FCC PART 15.247

TEST REPORT

For

Shenzhen Joystek Intelligence Co., Ltd

101-7, Commercial Podium of Building 25, Vanke PuYueShan, Banxuegang Blvd, Bantian, Longgang District, Shenzhen, China

FCC ID: 2AUSPBELL-J

Report Type:	Product Type:
Original Report	Video Doorbell

Report Number: RSZ200323814-00

Report Date: 2020-07-02

Reviewed By: Jimmy Xiao RF Engineer

Prepared By: Bay Area Compliance Laboratories Corp. (Shenzhen)
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Video Doorbell
Tested Model	Bell J2
Multiple Model	Bell J3 Bell J4 Bell J5
Model Differences	Refer to the DOS letter
Frequency Range	Wi-Fi: 2412~2472MHz/2422-2462MHz
Maximum Conducted Peak Output Power	Wi-Fi: 10.37dBm(802.11b), 14.53dBm(802.11g), 12.22dBm(802.11n20), 13.26dBm(802.11n40)
Modulation Technique	Wi-Fi: DSSS, OFDM
Antenna Specification	3.0dBi
Voltage Range	DC 3.7V from battery or AC 12-24V or DC 12V
Date of Test	2020-03-31 to 2020-07-02
Sample serial number	RSZ200323814-RF-S1 (Assigned by BACL, Shenzhen)
Received date	2020-03-23
Sample/EUT Status	Good condition

Objective

This report is prepared on behalf of *Shenzhen Joystek Intelligence 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)

N/A.

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

“Xshell-6.0.0185.exe” software was used to test.

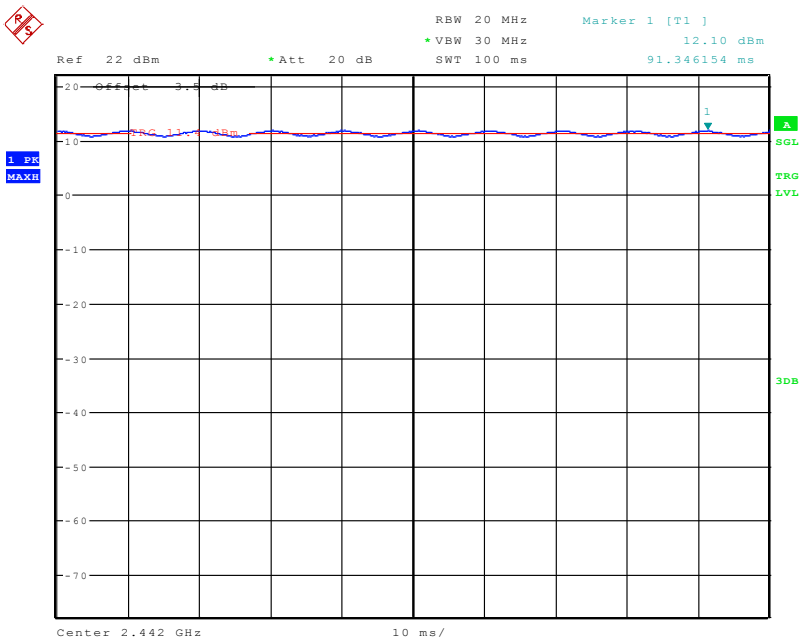
The device was tested with the worst case was performed as below:

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

The worse-case data rates are determined to be as follows for each mode based upon investigations by measuring the output power and PSD across all data rated bandwidths, and modulations.

Duty cycle

802.11b mode



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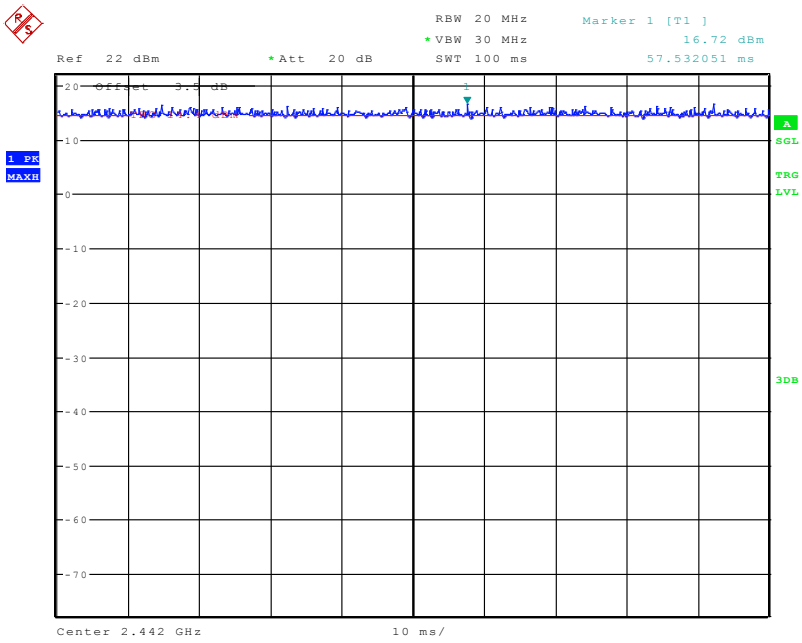
802.11g mode



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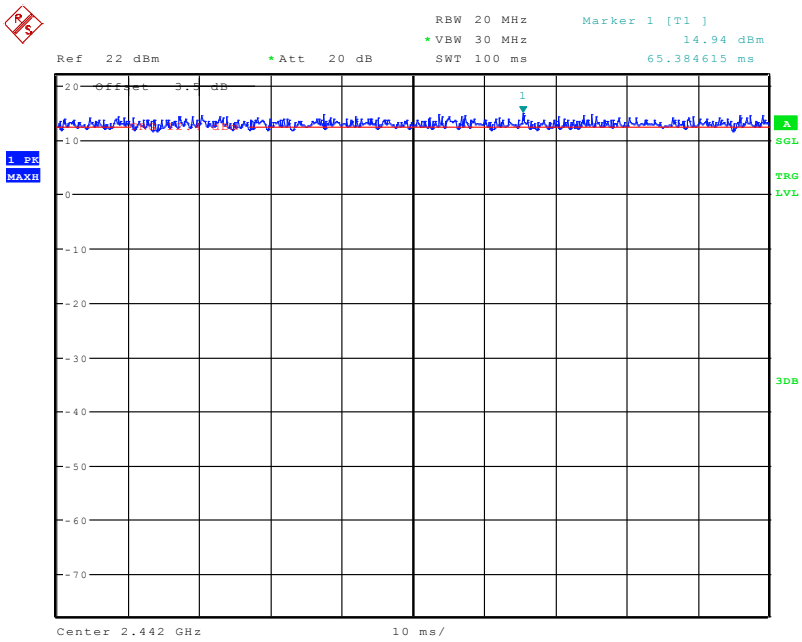
802.11n-HT20 Mode



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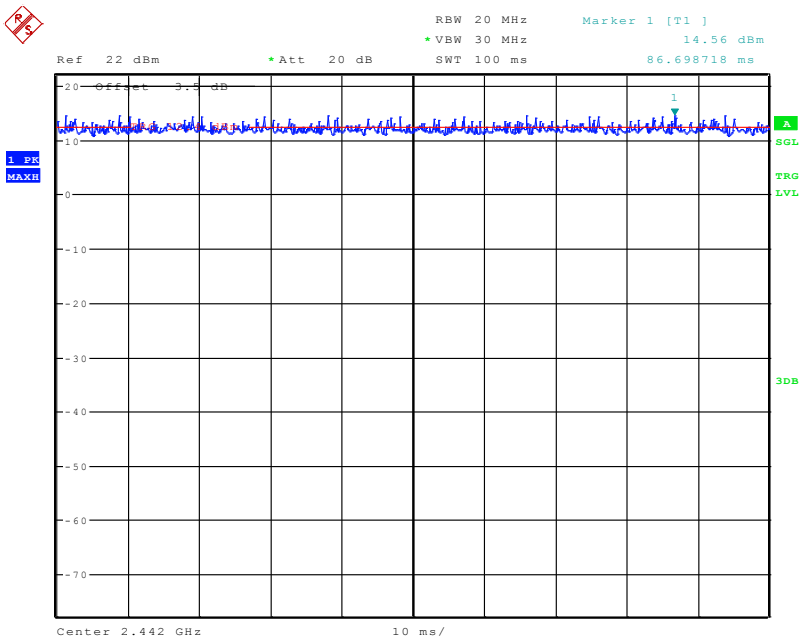
802.11n-HT40 Mode



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

Support Equipment List and Details

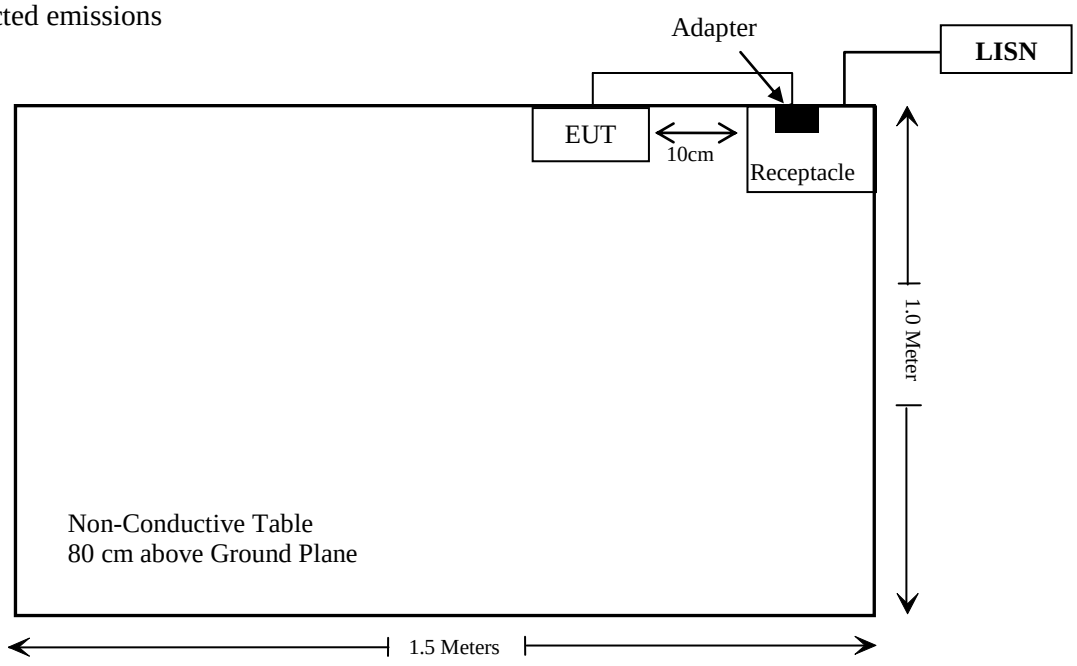
Manufacturer	Description	Model	Serial Number
EPK	Adapter	A8A-050200U-US1	1553
BULL	Socket	GN-415K	21642429
instek	DC Power Supply	GPS-3030DD	EM832096
SHENZHEN FRECOM ELECTRONICS CO.LTD	Adapter	F18W8-120150SPAUY	E257831
ZheJiang DELIXI ELECTRONIC Co.,LTD.	KVA Contact voltage regulator	TDGC2	TDGC2

External I/O Cable

Cable Description	Length (m)	From/Port	To
Un-Shielded Detachable USB cable	0.5	EUT	Adapter
Un-shielded Un-detachable AC cable	1.0	Socket	Mains

Block Diagram of Test Setup

For conducted emissions



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	2020/1/22	2021/1/21
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	2019/4/20	2020/4/20
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017/12/22	2020/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2019/11/29	2020/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	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	2020/7/21
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	F-19-EM005	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
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	5324	AU3842	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**		**Max Tune Up Conducted Power**		**Evaluation Distance (cm)**	**Power Density (mW/cm^2)**	**MPE Limit (mW/cm^2)**
	(dBi)	**(numeric)**	**(dBm)**	**(mW)**			
2412-2472	3.0	2.0	15.0	31.6	20	0.013	1.0

Note: 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 an internal antenna arrangement, which was permanently attached and the antenna gain is 3.0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

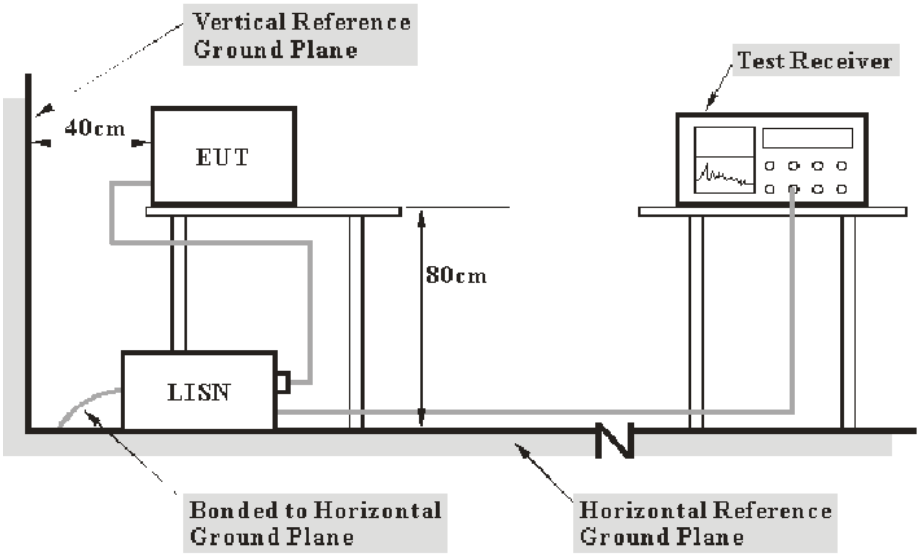
Result: Compliance.

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

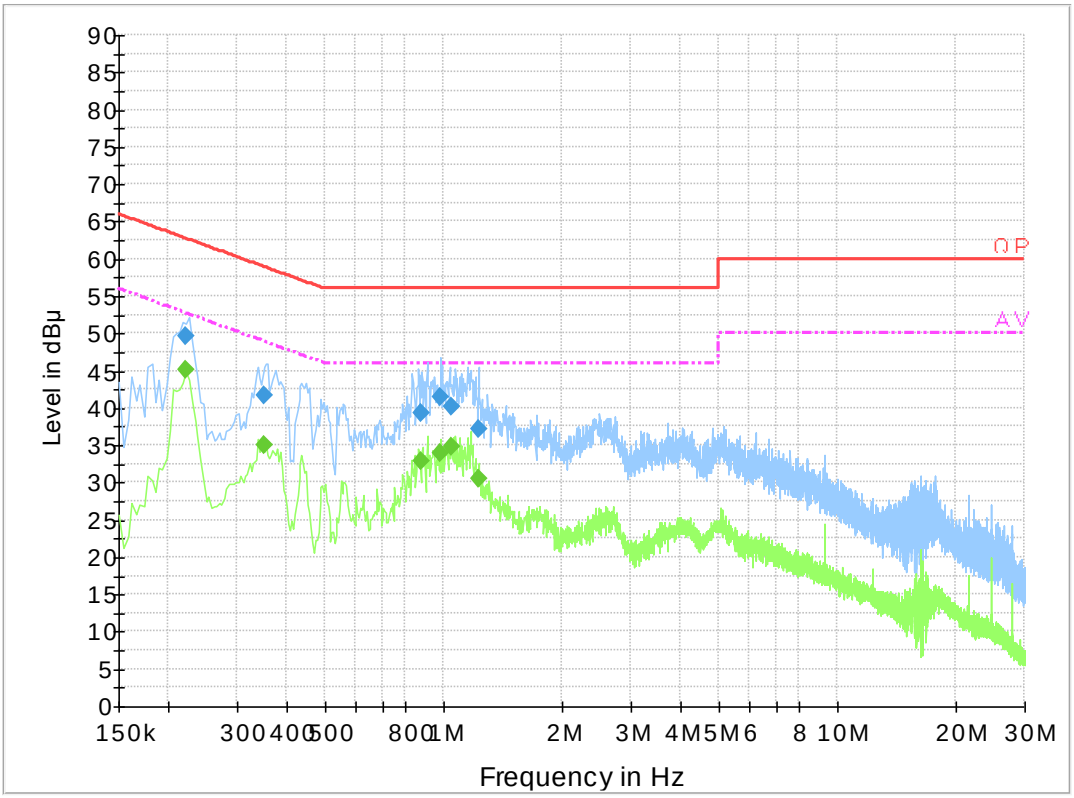
Temperature:	25 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2020-03-31 and 2020-07-02.

EUT operation mode: Transmitting (Wi-Fi Low channel in 802.11g mode was the worst case)

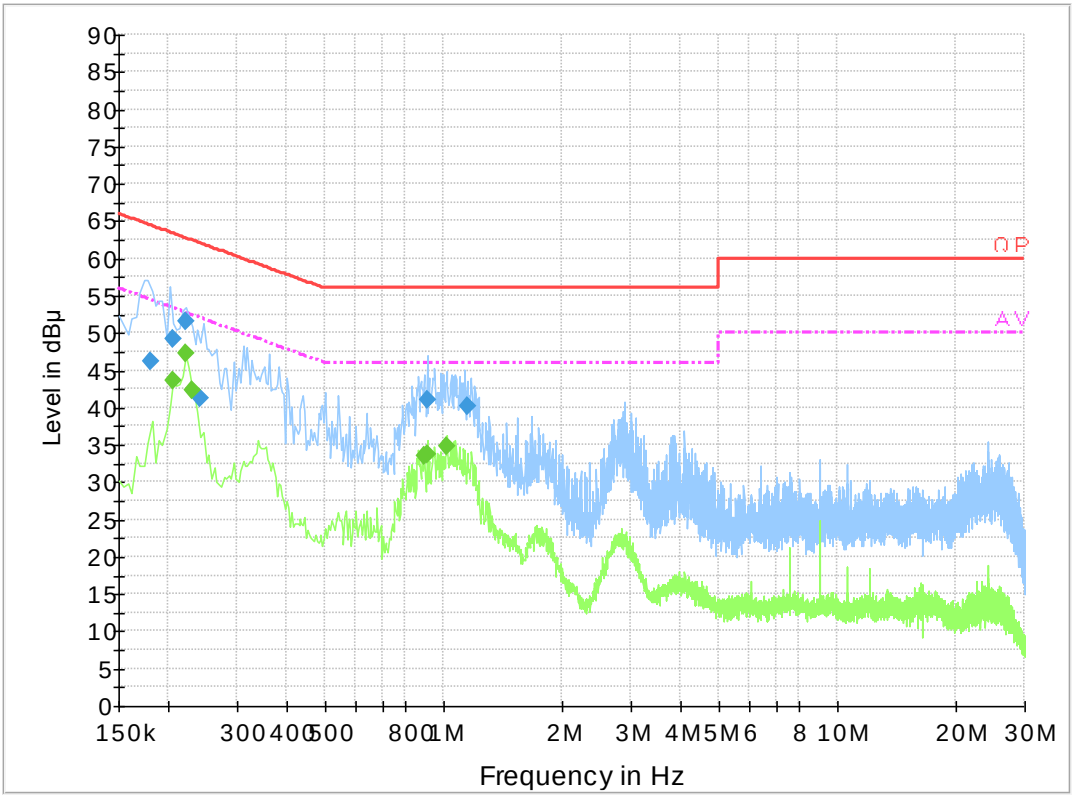
DC5V (adapter):

AC 120V/60 Hz, Line



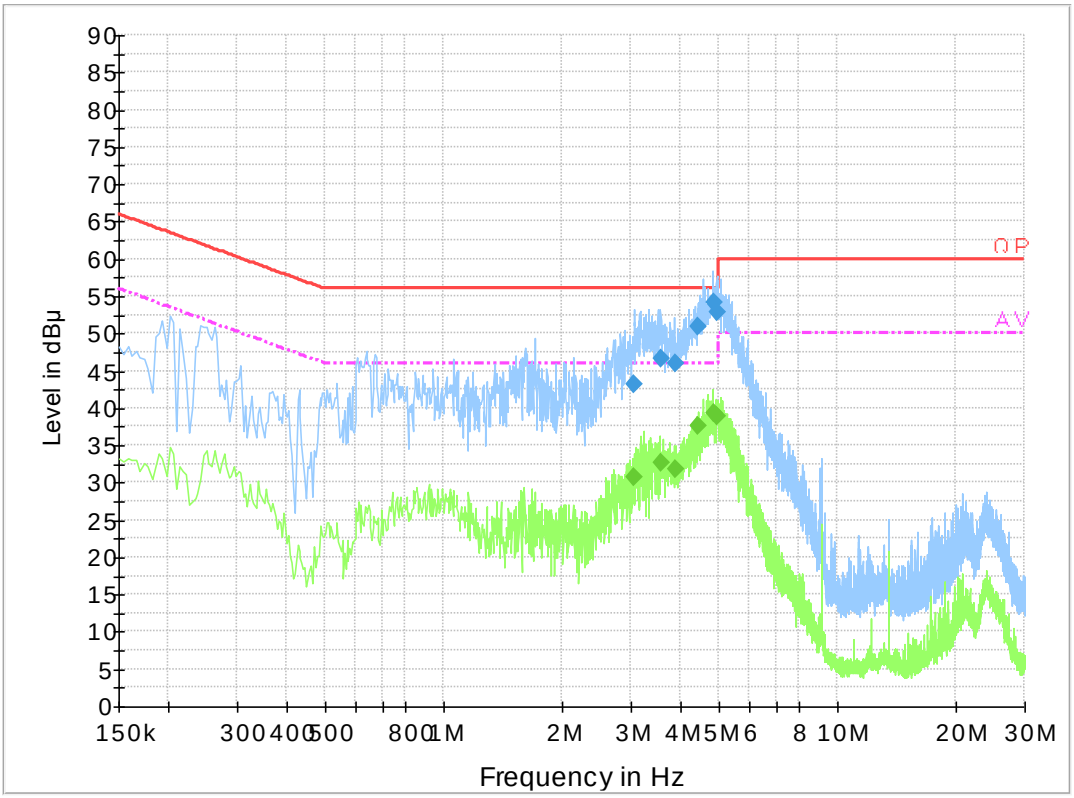
Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.221500	49.6	19.8	62.8	13.2	QP
0.352630	41.7	19.9	58.9	17.2	QP
0.878990	39.3	19.8	56.0	16.7	QP
0.987210	41.5	19.9	56.0	14.5	QP
1.050430	40.1	19.9	56.0	15.9	QP
1.235550	37.1	19.8	56.0	18.9	QP
0.221500	45.0	19.8	52.8	7.8	Ave.
0.352630	34.9	19.9	48.9	14.0	Ave.
0.878990	32.9	19.8	46.0	13.1	Ave.
0.987210	34.0	19.9	46.0	12.0	Ave.
1.050430	34.8	19.9	46.0	11.2	Ave.
1.235550	30.4	19.8	46.0	15.6	Ave.

AC 120V/60 Hz, Neutral



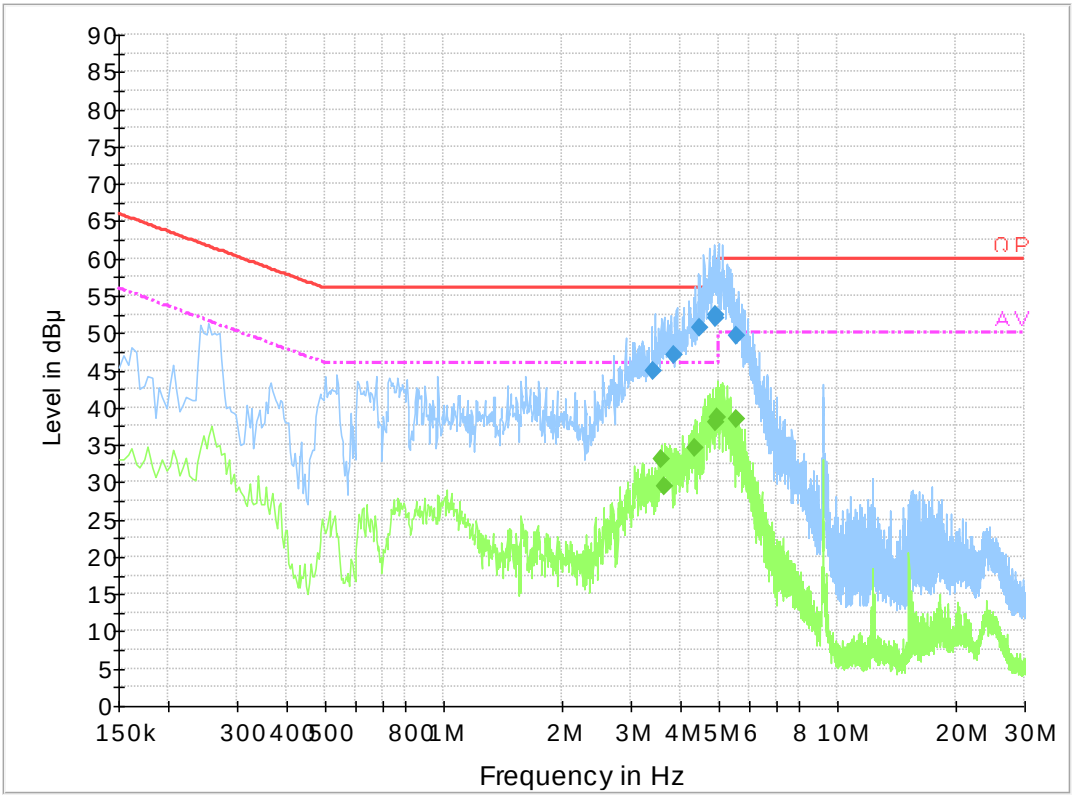
Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.181500	46.2	19.8	64.4	18.2	QP
0.206500	49.2	19.8	63.3	14.1	QP
0.221500	51.7	19.8	62.8	11.1	QP
0.241500	41.3	19.8	62.0	20.7	QP
0.912350	41.1	19.7	56.0	14.9	QP
1.152930	40.1	19.8	56.0	15.9	QP
0.206000	43.6	19.8	53.4	9.8	Ave.
0.222000	47.3	19.8	52.7	5.4	Ave.
0.230000	42.4	19.8	52.4	10.0	Ave.
0.894000	33.6	19.7	46.0	12.4	Ave.
0.910000	33.8	19.7	46.0	12.2	Ave.
1.022000	34.8	19.8	46.0	11.2	Ave.

AC 24V (Worst case), Line



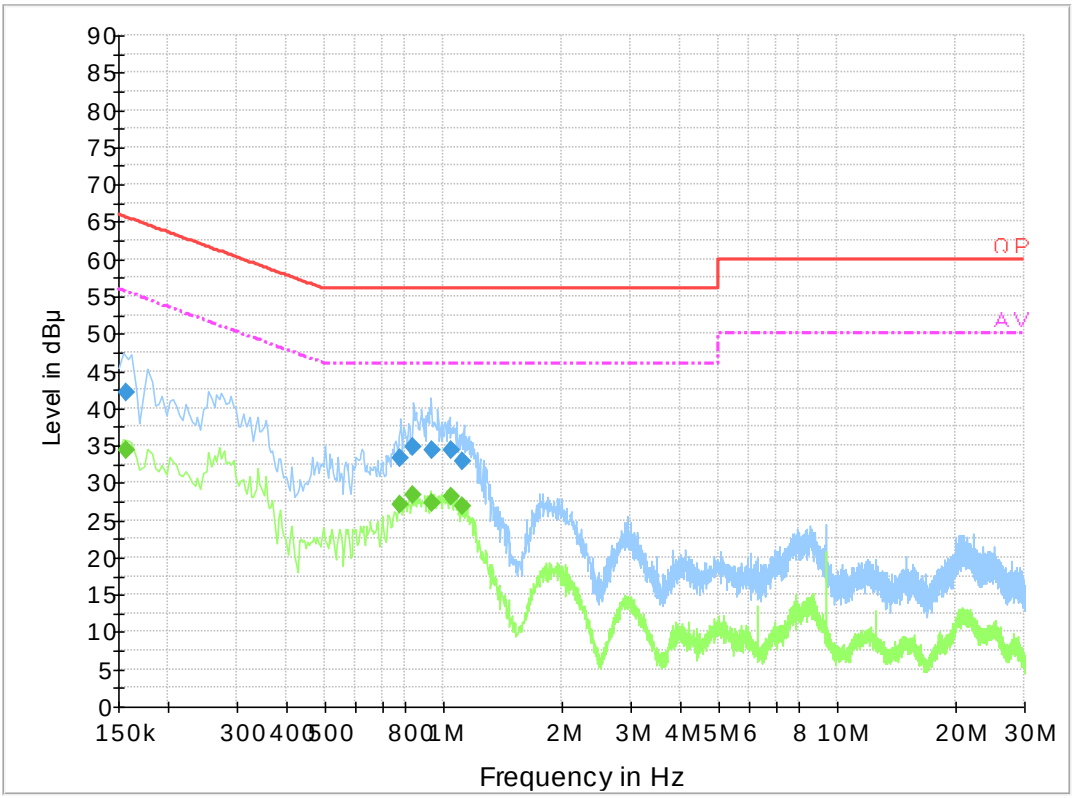
Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
3.060070	43.1	19.9	56.0	12.9	QP
3.568510	46.7	19.9	56.0	9.3	QP
3.912010	46.0	19.9	56.0	10.0	QP
4.455370	50.8	19.9	56.0	5.2	QP
4.861370	54.1	19.9	56.0	1.9	QP
4.995210	52.9	19.9	56.0	3.1	QP
3.060070	30.7	19.9	46.0	15.3	Ave.
3.568510	32.6	19.9	46.0	13.4	Ave.
3.912010	31.8	19.9	46.0	14.2	Ave.
4.455370	37.5	19.9	46.0	8.5	Ave.
4.861370	39.2	19.9	46.0	6.8	Ave.
4.995210	39.0	19.9	46.0	7.0	Ave.

AC 24V (Worst case), Neutral



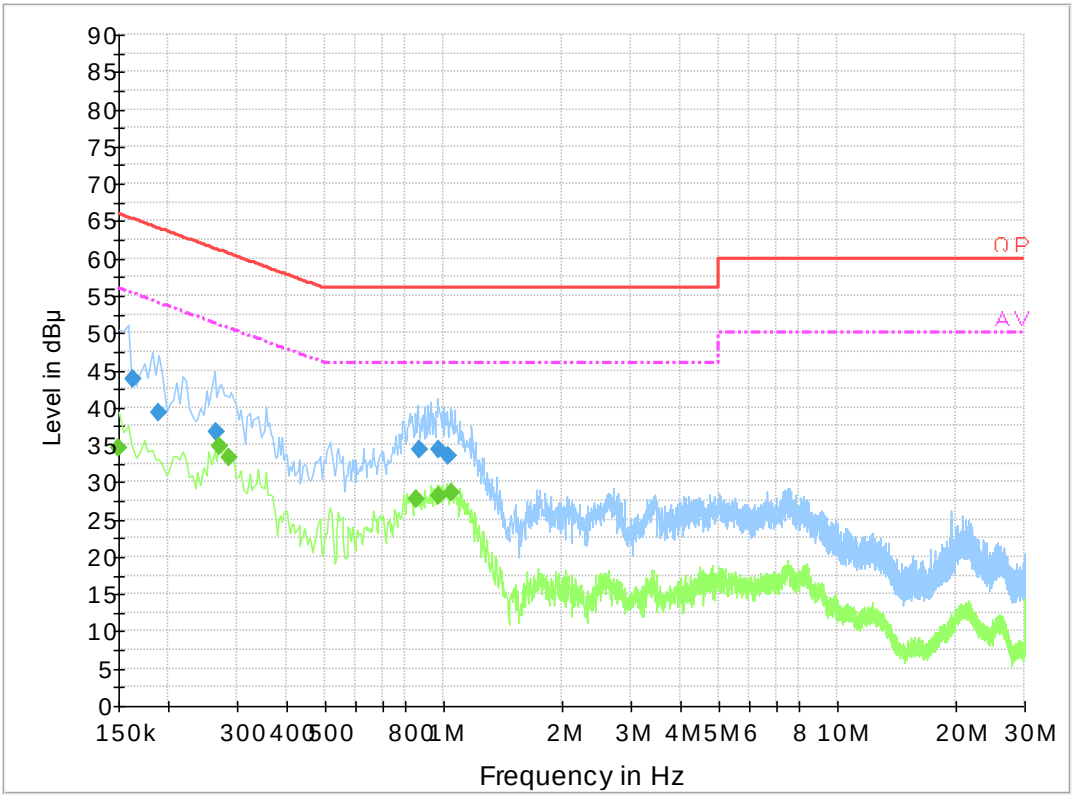
Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
3.410370	44.9	19.9	56.0	11.1	QP
3.879230	47.1	19.9	56.0	8.9	QP
4.467190	50.7	19.9	56.0	5.3	QP
4.921070	52.4	19.9	56.0	3.6	QP
4.931030	52.0	19.9	56.0	4.0	QP
5.545730	49.7	19.9	60.0	10.3	QP
3.578000	33.1	19.9	46.0	12.9	Ave.
3.638000	29.5	19.9	46.0	16.5	Ave.
4.358000	34.5	19.9	46.0	11.5	Ave.
4.942000	38.0	19.9	46.0	8.0	Ave.
4.954000	38.8	19.9	46.0	7.2	Ave.
5.550000	38.5	19.9	50.0	11.5	Ave.

DC12V (adapter):
AC 120V/60 Hz, Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.157500	42.1	19.8	65.6	23.5	QP
0.778270	33.2	19.8	56.0	22.8	QP
0.841370	34.7	19.8	56.0	21.3	QP
0.939990	34.3	19.8	56.0	21.7	QP
1.046430	34.5	19.9	56.0	21.5	QP
1.125050	32.9	19.8	56.0	23.1	QP
0.157500	34.5	19.8	55.6	21.1	Ave.
0.778270	27.0	19.8	46.0	19.0	Ave.
0.841370	28.4	19.8	46.0	17.6	Ave.
0.939990	27.3	19.8	46.0	18.7	Ave.
1.046430	28.2	19.9	46.0	17.8	Ave.
1.125050	26.9	19.8	46.0	19.1	Ave.

AC 120V/60 Hz, Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.162500	43.8	19.8	65.3	21.6	QP
0.189500	39.3	19.8	64.1	24.8	QP
0.265500	36.7	19.7	61.3	24.6	QP
0.873070	34.4	19.7	56.0	21.6	QP
0.971510	34.4	19.8	56.0	21.6	QP
1.030310	33.6	19.8	56.0	22.4	QP
0.150000	34.7	19.8	56.0	21.3	Ave.
0.270000	34.7	19.7	51.1	16.4	Ave.
0.286000	33.3	19.7	50.6	17.4	Ave.
0.858000	27.7	19.8	46.0	18.3	Ave.
0.974000	28.2	19.8	46.0	17.8	Ave.
1.050000	28.5	19.8	46.0	17.5	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

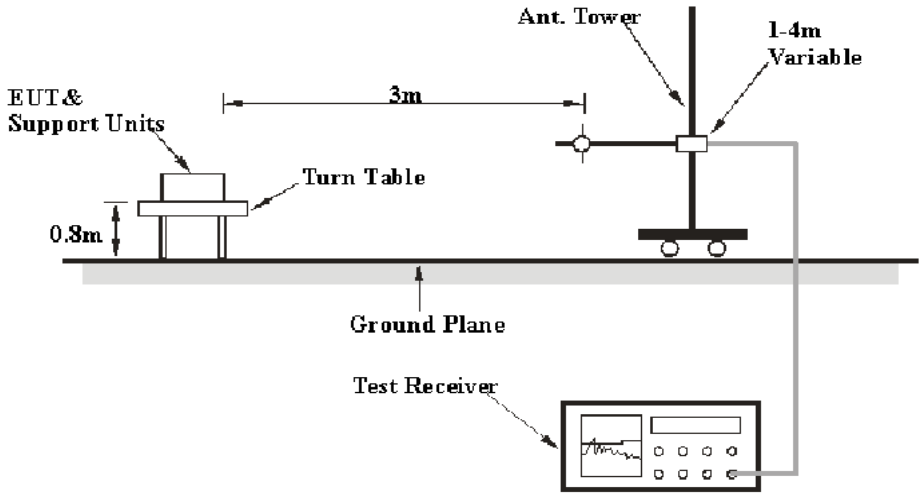
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

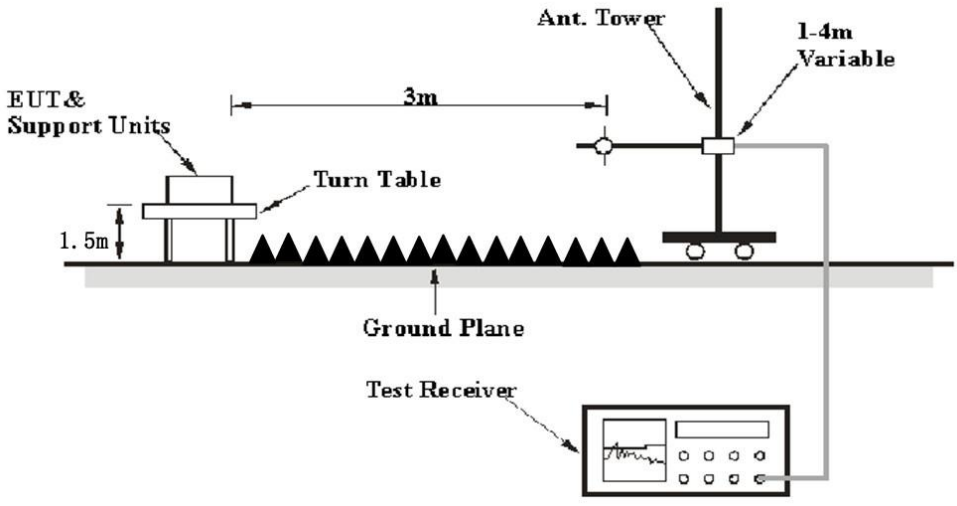
FCC §15.247 (d); §15.209; §15.205;

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

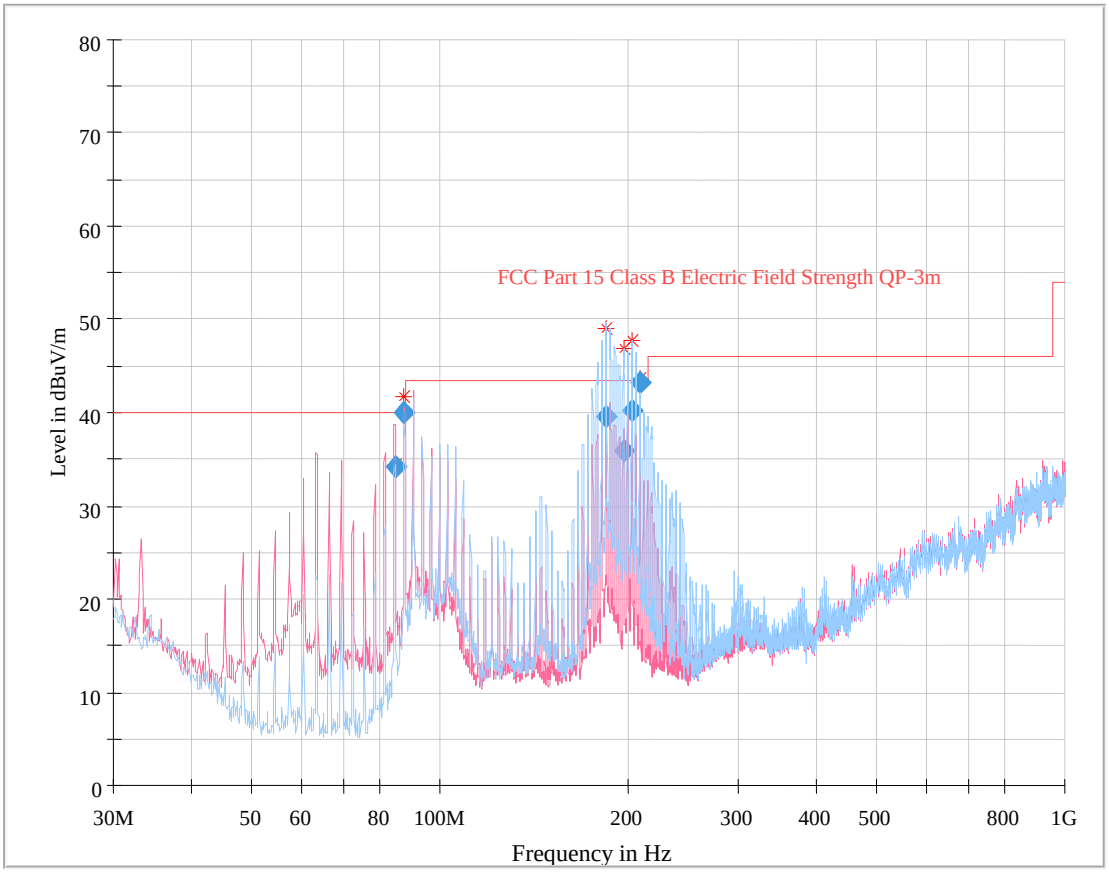
Temperature:	23 ℃
Relative Humidity:	65 %
ATM Pressure:	101.0 kPa

The testing was performed by Holland Yang on 2020-04-06 and 2020-07-02 for below 1G and Leven Gan on 2020-04-21 for above 1G.

EUT operation mode: Transmitting

DC 5V (adapter):

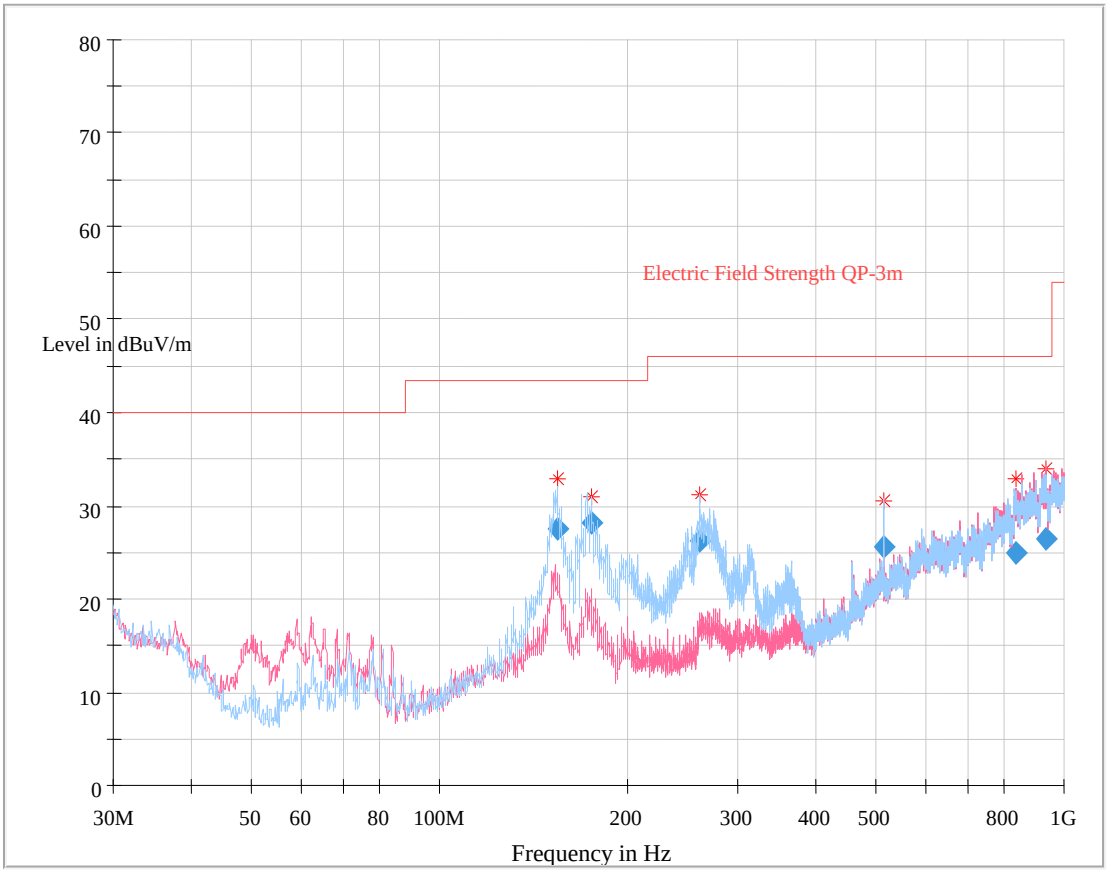
30 MHz~1 GHz (*Wi-Fi Low channel in 802.11g mode was the worst case*):



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
84.755000	34.14	133.0	V	13.0	-19.5	40.00	5.86
87.784875	39.98	109.0	V	81.0	-19.2	40.00	0.02
184.664750	39.63	192.0	H	252.0	-15.2	43.50	3.87
196.683750	36.00	180.0	H	256.0	-14.3	43.50	7.50
202.637625	40.20	172.0	H	262.0	-13.8	43.50	3.30
208.730375	43.15	149.0	H	280.0	-13.9	43.50	0.35

AC 24V (worst case):

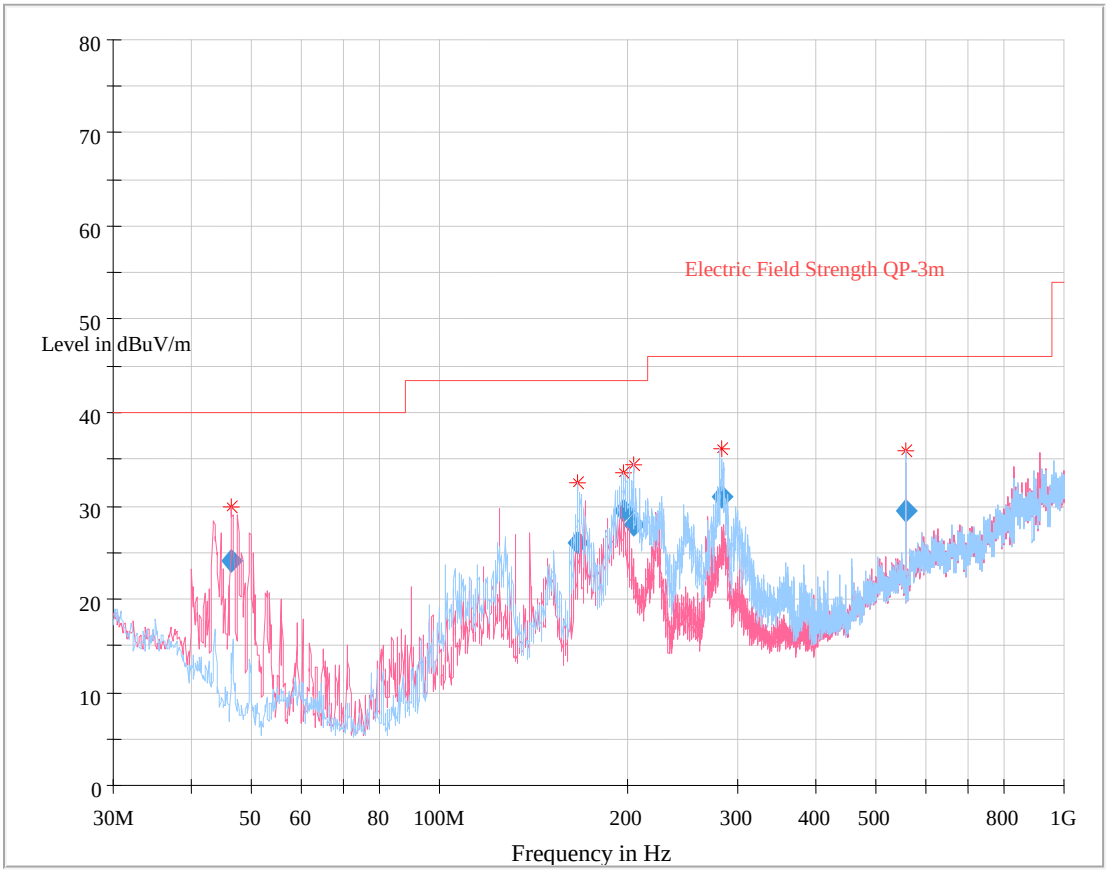
30 MHz~1 GHz (*Wi-Fi Low channel in 802.11g mode was the worst case*):



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
154.263250	27.58	222.0	H	290.0	-14.3	43.50	15.92
175.216750	28.09	126.0	H	291.0	-15.1	43.50	15.41
261.305500	26.17	107.0	H	91.0	-13.3	46.00	19.83
514.559750	25.63	311.0	H	239.0	-4.9	46.00	20.37
835.642000	24.86	175.0	V	0.0	2.7	46.00	21.14
932.950375	26.52	191.0	V	294.0	4.8	46.00	19.48

DC12V (adapter):

30 MHz~1 GHz (*Wi-Fi Low channel in 802.11g mode was the worst case*):



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
46.368750	24.07	102.0	V	223.0	-18.1	40.00	15.93
166.601125	26.04	161.0	H	87.0	-14.8	43.50	17.46
197.385250	29.55	168.0	H	293.0	-14.2	43.50	13.95
204.310750	28.02	129.0	H	269.0	-13.9	43.50	15.48
282.171500	30.96	101.0	H	285.0	-11.8	46.00	15.04
556.542250	29.37	141.0	H	45.0	-3.8	46.00	16.63

1 GHz-25 GHz (Wi-Fi)-DC 5V was worst case:

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)									
2383.23	28.70	PK	185	1.8	V	31.87	60.57	74	13.43
2383.23	13.85	Ave.	185	1.8	V	31.87	45.72	54	8.28
2484.89	28.38	PK	220	1.8	V	32.13	60.51	74	13.49
2484.89	13.40	Ave.	220	1.8	V	32.13	45.53	54	8.47
4824.00	43.14	PK	89	2.1	V	6.28	49.42	74	24.58
4824.00	28.17	Ave.	89	2.1	V	6.28	34.45	54	19.55
Middle Channel (2442MHz)									
4884.00	42.76	PK	72	2.3	V	6.76	49.52	74	24.48
4884.00	28.10	Ave.	72	2.3	V	6.76	34.86	54	19.14
High Channel (2472 MHz)									
2386.74	27.82	PK	70	1.7	V	31.87	59.69	74	14.31
2386.74	13.48	Ave.	70	1.7	V	31.87	45.35	54	8.65
2483.95	28.62	PK	102	1.9	V	32.13	60.75	74	13.25
2483.95	14.57	Ave.	102	1.9	V	32.13	46.70	54	7.30
4944.00	43.31	PK	282	1.6	V	6.76	50.07	74	23.93
4944.00	30.12	Ave.	282	1.6	V	6.76	36.88	54	17.12

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)									
2389.62	27.91	PK	82	1.6	V	31.87	59.78	74	14.22
2389.62	13.69	Ave.	82	1.6	V	31.87	45.56	54	8.44
2484.56	28.49	PK	308	1.3	V	32.13	60.62	74	13.38
2484.56	14.02	Ave.	308	1.3	V	32.13	46.15	54	7.85
4824.00	42.78	PK	287	2.3	V	6.28	49.06	74	24.94
4824.00	28.12	Ave.	287	2.3	V	6.28	34.40	54	19.60
Middle Channel (2442MHz)									
4884.00	42.52	PK	163	1.6	V	6.76	49.28	74	24.72
4884.00	28.16	Ave.	163	1.6	V	6.76	34.92	54	19.08
High Channel (2472 MHz)									
2389.22	28.95	PK	95	2.0	V	31.87	60.82	74	13.18
2389.22	13.65	Ave.	95	2.0	V	31.87	45.52	54	8.48
2484.80	30.67	PK	287	1.4	V	32.13	62.80	74	11.20
2484.80	15.05	Ave.	287	1.4	V	32.13	47.18	54	6.82
4944.00	43.23	PK	321	2.1	V	6.76	49.99	74	24.01
4944.00	28.36	Ave.	321	2.1	V	6.76	35.12	54	18.88

802.11n-HT20 Mode:

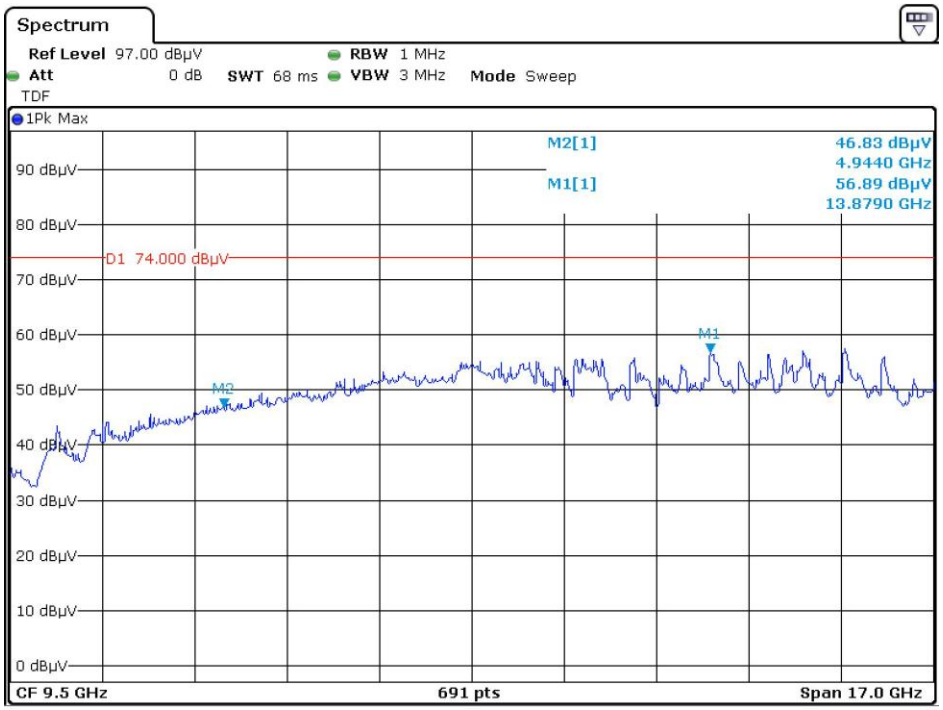
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2387.65	27.63	PK	329	1.4	V	31.87	59.50	74	14.50
2387.65	13.53	Ave.	329	1.4	V	31.87	45.40	54	8.60
2484.62	27.80	PK	42	2.0	V	32.13	59.93	74	14.07
2484.62	14.04	Ave.	42	2.0	V	32.13	46.17	54	7.83
4824.00	42.50	PK	111	2.1	V	6.28	48.78	74	25.22
4824.00	27.84	Ave.	111	2.1	V	6.28	34.12	54	19.88
Middle Channel (2442MHz)									
4884.00	42.61	PK	40	1.1	V	6.76	49.37	74	24.63
4884.00	28.04	Ave.	40	1.1	V	6.76	34.80	54	19.20
High Channel (2472 MHz)									
2388.66	27.71	PK	223	1.4	V	31.87	59.58	74	14.42
2388.66	15.50	Ave.	223	1.4	V	31.87	47.37	54	6.63
2483.94	29.05	PK	220	2.2	V	32.13	61.18	74	12.82
2483.94	15.32	Ave.	220	2.2	V	32.13	47.45	54	6.55
4944.00	42.82	PK	129	1.7	V	6.76	49.58	74	24.42
4944.00	27.69	Ave.	129	1.7	V	6.76	34.45	54	19.55

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)									
2387.64	28.43	PK	91	2.4	V	31.87	60.30	74	13.70
2387.64	14.32	Ave.	91	2.4	V	31.87	46.19	54	7.81
2483.94	27.83	PK	238	2.4	V	32.13	59.96	74	14.04
2483.94	13.85	Ave.	238	2.4	V	32.13	45.98	54	8.02
4844.00	43.12	PK	275	1.9	V	6.28	49.40	74	24.60
4844.00	27.82	Ave.	275	1.9	V	6.28	34.10	54	19.90
Middle Channel (2442MHz)									
4884.00	42.56	PK	227	1.2	V	6.76	49.32	74	24.68
4884.00	27.49	Ave.	223	2.1	V	6.76	34.25	54	19.75
High Channel (2462 MHz)									
2387.24	28.06	PK	140	1.2	V	31.87	59.93	74	14.07
2387.24	13.75	Ave.	140	1.2	V	31.87	45.62	54	8.38
2483.94	28.67	PK	126	2.0	V	32.13	60.80	74	13.20
2483.94	14.45	Ave.	126	2.0	V	32.13	46.58	54	7.42
4924.00	43.14	PK	85	1.9	V	6.76	49.90	74	24.10
4924.00	27.65	Ave.	85	1.9	V	6.76	34.41	54	19.59

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, High channel
Horizontal



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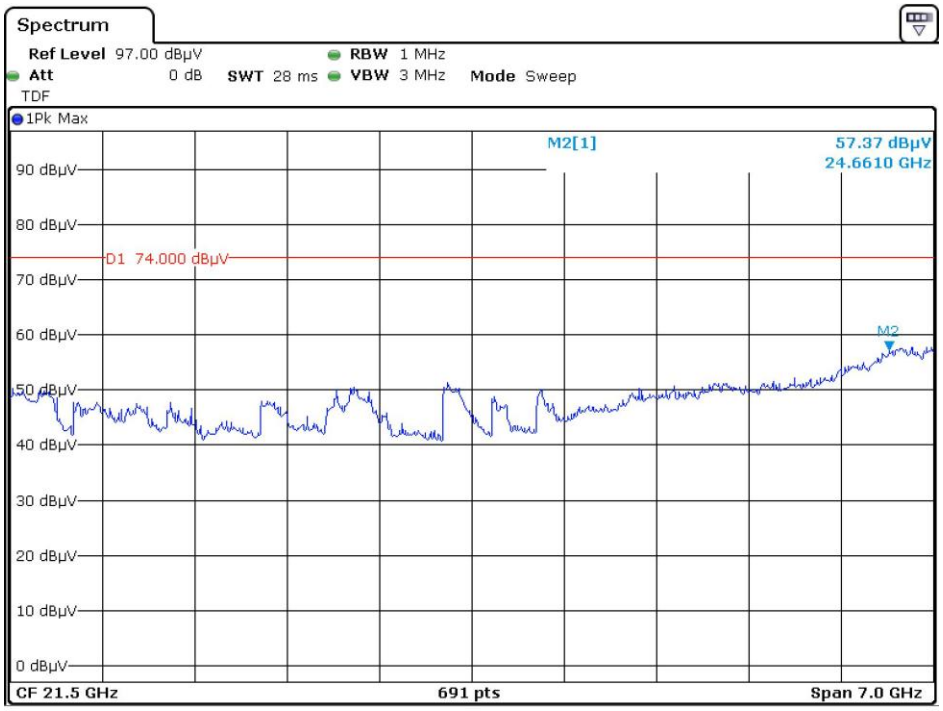

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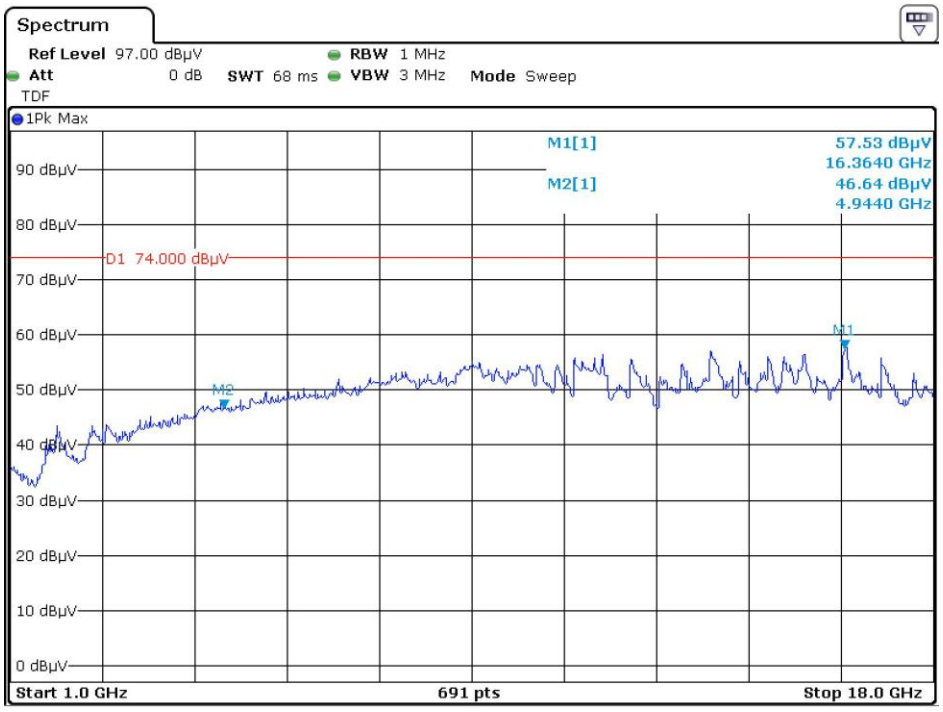
Vertical



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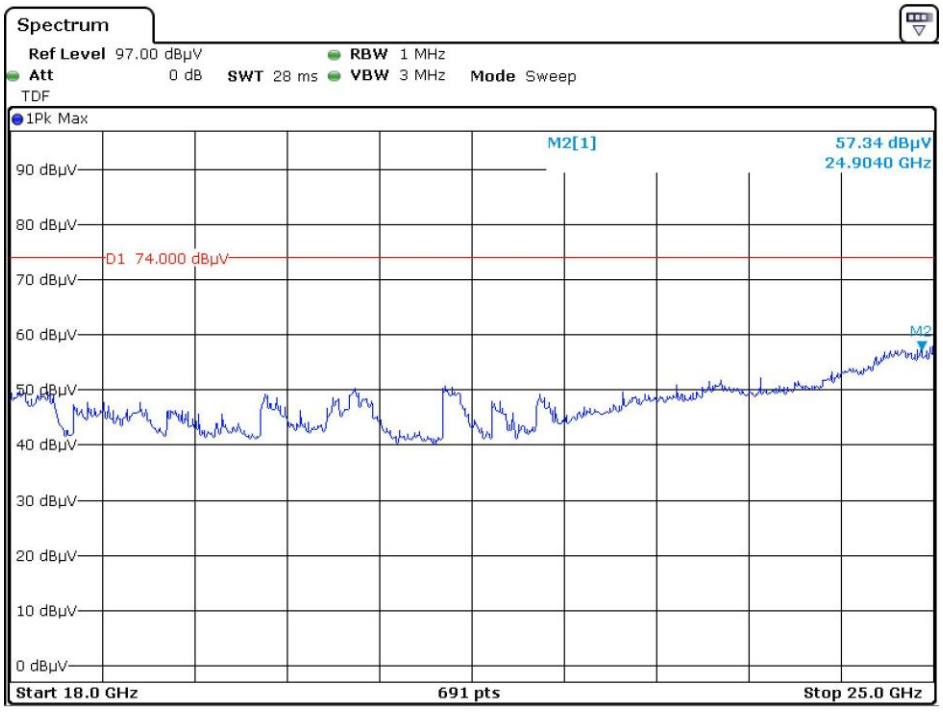
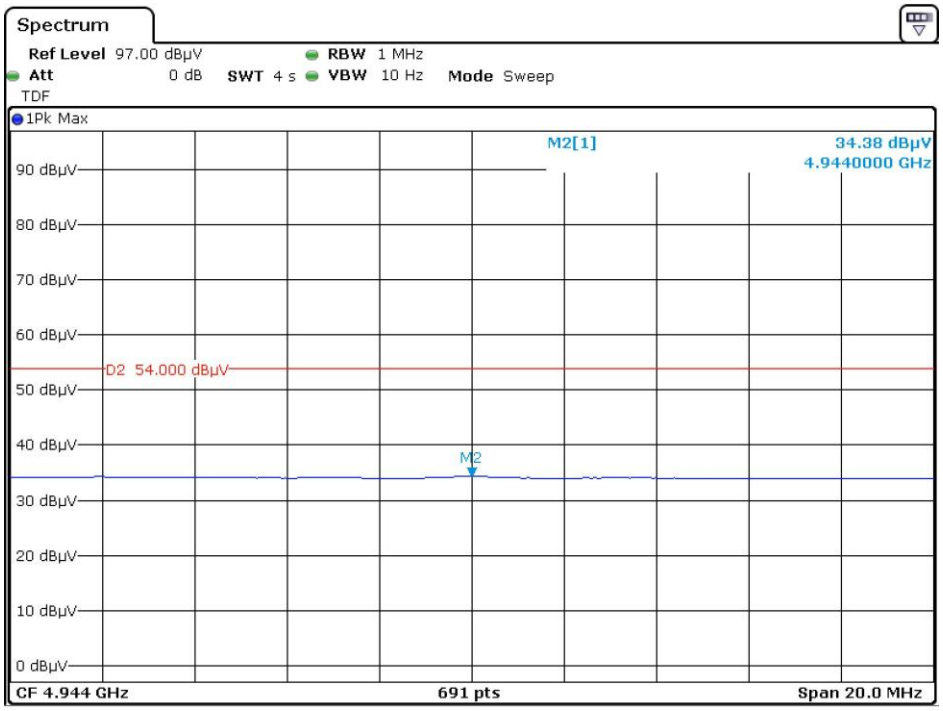


Date: 21.APR.2020 11:53:06

Pre-scan for Average
Horizontal



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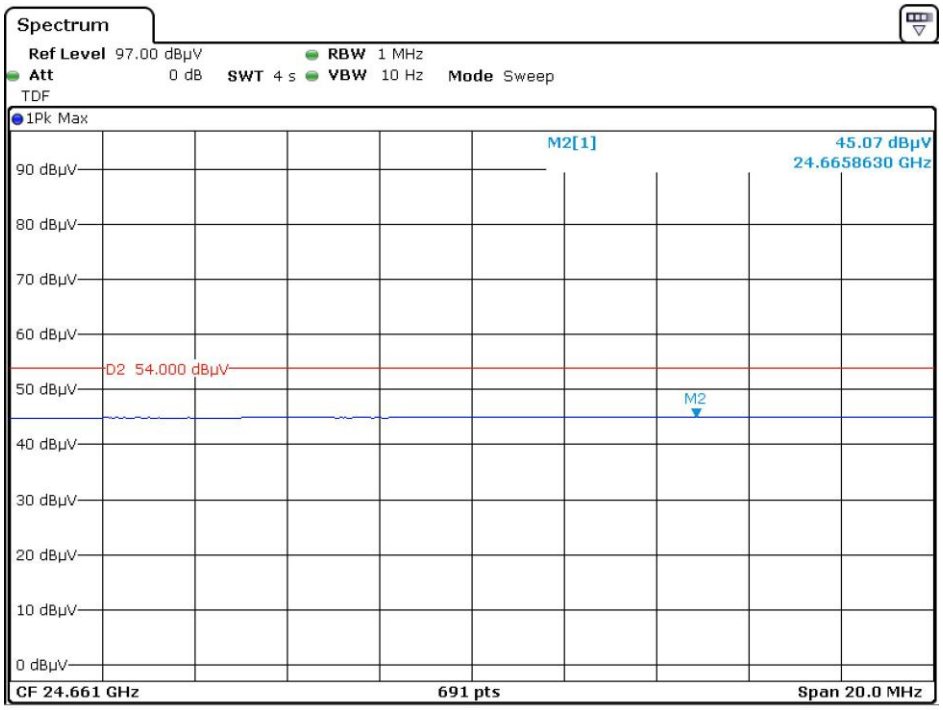
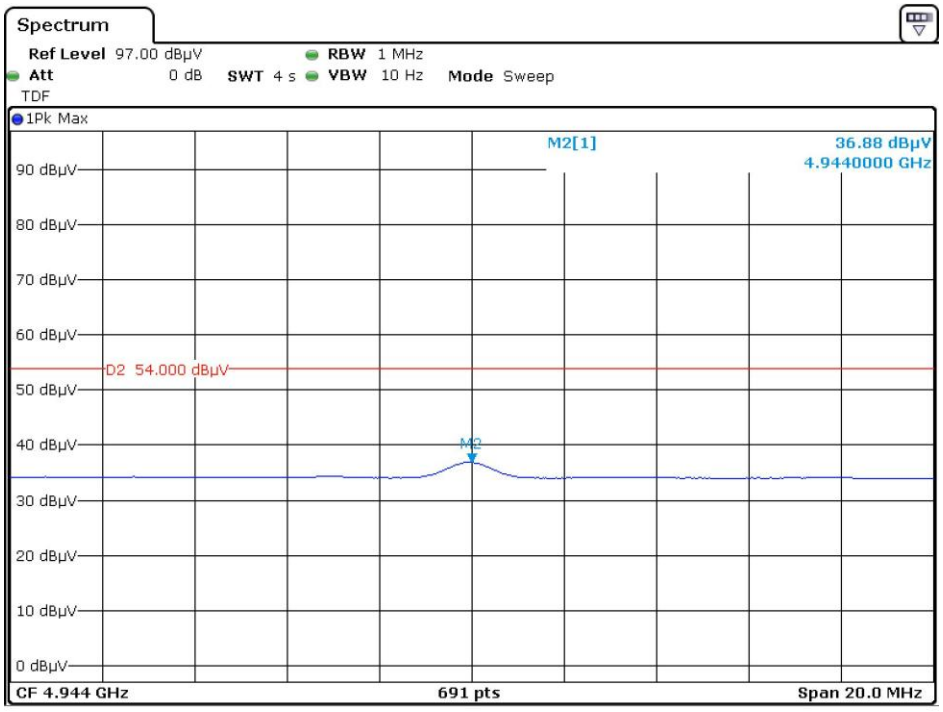


Date: 21.APR.2020 11:49:32

Vertical



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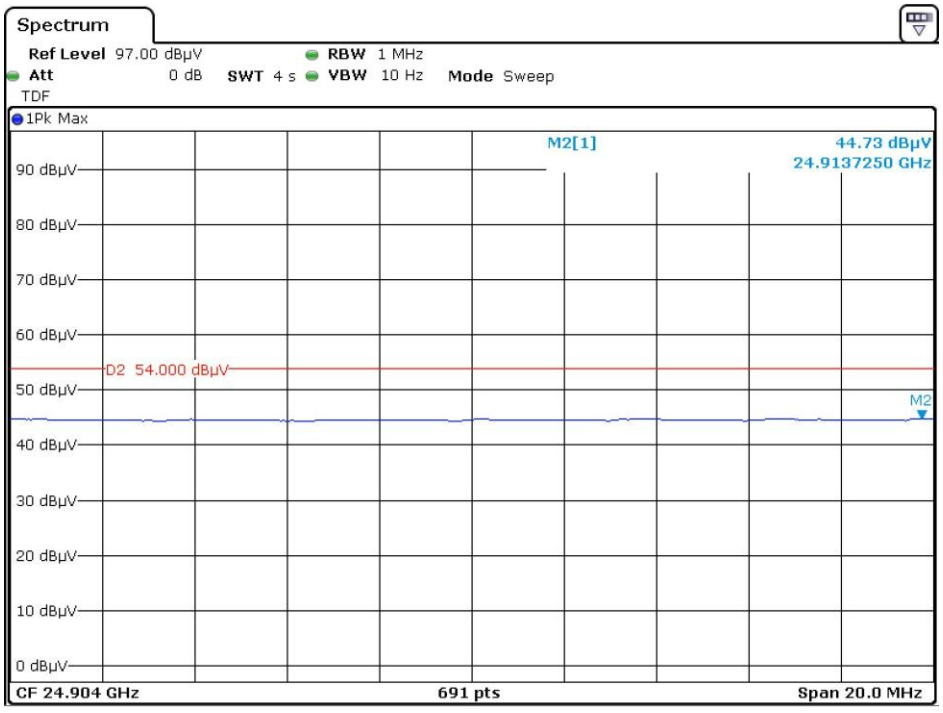


Date: 21.APR.2020 11:57:42

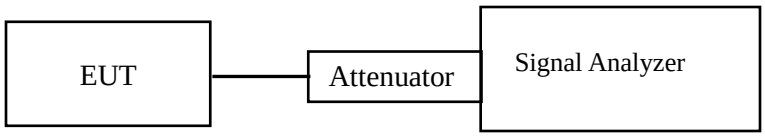
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

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:	24 ℃
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-04-25.

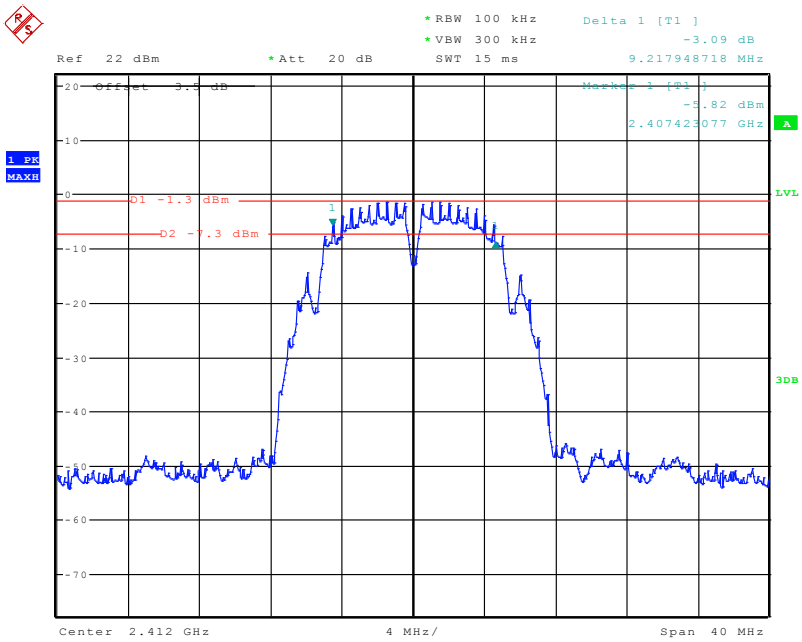
Test Result: Pass.

Please refer to the following table and plots.

EUT operation mode: Transmitting

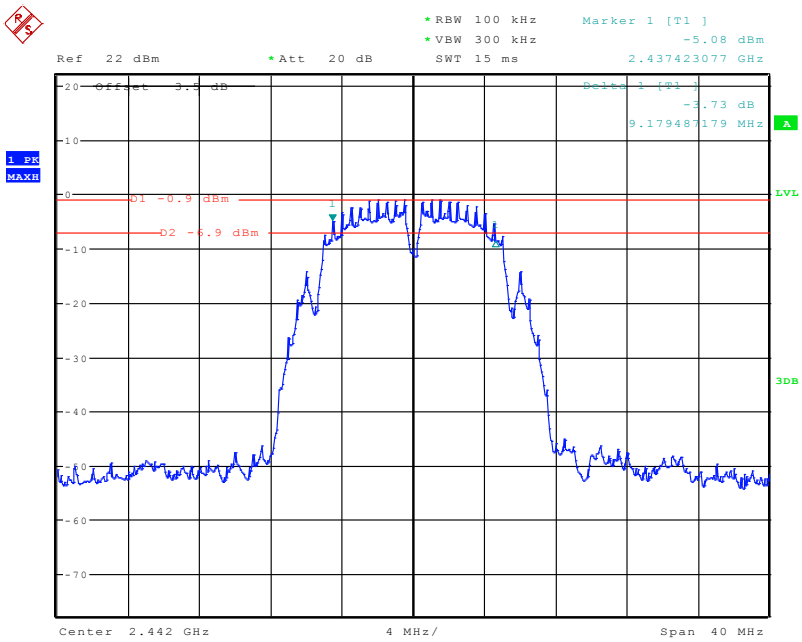
Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)
802.11b mode			
Low	2412	9.218	≥0.5
Middle	2442	9.179	≥0.5
High	2472	9.167	≥0.5
802.11g			
Low	2412	16.487	≥0.5
Middle	2442	16.487	≥0.5
High	2472	16.449	≥0.5
802.11n-HT20 mode			
Low	2412	17.603	≥0.5
Middle	2442	17.603	≥0.5
High	2472	17.692	≥0.5
802.11n-HT40 mode			
Low	2422	36.205	≥0.5
Middle	2442	36.064	≥0.5
High	2462	36.282	≥0.5

802.11b Low Channel



Date: 25.APR.2020 14:32:42

802.11b Middle Channel



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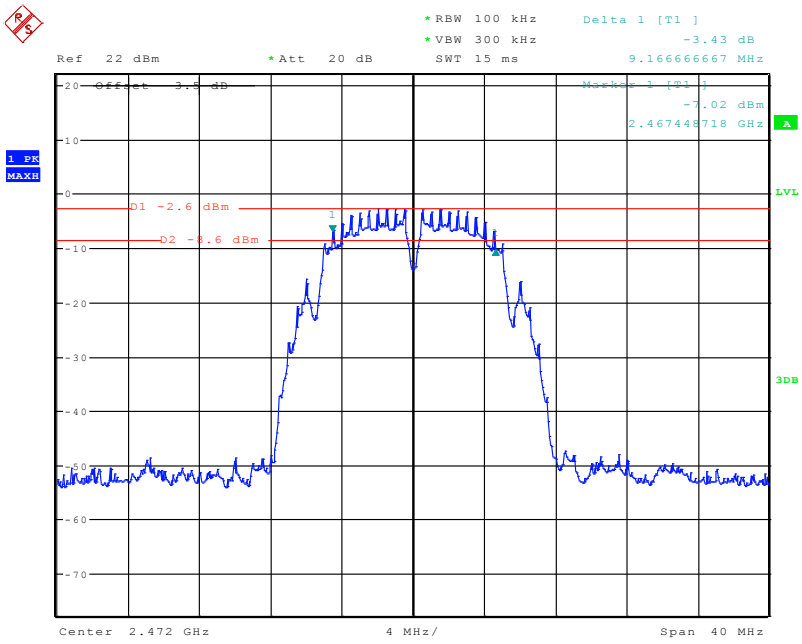
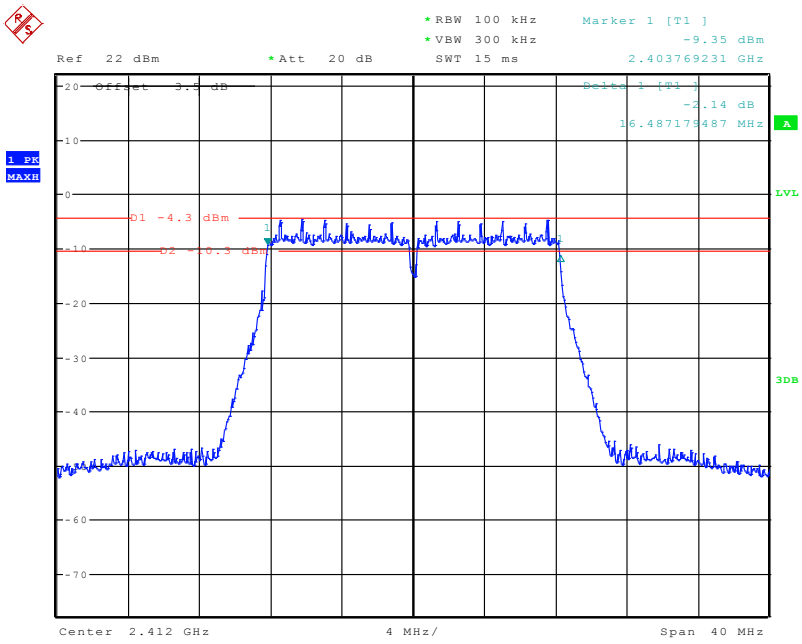
802.11b High Channel



Date: 25.APR.2020 14:29:21

802.11g Low Channel



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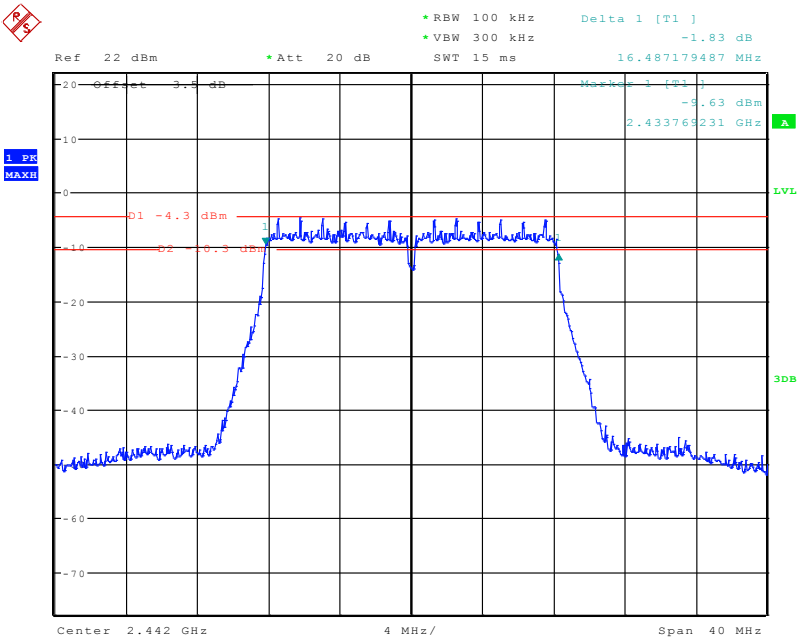
802.11g Middle Channel



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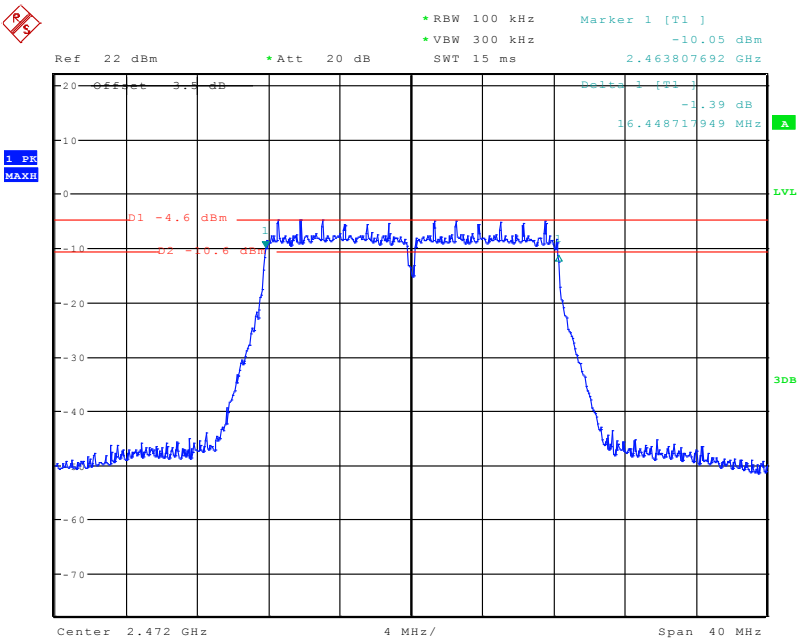
802.11g High Channel



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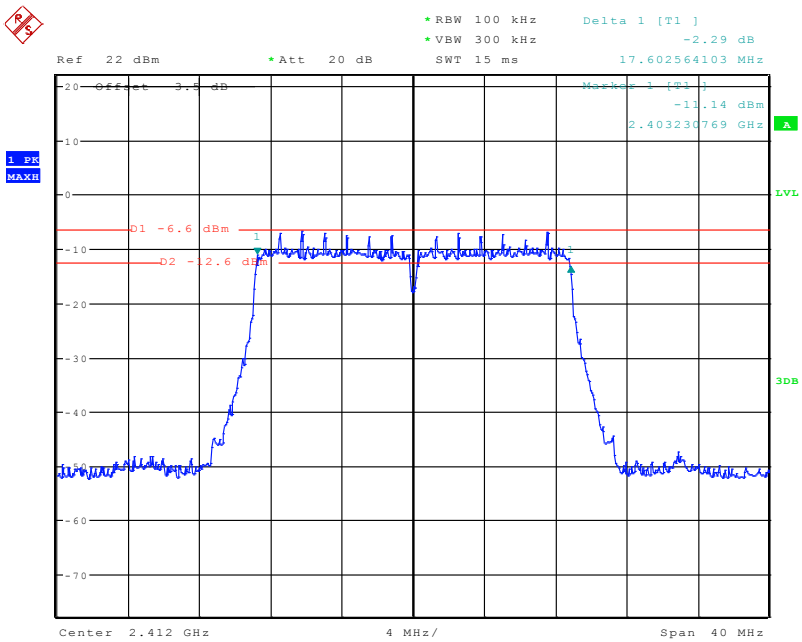
802.11n-HT20 Low Channel



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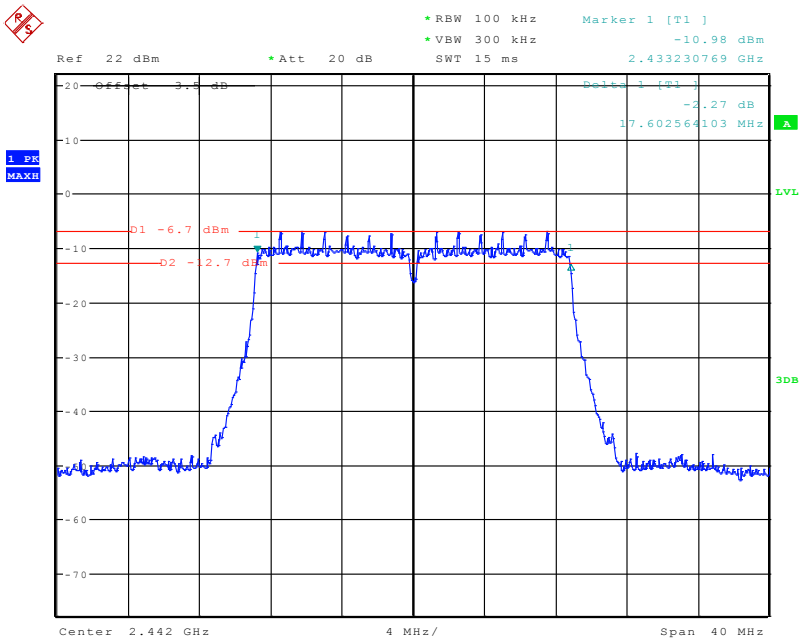
802.11n-HT20 Middle Channel



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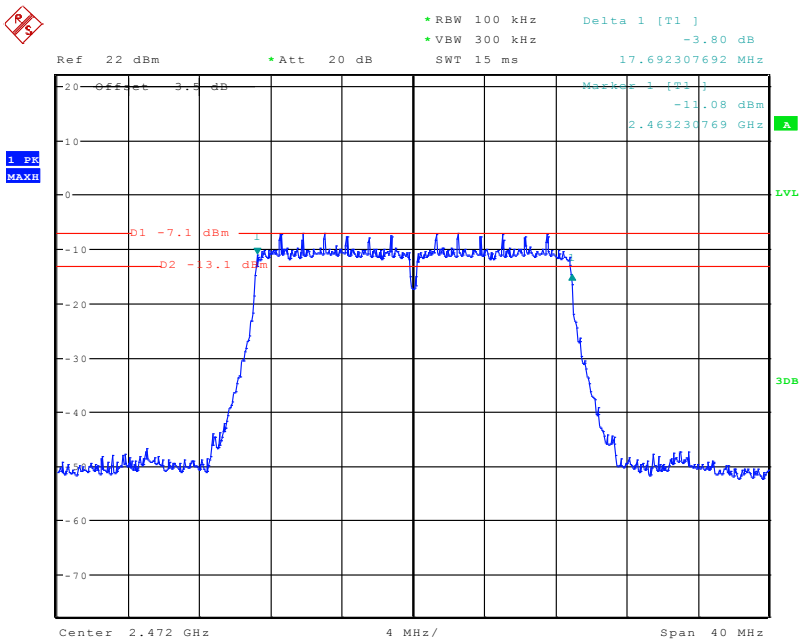
802.11n-HT20 High Channel



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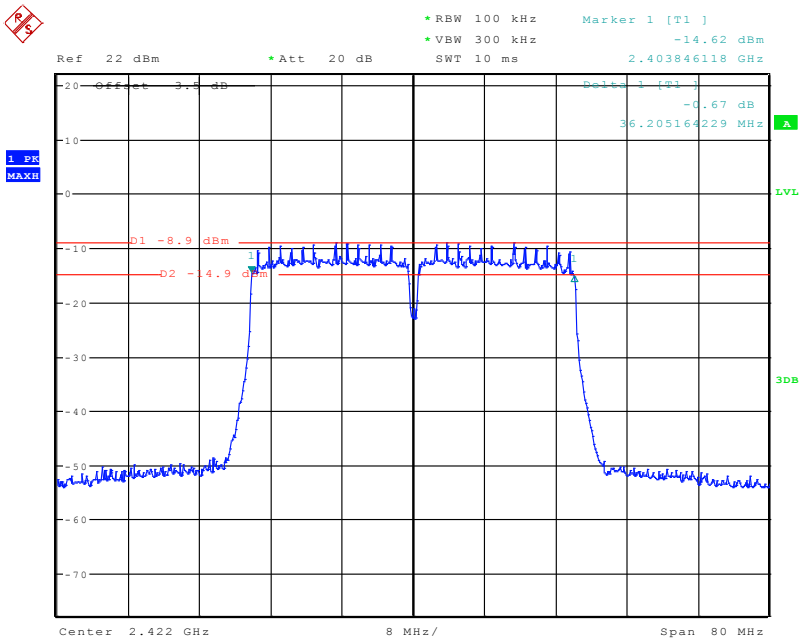
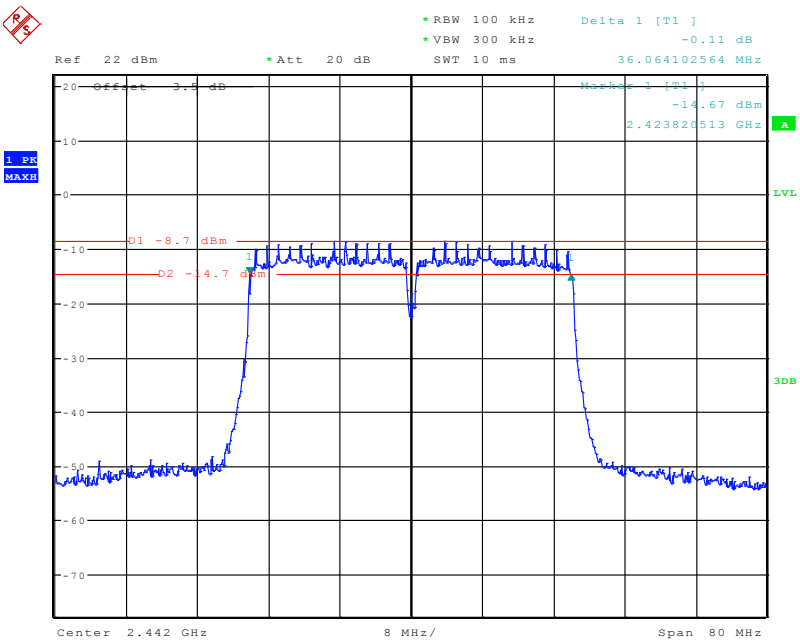
802.11n-HT40 Low Channel



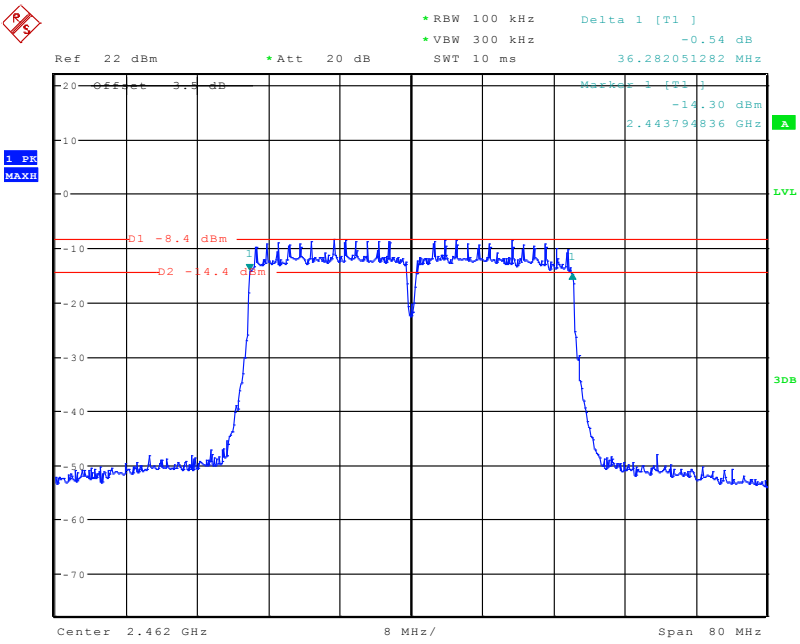
Date: 25.APR.2020 14:49:20

802.11n-HT40 Middle Channel



Date: 25.APR.2020 14:46:31

802.11n-HT40 High Channel



Date: 25.APR.2020 14:47:59

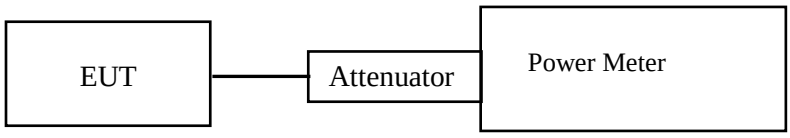
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

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:	24 ℃
Relative Humidity:	54 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-04-25.

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	10.37	7.68	30
Middle	2442	10.09	7.62	30
High	2472	10.00	7.18	30
802.11g				
Low	2412	14.42	8.45	30
Middle	2442	13.97	7.94	30
High	2472	14.53	8.04	30
802.11n HT20				
Low	2412	12.22	6.17	30
Middle	2442	11.79	6.02	30
High	2472	11.80	5.62	30
802.11n HT40				
Low	2422	13.21	7.06	30
Middle	2442	13.10	7.17	30
High	2462	13.26	7.34	30

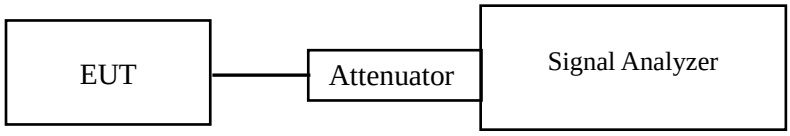
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

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:	23 ℃
Relative Humidity:	53%
ATM Pressure:	101.0 kPa

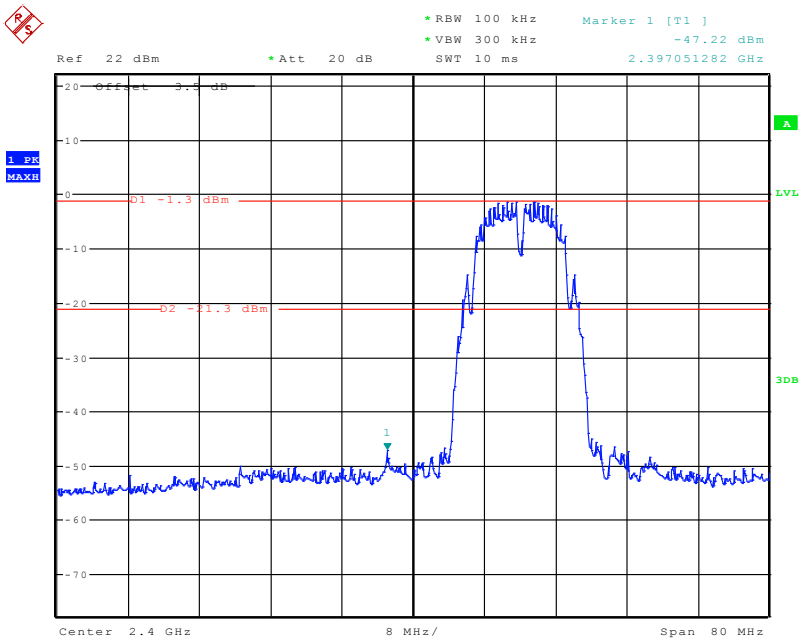
The testing was performed by Gavin Guo on 2020-04-25.

EUT operation mode: Transmitting

Test Result: Compliance

Please refer to the following plots.

802.11b: Band Edge, Left Side



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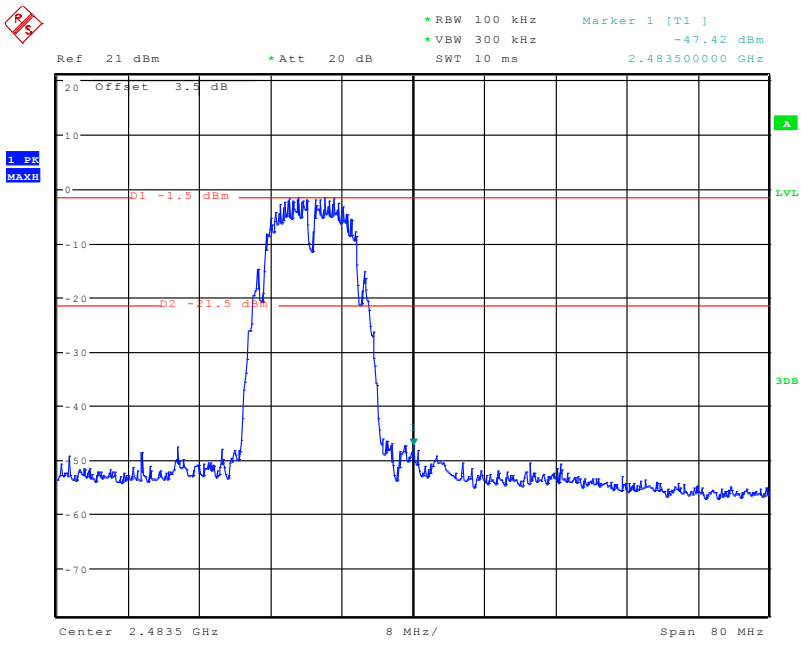
802.11b: Band Edge, Right Side



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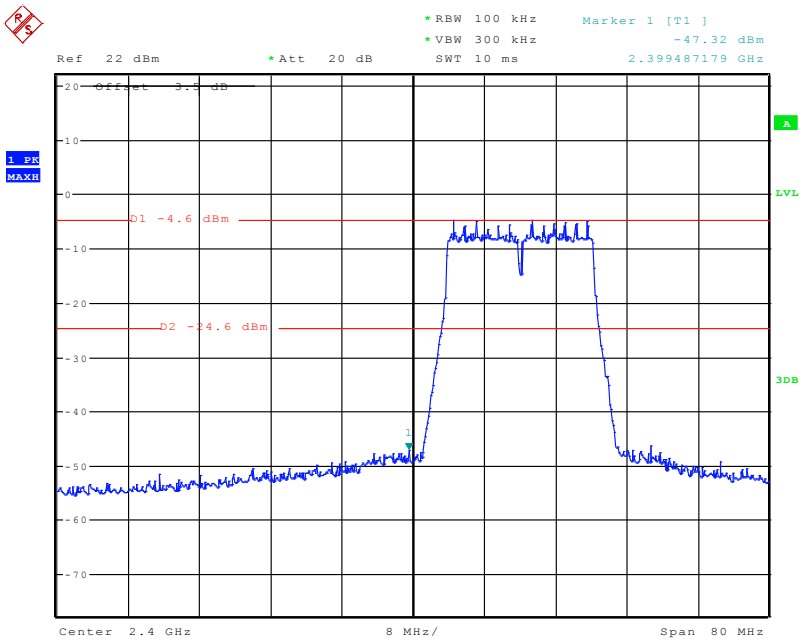
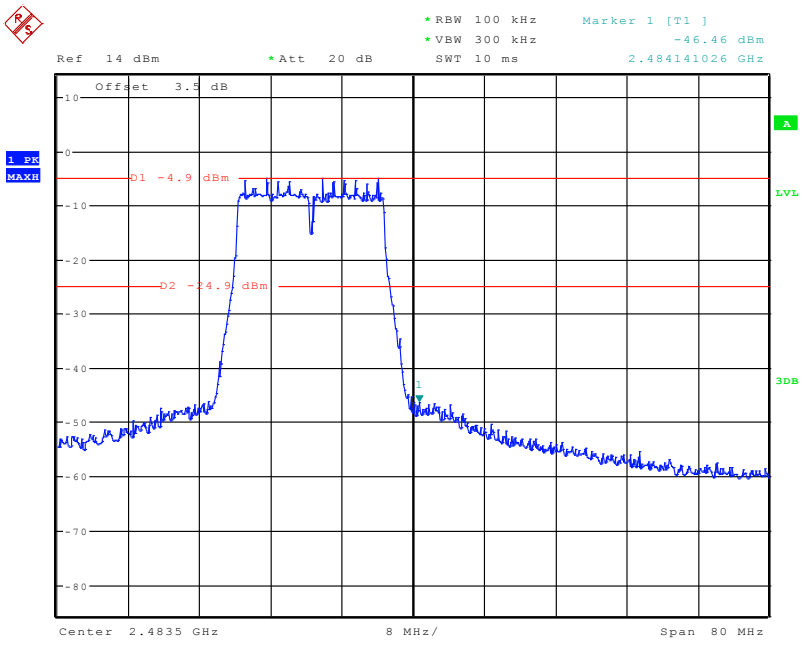
802.11g: Band Edge, Left Side



Date: 25.APR.2020 15:04:29

802.11g: Band Edge, Right Side



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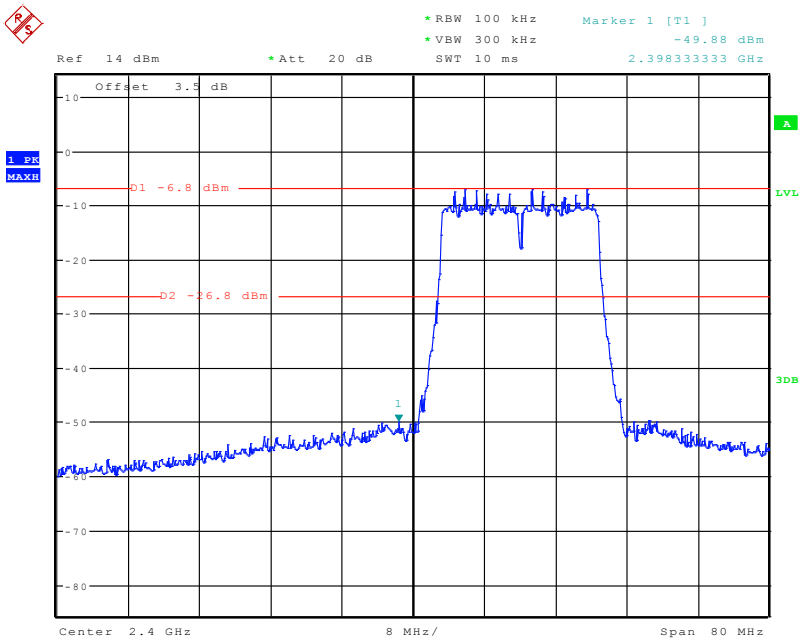
802.11n-HT20: Band Edge, Left Side



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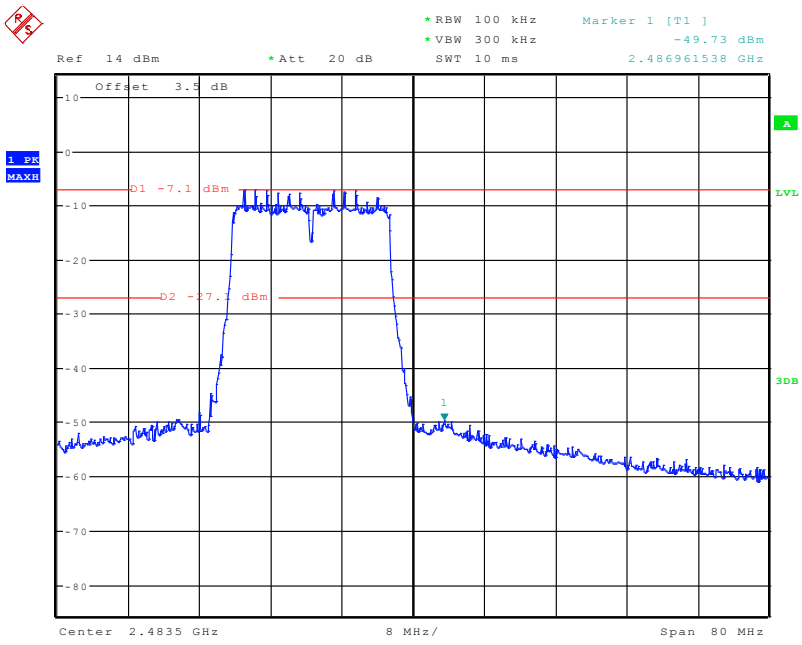
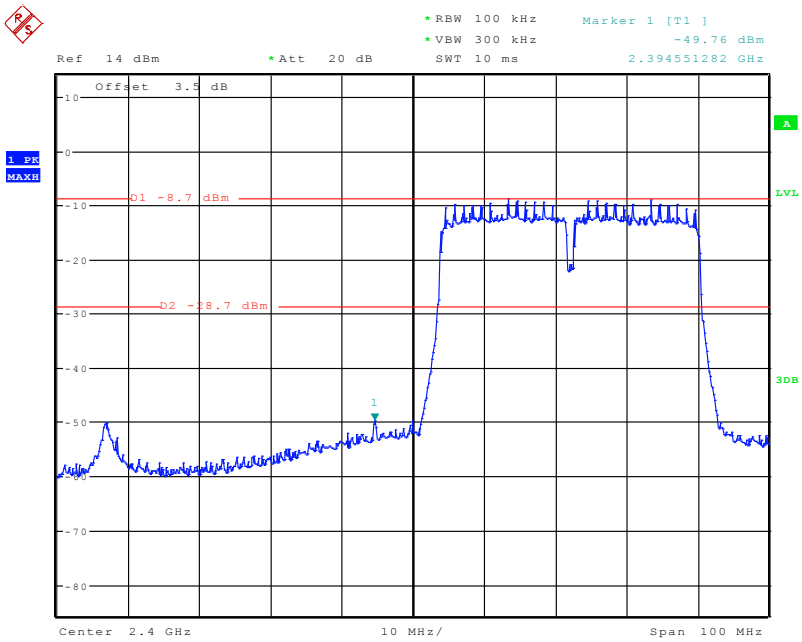
802.11n-HT20: Band Edge, Right Side



Date: 25.APR.2020 15:09:23

802.11n-HT40: Band Edge, Left Side



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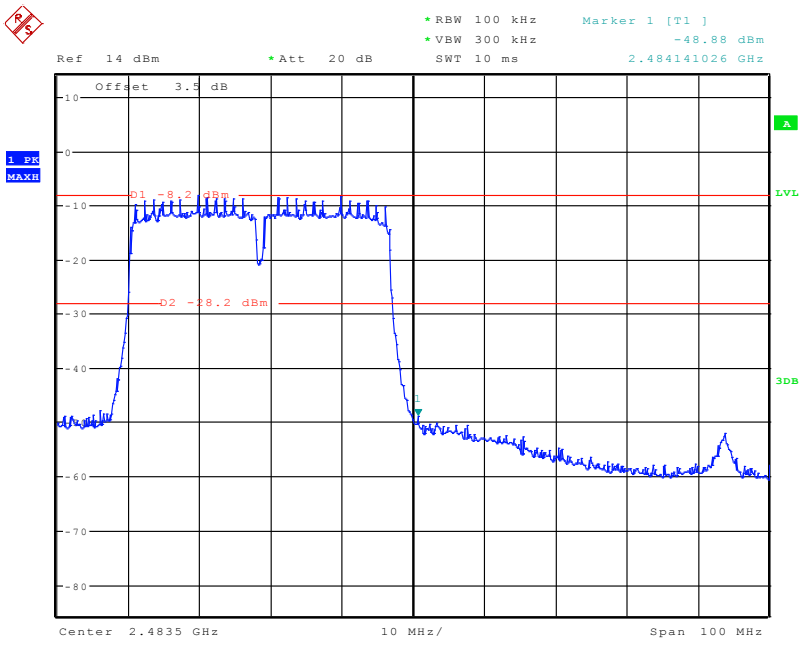
802.11n-HT40: Band Edge, Right Side



Date: 25.APR.2020 15:08:39

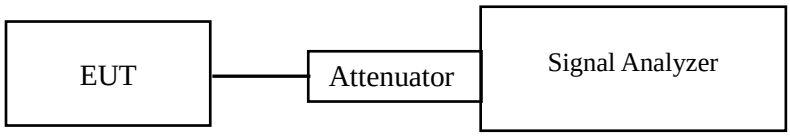
FCC §15.247(e) - POWER SPECTRAL DENSITY

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:	24 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

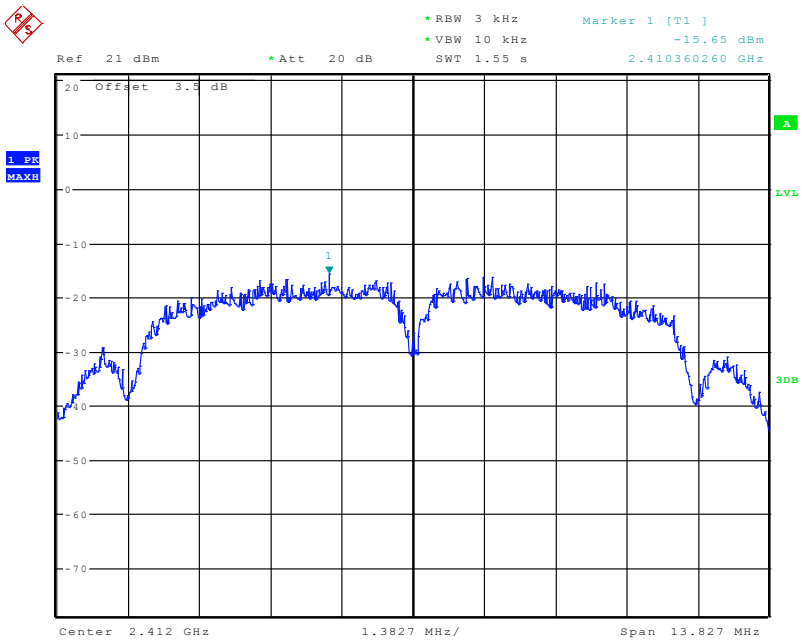
The testing was performed by Gavin Guo on 2020-04-25.

EUT operation mode: Transmitting

Test Result: Pass

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-15.65	≤8
Middle	2442	-15.22	≤8
High	2472	-15.73	≤8
802.11g mode			
Low	2412	-18.41	≤8
Middle	2442	-17.18	≤8
High	2472	-17.83	≤8
802.11n-HT20 mode			
Low	2412	-21.79	≤8
Middle	2442	-21.55	≤8
High	2472	-19.89	≤8
802.11n-HT40 mode			
Low	2422	-23.08	≤8
Middle	2442	-22.51	≤8
High	2462	-23.18	≤8

Power Spectral Density, 802.11b Low Channel



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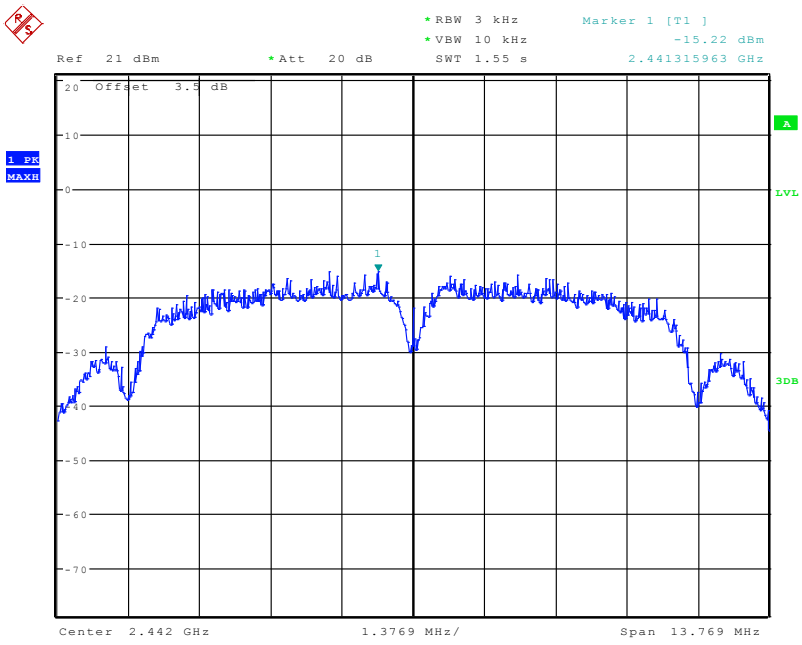
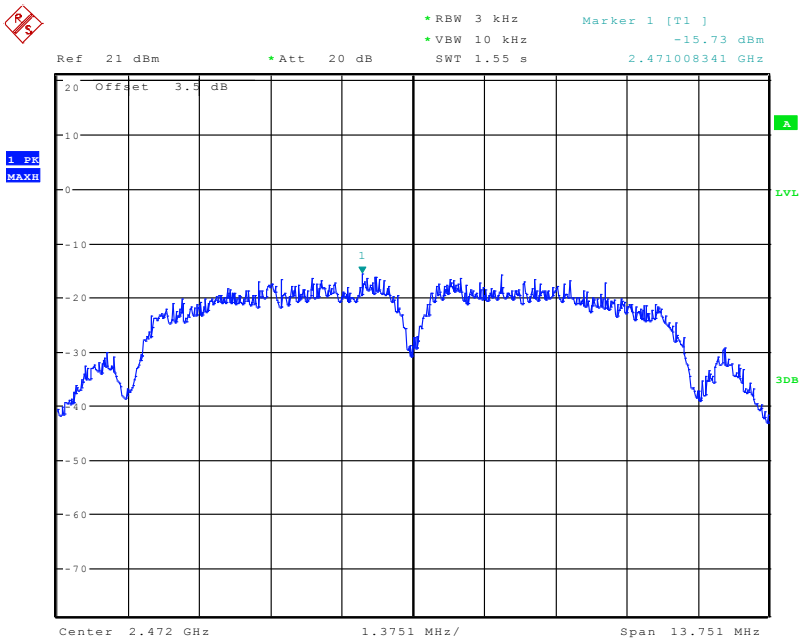
Power Spectral Density, 802.11b Middle Channel



Date: 25.APR.2020 15:18:38

Power Spectral Density, 802.11b High Channel



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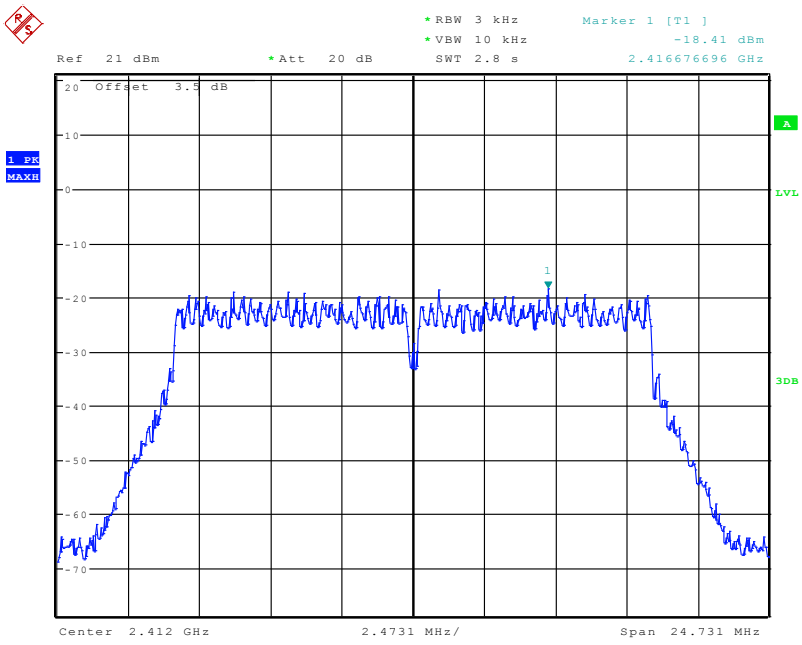
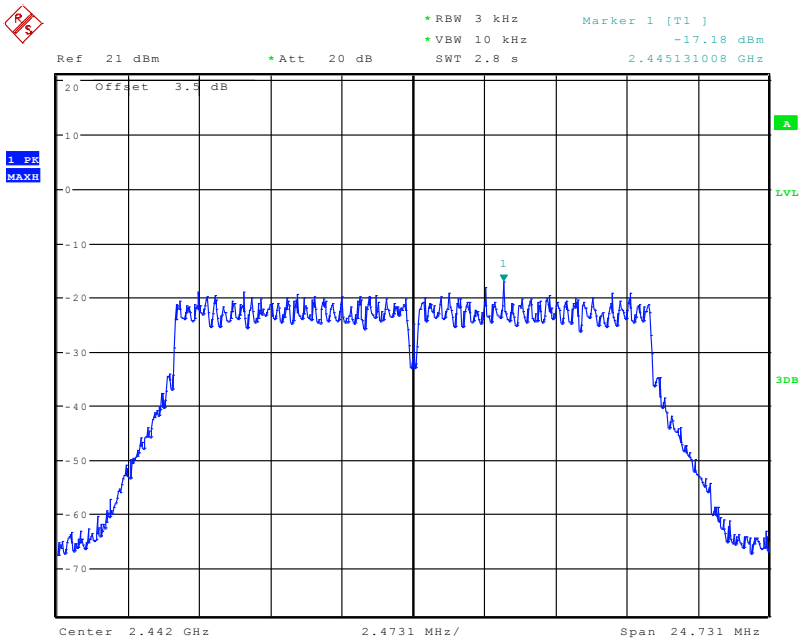
Power Spectral Density, 802.11g Low Channel



Date: 25.APR.2020 15:20:27

Power Spectral Density, 802.11g Middle Channel



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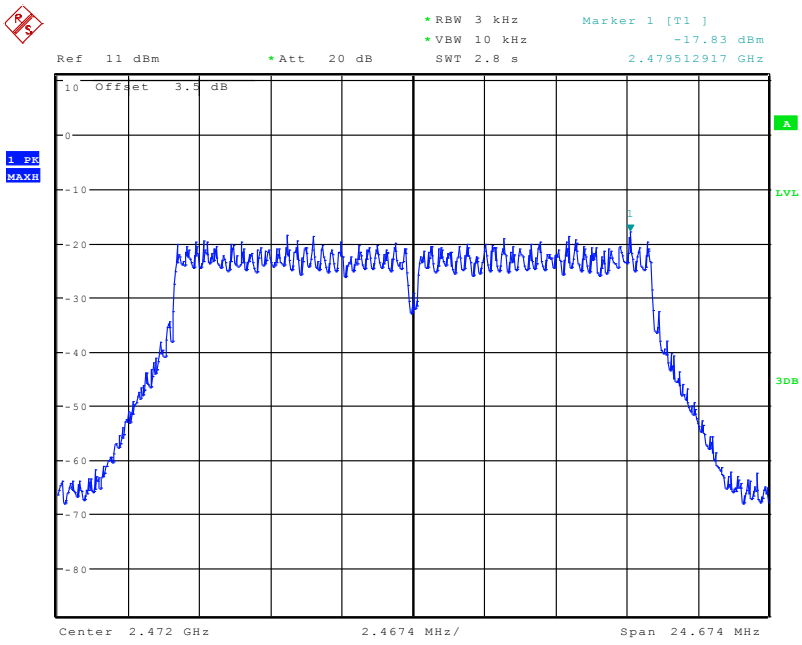
Power Spectral Density, 802.11g High Channel



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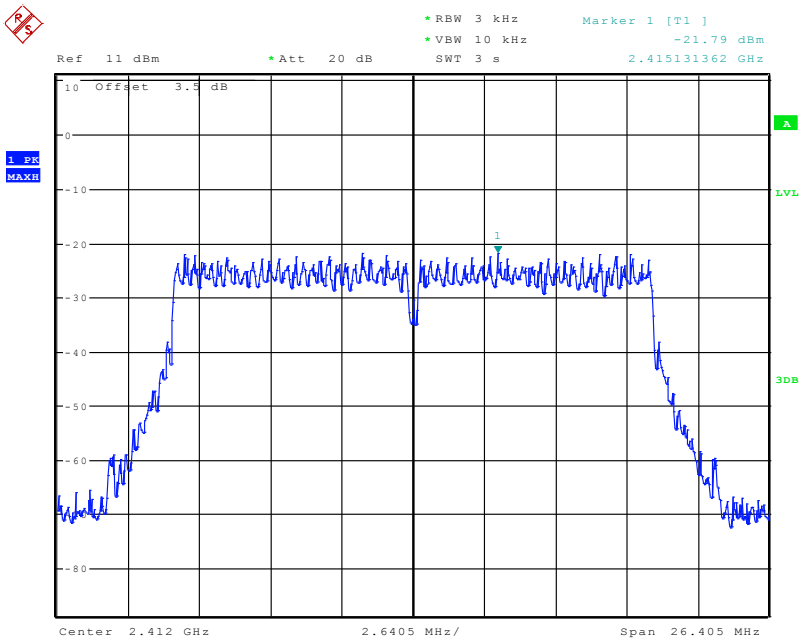
Power Spectral Density, 802.11n-HT20 Low Channel



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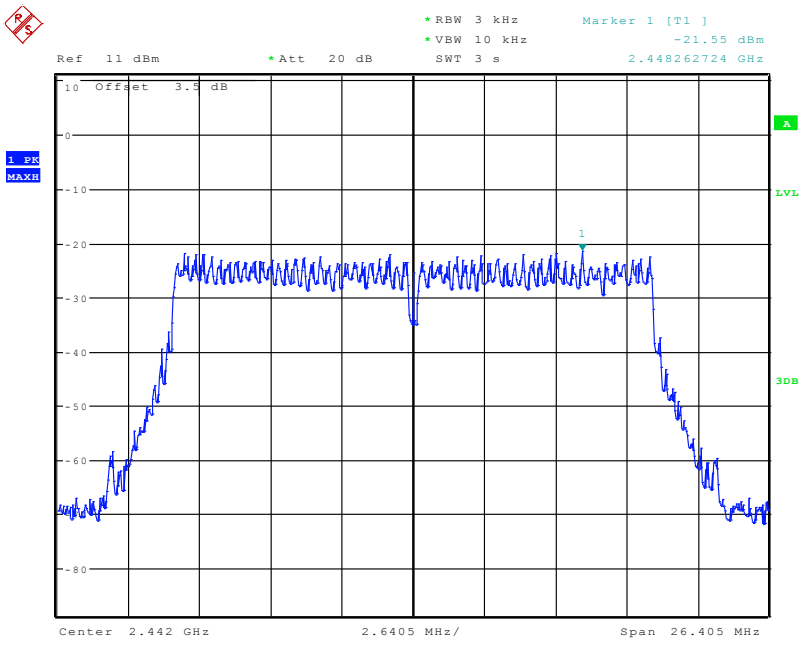
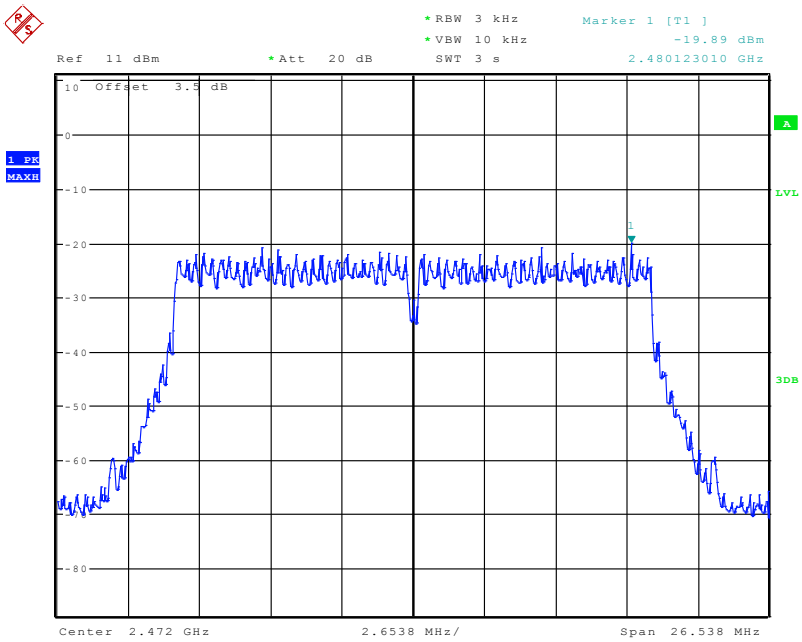
Power Spectral Density, 802.11n-HT20 Middle Channel



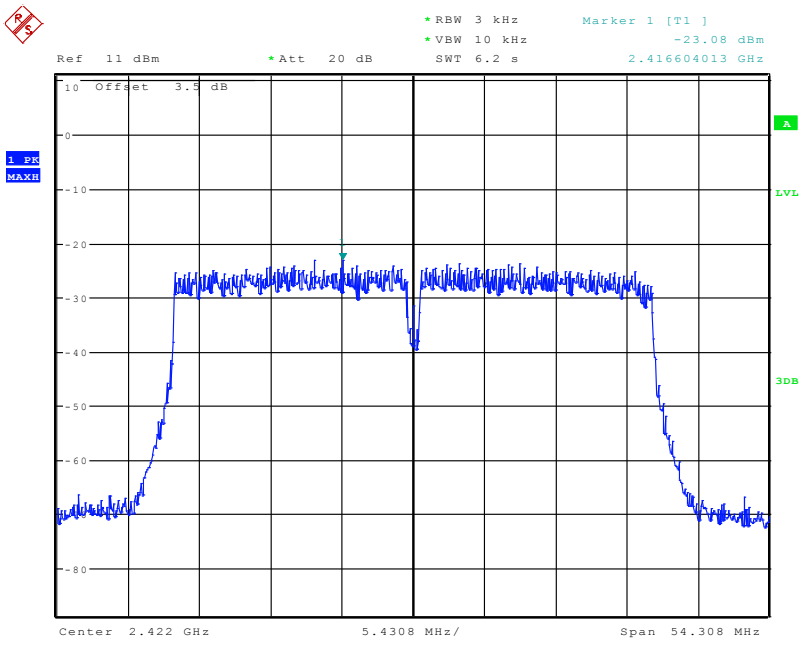
Date: 25.APR.2020 15:24:32

Power Spectral Density, 802.11n-HT20 High Channel



Date: 25.APR.2020 15:23:24

Power Spectral Density, 802.11n-HT40 Low Channel



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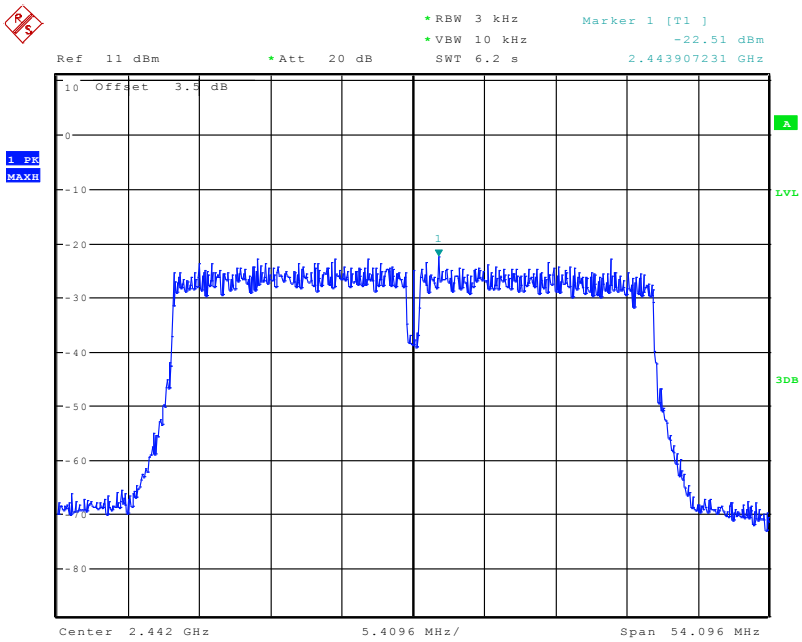
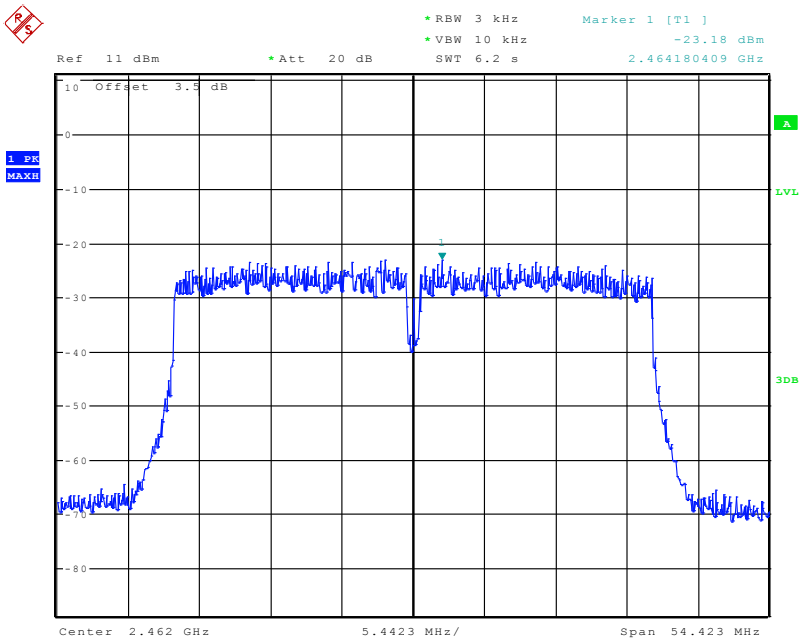
Power Spectral Density, 802.11n-HT40 Middle Channel



Date: 25.APR.2020 15:27:27

Power Spectral Density, 802.11n-HT40 High Channel



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