



FCC AND ISED CERTIFICATION TEST REPORT

Applicant	:	Harman International Industries, Inc.
Address of Applicant	:	8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES
Manufacturer	:	Harman International Industries, Inc.
Address of Manufacturer	:	8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES
Equipment under Test	:	BLUETOOTH HEADSET
Model No.	:	ENDURANCE RACE 2
FCC ID	:	APIENDRACE2
Test Standard(s)	:	FCC Rules and Regulations Part 15 Subpart C, RSS-247 Issue 3 August 2023, ANSI C63.10:2013, RSS-Gen Issue 5, Apr. 2018, Amendment 2 (February 2021)
Report No.	:	DDT-RE24022823-2E02
Issue Date	:	2024/05/17
Issue By	:	Guangdong Dongdian Testing Service Co., Ltd. Unit 2, Building 1, No. 17, Zongbu 2nd Road, Songshan Lake Park, Dongguan, Guangdong, China, 523808

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Test Report Declare

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Equipment under Test	:	BLUETOOTH HEADSET
Model No.	:	ENDURANCE RACE 2
Manufacturer	:	Harman International Industries, Inc.
Address of Manufacturer	:	8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES

Test Standard Used:

FCC Rules and Regulations Part 15 Subpart C,
 RSS-247 Issue 3 August 2023,
 ANSI C63.10:2013,
 RSS-Gen Issue 5, Apr. 2018, Amendment 2 (February 2021)

We Declare:

The equipment described above is tested by Guangdong Dongdian Testing Service Co., Ltd. and in the configuration tested the equipment complied with the standards specified above. The test results are contained in this test report and Guangdong Dongdian Testing Service Co., Ltd. is assumed of full responsibility for the accuracy and completeness of these tests.

Report No.:	DDT-RE24022823-2E02		
Date of Receipt:	2024/04/23	Date of Test:	2024/04/23~2024/05/17

Prepared By:

Approved By:

Bobo Chen

Bobo Chen/Engineer

Damon Hu

Damon Hu/EMC Manager

Note: This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Guangdong Dongdian Testing Service Co., Ltd.

Revision History

Rev.	Revisions	Issue Date	Revised By
---	Initial issue	2024/05/17	

1. Summary of Test Results

No.	Test Parameter	Clause No.	Condition	Result
1	6 dB Bandwidth and 99% Bandwidth	FCC Part 15: 15.247(a)(2), RSS-247 Issue 3 clause 5.2(a), RSS-Gen Issue 5 clause 6.7	/	Pass
2	Peak Output Power	FCC Part 15: 15.247(b)(3), RSS-247 Issue 3 clause 5.4(d)	/	Pass
3	Power Spectral Density	FCC Part 15:15.247(e), RSS-247 Issue 3 clause 5.2(b)	/	Pass
4	RF Conducted Spurious Emissions	FCC Part 15: 15.247(d), RSS-247 Issue 3 clause 5.5	/	Pass
5	Radiated Emission	FCC Part 15: 15.205, FCC Part 15: 15.209, FCC Part 15: 15.247(d), RSS-247 Issue 3 clause 5.5, RSS-Gen Issue 5 clause 8.9, RSS-Gen Issue 5 clause 8.10	/	Pass
6	Band Edge Compliance	FCC Part 15: 15.205, FCC Part 15: 15.209, FCC Part 15: 15.247(d), RSS-247 Issue 3 clause 5.5, RSS-Gen Issue 5 clause 8.9, RSS-Gen Issue 5 clause 8.10	/	Pass
7	Antenna Requirement	FCC Part 15: 15.203, RSS-Gen Issue 5 clause 6.8	/	Pass
8	Power Line Conducted Emissions	FCC Part 15: 15.207(a), RSS-Gen Issue 5 clause 8.8	/	Pass
<p>Note: N/A is an abbreviation for Not Applicable, and means this item is not applicable for this device or no need to test according to standard.</p>				

2. General Test Information

2.1. Description of EUT

EUT Name	: BLUETOOTH HEADSET
Model Number	: ENDURANCE RACE 2
EUT Function Description	: Please reference user manual of this device
Power Supply	: CHARGING CASE: DC 5V from USB cable EARBUDS: DC 5V from external charging case CHARGING CASE: DC 3.85V Polymer Li-ion built-in battery EARBUDS: DC 3.85V Polymer Li-ion built-in battery

Note: This EUT support Bluetooth BR/EDR/LE, this report only for Bluetooth LE.

Radio Specification	: Bluetooth LE
Operation Frequency	: 2402 MHz-2480 MHz
Modulation	: GFSK

Antenna information	
Antenna Type	: FPC
Left side Max Antenna Gain(dBi)	: -1.02
Right side Max Antenna Gain(dBi)	: -0.85

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

3	2408	17	2436	31	2464
4	2410	18	2438	32	2466
5	2412	19	2440	33	2468
6	2414	20	2442	34	2470
7	2416	21	2444	35	2472
8	2418	22	2446	36	2474
9	2420	23	2448	37	2476
10	2422	24	2450	38	2478
11	2424	25	2452	39	2480
12	2426	26	2454		
13	2428	27	2456		

The channels denoted with the grey background are excluded, because they are primary advertising channel only for the Bluetooth LE 1Mbps according to the Bluetooth Core Specification.

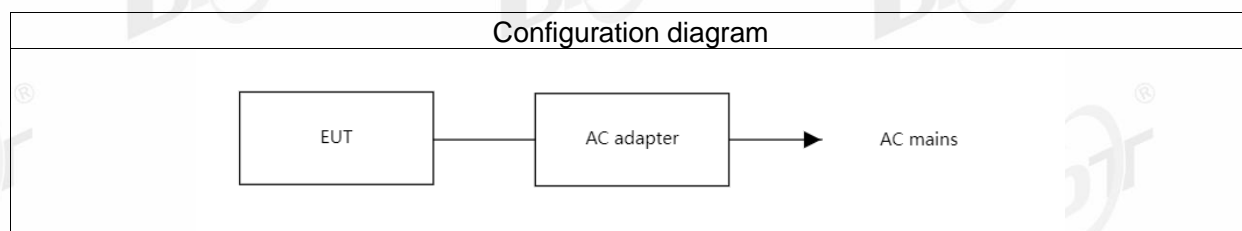
Note: The above EUT information is declared by manufacturer and for more detailed features description please refer to the manufacturer's specifications or User's Manual. The above Antenna information is declared by manufacturer and for more detailed features description please refer to the manufacturer's specifications, the laboratory shall not be held responsible.

“☑” means to be chosen or applicable; “☐” means don't to be chosen or not applicable; This note applies to entire report.

2.2. Accessories of EUT

Accessories	Manufacturer	Model number	Description
USB cable	/	/	Length: 0.2m; Unshielded

2.3. Block diagram of EUT configuration for test



2.4. Decision of final test mode

According pre-test, the worst test modes were reported as below:

Test software: Airoha.Tool.Kit.exe

The test software was used to control EUT work in Continuous Tx mode, and select test channel, wireless mode as below table:

The pathloss of external cable: 0.5dB (According to the manufacturer's claims)

Tested mode, channel, information			
Mode	Setting Tx Power	Channel	Frequency (MHz)
GFSK 1M	Default	CH0	2402
	Default	CH19	2440
	Default	CH39	2480
GFSK 2M	Default	CH1	2404
	Default	CH19	2440
	Default	CH38	2478

2.5. Deviations of test standard

No deviation.

2.6. Test environment conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature range:	+15°C to +35 °C
Humidity range:	20% to 75%
Pressure range:	86 kPa to106 kPa

Note: The specific temperature and humidity information of each test item refers to the temperature and humidity record in the corresponding test data.

2.7. Test laboratory

Guangdong Dongdian Testing Service Co., Ltd.

Add.: Unit 2, Building 1, No. 17, Zongbu 2nd Road, Songshan Lake Park, Dongguan, Guangdong, China, 523808.

Tel.: +86-0769-38826678, <http://www.dgddt.com>, Email: ddt@dgddt.com.

CNAS Accreditation No. L6451; A2LA Accreditation Number: 3870.01

FCC Designation Number: CN1182, Test Firm Registration Number: 540522

Innovation, Science and Economic Development Canada Site Registration Number: 10288A

Conformity Assessment Body identifier: CN0048

VCCI facility registration number: C-20087, T-20088, R-20123, R-20155, G-20118

2.8. Measurement uncertainty

Test Item	Uncertainty
Bandwidth	1.1%
Peak Output Power (Conducted) (Spectrum analyzer)	0.86 dB (10 MHz ≤ f < 3.6 GHz);
	1.38 dB (3.6 GHz ≤ f < 8 GHz)
Peak Output Power (Conducted) (Power Sensor)	0.74 dB
Power Spectral Density	0.74 dB (10 MHz ≤ f < 3.6 GHz);
	1.38 dB (3.6 GHz ≤ f < 8 GHz)
Frequencies Stability	6.7 x 10 ⁻⁸ (Antenna couple method)
	5.5 x 10 ⁻⁸ (Conducted method)
Conducted spurious emissions	0.86 dB (10 MHz ≤ f < 3.6 GHz);
	1.40 dB (3.6 GHz ≤ f < 8 GHz)
	1.66 dB (8 GHz ≤ f < 26.5 GHz)
Uncertainty for radio frequency (RBW < 20 kHz)	3×10 ⁻⁸
Temperature	0.4 °C
Humidity	2 %
Uncertainty for Radiation Emission test (9 kHz – 30 MHz)	3.44 dB
Uncertainty for Radiation Emission test (30 MHz - 1 GHz)	4.70 dB (Antenna Polarize: V)
	4.84 dB (Antenna Polarize: H)
Uncertainty for Radiation Emission test (1 GHz - 40 GHz)	4.10 dB (1 - 6 GHz)
	4.40 dB (6 GHz - 18 GHz)
	3.54 dB (18 GHz - 26 GHz)
	4.30 dB (26 GHz - 40 GHz)
Uncertainty for Power line conduction emission test	3.34dB (150KHz-30MHz)
	3.72dB (9KHz-150KHz)

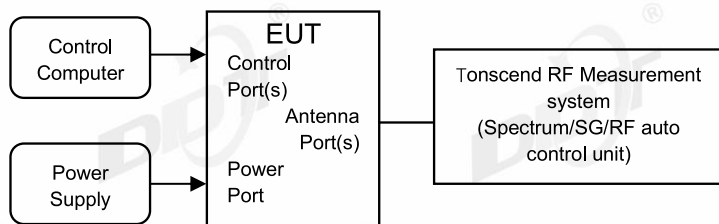
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3. Equipment Used During Conductive Test

Equipment	Manufacturer	Model No.	Serial Number	Due Date
<input checked="" type="checkbox"/> RF Connected Test (RF Measurement System 1#)				
SIGNAL ANALYZER	R&S	FSQ26	101272	2025/03/31
Wideband Radio Communication Tester	R&S	CMW500	120259	2024/07/14
MXG Vector Signal Generator	KEYSIGHT	N5182B	MY59100192	2025/03/31
MXG Vector Signal Generator	Agilent	N5182A	MY19060405	2025/03/31
RF Control Unit	Tonsend	JS0806-2	158060010	2025/03/31
TEMP&HUMI Programmable Chamber	ZHIXIANG	ZXGDJS-150L	ZX170110-A	2025/04/22
Test Software	Tonscend	JS1120-3	Ver.3.2.22	N/A

4. 6 dB Bandwidth

4.1. Block diagram of test setup



4.2. Limits

For direct sequence systems, the minimum 6 dB bandwidth shall be at least 500 kHz

4.3. Test procedure

- (1) The test according to ANSI C63.10-2013 clause 11.8.
- (2) Connect EUT's antenna output to spectrum analyzer by RF cable, the path loss was compensated to the results
- (3) Set the EUT as maximum power setting and enable the EUT transmit continuously
- (4) Use the following spectrum analyzer settings for 6 dB Bandwidth:

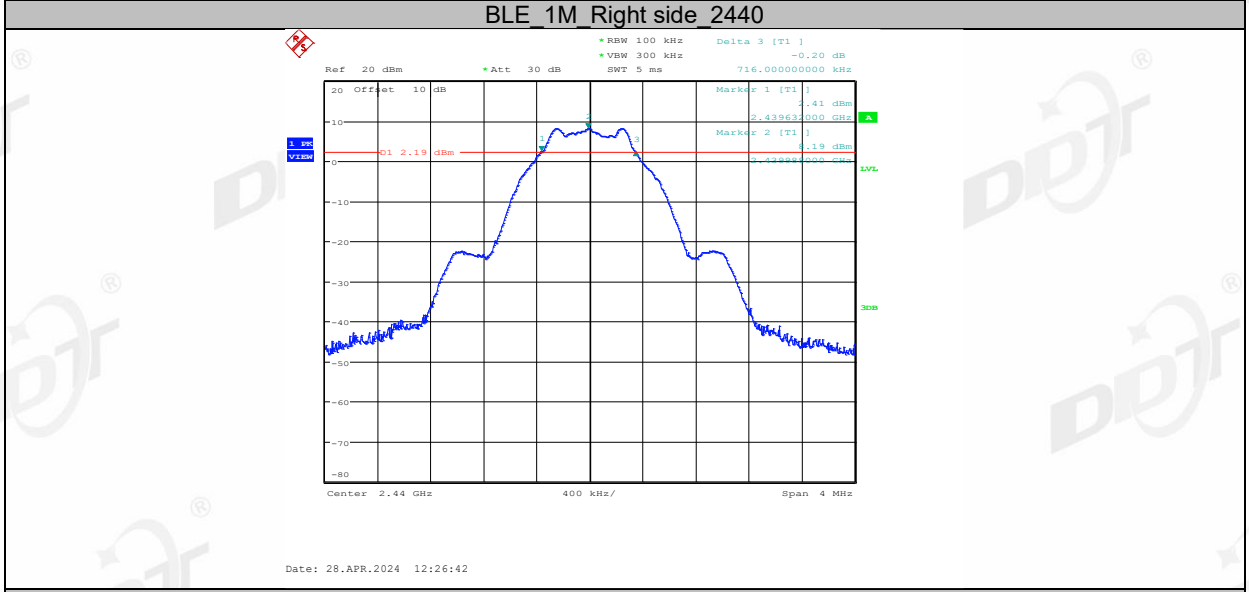
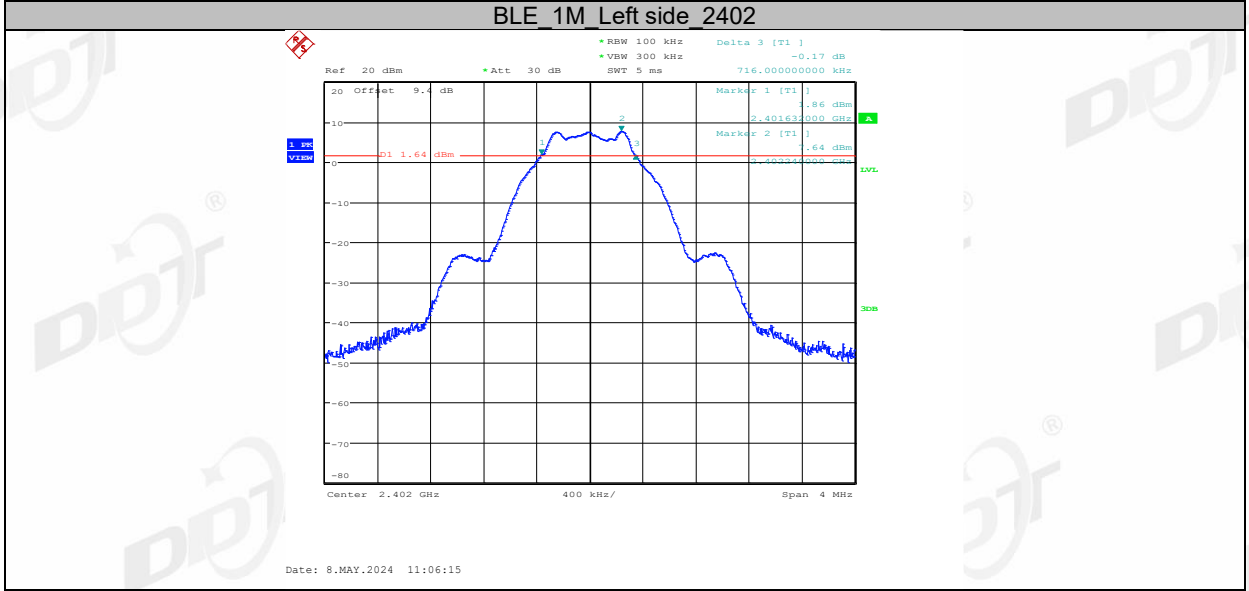
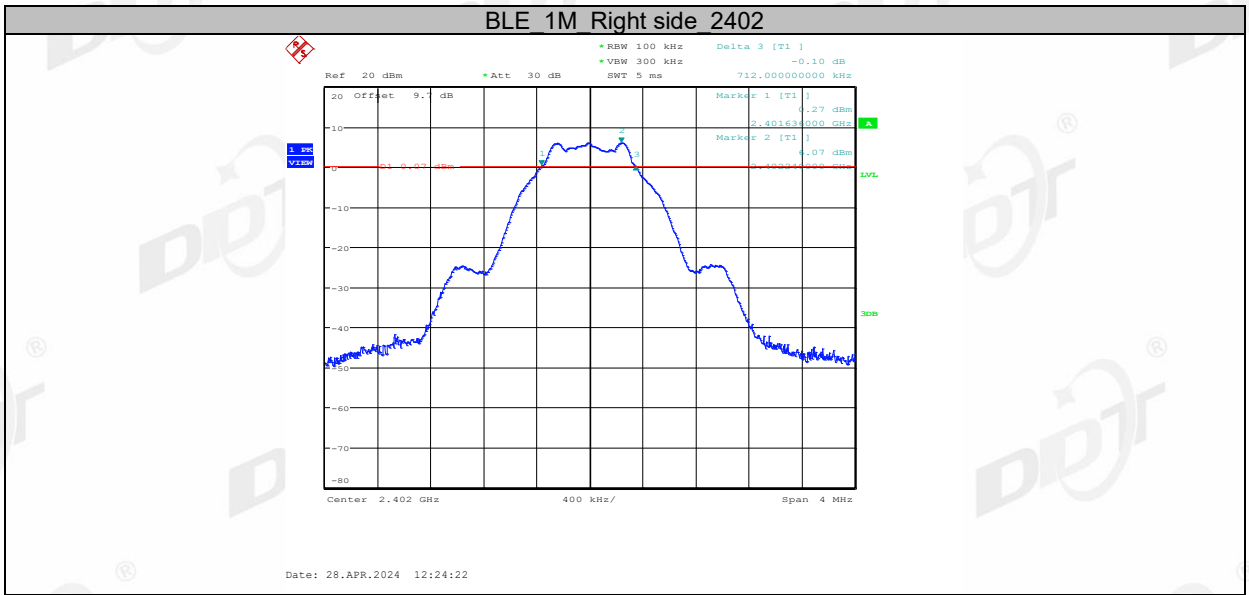
RBW:	100 kHz
VBW:	$\geq [3 \times \text{RBW}]$
Detector Mode:	Peak
Sweep time:	Auto
Trace mode	Max hold
- (5) Allow the trace to stabilize, measure the 6 dB bandwidth of signal, and record the results in the report.

4.4. Test result

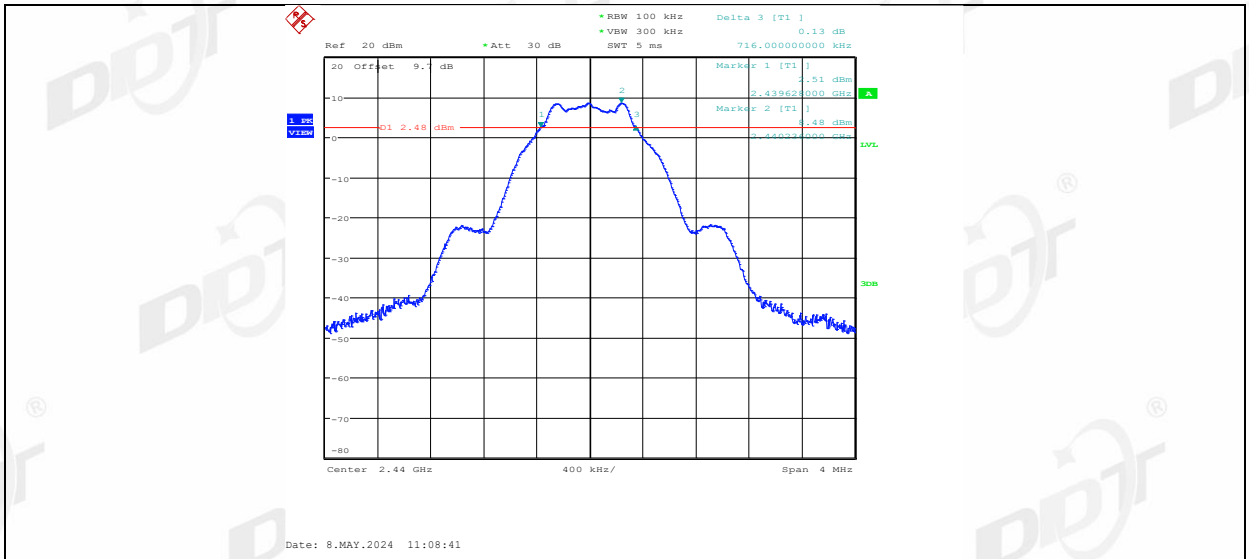
Test Engineer:	Zora Zhang	Test Site:	RF Measurement System 1#
Ambient Condition:	24.4°C,59.7%RH	Test Date:	2024.04.28-2024.05.08
Test Power Supply:	Battery	Sample Number:	S24022823-014

Test Mode	Antenna	Frequency [MHz]	DTS BW [MHz]	FL [MHz]	FH [MHz]	Limit [MHz]	Verdict
BLE_1M	Right side	2402	0.71	2401.64	2402.35	0.5	PASS
	Left side	2402	0.72	2401.63	2402.35	0.5	PASS
	Right side	2440	0.72	2439.63	2440.35	0.5	PASS
	Left side	2440	0.72	2439.63	2440.34	0.5	PASS
	Right side	2480	0.70	2479.64	2480.34	0.5	PASS
	Left side	2480	0.71	2479.64	2480.34	0.5	PASS
BLE_2M	Right side	2404	1.25	2403.34	2404.59	0.5	PASS
	Left side	2404	1.25	2403.34	2404.59	0.5	PASS
	Right side	2440	1.25	2439.33	2440.58	0.5	PASS
	Left side	2440	1.25	2439.34	2440.59	0.5	PASS
	Right side	2478	1.25	2477.34	2478.59	0.5	PASS
	Left side	2478	1.24	2477.35	2478.59	0.5	PASS

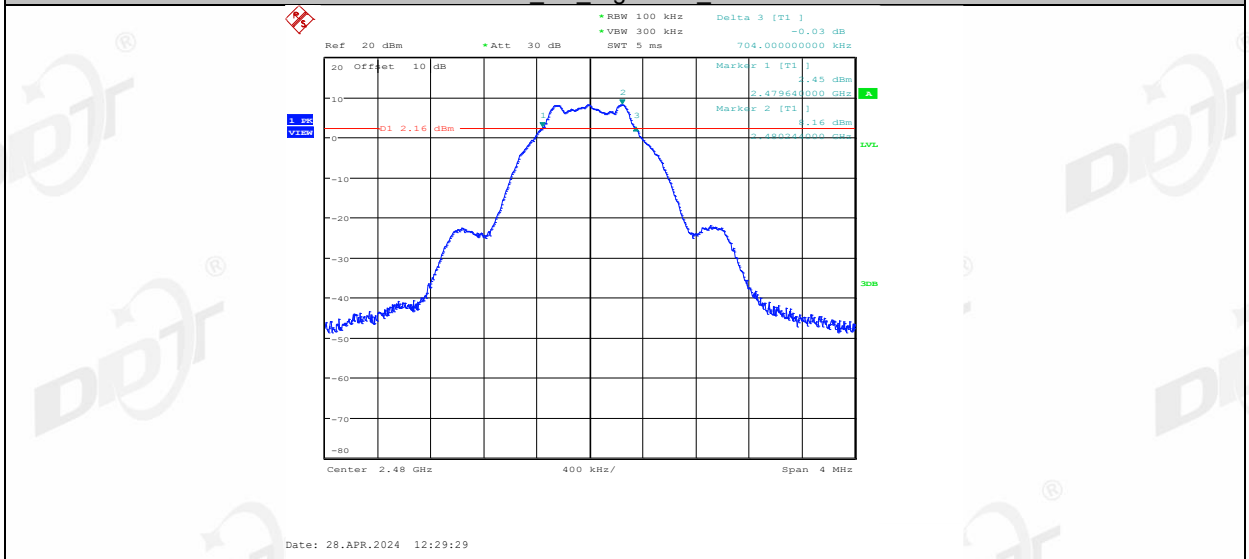
4.5. Test graphs



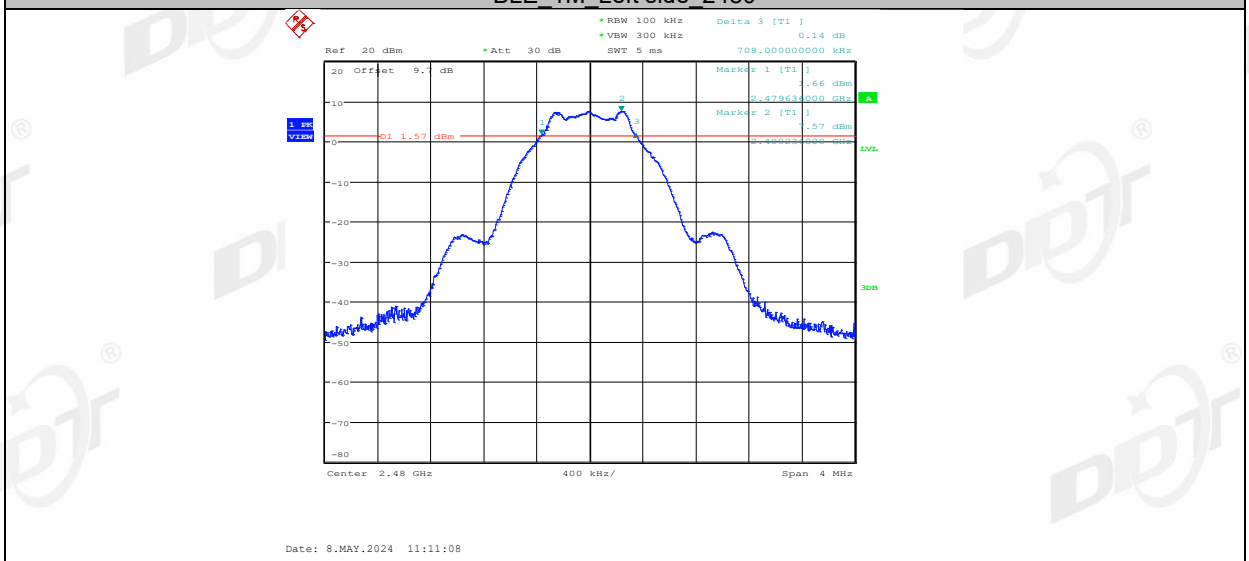
BLE 1M Left side 2440



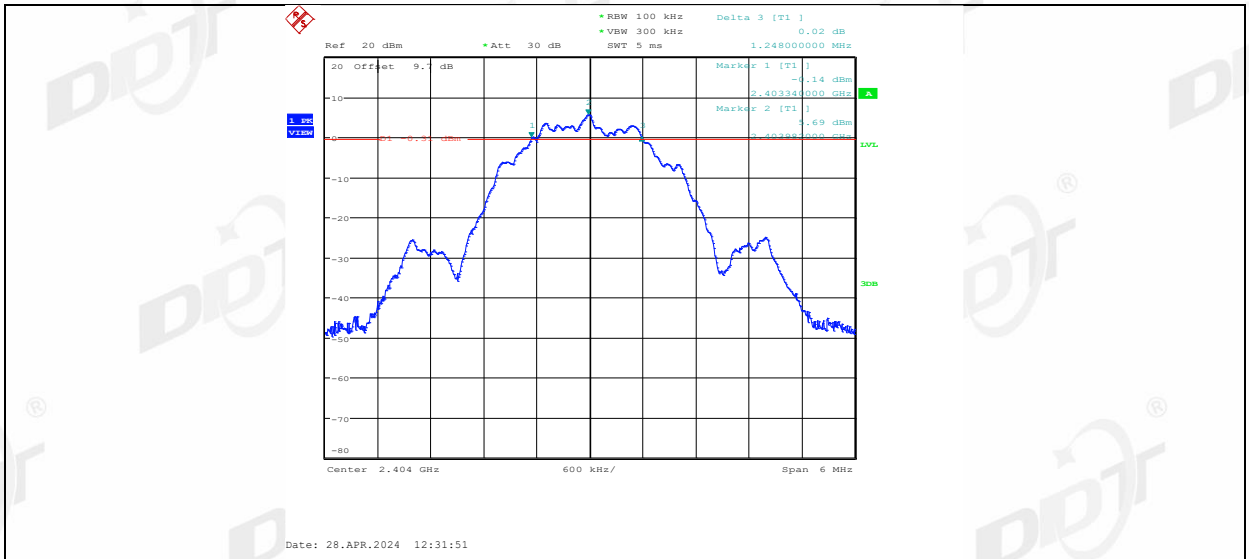
BLE_1M Right side 2480



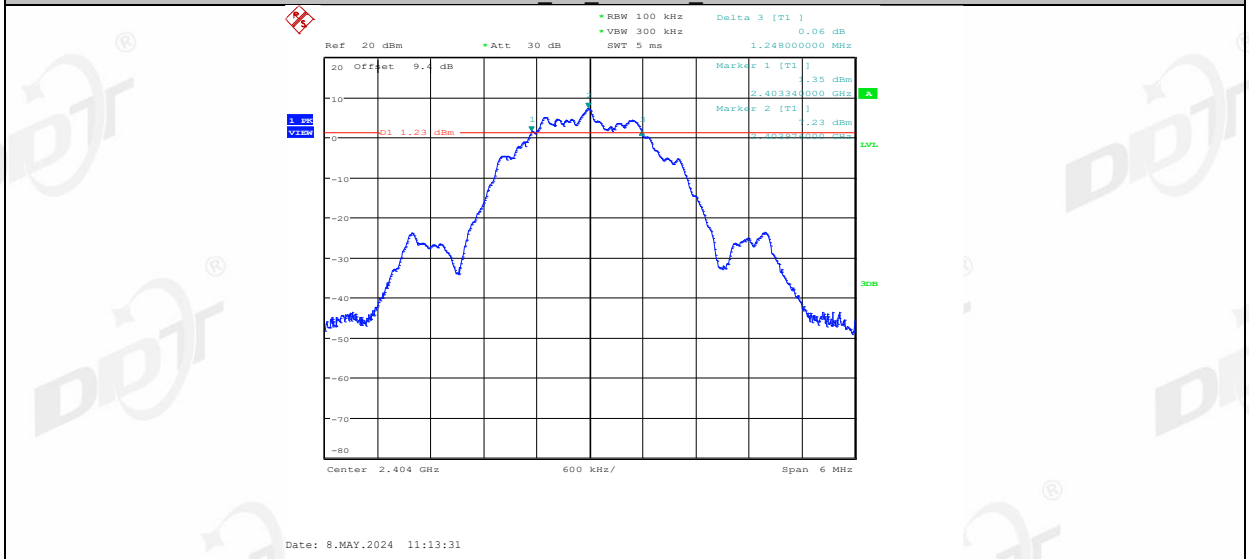
BLE_1M Left side 2480



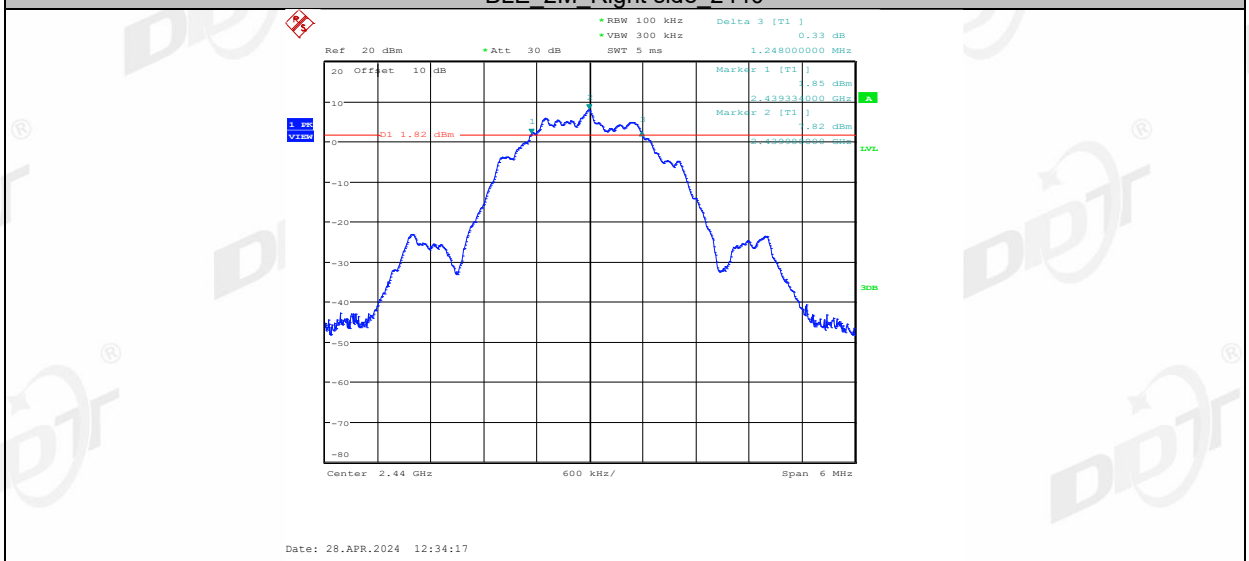
BLE_2M Right side 2404



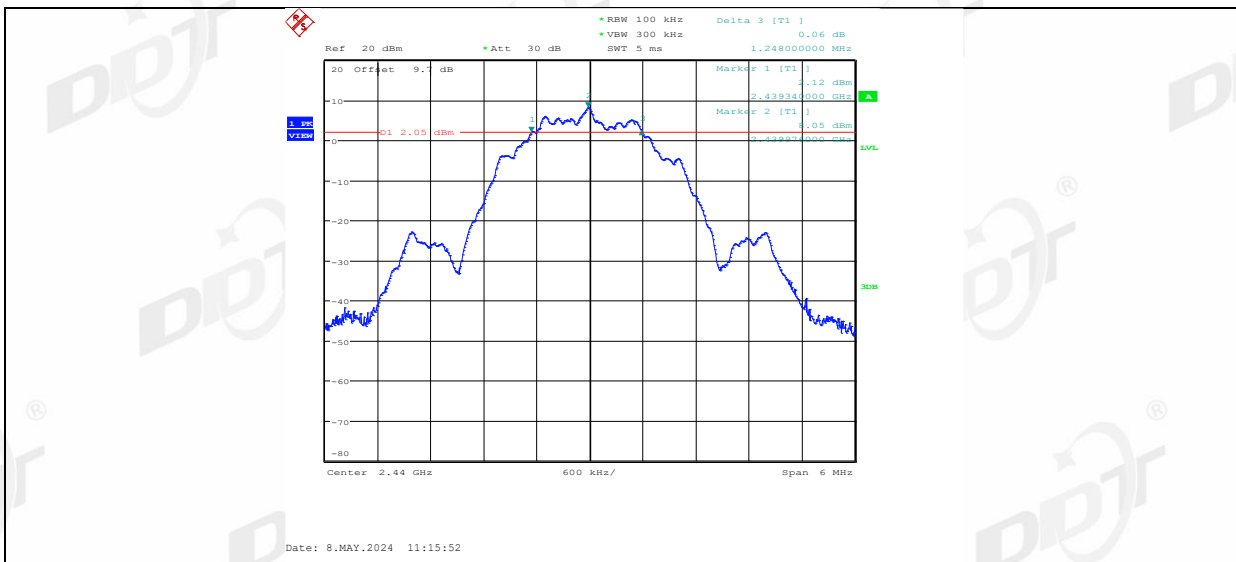
BLE 2M Left side 2404



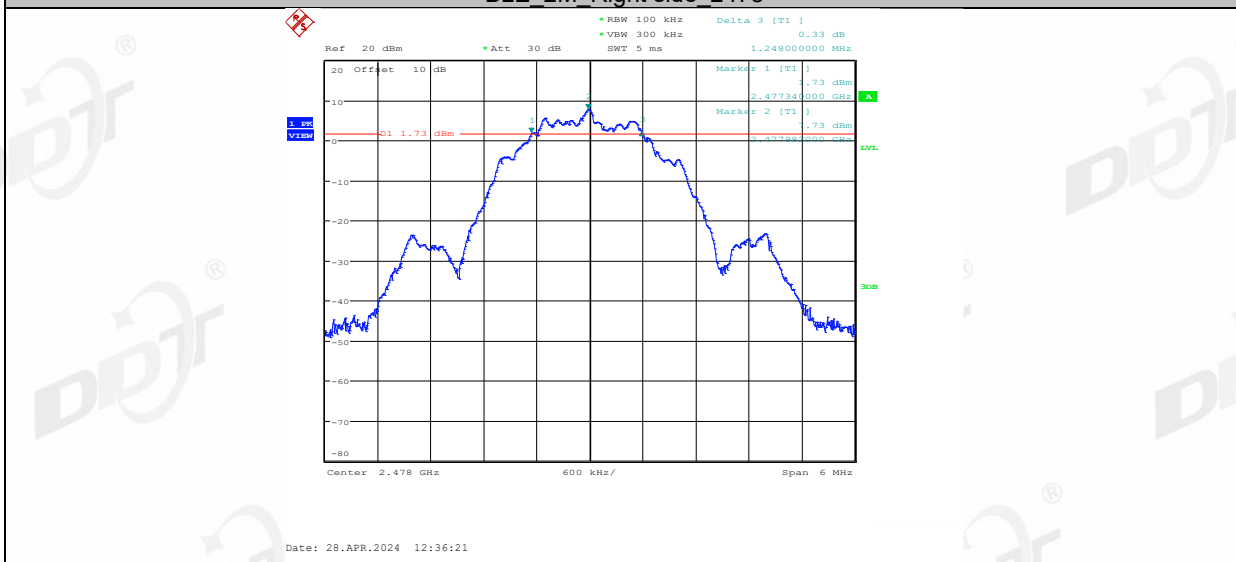
BLE 2M Right side 2440



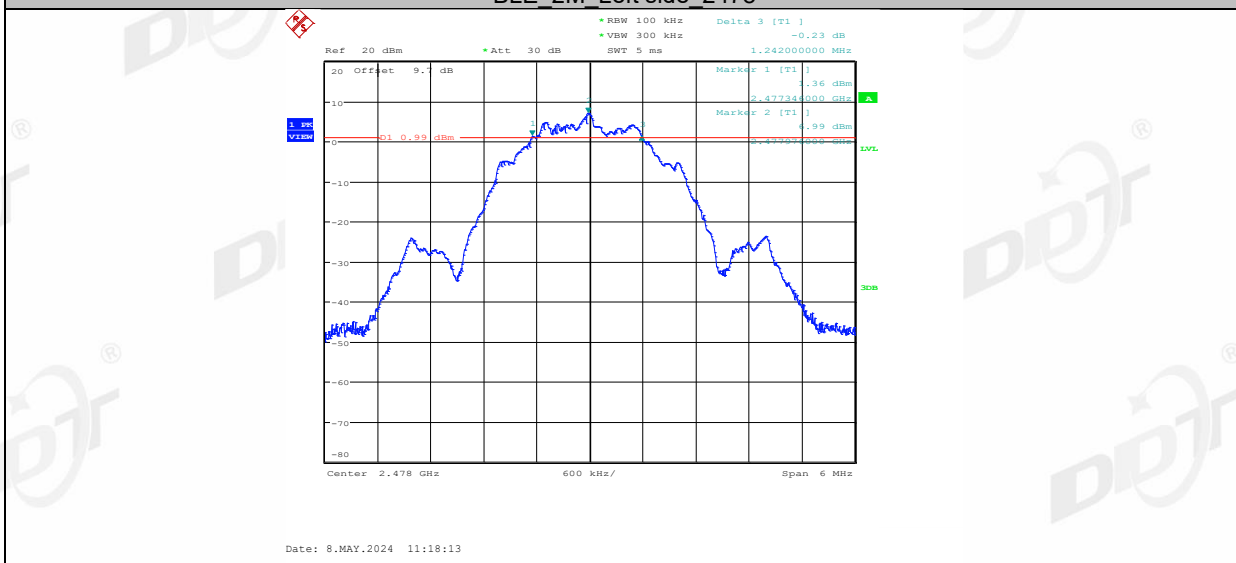
BLE 2M Left side 2440



BLE 2M Right side 2478

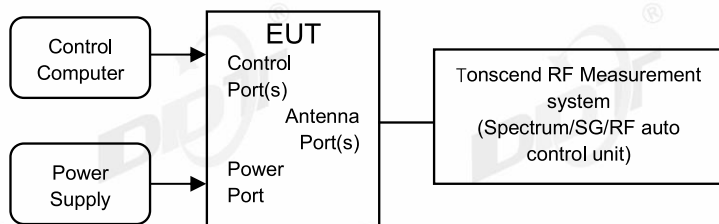


BLE 2M Left side 2478



5. 99% Bandwidth

5.1. Block diagram of test setup



5.2. Limits

Just for Report.

5.3. Test procedure

- (1) The test according to ANSI C63.10-2013 clause 6.9.3.
- (2) Connect EUT's antenna output to spectrum analyzer by RF cable, the path loss was compensated to the results
- (3) Set the EUT as maximum power setting and enable the EUT transmit continuously
- (4) Use the following spectrum analyzer settings for the 99% Bandwidth:

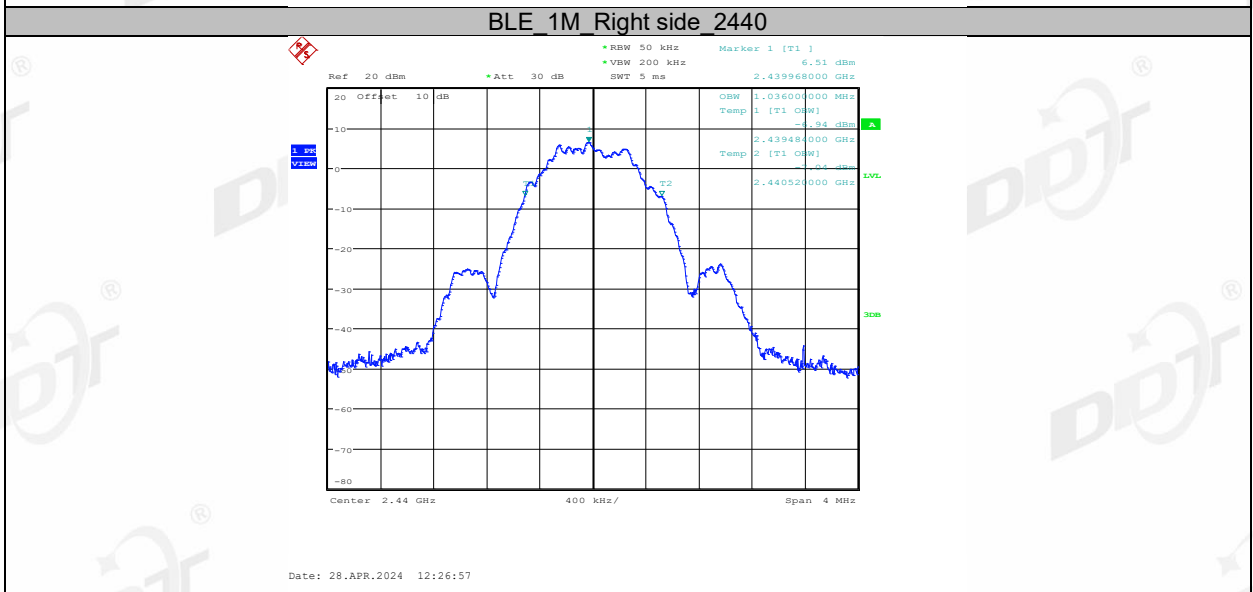
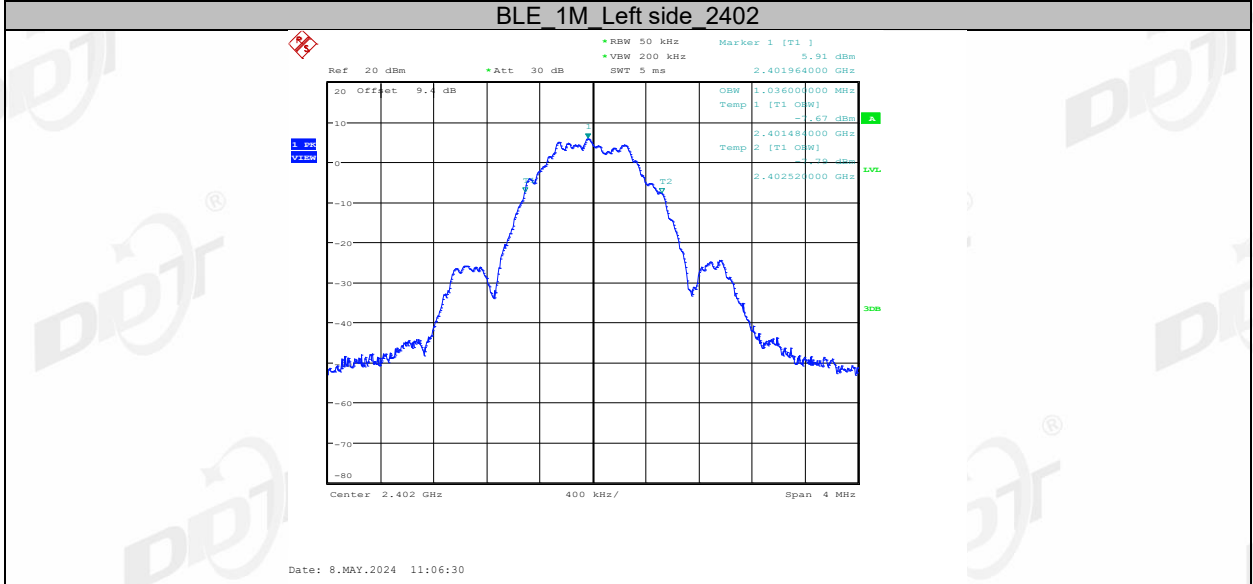
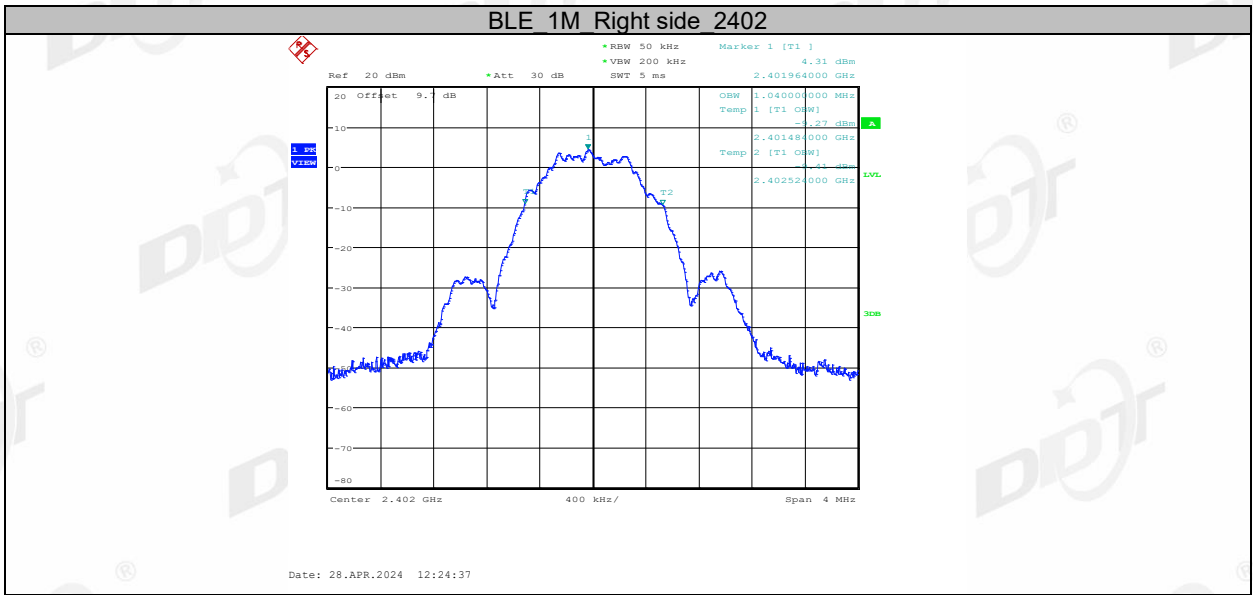
RBW:	1% to 5% of the OBW
VBW:	approximately three times RBW
Span:	between 1.5 times and 5.0 times the OBW
Detector Mode:	Peak
Sweep time:	Auto
Trace mode	Max hold
- (5) Allow the trace to stabilize, measure the 99% bandwidth of signal, and record the results in the report.

5.4. Test result

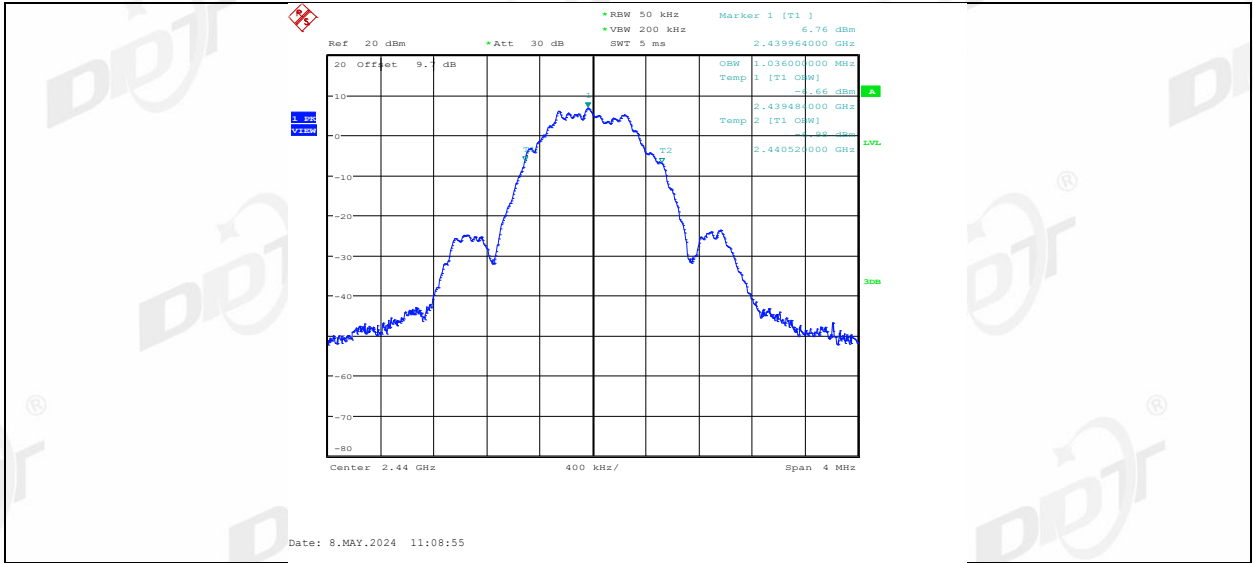
Test Engineer:	Zora Zhang	Test Site:	RF Measurement System 1#
Ambient Condition:	24.4°C,59.7%RH	Test Date:	2024.04.28-2024.05.08
Test Power Supply:	Battery	Sample Number:	S24022823-014

Test Mode	Antenna	Frequency [MHz]	OCB [MHz]	FL [MHz]	FH [MHz]	Limit [MHz]	Verdict
BLE_1M	Right side	2402	1.04	2401.4840	2402.5240	---	---
	Left side	2402	1.036	2401.4840	2402.5200	---	---
	Right side	2440	1.036	2439.4840	2440.5200	---	---
	Left side	2440	1.036	2439.4840	2440.5200	---	---
	Right side	2480	1.04	2479.4840	2480.5240	---	---
	Left side	2480	1.04	2479.4840	2480.5240	---	---
BLE_2M	Right side	2404	2.076	2402.9740	2405.0500	---	---
	Left side	2404	2.07	2402.9740	2405.0440	---	---
	Right side	2440	2.07	2438.9740	2441.0440	---	---
	Left side	2440	2.07	2438.9740	2441.0440	---	---
	Right side	2478	2.076	2476.9740	2479.0500	---	---
	Left side	2478	2.076	2476.9740	2479.0500	---	---

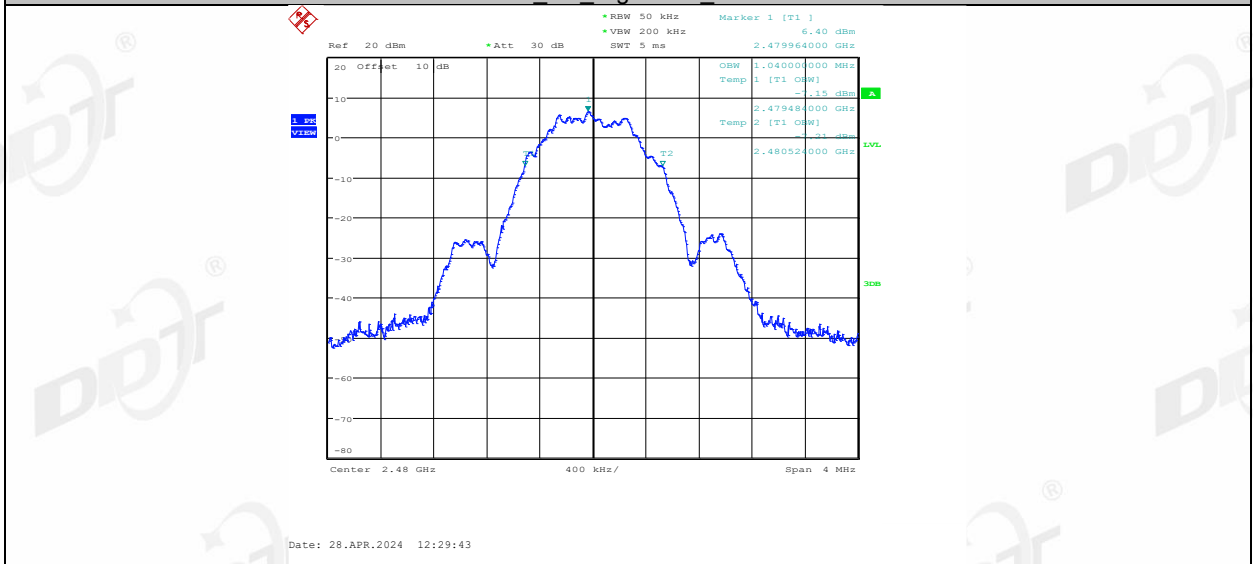
5.5. Test graphs



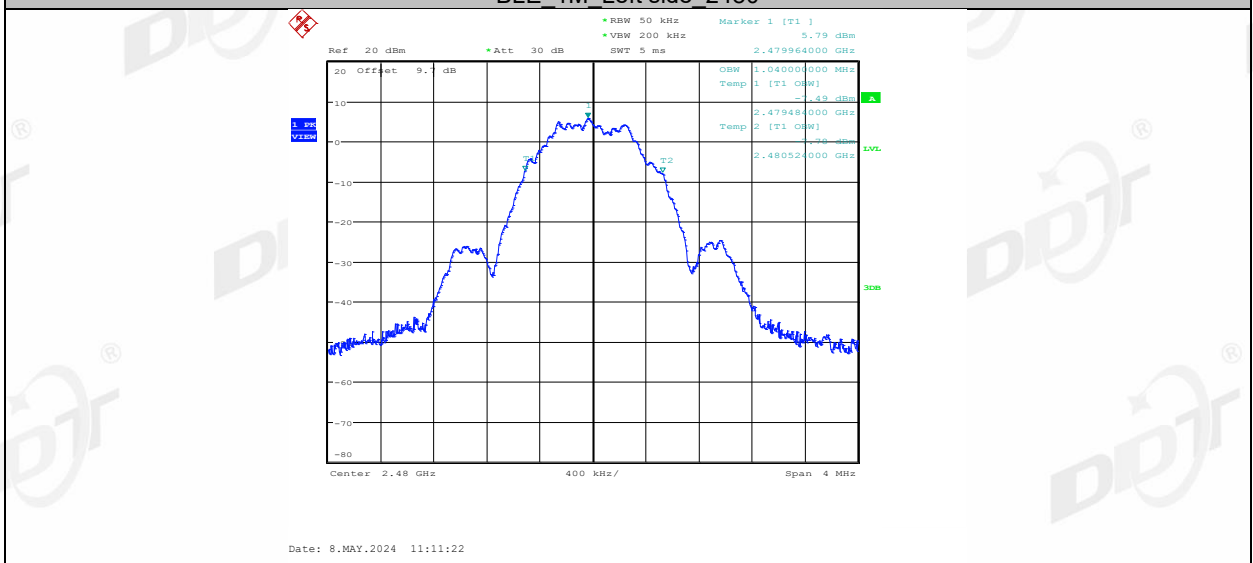
BLE 1M Left side 2440



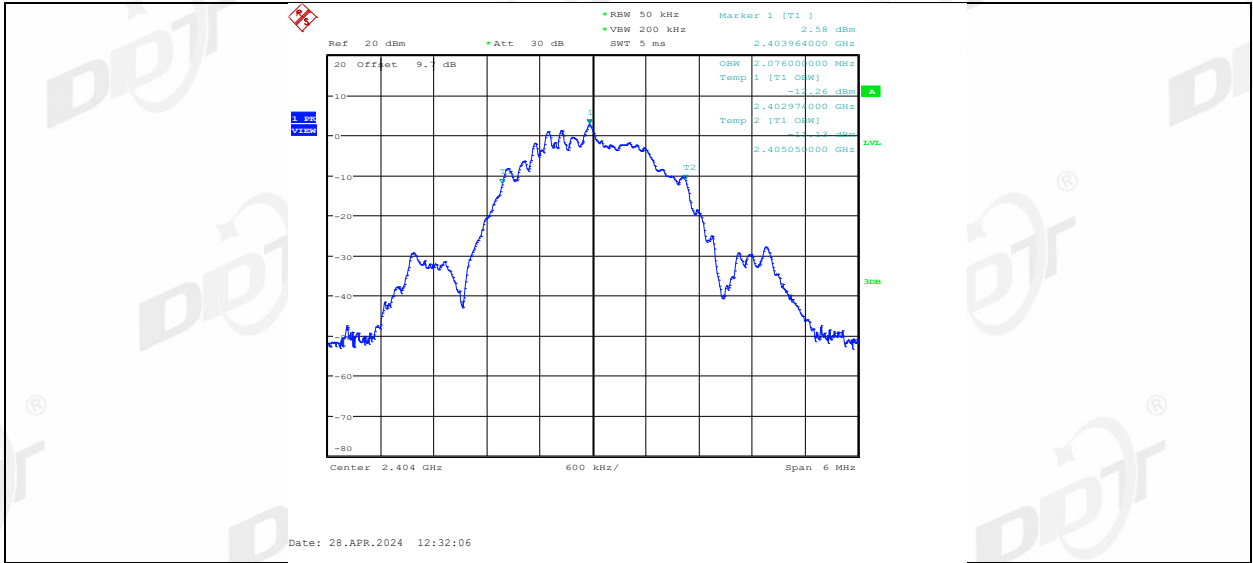
BLE 1M Right side 2480



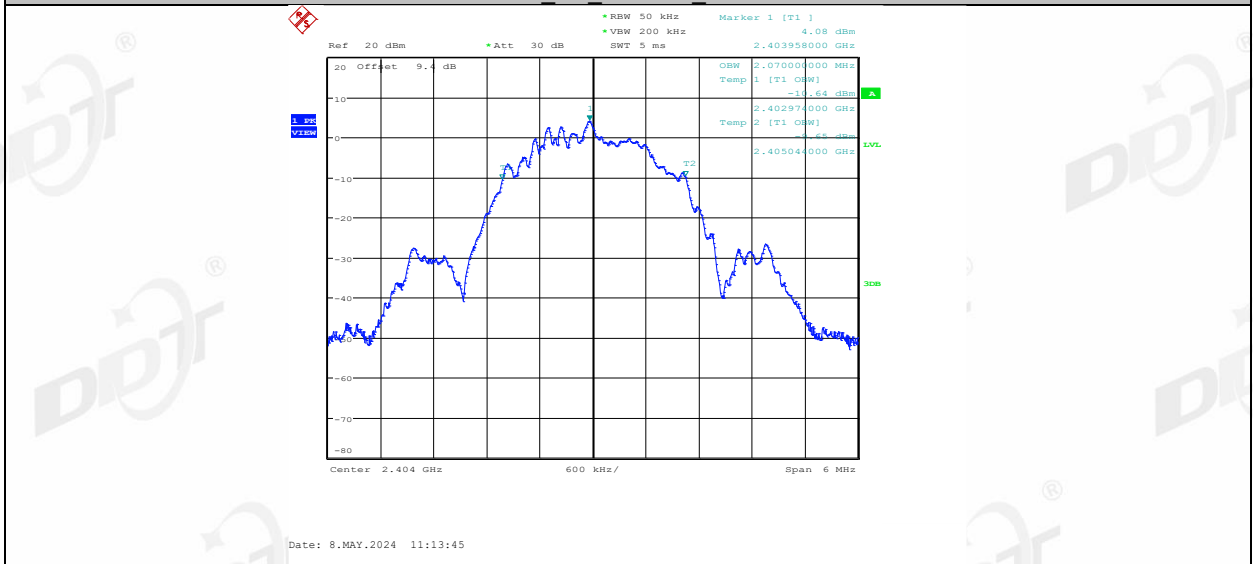
BLE 1M Left side 2480



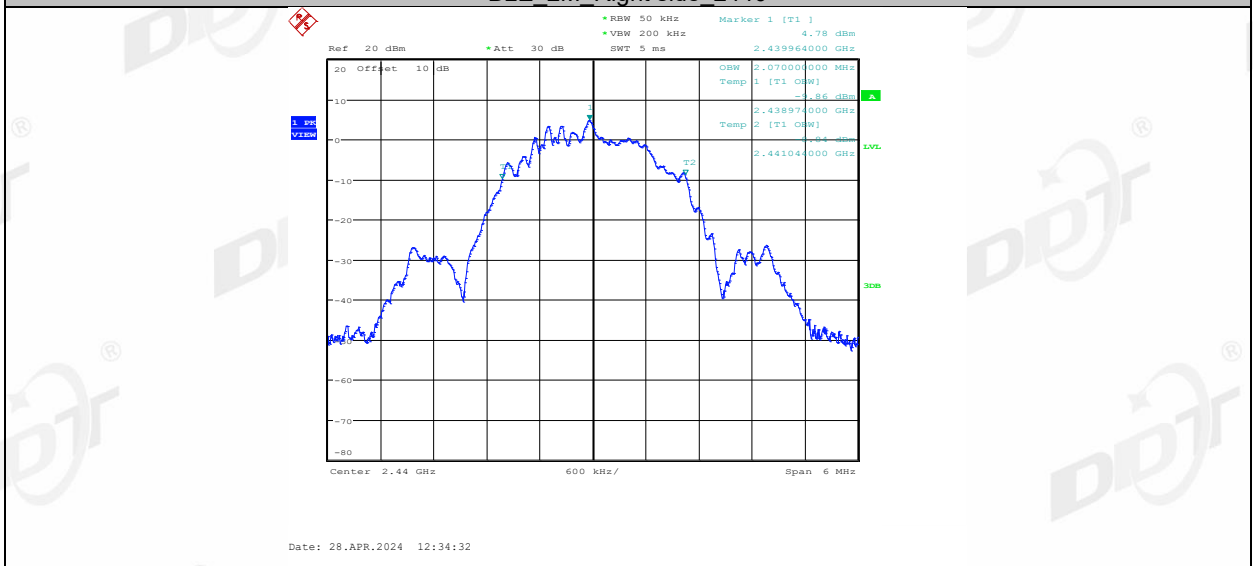
BLE 2M Right side 2404



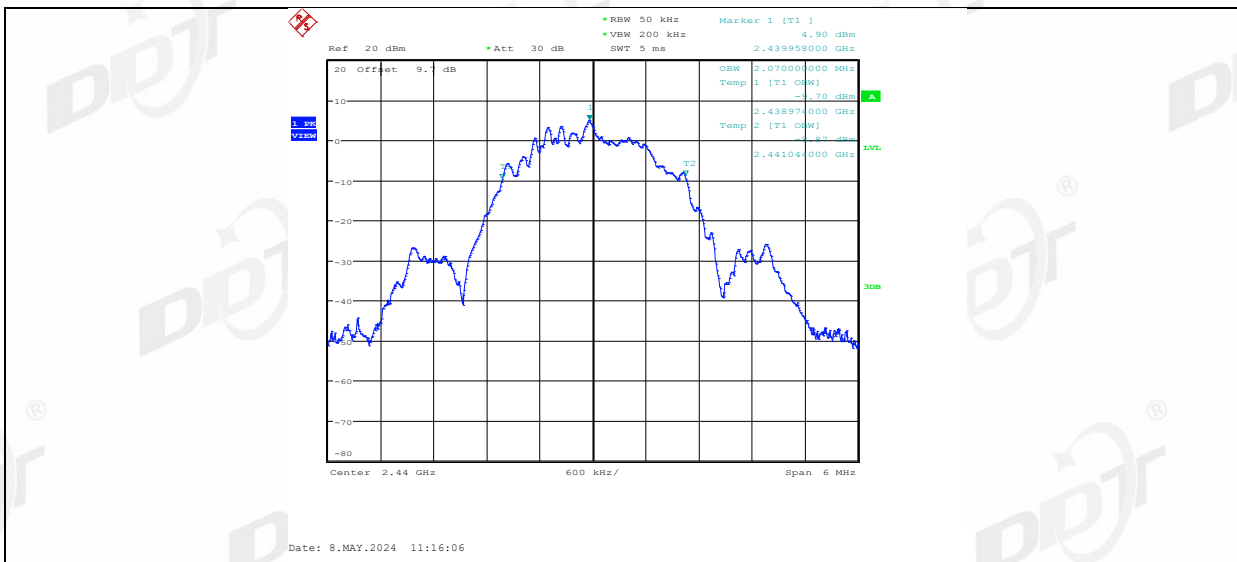
BLE_2M Left side 2404



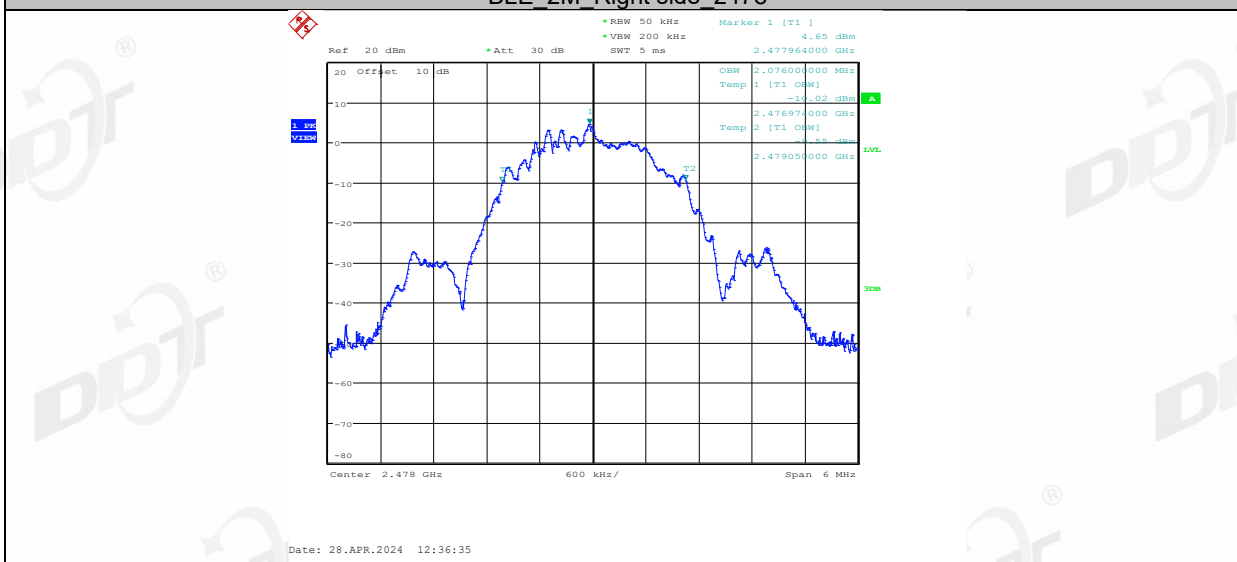
BLE_2M Right side 2440



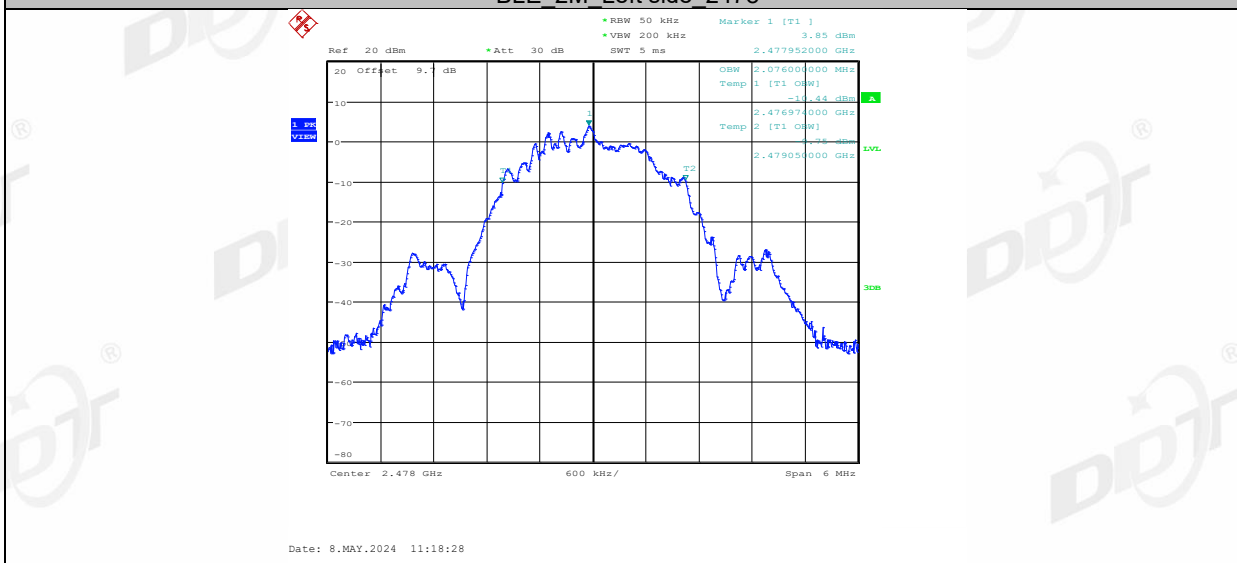
BLE_2M Left side 2440



BLE 2M Right side 2478

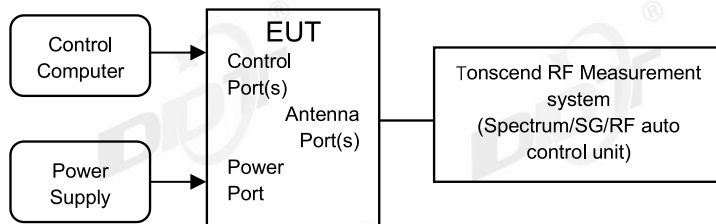


BLE 2M Left side 2478



6. Maximum Peak Output Power

6.1. Block diagram of test setup



6.2. Limits

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. If transmitting antennas of directional gain greater than 6dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi, the e.i.r.p shall not exceed 4W.

6.3. Test procedure

- (1) The test according to ANSI C63.10-2013 clause 11.9.1.1.
- (2) Connect EUT's antenna output to spectrum analyzer by RF cable, the path loss was compensated to the results.
- (3) Set the EUT as maximum power setting and enable the EUT transmit continuously.
- (4) Use the following spectrum analyzer settings for the maximum peak output power measurement:

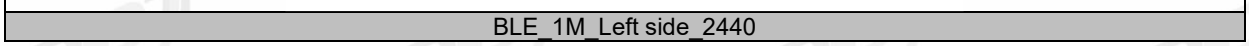
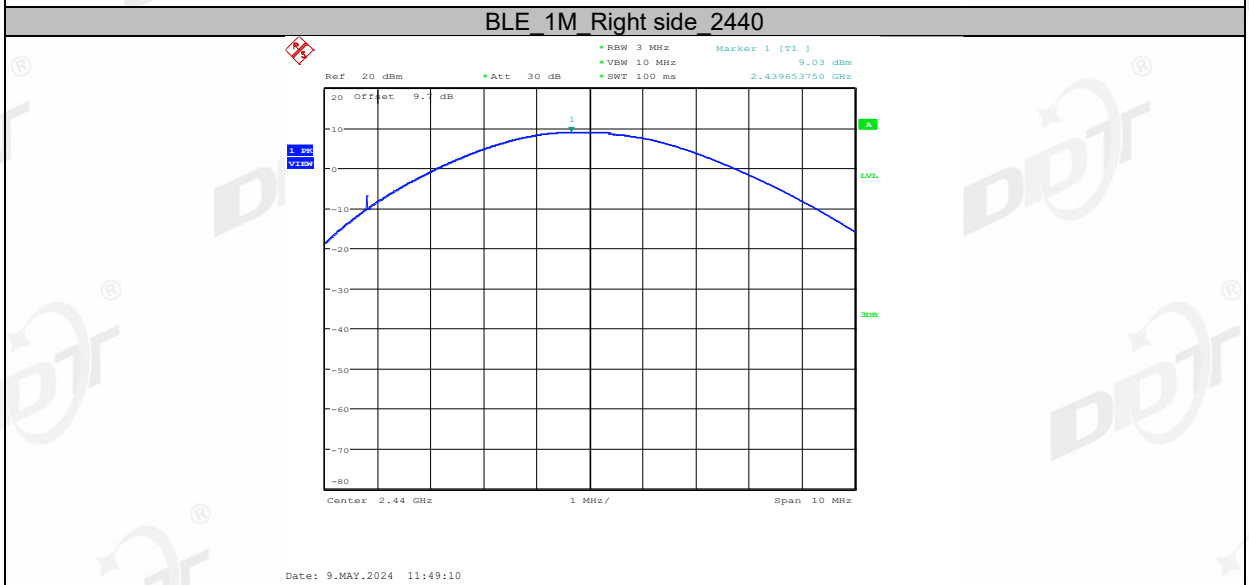
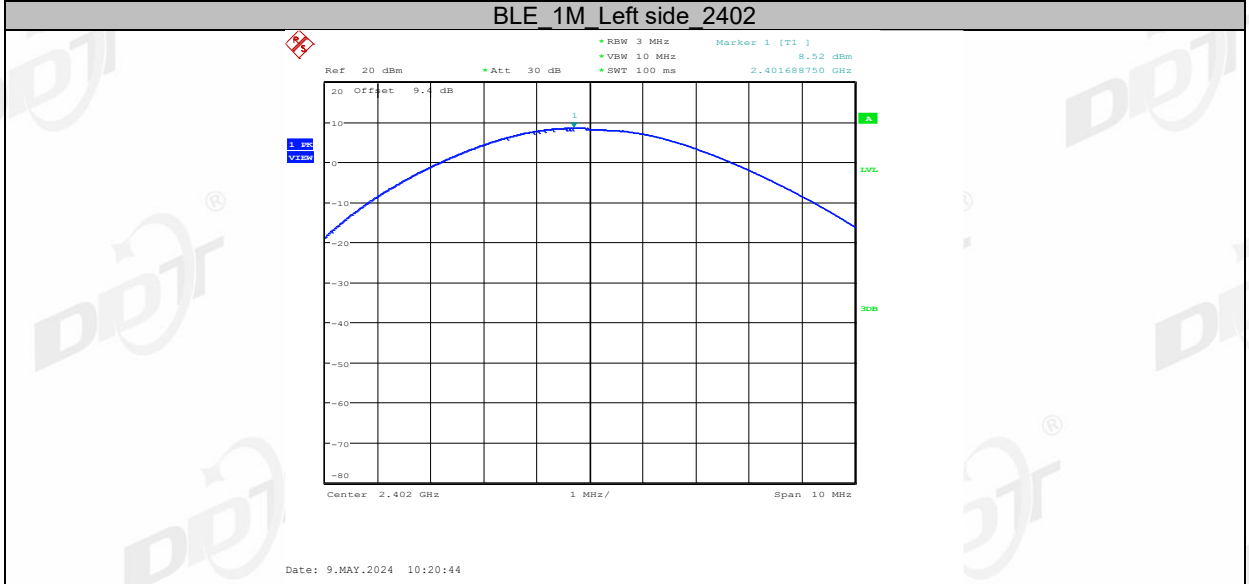
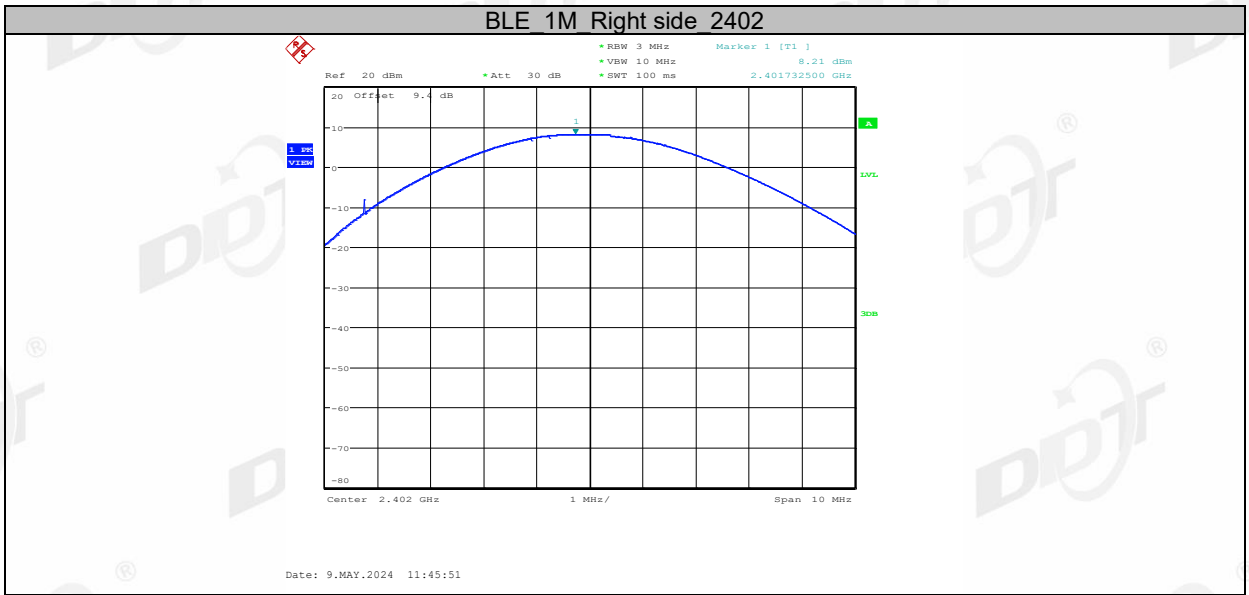
RBW:	≥DTS bandwidth
VBW:	≥3 x RBW
Span	≥3 x RBW
Detector Mode:	Peak
Sweep time:	Auto
Trace mode	Max hold
- (5) Allow the trace to stabilize, use peak marker function to determine the peak amplitude level.

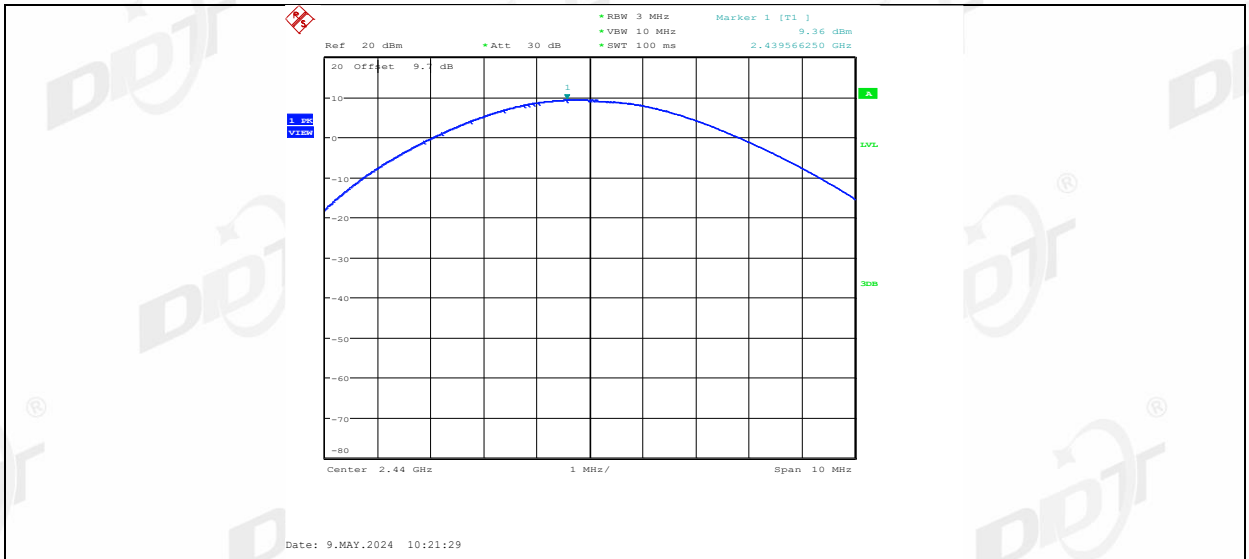
6.4. Test result

Test Engineer:	Zora Zhang	Test Site:	RF Measurement System 1#
Ambient Condition:	24.4℃,59.7%RH	Test Date:	2024.04.28-2024.05.09
Test Power Supply:	Battery	Sample Number:	S24022823-014

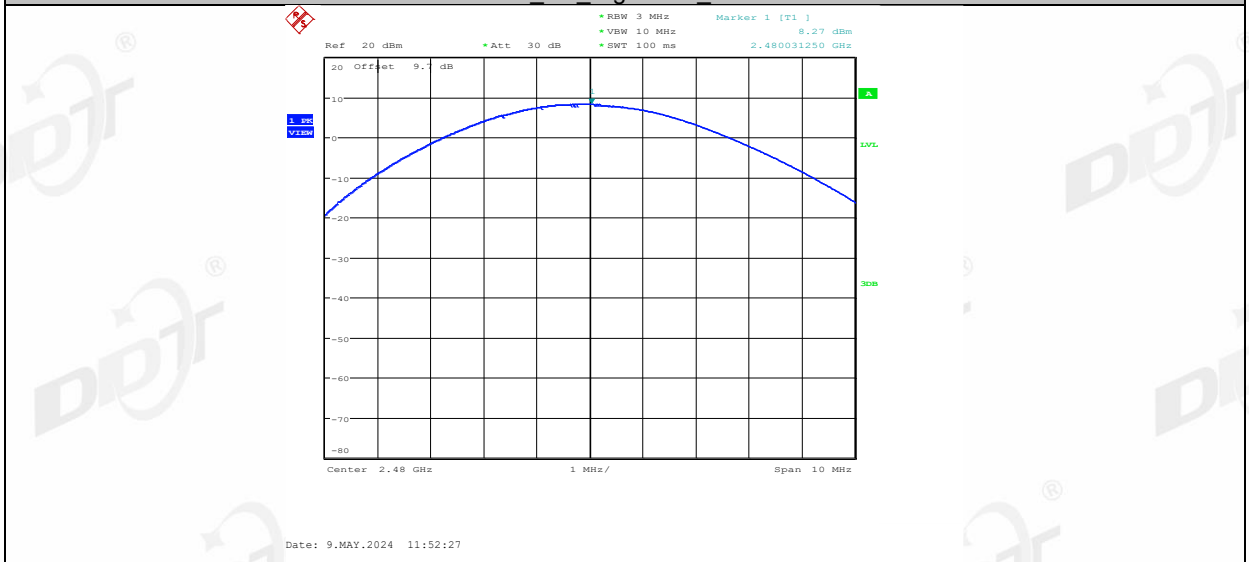
Test Mode	Antenna	Frequency [MHz]	Conducted Peak Power [dBm]	Conducted Limit [dBm]	EIRP [dBm]	EIRP Limit [dBm]	Verdict
BLE_1M	Right side	2402	8.21	≤30	7.36	≤36	PASS
	Left side	2402	8.52	≤30	7.50	≤36	PASS
	Right side	2440	9.03	≤30	8.18	≤36	PASS
	Left side	2440	9.36	≤30	8.34	≤36	PASS
	Right side	2480	8.27	≤30	7.42	≤36	PASS
	Left side	2480	8.72	≤30	7.70	≤36	PASS
BLE_2M	Right side	2404	8.23	≤30	7.38	≤36	PASS
	Left side	2404	8.58	≤30	7.56	≤36	PASS
	Right side	2440	8.99	≤30	8.14	≤36	PASS
	Left side	2440	9.05	≤30	8.03	≤36	PASS
	Right side	2478	8.14	≤30	7.29	≤36	PASS
	Left side	2478	8.44	≤30	7.42	≤36	PASS

6.5. Test graphs

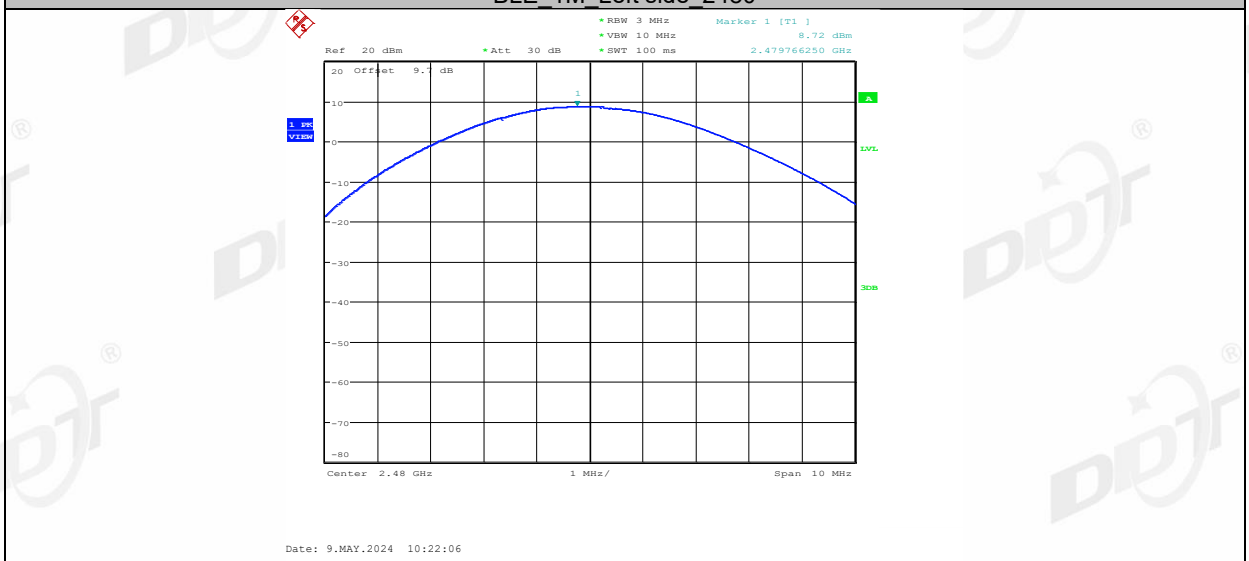




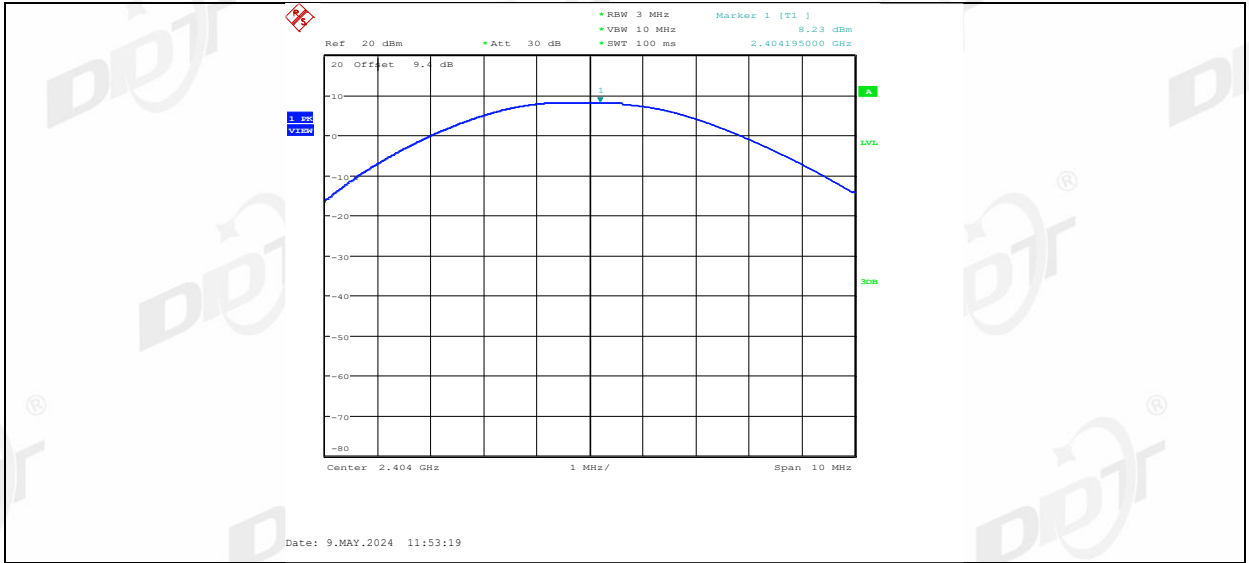
BLE 1M Right side 2480



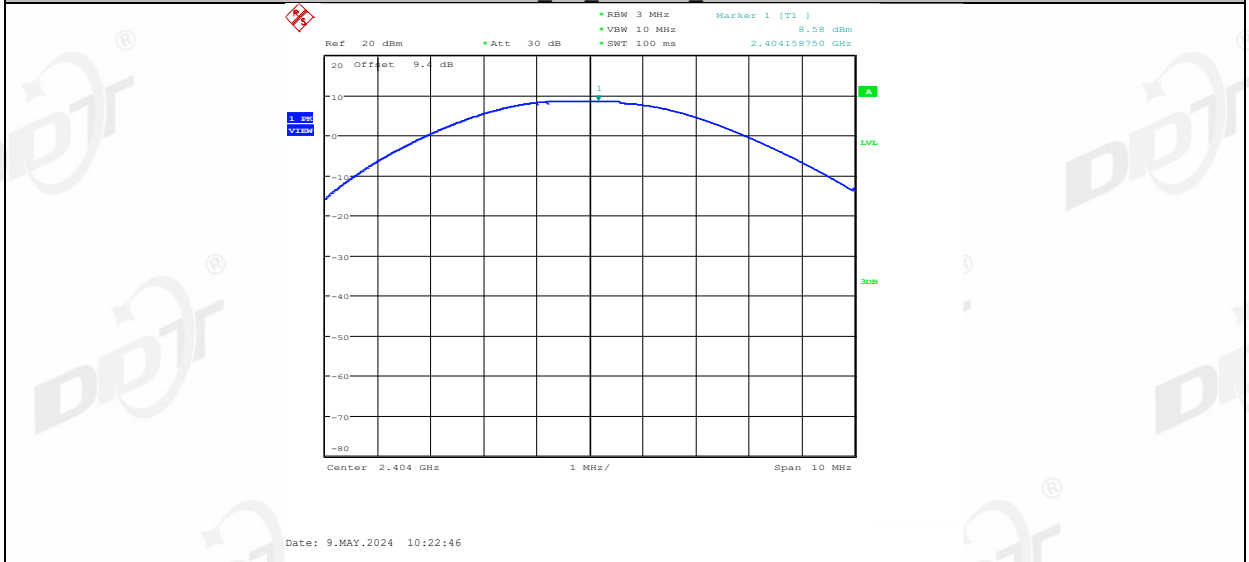
BLE 1M Left side 2480



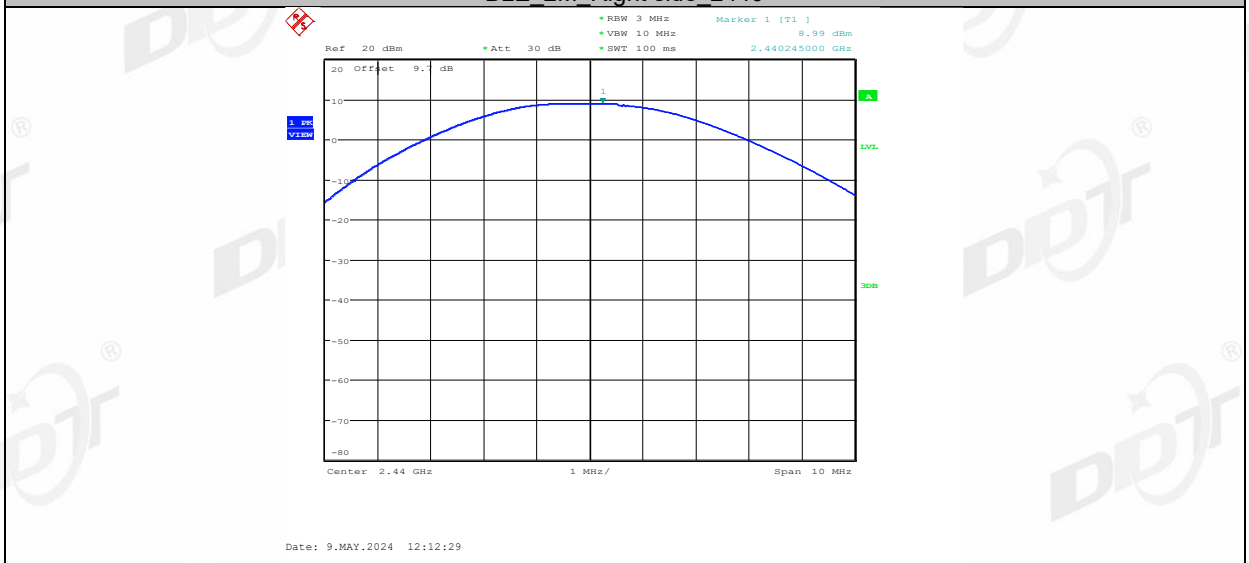
BLE 2M Right side 2404



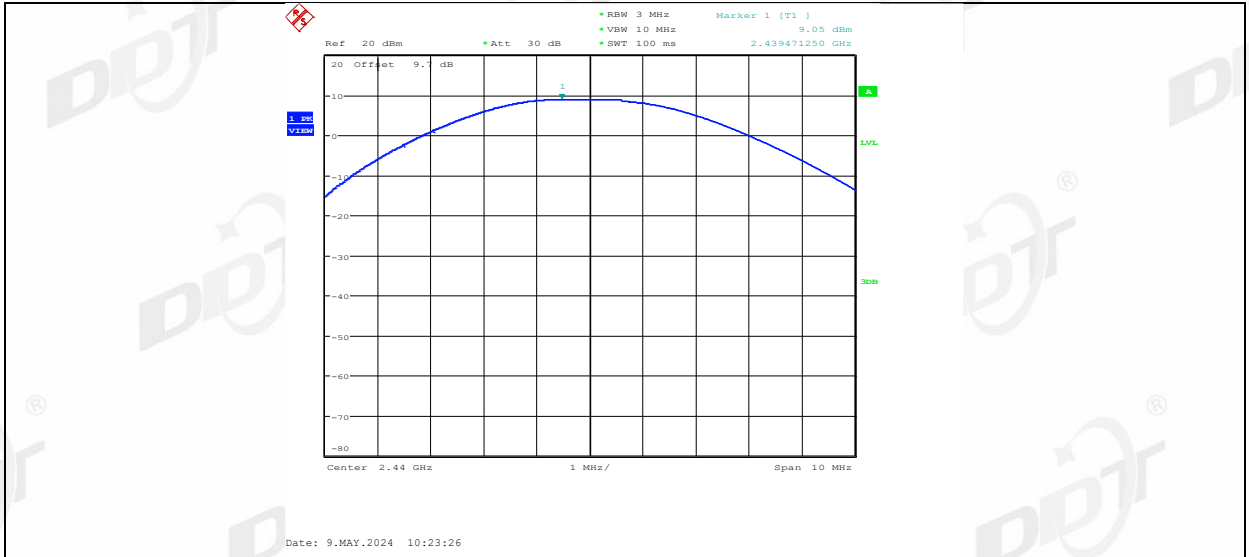
BLE 2M Left side 2404



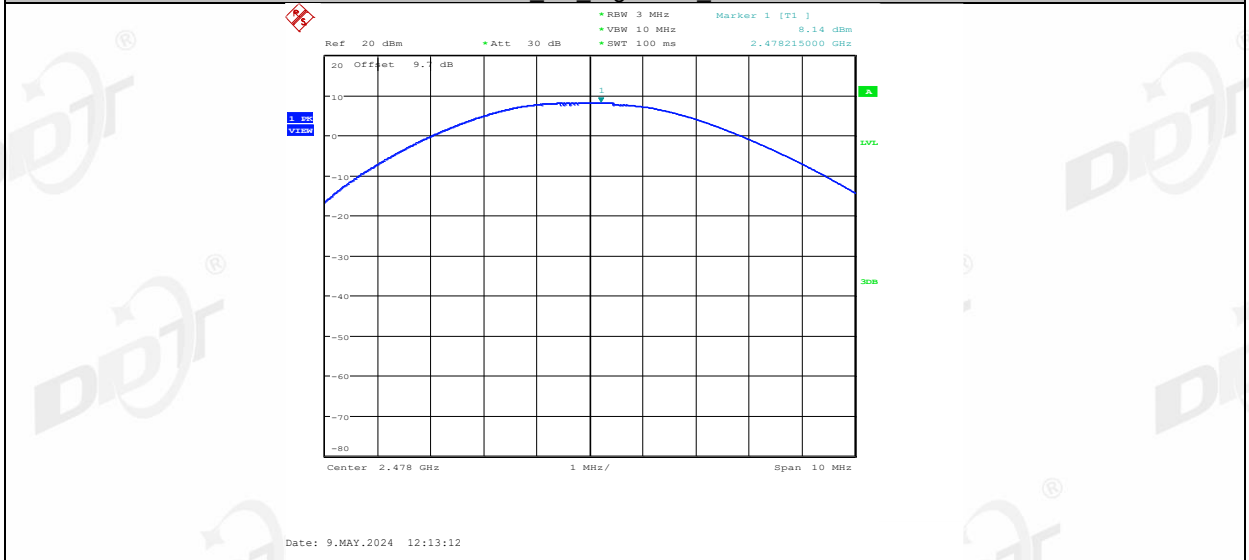
BLE 2M Right side 2440



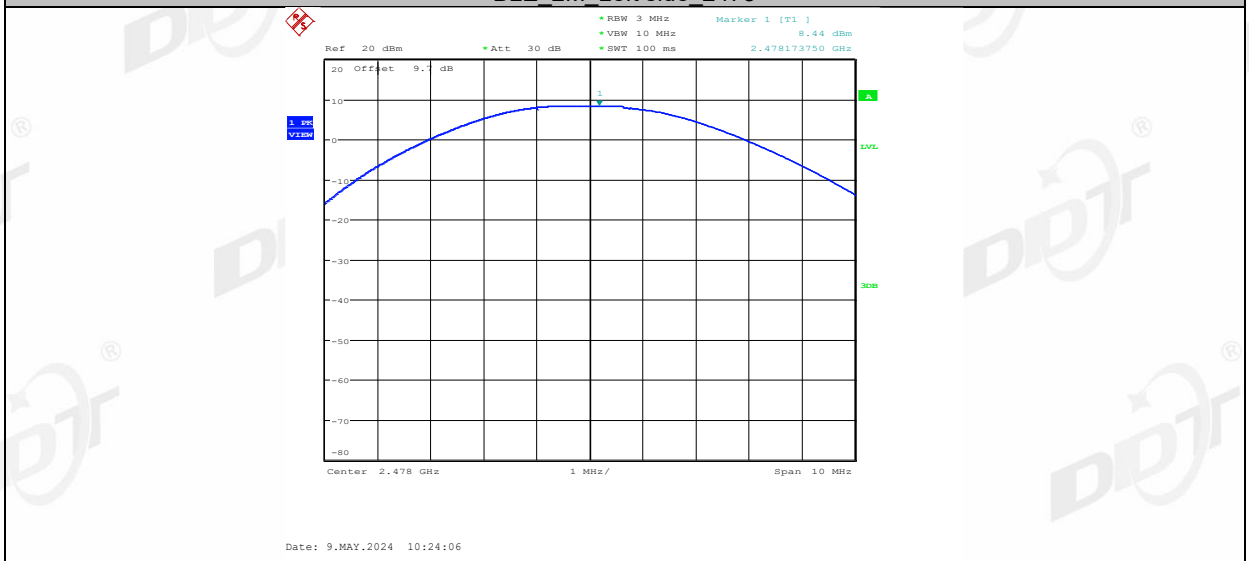
BLE 2M Left side 2440



BLE_2M_Right side_2478

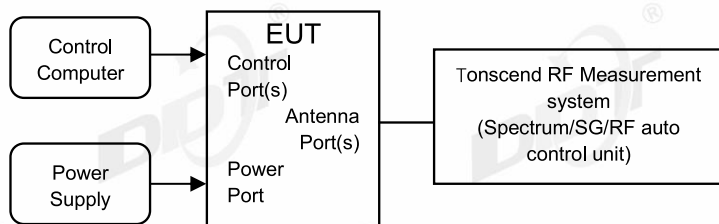


BLE_2M_Left side_2478



7. Power Spectral Density

7.1. Block diagram of test setup



7.2. Limits

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.

7.3. Test procedure

- (1) The test according to ANSI C63.10-2013 clause 11.10.2.
 - (2) Connect EUT's antenna output to spectrum analyzer by RF cable, the path loss was compensated to the results.
 - (3) Set the EUT as maximum power setting and enable the EUT transmit continuously.
 - (4) Use the following spectrum analyzer settings for Power Spectral Density measurement:

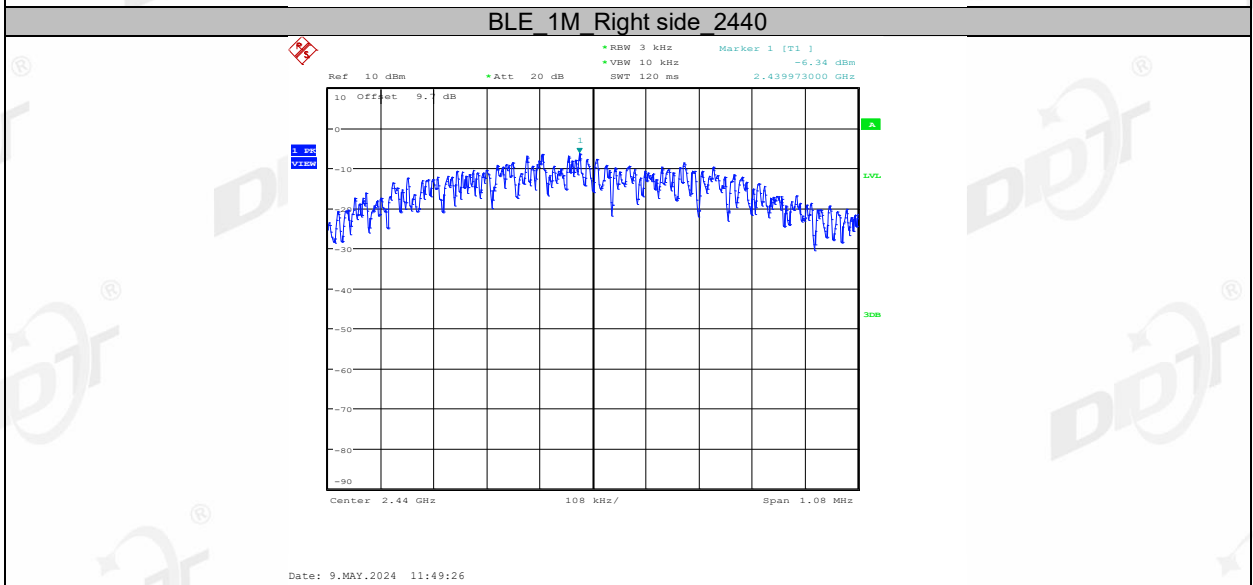
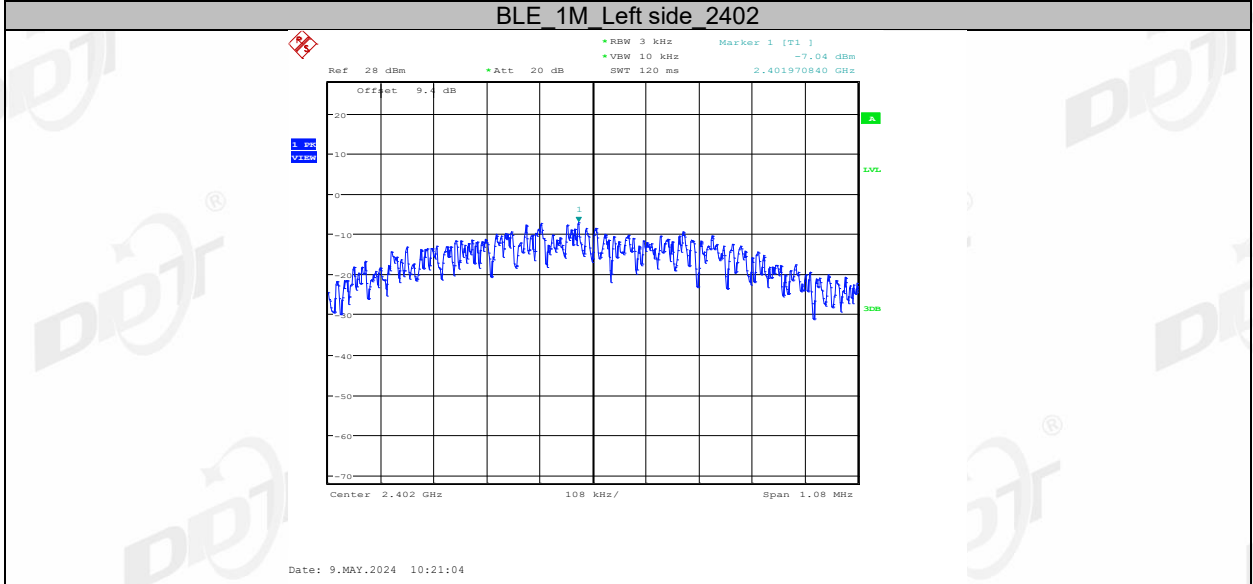
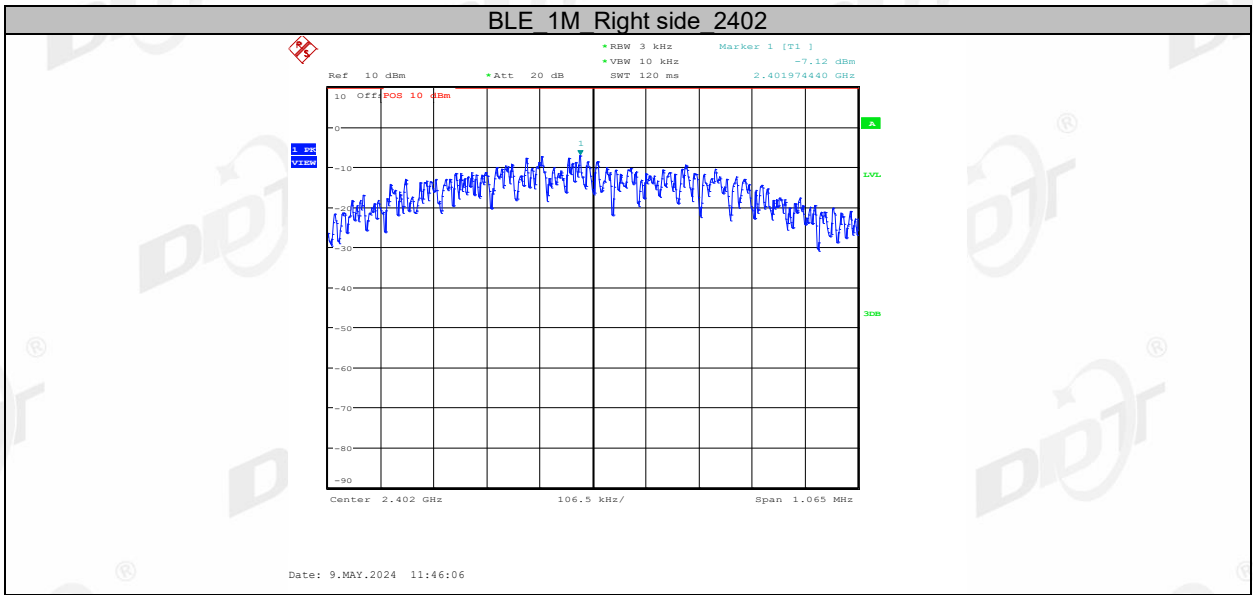
Center frequency	DTS Channel center frequency
RBW:	$3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
VBW:	$\geq 3\text{RBW}$
Span	1.5 times the DTS bandwidth
Detector Mode:	Peak
Sweep time:	Auto
Trace mode	Max hold
 - (5) Allow the trace to stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

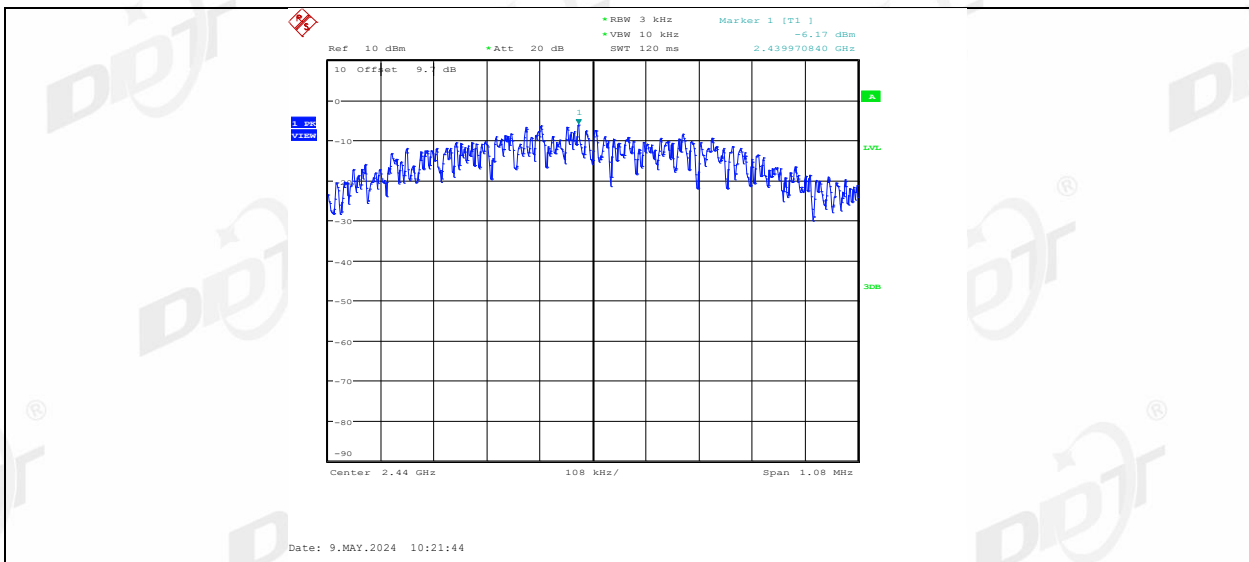
7.4. Test result

Test Engineer:	Zora Zhang	Test Site:	RF Measurement System 1#
Ambient Condition:	24.4°C,59.7%RH	Test Date:	2024.05.09
Test Power Supply:	Battery	Sample Number:	S24022823-014

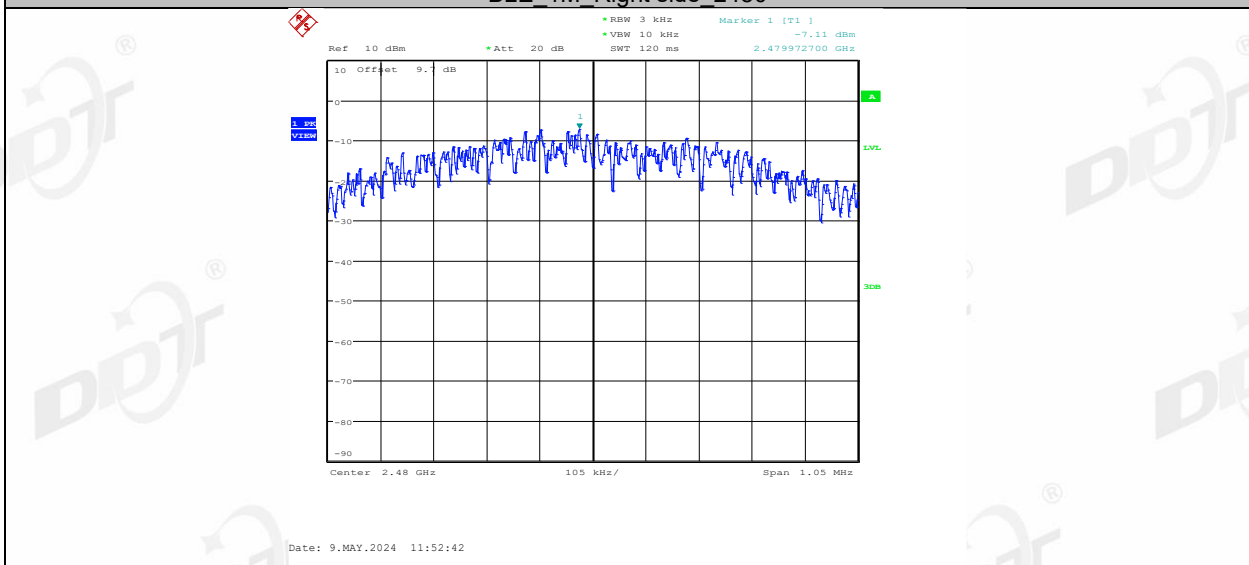
Test Mode	Antenna	Frequency [MHz]	Result [dBm/3kHz]	Limit [dBm/3kHz]	Verdict
BLE_1M	Right side	2402	-7.12	≤8.00	PASS
	Left side	2402	-7.04	≤8.00	PASS
	Right side	2440	-6.34	≤8.00	PASS
	Left side	2440	-6.17	≤8.00	PASS
	Right side	2480	-7.11	≤8.00	PASS
	Left side	2480	-6.76	≤8.00	PASS
BLE_2M	Right side	2404	-9.58	≤8.00	PASS
	Left side	2404	-9.76	≤8.00	PASS
	Right side	2440	-8.66	≤8.00	PASS
	Left side	2440	-8.88	≤8.00	PASS
	Right side	2478	-9.54	≤8.00	PASS
	Left side	2478	-9.52	≤8.00	PASS

7.5. Test graphs

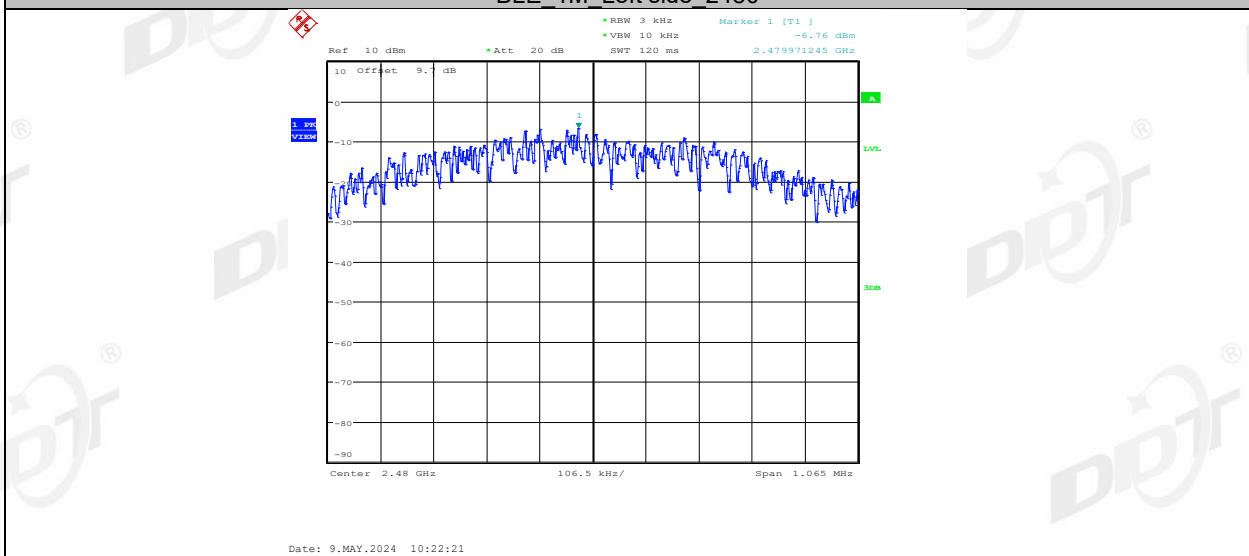




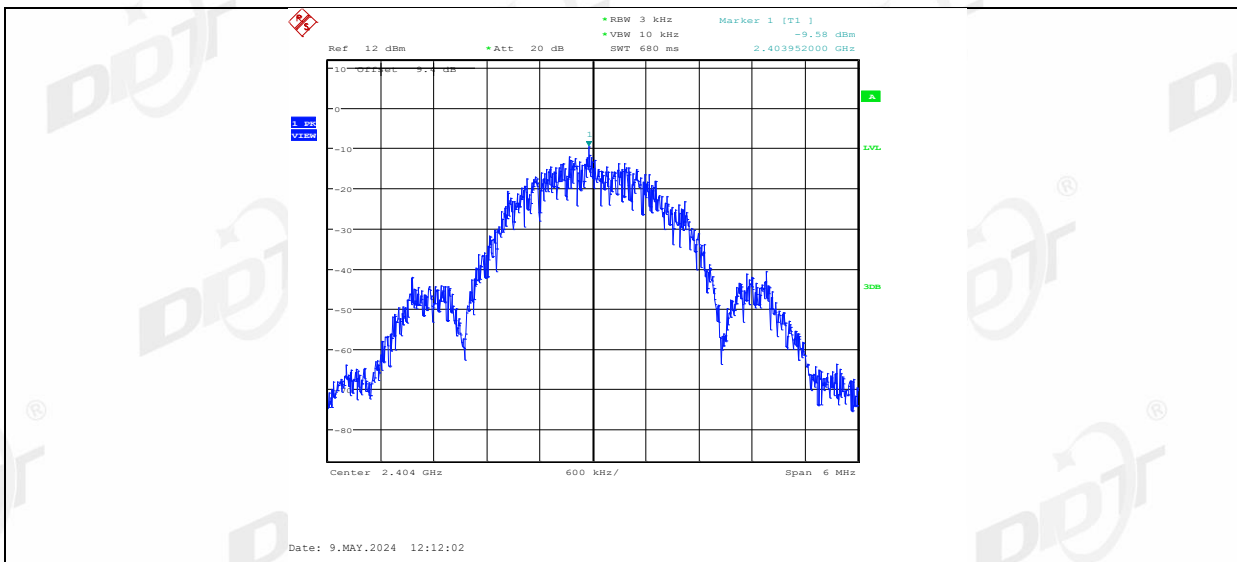
BLE_1M_Right side_2480



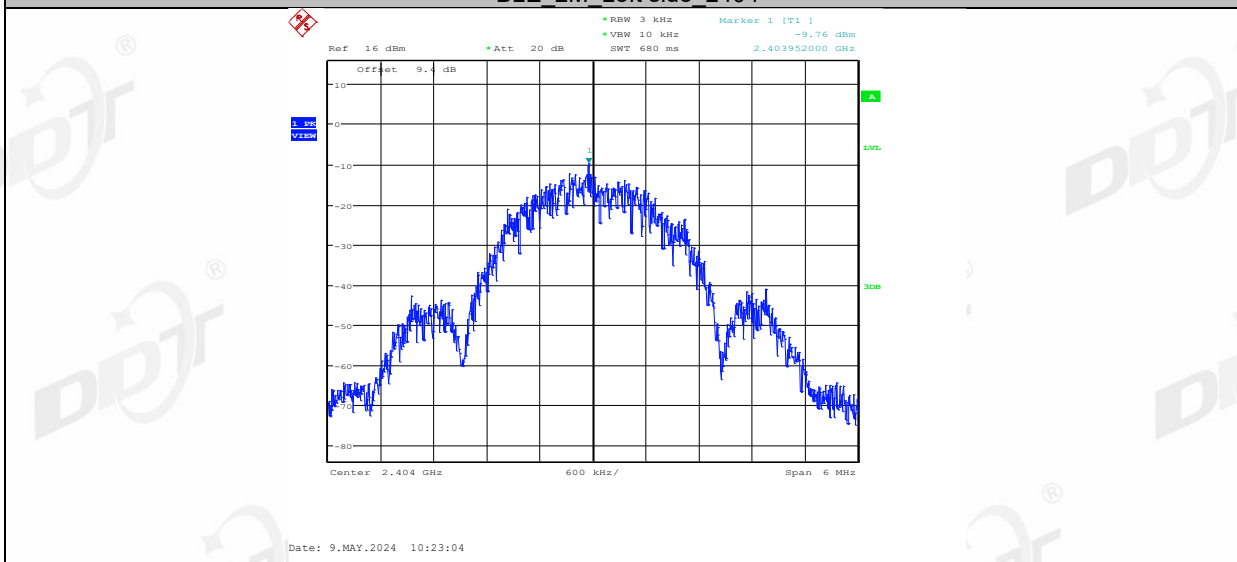
BLE_1M_Left side_2480



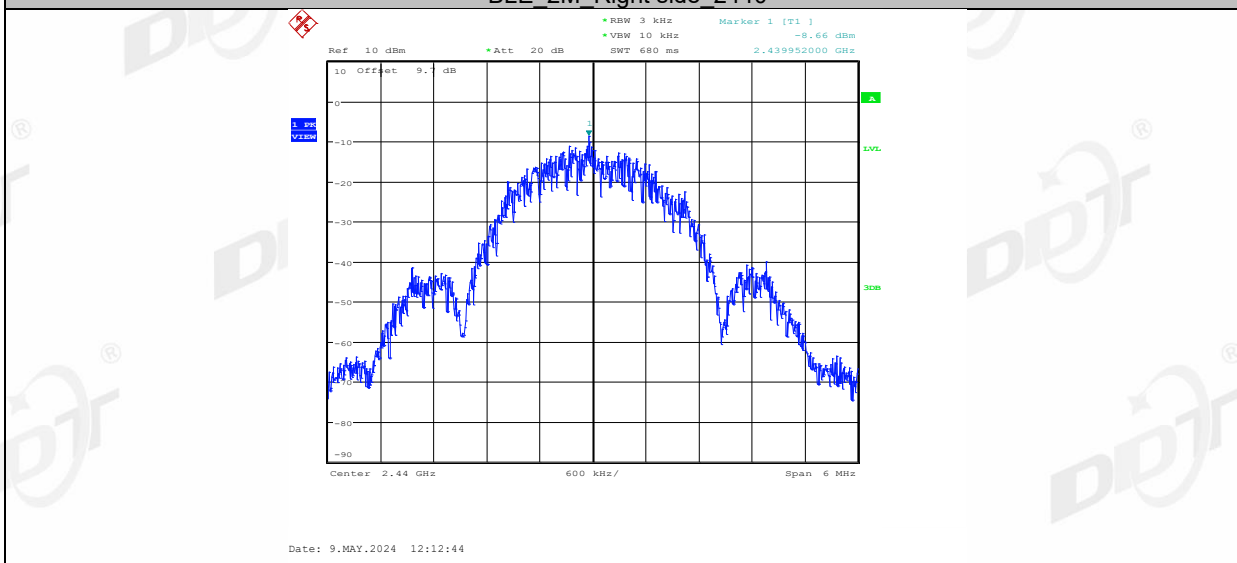
BLE_2M_Right side_2404



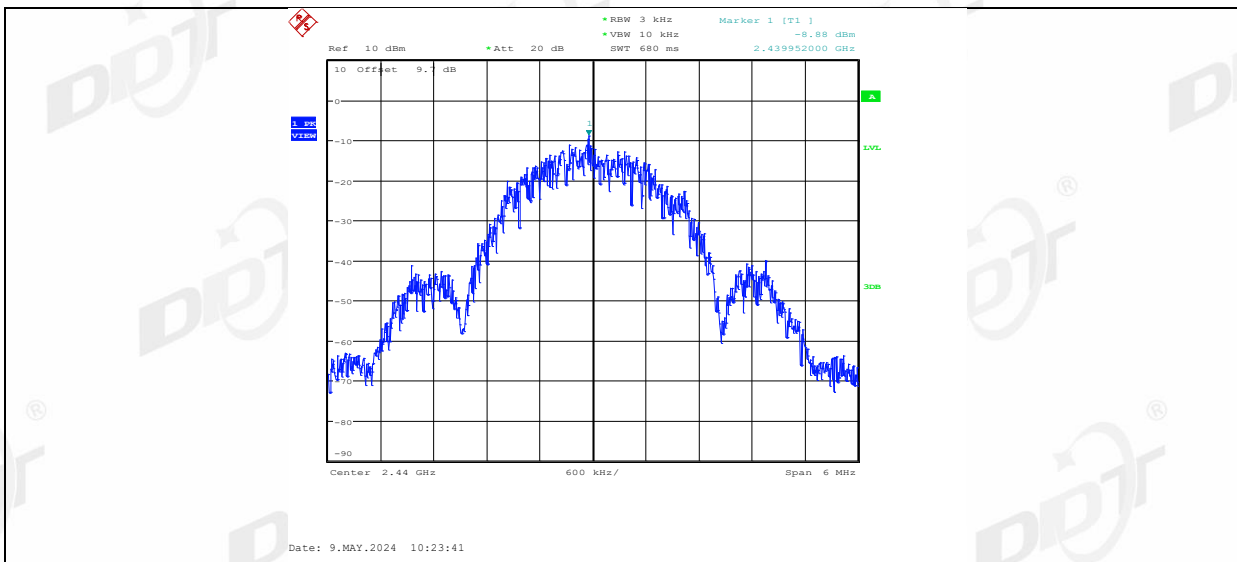
BLE_2M Left side 2404



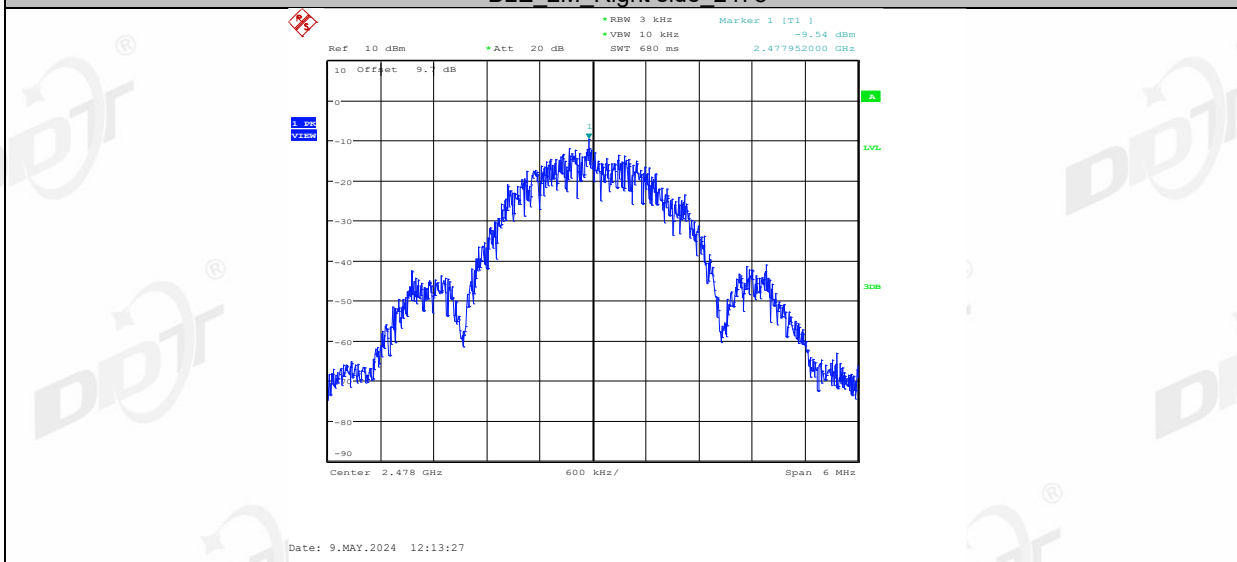
BLE_2M Right side 2440



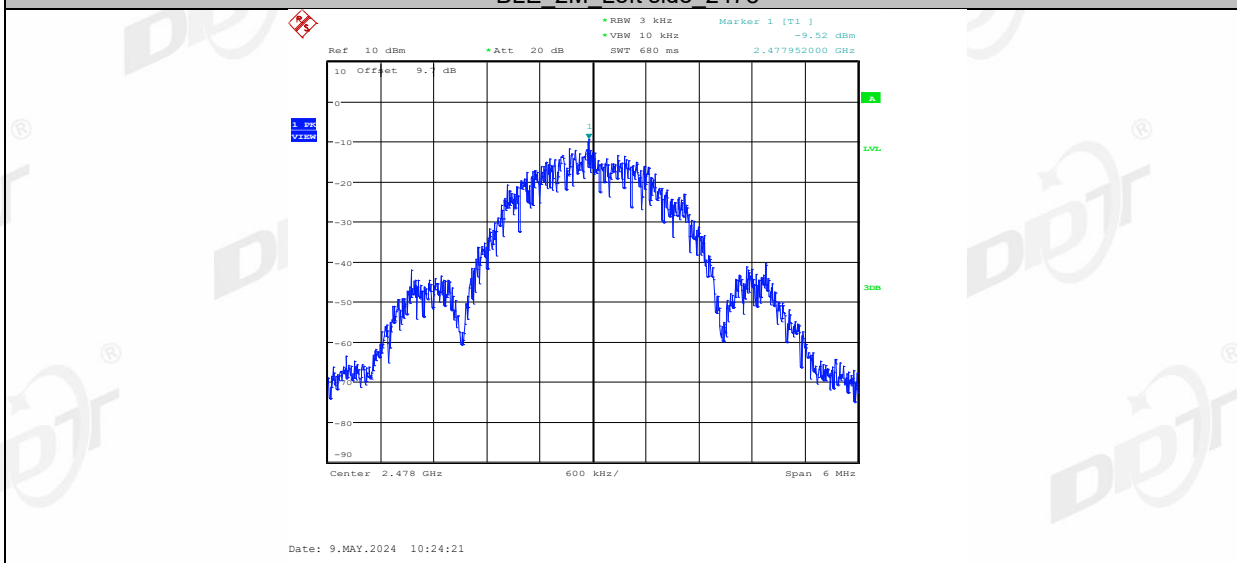
BLE_2M Left side 2440



BLE_2M_Right side_2478

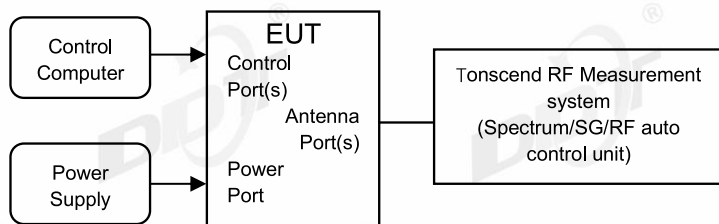


BLE_2M_Left side_2478



8. Band Edge Compliance (Conducted Method)

8.1. Block diagram of test setup



8.2. Limits

In any 100 kHz bandwidth outside the frequency bands in which the spread spectrum 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.

8.3. Test procedure

- (1) Connect EUT's antenna output to spectrum analyzer by RF cable.
- (2) Establish a reference level by using the following procedure:

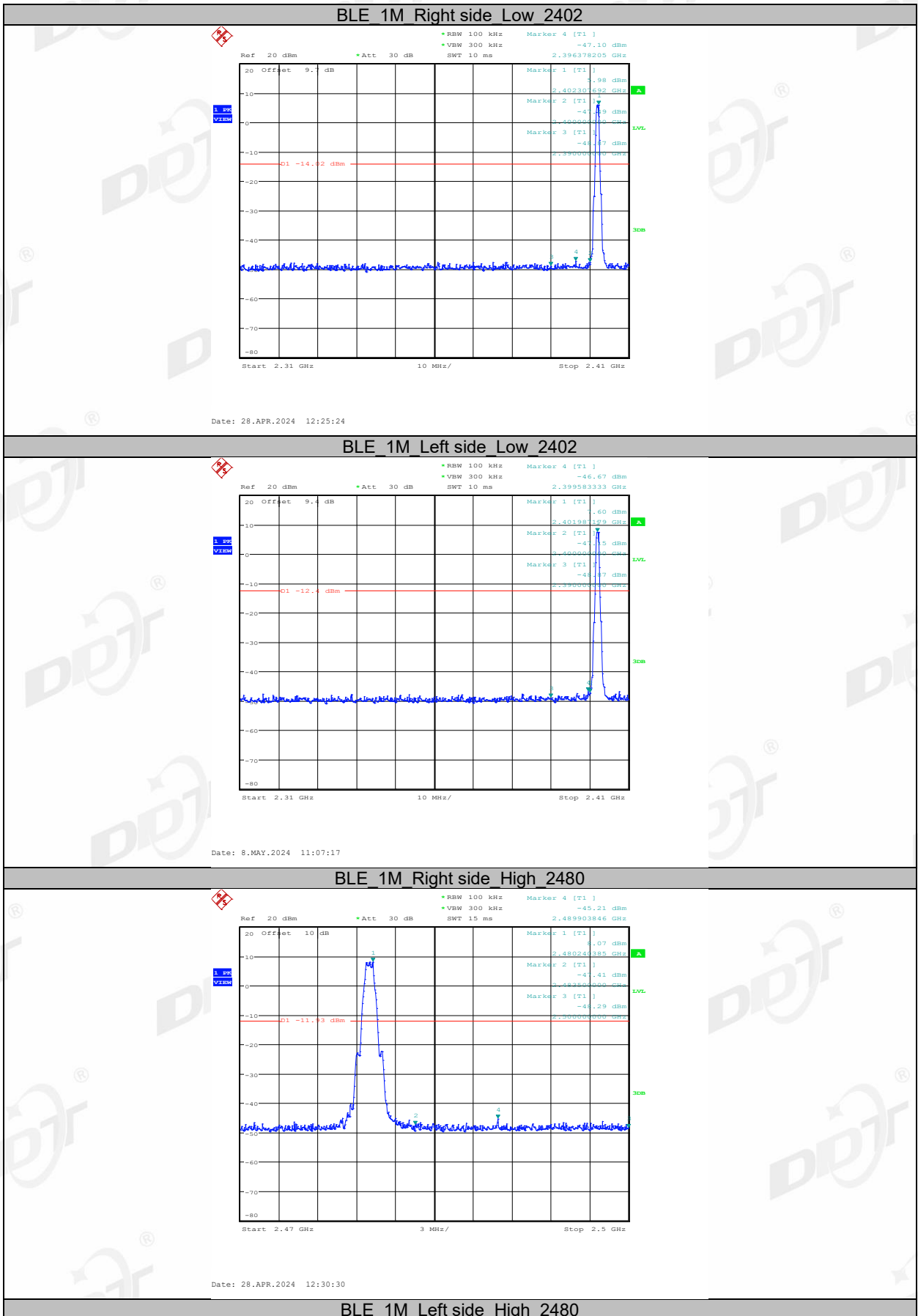
RBW:	100 kHz
VBW:	300 kHz
Span	Encompass frequency range to be measured
Detector Mode:	Peak
Sweep time:	Auto
Trace mode	Max hold
- (3) Allow the trace to stabilize, use the peak marker function to determine the maximum peak power level to establish the reference level.
- (4) Then mark the maximum amplitude of all unwanted emissions outside of the authorized frequency band.

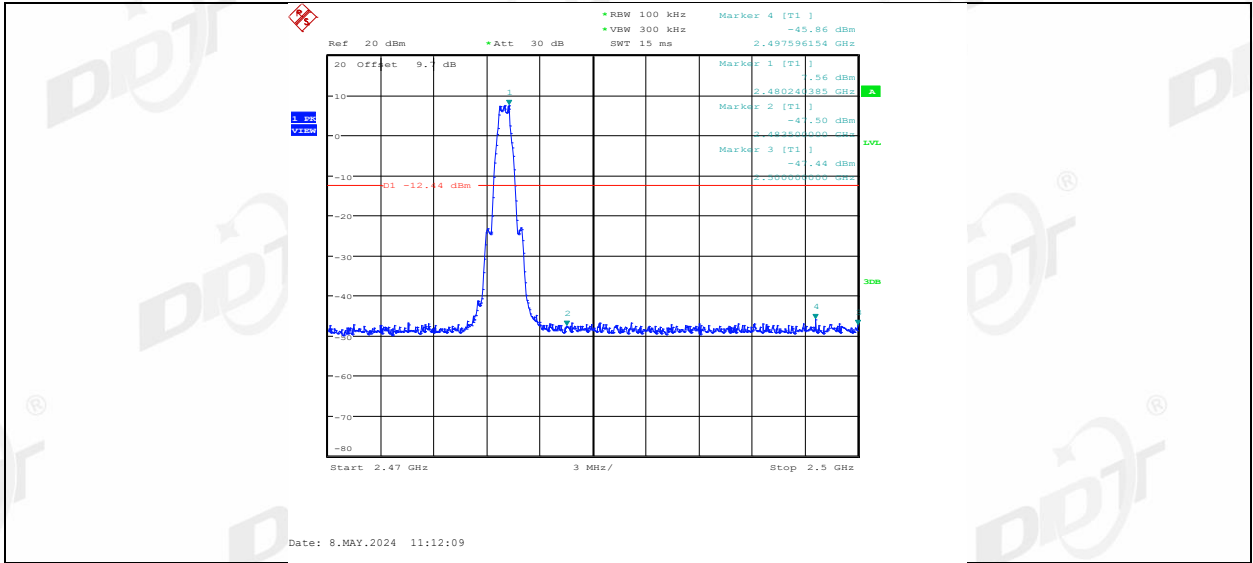
8.4. Test result

Test Engineer:	Zora Zhang	Test Site:	RF Measurement System 1#
Ambient Condition:	24.4°C,59.7%RH	Test Date:	2024.04.28-2024.05.08
Test Power Supply:	Battery	Sample Number:	S24022823-014

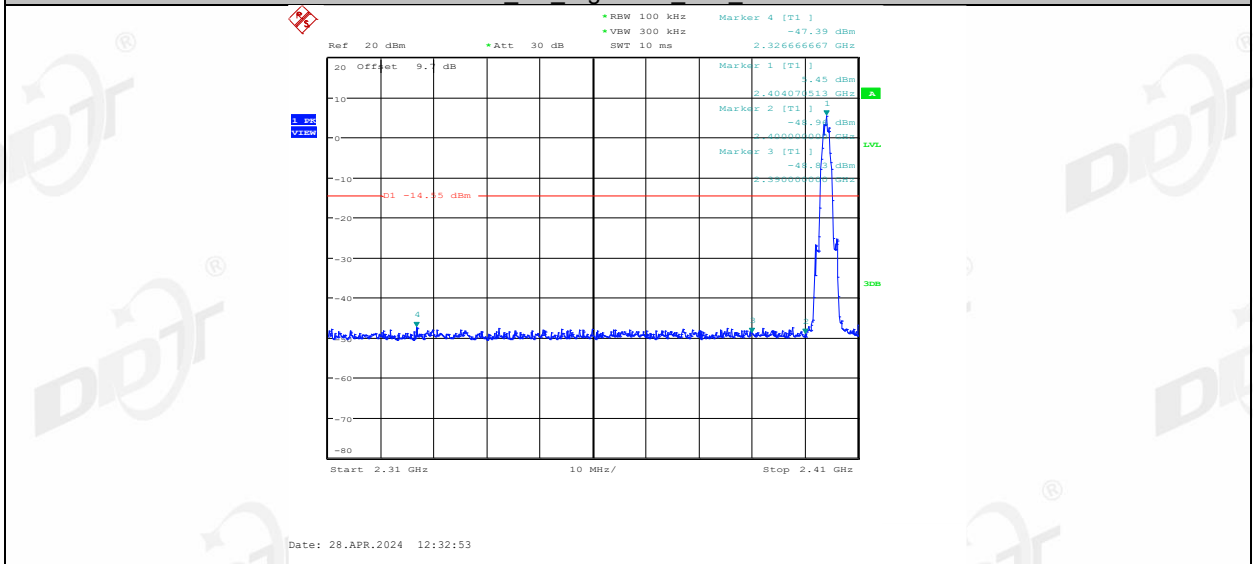
EUT Set Mode	CH or Frequency	Measured Range	Verdict
GFSK 1M	2402	2.310 GHz - 2.410 GHz	Pass
	2480	2.470 GHz - 2.500 GHz	Pass
GFSK 2M	2404	2.310 GHz - 2.410 GHz	Pass
	2478	2.470 GHz - 2.500 GHz	Pass

8.5. Test graphs

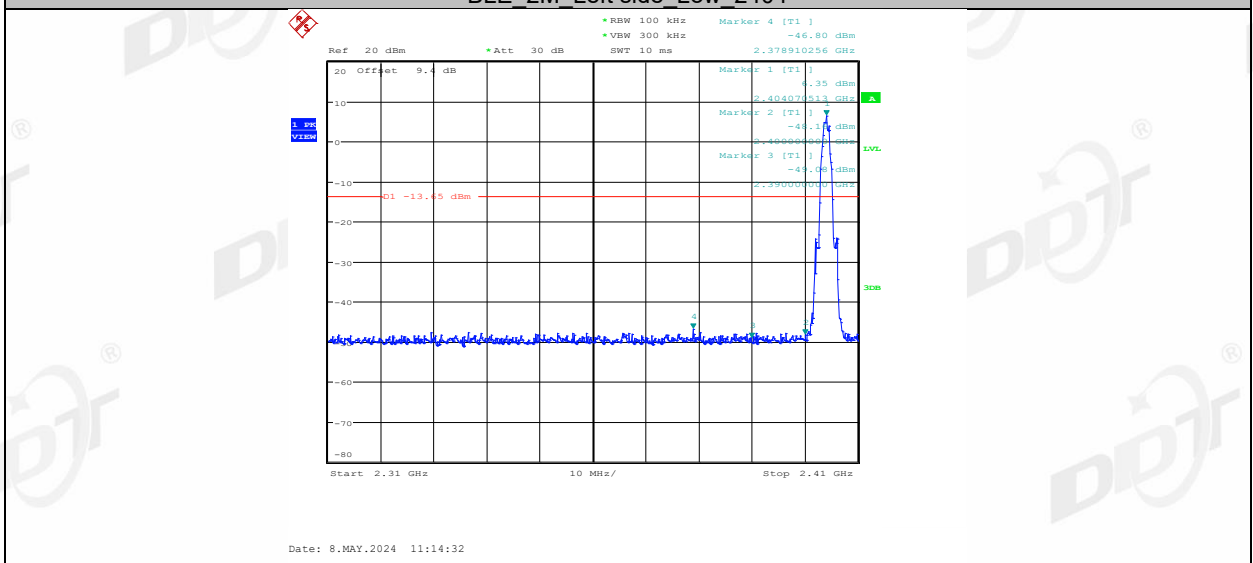




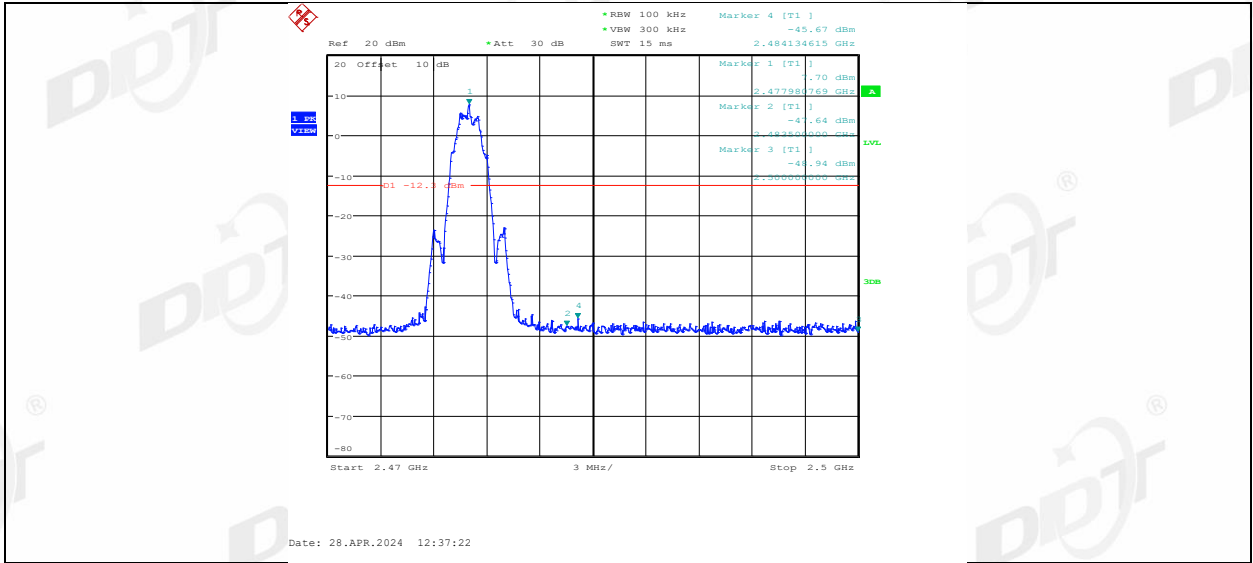
BLE 2M Right side Low 2404



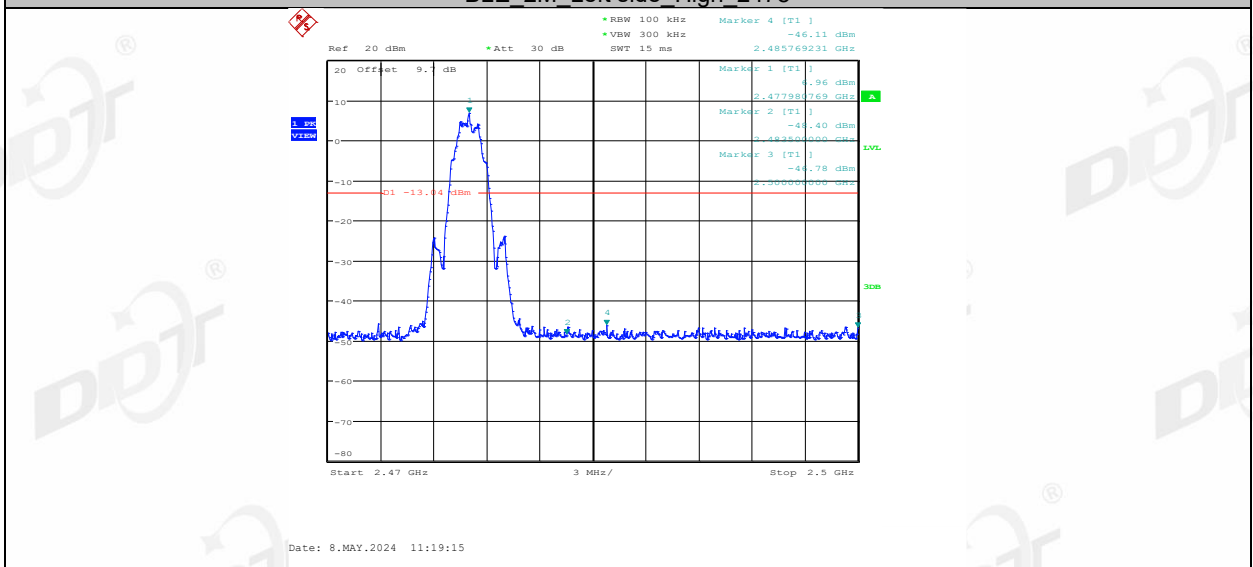
BLE 2M Left side Low 2404



BLE 2M Right side High 2478

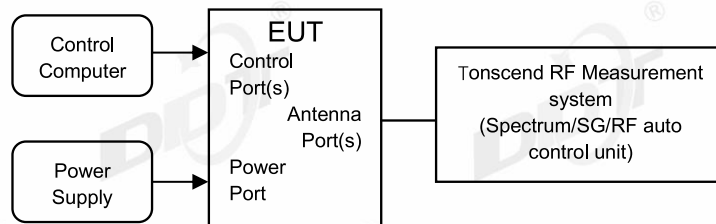


BLE_2M_Left side_High_2478



9. RF Conducted Spurious Emissions

9.1. Block diagram of test setup



9.2. Limits

In any 100 kHz bandwidth outside the frequency bands in which the spread spectrum 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.

9.3. Test procedure

(1) Connect EUT's antenna output to spectrum analyzer by RF cable.

(2) Establish a reference level by using the following procedure:

Center frequency	Test frequency
RBW:	100 kHz
VBW:	300 kHz
Span	Wide enough to capture the peak level of the in-band emission
Detector Mode:	Peak
Sweep time:	Auto
Trace mode	Max hold

(3) Allow the trace to stabilize, use the peak marker function to determine the maximum peak power level to establish the reference level.

(4) Set the spectrum analyzer as follows:

RBW:	100 kHz
VBW:	300 kHz
Span	Encompass frequency range to be measured
Number of measurement points	$\geq \text{Span}/\text{RBW}$
Detector Mode:	Peak
Sweep time:	Auto
Trace mode	Max hold

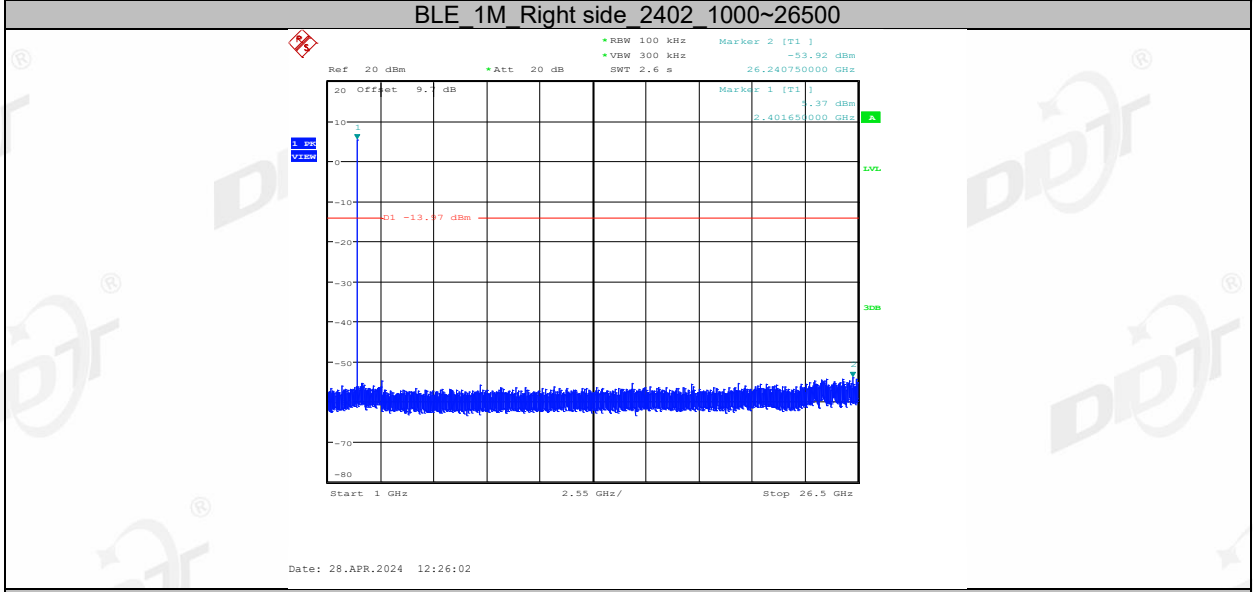
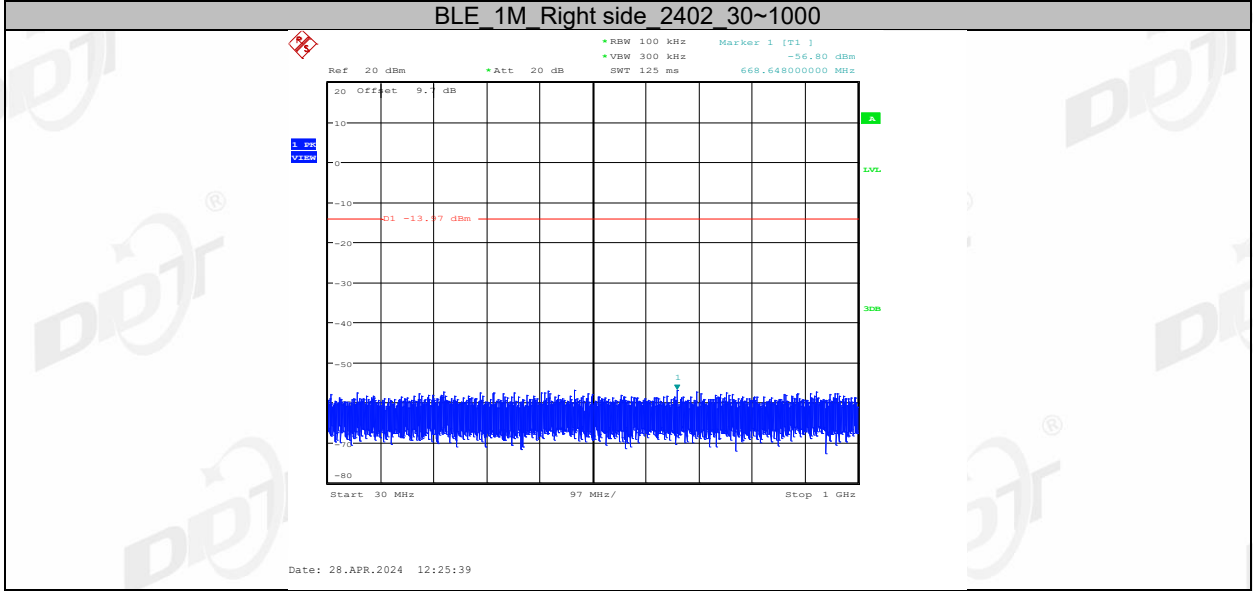
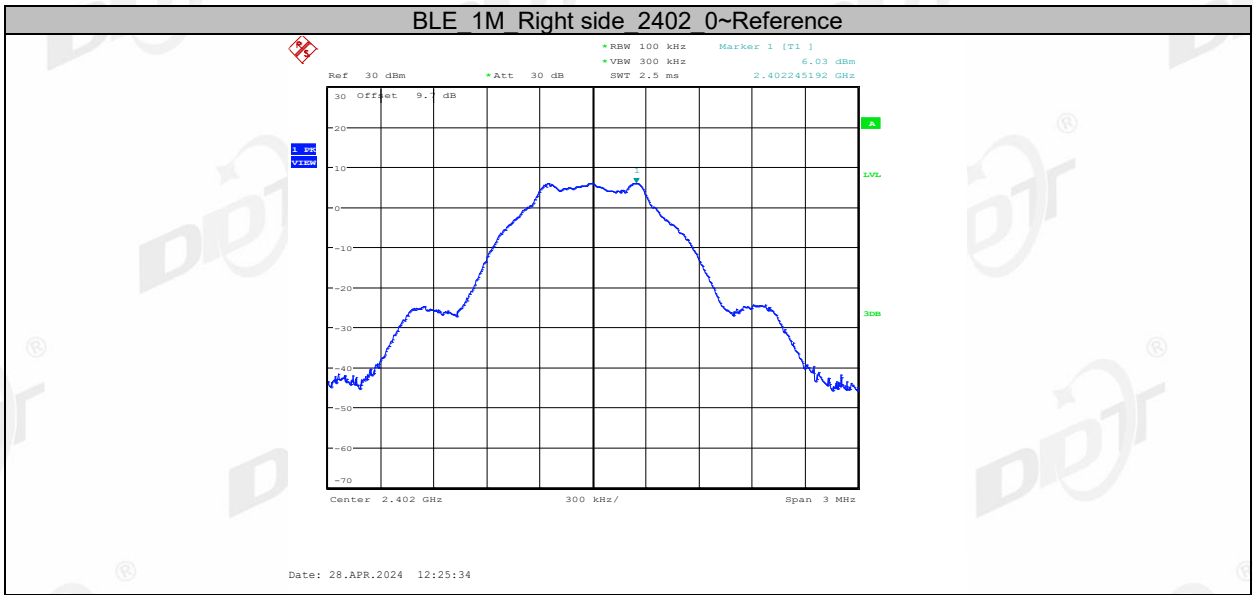
Allow the trace to stabilize, use the peak marker function to determine the maximum amplitude of all unwanted emissions outside of the authorized frequency band

9.4. Test result

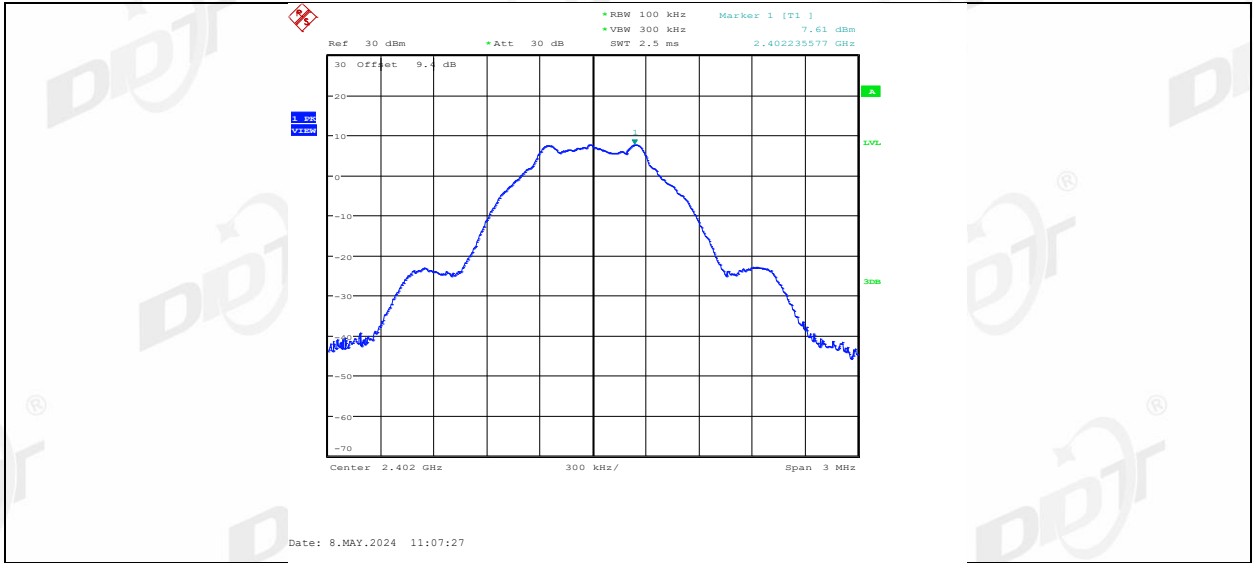
Test Engineer:	Zora Zhang	Test Site:	RF Measurement System 1#
Ambient Condition:	24.4°C,59.7%RH	Test Date:	2024.04.28-2024.05.08
Test Power Supply:	Battery	Sample Number:	S24022823-014

Mode	Freq. (MHz)	Verdict
GFSK 1M	2402	Pass
	2440	Pass
	2480	Pass
GFSK 2M	2404	Pass
	2440	Pass
	2478	Pass

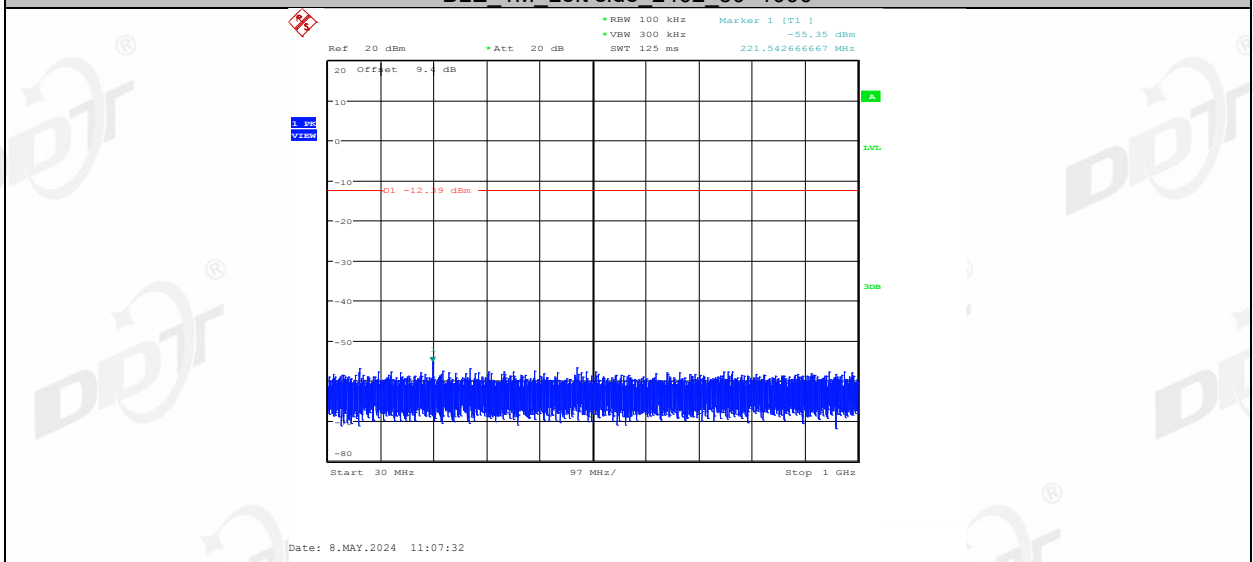
9.5. Test graphs



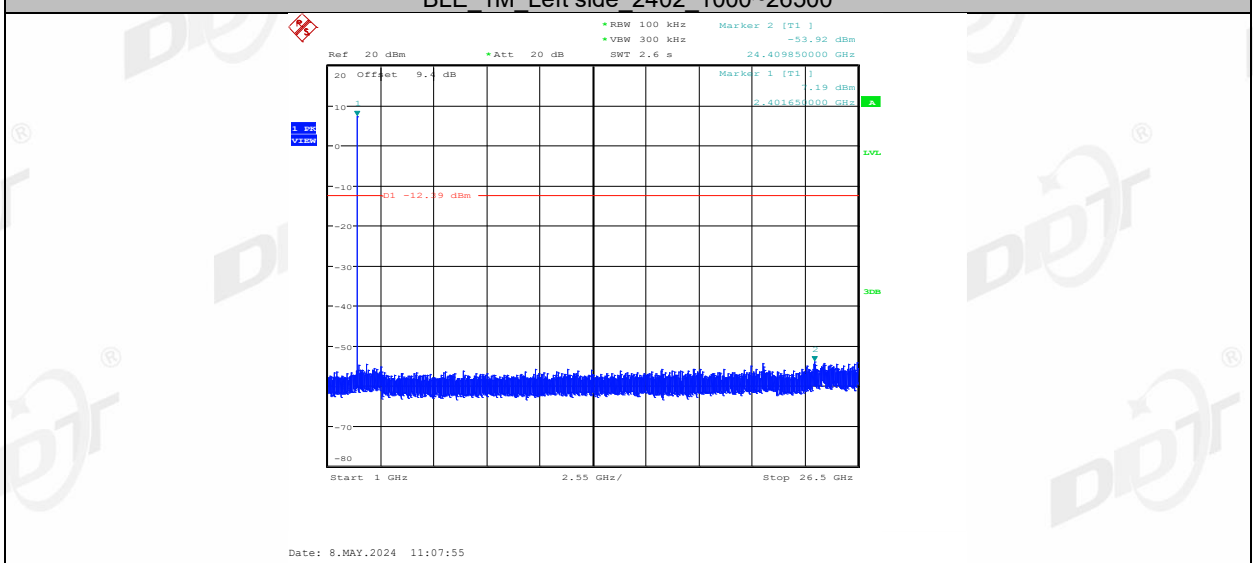
BLE 1M Left side 2402 0~Reference



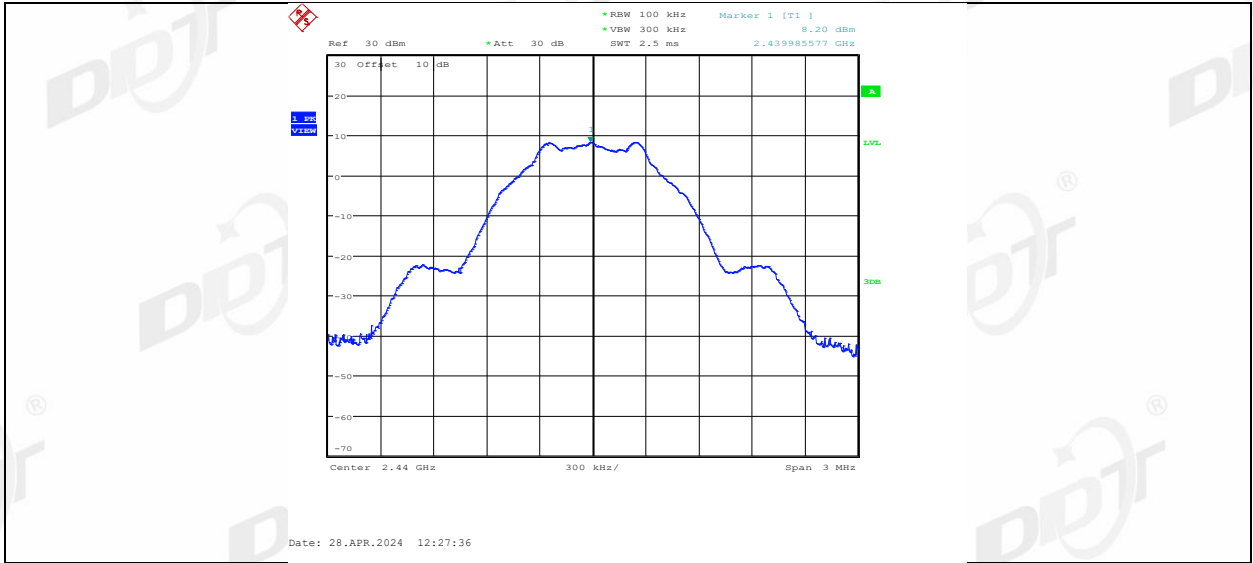
BLE_1M_Left side_2402_30~1000



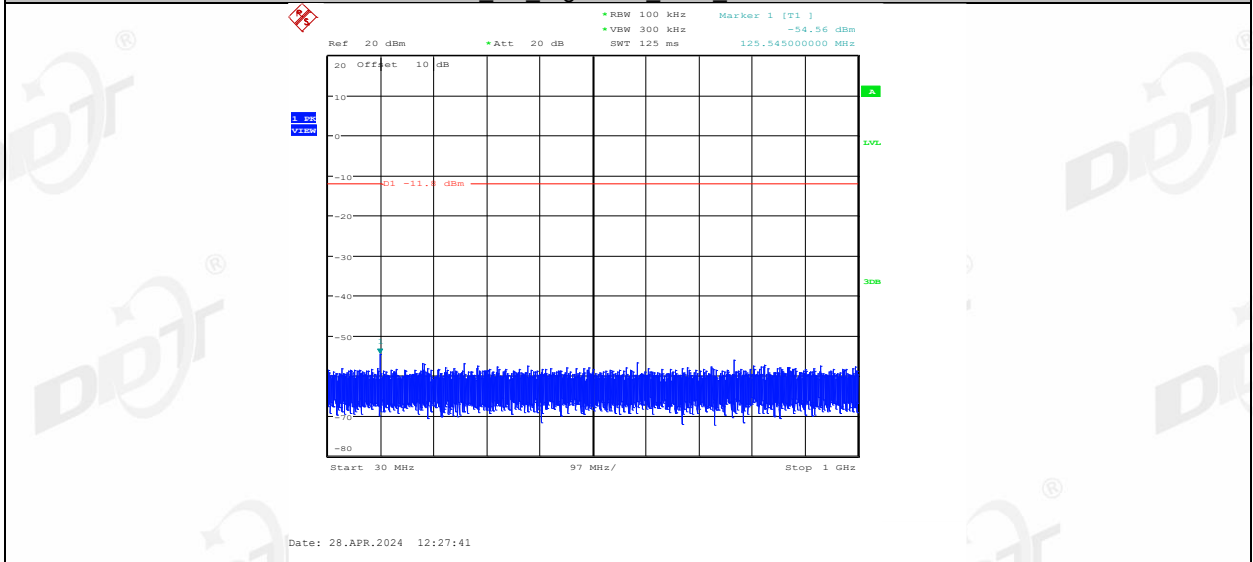
BLE_1M_Left side_2402_1000~26500



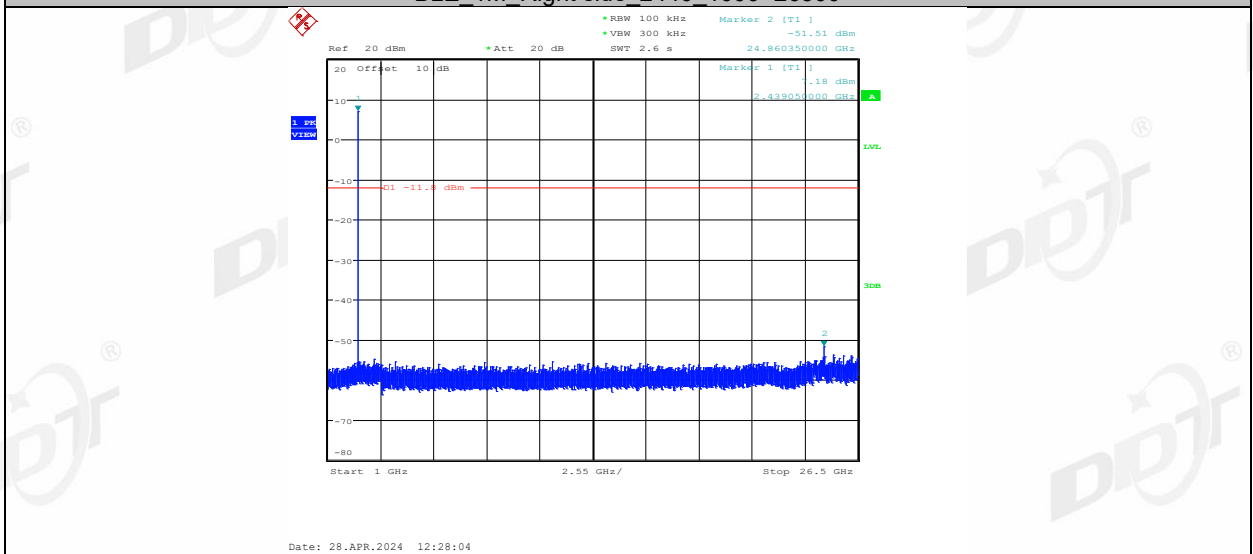
BLE_1M_Right side_2440_0~Reference



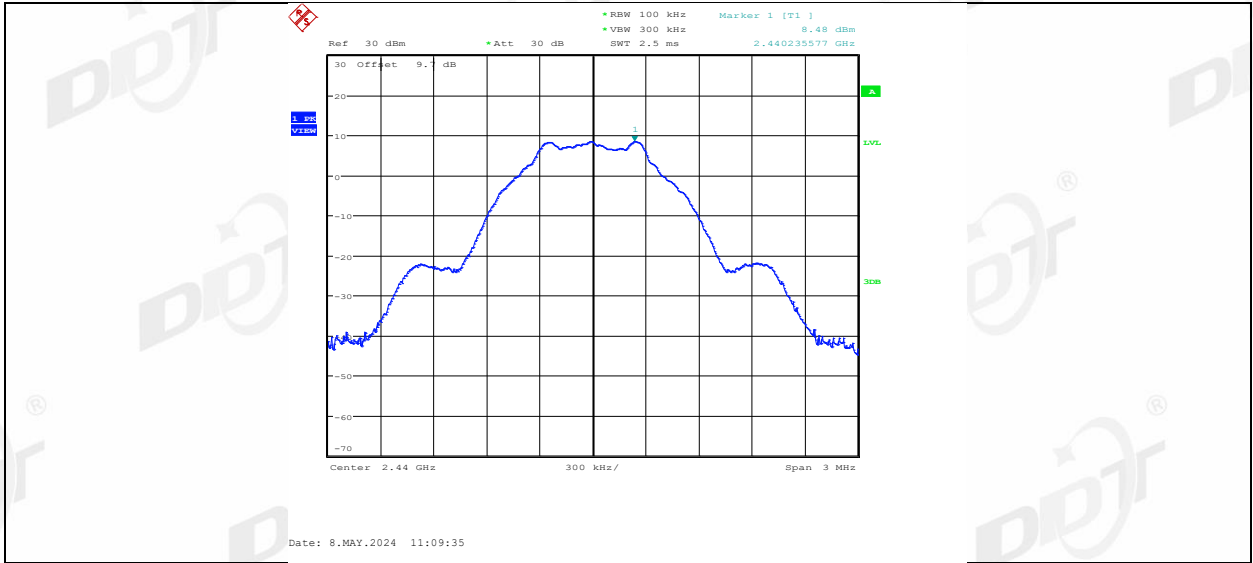
BLE_1M_Right side_2440_30~1000



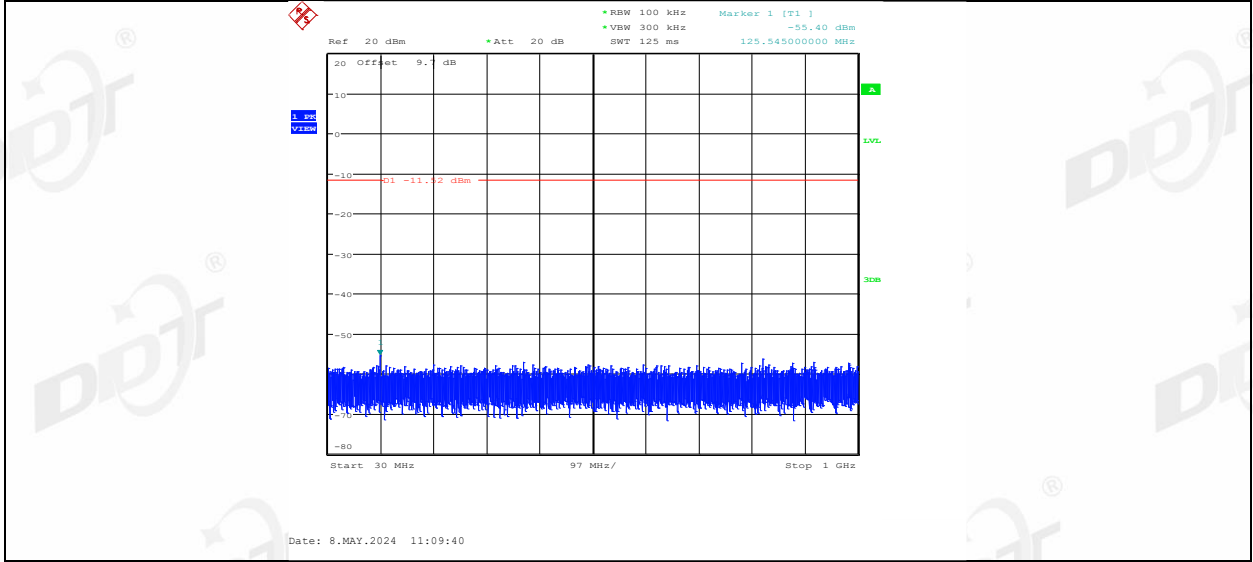
BLE_1M_Right side_2440_1000~26500



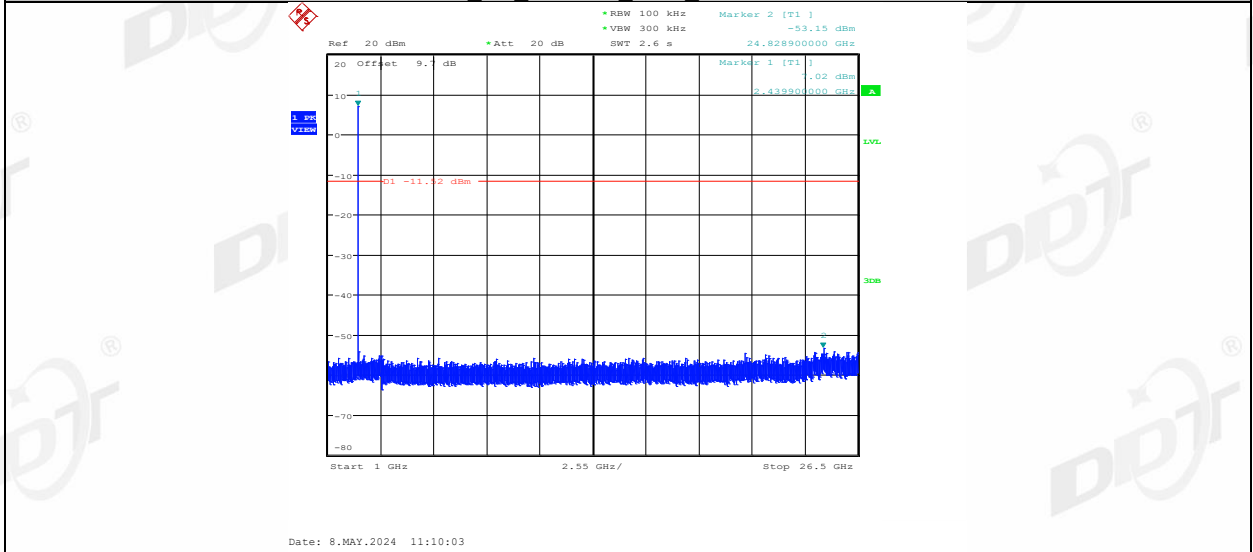
BLE_1M_Left side_2440_0~Reference



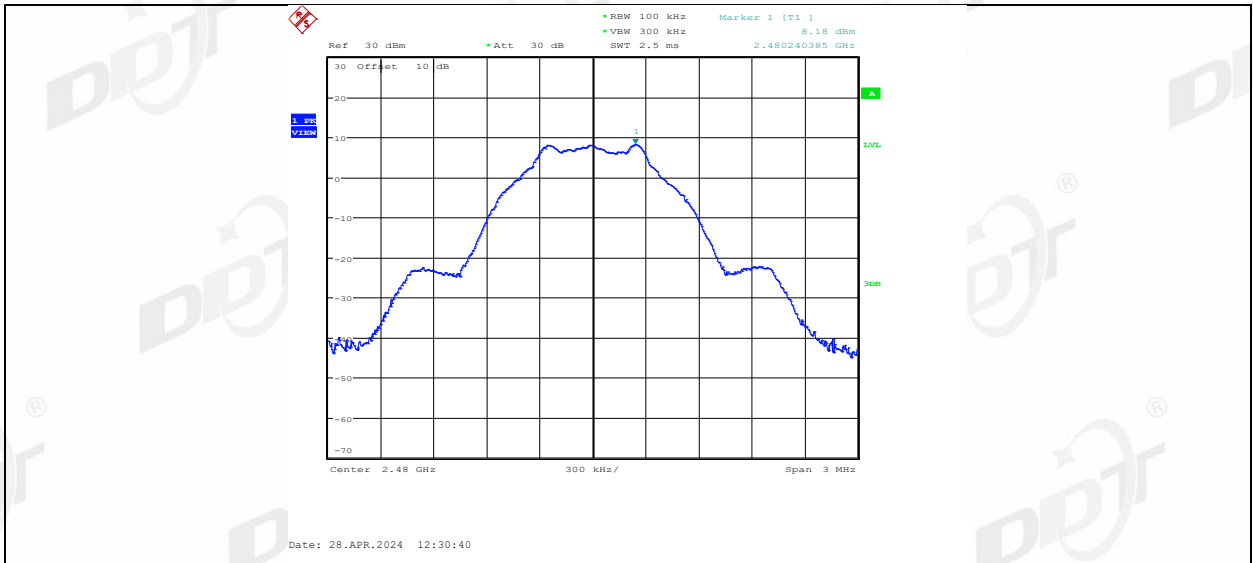
BLE 1M Left side 2440 30~1000



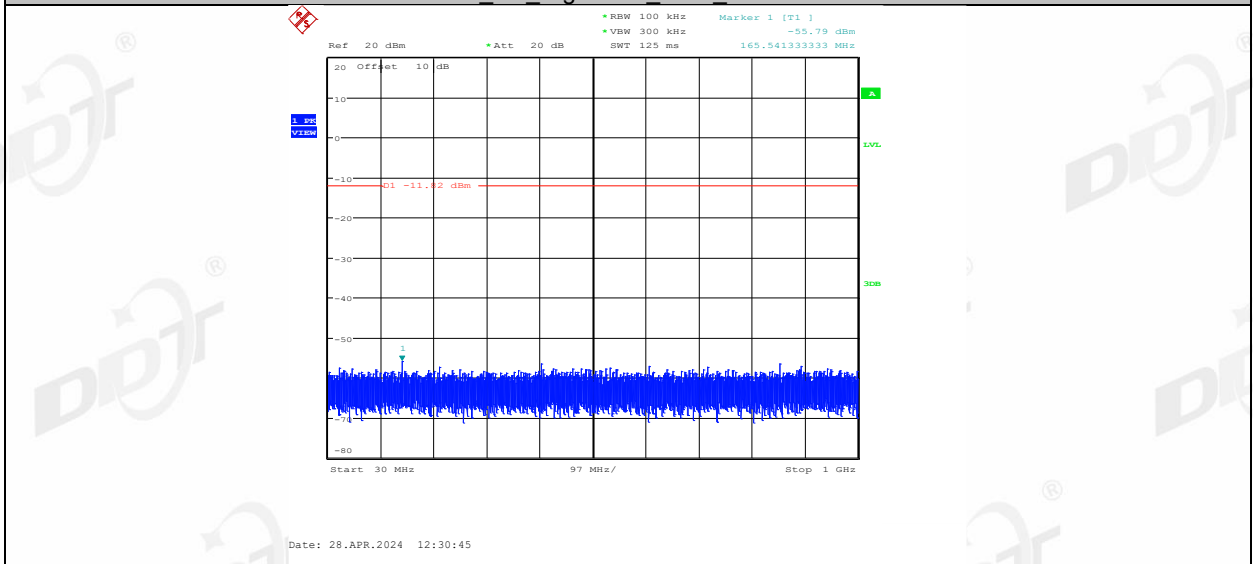
BLE 1M Left side 2440 1000~26500



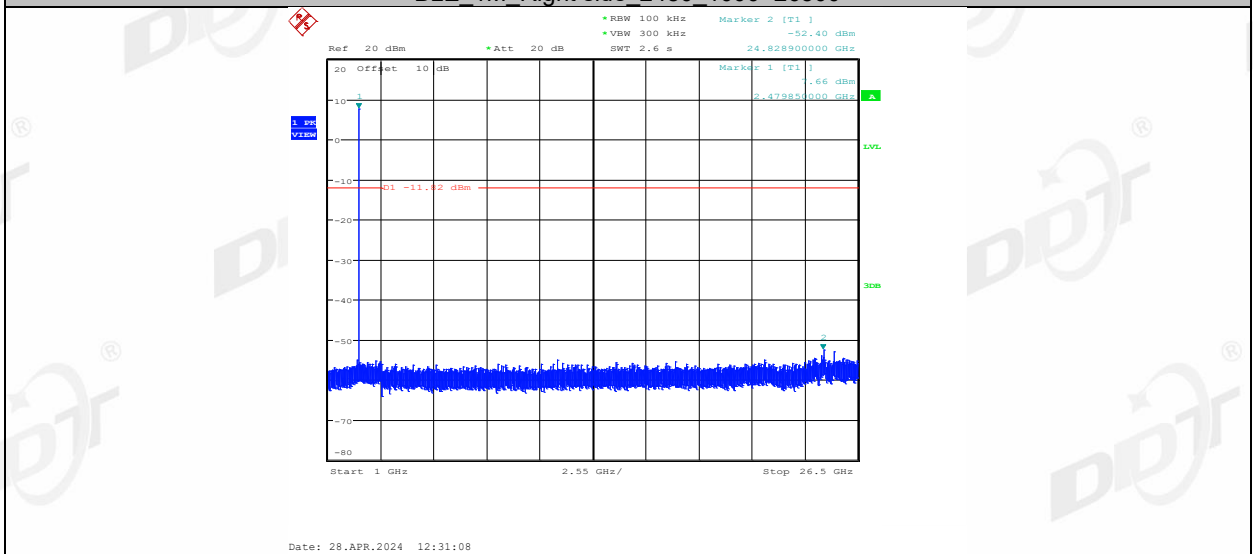
BLE 1M Right side 2480 0~Reference



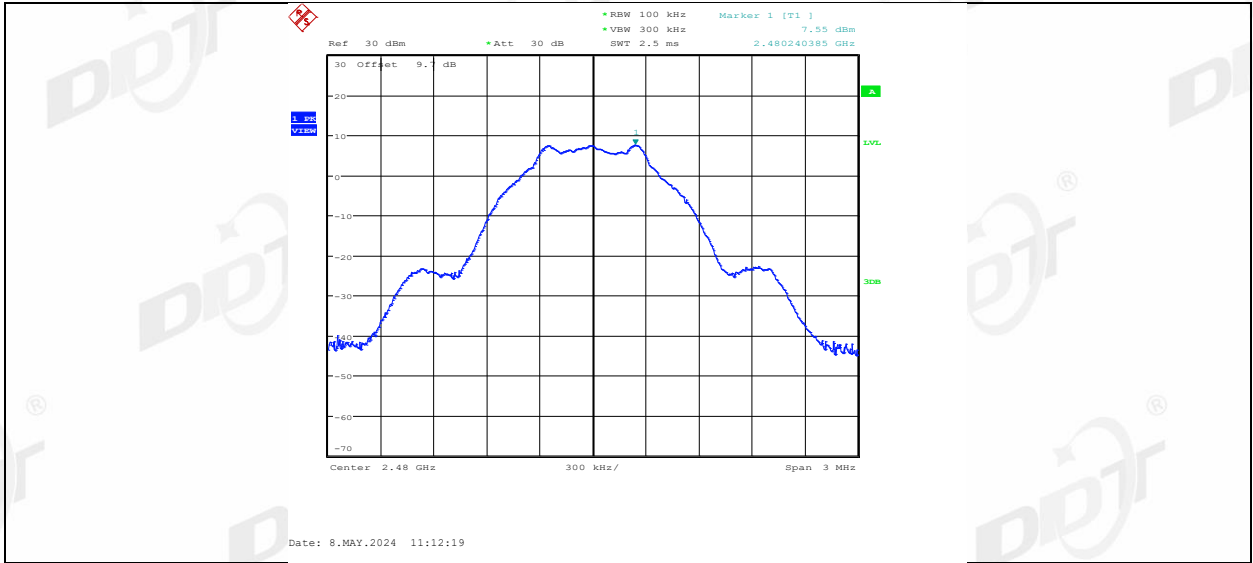
BLE_1M_Right side_2480_30~1000



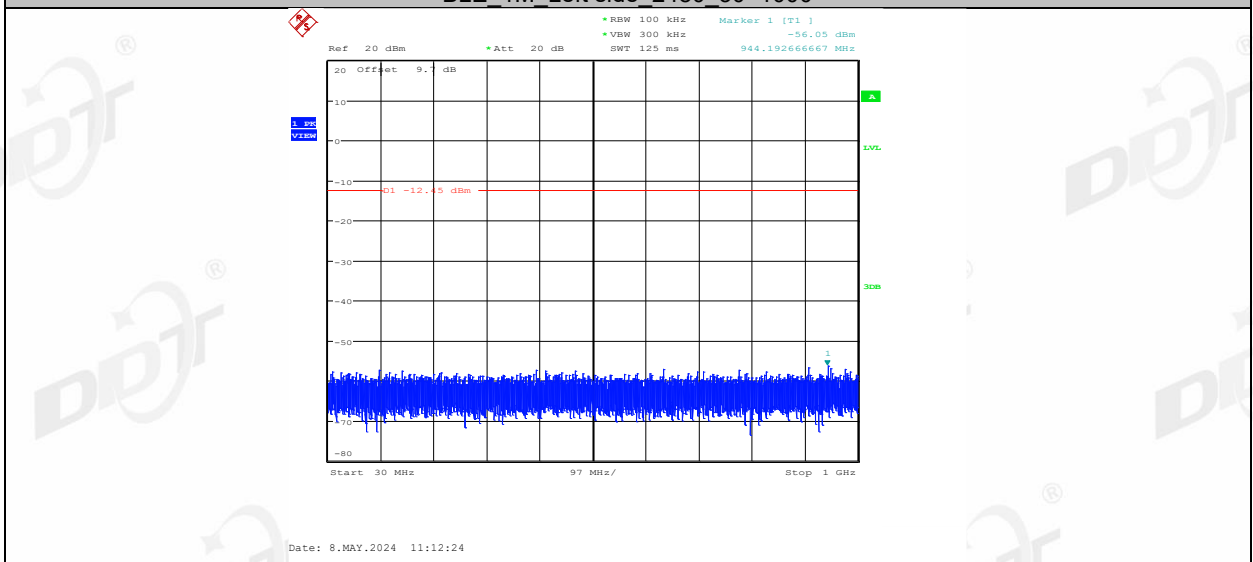
BLE_1M_Right side_2480_1000~26500



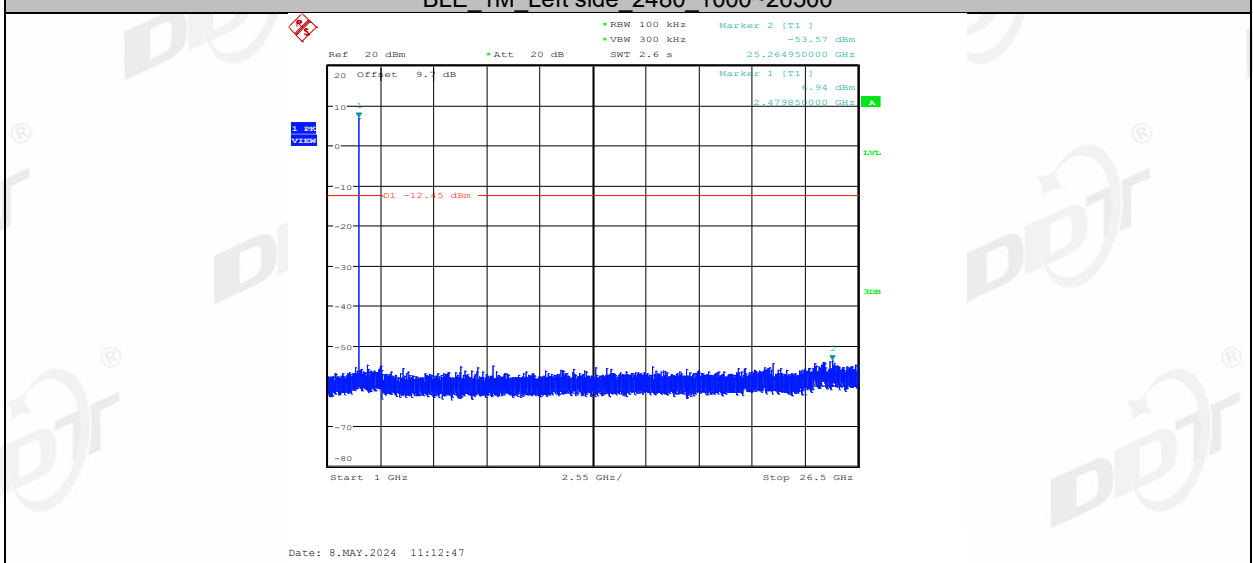
BLE_1M_Left side_2480_0~Reference



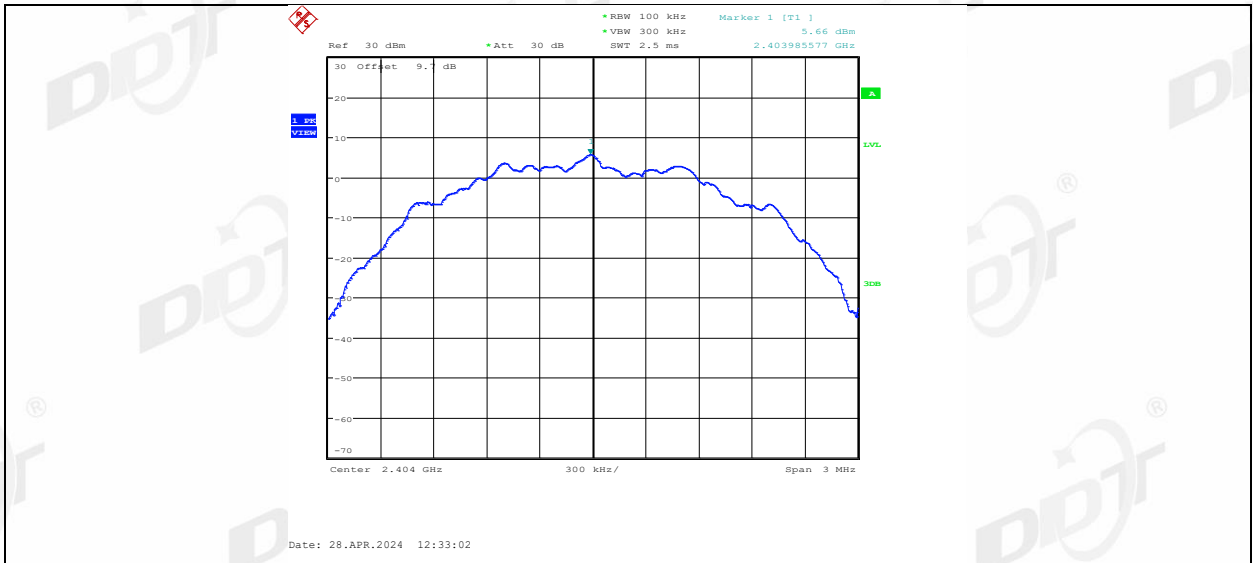
BLE 1M Left side 2480 30~1000



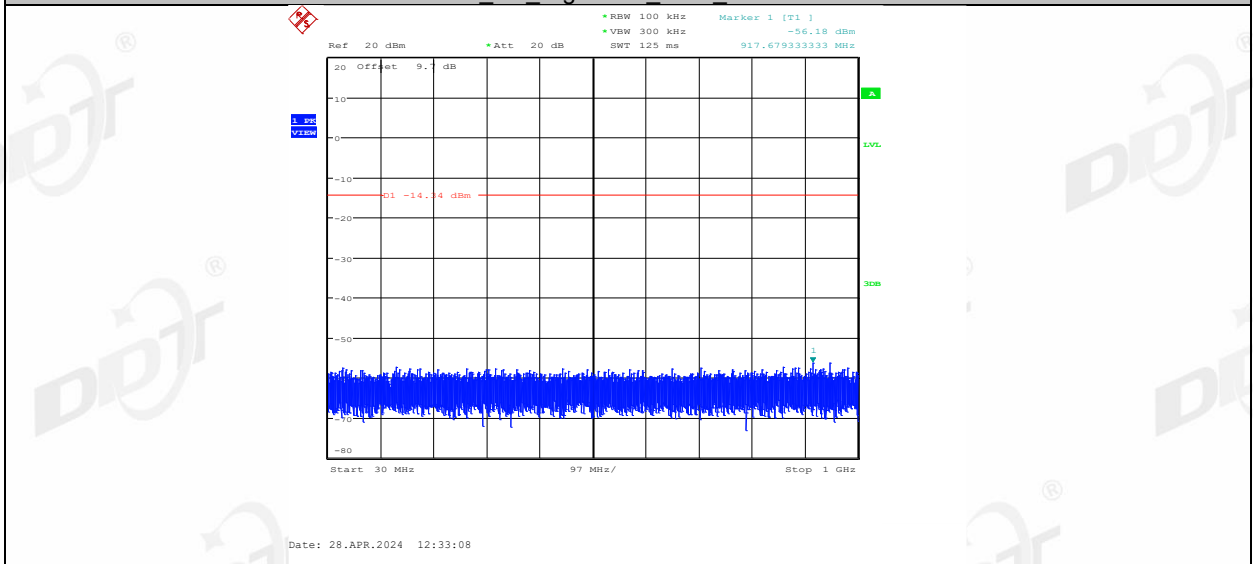
BLE 1M Left side 2480 1000~26500



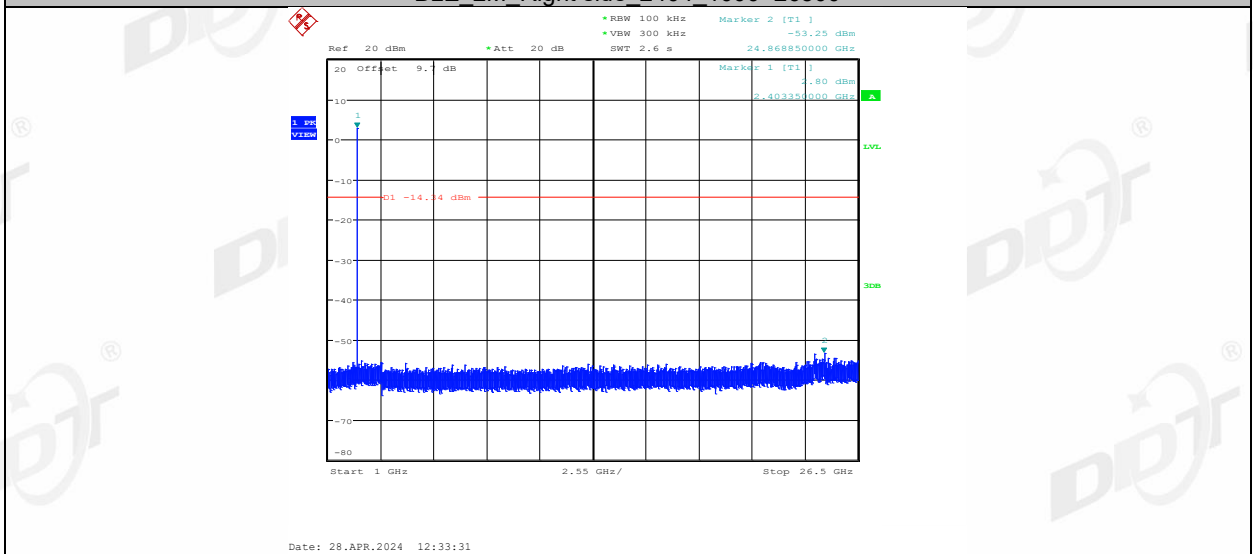
BLE 2M Right side 2404 0-Reference



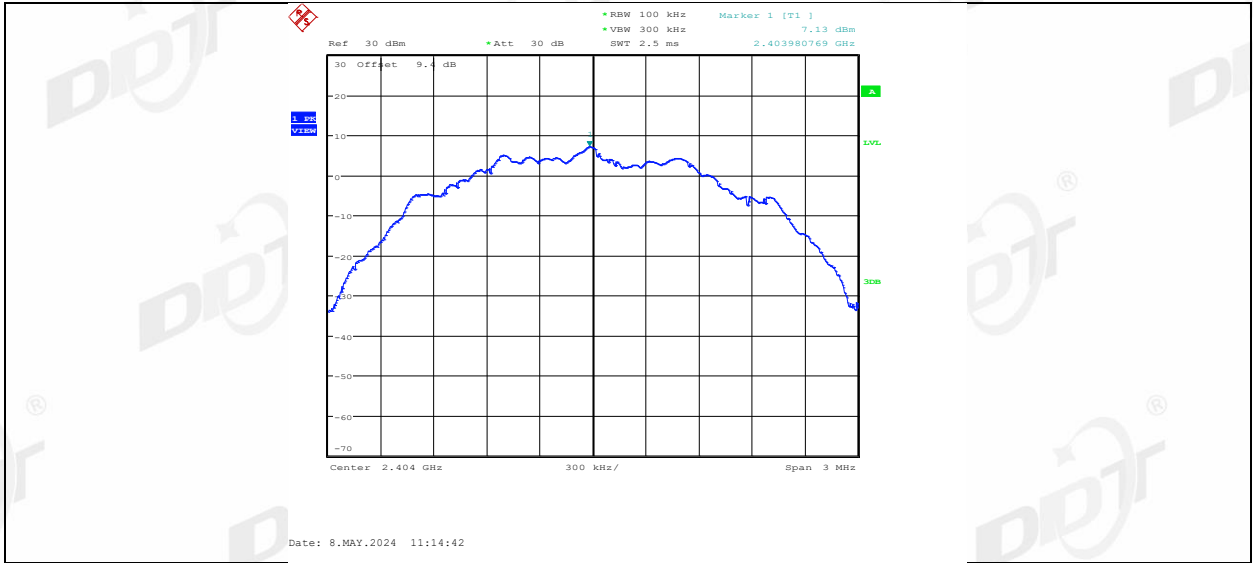
BLE 2M Right side 2404 30~1000



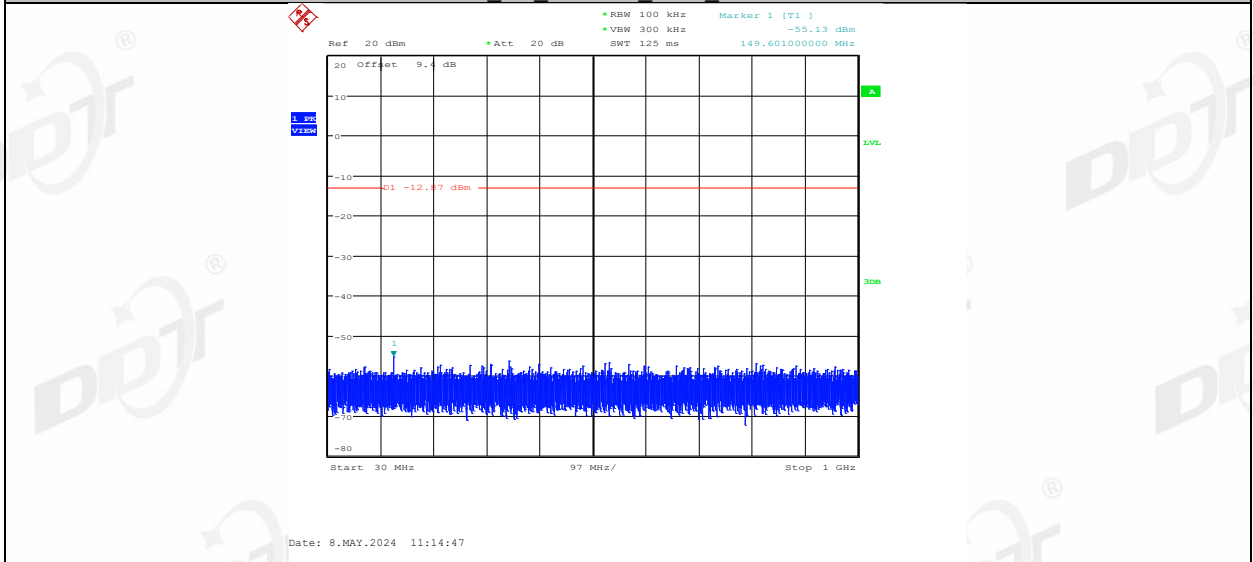
BLE 2M Right side 2404 1000~26500



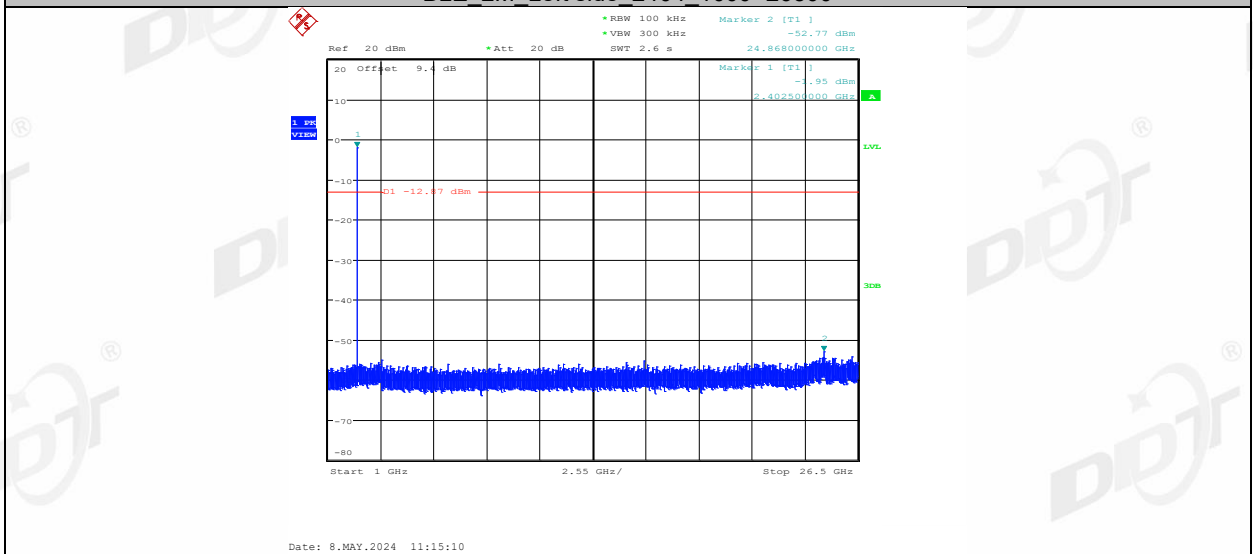
BLE 2M Left side 2404 0~Reference



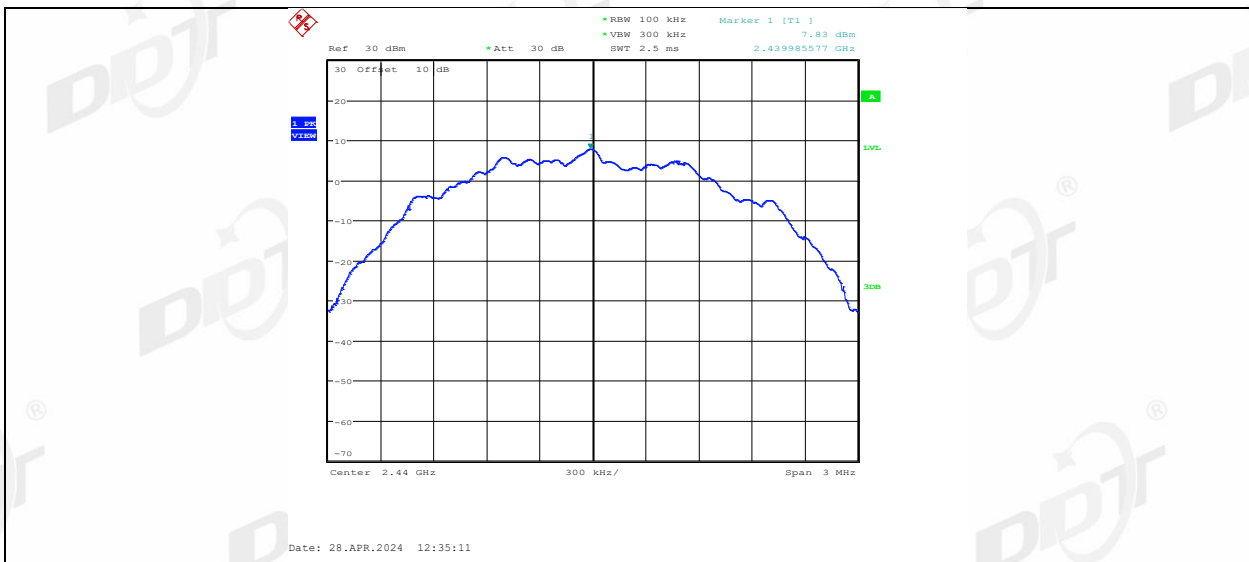
BLE_2M_Left side_2404_30~1000



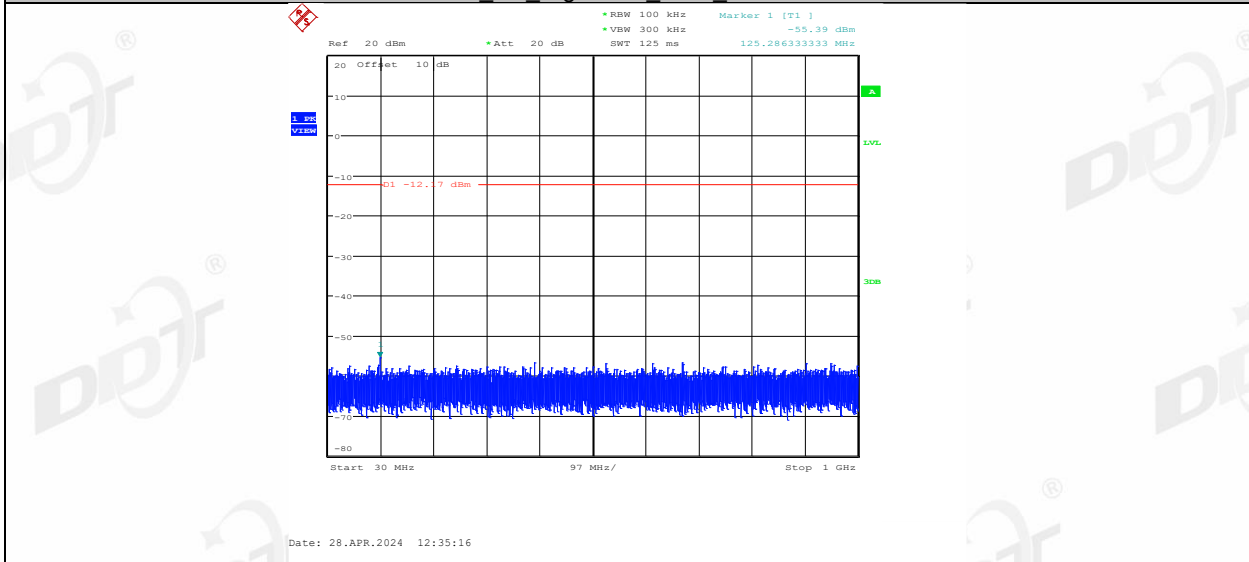
BLE_2M_Left side_2404_1000~26500



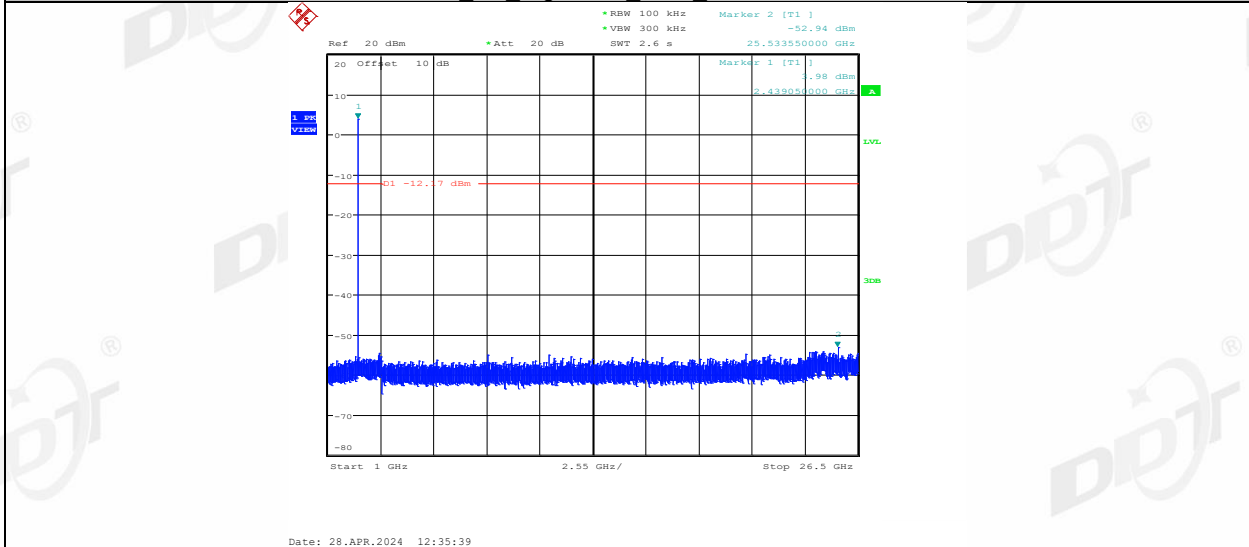
BLE_2M_Right side_2440_0~Reference



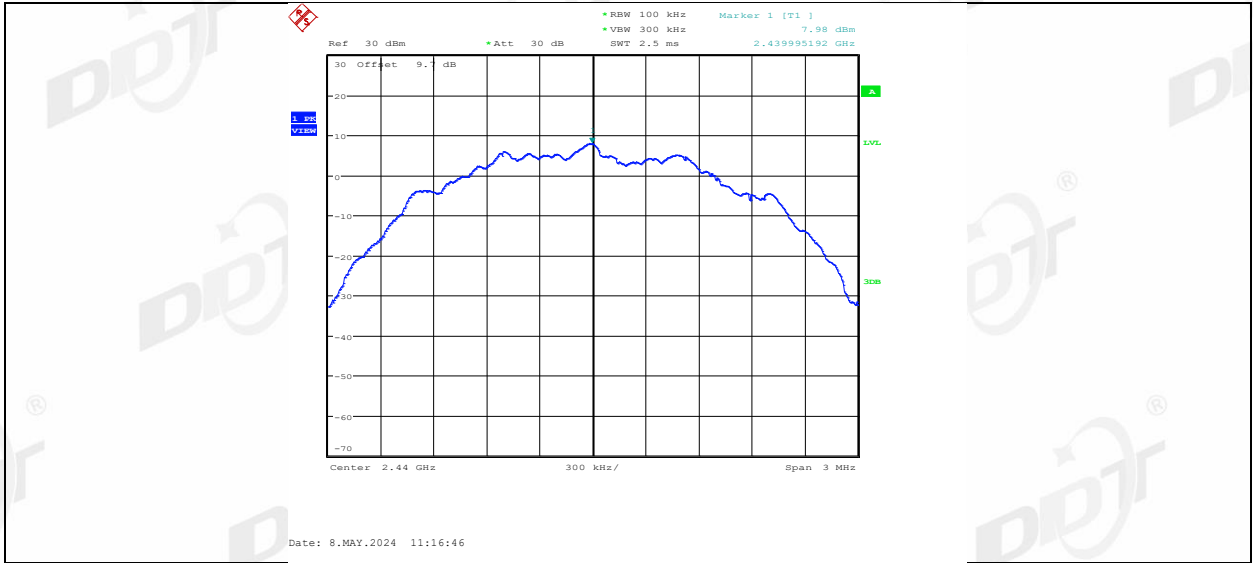
BLE_2M_Right side_2440_30~1000



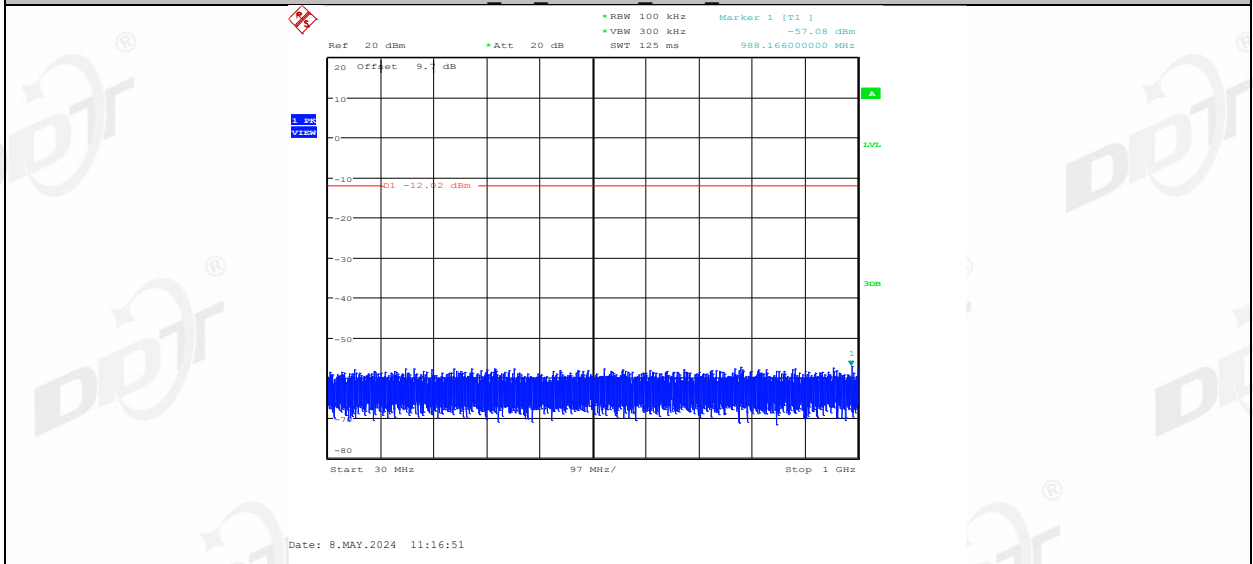
BLE_2M_Right side_2440_1000~26500



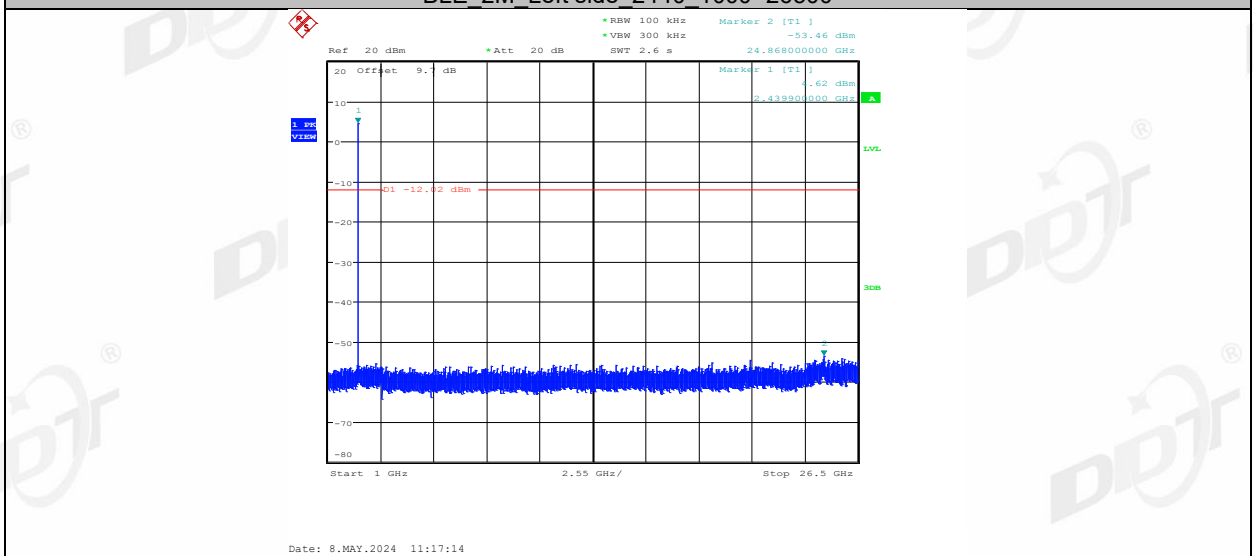
BLE_2M_Left side_2440_0~Reference



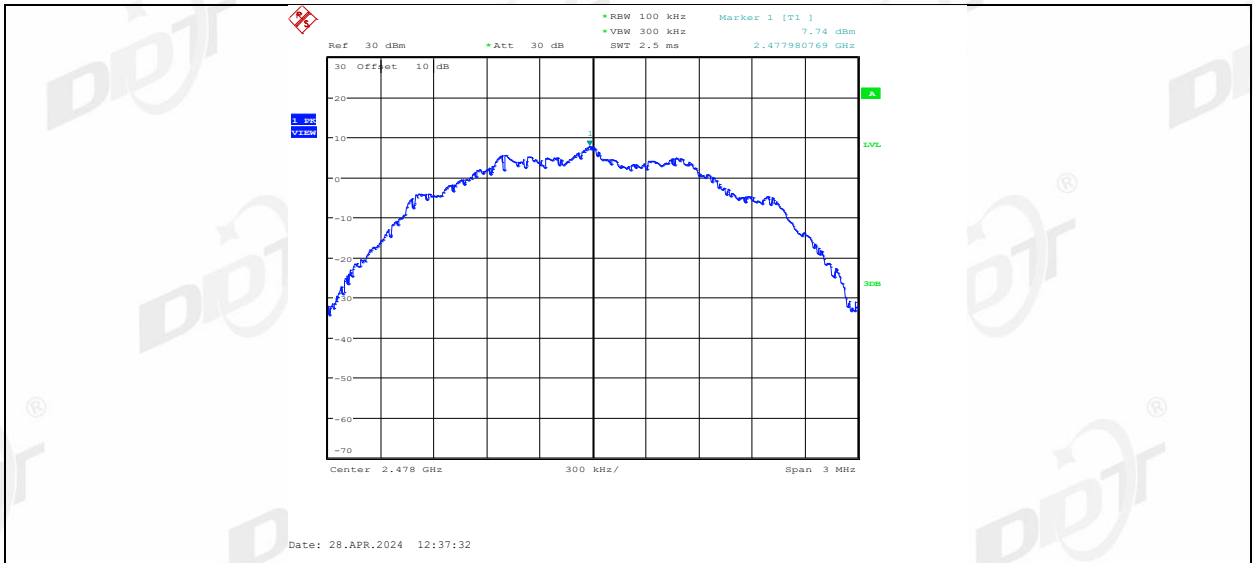
BLE 2M Left side 2440 30~1000



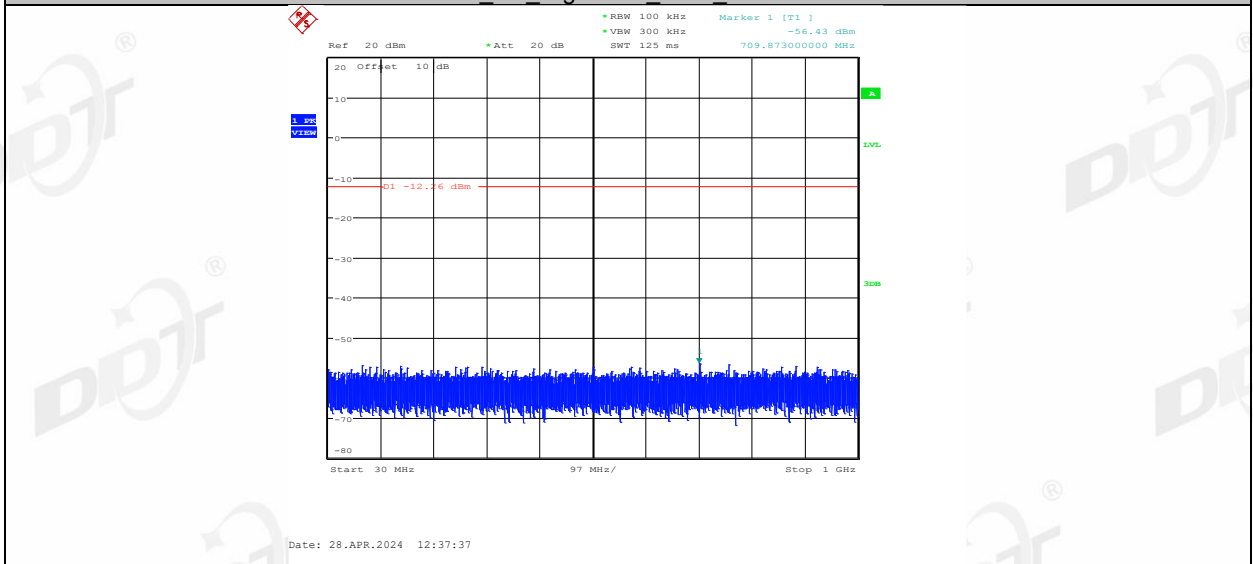
BLE 2M Left side 2440 1000~26500



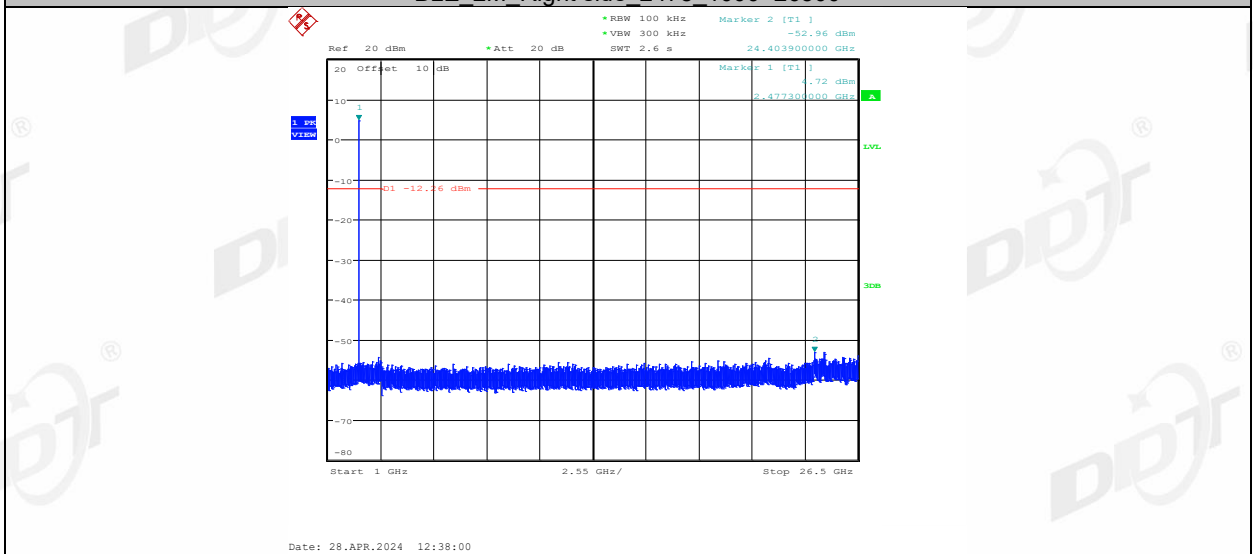
BLE 2M Right side 2478 0~Reference



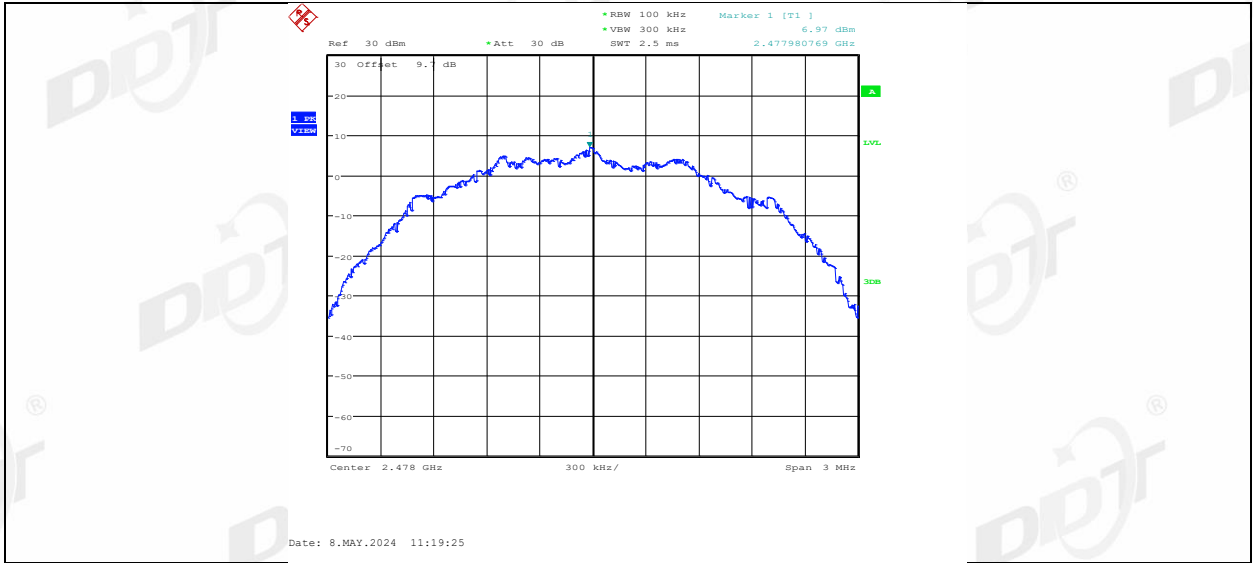
BLE_2M_Right side_2478_30~1000



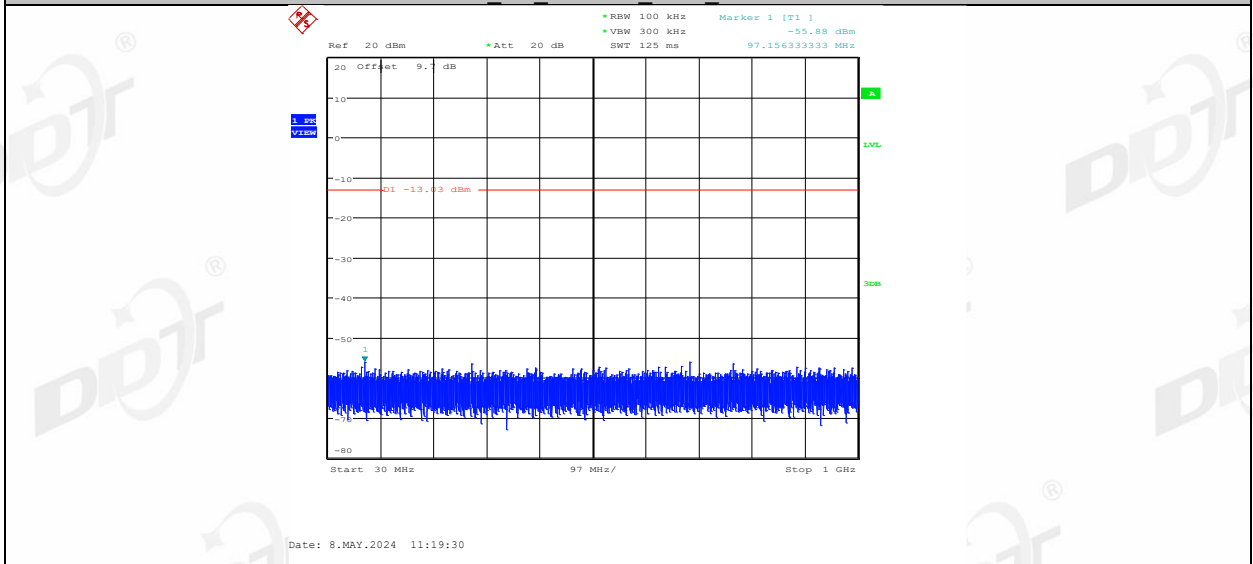
BLE_2M_Right side_2478_1000~26500



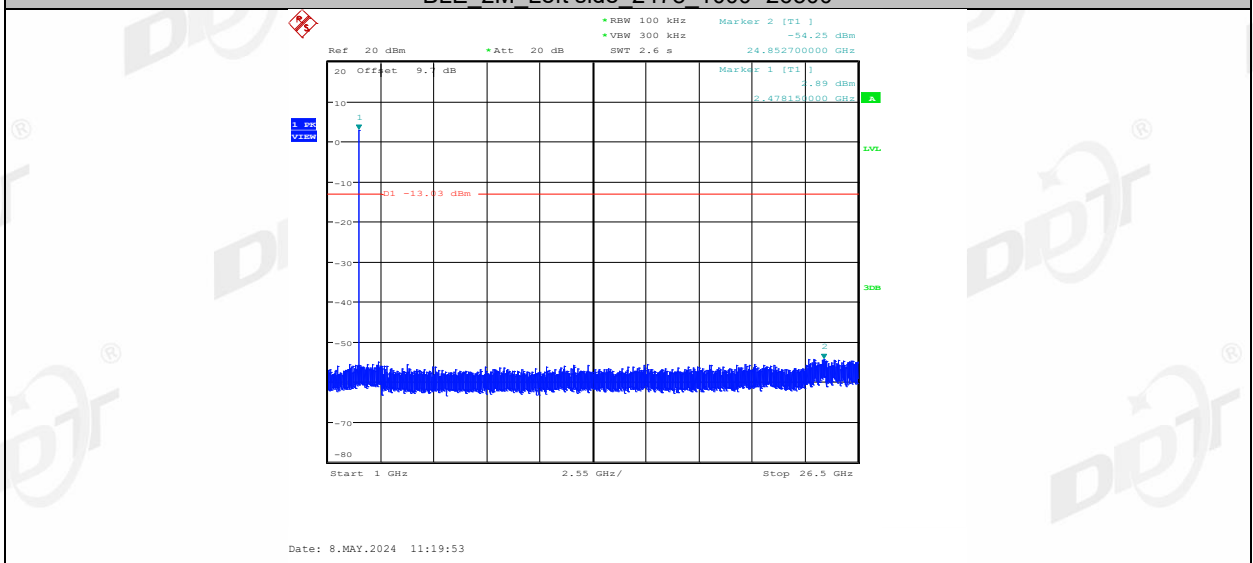
BLE_2M_Left side_2478_0~Reference



BLE_2M_Left side_2478_30~1000

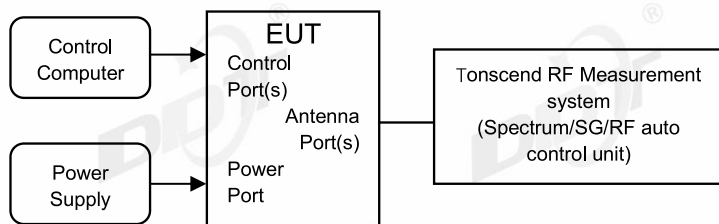


BLE_2M_Left side 2478 1000~26500



10. Duty Cycle

10.1. Block diagram of test setup



10.2. Limit

Just for Report.

10.3. Test procedure

- (1) Connected the EUT's antenna port to the Spectrum Analyzer by suitable attenuator, The cable loss and attenuator loss have been put into spectrum analyzer as amplitude offset.

set the Spectrum Analyzer as below:

Centre Frequency: The centre frequency of the middle hopping channel.

Resolution BW: 10 MHz.

Video BW: 10 MHz.

Span: Zero span.

Detector: Peak.

Trace Mode: Clear Write.

Sweep: Video Trigger

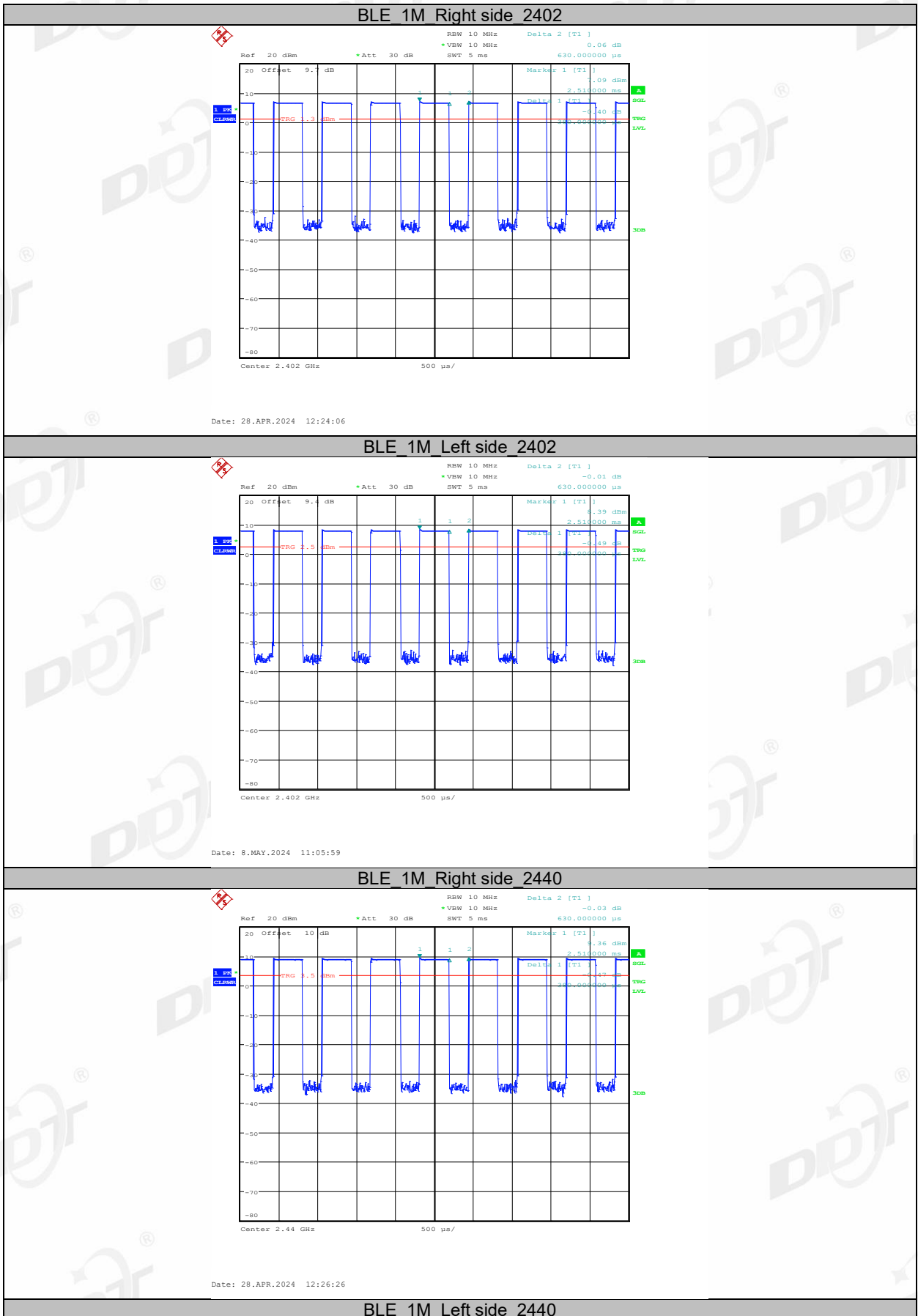
- (2) When the trace is complete, measure the sending time of 1 burst and the duty cycle of 1 burst cycle.
- (3) Calculate dwell time follow below formula:
Duty cycle= Pulse's on time / Burst cycle

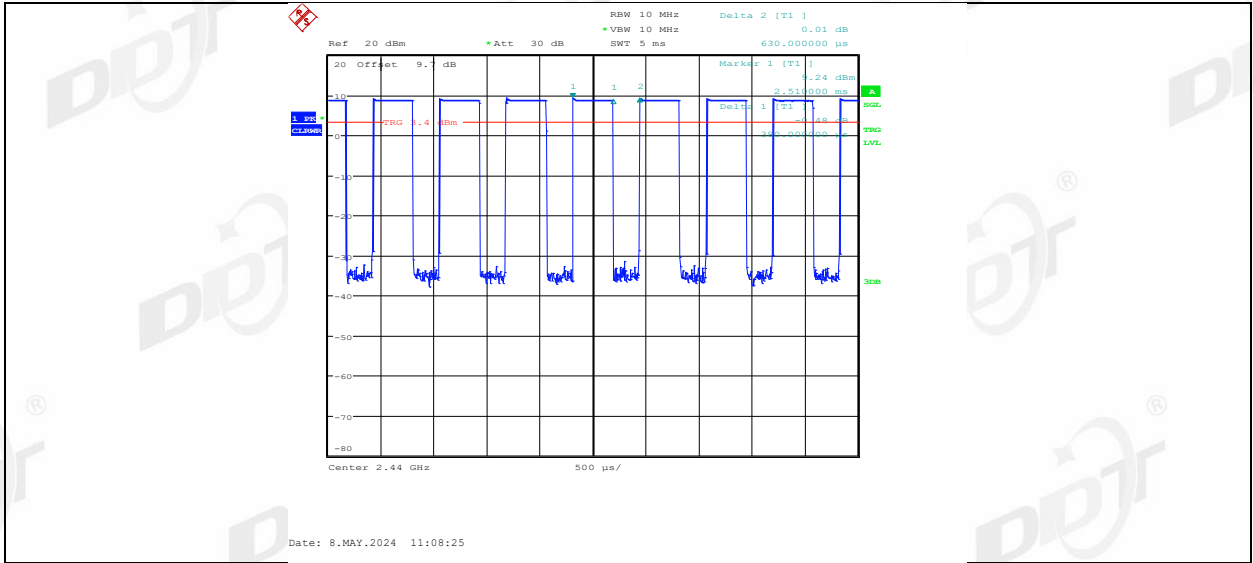
10.4. Test result

Test Engineer:	Zora Zhang	Test Site:	RF Measurement System 1#
Ambient Condition:	24.4°C,59.7%RH	Test Date:	2024.04.28-2024.05.08
Test Power Supply:	Battery	Sample Number:	S24022823-014

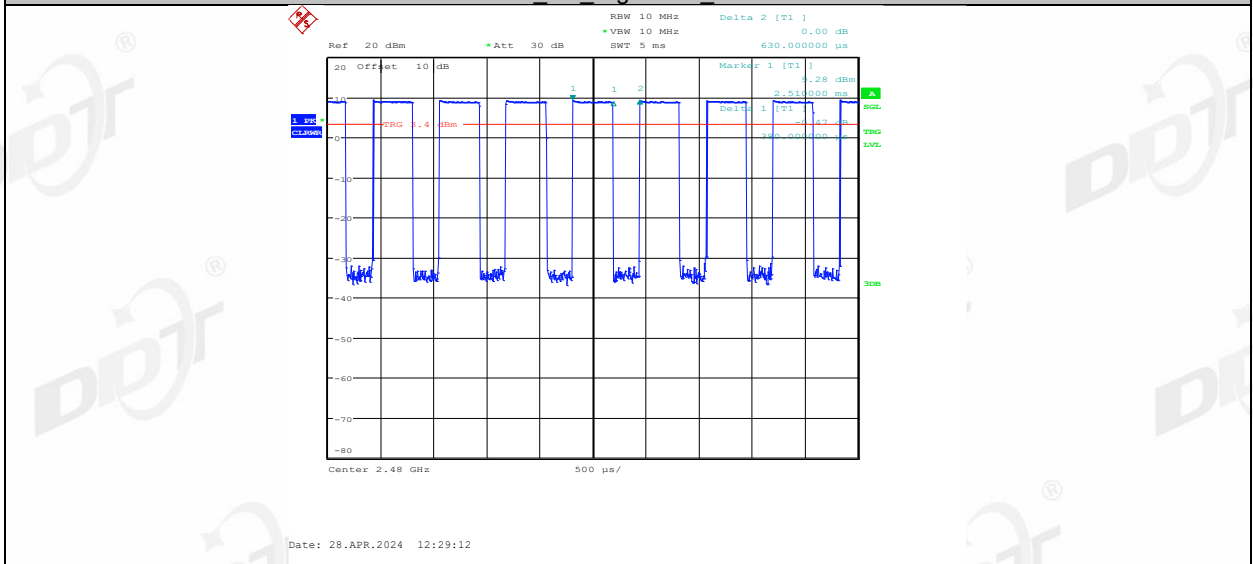
Test Mode	Antenna	Frequency [MHz]	ON Time [ms]	Period [ms]	Duty Cycle [%]	Duty Cycle Factor [dB]
BLE_1M	Right side	2402	0.38	0.63	60.32	2.20
	Left side	2402	0.38	0.63	60.32	2.20
	Right side	2440	0.38	0.63	60.32	2.20
	Left side	2440	0.38	0.63	60.32	2.20
	Right side	2480	0.38	0.63	60.32	2.20
	Left side	2480	0.38	0.63	60.32	2.20
BLE_2M	Right side	2404	0.20	0.63	31.75	4.98
	Left side	2404	0.20	0.63	31.75	4.98
	Right side	2440	0.20	0.63	31.75	4.98
	Left side	2440	0.20	0.63	31.75	4.98
	Right side	2478	0.20	0.63	31.75	4.98
	Left side	2478	0.20	0.63	31.75	4.98

10.5. Test graphs

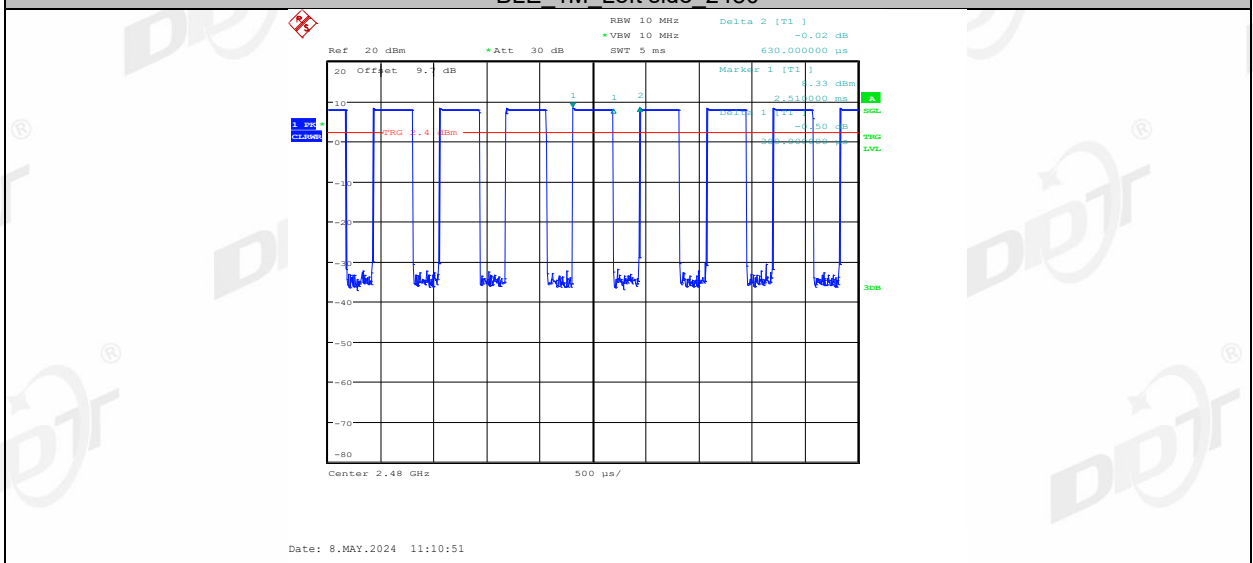




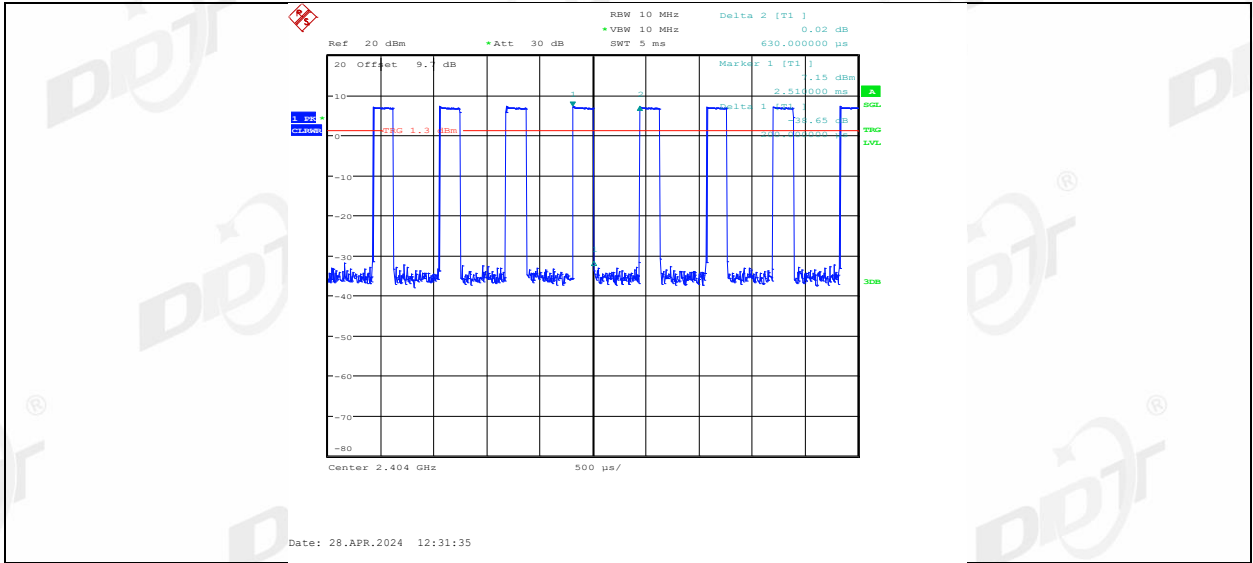
BLE 1M Right side 2480



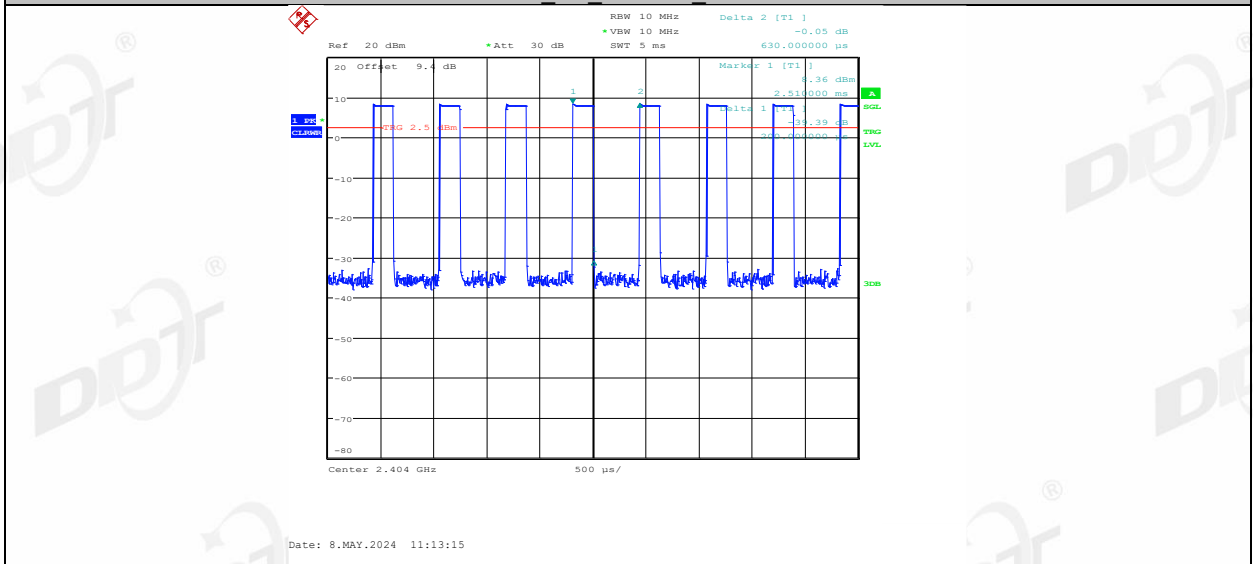
BLE 1M Left side 2480



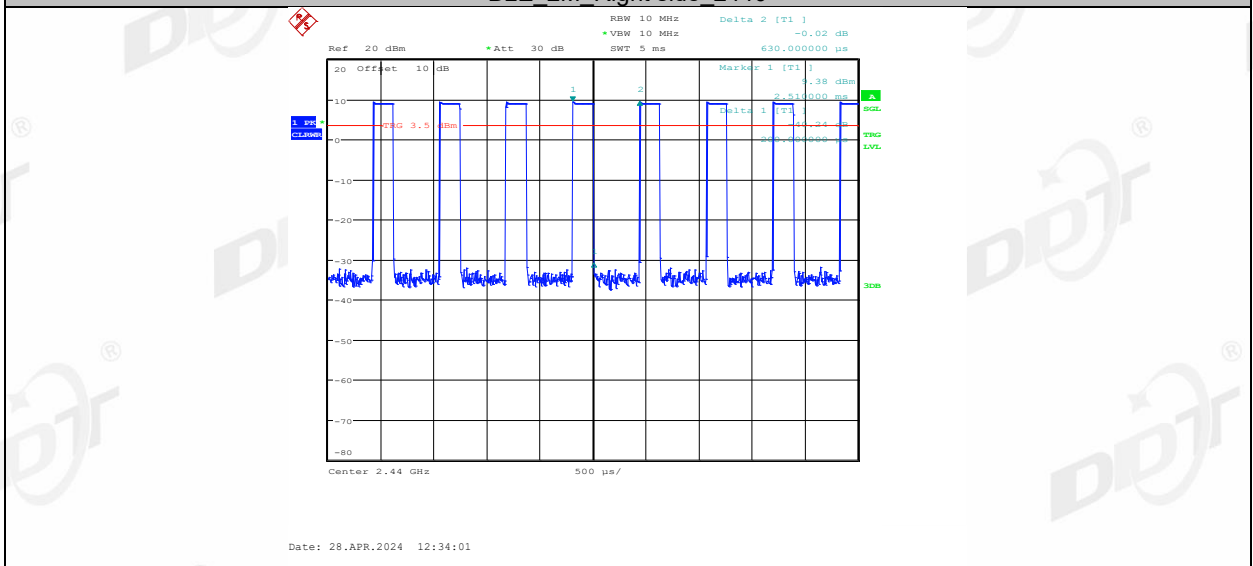
BLE 2M Right side 2404



BLE_2M Left side 2404



BLE_2M Right side 2440



BLE_2M Left side 2440