

FCC PART 15.247

TEST REPORT

For

Shenzhen Intellirocks Tech. Co., Ltd.

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FCC ID: 2AQA6-H7021

Report Type: Original Report	Product Type: Govee Lynx Dream LED Bulb String Lights
Report Number: SZ4210525-19286E-RF-00	
Report Date: 2021-08-16	
Reviewed By: RF Engineer	Jacob Kong
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TEST DATA56

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Govee Lynx Dream LED Bulb String Lights
Tested Model	H7021
Multiple Model	H7020
Model Differences	Refer to the DoS letter
Frequency Range	BLE: 2402-2480MHz Wi-Fi: 2412-2472MHz/2422-2462MHz
Maximum Conducted Peak Output Power	BLE: -6.25dBm Wi-Fi: 12.29dBm
Modulation Technique	BLE: GFSK Wi-Fi: DSSS, OFDM
Antenna Specification*	BLE: 1.5dBi(provided by the applicant) Wi-Fi: 1.5dBi(provided by the applicant)
Voltage Range	DC12V from adapter
Date of Test	2021-06-26 to 2021-08-10
Sample serial number	SZ4210525-19286E-RF-S_7VM (Assigned by BACL, Shenzhen)
Received date	2021-05-25
Sample/EUT Status	Good condition
Adapter information	Model: CW1202000US Input: AC 100-240V, 50/60Hz, 0.8A MAX Output: DC 12V, 2000mA

Objective

This report is 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.

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. Each test item follows test standards and with no deviation.

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: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. 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 5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, 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 lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0023.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

Wi-Fi

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, EUT was tested with Channel 3, 7 and 11

BLE

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

BLE: “SSCOM_v5.13.1” software was use to the EUT tested and power level is 8. The power level was provided by the applicant.

2.4GWIFI: “UI-mptool” software was use to the EUT tested and power level is default*. The power level was provided by the applicant.

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

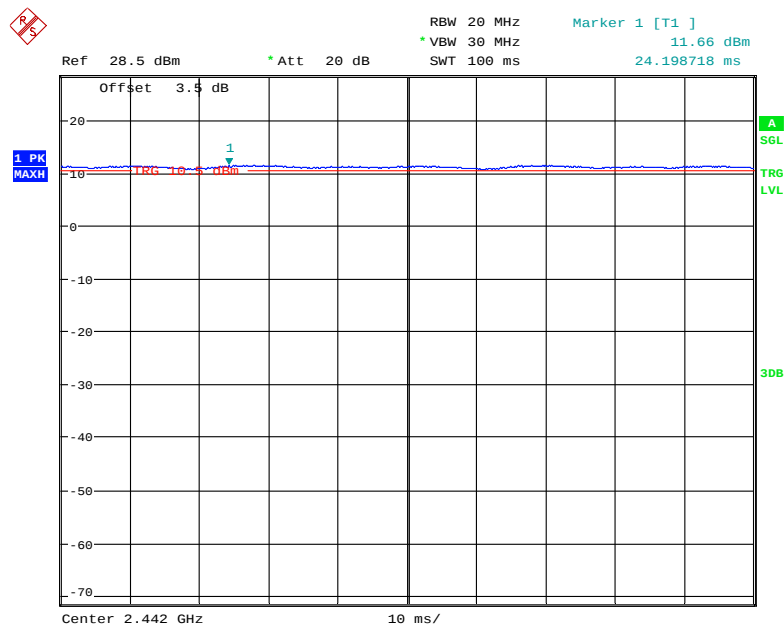
Mode	Data rate	Power level*		
		Low channel	Middle channel	High channel
802.11b	1 Mbps	default	default	default
802.11g	6 Mbps	default	default	default
802.11n-HT20	MCS0	default	default	default
802.11n-HT40	MCS0	default	default	default
BLE	/	8	8	8

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

The software and power level was provided by the applicant.

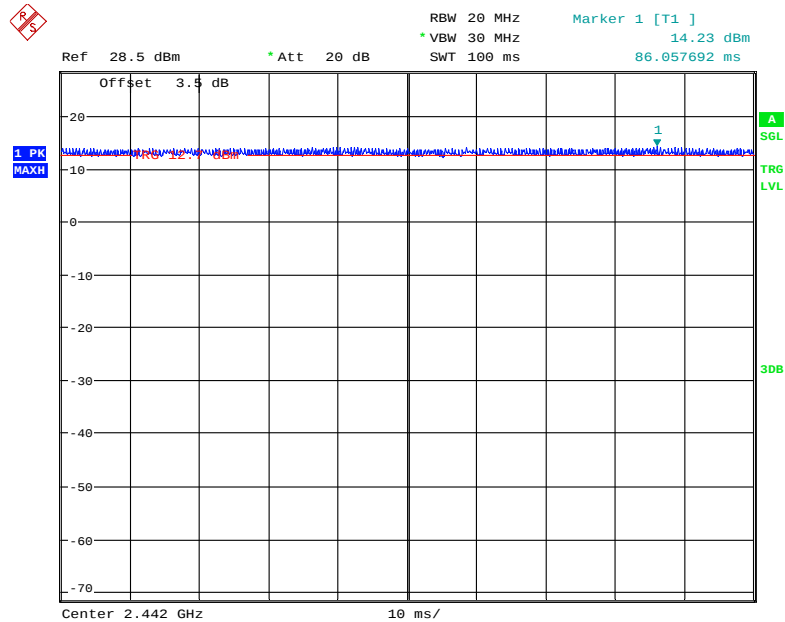
Duty cycle

802.11b mode



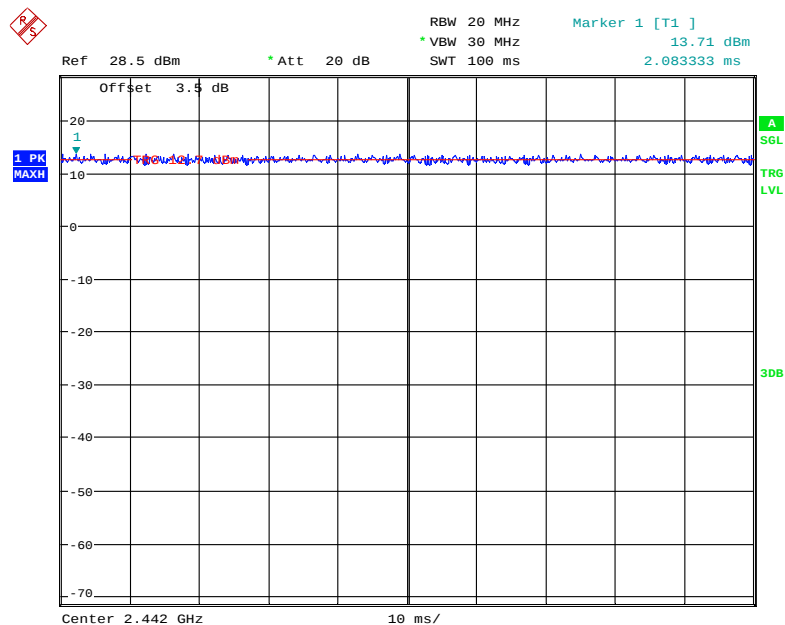
Date: 22. JUL. 2021 00:55:02

802.11g mode



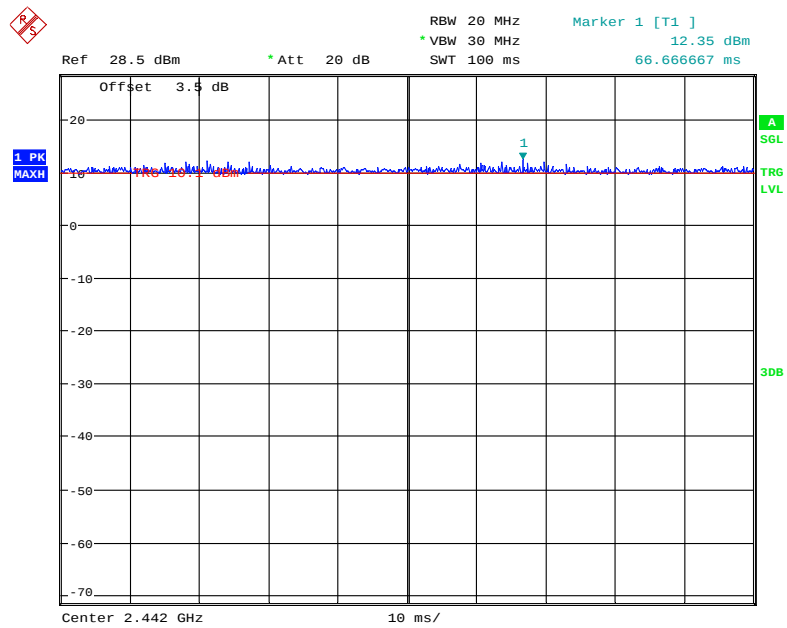
Date: 22.JUL.2021 00:55:40

802.11n-HT20 Mode



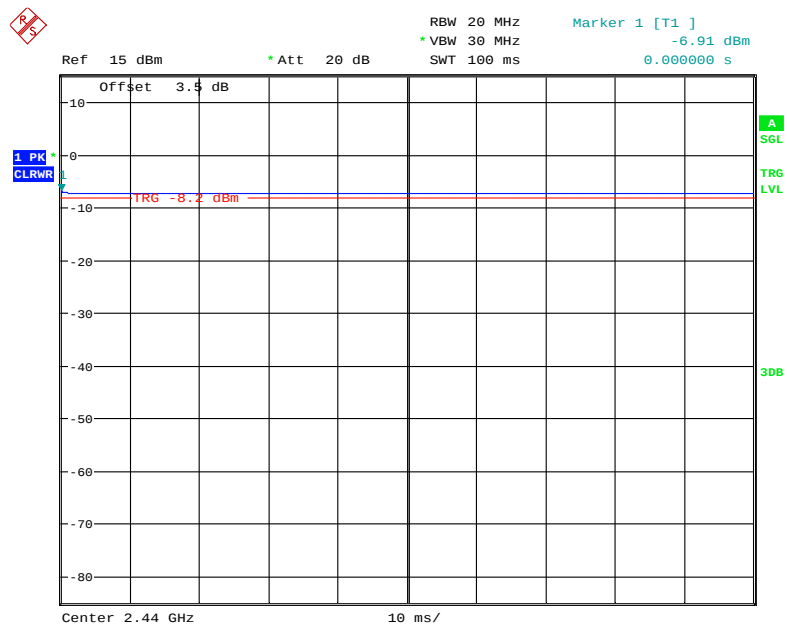
Date: 22.JUL.2021 00:56:25

802.11n-HT40 Mode



Date: 22.JUL.2021 00:57:09

BLE_1M



Date: 23.JUL.2021 19:05:08

Mode	T _{on} (ms)	T _{on+off} (ms)	Duty Cycle (%)
802.11b	100	100	100
802.11g	100	100	100
802.11n-HT20	100	100	100
802.11n-HT40	100	100	100
BLE_1M	100	100	100

Support Equipment List and Details

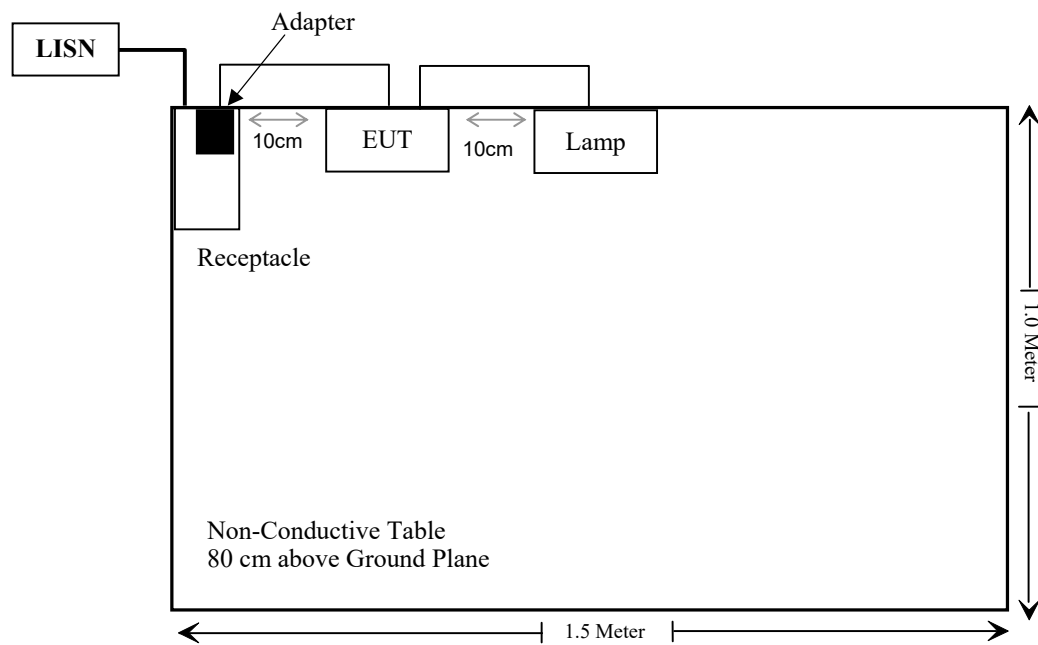
Manufacturer	Description	Model	Serial Number
BULL	Socket	GN-212	A37209315081183
Intelli rocks	Lamp	H7021	N/A

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shielded un-detachable AC cable	1.2	Socket	mains
Un-Shielding un-detachable DC Cable	1.2	EUT	Adapter
Un-Shielding un-detachable DC Cable	1.0	EUT	lamps

Block Diagram of Test Setup

For conducted emission:



SUMMARY OF TEST RESULTS

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

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2020/08/04	2021/08/03
Rohde & Schwarz	LISN	ENV216	101613	2020/08/04	2021/08/03
Rohde & Schwarz	Transient Limitor	ESH3Z2	DE25985	2020/11/29	2021/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2020/11/29	2021/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2021/07/06	2022/07/05
Sonoma instrument	Pre-amplifier	310 N	186238	2021/08/03	2022/08/02
Sunol Sciences	Broadband Antenna	JB1	A040904-2	2020/12/22	2023/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2020/11/29	2021/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2020/11/29	2021/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10.00	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2021/07/06	2022/07/05
COM-POWER	Pre-amplifier	PA-122	181919	2020/11/29	2021/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2020/11/28	2021/11/27
Sunol Sciences	Horn Antenna	3115	9107-3694	2021/01/15	2024/01/14
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2020/11/29	2021/11/28
Insulated Wire Inc.	RF Cable	SPS-2503-3150	02222010	2020/11/29	2021/11/28
SNSD	Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2021/04/20	2022/04/20
Ducommun Technologies	Horn antenna	ARH-4223-02	1007726-021304	2020/12/06	2023/12/05
RF Conducted Test					
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2021/04/02	2022/04/01
Tonscend Corporation	RF control Unit	JS0806-2	19D8060154	2021/07/06	2022/07/05
Unknown	RF Cable	Unknown	8082176/W6111	2020/11/29	2021/11/28

* **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

Result

Calculated Formulary:

Predication of MPE limit at a given distance

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

S = power density (in appropriate units, e.g. mW/cm²)

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)

Frequency (MHz)	Antenna Gain		Max Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE. Limit (mW/cm ²)
	(dBi)	(numeric)	(dBm)	(mW)			
2412-2472	1.5	1.41	13	19.95	20	0.0056	1
2402-2480	1.5	1.41	-6	0.25	20	0.0001	1
Simultaneous TX	/	/	/	/	20	0.0057	1

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 internal antenna arrangement, which were permanently attached, Wi-Fi antenna gain is 1.5 dBi and BLE antenna gain is 1.5 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

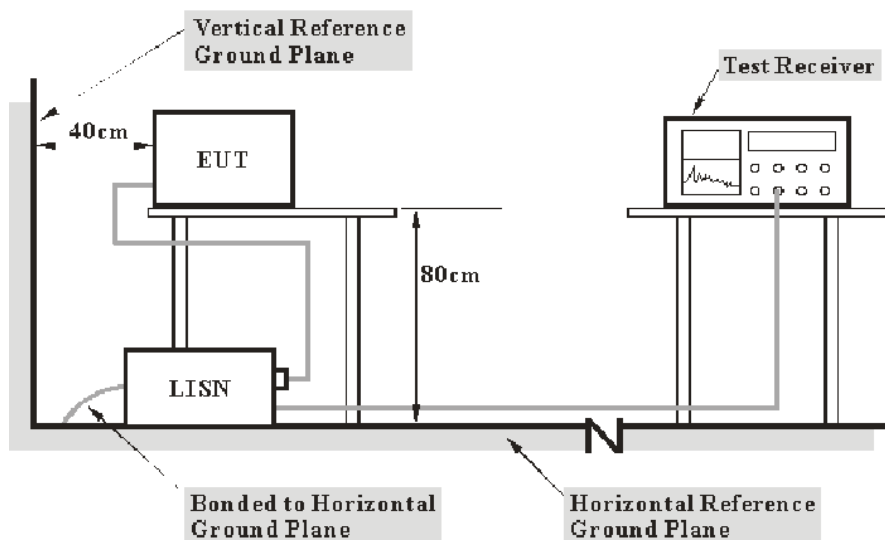
Result: Compliant.

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:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

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:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

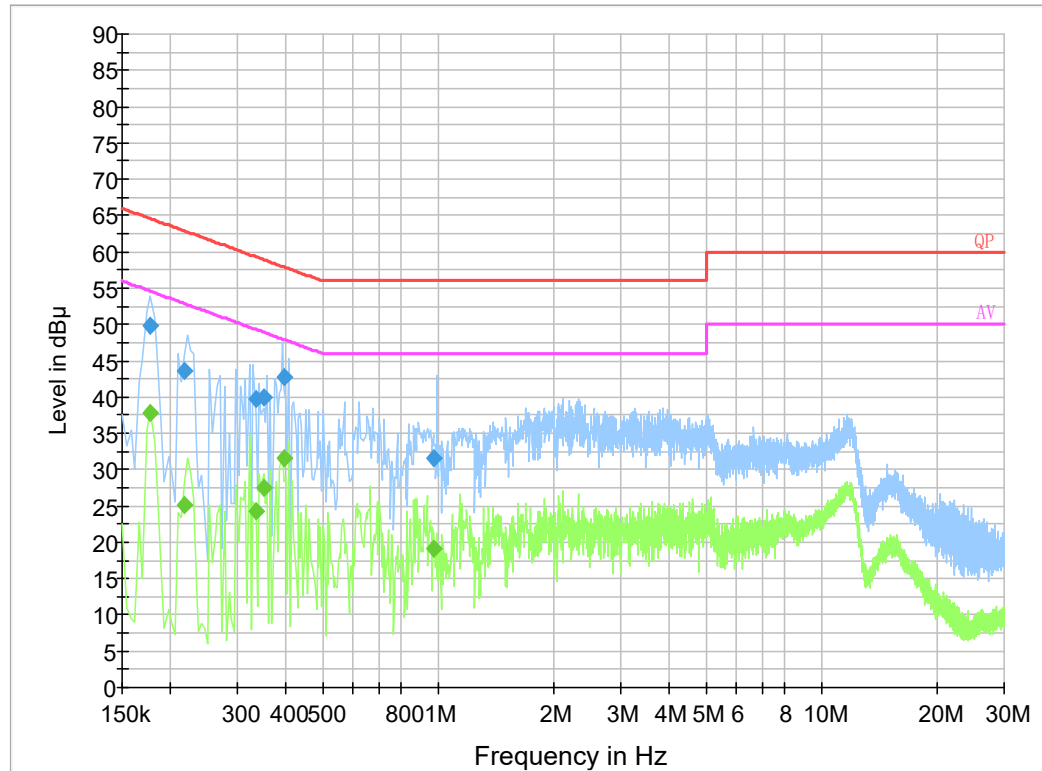
Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	70 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2021-06-26.

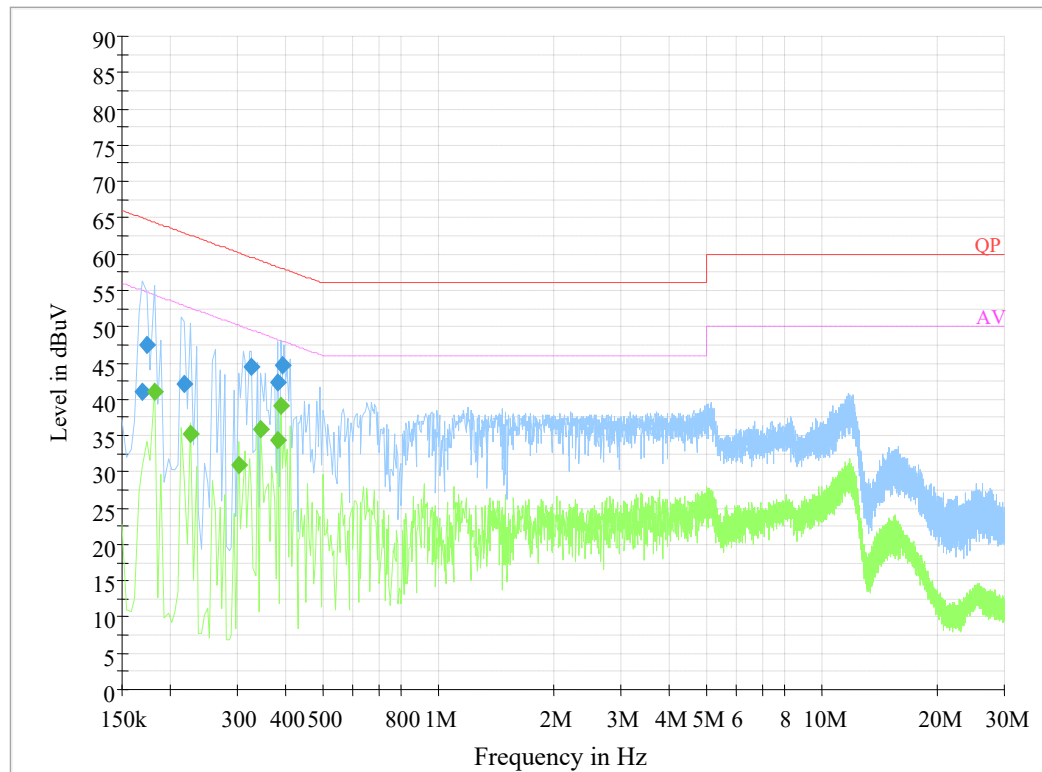
EUT operation mode: Transmitting

AC 120V/60 Hz, Line**Final Result 1**

Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.177500	49.8	9.000	L1	19.9	14.8	64.6
0.217500	43.6	9.000	L1	19.8	19.3	62.9
0.334950	39.7	9.000	L1	19.8	19.6	59.3
0.352630	39.9	9.000	L1	19.9	19.0	58.9
0.396090	42.7	9.000	L1	19.9	15.2	57.9
0.979090	31.6	9.000	L1	19.9	24.4	56.0

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.177500	37.7	9.000	L1	19.9	16.9	54.6
0.217500	25.1	9.000	L1	19.8	27.8	52.9
0.334950	24.3	9.000	L1	19.8	25.0	49.3
0.352630	27.6	9.000	L1	19.9	21.3	48.9
0.396090	31.6	9.000	L1	19.9	16.3	47.9
0.979090	19.1	9.000	L1	19.9	26.9	46.0

AC 120V/60 Hz, Neutral:**Final Result 1**

Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.169500	40.9	9.000	N	19.8	24.1	65.0
0.174500	47.4	9.000	N	19.8	17.3	64.7
0.217500	42.1	9.000	N	19.8	20.8	62.9
0.325110	44.4	9.000	N	19.8	15.2	59.6
0.384270	42.4	9.000	N	19.8	15.8	58.2
0.392150	44.7	9.000	N	19.8	13.3	58.0

Final Result 2

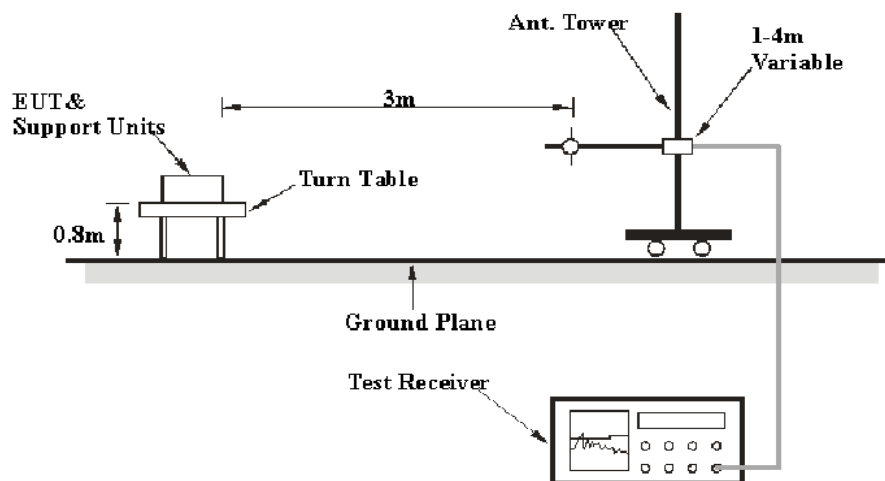
Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.182000	40.9	9.000	N	19.8	9.5	54.4
0.226000	35.3	9.000	N	19.8	17.3	52.6
0.302000	30.9	9.000	N	19.7	19.3	50.2
0.346000	35.9	9.000	N	19.8	13.2	49.1
0.382000	34.3	9.000	N	19.8	13.9	48.2
0.390000	39.2	9.000	N	19.8	8.9	48.1

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

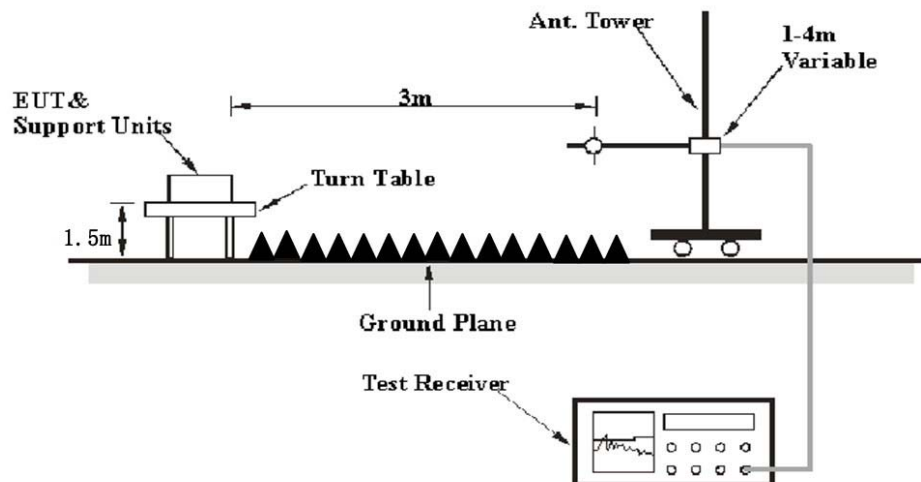
FCC §15.247 (d); §15.209; §15.205;

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

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:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

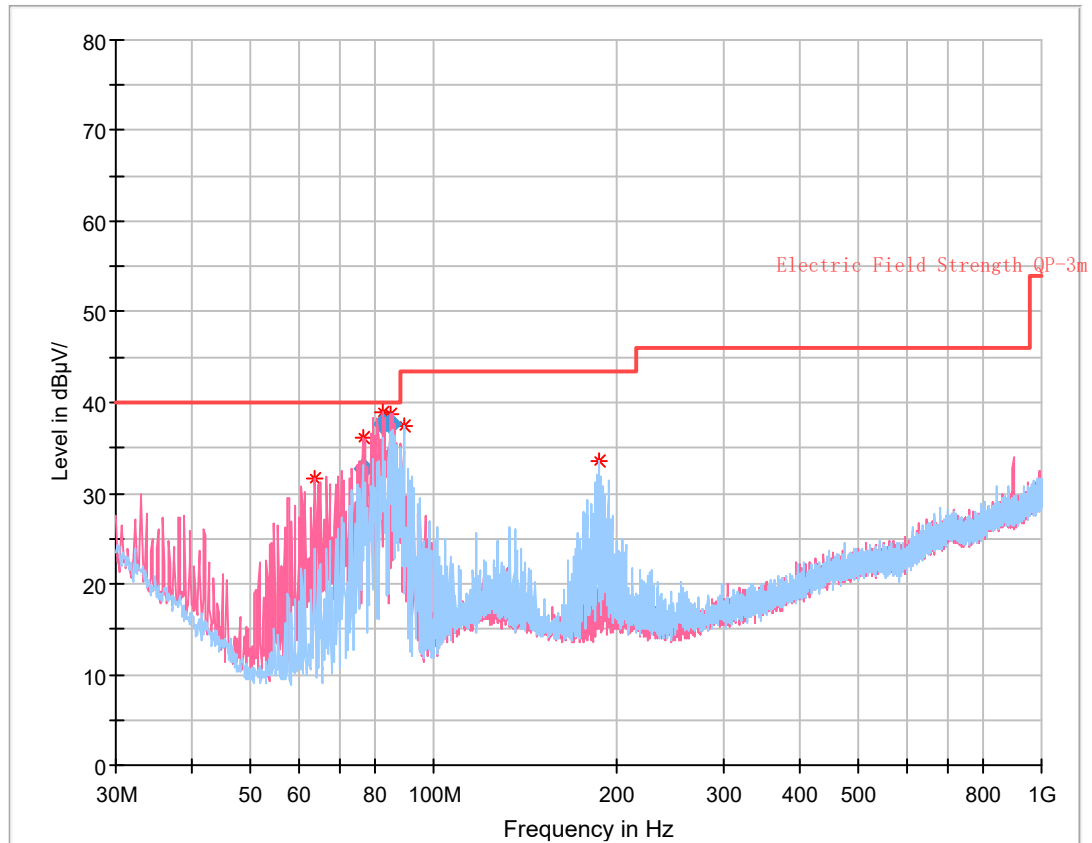
Test Data

Environmental Conditions

Temperature:	26~ 27.8 °C
Relative Humidity:	51~ 56 %
ATM Pressure:	101.0 kPa

The testing was performed by Cloud Qiu on 2021-08-10 for below 1GHz and Bruce Lin on 2021-07-14 for above 1GHz.

EUT operation mode: Transmitting

30 MHz~1 GHz:**Final Result**

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
76.492625	32.71	40.00	7.29	113.0	V	157.0	-16.5
82.528000	37.62	40.00	2.38	176.0	V	237.0	-16.7
84.703000	37.65	40.00	2.35	111.0	V	84.0	-16.6

Critical Freqs

Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
63.707500	31.69	40.00	8.31	100.0	V	7.0	-16.4
89.291250	37.40	43.50	6.10	200.0	H	214.0	-16.6
187.382500	33.58	43.50	9.92	100.0	H	121.0	-12.3

1 GHz-25 GHz:**BLE_1M:**

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(2402MHz)									
2389.50	28.54	PK	140	1.9	V	31.87	60.41	74	13.59
2389.50	14.56	Ave.	140	1.9	V	31.87	46.43	54	7.57
2483.80	28.97	PK	115	2.0	V	32.13	61.10	74	12.90
2483.80	14.65	Ave.	115	2.0	V	32.13	46.78	54	7.22
4804.00	44.15	PK	348	1.2	V	6.28	50.43	74	23.57
4804.00	29.83	Ave.	348	1.2	V	6.28	36.11	54	17.89
7206.00	47.68	PK	277	2.2	V	11.93	59.61	74	14.39
7206.00	37.86	Ave.	277	2.2	V	11.93	49.79	54	4.21
Middle Channel(2440MHz)									
4880.00	44.96	PK	137	1.7	V	6.76	51.72	74	22.28
4880.00	30.83	Ave.	137	1.7	V	6.76	37.59	54	16.41
7320.00	47.41	PK	16	1.3	V	11.56	58.97	74	15.03
7320.00	38.87	Ave.	16	1.3	V	11.56	50.43	54	3.57
High Channel(2480 MHz)									
2389.01	28.65	PK	132	1.4	V	31.87	60.52	74	13.48
2389.01	14.63	Ave.	132	1.4	V	31.87	46.50	54	7.50
2483.78	28.75	PK	311	1.7	V	32.13	60.88	74	13.12
2483.78	14.58	Ave.	311	1.7	V	32.13	46.71	54	7.29
4960.00	44.27	PK	273	2.3	V	6.80	51.07	74	22.93
4960.00	29.82	Ave.	273	2.3	V	6.80	36.62	54	17.38
7440.00	46.81	PK	221	2.3	V	12.39	59.20	74	14.80
7440.00	38.49	Ave.	221	2.3	V	12.39	50.88	54	3.12

802.11b 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 (2412 MHz)									
2389.64	29.56	PK	279	1.6	V	31.87	61.43	74	12.57
2389.64	14.69	Ave.	279	1.6	V	31.87	46.56	54	7.44
2483.53	29.80	PK	144	1.7	V	32.13	61.93	74	12.07
2483.53	14.70	Ave.	144	1.7	V	32.13	46.83	54	7.17
4824.00	50.88	PK	30	1.5	V	6.28	57.16	74	16.84
4824.00	46.35	Ave.	83	1.0	V	6.28	52.63	54	1.37
Middle Channel(2442MHz)									
4884.00	49.52	PK	68	2.3	V	6.76	56.28	74	17.72
4884.00	45.33	Ave.	68	2.3	V	6.76	52.09	54	1.91
High Channel(2472 MHz)									
2389.96	29.61	PK	312	1.8	V	31.87	61.48	74	12.52
2389.96	14.56	Ave.	312	1.8	V	31.87	46.43	54	7.57
2483.56	30.25	PK	46	2.5	V	32.13	62.38	74	11.62
2483.56	17.63	Ave.	46	2.5	V	32.13	49.76	54	4.24
4944.00	49.81	PK	343	1.4	V	6.76	56.57	74	17.43
4944.00	45.86	Ave.	343	1.4	V	6.76	52.62	54	1.38

802.11g 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 (2412 MHz)									
2389.84	28.95	PK	123	2.2	V	31.87	60.82	74	13.18
2389.84	14.68	Ave.	123	2.2	V	31.87	46.55	54	7.45
2484.31	29.66	PK	220	1.8	V	32.13	61.79	74	12.21
2484.31	14.63	Ave.	220	1.8	V	32.13	46.76	54	7.24
4824.00	44.97	PK	147	1.7	V	6.28	51.25	74	22.75
4824.00	29.61	Ave.	147	1.7	V	6.28	35.89	54	18.11
Middle Channel(2442MHz)									
4884.00	44.97	PK	255	2.3	V	6.76	51.73	74	22.27
4884.00	29.61	Ave.	255	2.3	V	6.76	36.37	54	17.63
High Channel(2472 MHz)									
2389.31	29.68	PK	278	2.1	V	31.87	61.55	74	12.45
2389.31	14.66	Ave.	278	2.1	V	31.87	46.53	54	7.47
2483.73	38.47	PK	153	1.1	V	32.13	70.60	74	3.40
2483.73	17.38	Ave.	153	1.1	V	32.13	49.51	54	4.49
4944.00	44.26	PK	170	1.9	V	6.76	51.02	74	22.98
4944.00	28.77	Ave.	170	1.9	V	6.76	35.53	54	18.47

802.11n-HT20 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 (2412 MHz)									
2389.19	29.35	PK	246	1.5	V	31.87	61.22	74	12.78
2389.19	14.69	Ave.	246	1.5	V	31.87	46.56	54	7.44
2483.97	28.92	PK	274	1.8	V	32.13	61.05	74	12.95
2483.97	14.53	Ave.	274	1.8	V	32.13	46.66	54	7.34
4824.00	46.06	PK	4	2.2	V	6.28	52.34	74	21.66
4824.00	29.73	AV	4	2.2	V	6.28	36.01	54	17.99
Middle Channel(2442MHz)									
4884.00	44.29	PK	63	1.2	V	6.76	51.05	74	22.95
4884.00	29.38	Ave.	63	1.2	V	6.76	36.14	54	17.86
High Channel(2472 MHz)									
2389.84	29.32	PK	248	1.3	V	31.87	61.19	74	12.81
2389.84	14.77	Ave.	248	1.3	V	31.87	46.64	54	7.36
2483.78	40.26	PK	186	1.5	V	32.13	72.39	74	1.61
2483.78	17.80	Ave.	186	1.5	V	32.13	49.93	54	4.07
4944.00	44.27	PK	4	1.3	V	6.76	51.03	74	22.97
4944.00	29.57	Ave.	4	1.3	V	6.76	36.33	54	17.67

802.11n-HT40 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 (2422 MHz)									
2389.16	29.35	PK	36	1.8	V	31.87	61.22	74	12.78
2389.16	14.56	Ave.	36	1.8	V	31.87	46.43	54	7.57
2484.16	29.87	PK	272	1.8	V	32.13	62.00	74	12.00
2484.16	14.73	Ave.	272	1.8	V	32.13	46.86	54	7.14
4844.00	44.14	PK	321	2.3	V	6.28	50.42	74	23.58
4844.00	29.37	AV	321	2.3	V	6.28	35.65	54	18.35
Middle Channel(2442MHz)									
4884.00	44.31	PK	358	2.2	V	6.76	51.07	74	22.93
4884.00	29.22	Ave.	358	2.2	V	6.76	35.98	54	18.02
High Channel(2462 MHz)									
2389.53	29.50	PK	195	1.3	V	31.87	61.37	74	12.63
2389.53	14.68	Ave.	195	1.3	V	31.87	46.55	54	7.45
2484.01	29.01	PK	18	1.0	V	32.13	61.14	74	12.86
2484.01	14.68	Ave.	18	1.0	V	32.13	46.81	54	7.19
4924.00	44.47	PK	166	2.4	V	6.76	51.23	74	22.77
4924.00	29.62	Ave.	166	2.4	V	6.76	36.38	54	17.62

Note:

Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

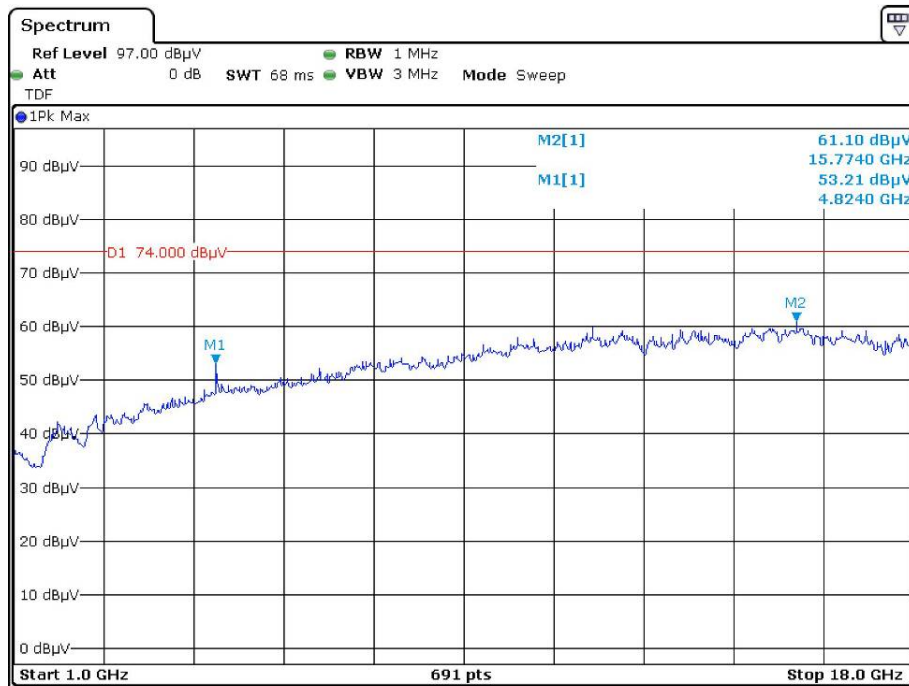
Corrected Amplitude = Corrected Factor + Reading

Margin = Limit - Corrected. Amplitude

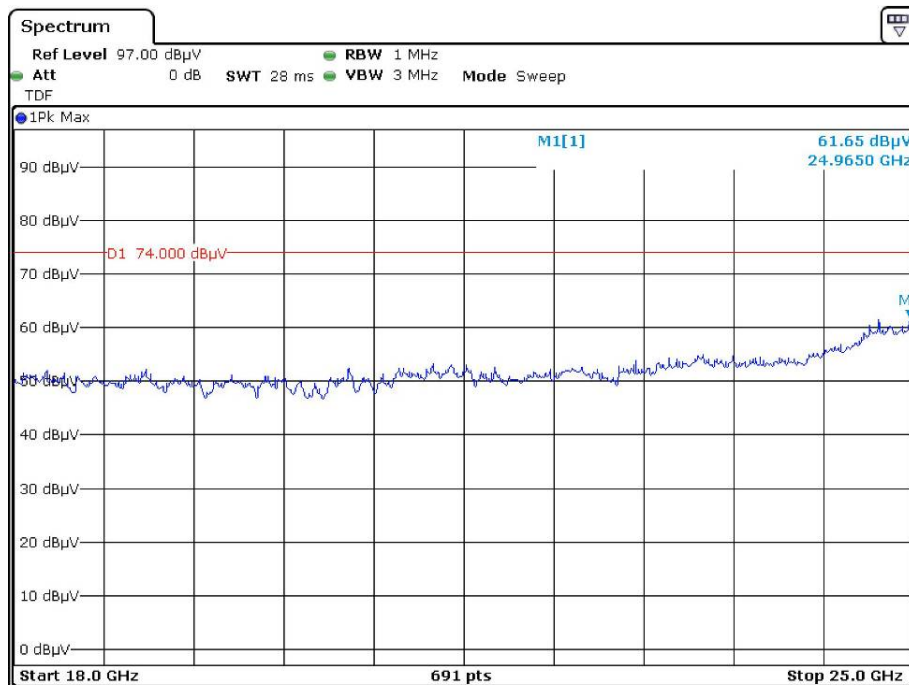
The other spurious emission which is 20dB below the limit or on the noise floor was not recorded.

And for the pre-scan is performed with the 2400-2483.5MHz band filter.

**Pre-scan with 802.11b Mode, low channel
Horizontal**

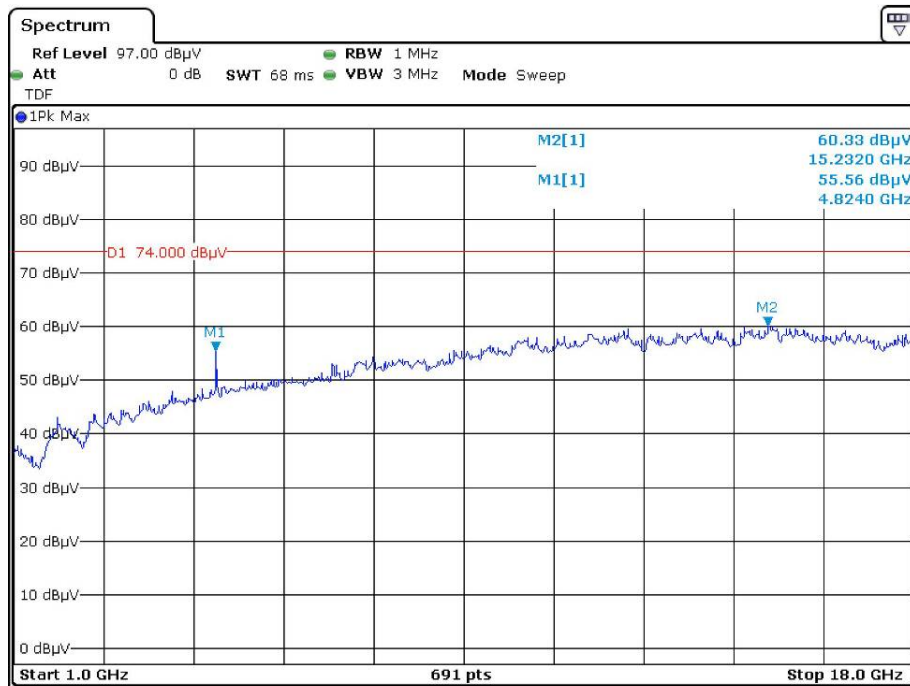


Date: 14.JUL.2021 20:40:14

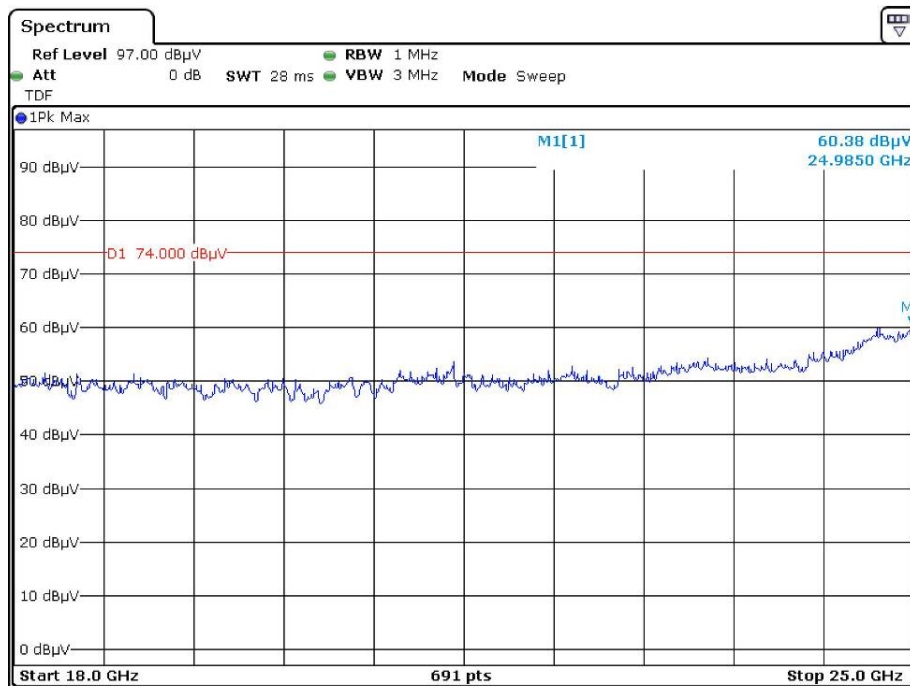


Date: 14.JUL.2021 21:15:12

Vertical

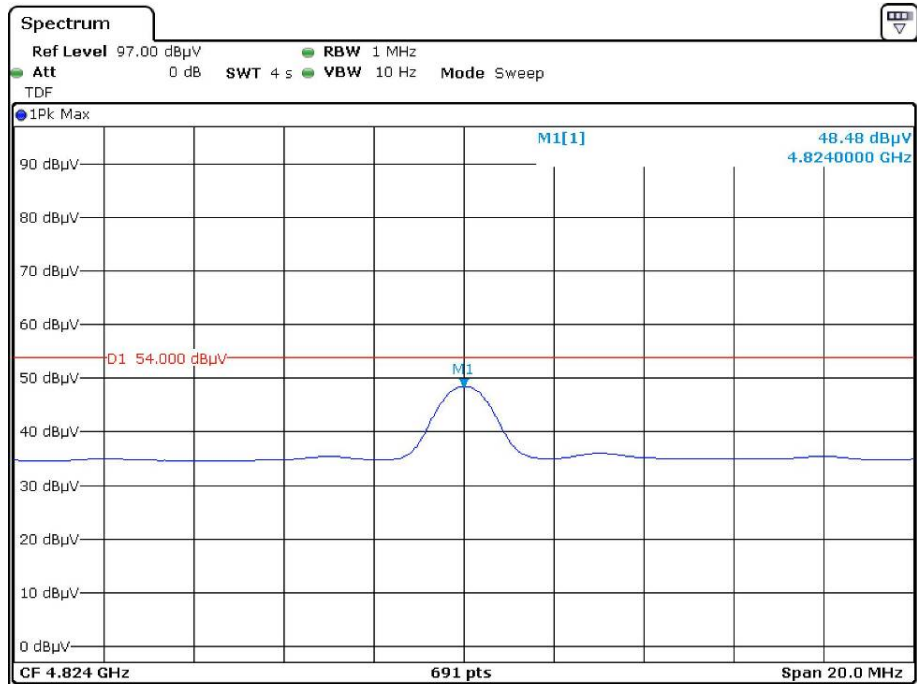


Date: 14.JUL.2021 20:30:34

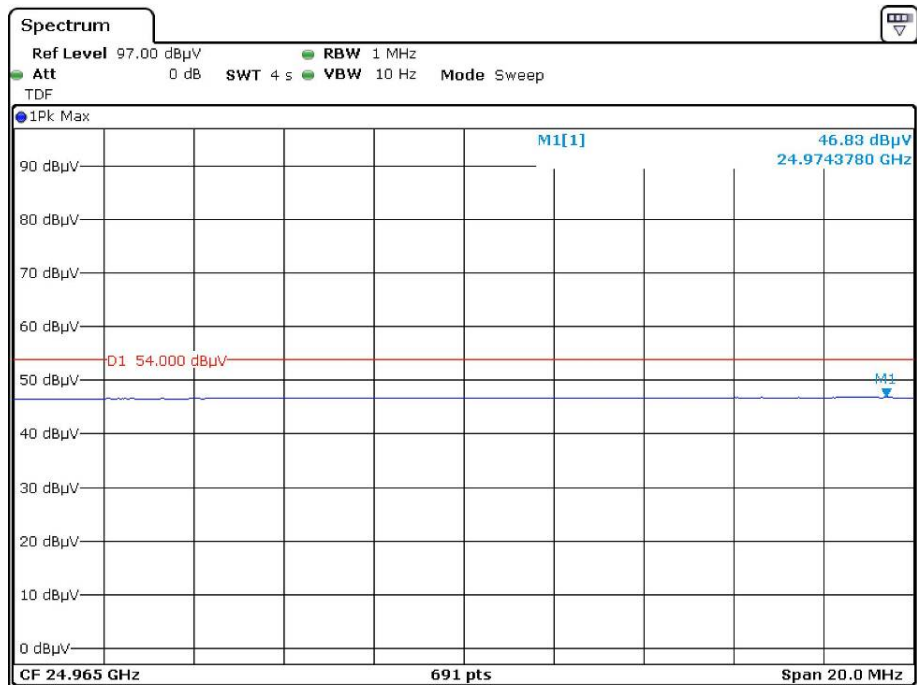


Date: 14.JUL.2021 21:25:29

Average Horizontal

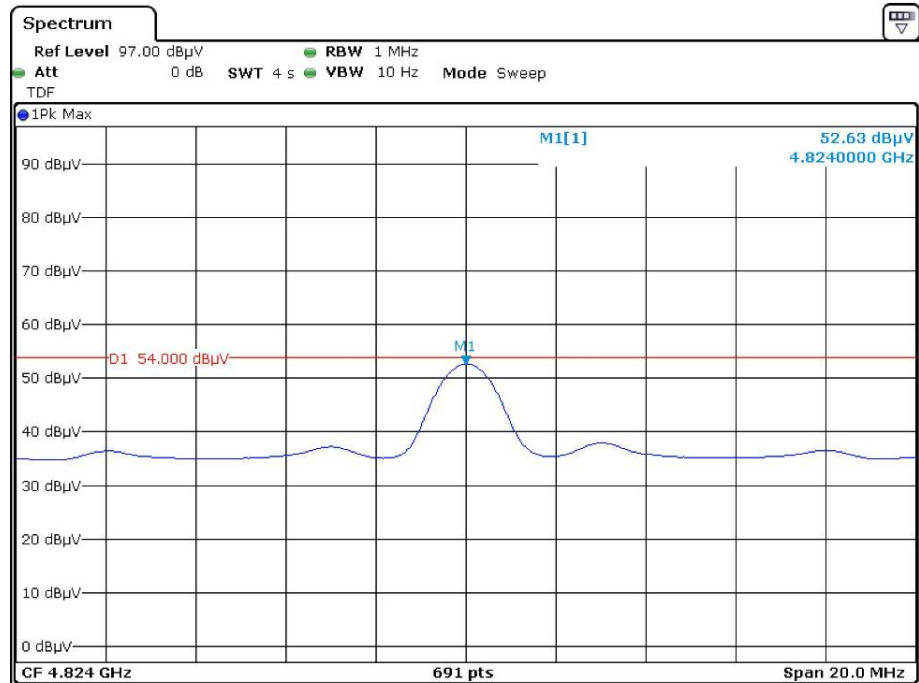


Date: 14.JUL.2021 20:46:04

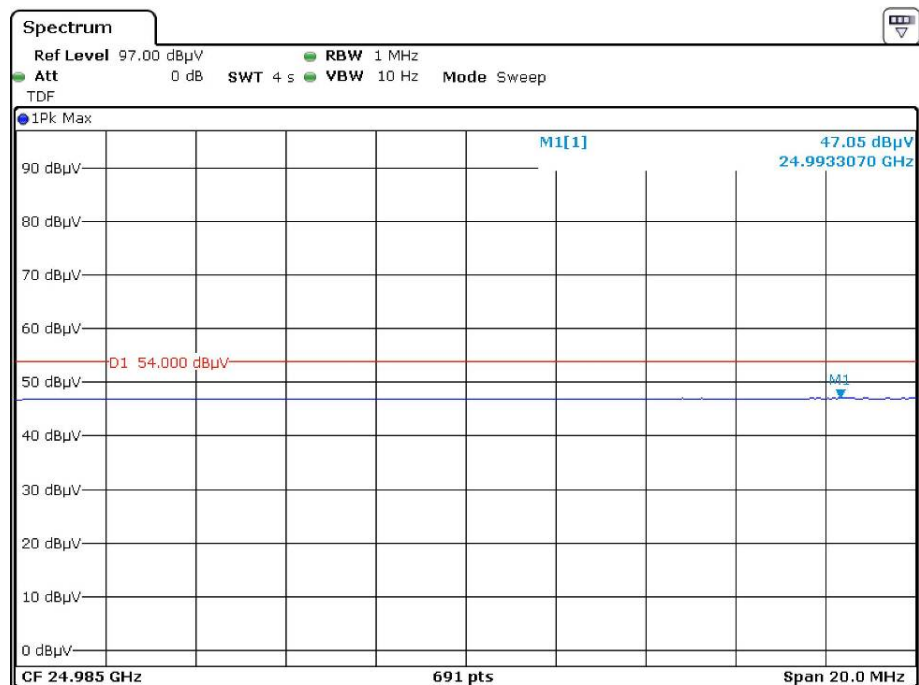


Date: 14.JUL.2021 21:20:20

Vertical



Date: 14.JUL.2021 20:35:59



Date: 14.JUL.2021 21:30:03

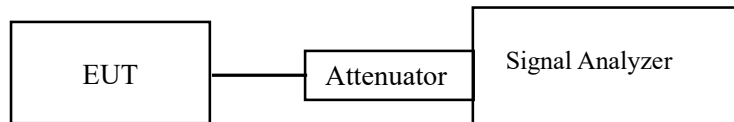
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

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:	28.6~ 29.1 °C
Relative Humidity:	51~ 52 °C
ATM Pressure:	101.0 kPa

The testing was performed by Pedro Yun on 2021-07-21 and 2021-07-23.

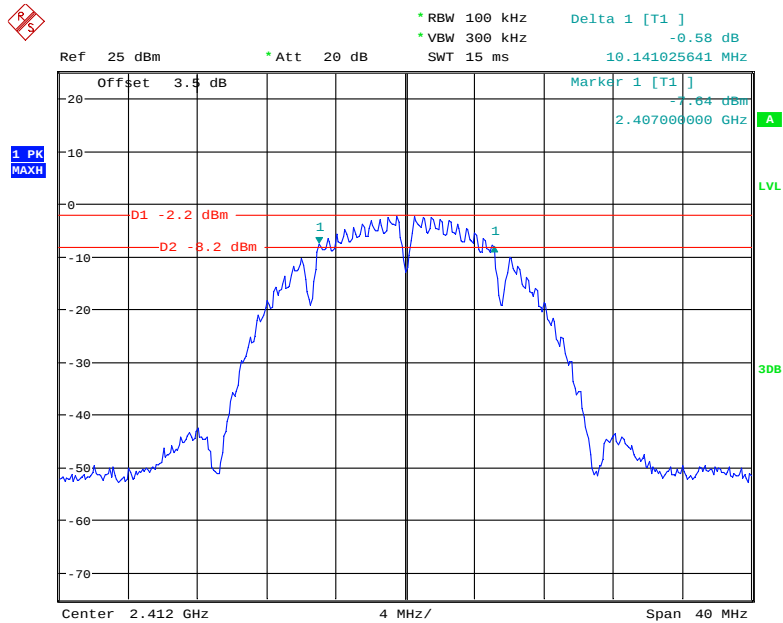
Test Result: Pass.

Please refer to the following table and plots.

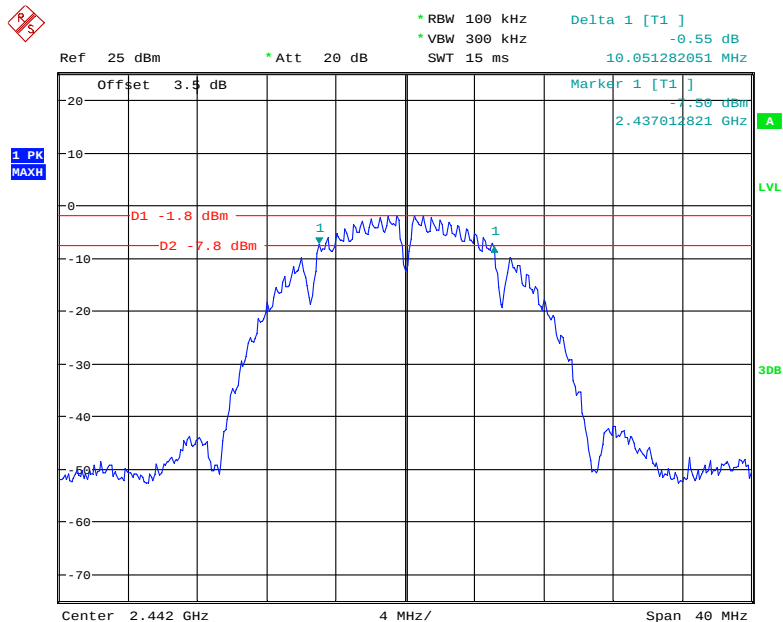
EUT operation mode: Transmitting

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)	Limit (kHz)
802.11b mode				
Low	2412	10.141	15.000	≥500
Middle	2442	10.051	14.900	≥500
High	2472	10.090	15.000	≥500
802.11g mode				
Low	2412	16.603	16.600	≥500
Middle	2442	16.654	16.600	≥500
High	2472	16.577	16.700	≥500
802.11n-HT20 mode				
Low	2412	17.846	17.800	≥500
Middle	2442	17.910	17.800	≥500
High	2472	17.769	17.800	≥500
802.11n-HT40 mode				
Low	2422	36.615	35.800	≥500
Middle	2442	36.513	35.800	≥500
High	2462	36.538	35.800	≥500

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (kHz)
BLE_1M			
Low	2402	0.714	≥500
Middle	2440	0.707	≥500
High	2480	0.702	≥500

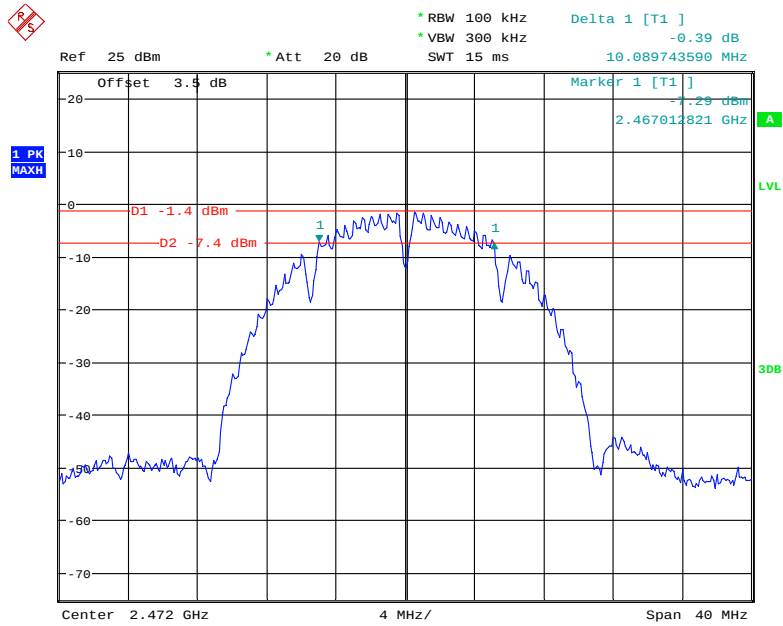
6dB Bandwidth, 802.11b Low Channel

Date: 21.JUL.2021 19:51:04

6dB Bandwidth, 802.11b Middle Channel

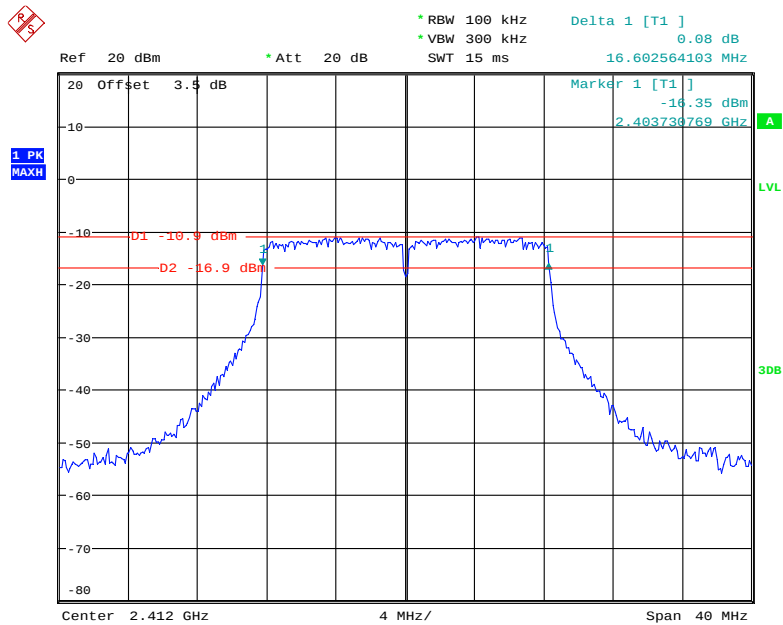
Date: 21.JUL.2021 19:52:16

6dB Bandwidth, 802.11b High Channel

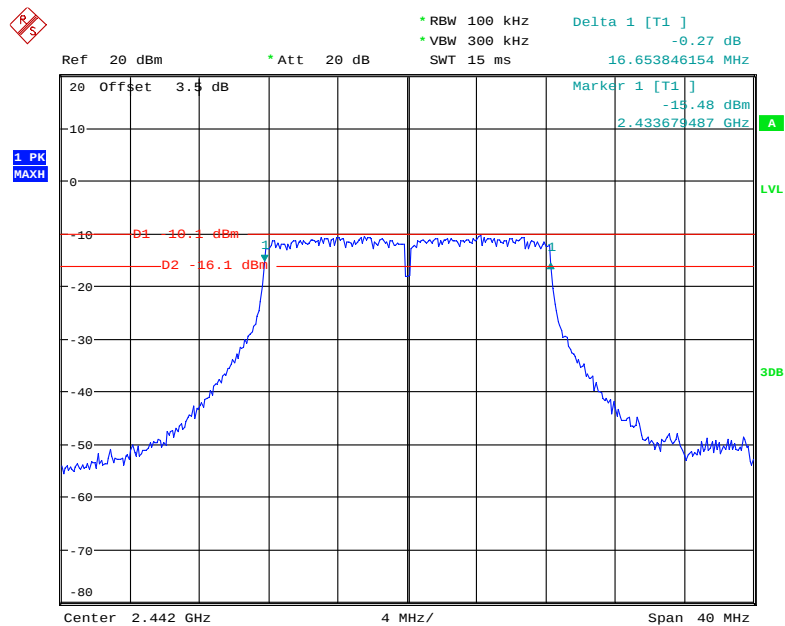


Date: 21.JUL.2021 19:50:05

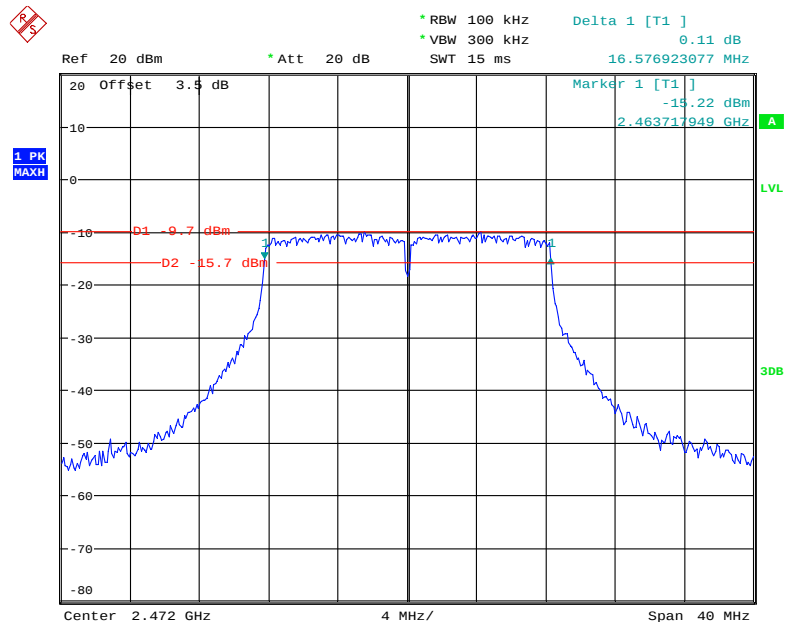
6dB Bandwidth, 802.11g Low Channel



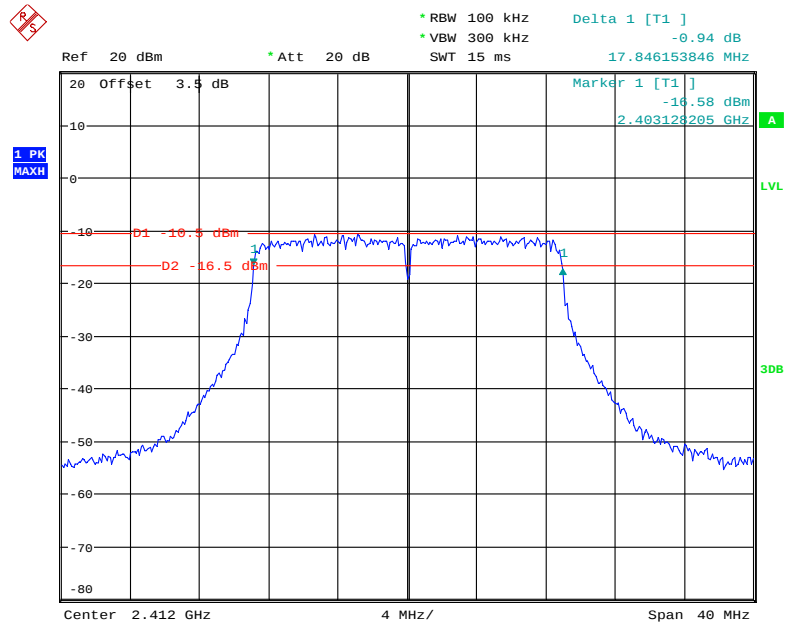
Date: 21.JUL.2021 19:54:11

6dB Bandwidth, 802.11g Middle Channel

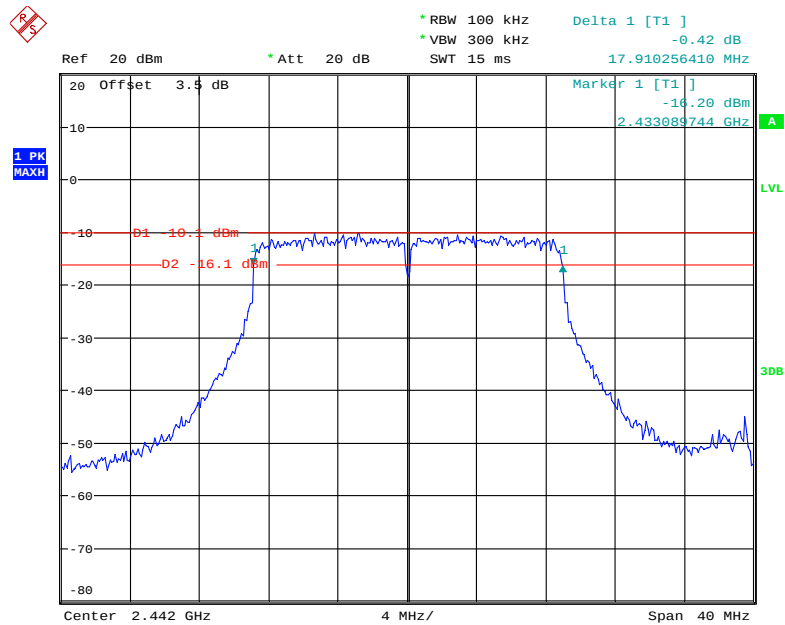
Date: 21.JUL.2021 19:55:42

6dB Bandwidth, 802.11g High Channel

Date: 21.JUL.2021 19:58:05

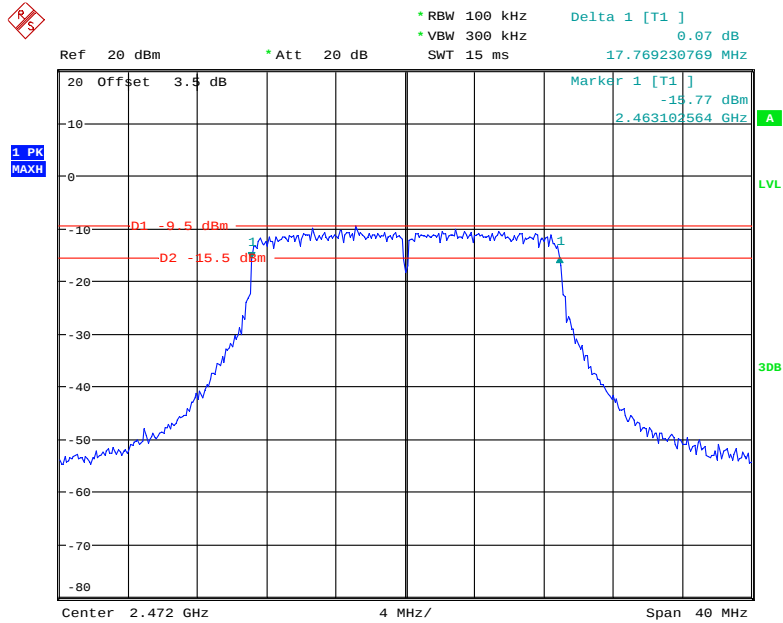
6dB Bandwidth, 802.11n-HT20 Low Channel

Date: 21.JUL.2021 20:02:35

6dB Bandwidth, 802.11n-HT20 Middle Channel

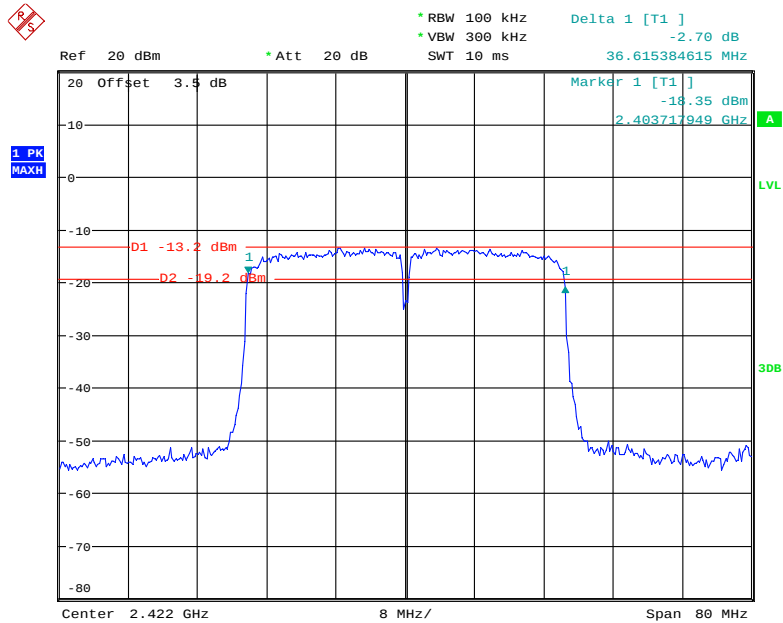
Date: 21.JUL.2021 20:03:39

6dB Bandwidth, 802.11n-HT20 High Channel



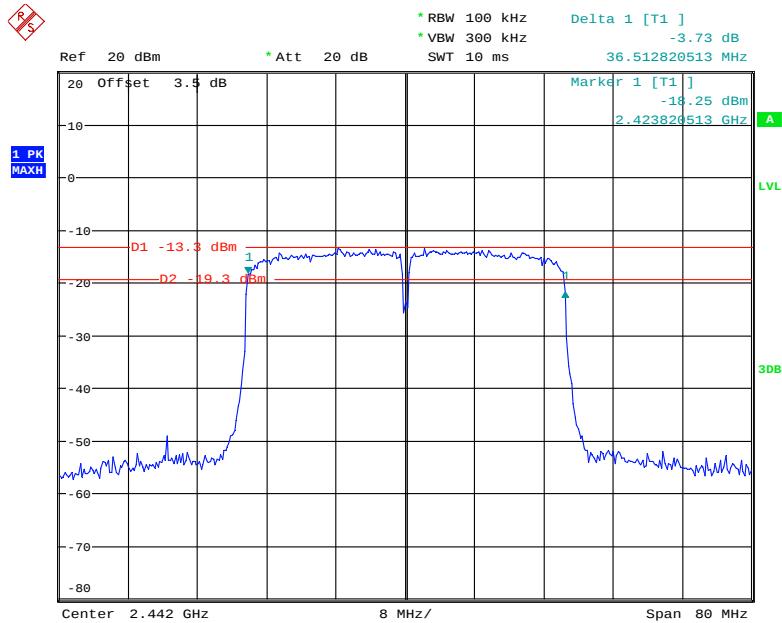
Date: 21.JUL.2021 20:04:49

6dB Bandwidth, 802.11n-HT40 Low Channel



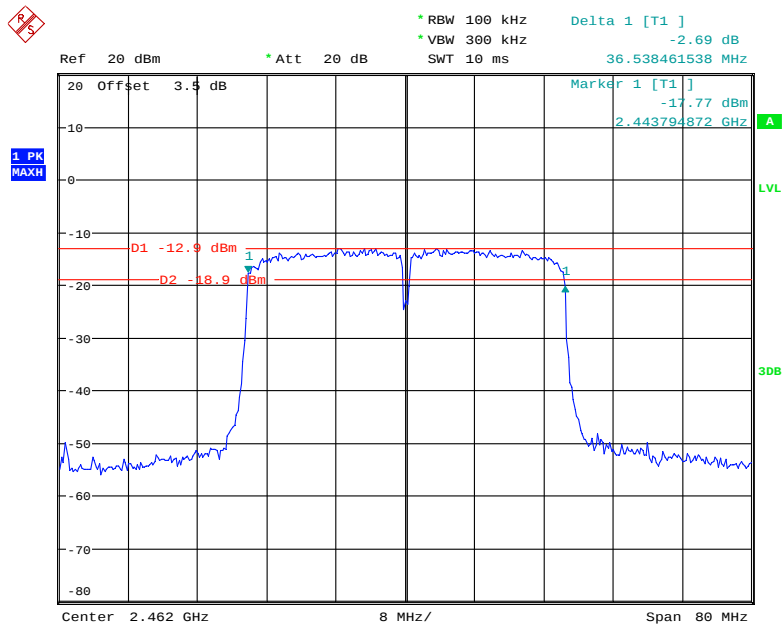
Date: 21.JUL.2021 20:06:55

6dB Bandwidth, 802.11n-HT40 Middle Channel



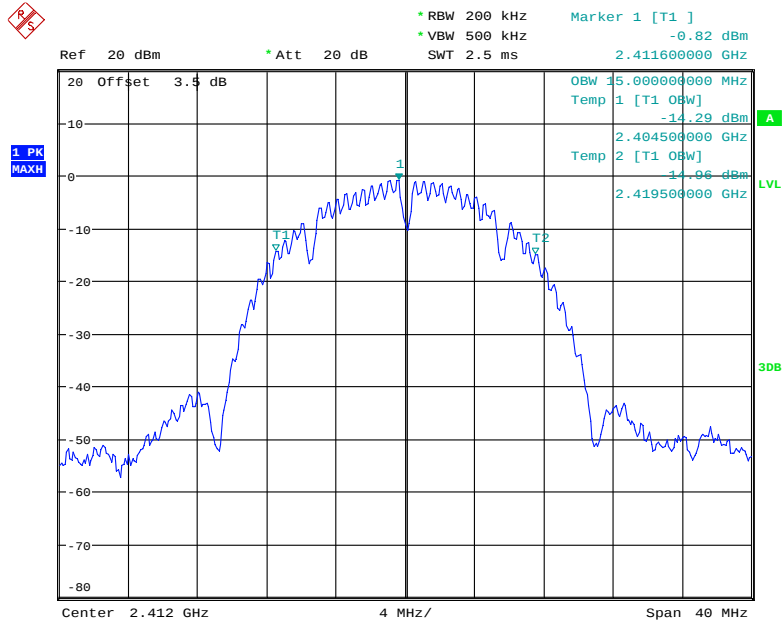
Date: 21.JUL.2021 20:10:42

6dB Bandwidth, 802.11n-HT20 High Channel



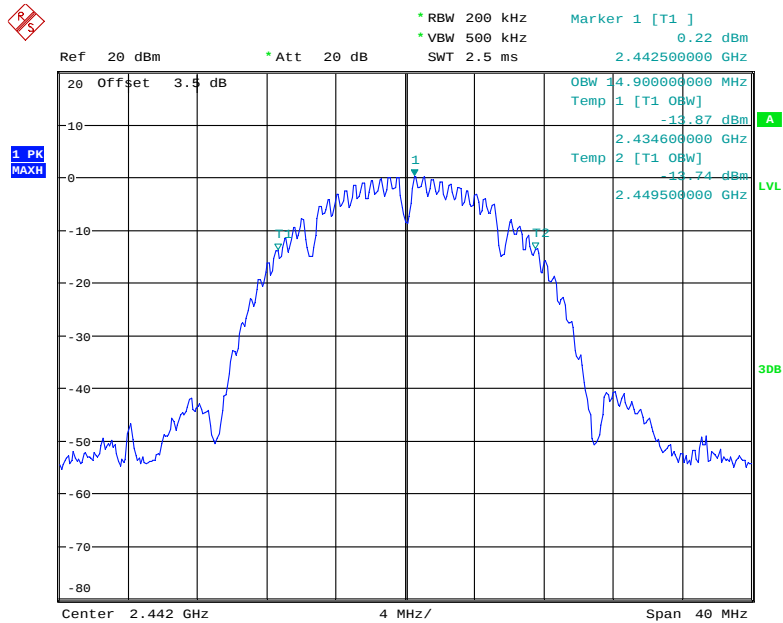
Date: 21.JUL.2021 20:12:21

99% Occupied Bandwidth, 802.11b Low Channel



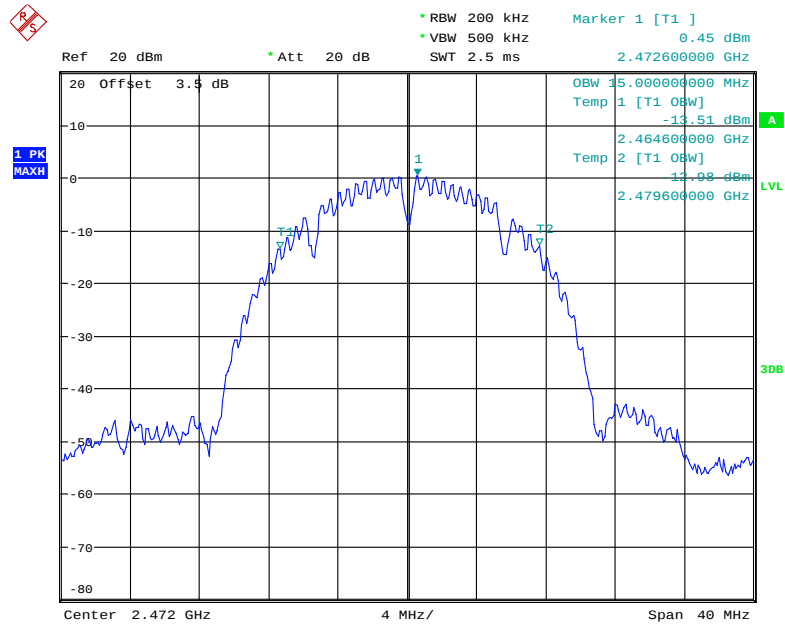
Date: 21.JUL.2021 21:40:46

99% Occupied Bandwidth, 802.11b Middle Channel



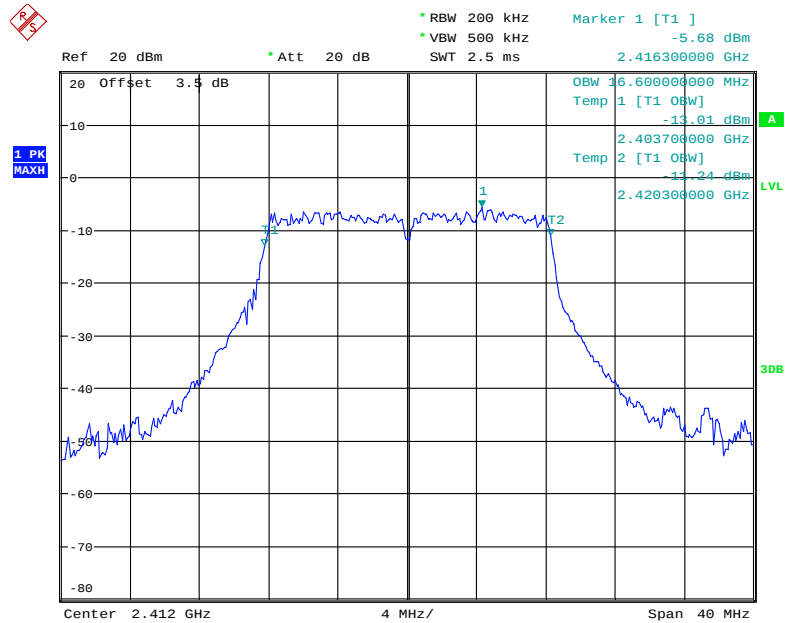
Date: 21.JUL.2021 21:41:28

99% Occupied Bandwidth, 802.11b High Channel



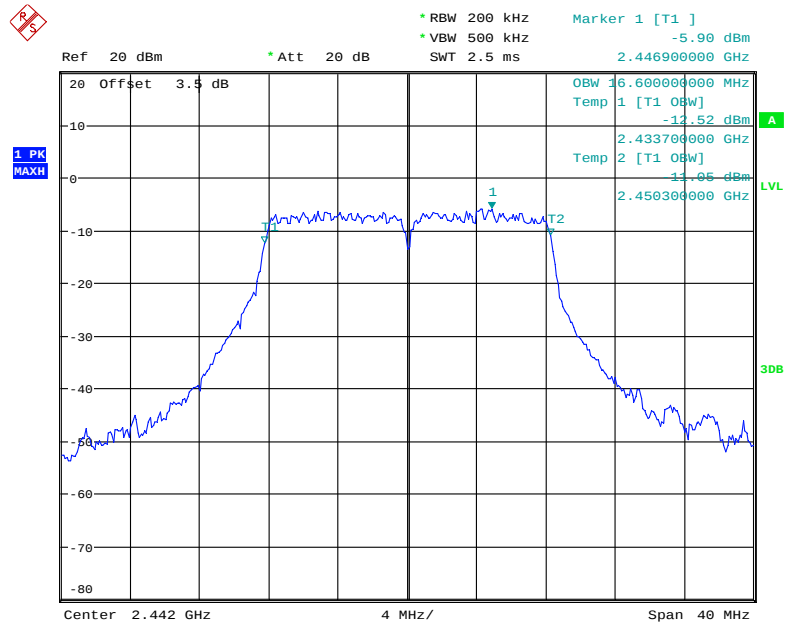
Date: 21.JUL.2021 21:42:03

99% Occupied Bandwidth, 802.11g Low Channel



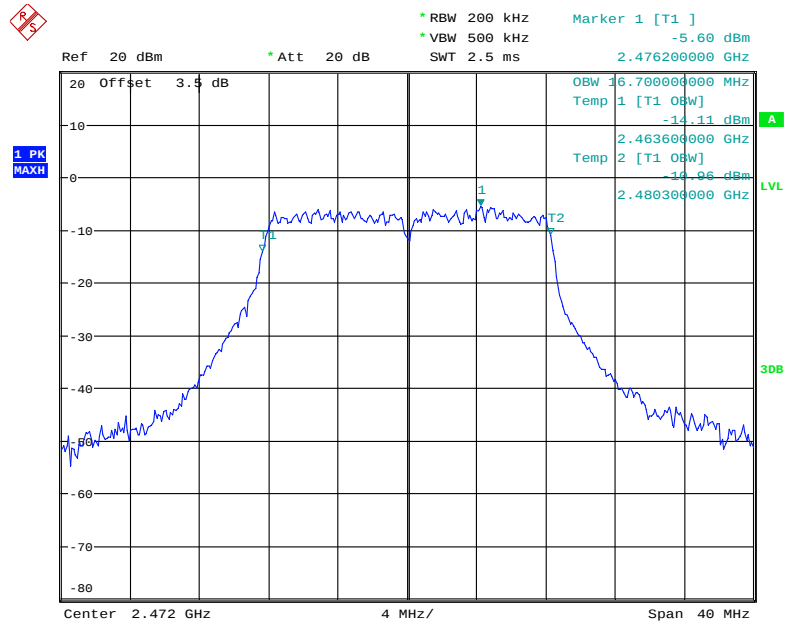
Date: 21.JUL.2021 21:38:25

99% Occupied Bandwidth, 802.11g Middle Channel



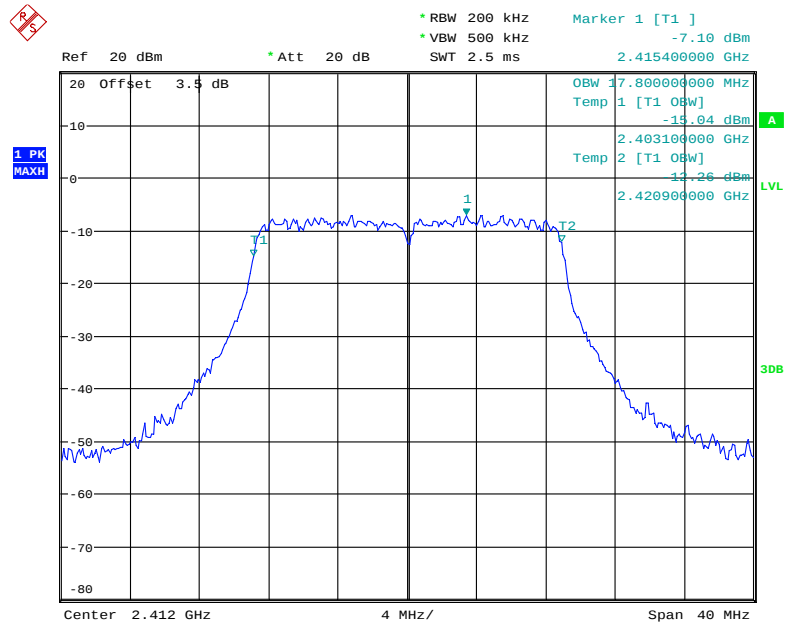
Date: 21.JUL.2021 21:39:04

99% Occupied Bandwidth, 802.11g High Channel



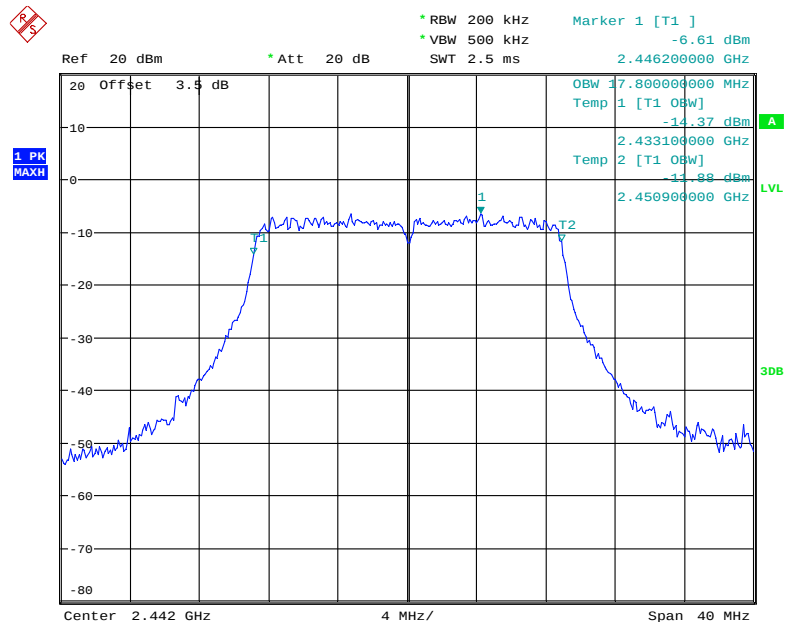
Date: 21.JUL.2021 21:40:12

99% Occupied Bandwidth, 802.11n-HT20 Low Channel



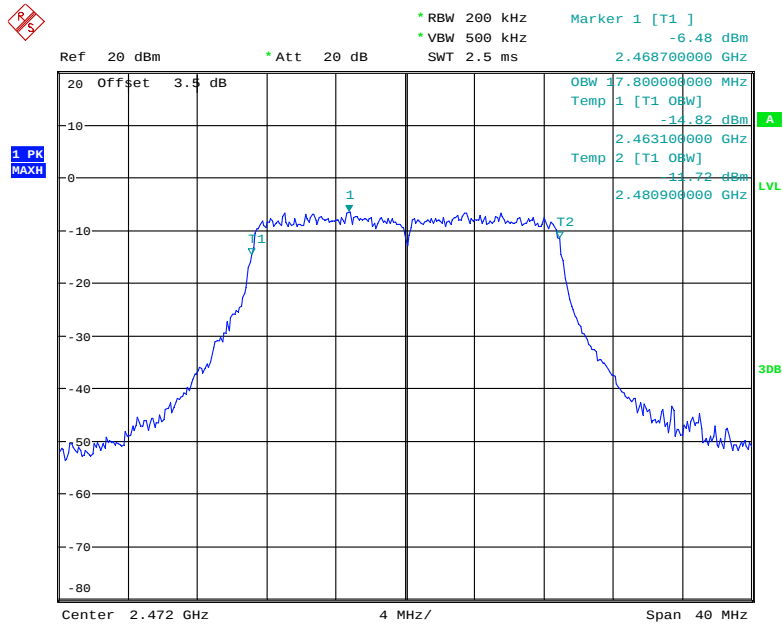
Date: 21.JUL.2021 21:35:56

99% Occupied Bandwidth, 802.11n-HT20 Middle Channel



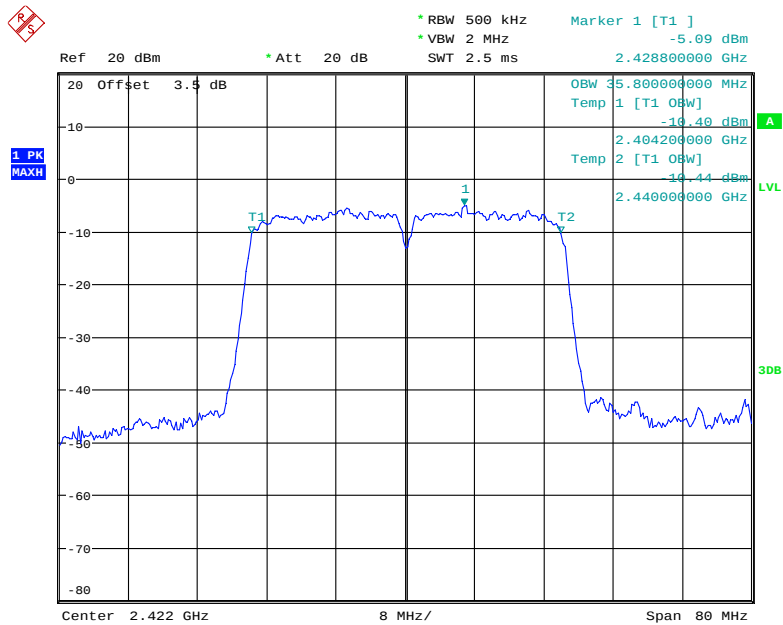
Date: 21.JUL.2021 21:36:34

99% Occupied Bandwidth, 802.11n-HT20 High Channel



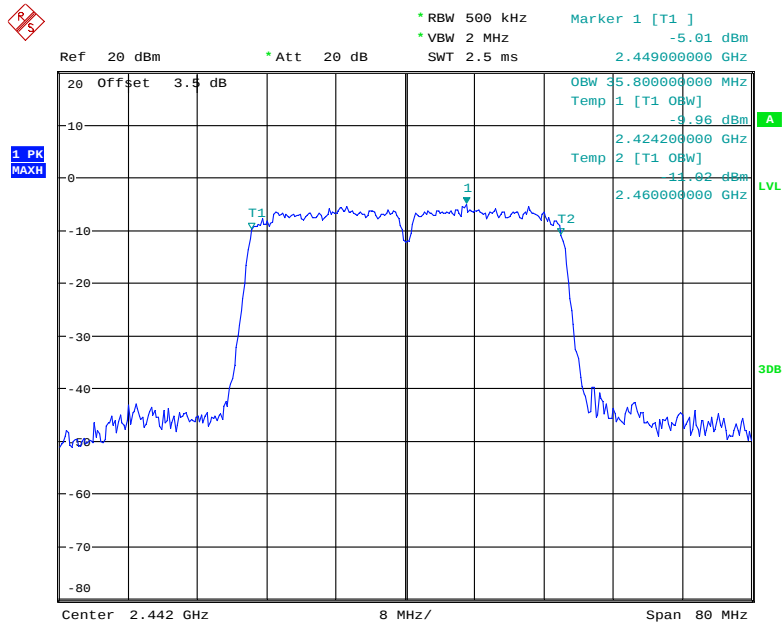
Date: 21.JUL.2021 21:37:01

99% Occupied Bandwidth, 802.11n-HT40 Low Channel



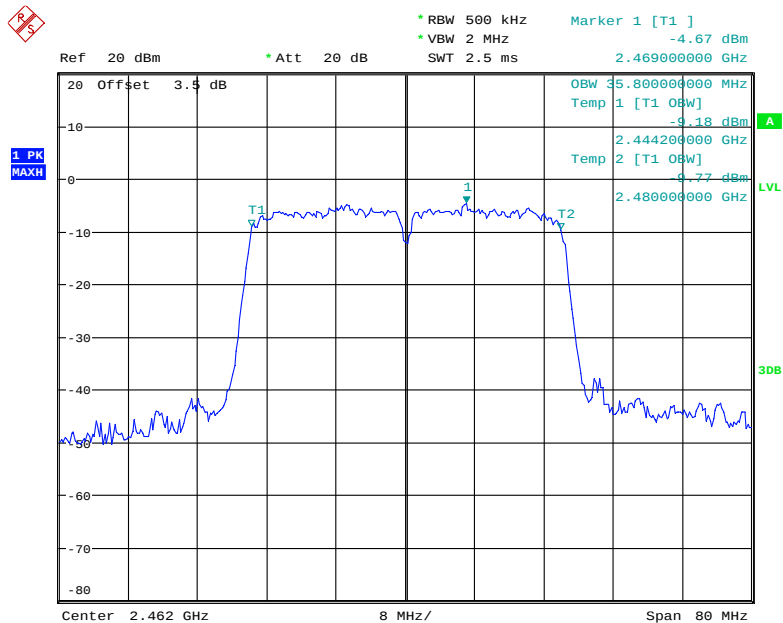
Date: 21.JUL.2021 21:32:24

99% Occupied Bandwidth, 802.11n-HT40 Middle Channel



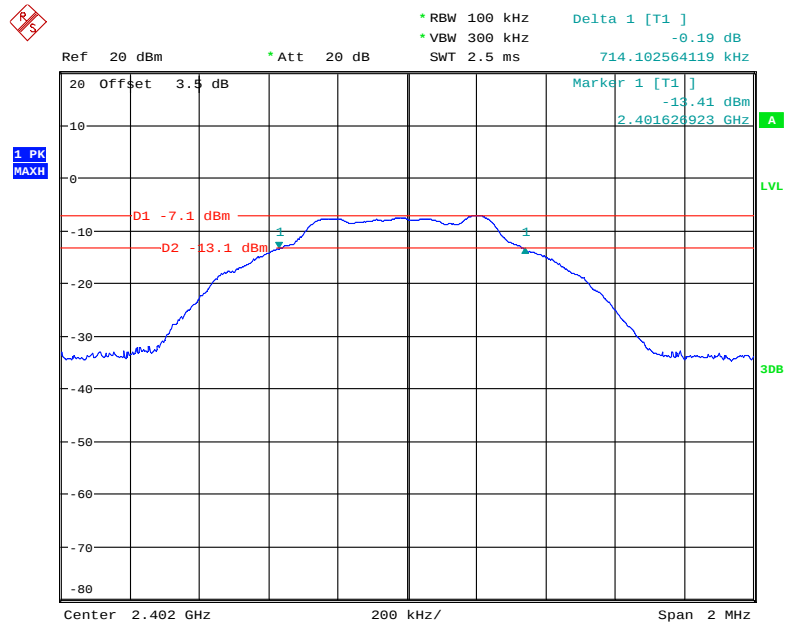
Date: 21.JUL.2021 21:34:24

99% Occupied Bandwidth, 802.11n-HT40 High Channel



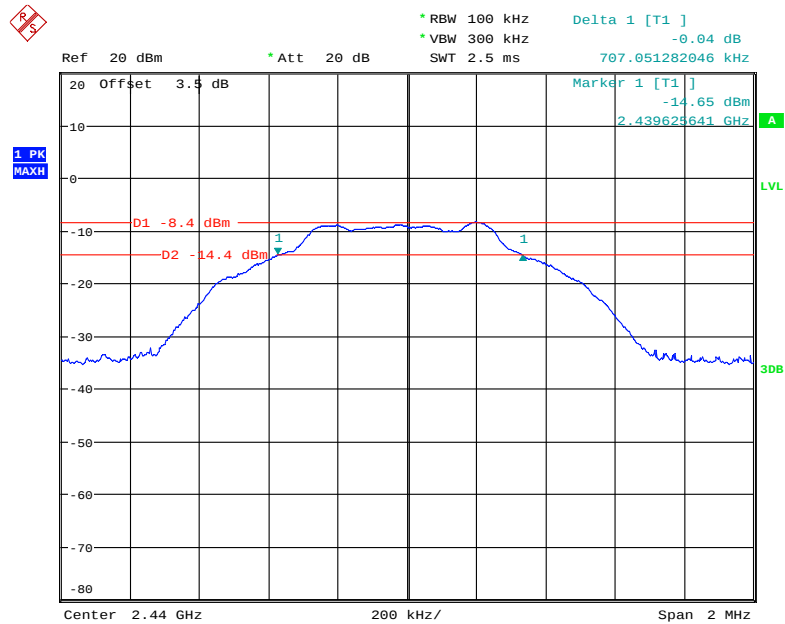
Date: 21.JUL.2021 21:34:59

6dB Bandwidth, BLE_1M Low Channel



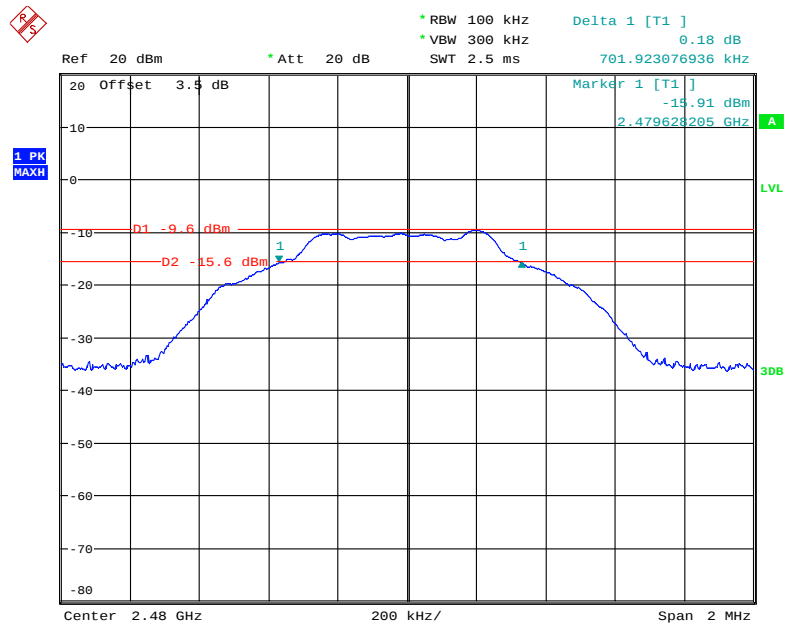
Date: 23.JUL.2021 18:56:38

6dB Bandwidth, BLE_1M Middle Channel



Date: 23.JUL.2021 18:52:04

6dB Bandwidth, BLE_1M High Channel



Date: 23.JUL.2021 18:49:43

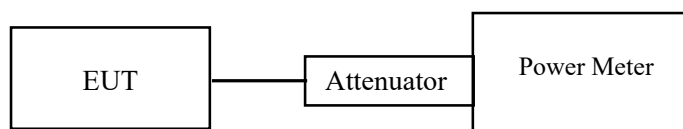
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

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:	28.6~ 29.1 °C
Relative Humidity:	51~ 52 °C
ATM Pressure:	101.0 kPa

The testing was performed by Pedro Yun on 2021-07-21 and 2021-07-23.

EUT operation mode: Transmitting

Wi-Fi mode

Channel	Frequency (MHz)	Max Conducted Average Output Power (dBm)	Max Conducted Peak Output Power (dBm)	Limit (dBm)
802.11b mode				
Low	2412	8.82	10.99	30
Middle	2442	8.74	11.55	30
High	2472	9.11	11.75	30
802.11g mode				
Low	2412	5.48	11.39	30
Middle	2442	5.98	11.78	30
High	2472	6.18	12.06	30
802.11n HT20 mode				
Low	2412	5.64	11.64	30
Middle	2442	6.02	12.03	30
High	2472	6.33	12.29	30
802.11n HT40 mode				
Low	2422	6.11	12.11	30
Middle	2442	5.87	11.74	30
High	2462	6.13	12.03	30

BLE mode

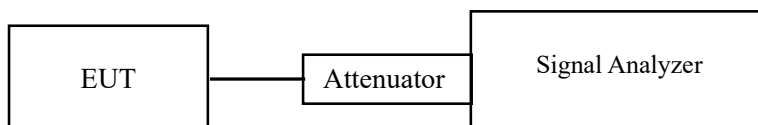
Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)
BLE_1M			
Low	2402	-6.25	30
Middle	2440	-7.52	30
High	2480	-8.78	30

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

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

Test Procedure

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

**Test Data**

Temperature:	28.6~ 29.1 °C
Relative Humidity:	51~ 52 °C
ATM Pressure:	101.0 kPa

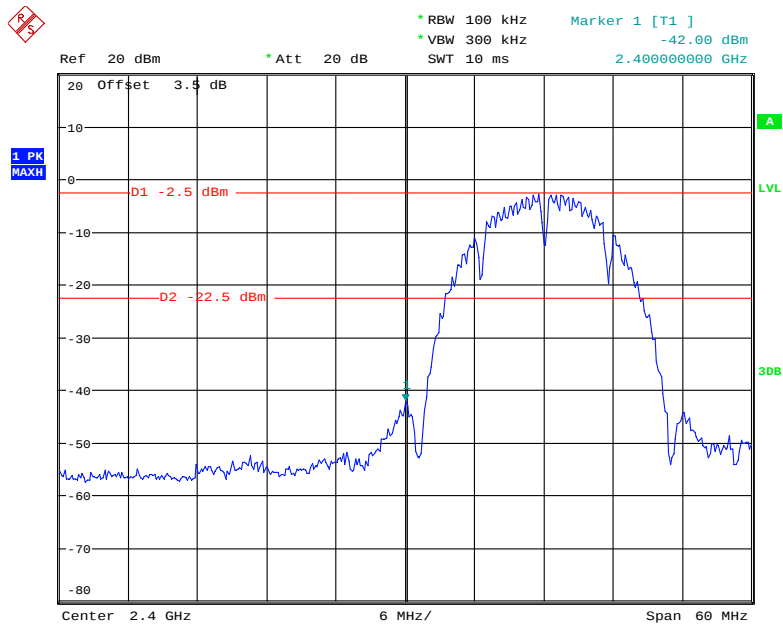
The testing was performed by Pedro Yun on 2021-07-21 and 2021-07-23.

EUT operation mode: Transmitting

Test Result: Compliance

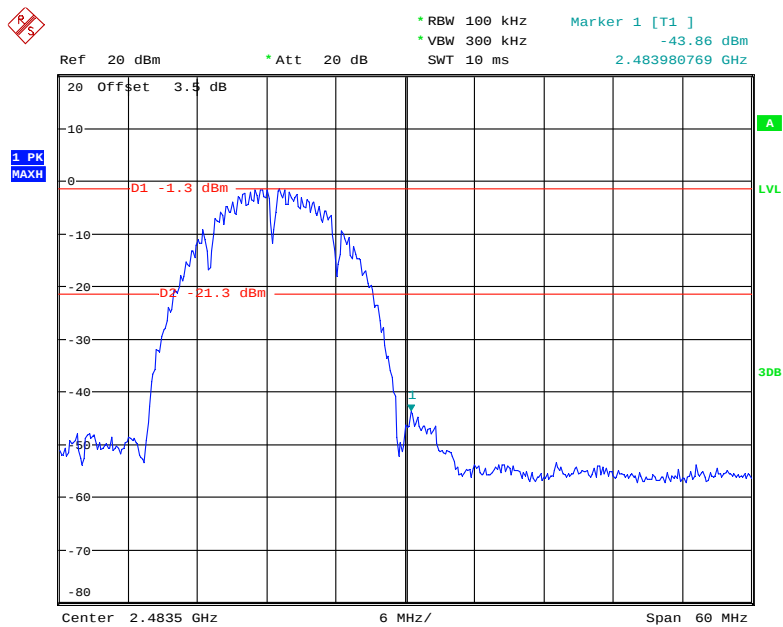
Please refer to the following plots.

802.11b: Band Edge, Left Side

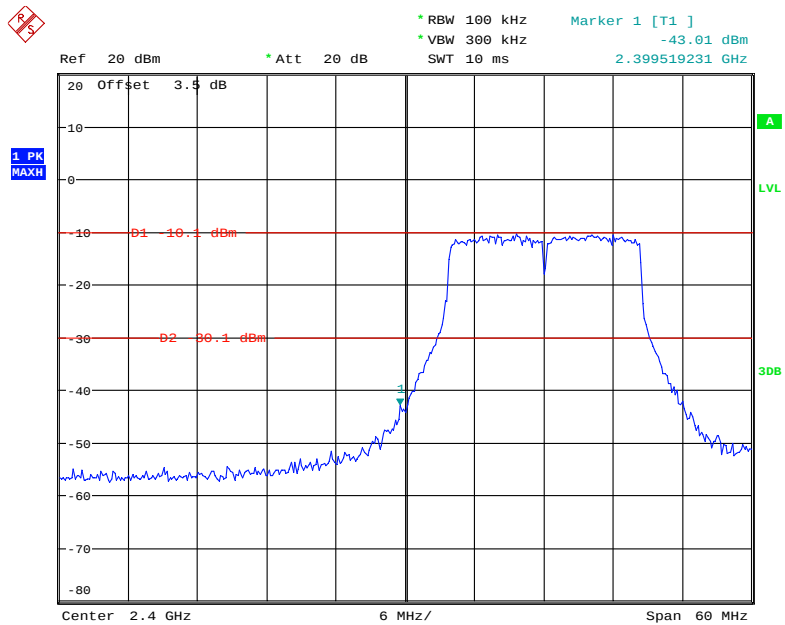


Date: 21.JUL.2021 20:14:25

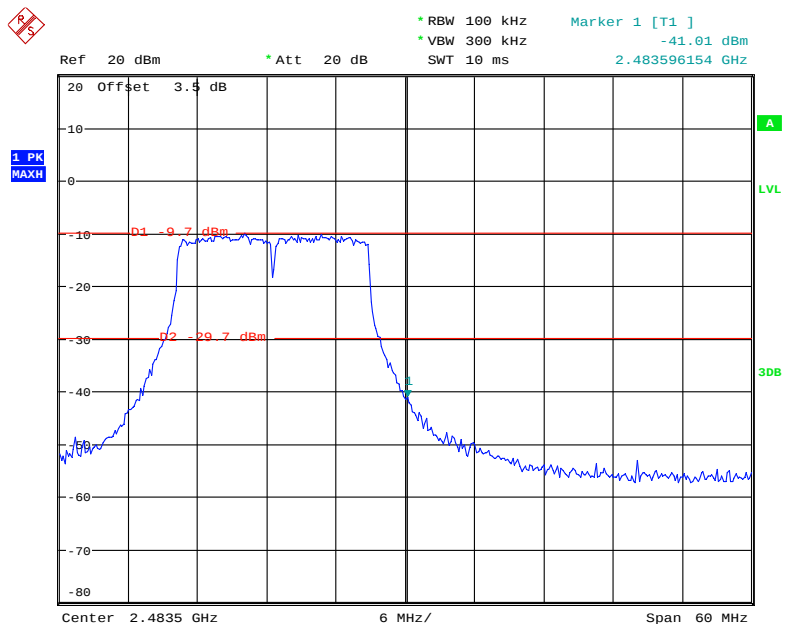
802.11b: Band Edge, Right Side



Date: 21.JUL.2021 20:15:36

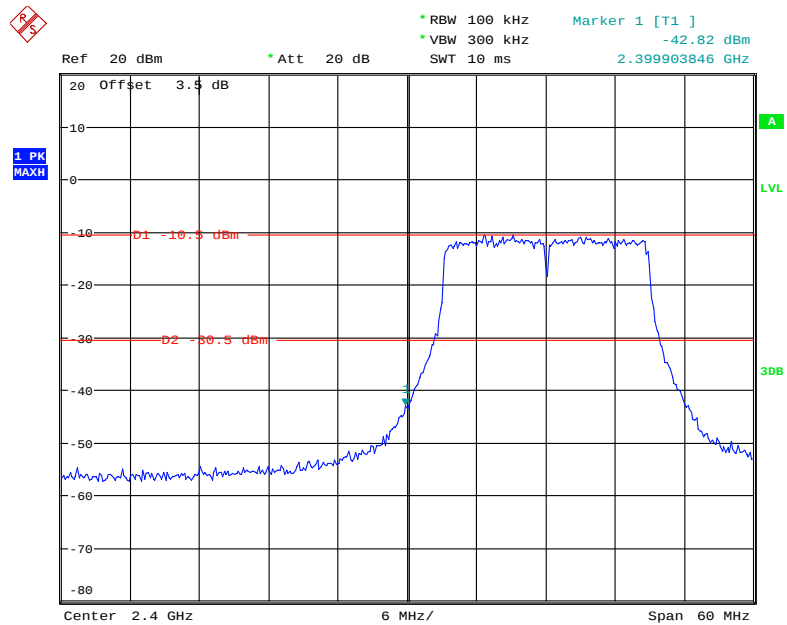
802.11g: Band Edge, Left Side

Date: 21.JUL.2021 20:18:21

802.11g: Band Edge, Right Side

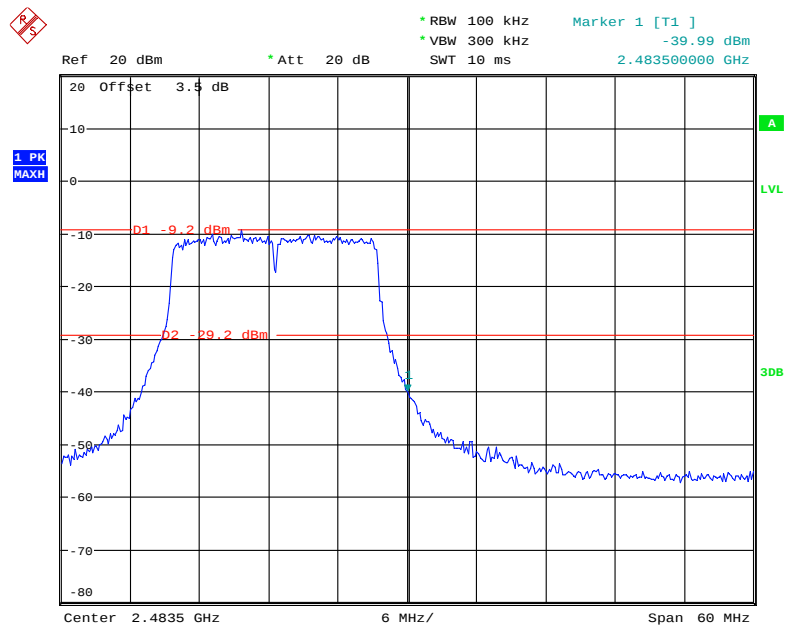
Date: 21.JUL.2021 20:17:01

802.11n-HT20: Band Edge, Left Side



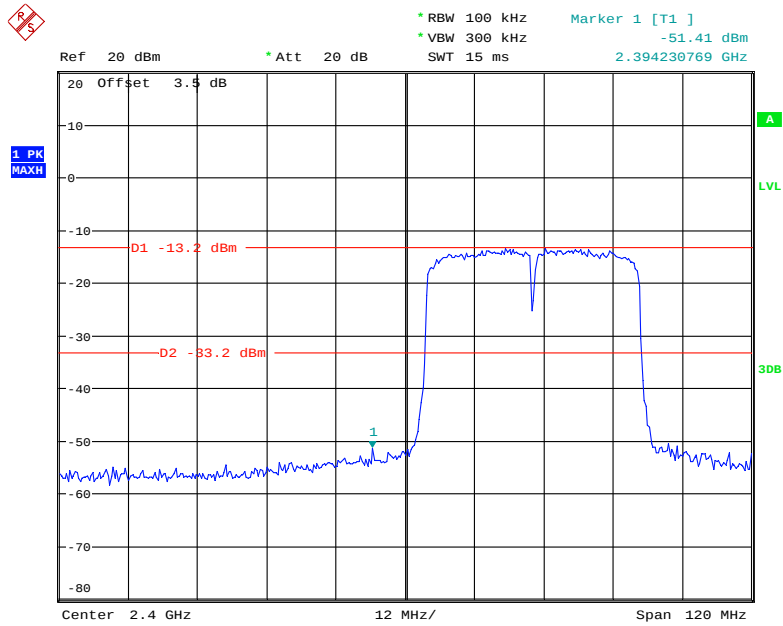
Date: 21.JUL.2021 20:19:35

802.11n-HT20: Band Edge, Right Side



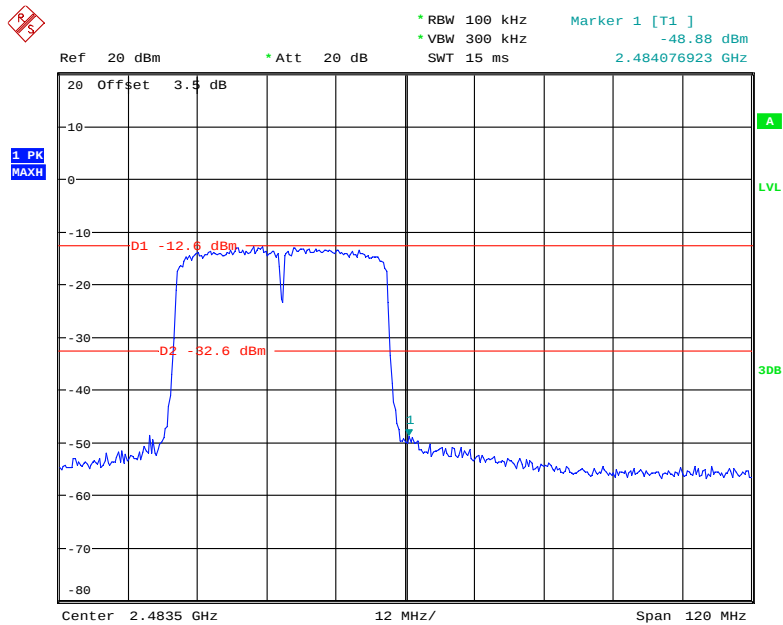
Date: 21.JUL.2021 20:20:35

802.11n-HT40: Band Edge, Left Side



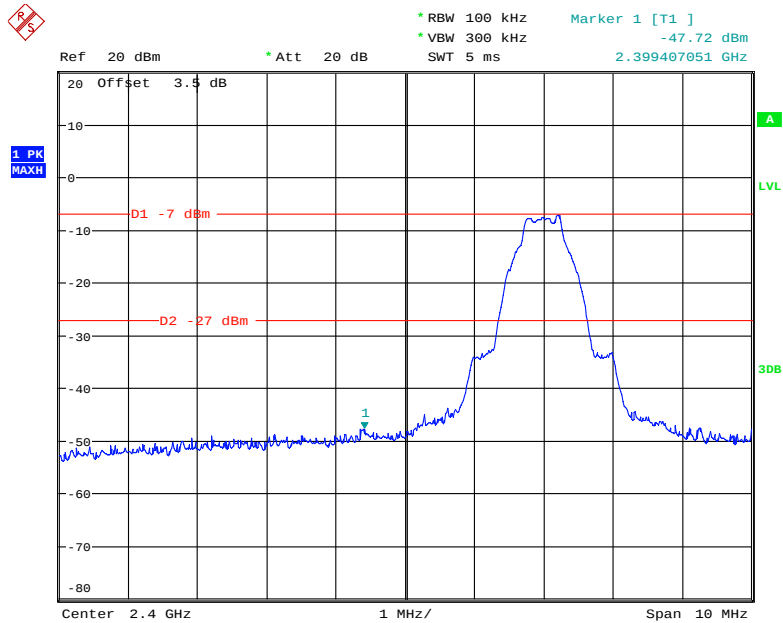
Date: 21.JUL.2021 20:22:43

802.11n-HT40: Band Edge, Right Side



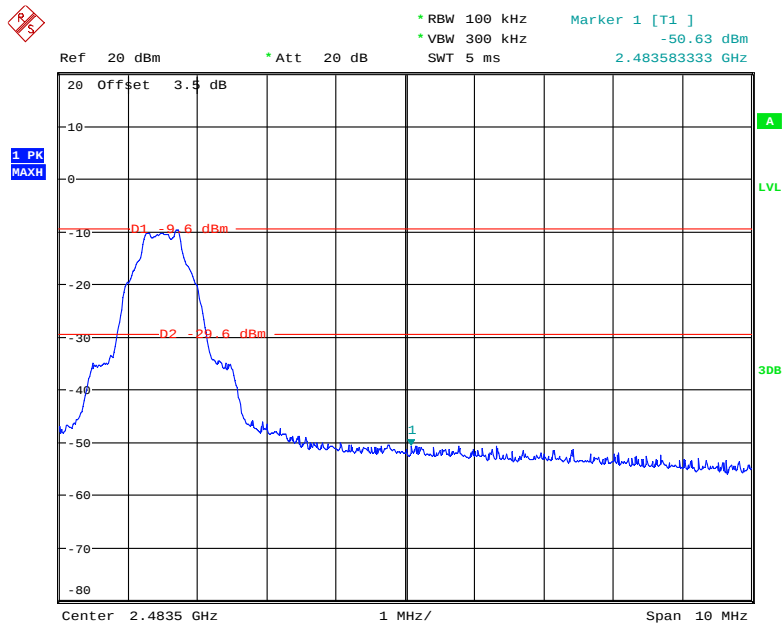
Date: 21.JUL.2021 20:22:00

BLE_1M: Band Edge, Left Side



Date: 23.JUL.2021 18:57:55

BLE_1M: Band Edge, Right Side



Date: 23.JUL.2021 18:58:51

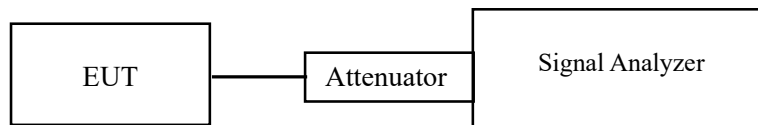
FCC §15.247(e) - POWER SPECTRAL DENSITY

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: $3\text{kHz} \leq \text{RBW} \leq 100\text{ kHz}$.
3. Set the VBW $\geq 3 \times \text{RBW}$.
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:	28.6~ 29.1 °C
Relative Humidity:	51~ 52 °C
ATM Pressure:	101.0 kPa

The testing was performed by Pedro Yun on 2021-07-21 and 2021-07-23.

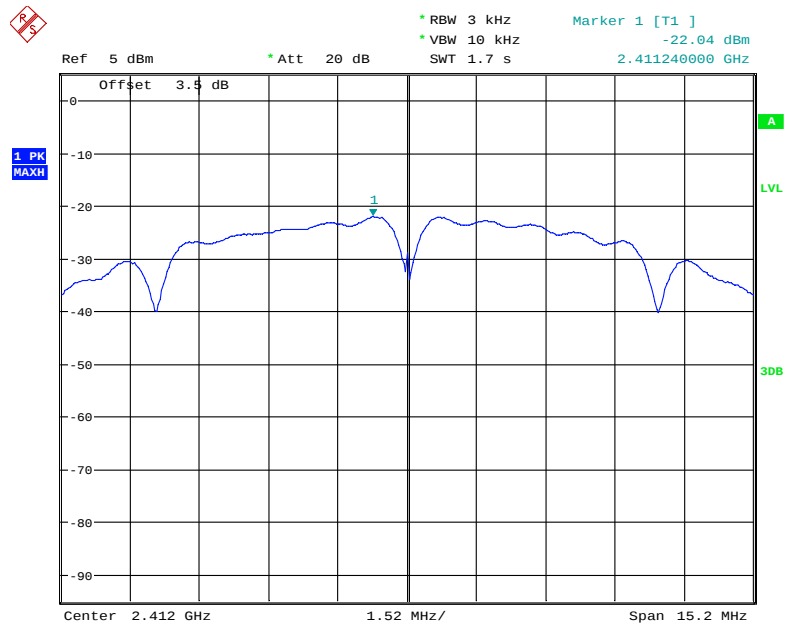
EUT operation mode: Transmitting

Test Result: Pass

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-22.04	≤ 8
Middle	2442	-21.69	≤ 8
High	2472	-21.25	≤ 8
802.11g mode			
Low	2412	-24.77	≤ 8
Middle	2442	-24.34	≤ 8
High	2472	-24.34	≤ 8
802.11n-HT20 mode			
Low	2412	-24.60	≤ 8
Middle	2442	-23.96	≤ 8
High	2472	-23.49	≤ 8
802.11n-HT40 mode			
Low	2422	-25.64	≤ 8
Middle	2442	-25.86	≤ 8
High	2462	-25.40	≤ 8

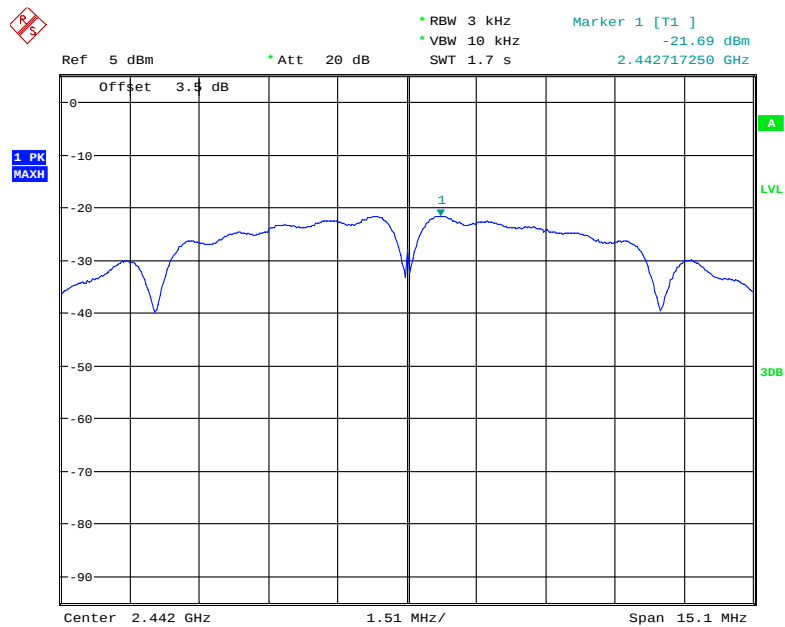
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
BLE_1M			
Low	2402	-19.89	≤ 8
Middle	2440	-21.23	≤ 8
High	2480	-22.49	≤ 8

Power Spectral Density, 802.11b Low Channel



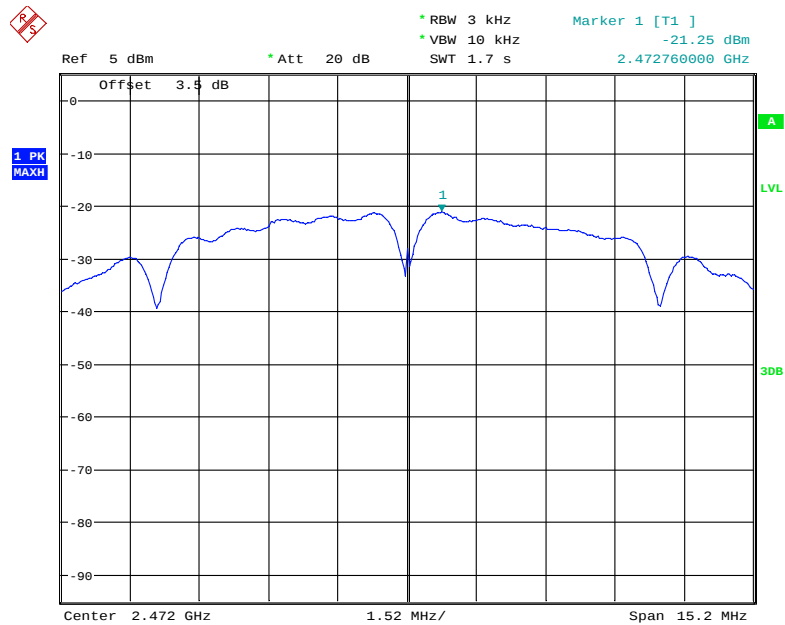
Date: 21.JUL.2021 21:51:04

Power Spectral Density, 802.11b Middle Channel



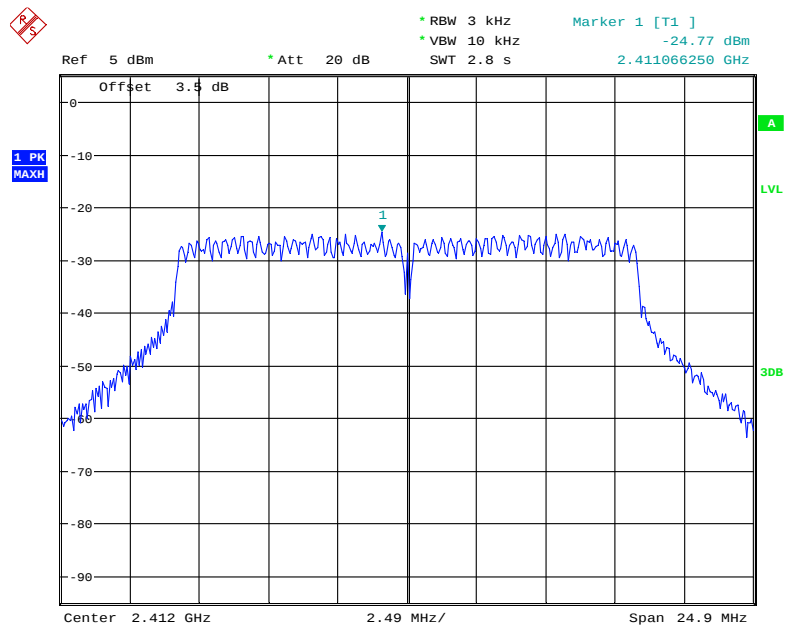
Date: 21.JUL.2021 21:52:10

Power Spectral Density, 802.11b High Channel



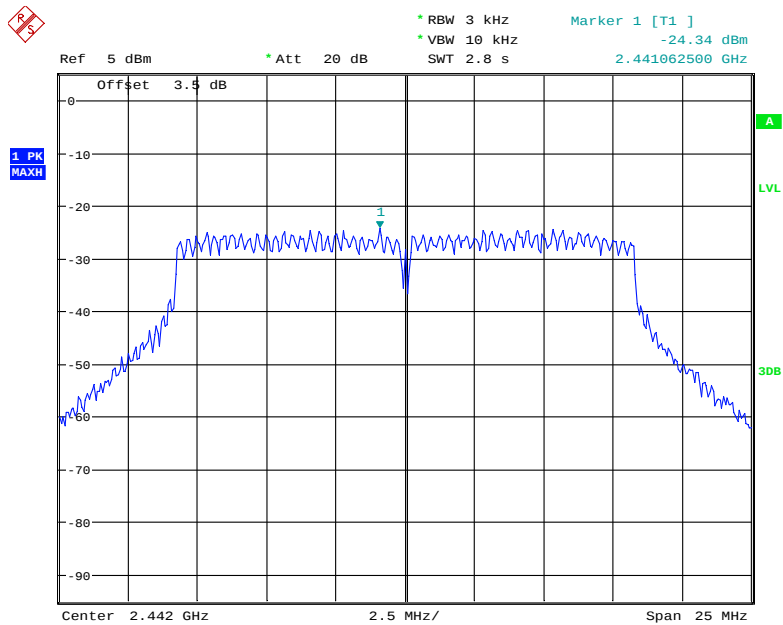
Date: 21.JUL.2021 21:52:41

Power Spectral Density, 802.11g Low Channel



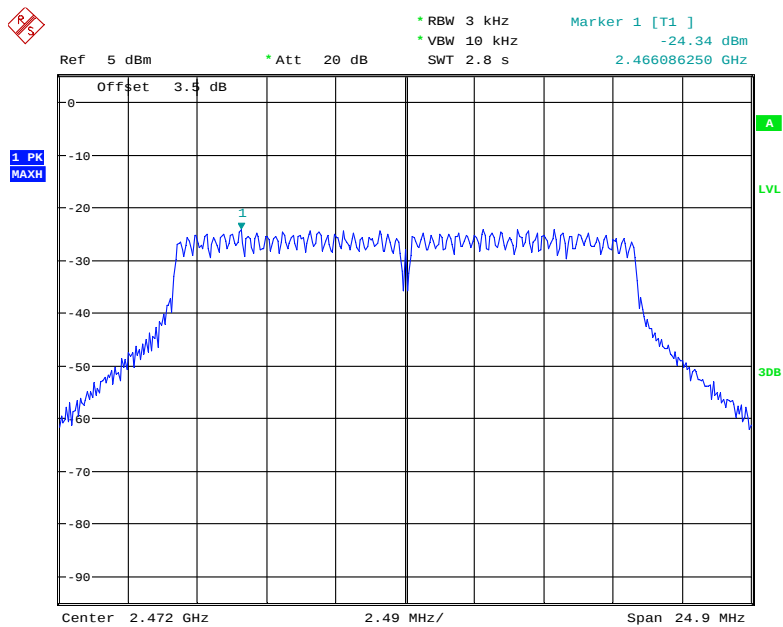
Date: 21.JUL.2021 21:53:39

Power Spectral Density, 802.11g Middle Channel



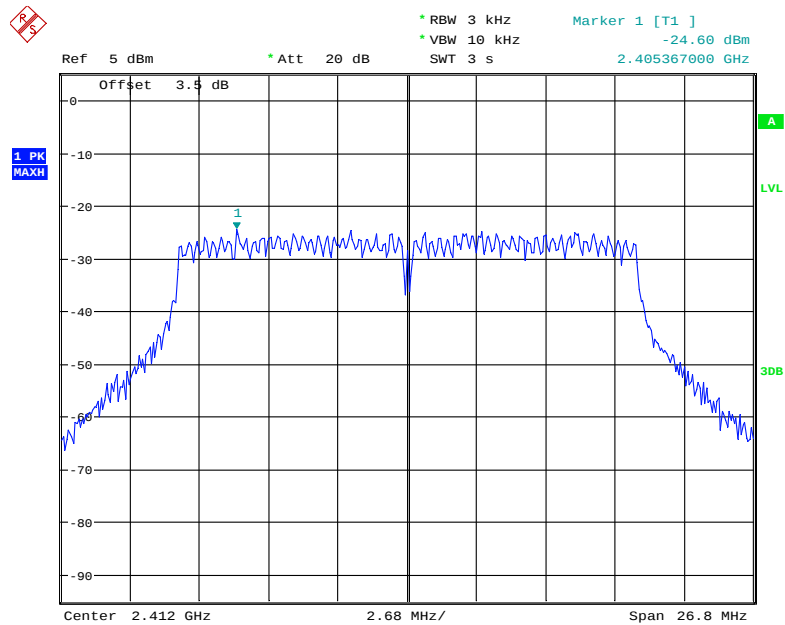
Date: 21.JUL.2021 21:54:23

Power Spectral Density, 802.11g High Channel



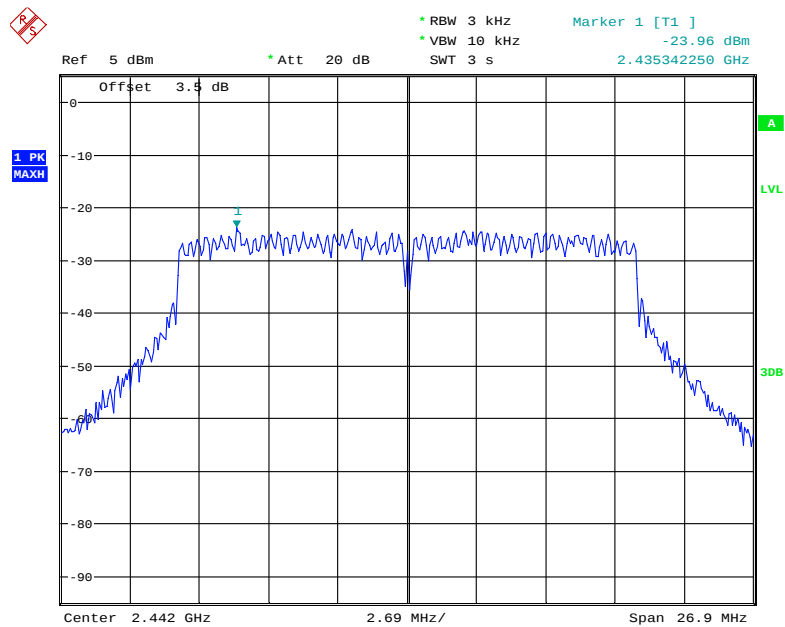
Date: 21.JUL.2021 21:55:02

Power Spectral Density, 802.11n-HT20 Low Channel



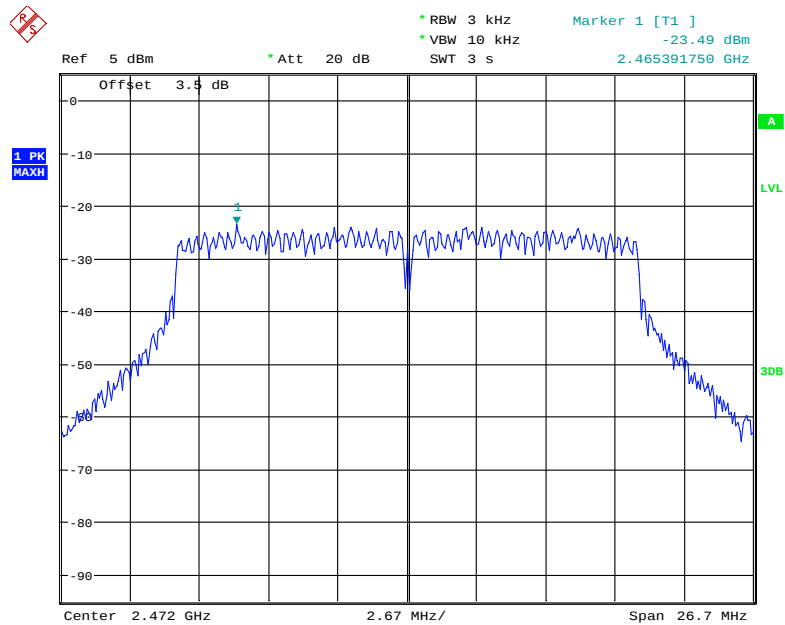
Date: 21.JUL.2021 21:55:54

Power Spectral Density, 802.11n-HT20 Middle Channel



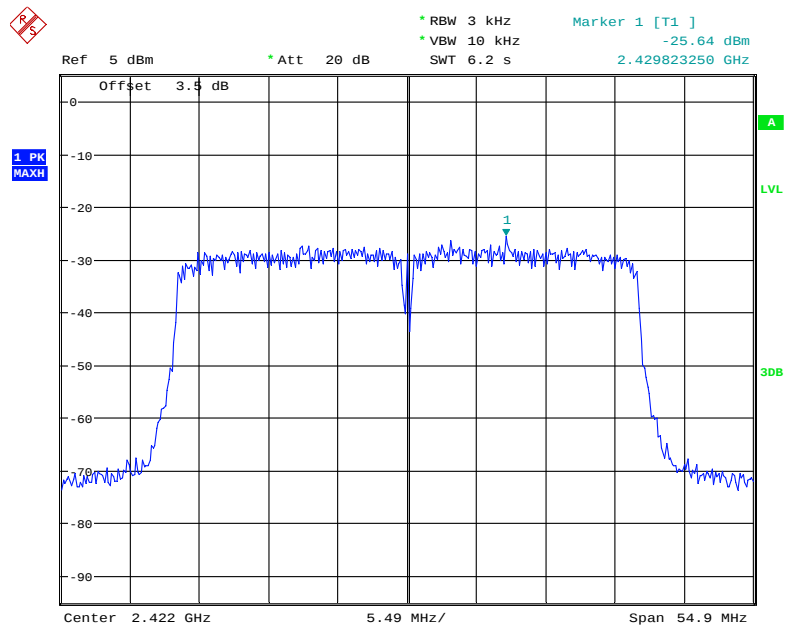
Date: 21.JUL.2021 21:56:46

Power Spectral Density, 802.11n-HT20 High Channel



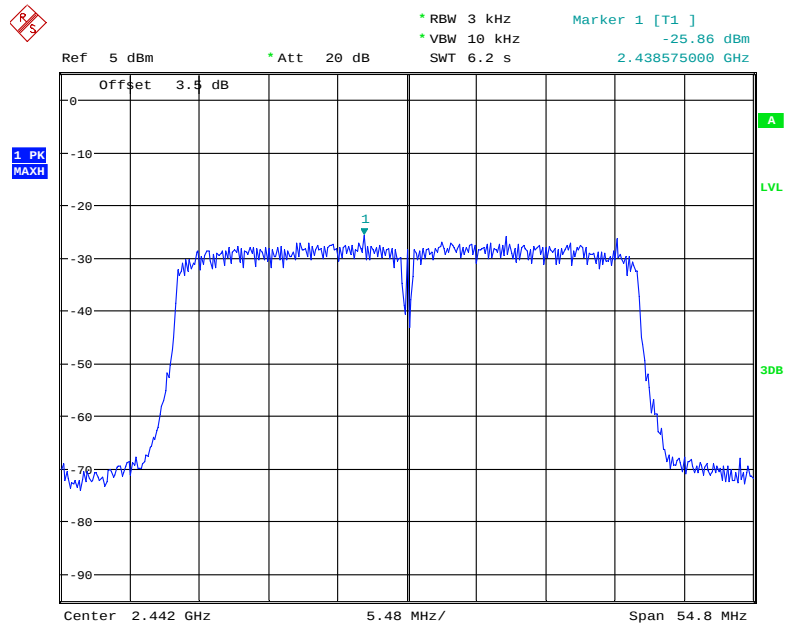
Date: 21.JUL.2021 21:57:24

Power Spectral Density, 802.11n-HT40 Low Channel



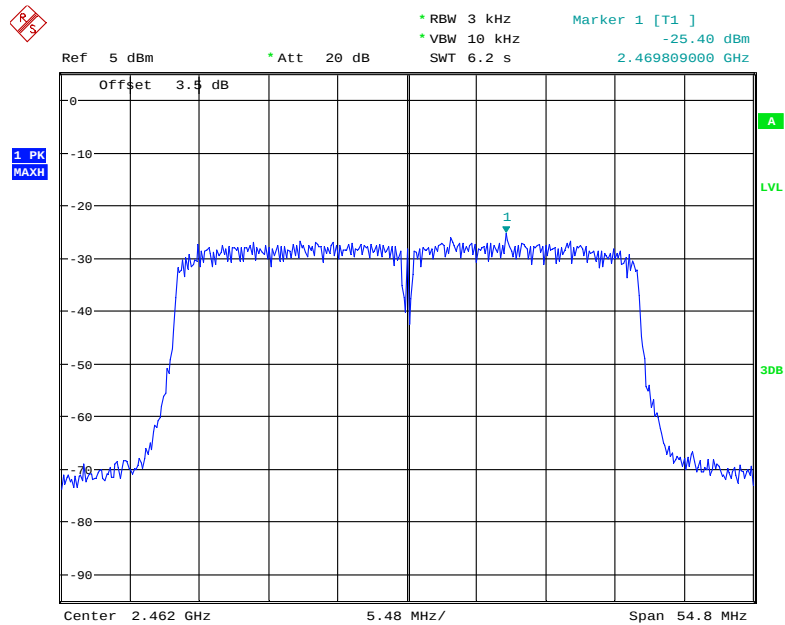
Date: 21.JUL.2021 21:59:11

Power Spectral Density, 802.11n-HT40 Middle Channel



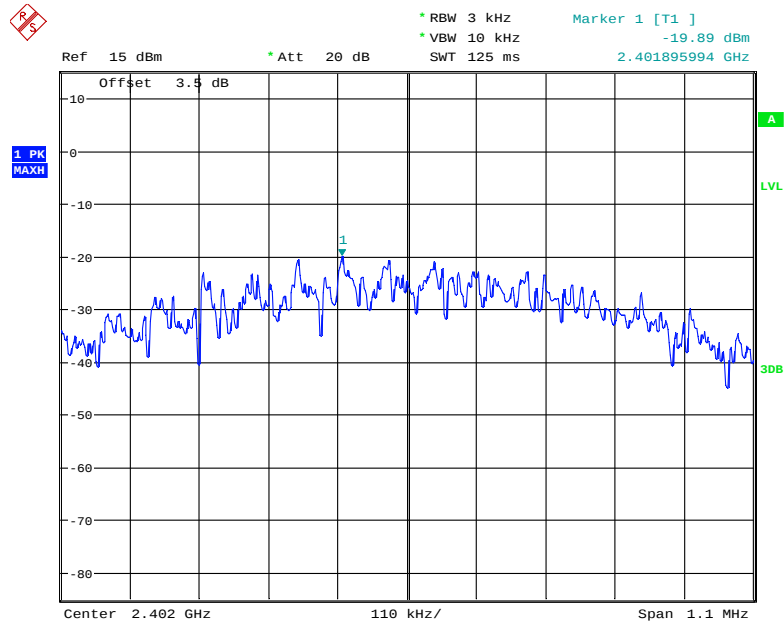
Date: 21.JUL.2021 22:00:12

Power Spectral Density, 802.11n-HT40 High Channel



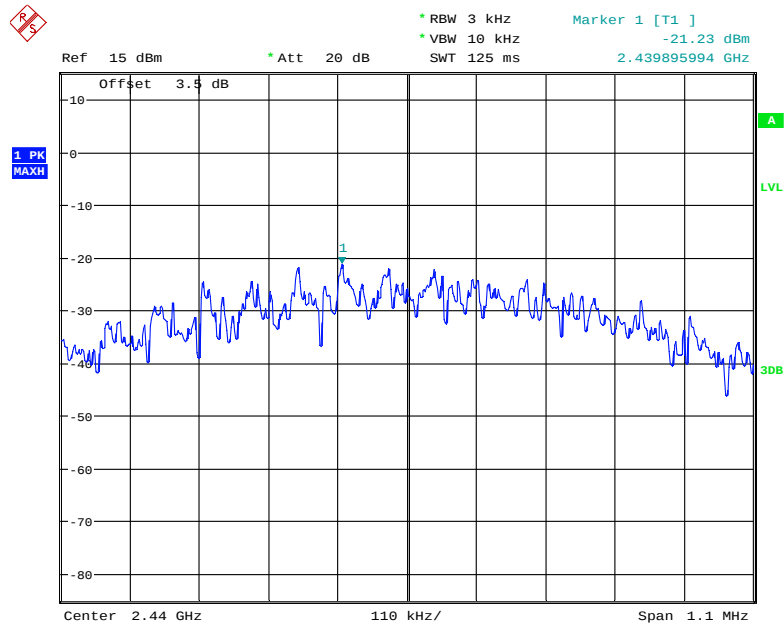
Date: 21.JUL.2021 22:00:50

Power Spectral Density, BLE_1M Low Channel



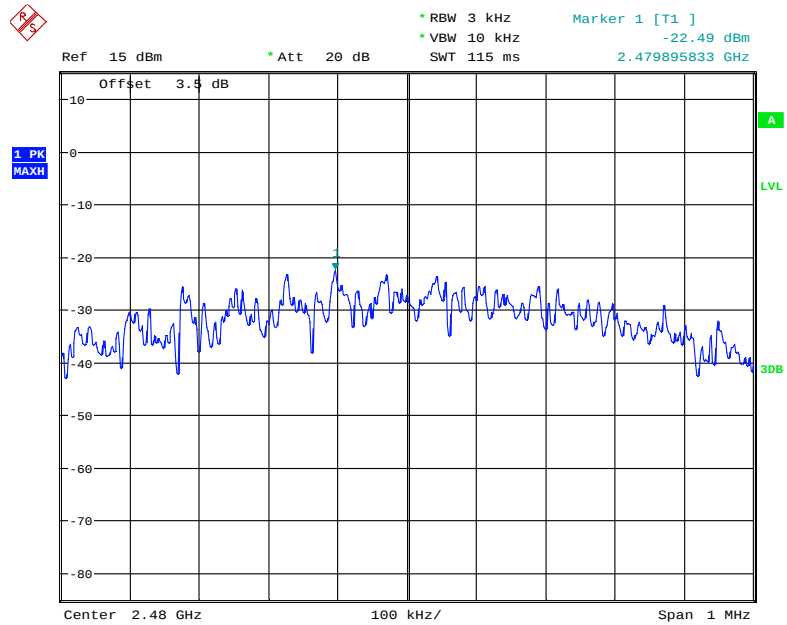
Date: 23.JUL.2021 19:09:08

Power Spectral Density, BLE_1M Middle Channel



Date: 23.JUL.2021 19:09:35

Power Spectral Density, BLE_1M High Channel



Date: 23.JUL.2021 19:10:07

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