

FCC AND ISED CERTIFICATION TEST REPORT

FOR

Applicant	:	Fender Musical Instruments
Address	:	17600 North Perimeter Drive, Suite 100, Scottsdale, AZ 85255 USA
Equipment under Test	:	Guitar Headphone Amplifier
Model No.	:	MUSTANG MICRO PLUS
TYPE	:	PR 6171
FCC ID	:	XQW-MUMPPR6171
IC	:	8690A-MUMPPR6171
Manufacturer	:	Fender Musical Instruments
Address	:	17600 North Perimeter Drive, Suite 100, Scottsdale, AZ 85255 USA

Issued By: Guangdong Dongdian Testing Service Co., Ltd.

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REPORT

Table of Contents

	Test report declares.....	4
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.	Assistant equipment used for test.....	9
2.4.	Test Sample Information	9
2.5.	Block diagram of EUT configuration for test	9
2.6.	Deviations of test standard.....	10
2.7.	Test environment conditions	10
2.8.	Test laboratory	10
2.9.	Measurement uncertainty.....	10
3.	Equipment Used During Test.....	11
3.1.	Equipment Used During Conductive Test.....	11
3.2.	Radiated Emission Test equipment	11
3.3.	Power Line Conducted Emission Test Equipment	11
4.	Maximum Peak Output Power	12
4.1.	Block diagram of test setup.....	12
4.2.	Limits	12
4.3.	Test procedure	12
4.4.	Test result.....	13
4.5.	Original test data	14
5.	20 dB Bandwidth and 99% Bandwidth.....	20
5.1.	Block diagram of test setup.....	20
5.2.	Limits	20
5.3.	Test procedure	20
5.4.	Test result.....	20
5.5.	Original test data	21
6.	Carrier Frequency Separation.....	27
6.1.	Block diagram of test setup.....	27
6.2.	Limits	27
6.3.	Test procedure	27
6.4.	Test result.....	27
6.5.	Original test data	28
7.	Number of Hopping Channel	29
7.1.	Block diagram of test setup.....	29
7.2.	Limits	29

7.3.	Test procedure	29
7.4.	Test result.....	29
7.5.	Original test data	30
8.	Dwell Time.....	31
8.1.	Block diagram of test setup.....	31
8.2.	Limits	31
8.3.	Test procedure	31
8.4.	Test result.....	31
8.5.	Original test data	32
9.	Band Edge Compliance (Conducted Method)	38
9.1.	Block diagram of test setup.....	38
9.2.	Limit	38
9.3.	Test procedure	38
9.4.	Test result.....	38
9.5.	Original test data	39
10.	Radiated Emission	47
10.1.	Block diagram of test setup.....	47
10.2.	Limit.....	48
10.3.	Test Procedure.....	50
10.4.	Test result.....	51
11.	RF Conducted Spurious Emissions	60
11.1.	Block diagram of test setup.....	60
11.2.	Limits	60
11.3.	Test procedure	60
11.4.	Test result.....	61
11.5.	Original test data	61
12.	Band Edge Compliance (Radiated Method)	80
12.1.	Block diagram of test setup.....	80
12.2.	Limit.....	80
12.3.	Test Procedure.....	80
12.4.	Test result.....	80
13.	Power Line Conducted Emission	93
13.1.	Block diagram of test setup.....	93
13.2.	Power Line Conducted Emission Limits	93
13.3.	Test Procedure.....	93
13.4.	Test Result	94
14.	Antenna Requirements	97
14.1.	Limit.....	97

14.2.	Result	97
15.	Test Setup Photograph	98
16.	Photos of the EUT	100

Test Report Declare

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Manufacturer	:	Fender Musical Instruments
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Test Standard Used:

FCC Rules and Regulations Part 15 Subpart C, RSS-247 Issue 2 February 2017

Test Procedure Used:

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.

After test and evaluation, our opinion is that the equipment provided for test compliance with the requirement of the above FCC&ISED standards.

Report No.:	DDT-RE23090520-2E01		
Date of Receipt:	Sep. 12, 2023	Date of Test:	Sep. 13, 2023 ~ Dec. 11, 2023

Prepared By:**Jacky Huang/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	Dec. 11, 2023	

1. Summary of Test Results

Description of Test Item	Standard	Results
Maximum Peak Output Power	FCC Part 15: 15.247(b)(1) ANSI C63.10:2013 RSS-247 Issue 2	Pass
20 dB Bandwidth and 99% Bandwidth	FCC Part 15: 15.215 ANSI C63.10:2013 RSS-247 Issue 2	Pass
Carrier Frequency Separation	FCC Part 15: 15.247(a)(1) ANSI C63.10:2013 RSS-247 Issue 2	Pass
Number of Hopping Channel	FCC Part 15: 15.247(a)(1)(iii) ANSI C63.10:2013 RSS-247 Issue 2	Pass
Dwell Time	FCC Part 15: 15.247(a)(1)(iii) ANSI C63.10:2013 RSS-247 Issue 2	Pass
Radiated Emission	FCC Part 15: 15.209 FCC Part 15: 15.247(d) ANSI C63.10:2013 RSS-247 Issue 2 RSS-Gen Issue 5	Pass
Band Edge Compliance	FCC Part 15: 15.247(d) ANSI C63.10:2013 RSS-247 Issue 2 RSS-Gen Issue 5	Pass
Power Line Conducted Emissions	FCC Part 15: 15.207 ANSI C63.10:2013 RSS-Gen Issue 5	Pass
Antenna Requirement	FCC Part 15: 15.203 RSS-Gen Issue 5	Pass
Note: EUT has two alternative chip Crystal oscillator (Y2, 32MHz): model CXA-032000-ADCD41 (AKER TECHNOLOGY CO., LTD.) and model Y32000w037 (JinHua East Crystal Electronic Co., Ltd.). The main difference between the two crystal oscillators is that they are manufactured by different manufacturers. In this report, Maximum Peak Output Power, Band Edge Compliance, RF Conducted Spurious Emission, Power Line Conducted Emissions and Radiated Emission are tested on two crystal oscillator products, and the remaining items are tested on crystal oscillator model CXA-032000-ADCD41.		

2. General Test Information

2.1. Description of EUT

EUT Name	: Guitar Headphone Amplifier
Model Number	: MUSTANG MICRO PLUS
EUT Function Description	: Please reference user manual of this device
Power Supply	: Powered by DC 5V external adapter or 3.85V built-in lithium battery
Radio Specification	: Bluetooth V5.1
Operation Frequency	: 2402 MHz - 2480 MHz
Modulation	: GFSK, $\pi/4$ -DQPSK, 8DPSK
Data Rate	: 1 Mbps, 2 Mbps, 3 Mbps
Antenna	: Ceramic antenna, maximum PK gain: 2.09 dBi
Sample Number	: S23090520-06 and S23090520-15 for radiated, S23090520-05 and S23090520-16 for conducted

Note: EUT is the abbreviation of equipment under test.

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		/

2.2. Accessories of EUT

Description of Accessories	Manufacturer	Model number	Other
Charging cable	GP Electronics	N/A	N/A

2.3. Assistant equipment used for test

Assistant equipment	Manufacturer	Model number	EMC Compliance	SN
Laptop	Lenovo	X201	N/A	00154-290-415-484
Adapter	SAMSUNG	EP-TA200	N/A	N/A

2.4. Test Sample Information

Test Sample Number	Test method	Crystal Oscillator model	Crystal Oscillator Manufacturer	Description
S23090520-05	conducted	CXA-032000-ADCD41	AKER TECHNOLOGY CO., LTD.	Crystal Oscillator is alternative
S23090520-06	radiated			
S23090520-15	radiated	Y32000w037	JinHua East Crystal Electronic Co., Ltd.	
S23090520-16	conducted			

2.5. Block diagram of EUT configuration for test

PC or adapter

EUT

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

Test software: BlueTest3.exe, Version3.3.2

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

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

2.6. Deviations of test standard

No deviation.

2.7. Test environment conditions

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

Temperature range:	+15°C to +35 °C
Humidity range:	20-75%
Pressure range:	86-106 kPa

2.8. 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

2.9. 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 ($8 \text{ GHz} \leq f < 22 \text{ GHz}$)
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	3.32 dB (150 kHz - 30 MHz)

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 Test

3.1. Equipment Used During Conductive Test

Equipment	Manufacturer	Model No.	Serial Number	Due Date
☑RF Connected Test (RF Measurement System 4#)				
Signal & Spectrum Analyzer	R&S	FSV3044	101173	2024/04/22
Wideband Radio Communication Tester	R&S	CMW500	168801	2024/04/26
MXG Vector Signal Generator	Agilent	N5182A	MY48180737	2024/04/26
PSG Vector Signal Generator	Agilent	E8267D	US49060192	2024/09/05
RF Control Unit	Tonsend	JS0806-2	2118060485	2024/04/26
TEMP&HUMI Programmable Chamber	ZHIXIANG	ZXGDS-150L	ZX170110-A	2024/05/14
Test Software	Tonscend	JS1120-3	Ver.3.2.22	N/A

3.2. Radiated Emission Test equipment

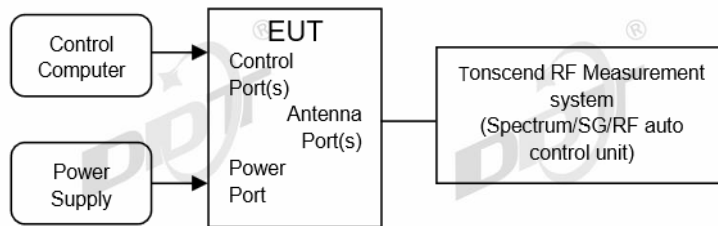
Equipment	Manufacturer	Model No.	Serial Number	Due Date
☑Radiation 3#chamber				
EMI TEST RECEIVER	R&S	ESU26	100472	2024/04/22
PSA Series Spectrum Analyzer	Agilent	E4447A	MY50180031	2024/04/22
Active Loop Antenna	Schwarzbeck	FMZB-1519	1519-038	2024/09/10
Trilog Broadband Antenna	Schwarzbeck	VULB 9163	01429	2024/07/11
Double Ridged Horn Antenna	Schwarzbeck	BBHA 9120 D	02468	2024/09/17
Broad Band Horn Antenna	Schwarzbeck	BBHA 9170	790	2024/04/25
Pre-amplifier	COM-POWER	PAM-118A	18040084	2024/07/14
Pre-amplifier	COM-POWER	PAM-840A	461369	2024/04/26
RE Cable	N/A	W23.02 CP1-X2 + W23.09 AP1-X8+ JCT26S-NJ-NJ-1.5M	4.5M+8M+1.5M	2024/04/20
RF Cable	Yuhu	JCTB810-NJ-NJ-9M+ ZT26S-SMAJ-SMAJ-1M	21123964	2024/04/22
Band Reject Filter (2400-2500 MHz)	REBES	BRM50702	G555	N/A
Test Software	Tonscend	JS32-RE	V 5.0.0.1	N/A

3.3. Power Line Conducted Emission Test Equipment

Equipment	Manufacturer	Model No.	Serial Number	Due Date
☑Power Line Conducted Emissions Test 1#				
Test Receiver	R&S	ESCI	100551	2024/07/10
LISN 1	R&S	ENV216	101109	2024/07/10
LISN 2	R&S	ESH2-Z5	100309	2024/07/11
Pulse Limiter	R&S	ESH3-Z2	101242	2024/07/14
CE Cable 1	HUBSER	N/A	W10.01	2024/07/14
Test software	Audix	E3	V 6.11111b	N/A

4. Maximum Peak Output Power

4.1. Block diagram of test setup



4.2. 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.

4.3. Test procedure

- (1) Connect EUT's antenna output to spectrum analyzer by RF cable.
- (2) Measure the maximum conducted output power of EUT by spectrum analyzer with PK detector and RBW=3 MHz (above 20 dB bandwidth of measured signal), VBW=10 MHz

Note:

- 1.The attenuator loss was inputted into spectrum analyzer as amplitude offset.
- 2.The pathloss of external cable: 0.5dB (According to the manufacturer's claims).

4.4. Test result

Sample S23090520-05:

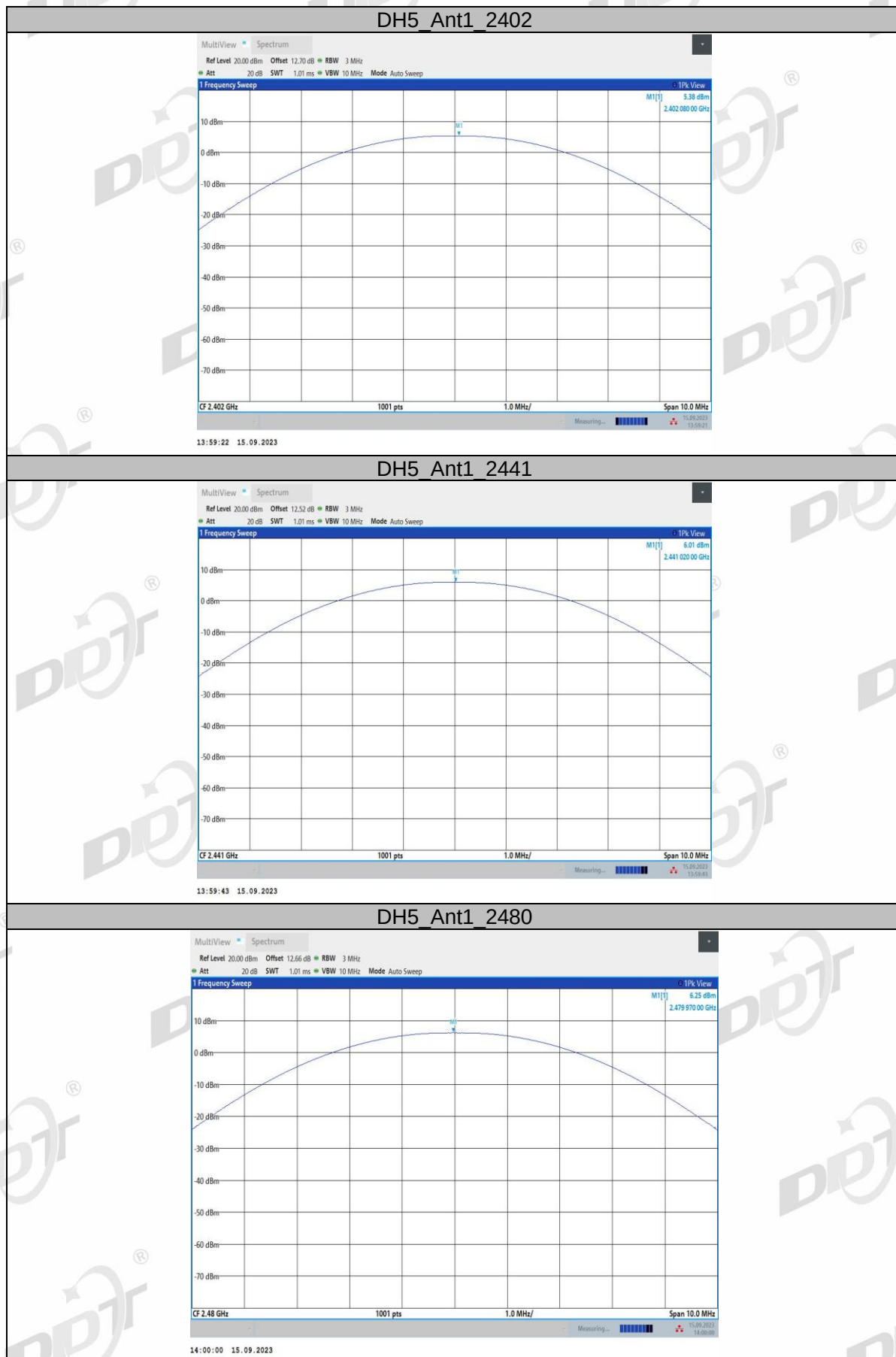
Test Mode	Antenna	Frequency [MHz]	Conducted Peak Power [dBm]	Conducted Limit [dBm]	EIRP [dBm]	EIRP Limit [dBm]	Verdict
DH5	Ant1	2402	5.38	≤ 20.97	7.47	≤ 36	PASS
		2441	6.01	≤ 20.97	8.10	≤ 36	PASS
		2480	6.25	≤ 20.97	8.34	≤ 36	PASS
2DH5	Ant1	2402	7.89	≤ 20.97	9.98	≤ 36	PASS
		2441	8.51	≤ 20.97	10.60	≤ 36	PASS
		2480	8.52	≤ 20.97	10.61	≤ 36	PASS
3DH5	Ant1	2402	8.86	≤ 20.97	10.95	≤ 36	PASS
		2441	9.23	≤ 20.97	11.32	≤ 36	PASS
		2480	9.18	≤ 20.97	11.27	≤ 36	PASS

Sample S23090520-16:

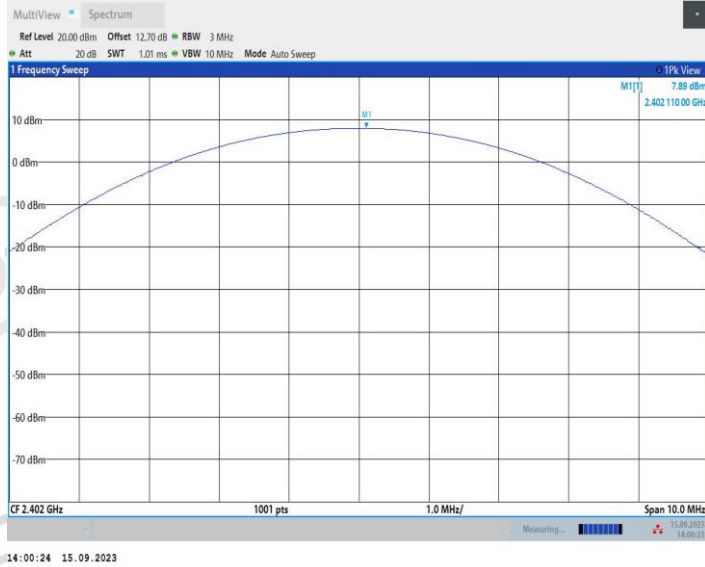
Test Mode	Antenna	Frequency [MHz]	Conducted Peak Power [dBm]	Conducted Limit [dBm]	EIRP [dBm]	EIRP Limit [dBm]	Verdict
DH5	Ant1	2402	5.67	≤ 20.97	7.76	≤ 36	PASS
		2441	5.22	≤ 20.97	7.31	≤ 36	PASS
		2480	6.11	≤ 20.97	8.20	≤ 36	PASS
2DH5	Ant1	2402	8.25	≤ 20.97	10.34	≤ 36	PASS
		2441	7.55	≤ 20.97	9.64	≤ 36	PASS
		2480	8.40	≤ 20.97	10.49	≤ 36	PASS
3DH5	Ant1	2402	8.99	≤ 20.97	11.08	≤ 36	PASS
		2441	8.15	≤ 20.97	10.24	≤ 36	PASS
		2480	9.06	≤ 20.97	11.15	≤ 36	PASS

4.5. Original test data

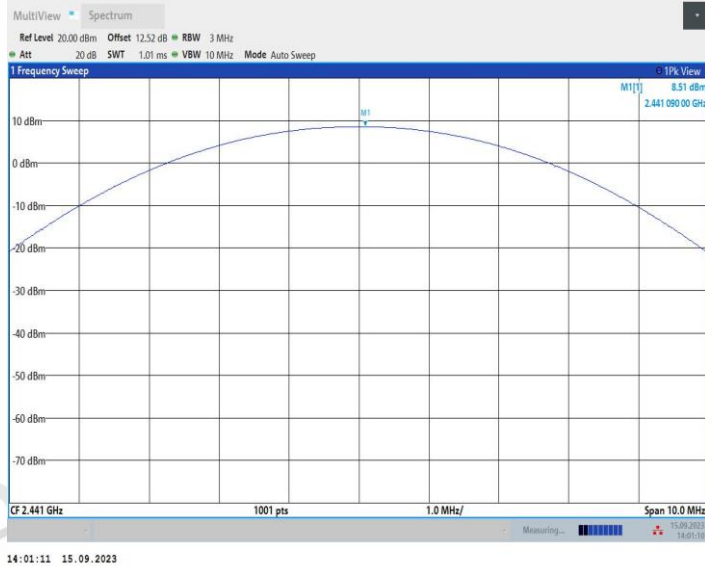
Sample S23090520-05:



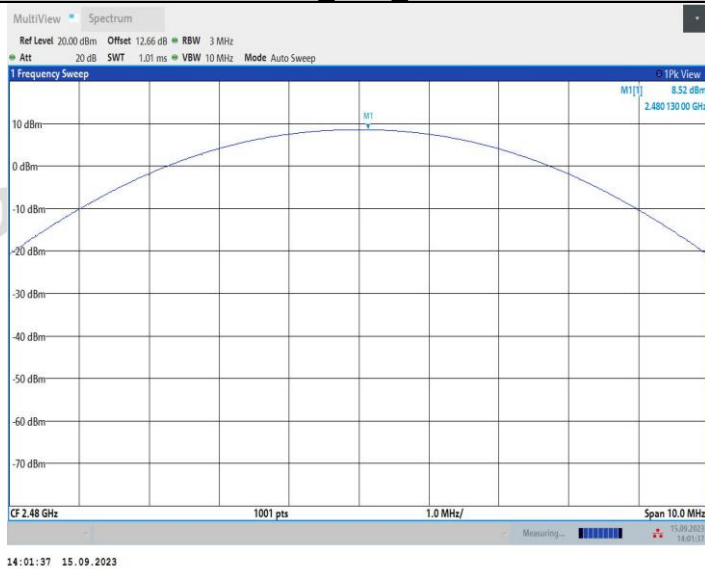
2DH5_Ant1_2402



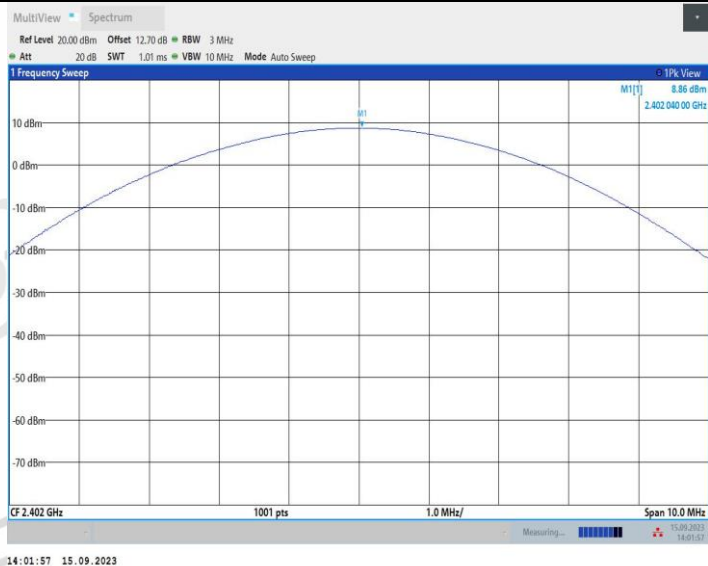
2DH5_Ant1_2441



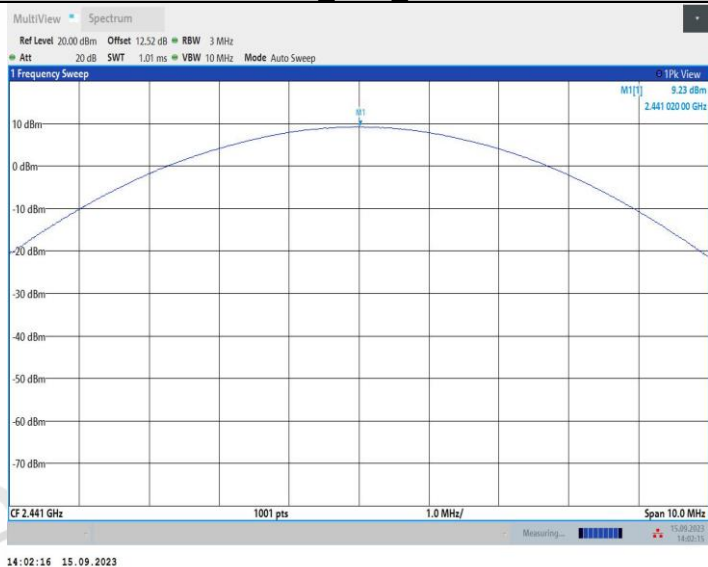
2DH5_Ant1_2480



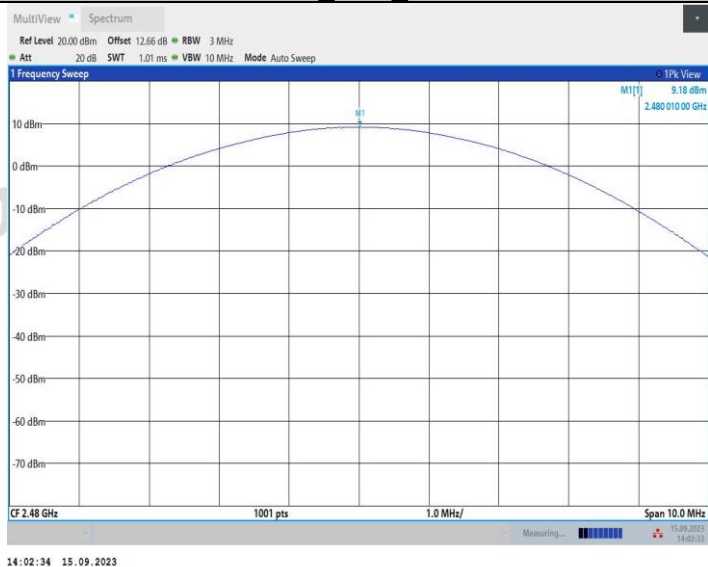
3DH5_Ant1_2402



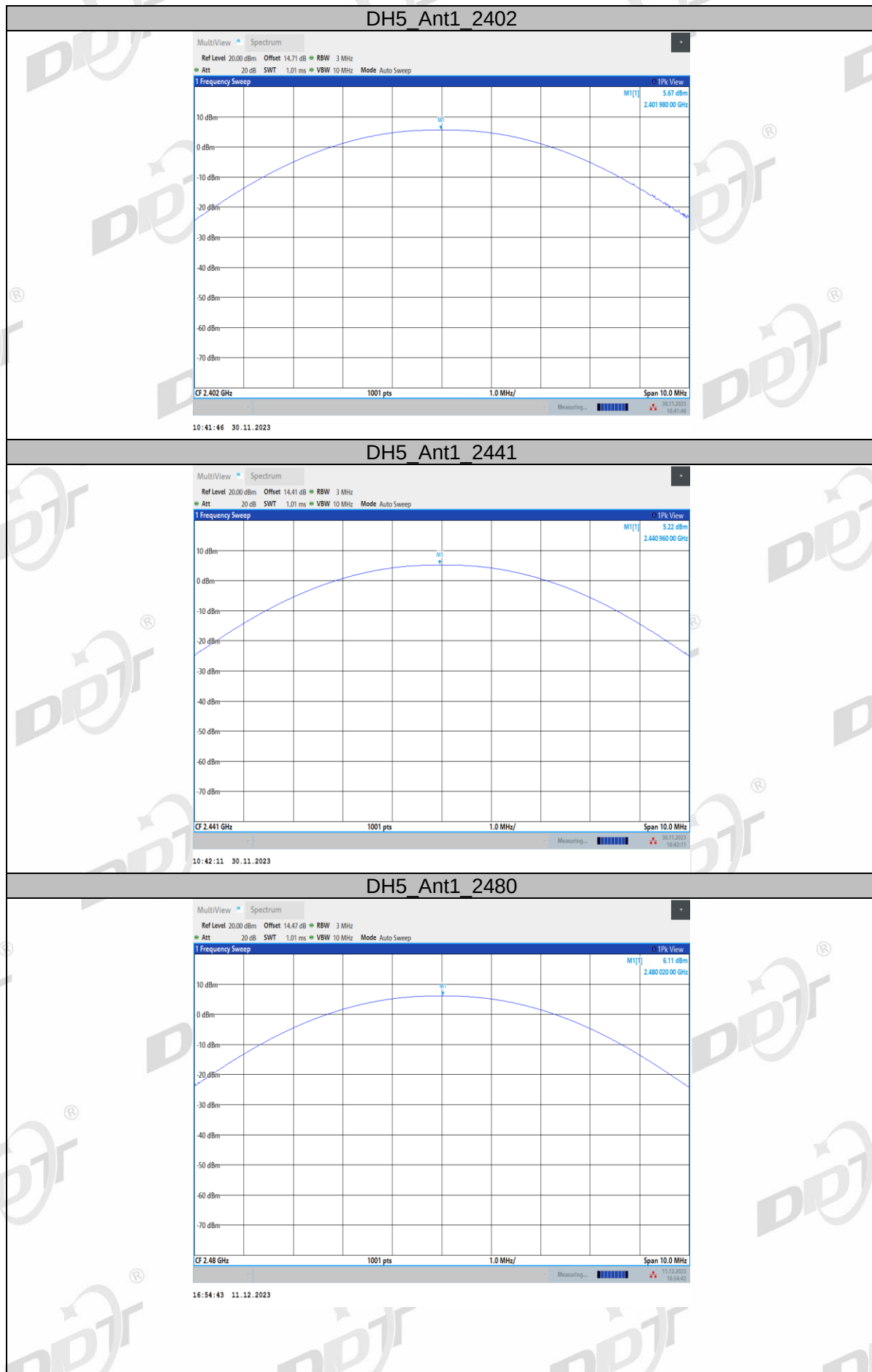
3DH5_Ant1_2441



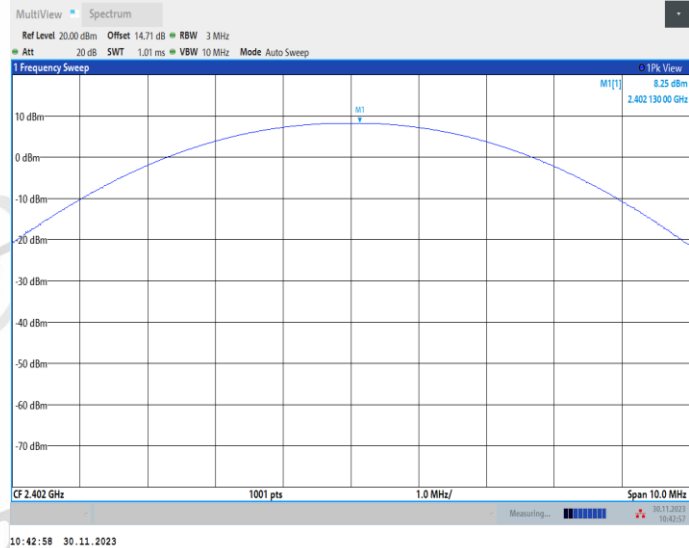
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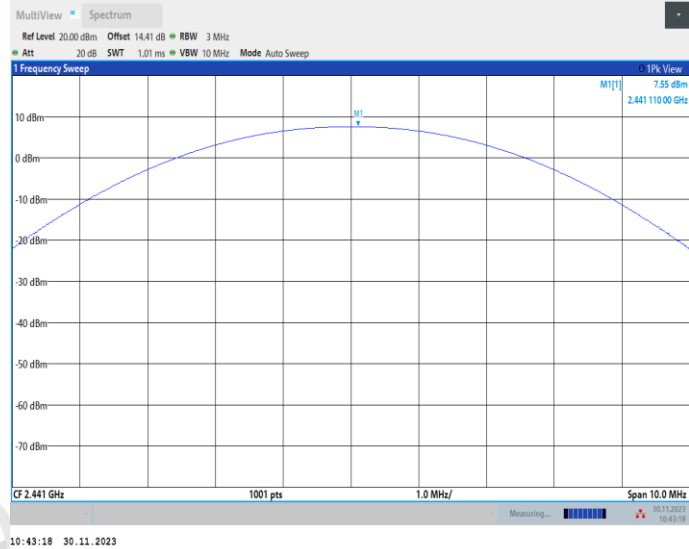
Sample S23090520-16:



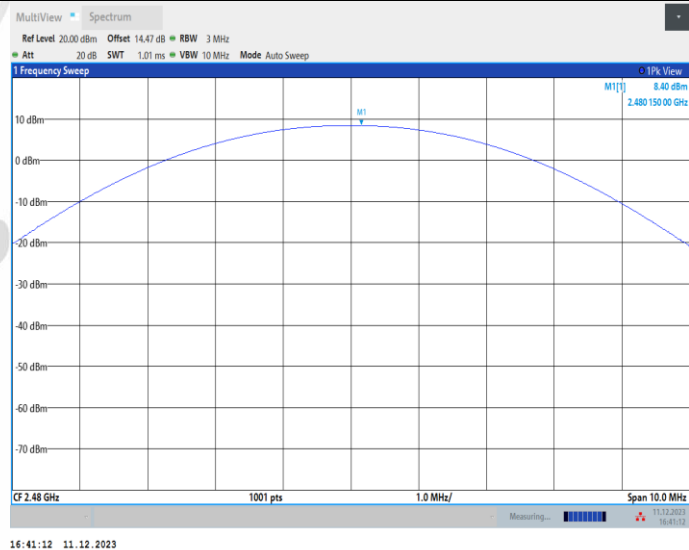
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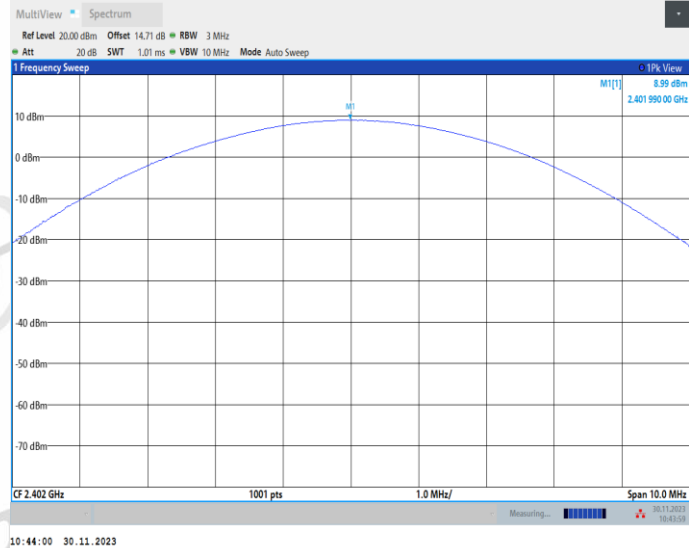
2DH5_Ant1_2441



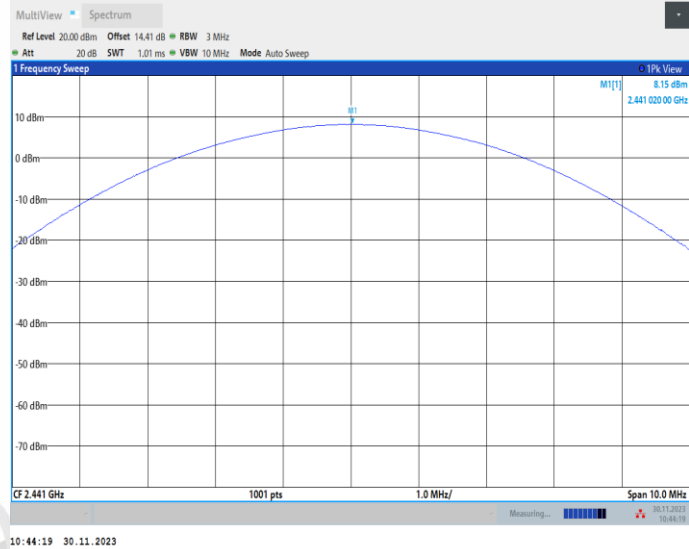
2DH5_Ant1_2480



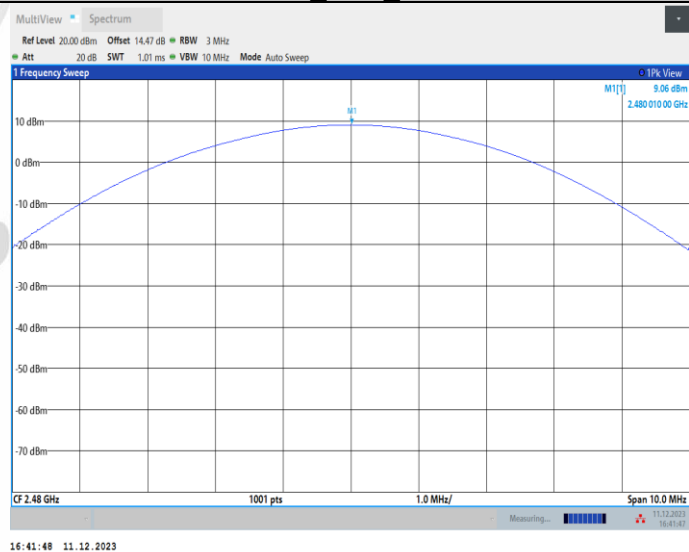
3DH5_Ant1_2402



3DH5_Ant1_2441



3DH5_Ant1_2480



5. 20 dB Bandwidth and 99% Bandwidth

5.1. Block diagram of test setup

Same as section 4.1

5.2. 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.

5.3. Test procedure

- (1) Connect EUT's antenna output to spectrum analyzer by RF cable.
- (2) The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30 kHz RBW and 100 kHz VBW. The 20 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20 dB.

Note:

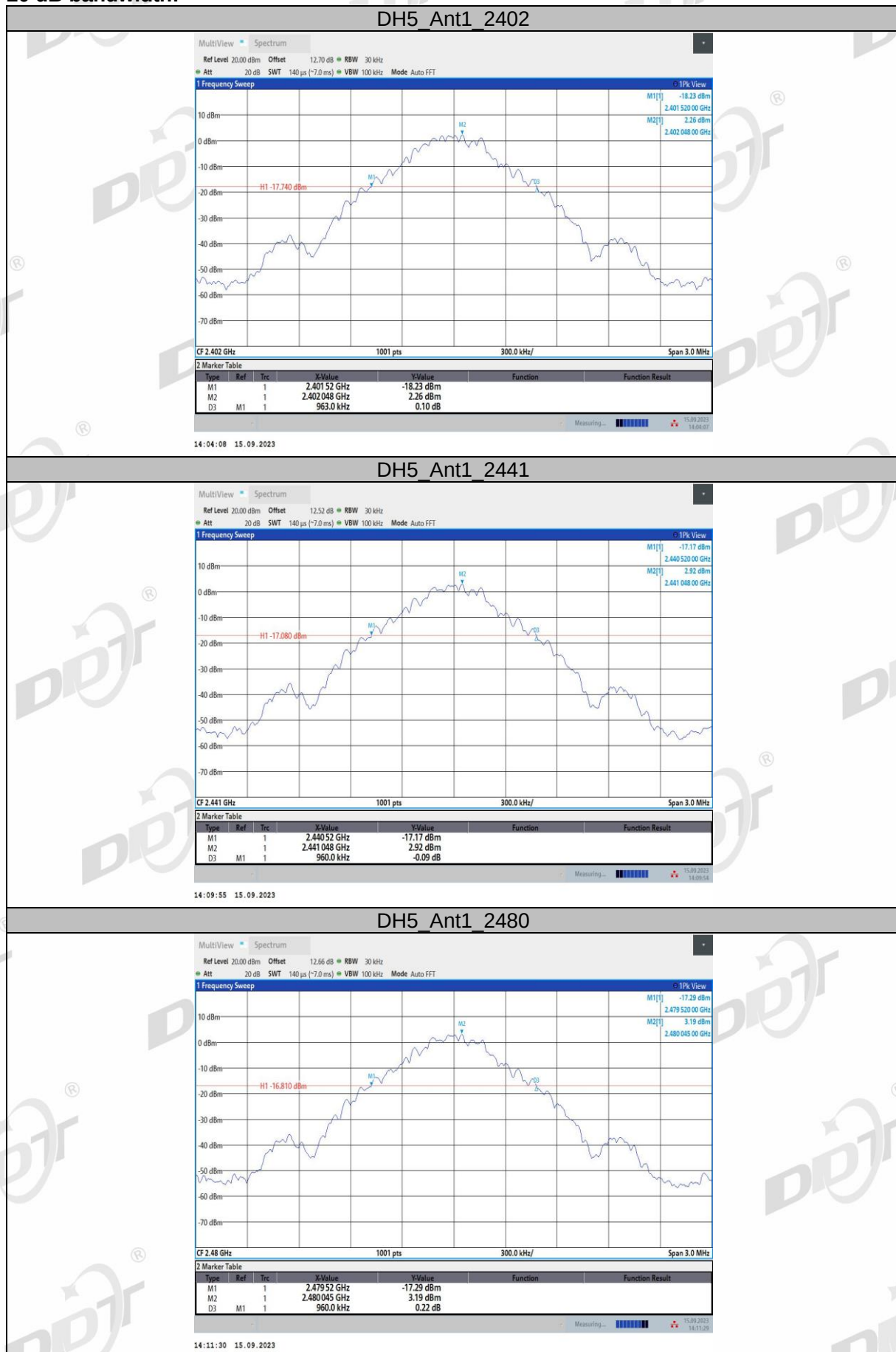
- 1.The attenuator loss was inputted into spectrum analyzer as amplitude offset.
- 2.The pathloss of external cable: 0.5dB (According to the manufacturer's claims).

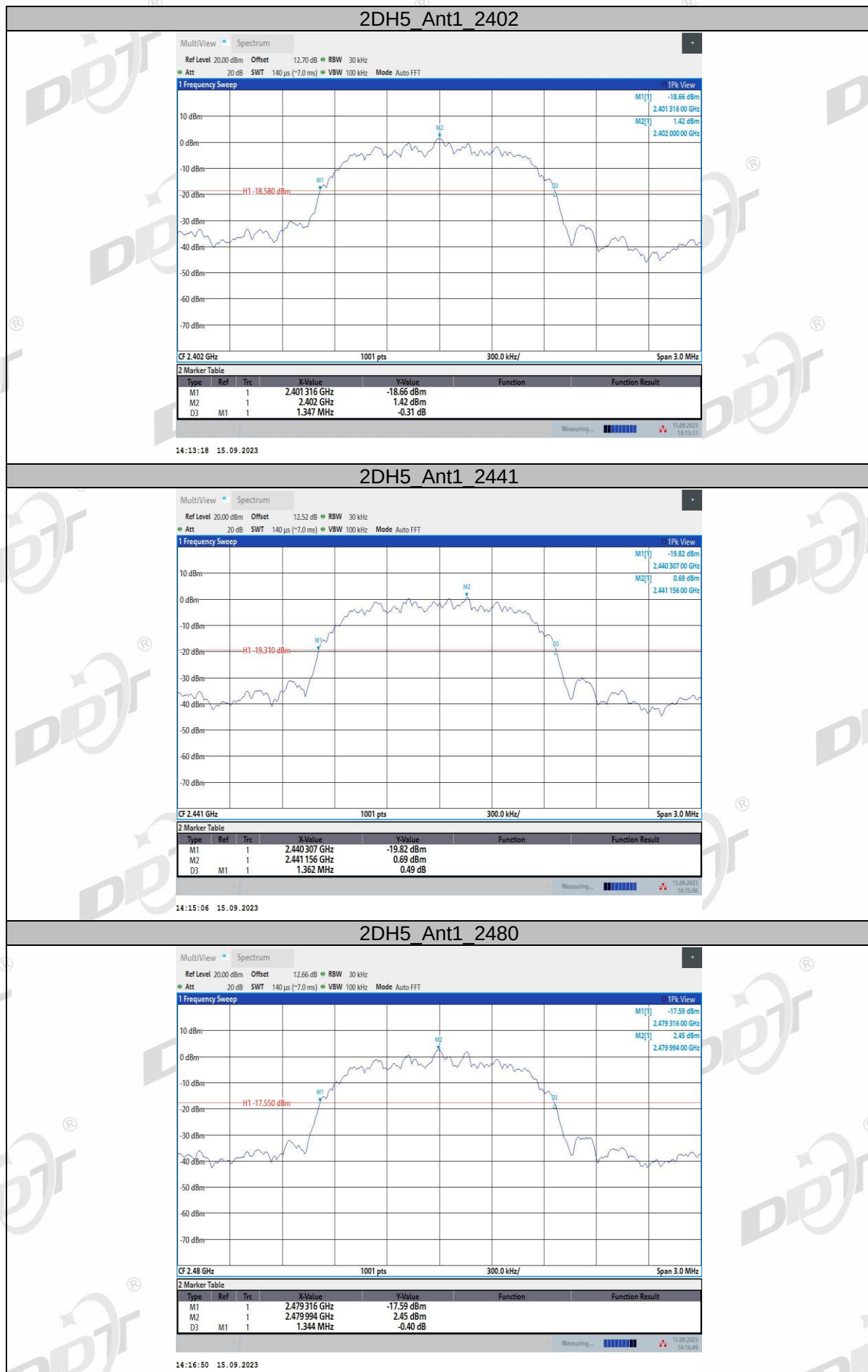
5.4. Test result

Test Mode	Frequency (MHz)	20 dB bandwidth Result (MHz)	99% bandwidth Result (MHz)	Verdict
DH5	2402	0.963	0.883	Pass
	2441	0.960	0.872	Pass
	2480	0.960	0.887	Pass
2DH5	2402	1.347	1.207	Pass
	2441	1.362	1.206	Pass
	2480	1.344	1.210	Pass
3DH5	2402	1.341	1.194	Pass
	2441	1.335	1.204	Pass
	2480	1.347	1.211	Pass

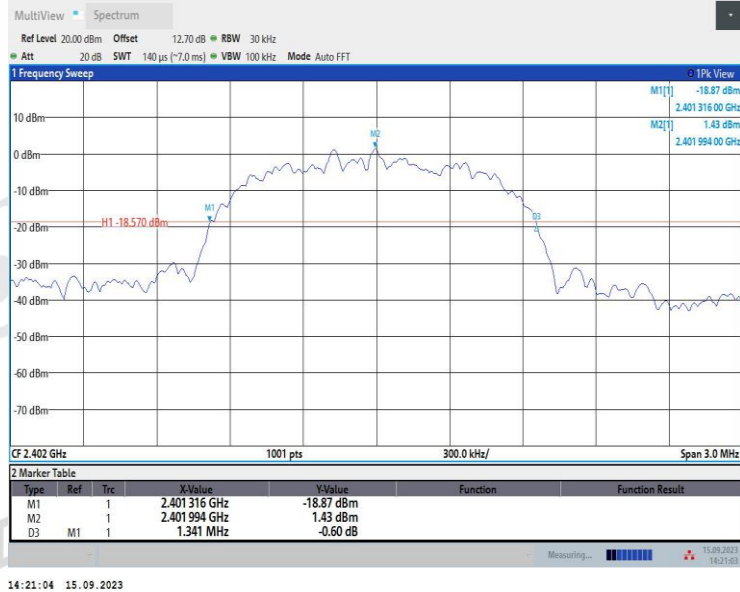
5.5. Original test data

20 dB bandwidth:





3DH5_Ant1_2402



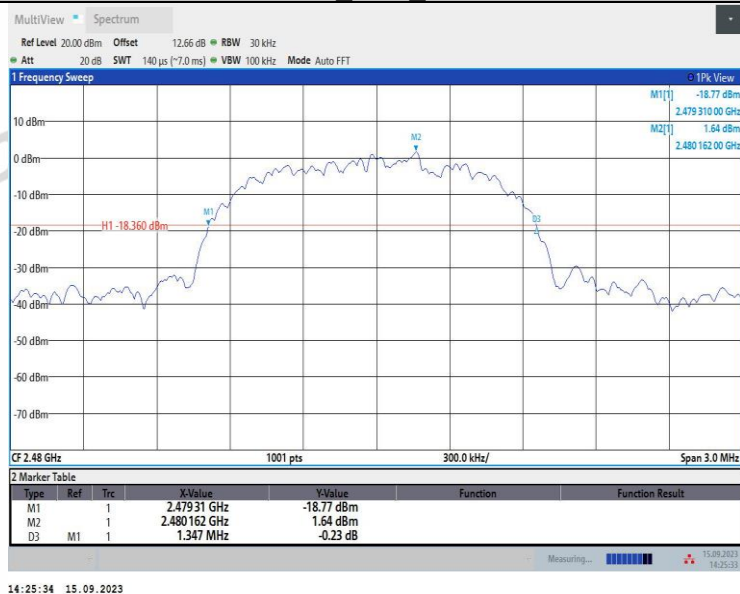
14:21:04 15.09.2023

3DH5_Ant1_2441



14:23:57 15.09.2023

3DH5_Ant1_2480

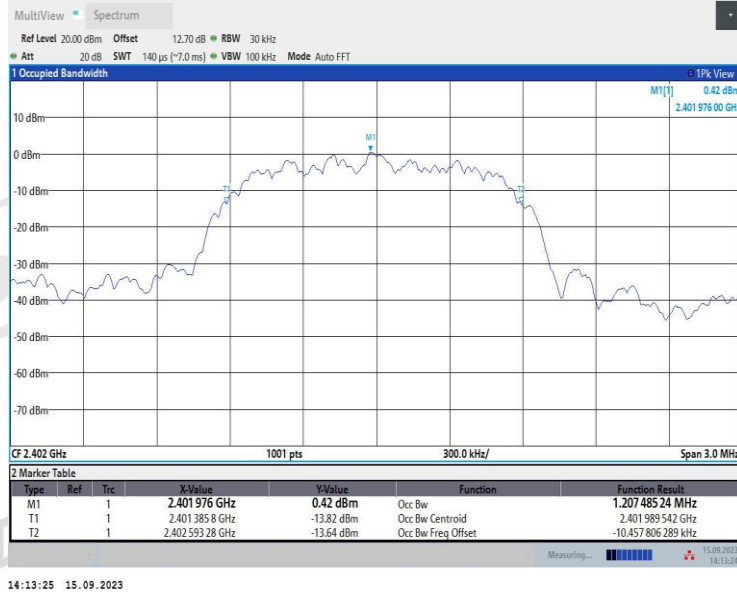


14:25:34 15.09.2023

99% bandwidth:

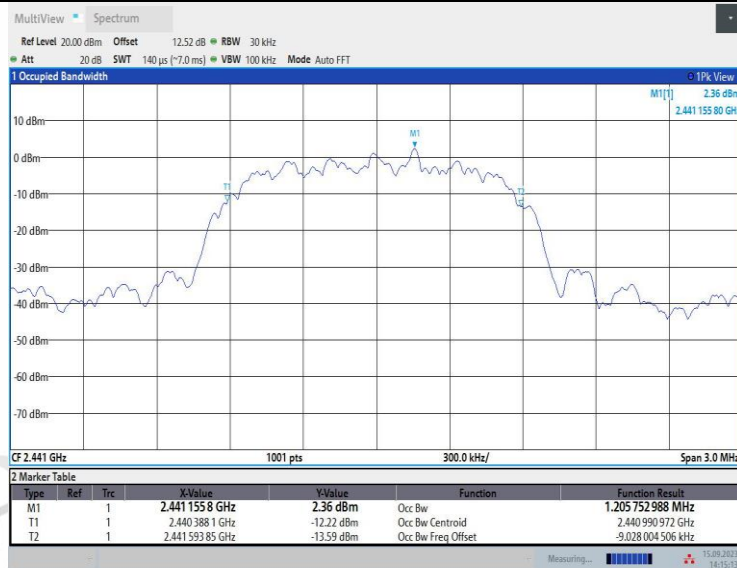


2DH5_Ant1_2402



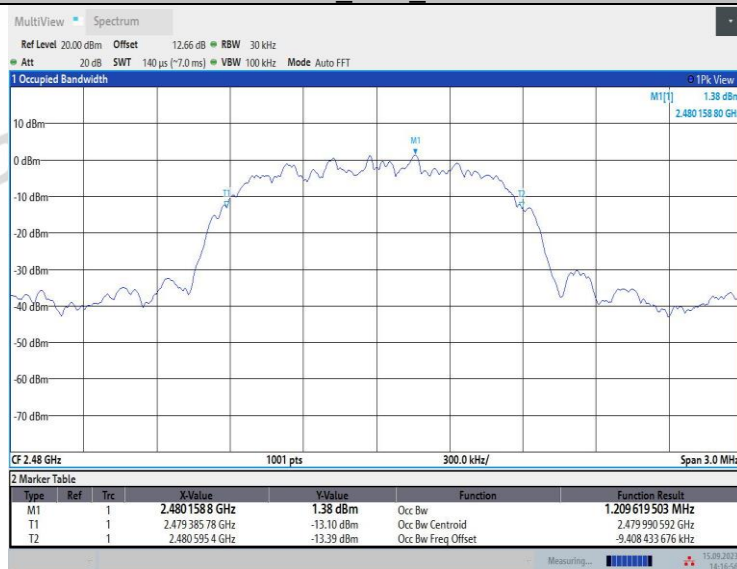
14:13:25 15.09.2023

2DH5_Ant1_2441

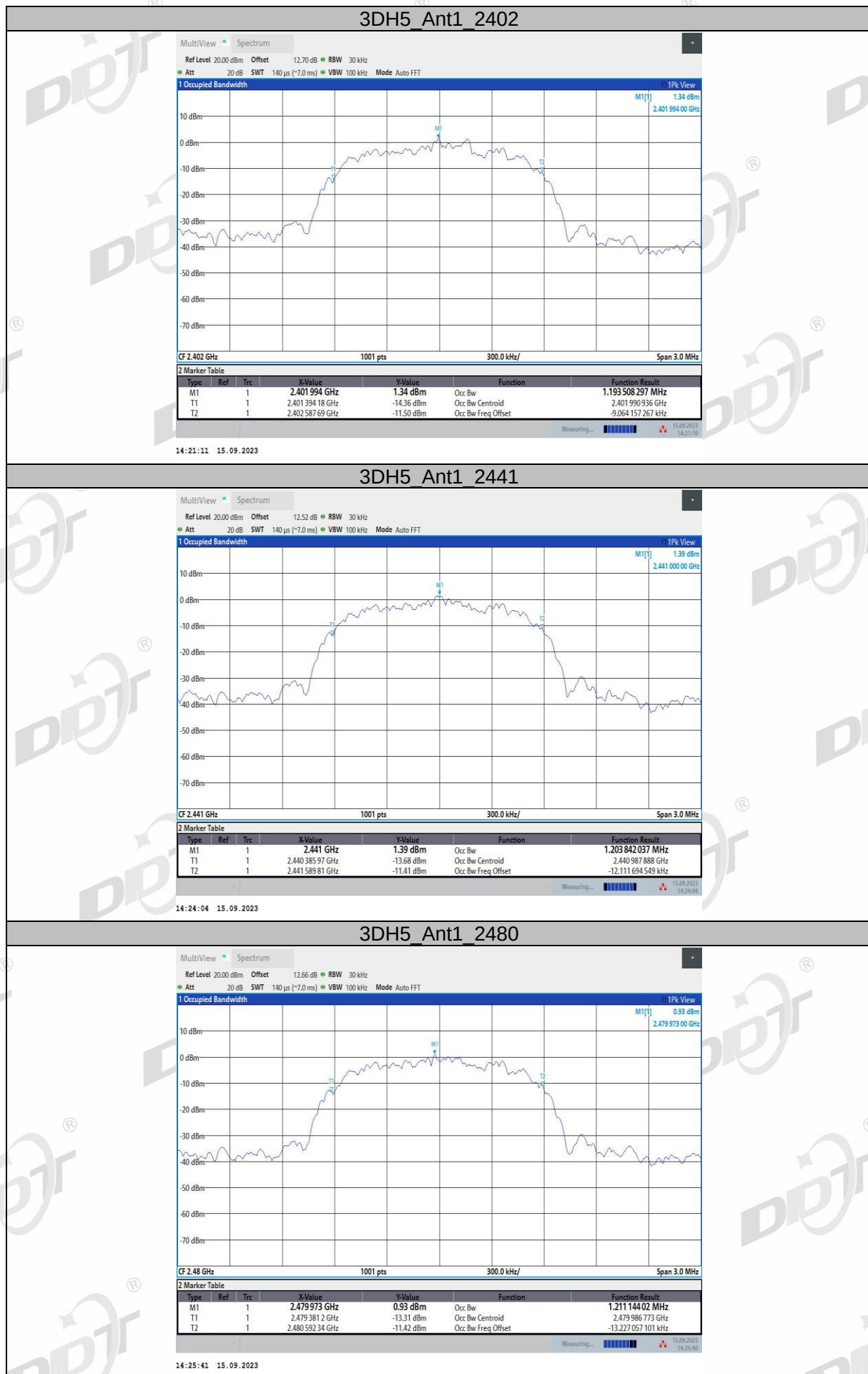


14:15:13 15.09.2023

2DH5_Ant1_2480



14:16:57 15.09.2023



6. Carrier Frequency Separation

6.1. Block diagram of test setup

Same as section 4.1

6.2. 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.

6.3. Test procedure

- (1) Connect EUT's antenna output to spectrum analyzer by RF cable.
- (2) The carrier frequency was measured by spectrum analyzer with 300 kHz RBW and 300 kHz VBW.

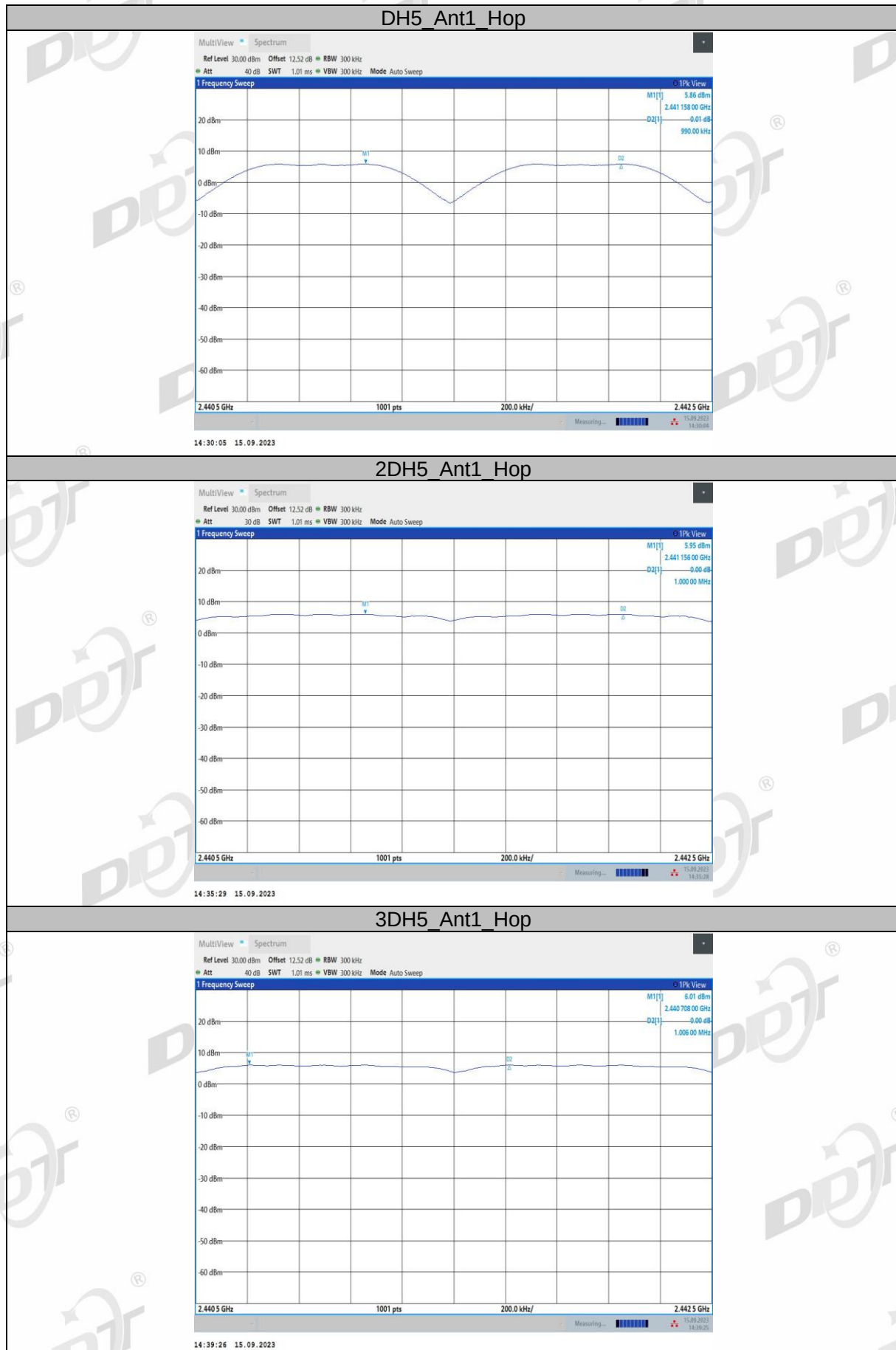
Note:

- 1.The attenuator loss was inputted into spectrum analyzer as amplitude offset.
- 2.The pathloss of external cable: 0.5dB (According to the manufacturer's claims).

6.4. Test result

Test Mode	Channel separation (MHz)	20dB bandwidth (MHz) (worst case)	Limit (MHz) 2/3 of 20dB bandwidth	Verdict
DH5	0.990	0.963	≥ 0.642	Pass
2DH5	1.000	1.362	≥ 0.908	Pass
3DH5	1.006	1.347	≥ 0.898	Pass

6.5. Original test data



7. Number of Hopping Channel

7.1. Block diagram of test setup

Same as section 4.1

7.2. Limits

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

7.3. Test procedure

- (1) Connect EUT's antenna output to spectrum analyzer by RF cable.
- (2) The number of hopping channels was measured by spectrum analyzer with 100 kHz RBW and 300 kHz VBW.

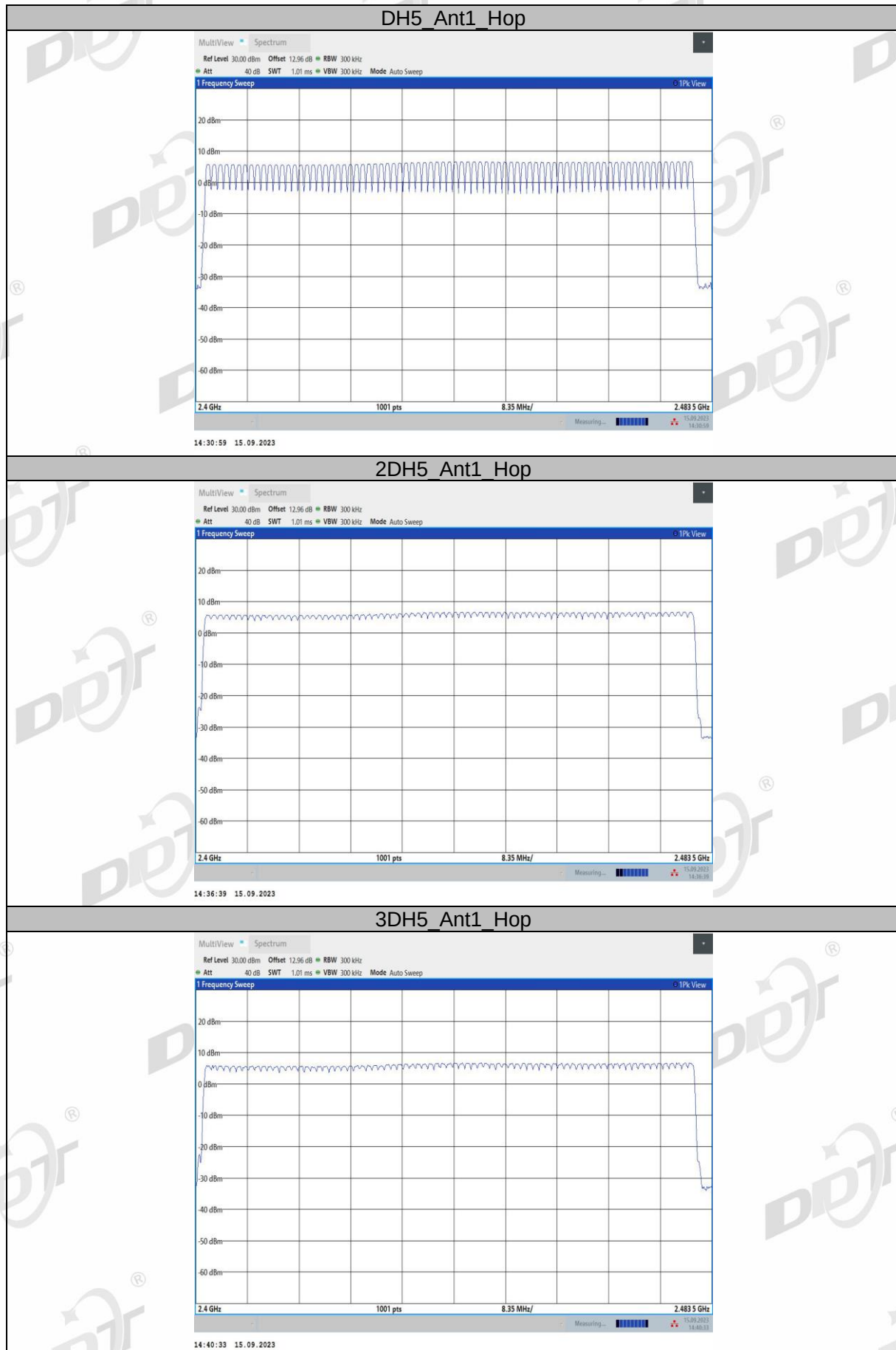
Note:

- 1.The attenuator loss was inputted into spectrum analyzer as amplitude offset.
- 2.The pathloss of external cable: 0.5dB (According to the manufacturer's claims).

7.4. Test result

Mode	Number of hopping channels	Limit	Verdict
DH5	79	>15	Pass
2DH5	79	>15	Pass
3DH5	79	>15	Pass

7.5. Original test data



8. Dwell Time

8.1. Block diagram of test setup

Same as section 4.1

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) Connect EUT's antenna output to spectrum analyzer by RF cable.
- (2) The test period: $T = 0.4 \text{ Second/Channel} \times 79 \text{ Channel} = 31.6 \text{ s}$.
- (3) Measure the hopping number and on time of each pulse with spectrum analyzer in zero span set, and calculate dwell time with formula $\text{Dwell time} = \text{total hops} \times \text{pulse's on time}$.

Note:

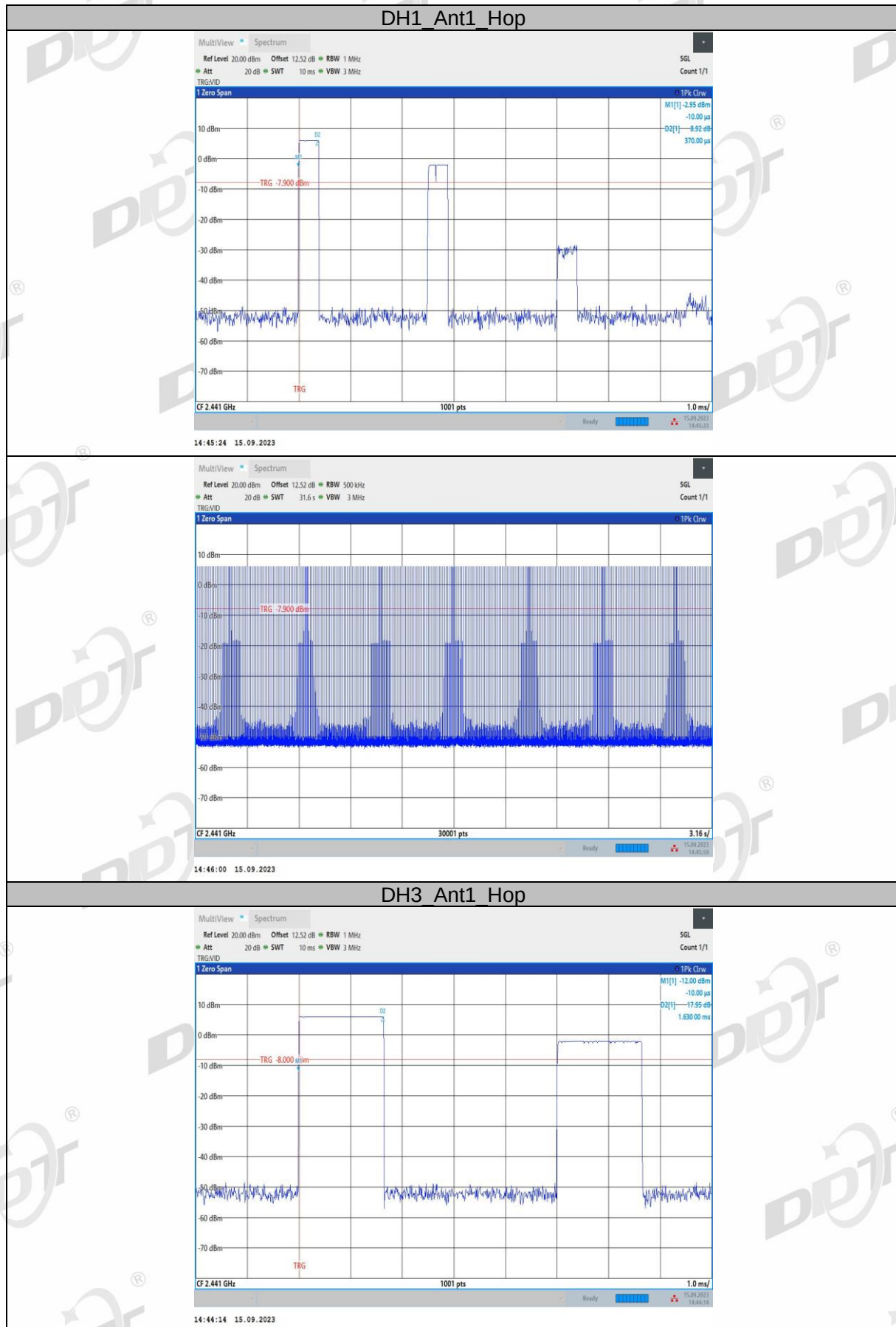
1. The attenuator loss was inputted into spectrum analyzer as amplitude offset.
2. The pathloss of external cable: 0.5dB (According to the manufacturer's claims).

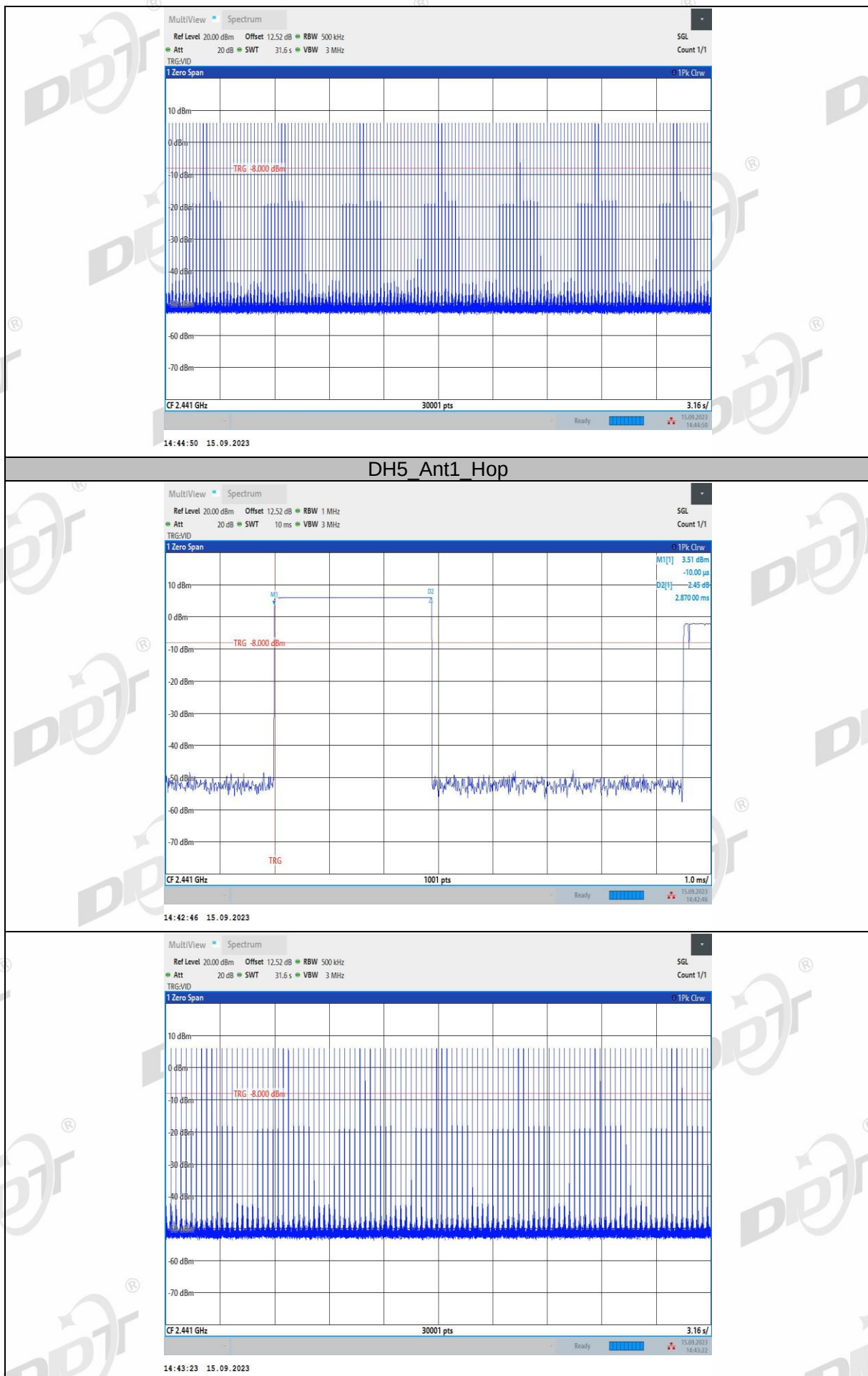
8.4. Test result

Mode	Dwell time (s)	Pulse's on time (ms)	Total hops	Limit	Verdict
DH1	0.118	0.370	320	<400ms	Pass
DH3	0.261	1.630	160	<400ms	Pass
DH5	0.307	2.870	107	<400ms	Pass
2DH1	0.122	0.380	320	<400ms	Pass
2DH3	0.261	1.630	160	<400ms	Pass
2DH5	0.308	2.880	107	<400ms	Pass
3DH1	0.122	0.380	320	<400ms	Pass
3DH3	0.261	1.630	160	<400ms	Pass
3DH5	0.309	2.890	107	<400ms	Pass

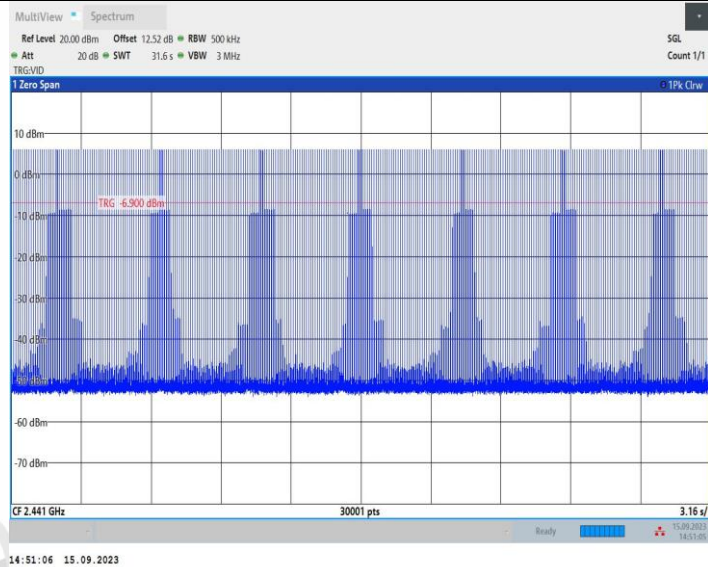
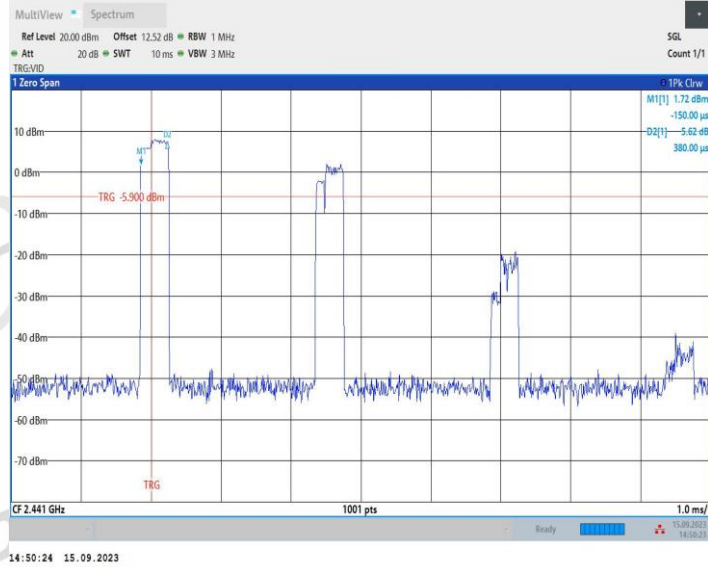
Note: $\text{Dwell time} = \text{total hops} \times \text{pulse's on time}$.

8.5. Original test data

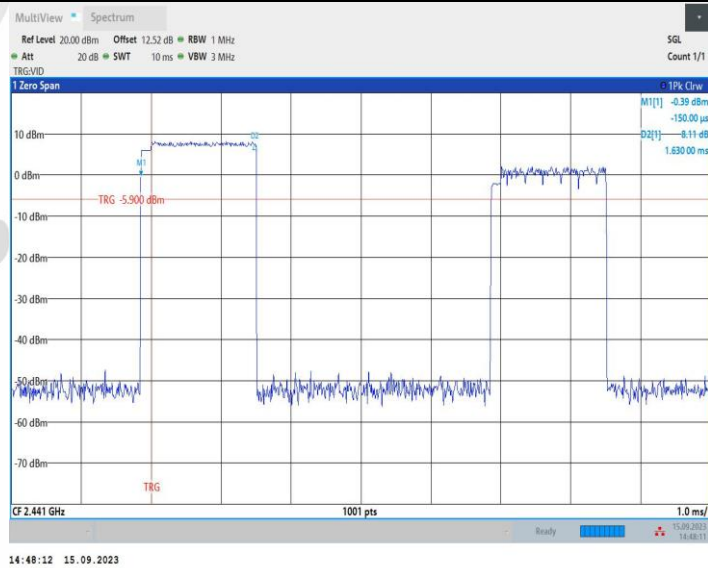


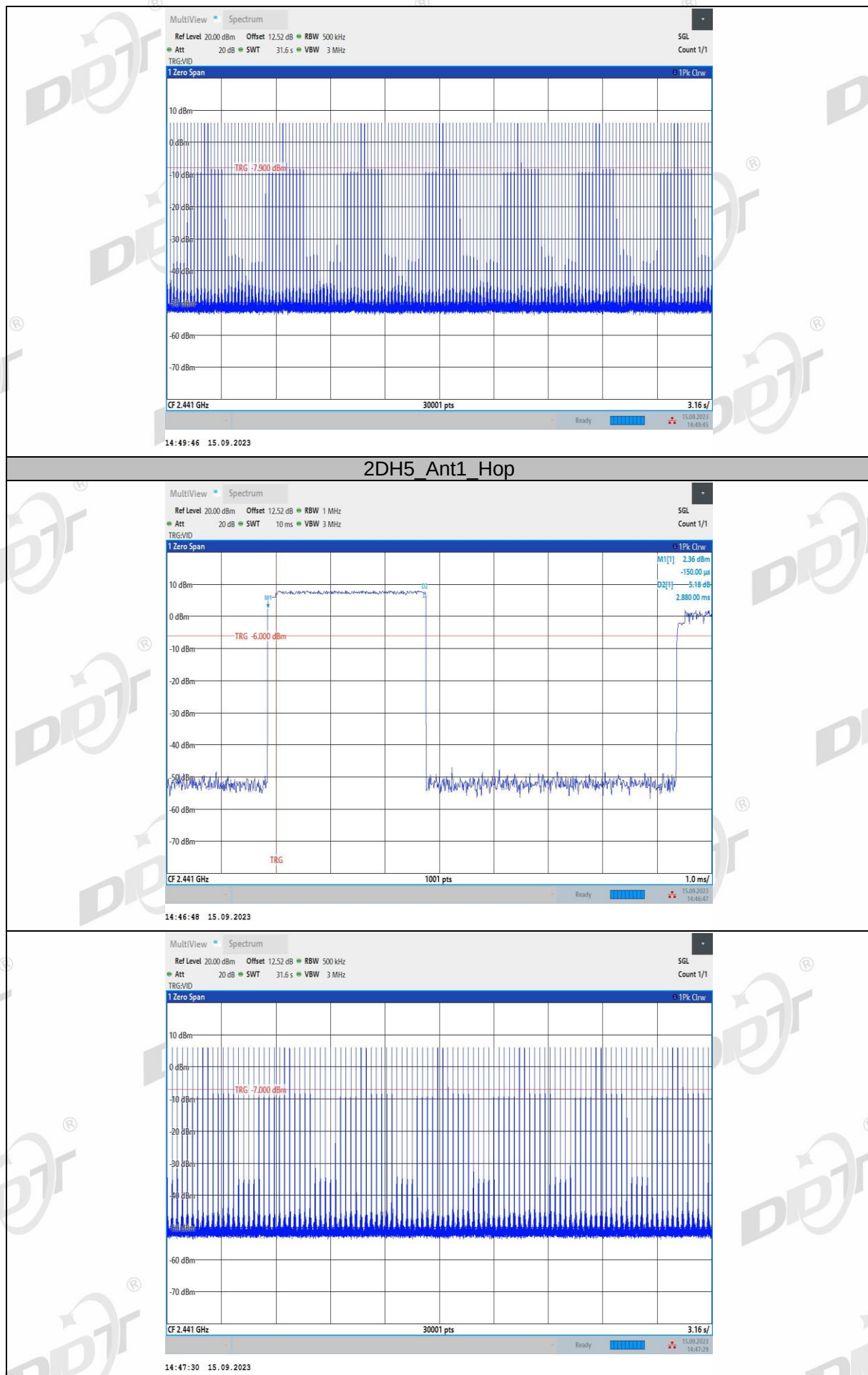


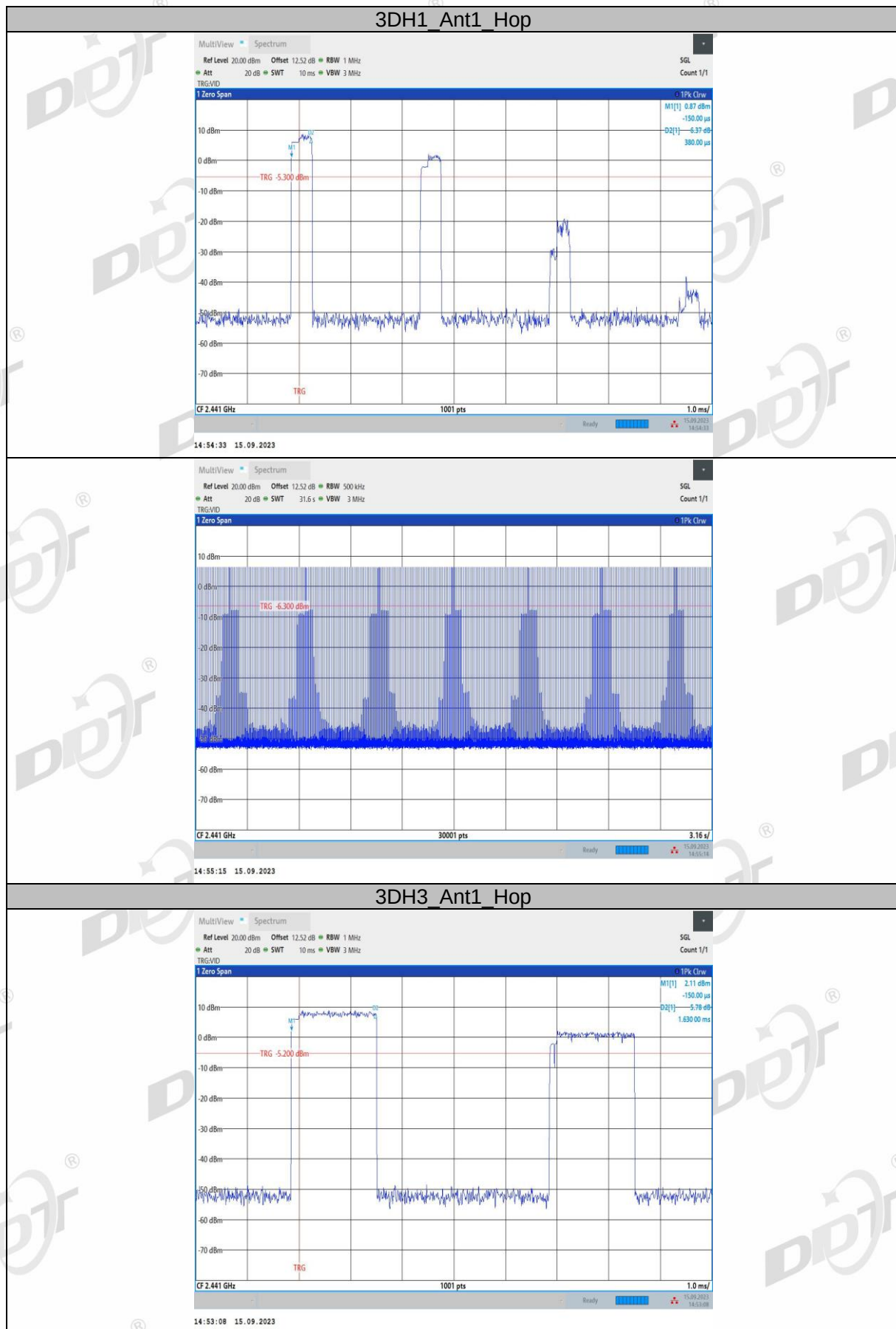
2DH1_Ant1_Hop

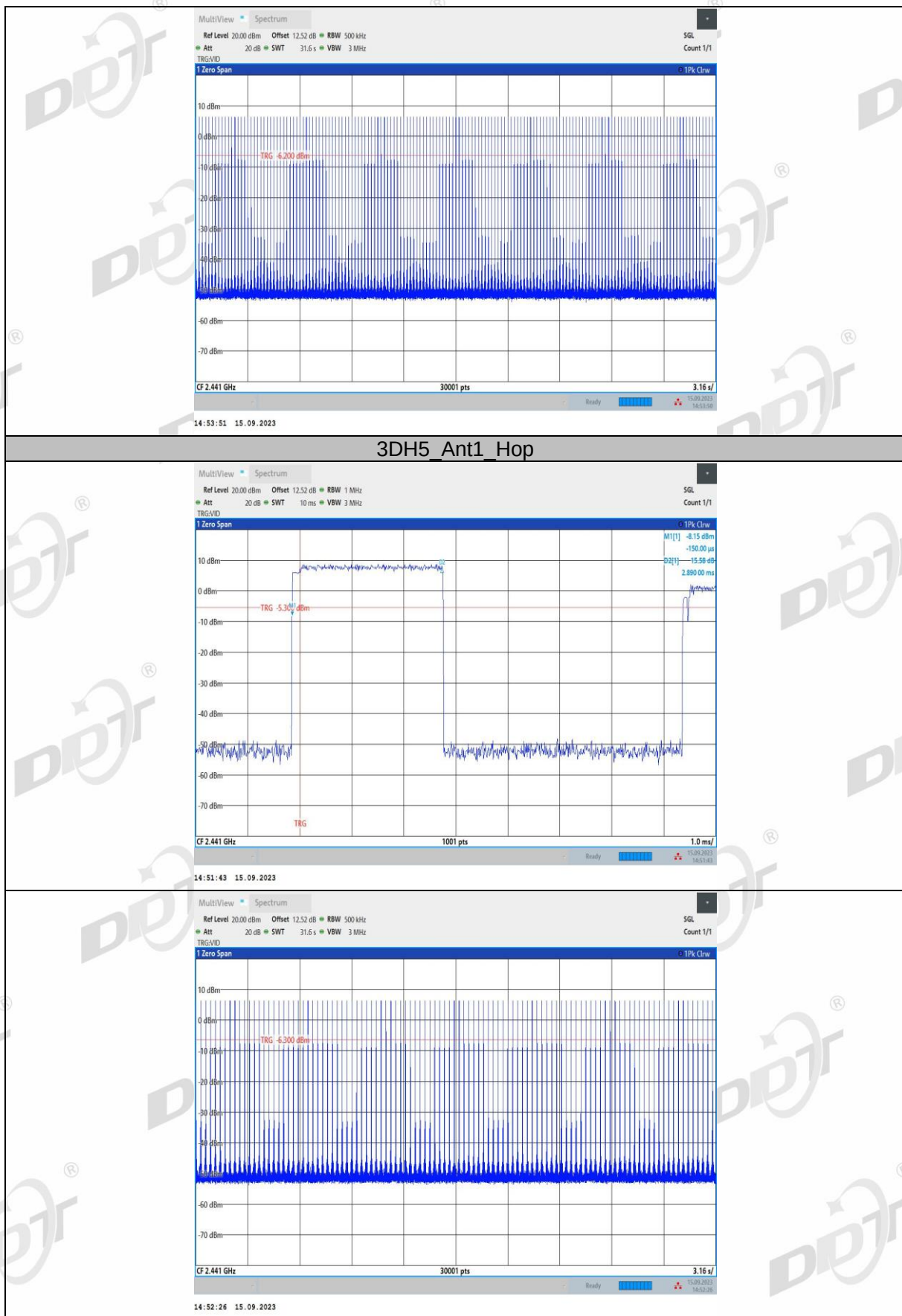


2DH3_Ant1_Hop









9. Band Edge Compliance (Conducted Method)

9.1. Block diagram of test setup

Same as section 4.1

9.2. Limit

All restriction band should comply with 15.209, other emission should be at least 20dB below the fundamental.

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:

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.

Note:

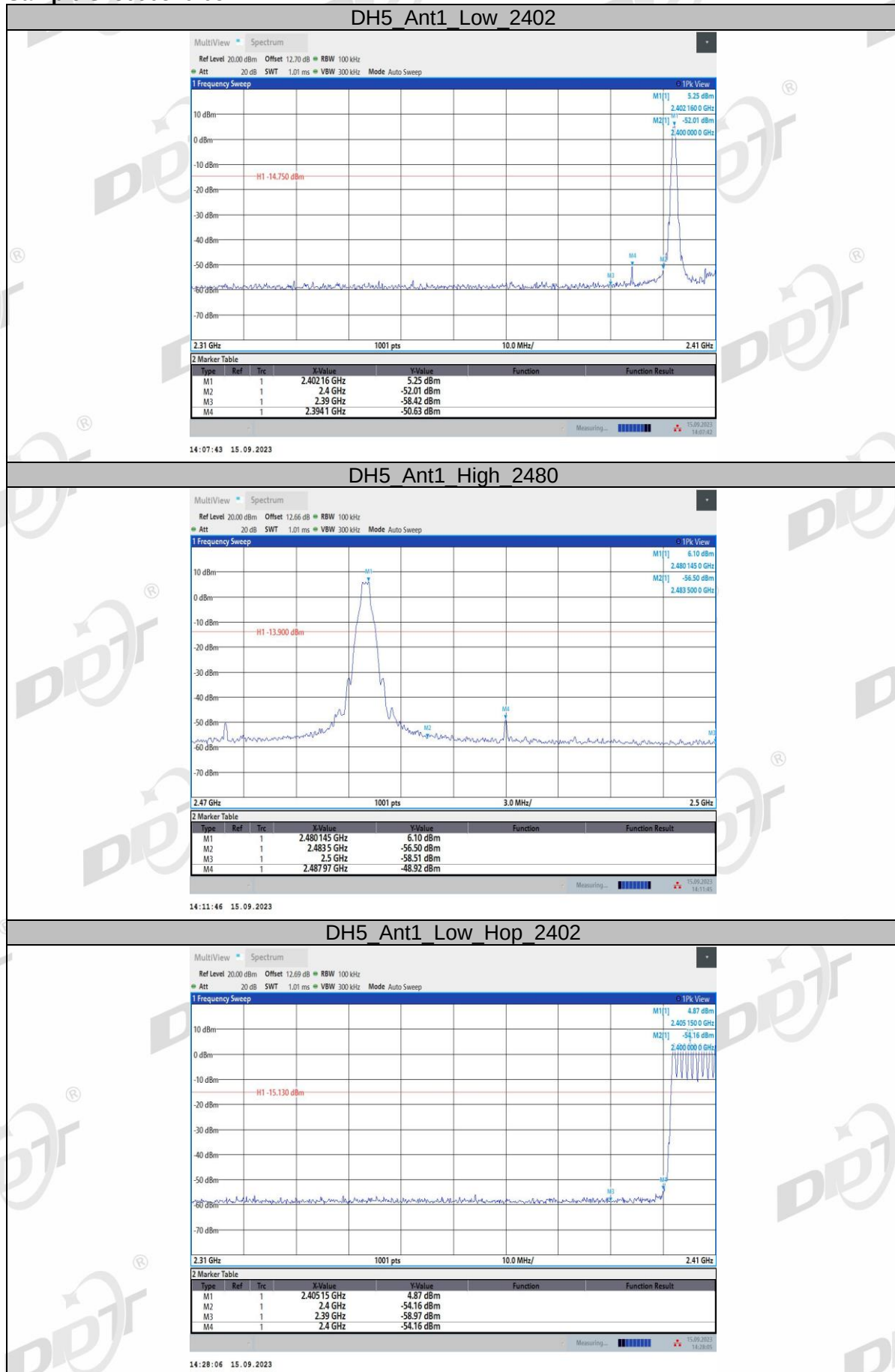
- 1.The attenuator loss was inputted into spectrum analyzer as amplitude offset.
- 2.The pathloss of external cable: 0.5dB (According to the manufacturer's claims).

9.4. Test result

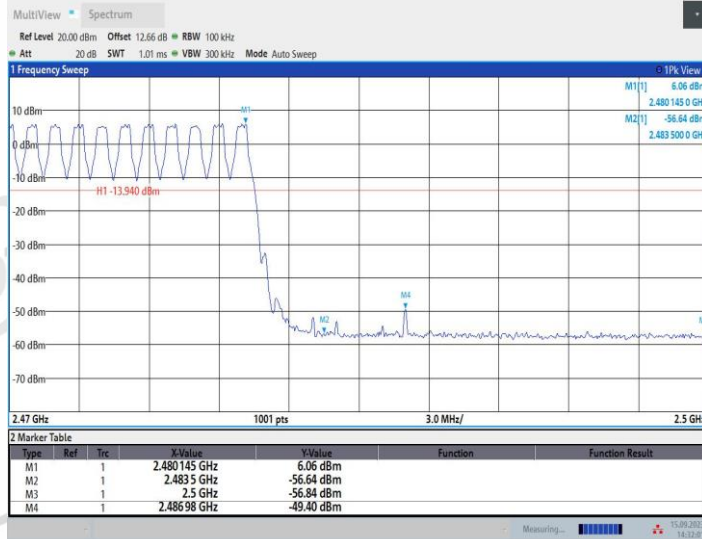
Mode	Frequency (MHz)	Verdict
DH5	Hopping off 2402	Pass
	Hopping off 2480	Pass
	Hopping on	Pass
2DH5	Hopping off 2402	Pass
	Hopping off 2480	Pass
	Hopping on	Pass
3DH5	Hopping off 2402	Pass
	Hopping off 2480	Pass
	Hopping on	Pass

9.5. Original test data

Sample S23090520-05:

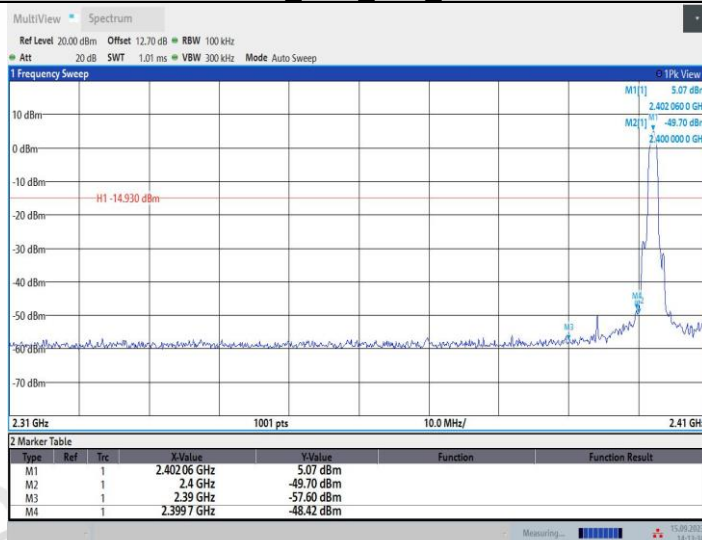


DH5 Ant1_High_Hop_2480



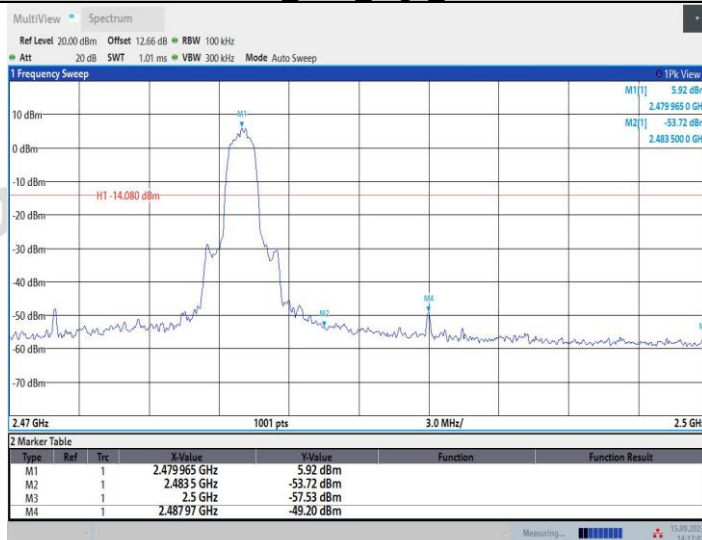
14:32:02 15.09.2023

2DH5 Ant1_Low_2402



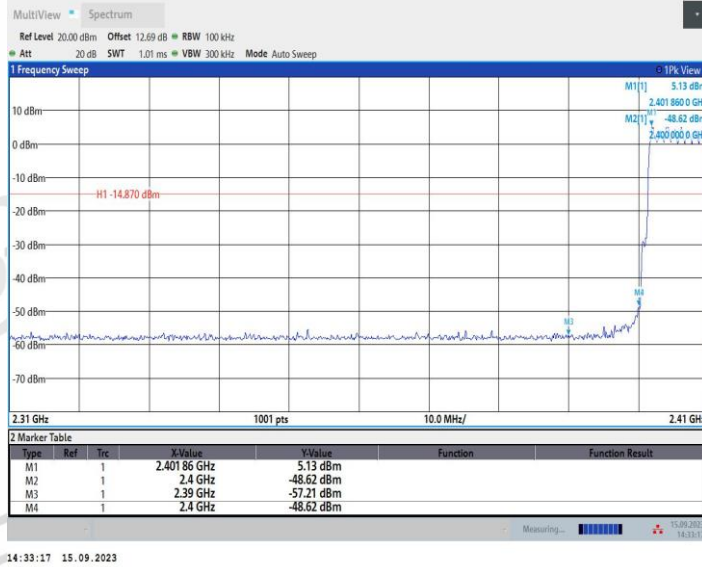
14:13:35 15.09.2023

2DH5 Ant1_High_2480

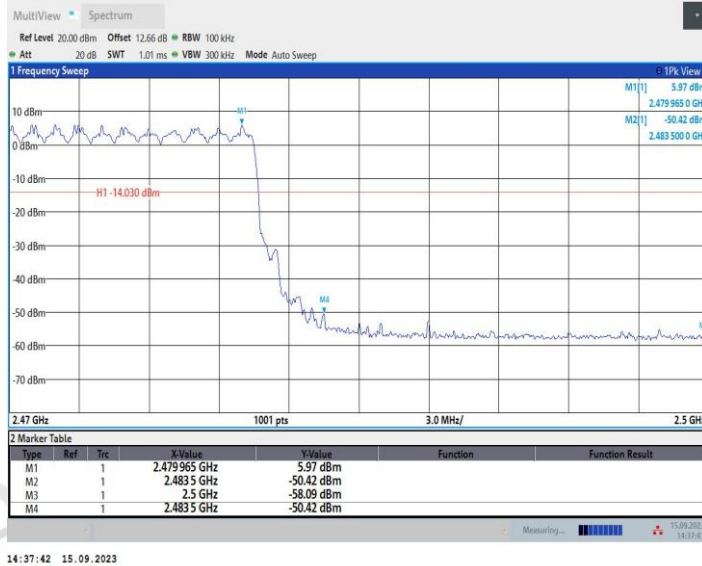


14:17:07 15.09.2023

2DH5_Ant1_Low_Hop_2402



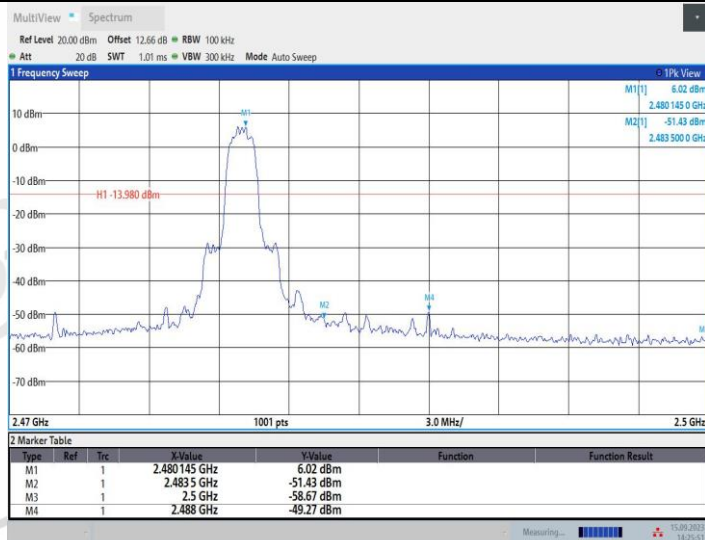
2DH5_Ant1_High_Hop_2480



3DH5_Ant1_Low_2402

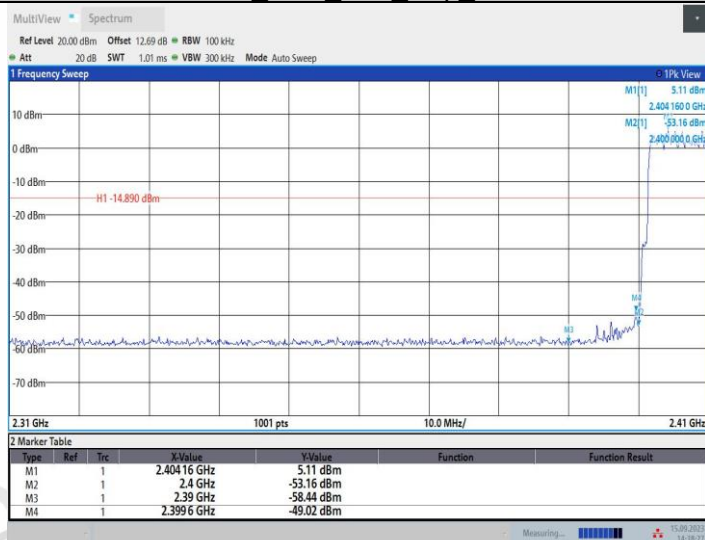


3DH5_Ant1_High_2480



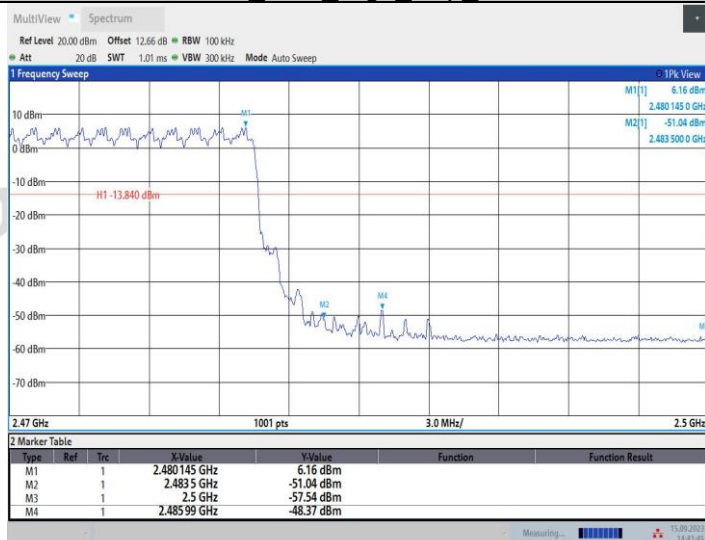
14:25:51 15.09.2023

3DH5_Ant1_Low_Hop_2402



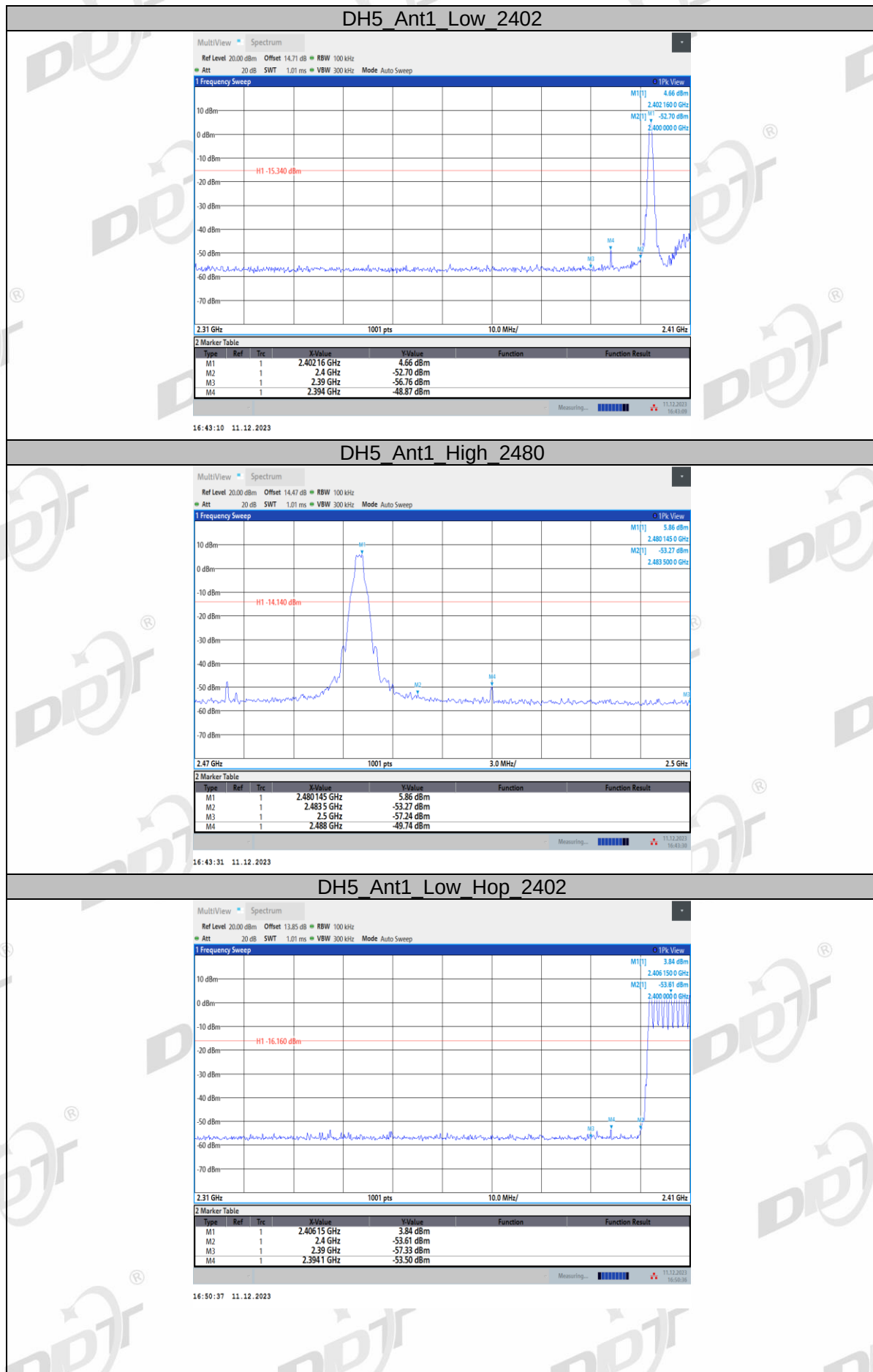
14:38:27 15.09.2023

3DH5_Ant1_High_Hop_2480

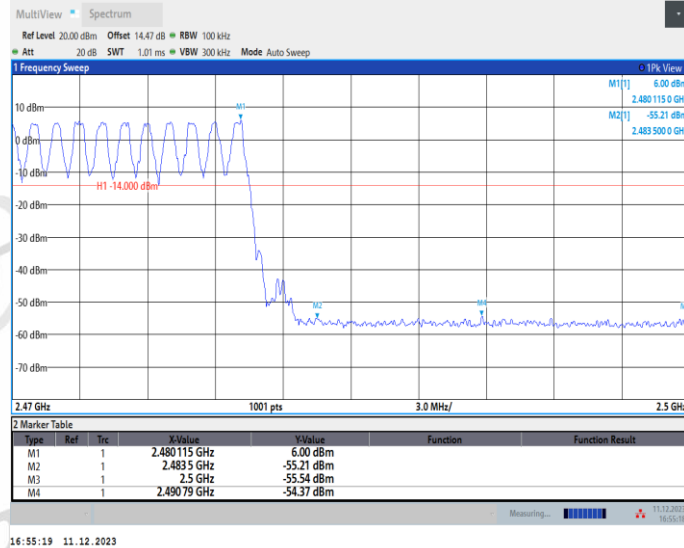


14:41:45 15.09.2023

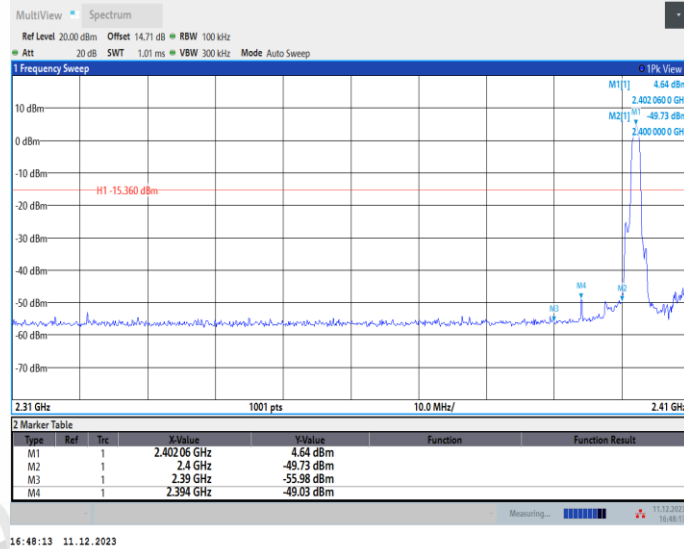
Sample S23090520-16:



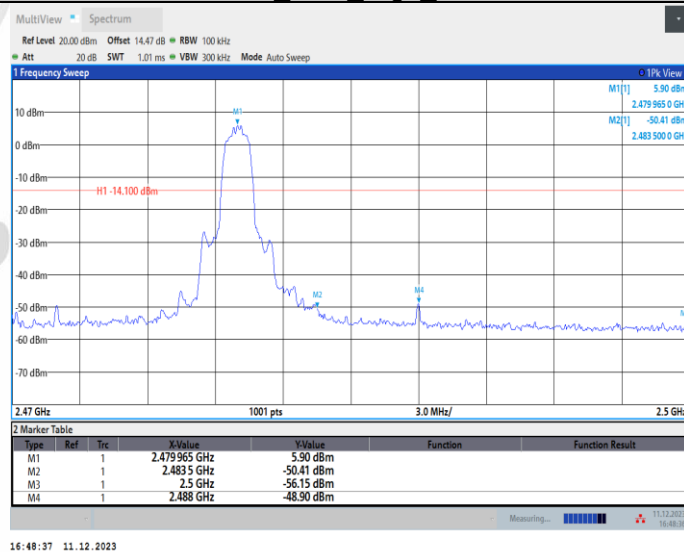
DH5 Ant1_High_Hop_2480



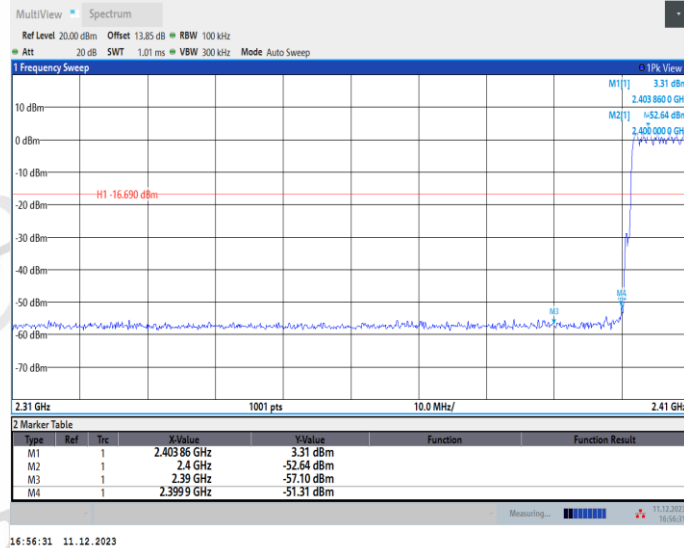
2DH5_Ant1_Low_2402



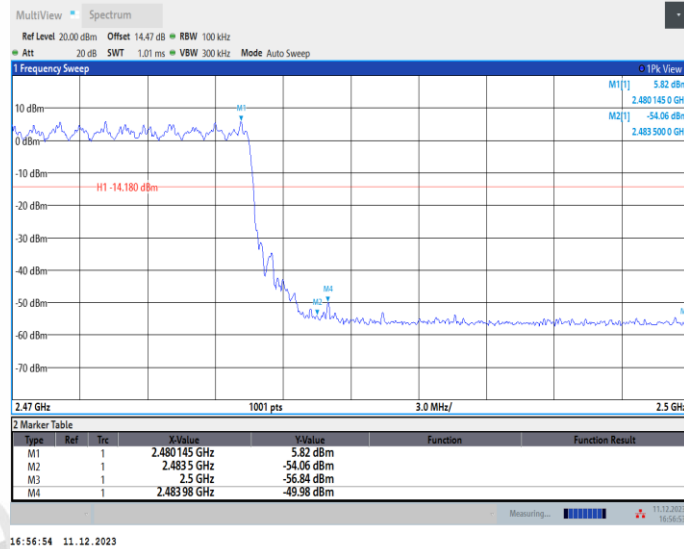
2DH5_Ant1_High_2480



2DH5_Ant1_Low_Hop_2402



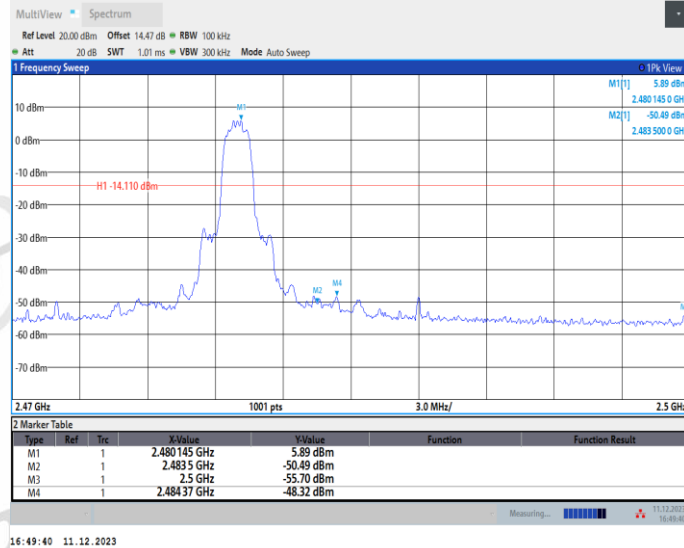
2DH5_Ant1_High_Hop_2480



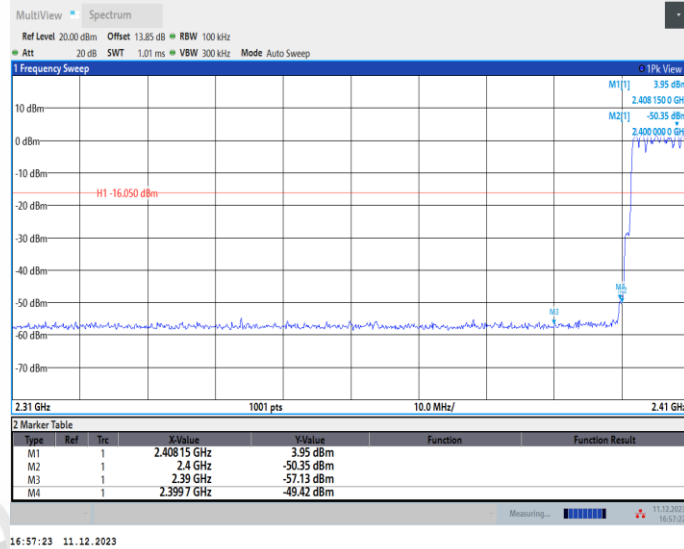
3DH5_Ant1_Low_2402



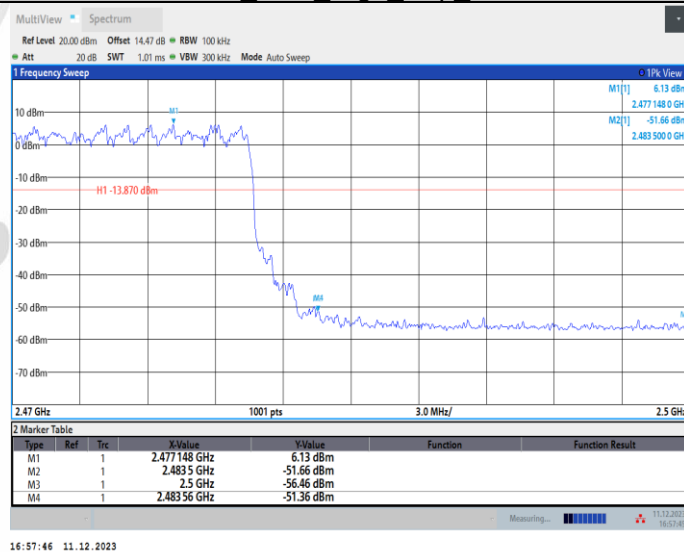
3DH5_Ant1_High_2480



3DH5_Ant1_Low_Hop_2402



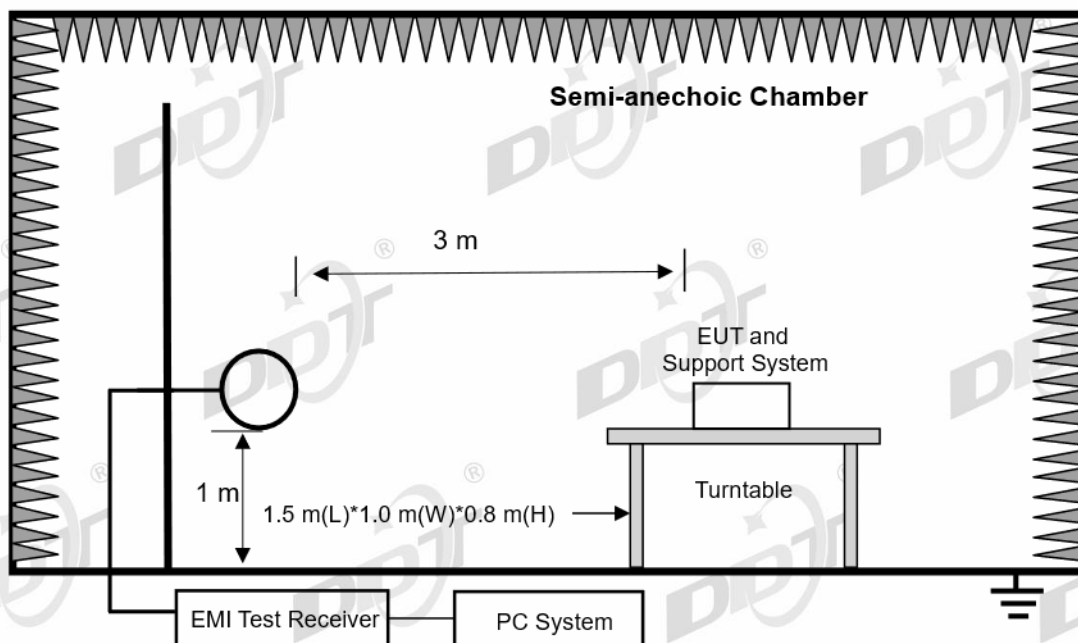
3DH5_Ant1_High_Hop_2480



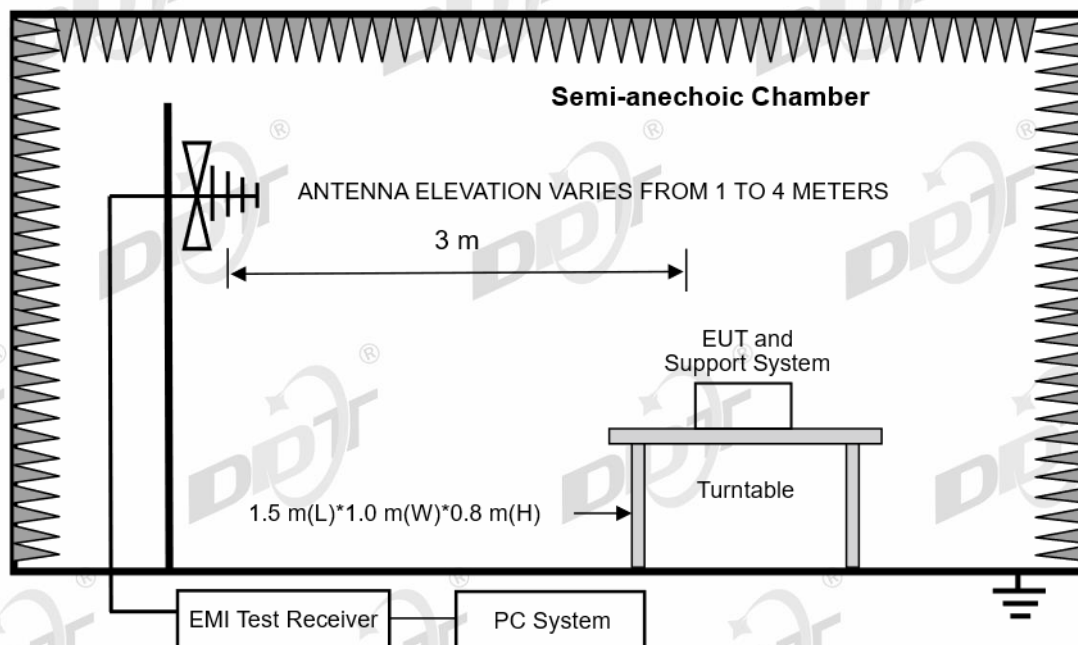
10. Radiated Emission

10.1. Block diagram of test setup

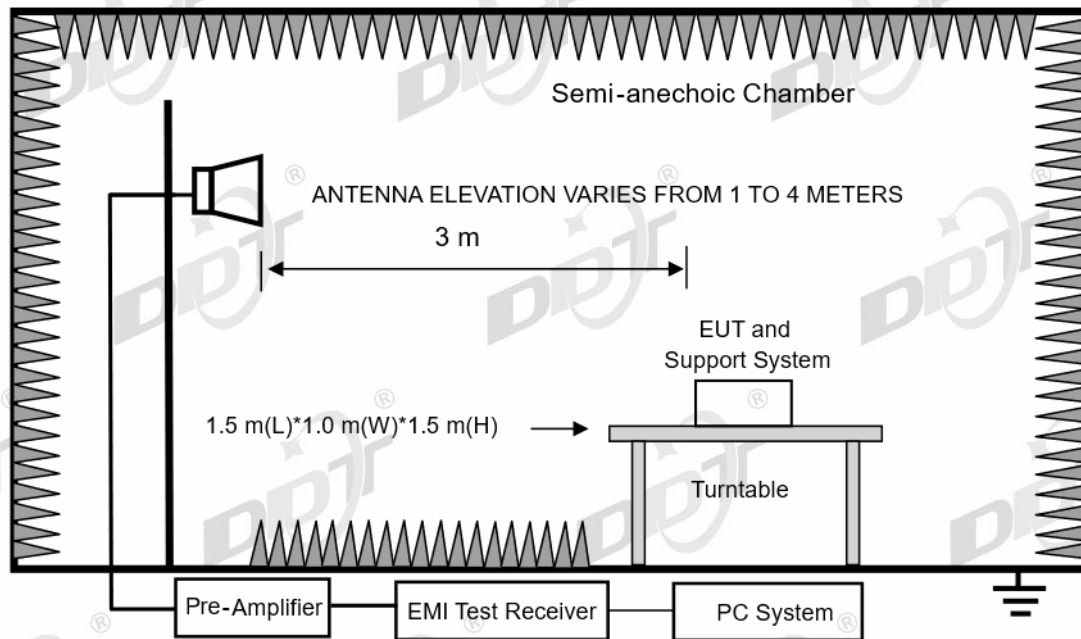
In 3 m Anechoic Chamber, test setup diagram for 9 kHz - 30 MHz:



In 3 m Anechoic Chamber, test setup diagram for 30 MHz - 1 GHz:



In 3 m Anechoic Chamber, test setup diagram for frequency above 1 GHz:



Note: For harmonic emissions test an appropriate high pass filter was inserted in the input port of AMP.

10.2. Limit

(1) FCC 15.205 Restricted frequency band

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.1772&4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.2072&4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(²)
13.36-13.41			

¹Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

²Above 38.6

RSS-Gen section 8.10 Restricted frequency band

MHz	MHz	MHz	GHz
0.090-0.110	12.51975-12.52025	240-285	3.5-4.4
0.495-0.505	12.57675-12.57725	322-335.4	4.5-5.15
2.1735-2.1905	13.36-13.41	399.9-410	5.35-5.46
3.020-3.026	16.42-16.423	608-614	7.25-7.75
4.125-4.128	16.69475-16.69525	960-1427	8.025-8.5
4.1772&4.17775	16.80425-16.80475	1435-1626.5	9.0-9.2
4.2072&4.20775	25.5-25.67	1645.5-1646.5	9.3-9.5
5.677-5.683	37.5-38.25	1660-1710	10.6-12.7
6.215-6.218	73-74.6	1718.8-1722.2	13.25-13.4
6.26775-6.26825	74.8-75.2	2200-2300	14.47-14.5
6.31175-6.31225	108-138	2310-2390	15.35-16.2
8.291-8.294	149.9-150.05	2483.5-2500	17.7-21.4
8.362-8.366	156.52475-156.52525	2655-2900	22.01-23.12
8.37625-8.38675	156.7-156.9	3260-3267	23.6-24.0
8.41425-8.41475	162.0125-167.17	3332-3339	31.2-31.8
12.29-12.293	167.72-173.2	3345.8-3358	36.43-36.5
			Above 38.6

Note: Certain frequency bands listed in above table and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

(2) FCC 15.209 Limit and RSS-Gen section 8.9 Limit.

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		$\mu\text{V/m}$	$\text{dB}(\mu\text{V})/\text{m}$
0.009 ~ 0.490	300	2400/F(kHz)	67.6-20log(F)
0.490 ~ 1.705	30	24000/F(kHz)	87.6-20log(F)
1.705 ~ 30.0	30	30	29.54
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	74.0 dB(μV)/m (Peak) 54.0 dB(μV)/m (Average)	

Note:

(1) The emission limits shown in the above table are based on measurements employing a CISPR QP detector except for the frequency bands 9 - 90 kHz, 110 - 490 kHz and above 1000 MHz, radiated emissions limits in these three bands are based on measurements employing an average detector.

(2) At frequencies below 30 MHz, measurement may be performed at a distance closer than that specified, and the limit at closer measurement distance can be extrapolated by below formula:

$$\text{Limit}_{3\text{m}}(\text{dB}\mu\text{V/m}) = \text{Limit}_{30\text{m}}(\text{dB}\mu\text{V/m}) + 40\text{Log}(30\text{m}/3\text{m})$$

(3) Limit for this EUT

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20 dB below the fundamental emissions or comply with 15.209 limits and RSS-Gen limits.

10.3. Test Procedure

- (1) EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber for below 1G and 150 cm above the ground plane inside a fully-anechoic chamber for above 1G.
- (2) Test antenna was located 3 m from the EUT on an adjustable mast, and the antenna used as below table.

Test frequency range	Test antenna used	Test antenna distance
9 kHz - 30 MHz	Active Loop antenna	3 m
30 MHz - 1 GHz	Trilog Broadband Antenna	3 m
1 GHz - 18 GHz	Double Ridged Horn Antenna (1 GHz - 18 GHz)	3 m
18 GHz - 40 GHz	Horn Antenna (18 GHz - 40 GHz)	1 m

According ANSI C63.10:2013 clause 6.4.6 and 6.5.3, for measurements below 30 MHz, Antenna was located 3 m from EUT, the loop antenna was positioned in three antenna orientations (parallel, perpendicular, and round-parallel), for each measurement antenna alignment, the EUT shall be rotated through 0° to 360° on a turntable, and the lowest height of the magnetic antenna shall be 1 m above the ground. For measurement above 30MHz, the trilog Broadband Antenna or Horn Antenna was located 3m from EUT, Measurements were made with the antenna positioned in both the horizontal and vertical planes of Polarization, and the measurement antenna was varied from 1 m to 4 m. in height above the reference ground plane to obtain the maximum signal strength.

- (3) Below pre-scan procedure was first performed in order to find prominent frequency spectrum radiated emissions from 9 kHz to 25 GHz:

(a) Scanning the peak frequency spectrum with the antenna specified in step (3), and the EUT was rotated 360 degree, the antenna height was varied from 1 m to 4 m (Except loop antenna, it's fixed 1 m above ground.)

(b) Change work frequency or channel of device if practicable.

(c) Change modulation type of device if practicable.

(d) Change power supply range from 85% to 115% of the rated supply voltage

(e) Rotated EUT though three orthogonal axes to determine the attitude of EUT arrangement produces highest emissions.

Spectrum frequency from 9 kHz to 25 GHz (tenth harmonic of fundamental frequency) was investigated, and no any obvious emission were detected from 18 GHz to 25 GHz, so below final test was performed with frequency range from 9 kHz to 18 GHz.

- (4) For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. In order to find the maximum emission, the relative positions of equipment and all of the interface cables were changed according to ANSI C63.10:2013 on Radiated Emission test.
- (5) The emissions from 9 kHz to 1 GHz were measured based on CISPR QP detector except for the frequency bands 9 - 90 kHz, 110 - 490 kHz, for emissions from 9 kHz - 90 kHz, 110 kHz - 490 kHz and above 1 GHz were measured based on average detector, for emissions above 1 GHz, peak emissions also be measured and need comply with Peak limit.
- (6) The emissions from 9 kHz to 1 GHz, QP or average values were measured with EMI receiver with below RBW.

Frequency band	RBW
9 kHz - 150 kHz	200 Hz
150 kHz - 30 MHz	9 kHz
30 MHz - 1 GHz	120 kHz

- (7) For emissions above 1GHz, both Peak and Average level were measured with Spectrum Analyzer, and the RBW is set at 1 MHz, VBW is set at 3 MHz for Peak measure; According ANSI C63.10:2013 clause 4.1.4.2.2 procedure for average measure.

10.4. Test result

Pass. (See below detailed test result)

All the emissions except fundamental emission from 9 kHz to 25 GHz were comply with 15.209 limits.

Note1: According exploratory test, the emission levels are 20 dB below the limit detected from 9 kHz to 30 MHz and 18 GHz to 25 GHz, so the final test was performed with frequency range from 30 MHz to 18 GHz and recorded in below.

Note2: For emissions below 1 GHz, according exploratory explorer test, when change Tx mode and channel, have no distinct influence on emissions level, so for emissions below 1 GHz, the final test was only performed with EUT working in 8DPSK, Tx 2441 MHz mode.

Note3: For emissions above 1 GHz. If peak results comply with AV limit, AV Result is deemed to comply with AV limit.

Note4: For emission above 1GHz that over the limit are fundamental, the report was only recorded the worst case: GFSK TX mode.

Note 5: Two alternative Crystal oscillator products have been tested, only recorded the worse model: CXA-032000-ADCD41' test data on this report.