FCC PART 15.247

TEST REPORT

For

ROYBI INC

2672 Bayshore Pkwy, Suite 1000 Mountain View, CA

FCC ID: 2AUP5RRERAM-R1

Report Type:	**Product Type:**
Original Report	Educational Toy

Report Number: RSZ190929816-00A

Report Date: 2019-11-27

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Educational Toy
Tested Model	R1
Frequency Range	Wi-Fi: 2412~2472MHz/2422-2462MHz
Conducted Peak Power	Wi-Fi: 802.11b:17.10dBm, 802.11G:15.06dBm, 802.11N20: 16.81dBm, 802.11N40: 18.54dBm
Modulation Technique	Wi-Fi: DSSS, OFDM
Antenna Specification	FPC Antenna Wi-Fi:2.5dBi@2.4GHz
Voltage Range	DC 3.7V from battery or DC5.0V from Adapter
Date of Test	2019-10-11 to 2019-11-27
Sample serial number	190929816 (Assigned by BACL, Shenzhen)
Received date	2019-09-29
Sample/EUT Status	Good condition
Adapter information	Model:TEKA012-0502000UK Input:100-240V~50/60Hz,0.35A Output:5V,2000mA

Objective

This report is prepared on behalf of *ROYBI INC* in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

FCC Part 15.407 NII submissions with FCC ID: 2AUP5RRERAM-R1.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Output Power with Power meter		±0.73dB
RF conducted test with spectrum		±1.6dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
Temperature		±1℃
Humidity		±6%
Supply voltages		±0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For 802.11b, 802.11g and 802.11n-HT20 mode, 13 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	12	2467
6	2437	13	2472
7	2442	/	/

For 802.11b, 802.11g, 802.11n-HT20 mode, EUT was tested with Channel 1, 7 and 13

For 802.11n-HT40 mode, 9 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2422	6	2447
2	2427	7	2452
3	2432	8	2457
4	2437	9	2462
5	2442	/	/

EUT was tested with Channel 1, 5 and 9.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

BLE & Wi-Fi test in the engineer mode.

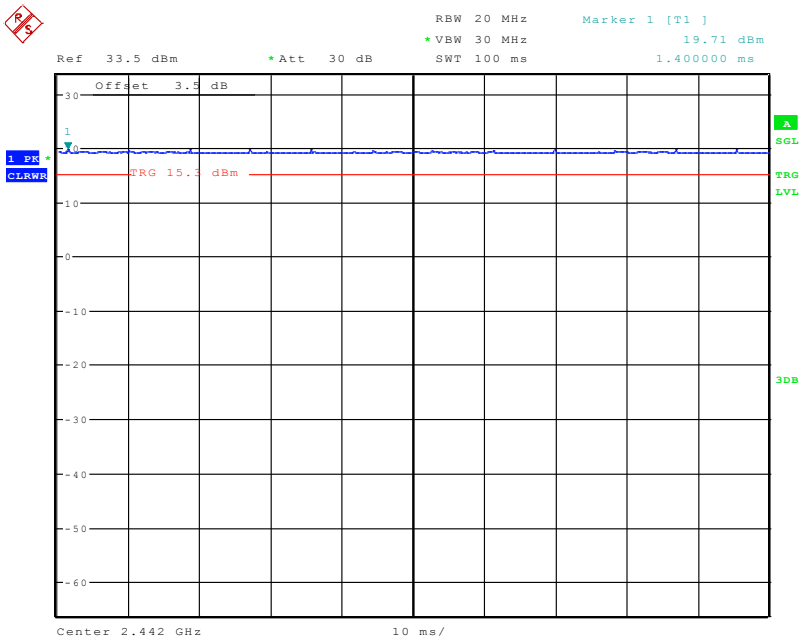
The device was tested with the worst case was performed as below:

Mode	Data rate	Power level		
		Low channel	Middle channel	High channel
802.11b	1 Mbps	10	10	10
802.11g	6 Mbps	7	7	7
802.11n-HT20	MCS0	8	8	8
802.11n-HT40	MCS0	8	8	8

Pre-scan with all the data rates, the above data rate is the worst case for Wi-Fi test.

Duty cycle

802.11b mode



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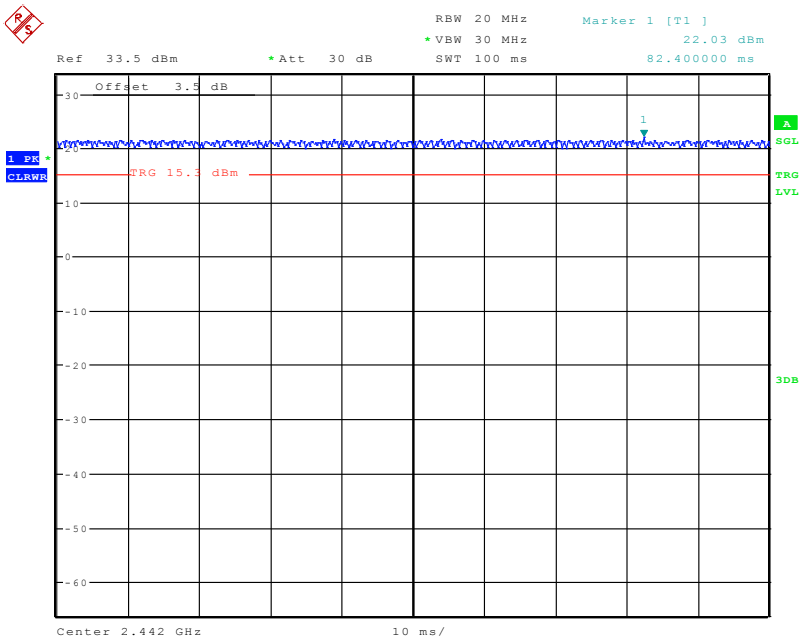
802.11g mode



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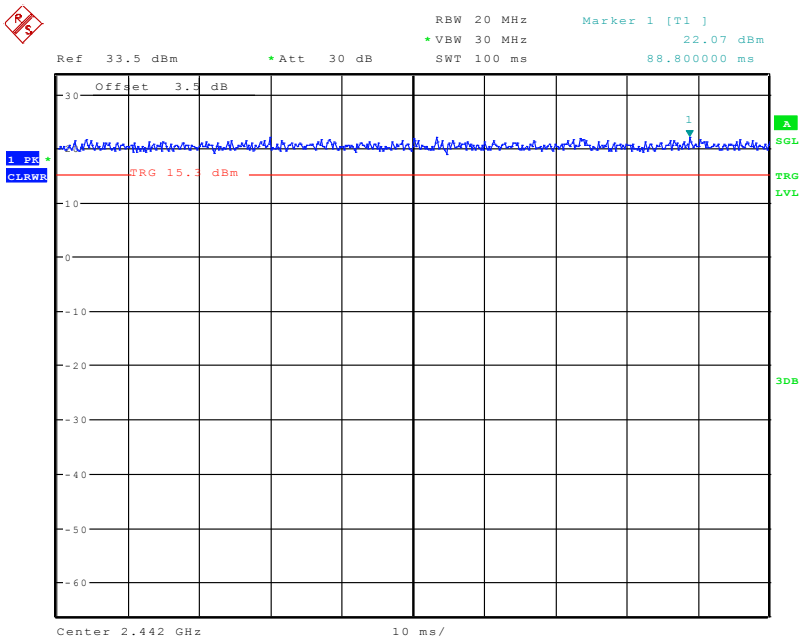
802.11n-HT20 Mode



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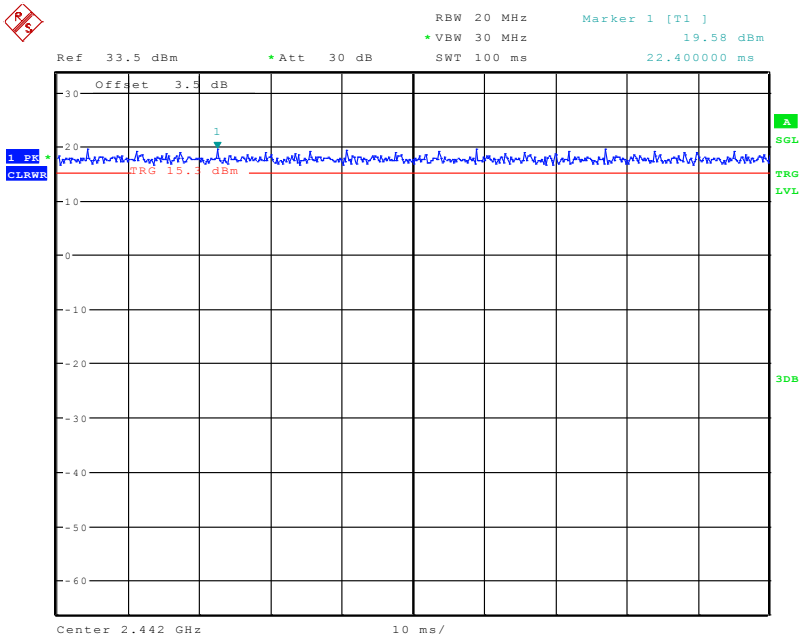
802.11n-HT40 Mode



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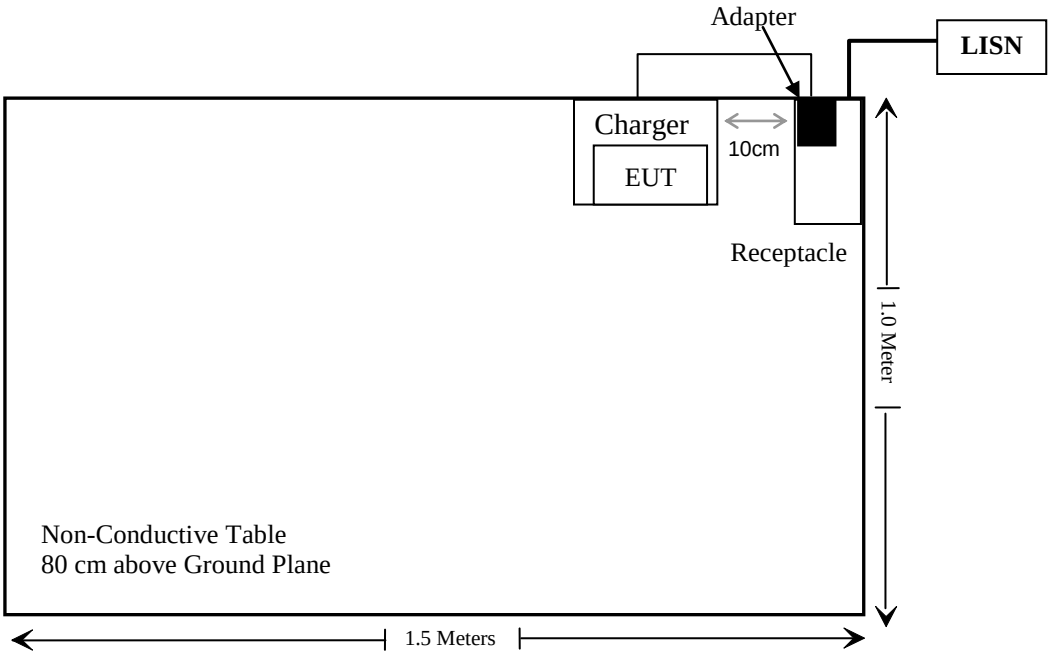
Mode	T_{on} (ms)	T_{on+off} (ms)	Duty Cycle (%)
802.11b	-	-	100
802.11g	-	-	100
802.11n-HT20	-	-	100
802.11n-HT40	-	-	100

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-Shielding Detachable DC Cable	1.0	Adapter	Charger

Block Diagram of Test Setup

For conducted emission



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §2.1091	Maximum Permissible Exposure(MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Conducted Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESCS30	100176	2019-07-11	2020-07-11
Rohde & Schwarz	LISN	ENV216	3560.6650.12-101613-Yb	2019-01-25	2020-01-25
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2019-03-02	2020-03-02
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Un-known	Conducted Emission Cable	78652	UF A210B-1-0720-504504	2018-11-12	2019-11-12
Radiated Emission Test					
A.H. System	Horn Antenna	SAS-200/571	135	2018-09-01	2021-08-31
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2019-07-22	2020-07-21
COM-POWER	Pre-amplifier	PA-122	181919	2018-11-12	2019-11-12
Sonoma Instrument	Amplifier	310N	186238	2018-11-12	2019-11-12
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017-12-22	2020-12-21
Rohde & Schwarz	EMI Test Receiver	ESR3	102455	2019-07-09	2020-07-08
Ducommun technologies	RF Cable	UFA147A-2362-100100	MFR64639 231029-003	2018-11-12	2019-11-12
Ducommun technologies	RF Cable	104PEA	218124002	2018-11-12	2019-11-12
Ducommun technologies	RF Cable	RG-214	1	2018-11-12	2019-11-12
Ducommun technologies	RF Cable	RG-214	2	2018-11-12	2019-11-12
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-04	2017-12-29	2020-12-28
Heatsink Required	Amplifier	QLW-18405536-J0	15964001002	2018-11-12	2019-11-12
Sinoscite	Band Reject Filter	BSF2402-2480MN-0898-001	99632	2018-11-12	2019-11-12
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Agilent	USB wideband power meter	U2021XA	MY54250003	2019-07-10	2020-07-09
WEINSCHEL	3dB Attenuator	6231	666	Each Time	
Rohde & Schwarz	Spectrum Analyzer	FSU26	200120	2018-12-24	2019-12-24
Ducommun technologies	RF Cable	RG-214	3	Each Time	

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (Minutes)**
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm2)
P = power input to the antenna (in appropriate units, e.g., mW).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Frequency (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
	(dBi)	(numeric)	(dBm)	(mW)			
2412-2472	2.5	1.78	13.5	22.39	20	0.01	1

Note:
1) To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

2) 2.4GHz and 5GHz Wi-Fi cannot transmit simultaneously for this device.

Result: Compliance

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.
And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has an internal antenna arrangement, which was permanently attached and the antenna gain is 2.5 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

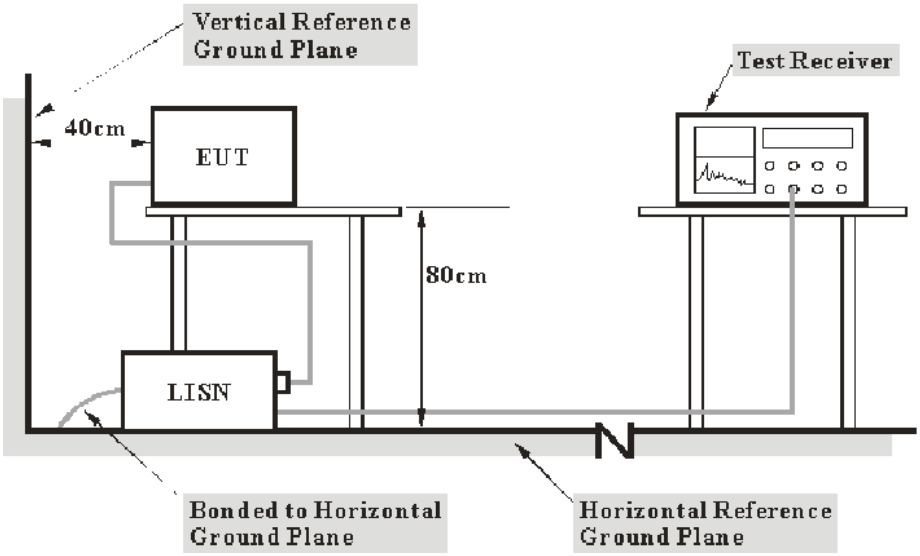
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Correction Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Results Summary

According to the EUT complied with the FCC Part 15.207,

Test Data

Environmental Conditions

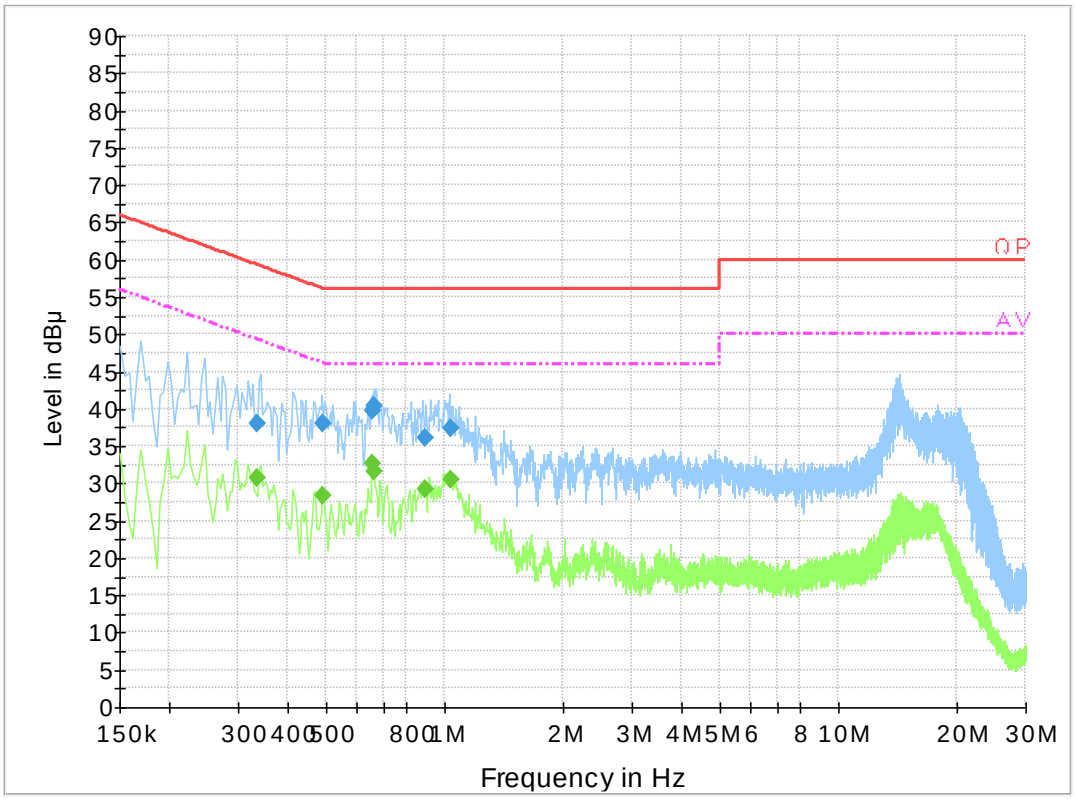
Temperature:	25 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Kiki Geng on 2019-10-16.

EUT operation mode: Transmitting

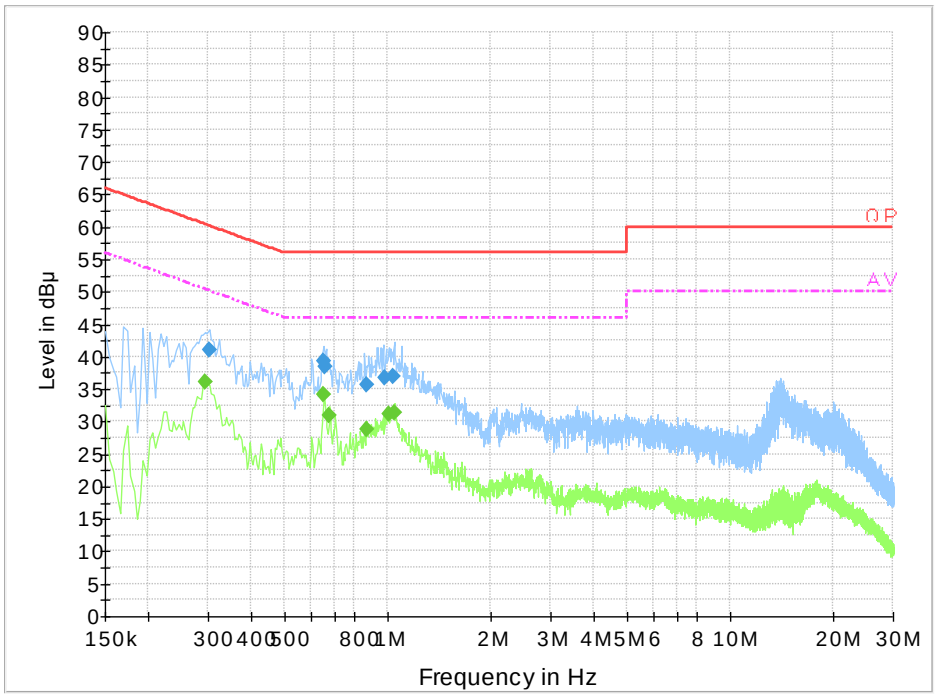
Wi-Fi Mode: (Worst case at 802.11b mode, High channel)

AC 120 V/60 Hz, Line:



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.336870	38.1	19.8	59.3	21.2	QP
0.494650	38.1	19.8	56.1	18.0	QP
0.660130	39.8	19.8	56.0	16.2	QP
0.664070	40.4	19.8	56.0	15.6	QP
0.892770	36.0	19.8	56.0	20.0	QP
1.042550	37.5	19.9	56.0	18.5	QP
0.336870	30.8	19.8	49.3	18.5	Ave.
0.494650	28.3	19.8	46.1	17.8	Ave.
0.660130	32.7	19.8	46.0	13.3	Ave.
0.664070	31.6	19.8	46.0	14.4	Ave.
0.892770	29.2	19.8	46.0	16.8	Ave.
1.042550	30.5	19.9	46.0	15.5	Ave.

AC 120V/ 60 Hz, Neutral:



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.301470	41.0	19.7	60.2	19.2	QP
0.652250	39.2	19.8	56.0	16.8	QP
0.656070	38.4	19.8	56.0	17.6	QP
0.870870	35.6	19.7	56.0	20.4	QP
0.983390	36.7	19.8	56.0	19.3	QP
1.038250	37.0	19.8	56.0	19.0	QP
0.294000	36.1	19.7	50.4	14.3	Ave.
0.654000	34.1	19.8	46.0	11.9	Ave.
0.678000	31.0	19.8	46.0	15.0	Ave.
0.870000	28.7	19.7	46.0	17.3	Ave.
1.010000	31.1	19.8	46.0	14.9	Ave.
1.050000	31.3	19.8	46.0	14.7	Ave.

Note:
1) Correction Factor =LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
2) Corrected Amplitude = Reading + Correction Factor
3) Margin = Limit – Corrected Amplitude

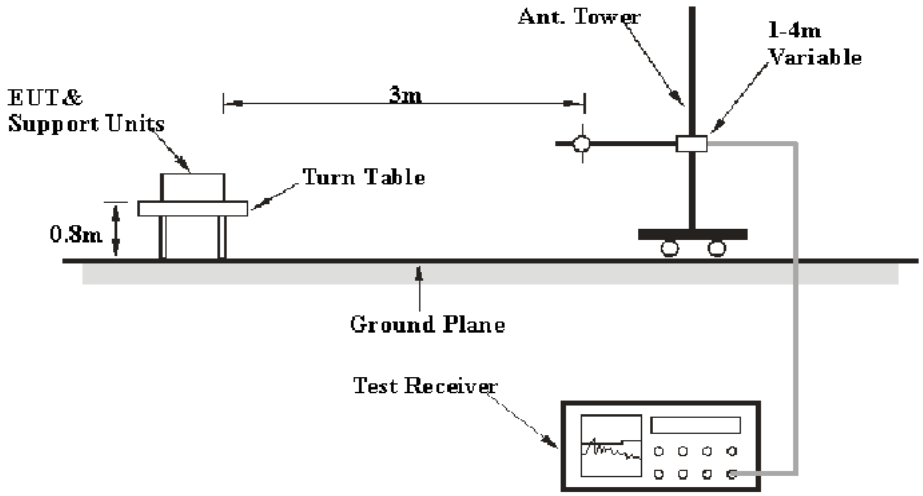
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

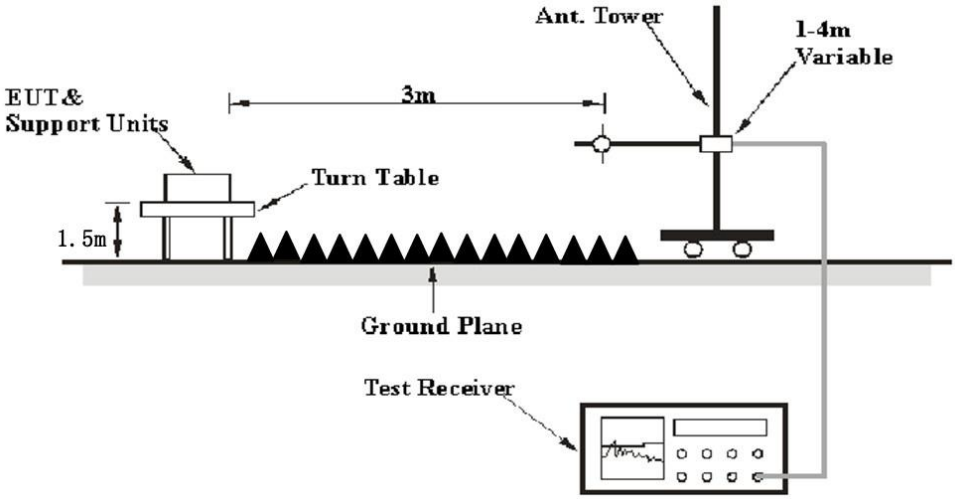
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz Note 1	/	Average
	1MHz	＞1/T Note 2	/	Average

Note 1: when duty cycle is no less than 98%
Note 2: when duty cycle is less than 98%

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Results Summary

According to the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Test Data

Environmental Conditions

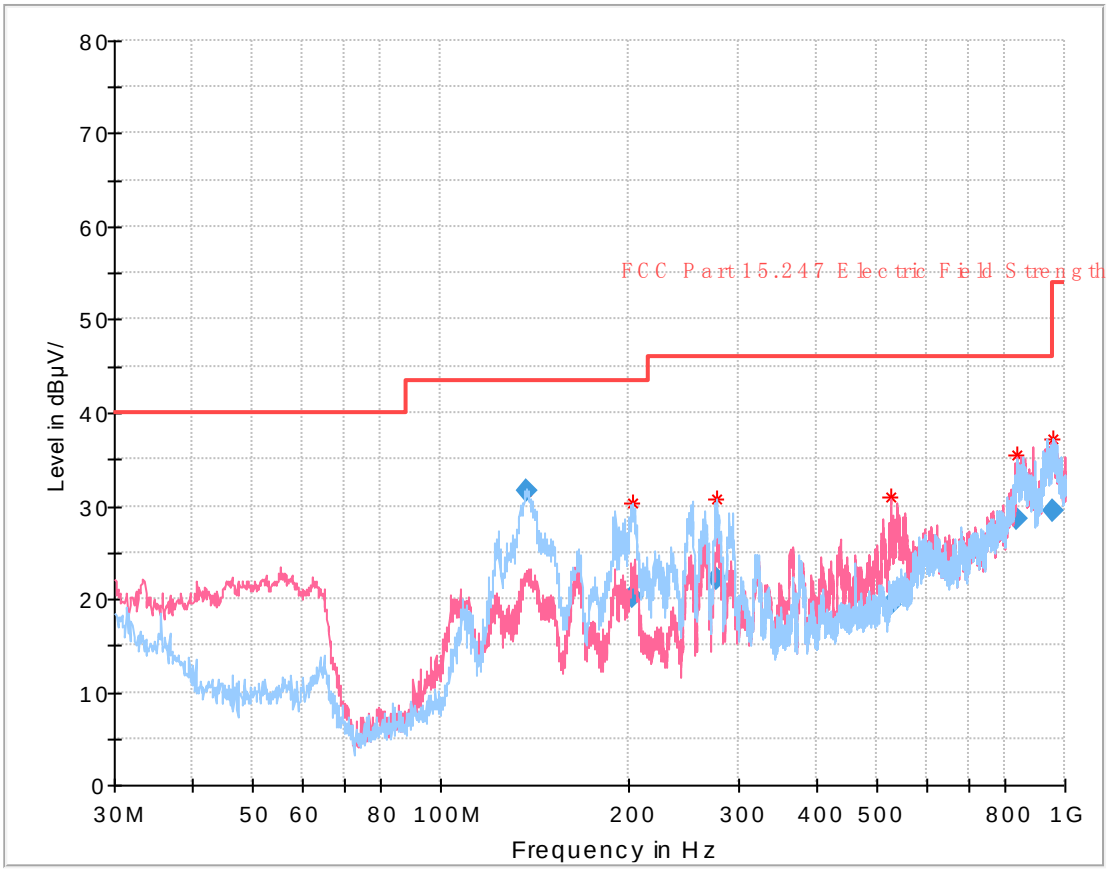
Temperature:	24~25 ℃
Relative Humidity:	50~52 %
ATM Pressure:	100.9~101.0 kPa

The testing was performed by Zero Yan on 2019-10-16 for below 1G and Curry Xiang on 2019-10-21 for above 1G.

EUT operation mode: Transmitting

Wi-Fi Mode: (Worst case at 802.11b mode, High channel)

30 MHz~1 GHz:



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
137.394500	31.72	190.0	H	96.0	-14.1	43.50	11.78
202.590500	20.32	153.0	H	250.0	-13.8	43.50	23.18
276.525500	22.14	114.0	H	287.0	-12.2	46.00	23.86
525.810875	19.37	120.0	V	319.0	-6.3	46.00	26.63
838.795000	28.66	196.0	V	84.0	5.8	46.00	17.34
955.239125	29.51	254.0	H	162.0	9.6	46.00	16.49

1 GHz-25 GHz(Wi-Fi):

802.11b Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2313.88	27.98	PK	13	1.2	V	31.64	59.62	74	14.38
2313.88	13.89	Ave.	13	1.2	V	31.64	45.53	54	8.47
2484.25	27.50	PK	286	1.7	V	32.13	59.63	74	14.37
2484.25	13.95	Ave.	286	1.7	V	32.13	46.08	54	7.92
4824.00	44.03	PK	352	1.8	V	5.40	49.43	74	24.57
4824.00	29.46	Ave.	352	1.8	V	5.40	34.86	54	19.14
Middle Channel (2442MHz)									
4884.00	43.81	PK	39	1.2	V	6.43	50.24	74	23.76
4884.00	28.95	Ave.	39	1.2	V	6.43	35.38	54	18.62
High Channel (2472 MHz)									
2313.88	28.14	PK	91	2.4	V	31.64	59.78	74	14.22
2313.88	14.89	Ave.	91	2.4	V	31.64	46.53	54	7.47
2484.25	30.26	PK	59	1.4	V	32.13	62.39	74	11.61
2484.25	17.59	Ave.	59	1.4	V	32.13	49.72	54	4.28
4944.00	44.93	PK	300	1.5	V	6.43	51.36	74	22.64
4944.00	30.26	Ave.	300	1.5	V	6.43	36.69	54	17.31

802.11g Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2351.74	28.67	PK	326	2.3	V	31.77	60.44	74	13.56
2351.74	15.72	Ave.	326	2.3	V	31.77	47.49	54	6.51
2485.66	28.41	PK	237	1.0	V	32.13	60.54	74	13.46
2485.66	15.18	Ave.	237	1.0	V	32.13	47.31	54	6.69
4824.00	43.71	PK	288	2.0	V	5.40	49.11	74	24.89
4824.00	29.82	Ave.	288	2.0	V	5.40	35.22	54	18.78
Middle Channel (2442MHz)									
4884.00	43.50	PK	282	1.3	V	6.43	49.93	74	24.07
4884.00	28.94	Ave.	282	1.3	V	6.43	35.37	54	18.63
High Channel (2472 MHz)									
2364.46	18.63	PK	117	1.9	V	31.87	50.50	74	23.50
2364.46	15.78	Ave.	117	1.9	V	31.87	47.65	54	6.35
2483.51	34.94	PK	353	2.0	V	32.13	67.07	74	6.93
2483.51	18.16	Ave.	353	2.0	V	32.13	50.29	54	3.71
4944.00	43.48	PK	359	2.0	V	6.43	49.91	74	24.09
4944.00	29.50	Ave.	359	2.0	V	6.43	35.93	54	18.07

802.11n-HT20 Mode:

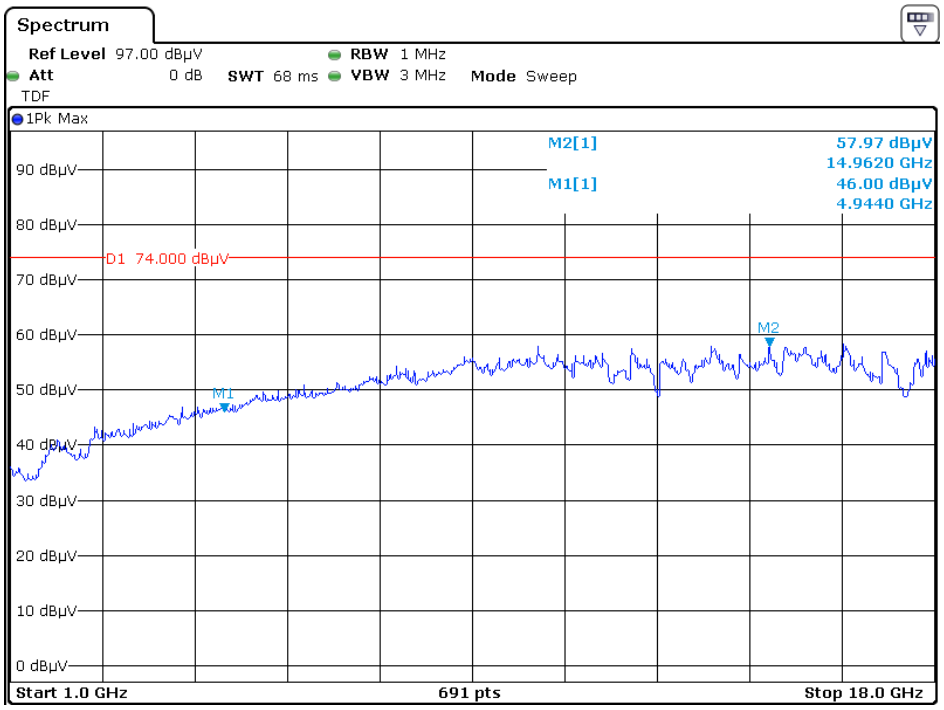
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2339.41	28.29	PK	58	1.9	V	31.64	59.93	74	14.07
2339.41	15.46	Ave.	58	1.9	V	31.64	47.10	54	6.90
2494.26	28.37	PK	126	1.5	V	32.13	60.50	74	13.50
2494.26	15.50	Ave.	126	1.5	V	32.13	47.63	54	6.37
4824.00	43.38	PK	350	1.4	V	5.40	48.78	74	25.22
4824.00	29.10	Ave.	350	1.4	V	5.40	34.50	54	19.50
Middle Channel (2442MHz)									
4884.00	43.75	PK	330	1.4	V	6.43	50.18	74	23.82
4884.00	29.91	Ave.	330	1.4	V	6.43	36.34	54	17.66
High Channel (2472 MHz)									
2349.88	28.32	PK	64	2.1	V	31.64	59.96	74	14.04
2349.88	15.62	Ave.	64	2.1	V	31.64	47.26	54	6.74
2492.25	28.11	PK	237	1.4	V	32.13	60.24	74	13.76
2492.25	15.20	Ave.	237	1.4	V	32.13	47.33	54	6.67
4944.00	43.58	PK	228	1.9	V	6.43	50.01	74	23.99
4944.00	29.86	Ave.	228	1.9	V	6.43	36.29	54	17.71

802.11n-HT40 Mode:

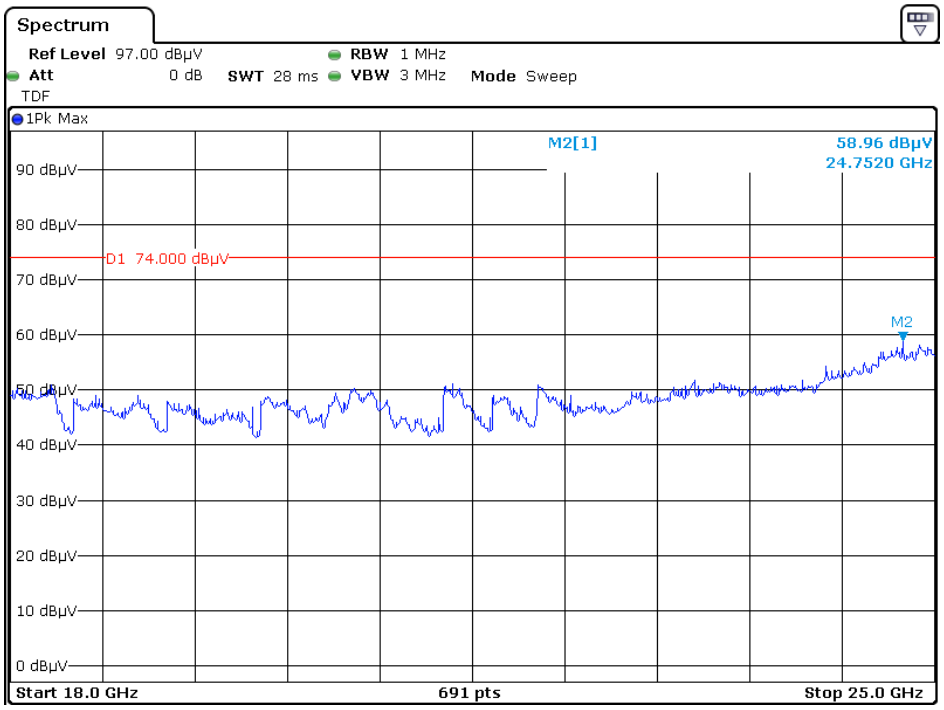
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2422 MHz)									
2389.94	29.71	PK	202	1.3	V	31.87	61.58	74	12.42
2389.94	16.66	Ave.	202	1.3	V	31.87	48.53	54	5.47
2499.74	28.13	PK	190	1.3	V	32.13	60.26	74	13.74
2499.74	16.21	Ave.	190	1.3	V	32.13	48.34	54	5.66
4844.00	43.41	PK	79	1.5	V	5.40	48.81	74	25.19
4844.00	30.27	Ave.	79	1.5	V	5.40	35.67	54	18.33
Middle Channel (2442MHz)									
4884.00	43.30	PK	323	1.3	V	6.43	49.73	74	24.27
4884.00	29.31	Ave.	323	1.3	V	6.43	35.74	54	18.26
High Channel (2462 MHz)									
2323.84	28.02	PK	190	1.1	V	31.64	59.66	74	14.34
2323.84	16.08	Ave.	190	1.1	V	31.64	47.72	54	6.28
2485.90	38.85	PK	327	1.7	V	32.13	70.98	74	3.02
2485.90	17.35	Ave.	327	1.7	V	32.13	49.48	54	4.52
4924.00	43.18	PK	143	2.1	V	6.43	49.61	74	24.39
4924.00	29.66	Ave.	143	2.1	V	6.43	36.09	54	17.91

Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is 20dB to the limit was not recorded.
And for the pre-scan is performed with the 2400-2483.5MHz band filter.

Pre-scan with 802.11B Mode, High channel
Horizontal

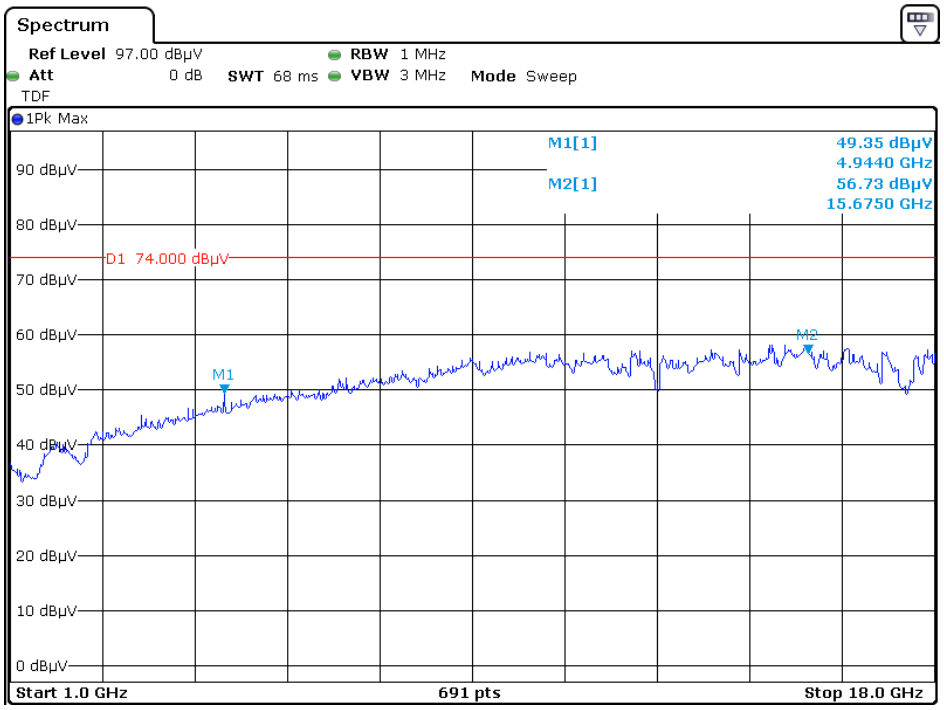


Date: 21.OCT.2019 08:42:47

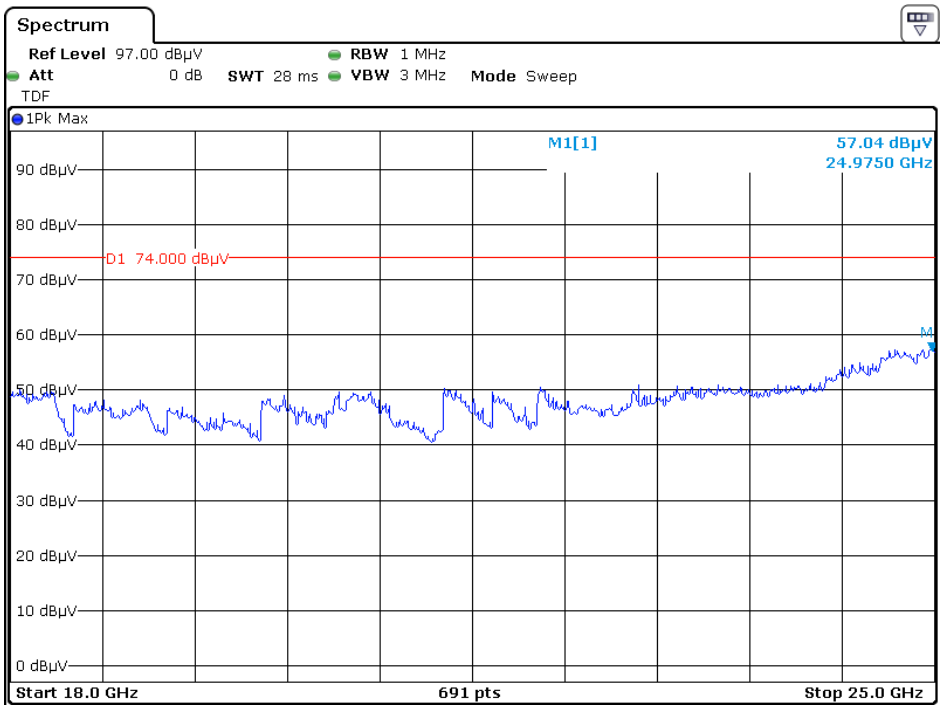


Date: 21.OCT.2019 09:36:54

Vertical

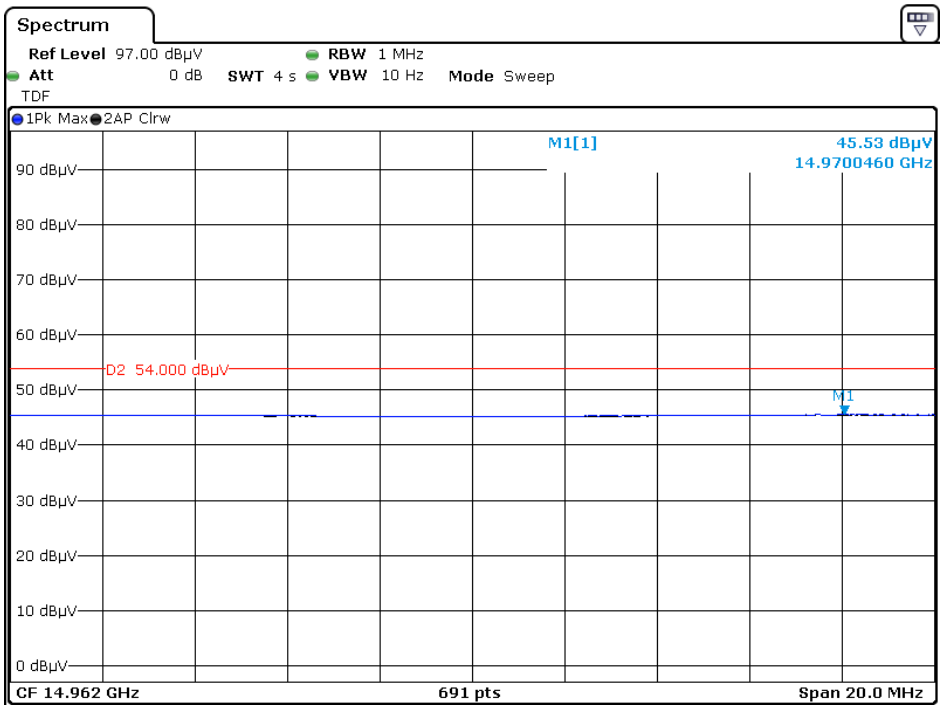


Date: 21.OCT.2019 08:50:24

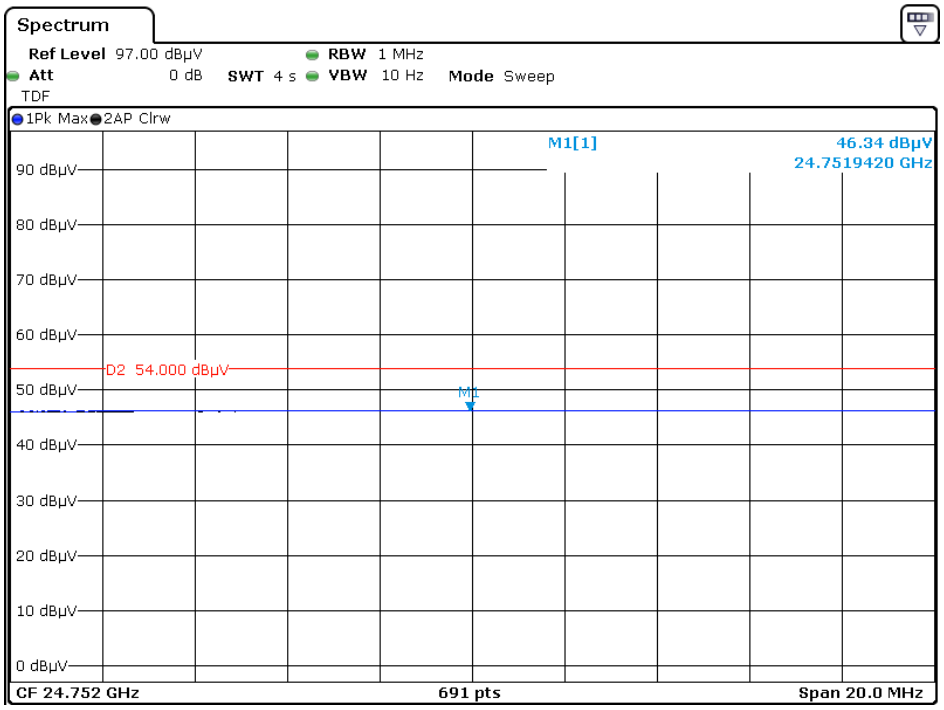


Date: 21.OCT.2019 09:43:58

Pre-scan for Average
Horizontal

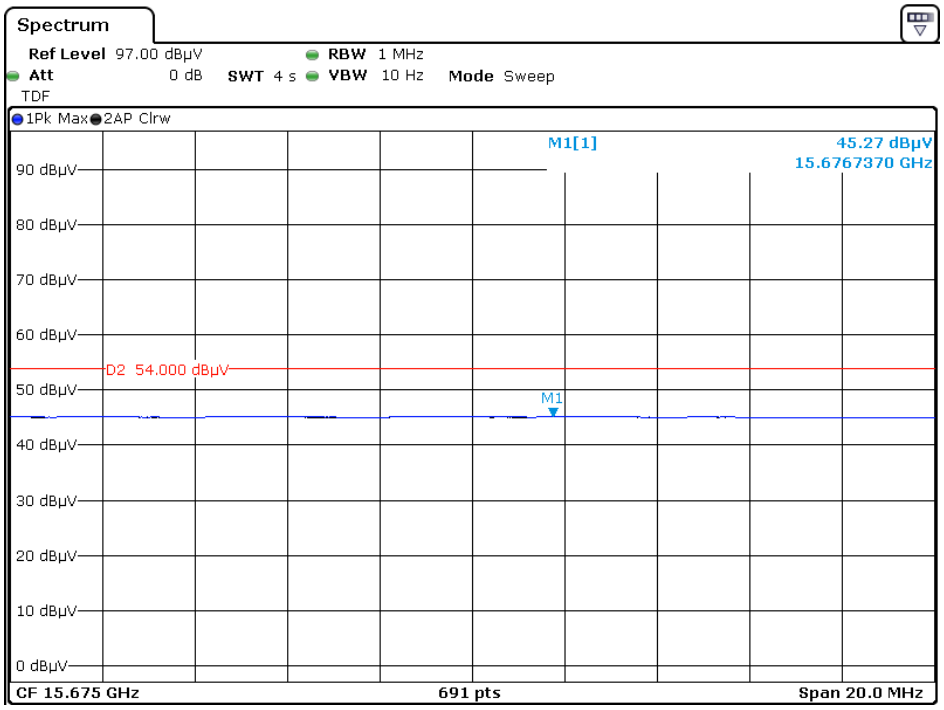


Date: 21.OCT.2019 08:46:40



Date: 21.OCT.2019 09:40:27

Vertical



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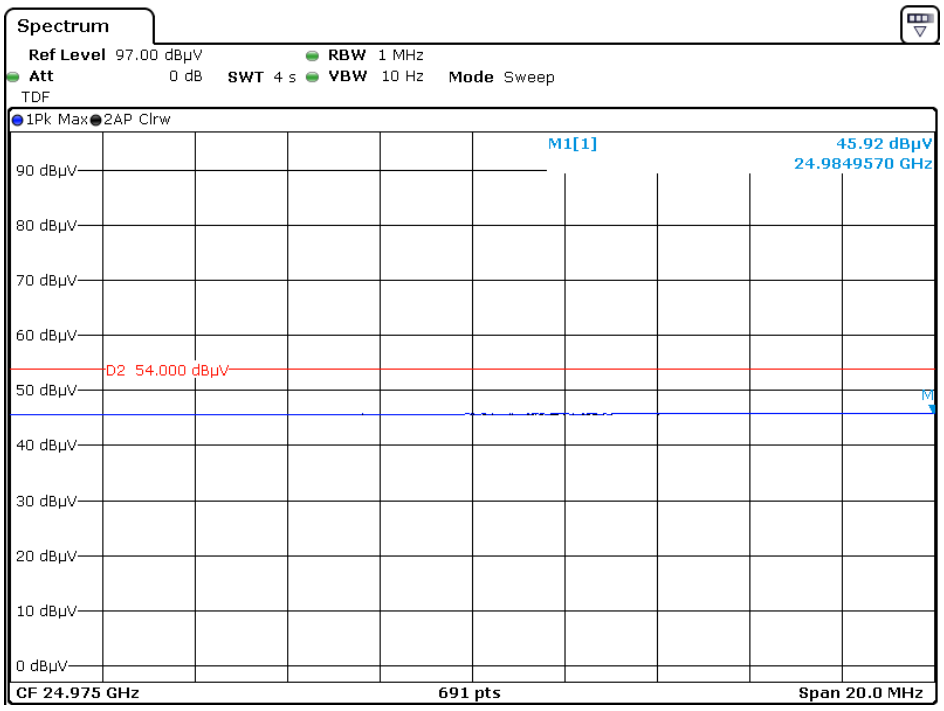


Date: 21.OCT.2019 09:48:06

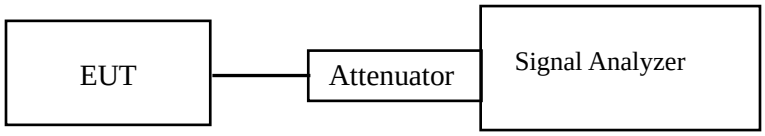
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.



Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Leo Huang on 2019-10-11.

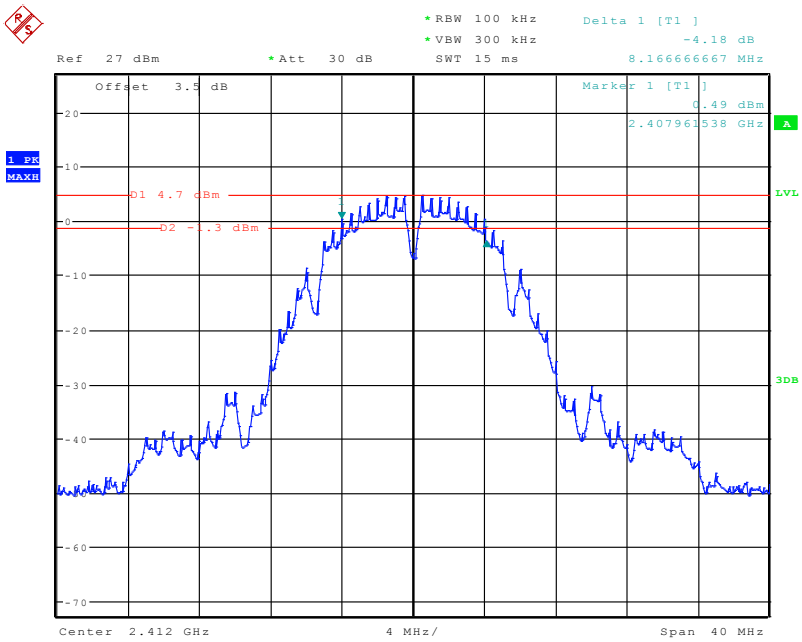
Test Result: Pass.

Please refer to the following table and plots.

EUT operation mode: Transmitting

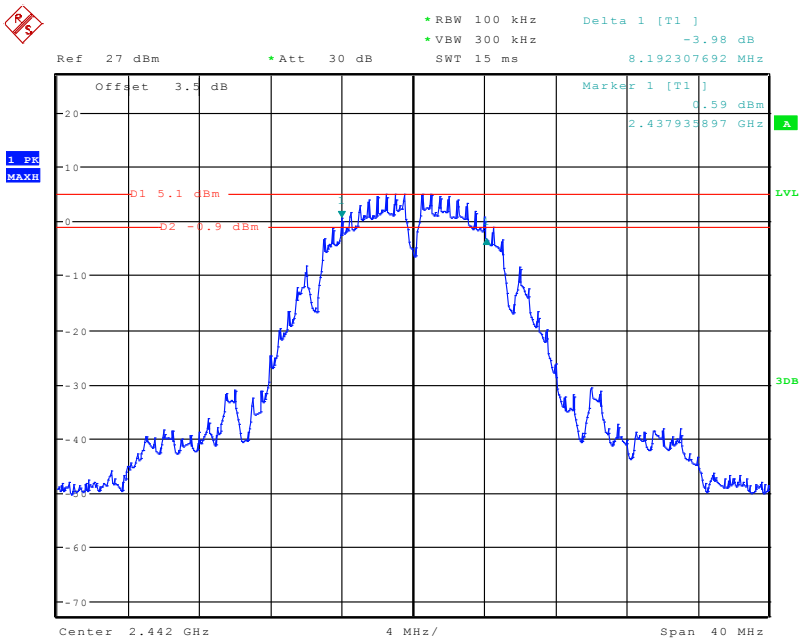
Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (kHz)
802.11b mode			
Low	2412	8.17	≥500
Middle	2442	8.19	≥500
High	2472	8.05	≥500
802.11g			
Low	2412	16.45	≥500
Middle	2442	16.41	≥500
High	2472	16.41	≥500
802.11n-HT20 mode			
Low	2412	17.67	≥500
Middle	2442	17.67	≥500
High	2472	17.67	≥500
802.11n-HT40 mode			
Low	2422	36.51	⩾500
Middle	2442	36.59	⩾500
High	2462	36.54	⩾500

802.11b Low Channel



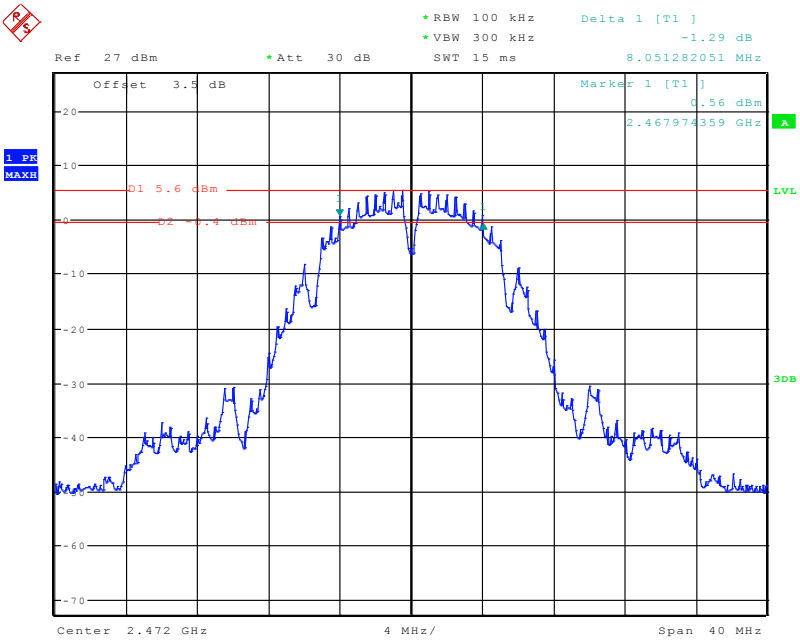
Date: 11.OCT.2019 11:38:36

802.11b Middle Channel



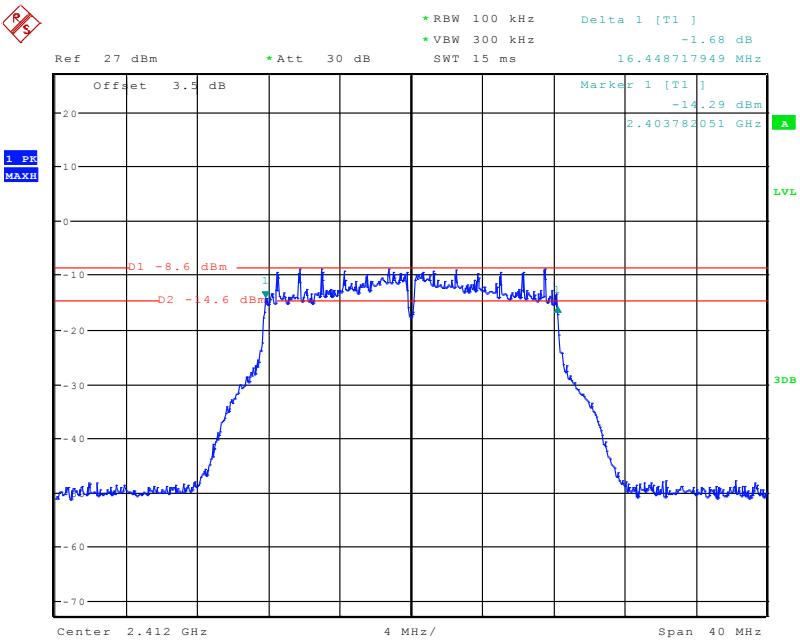
Date: 11.OCT.2019 11:31:21

802.11b High Channel



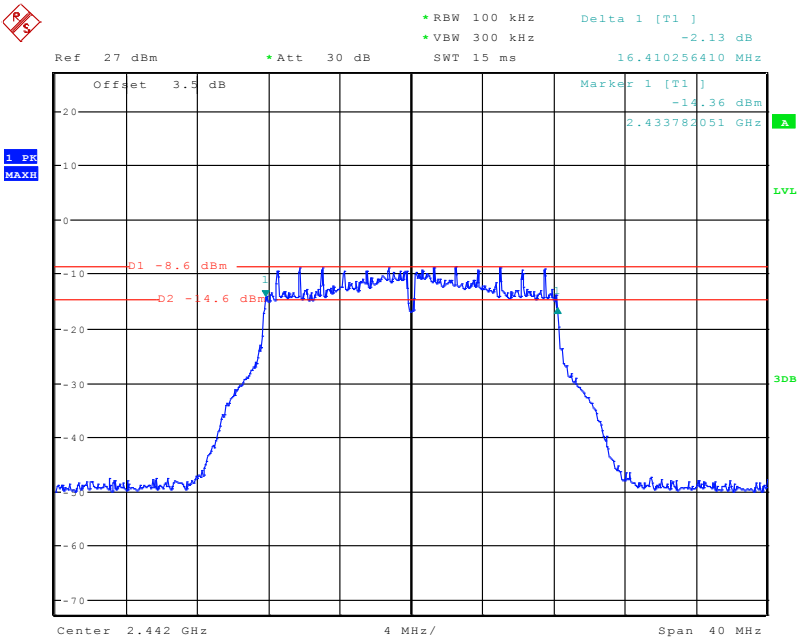
Date: 11.OCT.2019 11:33:39

802.11g Low Channel



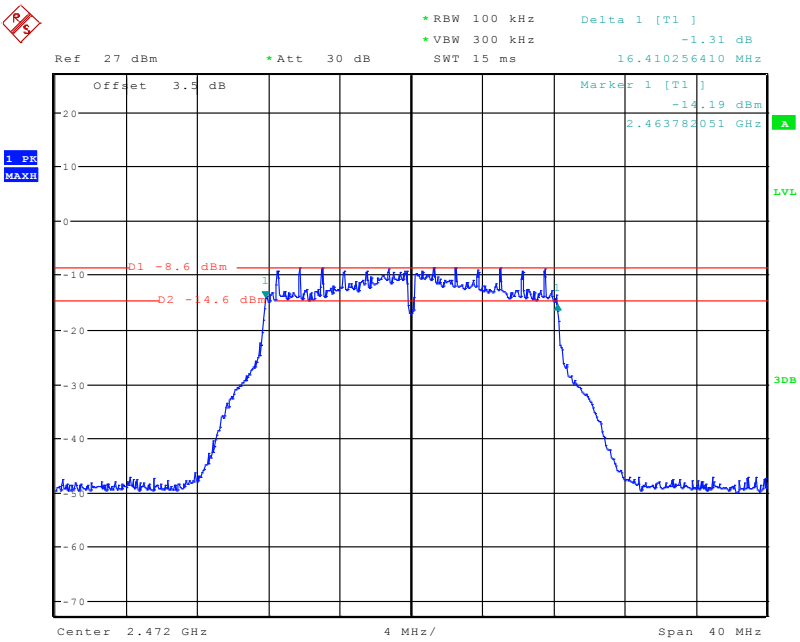
Date: 11.OCT.2019 11:26:34

802.11g Middle Channel



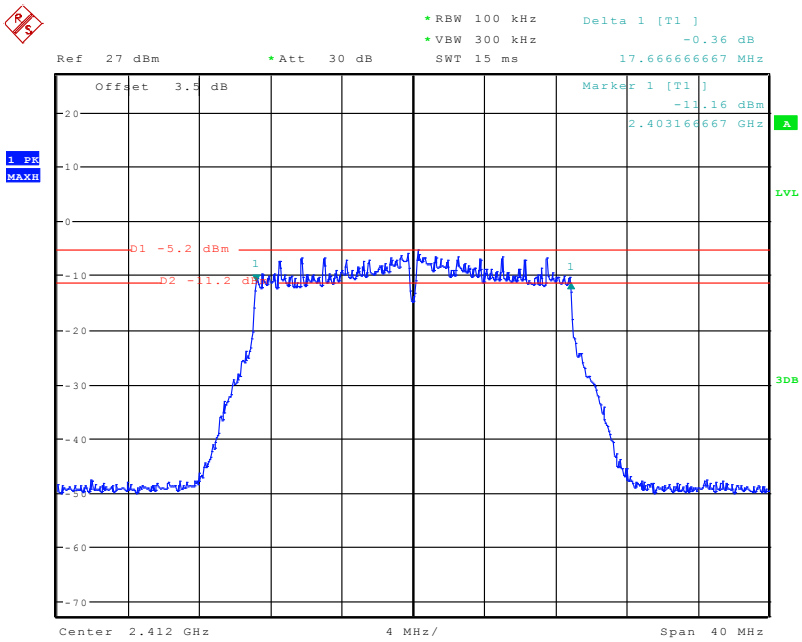
Date: 11.OCT.2019 11:24:35

802.11g High Channel



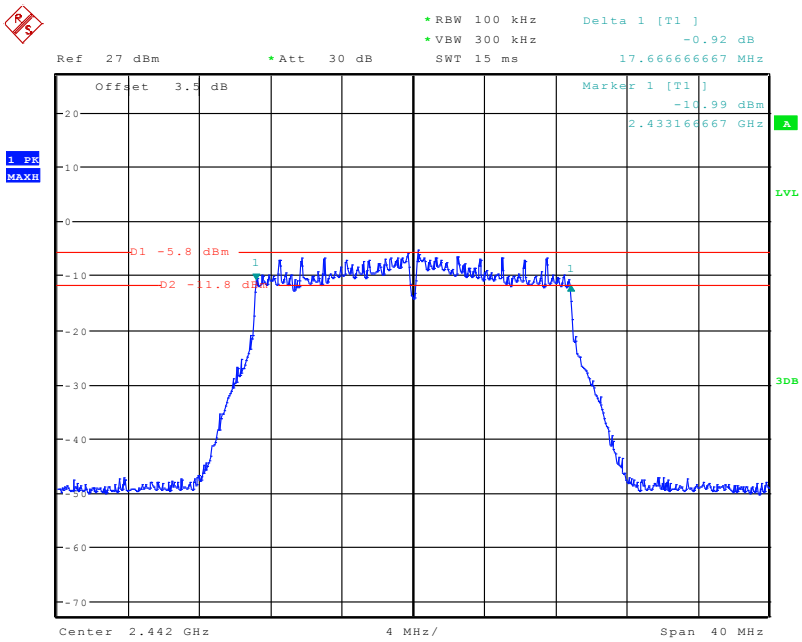
Date: 11.OCT.2019 11:22:53

802.11n-HT20 Low Channel



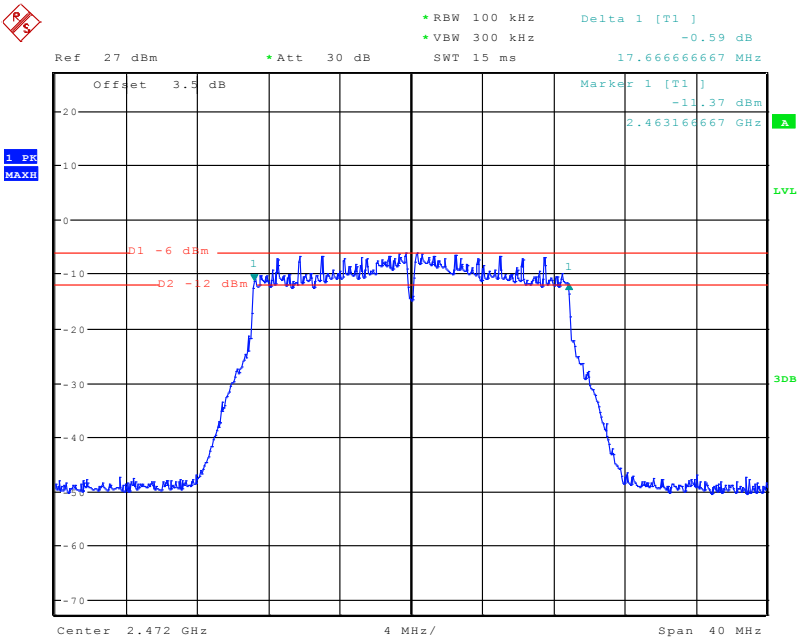
Date: 11.OCT.2019 11:15:20

802.11n-HT20 Middle Channel



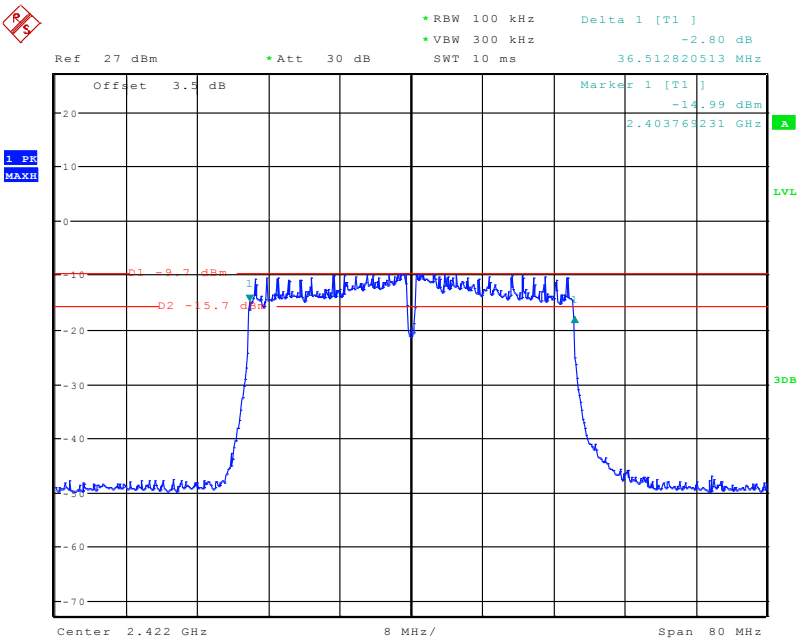
Date: 11.OCT.2019 11:13:11

802.11n-HT20 High Channel



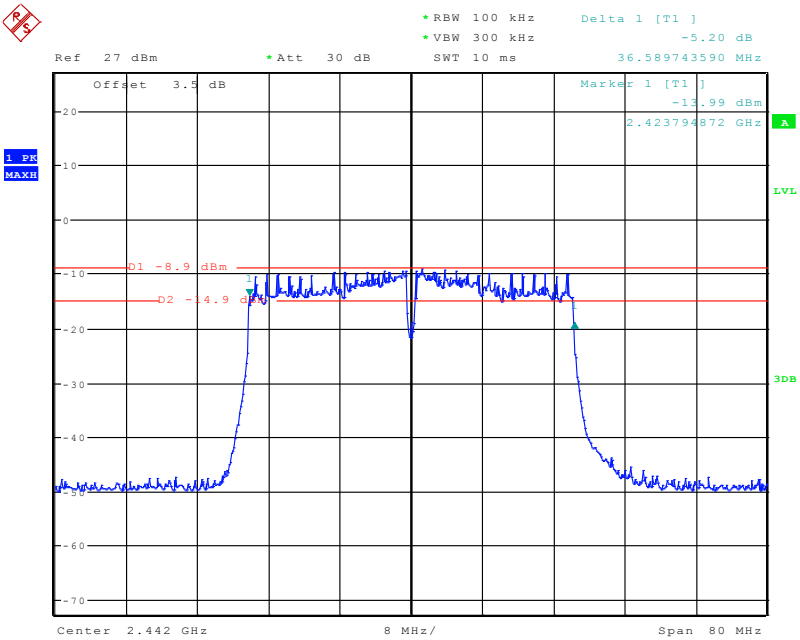
Date: 11.OCT.2019 11:11:05

802.11n-HT40 Low Channel



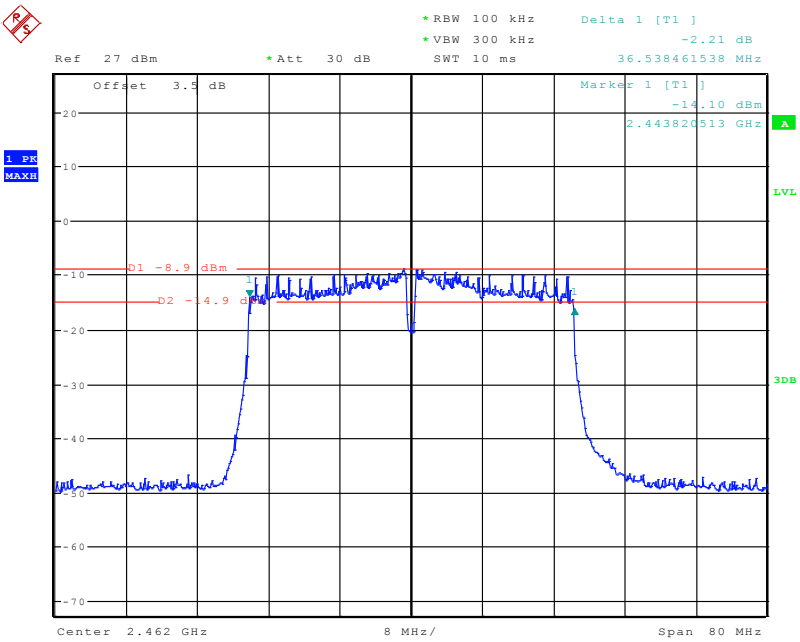
Date: 11.OCT.2019 11:09:17

802.11n-HT40 Middle Channel



Date: 11.OCT.2019 11:07:02

802.11n-HT40 High Channel



Date: 11.OCT.2019 11:04:53

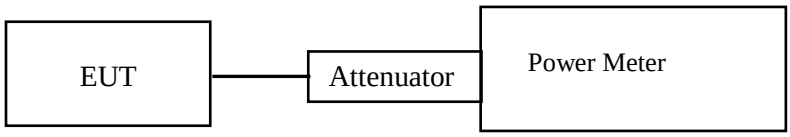
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



Test Data

Environmental Conditions

Temperature:	22 ℃
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Leo Huang on 2019-10-22.

EUT operation mode: Transmitting

Wi-Fi mode

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Max Conducted Average Output Power (dBm)	Limit (dBm)
802.11b				
Low	2412	16.77	13.06	30
Middle	2442	16.88	13.18	30
High	2472	17.10	13.39	30
802.11g				
Low	2412	14.64	9.33	30
Middle	2442	14.99	9.53	30
High	2472	15.06	9.63	30
802.11n HT20				
Low	2412	16.09	10.75	30
Middle	2442	16.55	10.98	30
High	2472	16.81	10.88	30
802.11n HT40				
Low	2422	17.75	12.02	30
Middle	2442	17.64	12.42	30
High	2462	18.54	12.38	30

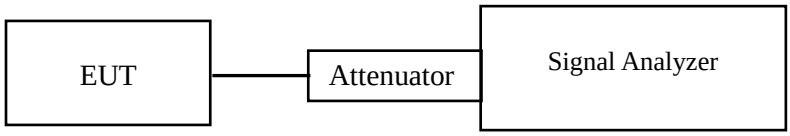
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

Applicable Standard

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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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) (see §15.205(c)).

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.



Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

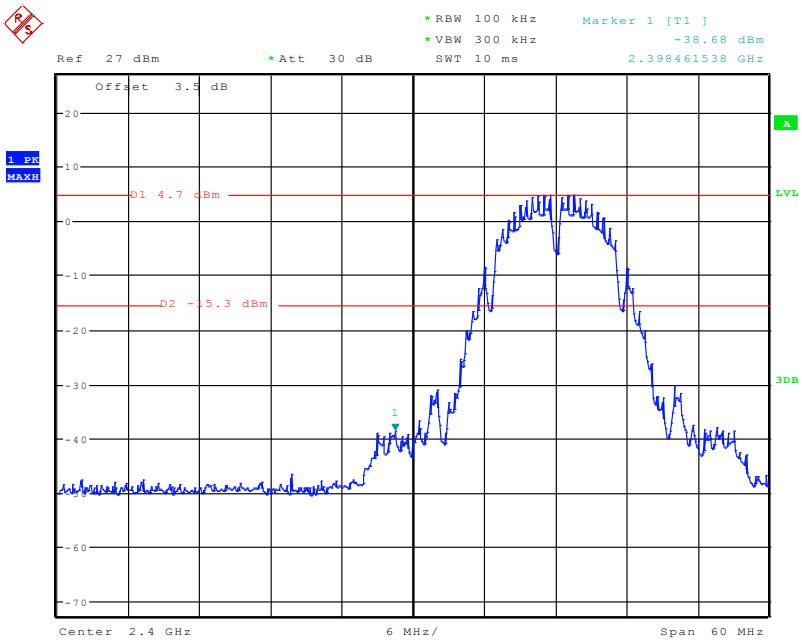
The testing was performed by Leo Huang on 2019-10-11.

EUT operation mode: Transmitting

Test Result: Compliance

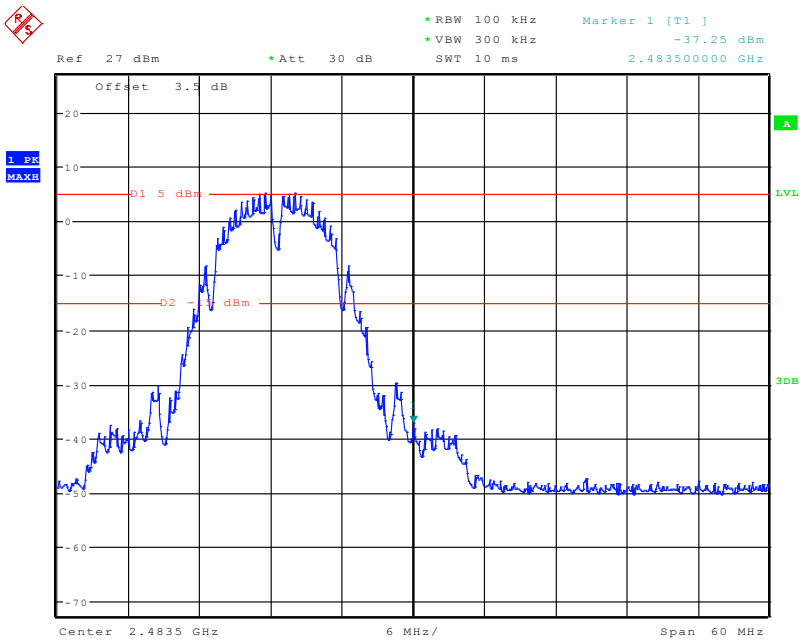
Please refer to the following plots.

802.11b: Band Edge, Left Side



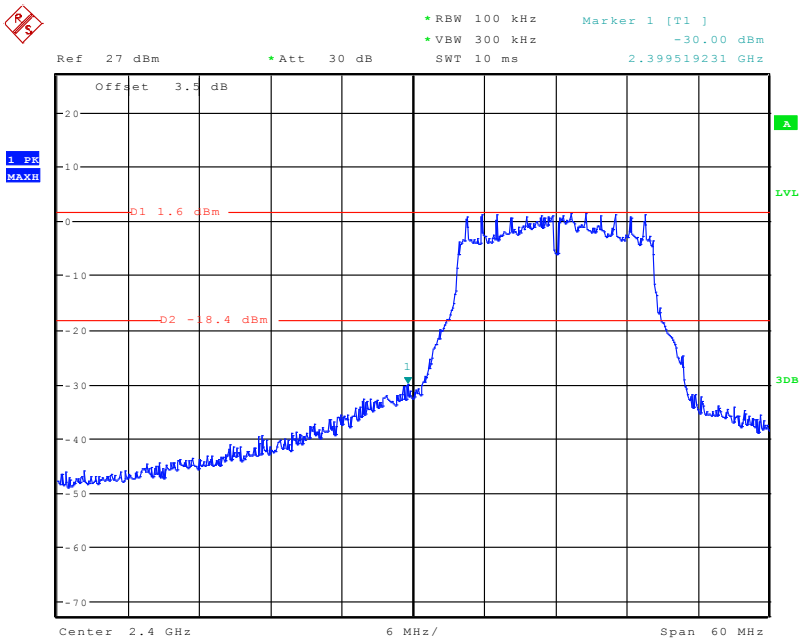
Date: 11.OCT.2019 11:36:47

802.11b: Band Edge, Right Side



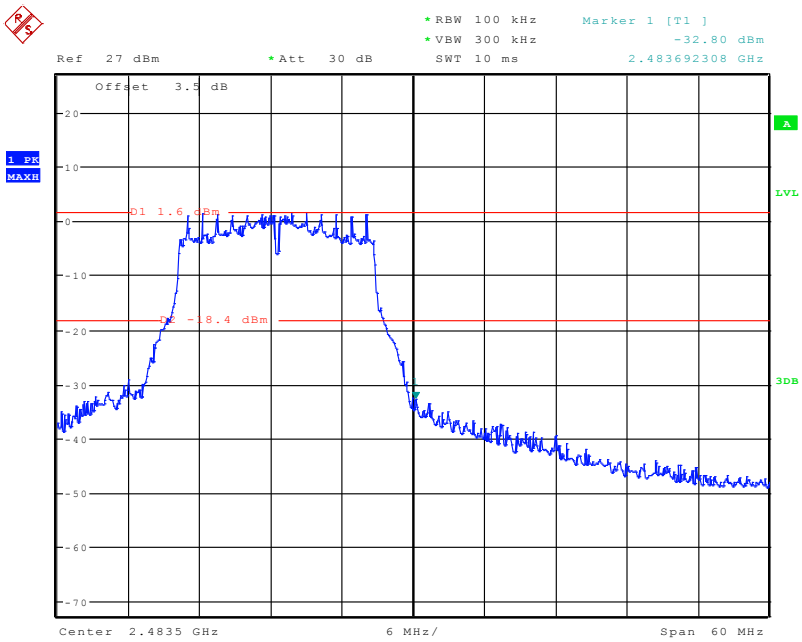
Date: 11.OCT.2019 11:35:14

802.11g: Band Edge, Left Side



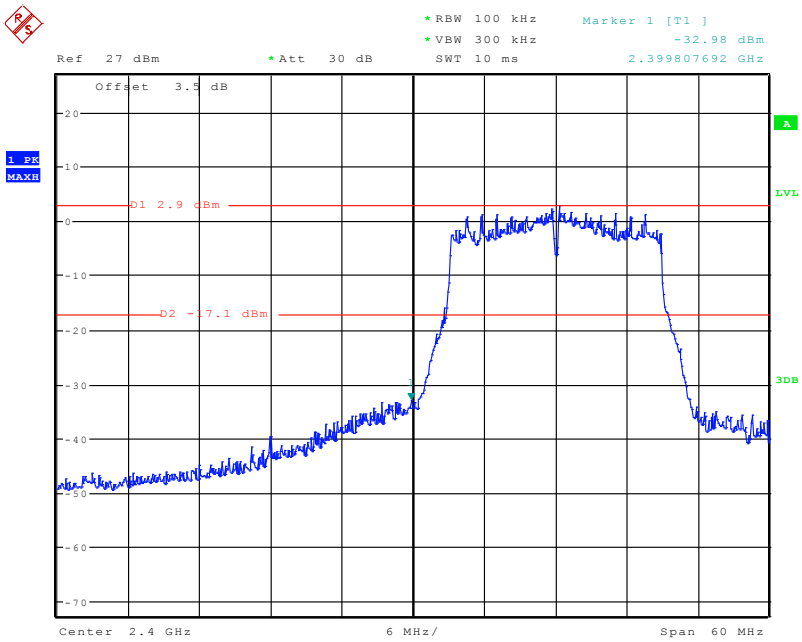
Date: 11.OCT.2019 11:40:57

802.11g: Band Edge, Right Side



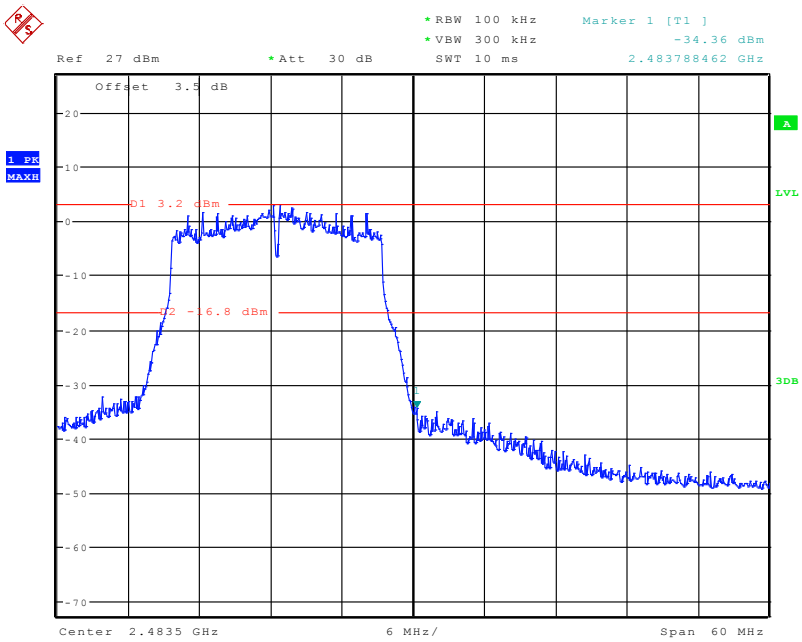
Date: 11.OCT.2019 11:41:56

802.11n-HT20: Band Edge, Left Side



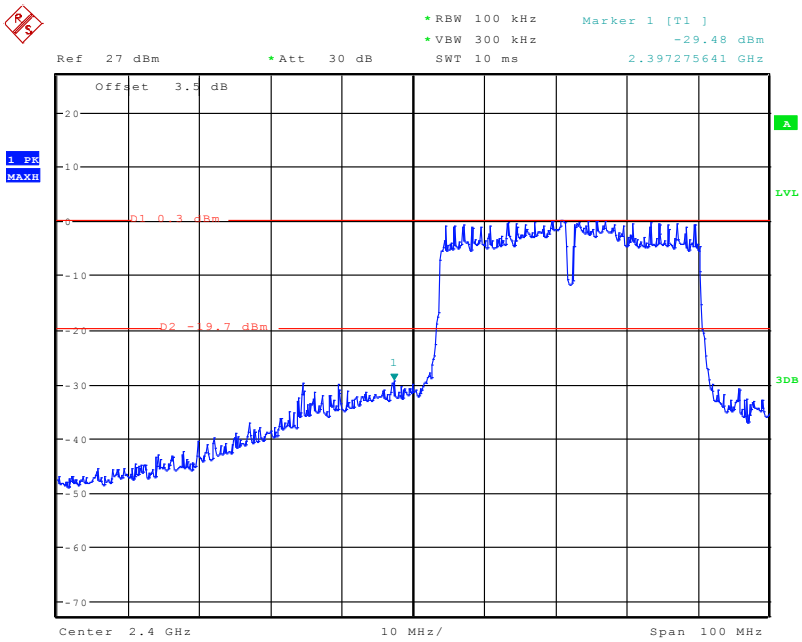
Date: 11.OCT.2019 11:44:22

802.11n-HT20: Band Edge, Right Side



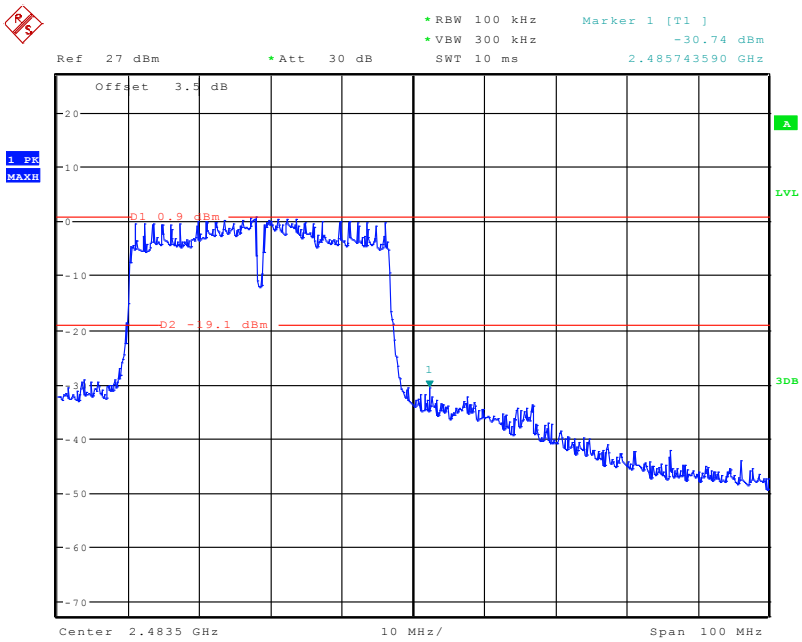
Date: 11.OCT.2019 11:43:21

802.11n-HT40: Band Edge, Left Side



Date: 11.OCT.2019 11:45:27

802.11n-HT40: Band Edge, Right Side



Date: 11.OCT.2019 11:46:12

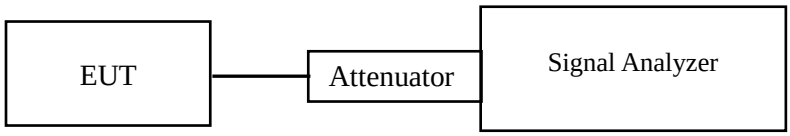
FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm 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.

Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to: 3kHz≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 1.5 times the DTS bandwidth.
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 within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

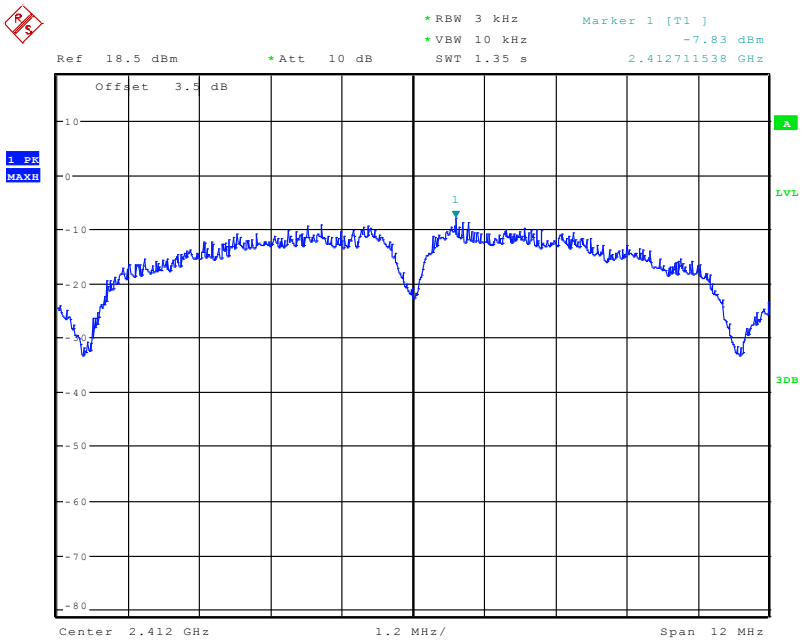
The testing was performed by Leo Huang on 2019-10-12.

EUT operation mode: Transmitting

Test Result: Pass

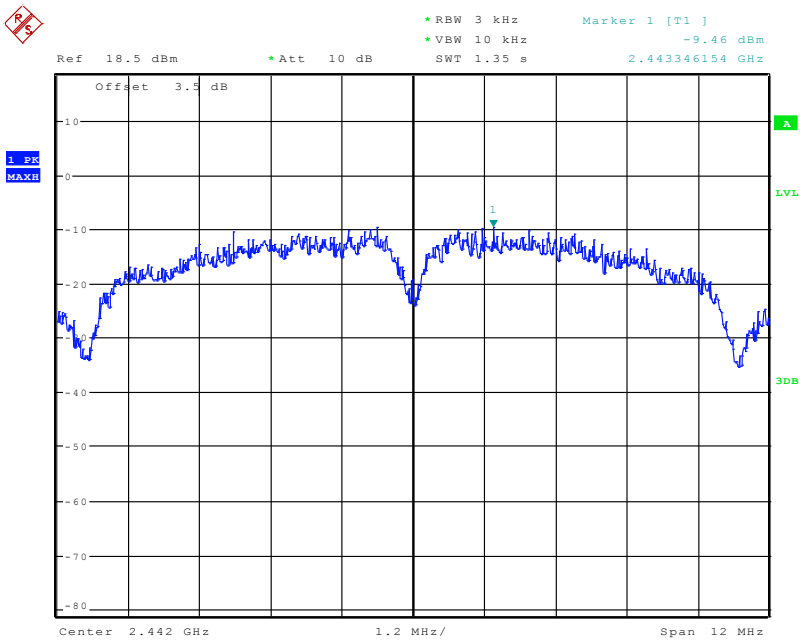
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-7.83	≤8
Middle	2442	-9.46	≤8
High	2472	-8.66	≤8
802.11g mode			
Low	2412	-10.61	≤8
Middle	2442	-10.86	≤8
High	2472	-9.59	≤8
802.11n-HT20 mode			
Low	2412	-12.88	≤8
Middle	2442	-12.52	≤8
High	2472	-11.51	≤8
802.11n-HT40 mode			
Low	2422	-14.07	≤8
Middle	2442	-13.43	≤8
High	2462	-14.55	≤8

Power Spectral Density, 802.11b Low Channel



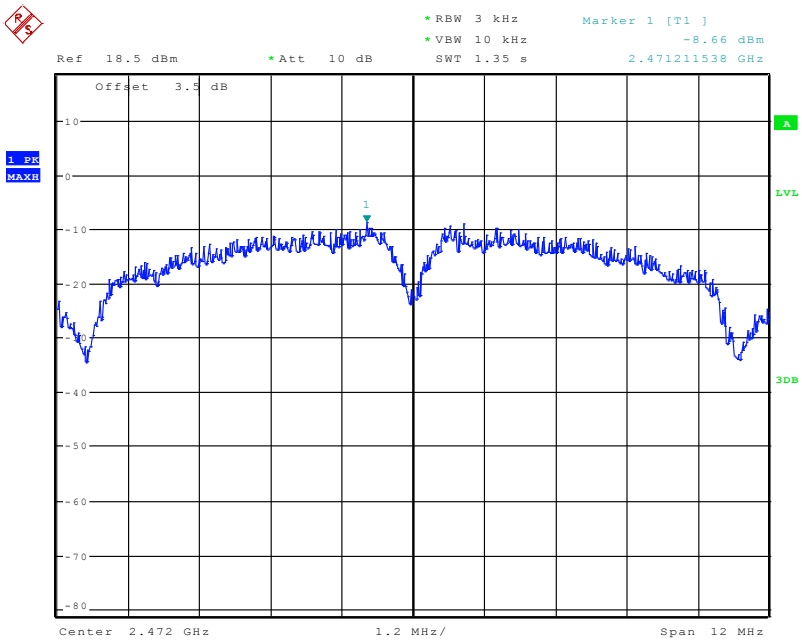
Date: 12.OCT.2019 08:40:51

Power Spectral Density, 802.11b Middle Channel



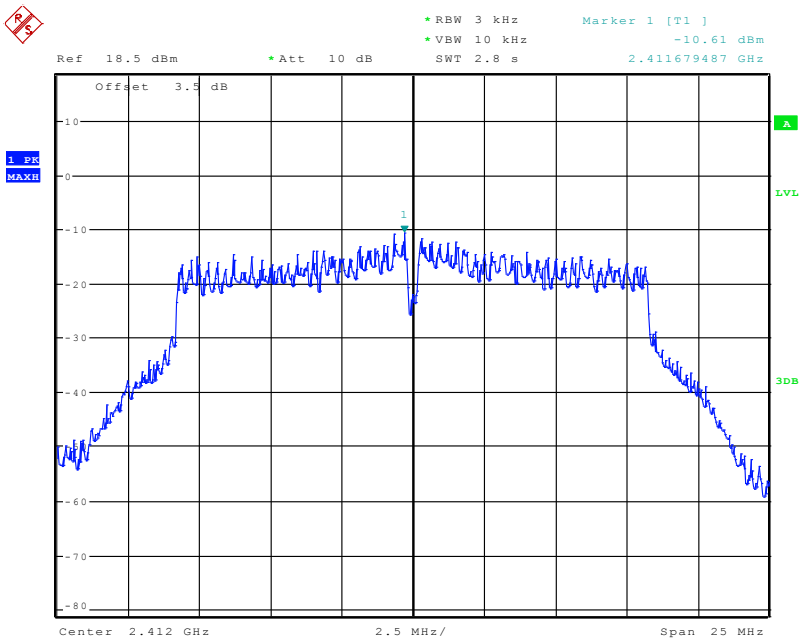
Date: 12.OCT.2019 08:47:46

Power Spectral Density, 802.11b High Channel



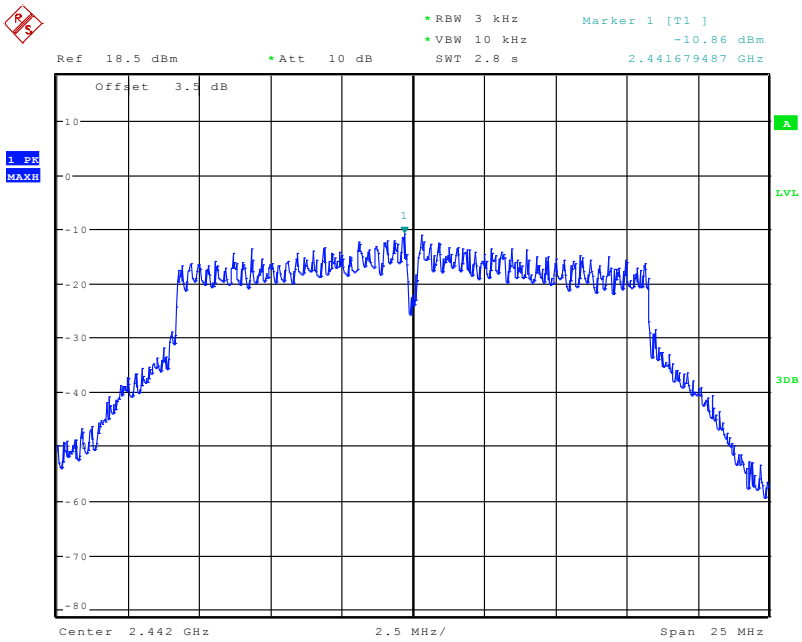
Date: 12.OCT.2019 08:47:00

Power Spectral Density, 802.11g Low Channel



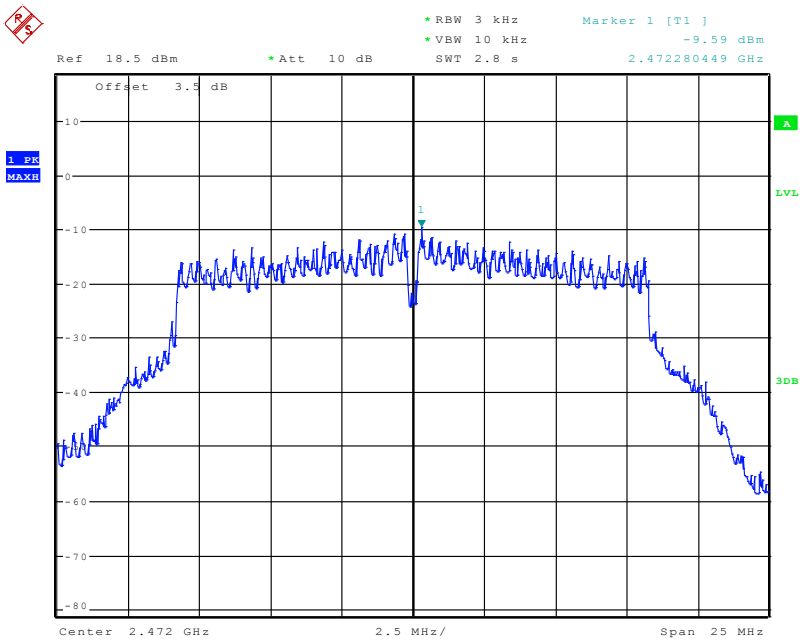
Date: 12.OCT.2019 08:51:01

Power Spectral Density, 802.11g Middle Channel



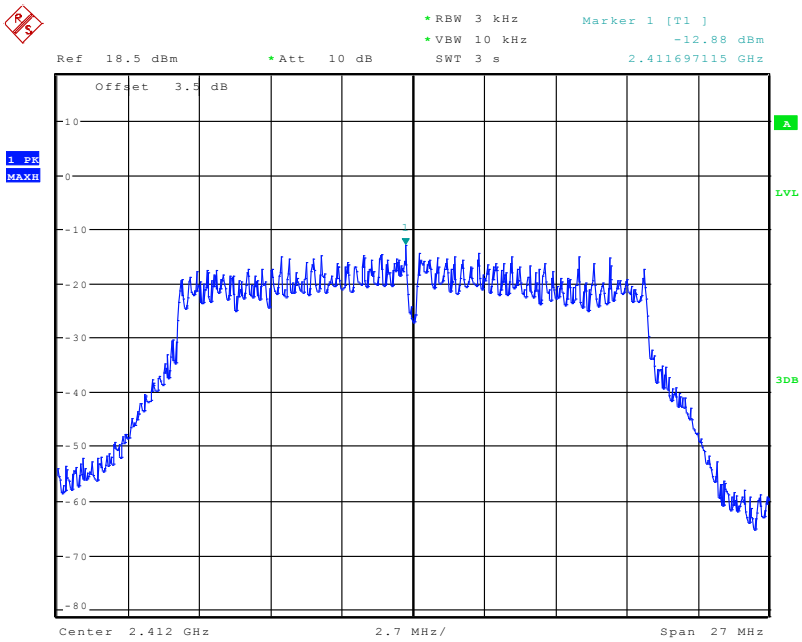
Date: 12.OCT.2019 08:51:33

Power Spectral Density, 802.11g High Channel



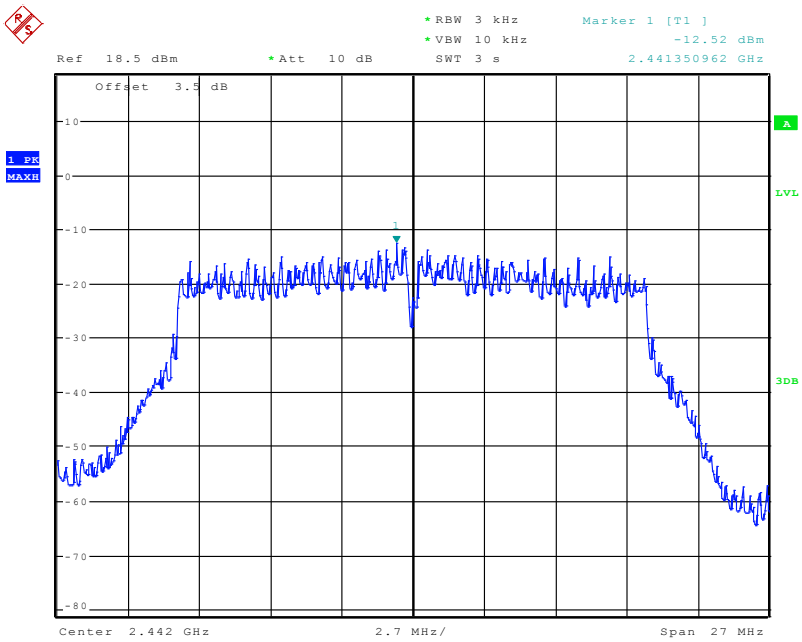
Date: 12.OCT.2019 08:50:09

Power Spectral Density, 802.11n-HT20 Low Channel



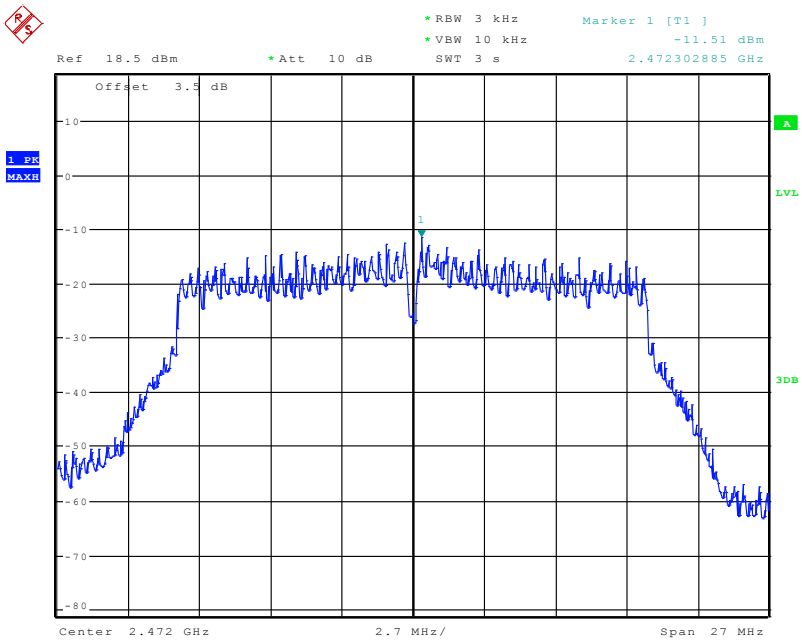
Date: 12.OCT.2019 08:53:12

Power Spectral Density, 802.11n-HT20 Middle Channel



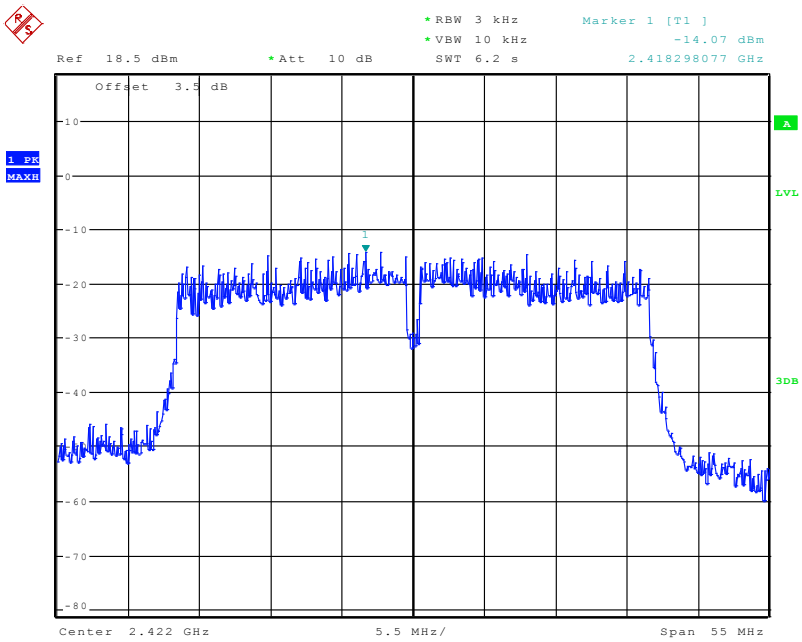
Date: 12.OCT.2019 08:54:05

Power Spectral Density, 802.11n-HT20 High Channel



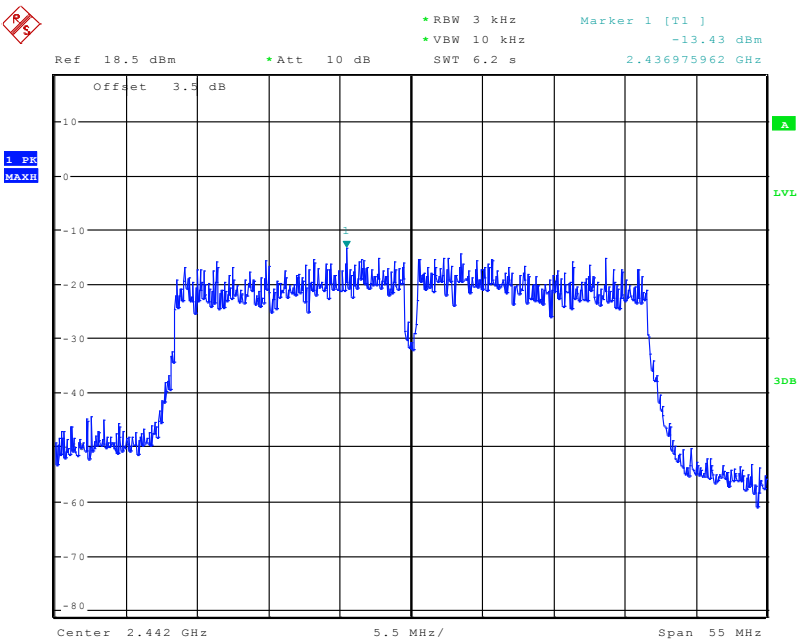
Date: 12.OCT.2019 08:52:25

Power Spectral Density, 802.11n-HT40 Low Channel



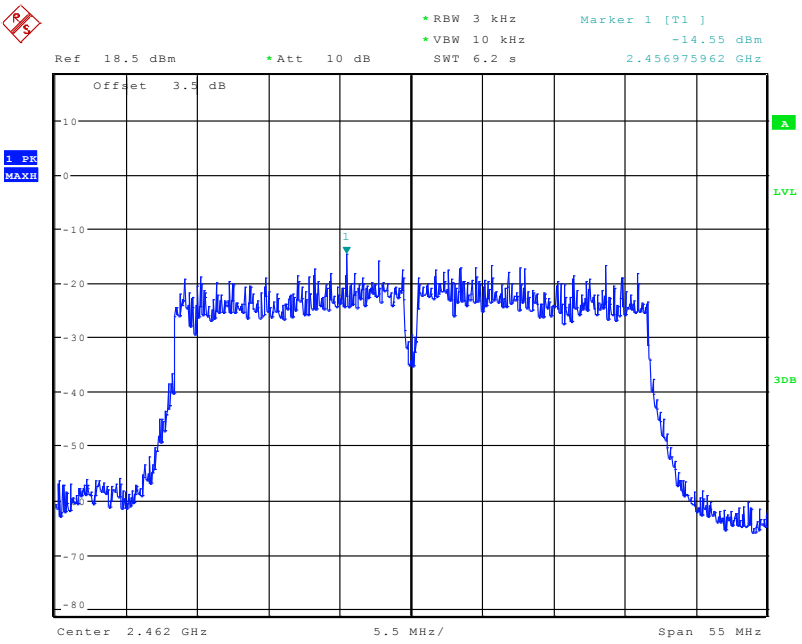
Date: 12.OCT.2019 08:55:08

Power Spectral Density, 802.11n-HT40 Middle Channel



Date: 12.OCT.2019 08:56:00

Power Spectral Density, 802.11n-HT40 High Channel



Date: 12.OCT.2019 09:12:51

******* END OF REPORT *******