

TEST REPORT

Applicant Name : ORAIMO TECHNOLOGY LIMITED
Address : FLAT N 16/F BLOCK B UNIVERSAL INDUSTRIAL CENTRE 19-25
SHAN MEI STREET FOTAN NT HONGKONG
Report Number : SZNS220914-41587E-RF-00B
FCC ID: 2AXYP-OPN-60D

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type: Audio Sunglasses
Model No.: OPN-60D
Multiple Model(s) No.: N/A
Trade Mark: oraimo
Date Received: 2022/09/14
Report Date: 2022/10/18

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

Prepared and Checked By:

Roger Ling

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EMC Engineer

Approved By:

Candy Li

Candy Li
EMC Engineer

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

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	SZNS220914-41587E-RF-00B	Original Report	2022/10/18

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Frequency Range	BLE: 2402-2480MHz
Data Rate	1Mbps/2Mbps
Maximum Conducted Peak Output Power	BLE: 4.12dBm
Modulation Technique	BLE: GFSK
Antenna Specification*	-0.01dBi for left ; -0.57dBi for right (provided by the applicant)
Voltage Range	DC3.7V from battery or DC5V from USB Charging Port
Sample serial number	SZNS220914-41587E-RF-S1 for Radiated Emissions SZNS220914-41587E-RF-S2 for RF Conducted Test (Assigned by ATC)
Sample/EUT Status	Good condition

Objective

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

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.209 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 4297.01.

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

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

Two bluetooths, only one of them work, according to the receiving quality of the signal, and the two cannot work at the same time

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

“BT FCC Tool v2.24” software was used to test and the power level is default for left and right, the software and power level was provided by manufacturer and power level as below:

Duty cycle

Test Result: Compliant. Please refer to the Appendix

Support Equipment List and Details

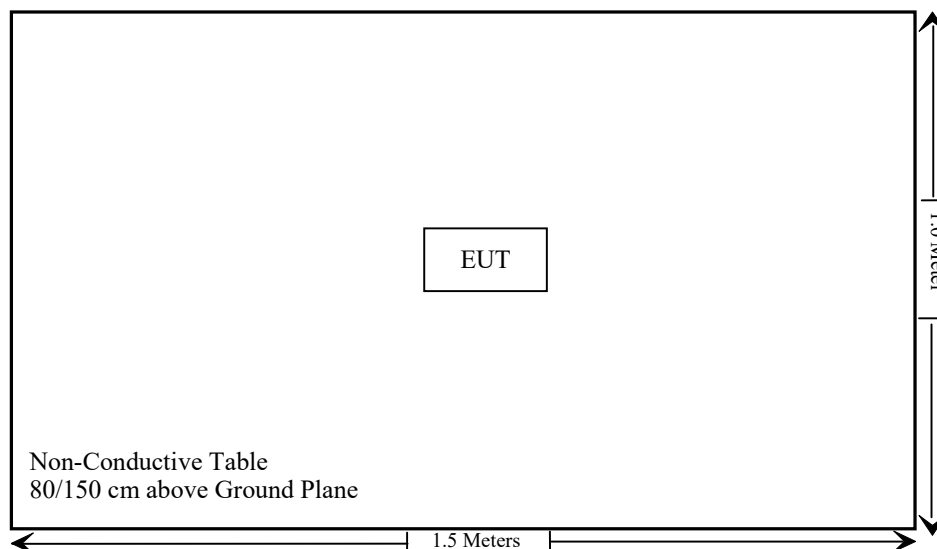
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

Cable Description	Length (m)	From Port	To
/	/	/	/

Block Diagram of Test Setup

For Radiated Emissions:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (3) & §2.1093	RF Exposure	Compliant
§15.203	Antenna Requirement	Compliant
§15.207 (a)	AC Line Conducted Emissions	Not Applicable
§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

Not Applicable: the Bluetooth function cannot used when in charging.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated emission test					
Rohde& Schwarz	Test Receiver	ESR	102725	2021/12/13	2022/12/12
Rohde&Schwarz	Spectrum Analyzer	FSV40	101949	2021/12/13	2022/12/12
SONOMA INSTRUMENT	Amplifier	310 N	186131	2021/11/09	2022/11/08
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2021/11/09	2022/11/08
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2021/11/11	2022/11/10
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2020/01/05	2023/01/04
Radiated Emission Test Software: e3 19821b (V9)					
Unknown	RF Coaxial Cable	No.10	N050	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.11	N1000	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.12	N040	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.13	N300	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.14	N800	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.15	N600	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.16	N650	2021/12/14	2022/12/13
Wainwright	High Pass Filter	WHKX3.6/18 G-10SS	5	2021/12/14	2022/12/13
RF conducted test					
Rohde&Schwarz	Spectrum Analyzer	FSV-40	101590	2022/01/19	2023/01/18
Tonscend	RF Control Unit	JS0806-2	19G8060182	2021/10/26	2022/10/25
WEINSCHHEL	10dB Attenuator	5324	AU 3842	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.31	RF-01	Each time	

* **Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC§15.247 (i), §1.1307 (b) (3) &§2.1093 – RF EXPOSURE

Applicable Standard

According to FCC §2.1093 and §1.1307(b) (3), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 D04 Interim General RF Exposure Guidance

SAR-Based Exemption:

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum timeaveraged power or maximum time-averaged ERP, whichever is greater.

Per § 1.1307(b)(3)(i)(B), for single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

For worst case:

Exemption limit:

For $f=2.48\text{GHz}$, $d=0.5\text{cm}$, the $P_{th}=2.72\text{mW}$

The higher of the available maximum time-averaged power or effective radiated power (ERP):

The antenna gain is -0.01dBi (-2.16dBd), $0\text{dBd}=2.15\text{dBi}$

The maximum tune-up conducted power is 4.3dBm (2.69mW), which less than $2.72\text{ mW}@2480\text{MHz}$ exemption limit

So the stand-alone SAR evaluation can be exempted.

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 two internal antennas, which was permanently attached, the maximum antenna gain is -0.01dBi for left and -0.57dBi for right, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

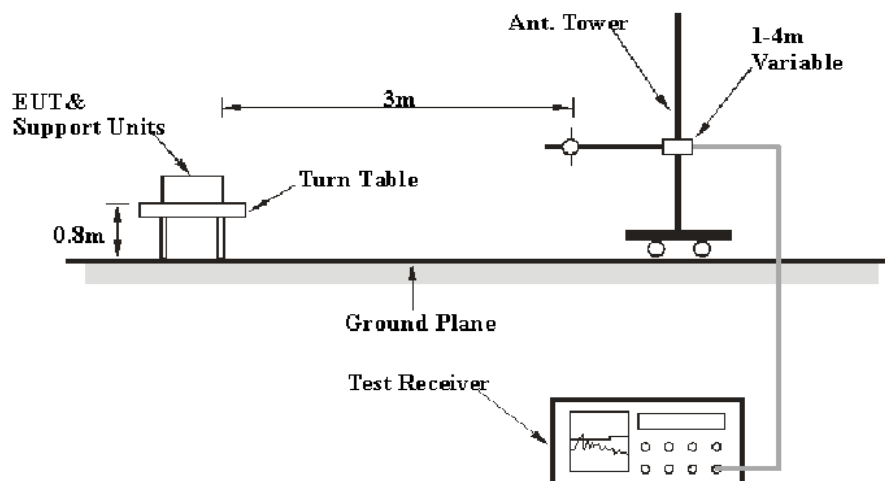
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

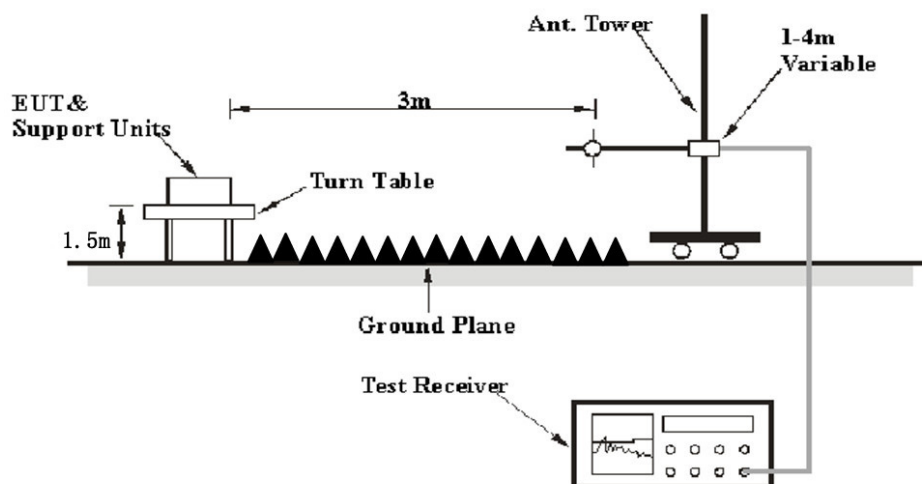
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



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

EMI Test Receiver & Spectrum Analyzer Setup

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

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

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

Note 2: when duty cycle is less than 98%

Test Procedure

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

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

Factor & Margin Calculation

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

$$\text{Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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:

$$\begin{aligned} \text{Over Limit/Margin} &= \text{Level} / \text{Corrected Amplitude} - \text{Limit} \\ \text{Level} / \text{Corrected Amplitude} &= \text{Read Level} + \text{Factor} \end{aligned}$$

Test Data

Environmental Conditions

Temperature:	24~25.6 °C
Relative Humidity:	50~60 %
ATM Pressure:	101.0 kPa

The testing was performed by Level Li on 2022-10-14 for below 1GHz, Zeki Ma on 2022-10-11 for above 1GHz

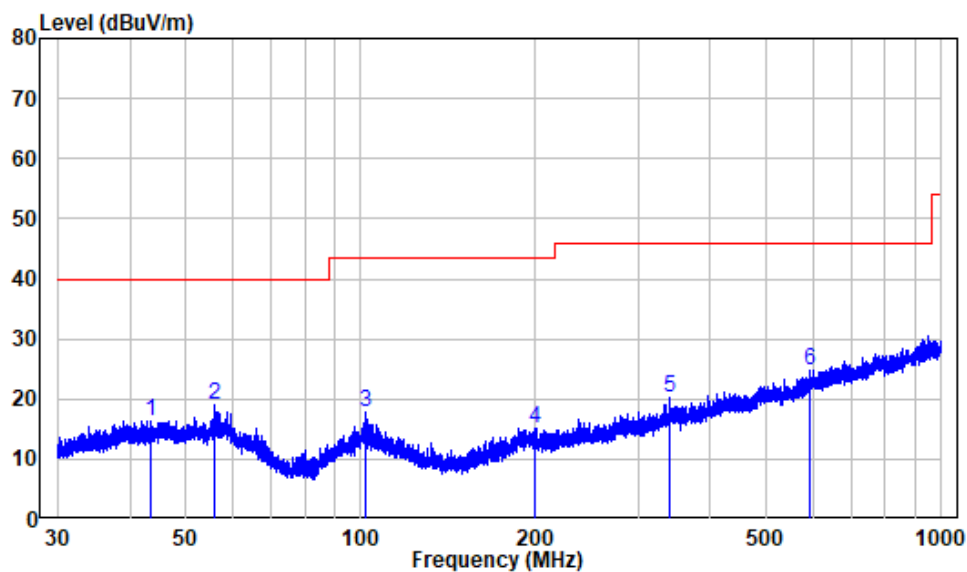
EUT operation mode: Transmitting(Pre-scan in the X,Y and Z axes of orientation, the worst case X-axes of orientation was recorded)

For Left**30MHz-1GHz:**

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

BLE 1M: Worst case is low channel

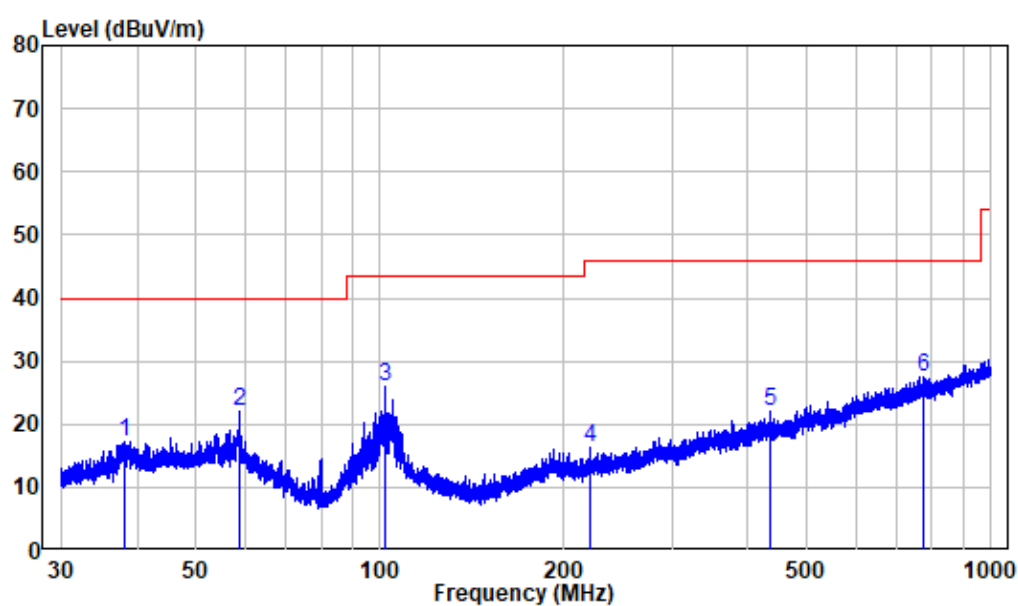
Horizontal:



Site : chamber
Condition: 3m HORIZONTAL
Job No. : SZNS220914-41587E-RF
Test Mode: BLE 1M
Note : Left

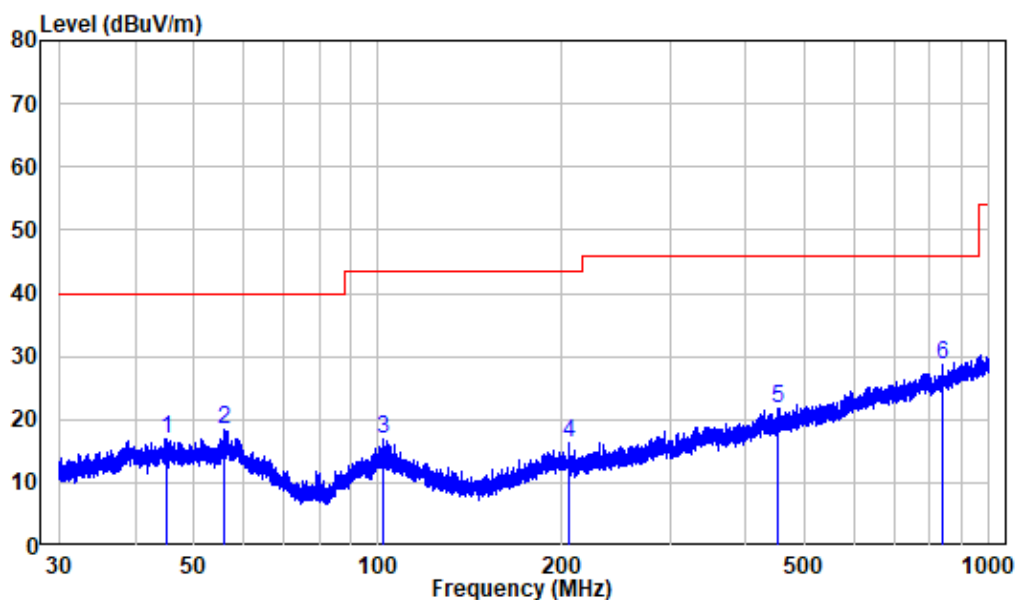
	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	43.315	-9.93	26.28	16.35	40.00	-23.65	Peak
2	56.050	-10.18	29.24	19.06	40.00	-20.94	Peak
3	101.867	-11.58	29.26	17.68	43.50	-25.82	Peak
4	199.898	-11.41	26.60	15.19	43.50	-28.31	Peak
5	340.334	-7.42	27.51	20.09	46.00	-25.91	Peak
6	594.090	-2.70	27.50	24.80	46.00	-21.20	Peak

Vertical



Site : chamber
 Condition: 3m VERTICAL
 Job No. : SZNS220914-41587E-RF
 Test Mode: BLE 1M
 Note : Left

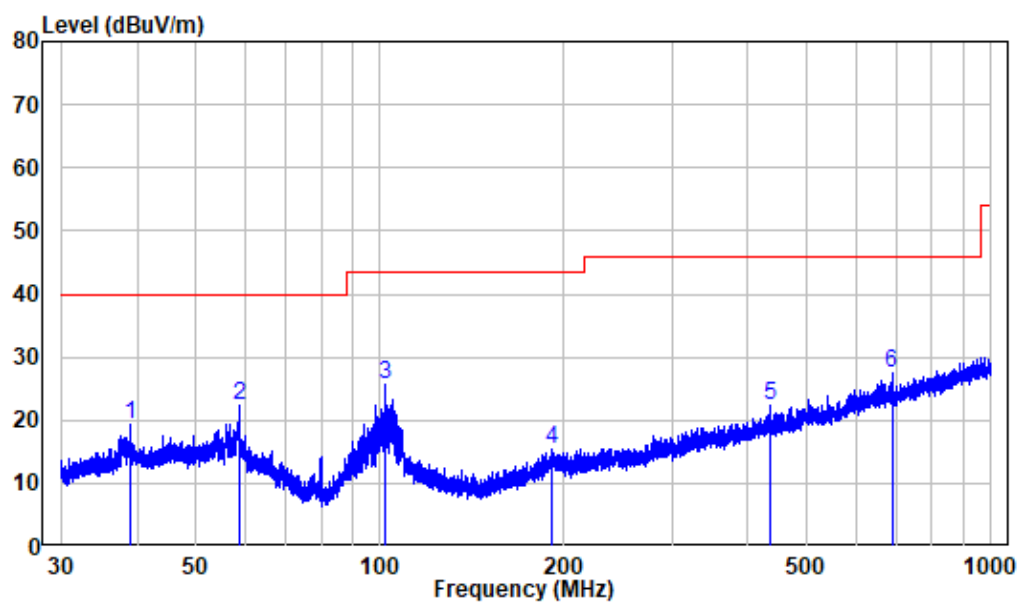
	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	38.078	-10.80	28.09	17.29	40.00	-22.71	Peak
2	58.715	-10.17	32.12	21.95	40.00	-18.05	Peak
3	101.912	-11.58	37.47	25.89	43.50	-17.61	Peak
4	221.392	-11.37	27.57	16.20	46.00	-29.80	Peak
5	435.399	-5.70	27.75	22.05	46.00	-23.95	Peak
6	774.837	0.03	27.38	27.41	46.00	-18.59	Peak

BLE 2M: Worst case is low channel**Horizontal:**

Site : chamber
Condition: 3m HORIZONTAL
Job No. : SZNS220914-41587E-RF
Test Mode: BLE 2M
Note : Left

	Freq Factor		Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	45.058	-9.94	26.81	16.87	40.00	-23.13	Peak
2	56.001	-10.18	28.57	18.39	40.00	-21.61	Peak
3	101.912	-11.58	28.61	17.03	43.50	-26.47	Peak
4	205.946	-11.84	28.04	16.20	43.50	-27.30	Peak
5	452.323	-5.57	27.31	21.74	46.00	-24.26	Peak
6	837.712	0.23	28.31	28.54	46.00	-17.46	Peak

Vertical



Site : chamber
 Condition: 3m VERTICAL
 Job No. : SZNS220914-41587E-RF
 Test Mode: BLE 2M
 Note : Left

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	38.888	-10.61	29.92	19.31	40.00	-20.69	Peak
2	58.715	-10.17	32.39	22.22	40.00	-17.78	Peak
3	101.912	-11.58	37.11	25.53	43.50	-17.97	Peak
4	191.158	-11.39	26.69	15.30	43.50	-28.20	Peak
5	434.446	-5.72	27.93	22.21	46.00	-23.79	Peak
6	688.055	-1.51	28.91	27.40	46.00	-18.60	Peak

1-25 GHz:**BLE 1M**

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
Low Channel(2402MHz)									
2310	68.13	PK	122	1	H	-7.24	60.89	74	-13.11
2310	53.96	AV	122	1	H	-7.24	46.72	54	-7.28
2310	67.81	PK	208	2.1	V	-7.24	60.57	74	-13.43
2310	54.07	AV	208	2.1	V	-7.24	46.83	54	-7.17
2390	69.43	PK	23	1.2	H	-7.22	62.21	74	-11.79
2390	54.94	AV	23	1.2	H	-7.22	47.72	54	-6.28
2390	69.59	PK	2	1.8	V	-7.22	62.37	74	-11.63
2390	54.79	AV	2	1.8	V	-7.22	47.57	54	-6.43
4804	54.10	PK	144	2	H	-3.51	50.59	74	-23.41
4804	54.31	PK	324	2	V	-3.51	50.80	74	-23.20
Middle Channel(2440MHz)									
4880	54.14	PK	214	1.4	H	-3.38	50.76	74	-23.24
4880	54.71	PK	141	1.4	V	-3.38	51.33	74	-22.67
High Channel(2480 MHz)									
2483.5	71.06	PK	83	1.6	H	-7.20	63.86	74	-10.14
2483.5	55.88	AV	83	1.6	H	-7.20	48.68	54	-5.32
2483.5	70.67	PK	324	1.4	V	-7.20	63.47	74	-10.53
2483.5	55.86	AV	324	1.4	V	-7.20	48.66	54	-5.34
2500	68.35	PK	151	2.3	H	-7.18	61.17	74	-12.83
2500	55.48	AV	151	2.3	H	-7.18	48.3	54	-5.70
2500	68.82	PK	51	1.7	V	-7.18	61.64	74	-12.36
2500	55.55	AV	51	1.7	V	-7.18	48.37	54	-5.63
4960	53.95	PK	48	1.3	H	-3.01	50.94	74	-23.06
4960	55.82	PK	174	1.3	V	-3.01	52.81	74	-21.19

BLE 2M

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
Low Channel(2402MHz)									
2310	68.57	PK	242	2	H	-7.24	61.33	74	-12.67
2310	54.09	AV	242	2	H	-7.24	46.85	54	-7.15
2310	68.01	PK	112	2.1	V	-7.24	60.77	74	-13.23
2310	53.98	AV	112	2.1	V	-7.24	46.74	54	-7.26
2390	69.88	PK	311	1.3	H	-7.22	62.66	74	-11.34
2390	54.88	AV	311	1.3	H	-7.22	47.66	54	-6.34
2390	69.13	PK	101	1.9	V	-7.22	61.91	74	-12.09
2390	54.96	AV	101	1.9	V	-7.22	47.74	54	-6.26
4804	54.26	PK	254	2	H	-3.51	50.75	74	-23.25
4804	54.11	PK	147	2	V	-3.51	50.60	74	-23.40
Middle Channel(2440MHz)									
4880	54.39	PK	221	2.3	H	-3.38	51.01	74	-22.99
4880	54.23	PK	29	2.3	V	-3.38	50.85	74	-23.15
High Channel(2480 MHz)									
2483.5	70.95	PK	324	1.2	H	-7.20	63.75	74	-10.25
2483.5	55.94	AV	324	1.2	H	-7.20	48.74	54	-5.26
2483.5	71.28	PK	350	1.2	V	-7.20	64.08	74	-9.92
2483.5	55.90	AV	350	1.2	V	-7.20	48.7	54	-5.30
2500	68.65	PK	10	1.9	H	-7.18	61.47	74	-12.53
2500	55.40	AV	10	1.9	H	-7.18	48.22	54	-5.78
2500	69.20	PK	38	1.5	V	-7.18	62.02	74	-11.98
2500	55.57	AV	38	1.5	V	-7.18	48.39	54	-5.61
4960	54.27	PK	256	1.3	H	-3.01	51.26	74	-22.74
4960	54.12	PK	339	1.3	V	-3.01	51.11	74	-22.89

Note:

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

Absolute Level = Corrected Factor + Reading

Margin = Absolute Level - Limit

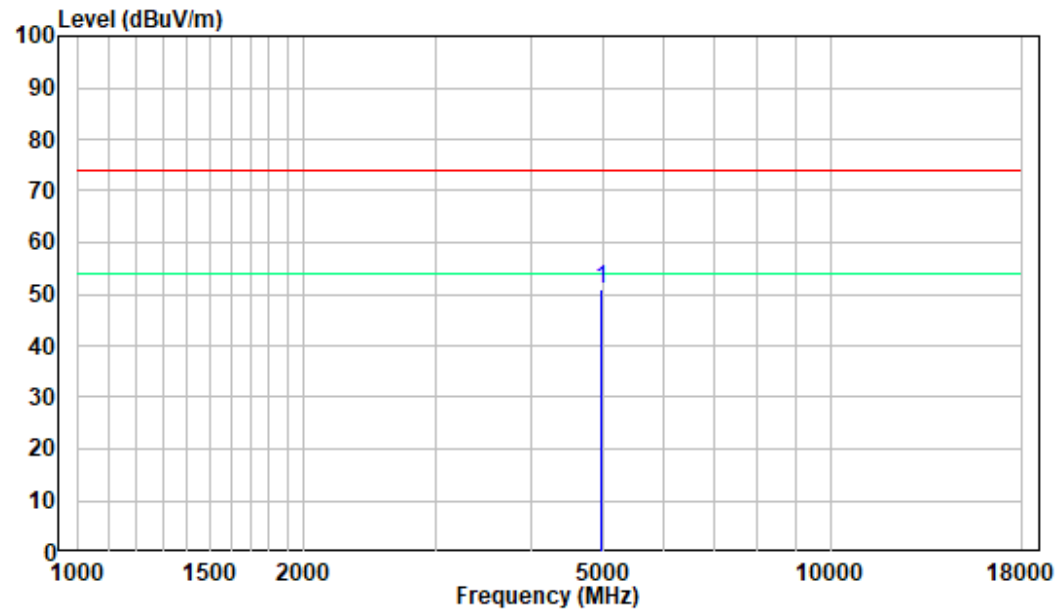
The other spurious emission which is in the noise floor level was not recorded.

When the test result of Peak was below the limit of average, just the Peak value was recorded.

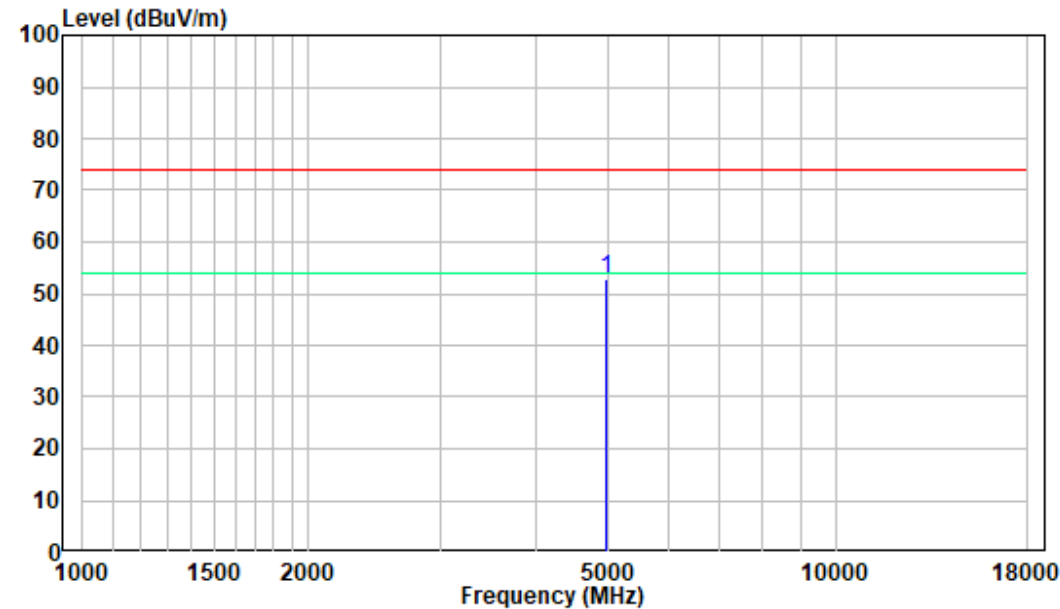
1-18 GHz:

Pre-scan for BLE 1M, High Channel

Horizontal



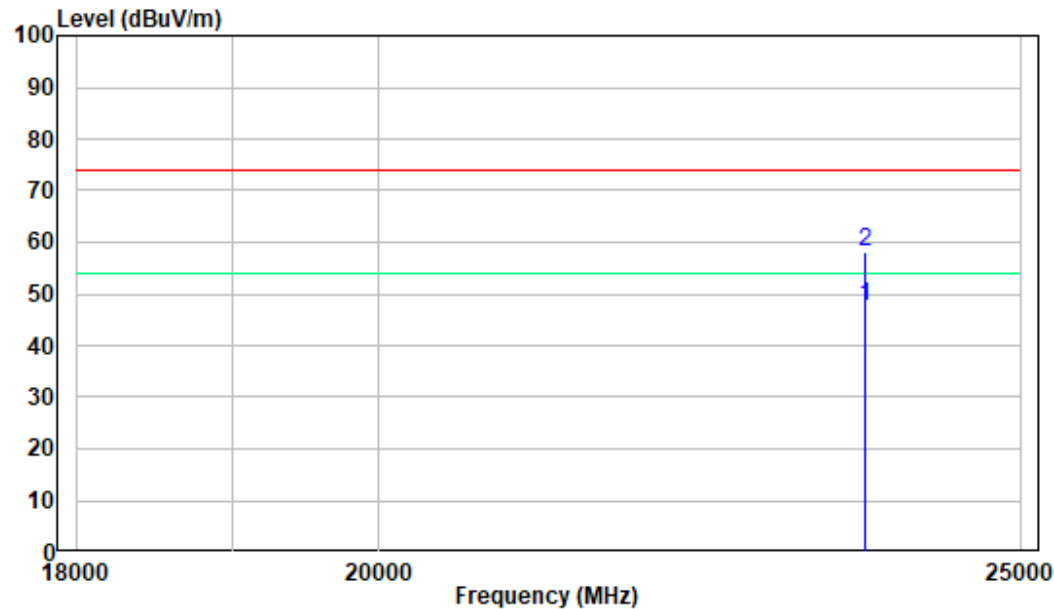
Vertical



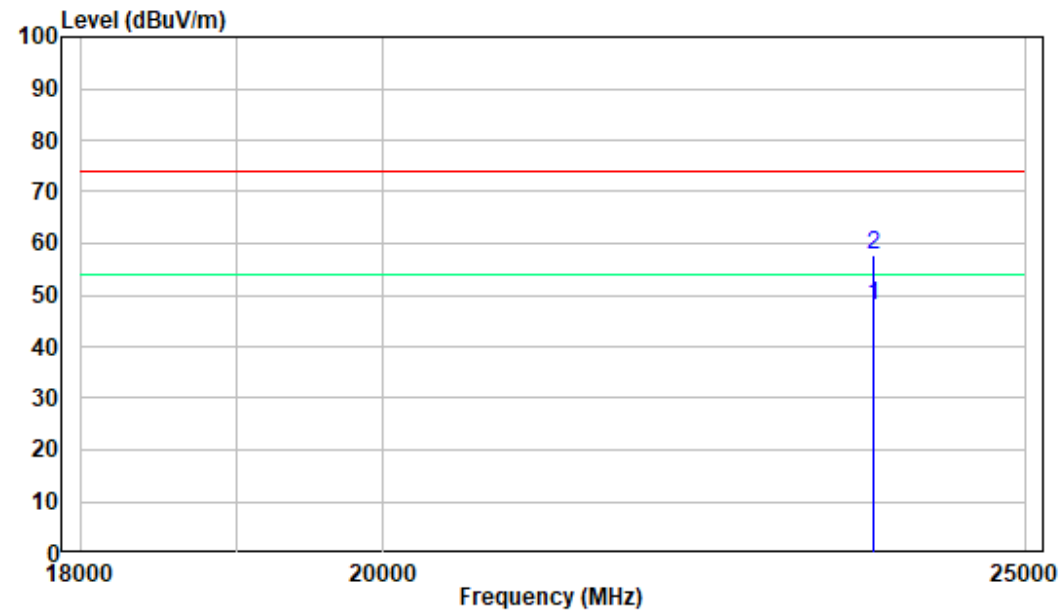
18 -25GHz:

Pre-scan for BLE 1M, High Channel

Horizontal



Vertical



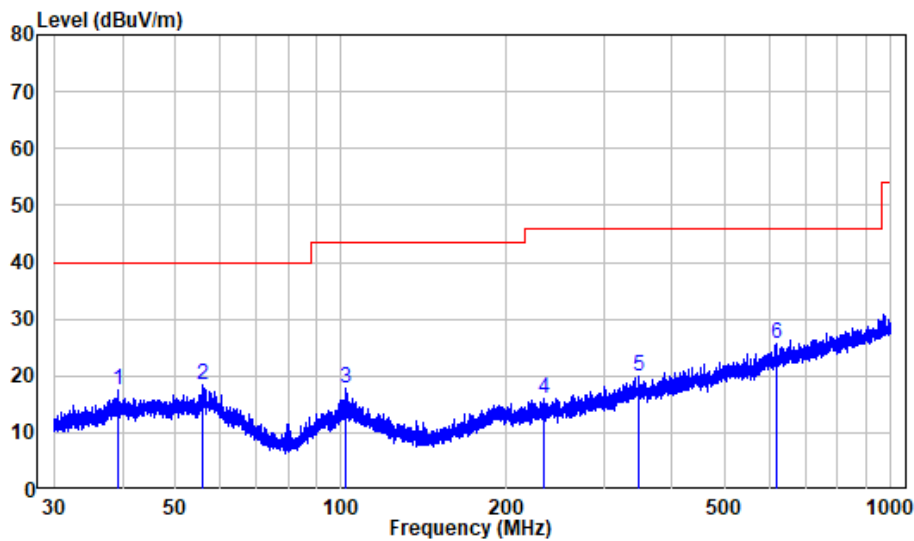
For Righth

30MHz-1GHz:

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

BLE 1M: Worst case is low channel

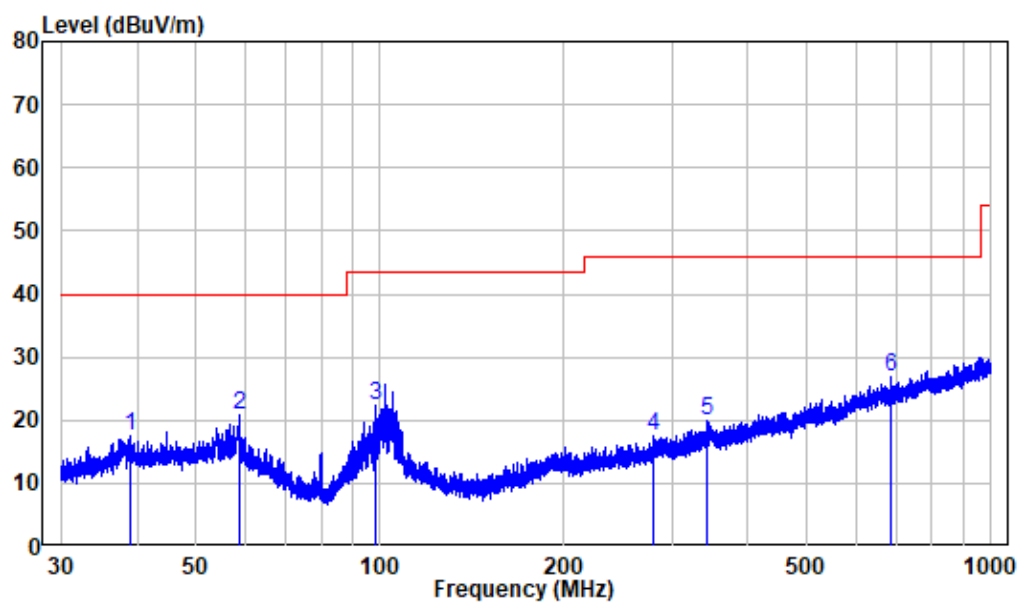
Horizontal:



Site : chamber
Condition: 3m HORIZONTAL
Job No. : SZNS220914-41587E-RF
Test Mode: BLE 1M
Note : Right

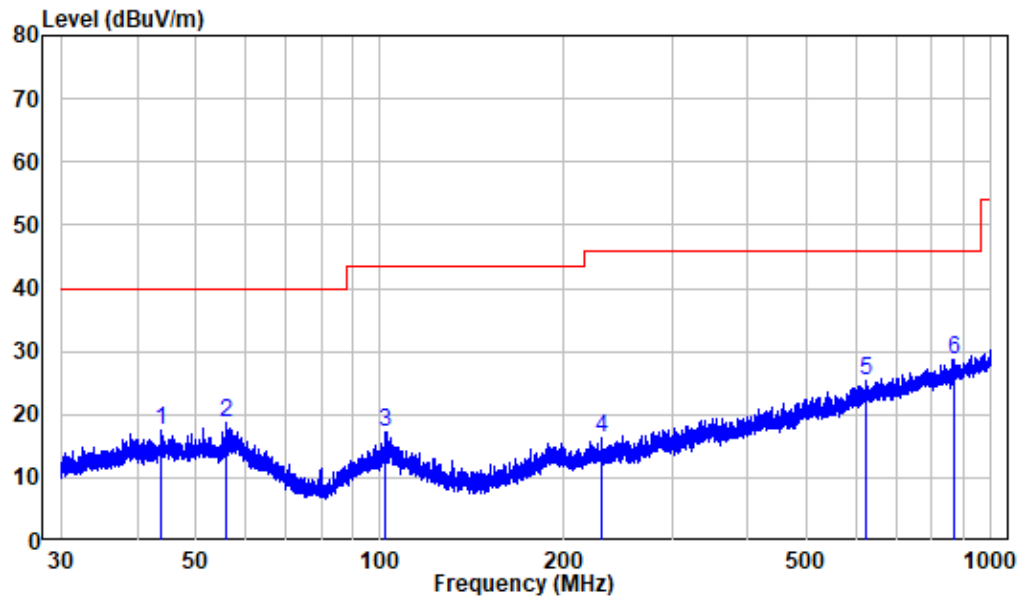
	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	39.299	-10.50	27.90	17.40	40.00	-22.60	Peak
2	56.001	-10.18	28.65	18.47	40.00	-21.53	Peak
3	101.912	-11.58	29.28	17.70	43.50	-25.80	Peak
4	234.066	-10.99	26.86	15.87	46.00	-30.13	Peak
5	348.638	-7.28	27.07	19.79	46.00	-26.21	Peak
6	617.724	-2.50	28.28	25.78	46.00	-20.22	Peak

Vertical



Site : chamber
 Condition: 3m VERTICAL
 Job No. : SZNS220914-41587E-RF
 Test Mode: BLE 1M
 Note : Right

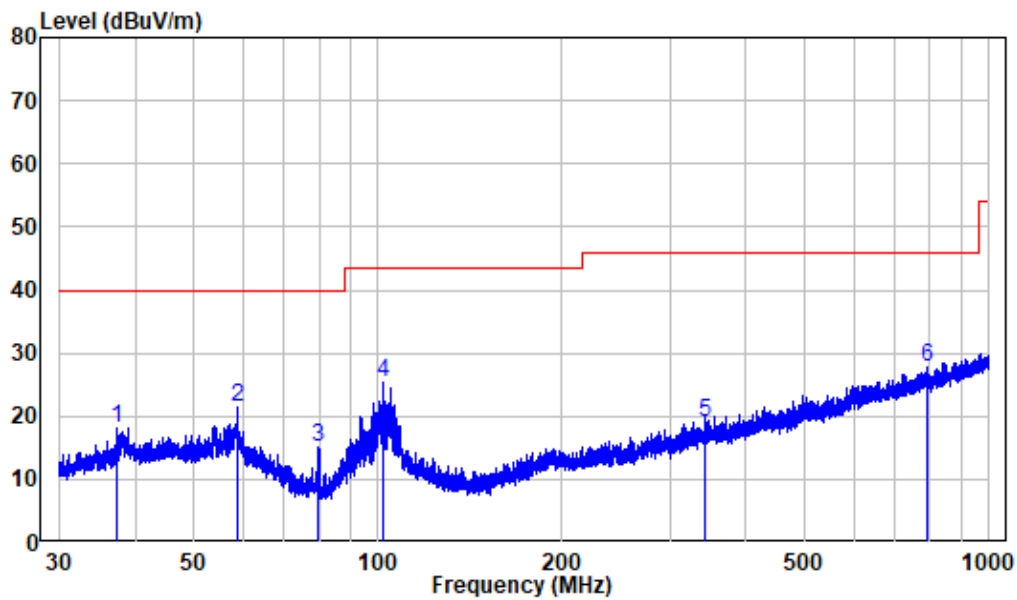
	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	38.888	-10.61	28.08	17.47	40.00	-22.53	Peak
2	58.715	-10.17	31.13	20.96	40.00	-19.04	Peak
3	98.443	-12.15	34.53	22.38	43.50	-21.12	Peak
4	280.024	-9.58	27.24	17.66	46.00	-28.34	Peak
5	343.180	-7.29	27.09	19.80	46.00	-26.20	Peak
6	686.248	-1.50	28.27	26.77	46.00	-19.23	Peak

BLE 2M: Worst case is low channel**Horizontal:**

Site : chamber
Condition: 3m HORIZONTAL
Job No. : SZNS220914-41587E-RF
Test Mode: BLE 2M
Note : Right

	Freq	Factor	Read Level	Level	Limit	Over	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	43.793	-9.91	27.34	17.43	40.00	-22.57	Peak
2	55.805	-10.21	28.80	18.59	40.00	-21.41	Peak
3	101.912	-11.58	28.93	17.35	43.50	-26.15	Peak
4	230.806	-11.08	27.50	16.42	46.00	-29.58	Peak
5	625.626	-2.32	27.66	25.34	46.00	-20.66	Peak
6	867.608	0.83	27.92	28.75	46.00	-17.25	Peak

Vertical



Site : chamber
 Condition: 3m VERTICAL
 Job No. : SZNS220914-41587E-RF
 Test Mode: BLE 2M
 Note : Right

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	37.367	-10.94	28.94	18.00	40.00	-22.00	Peak
2	58.690	-10.16	31.62	21.46	40.00	-18.54	Peak
3	79.975	-16.79	31.76	14.97	40.00	-25.03	Peak
4	101.912	-11.58	36.98	25.40	43.50	-18.10	Peak
5	341.679	-7.36	26.30	18.94	46.00	-27.06	Peak
6	790.272	-0.14	27.80	27.66	46.00	-18.34	Peak

1-25 GHz:

BLE 1M

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
Low Channel(2402MHz)									
2310	68.16	PK	303	1.1	H	-7.24	60.92	74	-13.08
2310	53.99	AV	303	1.1	H	-7.24	46.75	54	-7.25
2310	68.03	PK	300	1	V	-7.24	60.79	74	-13.21
2310	54.16	AV	300	1	V	-7.24	46.92	54	-7.08
2390	69.27	PK	11	1.1	H	-7.22	62.05	74	-11.95
2390	54.87	AV	11	1.1	H	-7.22	47.65	54	-6.35
2390	69.20	PK	74	2.4	V	-7.22	61.98	74	-12.02
2390	54.92	AV	74	2.4	V	-7.22	47.70	54	-6.30
4804	55.30	PK	161	2.5	H	-3.51	51.79	74	-22.21
4804	55.34	PK	29	2.5	V	-3.51	51.83	74	-22.17
Middle Channel(2440MHz)									
4880	54.83	PK	114	1.9	H	-3.38	51.45	74	-22.55
4880	55.00	PK	208	1.9	V	-3.38	51.62	74	-22.38
High Channel(2480 MHz)									
2483.5	70.55	PK	36	2	H	-7.20	63.35	74	-10.65
2483.5	55.91	AV	36	2	H	-7.20	48.71	54	-5.29
2483.5	71.18	PK	9	2.3	V	-7.20	63.98	74	-10.02
2483.5	55.83	AV	9	2.3	V	-7.20	48.63	54	-5.37
2500	69.05	PK	41	2.2	H	-7.18	61.87	74	-12.13
2500	55.43	AV	41	2.2	H	-7.18	48.25	54	-5.75
2500	69.13	PK	115	2.2	V	-7.18	61.95	74	-12.05
2500	55.58	AV	115	2.2	V	-7.18	48.4	54	-5.60
4960	53.48	PK	18	1.2	H	-3.01	50.47	74	-23.53
4960	52.84	PK	82	1.2	V	-3.01	49.83	74	-24.17

BLE 2M

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
Low Channel(2402MHz)									
2310	68.42	PK	165	1.8	H	-7.24	61.18	74	-12.82
2310	54.02	AV	165	1.8	H	-7.24	46.78	54	-7.22
2310	68.75	PK	288	1.2	V	-7.24	61.51	74	-12.49
2310	54.15	AV	288	1.2	V	-7.24	46.91	54	-7.09
2390	70.02	PK	308	1.3	H	-7.22	62.80	74	-11.20
2390	54.95	AV	308	1.3	H	-7.22	47.73	54	-6.27
2390	69.69	PK	54	1.2	V	-7.22	62.47	74	-11.53
2390	54.81	AV	54	1.2	V	-7.22	47.59	54	-6.41
4804	53.93	PK	109	1.4	H	-3.51	50.42	74	-23.58
4804	53.59	PK	200	1.4	V	-3.51	50.08	74	-23.92
Middle Channel(2440MHz)									
4880	54.37	PK	259	1.8	H	-3.38	50.99	74	-23.01
4880	54.01	PK	343	1.8	V	-3.38	50.63	74	-23.37
High Channel(2480 MHz)									
2483.5	70.77	PK	228	1.7	H	-7.20	63.57	74	-10.43
2483.5	56.00	AV	228	1.7	H	-7.20	48.8	54	-5.20
2483.5	70.43	PK	289	2.2	V	-7.20	63.23	74	-10.77
2483.5	55.90	AV	289	2.2	V	-7.20	48.7	54	-5.30
2500	68.43	PK	191	1.9	H	-7.18	61.25	74	-12.75
2500	55.40	AV	191	1.9	H	-7.18	48.22	54	-5.78
2500	69.15	PK	109	1.6	V	-7.18	61.97	74	-12.03
2500	55.41	AV	109	1.6	V	-7.18	48.23	54	-5.77
4960	53.27	PK	226	1.6	H	-3.01	50.26	74	-23.74
4960	52.64	PK	338	1.6	V	-3.01	49.63	74	-24.37

Note:

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

Absolute Level = Corrected Factor + Reading

Margin = Absolute Level - Limit

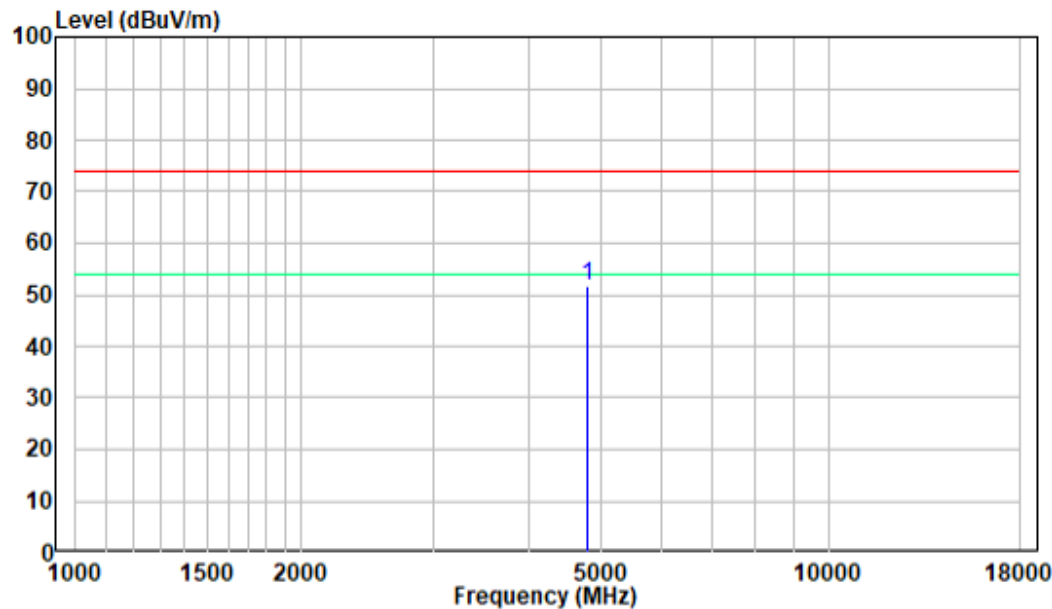
The other spurious emission which is in the noise floor level was not recorded.

When the test result of Peak was below the limit of average, just the Peak value was recorded.

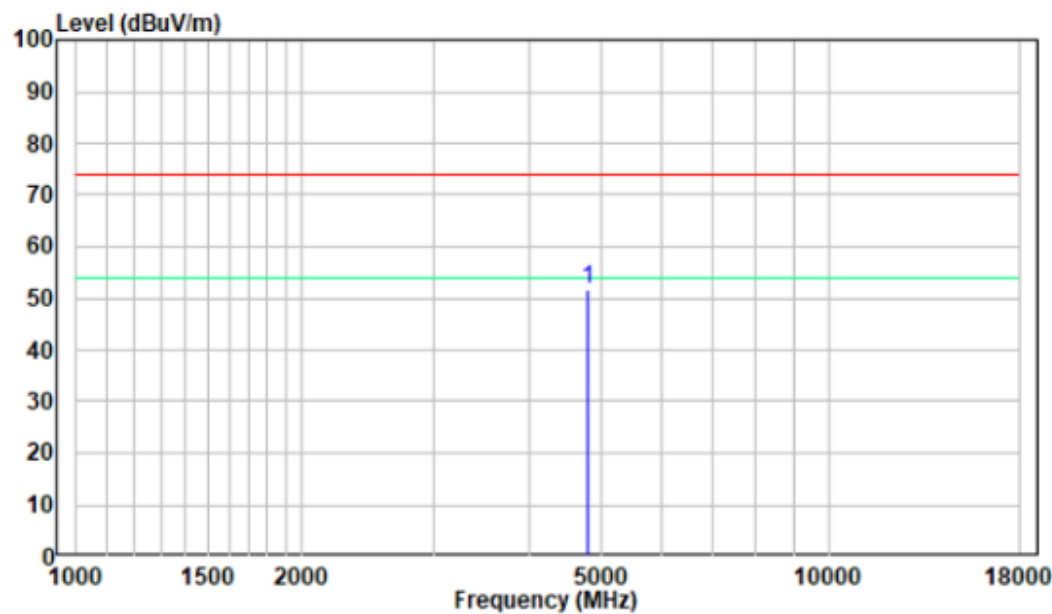
1-18 GHz:

Pre-scan for BLE 1M, Low Channel

Horizontal



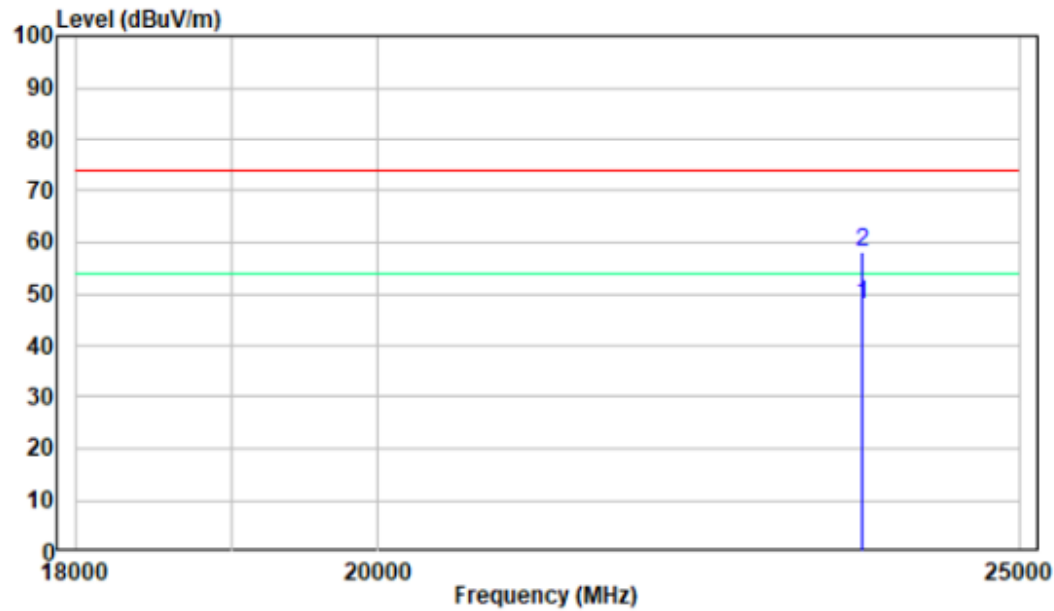
Vertical



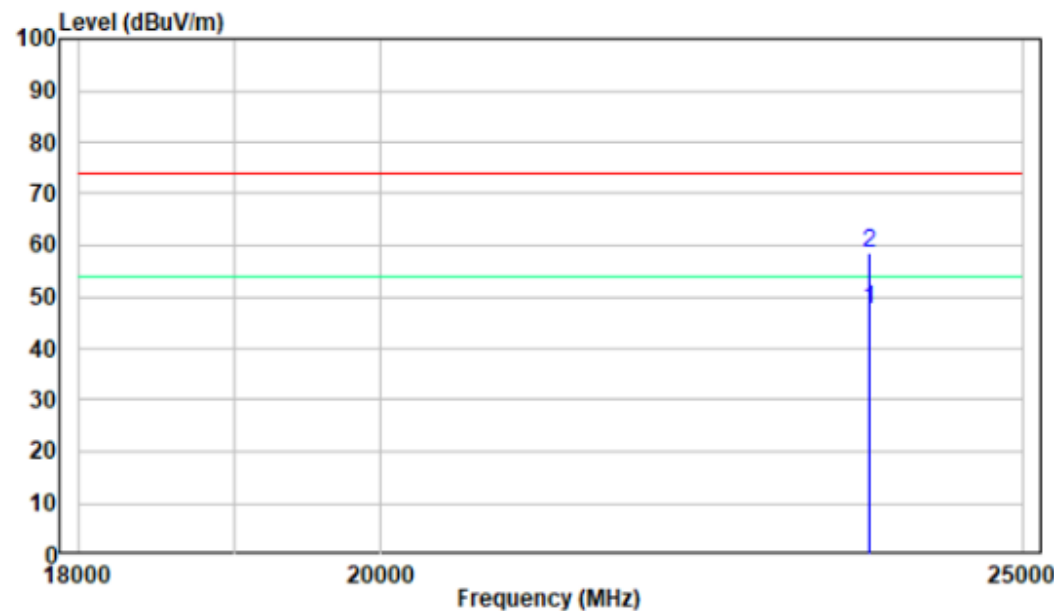
18 -25GHz:

Pre-scan for BLE 1M, Low Channel

Horizontal



Vertical



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

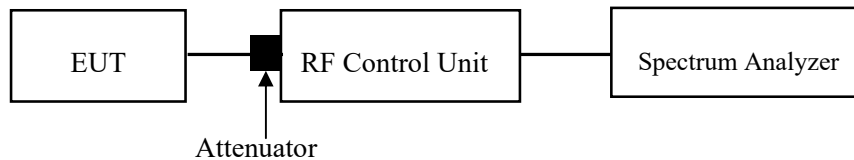
Applicable Standard

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

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

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



Test Data

Environmental Conditions

Temperature:	20 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2022-10-11.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

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

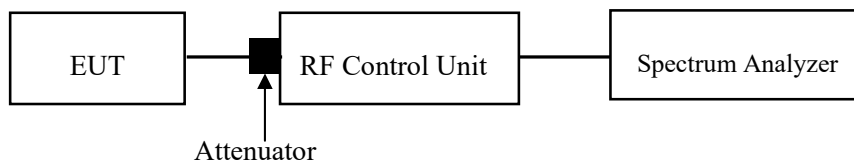
Applicable Standard

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

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.9.1.1

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:	20 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2022-10-11.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

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

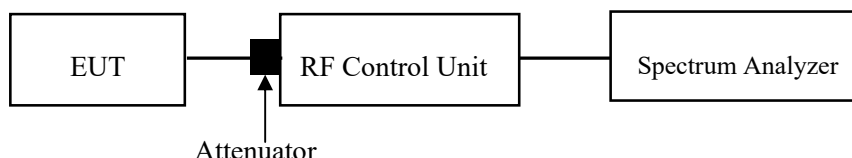
Applicable Standard

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

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.11

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



Test Data

Environmental Conditions

Temperature:	20 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2022-10-11.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(e) - POWER SPECTRAL DENSITY

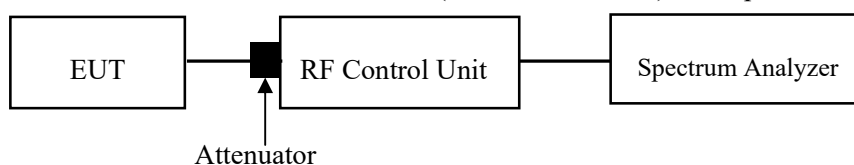
Applicable Standard

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

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.10.2

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



Test Data

Environmental Conditions

Temperature:	20 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2022-10-11.

EUT operation mode: Transmitting

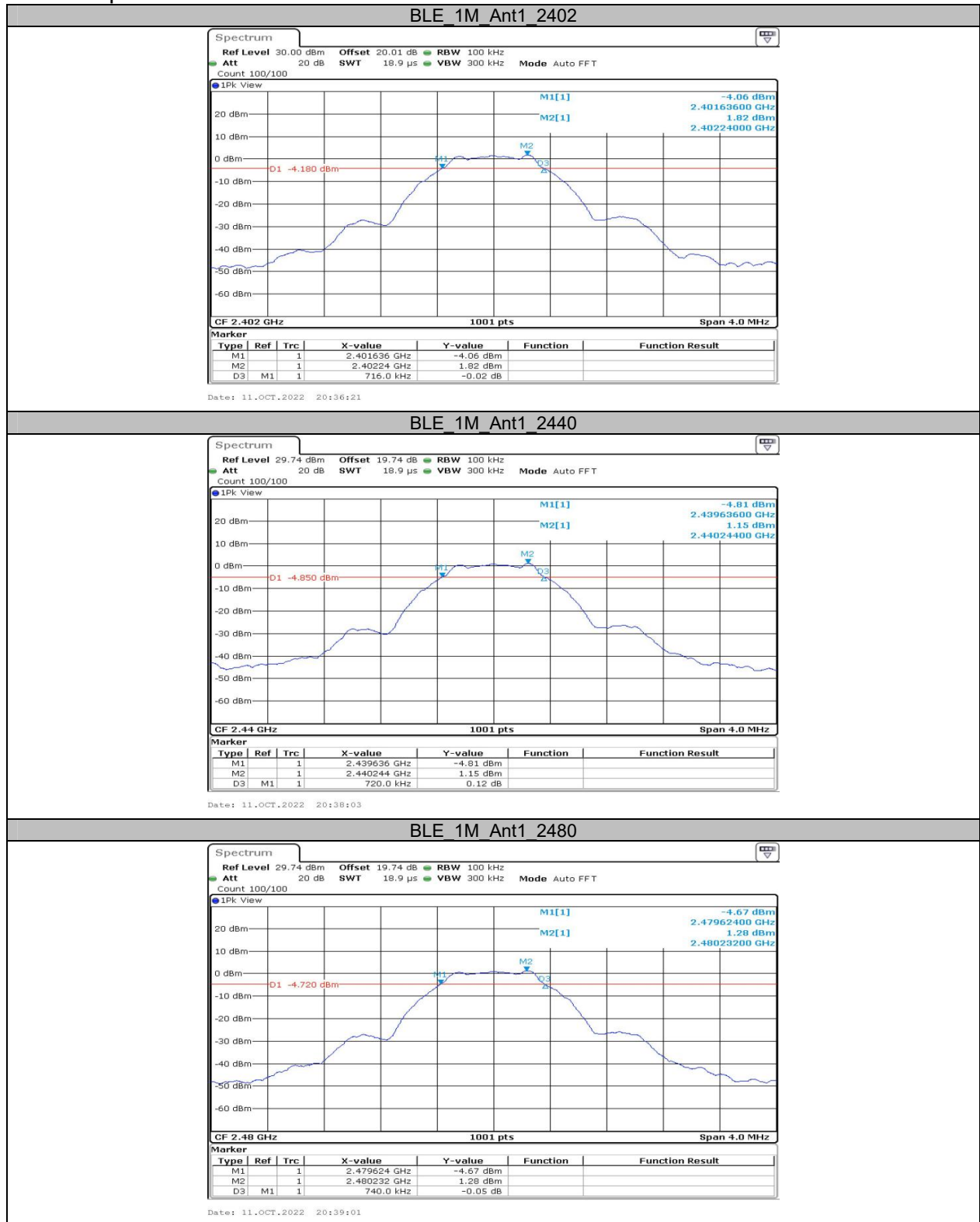
Test Result: Compliant. Please refer to the Appendix.

APPENDIX-For Left

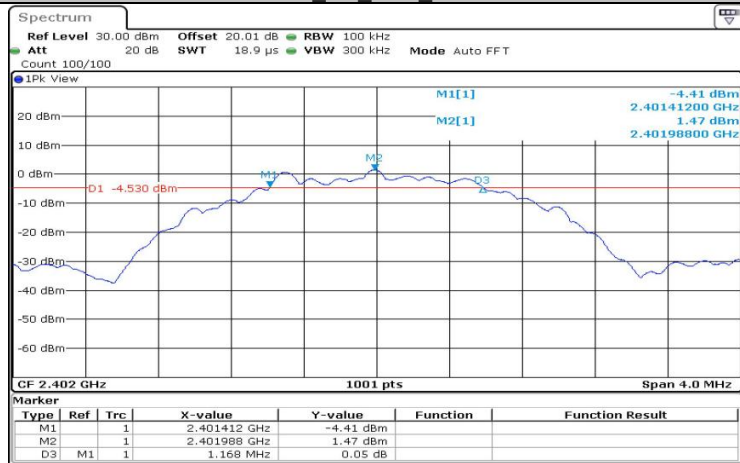
Appendix A: DTS Bandwidth Test Result

Test Mode	Antenna	Channel	DTS BW [MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	0.72	0.5	PASS
		2440	0.72	0.5	PASS
		2480	0.74	0.5	PASS
BLE_2M	Ant1	2402	1.17	0.5	PASS
		2440	1.17	0.5	PASS
		2480	1.19	0.5	PASS

Test Graphs

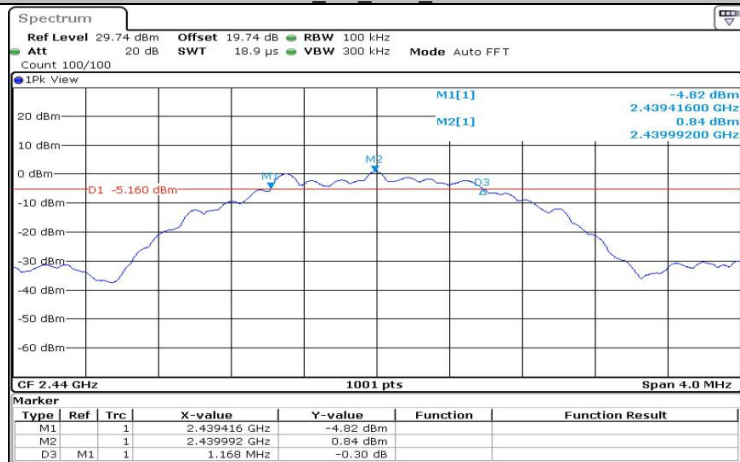


BLE 2M Ant1 2402



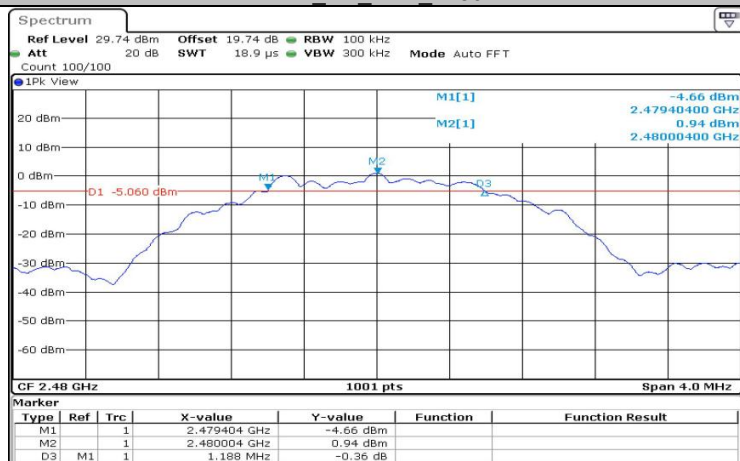
Date: 11.OCT.2022 20:40:19

BLE 2M Ant1 2440



Date: 11.OCT.2022 20:41:59

BLE 2M Ant1 2480

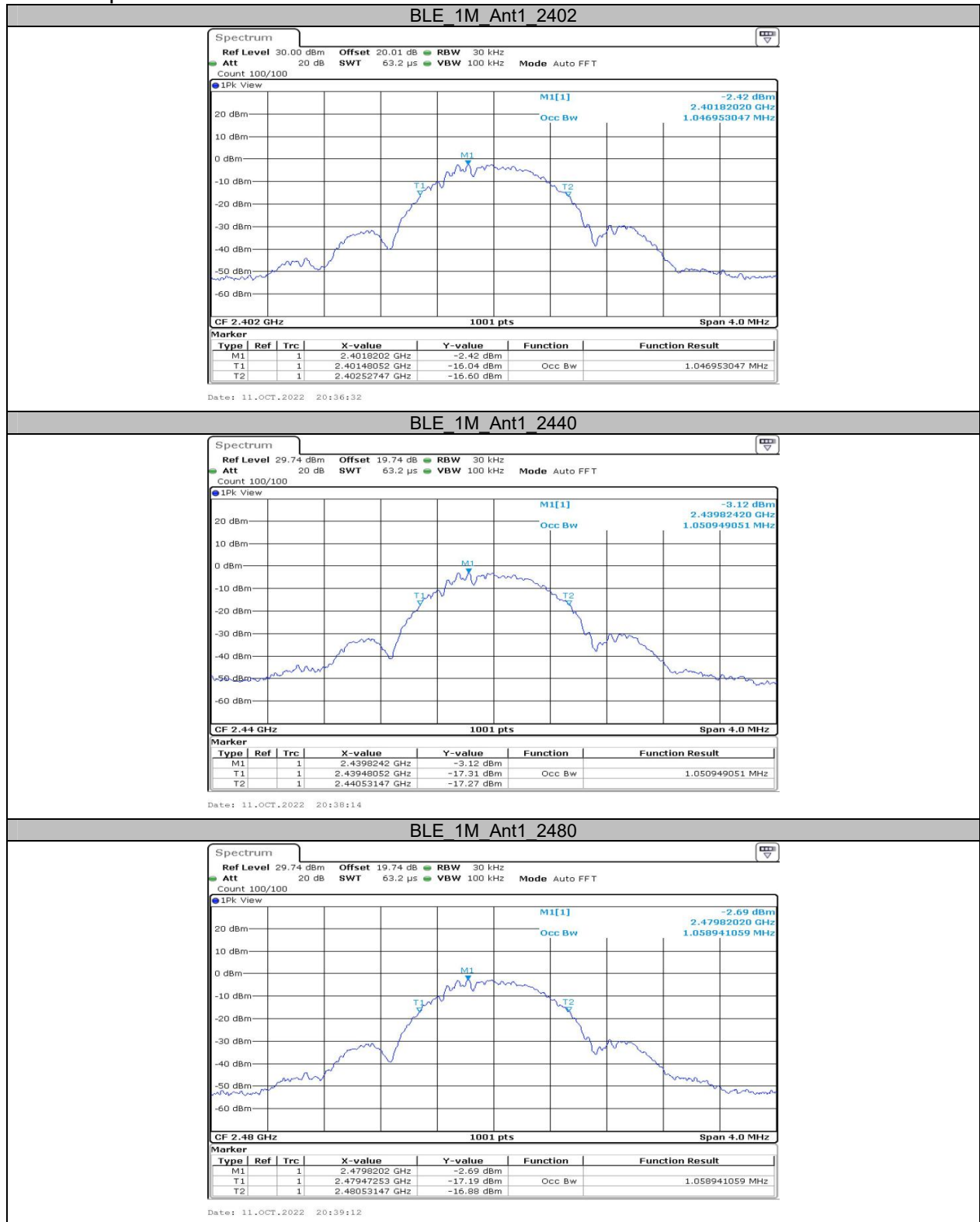


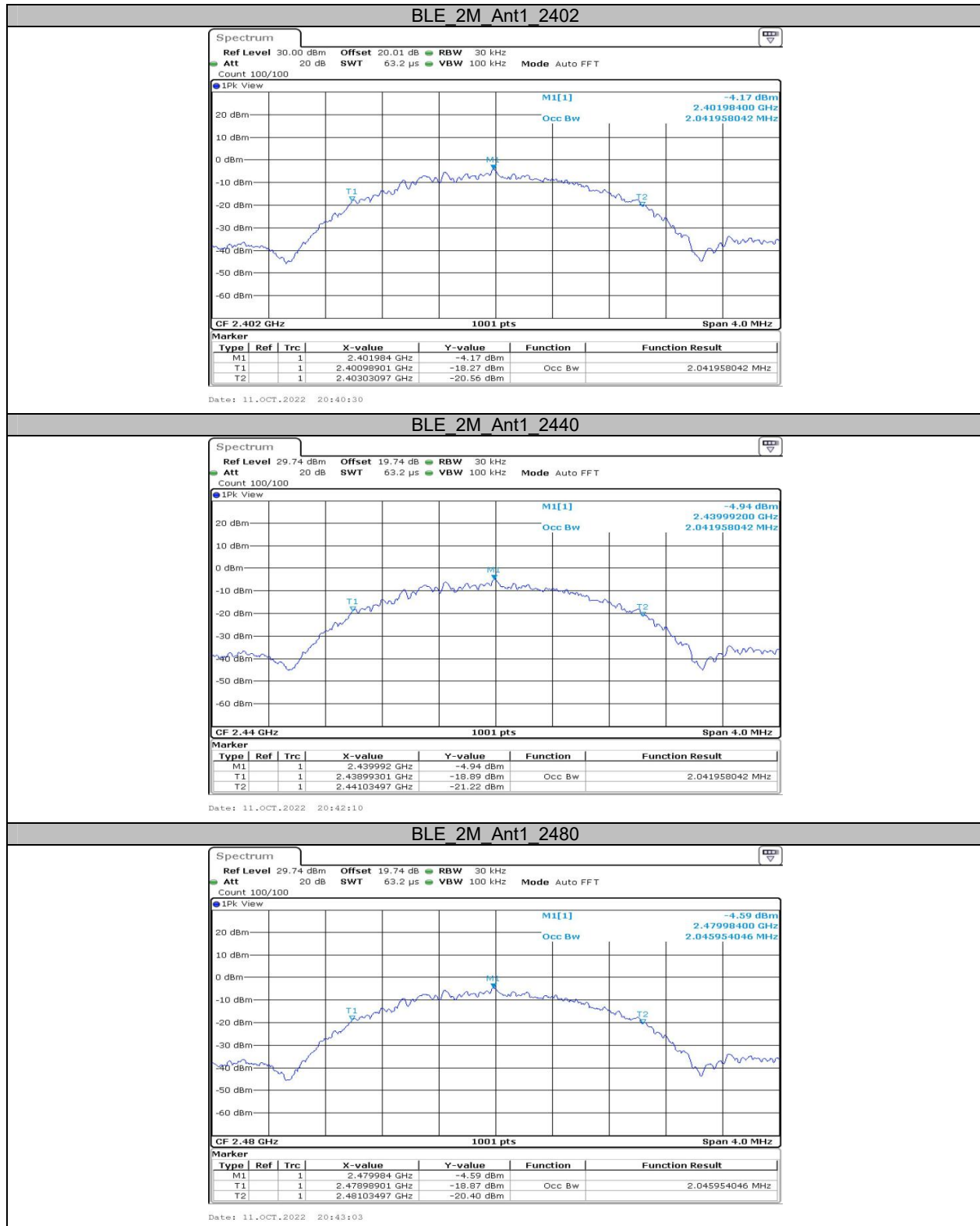
Date: 11.OCT.2022 20:42:52

**Appendix B: Occupied Channel Bandwidth
Test Result**

Test Mode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	1.047	2401.481	2402.527	---	---
		2440	1.051	2439.481	2440.531	---	---
		2480	1.059	2479.473	2480.531	---	---
BLE_2M	Ant1	2402	2.042	2400.989	2403.031	---	---
		2440	2.042	2438.993	2441.035	---	---
		2480	2.046	2478.989	2481.035	---	---

Test Graphs

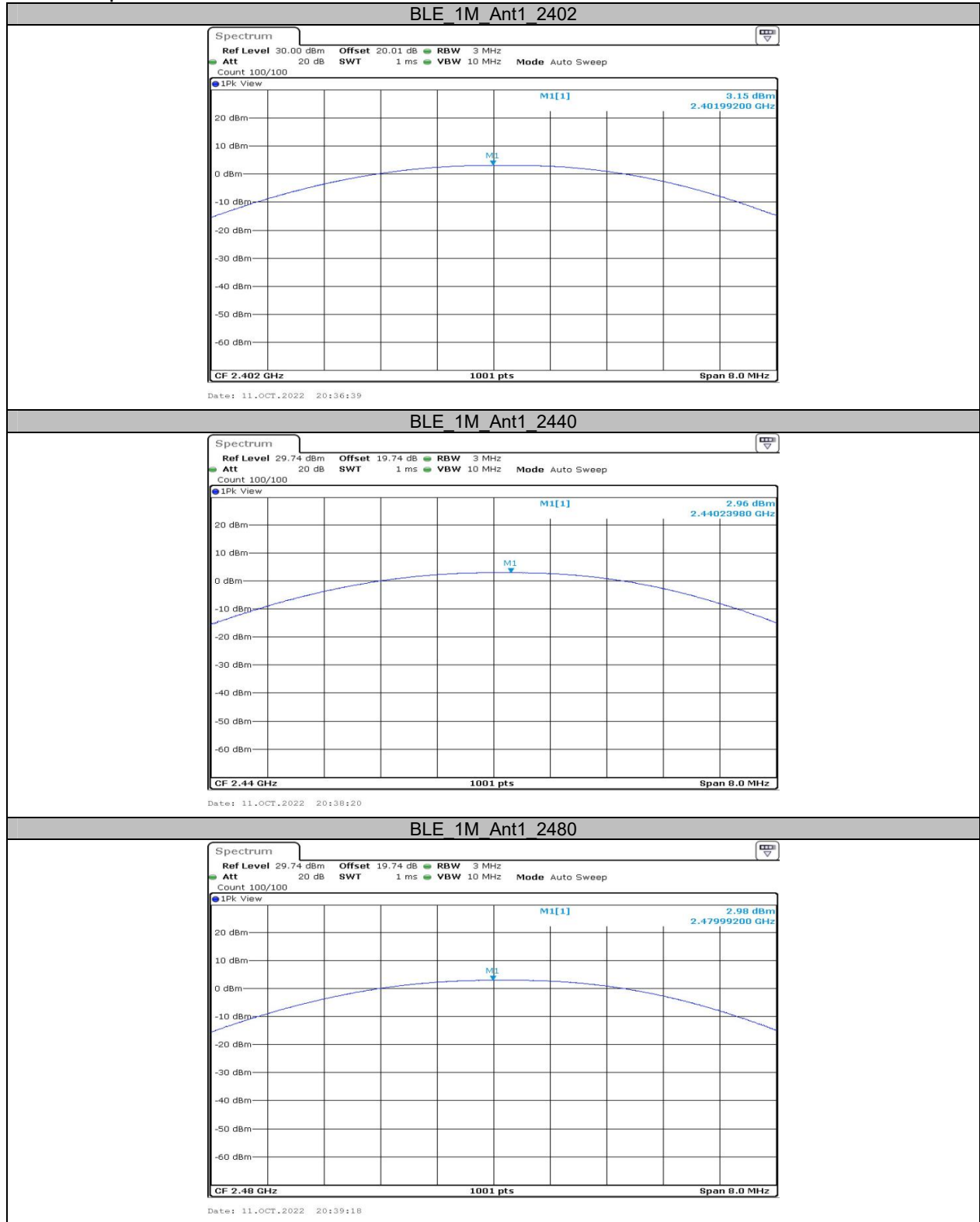




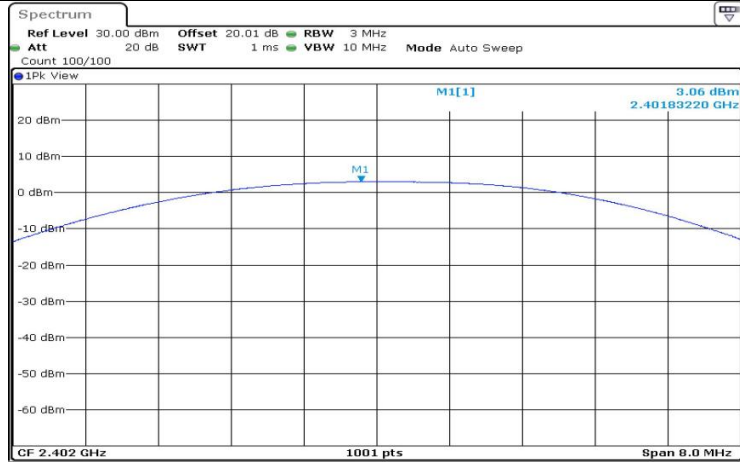
**Appendix C: Maximum output power
Test Result**

Test Mode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	3.15	≤30	PASS
		2440	2.96	≤30	PASS
		2480	2.98	≤30	PASS
BLE_2M	Ant1	2402	3.06	≤30	PASS
		2440	2.86	≤30	PASS
		2480	2.88	≤30	PASS

Test Graphs

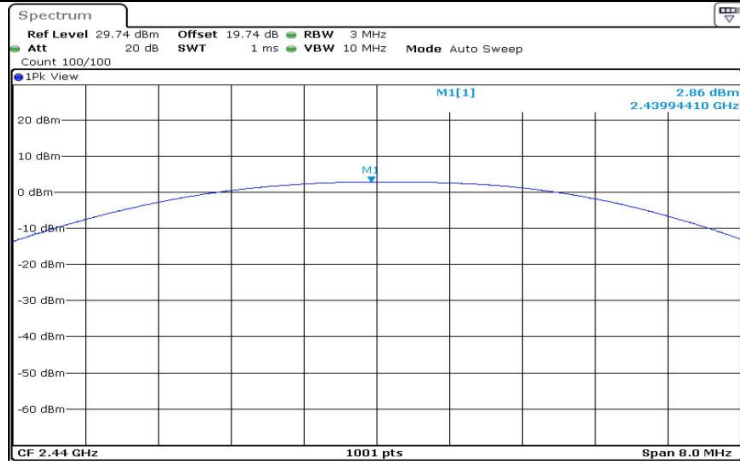


BLE_2M_Ant1_2402



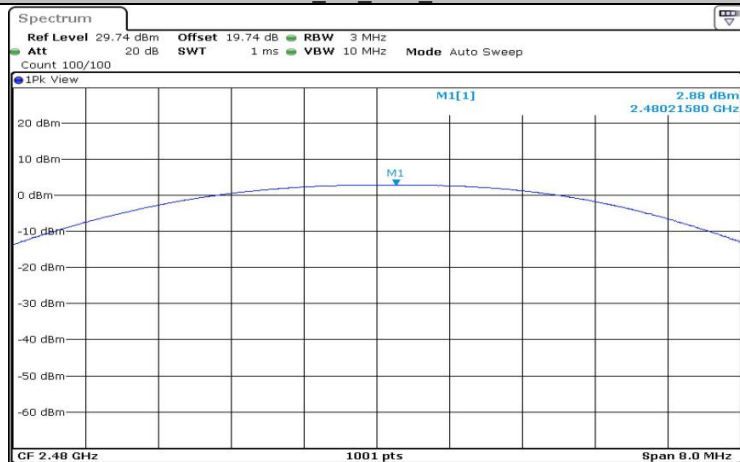
Date: 11.OCT.2022 20:40:36

BLE_2M_Ant1_2440



Date: 11.OCT.2022 20:42:16

BLE_2M_Ant1_2480

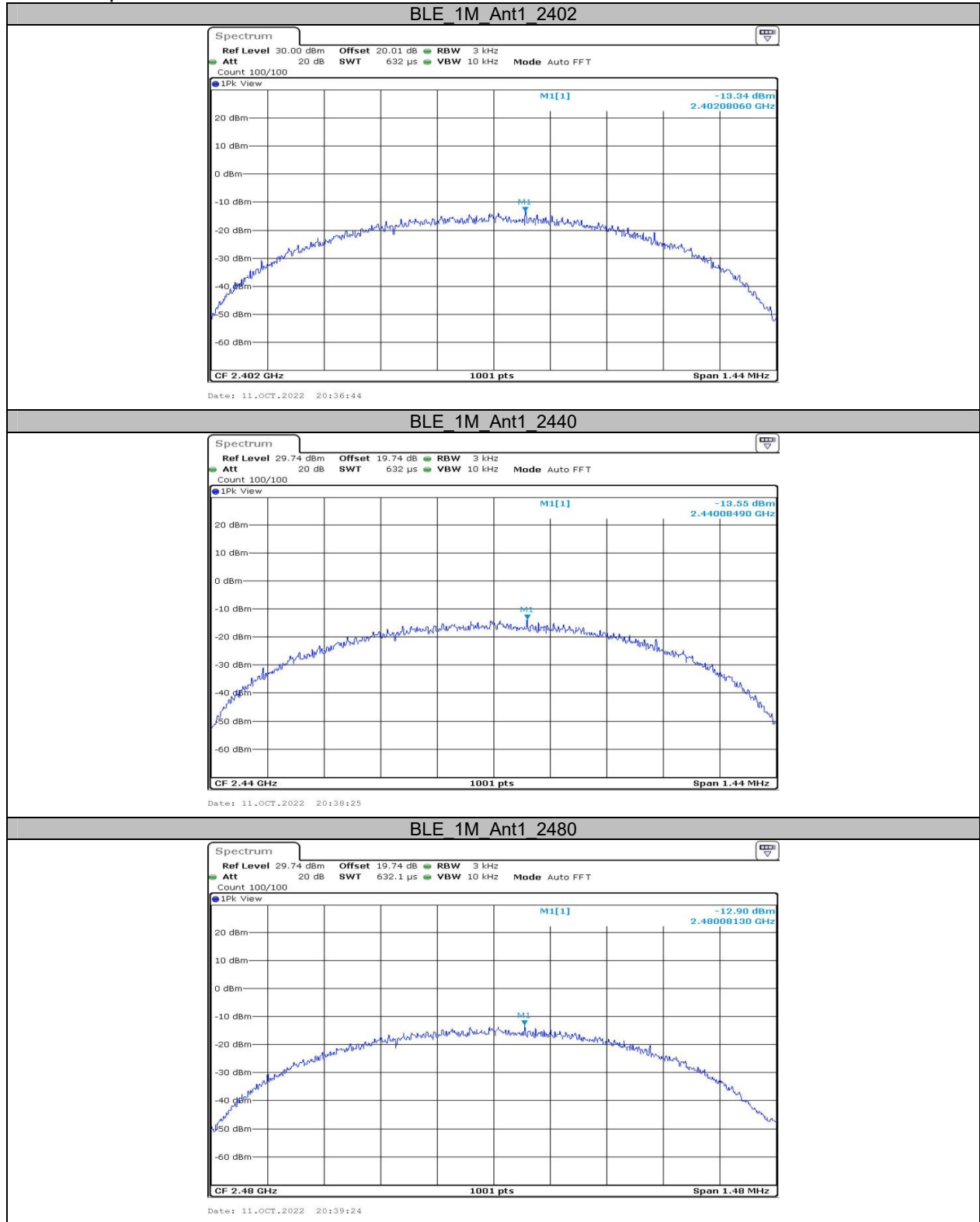


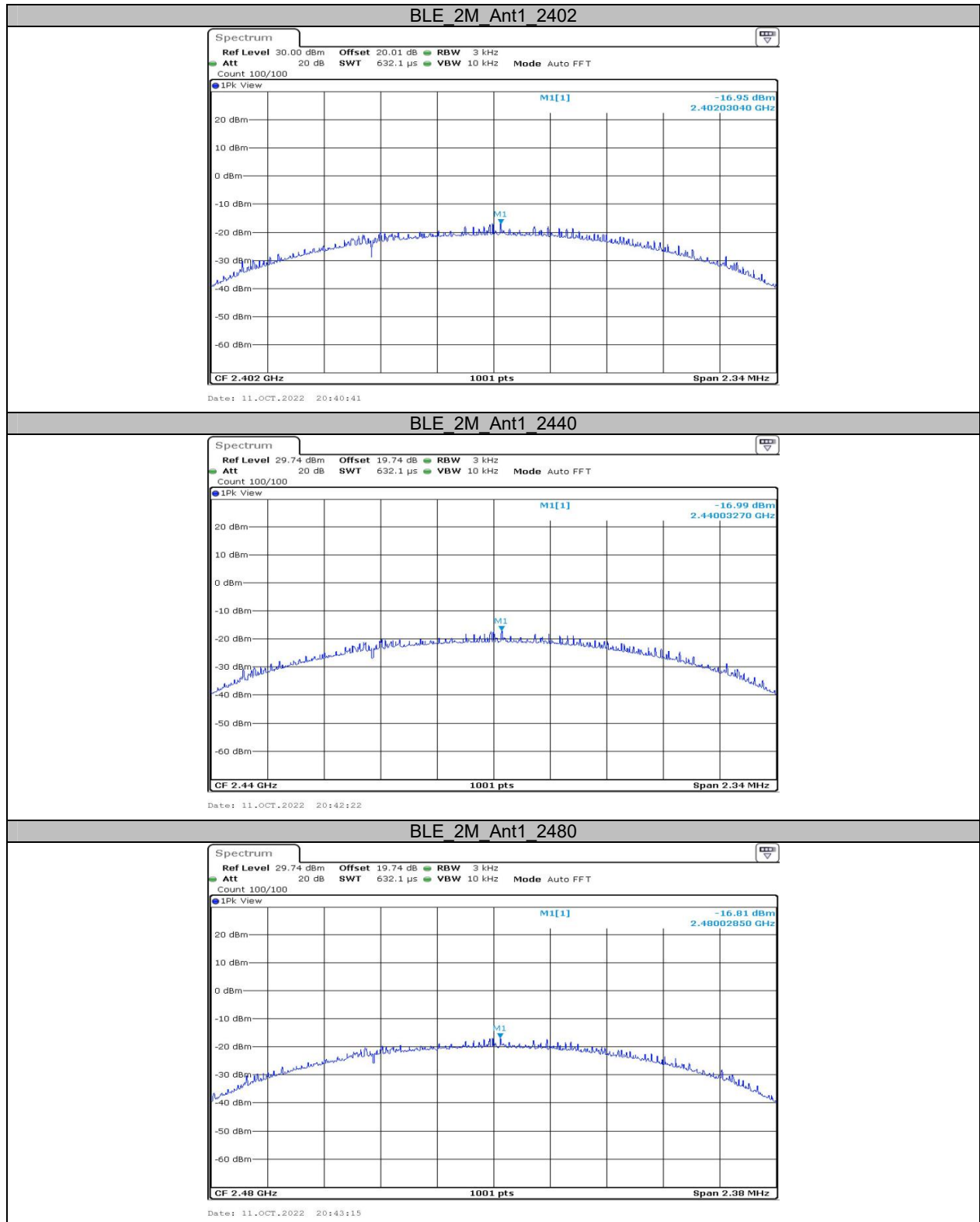
Date: 11.OCT.2022 20:43:09

**Appendix D: Maximum power spectral density
Test Result**

Test Mode	Antenna	Channel	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-13.34	≤8.00	PASS
		2440	-13.55	≤8.00	PASS
		2480	-12.90	≤8.00	PASS
BLE_2M	Ant1	2402	-16.95	≤8.00	PASS
		2440	-16.99	≤8.00	PASS
		2480	-16.81	≤8.00	PASS

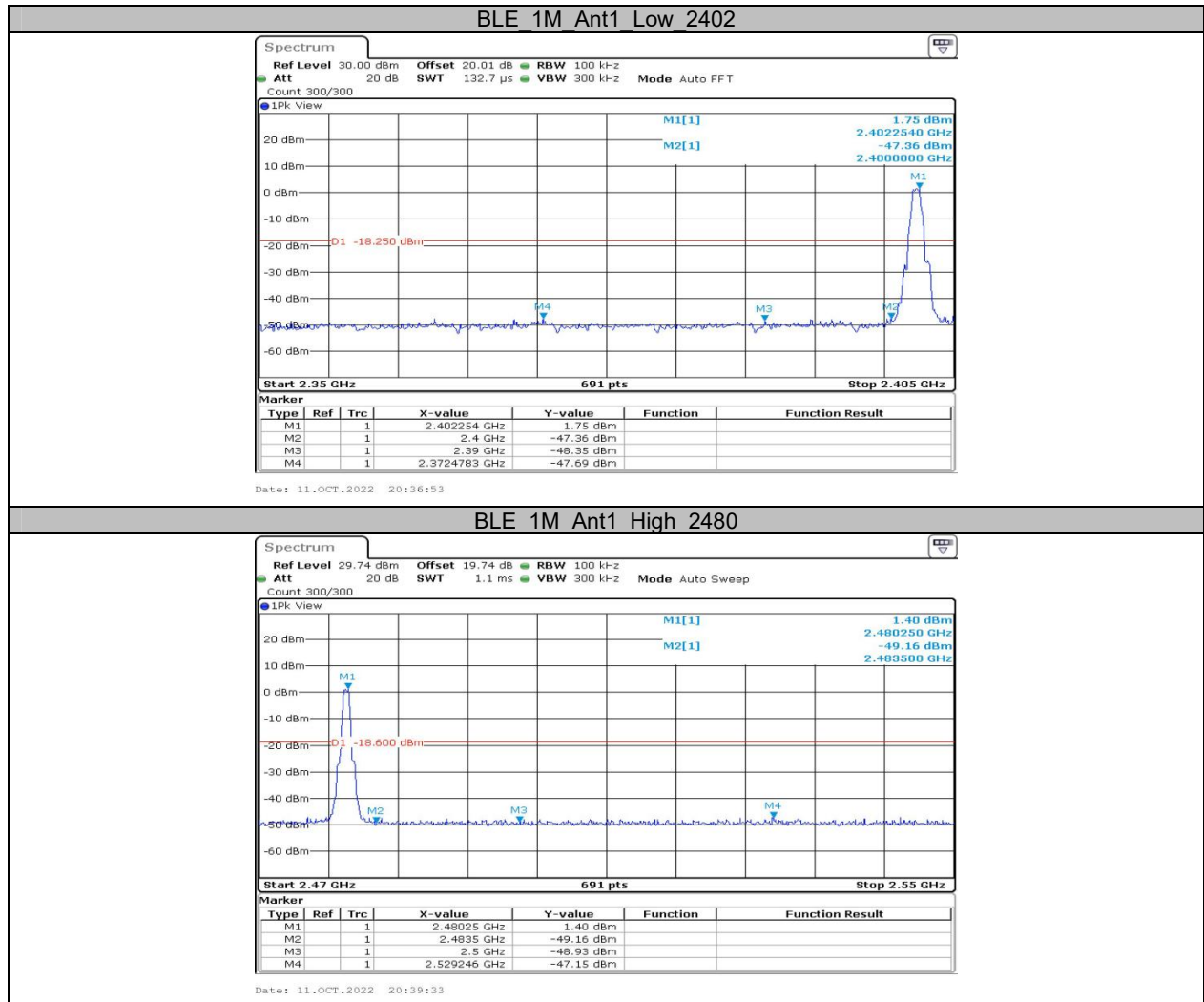
Test Graphs



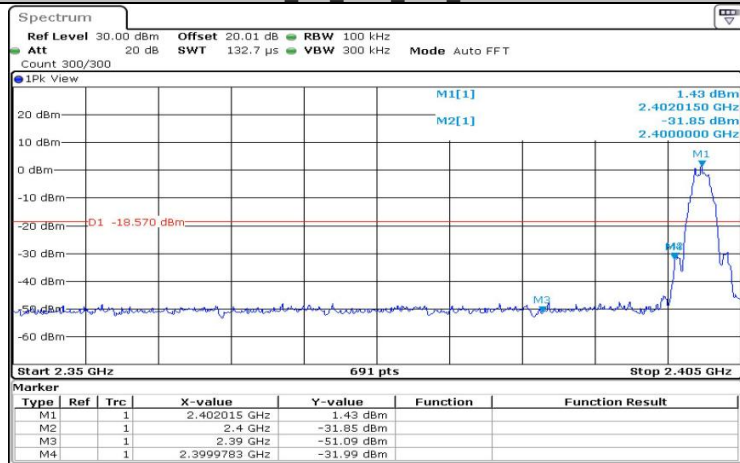


Appendix E: Band edge measurements

Test Graphs

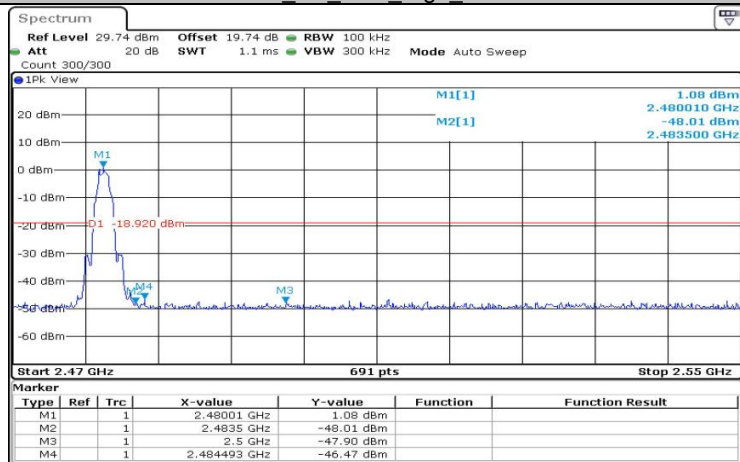


BLE 2M Ant1 Low 2402



Date: 11.OCT.2022 20:40:50

BLE 2M Ant1 High 2480



Date: 11.OCT.2022 20:43:24

Appendix F: Duty Cycle Test Result

Test Mode	Antenna	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
BLE_1M	Ant1	2440	2.13	2.51	84.86
BLE_2M	Ant1	2440	1.07	1.25	85.60

Test Graphs

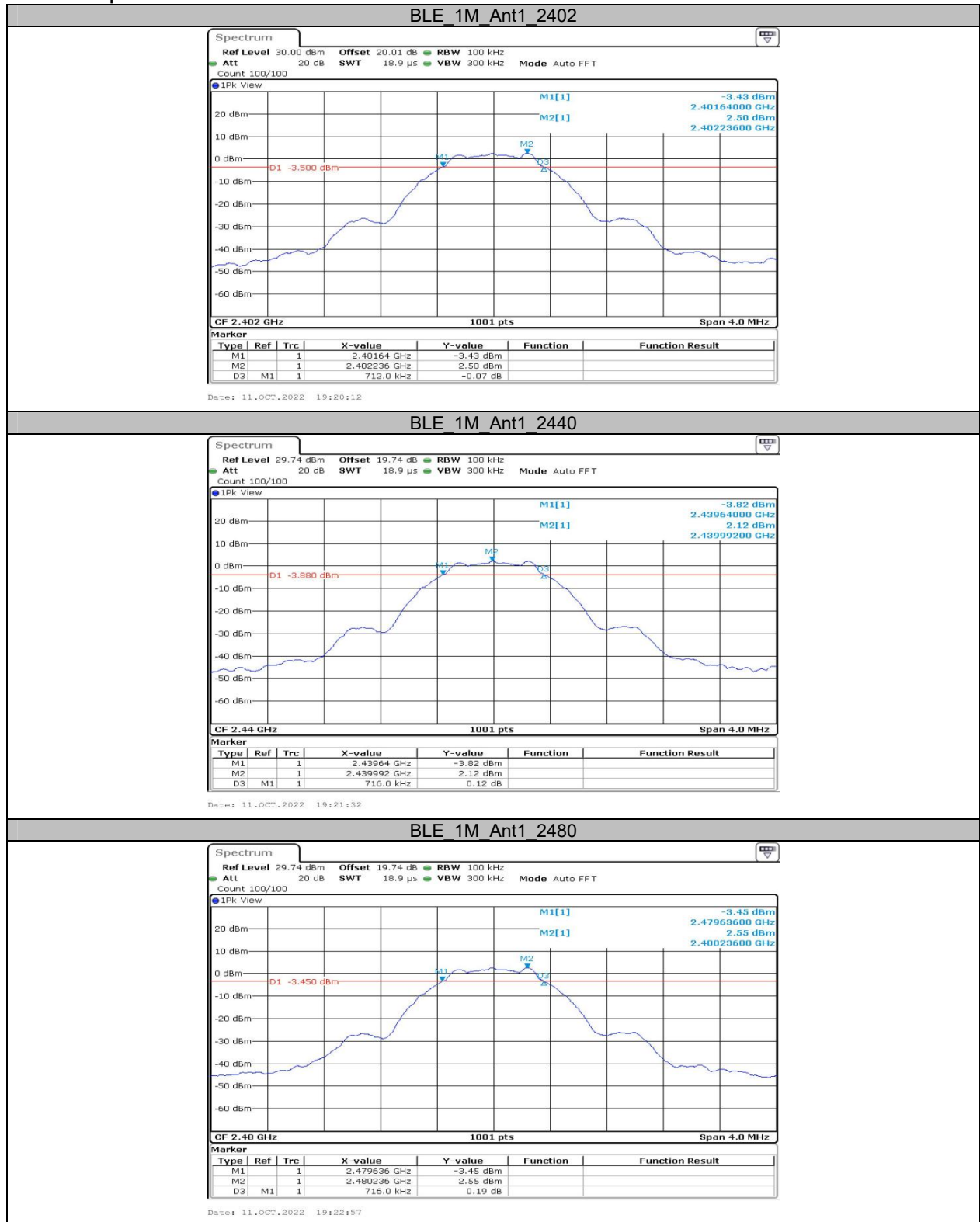


APPENDIX-For Right

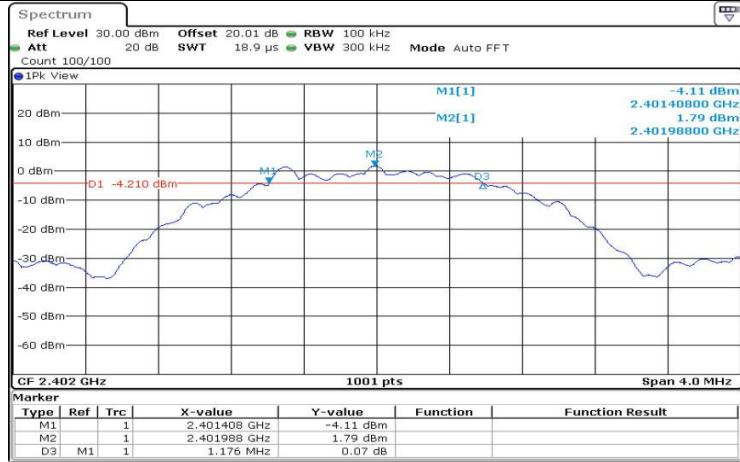
Appendix A: DTS Bandwidth Test Result

Test Mode	Antenna	Channel	DTS BW [MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	0.71	0.5	PASS
		2440	0.72	0.5	PASS
		2480	0.72	0.5	PASS
BLE_2M	Ant1	2402	1.18	0.5	PASS
		2440	1.23	0.5	PASS
		2480	1.18	0.5	PASS

Test Graphs

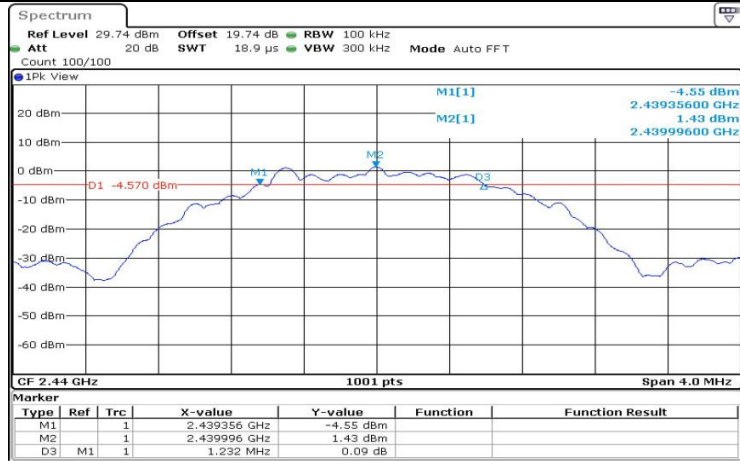


BLE 2M Ant1 2402



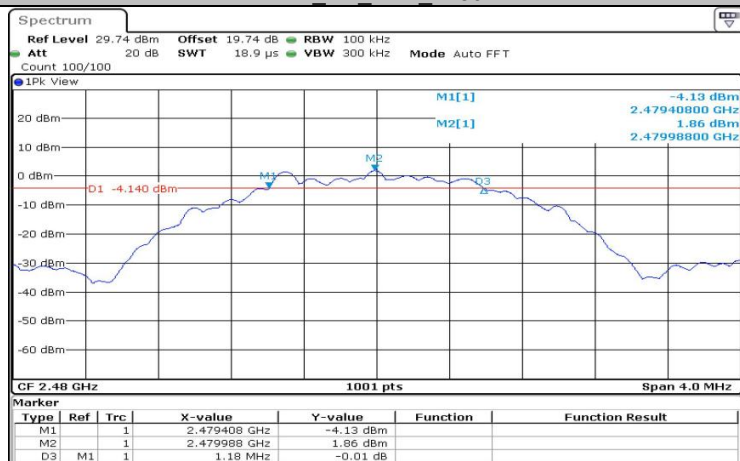
Date: 11.OCT.2022 19:25:56

BLE 2M Ant1 2440



Date: 11.OCT.2022 19:27:25

BLE 2M Ant1 2480

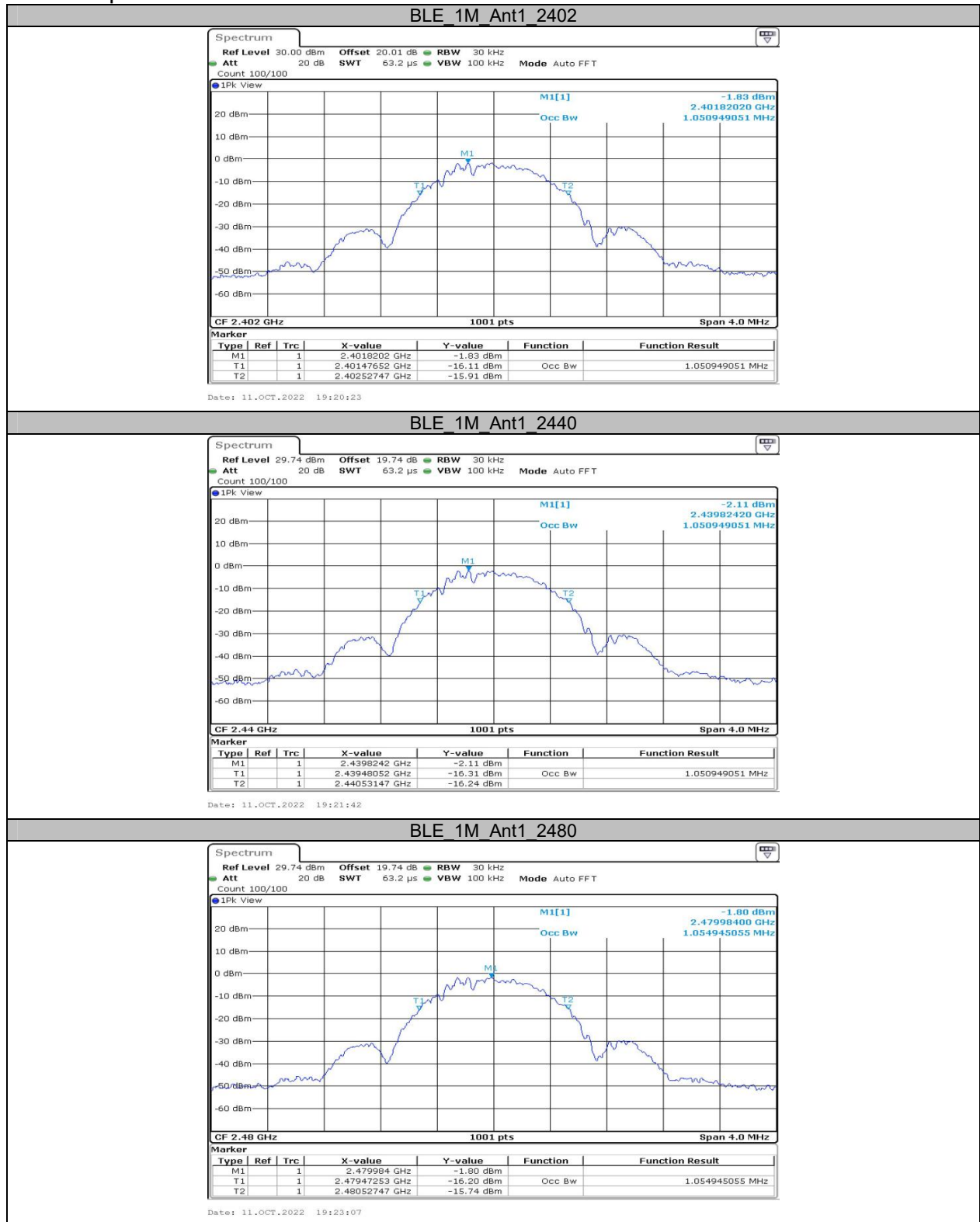


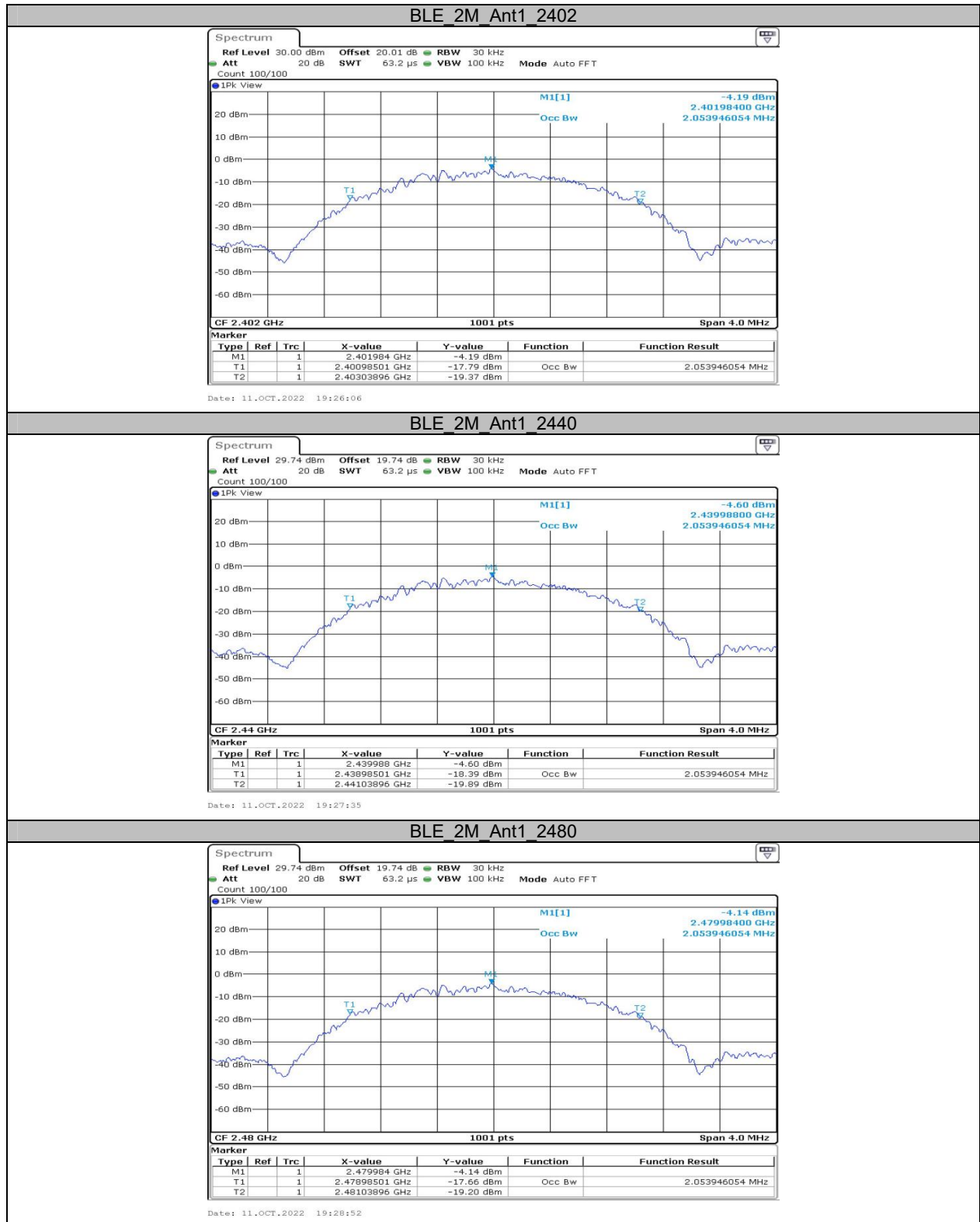
Date: 11.OCT.2022 19:28:41

**Appendix B: Occupied Channel Bandwidth
Test Result**

Test Mode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	1.051	2401.477	2402.527	---	---
		2440	1.051	2439.481	2440.531	---	---
		2480	1.055	2479.473	2480.527	---	---
BLE_2M	Ant1	2402	2.054	2400.985	2403.039	---	---
		2440	2.054	2438.985	2441.039	---	---
		2480	2.054	2478.985	2481.039	---	---

Test Graphs

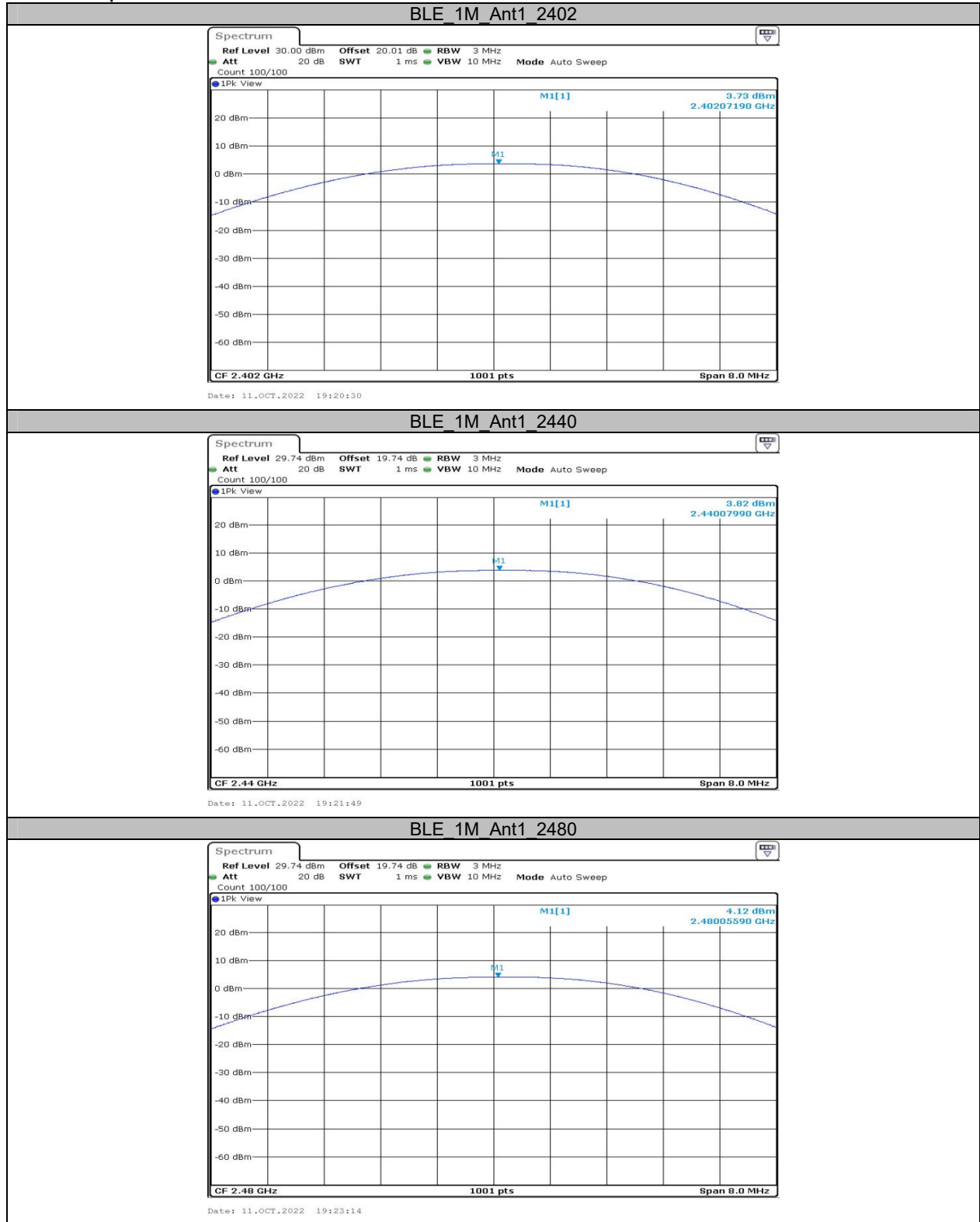


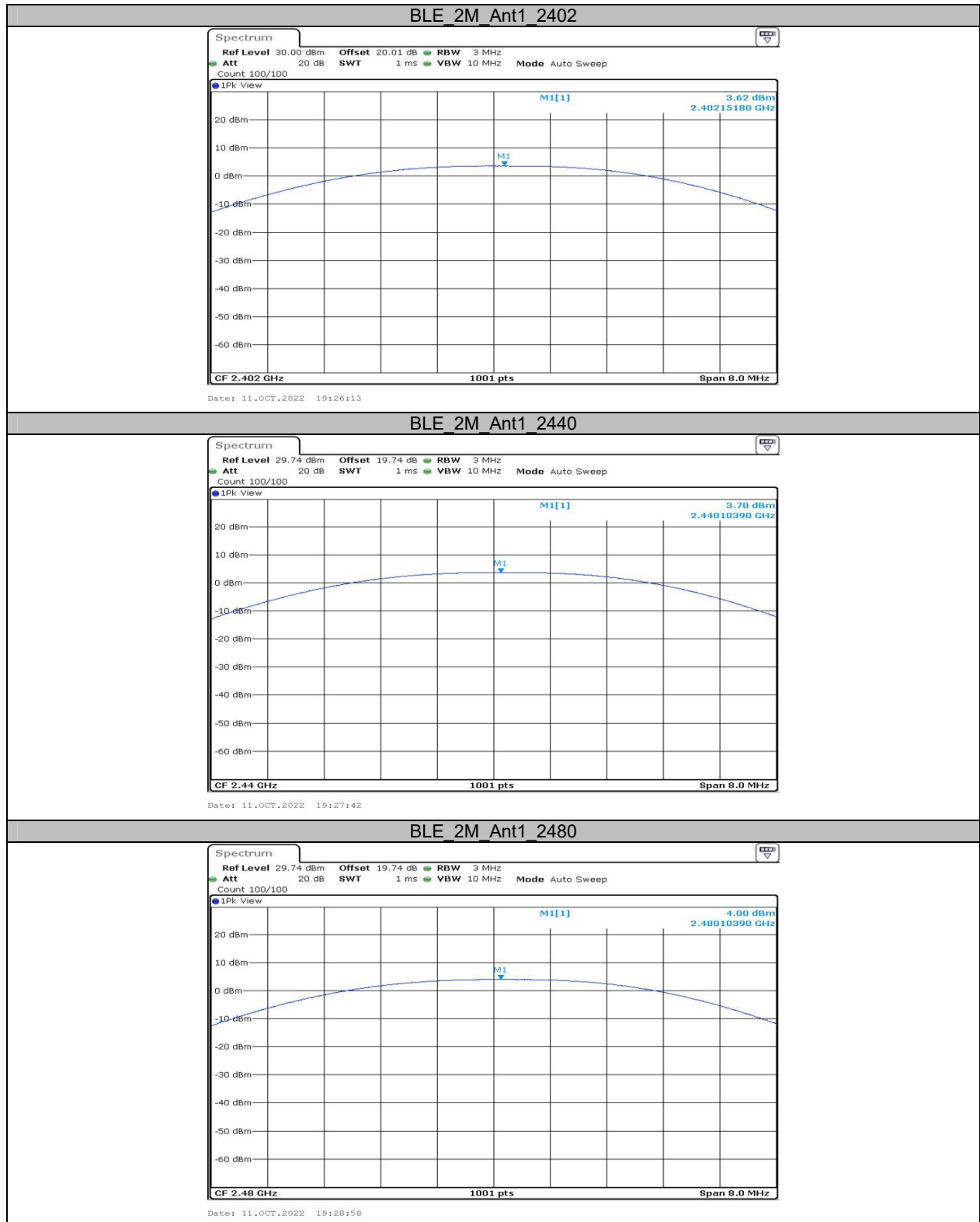


**Appendix C: Maximum output power
Test Result**

Test Mode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	3.73	≤30	PASS
		2440	3.82	≤30	PASS
		2480	4.12	≤30	PASS
BLE_2M	Ant1	2402	3.62	≤30	PASS
		2440	3.70	≤30	PASS
		2480	4.00	≤30	PASS

Test Graphs

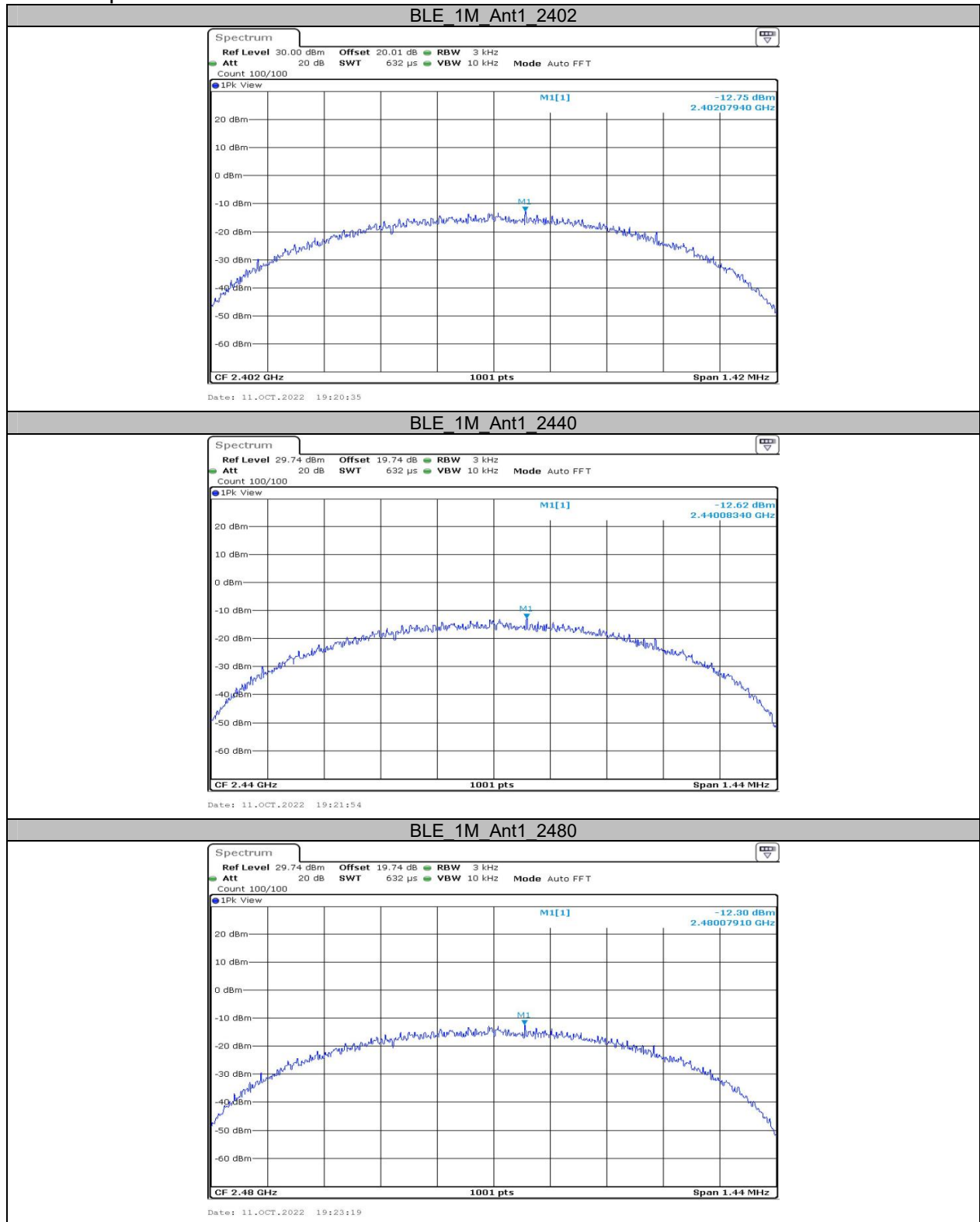


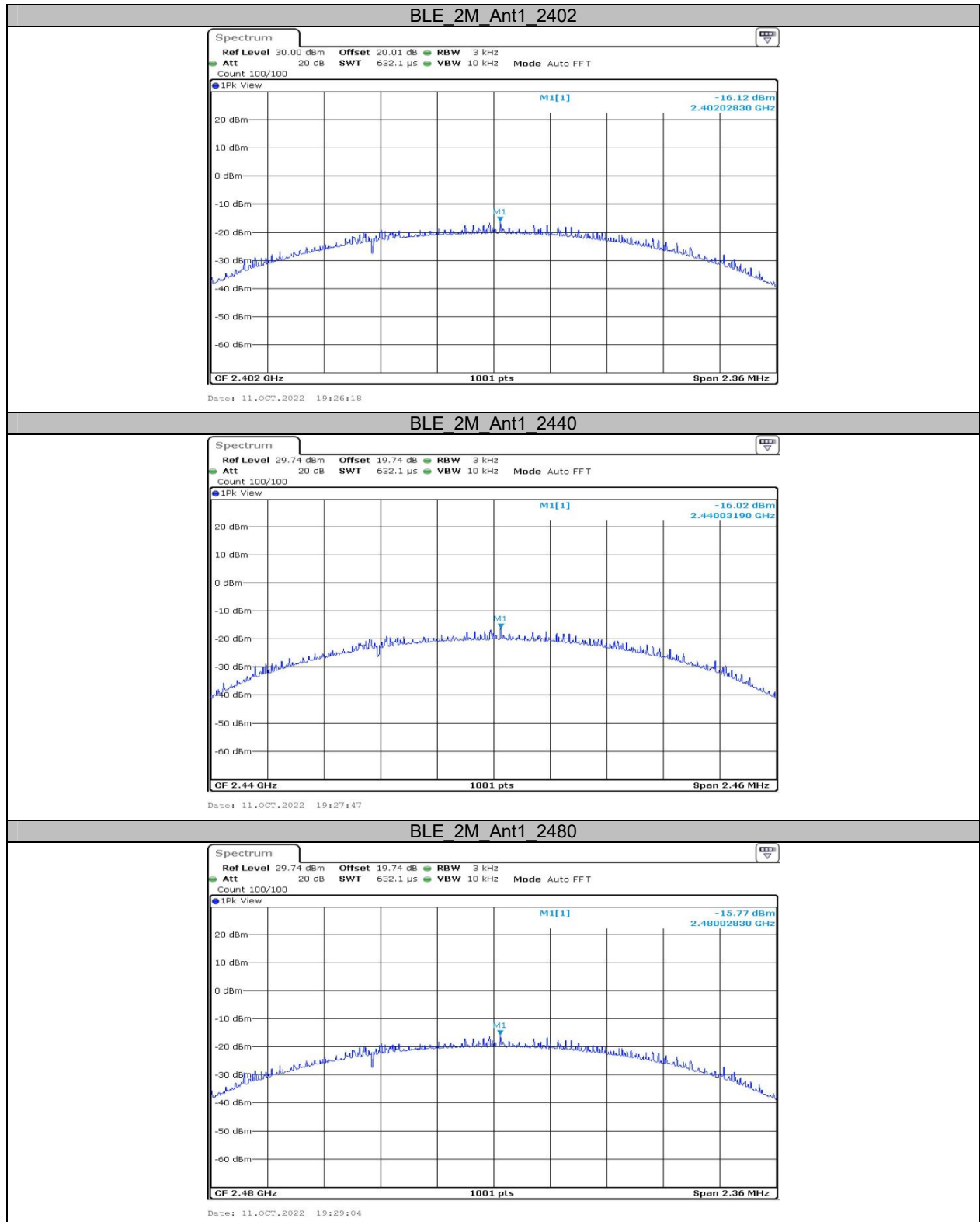


**Appendix D: Maximum power spectral density
Test Result**

Test Mode	Antenna	Channel	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-12.75	≤8.00	PASS
		2440	-12.62	≤8.00	PASS
		2480	-12.30	≤8.00	PASS
BLE_2M	Ant1	2402	-16.12	≤8.00	PASS
		2440	-16.02	≤8.00	PASS
		2480	-15.77	≤8.00	PASS

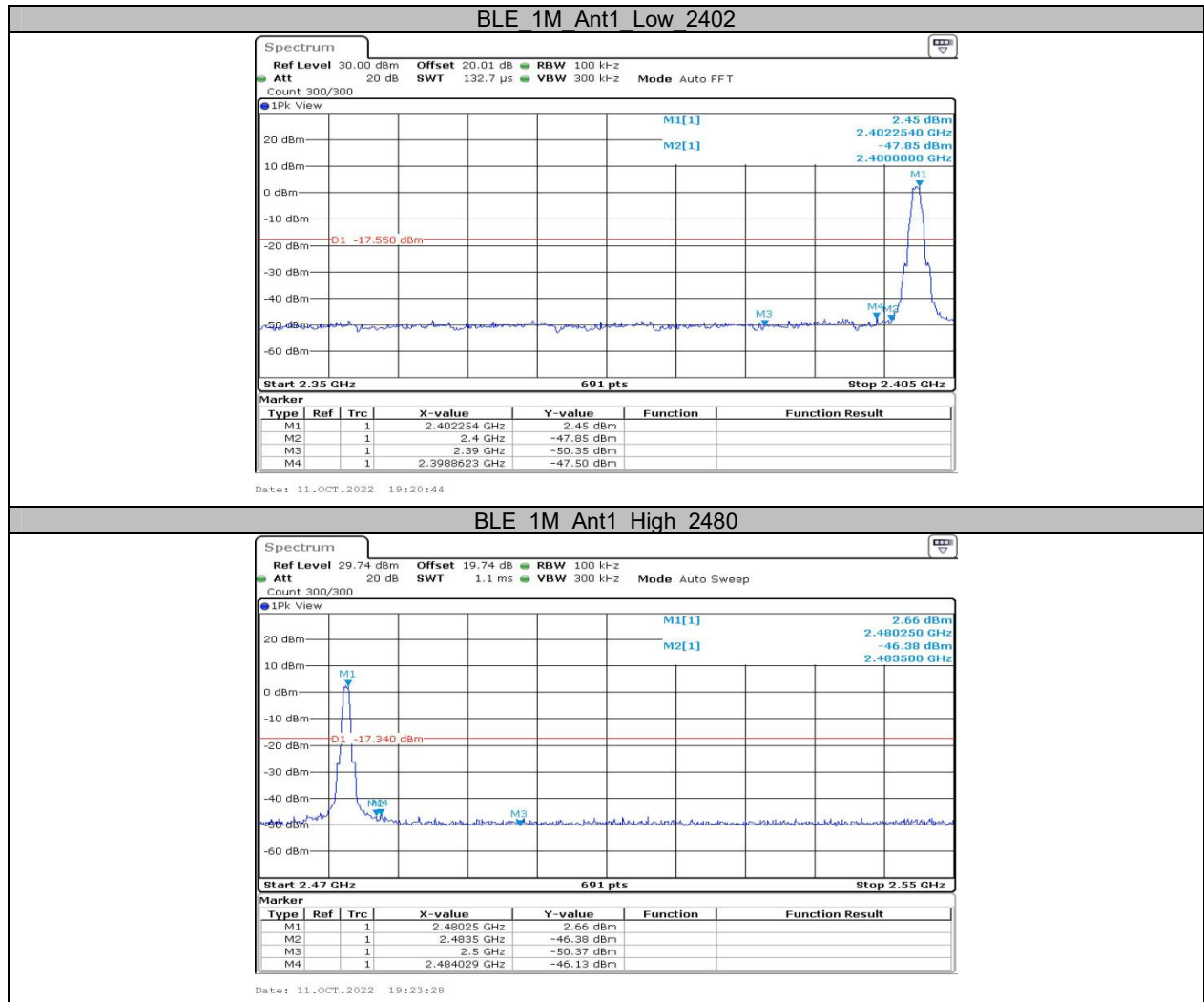
Test Graphs



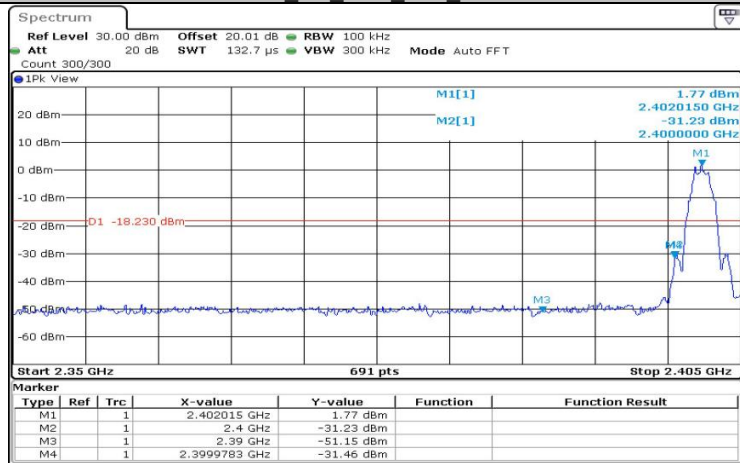


Appendix E: Band edge measurements

Test Graphs

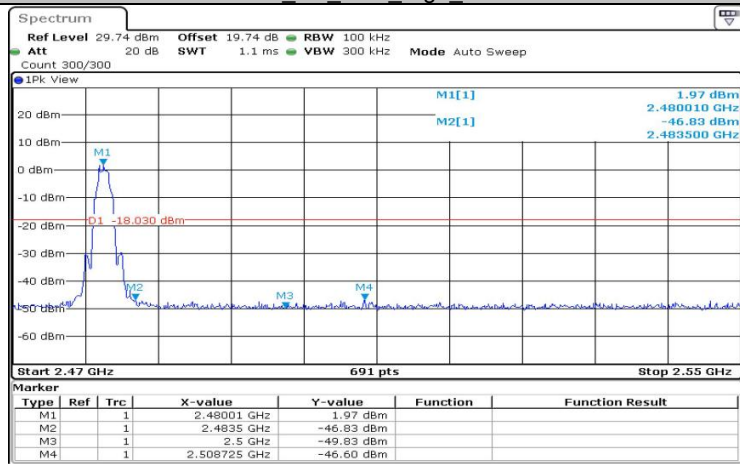


BLE 2M Ant1 Low 2402



Date: 11.OCT.2022 19:26:27

BLE 2M Ant1 High 2480



Date: 11.OCT.2022 19:29:13

Appendix F: Duty Cycle Test Result

Test Mode	Antenna	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
BLE_1M	Ant1	2440	2.13	2.51	84.86
BLE_2M	Ant1	2440	1.07	1.25	85.60

Test Graphs



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