TEST REPORT

Applicant Name :	Shenzhen Qianyan Technology LTD
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Report Number :	RA230317-12969E-RF-00
FCC ID:	2A7VD-H7135

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	Smart Space Heater Lite
Model No.:	H7135
Multiple Model(s) No.:	N/A
Trade Mark:	GoveeLife
Date Received:	2023/01/30
Report Date:	2023/04/27

Test Result:	Pass*

* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Andy Yu
EMC Engineer

Approved By:

Candy Li
EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★ ".
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RA230317-12969E-RF-00	Original Report	2023/04/27

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Frequency Range	BLE: 2402-2480MHz Wi-Fi: 2412-2462MHz
Maximum Conducted Output Power	BLE 1M: -5.54dBm Wi-Fi:11.33dBm(802.11b), 7.92dBm(802.11g) 7.69dBm(802.11n20)
Modulation Technique	BLE: GFSK Wi-Fi: DSSS, OFDM
Antenna Specification*	2.28dBi (provided by the applicant)
Voltage Range	AC 120V
Sample serial number	23CA_1for Conducted and Radiated Emissions Test 23CA_2 for RF Conducted Test (Assigned by ATC)
Sample/EUT Status	Good condition

Objective

This test 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 Shenzhen Accurate Technology Co., Ltd. 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, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Line Conducted emission		2.72dB
Emissions, Radiated	30MHz - 1GHz	4.28dB
	1GHz- 18GHz	4.98dB
	18GHz- 26.5GHz	5.06dB
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 Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the Floor 1, KuMaKe Building, Dongzhou Community, Guangming Street, Guangming District, 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.: 708358, the FCC Designation No.: CN1189. Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 429 7.01.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadia n radio equipment requirements, the CAB identifier: CN0016. The Registration Number is 30241.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For 802.11b, 802.11g, 802.11n-HT20 mode, total 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	/	/

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

For BLE mode, 40 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

EUT was tested with Channel 0, 19 and 39.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

"RTLBTAPP_5.2.2.59*" &"UartAssist.exe*" exercise software was used for BLE test, "UI_mptool 1v16*"exercise software was used for Wi-Fi test.

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	1Mbps	63	63	63
802.11g	6Mbps	63	63	63
802.11n-HT20	MCS0	63	63	63
BLE	1Mbps	0*3f	0*3f	0*3f

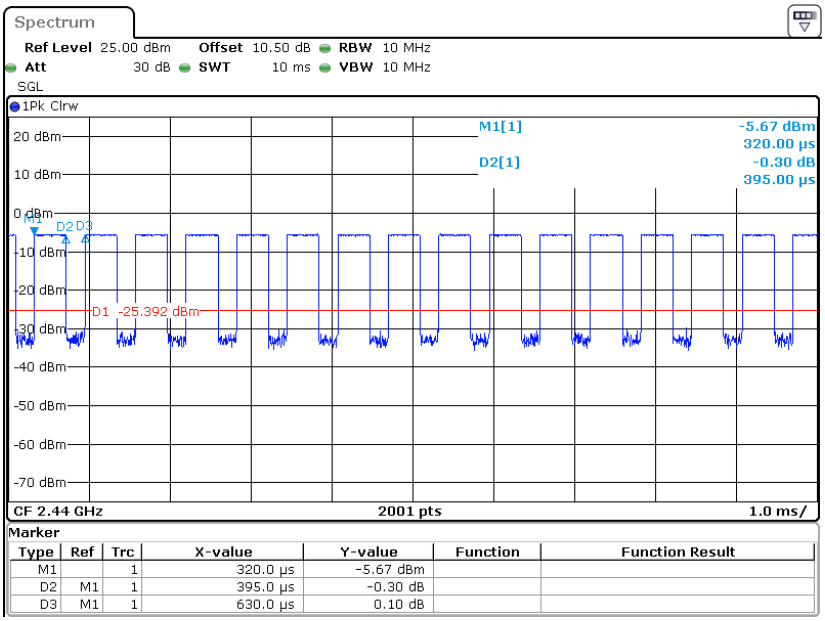
The worse-case data rates are determined to be as follows for each mode based upon investigations by measuring the output power and PSD across all data rated bandwidths, and modulations.

Note: the software and power level was provided by applicant.

Duty cycle

Mode	T_{on} (ms)	T_{on+off} (ms)	Duty Cycle (%)	1/T Minimum VBW(kHz)	Duty Cycle Correction Faction(dB)
BLE 1M	0.395	0.630	62.70	2.53	2.03
802.11b	12.419	12.556	98.91	/	/
802.11g	2.065	2.198	93.95	0.48	0.27
802.11n-HT20	1.920	2.053	93.52	0.52	0.29

BLE



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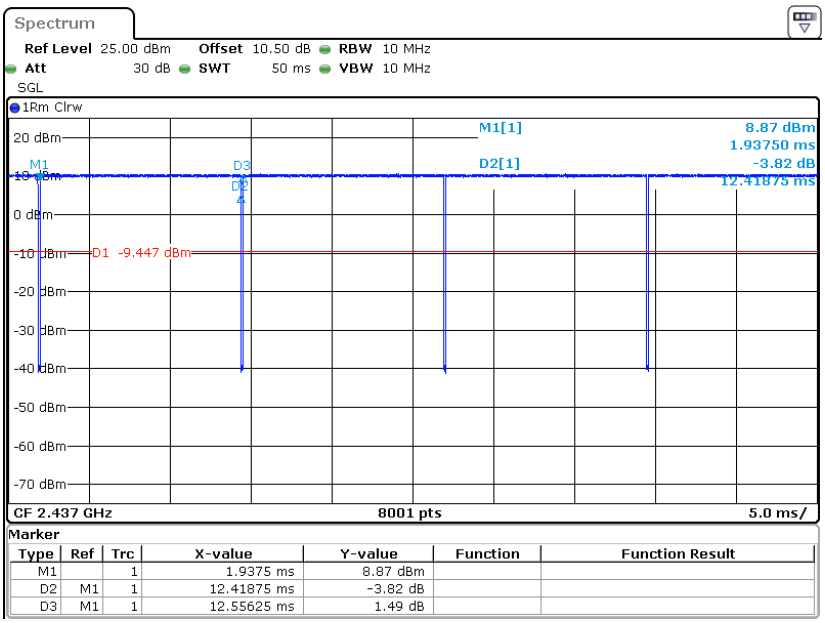
802.11b



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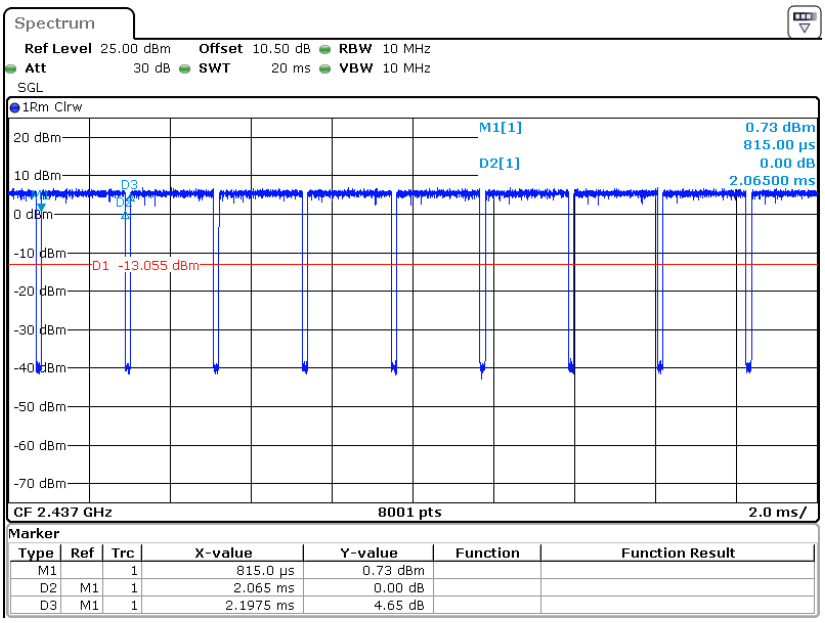
802.11g



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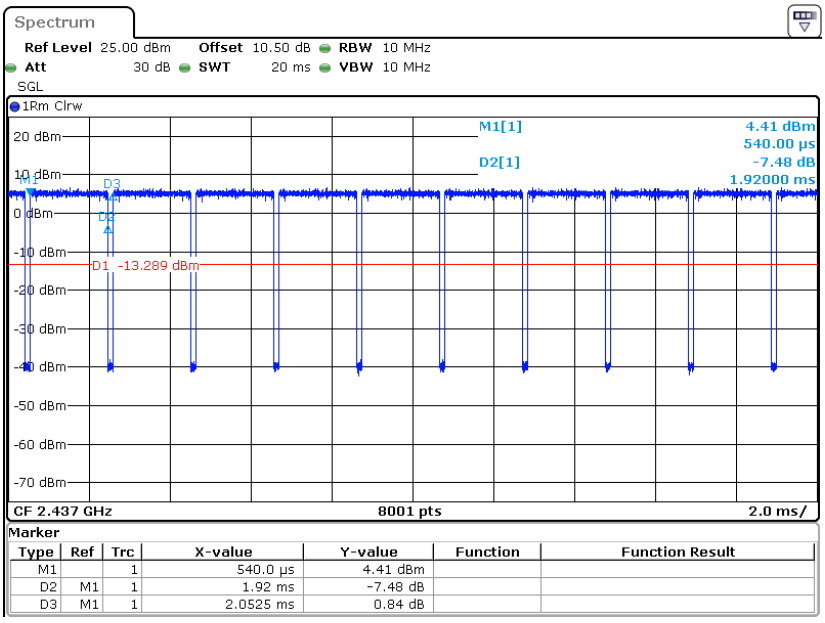
802.11n20



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Support Equipment List and Details

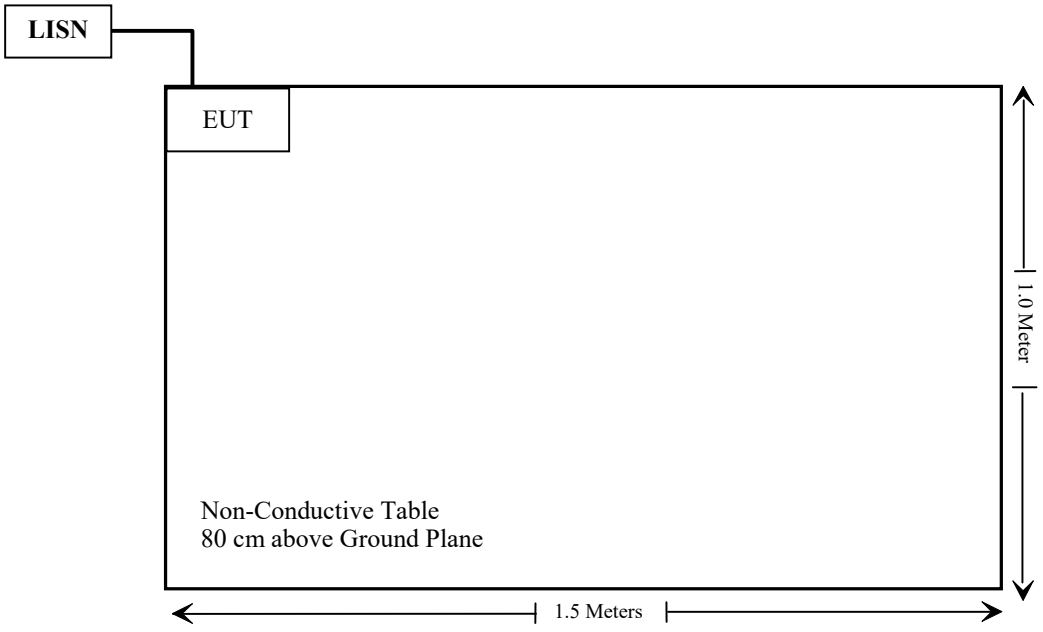
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

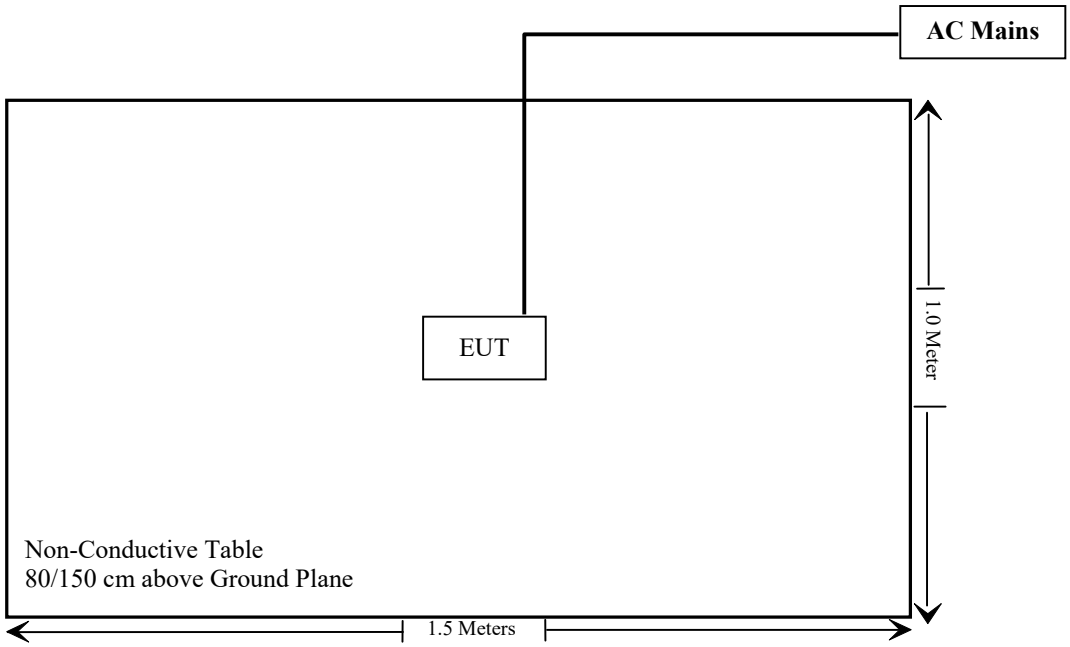
Cable Description	Length (m)	From Port	To
Un-shield Un-Detachable AC Power Cable	2.0	LISN/AC Mains	EUT

Block Diagram of Test Setup

For conducted emission



For Radiated Emissions:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC§15.247 (i), §1.1307 (b) (3) &§2.1091	RF Exposure	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 & Occupied 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 emission test					
Rohde& Schwarz	EMI Test Receiver	ESCI	100784	2022/11/25	2023/11/24
Rohde & Schwarz	L.I.S.N.	ENV216	101314	2022/11/25	2023/11/24
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2022/12/07	2023/12/06
Unknown	RF Coaxial Cable	No.17	N0350	2022/11/25	2023/11/24
Conducted Emission Test Software: e3 19821b (V9)					
Radiated emission test					
Rohde & Schwarz	Test Receiver	ESR	102725	2022/11/25	2023/11/24
Rohde & Schwarz	Spectrum Analyzer	FSV40	101949	2022/11/25	2023/11/24
SONOMA INSTRUMENT	Amplifier	310 N	186131	2022/11/08	2023/11/07
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2022/11/08	2023/11/07
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2022/11/08	2023/11/07
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2022/11/30	2025/11/29
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2022/12/26	2025/12/25
Radiated Emission Test Software: e3 19821b (V9)					
Unknown	RF Coaxial Cable	No.10	N050	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.11	N1000	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.12	N040	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.13	N300	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.14	N800	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.15	N600	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.16	N650	2022/11/25	2023/11/24
Wainwright	High Pass Filter	WHKX3.6/18G-10SS	5	2022/11/25	2023/11/24

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101948	2022/11/25	2023/11/24
Agilent	USB wideband power sensor	U2021XA	MY54250003	2022/06/27	2023/06/26
WEINSCHEL	10dB Attenuator	5324	AU 3842	2022/11/25	2023/11/24
Unknown	RF Cable	Unknown	1	Each time	

*** Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. 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) (3) &§2.1091 – RF EXPOSURE

Applicable Standard

According to subpart 15.247 (i) and subpart 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.

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

General frequency and separation-distance dependent MPE-based effective radiated power(ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemptionfrom further evaluation from 300 kHz through 100 GHz.

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

Ris the minimum separation distance in meters
f = frequency in MHz

Result

Mode	Frequency (MHz)	Antenna Gain		Tune up conducted power	ERP		Evaluation Distance (m)	ERP Limit (W)
		(dBi)	(dBd)	(dBm)	(dBm)	(W)		
BLE	2402-2480	2.28	0.13	-5.0	-4.87	0.0003	0.2	0.768
Wi-Fi	2412-2462	2.28	0.13	12.0	12.13	0.016	0.2	0.768

Note: Wi-Fi and Bluetooth cannot transmit simultaneous,
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 one internal antenna which was permanently attached, and the maximum antenna gain is 2.28dBi, fulfill the requirement of this section. Please refer to the EUT photos.

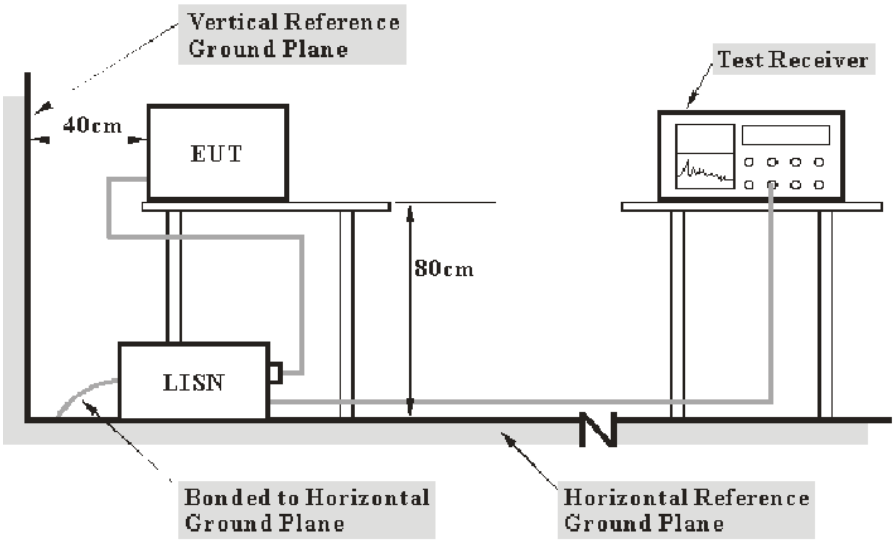
Result: Compliant.

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.

Transd Factor & Margin Calculation

The Transd factor is calculated by adding LISN VDF (Voltage Division Factor) and Cable Loss. The basic equation is as follows:

Transd Factor = LISN VDF + Cable Loss

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

Over Limit = Level – Limit
Level = Read Level + Factor

Test Data

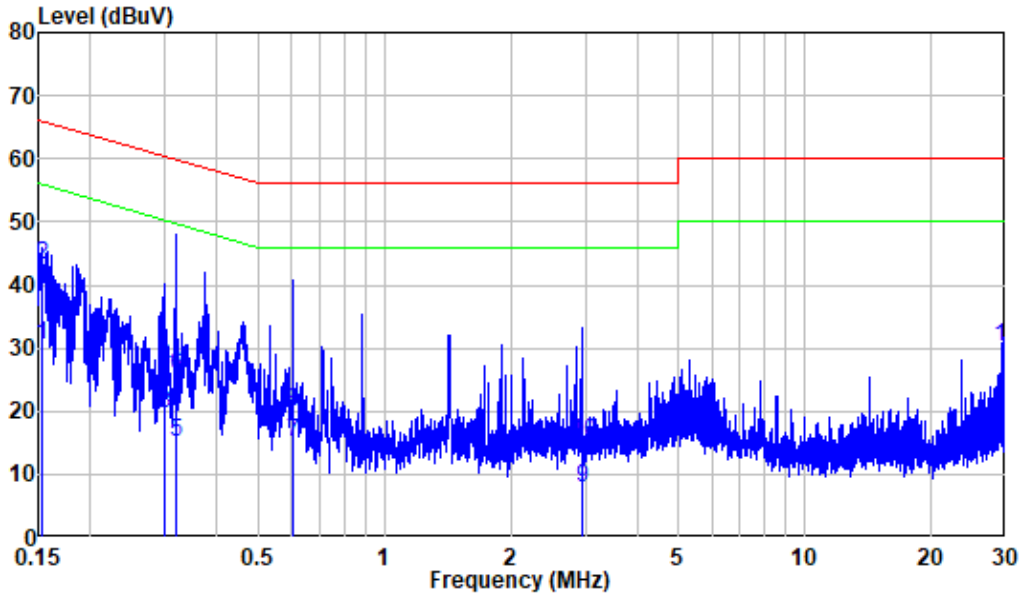
Environmental Conditions

Temperature:	21℃
Relative Humidity:	60 %
ATM Pressure:	101.3 kPa

The testing was performed by Jerry Wu on 2023-04-07.

EUT operation mode: Transmitting (Worst case is BLE 1M low channel)

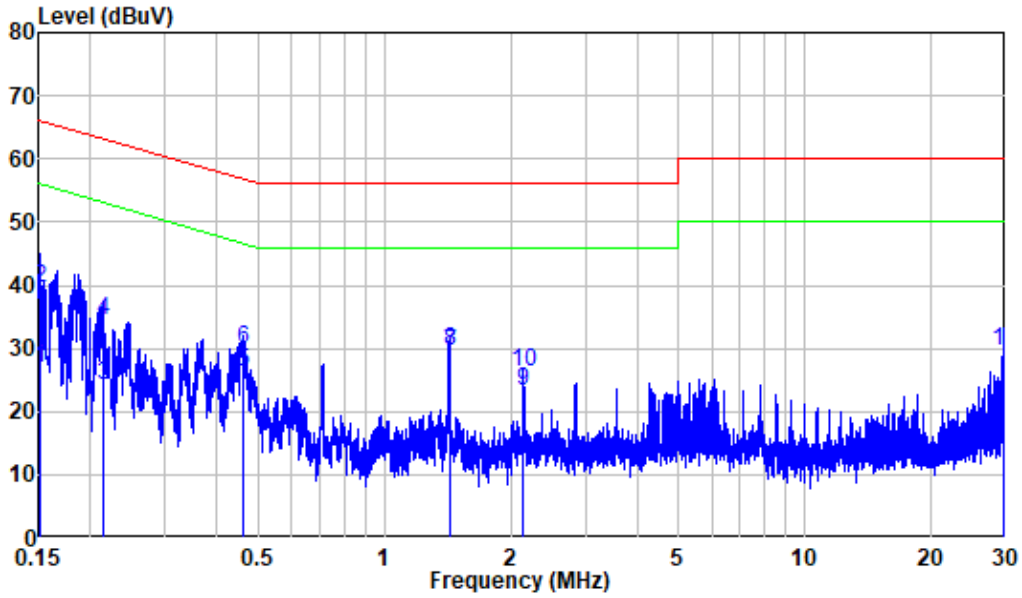
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Job No. : RA230317-12969-RF
Mode : BLE Transmitting
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.154	10.21	20.13	30.34	55.80	-25.46	Average
2	0.154	10.21	32.92	43.13	65.80	-22.67	QP
3	0.300	10.30	9.31	19.61	50.24	-30.63	Average
4	0.300	10.30	16.48	26.78	60.24	-33.46	QP
5	0.320	10.30	4.93	15.23	49.71	-34.48	Average
6	0.320	10.30	15.21	25.51	59.71	-34.20	QP
7	0.604	10.37	4.82	15.19	46.00	-30.81	Average
8	0.604	10.37	9.42	19.79	56.00	-36.21	QP
9	2.944	10.43	-2.66	7.77	46.00	-38.23	Average
10	2.944	10.43	4.79	15.22	56.00	-40.78	QP
11	29.921	9.80	7.56	17.36	50.00	-32.64	Average
12	29.921	9.80	20.39	30.19	60.00	-29.81	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Job No. : RA230317-12969-RF
Mode : BLE Transmitting
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.151	9.80	16.94	26.74	55.94	-29.20	Average
2	0.151	9.80	29.88	39.68	65.94	-26.26	QP
3	0.214	9.80	14.39	24.19	53.05	-28.86	Average
4	0.214	9.80	24.51	34.31	63.05	-28.74	QP
5	0.459	9.80	16.43	26.23	46.71	-20.48	Average
6	0.459	9.80	20.16	29.96	56.71	-26.75	QP
7	1.426	9.81	19.36	29.17	46.00	-16.83	Average
8	1.426	9.81	19.83	29.64	56.00	-26.36	QP
9	2.137	9.82	13.35	23.17	46.00	-22.83	Average
10	2.137	9.82	16.44	26.26	56.00	-29.74	QP
11	29.743	9.90	6.92	16.82	50.00	-33.18	Average
12	29.743	9.90	19.66	29.56	60.00	-30.44	QP

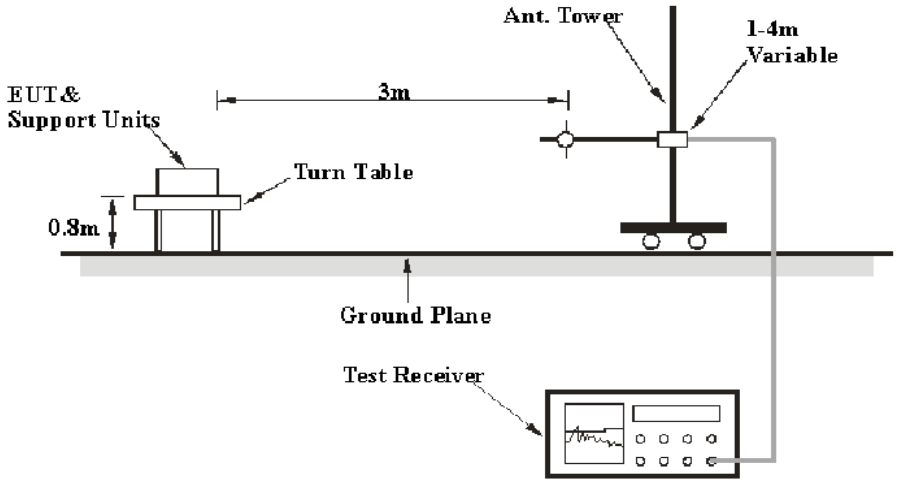
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

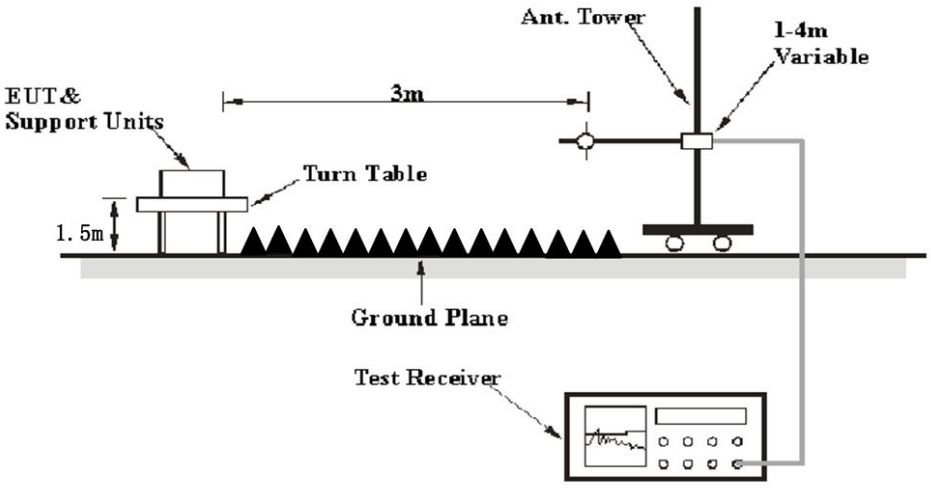
FCC §15.247 (d); §15.209; §15.205;

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.

Factor & Margin Calculation

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

Factor = Antenna Factor + Cable Loss - Amplifier Gain

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

Over Limit/Margin = Level / Corrected Amplitude – Limit
Level / Corrected Amplitude = Read Level + Factor

Test Data

Environmental Conditions

Temperature:	24~26.5 ℃
Relative Humidity:	58~60 %
ATM Pressure:	101.1 kPa

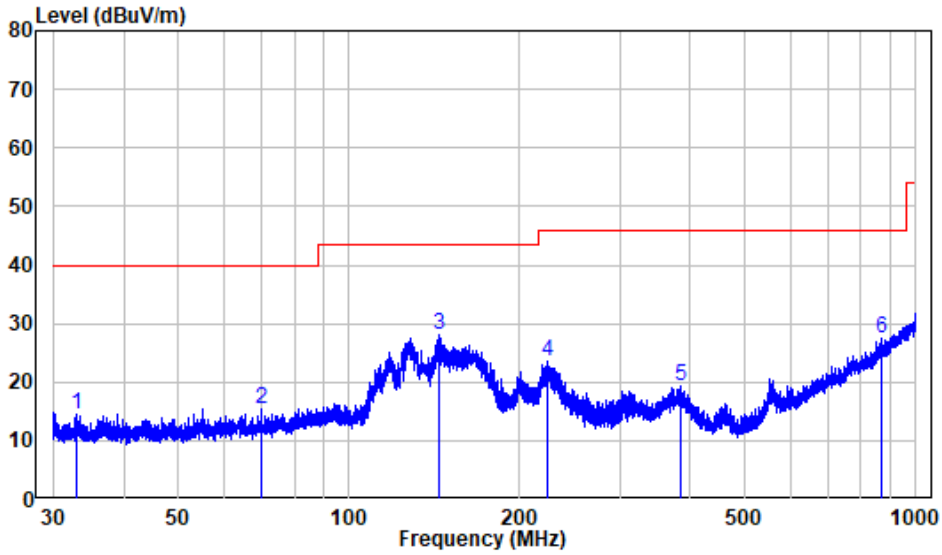
The testing was performed by Jason Liu on 2023-04-06 for below 1GHz and Jimi Zheng on 2023-04-04 for above 1GHz

EUT operation mode: Transmitting

30MHz-1GHz: *(Worst case is BLE 1M middle channel)*

Note: When the test result of Peak was less than the limit of QP, just the peak value was recorded.

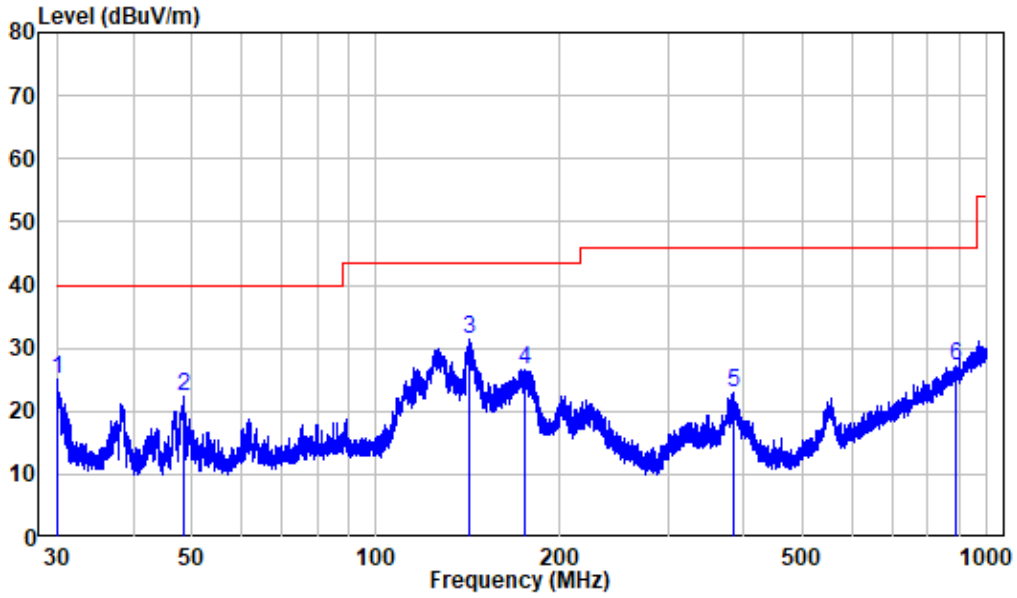
BLE *(Worst case is low channel)*
Horizontal:



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA230317-12969E-RF
Test Mode: BLE Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	32.994	-14.37	28.88	14.51	40.00	-25.49	Peak
2	69.906	-13.78	29.09	15.31	40.00	-24.69	Peak
3	144.082	-10.52	38.74	28.22	43.50	-15.28	Peak
4	223.341	-11.37	35.04	23.67	46.00	-22.33	Peak
5	385.281	-11.28	30.65	19.37	46.00	-26.63	Peak
6	869.130	-1.73	29.11	27.38	46.00	-18.62	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA230317-12969E-RF
Test Mode: BLE Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	30.000	-14.30	39.43	25.13	40.00	-14.87	Peak
2	48.459	-14.30	36.50	22.20	40.00	-17.80	Peak
3	142.200	-10.54	41.91	31.37	43.50	-12.13	Peak
4	175.190	-10.37	36.85	26.48	43.50	-17.02	Peak
5	384.606	-11.25	34.34	23.09	46.00	-22.91	Peak
6	889.168	-1.17	28.47	27.30	46.00	-18.70	Peak

1-25 GHz:

BLE 1M:

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
Low Channel(2402MHz)									
2357.2	67.59	PK	258	1.2	H	-10.77	56.82	74	-17.18
2357.2	54.29	AV	258	1.2	H	-10.77	43.52	54	-10.48
2347.6	66.87	PK	119	2.5	V	-10.76	56.11	74	-17.89
2347.6	53.82	AV	119	2.5	V	-10.76	43.06	54	-10.94
2390	66.75	PK	39	1.5	H	-10.70	56.05	74	-17.95
2390	53.60	AV	39	1.5	H	-10.70	42.90	54	-11.10
2390	65.33	PK	272	1.9	V	-10.70	54.63	74	-19.37
2390	53.81	AV	272	1.9	V	-10.70	43.11	54	-10.89
4804	60.15	PK	281	2.3	H	-6.11	54.04	74	-19.96
4804	46.38	AV	281	2.3	H	-6.11	40.27	54	-13.73
4804	60.12	PK	53	1.2	V	-6.11	54.01	74	-19.99
4804	46.39	AV	53	1.2	V	-6.11	40.28	54	-13.72
Middle Channel(2440MHz)									
4880	60.26	PK	17	1.5	H	-5.91	54.35	74	-19.65
4880	46.35	AV	17	1.5	H	-5.91	40.44	54	-13.56
4880	60.25	PK	226	1.4	V	-5.91	54.34	74	-19.66
4880	46.52	AV	226	1.4	V	-5.91	40.61	54	-13.39
High Channel(2480 MHz)									
2483.5	65.81	PK	112	2.4	H	-10.55	55.26	74	-18.74
2483.5	54.77	AV	112	2.4	H	-10.55	44.22	54	-9.78
2483.5	66.20	PK	49	1.1	V	-10.55	55.65	74	-18.35
2483.5	54.42	AV	49	1.1	V	-10.55	43.87	54	-10.13
2498.29	68.09	PK	32	1.7	H	-10.43	57.66	74	-16.34
2498.29	54.91	AV	32	1.7	H	-10.43	44.48	54	-9.52
2492.23	68.30	PK	38	2.5	V	-10.48	57.82	74	-16.18
2492.23	54.97	AV	38	2.5	V	-10.48	44.49	54	-9.51
4960	59.94	PK	344	2.2	H	-5.47	54.47	74	-19.53
4960	45.84	AV	344	2.2	H	-5.47	40.37	54	-13.63
4960	60.20	PK	224	2.2	V	-5.47	54.73	74	-19.27
4960	46.15	AV	224	2.2	V	-5.47	40.68	54	-13.32

Wi-Fi:

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
802.11b									
Low Channel(2412MHz)									
2386.32	67.64	PK	151	1.4	H	-10.71	56.93	74	-17.07
2386.32	53.21	AV	151	1.4	H	-10.71	42.50	54	-11.50
2380.08	67.44	PK	119	2.2	V	-10.72	56.72	74	-17.28
2380.08	53.25	AV	119	2.2	V	-10.72	42.53	54	-11.47
2390	65.14	PK	357	1.2	H	-10.70	54.44	74	-19.56
2390	53.15	AV	357	1.2	H	-10.70	42.45	54	-11.55
2390	66.53	PK	93	2.1	V	-10.70	55.83	74	-18.17
2390	53.21	AV	93	2.1	V	-10.70	42.51	54	-11.49
4824	59.72	PK	110	1.8	H	-6.10	53.62	74	-20.38
4824	60.02	PK	248	1.8	V	-6.10	53.92	74	-20.08
Middle Channel(2437MHz)									
4874	59.65	PK	41	1.8	H	-5.95	53.70	74	-20.30
4874	59.30	PK	112	1.8	V	-5.95	53.35	74	-20.65
High Channel(2462MHz)									
2483.5	66.47	PK	312	2.3	H	-10.55	55.92	74	-18.08
2483.5	53.89	AV	312	2.3	H	-10.55	43.34	54	-10.66
2483.5	67.40	PK	63	1.9	V	-10.55	56.85	74	-17.15
2483.5	54.01	AV	63	1.9	V	-10.55	43.46	54	-10.54
2490.15	67.65	PK	106	1.3	H	-10.50	57.15	74	-16.85
2490.15	53.84	AV	106	1.3	H	-10.50	43.34	54	-10.66
2488.05	68.42	PK	252	2.5	V	-10.51	57.91	74	-16.09
2488.05	54.03	AV	252	2.5	V	-10.51	43.52	54	-10.48
4924	58.98	PK	216	1.5	H	-5.67	53.31	74	-20.69
4924	59.50	PK	154	1.5	V	-5.67	53.83	74	-20.17

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
802.11g									
Low Channel(2412MHz)									
2385.72	68.10	PK	31	2	H	-10.71	57.39	74	-16.61
2385.72	53.23	AV	31	2	H	-10.71	42.52	54	-11.48
2382.6	67.60	PK	136	1.3	V	-10.72	56.88	74	-17.12
2382.6	53.23	AV	136	1.3	V	-10.72	42.51	54	-11.49
2390	66.08	PK	188	1.3	H	-10.70	55.38	74	-18.62
2390	53.17	AV	188	1.3	H	-10.70	42.47	54	-11.53
2390	65.00	PK	129	1.3	V	-10.70	54.30	74	-19.70
2390	53.19	AV	129	1.3	V	-10.70	42.49	54	-11.51
4824	59.86	PK	118	1.3	H	-6.10	53.76	74	-20.24
4824	59.48	PK	186	1.3	V	-6.10	53.38	74	-20.62
Middle Channel(2437MHz)									
4874	59.30	PK	156	2.4	H	-5.95	53.35	74	-20.65
4874	59.71	PK	74	2.4	V	-5.95	53.76	74	-20.24
High Channel(2462MHz)									
2483.5	66.86	PK	13	1.7	H	-10.55	56.31	74	-17.69
2483.5	54.04	AV	13	1.7	H	-10.55	43.49	54	-10.51
2483.5	66.77	PK	312	1.5	V	-10.55	56.22	74	-17.78
2483.5	54.16	AV	312	1.5	V	-10.55	43.61	54	-10.39
2488.2	68.24	PK	159	1.9	H	-10.51	57.73	74	-16.27
2488.2	54.01	AV	159	1.9	H	-10.51	43.5	54	-10.50
2490.85	68.28	PK	118	1.4	V	-10.49	57.79	74	-16.21
2490.85	54.12	AV	118	1.4	V	-10.49	43.63	54	-10.37
4924	59.05	PK	11	2.1	H	-5.67	53.38	74	-20.62
4924	59.27	PK	186	2.1	V	-5.67	53.60	74	-20.40

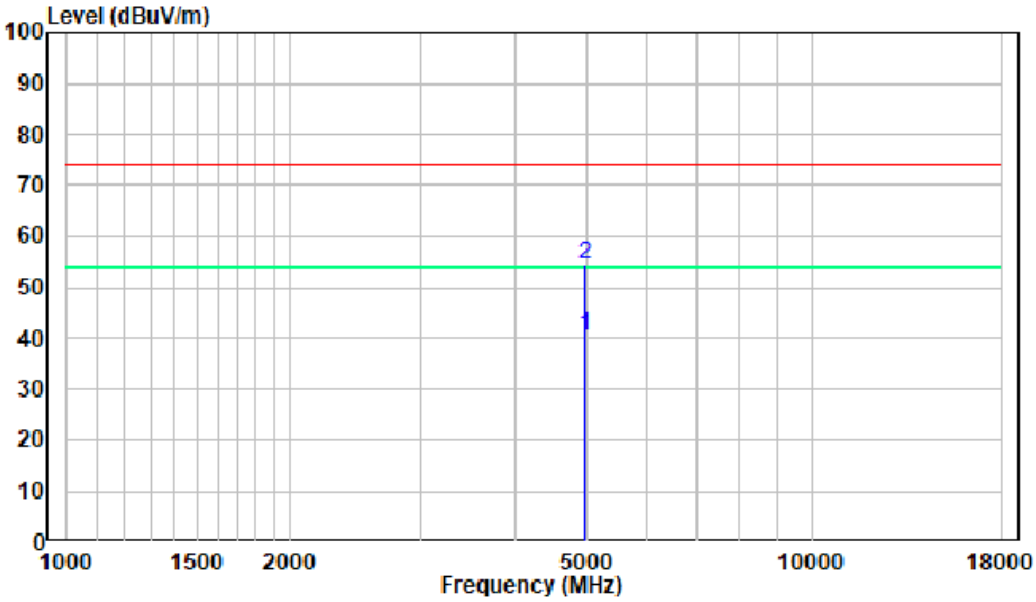
Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
802.11n20									
Low Channel(2412MHz)									
2357.64	68.83	PK	290	2.1	H	-10.77	58.06	74	-15.94
2357.64	53.60	AV	290	2.1	H	-10.77	42.83	54	-11.17
2389.92	67.90	PK	232	1.1	V	-10.70	57.20	74	-16.80
2389.92	53.48	AV	232	1.1	V	-10.70	42.78	54	-11.22
2390	65.57	PK	50	1.5	H	-10.70	54.87	74	-19.13
2390	53.60	AV	50	1.5	H	-10.70	42.90	54	-11.10
2390	65.40	PK	55	2.1	V	-10.70	54.70	74	-19.30
2390	53.51	AV	55	2.1	V	-10.70	42.81	54	-11.19
4824	59.79	PK	85	1.6	H	-6.10	53.69	74	-20.31
4824	59.56	PK	5	1.6	V	-6.10	53.46	74	-20.54
Middle Channel(2437MHz)									
4874	59.53	PK	54	2.3	H	-5.95	53.58	74	-20.42
4874	59.35	PK	233	2.3	V	-5.95	53.40	74	-20.60
High Channel(2462MHz)									
2483.5	65.93	PK	289	1.7	H	-10.55	55.38	74	-18.62
2483.5	53.61	AV	289	1.7	H	-10.55	43.06	54	-10.94
2483.5	66.17	PK	67	1.9	V	-10.55	55.62	74	-18.38
2483.5	53.69	AV	67	1.9	V	-10.55	43.14	54	-10.86
2495.5	67.81	PK	57	2.2	H	-10.46	57.35	74	-16.65
2495.5	53.65	AV	57	2.2	H	-10.46	43.19	54	-10.81
2495.25	67.62	PK	67	1.9	V	-10.46	57.16	74	-16.84
2495.25	53.64	AV	67	1.9	V	-10.46	43.18	54	-10.82
4924	59.18	PK	98	2.4	H	-5.67	53.51	74	-20.49
4924	59.50	PK	115	2.4	V	-5.67	53.83	74	-20.17

Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Corrected. Amplitude - Limit
The other spurious emission which is in the noise floor level was not recorded.
The test result of peak was less than the limit of average, so just peak value were recorded.

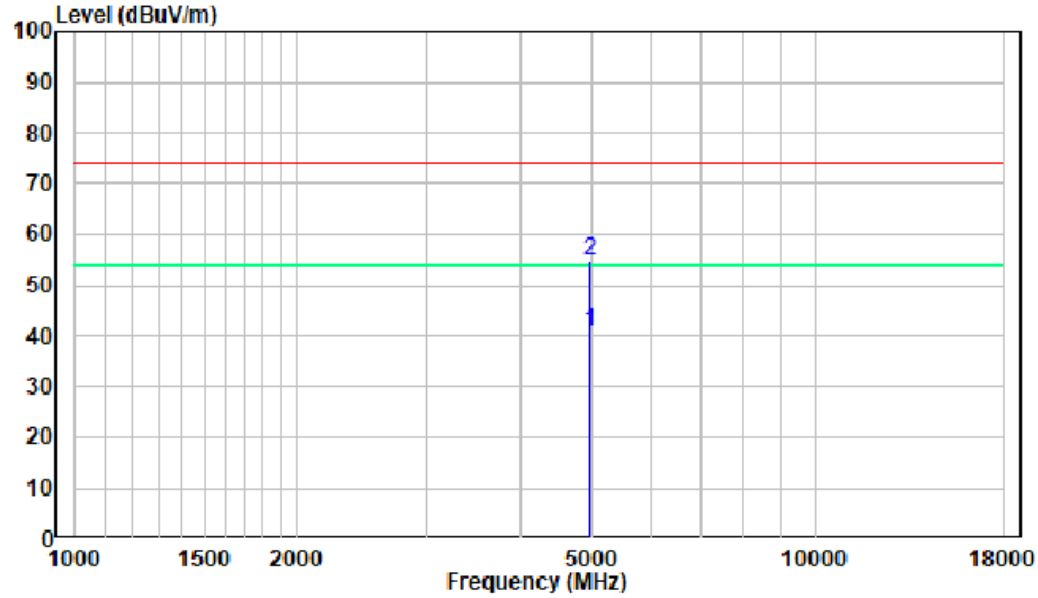
1-18 GHz:

Pre-scan for BLE 1M, High Channel

Horizontal



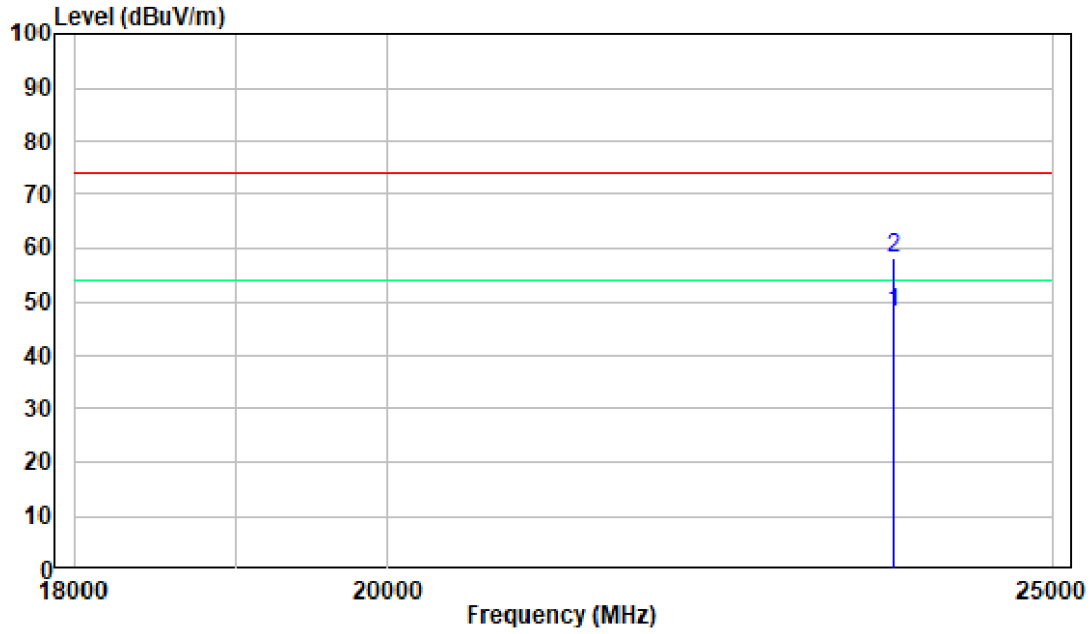
Vertical



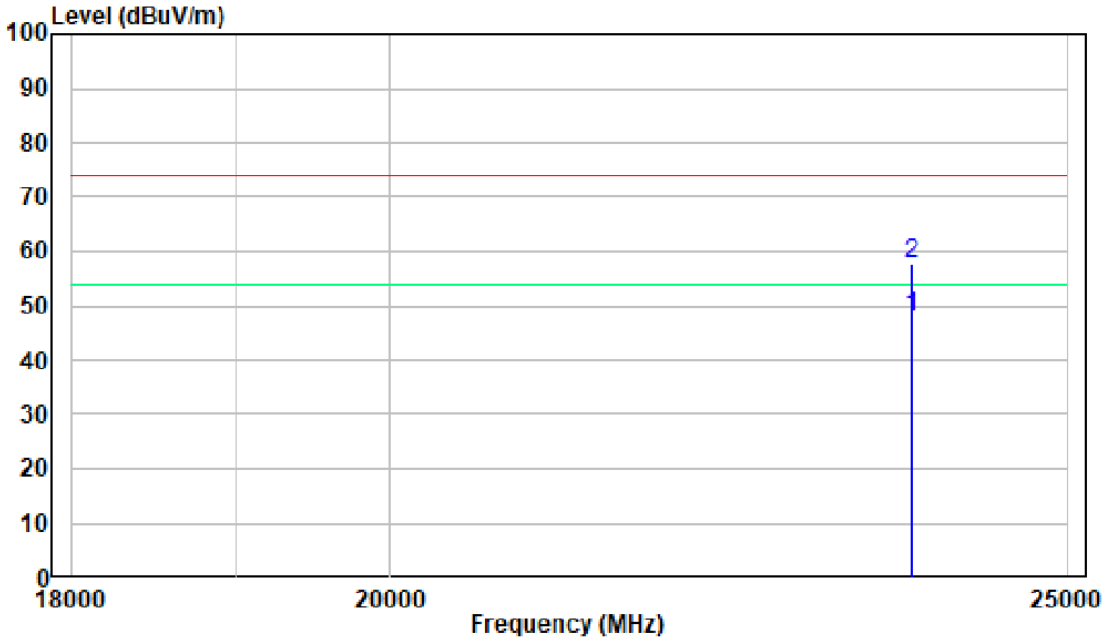
18 -25GHz:

Pre-scan for BLE 1M, High Channel

Horizontal



Vertical



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

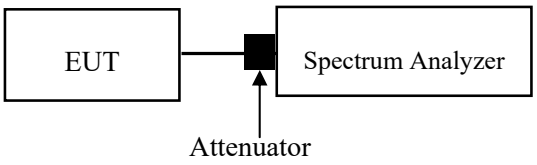
Applicable Standard

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

Test Method: ANSI C63.10-2013 Clause 11.8.1 & Clause 6.9.3

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:	28.2 ℃
Relative Humidity:	46 %
ATM Pressure:	101.0 kPa

The testing was performed by Mike Xiao on 2023-04-07.

EUT operation mode: Transmitting

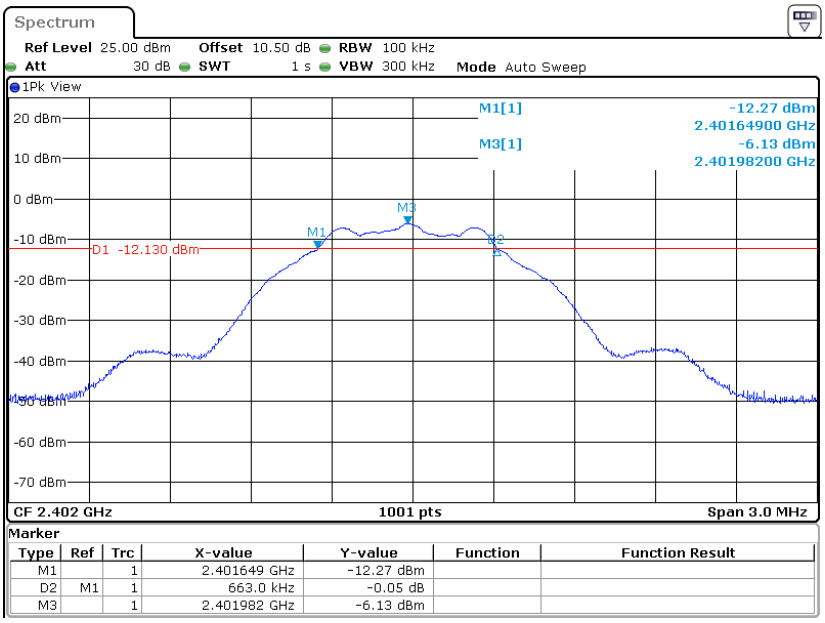
Test Result: Compliant.

BLE

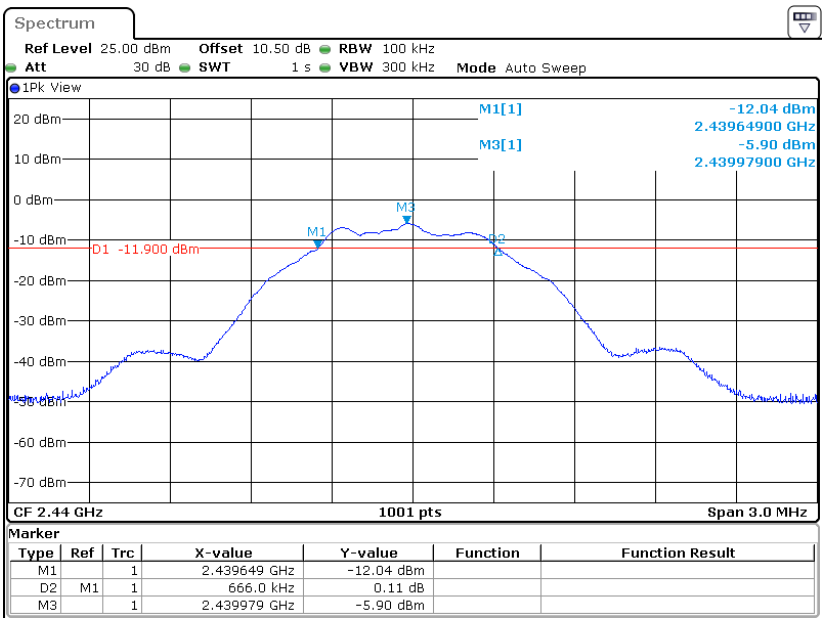
Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)	Limit (kHz)
BLE 1M				
Low	2412	0.663	1.022	≥500
Middle	2440	0.666	1.028	≥500
High	2480	0.654	1.040	≥500

6dB Bandwidth:

Low Channel

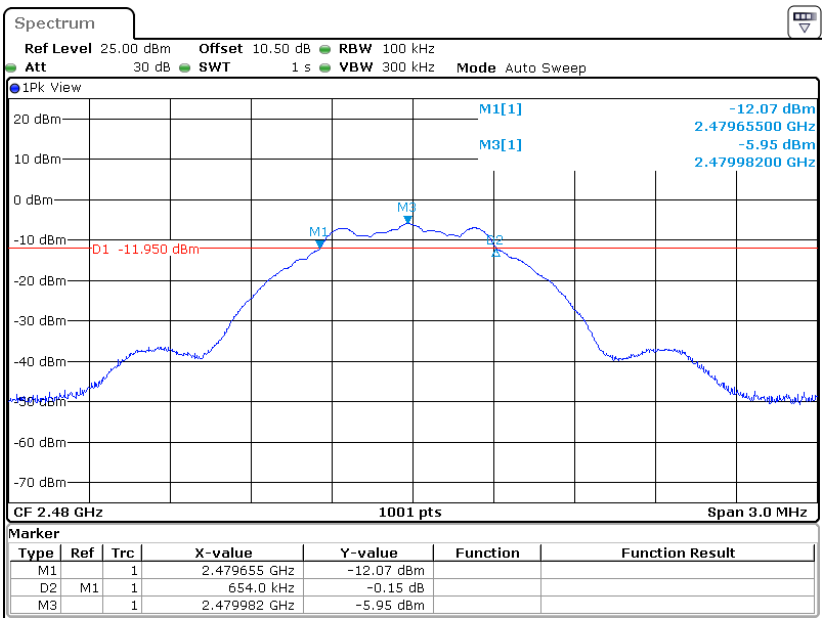


Middle Channel



Date: 7.APR.2023 15:41:57

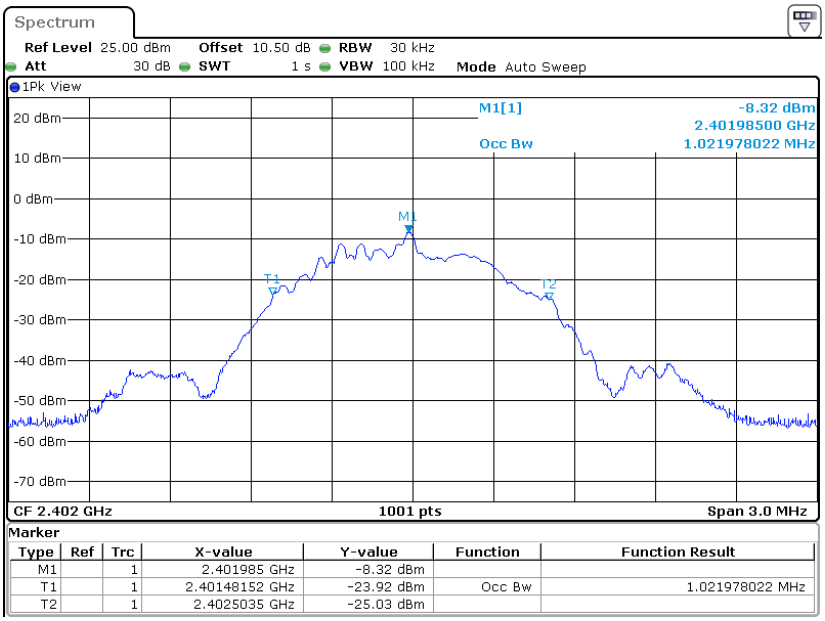
High Channel



Date: 7.APR.2023 15:44:42

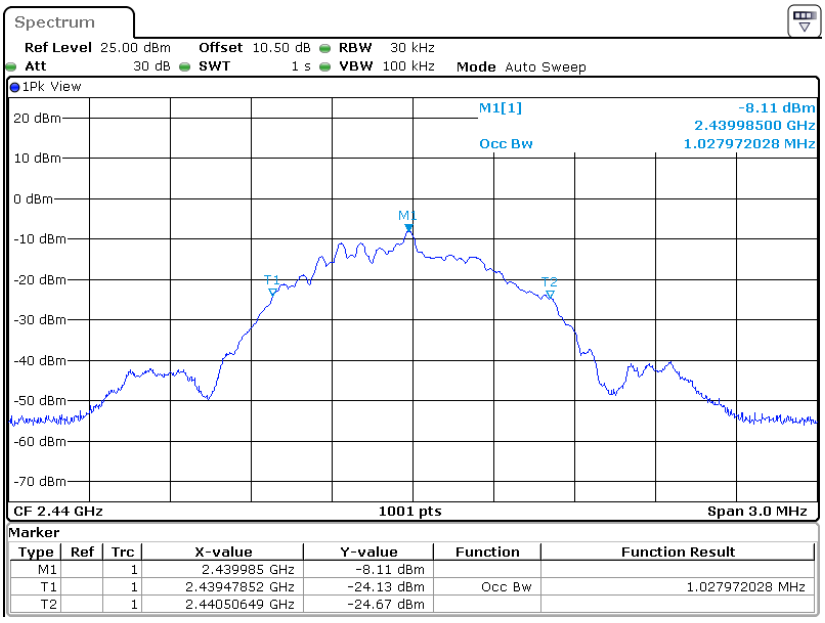
99% Emission Bandwidth:

Low Channel



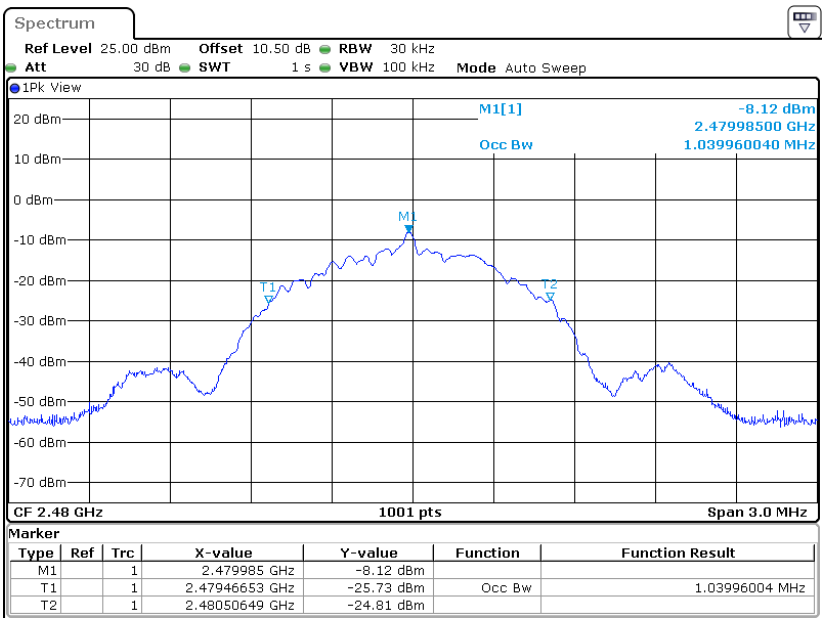
Date: 7.APR.2023 15:36:25

Middle Channel



Date: 7.APR.2023 15:41:35

High Channel

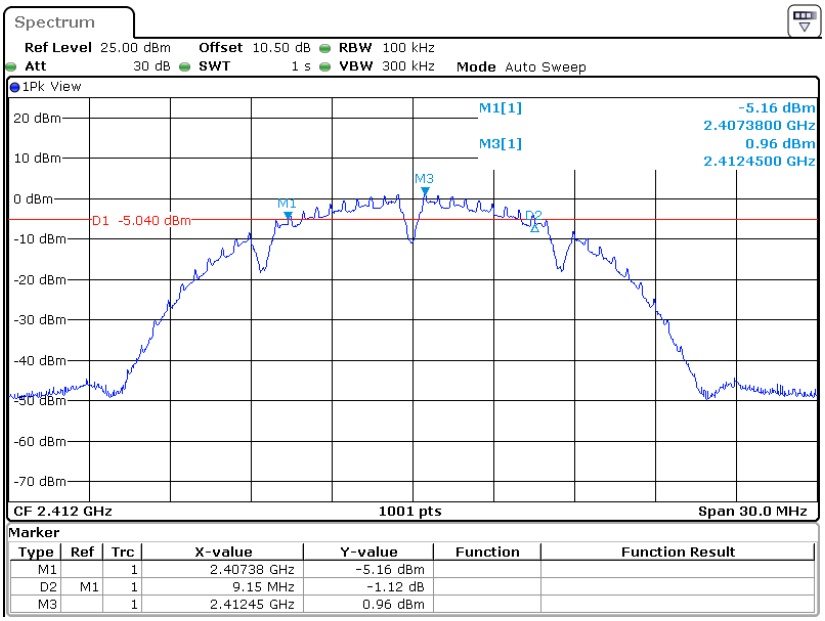


2.4G WiFi

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)	Limit (kHz)
802.11b mode				
Low	2412	9.15	14.146	≥500
Middle	2437	9.15	14.146	≥500
High	2462	9.18	14.146	≥500
802.11g mode				
Low	2412	16.62	16.983	≥500
Middle	2437	16.62	16.983	≥500
High	2462	16.62	16.983	≥500
802.11n-HT20 mode				
Low	2412	17.85	18.022	≥500
Middle	2437	17.82	18.022	≥500
High	2462	17.85	18.022	≥500

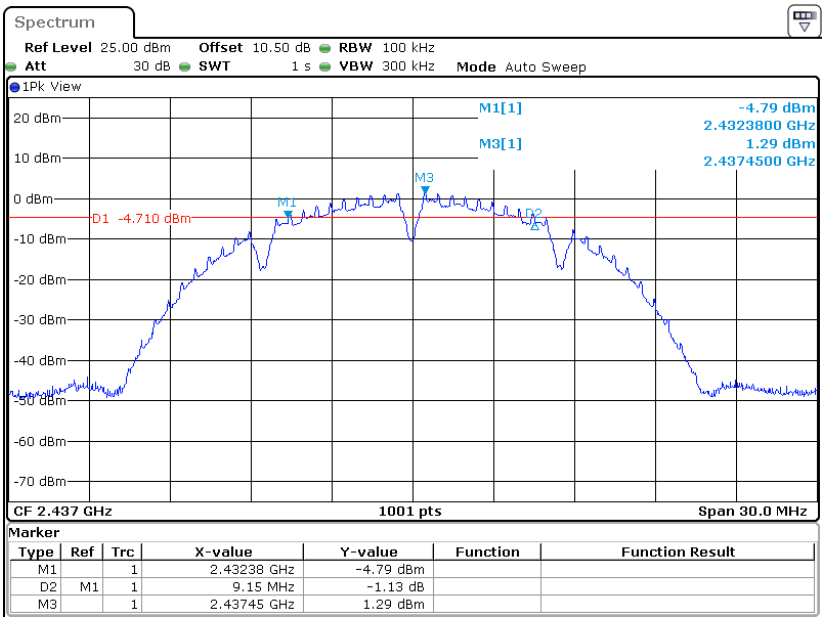
6dB Bandwidth:
802.11b

Low Channel



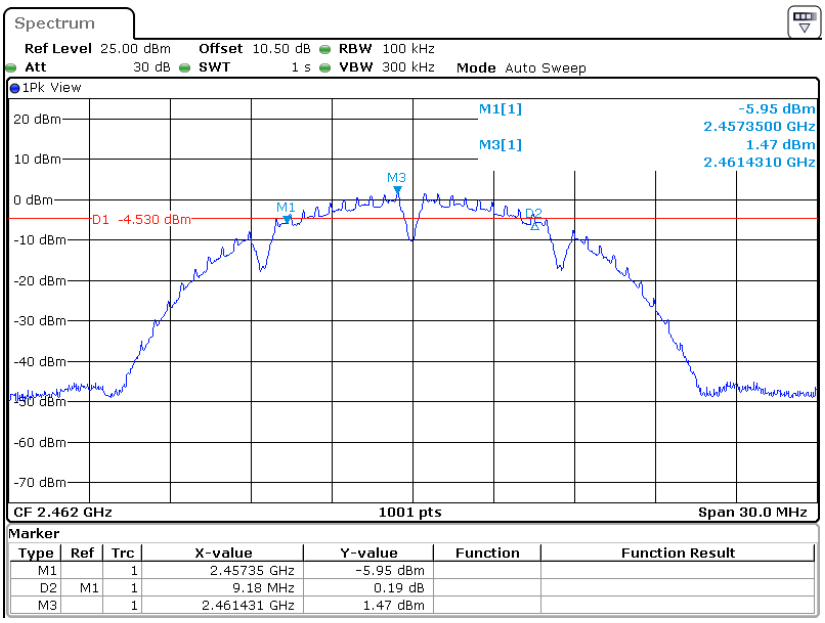
Date: 7.APR.2023 14:37:59

Middle Channel



Date: 7.APR.2023 15:02:53

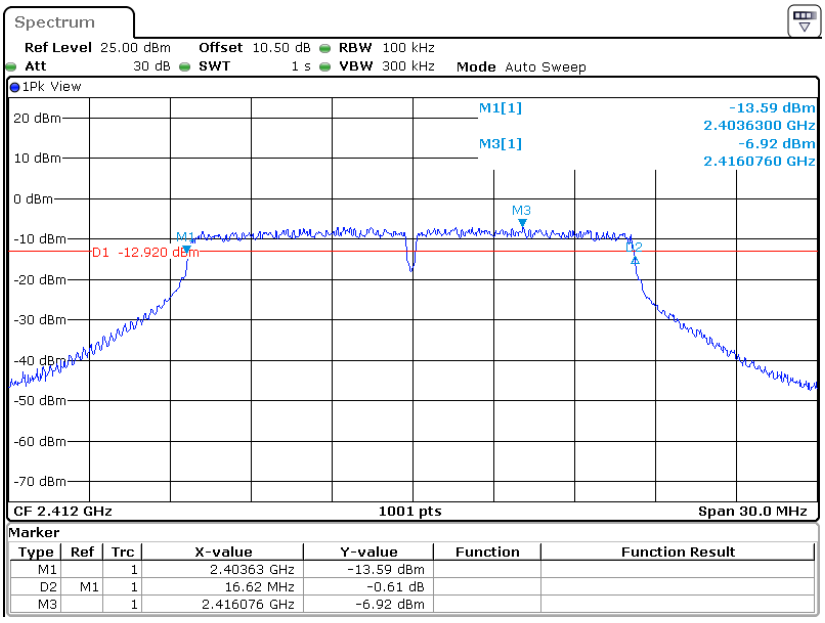
High Channel



Date: 7.APR.2023 15:04:37

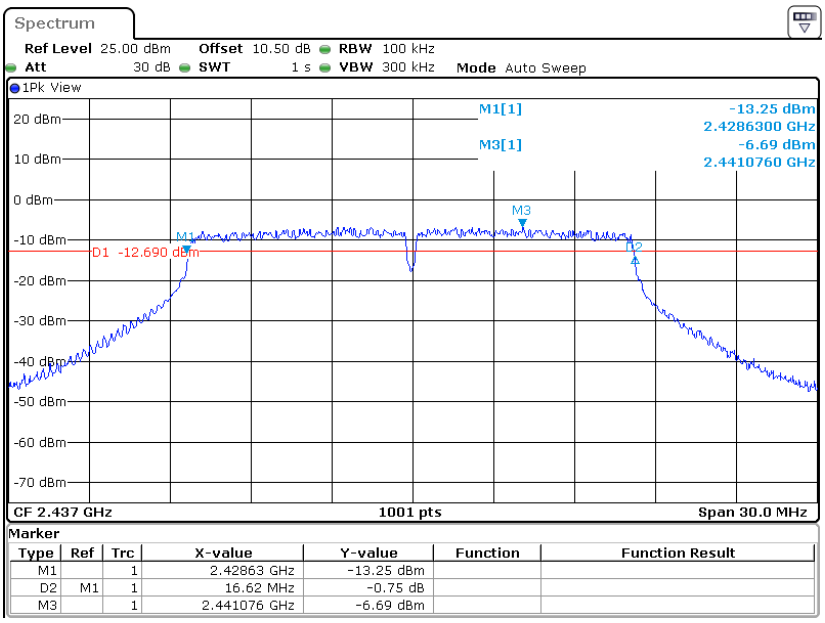
802.11g

Low Channel



Date: 7.APR.2023 15:13:32

Middle Channel

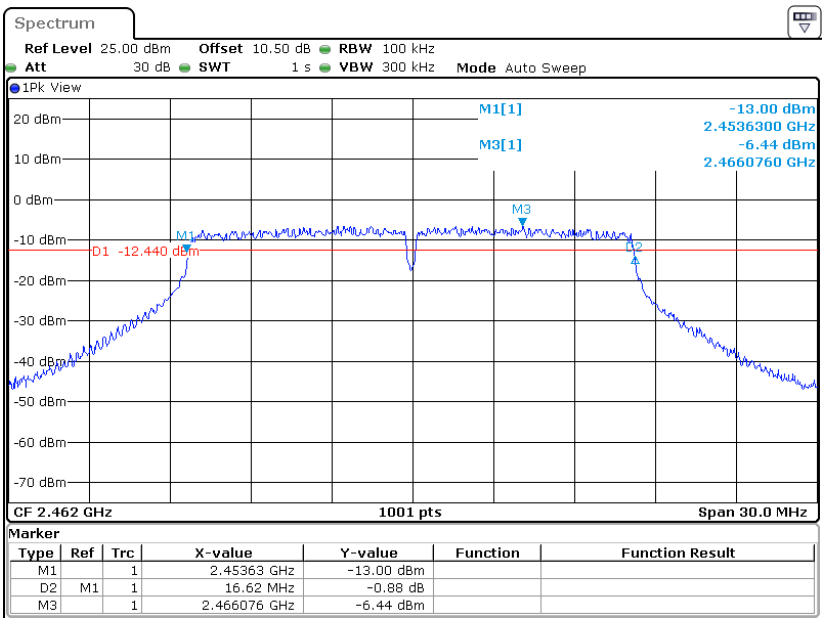


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.42863 GHz	-13.25 dBm		
D2	M1	1	16.62 MHz	-0.75 dB		
M3		1	2.441076 GHz	-6.69 dBm		

Date: 7.APR.2023 15:16:03

High Channel



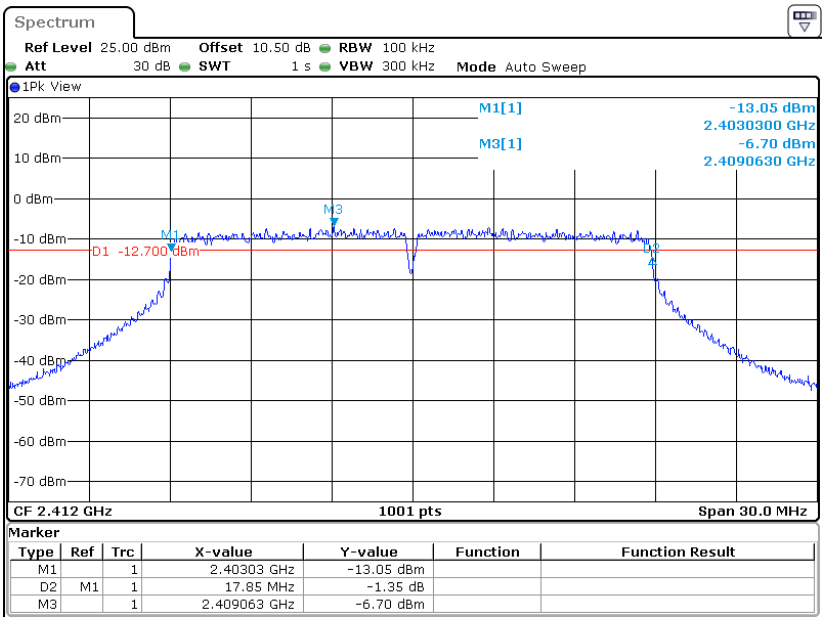
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.45363 GHz	-13.00 dBm		
D2	M1	1	16.62 MHz	-0.88 dB		
M3		1	2.466076 GHz	-6.44 dBm		

Date: 7.APR.2023 15:18:16

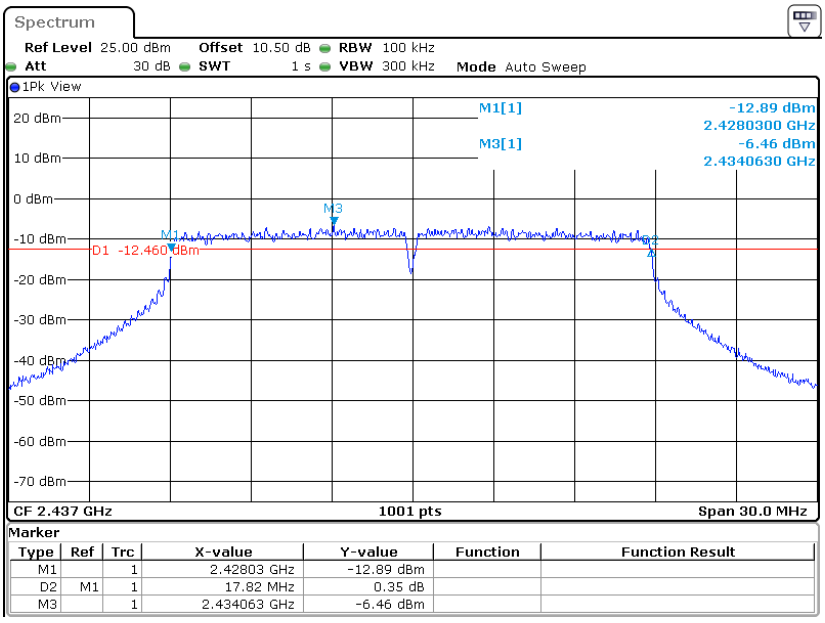
802.11n-HT20

Low Channel



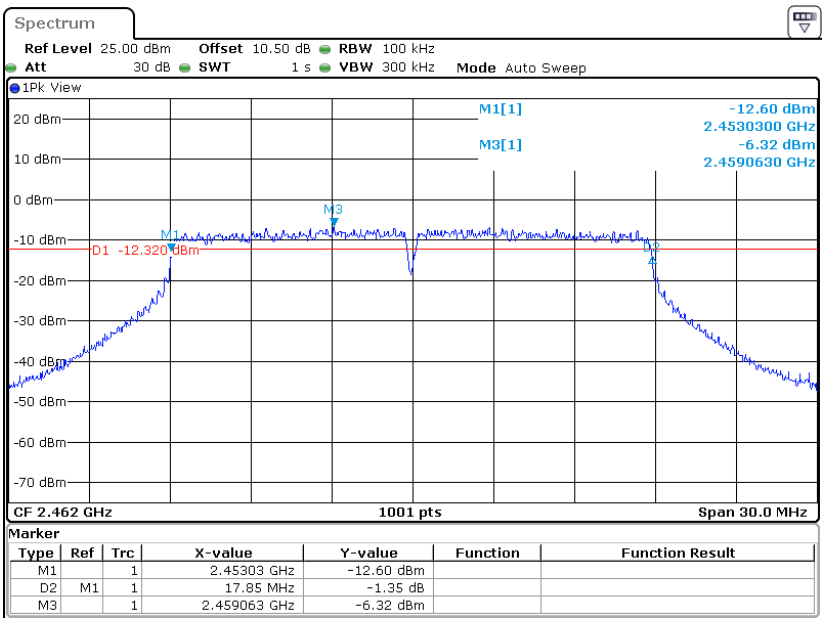
Date: 7.APR.2023 15:21:07

Middle Channel



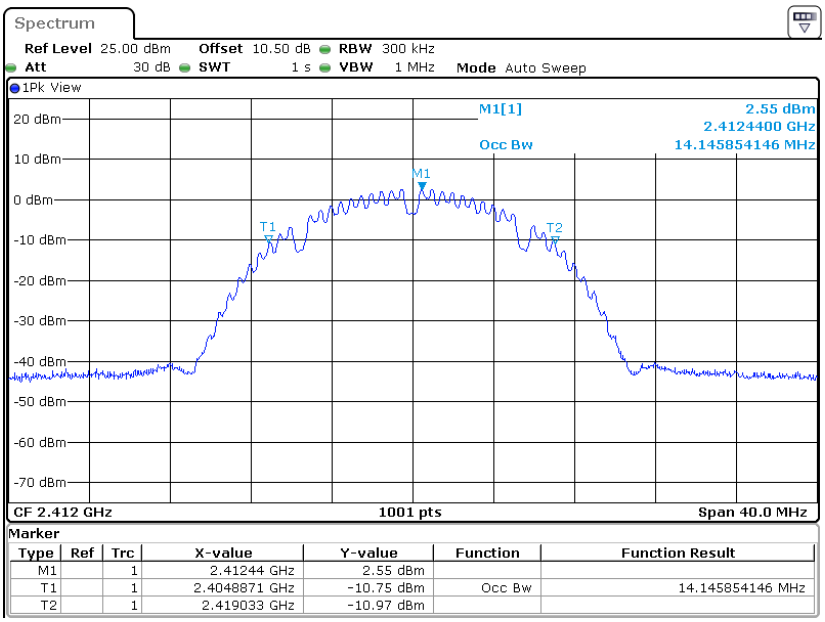
Date: 7.APR.2023 15:23:32

High Channel

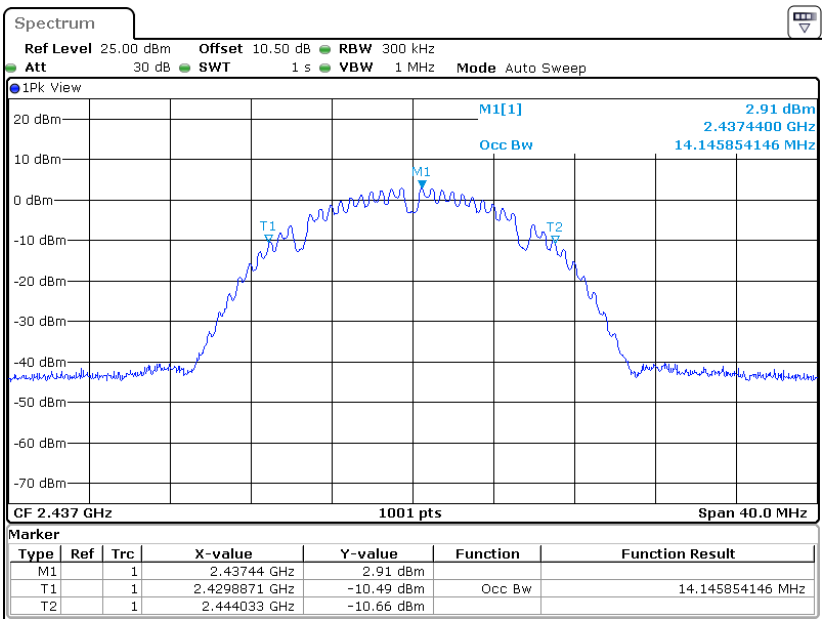


99% Emission Bandwidth:
802.11b

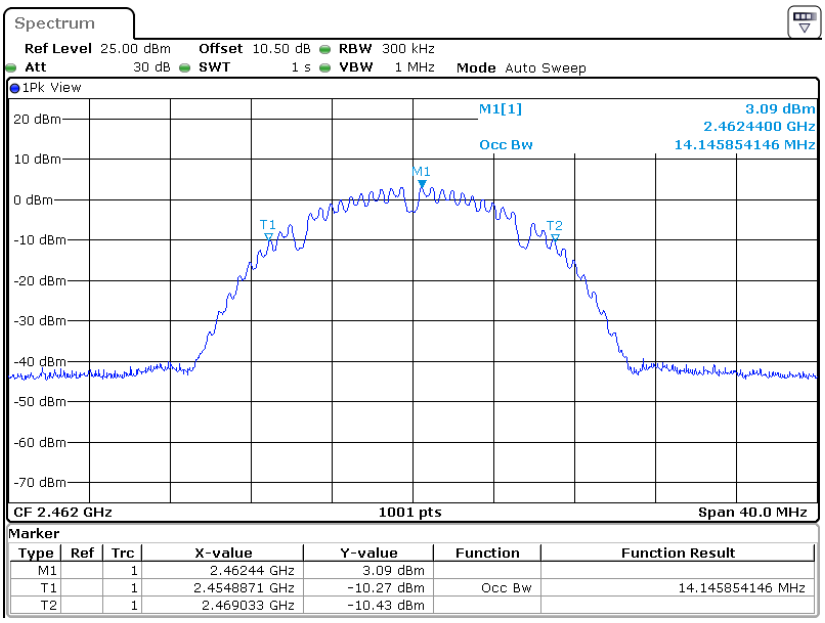
Low Channel



Middle Channel



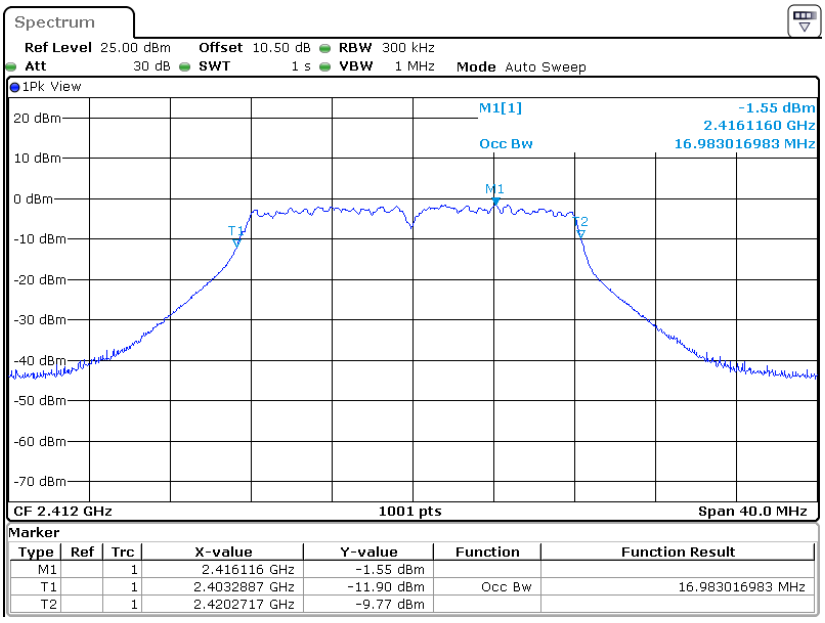
High Channel



Date: 7.APR.2023 15:04:12

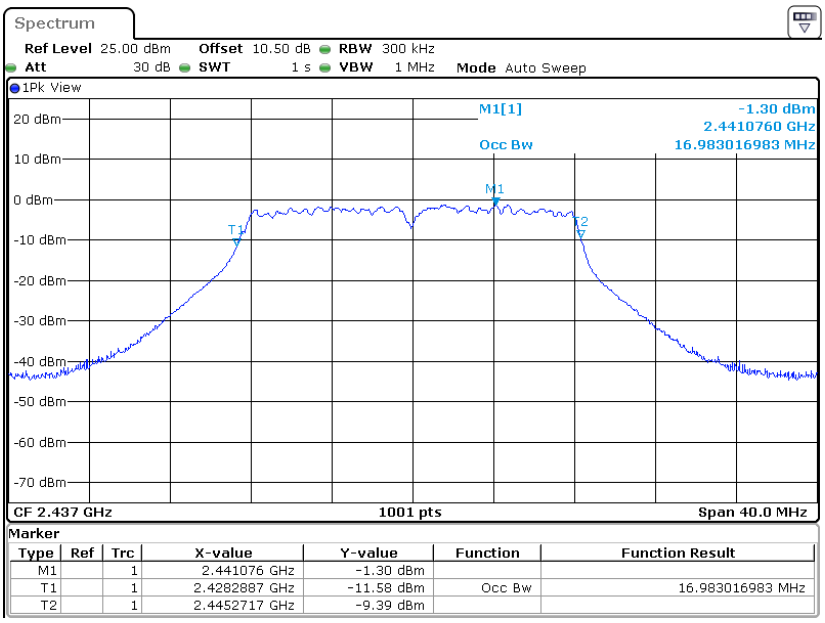
802.11g

Low Channel



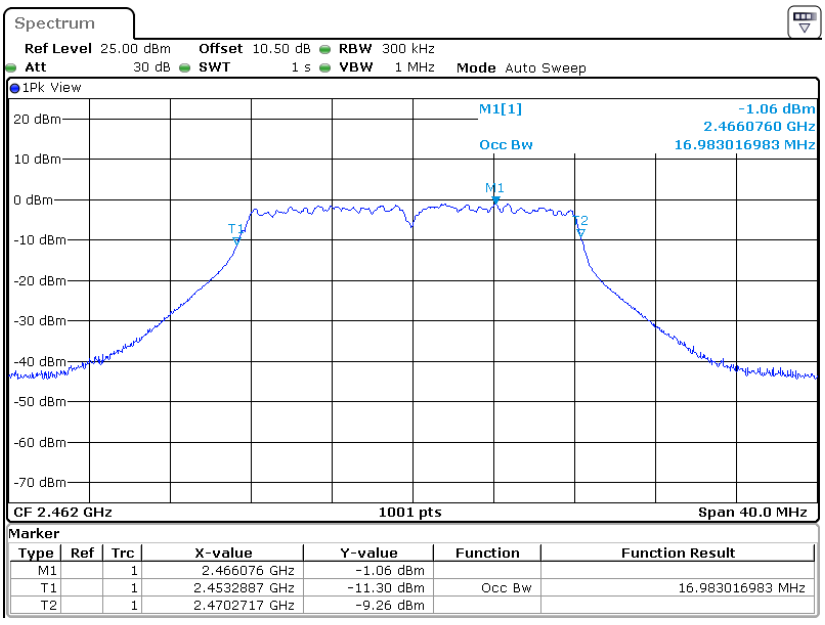
Date: 7.APR.2023 15:13:08

Middle Channel



Date: 7.APR.2023 15:15:39

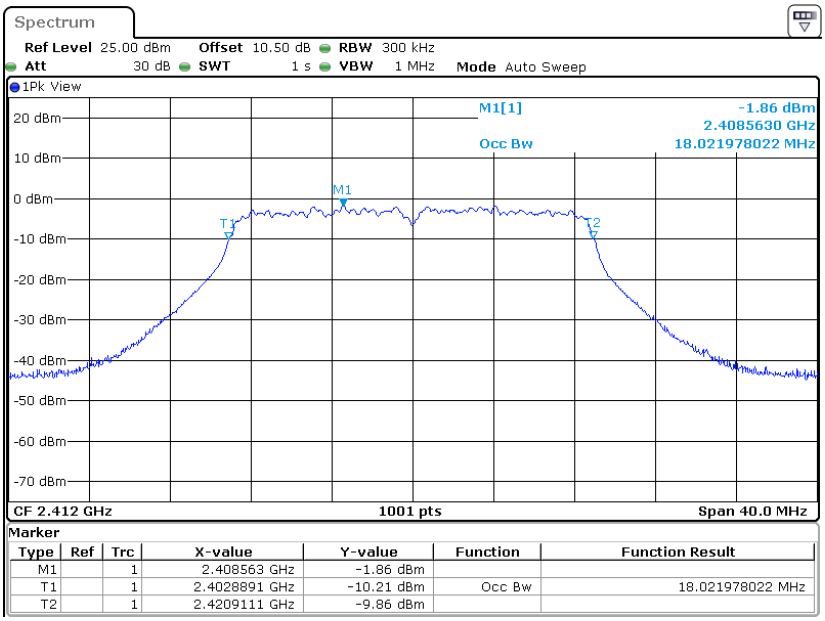
High Channel



Date: 7.APR.2023 15:17:51

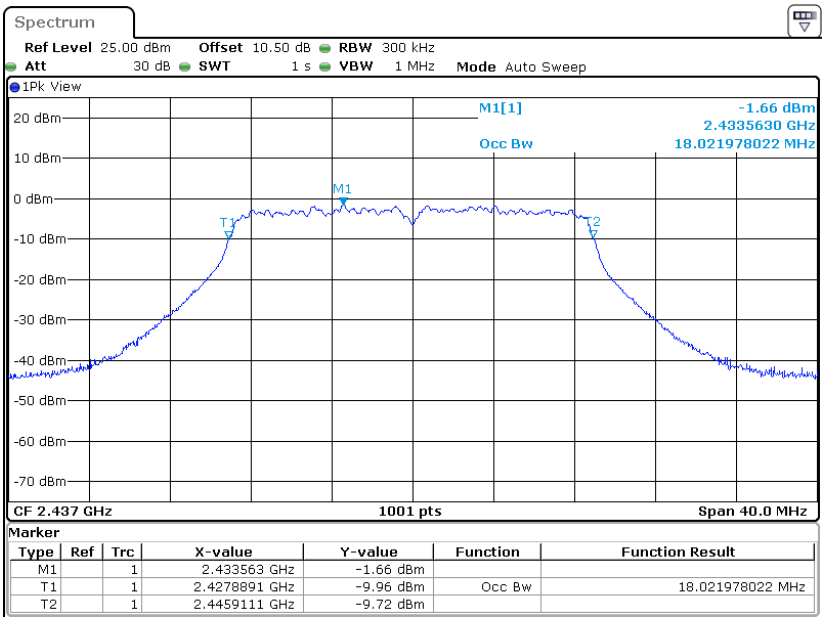
802.11n-HT20

Low Channel



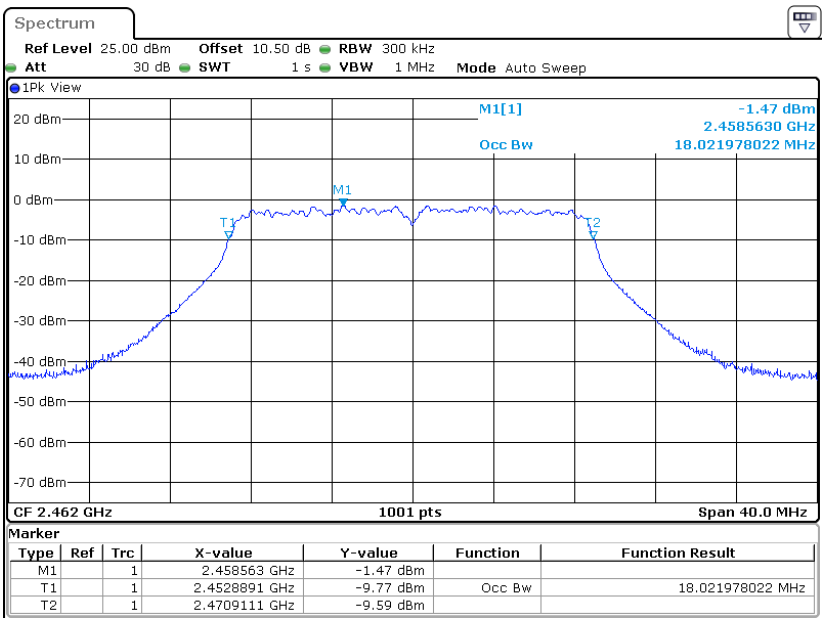
Date: 7.APR.2023 15:20:42

Middle Channel



Date: 7.APR.2023 15:23:09

High Channel



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

Applicable Standard

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

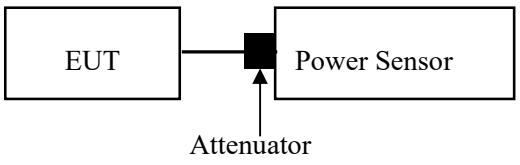
Test Procedure

Test Method:

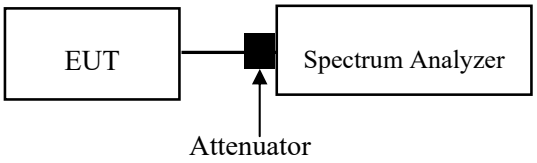
For BLE: ANSI C63.10-2013 Clause 11.9.1.1
For Wi-Fi: ANSI C63.10-2013 Clause 11.9.2.3.2

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.

For Wi-Fi mode:



For BLE mode:



Test Data

Environmental Conditions

Temperature:	28.2 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Mike Xiao on 2023-04-07.

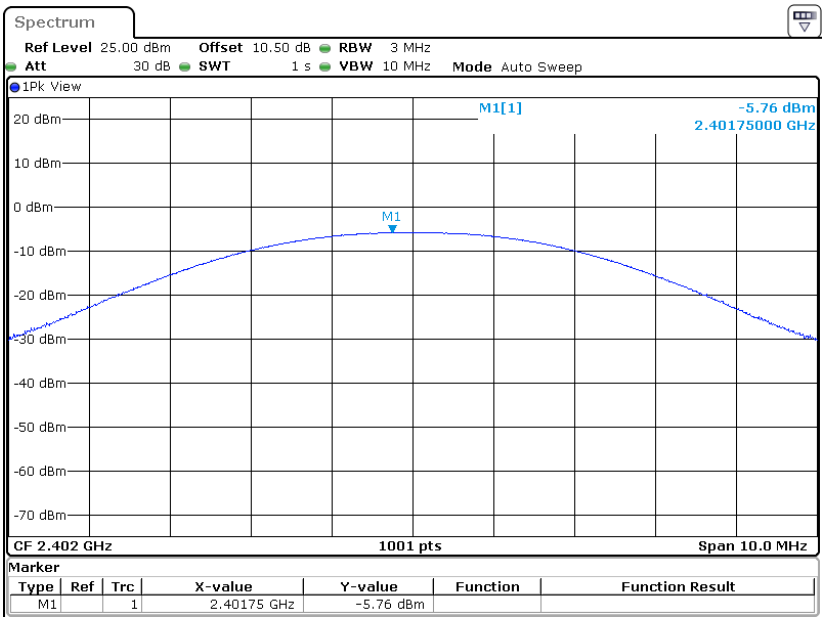
EUT operation mode: Transmitting

Test Result: Compliant.

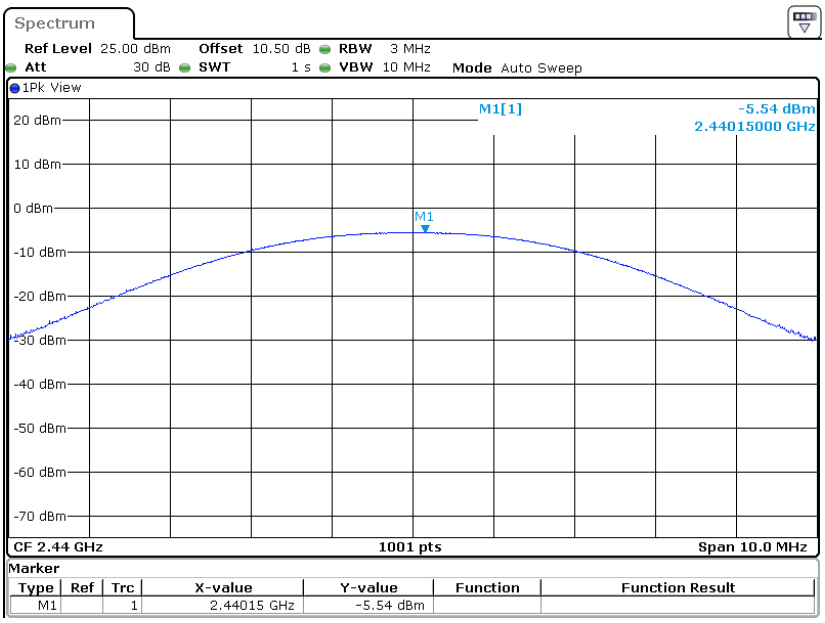
BLE

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)
BLE 1M			
Low	2402	-5.76	30
Middle	2440	-5.54	30
High	2480	-5.62	30

Low Channel

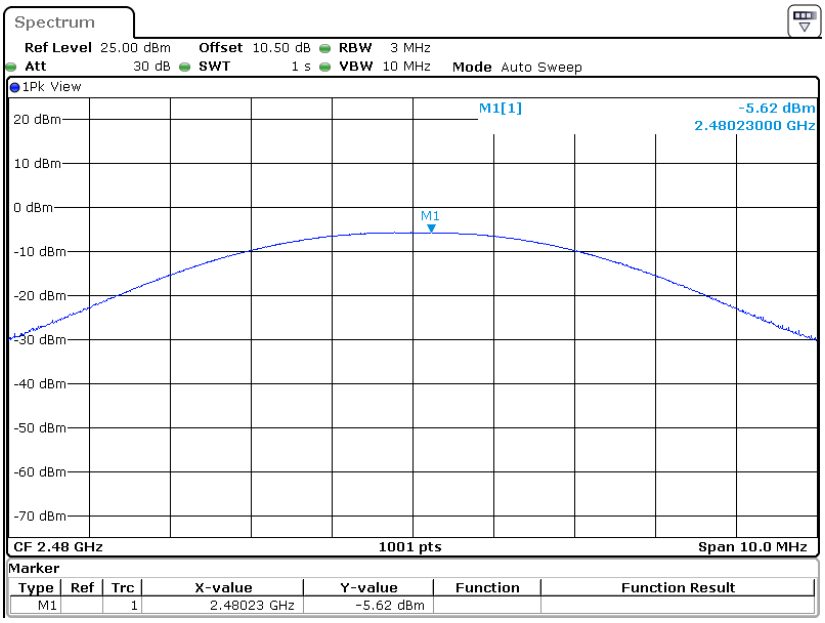


Middle Channel



Date: 7.APR.2023 15:41:00

High Channel



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2.4G Wi-Fi

Channel	Frequency (MHz)	Max Conducted Average Output Power (dBm)	Limit (dBm)
802.11b mode			
Low	2412	10.79	30
Middle	2437	11.16	30
High	2462	11.33	30
802.11g mode			
Low	2412	7.46	30
Middle	2437	7.67	30
High	2462	7.92	30
802.11n HT20 mode			
Low	2412	7.32	30
Middle	2437	7.47	30
High	2462	7.69	30

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

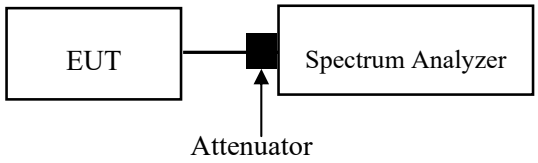
Applicable Standard

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

Test Method: ANSI C63.10-2013 Clause 11.11

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:	23.1~28.2 ℃
Relative Humidity:	46~50 %
ATM Pressure:	101.0 kPa

The testing was performed by Mike Xiao on 2023-04-07 and 2023-04-27.

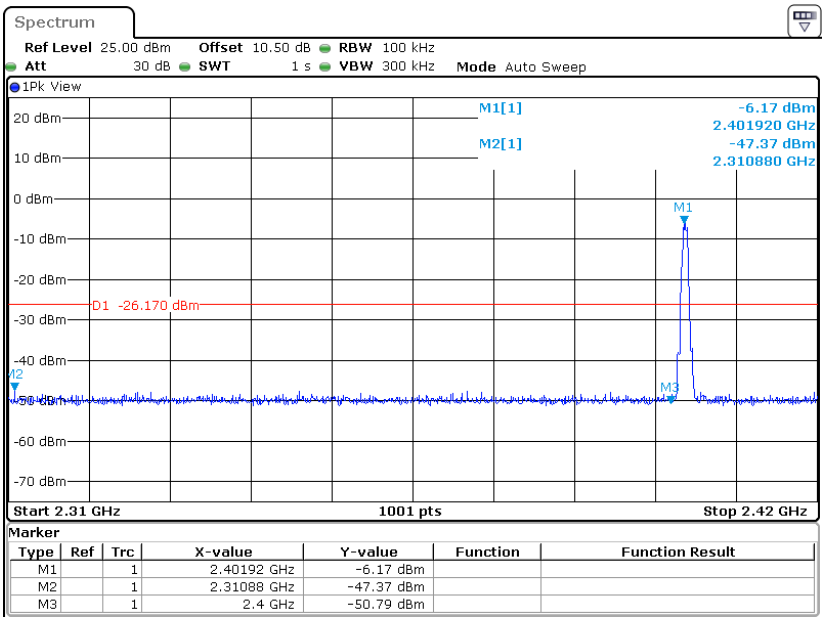
EUT operation mode: Transmitting

Test Result: Compliant.

Conducted Band Edge Result:

BLE

Band Edge, Left Side

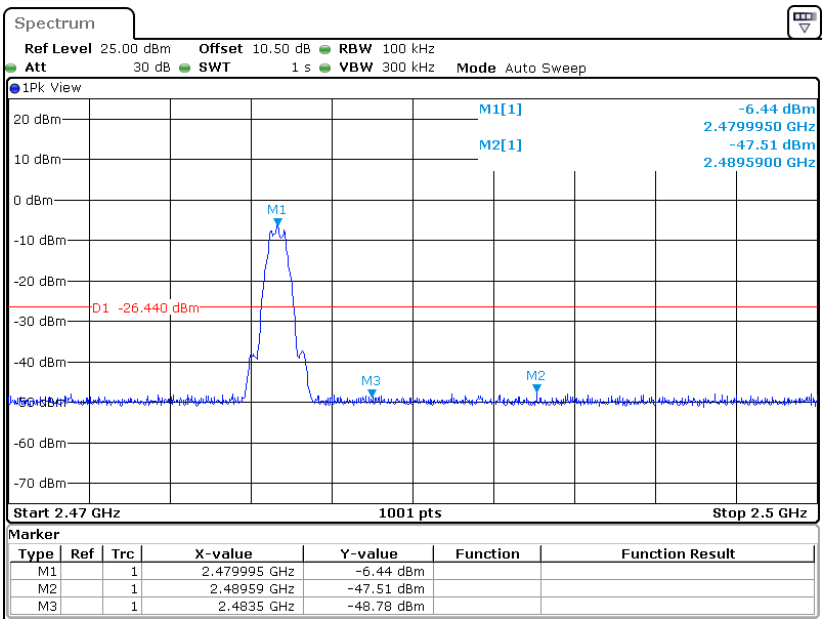


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40192 GHz	-6.17 dBm		
M2		1	2.31088 GHz	-47.37 dBm		
M3		1	2.4 GHz	-50.79 dBm		

Date: 7.APR.2023 15:37:35

Band Edge, Right Side



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479995 GHz	-6.44 dBm		
M2		1	2.48959 GHz	-47.51 dBm		
M3		1	2.4835 GHz	-48.78 dBm		

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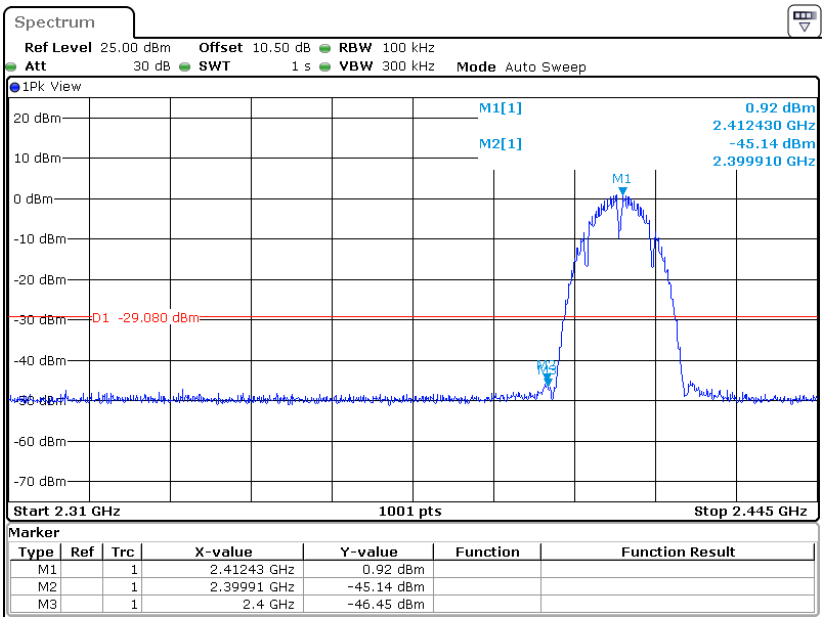
2.4 G WiFi

802.11b: Band Edge, Left Side

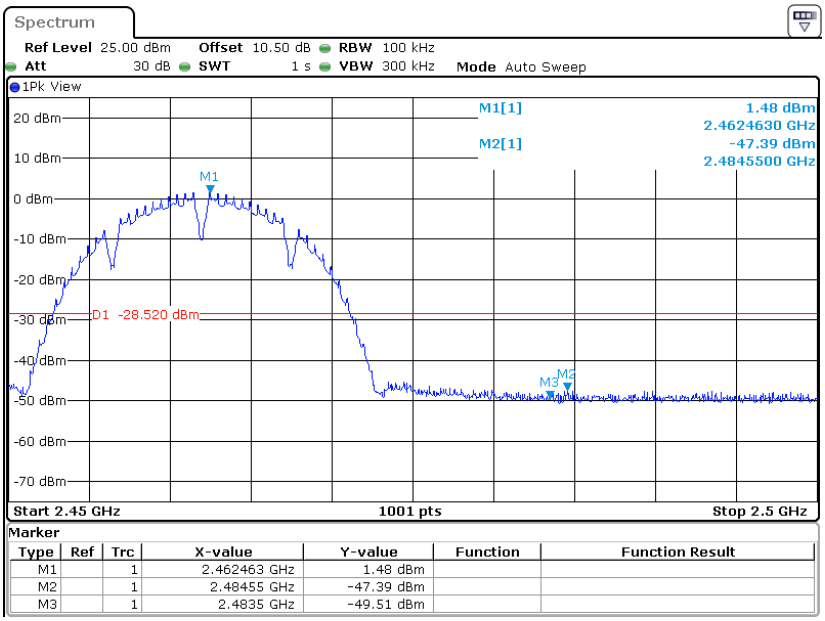


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.41243 GHz	0.92 dBm		
M2		1	2.39991 GHz	-45.14 dBm		
M3		1	2.4 GHz	-46.45 dBm		

Date: 7.APR.2023 14:42:43

802.11b: Band Edge, Right Side

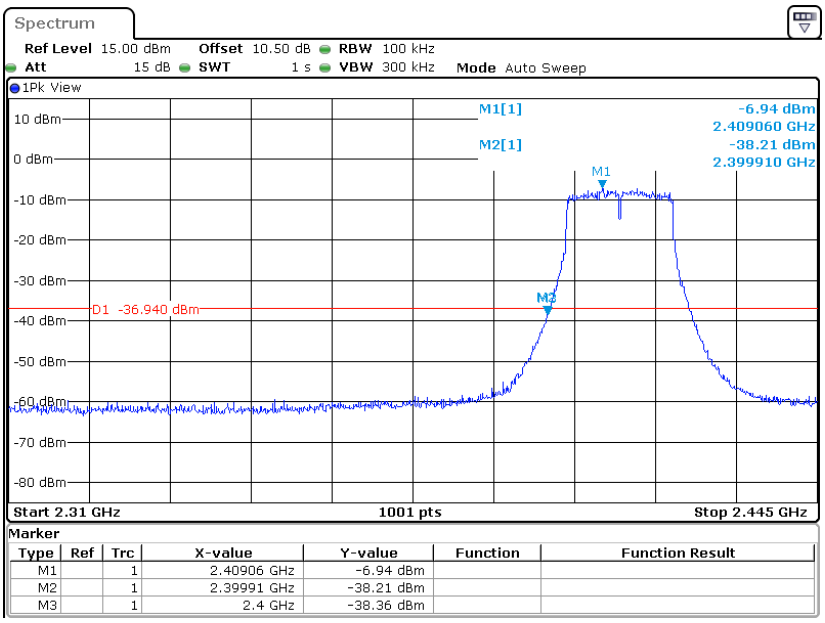


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.462463 GHz	1.48 dBm		
M2		1	2.48455 GHz	-47.39 dBm		
M3		1	2.4835 GHz	-49.51 dBm		

Date: 7.APR.2023 15:05:15

802.11g: Band Edge, Left Side



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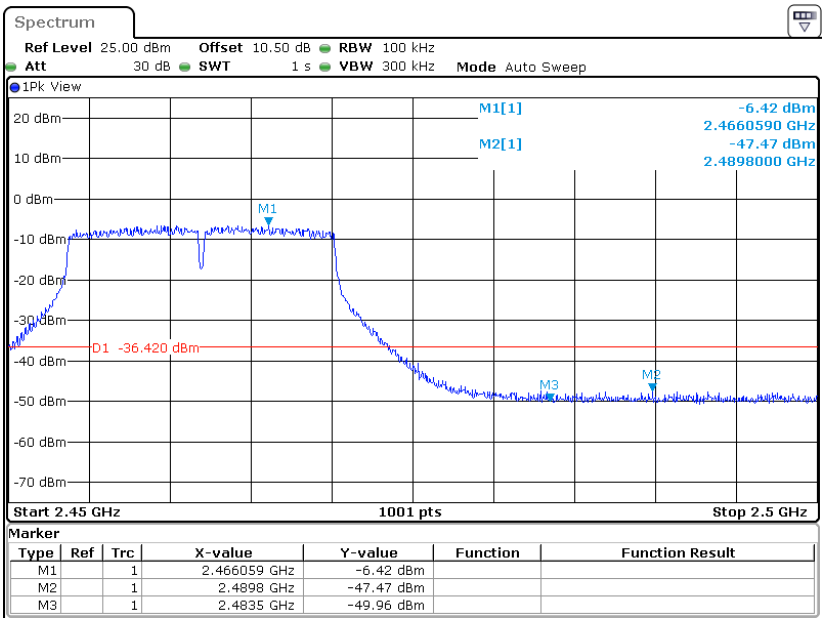
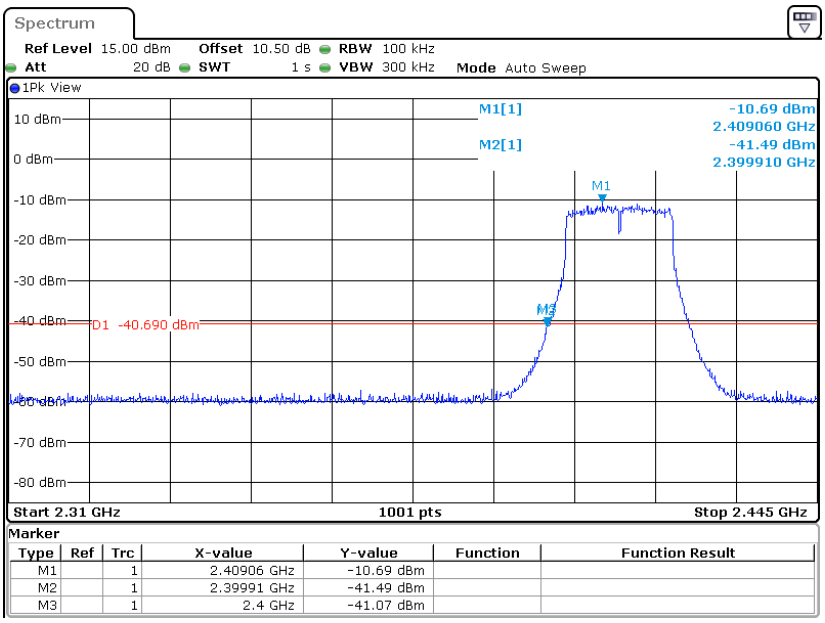
802.11g: Band Edge, Right Side



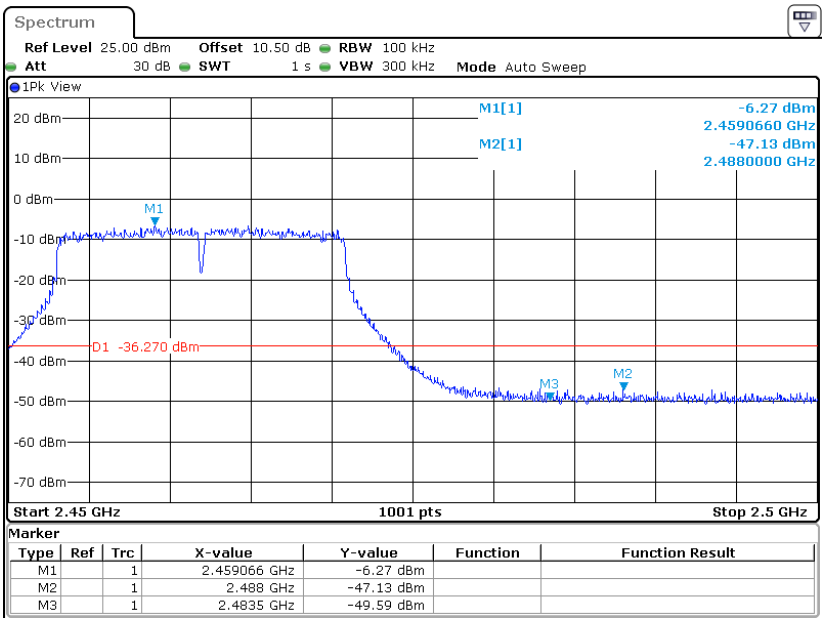
Date: 7.APR.2023 15:18:55

802.11n HT20: Band Edge, Left Side



Date: 27.APR.2023 13:22:26

802.11n HT20: Band Edge, Right Side



Date: 7.APR.2023 15:26:34

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

Test Method:

For BLE: ANSI C63.10-2013 Clause 11.10.2

Method PKPSD (peak PSD):

The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:
a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ [3 × RBW].
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

For Wi-Fi: ANSI C63.10-2013 Clause 11.10.3&11.10.5

Method AVGPSD-1:

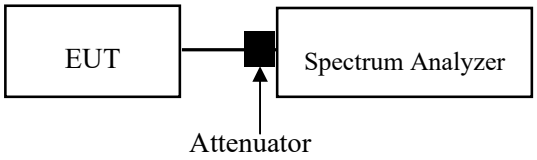
Method AVGPSD-1 uses trace averaging with EUT transmitting at full power throughout each sweep.

The following procedure may be used when the maximum (average) conducted output power was used to determine compliance to the fundamental output power limit. This is the baseline method for determining the maximum (average) conducted PSD level. If the instrument has a power averaging (rms) detector, then it must be used; otherwise, use the sample detector. The EUT must be configured to transmit continuously (D ≥ 98%), or else sweep triggering/signal gating must be implemented to ensure that measurements are made only when the EUT is transmitting at its maximum power control level (no transmitter OFF time to be considered):
a) Set instrument center frequency to DTS channel center frequency.
b) Set span to at least 1.5 times the OBW.
c) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set VBW ≥ [3 × RBW].
e) Detector = power averaging (rms) or sample detector (when rms not available).
f) Ensure that the number of measurement points in the sweep ≥ [2 × span / RBW].
g) Sweep time = auto couple.
h) Employ trace averaging (rms) mode over a minimum of 100 traces.
i) Use the peak marker function to determine the maximum amplitude level.
j) If the measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced).

Method AVGPSD-2:

Method AVGPSD-2 uses trace averaging across ON and OFF times of the EUT transmissions, followed by duty cycle correction.

The following procedure is applicable when the EUT cannot be configured to transmit continuously (i.e., D < 98%), when sweep triggering/signal gating cannot be used to measure only when the EUT is transmitting at its maximum power control level, and when the transmission duty cycle is constant (i.e., duty cycle variations are less than ±2%):
a) Measure the duty cycle (D) of the transmitter output signal as described in 11.6.
b) Set instrument center frequency to DTS channel center frequency.
c) Set span to at least 1.5 times the OBW.
d) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
e) Set VBW ≥ [3 × RBW].
f) Detector = power averaging (rms) or sample detector (when rms not available).
g) Ensure that the number of measurement points in the sweep ≥ [2 × span / RBW].
h) Sweep time = auto couple.
i) Do not use sweep triggering; allow sweep to "free run."
j) Employ trace averaging (rms) mode over a minimum of 100 traces.
k) Use the peak marker function to determine the maximum amplitude level.
l) Add [10 log (1 / D)], where D is the duty cycle measured in step a), to the measured PSD to compute the average PSD during the actual transmission time.
m) If measured value exceeds requirement specified by regulatory agency, then reduce RBW (but no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced)



Test Data

Environmental Conditions

Temperature:	28.2 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Mike Xiao on 2023-04-07.

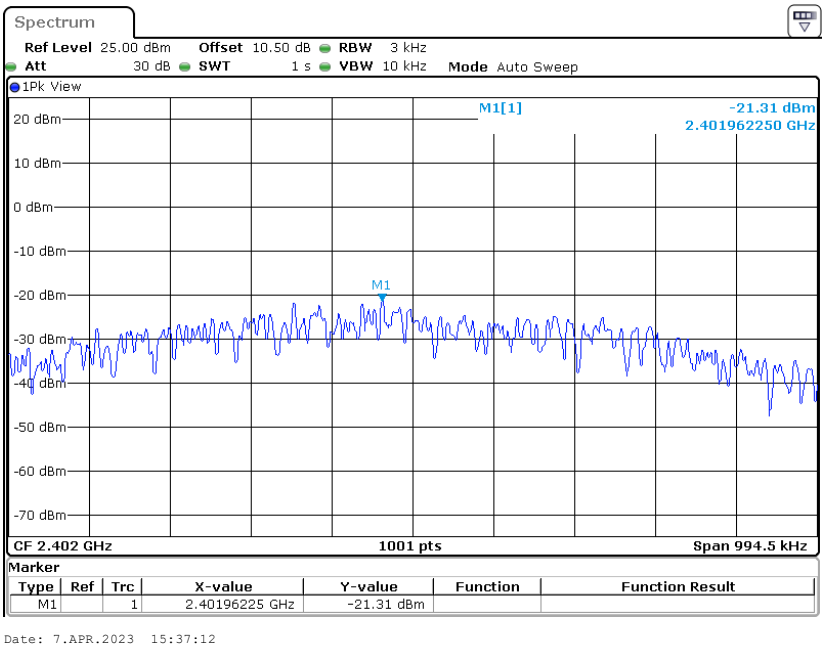
EUT operation mode: Transmitting

Test Result: Compliant.

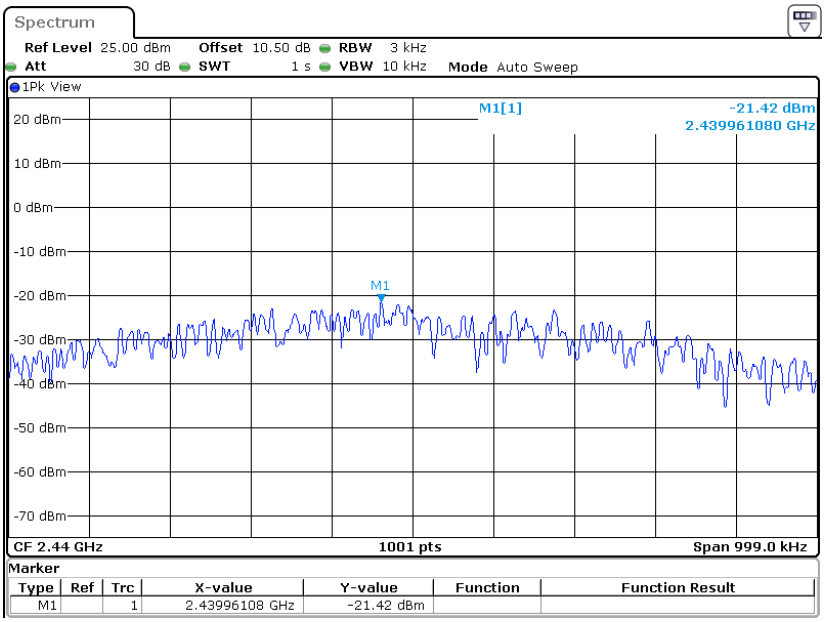
BLE

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
BLE 1M			
Low	2402	-21.31	≤8
Middle	2440	-21.42	≤8
High	2480	-21.69	≤8

Power Spectral Density, Low Channel

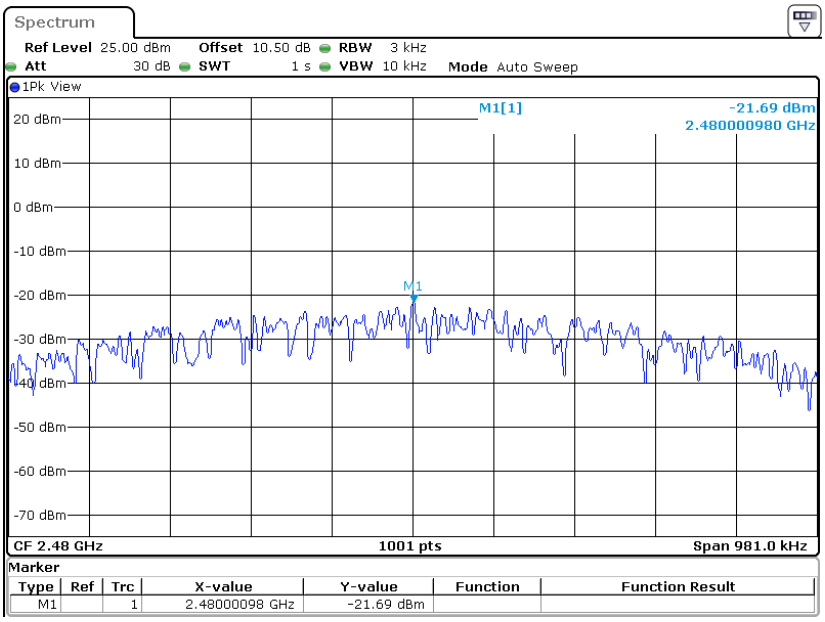


Power Spectral Density, Middle Channel



Date: 7.APR.2023 15:42:22

Power Spectral Density, High Channel

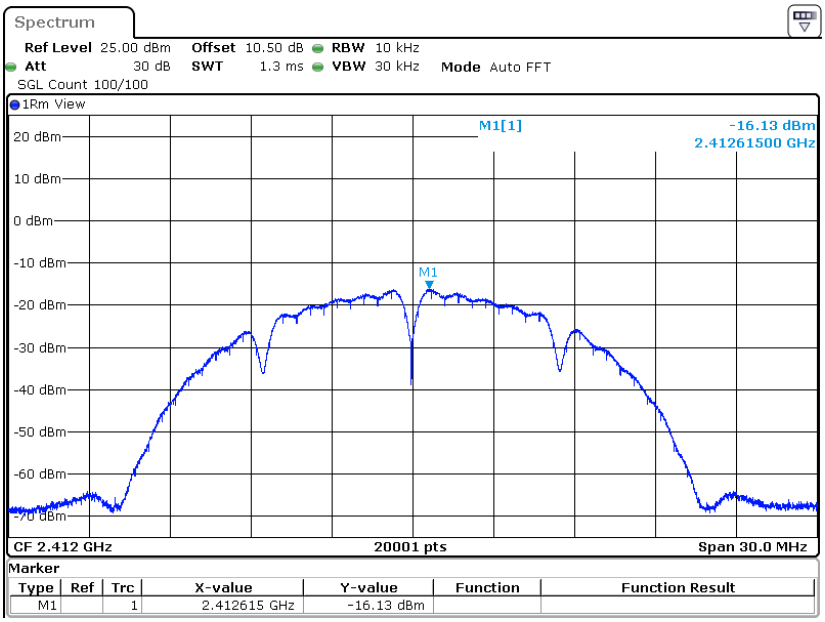


Date: 7.APR.2023 15:45:05

2.4G Wi-Fi

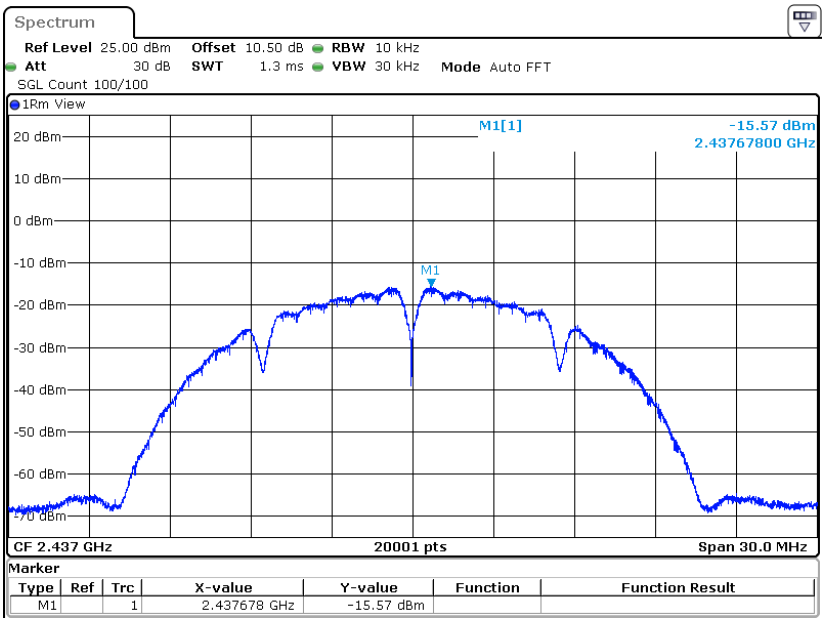
Channel	Frequency (MHz)	Reading (dBm/10kHz)	Duty cycle factor (dB)	PSD (dBm/10kHz)	Limit (dBm/3kHz)
802.11b mode					
Low	2412	-16.13	/	-16.13	≤8
Middle	2437	-15.57	/	-15.57	≤8
High	2462	-15.53	/	-15.53	≤8
802.11g mode					
Low	2412	-21.52	0.27	-21.25	≤8
Middle	2437	-20.58	0.27	-20.31	≤8
High	2462	-21.09	0.27	-20.82	≤8
802.11n-HT20 mode					
Low	2412	-21.51	0.29	-21.22	≤8
Middle	2437	-21.26	0.29	-20.97	≤8
High	2462	-21.07	0.29	-20.78	≤8

Power Spectral Density, 802.11b Low Channel



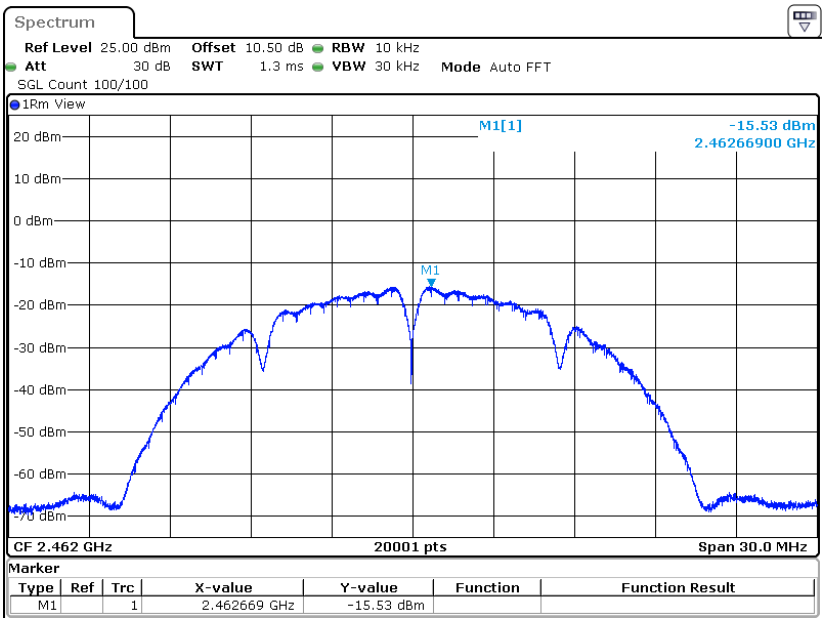
Date: 7.APR.2023 14:38:14

Power Spectral Density, 802.11b Middle Channel



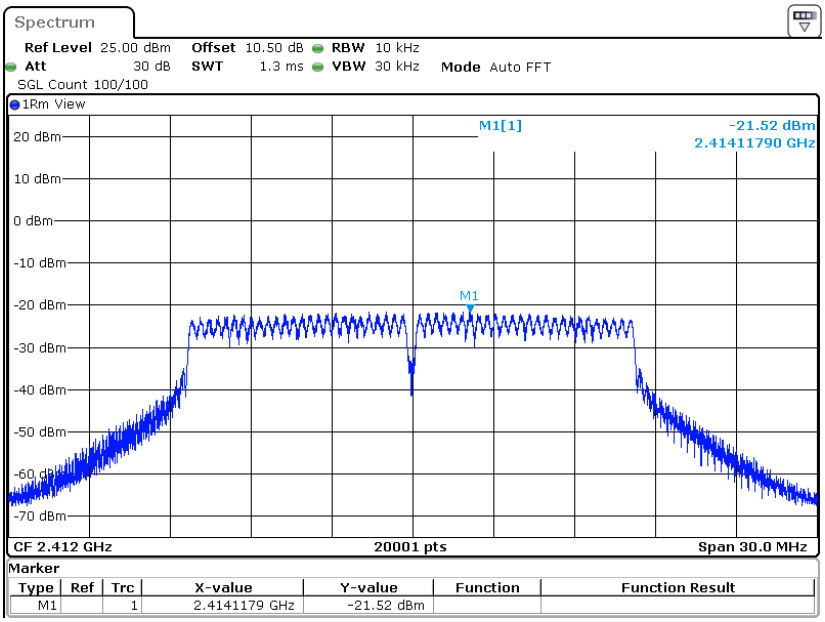
Date: 7.APR.2023 15:03:09

Power Spectral Density, 802.11b High Channel



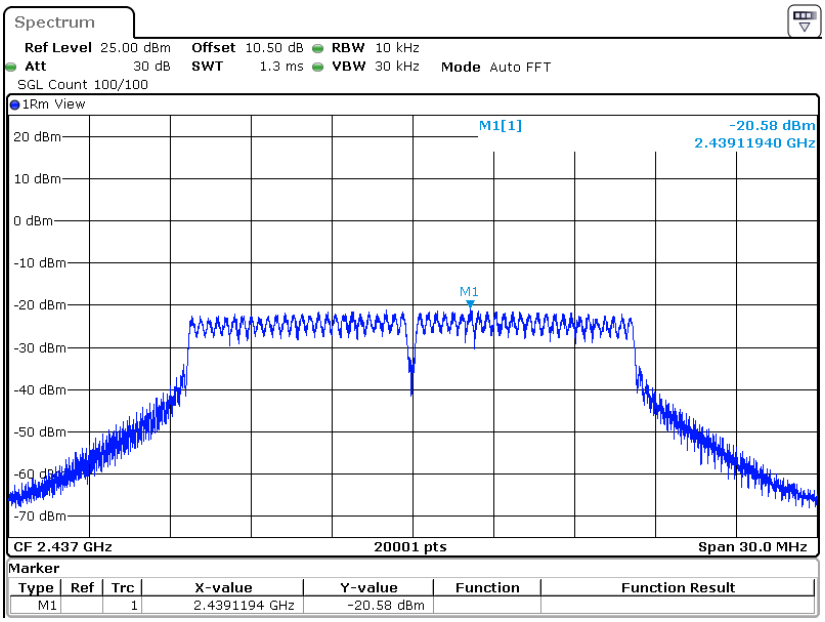
Date: 7.APR.2023 15:04:52

Power Spectral Density, 802.11g Low Channel



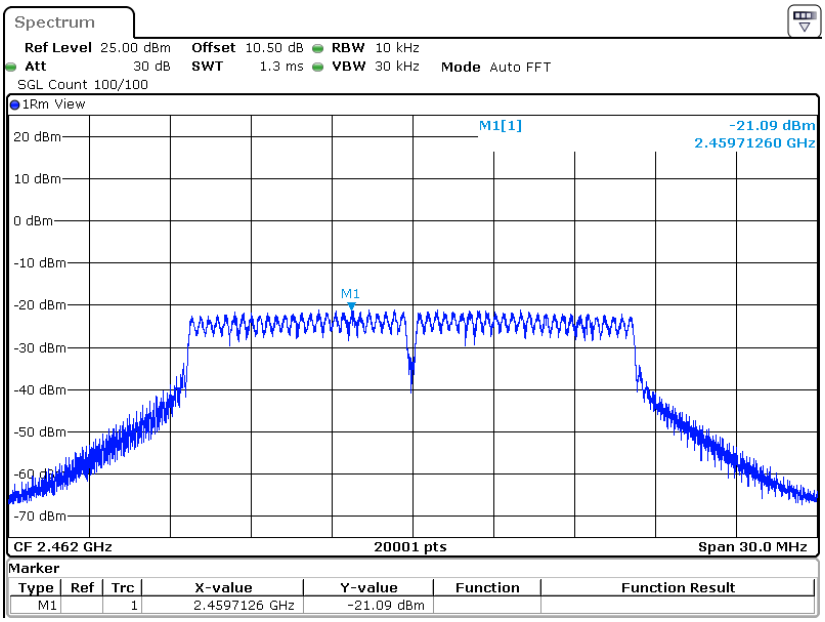
Date: 7.APR.2023 15:13:47

Power Spectral Density, 802.11g Middle Channel



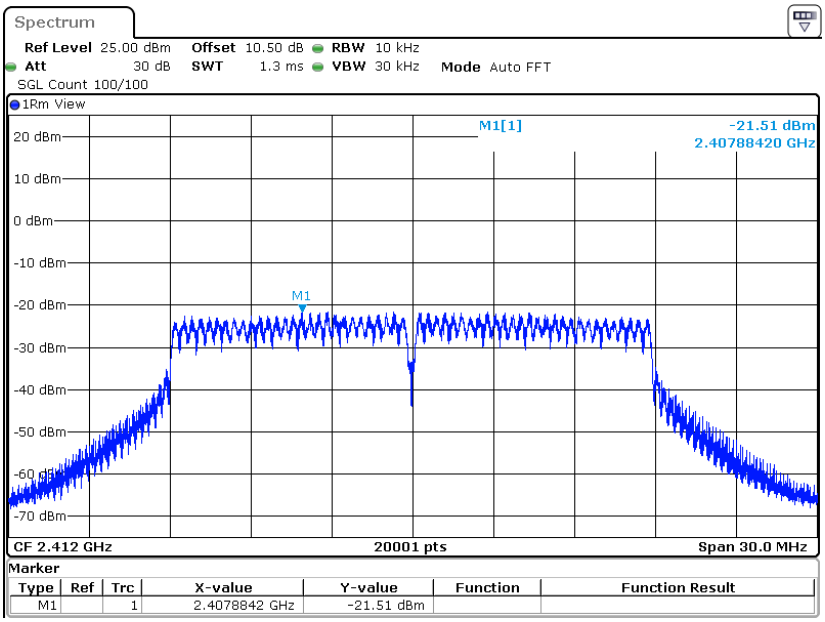
Date: 7.APR.2023 15:16:18

Power Spectral Density, 802.11g High Channel



Date: 7.APR.2023 15:18:31

Power Spectral Density, 802.11n-HT20 Low Channel



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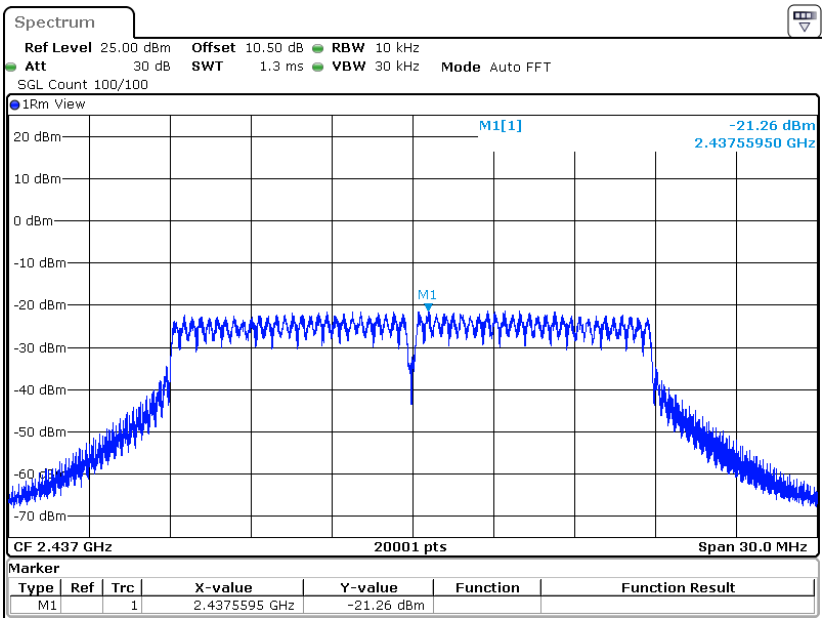
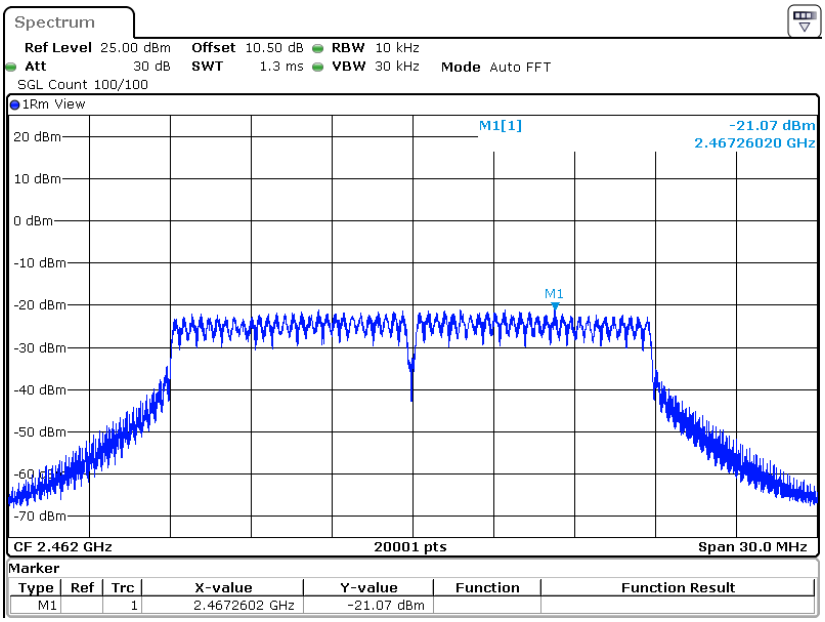
Power Spectral Density, 802.11n-HT20 Middle Channel



Date: 7.APR.2023 15:23:47

Power Spectral Density, 802.11n-HT20 High Channel



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