FCC PART 15.247

TEST REPORT

For

Ningbo Maxenergy Electronics Co., Ltd.

No.216 Waihuandong Road, Zhuangqiao Street Jiangbei District, Ningbo China 315032

FCC ID: 2ASX5CA-1000WIFI

Report Type:	**Product Type:**
Original Report	Recreational Vehicle Long Range High Performance Wifi Extender and Omnidirectional Television Antenna

Report Number: RSC190326001-00C

Report Date: 2019-06-17

Reviewed By: Candy Li, RF Engineer

Prepared By: Bay Area Compliance Laboratories Corp. (Shenzhen)
6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China
Tel: +86-755-33320018
Fax: +86-755-33320008
www.baclcorp.com.cn

Note: This report must not be used by the customer to claim product certification, approval, or endorsement by A2LA* or any agency of the Federal Government. * This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*".

The information marked # is provided by the applicant, the laboratory is not responsible for its authenticity.

TABLE OF CONTENTS

GENERAL INFORMATION **4**
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) 4
OBJECTIVE 4
RELATED SUBMITTAL(S)/GRANT(S) 4
TEST METHODOLOGY 4
MEASUREMENT UNCERTAINTY 5
SYSTEM TEST CONFIGURATION **6**
DESCRIPTION OF TEST CONFIGURATION 6
EQUIPMENT MODIFICATIONS 6
EUT EXERCISE SOFTWARE 7
DUTY CYCLE 8
SUPPORT EQUIPMENT LIST AND DETAILS 10
EXTERNAL I/O CABLE 10
BLOCK DIAGRAM OF TEST SETUP 11
SUMMARY OF TEST RESULTS **12**
TEST EQUIPMENT LIST **13**
FCC§15.247 (i), §1.1307 (b) (1) & §2.1091 –MAXIMUM PERMISSIBLE EXPOSURE (MPE) **14**
APPLICABLE STANDARD 14
FCC §15.203 - ANTENNA REQUIREMENT **16**
APPLICABLE STANDARD 16
ANTENNA CONNECTOR CONSTRUCTION 16
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS **17**
APPLICABLE STANDARD 17
EUT SETUP 17
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP 18
TEST PROCEDURE 18
CORRECTED AMPLITUDE & MARGIN CALCULATION 18
TEST RESULTS SUMMARY 19
TEST DATA 19
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH **41**
APPLICABLE STANDARD 41
TEST PROCEDURE 41
TEST DATA 41
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER **49**
APPLICABLE STANDARD 49
TEST PROCEDURE 49
TEST DATA 49
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE **52**
APPLICABLE STANDARD 52
TEST PROCEDURE 52
TEST DATA 52
FCC §15.247(e) - POWER SPECTRAL DENSITY **61**
APPLICABLE STANDARD 61

TEST PROCEDURE 61
TEST DATA 61

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Recreational Vehicle Long Range High Performance Wifi Extender and Omnidirectional Television Antenna
Tested Model	CA-1000 WIFI
Multiple Model#	CA-2000
Frequency Range	Wi-Fi: 802.11b/g/n20: 2412~2462MHz 802.11n40: 2422-2452MHz
Transmit Power	Wi-Fi: 802.11b:19.44 dBm, 802.11G: 24.68 dBm, 802.11N20: 27.27 dBm, 802.11N40: 27.50 dBm
Modulation Technique	Wi-Fi: DSSS, OFDM
Antenna Specification	3.5 dBi
Voltage Range	DC 12V (from Vehicle battery)
Date of Test	2019-04-24 ~ 2019-05-30
Sample serial number	190326001A for CA-1000 WIFI, 190326001B for CA-2000
Received date	2019-03-26
Sample/EUT Status	Good condition

Notes: This series products model: CA-2000 and CA-1000 WIFI are electrically identical. Model CA-1000 WIFI was selected for fully testing, the detailed information can be referred to the declaration which was stated and guaranteed by the applicant.

Objective

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

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

Related Submittal(s)/Grant(s)

FCC Part 15.407 NII submissions with FCC ID: 2ASX5CA-1000WIFI.

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, 11 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	/	/
6	2437	/	/
7	2442	/	/

For 802.11b, 802.11g, 802.11n-HT20 mode, EUT was tested with Channel 1, 6 and 11

For 802.11n-HT40 mode, 7 channels are provided to testing:

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

EUT was tested with Channel 1, 4 and 7.

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

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

Exercise software "artgui.exe" and Commands were used.

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

Antenna 0:

Mode	Data rate	Power level		
		Low channel	Middle channel	High channel
802.11b	1 Mbps	16	16	16
802.11g	6 Mbps	16	16	16
802.11n-HT20	MCS0	16	16	16
802.11n-HT40	MCS0	16	16	16

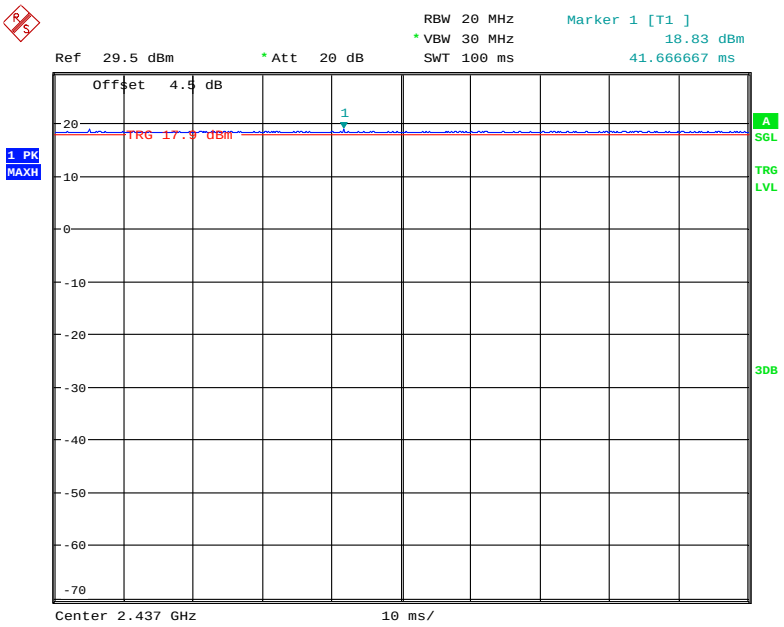
Antenna 1:

Mode	Data rate	Power level		
		Low channel	Middle channel	High channel
802.11b	1 Mbps	16	16	16
802.11g	6 Mbps	16	16	16
802.11n-HT20	MCS0	16	16	16
802.11n-HT40	MCS0	16	16	16

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

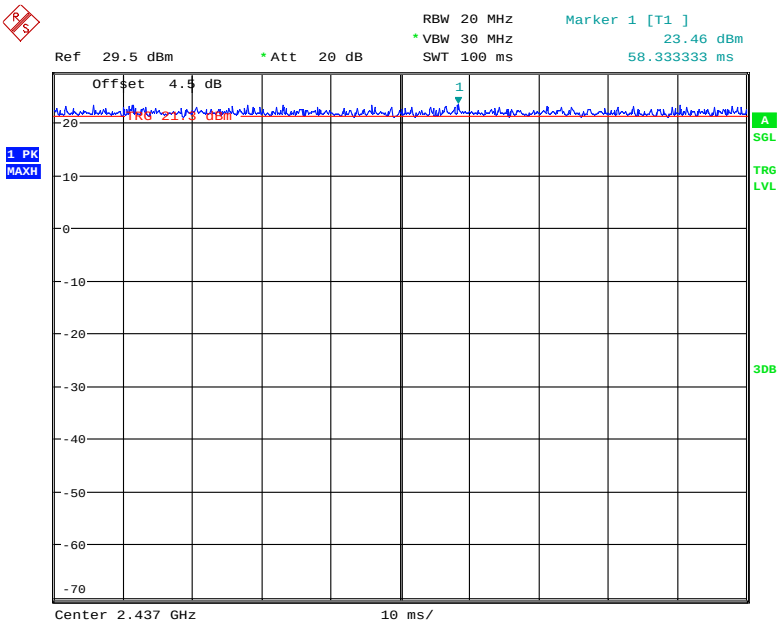
Duty cycle

802.11b mode



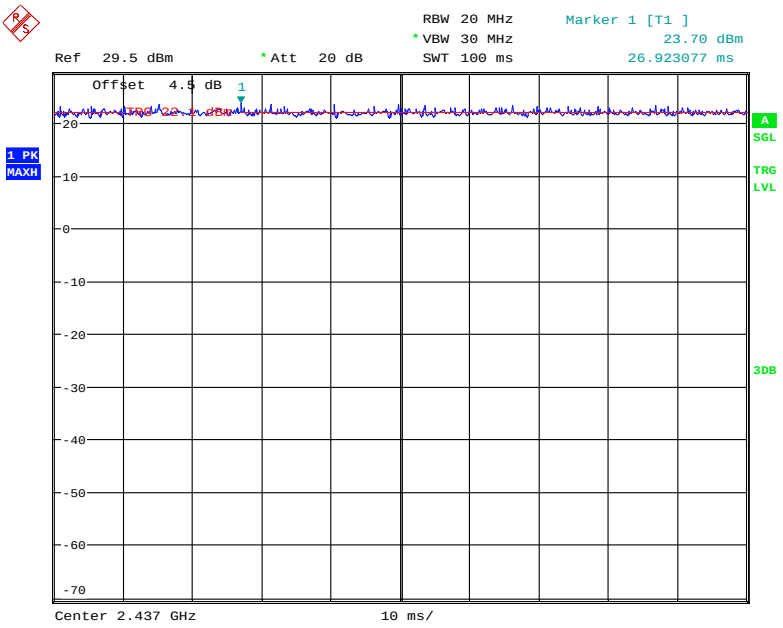
Date: 30.MAY.2019 21:48:16

802.11g mode



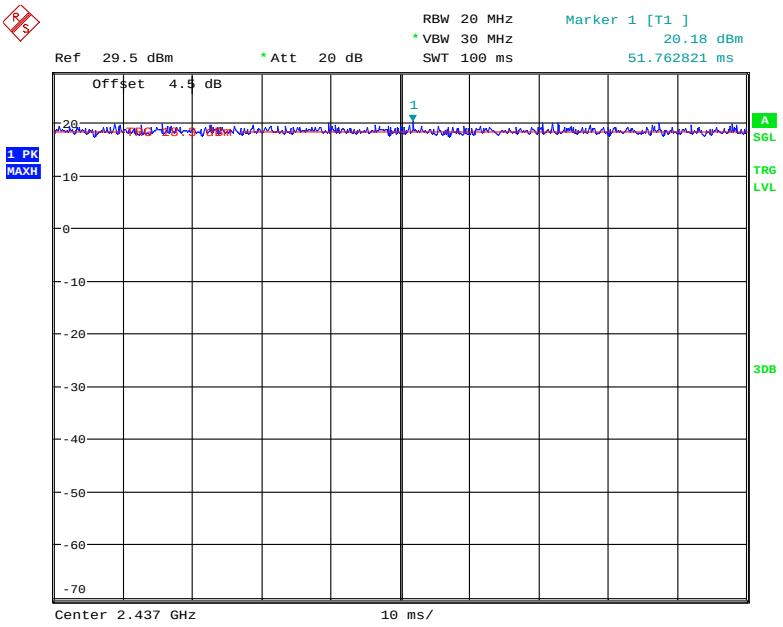
Date: 30.MAY.2019 21:48:50

802.11n-HT20 Mode



Date: 30.MAY.2019 21:49:36

802.11n-HT40 Mode



Date: 30.MAY.2019 21:50:08

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	-

Support Equipment List and Details

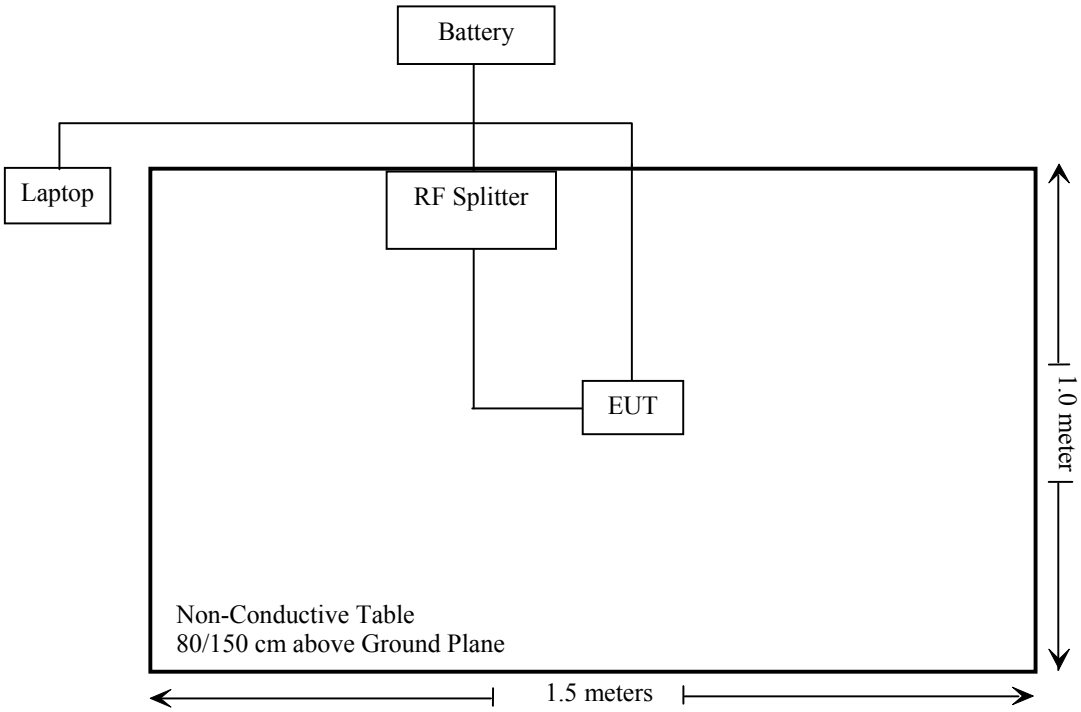
Manufacturer	Description	Model	Serial Number
HP	Laptop	CQ45-m02TU	5CG33407QL
Panasonic	Valve Regulated Lead-Acid Battery	LC-P1224ST	Unknown
Maxenergy	RF Splitter	Unknown	Unknown

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shielding Detachable DC Power cord	1.8	RF Splitter	Battery
Shielding Un-detachable Coaxial Cable	0.5	EUT	RF Splitter
Shielding Detachable RJ45 Cable	10.0	EUT	Laptop

Block Diagram of Test Setup

For spurious emissions:



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	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 EUT was powered by a DC 12V from vehicle battery.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
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	1	2019-05-21	2019-11-19
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
RF Conducted Test					
Agilent	USB wideband power meter	U2021XA	MY54250003	2018-06-23	2019-06-23
WEINSCHEL	3dB Attenuator	6231	666	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)

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

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

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)			
2412-2462	3.5	2.24	28.0	630.96	20	0.28	1.0
5150-5250	3.5	2.24	17.5	56.24	20	0.03	1.0
5725-5850	3.5	2.24	18.5	70.80	20	0.03	1.0

Note:

Simultaneous transmitting consideration: 2.4GHz Wi-Fi and 5GHz Wi-Fi

The ratio=MPE/$limit_{2.4GHz}$+MPE/$limit_{5GHz}$=0.28/1+0.03/1=0.31＜1.0, simultaneous exposure is not required.

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

Result: Compliance

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

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

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

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

Antenna Connector Construction

The EUT has two unique external antennas arrangement for 2.4GHz Wi-Fi, and the antenna gain is 3.5dBi for both Antennas, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

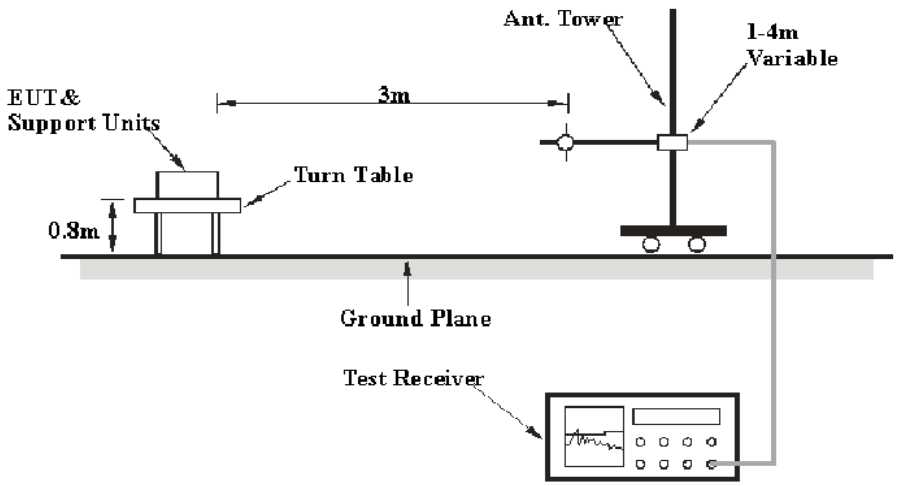
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

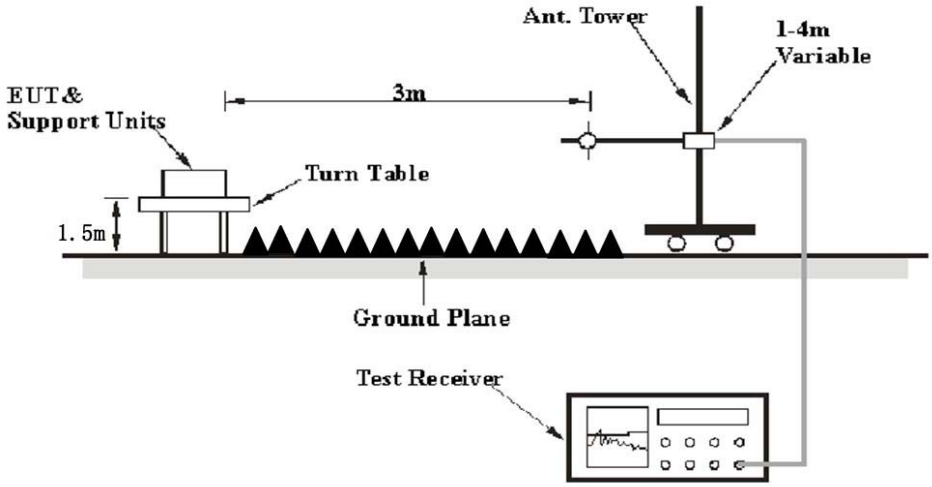
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 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

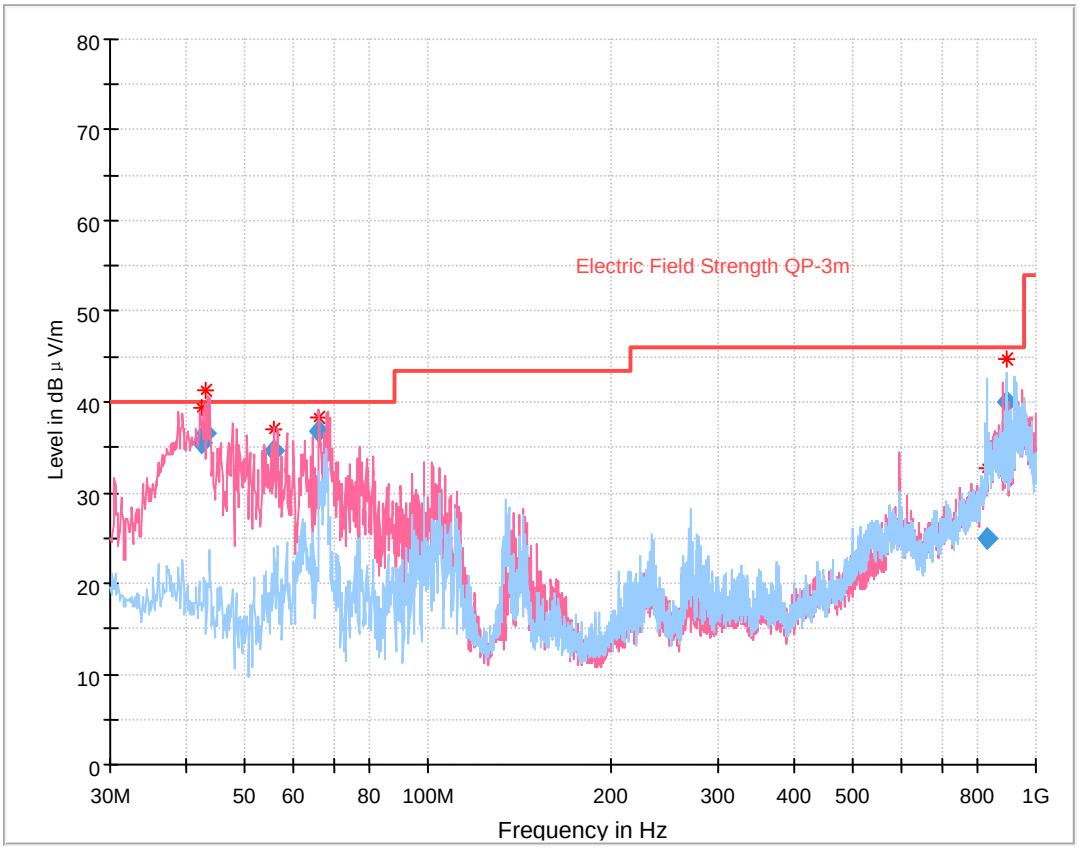
Temperature:	25~24 ℃
Relative Humidity:	52~54 %
ATM Pressure:	101.0 kPa

The testing was performed by Yooube Zhao and by Leo Huang from 2019-04-24 to 2019-05-30.

EUT operation mode: Transmitting

For Radiated emission:

30 MHz~1 GHz: Worst Case at Wi-Fi 802.11n-HT20 Mode, Antenna 0, 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)
42.386000	35.45	100.0	V	0.0	-15.5	40.00	4.55
42.965000	36.65	106.0	V	355.0	-15.9	40.00	3.35
55.889500	34.57	120.0	V	243.0	-20.0	40.00	5.43
66.279500	36.74	109.0	V	275.0	-20.5	40.00	3.26
828.884625	24.98	286.0	H	151.0	4.8	46.00	21.02
896.474000	40.01	321.0	H	288.0	4.3	46.00	5.99

1 GHz-25 GHz:

802.11b Mode (worst for Antenna 0):

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)									
2365.31	28.30	PK	281	1.7	V	31.87	60.17	74	13.83
2365.31	14.79	Ave.	281	1.7	V	31.87	46.66	54	7.34
2499.93	27.58	PK	268	1.8	V	32.13	59.71	74	14.29
2499.93	14.20	Ave.	268	1.8	V	32.13	46.33	54	7.67
4824.00	50.50	PK	5	2.2	V	6.28	56.78	74	17.22
4824.00	45.88	Ave.	5	2.2	V	6.28	52.16	54	1.84
Middle Channel (2437MHz)									
4874.00	50.65	PK	144	2.0	V	6.76	57.41	74	16.59
4874.00	45.04	Ave.	144	2.0	V	6.76	51.80	54	2.20
High Channel (2462 MHz)									
2328.12	27.86	PK	138	1.4	V	31.64	59.50	74	14.50
2328.12	14.09	Ave.	138	1.4	V	31.64	45.73	54	8.27
2499.14	28.72	PK	232	1.0	V	32.13	60.85	74	13.15
2499.14	15.18	Ave.	232	1.0	V	32.13	47.31	54	6.69
4924.00	48.85	PK	301	1.0	V	6.76	55.61	74	18.39
4924.00	43.02	Ave.	301	1.0	V	6.76	49.78	54	4.22

802.11g Mode (worst for Antenna 0):

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)									
2372.20	29.54	PK	331	2.3	V	31.87	61.41	74	12.59
2372.20	15.65	Ave.	331	2.3	V	31.87	47.52	54	6.48
2495.54	27.92	PK	268	1.2	V	32.13	60.05	74	13.95
2495.54	14.43	Ave.	268	1.2	V	32.13	46.56	54	7.44
4824.00	49.71	PK	333	1.4	V	6.28	55.99	74	18.01
4824.00	34.70	Ave.	333	1.4	V	6.28	40.98	54	13.02
Middle Channel (2437MHz)									
4874.00	49.89	PK	77	1.5	V	6.76	56.65	74	17.35
4874.00	34.80	Ave.	77	1.5	V	6.76	41.56	54	12.44
High Channel (2462 MHz)									
2343.19	27.55	PK	329	1.6	V	31.64	59.19	74	14.81
2343.19	14.15	Ave.	329	1.6	V	31.64	45.79	54	8.21
2499.31	29.55	PK	120	2.0	V	32.13	61.68	74	12.32
2499.31	15.45	Ave.	120	2.0	V	32.13	47.58	54	6.42
4924.00	48.81	PK	245	1.8	V	6.76	55.57	74	18.43
4924.00	33.53	Ave.	245	1.8	V	6.76	40.29	54	13.71

802.11n-HT20 Mode (Antenna 0 & Antenna 1):

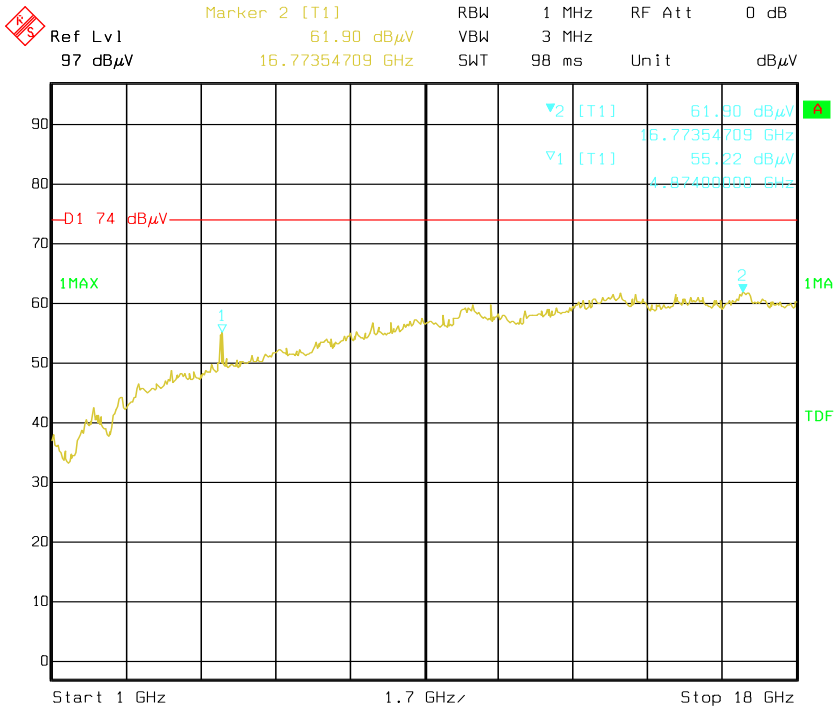
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2390.00	30.05	PK	20	1.4	V	31.87	61.92	74	12.08
2390.00	16.29	Ave.	20	1.4	V	31.87	48.16	54	5.84
2498.15	28.22	PK	31	1.7	V	32.13	60.35	74	13.65
2498.15	14.69	Ave.	31	1.7	V	32.13	46.82	54	7.18
4824.00	51.21	PK	111	1.2	V	6.28	57.49	74	16.51
4824.00	34.99	Ave.	111	1.2	V	6.28	41.27	54	12.73
Middle Channel (2437MHz)									
4874.00	50.46	PK	211	1.2	V	6.76	57.22	74	16.78
4874.00	34.58	Ave.	211	1.2	V	6.76	41.34	54	12.66
High Channel (2462 MHz)									
2335.65	27.60	PK	202	1.3	V	31.64	59.24	74	14.76
2335.65	14.46	Ave.	202	1.3	V	31.64	46.10	54	7.90
2484.23	29.98	PK	18	2.0	V	32.13	62.11	74	11.89
2484.23	16.27	Ave.	18	2.0	V	32.13	48.40	54	5.60
4924.00	47.27	PK	20	2.0	V	6.76	54.03	74	19.97
4924.00	32.59	Ave.	20	2.0	V	6.76	39.35	54	14.65

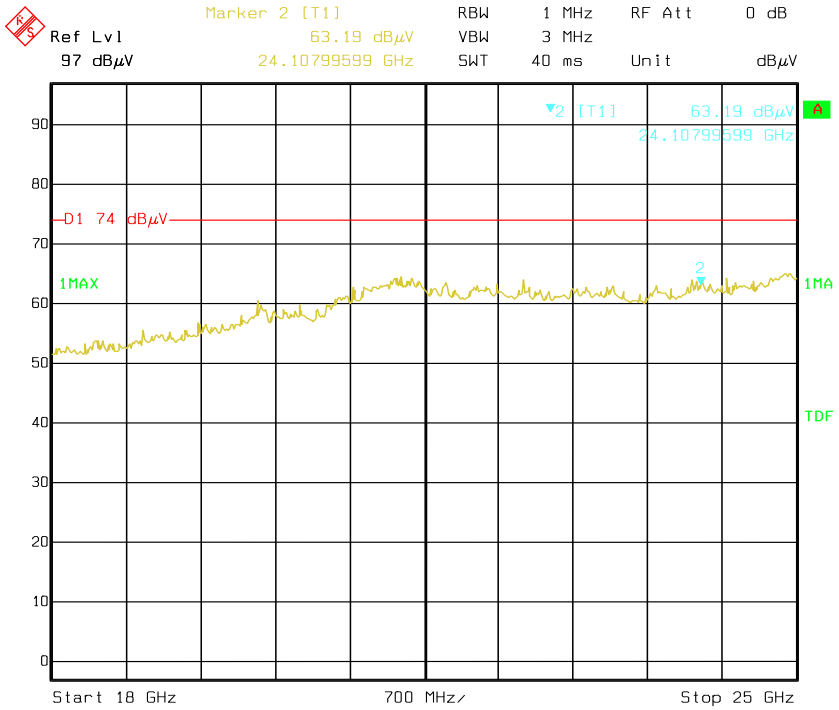
802.11n-HT40 Mode (Antenna 0 & Antenna 1):

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)									
2388.72	34.68	PK	185	1.3	V	31.87	66.55	74	7.45
2388.72	21.06	Ave.	185	1.3	V	31.87	52.93	54	1.07
2496.36	29.36	PK	79	1.4	V	32.13	61.49	74	12.51
2496.36	15.43	Ave.	79	1.4	V	32.13	47.56	54	6.44
4844.00	47.74	PK	226	2.0	V	6.28	54.02	74	19.98
4844.00	33.22	Ave.	226	2.0	V	6.28	39.50	54	14.50
Middle Channel (2437 MHz)									
4874.00	47.80	PK	102	1.0	V	6.76	54.56	74	19.44
4874.00	32.73	Ave.	102	1.0	V	6.76	39.49	54	14.51
High Channel (2452 MHz)									
2389.36	28.25	PK	21	2.3	V	31.87	60.12	74	13.88
2389.36	14.72	Ave.	21	2.3	V	31.87	46.59	54	7.41
2489.65	31.98	PK	257	1.1	V	32.13	64.11	74	9.89
2489.65	17.61	Ave.	257	1.1	V	32.13	49.74	54	4.26
4904.00	47.24	PK	341	1.7	V	6.76	54.00	74	20.00
4904.00	32.62	Ave.	341	1.7	V	6.76	39.38	54	14.62

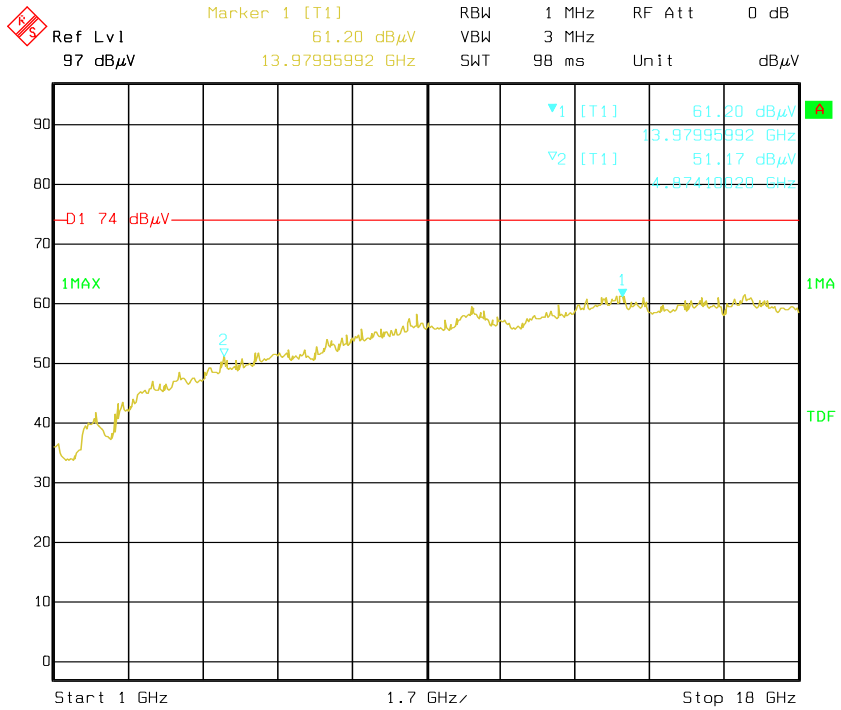
Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is 20dB to the limit was not recorded.
And for the pre-scan is performed with the 2400-2483.5MHz band filter.

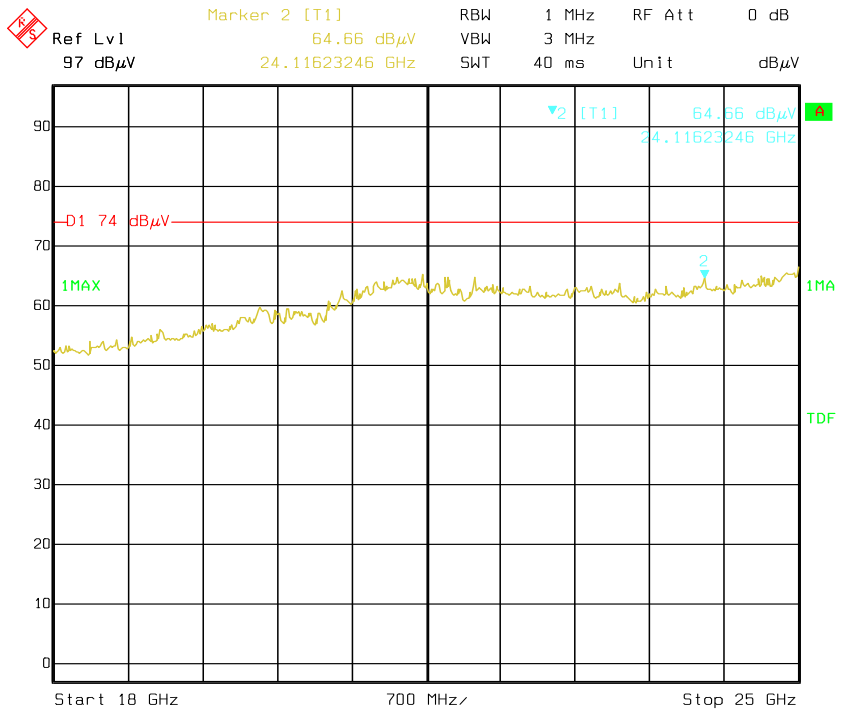
Pre-scan with 802.11n-HT20 Mode, Low channel
Horizontal - Peak



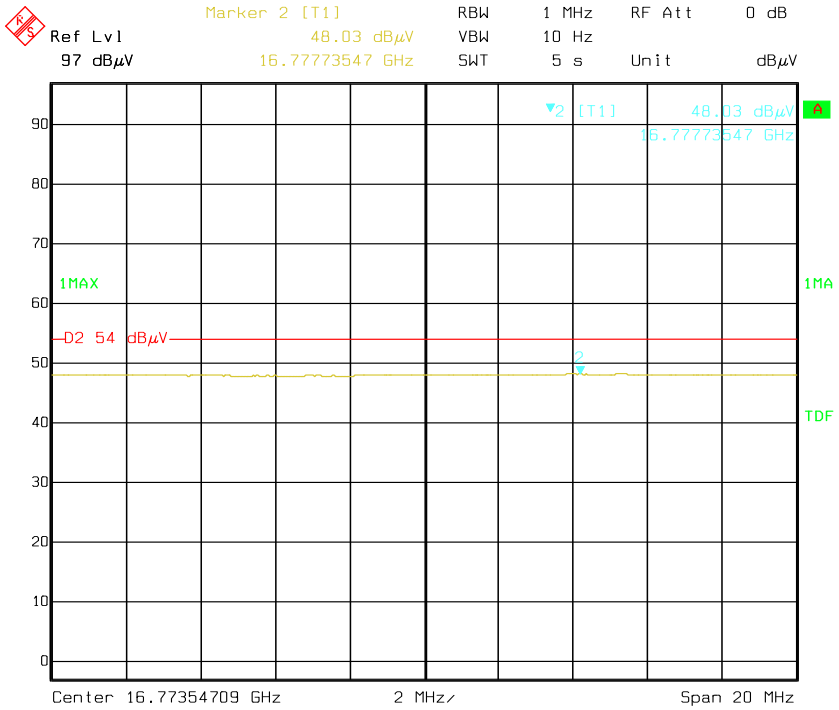


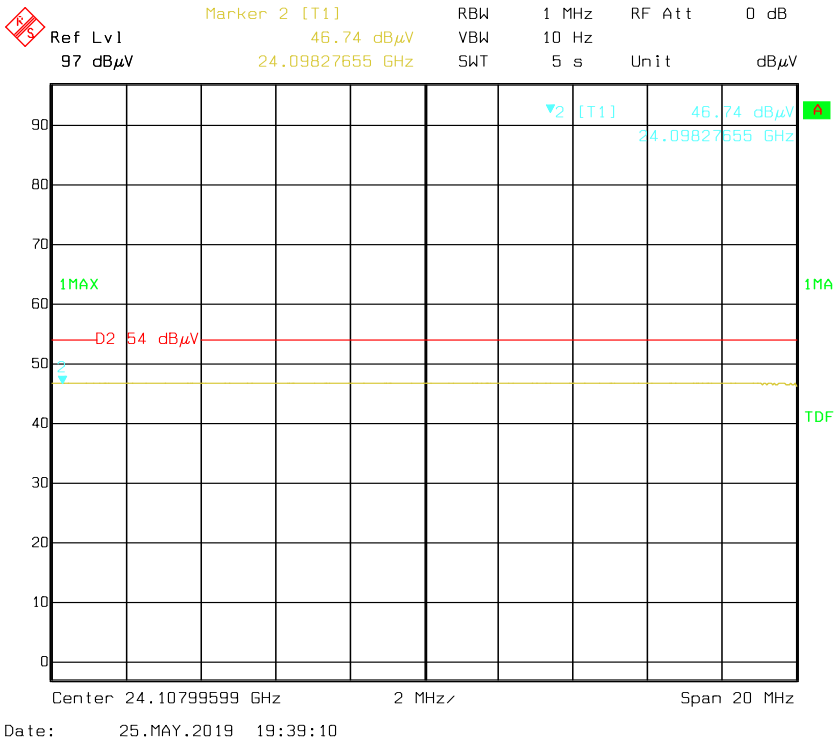
Vertical - Peak



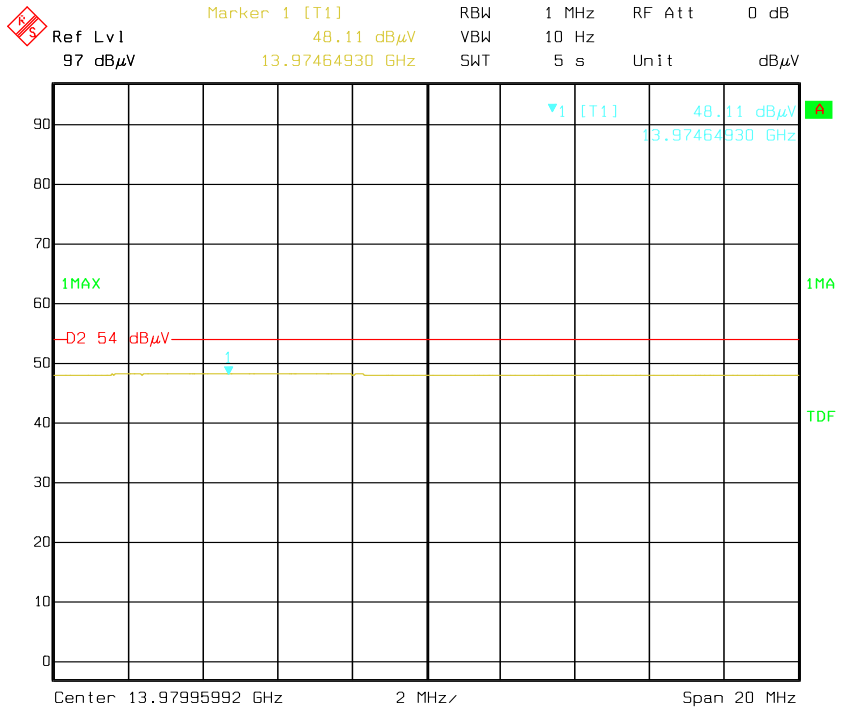


Pre-scan for Average
Horizontal

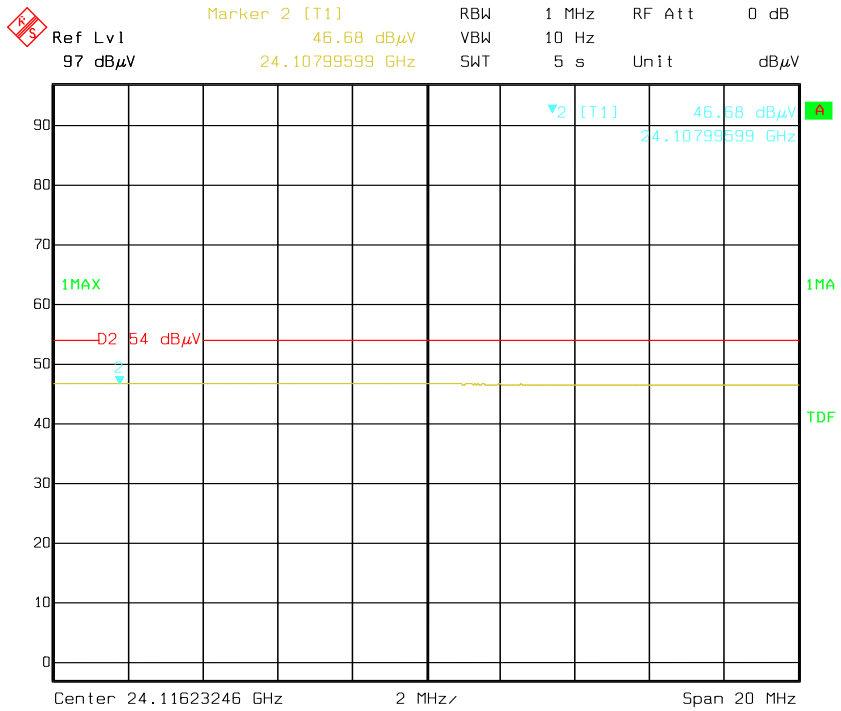




Vertical



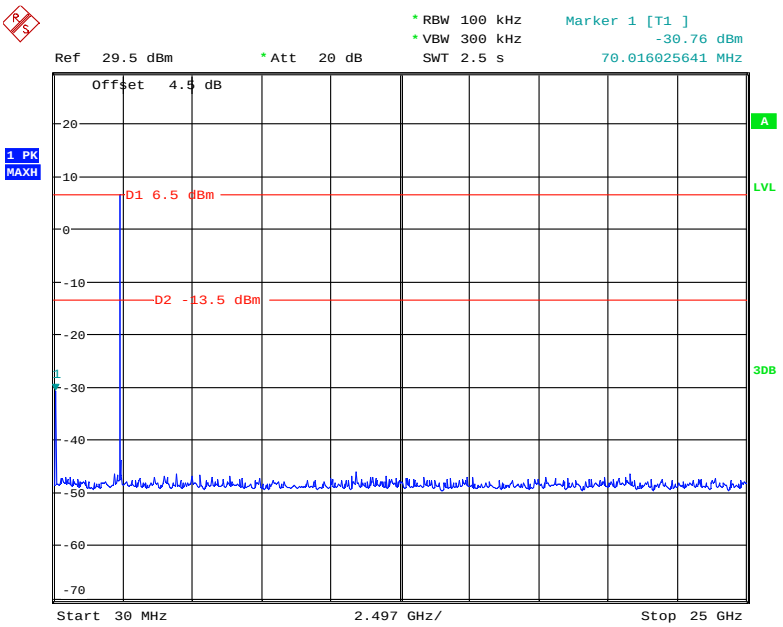
Date: 25.MAY.2019 18:56:12



Date: 25.MAY.2019 19:33:18

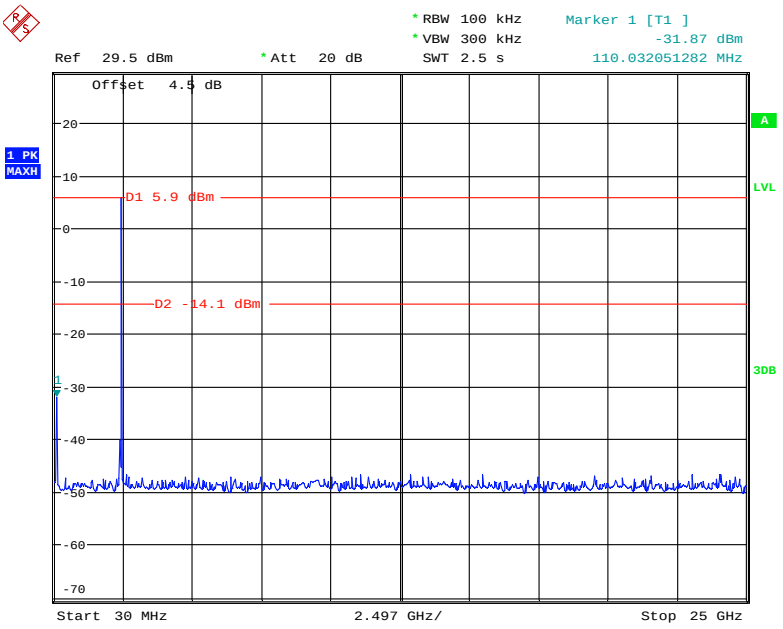
For Conducted emission:
Antenna 0 at Wi-Fi mode:

802.11b Low Channel



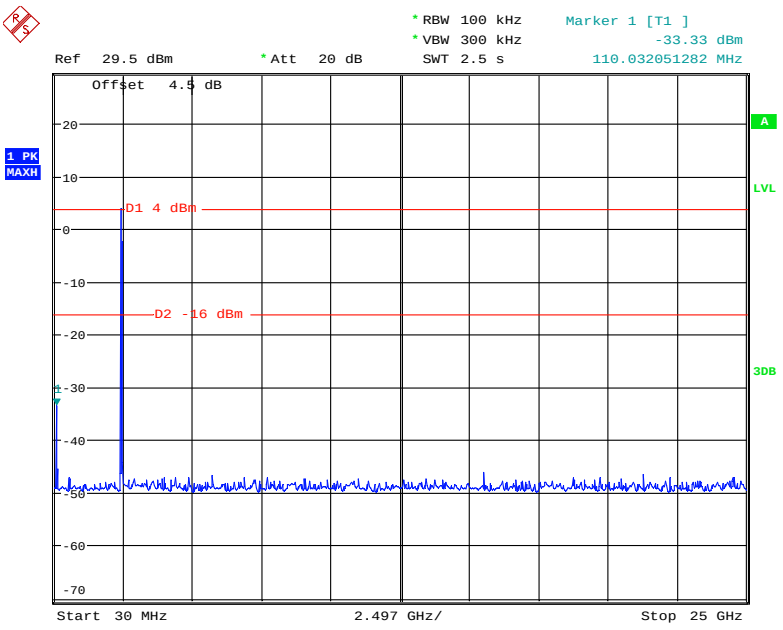
Date: 30.MAY.2019 21:59:31

802.11b Middle Channel



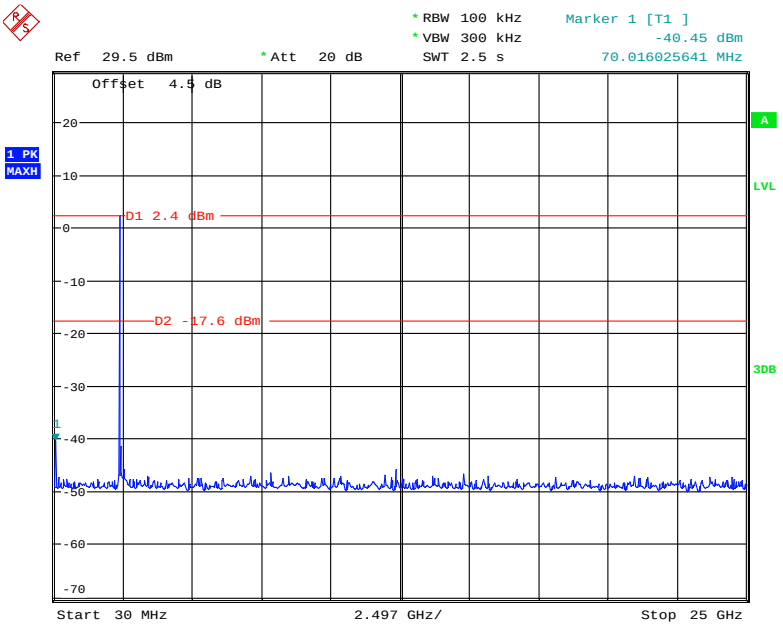
Date: 30.MAY.2019 22:00:14

802.11b High Channel



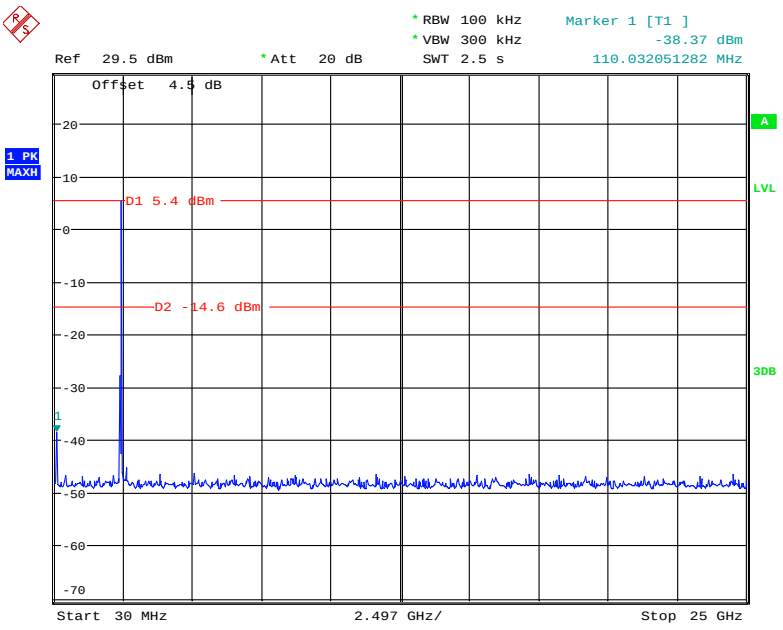
Date: 30.MAY.2019 22:00:49

802.11g Low Channel



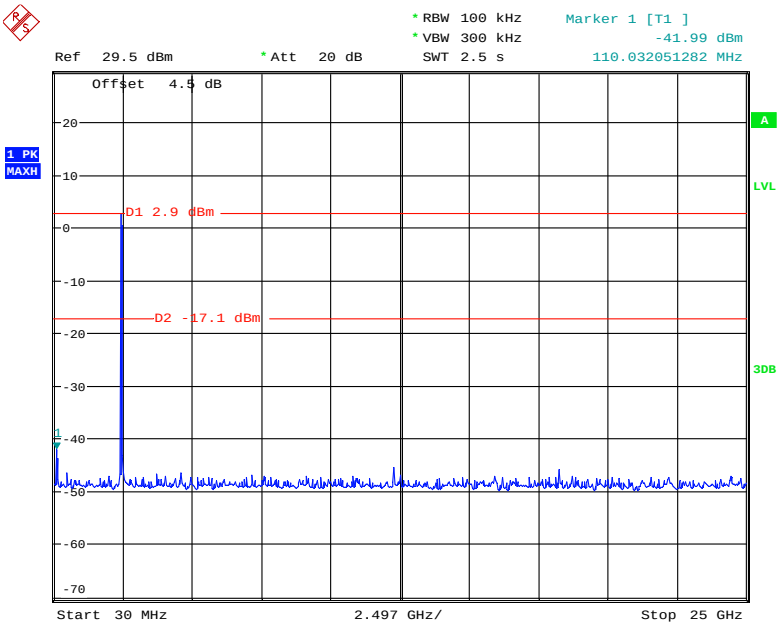
Date: 30.MAY.2019 21:56:44

802.11g Middle Channel



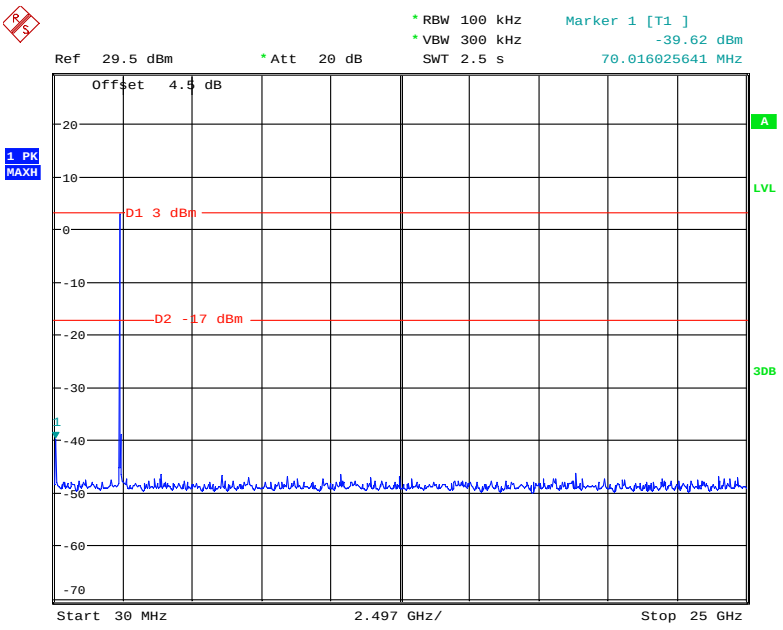
Date: 30.MAY.2019 21:57:50

802.11g High Channel



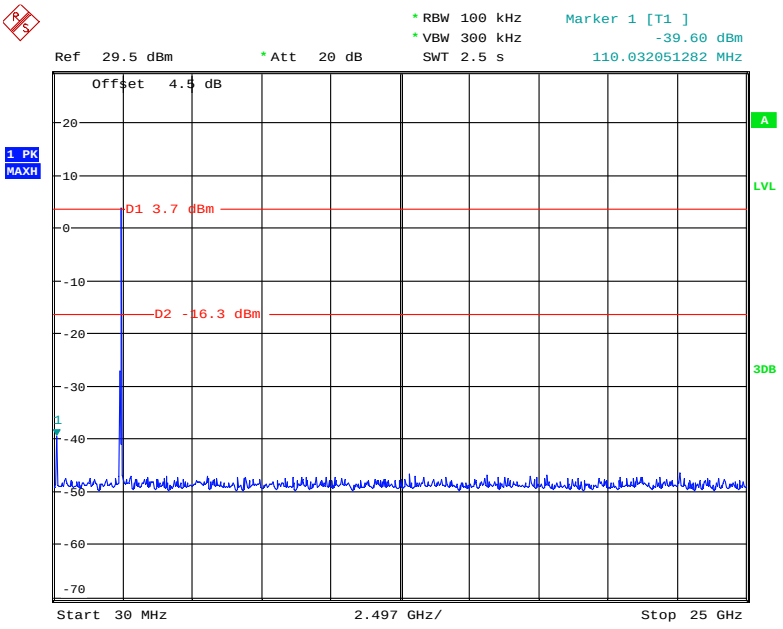
Date: 30.MAY.2019 21:58:47

802.11n-HT20 Low Channel



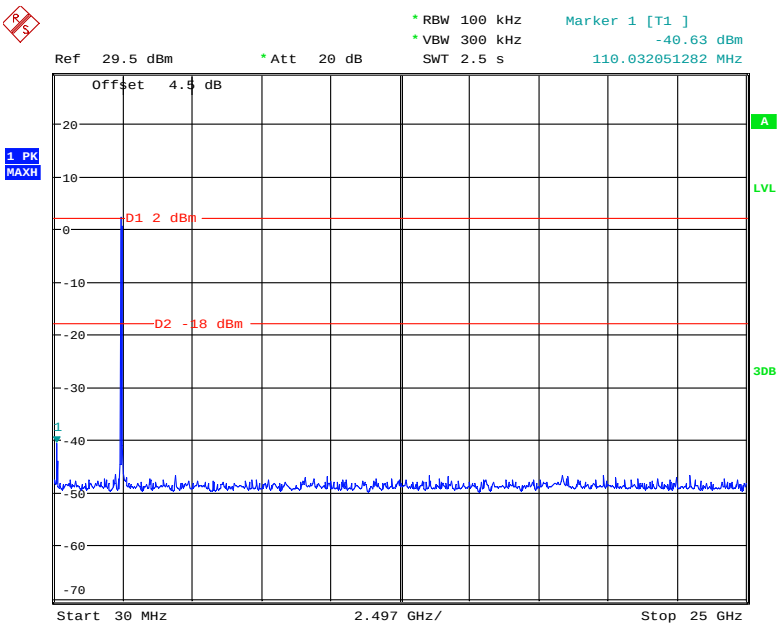
Date: 30.MAY.2019 21:54:44

802.11n-HT20 Middle Channel



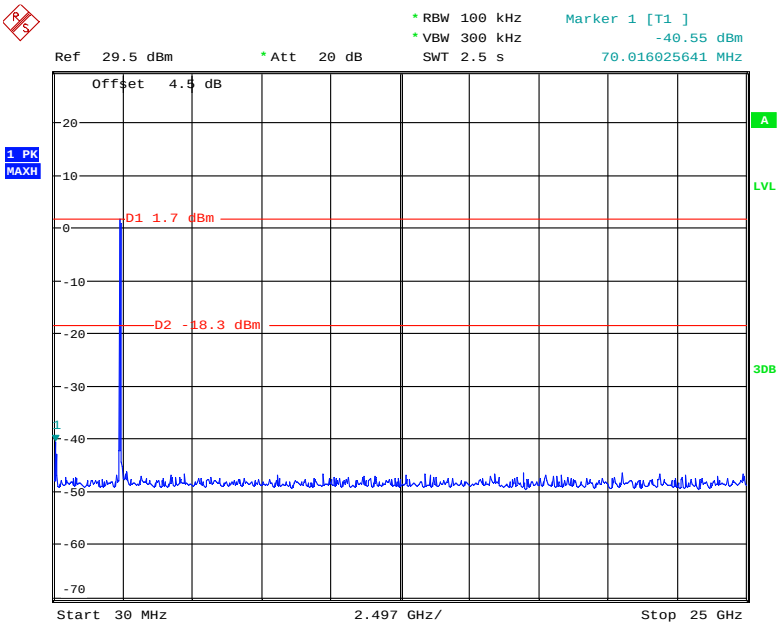
Date: 30.MAY.2019 21:55:26

802.11n-HT20 High Channel



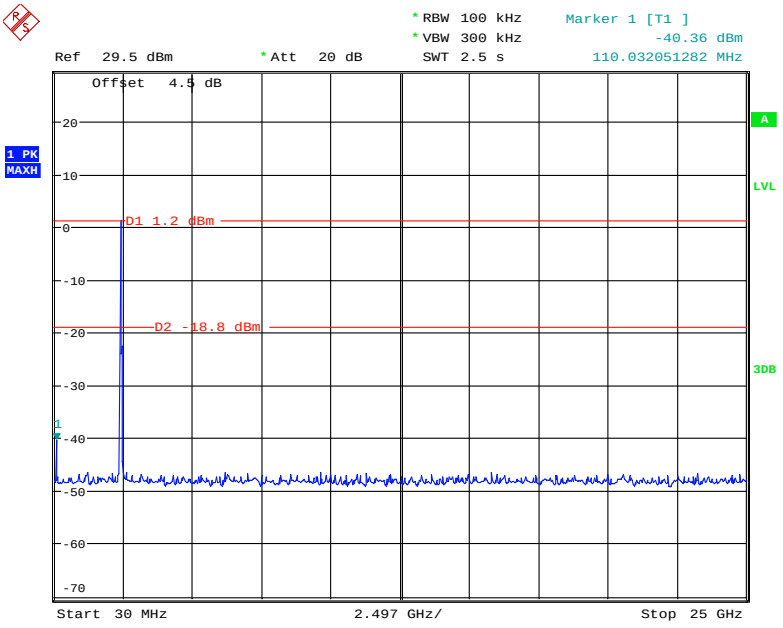
Date: 30.MAY.2019 21:56:09

802.11n-HT40 Low Channel



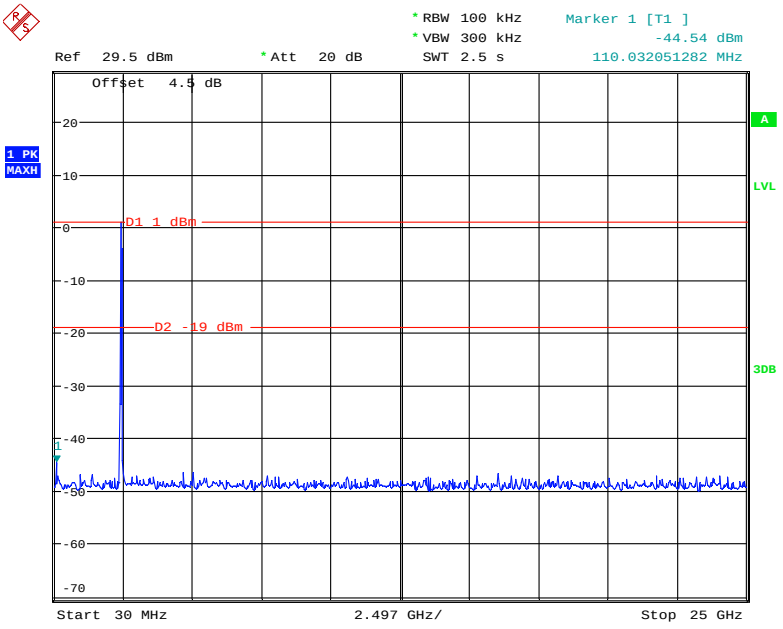
Date: 30.MAY.2019 21:53:16

802.11n-HT40 Middle Channel



Date: 30.MAY.2019 21:52:02

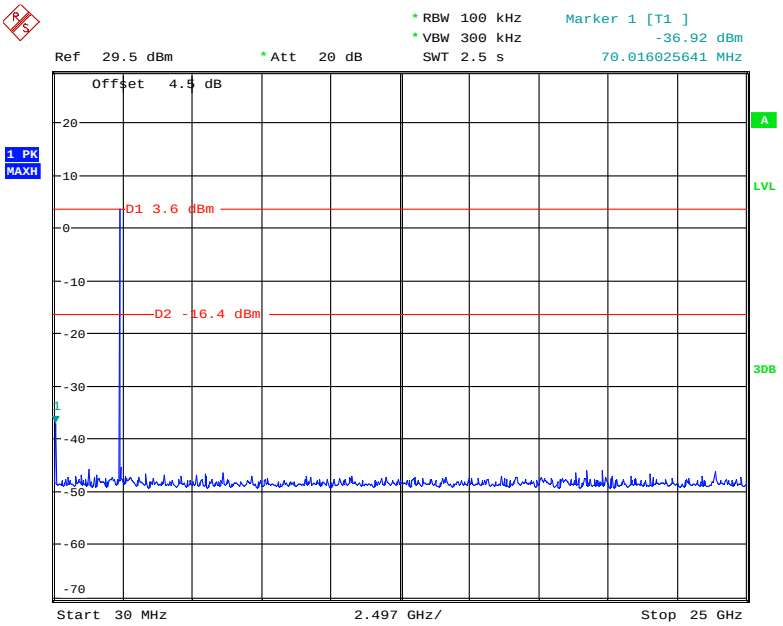
802.11n-HT40 High Channel



Date: 30.MAY.2019 21:53:54

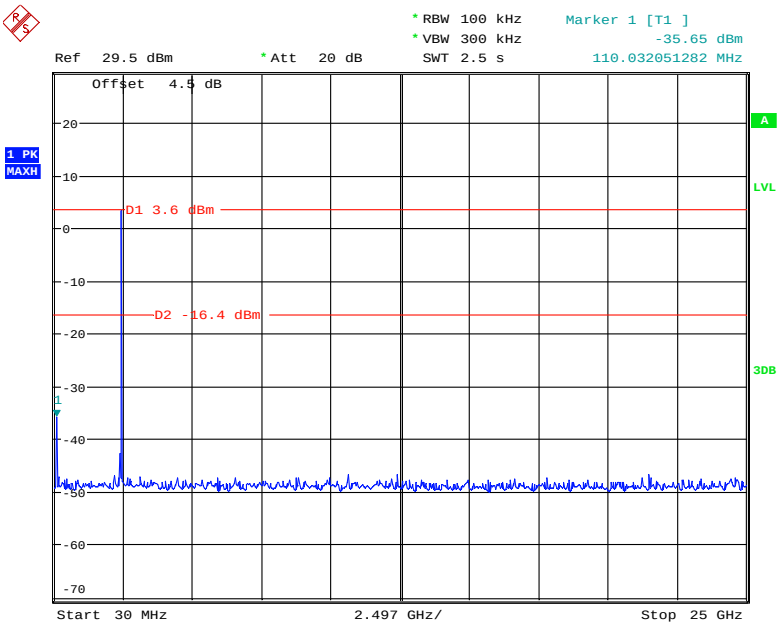
Antenna 1 at Wi-Fi mode:

802.11b Low Channel



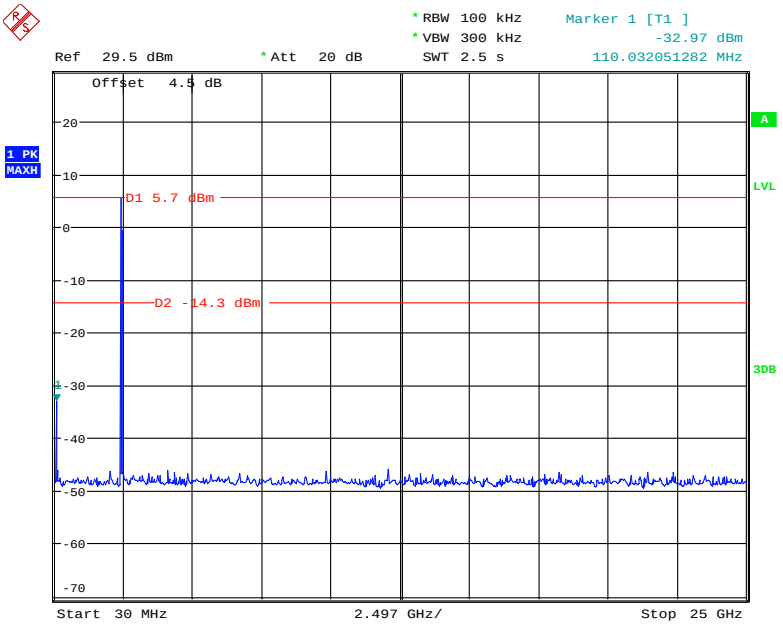
Date: 30.MAY.2019 23:10:25

802.11b Middle Channel



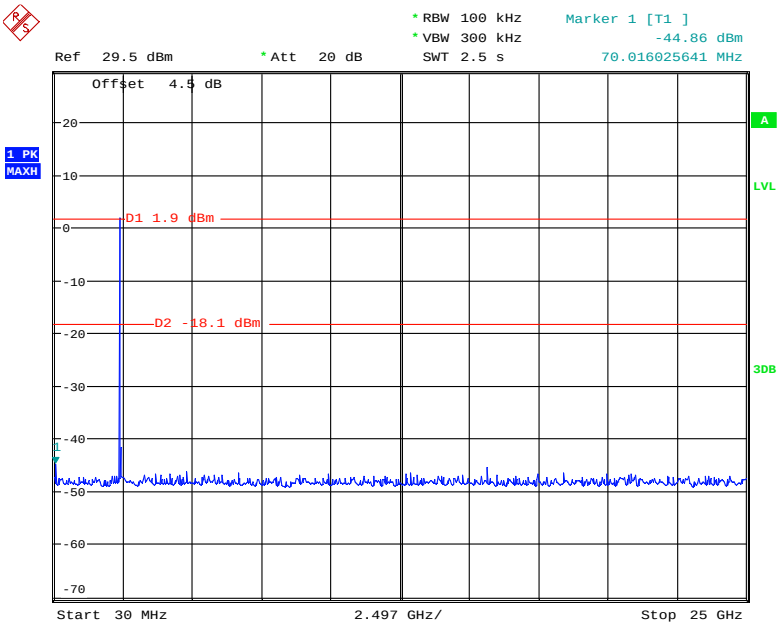
Date: 30.MAY.2019 23:11:02

802.11b High Channel



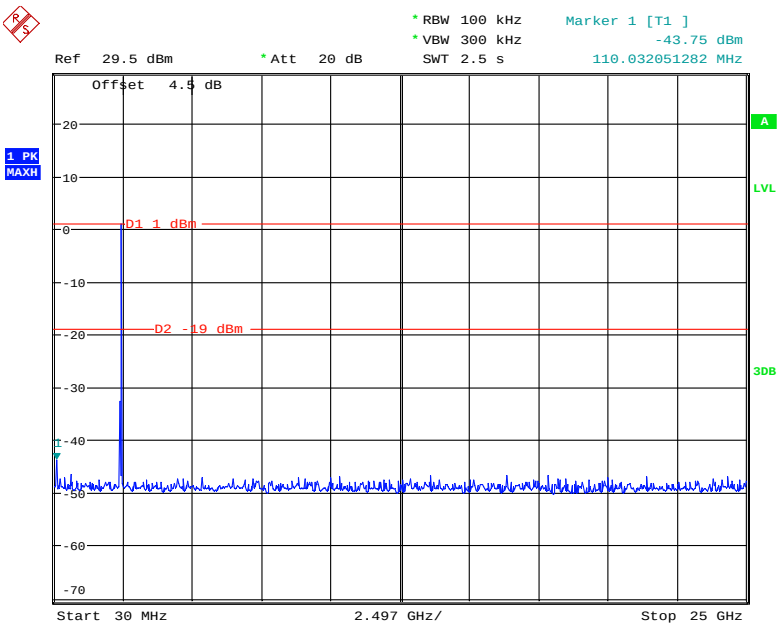
Date: 30.MAY.2019 23:12:05

802.11g Low Channel



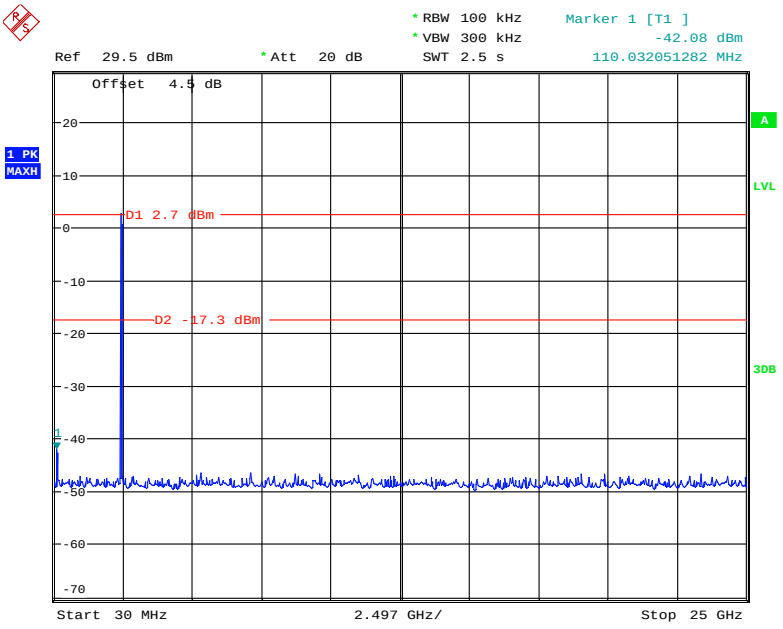
Date: 30.MAY.2019 23:07:51

802.11g Middle Channel



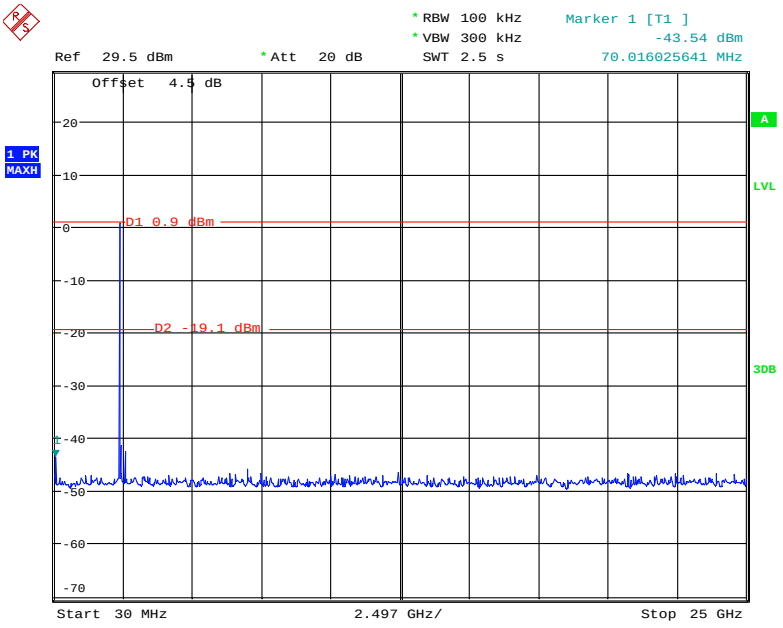
Date: 30.MAY.2019 23:08:32

802.11g High Channel



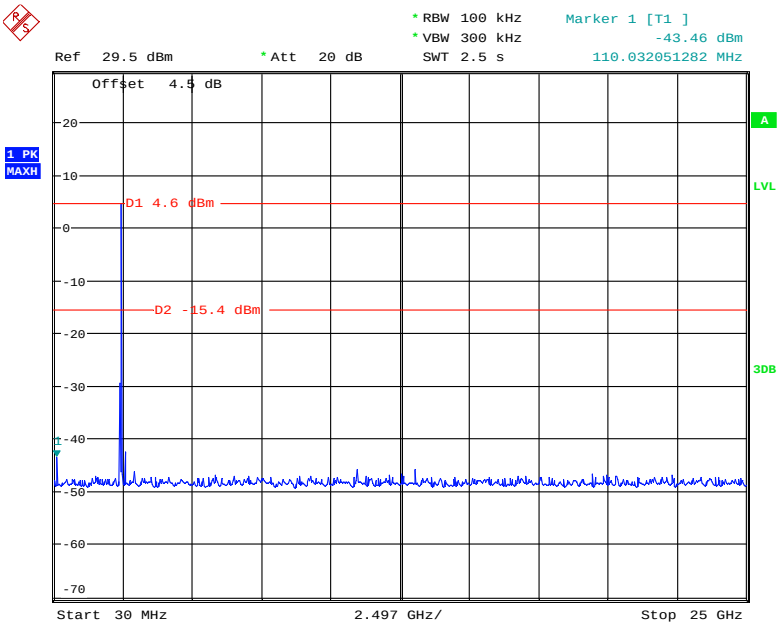
Date: 30.MAY.2019 23:09:36

802.11n-HT20 Low Channel



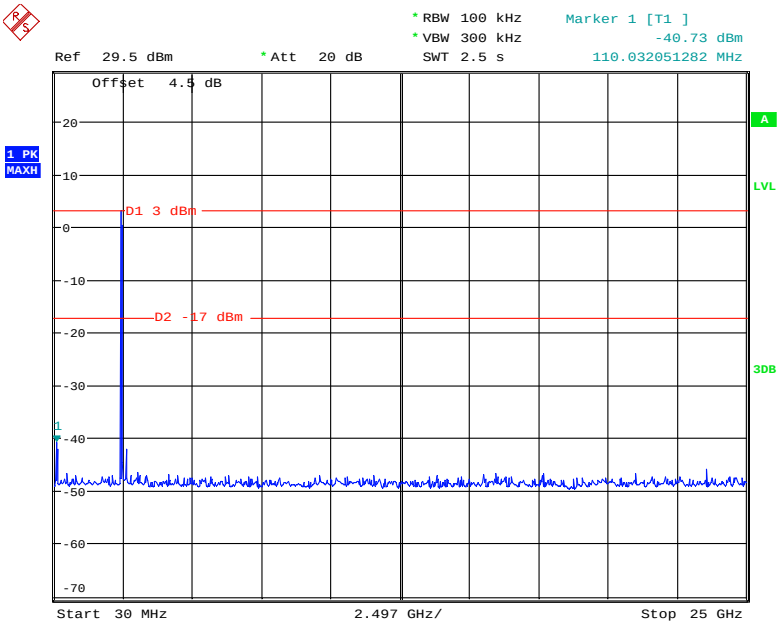
Date: 30.MAY.2019 23:04:35

802.11n-HT20 Middle Channel



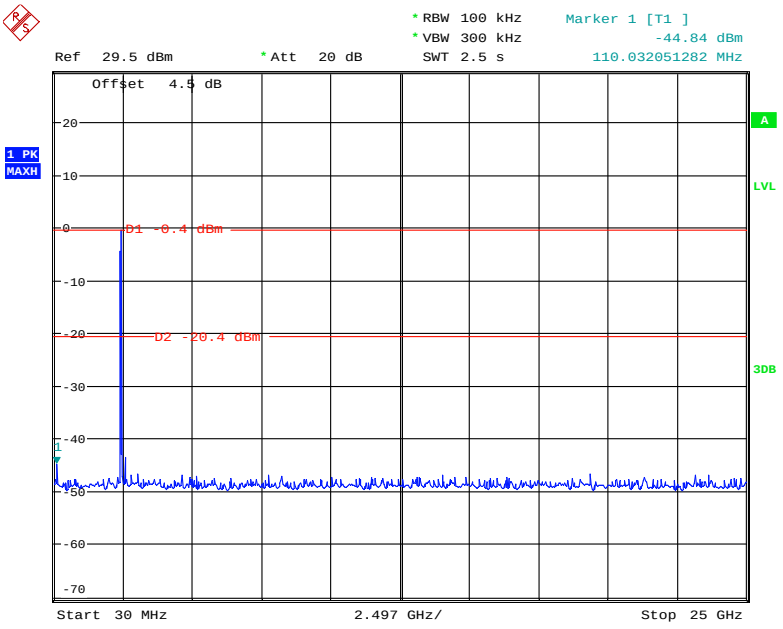
Date: 30.MAY.2019 23:05:34

802.11n-HT20 High Channel



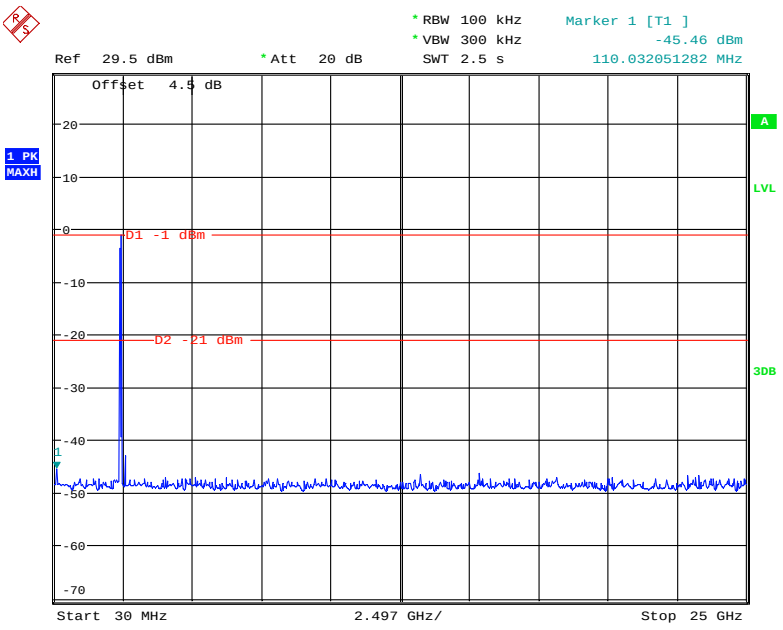
Date: 30.MAY.2019 23:06:32

802.11n-HT40 Low Channel



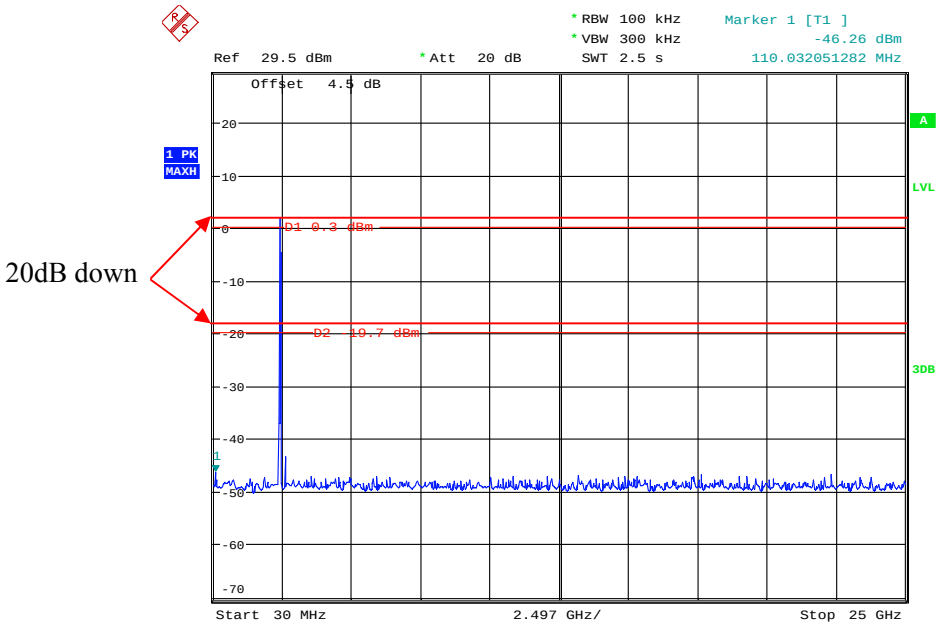
Date: 30.MAY.2019 23:01:45

802.11n-HT40 Middle Channel



Date: 30.MAY.2019 23:02:47

802.11n-HT40 High Channel



Date: 30.MAY.2019 23:03:29

Note: Test result is Compliance.

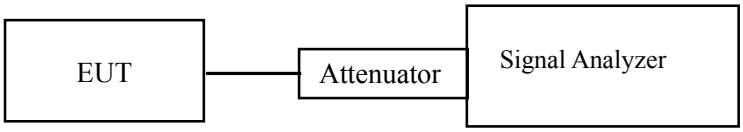
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

Applicable Standard

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

Test Procedure

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



Test Data

Environmental Conditions

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

The testing was performed by James Fu on 2019-05-30.

Test Result: Pass.

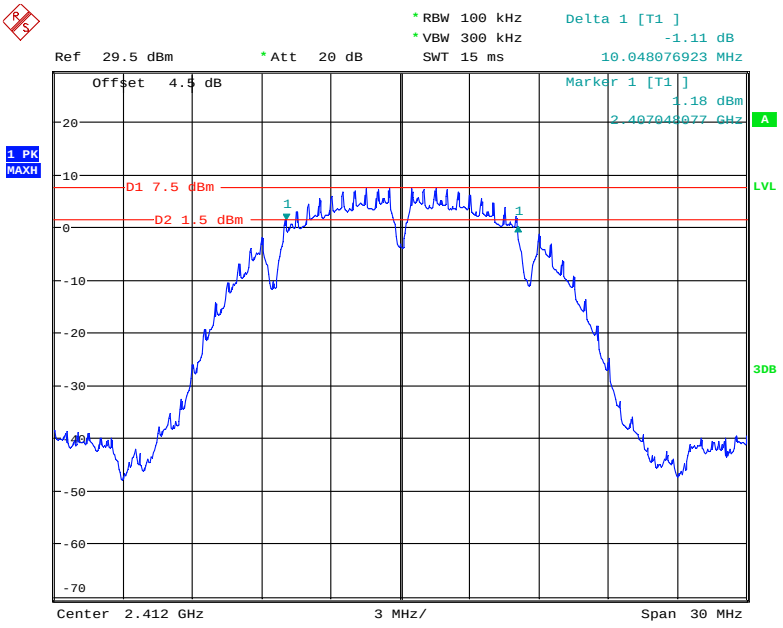
Please refer to the following table and plots.

EUT operation mode: Transmitting

Antenna 0 at Wi-Fi mode:

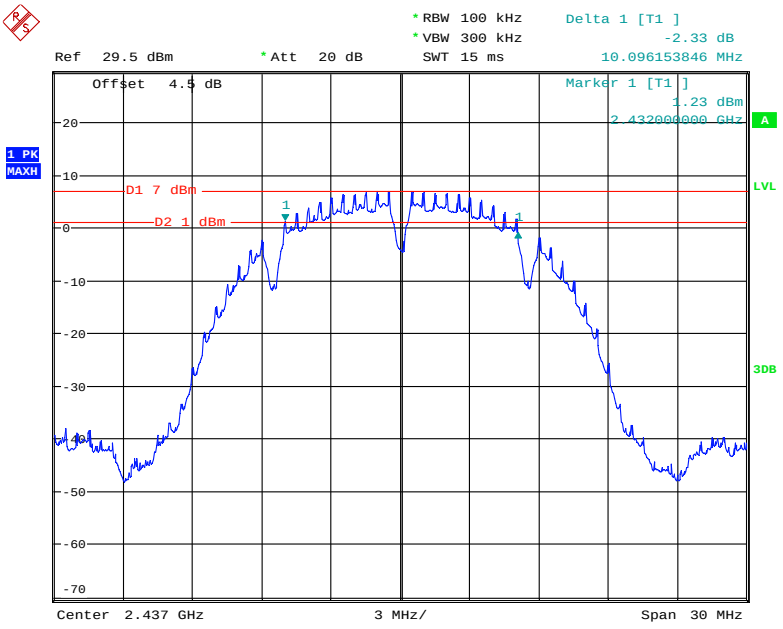
Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (kHz)
802.11b mode			
Low	2412	10.05	≥500
Middle	2437	10.10	≥500
High	2462	10.05	≥500
802.11g mode			
Low	2412	15.14	≥500
Middle	2437	15.19	≥500
High	2462	15.14	≥500
802.11n-HT20 mode			
Low	2412	15.14	≥500
Middle	2437	15.14	≥500
High	2462	15.14	≥500
802.11n-HT40 mode			
Low	2422	34.04	⩾500
Middle	2437	33.94	⩾500
High	2452	33.94	⩾500

802.11b Low Channel



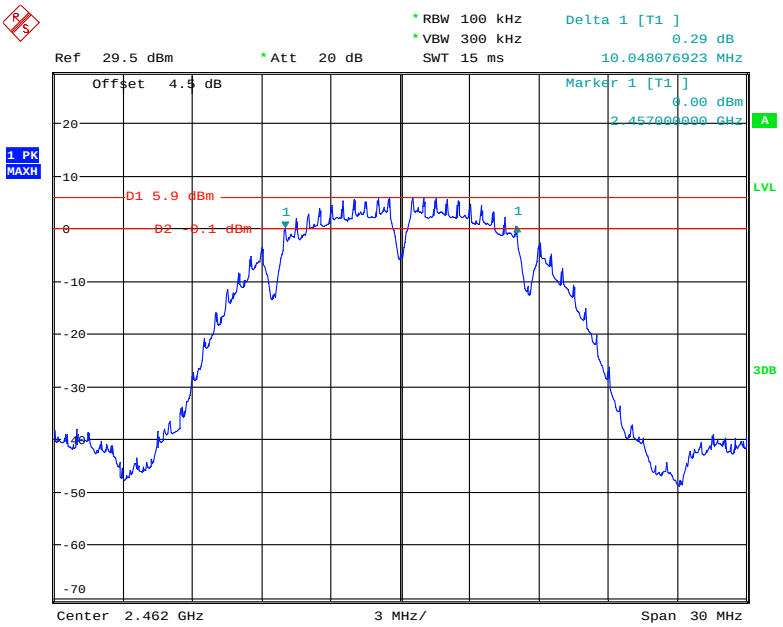
Date: 30.MAY.2019 21:10:21

802.11b Middle Channel



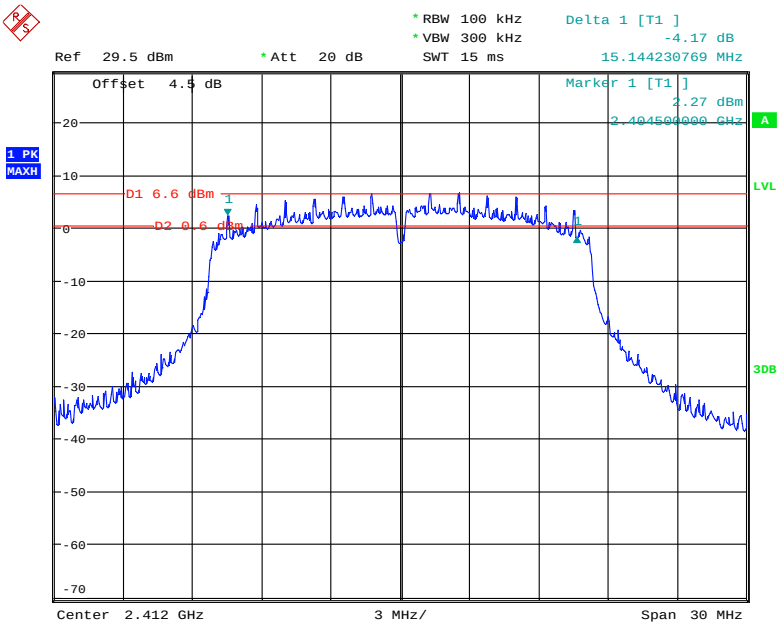
Date: 30.MAY.2019 21:11:36

802.11b High Channel



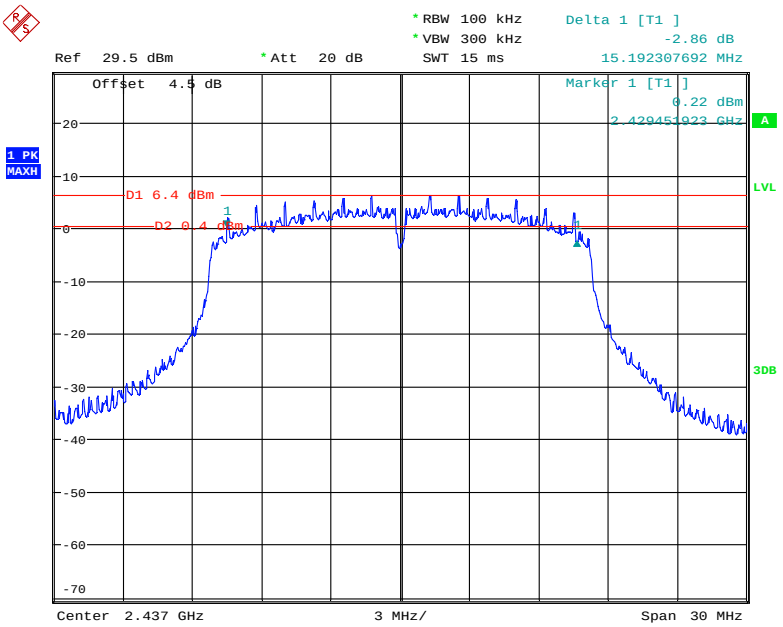
Date: 30.MAY.2019 21:12:38

802.11g Low Channel



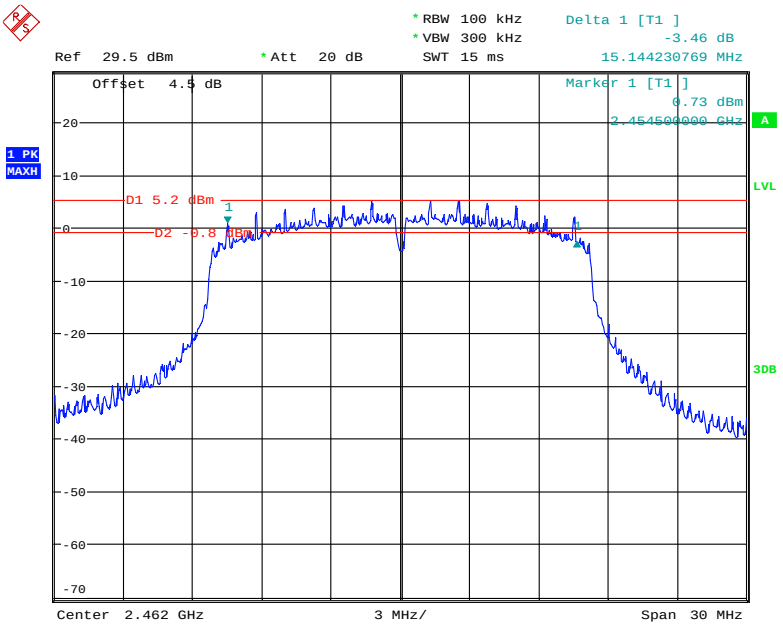
Date: 30.MAY.2019 21:07:50

802.11g Middle Channel



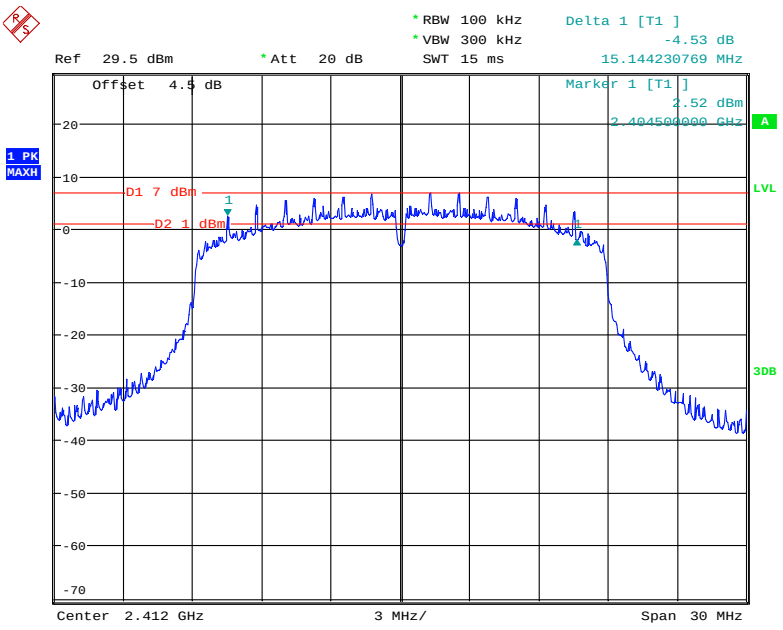
Date: 30.MAY.2019 21:08:36

802.11g High Channel



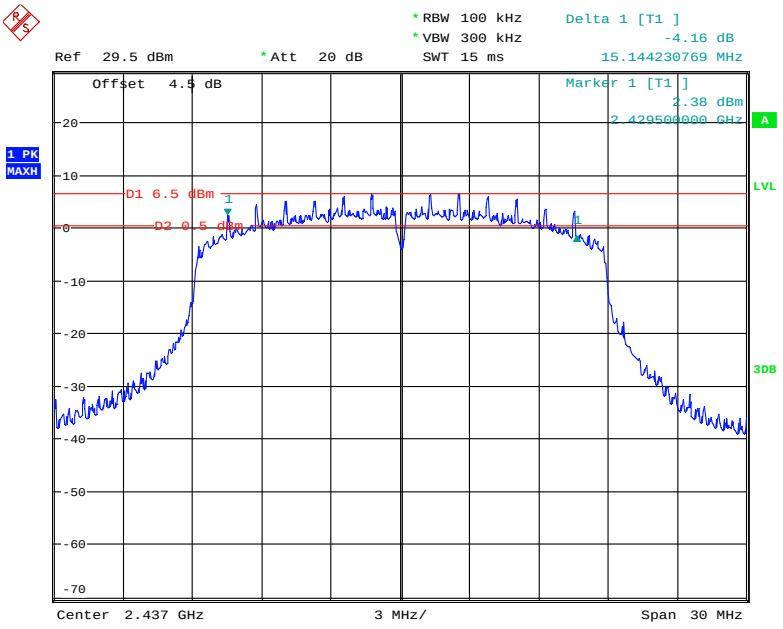
Date: 30.MAY.2019 21:09:25

802.11n-HT20 Low Channel



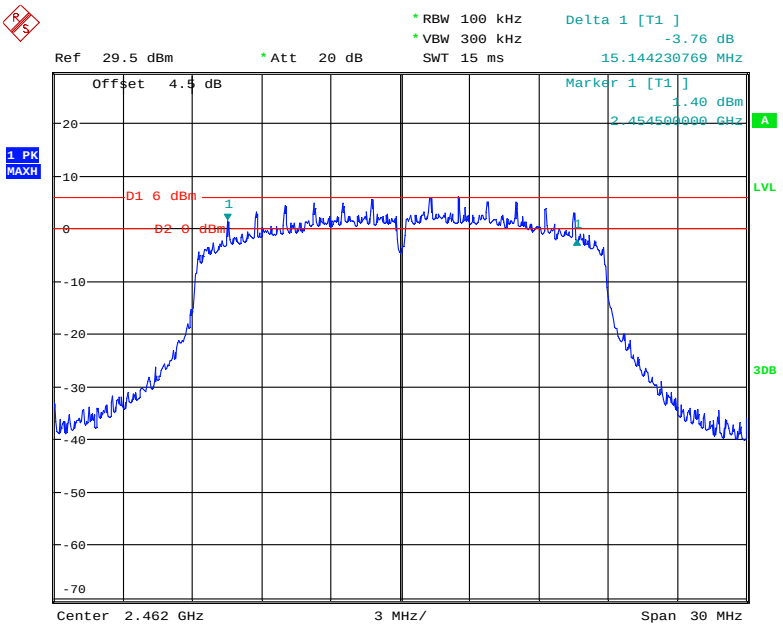
Date: 30.MAY.2019 21:06:44

802.11n-HT20 Middle Channel



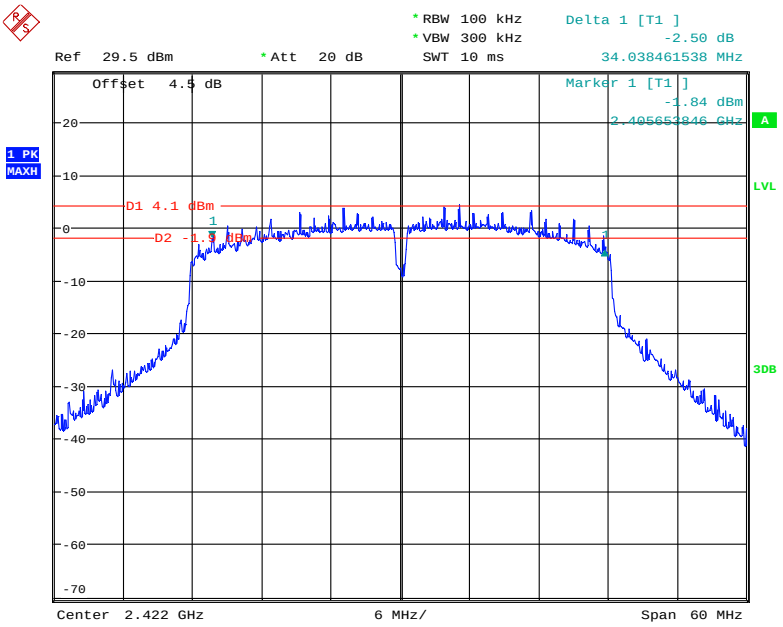
Date: 30.MAY.2019 21:04:10

802.11n-HT20 High Channel



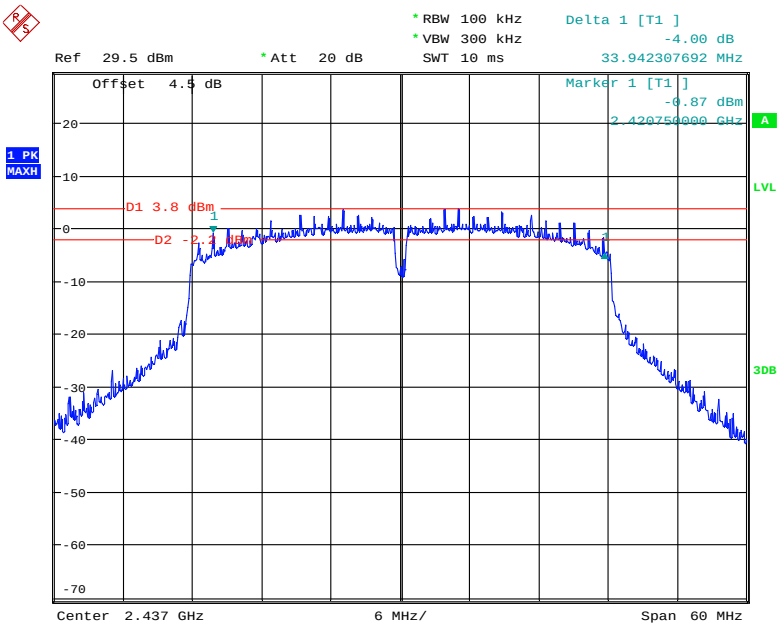
Date: 30.MAY.2019 21:04:59

802.11n-HT40 Low Channel



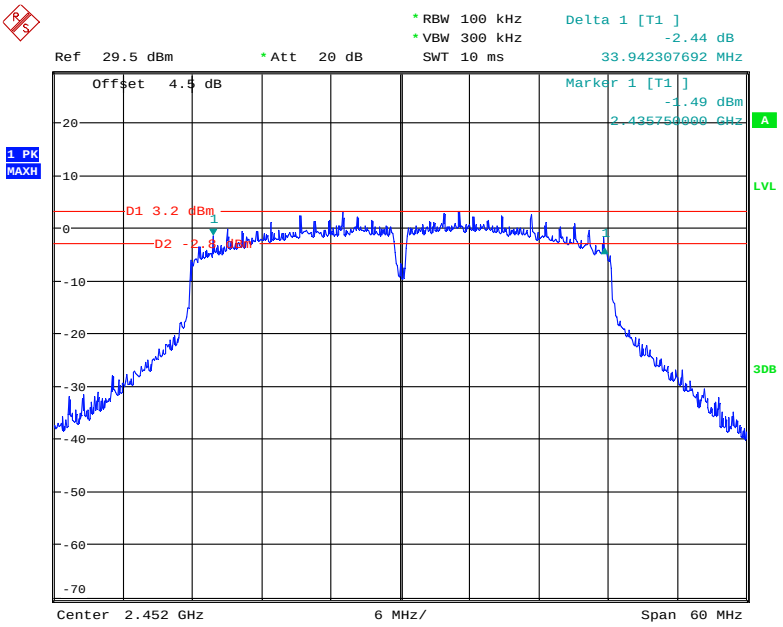
Date: 30.MAY.2019 20:53:41

802.11n-HT40 Middle Channel



Date: 30.MAY.2019 20:52:36

802.11n-HT40 High Channel



Date: 30.MAY.2019 20:51:25

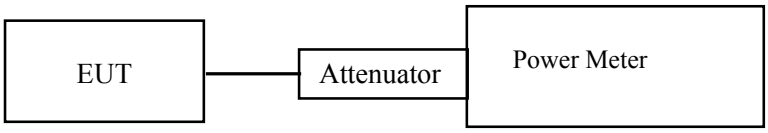
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

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

Test Procedure

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



Test Data

Environmental Conditions

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

The testing was performed by James Fu on 2019-05-30.

EUT operation mode: Transmitting

Note:

The maximum antenna gain is 3.5dBi.
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) =3.5

Wi-Fi mode

Frequency (MHz)	Antenna Port	Peak Conducted Output Power (dBm)	Total Power (dBm)	Conducted Output Power Limit (dBm)
802.11b				
2412	0	19.44	/	30
	1	16.62		
2437	0	19.04	/	30
	1	17.40		
2462	0	18.27	/	30
	1	19.01		
802.11g				
2412	0	24.38	/	30
	1	21.86		
2437	0	24.68	/	30
	1	22.98		
2462	0	23.80	/	30
	1	24.59		
802.11n HT20				
2412	0	24.93	26.51	30
	1	21.36		
2437	0	24.23	26.77	30
	1	23.23		
2462	0	23.84	27.27	30
	1	24.65		
802.11n HT40				
2422	0	25.10	27.06	30
	1	22.66		
2437	0	25.49	27.50	30
	1	23.20		
2452	0	24.61	27.30	30
	1	23.95		

Frequency (MHz)	Antenna Port	Average Conducted Output Power (dBm)	Total Power (dBm)	Conducted Output Power Limit (dBm)
802.11b				
2412	0	16.55	/	30
	1	13.83		
2437	0	16.11	/	30
	1	14.74		
2462	0	15.81	/	30
	1	16.41		
802.11g				
2412	0	18.80	/	30
	1	16.44		
2437	0	18.70	/	30
	1	16.99		
2462	0	17.99	/	30
	1	18.48		
802.11n HT20				
2412	0	18.88	20.61	30
	1	15.79		
2437	0	18.56	20.74	30
	1	16.71		
2462	0	17.91	21.35	30
	1	18.73		
802.11n HT40				
2422	0	19.56	21.39	30
	1	16.76		
2437	0	19.42	21.55	30
	1	17.44		
2452	0	18.54	21.27	30
	1	17.97		

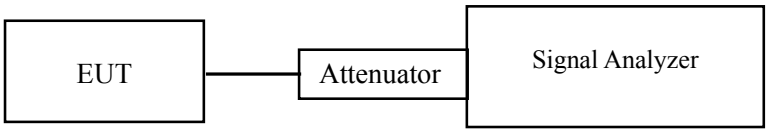
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

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

The testing was performed by James Fu on 2019-05-30.

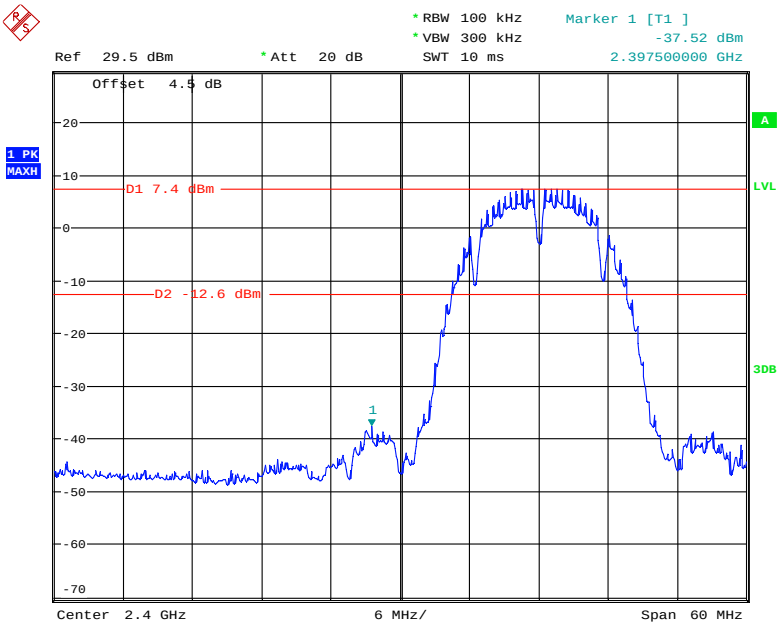
EUT operation mode: Transmitting

Test Result: Compliance

Please refer to the following plots.

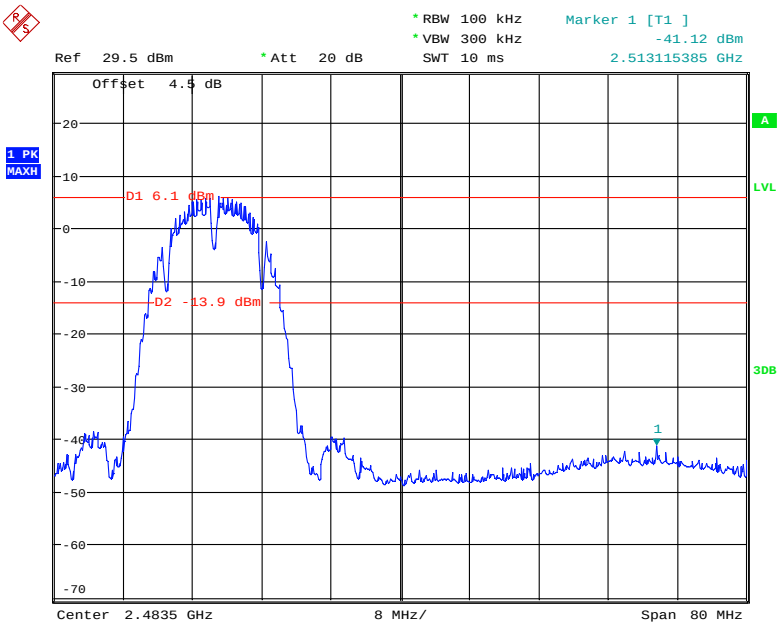
Antenna 0 at Wi-Fi mode:

802.11b: Band Edge, Left Side



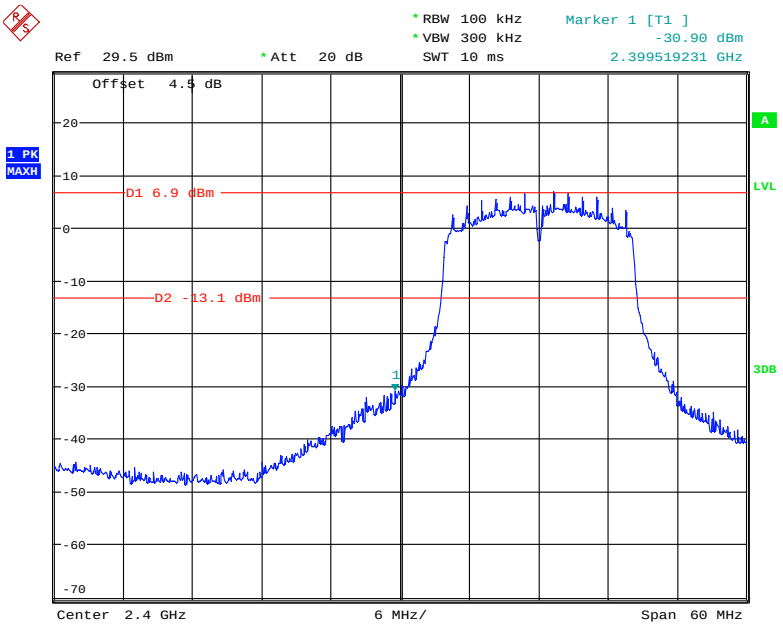
Date: 30.MAY.2019 21:16:42

802.11b: Band Edge, Right Side



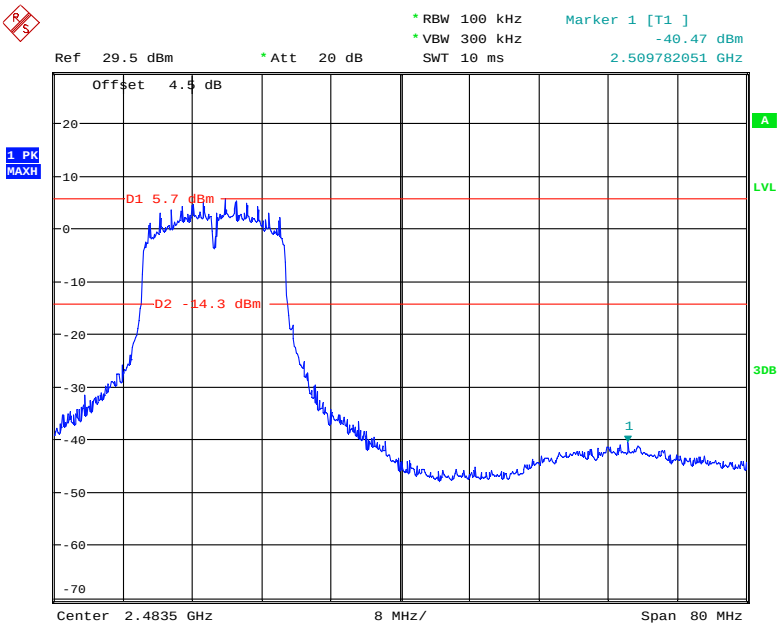
Date: 30.MAY.2019 21:14:47

802.11g: Band Edge, Left Side



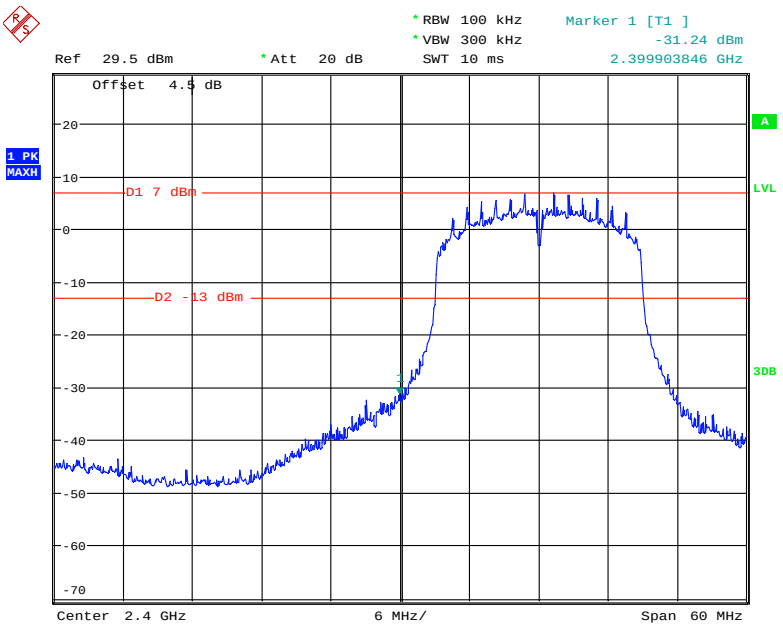
Date: 30.MAY.2019 21:17:48

802.11g: Band Edge, Right Side



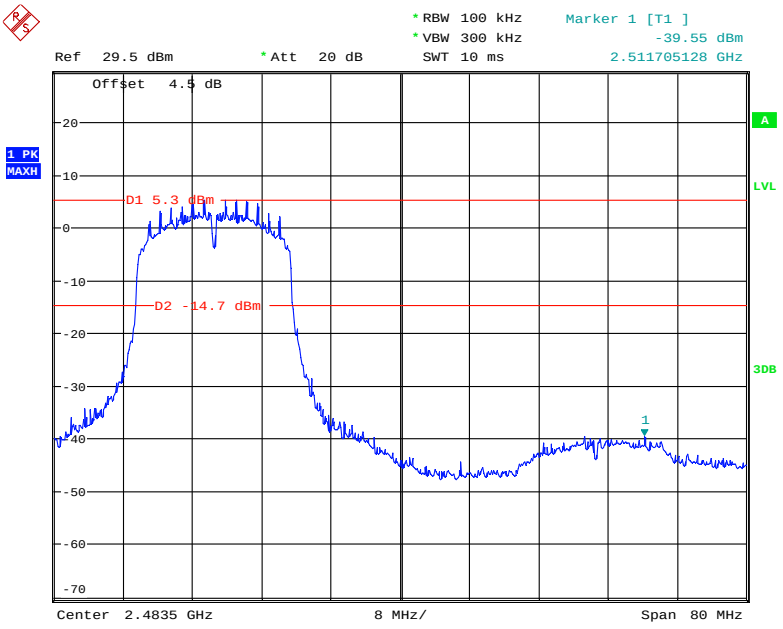
Date: 30.MAY.2019 21:19:04

802.11n-HT20: Band Edge, Left Side



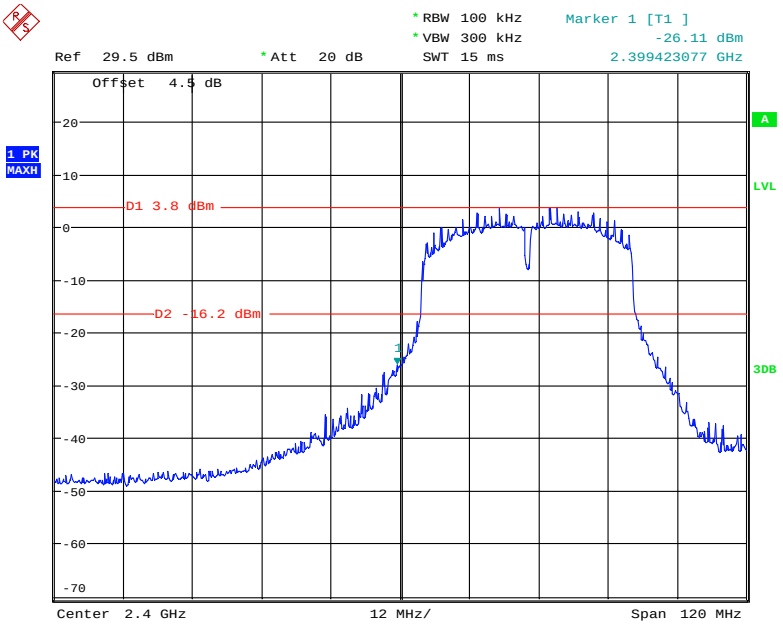
Date: 30.MAY.2019 21:20:06

802.11n-HT20: Band Edge, Right Side



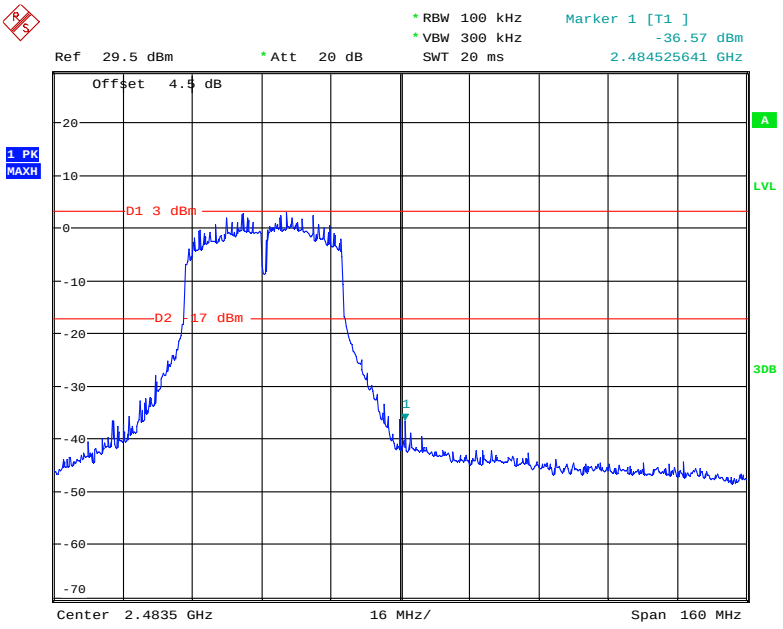
Date: 30.MAY.2019 21:26:22

802.11n-HT40: Band Edge, Left Side



Date: 30.MAY.2019 21:28:02

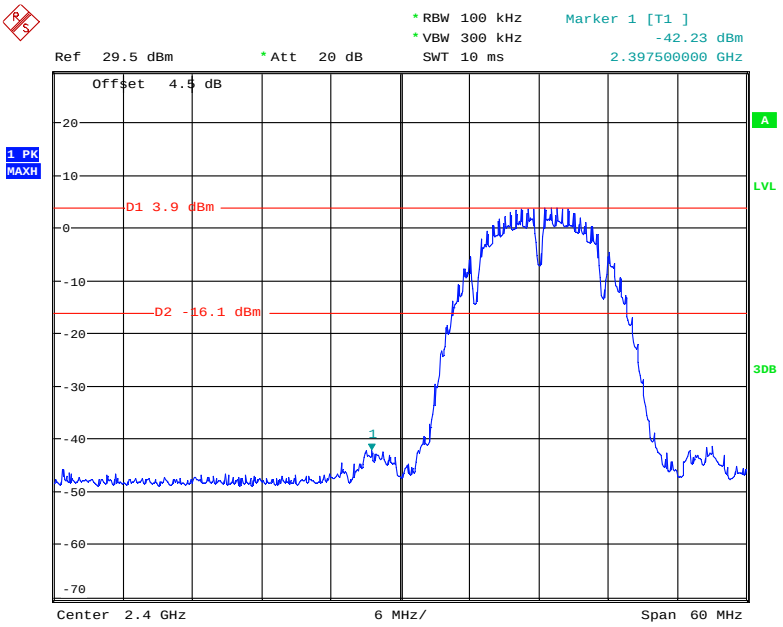
802.11n-HT40: Band Edge, Right Side



Date: 30.MAY.2019 21:28:58

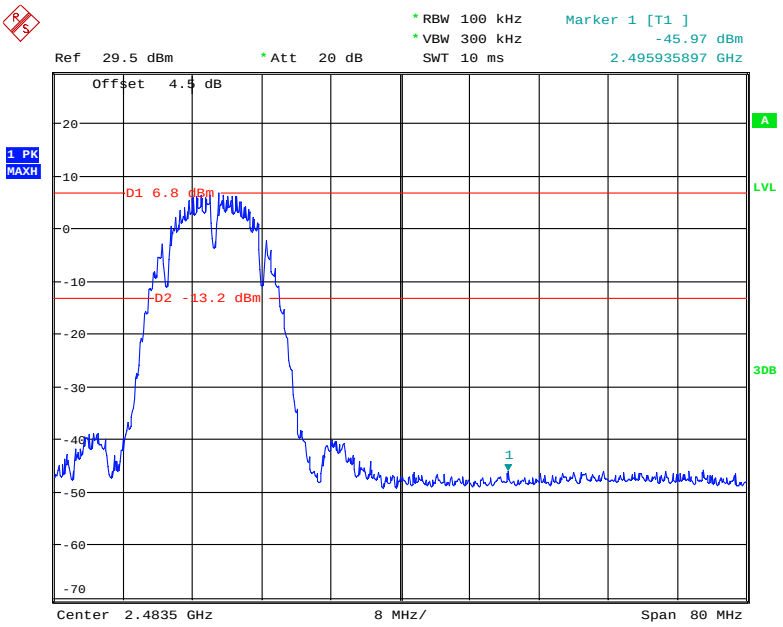
Antenna 1 at Wi-Fi mode:

802.11b: Band Edge, Left Side



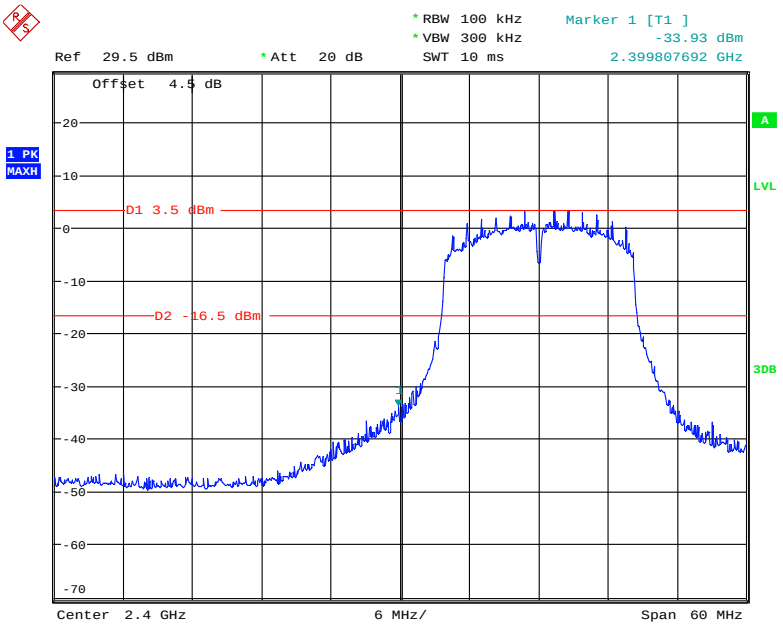
Date: 30.MAY.2019 22:39:18

802.11b: Band Edge, Right Side



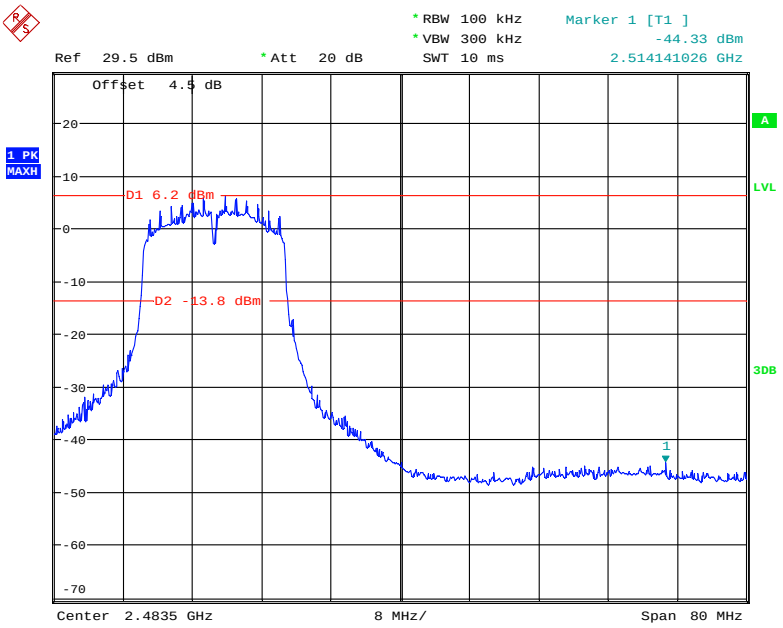
Date: 30.MAY.2019 22:40:17

802.11g: Band Edge, Left Side



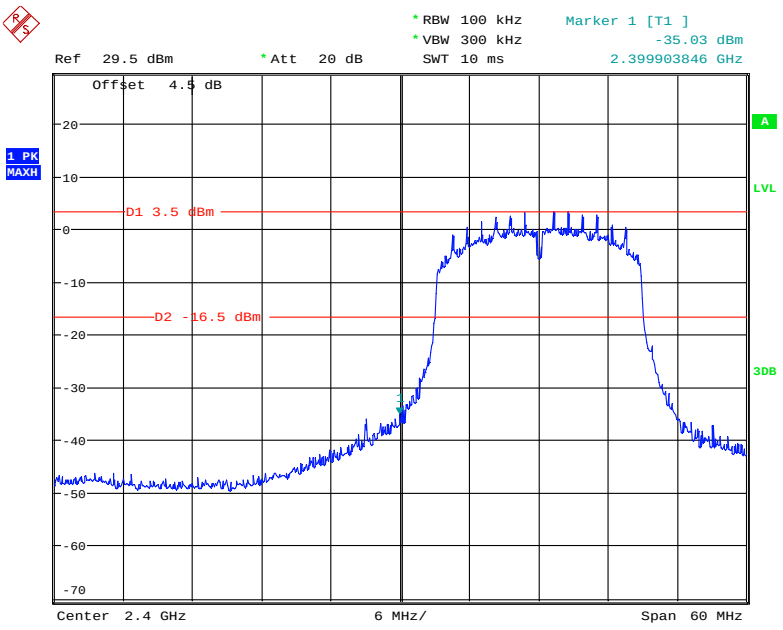
Date: 30.MAY.2019 22:42:22

802.11g: Band Edge, Right Side



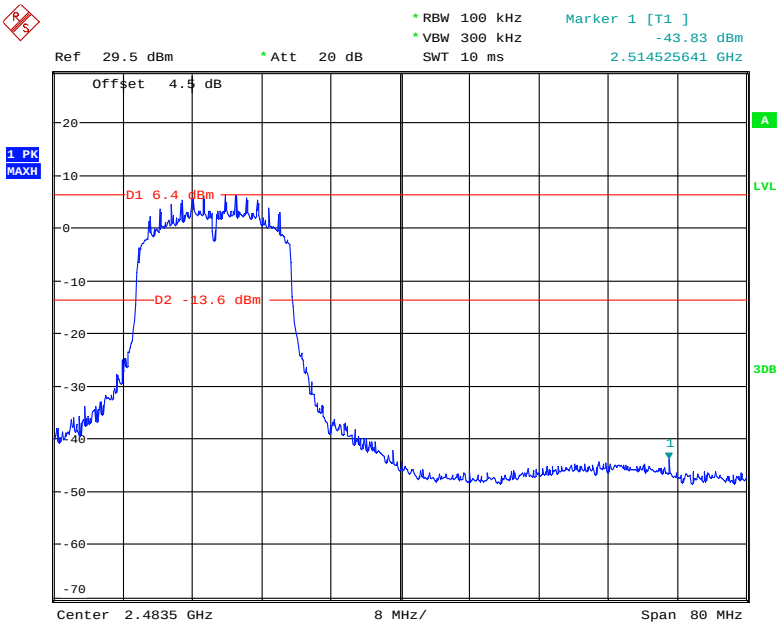
Date: 30.MAY.2019 22:41:39

802.11n-HT20: Band Edge, Left Side



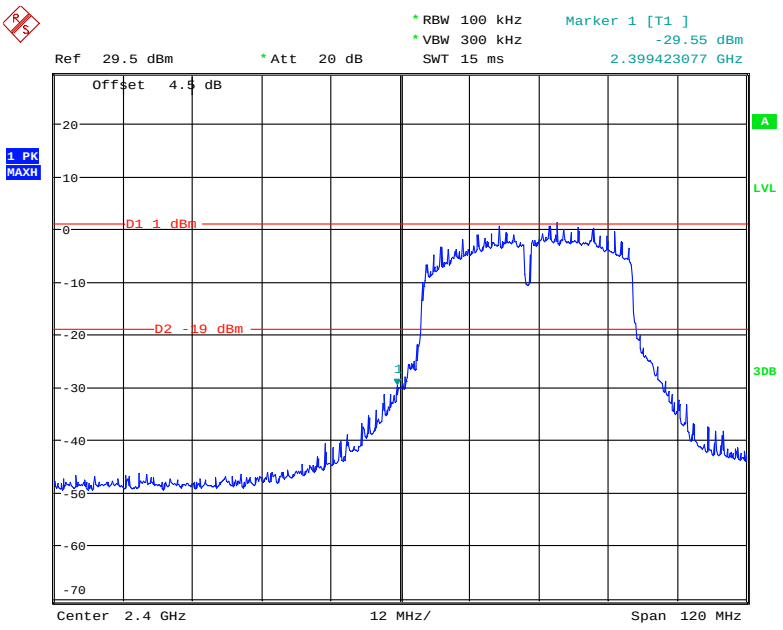
Date: 30.MAY.2019 22:43:40

802.11n-HT20: Band Edge, Right Side



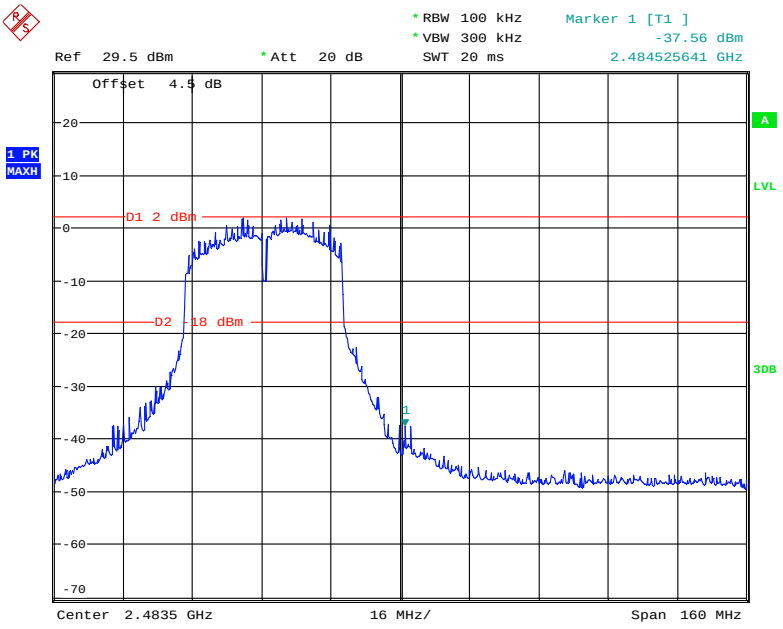
Date: 30.MAY.2019 22:45:07

802.11n-HT40: Band Edge, Left Side



Date: 30.MAY.2019 22:46:14

802.11n-HT40: Band Edge, Right Side



Date: 30.MAY.2019 22:47:09

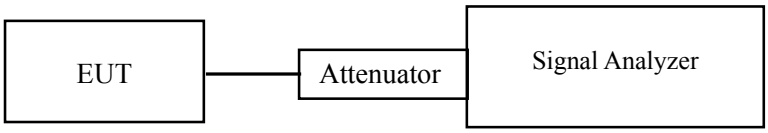
FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

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

Test Procedure

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



Test Data

Environmental Conditions

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

The testing was performed by James Fu on 2019-05-30.

EUT operation mode: Transmitting

Test Result: Pass

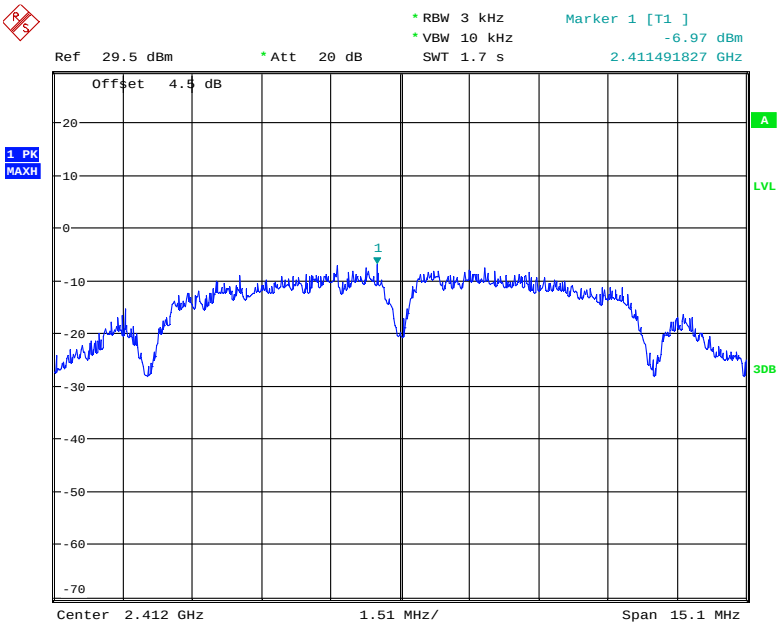
Note:

The maximum antenna gain is 3.5dBi.
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) =6.5dBi.

Frequency (MHz)	Antenna Port	PSD (dBm/3kHz)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b				
2412	0	-6.97	/	≤8
	1	-10.75		
2437	0	-7.19	/	≤8
	1	-9.16		
2462	0	-8.06	/	≤8
	1	-9.14		
802.11g				
2412	0	-8.29	/	≤8
	1	-10.88		
2437	0	-7.89	/	≤8
	1	-8.56		
2462	0	-8.06	/	≤8
	1	-8.94		
802.11n HT20				
2412	0	-8.17	-6.43	≤7.5
	1	-11.25		
2437	0	-8.57	-6.31	≤7.5
	1	-10.23		
2462	0	-9.41	-5.84	≤7.5
	1	-8.35		
802.11n HT40				
2422	0	-10.99	-8.16	≤7.5
	1	-11.35		
2437	0	-11.30	-8.87	≤7.5
	1	-12.55		
2452	0	-11.47	-8.57	≤7.5
	1	-11.70		

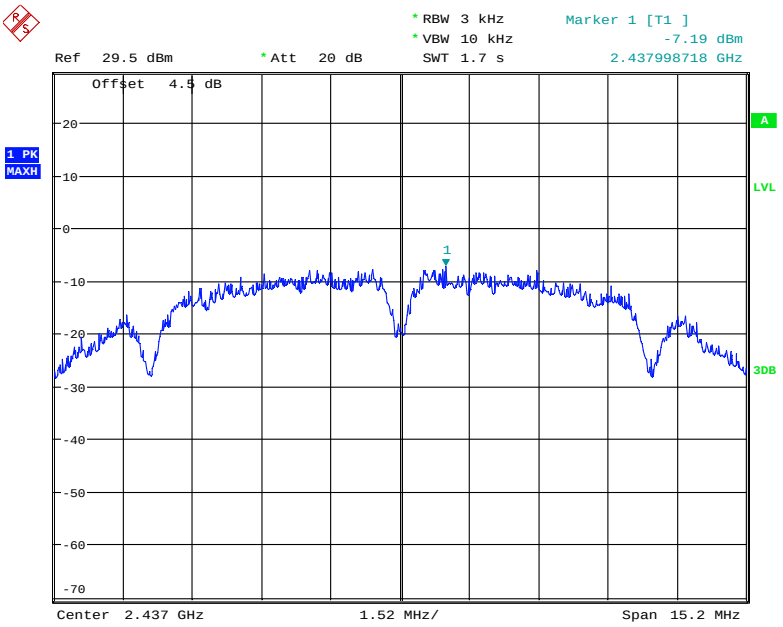
Antenna 0 at Wi-Fi mode:

Power Spectral Density, 802.11b Low Channel



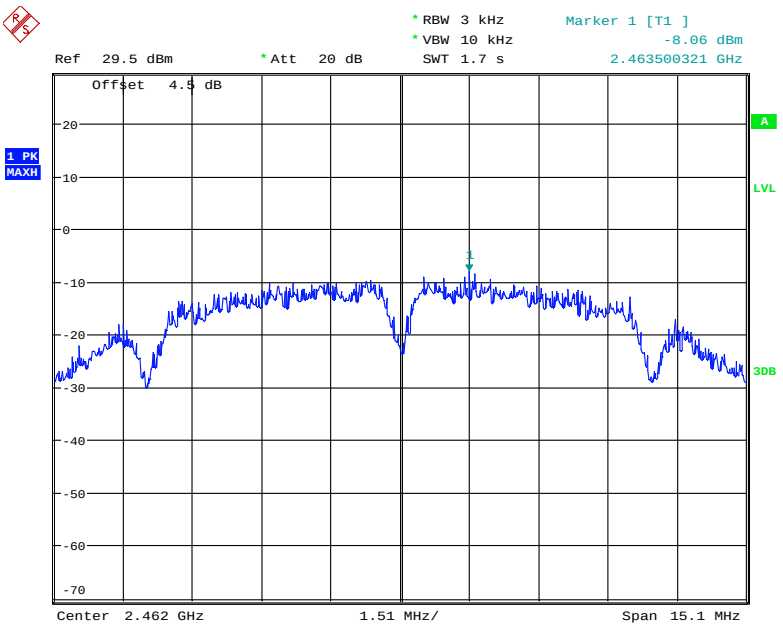
Date: 30.MAY.2019 21:44:56

Power Spectral Density, 802.11b Middle Channel



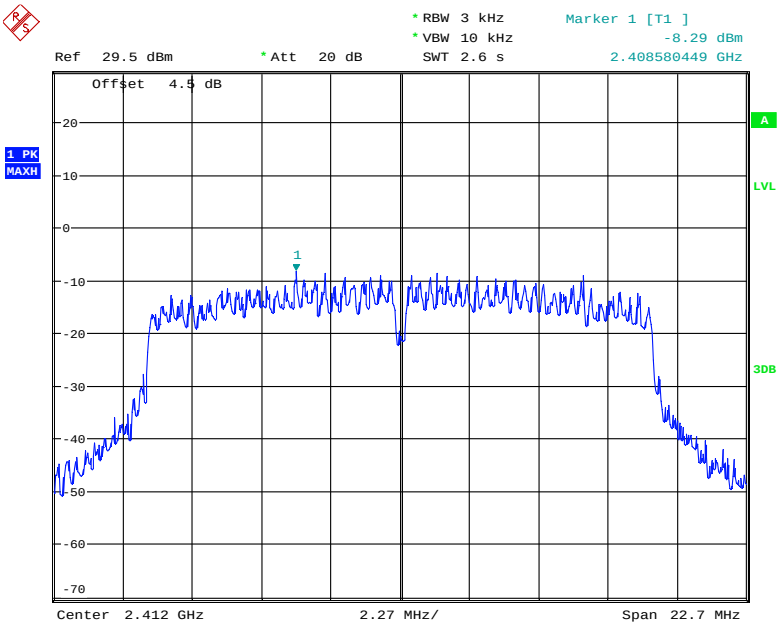
Date: 30.MAY.2019 21:45:48

Power Spectral Density, 802.11b High Channel



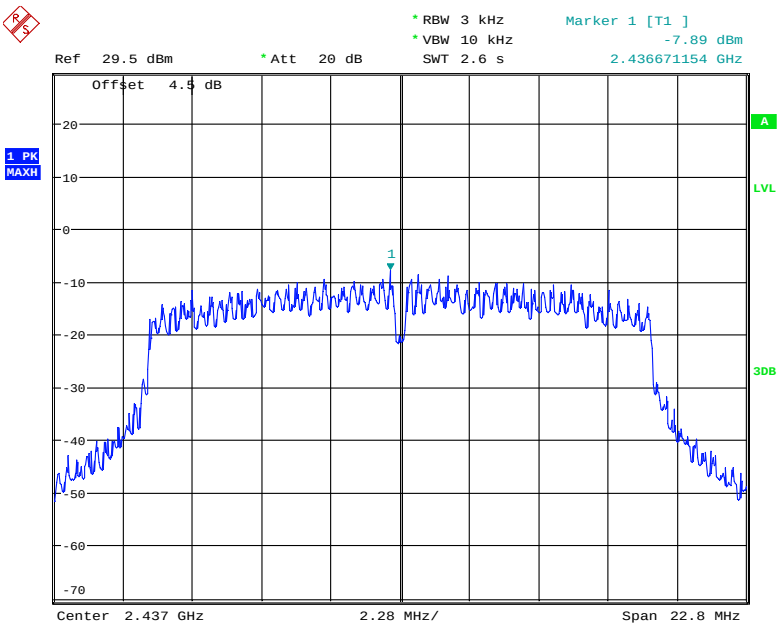
Date: 30.MAY.2019 21:46:19

Power Spectral Density, 802.11g Low Channel



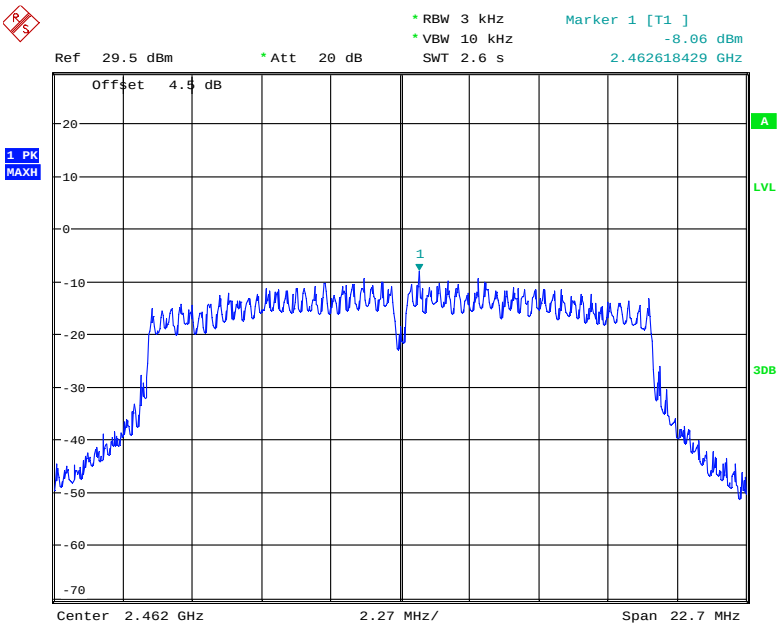
Date: 30.MAY.2019 21:41:41

Power Spectral Density, 802.11g Middle Channel



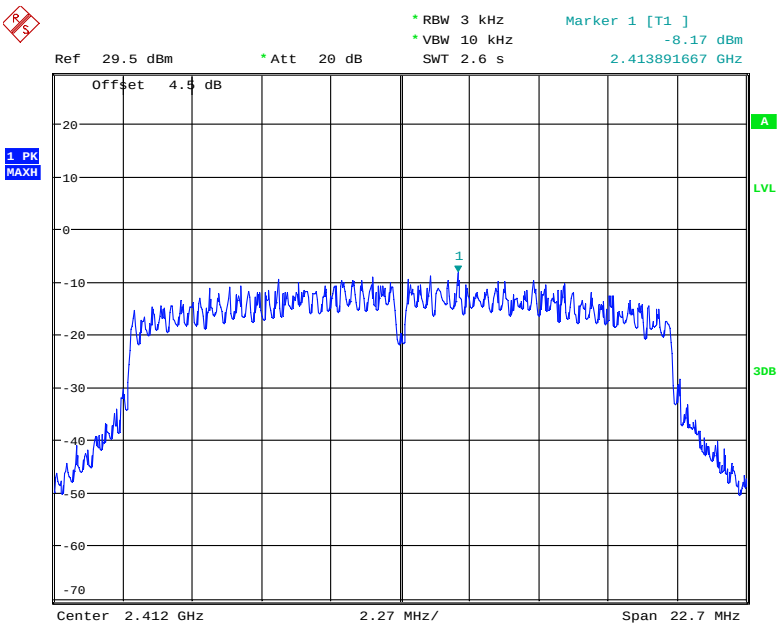
Date: 30.MAY.2019 21:42:22

Power Spectral Density, 802.11g High Channel



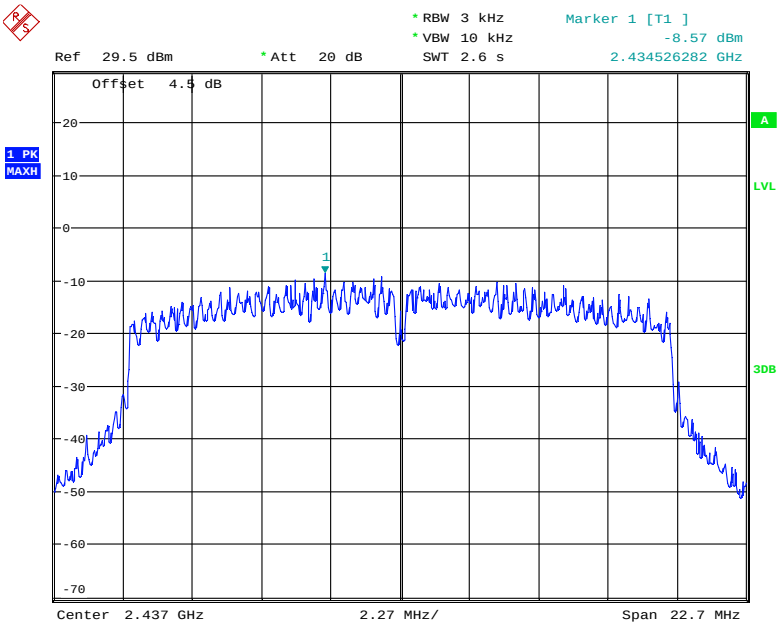
Date: 30.MAY.2019 21:43:02

Power Spectral Density, 802.11n-HT20 Low Channel



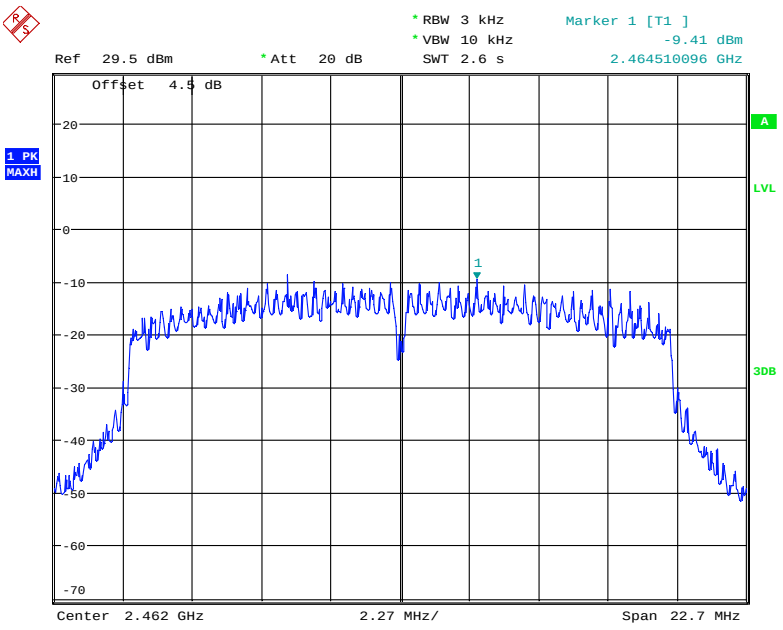
Date: 30.MAY.2019 21:39:39

Power Spectral Density, 802.11n-HT20 Middle Channel



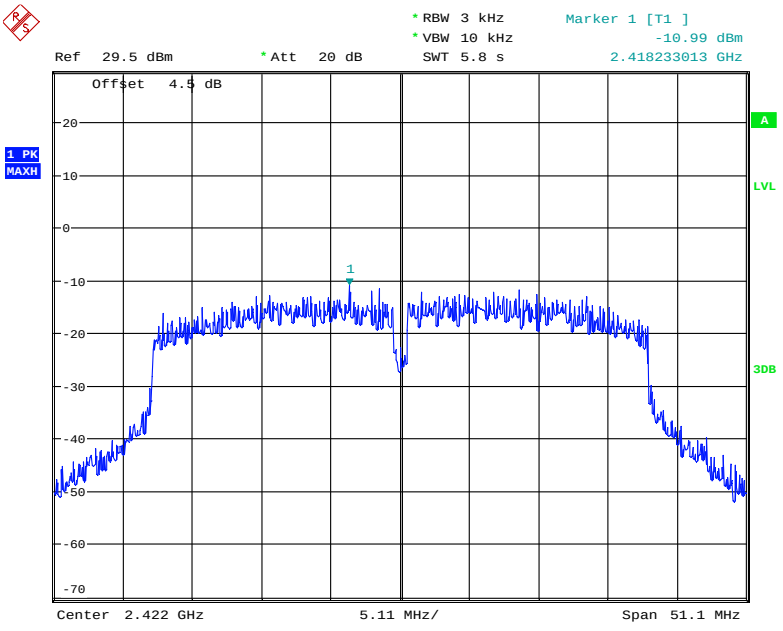
Date: 30.MAY.2019 21:40:16

Power Spectral Density, 802.11n-HT20 High Channel



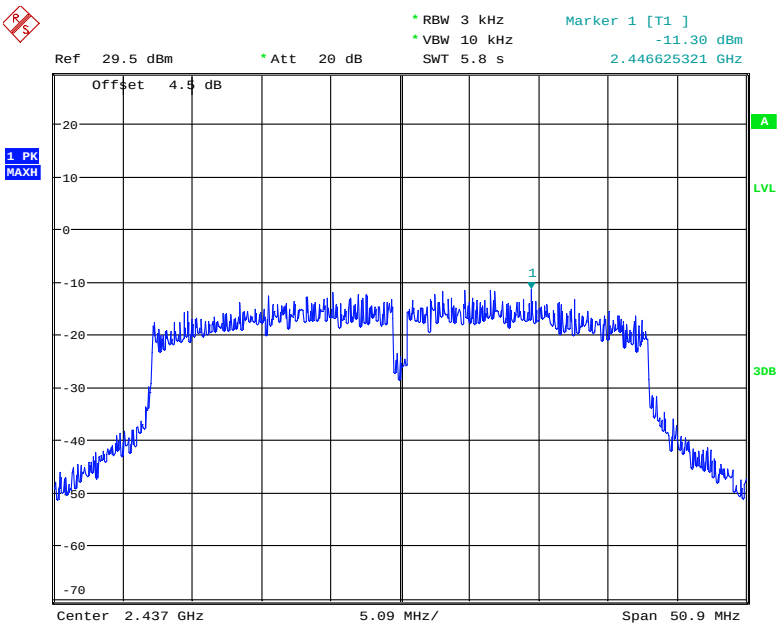
Date: 30.MAY.2019 21:40:54

Power Spectral Density, 802.11n-HT40 Low Channel



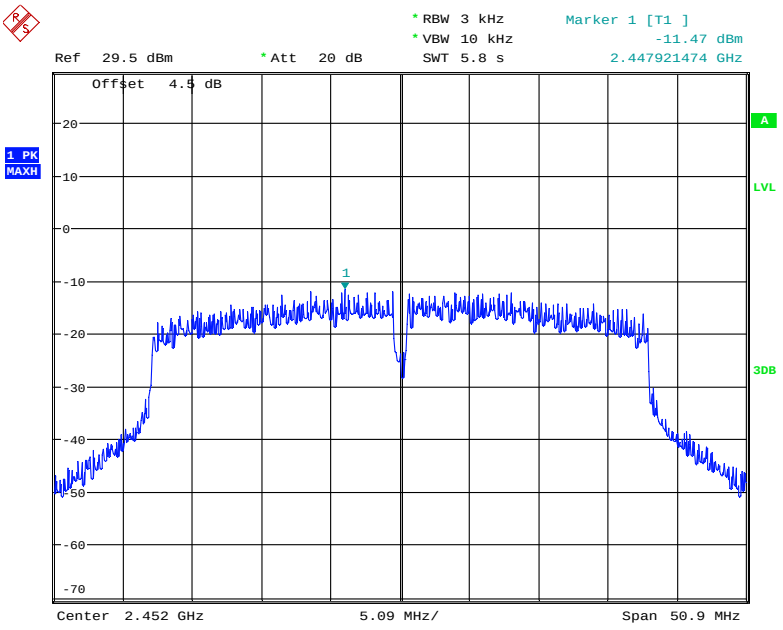
Date: 30.MAY.2019 21:38:58

Power Spectral Density, 802.11n-HT40 Middle Channel



Date: 30.MAY.2019 21:37:56

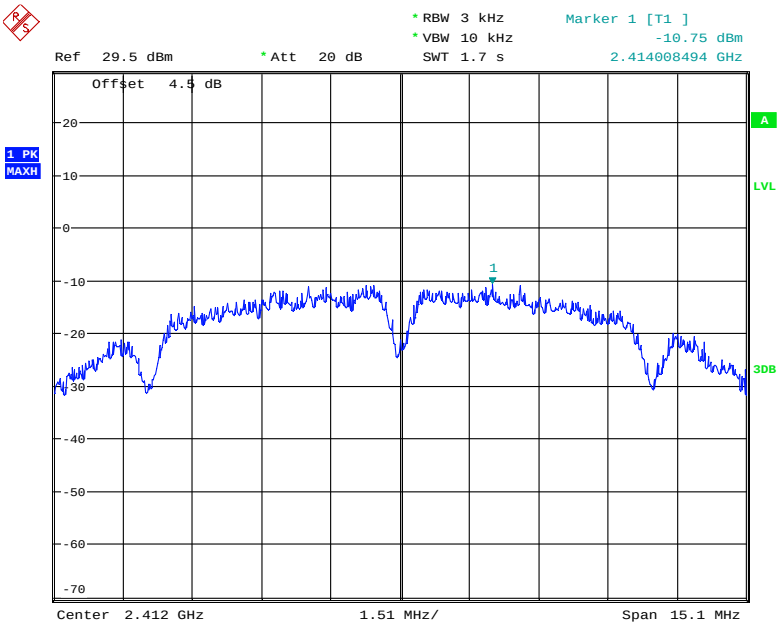
Power Spectral Density, 802.11n-HT40 High Channel



Date: 30.MAY.2019 21:37:00

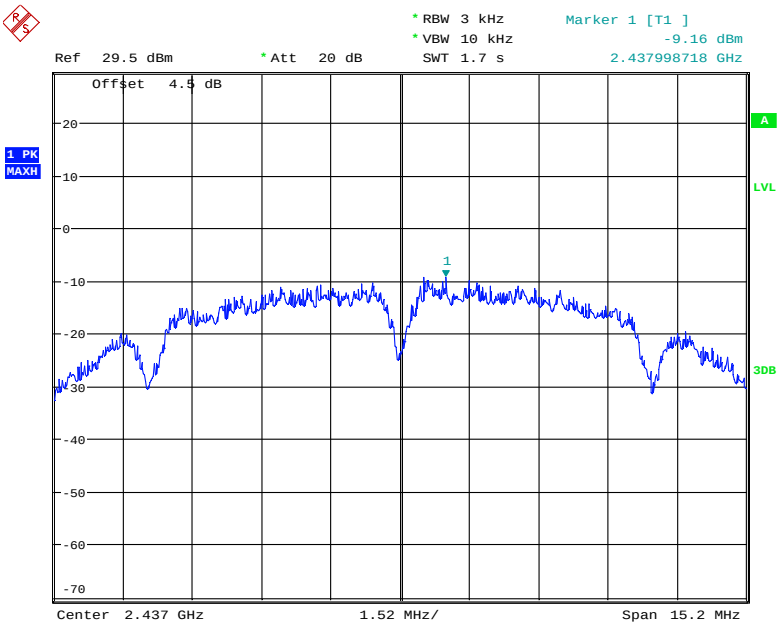
Antenna 1 at Wi-Fi mode:

Power Spectral Density, 802.11b Low Channel



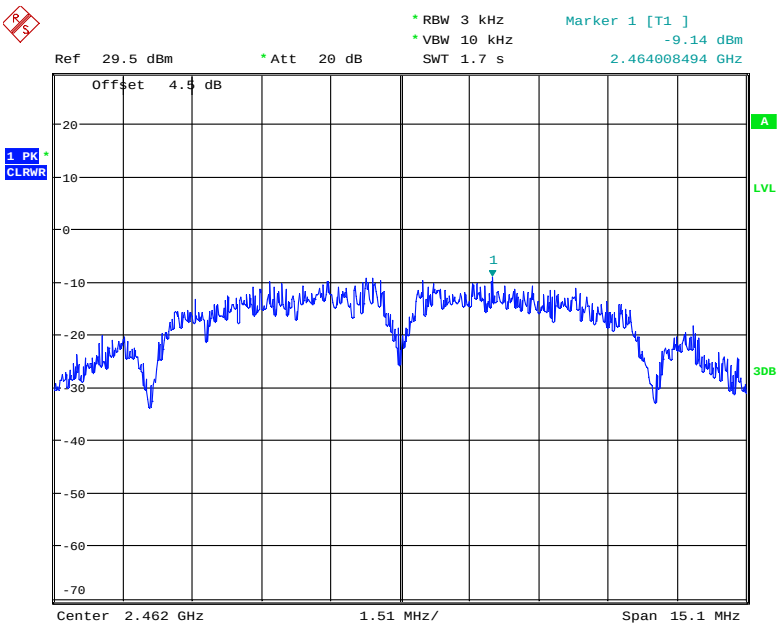
Date: 30.MAY.2019 22:54:43

Power Spectral Density, 802.11b Middle Channel



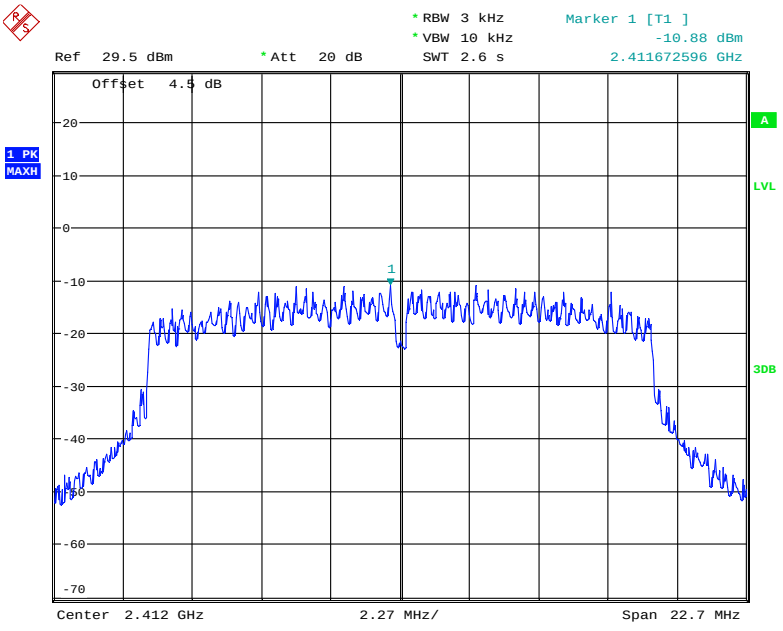
Date: 30.MAY.2019 22:55:18

Power Spectral Density, 802.11b High Channel



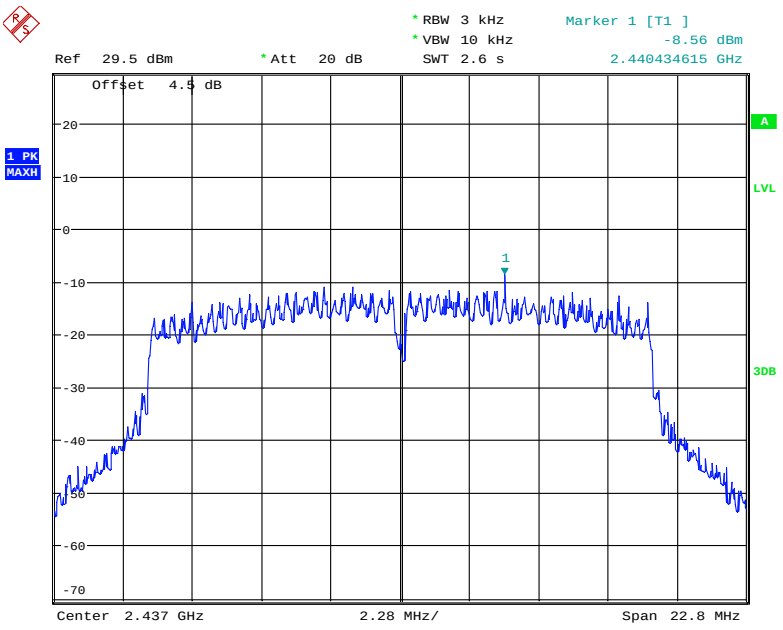
Date: 30.MAY.2019 22:55:57

Power Spectral Density, 802.11g Low Channel



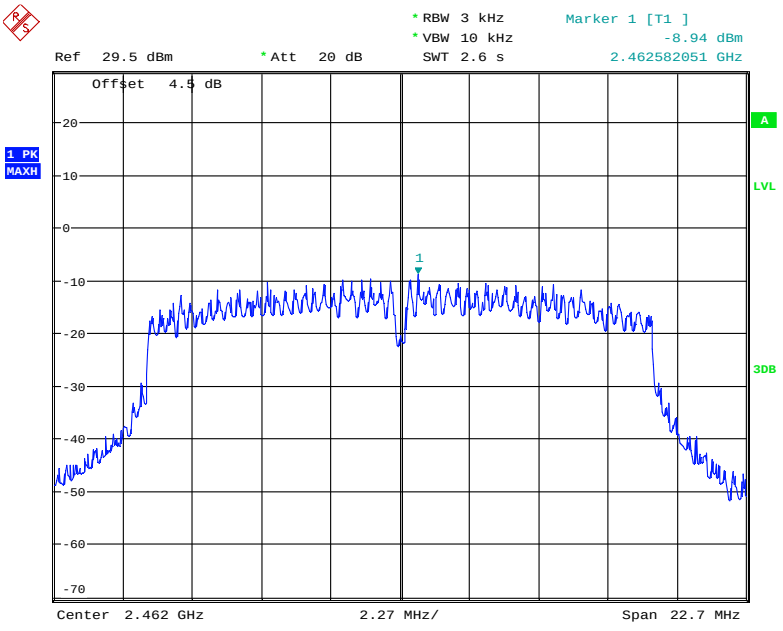
Date: 30.MAY.2019 22:52:03

Power Spectral Density, 802.11g Middle Channel



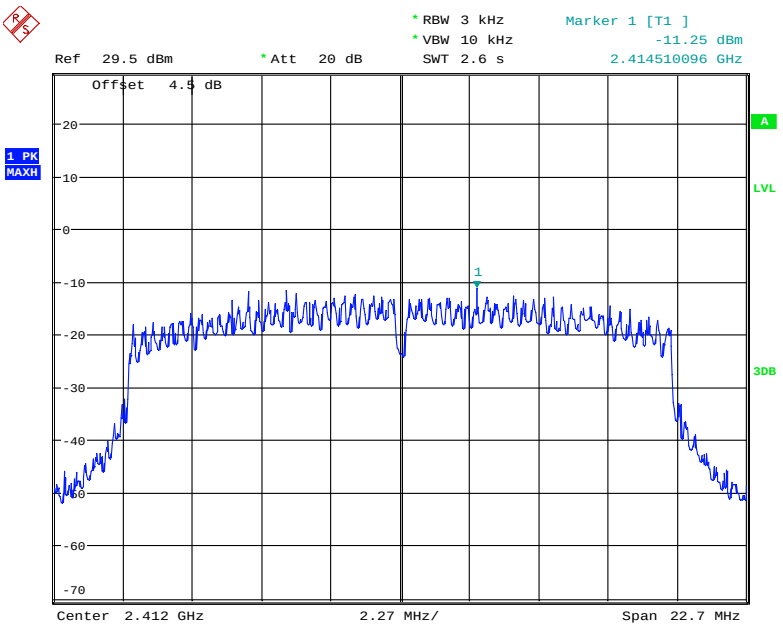
Date: 30.MAY.2019 22:52:45

Power Spectral Density, 802.11g High Channel



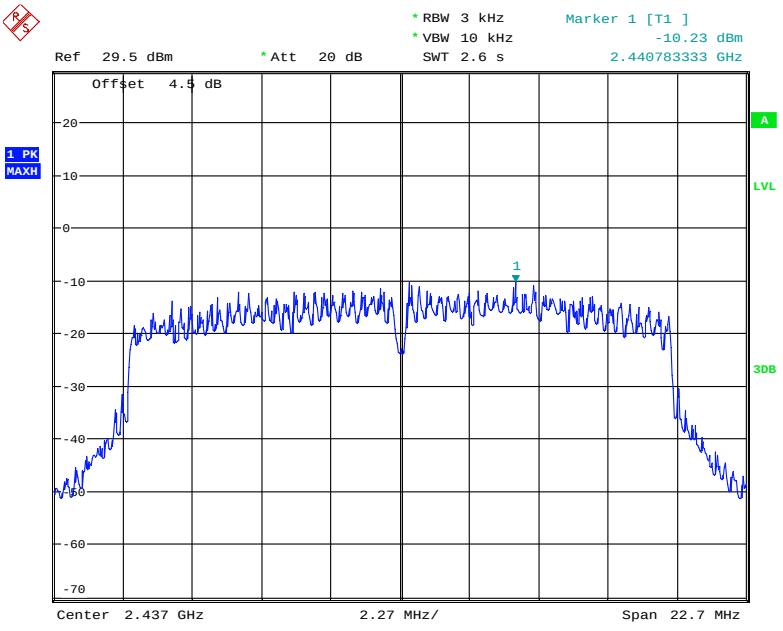
Date: 30.MAY.2019 22:54:09

Power Spectral Density, 802.11n-HT20 Low Channel



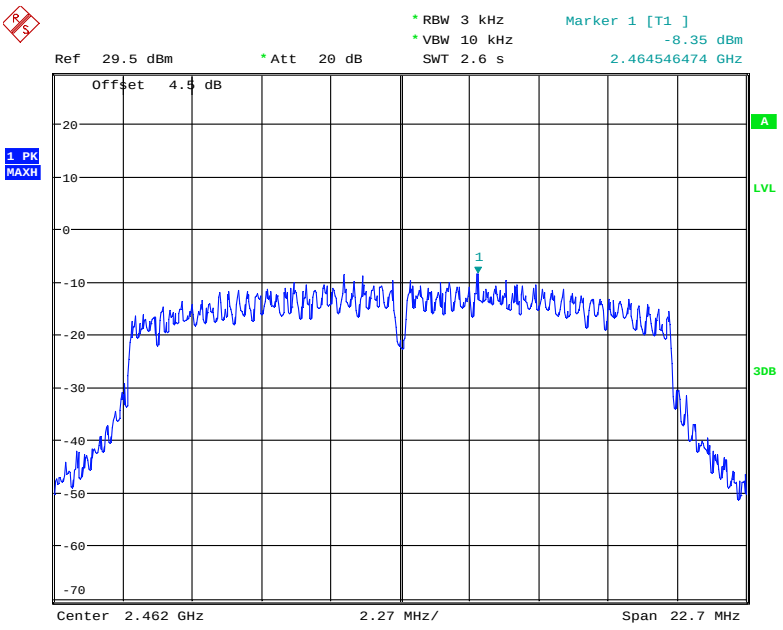
Date: 30.MAY.2019 22:49:55

Power Spectral Density, 802.11n-HT20 Middle Channel



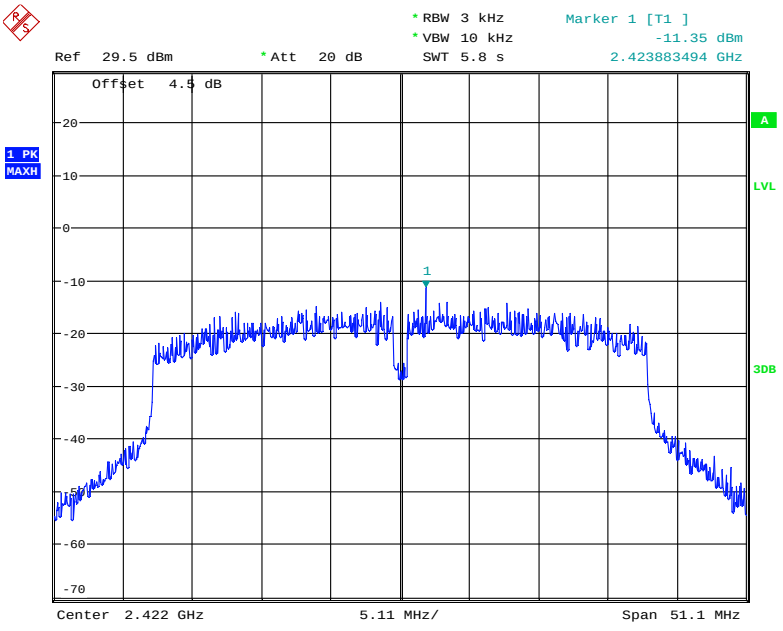
Date: 30.MAY.2019 22:50:50

Power Spectral Density, 802.11n-HT20 High Channel



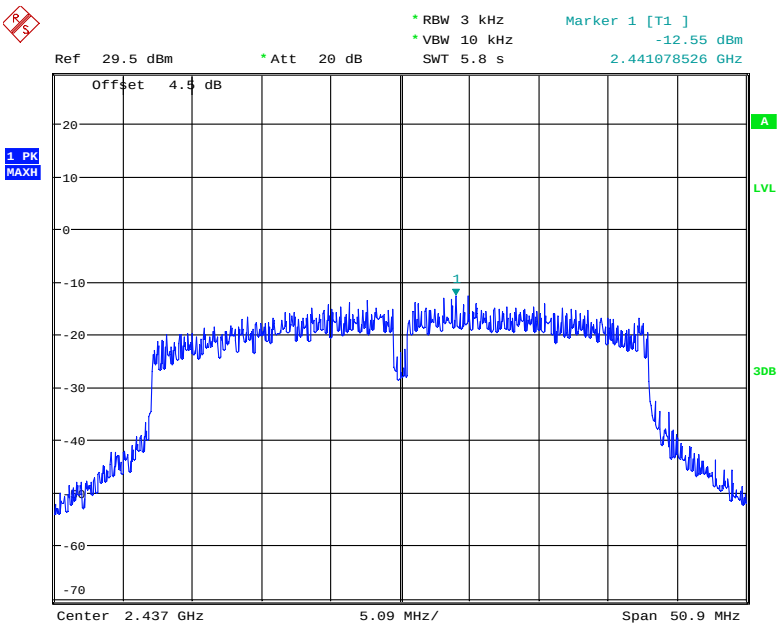
Date: 30.MAY.2019 22:51:24

Power Spectral Density, 802.11n-HT40 Low Channel



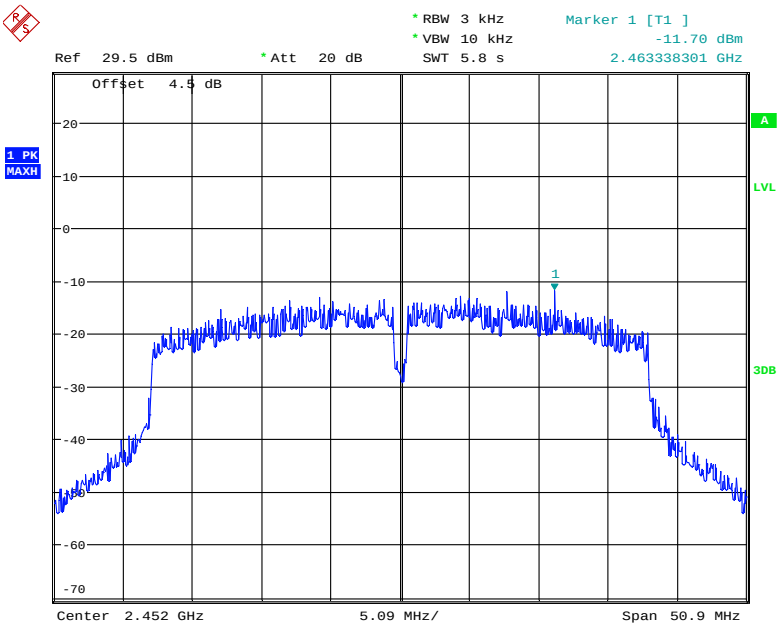
Date: 30.MAY.2019 22:49:16

Power Spectral Density, 802.11n-HT40 Middle Channel



Date: 30.MAY.2019 22:48:36

Power Spectral Density, 802.11n-HT40 High Channel



Date: 30.MAY.2019 22:47:52

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