TESTREPORT

Applicant Name :	Shenzhen MTC Lux Co., Ltd
Address :	A15,11F,Bldg F,West Sea Pearl Garden,XTY Rd South, NH Ave,NT Str,Nanshan Dis,Shenzhen, Guangdong,China
Factory :	Shenzhen MTC Lux Co., Ltd
Address :	MTC Industry Park, Xialilang Community, Nanwan Street, Longgang District, Shenzhen, China
Report Number:	SZ2220530-23664E-RF
FCC ID:	2A7MH-WBMCDA19

Test Standard (s)

FCC Part 15.247

Sample Description

Product:	Full Color Smart WiFi Light Bulbs
Tested Model:	WMCDA19-38**,** WBMCDA19-012T048UF-38,WMCDA19-012T048UF-38
Date Received:	2022-05-30
Date of Test:	2022-07-06 to 2022-07-09
Report Date:	2022-07-11

Test Result:	Pass*

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

Prepared andChecked By:

Jeff Jiang

EMC Engineer

Approved By:

Robert Li

EMC Engineer

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Full Color Smart WiFi Light Bulbs
Tested Model	WMCDA19-38
Multiple Model	WBMCDA19-012T048UF-38, WMCDA19-012T048UF-38
Model difference	Please refer to DOS letter.
Frequency Range	BLE: 2402-2480MHz Wi-Fi: 2412-2462MHz
Maximum Conducted Peak Output Power	BLE: 3.79dBm Wi-Fi: 16.88dBm(802.11b), 13.75dBm(802.11g), 13.32dBm(802.11n20), 12.96dBm(802.11n40)
Modulation Technique	BLE: GFSK Wi-Fi: DSSS, OFDM
Antenna Specification*	InternalCeramicAntenna: 1.2dBi(provided by the applicant)
Voltage Range	AC 120V/60Hz
Sample serial number	SZ2220530-23664E-RF-S1 (Assigned by ATC)
Sample/EUT Status	Good condition

Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices, and KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.72dB
Emissions, Radiated	30MHz - 1GHz	4.28dB
	1GHz- 18GHz	4.98dB
	18GHz- 26.5GHz	5.06dB
Temperature		1℃
Humidity		6%
Supply voltages		0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 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

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0016.The Registration Number is 5077A.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For 802.11b, 802.11g, 802.11n-HT20 and 802.11n-HT40 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	/	/

802.11b, 802.11g and 802.11n-HT20 modewas tested with Channel 1, 6 and 11.
802.11n-HT40 modewas tested with Channel 3, 6 and 9.

For BLE mode, 40 channels are provided to testing:

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

EUT was tested with Channel 0, 19 and 39.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

Software “Wifi Test Tool v1.6.0”* was used during testing and power level as below:

Mode	DataRate (Mbps)	Power Level*
802.11 b	1	18
802.11 g	6	22
802.11 n20	MCS0	18
802.11 n40	MCS0	24
BLE	1	Default

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

Duty cycle

Test Result: Compliant. Please refer to the Appendix Wi-Fi and Appendix BLE.

Support Equipment List and Details

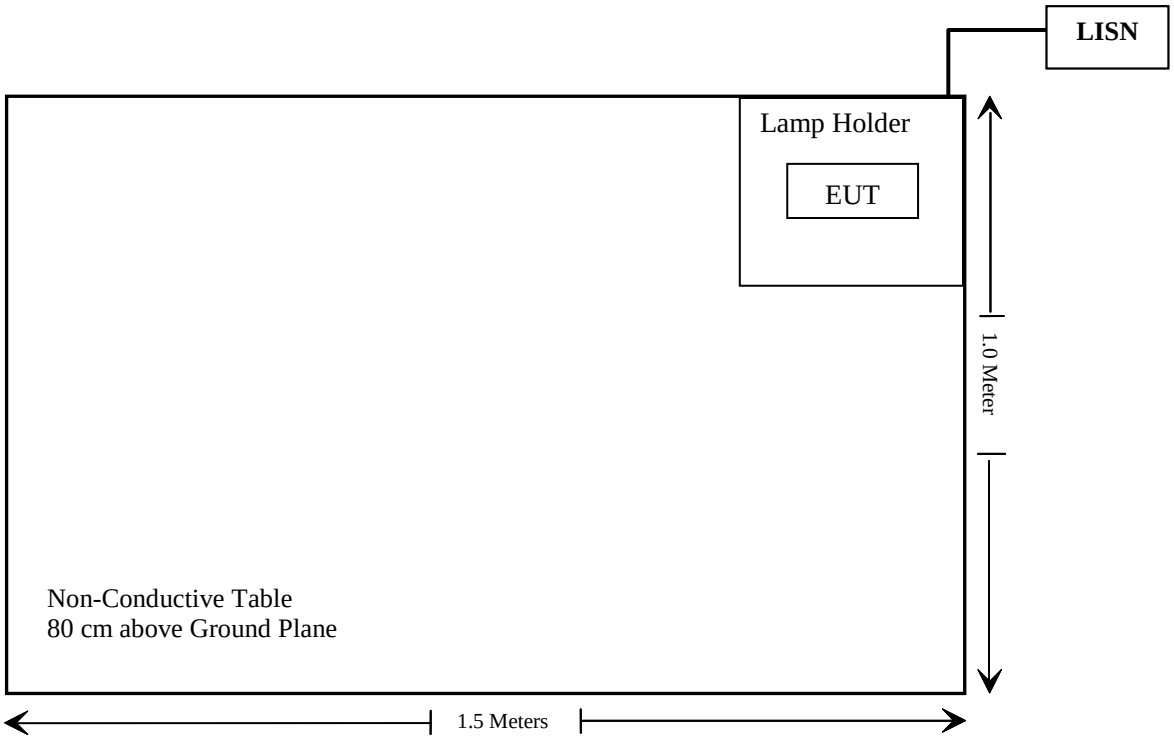
Manufacturer	Description	Model	Serial Number
Unknown	Lamp holder	Unknown	Unknown

External I/O Cable

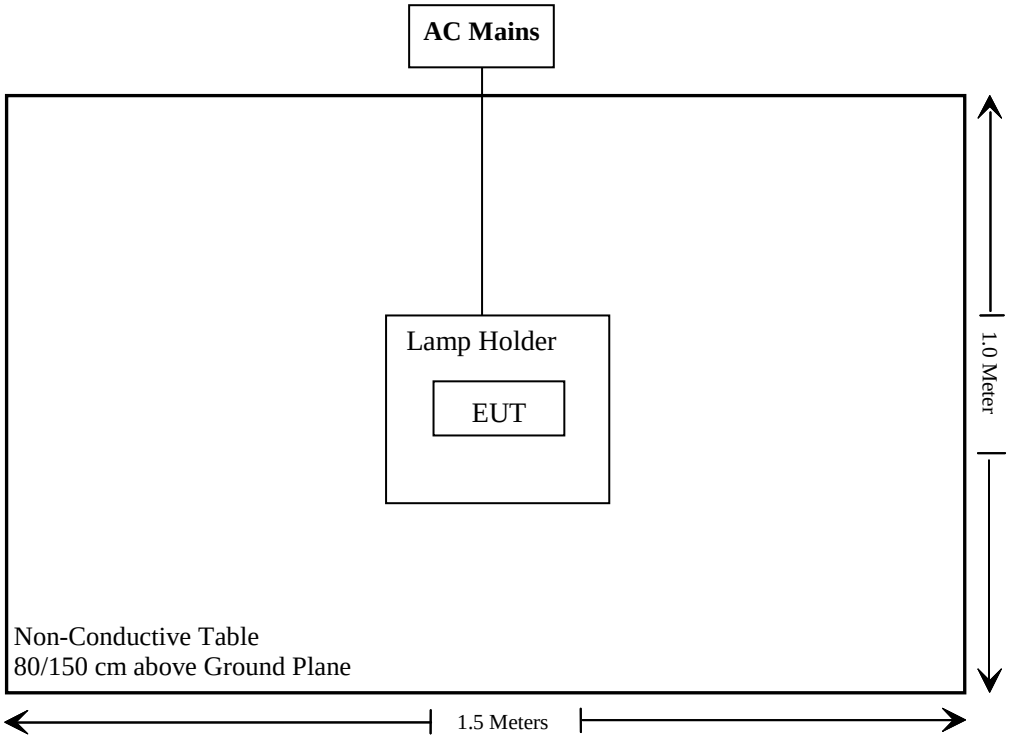
Cable Description	Length (m)	From Port	To
Un-shielding Detachable AC Cable	1.2	LISN	Lamp holder

Block Diagram of Test Setup

For conducted emission:



For Radiated emission:



SUMMARY OF TEST RESULTS

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

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde& Schwarz	EMI Test Receiver	ESCI	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
Wainwright	High Pass Filter	WHKX3.6/18G-10SS	5	2021/12/14	2022/12/13
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
Radiated Emission Test Software: e3 19821b (V9)					
RF Conducted Test					
Rohde&Schwarz	Spectrum Analyzer	FSV-40	101495	2021/12/13	2022/12/12
Rohde & Schwarz	Open Switch and ControlUnit	OSP120 + OSP-B157	101244 + 100866	2021/12/13	2022/12/12
WEINSCHEL	10dB Attenuator	5324	AU 3842	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.32	RF-02	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 §1.1307(b) – RF EXPOSURE

Applicable Standard

According to KDB 447498 D04 Interim General RF Exposure Guidance v01, clause 2.1.4–MPE-Based Exemption:

An alternative to the SAR-based exemption is provided in § 1.1307(b)(3)(i)(C), for a much wider frequency range, from 300 kHz to 100 GHz, applicable for separation distances greater or equal to $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. The MPE-based test exemption condition is in terms of ERP, defined as the product of the maximum antenna gain and the delivered maximum time-averaged power. For this case, a RF source is an RF exempt device if its ERP (watts) is no more than a frequency-dependent value, as detailed tabular form in Appendix B. These limits have been derived based on the basic specifications on Maximum Permissible Exposure (MPE) considered for the FCC rules in § 1.1310(e)(1).

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

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

f = frequency in MHz;
R = minimum separation distance from the body of a nearby person (appropriate units, e.g., m);

Test Result

For worst case:

Mode	Frequency Range (MHz)	Tune-up Output Power		Antenna Gain		ERP		Evaluation Distance (cm)	MPE-Based Exemption Limit (mW)
		(dBm)	(mW)	(dBi)	(dBd)	(dBm)	(mW)		
BLE	2402-2480	4	2.51	1.2	-0.95	3.05	2.02	20	768
2.4G Wi-Fi	2412-2462	17	50.12	1.2	-0.95	16.05	40.27	20	768

Note 1: The tune-up power was declared by the applicant.
Note 2: 0dBd=2.15dBi.
Note 3: The BLE can not transmit at the same time with the 2.4G Wi-Fi.

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

Result: Compliant.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

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

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

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

Antenna Connector Construction

The EUT has one Internal Ceramic Antenna arrangement, which was permanently attached and the antenna gain is 1.2 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

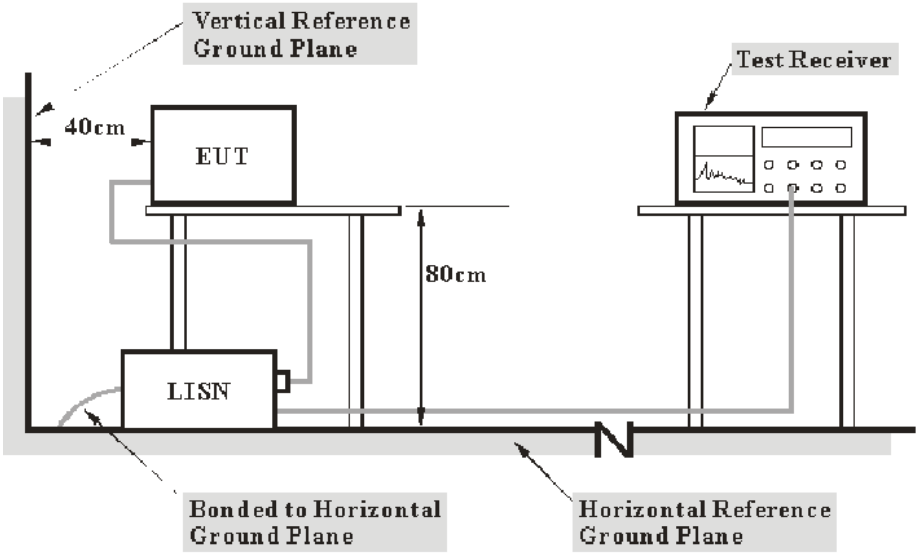
Result: Compliant.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

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

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

FrequencyRange	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Factor & Margin Calculation

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

Factor = LISN VDF + Cable Loss

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

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

Test Data

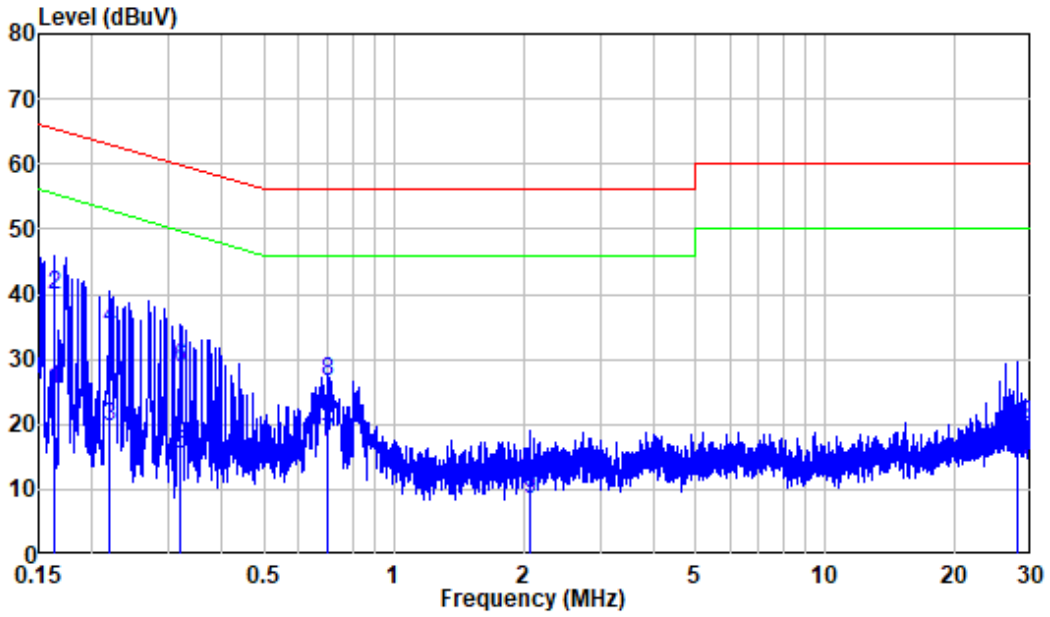
Environmental Conditions

Temperature:	24℃
Relative Humidity:	53 %
ATM Pressure:	101.2 kPa

The testing was performed by Jason Liu on 2022-07-06.

EUT worst operation mode: 2.4G WiFi Transmitting (Worst case for 802.11Bmiddle channel as below)

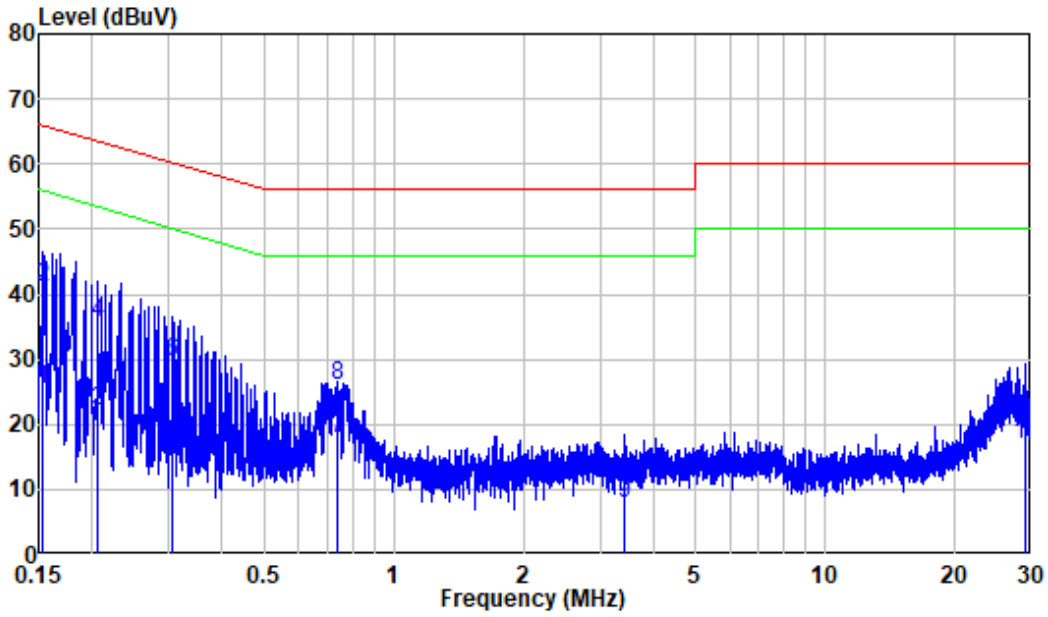
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Mode : 2.4G WiFi Transmitting
Model : WMCDA19-38
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.163	9.80	15.49	25.29	55.32	-30.03	Average
2	0.163	9.80	30.10	39.90	65.32	-25.42	QP
3	0.220	9.80	9.85	19.65	52.84	-33.19	Average
4	0.220	9.80	25.01	34.81	62.84	-28.03	QP
5	0.321	9.80	5.72	15.52	49.69	-34.17	Average
6	0.321	9.80	18.91	28.71	59.69	-30.98	QP
7	0.703	9.81	7.38	17.19	46.00	-28.81	Average
8	0.703	9.81	16.71	26.52	56.00	-29.48	QP
9	2.070	9.82	-1.48	8.34	46.00	-37.66	Average
10	2.070	9.82	1.50	11.32	56.00	-44.68	QP
11	27.911	10.08	4.55	14.63	50.00	-35.37	Average
12	27.911	10.08	9.88	19.96	60.00	-40.04	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Mode : 2.4G WiFi Transmitting
Model : WMCDA19-38
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.153	9.80	15.71	25.51	55.85	-30.34	Average
2	0.153	9.80	31.18	40.98	65.85	-24.87	QP
3	0.206	9.80	12.13	21.93	53.37	-31.44	Average
4	0.206	9.80	25.94	35.74	63.37	-27.63	QP
5	0.306	9.80	5.60	15.40	50.09	-34.69	Average
6	0.306	9.80	19.72	29.52	60.09	-30.57	QP
7	0.737	9.81	7.97	17.78	46.00	-28.22	Average
8	0.737	9.81	16.05	25.86	56.00	-30.14	QP
9	3.422	9.83	-2.12	7.71	46.00	-38.29	Average
10	3.422	9.83	1.40	11.23	56.00	-44.77	QP
11	28.927	10.19	6.86	17.05	50.00	-32.95	Average
12	28.927	10.19	11.57	21.76	60.00	-38.24	QP

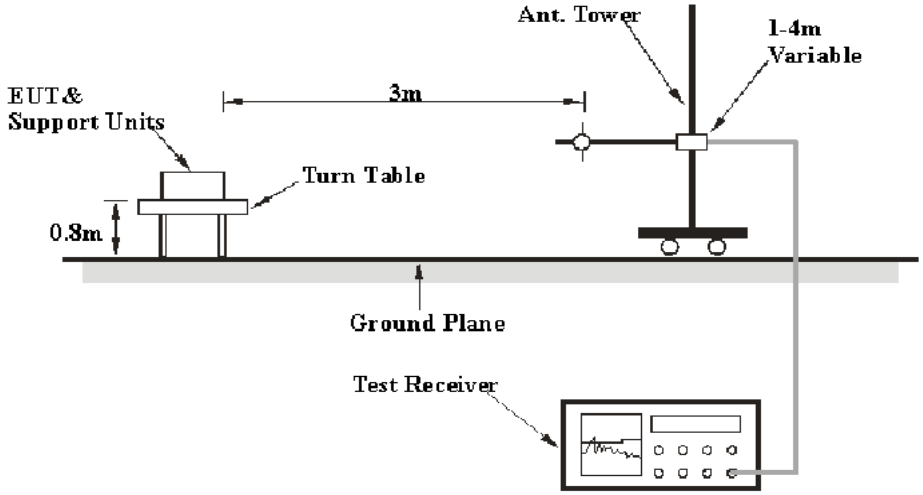
FCC §15.209, §15.205 &§15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

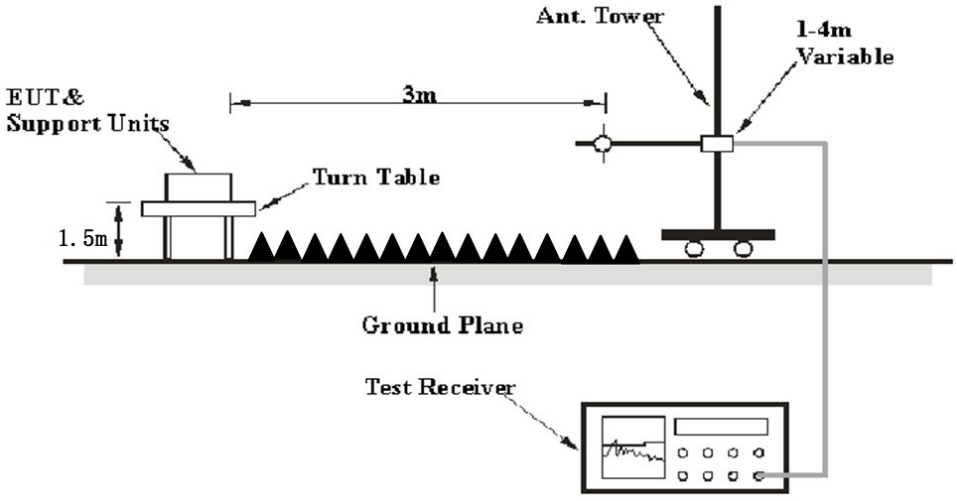
FCC §15.247 (d); §15.209;§15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30MHz – 1000 MHz	100 kHz	300 kHz	120kHz	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%

If the maximized peak measured value complies with the limit, then it is unnecessary to perform QP/Avera ge measurement.

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

Factor& Margin Calculation

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

Factor = Antenna Factor + Cable Loss - Amplifier Gain

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

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

Test Data

Environmental Conditions

Temperature:	21~24℃
Relative Humidity:	54~61 %
ATM Pressure:	101.0~108.0 kPa

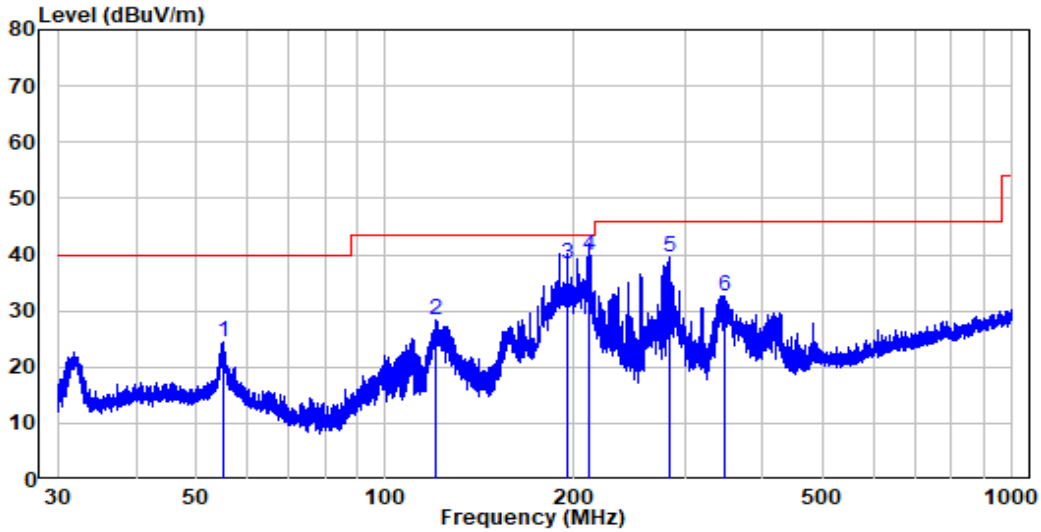
The testing was performed by Jimi Zhang on 2022-07-07 for below1Gand Level Li on 2022-07-09 for above 1G.

EUT worst operation mode: 2.4G WiFi (Pre-scan in the X,Y and Z axes of orientation, the worst case Y-axis of orientation was recorded)

30MHz-1GHz: (Worst case)

Wi-Fi: 802.11B mode, Middle Channel

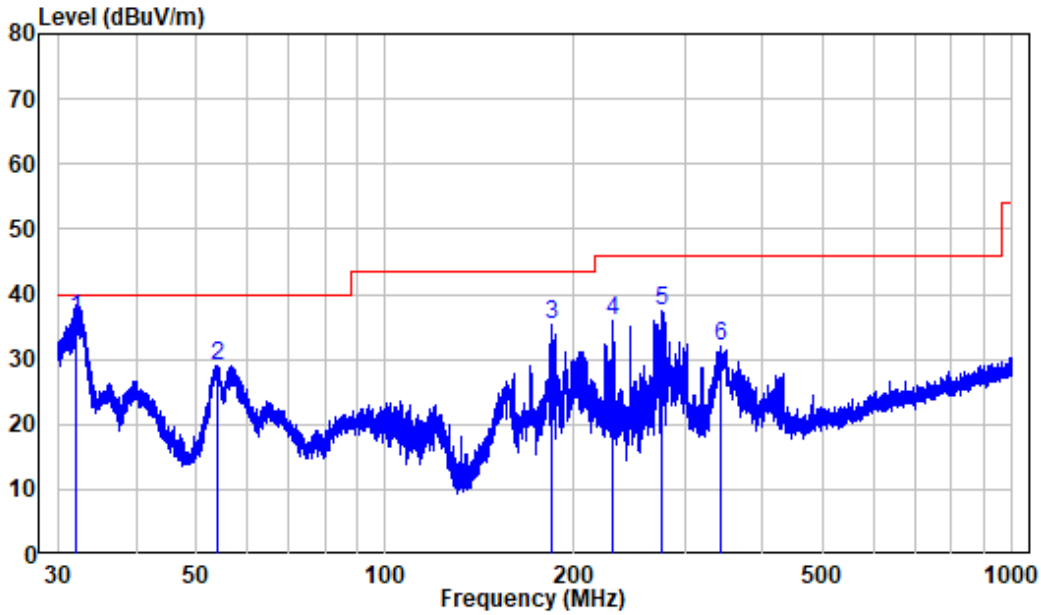
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : SZ2220530-23664E-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	55.124	-10.27	34.59	24.32	40.00	-15.68	Peak
2	120.488	-13.63	42.06	28.43	43.50	-15.07	Peak
3	194.966	-11.43	49.71	38.28	43.50	-5.22	QP
4	211.434	-11.80	51.74	39.94	43.50	-3.56	QP
5	284.104	-9.47	48.90	39.43	46.00	-6.57	Peak
6	347.418	-7.27	39.90	32.63	46.00	-13.37	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : SZ2220530-23664E-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	32.109	-12.15	48.41	36.26	40.00	-3.74	QP
2	54.071	-10.35	39.31	28.96	40.00	-11.04	Peak
3	184.328	-12.26	47.68	35.42	43.50	-8.08	Peak
4	229.897	-11.11	47.18	36.07	46.00	-9.93	Peak
5	276.608	-9.79	47.20	37.41	46.00	-8.59	Peak
6	342.579	-7.32	39.34	32.02	46.00	-13.98	Peak

1-25 GHz:

Wi-Fi:

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
	Reading (dBuV)	PK/AV		Height (m)	Polar (H/V)				
802.11B, Low Channel									
2310	44.44	PK	303	1.4	H	-7.23	37.21	74	-36.79
2310	44.68	PK	224	1.7	V	-7.23	37.45	74	-36.55
2390	48.09	PK	13	1.5	H	-7.21	40.88	74	-33.12
2390	49.24	PK	289	1.6	V	-7.21	42.03	74	-31.97
4824	52.3	PK	119	1.1	H	-3.53	48.77	74	-25.23
4824	53.37	PK	191	1.2	V	-3.53	49.84	74	-24.16
802.11B, Middle Channel									
4874	55.26	PK	150	1.3	H	-3.42	51.84	74	-22.16
4874	57.27	PK	299	2.1	V	-3.42	53.85	74	-20.15
802.11B, High Channel									
2483.5	47.95	PK	169	1.3	H	-7.2	40.75	74	-33.25
2483.5	51.06	PK	180	1.3	V	-7.2	43.86	74	-30.14
2500	44.06	PK	333	1.7	H	-7.18	36.88	74	-37.12
2500	45.9	PK	255	1.7	V	-7.18	38.72	74	-35.28
4924	53.05	PK	14	1.4	H	-3.16	49.89	74	-24.11
4924	54.1	PK	122	2.1	V	-3.16	50.94	74	-23.06
802.11G, Low Channel									
2310	44.66	PK	269	1.2	H	-7.23	37.43	74	-36.57
2310	46.02	PK	143	1.2	V	-7.23	38.79	74	-35.21
2390	49.07	PK	226	1.2	H	-7.21	41.86	74	-32.14
2390	51.53	PK	45	1.7	V	-7.21	44.32	74	-29.68
4824	51.29	PK	210	1.7	H	-3.53	47.76	74	-26.24
4824	52.96	PK	17	1.6	V	-3.53	49.43	74	-24.57
802.11G, Middle Channel									
4874	54.28	PK	54	1.2	H	-3.42	50.86	74	-23.14
4874	55.34	PK	130	1.5	V	-3.42	51.92	74	-22.08
802.11G, High Channel									
2483.5	45.52	PK	295	2.1	H	-7.2	38.32	74	-35.68
2483.5	47.08	PK	331	1.4	V	-7.2	39.88	74	-34.12
2500	47.61	PK	293	1.5	H	-7.18	40.43	74	-33.57
2500	51.93	PK	301	1.3	V	-7.18	44.75	74	-29.25
4924	51.39	PK	119	1.3	H	-3.16	48.23	74	-25.77
4924	53.47	PK	55	1.4	V	-3.16	50.31	74	-23.69

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
	Reading (dBuV)	PK/AV		Height (m)	Polar (H/V)				
802.11N20, Low Channel									
2310	44.21	PK	185	1.1	H	-7.23	36.98	74	-37.02
2310	45.75	PK	22	1.3	V	-7.23	38.52	74	-35.48
2390	46.92	PK	76	2.1	H	-7.21	39.71	74	-34.29
2390	50.43	PK	57	2.0	V	-7.21	43.22	74	-30.78
4824	52.26	PK	229	1.8	H	-3.53	48.73	74	-25.27
4824	53.95	PK	115	2.0	V	-3.53	50.42	74	-23.58
4824	53.95	PK	36	1.9	H	-3.53	50.42	74	-23.58
802.11N20, Middle Channel									
4874	54.23	PK	52	1.8	H	-3.42	50.81	74	-23.19
4874	55.88	PK	235	1.2	V	-3.42	52.46	74	-21.54
802.11N20, High Channel									
2483.5	47.99	PK	70	2.1	H	-7.2	40.79	74	-33.21
2483.5	51.13	PK	248	1.6	V	-7.2	43.93	74	-30.07
2500	44.76	PK	105	1.3	H	-7.18	37.58	74	-36.42
2500	46	PK	46	2.1	V	-7.18	38.82	74	-35.18
4924	53.67	PK	291	2.0	H	-3.16	50.51	74	-23.49
4924	54.84	PK	175	2.0	V	-3.16	51.68	74	-22.32
802.11N40, Low Channel									
2310	44.2	PK	277	1.8	H	-7.23	36.97	74	-37.03
2310	45.25	PK	275	1.3	V	-7.23	38.02	74	-35.98
2390	49.16	PK	312	2.0	H	-7.21	41.95	74	-32.05
2390	51.47	PK	41	1.4	V	-7.21	44.26	74	-29.74
4844	51.19	PK	254	2.2	H	-3.54	47.65	74	-26.35
4844	53.38	PK	320	2.2	V	-3.54	49.84	74	-24.16
802.11N40, Middle Channel									
4874	53.05	PK	249	1.9	H	-3.42	49.63	74	-24.37
4874	55.41	PK	52	1.5	V	-3.42	51.99	74	-22.01
802.11N40, High Channel									
2483.5	44.77	PK	247	1.2	H	-3.26	41.51	74	-32.49
2483.5	47.05	PK	76	1.5	V	-3.26	43.79	74	-30.21
2500	40.59	PK	318	1.2	H	-3.26	37.33	74	-36.67
2500	42.56	PK	153	1.9	V	-3.26	39.30	74	-34.70
4904	52.14	PK	168	1.8	H	-3.16	48.98	74	-25.02
4904	53.06	PK	193	2.0	V	-3.16	49.90	74	-24.10

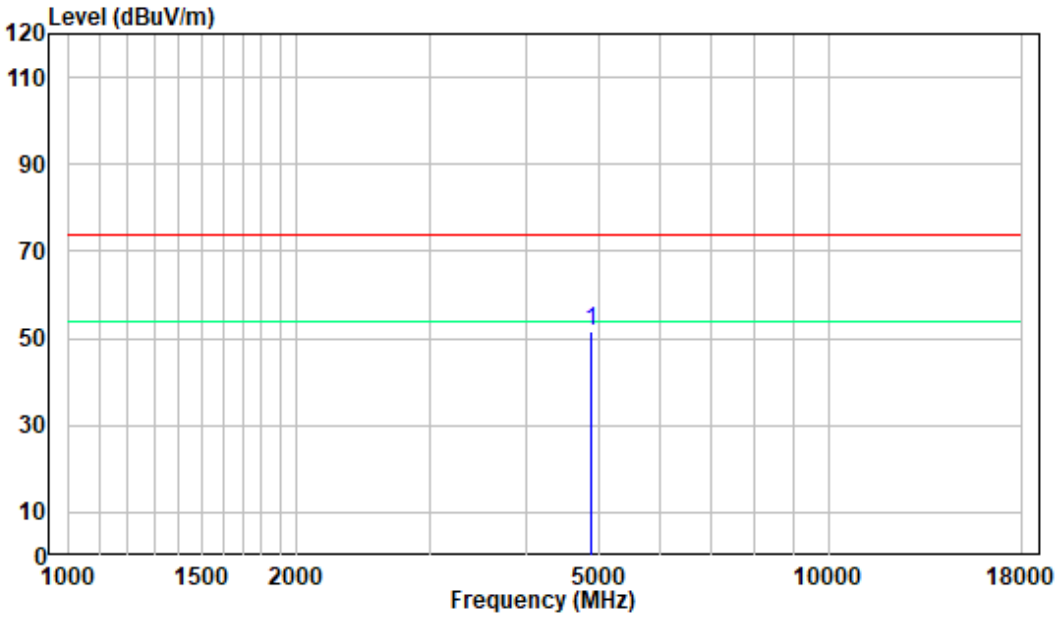
BLE:

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
	Reading (dBuV)	PK/Ave		Height (m)	Polar (H/V)				
BLE 1M, Low Channel									
2310	43.73	PK	108	1.7	H	-7.23	36.5	74	-37.5
2310	43.41	PK	169	2.0	V	-7.23	36.18	74	-37.82
2390	46.58	PK	312	1.7	H	-7.21	39.37	74	-34.63
2390	51.06	PK	47	2.1	V	-7.21	43.85	74	-30.15
4804	52.21	PK	290	1.3	H	-3.52	48.69	74	-25.31
4804	53.07	PK	352	1.5	V	-3.52	49.55	74	-24.45
BLE 1M, Middle Channel									
4880	49.02	PK	12	1.2	H	-3.38	45.64	74	-28.36
4880	50.65	PK	321	1.9	V	-3.38	47.27	74	-26.73
BLE 1M, High Channel									
2483.5	49.86	PK	121	1.4	H	-7.2	42.66	74	-31.34
2483.5	44.54	PK	328	1.2	V	-7.2	37.34	74	-36.66
2500	44.05	PK	233	2.0	H	-7.18	36.87	74	-37.13
2500	45.11	PK	252	2.1	V	-7.18	37.93	74	-36.07
4960	50.17	PK	315	1.4	H	-3.01	47.16	74	-26.84
4960	51.83	PK	86	1.4	V	-3.01	48.82	74	-25.18

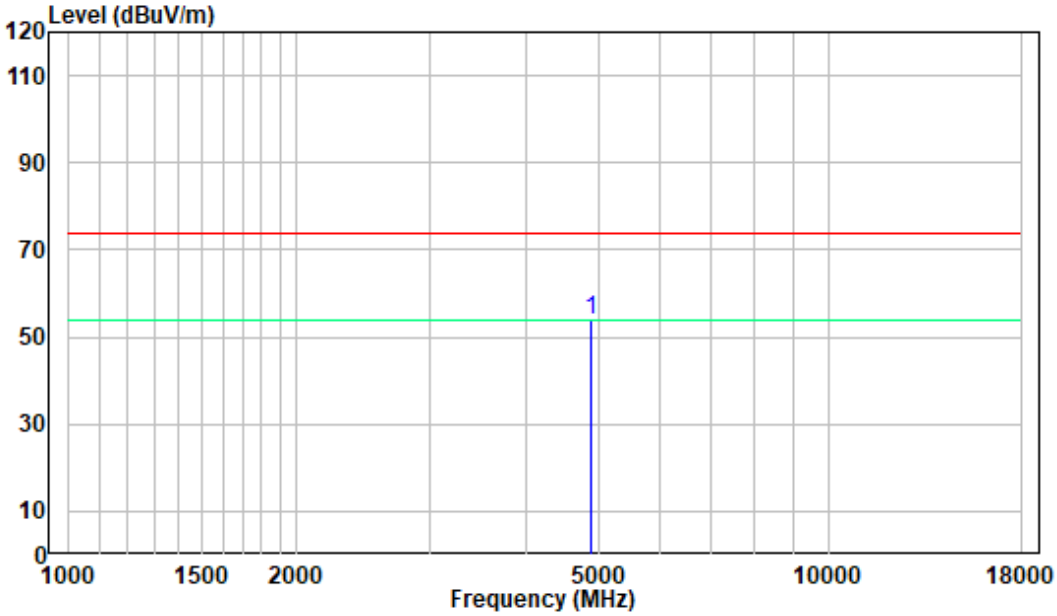
Note:
Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Absolute Level (Corrected Amplitude)= Factor + Reading
Margin = Absolute Level (Corrected Amplitude) –Limit
The other spurious emission which is in the noise floor level was not recorded.
For above 1GHz, the test result of peak was 20dB below to the limit of peak, which can be compliant to the average limit, so just peak value was recorded.

1-18 GHz:(Worst case)

Pre-scan plots
802.11 b Middle Channel
Horizontal

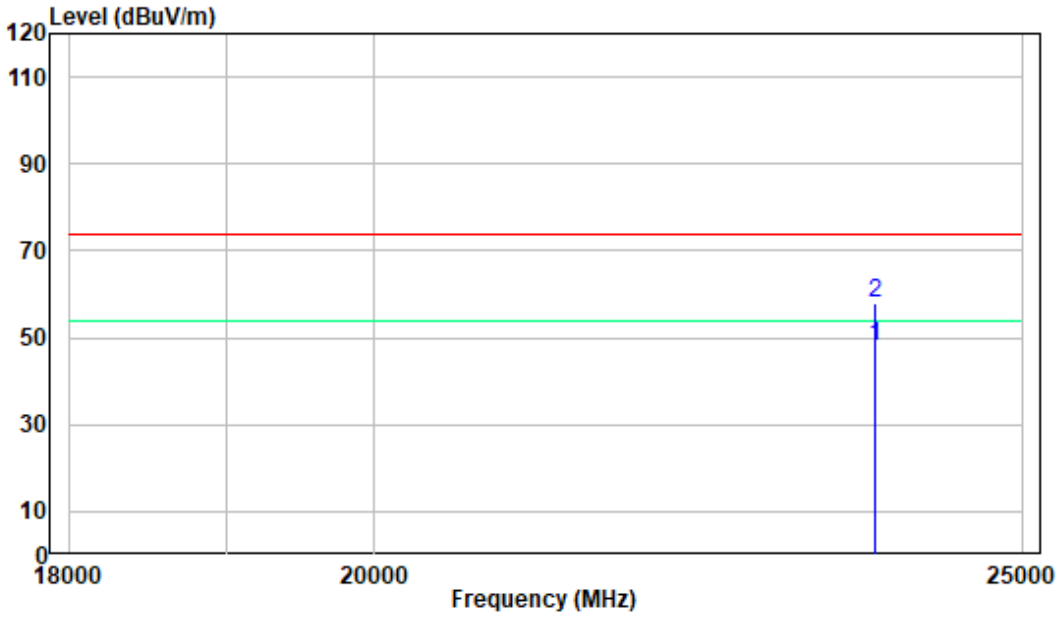


Vertical

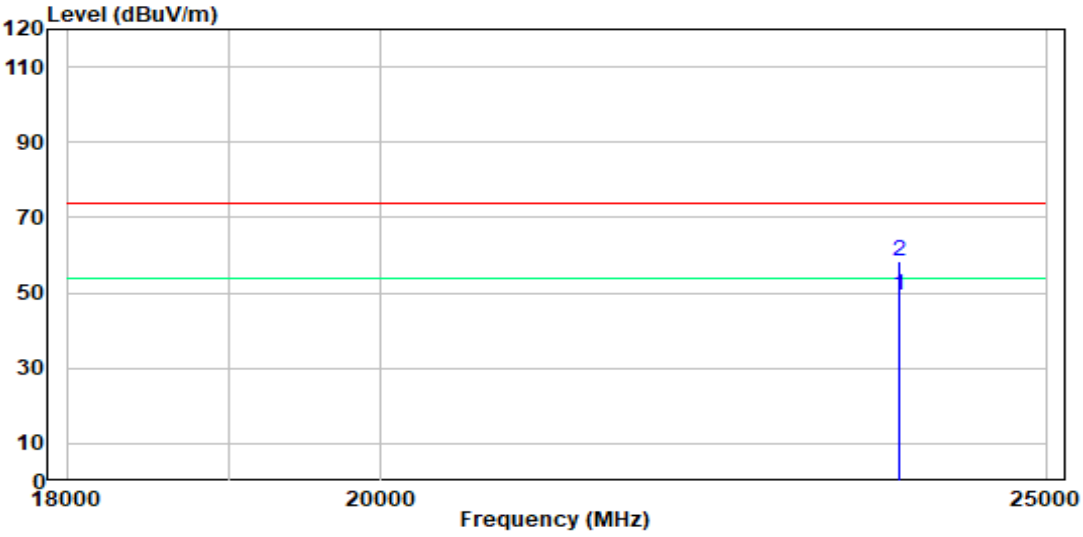


18 -25GHz: (Worst case)

Pre-scan plots
802.11 b Middle Channel
Horizontal



Vertical



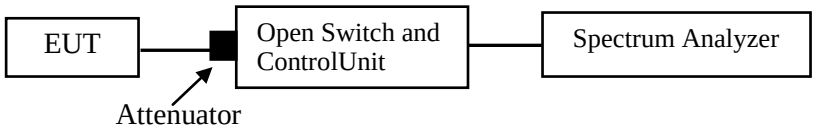
FCC §15.247(A) (2) – 6 DB EMISSION BANDWIDTH& OCCUPIED BANDWIDTH

Applicable Standard

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

Test Procedure

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



Test Data

Environmental Conditions

Temperature:	21 ~ 23 ℃
Relative Humidity:	51 ~ 52 %
ATM Pressure:	101.0~101.1 kPa

The testing was performed by Cat Kang on 2022-07-06 for BLE and 2022-07-07 for Wi-Fi.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix Wi-Fi and Appendix BLE.

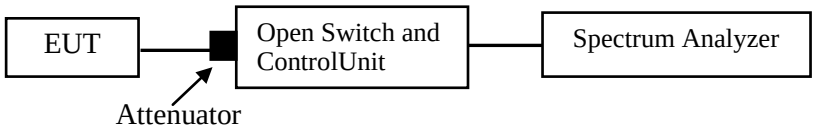
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

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

Test Procedure

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



Test Data

Environmental Conditions

Temperature:	21 ~ 23 ℃
Relative Humidity:	51 ~ 52 %
ATM Pressure:	101.0~101.1kPa

The testing was performed by Cat Kang on 2022-07-06 for BLE and 2022-07-07 for Wi-Fi.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix Wi-Fi and Appendix BLE.

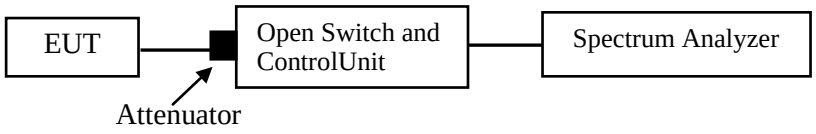
FCC §15.247(d) – 100kHz BANDWIDTH OF FREQUENCY BAND EDGE

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:	21 ~ 23 ℃
Relative Humidity:	51 ~ 52 %
ATM Pressure:	101.0~101.1 kPa

The testing was performed by Cat Kang on 2022-07-06 for BLE and 2022-07-07 for Wi-Fi.

EUT operation mode: Transmitting

Test Result: Compliant.

Conducted Band Edge Result:

Please refer to the Appendix Wi-Fi and Appendix BLE.

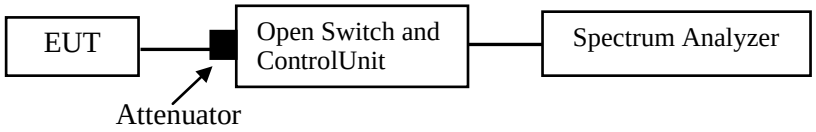
FCC §15.247(e)- POWER SPECTRAL DENSITY

Applicable Standard

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

Test Procedure

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



Test Data

Environmental Conditions

Temperature:	21 ~ 23 ℃
Relative Humidity:	51 ~ 52 %
ATM Pressure:	101.0~101.1 kPa

The testing was performed by Cat Kang on 2022-07-06 for BLE and 2022-07-07 for Wi-Fi..

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix Wi-Fi and Appendix BLE.

APPENDIX Wi-Fi

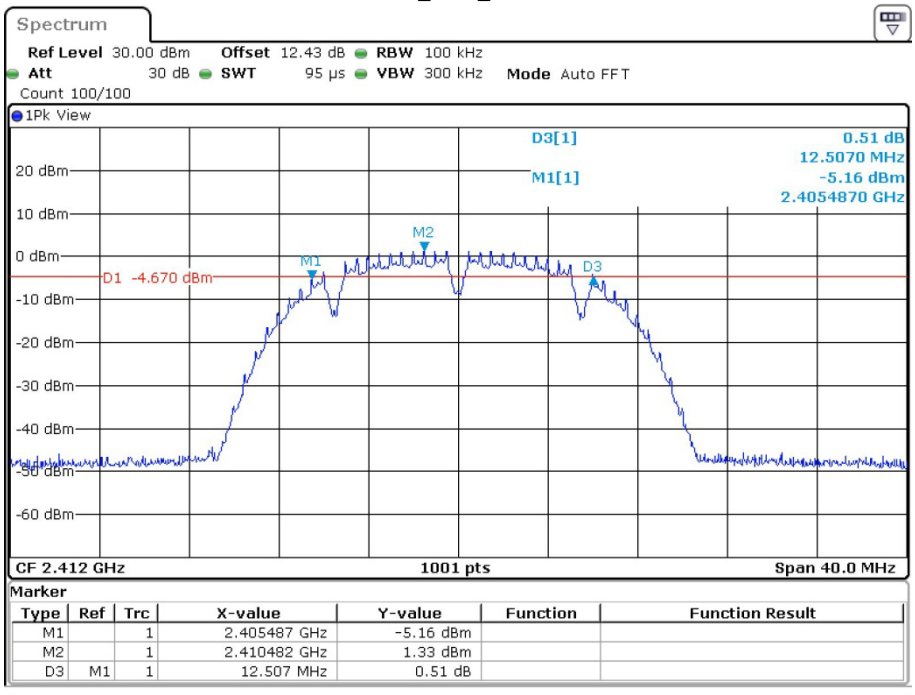
Appendix A: 6dB Emission Bandwidth

Test Result

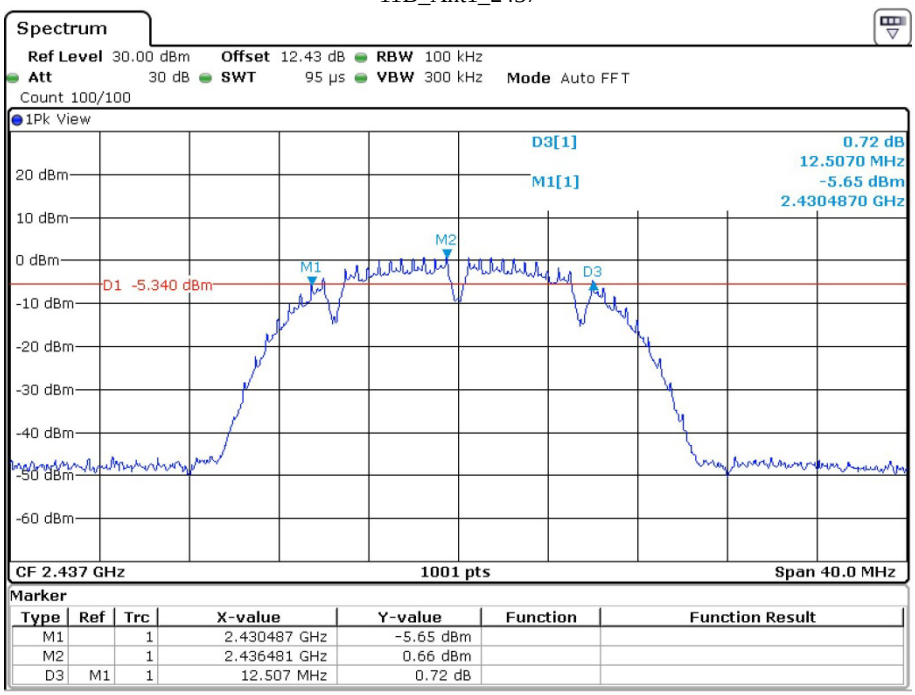
TestMode	Antenna	Channel [MHz]	DTS BW [MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	12.507	0.5	PASS
		2437	12.507	0.5	PASS
		2462	12.160	0.5	PASS
11G	Ant1	2412	15.200	0.5	PASS
		2437	15.200	0.5	PASS
		2462	15.200	0.5	PASS
11N20SISO	Ant1	2412	13.880	0.5	PASS
		2437	13.880	0.5	PASS
		2462	15.200	0.5	PASS
11N40SISO	Ant1	2422	35.200	0.5	PASS
		2437	35.200	0.5	PASS
		2452	35.200	0.5	PASS

Test Graphs

11B_Ant1_2412

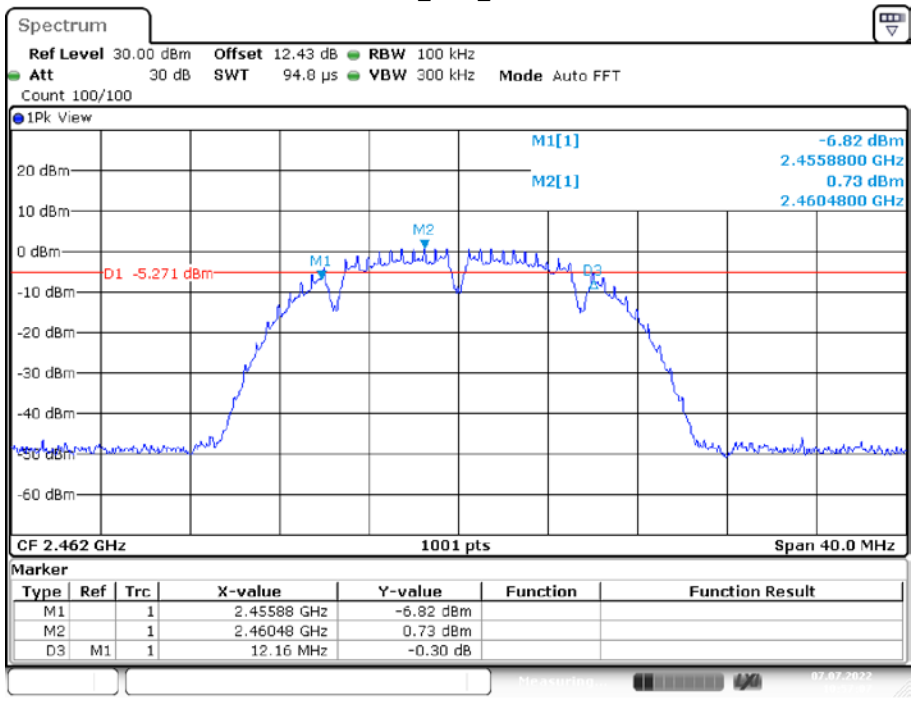


11B_Ant1_2437



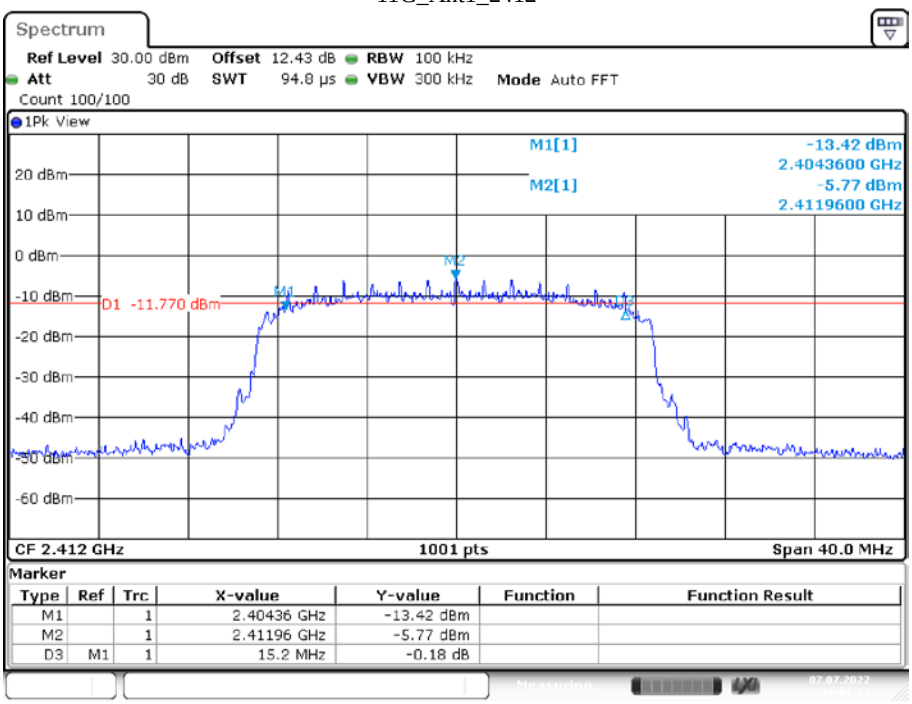
Date: 7.JUL.2022 11:20:46

11B_Ant1_2462



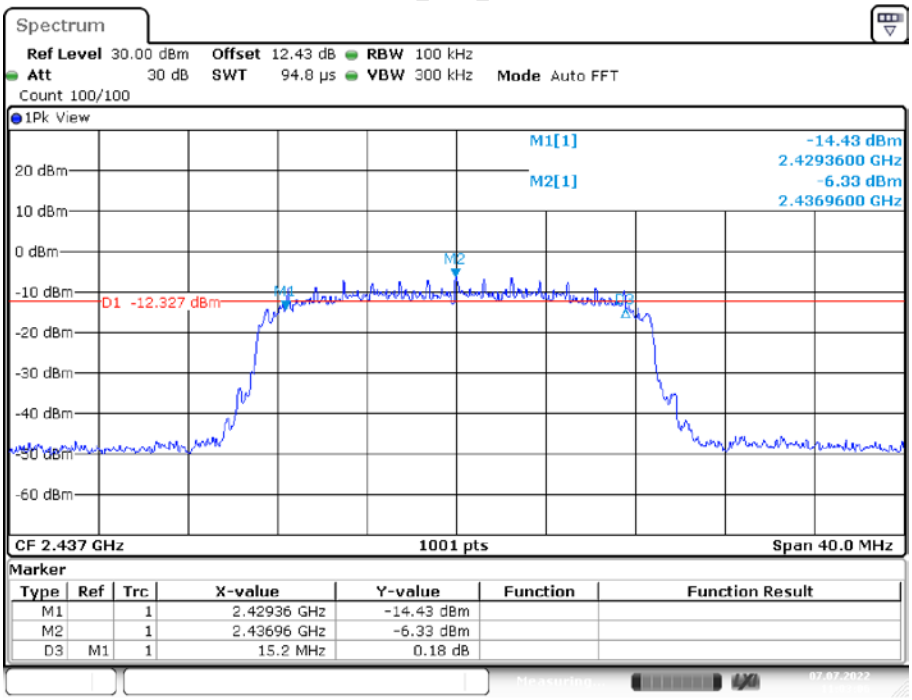
Date: 7.JUL.2022 10:57:08

11G_Ant1_2412



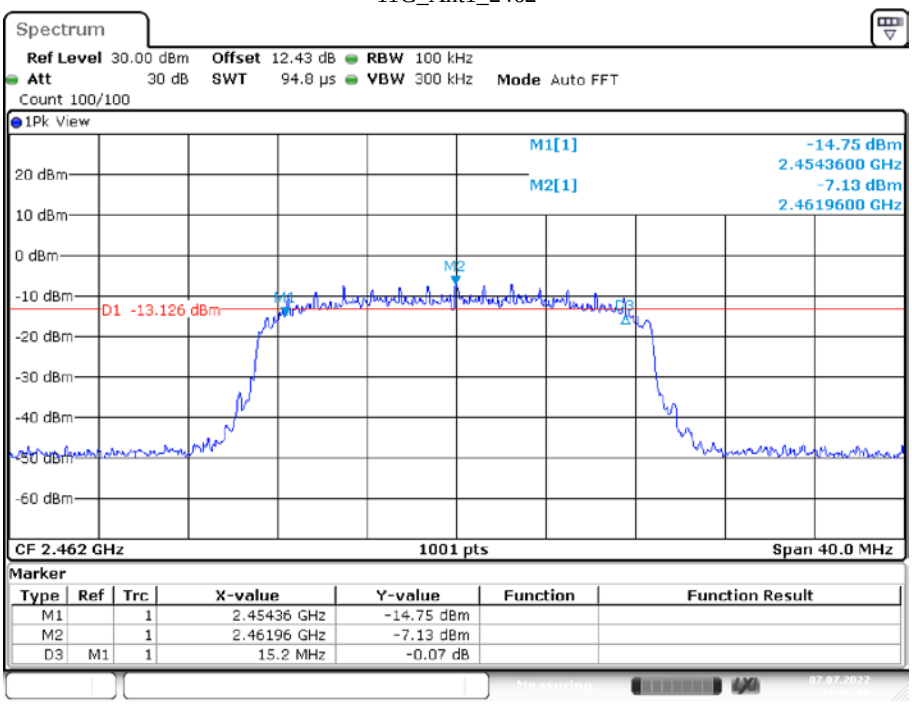
Date: 7.JUL.2022 11:01:11

11G_Ant1_2437



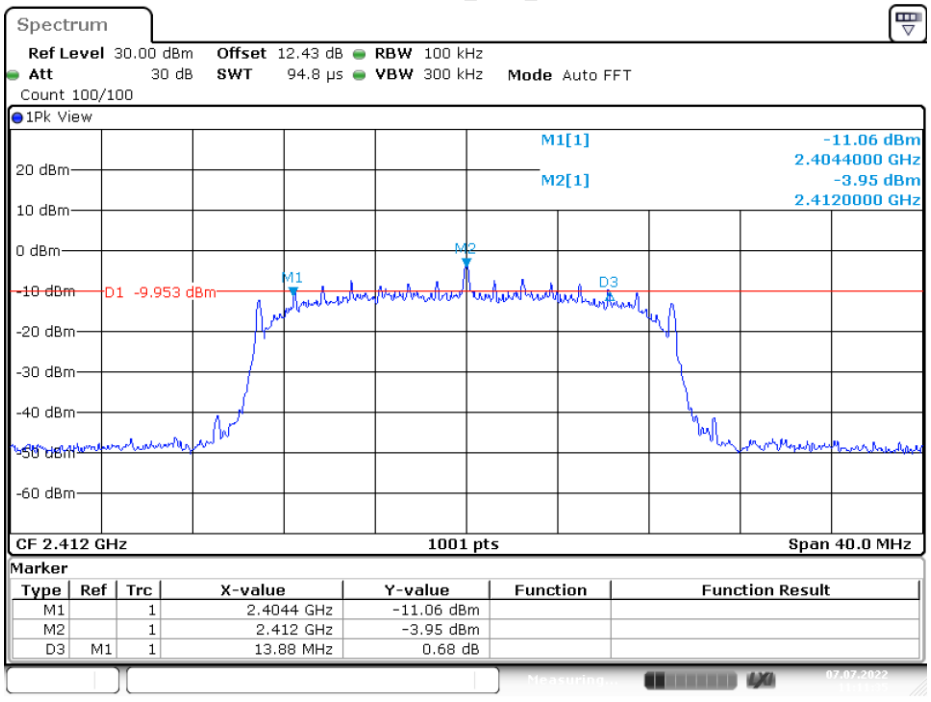
Date: 7.JUL.2022 11:03:07

11G_Ant1_2462



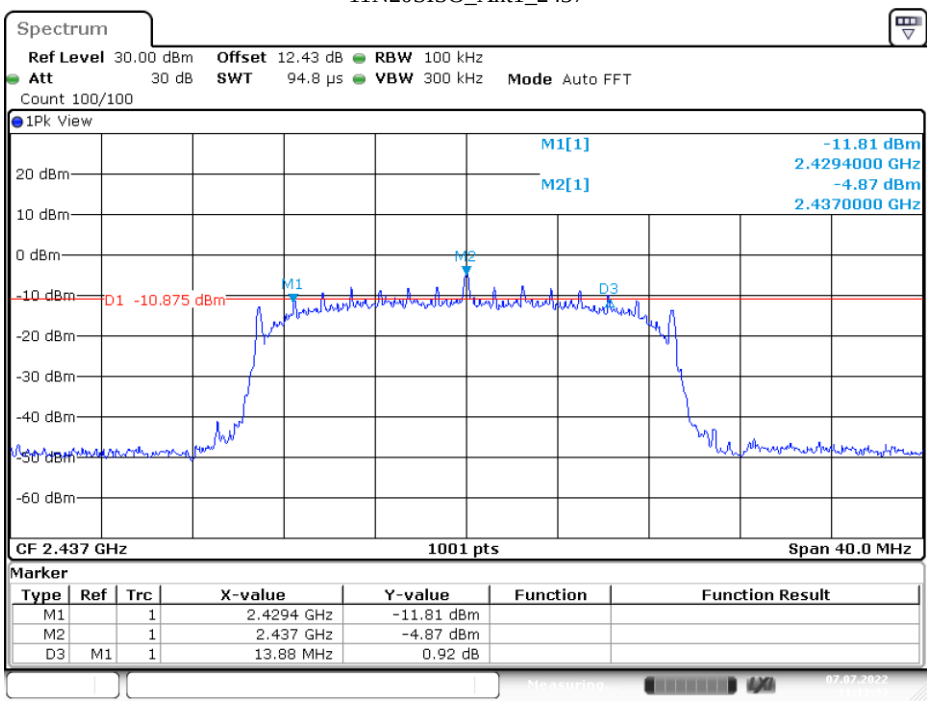
Date: 7.JUL.2022 11:05:01

11N20SISO_Ant1_2412



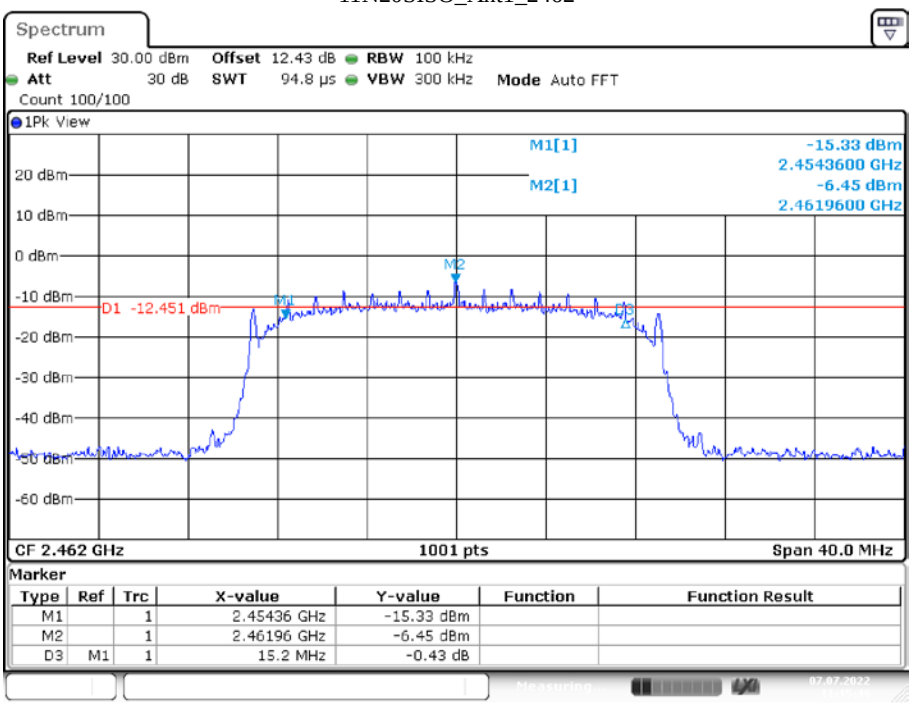
Date: 7.JUL.2022 11:11:35

11N20SISO_Ant1_2437



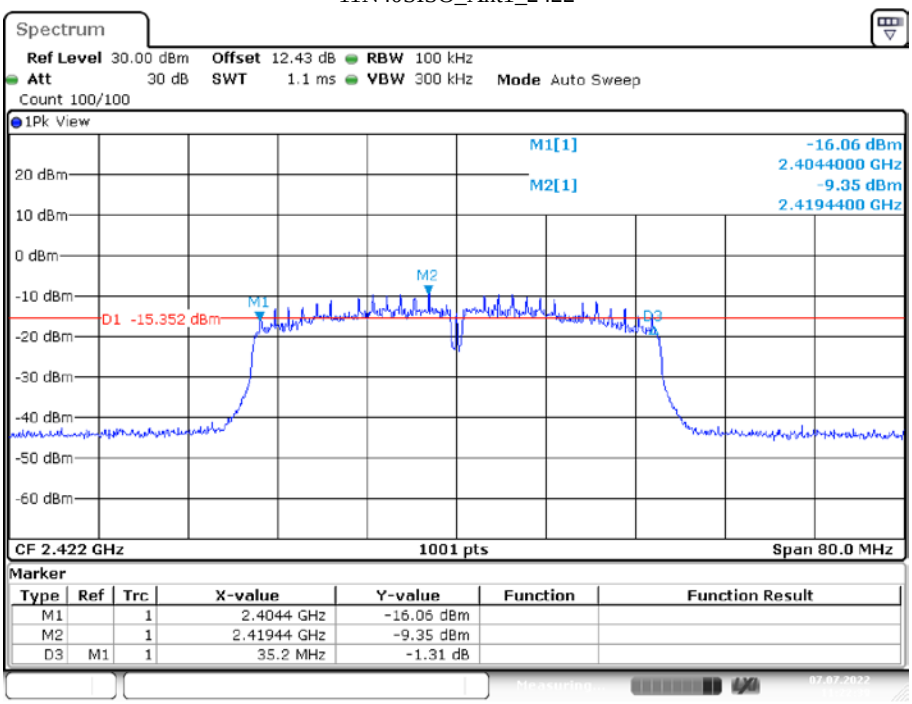
Date: 7.JUL.2022 11:13:34

11N20SISO_Ant1_2462



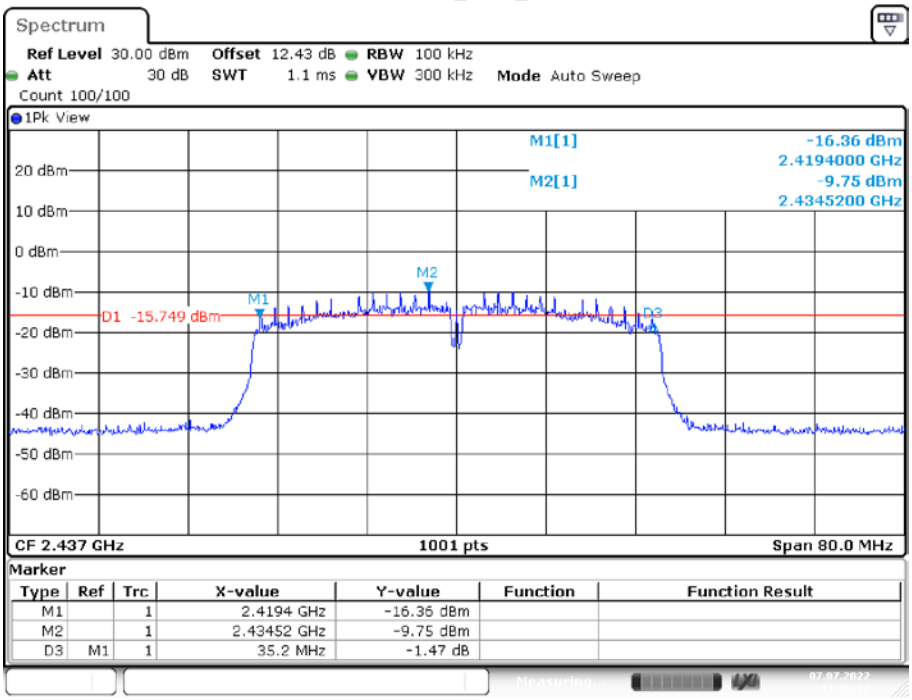
Date: 7.JUL.2022 11:15:50

11N40SISO_Ant1_2422



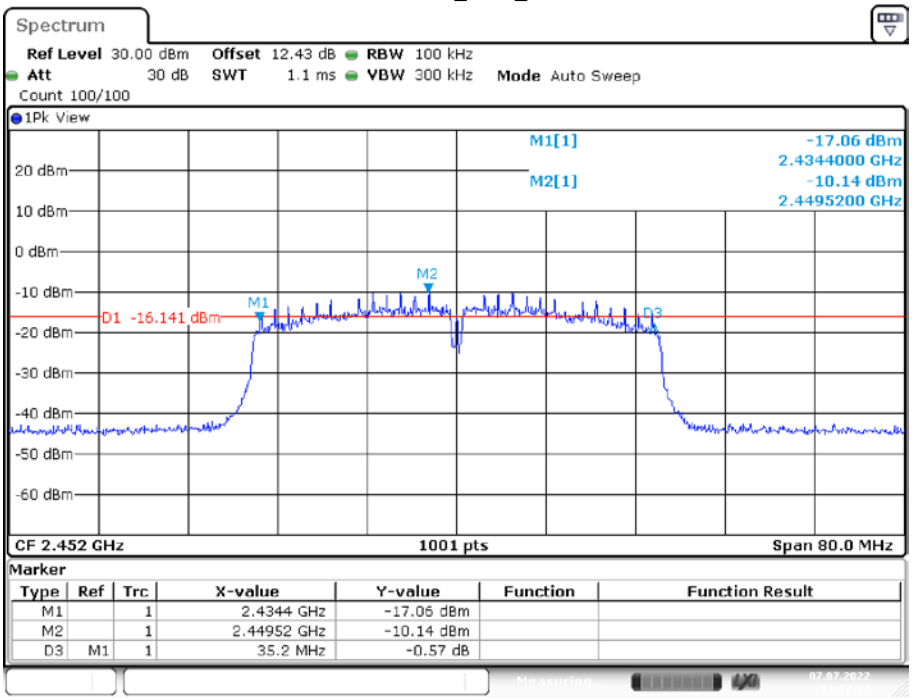
Date: 7.JUL.2022 11:22:40

11N40SISO_Ant1_2437



Date: 7.JUL.2022 11:25:12

11N40SISO_Ant1_2452



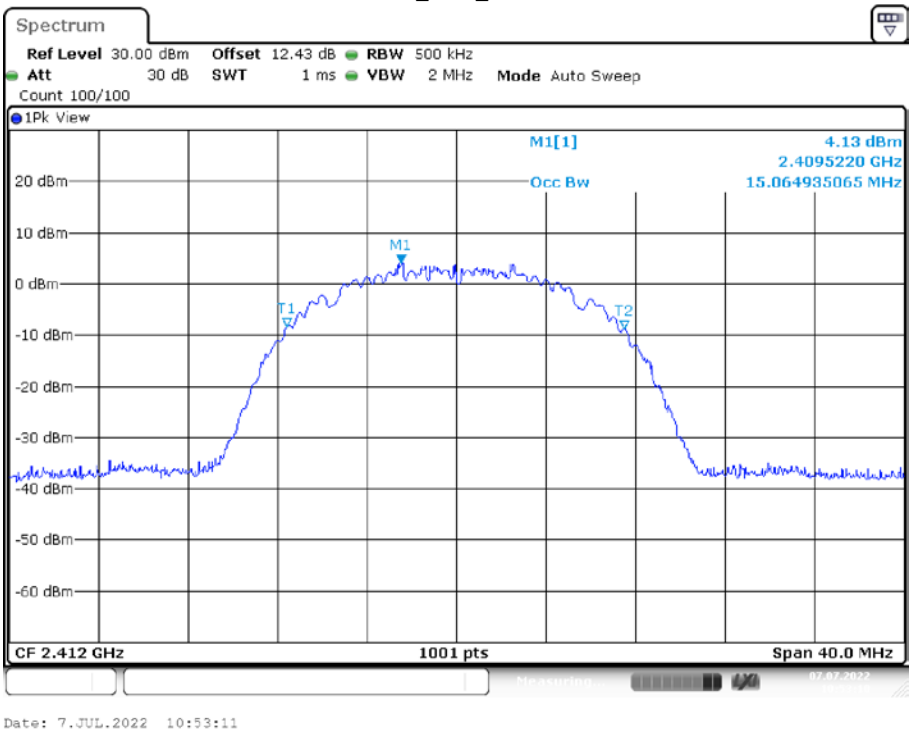
Appendix B: Occupied Channel Bandwidth

Test Result

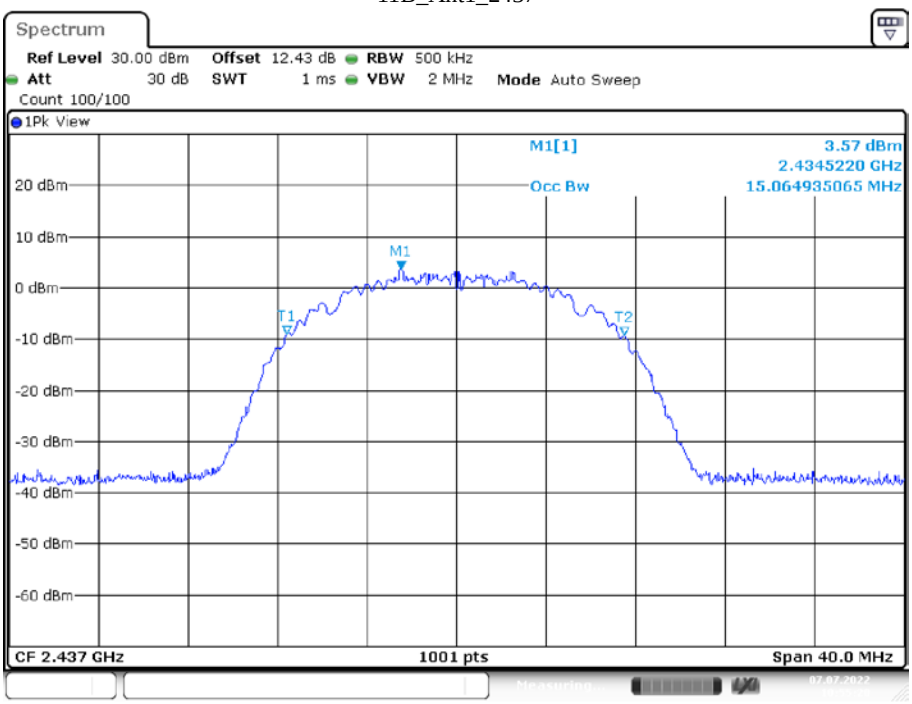
TestMode	Antenna	Channel [MHz]	OCB [MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	15.065	---	PASS
		2437	15.065	---	PASS
		2462	15.065	---	PASS
11G	Ant1	2412	17.463	---	PASS
		2437	17.463	---	PASS
		2462	17.463	---	PASS
11N20SISO	Ant1	2412	18.382	---	PASS
		2437	18.382	---	PASS
		2462	18.422	---	PASS
11N40SISO	Ant1	2422	35.964	---	PASS
		2437	35.964	---	PASS
		2452	36.044	---	PASS

Test Graphs

11B_Ant1_2412



11B_Ant1_2437



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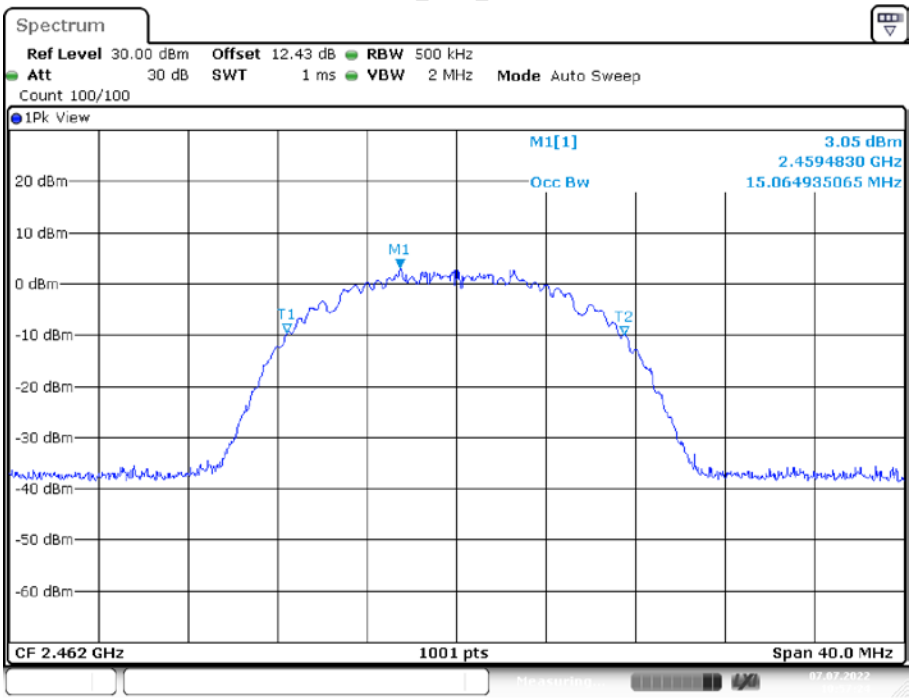
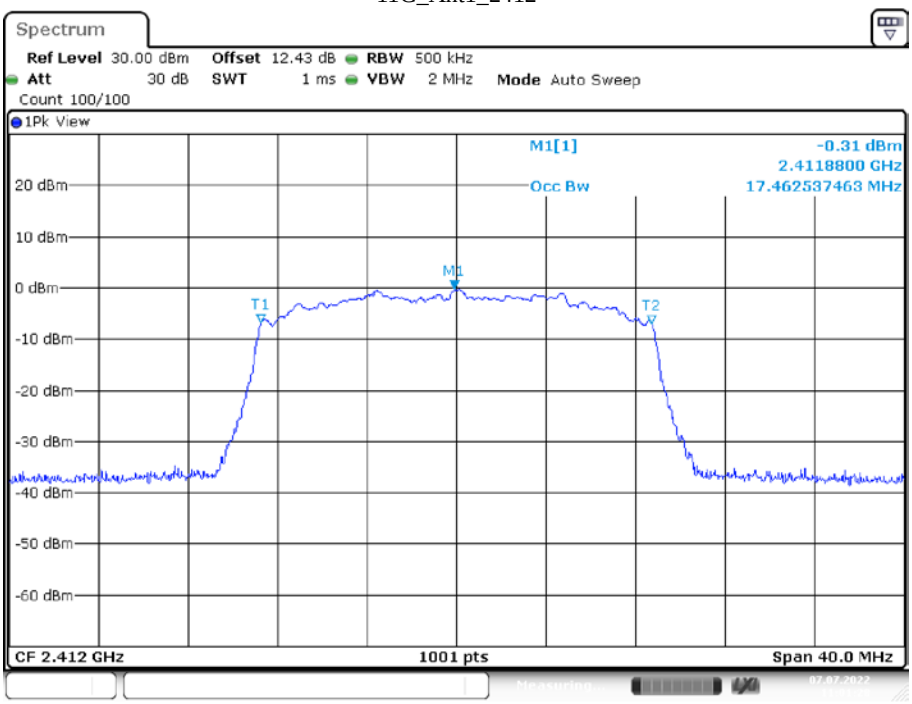
11B_Ant1_2462



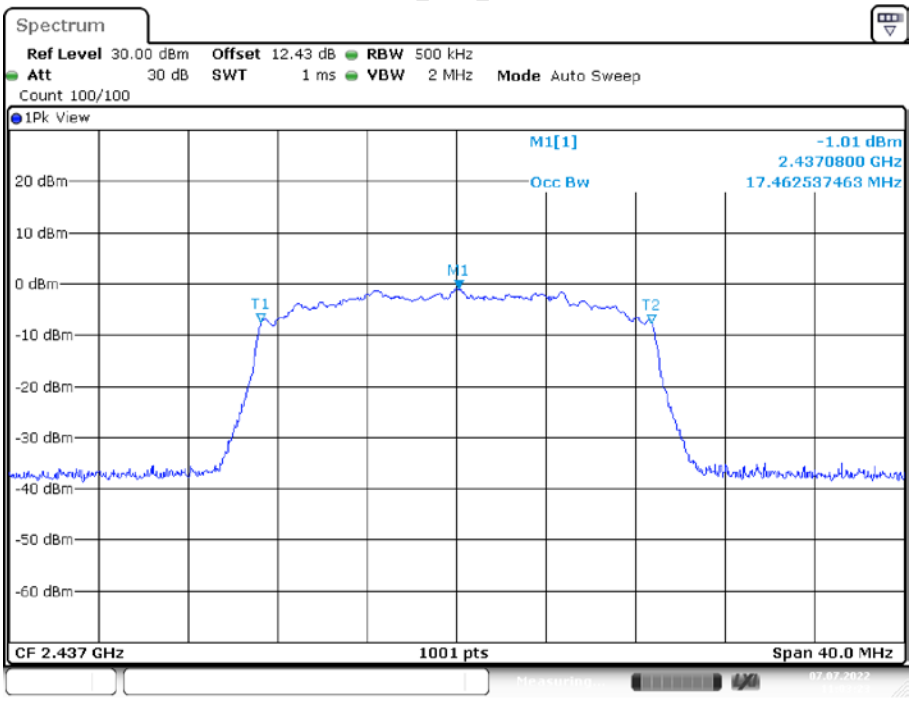
Date: 7.JUL.2022 10:57:24

11G_Ant1_2412



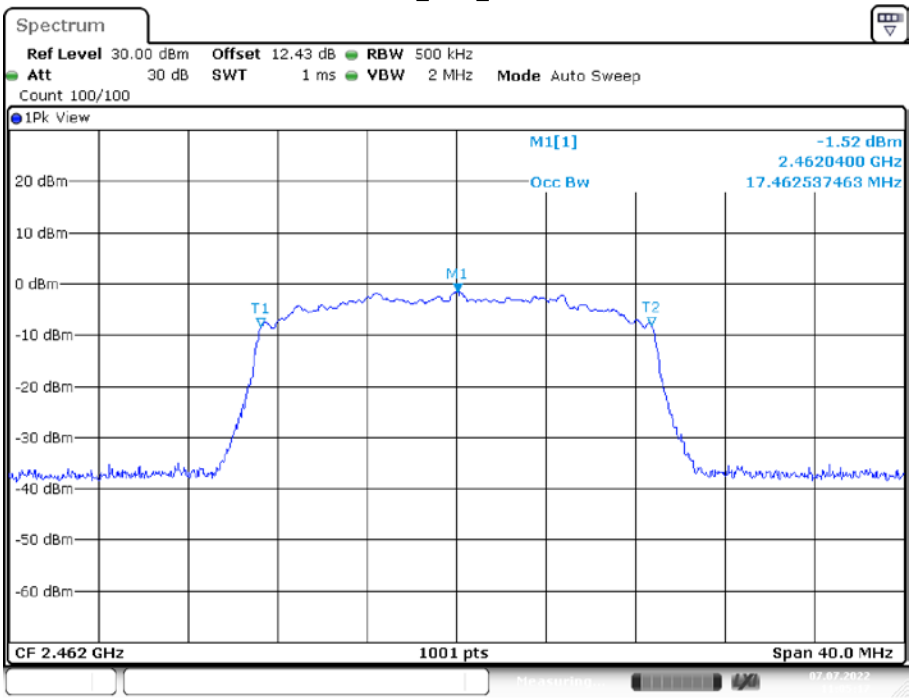
Date: 7.JUL.2022 11:01:28

11G_Ant1_2437



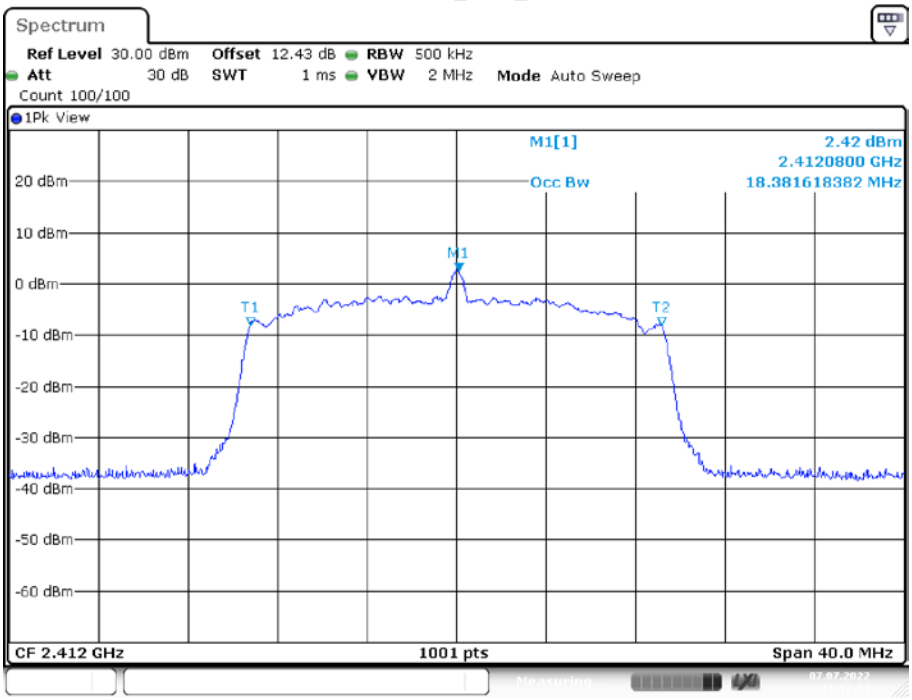
Date: 7.JUL.2022 11:03:23

11G_Ant1_2462



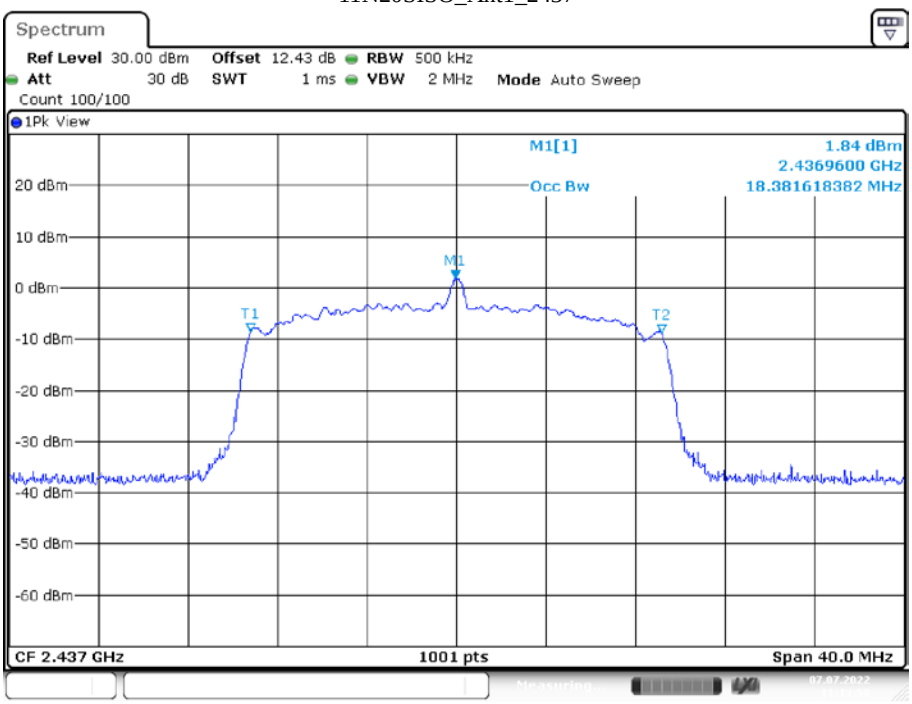
Date: 7.JUL.2022 11:05:17

11N20SISO_Ant1_2412



Date: 7.JUL.2022 11:11:52

11N20SISO_Ant1_2437



Date: 7.JUL.2022 11:13:50

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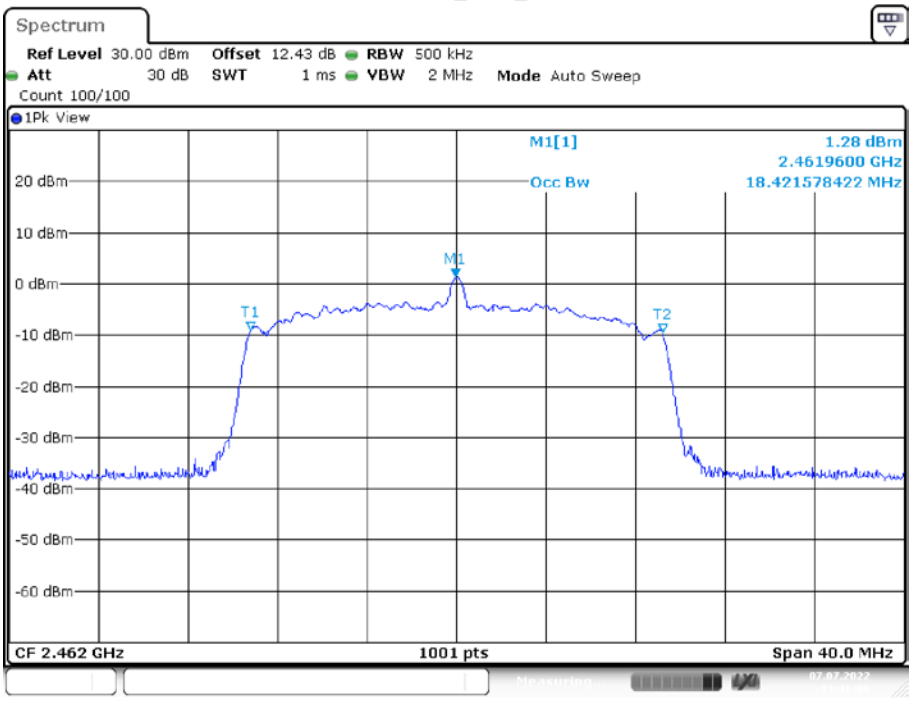
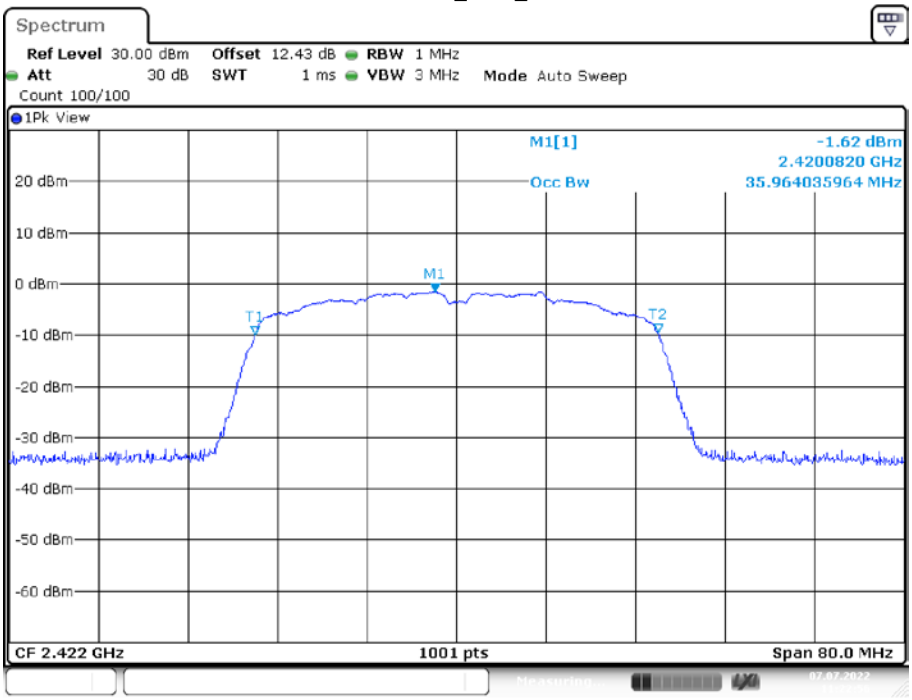


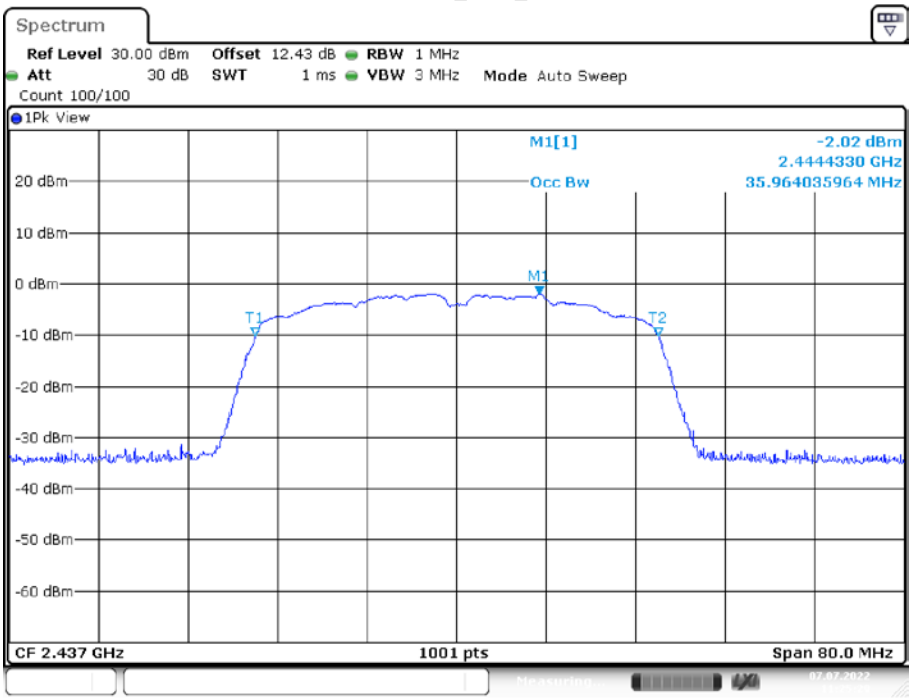
Date: 7.JUL.2022 11:16:06

11N40SISO_Ant1_2422



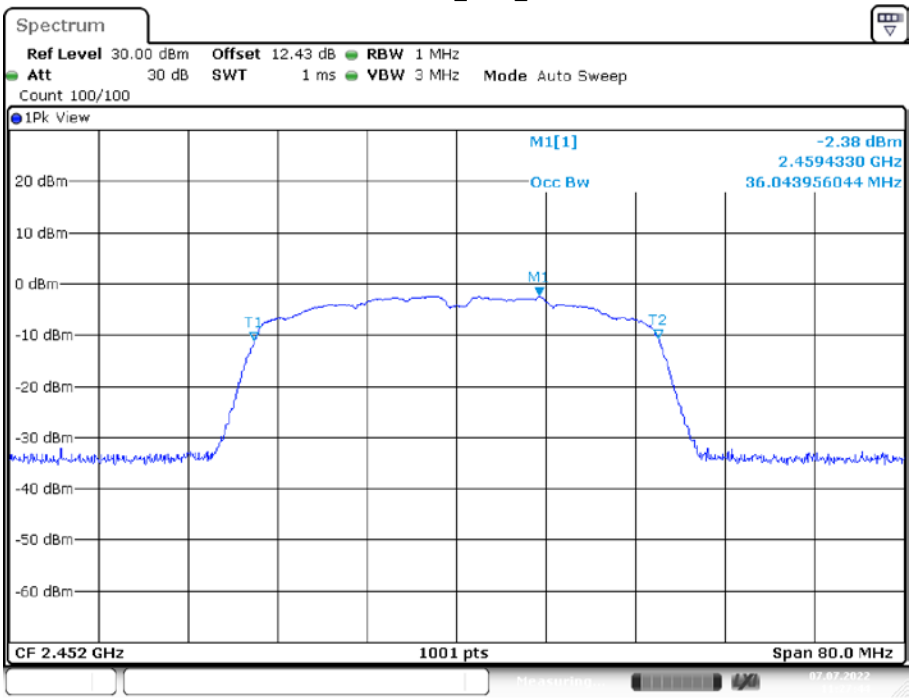
Date: 7.JUL.2022 11:22:57

11N40SISO_Ant1_2437



Date: 7.JUL.2022 11:25:29

11N40SISO_Ant1_2452



Appendix C: Maximum conducted output power

Test Result

TestMode	Antenna	Channel [MHz]	Peak Power Result [dBm]	Limit [dBm]	Verdict
11B	Ant1	2412	16.39	<=30	PASS
		2437	**16.88**	<=30	PASS
		2462	16.35	<=30	PASS
11G	Ant1	2412	13.63	<=30	PASS
		2437	13.75	<=30	PASS
		2462	12.57	<=30	PASS
11N20SISO	Ant1	2412	12.22	<=30	PASS
		2437	12.62	<=30	PASS
		2462	13.32	<=30	PASS
11N40SISO	Ant1	2422	12.86	<=30	PASS
		2437	12.96	<=30	PASS
		2452	12.73	<=30	PASS

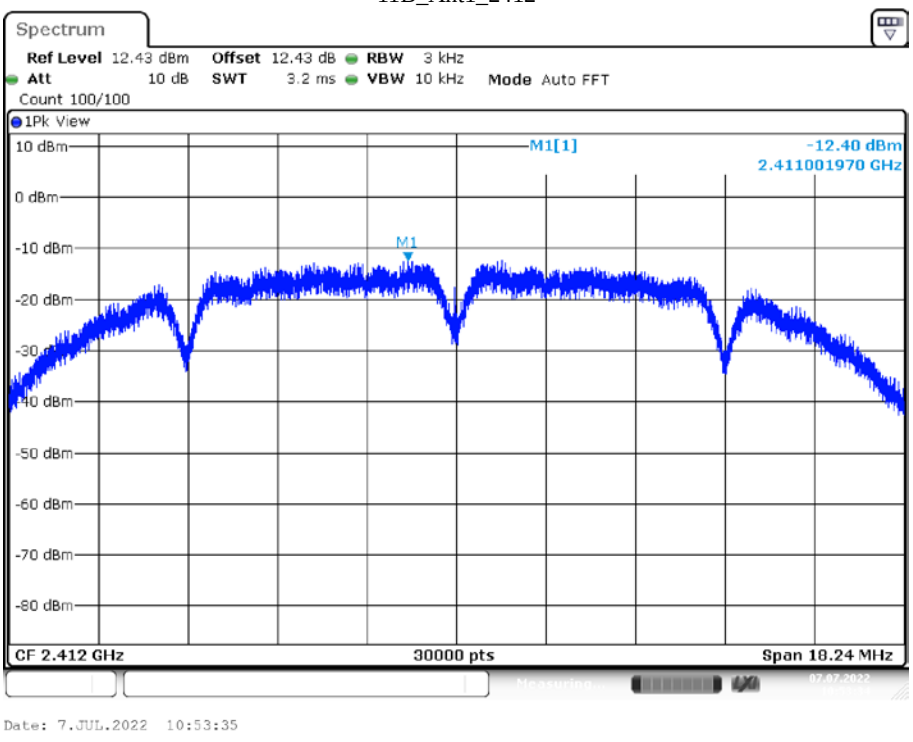
Appendix D: Power spectral density

Test Result

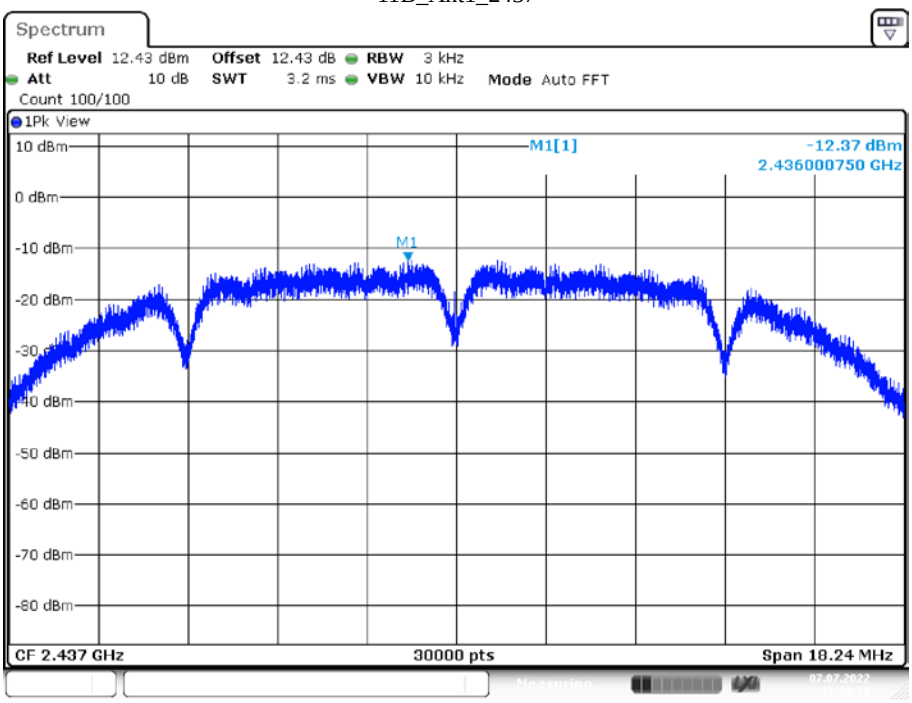
TestMode	Antenna	Channel[MHz]	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
11B	Ant1	2412	-12.4	<=8	PASS
		2437	-12.37	<=8	PASS
		2462	-13.51	<=8	PASS
11G	Ant1	2412	-17.64	<=8	PASS
		2437	-18.7	<=8	PASS
		2462	-19.01	<=8	PASS
11N20SISO	Ant1	2412	-16.31	<=8	PASS
		2437	-17.55	<=8	PASS
		2462	-17.79	<=8	PASS
11N40SISO	Ant1	2422	-17.06	<=8	PASS
		2437	-17.75	<=8	PASS
		2452	-18.31	<=8	PASS

Test Graphs

11B_Ant1_2412

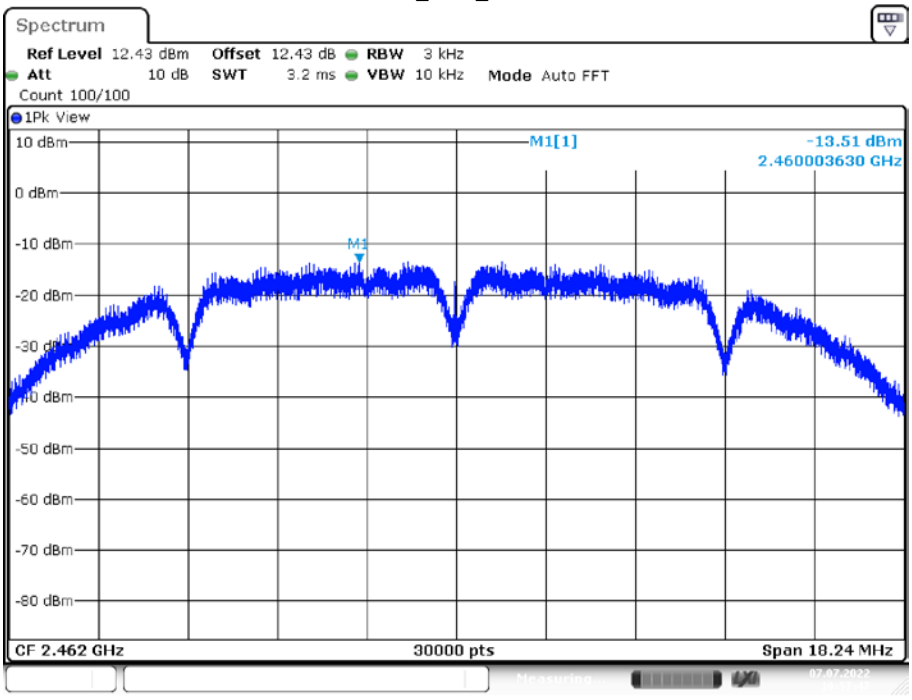


11B_Ant1_2437



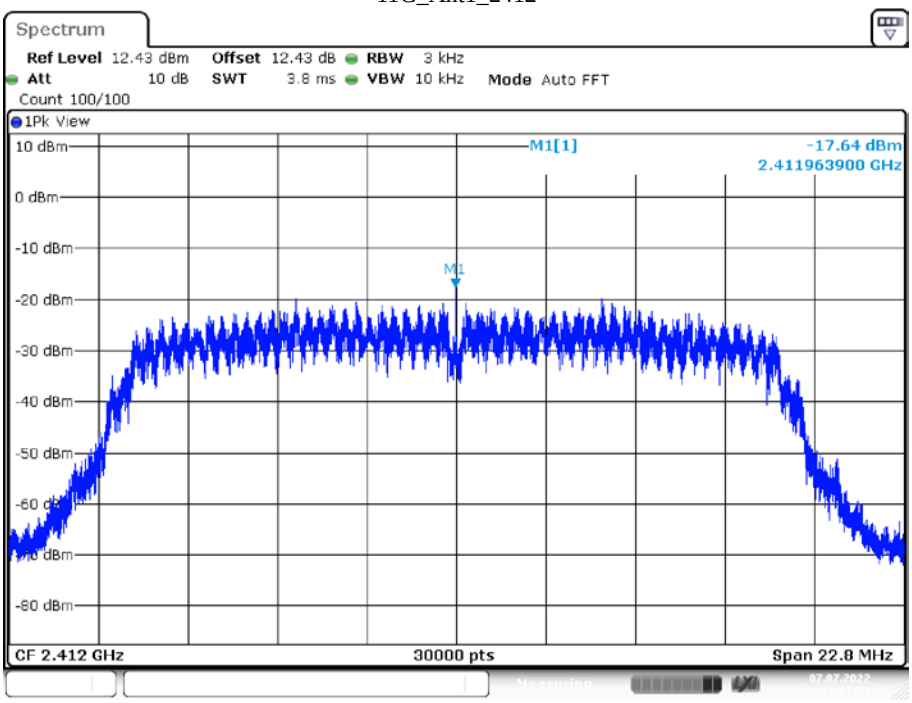
Date: 7.JUL.2022 11:39:19

11B_Ant1_2462



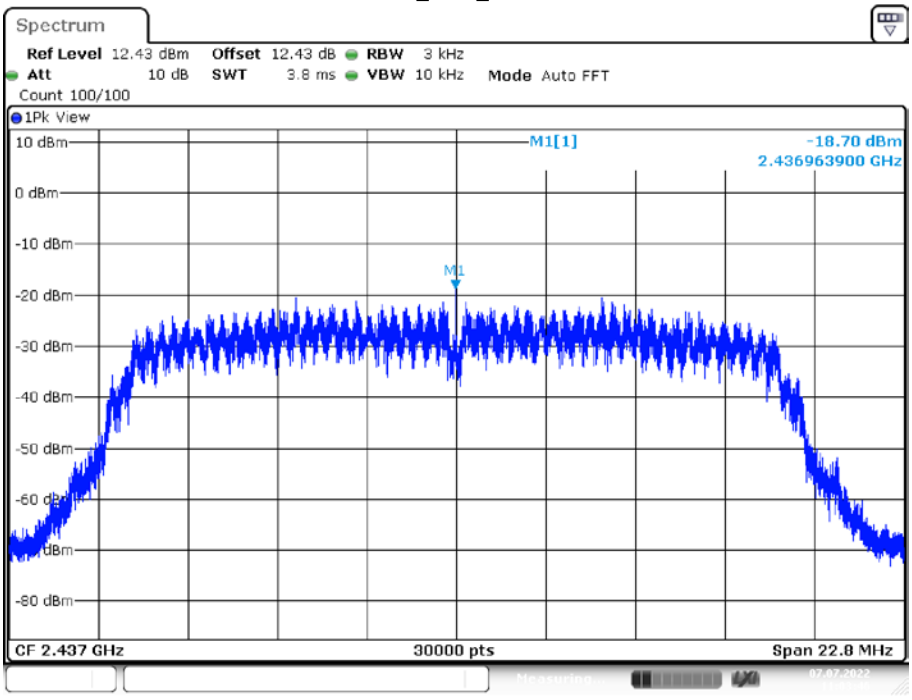
Date: 7.JUL.2022 10:57:48

11G_Ant1_2412



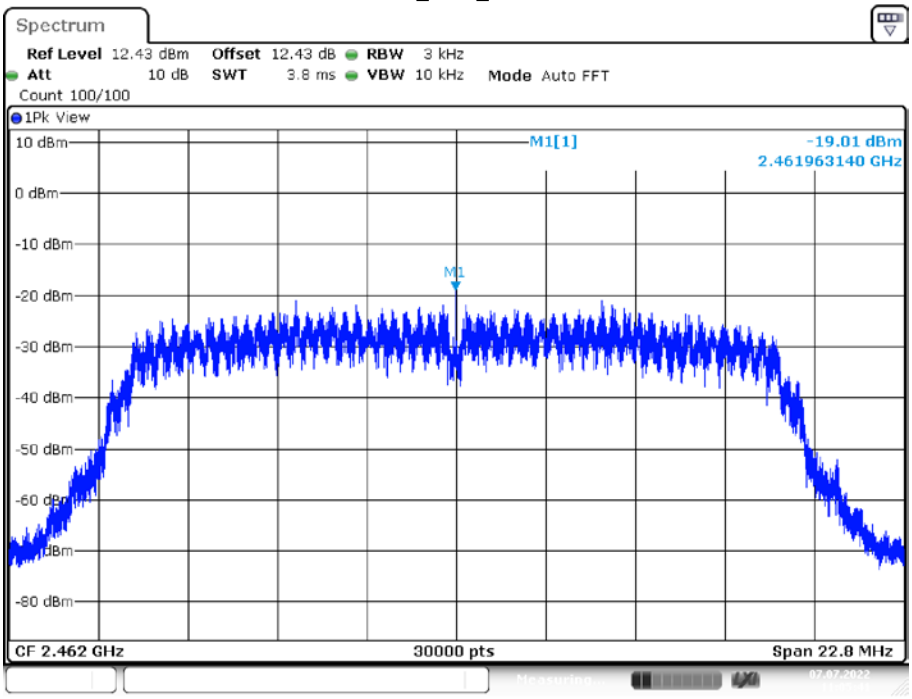
Date: 7.JUL.2022 11:01:52

11G_Ant1_2437



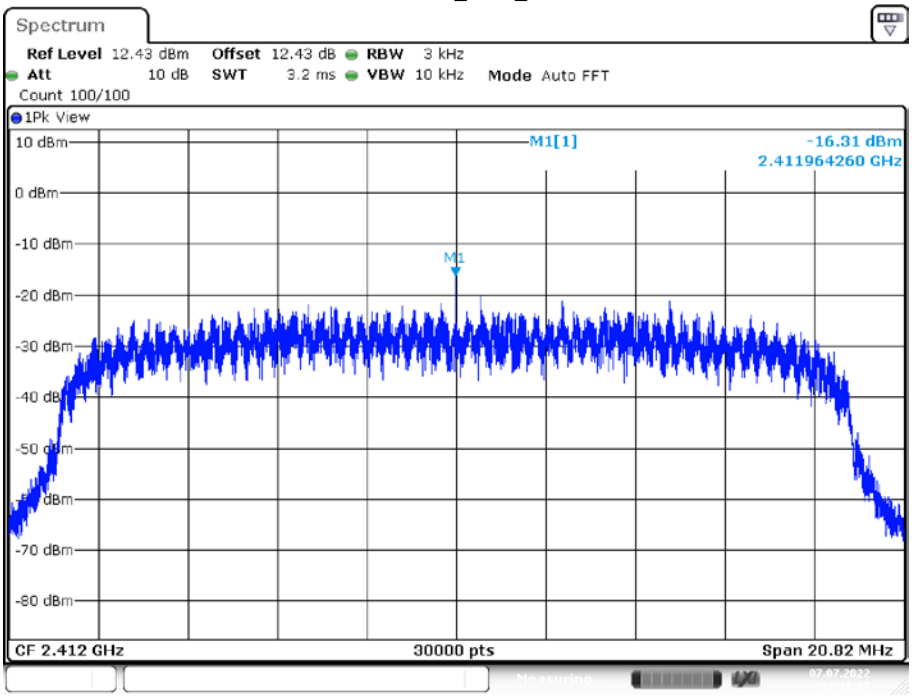
Date: 7.JUL.2022 11:03:47

11G_Ant1_2462



Date: 7.JUL.2022 11:05:41

11N20SISO_Ant1_2412



Date: 7.JUL.2022 11:12:16

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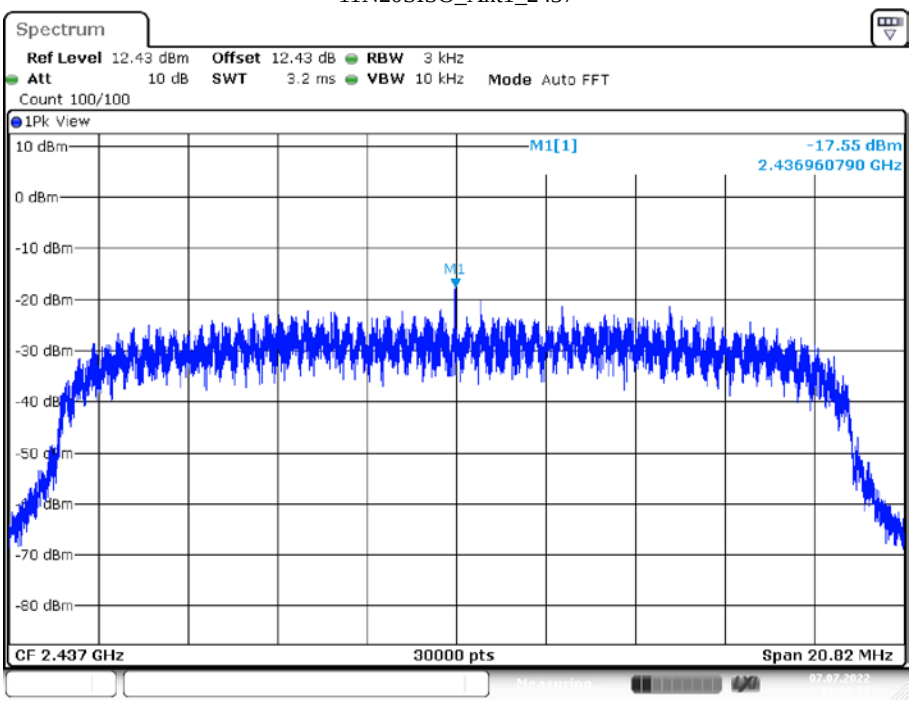
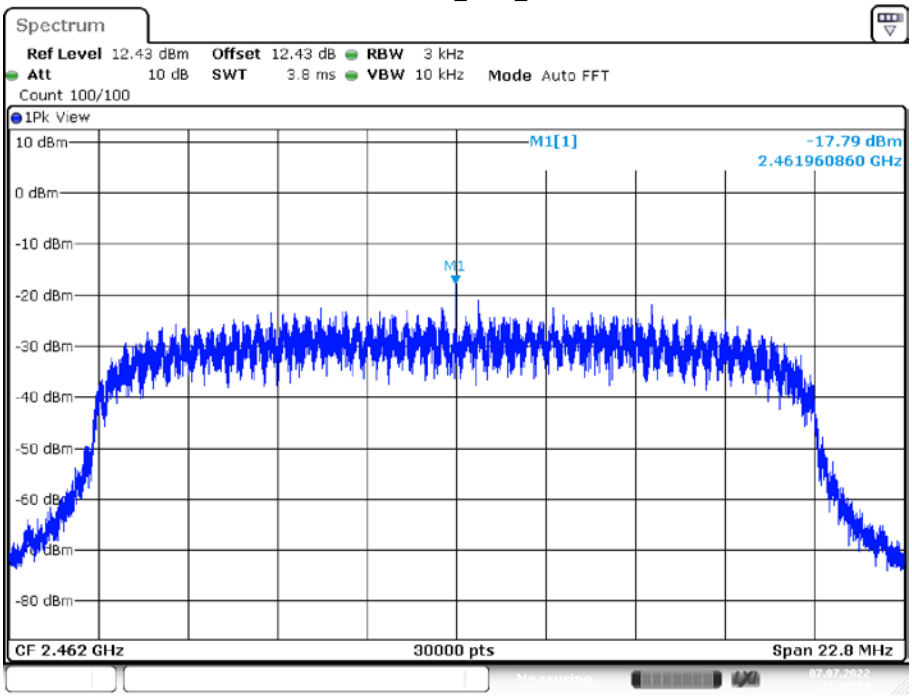


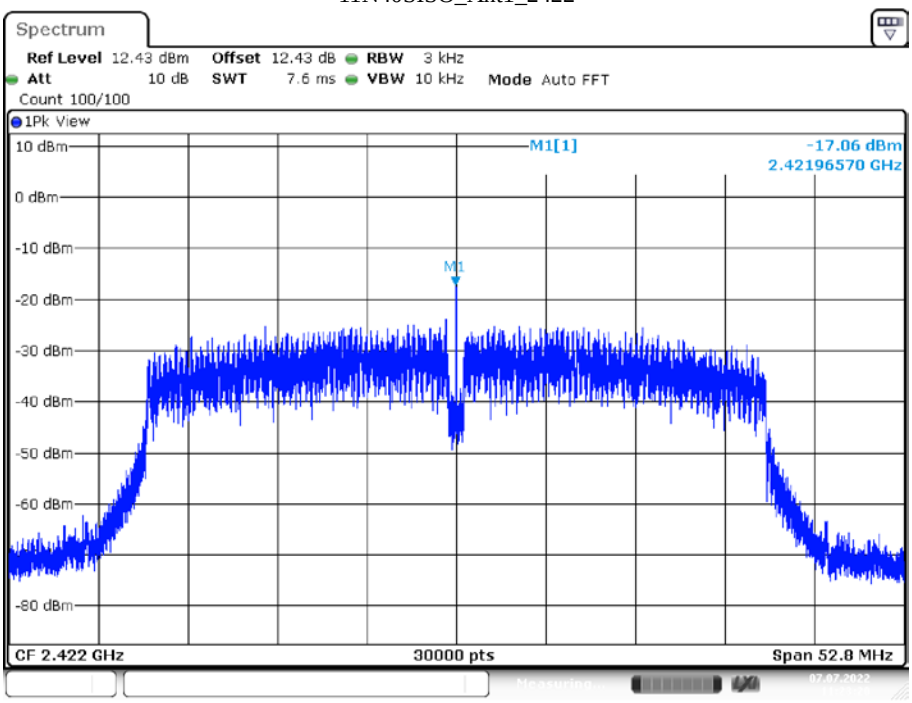
Date: 7.JUL.2022 11:39:57

11N20SISO_Ant1_2462



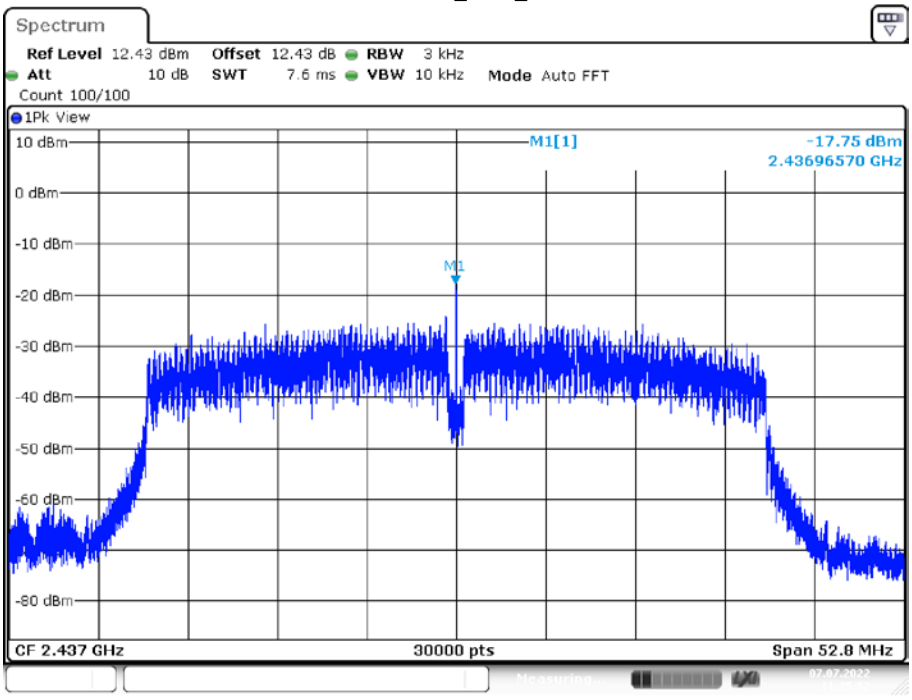
Date: 7.JUL.2022 11:40:20

11N40SISO_Ant1_2422



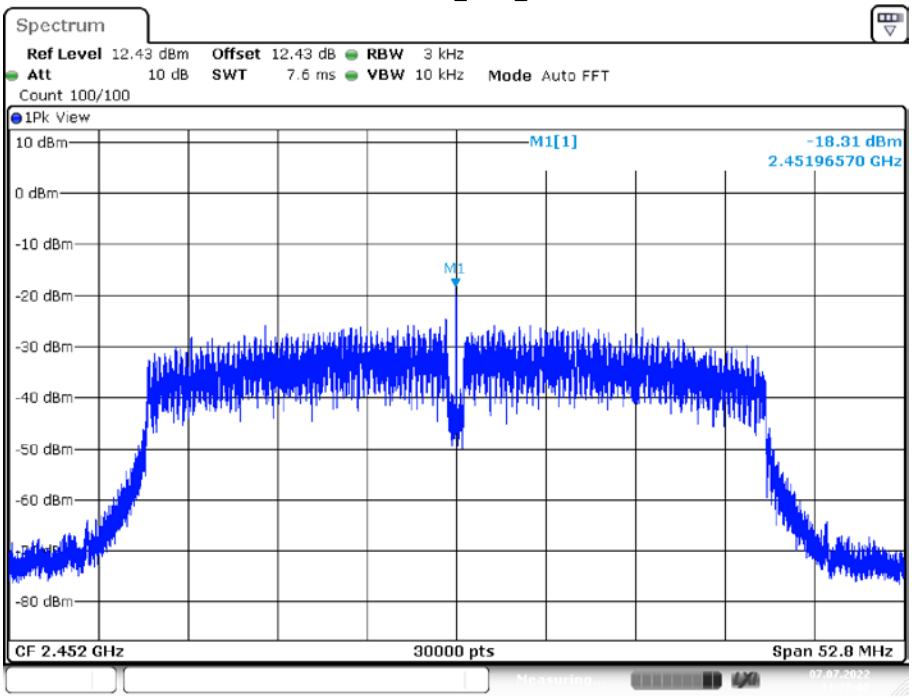
Date: 7.JUL.2022 11:23:20

11N40SISO_Ant1_2437



Date: 7.JUL.2022 11:25:53

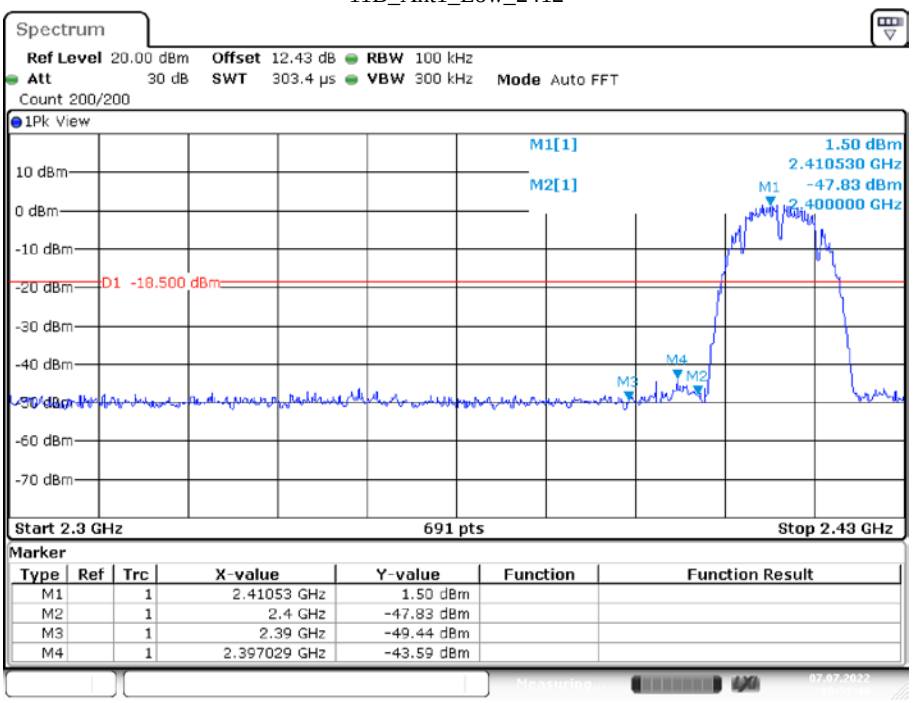
11N40SISO_Ant1_2452



Appendix E: Band edge measurements

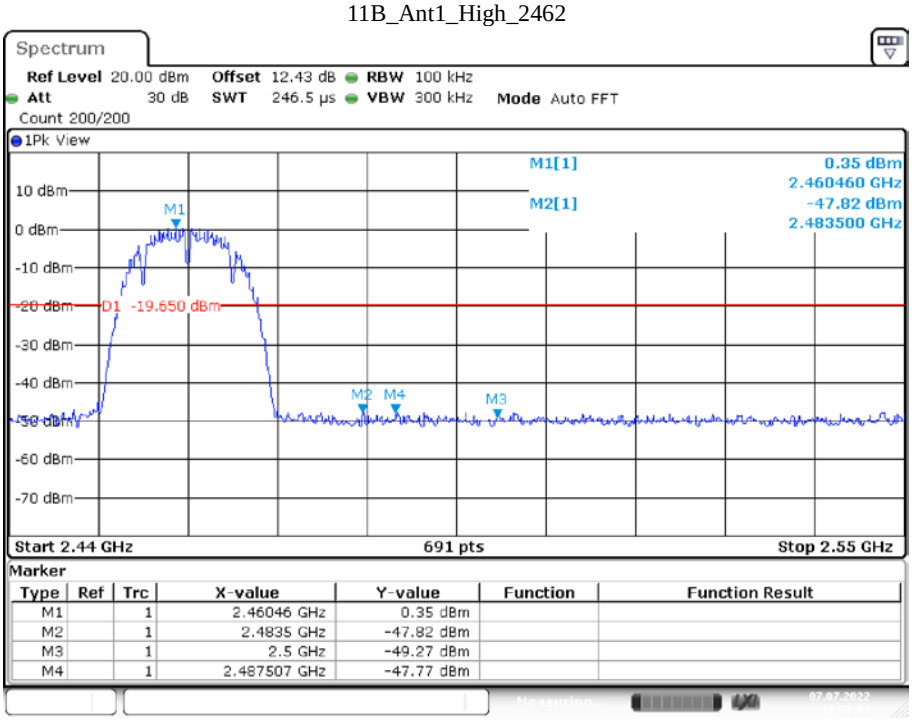
Test Graphs

11B_Ant1_Low_2412



Date: 7.JUL.2022 10:53:50

11B_Ant1_High_2462



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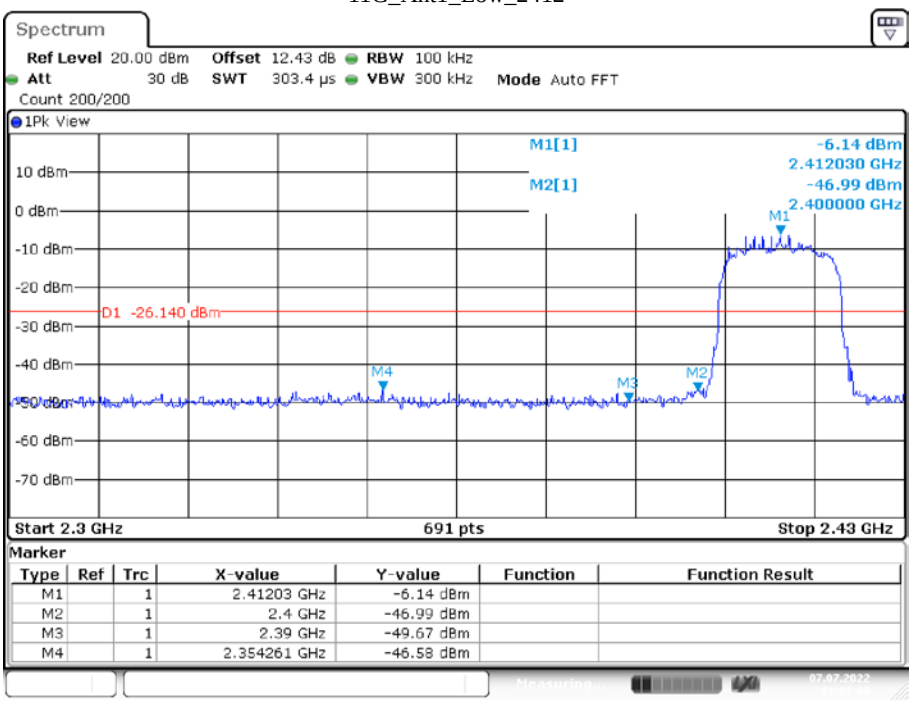
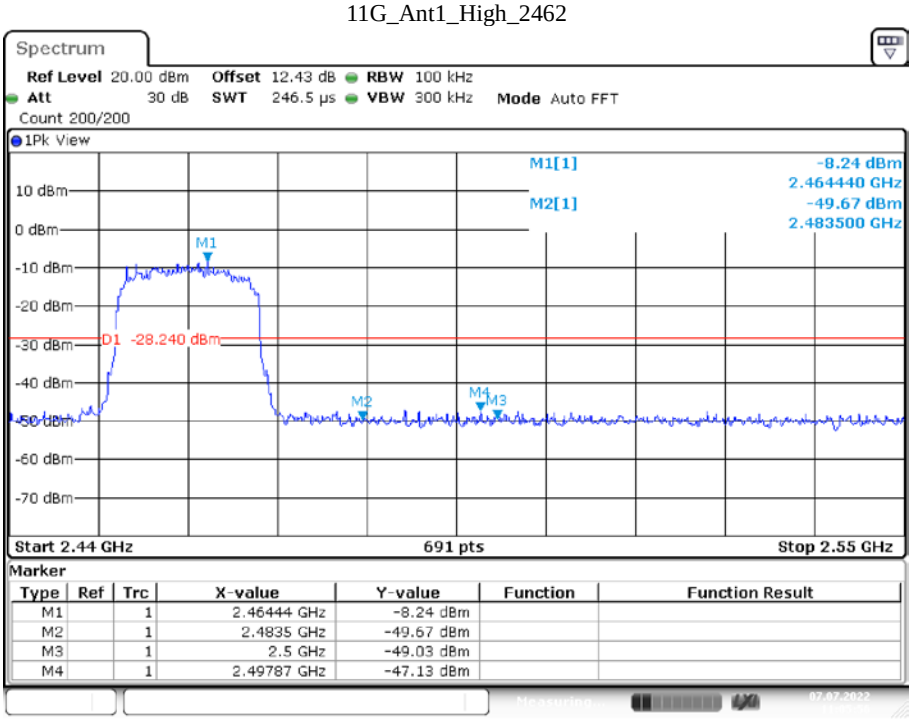
11G_Ant1_Low_2412



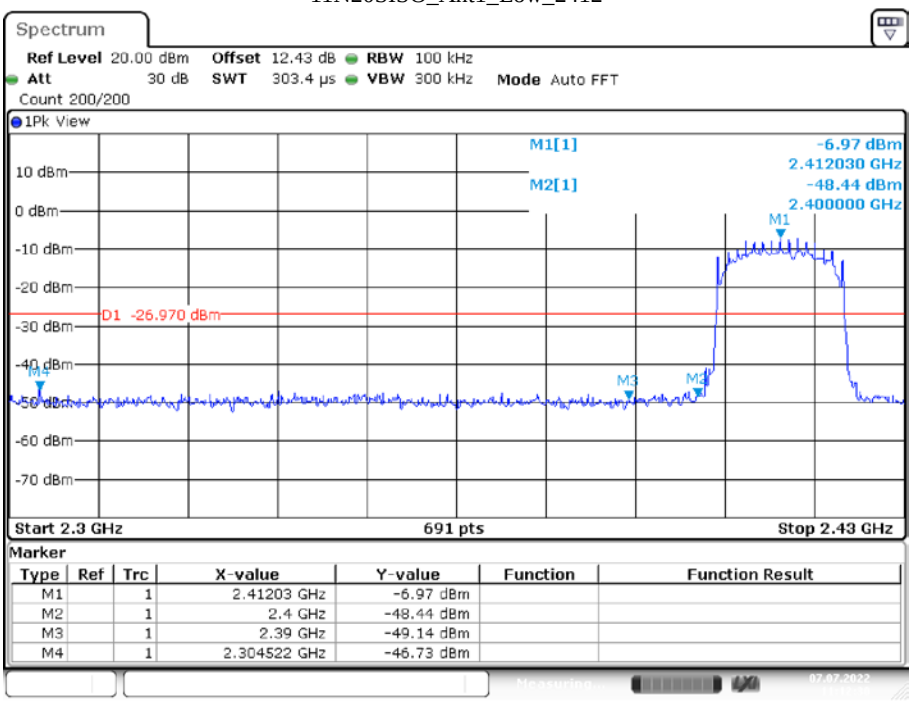
Date: 7.JUL.2022 11:02:07

11G_Ant1_High_2462



Date: 7.JUL.2022 11:05:56

11N20SISO_Ant1_Low_2412

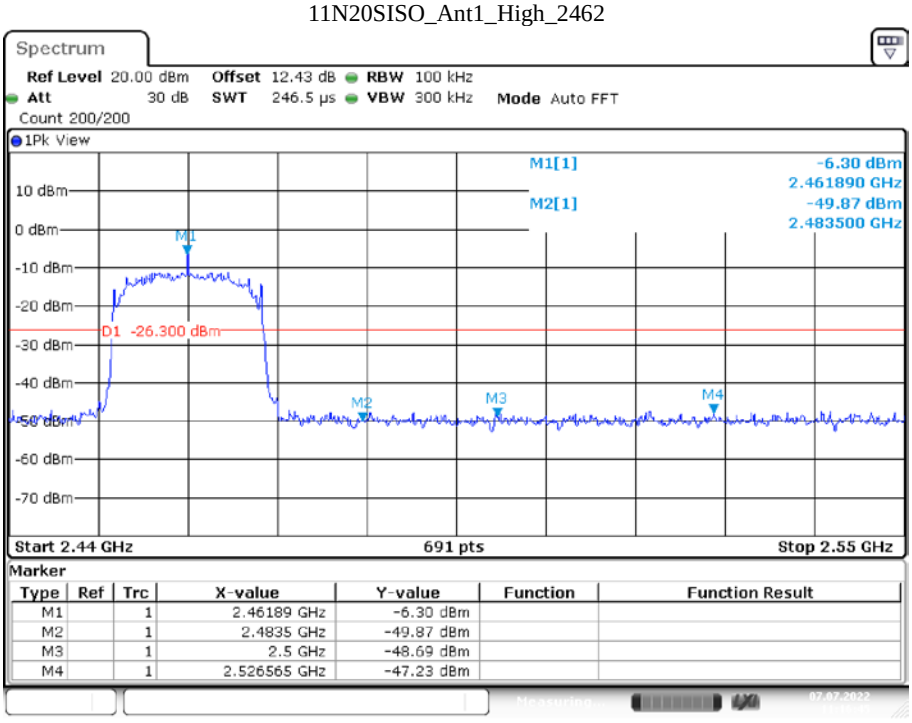


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.41203 GHz	-6.97 dBm		
M2		1	2.4 GHz	-48.44 dBm		
M3		1	2.39 GHz	-49.14 dBm		
M4		1	2.304522 GHz	-46.73 dBm		

Date: 7.JUL.2022 11:12:31

11N20SISO_Ant1_High_2462

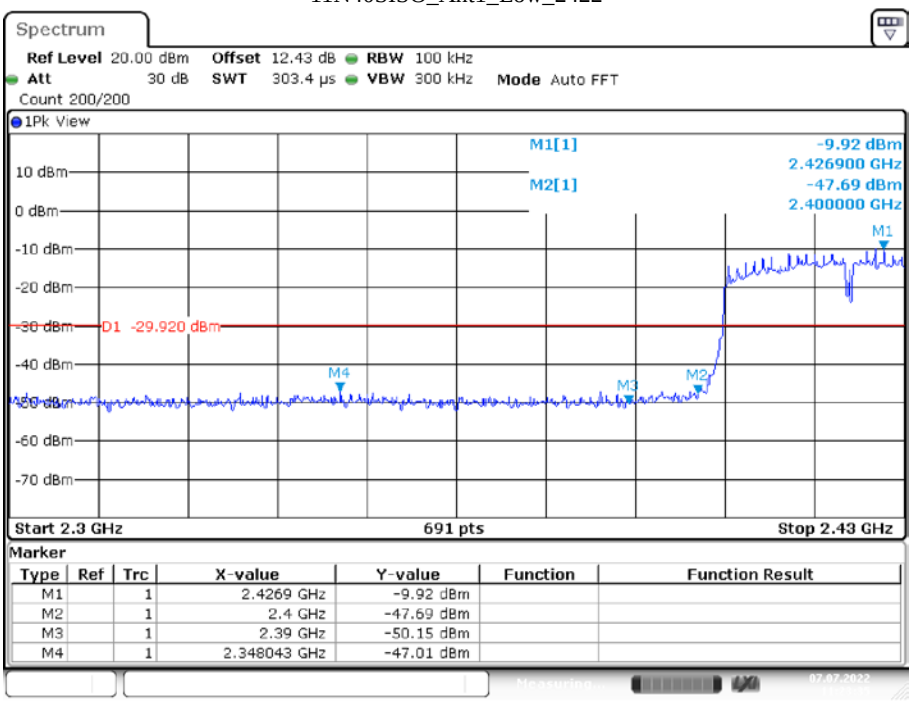


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.46189 GHz	-6.30 dBm		
M2		1	2.4835 GHz	-49.87 dBm		
M3		1	2.5 GHz	-48.69 dBm		
M4		1	2.526565 GHz	-47.23 dBm		

Date: 7.JUL.2022 11:16:45

11N40SISO_Ant1_Low_2422

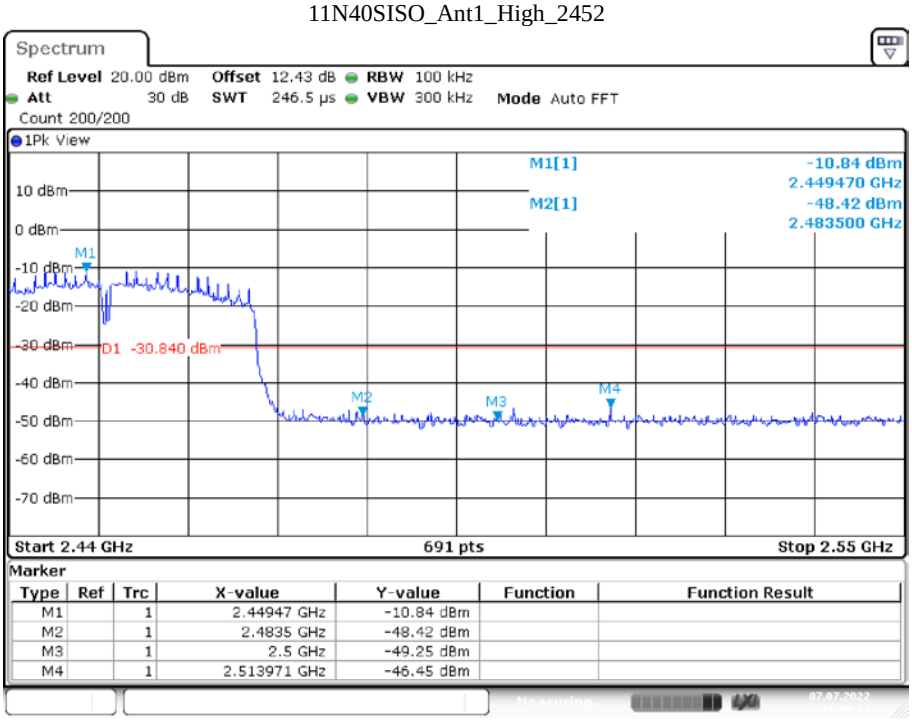


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4269 GHz	-9.92 dBm		
M2		1	2.4 GHz	-47.69 dBm		
M3		1	2.39 GHz	-50.15 dBm		
M4		1	2.348043 GHz	-47.01 dBm		

Date: 7.JUL.2022 11:23:35

11N40SISO_Ant1_High_2452



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.44947 GHz	-10.84 dBm		
M2		1	2.4835 GHz	-48.42 dBm		
M3		1	2.5 GHz	-49.25 dBm		
M4		1	2.513971 GHz	-46.45 dBm		

Date: 7.JUL.2022 11:28:23

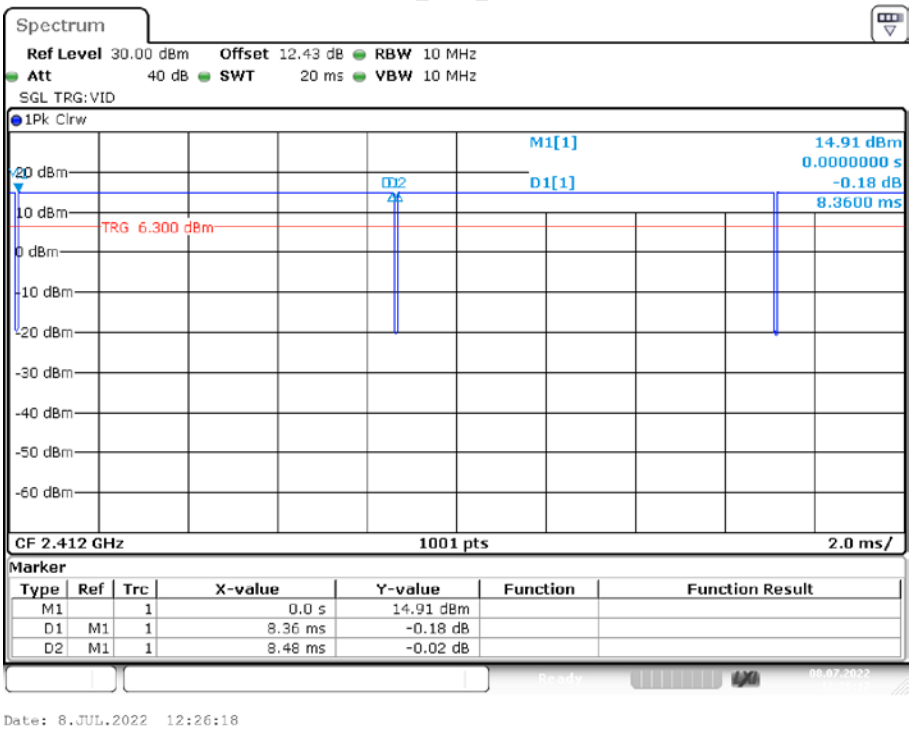
Appendix F: Duty Cycle

Test Result

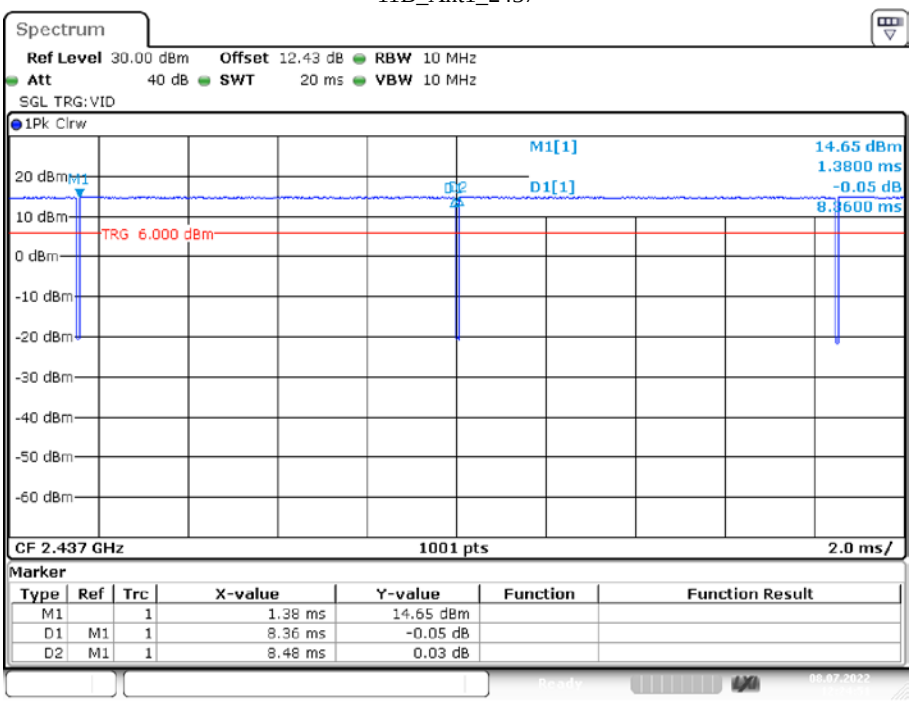
Test Mode	Antenna	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
11B	Ant1	2412	8.36	8.48	98.58
		2437	8.36	8.48	98.58
		2462	8.36	8.48	98.58
11G	Ant1	2412	50.00	50.00	100.00
		2437	50.00	50.00	100.00
		2462	50.00	50.00	100.00
11N20SISO	Ant1	2412	50.00	50.00	100.00
		2437	50.00	50.00	100.00
		2462	50.00	50.00	100.00
11N40SISO	Ant1	2422	50.00	50.00	100.00
		2437	50.00	50.00	100.00
		2452	50.00	50.00	100.00

Test Graphs

11B_Ant1_2412

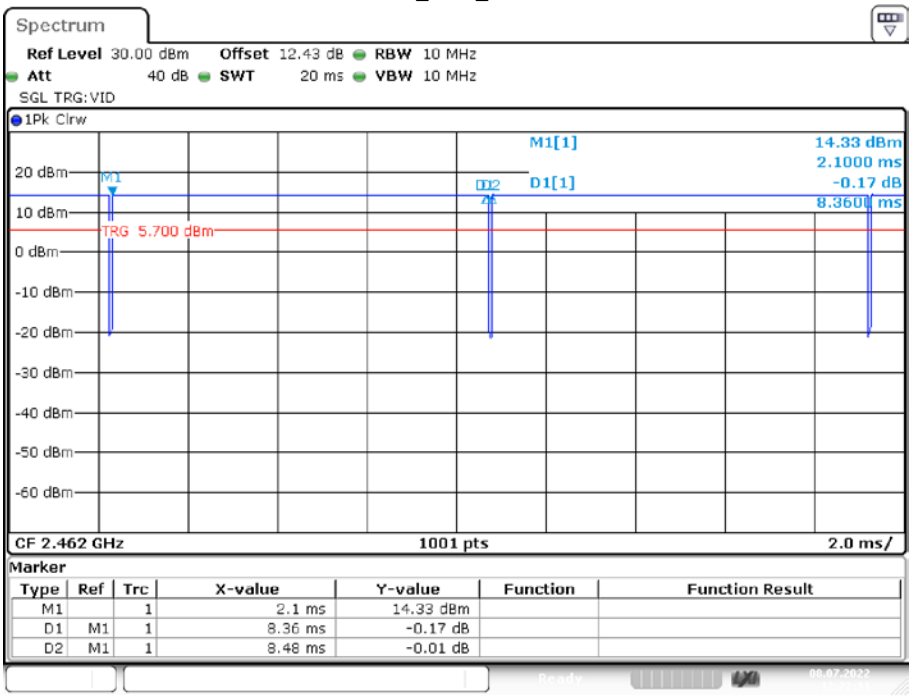


11B_Ant1_2437



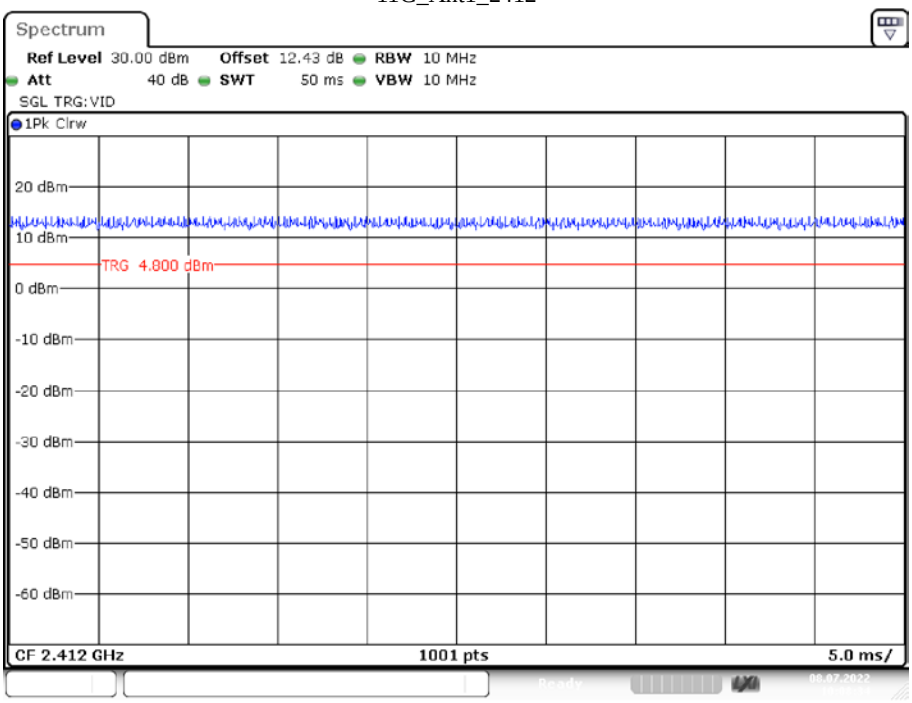
Date: 8.JUL.2022 12:24:52

11B_Ant1_2462



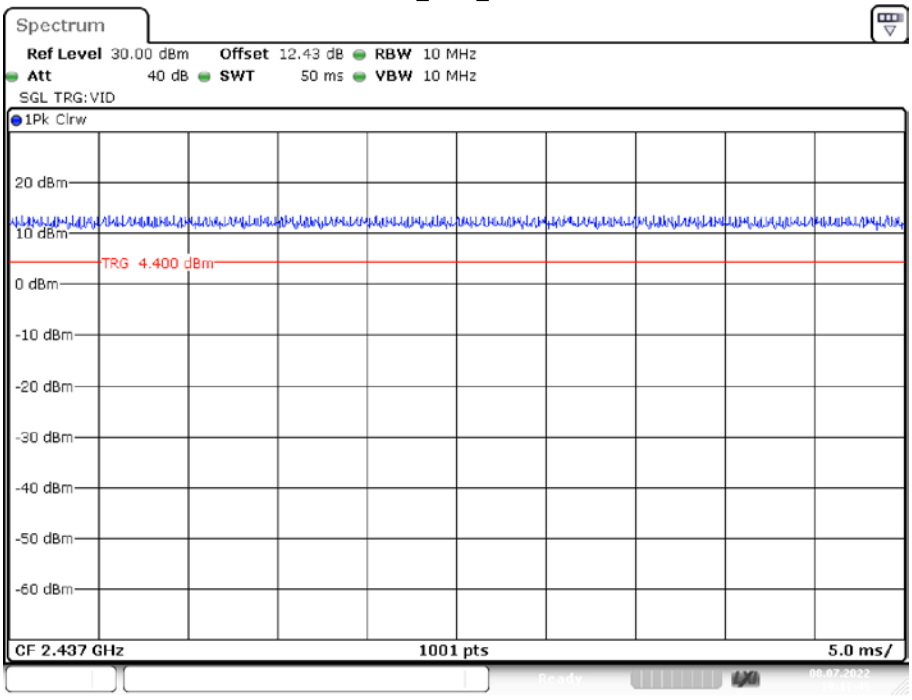
Date: 8.JUL.2022 12:22:32

11G_Ant1_2412



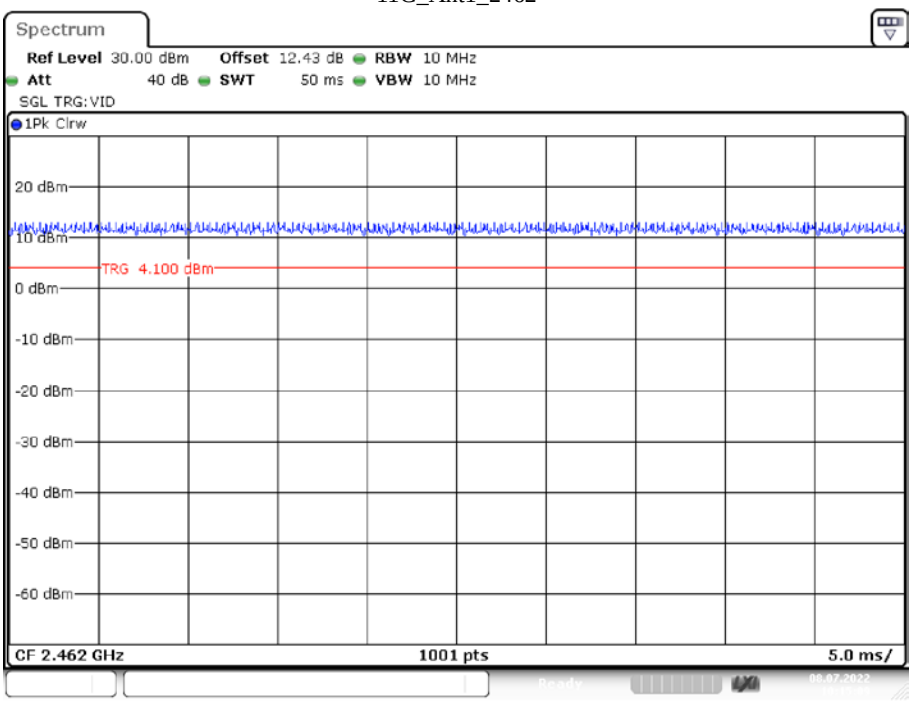
Date: 8.JUL.2022 10:08:35

11G_Ant1_2437



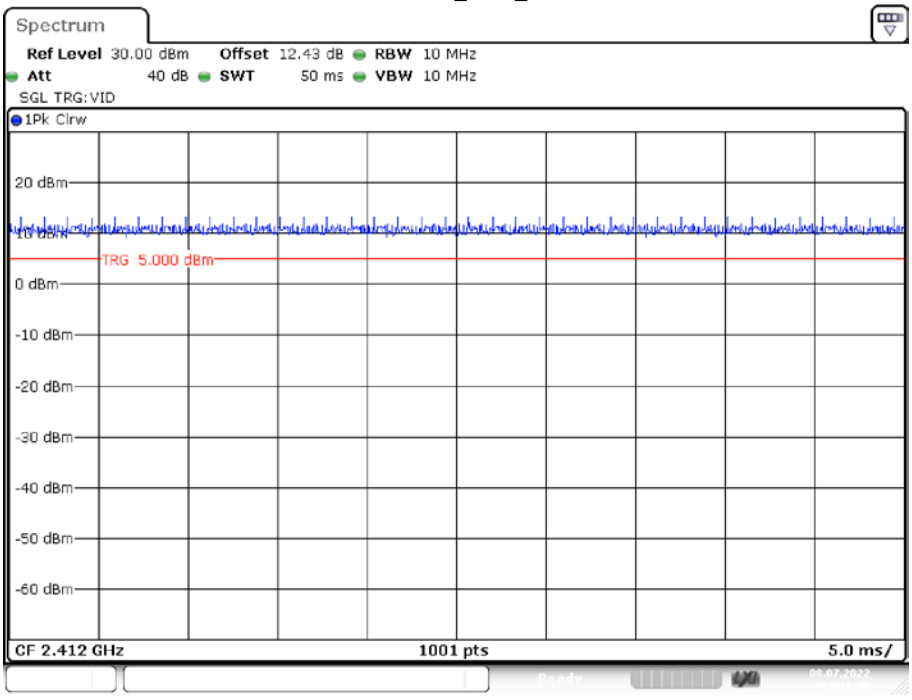
Date: 8.JUL.2022 10:11:50

11G_Ant1_2462



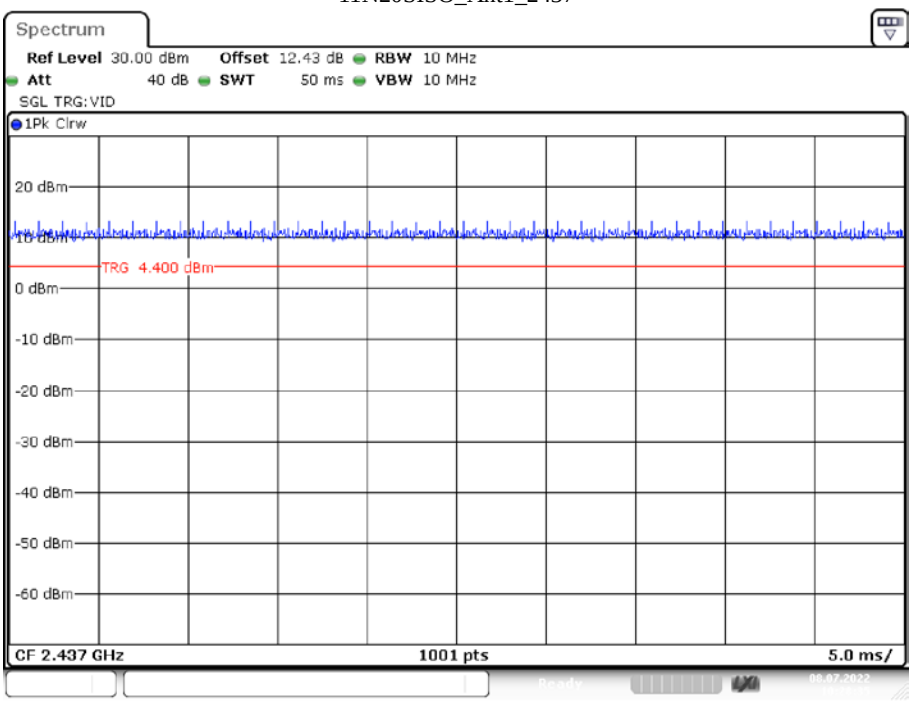
Date: 8.JUL.2022 10:15:10

11N20SISO_Ant1_2412



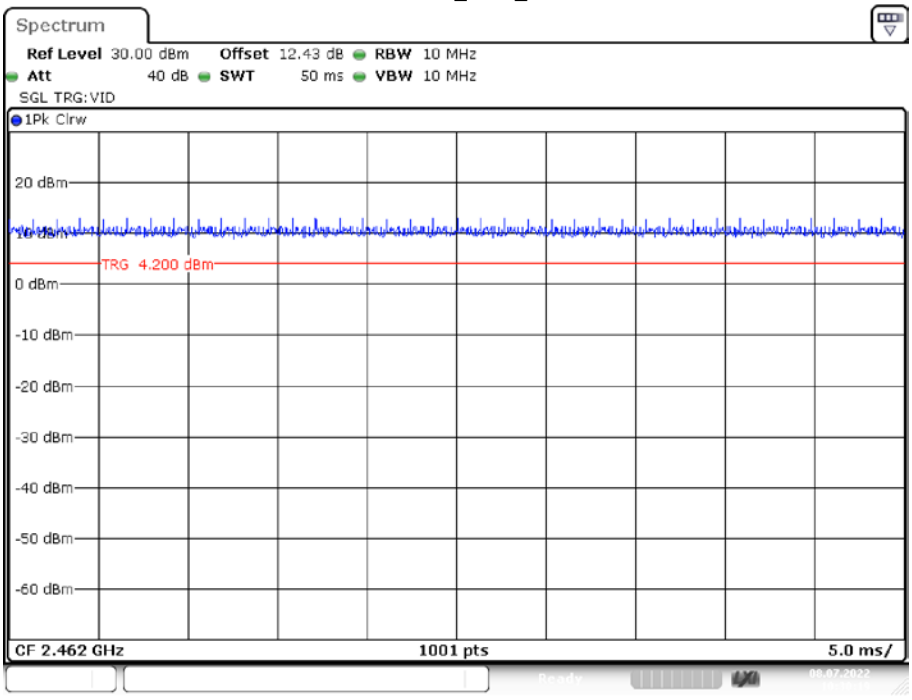
Date: 8.JUL.2022 10:18:47

11N20SISO_Ant1_2437



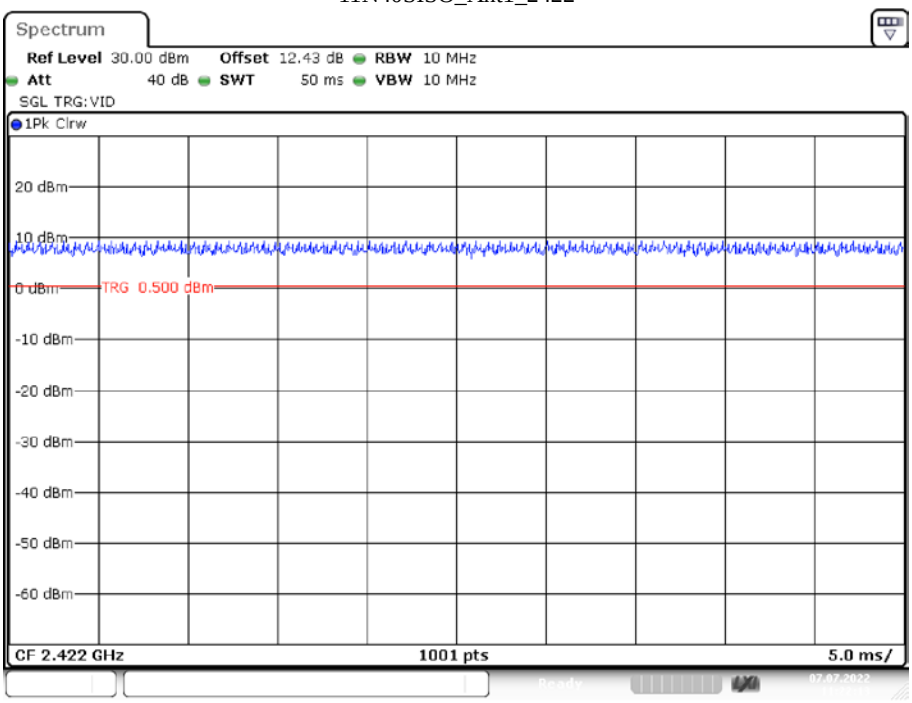
Date: 8.JUL.2022 10:28:36

11N20SISO_Ant1_2462



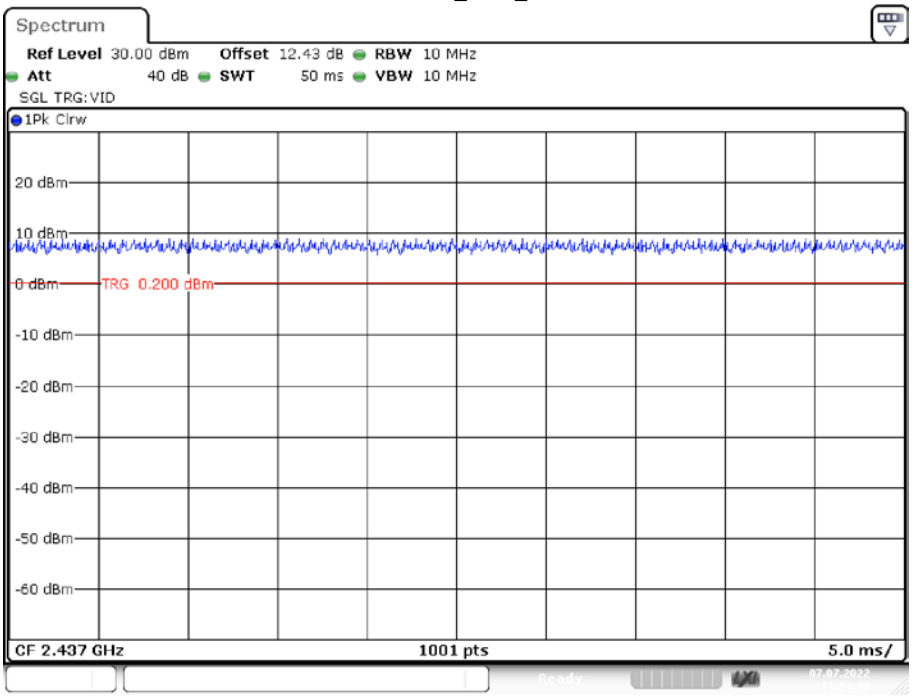
Date: 8.JUL.2022 10:30:20

11N40SISO_Ant1_2422



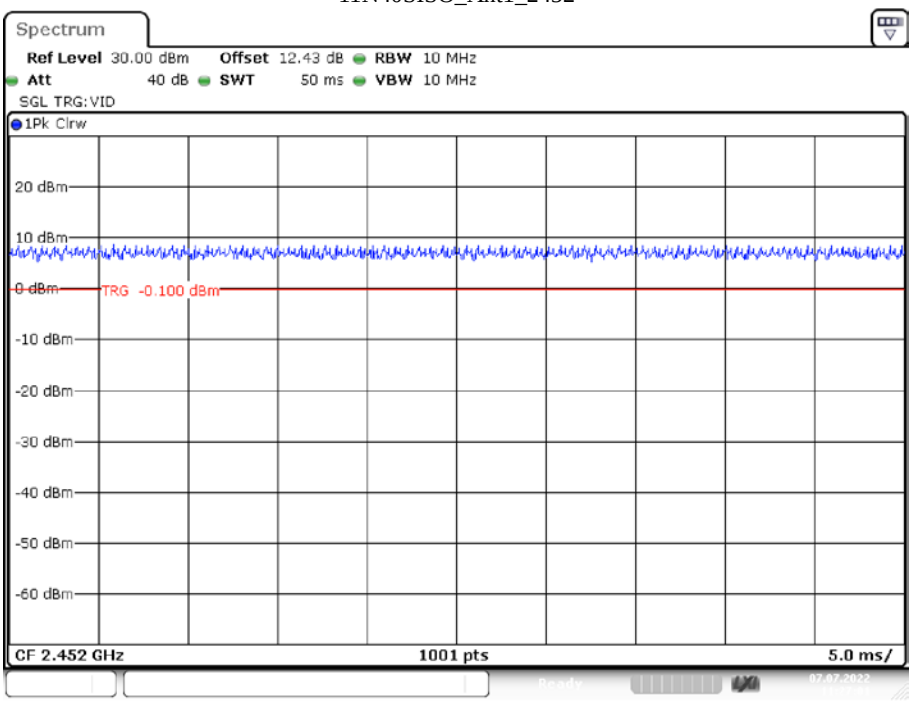
Date: 7.JUL.2022 11:22:14

11N40SISO_Ant1_2437



Date: 7.JUL.2022 11:24:46

11N40SISO_Ant1_2452



APPENDIX BLE

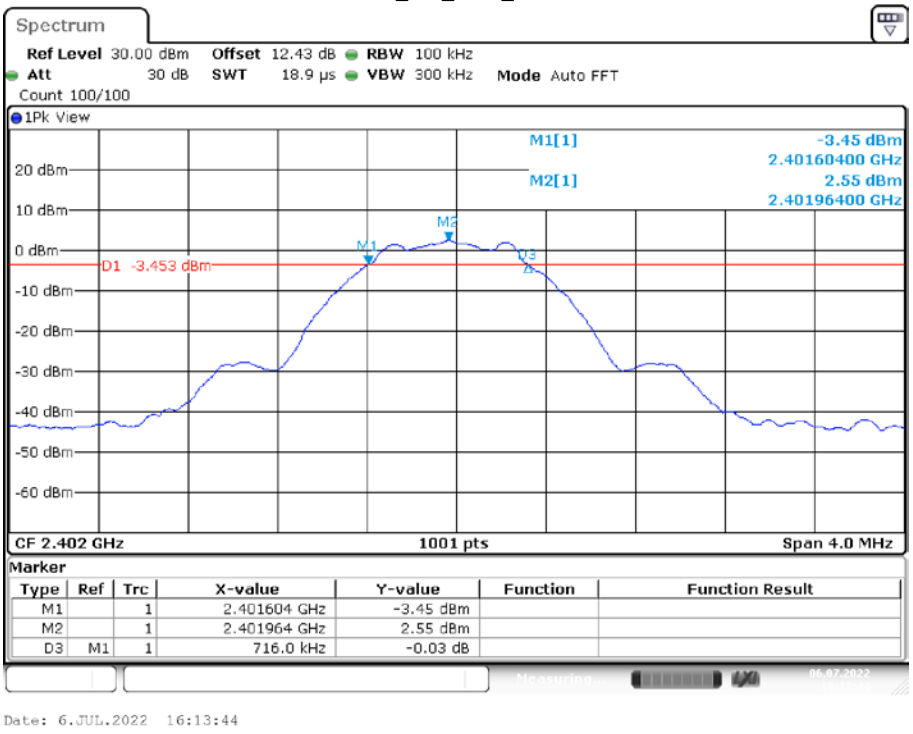
AppendixA: 6dB Emission Bandwidth

Test Result

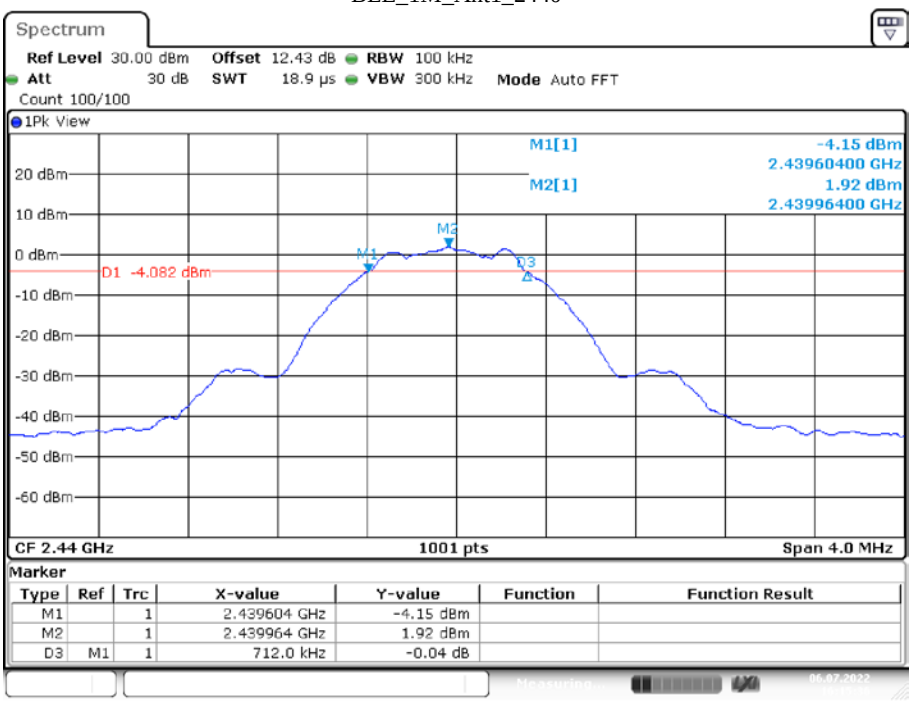
TestMode	Antenna	Channel	DTS BW [MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	0.716	0.5	PASS
		2440	0.712	0.5	PASS
		2480	0.720	0.5	PASS

Test Graphs

BLE_1M_Ant1_2402

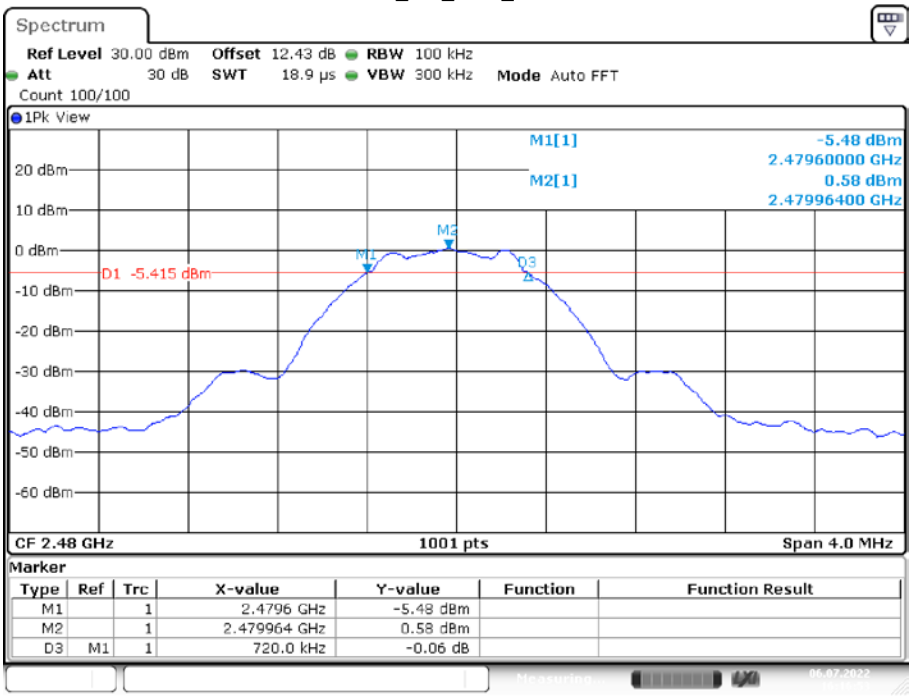


BLE_1M_Ant1_2440



Date: 6.JUL.2022 16:15:36

BLE_1M_Ant1_2480



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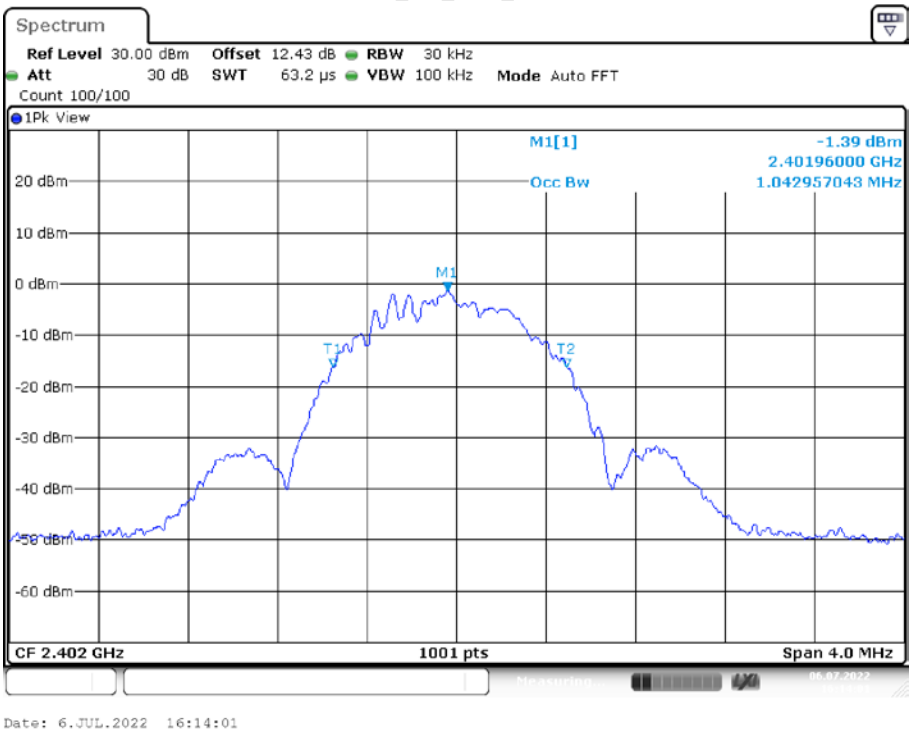
Appendix B: Occupied Channel Bandwidth

Test Result

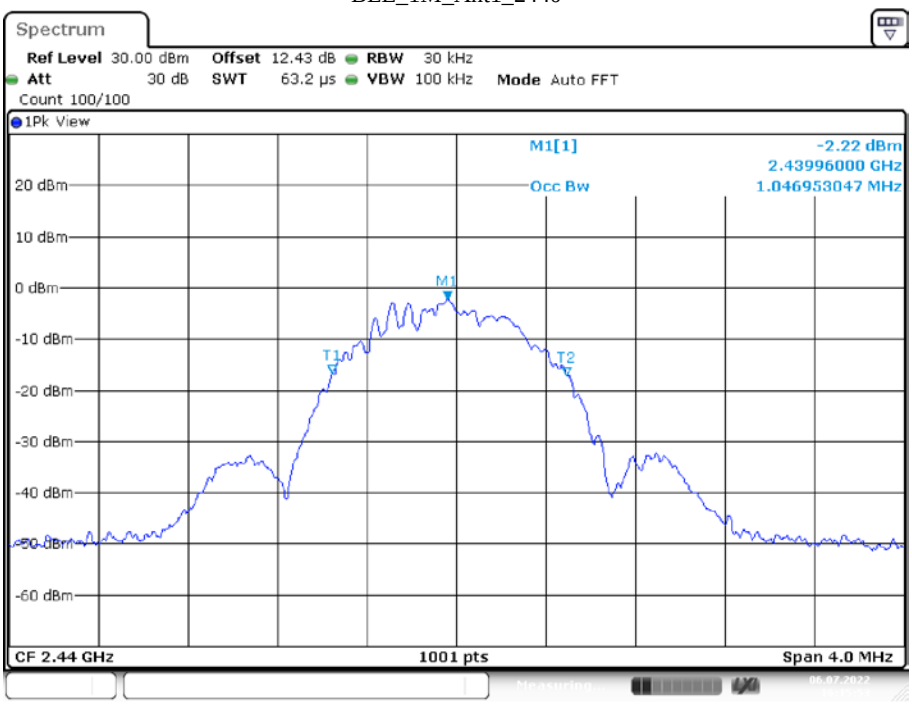
TestMode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	1.043	---	PASS
		2440	1.047	---	PASS
		2480	1.047	---	PASS

Test Graphs

BLE_1M_Ant1_2402



BLE_1M_Ant1_2440



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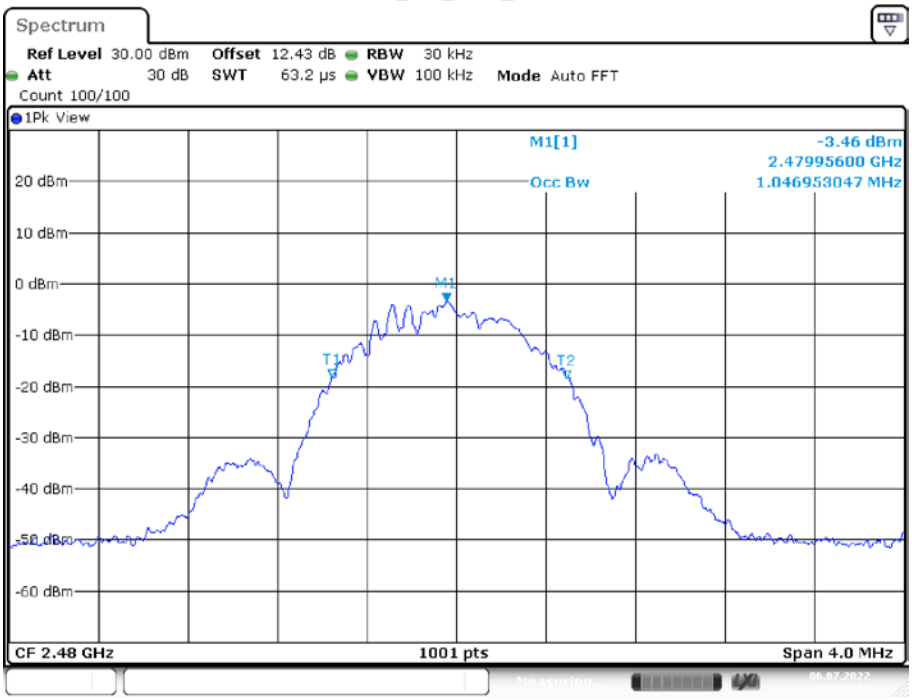
BLE_1M_Ant1_2480



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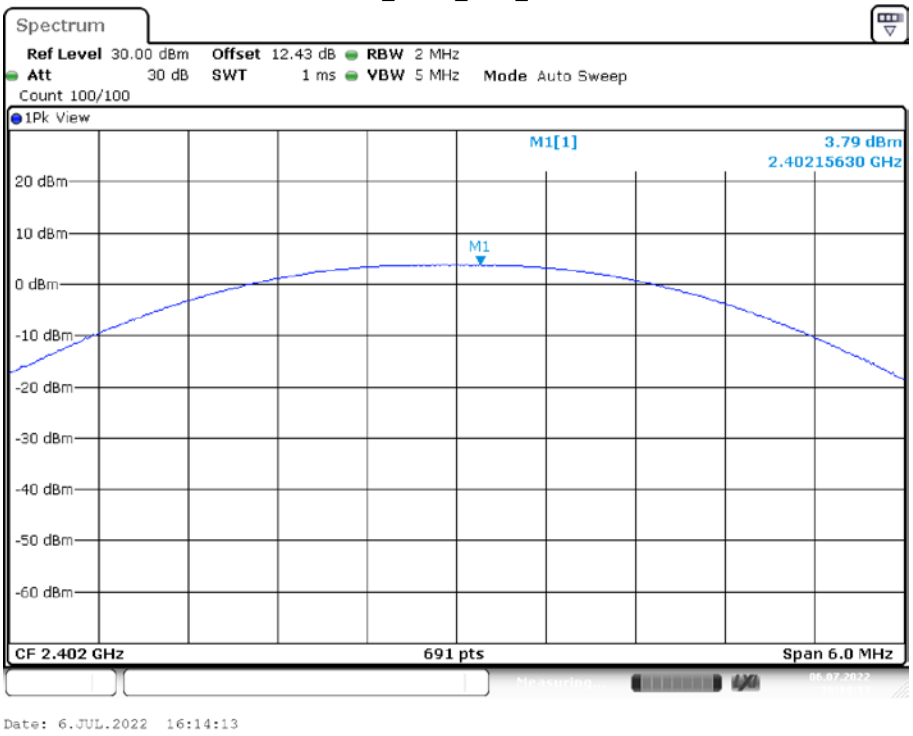
Appendix C: Maximum conducted output power

Test Result

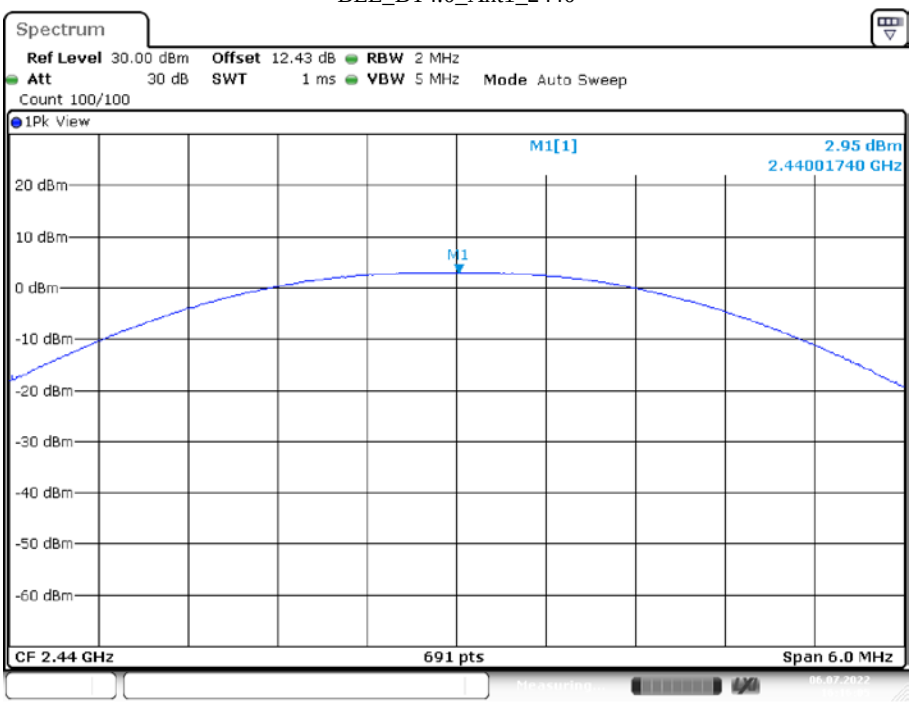
TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	3.79	<=30	PASS
		2440	2.95	<=30	PASS
		2480	1.73	<=30	PASS

Test Graphs

BLE_BT4.0_Ant1_2402



BLE_BT4.0_Ant1_2440



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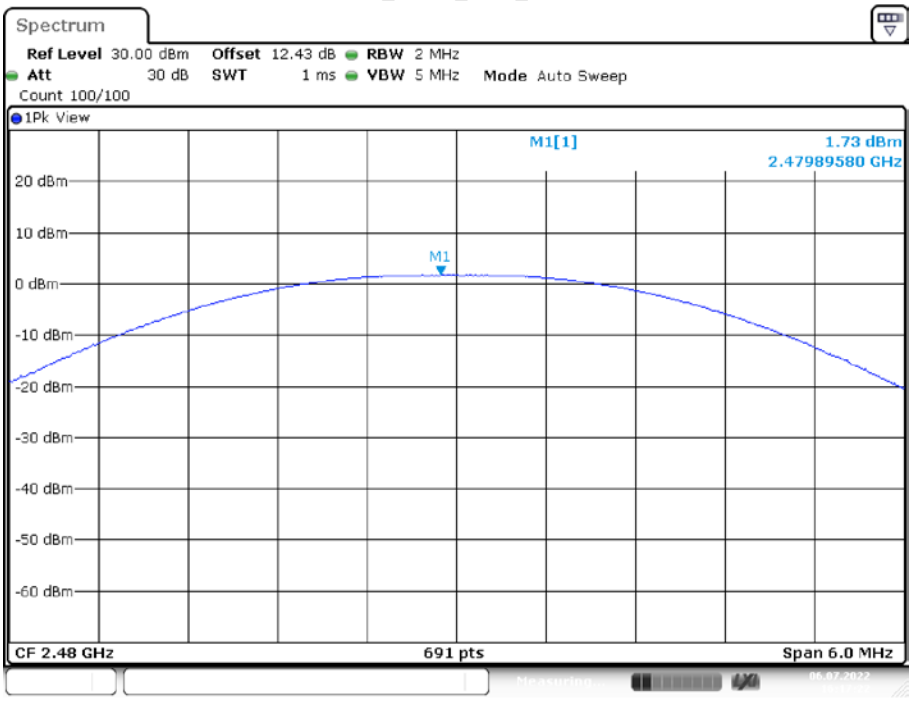
BLE_BT4.0_Ant1_2480



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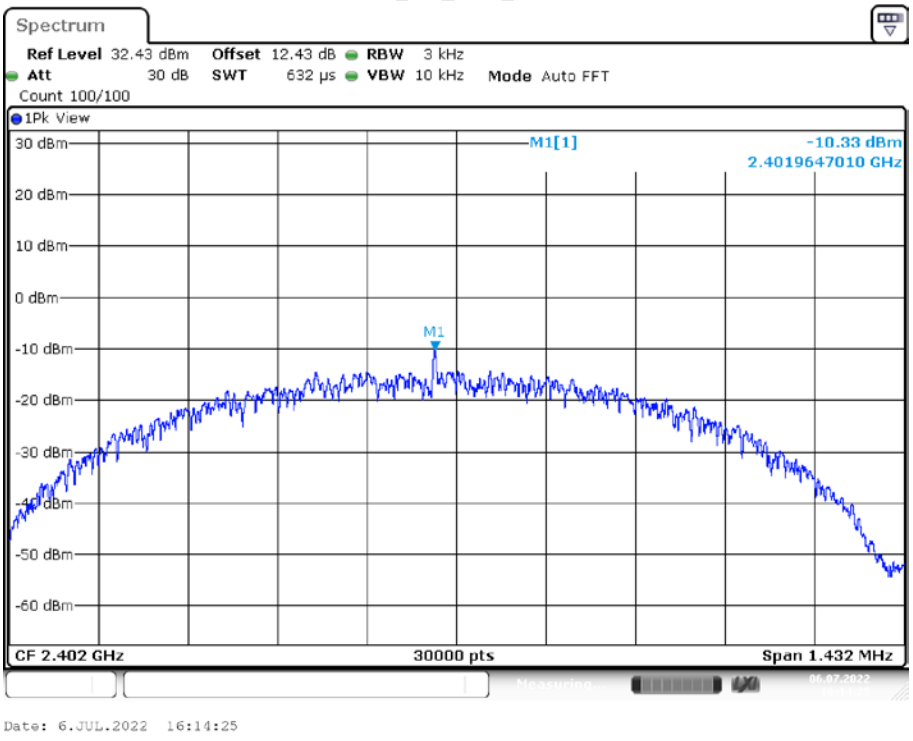
Appendix D: Power spectral density

Test Result

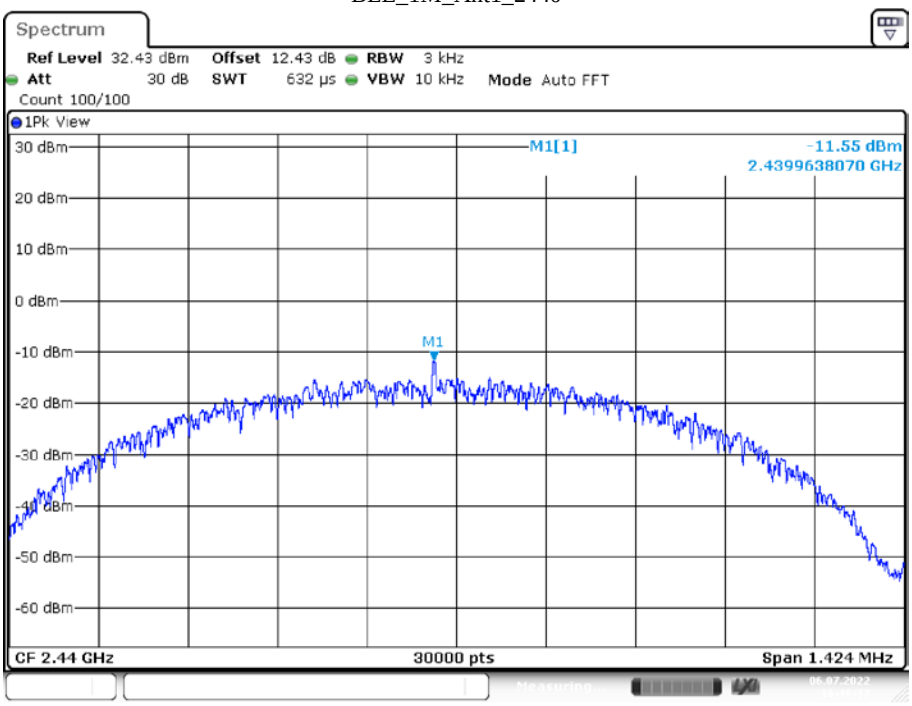
TestMode	Antenna	Channel	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-10.33	<=8	PASS
		2440	-11.55	<=8	PASS
		2480	-12.61	<=8	PASS

Test Graphs

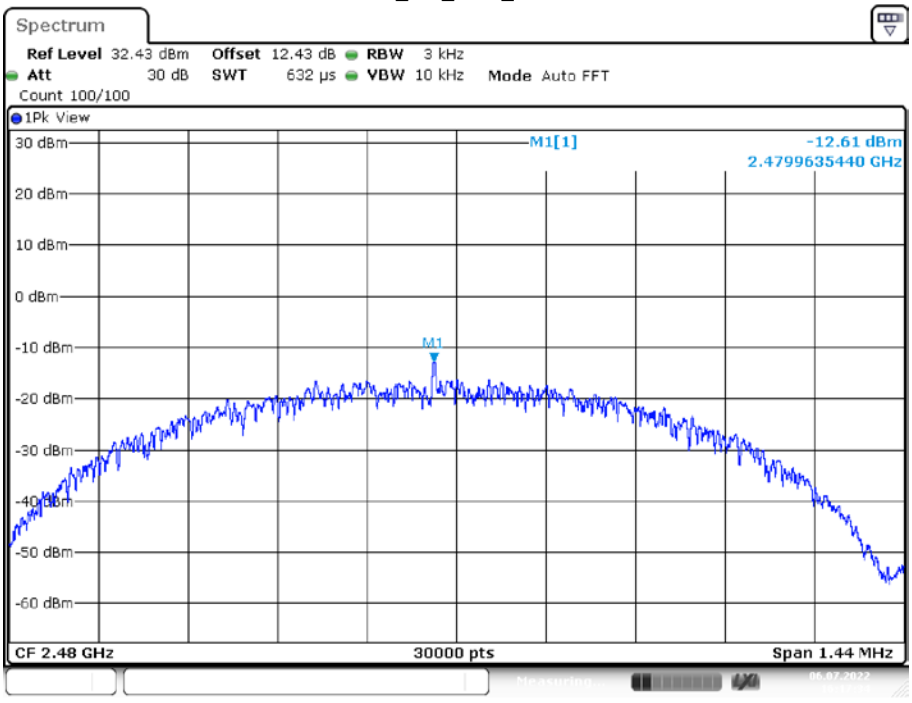
BLE_1M_Ant1_2402



BLE_1M_Ant1_2440



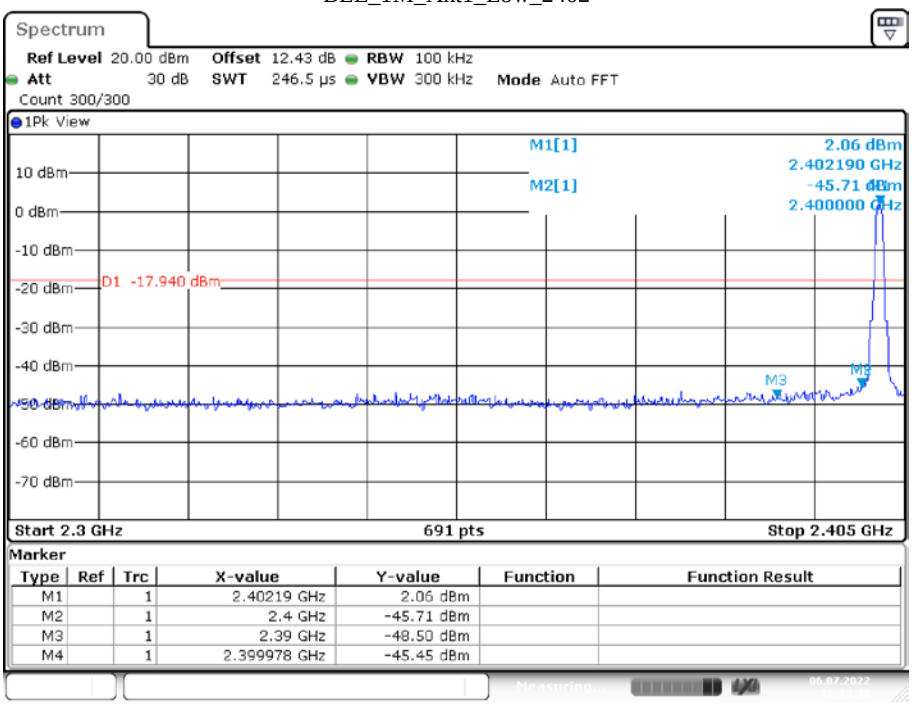
BLE_1M_Ant1_2480



Appendix E:Band edge measurements

Test Graphs

BLE_1M_Ant1_Low_2402



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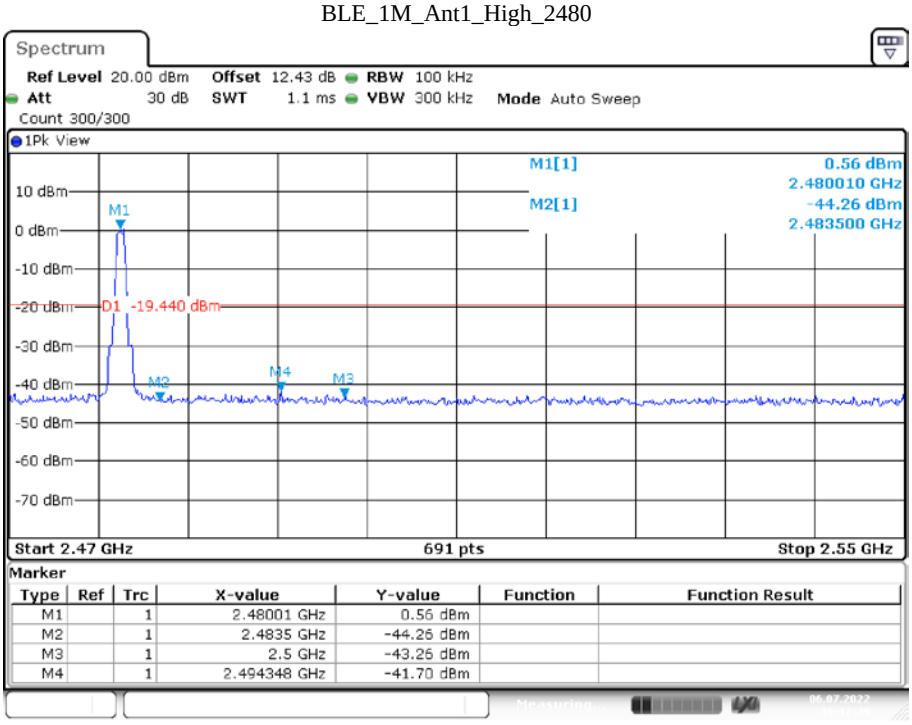
BLE_1M_Ant1_High_2480



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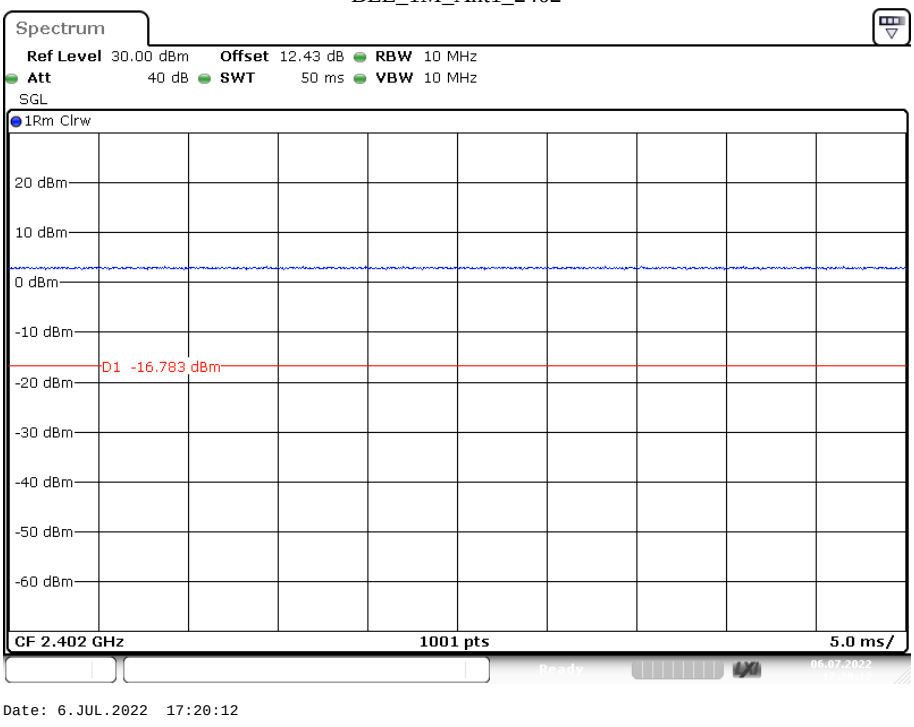
AppendixF:DutyCycle

Test Result

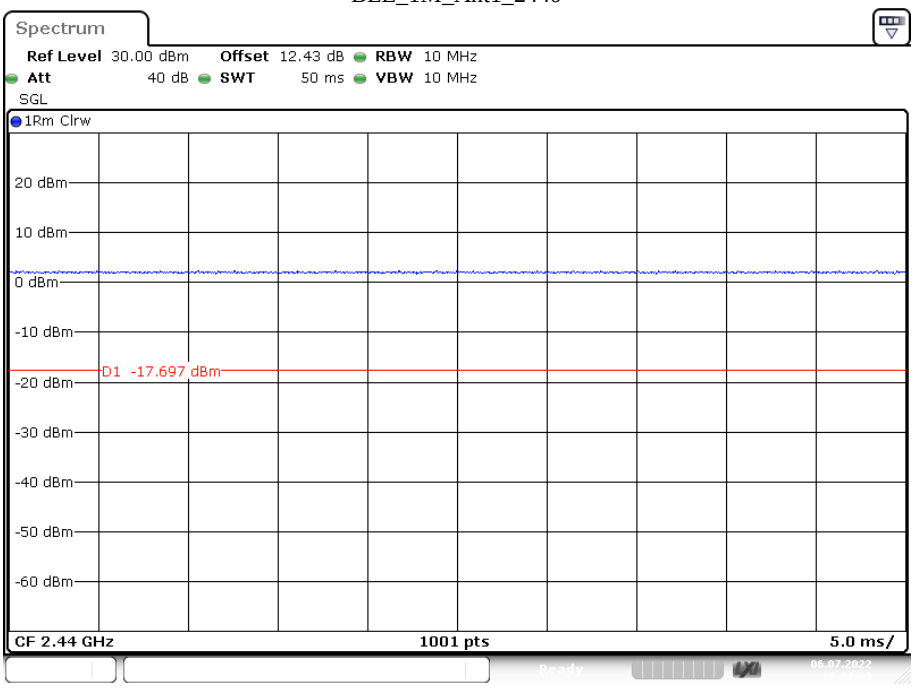
TestMode	Antenna	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
BLE_1M	Ant1	2402	50.00	50.00	100.00
		2440	50.00	50.00	100.00
		2480	50.00	50.00	100.00

Test Graphs

BLE_1M_Ant1_2402



BLE_1M_Ant1_2440



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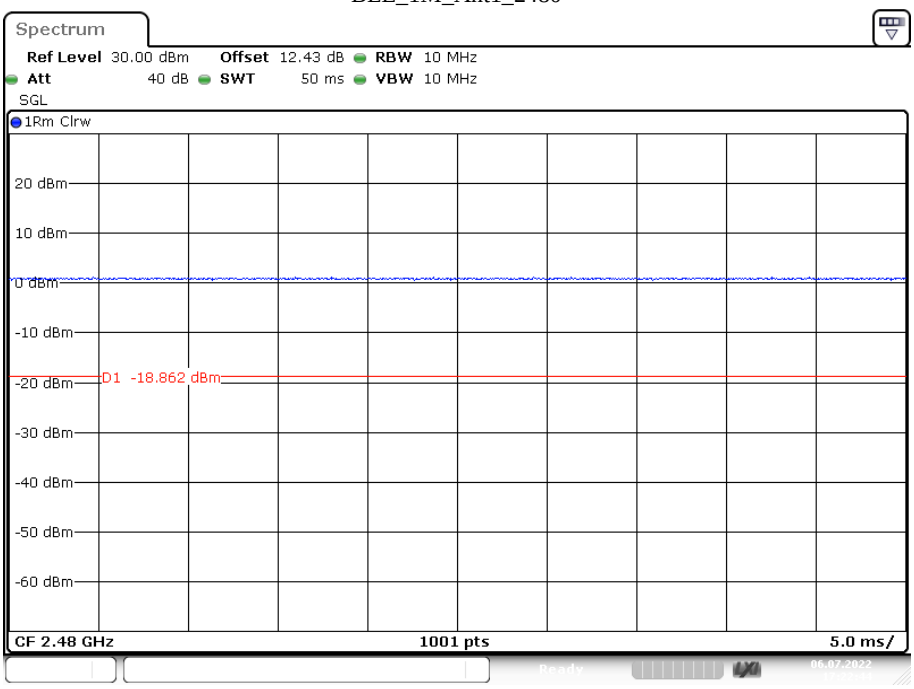
BLE_1M_Ant1_2480



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