FCC PART 15.247

TEST REPORT

For

DSG Global Inc.

2630 Croydon Dr., Suite 312, Surrey, British Columbia, Canada V3Z6T3

Tested Model: DSG-121-VT
FCC ID: 2ARPX-DSG121VT

Report Type:	**Product Name:**
Original Report	Embedded Computer

Report Number:	RSC180927003-0C
Date of Report Issue:	2019-04-22
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	DSG Global Inc.
Product	Embedded Computer
Tested Model	DSG-121-VT
FCC ID	2ARPX-DSG121VT
Frequency	2.4G Wi-Fi: 2412-2462MHz Bluetooth LE: 2402-2480MHz
Voltage Range	DC 7.4V (Rechargeable Li-ion battery) or DC12V-75V from golf vehicle
Measure approximately	238 mm (L) x 323 mm (W) x 36 mm (H)
Sample serial number	180927003/01 (assigned by the BACL, Chengdu)
Received date	2018-09-27
Sample/EUT Status	Good condition

Note: The EUT conformed to test requirements and all measurement and test data in this report was gathered from final production sample. It may have deviation from any other sample.

Objective

This report is prepared on behalf of **DSG Global 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: 2ARPX-DSG121VT
FCC Part 15C DSS submissions with FCC ID: 2ARPX-DSG121VT
FCC Part 15C DXX submissions with FCC ID: 2ARPX-DSG121VT

Measurement Uncertainty

Item			Uncertainty
Radiated Emission(Field Strength)	30MHz-200MHz	H	4.63 dB
		V	4.88 dB
	200MHz-1GHz	H	5.02 dB
		V	6.06 dB
	1GHz-6GHz		4.51 dB
	6GHz-18GHz		4.49 dB
	18GHz-40GHz		5.48 dB
Conducted RF Power			±0.61dB
Power Spectrum Density			±0.61dB
Occupied Bandwidth			±5%
Conducted Emission			±1.5dB
Humidity			±5%
Temperature			±1℃

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

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.
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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	-	-

802.11b, 802.11g and 802.11n HT20 modes were tested with Channel 1, 6 and 11.

For BLE 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.

Note: 802.11b/g supports SISO, 802.11n20 supports SISO and MIMO mode. For Radiated Emission, according to pretest, the worst case for 802.11b/g is Antenna 0, the worst case for 802.11n20 is MIMO mode. So 802.11b/g Antenna 0 & 802.11n20 MIMO mode test data were recorded in the report.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

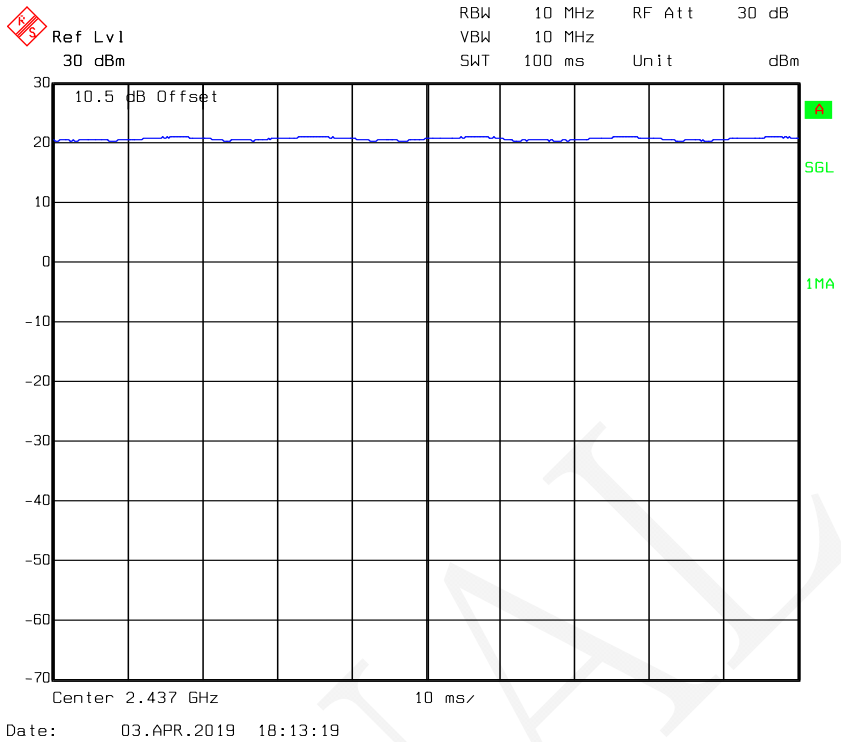
The worst condition (maximum power with maximum duty cycle) was setting by the software as following table:

Test Mode	Test Software Version	RF Test Tool		
802.11b	Test Frequency	2412MHz	2437MHz	2462MHz
	Data Rate	CCK 1M	CCK 1M	CCK 1M
	Power Level Setting Antenna 0	16	16	16
	Power Level Setting Antenna 1	16	16	16
802.11g	Test Frequency	2412MHz	2437MHz	2462MHz
	Data Rate	OFDM 6M	OFDM 6M	OFDM 6M
	Power Level Setting Antenna 0	13	13	13
	Power Level Setting Antenna 1	13	13	13
802.11n-HT20	Test Frequency	2412MHz	2437MHz	2462MHz
	Data Rate	MCS0	MCS0	MCS0
	Power Level Setting Antenna 0	15	15	15
	Power Level Setting Antenna 1	15	15	15
BLE	Test Frequency	2402MHz	2440MHz	2480MHz
	Data Rate	Default	Default	Default
	Power Level Setting	Default	Default	Default

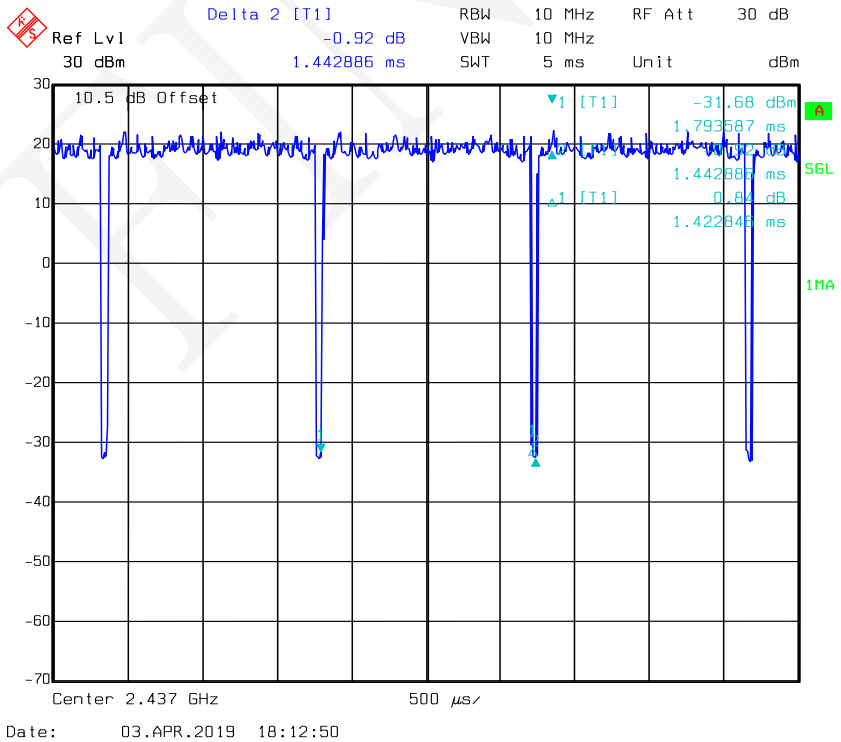
Duty Cycle information is below:

Mode	T_{on} (ms)	T_{on+off} (ms)	Duty Cycle (%)
802.11b	100.00	100.00	100.00
802.11g	1.42	1.44	98.61
802.11n-HT20	1.33	1.35	98.52
BLE	100.00	100.00	100.00

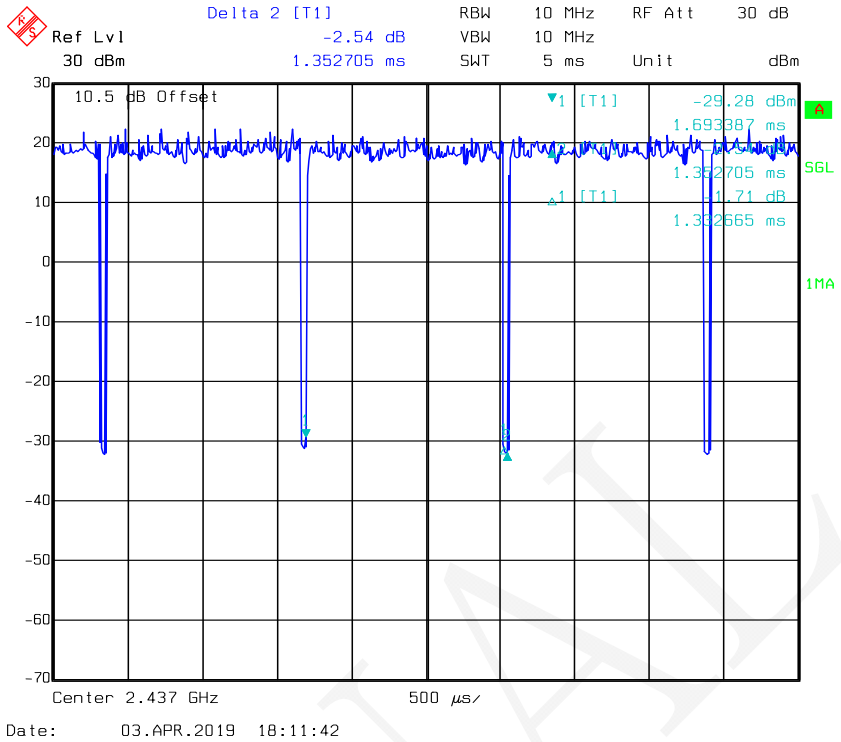
802.11b



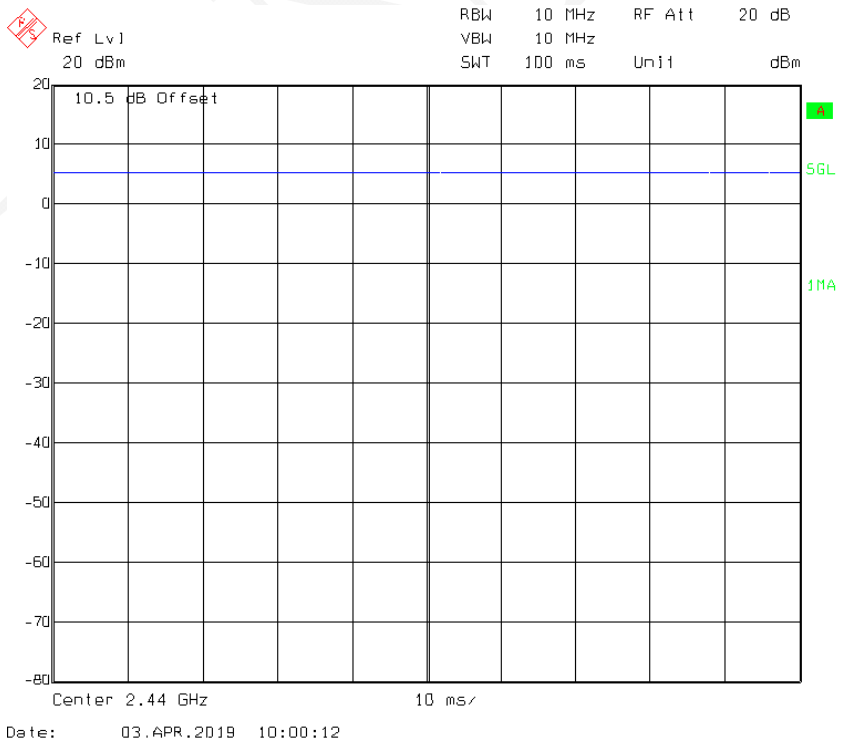
802.11g



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
Power Cable	1.20	EUT	DC Power Source

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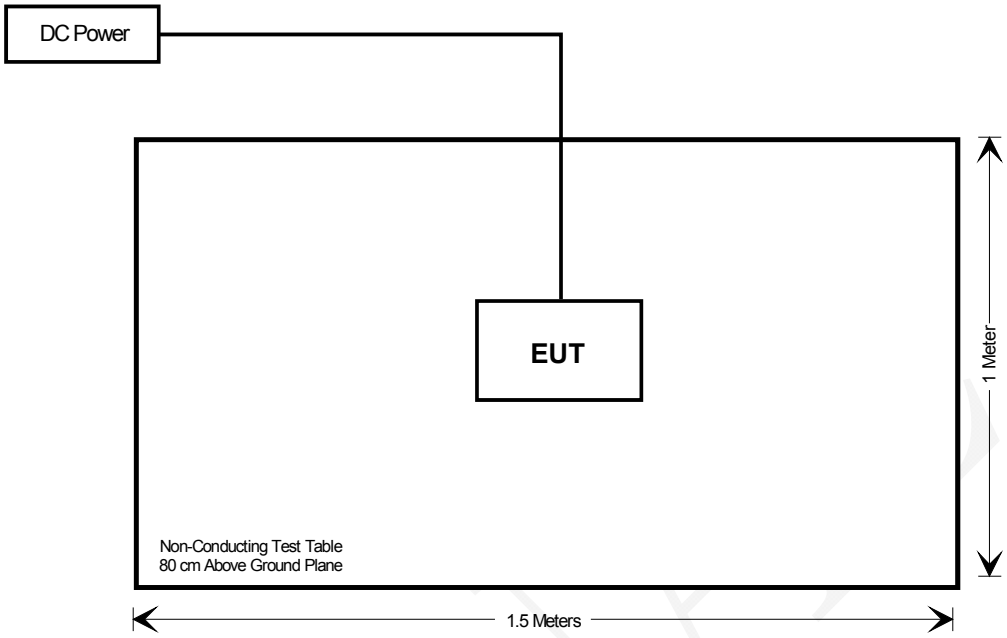
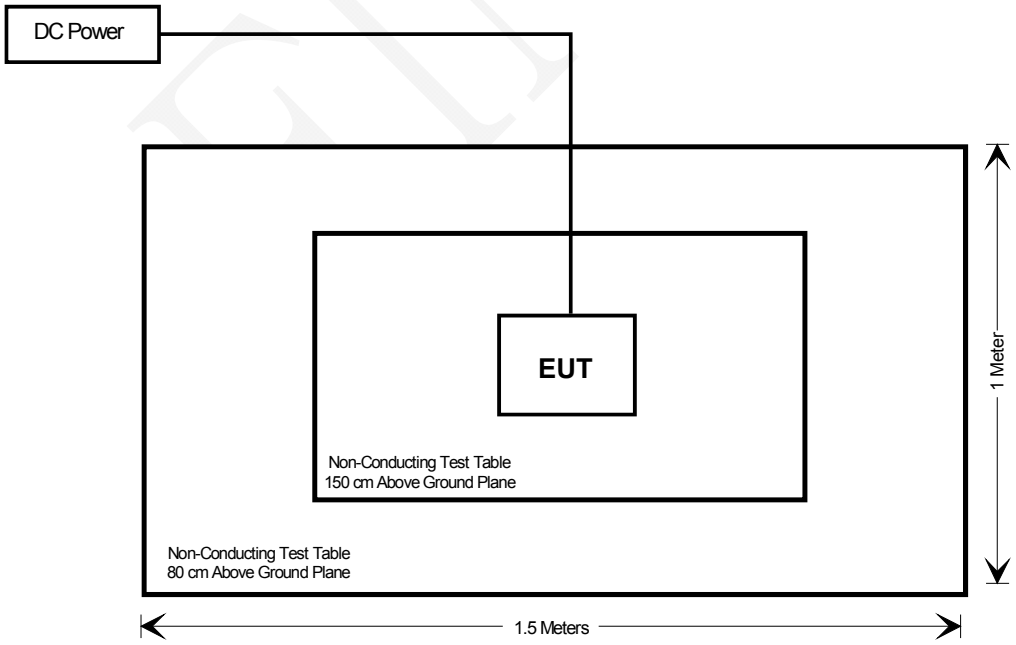
Block Diagram of Test Setup

Below 1GHz:



Above 1GHz:



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	Not Applicable
§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

Not Applicable: The device is battery operated equipment and only for golf vehicle use.

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TEST EQUIPMENTS LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission					
EMCT	Semi-Anechoic Chamber	966	001	2017-05-18	2020-05-17
SONOMA INSTRUMENT	Amplifier	310 N	186684	2018-08-24	2019-08-23
SUNOL SCIENCES	Broadband Antenna	JB3	A121808	2017-05-19	2020-05-18
Rohde & Schwarz	EMI Test Receiver	ESR 3	102456	2018-06-22	2019-06-21
Rohde & Schwarz	Spectrum Analyzer	FSU26	200835	2019-04-15	2020-04-14
A.H. Systems, Inc	Amplifier	PAM-0118P	467	2018-10-19	2019-10-18
EM Electronics	RF Pre-Amplifier	EM18G40	060725	2019-03-27	2020-03-26
SUNOL SCIENCES	Broadband Antenna	JB3	A121808	2017-05-19	2020-05-18
ETS	Horn Antenna	3115	003-6076	2017-05-19	2020-05-18
A.H. Systems, Inc	Horn Antenna	SAS-574	510	2017-05-19	2020-05-18
INMET	Attenuator	18N-6dB	64671	2018-11-27	2019-11-26
Sinoscite.,Co Ltd	Reject Band Filter	BSF 2402-2480MN	0898-005	2018-11-10	2019-11-09
Unknown	RF Cable (below 1GHz)	L-E005	000005	2018-11-27	2019-11-26
Unknown	RF Cable (below 1GHz)	T-E128	000128	2018-11-27	2019-11-26
Unknown	RF Cable (below 1GHz)	T-E129	000129	2018-11-27	2019-11-26
Unknown	RF Cable (above 1GHz)	T-E069	000069	2018-11-10	2019-11-09
Micro-coax	RF Cable (Above 1GHz)	T-E209	MFR 64639 2310	2019-03-14	2020-03-13
Rohde & Schwarz	EMC32	EMC32	V9.10.00	NCR	NCR
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2018-05-09	2019-05-08
WEINSCHEL ENGINEERING	Attenuator	1A 10dB	AA4135	2018-11-10	2019-11-09
Agilent	USB Wideband Power Sensor	U2021XA	MY53320008	2019-01-17	2020-01-16
E-Microwave	DC Block	EMDCB-00036	OE01304225	2018-11-27	2019-11-26
Unknown	RF Cable	No	000007	Each Time	Each Time

Statement of Traceability: BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

FCC §15.247 & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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);

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

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

Calculated Data:

(WiFi or Bluetooth) + NFC + WCDMA/LTE module (FCC ID: RI7LE910NAV2)

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)			
WLAN	2412-2462	3.00	2.00	26.0	398.11	20	0.158	1.00
	5180-5240	3.00	2.00	13.00	19.95	20	0.008	1.00
	5745-5825	3.00	2.00	12.50	17.78	20	0.007	1.00
BT3.0	2402-2480	3.00	2.00	7.50	5.62	20	0.002	1.00
BLE	2402-2480	3.00	2.00	6.00	3.98	20	0.002	1.00
NFC	13.56	0.0	1.0	-15.0	0.03	20	0.00001	0.98
WCDMA Band 5	826.4-846.6	3.0	2.00	24.5	281.84	20	0.112	0.55
LTE Band 5	824.7-848.3	3.0	2.00	24.0	251.19	20	0.100	0.55
WCDMA Band 2	1852.4-1907.6	3.0	2.00	24.5	281.84	20	0.112	1.0
LTE Band 2	1850.7-1909.3	3.0	2.00	24.0	251.19	20	0.100	1.0
LTE Band 4	1710.7-1754.3	3.0	2.00	24.0	251.19	20	0.100	1.0
LTE Band 12	699.7-715.3	3.0	2.00	24.0	251.19	20	0.100	0.47
LTE Band 13	779.5-784.5	3.0	2.00	24.0	251.19	20	0.100	0.52
LTE Band 17	706.5-713.5	3.0	2.00	24.0	251.19	20	0.100	0.47

MPE evaluation for simultaneous transmission:

Note: 1. Wi-Fi(2.4G) or Wi-Fi(5G) and Bluetooth can not transmit simultaneously.
2. Wi-Fi(2.4G) and Wi-Fi(5G) can not transmit simultaneously.

Wi-Fi or Bluetooth & NFC & WCDMA/LTE can transmit at the same time, 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 + Max MPE of NFC + Max MPE of LTE
= 0.158/1.0+0+0.10/0.47=0.371＜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 Wi-Fi/BT antenna, one Wi-Fi antenna, one NFC antenna, one LTE main antenna and one LTE diversity antenna which are permanently attached and fulfill the requirement of this section. Please refer to the EUT photos.

RF Mode	Manufacturer	Antenna Model	Max. Antenna Gain	Antenna Type
2.4G WLAN	Asian Creation Communication Co., ltd.	Chain 0 AC-Q2458N17-20MHF4	3dBi	PCB Antenna
5G WLAN				
Bluetooth				
2.4G WLAN	Asian Creation Communication Co., ltd.	Chain 1 AC-Q2458N17-20MHF4	3dBi	PCB Antenna
5G WLAN				
NFC	SHENZHEN SUNSHINE GOOD ELECTRONICS CO.,LTD	P134FQ2137A0	0dBi	FPC Antenna
4G (Main)	ShenZhen Master Wireless Technology Co.,Ltd.	JZC-4G-MP-V01	3dBi	PCB Antenna
4G (Diversity)	ShenZhen Master Wireless Technology Co.,Ltd.	JZC-4G-MP-V01	3dBi	PCB Antenna

Result: Compliance.

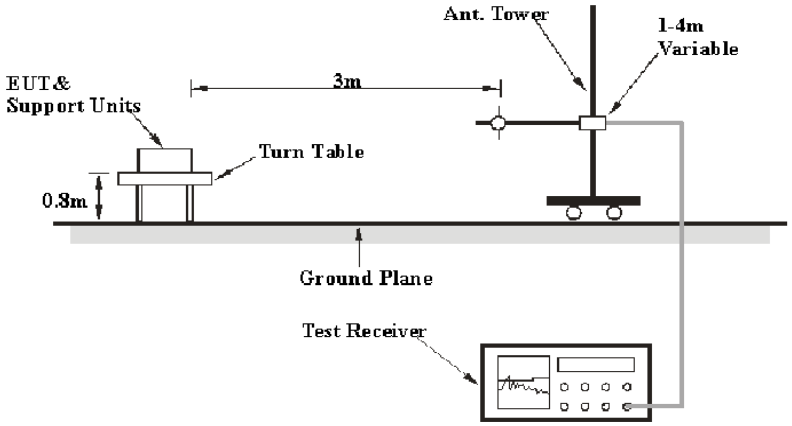
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

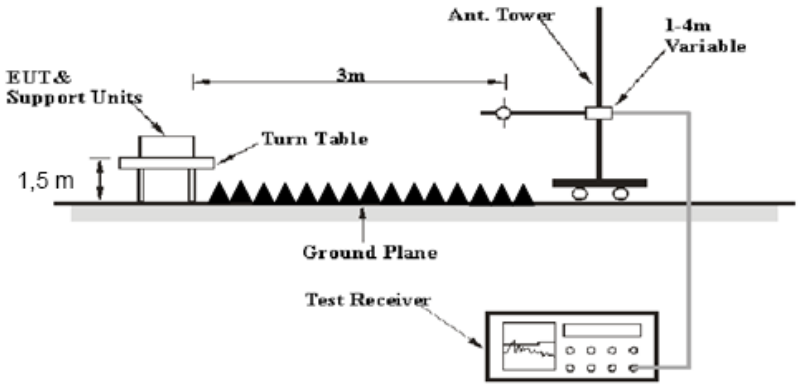
FCC §15.247 (d); §15.209; §15.205;

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.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver 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 1GHz	1MHz	3 MHz	/	PK
	1MHz	3 MHz	/	AV

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

Environmental Conditions

Temperature:	24 °C
Relative Humidity:	57 %
ATM Pressure:	95.1 kPa

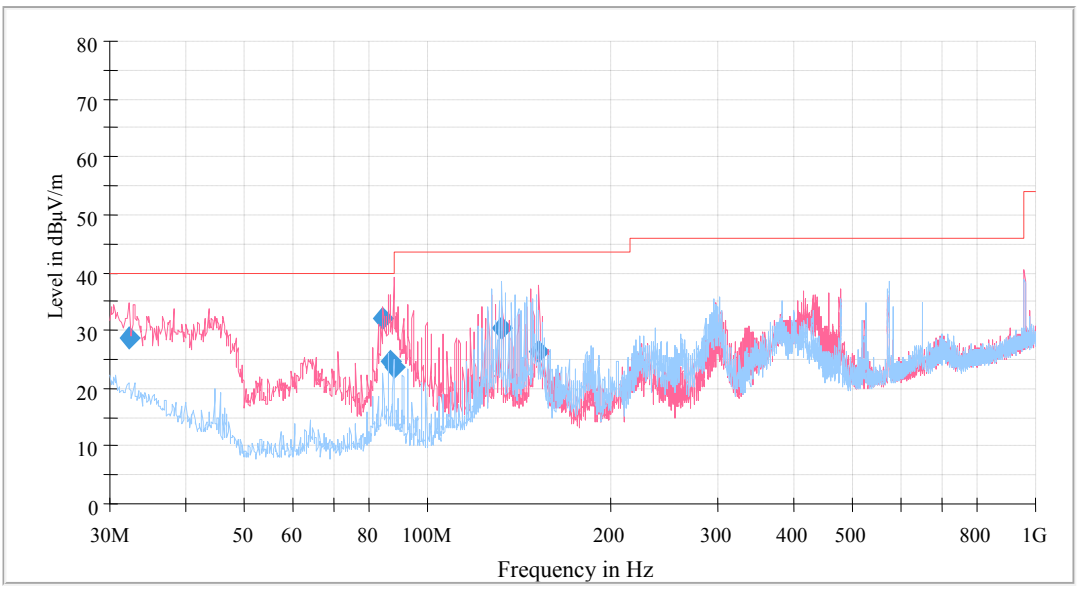
The testing was performed by Tom Tang on 2019-04-17.

Test Mode: Transmitting

Wi-Fi Mode

30 MHz to 1 GHz

802.11n-HT20-High channel - Worst Case



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarization	Azimuth (deg)	Corrected Factor (dB/m)
32.303750	28.69	40.00	11.31	100.0	V	302.0	-6.4
84.562500	32.17	40.00	7.83	119.0	V	194.0	-16.8
86.987500	24.67	40.00	15.33	112.0	V	221.0	-16.9
87.957500	23.73	40.00	16.27	101.0	V	234.0	-16.9
132.577500	30.29	43.50	13.21	199.0	H	297.0	-10.3
152.705000	26.46	43.50	17.04	104.0	V	165.0	-11.4

Above 1 GHz

802.11b Mode (SISO) (Antenna 0-Worst Case)

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	(dB/m)	dB	dB	dBμV/m	dBμV/m	dB
Frequency: 2412MHz									
2412	75.12	PK	H	28.74	3.07	0.00	106.93	N/A	N/A
2412	71.08	AV	H	28.74	3.07	0.00	102.89	N/A	N/A
2412	75.79	PK	V	28.74	3.07	0.00	107.60	N/A	N/A
2412	71.69	AV	V	28.74	3.07	0.00	103.50	N/A	N/A
2390	30.23	PK	V	28.67	3.06	0.00	61.96	74.00	12.04
2390	17.45	AV	V	28.67	3.06	0.00	49.18	54.00	4.82
4824	51.36	PK	V	33.91	4.36	44.72	44.91	74.00	29.09
4824	43.79	AV	V	33.91	4.36	44.72	37.34	54.00	16.66
7236	47.37	PK	V	36.43	5.42	44.00	45.22	74.00	28.78
7236	35.35	AV	V	36.43	5.42	44.00	33.20	54.00	20.80
Frequency: 2437MHz									
2437	74.27	PK	H	28.81	3.09	0.00	106.17	N/A	N/A
2437	70.05	AV	H	28.81	3.09	0.00	101.95	N/A	N/A
2437	76.58	PK	V	28.81	3.09	0.00	108.48	N/A	N/A
2437	72.43	AV	V	28.81	3.09	0.00	104.33	N/A	N/A
4874	51.29	PK	V	34.05	4.39	44.72	45.01	74.00	28.99
4874	44.40	AV	V	34.05	4.39	44.72	38.12	54.00	15.88
7311	46.93	PK	V	36.54	5.44	44.20	44.71	74.00	29.29
7311	34.29	AV	V	36.54	5.44	44.20	32.07	54.00	21.93
Frequency: 2462MHz									
2462	73.73	PK	H	28.89	3.10	0.00	105.72	N/A	N/A
2462	69.44	AV	H	28.89	3.10	0.00	101.43	N/A	N/A
2462	77.83	PK	V	28.89	3.10	0.00	109.82	N/A	N/A
2462	73.81	AV	V	28.89	3.10	0.00	105.80	N/A	N/A
2483.5	30.25	PK	V	28.95	3.12	0.00	62.32	74.00	11.68
2483.5	17.72	AV	V	28.95	3.12	0.00	49.79	54.00	4.21
4924	51.73	PK	V	34.19	4.42	44.71	45.63	74.00	28.37
4924	45.21	AV	V	34.19	4.42	44.71	39.11	54.00	14.89
7386	46.51	PK	V	36.64	5.46	44.40	44.21	74.00	29.79
7386	33.23	AV	V	36.64	5.46	44.40	30.93	54.00	23.07

802.11g Mode (SISO) (Antenna 0-Worst Case)

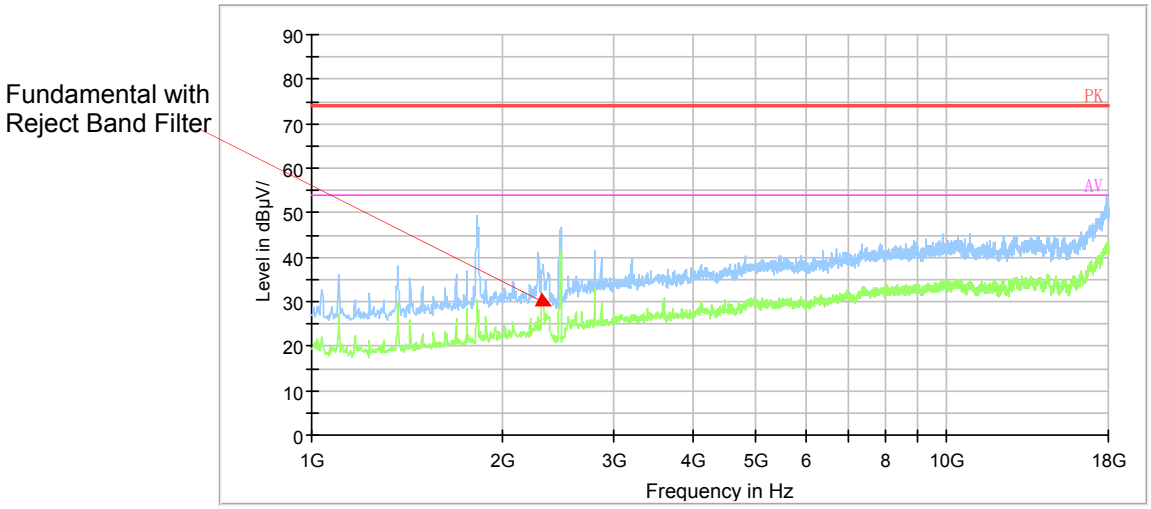
Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	(dB/m)	dB	dB	dBμV/m	dBμV/m	dB
Frequency: 2412MHz									
2412	73.95	PK	H	28.74	3.07	0.00	105.76	N/A	N/A
2412	64.54	AV	H	28.74	3.07	0.00	96.35	N/A	N/A
2412	75.69	PK	V	28.74	3.07	0.00	107.50	N/A	N/A
2412	66.27	AV	V	28.74	3.07	0.00	98.08	N/A	N/A
2390	37.93	PK	V	28.67	3.06	0.00	69.66	74.00	4.34
2390	18.77	AV	V	28.67	3.06	0.00	50.50	54.00	3.50
4824	49.97	PK	V	33.91	4.36	44.72	43.52	74.00	30.48
4824	35.57	AV	V	33.91	4.36	44.72	29.12	54.00	24.88
7236	46.87	PK	V	36.43	5.42	44.00	44.72	74.00	29.28
7236	34.24	AV	V	36.43	5.42	44.00	32.09	54.00	21.91
Frequency: 2437MHz									
2437	75.12	PK	H	28.81	3.09	0.00	107.02	N/A	N/A
2437	65.75	AV	H	28.81	3.09	0.00	97.65	N/A	N/A
2437	76.62	PK	V	28.81	3.09	0.00	108.52	N/A	N/A
2437	67.29	AV	V	28.81	3.09	0.00	99.19	N/A	N/A
4874	49.66	PK	V	34.05	4.39	44.72	43.38	74.00	30.62
4874	35.21	AV	V	34.05	4.39	44.72	28.93	54.00	25.07
7311	46.84	PK	V	36.54	5.44	44.20	44.62	74.00	29.38
7311	34.07	AV	V	36.54	5.44	44.20	31.85	54.00	22.15
Frequency: 2462MHz									
2462	76.14	PK	H	28.89	3.10	0.00	108.13	N/A	N/A
2462	66.71	AV	H	28.89	3.10	0.00	98.70	N/A	N/A
2462	77.52	PK	V	28.89	3.10	0.00	109.51	N/A	N/A
2462	67.96	AV	V	28.89	3.10	0.00	99.95	N/A	N/A
2483.5	38.34	PK	V	28.95	3.12	0.00	70.41	74.00	3.59
2483.5	18.16	AV	V	28.95	3.12	0.00	50.23	54.00	3.77
4924	49.13	PK	V	34.19	4.42	44.71	43.03	74.00	30.97
4924	35.07	AV	V	34.19	4.42	44.71	28.97	54.00	25.03
7386	46.47	PK	V	36.64	5.46	44.40	44.17	74.00	29.83
7386	33.96	AV	V	36.64	5.46	44.40	31.66	54.00	22.34

802.11n-HT20 Mode (MIMO)

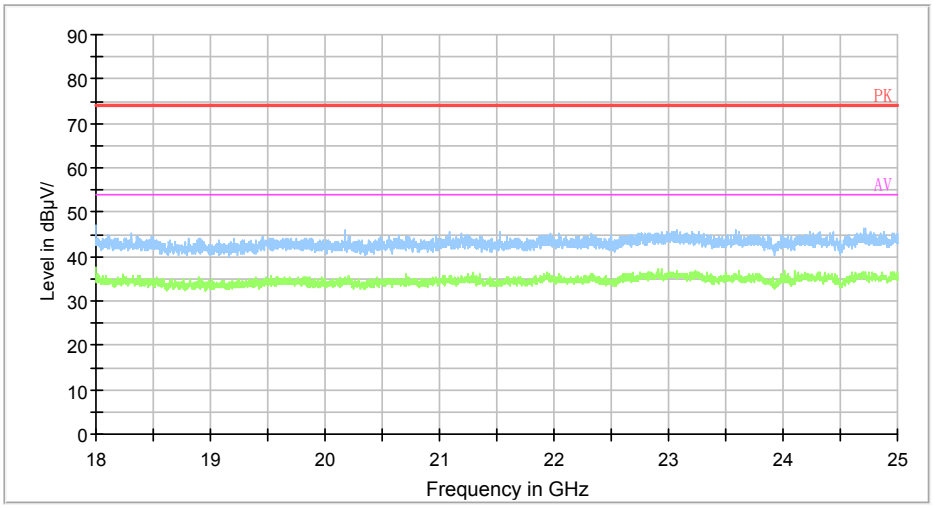
Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	(dB/m)	dB	dB	dBμV/m	dBμV/m	dB
Frequency: 2412MHz									
2412	75.07	PK	H	28.74	3.07	0.00	106.88	N/A	N/A
2412	64.81	AV	H	28.74	3.07	0.00	96.62	N/A	N/A
2412	76.59	PK	V	28.74	3.07	0.00	108.40	N/A	N/A
2412	66.24	AV	V	28.74	3.07	0.00	98.05	N/A	N/A
2390	37.87	PK	V	28.67	3.06	0.00	69.60	74.00	4.40
2390	18.57	AV	V	28.67	3.06	0.00	50.30	54.00	3.70
4824	48.56	PK	V	33.91	4.36	44.72	42.11	74.00	31.89
4824	34.69	AV	V	33.91	4.36	44.72	28.24	54.00	25.76
7236	46.07	PK	V	36.43	5.42	44.00	43.92	74.00	30.08
7236	33.47	AV	V	36.43	5.42	44.00	31.32	54.00	22.68
Frequency: 2437MHz									
2437	75.85	PK	H	28.81	3.09	0.00	107.75	N/A	N/A
2437	65.51	AV	H	28.81	3.09	0.00	97.41	N/A	N/A
2437	77.42	PK	V	28.81	3.09	0.00	109.32	N/A	N/A
2437	67.02	AV	V	28.81	3.09	0.00	98.92	N/A	N/A
4874	48.74	PK	V	34.05	4.39	44.72	42.46	74.00	31.54
4874	34.92	AV	V	34.05	4.39	44.72	28.64	54.00	25.36
7311	46.49	PK	V	36.54	5.44	44.20	44.27	74.00	29.73
7311	33.53	AV	V	36.54	5.44	44.20	31.31	54.00	22.69
Frequency: 2462MHz									
2462	76.14	PK	H	28.89	3.10	0.00	108.13	N/A	N/A
2462	66.09	AV	H	28.89	3.10	0.00	98.08	N/A	N/A
2462	77.56	PK	V	28.89	3.10	0.00	109.55	N/A	N/A
2462	67.75	AV	V	28.89	3.10	0.00	99.74	N/A	N/A
2483.5	39.07	PK	V	28.95	3.12	0.00	71.14	74.00	2.86
2483.5	18.35	AV	V	28.95	3.12	0.00	50.42	54.00	3.58
4924	48.34	PK	V	34.19	4.42	44.71	42.24	74.00	31.76
4924	34.84	AV	V	34.19	4.42	44.71	28.74	54.00	25.26
7386	46.74	PK	V	36.64	5.46	44.40	44.44	74.00	29.56
7386	33.09	AV	V	36.64	5.46	44.40	30.79	54.00	23.21

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

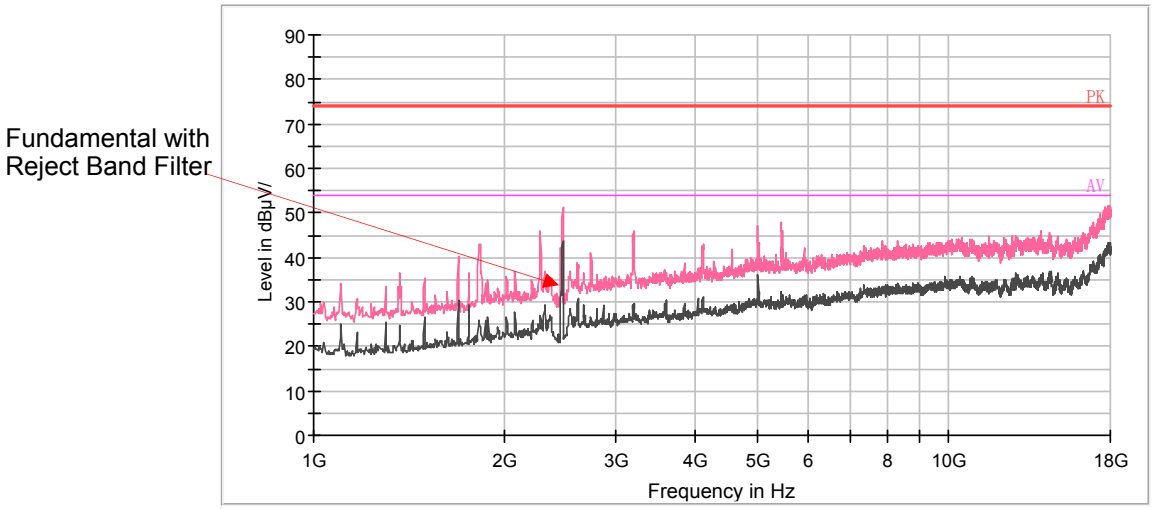
802.11n-HT20 Mode: High Channel_Horizontal_1GHz-18GHz



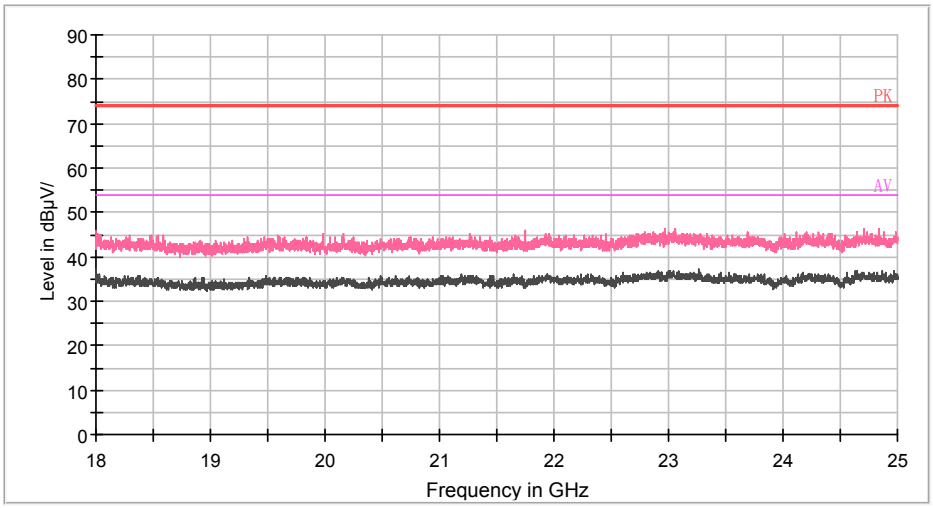
802.11n-HT20 Mode: High Channel_Horizontal_18GHz-25GHz



802.11n-HT20 Mode: High Channel_Vertical_1GHz-18GHz



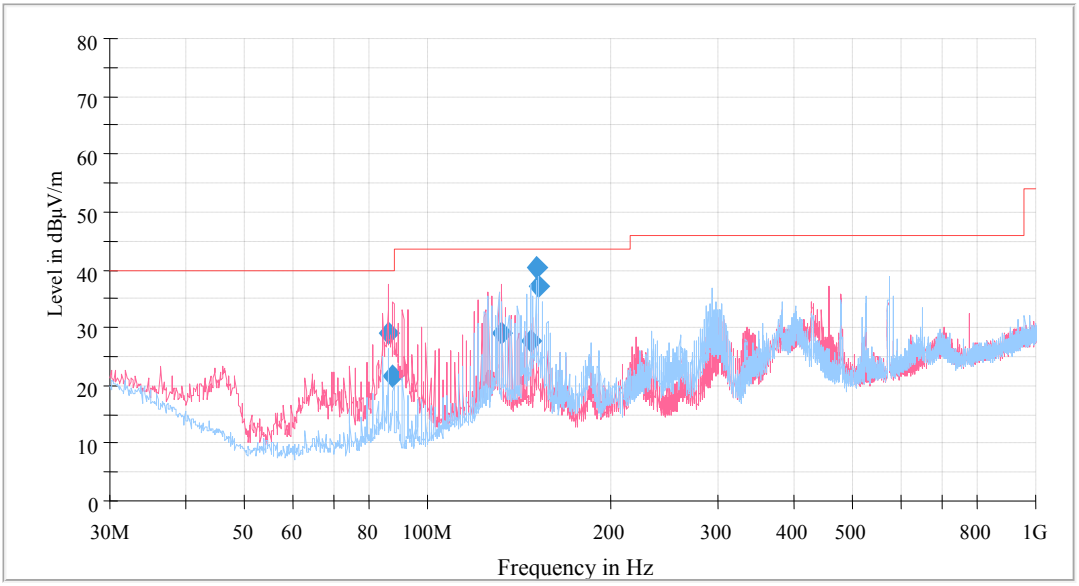
802.11n-HT20 Mode: High Channel_Vertical_18GHz-25GHz



BLE Mode

30 MHz to 1 GHz

High channel-worst case



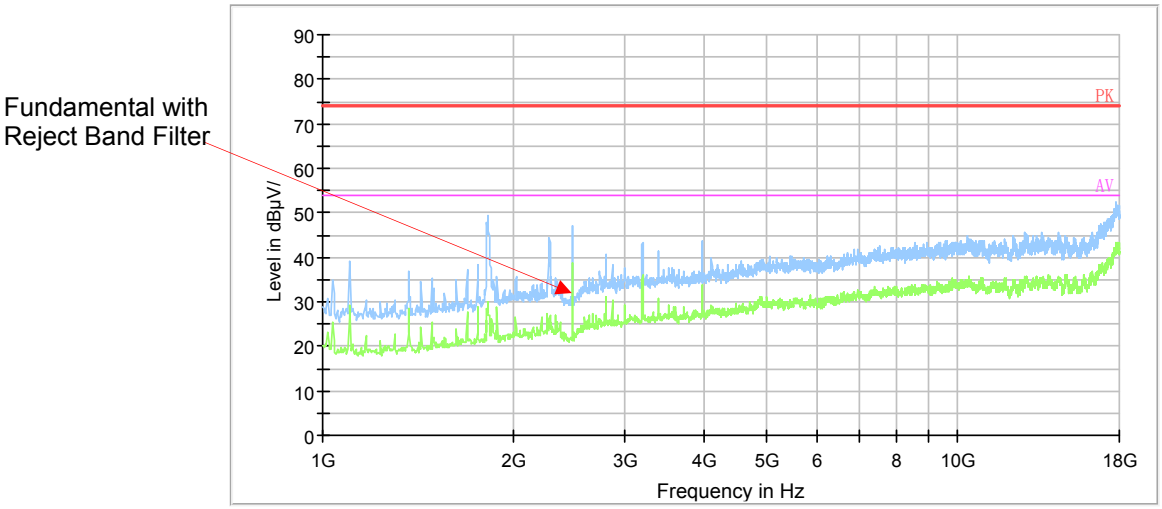
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarization	Azimuth (deg)	Corrected Factor (dB/m)
86.138750	29.08	40.00	10.92	125.0	V	223.0	-16.8
87.715000	21.45	40.00	18.55	100.0	V	307.0	-16.9
132.577500	29.09	43.50	14.41	103.0	V	182.0	-10.3
147.491250	27.68	43.50	15.82	189.0	H	107.0	-11.0
150.765000	40.90	43.50	2.60	168.0	H	104.0	-11.2
152.462500	37.14	43.50	6.36	161.0	H	103.0	-11.3

Above 1 GHz

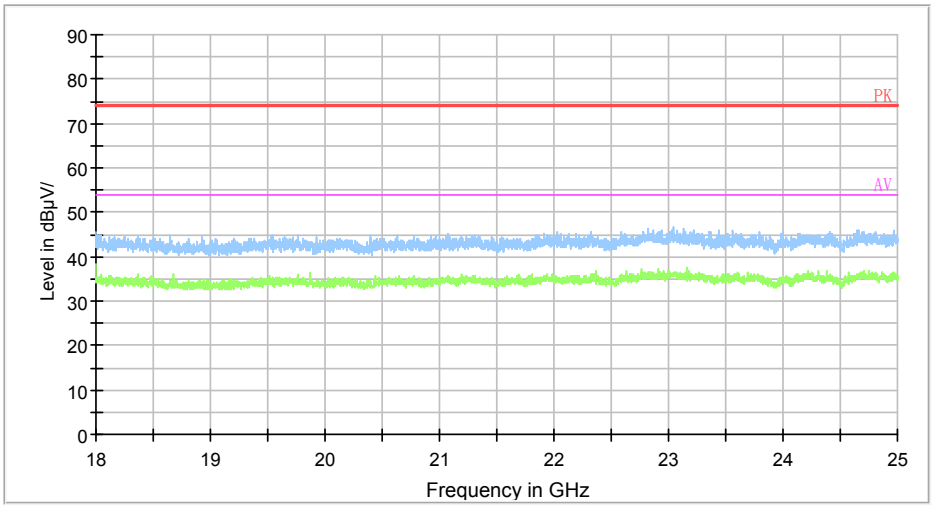
Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	(dB/m)	dB	dB	dBμV/m	dBμV/m	dB
frequency: 2402MHz									
2402	70.01	PK	H	28.71	3.06	0.00	101.78	N/A	N/A
2402	64.91	AV	H	28.71	3.06	0.00	96.68	N/A	N/A
2402	72.06	PK	V	28.71	3.06	0.00	103.83	N/A	N/A
2402	67.08	AV	V	28.71	3.06	0.00	98.85	N/A	N/A
2390	20.82	PK	V	28.67	3.06	0.00	52.55	74.00	21.45
2390	16.01	AV	V	28.67	3.06	0.00	47.74	54.00	6.26
4804	49.07	PK	V	33.85	4.35	44.73	42.54	74.00	31.46
4804	34.57	AV	V	33.85	4.35	44.73	28.04	54.00	25.96
7206	46.07	PK	V	36.39	5.41	43.92	43.95	74.00	30.05
7206	33.76	AV	V	36.39	5.41	43.92	31.64	54.00	22.36
frequency: 2440MHz									
2440	70.13	PK	H	28.82	3.09	0.00	102.04	N/A	N/A
2440	65.05	AV	H	28.82	3.09	0.00	96.96	N/A	N/A
2440	72.26	PK	V	28.82	3.09	0.00	104.17	N/A	N/A
2440	67.20	AV	V	28.82	3.09	0.00	99.11	N/A	N/A
4880	49.41	PK	V	34.06	4.40	44.72	43.15	74.00	30.85
4880	34.96	AV	V	34.06	4.40	44.72	28.70	54.00	25.30
7320	46.44	PK	V	36.55	5.44	44.22	44.21	74.00	29.79
7320	33.73	AV	V	36.55	5.44	44.22	31.50	54.00	22.50
frequency: 2480MHz									
2480	69.97	PK	H	28.94	3.12	0.00	102.03	N/A	N/A
2480	65.06	AV	H	28.94	3.12	0.00	97.12	N/A	N/A
2480	72.35	PK	V	28.94	3.12	0.00	104.41	N/A	N/A
2480	67.04	AV	V	28.94	3.12	0.00	99.10	N/A	N/A
2483.5	32.86	PK	V	28.95	3.12	0.00	64.93	74.00	9.07
2483.5	20.35	AV	V	28.95	3.12	0.00	52.42	54.00	1.58
4960	49.26	PK	V	34.29	4.44	44.71	43.28	74.00	30.72
4960	34.85	AV	V	34.29	4.44	44.71	28.87	54.00	25.13
7440	46.46	PK	V	36.72	5.48	44.54	44.12	74.00	29.88
7440	33.24	AV	V	36.72	5.48	44.54	30.90	54.00	23.10

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

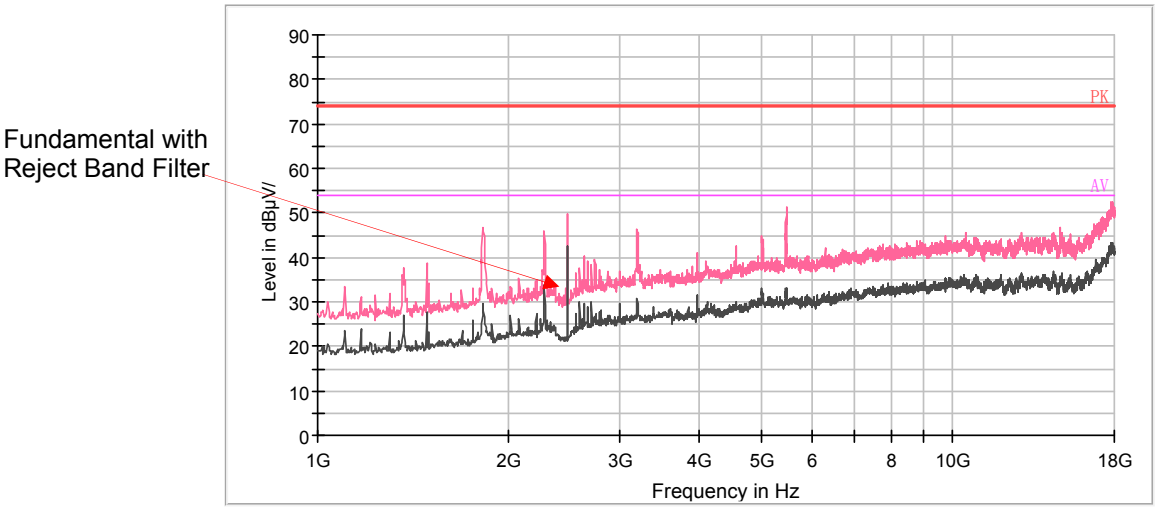
High Channel_Horizontal_1GHz-18GHz



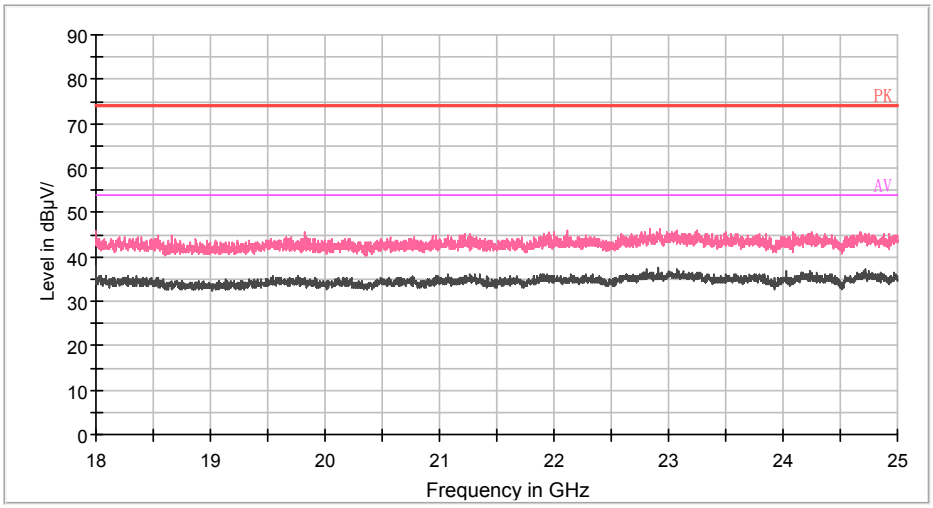
High Channel_Horizontal_18GHz-25GHz



High Channel_Vertical_1GHz-18GHz



High Channel_Vertical_18GHz-25GHz



Other Spurious Emissions (Worst case):

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	(dB/m)	dB	dB	dBμV/m	dBμV/m	dB
1813	62.78	PK	V	26.57	2.66	43.63	48.38	74.00	25.62
1813	42.21	AV	V	26.57	2.66	43.63	27.81	54.00	26.19
3124	57.26	PK	V	30.90	3.48	44.30	47.34	74.00	26.66
3124	39.64	AV	V	30.90	3.48	44.30	29.72	54.00	24.28
5003	54.63	PK	V	34.40	4.46	44.70	48.79	74.00	25.21
5003	42.86	AV	V	34.40	4.46	44.70	37.02	54.00	16.98
1813	65.29	PK	H	26.57	2.66	43.63	50.89	74.00	23.11
1813	45.86	AV	H	26.57	2.66	43.63	31.46	54.00	22.54

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

FINAL

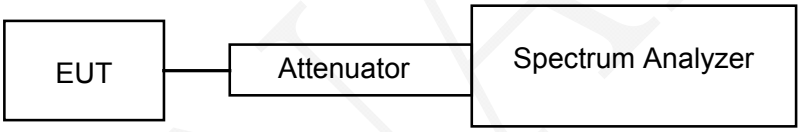
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

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:	56 %
ATM Pressure:	95.5 kPa

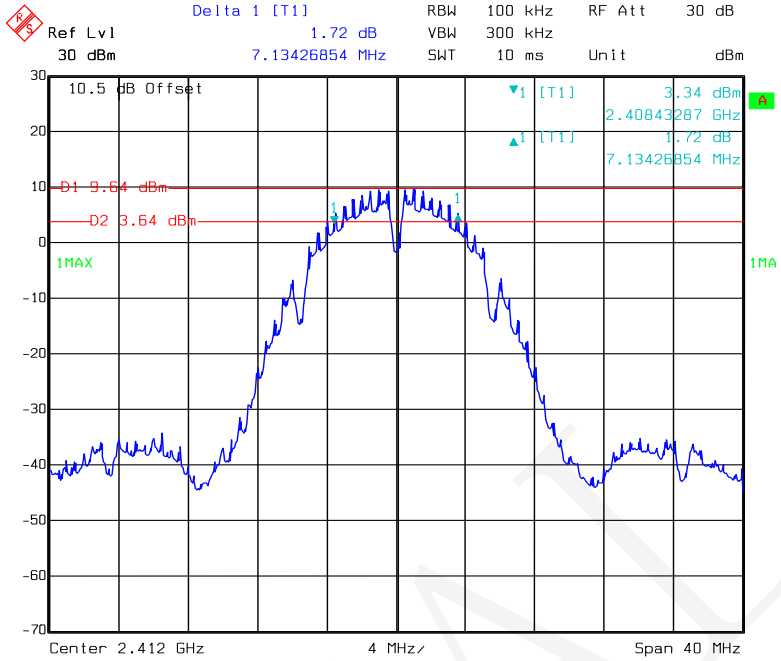
The testing was performed by Tom Tang on 2019-04-03.

Test Mode: Transmitting

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

Mode	Channel	Frequency (MHz)	6dB Emission Bandwidth (MHz)		Limit (MHz)
			Antenna 0	Antenna 1	
802.11b	Low	2412	7.13	7.13	≥0.50
	Middle	2437	7.13	7.54	≥0.50
	High	2462	6.97	7.13	≥0.50
802.11g	Low	2412	16.43	16.19	≥0.50
	Middle	2437	16.43	16.19	≥0.50
	High	2462	16.43	16.43	≥0.50
802.11n-HT20	Low	2412	17.64	17.39	≥0.50
	Middle	2437	17.56	17.64	≥0.50
	High	2462	17.64	17.47	≥0.50
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, Antenna 0



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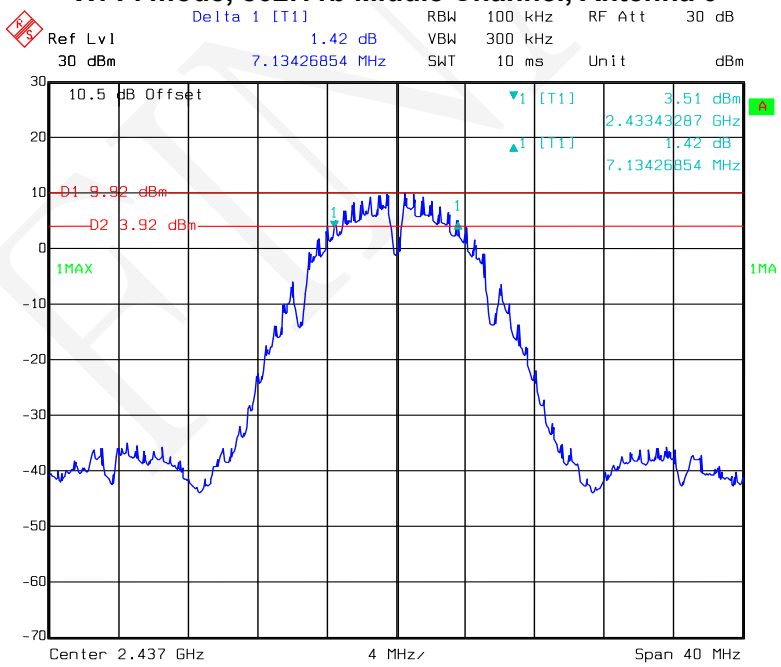
Wi-Fi mode, 802.11b Middle Channel, Antenna 0



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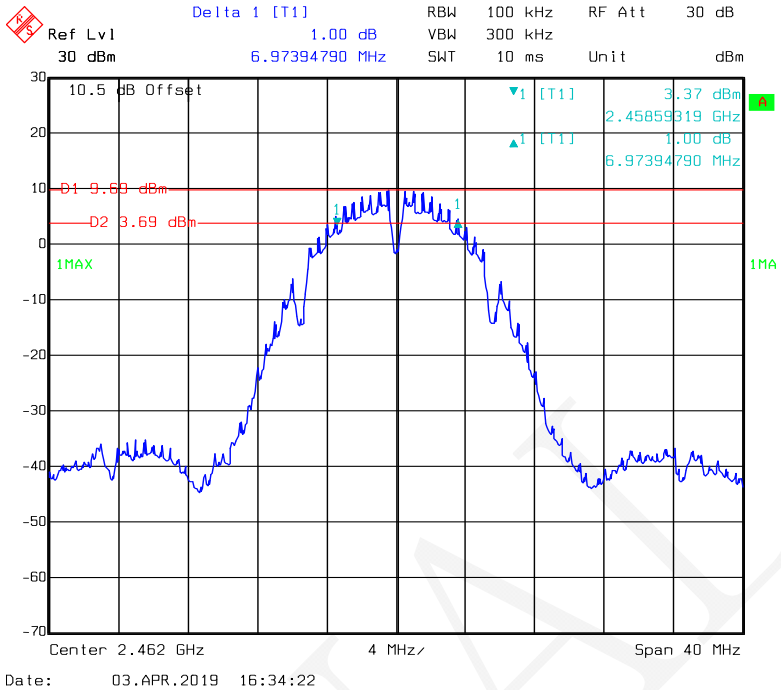
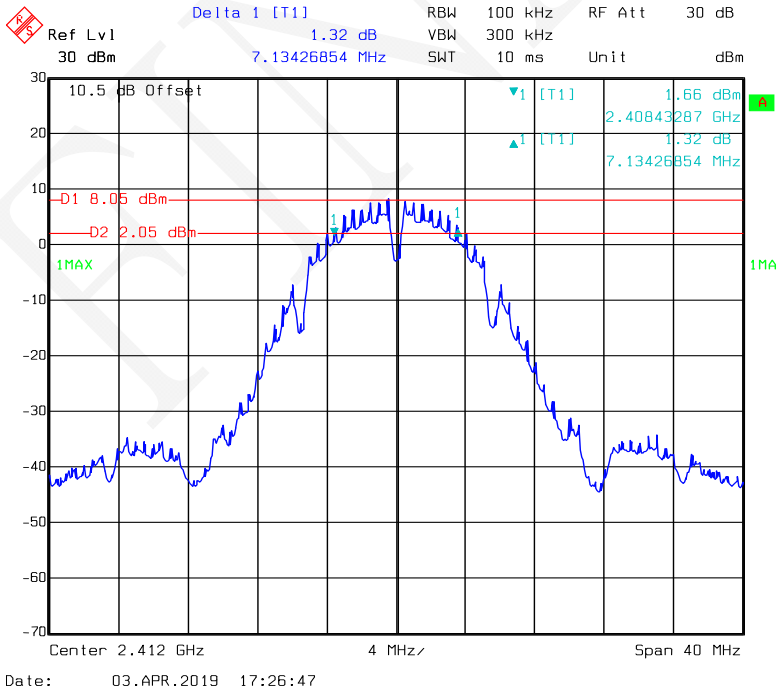
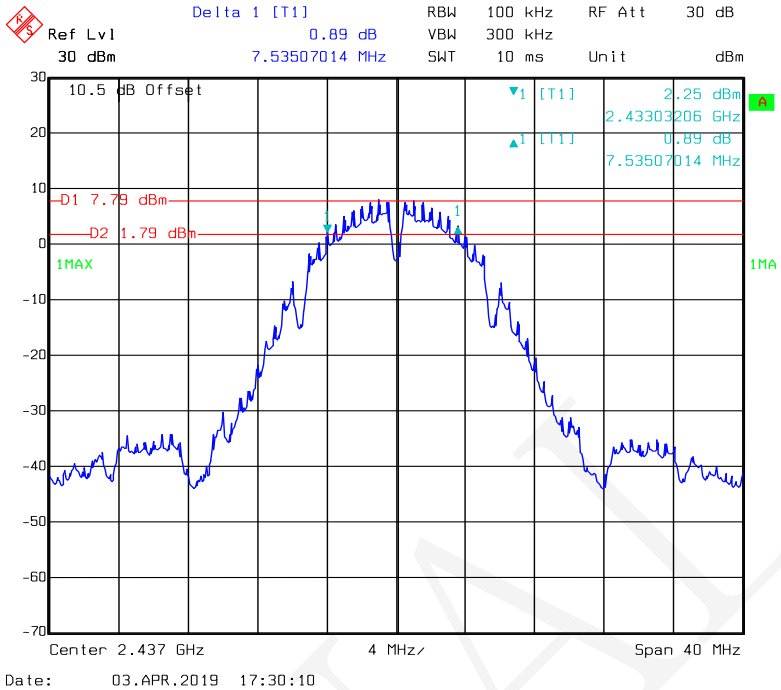
Wi-Fi mode, 802.11b High Channel, Antenna 0



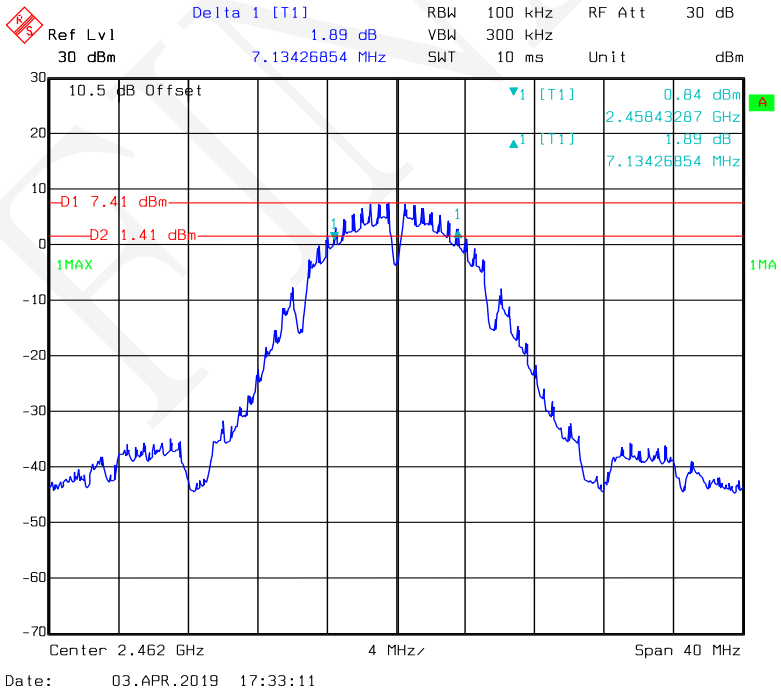
Wi-Fi mode, 802.11b Low Channel, Antenna 1



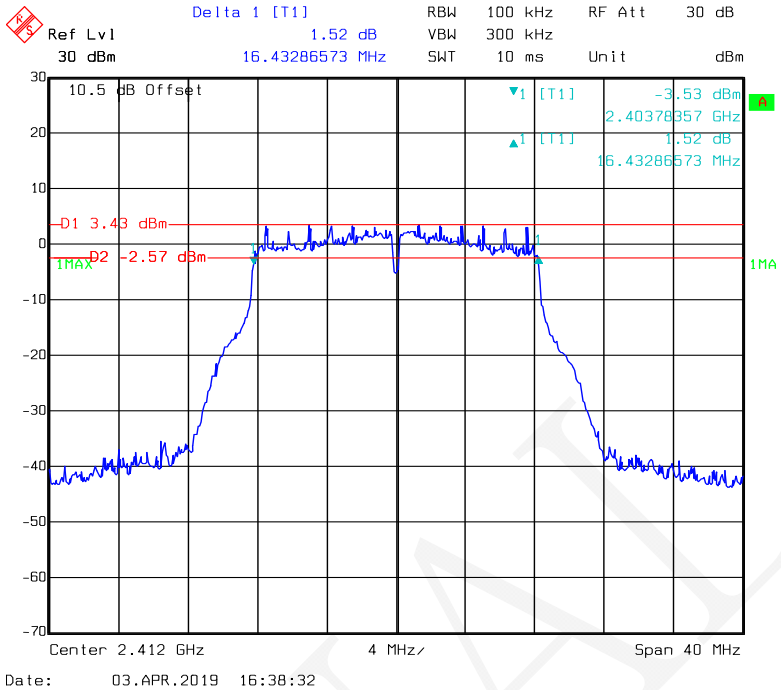
Wi-Fi mode, 802.11b Middle Channel, Antenna 1



Wi-Fi mode, 802.11b High Channel, Antenna 1

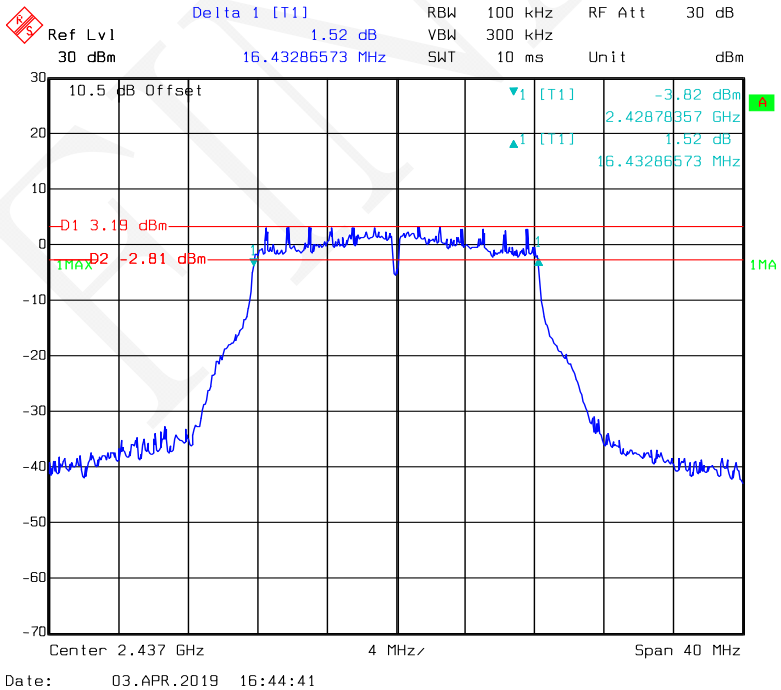


Wi-Fi mode, 802.11g Low Channel, Antenna 0



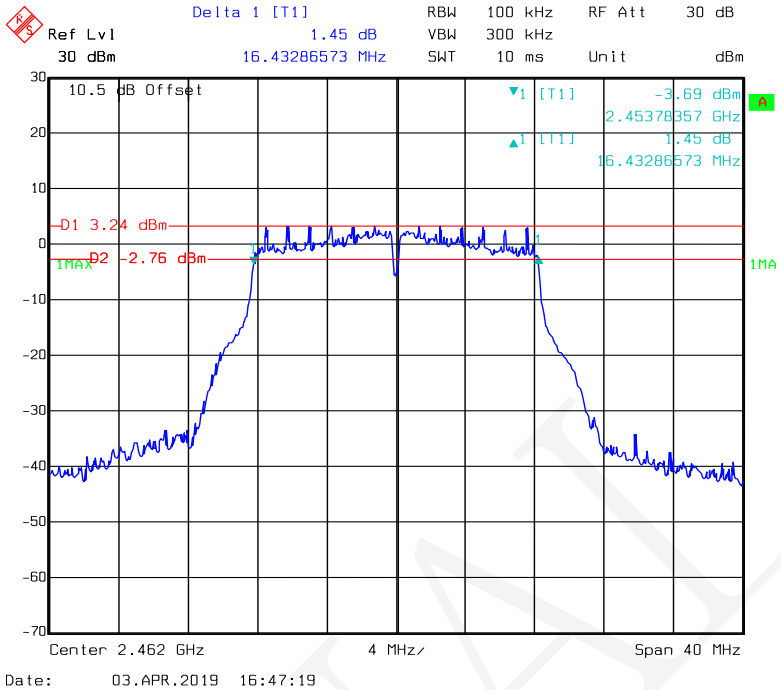
Date: 03.APR.2019 16:38:32

Wi-Fi mode, 802.11g Middle Channel, Antenna 0

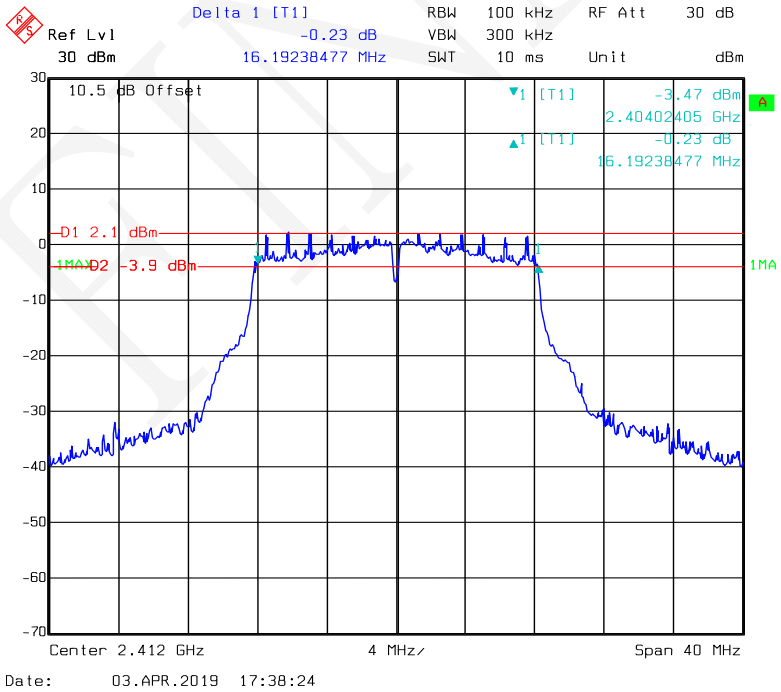


Date: 03.APR.2019 16:44:41

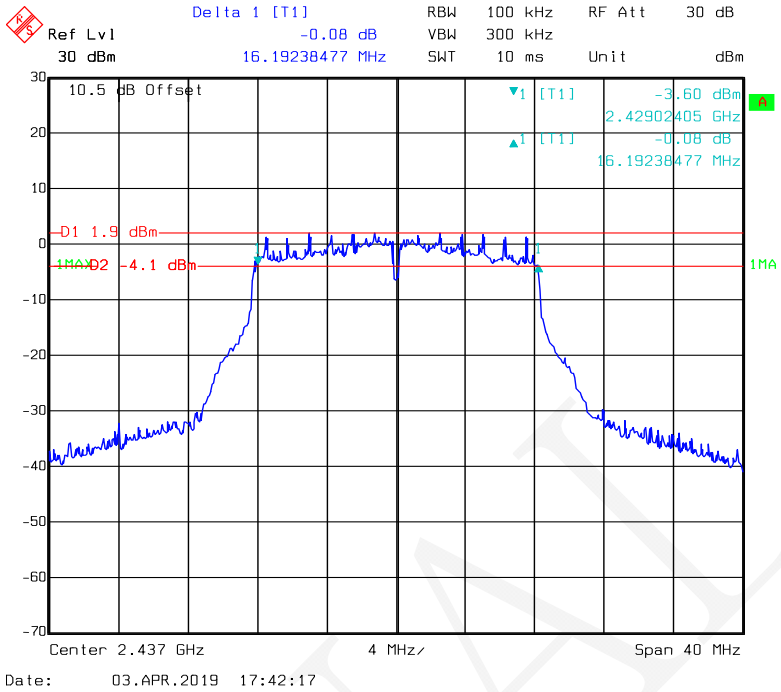
Wi-Fi mode, 802.11g High Channel, Antenna 0



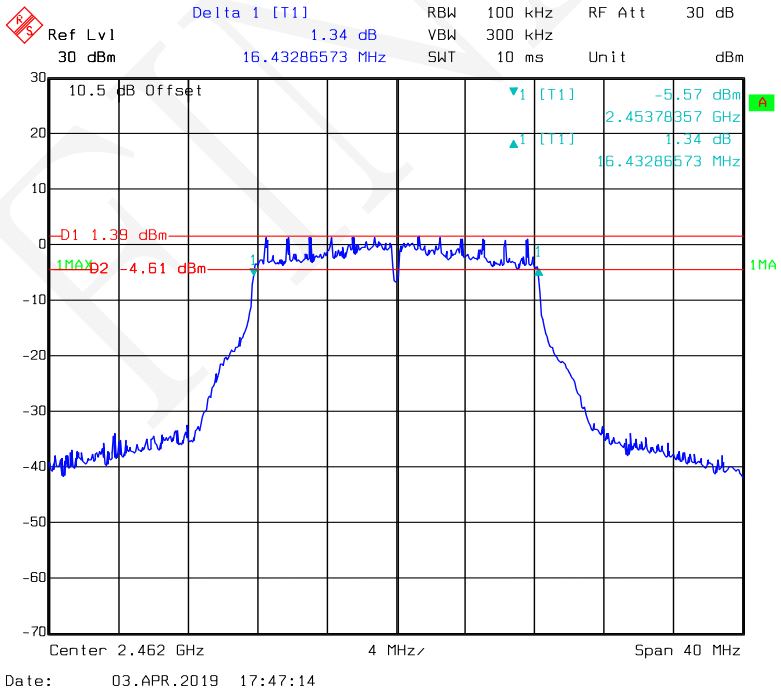
Wi-Fi mode, 802.11g Low Channel, Antenna 1



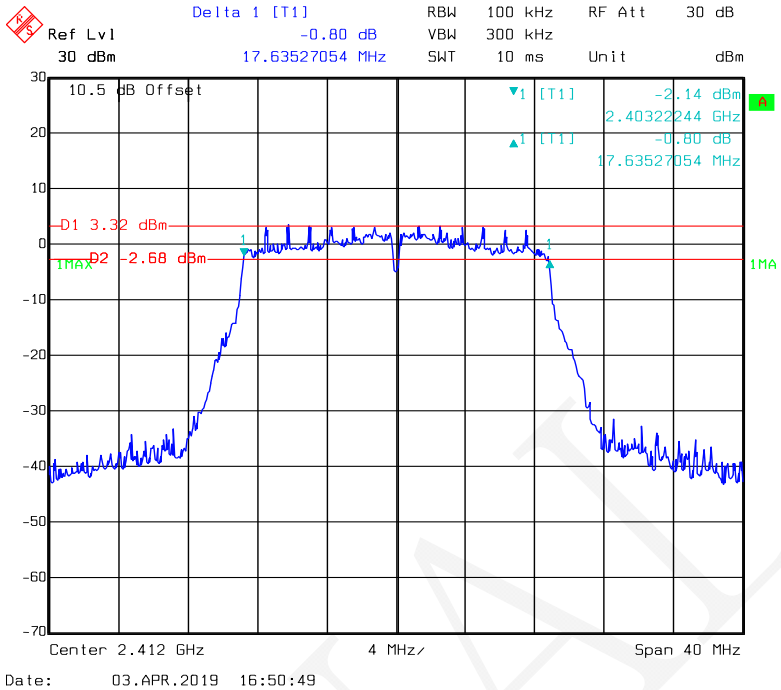
Wi-Fi mode, 802.11g Middle Channel, Antenna 1



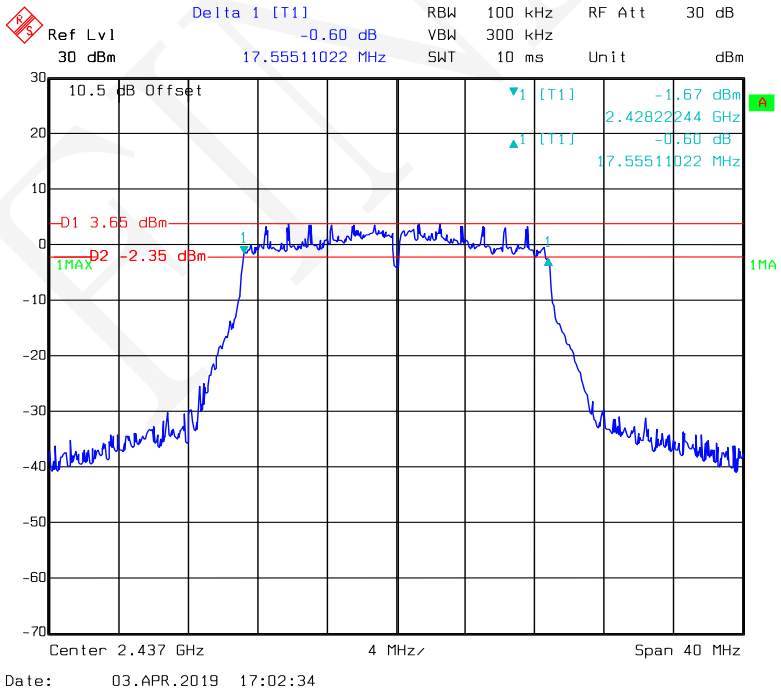
Wi-Fi mode, 802.11g High Channel, Antenna 1



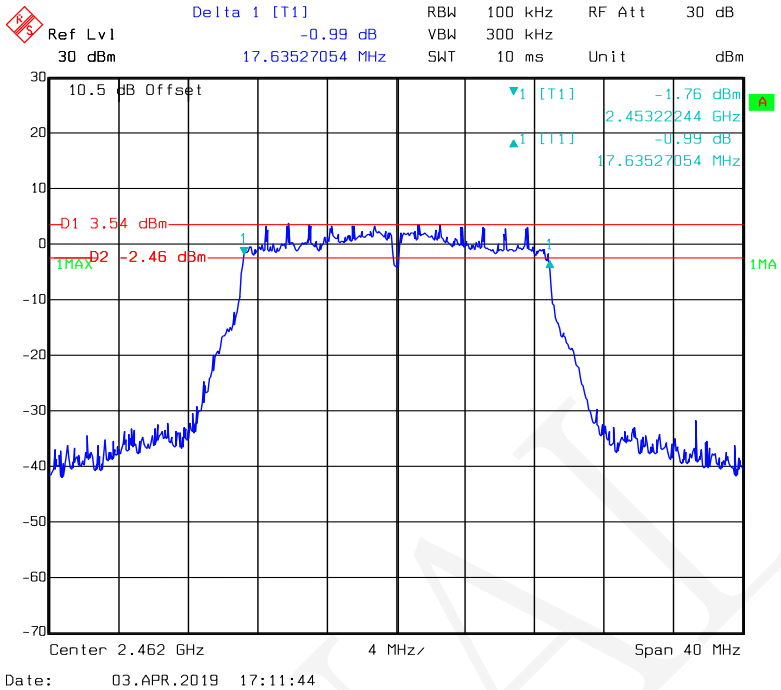
Wi-Fi mode, 802.11n-HT20 Low Channel, Antenna 0



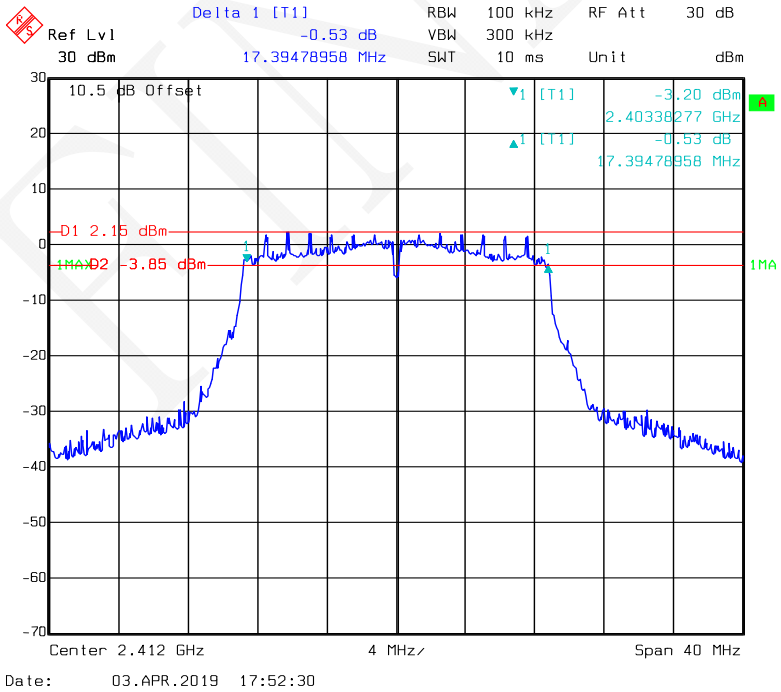
Wi-Fi mode, 802.11n-HT20 Middle Channel, Antenna 0



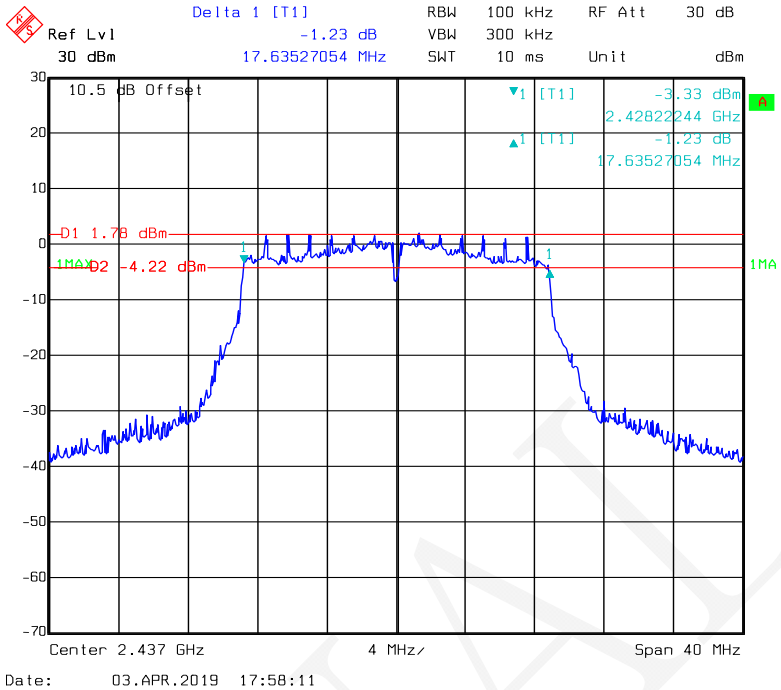
Wi-Fi mode, 802.11n-HT20 High Channel, Antenna 0



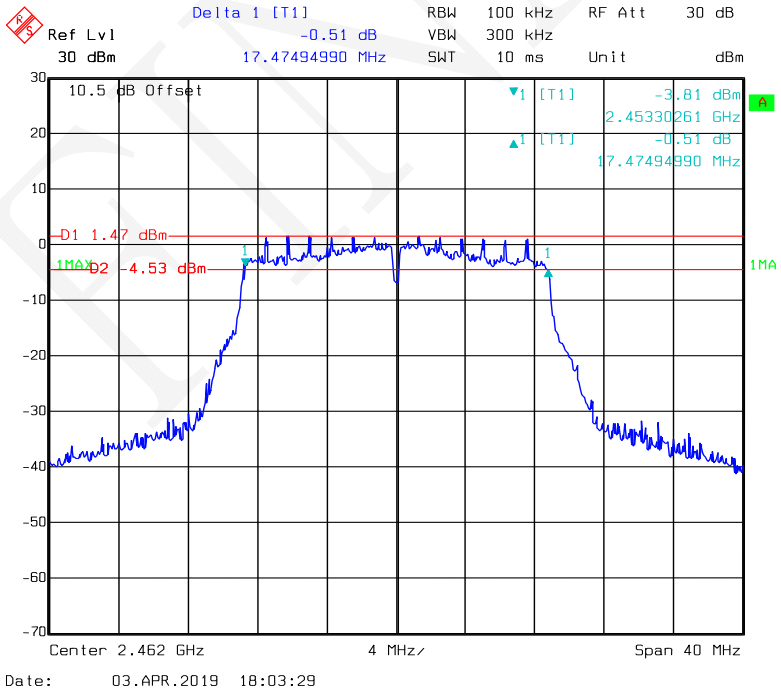
Wi-Fi mode, 802.11n-HT20 Low Channel, Antenna 1



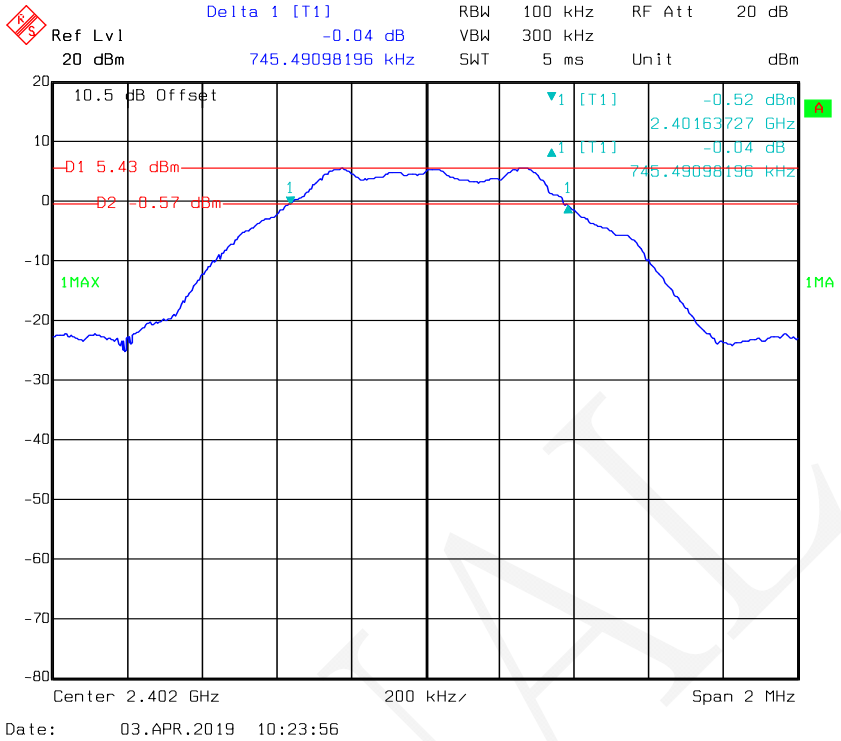
Wi-Fi mode, 802.11n-HT20 Middle Channel, Antenna 1



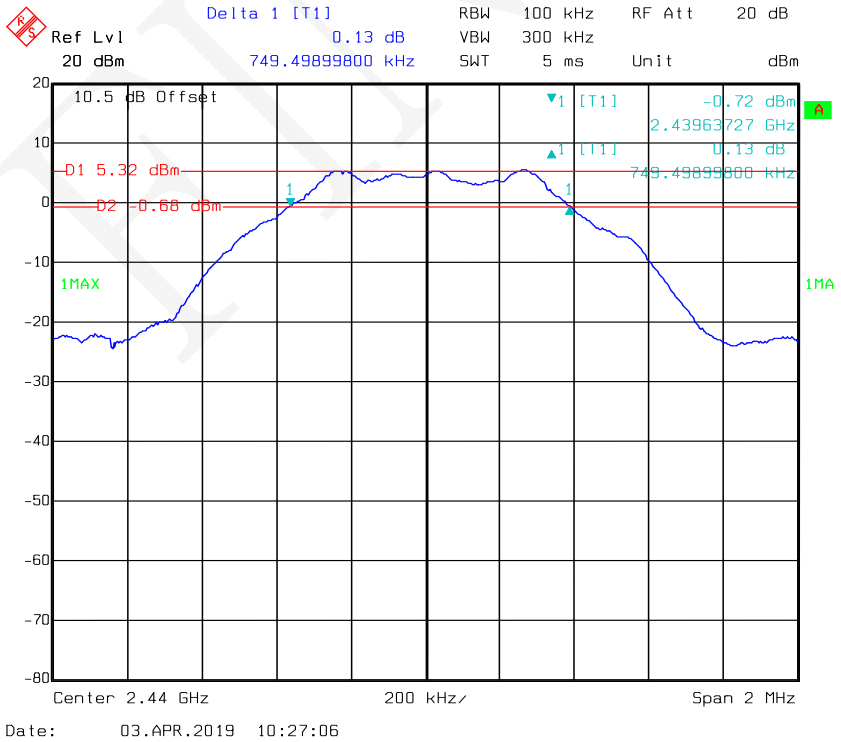
Wi-Fi mode, 802.11n-HT20 High Channel, Antenna 1



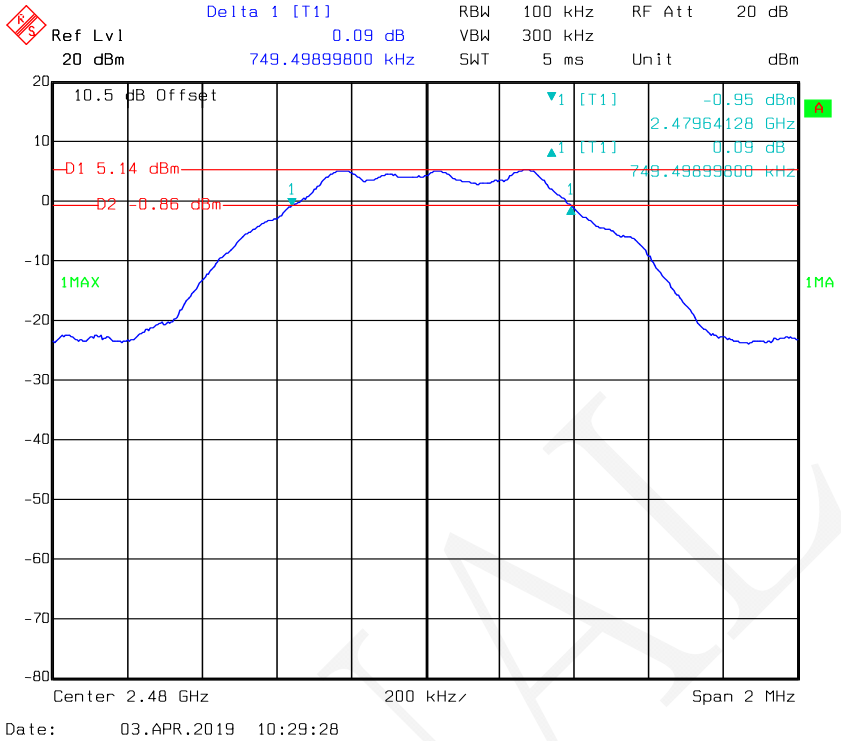
BLE mode, Low Channel, Antenna 0



BLE mode, Middle Channel, Antenna 0



BLE mode, High Channel, Antenna 0



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:	19 °C
Relative Humidity:	56 %
ATM Pressure:	95.5 kPa

The testing was performed by Tom Tang on 2019-04-03.

Test Mode: Transmitting

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

Wi-Fi mode

Mode	Channel	Frequency (MHz)	Max Peak Conducted Output Power (dBm)		Total (dBm)	Limit (dBm)
			Antenna 0	Antenna 1		
802.11b	Low	2412	19.93	18.46	/	30
	Middle	2437	20.32	18.43	/	30
	High	2462	19.77	17.64	/	30
802.11g	Low	2412	23.36	21.52	/	30
	Middle	2437	23.08	21.47	/	30
	High	2462	23.08	21.01	/	30
802.11n-HT20	Low	2412	23.22	21.65	25.52	30
	Middle	2437	23.34	21.31	25.45	30
	High	2462	23.14	21.05	25.23	30

Mode	Channel	Frequency (MHz)	Max Average Conducted Output Power (dBm)		Total (dBm)	Limit (dBm)
			Antenna 0	Antenna 1		
802.11b	Low	2412	16.87	15.40	/	30
	Middle	2437	17.17	15.18	/	30
	High	2462	16.71	14.59	/	30
802.11g	Low	2412	14.01	12.28	/	30
	Middle	2437	13.77	12.13	/	30
	High	2462	13.74	11.72	/	30
802.11n-HT20	Low	2412	13.72	12.24	16.05	30
	Middle	2437	13.89	11.85	16.00	30
	High	2462	13.65	11.58	15.75	30

BLE mode

Mode	Channel	Frequency (MHz)	Max Peak Conducted Output Power (dBm)	Limit (dBm)
BLE	Low	2402	5.81	30
	Middle	2440	5.91	30
	High	2480	5.71	30

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

Applicable Standard

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test Procedure

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

Test Data

Environmental Conditions

Temperature:	19 °C
Relative Humidity:	56 %
ATM Pressure:	95.5 kPa

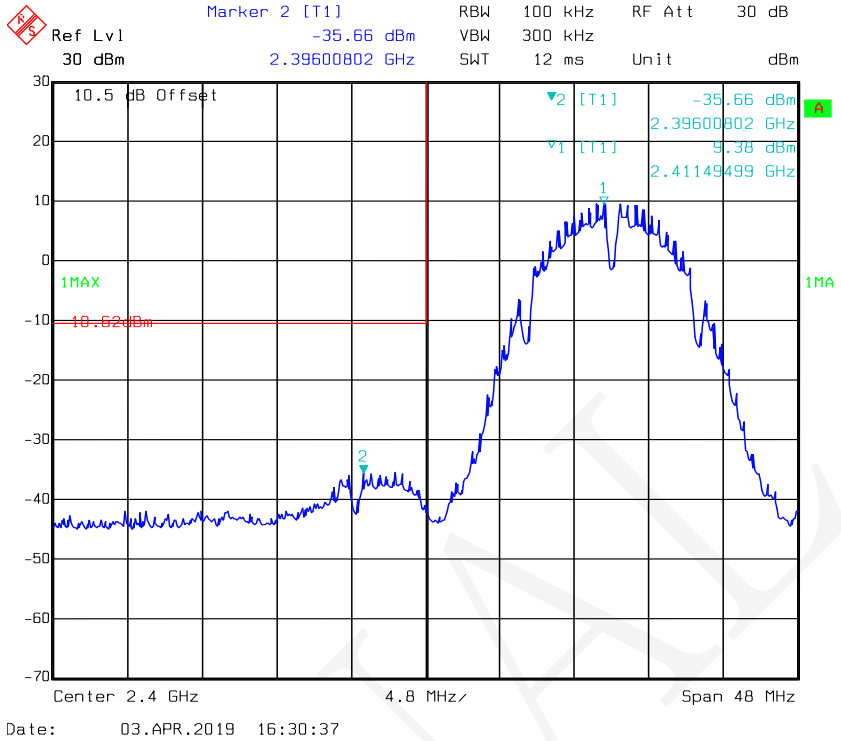
The testing was performed by Tom Tang on 2019-04-03.

Test mode: Transmitting

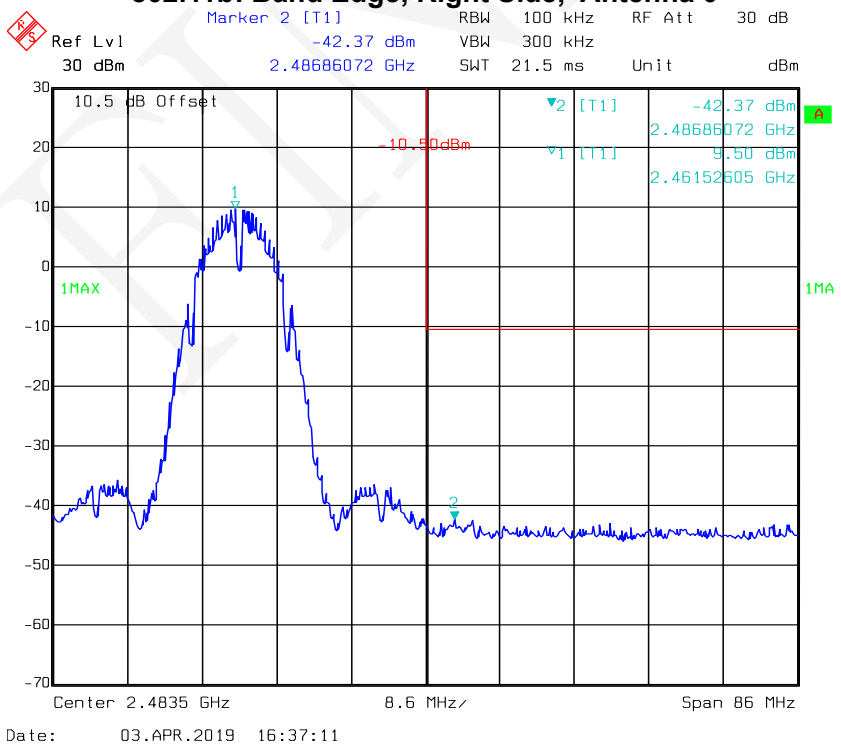
Test Result: Compliance. Please refer to following plots.

Wi-Fi mode

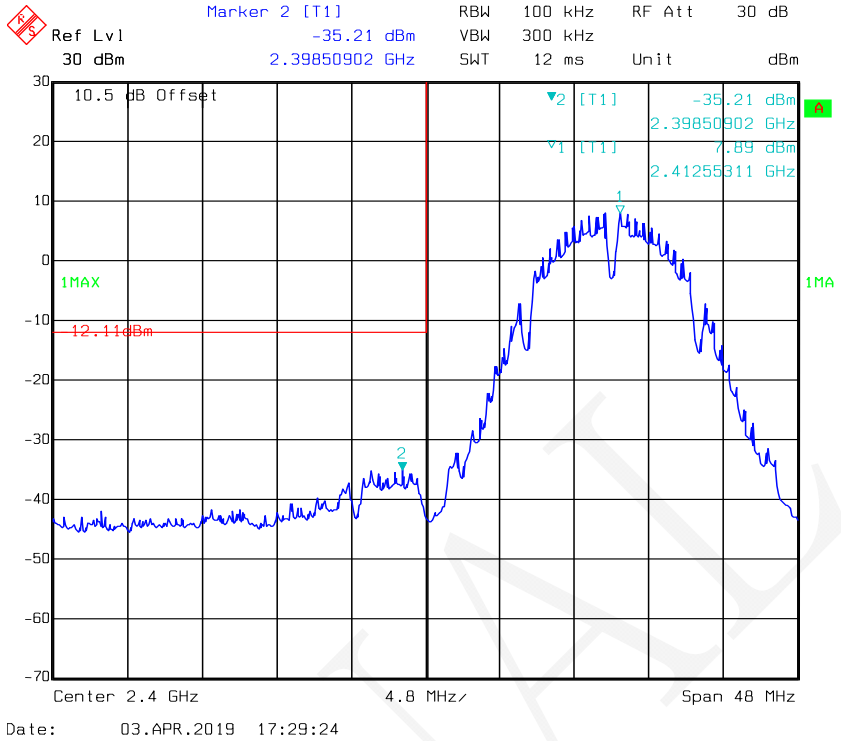
802.11b: Band Edge, Left Side, Antenna 0



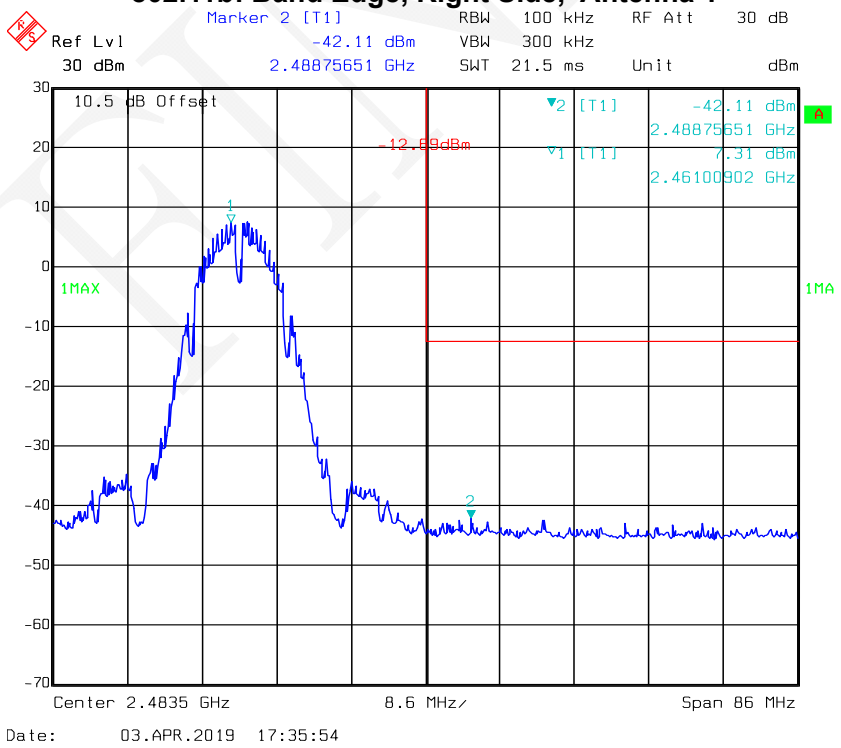
802.11b: Band Edge, Right Side, Antenna 0



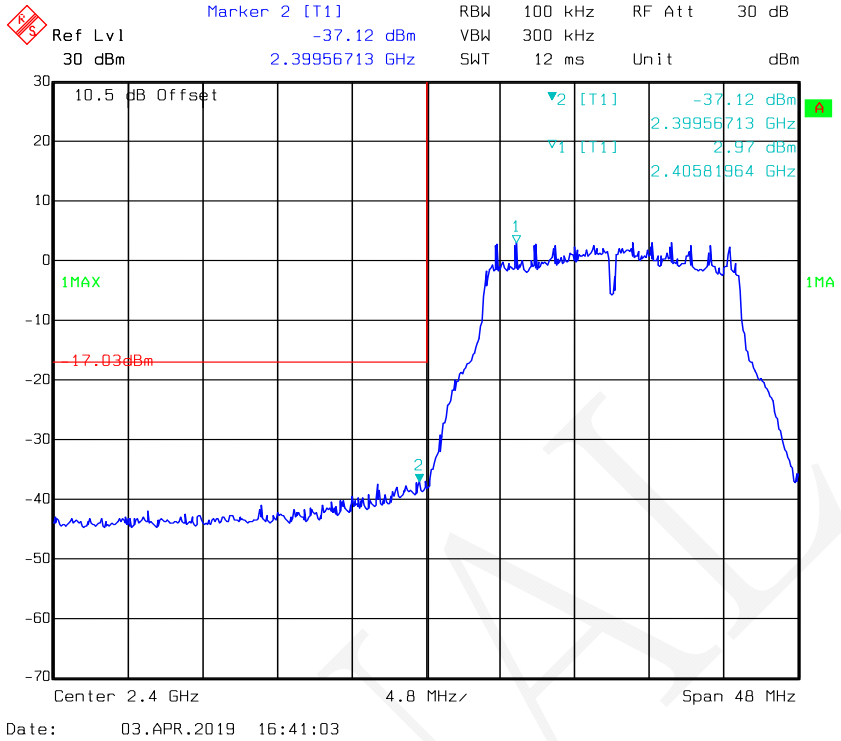
802.11b: Band Edge, Left Side, Antenna 1



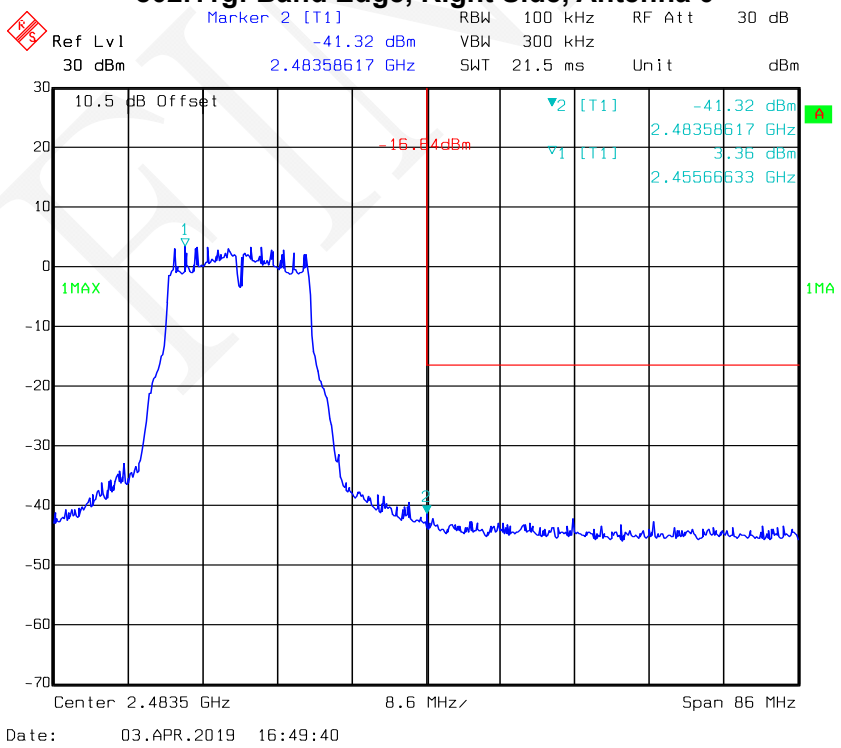
802.11b: Band Edge, Right Side, Antenna 1



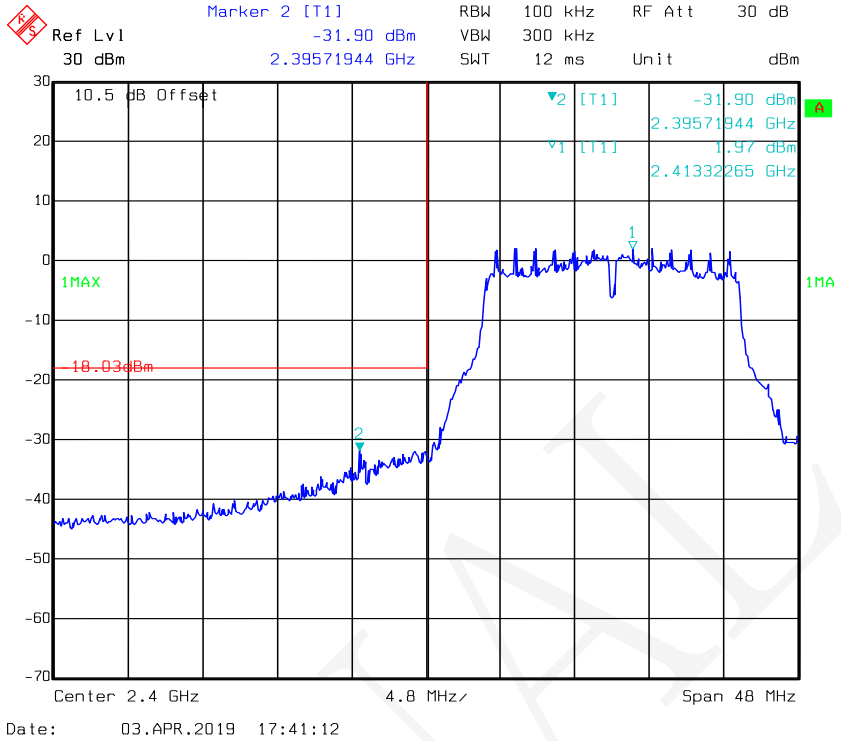
802.11g: Band Edge, Left Side, Antenna 0



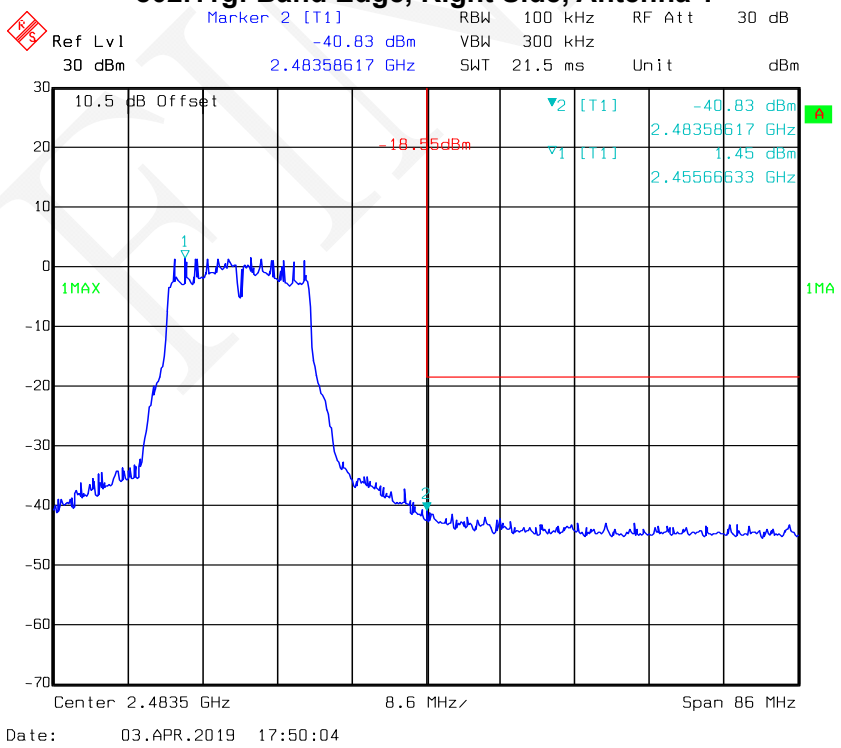
802.11g: Band Edge, Right Side, Antenna 0



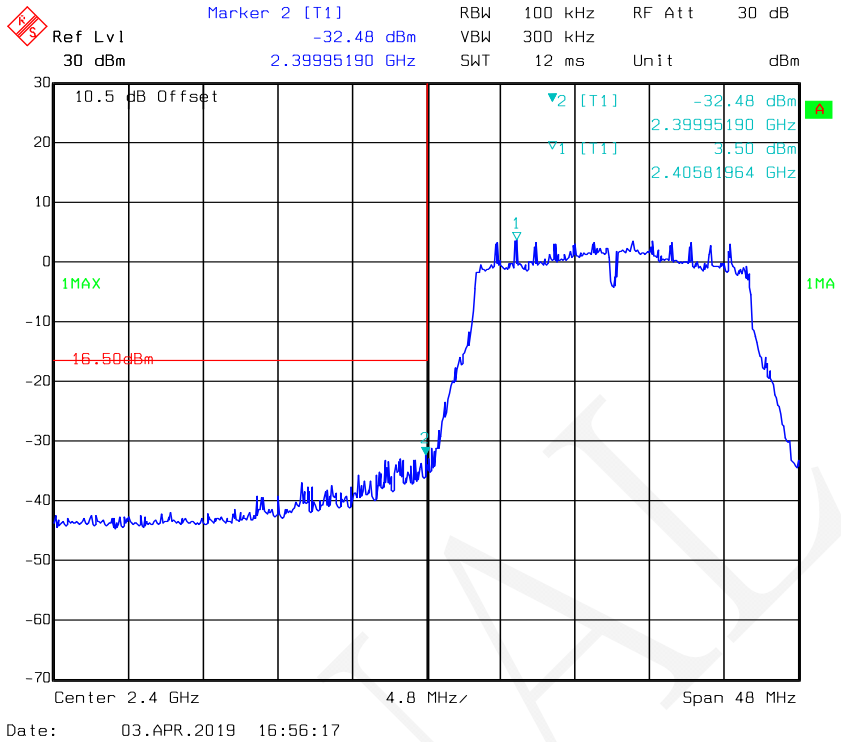
802.11g: Band Edge, Left Side, Antenna 1



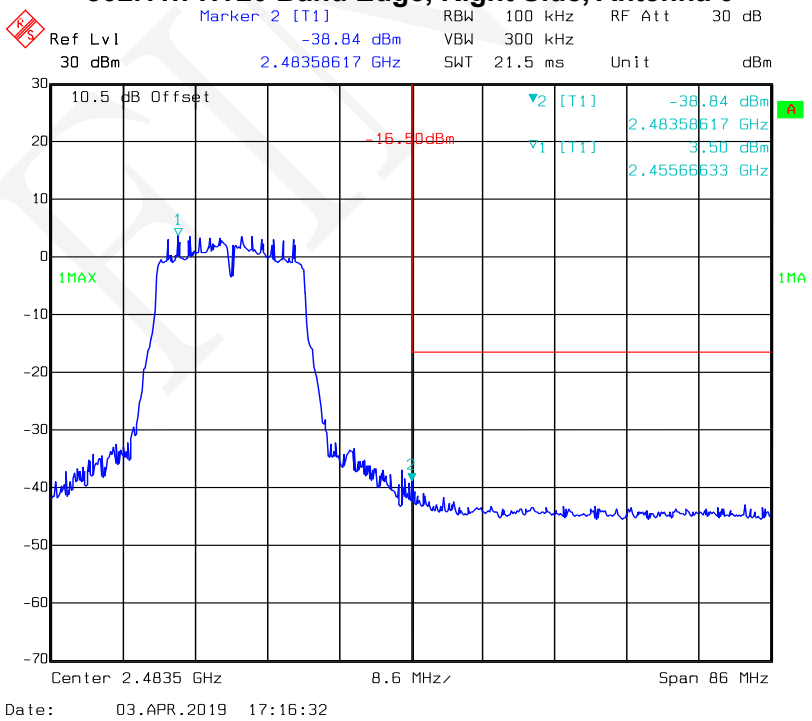
802.11g: Band Edge, Right Side, Antenna 1



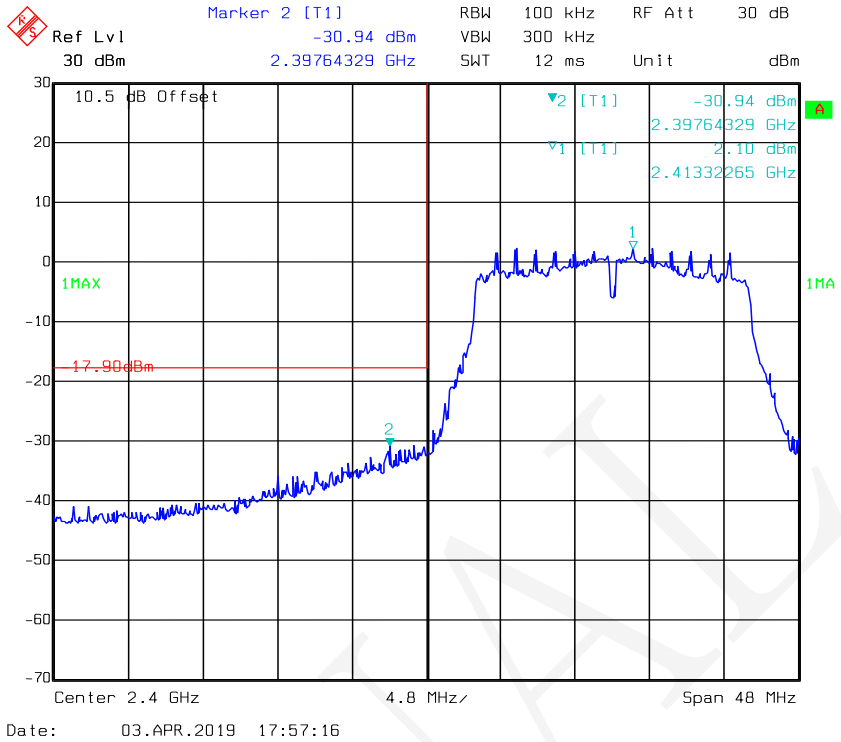
802.11n-HT20 Band Edge, Left Side, Antenna 0



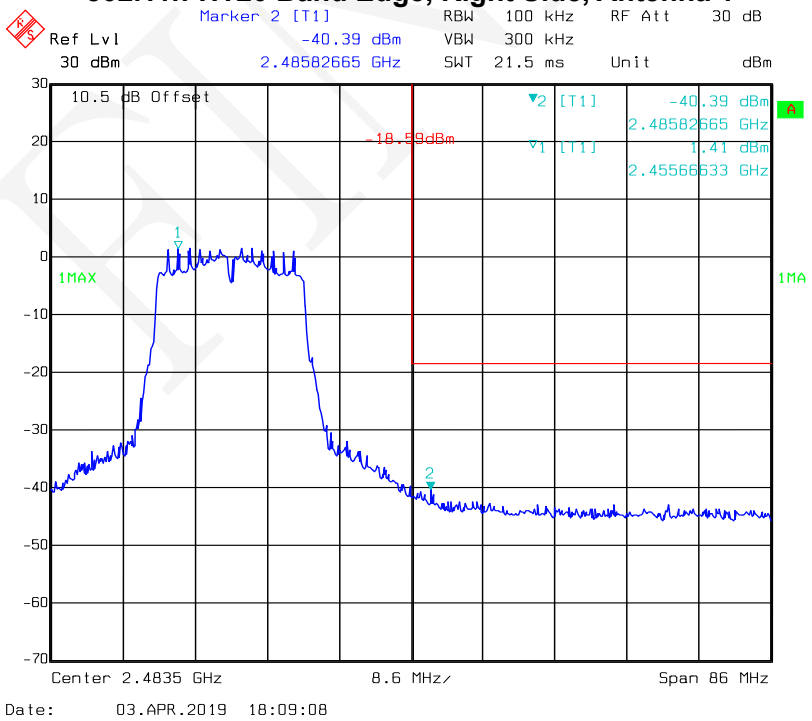
802.11n-HT20 Band Edge, Right Side, Antenna 0



802.11n-HT20 Band Edge, Left Side, Antenna 1

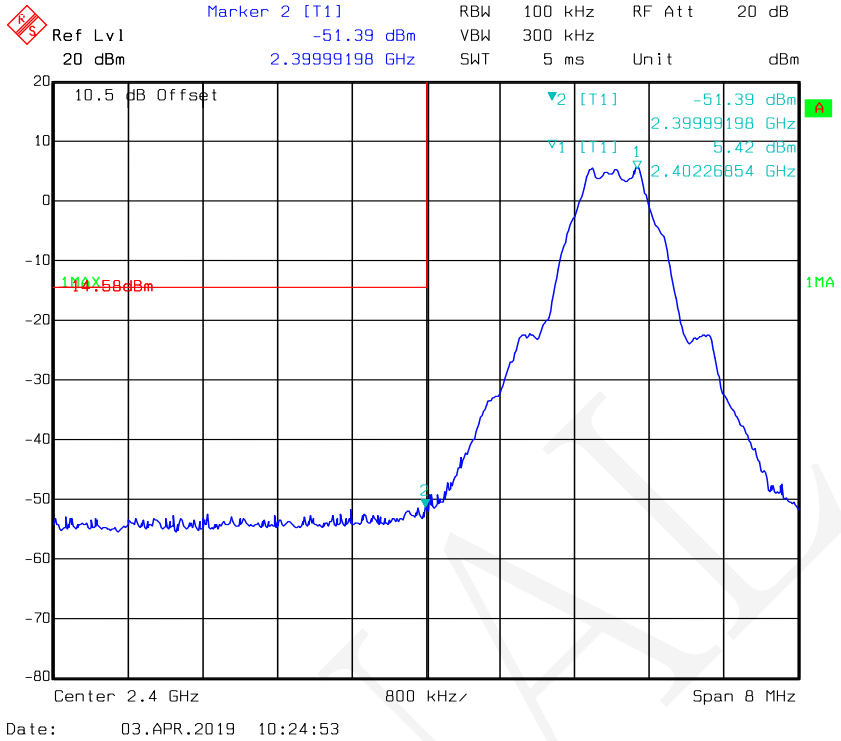


802.11n-HT20 Band Edge, Right Side, Antenna 1

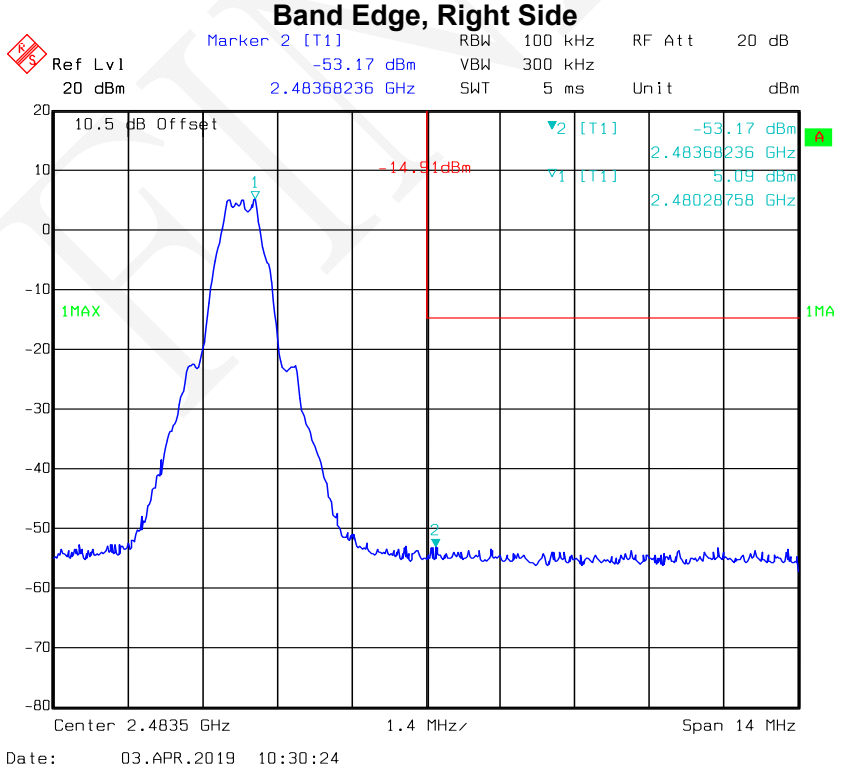


BLE mode

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:	19 °C
Relative Humidity:	56 %
ATM Pressure:	95.5 kPa

The testing was performed by Tom Tang on 2019-04-03.

Test Mode: Transmitting

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

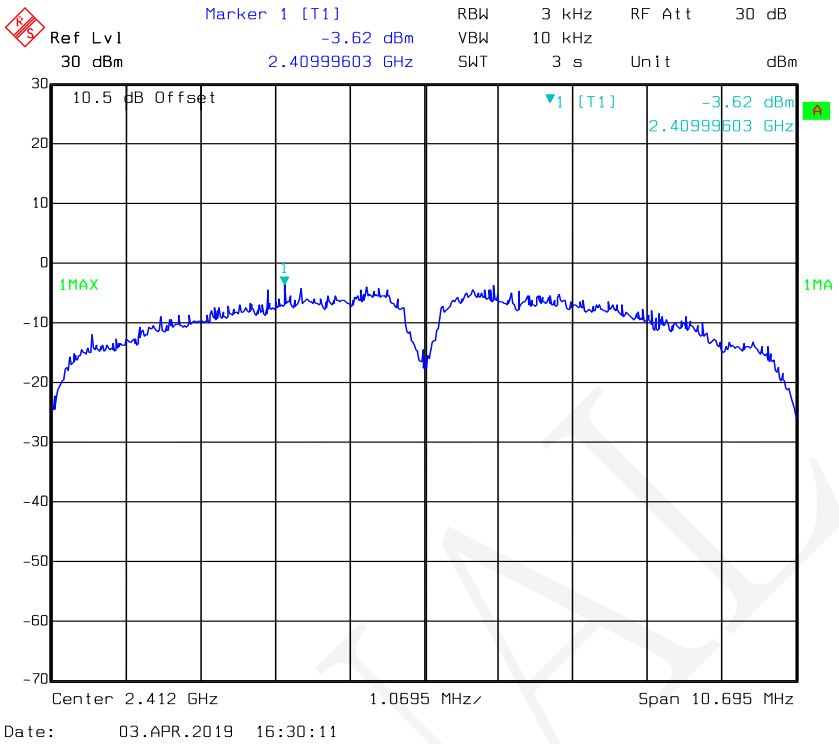
FINAL

Mode	Channel	Frequency (MHz)	Power Spectral Density (dBm/3kHz)		Total (dBm/3kHz)	Limit (dBm/3kHz)
			Antenna 0	Antenna 1		
802.11b	Low	2412	-3.62	-5.13	/	8
	Middle	2437	-3.63	-4.68	/	8
	High	2462	-3.36	-5.82	/	8
802.11g	Low	2412	-8.92	-10.52	/	8
	Middle	2437	-9.16	-10.57	/	8
	High	2462	-9.05	-11.03	/	8
802.11n-HT20	Low	2412	-8.32	-9.67	-5.93	8
	Middle	2437	-8.21	-10.46	-6.18	8
	High	2462	-8.43	-10.14	-6.19	8
BLE mode	Low	2402	-8.94	/	/	8
	Middle	2440	-9.05	/	/	8
	High	2480	-9.67	/	/	8

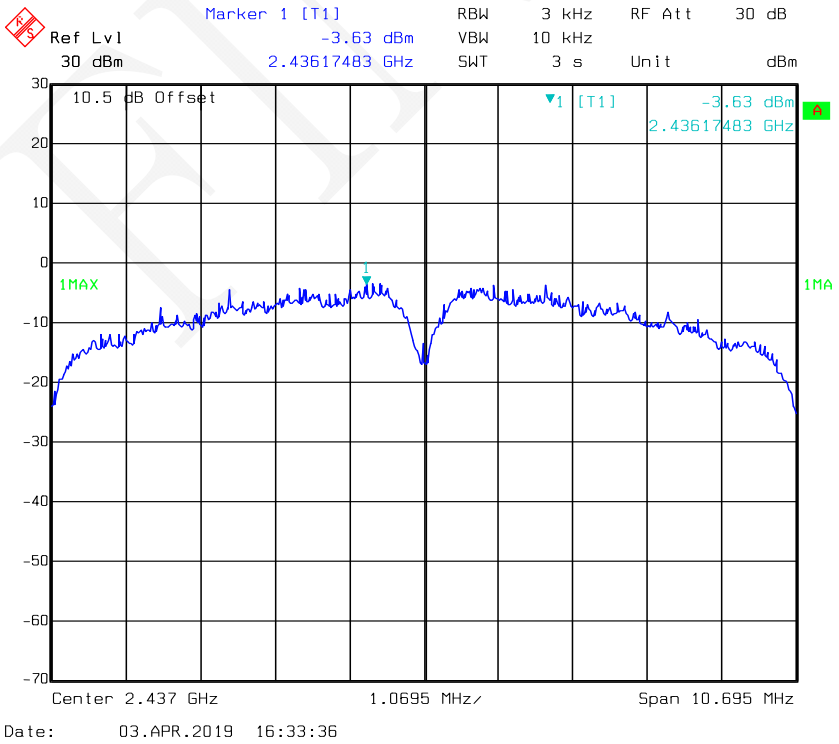
FINAL

Wi-Fi mode

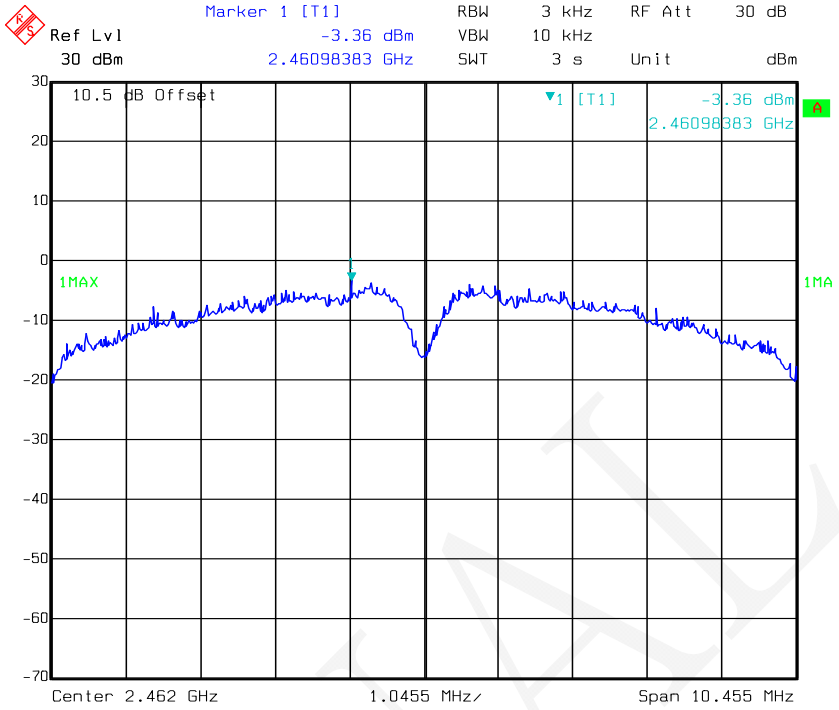
Power Spectral Density, 802.11b Low Channel, Antenna 0



Power Spectral Density, 802.11b Middle Channel, Antenna 0



Power Spectral Density, 802.11b High Channel, Antenna 0



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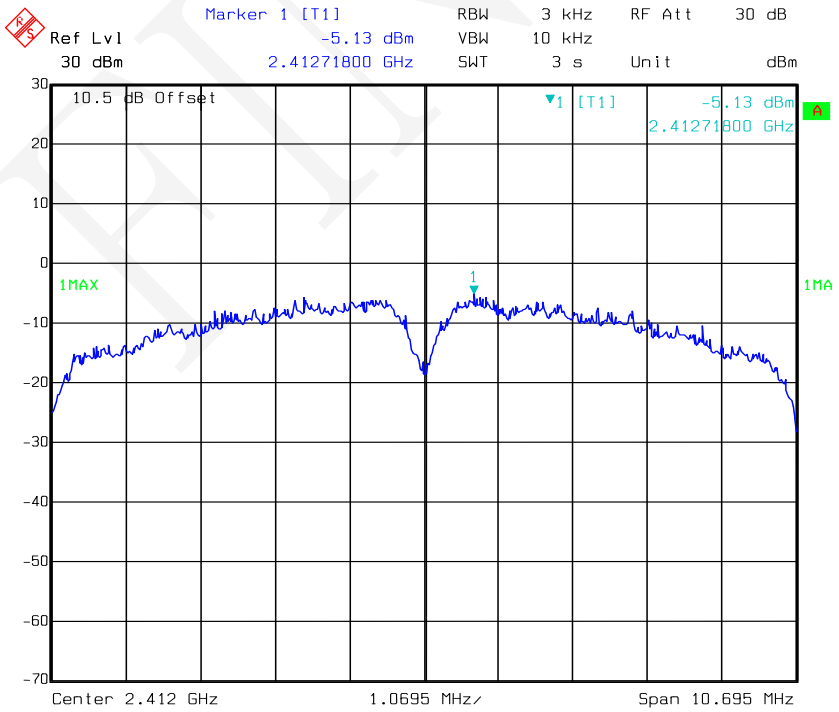
Power Spectral Density, 802.11b Low Channel, Antenna 1



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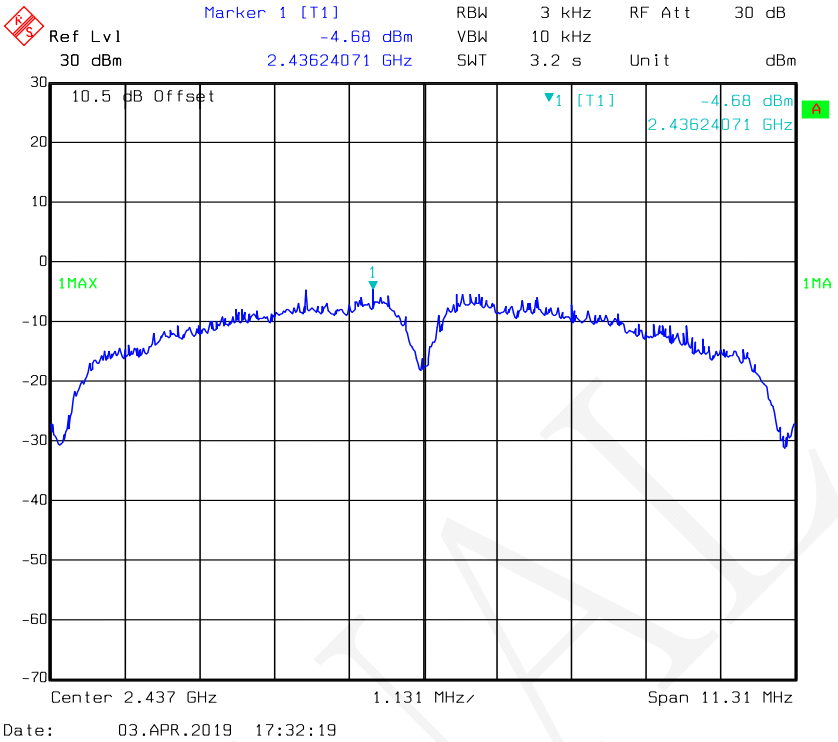
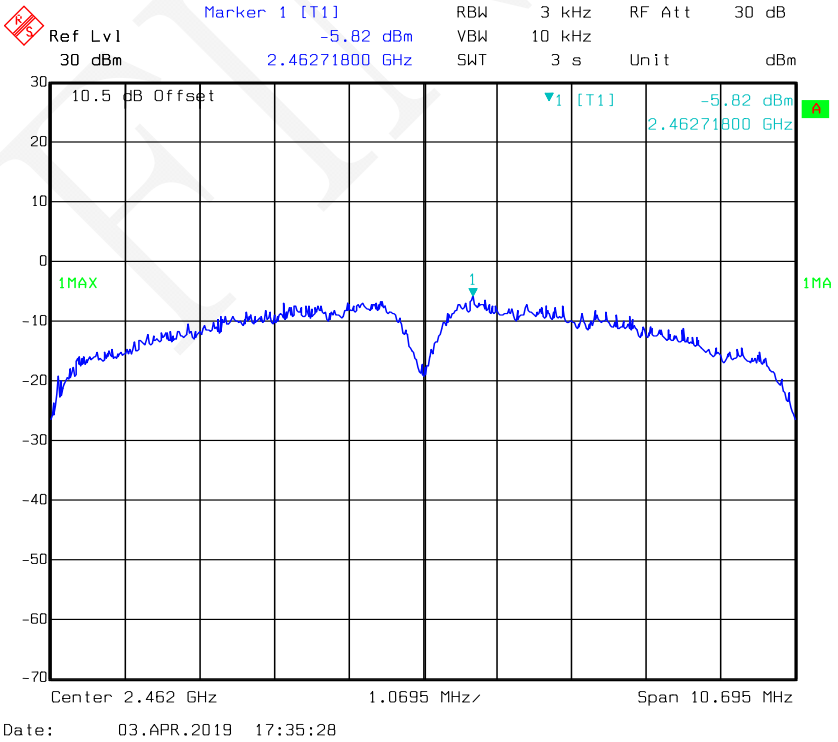
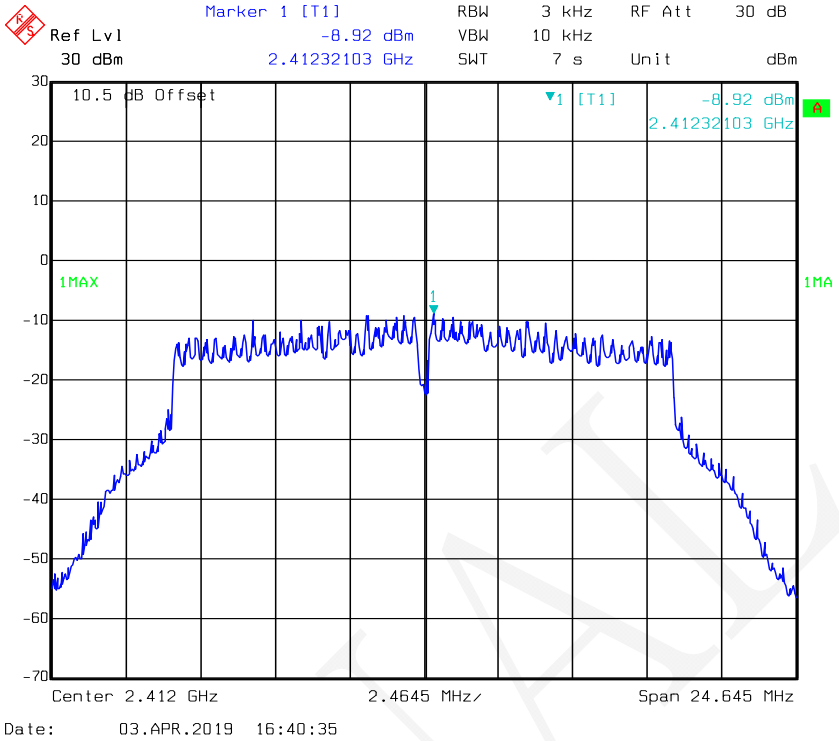
Power Spectral Density, 802.11b Middle Channel, Antenna 1



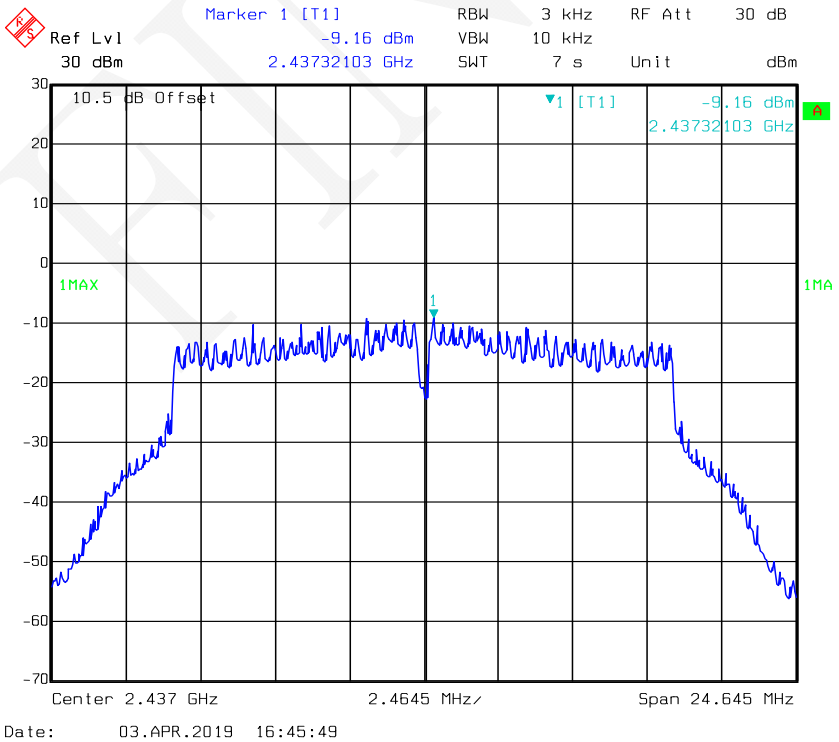
Power Spectral Density, 802.11b High Channel, Antenna 1



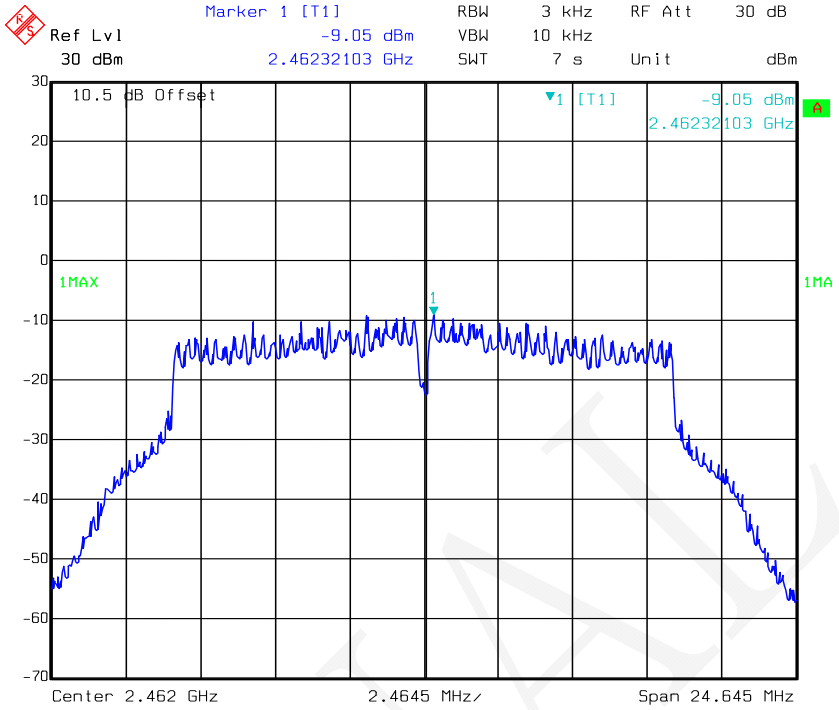
Power Spectral Density, 802.11g Low Channel, Antenna 0



Power Spectral Density, 802.11g Middle Channel, Antenna 0

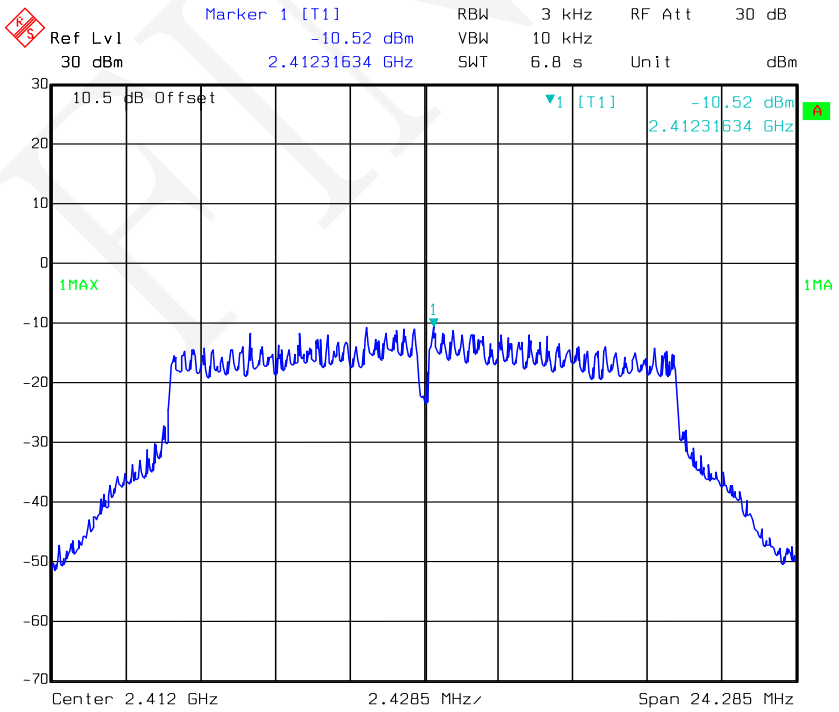


Power Spectral Density, 802.11g High Channel, Antenna 0



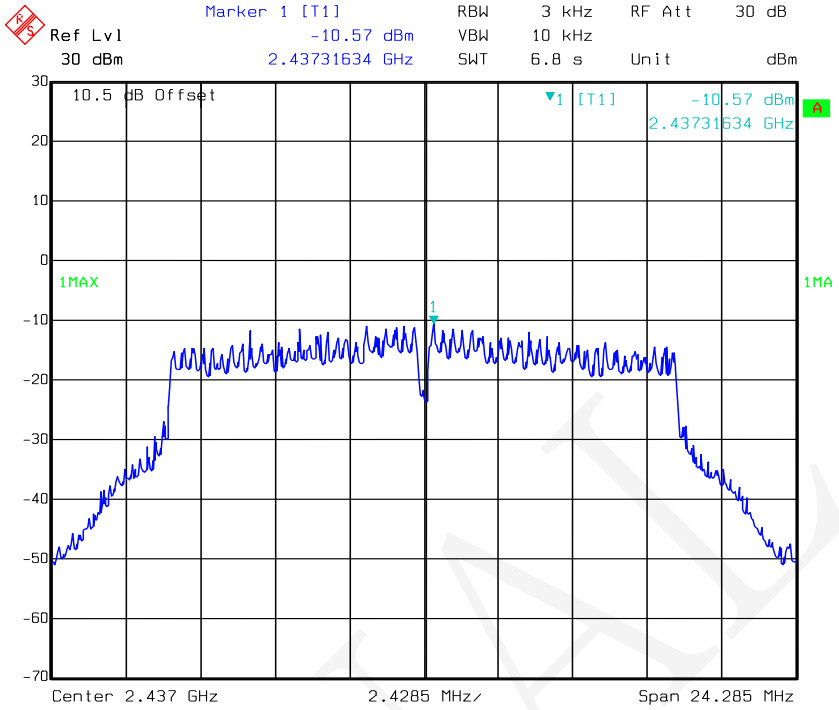
Date: 03.APR.2019 16:49:21

Power Spectral Density, 802.11g Low Channel, Antenna 1



Date: 03.APR.2019 17:40:47

Power Spectral Density, 802.11g Middle Channel, Antenna 1



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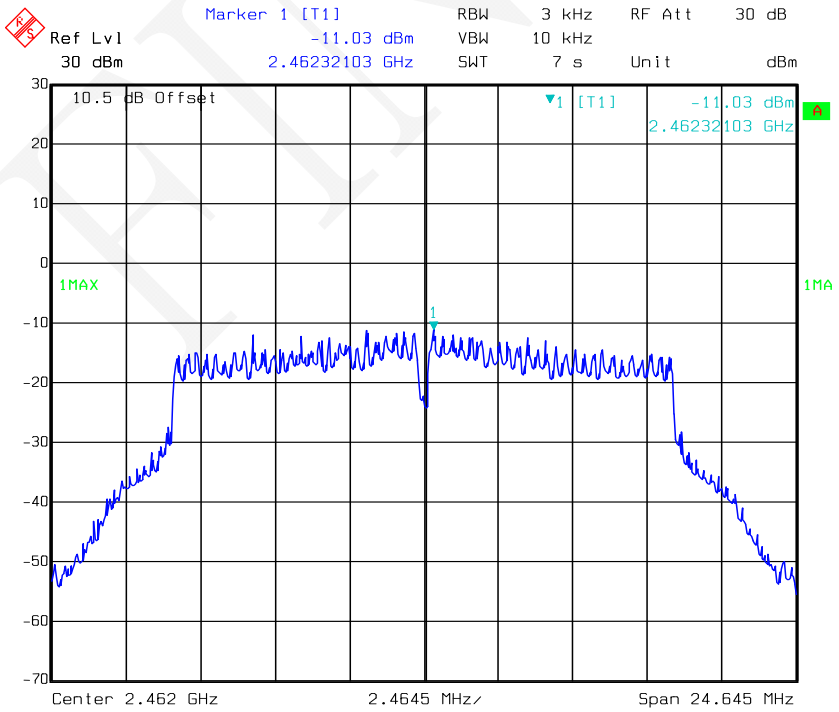
Power Spectral Density, 802.11g High Channel, Antenna 1



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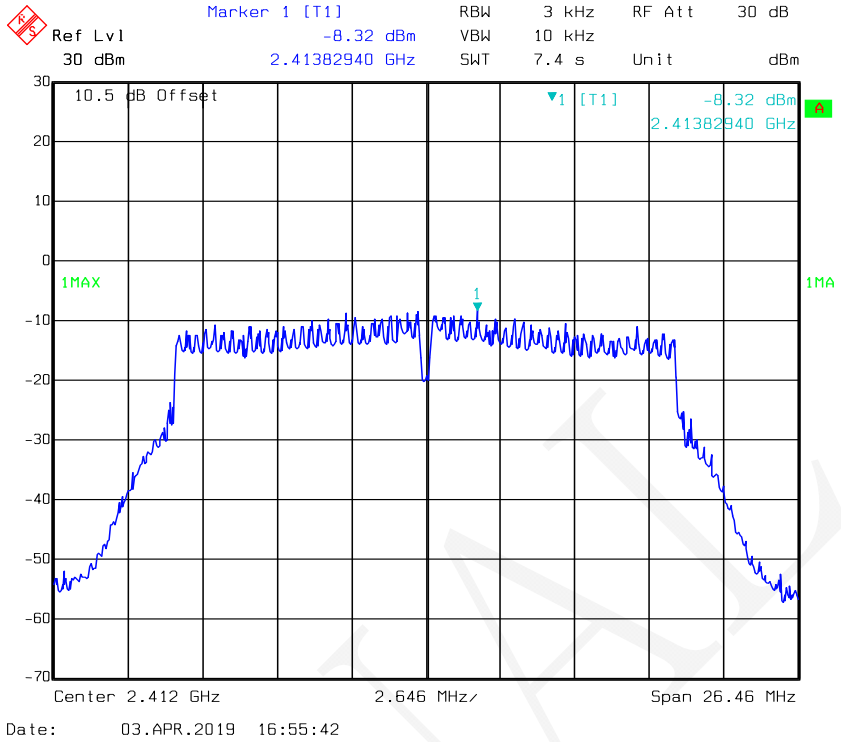
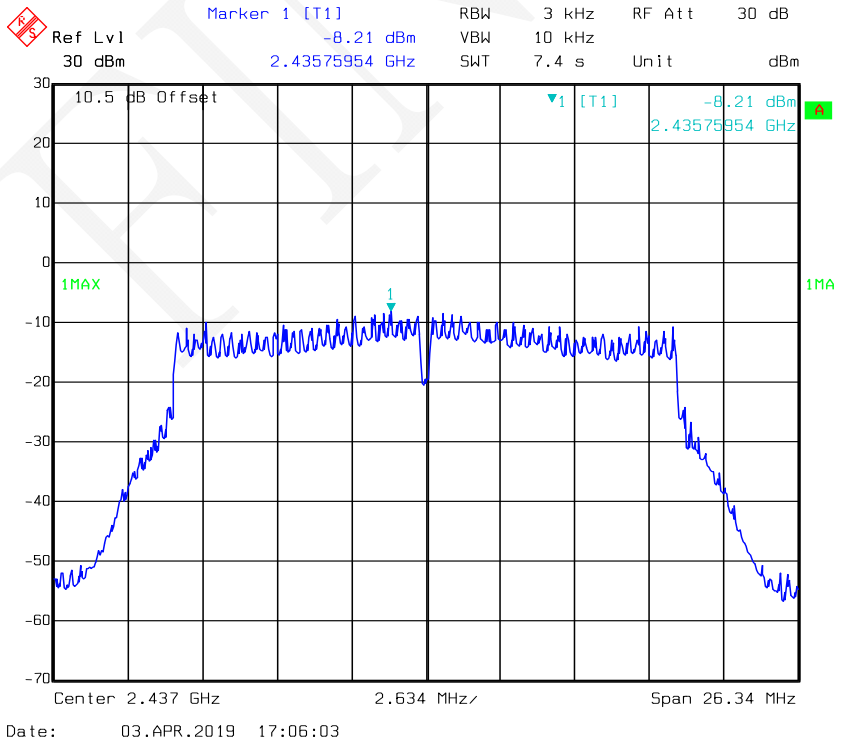
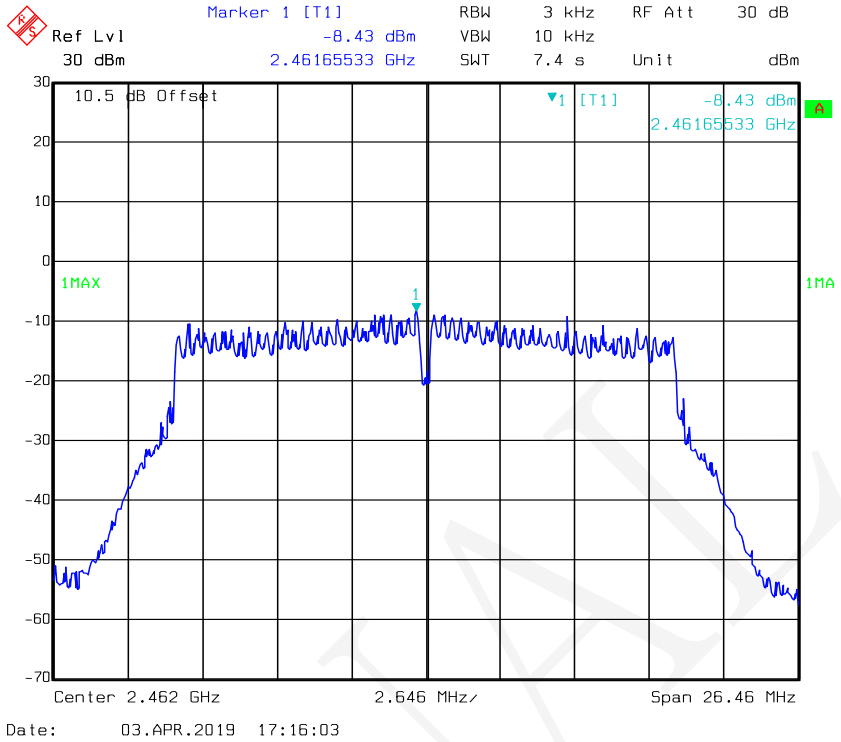
Power Spectral Density, 802.11n-HT20 Low Channel, Antenna 0



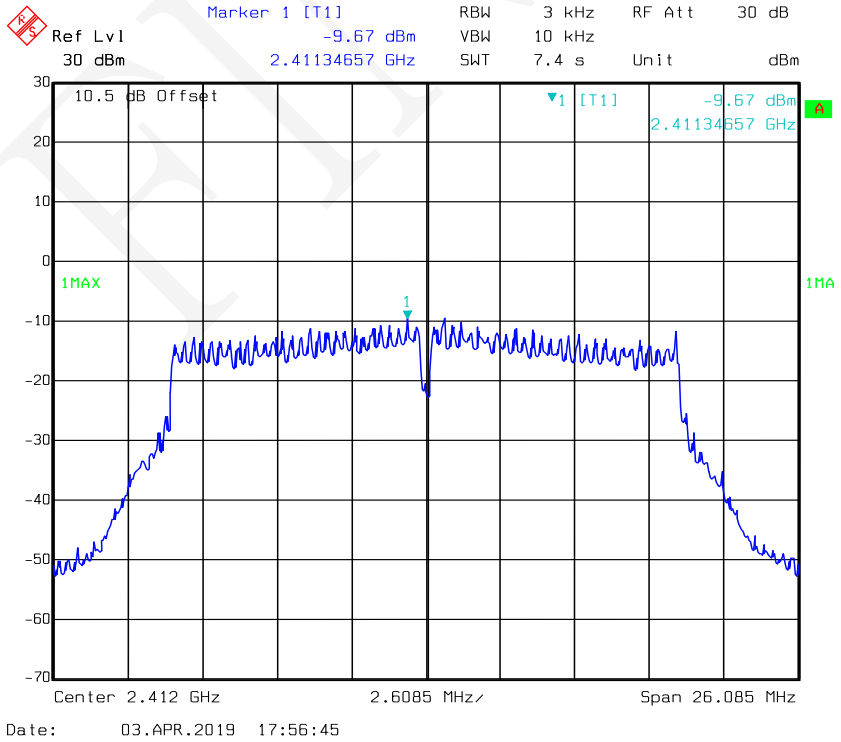
Power Spectral Density, 802.11n-HT20 Middle Channel, Antenna 0



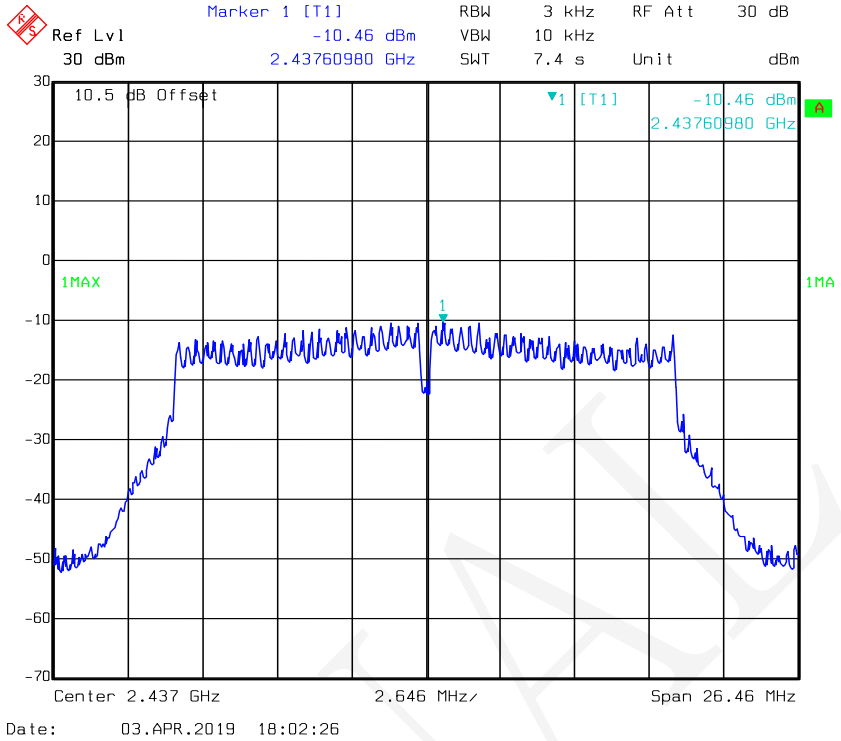
Power Spectral Density, 802.11n-HT20 High Channel, Antenna 0



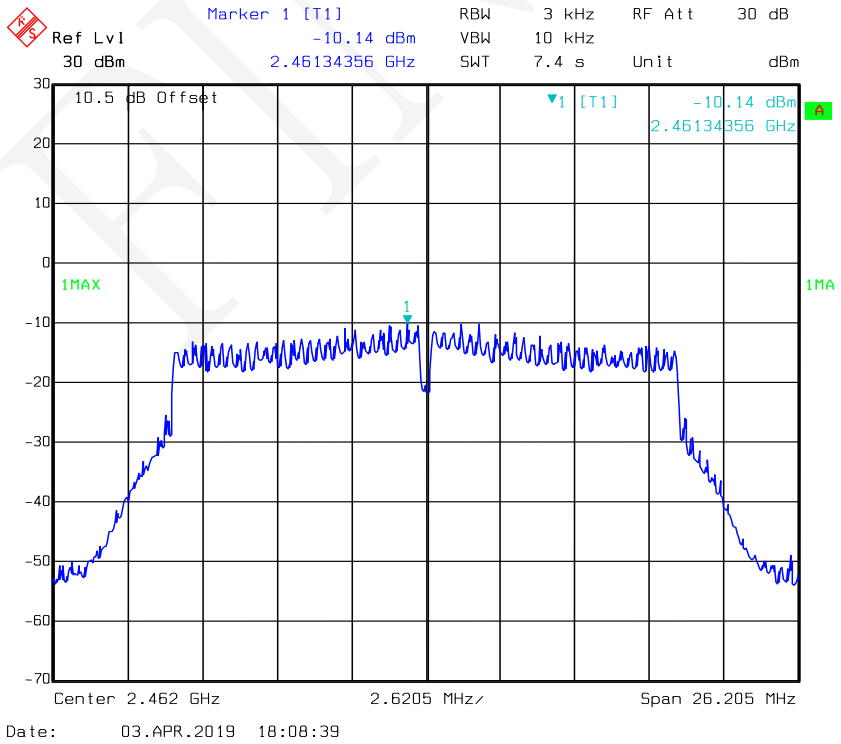
Power Spectral Density, 802.11n-HT20 Low Channel, Antenna 1



Power Spectral Density, 802.11n-HT20 Middle Channel, Antenna 1

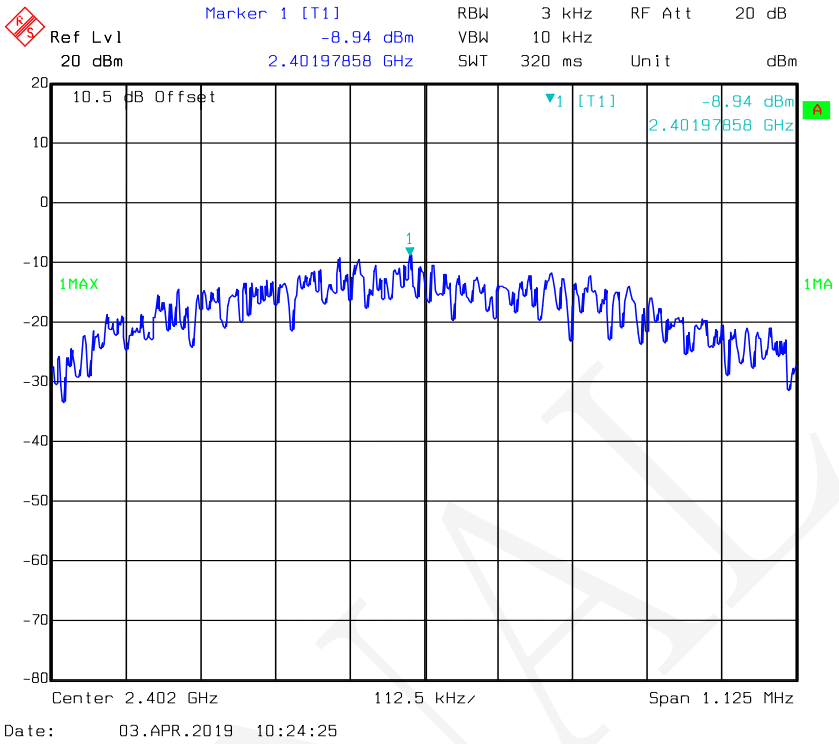


Power Spectral Density, 802.11n-HT20 High Channel, Antenna 1

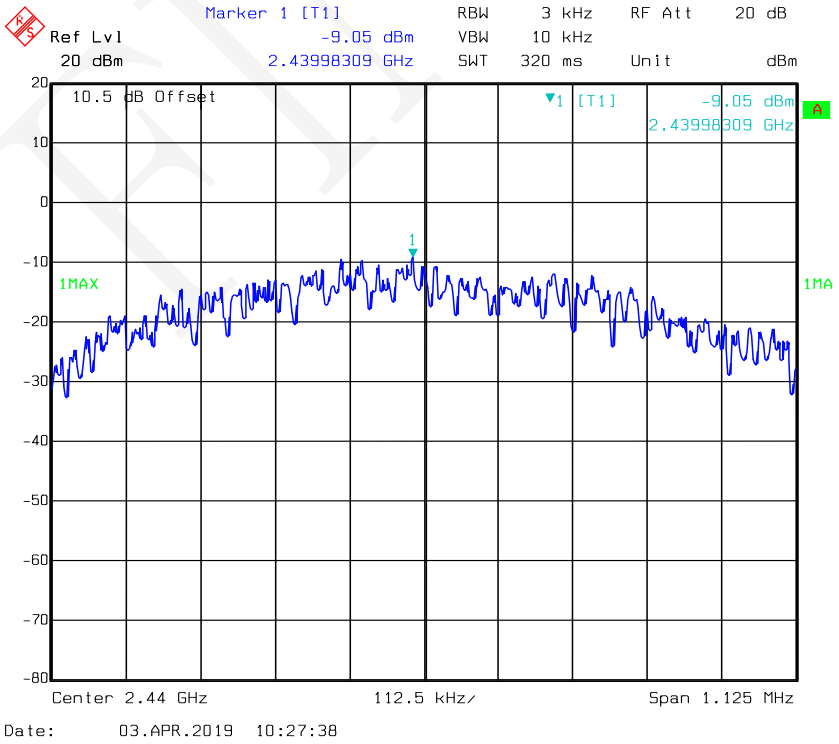


BLE mode

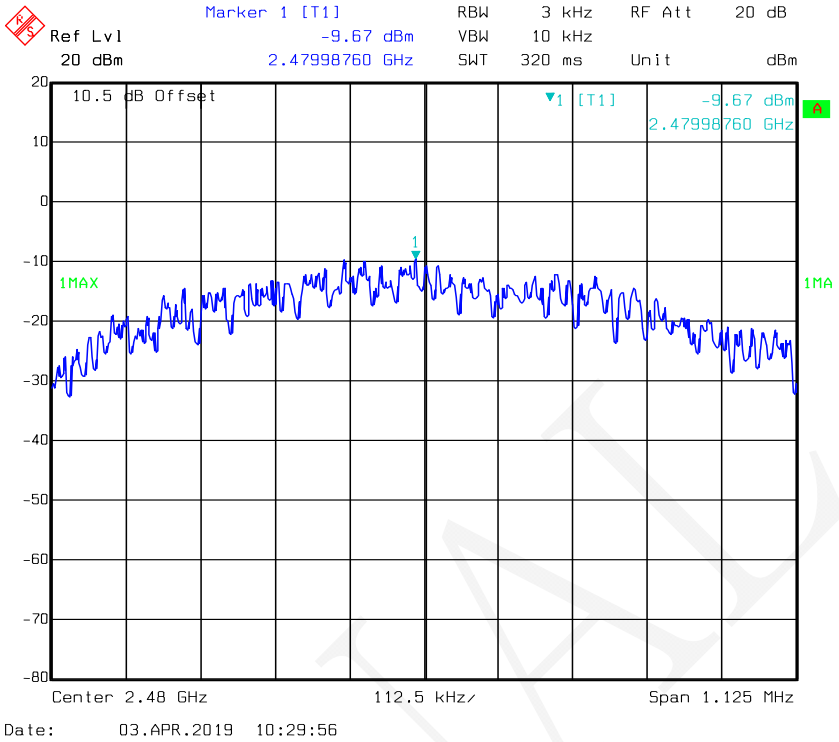
Power Spectral Density, Low Channel



Power Spectral Density, Middle Channel



Power Spectral Density, High Channel



END OF REPORT