FCC PART 15.247

TEST REPORT

For

Qolsys, Inc.

1900 The Alameda 4th Floor, San Jose, California 95126, United States

Tested Model: IQ HUB
FCC ID: 2AAJXQS-IQHUB

Report Type:	**Product Name:**
Original Report	IQ Hub

Report Number:	RSC191224001-0B
Date of Report Issue:	2019-12-31
Reviewed By:	Sula Huang
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Chengdu) No.5040, Huilongwan Plaza, No. 1, Shawan Road, Jinniu District, Chengdu, Sichuan, China Tel: +86-28-65525123 Fax: +86-28-65525125 www.baclcorp.com

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Qolsys, Inc.
Product	IQ Hub
Tested Model	IQ Hub
FCC ID	2AAJXQS-IQHUB
Voltage Range	DC 3.7V rechargeable Li-ion battery or DC 12V from adapter
Measure approximately	196.4 mm (L) x 155 mm (W) x 25.6 mm (H)
Frequency	2.4G WiFi: 2412-2462MHz (802.11b/g/n20) Bluetooth LE: 2402-2480MHz
Modulation Type:	802.11b: DSSS 802.11g/n20: OFDM Bluetooth LE: GFSK
Sample serial number	191224001/01 (assigned by the BACL, Chengdu)
Sample/EUT Status	The test sample was in good condition and received:2019-12-24
Adapter	Manufacturer: SURE-POWER Model: SW-120100 Voltage Input: AC 100-240V 50/60Hz Voltage Output: DC 12V 1000mA

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 **Qolsys, Inc.** 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)

FCC Part 15E NII submissions with FCC ID: 2AAJXQS-IQHUB
FCC Part 15C DXX submissions with FCC ID: 2AAJXQS-IQHUB

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		4.51 dB
	6GHz-18GHz		4.49 dB
	18GHz-40GHz		5.48 dB

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.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

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

For Wi-Fi 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.

For Bluetooth LE mode, 40 channels are provided for testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	…	…
…	…	…	…
…	…	…	…
..	…	38	2478
19	2440	39	2480

EUT was tested with channel 0, 19 and 39.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

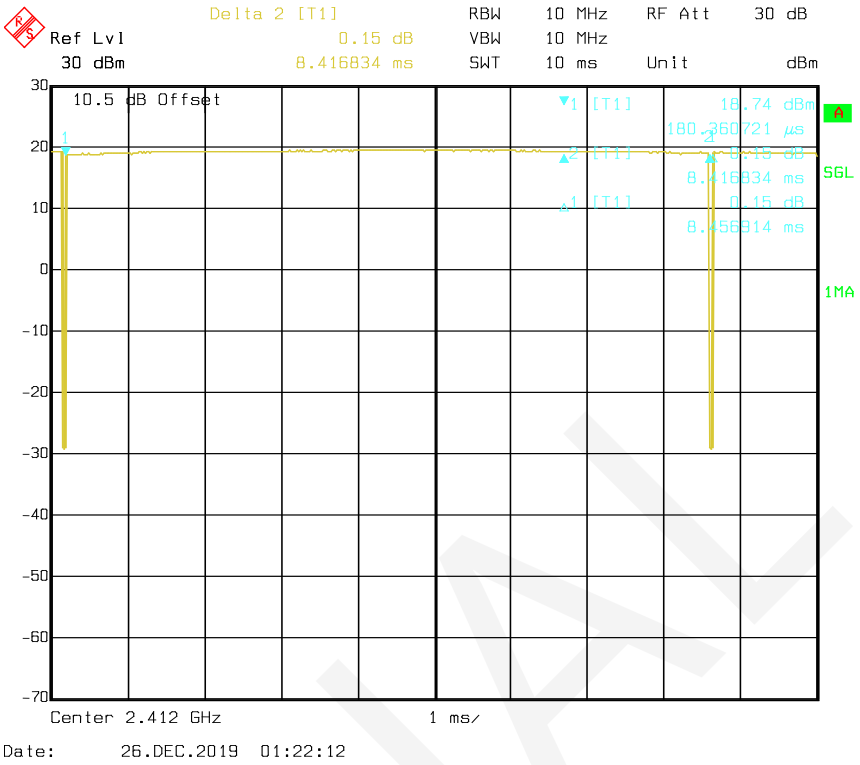
The setting by the software as following table:

Test Mode	Test Software Version	RF test tool		
802.11b	Test Frequency	2412MHz	2437MHz	2462MHz
	Data Rate	1Mbps	1Mbps	1Mbps
	Power Level	Default	Default	Default
802.11g	Test Frequency	2412MHz	2437MHz	2462MHz
	Data Rate	6Mbps	6Mbps	6Mbps
	Power Level	Default	Default	Default
802.11n-HT20	Test Frequency	2412MHz	2437MHz	2462MHz
	Data Rate	MCS0	MCS0	MCS0
	Power Level	Default	Default	Default
BLE	Test Frequency	2402MHz	2440MHz	2480MHz
	Data Rate	Default	Default	Default
	Power Level Setting	Default	Default	Default

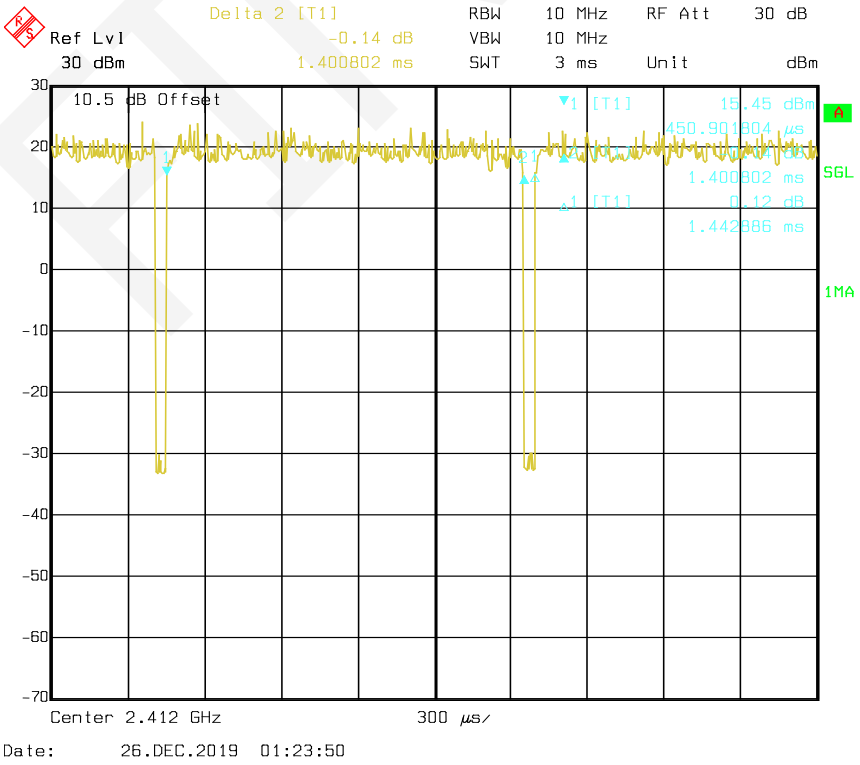
Duty Cycle information is below:

Mode	T_{on} (ms)	T_p (ms)	Duty Cycle (%)	Duty Cycle Factor(dB)
802.11b	8.42	8.46	99	0.02
802.11g	1.40	1.44	97	0.12
802.11n-HT20	1.31	1.35	97	0.13
BLE	0.39	0.63	62	2.08

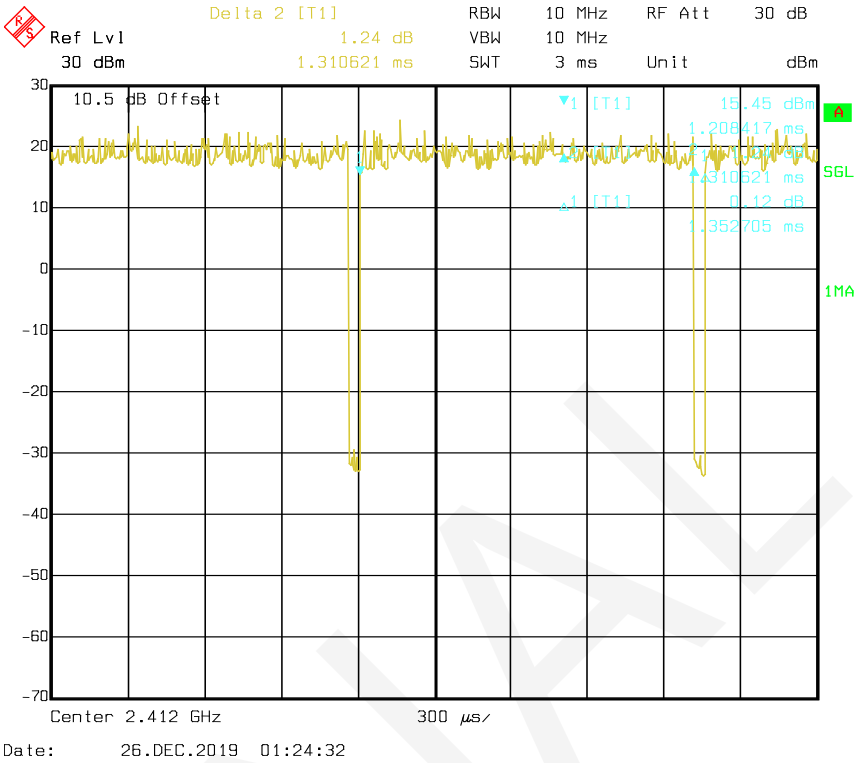
802.11b



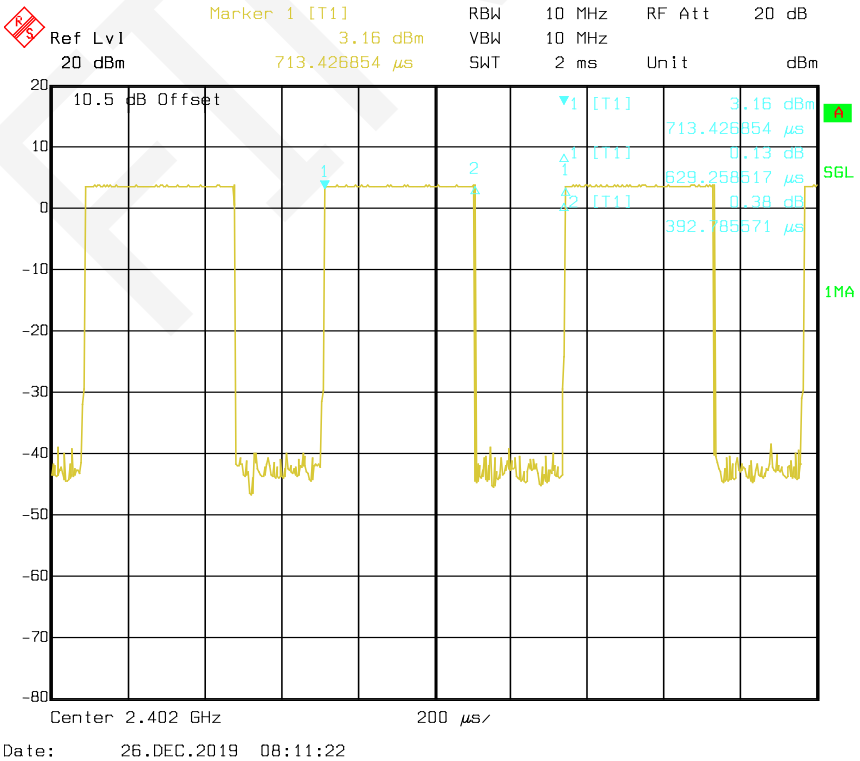
802.11g



802.11n-HT20



BLE mode



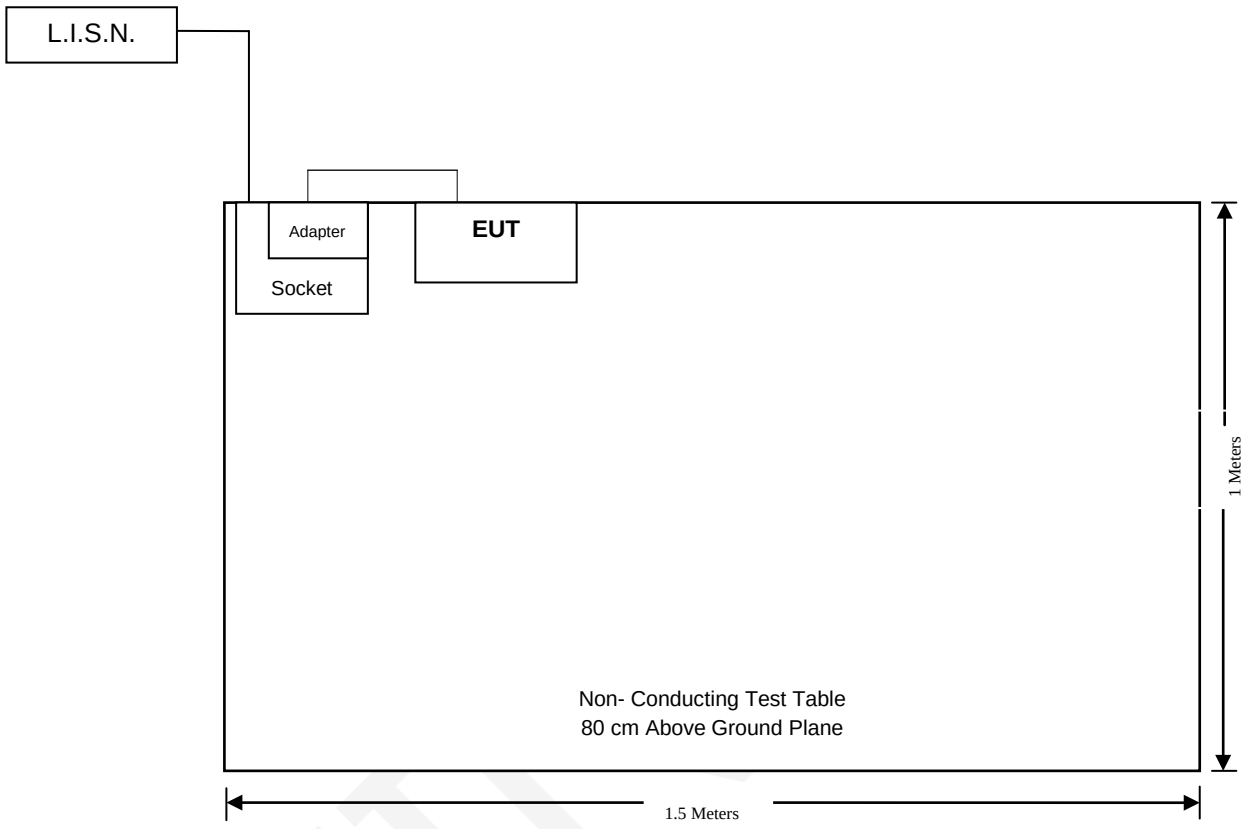
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
-	-	-	-

External I/O Cable

Cable Description	Length (m)	From	To
DC Power Cable	1.50	Adapter	EUT

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.

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	2019-02-25	2020-02-24
HP	RF Limiter	11947A	3107A01270	2019-10-18	2020-10-17
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	Amplifier	310 N	186684	2019-09-06	2020-09-05
SUNOL SCIENCES	Broadband Antenna	JB3	A121808	2017-05-19	2020-05-18
INMET	Attenuator	18N-6dB	N/A	2019-10-17	2020-10-16
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
EMCO	Horn Antenna	3115	2192	2019-09-25	2021-09-24
A.H. Systems, Inc	Amplifier	PAM-0118P	467	2019-08-30	2020-08-29
EM Electronics	RF Pre-Amplifier	EM18G40	060725	2019-07-24	2020-07-23
Rohde & Schwarz	EMI Test Receiver	ESIB 40	100215	2019-04-15	2020-04-14
A.H. Systems, Inc	Horn Antenna	SAS-574	510	2019-09-02	2021-09-01
Sinoscite.,Co Ltd	Reject Band Filter	BSF 2402-2480MN	0898-005	2019-11-10	2020-11-09
MICRO-TRONICS	High Pass Filter	HPM50111	G216	2019-11-10	2020-11-09
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
MICRO-COAX	Flexible microwave cable	T-E237	233522-001	2019-07-19	2020-07-18
Unknown	RF Cable (Above 1GHz)	T-E069	000069	2019-07-24	2020-07-23
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	2019-01-17	2020-01-16
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

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/f²)	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);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \le 1$$

Calculated Data:

(WiFi or BLE) + Z-wave + G-power (FCC ID: WP3PGMODEMLP) + WCDMA/LTE module (FCC ID: XMR201807EG91NA)

MPE evaluation for single transmission:

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)			
WiFi	2412-2462	2.67	1.85	23.0	199.53	20	0.073	1.0
	5180-5240	1.02	1.26	13.0	19.95	20	0.005	1.0
	5745-5825	1.02	1.26	6.0	3.98	20	0.001	1.0
BLE	2402-2480	2.67	1.85	5.0	3.16	20	0.001	1.0
Power-G	912.75-919.106	0.43	1.10	13.5	22.39	20	0.005	0.61
Z-wave	908.4-916	0.50	1.12	-20.0	0.01	20	0.000	0.61
WCDMA Band 5	824-849	1.6	1.45	24.0	251.19	20	0.072	0.55
WCDMA Band 4	1710-1755	2.4	1.74	24.0	251.19	20	0.087	1.0
WCDMA Band 2	1850-1910	2.4	1.74	24.0	251.19	20	0.087	1.0
LTE Band 2	1850-1910	2.4	1.74	24.5	281.84	20	0.098	1.0
LTE Band 4	1710-1755	2.4	1.74	24.5	281.84	20	0.098	1.0
LTE Band 5	824-849	1.6	1.45	24.5	281.84	20	0.081	0.55
LTE Band 12	699-716	1.6	1.45	24.5	281.84	20	0.081	0.47
LTE Band 13	777-787	1.6	1.45	24.5	281.84	20	0.081	0.52

MPE evaluation for simultaneous transmission:

Note: 1. Wi-Fi & BLE can't transmit simultaneously.
2. Wi-Fi(2.4G) & Wi-Fi(5G) can't transmit simultaneously.
3. Wi-Fi &Z-wave&Power-G&WCDMA/LTE or BLE&Z-wave&Power-G&WCDMA/LTE can transmit simultaneously, MPE evaluation is as below formula:

PD1/Limit1+PD2/Limit2+……＜1, PD (Power Density)

The worst case is as below:

Max MPE of Wi-Fi(2.4G) + Max MPE of Power-G + Max MPE of LTE

= 0.073/1.0+0.005/0.61+0.081/0.47=0.254＜1.0

Result: MPE evaluation of single and simultaneous transmission meet the requirement of standard.

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 WiFi/Bluetooth LE antenna, one LTE antenna, one Z-wave antenna and one Power-G antenna, fulfill the requirement of this section. Please refer to the table below and EUT photo.

Antenna	Manufacturer	Model Number	Antenna Gain (Max)	Antenna Connector	Impedance	Antenna Type
WLAN/ Bluetooth LE	Taoglas	FXP838	2.67dBi(2400-2500MHz) 1.02dBi(5150-5850MHz)	IPEX	50 Ohm	PCB
LTE	Taoglas	FXUB79	1.6dBi (698-960MHz) 2.4dBi (1710-2700MHz)	IPEX	50 Ohm	PCB
Power-G	Taoglas	PC95	0.43dBi (902-928MHz)	IPEX	50 Ohm	PCB
Z-wave	Taoglas	FXP291	0.5dBi (902-928MHz)	IPEX	50 Ohm	PCB

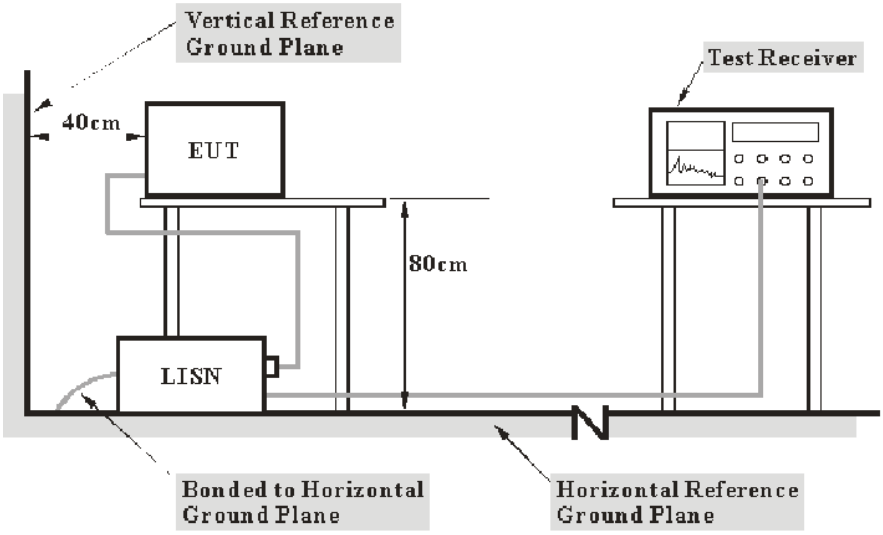
Result: Compliance.

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 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

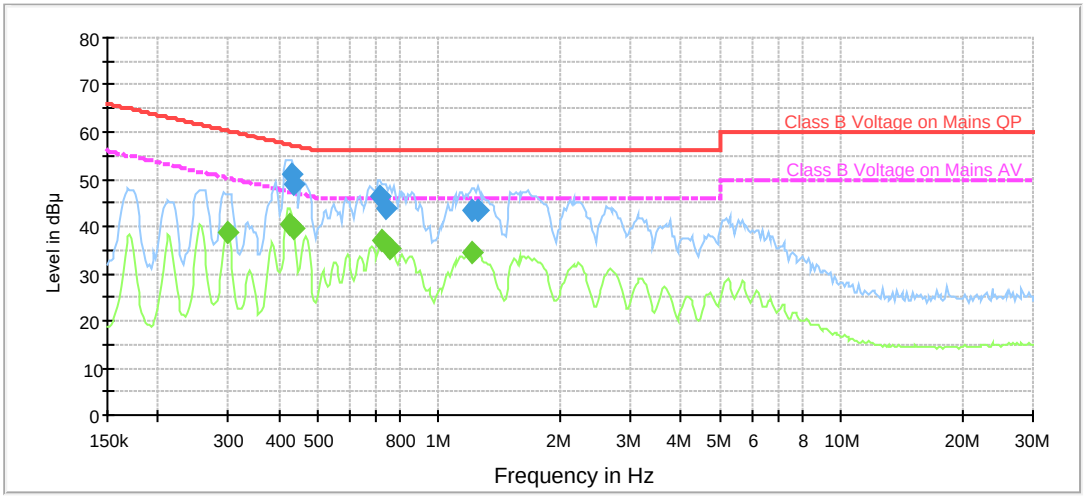
Temperature:	17 °C
Relative Humidity:	52 %
ATM Pressure:	96.2 kPa

The testing was performed by Eric Xiao on 2019-12-25.

Test Mode: Transmitting

Wi-Fi Mode: (802.11b Middle channel)-Worst Case

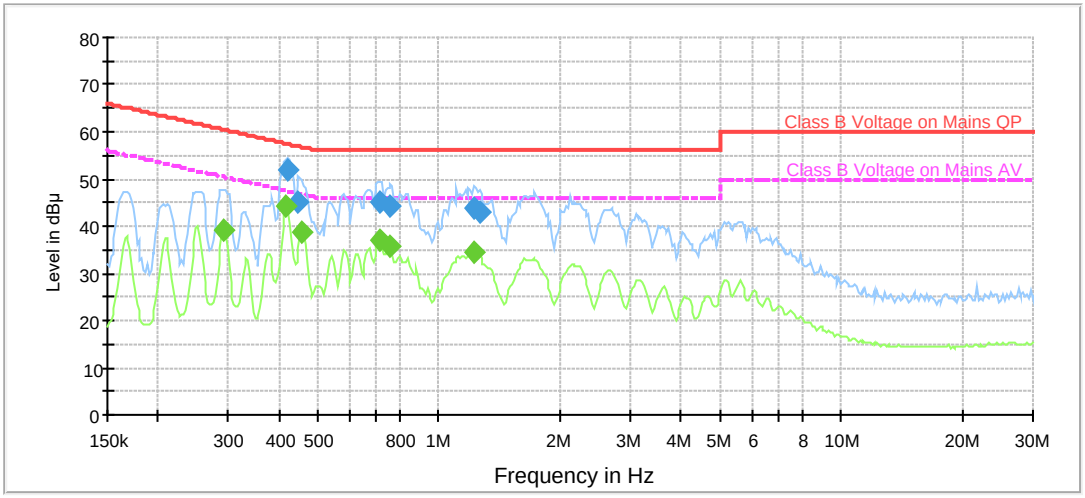
AC120 V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.430682	51.0	200.0	9.000	L1	19.6	6.2	57.2
0.434989	49.0	200.0	9.000	L1	19.6	8.2	57.2
0.715397	46.2	200.0	9.000	L1	19.6	9.8	56.0
0.737074	43.8	200.0	9.000	L1	19.6	12.2	56.0
1.212216	43.6	200.0	9.000	L1	19.6	12.4	56.0
1.248947	43.5	200.0	9.000	L1	19.6	12.5	56.0

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.298034	38.9	200.0	9.000	L1	19.6	11.4	50.3
0.426418	40.5	200.0	9.000	L1	19.6	6.8	47.3
0.434989	39.4	200.0	9.000	L1	19.6	7.8	47.2
0.722551	36.8	200.0	9.000	L1	19.6	9.2	46.0
0.759409	35.2	200.0	9.000	L1	19.6	10.8	46.0
1.212216	34.3	200.0	9.000	L1	19.6	11.7	46.0

AC120 V, 60 Hz, Neutral:

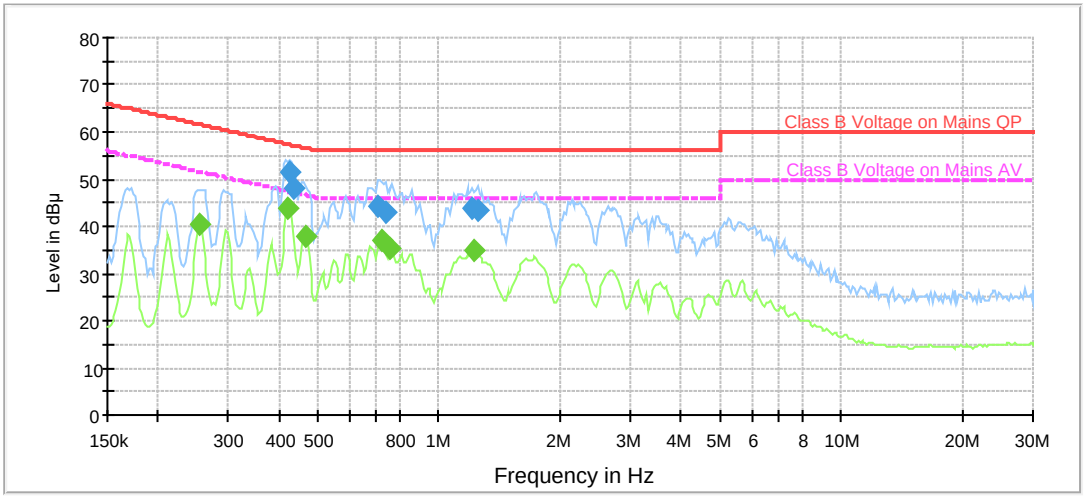


Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.422196	51.8	200.0	9.000	N	19.6	5.6	57.4
0.448170	44.9	200.0	9.000	N	19.6	12.0	56.9
0.715397	45.2	200.0	9.000	N	19.7	10.8	56.0
0.759409	44.4	200.0	9.000	N	19.7	11.6	56.0
1.224338	43.6	200.0	9.000	N	19.7	12.4	56.0
1.261437	42.8	200.0	9.000	N	19.7	13.2	56.0

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.292162	39.3	200.0	9.000	N	19.6	11.2	50.5
0.418016	44.2	200.0	9.000	N	19.6	3.3	47.5
0.457178	38.7	200.0	9.000	N	19.6	8.0	46.7
0.715397	36.8	200.0	9.000	N	19.7	9.2	46.0
0.751890	35.8	200.0	9.000	N	19.7	10.2	46.0
1.224338	34.4	200.0	9.000	N	19.7	11.6	46.0

BLE Mode: (Low channel)-worst case

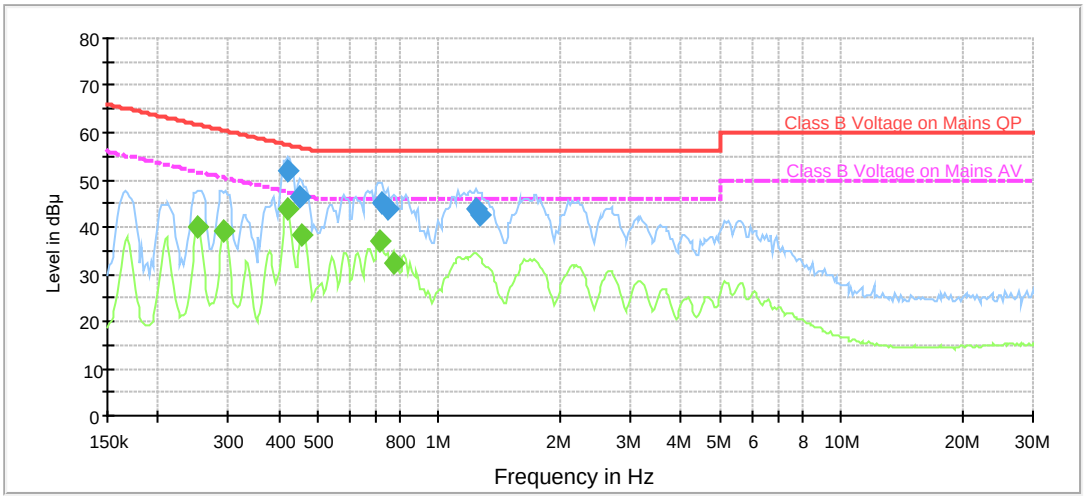
AC120 V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.426418	51.4	200.0	9.000	L1	19.6	5.9	57.3
0.434989	47.9	200.0	9.000	L1	19.6	9.3	57.2
0.708314	44.3	200.0	9.000	L1	19.6	11.7	56.0
0.737074	43.0	200.0	9.000	L1	19.6	13.0	56.0
1.212216	43.7	200.0	9.000	L1	19.6	12.3	56.0
1.248947	43.5	200.0	9.000	L1	19.6	12.5	56.0

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.254170	40.4	200.0	9.000	L1	19.6	11.2	51.6
0.422196	43.9	200.0	9.000	L1	19.6	3.5	47.4
0.466367	37.8	200.0	9.000	L1	19.6	8.8	46.6
0.722551	36.9	200.0	9.000	L1	19.6	9.1	46.0
0.759409	35.5	200.0	9.000	L1	19.6	10.5	46.0
1.224338	34.8	200.0	9.000	L1	19.6	11.2	46.0

AC120 V, 60 Hz, Neutral:



Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.422196	51.7	200.0	9.000	N	19.6	5.7	57.4
0.452652	46.4	200.0	9.000	N	19.6	10.4	56.8
0.722551	45.2	200.0	9.000	N	19.7	10.8	56.0
0.744445	44.0	200.0	9.000	N	19.7	12.0	56.0
1.236582	43.7	200.0	9.000	N	19.7	12.3	56.0
1.261437	42.7	200.0	9.000	N	19.7	13.3	56.0

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.251654	40.1	200.0	9.000	N	19.6	11.6	51.7
0.292162	39.0	200.0	9.000	N	19.6	11.5	50.5
0.422196	44.0	200.0	9.000	N	19.6	3.4	47.4
0.457178	38.3	200.0	9.000	N	19.6	8.4	46.7
0.715397	37.0	200.0	9.000	N	19.7	9.0	46.0
0.774673	32.6	200.0	9.000	N	19.7	13.4	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

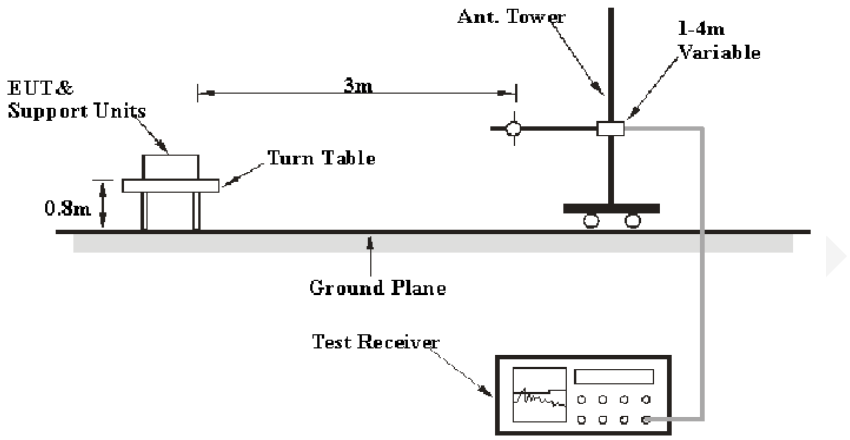
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

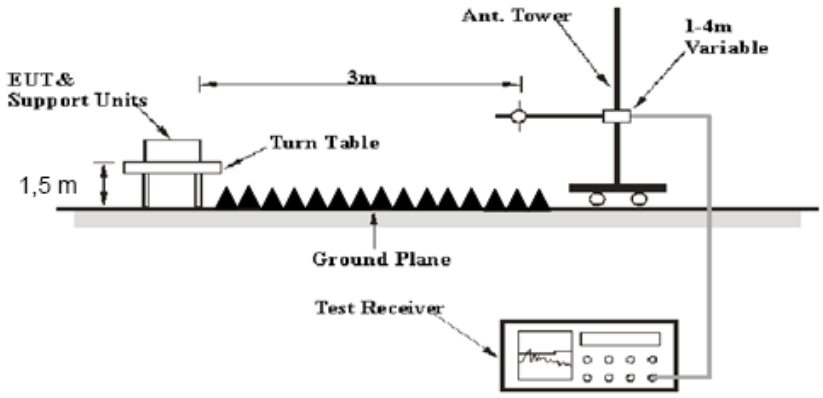
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1GHz:



Above 1GHz:



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.

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	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 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.

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 Loss + 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

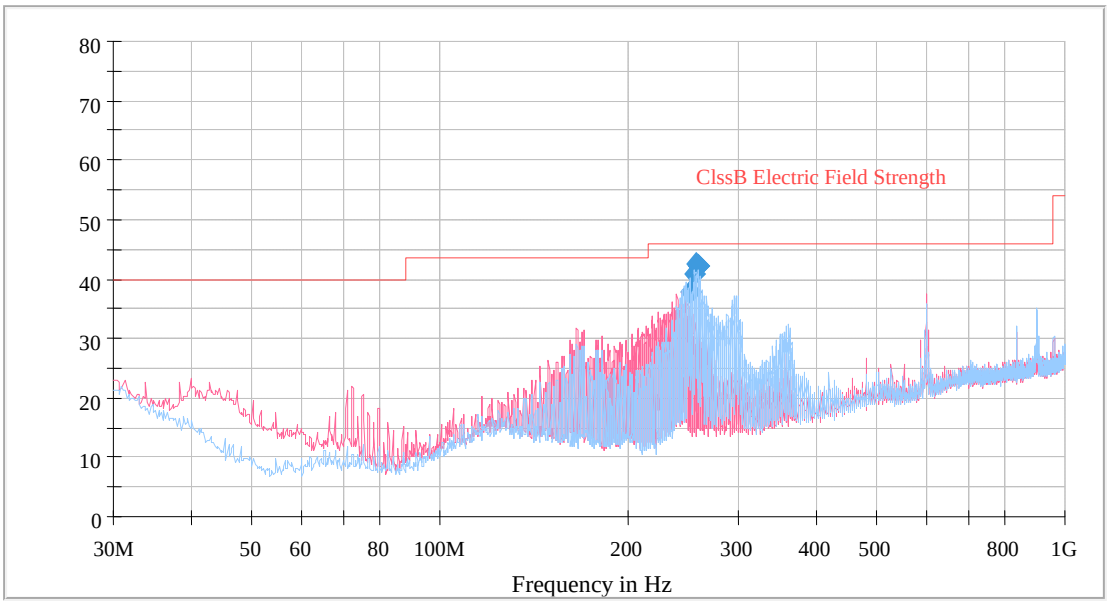
Temperature:	18°C
Relative Humidity:	53 %
ATM Pressure:	95.8 kPa

The testing was performed by Eric Xiao on 2019-12-29

Test Mode: Transmitting

Wi-Fi Mode

30 MHz to 1 GHz: 802.11b_Middle Channel



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
251.420000	37.93	46.00	8.07	200.0	120.000	132.0	H	148.0	-12.7
254.340500	40.92	46.00	5.08	200.0	120.000	128.0	H	166.0	-12.6
257.277900	42.62	46.00	3.38	200.0	120.000	130.0	H	0.0	-12.4
258.751900	42.36	46.00	3.64	200.0	120.000	128.0	H	5.0	-12.3
258.765300	42.12	46.00	3.88	200.0	120.000	110.0	H	24.0	-12.3
258.789100	42.36	46.00	3.64	200.0	120.000	124.0	H	13.0	-12.3

Above 1GHz

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	72.13	PK	H	29.12	3.55	0.00	104.80	N/A	N/A
2412	67.74	AV	H	29.12	3.55	0.00	100.41	N/A	N/A
2390	28.88	PK	H	29.15	3.54	0.00	61.57	74.00	12.43
2390	16.18	AV	H	29.15	3.54	0.00	48.87	54.00	5.13
1499.8	73.04	PK	V	25.40	2.83	41.60	60.33	74.00	13.67
1499.8	53.25	AV	V	25.40	2.83	41.60	40.82	54.00	13.18
1799	73.28	PK	H	27.97	3.08	41.78	62.16	74.00	11.84
1799	52.13	AV	H	27.97	3.08	41.78	41.88	54.00	12.12
2700	70.87	PK	V	29.48	3.76	42.14	61.68	74.00	12.32
2700	53.7	AV	V	29.48	3.76	42.14	45.12	54.00	8.88
4824	45.98	PK	H	33.04	5.06	42.89	41.19	74.00	32.81
4824	36.01	AV	H	33.04	5.06	42.89	31.22	54.00	22.78
7236	43.62	PK	H	35.82	6.44	43.55	42.33	74.00	31.67
7236	32.06	AV	H	35.82	6.44	43.55	30.77	54.00	23.23
Frequency:2437 MHz									
2437	72.45	PK	H	29.09	3.57	0.00	105.11	N/A	N/A
2437	67.85	AV	H	29.09	3.57	0.00	100.51	N/A	N/A
1499.8	72.18	PK	V	25.40	2.83	41.60	58.81	74.00	15.19
1499.8	53.39	AV	V	25.40	2.83	41.60	40.02	54.00	13.98
1799	72.61	PK	H	27.97	3.08	41.78	61.88	74.00	12.12
1799	52.57	AV	H	27.97	3.08	41.78	41.84	54.00	12.16
2700	70.15	PK	V	29.48	3.76	42.14	61.25	74.00	12.75
2700	53.28	AV	V	29.48	3.76	42.14	44.38	54.00	9.62
4874	45.42	AV	H	33.17	5.09	42.92	40.76	54.00	13.24
4874	35.78	PK	H	33.17	5.09	42.92	31.12	74.00	42.88
7311	42.46	AV	H	35.98	6.48	43.56	41.36	54.00	12.64
7311	32.13	AV	H	35.98	6.48	43.56	31.03	54.00	22.97
Frequency:2462 MHz									
2462	73.18	PK	H	29.05	3.59	0.00	105.82	N/A	N/A
2462	67.16	AV	H	29.05	3.59	0.00	99.80	N/A	N/A
2483.5	30.71	PK	H	29.02	3.61	0.00	63.34	74.00	10.66
2483.5	17.16	AV	H	29.02	3.61	0.00	49.79	54.00	4.21
1499.8	73.46	PK	V	25.40	2.83	41.60	60.09	74.00	13.91
1499.8	53.64	AV	V	25.40	2.83	41.60	40.27	54.00	13.73
1799	72.78	PK	H	27.97	3.08	41.78	62.05	74.00	11.95
1799	51.84	AV	H	27.97	3.08	41.78	41.11	54.00	12.89
2700	71.06	PK	V	29.48	3.76	42.14	62.16	74.00	11.84
2700	53.35	AV	V	29.48	3.76	42.14	44.45	54.00	9.55
4924	45.82	PK	H	33.30	5.12	42.95	41.29	74.00	32.71
4924	36.33	AV	H	33.30	5.12	42.95	31.80	54.00	22.20
7386	42.72	PK	H	36.15	6.52	43.58	41.81	74.00	32.19
7386	32.56	AV	H	36.15	6.52	43.58	31.65	54.00	22.35

802.11g Mode

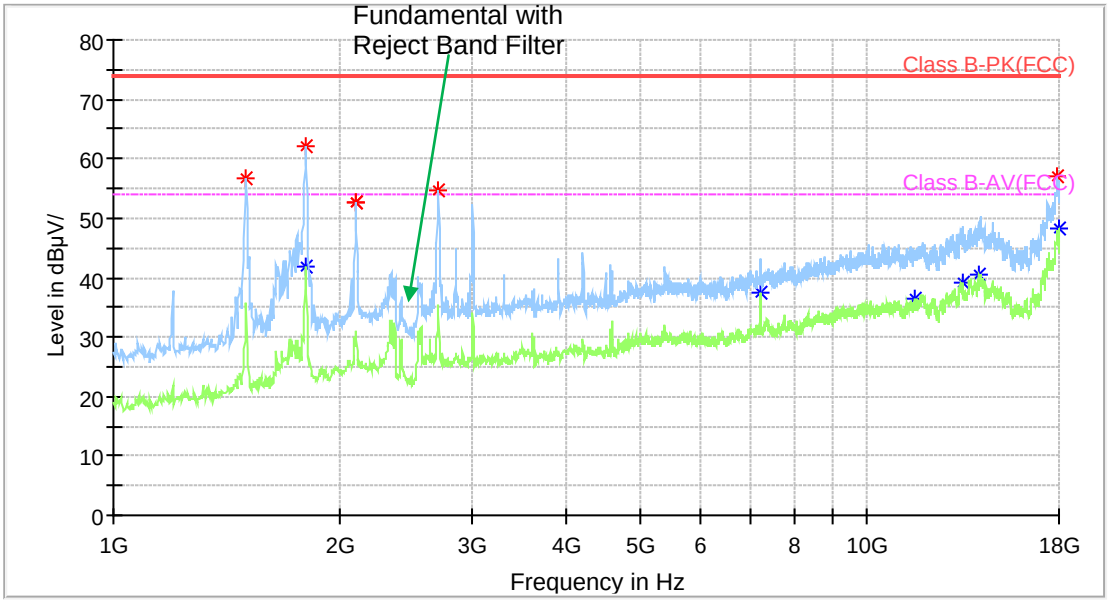
Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBµV	PK/AV	H/V	dB(1/m)	dB	dB	dBµV/m	dBµV/m	dB
Frequency:2412 MHz									
2412	75.36	PK	H	29.12	3.55	0.00	108.03	N/A	N/A
2412	69.34	AV	H	29.12	3.55	0.00	102.01	N/A	N/A
2390	30.81	PK	H	29.15	3.54	0.00	63.50	74.00	10.50
2390	18.63	AV	H	29.15	3.54	0.00	51.32	54.00	2.68
1499.8	72.86	PK	V	25.40	2.83	41.60	59.49	74.00	14.51
1499.8	52.01	AV	V	25.40	2.83	41.60	38.64	54.00	15.36
1799	74.95	PK	H	27.97	3.08	41.78	64.22	74.00	9.78
1799	51.99	AV	H	27.97	3.08	41.78	41.26	54.00	12.74
2700	71.42	PK	V	29.48	3.76	42.14	62.52	74.00	11.48
2700	53.93	AV	V	29.48	3.76	42.14	45.03	54.00	8.97
4824	46.23	PK	H	33.04	5.06	42.89	41.44	74.00	32.56
4824	36.48	AV	H	33.04	5.06	42.89	31.69	54.00	22.31
7236	42.86	PK	H	35.82	6.44	43.55	41.57	74.00	32.43
7236	32.61	AV	H	35.82	6.44	43.55	31.32	54.00	22.68
Frequency:2437 MHz									
2437	75.68	PK	H	29.09	3.57	0.00	108.34	N/A	N/A
2437	69.58	AV	H	29.09	3.57	0.00	102.24	N/A	N/A
1499.8	73.62	PK	V	25.40	2.83	41.60	60.25	74.00	13.75
1499.8	52.85	AV	V	25.40	2.83	41.60	39.48	54.00	14.52
1799	74.48	PK	H	27.97	3.08	41.78	63.75	74.00	10.25
1799	51.26	AV	H	27.97	3.08	41.78	40.53	54.00	13.47
2700	70.11	PK	V	29.48	3.76	42.14	61.21	74.00	12.79
2700	54.18	AV	V	29.48	3.76	42.14	45.28	54.00	8.72
4874	45.77	AV	H	33.17	5.09	42.92	41.11	54.00	12.89
4874	36.23	PK	H	33.17	5.09	42.92	31.57	74.00	42.43
7311	41.93	AV	H	35.98	6.48	43.56	40.83	54.00	13.17
7311	32.02	AV	H	35.98	6.48	43.56	30.92	54.00	23.08
Frequency:2462 MHz									
2462	76.08	PK	H	29.05	3.59	0.00	108.72	N/A	N/A
2462	69.81	AV	H	29.05	3.59	0.00	102.45	N/A	N/A
2483.5	31.23	PK	H	29.02	3.61	0.00	63.86	74.00	10.14
2483.5	18.27	AV	H	29.02	3.61	0.00	50.90	54.00	3.10
1499.8	73.59	PK	V	25.40	2.83	41.60	60.22	74.00	13.78
1499.8	52.54	AV	V	25.40	2.83	41.60	39.17	54.00	14.83
1799	72.73	PK	H	27.97	3.08	41.78	62.00	74.00	12.00
1799	53.26	AV	H	27.97	3.08	41.78	42.53	54.00	11.47
2700	72.16	PK	V	29.48	3.76	42.14	63.26	74.00	10.74
2700	53.23	AV	V	29.48	3.76	42.14	44.33	54.00	9.67
4924	45.69	PK	H	33.30	5.12	42.95	41.16	74.00	32.84
4924	36.01	AV	H	33.30	5.12	42.95	31.48	54.00	22.52
7386	42.3	PK	H	36.15	6.52	43.58	41.39	74.00	32.61
7386	32.48	AV	H	36.15	6.52	43.58	31.57	54.00	22.43

802.11n-HT20 Mode

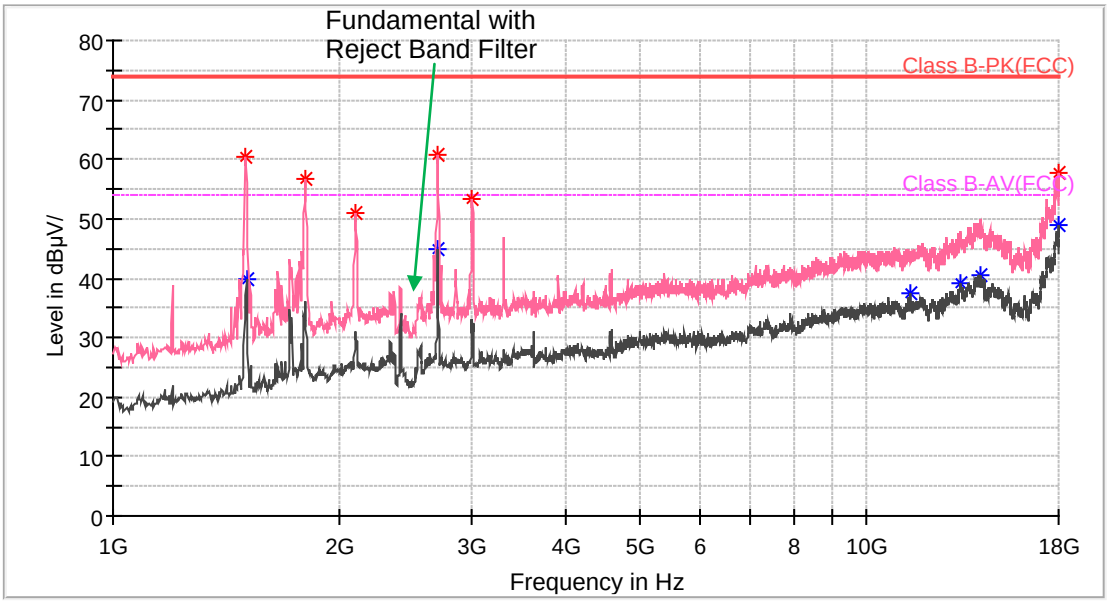
Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBµV	PK/AV	H/V	dB(1/m)	dB	dB	dBµV/m	dBµV/m	dB
Frequency:2412 MHz									
2412	75.42	PK	H	29.12	3.55	0.00	108.09	N/A	N/A
2412	68.41	AV	H	29.12	3.55	0.00	101.08	N/A	N/A
2390	30.25	PK	H	29.15	3.54	0.00	62.94	74.00	11.06
2390	18.31	AV	H	29.15	3.54	0.00	51.00	54.00	3.00
1499.8	73.24	PK	V	25.40	2.83	41.60	59.87	74.00	14.13
1499.8	52.83	AV	V	25.40	2.83	41.60	39.46	54.00	14.54
1799	73.63	PK	H	27.97	3.08	41.78	62.90	74.00	11.10
1799	52.2	AV	H	27.97	3.08	41.78	41.47	54.00	12.53
2700	70.75	PK	V	29.48	3.76	42.14	61.85	74.00	12.15
2700	53.44	AV	V	29.48	3.76	42.14	44.54	54.00	9.46
4824	46.23	PK	H	33.04	5.06	42.89	41.44	74.00	32.56
4824	36.48	AV	H	33.04	5.06	42.89	31.69	54.00	22.31
7236	42.86	PK	H	35.82	6.44	43.55	41.57	74.00	32.43
7236	32.61	AV	H	35.82	6.44	43.55	31.32	54.00	22.68
Frequency:2437 MHz									
2437	75.66	PK	H	29.09	3.57	0.00	108.32	N/A	N/A
2437	68.53	AV	H	29.09	3.57	0.00	101.19	N/A	N/A
1499.8	72.41	PK	V	25.40	2.83	41.60	59.04	74.00	14.96
1499.8	52.88	AV	V	25.40	2.83	41.60	39.51	54.00	14.49
1799	73.21	PK	H	27.97	3.08	41.78	62.48	74.00	11.52
1799	51.98	AV	H	27.97	3.08	41.78	41.25	54.00	12.75
2700	70.88	PK	V	29.48	3.76	42.14	61.98	74.00	12.02
2700	53.52	AV	V	29.48	3.76	42.14	44.62	54.00	9.38
4874	45.69	AV	H	33.17	5.09	42.92	41.03	54.00	12.97
4874	36.44	PK	H	33.17	5.09	42.92	31.78	74.00	42.22
7311	42.39	AV	H	35.98	6.48	43.56	41.29	54.00	12.71
7311	32.61	AV	H	35.98	6.48	43.56	31.51	54.00	22.49
Frequency:2462 MHz									
2462	75.81	PK	H	29.05	3.59	0.00	108.45	N/A	N/A
2462	68.81	AV	H	29.05	3.59	0.00	101.45	N/A	N/A
2483.5	30.22	PK	H	29.02	3.61	0.00	62.85	74.00	11.15
2483.5	18.21	AV	H	29.02	3.61	0.00	50.84	54.00	3.16
1499.8	73.21	PK	V	25.40	2.83	41.60	59.84	74.00	14.16
1499.8	53.52	AV	V	25.40	2.83	41.60	40.15	54.00	13.85
1799	72.56	PK	H	27.97	3.08	41.78	61.83	74.00	12.17
1799	52.34	AV	H	27.97	3.08	41.78	41.61	54.00	12.39
2700	70.76	PK	V	29.48	3.76	42.14	61.86	74.00	12.14
2700	53.75	AV	V	29.48	3.76	42.14	44.85	54.00	9.15
4924	45.46	PK	H	33.30	5.12	42.95	40.93	74.00	33.07
4924	36.05	AV	H	33.30	5.12	42.95	31.52	54.00	22.48
7386	42.82	PK	H	36.15	6.52	43.58	41.91	74.00	32.09
7386	31.99	AV	H	36.15	6.52	43.58	31.08	54.00	22.92

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

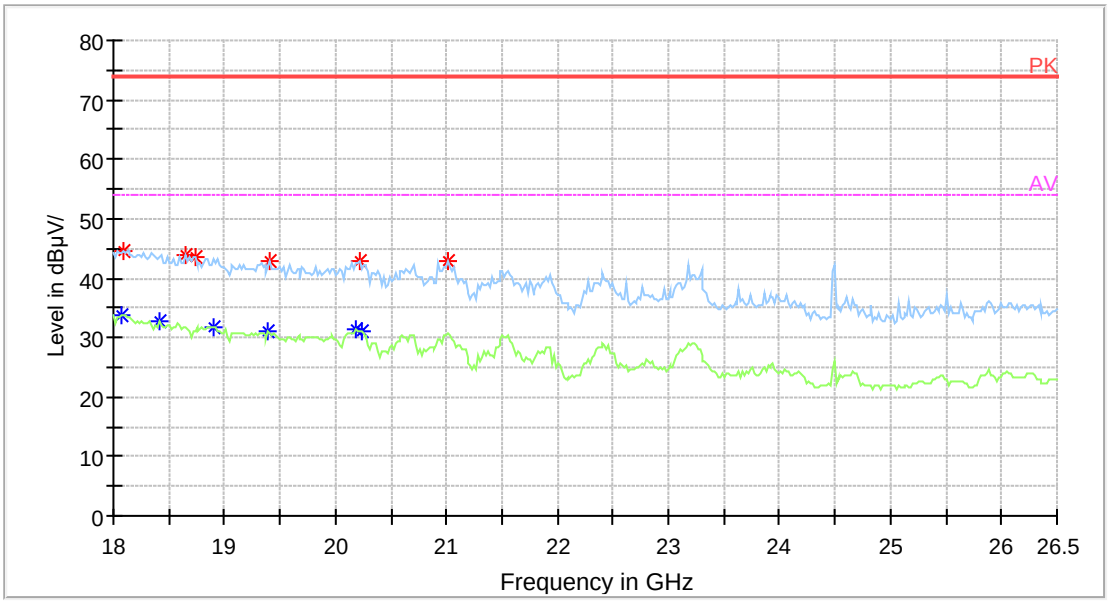
802.11g Mode: Low Channel_Horizontal_1GHz-18GHz



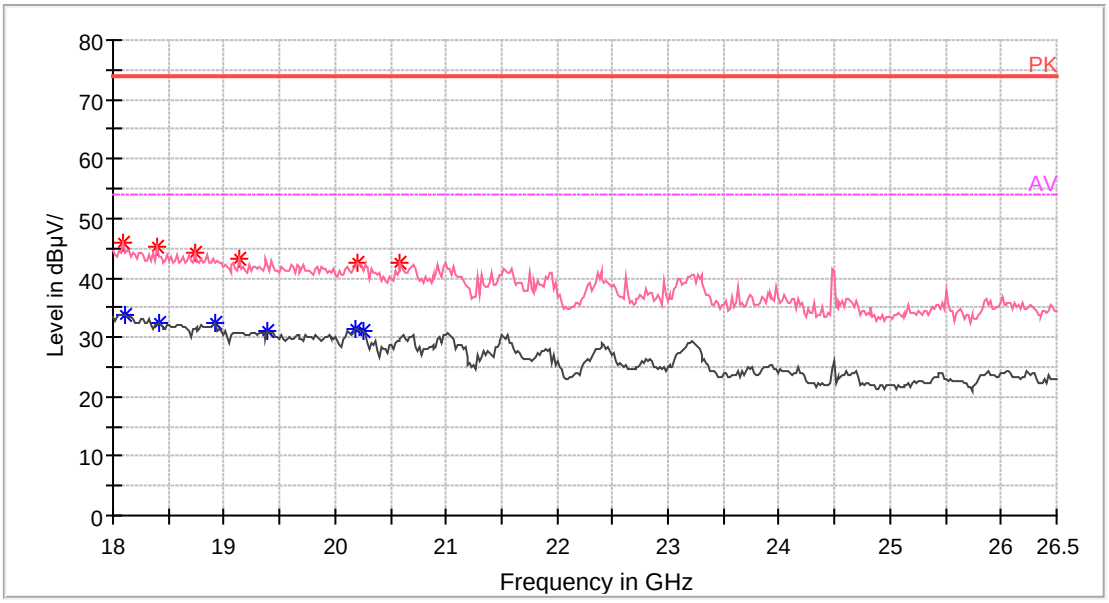
802.11g Mode: Low Channel_Vertical_1GHz-18GHz



802.11g Mode: Low Channel_Horizontal_18 GHz-26.5 GHz



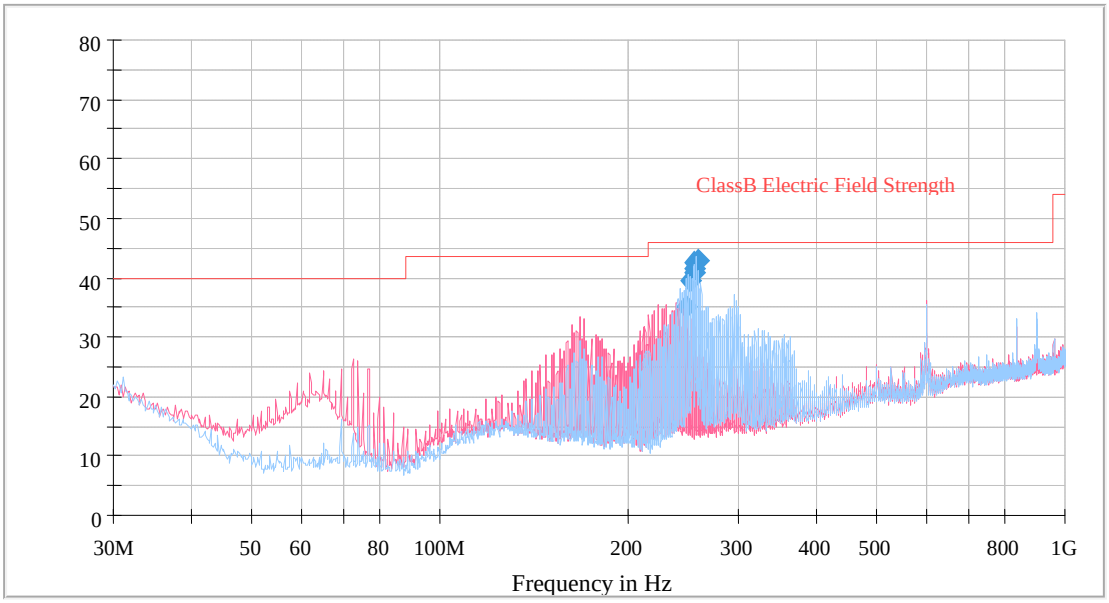
802.11g Mode: Low Channel_Vertical_18GHz-26.5GHz



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

BLE Mode

30 MHz to 1 GHz-Middle channel-worst case



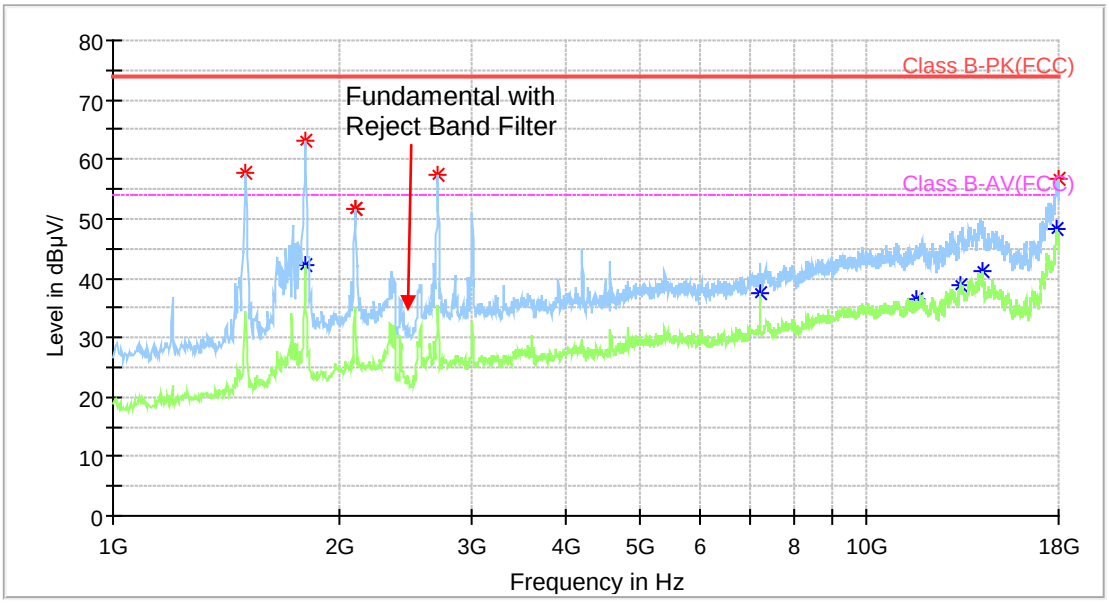
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
248.584500	35.04	46.00	10.96	200.0	120.000	127.0	H	340.0	-12.8
251.549200	39.33	46.00	6.67	200.0	120.000	123.0	H	346.0	-12.7
254.502900	40.69	46.00	5.31	200.0	120.000	124.0	H	0.0	-12.6
254.503600	41.55	46.00	4.45	200.0	120.000	124.0	H	1.0	-12.6
255.947500	42.38	46.00	3.62	200.0	120.000	127.0	H	6.0	-12.5
258.922400	42.84	46.00	3.16	200.0	120.000	124.0	H	7.0	-12.3

Above 1 GHz

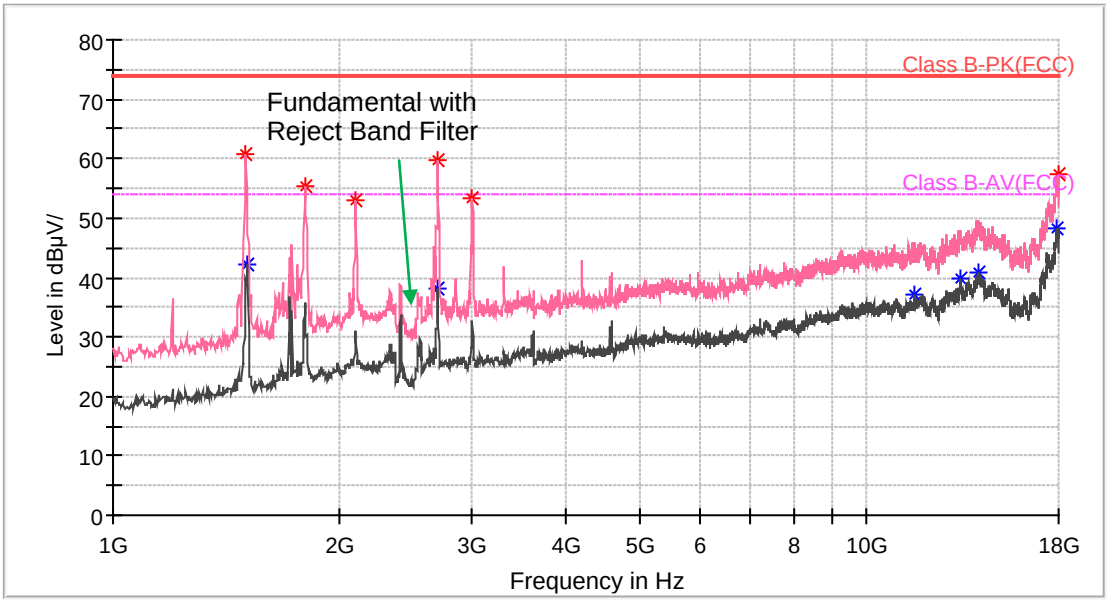
Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBµV	PK/AV	H/V	dB(1/m)	dB	dB	dBµV/m	dBµV/m	dB
Frequency:2402 MHz									
2402	65.93	PK	H	28.71	3.55	0.00	98.19	N/A	N/A
2402	65.17	AV	H	28.71	3.55	0.00	97.43	N/A	N/A
2390	29.34	PK	V	28.67	3.54	0.00	61.55	74.00	12.45
2390	16.05	AV	V	28.67	3.54	0.00	48.26	54.00	5.74
1499	75.04	PK	V	25.00	2.83	41.60	61.27	74.00	12.73
1499	54.21	AV	V	25.00	2.83	41.60	40.44	54.00	13.56
1799	75.41	PK	H	26.50	3.08	41.78	63.21	74.00	10.79
1799	54.38	AV	H	26.50	3.08	41.78	42.18	54.00	11.82
2700	69.07	PK	V	29.64	3.76	42.14	60.33	74.00	13.67
2700	53.37	AV	V	29.64	3.76	42.14	44.63	54.00	9.37
4804	45.28	PK	H	33.85	5.05	42.88	41.30	74.00	32.70
4804	35.94	AV	H	33.85	5.05	42.88	31.96	54.00	22.04
7206	41.94	PK	H	36.39	6.43	43.54	41.22	74.00	32.78
7206	32.24	AV	H	36.39	6.43	43.54	31.52	54.00	22.48
Frequency:2440 MHz									
2440	66.23	PK	H	28.82	3.58	0.00	98.63	N/A	N/A
2440	65.86	AV	H	28.82	3.58	0.00	98.26	N/A	N/A
1499	74.23	PK	V	25.00	2.83	41.60	60.46	74.00	13.54
1499	53.21	AV	V	25.00	2.83	41.60	39.44	54.00	14.56
1799	74.96	PK	H	26.50	3.08	41.78	62.76	74.00	11.24
1799	53.95	AV	H	26.50	3.08	41.78	41.75	54.00	12.25
2700	68.27	PK	V	29.64	3.76	42.14	59.53	74.00	14.47
2700	53.43	AV	V	29.64	3.76	42.14	44.69	54.00	9.31
4880	45.25	PK	H	34.06	5.09	42.93	41.47	74.00	32.53
4880	36.25	AV	H	34.06	5.09	42.93	32.47	54.00	21.53
7320	42.81	PK	H	36.55	6.49	43.56	42.29	74.00	31.71
7320	31.92	AV	H	36.55	6.49	43.56	31.40	54.00	22.60
Frequency:2480 MHz									
2480	66.51	PK	H	28.94	3.61	0.00	99.06	N/A	N/A
2480	66.34	AV	H	28.94	3.61	0.00	98.89	N/A	N/A
2483.5	29.46	PK	V	28.95	3.61	0.00	62.02	74.00	11.98
2483.5	17.03	AV	V	28.95	3.61	0.00	49.59	54.00	4.41
1499	73.54	PK	V	25.00	2.83	41.60	59.77	74.00	14.23
1499	53.33	AV	V	25.00	2.83	41.60	39.56	54.00	14.44
1799	74.47	PK	H	26.50	3.08	41.78	62.27	74.00	11.73
1799	53.77	AV	H	26.50	3.08	41.78	41.57	54.00	12.43
2700	68.58	PK	V	29.64	3.76	42.14	59.84	74.00	14.16
2700	53.68	AV	V	29.64	3.76	42.14	44.94	54.00	9.06
4960	45.74	PK	H	34.29	5.14	42.98	42.19	74.00	31.81
4960	36.11	AV	H	34.29	5.14	42.98	32.56	54.00	21.44
7440	42.01	PK	H	36.72	6.55	43.59	41.69	74.00	32.31
7440	31.71	AV	H	36.72	6.55	43.59	31.39	54.00	22.61

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

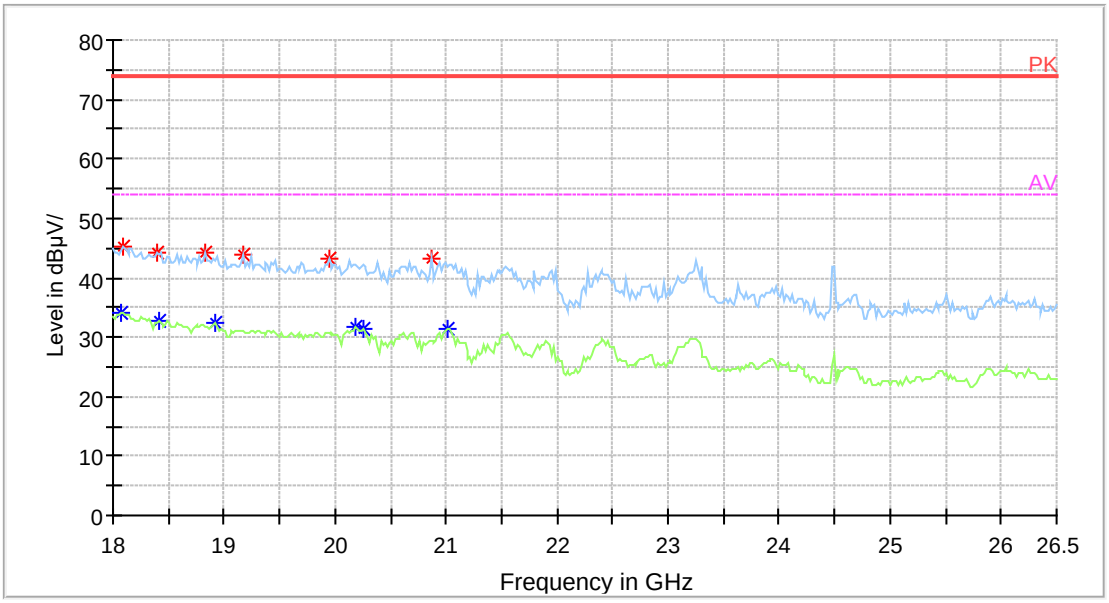
High Channel_Horizontal_1GHz-18GHz



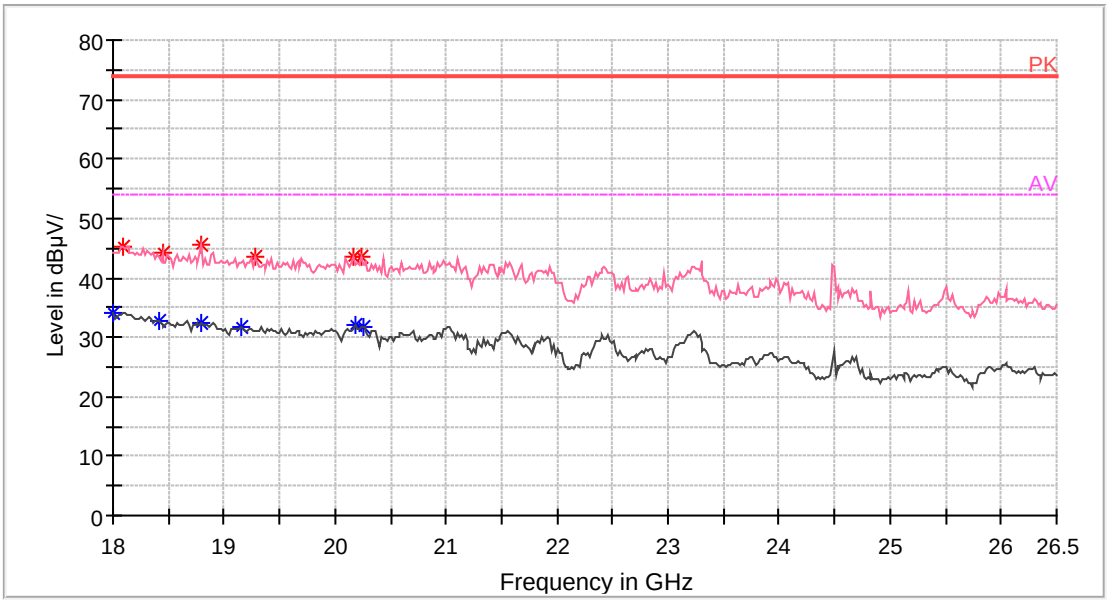
High Channel_Vertical_1GHz-18GHz



High Channel_Horizontal_18GHz-26.5GHz



High Channel_Vertical_18GHz-26.5GHz



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

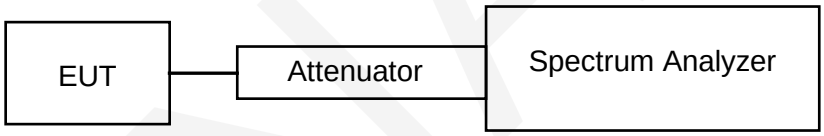
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

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.



Test Data

Environmental Conditions

Temperature:	20°C
Relative Humidity:	61 %
ATM Pressure:	95.9 kPa

The testing was performed by Eric Xiao on 2019-12-26.

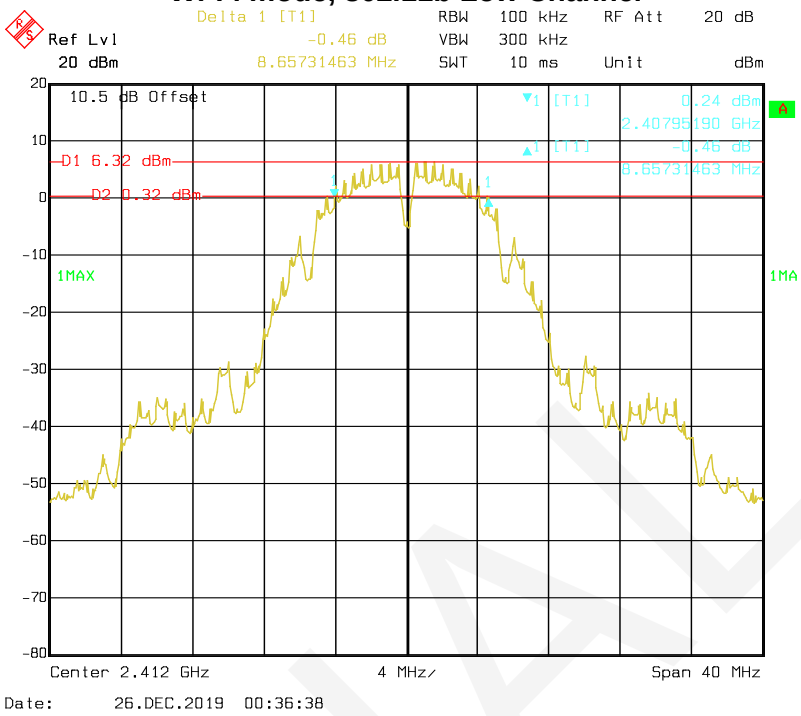
Test Mode: Transmitting

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

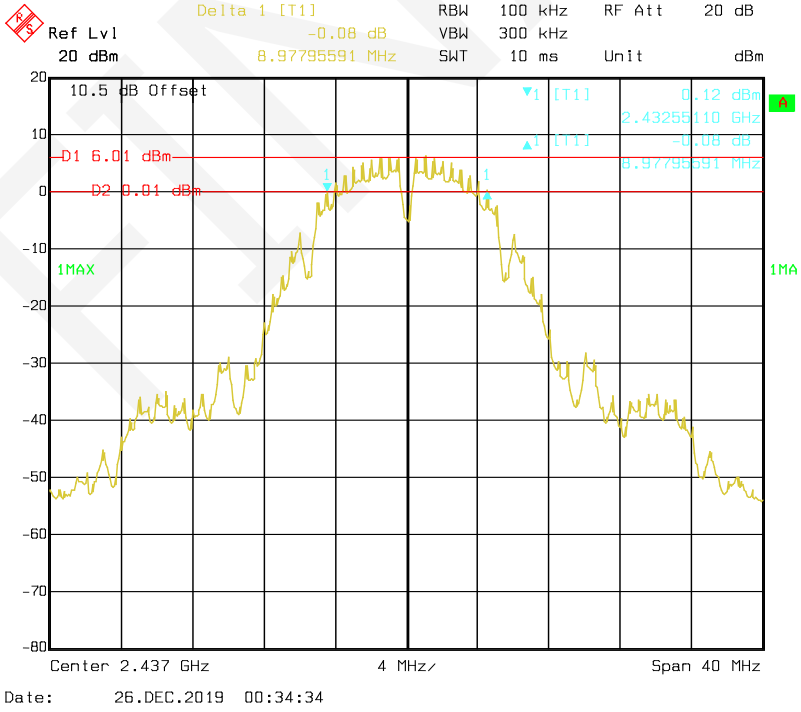
Mode	Channel	Frequency(MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)
802.11b	Low	2412	8.65	≥0.50
	Middle	2437	8.97	≥0.50
	High	2462	9.06	≥0.50
802.11g	Low	2412	16.35	≥0.50
	Middle	2437	16.35	≥0.50
	High	2462	16.11	≥0.50
802.11-HT20	Low	2412	17.56	≥0.50
	Middle	2437	17.47	≥0.50
	High	2462	17.15	≥0.50

Mode	Channel	Frequency(MHz)	6 dB Bandwidth (MHz)	Limit (MHz)
BLE	Low	2402	0.75	≥0.50
	Middle	2440	0.75	≥0.50
	High	2480	0.75	≥0.50

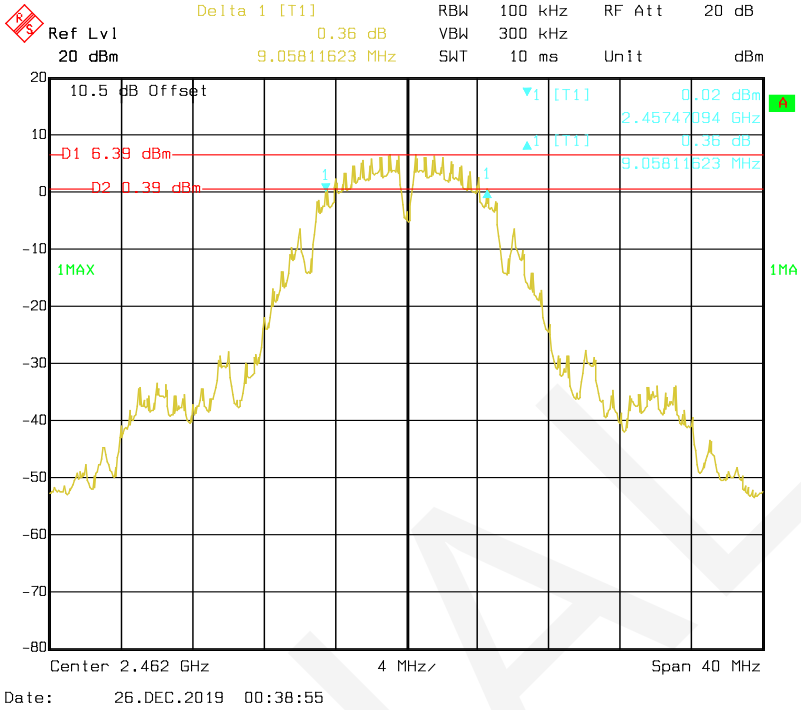
Wi-Fi mode, 802.11b Low Channel



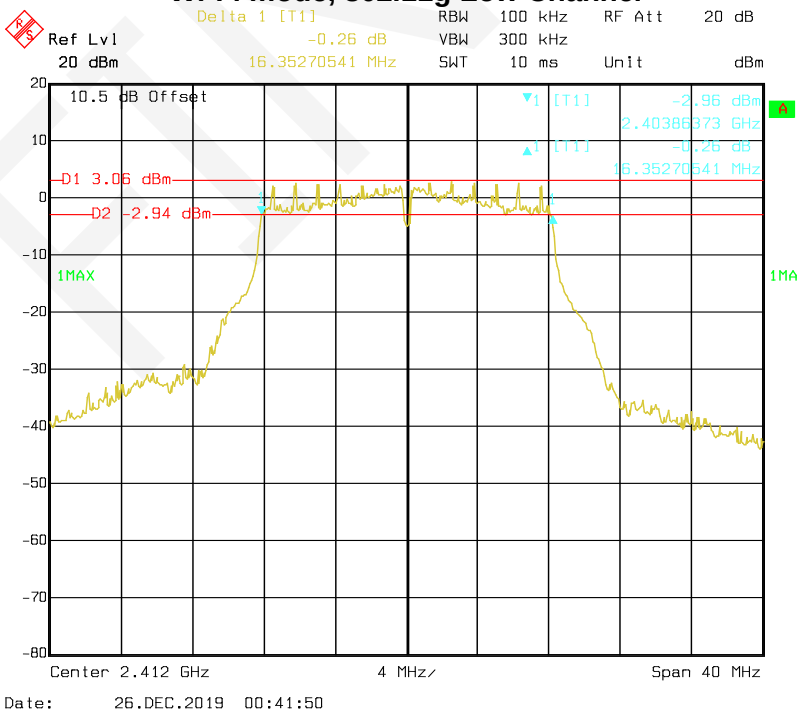
Wi-Fi mode, 802.11b Middle Channel



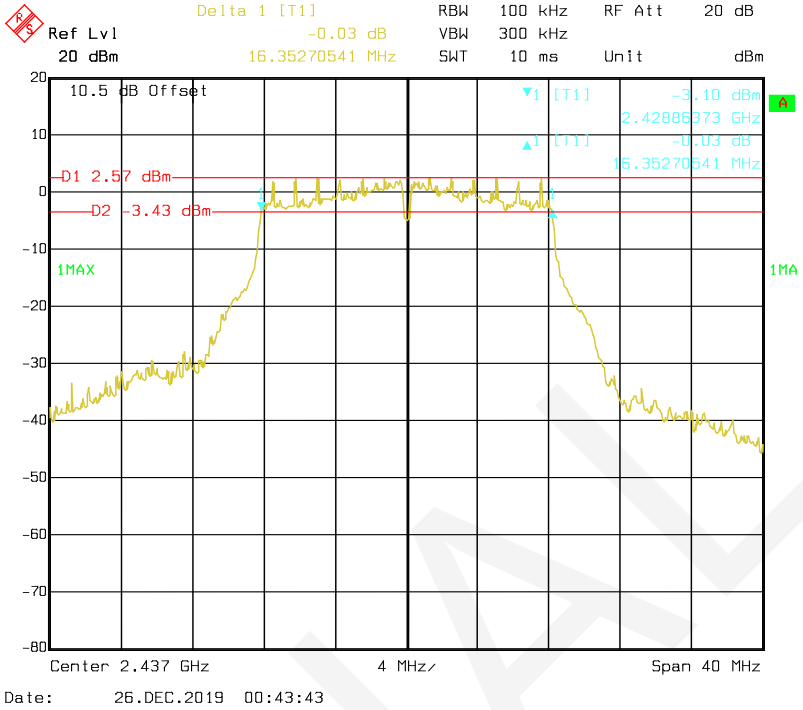
Wi-Fi mode, 802.11b High Channel



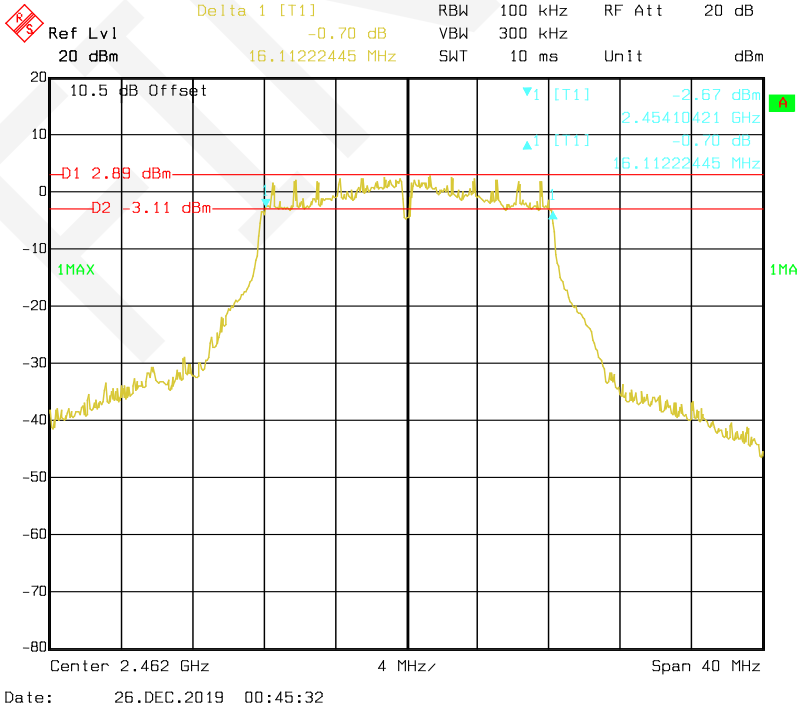
Wi-Fi mode, 802.11g Low Channel



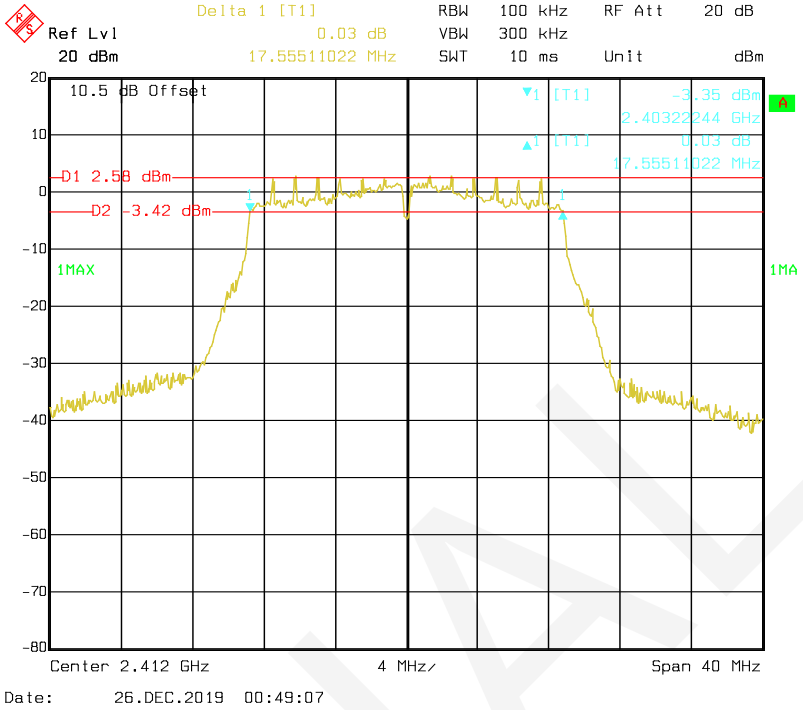
Wi-Fi mode, 802.11g Middle Channel



Wi-Fi mode, 802.11g High Channel

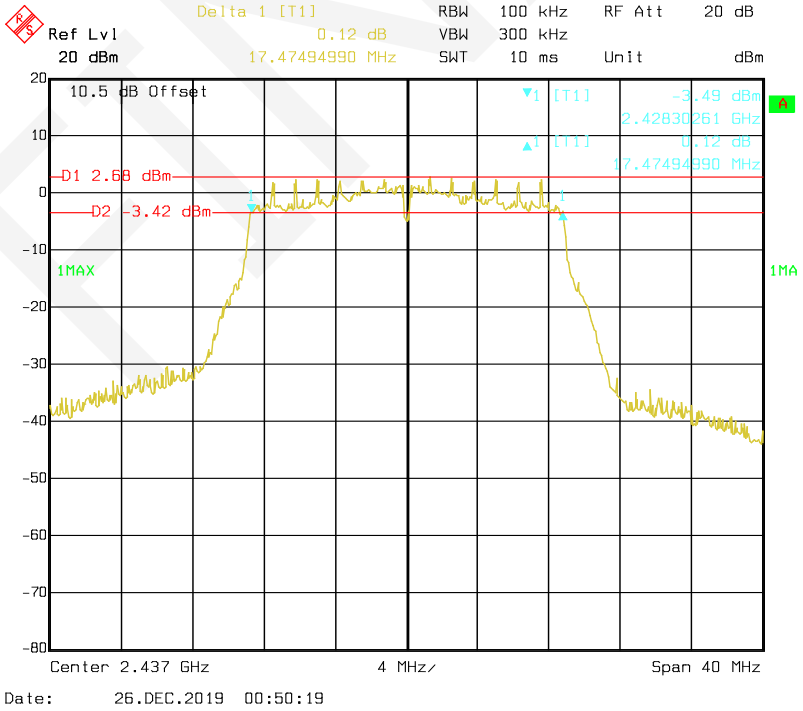


Wi-Fi mode, 802.11n-HT20 Low Channel



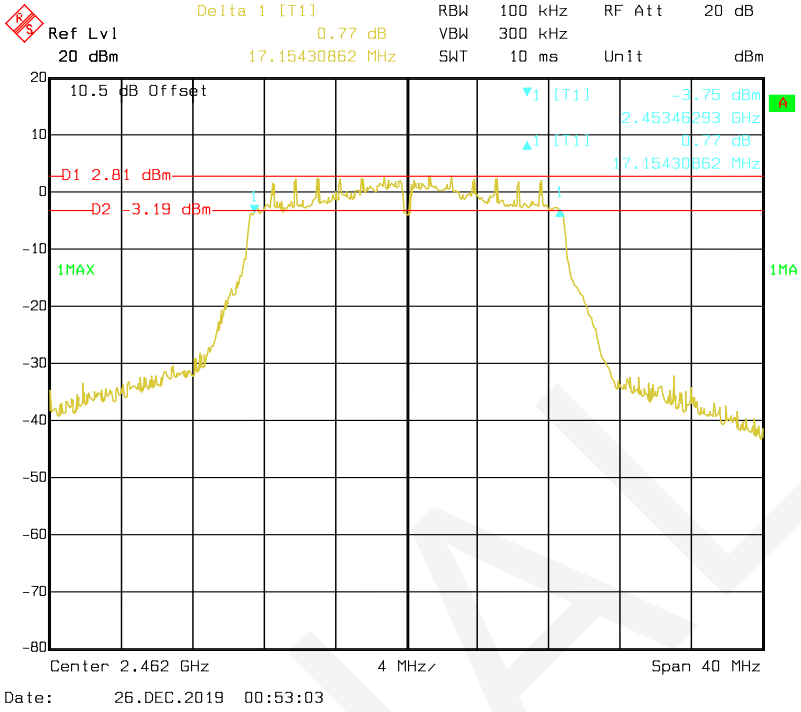
Date: 26.DEC.2019 00:49:07

Wi-Fi mode, 802.11n-HT20 Middle Channel

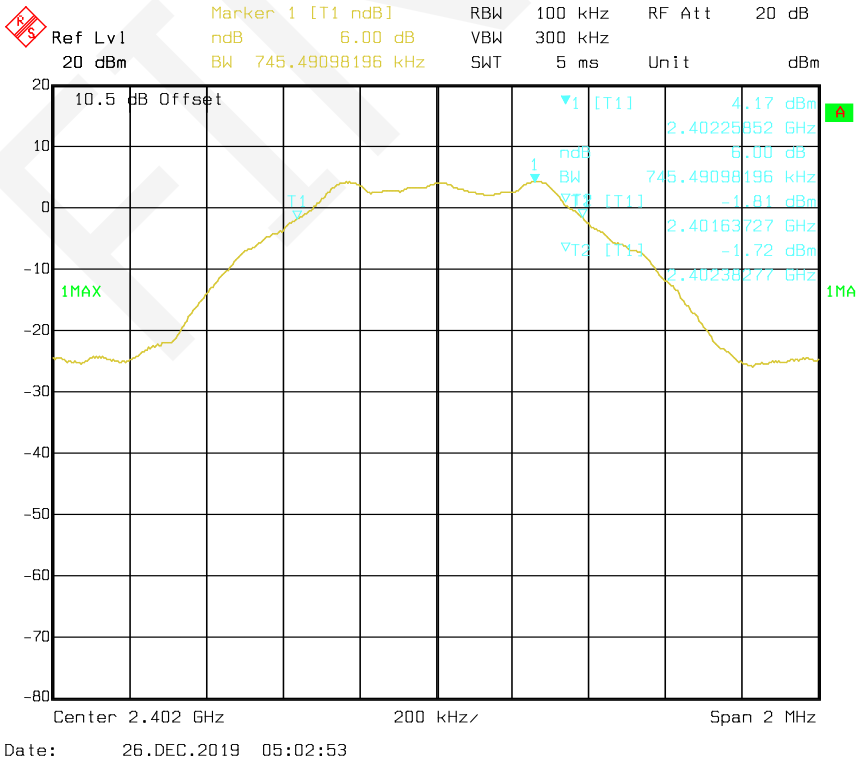


Date: 26.DEC.2019 00:50:19

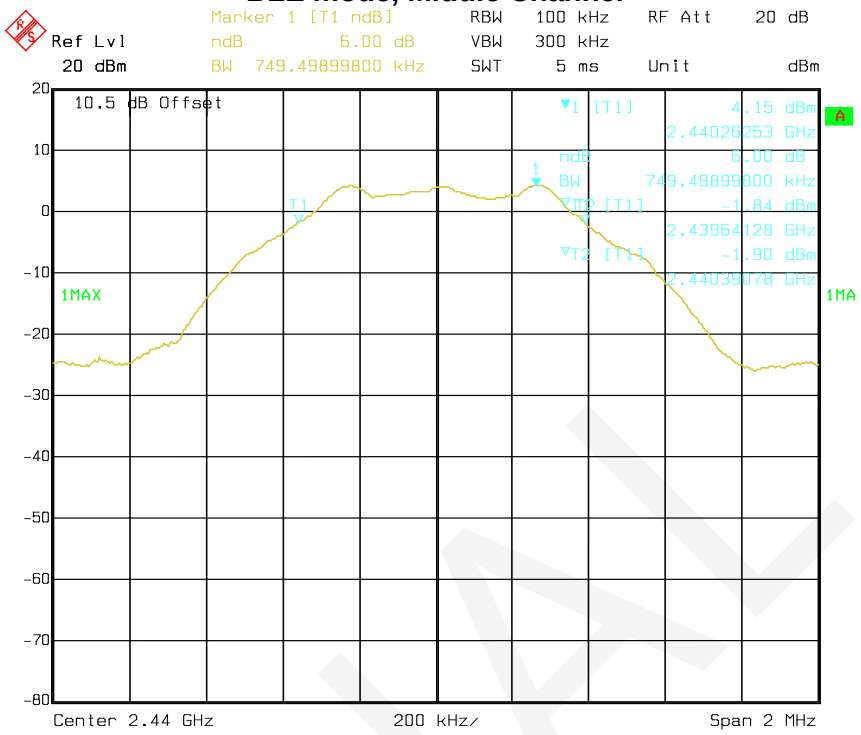
Wi-Fi mode, 802.11n-HT20 High Channel



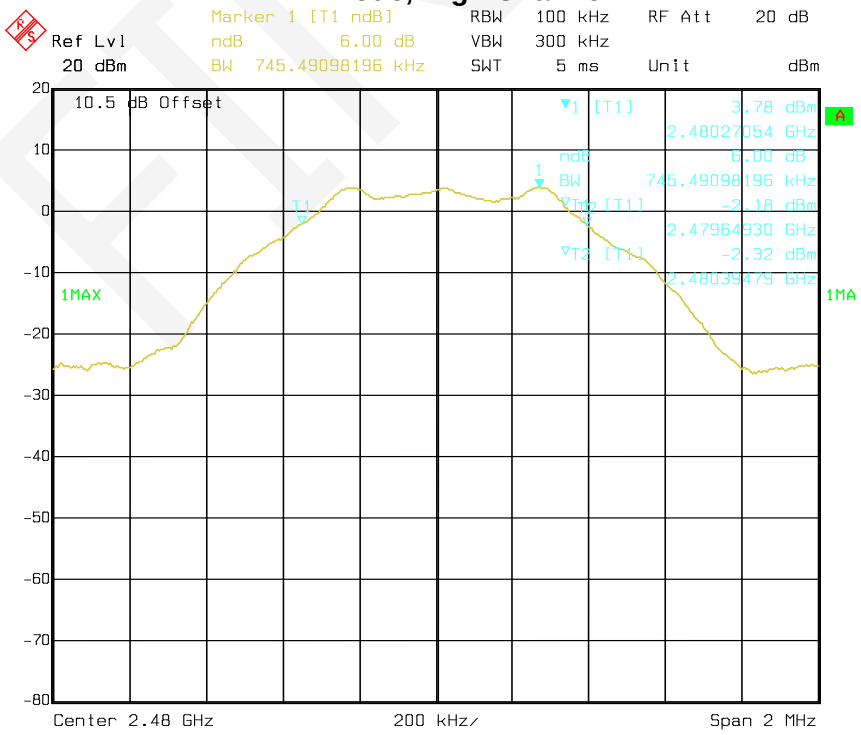
BLE mode, Low Channel



BLE mode, Middle Channel



BLE mode, 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.

Test Data

Environmental Conditions

Temperature:	20°C
Relative Humidity:	61 %
ATM Pressure:	95.9 kPa

The testing was performed by Eric Xiao on 2019-12-26.

Test Mode: Transmitting

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

WIFI:

Mode	Channel	Frequency (MHz)	Max Peak Conducted Output Power (dBm)	Max Average Conducted Output Power (dBm)	Limit (dBm)
802.11b	Low	2412	16.72	13.43	30
	Middle	2437	16.82	13.78	30
	High	2462	16.68	13.66	30
802.11g	Low	2412	22.30	12.90	30
	Middle	2437	22.46	12.88	30
	High	2462	22.58	12.93	30
802.11n-HT20	Low	2412	22.50	12.36	30
	Middle	2437	22.37	12.51	30
	High	2462	22.64	12.69	30

Mode	Channel	Frequency (MHz)	Max Peak Conducted Output Power (dBm)	Limit (dBm)
BLE	Low	2402	4.71	30
	Middle	2440	4.71	30
	High	2480	4.31	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:	20°C
Relative Humidity:	61 %
ATM Pressure:	95.9 kPa

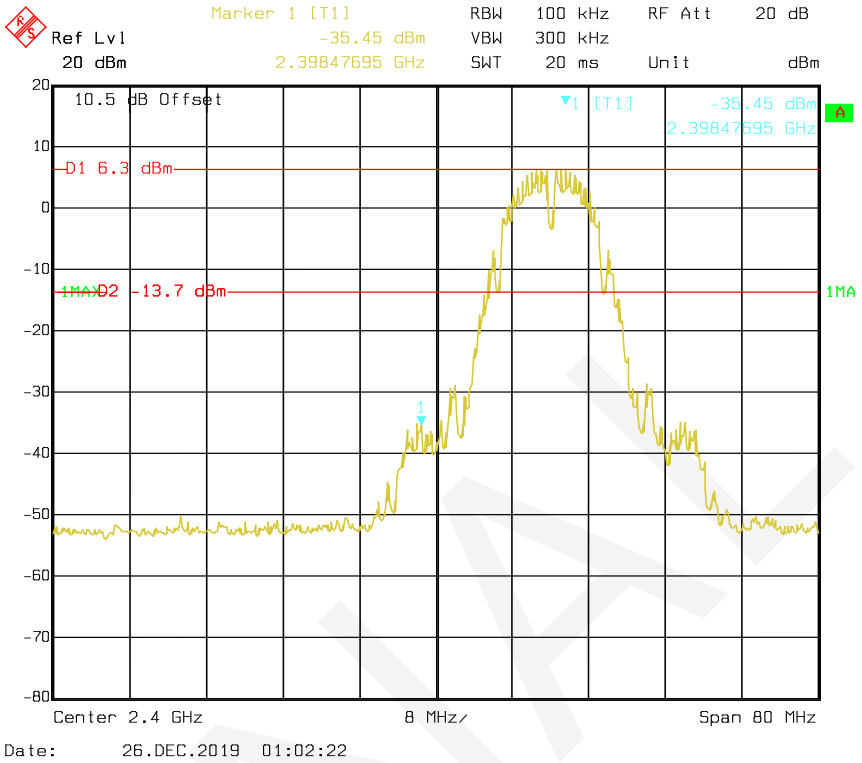
The testing was performed by Eric Xiao on 2019-12-26.

Test mode: Transmitting

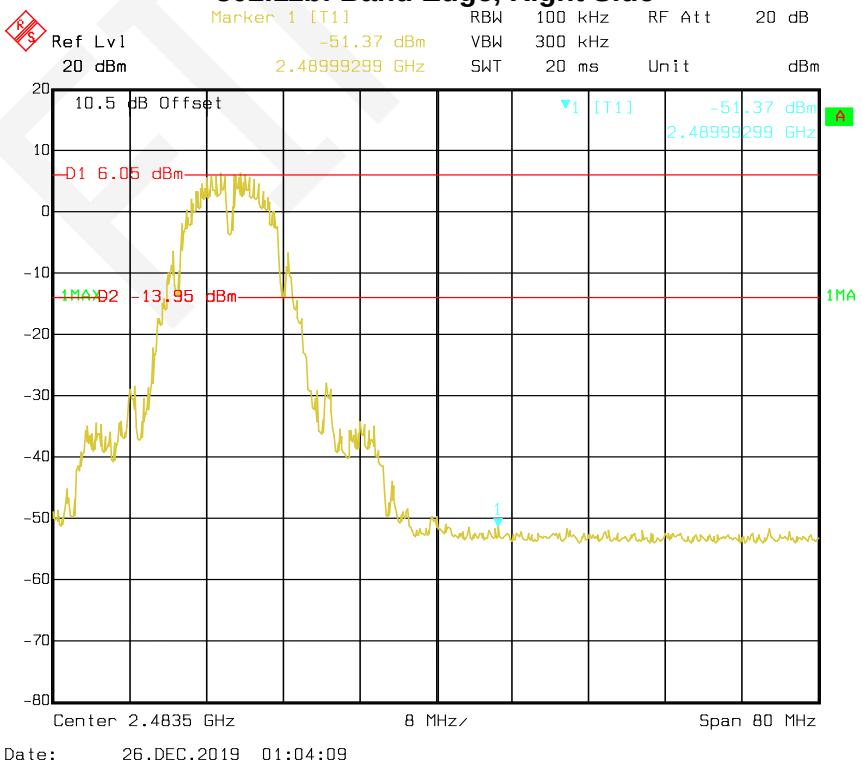
Test Result: Compliance. Please refer to following plots.

Wi-Fi mode

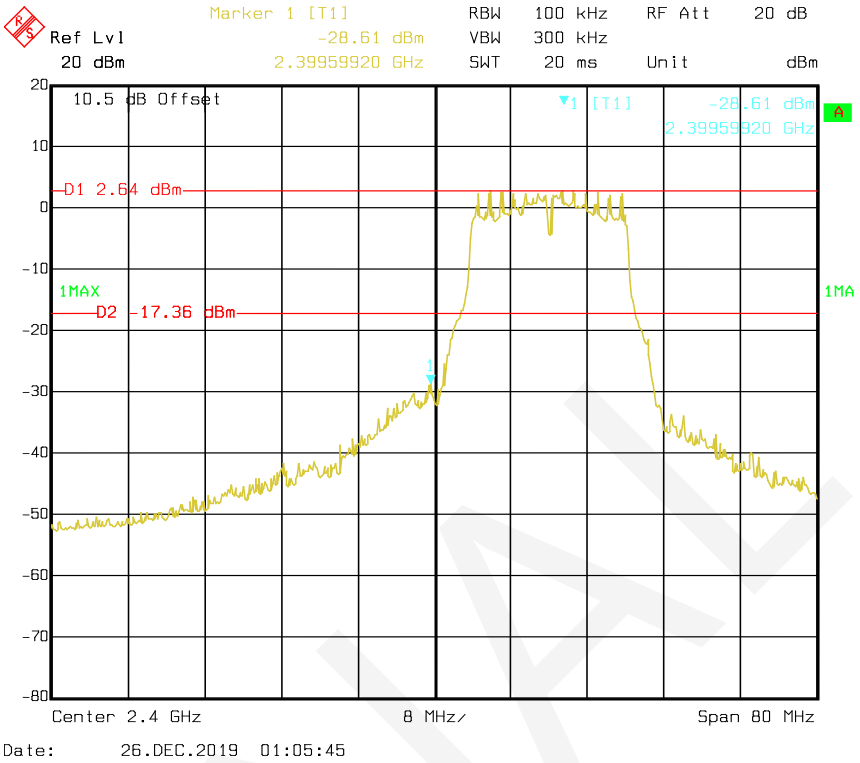
802.11b: Band Edge, Left Side



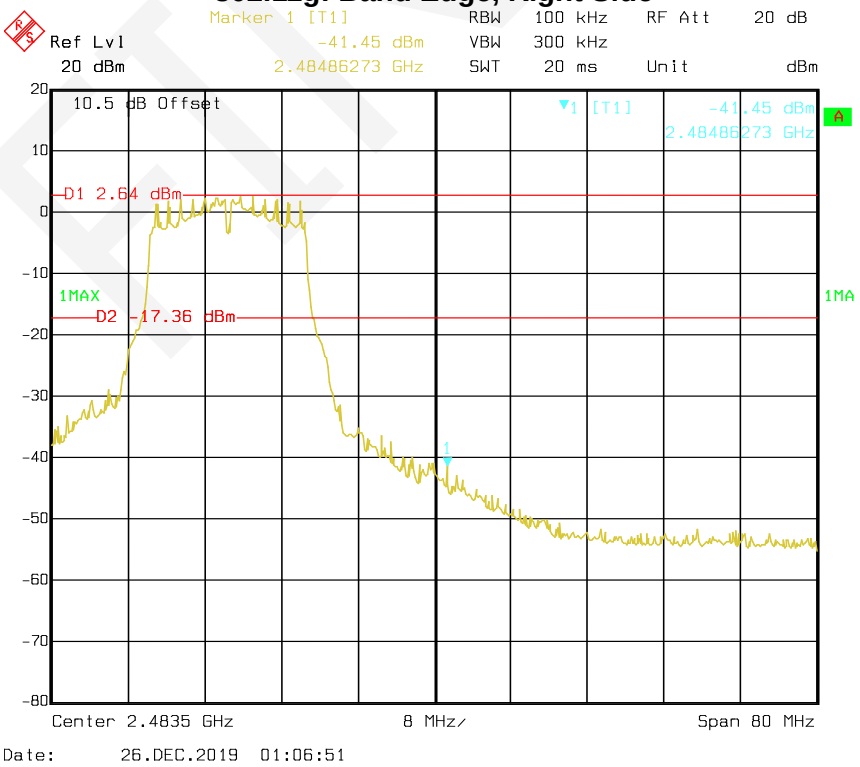
802.11b: Band Edge, Right Side



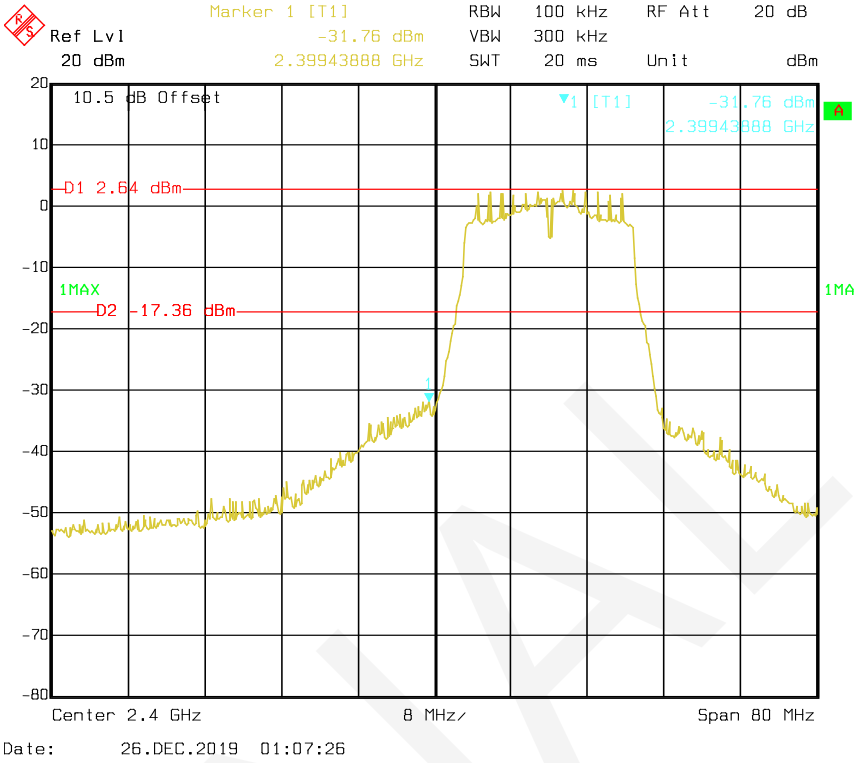
802.11g: Band Edge, Left Side



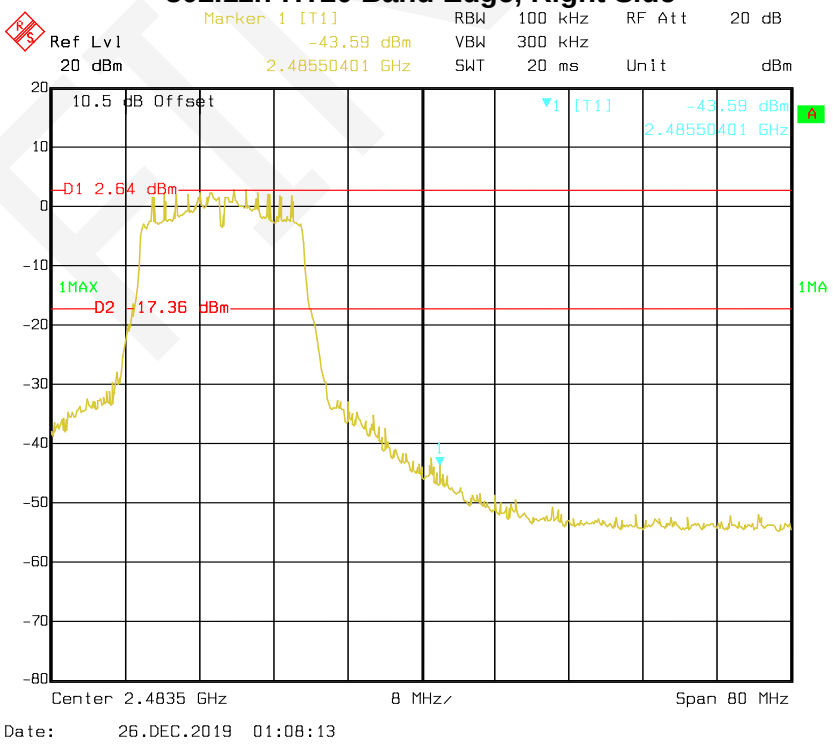
802.11g: Band Edge, Right Side



802.11n-HT20 Band Edge, Left Side

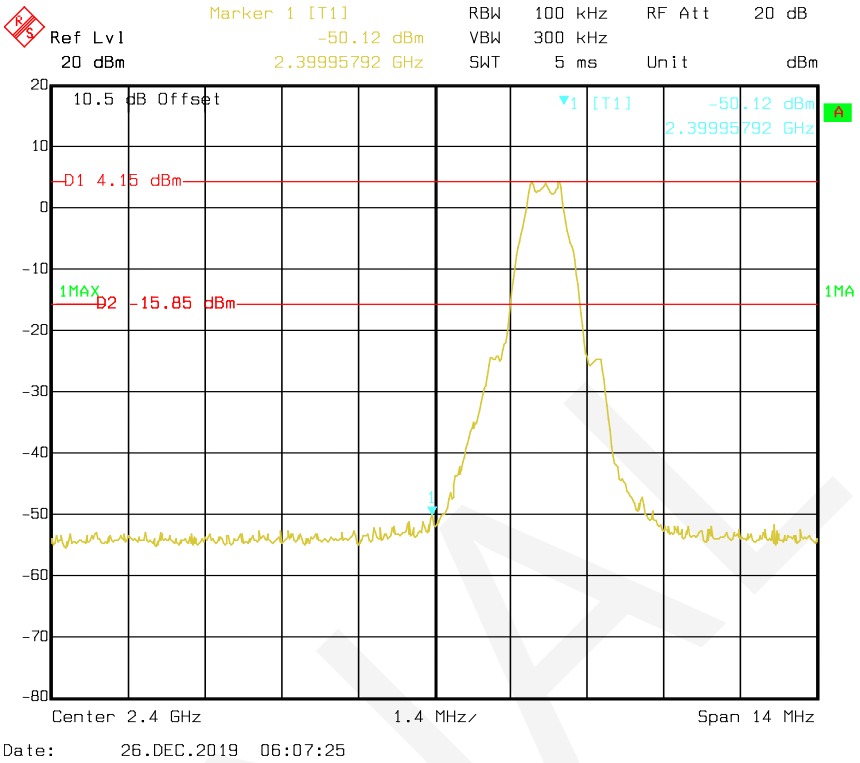


802.11n-HT20 Band Edge, Right Side

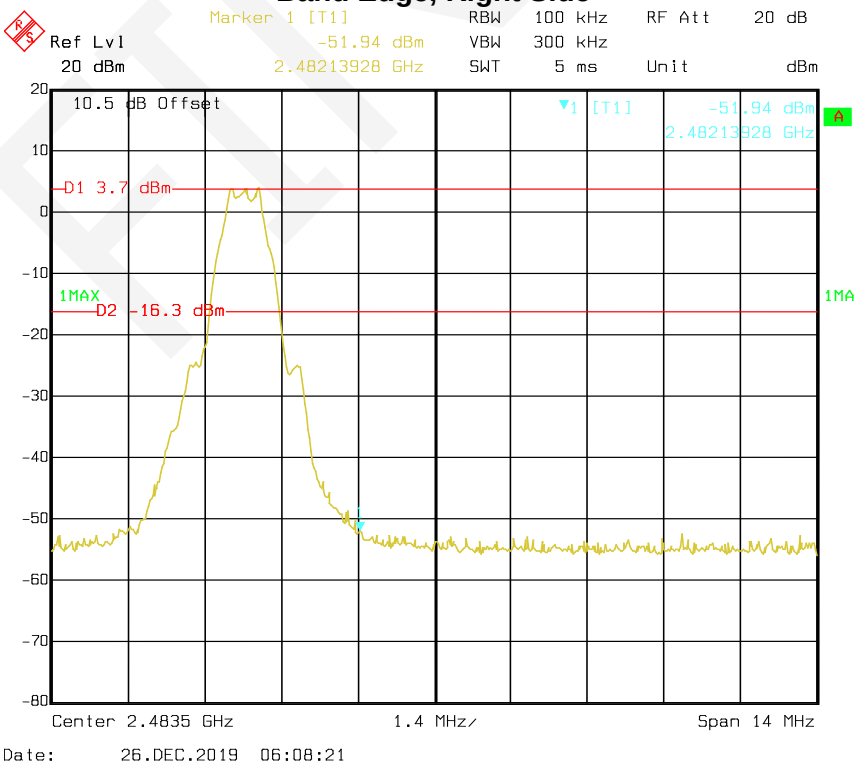


BLE mode

Band Edge, Left Side



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.

Test Data

Environmental Conditions

Temperature:	20°C
Relative Humidity:	61 %
ATM Pressure:	95.9 kPa

The testing was performed by Eric Xiao on 2019-12-26.

Test Mode: Transmitting

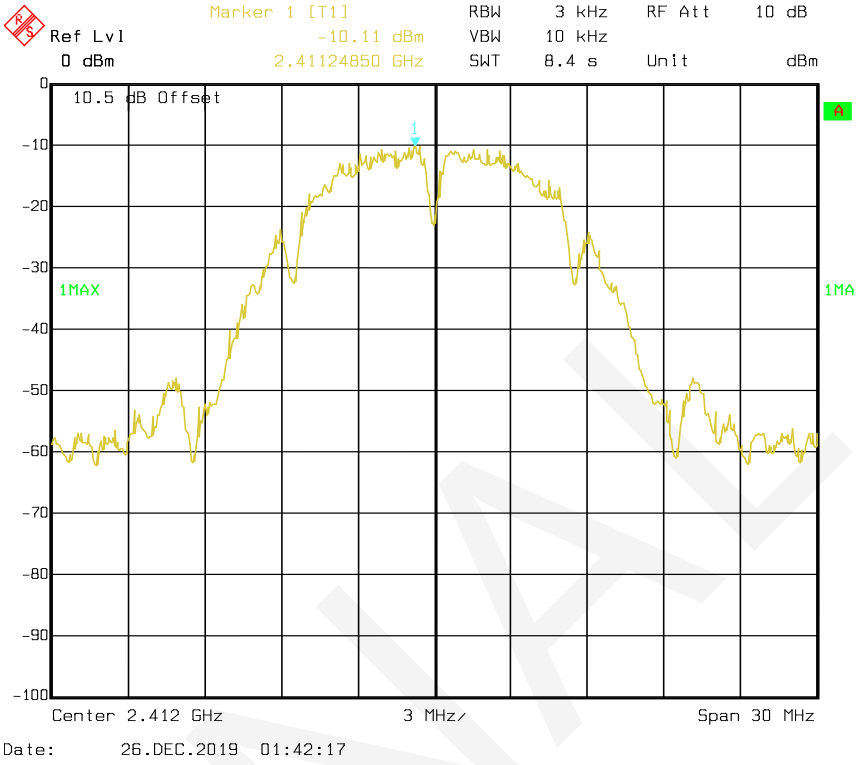
Test Result: Compliance. Please refer to the following table and plots

Mode	Channel	Frequency (MHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
802.11b	Low	2412	-10.11	⩽8
	Middle	2437	-10.15	⩽8
	High	2462	-10.41	⩽8
802.11g	Low	2412	-13.21	⩽8
	Middle	2437	-12.27	⩽8
	High	2462	-13.06	⩽8
802.11n-HT20	Low	2412	-12.80	⩽8
	Middle	2437	-12.30	⩽8
	High	2462	-13.88	⩽8

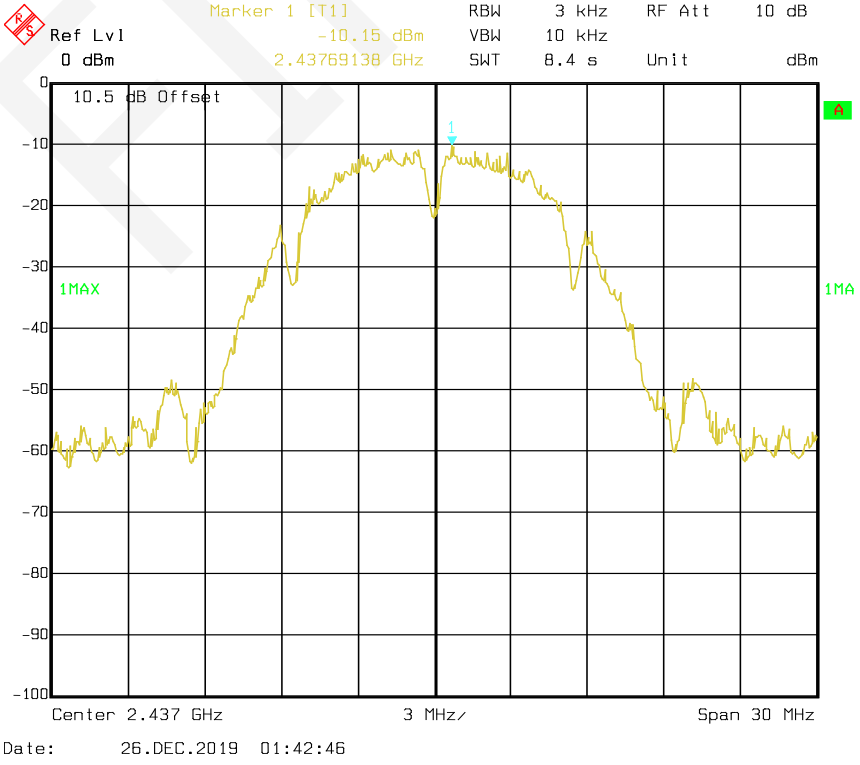
Mode	Channel	Frequency (MHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
BLE	Low	2402	-9.78	⩽8
	Middle	2440	-9.71	⩽8
	High	2480	-10.09	⩽8

Wi-Fi mode

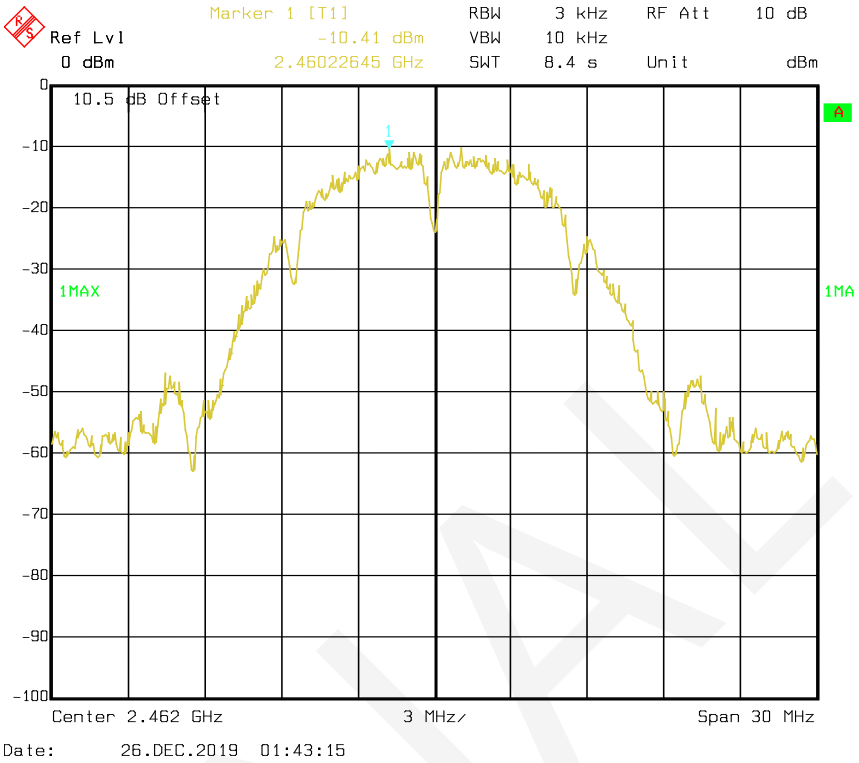
Power Spectral Density, 802.11b Low Channel



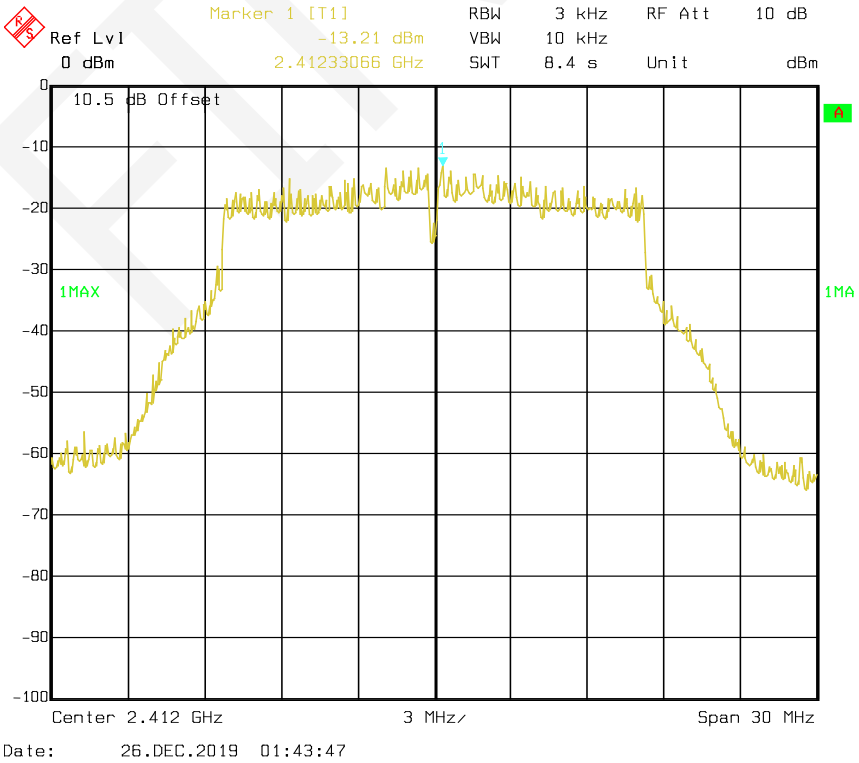
Power Spectral Density, 802.11b Middle Channel



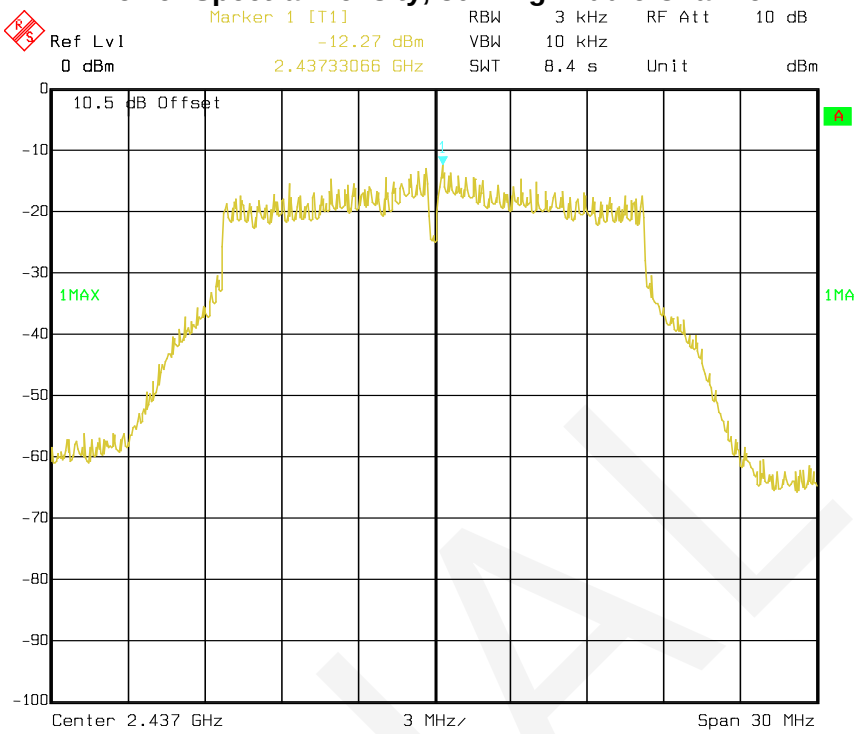
Power Spectral Density, 802.11b High Channel



Power Spectral Density, 802.11g Low Channel



Power Spectral Density, 802.11g Middle Channel



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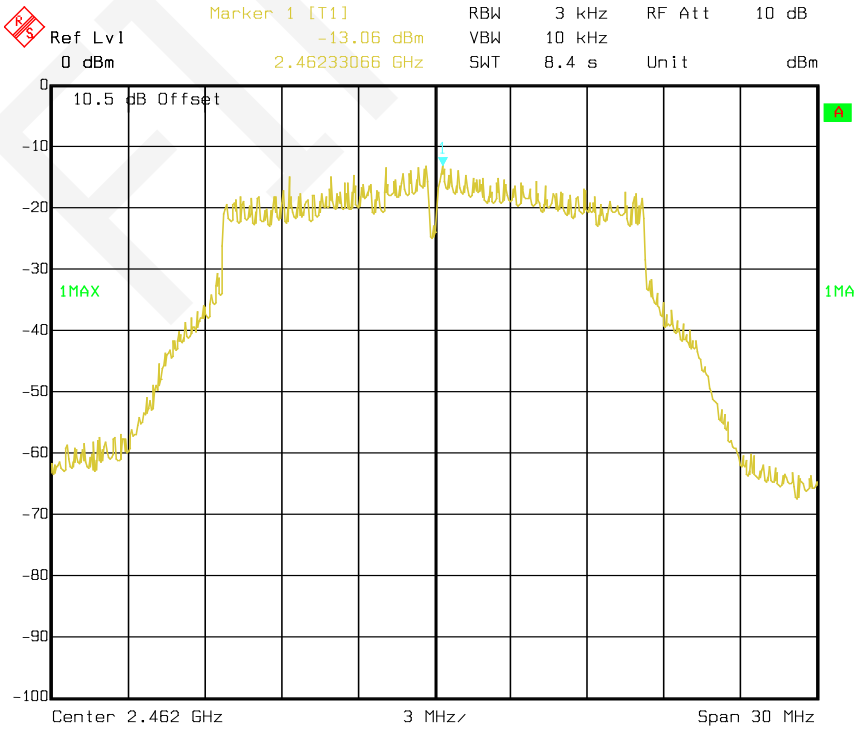
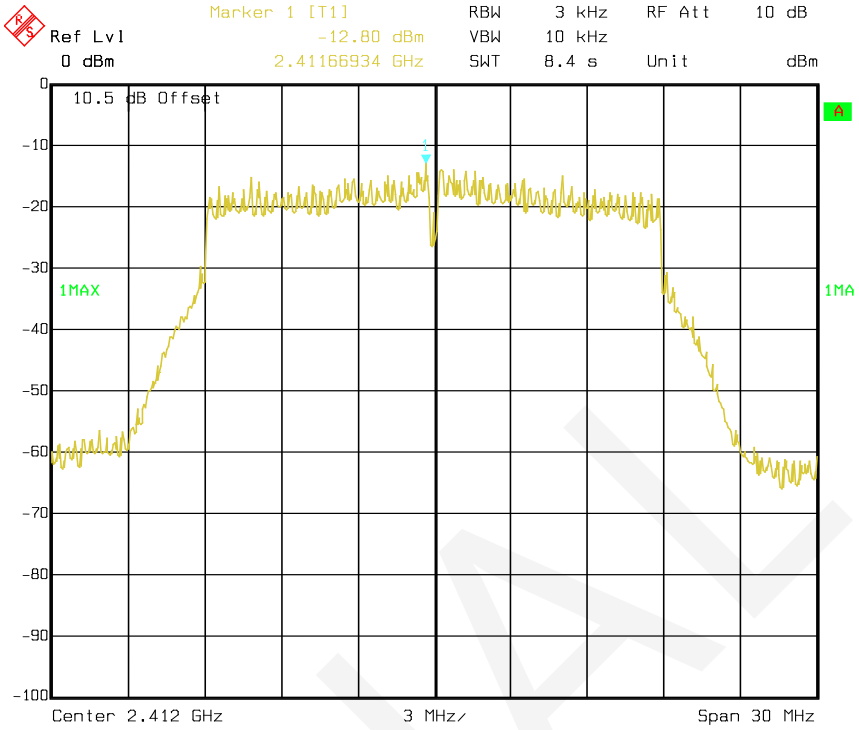
Power Spectral Density, 802.11g High Channel

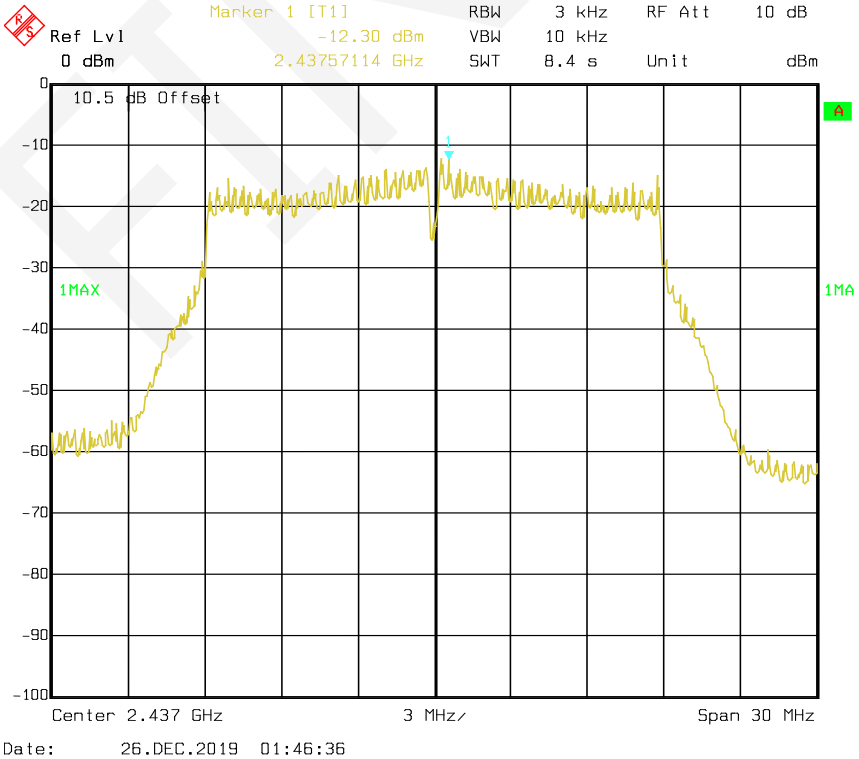


Date: 26.DEC.2019 01:44:48

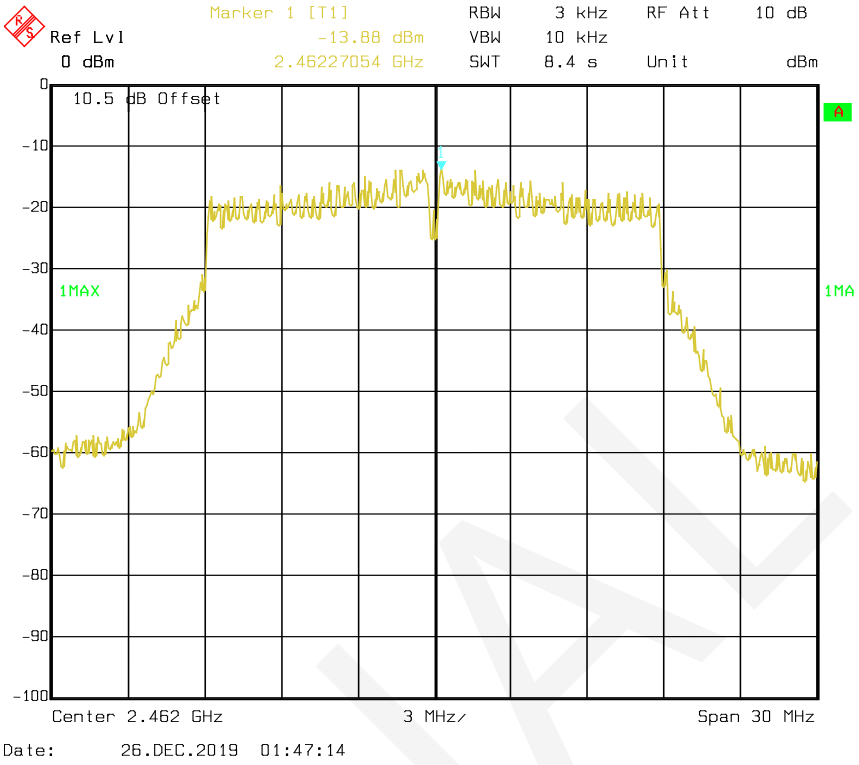
Power Spectral Density, 802.11n-HT20 Low Channel



Power Spectral Density, 802.11n-HT20 Middle Channel

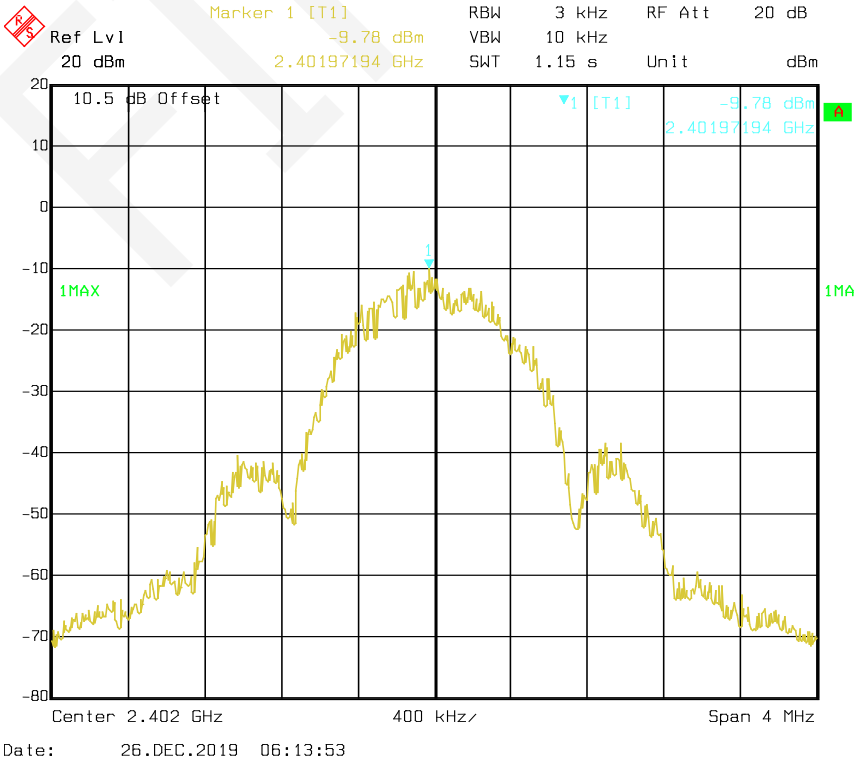


Power Spectral Density, 802.11n-HT20 High Channel

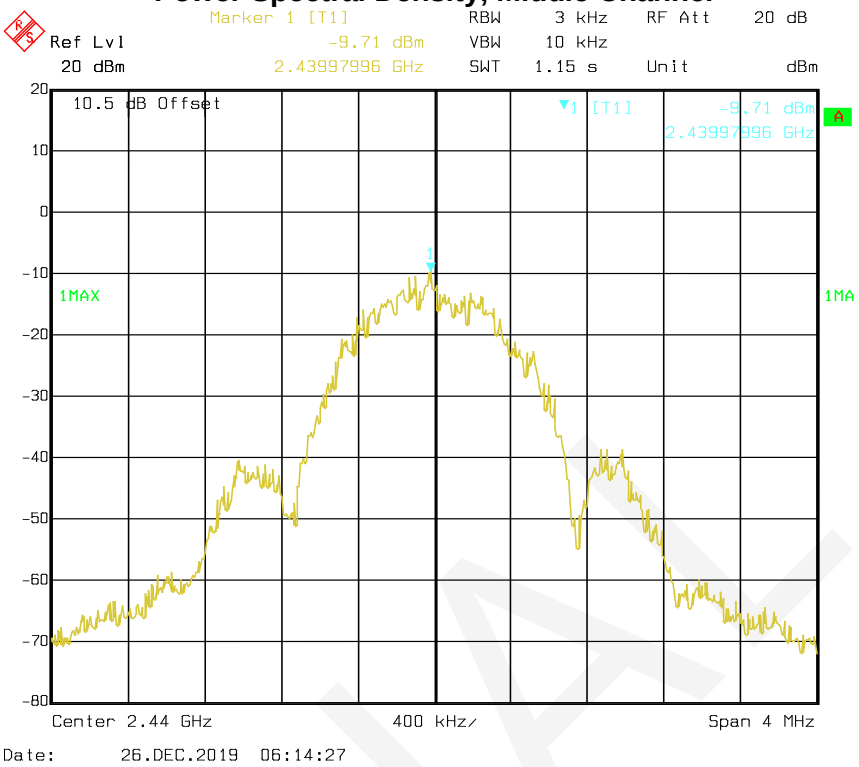


BLE mode

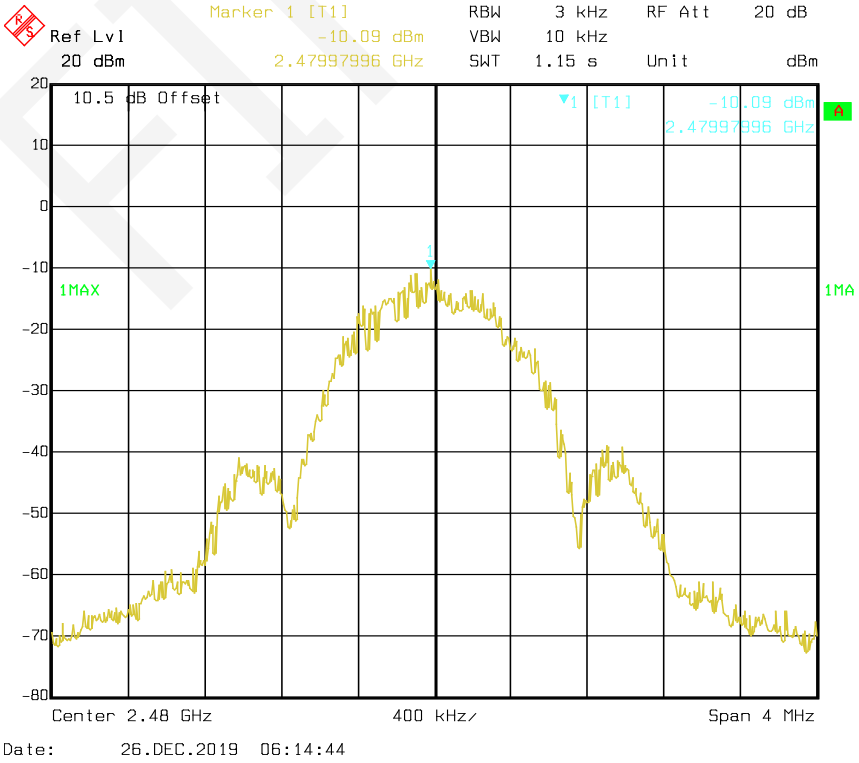
Power Spectral Density, Low Channel



Power Spectral Density, Middle Channel



Power Spectral Density, High Channel



END OF REPORT