FCC PART 15.247

TEST REPORT

For

Proton Products International Ltd.

10 Aylesbury End, Beaconsfield, Buckinghamshire HP9 1LW, UNITED KINGDOM

Tested Model: PT_CC3200
FCC ID: 2AKS2PTCC3200

Report Type:	**Product Name:**
Original Report	WIFI Module

Report Number: RSC191122001-0B

Date of Report Issue: 2020-03-27

Reviewed By: Sula Huang

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Proton Products International Ltd.
Product	WIFI Module
Tested Model	PT_CC3200
FCC ID	2AKS2PTCC3200
Frequency	2412 MHz-2462 MHz (802.11b/g/n20)
Number of Channel	11
RF Output Power	802.11b:14.35 dBm 802.11g:18.78 dBm 802.11n20:18.56 dBm
Modulation Type	802.11b: DSSS 802.11g/n20: OFDM
Antenna Specification	Monopole Antenna/Gain: 2.0 dBi (max)
Voltage Range	DC 3.3V
Measure approximately	25.5 mm (L) x 15.5 mm (W) x 1.0m (H)
Sample serial number	191122001/01 (assigned by the BACL, Chengdu)
Sample/EUT Status	The test sample was in good condition and received: 2019-11-22

Note: Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

Objective

This report is prepared on behalf of **Proton Products International Ltd.** in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communications Commission's rules.

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

Related Submittal(s)/Grant(s)

N/A

Measurement Uncertainty

Item			Uncertainty
AC power line conducted emission			2.24 dB
Radiated Emission(Field Strength)	30MHz-200MHz	H	4.47 dB
		V	4.73 dB
	200MHz-1GHz	H	4.87 dB
		V	5.93 dB
	1GHz-6GHz		4.74 dB
	6GHz-18GHz		4.76 dB
	18GHz-40GHz		-

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the corresponding inclusion factor K when the inclusion probability is about 95%.

Test Methodology

All measurements contained in this report were conducted with:

1. ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

2. KDB558074 D01 DTS Meas Guidance v05r02.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Chengdu) to collect test data is located No.5040, Huilongwan Plaza, No. 1, Shawan Road, Jinniu District, Chengdu, Sichuan, China.

Bay Area Compliance Laboratories Corp. (Chengdu) lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4324.01) and the FCC designation No. CN1186 under the FCC KDB 974614 D01. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

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SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured in testing mode, which was provided by manufacturer.

For WiFi mode, 802.11b, 802.11g, and 802.11n-HT20 mode, 11 channels are provided to testing:

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

EUT were tested with Channel 1, 6 and 11.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

The setting by the software as following table:

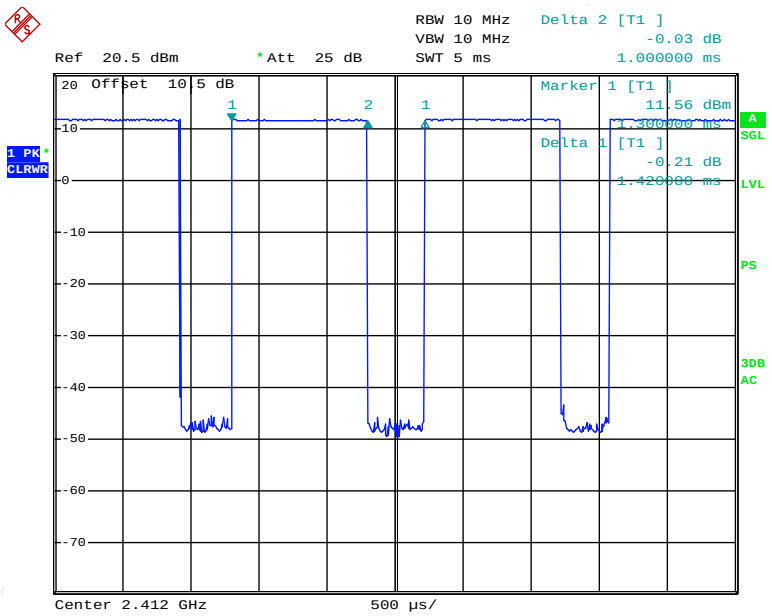
Test Mode	Test Software Version	CC3200		
802.11b	Test Frequency	2412 MHz	2437 MHz	2462 MHz
	Data Rate	1Mbps	1Mbps	1Mbps
	Power Level	5	5	5
802.11g	Test Frequency	2412 MHz	2437 MHz	2462 MHz
	Data Rate	6Mbps	6Mbps	6Mbps
	Power Level	5	5	5
802.11n-HT20	Test Frequency	2412 MHz	2437 MHz	2462 MHz
	Data Rate	MCS0	MCS0	MCS0
	Power Level	5	5	5

Duty Cycle information is below:

Mode	T_{on}	T_p	Duty Cycle	1/T	Duty Cycle Factor
	(ms)	(ms)	(%)	(kHz)	(dB)
802.11b	1.00	1.42	70.42	1.00	1.52
802.11g	0.160	0.338	47.34	6.25	3.25
802.11n-HT20	0.164	0.352	46.59	6.10	3.42

Duty Cycle Factor =10*log (1/x), “x” means Duty Cycle.

802.11b



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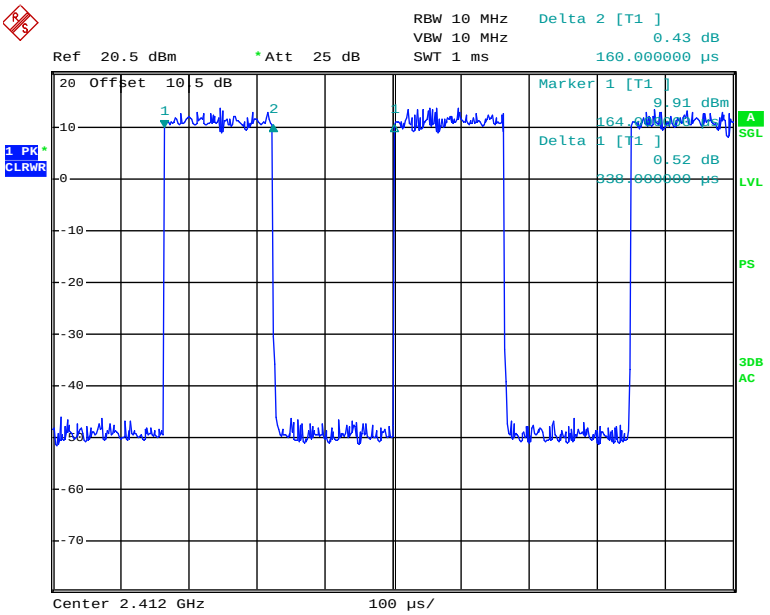
802.11g



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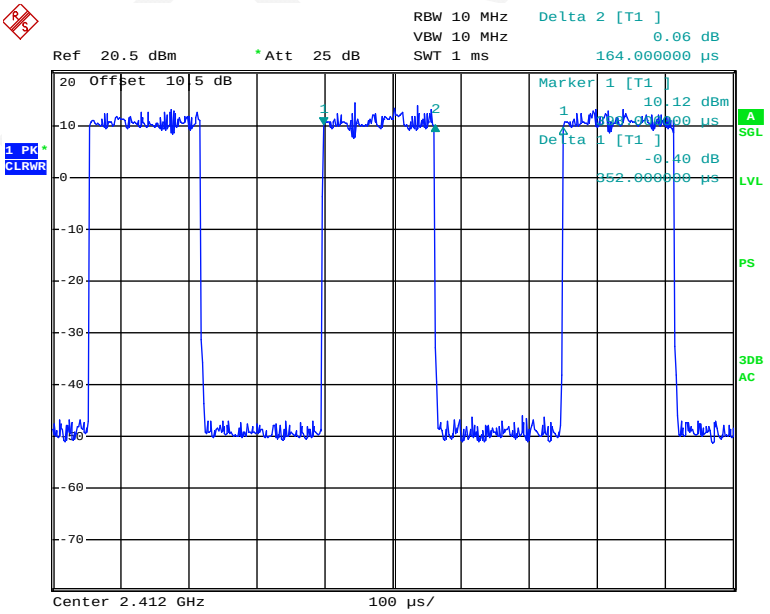
802.11n-HT20



Date: 20.MAR.2020 21:15:40

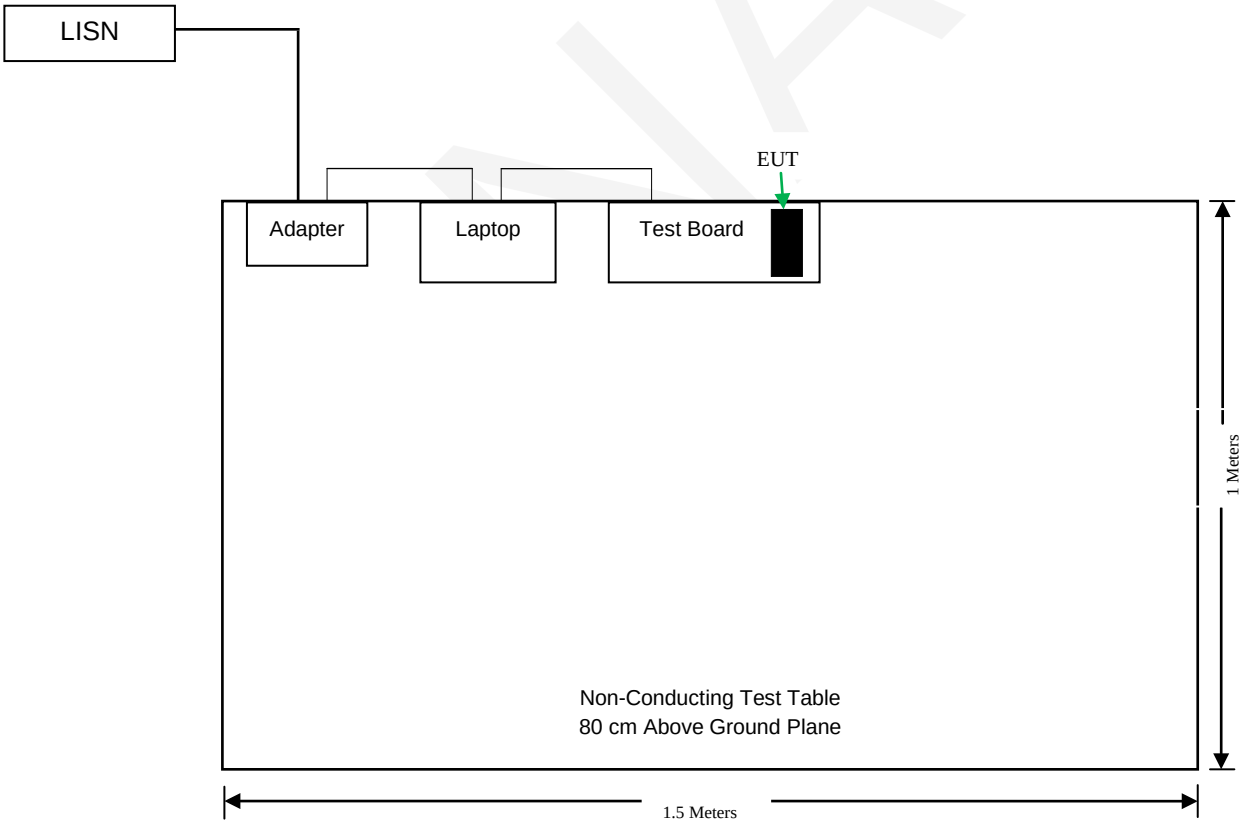
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
DELL	Laptop	E75	PCOR364L
DELL	Adapter	UE532	BTXWLX1
Proton	Test Board	Unknown	Unknown

External I/O Cable

Cable Description	Length (m)	From	To
Unshielded USB Cable	1.0	Test Board	Laptop

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §15.247 & §1.1310 & §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

Note: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

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TEST EQUIPMENTS LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emission					
Rohde & Schwarz	EMI Test Receiver	ESCI	100028	2019-04-15	2020-04-14
ROHDE&SCHWARZ	L.I.S.N.	ENV216	3560.6550.16	2020-01-13	2021-01-12
HP	RF Limiter	11947A	3107A01270	2019-10-18	2020-10-17
Utiflex MICRO-COAX	Conducted Cable	L-E003	000003	2019-08-05	2020-08-04
Rohde & Schwarz	EMC32	EMC32	V 8.52.0	NCR	NCR
Radiated Emission					
EMCT	Semi-Anechoic Chamber	966	001	2017-05-18	2020-05-17
SONOMA INSTRUMENT	Pre-Amplifier	310 N	186684	2019-10-17	2020-10-16
Mini-circuits	Pre-Amplifier	ZVA-183-S+	771001215	2019-09-20	2020-09-19
EM Electronics	RF Pre-Amplifier	EM18G40	060725	2019-07-24	2020-07-23
SUNOL SCIENCES	Broadband Antenna	JB3	A121808	2019-12-10	2022-12-09
INMET	Attenuator	18N-6dB	N/A	2019-12-10	2022-12-09
EMCO	Horn Antenna	3115	2192	2019-09-25	2021-09-24
A.H. Systems, Inc	Horn Antenna	SAS-574	510	2019-09-02	2021-09-01
Rohde & Schwarz	EMI Test Receiver	ESR3	102456	2019-04-15	2020-04-14
Rohde & Schwarz	Spectrum Analyzer	FSU26	200835	2019-04-15	2020-04-14
MICRO-TRONICS	2.4GHz Notch Filter	BRM50702	G396	2020-02-22	2021-02-21
Rohde & Schwarz	EMI Test Receiver	ESIB 40	100215	2019-04-15	2020-04-14
Unknown	RF Cable (Below 1GHz)	L-E005	000005	2019-09-06	2020-09-05
Unknown	RF Cable (Below 1GHz)	T-E128	000128	2019-10-17	2020-10-16
UTiFLEX MICRO-COAX	Flexible microwave cable	T-E237	233522-001	2019-07-19	2020-07-18
UTiFLEX MICRO-COAX	RF Cable (Above 1GHz)	T-E069	000069	2019-07-24	2020-07-23
UTiFLEX MICRO-COAX	RF Cable (Above 1GHz)	T-E209	MFR 64639 2310	2019-07-19	2020-07-18
Rohde & Schwarz	EMC32	EMC32	V9.10.00	NCR	NCR

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2019-04-15	2020-04-14
Agilent	USB power sensor	U2021XA	MY53320008	2020-01-13	2021-01-12
WEINSCHEL ENGINEERING	Attenuator	1A 10dB	AB1165	2019-08-05	2020-08-04
RF Superstore	DC Block	RF-530004	Unknown	2019-08-05	2020-08-04
Unknown	RF Cable	Unknown	000007	Each Time	Each Time

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FCC §15.247 & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE

Applicable Standard

According to subpart 15.247 and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) 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;

According to §1.1310 and §2.1091 RF exposure is calculated.

Per 447498 D01 General RF Exposure Guidance v06**,** simultaneous transmission MPE test exclusion applies when the sum of the MPE for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0.
Calculated Formulary:

Predication of MPE limit at a given distance

$$S = PG/4\pi R^2$$

Where:
S = power density (in appropriate units, e.g. mW/cm^2);
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);

Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
802.11b	2412-2462	2.0	1.58	14.5	28.18	20	0.009	1.0
802.11g	2412-2462	2.0	1.58	19.0	79.43	20	0.025	1.0
802.11n20	2412-2462	2.0	1.58	19.0	79.43	20	0.025	1.0

Result: The device meets RF exposure evaluation greater than 20cm distance specified in §2.1091. If the device built into a host as a portable usage, the additional RF exposure evaluation may be required as specified by §2.1093.

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.

Antenna Connector Construction

The EUT has one external monopole antenna, fulfill the requirement of this section. Please refer to the EUT photos.

Manufacturer	Model Number	Antenna Size	Antenna Gain	Nominal Impedance	Antenna Connector	Antenna Type
Low Power Radio Solutions Ltd	ANT-SS2.4G	62mmx8mm	2.0dBi	50 ohm	Reverse SMA male	Monopole

Result: Compliance

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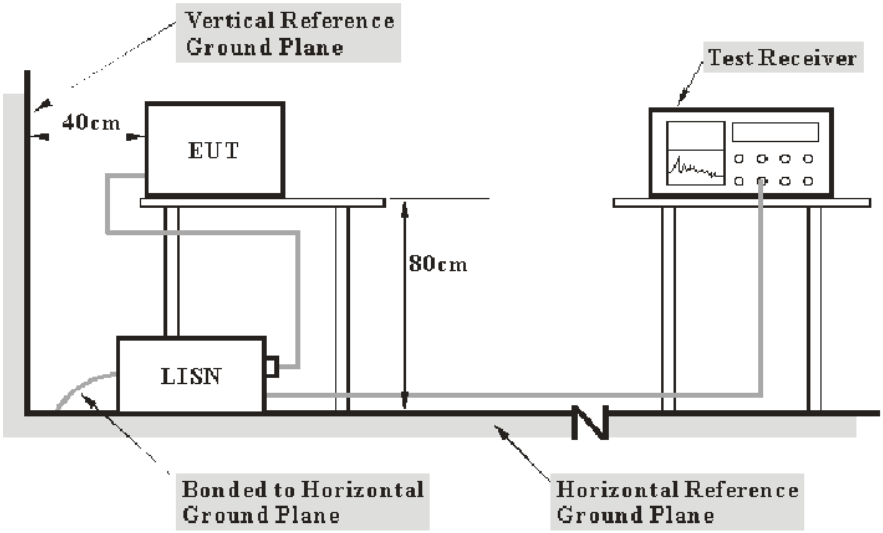
FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

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 first L.I.S.N.

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

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

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$V_C = V_R + A_C + VDF$
$C_f = A_C + VDF$

Herein,
V_C (cord. Reading): corrected voltage amplitude
V_R: reading voltage amplitude
A_c: attenuation caused by cable loss
VDF: voltage division factor of AMN
C_f: Correction Factor

The "**Margin**" column of the following data tables indicates the degree of compliance within 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

Test Environment Conditions

Temperature:	20 °C
Relative Humidity:	65 %
ATM Pressure:	95.1 kPa

The testing was performed by Eric Xiao on 2020-03-20.

Test Mode: Transmitting (802.11b Low Channel-Worst Case)

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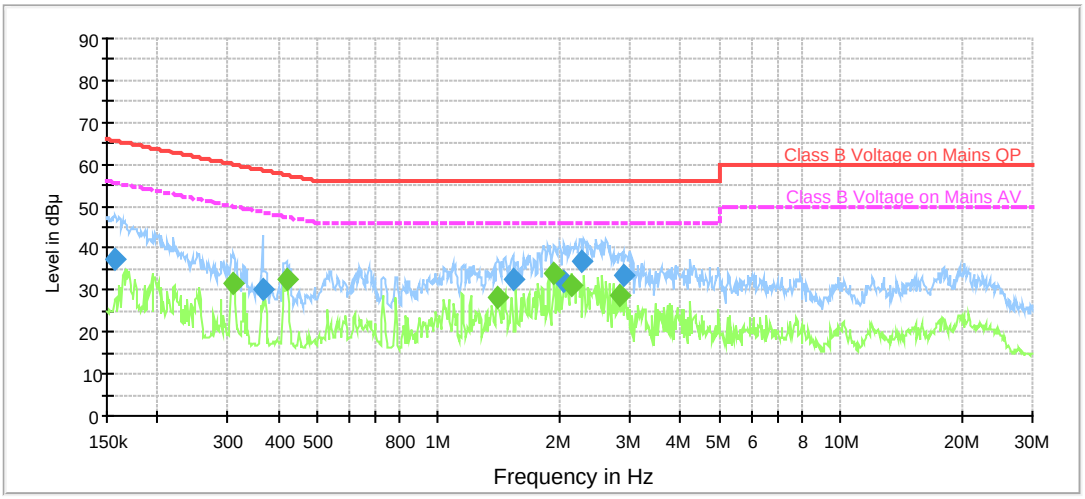
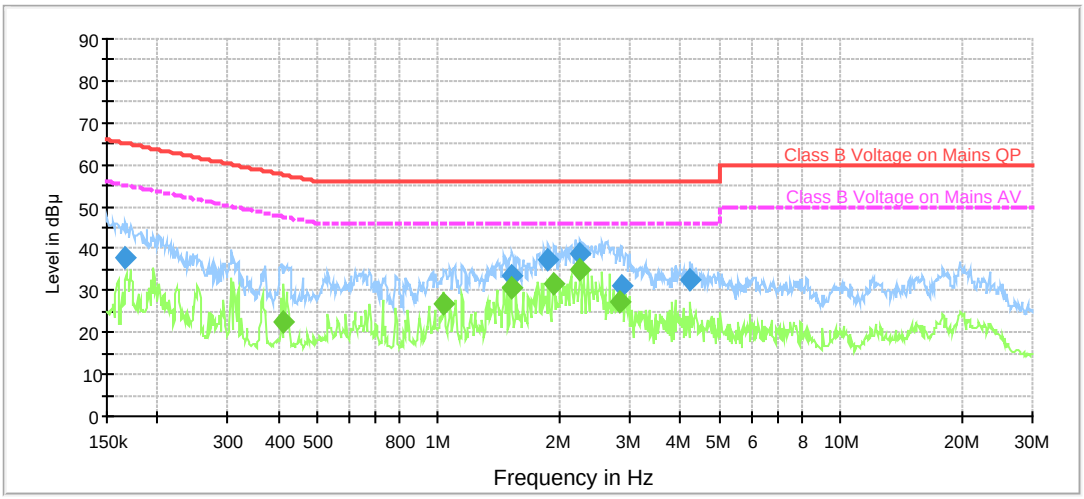
AC120 V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.157671	37.2	9.000	L1	19.6	28.4	65.6
0.366283	30.2	9.000	L1	19.8	28.4	58.6
1.532768	32.3	9.000	L1	19.8	23.7	56.0
2.057188	32.0	9.000	L1	19.8	24.0	56.0
2.261670	37.0	9.000	L1	19.8	19.0	56.0
2.887794	33.5	9.000	L1	19.8	22.5	56.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.310697	31.6	9.000	L1	19.8	18.4	50.0
0.421179	32.7	9.000	L1	19.8	14.7	47.4
1.401158	28.4	9.000	L1	19.8	17.6	46.0
1.937676	33.9	9.000	L1	19.8	12.1	46.0
2.140930	31.0	9.000	L1	19.8	15.0	46.0
2.830753	28.5	9.000	L1	19.8	17.5	46.0

AC120 V, 60 Hz, Neutral:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.166563	38.0	9.000	N	19.6	27.1	65.1
1.525142	33.6	9.000	N	19.8	22.4	56.0
1.880550	37.2	9.000	N	19.8	18.8	56.0
2.250417	38.9	9.000	N	19.8	17.1	56.0
2.844906	31.1	9.000	N	19.8	24.9	56.0
4.239874	32.5	9.000	N	19.7	23.5	56.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.412859	22.3	9.000	N	19.8	25.3	47.6
1.033612	26.6	9.000	N	19.8	19.4	46.0
1.517554	30.9	9.000	N	19.8	15.1	46.0
1.937676	31.6	9.000	N	19.8	14.4	46.0
2.250417	34.9	9.000	N	19.8	11.1	46.0
2.816669	27.3	9.000	N	19.8	18.7	46.0

Note:

1) Correction Factor =LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
   The corrected factor has been input into the transducer of the test software.
2) Corrected Amplitude = Reading + Correction Factor
3) Margin = Limit – Corrected Amplitude

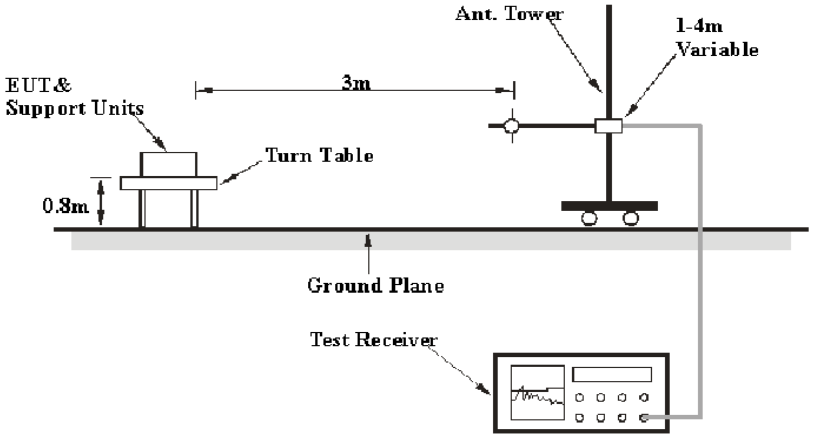
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

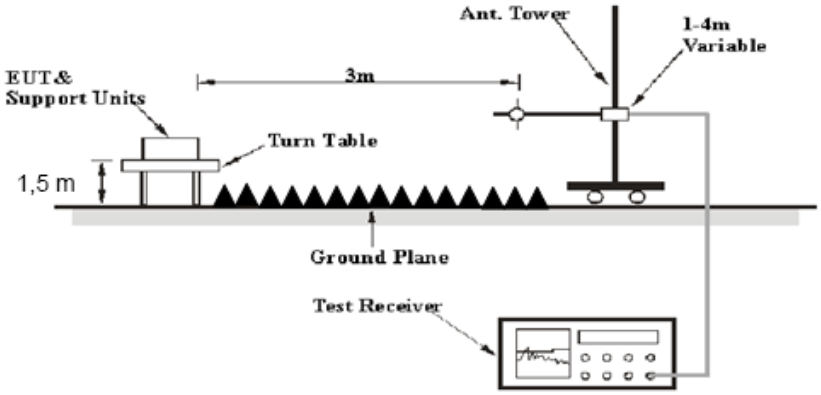
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

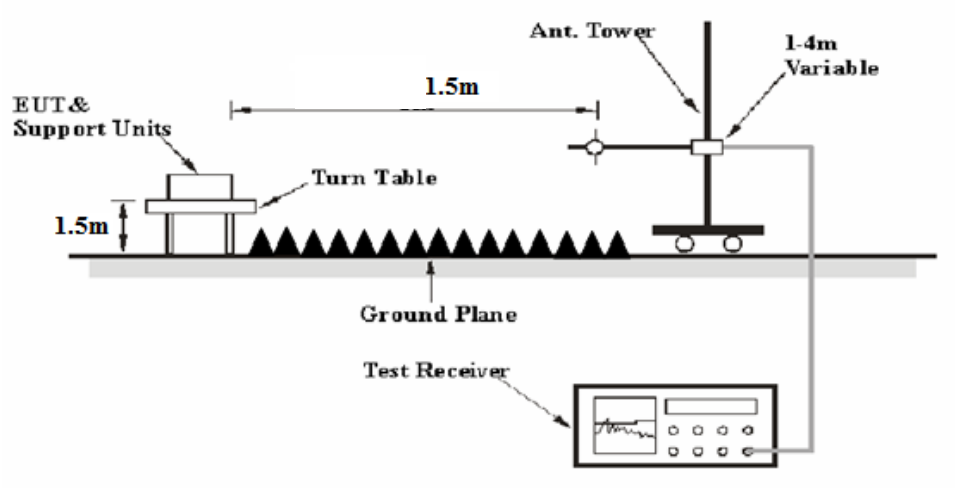
Below 1GHz:



1GHz-13GHz:



13GHz-26.5GHz:



The radiated emission tests were performed in the 3 meters chamber 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.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

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EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 26.5 GHz.

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

Frequency Range	RBW	Video B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	QP
Above 1 GHz	1MHz	3 MHz	PK
	1MHz	3 MHz	AV

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

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.

According to C63.10, the above 1G test result shall be extrapolated to the specified distance using an extrapolation factor of 20dB/decade from 3m to 1.5m
Distance extrapolation factor =20*log (specific distance [3m]/test distance [1.5m]) dB
Extrapolation result = Corrected Amplitude (dBµV/m)-distance extrapolation factor (6dB)
or
In this case the limit L_2, corresponding to the selected measurement distance d_2, shall be calculated by applying the following formula:

$$L_2 = L_1 + 20 \log(d_1/d_2)$$

Where L_1 is the specified limit in dBµV/m at the distance d_1; and, L_2 is the new limit for distance d_2. The distances d_1 and d_2 use the same unit, such as m.

Corrected Amplitude & Margin Calculation

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

Corrected Amplitude = Meter Reading + Antenna Factor (dB/m) + 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

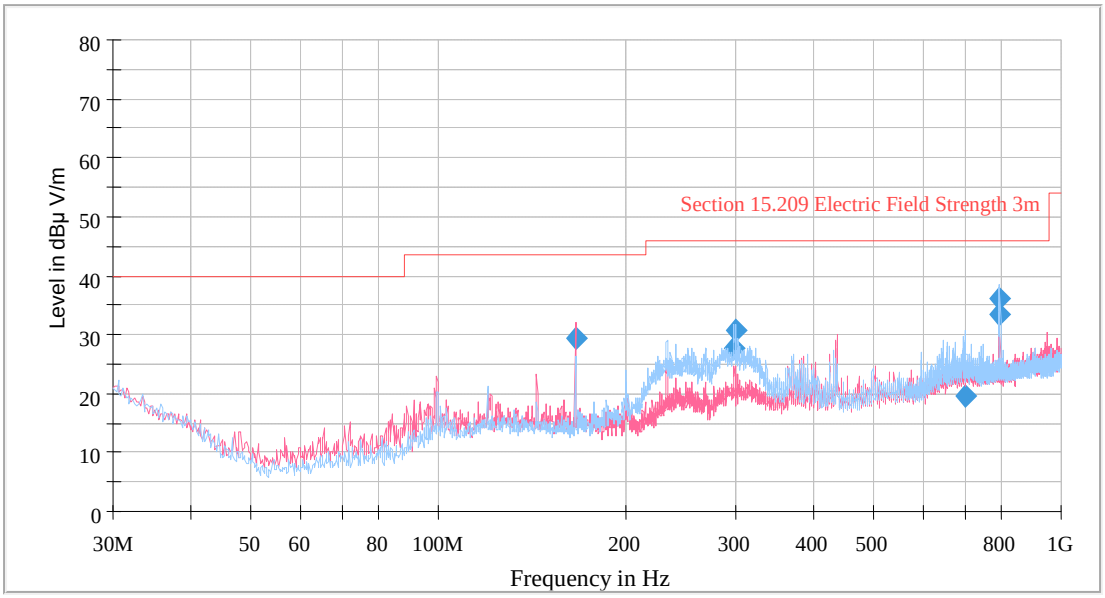
Test Environment Conditions

Temperature:	21 °C
Relative Humidity:	49 %
ATM Pressure:	96.1 kPa

The testing was performed by Eric Xiao on 2020-03-20.

Test Mode: Transmitting

30 MHz to 1 GHz: (802.11b_Low Channel-Worst case)



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
165.982000	29.38	43.50	14.12	120.000	111.0	V	165.0	-13.0
298.695300	27.73	46.00	18.27	120.000	124.0	H	307.0	-11.3
299.321500	30.64	46.00	15.36	120.000	120.0	H	166.0	-11.3
701.967700	19.44	46.00	26.56	120.000	106.0	H	43.0	-3.1
796.583900	36.15	46.00	9.85	120.000	103.0	H	4.0	-2.4
798.222300	33.55	46.00	12.45	120.000	114.0	H	9.0	-2.3

1 GHz to 26.5 GHz:

802.11b Mode

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	dB(1/m)	dB	dB	dBμV/m	dBμV/m	dB
Frequency: 2412 MHz									
2412	70.39	PK	V	29.12	3.55	0.00	103.06	N/A	N/A
2412	66.71	AV	V	29.12	3.55	0.00	99.38	N/A	N/A
2390	34.36	PK	V	29.15	3.54	0.00	67.05	74.00	6.95
2390	18.22	AV	V	29.15	3.54	0.00	50.91	54.00	3.09
4824	34.21	PK	V	33.04	5.06	27.27	45.04	74.00	28.96
4824	26.69	AV	V	33.04	5.06	27.27	37.52	54.00	16.48
7236	43.84	PK	V	35.82	6.44	27.10	59.00	74.00	15.00
7236	26.82	AV	V	35.82	6.44	27.10	41.98	54.00	12.02
3214	34.22	PK	V	30.71	4.16	27.60	41.49	74.00	32.51
3214	30.43	AV	V	30.71	4.16	27.60	37.70	54.00	16.30
4021	43.43	PK	V	32.39	4.66	27.49	52.99	74.00	21.01
4021	39.31	AV	V	32.39	4.66	28.00	48.36	54.00	5.64
Frequency: 2437 MHz									
2437	71.36	PK	V	29.09	3.57	0.00	104.02	N/A	N/A
2437	67.42	AV	V	29.09	3.57	0.00	100.08	N/A	N/A
4874	43.88	PK	V	33.17	5.09	27.26	54.88	74.00	19.12
4874	30.39	AV	V	33.17	5.09	27.26	41.39	54.00	12.61
7311	41.79	PK	V	35.98	6.48	27.11	57.14	74.00	16.86
7311	28.05	AV	V	35.98	6.48	27.11	43.40	54.00	10.60
3243	35.22	PK	V	30.78	4.18	27.60	42.58	74.00	31.42
3243	29.63	AV	V	30.78	4.18	27.60	36.99	54.00	17.01
4060	42.15	PK	V	32.38	4.68	27.48	51.73	74.00	22.27
4060	39.21	AV	V	32.38	4.68	27.48	48.79	54.00	5.21
Frequency: 2462 MHz									
2462	71.21	PK	V	29.05	3.59	0.00	103.85	N/A	N/A
2462	65.82	AV	V	29.05	3.59	0.00	98.46	N/A	N/A
2483.5	38.36	PK	V	29.02	3.61	0.00	70.99	74.00	3.01
2483.5	18.64	AV	V	29.02	3.61	0.00	51.27	54.00	2.73
4924	43.66	PK	V	33.30	5.12	27.25	54.83	74.00	19.17
4924	29.73	AV	V	33.30	5.12	27.25	40.90	54.00	13.10
7386	43.42	PK	V	36.15	6.52	27.12	58.97	74.00	15.03
7386	27.96	PK	V	36.15	6.52	27.12	43.51	74.00	30.49
3279	33.54	PK	V	30.87	4.21	27.59	41.03	74.00	32.97
3279	29.33	AV	V	30.87	4.21	27.59	36.82	54.00	17.18
4096	42.33	PK	V	32.36	4.69	27.47	51.91	74.00	22.09
4096	39.41	AV	V	32.36	4.69	27.47	48.99	54.00	5.01

802.11g Mode

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBµV	PK/AV	H/V	dB(1/m)	dB	dB	dBµV/m	dBµV/m	dB
Frequency: 2412 MHz									
2412	72.48	PK	V	29.12	3.55	0.00	105.15	N/A	N/A
2412	63.14	AV	V	29.12	3.55	0.00	95.81	N/A	N/A
2390	32.16	PK	V	29.15	3.54	0.00	64.85	74.00	9.15
2390	18.44	AV	V	29.15	3.54	0.00	51.13	54.00	2.87
4824	33.58	PK	V	33.04	5.06	27.27	44.41	74.00	29.59
4824	25.36	AV	V	33.04	5.06	27.27	36.19	54.00	17.81
7236	42.85	PK	V	35.82	6.44	27.10	58.01	74.00	15.99
7236	26.82	AV	V	35.82	6.44	27.10	41.98	54.00	12.02
3214	33.21	PK	V	30.71	4.16	27.60	40.48	74.00	33.52
3214	29.63	AV	V	30.71	4.16	27.60	36.90	54.00	17.10
4021	44.21	PK	V	32.39	4.66	27.49	53.77	74.00	20.23
4021	38.36	AV	V	32.39	4.66	28.00	47.41	54.00	6.59
Frequency: 2437 MHz									
2437	73.42	PK	V	29.09	3.57	0.00	106.08	N/A	N/A
2437	64.57	AV	V	29.09	3.57	0.00	97.23	N/A	N/A
4874	44.06	PK	V	33.17	5.09	27.26	55.06	74.00	18.94
4874	31.25	AV	V	33.17	5.09	27.26	42.25	54.00	11.75
7311	40.78	PK	V	35.98	6.48	27.11	56.13	74.00	17.87
7311	29.36	AV	V	35.98	6.48	27.11	44.71	54.00	9.29
3243	34.22	PK	V	30.78	4.18	27.60	41.58	74.00	32.42
3243	30.42	AV	V	30.78	4.18	27.60	37.78	54.00	16.22
4060	43.02	PK	V	32.38	4.68	27.48	52.60	74.00	21.40
4060	39.51	AV	V	32.38	4.68	27.48	49.09	54.00	4.91
Frequency: 2462 MHz									
2462	72.96	PK	V	29.05	3.59	0.00	105.60	N/A	N/A
2462	66.21	AV	V	29.05	3.59	0.00	98.85	N/A	N/A
2483.5	39.42	PK	V	29.02	3.61	0.00	72.05	74.00	**1.95**
2483.5	19.04	AV	V	29.02	3.61	0.00	51.67	54.00	2.33
4924	44.22	PK	V	33.30	5.12	27.25	55.39	74.00	18.61
4924	30.45	AV	V	33.30	5.12	27.25	41.62	54.00	12.38
7386	44.26	PK	V	36.15	6.52	27.12	59.81	74.00	14.19
7386	28.15	PK	V	36.15	6.52	27.12	43.70	74.00	30.30
3279	34.26	PK	V	30.87	4.21	27.59	41.75	74.00	32.25
3279	28.41	AV	V	30.87	4.21	27.59	35.90	54.00	18.10
4096	43.21	PK	V	32.36	4.69	27.47	52.79	74.00	21.21
4096	38.12	AV	V	32.36	4.69	27.47	47.70	54.00	6.30

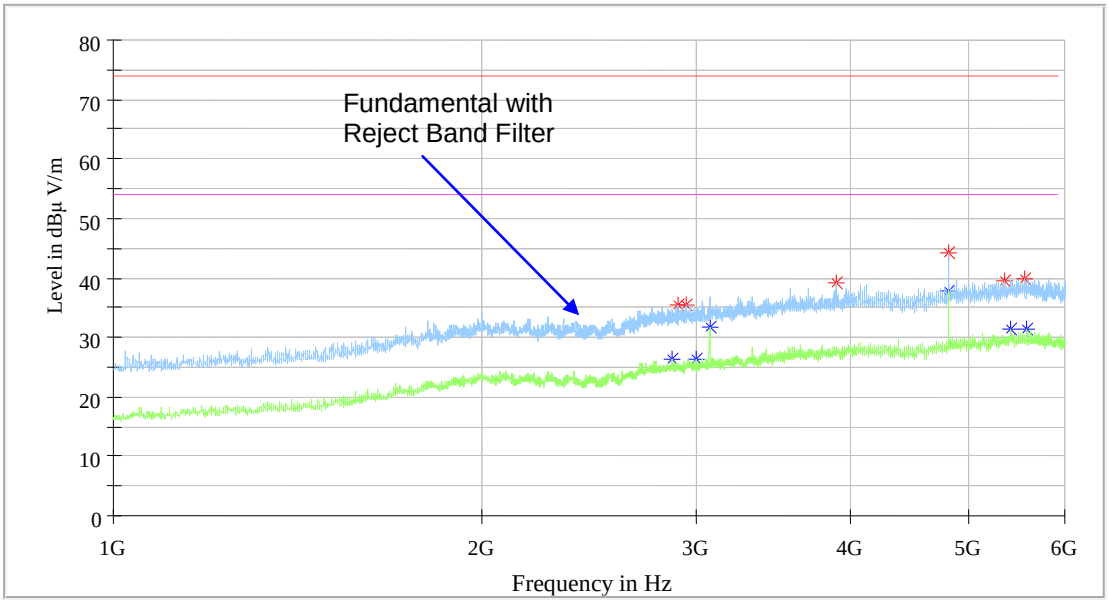
802.11n-HT20 Mode

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBµV	PK/AV	H/V	dB(1/m)	dB	dB	dBµV/m	dBµV/m	dB
Frequency: 2412 MHz									
2412	73.14	PK	V	29.12	3.55	0.00	105.81	N/A	N/A
2412	64.82	AV	V	29.12	3.55	0.00	97.49	N/A	N/A
2390	34.36	PK	V	29.15	3.54	0.00	67.05	74.00	6.95
2390	18.22	AV	V	29.15	3.54	0.00	50.91	54.00	3.09
4824	34.21	PK	V	33.04	5.06	27.27	45.04	74.00	28.96
4824	26.69	AV	V	33.04	5.06	27.27	37.52	54.00	16.48
7236	43.84	PK	V	35.82	6.44	27.10	59.00	74.00	15.00
7236	26.82	AV	V	35.82	6.44	27.10	41.98	54.00	12.02
3214	34.22	PK	V	30.71	4.16	27.60	41.49	74.00	32.51
3214	30.43	AV	V	30.71	4.16	27.60	37.70	54.00	16.30
4021	43.43	PK	V	32.39	4.66	27.49	52.99	74.00	21.01
4021	39.31	AV	V	32.39	4.66	28.00	48.36	54.00	5.64
Frequency: 2437 MHz									
2437	74.15	PK	V	29.09	3.57	0.00	106.81	N/A	N/A
2437	64.92	AV	V	29.09	3.57	0.00	97.58	N/A	N/A
4874	44.45	PK	V	33.17	5.09	27.26	55.45	74.00	18.55
4874	29.14	AV	V	33.17	5.09	27.26	40.14	54.00	13.86
7311	43.71	PK	V	35.98	6.48	27.11	59.06	74.00	14.94
7311	26.14	AV	V	35.98	6.48	27.11	41.49	54.00	12.51
3243	33.75	PK	V	30.78	4.18	27.60	41.11	74.00	32.89
3243	29.65	AV	V	30.78	4.18	27.60	37.01	54.00	16.99
4060	41.57	PK	V	32.38	4.68	27.48	51.15	74.00	22.85
4060	39.3	AV	V	32.38	4.68	27.48	48.88	54.00	5.12
Frequency: 2462 MHz									
2462	73.92	PK	V	29.05	3.59	0.00	106.56	N/A	N/A
2462	64.01	AV	V	29.05	3.59	0.00	96.65	N/A	N/A
2483.5	38.61	PK	V	29.02	3.61	0.00	71.24	74.00	2.76
2483.5	19.19	AV	V	29.02	3.61	0.00	51.82	54.00	2.18
4924	43.05	PK	V	33.30	5.12	27.25	54.22	74.00	19.78
4924	28.59	AV	V	33.30	5.12	27.25	39.76	54.00	14.24
7386	44.36	PK	V	36.15	6.52	27.12	59.91	74.00	14.09
7386	26.2	PK	V	36.15	6.52	27.12	41.75	74.00	32.25
3279	34.07	PK	V	30.87	4.21	27.59	41.56	74.00	32.44
3279	27.74	AV	V	30.87	4.21	27.59	35.23	54.00	18.77
4096	41.23	PK	V	32.36	4.69	27.47	50.81	74.00	23.19
4096	39.27	AV	V	32.36	4.69	27.47	48.85	54.00	5.15

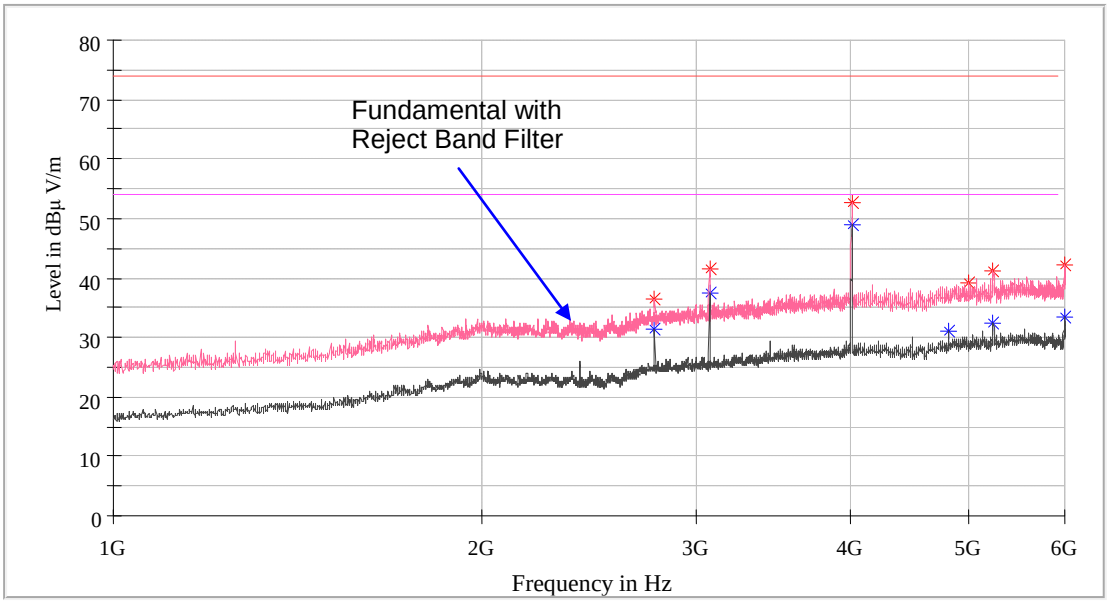
Note:
Corrected Amplitude = Corrected Factor + Reading
Corrected Factor=Antenna factor (RX) + Cable Loss – Amplifier Factor
Margin = Limit- Corr. Amplitude

Please refer to the below pre-scan plot of worst case:

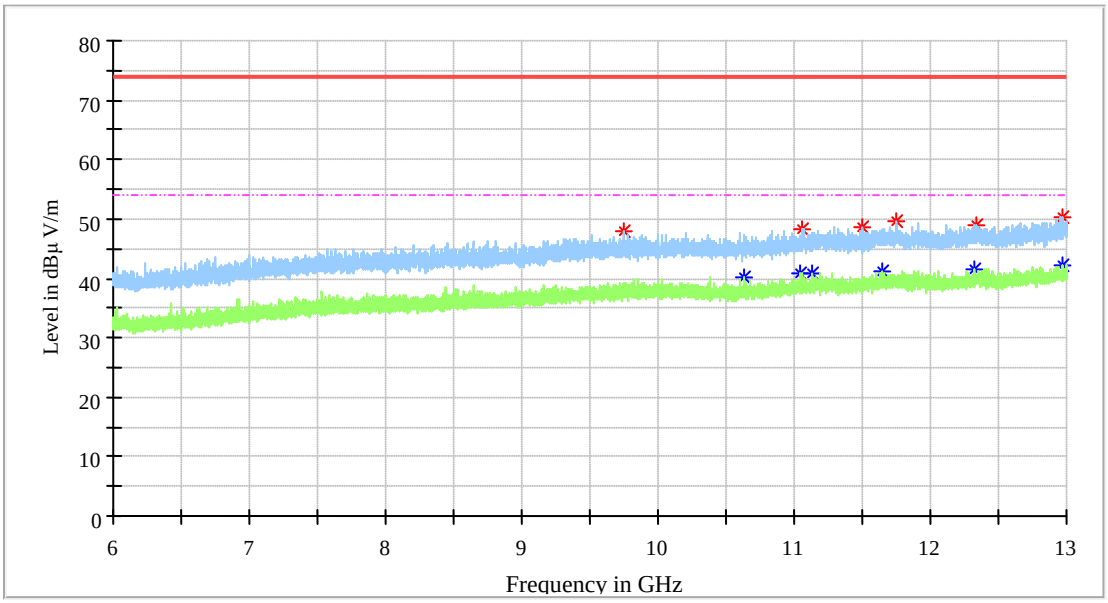
802.11g Mode: High Channel_Horizontal_1 GHz-6 GHz



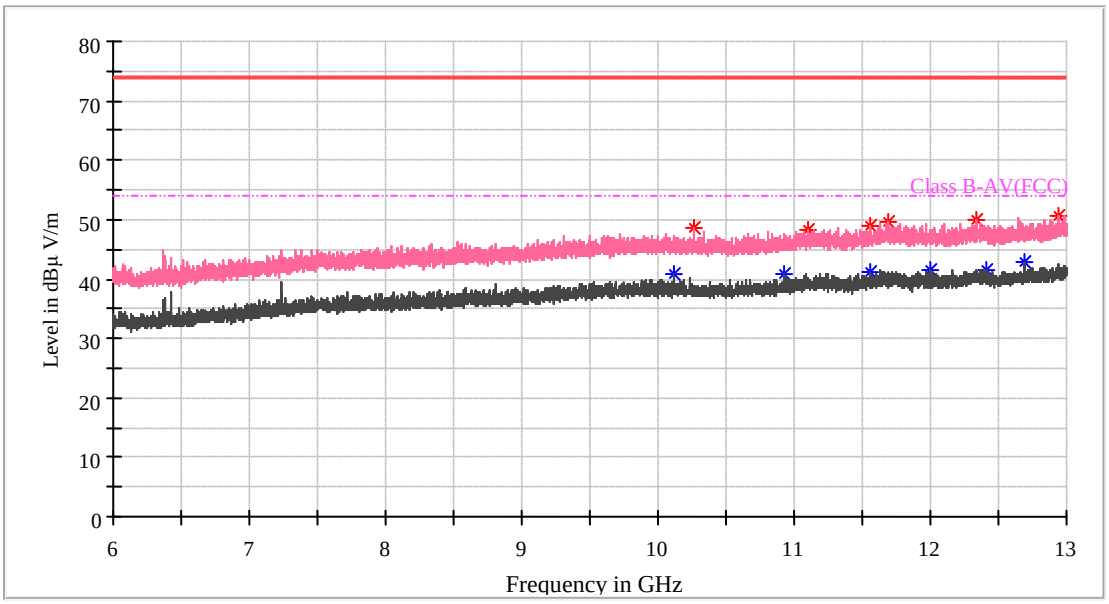
802.11g Mode: High Channel_Vertical_1 GHz-6 GHz



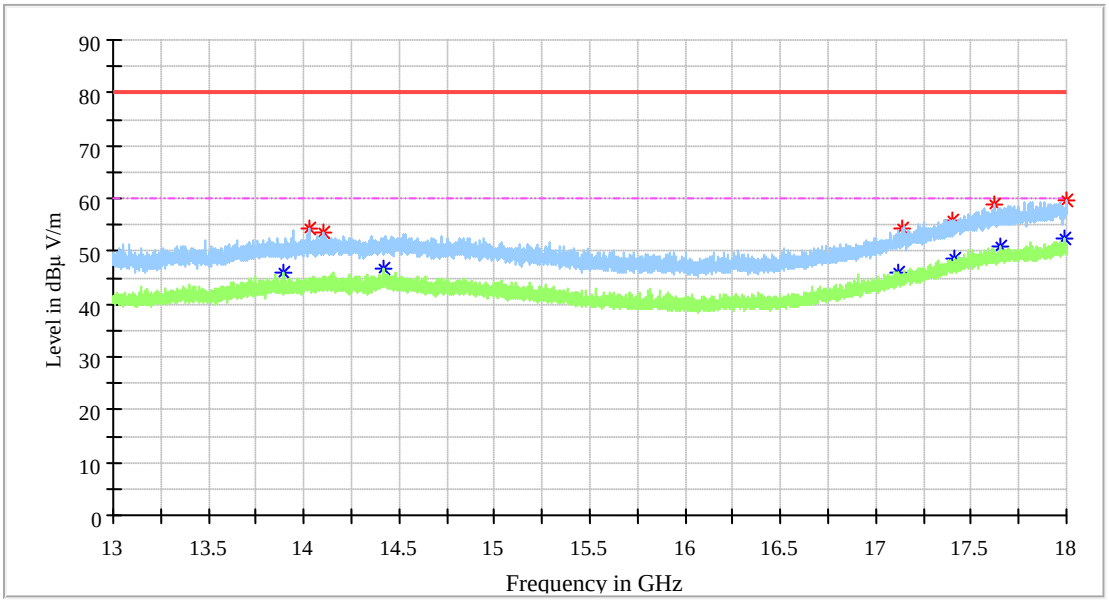
802.11g Mode: High Channel_Horizontal_6 GHz-13 GHz



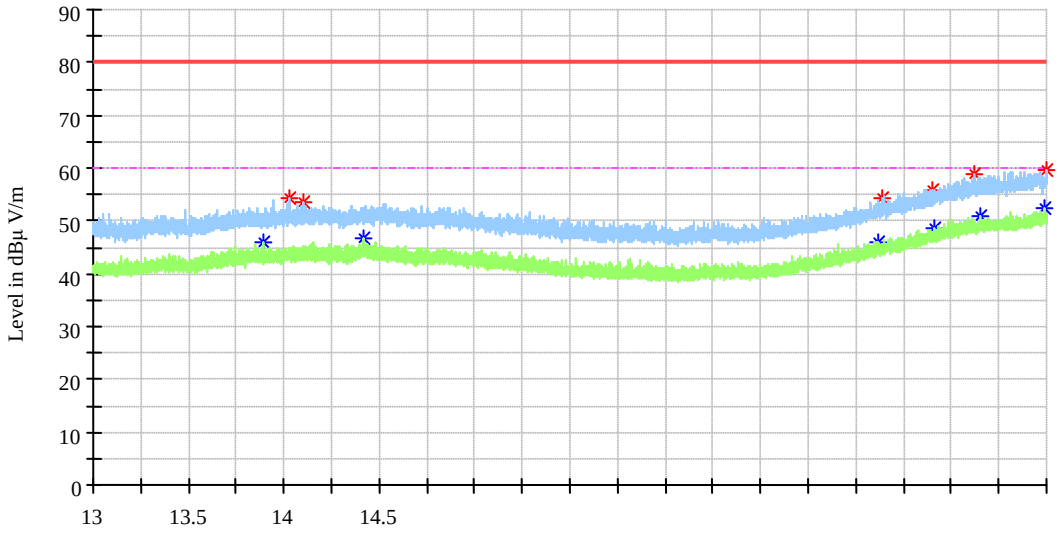
802.11g Mode: High Channel_Vertical_6 GHz-13 GHz



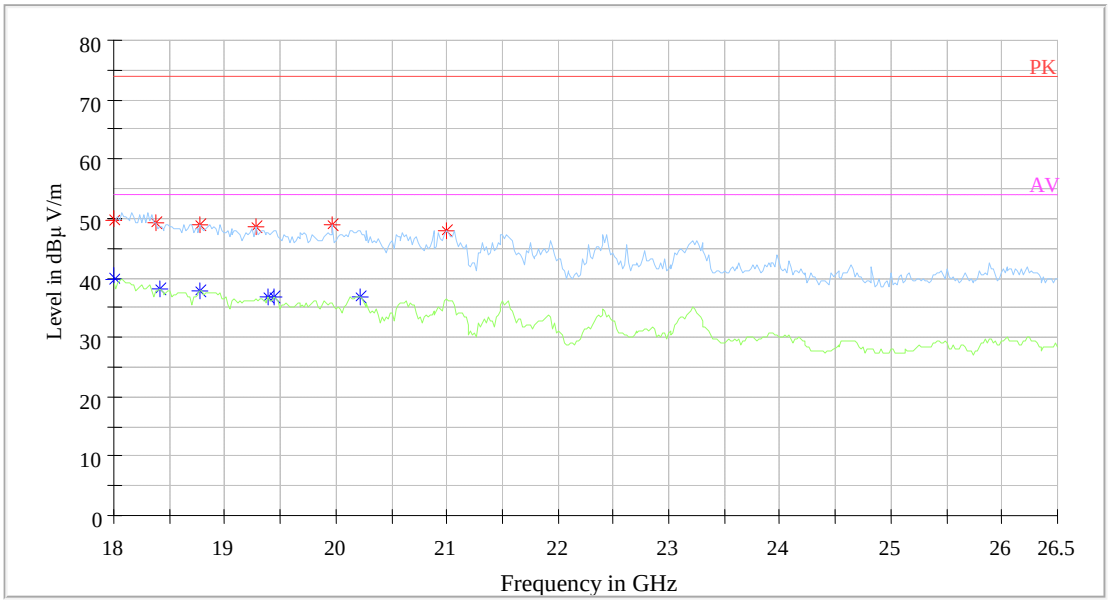
802.11g Mode: High Channel_Horizontal_13 GHz-18 GHz



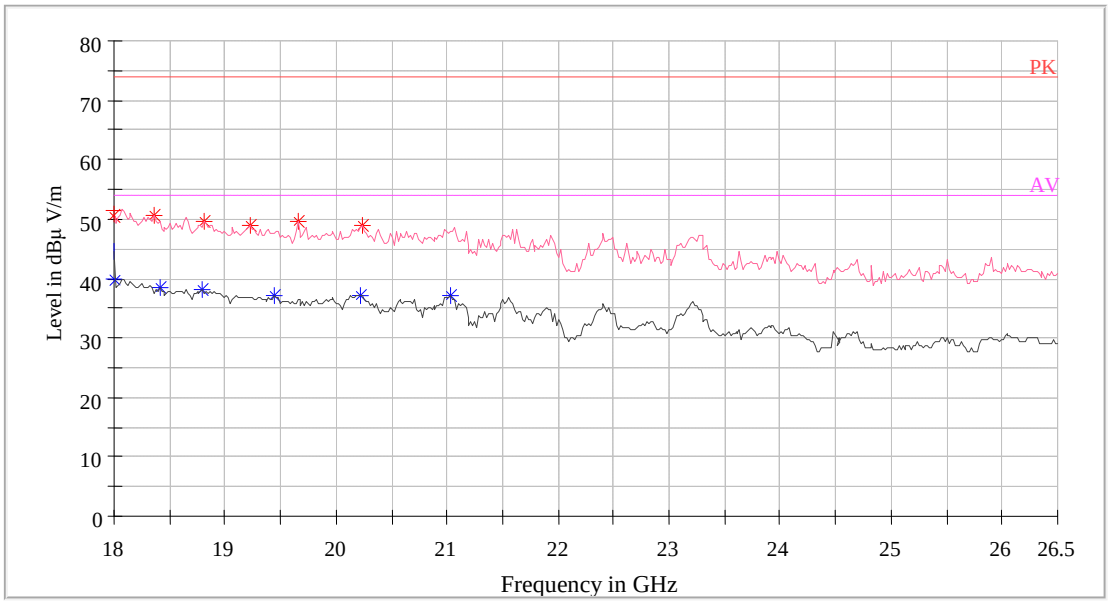
802.11g Mode: High Channel_Vertical_13 GHz-18 GHz



802.11g Mode: High Channel_Horizontal_18 GHz-26.5 GHz



802.11g Mode: High Channel_Vertical_18 GHz-26.5 GHz



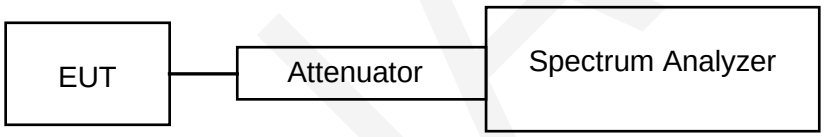
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

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

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3×RBW
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.



FINAL

Test Data

Environmental Conditions

Temperature:	19 °C
Relative Humidity:	63 %
ATM Pressure:	96.1 kPa

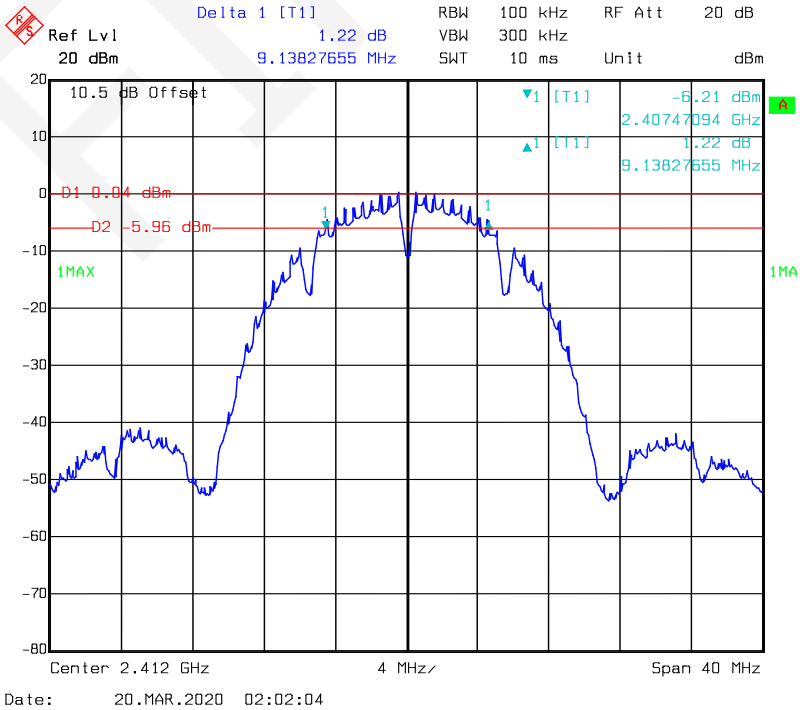
The testing was performed by Eric Xiao on 2020-03-20.

Test Mode: Transmitting

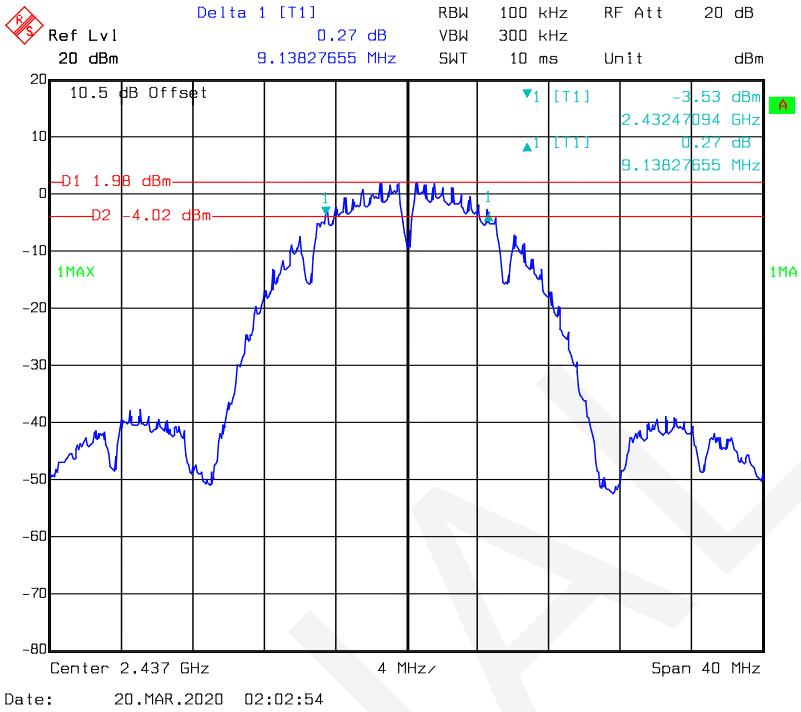
Test Result: Compliance. Please refer to the following table and plots.

Mode	Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)
802.11b	Low	2412	9.138	≥0.50
	Middle	2437	9.138	≥0.50
	High	2462	9.138	≥0.50
802.11g	Low	2412	15.15	≥0.50
	Middle	2437	14.99	≥0.50
	High	2462	14.99	≥0.50
802.11n-HT20	Low	2412	15.15	≥0.50
	Middle	2437	15.15	≥0.50
	High	2462	15.15	≥0.50

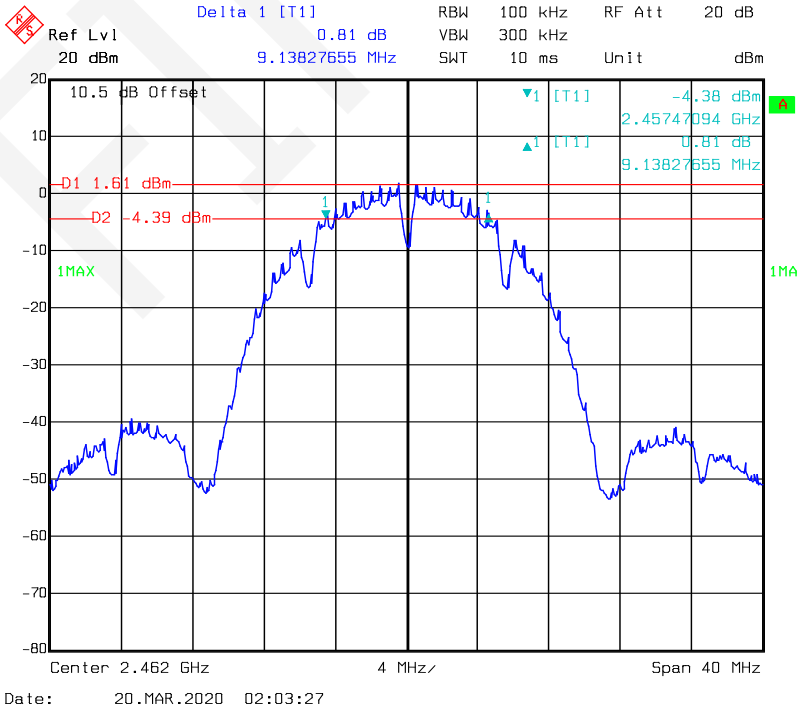
802.11b Low Channel



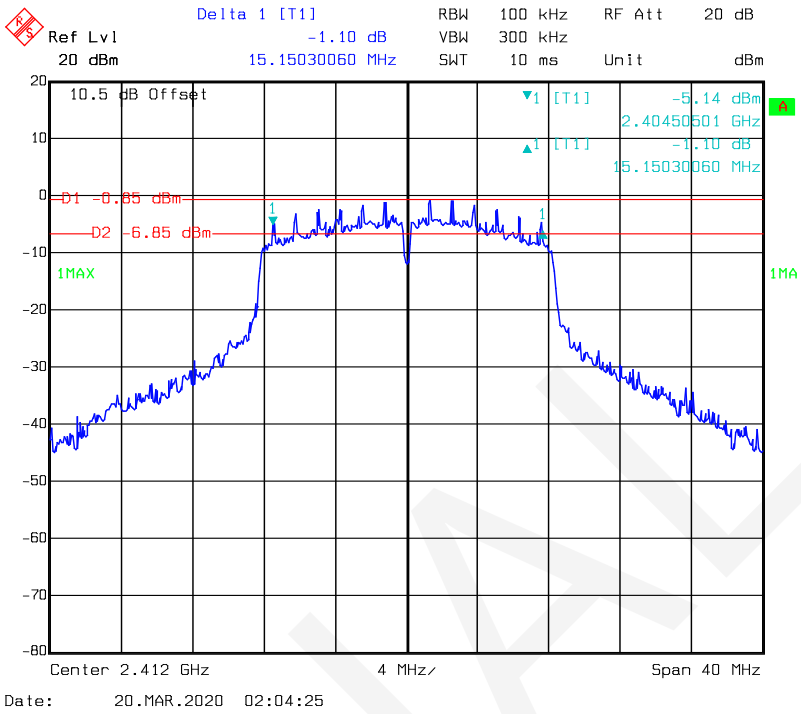
802.11b Middle Channel



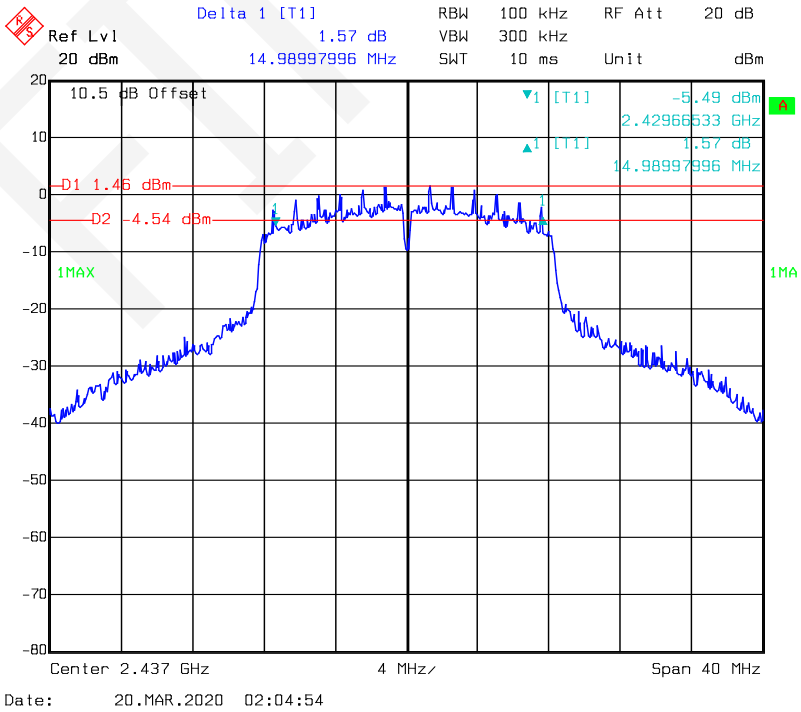
802.11b High Channel



802.11g Low Channel

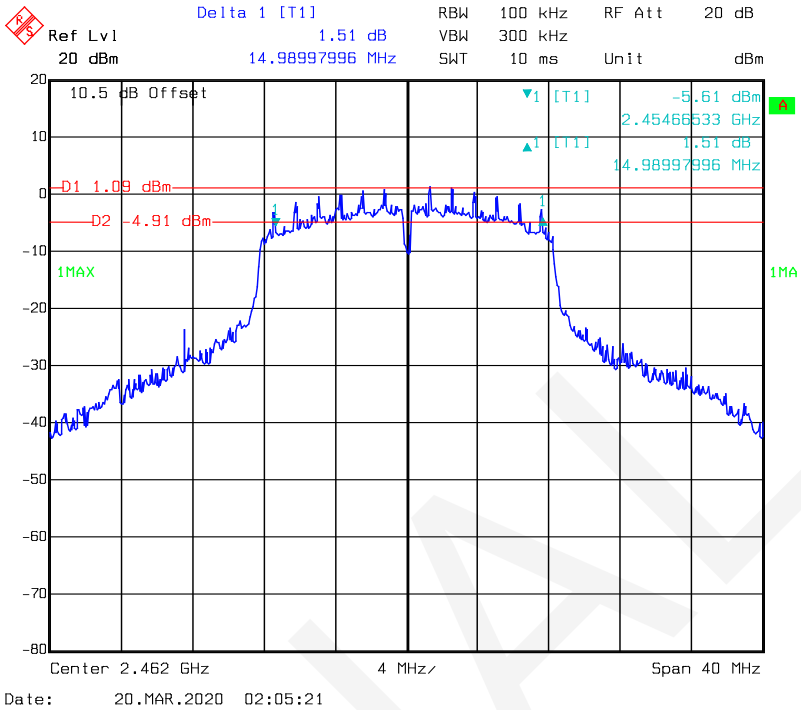


802.11g Middle Channel

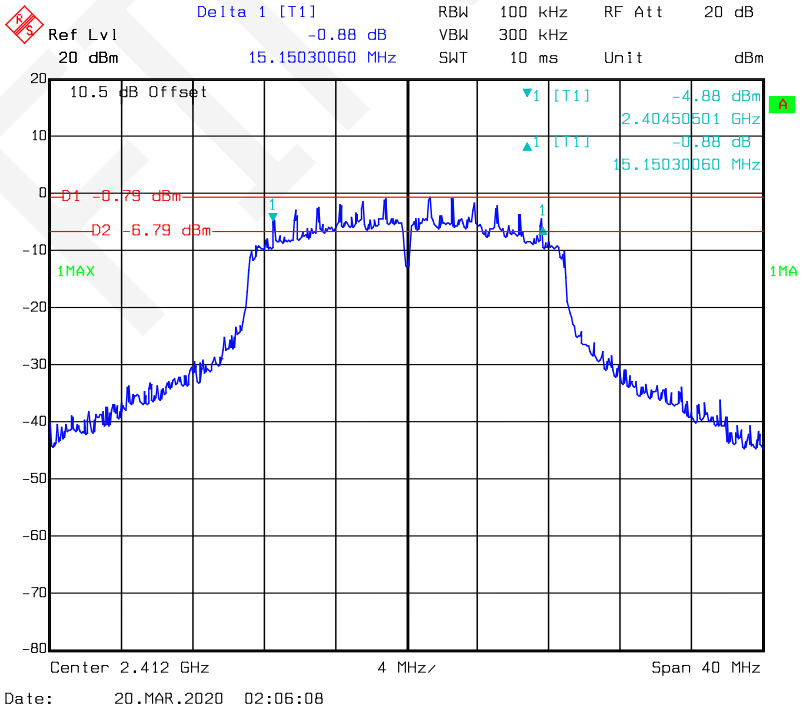


FINAL

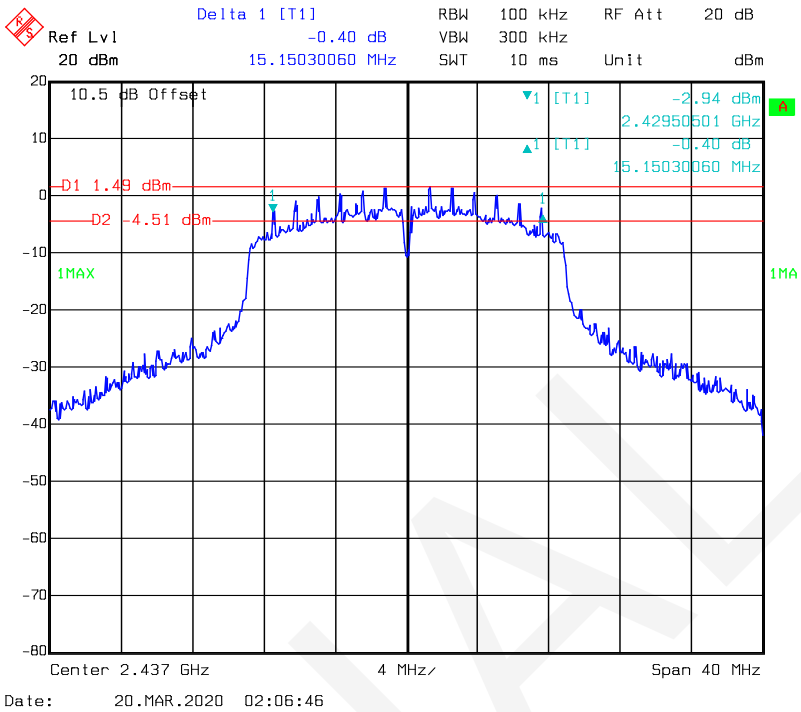
802.11g High Channel



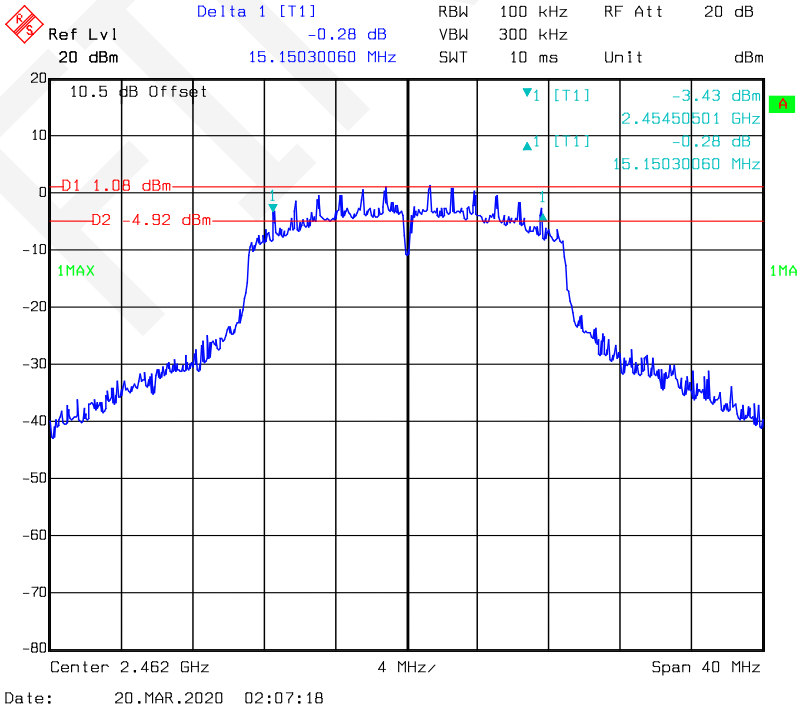
802.11n-HT20 Low Channel



802.11n-HT20 Middle Channel



802.11n-HT20 High Channel



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 test equipment.
3. Add a correction factor to the display.

FINAL

Test Data

Environmental Conditions

Temperature:	19 °C
Relative Humidity:	63 %
ATM Pressure:	96.1 kPa

The testing was performed by Eric Xiao on 2020-03-20.

Test Mode: Transmitting

Test Result: Compliance. Please refer to the following table.

Mode	Channel	Frequency (MHz)	Max Peak Conducted Output Power (dBm)	Limit (dBm)
802.11b	Low	2412	12.04	30
	Middle	2437	14.35	30
	High	2462	13.78	30
802.11g	Low	2412	16.85	30
	Middle	2437	18.78	30
	High	2462	18.56	30
802.11n-HT20	Low	2412	16.65	30
	Middle	2437	18.56	30
	High	2462	18.43	30

Note: The duty cycle factor was calculated in result.

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:	19 °C
Relative Humidity:	61 %
ATM Pressure:	95.9 kPa

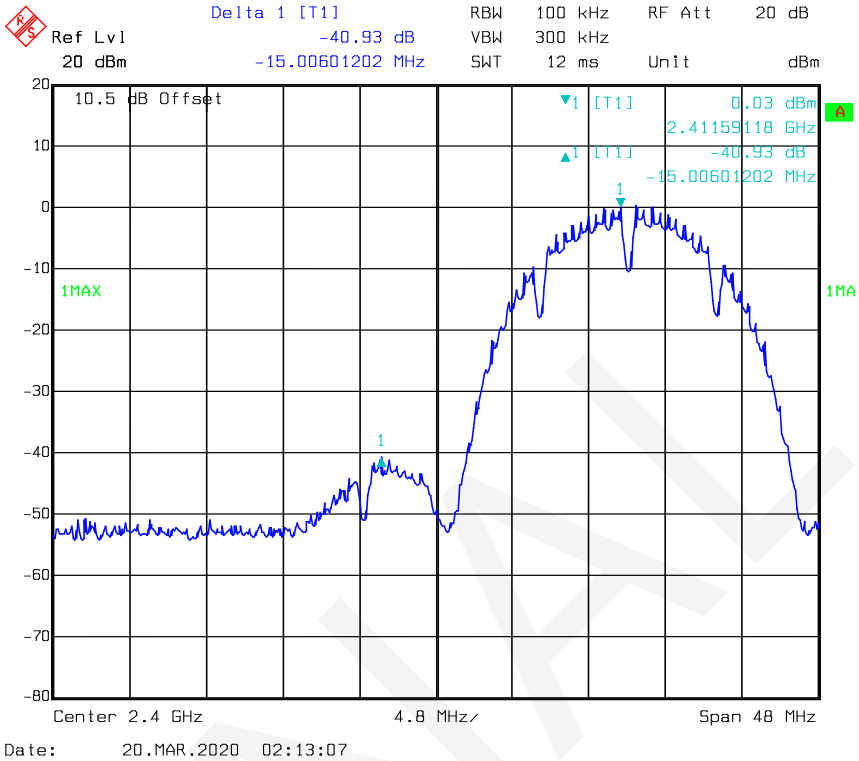
The testing was performed by Eric Xiao on 2020-03-20.

Test mode: Transmitting

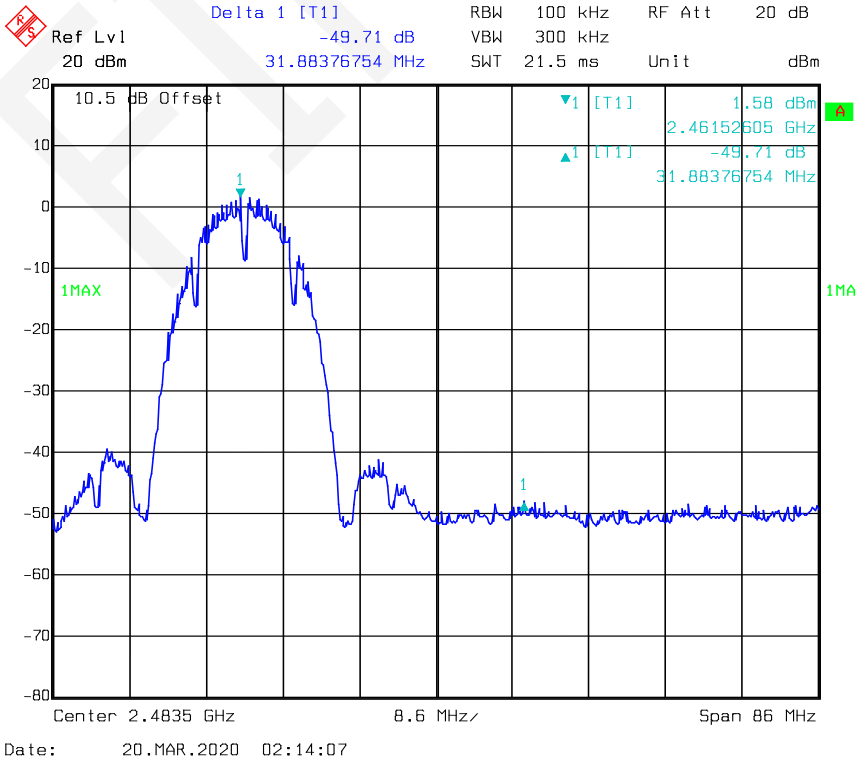
Test Result: Compliance. Please refer to following plots.

FINAL

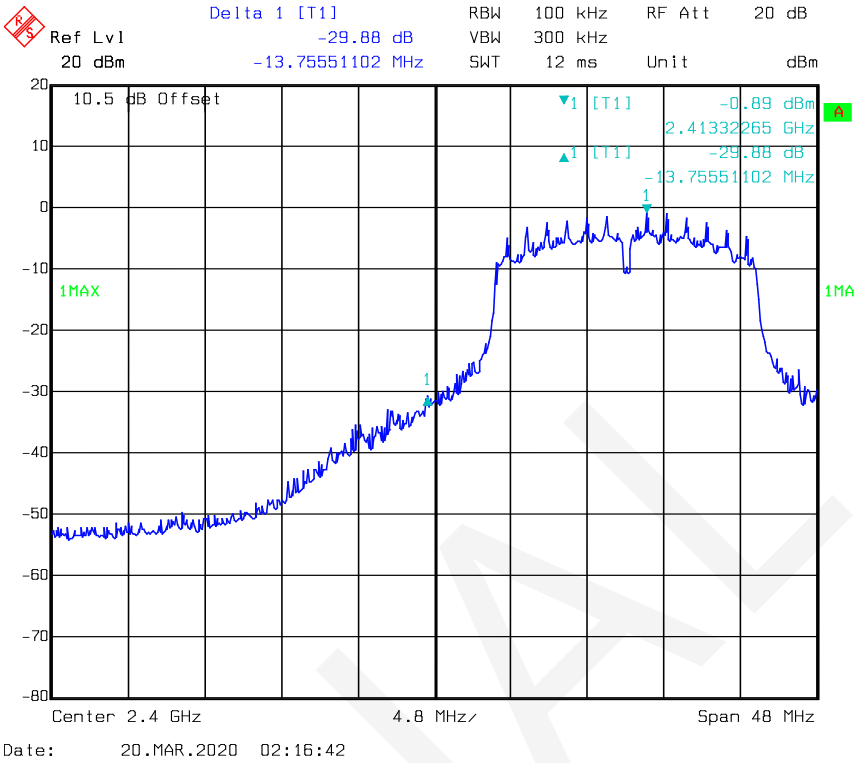
802.11b: Band Edge, Left Side



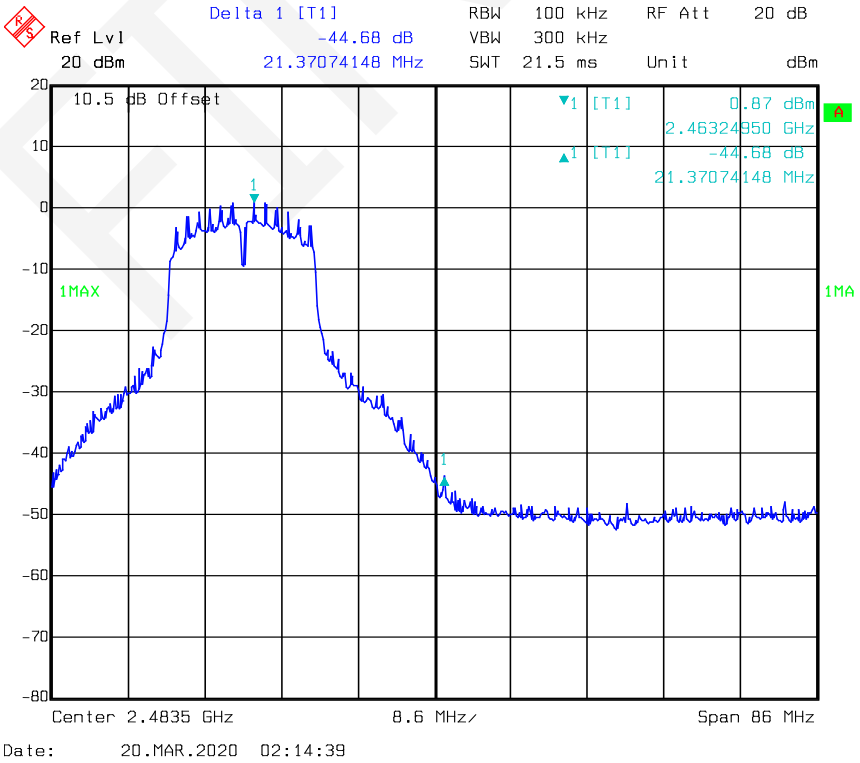
802.11b: Band Edge, Right Side



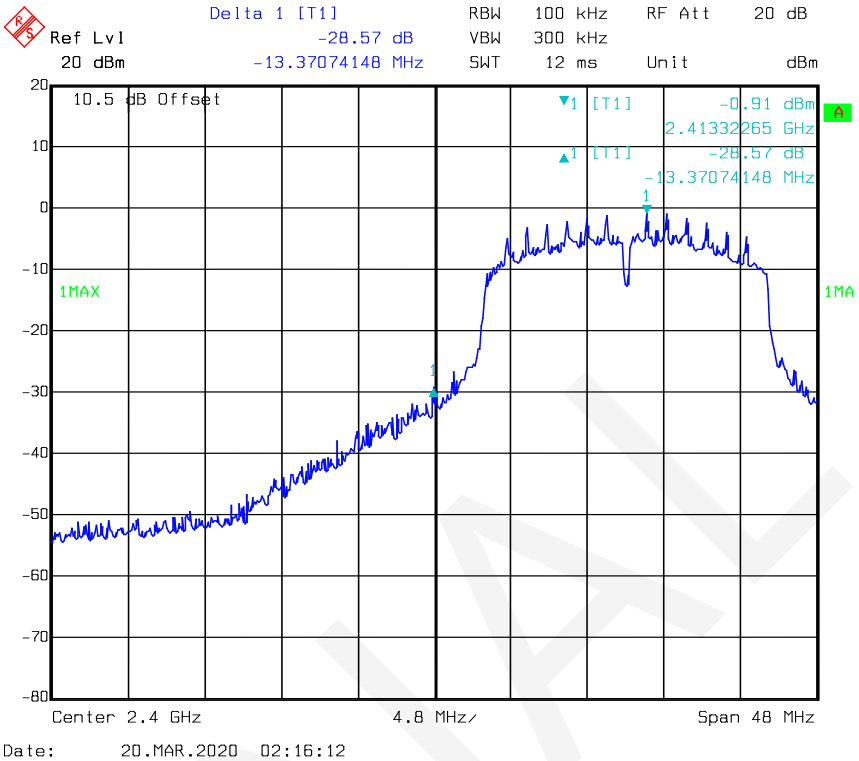
802.11g: Band Edge, Left Side



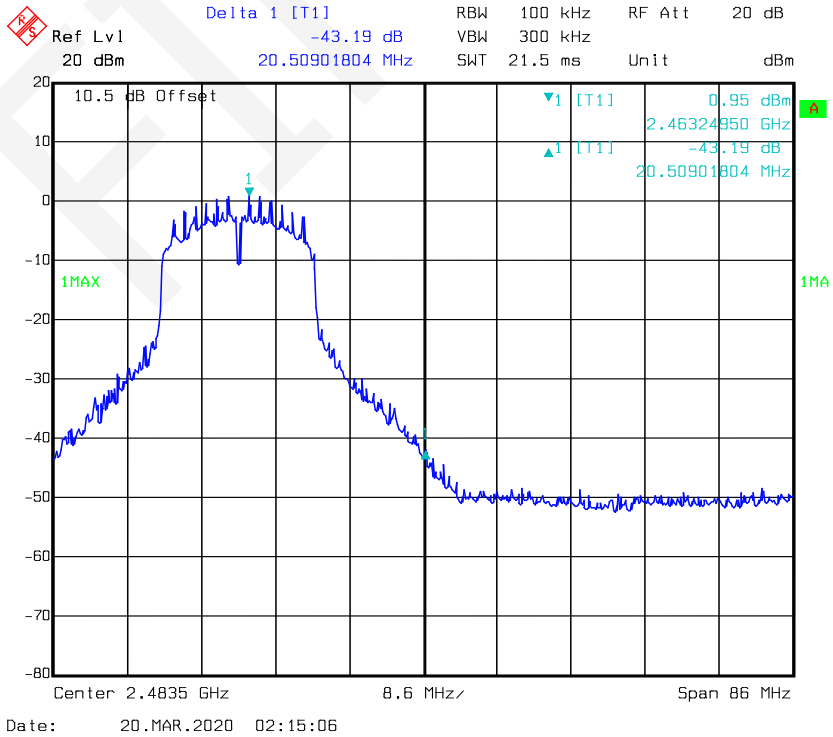
802.11g: Band Edge, Right Side



802.11n-HT20 Band Edge, Left Side



802.11n-HT20 Band Edge, Right Side



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

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3×RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

FINAL

Test Data

Environmental Conditions

Temperature:	20 °C
Relative Humidity:	52 %
ATM Pressure:	96.1 kPa

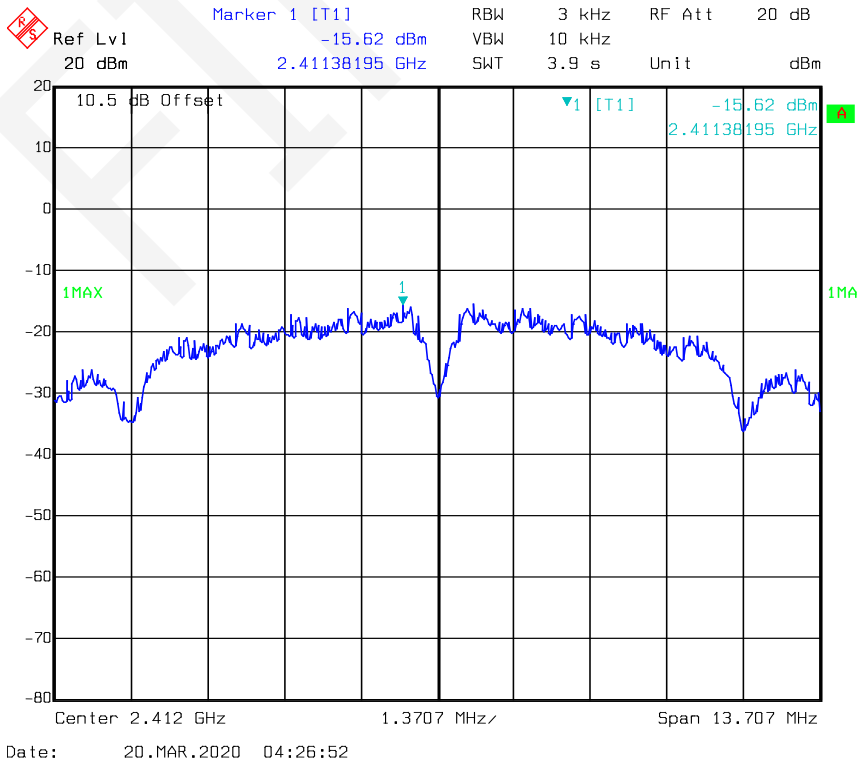
The testing was performed by Eric Xiao on 2020-03-20.

Test Mode: Transmitting

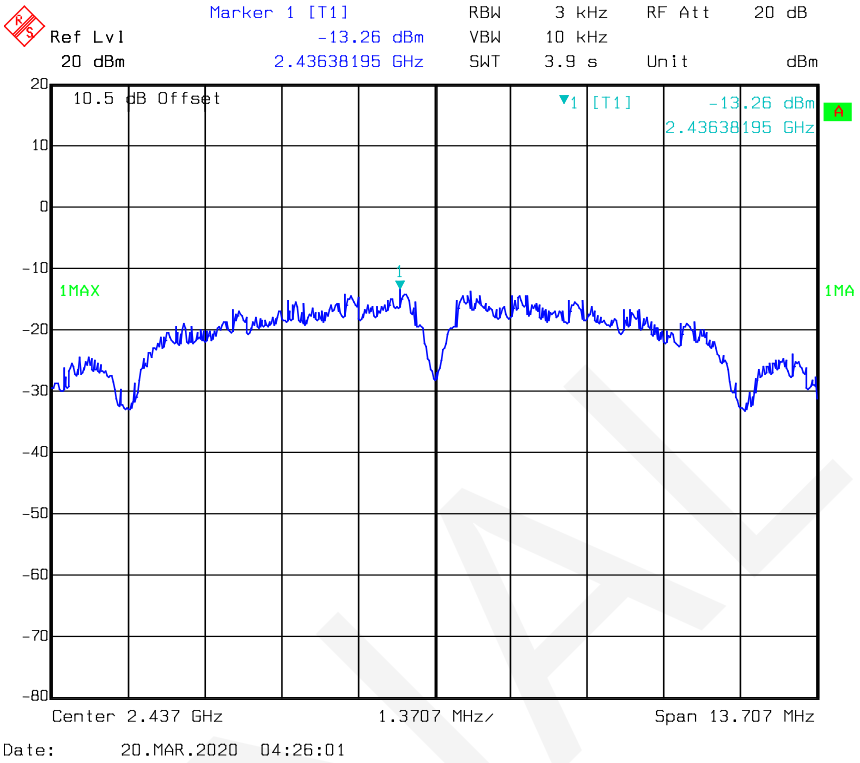
Test Result: Compliance. Please refer to the following table and plots

Mode	Channel	Frequency (MHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
802.11b	Low	2412	-15.62	≤8
	Middle	2437	-13.26	≤8
	High	2462	-13.79	≤8
802.11g	Low	2412	-16.21	≤8
	Middle	2437	-14.93	≤8
	High	2462	-14.32	≤8
802.11n-HT20	Low	2412	-16.23	≤8
	Middle	2437	-13.51	≤8
	High	2462	-13.97	≤8

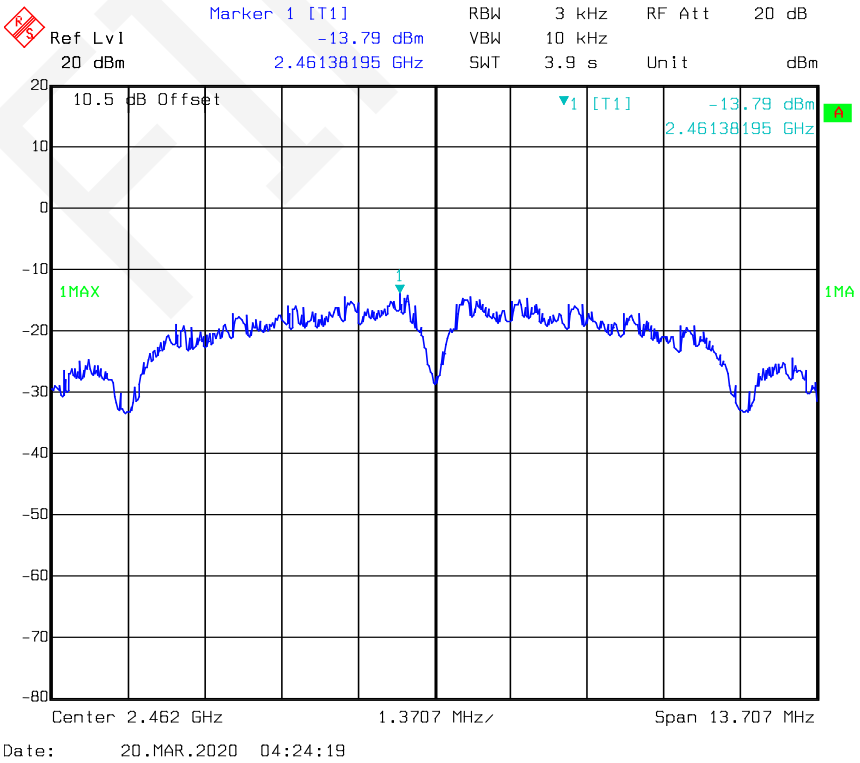
Power Spectral Density, 802.11b Low Channel



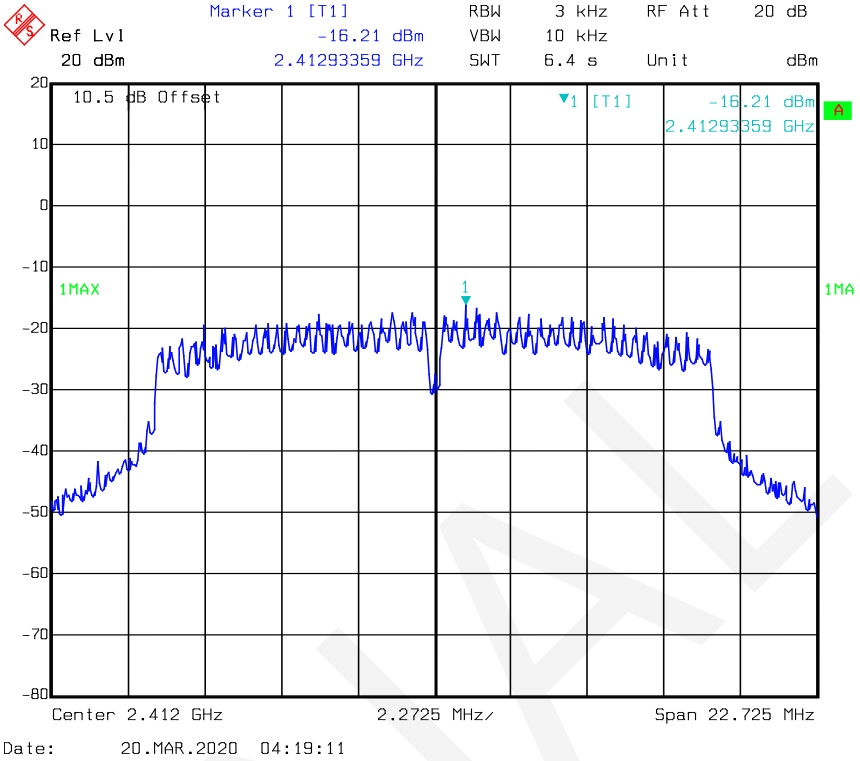
Power Spectral Density, 802.11b Middle Channel



Power Spectral Density, 802.11b High Channel



Power Spectral Density, 802.11g Low Channel



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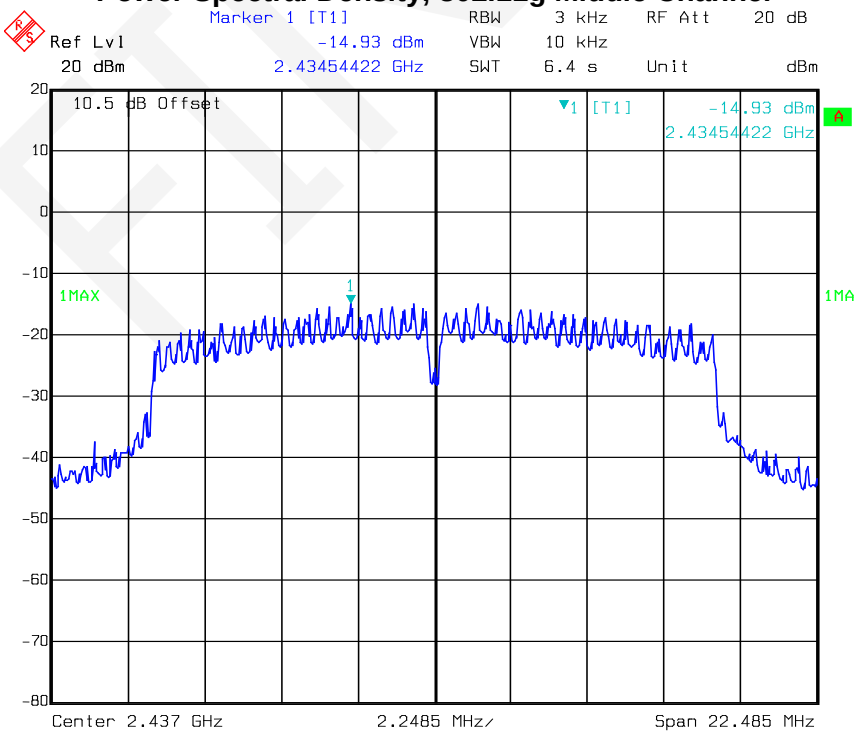
Power Spectral Density, 802.11g Middle Channel



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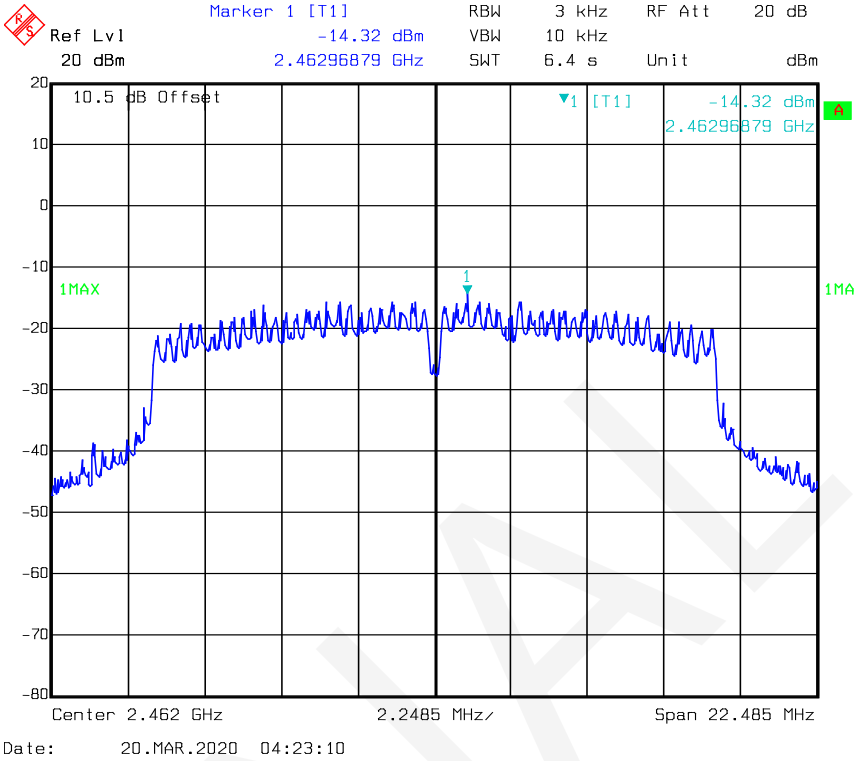
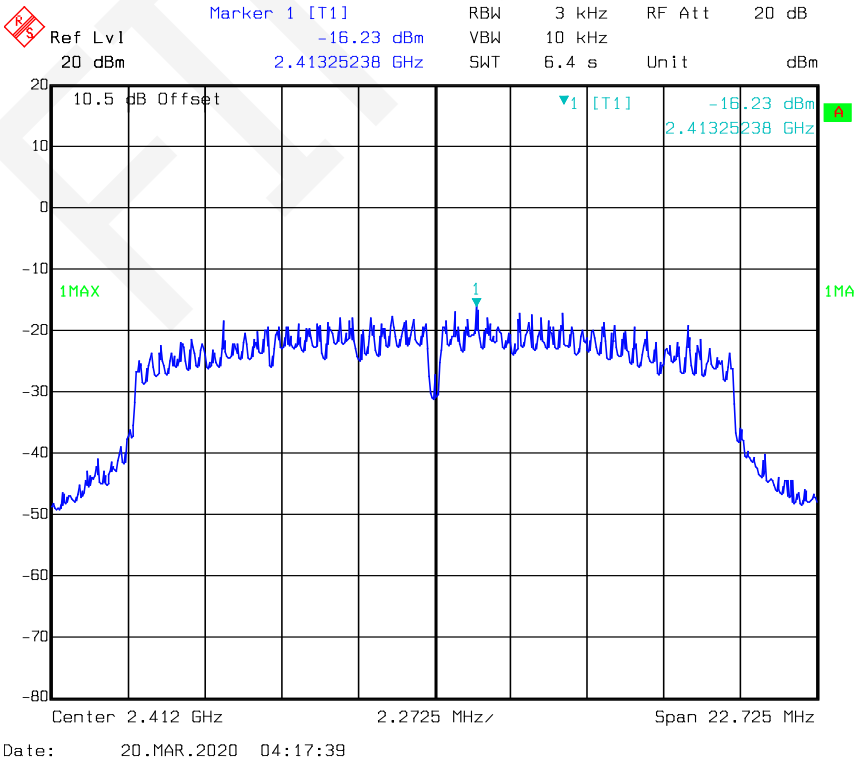
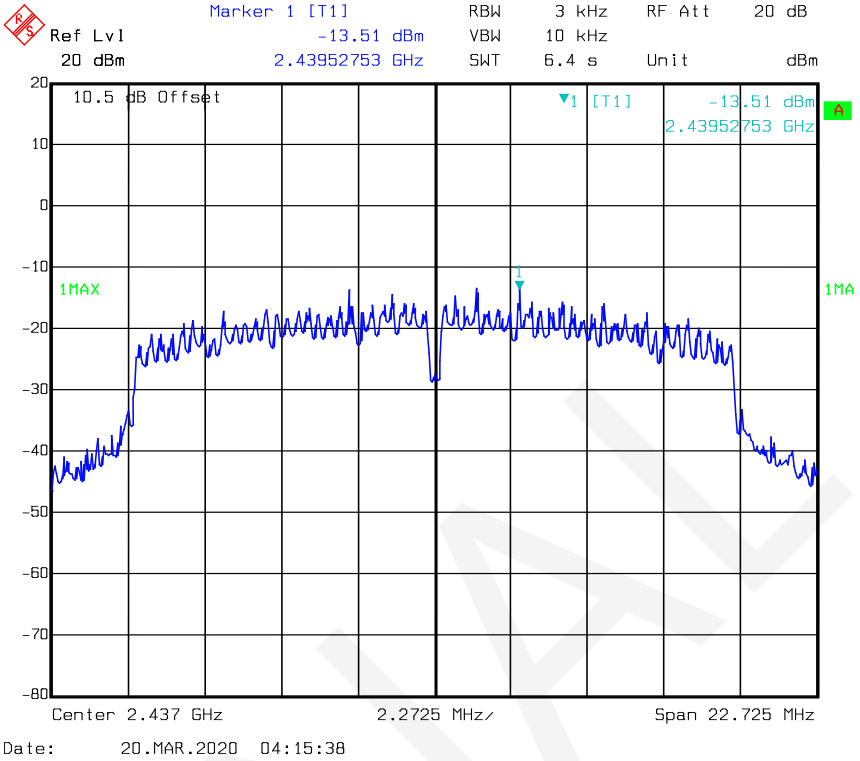
Power Spectral Density, 802.11g High Channel



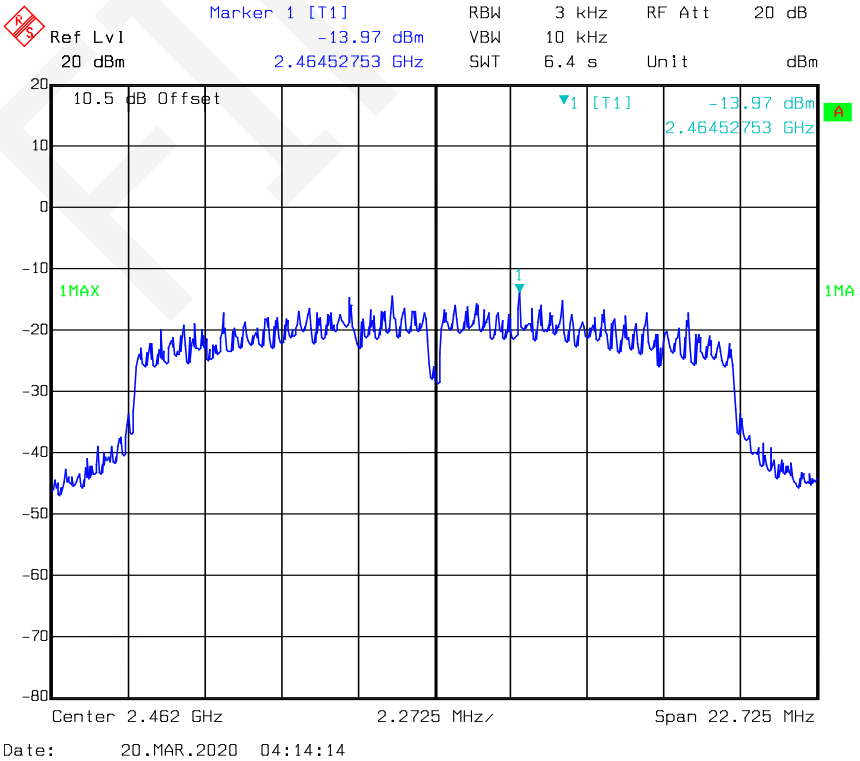
Power Spectral Density, 802.11n-HT20 Low Channel



Power Spectral Density, 802.11n-HT20 Middle Channel



Power Spectral Density, 802.11n-HT20 High Channel



END OF REPORT