BACL
Bay Area Compliance Labs Corp.

FCC PART 15.247

TEST REPORT

For

ShenZhen RuiMaiDe(RMD) Technology Co., LTD

#02-J201, Jinhetian Commercial Center, No.329 Longhuan 3rd Street, Longhua District Shenzhen, China

FCC ID: 2ANIFSK50

Report Type:	Product Type:
Original Report	Smart Plug

Report Number:	RSZ200605812-00
Report Date:	2020-07-09
Reviewed By:	Jacob Kong RF Engineer
Prepared By:	Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Smart Plug
Model	SK50
Voltage	120V/60Hz
Frequency Range	Wi-Fi: 2412~2462MHz
Maximum Conducted Peak Output Power	Wi-Fi: 18.58dBm(802.11b), 17.79dBm(802.11g) 17.40dBm((802.11n20), 16.46dBm((802.11n40)
Modulation Technique	Wi-Fi: DSSS, OFDM
Antenna Specification	2.5dBi
Date of Test	2020-06-15 to 2020-07-07
Sample serial number	RSZ200605812-RF-S1 (Assigned by BACL, Shenzhen)
Received date	2020-06-05
Sample/EUT Status	Good condition

Objective

This report is prepared on behalf of *ShenZhen RuiMaiDe(RMD) Technology Co., LTD* 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)

No Related submissions.

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, 11 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	/	/
6	2437	/	/
7	2442	/	/

For 802.11b, 802.11g, 802.11n-HT20 mode, EUT was tested with Channel 1, 6 and 11

For 802.11n-HT40 mode, 7 channels are provided to testing:

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

EUT was tested with Channel 1, 4 and 7.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

Software: wifi test -tool

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	13	13	13
802.11g	6 Mbps	10	10	10
802.11n-HT20	MCS0	10	10	10
802.11n-HT40	MCS0	10	10	10

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

Duty cycle

802.11b mode

```
                                            RBW  20 MHz      Marker 1 [T1 ]
                                           *VBW  30 MHz               18.49 dBm
          Ref   28.5 dBm        *Att  20 dB   SWT 100 ms        16.666667 ms
```



```
Center 2.437 GHz                            10 ms/
```
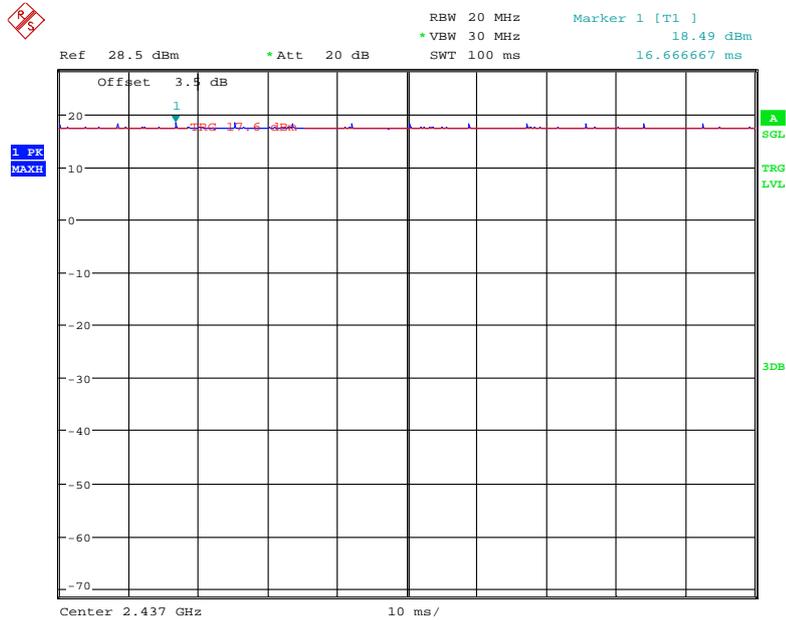
```
Date: 15.JUN.2020  10:34:10
```

802.11g mode

```
                                            RBW  20 MHz      Marker 1 [T1 ]
                                           *VBW  30 MHz               19.57 dBm
          Ref   28.5 dBm        *Att  20 dB   SWT 100 ms        62.660256 ms
```



```
Center 2.437 GHz                            10 ms/
```
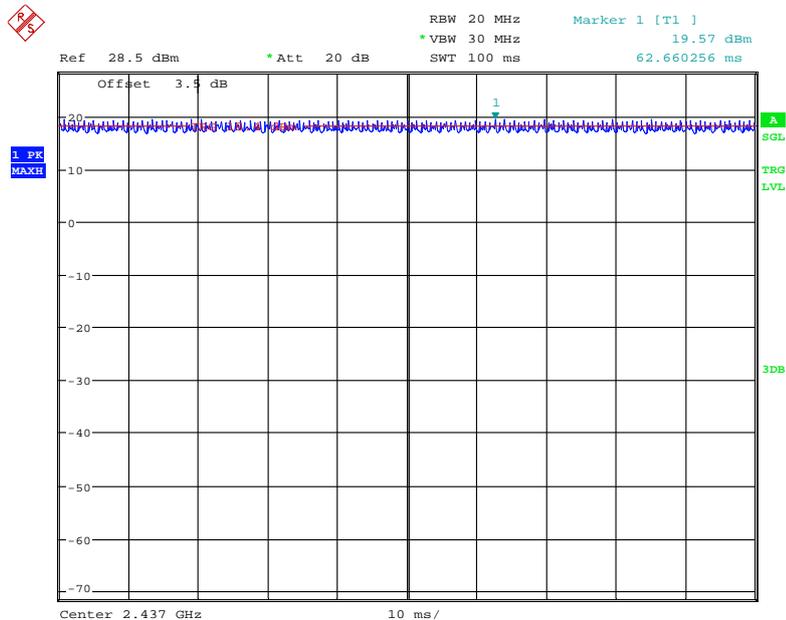
```
Date: 15.JUN.2020  10:35:30
```

802.11n-HT20 Mode

```
                                    RBW 20 MHz     Marker 1 [T1 ]
                                   * VBW 30 MHz            19.35 dBm
       Ref   28.5 dBm       * Att   20 dB    SWT 100 ms        98.076923 ms
          Offset   3.5 dB
```



```
Center 2.437 GHz                       10 ms/
```
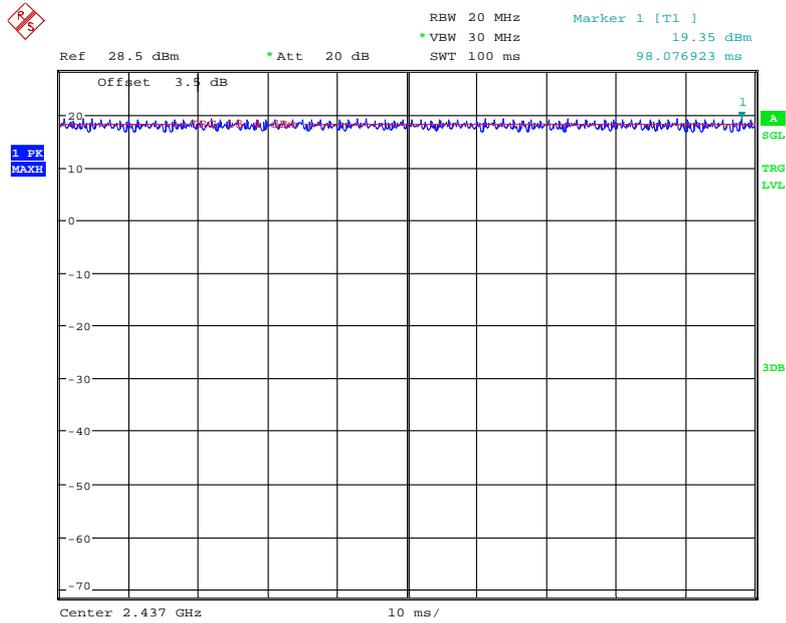
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Date: 15.JUN.2020  10:35:57
```

802.11n-HT40 Mode

```
                                    RBW 20 MHz     Marker 1 [T1 ]
                                   * VBW 30 MHz            20.23 dBm
       Ref   28.5 dBm       * Att   20 dB    SWT 100 ms        69.551282 ms
          Offset   3.5 dB
```



```
Center 2.437 GHz                       10 ms/
```
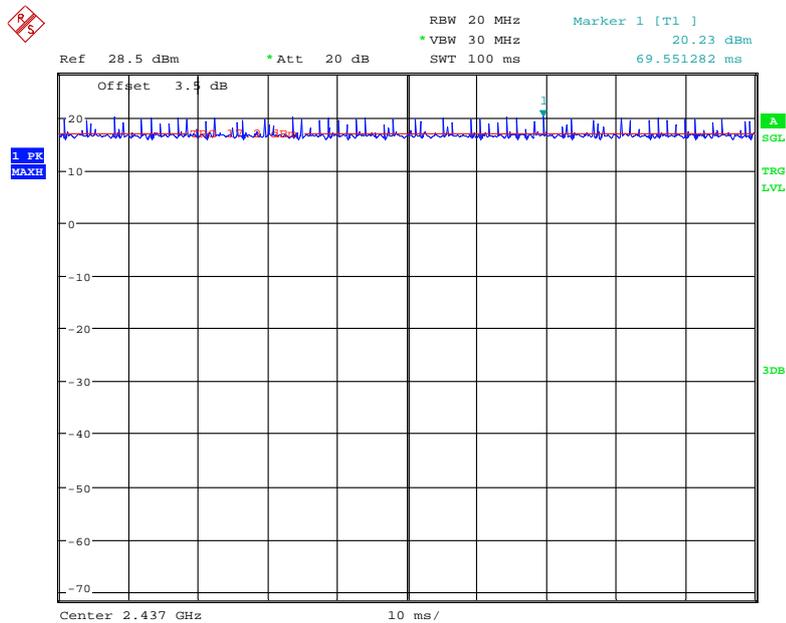
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Date: 15.JUN.2020  10:36:42
```

Mode	Ton (ms)	Ton+off (ms)	Duty Cycle (%)
802.11b	/	/	100
802.11g	/	/	100
802.11n-HT20	/	/	100
802.11n-HT40	/	/	100

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Shanghai Shengxin Electric Appliance Factory	Rheostat	BX8-17	Unknwon
BULL	Socket	GN-415K	5503290068073

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-Shielded Un-Detachable AC Cable	1.2	Socket	Mains
Un-shielded un-detachable AC cable	2.0	Rheostat	EUT

Block Diagram of Test Setup
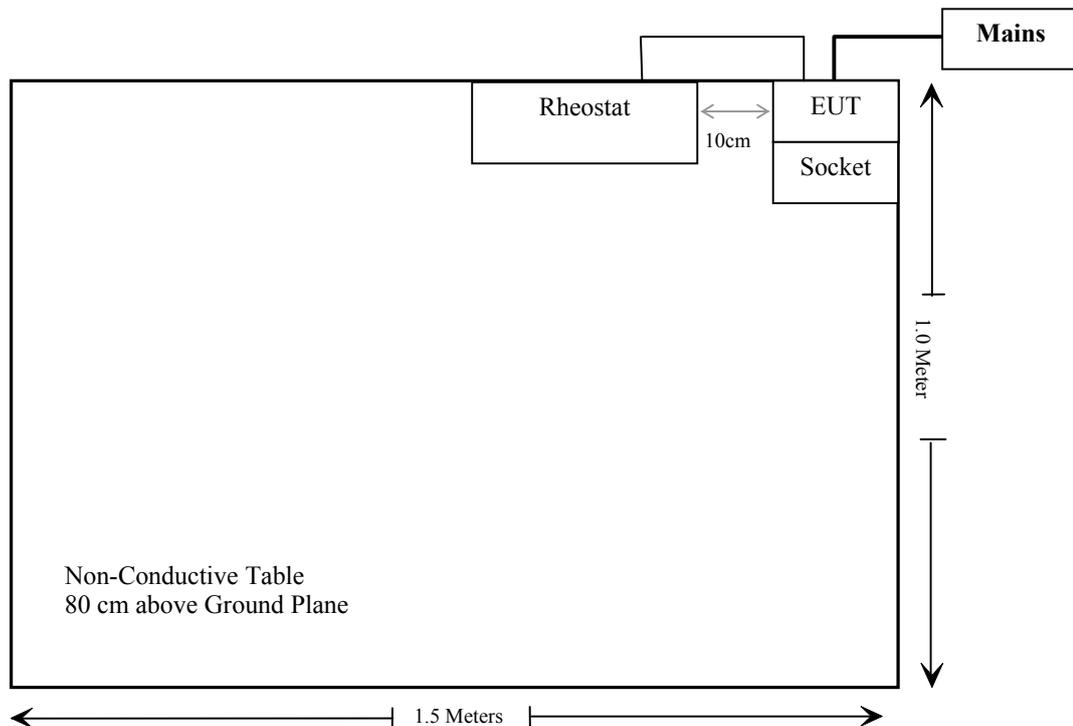
SUMMARY OF TEST RESULTS

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	ESCI	101120	2019/7/9	2020/7/8
Rohde & Schwarz	LISN	ENV216	101613	2020/1/24	2021/1/23
Rohde & Schwarz	Transient Limitor	ESH3Z2	DE25985	2019/11/29	2020/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2019/11/29	2020/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2019/7/9	2020/7/8
Sonoma instrument	Pre-amplifier	310 N	186238	2020/4/20	2021/4/20
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017/12/22	2020/12/21
Unknown	Cable	Chamber Cable 1	Unknown	2019/11/29	2020/11/28
Unknown	Cable	Chamber Cable 4	EC-007	2019/11/29	2020/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2019/7/22	2020/07/21
COM-POWER	Pre-amplifier	PA-122	181919	2019/11/29	2020/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2019/11/29	2020/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017/12/22	2020/12/21
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2019/11/29	2020/11/28
Unknown	RF Cable	W1101-EQ1 OUT	Unknown	2019/11/29	2020/11/28
SNSD	Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2020/4/20	2021/4/20
Ducommun Technolagies	Horn antenna	ARH-4223-02	1007726-02 1304	2017/12/6	2020/12/5

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Agilent	USB Wideband Power Sensor	U2021XA	MY54250003	2019/7/10	2020/7/9
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2020/3/2	2021/3/1
WEINSCHEL	3dB Attenuator	Unknown	Unknown	2019/11/29	2020/11/28
Unknown	RF Cable	Unknown	2301 276	2019/11/29	2020/11/28

 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)			
2412-2462	2.5	1.78	19.0	79.43	20	0.028	1.0

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

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 one internal PCB antenna arrangement, which was permanently attached and the antenna gain is 2.5dBi, 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
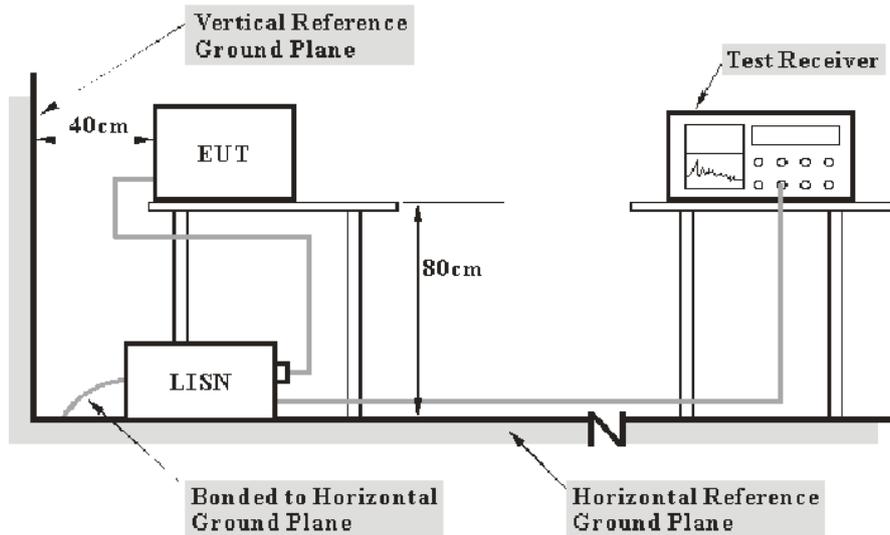
Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

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 Data

Environmental Conditions

|	
Temperature:	25 ℃
Relative Humidity:	65 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2020-07-06.

EUT operation mode: Transmitting (worst case: 802.11b Middle channel with full load)

AC 120V/60 Hz, Line
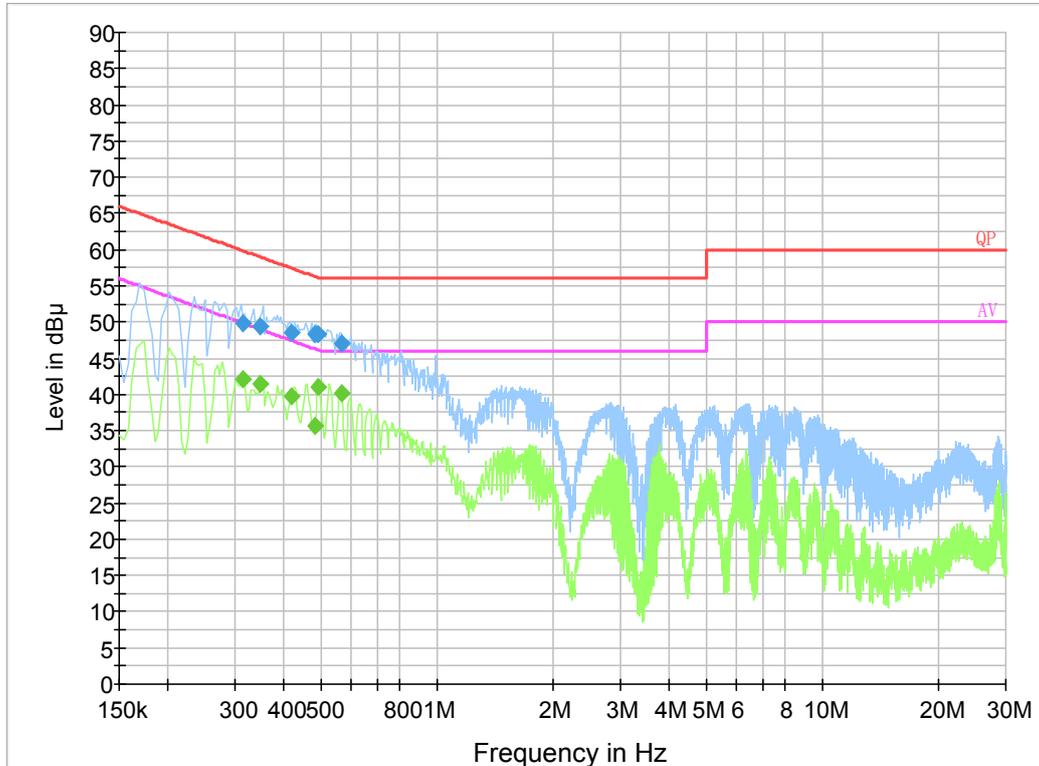
| Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
0.314650	49.9	19.8	59.8	9.9	QP
0.348690	49.4	19.9	59.0	9.6	QP
0.419610	48.5	19.9	57.5	9.0	QP
0.481110	48.4	19.8	56.3	7.9	QP
0.490710	48.4	19.8	56.2	7.8	QP
0.565570	47.0	19.8	56.0	9.0	QP
0.314650	42.2	19.8	49.8	7.6	Ave.
0.348690	41.4	19.9	49.0	7.6	Ave.
0.419610	39.8	19.9	47.5	7.7	Ave.
0.481110	35.7	19.8	46.3	10.6	Ave.
0.490710	40.9	19.8	46.2	5.3	Ave.
0.565570	40.2	19.8	46.0	5.8	Ave.

AC 120V/60 Hz, Neutral
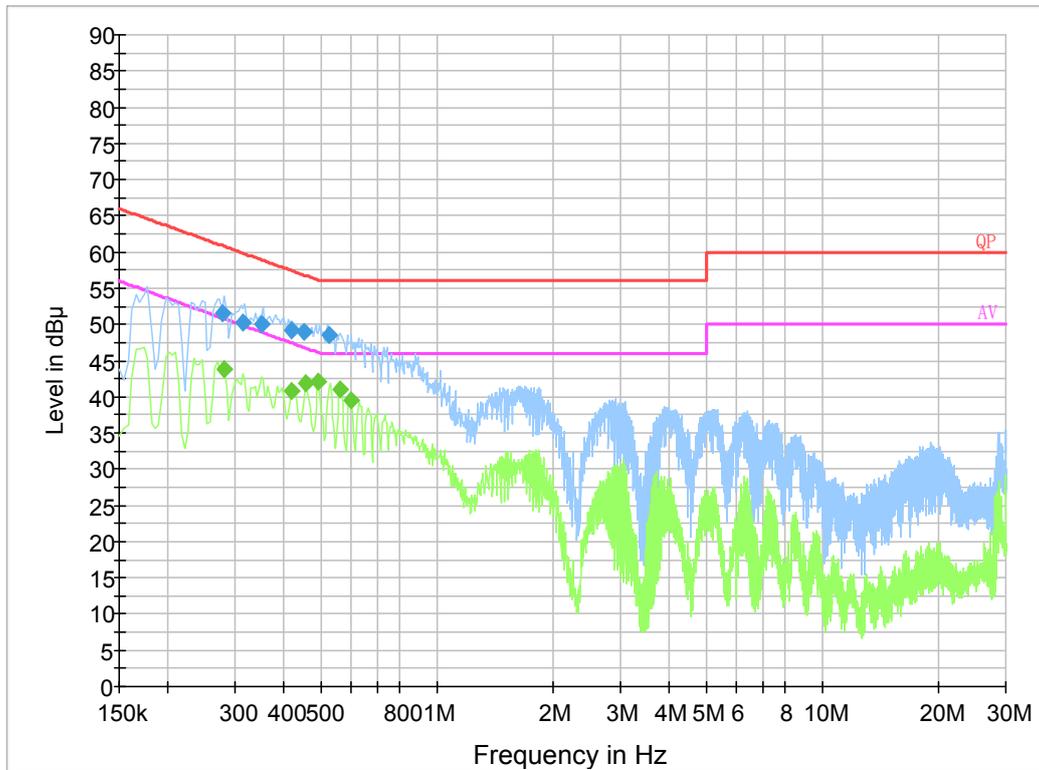
Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.277500	51.6	19.7	60.9	9.3	QP
0.313230	50.4	19.7	59.9	9.5	QP
0.352690	50.1	19.9	58.9	8.8	QP
0.420210	49.2	19.8	57.4	8.2	QP
0.451190	49.0	19.8	56.9	7.9	QP
0.526170	48.4	19.8	56.0	7.6	QP
0.282000	43.7	19.7	50.8	7.1	Ave.
0.422000	40.8	19.8	47.4	6.6	Ave.
0.458000	41.8	19.8	46.7	4.9	Ave.
0.494000	42.1	19.8	46.1	4.0	Ave.
0.562000	41.1	19.8	46.0	4.9	Ave.
0.602000	39.6	19.8	46.0	6.4	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:
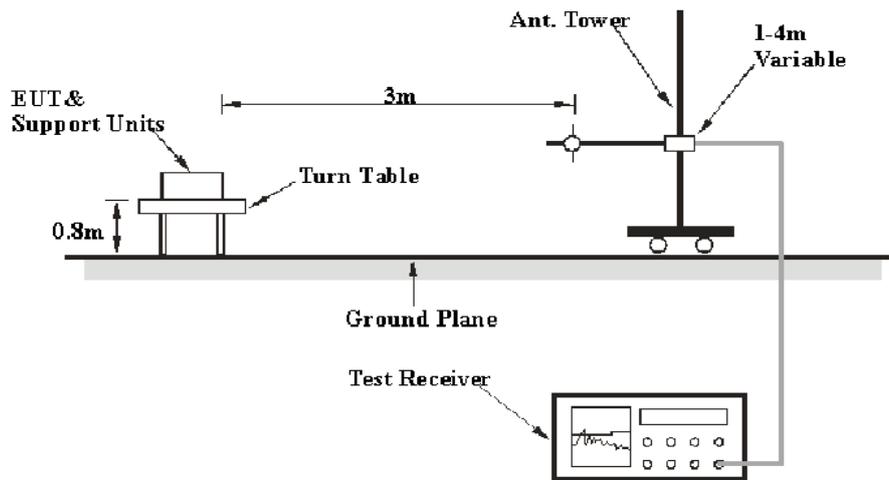
Above 1GHz:
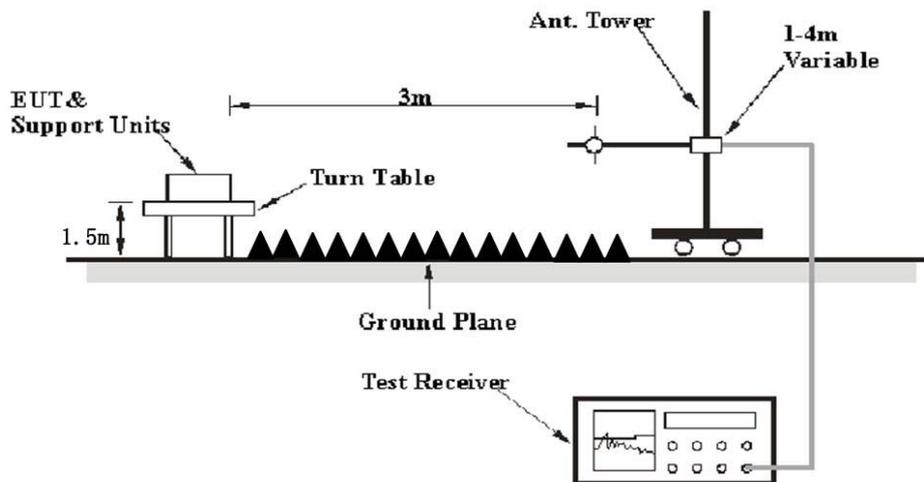
The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

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 Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	65 %
ATM Pressure:	101.0~101.3 kPa

The testing was performed by Charlie Cha on 2020-07-07 for below 1GHz and Leven Gan on 2020-06-15 for above 1GHz.
EUT operation mode: Transmitting

30 MHz~1 GHz: (Worst case at 802.11b mode, middle channel)
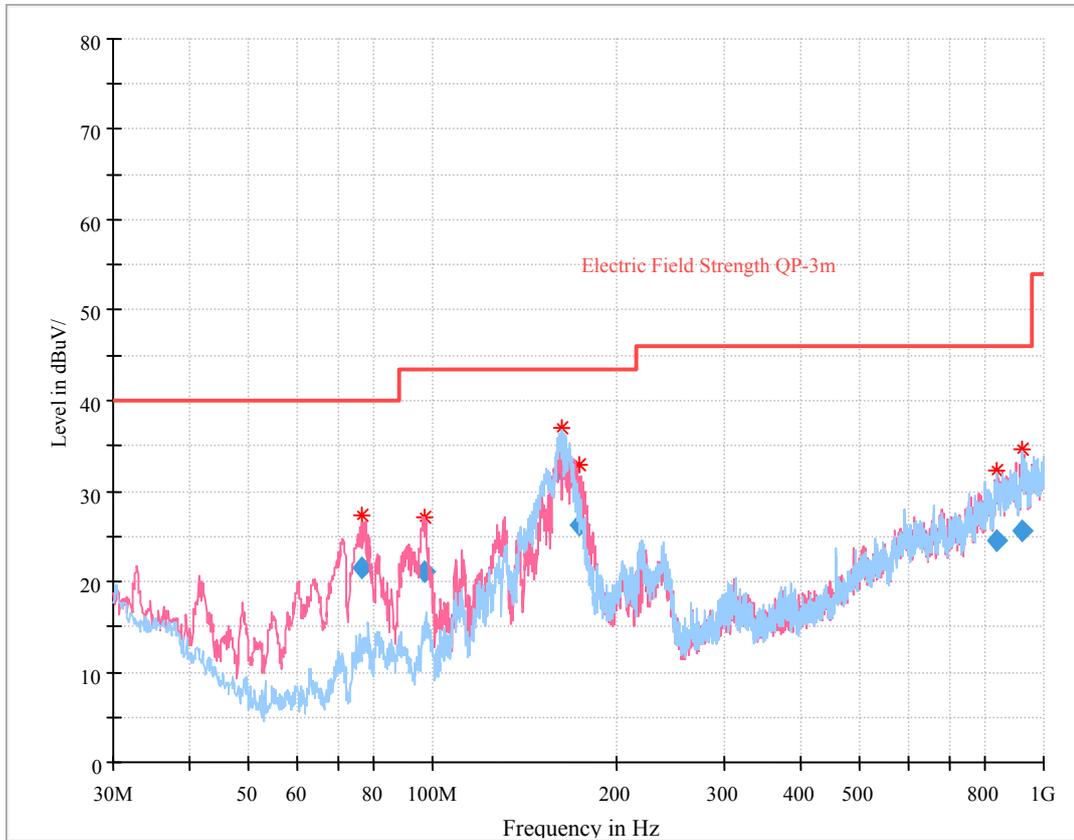
Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
76.880000	21.42	108.0	V	107.0	-20.2	40.00	18.58
96.839750	21.07	108.0	V	66.0	-17.8	43.50	22.43
162.996125	32.21	234.0	H	218.0	-14.6	43.50	11.29
173.276000	26.24	102.0	V	25.0	-15.0	43.50	17.26
837.223750	24.51	358.0	V	271.0	2.7	46.00	21.49
919.322375	25.50	277.0	H	0.0	4.6	46.00	20.50

1 GHz-25 GHz:

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)									
2389.46	28.27	PK	134	2.1	H	31.87	60.14	74	13.86
2389.46	13.74	Ave.	134	2.1	H	31.87	45.61	54	8.39
2484.54	28.33	PK	209	1.1	H	32.13	60.46	74	13.54
2484.54	13.76	Ave.	209	1.1	H	32.13	45.89	54	8.11
4824.00	45.99	PK	47	1.4	H	6.28	52.27	74	21.73
4824.00	35.14	Ave.	47	1.4	H	6.28	41.42	54	12.58
Middle Channel (2437MHz)									
4874.00	44.54	PK	323	2.5	H	6.76	51.30	74	22.70
4874.00	33.06	Ave.	323	2.5	H	6.76	39.82	54	14.18
High Channel (2462 MHz)									
2388.44	28.12	PK	299	1.1	H	31.87	59.99	74	14.01
2388.44	13.72	Ave.	299	1.1	H	31.87	45.59	54	8.41
2484.76	28.44	PK	255	1.2	H	32.13	60.57	74	13.43
2484.76	13.77	Ave.	255	1.2	H	32.13	45.90	54	8.10
4924.00	43.60	PK	150	2.3	H	6.76	50.36	74	23.64
4924.00	31.78	Ave.	150	2.3	H	6.76	38.54	54	15.46

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)									
2388.27	27.97	PK	192	1.1	H	31.87	59.84	74	14.16
2388.27	13.69	Ave.	192	1.1	H	31.87	45.56	54	8.44
2484.31	27.84	PK	70	1.4	H	32.13	59.97	74	14.03
2484.31	13.66	Ave.	70	1.4	H	32.13	45.79	54	8.21
4824.00	43.39	PK	285	1.2	H	6.28	49.67	74	24.33
4824.00	29.39	Ave.	285	1.2	H	6.28	35.67	54	18.33
Middle Channel (2437MHz)									
4874.00	43.35	PK	67	1.8	H	6.76	50.11	74	23.89
4874.00	29.27	Ave.	67	1.8	H	6.76	36.03	54	17.97
High Channel (2462 MHz)									
2389.74	27.84	PK	338	2.4	H	31.87	59.71	74	14.29
2389.74	13.67	Ave.	338	2.4	H	31.87	45.54	54	8.46
2483.99	28.12	PK	304	2.0	H	32.13	60.25	74	13.75
2483.99	13.96	Ave.	304	2.0	H	32.13	46.09	54	7.91
4924.00	43.34	PK	351	1.0	H	6.76	50.10	74	23.90
4924.00	28.84	Ave.	351	1.0	H	6.76	35.60	54	18.40

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)									
2388.61	28.71	PK	345	2.5	H	31.87	60.58	74	13.42
2388.61	13.56	Ave.	345	2.5	H	31.87	45.43	54	8.57
2484.36	28.63	PK	241	2.2	H	32.13	60.76	74	13.24
2484.36	13.57	Ave.	241	2.2	H	32.13	45.70	54	8.30
4824.00	44.04	PK	201	1.0	H	6.28	50.32	74	23.68
4824.00	28.98	Ave.	201	1.0	H	6.28	35.26	54	18.74
Middle Channel (2437MHz)									
4874.00	43.51	PK	233	1.1	H	6.76	50.27	74	23.73
4874.00	29.04	Ave.	233	1.1	H	6.76	35.80	54	18.20
High Channel (2462 MHz)									
2388.41	28.34	PK	28	2.2	H	31.87	60.21	74	13.79
2388.41	13.67	Ave.	28	2.2	H	31.87	45.54	54	8.46
2484.54	29.09	PK	173	1.7	H	32.13	61.22	74	12.78
2484.54	13.69	Ave.	173	1.7	H	32.13	45.82	54	8.18
4924.00	43.03	PK	140	1.8	H	6.76	49.79	74	24.21
4924.00	29.22	Ave.	140	1.8	H	6.76	35.98	54	18.02

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)									
2387.69	28.14	PK	266	1.2	H	31.87	60.01	74	13.99
2387.69	13.60	Ave.	266	1.2	H	31.87	45.47	54	8.53
2483.84	27.94	PK	285	1.4	H	32.13	60.07	74	13.93
2483.84	13.58	Ave.	285	1.4	H	32.13	45.71	54	8.29
4844.00	43.47	PK	239	1.7	H	6.28	49.75	74	24.25
4844.00	28.79	Ave.	239	1.7	H	6.28	35.07	54	18.93
Middle Channel (2437MHz)									
4874.00	43.05	PK	107	1.7	H	6.76	49.81	74	24.19
4874.00	28.48	Ave.	107	1.7	H	6.76	35.24	54	18.76
High Channel (2452 MHz)									
2388.79	28.12	PK	45	1.2	H	31.87	59.99	74	14.01
2388.79	13.61	Ave.	45	1.2	H	31.87	45.48	54	8.52
2484.62	28.60	PK	4	2.0	H	32.13	60.73	74	13.27
2484.62	13.67	Ave.	4	2.0	H	32.13	45.80	54	8.20
4904.00	42.47	PK	292	2.3	H	6.76	49.23	74	24.77
4904.00	28.29	Ave.	292	2.3	H	6.76	35.05	54	18.95

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 harmonic test, it is performed with the 2400-2483.5MHz band filter.

## Pre-scan with 802.11b Mode, Low channel

Horizontal
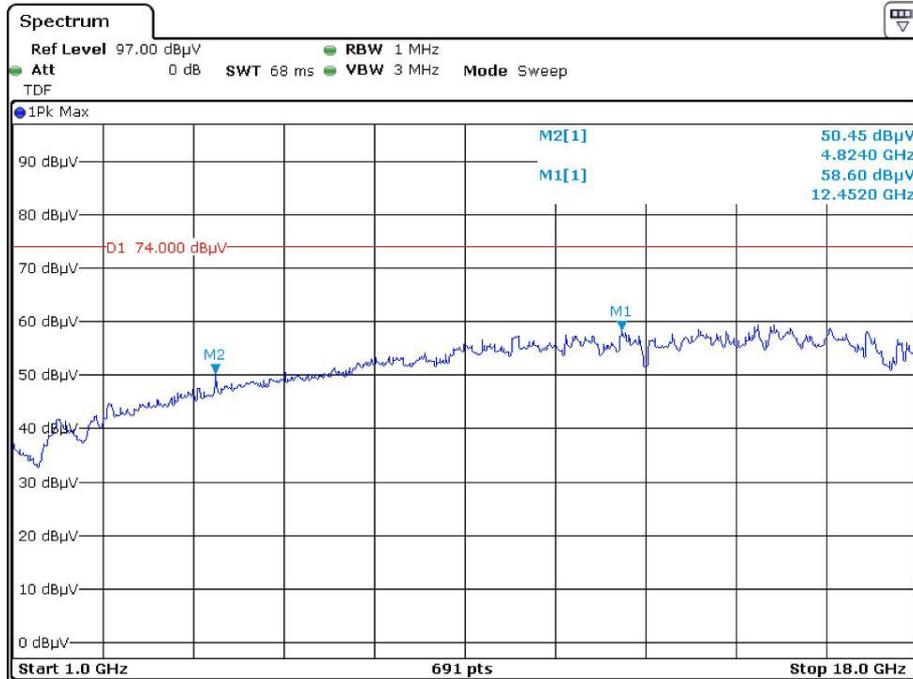
Date: 15.JUN.2020 20:42:10
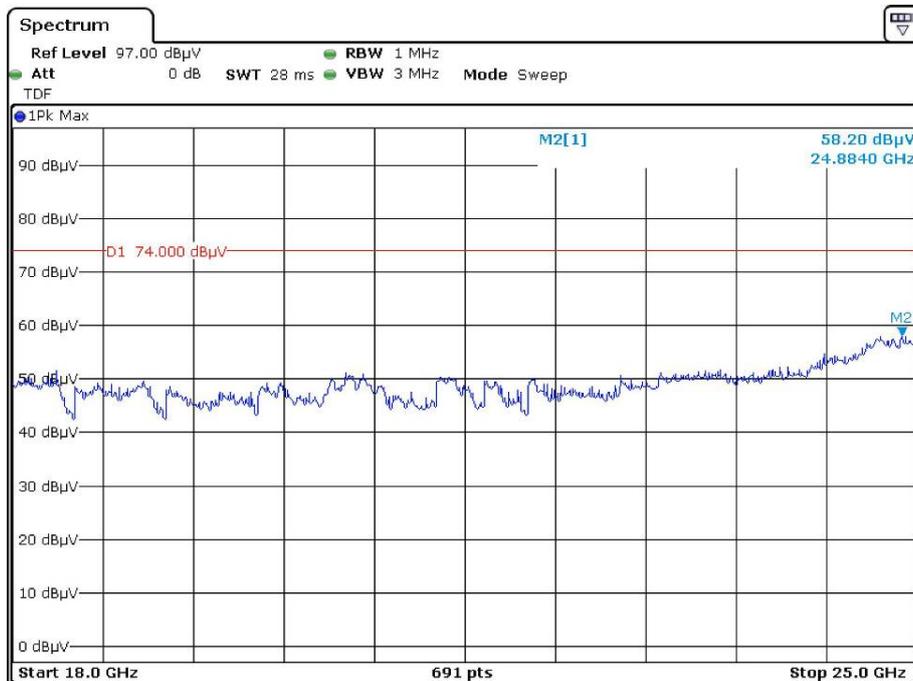

Date: 15.JUN.2020 21:27:02

Vertical

Spectrum

Ref Level 97.00 dBµV   ● RBW 1 MHz
● Att   0 dB   SWT 68 ms ● VBW 3 MHz   Mode Sweep
TDF
● 1Pk Max

M2[1]   49.44 dBµV
4.8240 GHz
M1[1]   58.10 dBµV
13.8790 GHz

D1 74.000 dBµV

Start 1.0 GHz   691 pts   Stop 18.0 GHz

Date: 15.JUN.2020 20:51:16

Spectrum

Ref Level 97.00 dBµV   ● RBW 1 MHz
● Att   0 dB   SWT 28 ms ● VBW 3 MHz   Mode Sweep
TDF
● 1Pk Max

M2[1]   58.63 dBµV
24.9950 GHz

D1 74.000 dBµV

Start 18.0 GHz   691 pts   Stop 25.0 GHz
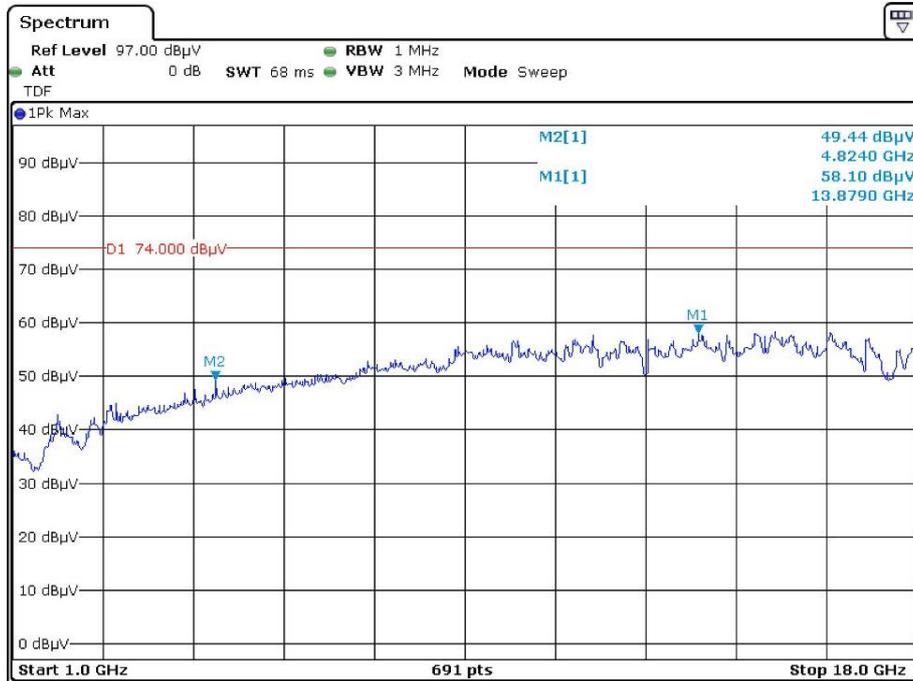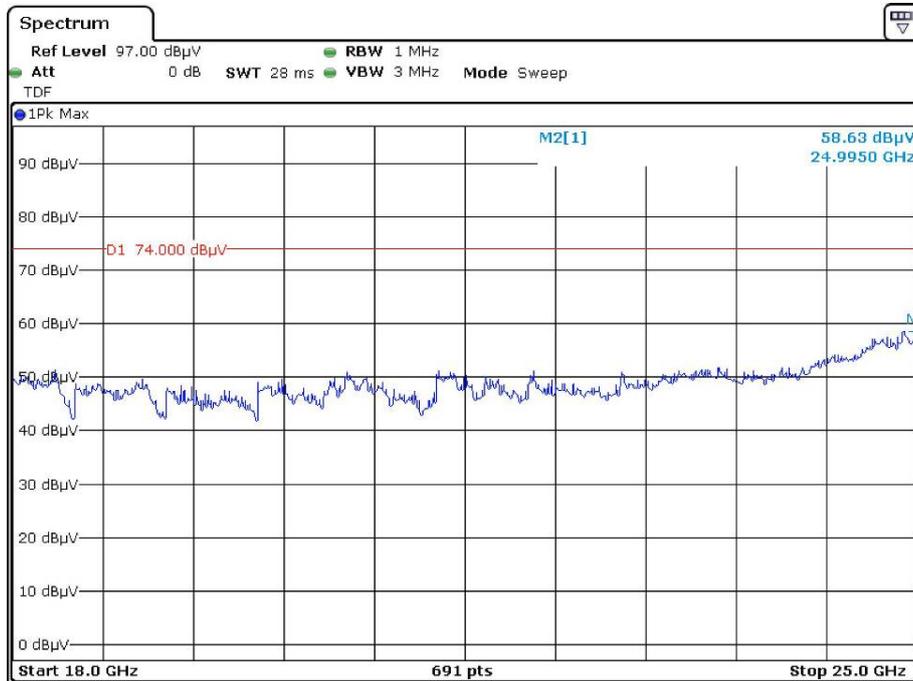
Date: 15.JUN.2020 21:34:01

Pre-scan for Average
Horizontal

Spectrum

Ref Level 97.00 dBµV   ● RBW 1 MHz
● Att   0 dB   SWT 4 s ● VBW 10 Hz   Mode Sweep
TDF
● 1Pk Max

M2[1]   41.42 dBµV
90 dBµV—   4.8240870 GHz

80 dBµV—

70 dBµV—

60 dBµV—

D2 54.000 dBµV
50 dBµV—

M2
40 dBµV—

30 dBµV—

20 dBµV—

10 dBµV—

0 dBµV—
CF 4.824 GHz   691 pts   Span 20.0 MHz

Date: 15.JUN.2020 20:46:53

Spectrum

Ref Level 97.00 dBµV   ● RBW 1 MHz
● Att   0 dB   SWT 4 s ● VBW 10 Hz   Mode Sweep
TDF
● 1Pk Max

M2[1]   45.16 dBµV
90 dBµV—   24.8871550 GHz

80 dBµV—

70 dBµV—

60 dBµV—

D2 54.000 dBµV
50 dBµV—   M2

40 dBµV—

30 dBµV—

20 dBµV—

10 dBµV—

0 dBµV—
CF 24.884 GHz   691 pts   Span 20.0 MHz

Date: 15.JUN.2020 21:30:38

Vertical

```
Spectrum                                                              ⊞▽
   Ref Level 97.00 dBμV          ● RBW  1 MHz
 ● Att              0 dB   SWT 4 s ● VBW  10 Hz   Mode Sweep
   TDF
 ●1Pk Max
                                         M2[1]               38.87 dBμV
 90 dBμV—                                                4.8240580 GHz

 80 dBμV—

 70 dBμV—

 60 dBμV—
        ─────────D2 54.000 dBμV────────────────────────────────
 50 dBμV—

 40 dBμV—                            M2
                                   ▼
 30 dBμV—

 20 dBμV—

 10 dBμV—

  0 dBμV—
   CF 4.824 GHz                   691 pts              Span 20.0 MHz
```
Date: 15.JUN.2020 20:56:16

```
Spectrum                                                              ⊞▽
   Ref Level 97.00 dBμV          ● RBW  1 MHz
 ● Att              0 dB   SWT 4 s ● VBW  10 Hz   Mode Sweep
   TDF
 ●1Pk Max
                                         M2[1]               45.81 dBμV
 90 dBμV—                                               25.0024100 GHz

 80 dBμV—

 70 dBμV—

 60 dBμV—
        ─────────D2 54.000 dBμV────────────────────────────────
 50 dBμV—                                            M2
                                                    ▼
 40 dBμV—

 30 dBμV—

 20 dBμV—

 10 dBμV—

  0 dBμV—
   CF 24.995 GHz                  691 pts              Span 20.0 MHz
```
Date: 15.JUN.2020 21:37:27

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.
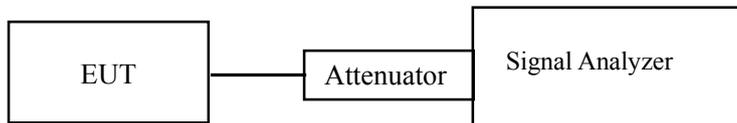
```
┌──────────┐        ┌────────────┬──────────────────┐
│   EUT    │────────│ Attenuator │ Signal Analyzer  │
└──────────┘        └────────────┴──────────────────┘
```

Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-06-15.

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	9.218	≥500
Middle	2437	9.179	≥500
High	2462	9.667	≥500
802.11g			
Low	2412	12.564	≥500
Middle	2437	12.538	≥500
High	2462	12.615	≥500
802.11n-HT20 mode			
Low	2412	12.564	≥500
Middle	2437	12.577	≥500
High	2462	12.577	≥500
802.11n-HT40 mode			
Low	2422	31.397	≥500
Middle	2437	30.244	≥500
High	2452	32.551	≥500

802.11b Low Channel
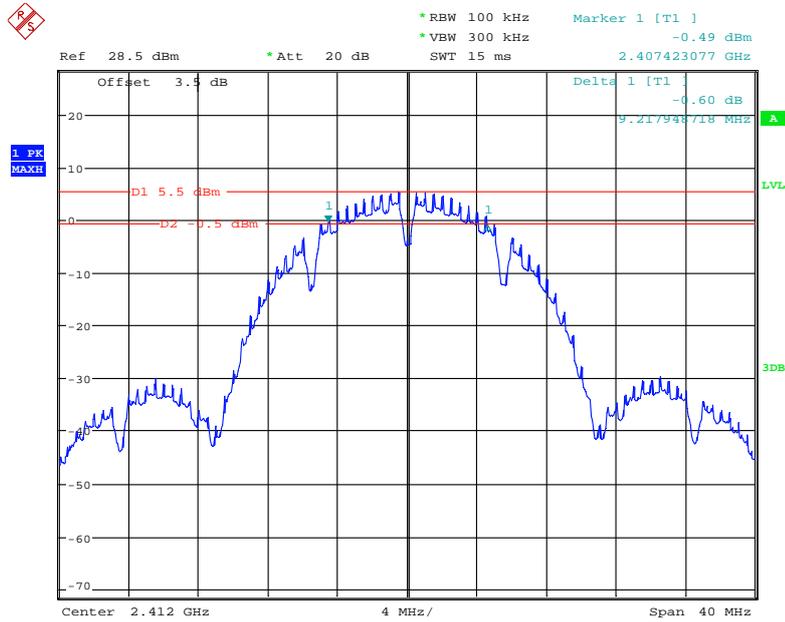
Date: 15.JUN.2020 10:05:18

802.11b Middle Channel
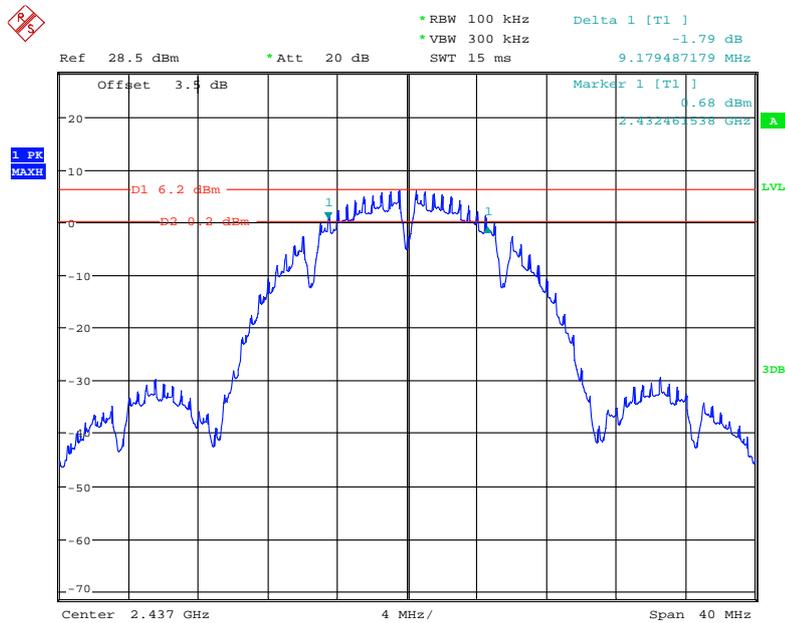
Date: 15.JUN.2020 10:03:49

802.11b High Channel
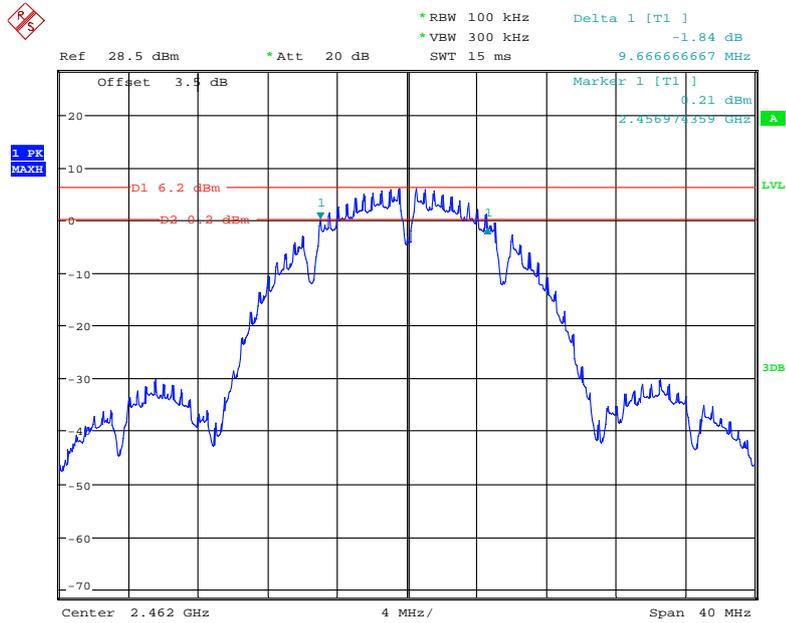
Date: 15.JUN.2020 10:06:40

802.11g Low Channel
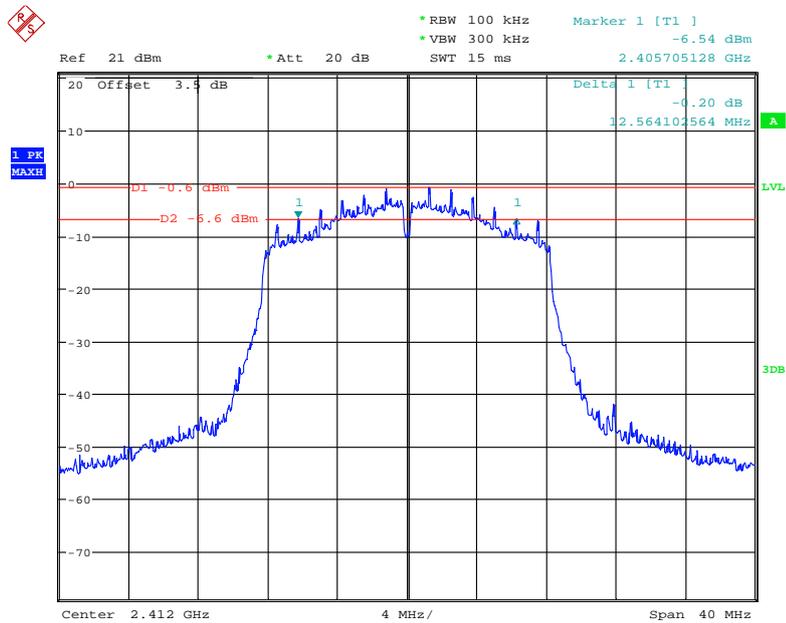
Date: 15.JUN.2020 10:11:19

802.11g Middle Channel
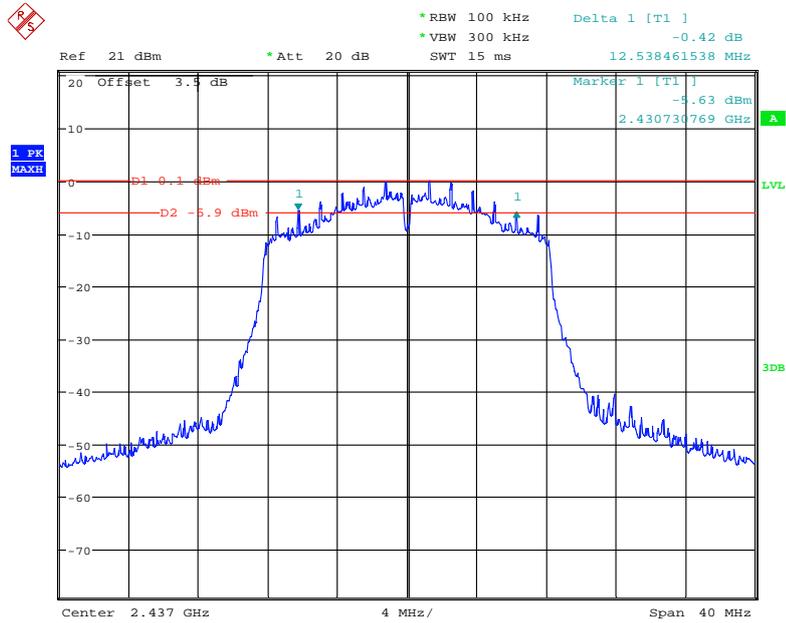

Date: 15.JUN.2020 10:10:05

802.11g High Channel
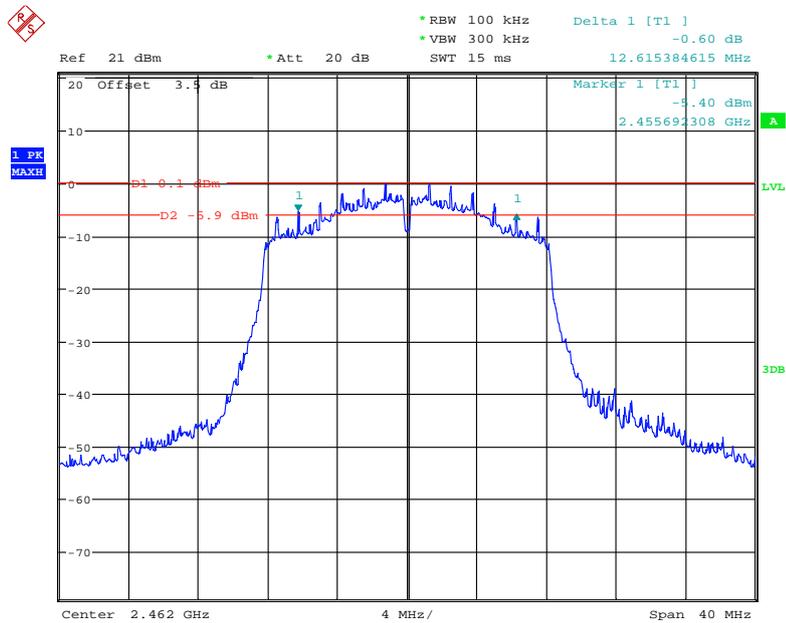
Date: 15.JUN.2020 10:08:40

802.11n-HT20 Low Channel
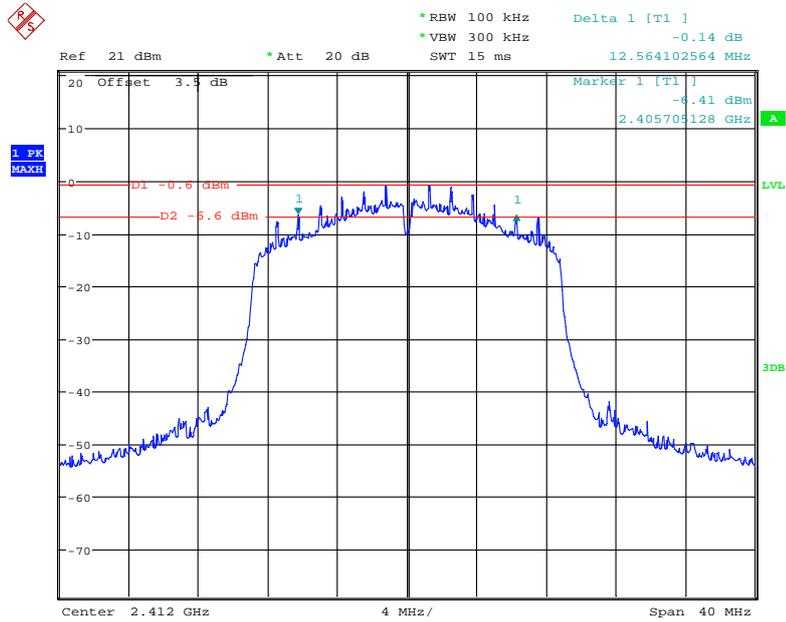
Date: 15.JUN.2020 10:13:37

802.11n-HT20 Middle Channel
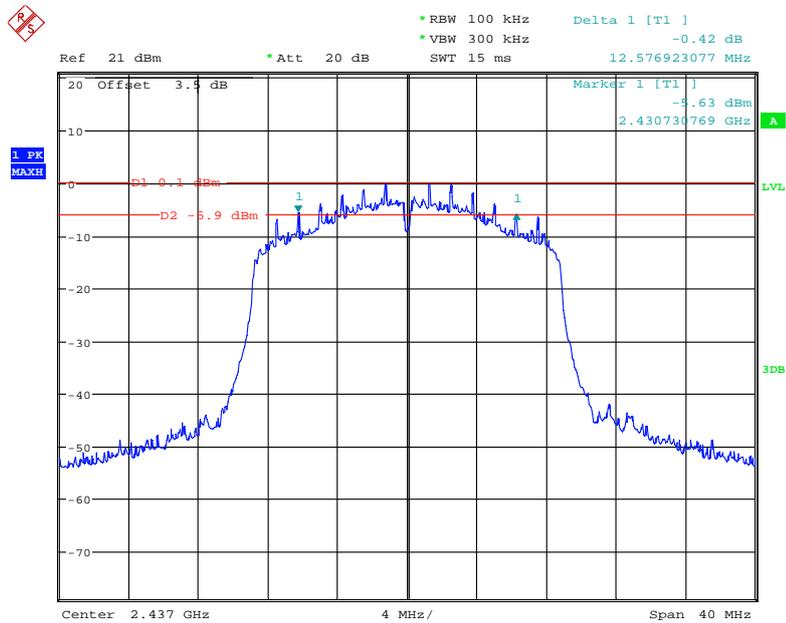


Date: 15.JUN.2020 10:15:35

802.11n-HT20 High Channel

```
                                         *RBW  100 kHz      Delta 1 [T1 ]
                                         *VBW  300 kHz              -0.59 dB
      Ref   21 dBm        *Att  20 dB     SWT 15 ms        12.576923077 MHz
      20  Offset  3.5 dB                                  Marker 1 [T1 ]
                                                                  -5.35 dBm
                                                          2.455730769 GHz   A
  1 PK
  MAXH
      D1 0.1 dBm                                                            LVL
      D2 -5.9 dBm


                                                                           3DB




      Center  2.462 GHz              4 MHz/                    Span 40 MHz
```
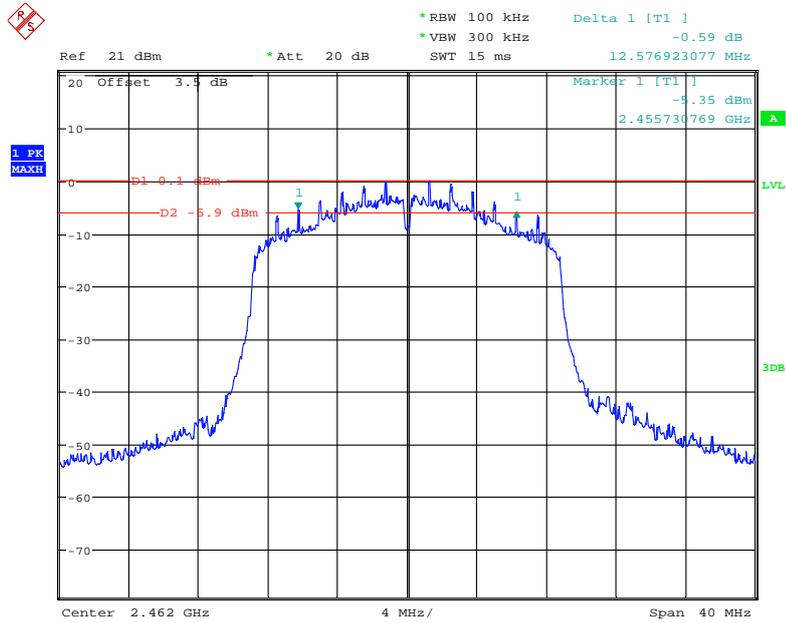
Date: 15.JUN.2020 10:16:50

802.11n-HT40 Low Channel

```
                                         *RBW  100 kHz      Marker 1 [T1 ]
                                         *VBW  300 kHz              -9.38 dBm
      Ref   21 dBm        *Att  20 dB     SWT 10 ms         2.406961538 GHz
      20  Offset  3.5 dB                                  Delta 1 [T1 ]
                                                                  -0.18 dB
                                                         31.397435897 MHz   A
  1 PK
  MAXH
      D1 -3.4 dBm                                                           LVL
      D2 -9.4 dBm


                                                                           3DB




      Center  2.422 GHz              8 MHz/                    Span 80 MHz
```
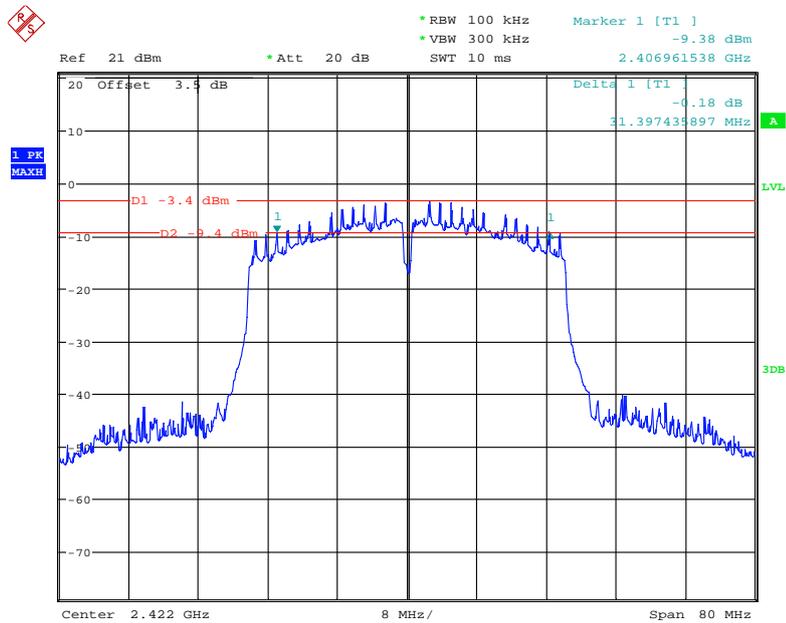
Date: 15.JUN.2020 10:21:36

802.11n-HT40 Middle Channel
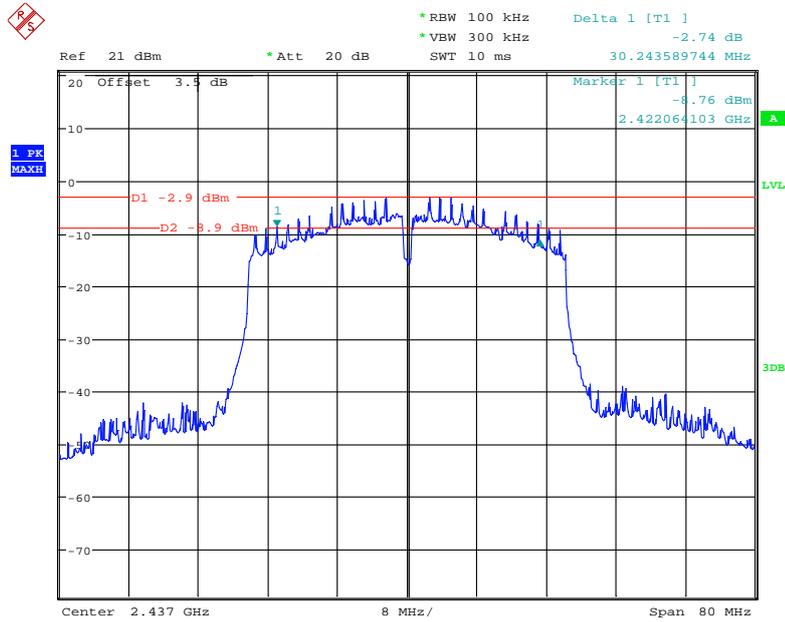
Date: 15.JUN.2020 10:20:07

802.11n-HT40 High Channel
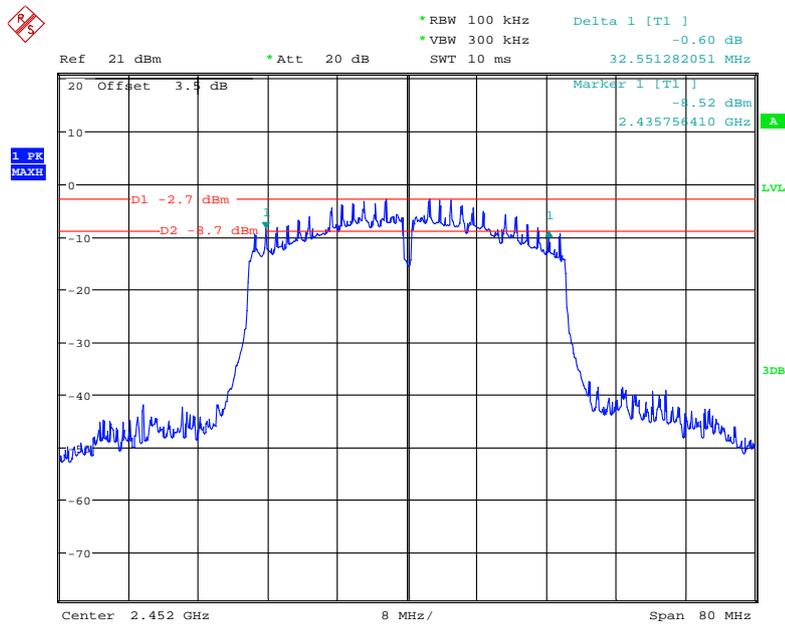

Date: 15.JUN.2020 10:18:37

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.
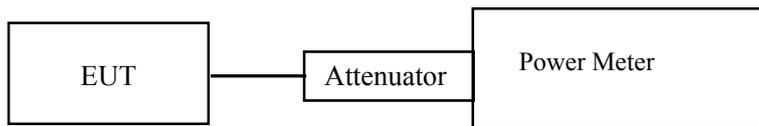
Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	54 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-06-15.

EUT operation mode: Transmitting

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Max Conducted Average Output Power (dBm)	Limit (dBm)
802.11b				
Low	2412	18.46	14.97	30
Middle	2437	18.58	15.57	30
High	2462	18.39	15.75	30
802.11g				
Low	2412	16.75	10.86	30
Middle	2437	17.76	11.68	30
High	2462	17.79	12.18	30
802.11n HT20				
Low	2412	16.44	10.40	30
Middle	2437	17.14	11.36	30
High	2462	17.40	11.50	30
802.11n HT40				
Low	2422	15.87	10.00	30
Middle	2437	16.23	10.53	30
High	2452	16.46	10.62	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.
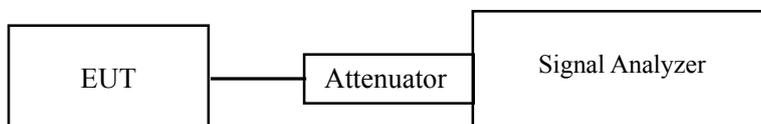
```
┌──────────┐      ┌────────────┐   ┌──────────────────┐
│          │      │            │   │                  │
│   EUT    │──────│ Attenuator │───│  Signal Analyzer │
│          │      │            │   │                  │
└──────────┘      └────────────┘   └──────────────────┘
```

Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	54 %
ATM Pressure:	101.0 kPa

*The testing was performed by Gavin Guo on 2020-06-15.*

EUT operation mode: Transmitting

Test Result: Compliance

802.11b: Band Edge, Left Side
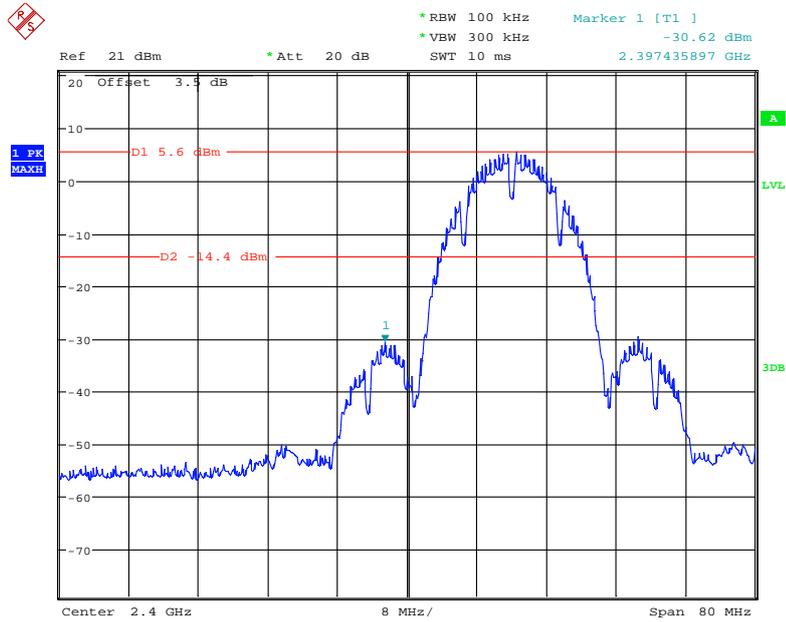
Date: 15.JUN.2020 10:32:46

802.11b: Band Edge, Right Side
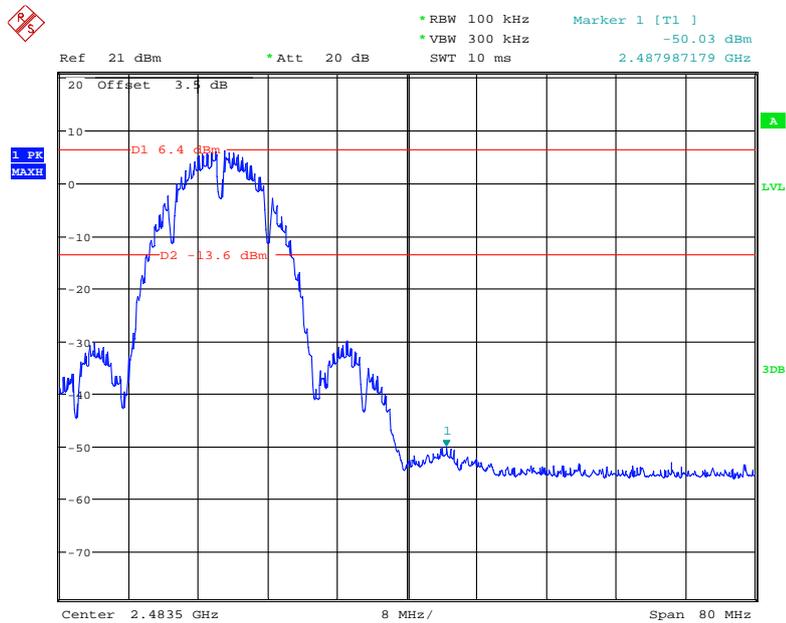
Date: 15.JUN.2020 10:31:59

802.11g: Band Edge, Left Side

```
                                    * RBW 100 kHz      Marker 1 [T1 ]
                                    * VBW 300 kHz            -45.95 dBm
        Ref  21 dBm    * Att  20 dB   SWT 10 ms         2.398846154 GHz
```
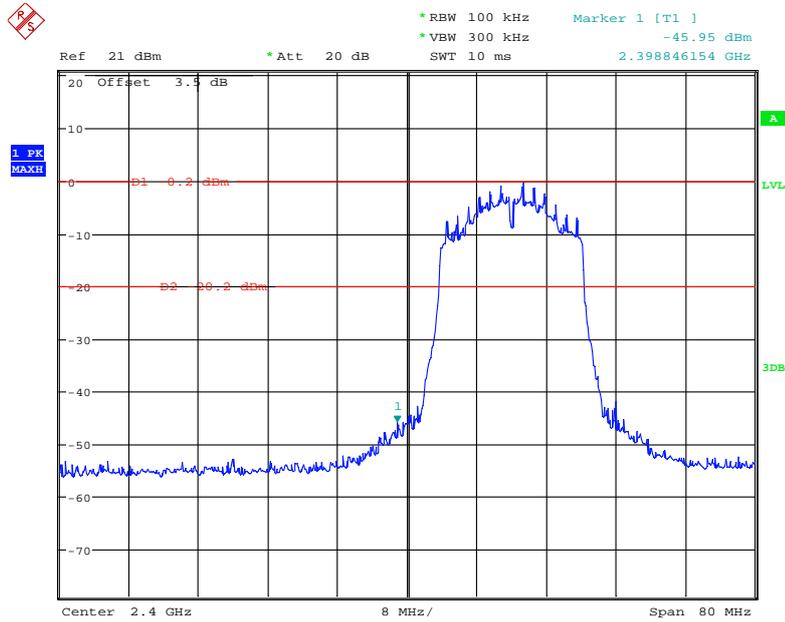


```
Date: 15.JUN.2020  10:30:05
```

802.11g: Band Edge, Right Side

```
                                    * RBW 100 kHz      Marker 1 [T1 ]
                                    * VBW 300 kHz            -52.64 dBm
        Ref  21 dBm    * Att  20 dB   SWT 10 ms         2.486064103 GHz
```
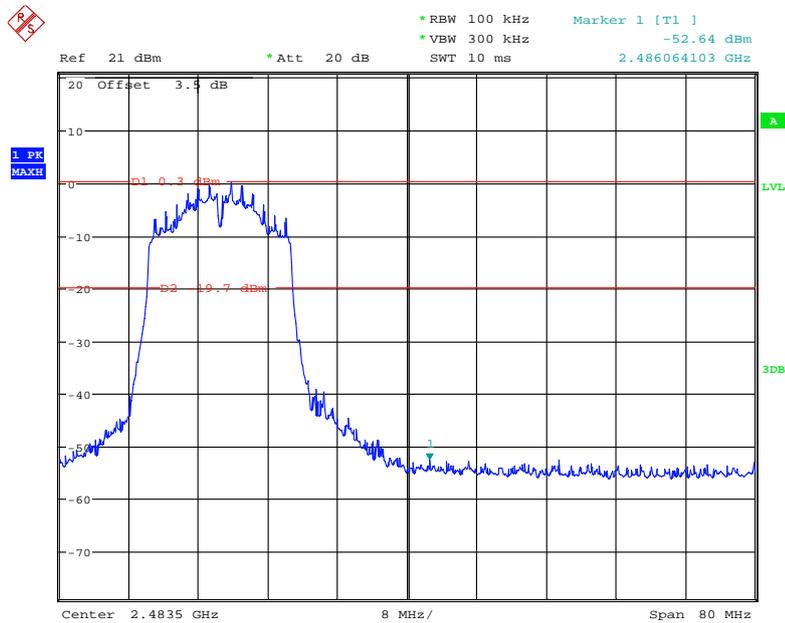


```
Date: 15.JUN.2020  10:30:49
```

802.11n-HT20: Band Edge, Left Side

```
                                    *RBW 100 kHz      Marker 1 [T1 ]
                                    *VBW 300 kHz              -46.37 dBm
        Ref   21 dBm      *Att  20 dB   SWT 10 ms         2.399102564 GHz
```
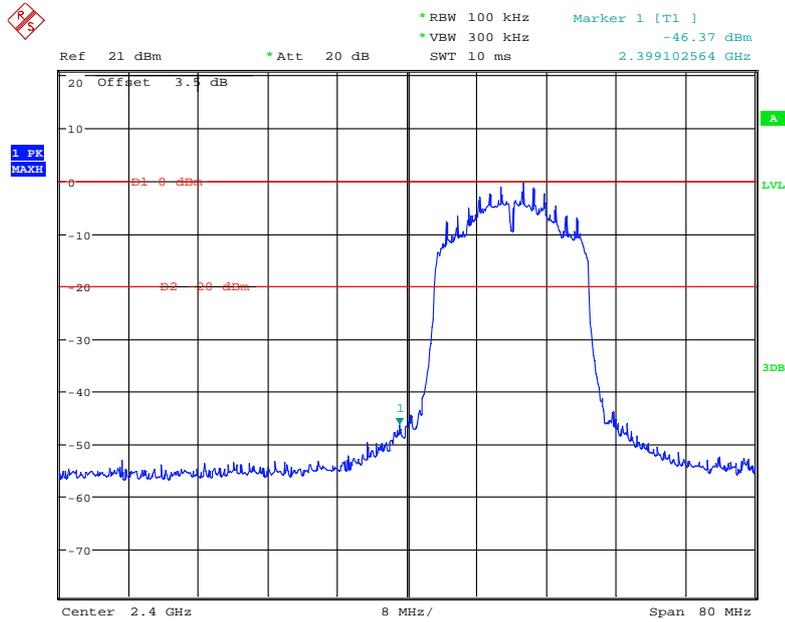
Date: 15.JUN.2020 10:28:58

802.11n-HT20: Band Edge, Right Side

```
                                    *RBW 100 kHz      Marker 1 [T1 ]
                                    *VBW 300 kHz              -52.90 dBm
        Ref   21 dBm      *Att  20 dB   SWT 10 ms         2.500038462 GHz
```
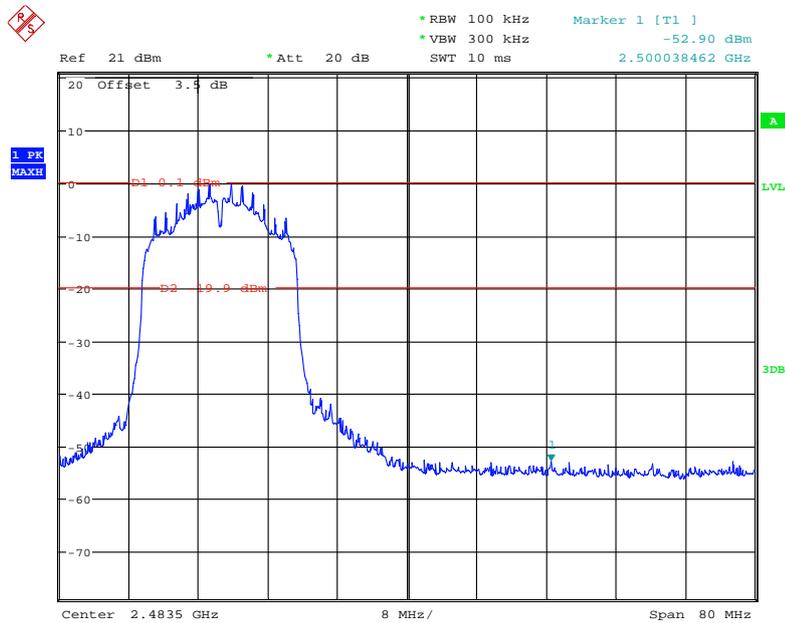
Date: 15.JUN.2020 10:28:06

802.11n-HT40: Band Edge, Left Side
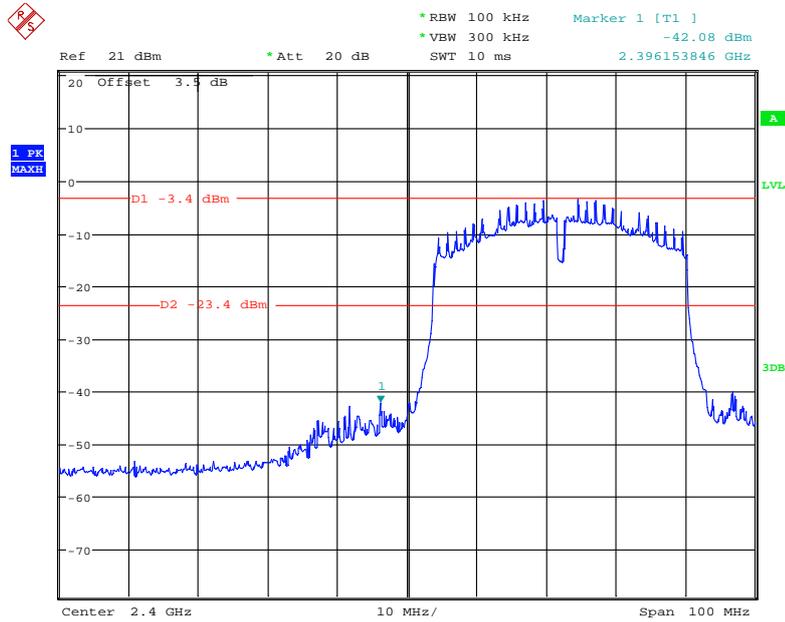
Date: 15.JUN.2020 10:25:22

802.11n-HT40: Band Edge, Right Side
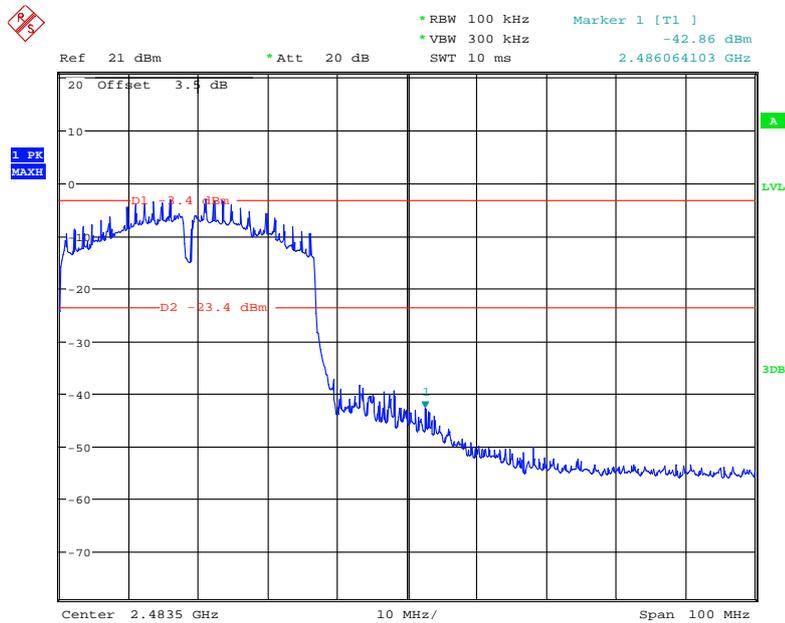
Date: 15.JUN.2020 10:27:06

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.
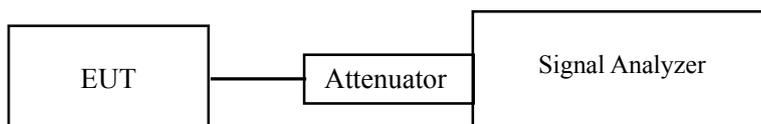
```
┌─────────┐        ┌────────────┐    ┌──────────────────┐
│         │        │            │    │                  │
│   EUT   │────────│ Attenuator │────│  Signal Analyzer │
│         │        │            │    │                  │
└─────────┘        └────────────┘    └──────────────────┘
```

Test Data

Environmental Conditions

|	
Temperature:	23 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-06-15.

EUT operation mode: Transmitting

Test Result: Compliance

Please refer to the following table and plots.

Bay Area Compliance Laboratories Corp. (Shenzhen)   Report No.: RSZ200605812-00

| Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-9.23	≤8
Middle	2437	-7.75	≤8
High	2462	-8.36	≤8
802.11g mode			
Low	2412	-15.02	≤8
Middle	2437	-14.16	≤8
High	2462	-14.03	≤8
802.11n-HT20 mode			
Low	2412	-15.03	≤8
Middle	2437	-14.47	≤8
High	2462	-13.88	≤8
802.11n-HT40 mode			
Low	2422	-17.02	≤8
Middle	2437	-16.43	≤8
High	2452	-16.05	≤8

Bay Area Compliance Laboratories Corp. (Shenzhen)

Power Spectral Density, 802.11b Low Channel
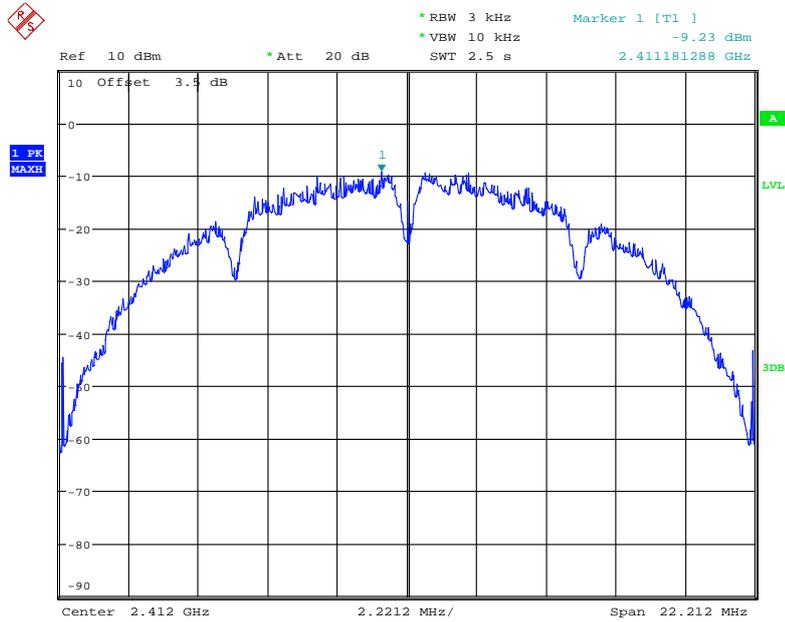
Date: 15.JUN.2020 11:13:08

## Power Spectral Density, 802.11b Middle Channel
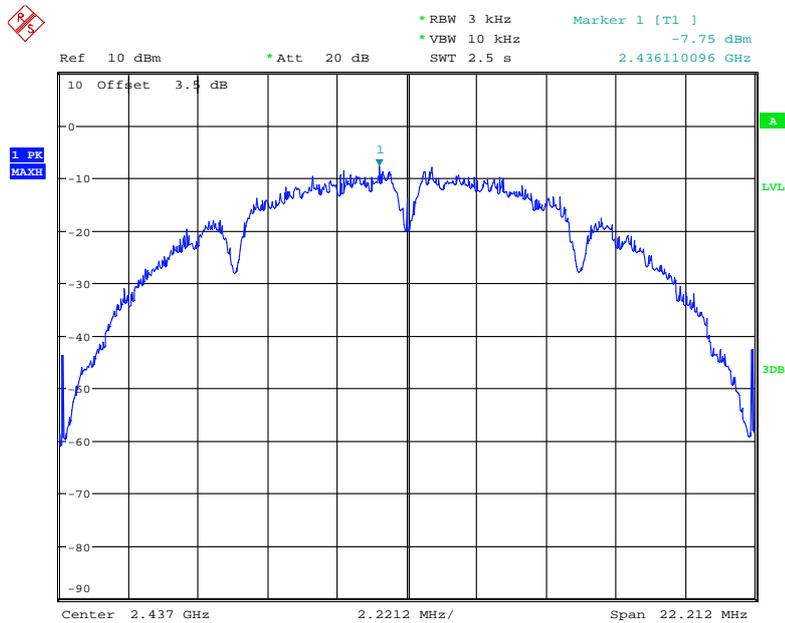
Date: 15.JUN.2020 11:12:29

Power Spectral Density, 802.11b High Channel

```
                                    * RBW  3 kHz        Marker 1 [T1 ]
                                    * VBW  10 kHz                -8.36 dBm
       Ref   10 dBm      * Att  20 dB    SWT 2.5 s       2.463027827 GHz
       10  Offset   3.5 dB
```

```
 1 PK
 MAXH
```

```
Center  2.462 GHz        2.2116 MHz/           Span  22.116 MHz
```
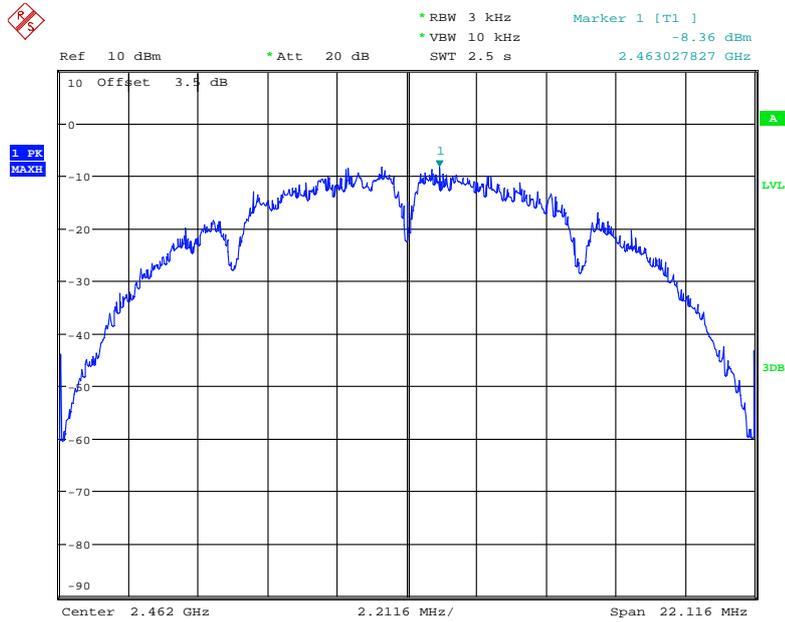
Date: 15.JUN.2020 11:14:04

Power Spectral Density, 802.11g Low Channel

```
                                    * RBW  3 kHz        Marker 1 [T1 ]
                                    * VBW  10 kHz               -15.02 dBm
       Ref   10 dBm      * Att  20 dB    SWT 2.7 s       2.411381154 GHz
       10  Offset   3.5 dB
```

```
 1 PK *
 CLRWR
```

```
Center  2.412 GHz        2.4135 MHz/           Span  24.135 MHz
```
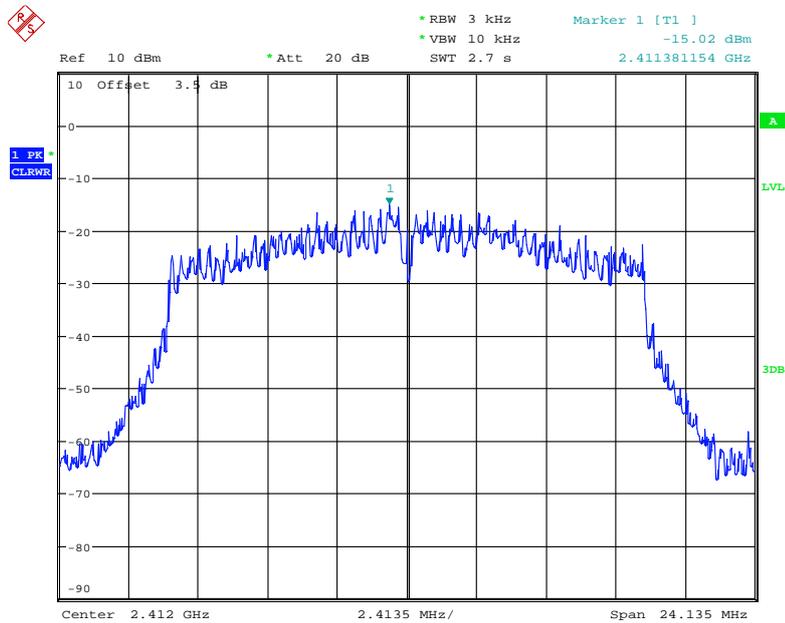
Date: 15.JUN.2020 11:00:58

Power Spectral Density, 802.11g Middle Channel
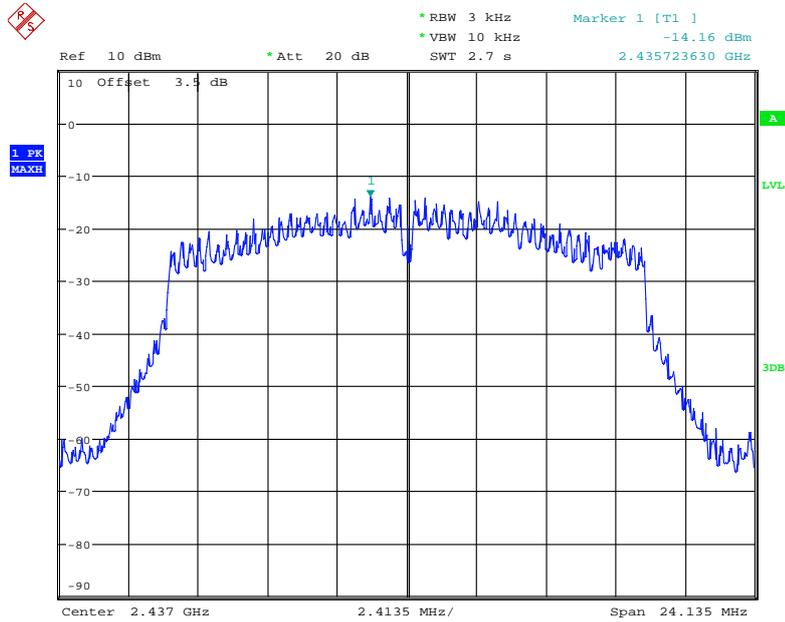
Date: 15.JUN.2020 11:01:31

Power Spectral Density, 802.11g High Channel
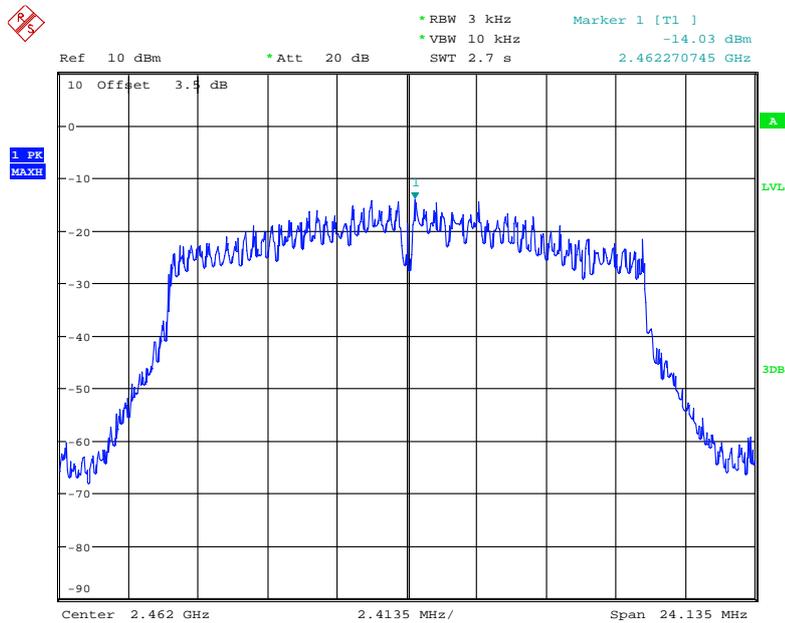
Date: 15.JUN.2020 11:02:01

Power Spectral Density, 802.11n-HT20 Low Channel
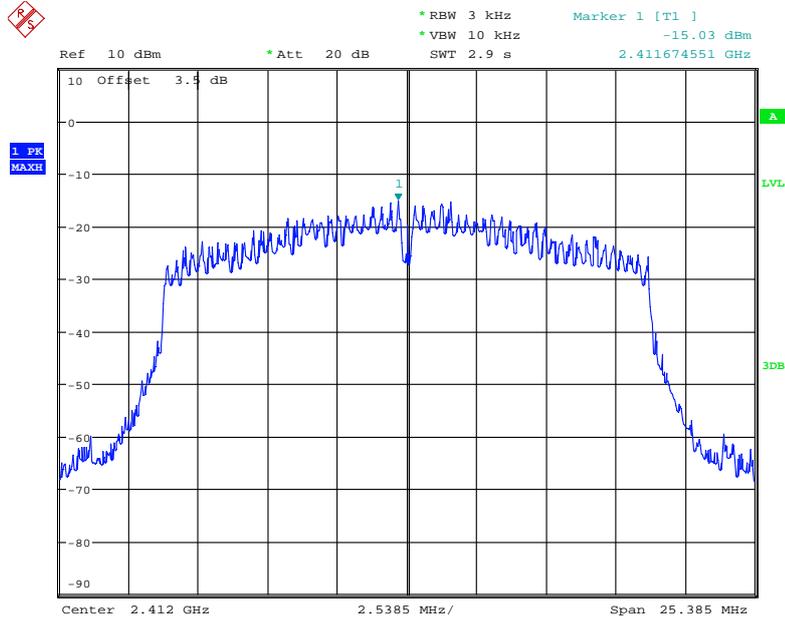


Date: 15.JUN.2020 10:52:08

## Power Spectral Density, 802.11n-HT20 Middle Channel
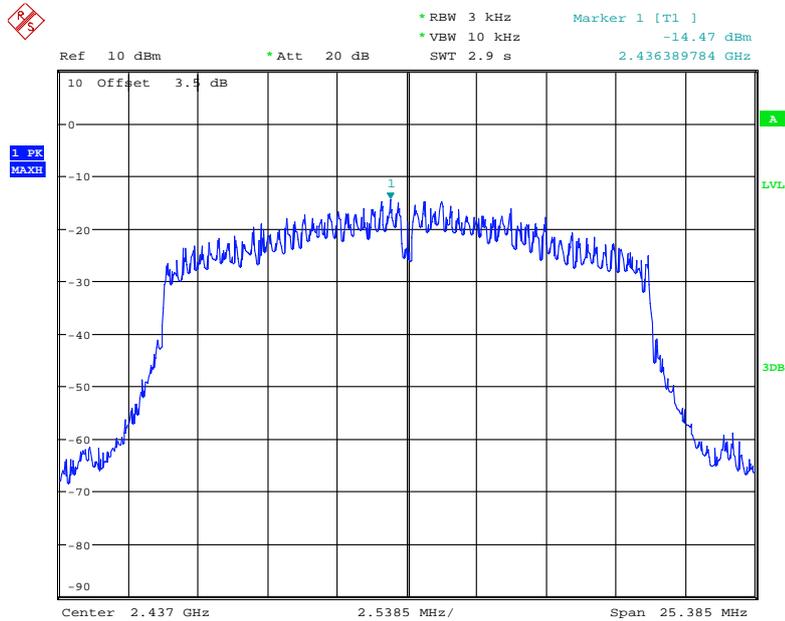
Date: 15.JUN.2020 10:51:25

## Power Spectral Density, 802.11n-HT20 High Channel
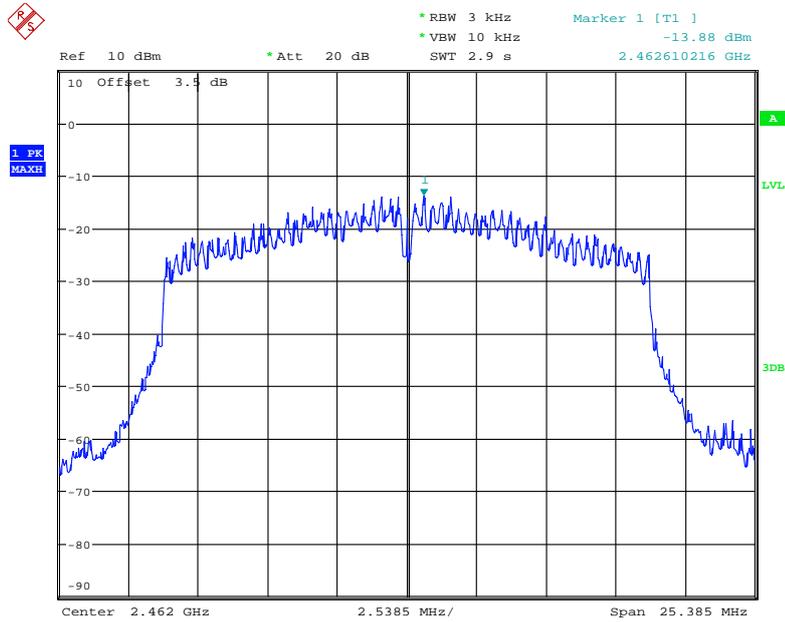
Date: 15.JUN.2020 10:50:44

## Power Spectral Density, 802.11n-HT40 Low Channel
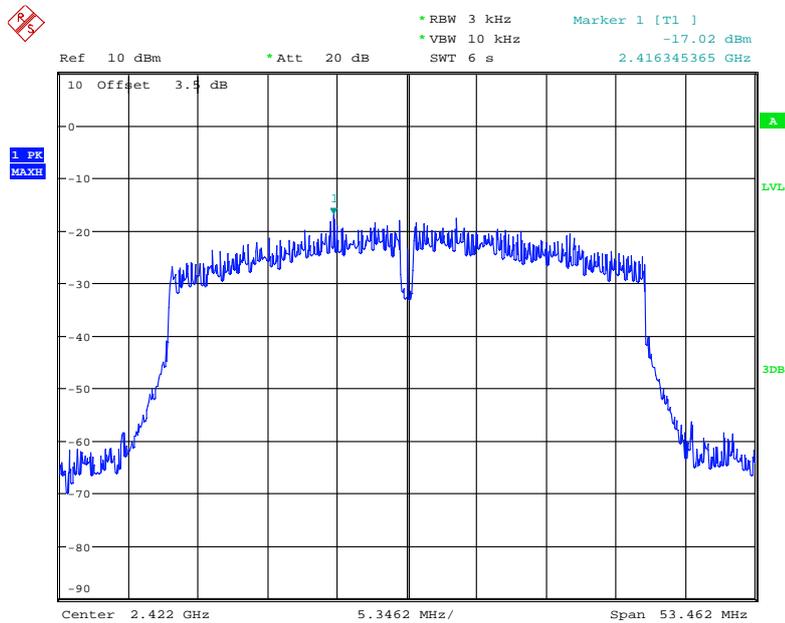
Date: 15.JUN.2020 10:48:19

Power Spectral Density, 802.11n-HT40 Middle Channel
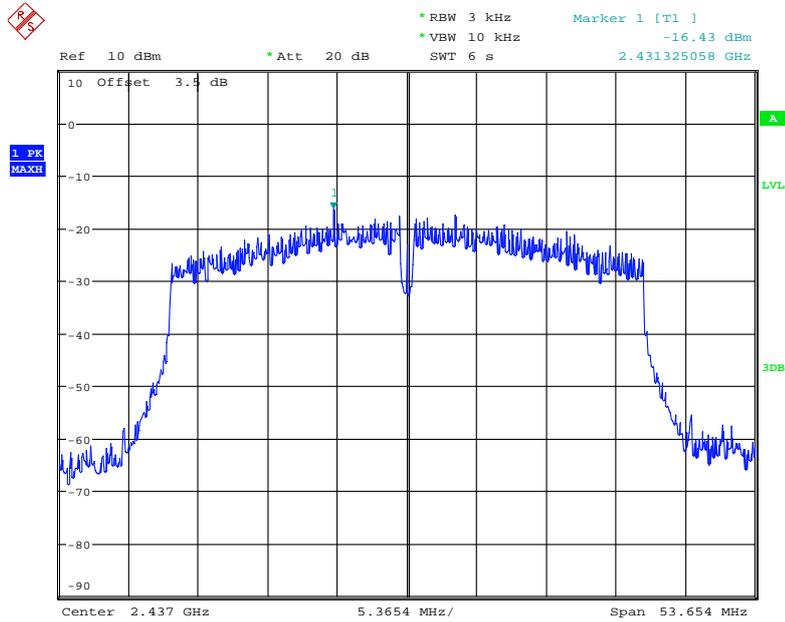
Date: 15.JUN.2020 10:47:10

Power Spectral Density, 802.11n-HT40 High Channel
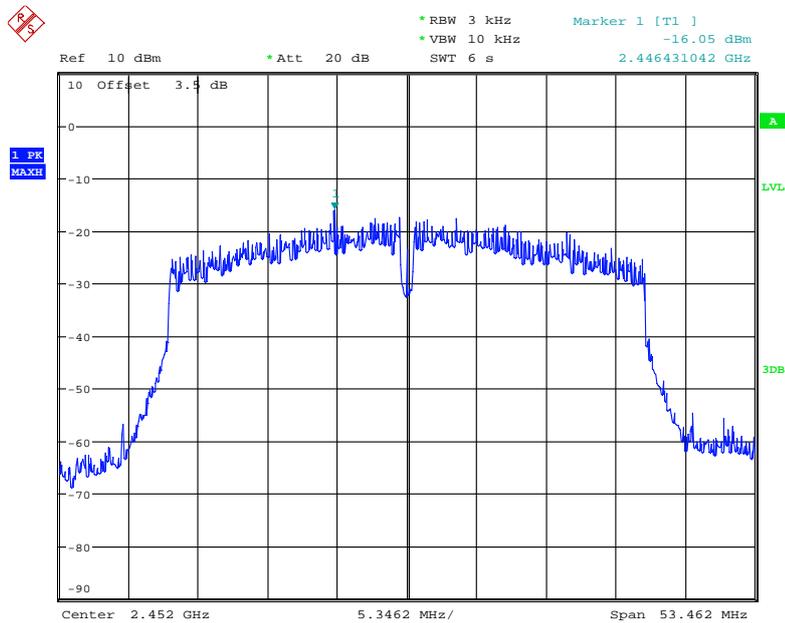
Date: 15.JUN.2020 10:49:11

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