



## FCC AND ISED CERTIFICATION TEST REPORT

<b>Applicant</b>	:	Harman International Industries, Inc.
<b>Address of Applicant</b>	:	8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES
<b>Manufacturer</b>	:	Harman International Industries, Inc.
<b>Address of Manufacturer</b>	:	8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES
<b>Equipment under Test</b>	:	BLUETOOTH HEADSET
<b>Model No.</b>	:	TUNE BUDS 2
<b>FCC ID</b>	:	APITUNEBUDS2
<b>IC</b>	:	6132A-TUNEBUDS2
<b>Test Standard(s)</b>	:	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)
<b>Report No.</b>	:	DDT-RE24061107-1E01
<b>Issue Date</b>	:	2024/07/03
<b>Issue By</b>	:	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.....	146
16.6.	Test result .....	147
16.7.	Test data .....	148
17.	Test Setup Photograph.....	150
18.	Photos of the EUT .....	153

## Test Report Declare

<b>Applicant</b>	:	Harman International Industries, Inc.
<b>Address of Applicant</b>	:	8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES
<b>Equipment under Test</b>	:	BLUETOOTH HEADSET
<b>Model No.</b>	:	TUNE BUDS 2
<b>Manufacturer</b>	:	Harman International Industries, Inc.
<b>Address of Manufacturer</b>	:	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.

<b>Report No.:</b>	DDT-RE24061107-1E01		
<b>Date of Receipt:</b>	2024/06/12	<b>Date of Test:</b>	2024/06/12~2024/07/03

**Prepared By:**

*Bobo Chen*

**Bobo Chen/Engineer**

**Approved By:**



**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	2024/07/03	

## 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	Antenna Requirement	FCC Part 15: 15.203, RSS- Gen Issue 5 clause 6.8	/	Pass
11	Power Line Conducted Emissions	FCC Part 15: 15.207(a), RSS- Gen Issue 5 clause 8.8	/	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	: TUNE BUDS 2
Color differences	The prototype has a solid color version and a transparent version, and the differences are as follows: 1. The layout and material of the charging case are different, and the LED part of the circuit diagram is different, other circuits are the same 2. The earphones are only made of different materials; Everything else is the same as that judged by engineering, no test is required.
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 3.8V Lithium-ion built-in battery EARBUDS: DC 3.85V Lithium-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)	: -3.29
Right side Max Antenna Gain(dBi)	: -3.31

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		

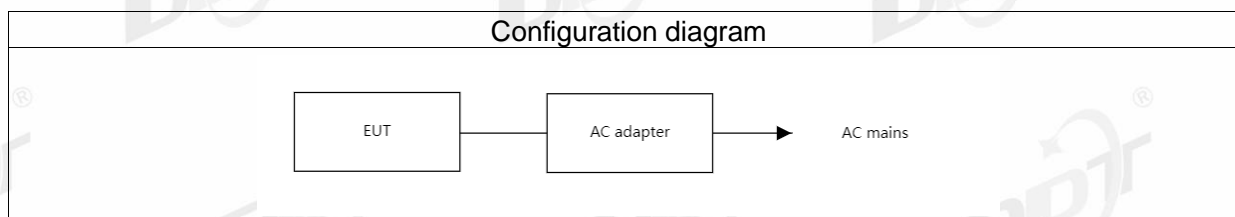
Note: The above EUT information is declared by manufacturer and for more detailed features description please refer to the manufacturer's specifications or User's Manual. The above Antenna information is declared by manufacturer and for more detailed features description please refer to the manufacturer's 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: BQB.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	3	CH0 to CH78	2402 to 2480
$\pi/4$ -DQPSK hopping on Tx mode	3	CH0 to CH78	2402 to 2480
8DPSK hopping on Tx mode	3	CH0 to CH78	2402 to 2480
GFSK hopping off Tx mode	3	CH0	2402
	3	CH39	2441
	3	CH78	2480
$\pi/4$ -DQPSK hopping off Tx mode	3	CH0	2402
	3	CH39	2441
	3	CH78	2480
8DPSK hopping off Tx mode	3	CH0	2402
	3	CH39	2441
	3	CH78	2480

Worst-case data rates were: GFSK mode: DH5,  $\pi/4$ -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](mailto: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 <sup>-8</sup> (Antenna couple method)
	5.5 x 10 <sup>-8</sup> (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)	3x10 <sup>-8</sup>
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)

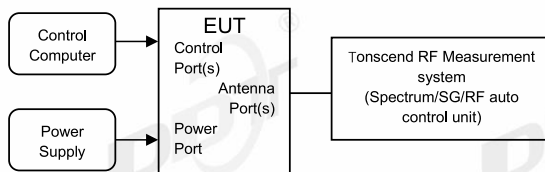
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

### 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:
 

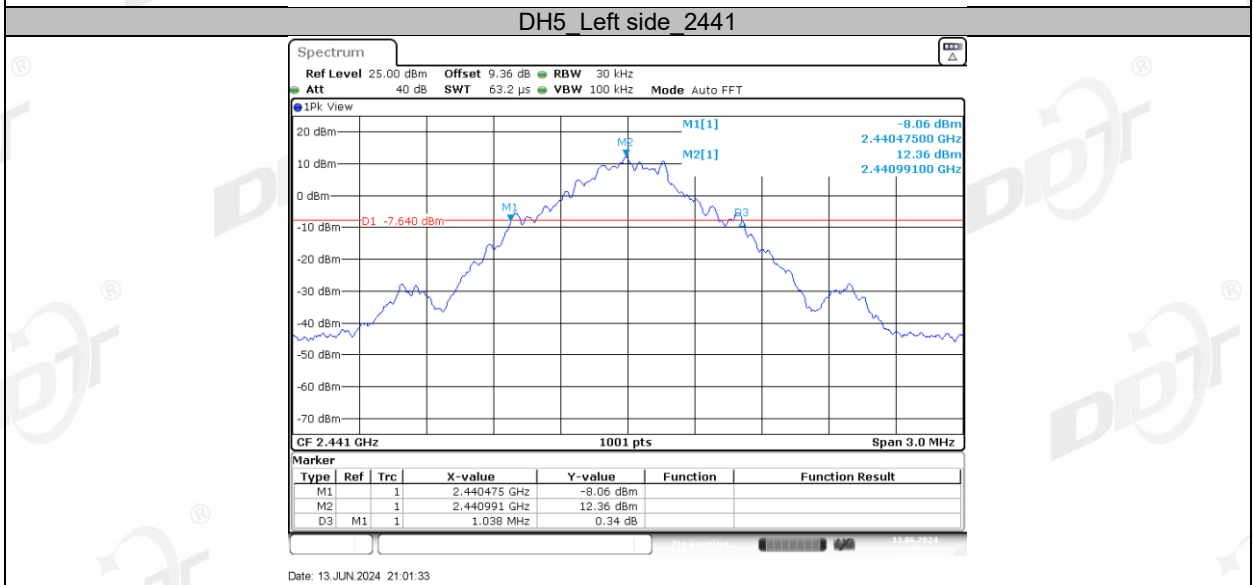
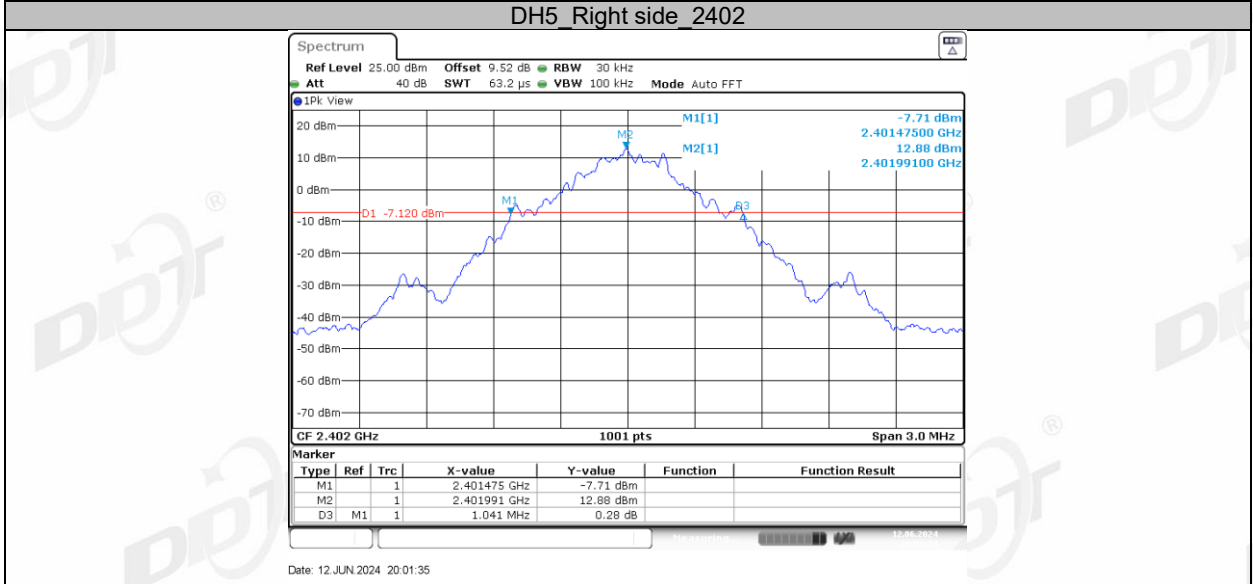
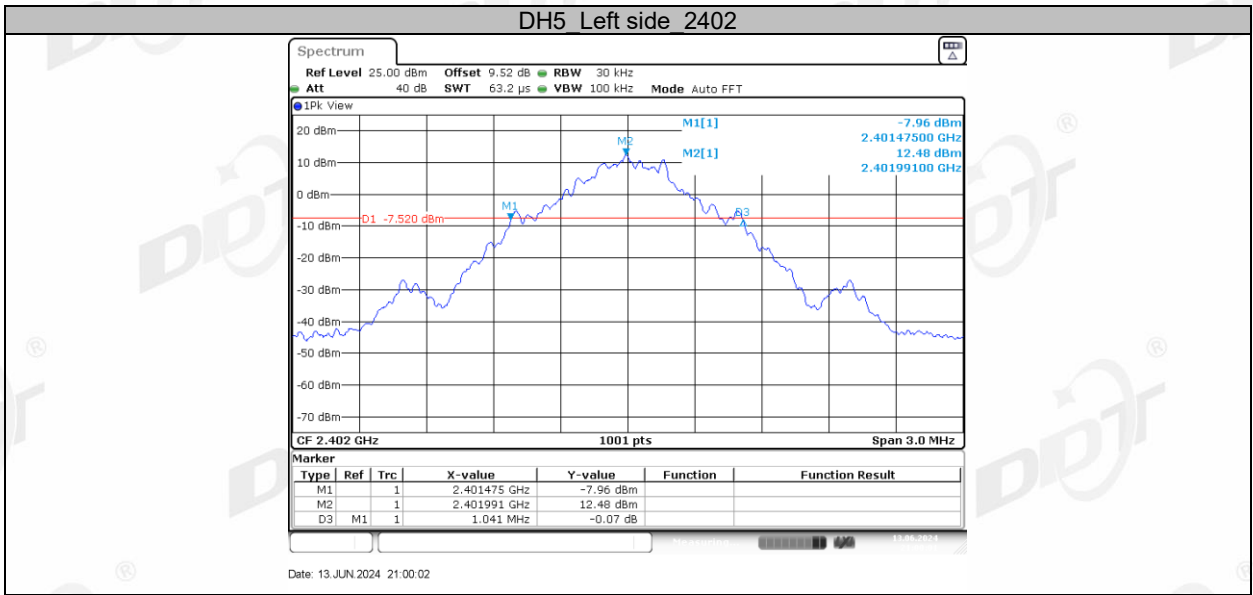
RBW:	1% to 5% of the OBW
VBW:	approximately three times RBW
Span:	between 2 times and 5 times the OBW
Detector Mode:	Peak
Sweep time:	Auto
Trace mode:	Max hold
- (5) Measure and record the results in the report.

#### 4.4. Test result

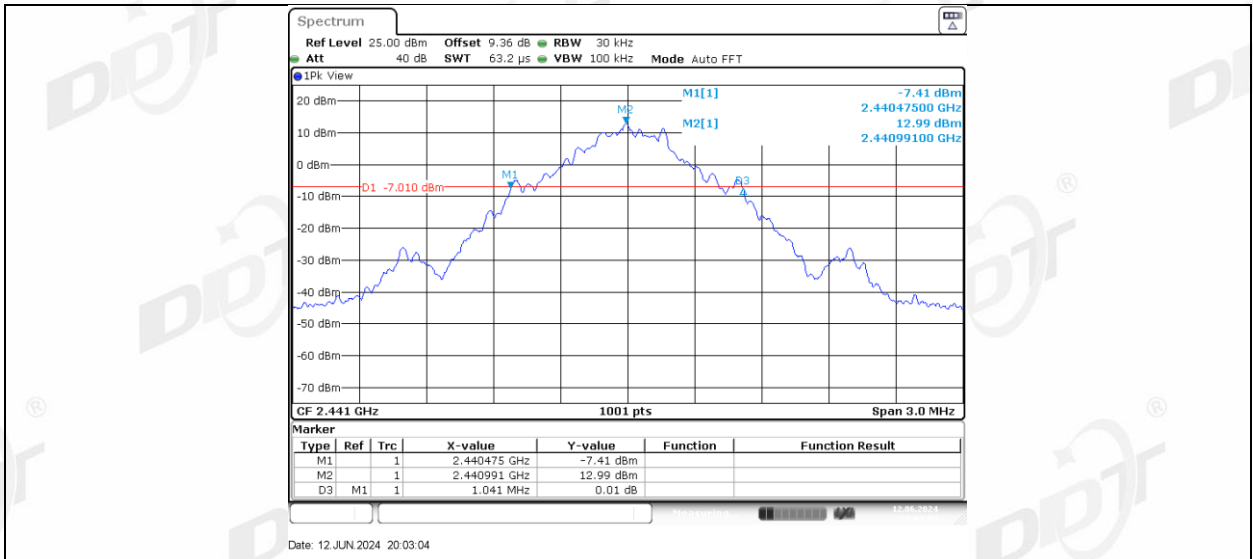
Test Engineer:	Zhongyao	Test Site:	RF Measurement System 3#
Ambient Condition:	23.6-25.5℃,42.8-46.7%RH	Test Date:	2024.06.12-2024.06.14
Test Power Supply:	Battery	Sample Number:	S24061107-053

Test Mode	Antenna	Frequency [MHz]	20dB EBW[MHz]
DH5	Left side	2402	1.04
	Right side	2402	1.04
	Left side	2441	1.04
	Right side	2441	1.04
	Left side	2480	1.04
	Right side	2480	1.04
2DH5	Left side	2402	1.18
	Right side	2402	1.20
	Left side	2441	1.19
	Right side	2441	1.21
	Left side	2480	1.20
	Right side	2480	1.21
3DH5	Left side	2402	1.20
	Right side	2402	1.20
	Left side	2441	1.20
	Right side	2441	1.20
	Left side	2480	1.20
	Right side	2480	1.20

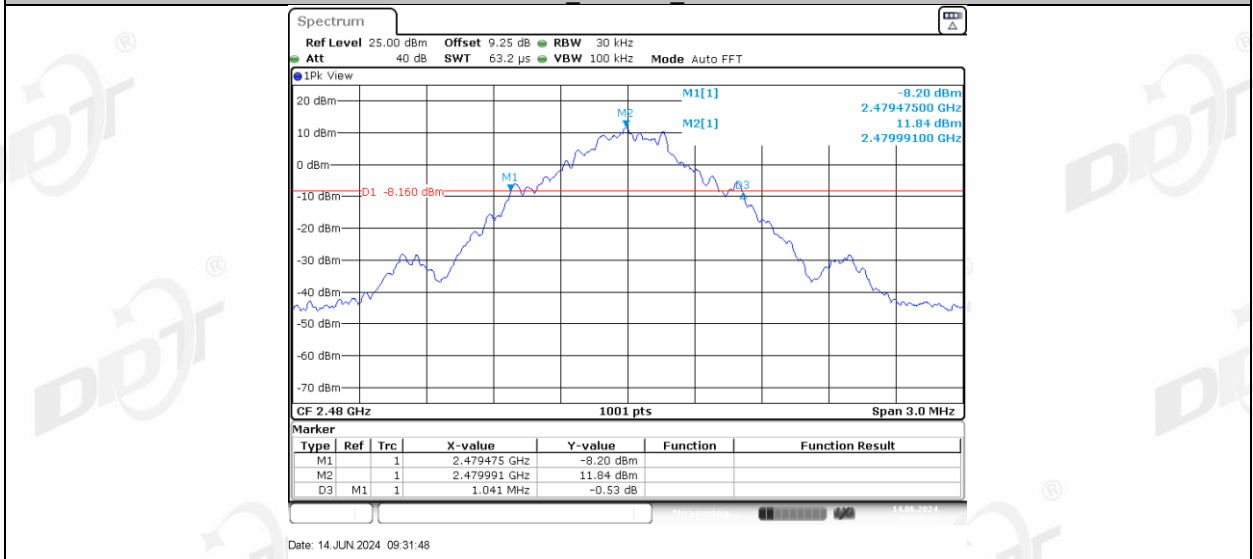
### 4.5. Test graphs



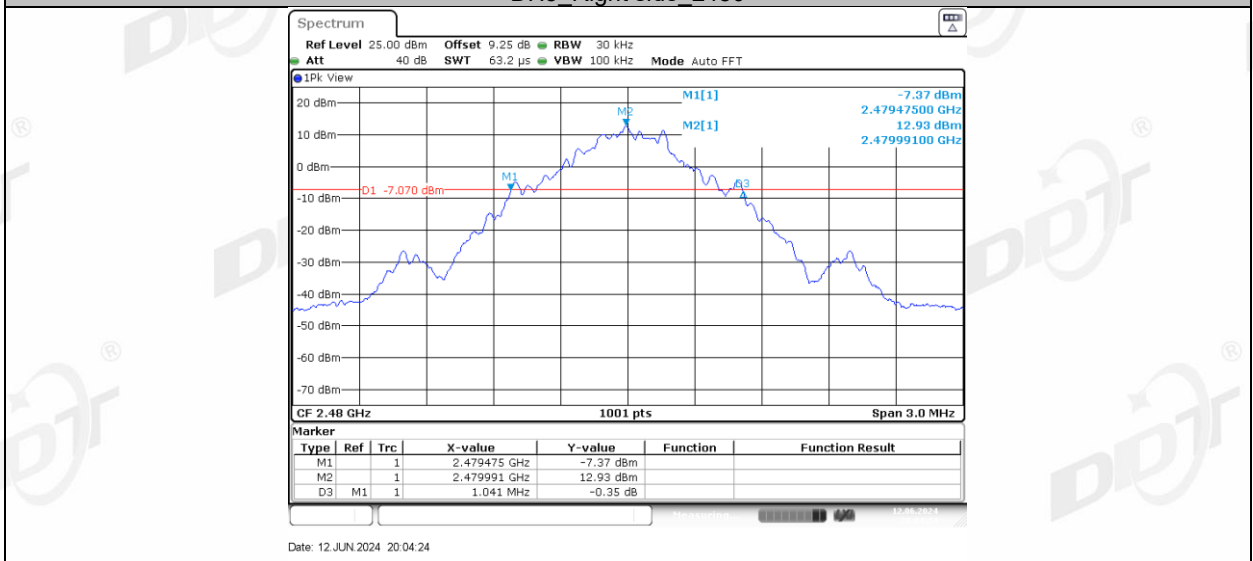
**DH5 Right side 2441**



DH5 Left side 2480

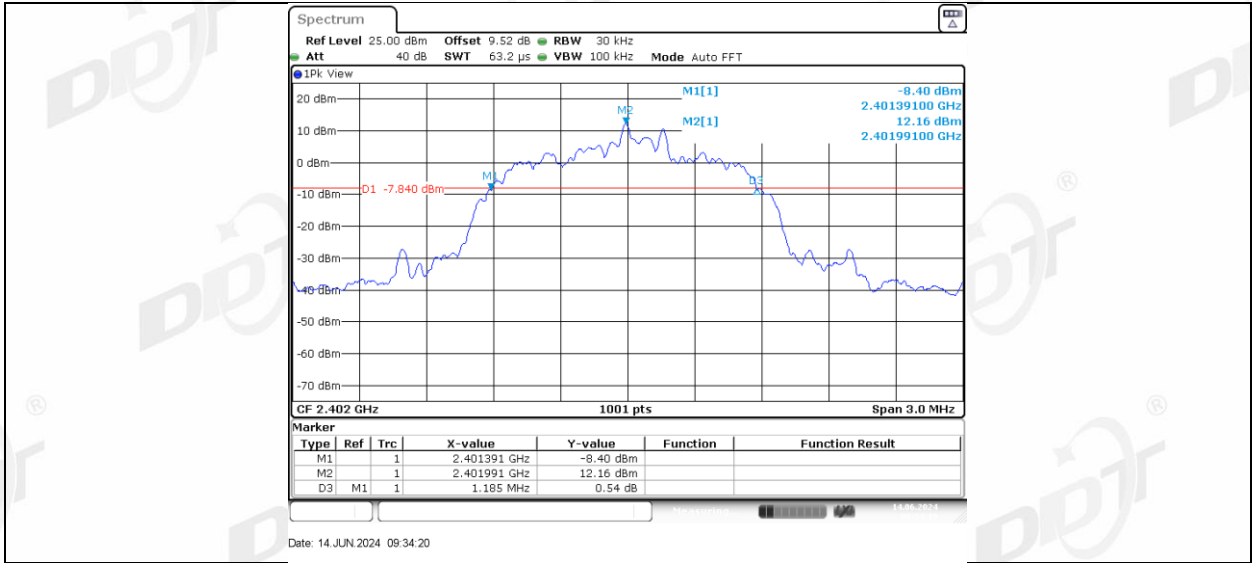


DH5 Right side 2480

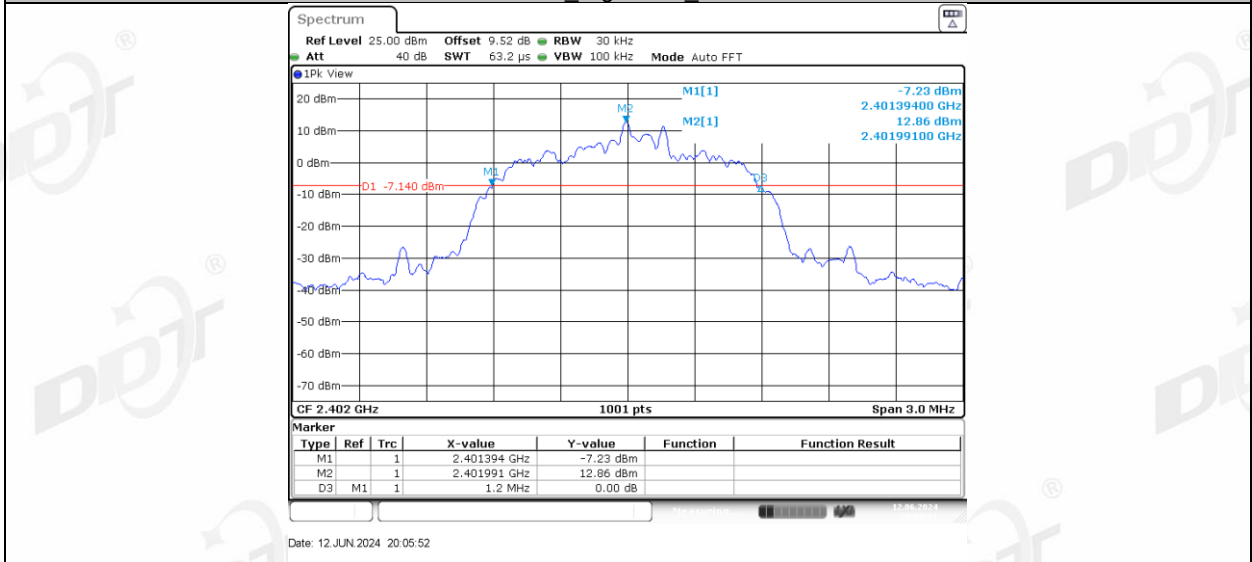


2DH5 Left side 2402

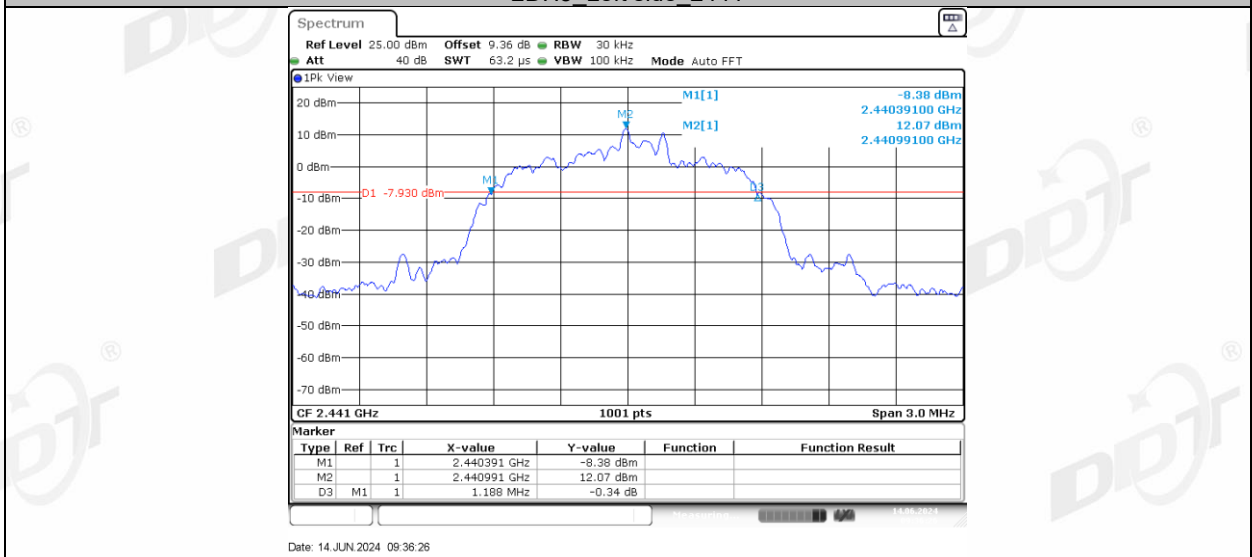




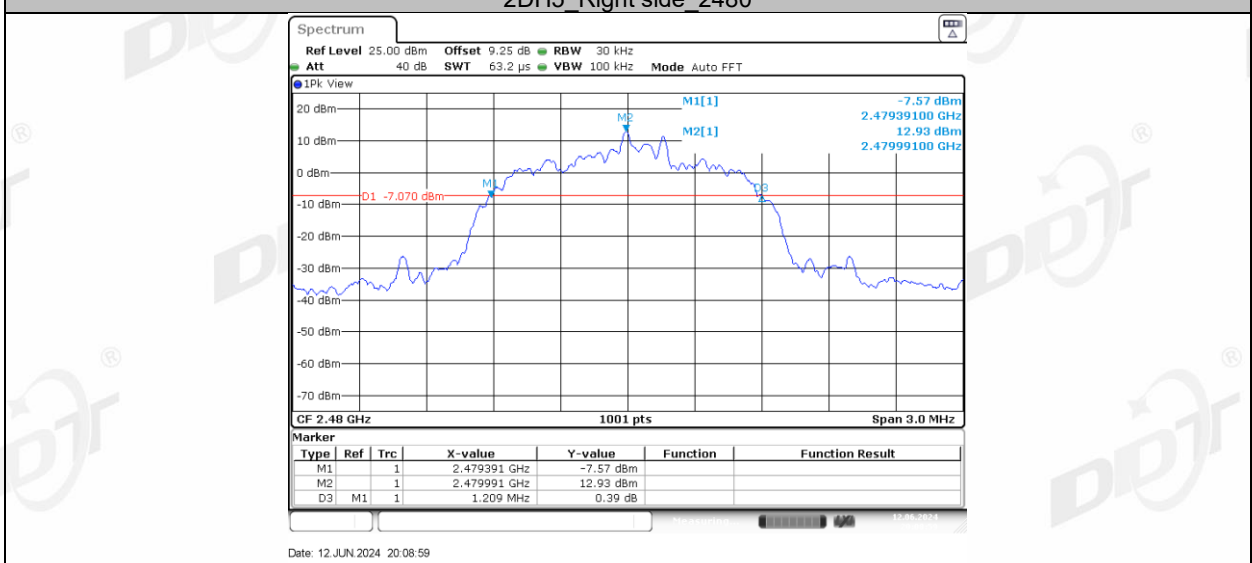
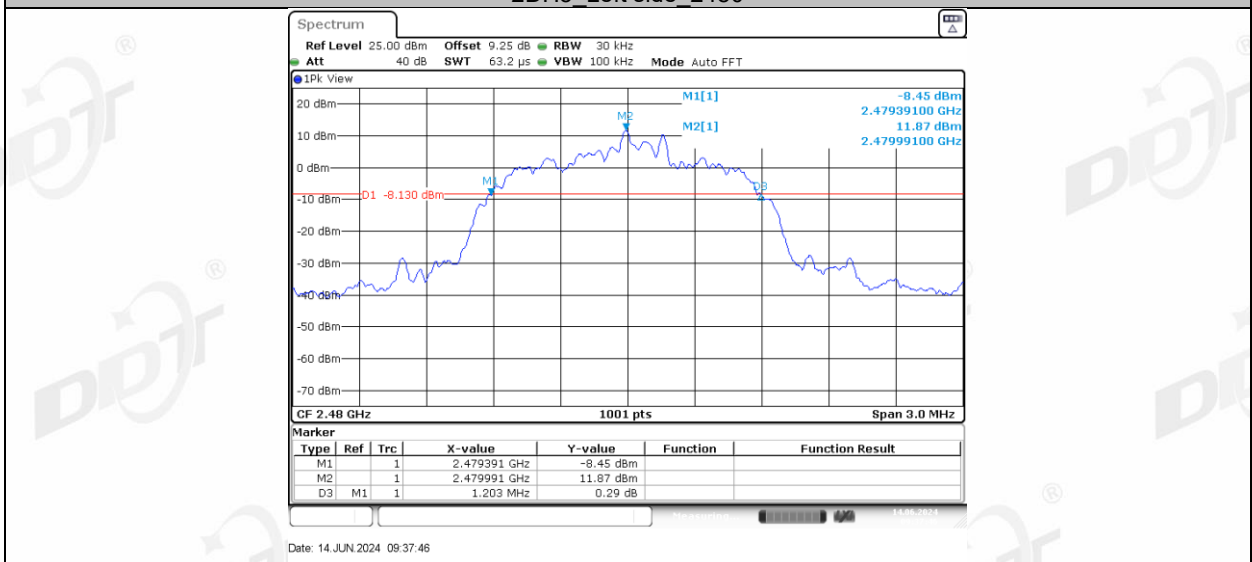
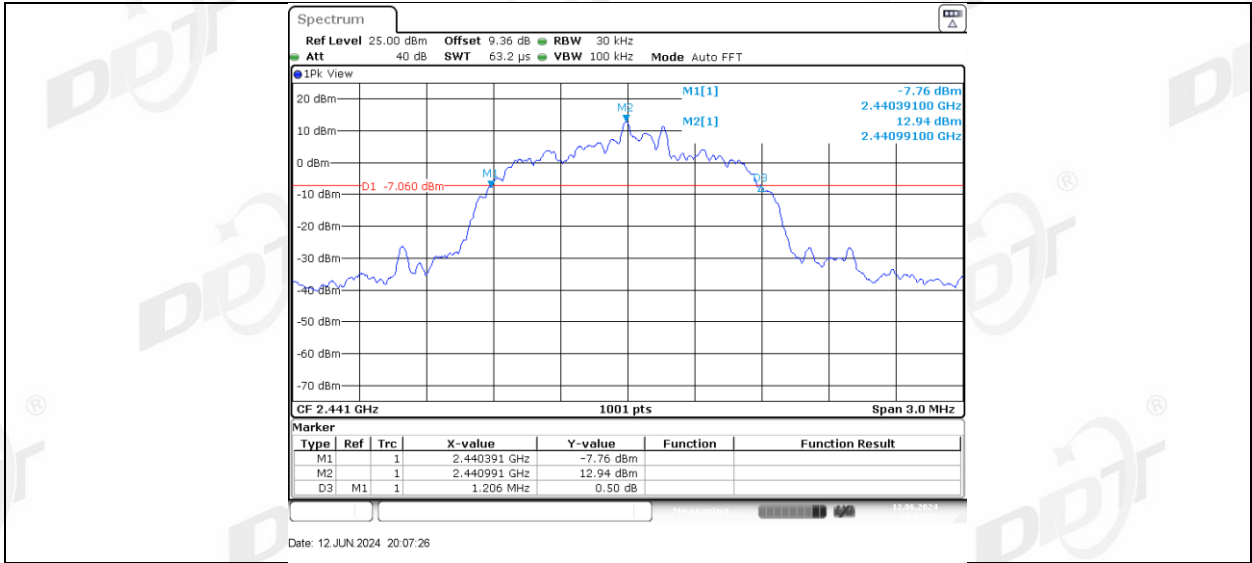
2DH5 Right side 2402



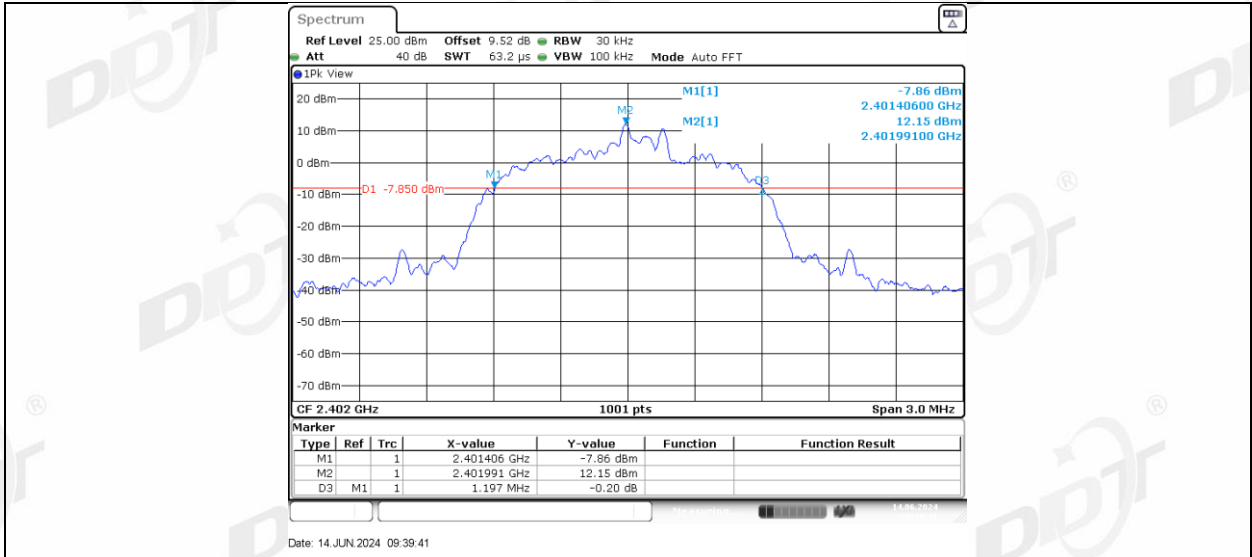
2DH5 Left side 2441



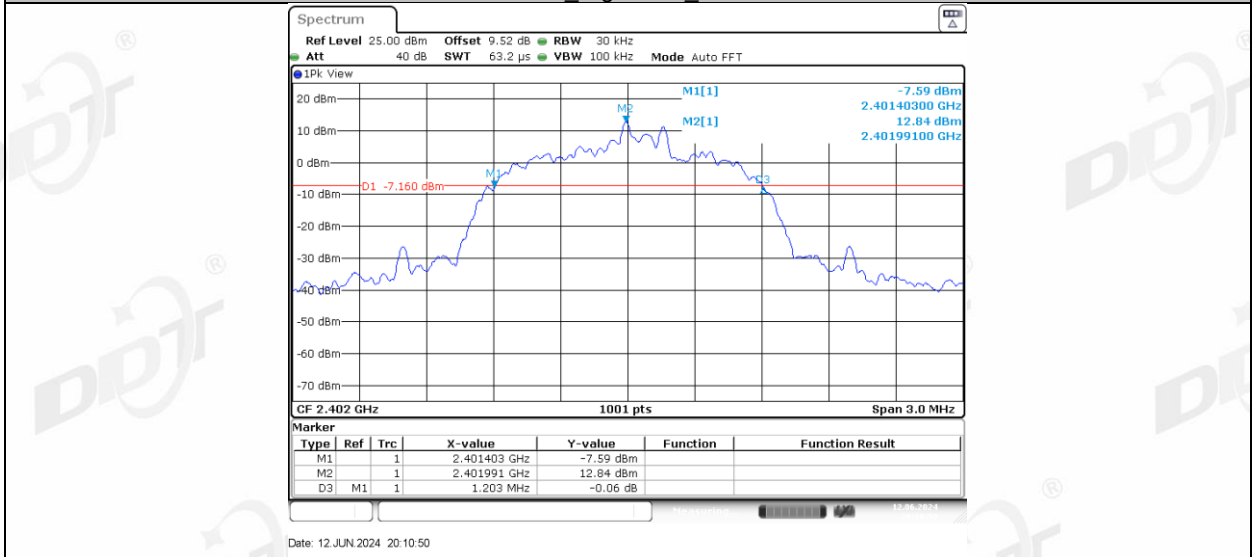
2DH5 Right side 2441



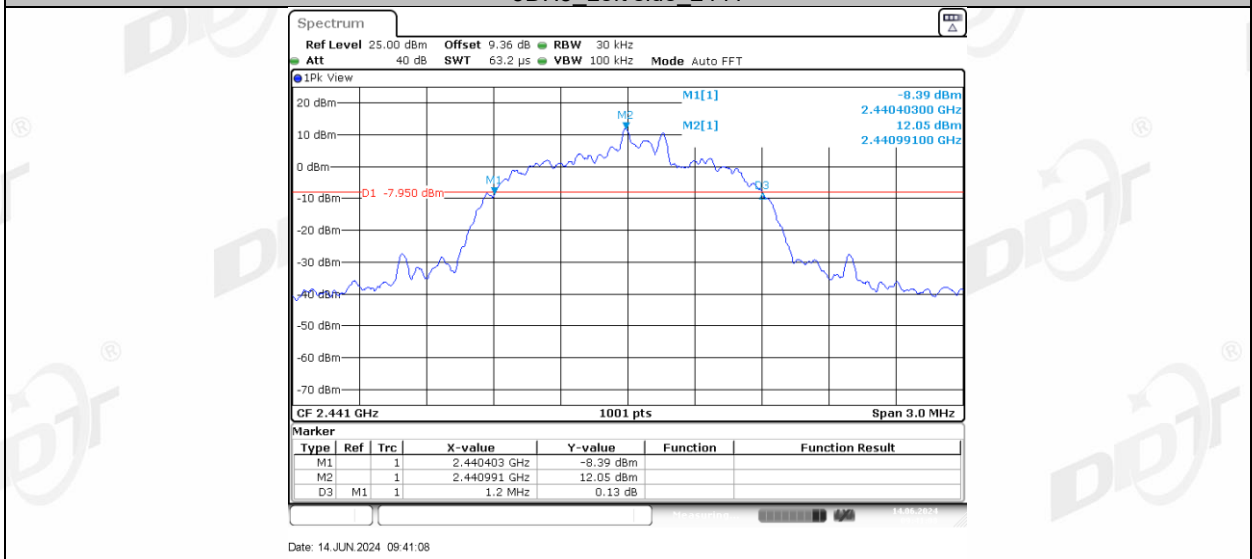
3DH5 Left side 2402



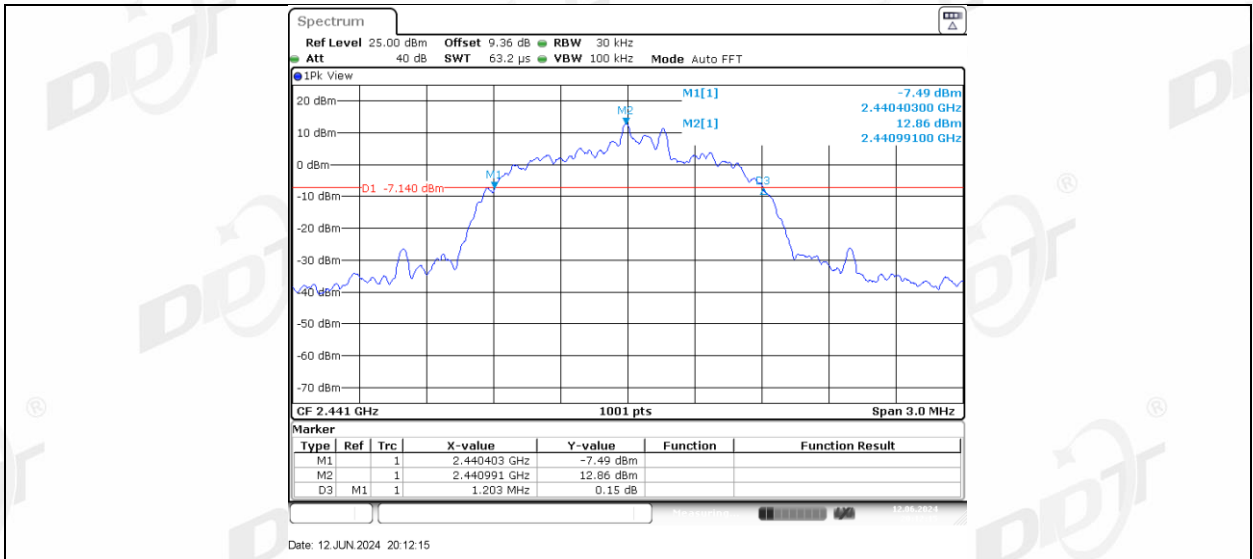
3DH5 Right side 2402



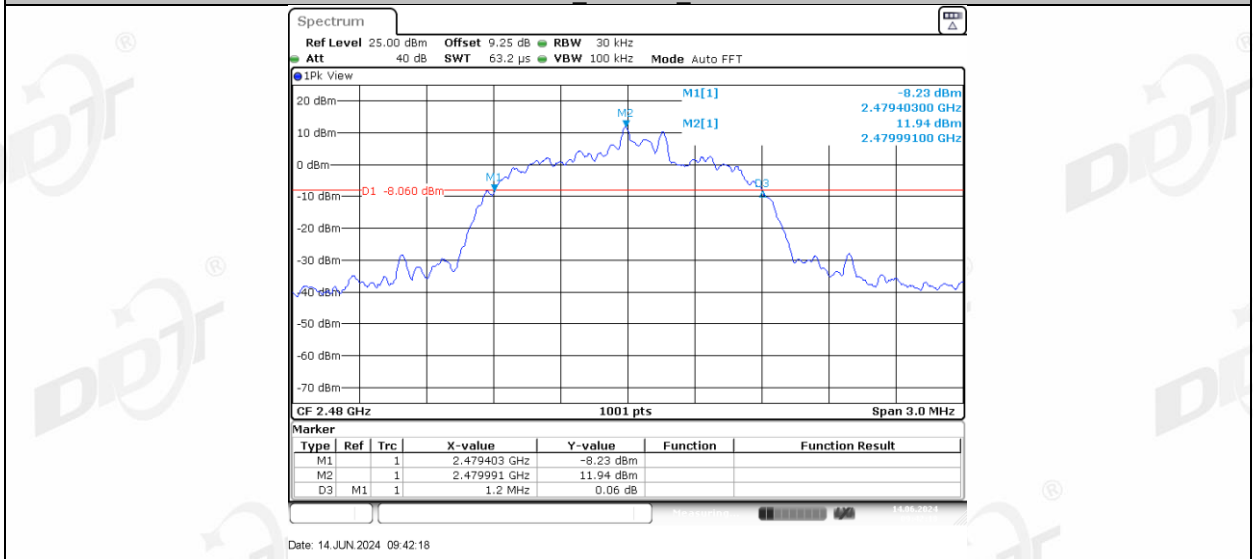
3DH5 Left side 2441



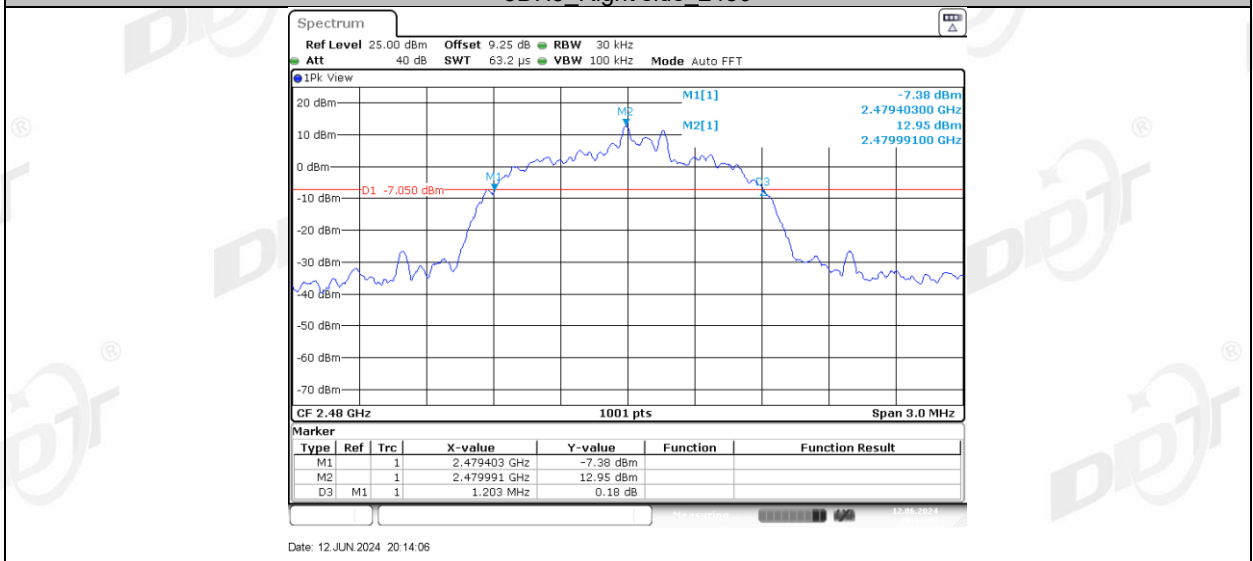
3DH5 Right side 2441



3DH5 Left side 2480

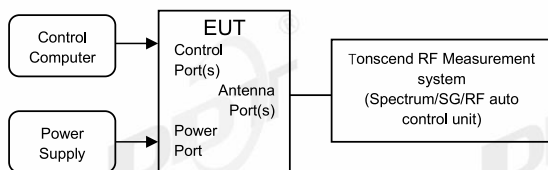


3DH5 Right side 2480



## 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:

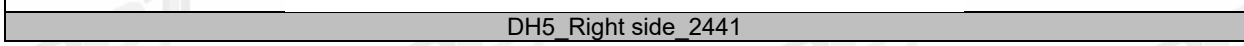
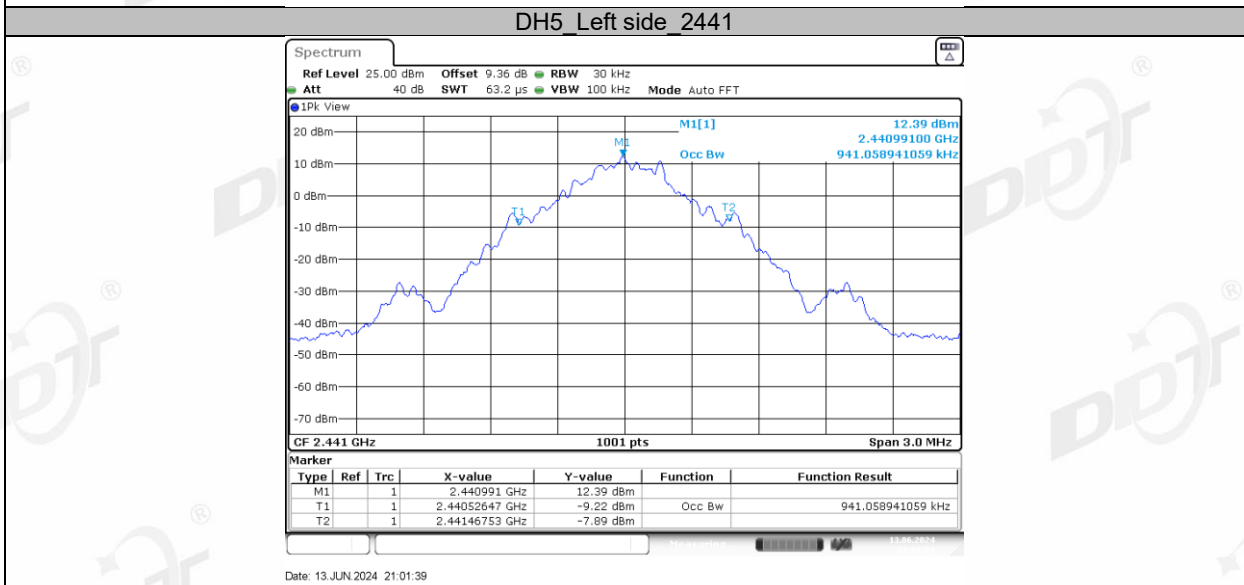
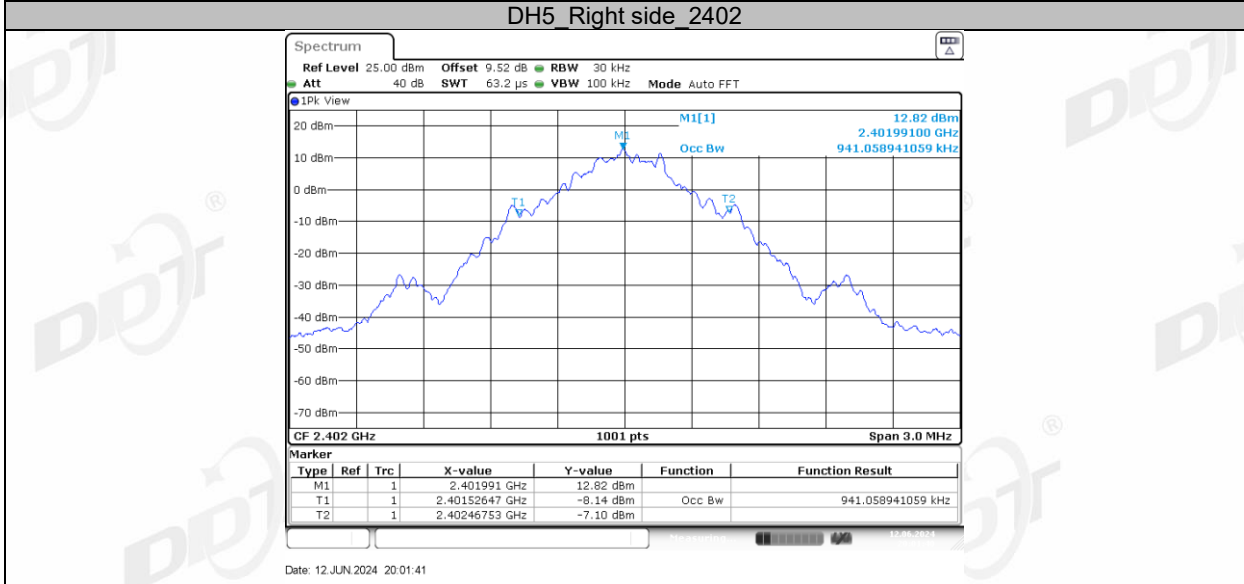
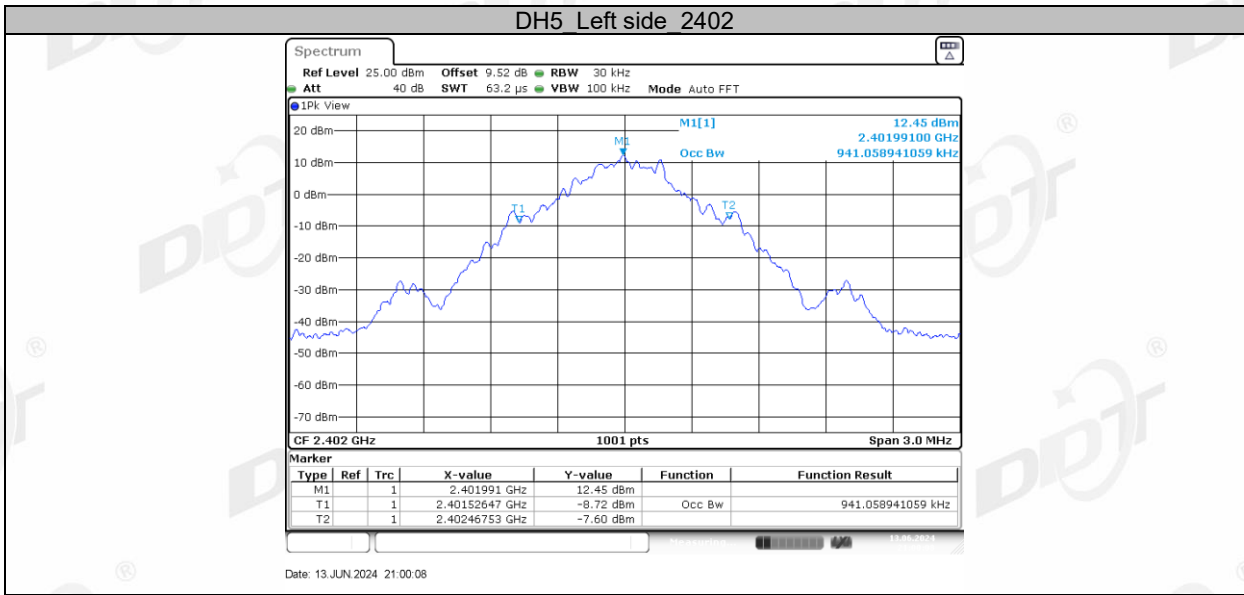
RBW:	1% to 5% of the OBW
VBW:	approximately three times RBW
Span:	between 1.5 times and 5.0 times the OBW
Detector Mode:	Peak
Sweep time:	Auto
Trace mode:	Max hold
- (5) Measure and record the results in the report.

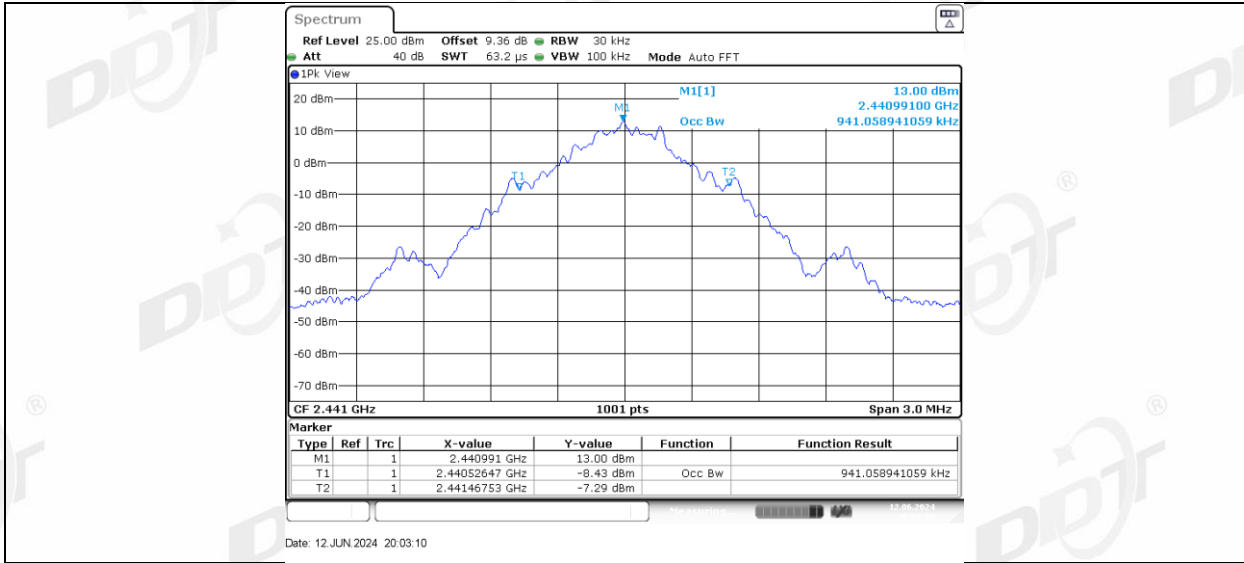
#### 5.4. Test result

Test Engineer:	Zhongyao	Test Site:	RF Measurement System 3#
Ambient Condition:	23.6-25.5℃,42.8-46.7%RH	Test Date:	2024.06.12-2024.06.14
Test Power Supply:	Battery	Sample Number:	S24061107-053

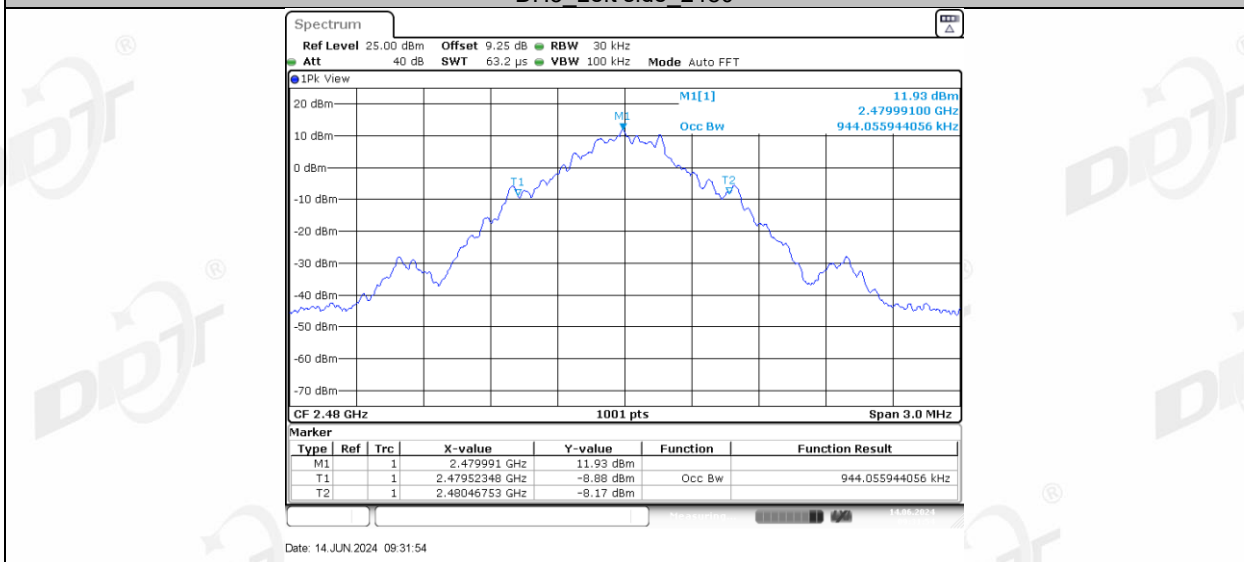
Test Mode	Antenna	Frequency [MHz]	OCB [MHz]	FL[MHz]	FH[MHz]
DH5	Left side	2402	0.941	2401.5265	2402.4675
	Right side	2402	0.941	2401.5265	2402.4675
	Left side	2441	0.941	2440.5265	2441.4675
	Right side	2441	0.941	2440.5265	2441.4675
	Left side	2480	0.944	2479.5235	2480.4675
	Right side	2480	0.944	2479.5235	2480.4675
2DH5	Left side	2402	1.136	2401.4246	2402.5604
	Right side	2402	1.139	2401.4246	2402.5634
	Left side	2441	1.139	2440.4216	2441.5604
	Right side	2441	1.142	2440.4216	2441.5634
	Left side	2480	1.139	2479.4216	2480.5604
	Right side	2480	1.142	2479.4216	2480.5634
3DH5	Left side	2402	1.136	2401.4276	2402.5634
	Right side	2402	1.139	2401.4276	2402.5664
	Left side	2441	1.139	2440.4276	2441.5664
	Right side	2441	1.145	2440.4246	2441.5694
	Left side	2480	1.142	2479.4246	2480.5664
	Right side	2480	1.145	2479.4246	2480.5694

### 5.5. Test graphs

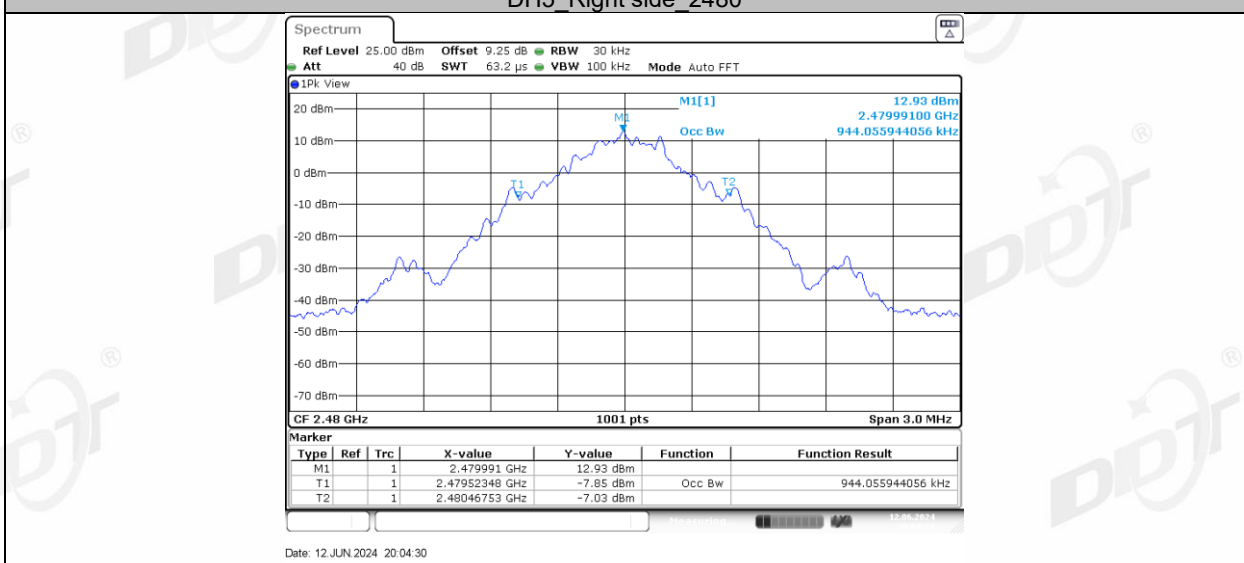




DH5 Left side 2480

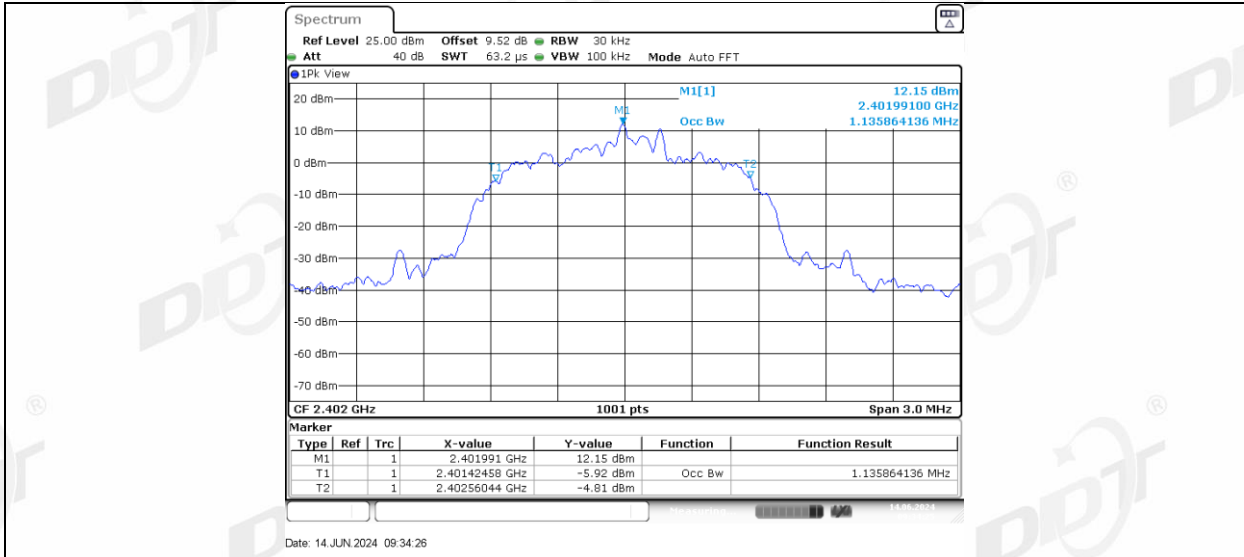


DH5 Right side 2480

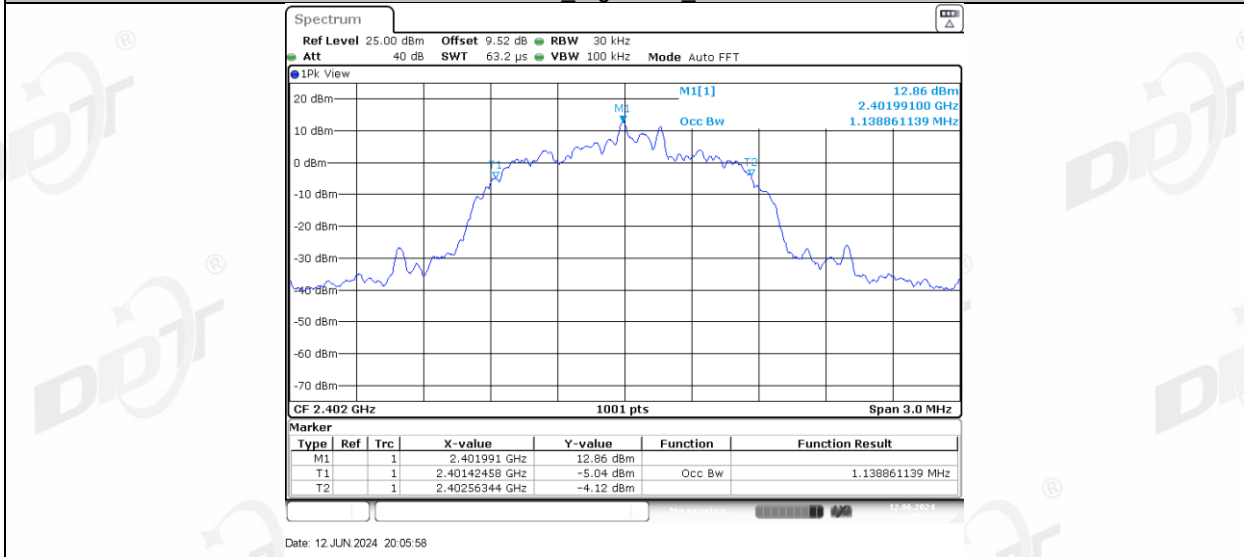


2DH5 Left side 2402

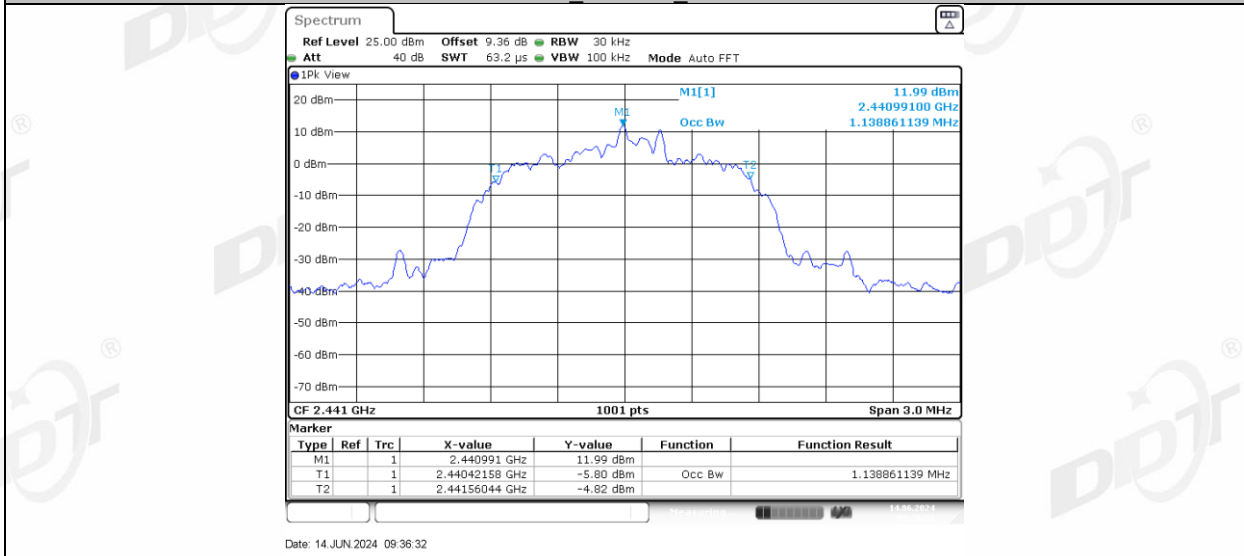




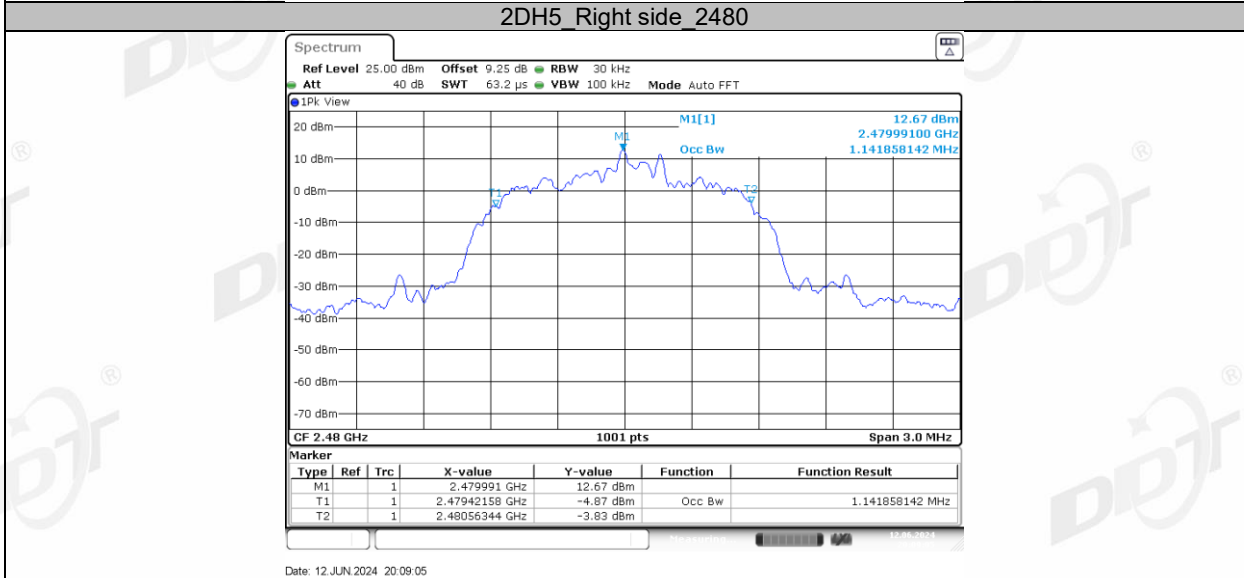
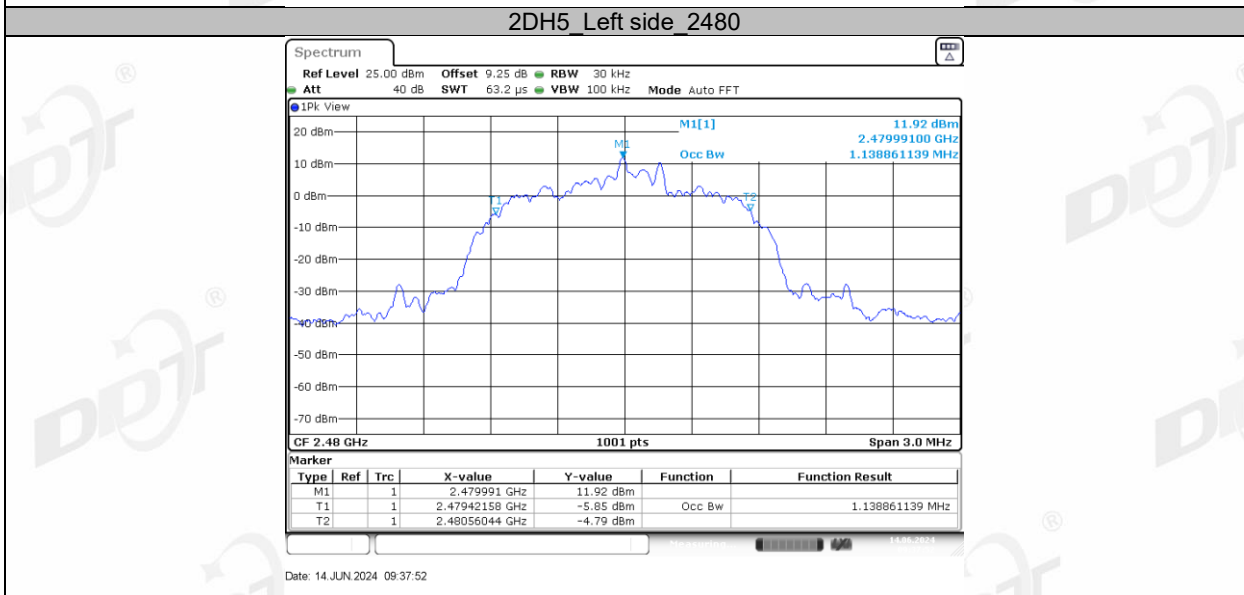
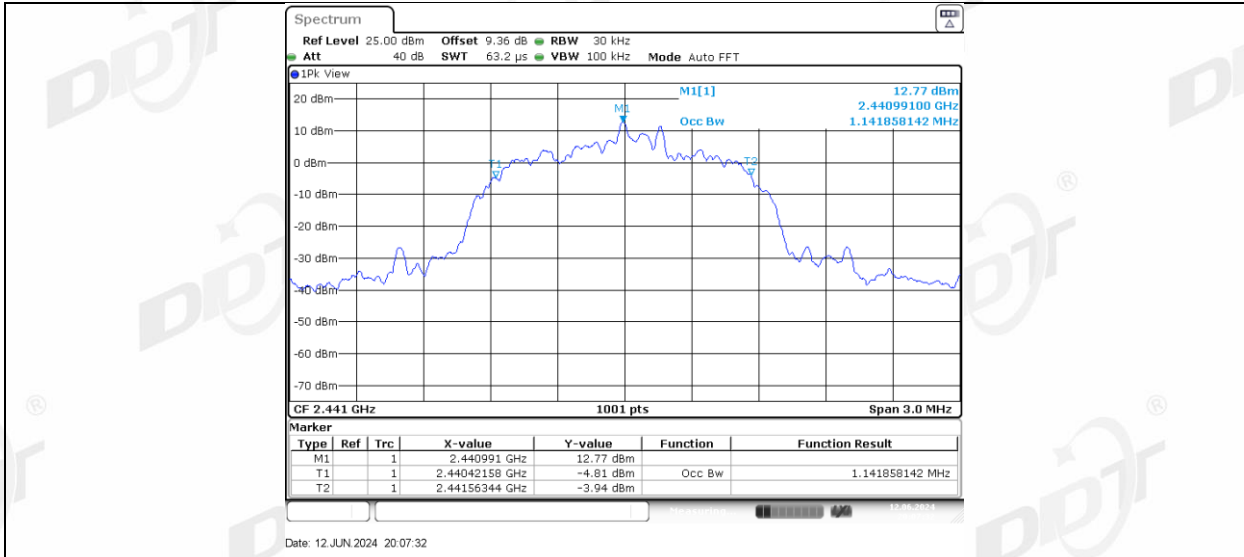
2DH5 Right side 2402

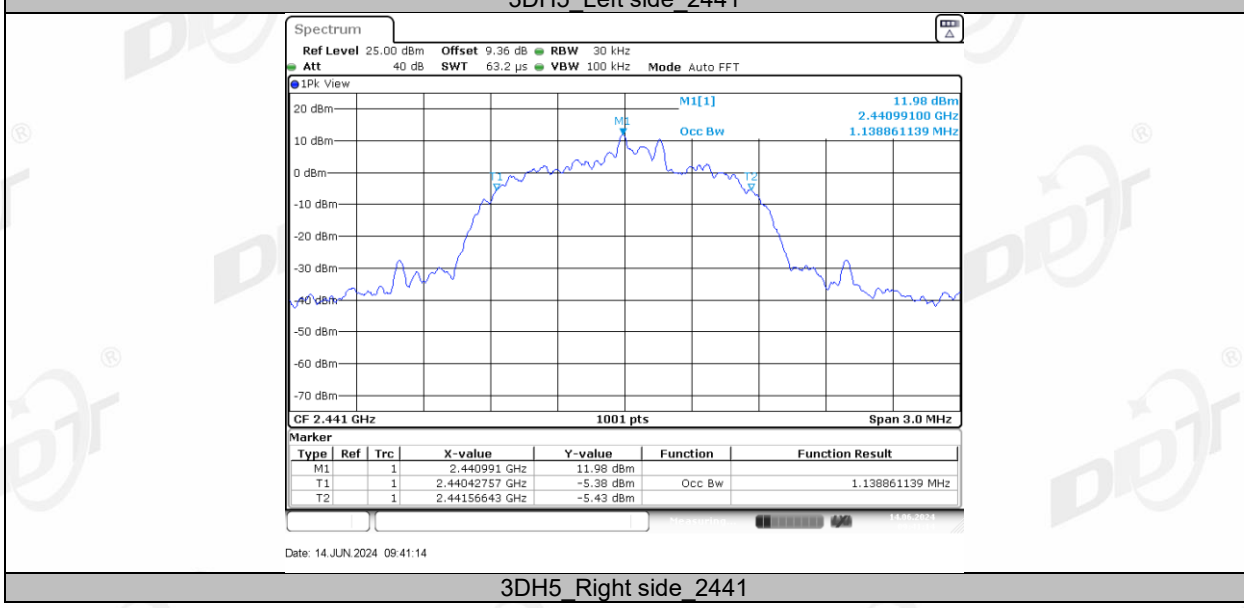
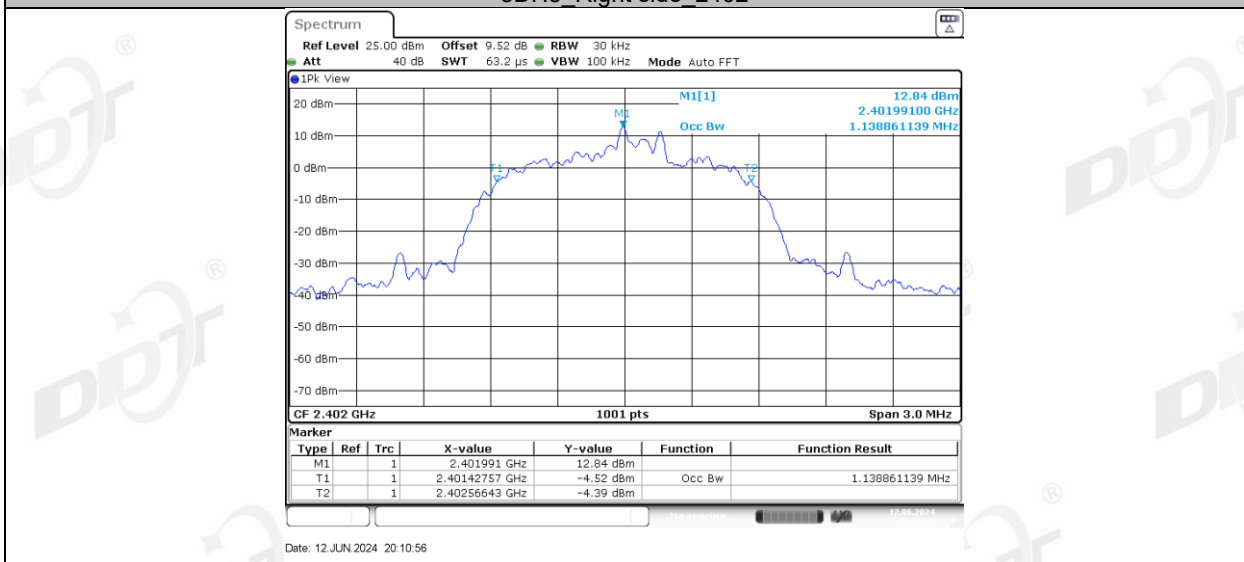
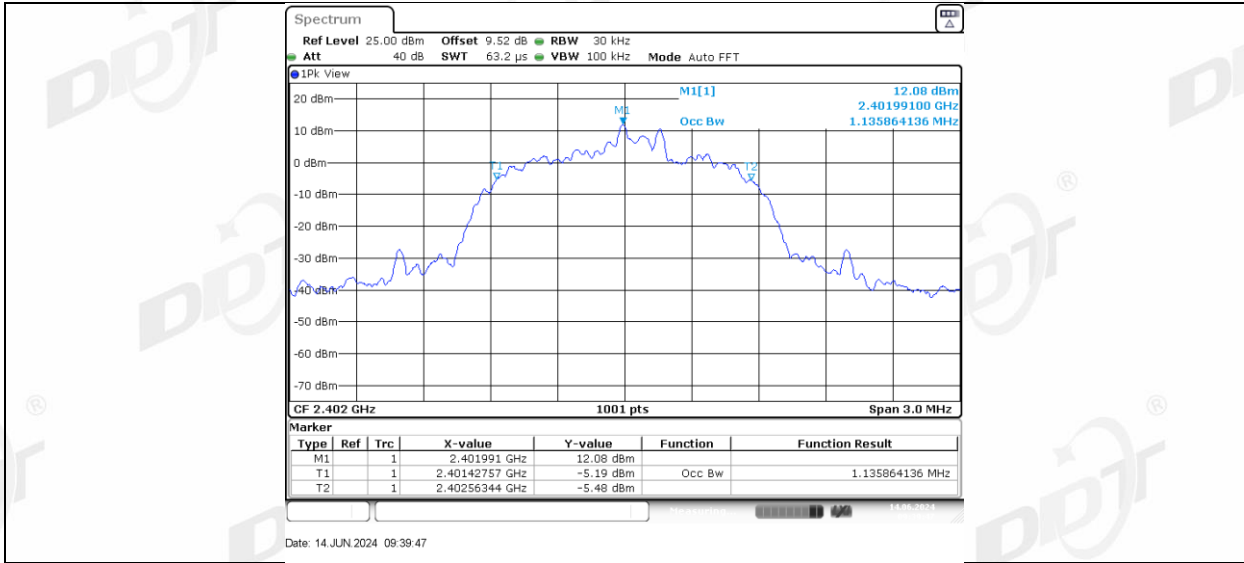


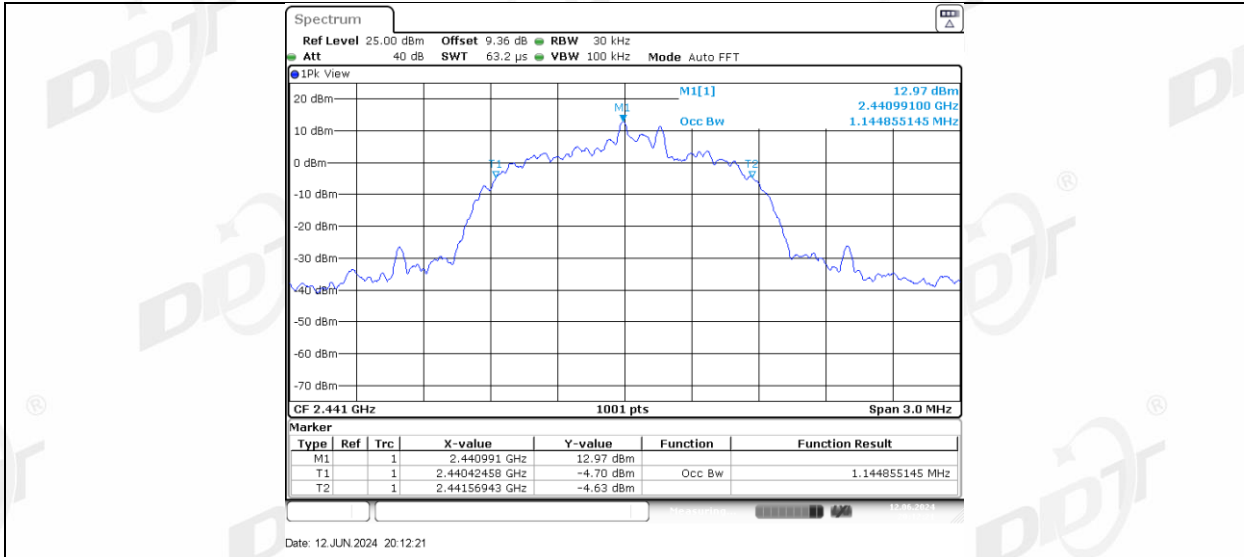
2DH5 Left side 2441



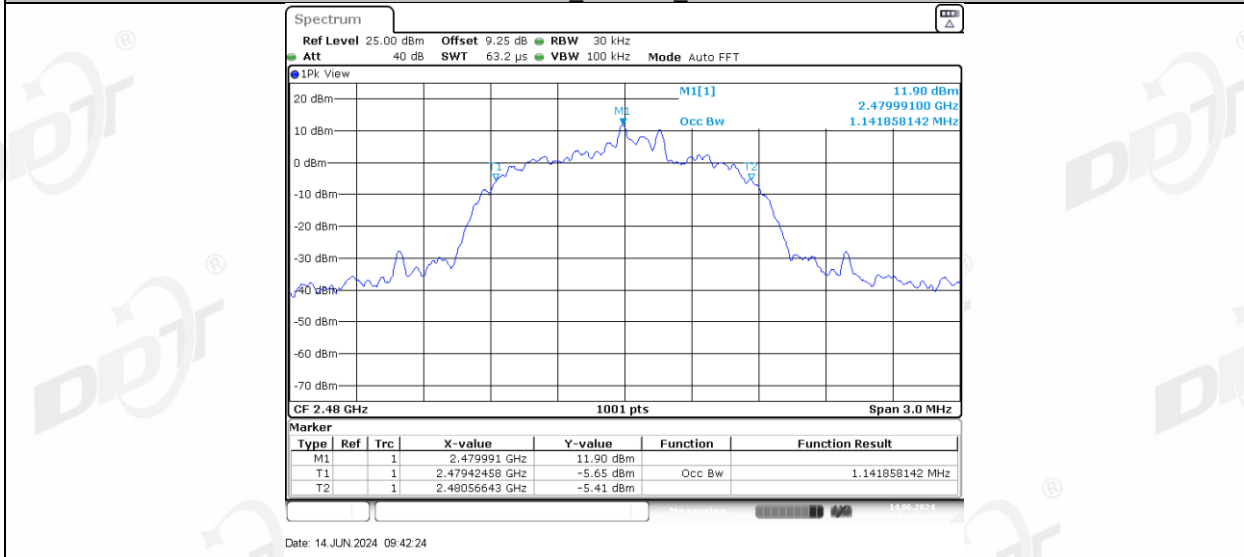
2DH5 Right side 2441



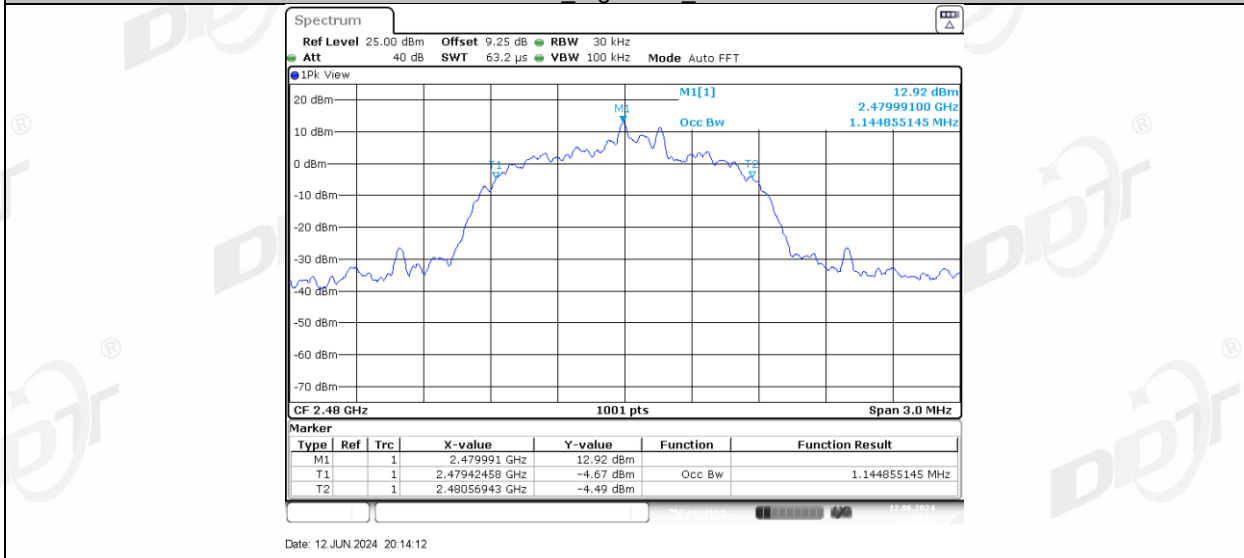




3DH5 Left side 2480

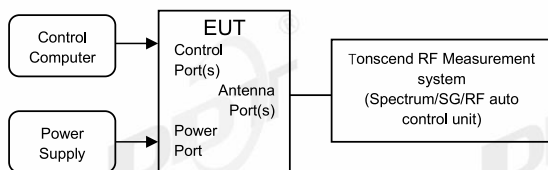


3DH5 Right side 2480



## 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:
 

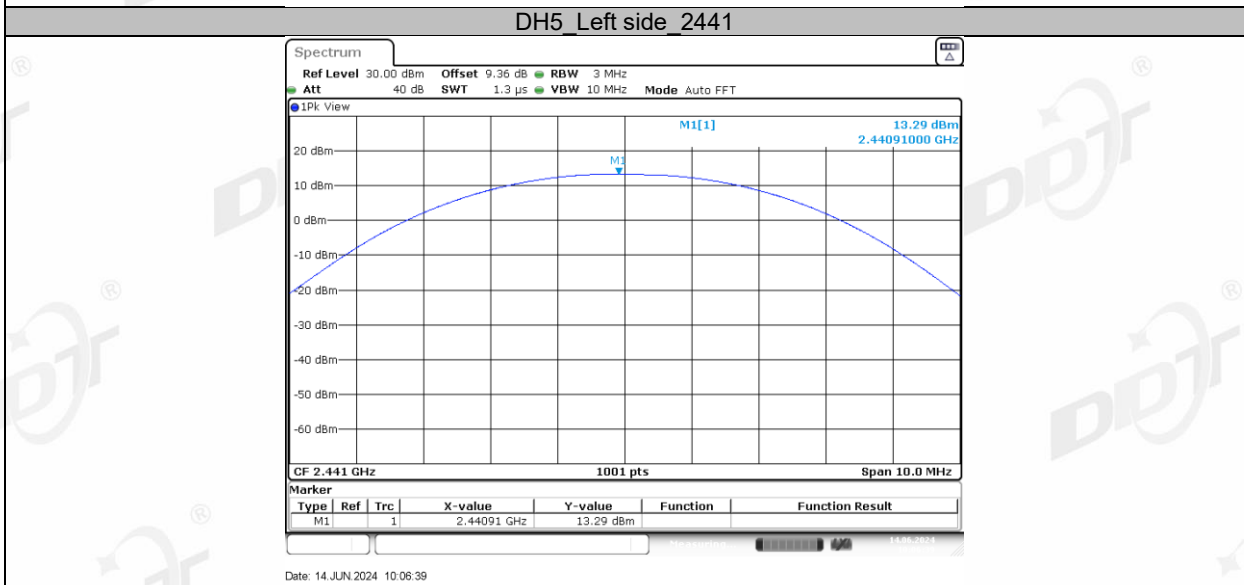
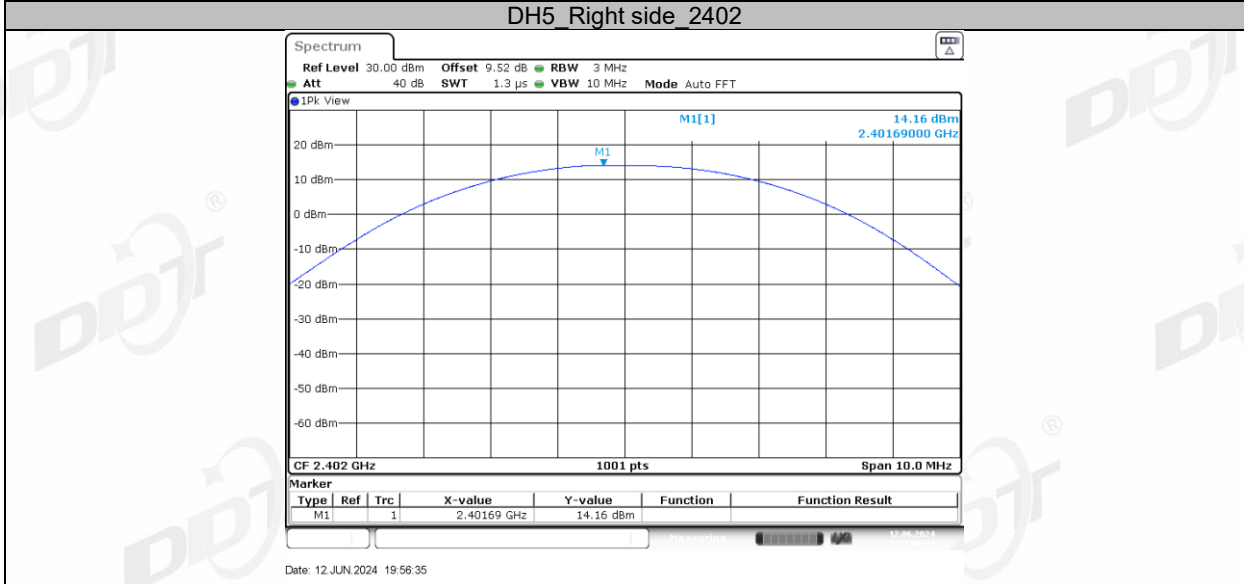
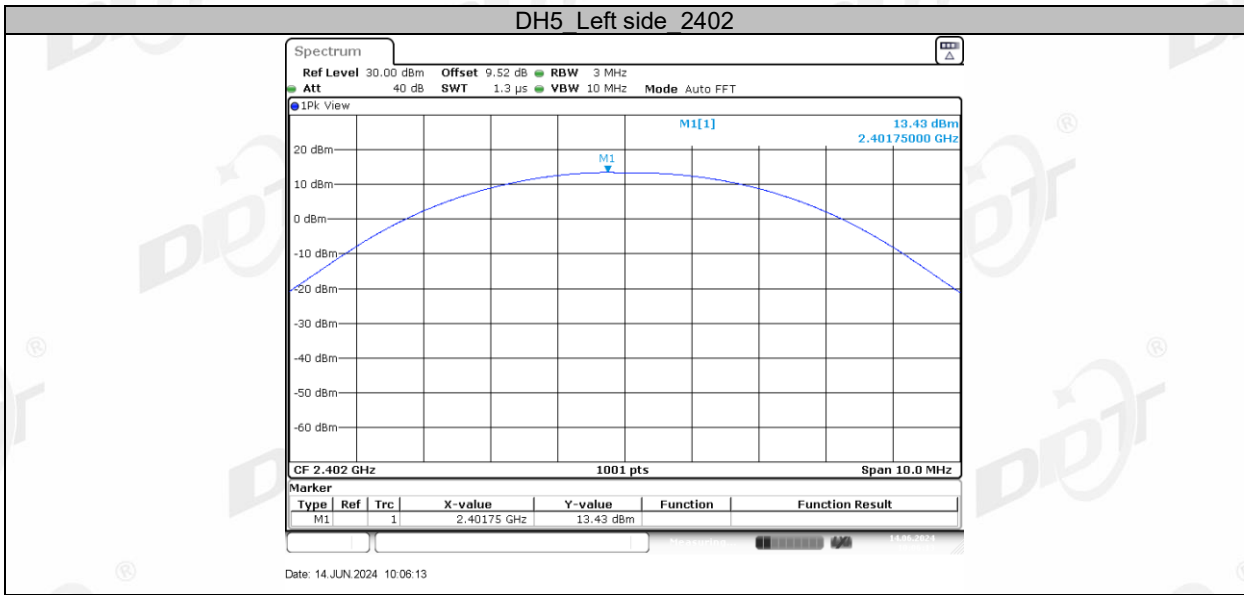
RBW:	> 20 dB bandwidth of the emission being measured.
VBW:	$VBW \geq RBW$ .
Span:	Approximately five times the 20 dB bandwidth, centered on a hopping channel.
Detector Mode:	Peak
Sweep time:	Auto
Trace mode:	Max hold
- (5) Use the marker-to-peak function to set the marker to the peak of the emission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

#### 6.4. Test result

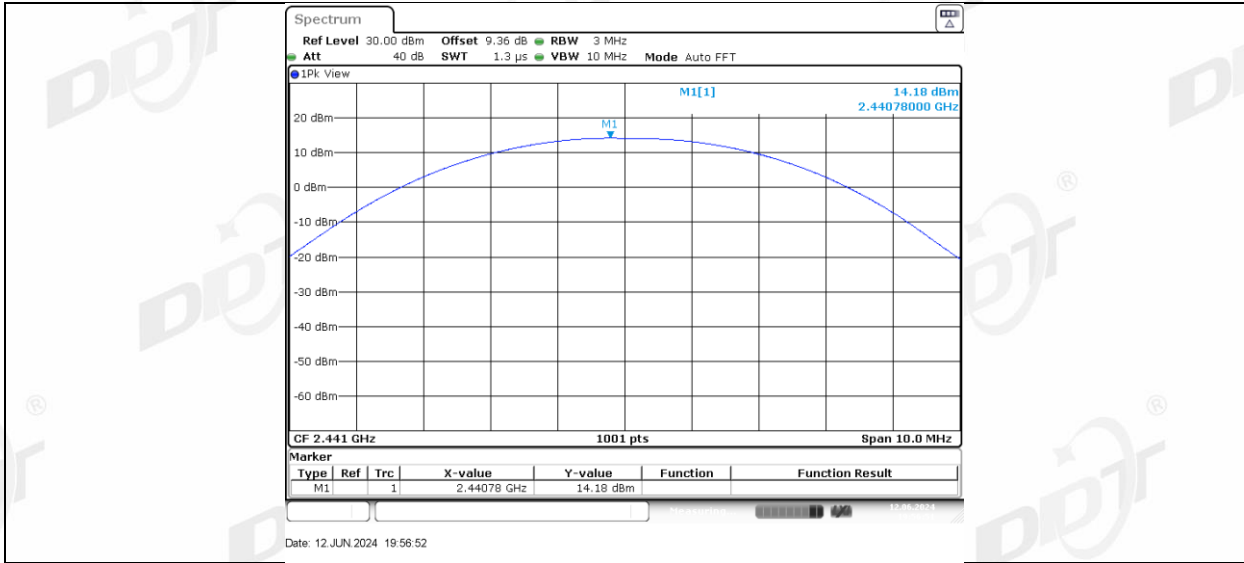
Test Engineer:	Zhongyao	Test Site:	RF Measurement System 3#
Ambient Condition:	23.6-25.5℃,42.8-46.7%RH	Test Date:	2024.06.12-2024.06.14
Test Power Supply:	Battery	Sample Number:	S24061107-053

Test Mode	Antenna	Frequency [MHz]	Conducted Peak Power [dBm]	Conducted Limit [dBm]	EIRP [dBm]	EIRP Limit [dBm]	Verdict
DH5	Left side	2402	13.43	≤20.97	10.14	≤30	PASS
	Right side	2402	14.16	≤20.97	10.85	≤30	PASS
	Left side	2441	13.29	≤20.97	10.00	≤30	PASS
	Right side	2441	14.18	≤20.97	10.87	≤30	PASS
	Left side	2480	13.17	≤20.97	9.88	≤30	PASS
	Right side	2480	14.12	≤20.97	10.81	≤30	PASS
2DH5	Left side	2402	13.22	≤20.97	9.93	≤30	PASS
	Right side	2402	14.06	≤20.97	10.75	≤30	PASS
	Left side	2441	13.25	≤20.97	9.96	≤30	PASS
	Right side	2441	14.05	≤20.97	10.74	≤30	PASS
	Left side	2480	13.03	≤20.97	9.74	≤30	PASS
	Right side	2480	14.02	≤20.97	10.71	≤30	PASS
3DH5	Left side	2402	13.30	≤20.97	10.01	≤30	PASS
	Right side	2402	14.01	≤20.97	10.70	≤30	PASS
	Left side	2441	13.21	≤20.97	9.92	≤30	PASS
	Right side	2441	14.00	≤20.97	10.69	≤30	PASS
	Left side	2480	13.01	≤20.97	9.72	≤30	PASS
	Right side	2480	14.01	≤20.97	10.70	≤30	PASS

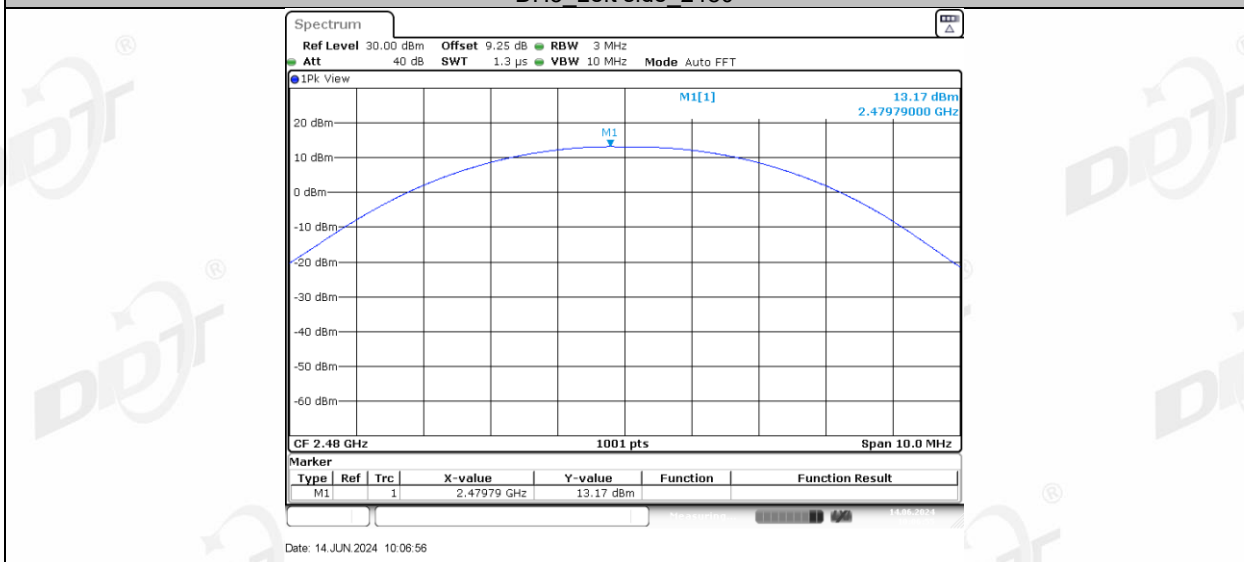
### 6.5. Test graphs



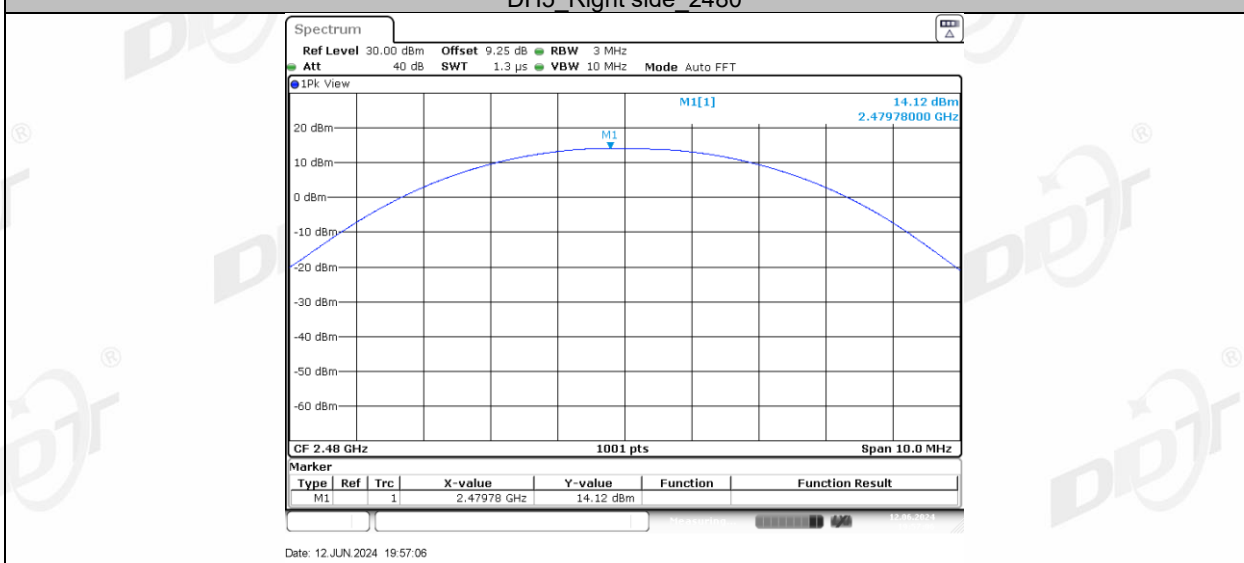
**DH5 Right side 2441**



DH5 Left side 2480

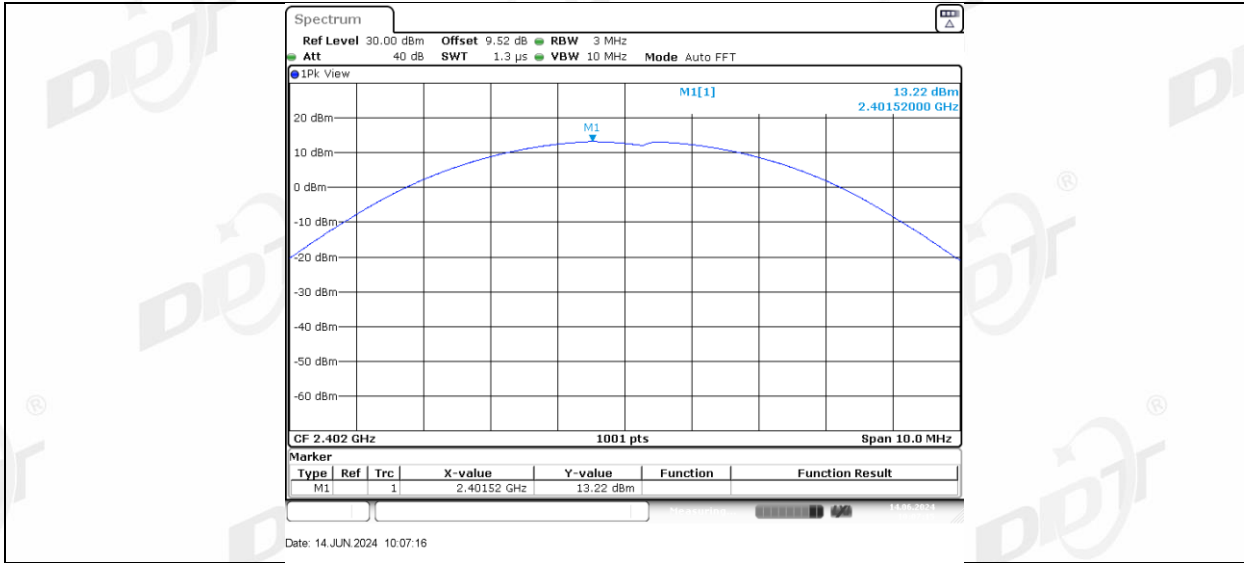


DH5 Right side 2480

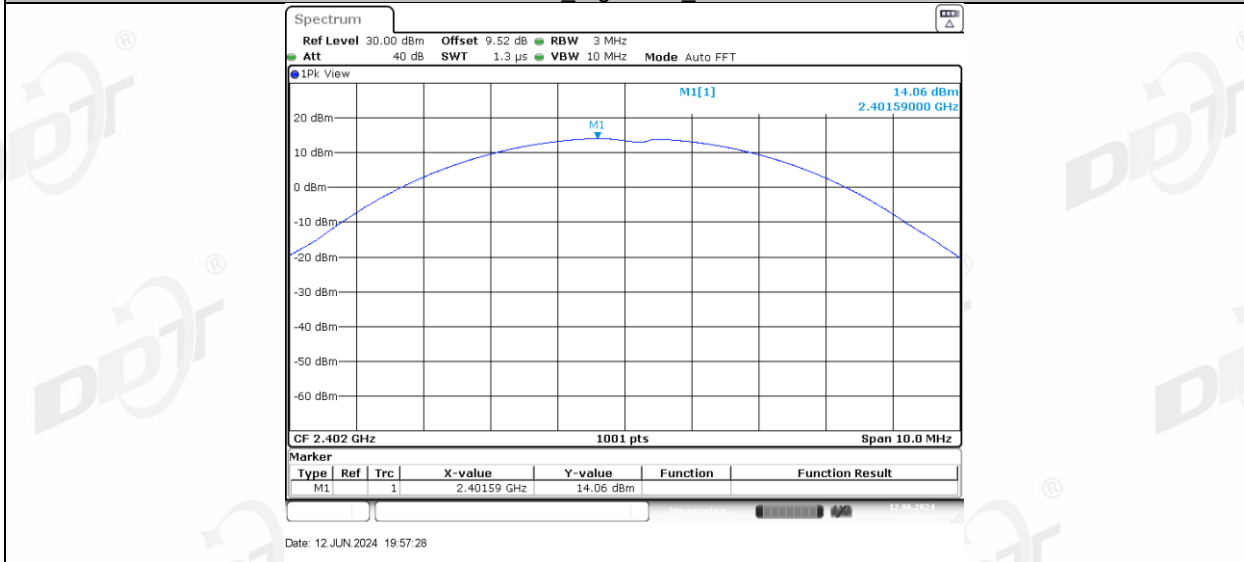


2DH5 Left side 2402

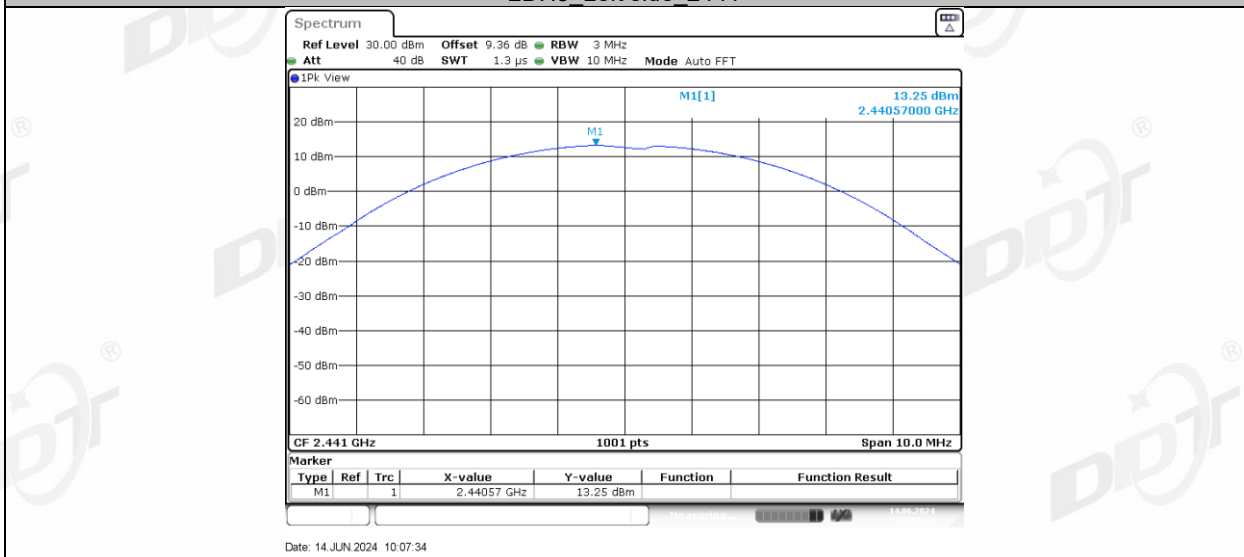




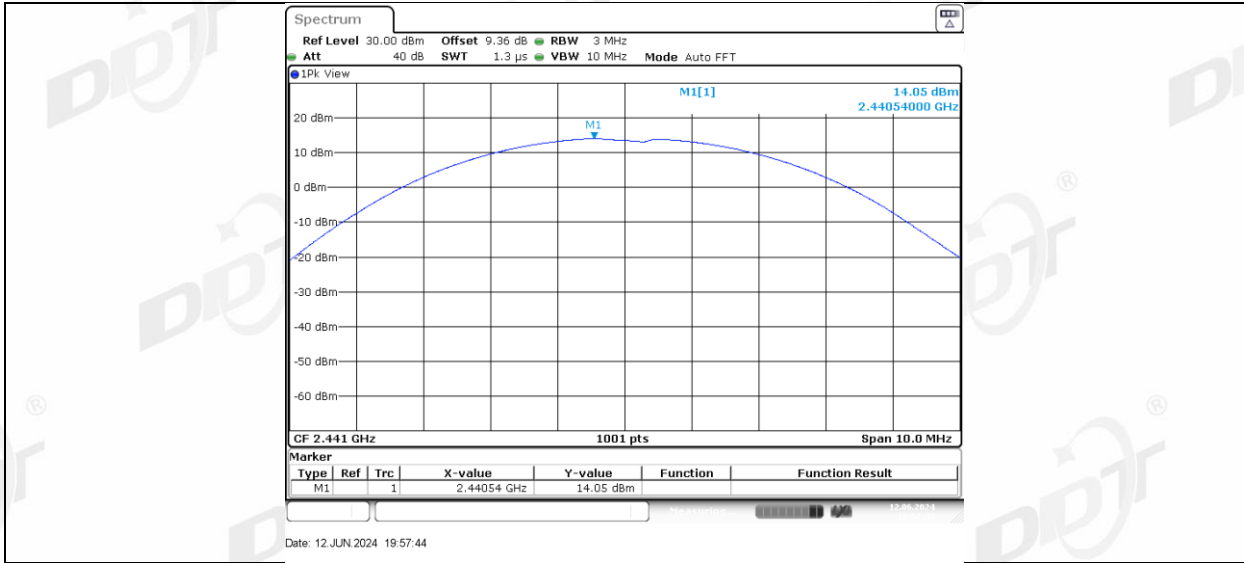
2DH5 Right side 2402



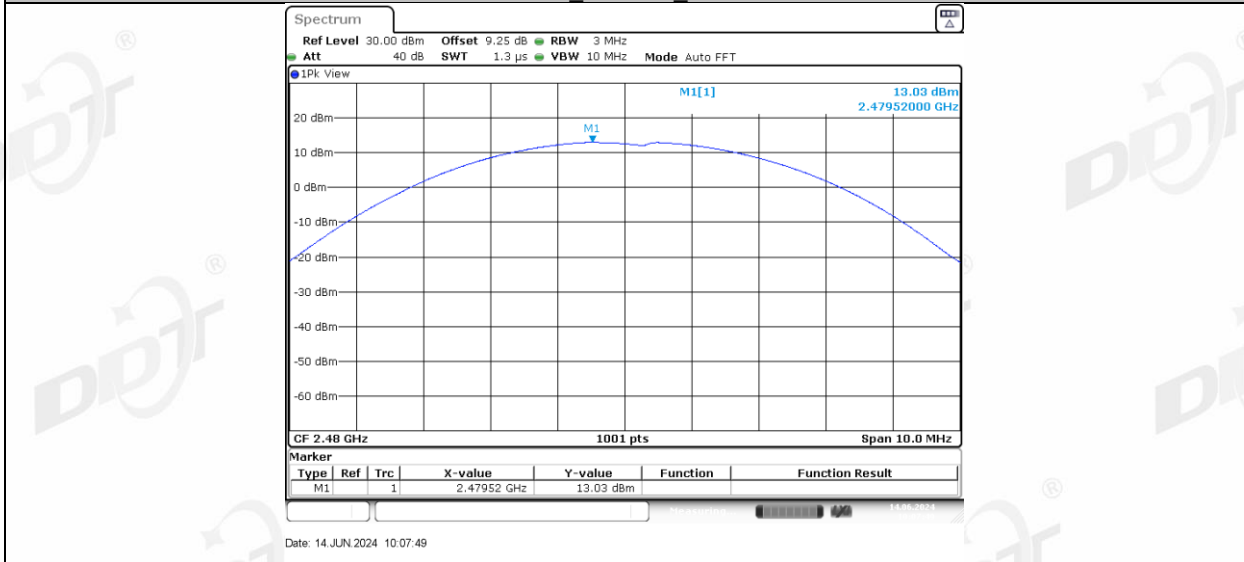
2DH5 Left side 2441



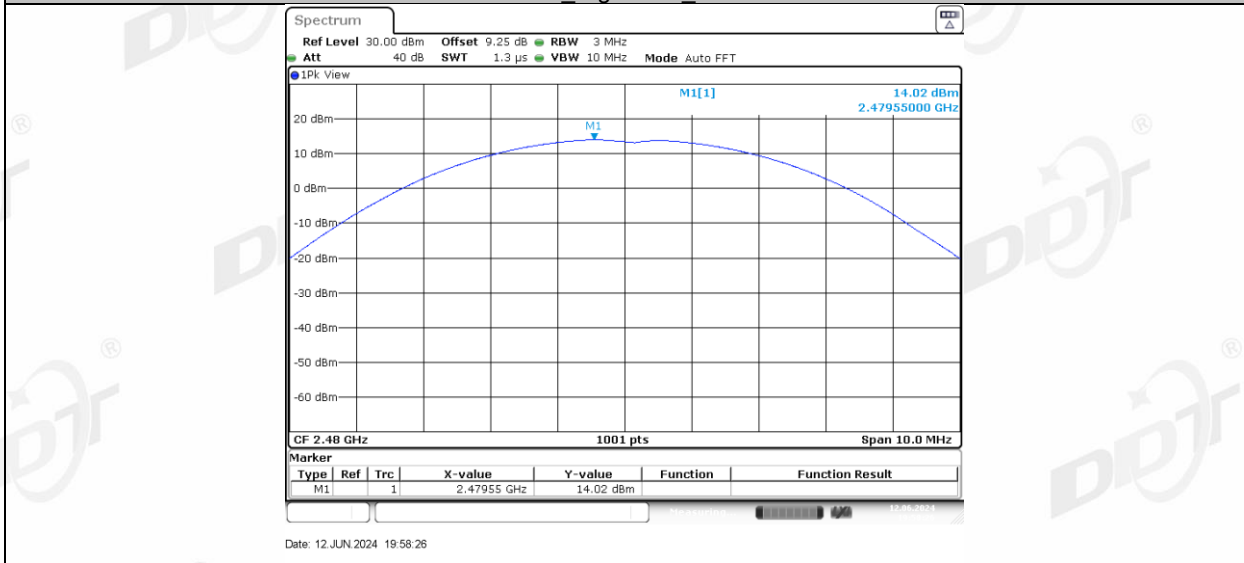
2DH5 Right side 2441



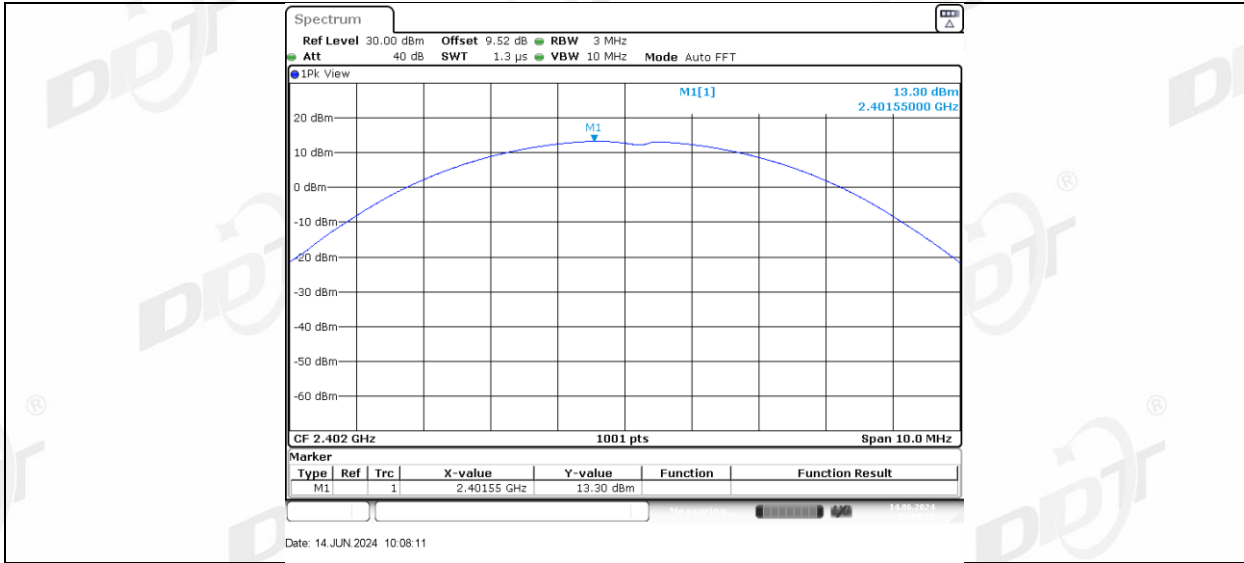
2DH5 Left side 2480



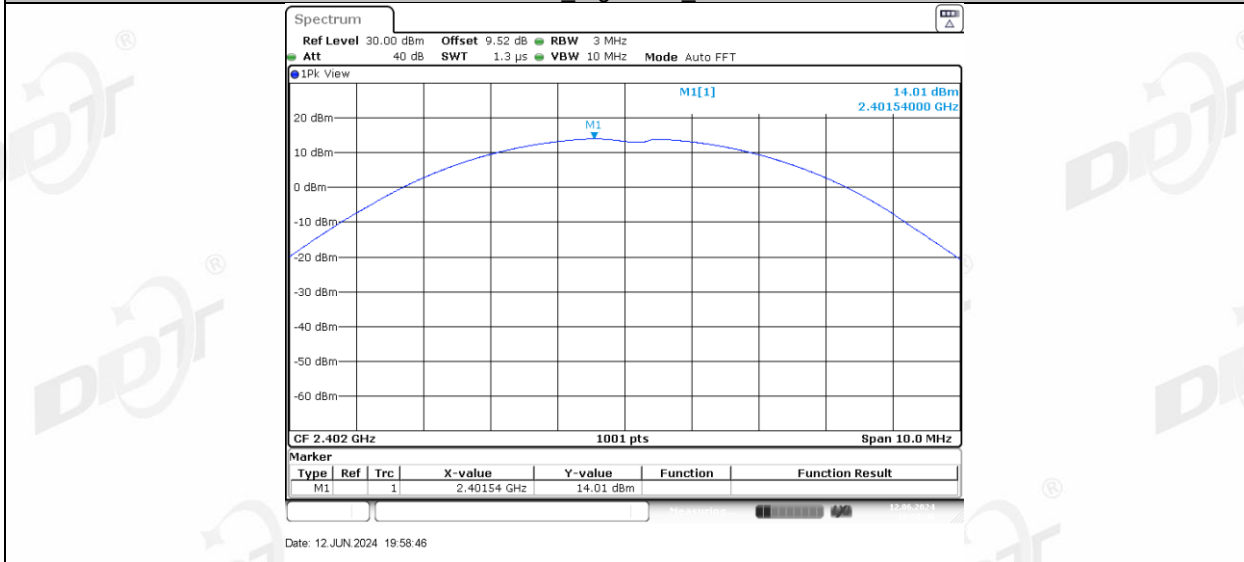
2DH5 Right side 2480



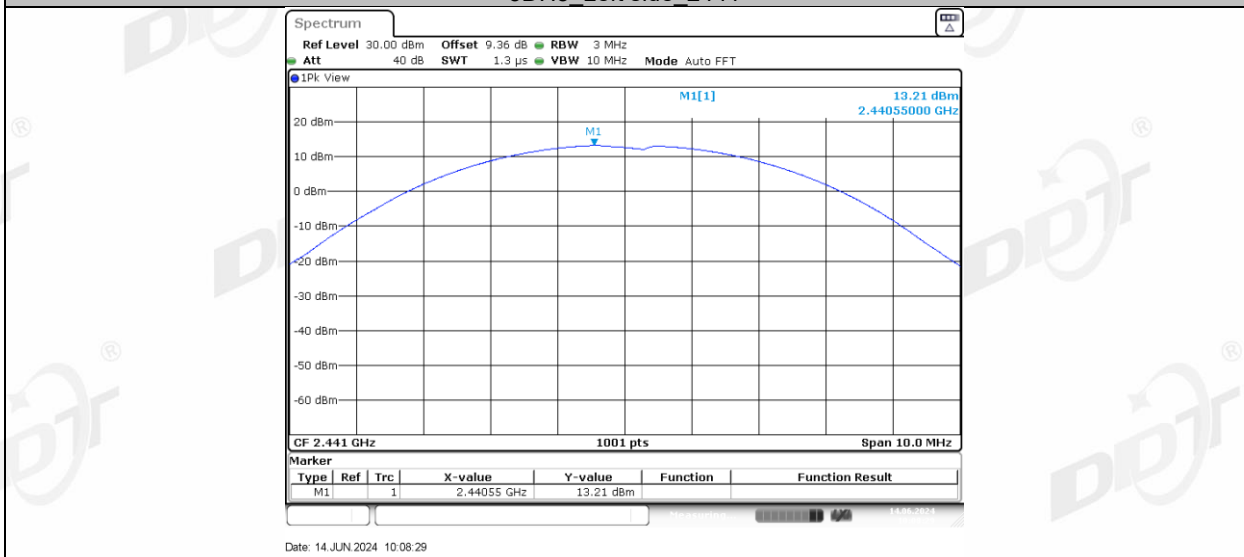
3DH5 Left side 2402



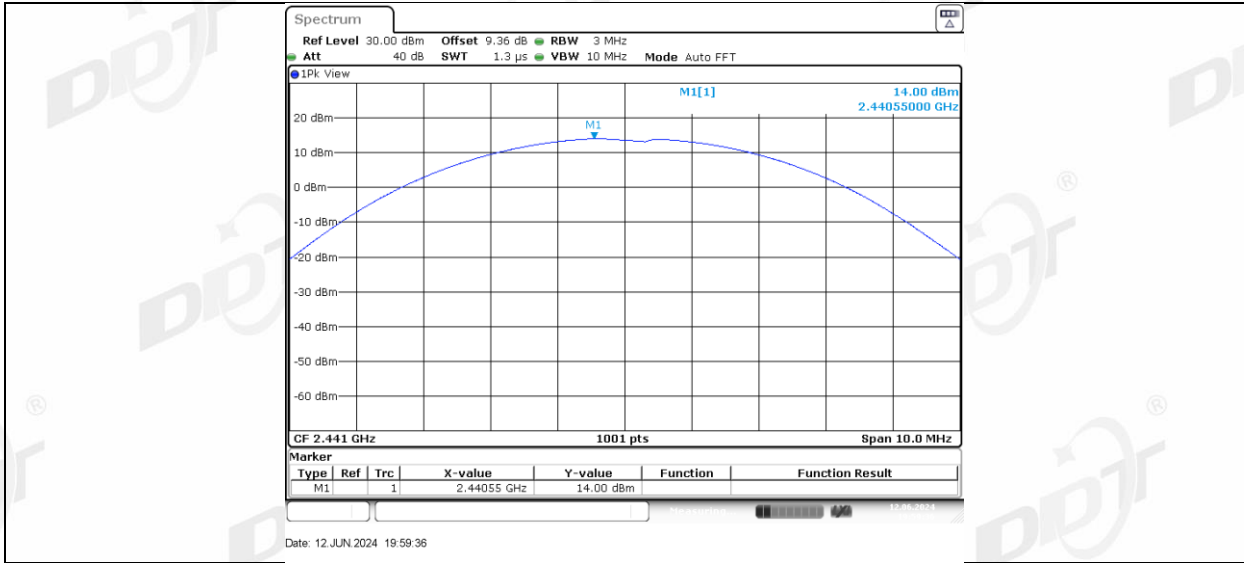
3DH5 Right side 2402



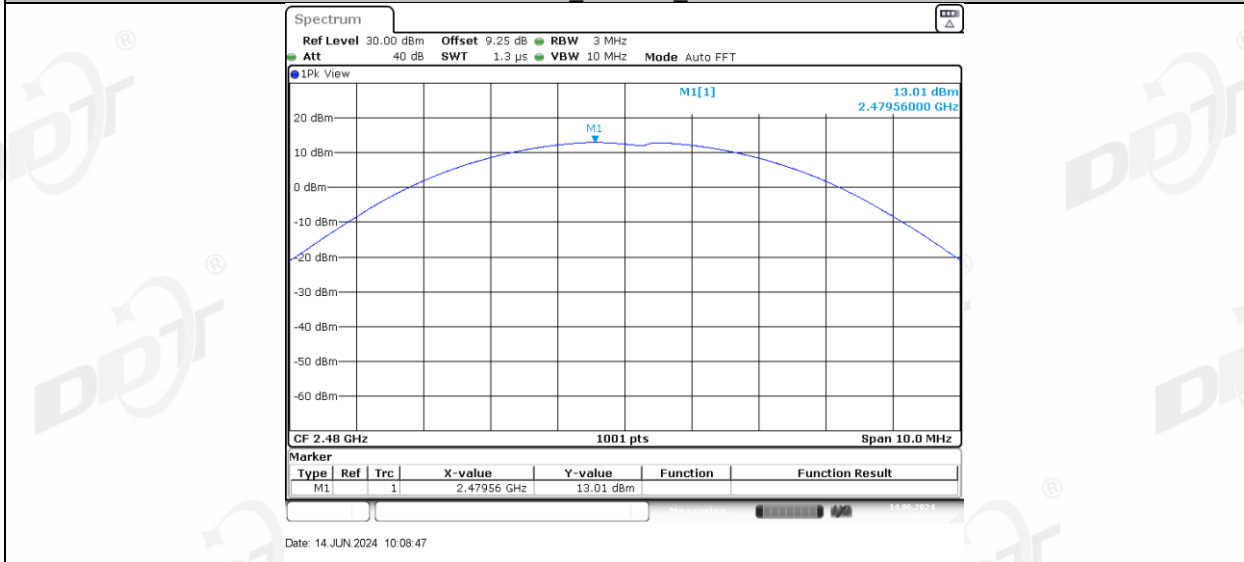
3DH5 Left side 2441



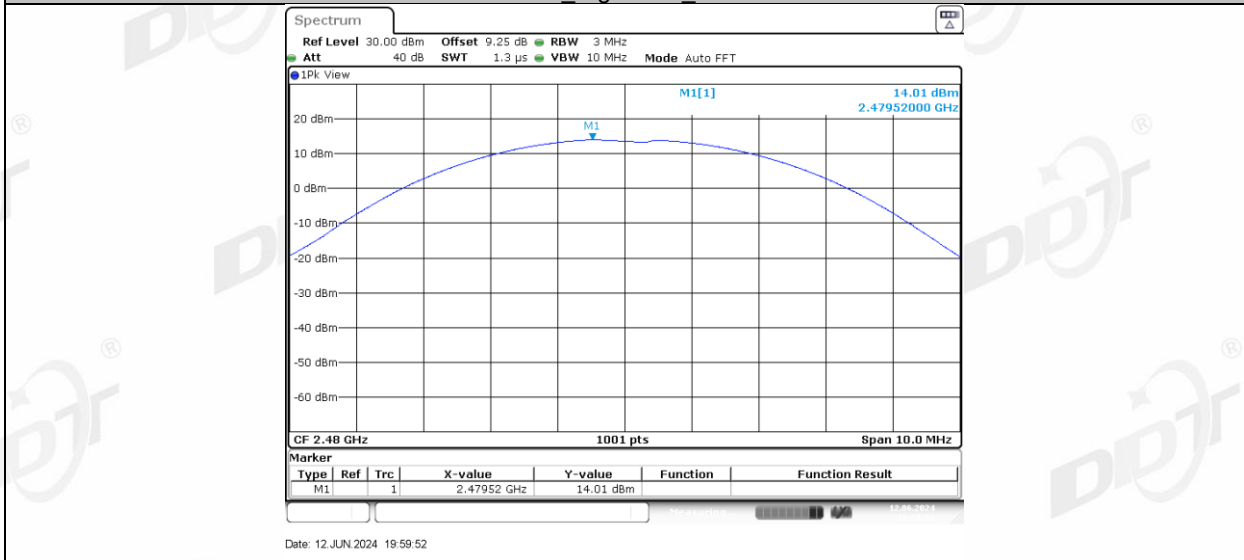
3DH5 Right side 2441



3DH5 Left side 2480

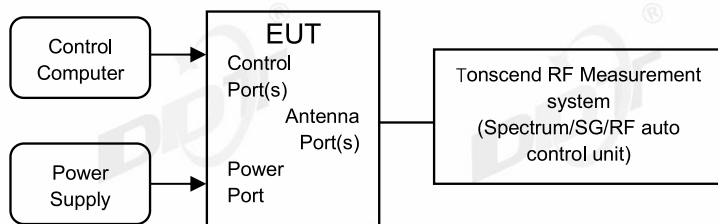


3DH5 Right side 2480



## 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:
 

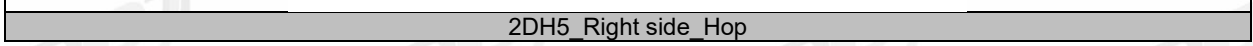
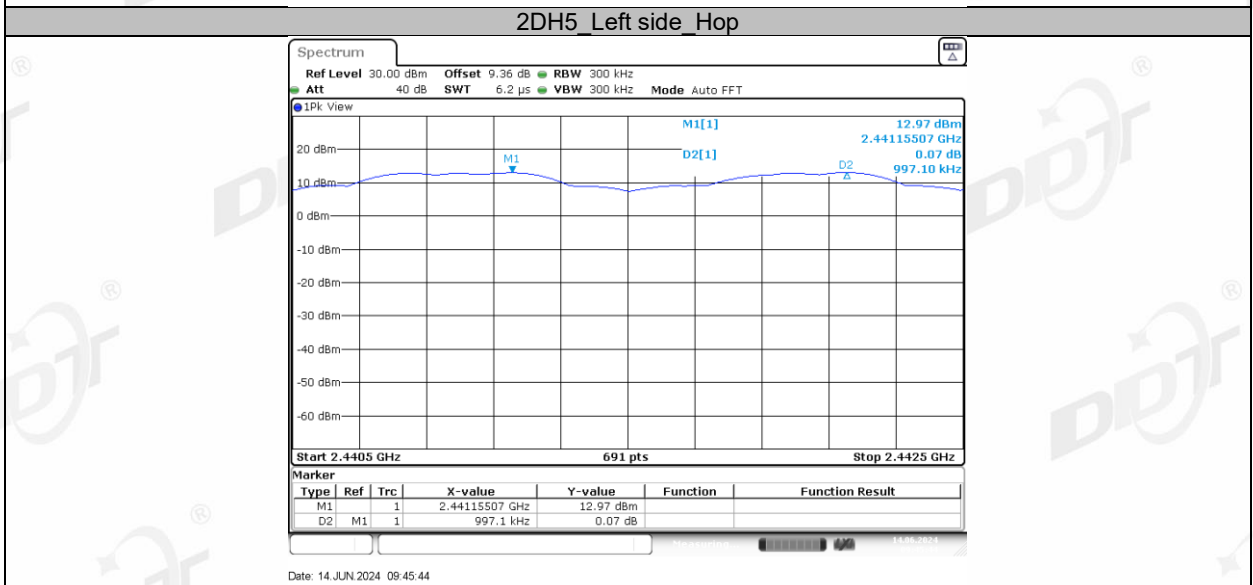
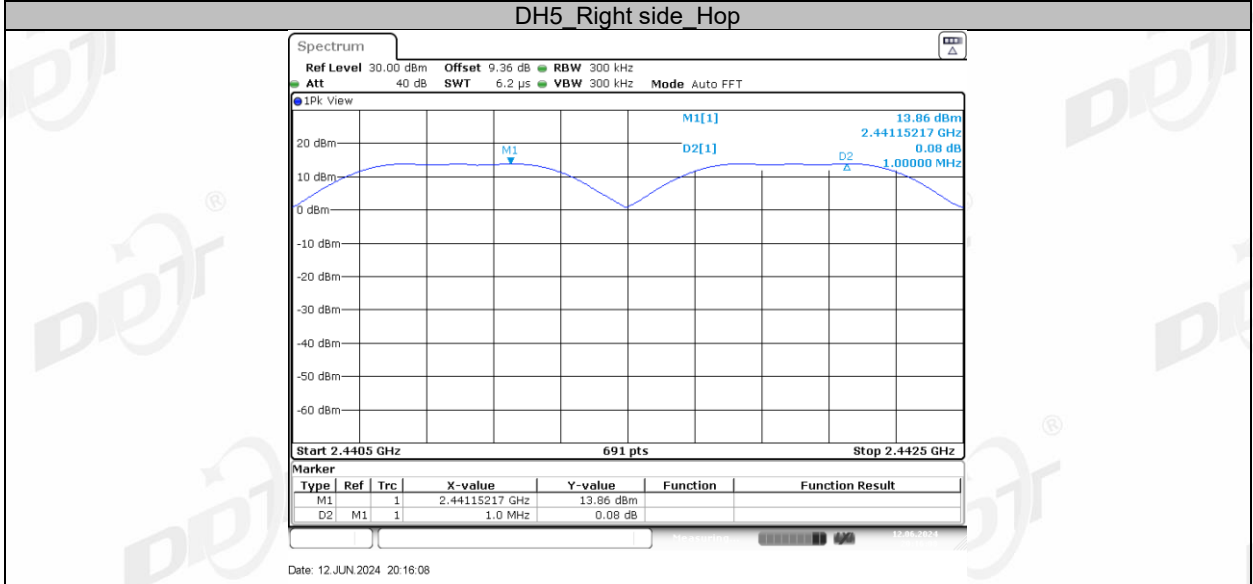
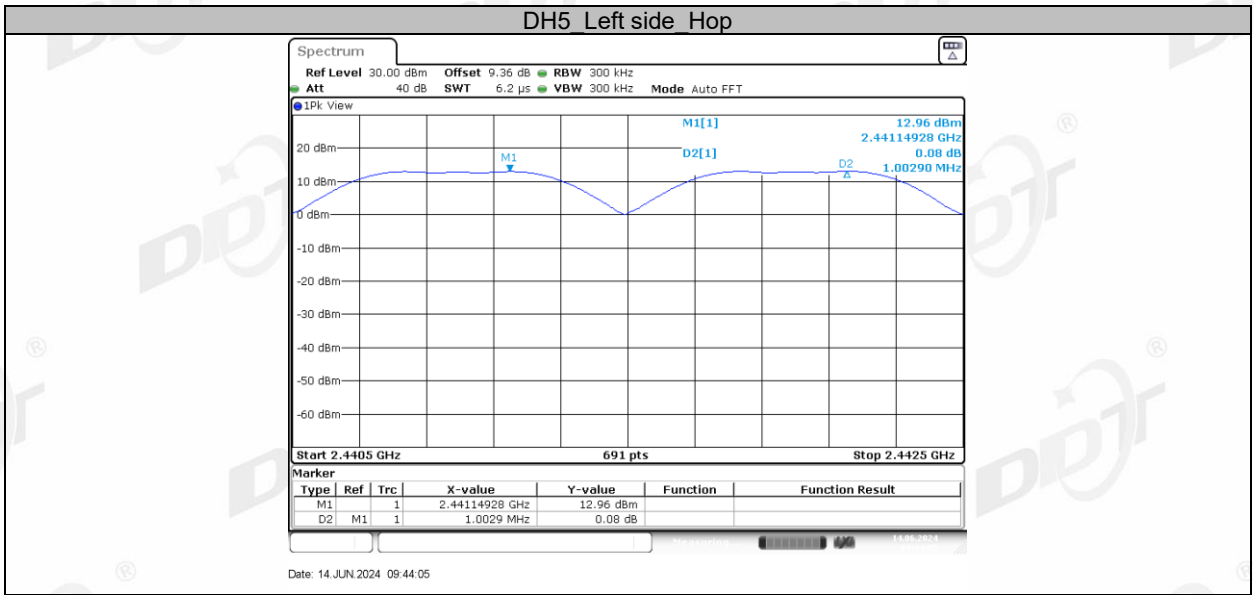
RBW:	approximately 30% of the channel spacing
VBW:	VBW $\geq$ RBW.
Span:	Wide enough to capture the peaks of two adjacent channels.
Detector Mode:	Peak
Sweep time:	Auto
Trace mode:	Max hold
- (5) Use the marker-delta function to determine the separation between the peaks of the adjacent channels and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

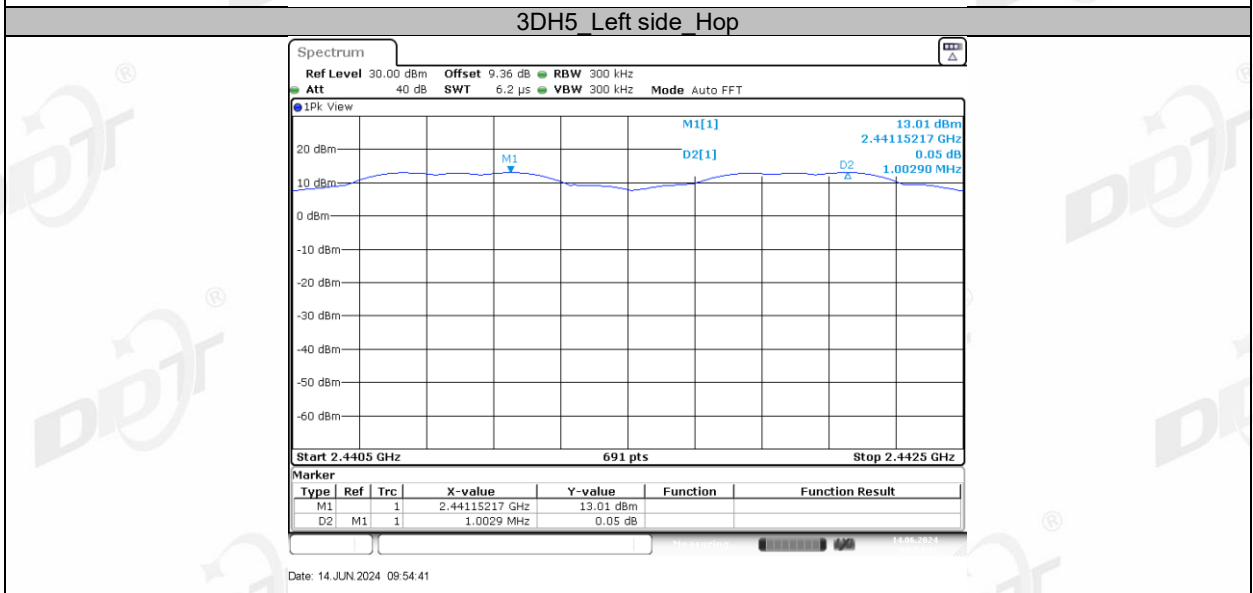
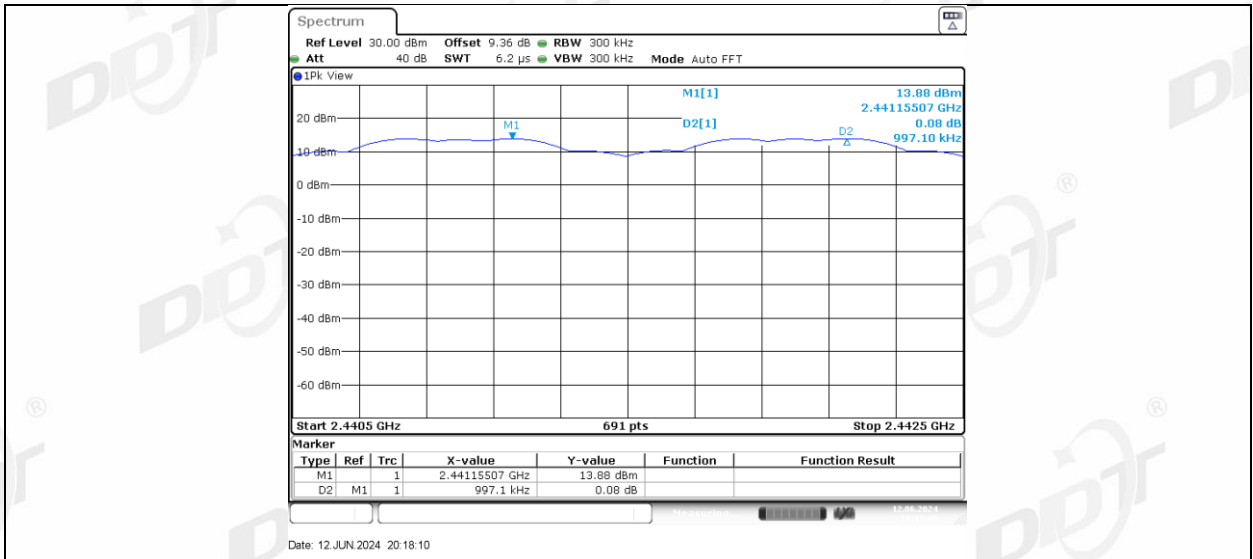
#### 7.4. Test result

Test Engineer:	Zhongyao	Test Site:	RF Measurement System 3#
Ambient Condition:	23.6-25.5℃,42.8-46.7%RH	Test Date:	2024.06.12-2024.06.14
Test Power Supply:	Battery	Sample Number:	S24061107-053

Test Mode	Antenna	Frequency [MHz]	Result [MHz]	Limit [MHz]	Verdict
DH5	Left side	Hop	1.003	≥0.693	PASS
	Right side	Hop	1.000	≥0.693	PASS
2DH5	Left side	Hop	0.997	≥0.807	PASS
	Right side	Hop	0.997	≥0.807	PASS
3DH5	Left side	Hop	1.003	≥0.800	PASS
	Right side	Hop	0.997	≥0.800	PASS

### 7.5. Test graphs

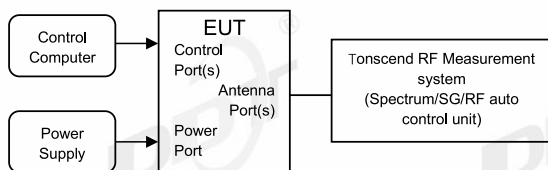






## 8. Dwell Time

### 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:
 

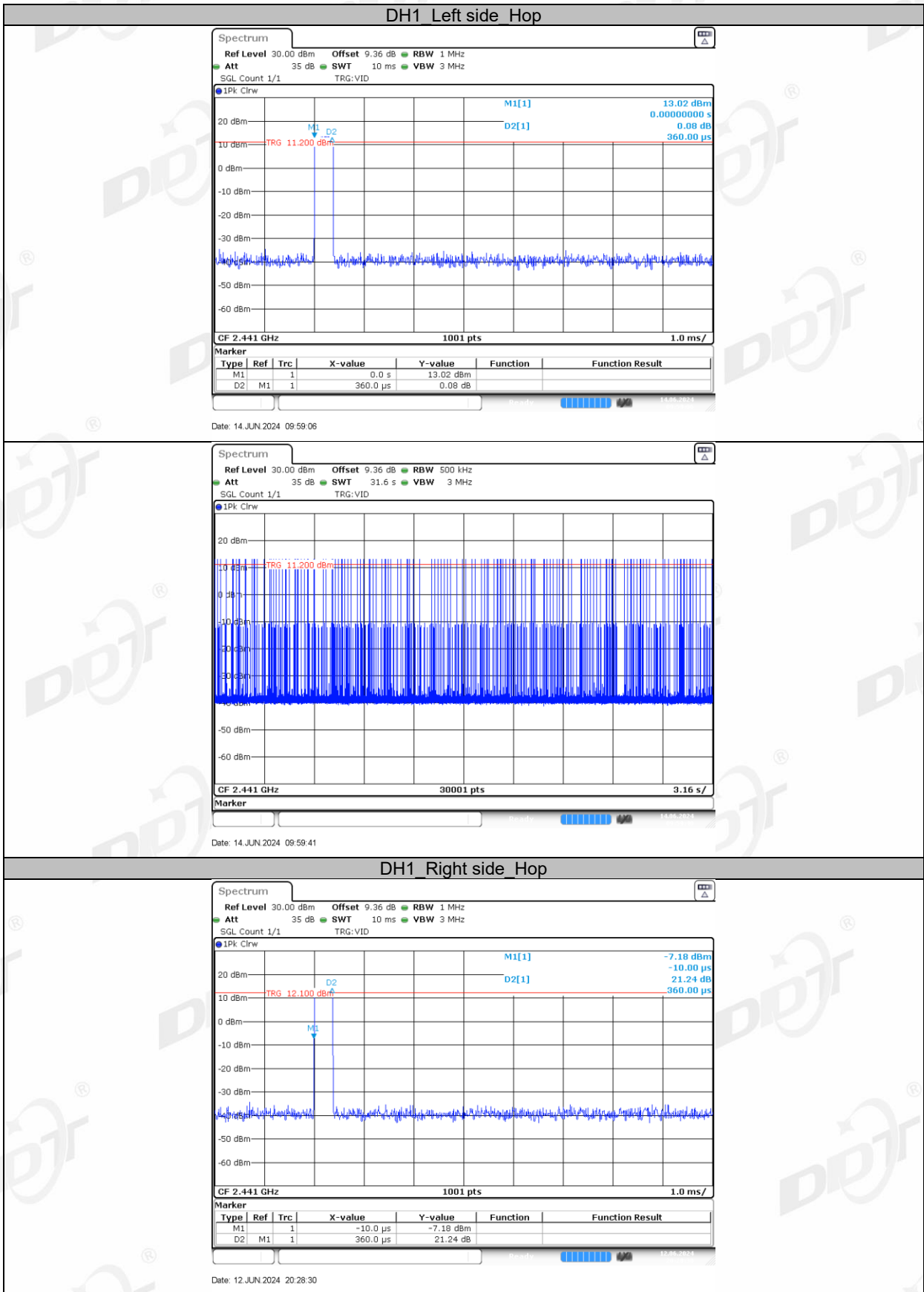
RBW:	$\leq$ channel spacing and where possible RBW should be set $\gg 1 / T$
VBW:	$VBW \geq RBW$ .
Span:	Zero span, centered on a hopping channel.
Detector Mode:	Peak
Sweep time:	Auto
Trace mode:	Clear Write.
- (5) The test period:  $T = 0.4 \text{ Second/Channel} \times 79 \text{ Channel} = 31.6 \text{ s}$
- (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.

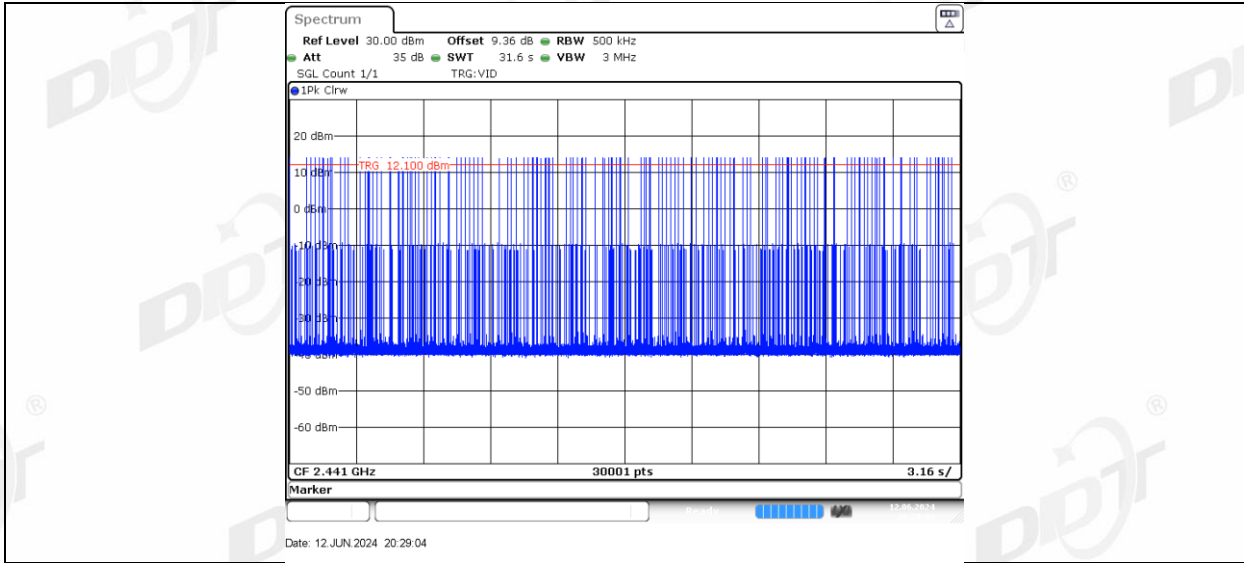
### 8.4. Test result

Test Engineer:	Zhongyao	Test Site:	RF Measurement System 3#
Ambient Condition:	23.6-25.5℃,42.8-46.7%RH	Test Date:	2024.06.12-2024.06.14
Test Power Supply:	Battery	Sample Number:	S24061107-053

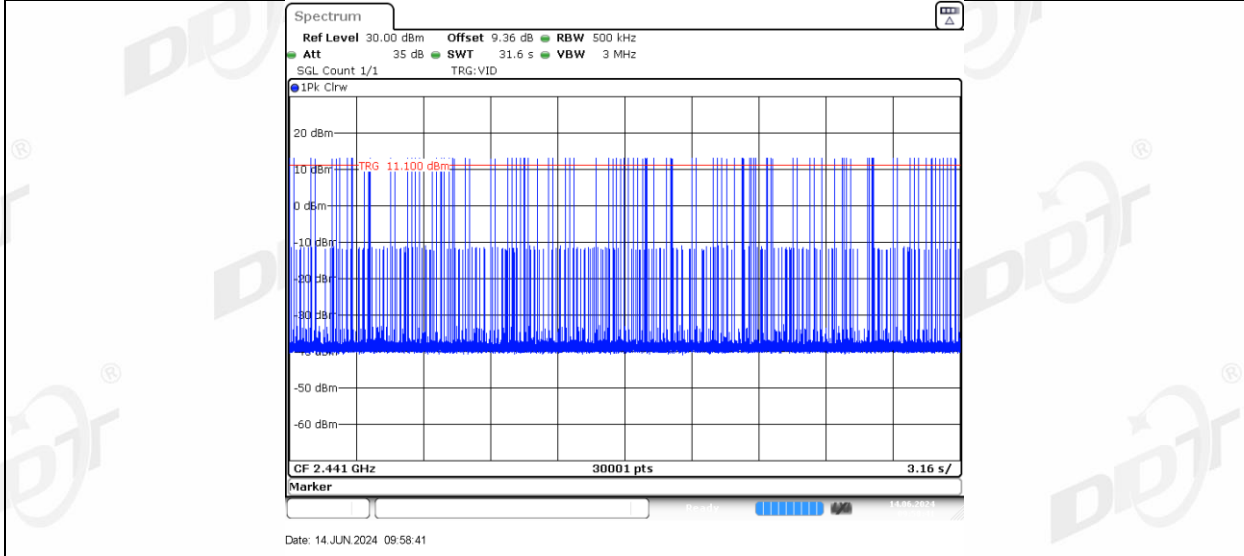
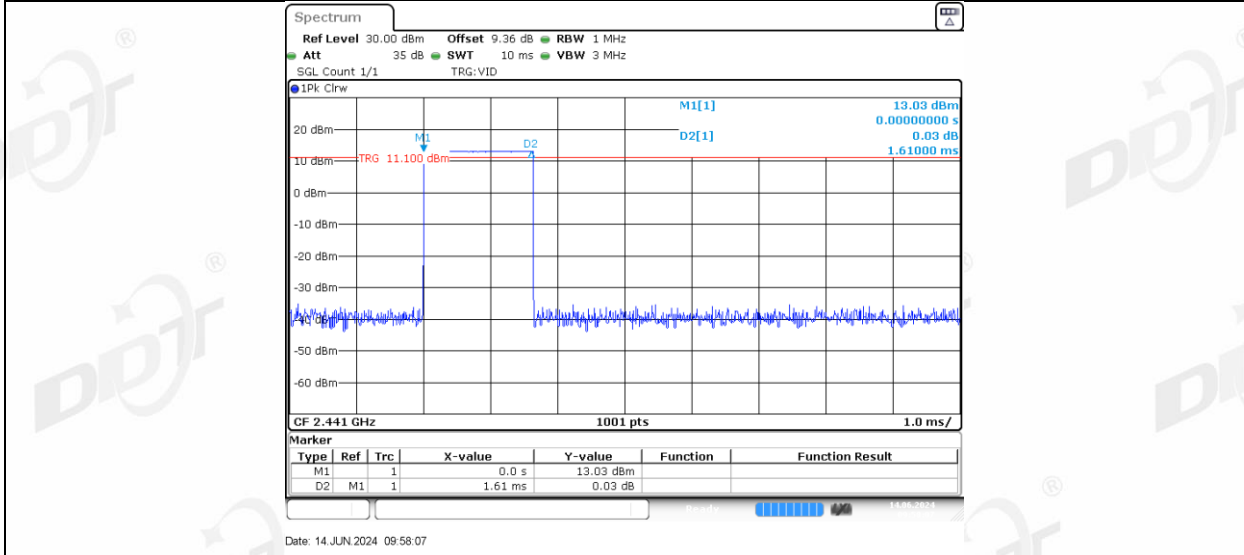
Test Mode	Antenna	Frequency [MHz]	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Left side	Hop	0.360	161	0.058	≤0.4	PASS
	Right side	Hop	0.360	160	0.058	≤0.4	PASS
DH3	Left side	Hop	1.610	104	0.167	≤0.4	PASS
	Right side	Hop	1.610	127	0.204	≤0.4	PASS
DH5	Left side	Hop	2.860	79	0.226	≤0.4	PASS
	Right side	Hop	2.870	84	0.241	≤0.4	PASS
2DH1	Left side	Hop	0.370	144	0.053	≤0.4	PASS
	Right side	Hop	0.370	153	0.057	≤0.4	PASS
2DH3	Left side	Hop	1.620	117	0.19	≤0.4	PASS
	Right side	Hop	1.630	101	0.165	≤0.4	PASS
2DH5	Left side	Hop	2.870	70	0.201	≤0.4	PASS
	Right side	Hop	2.870	93	0.267	≤0.4	PASS
3DH1	Left side	Hop	0.370	164	0.061	≤0.4	PASS
	Right side	Hop	0.370	154	0.057	≤0.4	PASS
3DH3	Left side	Hop	1.620	102	0.165	≤0.4	PASS
	Right side	Hop	1.620	112	0.181	≤0.4	PASS
3DH5	Left side	Hop	2.870	79	0.227	≤0.4	PASS
	Right side	Hop	2.870	88	0.253	≤0.4	PASS

### 8.5. Test graphs

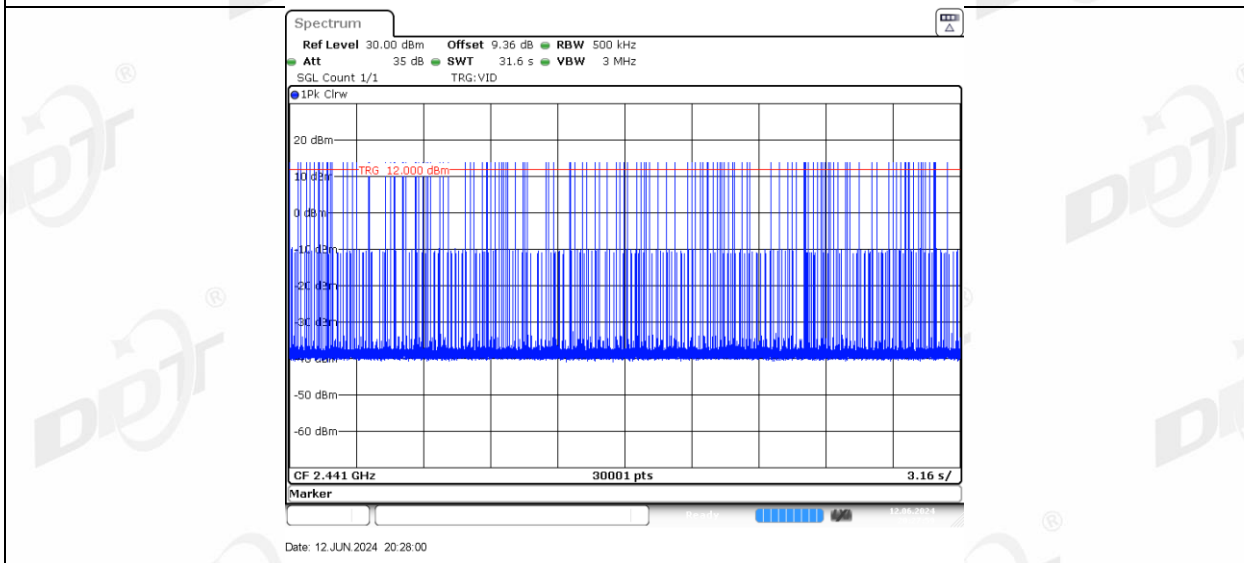
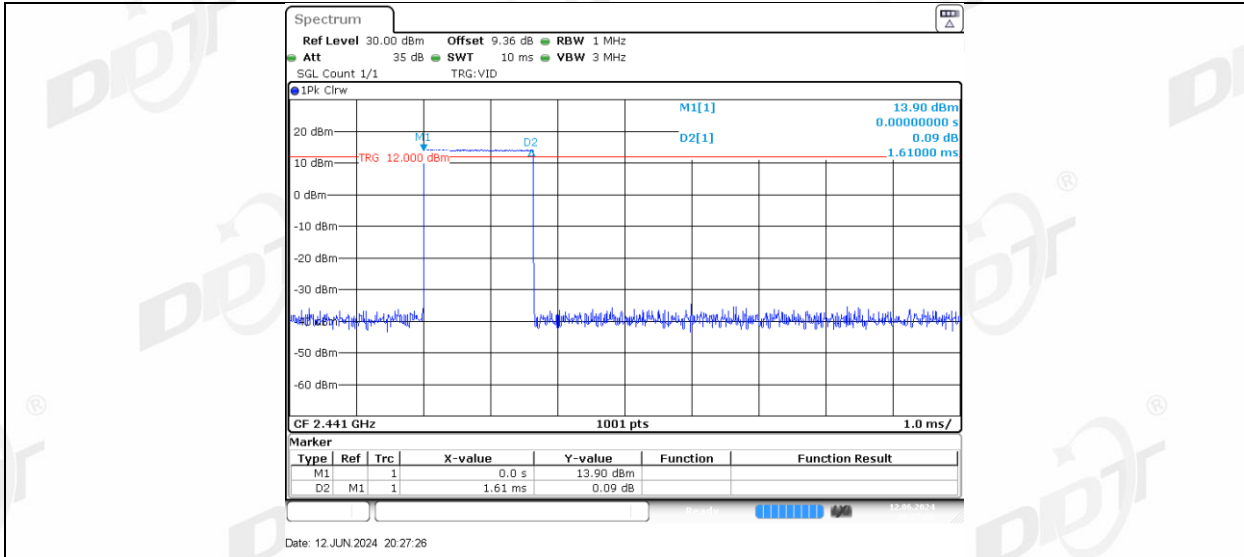




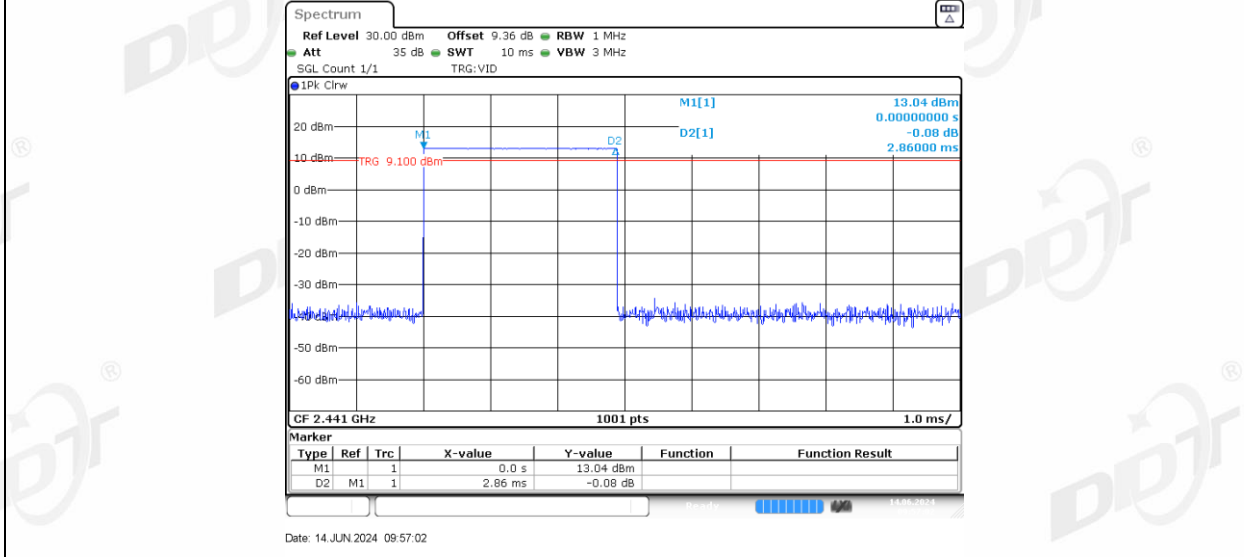
DH3 Left side Hop

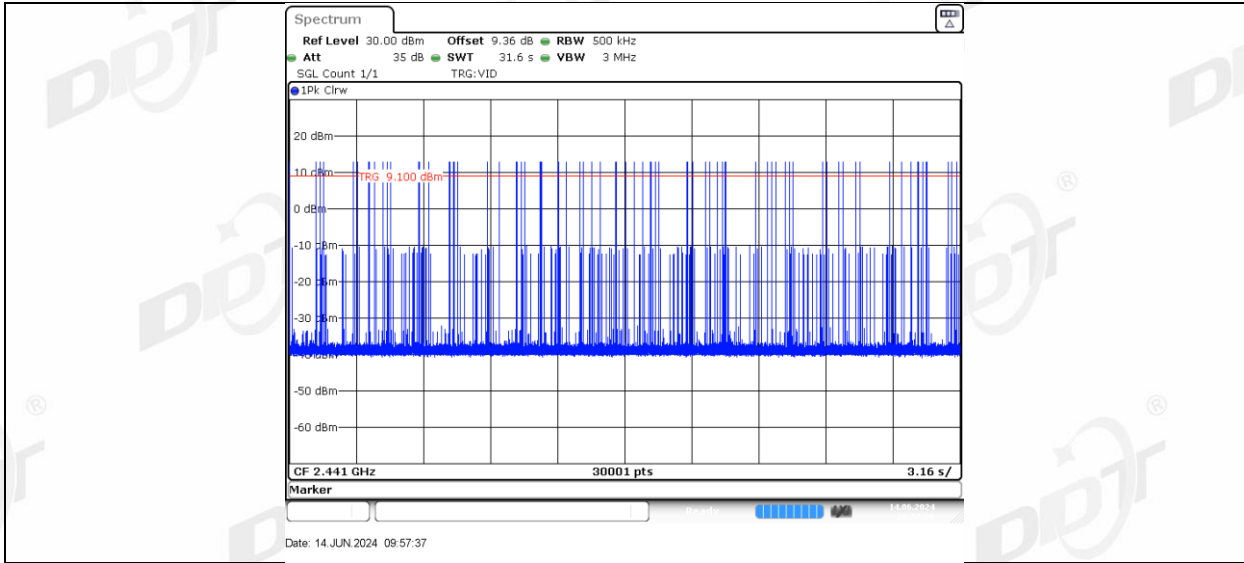


DH3 Right side Hop

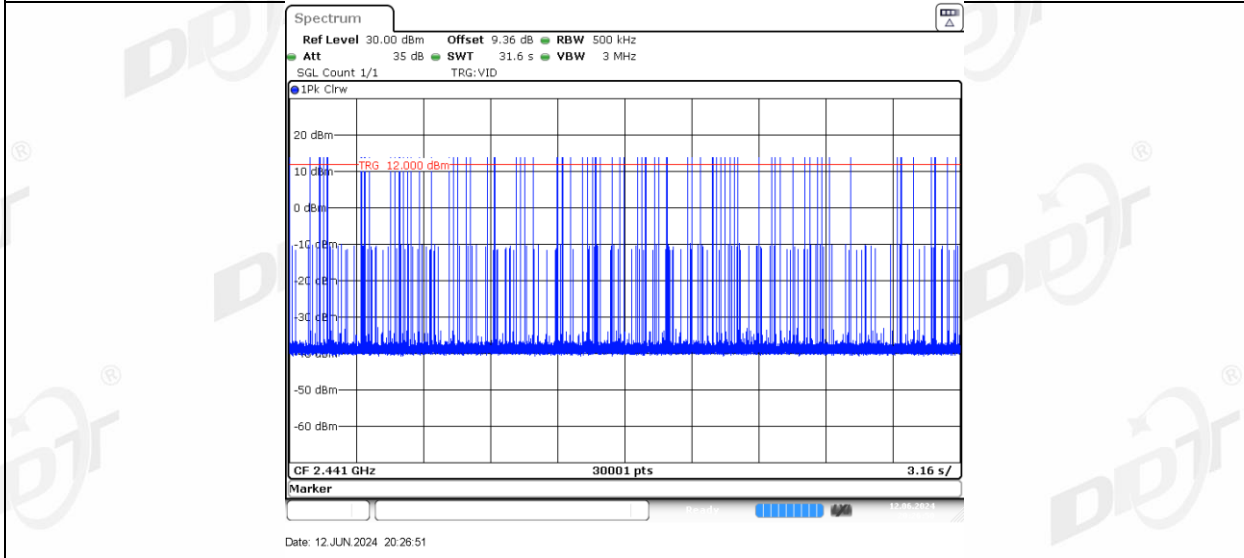
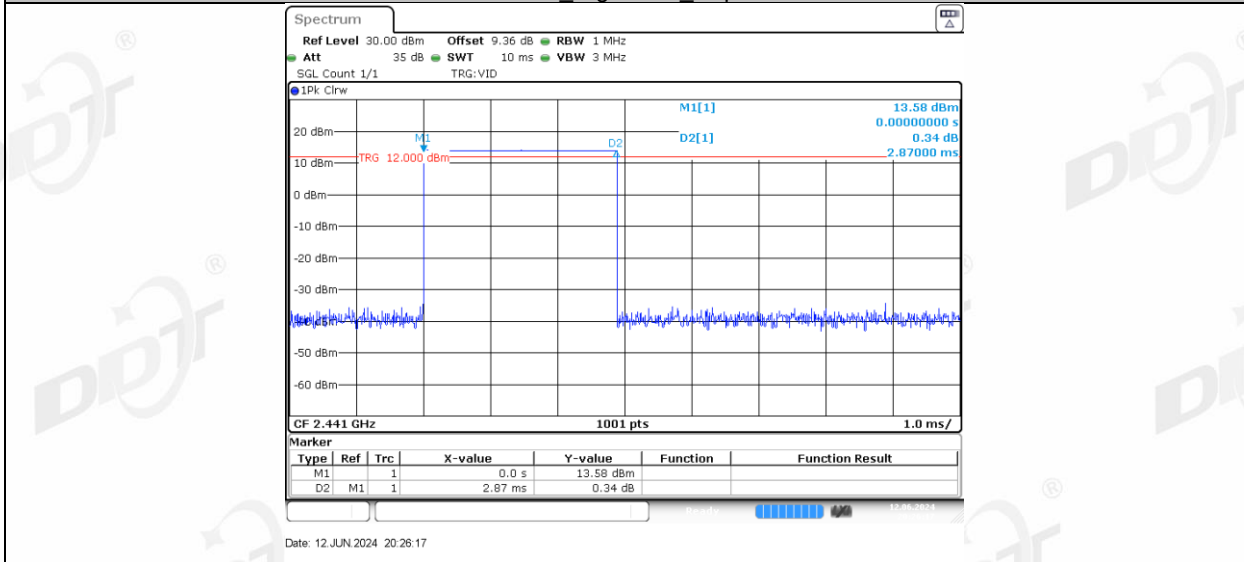


DH5 Left side Hop

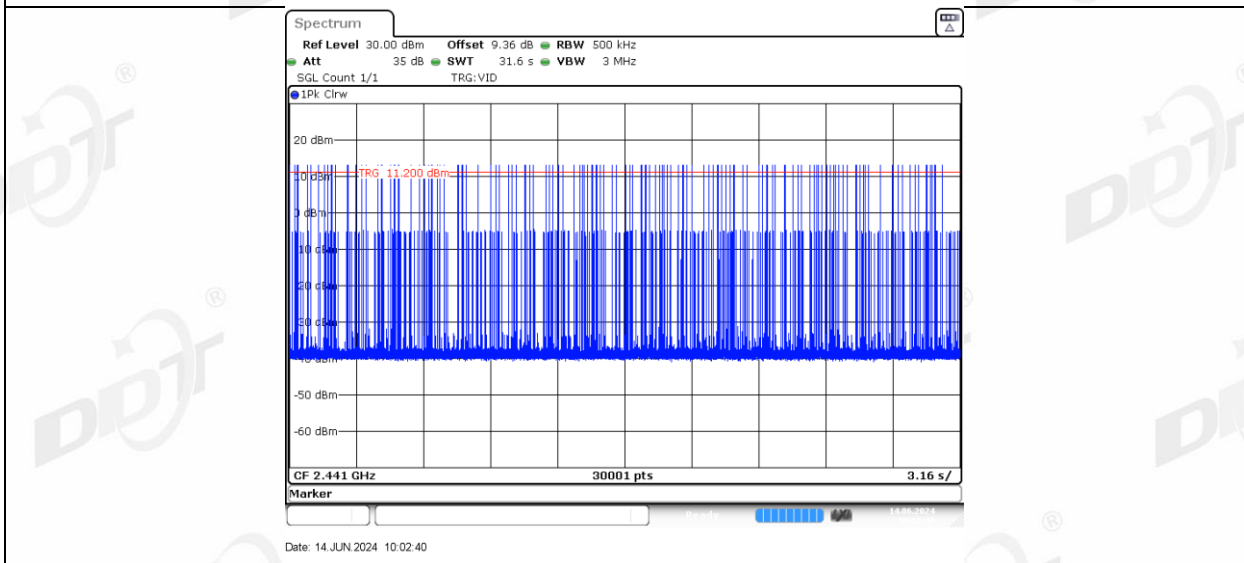
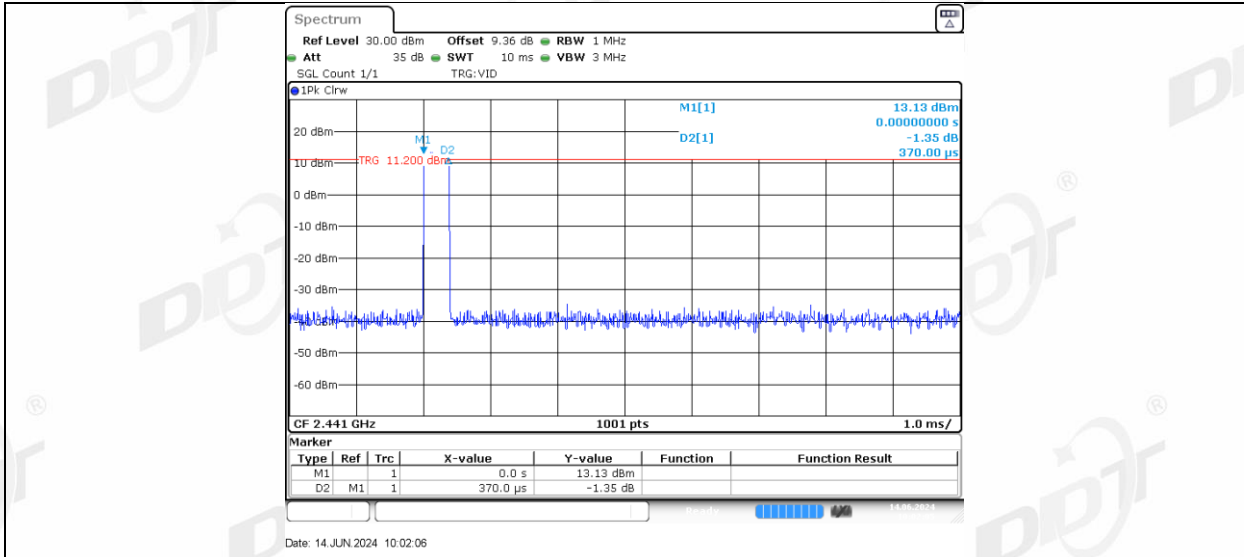




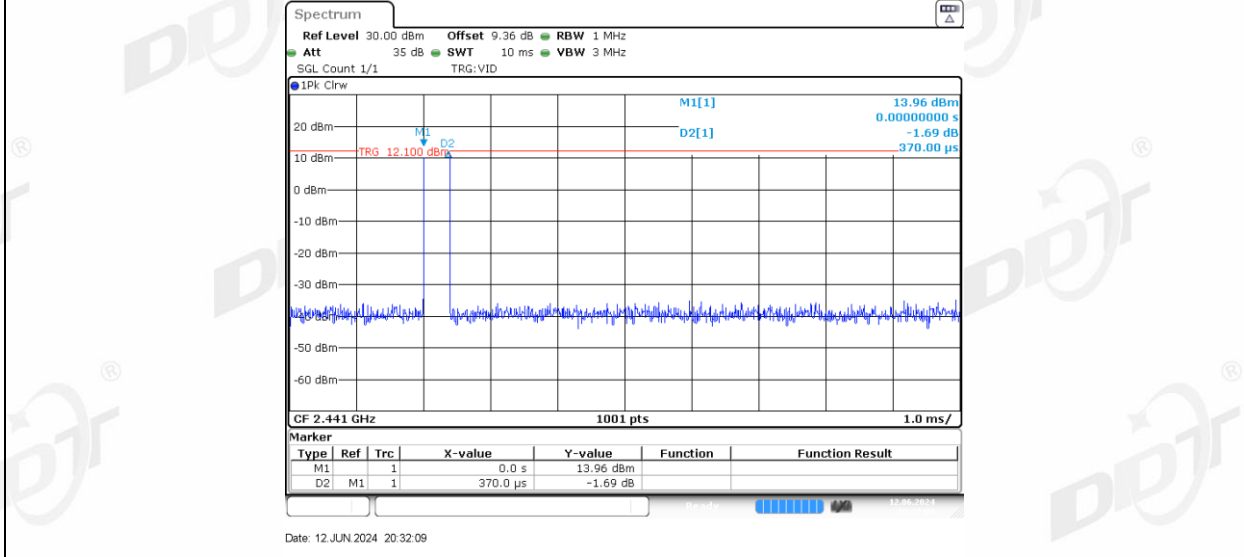
DH5 Right side Hop

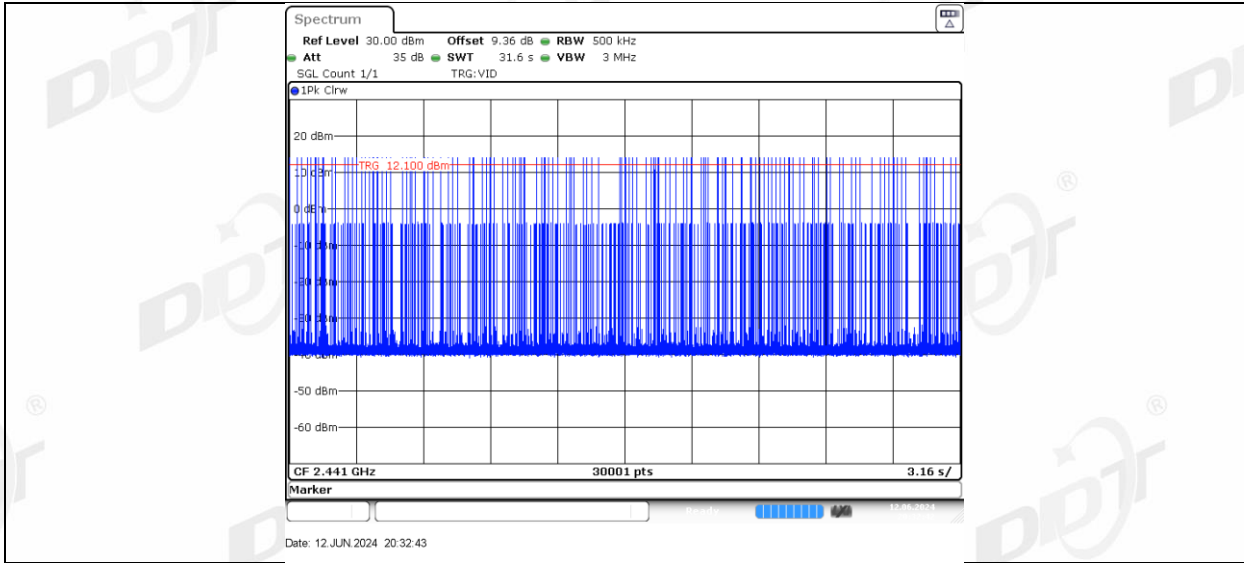


2DH1 Left side Hop

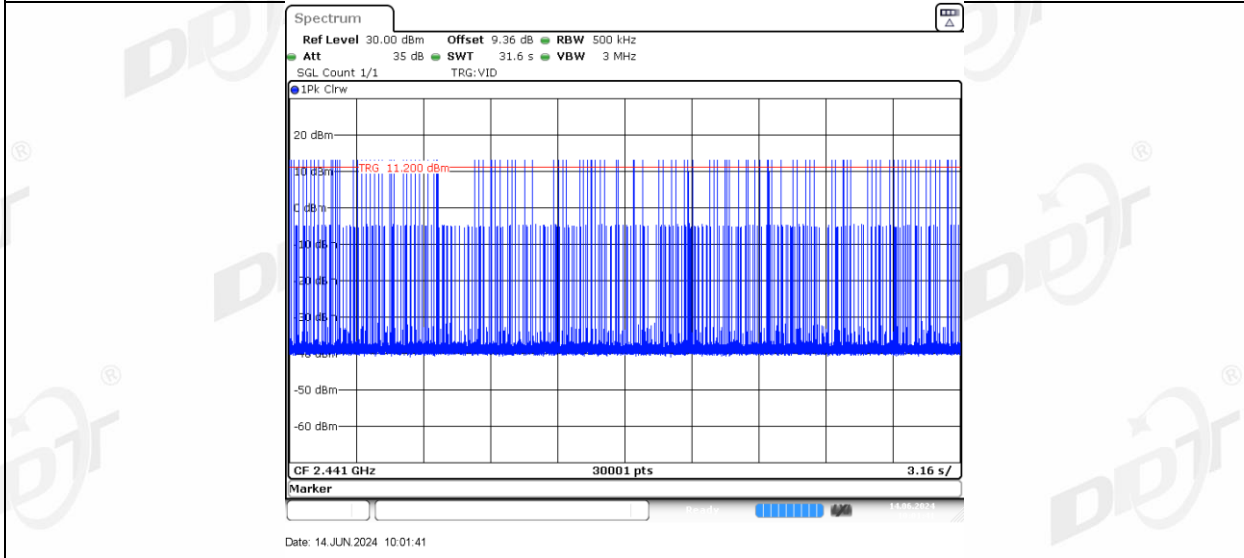
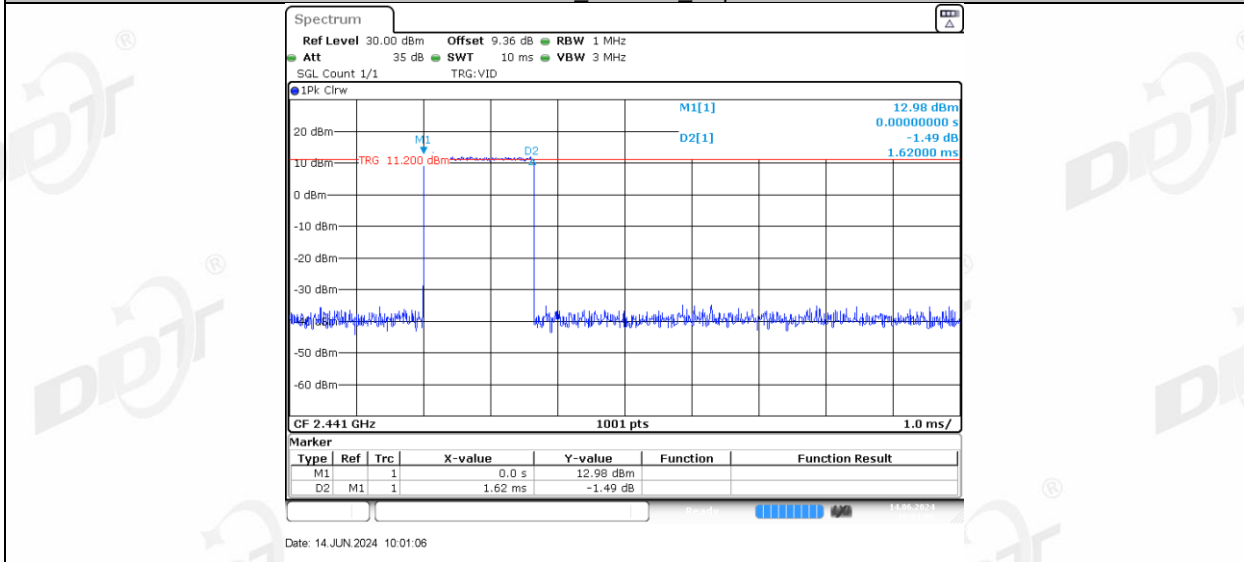


2DH1\_Right side Hop



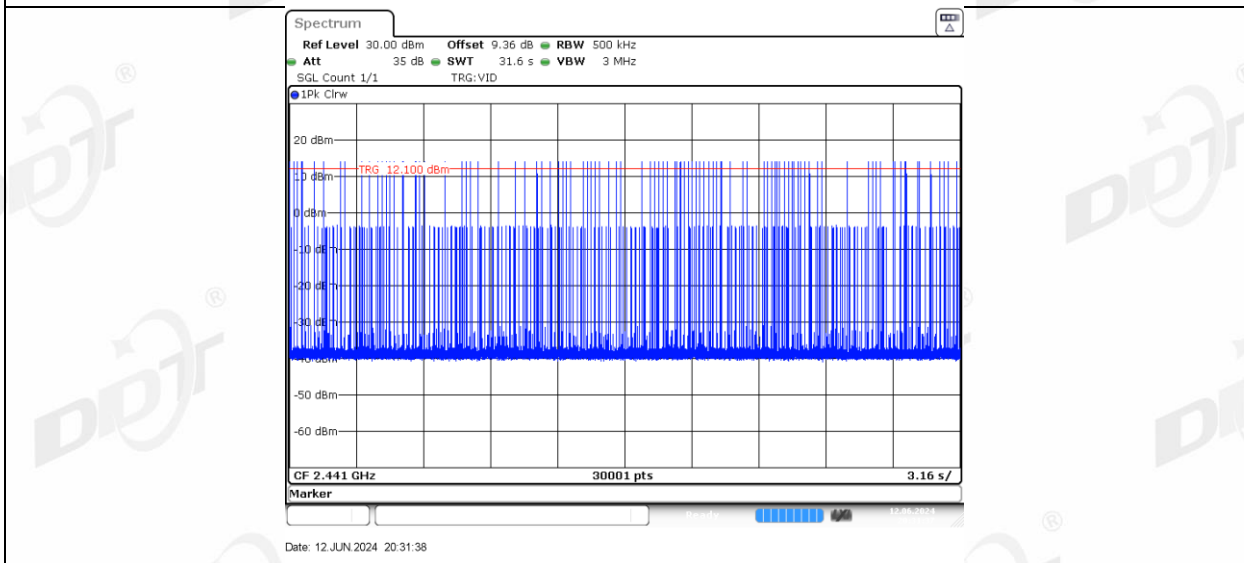
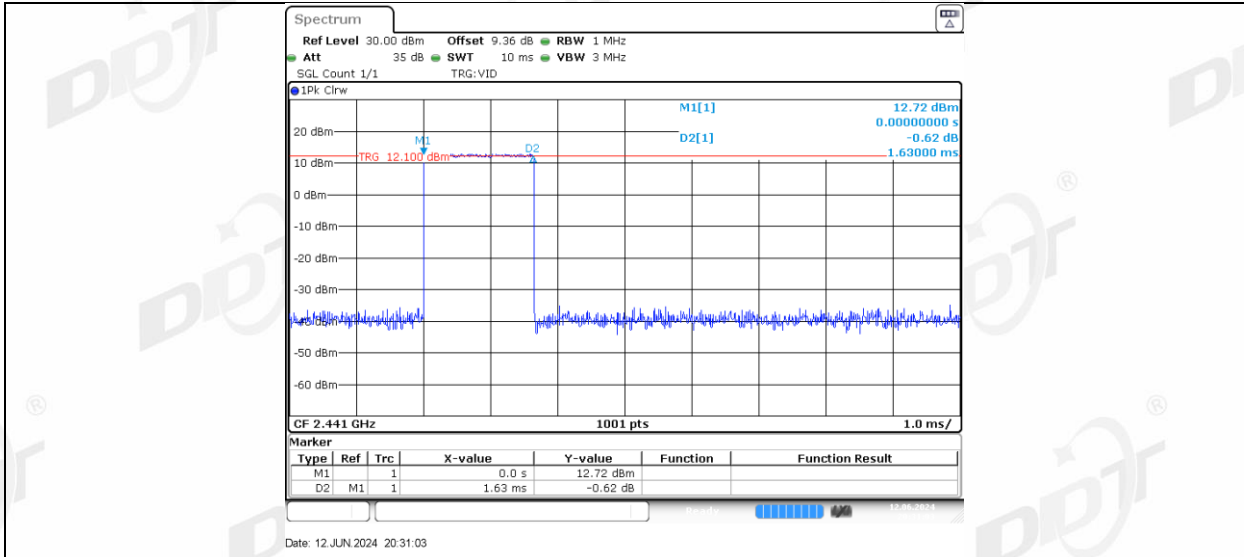


2DH3 Left side Hop

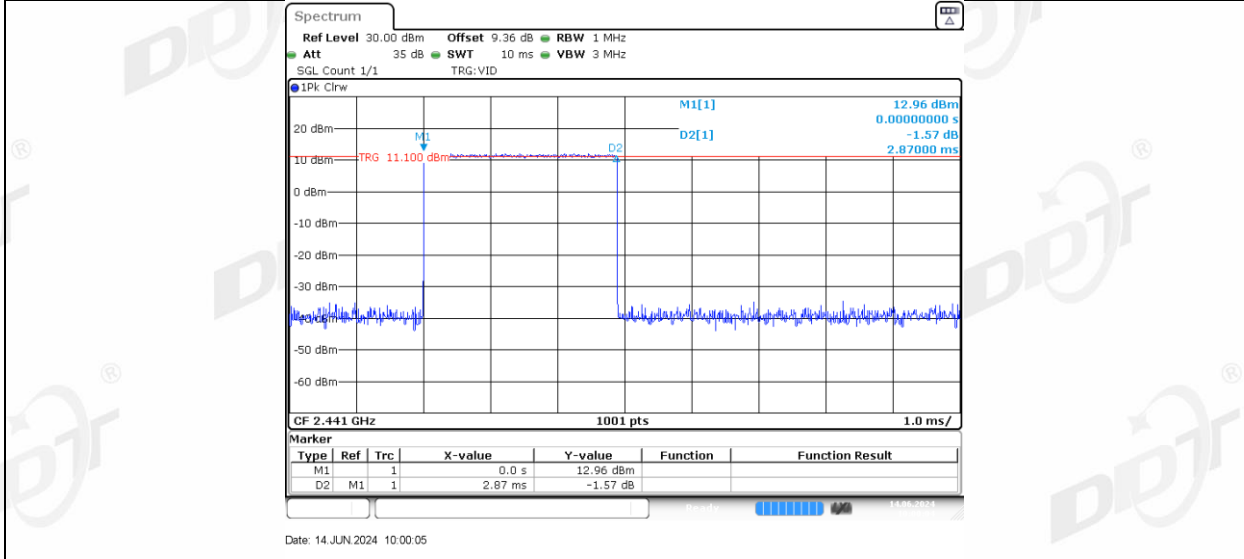


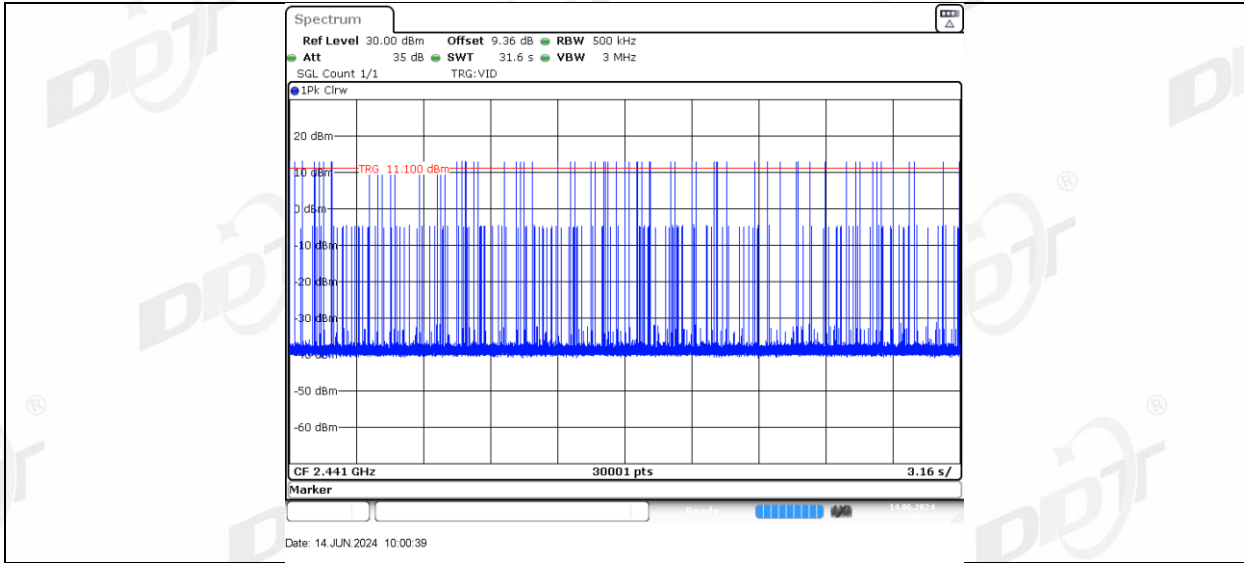
2DH3 Right side Hop



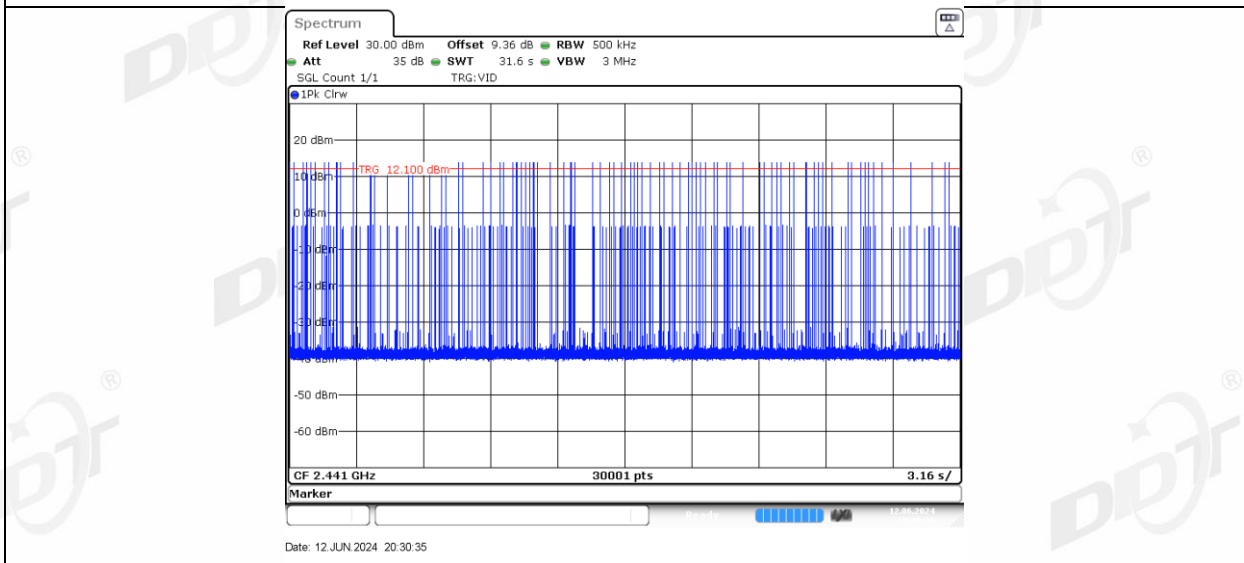
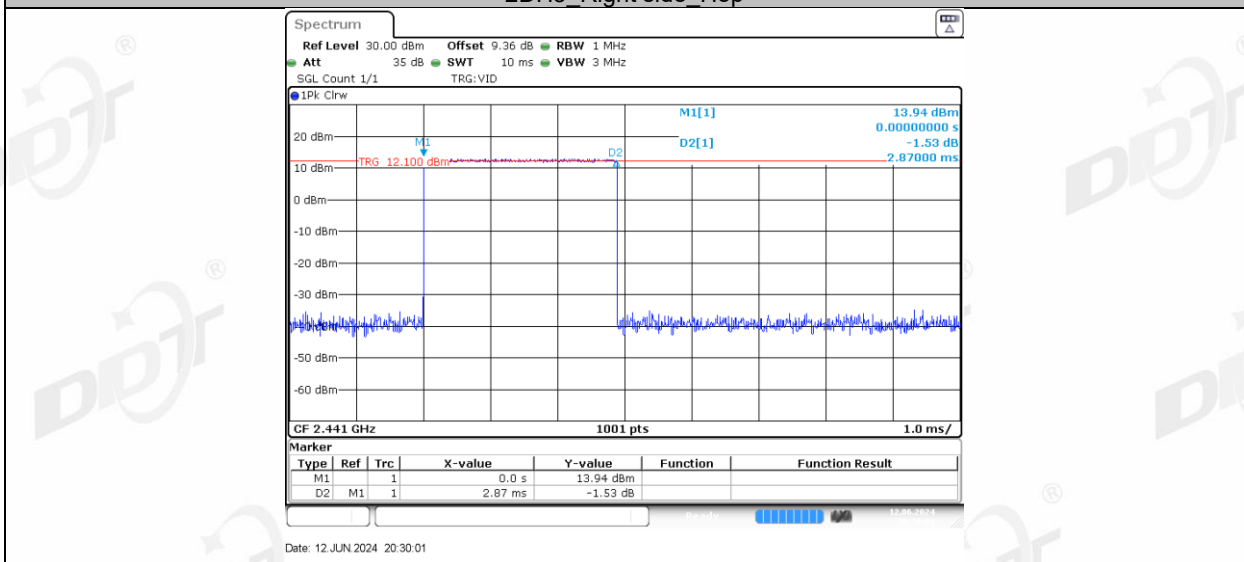


2DH5 Left side Hop





2DH5 Right side Hop



3DH1 Left side Hop