



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.	:	WAVE BEAM 2, VIBE BEAM 2
FCC ID	:	APIJBLVBEAM2
IC	:	6132A-JBLVBEAM2
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-RE24020411-2E01
Issue Date	:	2024/05/27
Issue By	:	Guangdong Dongdian Testing Service Co., Ltd. Unit 2, Building 1, No. 17, Zongbu 2nd Road, Songshan Lake Park, Dongguan, Guangdong, China, 523808

Table of Contents

1.	Summary of Test Results	7
2.	General Test Information	8
2.1.	Description of EUT	8
2.2.	Accessories of EUT	9
2.3.	Block diagram of EUT configuration for test.....	9
2.4.	Decision of final test mode	9
2.5.	Deviations of test standard	10
2.6.	Test environment conditions.....	10
2.7.	Test laboratory	10
2.8.	Measurement uncertainty	11
3.	Equipment Used During Conductive Test	12
4.	20 dB Bandwidth.....	13
4.1.	Block diagram of test setup	13
4.2.	Limits.....	13
4.3.	Test procedure.....	13
4.4.	Test result	14
4.5.	Test graphs	15
5.	99% Bandwidth	21
5.1.	Block diagram of test setup	21
5.2.	Limits.....	21
5.3.	Test procedure.....	21
5.4.	Test result	22
5.5.	Test graphs	23
6.	Maximum Peak Output Power.....	29
6.1.	Block diagram of test setup	29
6.2.	Limits.....	29
6.3.	Test procedure.....	29
6.4.	Test result	30
6.5.	Test graphs	31
7.	Carrier Frequency Separation	37
7.1.	Block diagram of test setup	37
7.2.	Limits.....	37
7.3.	Test procedure.....	37
7.4.	Test result	38
7.5.	Test graphs	39
8.	Dwell Time	41

8.1.	Block diagram of test setup	41
8.2.	Limits.....	41
8.3.	Test procedure.....	41
8.4.	Test result	42
8.5.	Test graphs.....	43
9.	Number of Hopping Channel.....	55
9.1.	Block diagram of test setup	55
9.2.	Limits.....	55
9.3.	Test procedure.....	55
9.4.	Test result	56
9.5.	Test graphs.....	57
10.	Band Edge Compliance (Conducted Method).....	59
10.1.	Block diagram of test setup	59
10.2.	Limit.....	59
10.3.	Test procedure.....	59
10.4.	Test result	60
10.5.	Test graphs.....	61
11.	RF Conducted Spurious Emissions.....	69
11.1.	Block diagram of test setup	69
11.2.	Limits.....	69
11.3.	Test procedure.....	69
11.4.	Test result	70
11.5.	Test graphs.....	71
12.	Duty cycle	89
12.1.	Block diagram of test setup	89
12.2.	Limit.....	89
12.3.	Test procedure.....	89
12.4.	Test result	90
12.5.	Test graphs.....	91
13.	Antenna Requirements.....	97
13.1.	Limit.....	97
13.2.	Result.....	97
14.	Radiated Emission.....	98
14.1.	Test equipment.....	98
14.2.	Block diagram of test setup	99
14.3.	Limits.....	100
14.4.	Assistant equipment used for test	102
14.5.	Test procedure.....	102

14.6.	Test result	103
14.7.	Test data	104
15.	Band Edge Compliance	120
15.1.	Test equipment	120
15.2.	Block diagram of test setup	121
15.3.	Limits.....	121
15.4.	Assistant equipment used for test	121
15.5.	Test procedure.....	121
15.6.	Test result	121
15.7.	Test data	122
16.	Power Line Conducted Emissions.....	146
16.1.	Test equipment	146
16.2.	Block diagram of test setup	146
16.3.	Limits.....	146
16.4.	Assistant equipment used for test	146
16.5.	Test procedure.....	147
16.6.	Test result	147
16.7.	Test data	148
17.	Test Setup Photograph.....	150
18.	Photos of the EUT	153

Test Report Declare

Applicant	:	Harman International Industries, Inc.
Address of Applicant	:	8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES
Equipment under Test	:	BLUETOOTH HEADSET
Model No.	:	WAVE BEAM 2, VIBE BEAM 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-RE24020411-2E01		
Date of Receipt:	2024/04/25	Date of Test:	2024/04/25~2024/05/24

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	2024/05/27	

1. Summary of Test Results

No.	Test Parameter	Clause No.	Condition	Result
1	Maximum Peak Output Power	FCC Part 15: 15.247(b)(1), RSS-247 Issue 3 clause 5.4(b)	/	Pass
2	20 dB Bandwidth	FCC Part 15: 15.247(a)(1), RSS-247 Issue 3 clause 5.1(a)	/	Pass
3	99% Bandwidth	RSS-Gen Issue 5 clause 6.7	/	Pass
4	Carrier Frequency Separation	FCC Part 15: 15.247(a)(1), RSS-247 Issue 3 clause 5.1(b)	/	Pass
5	Number of Hopping Channel	FCC Part 15: 15.247(a)(1)(iii), RSS-247 Issue 3 clause 5.1(d)	/	Pass
6	Dwell Time	FCC Part 15: 15.247(a)(1)(iii), RSS-247 Issue 3 clause 5.1(d)	/	Pass
7	RF Conducted Spurious Emissions	FCC Part 15: 15.247(d), RSS- 247 Issue 3 clause 5.5	/	Pass
8	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
9	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
10	Power Line Conducted Emissions	FCC Part 15: 15.207(a), RSS- Gen Issue 5 clause 8.8	/	Pass
11	Antenna Requirement	FCC Part 15: 15.203, RSS- Gen Issue 5 clause 6.8	/	Pass

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.

2. General Test Information

2.1. Description of EUT

EUT Name	: BLUETOOTH HEADSET
Model Number	: WAVE BEAM 2, VIBE BEAM 2
Difference of model number	: The product circuit design, layout, components used and internal wiring are the same, only the model and sales purpose are different. We chose the model "WAVE BEAM 2" as a representative model for compliance testing.
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 3.7V 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 BR/EDR.

Radio Specification	: Bluetooth BR/EDR
Operation Frequency	: 2402 MHz-2480 MHz
Modulation	: GFSK, $\pi/4$ -DQPSK, 8DPSK

Antenna information	
Antenna Type	: FPC
Left side Max Antenna Gain(dBi)	: -0.45
Right side Max Antenna Gain(dBi)	: -0.32

Channel information					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	27	2429	54	2456
1	2403	28	2430	55	2457
2	2404	29	2431	56	2458
3	2405	30	2432	57	2459
4	2406	31	2433	58	2460
5	2407	32	2434	59	2461
6	2408	33	2435	60	2462
7	2409	34	2436	61	2463
8	2410	35	2437	62	2464
9	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	39	2441	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471

16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	78	2480
25	2427	52	2454		
26	2428	53	2455		

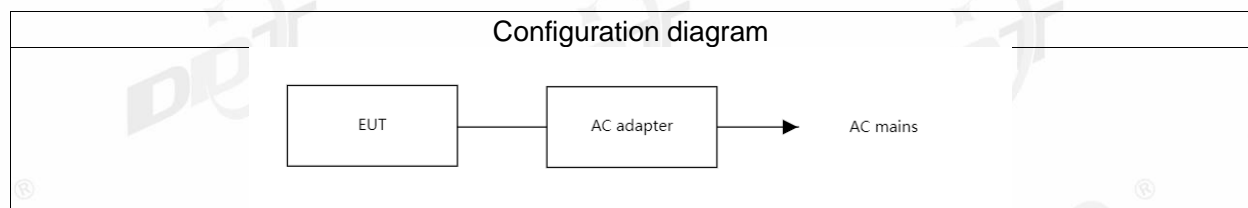
Note: The above EUT information is declared by manufacturer and for more detailed features description please refer to the manufacturer's specifications or User's Manual. The above Antenna information is declared by manufacturer and for more detailed features description please refer to the manufacturer's 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	Harman	N/A	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: 0.5 dB (According to the manufacturer's claims)

Tested mode, channel, information			
Mode	Setting Tx Power	Channel	Frequency (MHz)
GFSK hopping on Tx mode	Default	CH0 to CH78	2402 to 2480

$\pi/4$ -DQPSK hopping on Tx mode	Default	CH0 to CH78	2402 to 2480
8DPSK hopping on Tx mode	Default	CH0 to CH78	2402 to 2480
GFSK hopping off Tx mode	Default	CH0	2402
	Default	CH39	2441
	Default	CH78	2480
$\pi/4$ -DQPSK hopping off Tx mode	Default	CH0	2402
	Default	CH39	2441
	Default	CH78	2480
8DPSK hopping off Tx mode	Default	CH0	2402
	Default	CH39	2441
	Default	CH78	2480
Worst-case data rates were: GFSK mode: DH5, p/4-DQPSK mode: 2DH5, 8DPSK mode: 3DH5			

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 to 106 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 ($10 \text{ MHz} \leq f < 3.6 \text{ GHz}$);
	1.38 dB ($3.6 \text{ GHz} \leq f < 8 \text{ GHz}$)
Peak Output Power (Conducted) (Power Sensor)	0.74 dB
Power Spectral Density	0.74 dB ($10 \text{ MHz} \leq f < 3.6 \text{ GHz}$);
	1.38 dB ($3.6 \text{ GHz} \leq f < 8 \text{ GHz}$)
Frequencies Stability	6.7×10^{-8} (Antenna couple method)
	5.5×10^{-8} (Conducted method)
Conducted spurious emissions	0.86 dB ($10 \text{ MHz} \leq f < 3.6 \text{ GHz}$);
	1.40 dB ($3.6 \text{ GHz} \leq f < 8 \text{ GHz}$)
	1.66 dB ($8 \text{ GHz} \leq f < 26.5 \text{ GHz}$)
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)

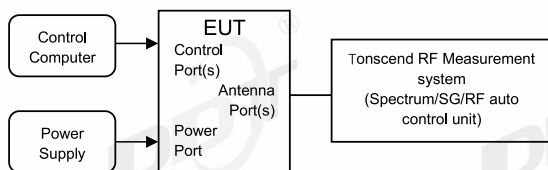
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3. Equipment Used During Conductive Test

Equipment	Manufacturer	Model No.	Serial Number	Due Date
☑RF Connected Test (RF Measurement System 3#)				
SIGNAL ANALYZER	R&S	FSV40	101407	2024/07/11
Wideband Radio Communication Tester	R&S	CMW500	117491	2025/03/31
EXG Analog Signal Generator	KEYSIGHT	N5173B	MY62153058	2024/07/11
MXG Vector Signal Generator	Agilent	N5182A	MY48180912	2025/03/31
RF Control Unit	Tonscend	JS0806-2	20C8060230	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. 20 dB Bandwidth

4.1. Block diagram of test setup



4.2. Limits

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

4.3. Test procedure

- (1) The test according to ANSI C63.10-2013 clause 6.9.2.
- (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 the 20 dB bandwidth measurement:

RBW:	1% to 5% of the OBW
VBW:	approximately three times RBW
Span:	between 2 times and 5 times the OBW
Detector Mode:	Peak
Sweep time:	Auto
Trace mode:	Max hold

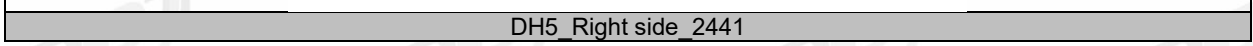
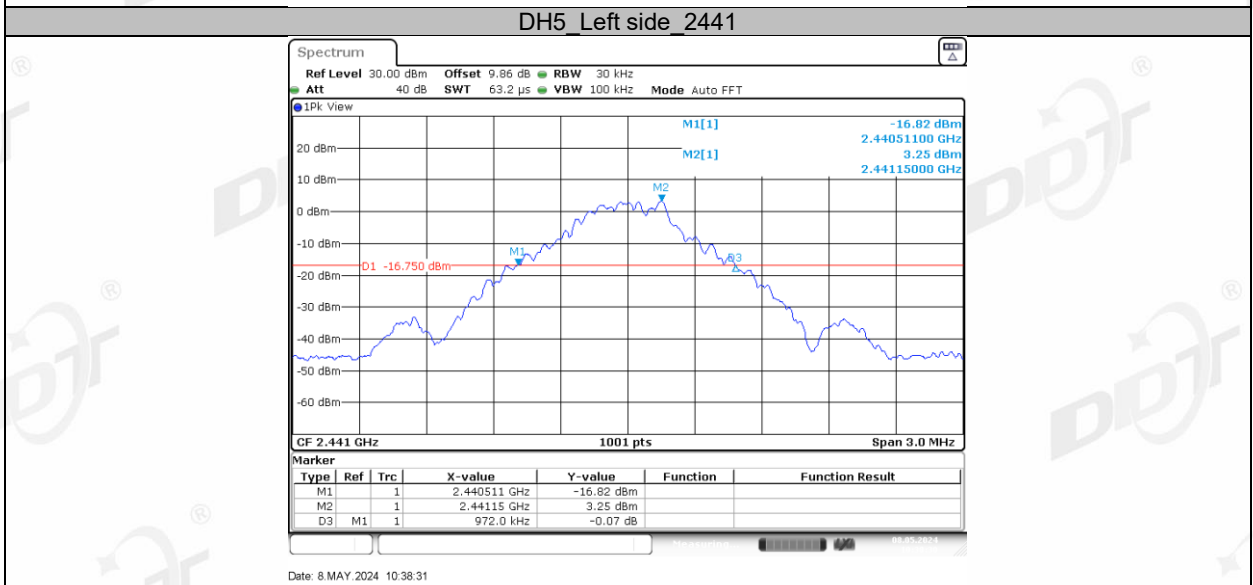
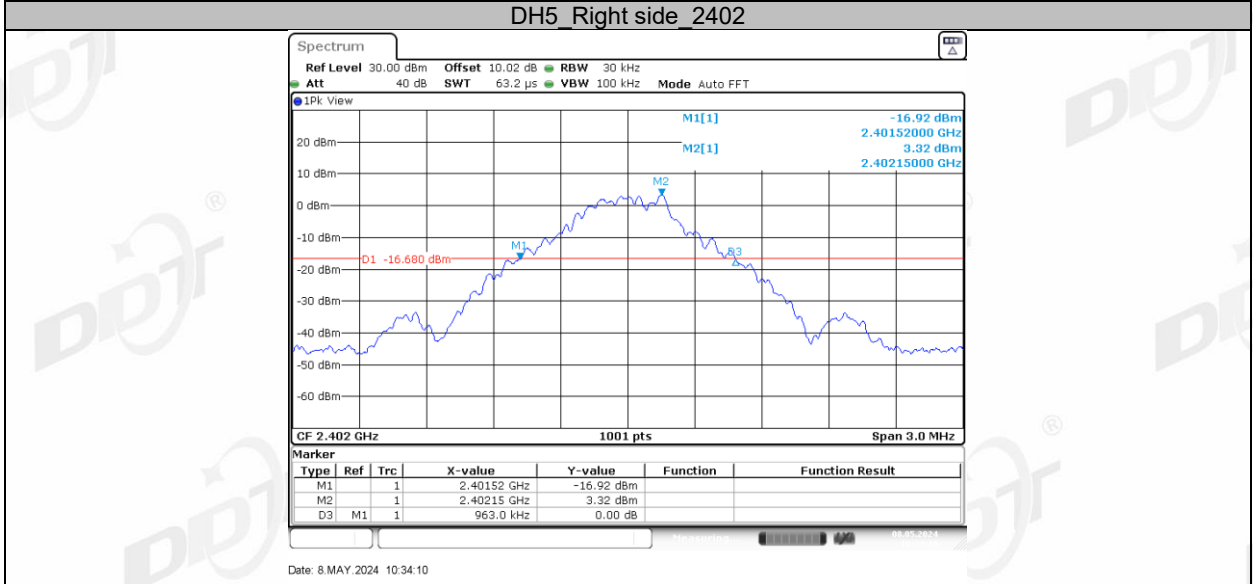
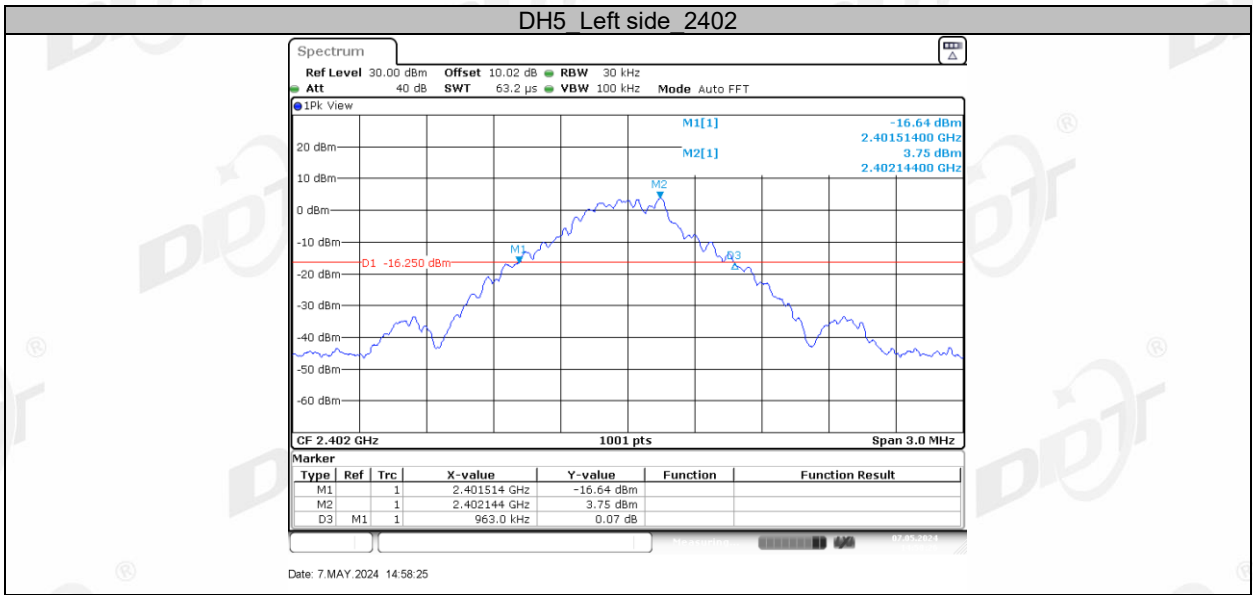
- (5) Measure and record the results in the report.

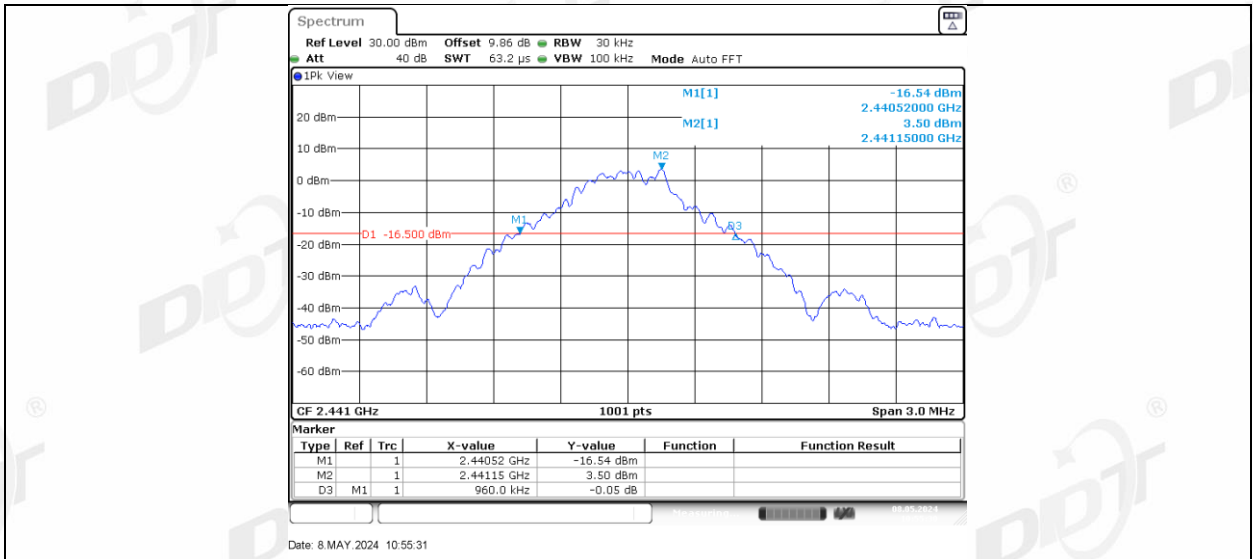
4.4. Test result

Test Engineer:	Zhongyao	Test Site:	RF Measurement System 3#
Ambient Condition:	24.4-25.3℃,47.5-47.9%RH	Test Date:	2024.05.07-2024.05.08
Test Power Supply:	Battery	Sample Number:	S24020411-012

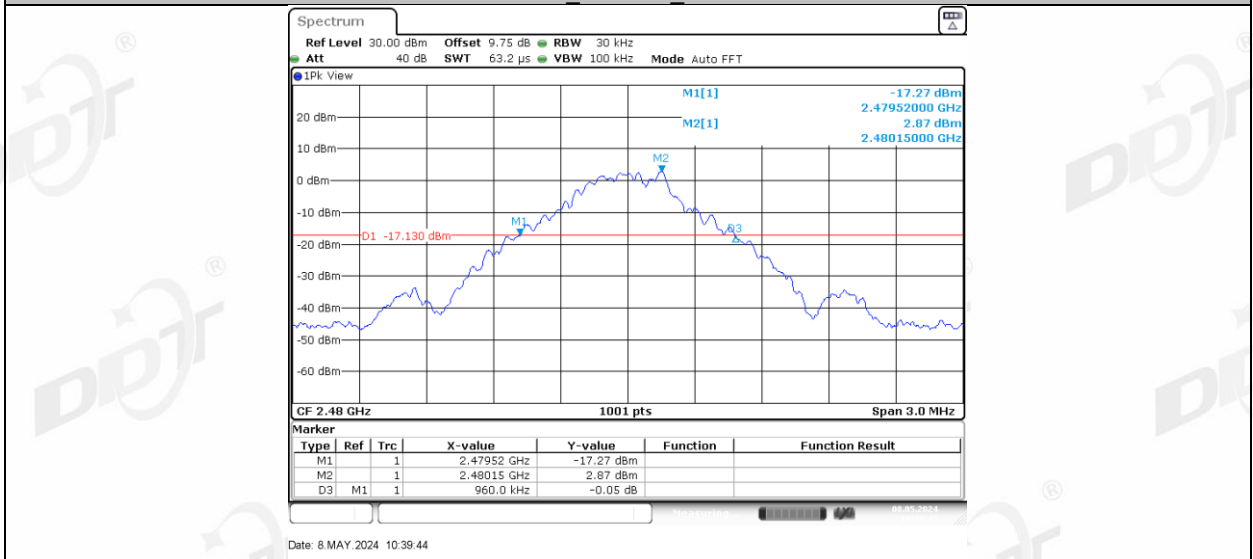
Test Mode	Antenna	Frequency [MHz]	20dB EBW[MHz]
DH5	Left side	2402	0.96
	Right side	2402	0.96
	Left side	2441	0.97
	Right side	2441	0.96
	Left side	2480	0.96
	Right side	2480	0.96
2DH5	Left side	2402	1.24
	Right side	2402	1.24
	Left side	2441	1.24
	Right side	2441	1.24
	Left side	2480	1.24
	Right side	2480	1.24
3DH5	Left side	2402	1.26
	Right side	2402	1.26
	Left side	2441	1.27
	Right side	2441	1.26
	Left side	2480	1.27
	Right side	2480	1.26

4.5. Test graphs

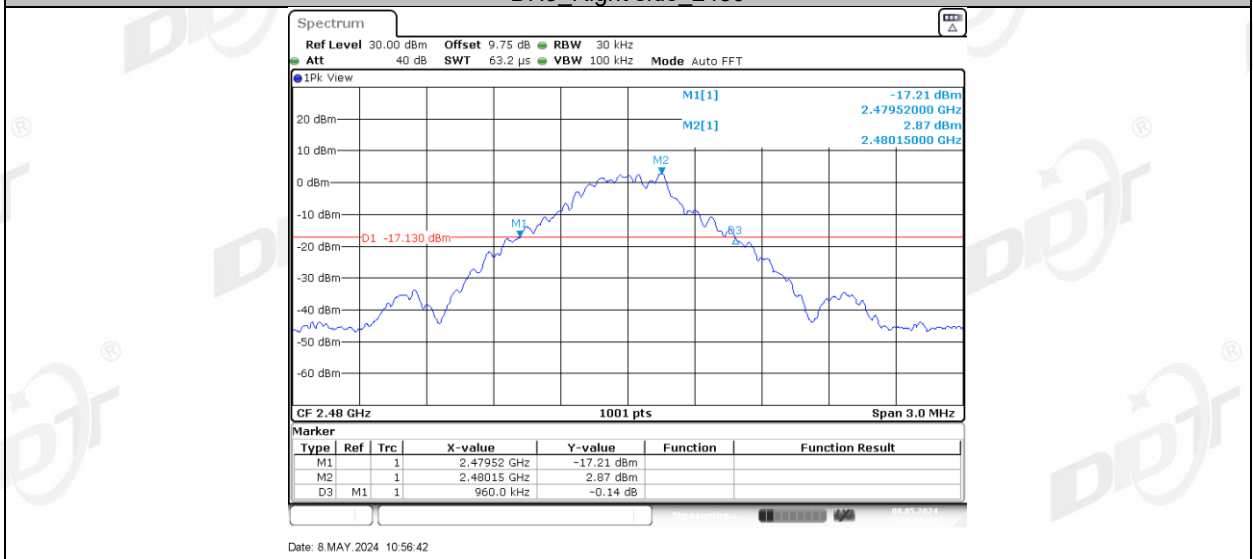




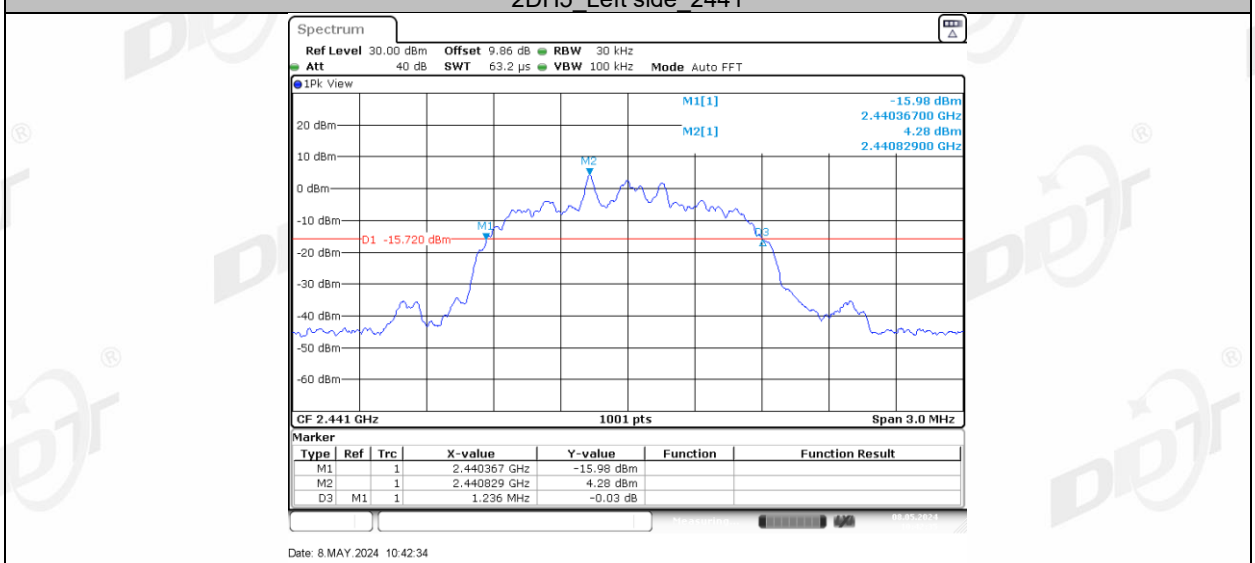
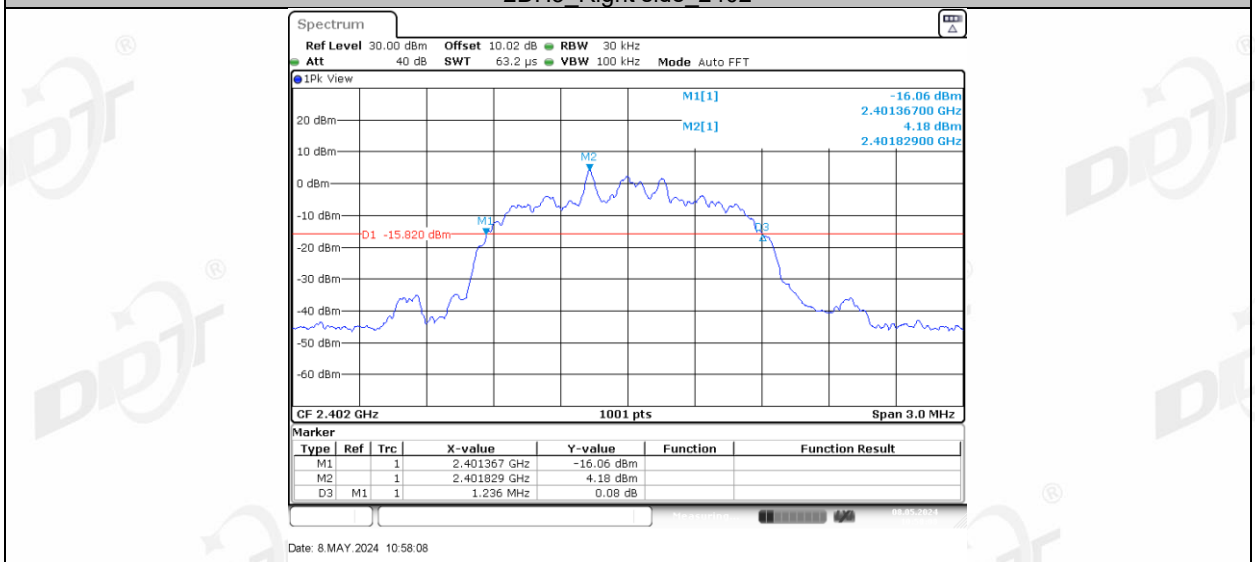
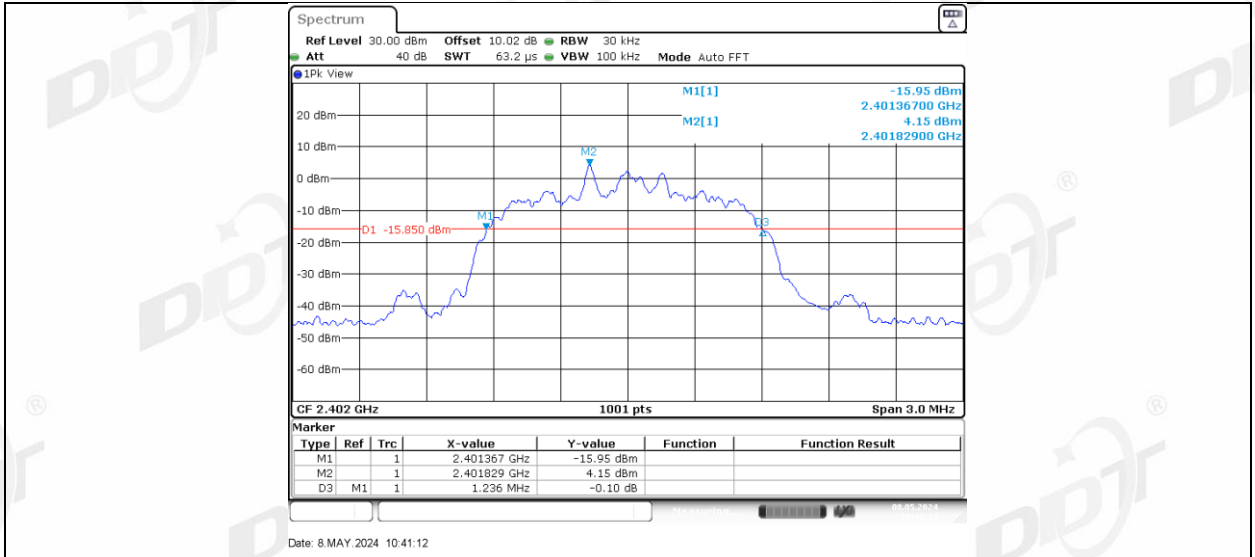
DH5 Left side 2480

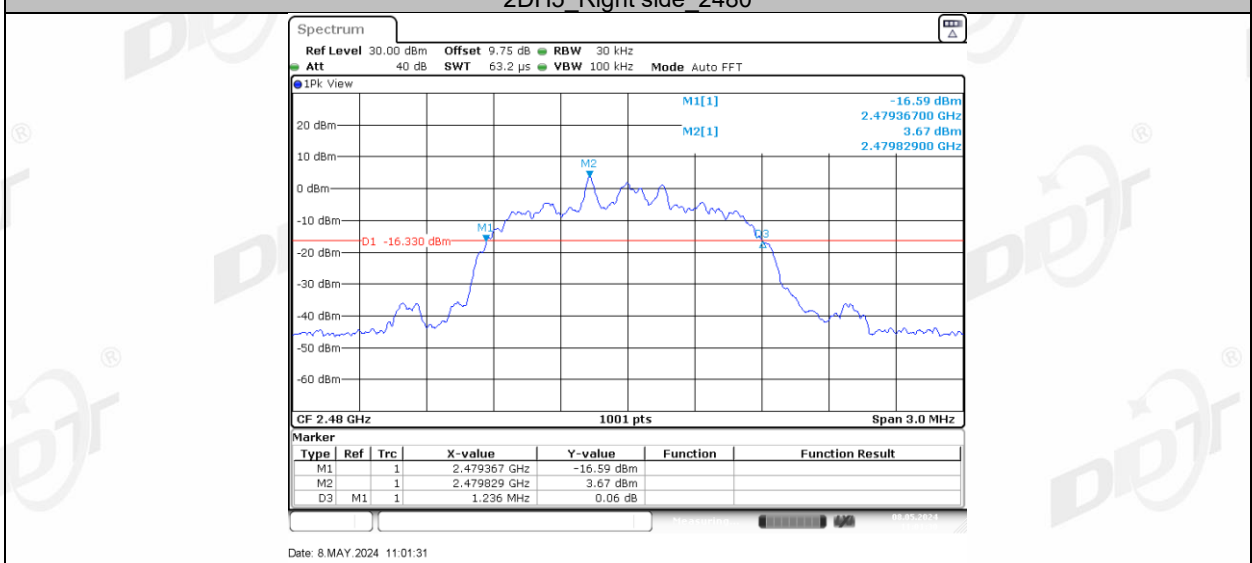
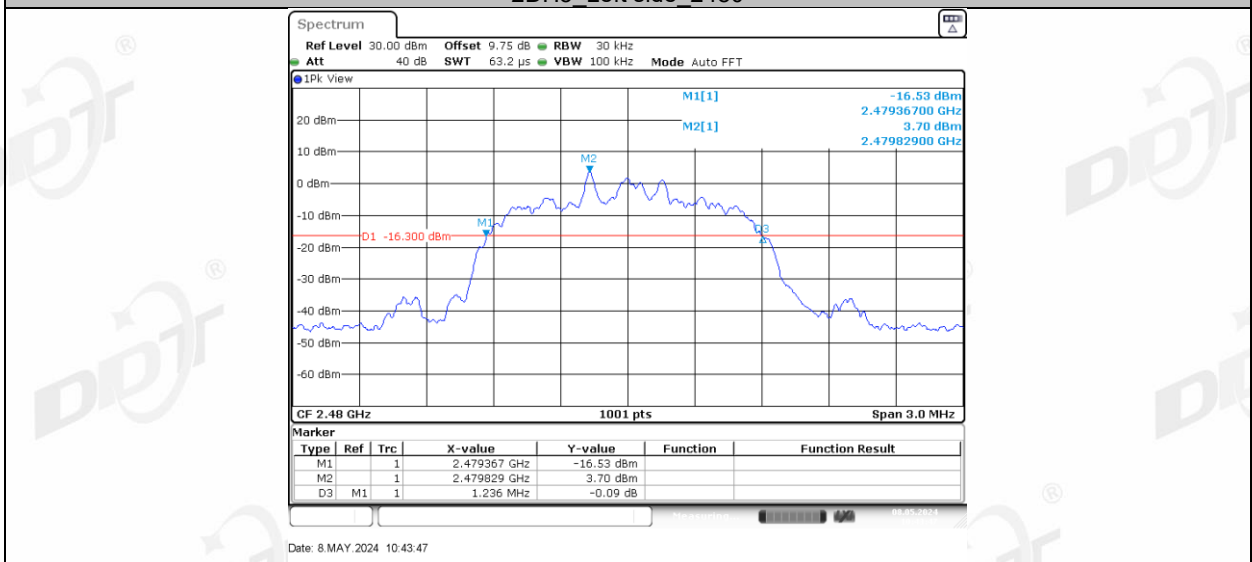
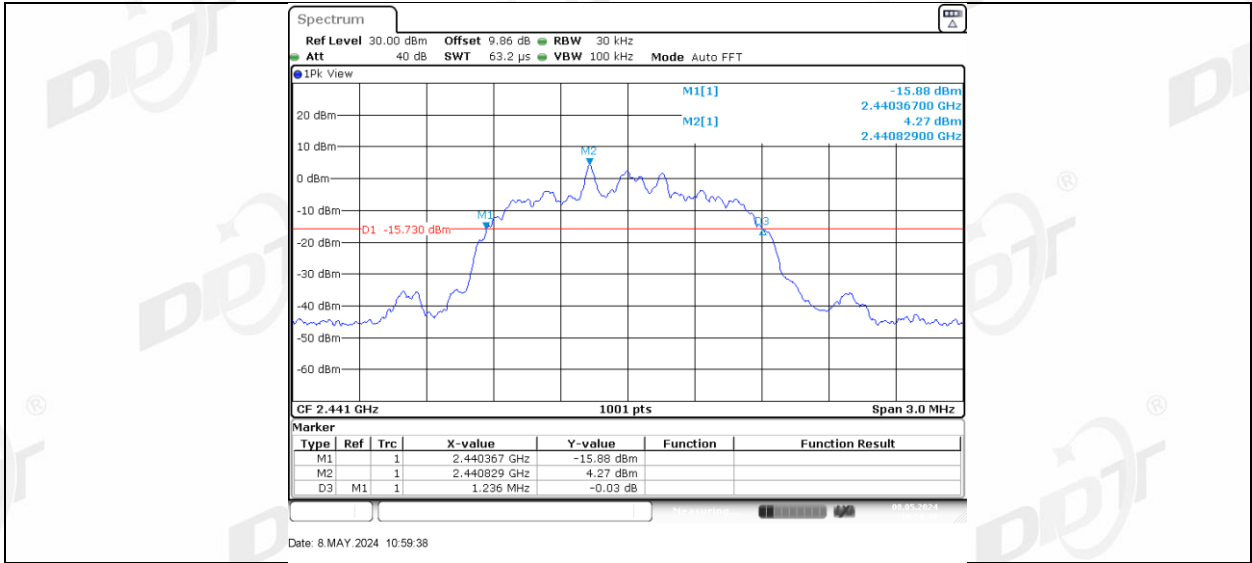


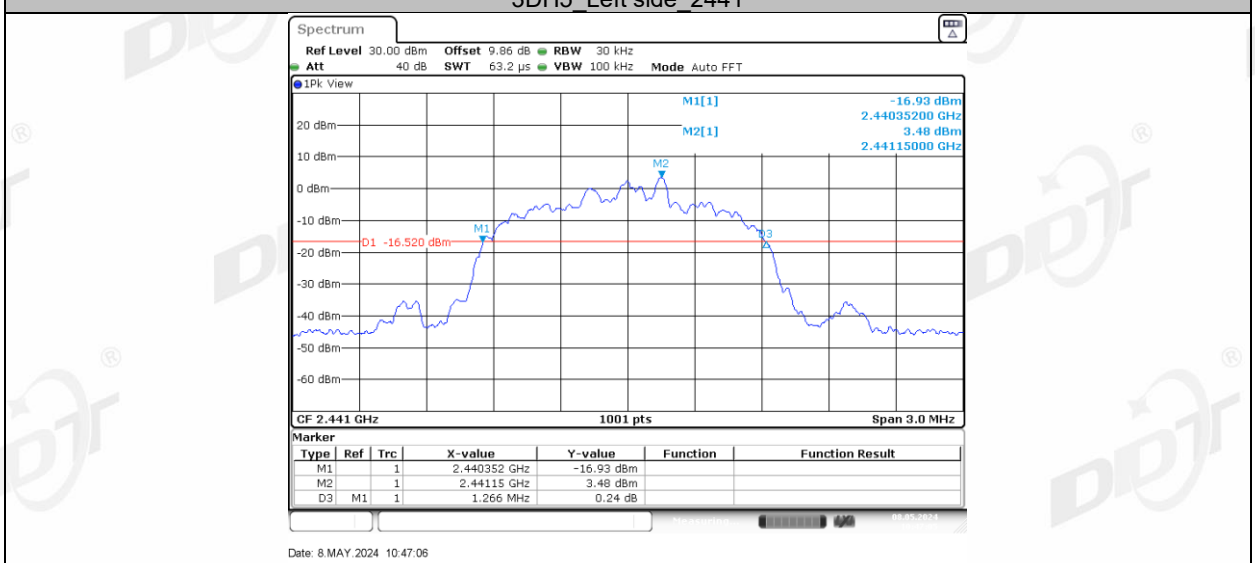
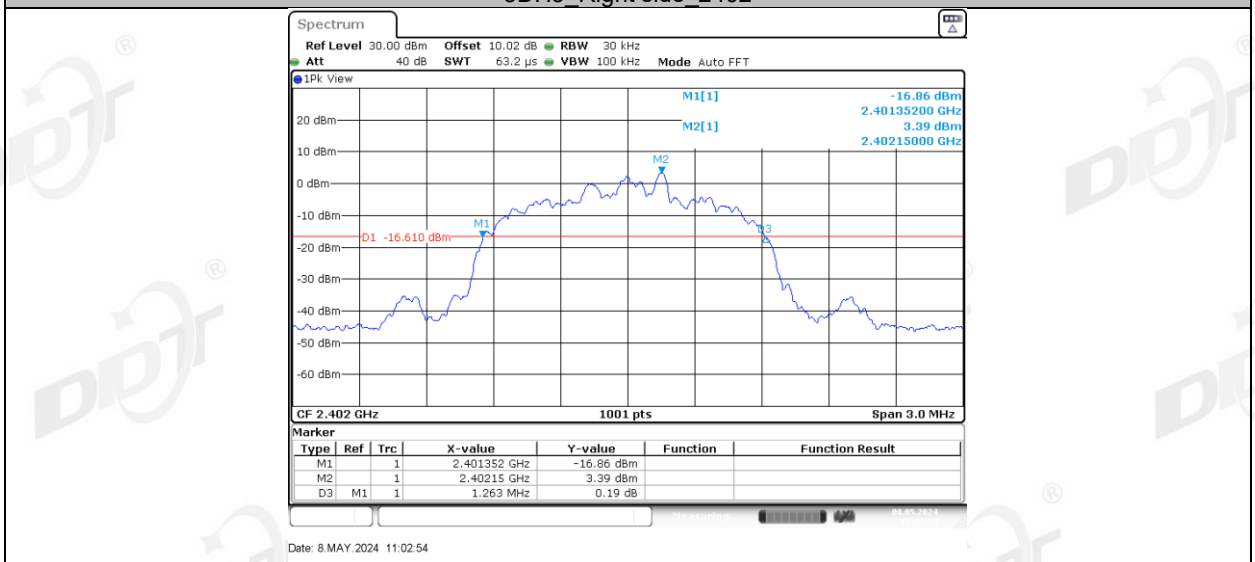
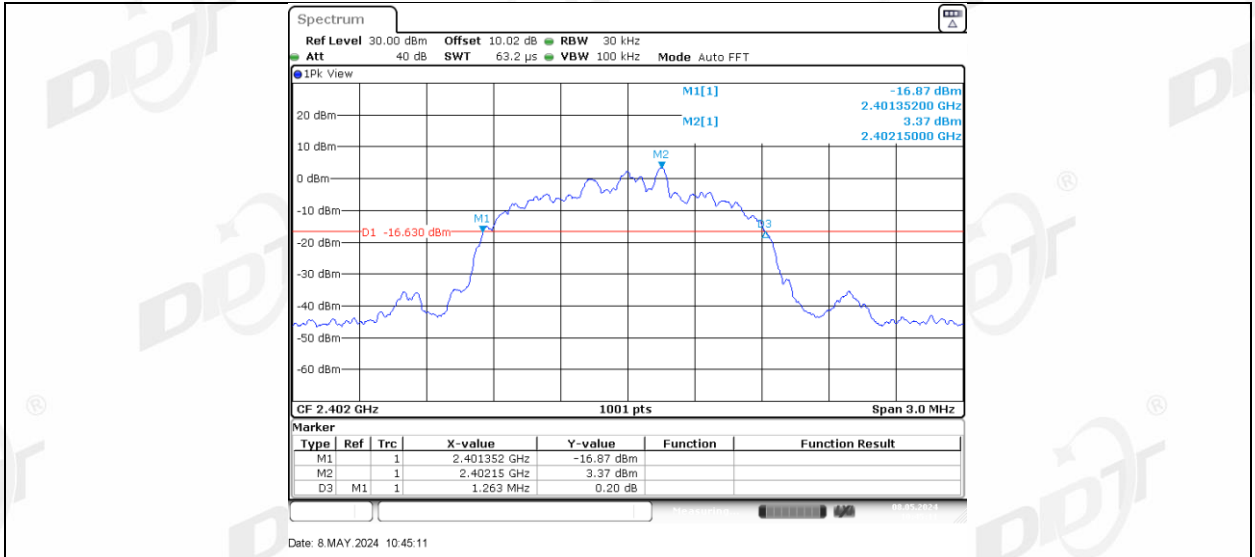
DH5 Right side 2480



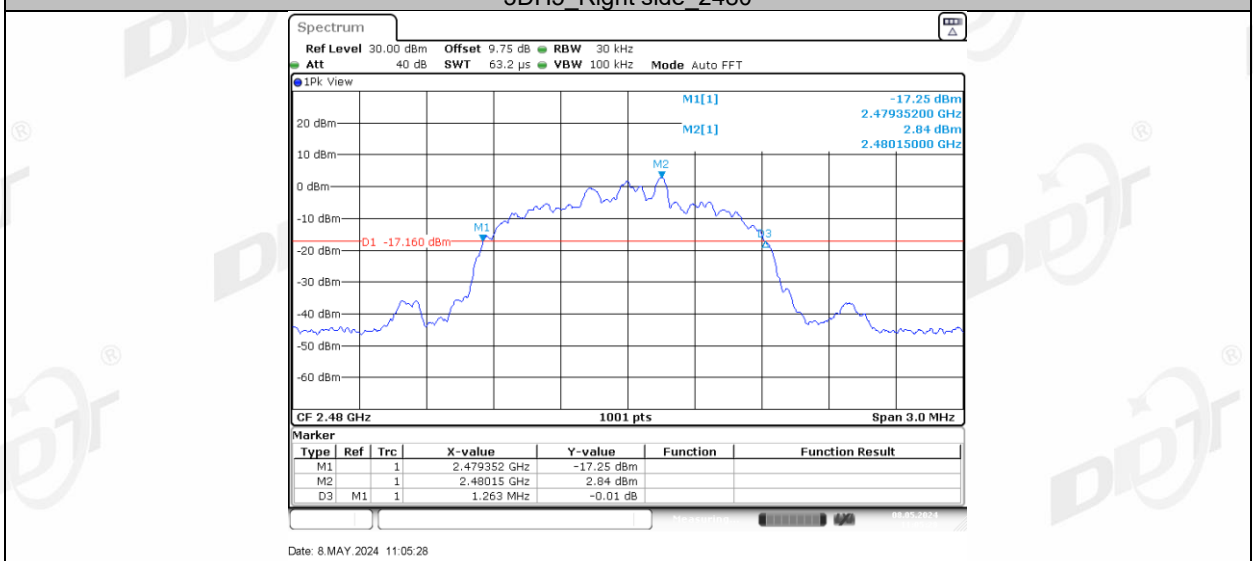
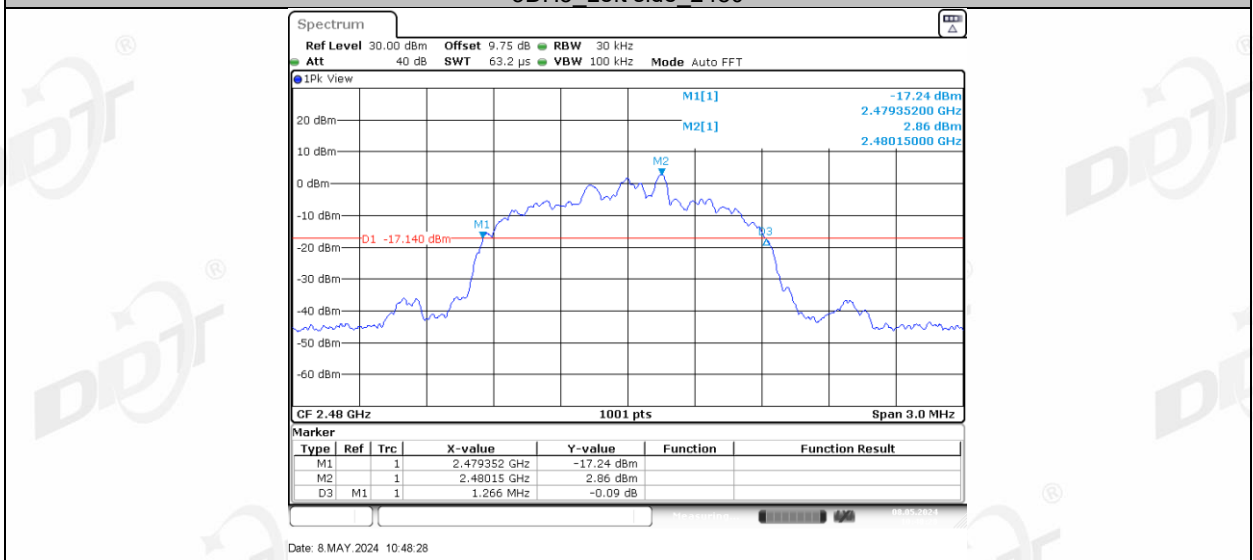
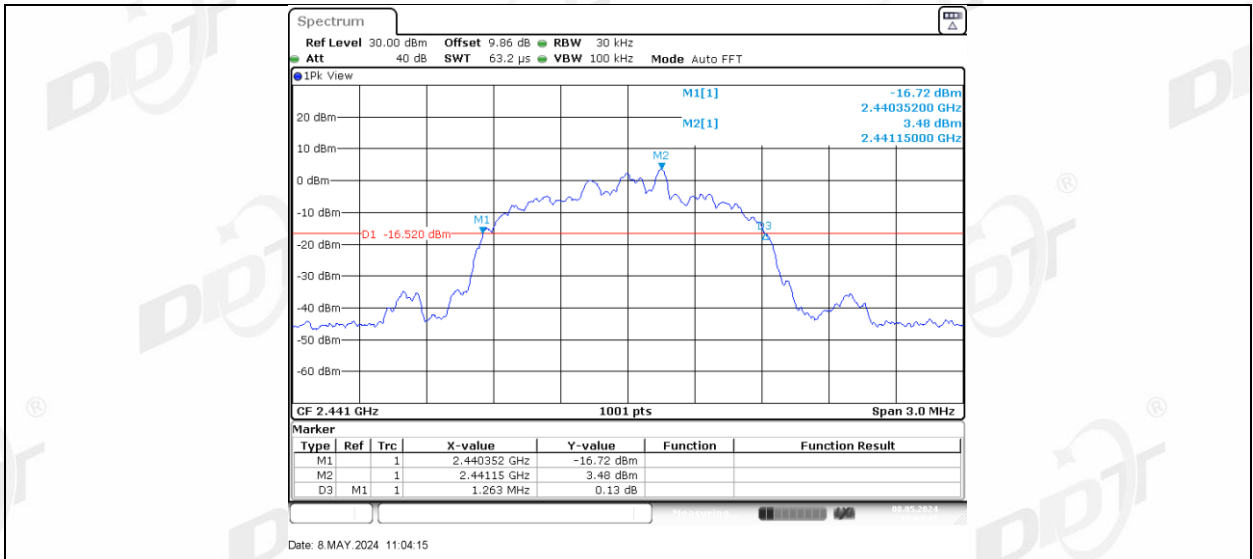
2DH5 Left side 2402





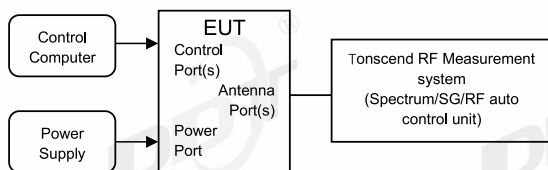


3DH5 Right side 2441



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 measurement:

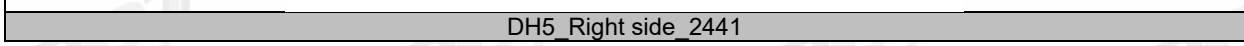
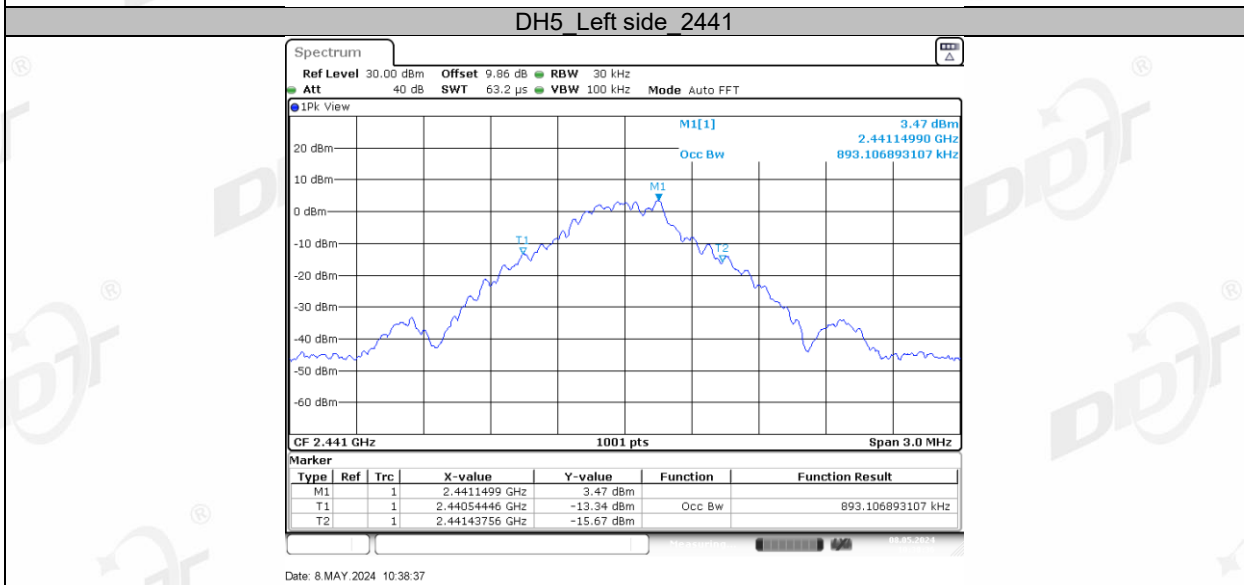
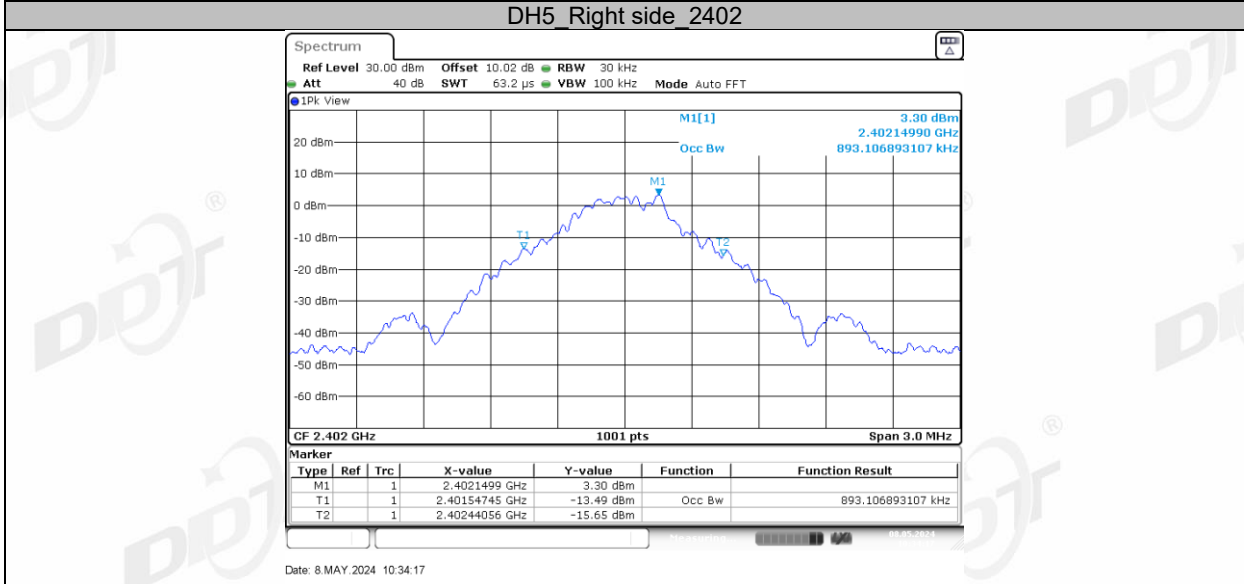
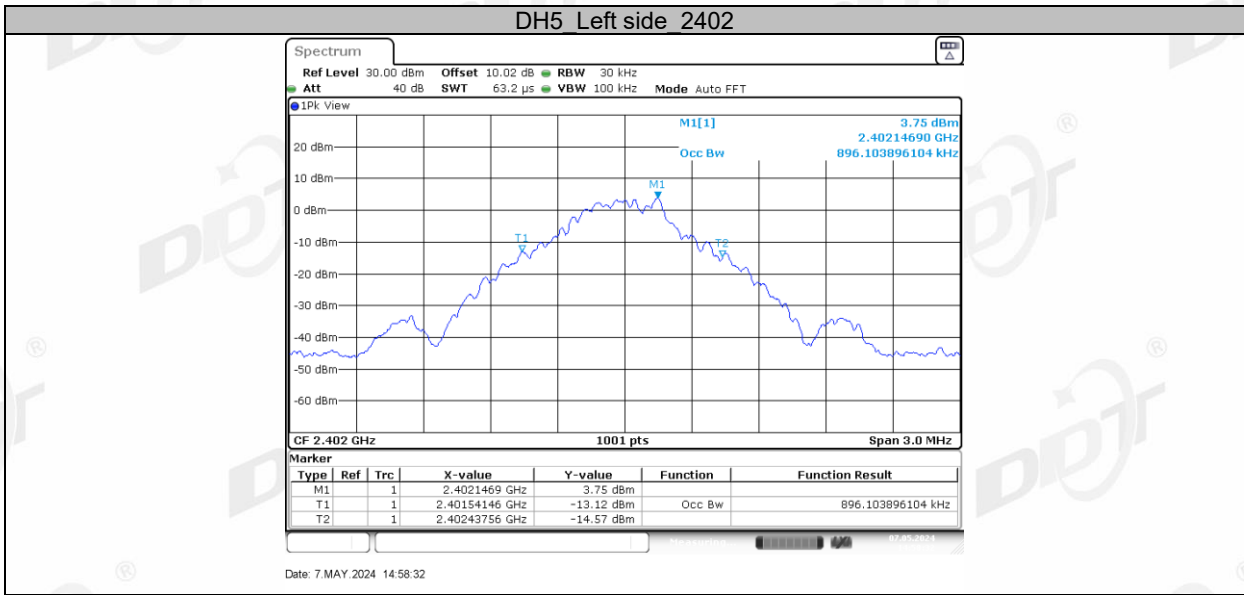
RBW:	1% to 5% of the OBW
VBW:	approximately three times RBW
Span:	between 1.5 times and 5.0 times the OBW
Detector Mode:	Peak
Sweep time:	Auto
Trace mode:	Max hold
- (5) Measure and record the results in the report.

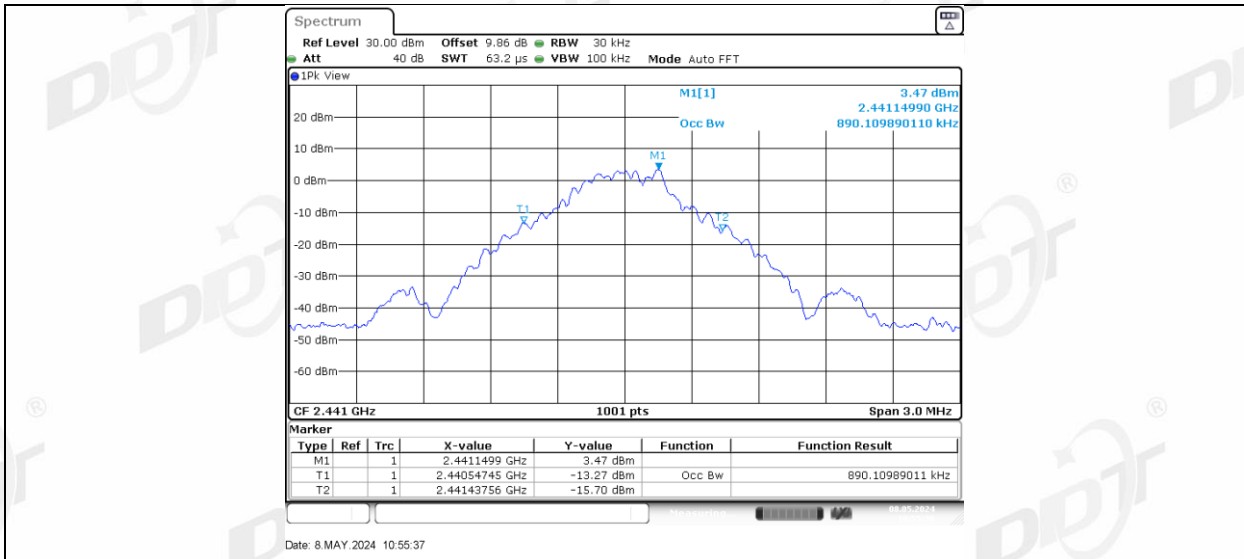
5.4. Test result

Test Engineer:	Zhongyao	Test Site:	RF Measurement System 3#
Ambient Condition:	24.4-25.3℃,47.5-47.9%RH	Test Date:	2024.05.07-2024.05.08
Test Power Supply:	Battery	Sample Number:	S24020411-012

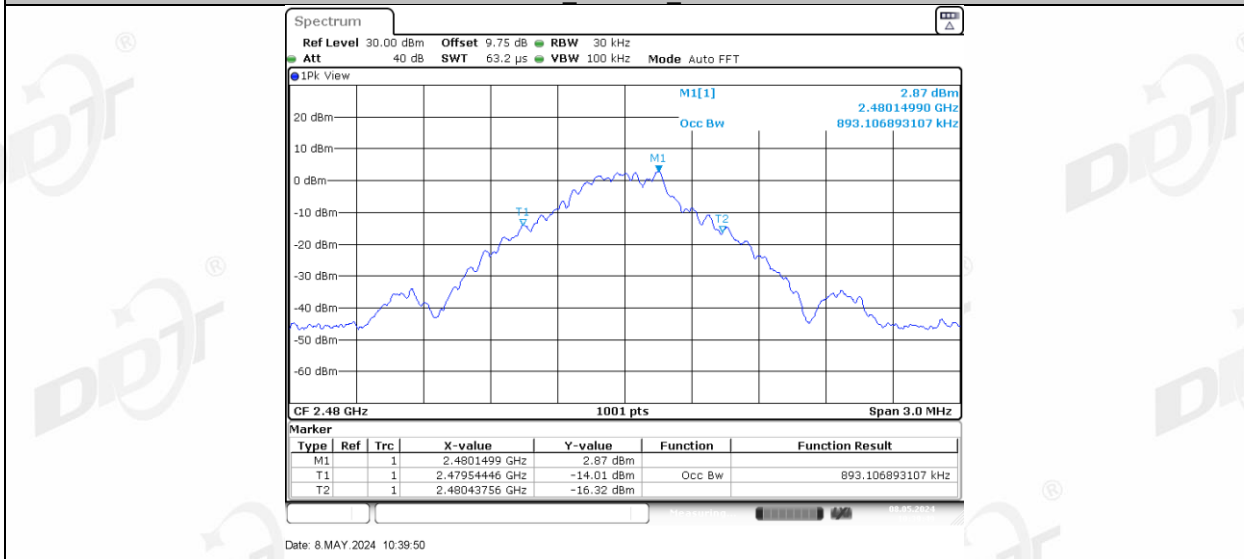
Test Mode	Antenna	Frequency [MHz]	OCB [MHz]	FL[MHz]	FH[MHz]
DH5	Left side	2402	0.896	2401.5415	2402.4376
	Right side	2402	0.893	2401.5475	2402.4406
	Left side	2441	0.893	2440.5445	2441.4376
	Right side	2441	0.890	2440.5475	2441.4376
	Left side	2480	0.893	2479.5445	2480.4376
	Right side	2480	0.896	2479.5445	2480.4406
2DH5	Left side	2402	1.151	2401.4126	2402.5634
	Right side	2402	1.151	2401.4126	2402.5634
	Left side	2441	1.151	2440.4126	2441.5634
	Right side	2441	1.151	2440.4126	2441.5634
	Left side	2480	1.151	2479.4126	2480.5634
	Right side	2480	1.151	2479.4126	2480.5634
3DH5	Left side	2402	1.151	2401.4186	2402.5694
	Right side	2402	1.151	2401.4186	2402.5694
	Left side	2441	1.151	2440.4186	2441.5694
	Right side	2441	1.154	2440.4156	2441.5694
	Left side	2480	1.154	2479.4156	2480.5694
	Right side	2480	1.154	2479.4156	2480.5694

5.5. Test graphs

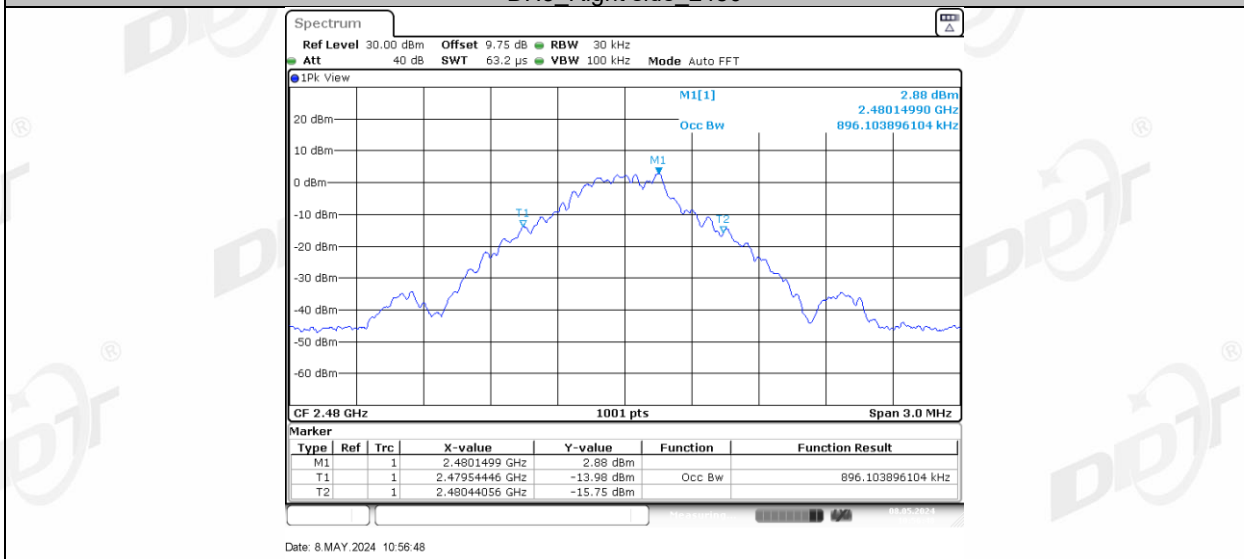




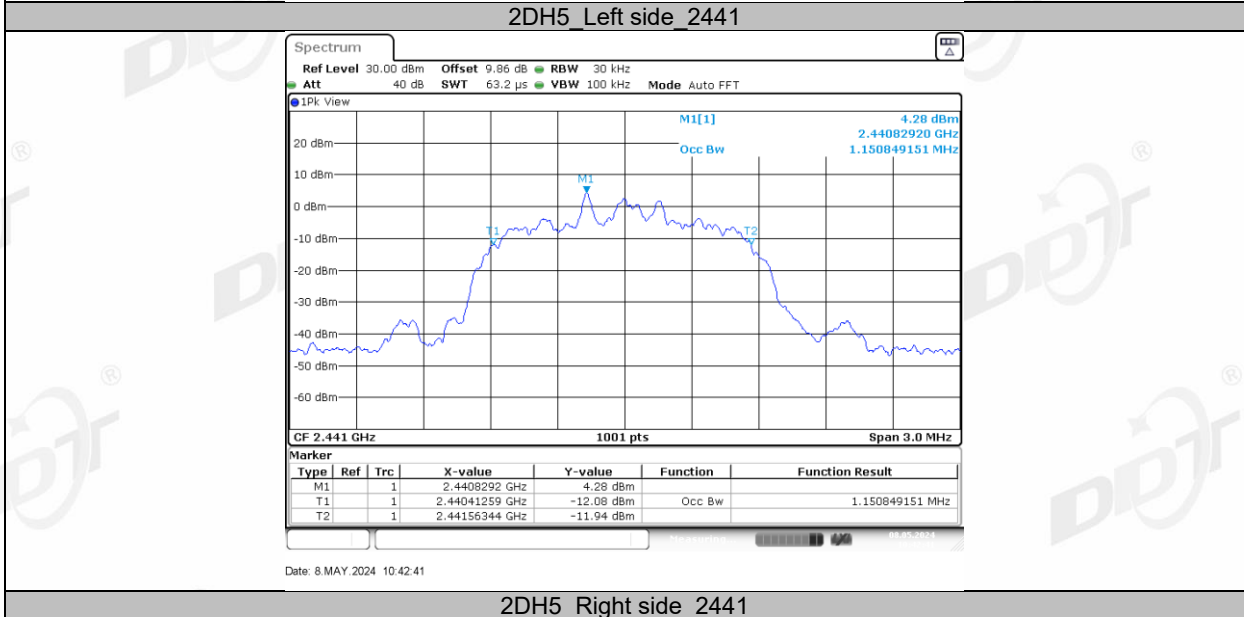
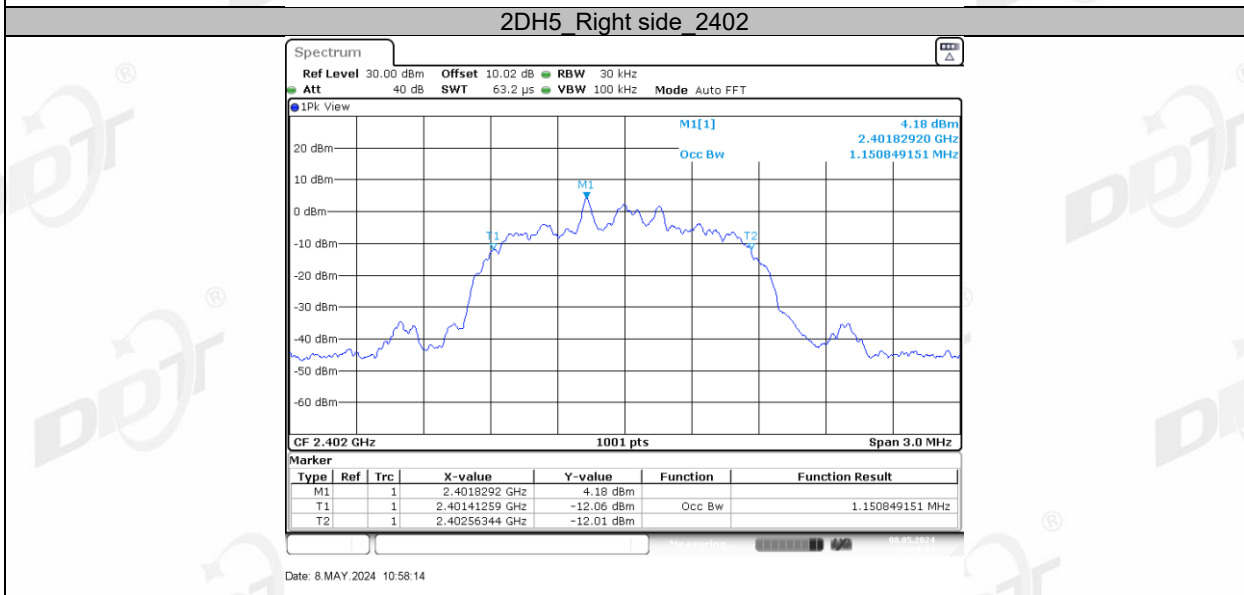
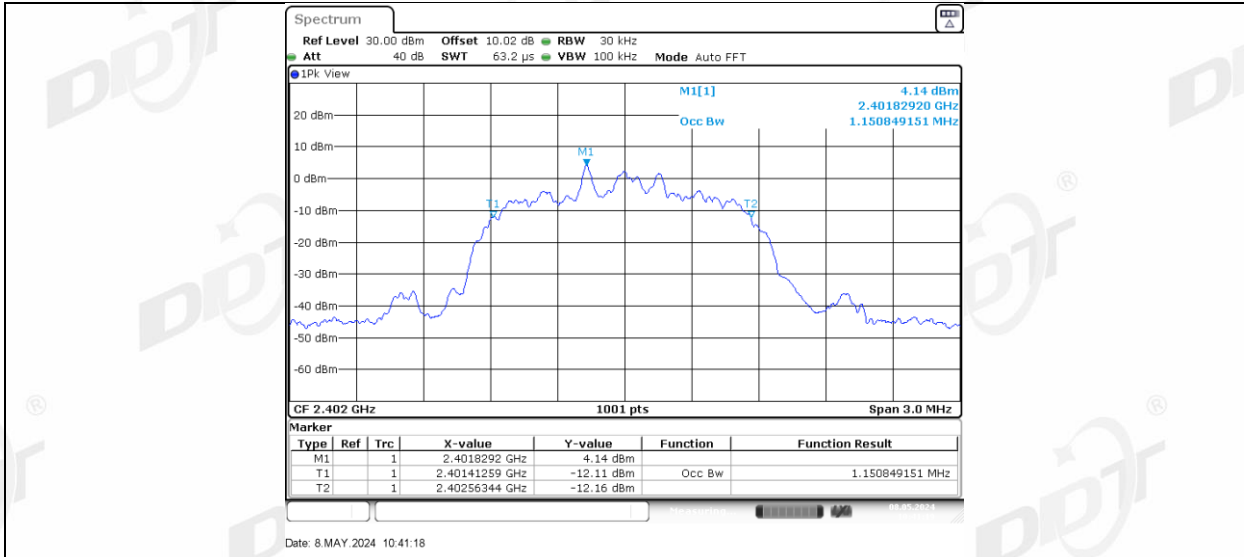
DH5 Left side 2480

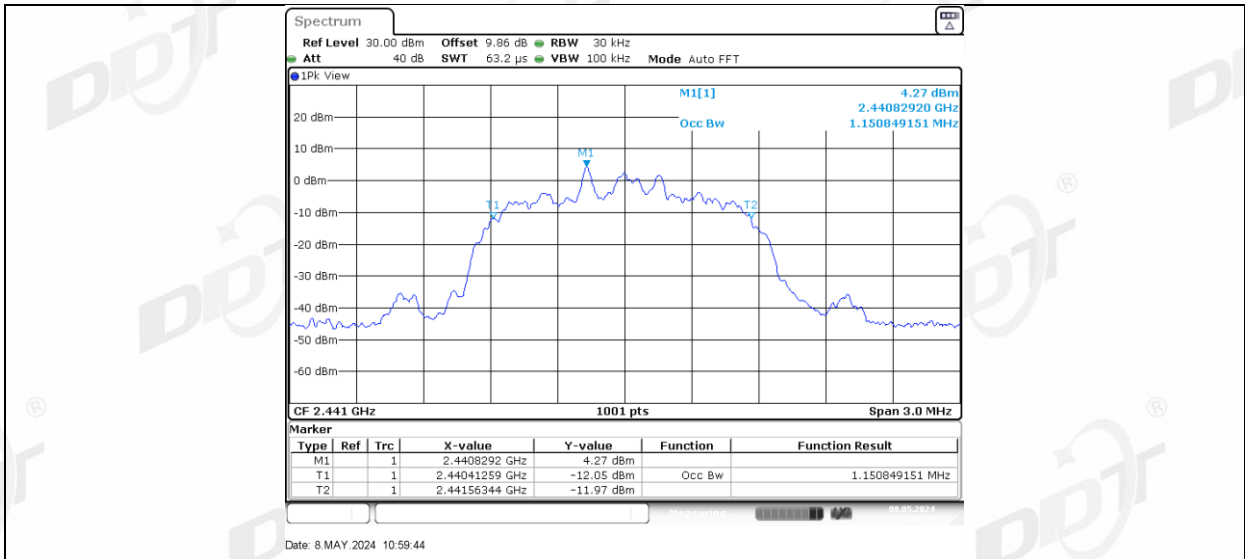


DH5 Right side 2480

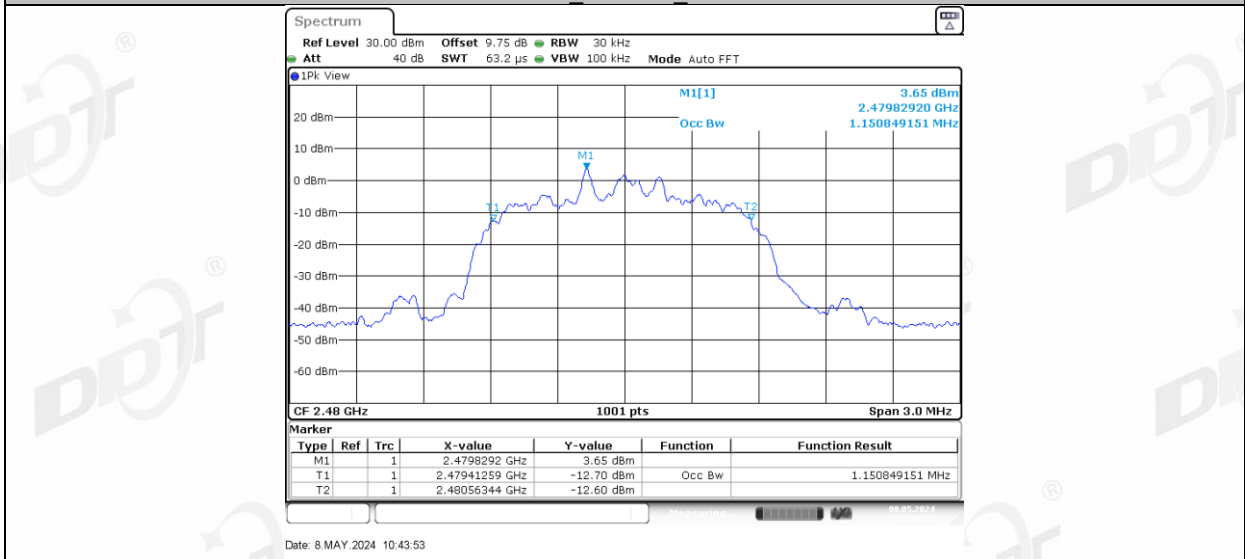


2DH5 Left side 2402

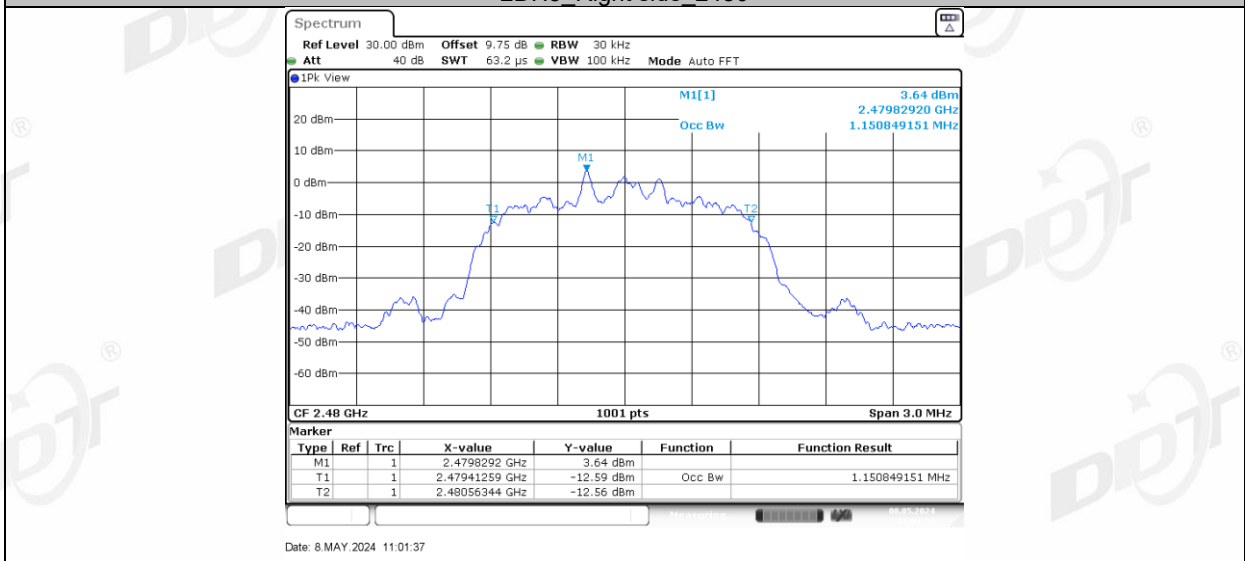




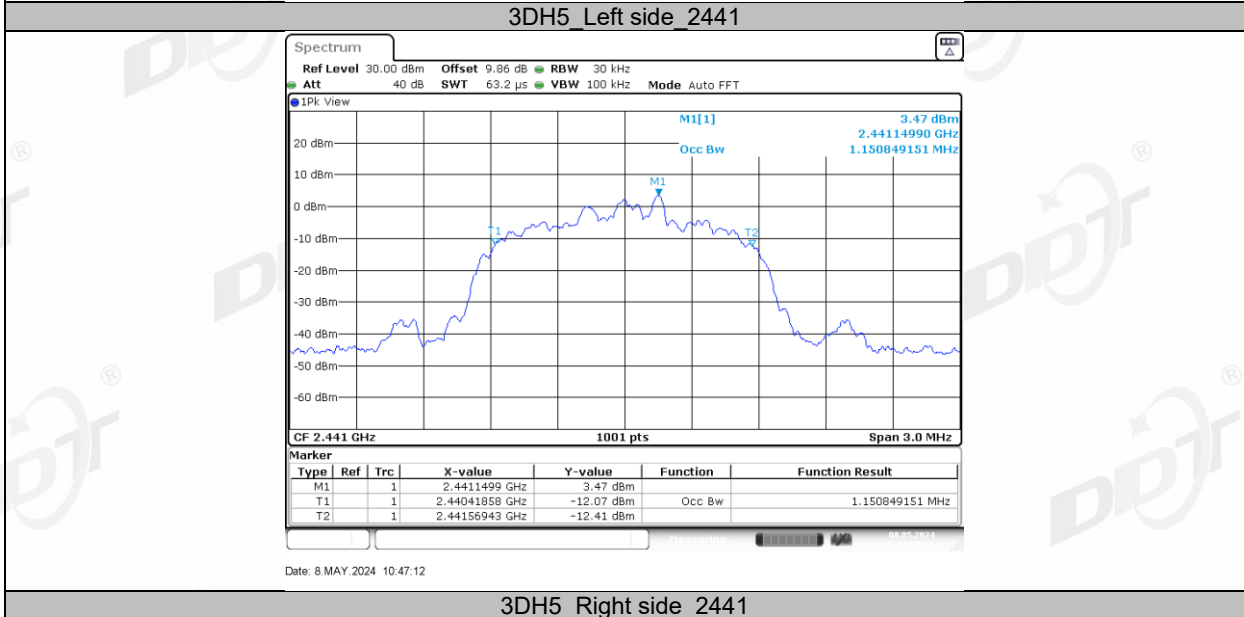
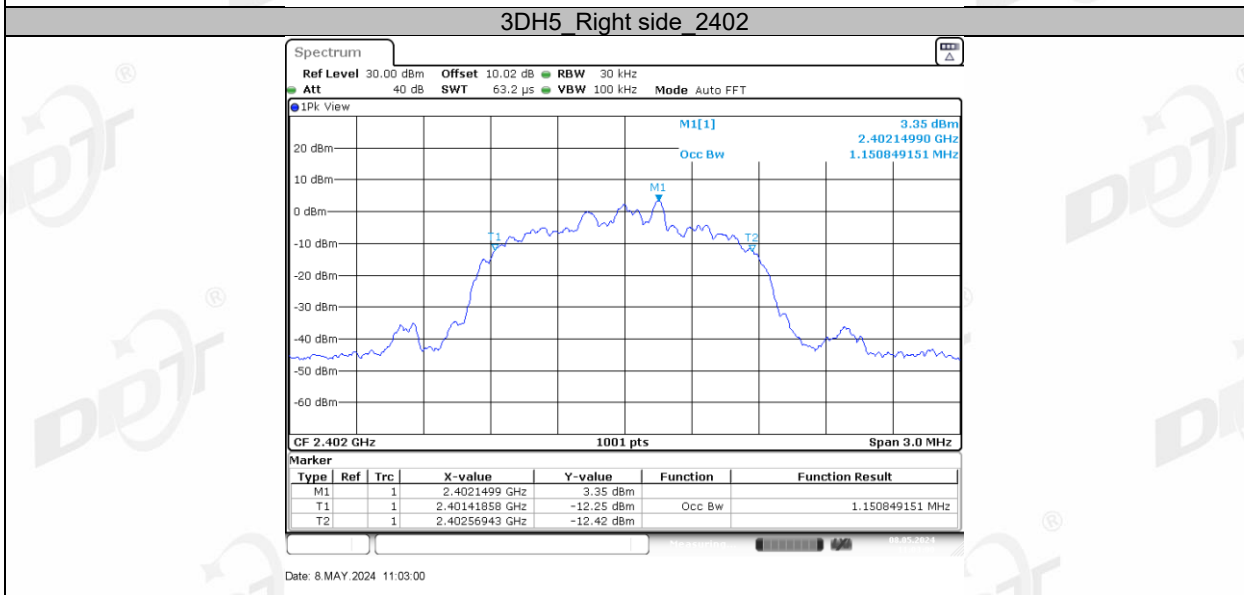
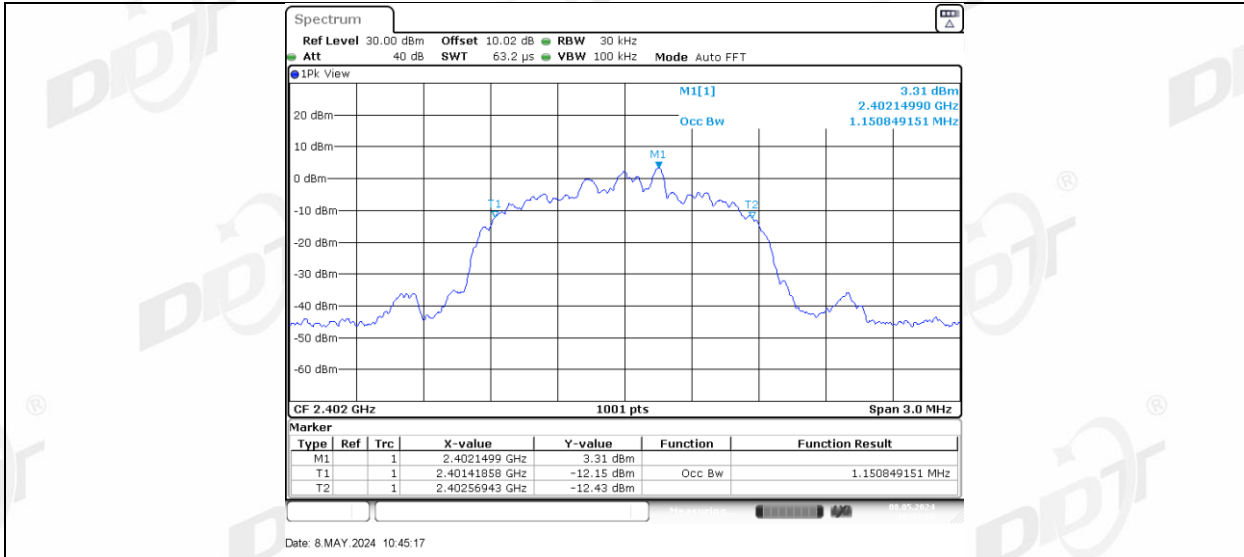
2DH5 Left side 2480

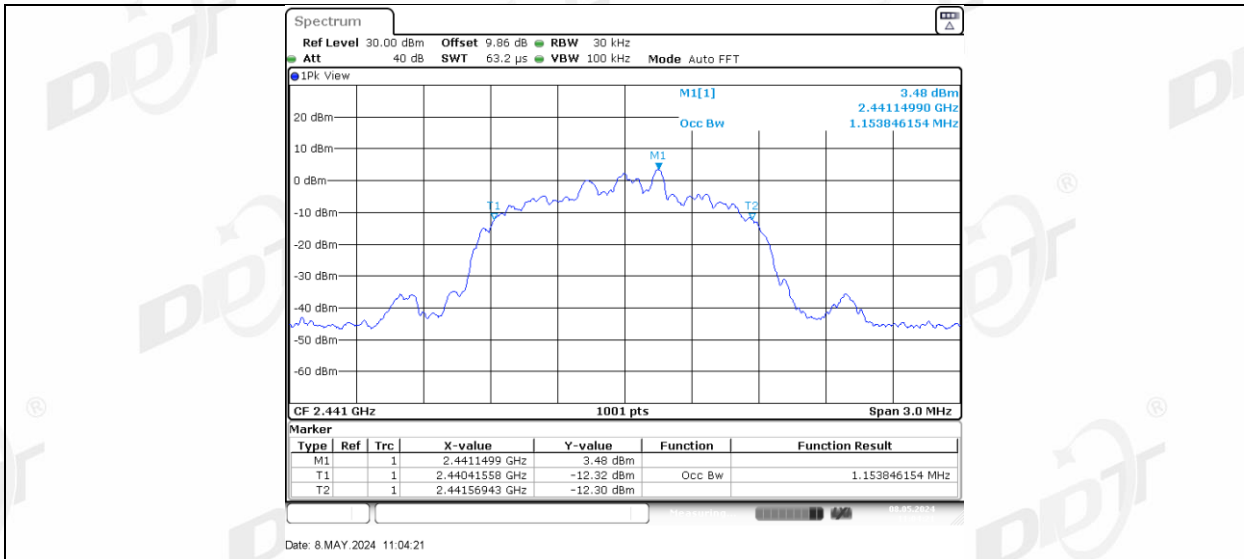


2DH5 Right side 2480

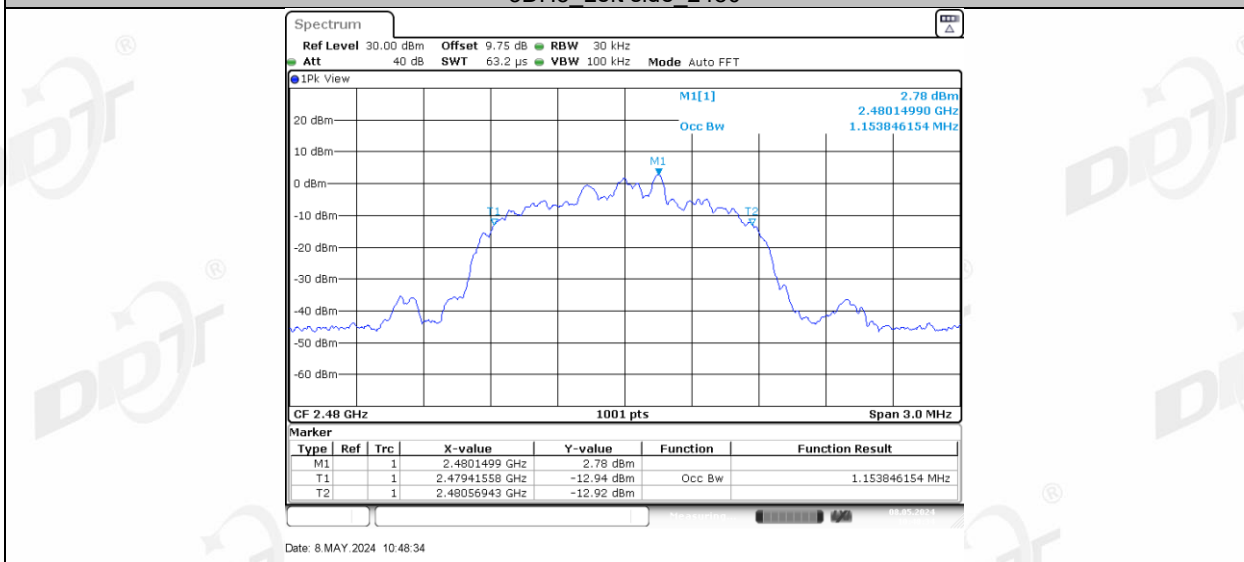


3DH5 Left side 2402

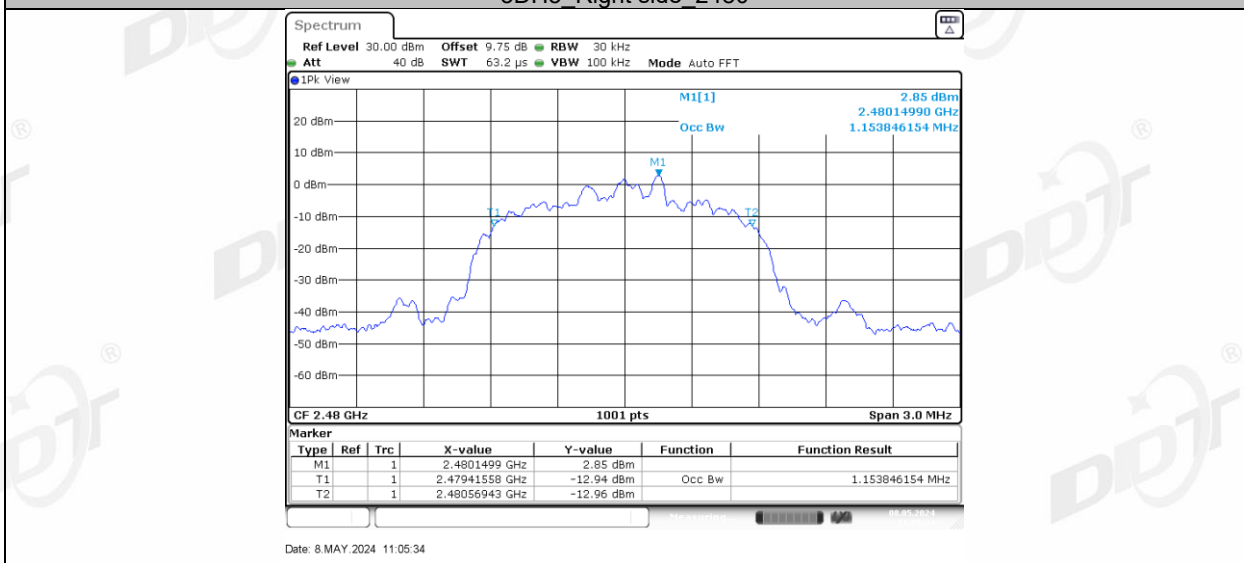




3DH5 Left side 2480

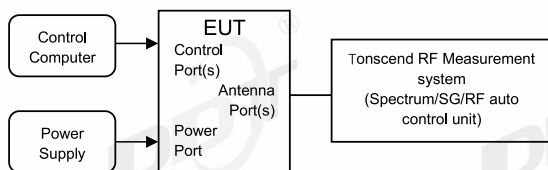


3DH5 Right side 2480



6. Maximum Peak Output Power

6.1. Block diagram of test setup



6.2. Limits

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts, the e.i.r.p shall not exceed 4W.

6.3. Test procedure

- (1) The test according to ANSI C63.10-2013 clause 7.8.5.
- (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:

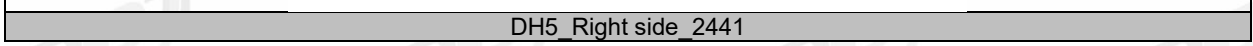
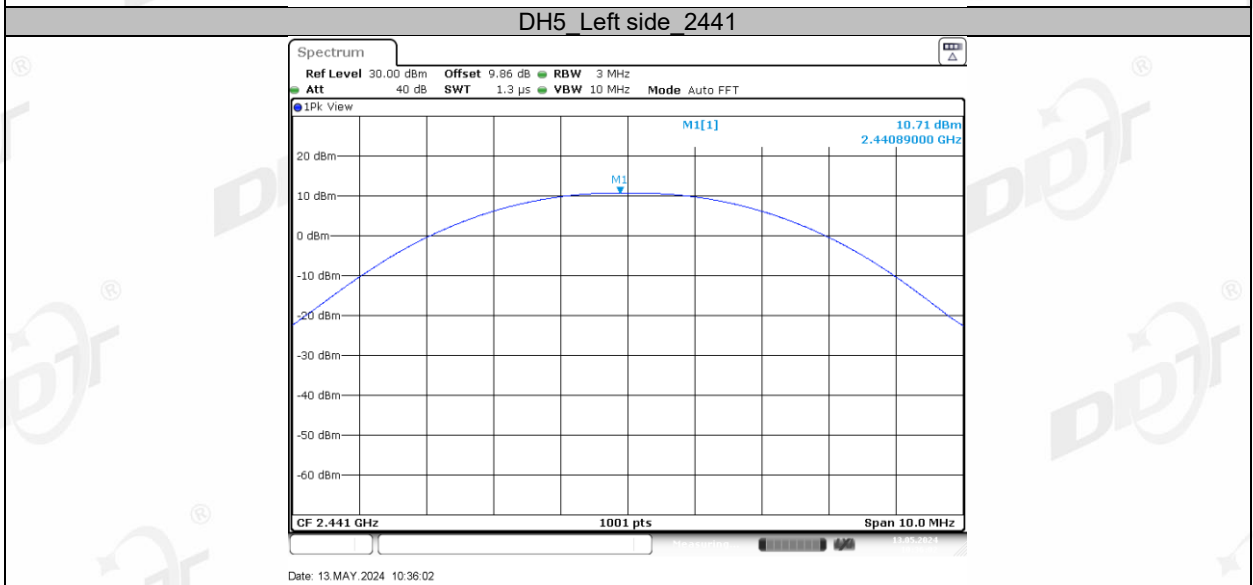
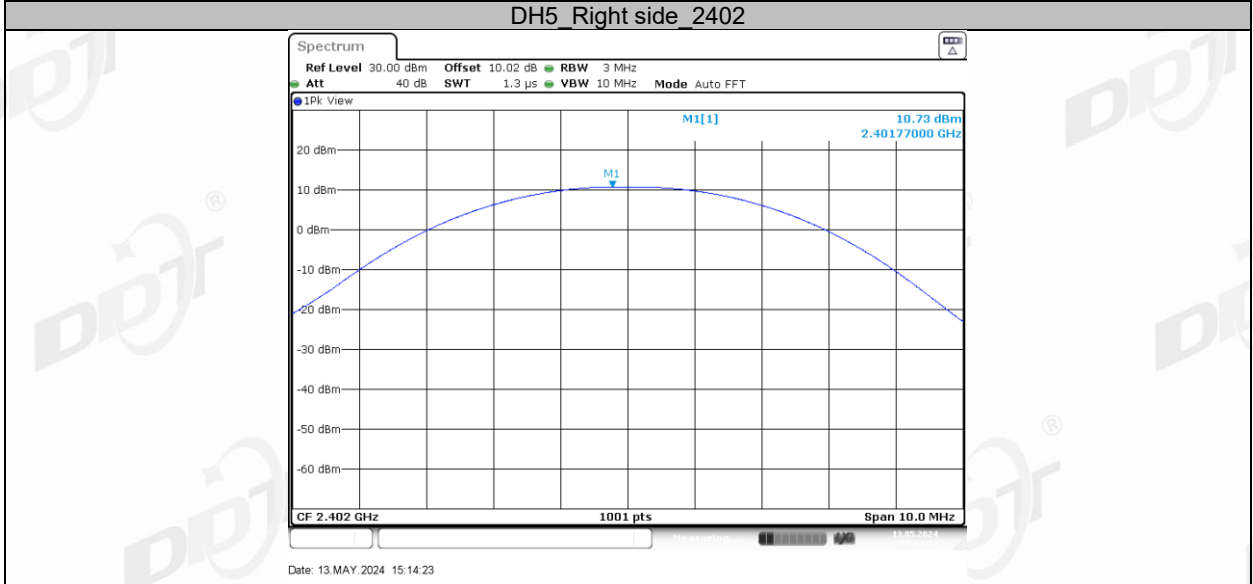
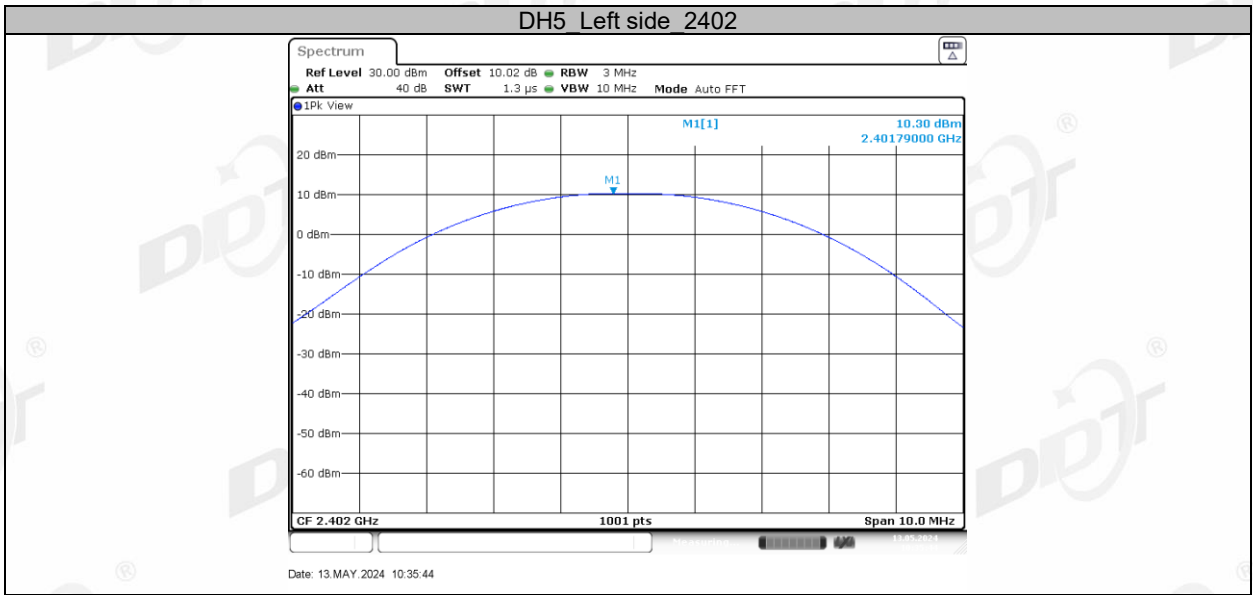
RBW:	> 20 dB bandwidth of the emission being measured.
VBW:	$VBW \geq RBW$.
Span:	Approximately five times the 20 dB bandwidth, centered on a hopping channel.
Detector Mode:	Peak
Sweep time:	Auto
Trace mode:	Max hold
- (5) Use the marker-to-peak function to set the marker to the peak of the emission and record the results in the report.

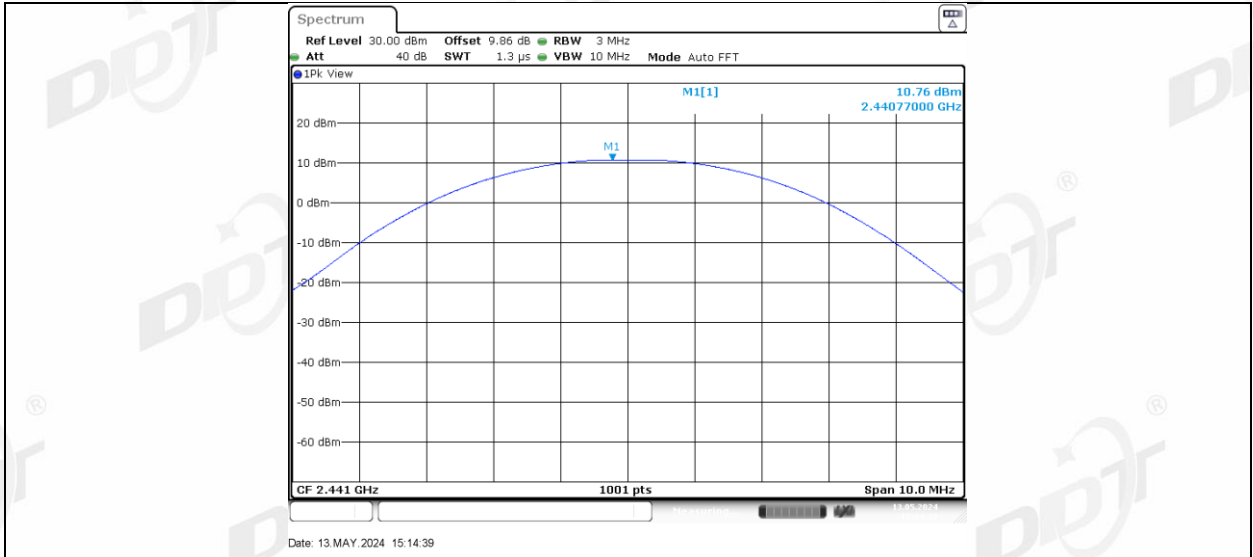
6.4. Test result

Test Engineer:	Zhongyao	Test Site:	RF Measurement System 3#
Ambient Condition:	25.3°C, 47.9%RH	Test Date:	2024.05.13
Test Power Supply:	Battery	Sample Number:	S24020411-012

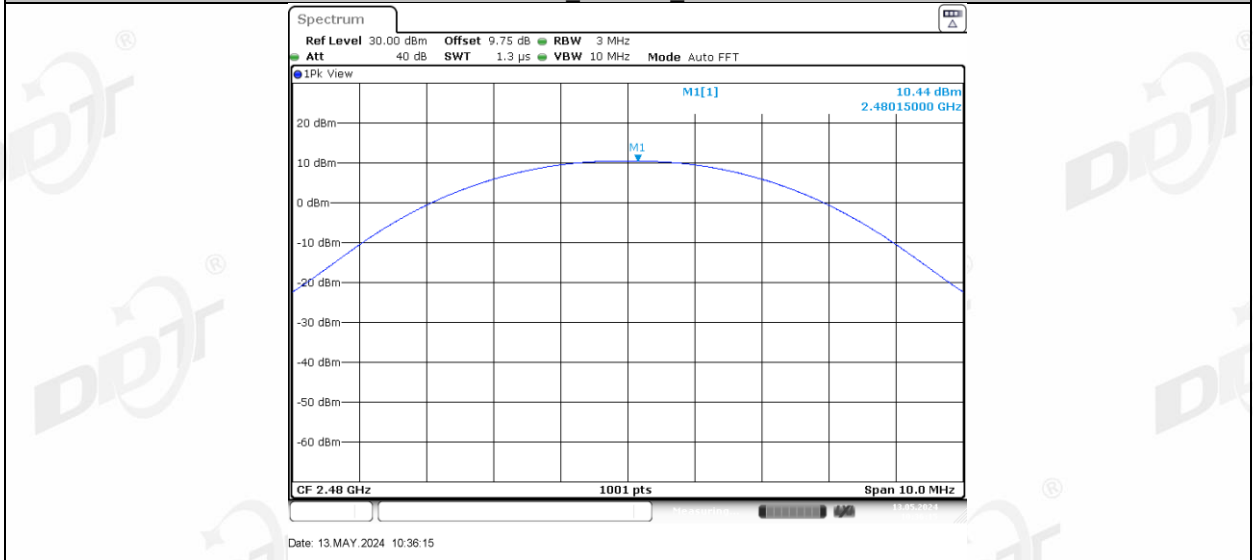
Test Mode	Antenna	Frequency [MHz]	Conducted Peak Power [dBm]	Conducted Limit [dBm]	EIRP [dBm]	EIRP Limit [dBm]	Verdict
DH5	Left side	2402	10.30	≤20.97	9.85	≤30	PASS
	Right side	2402	10.73	≤20.97	10.41	≤30	PASS
	Left side	2441	10.71	≤20.97	10.26	≤30	PASS
	Right side	2441	10.76	≤20.97	10.44	≤30	PASS
	Left side	2480	10.44	≤20.97	9.99	≤30	PASS
	Right side	2480	11.20	≤20.97	10.88	≤30	PASS
2DH5	Left side	2402	10.22	≤20.97	9.77	≤30	PASS
	Right side	2402	10.62	≤20.97	10.30	≤30	PASS
	Left side	2441	10.57	≤20.97	10.12	≤30	PASS
	Right side	2441	10.72	≤20.97	10.40	≤30	PASS
	Left side	2480	10.32	≤20.97	9.87	≤30	PASS
	Right side	2480	11.11	≤20.97	10.79	≤30	PASS
3DH5	Left side	2402	10.21	≤20.97	9.76	≤30	PASS
	Right side	2402	10.61	≤20.97	10.29	≤30	PASS
	Left side	2441	10.60	≤20.97	10.15	≤30	PASS
	Right side	2441	10.69	≤20.97	10.37	≤30	PASS
	Left side	2480	10.48	≤20.97	10.03	≤30	PASS
	Right side	2480	11.10	≤20.97	10.78	≤30	PASS

6.5. Test graphs

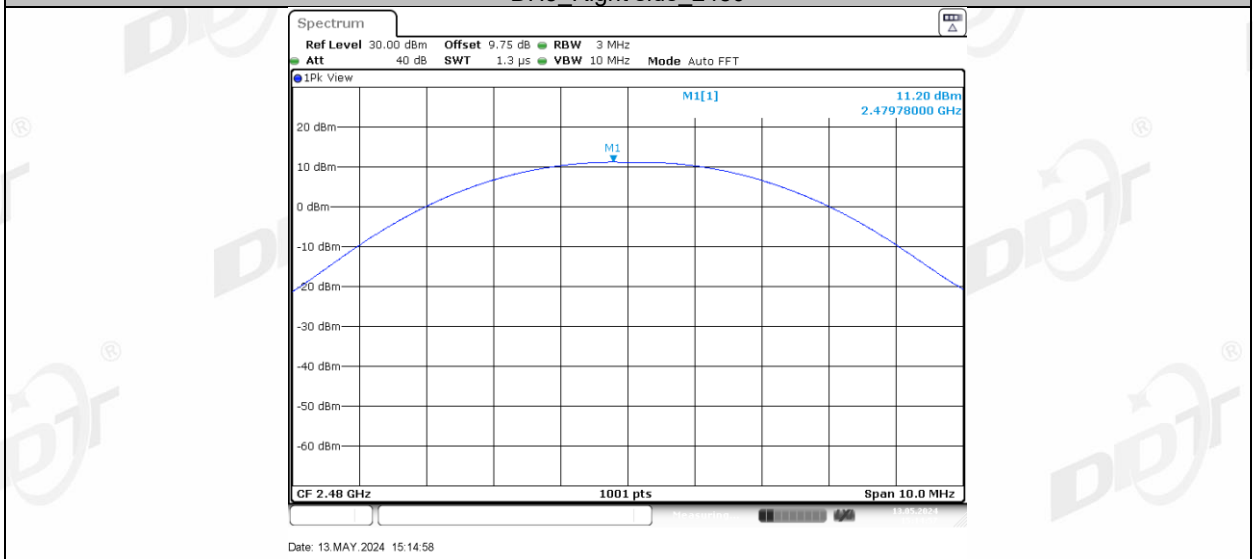




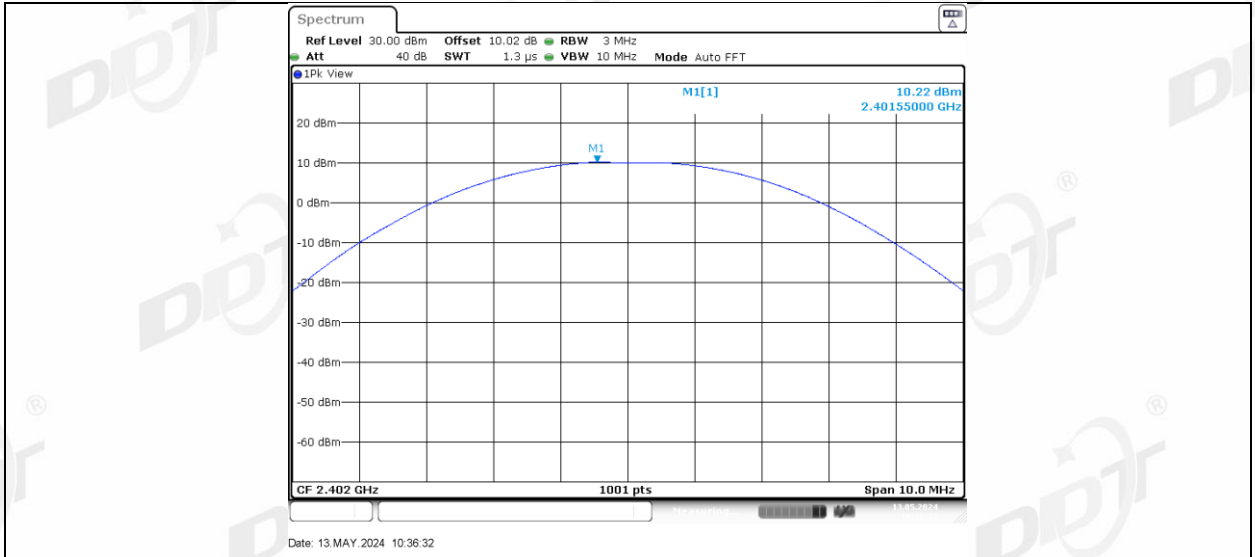
DH5 Left side 2480



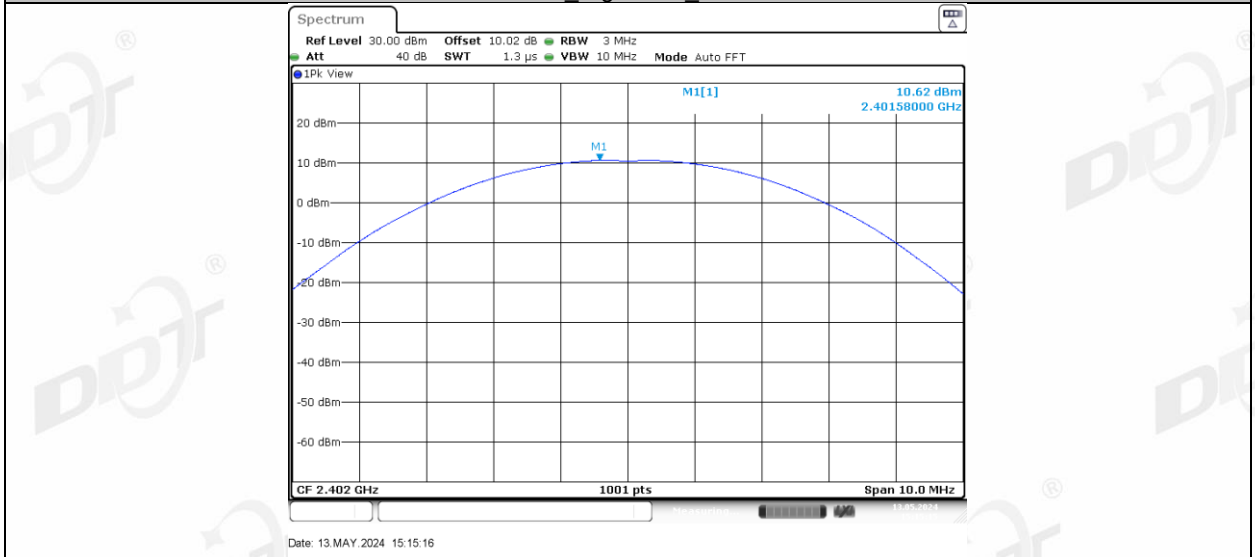
DH5 Right side 2480



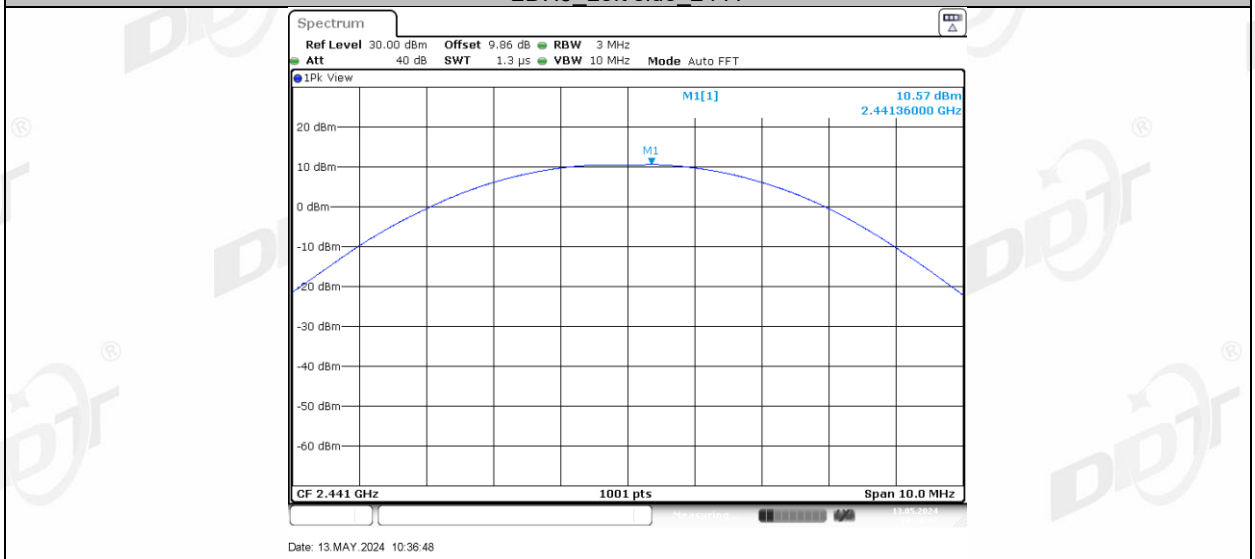
2DH5 Left side 2402



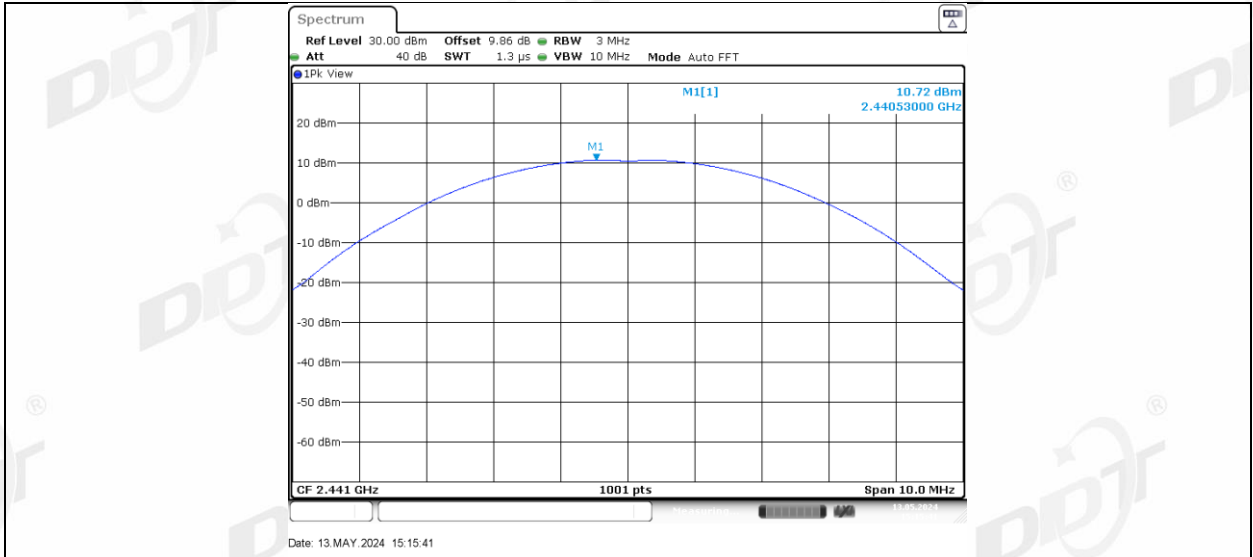
2DH5 Right side 2402



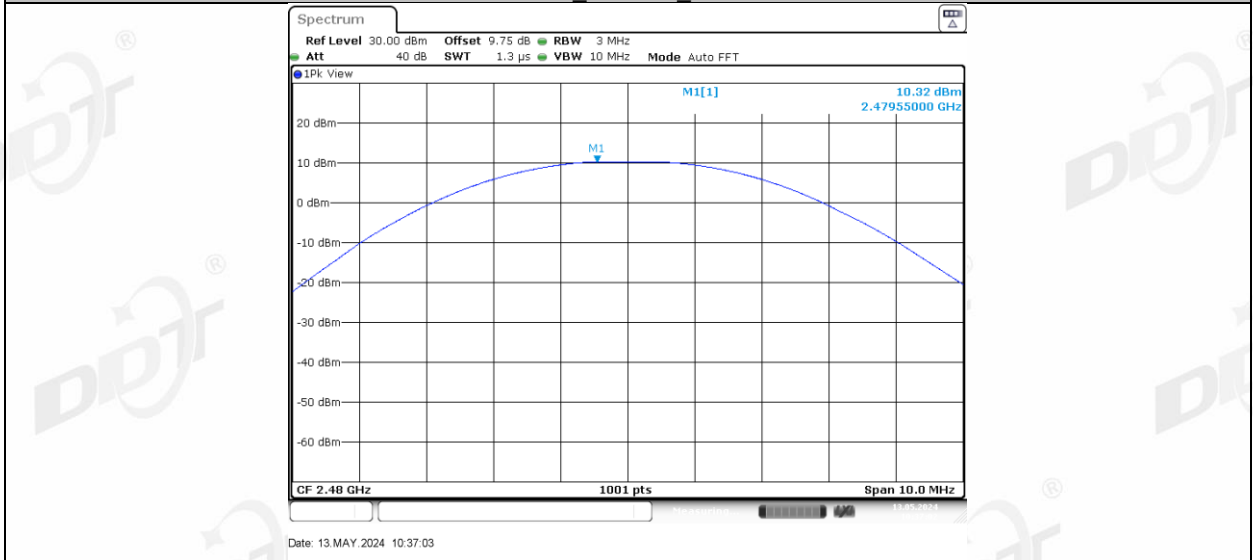
2DH5 Left side 2441



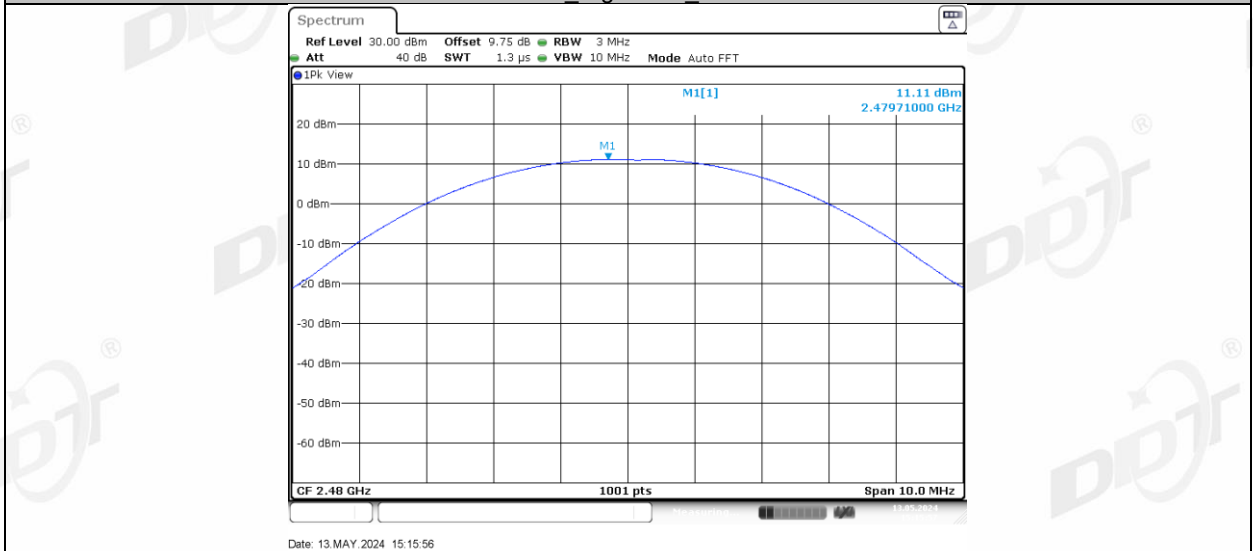
2DH5 Right side 2441



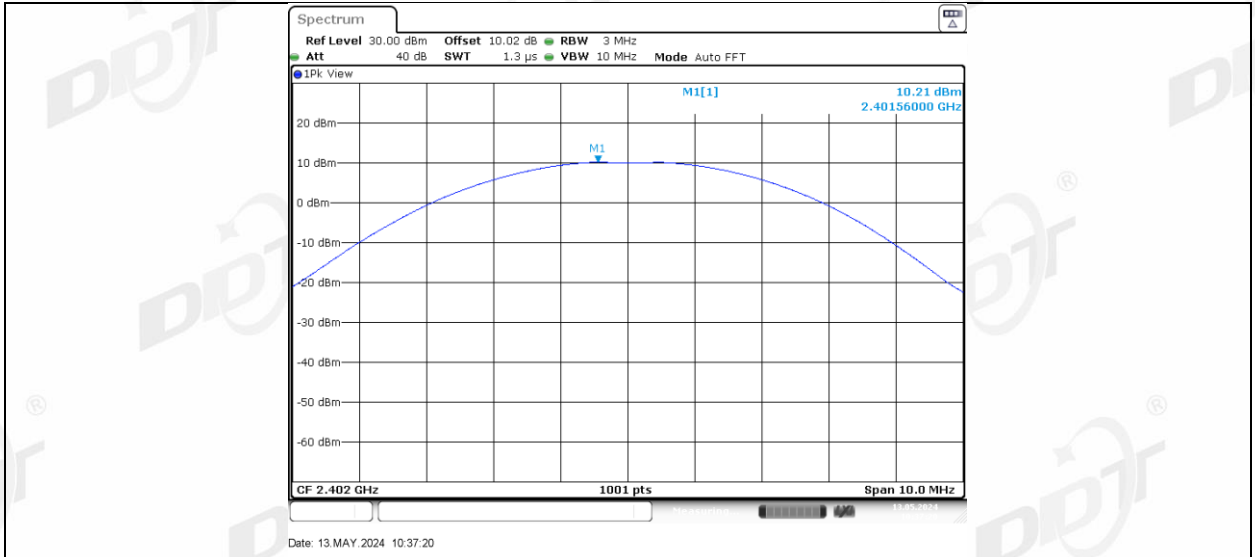
2DH5 Left side 2480



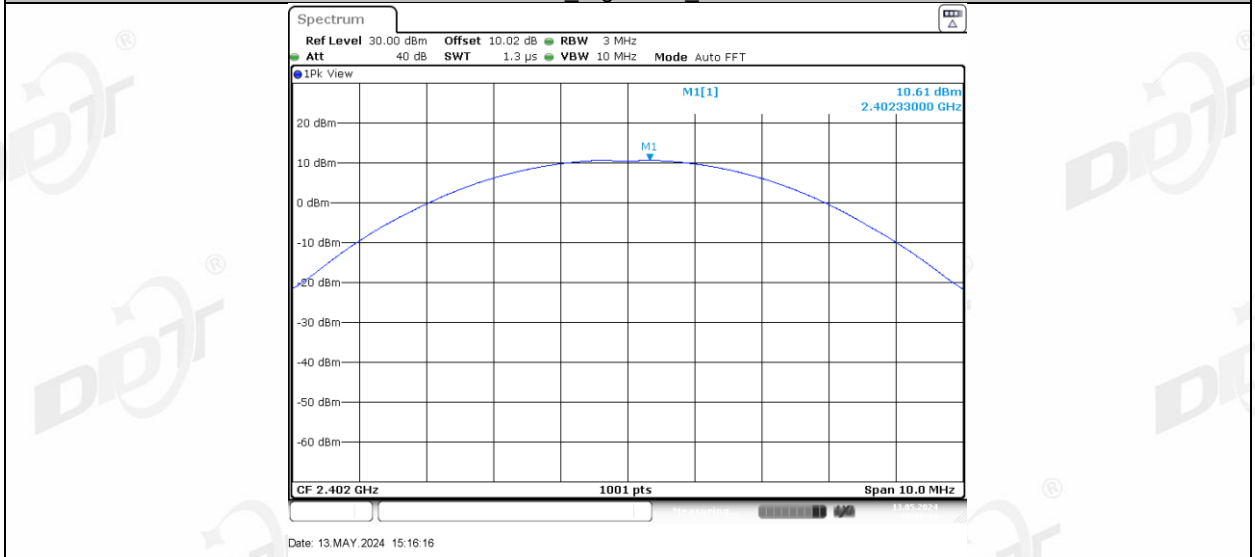
2DH5 Right side 2480



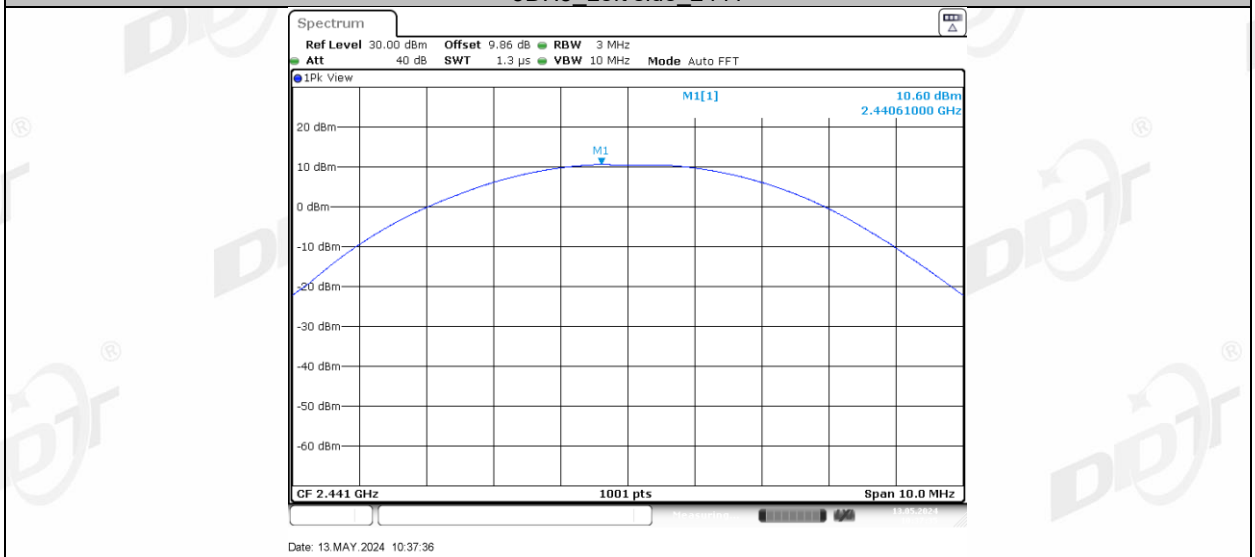
3DH5 Left side 2402



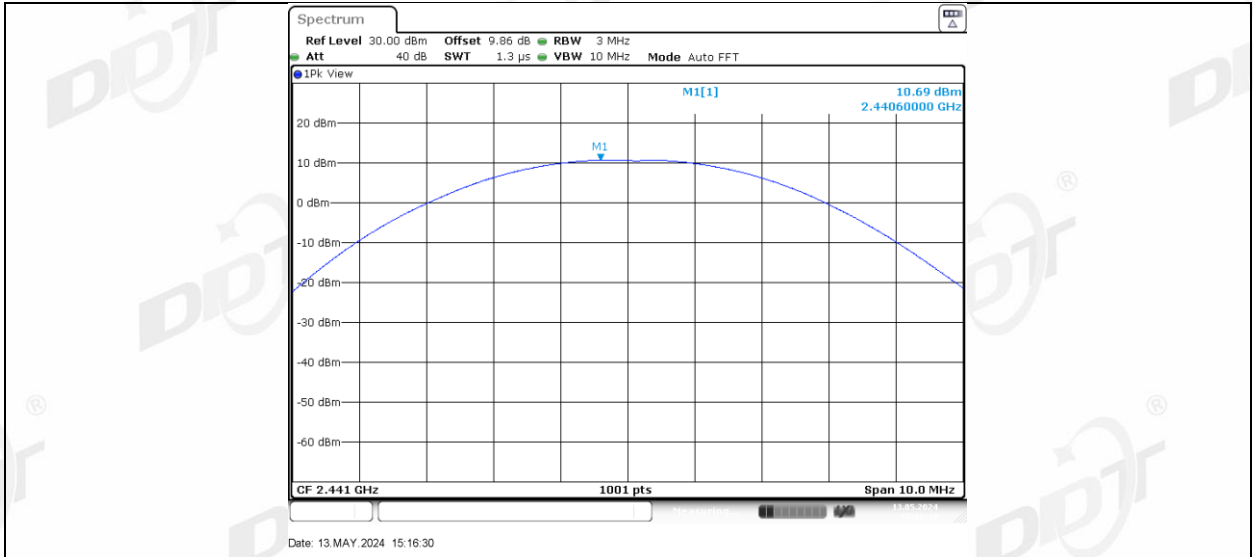
3DH5 Right side 2402



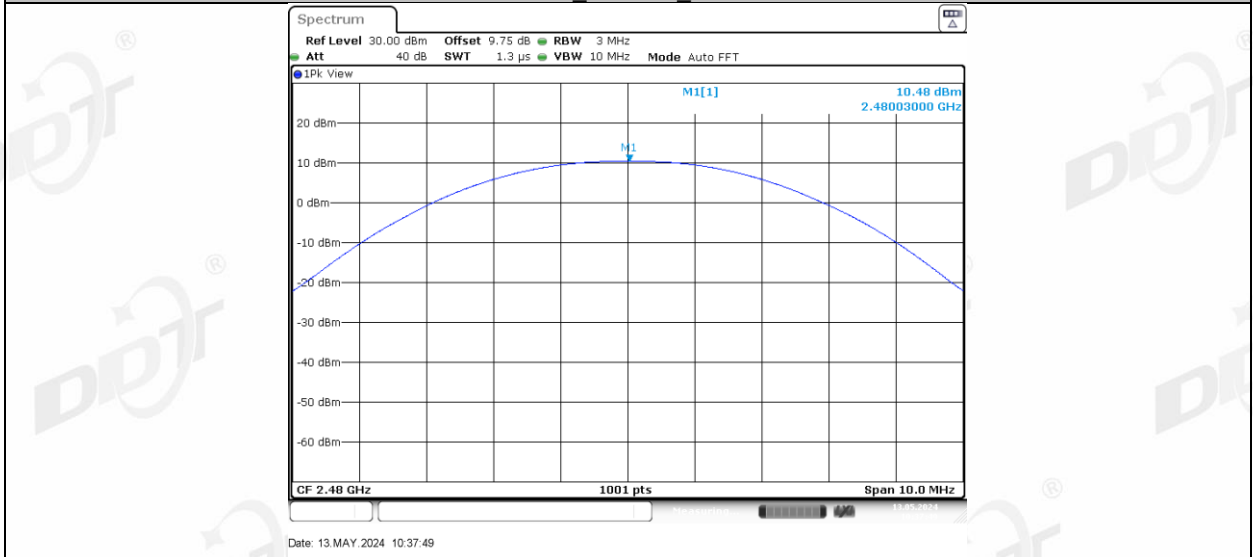
3DH5 Left side 2441



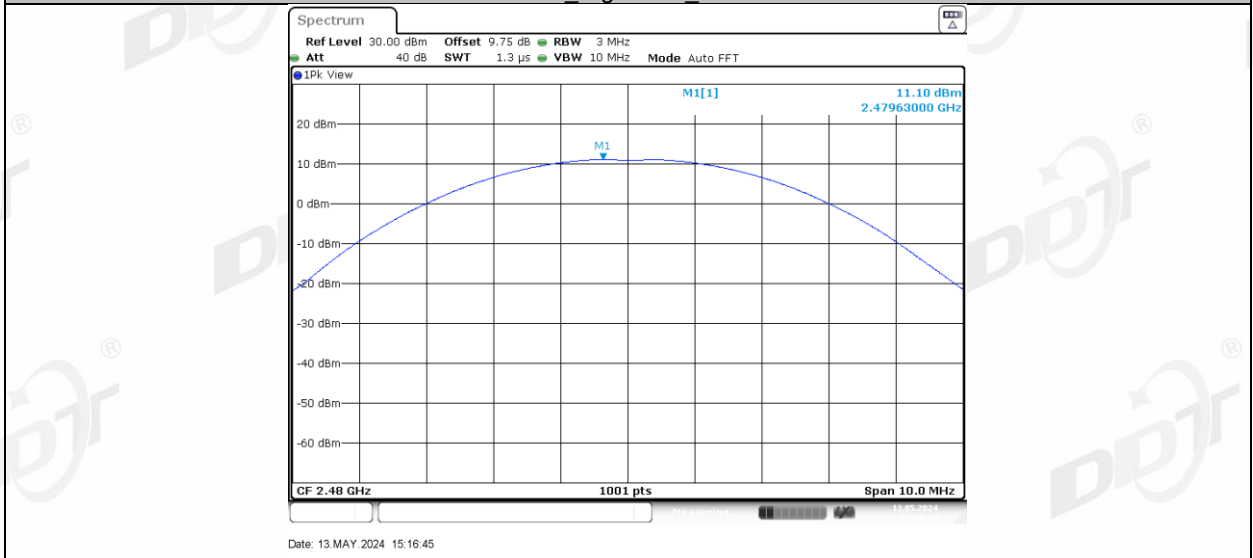
3DH5 Right side 2441



3DH5_Left side_2480

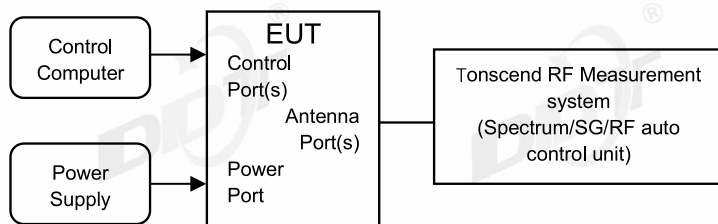


3DH5_Right side_2480



7. Carrier Frequency Separation

7.1. Block diagram of test setup



7.2. Limits

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

7.3. Test procedure

- (1) The test according to ANSI C63.10-2013 clause 7.8.2.
- (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 the maximum peak output power measurement:

RBW:	approximately 30% of the channel spacing
VBW:	VBW \geq RBW.
Span:	Wide enough to capture the peaks of two adjacent channels.
Detector Mode:	Peak
Sweep time:	Auto
Trace mode:	Max hold
- (5) Use the marker-delta function to determine the separation between the peaks of the adjacent channels and record the results in the report.

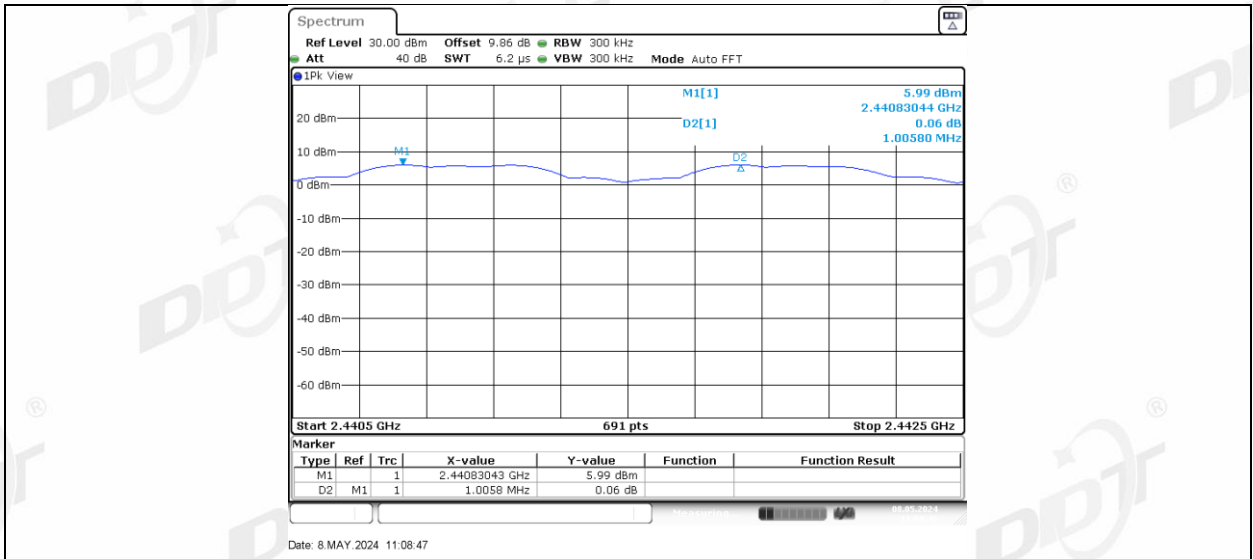
7.4. Test result

Test Engineer:	Zhongyao	Test Site:	RF Measurement System 3#
Ambient Condition:	24.4-25.3℃,47.5-47.9%RH	Test Date:	2024.05.07-2024.05.08
Test Power Supply:	Battery	Sample Number:	S24020411-012

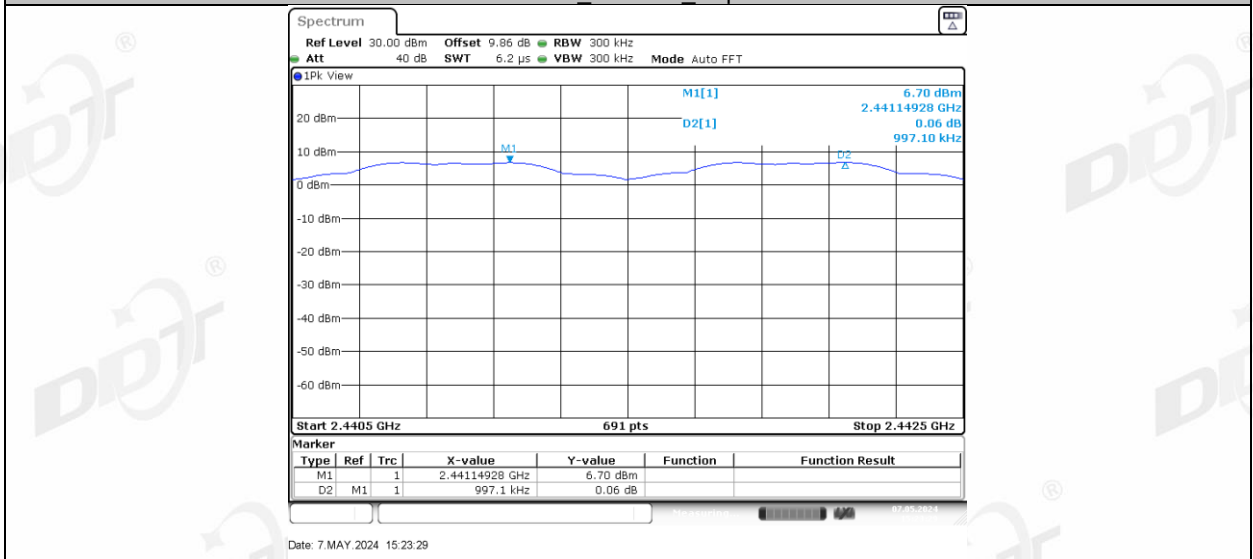
Test Mode	Antenna	Frequency [MHz]	Result [MHz]	Limit [MHz]	Verdict
DH5	Left side	Hop	0.997	≥0.970	PASS
	Right side	Hop	1.006	≥0.970	PASS
2DH5	Left side	Hop	1.000	≥0.827	PASS
	Right side	Hop	1.006	≥0.827	PASS
3DH5	Left side	Hop	0.997	≥0.847	PASS
	Right side	Hop	1.003	≥0.847	PASS

7.5. Test graphs

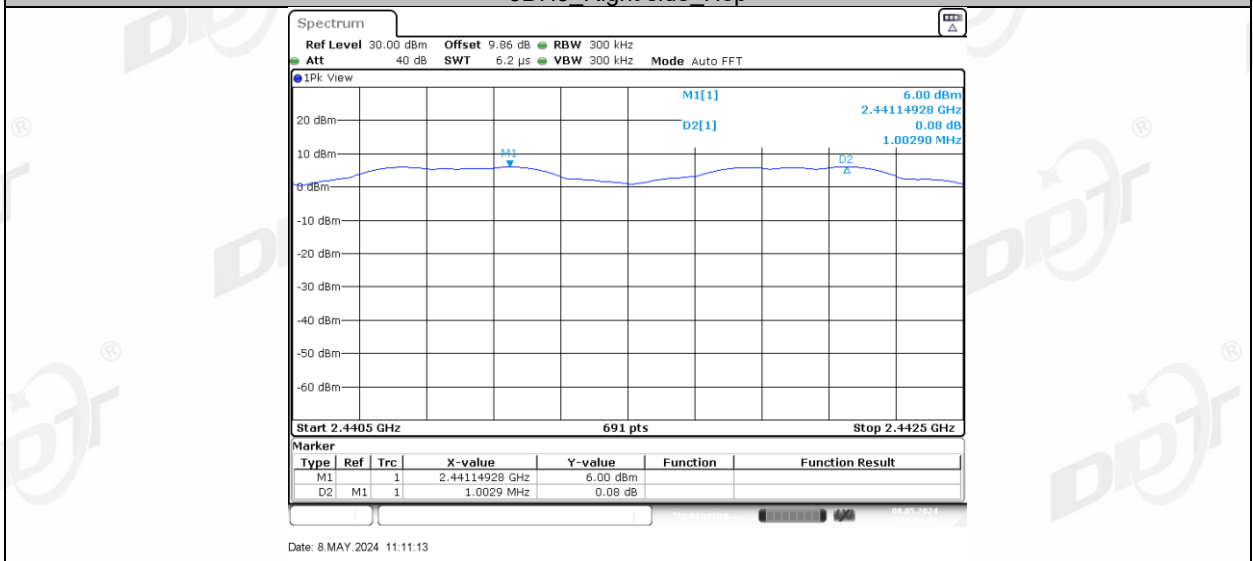




3DH5_Left side_Hop

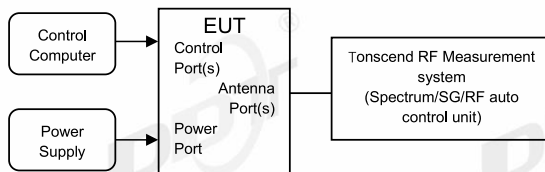


3DH5_Right side_Hop



8. Dwell Time

8.1. Block diagram of test setup



8.2. Limits

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

8.3. Test procedure

- (1) The test according to ANSI C63.10-2013 clause 7.8.4.
- (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:

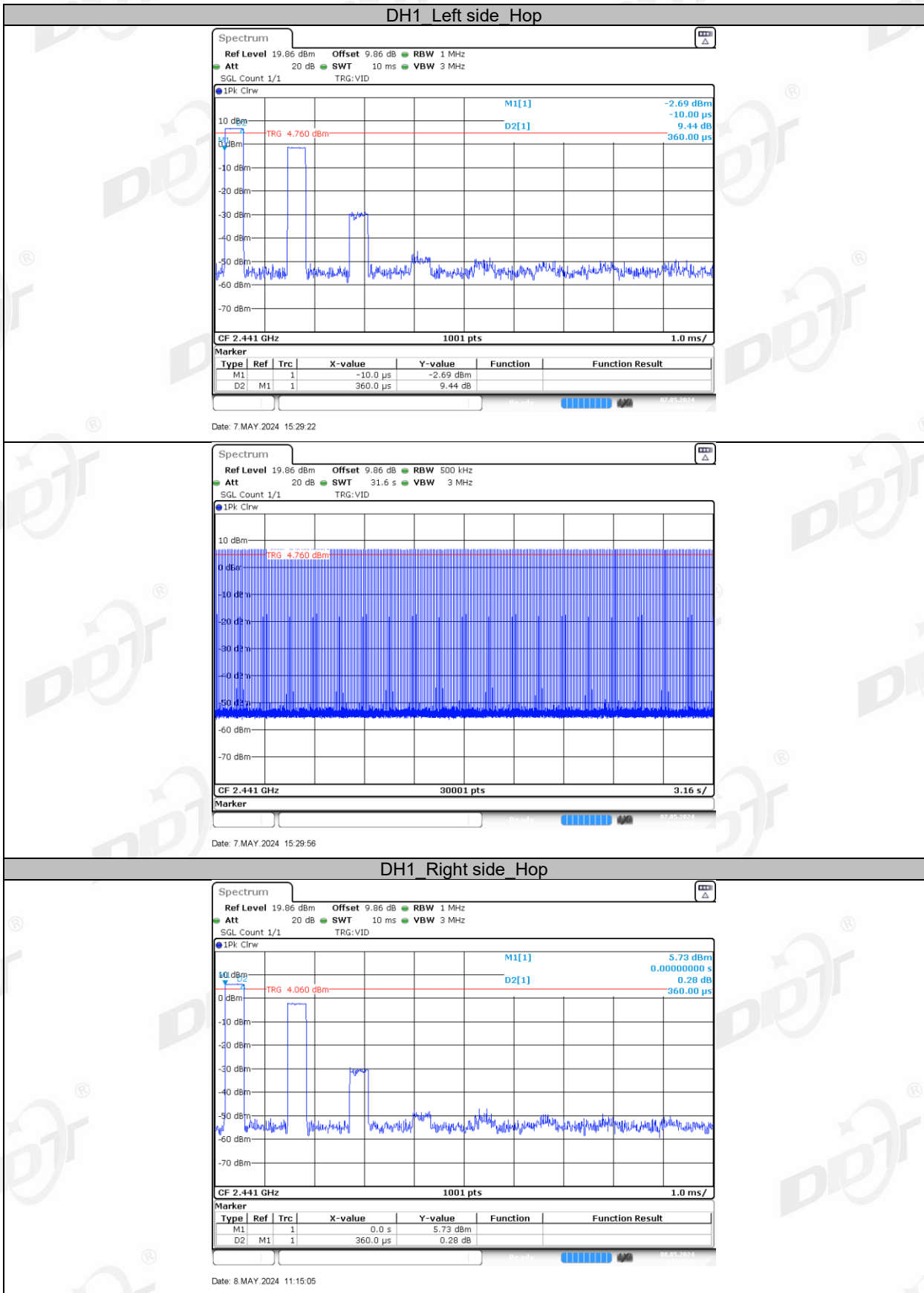
RBW:	≤ channel spacing and where possible RBW should be set $\gg 1 / T$
VBW:	$VBW \geq RBW$.
Span:	Zero span, centered on a hopping channel.
Detector Mode:	Peak
Sweep time:	Auto
Trace mode:	Clear Write.
- (5) The test period: $T = 0.4 \text{ Second/Channel} \times 79 \text{ Channel} = 31.6 \text{ s}$
- (6) Measure the hopping number and on time of each pulse with spectrum analyzer in zero span set, and calculate dwell time with formula Dwell time = total hops * pulse's on time.
- (7) Measure and record the results in the report.

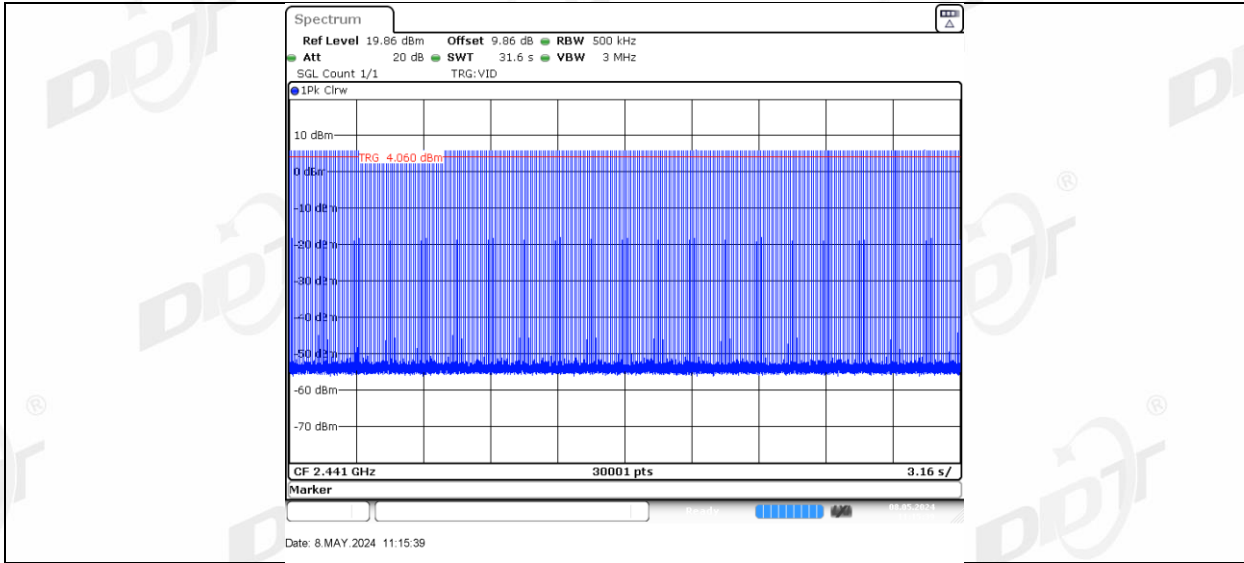
8.4. Test result

Test Engineer:	Zhongyao	Test Site:	RF Measurement System 3#
Ambient Condition:	24.4-25.3℃,47.5-47.9%RH	Test Date:	2024.05.07-2024.05.08
Test Power Supply:	Battery	Sample Number:	S24020411-012

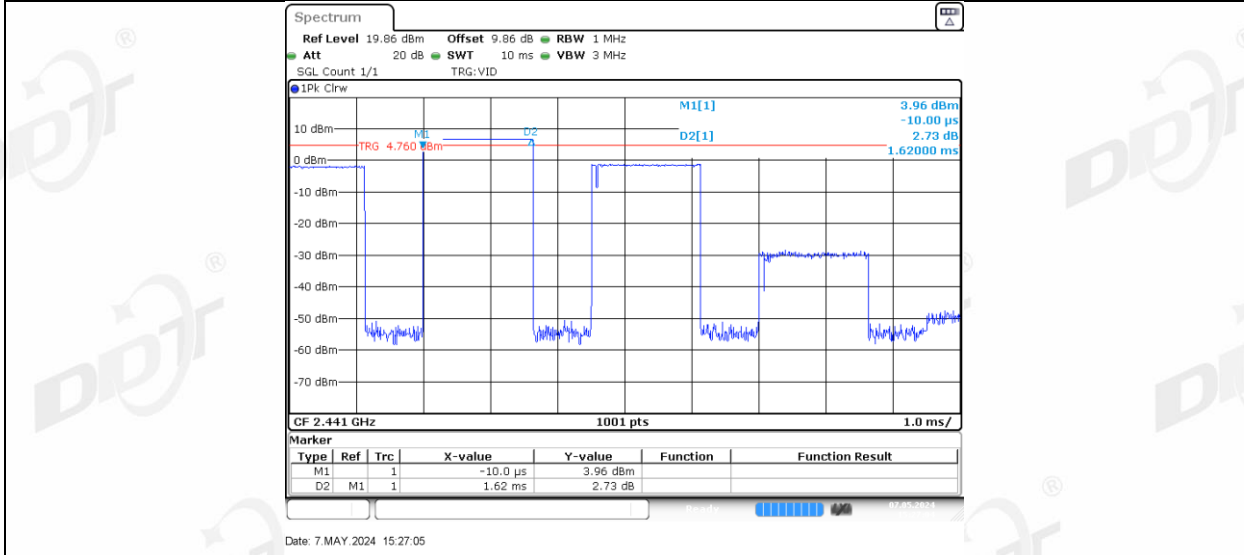
Test Mode	Antenna	Frequency [MHz]	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Left side	Hop	0.360	320	0.115	≤0.4	PASS
	Right side	Hop	0.360	320	0.115	≤0.4	PASS
DH3	Left side	Hop	1.620	160	0.259	≤0.4	PASS
	Right side	Hop	1.610	160	0.258	≤0.4	PASS
DH5	Left side	Hop	2.860	107	0.306	≤0.4	PASS
	Right side	Hop	2.860	107	0.306	≤0.4	PASS
2DH1	Left side	Hop	0.370	320	0.118	≤0.4	PASS
	Right side	Hop	0.360	320	0.115	≤0.4	PASS
2DH3	Left side	Hop	1.620	160	0.259	≤0.4	PASS
	Right side	Hop	1.610	160	0.258	≤0.4	PASS
2DH5	Left side	Hop	2.870	107	0.307	≤0.4	PASS
	Right side	Hop	2.860	107	0.306	≤0.4	PASS
3DH1	Left side	Hop	0.360	320	0.115	≤0.4	PASS
	Right side	Hop	0.370	320	0.118	≤0.4	PASS
3DH3	Left side	Hop	1.620	160	0.259	≤0.4	PASS
	Right side	Hop	1.620	160	0.259	≤0.4	PASS
3DH5	Left side	Hop	2.870	107	0.307	≤0.4	PASS
	Right side	Hop	2.870	107	0.307	≤0.4	PASS

8.5. Test graphs

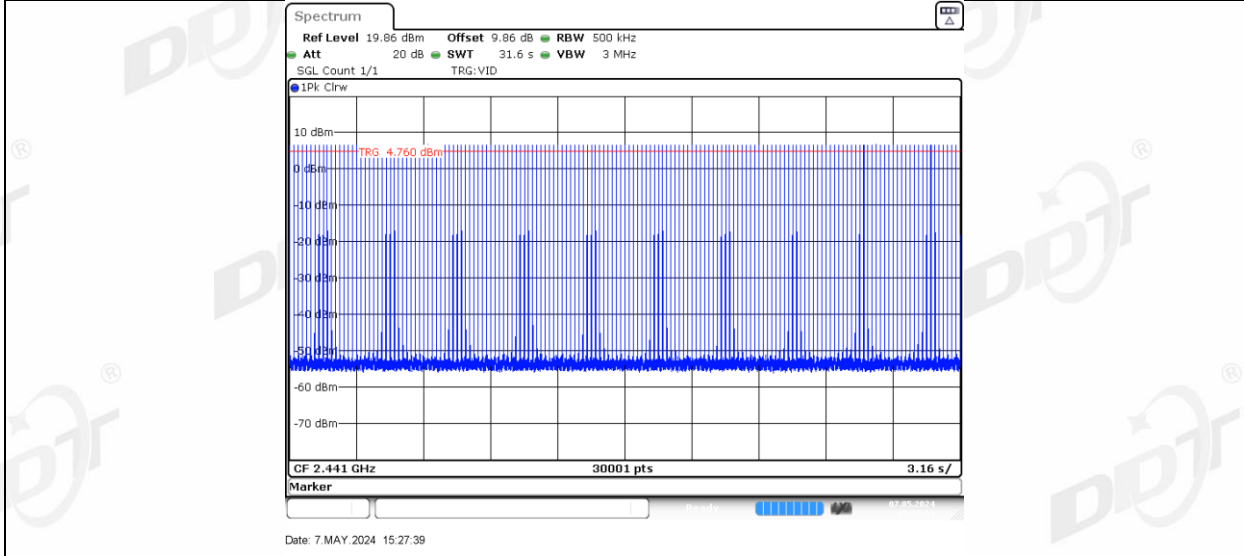




DH3 Left side Hop

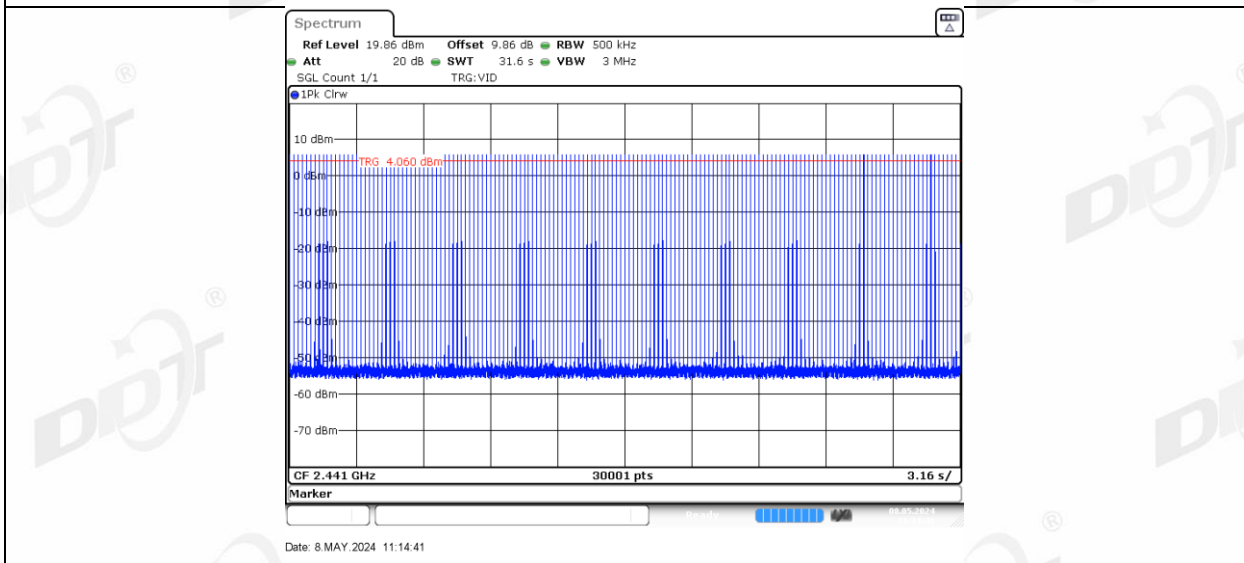
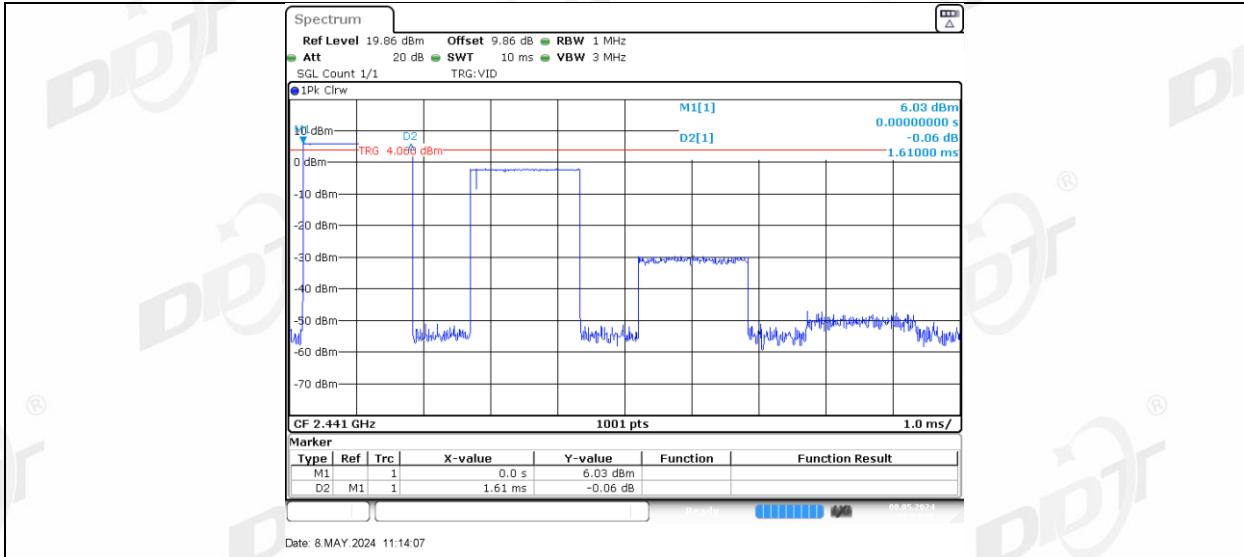


Date: 7 MAY 2024 15:27:05

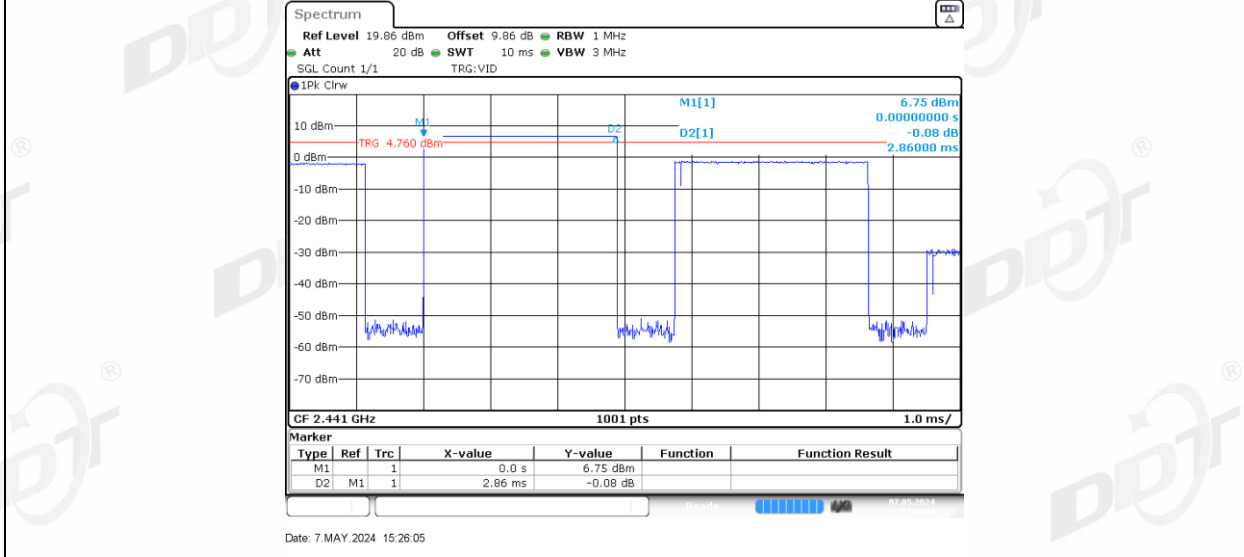


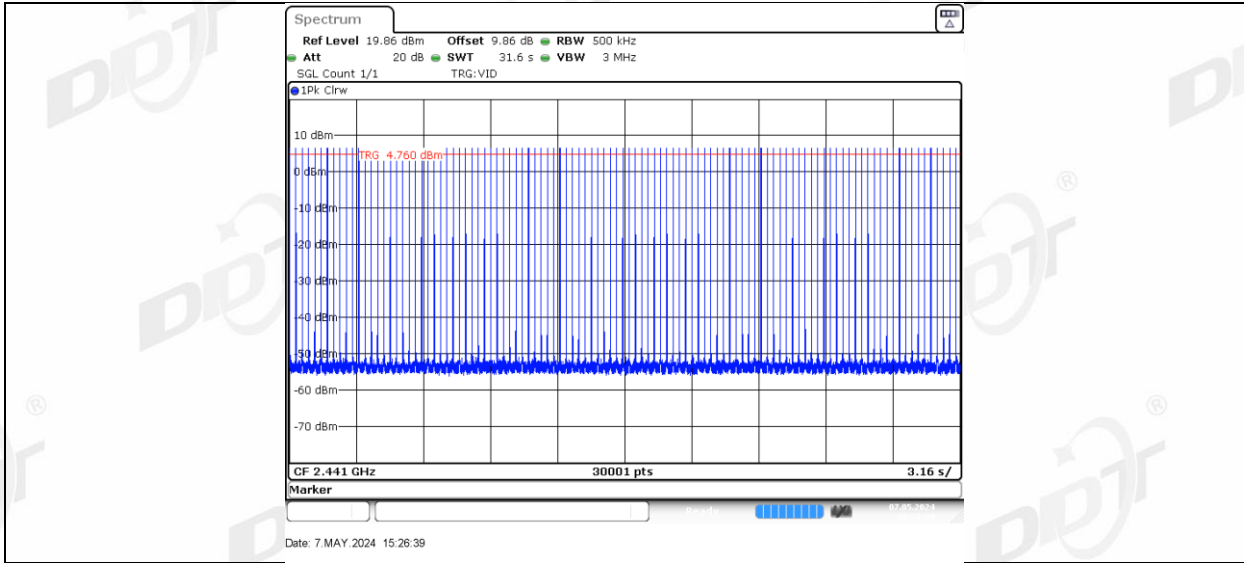
Date: 7 MAY 2024 15:27:39

DH3 Right side Hop

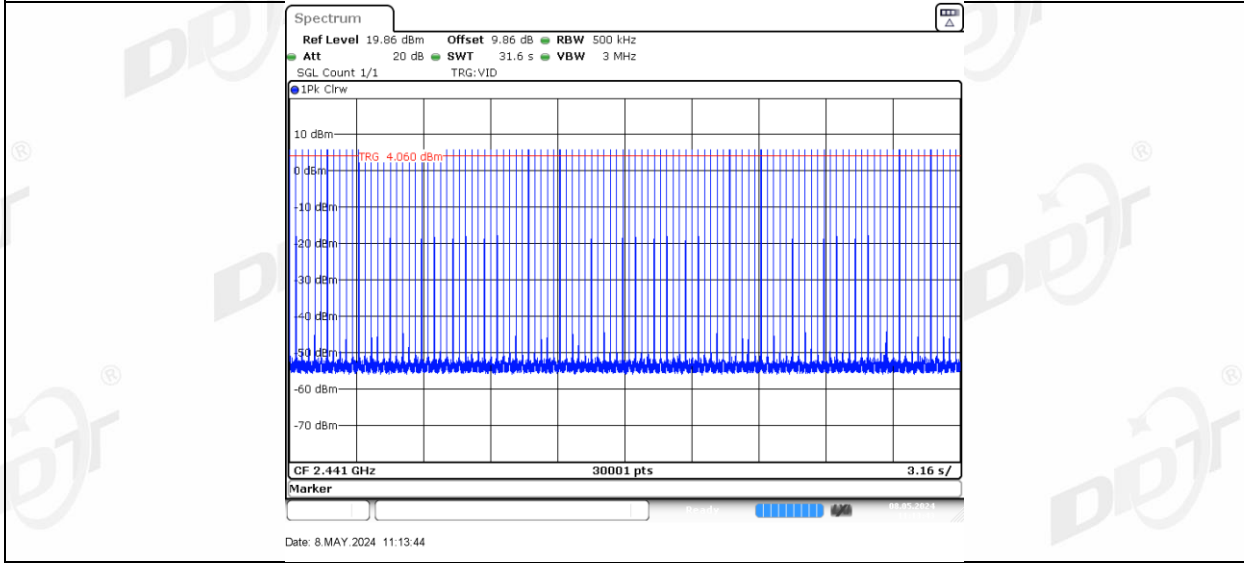
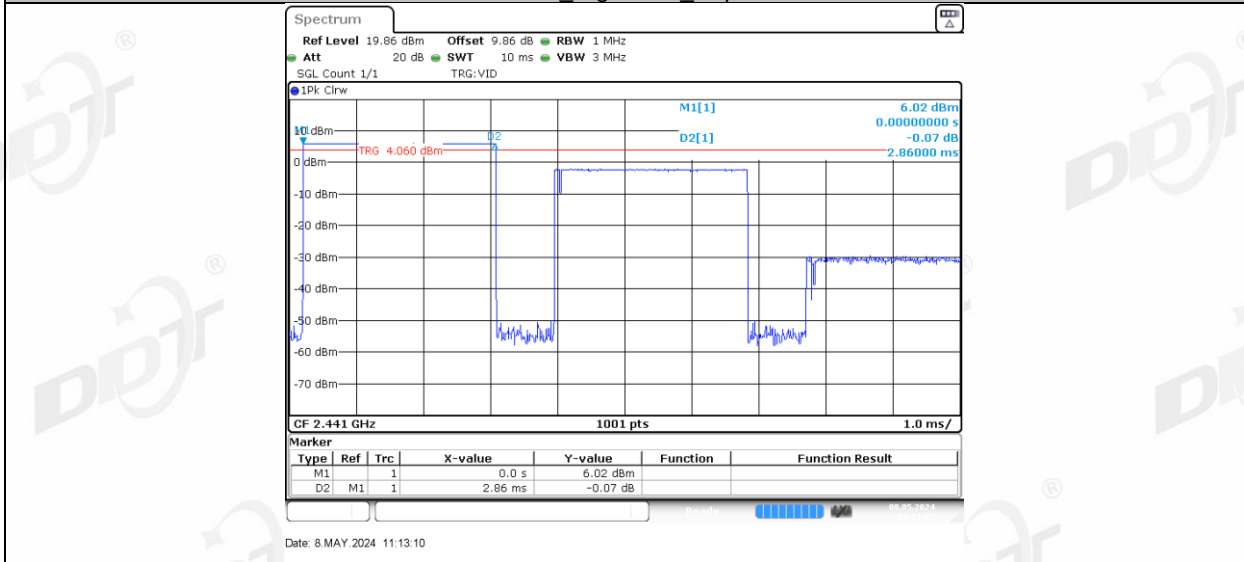


DH5 Left side Hop

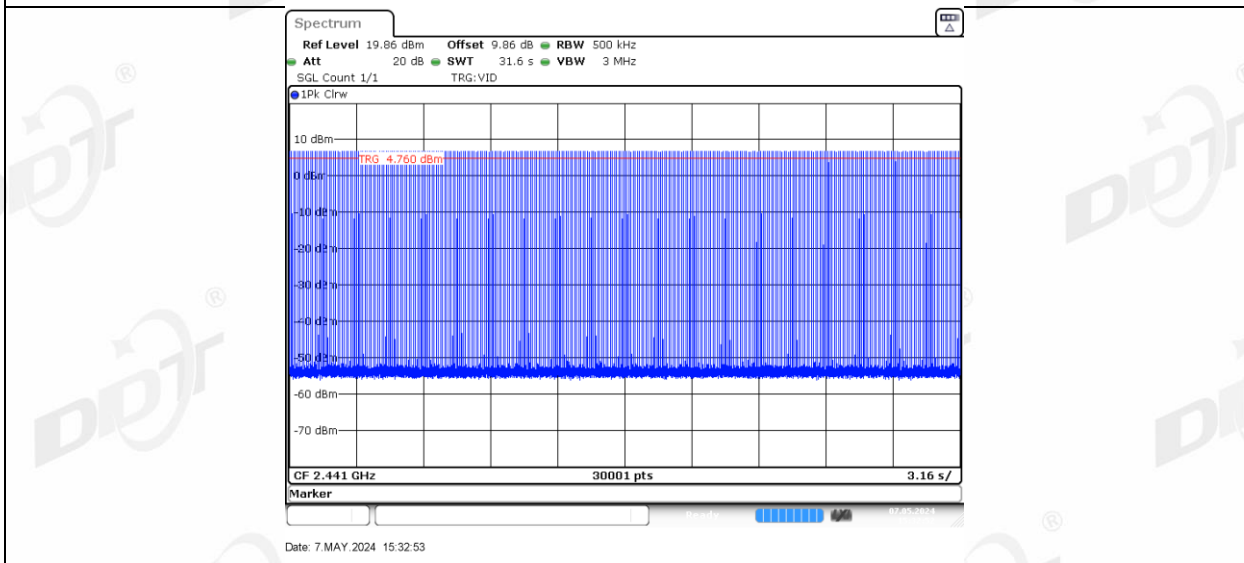
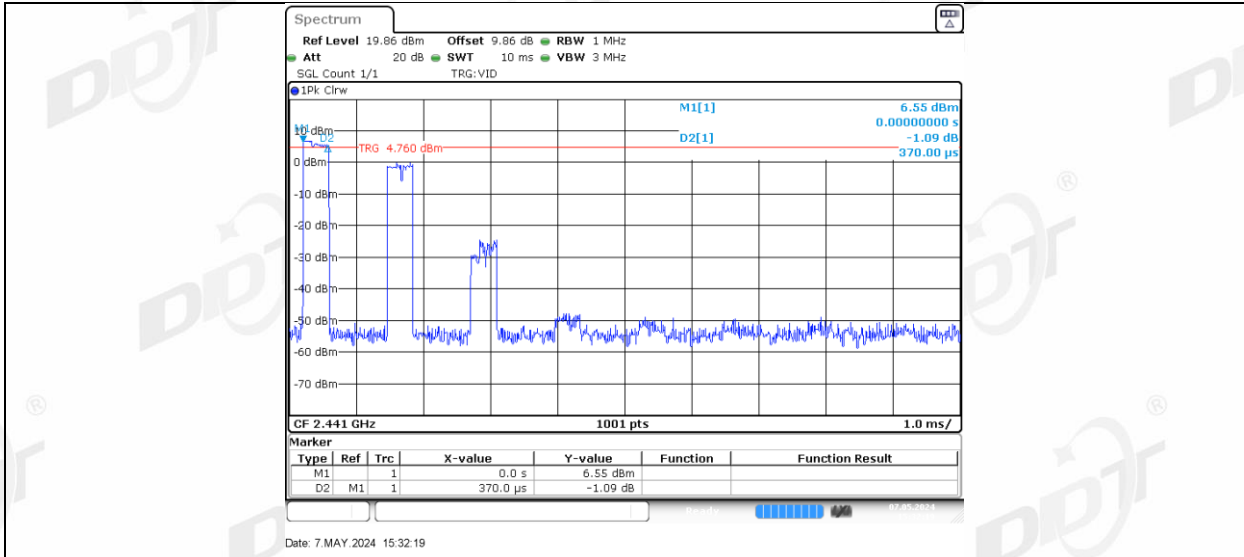




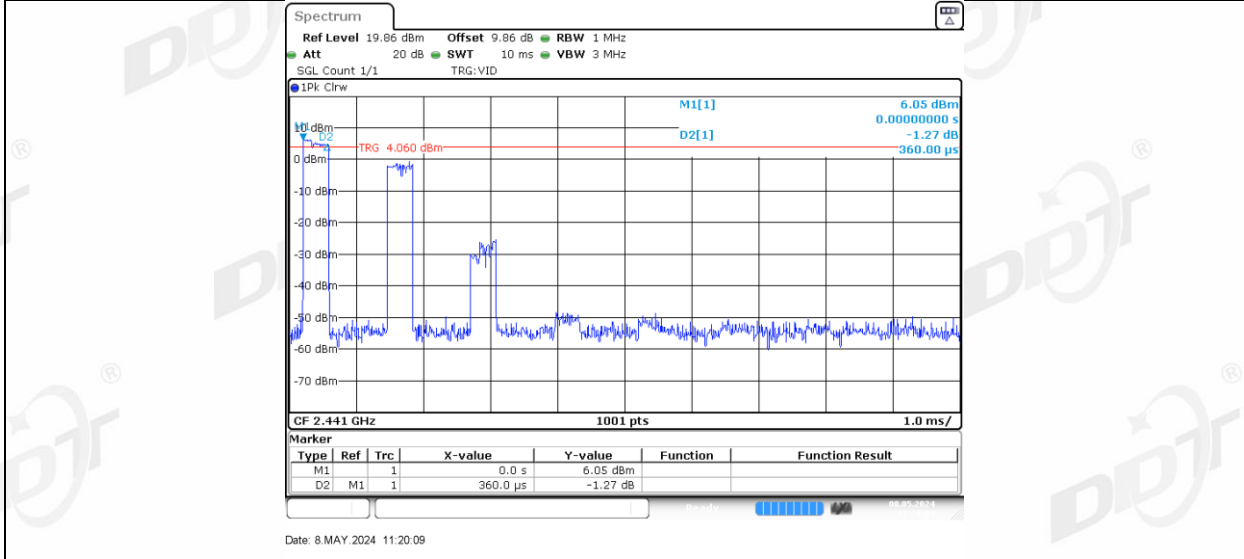
DH5 Right side Hop

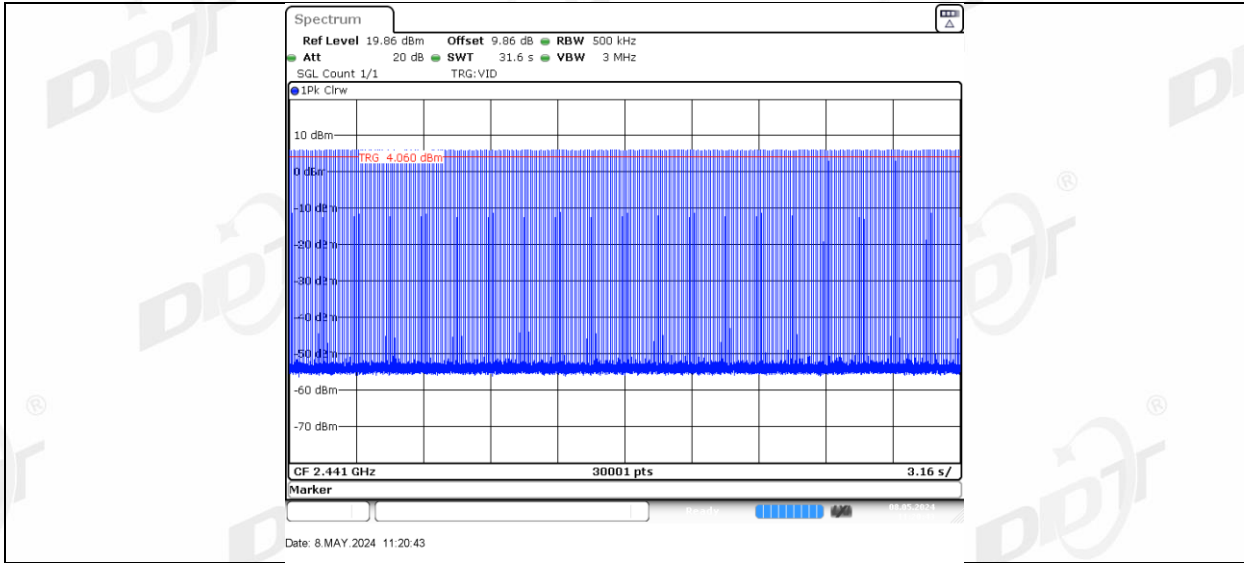


2DH1 Left side Hop

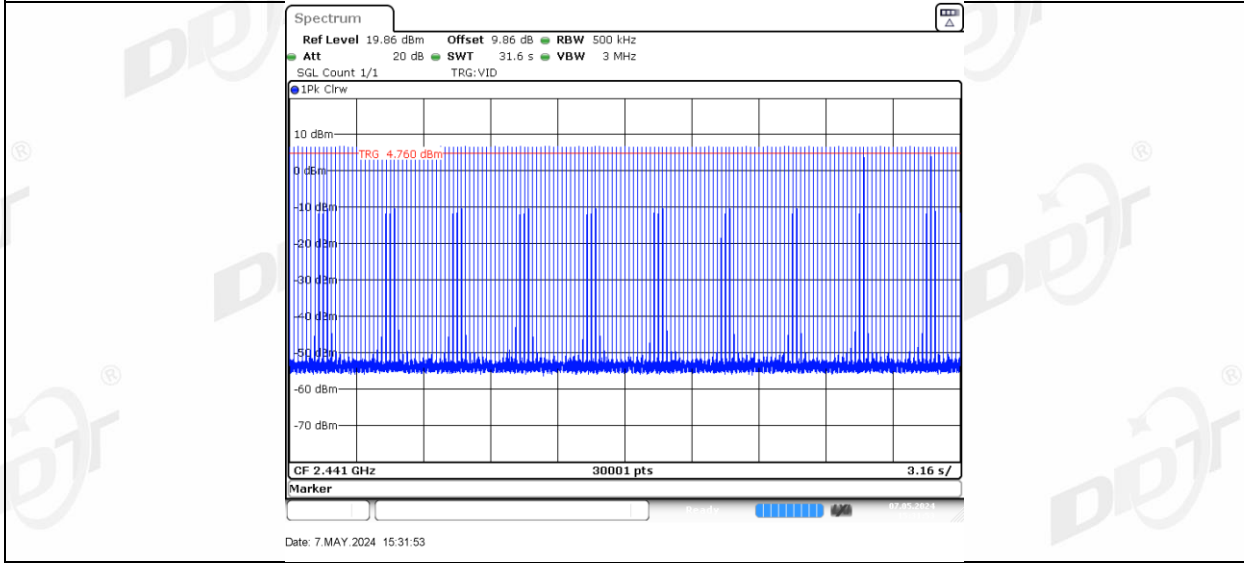
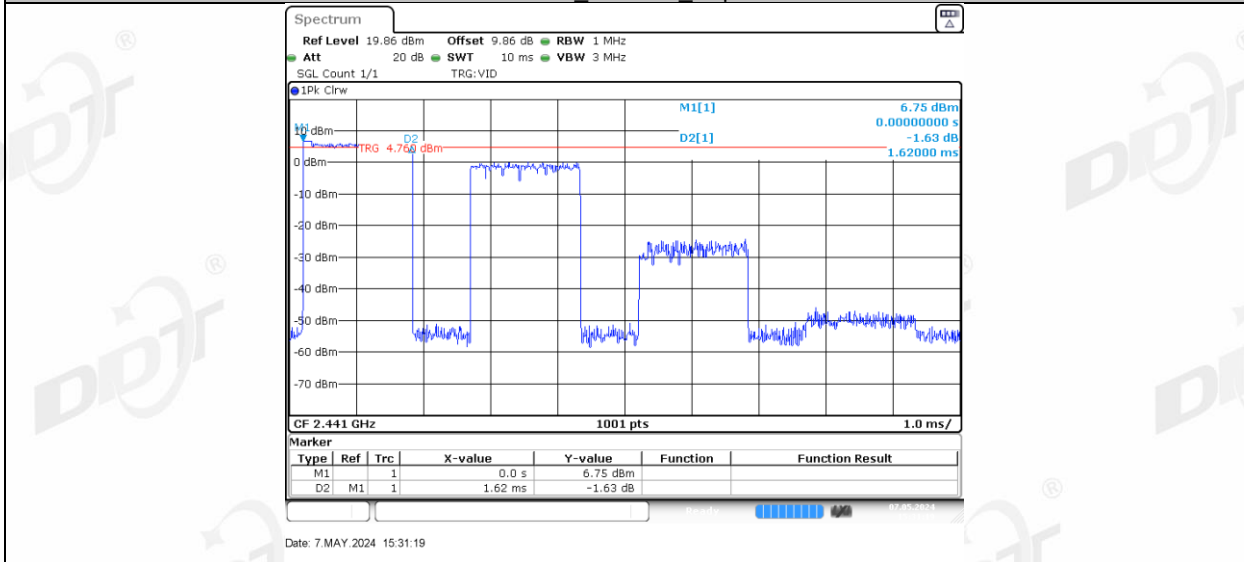


2DH1_Right side_Hop

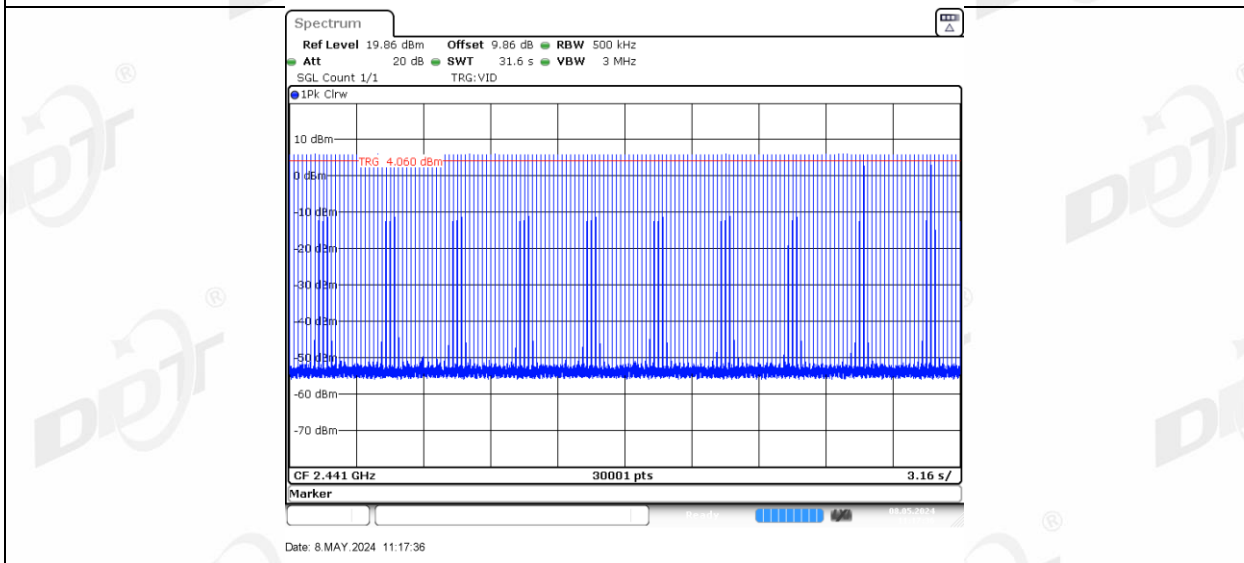
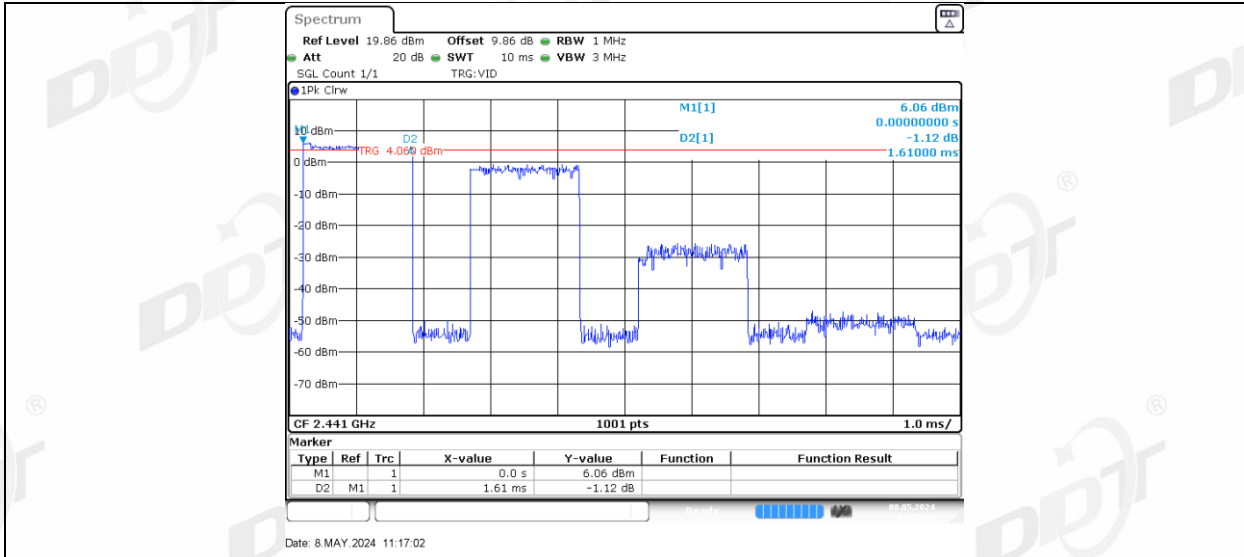




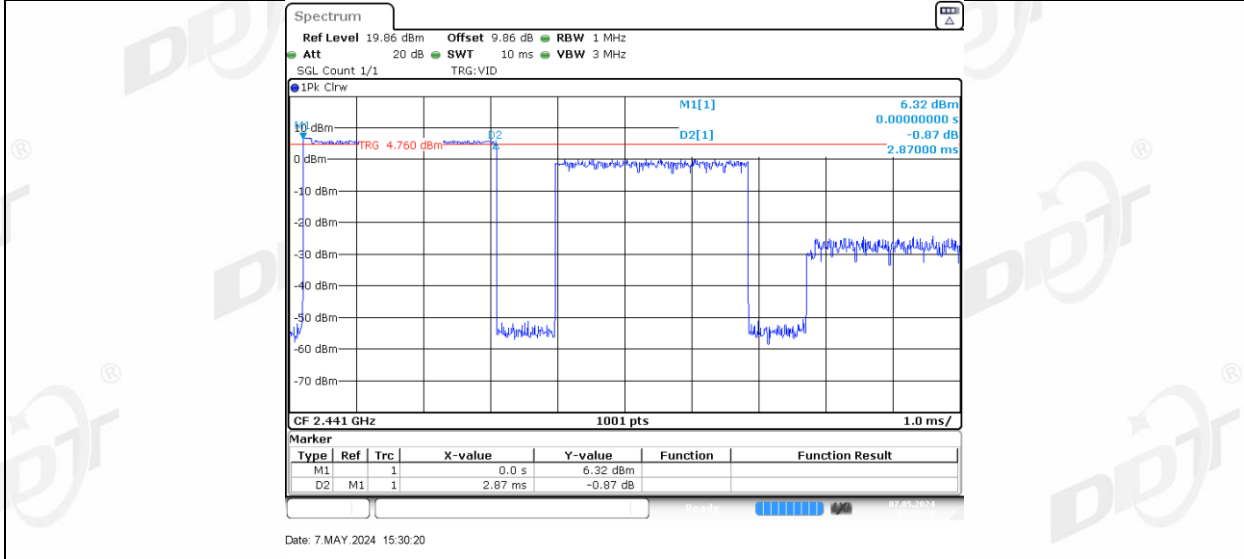
2DH3 Left side Hop

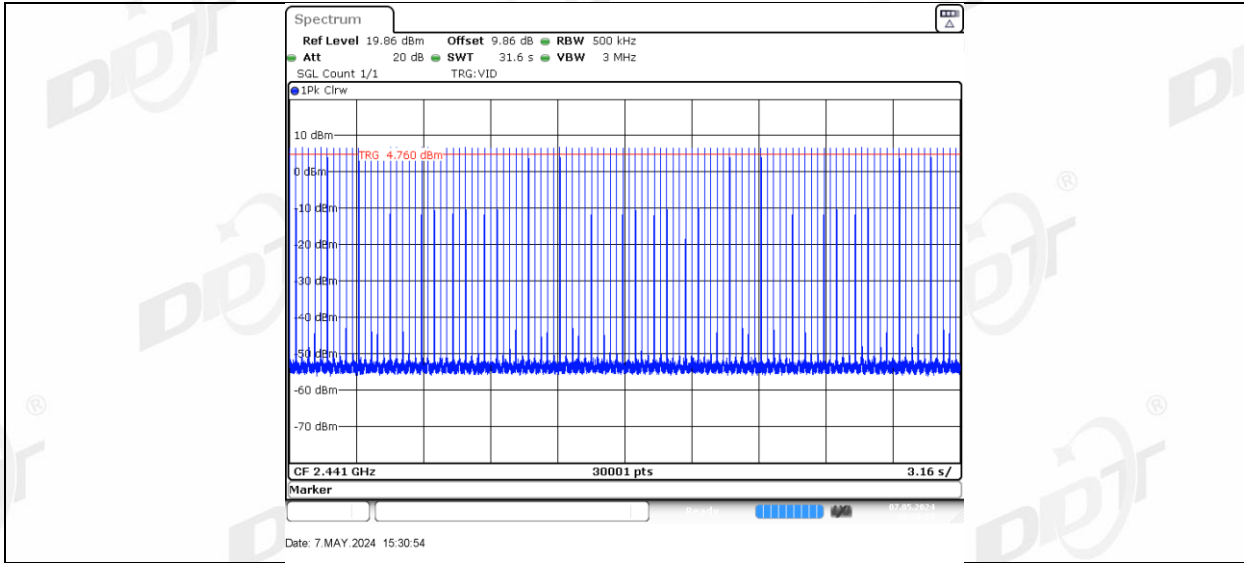


2DH3 Right side Hop

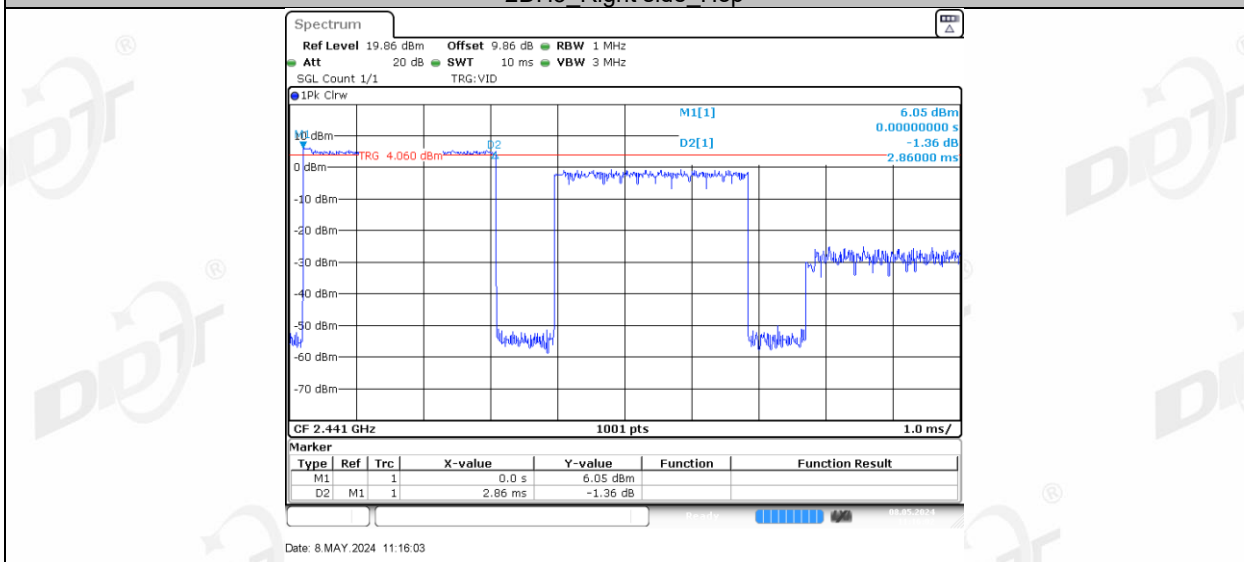


2DH5 Left side Hop

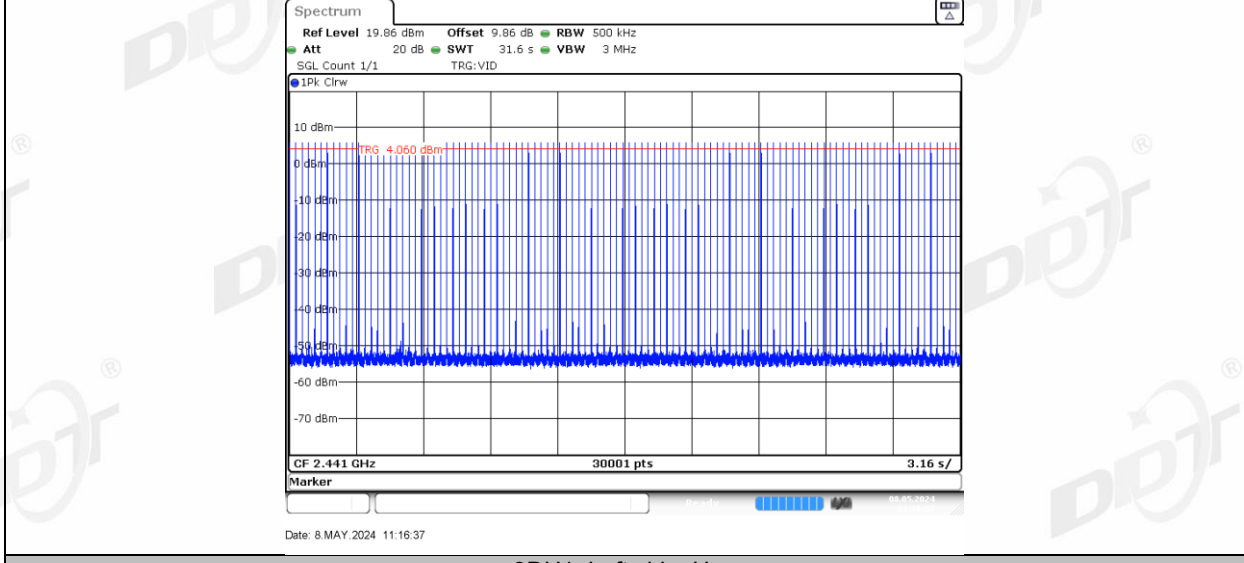




2DH5 Right side Hop



2DH5 Right side Hop



3DH1 Left side Hop