TEST REPORT

Applicant Name :	Shenzhen Andy Optoelectronics technology limited
Address :	302, Building B5, Dongfang Jianfu Yijing Industrial City, Guangming New District, Shenzhen, China
Report Number :	SZNS1220221-05268E-RF
FCC ID:	2AYU6-AD-FW601

Test Standard (s)

FCC PART 15.247

Sample Description

Product:	LED LIGHT BAR
Tested Model:	AD-FW601
Multiple Model:	AD-FW602, AD-FW603, AD-FW604, AD-FW605, AD-FW606, AD-FW607
Date Received:	2022-02-21
Date of Test:	2022-03-01 to 2022-03-08
Report Date:	2022-03-09

Test Result:	Pass*

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

Prepared and Checked By:

Black Ding
EMC Engineer

Approved By:

Candy Li
EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★ ".
Shenzhen Accurate Technology Co., Ltd. is not responsible for the authenticity of any test data provided by the applicant. Data ir
affect test results are marked with an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered c
This report cannot be reproduced except in full, without prior written approval of the Company. Unless otherwise stated the resul
the sample(s) tested. This report is valid only with a valid digital signature. The digital signature may be available only under the A

version 7.0.

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 7
BLOCK DIAGRAM OF TEST SETUP 8
SUMMARY OF TEST RESULTS **10**
TEST EQUIPMENT LIST **11**
FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE) **12**
FCC §15.203 - ANTENNA REQUIREMENT **14**
APPLICABLE STANDARD 14
ANTENNA CONNECTOR CONSTRUCTION 14
FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS **15**
APPLICABLE STANDARD 15
EUT SETUP 15
EMI TEST RECEIVER SETUP 15
TEST PROCEDURE 15
TRANSD FACTOR & MARGIN CALCULATION 16
TEST DATA 16
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS **19**
APPLICABLE STANDARD 19
EUT SETUP 19
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP 20
TEST PROCEDURE 20
FACTOR & MARGIN CALCULATION 20
TEST DATA 20
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH & OCCUPIED BANDWIDTH **27**
APPLICABLE STANDARD 27
TEST PROCEDURE 27
TEST DATA 27
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER **28**
APPLICABLE STANDARD 28
TEST PROCEDURE 28
TEST DATA 28
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE **29**
APPLICABLE STANDARD 29
TEST PROCEDURE 29
TEST DATA 29
FCC §15.247(e) - POWER SPECTRAL DENSITY **30**

APPLICABLE STANDARD 30
TEST PROCEDURE 30
TEST DATA 30

APPENDIX Wi-Fi.....31

APPENDIX A: 6DB EMISSION BANDWIDTH.....31
APPENDIX B: OCCUPIED CHANNEL BANDWIDTH 37
APPENDIX C: MAXIMUM CONDUCTED OUTPUT POWER 43
APPENDIX D: POWER SPECTRAL DENSITY 44
APPENDIX E: BAND EDGE MEASUREMENTS.....50
APPENDIX F: DUTY CYCLE 53

APPENDIX BLE.....59

APPENDIX A: 6DB EMISSION BANDWIDTH.....59
APPENDIX B: OCCUPIED CHANNEL BANDWIDTH 61
APPENDIX C: MAXIMUM CONDUCTED OUTPUT POWER 63
APPENDIX D: POWER SPECTRAL DENSITY 65
APPENDIX E: BAND EDGE MEASUREMENTS.....67
APPENDIX F: DUTY CYCLE 68

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	LED LIGHT BAR
Tested Model	AD-FW601
Multiple Model	AD-FW602, AD-FW603, AD-FW604, AD-FW605, AD-FW606, AD-FW607
Model difference	Please refer to the DoS letter
Frequency Range	BLE: 2402-2480MHz Wi-Fi: 2412-2462MHz
Maximum Conducted Peak Output Power	BLE: 1.68dBm Wi-Fi: 17.53dBm(802.11b), 15.41dBm(802.11g), 14.59dBm(802.11n20)
Modulation Technique	BLE: GFSK Wi-Fi: DSSS, OFDM
Antenna Specification*	Internal PCB Antenna: 1dBi (provided by the applicant)
Voltage Range	DC 5V from adapter.
Sample serial number	SZNS1220221-05268E-RF -S1
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 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 429 7.01.

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

SYSTEM TEST CONFIGURATION

Description of Test Configuration

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

For BLE mode, 40 channels are provided to testing:

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

EUT was tested with Channel 0, 19 and 39.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

No software was used to test, “app DRTU”* provided by manufacturer and power level as below:

Item	Mode	Data Rate (Mbps)	Power Level*
Wi-Fi	802.11 b	1	15
	802.11 g	6	13
	802.11 n20	MCS0	12
BLE 1M	1M	Default	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

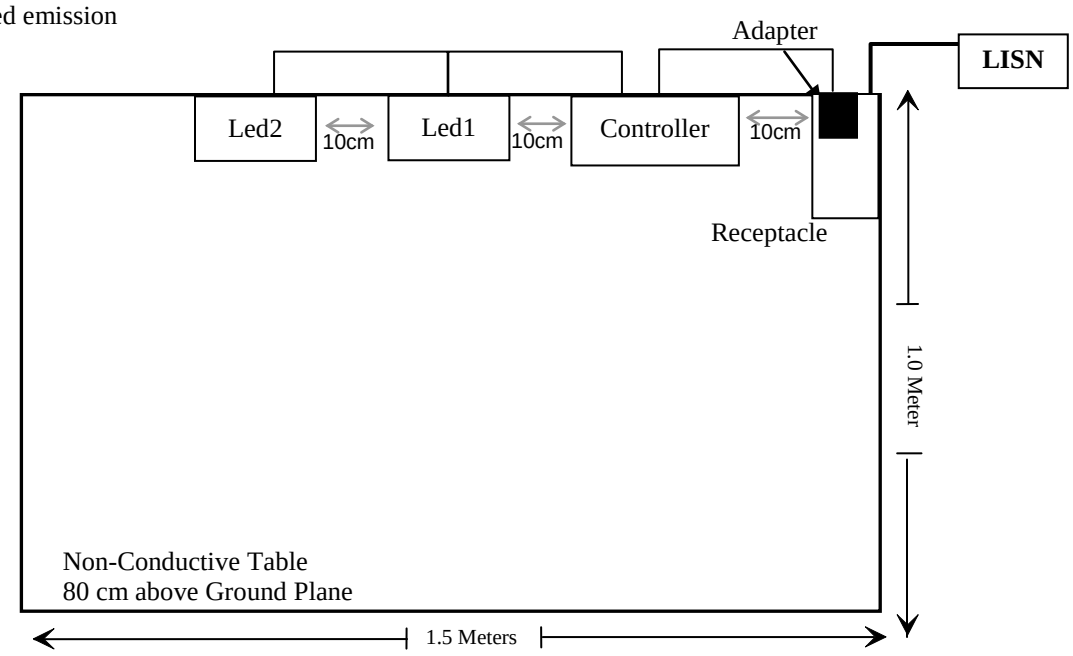
Manufacturer	Description	Model	Serial Number
SHENZHEN KEYU POWER SUPPLY TECHNOLOGY CO.,LTD	Adapter	KA1803A-US	2045

External I/O Cable

Cable Description	Length (m)	From/Port	To
Un-shielding Detachable USB Cable	1.5	Controller	Adapter
Un-shielding Detachable Type-C Cable*2	2.0	LED	Controller

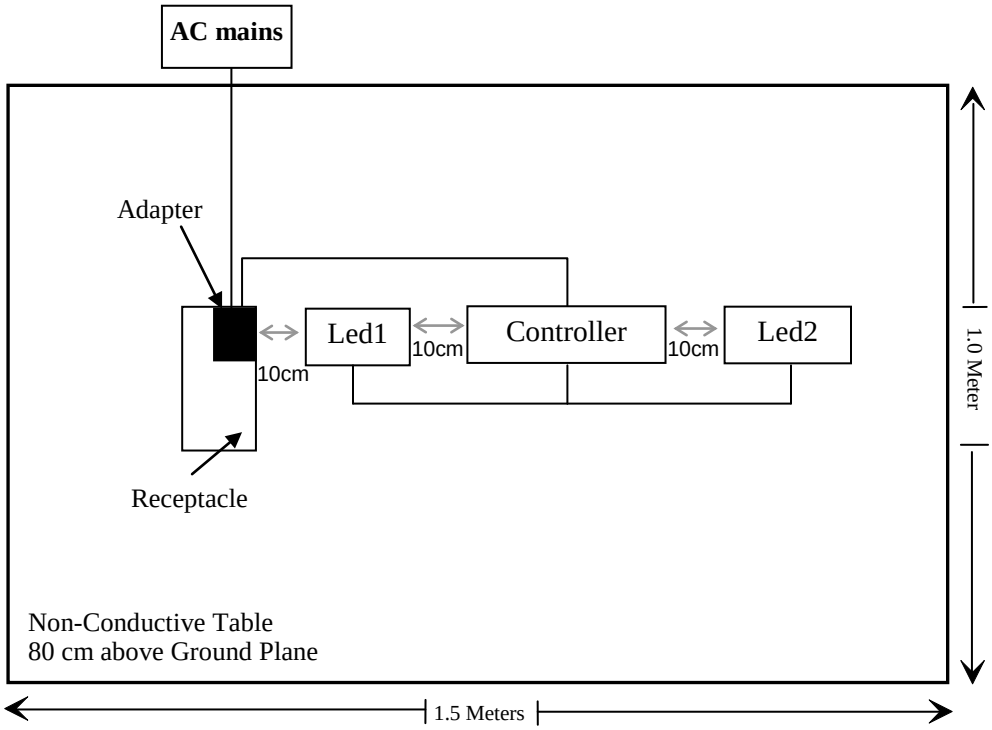
Block Diagram of Test Setup

For conducted emission

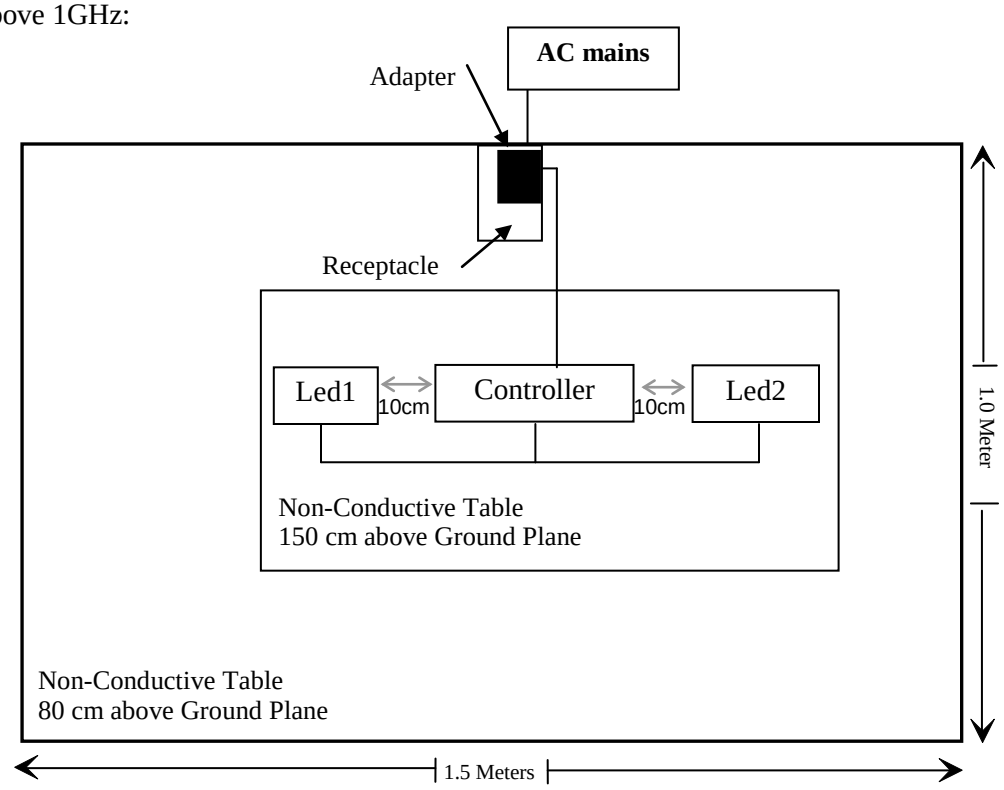


For Radiated Emission:

Below 1GHz:



Above 1GHz:


AC mains
Adapter
Receptacle
Led1
10cm
Controller
10cm
Led2
Non-Conductive Table
150 cm above Ground Plane
Non-Conductive Table
80 cm above Ground Plane
1.0 Meter
1.5 Meters

SUMMARY OF TEST RESULTS

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

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted 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-184055 36-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	WHKX3.6/18 G-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: EZ_EMC V 1.1.4.2					
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
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 §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (Minutes)**
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

Result

Calculated Formulary:

Predication of MPE limit at a given distance

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

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

For worst case:

Frequency (MHz)	Maximum Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
	(dBi)	(numeric)	(dBm)	(mW)			
2402-2480	1	1.26	2	1.58	20	0.0004	1
2412-2462	1	1.26	18	63.10	20	0.0158	1

Note: 1. The tune up conducted power was declared by the applicant.
2. The BT and Wi-Fi can't transmit at the same time.

To maintain 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 PCB Antenna arrangement, which was permanently attached and the antenna gain is 1dBi, fulfill the requirement of this section. Please refer to the EUT photos.

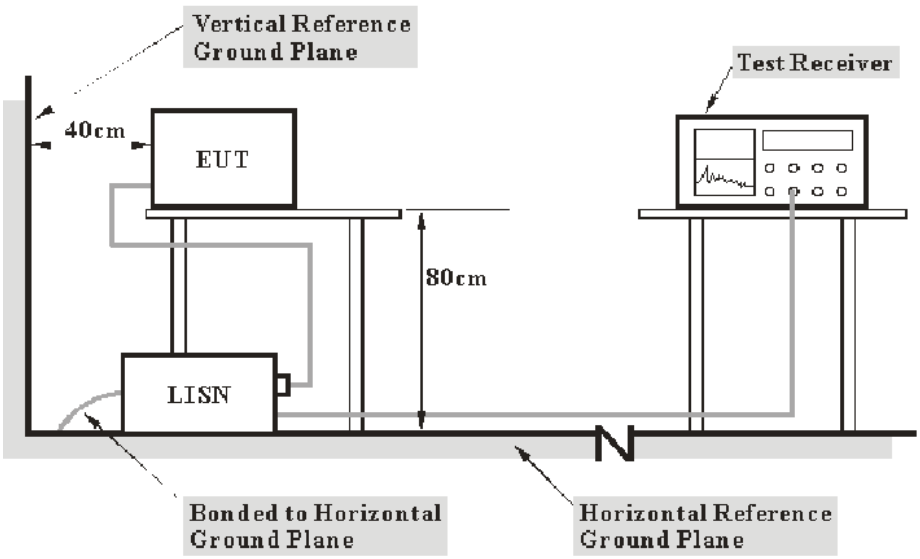
Result: Compliant.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

EUT Setup



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

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

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

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

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

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

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

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

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

Factor & Margin Calculation

The factor is calculated by adding LISN 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 applicable limit. For example, an Over limit of -7 dB means the emission is 7 dB below the limit. The equation for calculation is as follows:

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

Test Data

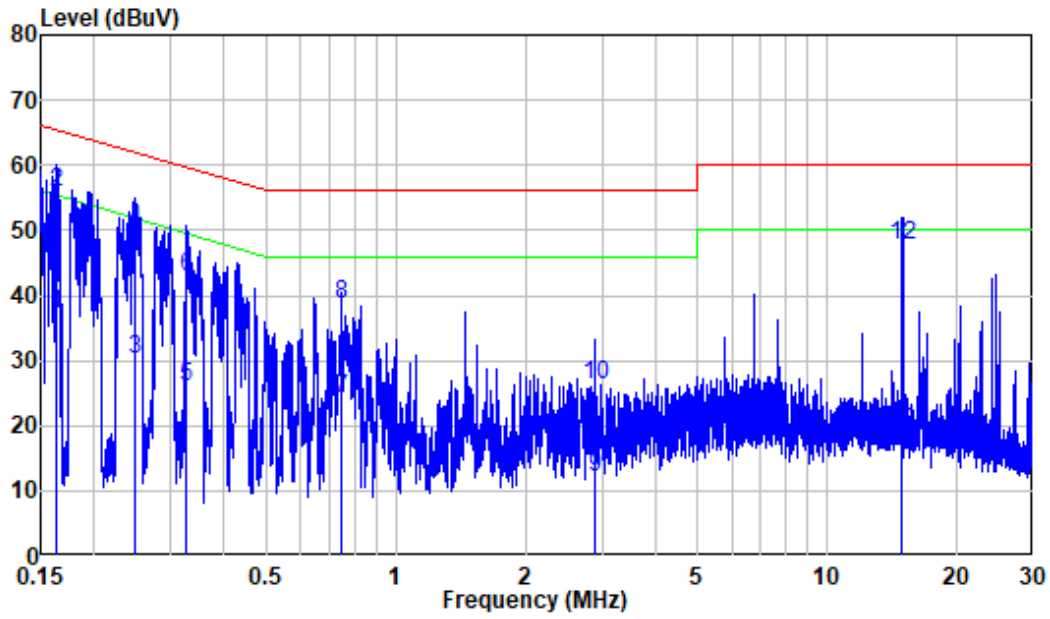
Environmental Conditions

Temperature:	23 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Bin Duan on 2022-03-02.

EUT operation mode: Transmitting (Worst case for 802.11b low channel as below)

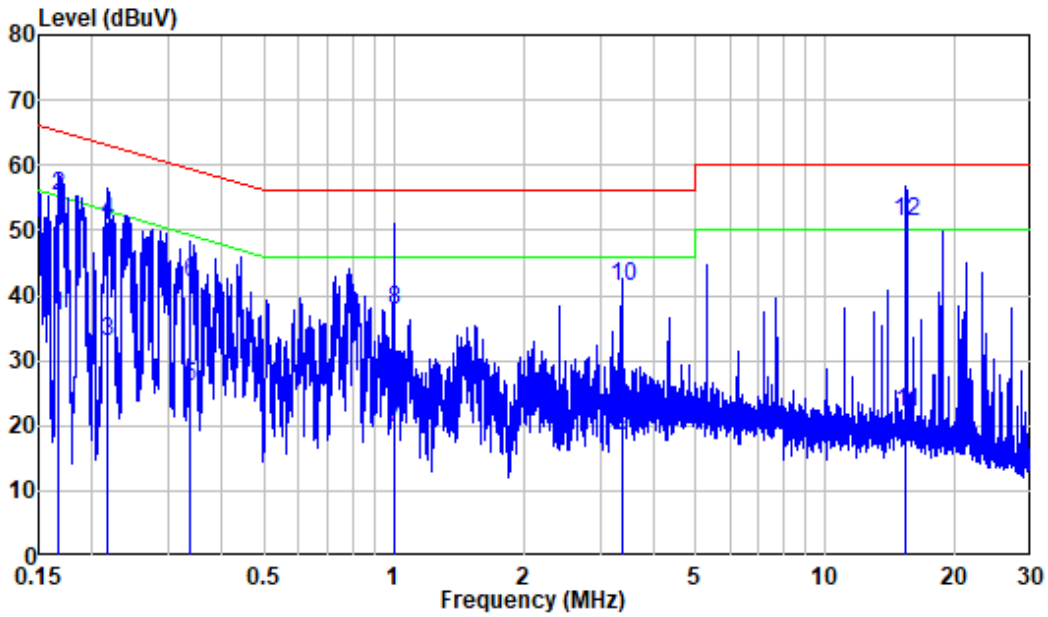
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Mode : 2.4G WIFI Transmitting
Model : AD-FW601
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.164	9.80	27.39	37.19	55.27	-18.08	Average
2	0.164	9.80	46.17	55.97	65.27	-9.30	QP
3	0.249	9.80	20.53	30.33	51.78	-21.45	Average
4	0.249	9.80	40.36	50.16	61.78	-11.62	QP
5	0.327	9.80	16.05	25.85	49.51	-23.66	Average
6	0.327	9.80	33.13	42.93	59.51	-16.58	QP
7	0.745	9.81	14.22	24.03	46.00	-21.97	Average
8	0.745	9.81	28.71	38.52	56.00	-17.48	QP
9	2.894	9.83	2.15	11.98	46.00	-34.02	Average
10	2.894	9.83	16.53	26.36	56.00	-29.64	QP
11	14.927	9.95	9.44	19.39	50.00	-30.61	Average
12	14.927	9.95	37.67	47.62	60.00	-12.38	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Mode : 2.4G WIFI Transmitting
Model : AD-FW601
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.167	9.80	27.09	36.89	55.12	-18.23	Average
2	0.167	9.80	45.31	55.11	65.12	-10.01	QP
3	0.216	9.80	23.11	32.91	52.96	-20.05	Average
4	0.216	9.80	41.64	51.44	62.96	-11.52	QP
5	0.337	9.80	16.14	25.94	49.27	-23.33	Average
6	0.337	9.80	32.23	42.03	59.27	-17.24	QP
7	1.003	9.81	9.79	19.60	46.00	-26.40	Average
8	1.003	9.81	28.05	37.86	56.00	-18.14	QP
9	3.370	9.83	8.66	18.49	46.00	-27.51	Average
10	3.370	9.83	31.54	41.37	56.00	-14.63	QP
11	15.409	10.05	11.93	21.98	50.00	-28.02	Average
12	15.409	10.05	41.24	51.29	60.00	-8.71	QP

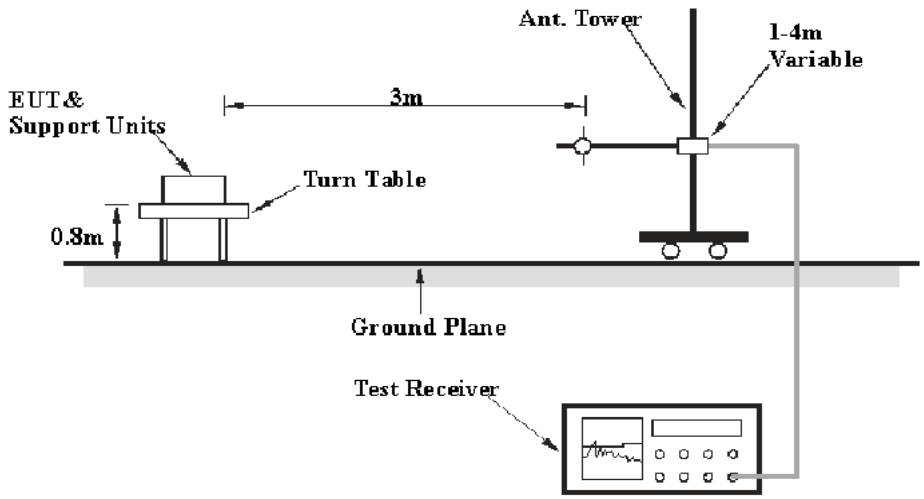
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

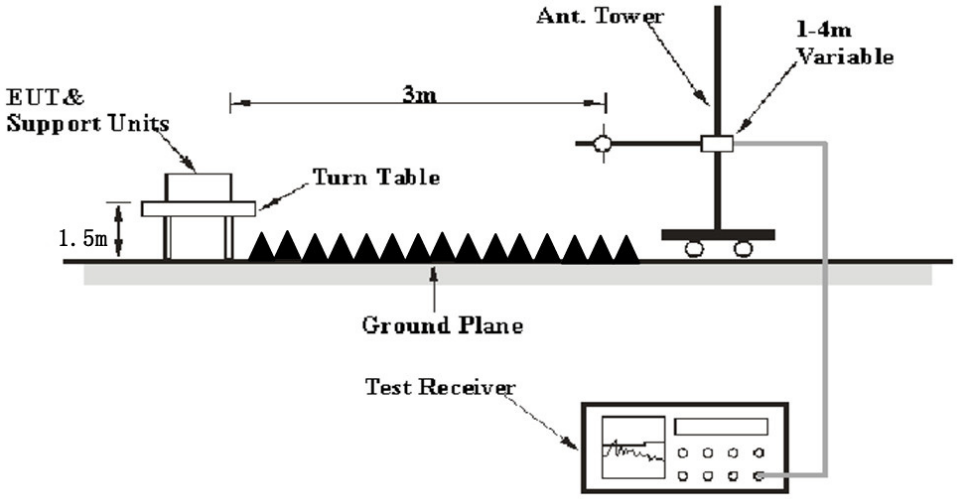
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



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

EMI Test Receiver & Spectrum Analyzer Setup

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

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz Note 1	/	Average
	1MHz	＞1/T Note 2	/	Average

Note 1: when duty cycle is no less than 98%
Note 2: when duty cycle is less than 98%

If the maximized peak measured value complies with the limit, then it is unnecessary to perform a QP/Average 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 = Result / Corrected Amplitude – Limit
Result / Corrected Amplitude = Read Level + Factor

Test Data

Environmental Conditions

Temperature:	22 ℃
Relative Humidity:	55 %
ATM Pressure:	101.2 kPa

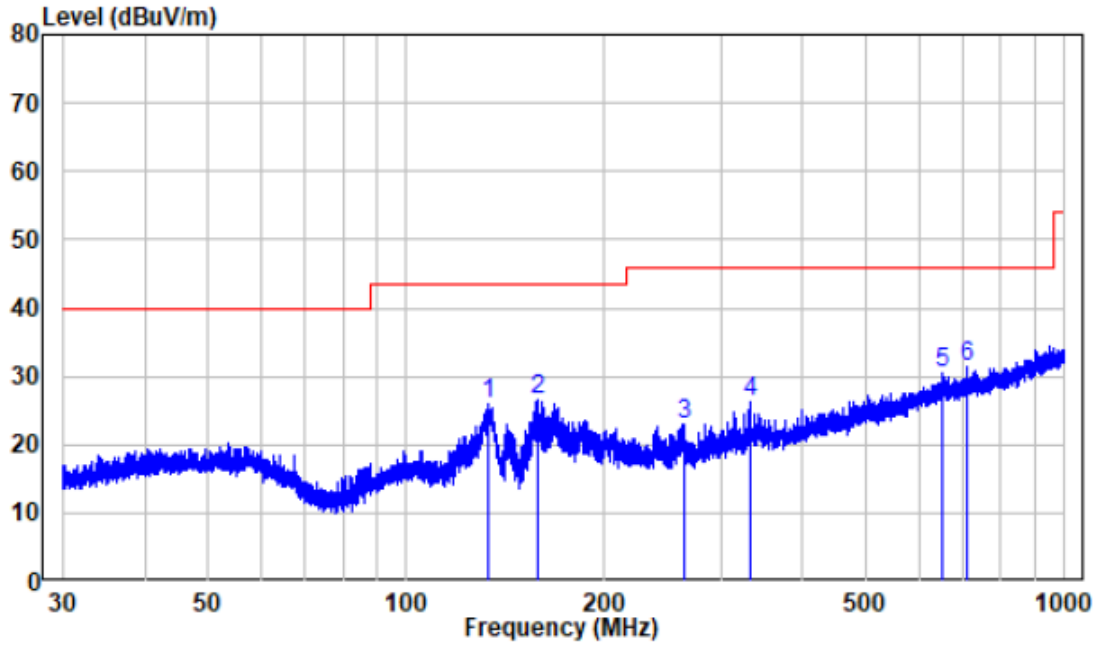
The testing was performed by Chao Mo on 2022-03-04.

EUT operation mode: Transmitting

(Scan with BLE, 802.11b, 802.11g, 802.11n-HT20 mode at X axis, Y axis, Z axis, the worst case is at X axis)

30MHz-1GHz: (Worst case)
Wi-Fi: 802.11B mode, Low Channel

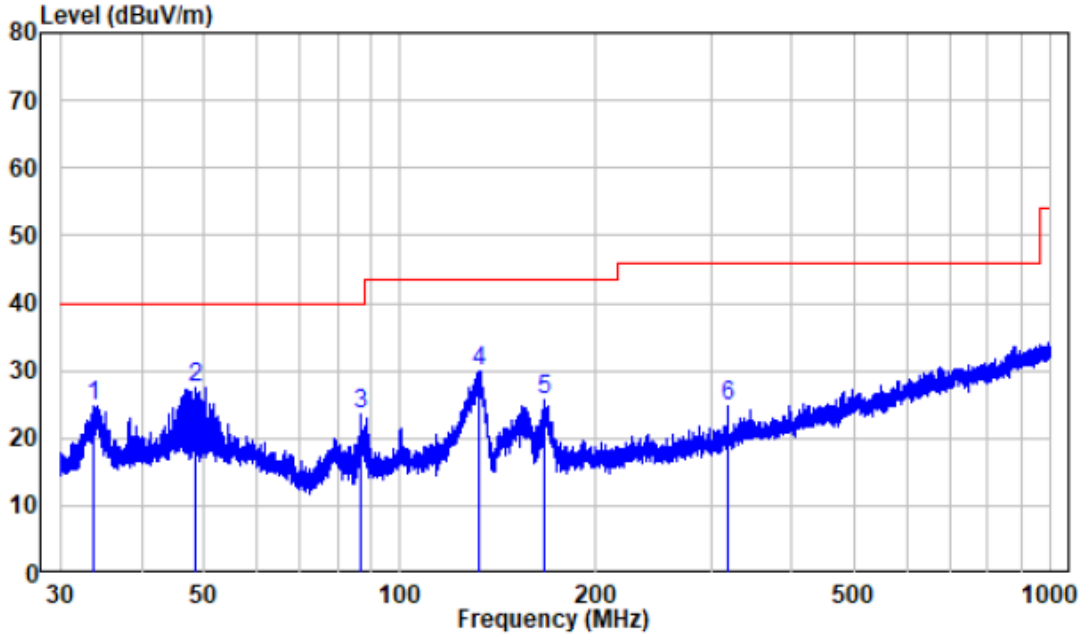
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : SZNS1220221-05268E-RF
Mode : 2.4G WIFI Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	132.801	-14.98	40.95	25.97	43.50	-17.53	Peak
2	157.766	-14.54	41.15	26.61	43.50	-16.89	Peak
3	264.862	-10.46	33.38	22.92	46.00	-23.08	Peak
4	333.102	-7.76	34.05	26.29	46.00	-19.71	Peak
5	651.942	-1.67	32.28	30.61	46.00	-15.39	Peak
6	711.674	-1.44	32.75	31.31	46.00	-14.69	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : SZNS1220221-05268E-RF
Mode : 2.4G WIFI Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	33.739	-11.89	36.74	24.85	40.00	-15.15	Peak
2	48.268	-9.99	37.33	27.34	40.00	-12.66	Peak
3	87.074	-14.87	38.34	23.47	40.00	-16.53	Peak
4	131.816	-14.97	44.78	29.81	43.50	-13.69	Peak
5	166.725	-13.91	39.48	25.57	43.50	-17.93	Peak
6	319.237	-8.49	33.11	24.62	46.00	-21.38	Peak

1-25 GHz:
BLE:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/AV		Height (m)	Polar (H/V)				
BLE 1M Low channel									
2310	50.98	PK	203	1.9	H	-7.23	43.75	74	-30.25
2310	49.55	PK	62	2.0	V	-7.23	42.32	74	-31.68
2390	53.05	PK	344	1.0	H	-7.21	45.84	74	-28.16
2390	51.68	PK	48	1.3	V	-7.21	44.47	74	-29.53
4804	50.65	PK	330	1.9	H	-3.52	47.13	74	-26.87
4804	46.64	PK	122	2.1	V	-3.52	43.12	74	-30.88
BLE 1M Middle channel									
4880	49.39	PK	3	1.2	H	-3.37	46.02	74	-27.98
4880	46.06	PK	278	2.2	V	-3.37	42.69	74	-31.31
BLE 1M High channel									
2483.5	53.56	PK	356	1.6	H	-7.2	46.36	74	-27.64
2483.5	51.93	PK	354	2.0	V	-7.2	44.73	74	-29.27
2500	49.6	PK	323	1.8	H	-7.18	42.42	74	-31.58
2500	49.13	PK	23	1.4	V	-7.18	41.95	74	-32.05
4960	48.32	PK	51	1.3	H	-3.01	45.31	74	-28.69
4960	45.17	PK	306	1.6	V	-3.01	42.16	74	-31.84

Wi-Fi

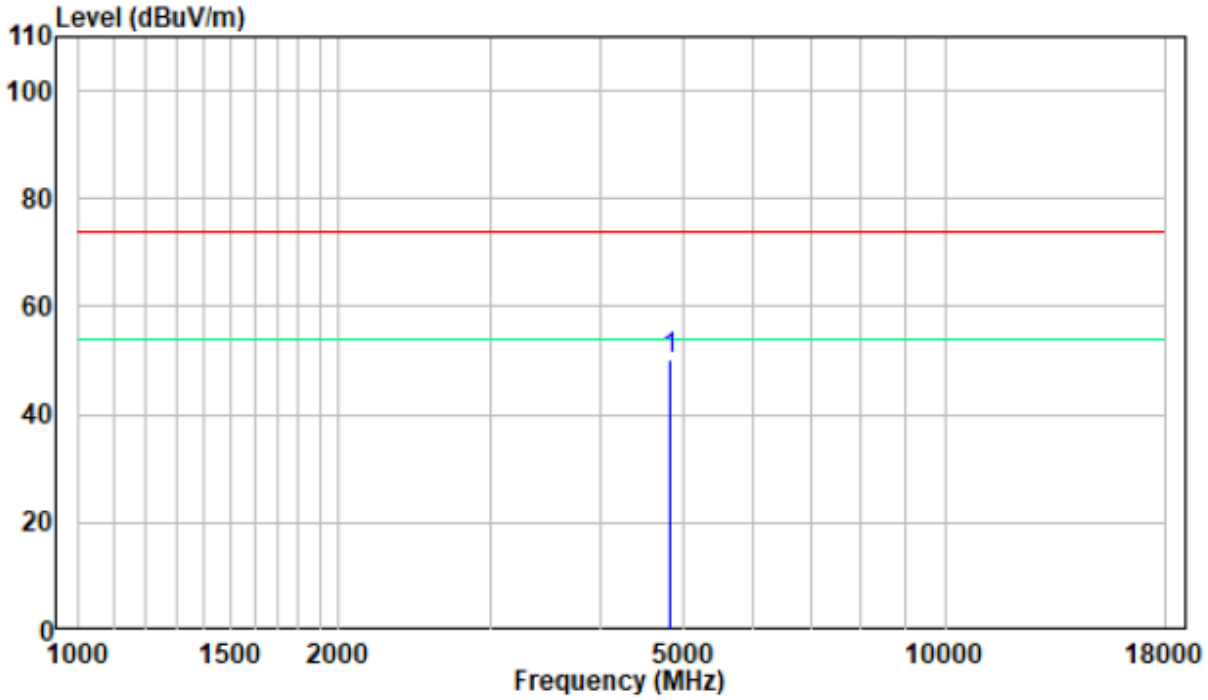
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/AV		Height (m)	Polar (H/V)				
802.11B Low channel									
2310	52	PK	203	1.9	H	-7.23	44.77	74	-29.23
2310	52.8	PK	62	2.0	V	-7.23	45.57	74	-28.43
2390	54.72	PK	344	1.0	H	-7.21	47.51	74	-26.49
2390	53.85	PK	48	1.3	V	-7.21	46.64	74	-27.36
4824	53.95	PK	330	1.9	H	-3.53	50.42	74	-23.58
4824	52.2	PK	122	2.1	V	-3.53	48.67	74	-25.33
802.11B Middle channel									
4874	52.3	PK	68	1.4	H	-3.42	48.88	74	-25.12
4874	49.76	PK	328	1.4	V	-3.42	46.34	74	-27.66
802.11B High channel									
2483.5	53.1	PK	251	1.4	H	-7.2	45.90	74	-28.10
2483.5	51.42	PK	259	2.0	V	-7.2	44.22	74	-29.78
2500	50.95	PK	356	1.6	H	-7.18	43.77	74	-30.23
2500	50.77	PK	354	2.0	V	-7.18	43.59	74	-30.41
4924	51.54	PK	323	1.8	H	-3.16	48.38	74	-25.62
4924	48.86	PK	23	1.4	V	-3.16	45.70	74	-28.30
802.11G Low channel									
2310	52.22	PK	29	2.0	H	-7.23	44.99	74	-29.01
2310	51.91	PK	306	1.6	V	-7.23	44.68	74	-29.32

2390	52.85	PK	338	1.4	H	-7.21	45.64	74	-28.36
2390	52.13	PK	165	1.7	V	-7.21	44.92	74	-29.08
4824	50.82	PK	287	1.0	H	-3.53	47.29	74	-26.71
4824	49.17	PK	310	1.4	V	-3.53	45.64	74	-28.36
802.11G Middle channel									
4874	49.73	PK	236	1.9	H	-3.42	46.31	74	-27.69
4874	47.76	PK	35	1.6	V	-3.42	44.34	74	-29.66
802.11G High channel									
2483.5	54.08	PK	101	1.5	H	-7.2	46.88	74	-27.12
2483.5	52.53	PK	72	2.1	V	-7.2	45.33	74	-28.67
2500	50.96	PK	281	1.5	H	-7.18	43.78	74	-30.22
2500	51.44	PK	145	1.5	V	-7.18	44.26	74	-29.74
4924	49.84	PK	219	1.4	H	-3.16	46.68	74	-27.32
4924	47.05	PK	208	2.1	V	-3.16	43.89	74	-30.11
802.11N20 Low channel									
2310	51.15	PK	196	2.2	H	-7.23	43.92	74	-30.08
2310	50.97	PK	81	1.9	V	-7.23	43.74	74	-30.26
2390	51.9	PK	40	2.0	H	-7.21	44.69	74	-29.31
2390	51.5	PK	316	1.7	V	-7.21	44.29	74	-29.71
4824	47.33	PK	0	1.7	H	-3.53	43.80	74	-30.20
4824	46.27	PK	156	1.2	V	-3.53	42.74	74	-31.26
802.11N20 Middle channel									
4874	46.34	PK	7	1.9	H	-3.42	42.92	74	-31.08
4874	45.87	PK	18	1.3	V	-3.42	42.45	74	-31.55
802.11N20 High channel									
2483.5	51.68	PK	173	2.0	H	-7.2	44.48	74	-29.52
2483.5	51.09	PK	102	2.2	V	-7.2	43.89	74	-30.11
2500	50.36	PK	325	1.7	H	-7.18	43.18	74	-30.82
2500	50.44	PK	113	1.1	V	-7.18	43.26	74	-30.74
4924	44.64	PK	2	1.3	H	-3.16	41.48	74	-32.52
4924	44.52	PK	291	1.9	V	-3.16	41.36	74	-32.64

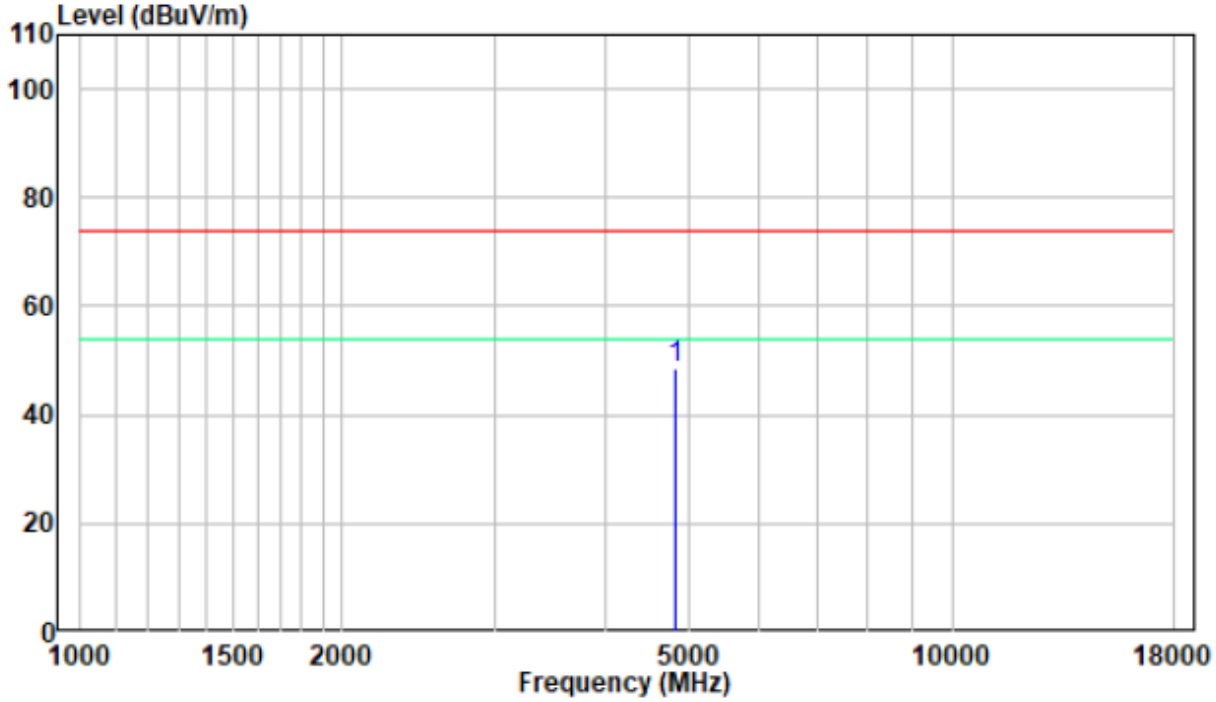
Note:
Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Absolute Level (Corrected Amplitude) = Factor + Reading
Margin = Absolute Level - Limit
The other spurious emission which is in the noise floor level was not recorded.
For above 1GHz, the test result of peak was 20dB below to the limit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

1-18 GHz:

Pre-scan for Peak
802.11 b Low Channel
Horizontal

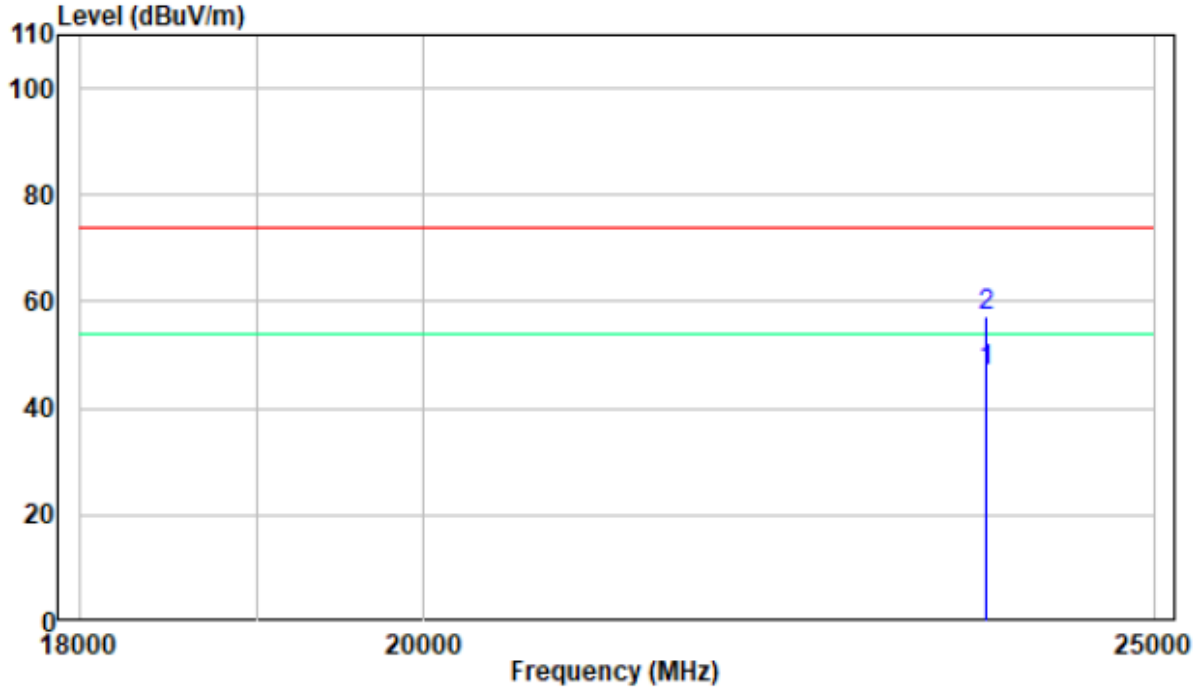


Vertical

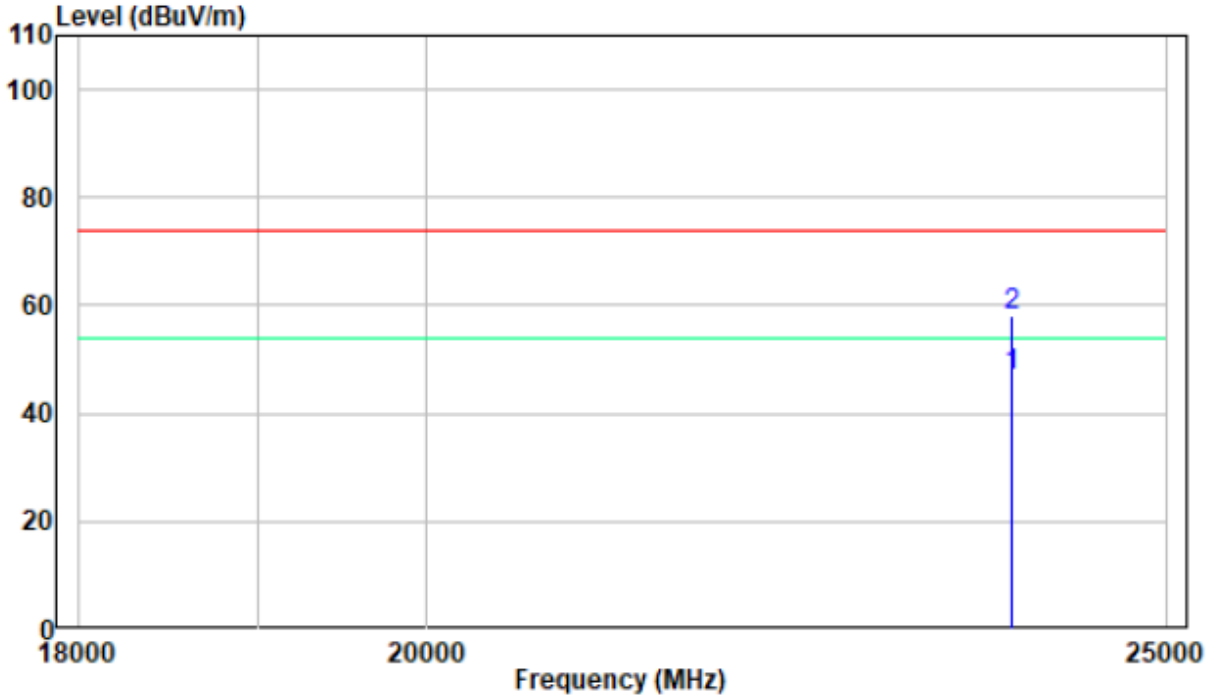


18 -25GHz:

Pre-scan for Peak
802.11 b Low Channel
Horizontal



Vertical



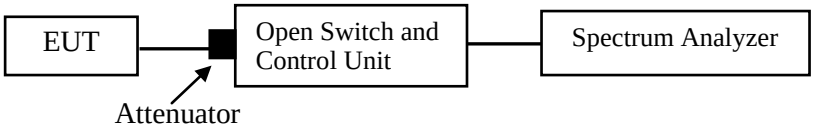
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH & OCCUPIED BANDWIDTH

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:	19~21 ℃
Relative Humidity:	48~50 %
ATM Pressure:	101.0~101.2 kPa

The testing was performed by Pual Liu on 2022-03-08 for BLE and 2022-03-04 for Wi-Fi.

EUT operation mode: Transmitting

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

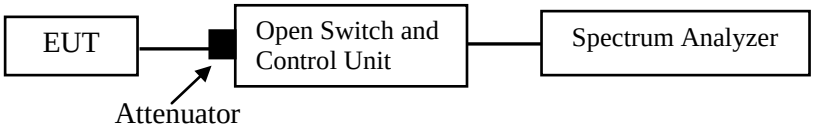
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

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:	19~21 ℃
Relative Humidity:	48~50 %
ATM Pressure:	101.0~101.2 kPa

The testing was performed by Pual Liu on 2022-03-08 for BLE and 2022-03-04 for Wi-Fi.

EUT operation mode: Transmitting

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

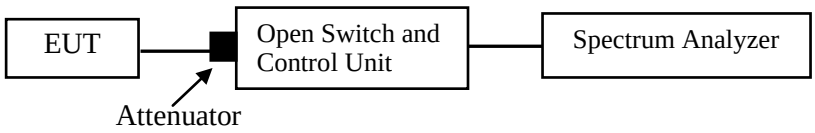
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

Applicable Standard

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

Test Procedure

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



Test Data

Environmental Conditions

Temperature:	19~21 ℃
Relative Humidity:	48~50 %
ATM Pressure:	101.0~101.2 kPa

The testing was performed by Pual Liu on 2022-03-08 for BLE and 2022-03-04 for Wi-Fi.

EUT operation mode: Transmitting

Test Result: Compliant.

Conducted Band Edge Result:

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

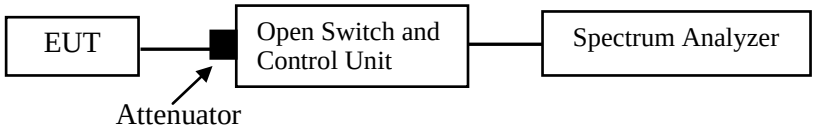
FCC §15.247(e) - POWER SPECTRAL DENSITY

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:	19~21 ℃
Relative Humidity:	48~50 %
ATM Pressure:	101.0~101.2 kPa

The testing was performed by Pual Liu on 2022-03-08 for BLE and 2022-03-04 for Wi-Fi.

EUT operation mode: Transmitting

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

APPENDIX Wi-Fi

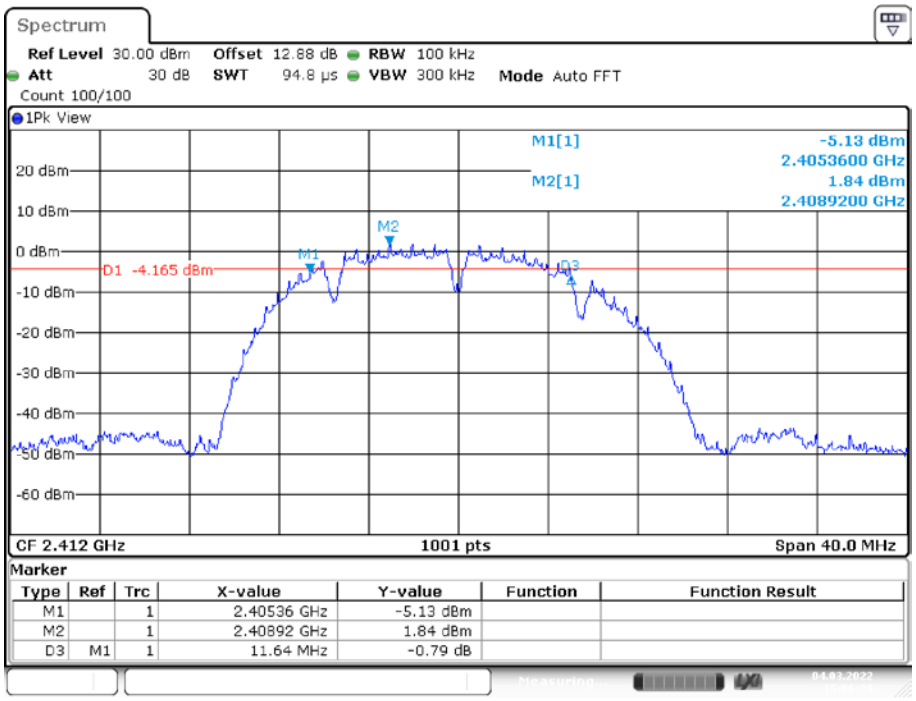
Appendix A: 6dB Emission Bandwidth

Test Result

TestMode	Antenna	Channel [MHz]	DTS BW [MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	11.640	0.5	PASS
		2437	10.160	0.5	PASS
		2462	11.200	0.5	PASS
11G	Ant1	2412	16.040	0.5	PASS
		2437	15.520	0.5	PASS
		2462	15.160	0.5	PASS
11N20SISO	Ant1	2412	17.160	0.5	PASS
		2437	17.320	0.5	PASS
		2462	16.840	0.5	PASS

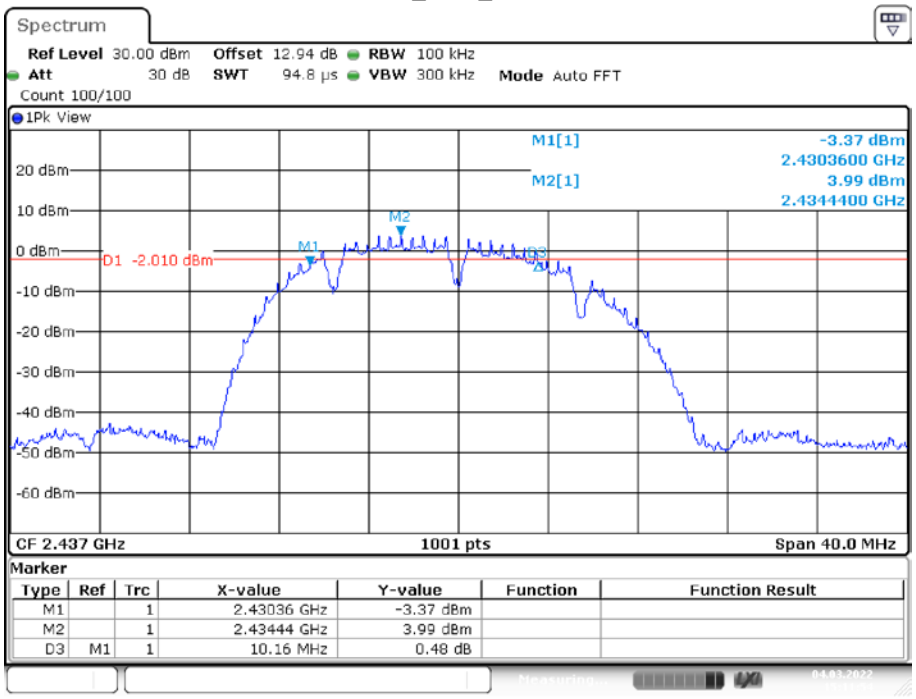
Test Graphs

11B_Ant1_2412



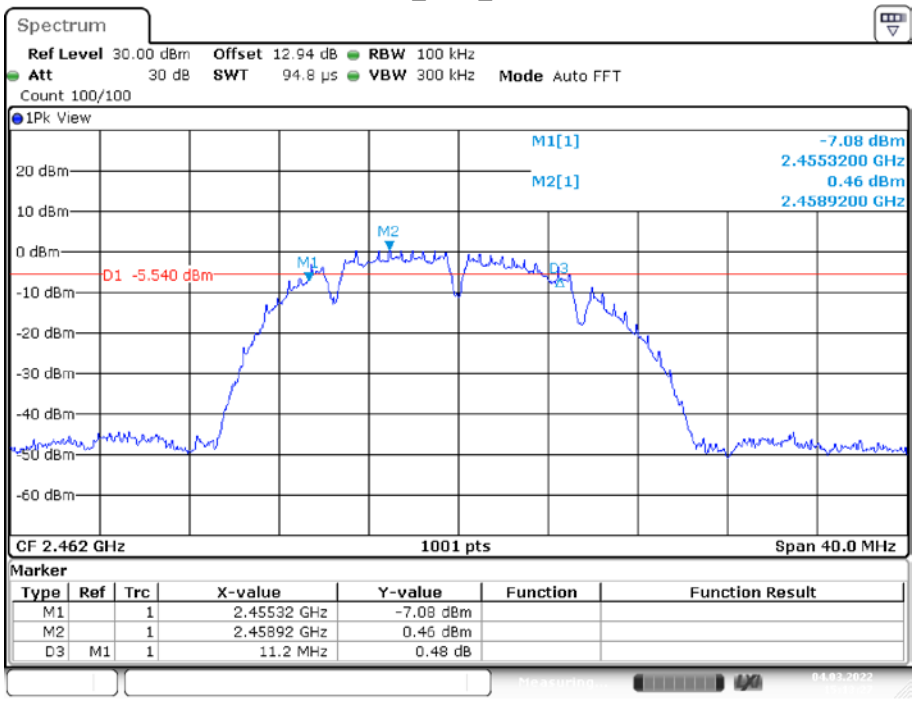
Date: 4.MAR.2022 15:06:29

11B_Ant1_2437



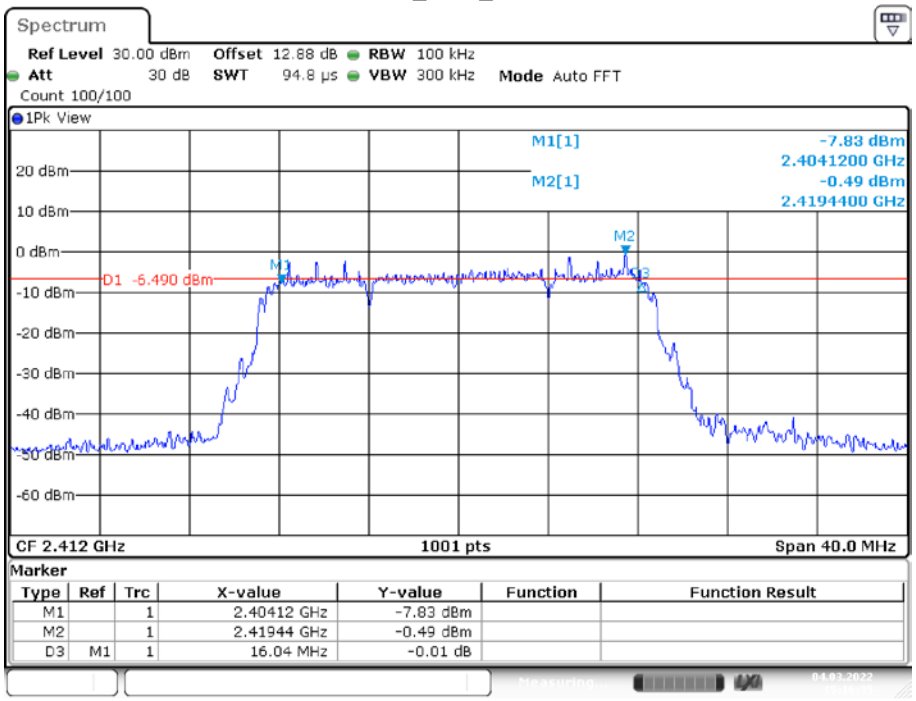
Date: 4.MAR.2022 15:11:54

11B_Ant1_2462



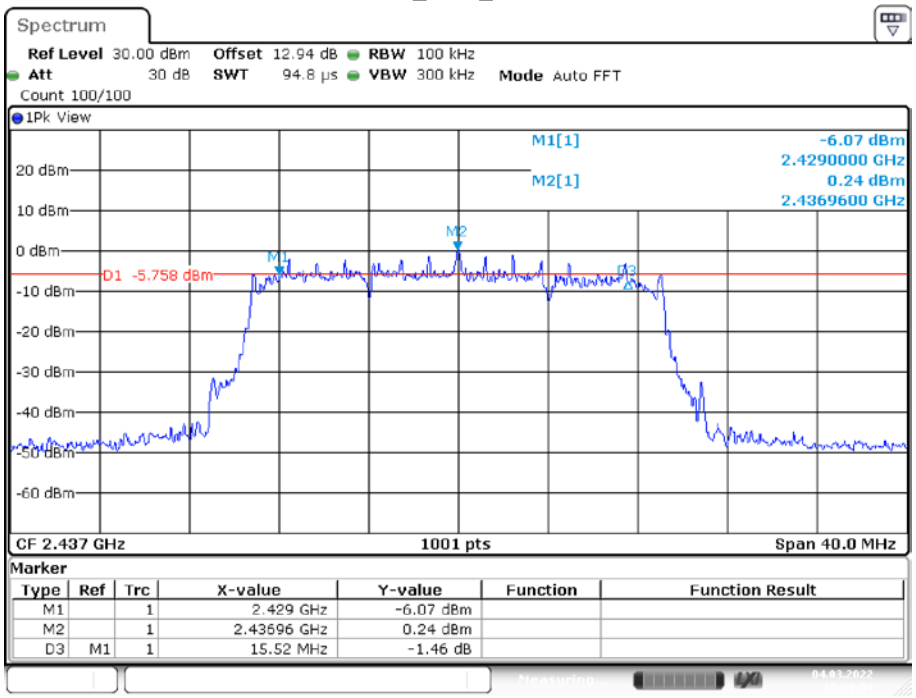
Date: 4.MAR.2022 15:13:27

11G_Ant1_2412



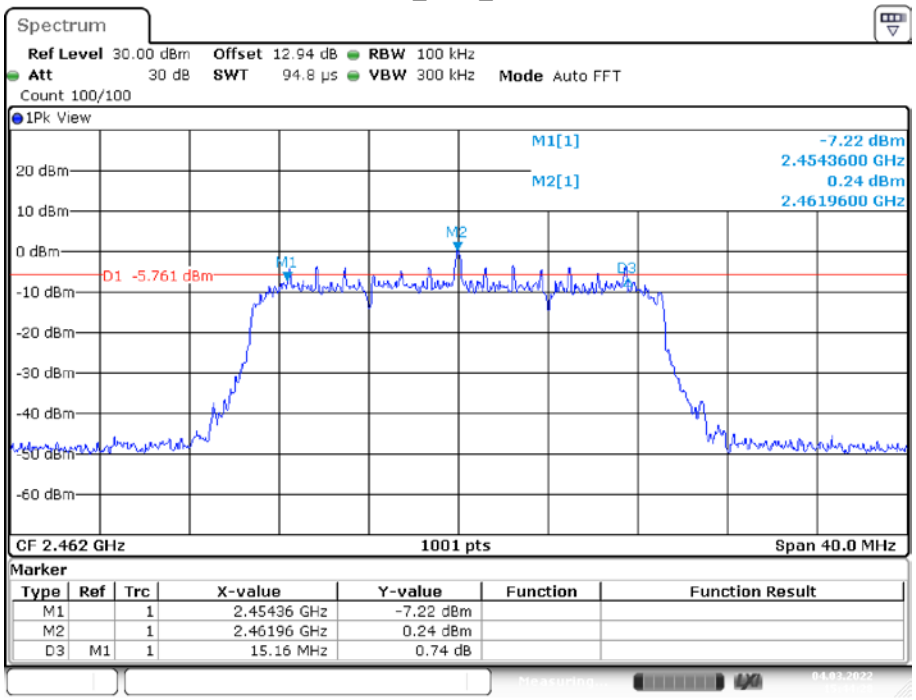
Date: 4.MAR.2022 15:16:35

11G_Ant1_2437



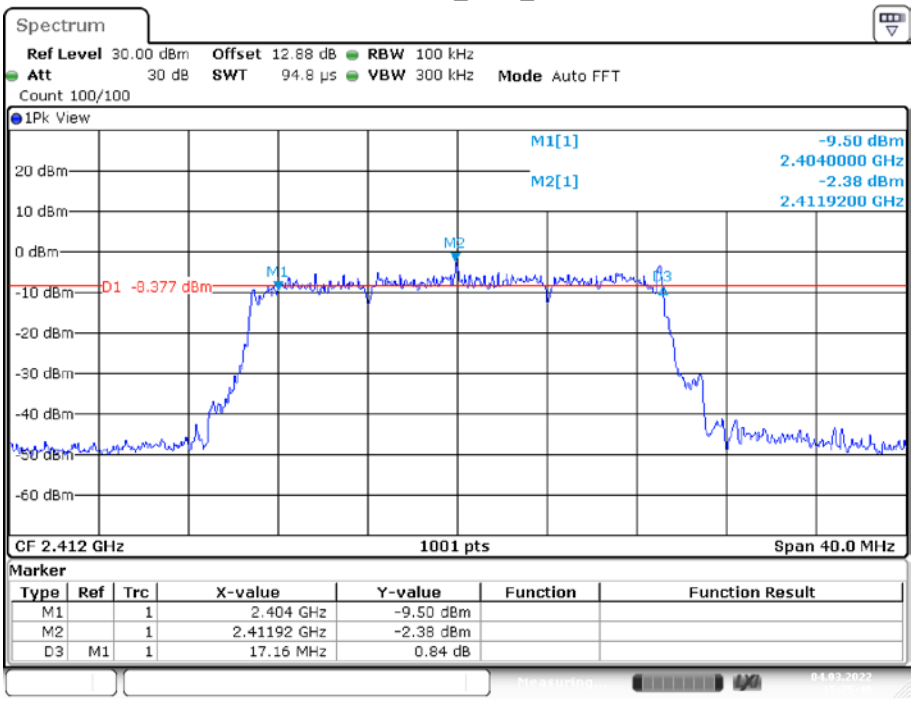
Date: 4.MAR.2022 15:29:54

11G_Ant1_2462



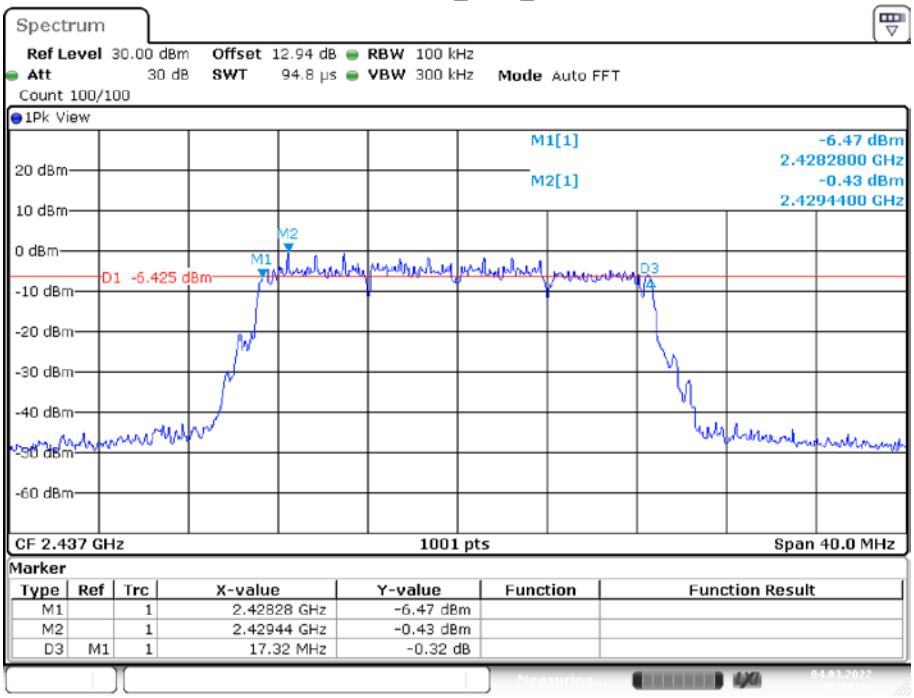
Date: 4.MAR.2022 15:44:28

11N20SISO_Ant1_2412



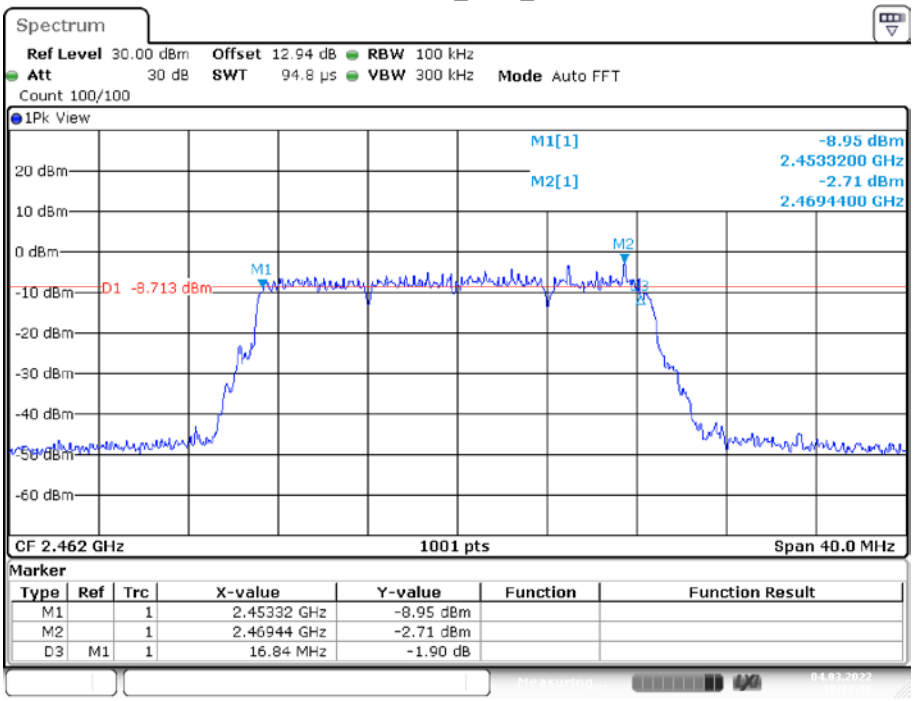
Date: 4.MAR.2022 15:25:48

11N20SISO_Ant1_2437



Date: 4.MAR.2022 15:18:24

11N20SISO_Ant1_2462



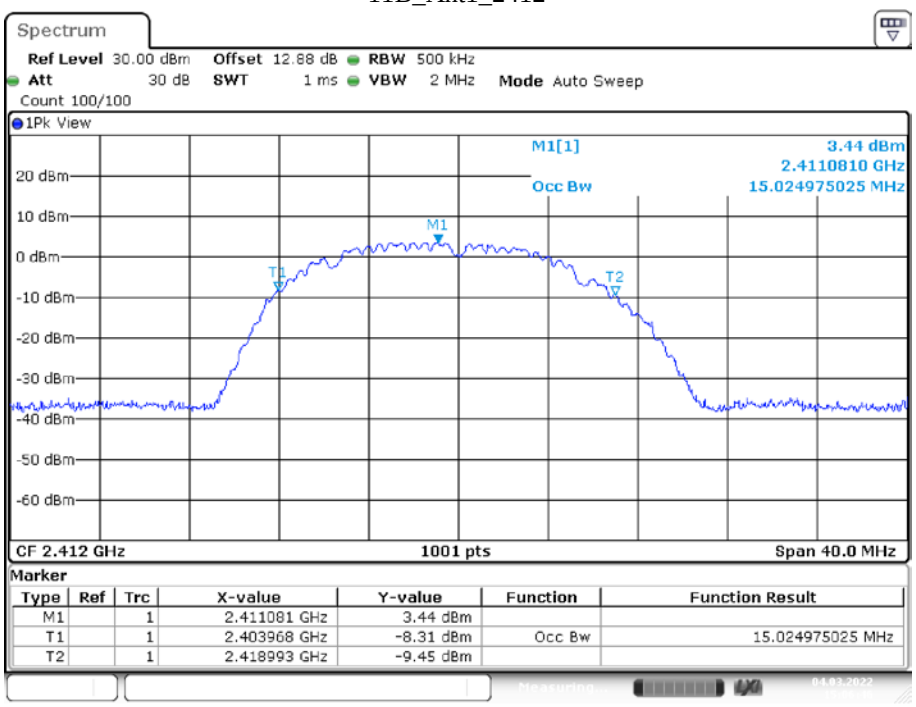
Appendix B: Occupied Channel Bandwidth

Test Result

TestMode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	15.025	---	PASS
		2437	14.705	---	PASS
		2462	14.945	---	PASS
11G	Ant1	2412	17.742	---	PASS
		2437	17.702	---	PASS
		2462	17.702	---	PASS
11N20SISO	Ant1	2412	18.741	---	PASS
		2437	18.661	---	PASS
		2462	18.741	---	PASS

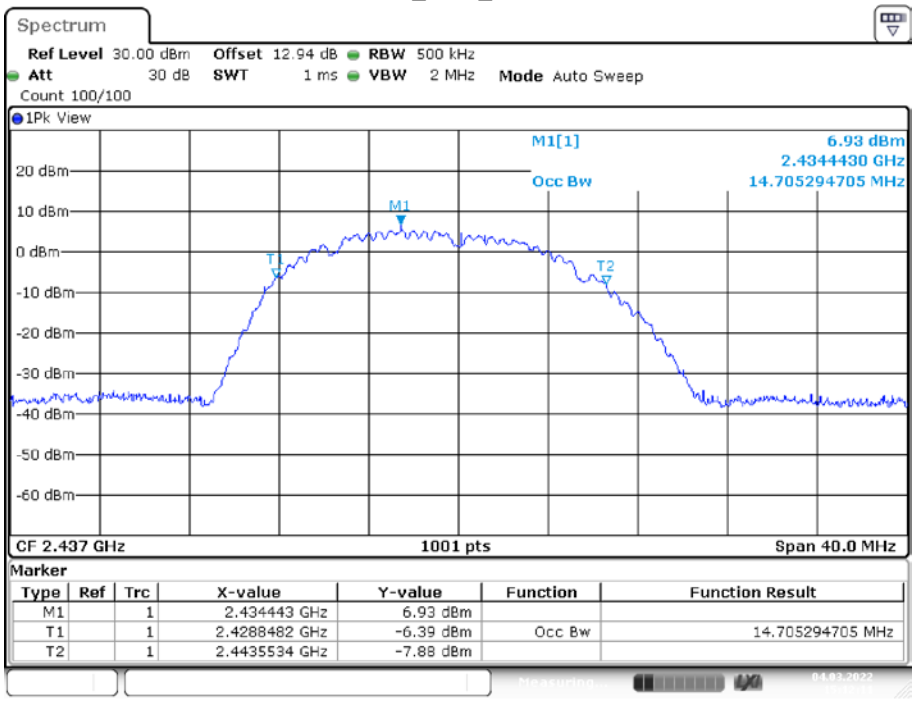
Test Graphs

11B_Ant1_2412



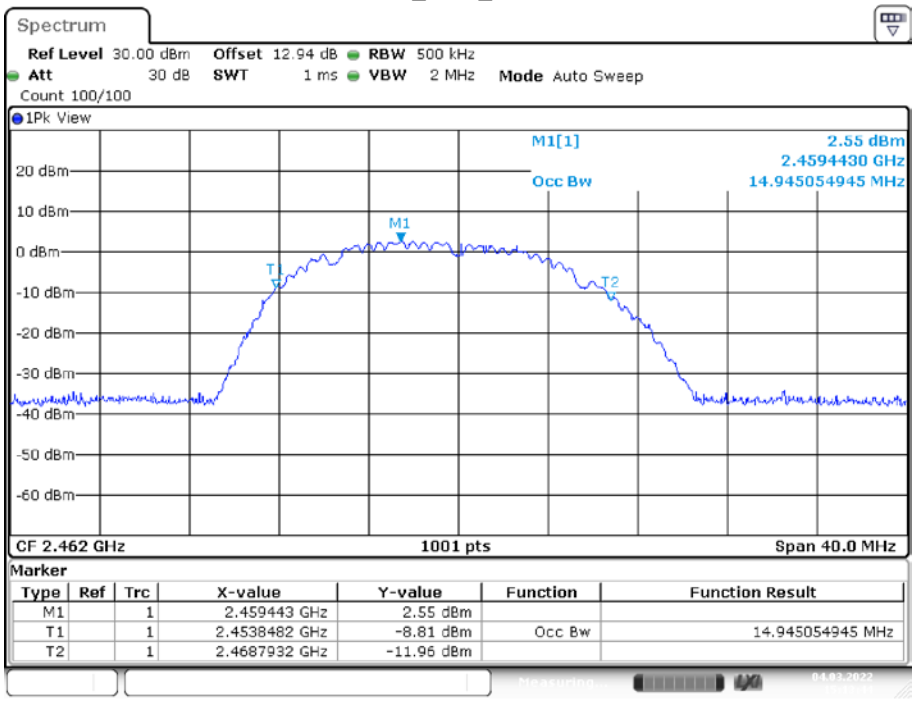
Date: 4.MAR.2022 15:06:46

11B_Ant1_2437

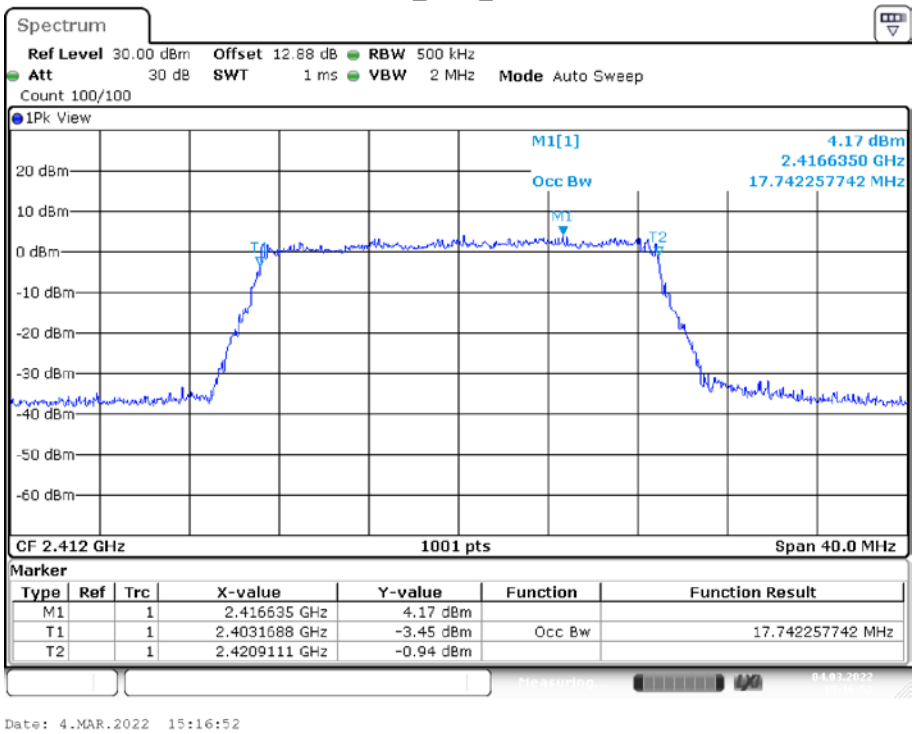


Date: 4.MAR.2022 15:12:11

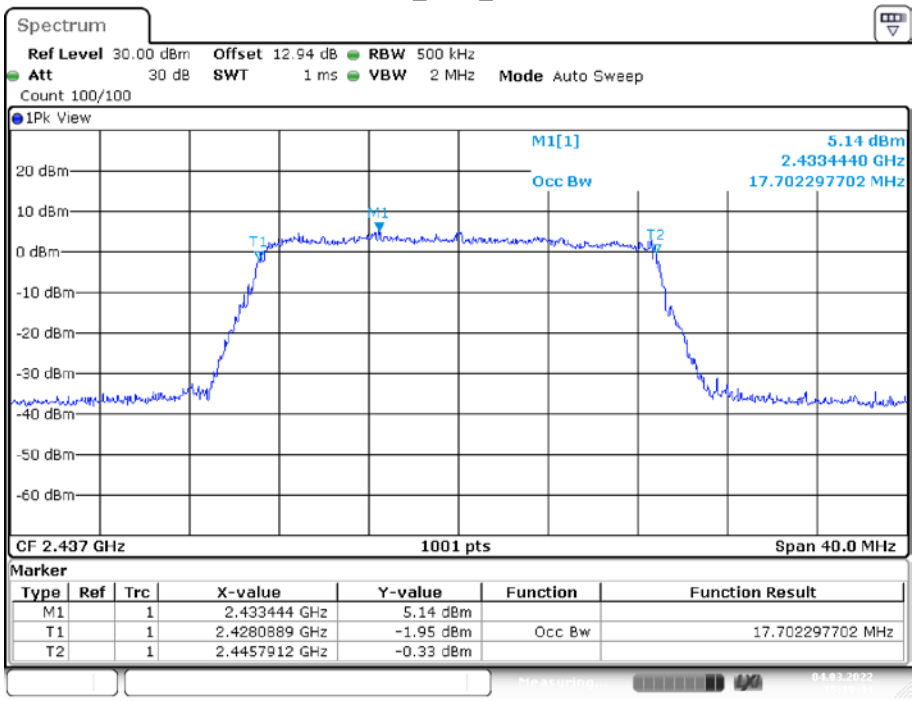
11B_Ant1_2462



11G_Ant1_2412

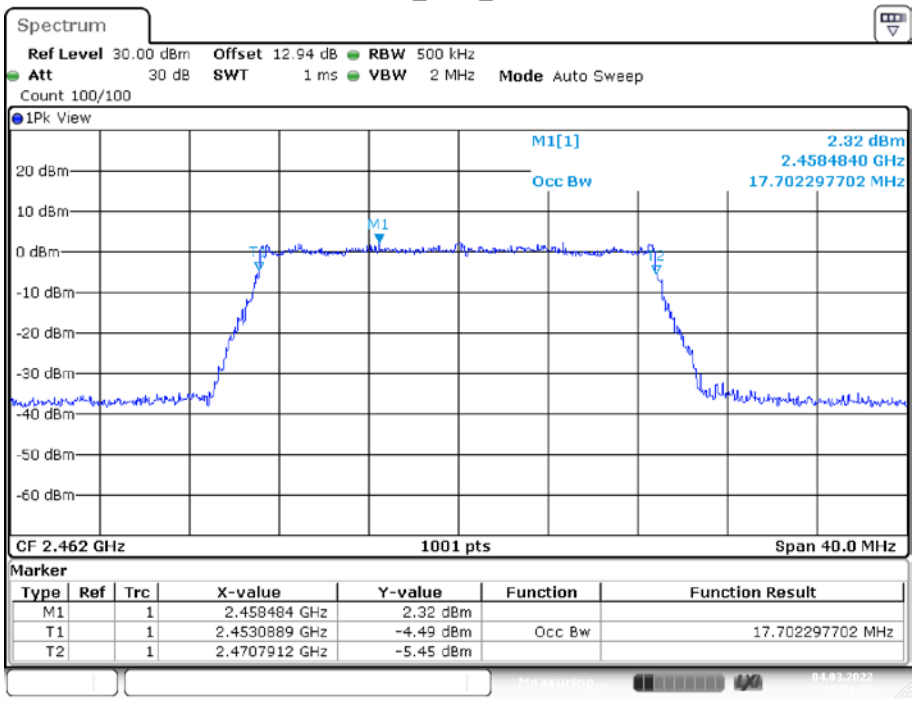


11G_Ant1_2437



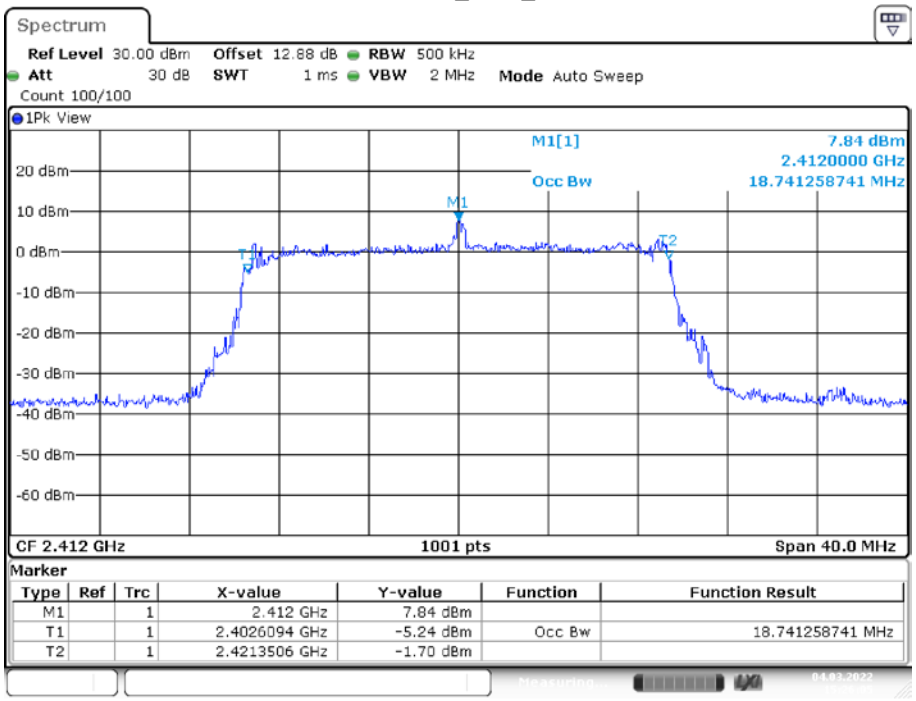
Date: 4.MAR.2022 15:19:44

11G_Ant1_2462



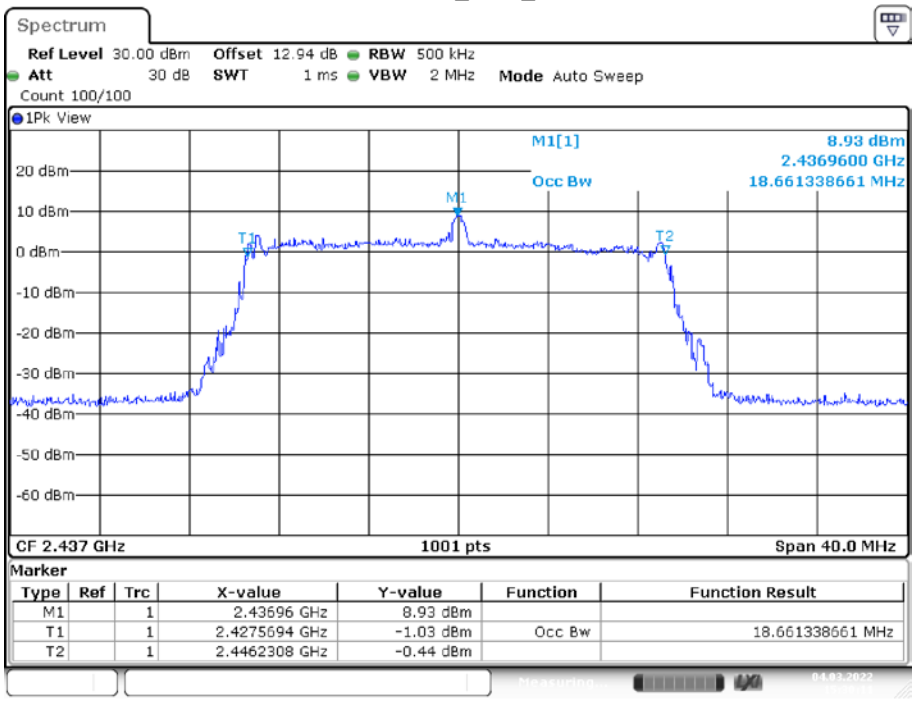
Date: 4.MAR.2022 15:21:32

11N20SISO_Ant1_2412



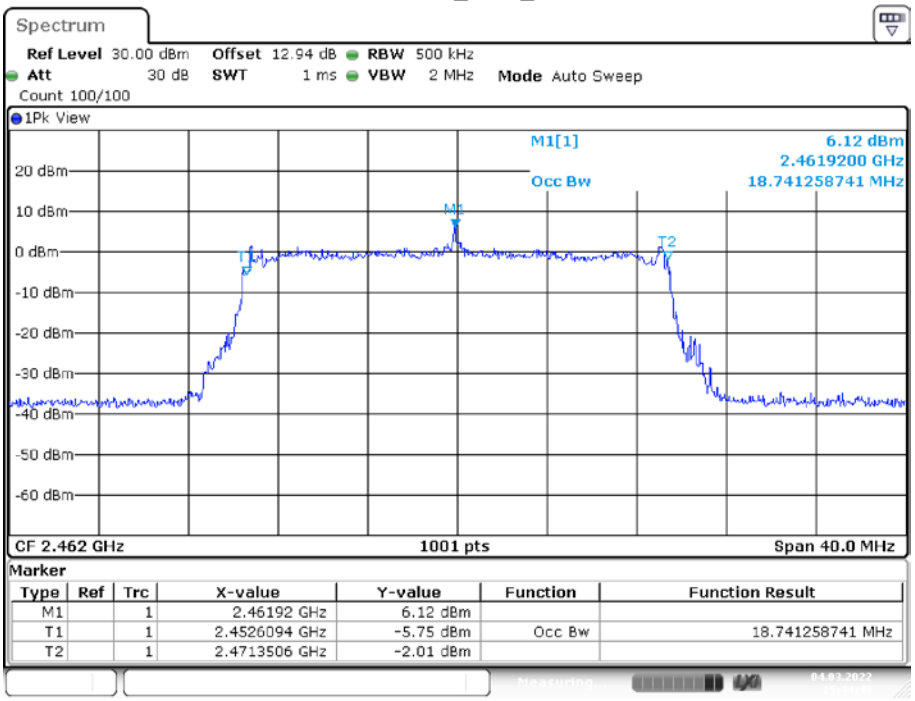
Date: 4.MAR.2022 15:26:05

11N20SISO_Ant1_2437



Date: 4.MAR.2022 15:30:11

11N20SISO_Ant1_2462



Date: 4.MAR.2022 15:44:45

Appendix C: Maximum conducted output power

Test Result

Peak output power:

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
11B	Ant1	2412	16.94	<=30	PASS
		2437	17.53	<=30	PASS
		2462	15.62	<=30	PASS
11G	Ant1	2412	14.85	<=30	PASS
		2437	15.41	<=30	PASS
		2462	13.67	<=30	PASS
11N20SISO	Ant1	2412	13.76	<=30	PASS
		2437	14.59	<=30	PASS
		2462	12.37	<=30	PASS

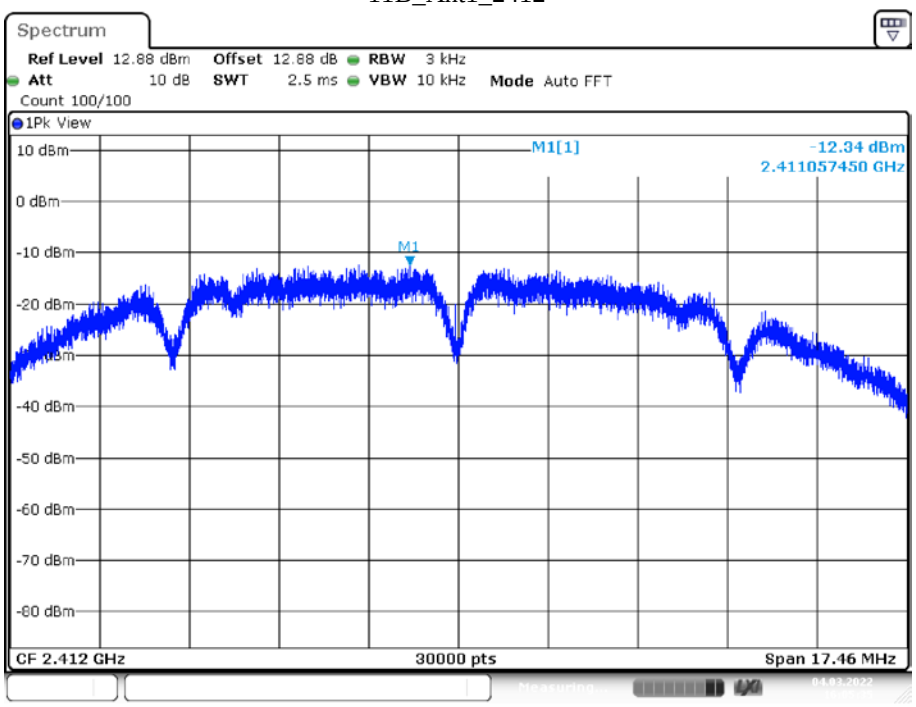
Appendix D: Power spectral density

Test Result

TestMode	Antenna	Channel	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
11B	Ant1	2412	-12.34	<=8	PASS
		2437	-11.81	<=8	PASS
		2462	-14.46	<=8	PASS
11G	Ant1	2412	-15.24	<=8	PASS
		2437	-14.57	<=8	PASS
		2462	-16.86	<=8	PASS
11N20SISO	Ant1	2412	-15.44	<=8	PASS
		2437	-14.33	<=8	PASS
		2462	-16.64	<=8	PASS

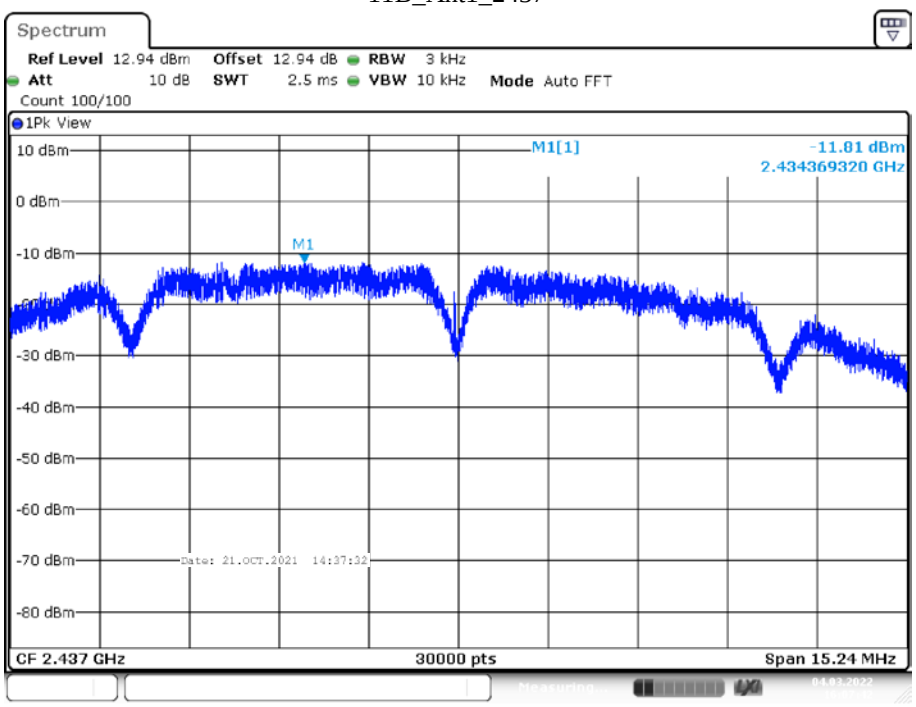
Test Graphs

11B_Ant1_2412



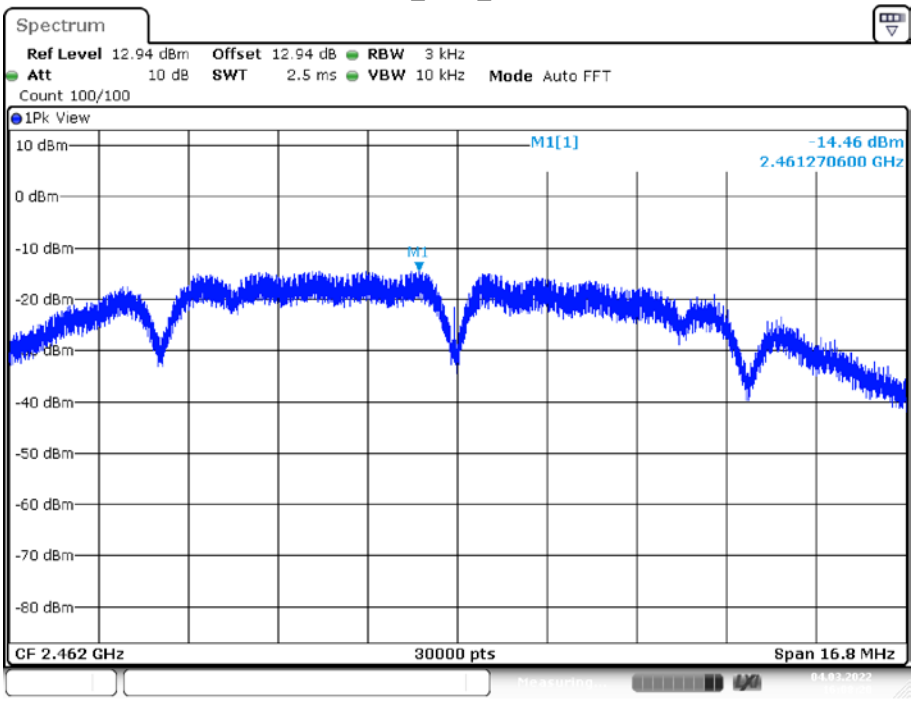
Date: 4.MAR.2022 16:05:35

11B_Ant1_2437



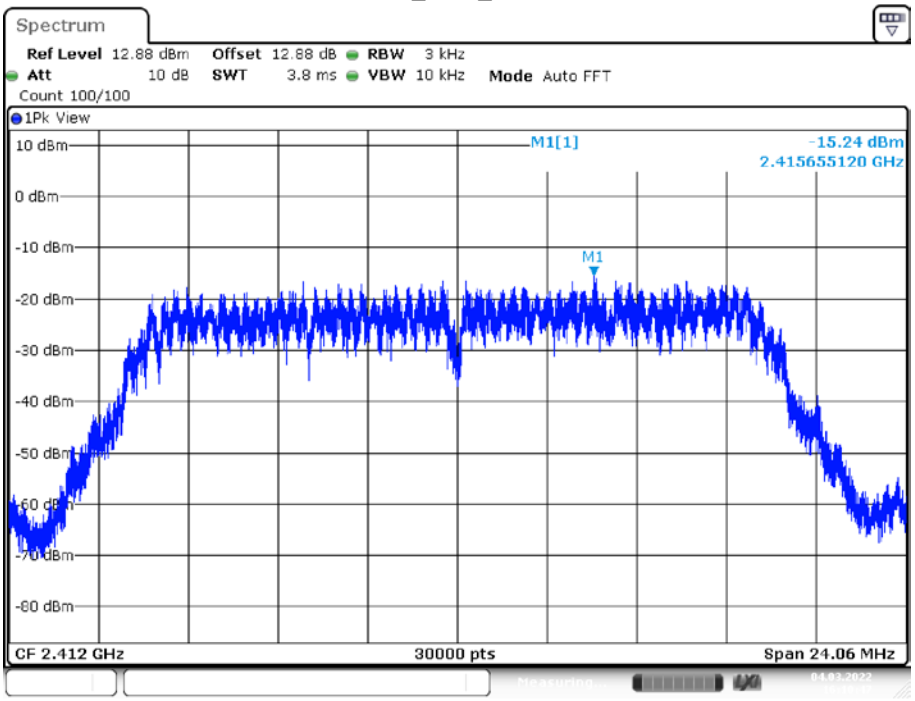
Date: 4.MAR.2022 16:07:42

11B_Ant1_2462



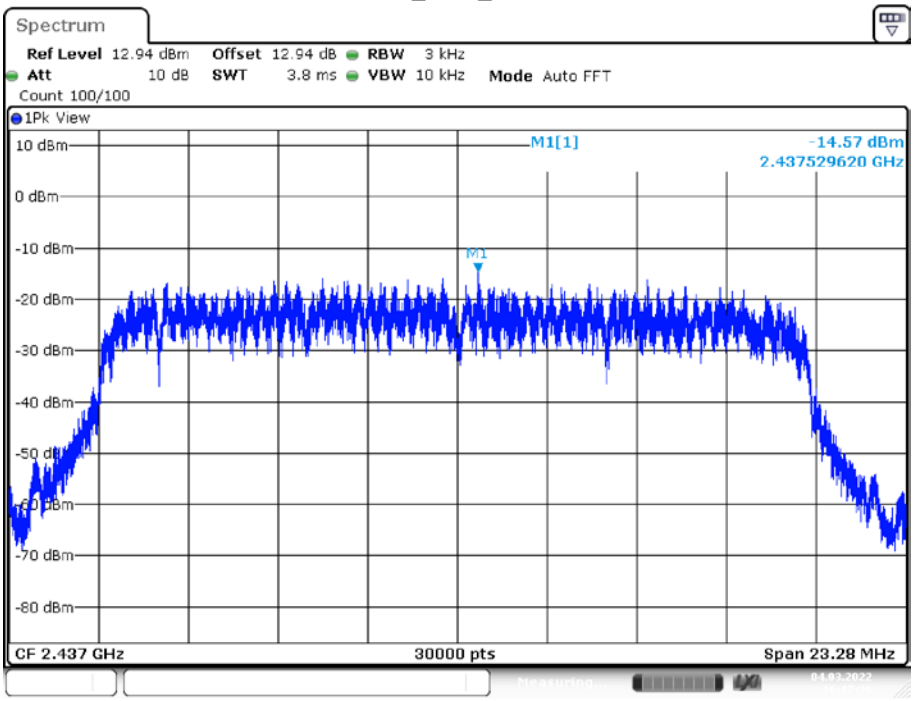
Date: 4.MAR.2022 16:08:20

11G_Ant1_2412



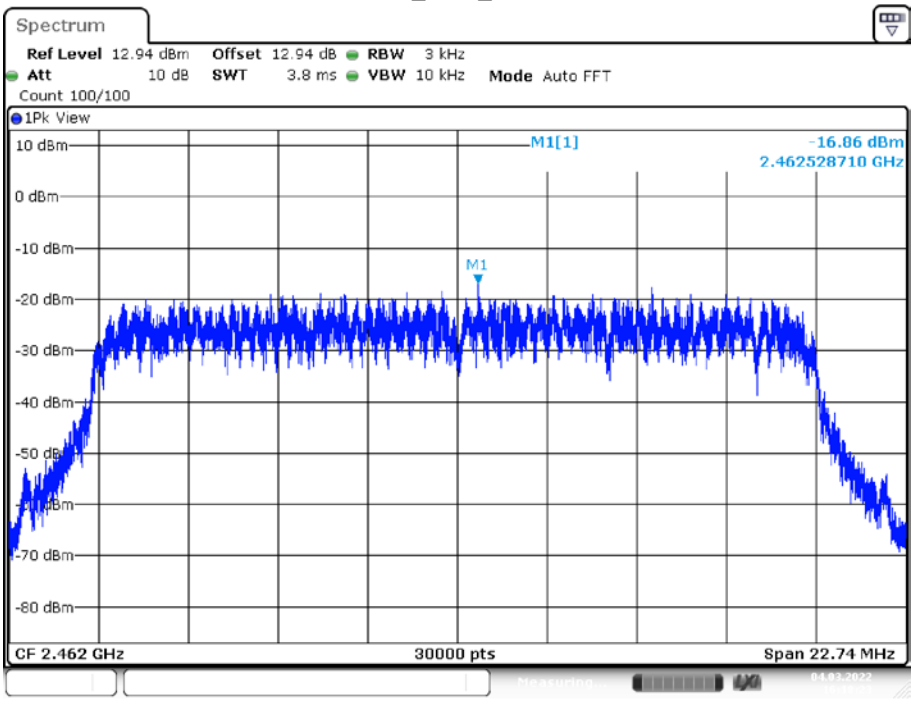
Date: 4.MAR.2022 16:10:47

11G_Ant1_2437



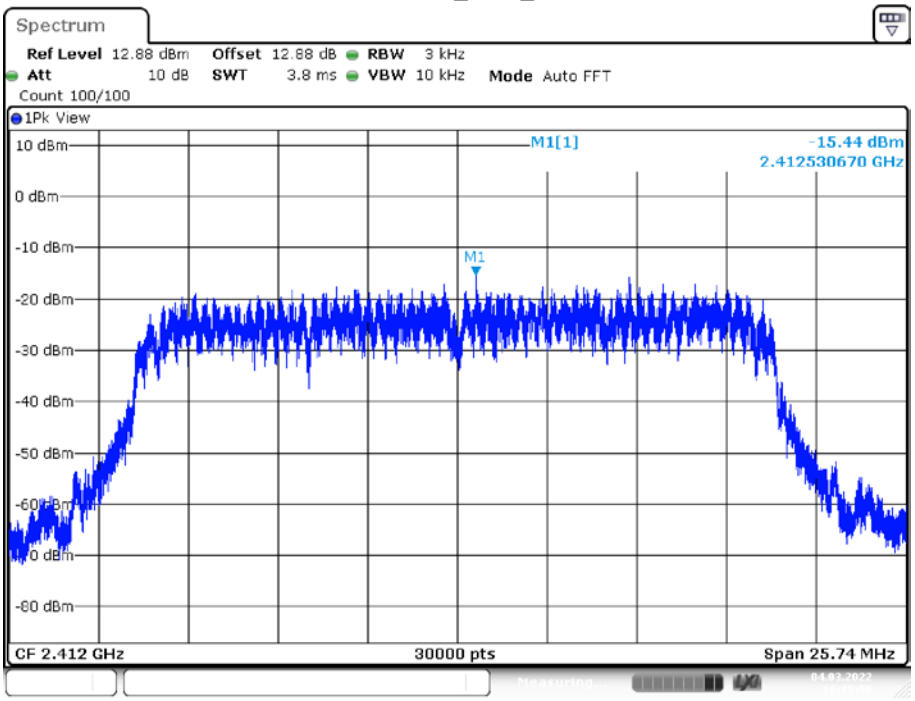
Date: 4.MAR.2022 16:17:26

11G_Ant1_2462



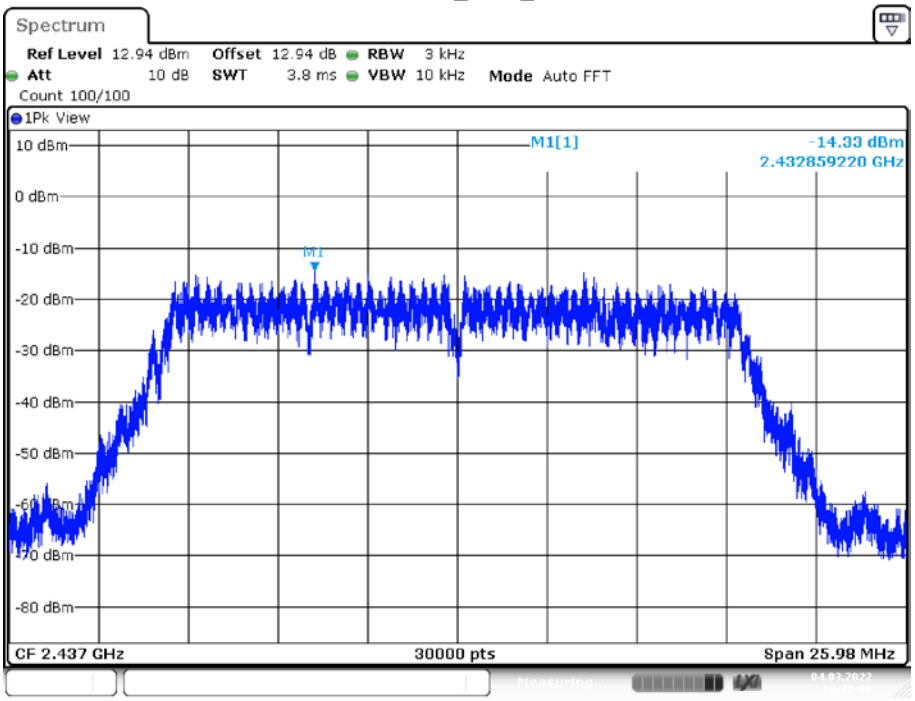
Date: 4.MAR.2022 16:18:23

11N20SISO_Ant1_2412



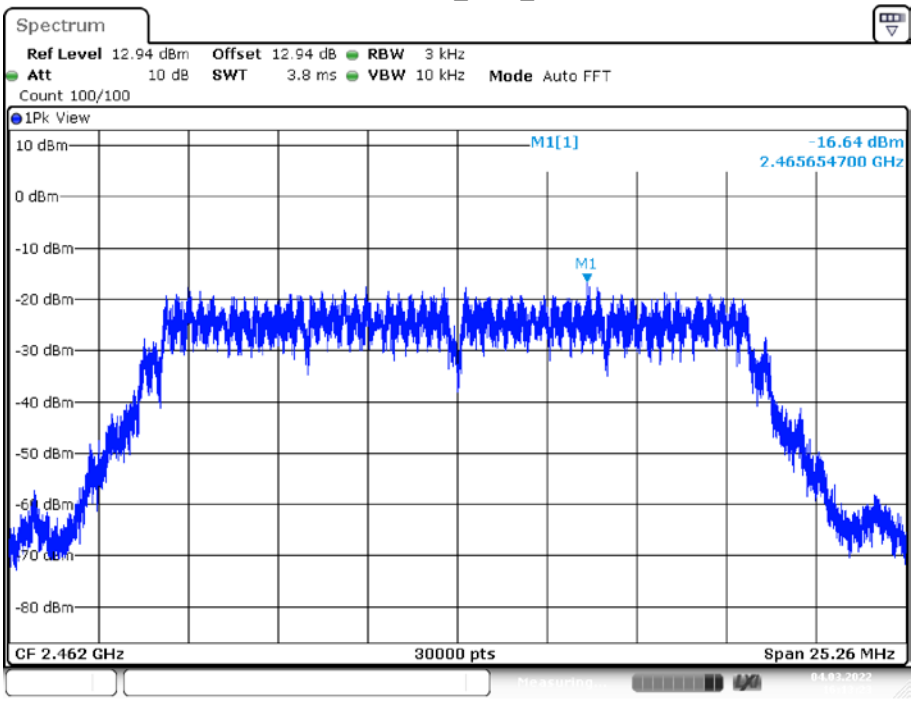
Date: 4.MAR.2022 16:15:58

11N20SISO_Ant1_2437



Date: 4.MAR.2022 16:12:06

11N20SISO_Ant1_2462

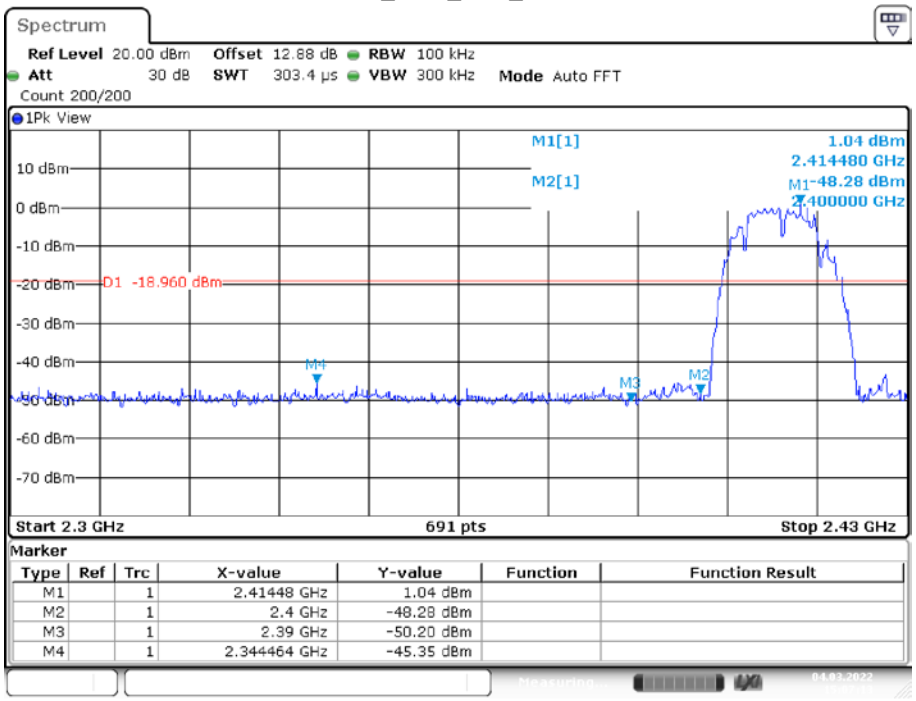


Date: 4.MAR.2022 16:13:23

Appendix E: Band edge measurements

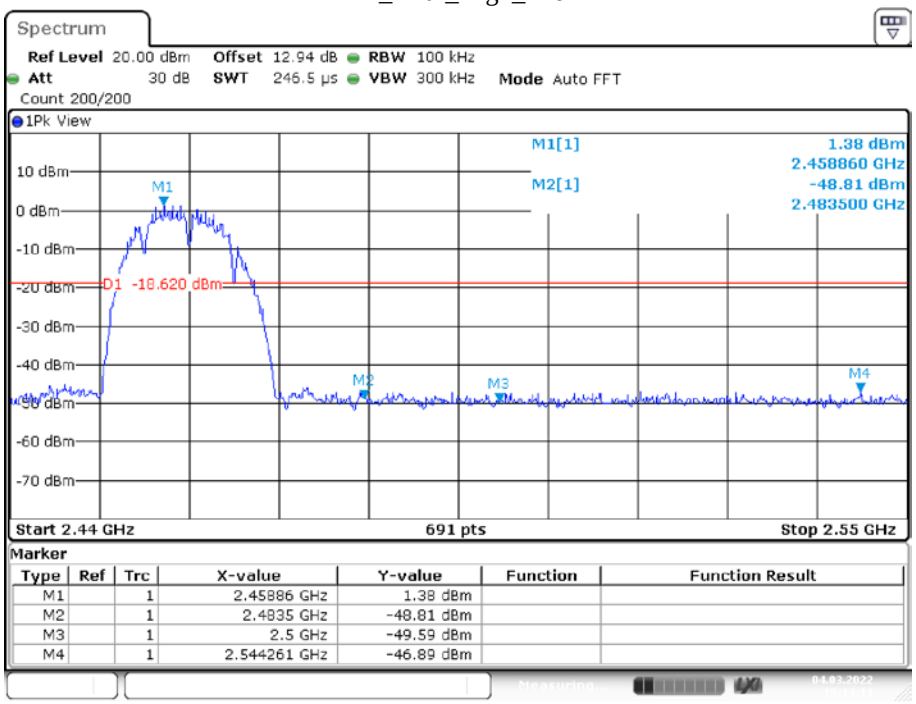
Test Graphs

11B_Ant1_Low_2412



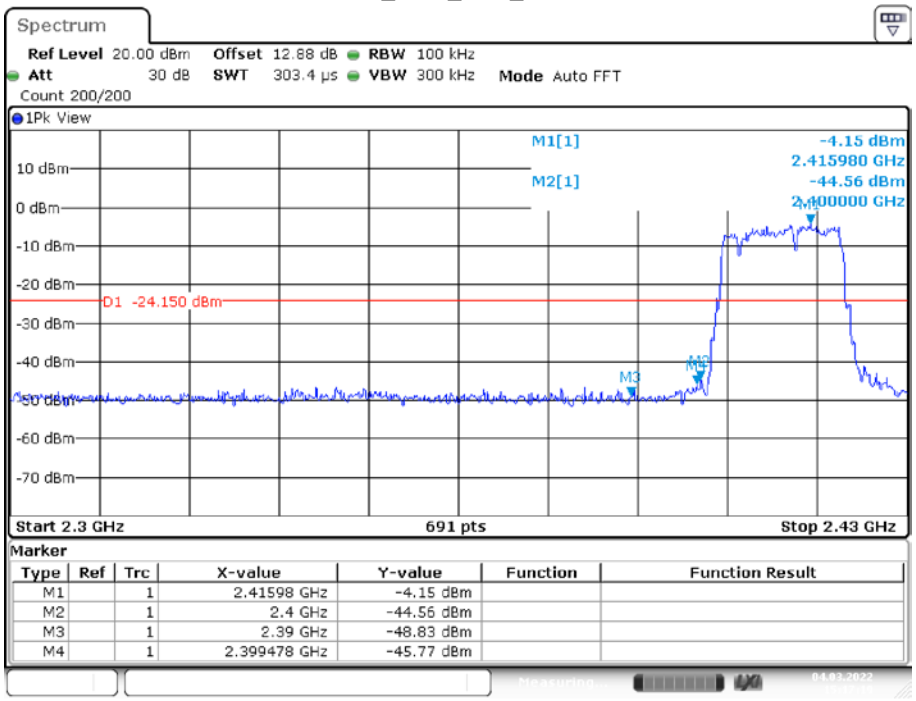
Date: 4.MAR.2022 15:07:13

11B_Ant1_High_2462



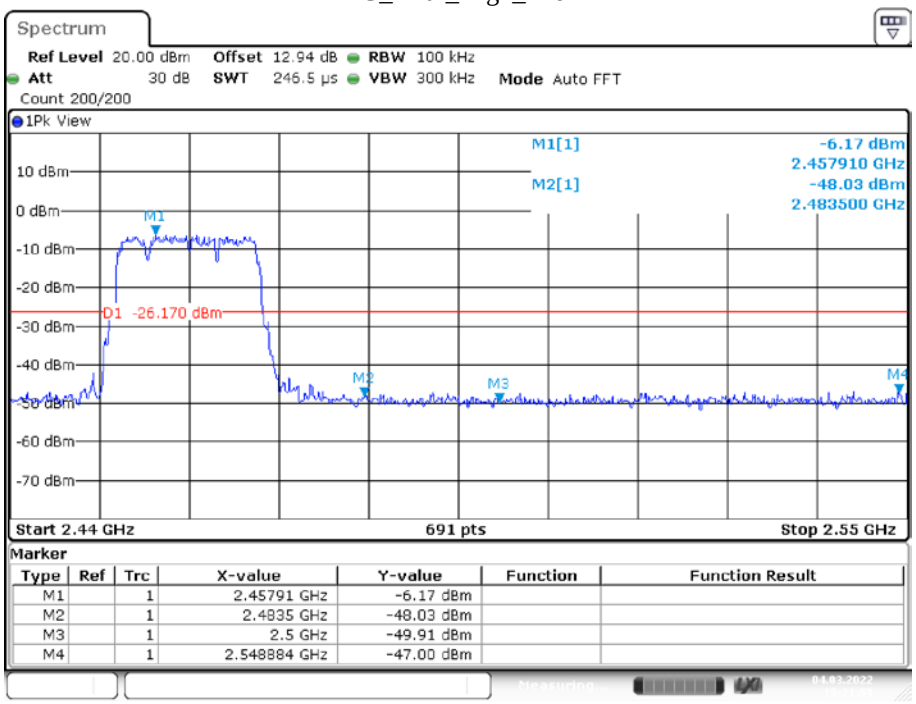
Date: 4.MAR.2022 15:14:11

11G_Ant1_Low_2412



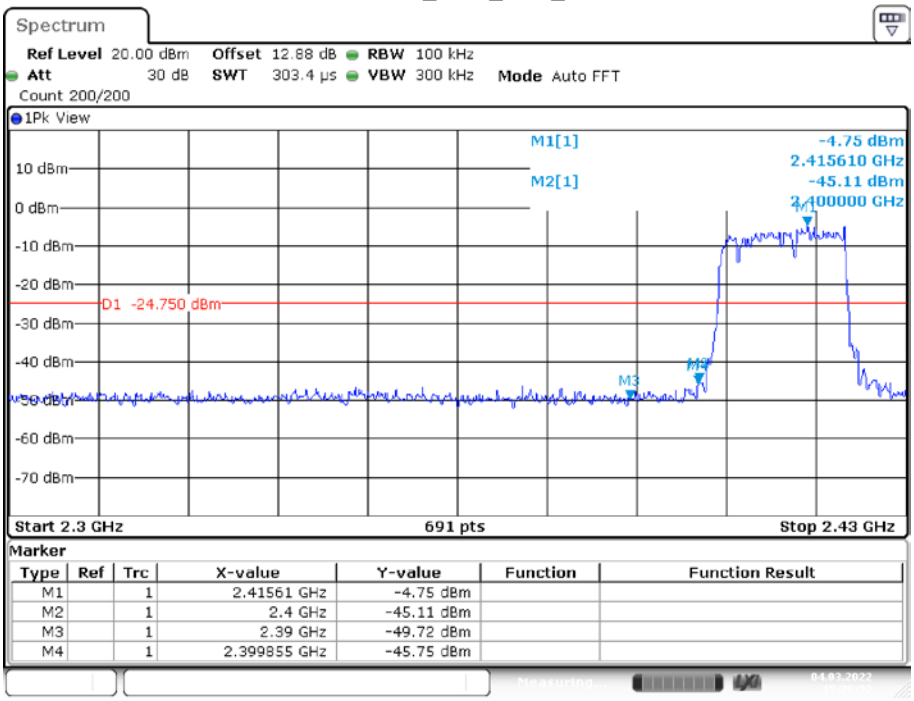
Date: 4.MAR.2022 15:17:19

11G_Ant1_High_2462

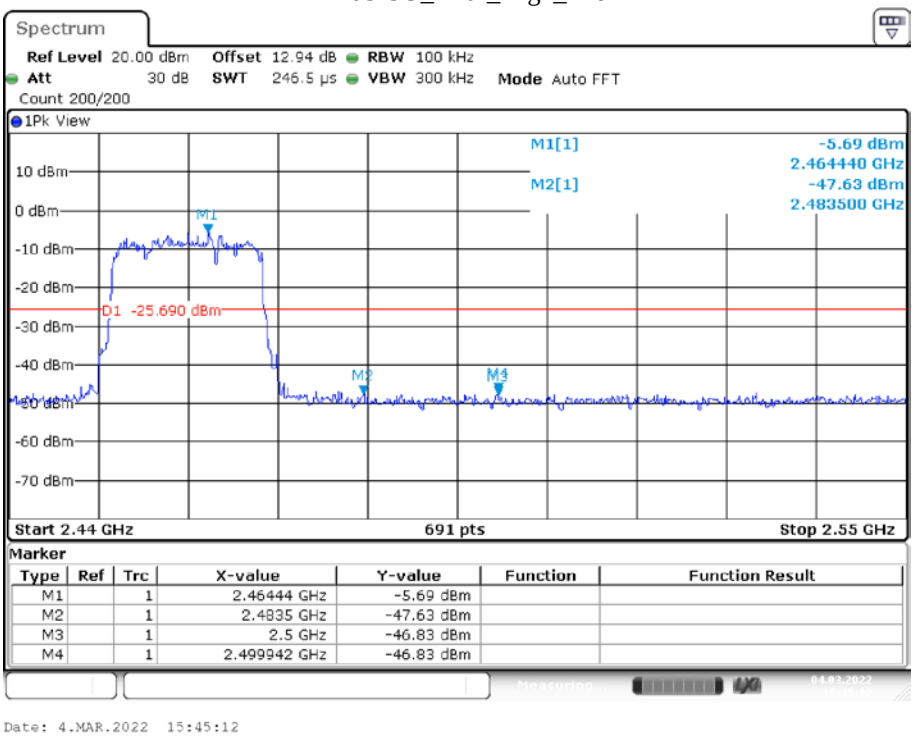


Date: 4.MAR.2022 15:21:59

11N20SISO_Ant1_Low_2412



11N20SISO_Ant1_High_2462



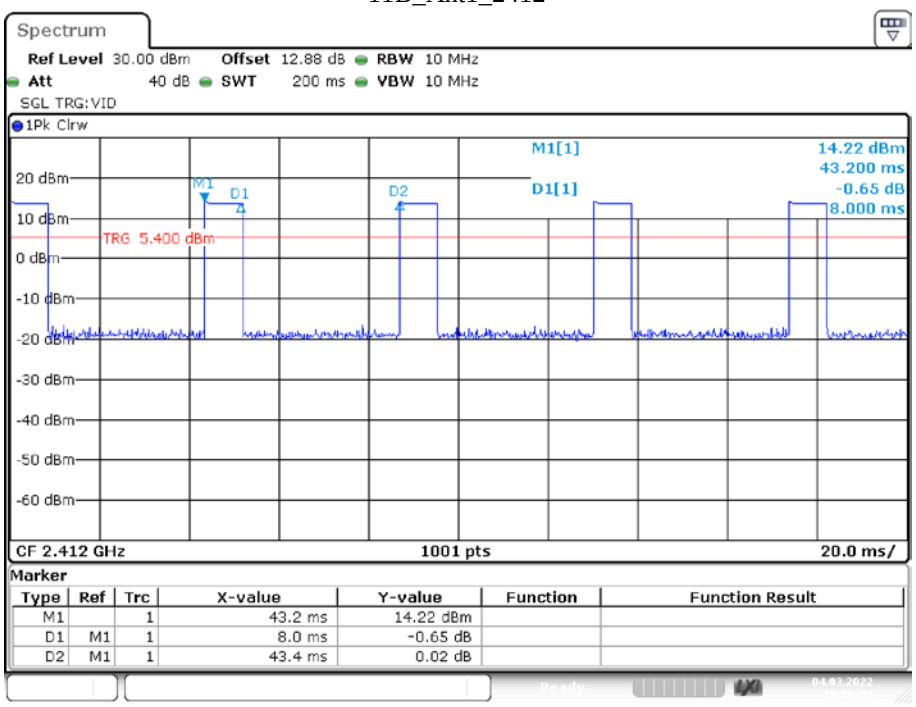
Appendix F: Duty Cycle

Test Result

TestMode	Antenna	Channel	TransmissionDuration [ms]	Transmission Period [ms]	Duty Cycle [%]
11B	Ant1	2412	8.00	43.40	18.43
		2437	8.00	43.40	18.43
		2462	8.00	43.40	18.43
11G	Ant1	2412	1.26	13.98	9.01
		2437	1.32	14.04	9.40
		2462	1.26	13.98	9.01
11N20SISO	Ant1	2412	1.20	13.08	9.17
		2437	1.20	13.08	9.17
		2462	1.20	13.08	9.17

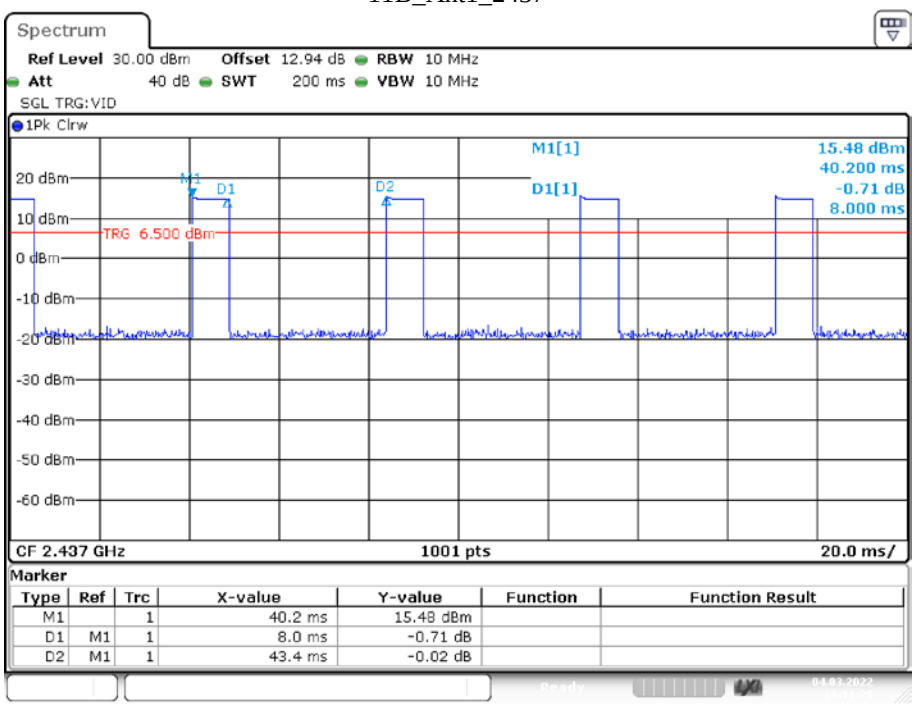
Test Graphs

11B_Ant1_2412



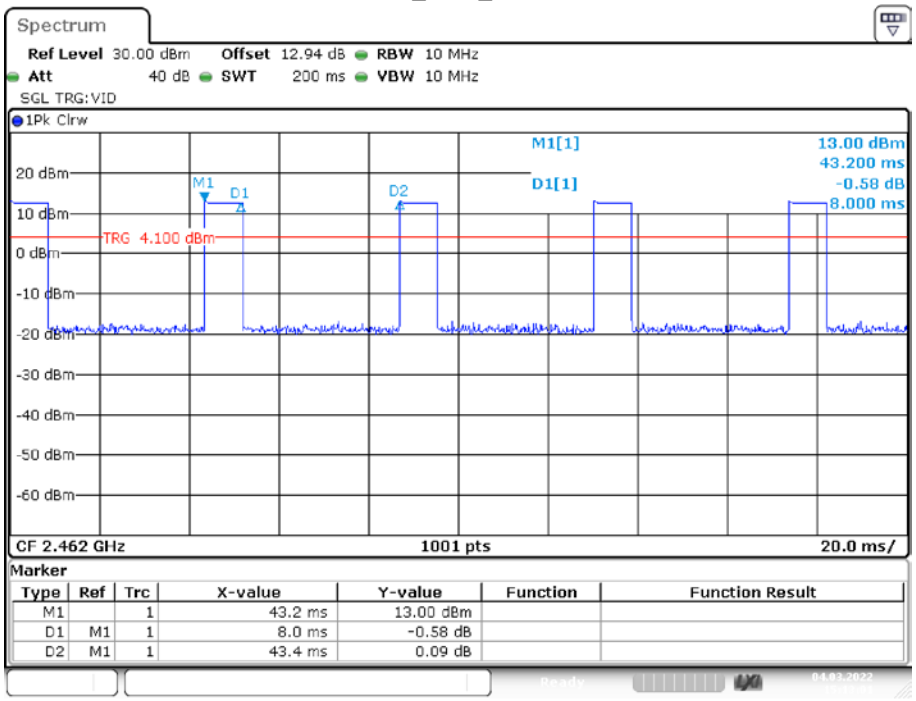
Date: 4.MAR.2022 15:06:03

11B_Ant1_2437



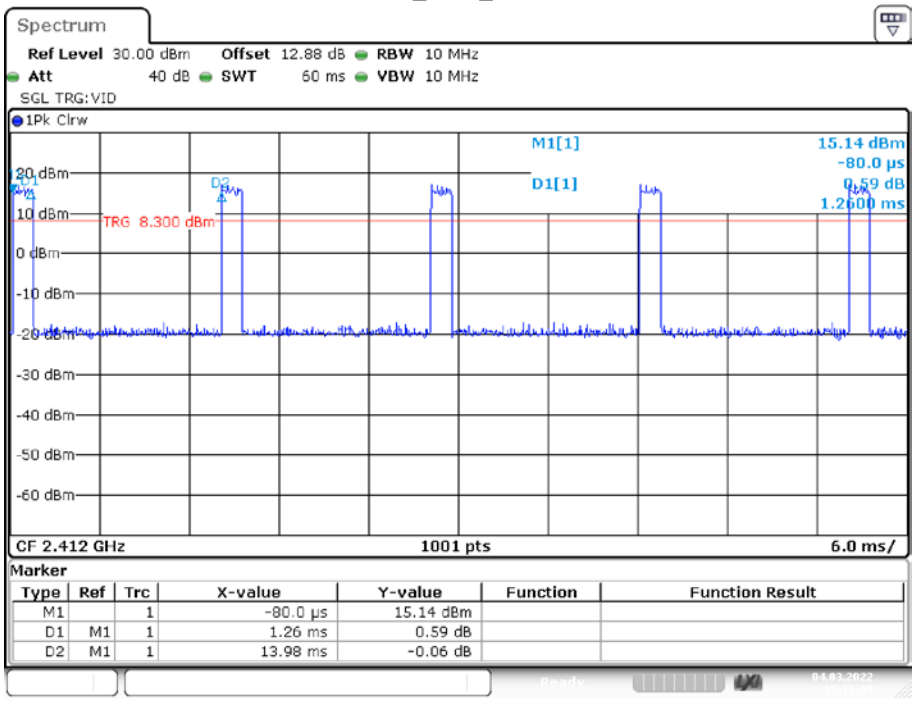
Date: 4.MAR.2022 15:11:28

11B_Ant1_2462



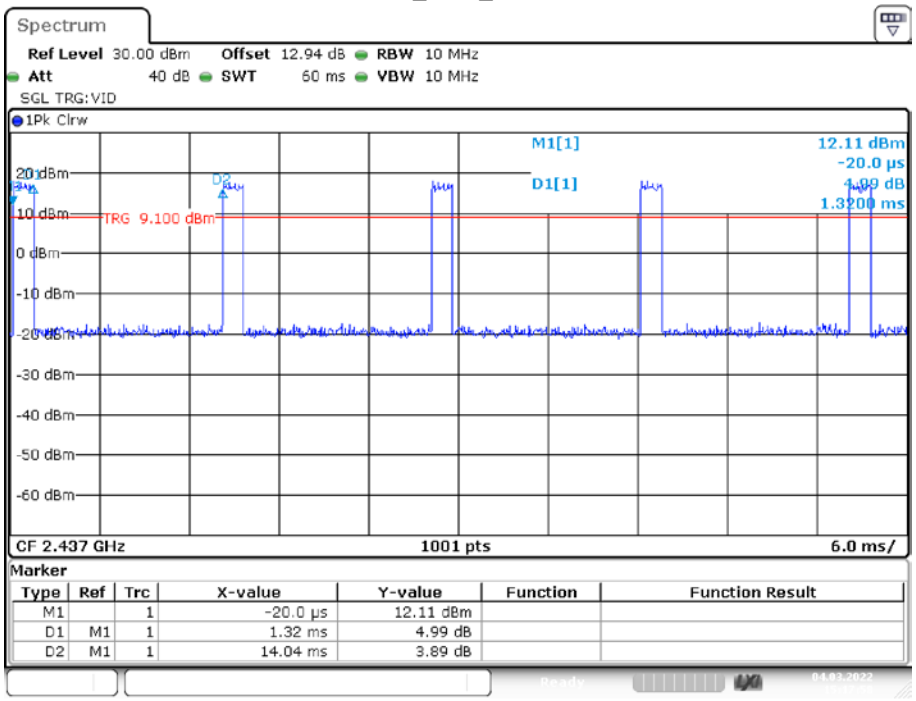
Date: 4.MAR.2022 15:13:01

11G_Ant1_2412



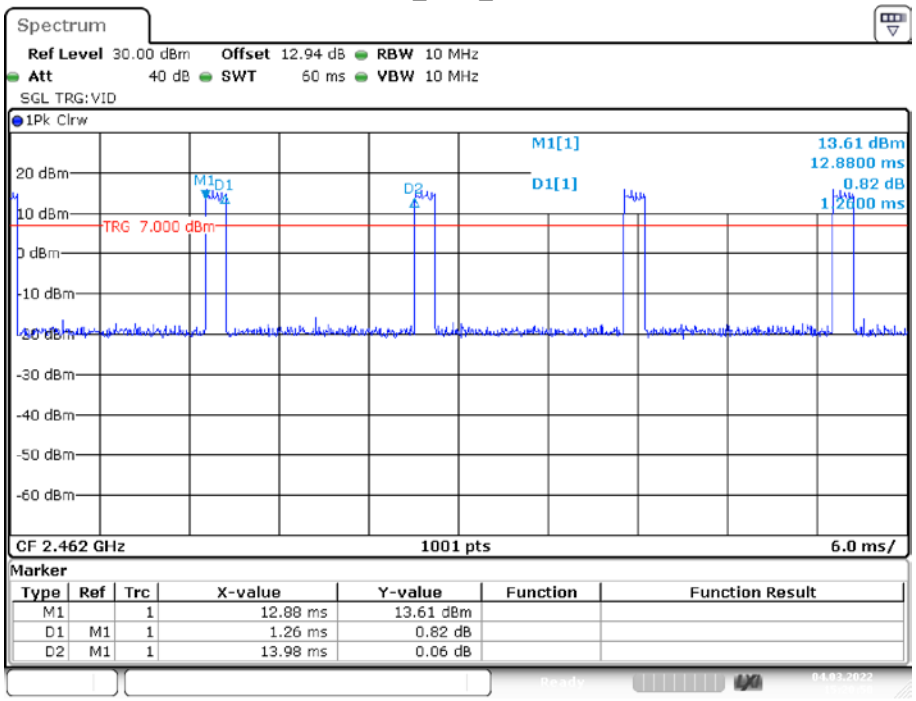
Date: 4.MAR.2022 15:16:09

11G_Ant1_2437



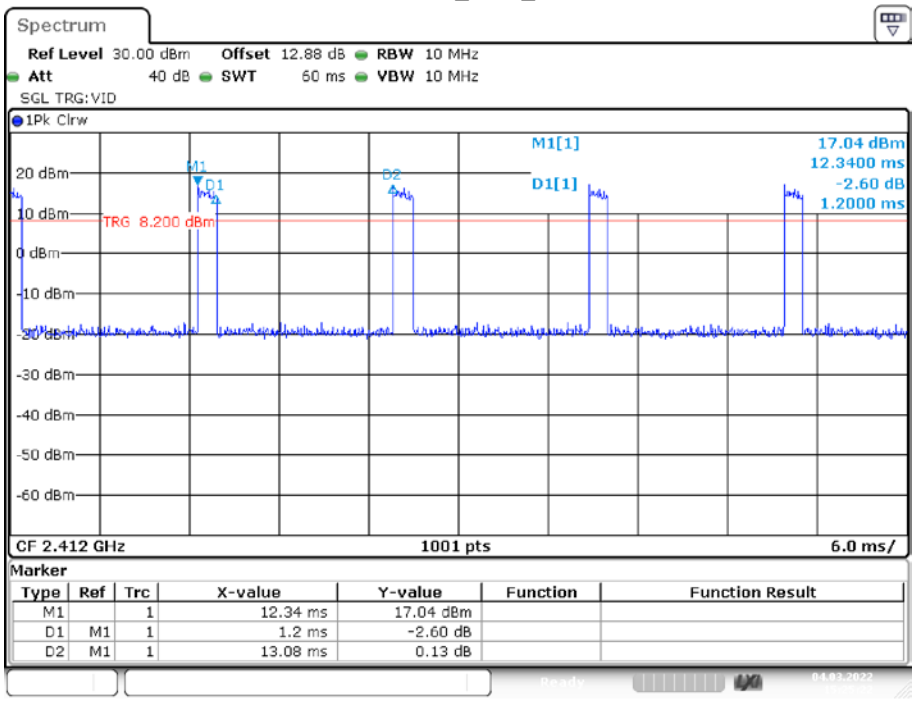
Date: 4.MAR.2022 15:17:58

11G_Ant1_2462



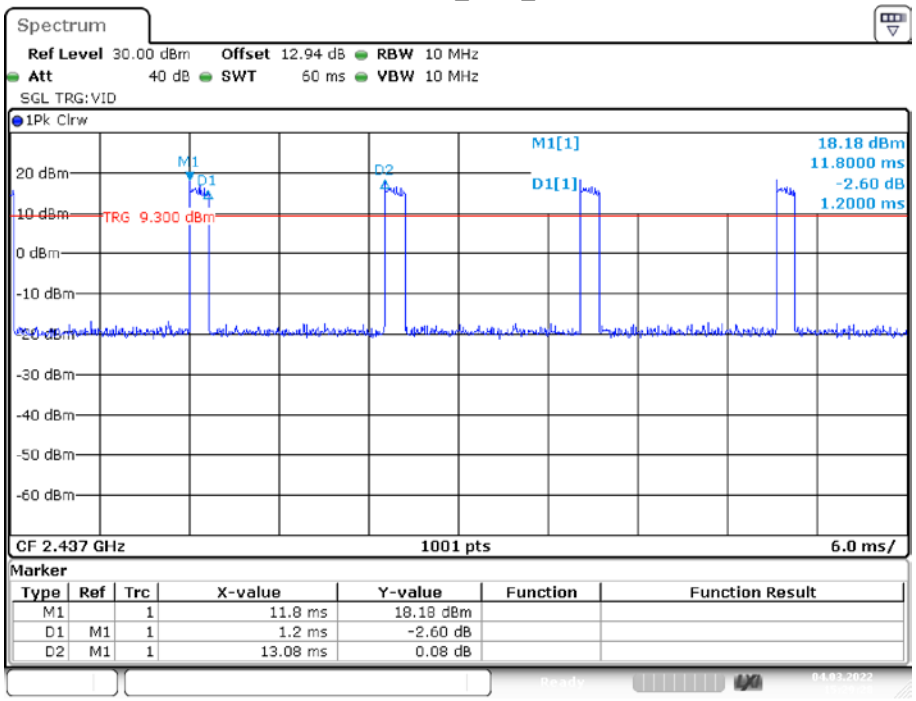
Date: 4.MAR.2022 15:20:50

11N20SISO_Ant1_2412



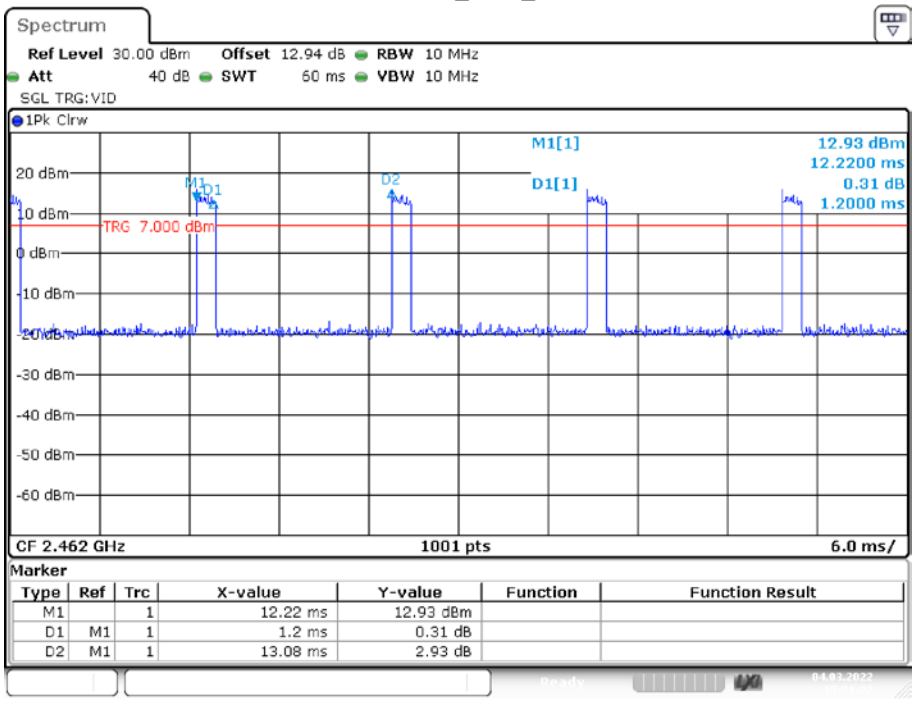
Date: 4.MAR.2022 15:25:22

11N20SISO_Ant1_2437



Date: 4.MAR.2022 15:29:28

11N20SISO_Ant1_2462



APPENDIX BLE

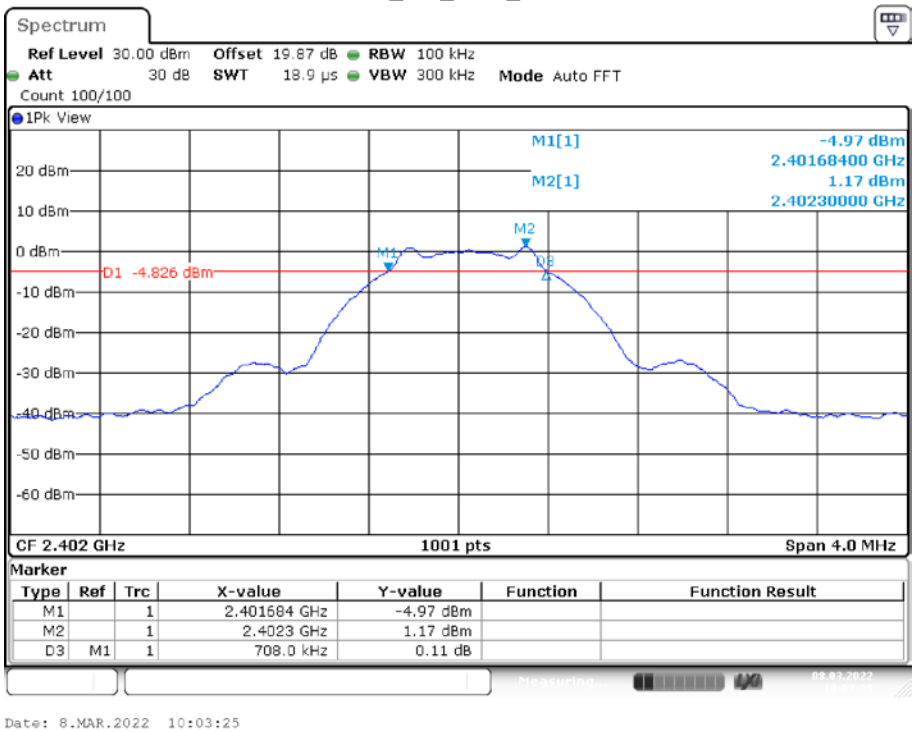
Appendix A: 6dB Emission Bandwidth

Test Result

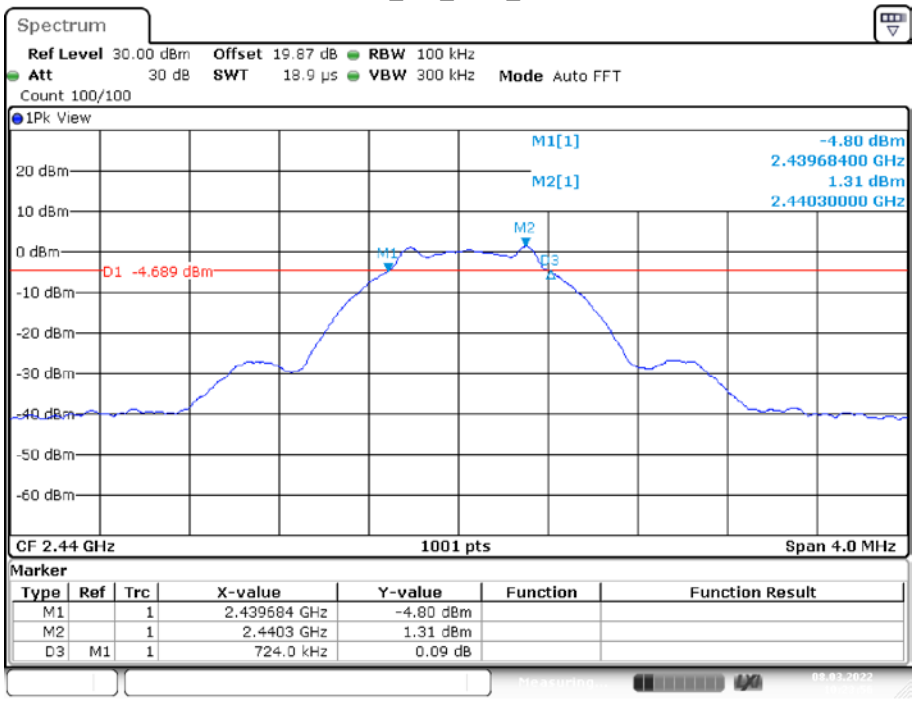
TestMode	Antenna	Channel	DTS BW [MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	0.708	0.5	PASS
		2440	0.724	0.5	PASS
		2480	0.736	0.5	PASS

Test Graphs

BLE_1M_Ant1_2402

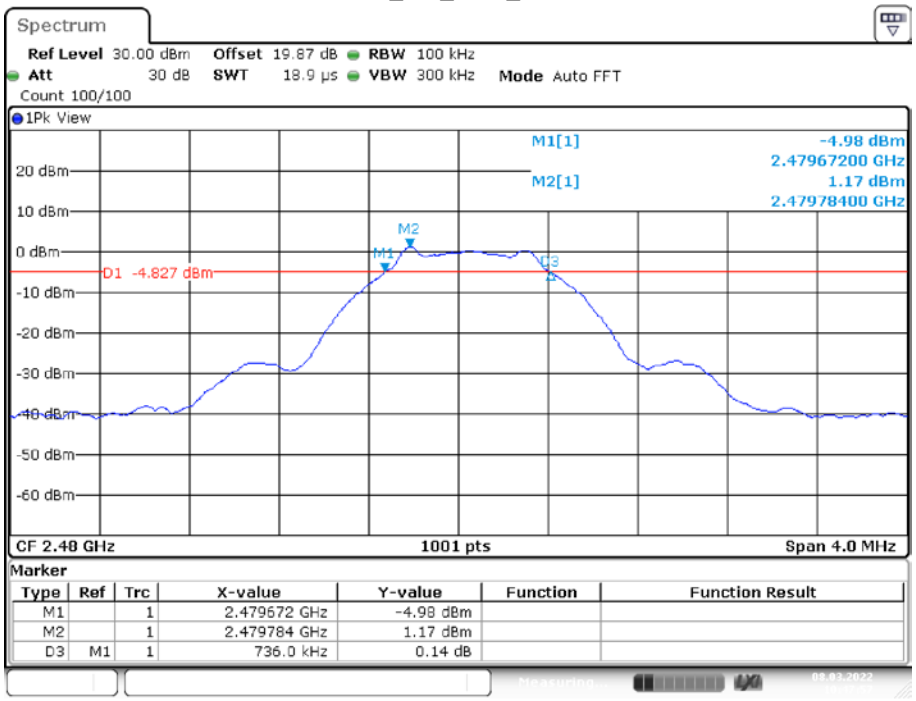


BLE_1M_Ant1_2440



Date: 8.MAR.2022 10:23:56

BLE_1M_Ant1_2480



Date: 8.MAR.2022 10:47:58

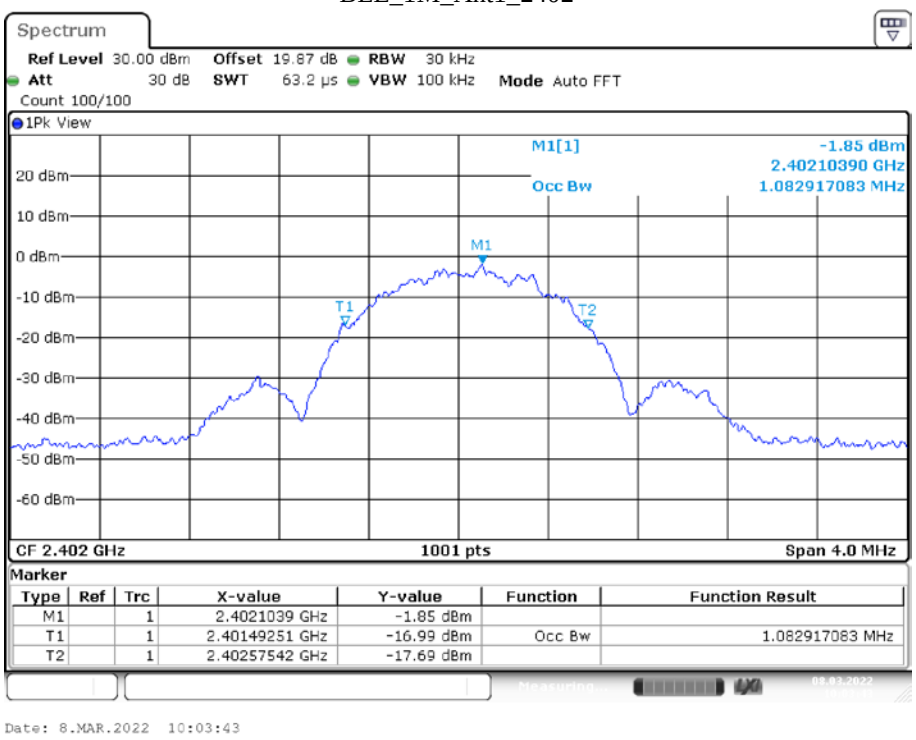
Appendix B: Occupied Channel Bandwidth

Test Result

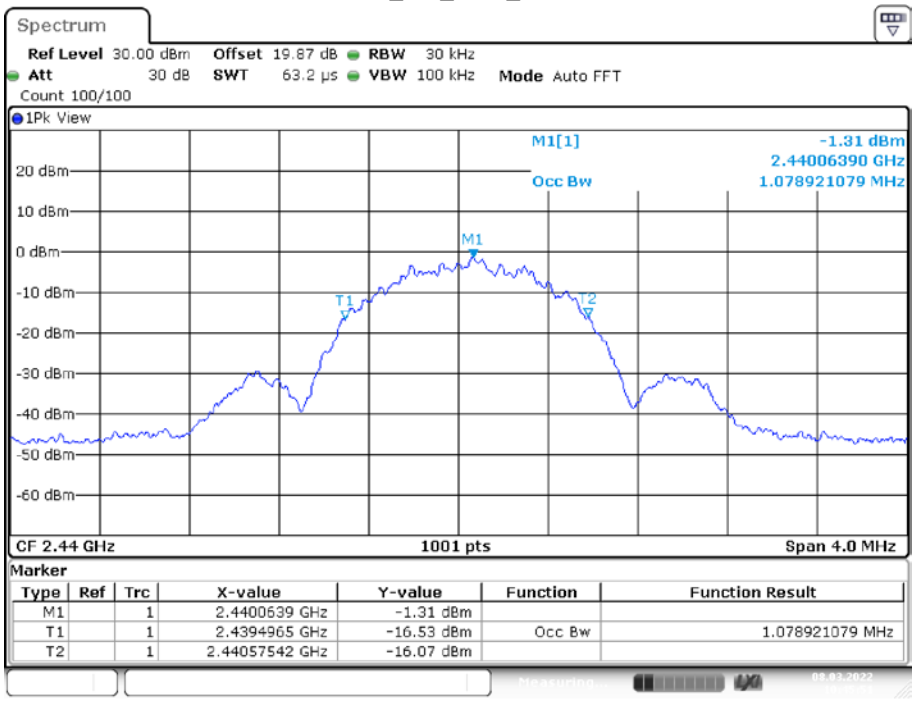
TestMode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	1.083	---	PASS
		2440	1.079	---	PASS
		2480	1.091	---	PASS

Test Graphs

BLE_1M_Ant1_2402

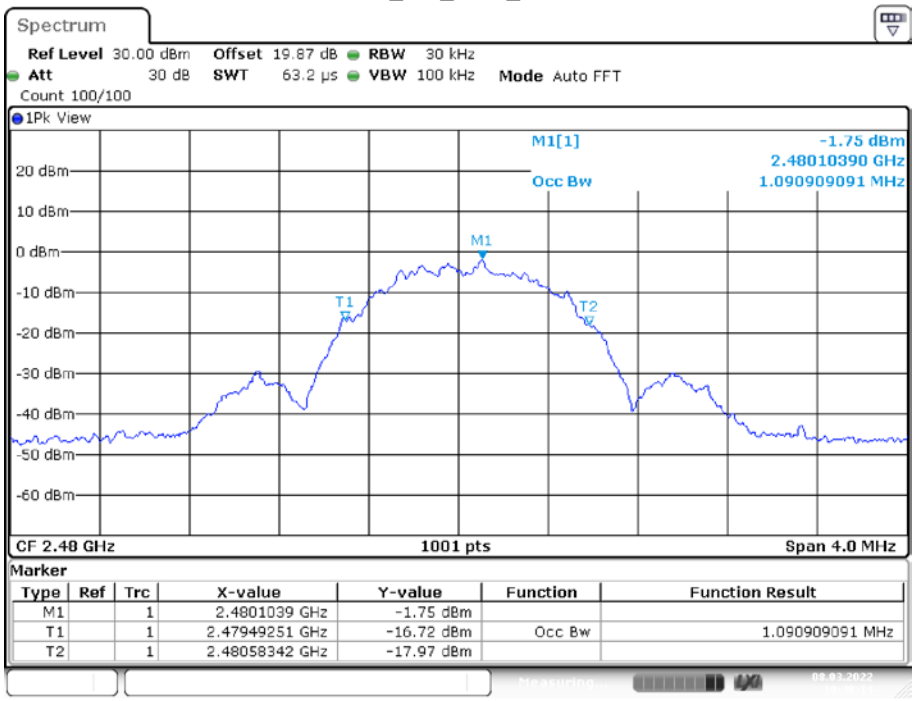


BLE_1M_Ant1_2440



Date: 8.MAR.2022 10:45:52

BLE_1M_Ant1_2480



Date: 8.MAR.2022 10:48:14

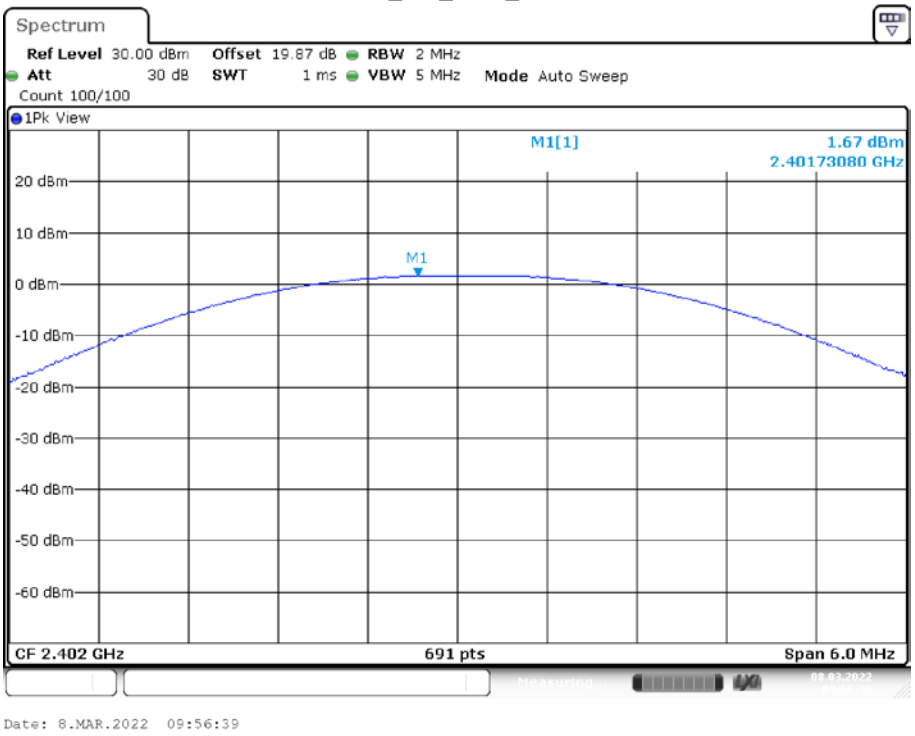
Appendix C: Maximum conducted output power

Test Result

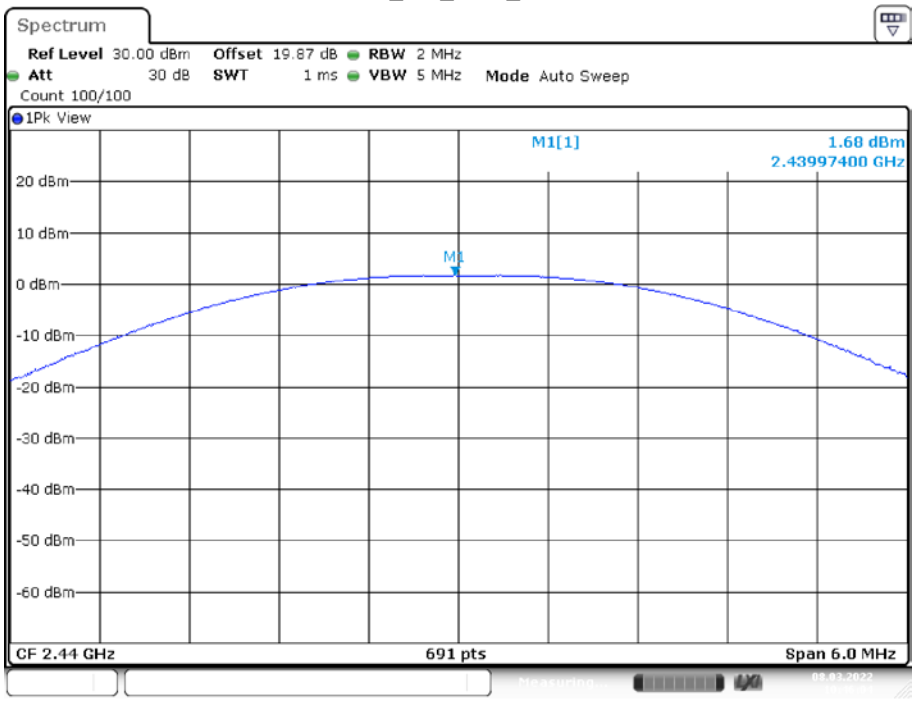
TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	1.67	<=30	PASS
		2440	1.68	<=30	PASS
		2480	1.63	<=30	PASS

Test Graphs

BLE_1M_Ant1_2402

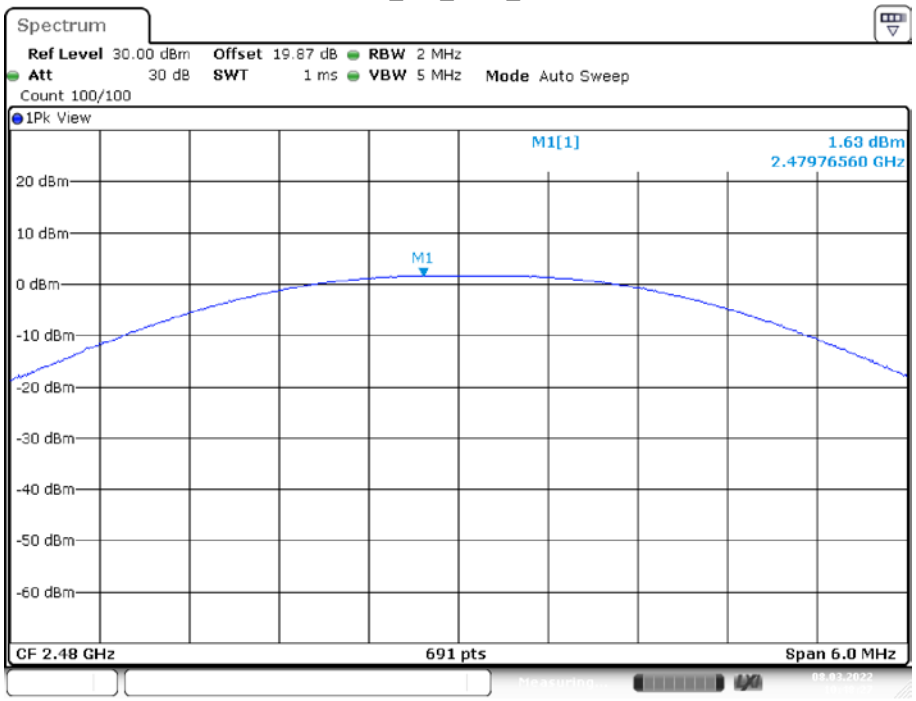


BLE_1M_Ant1_2440



Date: 8.MAR.2022 10:46:04

BLE_1M_Ant1_2480



Date: 8.MAR.2022 10:48:27

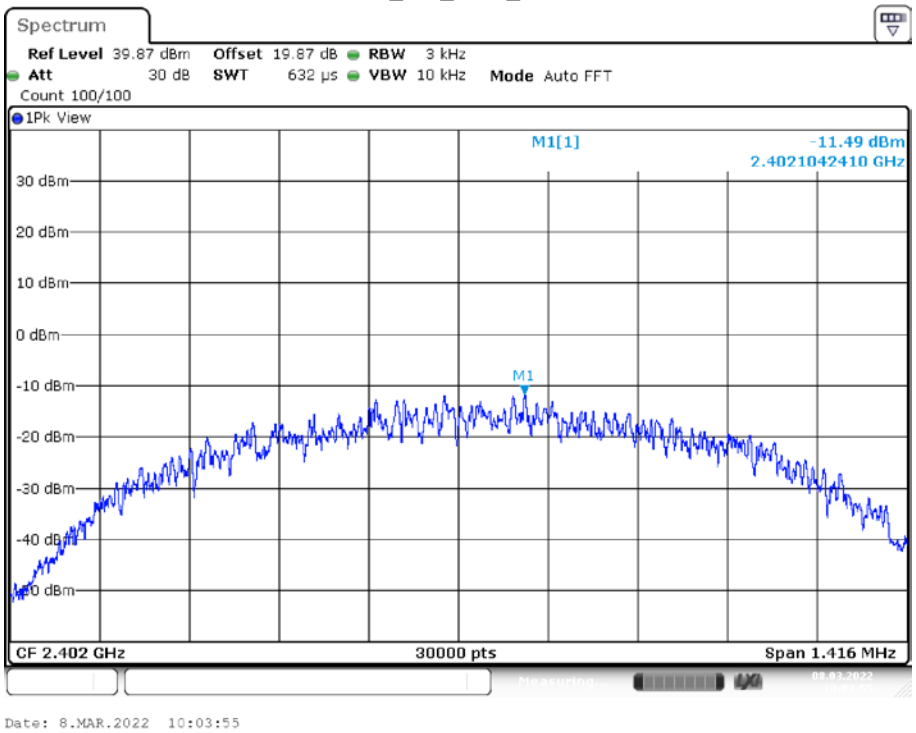
Appendix D: Power spectral density

Test Result

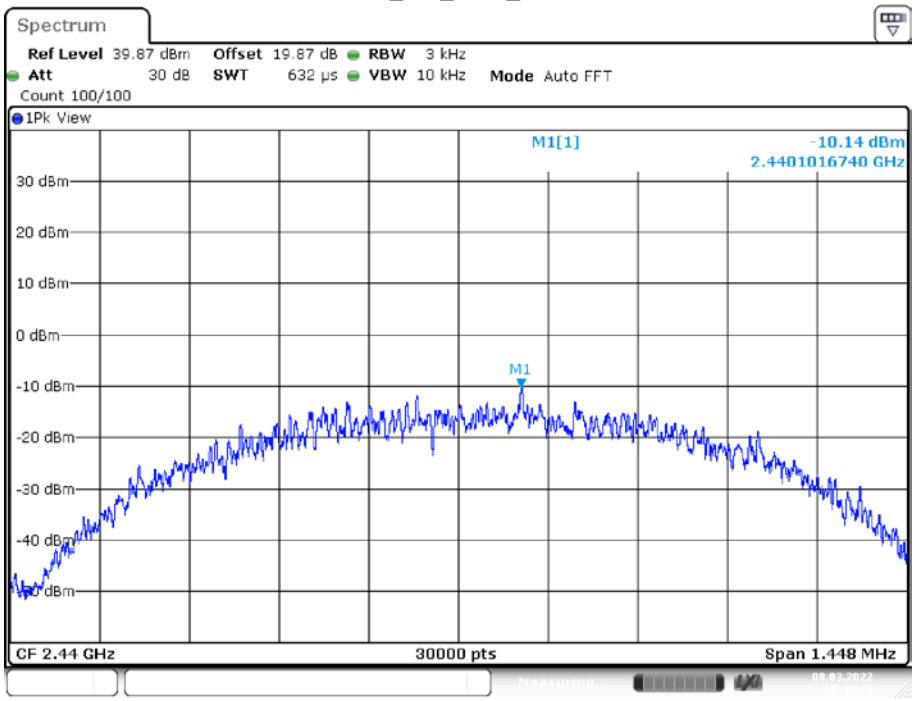
TestMode	Antenna	Channel	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-11.49	<=8	PASS
		2440	-10.14	<=8	PASS
		2480	-11.25	<=8	PASS

Test Graphs

BLE_1M_Ant1_2402

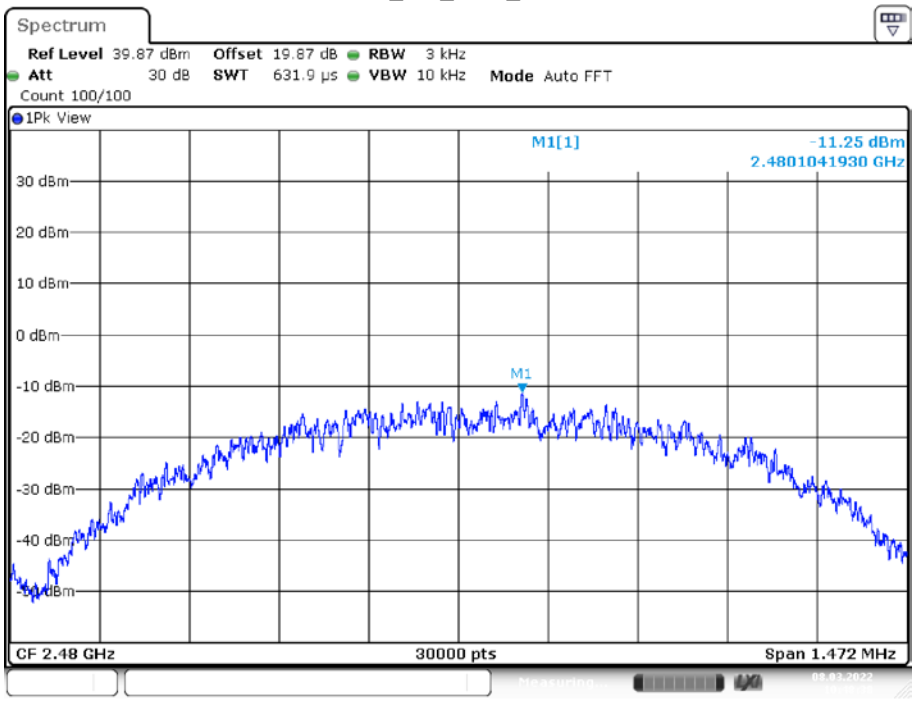


BLE_1M_Ant1_2440



Date: 8.MAR.2022 10:46:16

BLE_1M_Ant1_2480

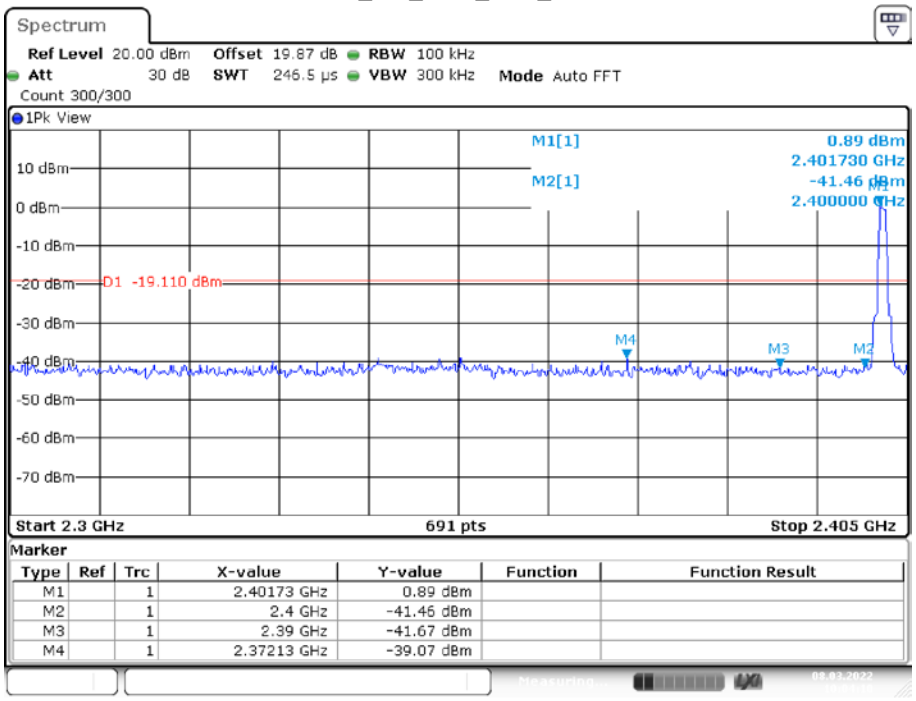


Date: 8.MAR.2022 10:48:39

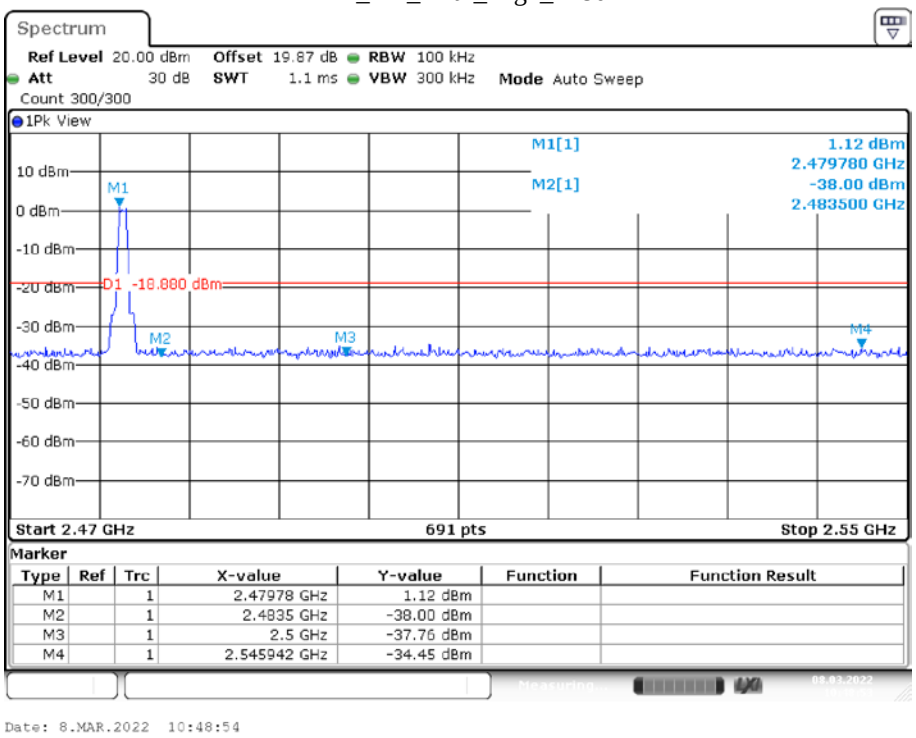
Appendix E: Band edge measurements

Test Graphs

BLE_1M_Ant1_Low_2402



BLE_1M_Ant1_High_2480



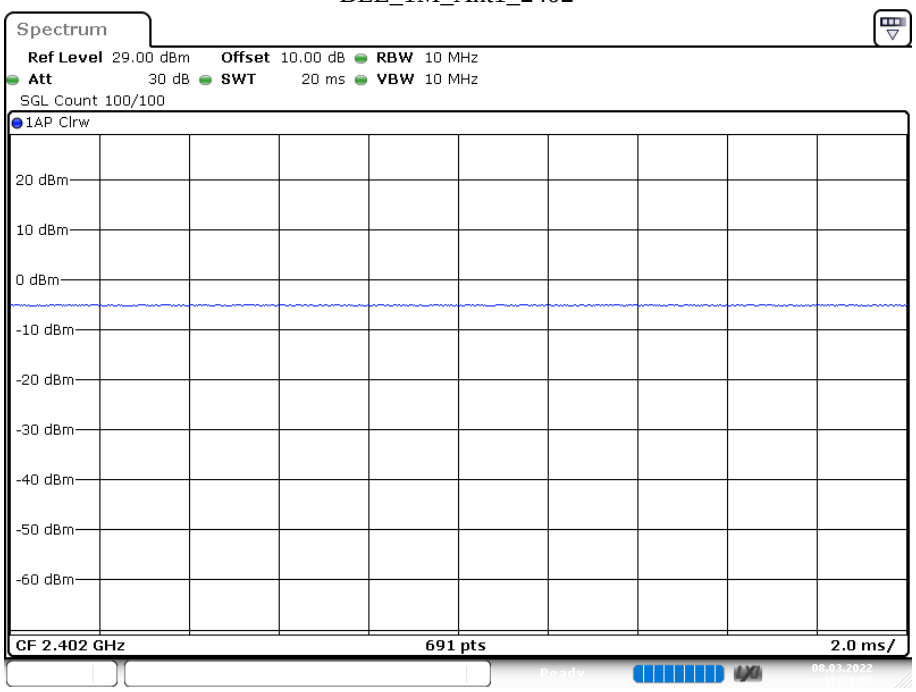
Appendix F: Duty Cycle

Test Result

TestMode	Antenna	Channel	TransmissionDuration [ms]	Transmission Period [ms]	Duty Cycle [%]
BLE_1M	Ant1	2402	20.00	20.00	20.00
		2440	20.00	20.00	20.00
		2480	20.00	20.00	20.00

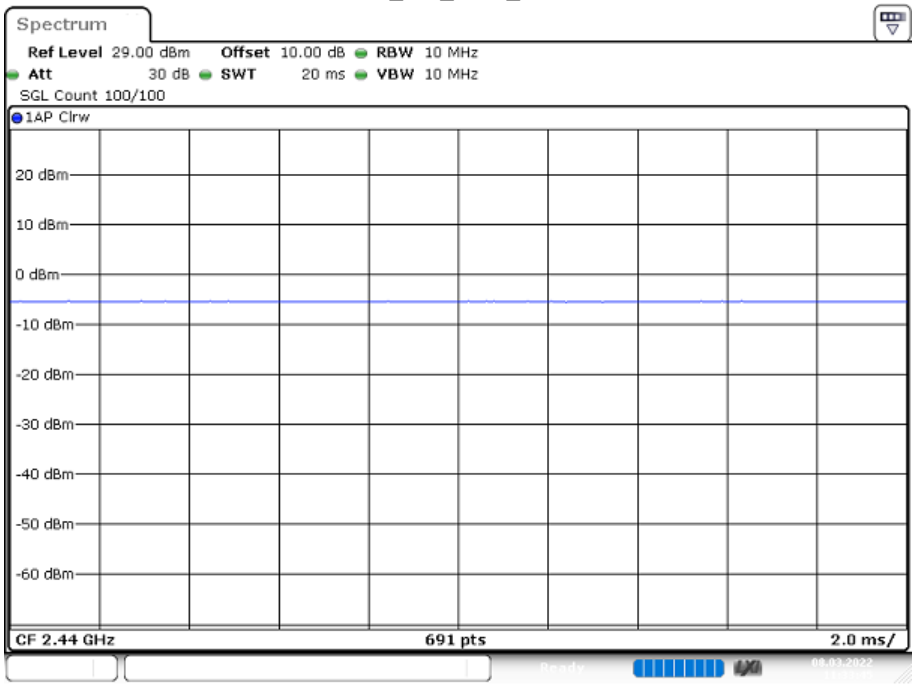
Test Graphs

BLE_1M_Ant1_2402



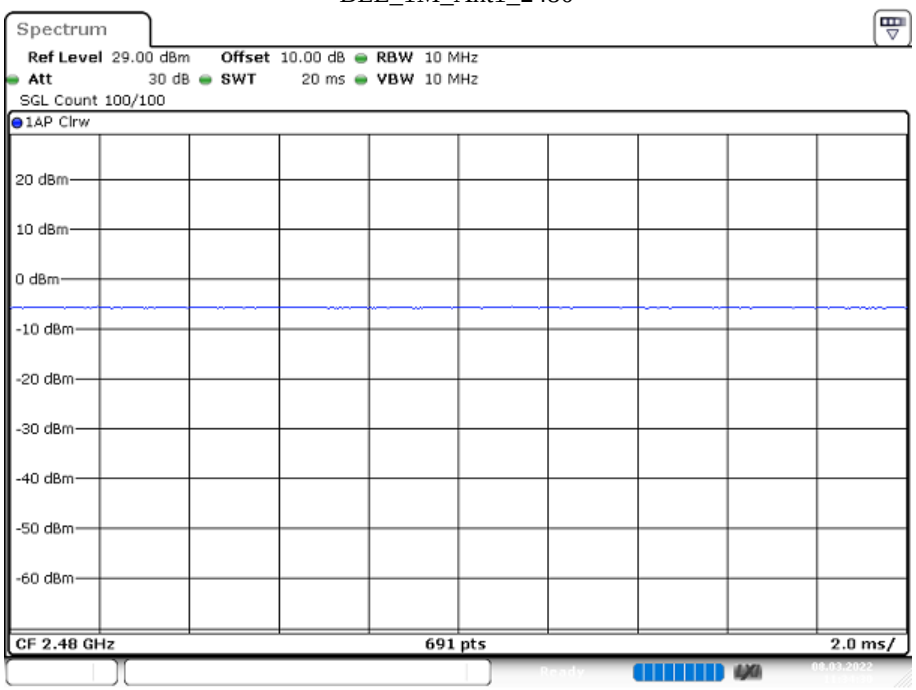
Date: 8.MAR.2022 11:31:59

BLE_1M_Ant1_2440



Date: 8.MAR.2022 11:33:46

BLE_1M_Ant1_2480



Date: 8.MAR.2022 11:34:30

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