TESTING LABORATORY
CERTIFICATE # 4821.01

FCC PART 15.247

TEST REPORT

For

Smartlabs Holding Ltd

Nafpliou 15, Limassol, 3025 Cyprus

FCC ID: 2ASFLSML5041W

Report Type:	**Product Type:**
Original Report	IPTV Set-top box

Report Number: RSZ190311810-00B

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	IPTV Set-top box
Model	SML-5041W
Frequency Range	Bluetooth LE: 2402~2480MHz Wi-Fi: 2412~2472MHz
Transmit Power	Bluetooth LE: 4.98 dBm Wi-Fi: 802.11b:15.95 dBm, 802.11G:13.29 dBm, 802.11N20: 13.54 dBm, 802.11N40: 12.98 dBm
Modulation Technique	Bluetooth LE: GFSK Wi-Fi: DSSS, OFDM
Antenna Specification	Bluetooth LE/Wi-Fi: 2dBi@2.4GHz
Voltage Range	DC 12V from adapter
Date of Test	2019/03/19~2019/05/09
Sample serial number	190311810
Received date	2019/03/11
Sample/EUT Status	Good condition
Adapter information	Model: TEKA018-1201200UK Input: AC 100-240V, 50/60Hz, 0.5A Max Output: DC 12V, 1.2A

Objective

This report is prepared on behalf of *Smartlabs Holding Ltd* in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

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

Related Submittal(s)/Grant(s)

FCC Part 15.247 DSS and Part 15.407 NII submissions with FCC ID: 2ASFLSML5041W.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Output Power with Power meter		±0.73dB
RF conducted test with spectrum		±1.6dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
Temperature		±1℃
Humidity		±6%
Supply voltages		±0.4%

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

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For 802.11b, 802.11g and 802.11n-HT20 mode, 13 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	12	2467
6	2437	13	2472
7	2442	/	/

For 802.11b, 802.11g, 802.11n-HT20 mode, EUT was tested with Channel 1, 7 and 13

For 802.11n-HT40 mode, 9 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2422	6	2447
2	2427	7	2452
3	2432	8	2457
4	2437	9	2462
5	2442	/	/

EUT was tested with Channel 1, 5 and 9.

The EUT 802.11b/g mode only support SISO mode, the others mode can support SISO and MIMO mode, pre-scan the output power of both modes, the result of both modes was almost identical, so the MIMO mode was chosen for testing.

For BLE mode, 40 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	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

Exercise software "Xshell" and Commands were used.

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

Antenna A:

Mode	Data rate	Power level		
		Low channel	Middle channel	High channel
802.11b	1 Mbps	37	39	40
802.11g	6 Mbps	28	30	31
802.11n-HT20	MCS0	26	28	29
802.11n-HT40	MCS0	26	26	26

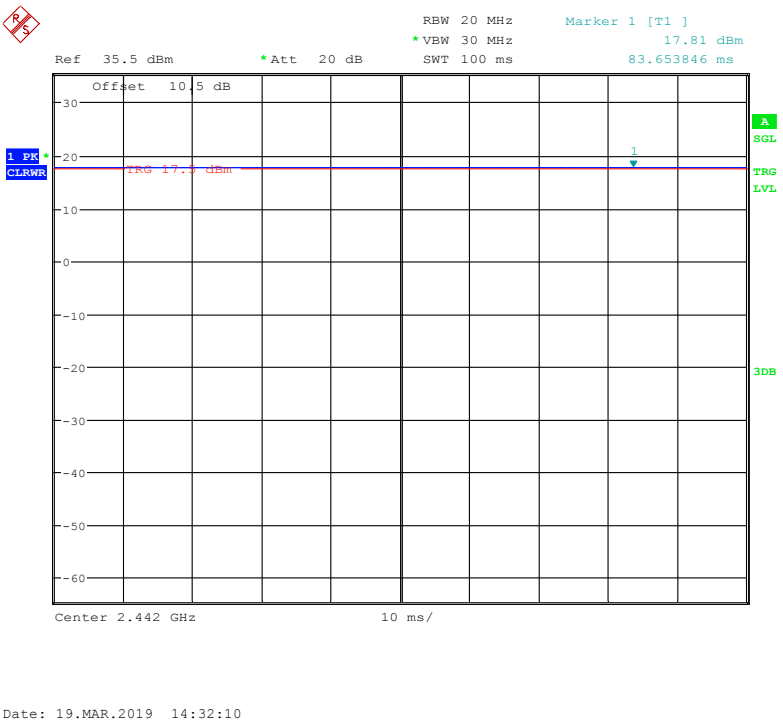
Antenna B:

Mode	Data rate	Power level		
		Low channel	Middle channel	High channel
802.11b	1 Mbps	37	37	38
802.11g	6 Mbps	28	30	31
802.11n-HT20	MCS0	25	25	27
802.11n-HT40	MCS0	24	24	24
BLE	/	Default	Default	Default

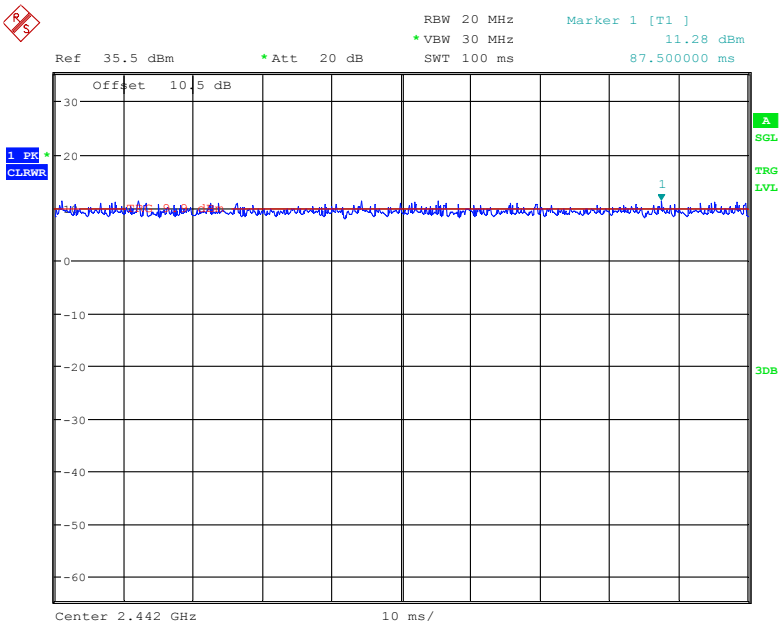
Pre-scan with all the data rates, the above data rate is the worst case for Wi-Fi test.

Duty cycle

802.11b mode



802.11g mode



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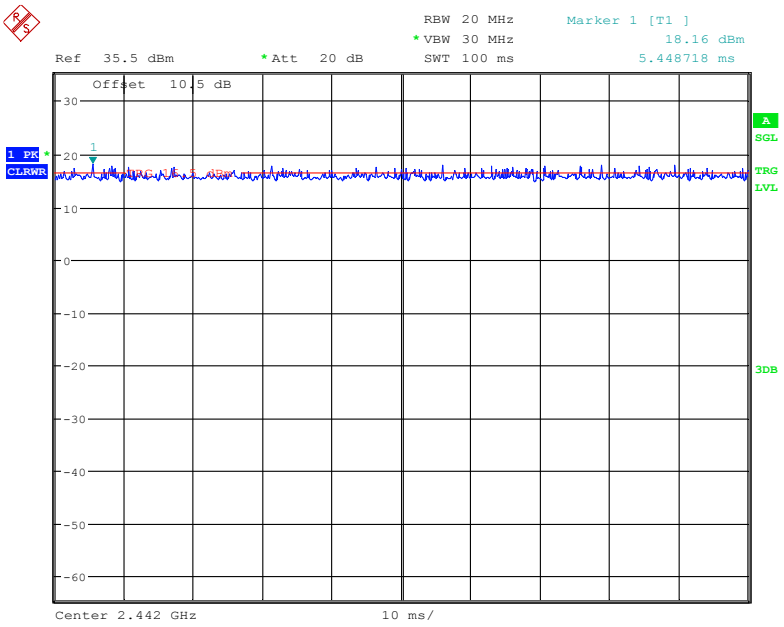
802.11n-HT20 Mode



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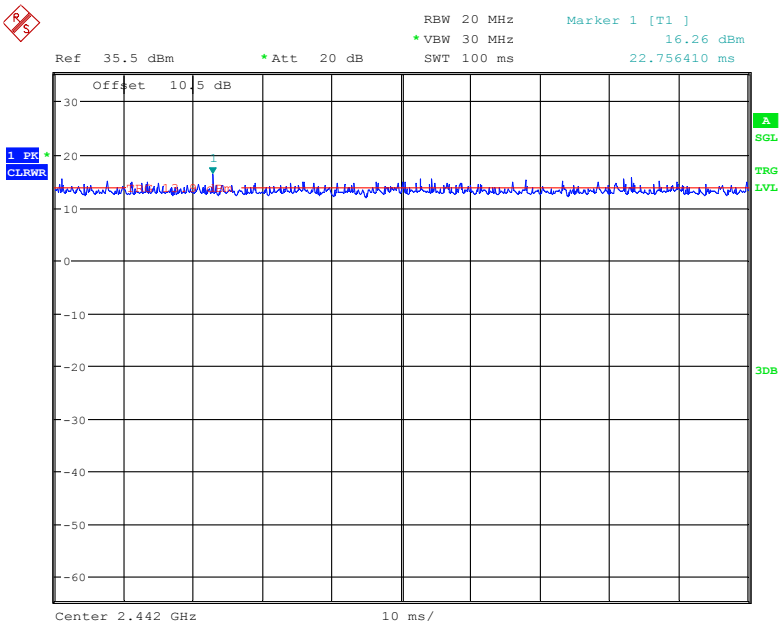
802.11n-HT40 Mode



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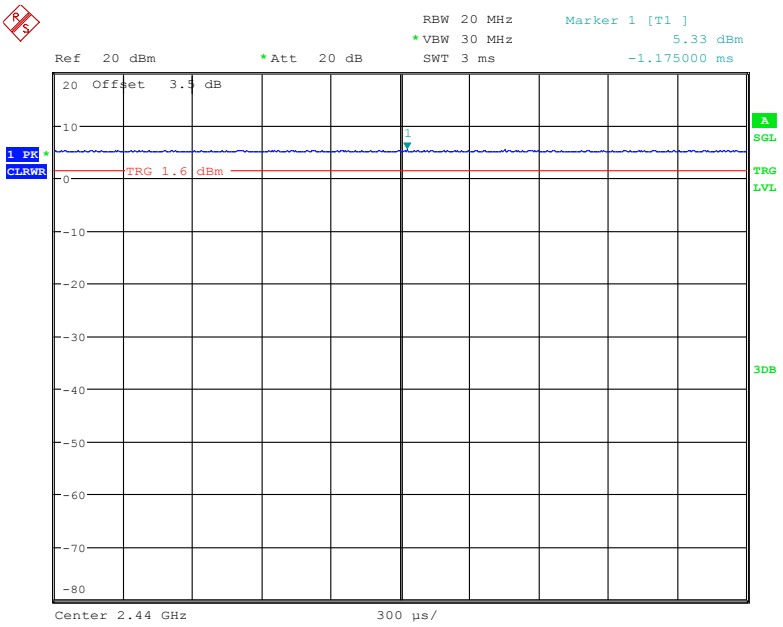
BLE Mode



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Mode	Duty Cycle (%)	T(us)	1/T(kHz)	VBW Setting	10log(1/ Duty Cycle)
802.11b	100	-	-	10Hz	-
802.11g	100	-	-	10Hz	-
802.11n-HT20	100	-	-	10Hz	-
802.11n-HT40	100	-	-	10Hz	-
BLE	100	-	-	10Hz	-

Support Equipment List and Details

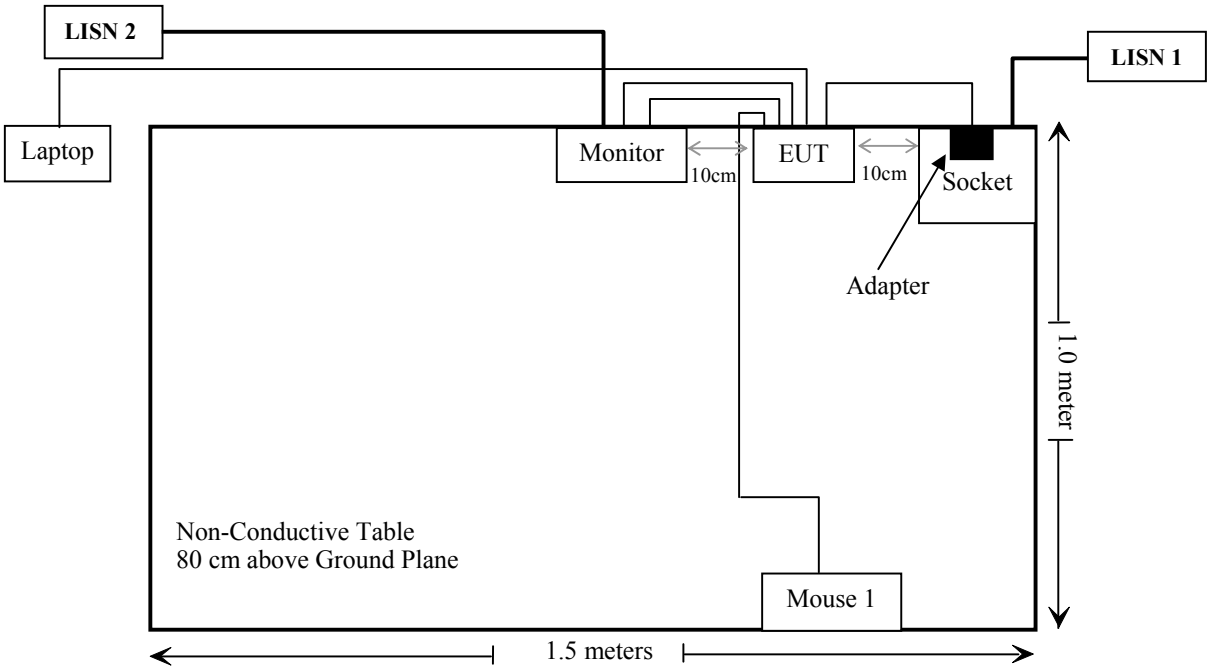
Manufacturer	Description	Model	Serial Number
Lenovo	Mouse 1	Unknown	Unknown
DELL	Mouse 2	MOC5UO	G1900NKD
HP	Laptop	CQ45-m02TU	5CG33407QL
Samsung	Monitor	225MS	LS22CRWSB/XSF

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shielding Un-detachable DC Power Cable	2.4	EUT	Adapter
Un-shielding Detachable AV Cable	1.3	EUT	Monitor
Shielding Detachable HDMI Cable With Ferrite Core	1.6	EUT	Monitor
Un-Shielding Detachable USB Cable	1.5	EUT	Mouse 1 or 2
Un-shielding Detachable RJ45 Cable	10.0	EUT	Laptop

Block Diagram of Test Setup

For conducted emission:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (1) & §2.1091	Maximum Permissible exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Conducted Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESCS30	100176	2018-07-11	2019-07-11
Rohde & Schwarz	LISN	ENV216	3560.6650.12-101613-Yb	2019-01-25	2020-01-25
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2019-03-02	2020-03-02
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Unknown	Conducted Emission Cable	78652	UF A210B-1-0720-504504	2018-11-12	2019-11-12
Radiated Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2018-07-11	2019-07-11
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017-12-22	2020-12-21
Sonoma Instrument	Amplifier	310N	186238	2018-11-12	2019-11-12
Rohde & Schwarz	Signal Analyzer	FSEM	845987/005	2018-06-23	2019-06-23
COM-POWER	Pre-amplifier	PA-122	181919	2018-11-12	2019-11-12
A.H. System	Horn Antenna	SAS-200/571	135	2018-09-01	2021-08-31
UTiFLEX MICRO-C0AX	RF Cable	UFA147A-2362-100100	MFR64639 231029-003	2018-11-12	2019-11-12
Ducommun technologies	RF Cable	104PEA	218124002	2018-11-12	2019-11-12
Ducommun technologies	RF Cable	RG-214	1	2018-11-19	2019-05-21
Ducommun technologies	RF Cable	RG-214	2	2018-11-12	2019-11-12
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-04	2017-12-29	2020-12-28
Heatsink Required	Amplifier	QLW-18405536-J0	15964001002	2018-11-12	2019-11-12
Sinoscite	Band Reject Filter	BSF2402-2480MN-0898-001	99632	2018-11-12	2019-11-12
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Agilent	USB wideband power meter	U2021XA	MY54250003	2018-06-23	2019-06-23
WEINSCHEL	3dB Attenuator	6231	666	Each Time	
WEINSCHEL	10dB Attenuator	5324	AU 3842	Each Time	
Rohde & Schwarz	Spectrum Analyzer	FSU26	200120	2019-03-02	2020-03-01
Ducommun technologies	RF Cable	RG-214	3	Each Time	

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC§15.247 (i), §1.1307 (b) (1) & §2.1091 –MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (Minutes)**
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

MPE Calculated :

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

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)

Results

Tune-Up Power Including Tolerance:

Frequency (MHz)	Antenna Gain		Max Tune-up Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
	(dBi)	(numeric)	(dBm)	(mW)			
2402-2480	2	1.58	5.0	3.16	20	0.0010	1.0
2412-2472	2	1.58	16.0	39.81	20	0.0126	1.0

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

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.
And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has two internal antenna arrangement for Wi-Fi and one internal antenna arrangement for BLE, which were permanently attached and the antenna gain is 2dBi for both Antennas, fulfill the requirement of this section. Please refer to the EUT photos.

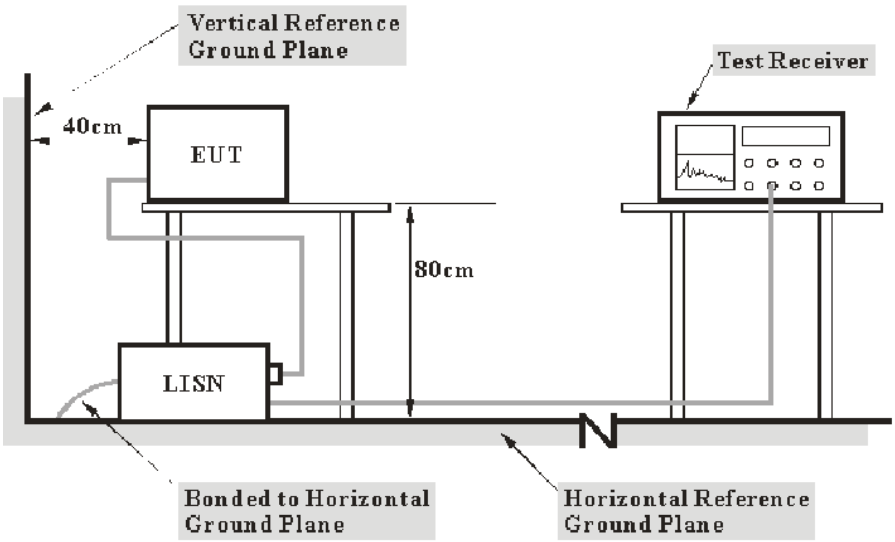
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

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

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

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

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

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Correction Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207,

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

In BACL, $U_{(Lm)}$ is less than U_{cispr}, if L_m is less than L_{lim}, it implies that the EUT complies with the limit.

Test Data

Environmental Conditions

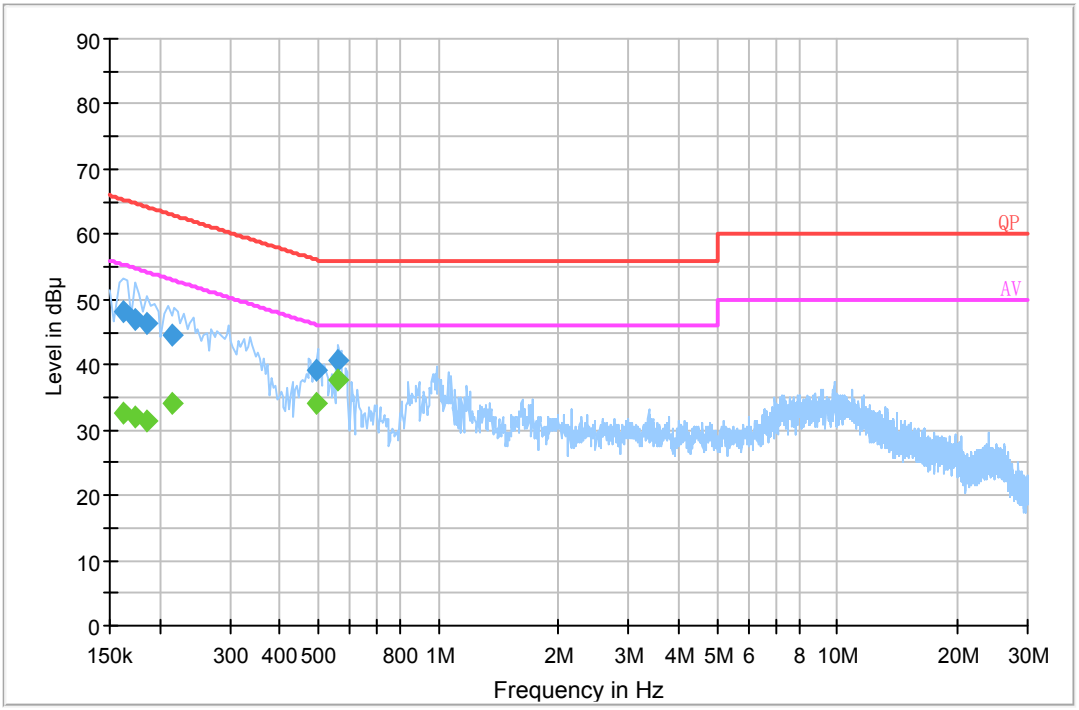
Temperature:	25 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2019-04-23.

EUT operation mode: Transmitting

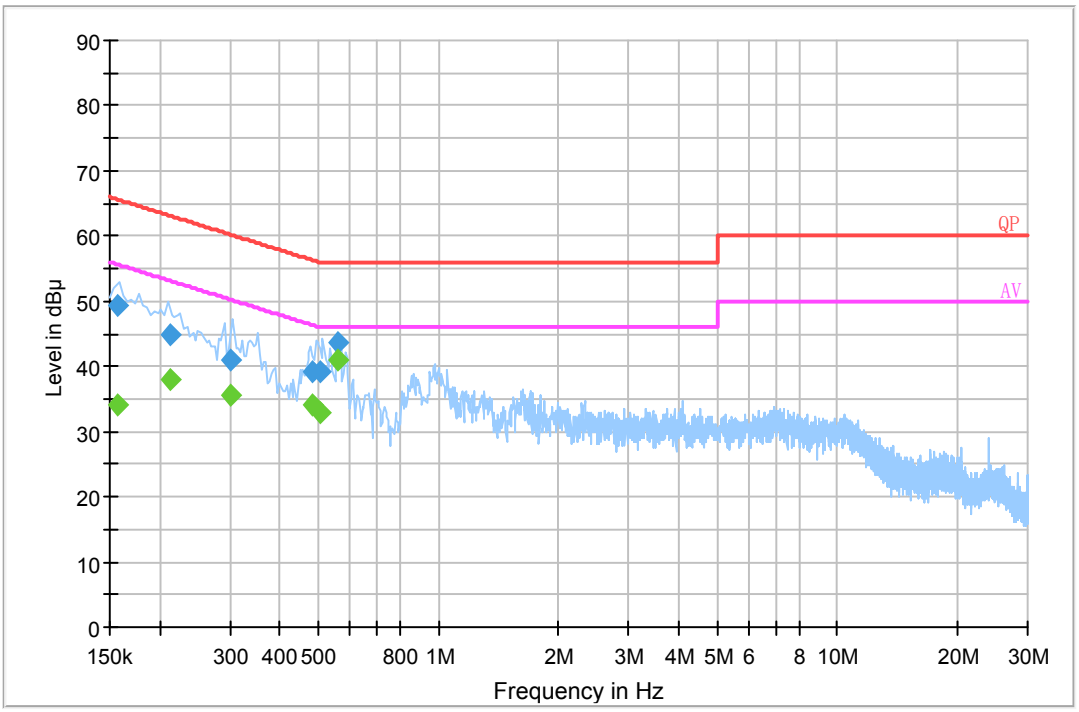
Worst Case: Wi-Fi 802.11b Mode, Low channel

AC 120 V/60 Hz, Line:



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.161500	48.1	19.9	65.4	17.3	QP
0.173500	47.0	19.9	64.8	17.8	QP
0.185500	46.4	19.8	64.2	17.8	QP
0.214501	44.5	19.8	63.0	18.5	QP
0.494530	39.0	19.8	56.1	17.1	QP
0.561570	40.8	19.8	56.0	15.2	QP
0.161500	32.5	19.9	55.4	22.9	Ave.
0.173500	32.0	19.9	54.8	22.8	Ave.
0.185500	31.4	19.8	54.2	22.8	Ave.
0.214501	34.1	19.8	53.0	18.9	Ave.
0.494530	34.2	19.8	46.1	11.9	Ave.
0.561570	37.6	19.8	46.0	8.4	Ave.

AC 120V/ 60 Hz, Neutral:



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.157500	49.2	19.8	65.6	16.4	QP
0.213500	44.7	19.8	63.1	18.4	QP
0.301410	40.9	19.7	60.2	19.3	QP
0.482830	39.2	19.8	56.3	17.1	QP
0.506290	39.2	19.8	56.0	16.8	QP
0.561570	43.6	19.8	56.0	12.4	QP
0.157500	34.0	19.8	55.6	21.6	Ave.
0.213500	37.9	19.8	53.1	15.2	Ave.
0.301410	35.7	19.7	50.2	14.5	Ave.
0.482830	34.1	19.8	46.3	12.2	Ave.
0.506290	33.0	19.8	46.0	13.0	Ave.
0.561570	41.0	19.8	46.0	5.0	Ave.

Note:
1) Correction Factor =LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
2) Corrected Amplitude = Reading + Correction Factor
3) Margin = Limit – Corrected Amplitude

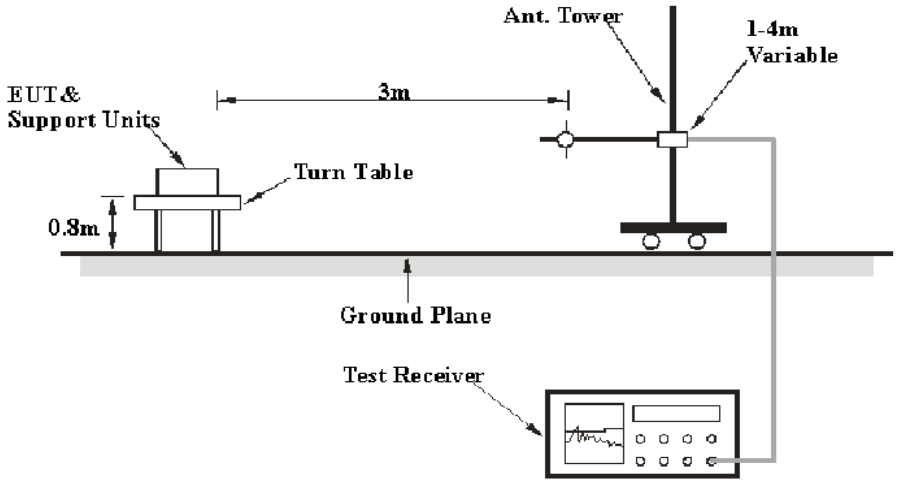
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

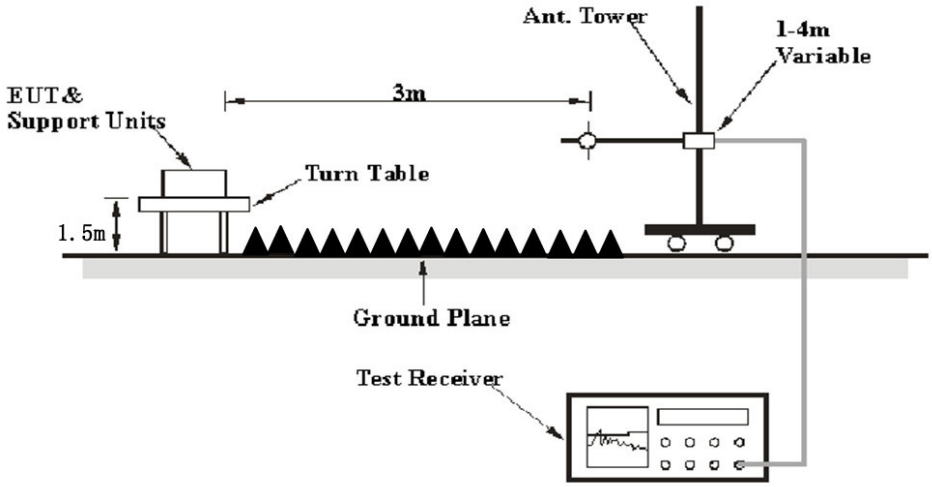
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz Note 1	/	Average
	1MHz	＞1/T Note 2	/	Average

Note 1: when duty cycle is no less than 98%
Note 2: when duty cycle is less than 98%

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

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

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

In BACL, $U_{(Lm)}$ is less than U_{cispr}, if L_m is less than L_{lim}, it implies that the EUT complies with the limit.

Test Data

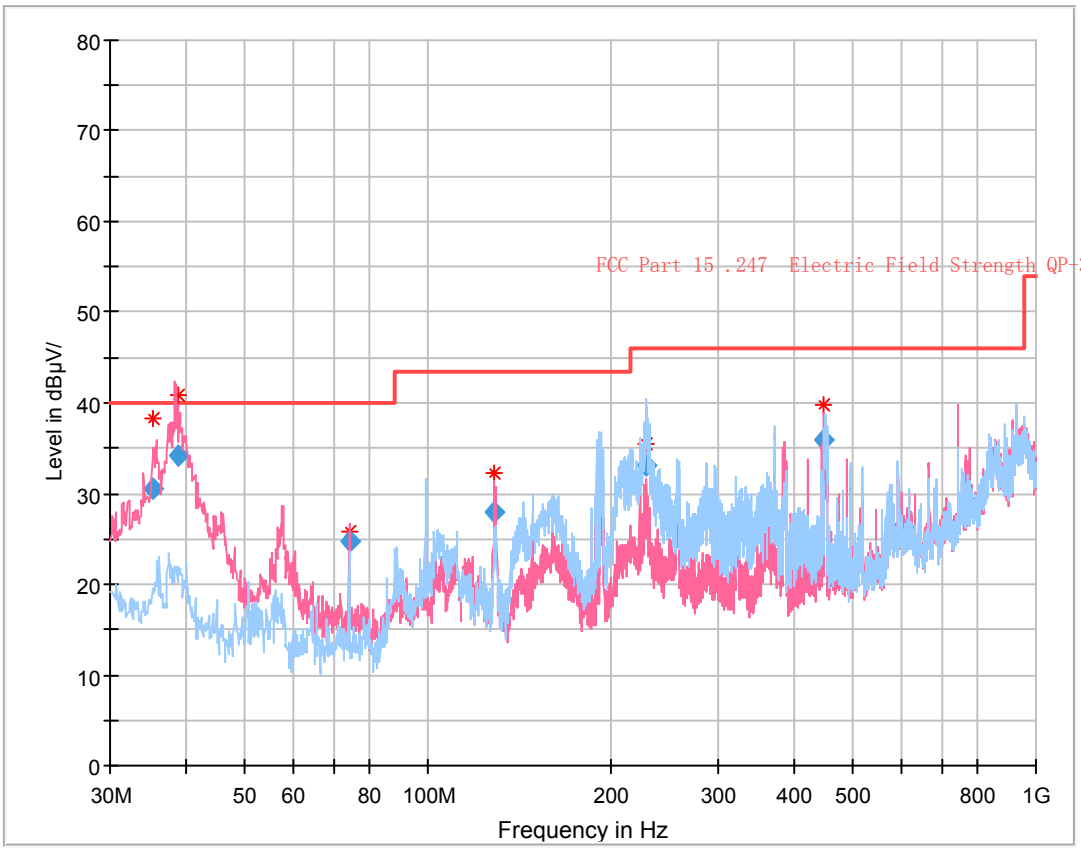
Environmental Conditions

Temperature:	25~26 ℃
Relative Humidity:	50~52 %
ATM Pressure:	101.0 kPa

The testing was performed by Yooube Zhao on 2019-04-23, by Curry Xiang on 2019-04-24, and by Leo Huang on 2019-04-29.

EUT operation mode: Transmitting

30 MHz~1 GHz: Worst Case at Wi-Fi 802.11b Mode, Low channel



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
35.409375	30.46	106.0	V	82.0	-10.8	40.00	9.54
38.731375	34.21	100.0	V	98.0	-13.0	40.00	5.79
74.279500	24.80	100.0	V	111.0	-20.3	40.00	15.20
128.380625	27.96	116.0	V	101.0	-13.7	43.50	15.54
228.003625	33.15	169.0	H	116.0	-14.0	46.00	12.85
448.776125	36.00	100.0	V	174.0	-8.3	46.00	10.00

1 GHz-25 GHz:

802.11b Mode (worst for Antenna A):

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2389.43	27.98	PK	278	2.2	H	31.87	59.85	74	14.15
2389.43	13.98	Ave.	278	2.2	H	31.87	45.85	54	8.15
2484.78	28.43	PK	265	2.1	H	32.13	60.56	74	13.44
2484.78	13.44	Ave.	265	2.1	H	32.13	45.57	54	8.43
4824.00	54.33	PK	76	1.5	H	6.28	60.61	74	13.39
4824.00	47.02	Ave.	76	1.5	H	6.28	53.30	54	0.70
Middle Channel (2442MHz)									
4884.00	51.37	PK	43	1.8	H	6.76	58.13	74	15.87
4884.00	46.14	Ave.	43	1.8	H	6.76	52.90	54	1.10
High Channel (2472 MHz)									
2388.94	28.43	PK	121	2.1	H	31.87	60.30	74	13.70
2388.94	14.13	Ave.	121	2.1	H	31.87	46.00	54	8.00
2483.70	28.34	PK	68	1.2	H	32.13	60.47	74	13.53
2483.70	13.54	Ave.	68	1.2	H	32.13	45.67	54	8.33
4944.00	49.01	PK	289	1.3	H	6.76	55.77	74	18.23
4944.00	44.86	Ave.	289	1.3	H	6.76	51.62	54	2.38

802.11g Mode (worst for Antenna A):

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2389.72	28.55	PK	175	1.3	H	31.87	60.42	74	13.58
2389.72	14.32	Ave.	175	1.3	H	31.87	46.19	54	7.81
2483.66	28.24	PK	3	2.4	H	32.13	60.37	74	13.63
2483.66	13.62	Ave.	3	2.4	H	32.13	45.75	54	8.25
4824.00	52.36	PK	313	2.0	H	6.28	58.64	74	15.36
4824.00	44.35	Ave.	313	2.0	H	6.28	50.63	54	3.37
Middle Channel (2442MHz)									
4884.00	49.46	PK	353	2.2	H	6.76	56.22	74	17.78
4884.00	41.23	Ave.	353	2.2	H	6.76	47.99	54	6.01
High Channel (2472 MHz)									
2388.95	28.74	PK	346	1.5	H	31.87	60.61	74	13.39
2388.95	14.12	Ave.	346	1.5	H	31.87	45.99	54	8.01
2483.67	28.41	PK	256	1.2	H	32.13	60.54	74	13.46
2483.67	13.46	Ave.	256	1.2	H	32.13	45.59	54	8.41
4944.00	51.63	PK	226	1.1	H	6.76	58.39	74	15.61
4944.00	42.46	Ave.	226	1.1	H	6.76	49.22	54	4.78

802.11n-HT20 Mode (Antenna A & Antenna B):

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2388.79	28.46	PK	29	1.5	H	31.87	60.33	74	13.67
2388.79	13.86	Ave.	29	1.5	H	31.87	45.73	54	8.27
2483.65	28.46	PK	24	1.4	H	32.13	60.59	74	13.41
2483.65	13.59	Ave.	24	1.4	H	32.13	45.72	54	8.28
4824.00	48.03	PK	314	2.0	H	6.28	54.31	74	19.69
4824.00	40.75	Ave.	314	2.0	H	6.28	47.03	54	6.97
Middle Channel (2442MHz)									
4884.00	46.55	PK	205	1.6	H	6.76	53.31	74	20.69
4884.00	37.83	Ave.	205	1.6	H	6.76	44.59	54	9.41
High Channel (2472 MHz)									
2389.67	28.46	PK	274	1.1	H	31.87	60.33	74	13.67
2389.67	13.86	Ave.	274	1.1	H	31.87	45.73	54	8.27
2483.53	29.99	PK	176	1.5	H	32.13	62.12	74	11.88
2483.53	14.30	Ave.	176	1.5	H	32.13	46.43	54	7.57
4944.00	44.29	PK	249	2.0	H	6.76	51.05	74	22.95
4944.00	35.37	Ave.	249	2.0	H	6.76	42.13	54	11.87

802.11n-HT40 Mode (Antenna A & Antenna B):

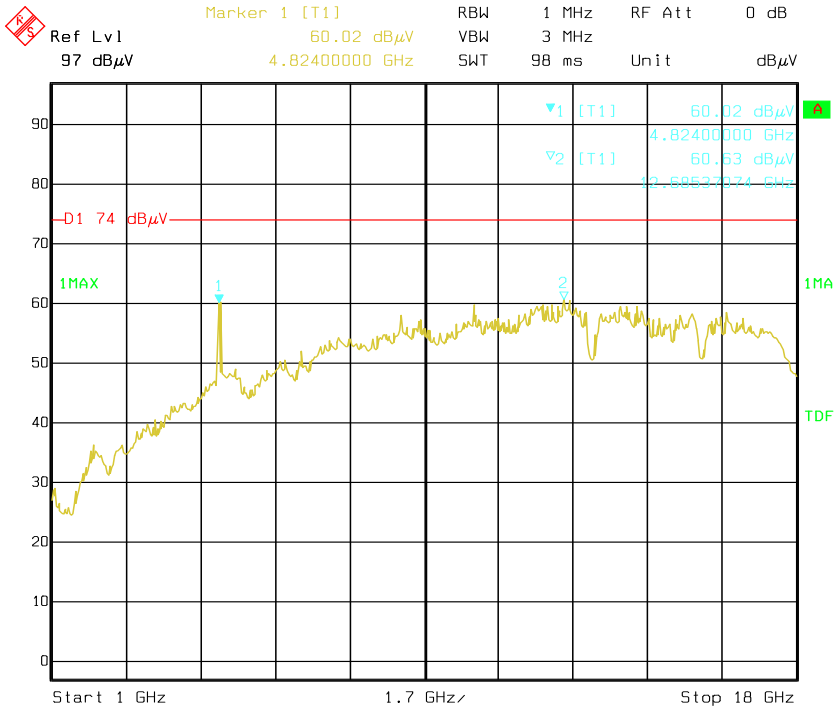
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2422 MHz)									
2387.92	27.85	PK	147	1.6	H	31.87	59.72	74	14.28
2387.92	13.69	Ave.	147	1.6	H	31.87	45.56	54	8.44
2483.59	27.43	PK	350	1.3	H	32.13	59.56	74	14.44
2483.59	13.57	Ave.	350	1.3	H	32.13	45.70	54	8.30
4844.00	45.51	PK	49	1.6	H	6.28	51.79	74	22.21
4844.00	38.51	Ave.	49	1.6	H	6.28	44.79	54	9.21
Middle Channel (2442 MHz)									
4884.00	44.96	PK	136	2.0	H	6.76	51.72	74	22.28
4884.00	35.94	Ave.	136	2.0	H	6.76	42.70	54	11.30
High Channel (2462 MHz)									
2388.78	27.88	PK	2	2.5	H	31.87	59.75	74	14.25
2388.78	13.84	Ave.	2	2.5	H	31.87	45.71	54	8.29
2485.22	27.98	PK	133	1.7	H	32.13	60.11	74	13.89
2485.22	13.51	Ave.	133	1.7	H	32.13	45.64	54	8.36
4924.00	44.32	PK	82	1.4	H	6.76	51.08	74	22.92
4924.00	35.64	Ave.	82	1.4	H	6.76	42.40	54	11.60

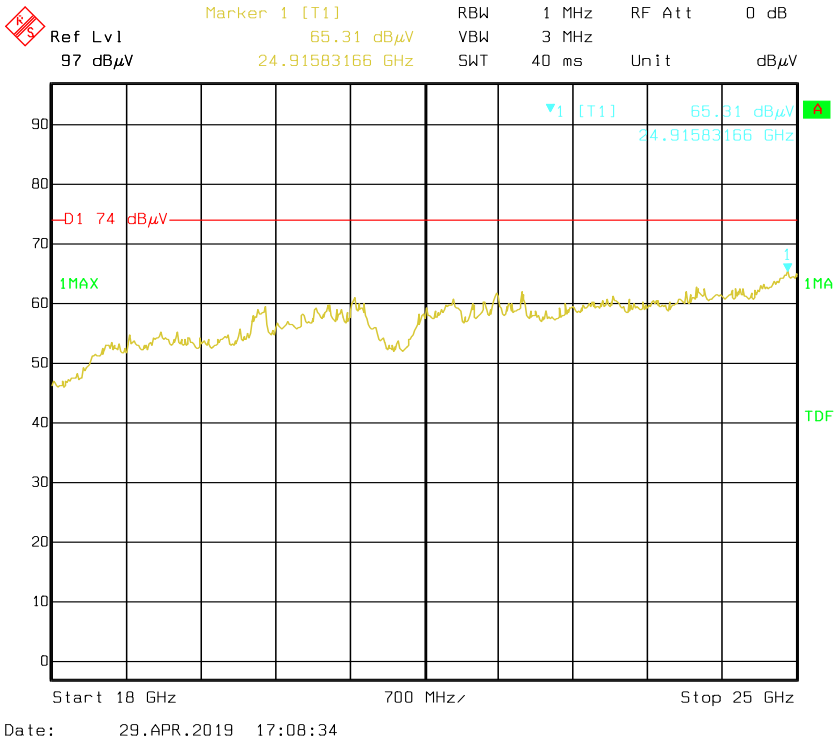
BLE mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2402 MHz)									
2388.16	28.98	PK	272	1.9	H	31.87	60.85	74	13.15
2388.16	13.33	Ave.	272	1.9	H	31.87	45.20	54	8.80
2483.53	28.81	PK	344	1.2	H	32.13	60.94	74	13.06
2483.53	13.20	Ave.	344	1.2	H	32.13	45.33	54	8.67
4804.00	43.10	PK	216	1.7	H	6.28	49.38	74	24.62
4804.00	30.79	Ave.	216	1.7	H	6.28	37.07	54	16.93
Middle Channel (2440 MHz)									
4880.00	43.58	PK	172	1.5	H	6.76	50.34	74	23.66
4880.00	30.57	Ave.	172	1.5	H	6.76	37.33	54	16.67
High Channel (2480 MHz)									
2379.41	26.21	PK	285	1.7	H	31.64	57.85	74	16.15
2379.41	13.47	Ave.	285	1.7	H	31.64	45.11	54	8.89
2483.98	25.74	PK	106	1.9	H	32.13	57.87	74	16.13
2483.98	13.42	Ave.	106	1.9	H	32.13	45.55	54	8.45
4960.00	42.53	PK	255	1.2	H	6.80	49.33	74	24.67
4960.00	30.52	Ave.	255	1.2	H	6.80	37.32	54	16.68

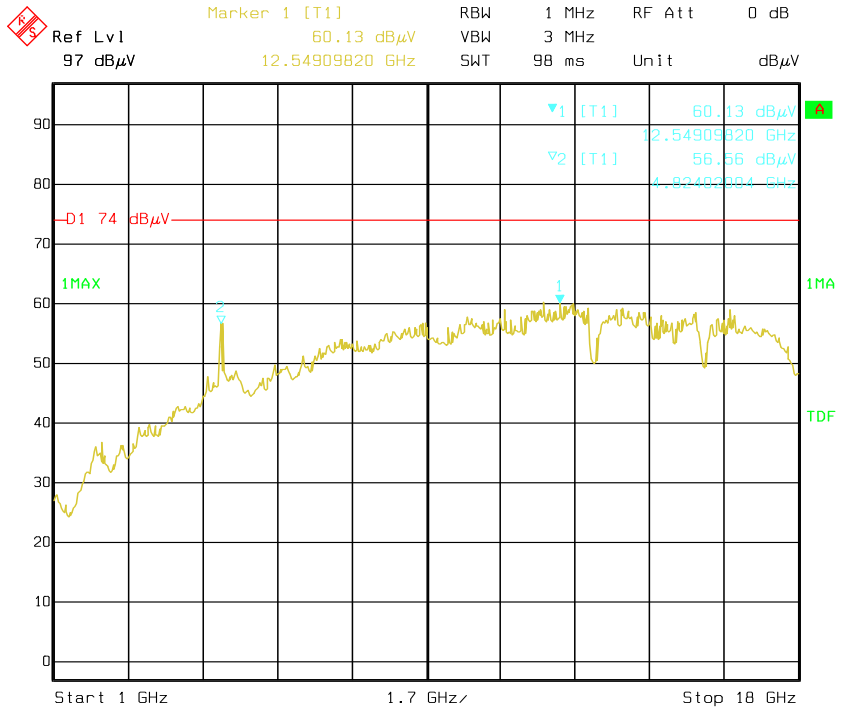
Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is 20dB to the limit was not recorded.
And for the pre-scan is performed with the 2400-2483.5MHz band filter.

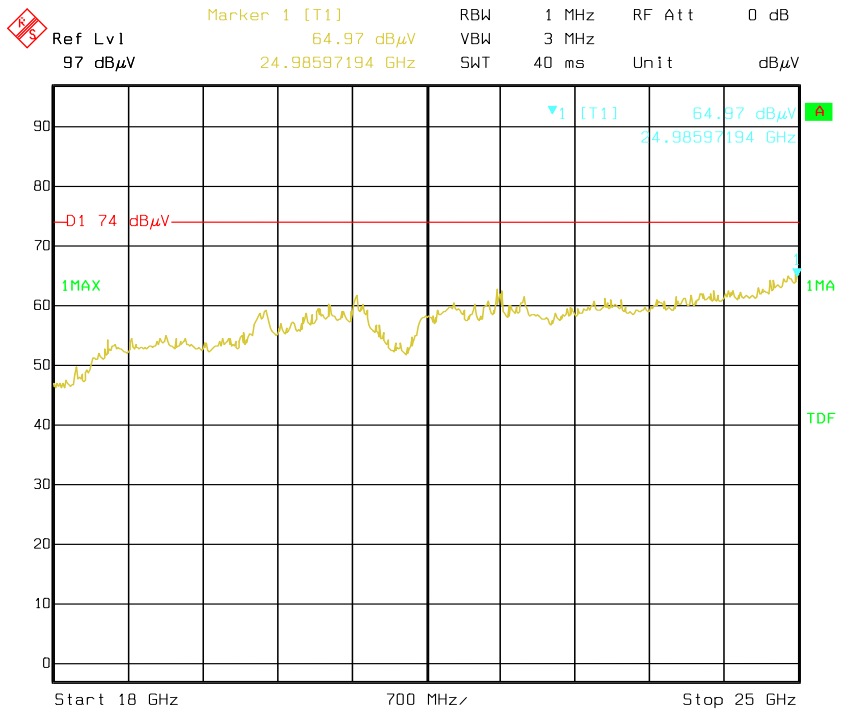
Pre-scan with 802.11b Mode, Low channel
Horizontal



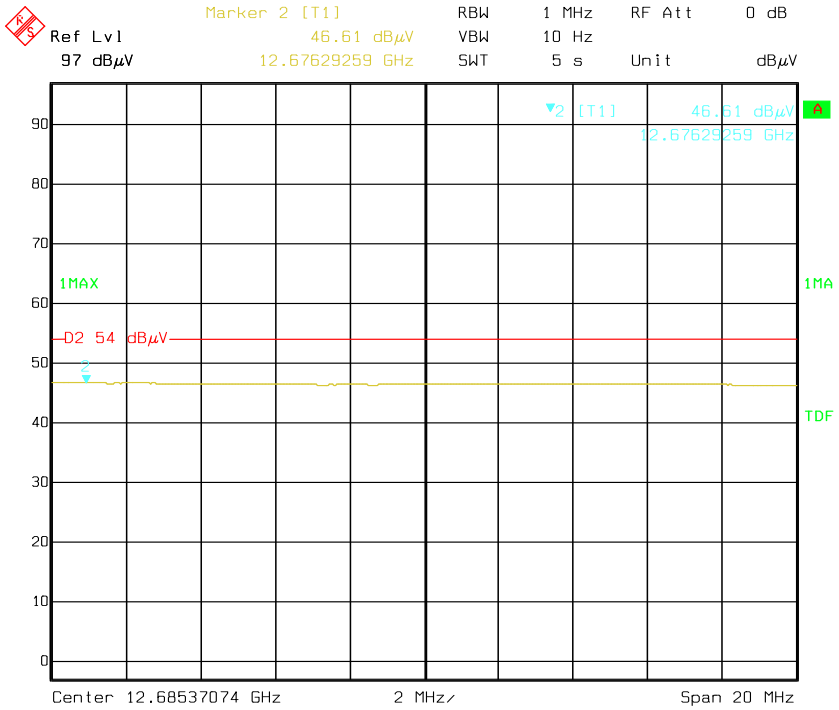


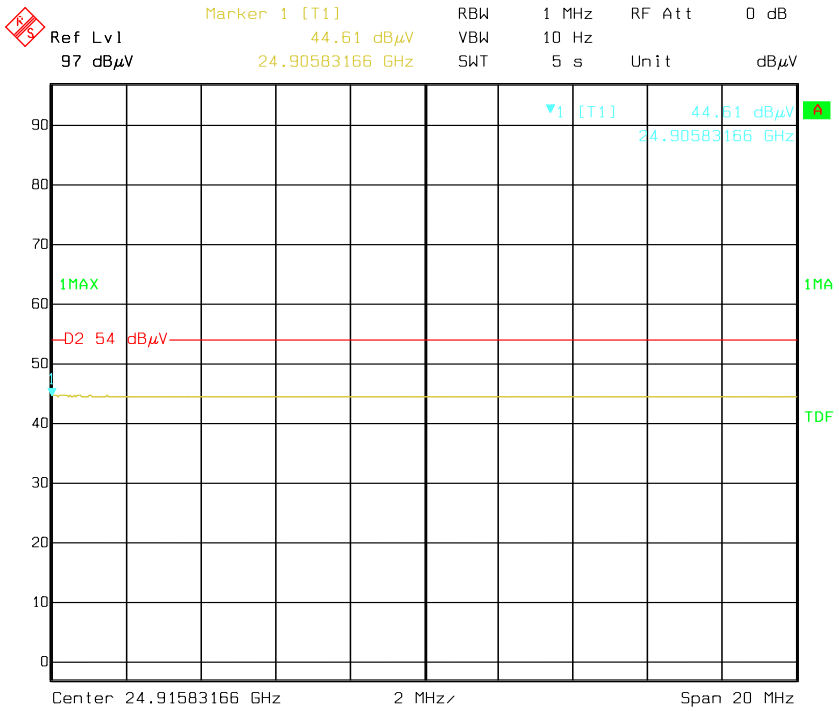
Vertical


Marker 1 [T1]
60.13 dBµV
12.54909820 GHz
RBW 1 MHz
VBW 3 MHz
SWT 98 ms
RF Att 0 dB
Unit dBµV
Ref Lvl
97 dBµV
▼1 [T1] 60.13 dBµV
12.54909820 GHz
▽2 [T1] 56.56 dBµV
D1 74 dBµV
1MAX
1MA
TDF
Start 1 GHz
1.7 GHz/
Stop 18 GHz
Date: 29.APR.2019 16:28:06

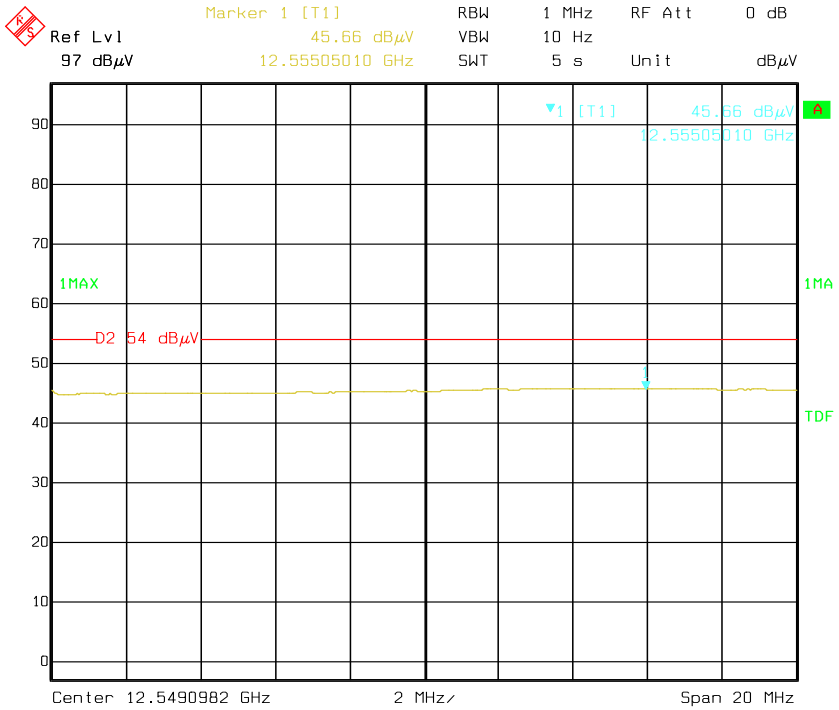

Marker 1 [T1]
64.97 dBµV
24.98597194 GHz
RBW 1 MHz
VBW 3 MHz
SWT 40 ms
RF Att 0 dB
Unit dBµV
Ref Lvl
97 dBµV
▼1 [T1] 64.97 dBµV
24.98597194 GHz
D1 74 dBµV
1MAX
1MA
TDF
Start 18 GHz
700 MHz/
Stop 25 GHz
Date: 29.APR.2019 17:03:40

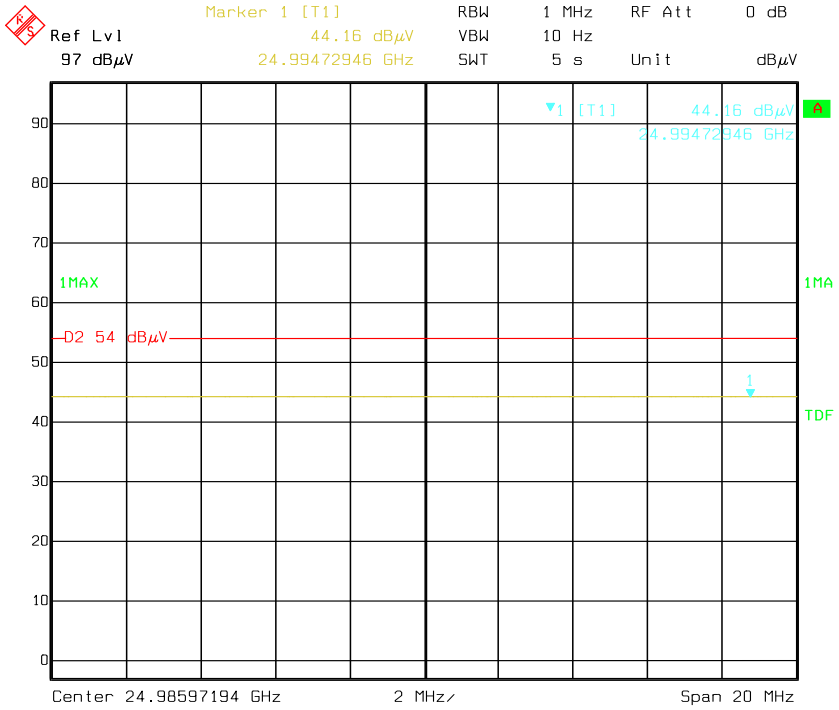
Pre-scan for Average
Horizontal





Vertical


Marker 1 [T1]
45.66 dBµV
12.55505010 GHz
RBW 1 MHz
VBW 10 Hz
SWT 5 s
RF Att 0 dB
Unit dBµV
Ref Lvl
97 dBµV
1 [T1] 45.66 dBµV
12.55505010 GHz
1MAX
1MA
D2 54 dBµV
TDF
Center 12.5490982 GHz
2 MHz/
Span 20 MHz
Date: 29.APR.2019 16:30:57


Marker 1 [T1]
44.16 dBµV
24.99472946 GHz
RBW 1 MHz
VBW 10 Hz
SWT 5 s
RF Att 0 dB
Unit dBµV
Ref Lvl
97 dBµV
1 [T1] 44.16 dBµV
24.99472946 GHz
1MAX
1MA
D2 54 dBµV
TDF
Center 24.98597194 GHz
2 MHz/
Span 20 MHz
Date: 29.APR.2019 17:06:06

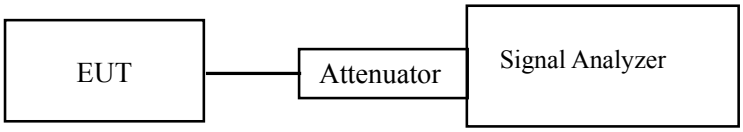
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.



Test Data

Environmental Conditions

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

The testing was performed by Kieron Luo on 2019-04-12 and by George Zhong 2019-05-09.

Test Result: Pass.

Please refer to the following table and plots.

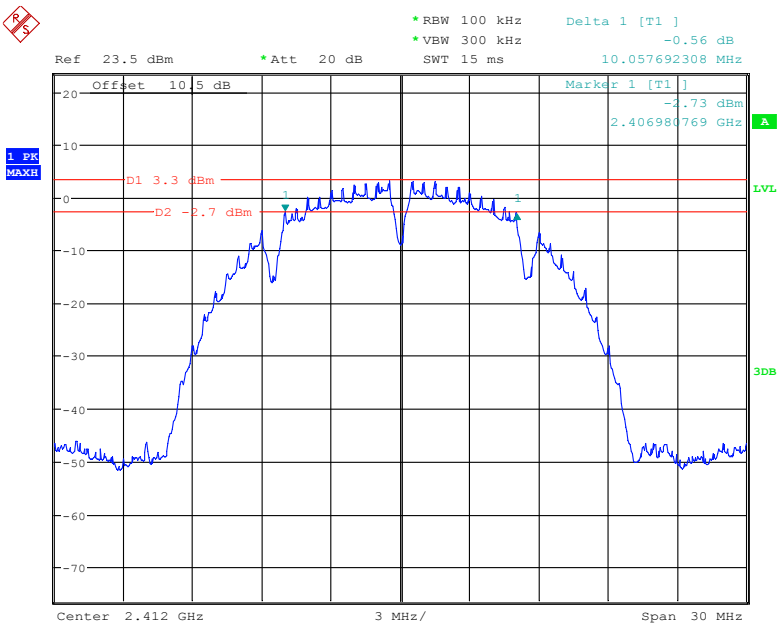
EUT operation mode: Transmitting

Antenna A at Wi-Fi mode:

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (kHz)
802.11b mode			
Low	2412	10.06	≥500
Middle	2442	10.06	≥500
High	2472	9.58	≥500
802.11g mode			
Low	2412	16.54	≥500
Middle	2442	16.56	≥500
High	2472	16.54	≥500
802.11n-HT20 mode			
Low	2412	17.66	≥500
Middle	2442	17.71	≥500
High	2472	17.66	≥500
802.11n-HT40 mode			
Low	2422	36.63	⩾500
Middle	2442	36.67	⩾500
High	2462	36.58	⩾500

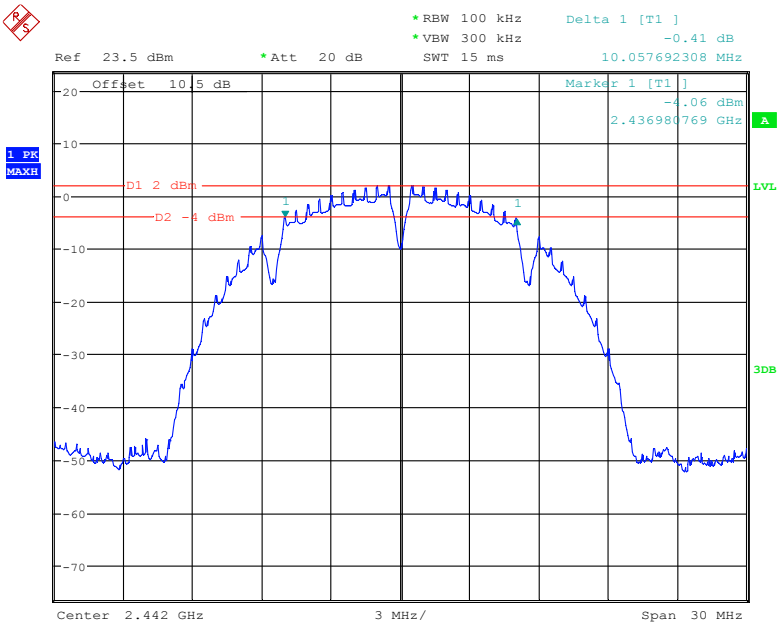
Channel	Frequency (MHz)	6 dB Emission Bandwidth(MHz)	Limit (kHz)
BLE mode			
Low	2402	0.505	≥500
Middle	2440	0.517	≥500
High	2480	0.519	≥500

802.11b Low Channel



Date: 9.MAY.2019 09:50:09

802.11b Middle Channel



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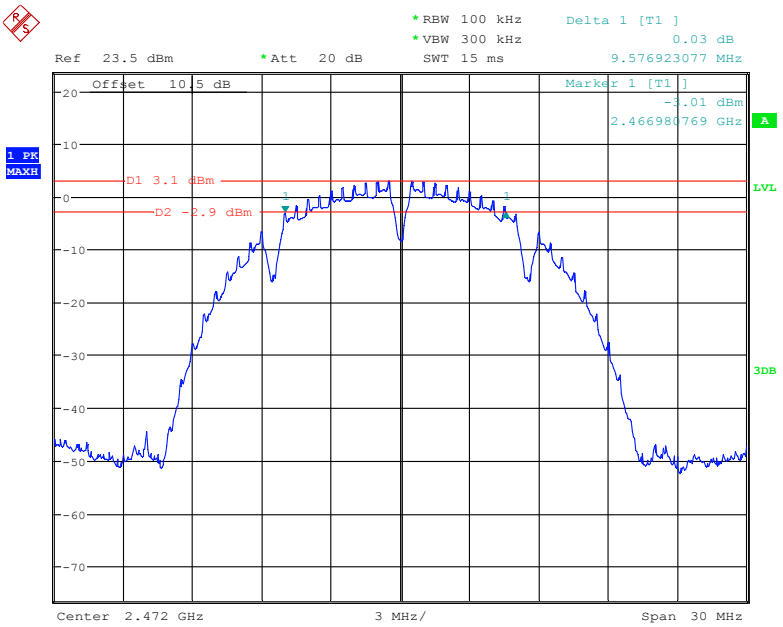
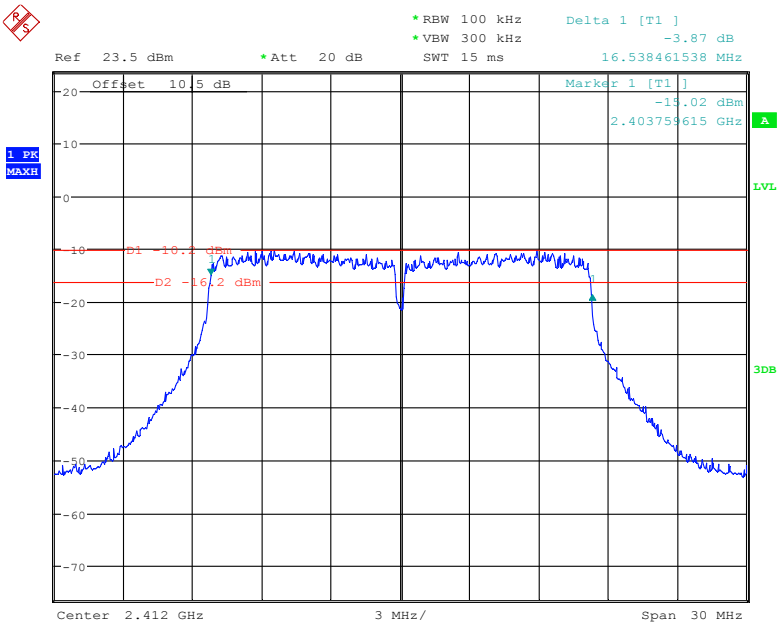
802.11b High Channel



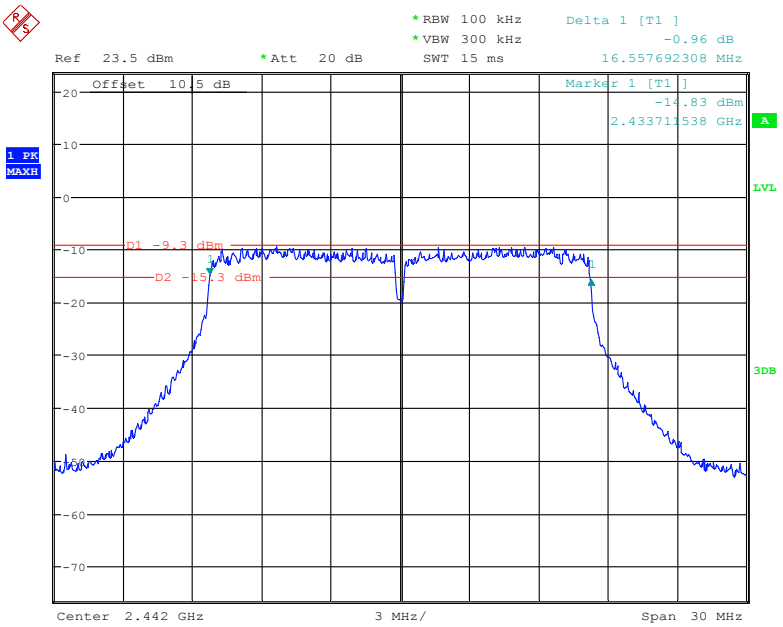
Date: 9.MAY.2019 09:53:45

802.11g Low Channel



Date: 9.MAY.2019 09:58:01

802.11g Middle Channel



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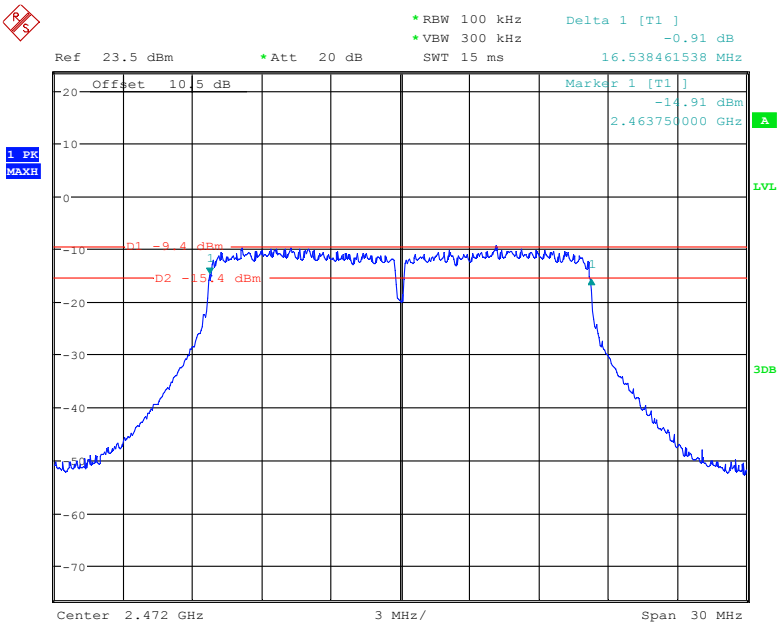
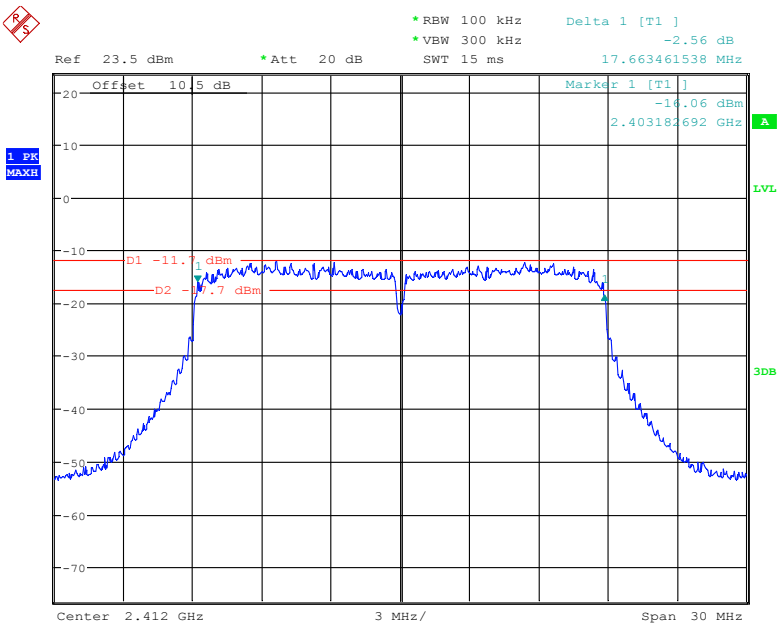
802.11g High Channel



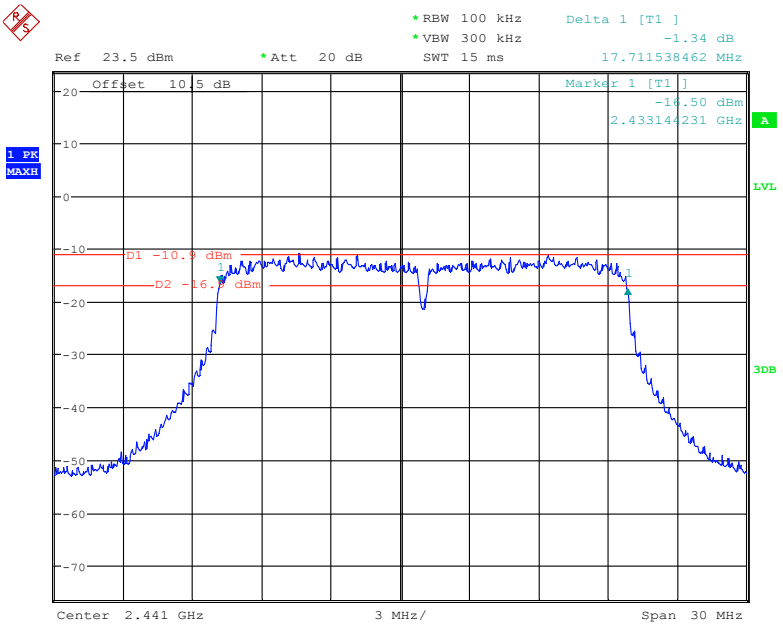
Date: 9.MAY.2019 09:55:23

802.11n-HT20 Low Channel



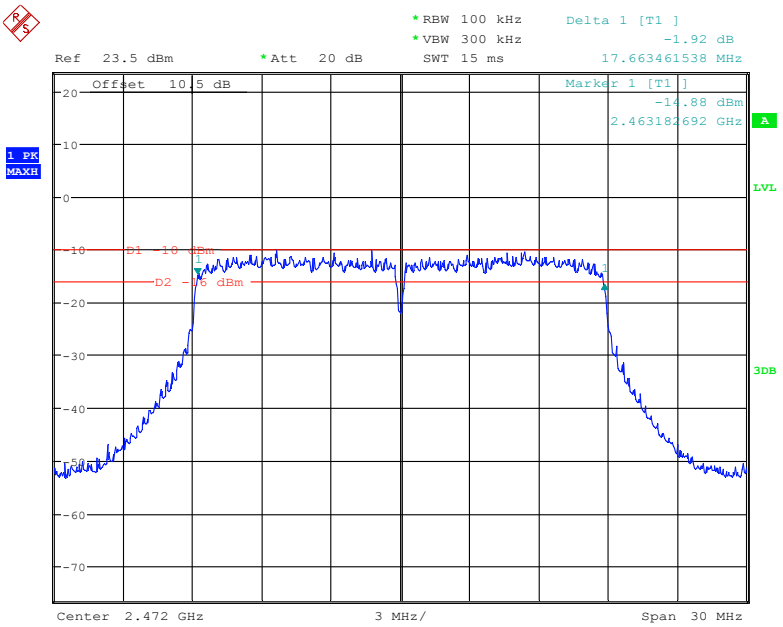
Date: 9.MAY.2019 09:59:05

802.11n-HT20 Middle Channel



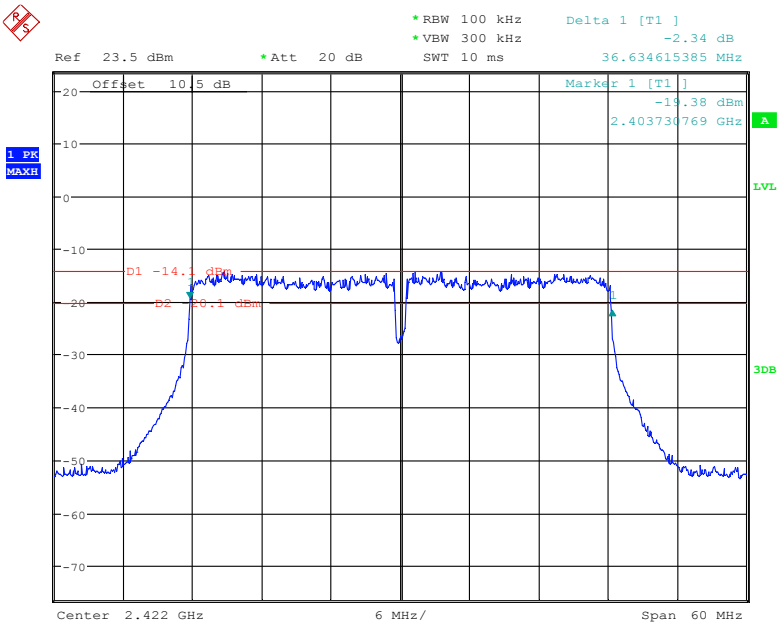
Date: 9.MAY.2019 10:00:22

802.11n-HT20 High Channel



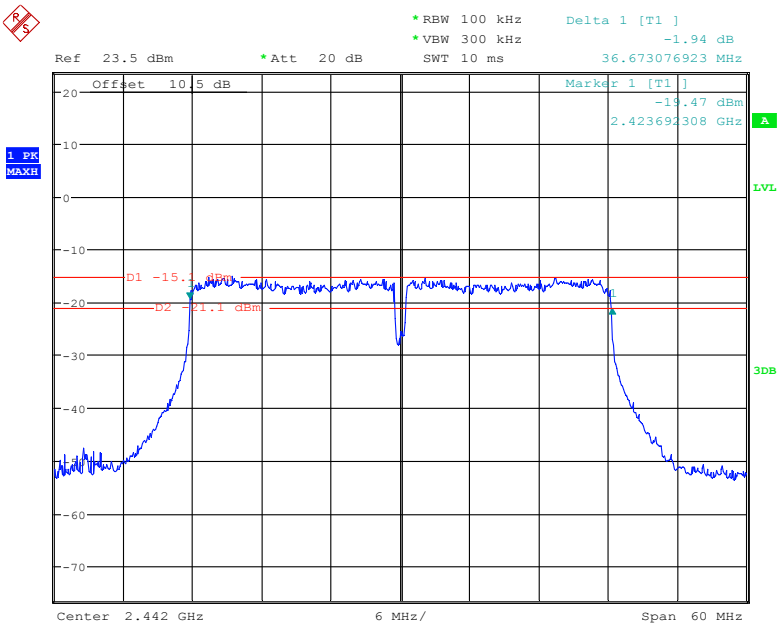
Date: 9.MAY.2019 10:01:35

802.11n-HT40 Low Channel



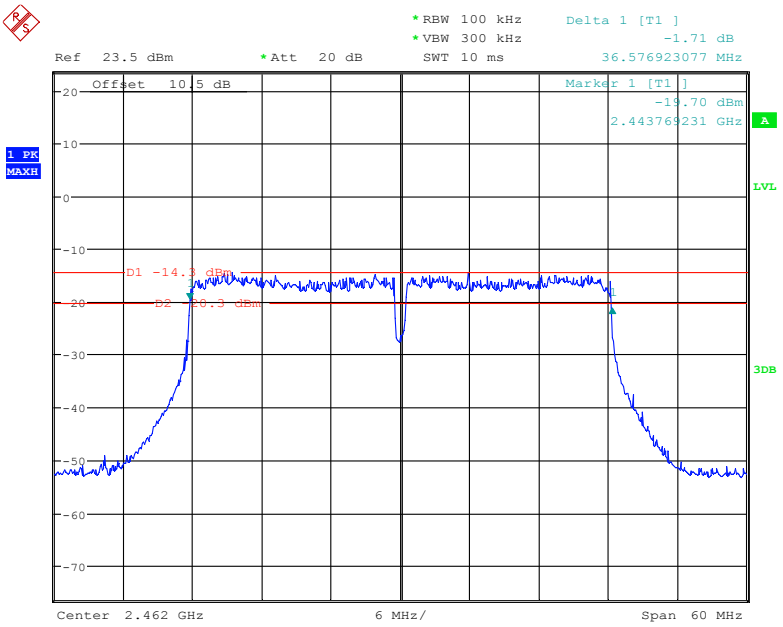
Date: 9.MAY.2019 10:05:18

802.11n-HT40 Middle Channel



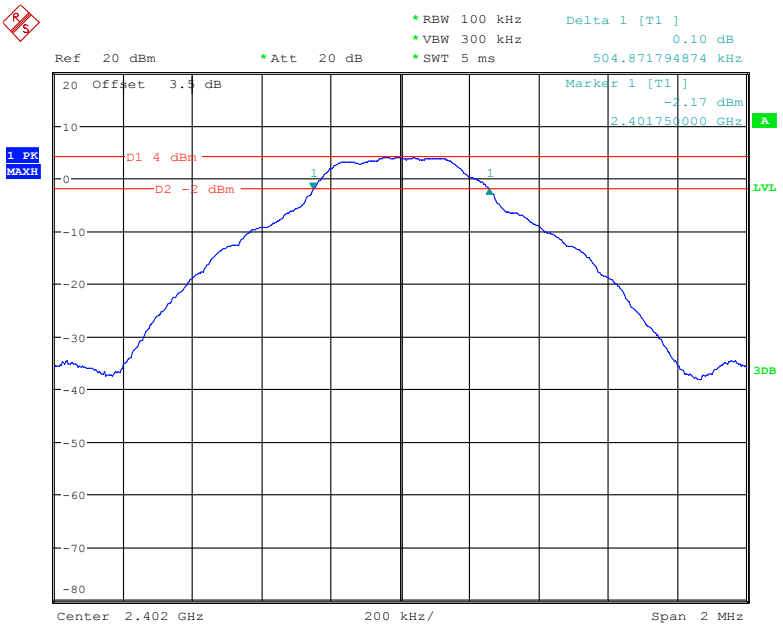
Date: 9.MAY.2019 10:04:06

802.11n-HT40 High Channel



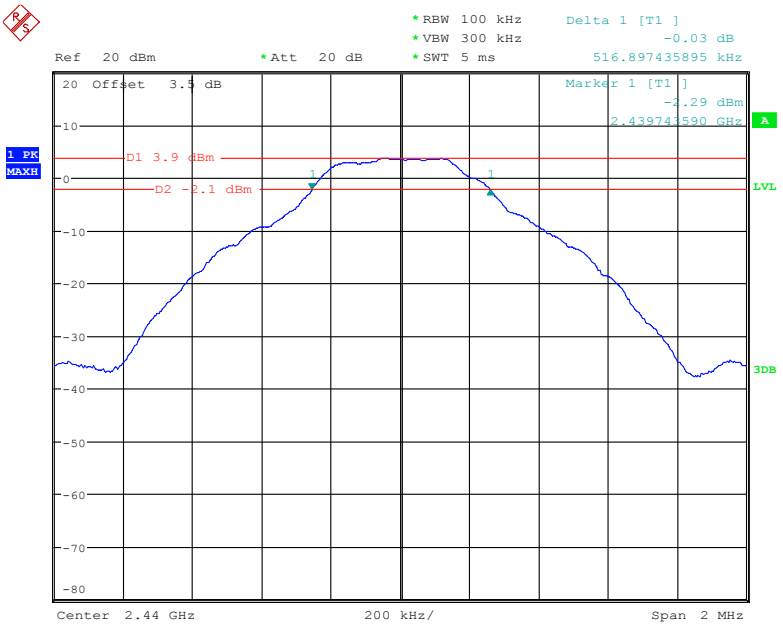
Date: 9.MAY.2019 10:02:51

BLE Low Channel



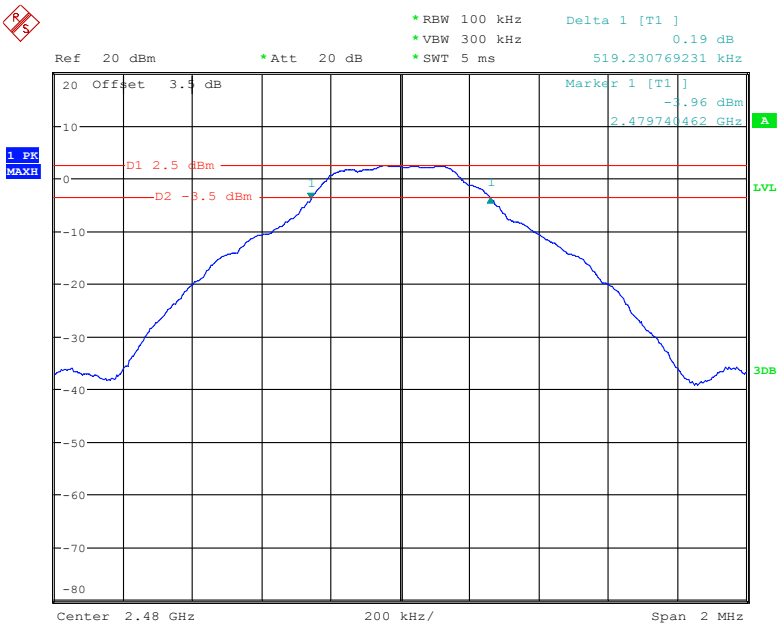
Date: 12.APR.2019 14:33:06

BLE Middle Channel



Date: 12.APR.2019 14:31:48

BLE High Channel



Date: 12.APR.2019 14:28:57

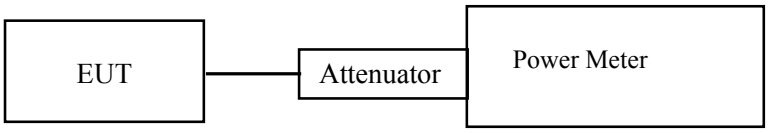
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



Test Data

Environmental Conditions

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

The testing was performed by Kieron Luo on 2019-04-12 and by George Zhong 2019-05-08.

EUT operation mode: Transmitting

Note:

The maximum antenna gain is 2dBi.
This Device Employed Cyclic Delay Diversity.
When determining reductions in conducted power limits, array gain is calculated as follows:
As to this device, $N_{ANT} \leqslant 2$, Array Gain = 0 dB.
Total directional gain (dBi) = gain of individual transmit antennas (dBi) + 0 (dB) =2dBi.

Wi-Fi mode

Frequency (MHz)	Antenna Port	Peak Conducted Output Power (dBm)	Total Power (dBm)	Conducted Output Power Limit (dBm)
802.11b				
2412	A	15.06	/	30
	B	15.95		
2442	A	14.75	/	30
	B	15.43		
2472	A	14.40	/	30
	B	15.19		
802.11g				
2412	A	13.29	/	30
	B	12.75		
2442	A	13.09	/	30
	B	13.13		
2472	A	12.88	/	30
	B	13.21		
802.11n HT20				
2412	A	10.19	13.54	30
	B	10.85		
2442	A	9.74	13.21	30
	B	10.62		
2472	A	9.49	13.19	30
	B	10.77		
802.11n HT40				
2422	A	9.80	12.98	30
	B	10.14		
2442	A	9.74	12.74	30
	B	9.71		
2462	A	9.81	12.97	30
	B	10.11		

BLE mode

Channel	Frequency (MHz)	Max Peak Output Power (dBm)	Limit (dBm)	Result
Low	2402	4.98	30	Pass
Middle	2440	4.50	30	Pass
High	2480	3.29	30	Pass

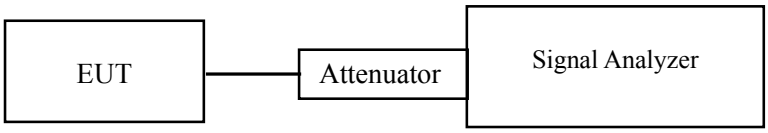
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

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

The testing was performed by Kieron Luo on 2019-04-12 and by George Zhong 2019-05-09.

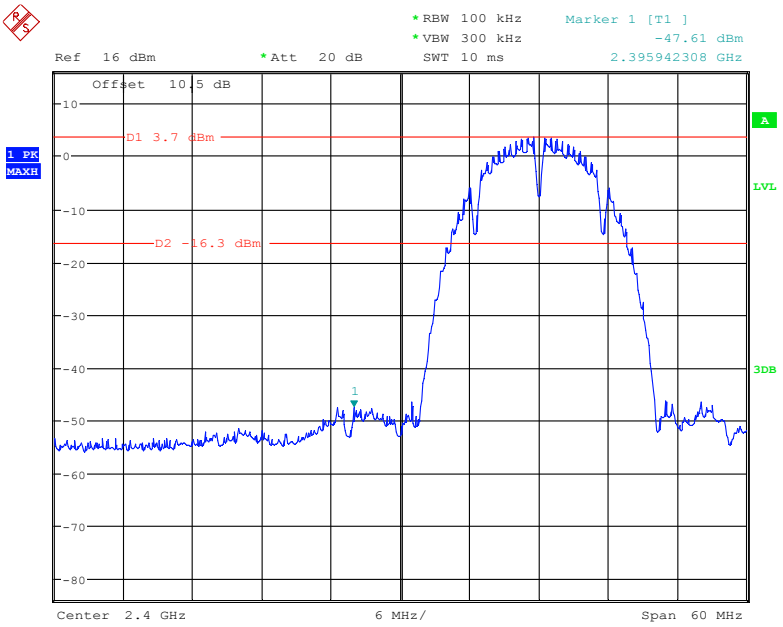
EUT operation mode: Transmitting

Test Result: Compliance

Please refer to the following plots.

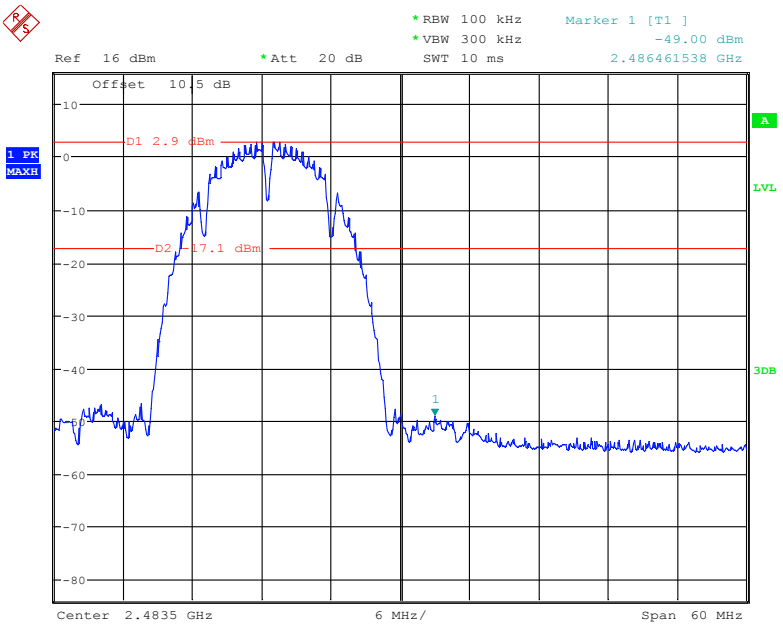
Antenna A at Wi-Fi mode:

802.11b: Band Edge, Left Side



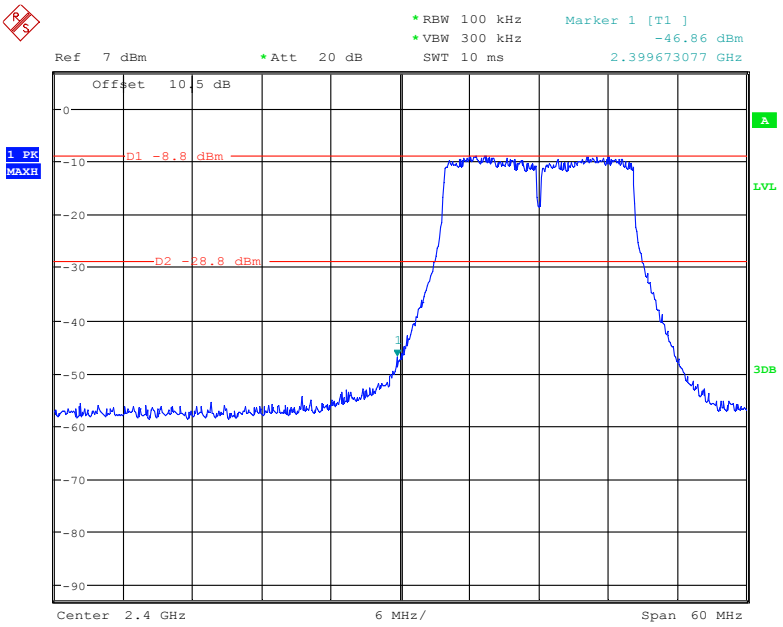
Date: 9.MAY.2019 10:31:20

802.11b: Band Edge, Right Side



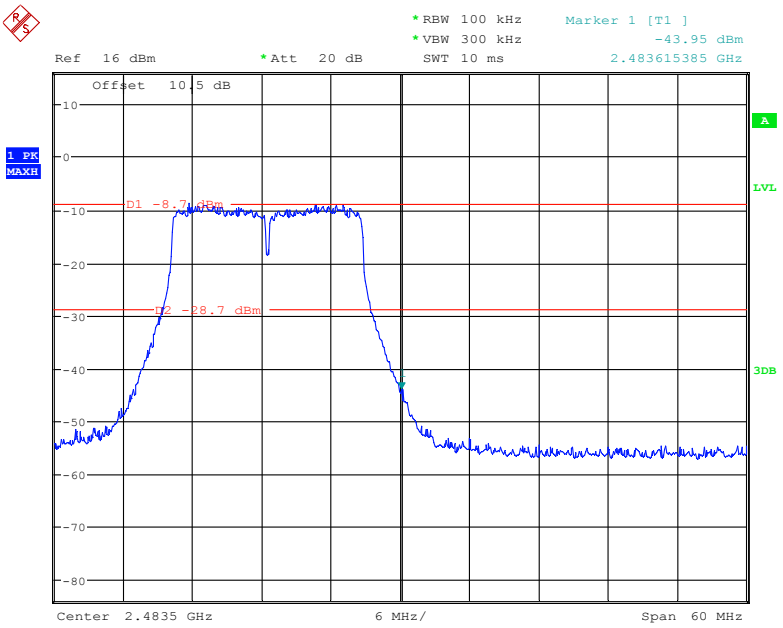
Date: 9.MAY.2019 10:29:14

802.11g: Band Edge, Left Side



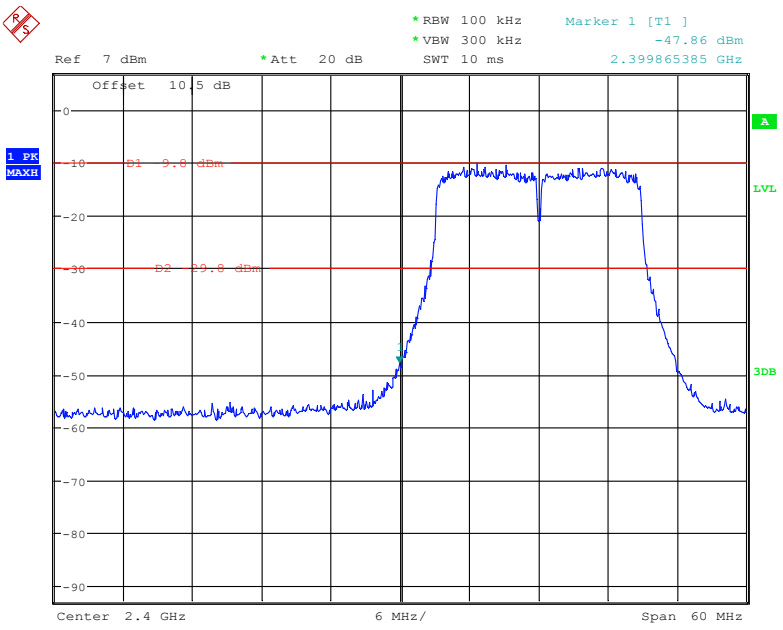
Date: 9.MAY.2019 10:26:35

802.11g: Band Edge, Right Side



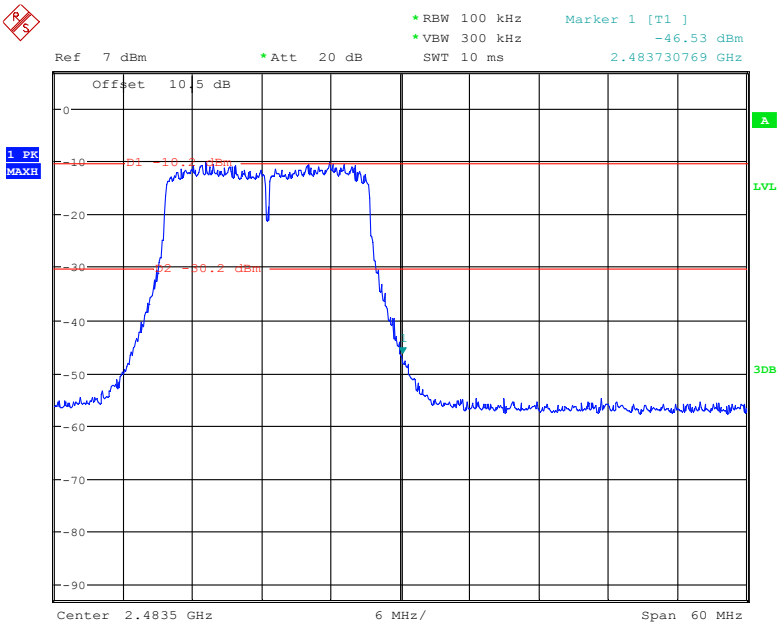
Date: 9.MAY.2019 10:30:11

802.11n-HT20: Band Edge, Left Side



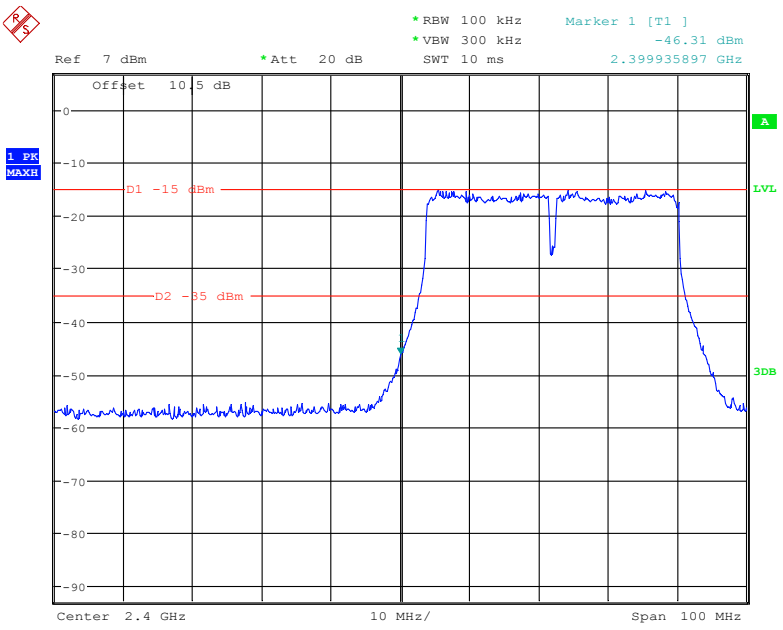
Date: 9.MAY.2019 10:25:43

802.11n-HT20: Band Edge, Right Side



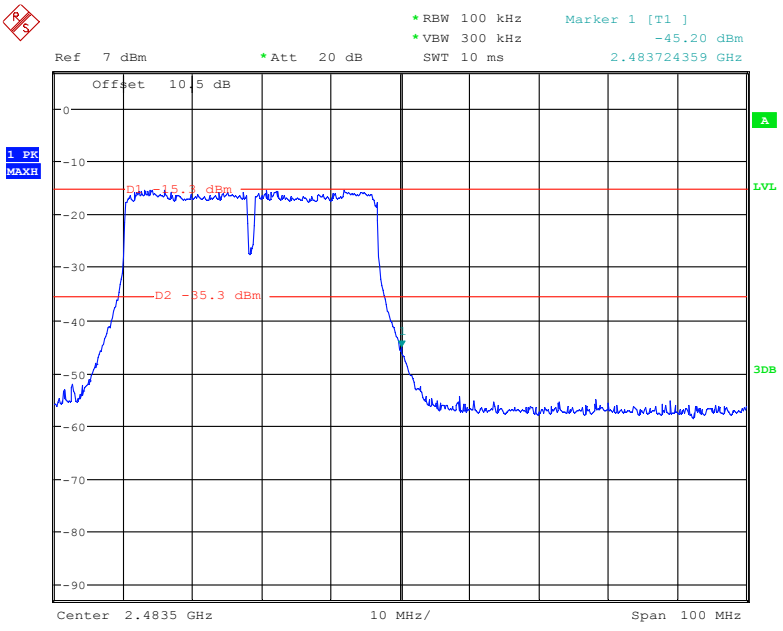
Date: 9.MAY.2019 10:24:02

802.11n-HT40: Band Edge, Left Side



Date: 9.MAY.2019 10:20:33

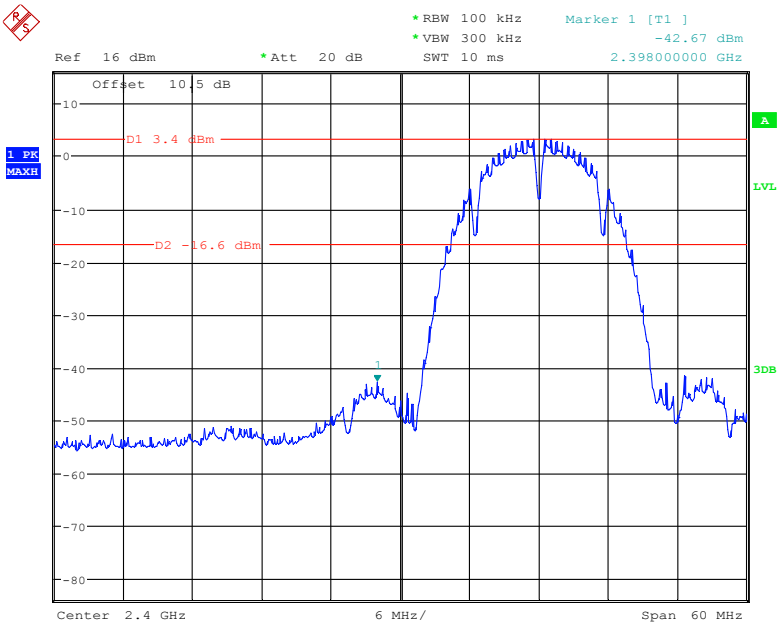
802.11n-HT40: Band Edge, Right Side



Date: 9.MAY.2019 10:22:18

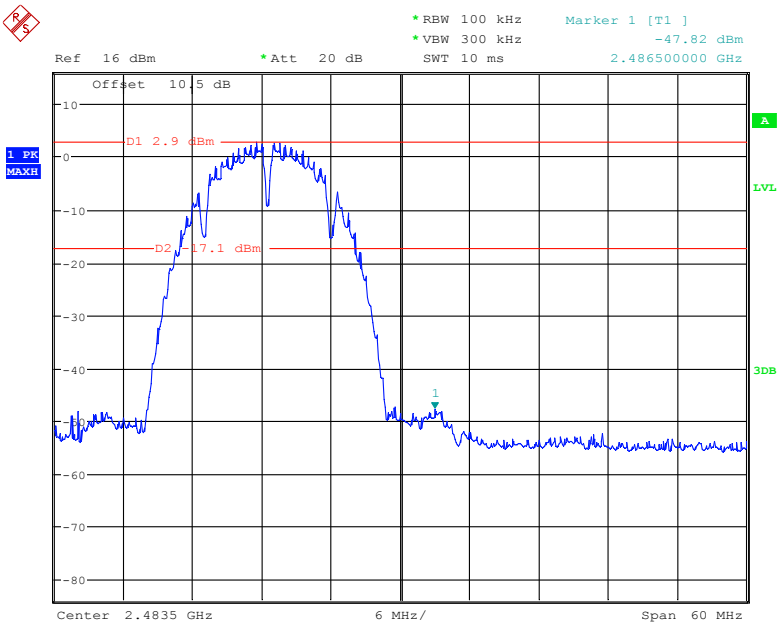
Antenna B at Wi-Fi mode:

802.11b: Band Edge, Left Side



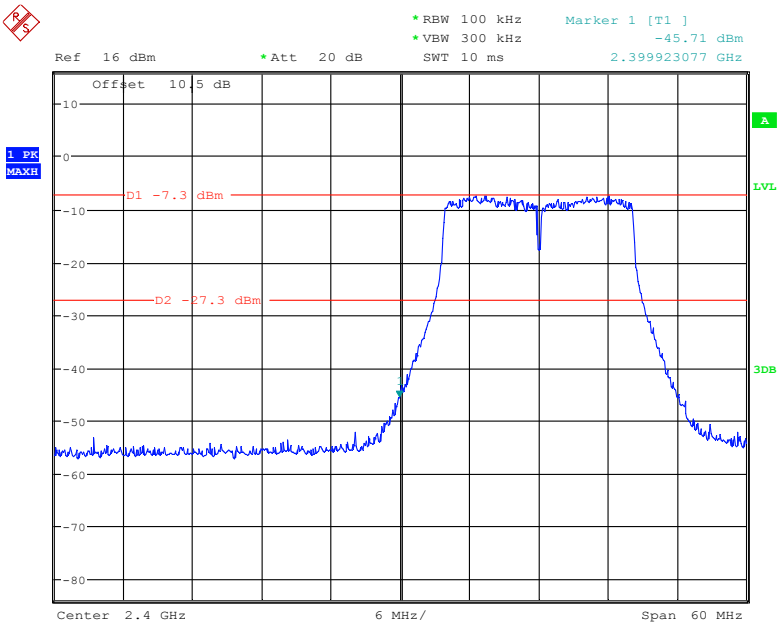
Date: 9.MAY.2019 10:33:13

802.11b: Band Edge, Right Side



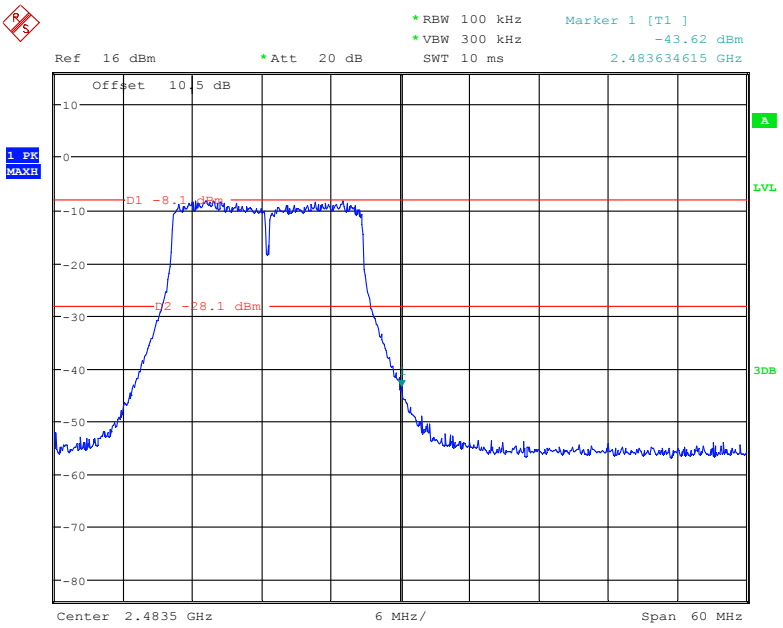
Date: 9.MAY.2019 10:35:05

802.11g: Band Edge, Left Side



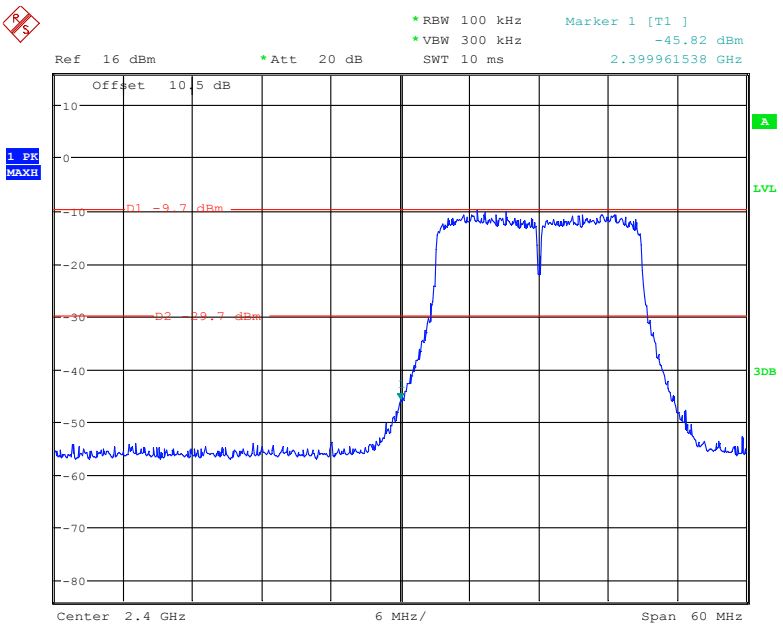
Date: 9.MAY.2019 10:37:02

802.11g: Band Edge, Right Side



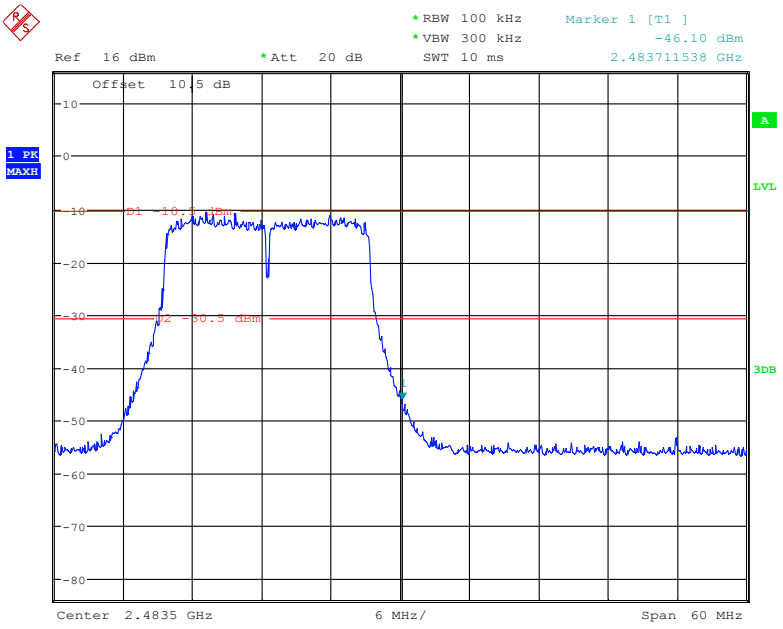
Date: 9.MAY.2019 10:36:05

802.11n-HT20: Band Edge, Left Side



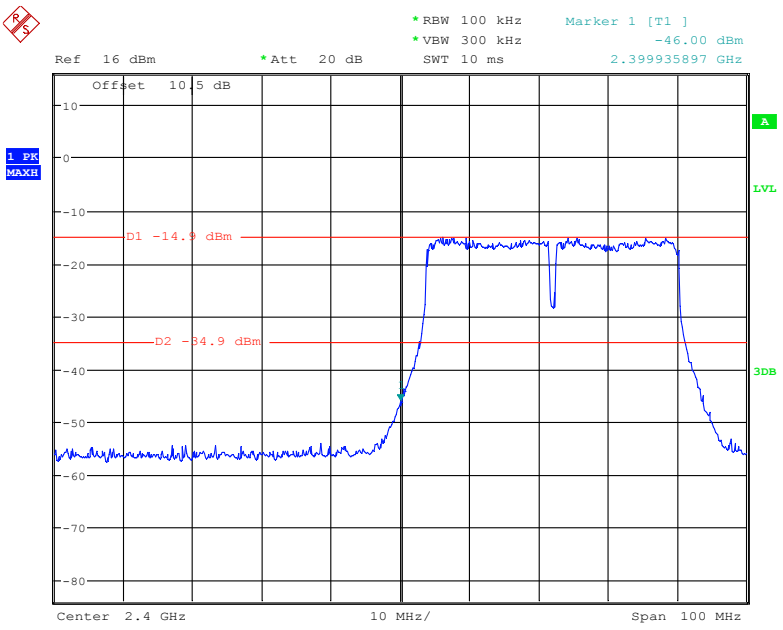
Date: 9.MAY.2019 10:38:41

802.11n-HT20: Band Edge, Right Side



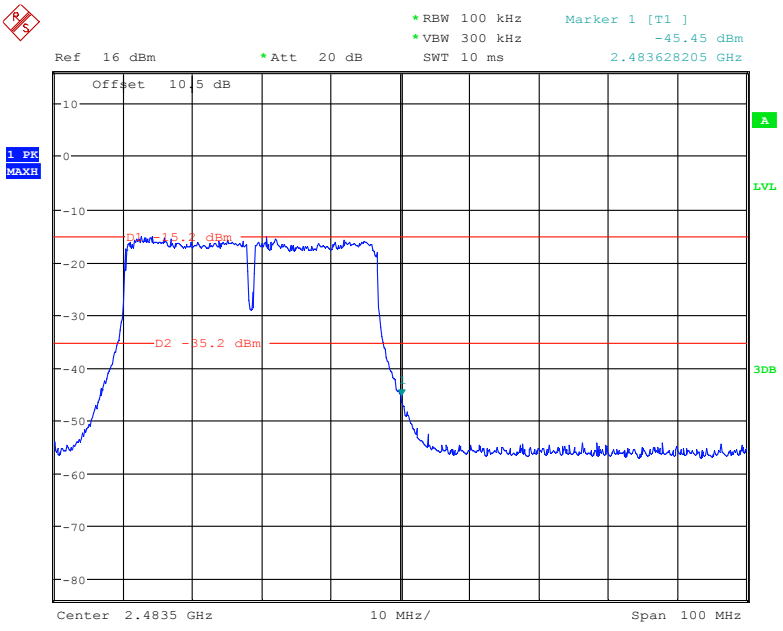
Date: 9.MAY.2019 10:40:16

802.11n-HT40: Band Edge, Left Side



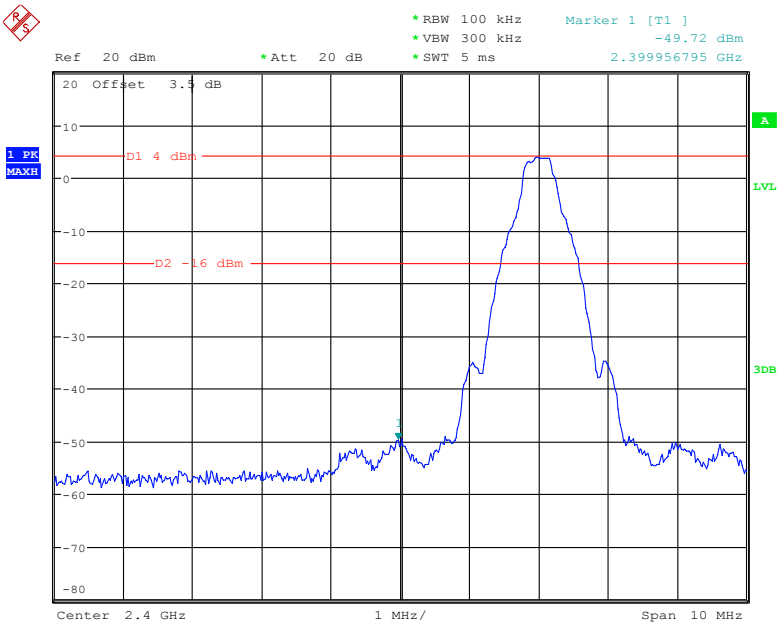
Date: 9.MAY.2019 10:42:16

802.11n-HT40: Band Edge, Right Side



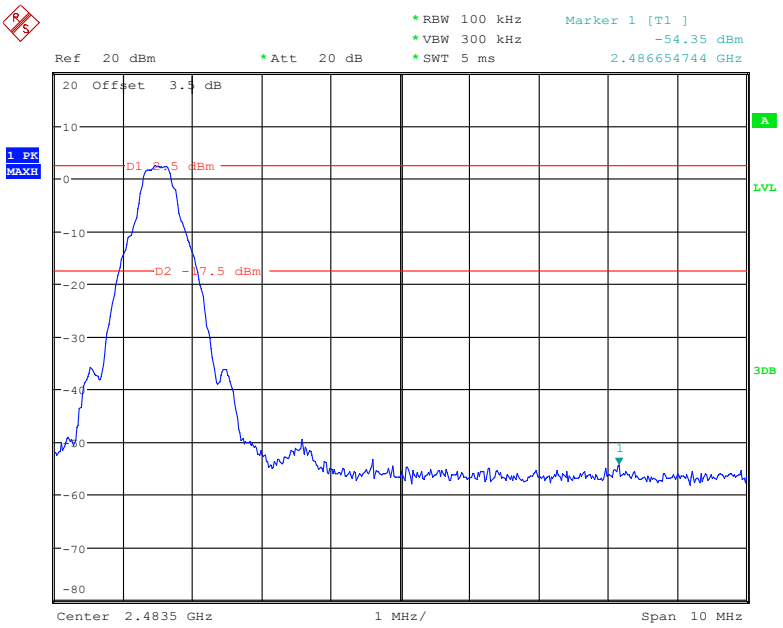
Date: 9.MAY.2019 10:41:22

BLE: Band Edge, Left Side



Date: 12.APR.2019 14:34:30

BLE: Band Edge, Right Side



Date: 12.APR.2019 14:36:26

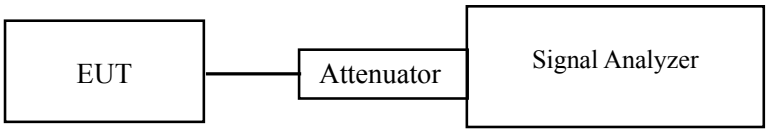
FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to: 3kHz≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 1.5 times the DTS bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



Test Data

Environmental Conditions

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

The testing was performed by Kieron Luo on 2019-04-12 and by George Zhong 2019-05-09.

EUT operation mode: Transmitting

Test Result: Pass

Note:

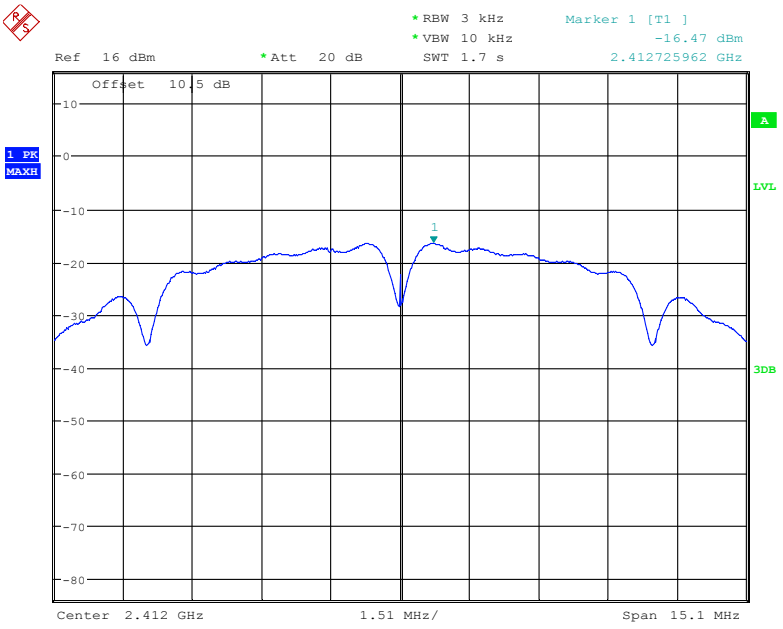
The maximum antenna gain is 2dBi.
This Device Employed Cyclic Delay Diversity.
When determining reductions in power spectral density limits, array gain is calculated as follows:
Array gain = 10 log (N_{ANT}/N_{ss}), where N_{ANT} is the number of transmit antennas is 2,
and N_{ss} = the number of independent spatial streams of data=1.
Total directional gain (dBi) = gain of individual transmit antennas (dBi) +10*log(2/1) =5dBi.

Frequency (MHz)	Antenna Port	PSD (dBm/3kHz)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b				
2412	A	-16.47	/	≤8
	B	-16.49		
2442	A	-16.72	/	≤8
	B	-16.57		
2472	A	-16.94	/	≤8
	B	-17.24		
802.11g				
2412	A	-22.10	/	≤8
	B	-21.17		
2442	A	-22.83	/	≤8
	B	-21.93		
2472	A	-23.05	/	≤8
	B	-22.46		
802.11n HT20				
2412	A	-24.52	-20.82	≤8
	B	-23.23		
2442	A	-23.11	-20.21	≤8
	B	-23.33		
2472	A	-24.11	-21.64	≤8
	B	-25.27		
802.11n HT40				
2422	A	-28.02	-25.39	≤8
	B	-28.81		
2442	A	-27.47	-24.46	≤8
	B	-27.48		
2462	A	-28.31	-25.31	≤8
	B	-28.33		

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
BLE mode			
Low	2402	-5.41	≤8
Middle	2440	-5.49	≤8
High	2480	-6.86	≤8

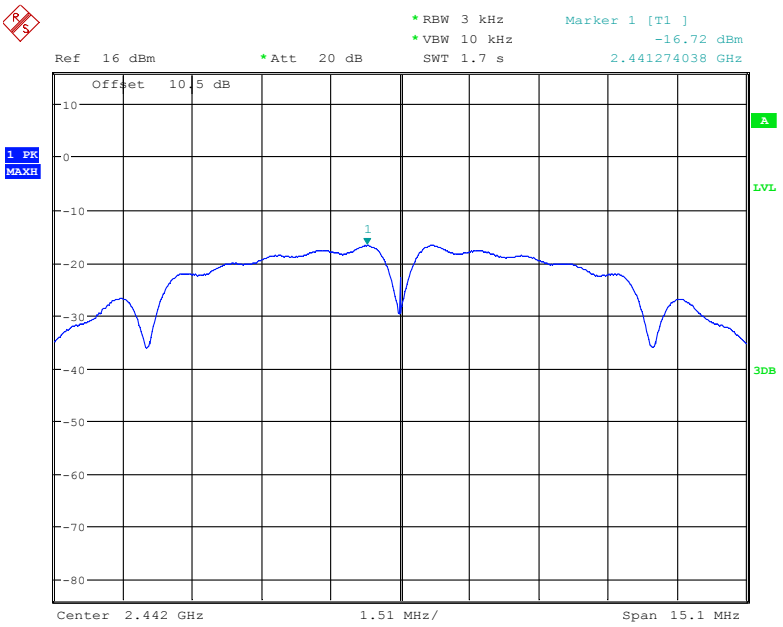
Antenna A at Wi-Fi mode:

Power Spectral Density, 802.11b Low Channel



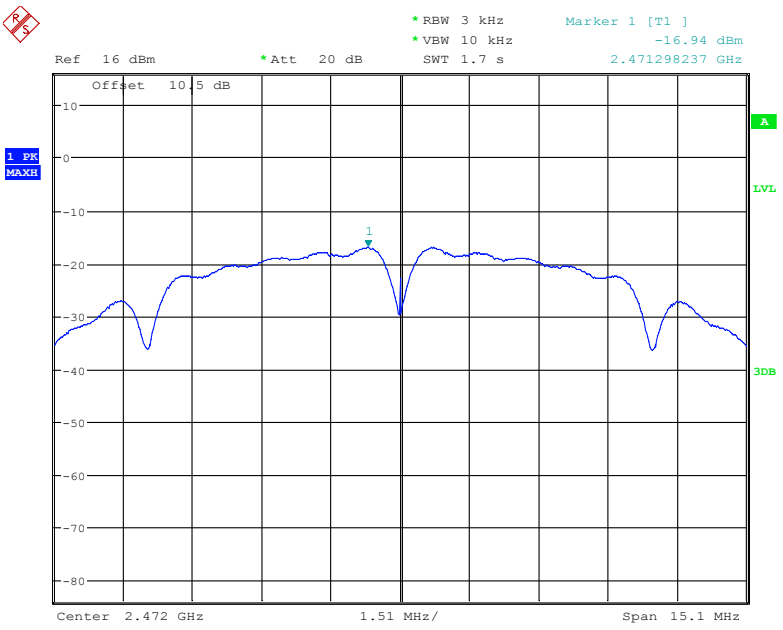
Date: 9.MAY.2019 11:01:18

Power Spectral Density, 802.11b Middle Channel



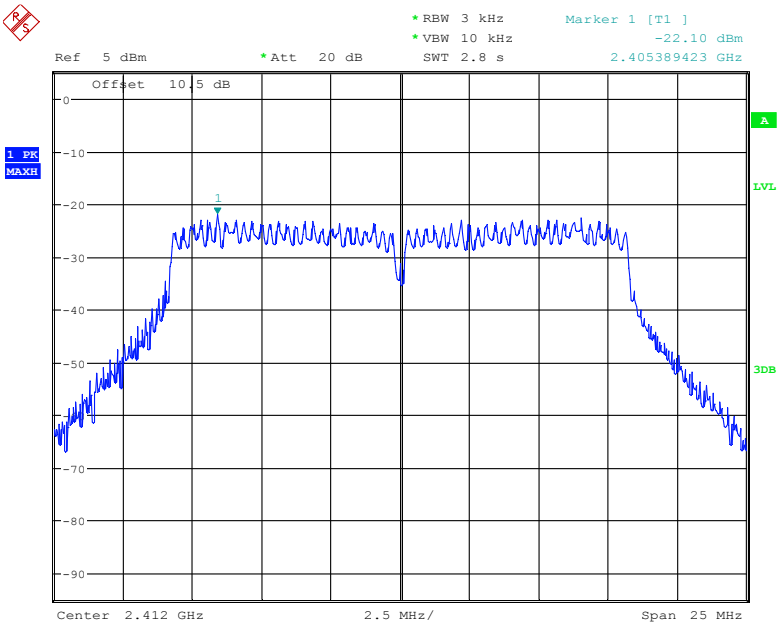
Date: 9.MAY.2019 11:00:50

Power Spectral Density, 802.11b High Channel



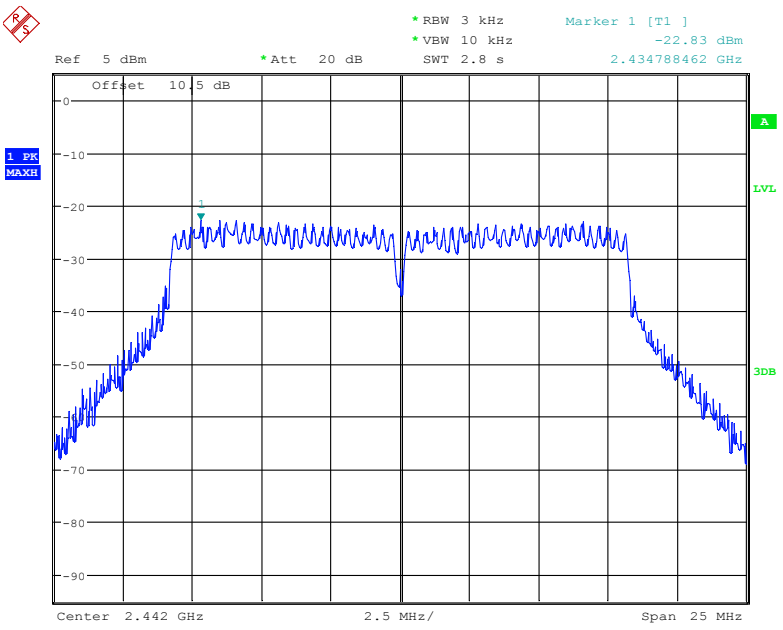
Date: 9.MAY.2019 11:00:06

Power Spectral Density, 802.11g Low Channel



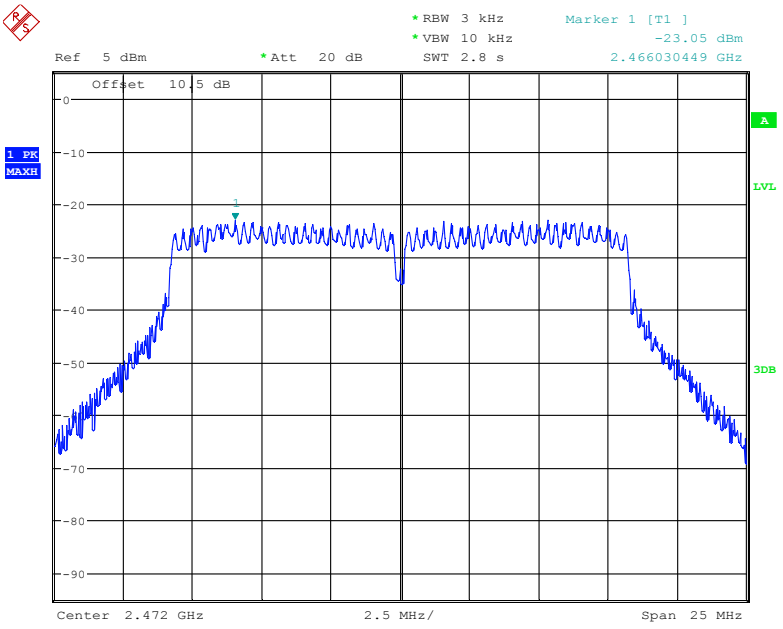
Date: 9.MAY.2019 11:04:16

Power Spectral Density, 802.11g Middle Channel



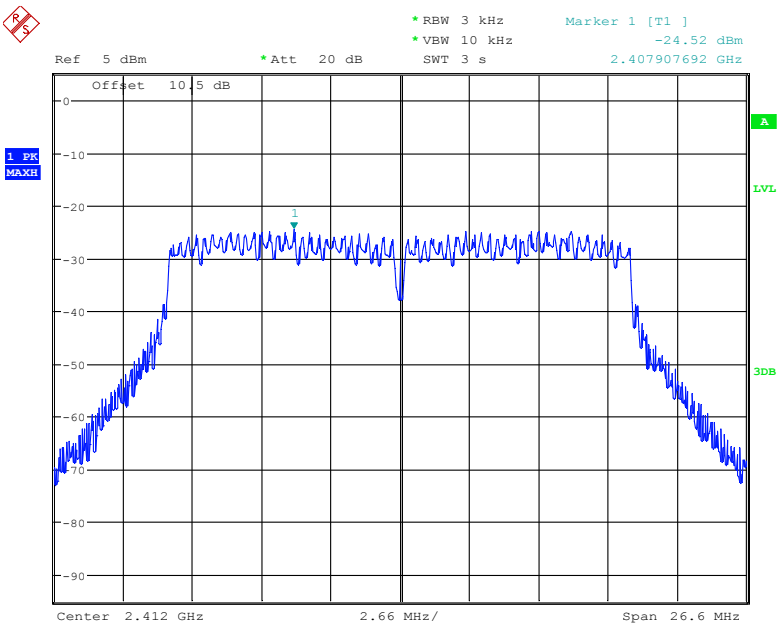
Date: 9.MAY.2019 11:04:39

Power Spectral Density, 802.11g High Channel



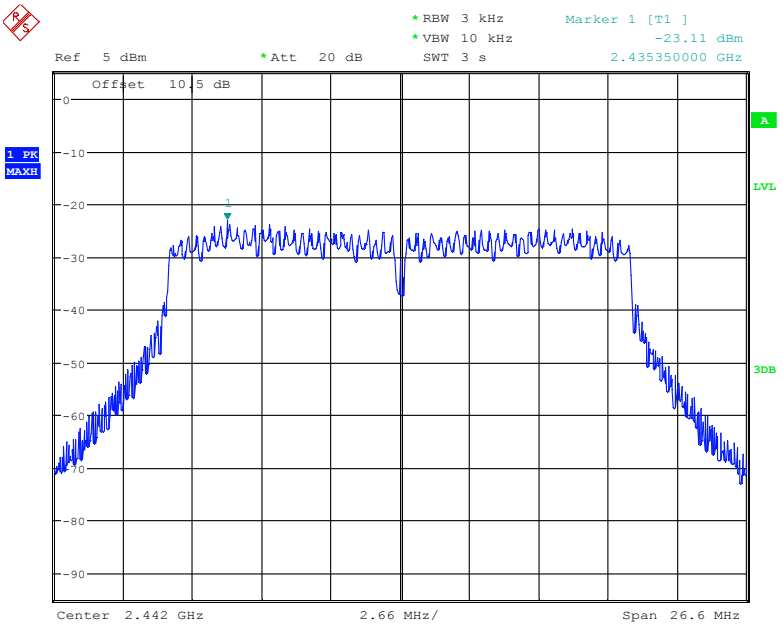
Date: 9.MAY.2019 11:05:04

Power Spectral Density, 802.11n-HT20 Low Channel



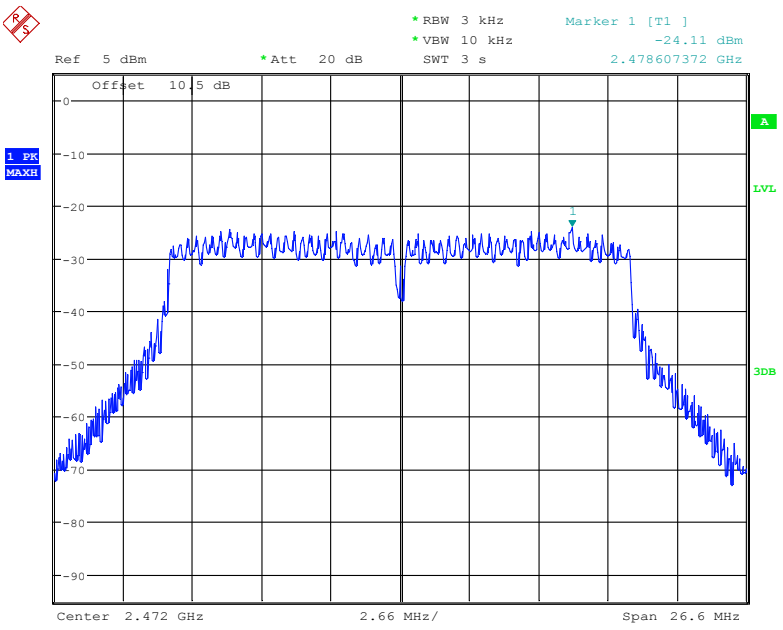
Date: 9.MAY.2019 11:06:40

Power Spectral Density, 802.11n-HT20 Middle Channel



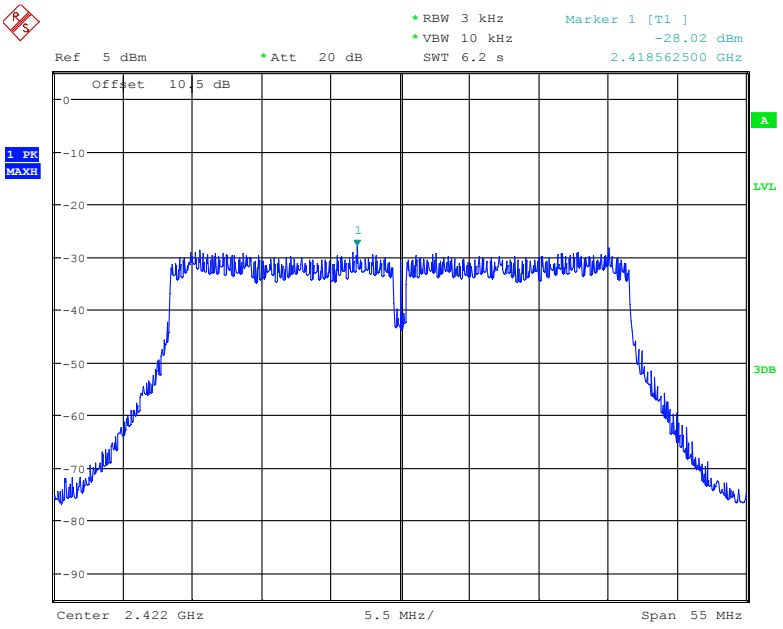
Date: 9.MAY.2019 11:06:04

Power Spectral Density, 802.11n-HT20 High Channel



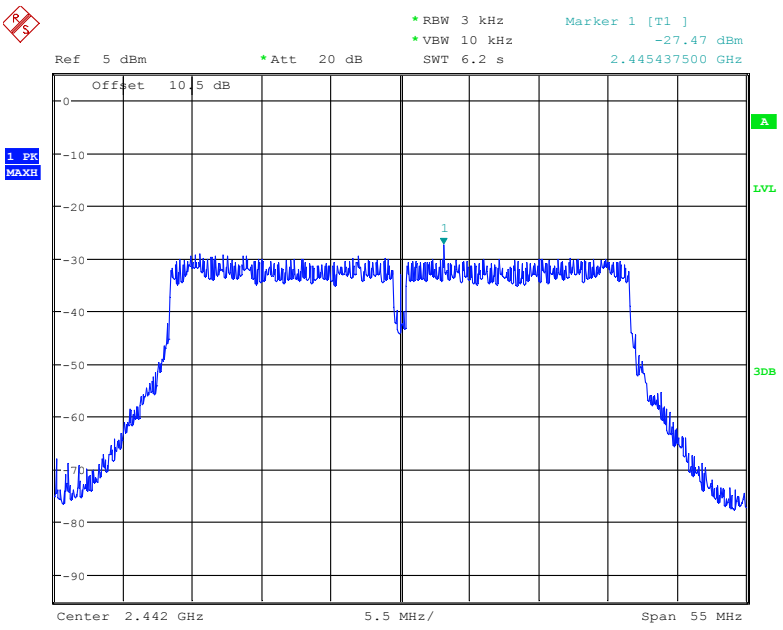
Date: 9.MAY.2019 11:05:34

Power Spectral Density, 802.11n-HT40 Low Channel



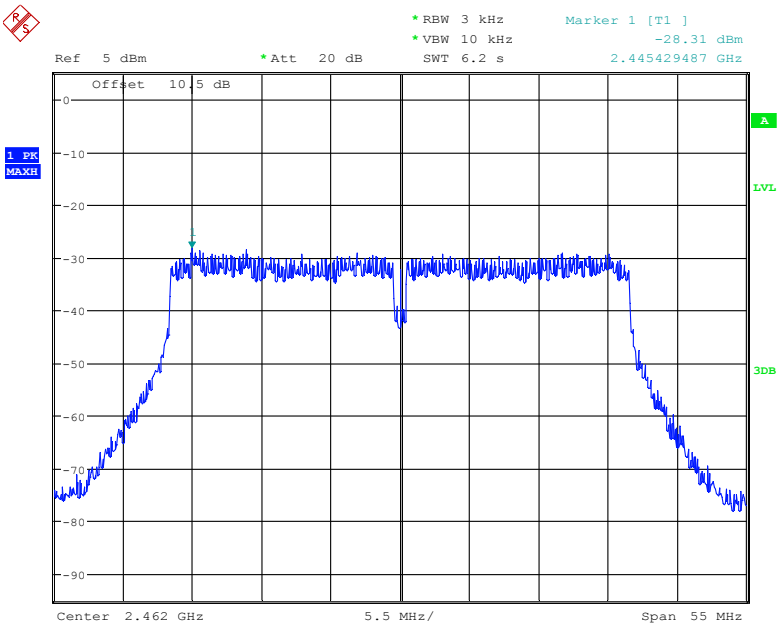
Date: 9.MAY.2019 11:13:33

Power Spectral Density, 802.11n-HT40 Middle Channel



Date: 9.MAY.2019 11:14:30

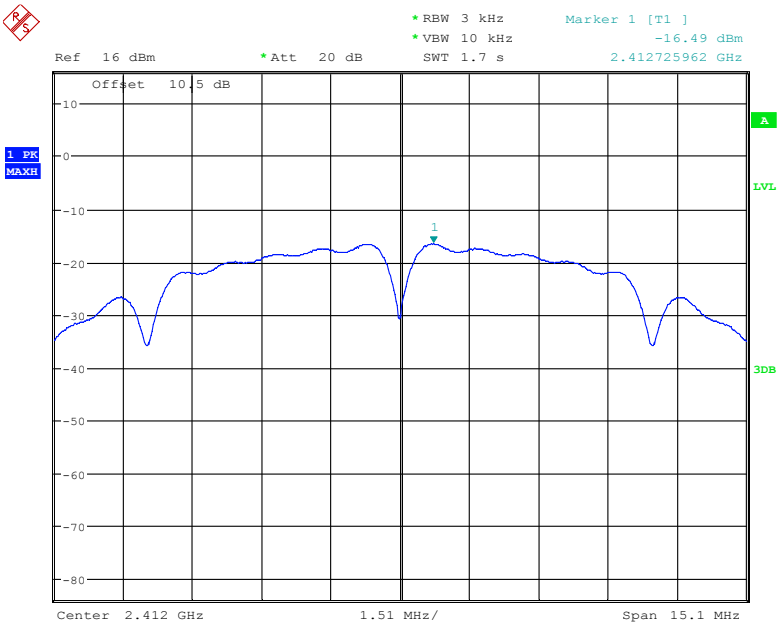
Power Spectral Density, 802.11n-HT40 High Channel



Date: 9.MAY.2019 11:15:01

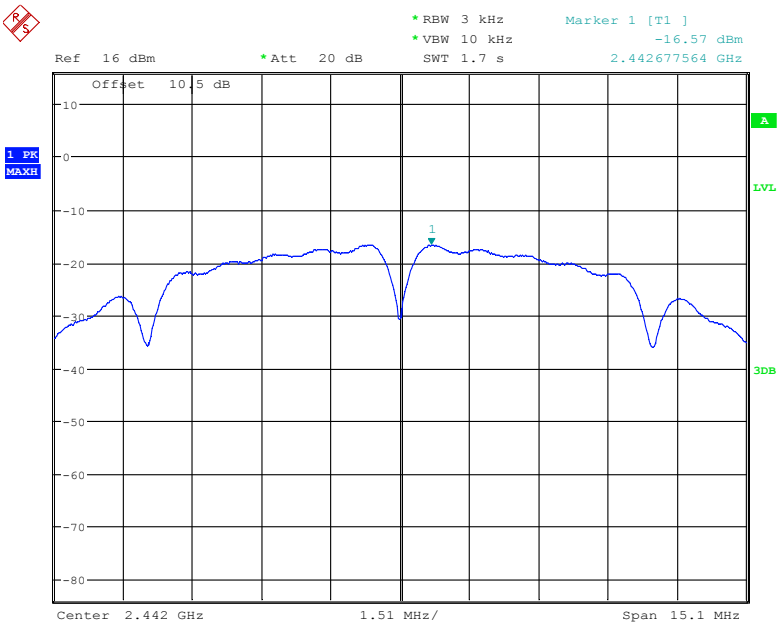
Antenna B at Wi-Fi mode:

Power Spectral Density, 802.11b Low Channel



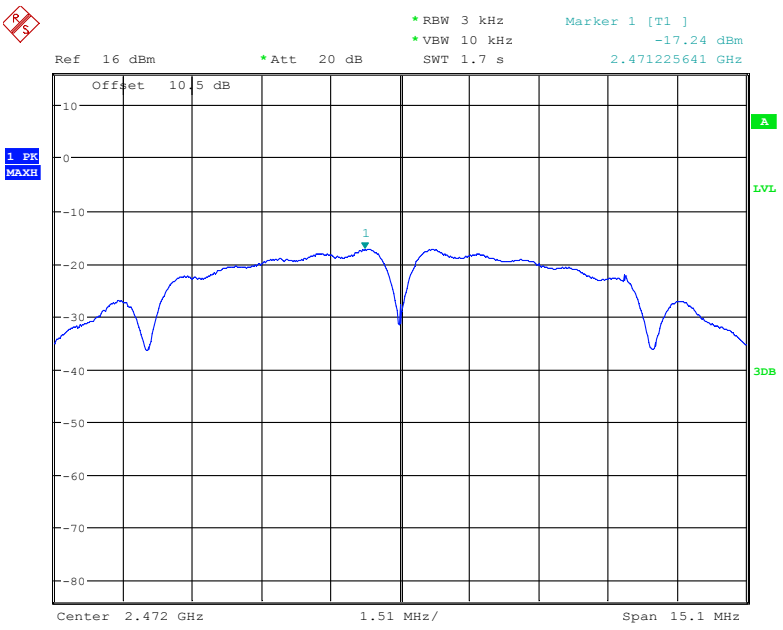
Date: 9.MAY.2019 10:58:28

Power Spectral Density, 802.11b Middle Channel



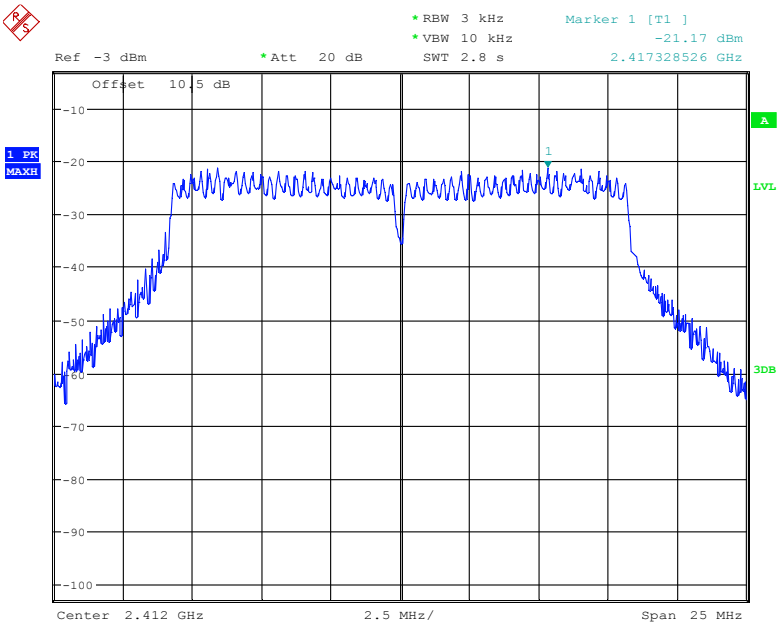
Date: 9.MAY.2019 10:58:52

Power Spectral Density, 802.11b High Channel



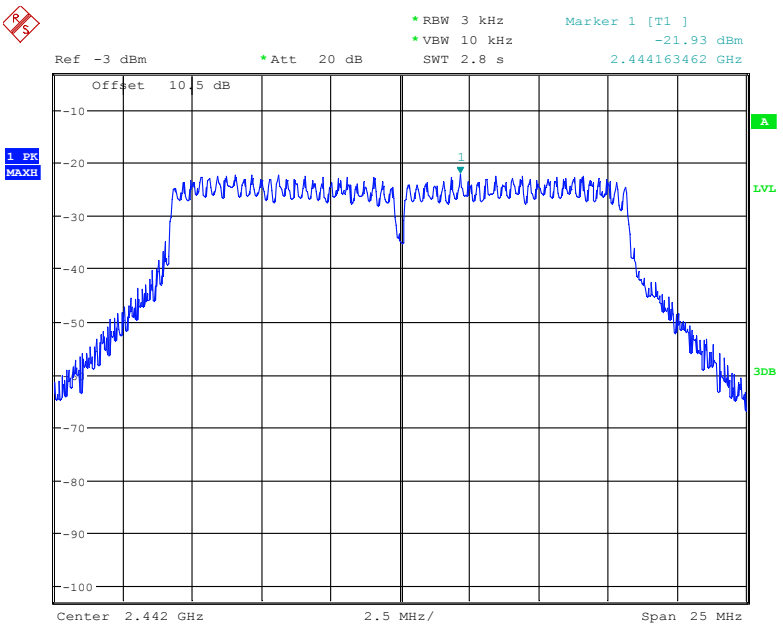
Date: 9.MAY.2019 10:59:17

Power Spectral Density, 802.11g Low Channel



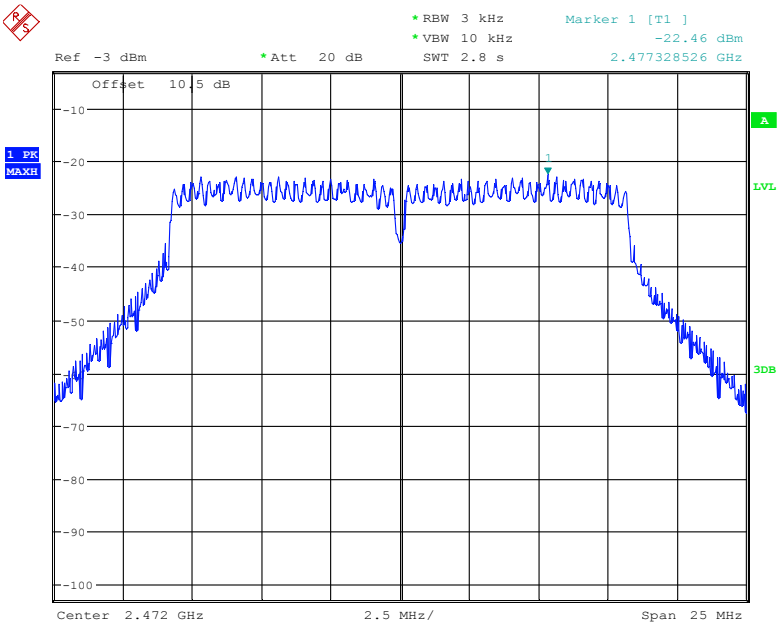
Date: 9.MAY.2019 10:57:05

Power Spectral Density, 802.11g Middle Channel



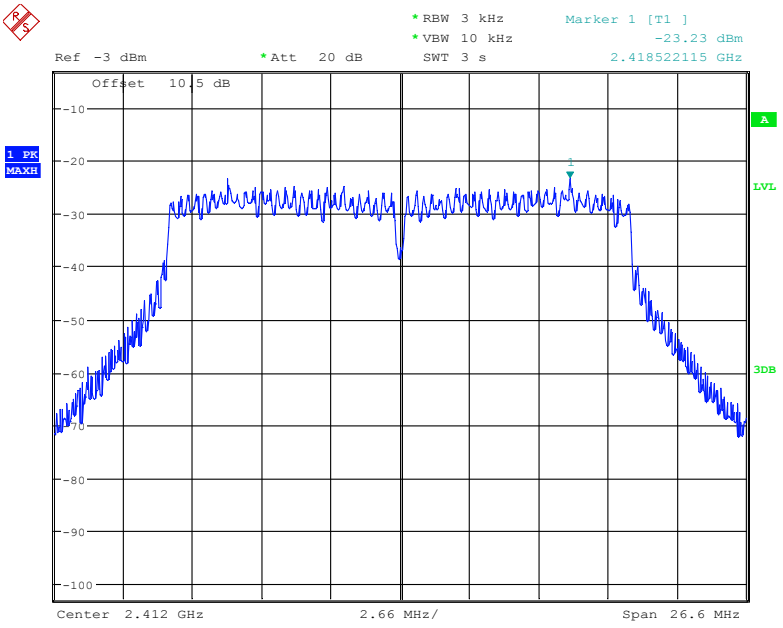
Date: 9.MAY.2019 10:56:03

Power Spectral Density, 802.11g High Channel



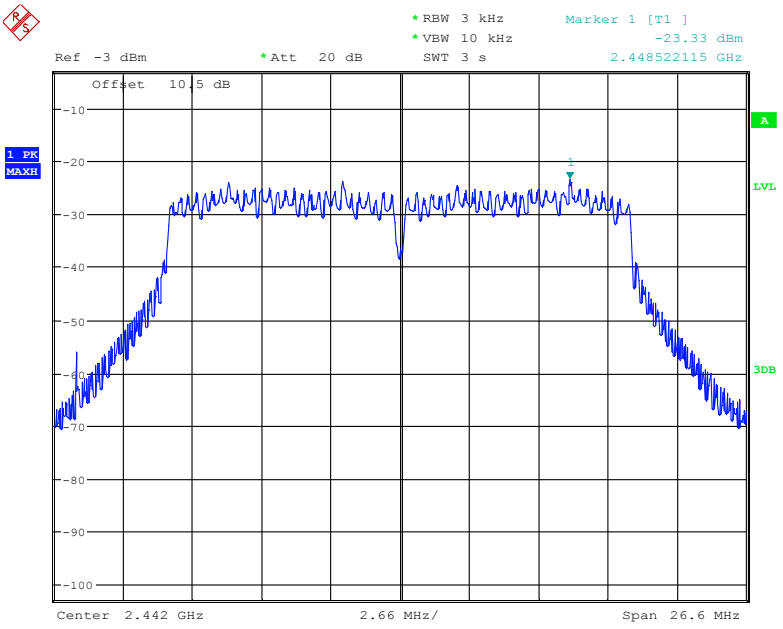
Date: 9.MAY.2019 10:55:38

Power Spectral Density, 802.11n-HT20 Low Channel



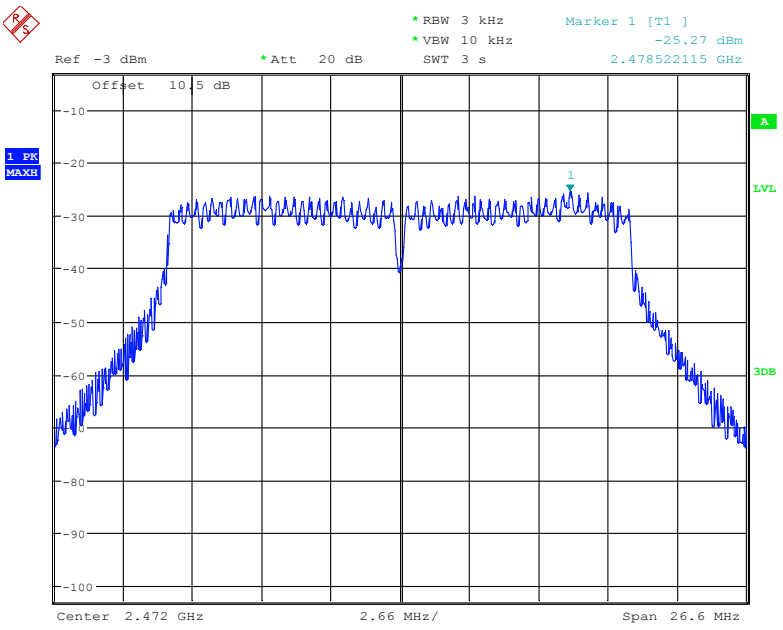
Date: 9.MAY.2019 10:51:01

Power Spectral Density, 802.11n-HT20 Middle Channel



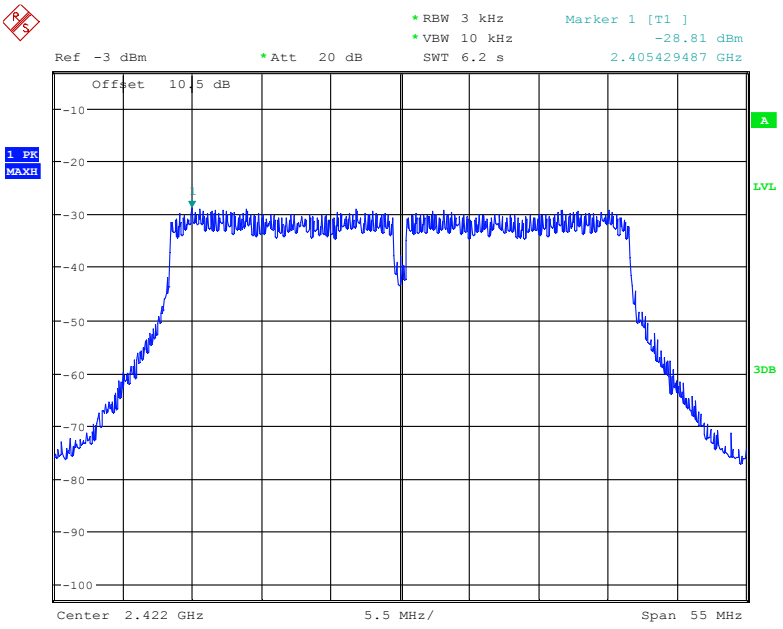
Date: 9.MAY.2019 10:50:09

Power Spectral Density, 802.11n-HT20 High Channel



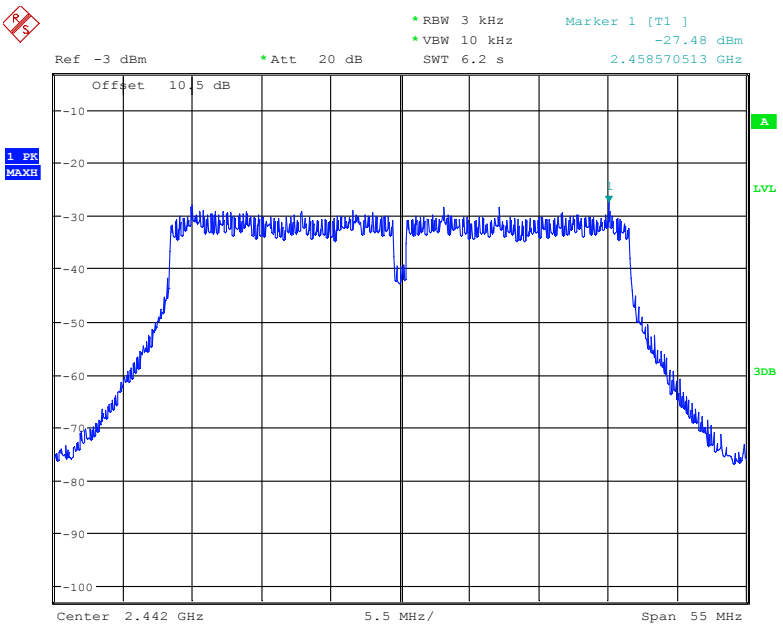
Date: 9.MAY.2019 10:50:36

Power Spectral Density, 802.11n-HT40 Low Channel



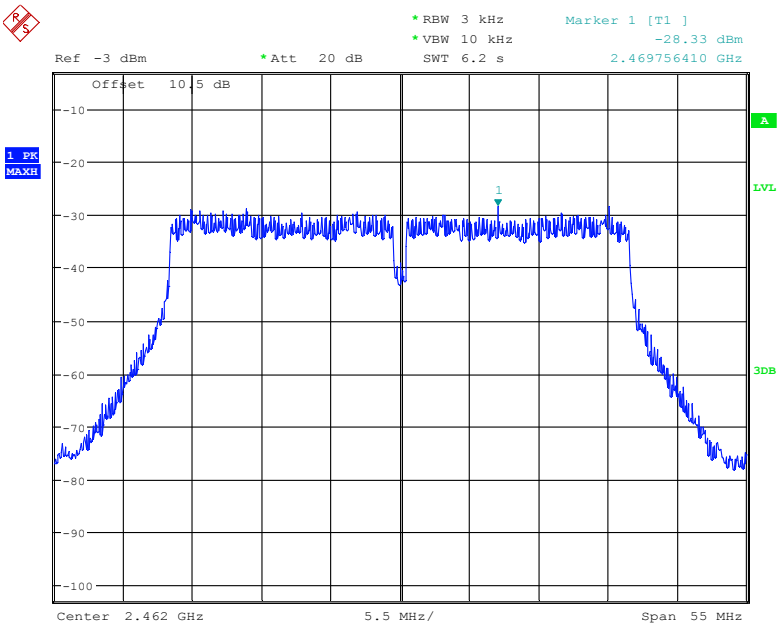
Date: 9.MAY.2019 10:44:29

Power Spectral Density, 802.11n-HT40 Middle Channel



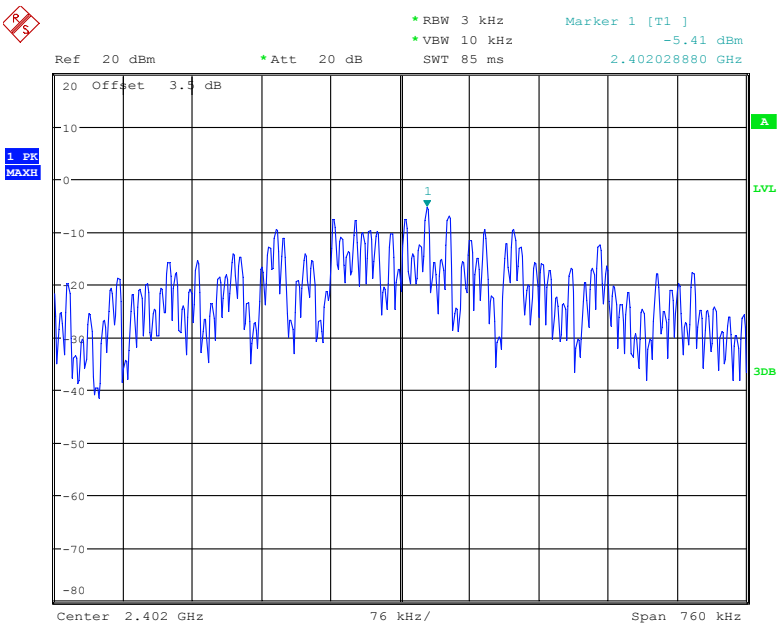
Date: 9.MAY.2019 10:53:11

Power Spectral Density, 802.11n-HT40 High Channel



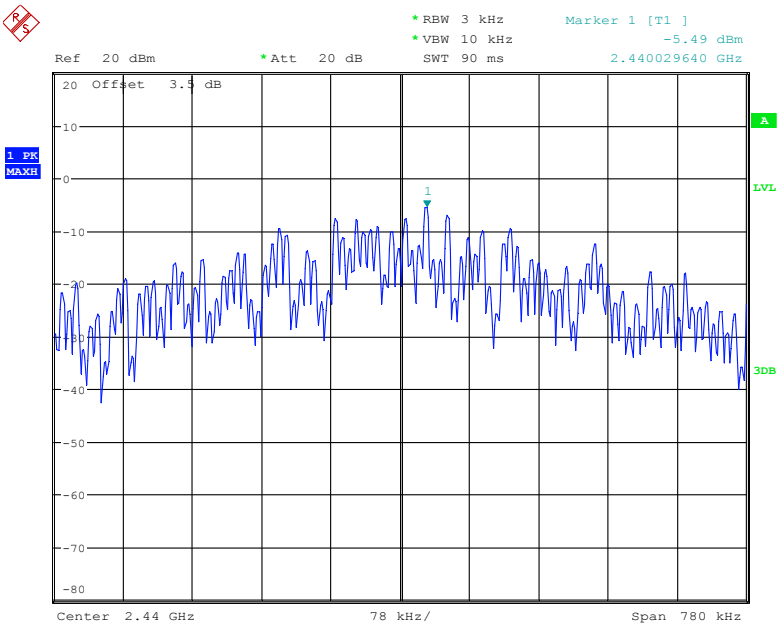
Date: 9.MAY.2019 10:53:41

Power Spectral Density, BLE Low Channel



Date: 12.APR.2019 14:40:10

Power Spectral Density, BLE Middle Channel



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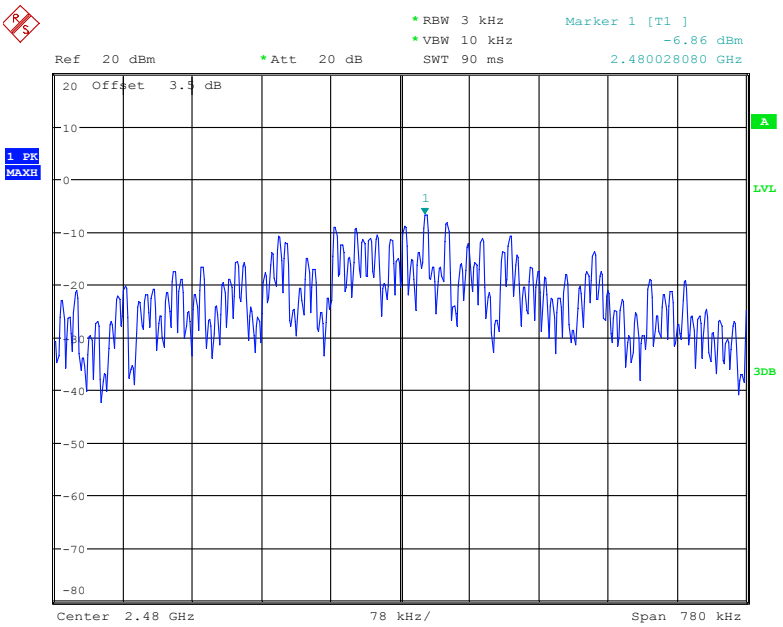
Power Spectral Density, BLE High Channel



Date: 12.APR.2019 14:38:44

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