

TEST REPORT

Applicant Name : Vuzix Corporation
Address : FCC: 25 Hendrix Rd, West Henrietta, New York, United States
14586
ISED: 25 Hendrix Road West Henrietta NY 14586 United
States Of America (Excluding The States Of Alaska
Report Number : SZNS220630-29398E-RFB
FCC ID: 2AA9D-492
IC: 11503A-492

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: Shield
Model No.: 492
Multiple Model(s) No.: N/A
Trade Mark: Vuzix
Date Received: 2022/06/30
Report Date: 2022/08/22

Test Result:	Pass*
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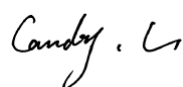
* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Approved By:



Nick Fang
EMC Engineer



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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TABLE OF CONTENTS

GENERAL INFORMATION	4
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	4
OBJECTIVE	4
TEST METHODOLOGY	4
MEASUREMENT UNCERTAINTY	5
SYSTEM TEST CONFIGURATION	6
DESCRIPTION OF TEST CONFIGURATION	6
EQUIPMENT MODIFICATIONS	7
EUT EXERCISE SOFTWARE	7
DUTY CYCLE	7
SUPPORT EQUIPMENT LIST AND DETAILS	11
EXTERNAL I/O CABLE	11
BLOCK DIAGRAM OF TEST SETUP	11
SUMMARY OF TEST RESULTS	13
TEST EQUIPMENT LIST	14
FCC §1.1307 & §2.1093 - RF EXPOSURE	16
APPLICABLE STANDARD	16
TEST RESULT	16
RSS-102 – RF EXPOSURE	17
APPLICABLE STANDARD	17
§15.203 & RSS-GEN §6.8 ANTENNA REQUIREMENT	18
APPLICABLE STANDARD	18
ANTENNA CONNECTOR CONSTRUCTION	19
§15.207 (A) & RSS-GEN §8.8 AC LINE CONDUCTED EMISSIONS	20
APPLICABLE STANDARD	20
EUT SETUP	21
EMI TEST RECEIVER SETUP	21
TEST PROCEDURE	21
CORRECTED FACTOR & MARGIN CALCULATION	22
TEST DATA	22
§15.205, §15.209, §15.247(D) & RSS-GEN § 8.10 & RSS-247 § 5.5 SPURIOUS EMISSIONS	27
APPLICABLE STANDARD	27
EUT SETUP	27
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP	28
TEST PROCEDURE	29
CORRECTED AMPLITUDE & MARGIN CALCULATION	29
TEST DATA	29
§15.247 (A)(2) & RSS-GEN§6.7 RSS-247 § 5.2 (A) 99% OCCUPIED BANDWIDTH & 6 DB EMISSION BANDWIDTH	40
APPLICABLE STANDARD	40
TEST PROCEDURE	40
TEST DATA	41

§15.247(B)(3) & RSS-247 § 5.4(D) MAXIMUM CONDUCTED OUTPUT POWER	61
APPLICABLE STANDARD	61
TEST PROCEDURE	61
TEST DATA	61
§15.247(D) & RSS-247 § 5.5 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE.....	63
APPLICABLE STANDARD	63
TEST PROCEDURE	63
TEST DATA	63
§15.247(E) & RSS-247 § 5.2 (B) POWER SPECTRAL DENSITY	70
APPLICABLE STANDARD	70
TEST PROCEDURE	70
TEST DATA	70

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

HVIN	492
FVIN	492
Frequency Range	BLE 1M/2M: 2402-2480MHz Wi-Fi: 2412-2462MHz
Maximum Conducted Peak Output Power	BLE 1M: 7.52dBm, BLE 2M: 7.58dBm Wi-Fi: 20.15dBm(802.11b), 23.59dBm(802.11g) 23.44dBm(802.11n-HT20), 23.89dBm(802.11n-HT40)
Modulation Technique	BLE: GFSK Wi-Fi: DSSS, OFDM
Antenna Specification*	1.5dBi (It is provided by the applicant)
Voltage Range	DC 3.8V from battery or DC 5.0V from USB Port
Sample serial number	SZNS220630-29398E-RF-S1 (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.

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°C
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 4297.01.

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

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For Wi-Fi mode, total 11 channels are provided to testing:

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, 6 and 11.

For 802.11n-HT40, EUT was tested with Channel 3, 6 and 9.

For BLE 1M/2M 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

“ QRCT3 ”* exercise software was used for BLE, “ QRCT4 ”*exercise software was used for Wi-Fi .

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

Mode	Date rate	Power Level		
		Low Channel	Middle Channel	High Channel
802.11b	1Mbps	16	16	16
802.11g	6Mbps	16	16	16
802.11n-HT20	MCS0	16	16	16
802.11n-HT40	MCS0	16	16	16
BLE 1M	1Mbps	9	9	9
BLE 2M	2Mbps	9	9	9

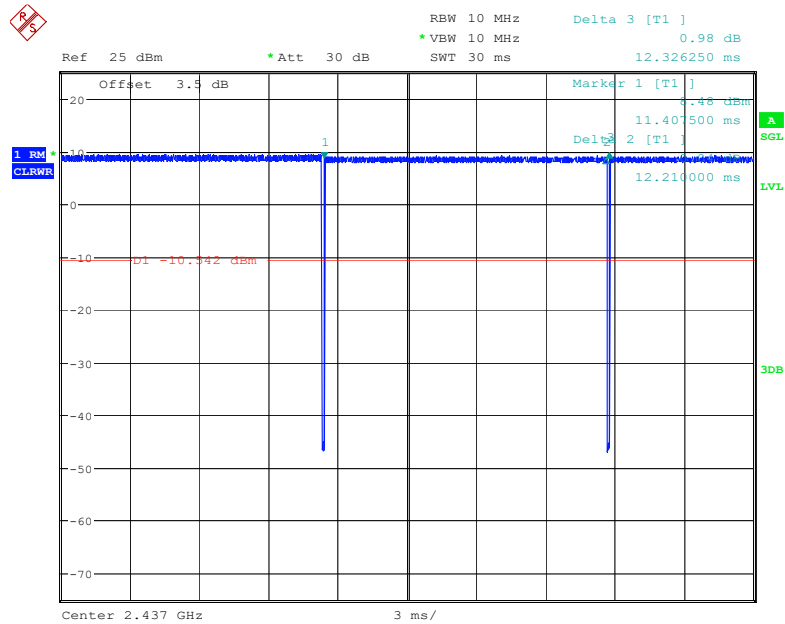
The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PSD across all data rates, bandwidths and modulations.

The software and power level was provided by the applicant.

Duty cycle

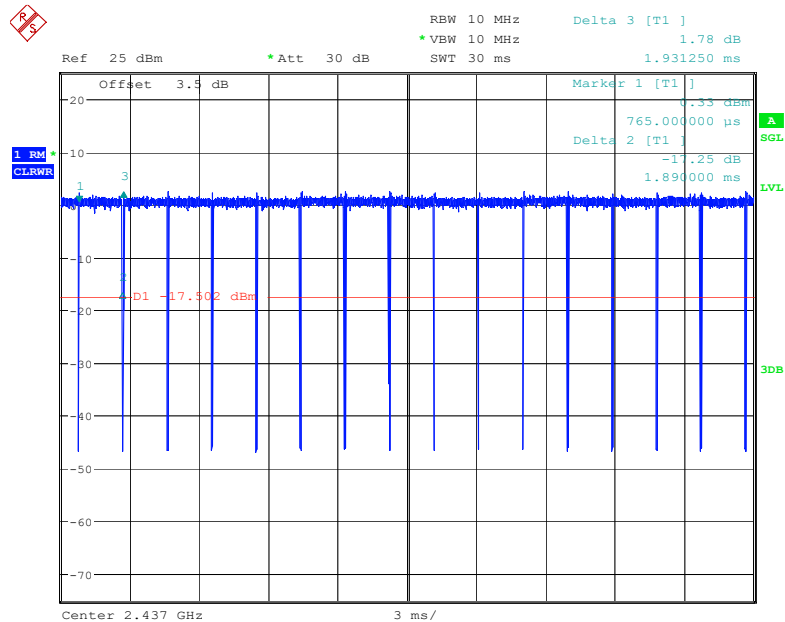
Mode	Ton(ms)	Ton+Toff (ms)	Duty Cycle (%)
802.11b	12.21	12.33	99.03
802.11g	1.89	1.93	97.93
802.11n-HT20	1.89	1.93	97.93
802.11n-HT40	0.93	0.98	94.90
BLE 1M	0.39	0.63	61.90
BLE 2M	0.21	0.63	33.33

802.11b mode



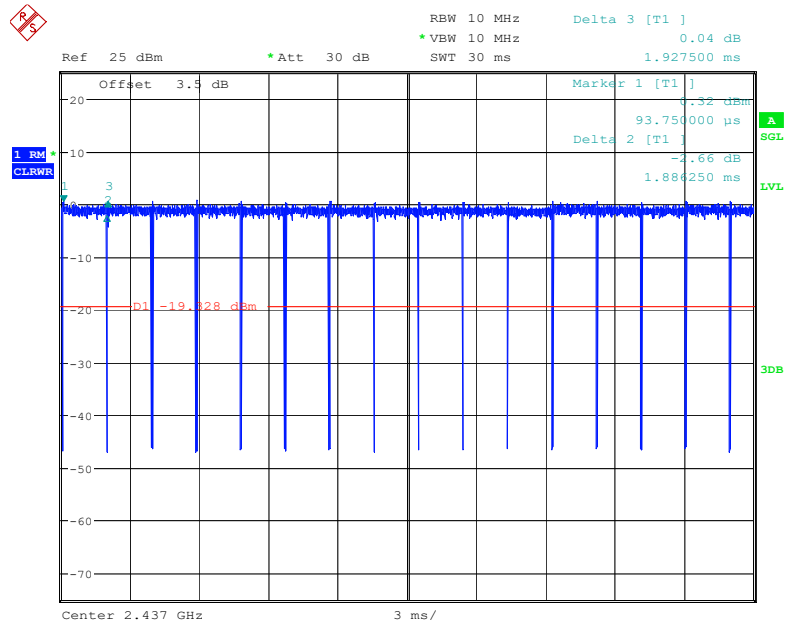
Date: 28.JUL.2022 19:11:41

802.11g mode



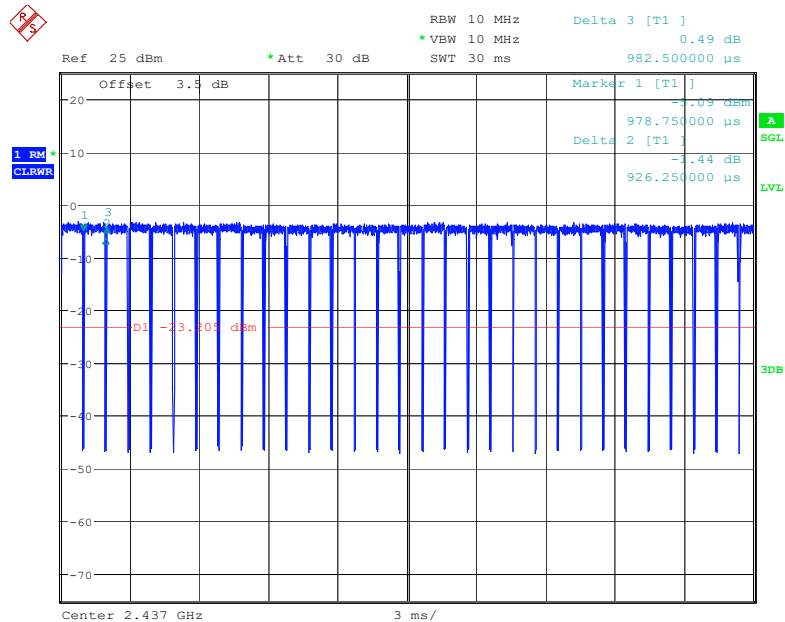
Date: 28.JUL.2022 20:25:07

802.11n20 mode



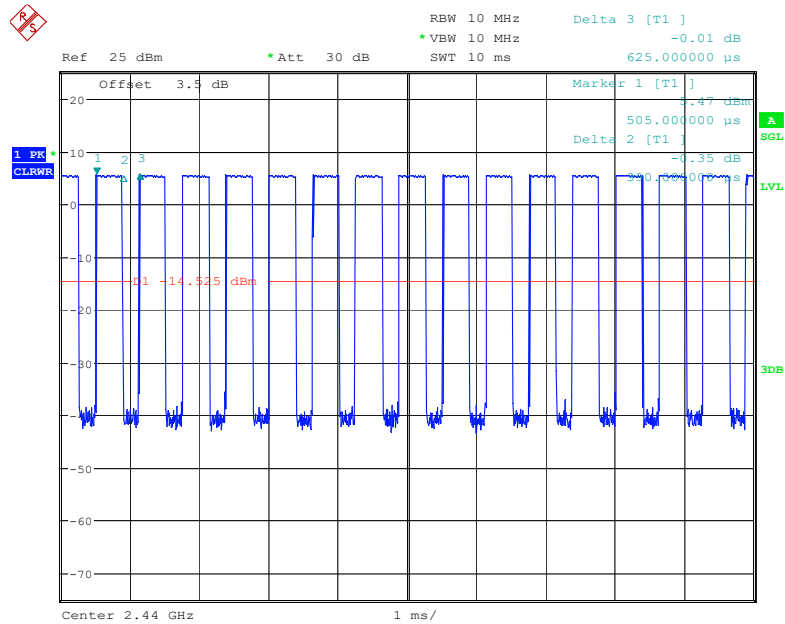
Date: 28.JUL.2022 20:13:53

802.11n40 mode



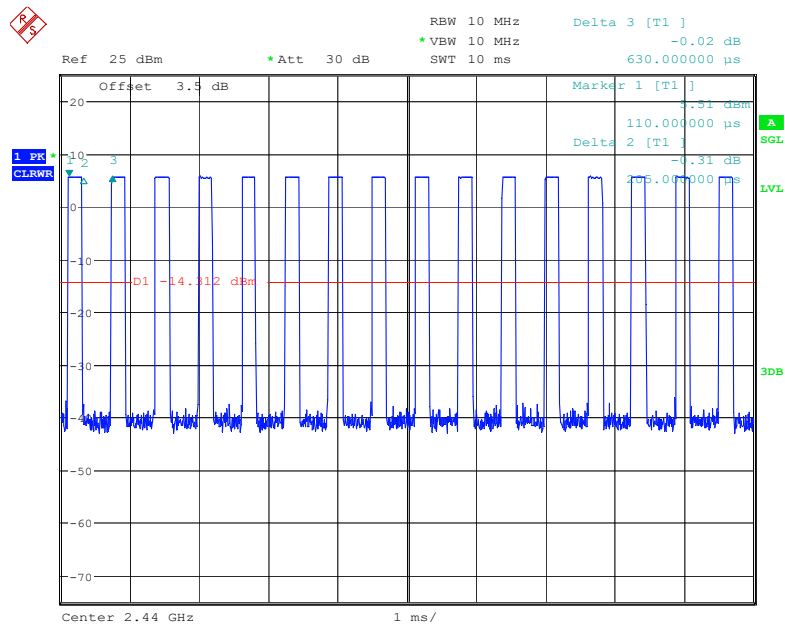
Date: 28.JUL.2022 20:37:42

BLE mode--1M



Date: 29.JUL.2022 20:07:13

BLE mode--2M



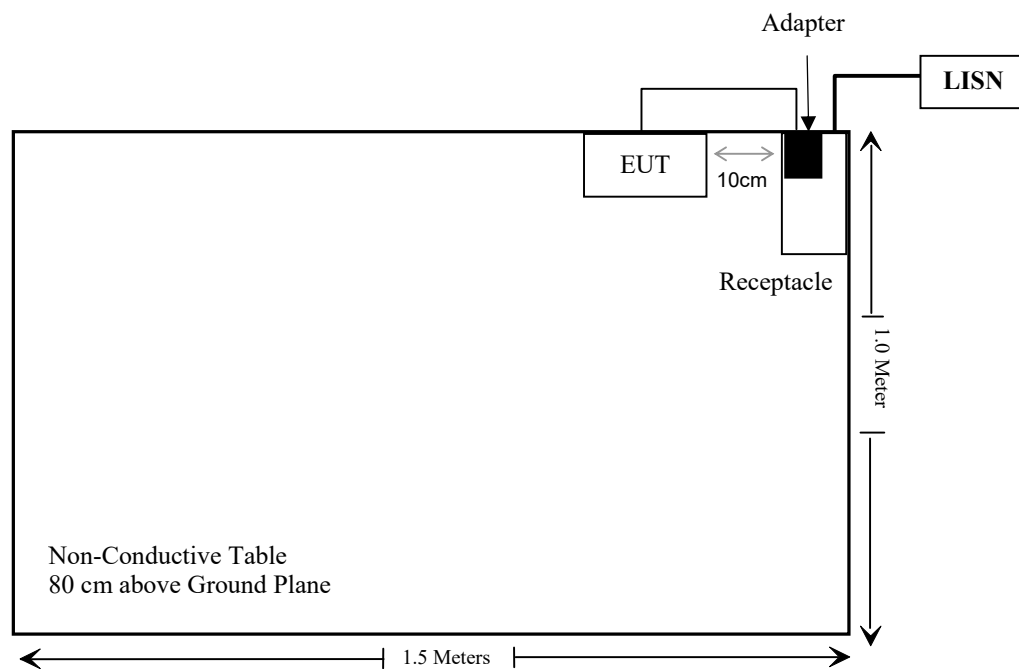
Date: 29.JUL.2022 20:17:37

Support Equipment List and Details

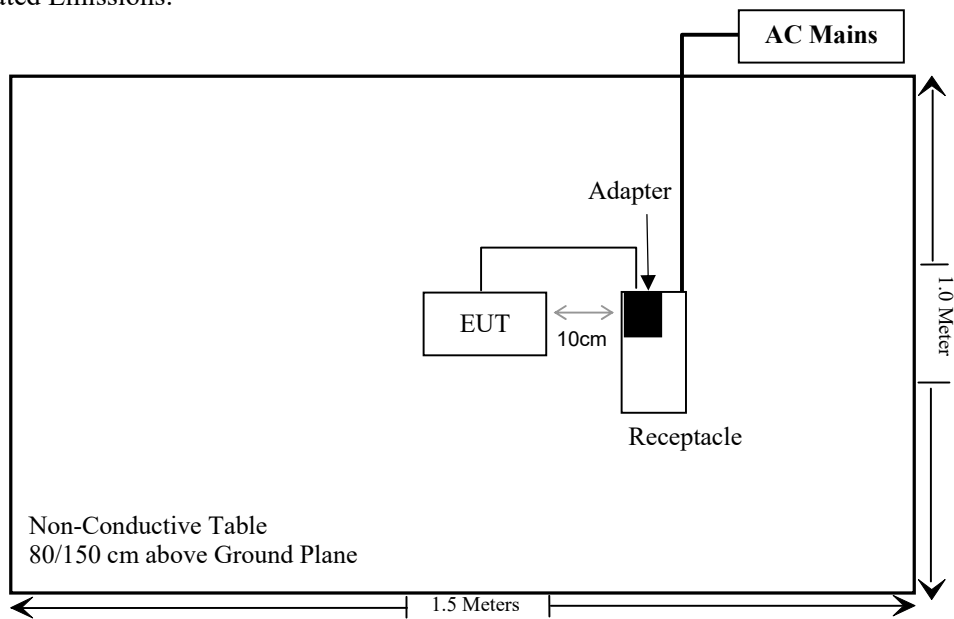
Manufacturer	Description	Model	Serial Number
Epik	Adapter	E250	Unknown

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shield Detachable USB Cable	1.0	Adapter	EUT

Block Diagram of Test Setup**For Conducted Emission**

For Radiated Emissions:



SUMMARY OF TEST RESULTS

FCC Rules	RSS Rules	Description of Test	Result
§15.247 (i), §2.1093	RSS-102	RF EXPOSURE	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
Unknown	RF Coaxial Cable	No.18	N0850	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					
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2021/12/13	2022/12/12
Rohde & Schwarz	Open Switch and Control Unit	OSP120 + OSP-B157	101244 + 100866	2021/12/13	2022/12/12
SPECTRUM ANALYZER	Rohde & Schwarz	FSU26	200982	2022/07/05	2023/07/04
WEINSCHTEL	3dB Attenuator	Unknown	F-03-EM121	2021/11/28	2022/11/27

* **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 §1.1307 & §2.1093 - RF EXPOSURE

Applicable Standard

FCC§1.1310 and §2.1093.

Test Result

Compliance, please refer to the SAR report: SZNS220630-29398E-SA

RSS-102 – RF EXPOSURE

Applicable Standard

According to RSS-102, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

Result: Compliance.

Compliance, please refer to the SAR report: SZNS220630-29398E-SA

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

Type	Antenna Gain	Impedance
Integral	1.5dBi	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 μ H / 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.

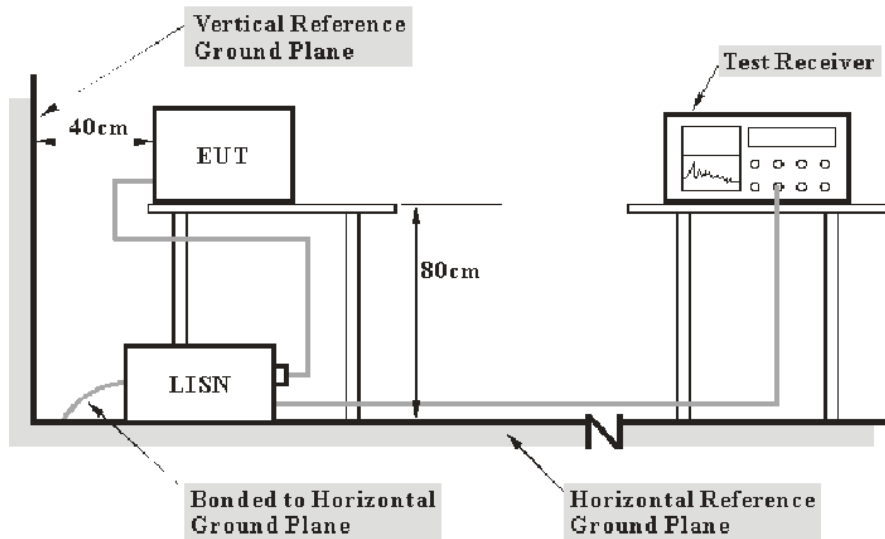
Table 4 - AC Power Lines Conducted Emission Limits		
Frequency range (MHz)	Conducted limit (dB μ V)	
	Quasi-Peak	Average
0.15 – 0.5	66 to 56 ¹	56 to 46 ¹
0.5 – 5	56	46
5 – 30	60	50

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:

- 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.
- 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



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

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

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

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

Test Data

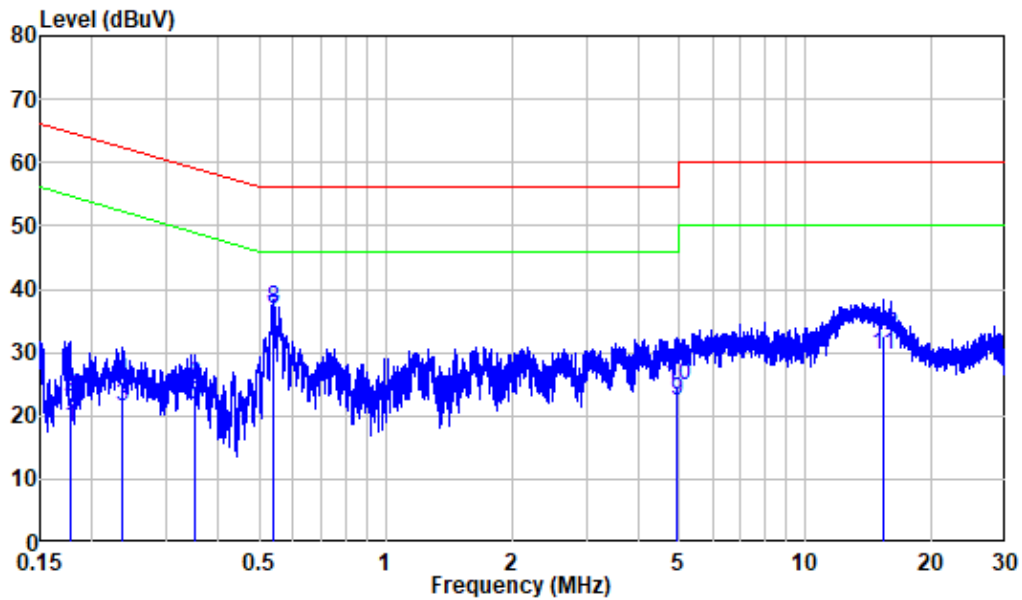
Environmental Conditions

Temperature:	24 °C
Relative Humidity:	49 %
ATM Pressure:	101.0 kPa

The testing was performed by Jason on 2022-08-11.

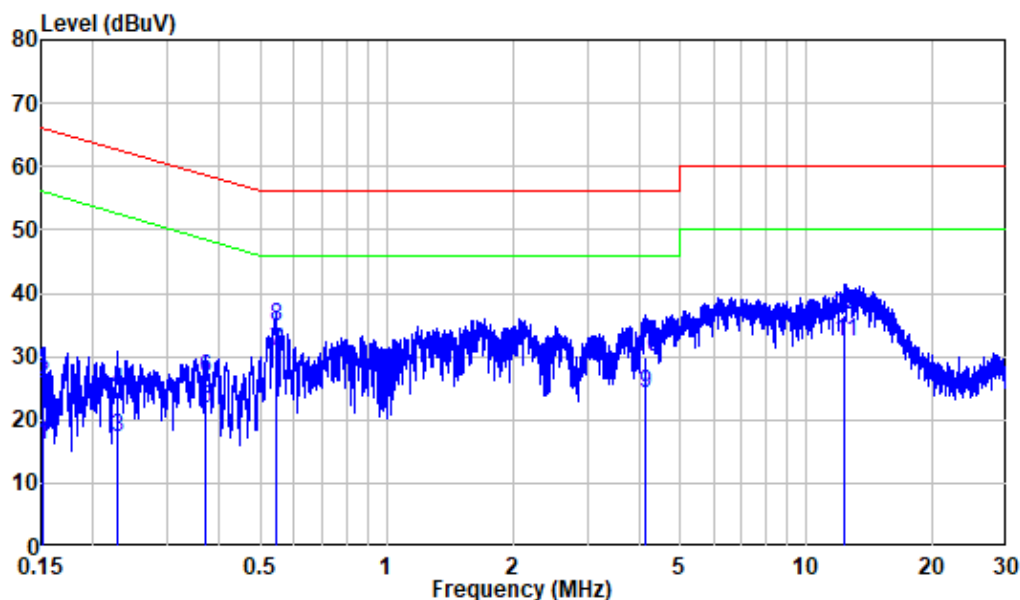
EUT operation mode: Transmitting

Wi-Fi: (worst case is 802.11b mode, low channel)
AC 120V/60 Hz, Line



Site : Shielding Room
 Condition: Line
 Mode : 2.4G WIFI
 Model : 492
 Power : AC 120V 60Hz

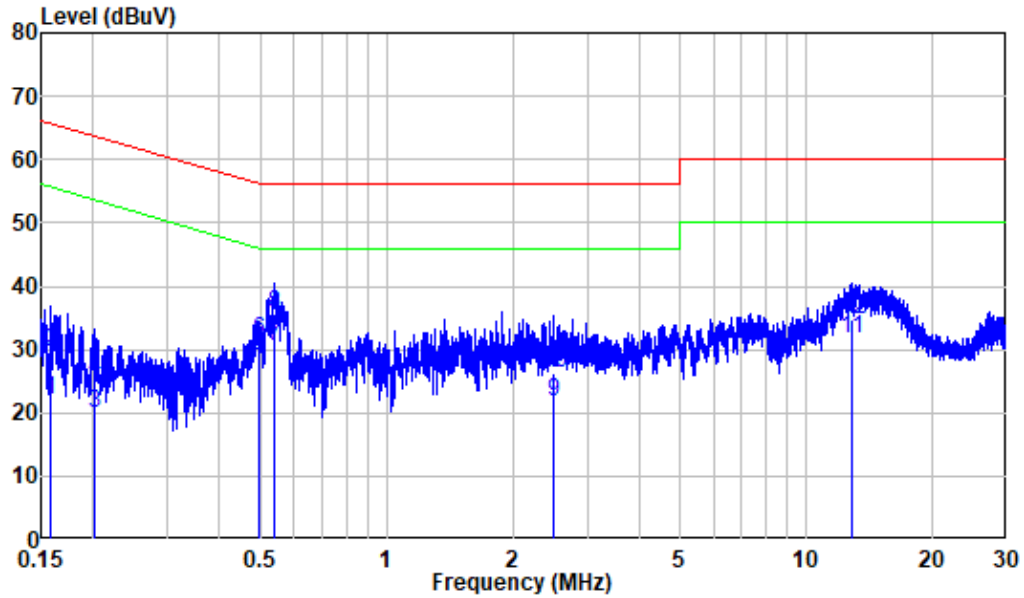
	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.177	9.80	8.30	18.10	54.63	-36.53	Average
2	0.177	9.80	13.11	22.91	64.63	-41.72	QP
3	0.236	9.80	11.50	21.30	52.25	-30.95	Average
4	0.236	9.80	15.53	25.33	62.25	-36.92	QP
5	0.351	9.80	12.03	21.83	48.93	-27.10	Average
6	0.351	9.80	14.91	24.71	58.93	-34.22	QP
7	0.541	9.81	25.45	35.26	46.00	-10.74	Average
8	0.541	9.81	26.99	36.80	56.00	-19.20	QP
9	4.936	9.85	12.57	22.42	46.00	-23.58	Average
10	4.936	9.85	14.95	24.80	56.00	-31.20	QP
11	15.297	9.95	19.66	29.61	50.00	-20.39	Average
12	15.297	9.95	22.75	32.70	60.00	-27.30	QP

AC 120V/60 Hz, Neutral

Site : Shielding Room
 Condition: Neutral
 Mode : 2.4G WIFI
 Model : 492
 Power : AC 120V 60Hz

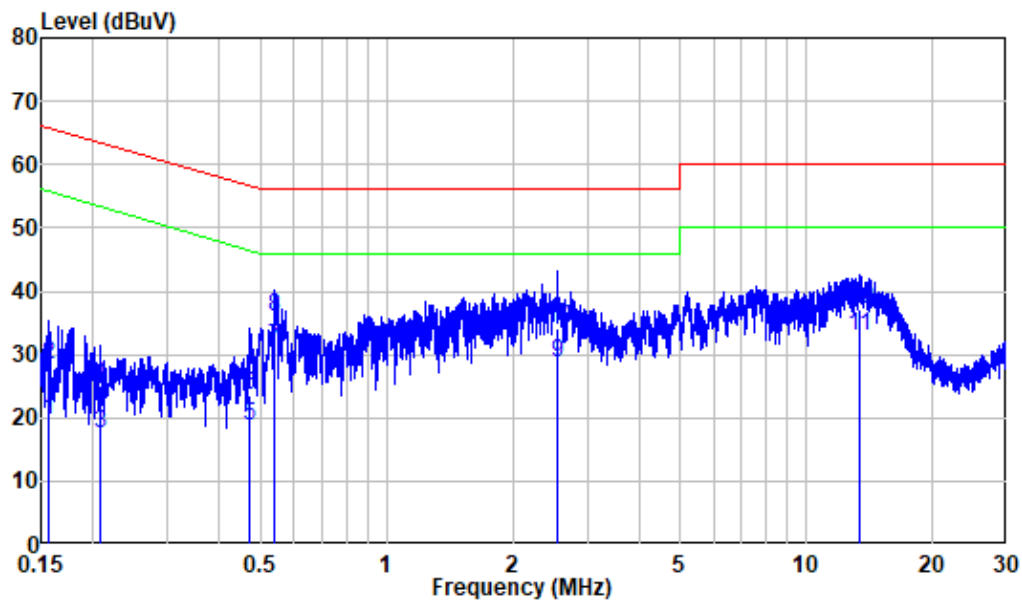
	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.152	9.80	6.24	16.04	55.87	-39.83	Average
2	0.152	9.80	15.95	25.75	65.87	-40.12	QP
3	0.228	9.80	7.56	17.36	52.54	-35.18	Average
4	0.228	9.80	14.67	24.47	62.54	-38.07	QP
5	0.370	9.80	11.96	21.76	48.50	-26.74	Average
6	0.370	9.80	16.64	26.44	58.50	-32.06	QP
7	0.543	9.81	20.86	30.67	46.00	-15.33	Average
8	0.543	9.81	25.01	34.82	56.00	-21.18	QP
9	4.149	9.85	14.42	24.27	46.00	-21.73	Average
10	4.149	9.85	20.02	29.87	56.00	-26.13	QP
11	12.359	10.02	22.28	32.30	50.00	-17.70	Average
12	12.359	10.02	26.48	36.50	60.00	-23.50	QP

BLE: (worst case is BLE 1M, low channel)
AC 120V/60 Hz, Line



Site : Shielding Room
 Condition: Line
 Mode : BLE
 Model : 492
 Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit	Over	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.158	9.80	12.20	22.00	55.57	-33.57	Average
2	0.158	9.80	19.86	29.66	65.57	-35.91	QP
3	0.201	9.80	10.09	19.89	53.56	-33.67	Average
4	0.201	9.80	15.53	25.33	63.56	-38.23	QP
5	0.497	9.80	19.30	29.10	46.04	-16.94	Average
6	0.497	9.80	21.71	31.51	56.04	-24.53	QP
7	0.539	9.81	20.55	30.36	46.00	-15.64	Average
8	0.539	9.81	25.68	35.49	56.00	-20.51	QP
9	2.507	9.82	12.01	21.83	46.00	-24.17	Average
10	2.507	9.82	16.35	26.17	56.00	-29.83	QP
11	12.784	9.93	21.71	31.64	50.00	-18.36	Average
12	12.784	9.93	24.91	34.84	60.00	-25.16	QP

AC 120V/60 Hz, Neutral

Site : Shielding Room
 Condition: Neutral
 Mode : BLE
 Model : 492
 Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.157	9.80	9.71	19.51	55.61	-36.10	Average
2	0.157	9.80	18.70	28.50	65.61	-37.11	QP
3	0.208	9.80	7.74	17.54	53.29	-35.75	Average
4	0.208	9.80	15.17	24.97	63.29	-38.32	QP
5	0.470	9.80	9.03	18.83	46.51	-27.68	Average
6	0.470	9.80	13.83	23.63	56.51	-32.88	QP
7	0.542	9.81	21.19	31.00	46.00	-15.00	Average
8	0.542	9.81	26.07	35.88	56.00	-20.12	QP
9	2.540	9.83	18.85	28.68	46.00	-17.32	Average
10	2.540	9.83	24.20	34.03	56.00	-21.97	QP
11	13.373	10.03	22.83	32.86	50.00	-17.14	Average
12	13.373	10.03	27.08	37.11	60.00	-22.89	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;

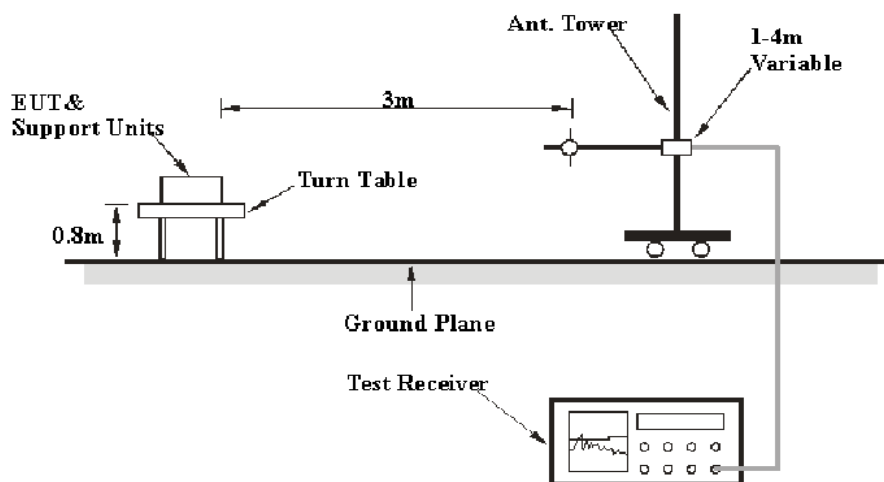
According to RSS-GEN § 8.10 & RSS-247 § 5.5

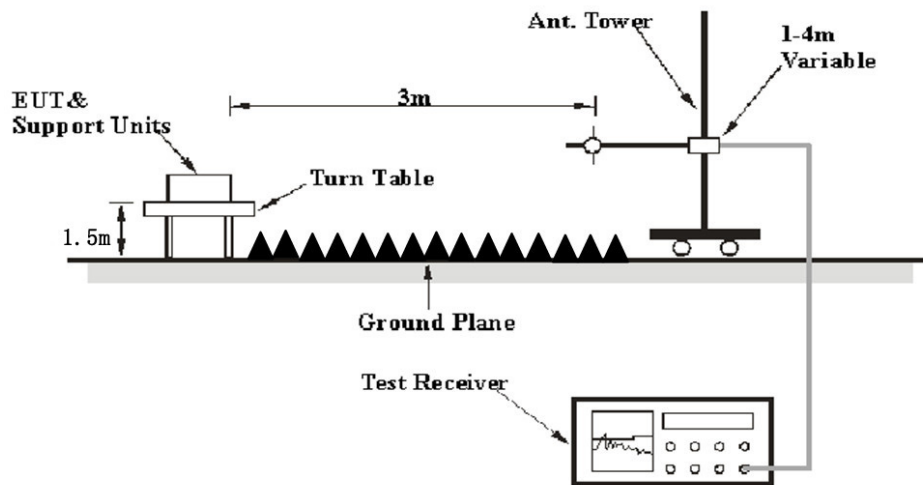
Restricted frequency bands, identified in table 7, are designated primarily for safety-of-life services (distress calling and certain aeronautical activities), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following conditions related to 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.

Corrected Amplitude & Margin Calculation

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

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

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

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

Test Data

Environmental Conditions

Temperature:	26.8~28℃
Relative Humidity:	52~68%
ATM Pressure:	101.0 kPa

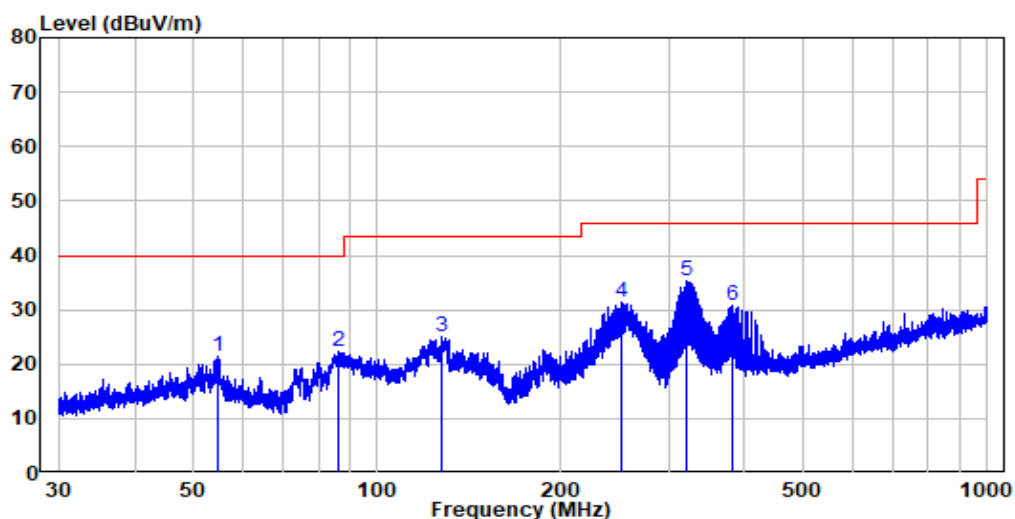
The testing was performed by RSE on 2022-08-11 for below 1GHz, Jeff Jiang on 2022-07-31 for above 1GHz.

EUT operation mode: Transmitting (Pre-scan in the X,Y and Z axes of orientation, the worst case of X-axes orientation was recorded)

30 MHz~1 GHz: (worst case is 802.11b mode, low channel)

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

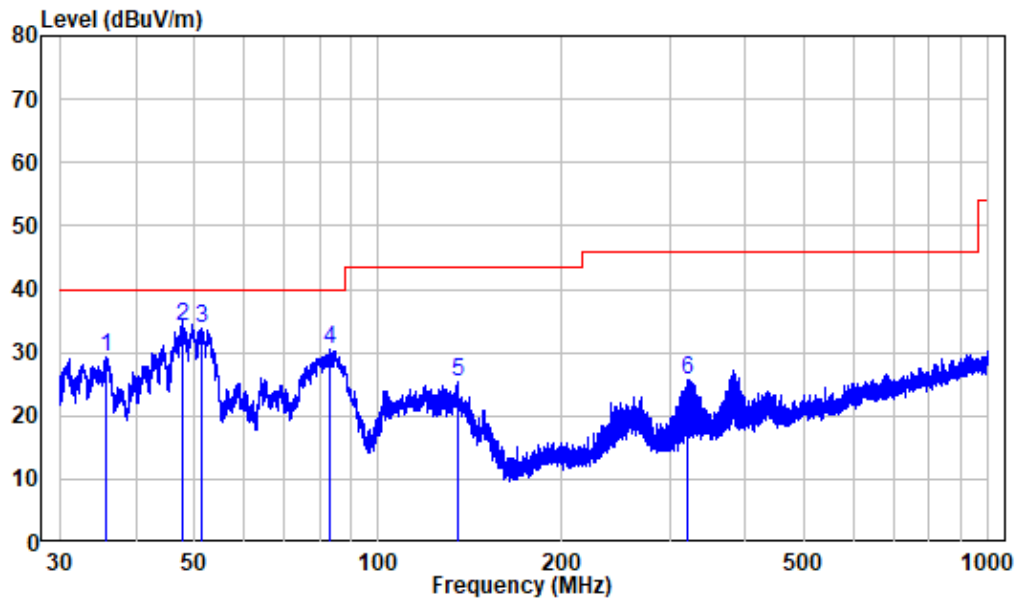
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : SZNS220630-29398E-RF
Test Mode: 2.4G WIFI

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	54.931	-10.28	31.77	21.49	40.00	-18.51	Peak
2	86.579	-15.02	37.23	22.21	40.00	-17.79	Peak
3	127.833	-14.67	39.72	25.05	43.50	-18.45	Peak
4	250.960	-10.72	42.00	31.28	46.00	-14.72	Peak
5	321.906	-8.38	43.56	35.18	46.00	-10.82	Peak
6	381.416	-7.11	37.94	30.83	46.00	-15.17	Peak

Vertical



Site : chamber
 Condition: 3m VERTICAL
 Job No. : SZNS220630-29398E-RF
 Test Mode: 2.4G WIFI

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	35.655	-11.32	40.53	29.21	40.00	-10.79	Peak
2	47.659	-10.00	44.13	34.13	40.00	-5.87	QP
3	51.256	-9.95	43.65	33.70	40.00	-6.30	Peak
4	83.486	-16.20	46.54	30.34	40.00	-9.66	Peak
5	134.973	-15.02	40.26	25.24	43.50	-18.26	Peak
6	321.342	-8.40	34.11	25.71	46.00	-20.29	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	67.8	PK	28	1	H	-7.24	60.56	74	-13.44
2310	53.29	AV	28	1	H	-7.24	46.05	54	-7.95
2310	68.12	PK	317	1.6	V	-7.24	60.88	74	-13.12
2310	53.28	AV	317	1.6	V	-7.24	46.04	54	-7.96
2390	70.01	PK	209	1.7	H	-7.22	62.79	74	-11.21
2390	53.88	AV	209	1.7	H	-7.22	46.66	54	-7.34
2390	69.49	PK	185	2	V	-7.22	62.27	74	-11.73
2390	53.81	AV	185	2	V	-7.22	46.59	54	-7.41
4824	54.15	PK	128	1.8	H	-3.53	50.62	74	-23.38
4824	53.72	PK	29	1.6	V	-3.53	50.19	74	-23.81
Middle Channel (2437MHz)									
4874	54.36	PK	280	1.5	H	-3.42	50.94	74	-23.06
4874	53.76	PK	149	2.2	V	-3.42	50.34	74	-23.66
High Channel (2462 MHz)									
2483.5	69.38	PK	78	1.7	H	-7.2	62.18	74	-11.82
2483.5	54.99	AV	78	1.7	H	-7.2	47.79	54	-6.21
2483.5	69.87	PK	78	2.4	V	-7.2	62.67	74	-11.33
2483.5	55.05	AV	78	2.4	V	-7.2	47.85	54	-6.15
2500	68.47	PK	335	2.4	H	-7.18	61.29	74	-12.71
2500	54.82	AV	335	2.4	H	-7.18	47.64	54	-6.36
2500	69.09	PK	208	2.4	V	-7.18	61.91	74	-12.09
2500	54.93	AV	208	2.4	V	-7.18	47.75	54	-6.25
4924	54.16	PK	249	1.5	H	-3.16	51	74	-23
4924	53.74	PK	39	2.2	V	-3.16	50.58	74	-23.42

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	68.71	PK	21	2	H	-7.24	61.47	74	-12.53
2310	54.16	AV	21	2	H	-7.24	46.92	54	-7.08
2310	68.72	PK	280	1.3	V	-7.24	61.48	74	-12.52
2310	53.97	AV	280	1.3	V	-7.24	46.73	54	-7.27
2390	70.04	PK	286	1.5	H	-7.22	62.82	74	-11.18
2390	54.76	AV	286	1.5	H	-7.22	47.54	54	-6.46
2390	69.41	PK	272	1.2	V	-7.22	62.19	74	-11.81
2390	54.77	AV	272	1.2	V	-7.22	47.55	54	-6.45
4824	54.26	PK	87	1.3	H	-3.53	50.73	74	-23.27
4824	53.63	PK	139	1.8	V	-3.53	50.1	74	-23.9
Middle Channel (2437 MHz)									
4874	54.52	PK	98	2.2	H	-3.42	51.1	74	-22.9
4874	53.72	PK	112	2.3	V	-3.42	50.3	74	-23.7
High Channel (2462 MHz)									
2483.5	69.35	PK	221	2.4	H	-7.2	62.15	74	-11.85
2483.5	56.05	AV	221	2.4	H	-7.2	48.85	54	-5.15
2483.5	69.77	PK	308	2.4	V	-7.2	62.57	74	-11.43
2483.5	56.07	AV	308	2.4	V	-7.2	48.87	54	-5.13
2500	68.59	PK	86	2.3	H	-7.18	61.41	74	-12.59
2500	55.33	AV	86	2.3	H	-7.18	48.15	54	-5.85
2500	68.43	PK	186	2.3	V	-7.18	61.25	74	-12.75
2500	55.41	AV	186	2.3	V	-7.18	48.23	54	-5.77
4924	54.06	PK	111	1.8	H	-3.16	50.9	74	-23.1
4924	53.69	PK	208	2.3	V	-3.16	50.53	74	-23.47

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	68.33	PK	176	2.4	H	-7.24	61.09	74	-12.91
2310	54.06	AV	176	2.4	H	-7.24	46.82	54	-7.18
2310	68.02	PK	131	2	V	-7.24	60.78	74	-13.22
2310	53.92	AV	131	2	V	-7.24	46.68	54	-7.32
2390	69.39	PK	318	1.9	H	-7.22	62.17	74	-11.83
2390	54.73	AV	318	1.9	H	-7.22	47.51	54	-6.49
2390	69.2	PK	242	2.2	V	-7.22	61.98	74	-12.02
2390	54.6	AV	242	2.2	V	-7.22	47.38	54	-6.62
4824	53.91	PK	114	1.3	H	-3.53	50.38	74	-23.62
4824	53.64	PK	22	2.4	V	-3.53	50.11	74	-23.89
Middle Channel (2437MHz)									
4874	54.42	PK	53	2.2	H	-3.42	51	74	-23
4874	54.07	PK	167	2.3	V	-3.42	50.65	74	-23.35
High Channel (2462 MHz)									
2483.5	70.02	PK	283	1.1	H	-7.2	62.82	74	-11.18
2483.5	55.84	AV	283	1.1	H	-7.2	48.64	54	-5.36
2483.5	70.19	PK	64	1	V	-7.2	62.99	74	-11.01
2483.5	55.88	AV	64	1	V	-7.2	48.68	54	-5.32
2500	68.92	PK	267	2	H	-7.18	61.74	74	-12.26
2500	55.6	AV	267	2	H	-7.18	48.42	54	-5.58
2500	69.3	PK	235	2	V	-7.18	62.12	74	-11.88
2500	55.55	AV	235	2	V	-7.18	48.37	54	-5.63
4924	54.14	PK	204	2.3	H	-3.16	50.98	74	-23.02
4924	53.6	PK	21	2.5	V	-3.16	50.44	74	-23.56

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)				
802.11n40 Mode									
Low Channel (2422 MHz)									
2310	68.71	PK	221	1.9	H	-7.24	61.47	74	-12.53
2310	54.63	AV	221	1.9	H	-7.24	47.39	54	-6.61
2310	68.7	PK	295	1.3	V	-7.24	61.46	74	-12.54
2310	54.42	AV	295	1.3	V	-7.24	47.18	54	-6.82
2390	69.95	PK	320	1.5	H	-7.22	62.73	74	-11.27
2390	57.75	AV	320	1.5	H	-7.22	50.53	54	-3.47
2390	69.91	PK	307	2.1	V	-7.22	62.69	74	-11.31
2390	57.34	AV	307	2.1	V	-7.22	50.12	54	-3.88
4844	54.05	PK	18	1.2	H	-3.54	50.51	74	-23.49
4844	53.61	PK	221	1.8	V	-3.54	50.07	74	-23.93
Middle Channel (2437MHz)									
4874	54.34	PK	156	1.6	H	-3.42	50.92	74	-23.08
4874	53.89	PK	46	2	V	-3.42	50.47	74	-23.53
High Channel (2452 MHz)									
2483.5	71.38	PK	202	1.6	H	-7.2	64.18	74	-9.82
2483.5	59.16	AV	202	1.6	H	-7.2	51.96	54	-2.04
2483.5	71.2	PK	351	2.3	V	-7.2	64	74	-10
2483.5	58.53	AV	351	2.3	V	-7.2	51.33	54	-2.67
2500	68.84	PK	289	1.2	H	-7.18	61.66	74	-12.34
2500	55.33	AV	289	1.2	H	-7.18	48.15	54	-5.85
2500	68.69	PK	85	2.3	V	-7.18	61.51	74	-12.49
2500	55.36	AV	85	2.3	V	-7.18	48.18	54	-5.82
4904	54.44	PK	53	1.2	H	-3.26	51.18	74	-22.82
4904	53.77	PK	41	1.3	V	-3.26	50.51	74	-23.49

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	68.66	PK	108	1.1	H	-7.24	61.42	74	-12.58
2310	53.65	AV	108	1.1	H	-7.24	46.41	54	-7.59
2310	67.93	PK	15	1.1	V	-7.24	60.69	74	-13.31
2310	53.69	AV	15	1.1	V	-7.24	46.45	54	-7.55
2390	70.01	PK	349	1.4	H	-7.22	62.79	74	-11.21
2390	54.1	AV	349	1.4	H	-7.22	46.88	54	-7.12
2390	69.16	PK	147	1.7	V	-7.22	61.94	74	-12.06
2390	54.15	AV	147	1.7	V	-7.22	46.93	54	-7.07
4804	54.34	PK	357	2	H	-3.51	50.83	74	-23.17
4804	53.91	PK	195	1.4	V	-3.51	50.4	74	-23.6
Middle Channel (2440 MHz)									
4880	55.07	PK	203	1.5	H	-3.38	51.69	74	-22.31
4880	54.39	PK	305	1.8	V	-3.38	51.01	74	-22.99
High Channel (2480 MHz)									
2483.5	69.43	PK	332	1.3	H	-7.2	62.23	74	-11.77
2483.5	55.56	AV	332	1.3	H	-7.2	48.36	54	-5.64
2483.5	69.46	PK	237	2.4	V	-7.2	62.26	74	-11.74
2483.5	55.62	AV	237	2.4	V	-7.2	48.42	54	-5.58
2500	69.22	PK	255	1	H	-7.18	62.04	74	-11.96
2500	55	AV	255	1	H	-7.18	47.82	54	-6.18
2500	68.74	PK	139	2.2	V	-7.18	61.56	74	-12.44
2500	55.02	AV	139	2.2	V	-7.18	47.84	54	-6.16
4960	54.48	PK	58	2.4	H	-3.01	51.47	74	-22.53
4960	54.17	PK	293	2	V	-3.01	51.16	74	-22.84

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	68.12	PK	65	1.5	H	-7.24	60.88	74	-13.12
2310	53.81	AV	65	1.5	H	-7.24	46.57	54	-7.43
2310	68.35	PK	211	1.5	V	-7.24	61.11	74	-12.89
2310	53.85	AV	211	1.5	V	-7.24	46.61	54	-7.39
2390	69.96	PK	121	1.1	H	-7.22	62.74	74	-11.26
2390	54.14	AV	121	1.1	H	-7.22	46.92	54	-7.08
2390	70.08	PK	63	1.9	V	-7.22	62.86	74	-11.14
2390	54.38	AV	63	1.9	V	-7.22	47.16	54	-6.84
4804	54.59	PK	209	1.7	H	-3.51	51.08	74	-22.92
4804	54.12	PK	316	1.9	V	-3.51	50.61	74	-23.39
Middle Channel (2440 MHz)									
4880	54.88	PK	164	1.3	H	-3.38	51.5	74	-22.5
4880	54.35	PK	44	1.2	V	-3.38	50.97	74	-23.03
High Channel (2480 MHz)									
2483.5	69.44	PK	46	2.4	H	-7.2	62.24	74	-11.76
2483.5	55.33	AV	46	2.4	H	-7.2	48.13	54	-5.87
2483.5	69.66	PK	38	1.5	V	-7.2	62.46	74	-11.54
2483.5	55.46	AV	38	1.5	V	-7.2	48.26	54	-5.74
2500	69.11	PK	73	2.2	H	-7.18	61.93	74	-12.07
2500	54.84	AV	73	2.2	H	-7.18	47.66	54	-6.34
2500	69.11	PK	20	1.4	V	-7.18	61.93	74	-12.07
2500	54.91	AV	20	1.4	V	-7.18	47.73	54	-6.27
4960	54.5	PK	320	1.2	H	-3.01	51.49	74	-22.51
4960	54.25	PK	146	1.9	V	-3.01	51.24	74	-22.76

Note:

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

Corrected Amplitude = Corrected Factor + Reading

Margin = Corrected. Amplitude - Limit

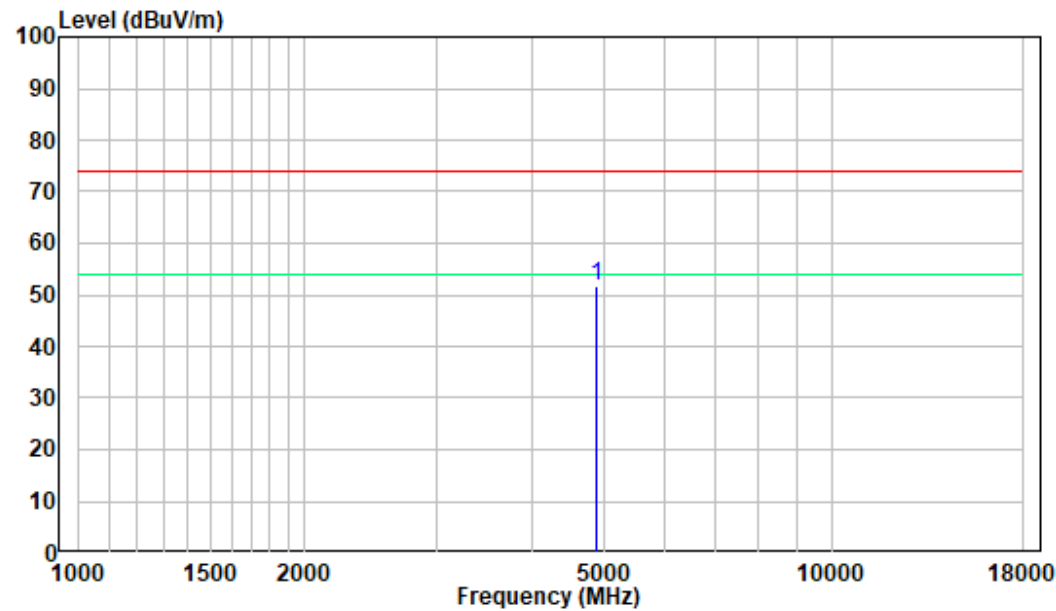
The other spurious emission which is 20dB to the limit or in the noise floor level was not recorded.

When the test result of peak was less than the limit of average, just peak value were recorded.

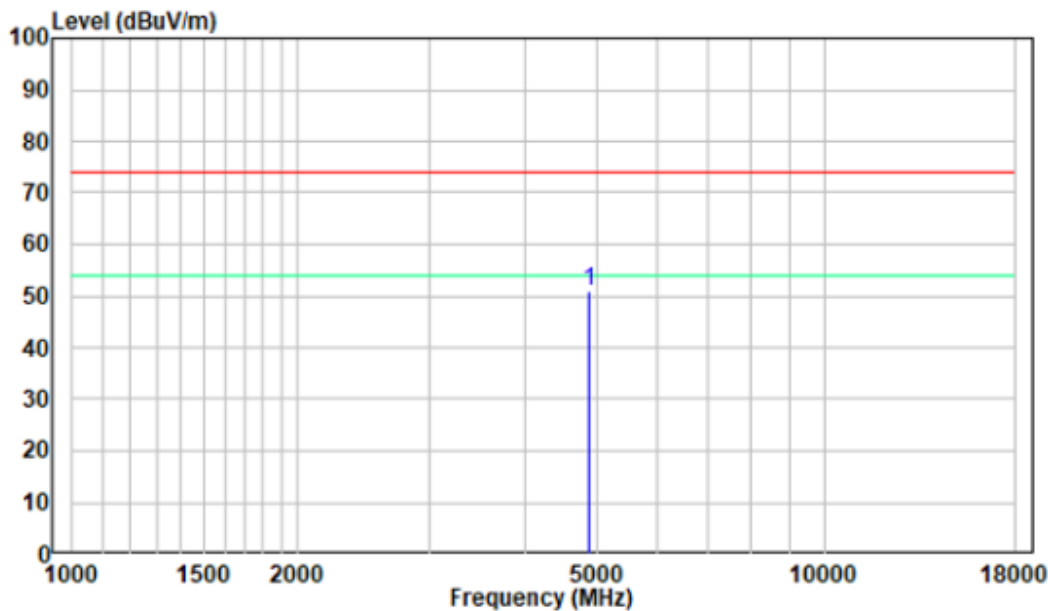
1-18 GHz:

Pre-scan for BLE 1M Middle Channel

Horizontal



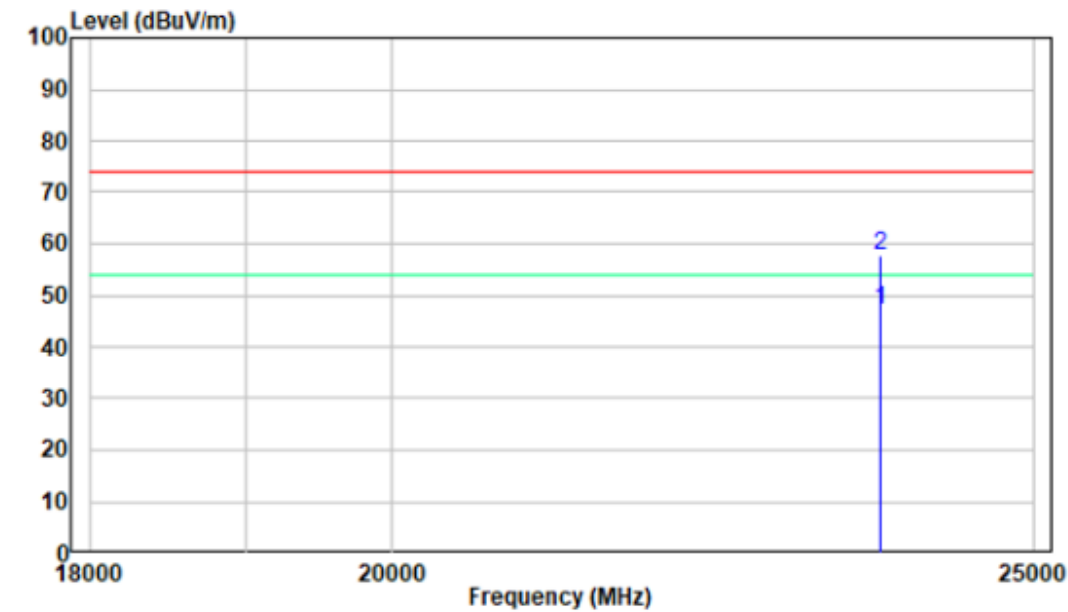
Vertical



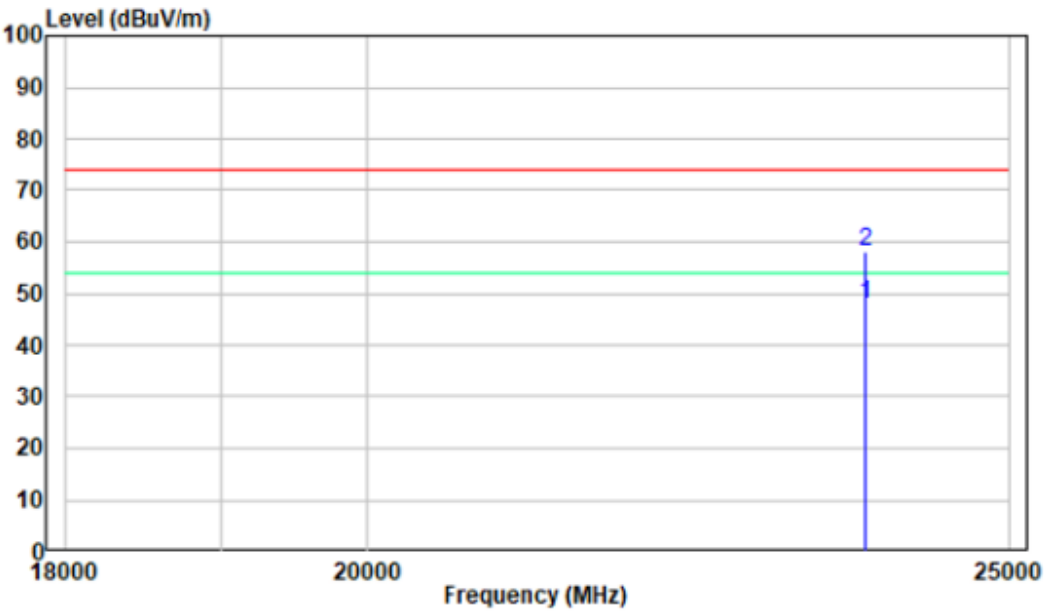
18 -25GHz:

Pre-scan for BLE 1M Middle 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

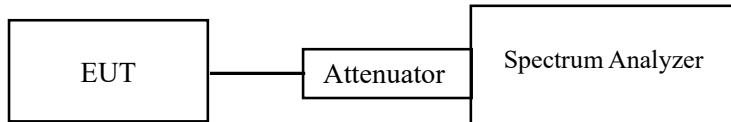
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency 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:	27.1 °C
Relative Humidity:	58 %
ATM Pressure:	101kPa

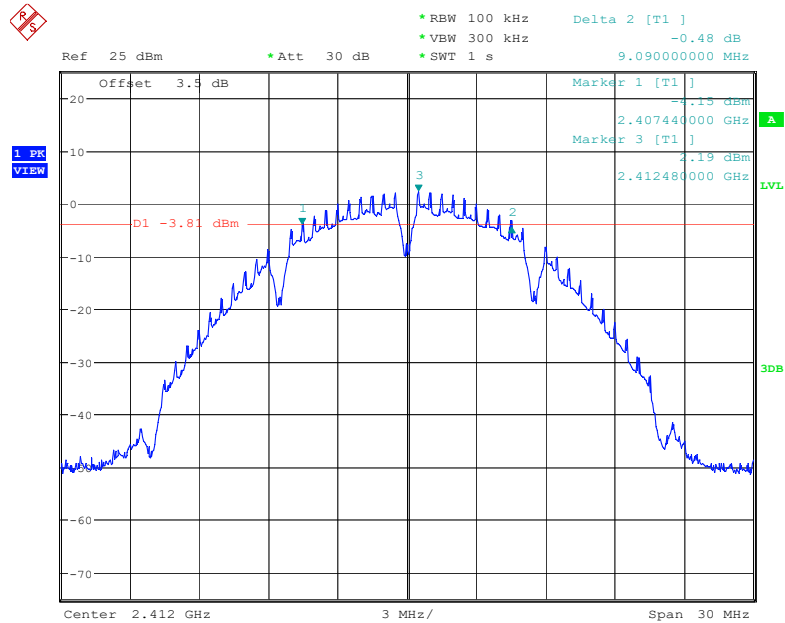
The testing was performed by Roger Ling from 2022-07-28 to 2022-08-28.

EUT operation mode: Transmitting

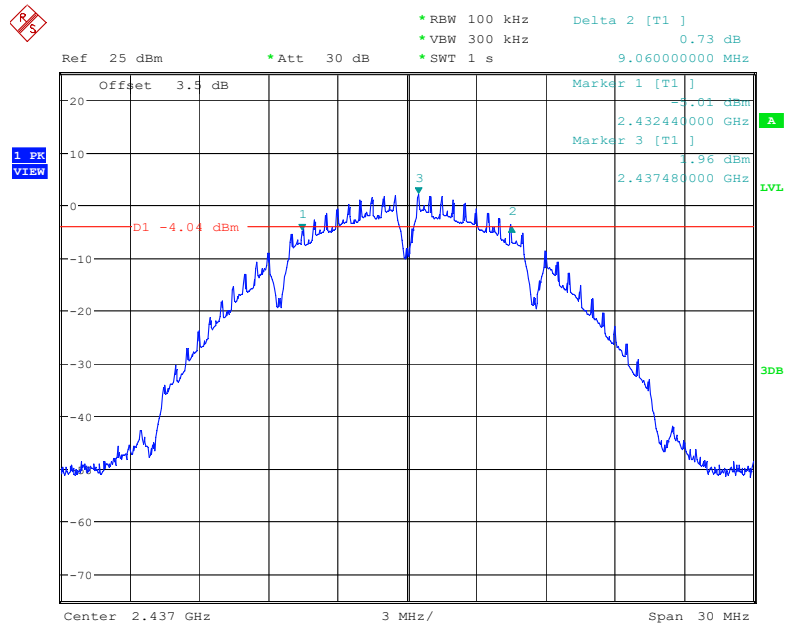
Test Result: Pass.

Please refer to the following table and plots.

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)	Limit (kHz)
802.11b mode				
Low	2412	9.09	13.84	≥ 500
Middle	2437	9.06	13.84	≥ 500
High	2462	9.03	13.68	≥ 500
802.11g mode				
Low	2412	17.22	17.04	≥ 500
Middle	2437	16.83	17.00	≥ 500
High	2462	15.18	16.84	≥ 500
802.11n-HT20 mode				
Low	2412	16.02	18.04	≥ 500
Middle	2437	16.83	18.08	≥ 500
High	2462	15.99	17.96	≥ 500
802.11n-HT40 mode				
Low	2422	35.58	36.40	≥ 500
Middle	2437	35.88	36.40	≥ 500
High	2452	35.28	36.32	≥ 500
BLE 1M				
Low	2402	0.675	1.026	≥ 500
Middle	2440	0.681	1.026	≥ 500
High	2480	0.678	1.026	≥ 500
BLE 2M				
Low	2402	1.158	2.034	≥ 500
Middle	2440	1.158	2.028	≥ 500
High	2480	1.158	2.028	≥ 500

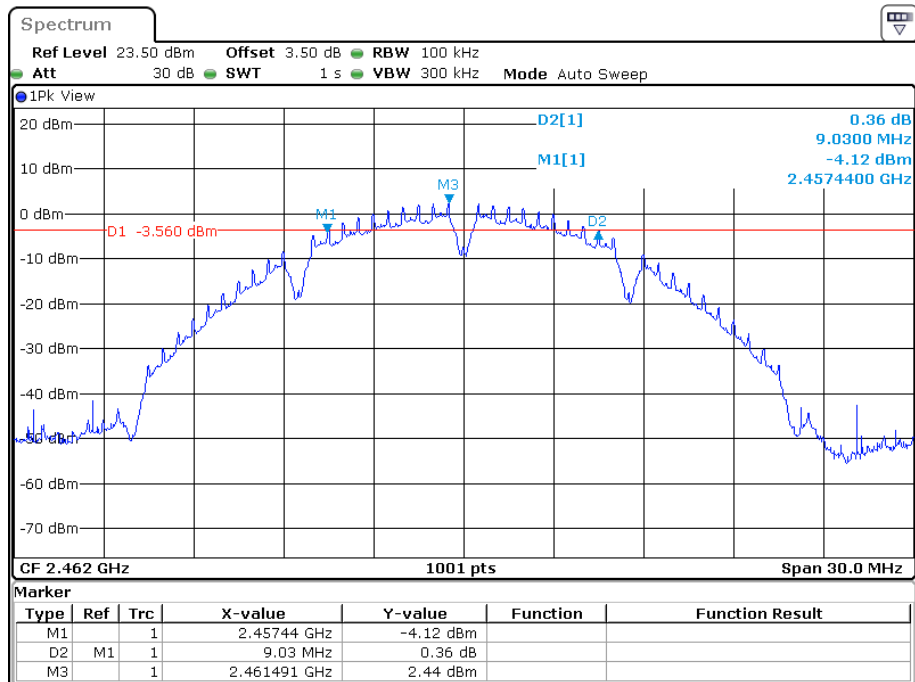
6dB Bandwidth:**802.11b Low Channel**

Date: 28.JUL.2022 19:09:55

802.11b Middle Channel

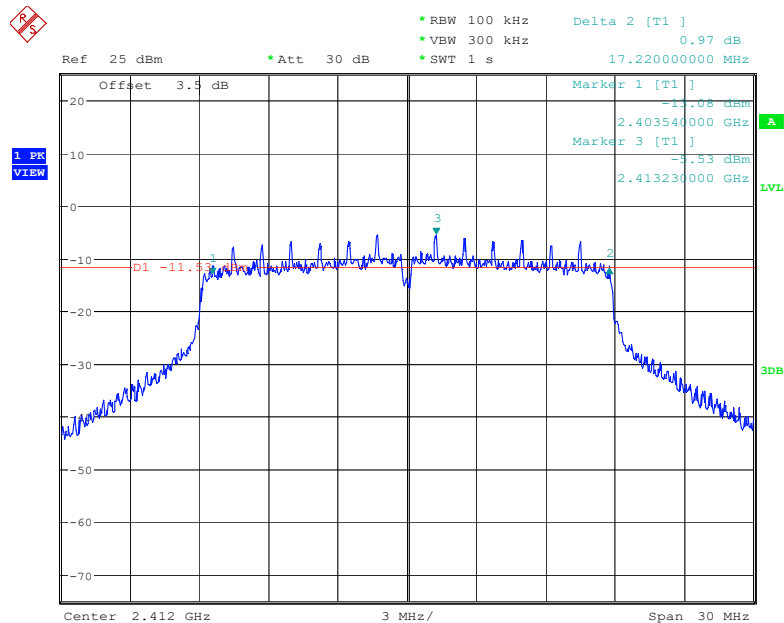
Date: 28.JUL.2022 19:13:32

802.11b High Channel



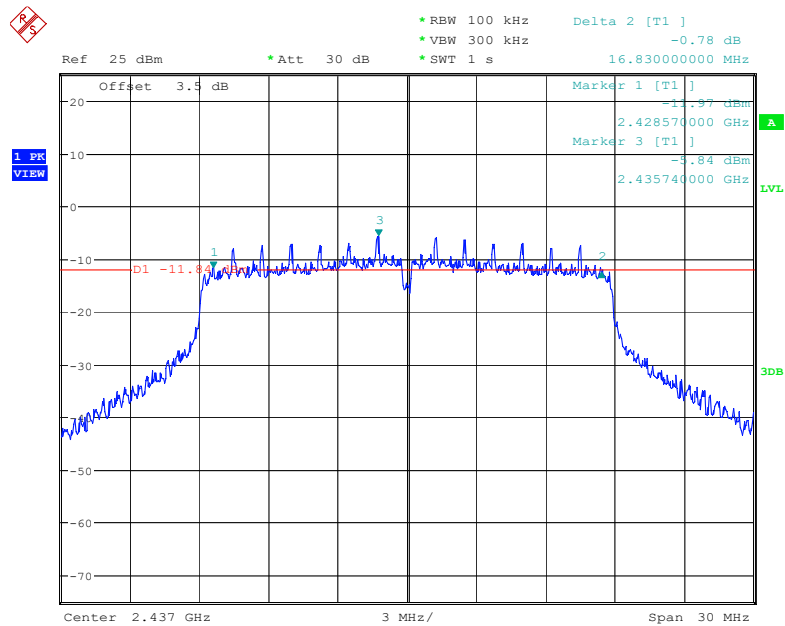
Date: 27.AUG.2022 20:06:11

802.11g Low Channel



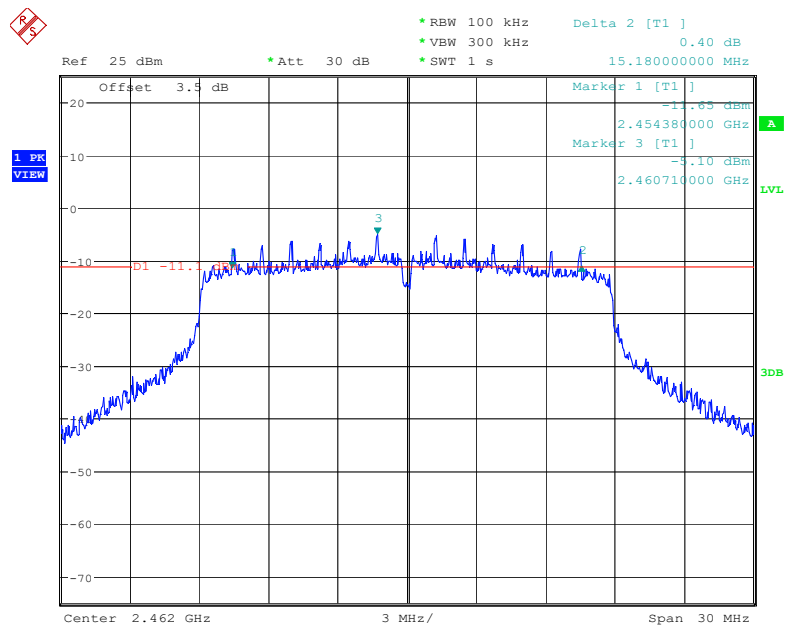
Date: 28.JUL.2022 20:22:49

802.11g Middle Channel



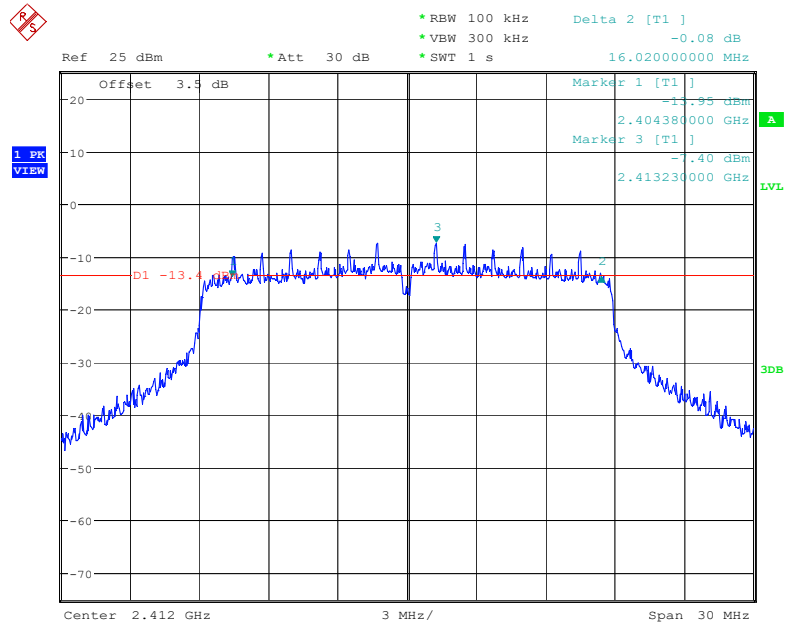
Date: 28.JUL.2022 20:26:58

802.11g High Channel



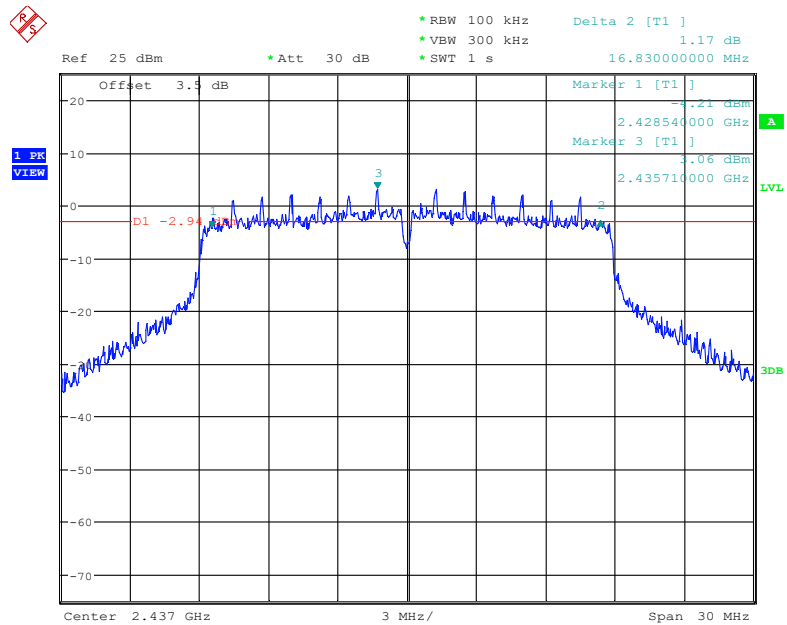
Date: 28.JUL.2022 20:30:19

802.11n-HT20 Low Channel



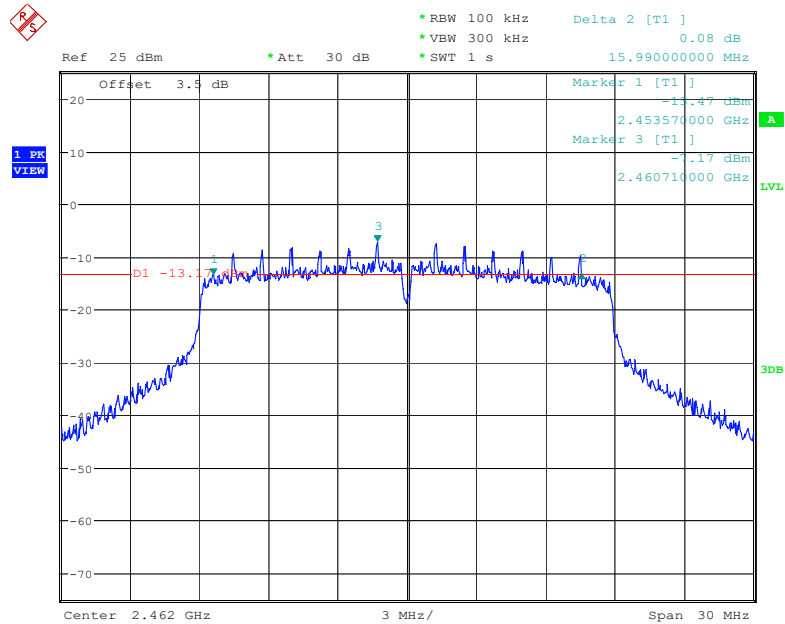
Date: 28.JUL.2022 20:12:08

802.11n-HT20 Middle Channel



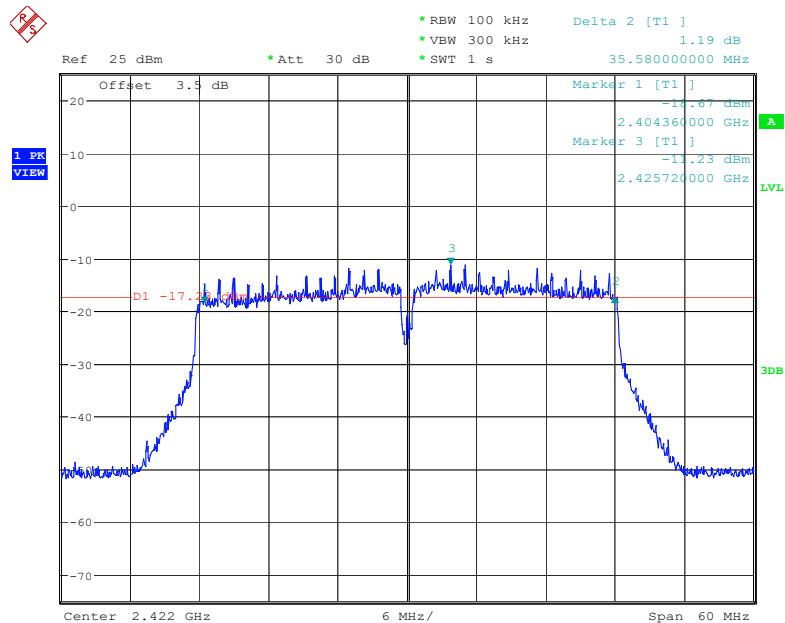
Date: 28.AUG.2022 20:43:49

802.11n-HT20 High Channel



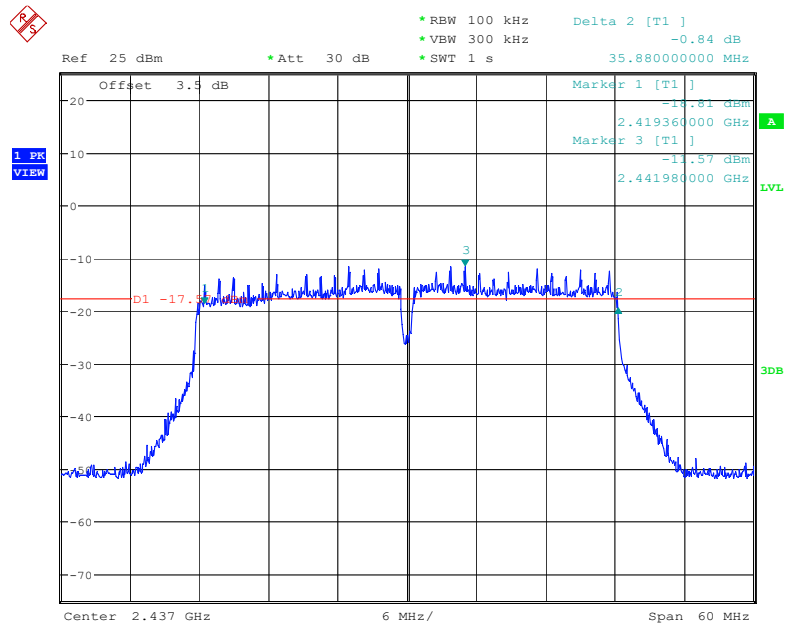
Date: 28.JUL.2022 20:18:46

802.11n-HT40 Low Channel



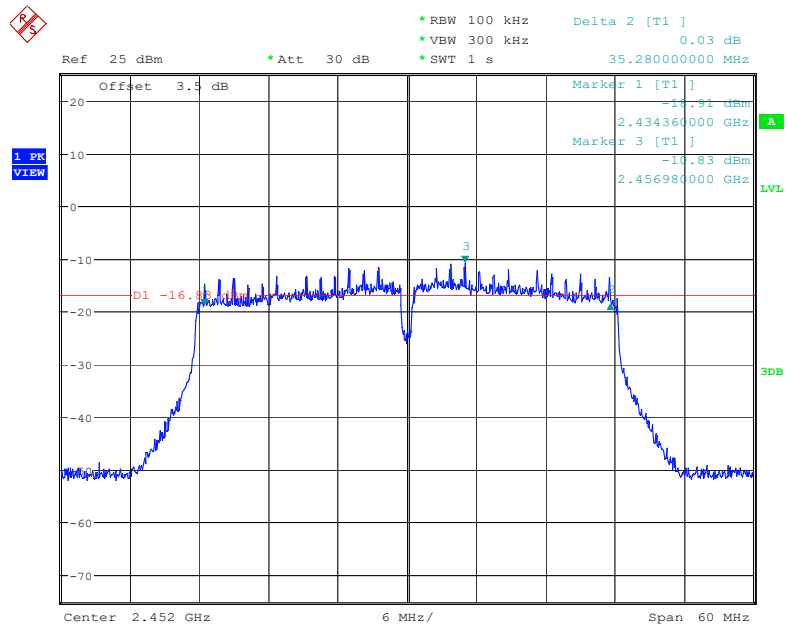
Date: 28.JUL.2022 20:35:32

802.11n-HT40 Middle Channel



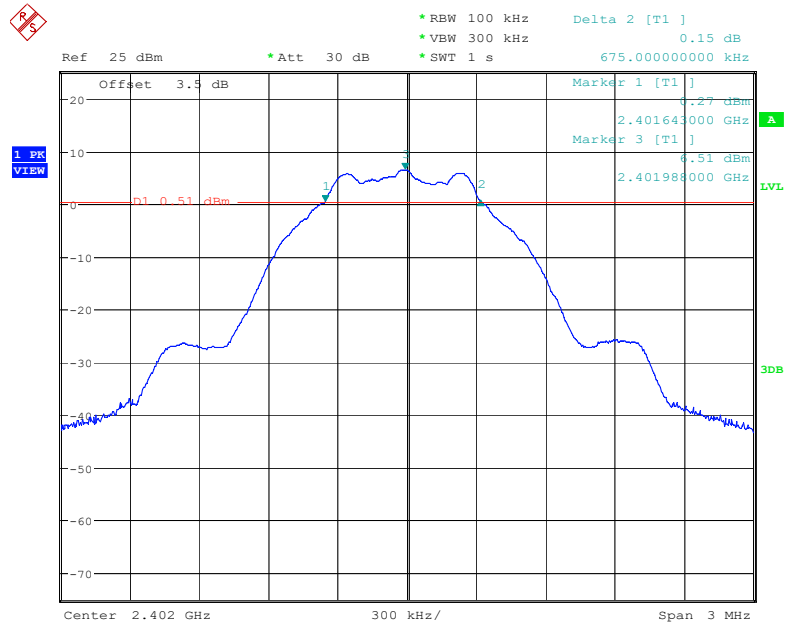
Date: 28.JUL.2022 20:39:33

802.11n-HT40 High Channel



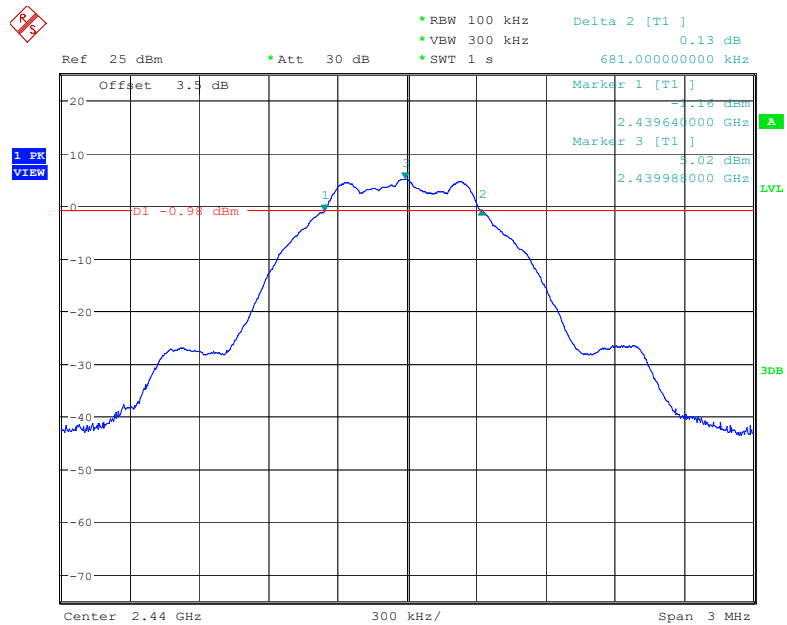
Date: 28.JUL.2022 20:42:50

BLE_1M Low Channel



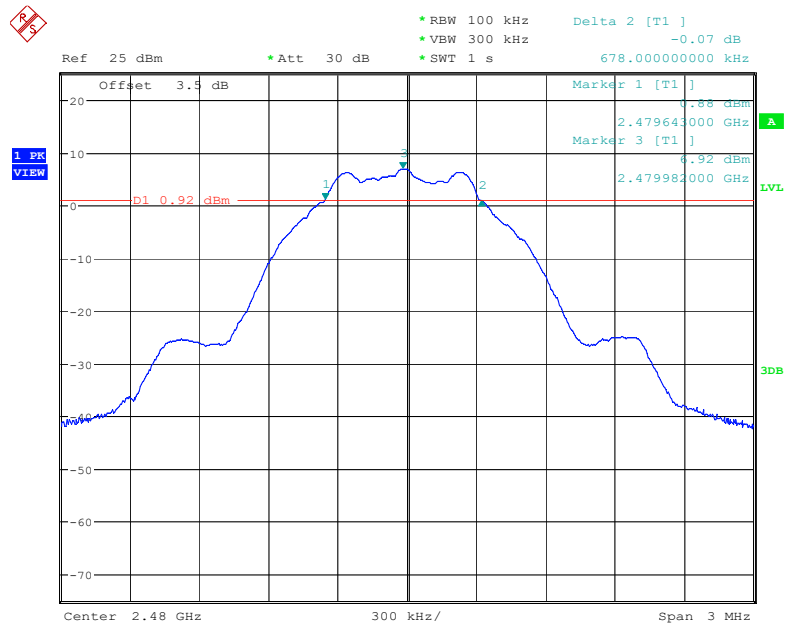
Date: 29.JUL.2022 20:04:32

BLE_1M Middle Channel



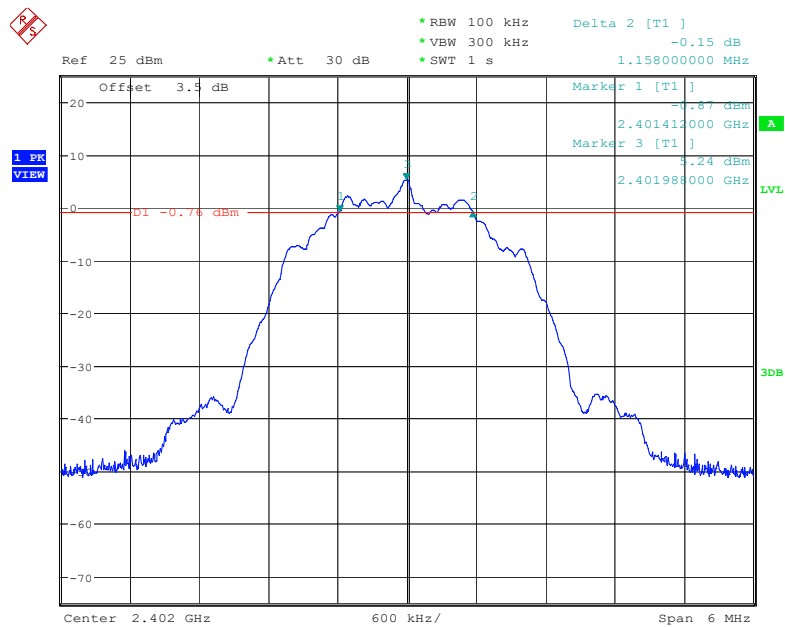
Date: 29.JUL.2022 20:08:37

BLE_1M High Channel



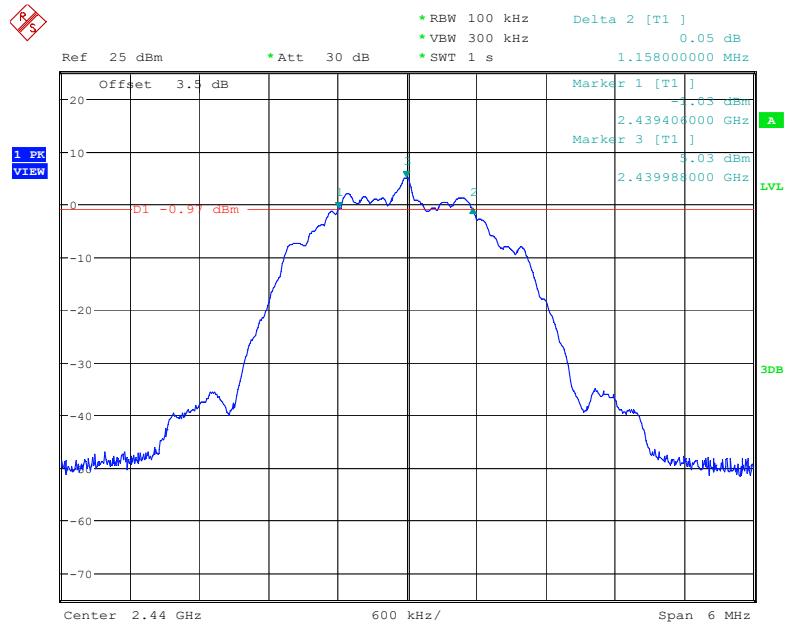
Date: 29.JUL.2022 20:10:58

BLE_2M Low Channel



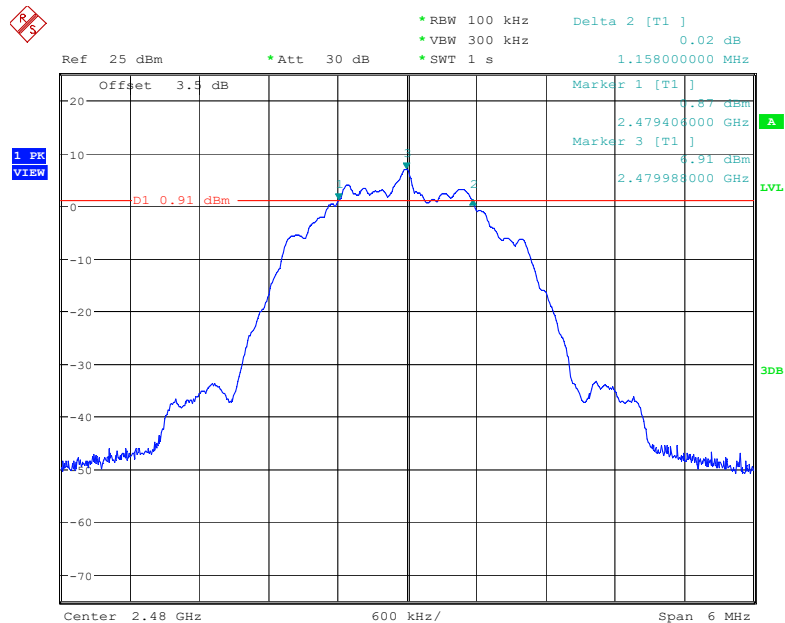
Date: 29.JUL.2022 20:22:46

BLE_2M Middle Channel

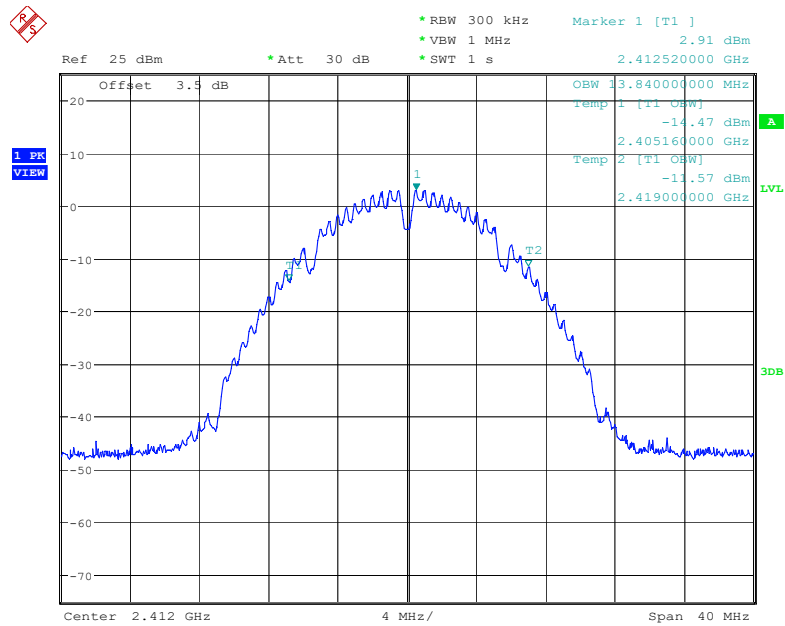


Date: 29.JUL.2022 20:19:00

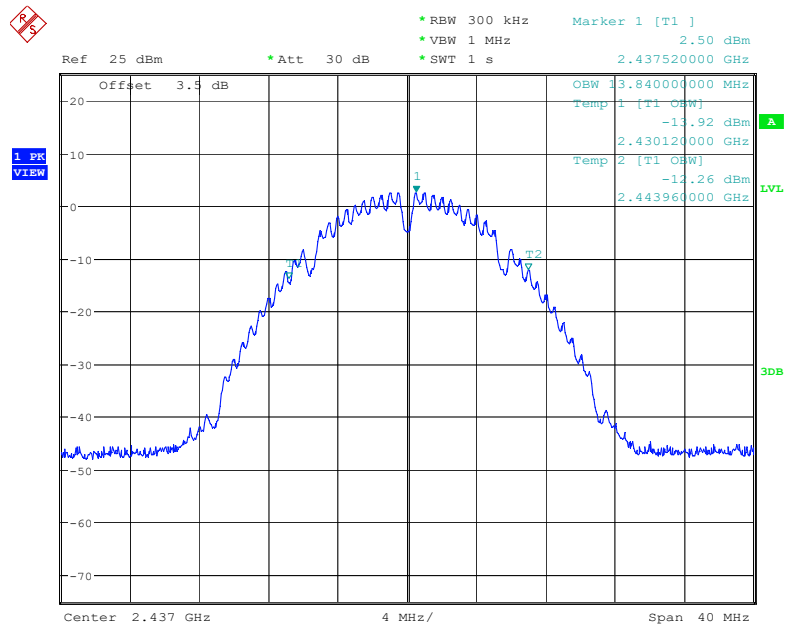
BLE_2M High Channel



Date: 29.JUL.2022 20:15:40

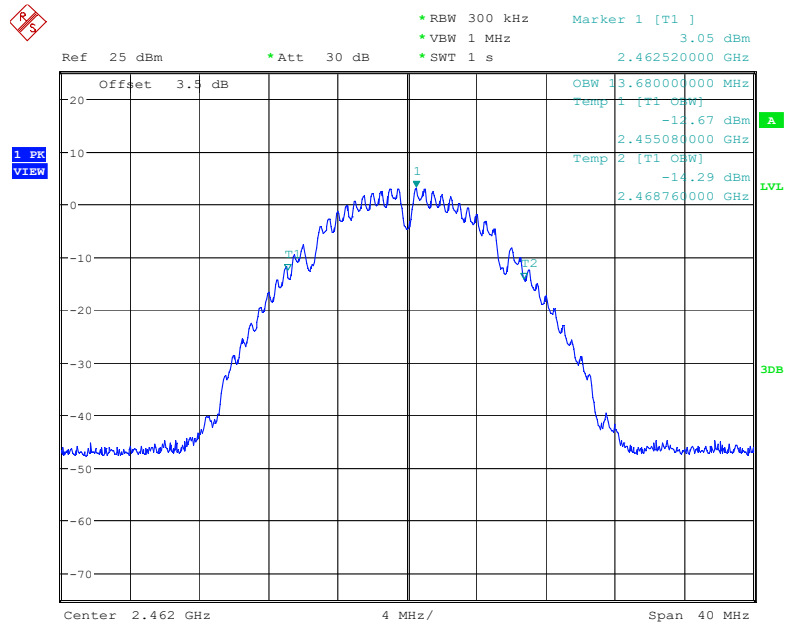
99% Occupied bandwidth:**802.11b Low Channel**

Date: 28.JUL.2022 19:09:28

802.11b Middle Channel

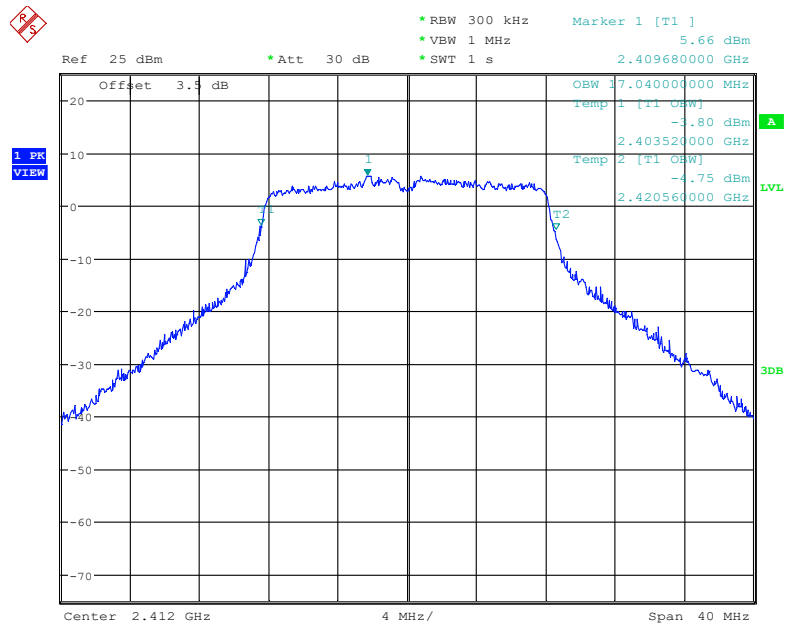
Date: 28.JUL.2022 19:13:04

802.11b High Channel



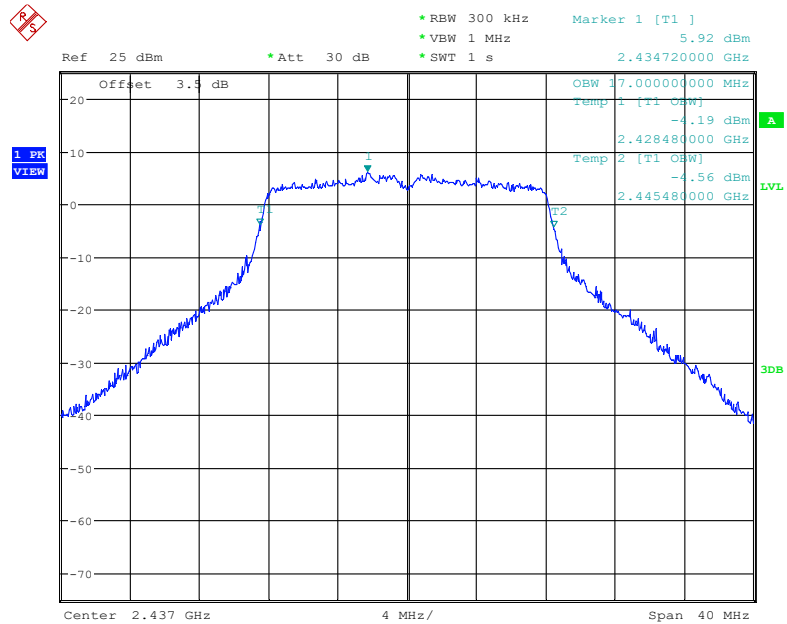
Date: 28.JUL.2022 19:16:03

802.11g Low Channel



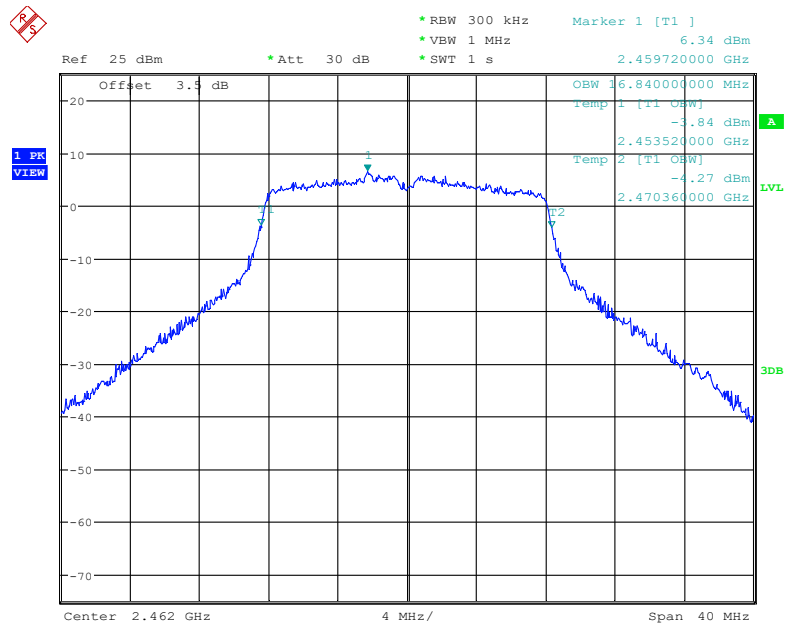
Date: 28.AUG.2022 20:37:08

802.11g Middle Channel



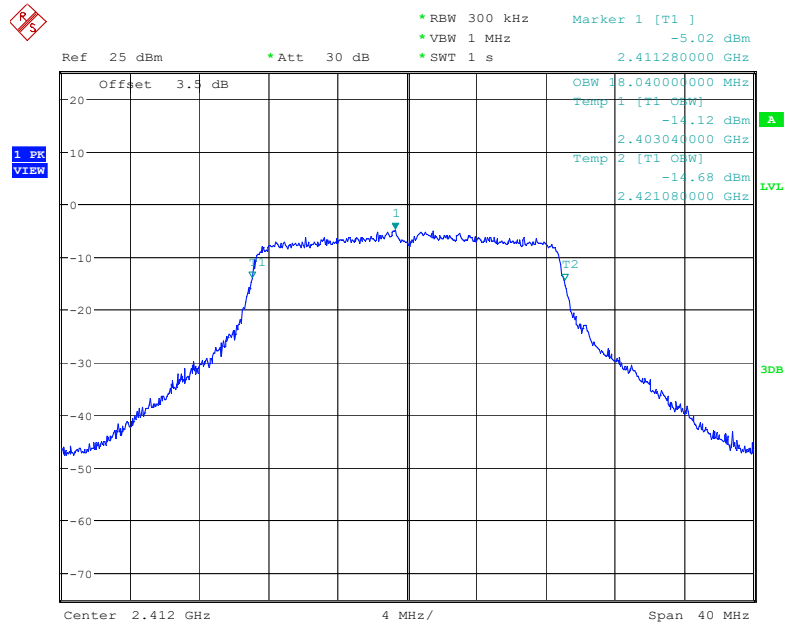
Date: 28.AUG.2022 20:39:47

802.11g High Channel



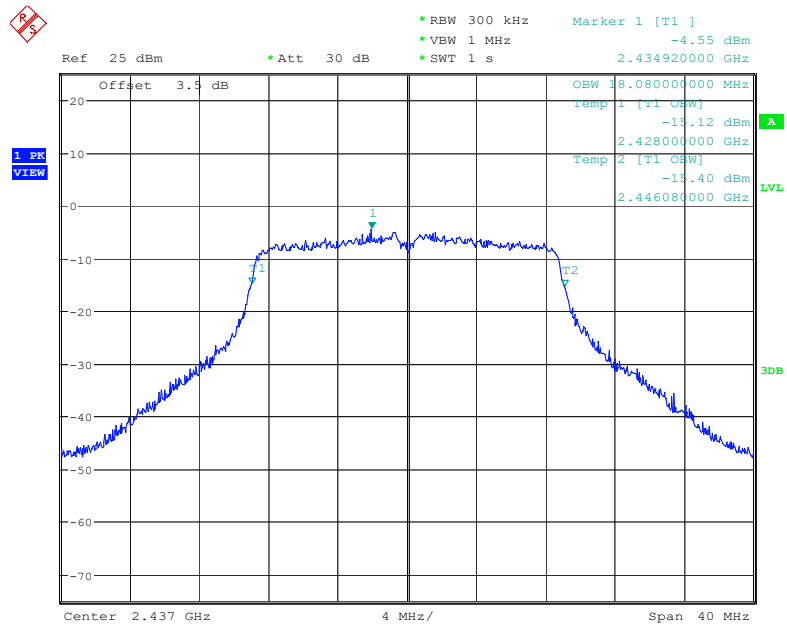
Date: 28.AUG.2022 20:40:44

802.11n-HT20 Low Channel



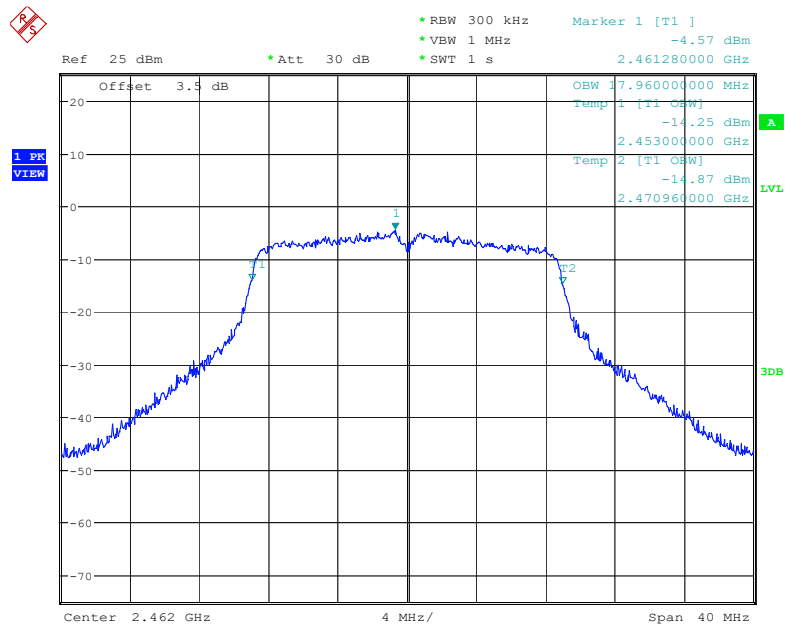
Date: 28.JUL.2022 20:11:40

802.11n-HT20 Middle Channel



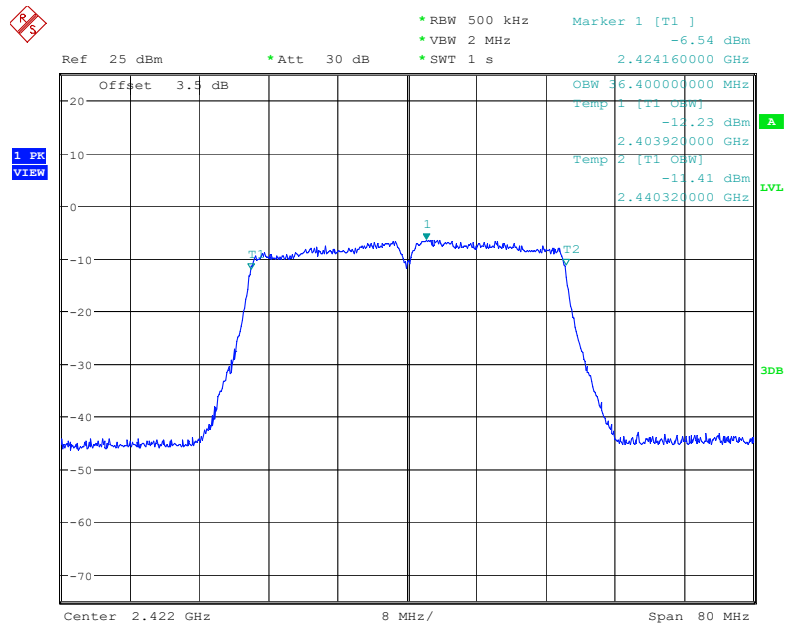
Date: 28.JUL.2022 20:15:17

802.11n-HT20 High Channel



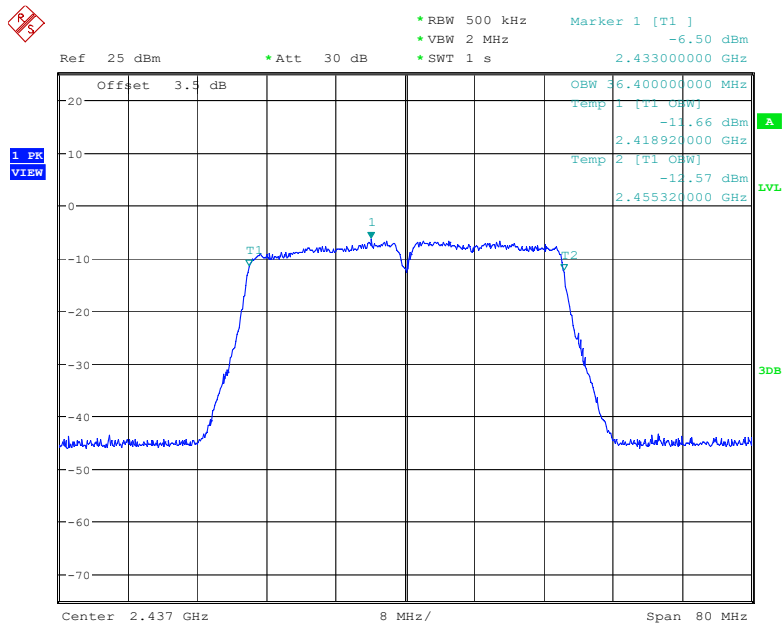
Date: 28.JUL.2022 20:18:19

802.11n-HT40 Low Channel



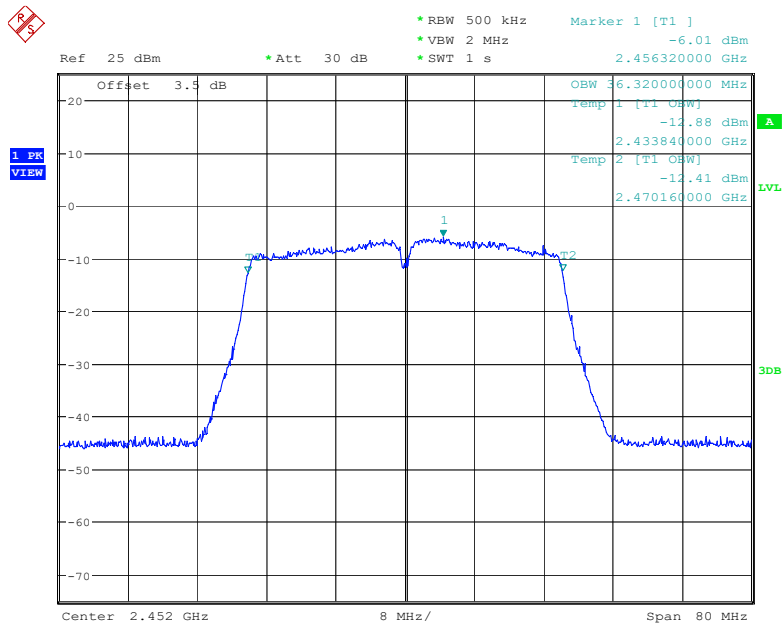
Date: 28.JUL.2022 20:35:05

802.11n-HT40 Middle Channel



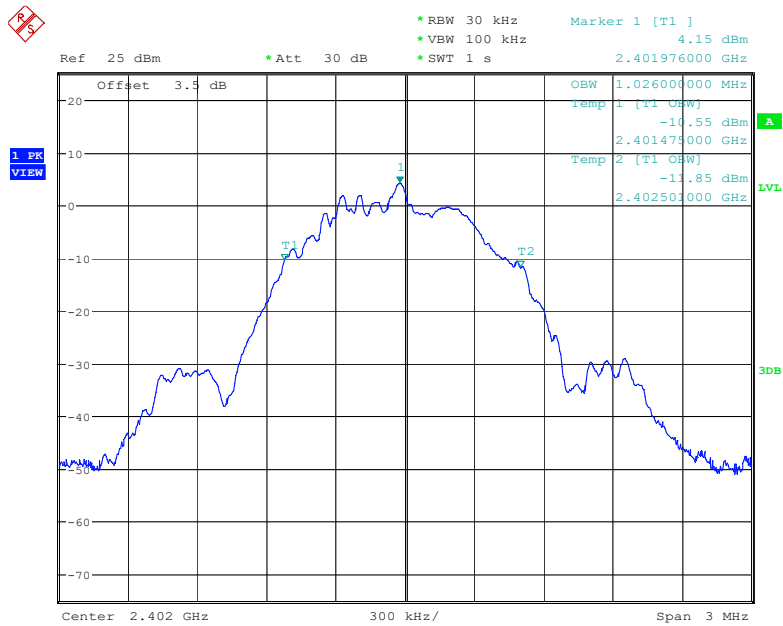
Date: 28.JUL.2022 20:39:06

802.11n-HT40 High Channel



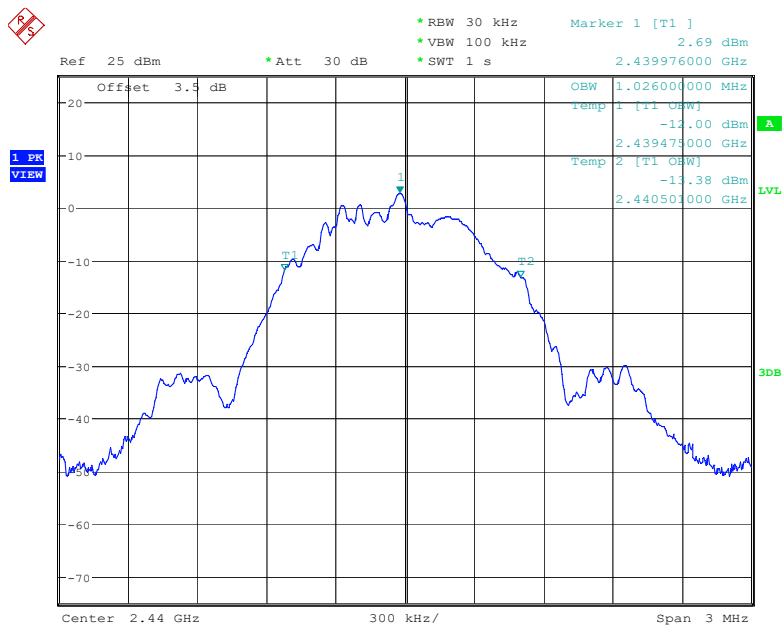
Date: 28.JUL.2022 20:42:23

BLE_1M Low Channel

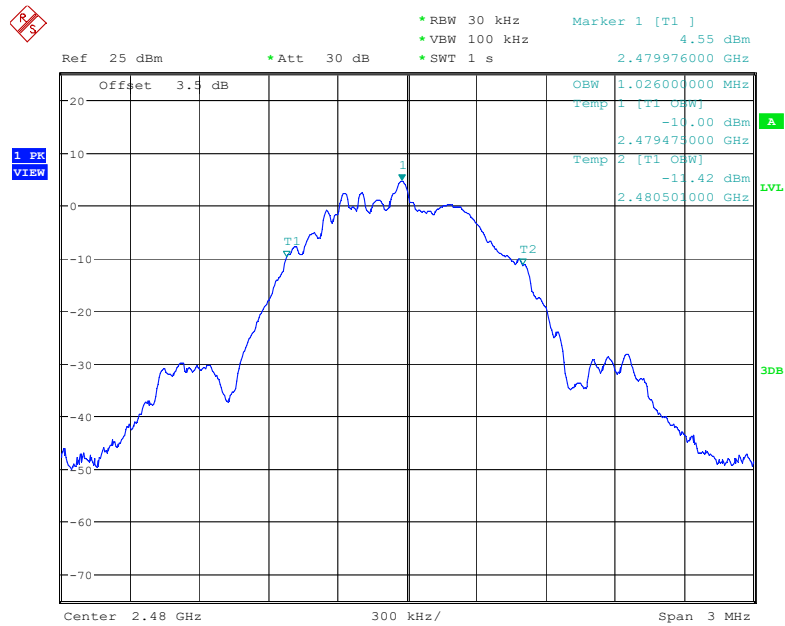


Date: 29.JUL.2022 20:04:04

BLE_1M Middle Channel

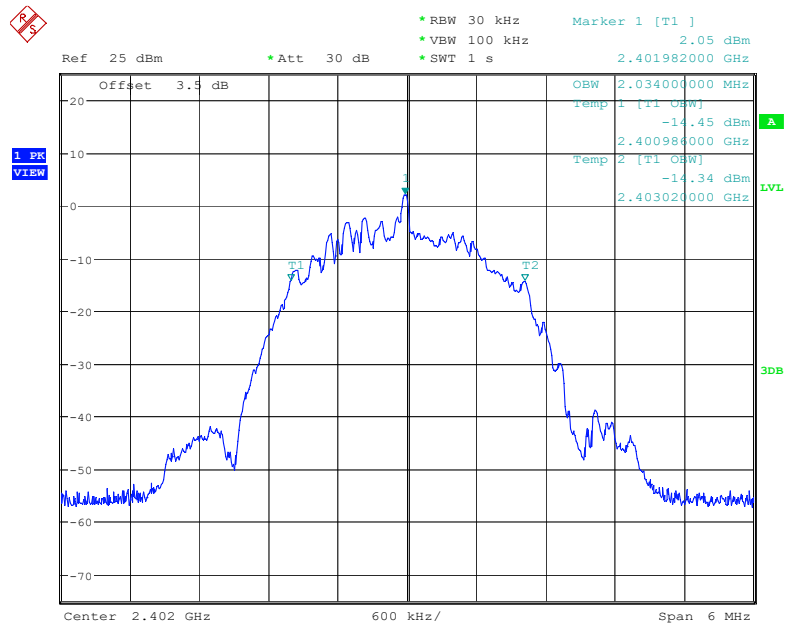


BLE_1M High Channel



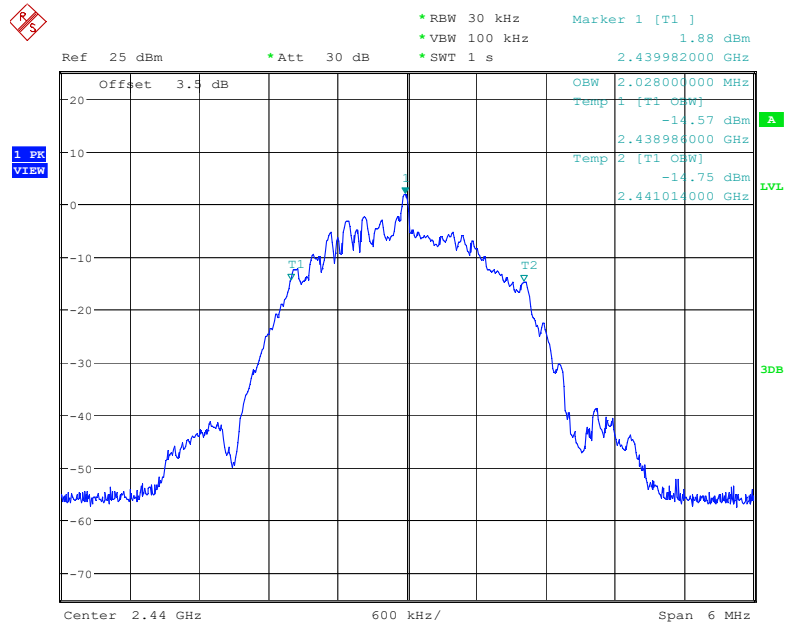
Date: 29.JUL.2022 20:10:31

BLE_2M Low Channel



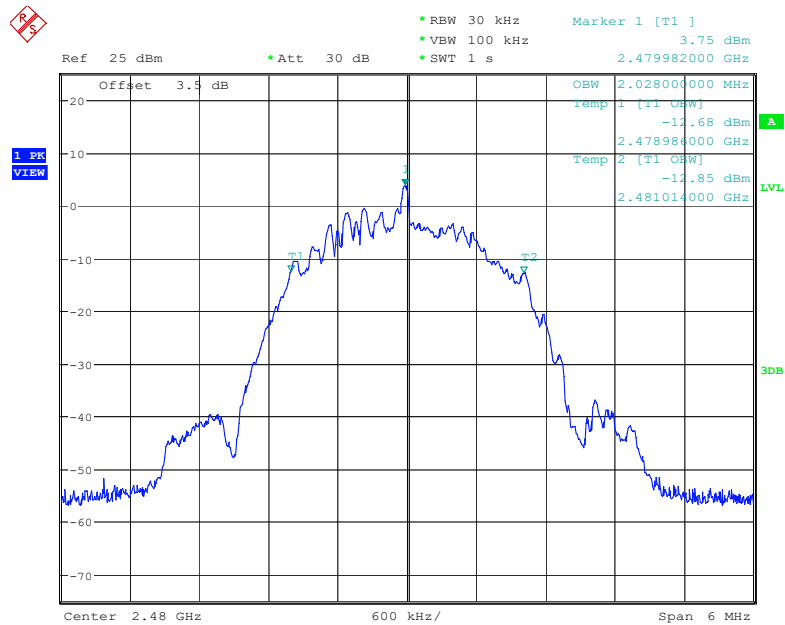
Date: 29.JUL.2022 20:22:19

BLE_2M Middle Channel



Date: 29.JUL.2022 20:18:33

BLE_2M High Channel



Date: 29.JUL.2022 20:15:13

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

Applicable Standard

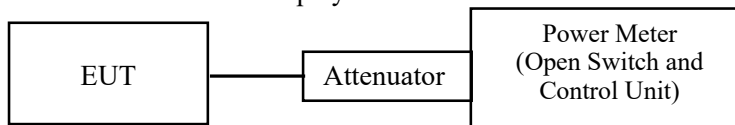
According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted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

Test Data

Environmental Conditions

Temperature:	27.1 °C
Relative Humidity:	58 %
ATM Pressure:	101kPa

The testing was performed by Roger Ling from 2022-07-28 to 2022-07-29.

*EUT operation mode: Transmitting***Wi-Fi mode**

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Max Conducted Average Output Power (dBm)	Limit (dBm)
802.11b mode				
Low	2412	20.13	16.49	30
Middle	2437	20.15	16.50	30
High	2462	20.14	16.35	30
802.11g mode				
Low	2412	23.57	14.71	30
Middle	2437	23.54	14.55	30
High	2462	23.59	14.64	30
802.11n HT20 mode				
Low	2412	23.43	14.53	30
Middle	2437	23.40	14.45	30
High	2462	23.44	14.57	30
802.11n HT40 mode				
Low	2422	23.72	14.49	30
Middle	2437	23.88	14.68	30
High	2452	23.89	14.68	30

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)
BLE 1M			
Low	2402	7.11	30
Middle	2440	5.63	30
High	2480	7.52	30
BLE 2M			
Low	2402	5.94	30
Middle	2440	5.70	30
High	2480	7.58	30

Note 1: The data above was tested in conducted mode.

Note 2: The maximum EIRP is 23.89dBm+1.5dBi=25.39dBm<36dBm, so it can meet the EIRP limit of ISCEDC.

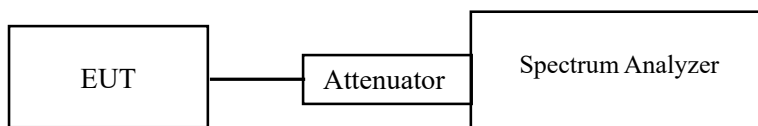
§ 15.247(d) & RSS-247 § 5.5 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

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:	27.1 °C
Relative Humidity:	58 %
ATM Pressure:	101kPa

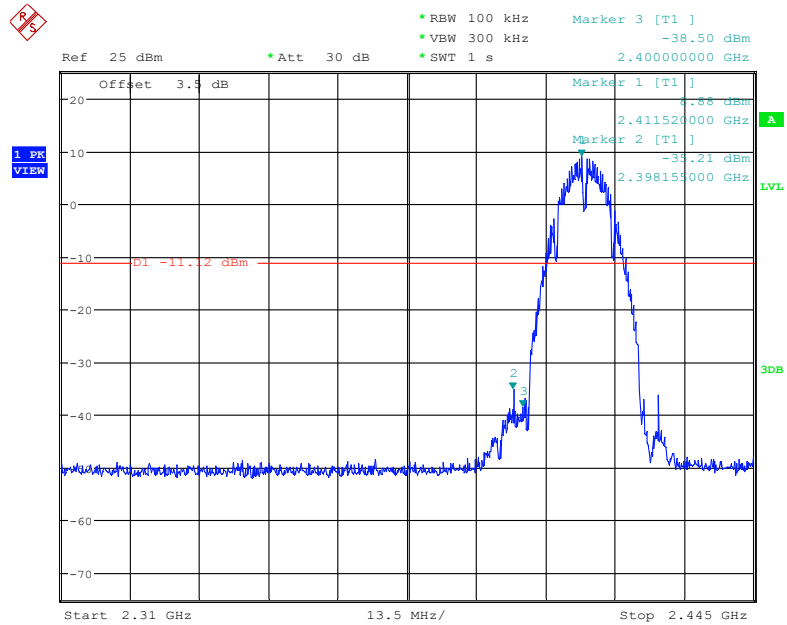
The testing was performed by Roger Ling from 2022-07-29 to 2022-08-05.

EUT operation mode: Transmitting

Test Result: Compliance

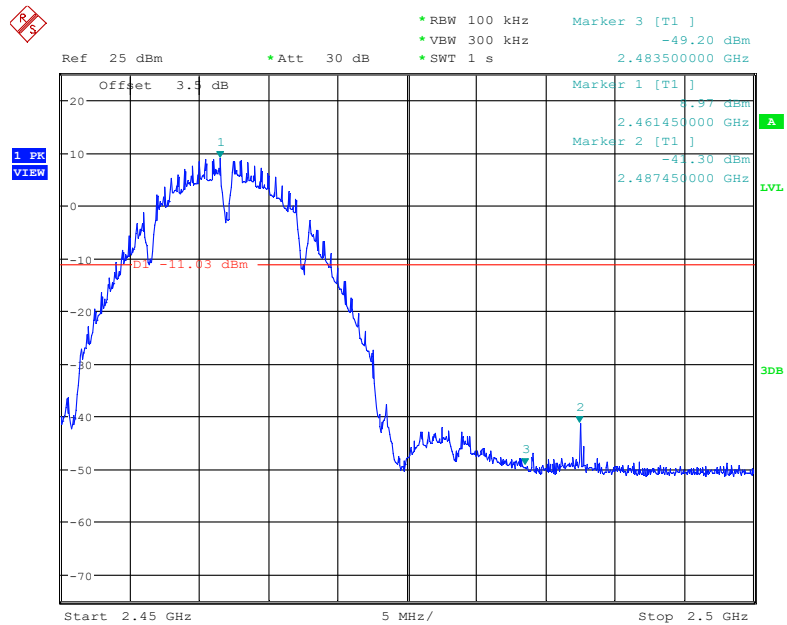
Please refer to the following plots.

802.11b: Band Edge, Left Side

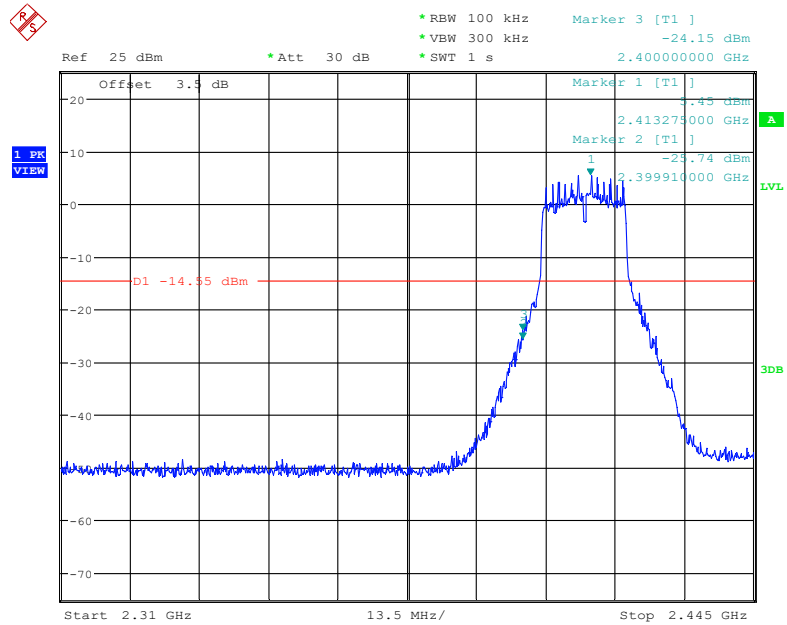


Date: 5.AUG.2022 13:29:12

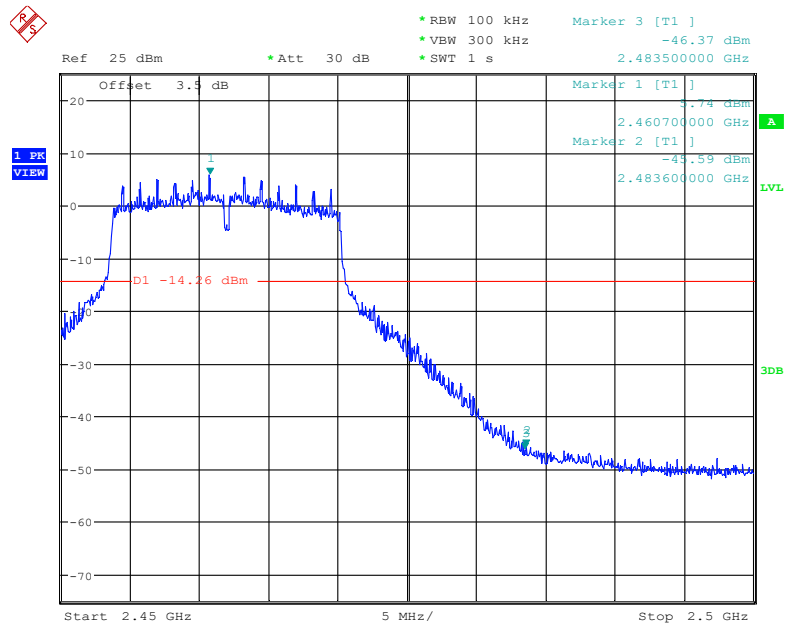
802.11b: Band Edge, Right Side



Date: 5.AUG.2022 13:34:44

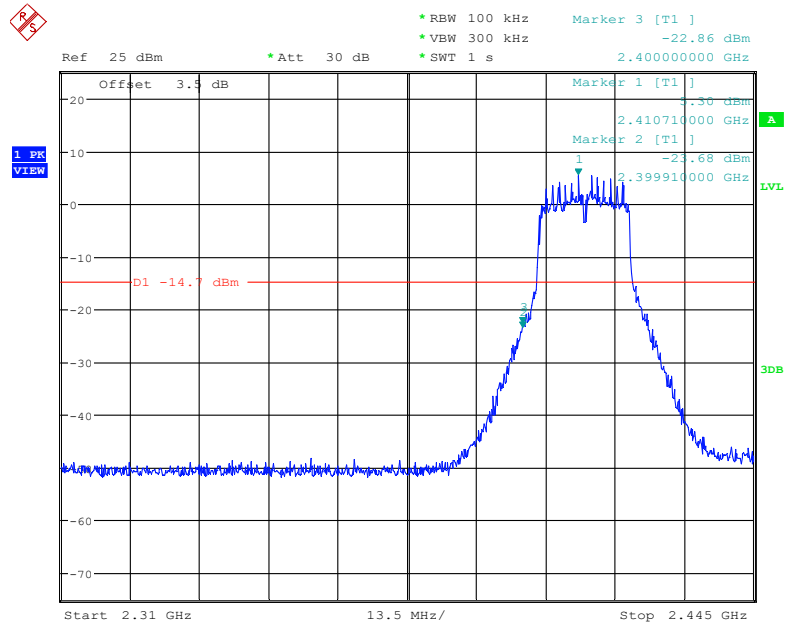
802.11g: Band Edge, Left Side

Date: 5.AUG.2022 13:37:48

802.11g: Band Edge, Right Side

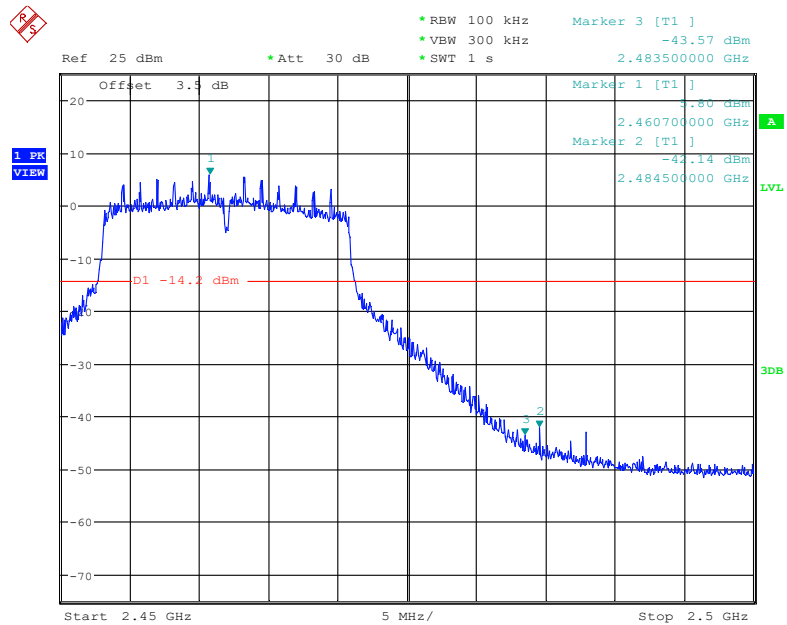
Date: 5.AUG.2022 13:43:02

802.11n-HT20: Band Edge, Left Side



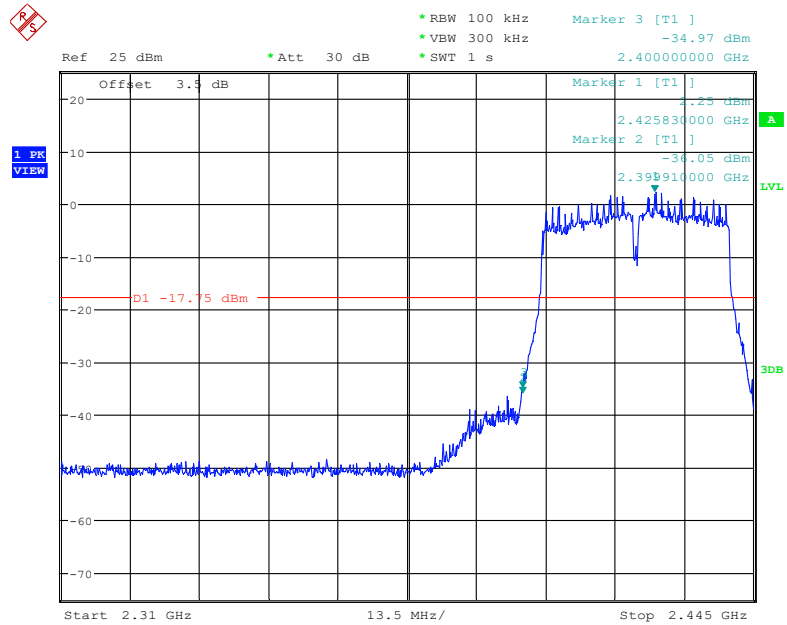
Date: 5.AUG.2022 13:46:23

802.11n-HT20: Band Edge, Right Side



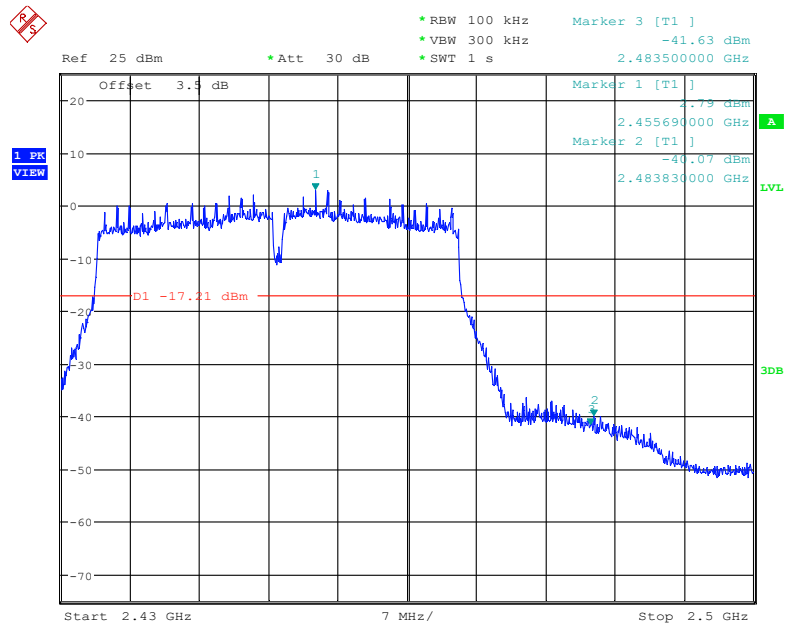
Date: 5.AUG.2022 13:52:29

802.11n-HT40: Band Edge, Left Side

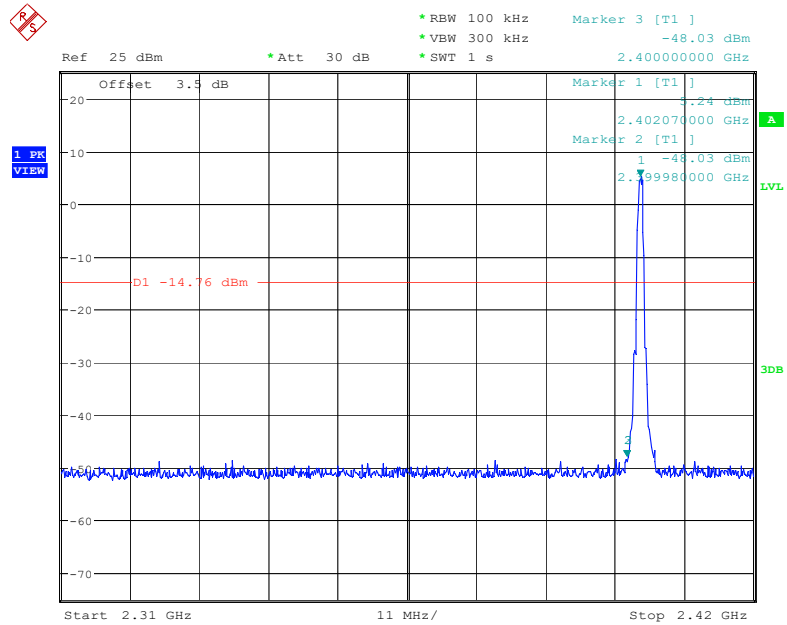


Date: 5.AUG.2022 13:56:18

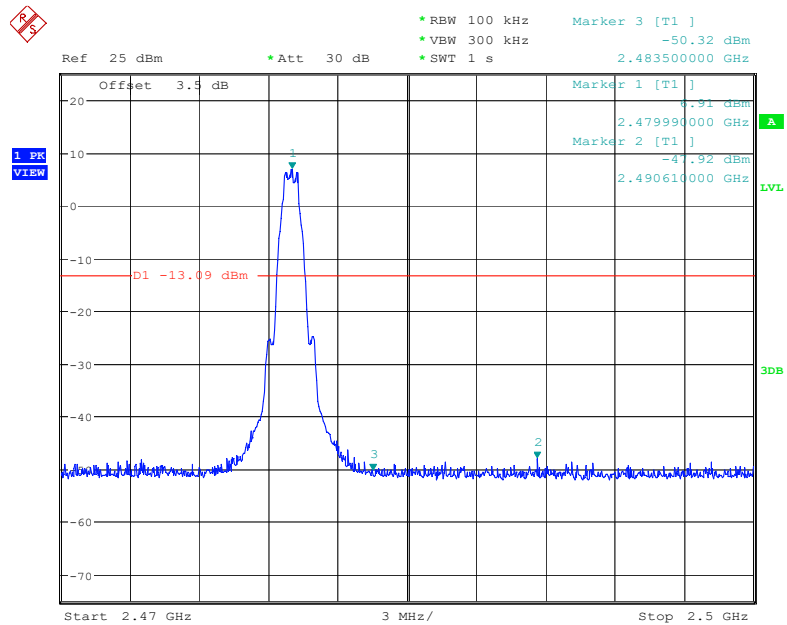
802.11n-HT40: Band Edge, Right Side



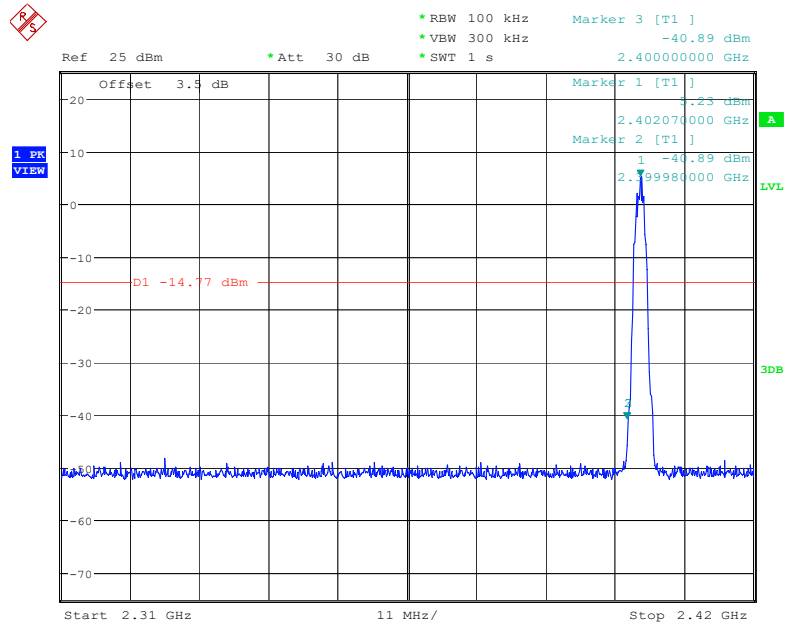
Date: 5.AUG.2022 14:01:32

BLE_1M: Band Edge, Left Side

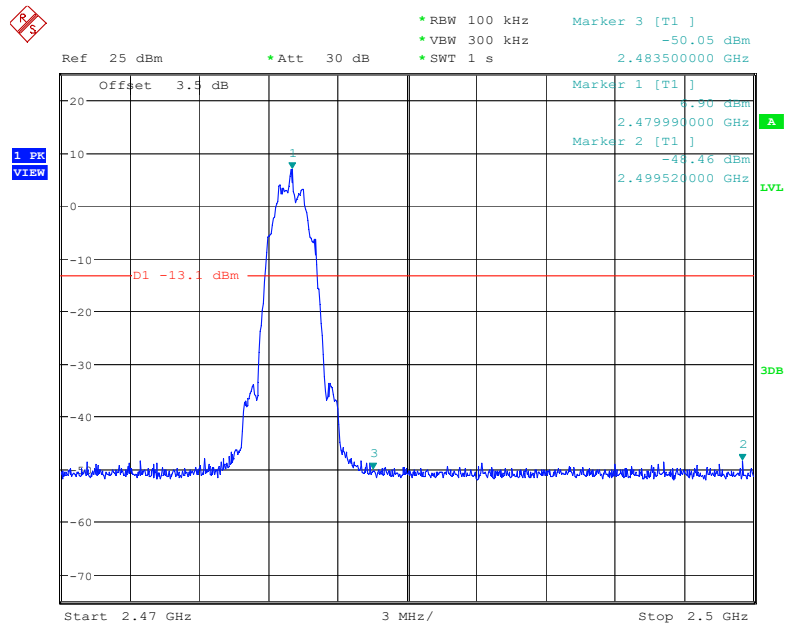
Date: 29.JUL.2022 20:05:27

BLE_1M: Band Edge, Right Side

Date: 29.JUL.2022 20:11:54

BLE_2M: Band Edge, Left Side

Date: 29.JUL.2022 20:23:41

BLE_2M: Band Edge, Right Side

Date: 29.JUL.2022 20:16:36

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

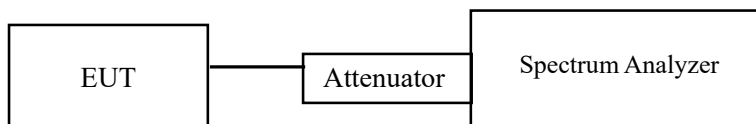
Applicable Standard

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 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 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: $3\text{ kHz} \leq \text{RBW} \leq 100\text{ kHz}$.
3. Set the VBW $\geq 3 \times \text{RBW}$.
4. Set the span to 1.5 times the DTS bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



Test Data

Environmental Conditions

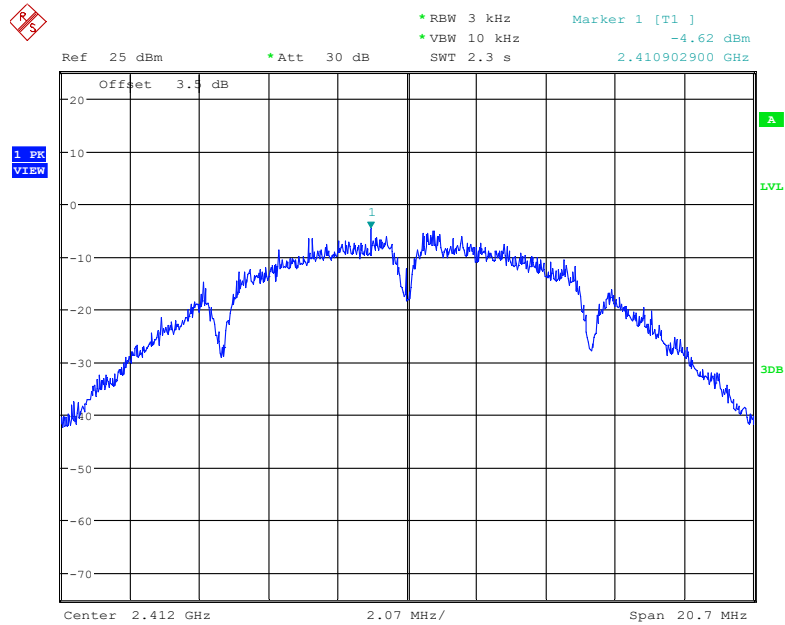
Temperature:	27.1 °C
Relative Humidity:	58 %
ATM Pressure:	101kPa

The testing was performed by Roger Ling from 2022-07-29 to 2022-08-22.

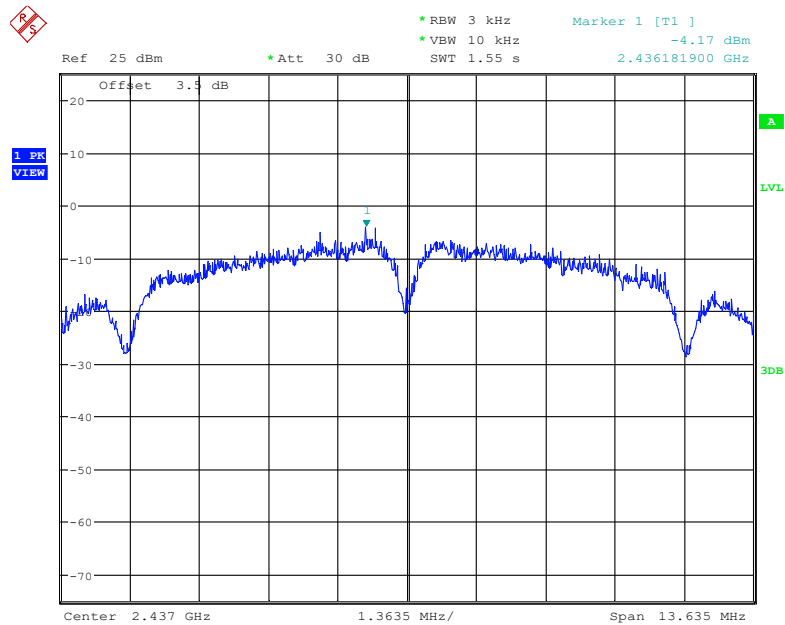
EUT operation mode: Transmitting

Test Result: Pass

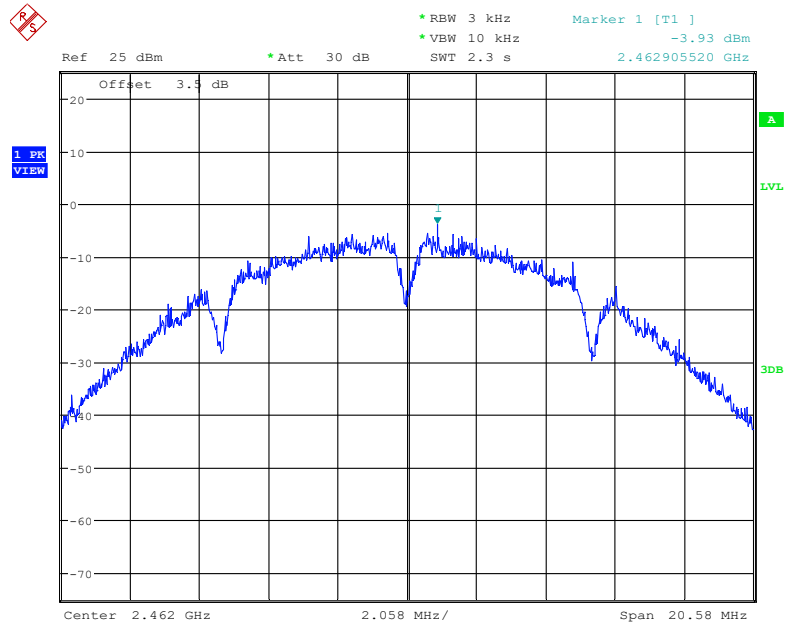
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-4.62	≤ 8
Middle	2437	-4.17	≤ 8
High	2462	-3.93	≤ 8
802.11g mode			
Low	2412	-9.44	≤ 8
Middle	2437	-8.67	≤ 8
High	2462	-9.30	≤ 8
802.11n-HT20 mode			
Low	2412	-8.88	≤ 8
Middle	2437	-10.00	≤ 8
High	2462	-9.79	≤ 8
802.11n-HT40 mode			
Low	2422	-13.86	≤ 8
Middle	2437	-13.48	≤ 8
High	2452	-12.44	≤ 8
BLE 1M mode			
Low	2402	-9.11	≤ 8
Middle	2440	-9.38	≤ 8
High	2480	-7.47	≤ 8
BLE 2M mode			
Low	2402	-12.90	≤ 8
Middle	2440	-12.91	≤ 8
High	2480	-11.08	≤ 8

Power Spectral Density, 802.11b Low Channel

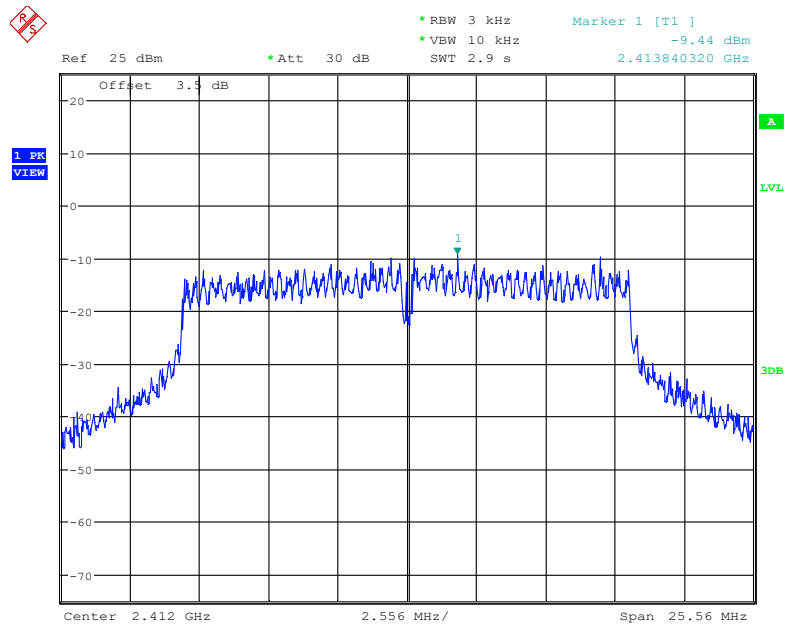
Date: 5.AUG.2022 13:28:45

Power Spectral Density, 802.11b Middle Channel

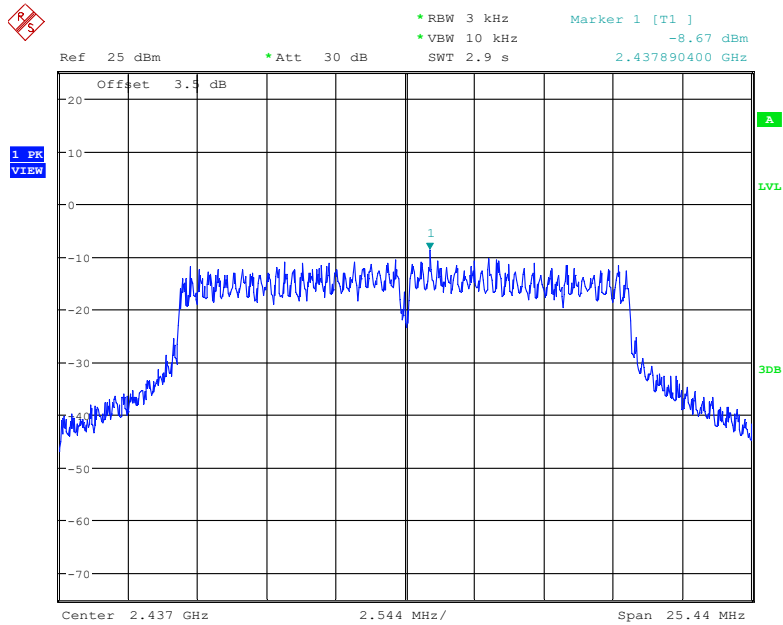
Date: 22.AUG.2022 17:35:33

Power Spectral Density, 802.11b High Channel

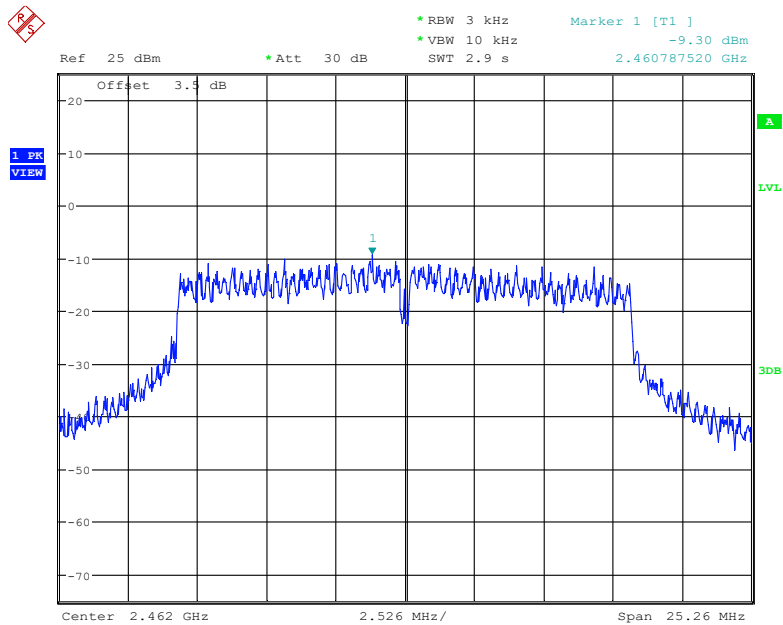
Date: 5.AUG.2022 13:34:16

Power Spectral Density, 802.11g Low Channel

Date: 5.AUG.2022 13:37:20

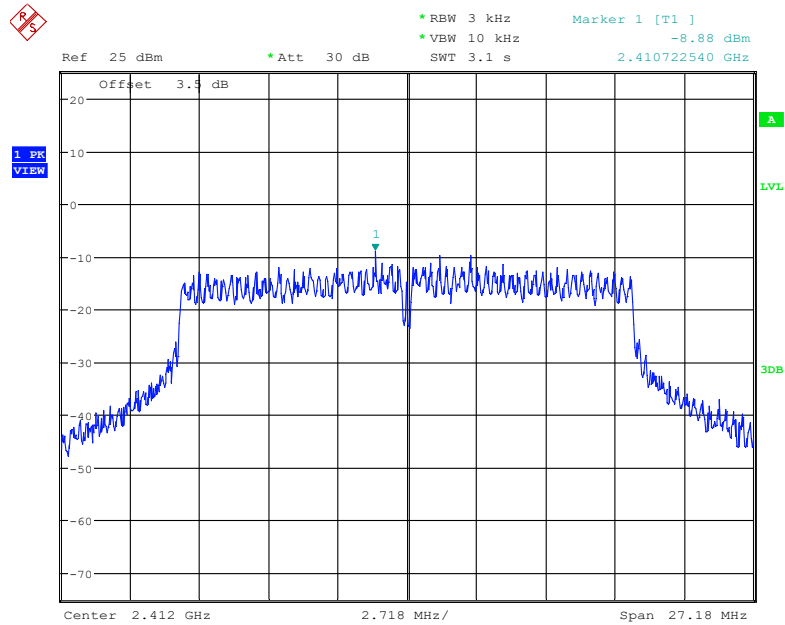
Power Spectral Density, 802.11g Middle Channel

Date: 5.AUG.2022 13:40:17

Power Spectral Density, 802.11g High Channel

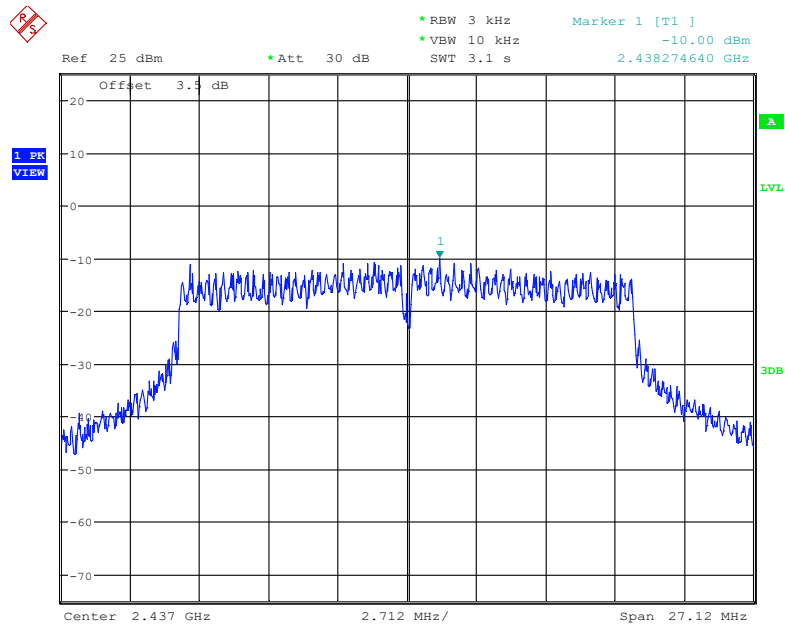
Date: 5.AUG.2022 13:42:34

Power Spectral Density, 802.11n-HT20 Low Channel

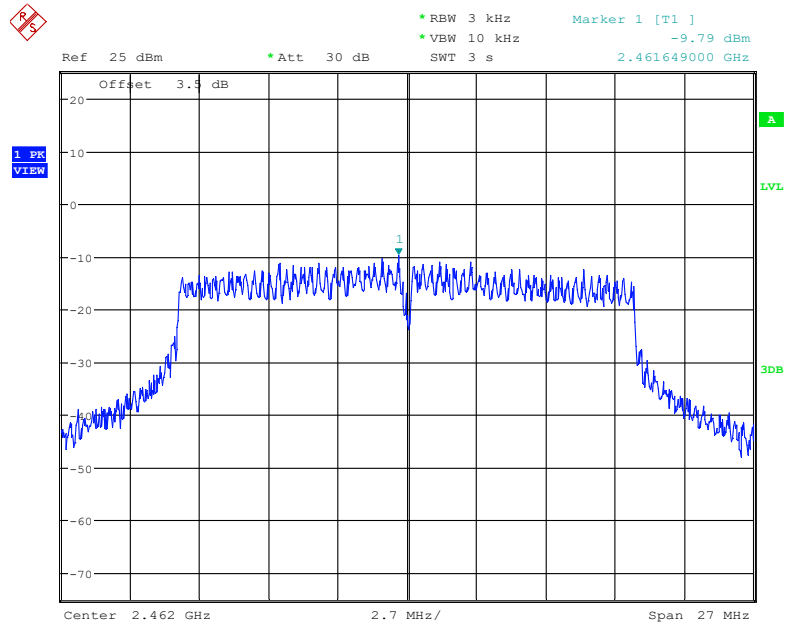


Date: 5.AUG.2022 13:45:55

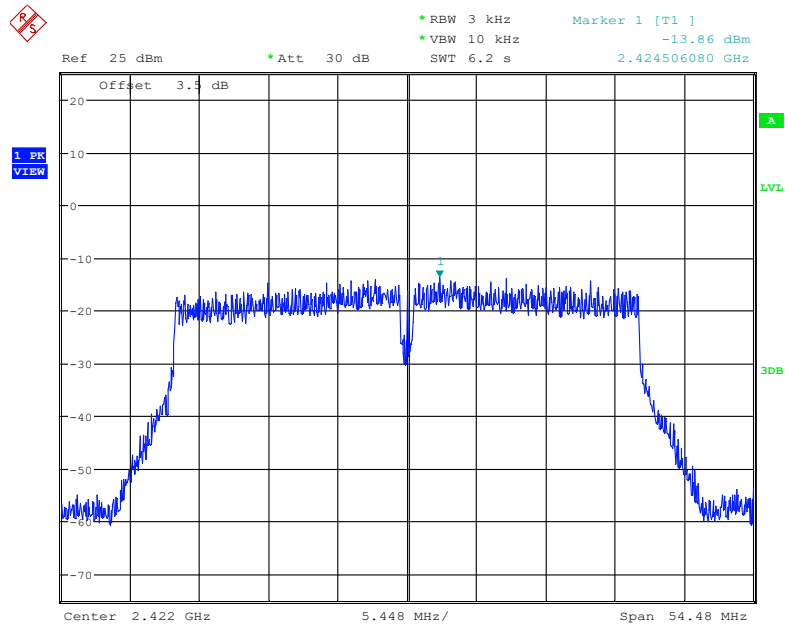
Power Spectral Density, 802.11n-HT20 Middle Channel



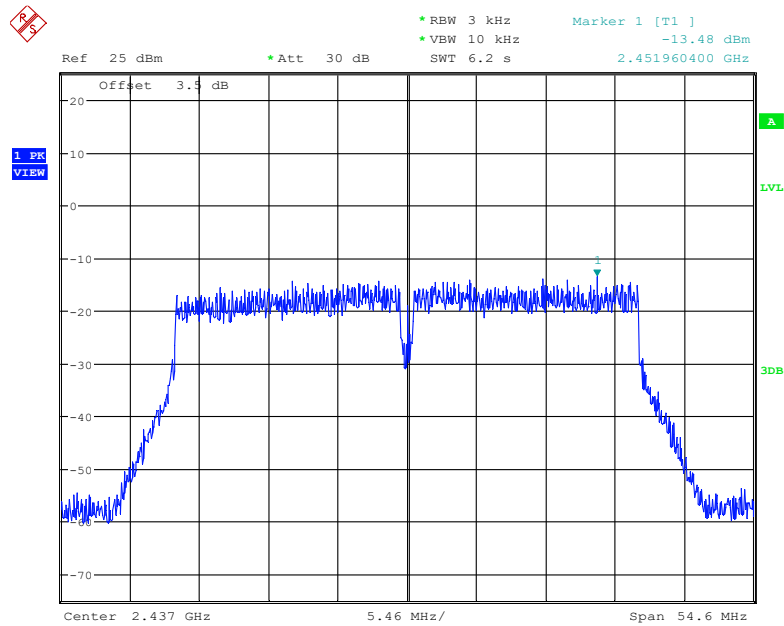
Date: 5.AUG.2022 13:49:05

Power Spectral Density, 802.11n-HT20 High Channel

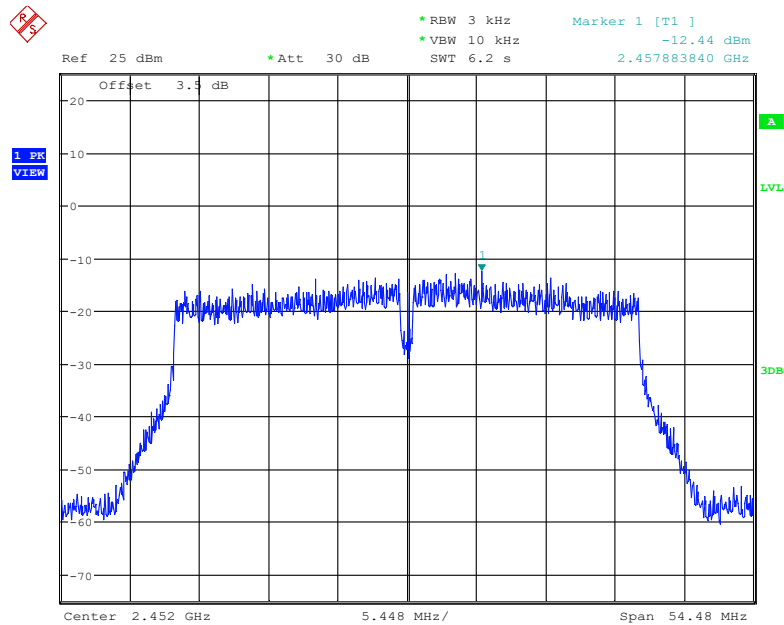
Date: 5.AUG.2022 13:52:02

Power Spectral Density, 802.11n-HT40 Low Channel

Date: 5.AUG.2022 13:55:50

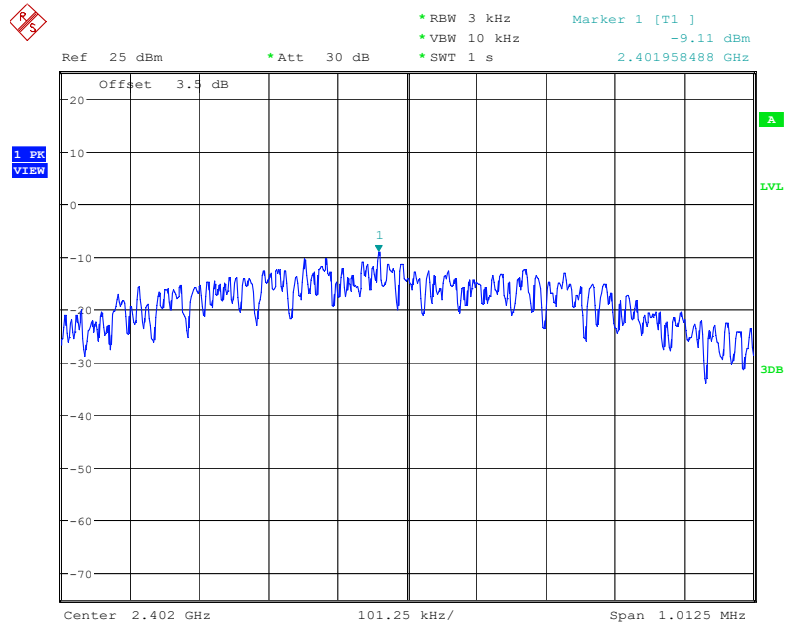
Power Spectral Density, 802.11n-HT40 Middle Channel

Date: 5.AUG.2022 13:58:45

Power Spectral Density, 802.11n-HT40 High Channel

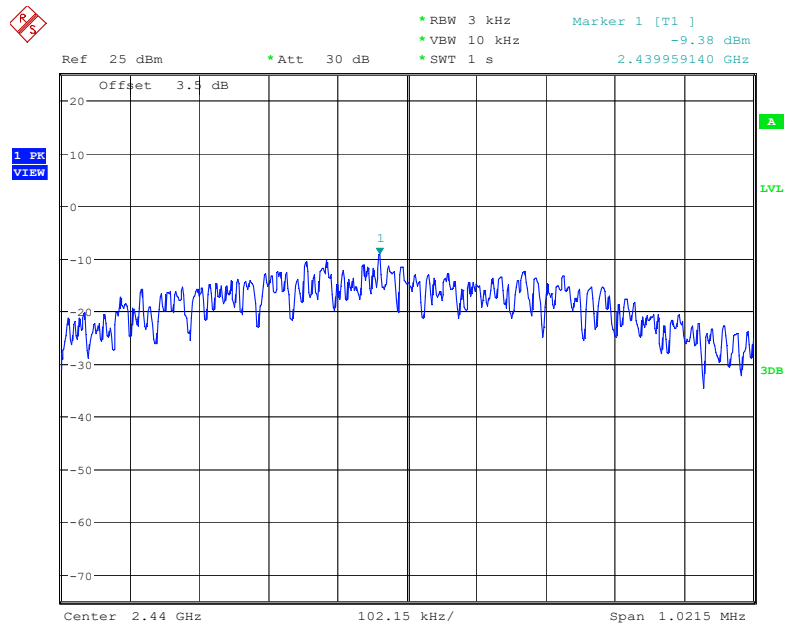
Date: 5.AUG.2022 14:01:05

Power Spectral Density, BLE_1M Low Channel

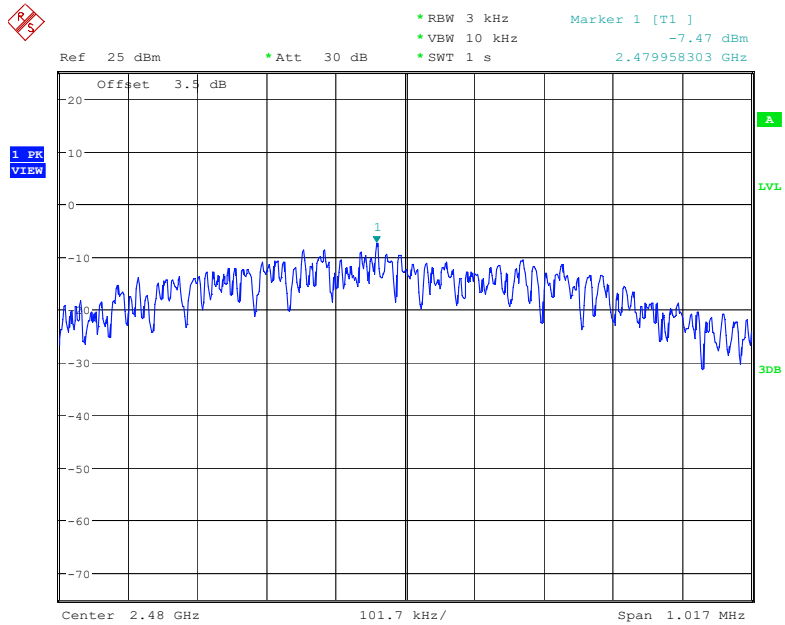


Date: 29.JUL.2022 20:04:59

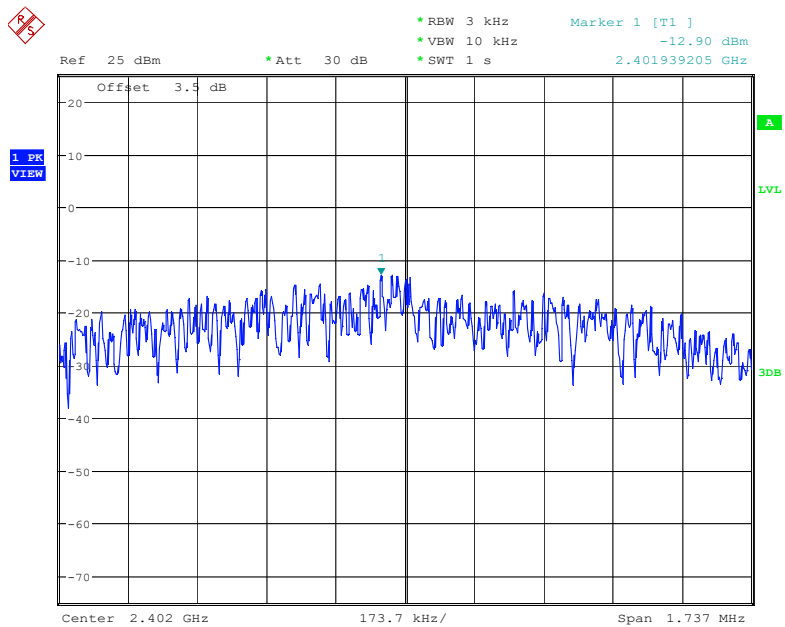
Power Spectral Density, BLE_1M Middle Channel



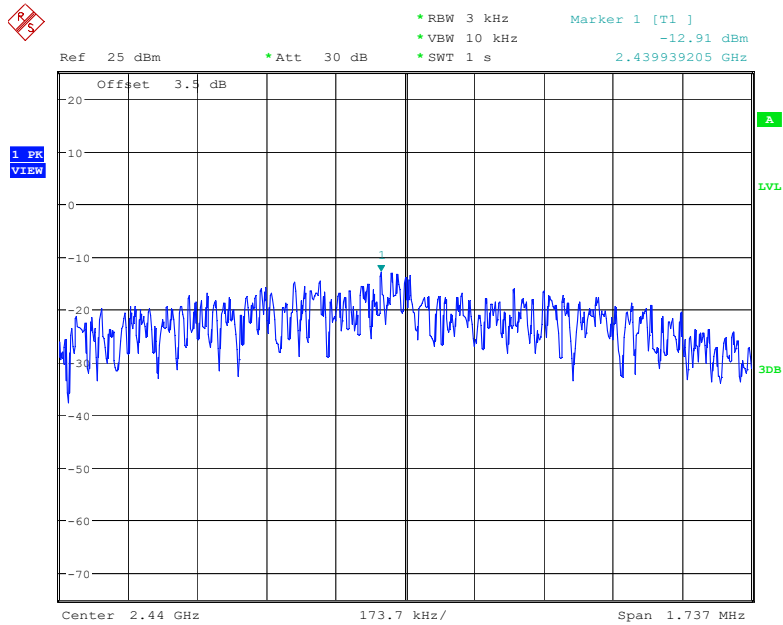
Date: 29.JUL.2022 20:09:04

Power Spectral Density, BLE_1M High Channel

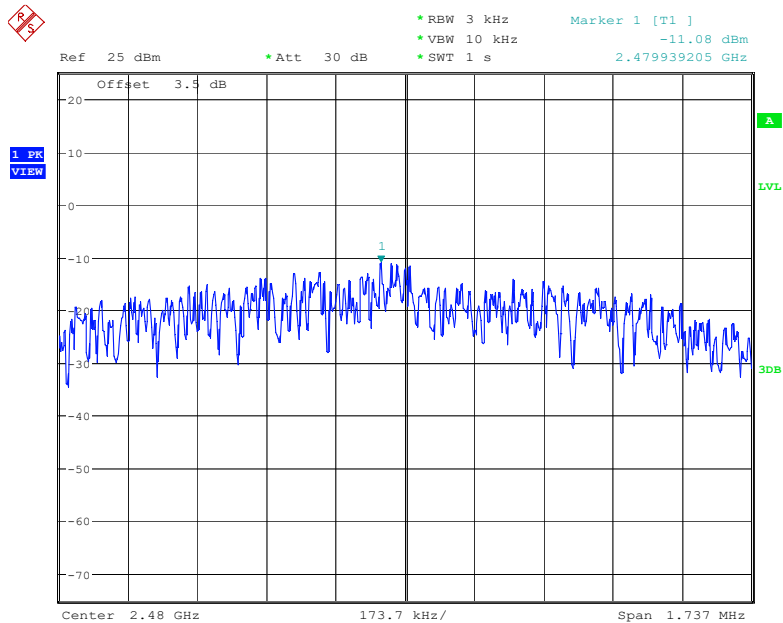
Date: 29.JUL.2022 20:11:26

Power Spectral Density, BLE_2M Low Channel

Date: 29.JUL.2022 20:23:14

Power Spectral Density, BLE_2M Middle Channel

Date: 29.JUL.2022 20:19:28

Power Spectral Density, BLE_2M High Channel

Date: 29.JUL.2022 20:16:08

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