore, reduction of power is not required.

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12.6 Power spectral density

POWER DENSITY 802.11b					
Freq. (MHz)	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-9.62	-10.64	-7.09	8.00	PASS
2437	-9.98	-10.74	-7.33	8.00	PASS
2462	-10.33	-9.03	-6.62	8.00	PASS

POWER DENSITY 802.11g					
Freq. (MHz)	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-11.16	-10.17	-7.63	8.00	PASS
2437	-10.59	-11.13	-7.84	8.00	PASS
2462	-11.01	-10.16	-7.55	8.00	PASS

POWER DENSITY 802.11n HT20					
Freq. (MHz)	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-12.5	-10.26	-8.23	8.00	PASS
2437	-11.11	-12.21	-8.61	8.00	PASS
2462	-12.37	-10.73	-8.46	8.00	PASS

Refer to next page for plots

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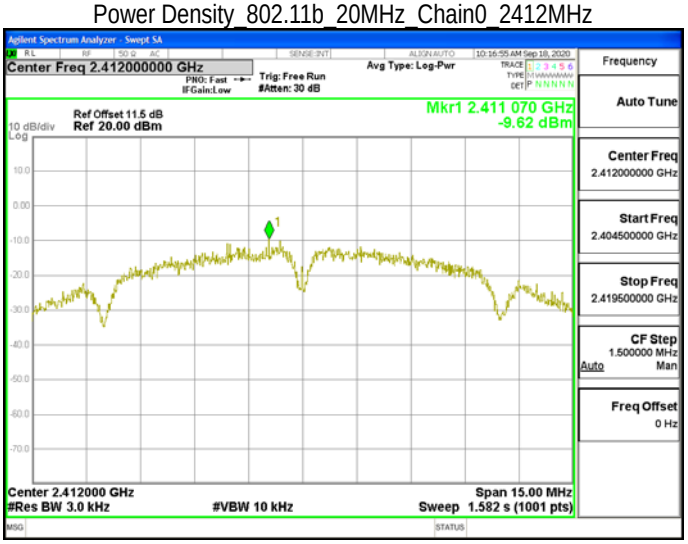
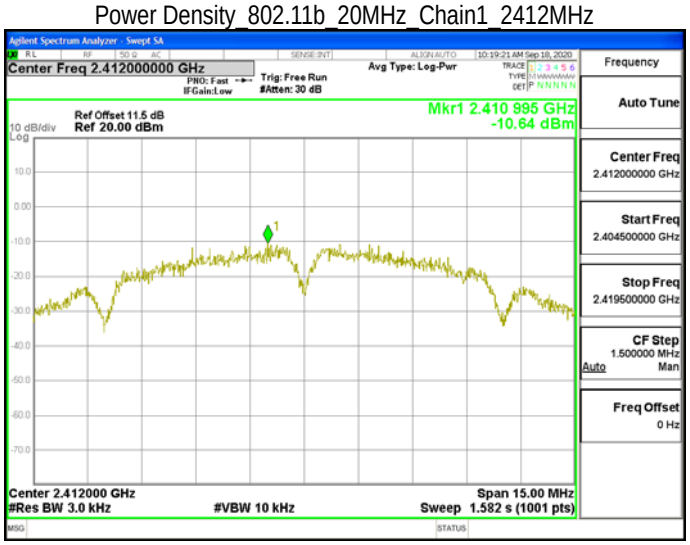
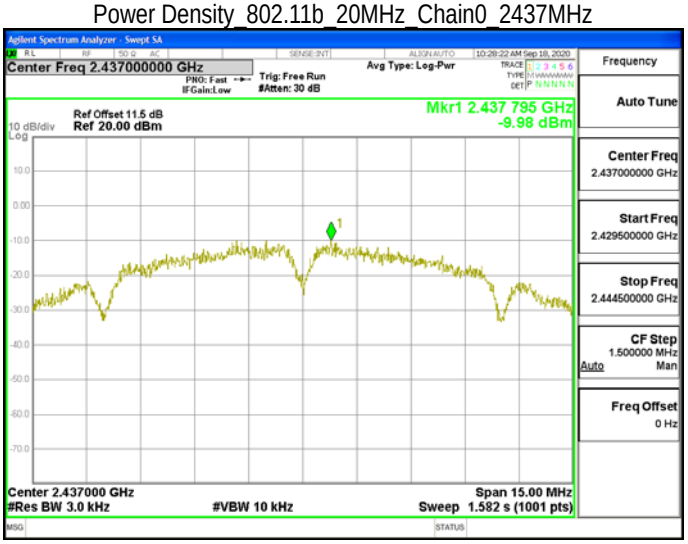
Power Density_802.11b_20MHz_Chain0_2412MHz



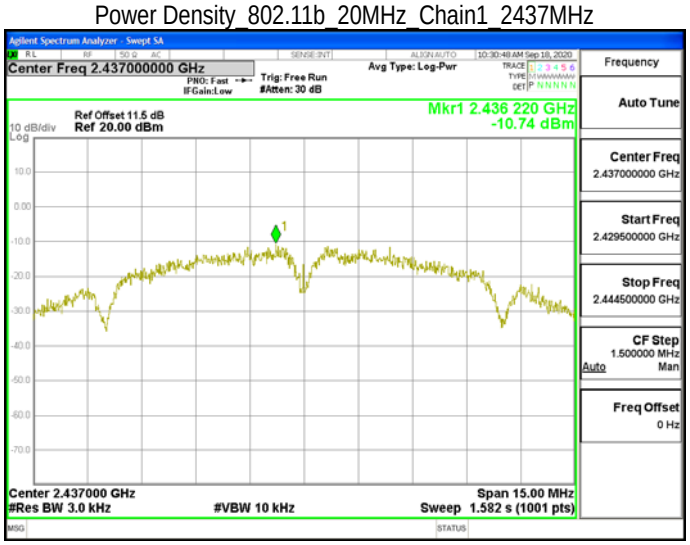
Power Density_802.11b_20MHz_Chain1_2412MHz



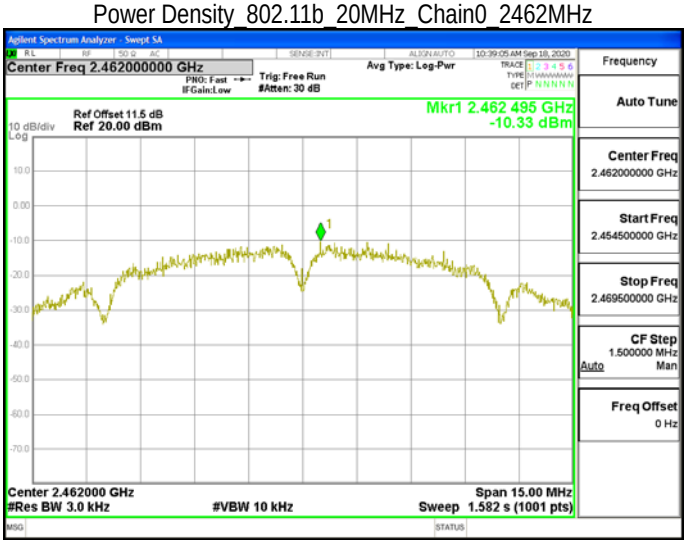
Power Density_802.11b_20MHz_Chain0_2437MHz



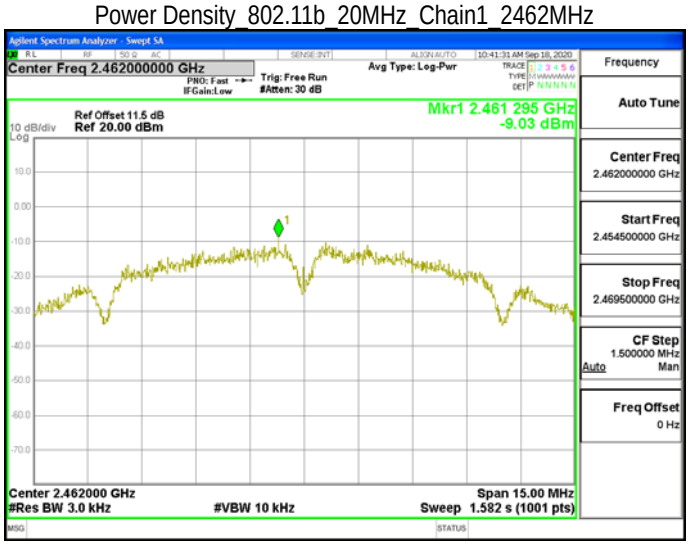
Power Density_802.11b_20MHz_Chain1_2437MHz



Power Density_802.11b_20MHz_Chain0_2462MHz



Power Density_802.11b_20MHz_Chain1_2462MHz



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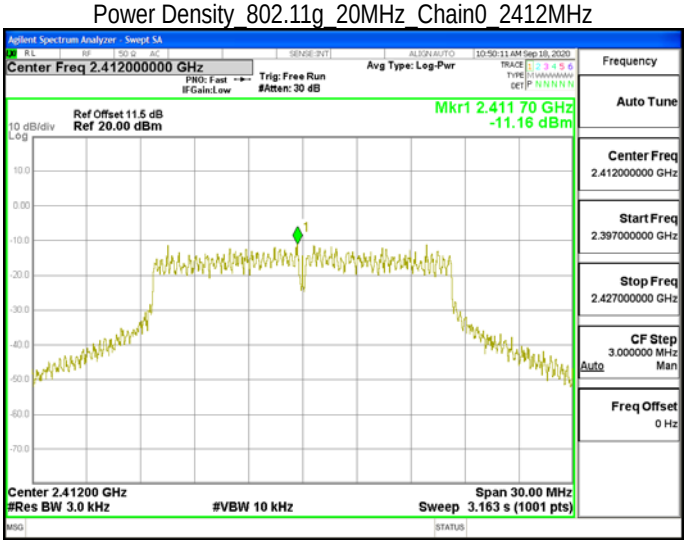
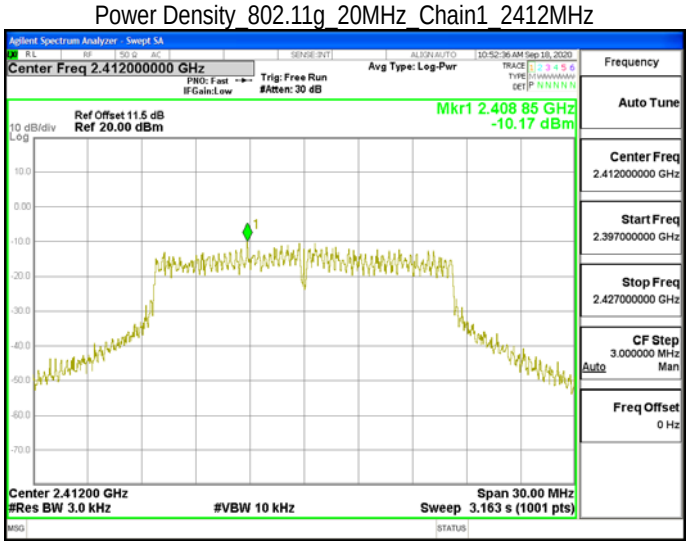
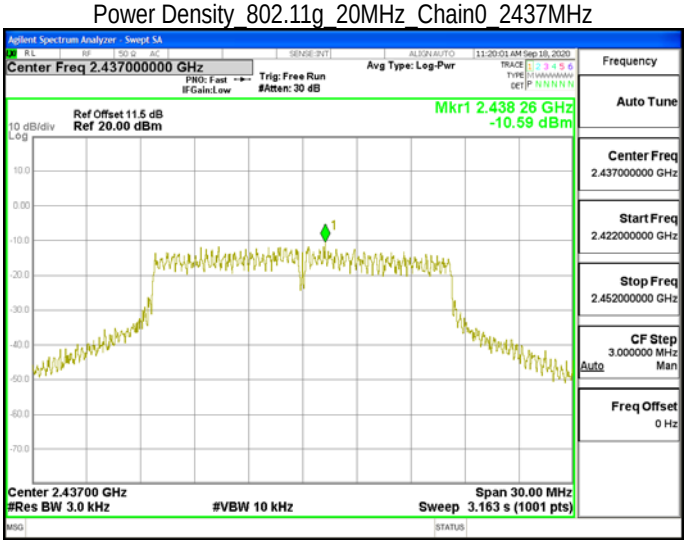
Power Density_802.11g_20MHz_Chain0_2412MHz



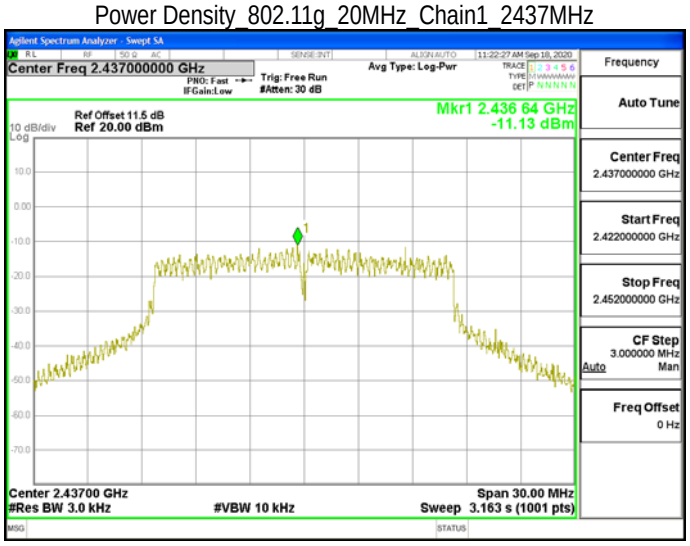
Power Density_802.11g_20MHz_Chain1_2412MHz



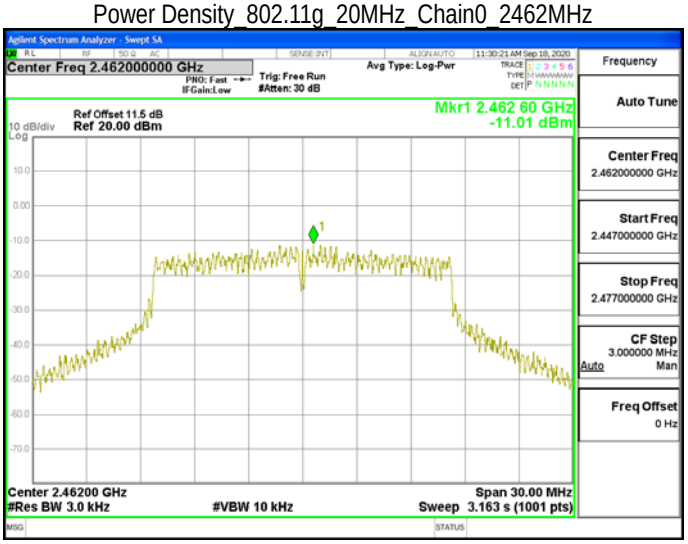
Power Density_802.11g_20MHz_Chain0_2437MHz



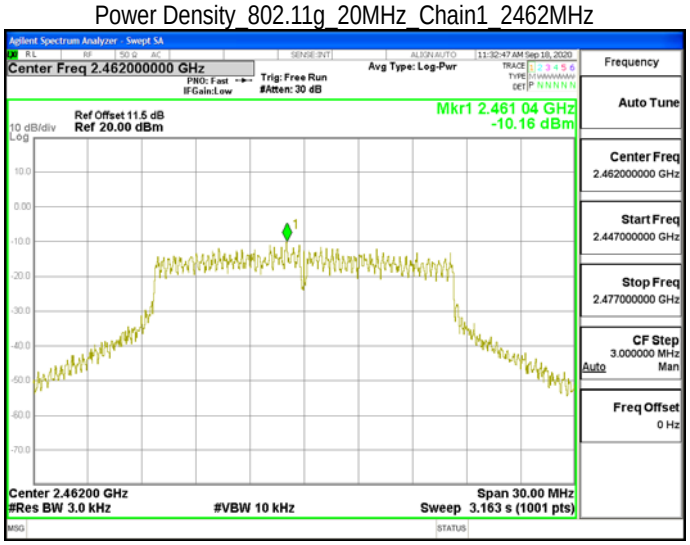
Power Density_802.11g_20MHz_Chain1_2437MHz



Power Density_802.11g_20MHz_Chain0_2462MHz



Power Density_802.11g_20MHz_Chain1_2462MHz



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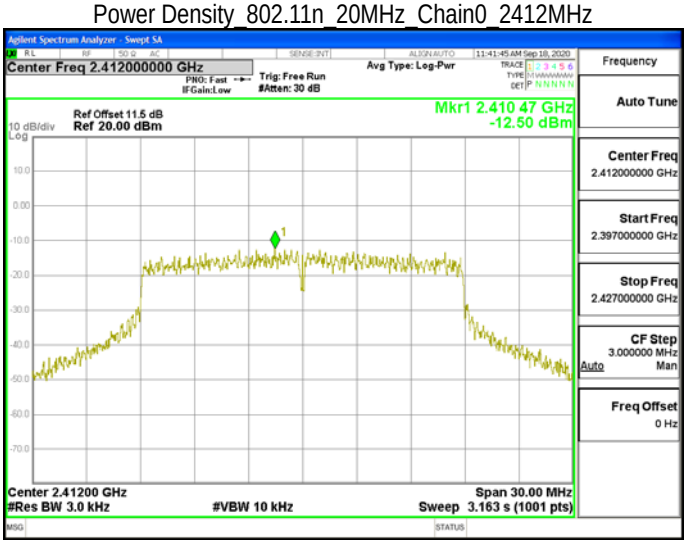
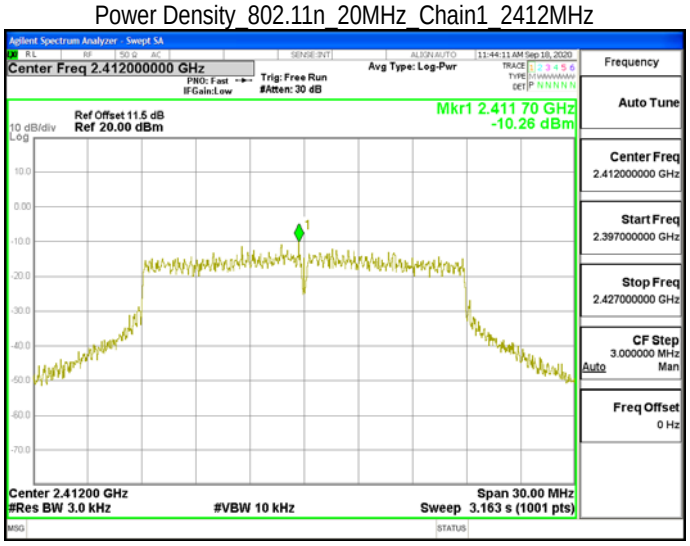
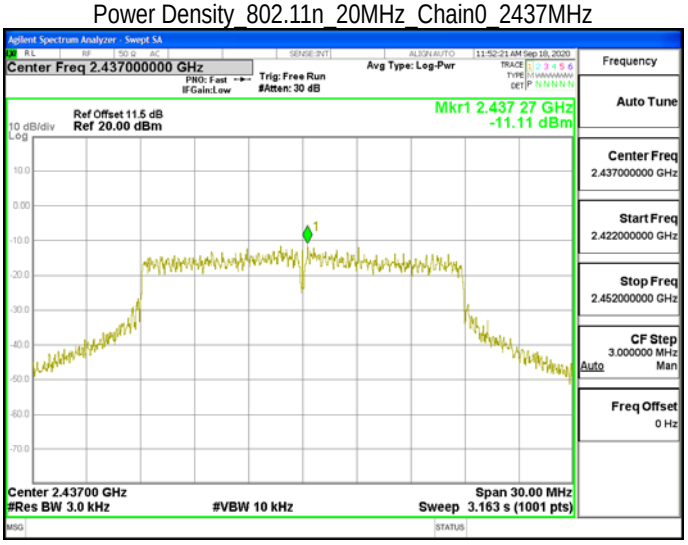
Power Density_802.11n_20MHz_Chain0_2412MHz



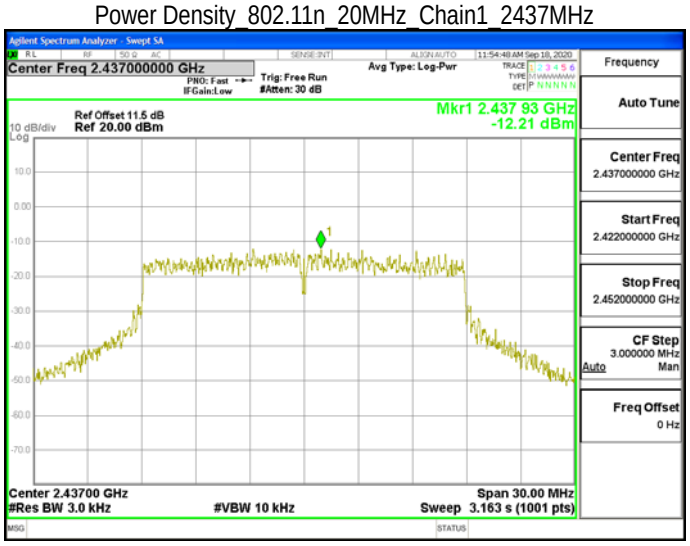
Power Density_802.11n_20MHz_Chain1_2412MHz



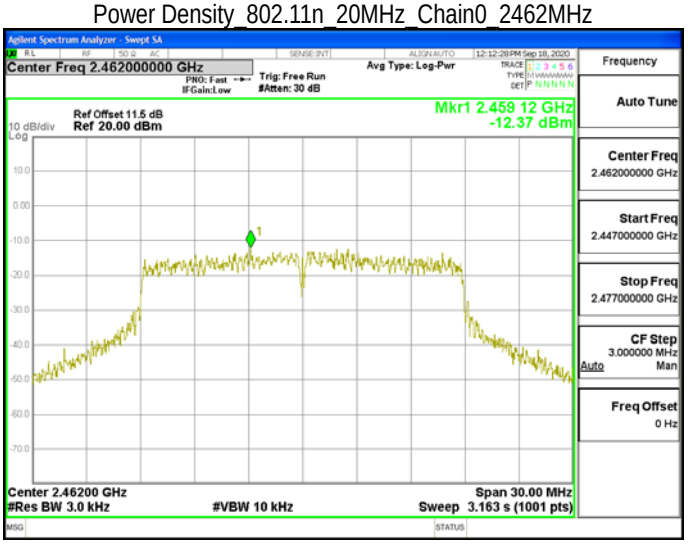
Power Density_802.11n_20MHz_Chain0_2437MHz



Power Density_802.11n_20MHz_Chain1_2437MHz



Power Density_802.11n_20MHz_Chain0_2462MHz



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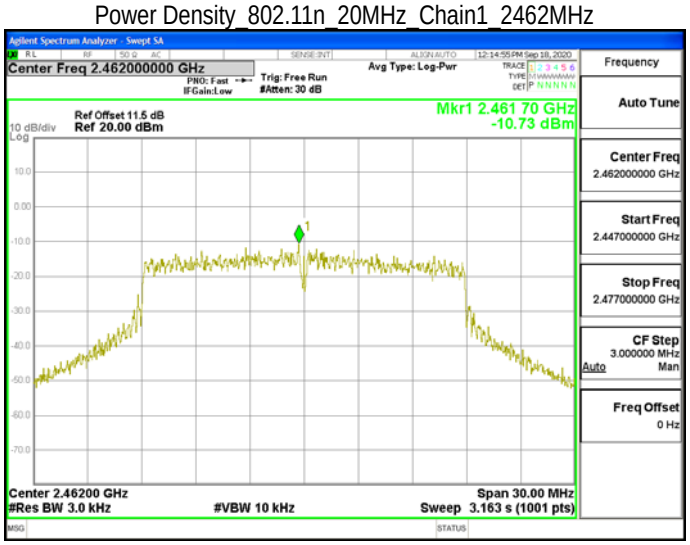

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13 ANTENNA REQUIREMENT

13.1 Standard Applicable

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

13.2 Antenna Connected Construction

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

~ End of Report ~

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