TEST REPORT

Applicant Name :	Yunjing Intelligence Technology (Dongguan) Co., Ltd.
Address :	Building 7, No.4 Xingye Rd., SongShanLake Park, Dongguan, Guangdong,China
Report Number :	SZNS220520-21880E-RF
FCC ID:	2ARXZYJCC012
IC	26892-YJCC012

Test Standard (s)

FCC PART 15.247; RSS-GEN ISSUE 5, FEBRUARY 2021 AMENDMENT 2; RSS-247, ISSUE 2, FEBRUARY 2017

Sample Description

Product Type:	Narwal Freo Robot Vacuum and Mop
Model No.:	YJCC012
Multiple Model(s) No.:	N/A
Trade Mark:	NARWAL
Date Received:	2022/05/20
Report Date:	2022/06/28

Test Result:	Pass*

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

Prepared and Checked By:

Nick Fang

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 "★ ".

Shenzhen Accurate Technology Co., Ltd. is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

HVIN	YJCC012
Frequency Range	BLE 1M/2M: 2402-2480MHz Wi-Fi: 2412-2462MHz
Maximum Conducted Peak Output Power	BLE 1M: 10.41dBm, BLE 2M: 10.30dBm Wi-Fi:17.94dBm(802.11b), 22.33dBm(802.11g) 22.48dBm(802.11n-HT20)
Modulation Technique	BLE: GFSK Wi-Fi: DSSS, OFDM
Antenna Specification*	2.0dBi (It is provided by the applicant)
Voltage Range	DC 20V from adapter, DC 14.4V from Battery
Sample serial number	SZNS220520-21880E-RF-S2 for RF conducted SZNS220520-21880E-RF-S1 for CE&RE (Assigned by ATC)
Sample/EUT Status	Good condition

Objective

This report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules and RSS-GEN Issue 5, February 2021 Amendment 2 and RSS-247, Issue 2, February 2017 of the Innovation, Science and Economic Development Canada 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 Compliant Testing of Unlicensed Wireless Devices and RSS-GEN Issue 5, February 2021 Amendment 2 and RSS-247, Issue 2, February 2017.

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 Frequency		$0.082*10^{-7}$
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.72dB
Emissions, Radiated	9kHz - 30MHz	2.66dB
	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
	26.5GHz - 40GHz	4.72dB
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 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. 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.

Listed by Innovation, Science and Economic Development Canada (ISEDC), the Registration Number is 5077A.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

Channel List

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

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

Channel List

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

"ADB Tool"* exercise software was used for WIFI mode, "EMI_TEST_v2.0"* exercise software was used for BLE mode

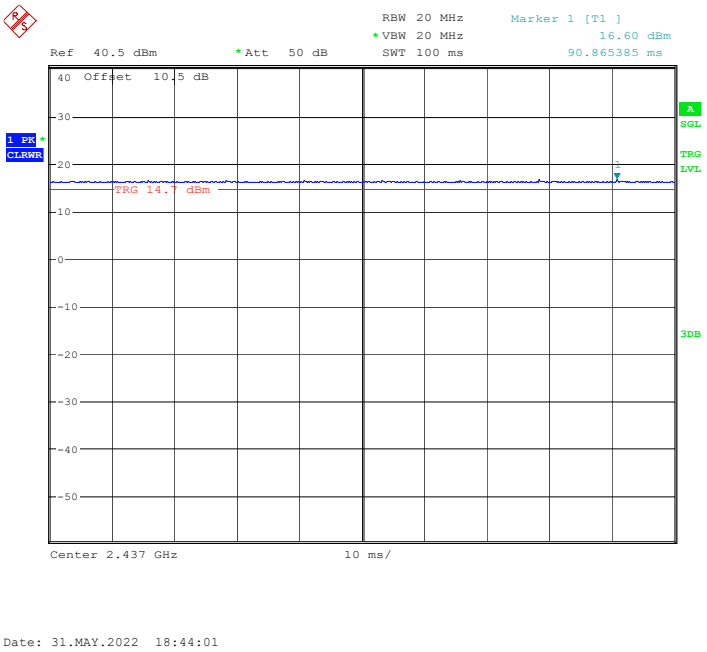
The device was tested with the worst case was performed as below:

Mode	Data rate	Power Level		
		Low Channel	Middle Channel	High Channel
BLE	1Mbps	default	default	default
	2Mbps	default	default	default
802.11b	1Mbps	default	default	default
802.11g	6Mbps	default	default	default
802.11n-HT20	MCS0	default	default	default

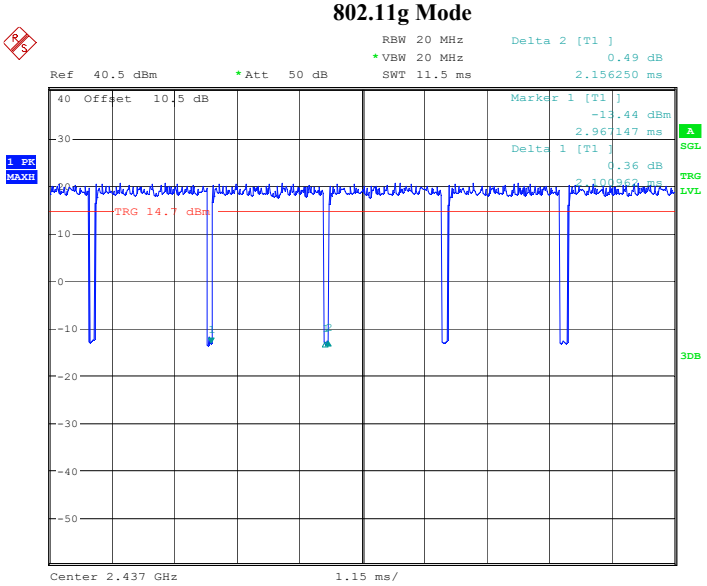
The software and power level was provided by applicant.

Duty Cycle

802.11b Mode

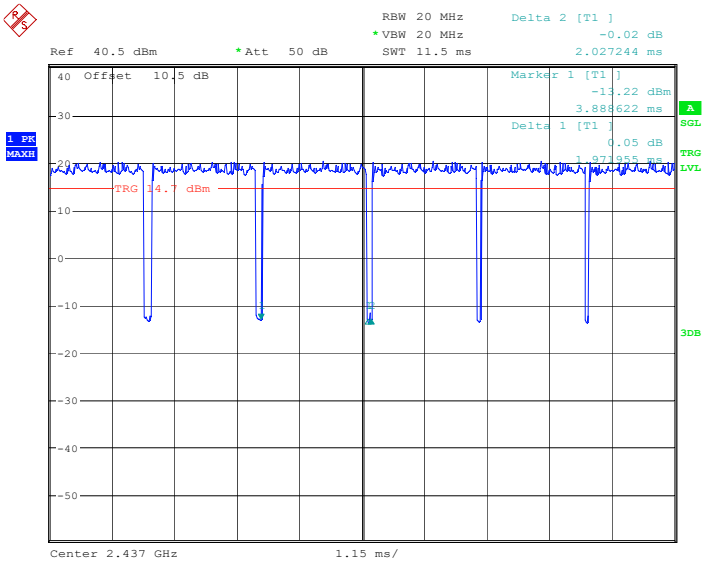


802.11g Mode



Date: 31.MAY.2022 18:43:18

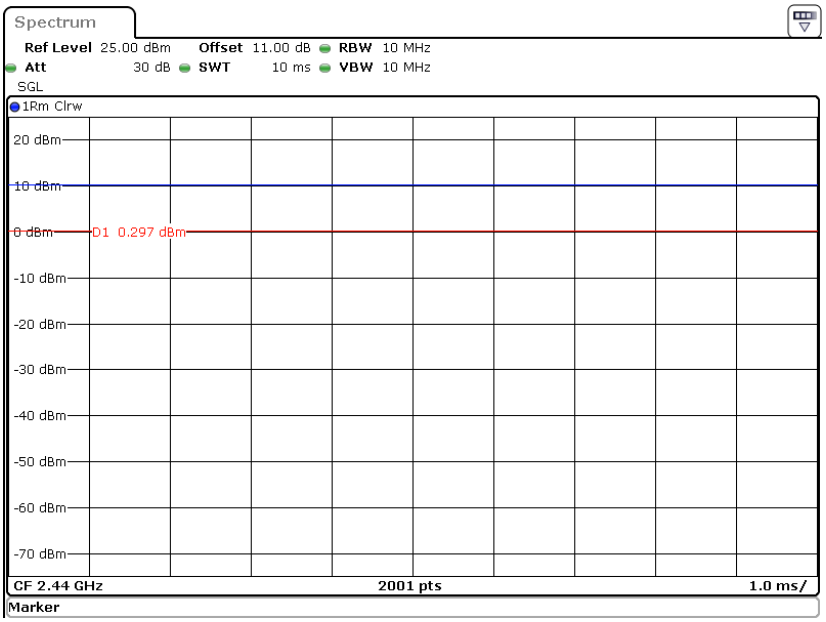
802.11n20



Date: 31.MAY.2022 18:42:29

BLE-1M:

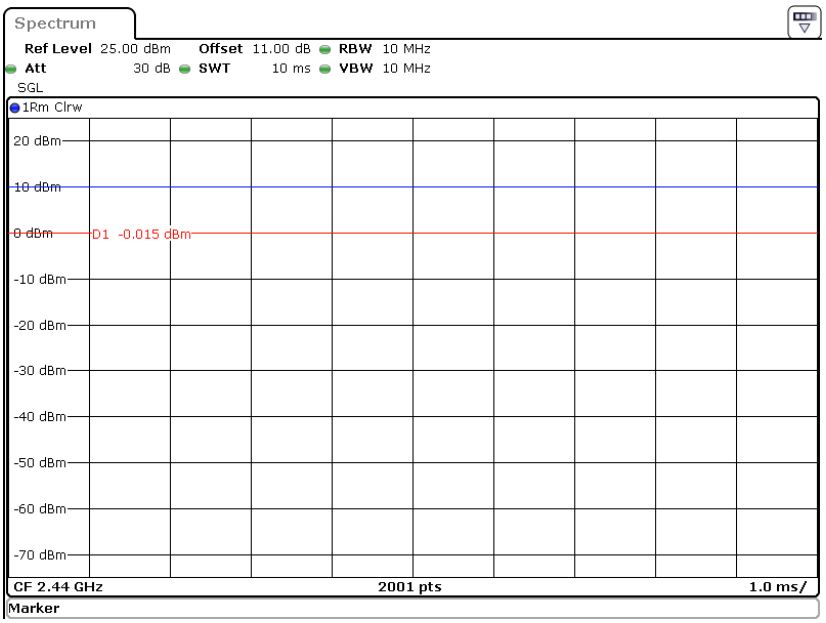
2440MHz



Date: 22.JUN.2022 10:55:45

BLE-2M:

2440MHz



Date: 22.JUN.2022 11:23:43

Mode	Ton (ms)	Ton+off (ms)	Duty Cycle (%)
802.11b	100	100	100
802.11g	2.101	2.156	97.45
802.11n-HT20	1.972	2.027	97.29
BLE 1M	10	10	100
BLE 2M	10	10	100

Support Equipment List and Details

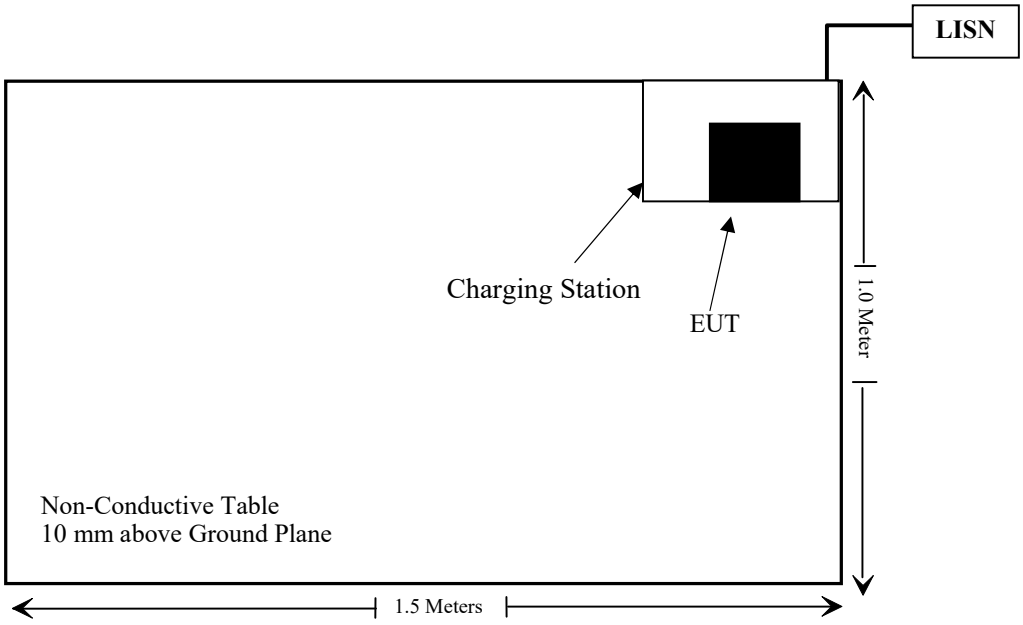
Manufacturer	Description	Model	Serial Number
Yunjing Intelligence	Charging Station	YJCB012	Unknown

External I/O Cable

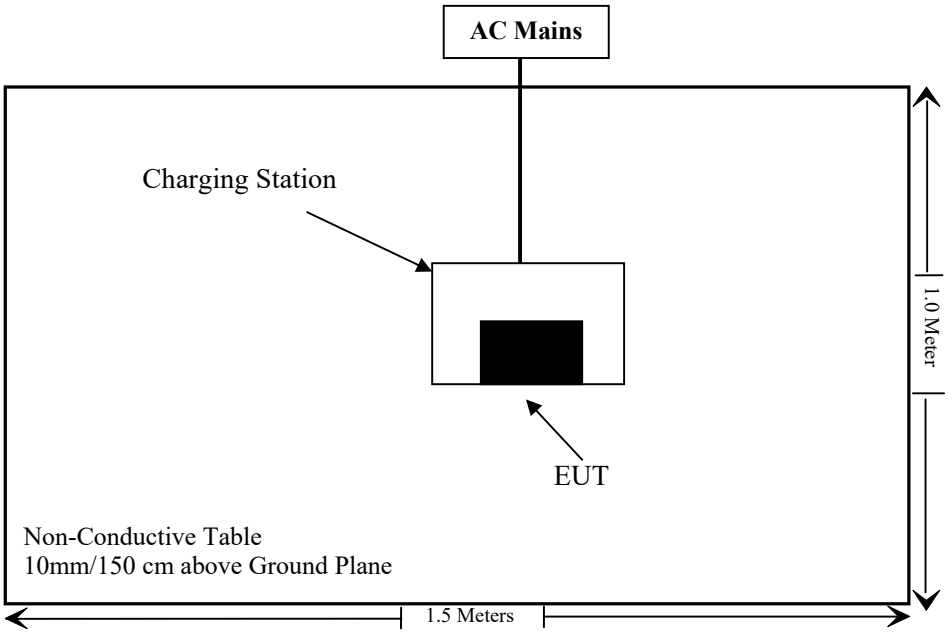
Cable Description	Length (m)	From	To
Un-shielding Detachable AC Cable	1.2	Charging Station	LISN

Block Diagram of Test Setup

For conducted emission:



For radiated emission:



SUMMARY OF TEST RESULTS

FCC Rules	RSS Rules	Description of Test	Result
§ 15.247 (i), §2.1091	RSS-102 § 4	Maximum Permissible Exposure(MPE) & RF Exposure Limit	Compliant
§15.203	RSS-Gen §6.8	Antenna Requirement	Compliant
§15.207 (a)	RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
§15.205, §15.209, §15.247(d)	RSS-GEN § 8.10 & RSS-247 § 5.5	Spurious Emissions	Compliant
§15.247 (a)(2)	RSS- Gen§6.7 RSS-247 § 5.2 (a)	99% Occupied Bandwidth & 6 dB Emission Bandwidth	Compliant
§15.247(b)(3)	RSS-247 § 5.4(d)	Maximum Conducted Output Power	Compliant
§15.247(d)	RSS-247 § 5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
§15.247(e)	RSS-247 § 5.2 (b)	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	100784	2021/12/13	2022/12/12
Rohde & Schwarz	L.I.S.N.	ENV216	101314	2021/12/13	2022/12/12
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2021/12/13	2022/12/12
Unknown	RF Coaxial Cable	No.17	N0350	2021/12/14	2022/12/13
Conducted Emission Test Software: e3 19821b (V9)					
Radiated Emissions Test					
Rohde& Schwarz	Test Receiver	ESR	102725	2021/12/13	2022/12/12
Rohde&Schwarz	Spectrum Analyzer	FSV40	101949	2021/12/13	2022/12/12
SONOMA INSTRUMENT	Amplifier	310 N	186131	2021/11/09	2022/11/08
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2021/11/09	2022/11/08
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2021/11/11	2022/11/10
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2020/01/05	2023/01/04
Radiated Emission Test Software: e3 19821b (V9)					
Unknown	RF Coaxial Cable	No.10	N050	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.11	N1000	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.12	N040	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.13	N300	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.14	N800	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.15	N600	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.16	N650	2021/12/14	2022/12/13
Wainwright	High Pass Filter	WHKX3.6/18 G-10SS	5	2021/12/14	2022/12/13

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Tonscend	RF Control Unit	JS0806-2	19G8060182	2021/07/06	2022/07/05
SPECTRUM ANALYZER	Rohde & Schwarz	FSU26	200982	2021/07/06	2022/07/05
Rohde&Schwarz	Spectrum Analyzer	FSV-40	101948	2021/12/13	2022/12/12
WEINSCHEL	10dB Attenuator	5324	AU 3842	2021/12/14	2022/12/13
Unknown	RF Cable	Unknown	1	Each time	/
Unknown	RF Cable	Unknown	2	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) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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.

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/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator,the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

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

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

Mode	Frequency (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
BLE	2402-2480	2.0	1.58	11.0	12.59	20	0.004	1
Wi-Fi	2412-2462	2.0	1.58	23.0	199.53	20	0.063	1

Note: 1. The tune up conducted power and antenna gain was declared by the applicant.
2. The BLE can transmit at the same time with the Wi-Fi.

Simultaneous transmitting consideration (worst case):

The ratio=MPE_{BLE}/limit+$MPE_{Wi\text{-}Fi}$/limit=0.004/1+0.063/1=0.067＜1.0, so simultaneous exposure is compliant.

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

Result: Compliant.

RSS-102 § 4 – EXPOSURE LIMITS

Applicable Standard

According to RSS-102 §4:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	0.73/ ƒ	-	6**
1.1-10	$87/ f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/ f^{0.25}$	$0.1540/ f^{0.25}$	$8.944/ f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/ f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: ƒ is frequency in MHz.
* Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

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/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

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

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

Mode	Frequency (MHz)	Antenna Gain		Turn up Power		Evaluation Distance (m)	Power Density (W/m^2)	MPE Limit (W/m^2)
		(dBi)	(numeric)	(dBm)	(W)			
BLE	2402-2480	2.0	1.58	11.0	0.013	0.2	0.041	5.35
Wi-Fi	2412-2462	2.0	1.58	23.0	0.200	0.2	0.629	5.37

Note: 1. The tune up conducted power and antenna gain was declared by the applicant.
2. The BLE can transmit at the same time with the Wi-Fi.

Simultaneous transmitting consideration (worst case):

The ratio=MPE_{BLE}/limit+$MPE_{Wi\text{-}Fi}$/limit=0.041/5.35+0.629/5.37=0.125＜1.0, so simultaneous exposure is compliant.

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

Result: Compliant.

§ 15.203 & RSS-Gen §6.8 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.

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.
Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

Antenna Connector Construction

The EUT has two internal antenna arrangement which was permanently attached, one for BLE and one for WI-Fi, both the antenna gain is 2.0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Mode	Antenna Type	Antenna Gain	Impedance
Wi-Fi ANT	FPC	2.0dBi	50 Ω
BLE ANT	PCB	2.0dBi	50 Ω

Result: Compliant

§ 15.207 (a) & RSS-GEN §8.8 AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC § 15.207 (a) & RSS-GEN §8.8

Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50 µH / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

Table 4 - AC Power Lines Conducted Emission Limits		
Frequency range (MHz)	Conducted limit (dBµV)	
	Quasi-Peak	Average
0.15 – 0.5	66 to 56[1]	56 to 46[1]
0.5 – 5	56	46
5 – 30	60	50

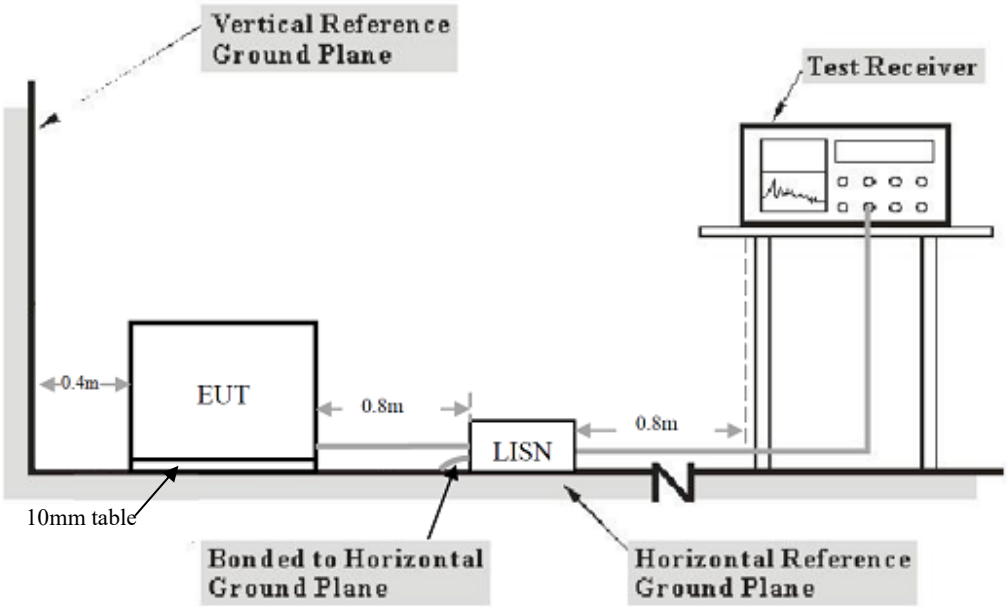
Note 1: The level decreases linearly with the logarithm of the frequency.

For an EUT with a permanent or detachable antenna operating between 150 kHz and 30 MHz, the AC power-line conducted emissions must be measured using the following configurations:

(a) Perform the AC power-line conducted emissions test with the antenna connected to determine compliance with the limits of table 4 outside the transmitter's fundamental emission band.

(b) Retest with a dummy load instead of the antenna to determine compliance with the limits of table 4 within the transmitter's fundamental emission band. For a detachable antenna, remove the antenna and connect a suitable dummy load to the antenna connector. For a permanent antenna, remove the antenna and terminate the RF output with a dummy load or network that simulates the antenna in the fundamental frequency band.

EUT Setup



The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 & RSS-247/RSS-Gen limits.

The spacing between the peripherals was 10 cm.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

EMI Test Receiver 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

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 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

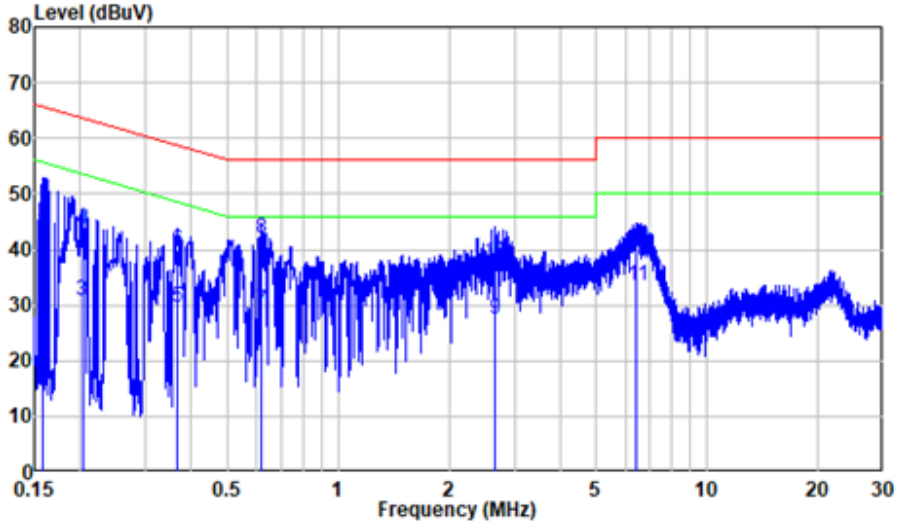
Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Jason on 2022-06-23.

EUT operation mode: Transmitting (worst case is 802.11g mode, high channel)

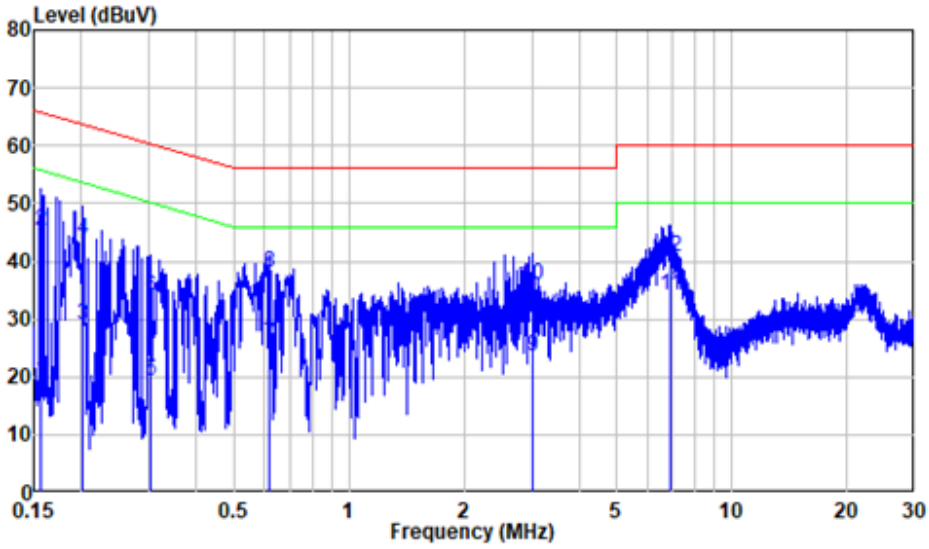
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Mode : Transmitting
Model : YJCC012
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.159	9.80	9.12	18.92	55.52	-36.60	Average
2	0.159	9.80	35.05	44.85	65.52	-20.67	QP
3	0.202	9.80	20.87	30.67	53.51	-22.84	Average
4	0.202	9.80	33.80	43.60	63.51	-19.91	QP
5	0.367	9.80	19.75	29.55	48.56	-19.01	Average
6	0.367	9.80	30.08	39.88	58.56	-18.68	QP
7	0.617	9.81	19.27	29.08	46.00	-16.92	Average
8	0.617	9.81	32.11	41.92	56.00	-14.08	QP
9	2.648	9.83	17.49	27.32	46.00	-18.68	Average
10	2.648	9.83	27.79	37.62	56.00	-18.38	QP
11	6.450	9.86	23.59	33.45	50.00	-16.55	Average
12	6.450	9.86	30.16	40.02	60.00	-19.98	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Mode : Transmitting
Model : YJCC012
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.156	9.80	9.42	19.22	55.68	-36.46	Average
2	0.156	9.80	35.50	45.30	65.68	-20.38	QP
3	0.202	9.80	19.17	28.97	53.54	-24.57	Average
4	0.202	9.80	33.98	43.78	63.54	-19.76	QP
5	0.302	9.80	9.59	19.39	50.17	-30.78	Average
6	0.302	9.80	24.08	33.88	60.17	-26.29	QP
7	0.619	9.81	15.75	25.56	46.00	-20.44	Average
8	0.619	9.81	28.22	38.03	56.00	-17.97	QP
9	3.001	9.83	13.76	23.59	46.00	-22.41	Average
10	3.001	9.83	26.17	36.00	56.00	-20.00	QP
11	6.873	9.97	24.15	34.12	50.00	-15.88	Average
12	6.873	9.97	30.93	40.90	60.00	-19.10	QP

§15.205, §15.209, §15.247(d) & RSS-GEN § 8.10 & RSS-247 § 5.5 SPURIOUS EMISSIONS

Applicable Standard

FCC §15.247 (d); §15.209; §15.205;

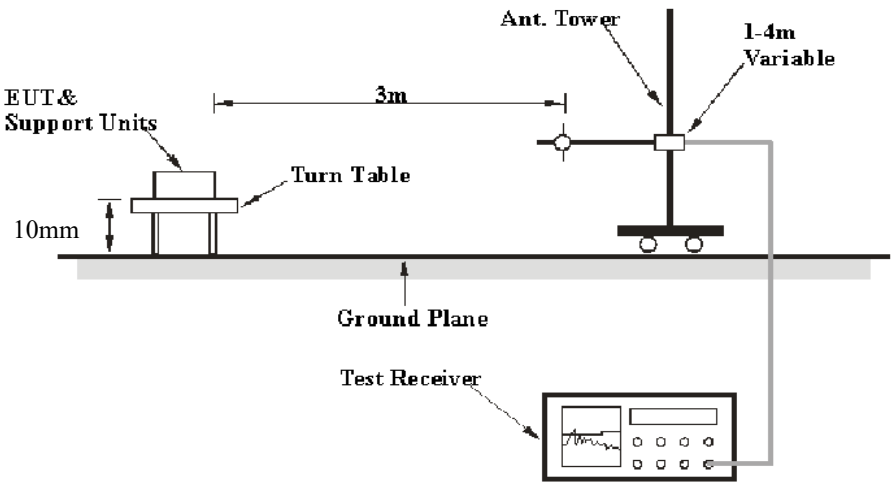
According to RSS-GEN § 8.10 & RSS-247 § 5.5

Restricted frequency bands, identified in table 7, are designated primarily for safety-of-life services (distress calling and certain aeronautical activities), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following conditions related to the restricted frequency bands apply:(a) The transmit frequency, including fundamental components of modulation, of licence-exempt radio apparatus shall not fall within the restricted frequency bands listed in table 7 except for apparatus compliant with RSS-287, Emergency Position Indicating Radio Beacons (EPIRB), Emergency Locator Transmitters (ELT), Personal Locator Beacons (PLB), and Maritime Survivor Locator Devices (MSLD).(b) Unwanted emissions that fall into restricted frequency bands listed in table 7 shall comply with the limits specified in table 5 and table 6.(c) Unwanted emissions that do not fall within the restricted frequency bands listed in table 7 shall comply either with the limits specified in the applicable RSS or with those specified in table 5 and table 6.

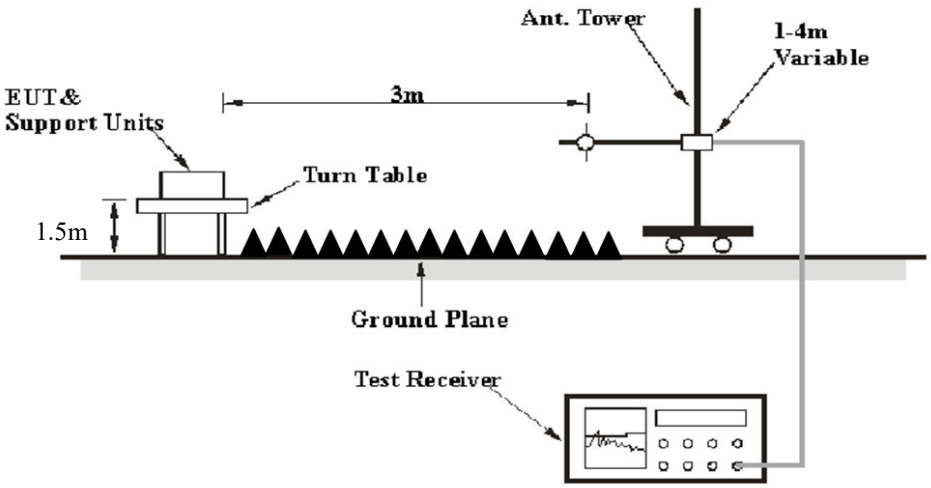
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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 & RSS-Gen. The specification used was the FCC 15.209, and FCC 15.247 & RSS-Gen limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & 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.

Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

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.

Repeat above procedures until all measured frequencies were complete.

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:	25.5~29 ℃
Relative Humidity:	50~54 %
ATM Pressure:	101.0 kPa

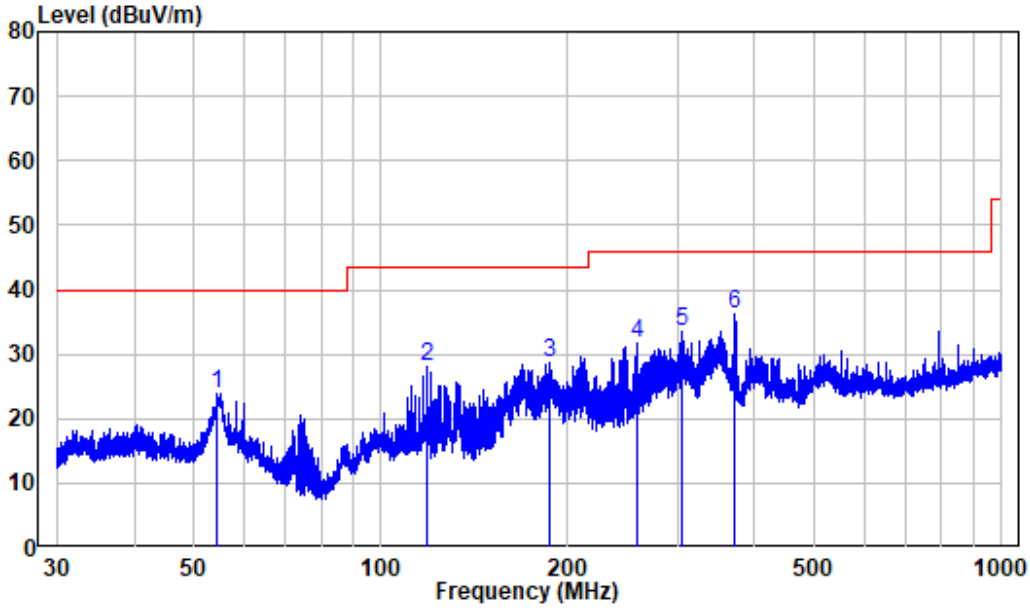
The testing was performed by Level on 2022-06-27 for below 1GHz , Zeki Ma and Level from 2022-05-27 to 2022-06-27 for above 1GHz.

EUT operation mode: Transmitting

30 MHz~1 GHz: *(worst case is 802.11g mode, high channel)*

Note: When the test result of Peak was below the limit of QP more than 6dB, just the peak value was recorded.

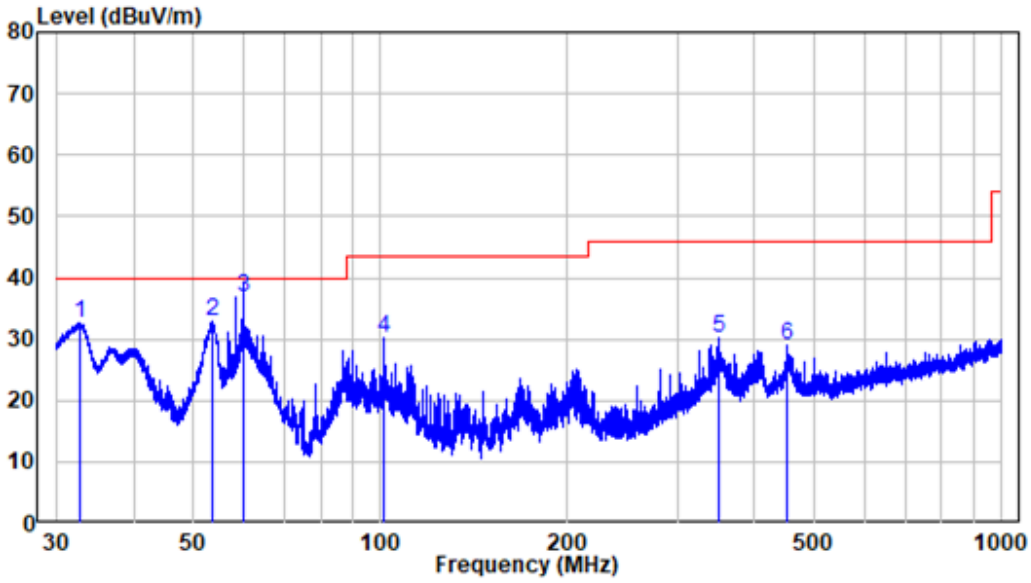
Horizontal:



Site : chamber
Condition: 3m HORIZONTAL
Job No. : SZNS220520-21880E-RF
Test Mode: Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	54.523	-10.31	34.09	23.78	40.00	-16.22	Peak
2	118.446	-13.24	41.27	28.03	43.50	-15.47	Peak
3	186.359	-12.01	40.66	28.65	43.50	-14.85	Peak
4	258.780	-10.59	42.29	31.70	46.00	-14.30	Peak
5	304.877	-9.06	42.63	33.57	46.00	-12.43	Peak
6	370.702	-7.30	43.54	36.24	46.00	-9.76	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : SZNS220520-21880E-RF
Test Mode: Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	32.835	-12.04	44.78	32.74	40.00	-7.26	Peak
2	53.740	-10.30	43.31	33.01	40.00	-6.99	Peak
3	60.016	-10.63	47.50	36.87	40.00	-3.13	QP
4	101.289	-11.65	41.82	30.17	43.50	-13.33	Peak
5	349.250	-7.28	37.45	30.17	46.00	-15.83	Peak
6	452.521	-5.57	34.50	28.93	46.00	-17.07	Peak

1 GHz-25 GHz:

For Wi-Fi

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)				
802.11b Mode									
Low Channel (2412 MHz)									
2310	68.01	PK	108	1.5	H	-7.24	60.77	74	-13.23
2310	53.47	AV	108	1.5	H	-7.24	46.23	54	-7.77
2310	68.65	PK	282	2.0	V	-7.24	61.41	74	-12.59
2310	53.43	AV	282	2.0	V	-7.24	46.19	54	-7.81
2390	69.76	PK	30	1.5	H	-7.22	62.54	74	-11.46
2390	54.49	AV	30	1.5	H	-7.22	47.27	54	-6.73
2390	69.31	PK	169	1.8	V	-7.22	62.09	74	-11.91
2390	54.29	AV	169	1.8	V	-7.22	47.07	54	-6.93
4824	54.22	PK	110	1.6	H	-3.52	50.7	74	-23.30
4824	43.03	AV	110	1.6	H	-3.52	39.51	54	-14.49
4824	54.30	PK	300	2.0	V	-3.52	50.78	74	-23.22
4824	42.51	AV	300	2.0	V	-3.52	38.99	54	-15.01
Middle Channel (2437MHz)									
4874	54.20	PK	48	1.8	H	-3.42	50.78	74	-23.22
4874	43.26	AV	48	1.8	H	-3.42	39.84	54	-14.16
4874	54.54	PK	232	2.1	V	-3.42	51.12	74	-22.88
4874	42.79	AV	232	2.1	V	-3.42	39.37	54	-14.63
High Channel (2462 MHz)									
2483.5	70.08	PK	235	2.0	H	-7.2	62.88	74	-11.12
2483.5	55.06	AV	235	2.0	H	-7.2	47.86	54	-6.14
2483.5	69.74	PK	5	2.1	V	-7.2	62.54	74	-11.46
2483.5	55.12	AV	5	2.1	V	-7.2	47.92	54	-6.08
2500	68.33	PK	196	2.0	H	-7.18	61.15	74	-12.85
2500	55.09	AV	196	2.0	H	-7.18	47.91	54	-6.09
2500	68.54	PK	10	1.7	V	-7.18	61.36	74	-12.64
2500	54.87	AV	10	1.7	V	-7.18	47.69	54	-6.31
4924	54.10	PK	228	1.6	H	-3.16	50.94	74	-23.06
4924	43.21	AV	228	1.6	H	-3.16	40.05	54	-13.95
4924	54.54	PK	179	2.0	V	-3.16	51.38	74	-22.62
4924	42.44	AV	179	2.0	V	-3.16	39.28	54	-14.72

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)				
802.11g Mode									
Low Channel (2412 MHz)									
2310	68.57	PK	129	1.7	H	-7.24	61.33	74	-12.67
2310	54.18	AV	129	1.7	H	-7.24	46.94	54	-7.06
2310	68.23	PK	321	2	V	-7.24	60.99	74	-13.01
2310	54.27	AV	321	2	V	-7.24	47.03	54	-6.97
2390	77.43	PK	122	1.7	H	-7.22	70.21	74	-3.79
2390	57.31	AV	122	1.7	H	-7.22	50.09	54	-3.91
2390	75.82	PK	159	1.9	V	-7.22	68.6	74	-5.4
2390	55.81	AV	159	1.9	V	-7.22	48.59	54	-5.41
4824	54.05	PK	183	1.8	H	-3.52	50.53	74	-23.47
4824	41.47	AV	183	1.8	H	-3.52	37.95	54	-16.05
4824	53.85	PK	245	1.6	V	-3.52	50.33	74	-23.67
4824	41.14	AV	245	1.6	V	-3.52	37.62	54	-16.38
Middle Channel (2437MHz)									
4874	54.42	PK	268	1.6	H	-3.42	51	74	-23.00
4874	41.90	AV	268	1.6	H	-3.42	38.48	54	-15.52
4874	54.19	PK	220	1.9	V	-3.42	50.77	74	-23.23
4874	41.41	AV	220	1.9	V	-3.42	37.99	54	-16.01
High Channel (2462 MHz)									
2483.5	69.83	PK	92	1.6	H	-7.2	62.63	74	-11.37
2483.5	57.42	AV	92	1.6	H	-7.2	50.22	54	-3.78
2483.5	69.76	PK	328	1.6	V	-7.2	62.56	74	-11.44
2483.5	57.38	AV	328	1.6	V	-7.2	50.18	54	-3.82
2500	68.32	PK	78	1.5	H	-7.18	61.14	74	-12.86
2500	55.88	AV	78	1.5	H	-7.18	48.7	54	-5.30
2500	68.65	PK	73	1.6	V	-7.18	61.47	74	-12.53
2500	55.79	AV	73	1.6	V	-7.18	48.61	54	-5.39
4924	54.41	PK	226	1.7	H	-3.16	51.25	74	-22.75
4924	41.76	AV	226	1.7	H	-3.16	38.6	54	-15.40
4924	54.03	PK	133	1.6	V	-3.16	50.87	74	-23.13
4924	41.03	AV	133	1.6	V	-3.16	37.87	54	-16.13

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)				
802.11n20 Mode									
Low Channel (2412 MHz)									
2310	68.61	PK	261	1.6	H	-7.24	61.37	74	-12.63
2310	54.23	AV	261	1.6	H	-7.24	46.99	54	-7.01
2310	67.87	PK	172	2	V	-7.24	60.63	74	-13.37
2310	54.26	AV	172	2	V	-7.24	47.02	54	-6.98
2390	77.27	PK	164	1.8	H	-7.22	70.05	74	-3.95
2390	57.25	AV	164	1.8	H	-7.22	50.03	54	-3.97
2390	75.29	PK	42	1.5	V	-7.22	68.07	74	-5.93
2390	56.03	AV	42	1.5	V	-7.22	48.81	54	-5.19
4824	54.27	PK	74	1.8	H	-3.52	50.75	74	-23.25
4824	41.45	AV	74	1.8	H	-3.52	37.93	54	-16.07
4824	54.07	PK	165	2	V	-3.52	50.55	74	-23.45
4824	40.94	AV	165	2	V	-3.52	37.42	54	-16.58
Middle Channel (2437MHz)									
4874	54.25	PK	188	1.9	H	-3.42	50.83	74	-23.17
4874	42.00	AV	188	1.9	H	-3.42	38.58	54	-15.42
4874	54.33	PK	217	1.5	V	-3.42	50.91	74	-23.09
4874	41.24	AV	217	1.5	V	-3.42	37.82	54	-16.18
High Channel (2462 MHz)									
2483.5	69.42	PK	8	1.8	H	-7.2	62.22	74	-11.78
2483.5	57.43	AV	8	1.8	H	-7.2	50.23	54	-3.77
2483.5	70.05	PK	336	2.0	V	-7.2	62.85	74	-11.15
2483.5	57.57	AV	336	2.0	V	-7.2	50.37	54	-3.63
2500	68.61	PK	309	1.6	H	-7.18	61.43	74	-12.57
2500	55.68	AV	309	1.6	H	-7.18	48.5	54	-5.50
2500	68.77	PK	265	1.6	V	-7.18	61.59	74	-12.41
2500	55.71	AV	265	1.6	V	-7.18	48.53	54	-5.47
4924	54.04	PK	317	1.7	H	-3.16	50.88	74	-23.12
4924	41.66	AV	317	1.7	H	-3.16	38.5	54	-15.50
4924	53.97	PK	341	2.1	V	-3.16	50.81	74	-23.19
4924	41.19	AV	341	2.1	V	-3.16	38.03	54	-15.97

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 (2402 MHz)									
2310	66.98	PK	189	1.8	H	-7.24	59.74	74	-14.26
2310	52.86	AV	189	1.8	H	-7.24	45.62	54	-8.38
2310	67.71	PK	311	1.7	V	-7.24	60.47	74	-13.53
2310	52.88	AV	311	1.7	V	-7.24	45.64	54	-8.36
2390	68.49	PK	149	1.6	H	-7.22	61.27	74	-12.73
2390	54.00	AV	149	1.6	H	-7.22	46.78	54	-7.22
2390	67.98	PK	163	1.5	V	-7.22	60.76	74	-13.24
2390	54.02	AV	163	1.5	V	-7.22	46.8	54	-7.20
4804	54.85	PK	14	1.8	H	-3.51	51.34	74	-22.66
4804	39.89	AV	14	1.8	H	-3.51	36.38	54	-17.62
4804	56.63	PK	319	1.8	V	-3.51	53.12	74	-20.88
4804	45.15	AV	319	1.8	V	-3.51	41.64	54	-12.36
Middle Channel (2440 MHz)									
4880	54.28	PK	332	1.6	H	-3.38	50.9	74	-23.10
4880	38.76	AV	332	1.6	H	-3.38	35.38	54	-18.62
4880	54.01	PK	276	2.1	V	-3.38	50.63	74	-23.37
4880	39.11	AV	276	2.1	V	-3.38	35.73	54	-18.27
High Channel (2480 MHz)									
2483.5	68.76	PK	235	1.8	H	-7.2	61.56	74	-12.44
2483.5	53.98	AV	235	1.8	H	-7.2	46.78	54	-7.22
2483.5	69.17	PK	270	1.9	V	-7.2	61.97	74	-12.03
2483.5	54.67	AV	270	1.9	V	-7.2	47.47	54	-6.53
2500	69.16	PK	226	1.6	H	-7.18	61.98	74	-12.02
2500	54.59	AV	226	1.6	H	-7.18	47.41	54	-6.59
2500	68.38	PK	84	1.7	V	-7.18	61.2	74	-12.80
2500	53.99	AV	84	1.7	V	-7.18	46.81	54	-7.19
4960	53.69	PK	122	1.7	H	-3.01	50.68	74	-23.32
4960	38.89	AV	122	1.7	H	-3.01	35.88	54	-18.12
4960	54.33	PK	328	1.7	V	-3.01	51.32	74	-22.68
4960	38.67	AV	328	1.7	V	-3.01	35.66	54	-18.34

BLE 2M:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2402 MHz)									
2310	67.53	PK	87	1.8	H	-7.24	60.29	74	-13.71
2310	52.87	AV	87	1.8	H	-7.24	45.63	54	-8.37
2310	67.42	PK	81	1.6	V	-7.24	60.18	74	-13.82
2310	52.75	AV	81	1.6	V	-7.24	45.51	54	-8.49
2390	68.11	PK	186	2.0	H	-7.22	60.89	74	-13.11
2390	54.00	AV	186	2.0	H	-7.22	46.78	54	-7.22
2390	67.98	PK	211	2.1	V	-7.22	60.76	74	-13.24
2390	53.75	AV	211	2.1	V	-7.22	46.53	54	-7.47
4804	54.06	PK	141	2.0	H	-3.51	50.55	74	-23.45
4804	39.70	AV	141	2.0	H	-3.51	36.19	54	-17.81
4804	56.70	PK	124	2.0	V	-3.51	53.19	74	-20.81
4804	44.70	AV	124	2.0	V	-3.51	41.19	54	-12.81
Middle Channel (2440 MHz)									
4880	54.44	PK	308	1.7	H	-3.38	51.06	74	-22.94
4880	39.52	AV	308	1.7	H	-3.38	36.14	54	-17.86
4880	55.35	PK	171	1.5	V	-3.38	51.97	74	-22.03
4880	40.40	AV	171	1.5	V	-3.38	37.02	54	-16.98
High Channel (2480 MHz)									
2483.5	69.06	PK	247	2.0	H	-7.2	61.86	74	-12.14
2483.5	55.26	AV	247	2.0	H	-7.2	48.06	54	-5.94
2483.5	70.05	PK	329	1.7	V	-7.2	62.85	74	-11.15
2483.5	57.83	AV	329	1.7	V	-7.2	50.63	54	-3.37
2500	68.30	PK	110	2.1	H	-7.18	61.12	74	-12.88
2500	54.11	AV	110	2.1	H	-7.18	46.93	54	-7.07
2500	69.17	PK	81	1.5	V	-7.18	61.99	74	-12.01
2500	54.14	AV	81	1.5	V	-7.18	46.96	54	-7.04
4960	53.51	PK	286	2.0	H	-3.01	50.5	74	-23.50
4960	38.57	AV	286	2.0	H	-3.01	35.56	54	-18.44
4960	53.99	PK	77	1.7	V	-3.01	50.98	74	-23.02
4960	40.13	AV	77	1.7	V	-3.01	37.12	54	-16.88

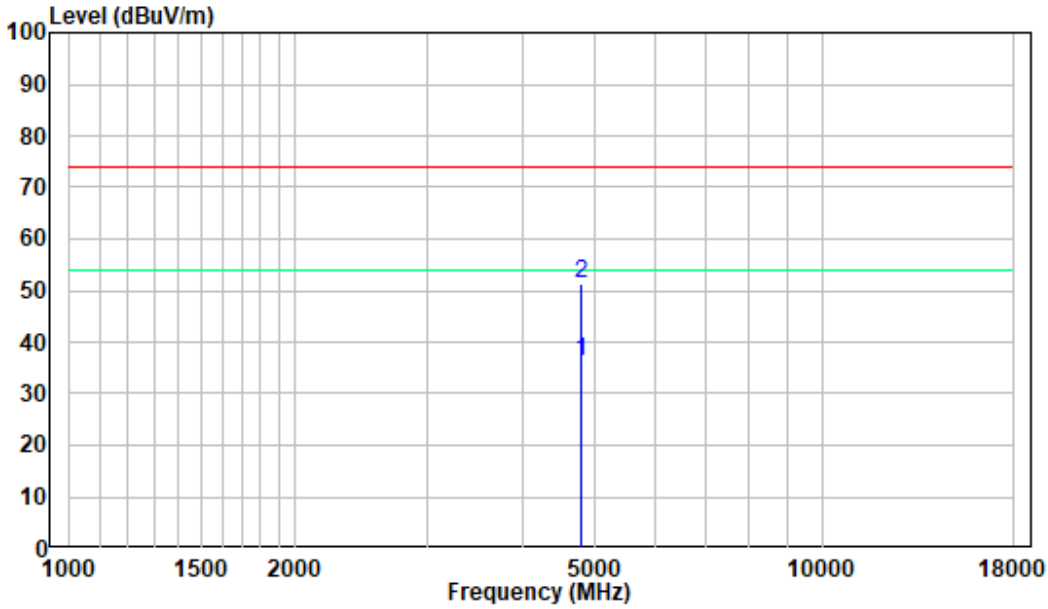
simultaneously transmitcodition: (worst case as below)

Frequency (MHz)	Receiver		Turn-Table	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	/	
	Reading (dBμV)	Detector (PK/QP/AV)	Angle Degree	Height (m)	Polar (H / V)			Limit (dBμV/m)	Margin (dB)
2.4G 802.11b Mode 2462MHz + BLE 1M 2402MHz									
370.702	43.42	PK	88	2	H	-7.3	36.12	46	-9.88
60.016	46.98	QP	296	2	V	-10.63	36.35	40	-3.65
4924	53.97	PK	291	2.1	H	-3.16	50.81	74	-23.19
4924	42.72	AV	291	2.1	H	-3.16	39.56	54	-14.44
4924	54.18	PK	341	2.0	V	-3.16	51.02	74	-22.98
4924	42.27	AV	341	2.0	V	-3.16	39.11	54	-14.89
4804	54.63	PK	349	1.6	H	-3.51	51.12	74	-22.88
4804	39.53	AV	349	1.6	H	-3.51	36.02	54	-17.98
4804	56.46	PK	233	1.5	V	-3.51	52.95	74	-21.05
4804	44.74	AV	233	1.5	V	-3.51	41.23	54	-12.77

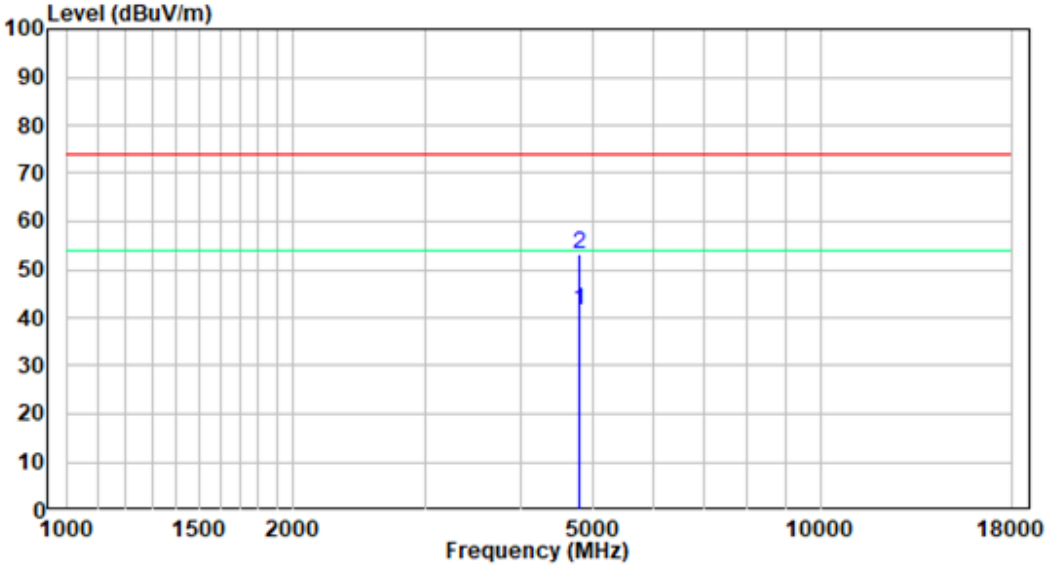
Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Corrected. Amplitude - Limit
The other spurious emission which is 20dB to the limit or in noise floor level was not recorded.

1-18 GHz: (pre-scan for 802.11b, high channel)

Horizontal

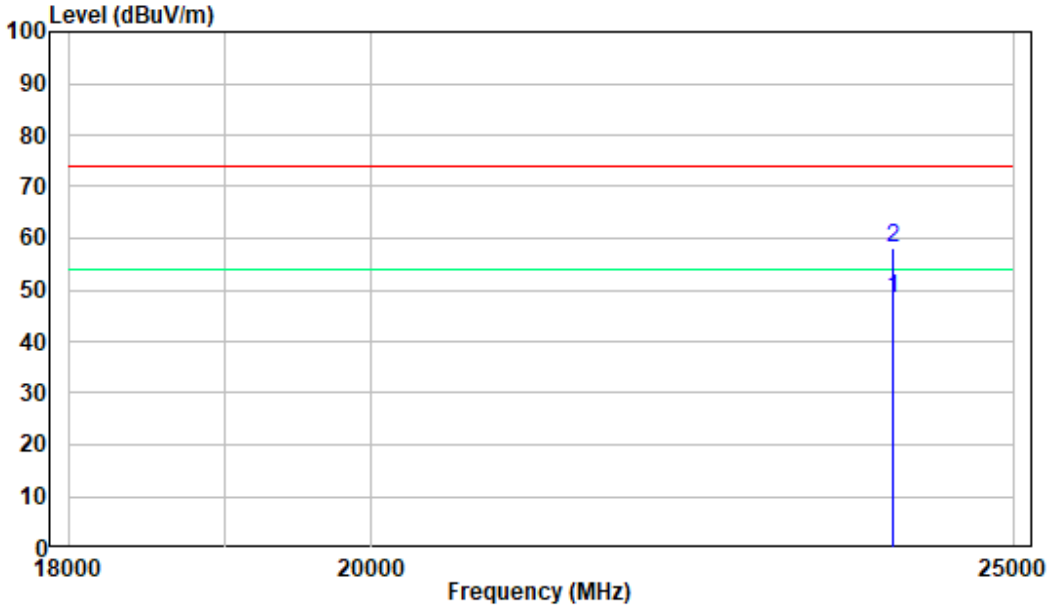


Vertical

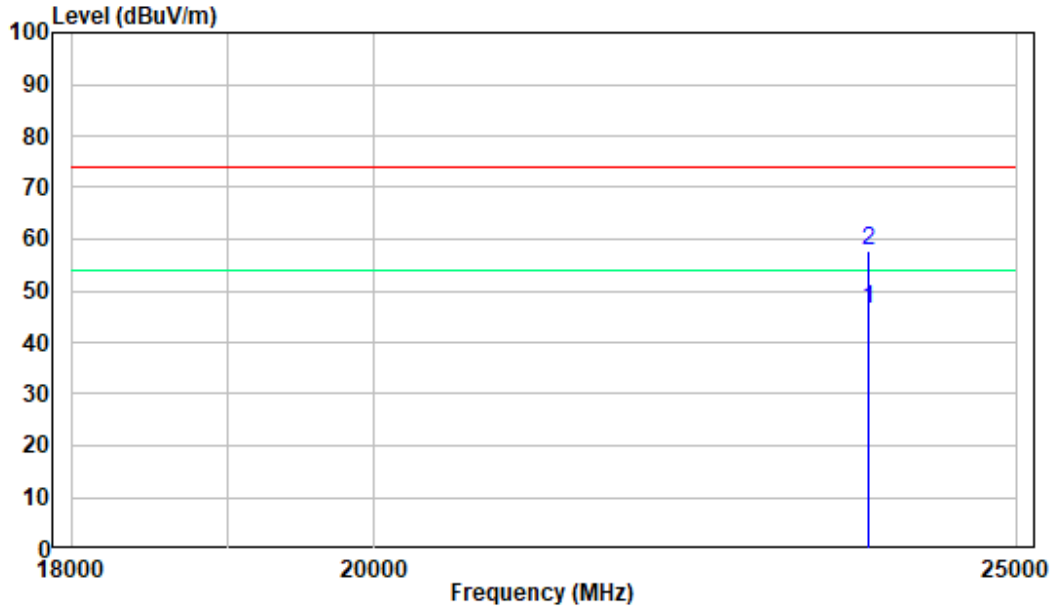


18 -25GHz: (pre-scan for 802.11b, high channel)

Horizontal



Vertical



§15.247 (a)(2) & RSS-Gen§6.7 RSS-247 § 5.2 (a) 99% OCCUPIED BANDWIDTH & 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.

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the "6 dB bandwidth" is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated 6 dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

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.

The following conditions shall be observed for measuring the occupied bandwidth and 6 dB bandwidth:
• The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

• The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.

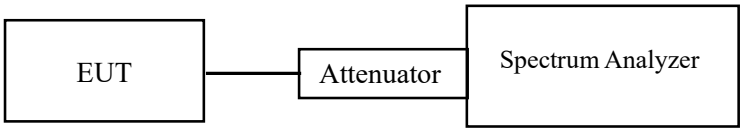
• The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / 6 dB bandwidth if the device is not transmitting continuously.

• The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / 6 dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed

in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).



Test Data

Environmental Conditions

Temperature:	26.1~27 ℃
Relative Humidity:	53.6~55 %
ATM Pressure:	101.0 kPa

The testing was performed by Cat Kang from 2022-05-31 to 2022-06-27.

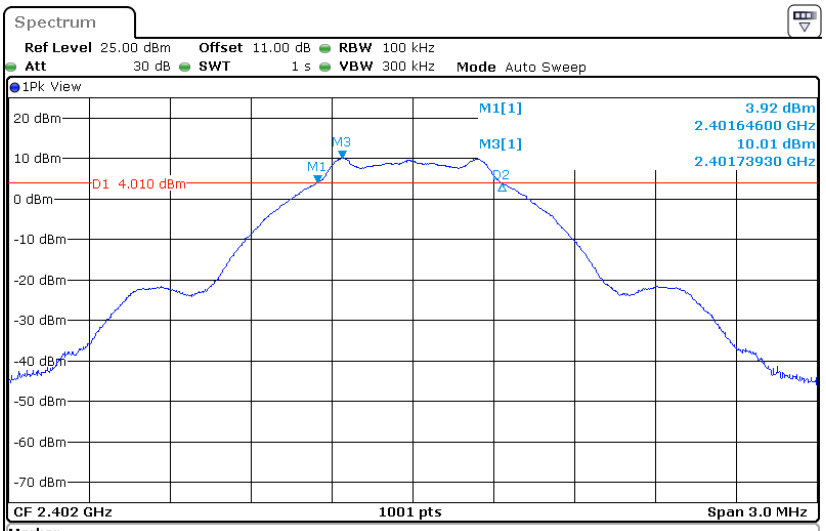
EUT operation mode: Transmitting

Test Result Compliant.

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)	Limit (kHz)
802.11b mode				
Low	2412	9.936	14.872	≥500
Middle	2437	10.000	14.872	≥500
High	2462	10.000	14.936	≥500
802.11g mode				
Low	2412	16.474	17.628	≥500
Middle	2437	16.410	17.885	≥500
High	2462	16.410	17.949	≥500
802.11n-HT20 mode				
Low	2412	17.564	18.654	≥500
Middle	2437	17.564	18.654	≥500
High	2462	17.564	18.654	≥500
BLE 1M				
Low	2402	0.684	1.029	≥500
Middle	2440	0.672	1.016	≥500
High	2480	0.684	1.020	≥500
BLE 2M				
Low	2402	1.374	2.055	≥500
Middle	2440	1.458	2.043	≥500
High	2480	1.374	2.061	≥500

6dB Bandwidth:
BLE 1M:

Low Channel

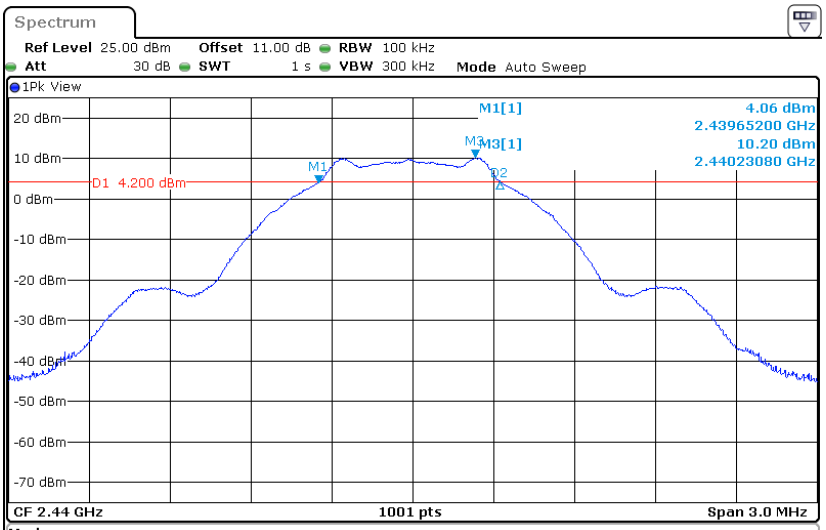


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.401646 GHz	3.92 dBm		
D2	M1	1	684.0 kHz	-0.07 dB		
M3		1	2.4017393 GHz	10.01 dBm		

Date: 22.JUN.2022 10:46:52

Middle Channel

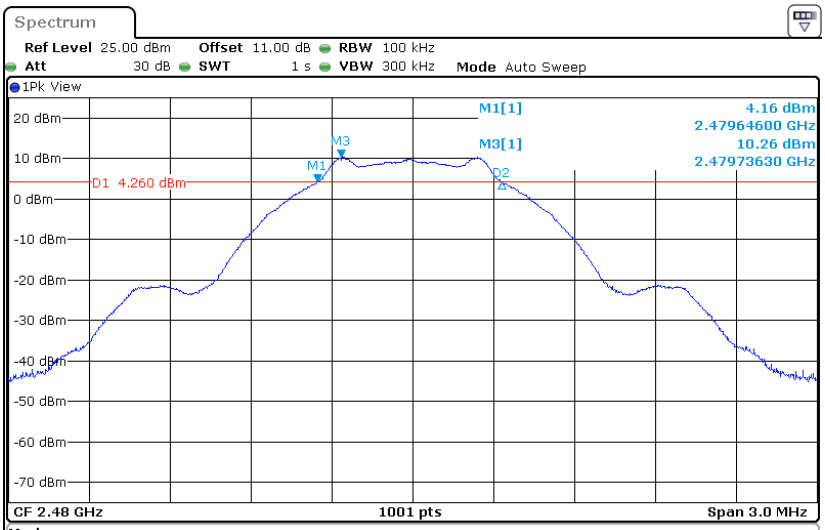


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.439652 GHz	4.06 dBm		
D2	M1	1	672.0 kHz	0.06 dB		
M3		1	2.4402308 GHz	10.20 dBm		

Date: 22.JUN.2022 10:57:09

High Channel

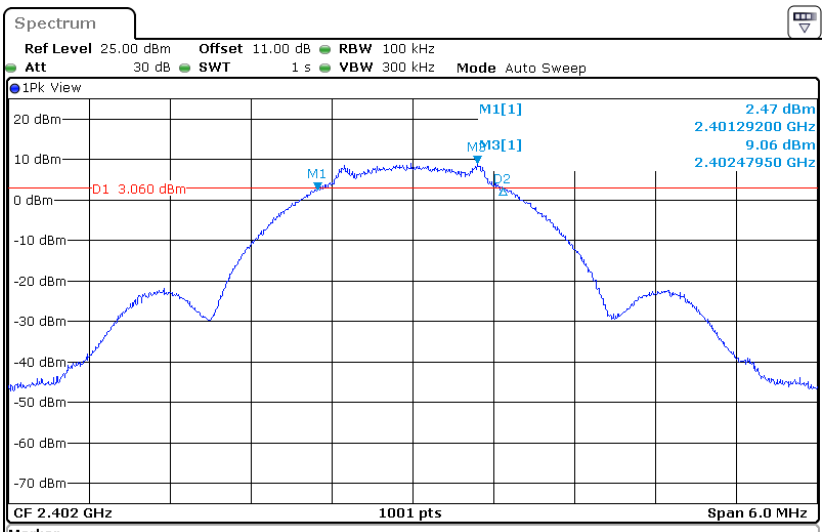


Marker						
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479646 GHz	4.16 dBm		
D2	M1	1	684.0 kHz	-0.03 dB		
M3		1	2.4797363 GHz	10.26 dBm		

Date: 22.JUN.2022 11:01:13

BLE 2M:

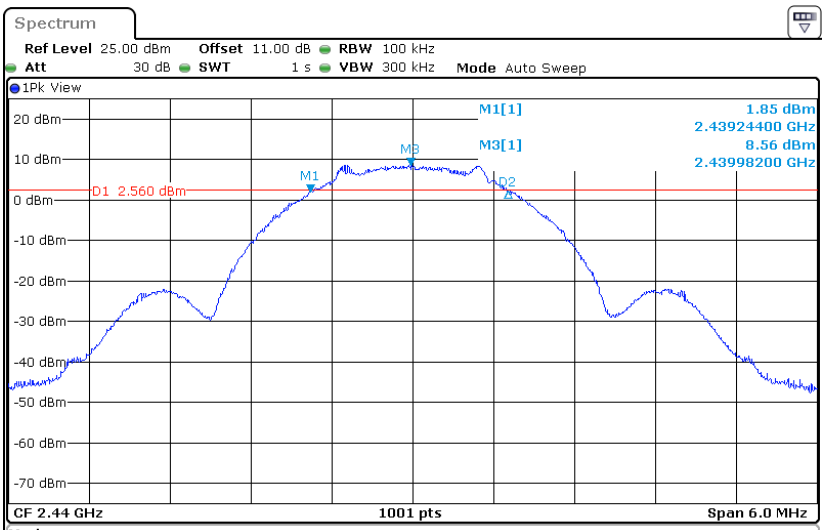
Low Channel



Marker						
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.401292 GHz	2.47 dBm		
D2	M1	1	1.374 MHz	0.50 dB		
M3		1	2.4024795 GHz	9.06 dBm		

Date: 22.JUN.2022 11:15:06

Middle Channel

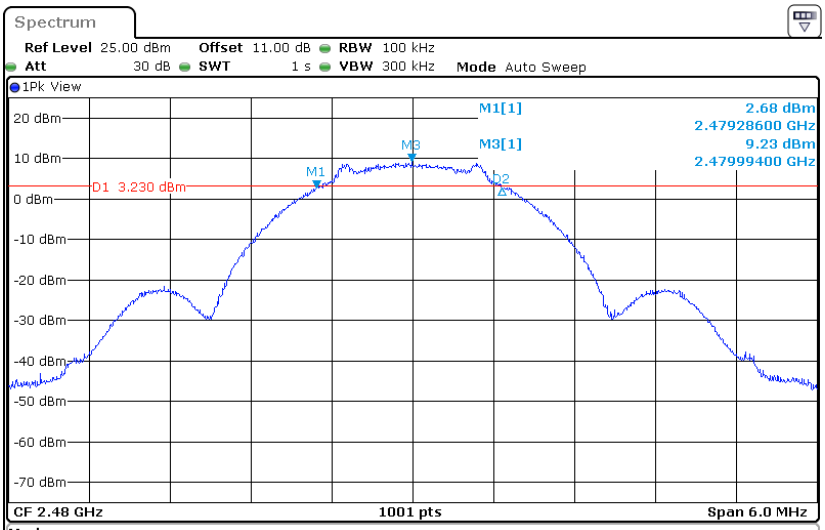


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.439244 GHz	1.85 dBm		
D2	M1	1	1.458 MHz	0.28 dB		
M3		1	2.439982 GHz	8.56 dBm		

Date: 22.JUN.2022 11:25:07

High Channel



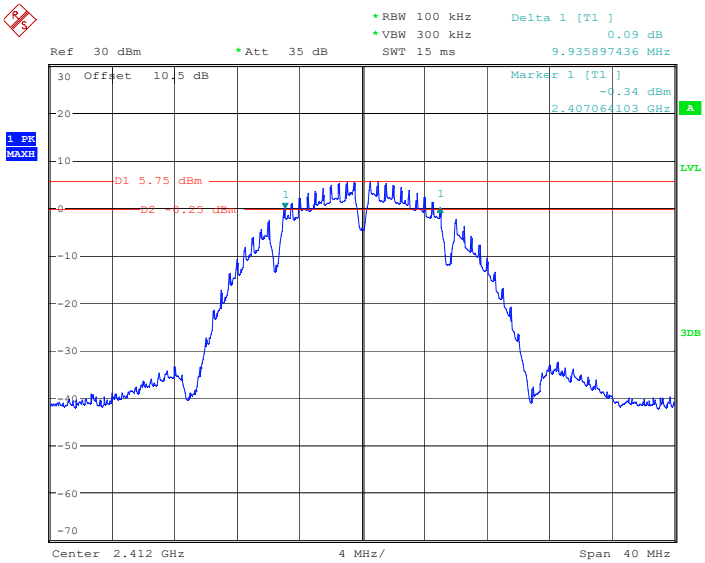
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479286 GHz	2.68 dBm		
D2	M1	1	1.374 MHz	0.08 dB		
M3		1	2.479994 GHz	9.23 dBm		

Date: 22.JUN.2022 11:30:58

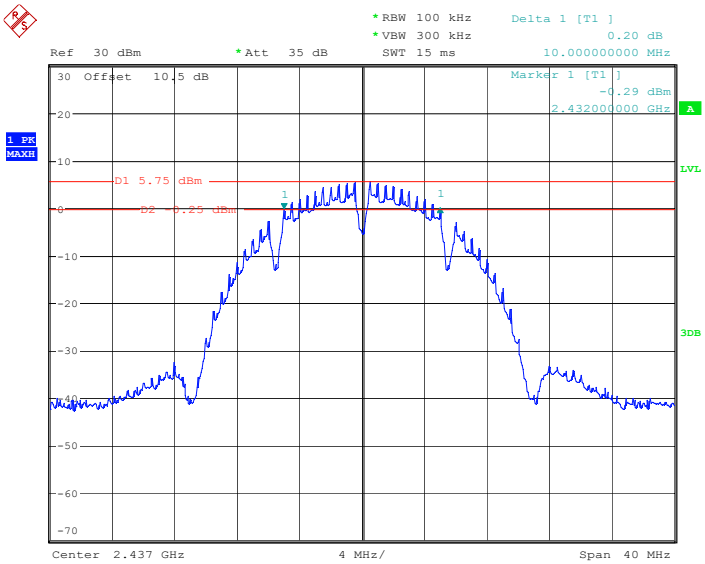
802.11b Mode:

Low Channel



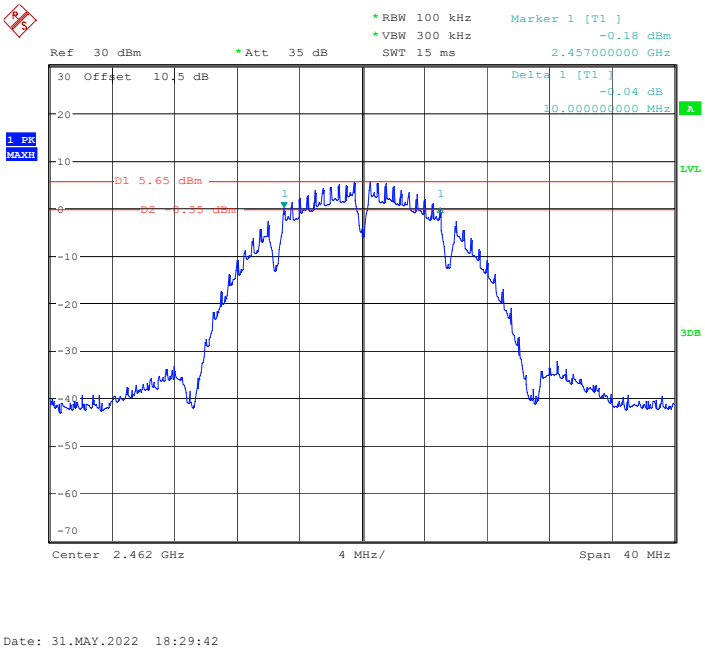
Date: 31.MAY.2022 18:31:12

Middle Channel



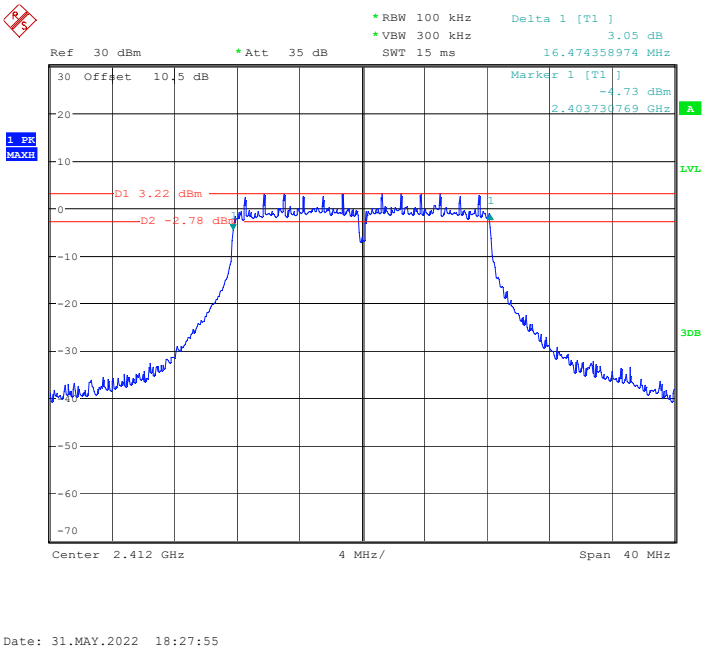
Date: 31.MAY.2022 18:32:11

High Channel

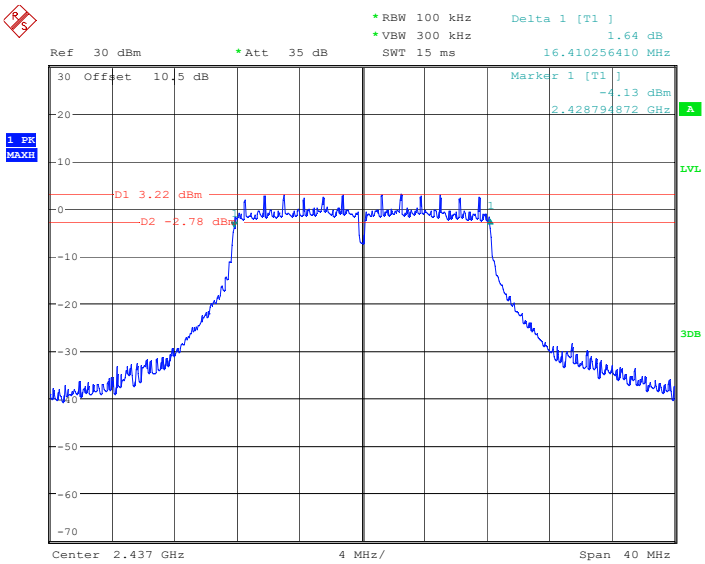


802.11g Mode:

Low Channel

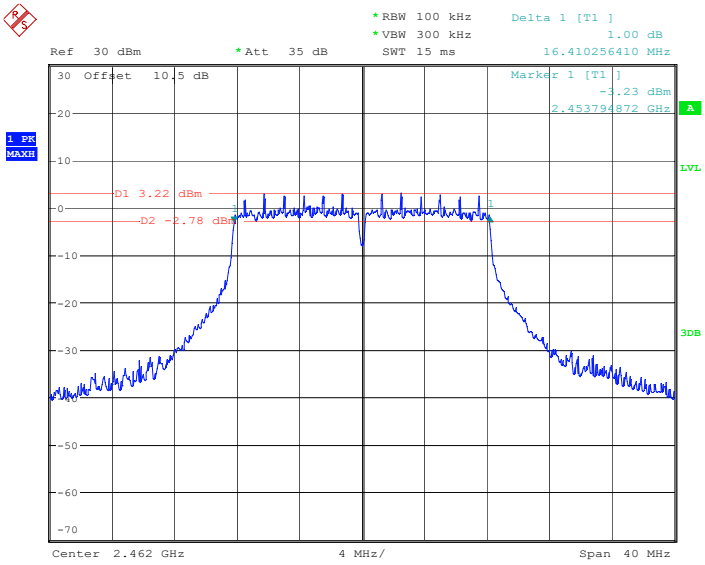


Middle Channel



Date: 31.MAY.2022 18:26:22

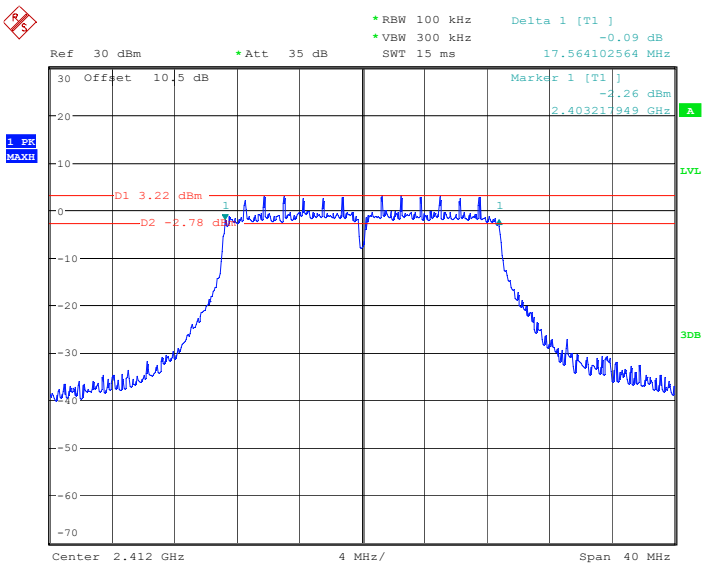
High Channel



Date: 31.MAY.2022 18:28:39

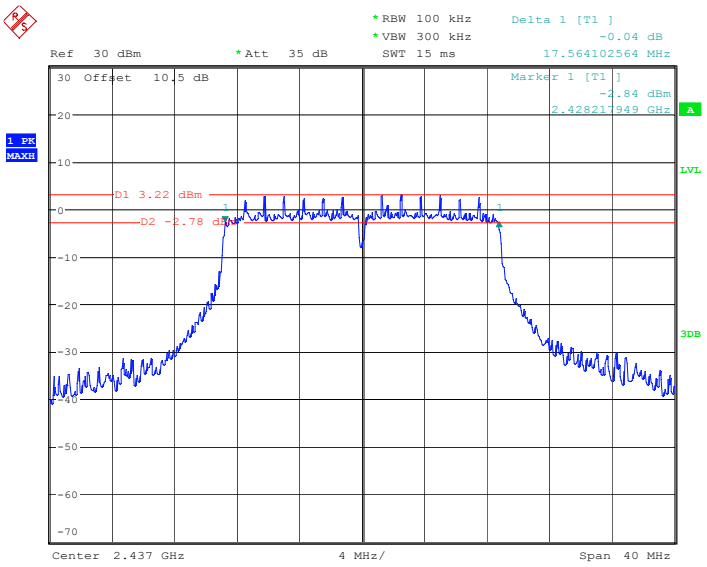
802.11n-20 Mode:

Low Channel



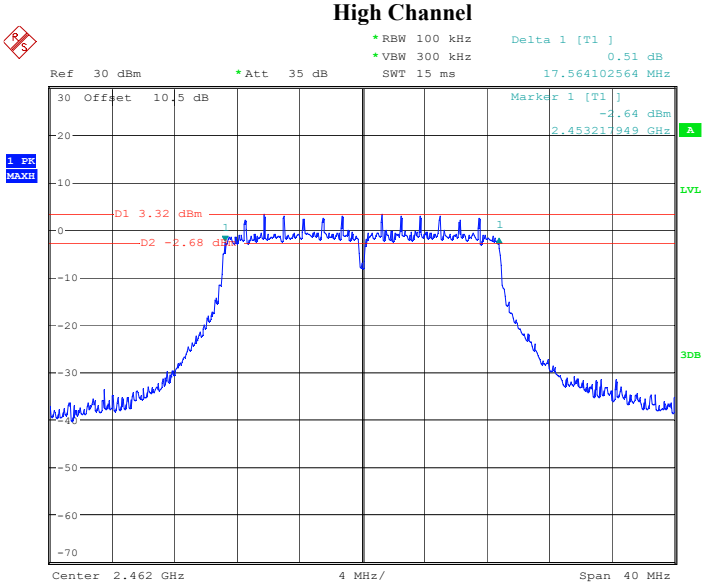
Date: 31.MAY.2022 18:24:27

Middle Channel



Date: 31.MAY.2022 18:25:18

High Channel

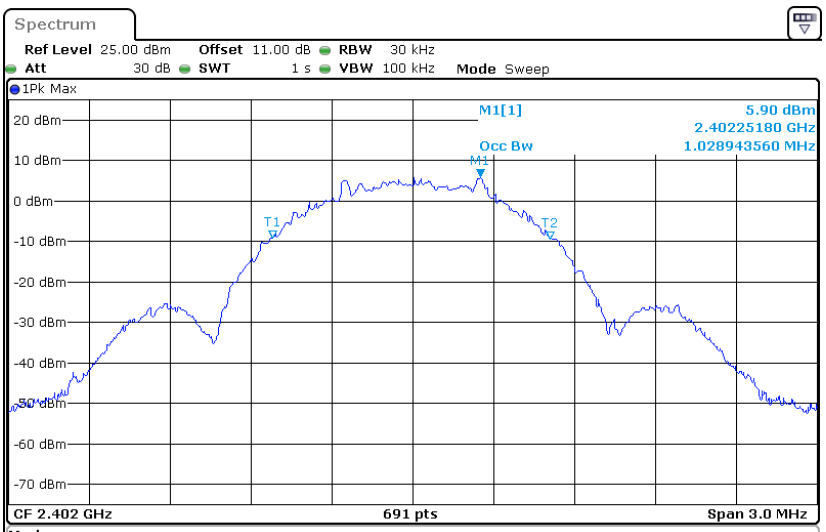


Date: 31.MAY.2022 18:23:26

99% Emission Bandwidth:

BLE 1M:

Low Channel

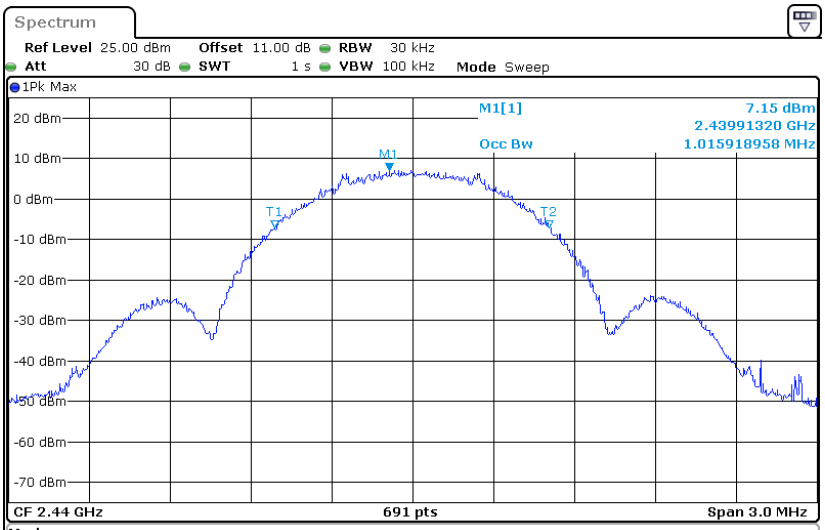


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4022518 GHz	5.90 dBm		
T1		1	2.40147902 GHz	-9.25 dBm	Occ Bw	1.02894356 MHz
T2		1	2.40250796 GHz	-9.53 dBm		

Date: 27.JUN.2022 18:41:49

Middle Channel

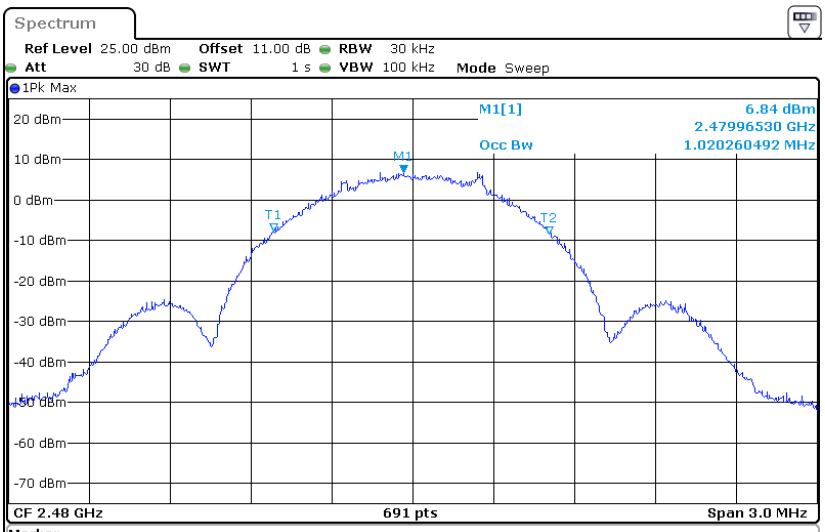


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4399132 GHz	7.15 dBm		
T1		1	2.4394877 GHz	-7.19 dBm	Occ Bw	1.015918958 MHz
T2		1	2.44050362 GHz	-7.13 dBm		

Date: 27.JUN.2022 18:40:59

High Channel



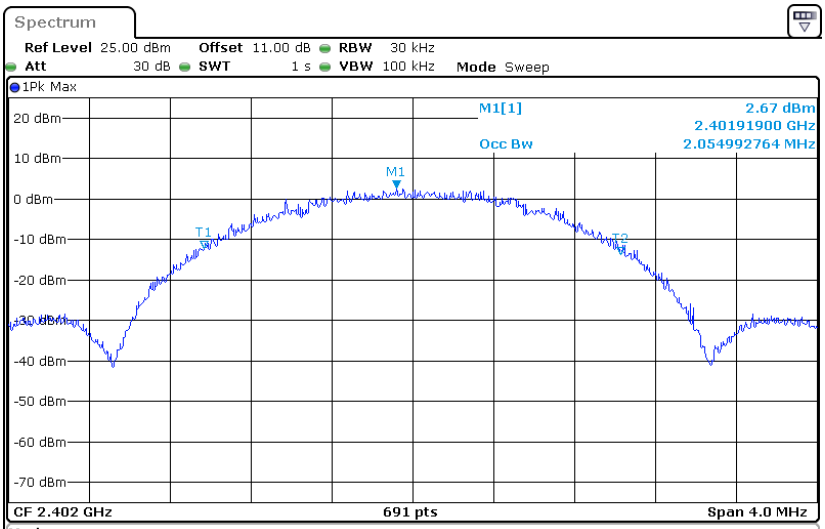
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4799653 GHz	6.84 dBm		
T1		1	2.47948336 GHz	-7.72 dBm	Occ Bw	1.020260492 MHz
T2		1	2.48050362 GHz	-8.46 dBm		

Date: 27.JUN.2022 18:43:05

BLE 2M:

Low Channel

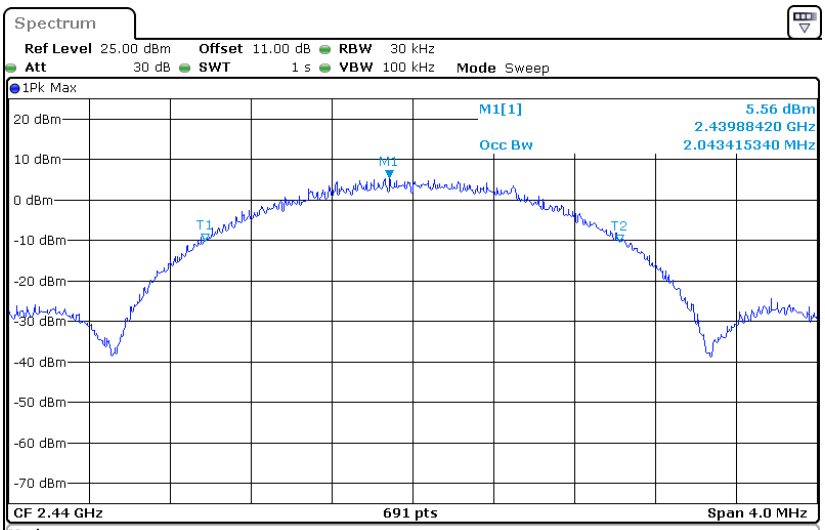


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.401919 GHz	2.67 dBm		
T1		1	2.40096961 GHz	-12.14 dBm	Occ Bw	2.054992764 MHz
T2		1	2.4030246 GHz	-13.86 dBm		

Date: 27.JUN.2022 18:46:00

Middle Channel

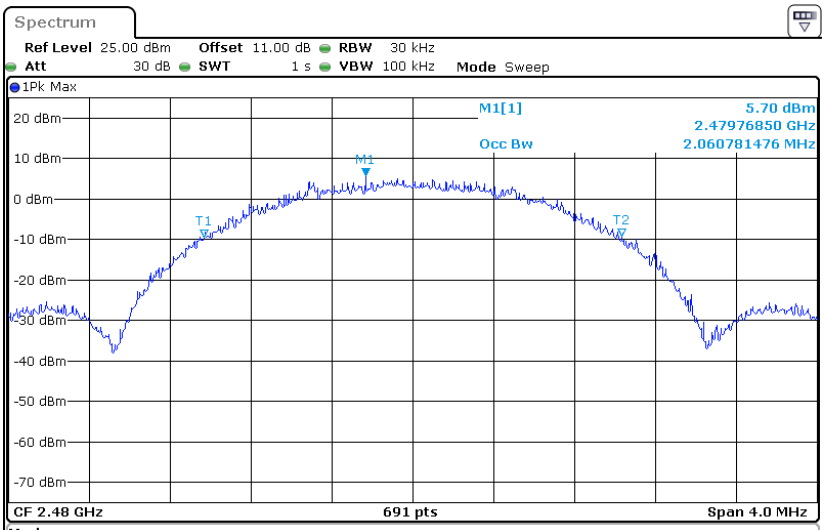


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4398842 GHz	5.56 dBm		
T1		1	2.4389754 GHz	-10.14 dBm	Occ Bw	2.04341534 MHz
T2		1	2.44101881 GHz	-10.53 dBm		

Date: 27.JUN.2022 18:45:17

High Channel



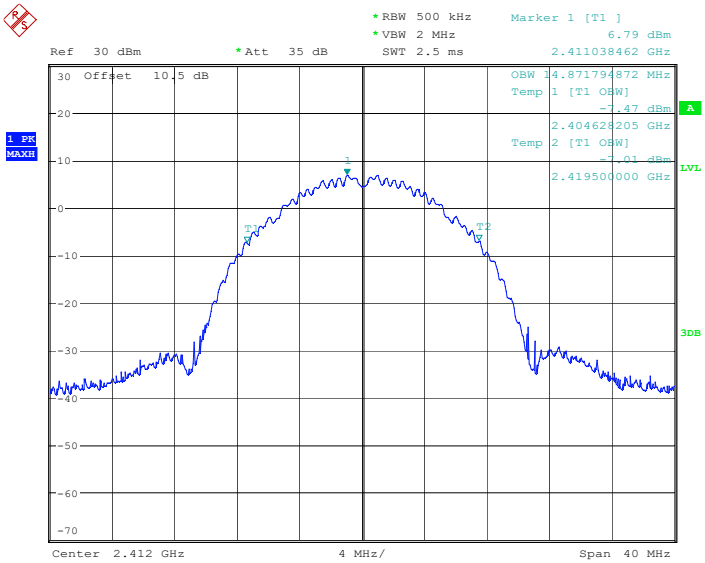
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4797685 GHz	5.70 dBm		
T1		1	2.47896961 GHz	-9.37 dBm	Occ Bw	2.060781476 MHz
T2		1	2.48103039 GHz	-9.30 dBm		

Date: 27.JUN.2022 18:44:18

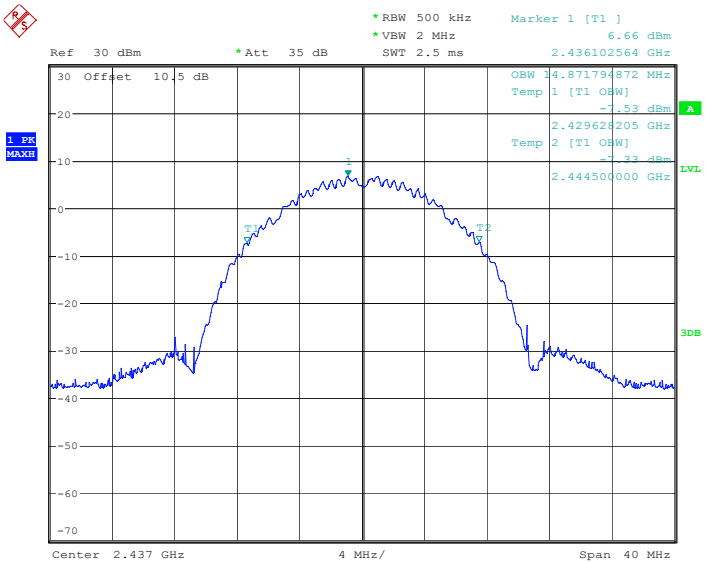
802.11b Mode:

Low Channel



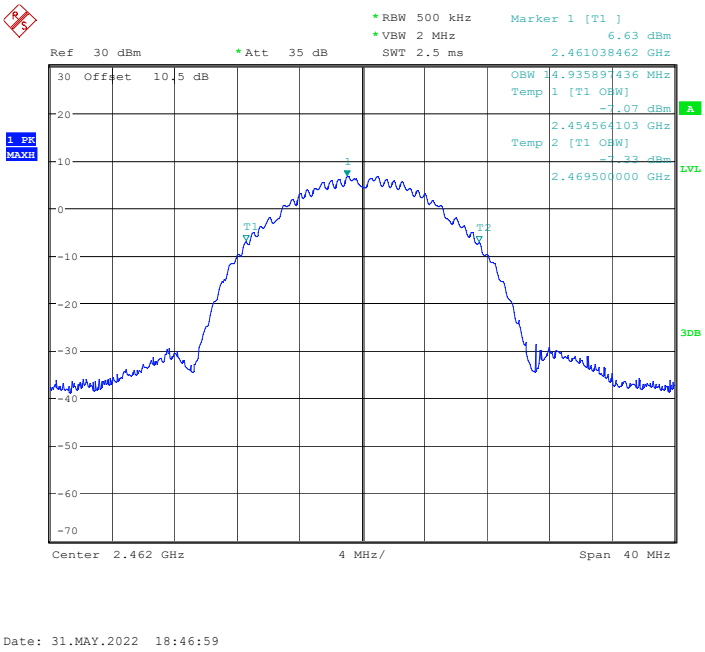
Date: 31.MAY.2022 18:46:30

Middle Channel



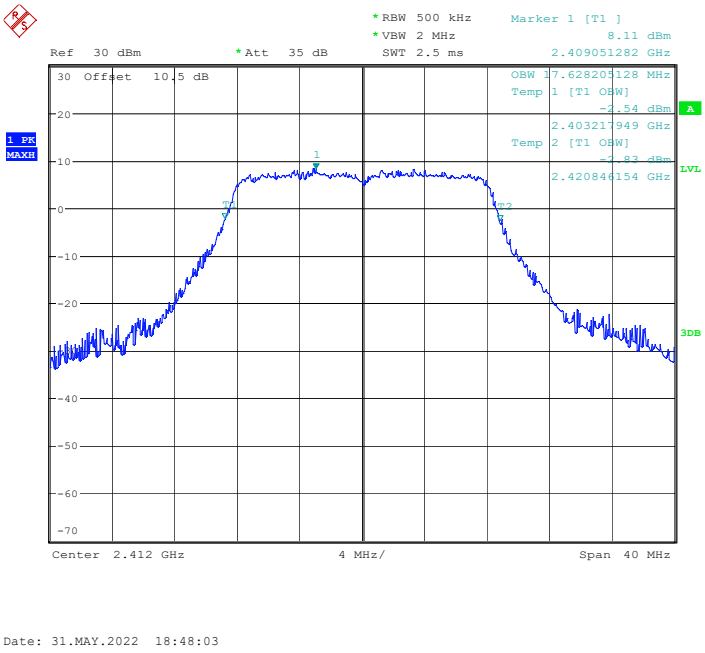
Date: 31.MAY.2022 18:46:10

High Channel

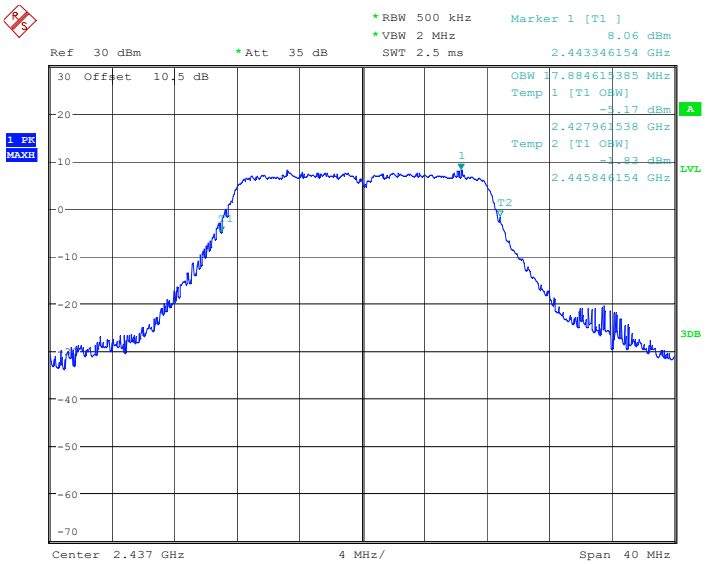


802.11g Mode:

Low Channel

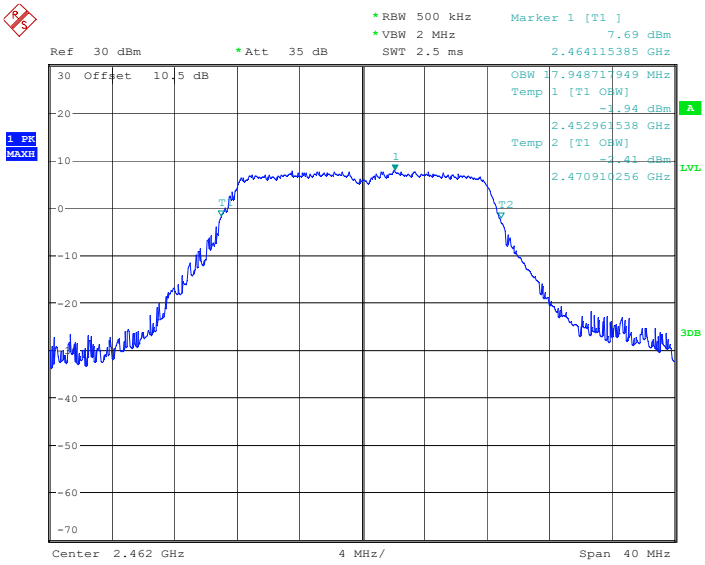


Middle Channel



Date: 31.MAY.2022 18:48:36

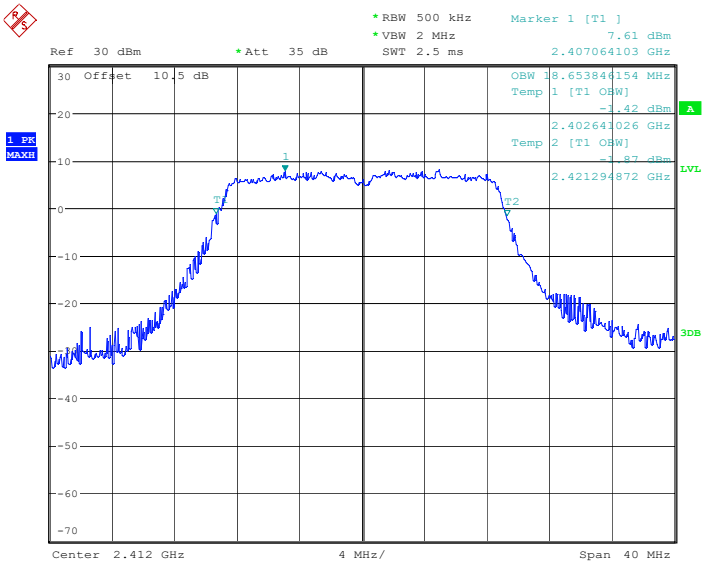
High Channel



Date: 31.MAY.2022 18:47:28

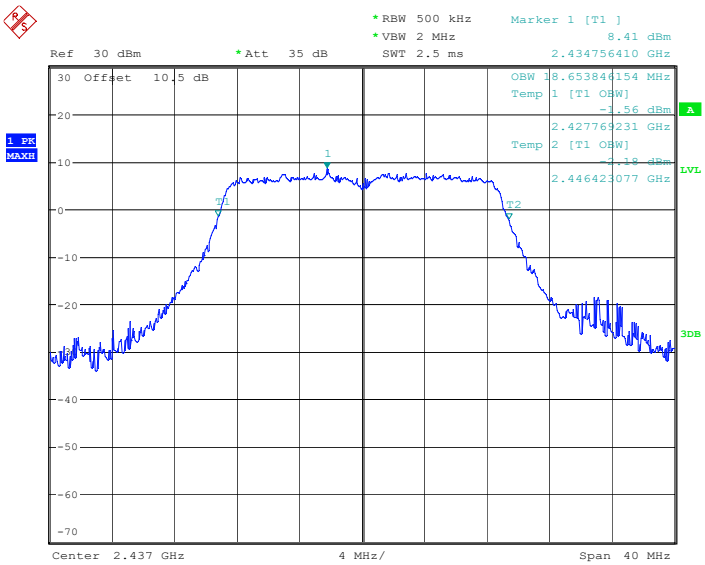
802.11n-20 Mode:

Low Channel



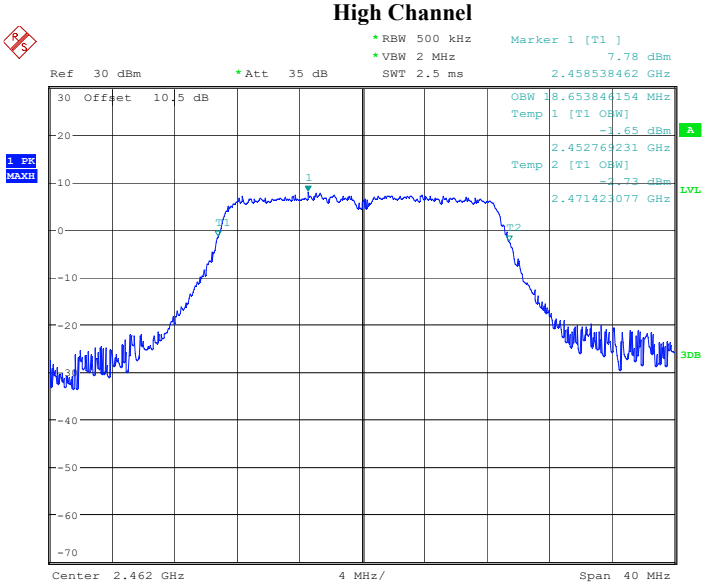
Date: 31.MAY.2022 18:49:35

Middle Channel



Date: 31.MAY.2022 18:49:00

High Channel



Date: 31.MAY.2022 18:49:57

§15.247(b)(3) & RSS-247 § 5.4(d) MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

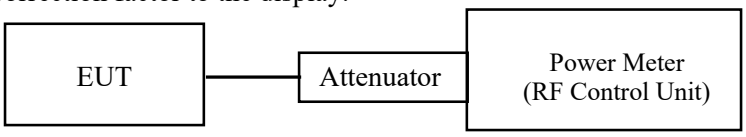
According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted 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.

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling 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 transmitting at a reduced power level. If multiple modes of operation are implemented, 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.



Note: The RF control unit has a built-in power sensor.

Test Data

Environmental Conditions

Temperature:	26.1~27 ℃
Relative Humidity:	53.6~55 %
ATM Pressure:	101.0 kPa

The testing was performed by Cat Fang from 2022-05-31 to 2022-06-22.

EUT operation mode: Transmitting

Test Result Compliant.

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)
BLE 1M						
Low	2402	10.19	30	2.0	12.19	36
Middle	2440	10.41	30	2.0	12.41	36
High	2480	10.40	30	2.0	12.40	36
BLE 2M						
Low	2402	10.09	30	2.0	12.09	36
Middle	2440	10.21	30	2.0	12.21	36
High	2480	10.30	30	2.0	12.30	36
802.11b mode						
Low	2412	17.94	30	2.0	19.94	36
Middle	2437	17.35	30	2.0	19.35	36
High	2462	17.56	30	2.0	19.56	36
802.11g mode						
Low	2412	22.08	30	2.0	24.08	36
Middle	2437	22.33	30	2.0	24.33	36
High	2462	22.25	30	2.0	24.25	36
802.11n HT20 mode						
Low	2412	22.14	30	2.0	24.14	36
Middle	2437	22.48	30	2.0	24.48	36
High	2462	22.26	30	2.0	24.26	36

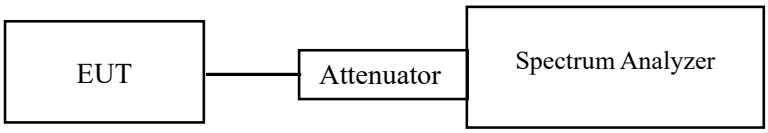
§ 15.247(d) & RSS-247 § 5.5 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

Applicable Standard

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

Test Procedure

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



Test Data

Environmental Conditions

Temperature:	26.1~27 ℃
Relative Humidity:	53.6~55 %
ATM Pressure:	101.0 kPa

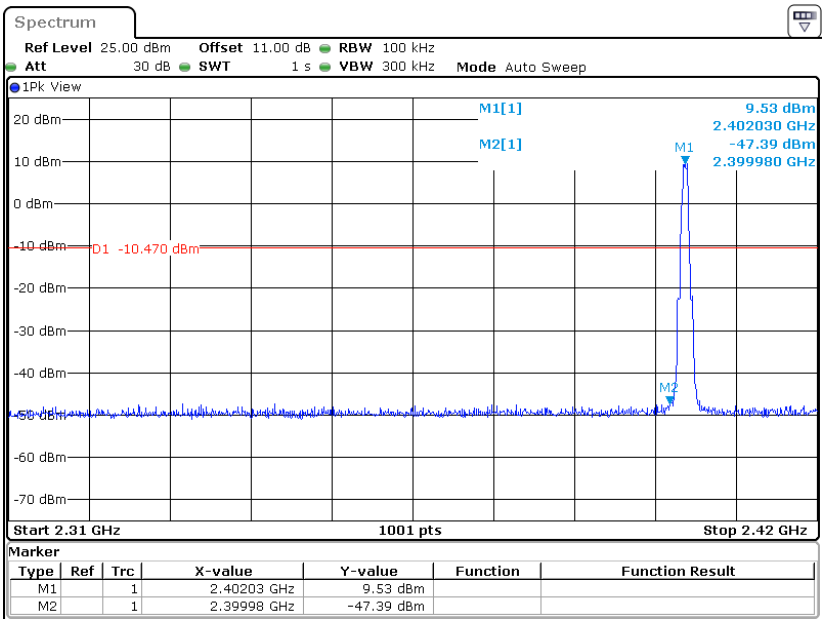
The testing was performed by Cat Fang from 2022-05-31 to 2022-06-22.

EUT operation mode: Transmitting

Test Result Compliant.

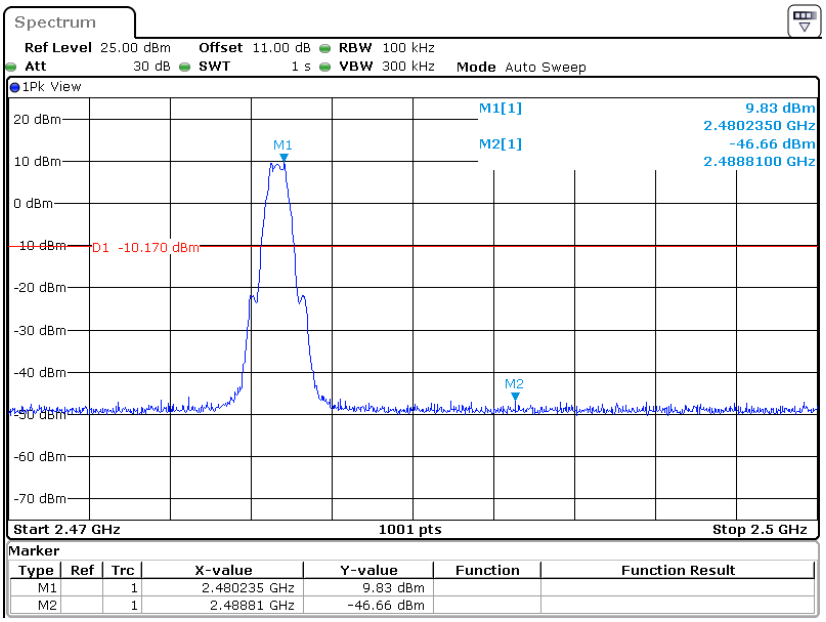
BLE 1M:

Band Edge, Left Side



Date: 22.JUN.2022 10:49:01

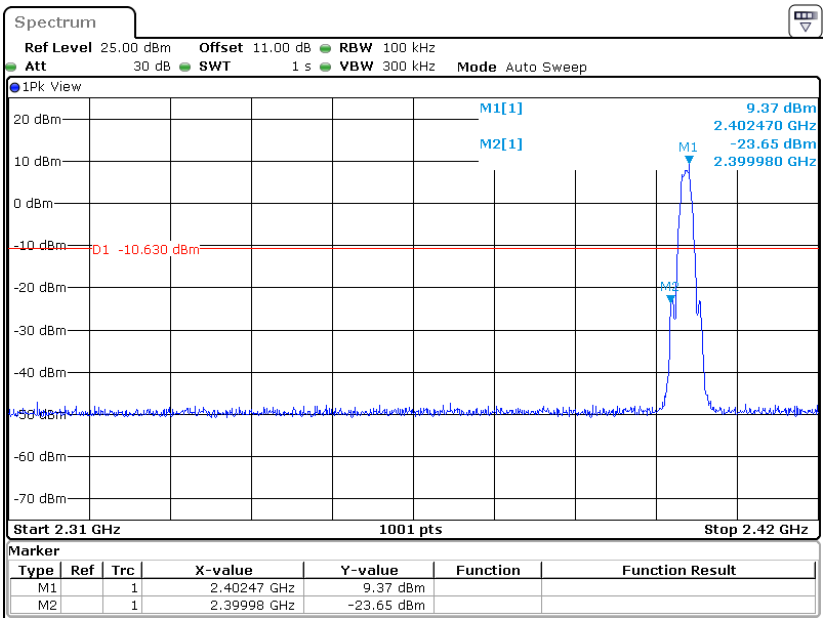
Band Edge, Right Side



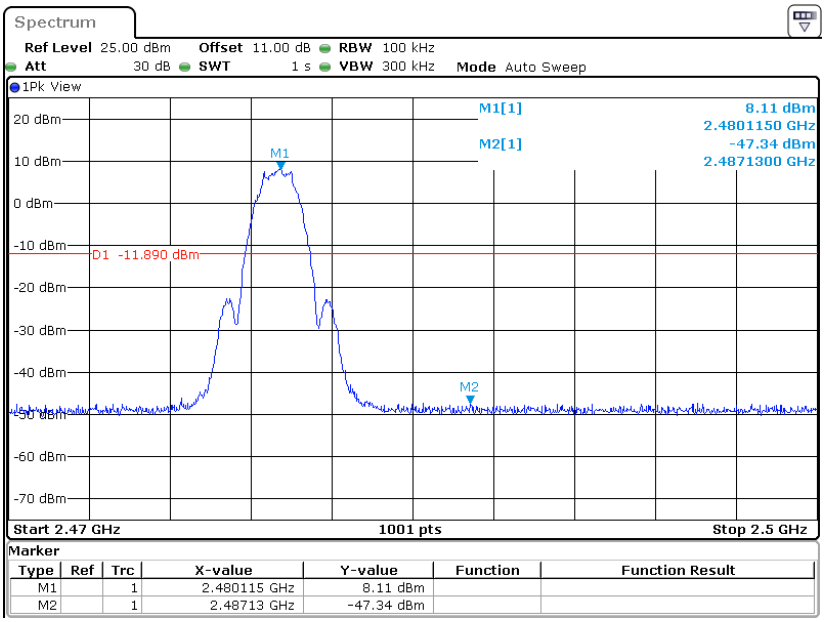
Date: 22.JUN.2022 11:07:20

BLE 2M:

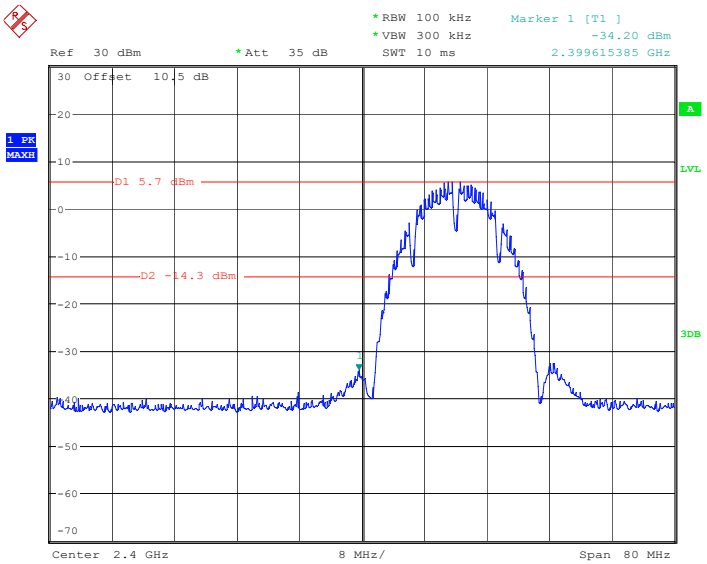
Band Edge, Left Side



Band Edge, Right Side

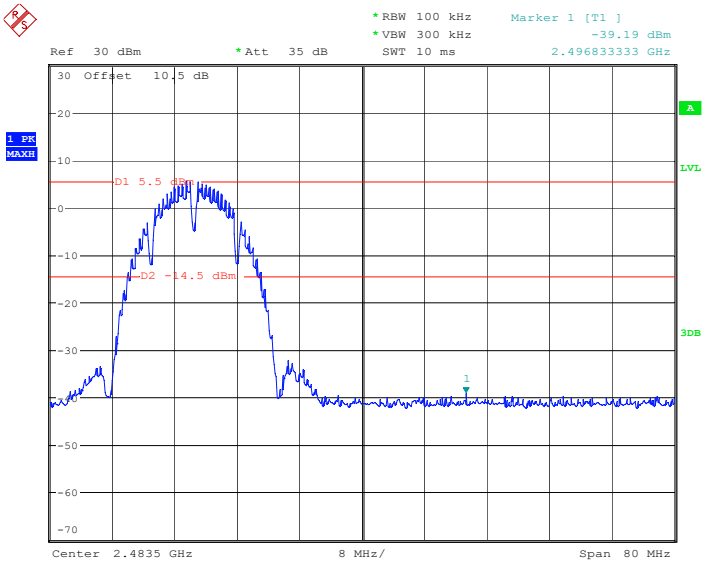


802.11b mode Left Side



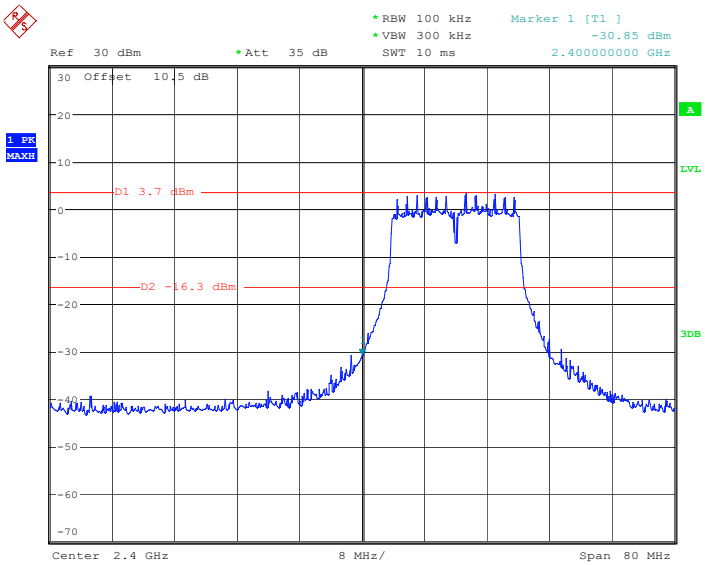
Date: 31.MAY.2022 18:35:55

802.11b mode Right Side



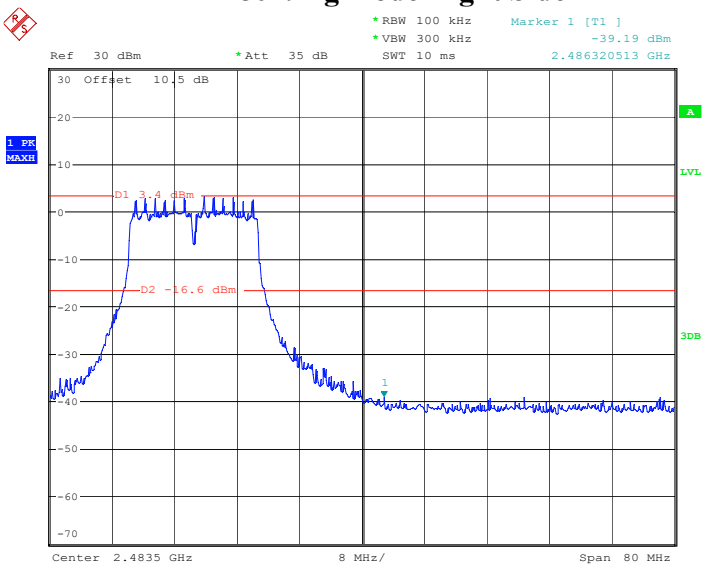
Date: 31.MAY.2022 18:35:01

802.11g mode Left Side



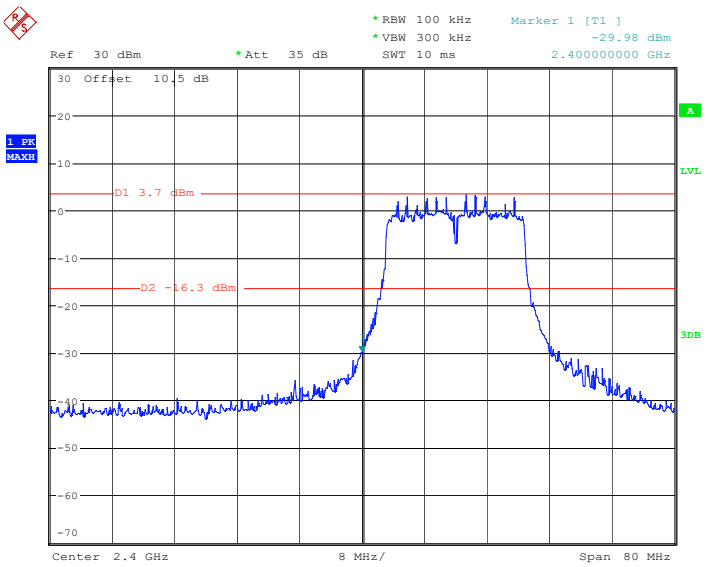
Date: 31.MAY.2022 18:36:27

802.11g mode Right Side



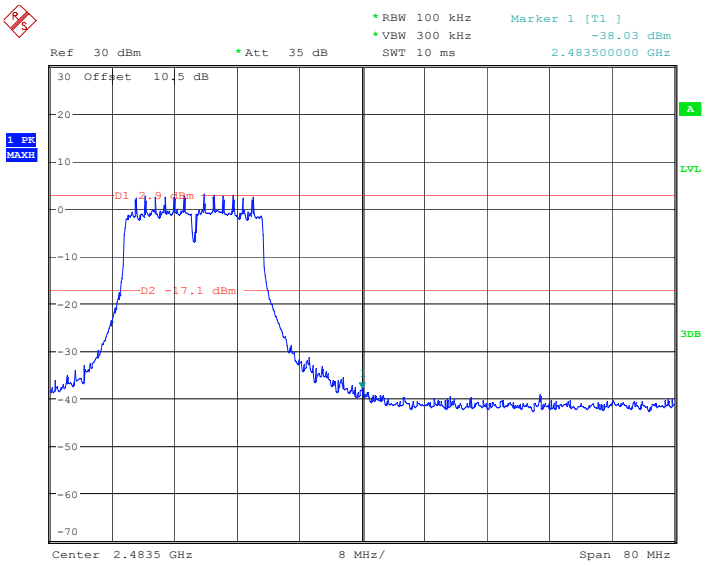
Date: 31.MAY.2022 18:37:18

802.11n-20 mode Left Side



Date: 31.MAY.2022 18:39:48

802.11n-20 mode Right Side



Date: 31.MAY.2022 18:38:58

§15.247(e) & RSS-247 § 5.2 (b) POWER SPECTRAL DENSITY

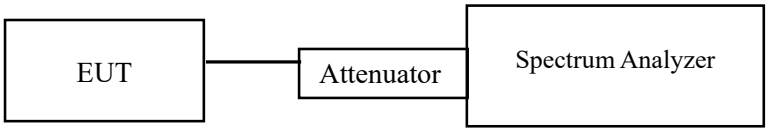
Applicable Standard

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.

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than8 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 section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

Test Procedure

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



Test Data

Environmental Conditions

Temperature:	26.1~27 ℃
Relative Humidity:	53.6~55 %
ATM Pressure:	101.0 kPa

The testing was performed by Cat Fang from 2022-05-31 to 2022-06-22.

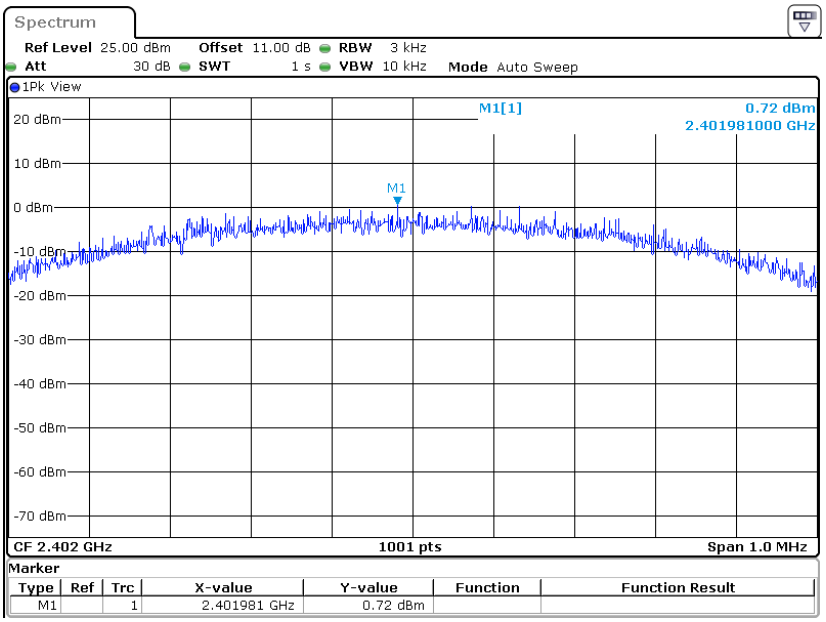
EUT operation mode: Transmitting

Test Result: Compliant.

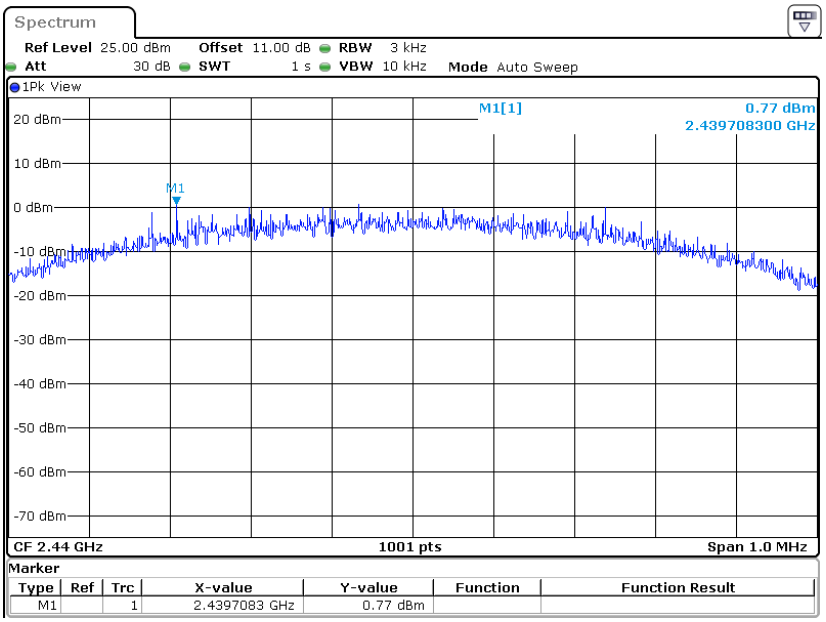
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-15.08	≤8
Middle	2437	-16.15	≤8
High	2462	-16.21	≤8
802.11g mode			
Low	2412	-19.09	≤8
Middle	2437	-18.66	≤8
High	2462	-18.33	≤8
802.11n-HT20 mode			
Low	2412	-19.23	≤8
Middle	2437	-18.89	≤8
High	2462	-19.32	≤8
BLE 1M			
Low	2402	0.72	≤8
Middle	2440	0.77	≤8
High	2480	0.53	≤8
BLE 2M			
Low	2402	-3.53	≤8
Middle	2440	-2.94	≤8
High	2480	-1.52	≤8

BLE 1M:

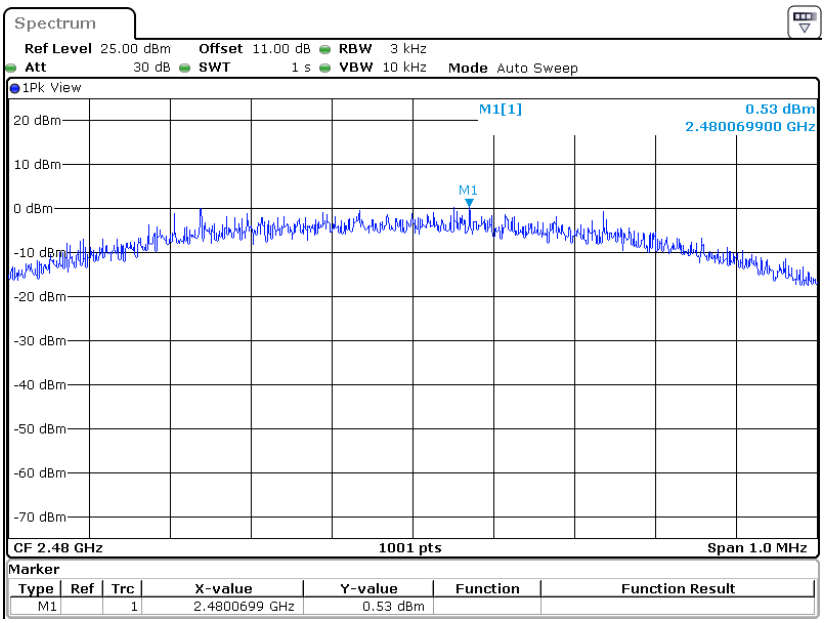
Power Spectral Density, Low Channel



Power Spectral Density, Middle Channel

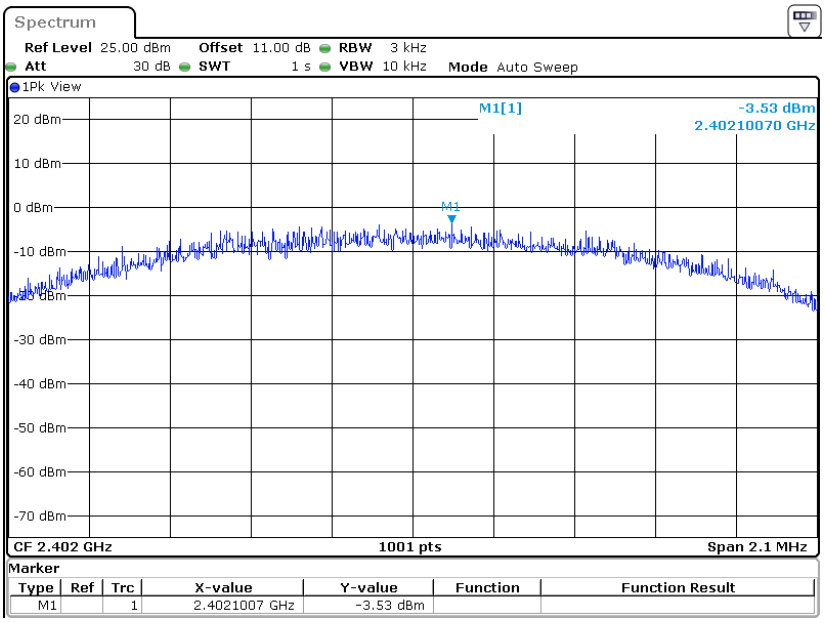


Power Spectral Density, High Channel

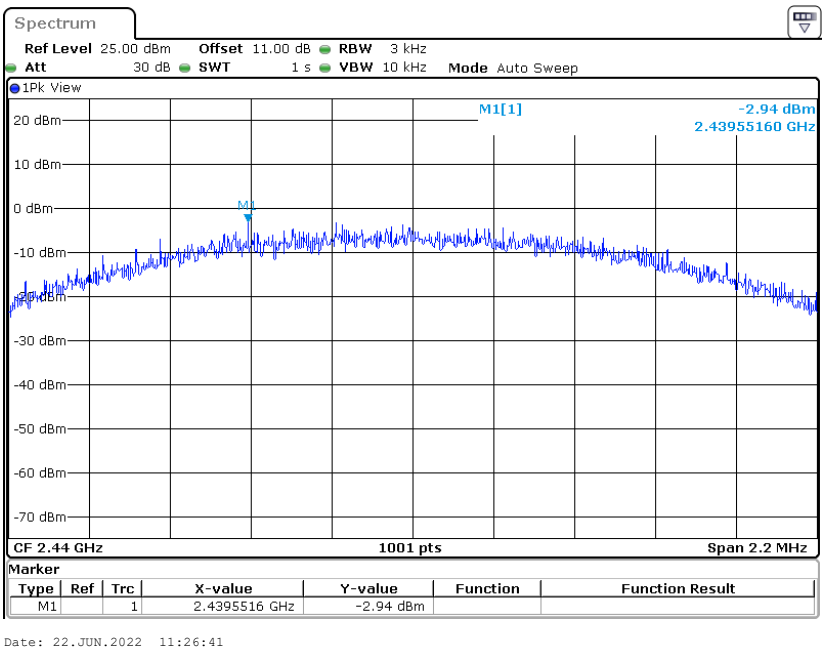


BLE 2M:

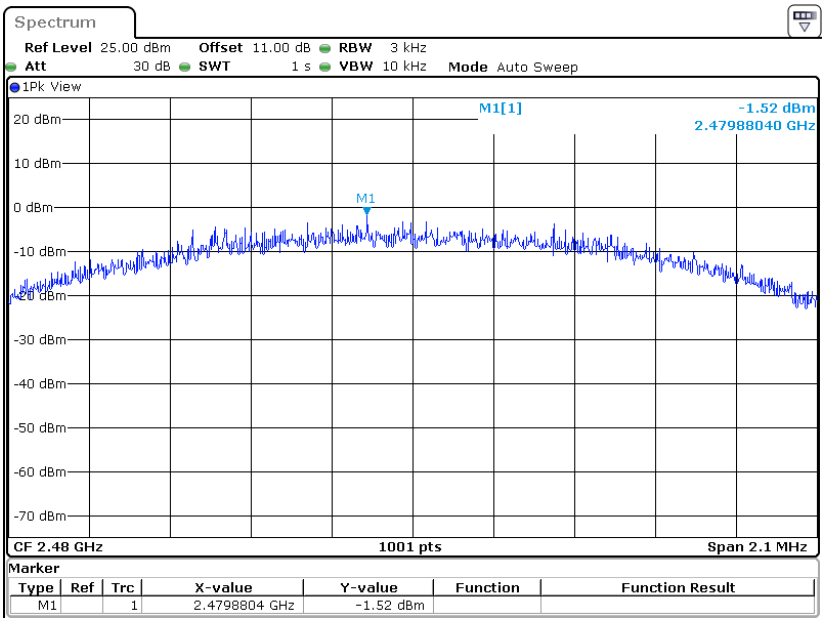
Power Spectral Density, Low Channel



Power Spectral Density, Middle Channel

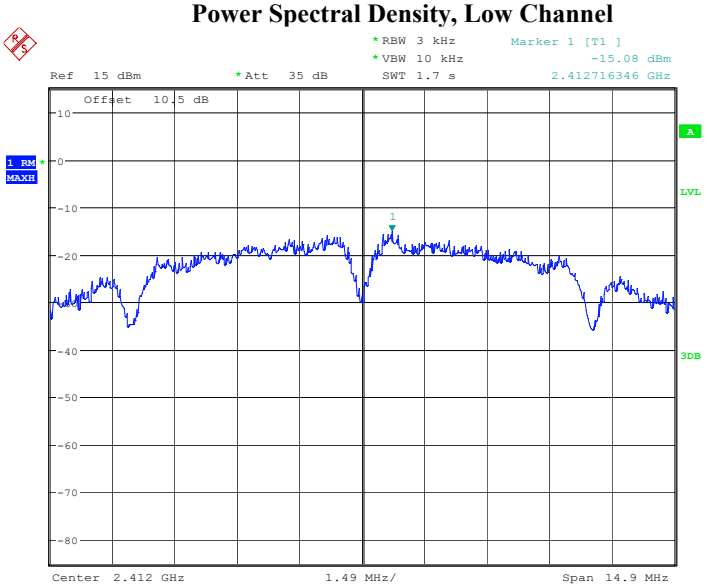


Power Spectral Density, High Channel



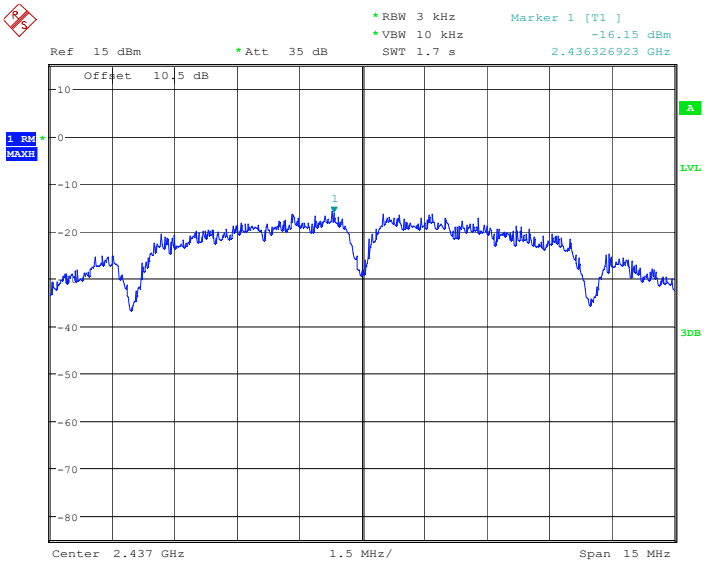
802.11 b mode:

Power Spectral Density, Low Channel



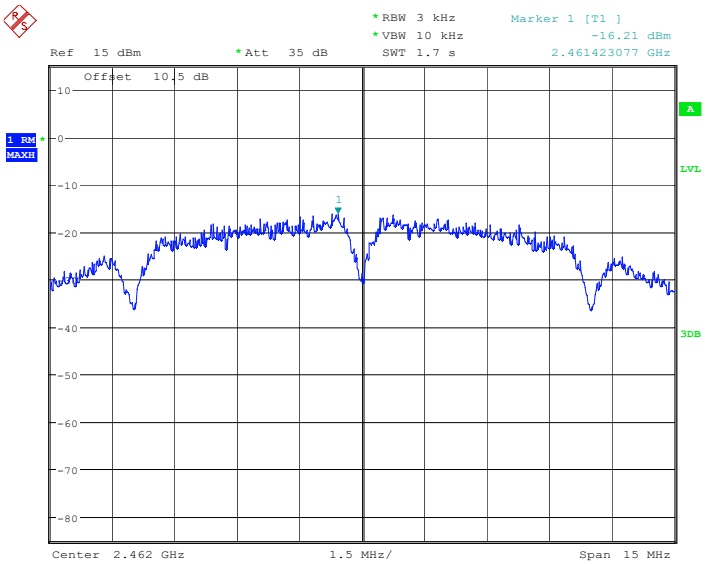
Date: 31.MAY.2022 18:58:54

Power Spectral Density, Middle Channel



Date: 31.MAY.2022 18:58:17

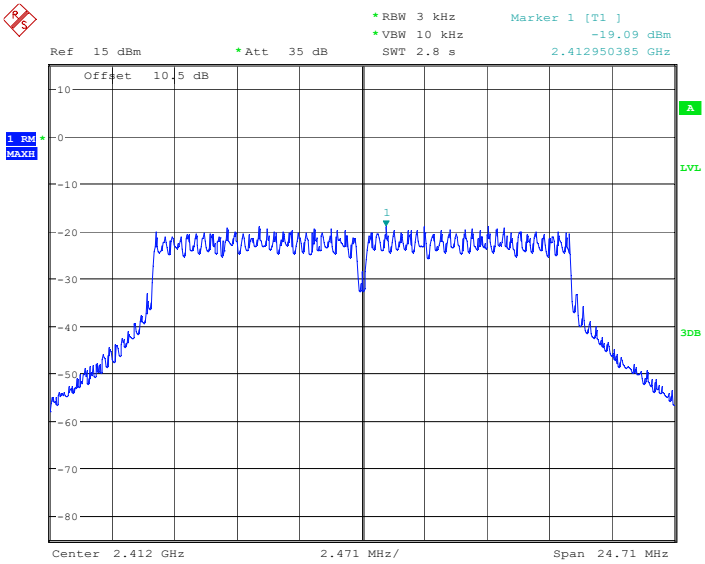
Power Spectral Density, High Channel



Date: 31.MAY.2022 18:59:30

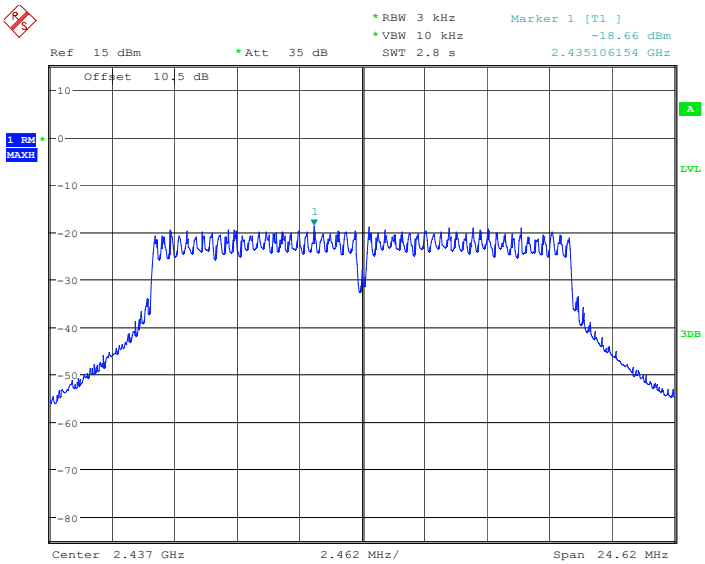
802.11 g mode:

Power Spectral Density, Low Channel



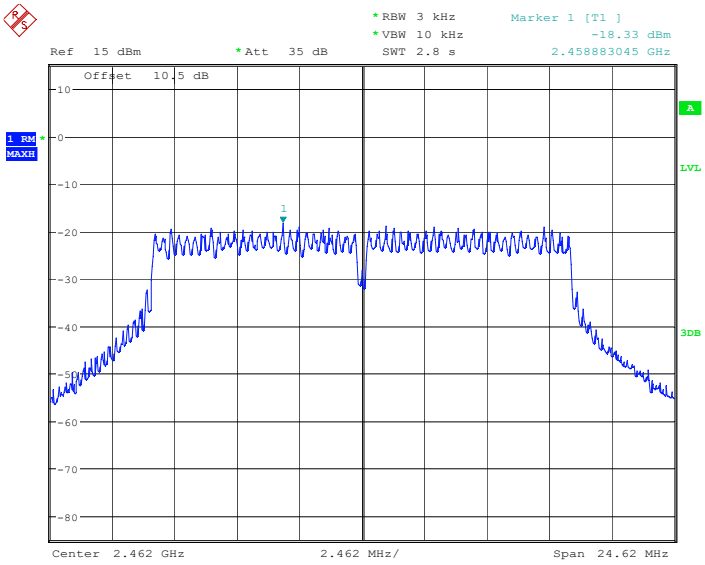
Date: 31.MAY.2022 19:01:41

Power Spectral Density, Middle Channel



Date: 31.MAY.2022 19:00:58

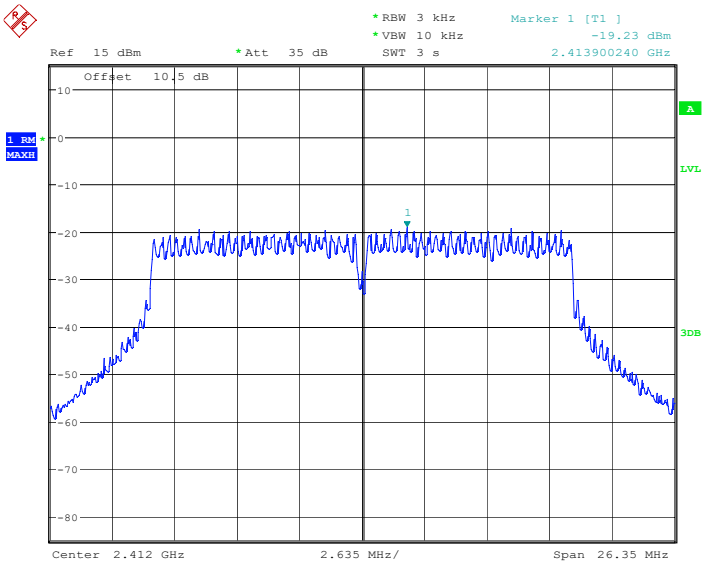
Power Spectral Density, High Channel



Date: 31.MAY.2022 19:00:26

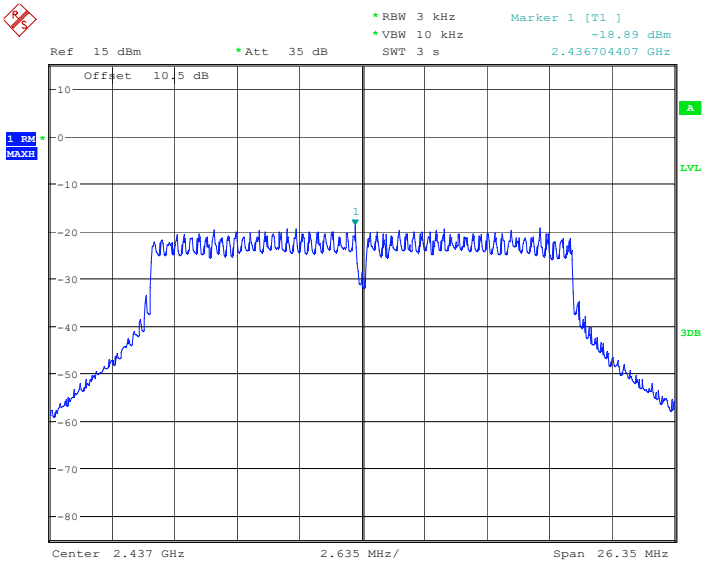
802.11n-20 mode:

Power Spectral Density, Low Channel



Date: 31.MAY.2022 19:02:17

Power Spectral Density, Middle Channel



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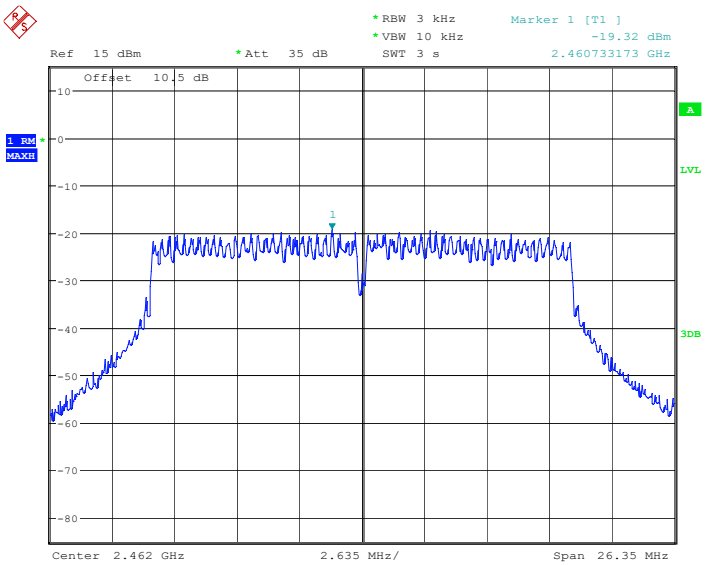
Power Spectral Density, High Channel



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