



Test Report No.: FCC2022-0023-RF

TEST REPORT

FCC ID	:	2A4IK-H20T
Applicant	:	OPSMEN TECH CO.,LTD
Product Name	:	Wireless headset
Mode No.	:	XDZ-H20T、XDZ-H30T、XDZ-H50T、 XDZ-H60T、XDZ-H70T、XDZ-H80T、 XDZ-H90T、M20T

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Applicant	Name: OPSMEN TECH CO.,LTD Address: Room 601, Building A, No.94 Liwan Road, Liwan District, Guangzhou, China		
Manufacturer	Name: OPSMEN TECH CO.,LTD Address: Room 601, Building A, No.94 Liwan Road, Liwan District, Guangzhou, China		
Equipment Under Test	Product Name : Wireless headset Model No. : XDZ-H20T Trade mark : Earmor Serial no. : H20T202206010001 Sampling : —		
Date of Receipt.	2022.04.12	Date of Testing	2022.04.12~2022.06.10
Test Specification		Test Result	
FCC CFR47 Part 15C (2020) Radio Frequency Devices ANSI C63.10 (2013) DA00-705 Filing and Frequency Measurement Guidelines For Frequency Hopping Spread Spectrum System (2000).		PASS	
Evaluation of Test Result	The equipment under test was found to comply with the requirements of the standards applied. <div style="text-align: right;">Seal of CVC Issue Date: 2022.06.30</div>		
Tested by: Xu Zhenfei <i>LuWeiJi</i>	Reviewed by: Liu YongHai <i>XuZhenfei</i>	Approved by: Chen HuaWen <i>ChenHuaWen</i>	
Other Aspects: NONE.			
Abbreviations:OK, Pass= passed Fail = failed N/A= not applicable EUT= equipment, sample(s) under tested			
This test report relates only to the EUT, and shall not be reproduced except in full, without written approval of CVC .			

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1. General Product Information

1.1 General information

Product Name	Wireless headset	
Model No.	XDZ-H20T	
Series Model No.	XDZ-H30T、XDZ-H50T、XDZ-H60T、XDZ-H70T、XDZ-H80T、XDZ-H90T、M20T	
Power Supply	DC 5V	
Serial Number(SN)	H20T202206010001	
Power Supply	Adapter	/
	Battery	/
Antenna Type	Internal Antenna	
Antenna Connector	A permanently attached antenna (meet with the standard FCC Part 15.203 requirement)	
Antenna Gain	Antenna 1: 10.0 dBi (provided by client)	
Frequency Range	2402MHz~2480MHz	
Bluetooth Version:	BT5.3	
Channel Number	79	
Type of Modulation	GFSK, $\pi/4$ DQPSK	
Hopping Channel Type:	Adaptive Frequency Hopping systems	
Max. Conducted Power	DH5: -13.88 dBm 2DH5: -13.14 dBm	
Operate Temp.Range	-40°C to +70°C	
Note:	<ol style="list-style-type: none">1. The information of the EUT is declared by the manufacturer.2. The laboratory is not responsible for the product technical specification provided by the client.	

The difference between model XDZ-H20T and model XDZ-H30T, XDZ-H50T, XDZ-H60T, XDZ-H70T, XDZ-H80T, XDZ-H90T is the color of plastic shell, and the rest of the structure, electrical and software are the same. The difference between model XDZ-H20T and model M20T is the difference of ear cap, and the others are the same.

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2. Test Sites

2.1 Test Facilities

The tests and measurements refer to this report were performed by EMC testing Lab. of CVC Testing Technology Co., Ltd.

Add.: No.3, Tiantaiyi Road, Kaitai Avenue, Science City, Guangzhou, Guangdong, 510663, People's Republic of China

Telephone : +86-20-32293888

Fax : +86-20-32293889

FCC(Test firm designation number: CN1282)

IC(Test firm CAB identifier number: CN0103)

2.2 Description of Non-standard Method and Deviations

The testing and measurement methods used in this report are applied by all standard methods. Not any non-standard method or deviation from the used standards was used.

2.3 List of Test and Measurement Instruments

Refer to **Appendix E**.

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3. Test Configuration

3.1 Test Mode

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.

In order to find the worst case condition, Pre-tests are needed at the presence of different data rate. Preliminary tests have been done on all the configuration for confirming worst case. Data rate below means worst-case rate of each test item.

Worst-case data rates are shown as following table.

Test Mode	Antenna Delivery	Test Channel
DH5/2DH5	1TX / 1RX	0,39,78

Test Mode	Test Modes
Radiated Emissions	2DH5
Peak Power Output -Conducted	DH5/2DH5
20dB Emission Bandwidth	DH5/2DH5
Occupied Channel Bandwidth	DH5/2DH5
Frequency Separation	DH5/2DH5
Time of Occupancy (Dwell Time)	DH1/DH3/DH5/2DH1/2DH3/2DH5
Band Edge Compliance	DH5/2DH5
Number of Hopping Frequency	DH5/2DH5
Spurious RF Conducted Emissions	DH5/2DH5

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3.2 Duty cycle

TestMode	Antenna	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]	Limit	Verdict
DH5	Ant1	2402	2.90	3.75	77.33	---	PASS
	Ant1	2441	2.89	3.74	77.27	---	PASS
	Ant1	2480	2.90	3.75	77.33	---	PASS
2DH5	Ant1	2402	2.89	3.74	77.27	---	PASS
	Ant1	2441	2.90	3.75	77.33	---	PASS
	Ant1	2480	2.90	3.75	77.33	---	PASS

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4. Summary of measurement results

Summary of measurements of results	Clause in FCC rules	Verdict	Note
Conducted Emissions	15.207	N/A	Note
Radiated Emissions	15.247(d),15.205,15.209	PASS	/
Peak Power Output -Conducted	15.247(b)(1)	PASS	/
20dB Emission Bandwidth	15.247(a)(1)	PASS	/
Occupied Channel Bandwidth	15.247(a)(1)	PASS	/
Frequency Separation	15.247(a)(1)	PASS	/
Time of Occupancy (Dwell Time)	15.247(a)(1)(iii)	PASS	/
Band Edge Compliance	15.247(d)	PASS	/
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS	/
Spurious RF Conducted Emissions	15.247(d)	PASS	/

Note: The Conducted Emission is not applicable the EUT powered by built-in battery.

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5. Measurement procedure

5.1 Conducted Emission

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement:

The EUT was setup according to ANSI C63.10, 2013 for compliance to FCC 47CFR 15.247 requirements. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface. The EUT and simulators are connected to the main power through a line impedance stabilization network (LISN). The LISN provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs) Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.

The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.

Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.

Limits:

Frequency (MHz)	Conducted Limits(dBμV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 *	56 to 46*
0.5 - 5	56	46
5 - 30	60	50

Note 1: The lower limit shall apply at the transition frequencies.

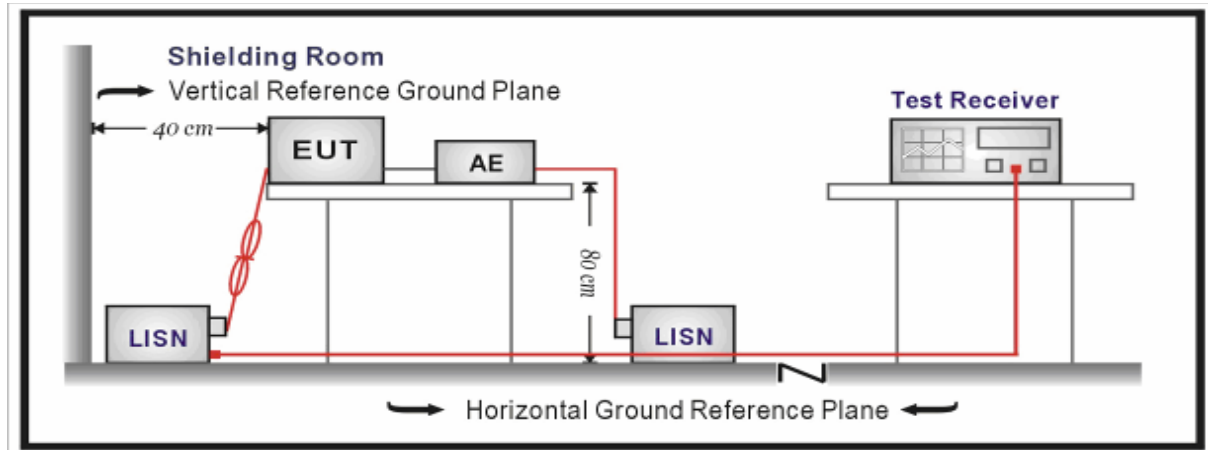
Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

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Test Setup:



Note: AC Power source is used to change the voltage 220V/60Hz.

Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Notes:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Level = Reading + Factor.

Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$. $U = 3.12$ dB.

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Test Results:

The EUT is powered by built-in battery, thus the Conducted Emission is not applicable.

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5.2 Radiated Emission

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement:

The EUT was setup and tested according to ANSI C63.10, 2013.

The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from Antenna to the EUT was 3 meters.

The Antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the Antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.

The resolution bandwidth below 1GHz setting on the field strength meter is 120 kHz and above 1GHz is 1MHz.

The frequency range from 30MHz to 10th harmonic is checked.

Note: When doing emission measurement above 1GHz, the horn Antenna will be bended down a little (as horn

Antenna has the narrow beamwidth) in order to keeping the Antenna in the “cone of radiation” of EUT. The 3dB beamwidth is 10~60 degrees for H-plane and 10~90 degrees for E-plane.

Limits:

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a) of FCC part 15, must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Frequency	Limit (dB μ V/m @3m)	Remark
30MHz-88MHz	40.0	Quasi-peak Level
88MHz-216MHz	43.5	Quasi-peak Level
216MHz-960MHz	46.0	Quasi-peak Level
960MHz-1GHz	54.0	Quasi-peak Level

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Above 1GHz	54.0	Average Level
	74.0	Peak Level

Spurious Radiated Emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
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
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	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.
12.57675-12.57725	322-335.4	3600-4400	/
13.36-13.41	/	/	/

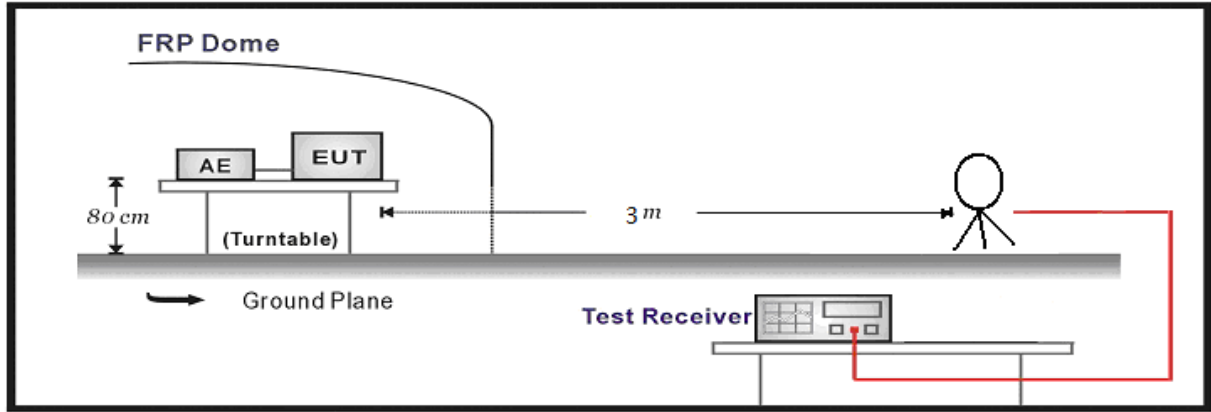
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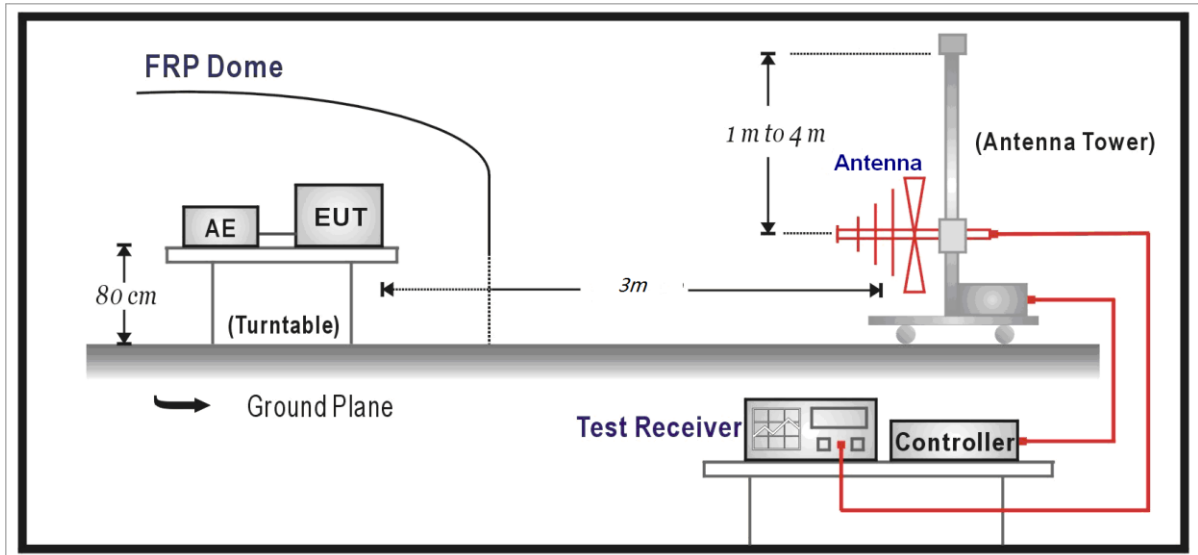
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Test Setup:

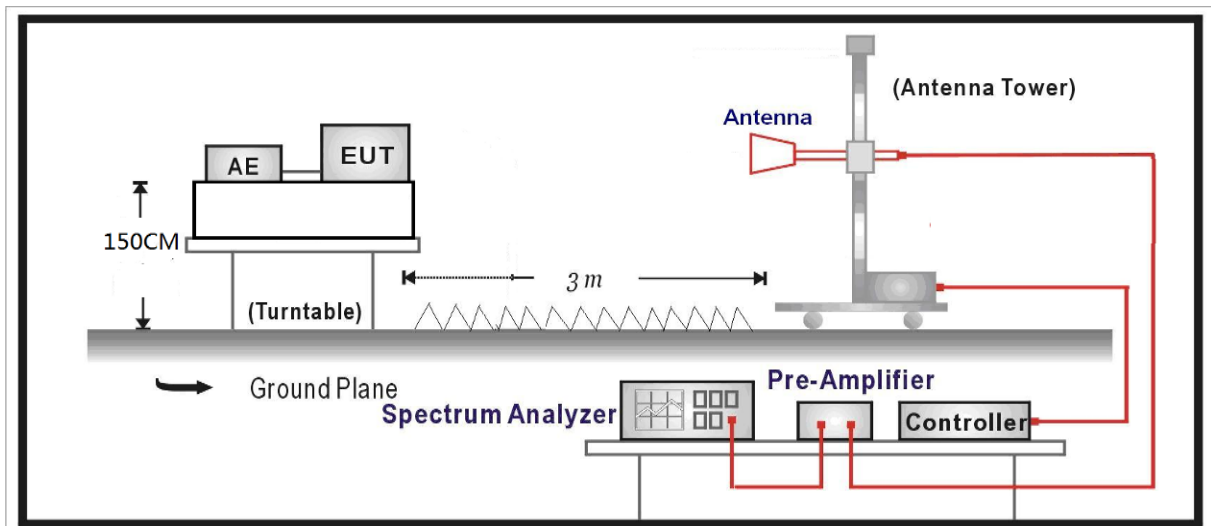
Below 30MHz Test Setup:



Below 1GHz Test Setup:



Above 1GHz Test Setup:



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Measurement Data:

The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Level = Reading - Factor

Factor = Preamplifier Factor – Antenna Factor–Cable Loss

Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$.

Frequency	Uncertainty
9KHz-30MHz	3.55 dB
30MHz-200MHz	4.19 dB
200MHz-1GHz	3.63 dB
Above 1GHz	3.68 dB

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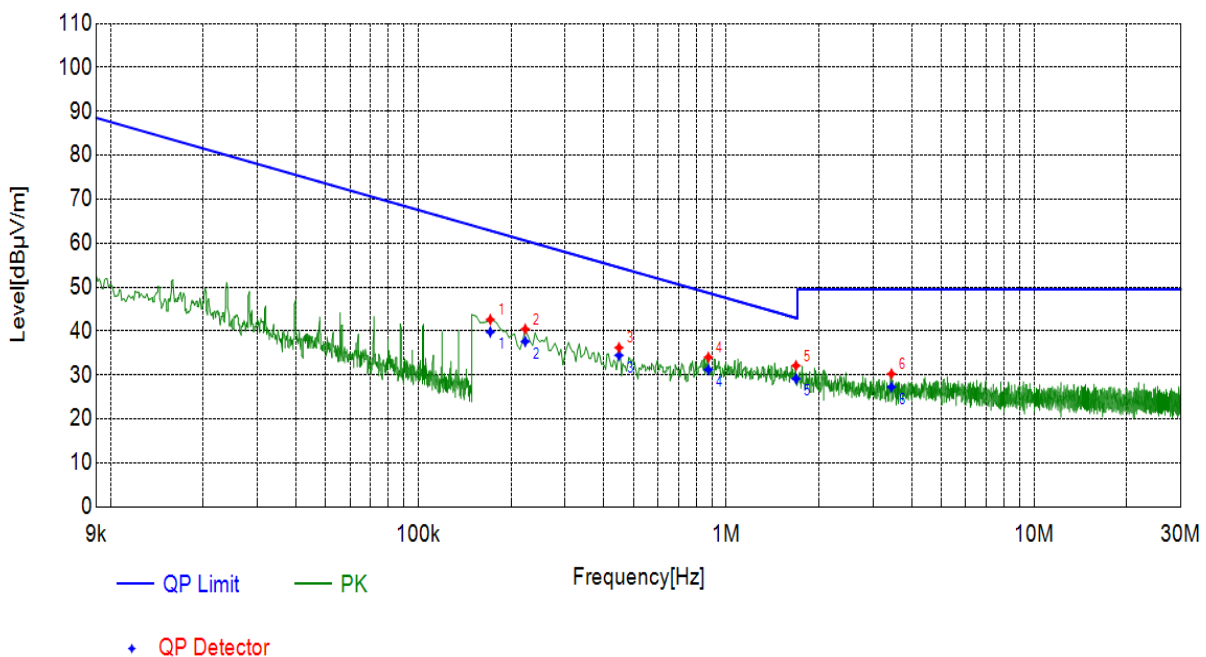
Test Results:

During the test, the Radiates Emission from 9KHz to 40GHz was performed in all modes with all channels, and all antenna, BT π /4DQPSK Channel 0, antenna 1 are selected as the worst condition. The test data of the worst-case condition was recorded in this report.

SPURIOUS EMISSIONS:

Radiated Emission	9KHz-30MHz
Polarity	X axis
Test channel	Worst-Case

Final Data List								
Frequency [MHz]	Polarity	Factor [dB]	QP Value [dB μ V/m]	QP Limit [dB μ V/m]	QP Margin [dB]	Height [cm]	Angle [°]	Pass/Fail
0.1713	X axis	20.40	39.78	62.85	23.07	100	150	PASS
0.2225	X axis	20.37	37.61	60.57	22.96	100	90	PASS
0.4485	X axis	20.41	34.47	54.47	20.00	100	250	PASS
0.8750	X axis	20.59	31.21	48.68	17.47	100	320	PASS
1.6854	X axis	20.73	29.14	43.00	13.86	100	40	PASS
3.4425	X axis	20.99	27.26	49.50	22.24	100	0	PASS



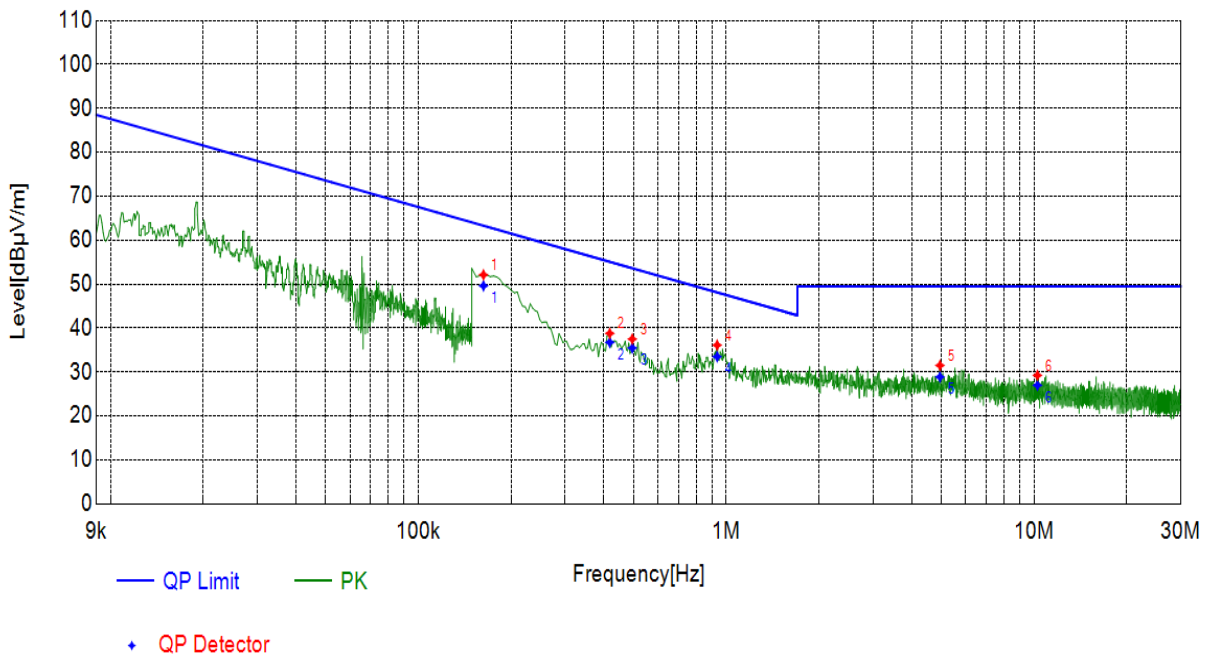
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Radiated Emission	9KHz-30MHz
Polarity	Y axis
Test channel	Worst-Case

Final Data List								
Frequency [MHz]	Polarity	Factor [dB]	QP Value [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Pass/Fail
0.1628	Y axis	20.41	49.61	63.29	13.68	100	270	PASS
0.4187	Y axis	20.32	36.75	55.07	18.32	100	300	PASS
0.4955	Y axis	20.56	35.47	53.60	18.13	100	320	PASS
0.9347	Y axis	20.56	33.49	48.11	14.62	100	90	PASS
4.9480	Y axis	21.13	28.87	49.50	20.63	100	270	PASS
10.2578	Y axis	20.95	26.98	49.50	22.52	100	230	PASS



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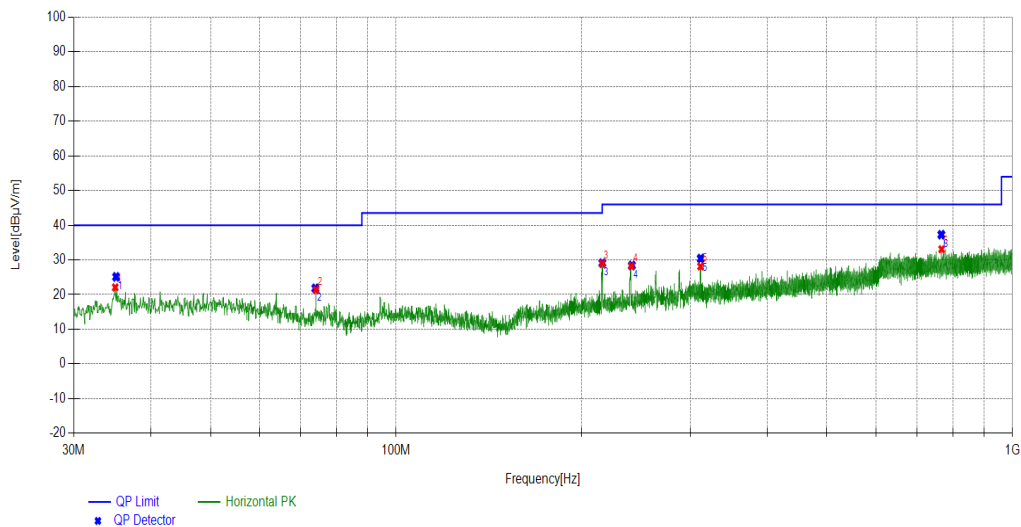
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Radiates Emission	30M~1G
Test channel	Worst-Case

Suspected List										
Frequency [MHz]	Polarity	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
35.0215	Horizontal	12.86	9.24	22.10	40.00	17.90	PK	100	0	PASS
74.1661	Horizontal	10.03	11.32	21.35	40.00	18.65	PK	100	0	PASS
216.0798	Horizontal	13.30	15.63	28.93	46.02	17.09	PK	100	0	PASS
240.8448	Horizontal	14.49	13.74	28.23	46.02	17.79	PK	100	0	PASS
311.8872	Horizontal	15.54	12.59	28.13	46.02	17.89	PK	100	0	PASS
767.4146	Horizontal	23.10	9.99	33.09	46.02	12.93	PK	100	0	PASS

Final Data List									
Frequency [MHz]	Polarity	Factor [dB]	QP Value [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Pass/Fail	
35.1409	Horizontal	12.86	24.90	40.00	15.10	120	0	PASS	
73.9562	Horizontal	10.03	21.85	40.00	18.15	200	0	PASS	
216.0582	Horizontal	13.30	28.97	46.02	17.05	290	0	PASS	
241.3385	Horizontal	14.49	28.32	46.02	17.70	210	0	PASS	
312.0743	Horizontal	15.54	30.21	46.02	15.81	100	0	PASS	
766.7623	Horizontal	23.09	37.89	46.02	8.13	270	0	PASS	



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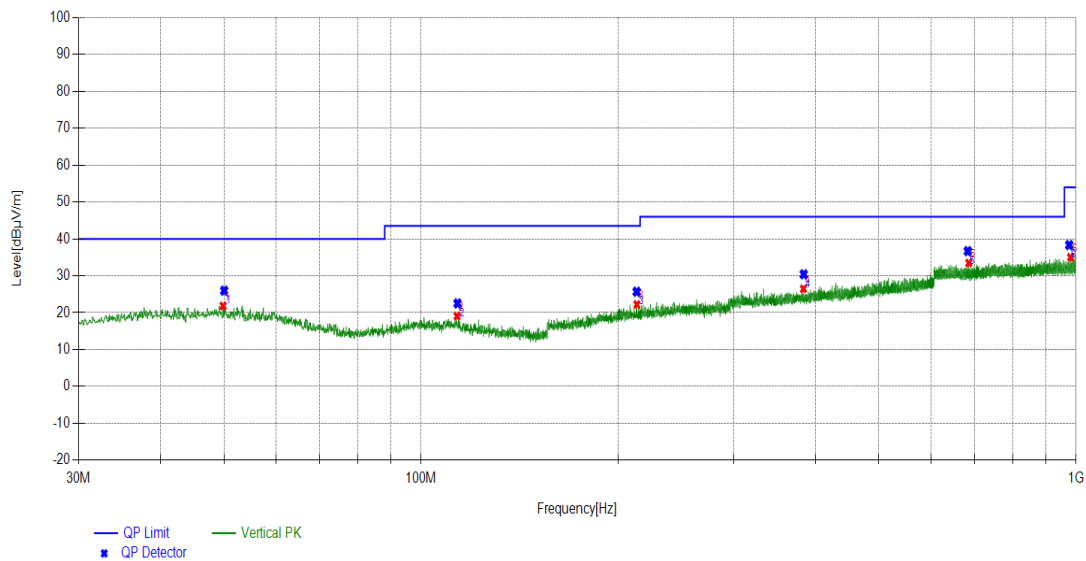
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Radiates Emission	30M~1G
Test channel	Worst-Case

Suspected List										
Frequency [MHz]	Polarity	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
49.8576	Vertical	14.51	7.34	21.85	40.00	18.15	PK	100	281	PASS
113.482	Vertical	12.10	6.97	19.07	43.52	24.45	PK	100	336	PASS
213.512	Vertical	13.18	9.06	22.24	43.52	21.28	PK	100	181	PASS
383.4431	Vertical	16.94	9.51	26.45	46.02	19.57	PK	100	353	PASS
685.8727	Vertical	21.91	11.54	33.45	46.02	12.57	PK	100	326	PASS
981.0554	Vertical	25.14	9.88	35.02	53.98	18.96	PK	100	154	PASS

Final Data List									
Frequency [MHz]	Polarity	Factor [dB]	QP Value [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Pass/Fail	
50.054	Vertical	14.51	25.89	40.00	14.11	190	281	PASS	
113.6783	Vertical	12.09	22.17	43.52	21.35	110	314	PASS	
213.3946	Vertical	13.18	25.45	43.52	18.07	170	181	PASS	
383.8649	Vertical	16.94	30.15	46.02	15.87	170	293	PASS	
683.4516	Vertical	21.91	36.85	46.02	9.17	290	326	PASS	
976.3071	Vertical	25.15	39.01	53.98	14.97	100	154	PASS	



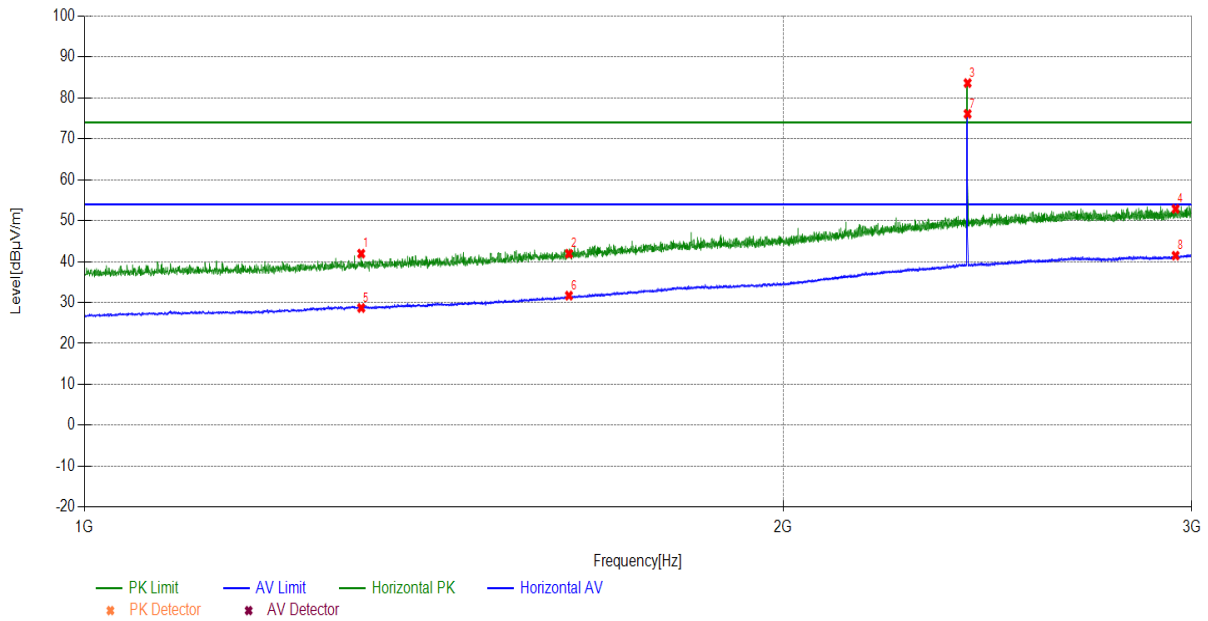
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Radiates Emission	1G~3G
Test channel	Worst-Case

Suspected List										
Frequency [MHz]	Polarity	Factor [dB]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Detector	Height [cm]	Angle deg	Pass/Fail
1316.03	Horizontal	27.53	14.42	41.95	74.00	32.05	PK	150	187	PASS
1617.26	Horizontal	29.81	12.12	41.93	74.00	32.07	PK	150	29	PASS
2401.94	Horizontal	36.57	47.04	83.61	74.00	-9.61	PK	150	359	---
2952.39	Horizontal	38.57	14.30	52.87	74.00	21.13	PK	150	359	PASS
1316.03	Horizontal	27.53	1.14	28.67	54.00	25.33	AV	150	301	PASS
1617.26	Horizontal	29.81	1.87	31.68	54.00	22.32	AV	150	10	PASS
2401.94	Horizontal	36.57	39.51	76.08	54.00	-22.08	AV	150	88	---
2952.39	Horizontal	38.57	2.88	41.45	54.00	12.55	AV	150	110	PASS



Note: The signal beyond the limit is carrier

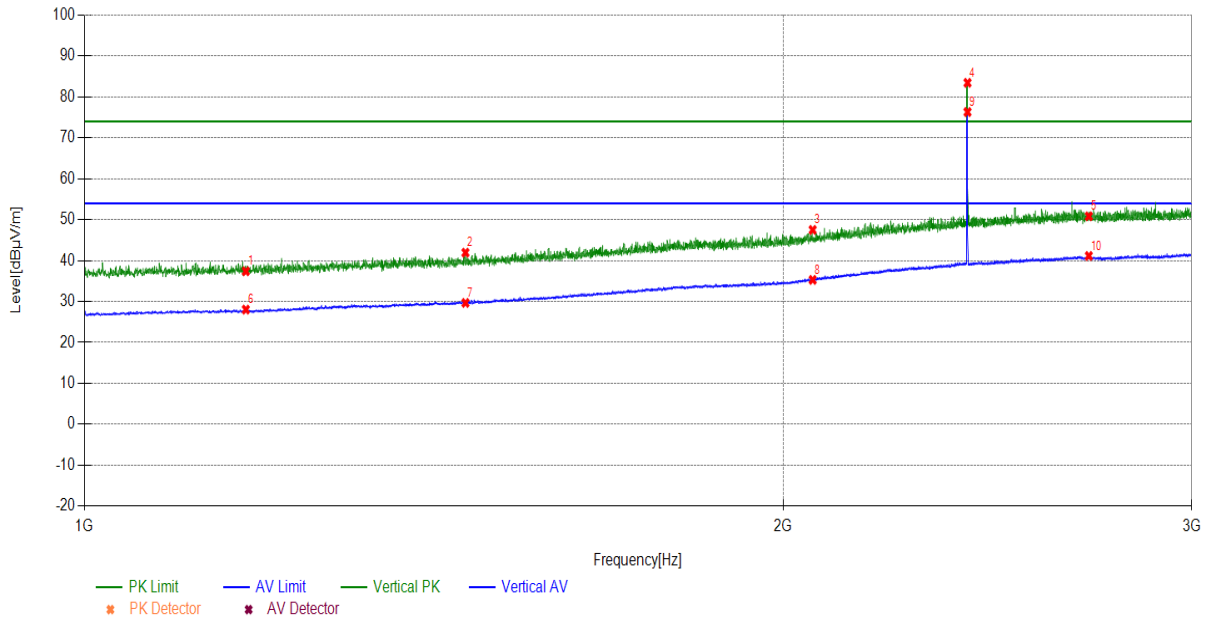
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Radiates Emission	1G~3G
Test channel	Worst-Case

Suspected List										
Frequency [MHz]	Polarity	Factor [dB]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
1173.61	Vertical	26.76	10.64	37.40	74.00	36.60	PK	150	233	PASS
1459.44	Vertical	28.44	13.51	41.95	74.00	32.05	PK	150	233	PASS
2059.70	Vertical	33.26	14.24	47.50	74.00	26.50	PK	150	334	PASS
2401.74	Vertical	36.57	46.86	83.43	74.00	-9.43	PK	150	106	---
2708.97	Vertical	37.74	13.09	50.83	74.00	23.17	PK	150	96	PASS
1173.61	Vertical	26.76	1.28	28.04	54.00	25.96	AV	150	134	PASS
1459.44	Vertical	28.44	1.23	29.67	54.00	24.33	AV	150	303	PASS
2059.70	Vertical	33.26	2.04	35.30	54.00	18.70	AV	150	238	PASS
2401.74	Vertical	36.57	39.72	76.29	54.00	-22.29	AV	150	112	---
2708.97	Vertical	37.74	3.40	41.14	54.00	12.86	AV	150	308	PASS



Note: The signal beyond the limit is carrier

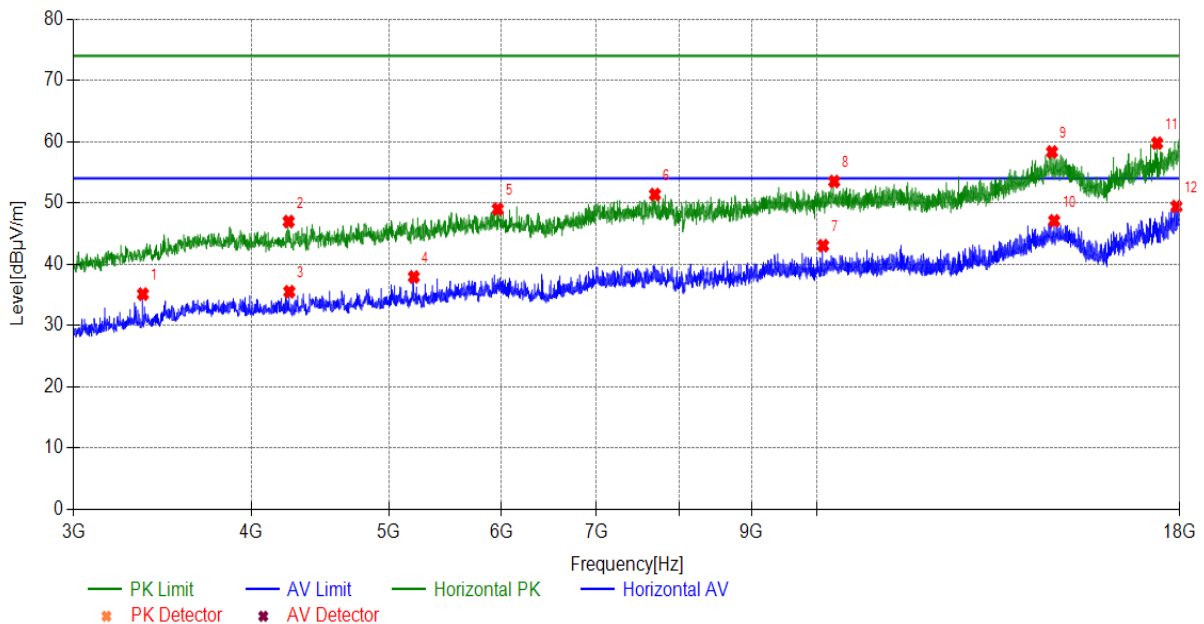
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Radiates Emission	3G~18G
Test channel	Worst-Case

Suspected List										
Frequency [MHz]	Polarity	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
7693.96	Horizont	-0.26	51.63	51.37	74.00	22.63	PK	100	350	PASS
14638.1	Horizont	8.62	49.69	58.31	74.00	15.69	PK	100	40	PASS
17354.9	Horizont	12.07	47.67	59.74	74.00	14.26	PK	100	190	PASS
10286.2	Horizont	4.29	49.21	53.50	74.00	20.50	PK	100	260	PASS
4251.12	Horizont	-6.36	53.32	46.96	74.00	27.04	PK	100	330	PASS
5964.29	Horizont	-4.14	53.12	48.98	74.00	25.02	PK	100	320	PASS
5206.72	Horizont	-5.60	43.53	37.93	54.00	16.07	AV	100	10	PASS
17908.4	Horizont	14.97	34.44	49.41	54.00	4.59	AV	100	10	PASS
4255.62	Horizont	-6.36	41.87	35.51	54.00	18.49	AV	100	10	PASS
10103.2	Horizont	3.84	39.19	43.03	54.00	10.97	AV	100	10	PASS
14690.6	Horizont	8.62	38.46	47.08	54.00	6.92	AV	100	10	PASS
3357.03	Horizont	-8.26	43.39	35.13	54.00	18.87	AV	100	10	PASS



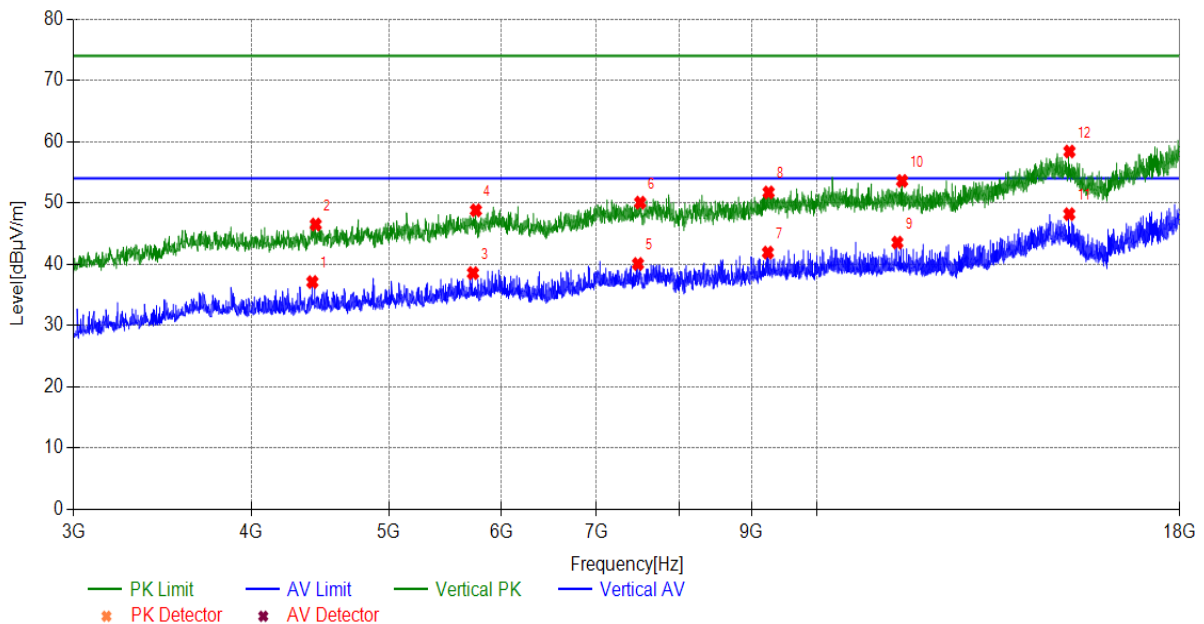
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Radiates Emission	3G~18G
Test channel	Worst-Case

Suspected List										
Frequency [MHz]	Polarity	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
15058.2	Vertical	8.47	49.92	58.39	74.00	15.61	PK	100	220	PASS
11483.3	Vertical	5.03	48.56	53.59	74.00	20.41	PK	100	180	PASS
7512.45	Vertical	-0.32	50.37	50.05	74.00	23.95	PK	100	210	PASS
9249.62	Vertical	2.10	49.62	51.72	74.00	22.28	PK	100	320	PASS
4441.64	Vertical	-6.22	52.70	46.48	74.00	27.52	PK	100	170	PASS
5757.27	Vertical	-4.81	53.60	48.79	74.00	25.21	PK	100	120	PASS
15053.7	Vertical	8.48	39.69	48.17	54.00	5.83	AV	100	10	PASS
7485.44	Vertical	-0.35	40.40	40.05	54.00	13.95	AV	100	10	PASS
5730.27	Vertical	-4.90	43.45	38.55	54.00	15.45	AV	100	10	PASS
9239.12	Vertical	2.08	39.82	41.90	54.00	12.10	AV	100	10	PASS
11394.8	Vertical	5.07	38.46	43.53	54.00	10.47	AV	100	10	PASS
4417.64	Vertical	-6.24	43.33	37.09	54.00	16.91	AV	100	10	PASS



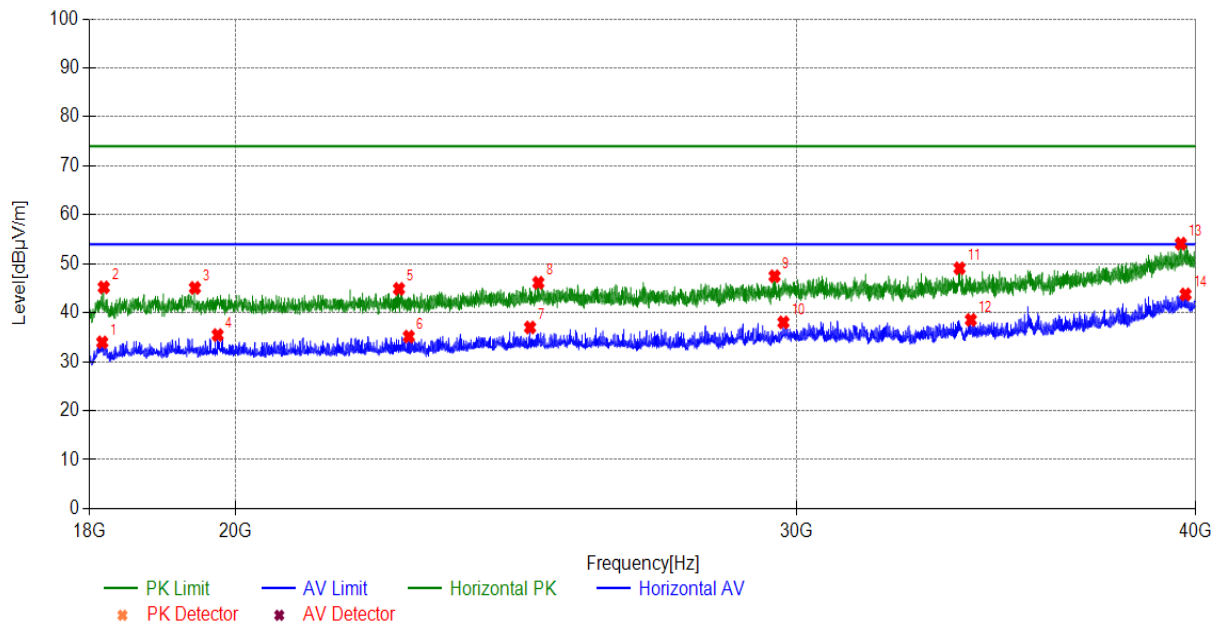
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Radiates Emission	18G~40G
Test channel	Worst-Case

Suspected List										
Frequency [MHz]	Polarity	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
19423.5	Horizont	1.33	43.74	45.07	74.00	28.93	PK	100	100	PASS
24888.8	Horizont	4.06	42.06	46.12	74.00	27.88	PK	100	60	PASS
39575.3	Horizont	10.78	43.33	54.11	74.00	19.89	PK	100	150	PASS
18187.0	Horizont	1.15	44.03	45.18	74.00	28.82	PK	100	60	PASS
33731.5	Horizont	6.52	42.56	49.08	74.00	24.92	PK	100	180	PASS
22506.0	Horizont	2.41	42.47	44.88	74.00	29.12	PK	100	90	PASS
29515.9	Horizont	6.36	41.10	47.46	74.00	26.54	PK	100	170	PASS
19744.7	Horizont	1.31	34.14	35.45	54.00	18.55	AV	100	10	PASS
22666.6	Horizont	2.57	32.56	35.13	54.00	18.87	AV	100	10	PASS
24739.2	Horizont	4.00	32.99	36.99	54.00	17.01	AV	100	10	PASS
39709.5	Horizont	10.79	32.95	43.74	54.00	10.26	AV	100	10	PASS
29705.1	Horizont	6.49	31.53	38.02	54.00	15.98	AV	100	10	PASS
34008.8	Horizont	6.60	31.94	38.54	54.00	15.46	AV	100	10	PASS
18167.2	Horizont	1.14	32.82	33.96	54.00	20.04	AV	100	10	PASS



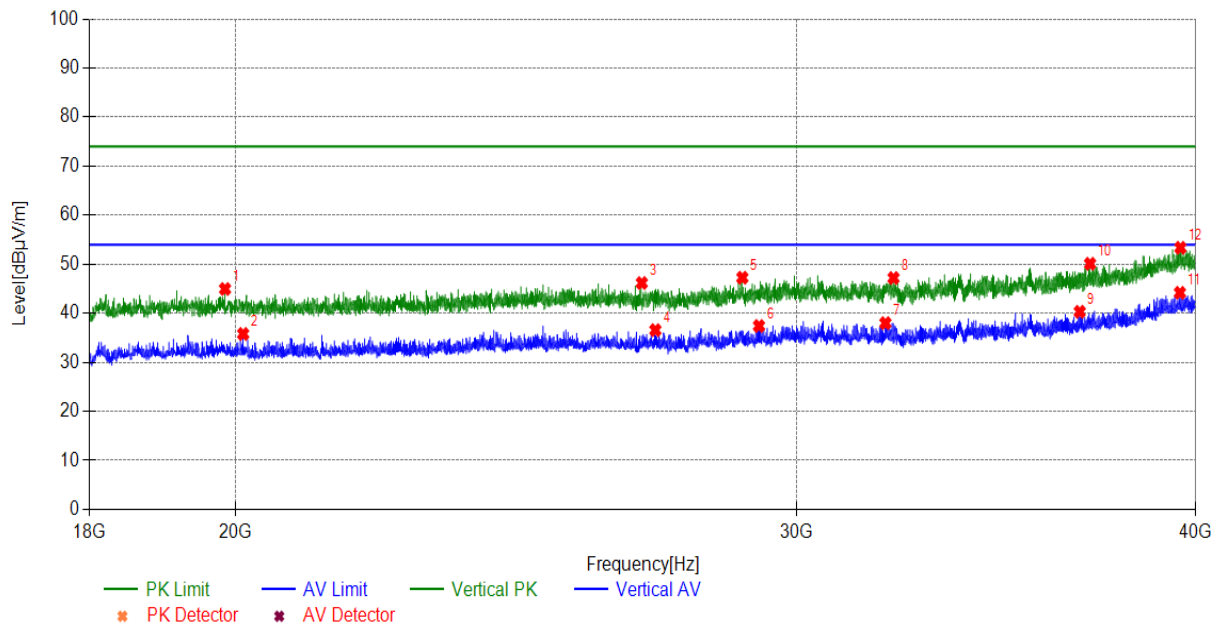
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Radiates Emission	18G~40G
Test channel	Worst-Case

Suspected List										
Frequency [MHz]	Polarity	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
39564.3	Vertical	10.78	42.57	53.35	74.00	20.65	PK	100	50	PASS
37064.9	Vertical	7.93	42.16	50.09	74.00	23.91	PK	100	120	PASS
19850.3	Vertical	1.31	43.64	44.95	74.00	29.05	PK	100	120	PASS
32162.8	Vertical	5.97	41.22	47.19	74.00	26.81	PK	100	20	PASS
28838.2	Vertical	5.90	41.35	47.25	74.00	26.75	PK	100	70	PASS
26818.4	Vertical	4.83	41.34	46.17	74.00	27.83	PK	100	70	PASS
39548.9	Vertical	10.78	33.39	44.17	54.00	9.83	AV	100	10	PASS
20112.2	Vertical	1.34	34.44	35.78	54.00	18.22	AV	100	10	PASS
27082.5	Vertical	4.94	31.62	36.56	54.00	17.44	AV	100	10	PASS
36789.8	Vertical	7.72	32.59	40.31	54.00	13.69	AV	100	10	PASS
31975.7	Vertical	5.91	32.08	37.99	54.00	16.01	AV	100	10	PASS
29185.9	Vertical	6.13	31.27	37.40	54.00	16.60	AV	100	10	PASS



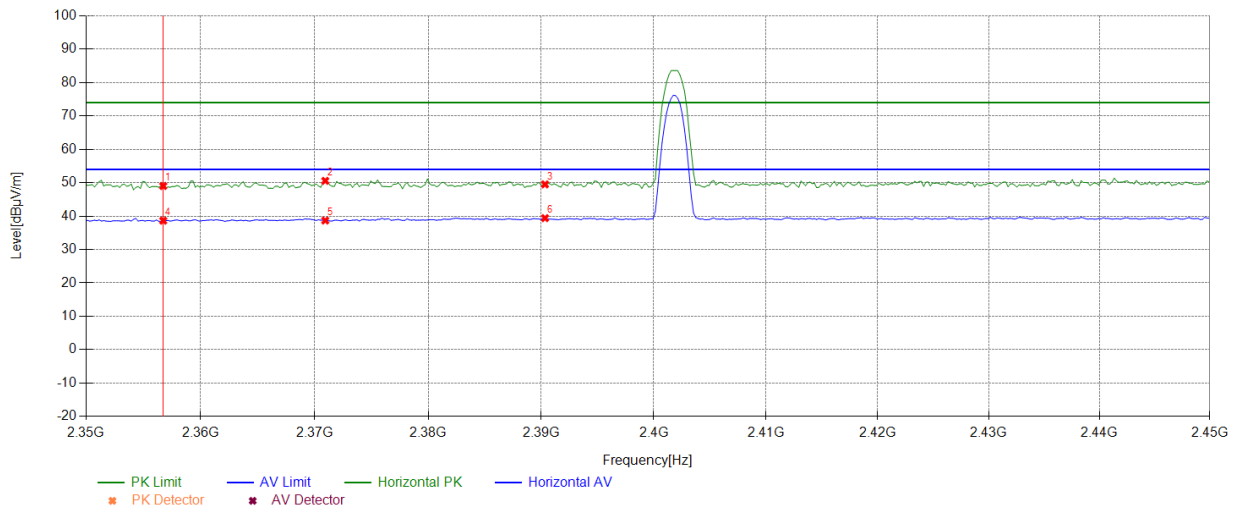
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Band Edge:

Test mode	2DH5									
Test channel	LOW channel									
Suspected List										
Frequency [MHz]	Polarity	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detector	Height [cm]	Angle deg	Pass/Fail
2356.73	Horizont	36.20	12.82	49.02	74.00	24.98	PK	150	203	PASS
2370.93	Horizont	36.32	14.24	50.56	74.00	23.44	PK	150	359	PASS
2390.33	Horizont	36.48	13.02	49.50	74.00	24.50	PK	150	359	PASS
2356.73	Horizont	36.20	2.44	38.64	54.00	15.36	AV	150	132	PASS
2370.93	Horizont	36.32	2.36	38.68	54.00	15.32	AV	150	273	PASS
2390.33	Horizont	36.48	2.91	39.39	54.00	14.61	AV	150	289	PASS

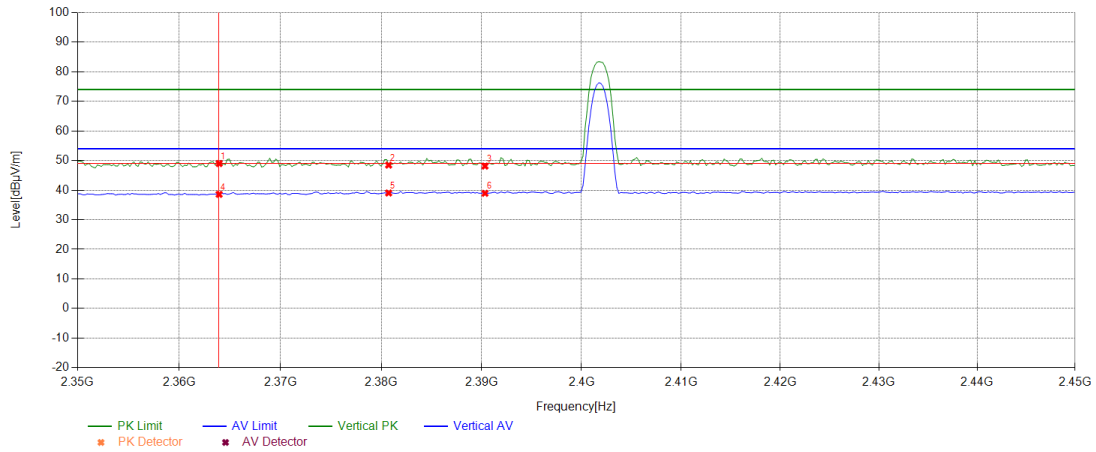


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Test mode	2DH5									
Test channel	LOW channel									
Suspected List										
Frequency [MHz]	Polarity	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detector	Height [cm]	Angle deg	Pass/Fail
2363.93	Vertical	36.26	12.74	49.00	74.00	25.00	PK	150	339	PASS
2380.73	Vertical	36.40	12.07	48.47	74.00	25.53	PK	150	14	PASS
2390.33	Vertical	36.48	11.65	48.13	74.00	25.87	PK	150	129	PASS
2363.93	Vertical	36.26	2.33	38.59	54.00	15.41	AV	150	334	PASS
2380.73	Vertical	36.40	2.64	39.04	54.00	14.96	AV	150	334	PASS
2390.33	Vertical	36.48	2.45	38.93	54.00	15.07	AV	150	68	PASS

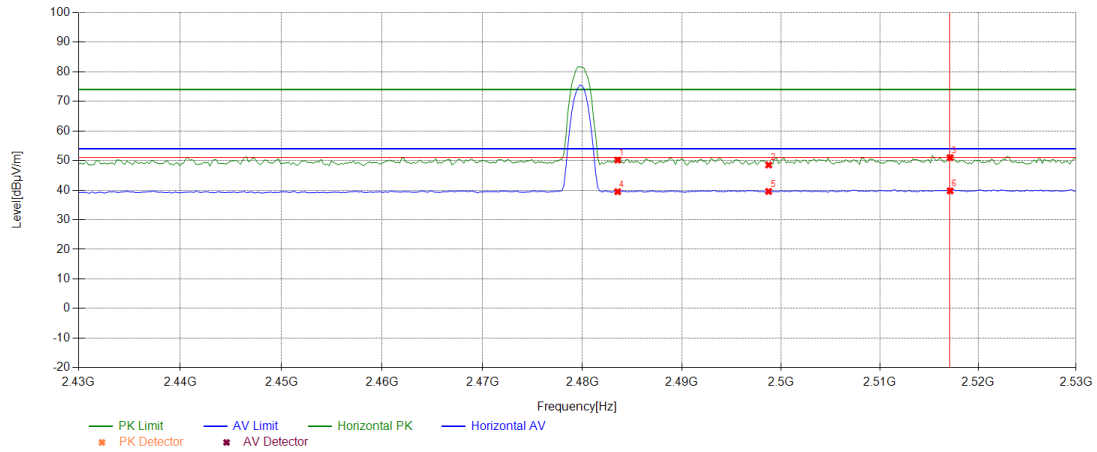


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Test mode		2DH5								
Test channel		HIGH channel								
Suspected List										
Frequency [MHz]	Polarity	Factor [dB]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Detector	Height [cm]	Angle deg	Pass/Fail
2483.54	Horizont	36.90	13.25	50.15	74.00	23.85	PK	150	179	PASS
2498.74	Horizont	36.96	11.55	48.51	74.00	25.49	PK	150	360	PASS
2517.15	Horizont	37.04	13.93	50.97	74.00	23.03	PK	150	360	PASS
2483.54	Horizont	36.90	2.58	39.48	54.00	14.52	AV	150	330	PASS
2498.74	Horizont	36.96	2.60	39.56	54.00	14.44	AV	150	360	PASS
2517.15	Horizont	37.04	2.71	39.75	54.00	14.25	AV	150	0	PASS

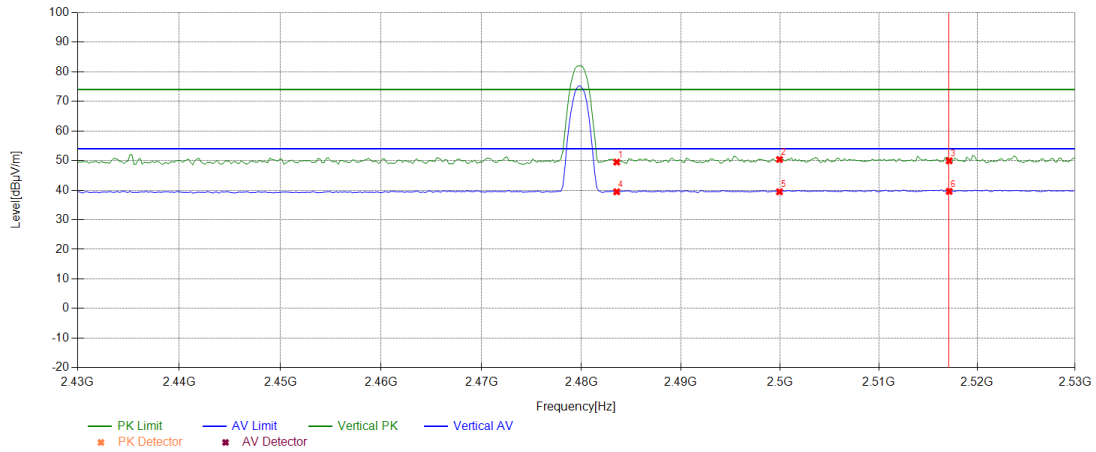


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Test mode		2DH5								
Test channel		HIGH channel								
Suspected List										
Frequency [MHz]	Polarity	Factor [dB]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Detector	Height [cm]	Angle deg	Pass/Fail
2483.54	Vertical	36.90	12.59	49.49	74.00	24.51	PK	150	4	PASS
2499.95	Vertical	36.96	13.39	50.35	74.00	23.65	PK	150	4	PASS
2517.15	Vertical	37.04	12.87	49.91	74.00	24.09	PK	150	4	PASS
2483.54	Vertical	36.90	2.55	39.45	54.00	14.55	AV	150	309	PASS
2499.95	Vertical	36.96	2.48	39.44	54.00	14.56	AV	150	353	PASS
2517.15	Vertical	37.04	2.55	39.59	54.00	14.41	AV	150	109	PASS



5.3 Peak Power Output -Conducted

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement:

During the process of the testing, The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. The EUT is controlled by the Bluetooth test set to ensure max power transmission with proper modulation. The peak detector is used.

Limits:

Rule Part 15.247 (b) (1) specifies that " 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."

Peak Output Power	$\leq 0.125W$ (21dBm)
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Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 0.44$ dB.

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Test Results:

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH5	Ant1	2402	-14.77	≤ 20.97	PASS
	Ant1	2441	-14.3	≤ 20.97	PASS
	Ant1	2480	-13.88	≤ 20.97	PASS
2DH5	Ant1	2402	-14.13	≤ 20.97	PASS
	Ant1	2441	-13.67	≤ 20.97	PASS
	Ant1	2480	-13.14	≤ 20.97	PASS

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5.4 20dB Emission Bandwidth

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement:

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable. RBW is set to 20 kHz; VBW is set to 100 kHz on spectrum analyzer.

Detector=Peak, Trace mode=Max hold.

Limits:

No specific occupied bandwidth requirements in part 15.247(a) (1).

Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 936$ Hz.

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Test Results:

TestMode	Antenna	Channel	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.96	2401.484	2402.444	---	PASS
	Ant1	2441	0.96	2440.484	2441.444	---	PASS
	Ant1	2480	0.96	2479.481	2480.441	---	PASS
2DH5	Ant1	2402	1.29	2401.322	2402.612	---	PASS
	Ant1	2441	1.29	2440.319	2441.609	---	PASS
	Ant1	2480	1.32	2479.295	2480.615	---	PASS

Test Graphs

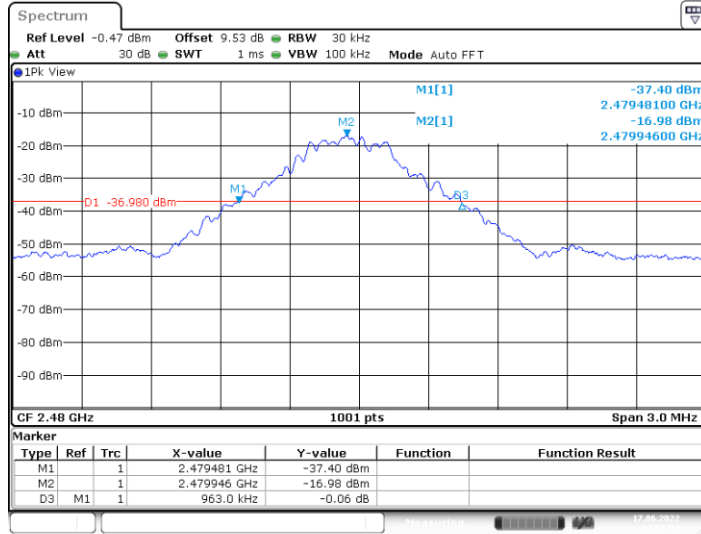


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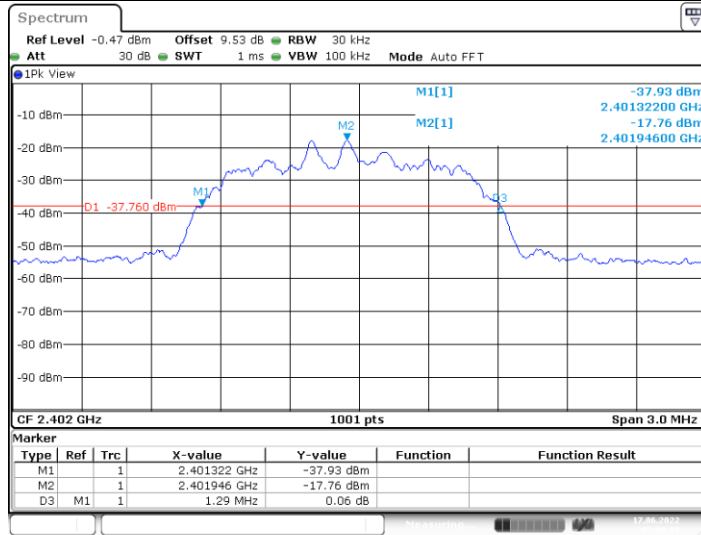
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DH5_Ant1_2480



2DH5_Ant1_2402

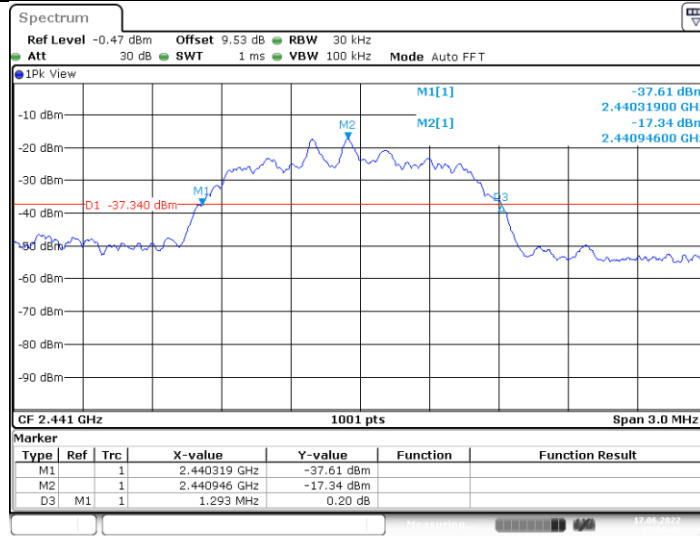


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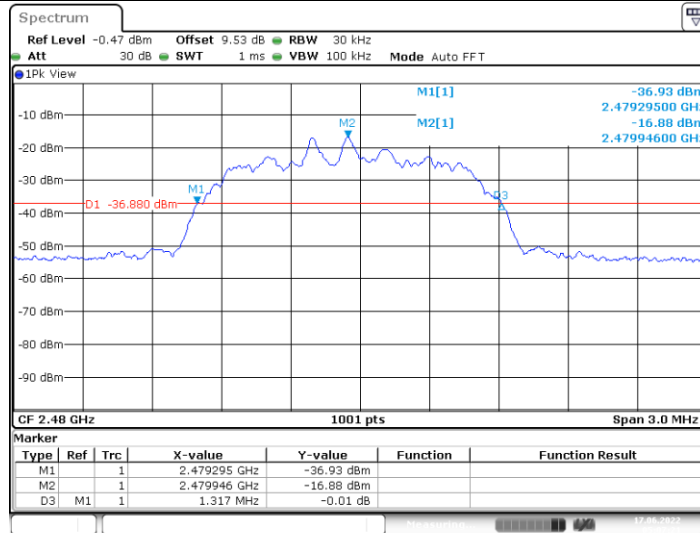
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2DH5_Ant1_2441



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2DH5_Ant1_2480



Date: 17.JUN.2022 05:07:22

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5.5 Occupied Channel Bandwidth

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement:

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable. RBW is set to 20 kHz; VBW is set to 100 kHz on spectrum analyzer.

Detector=Peak, Trace mode=Max hold.

Limits:

No specific occupied bandwidth requirements in part 15.247(a) (1).

Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 936$ Hz.

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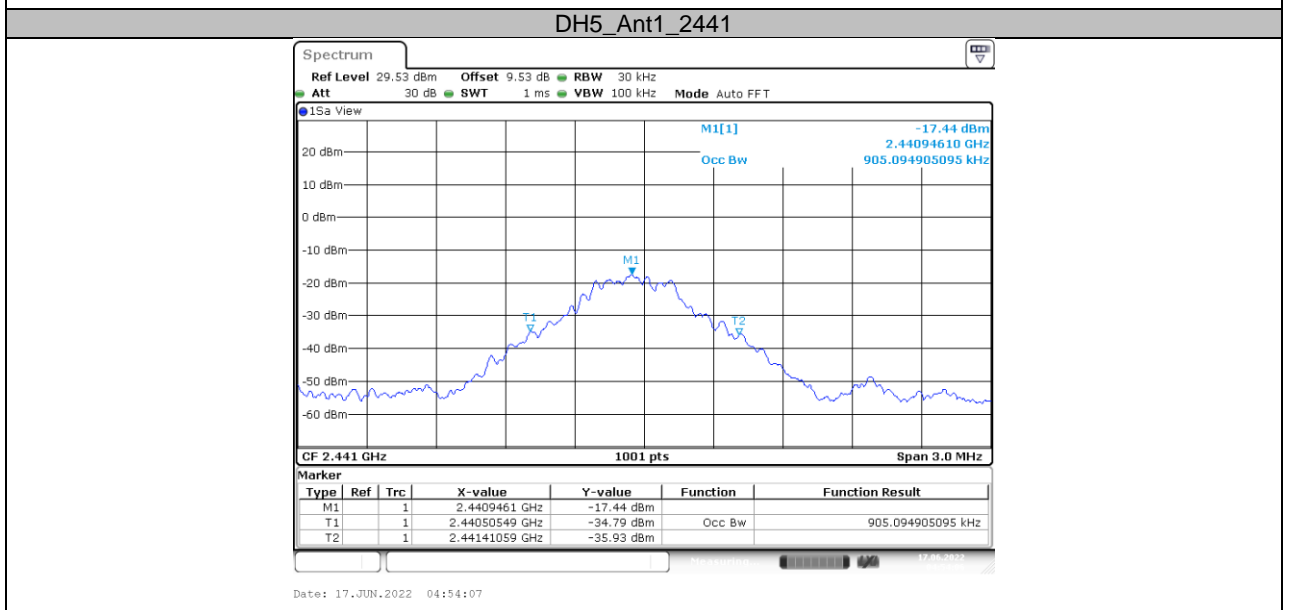
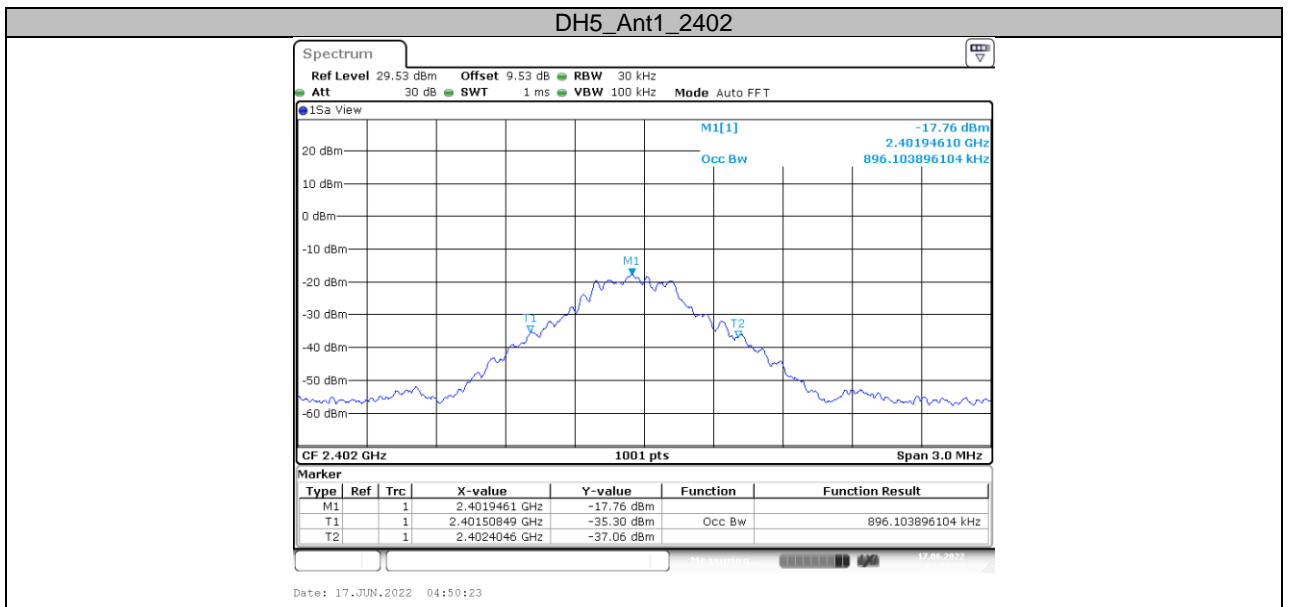
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Test Results:

TestMode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.896	2401.508	2402.405	---	PASS
	Ant1	2441	0.905	2440.505	2441.411	---	PASS
	Ant1	2480	0.899	2479.505	2480.405	---	PASS
2DH5	Ant1	2402	1.190	2401.362	2402.551	---	PASS
	Ant1	2441	1.190	2440.359	2441.548	---	PASS
	Ant1	2480	1.187	2479.362	2480.548	---	PASS

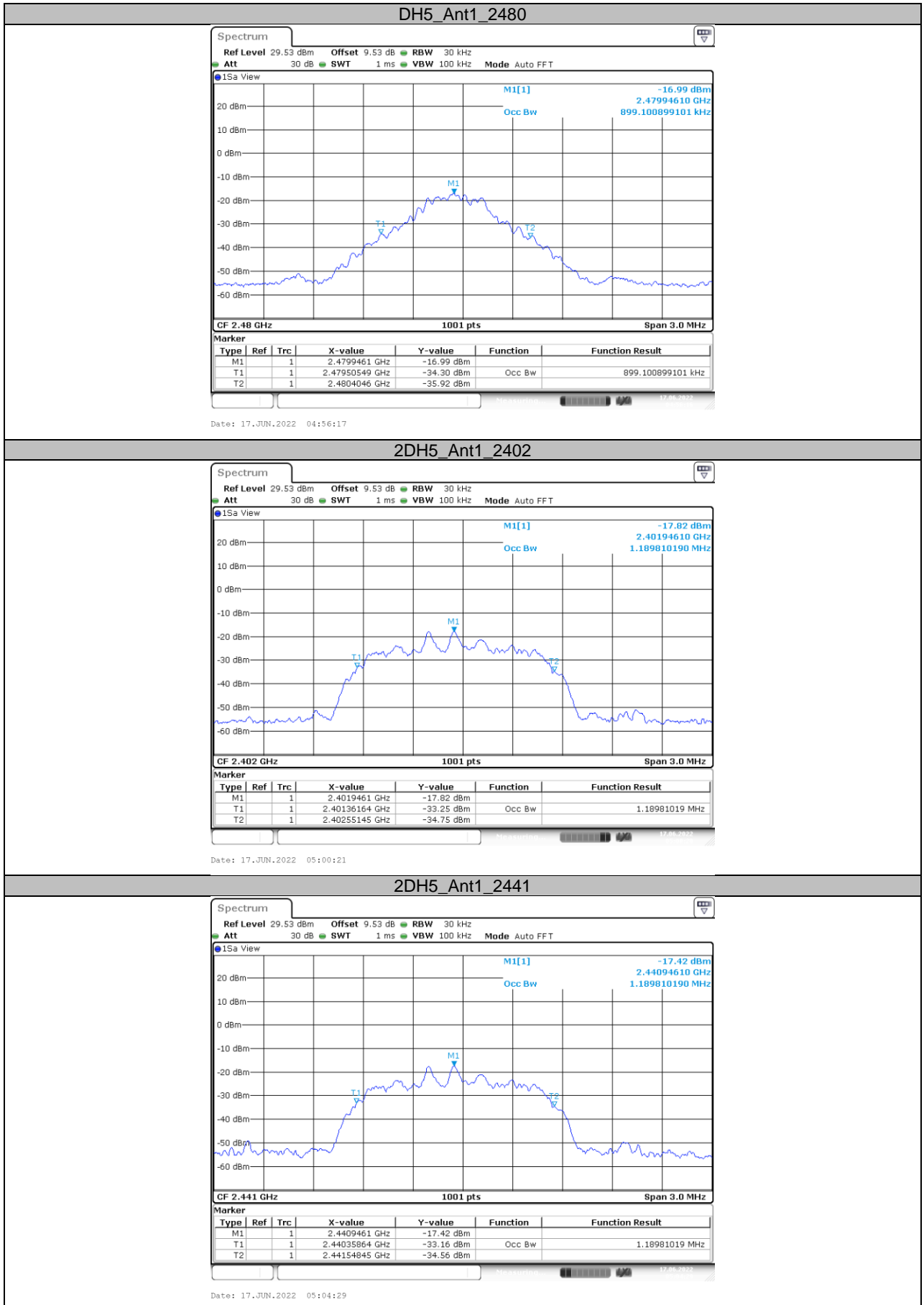
Test Graphs



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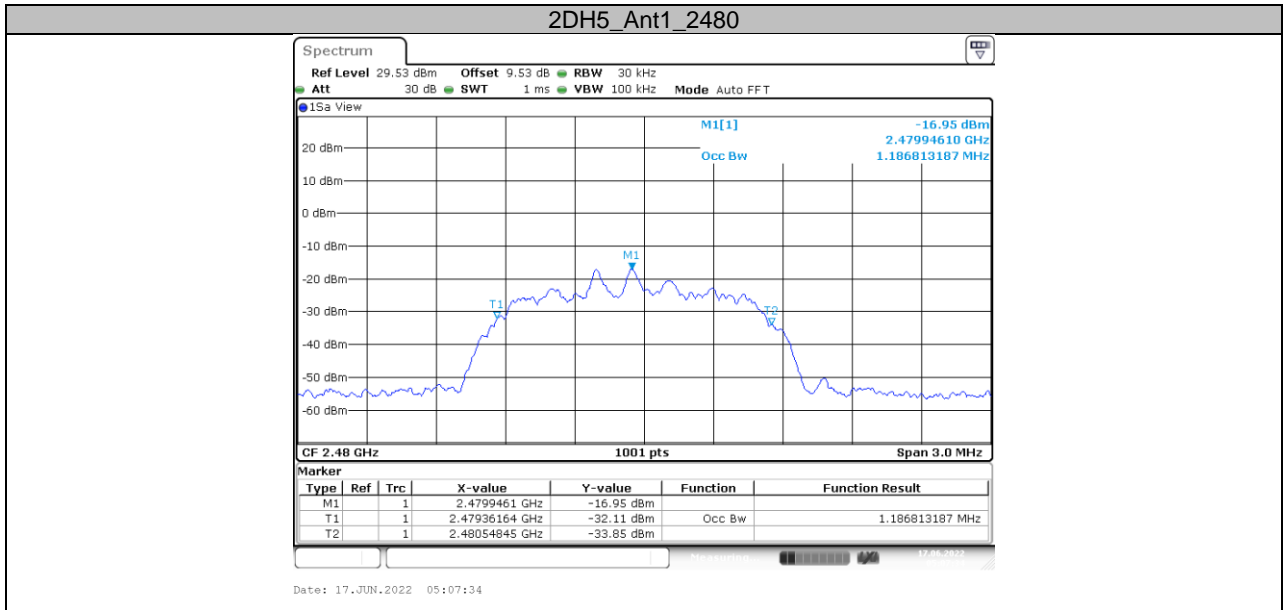
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5.6 Frequency Separation

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement:

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable the band edge of the lowest and highest channels were measured. The peak detector is used and RBW is set to 100 kHz and VBW is set to 300 kHz on spectrum analyzer.

Limits:

Rule Part 15.247(a)(1) specifies that "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. "

Note: The value of two-thirds of 20 dB bandwidth is always greater than 25 kHz.

Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U=936$ Hz.

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Test Results:

TestMode	Antenna	Channel	Result[MHz]	Limit[MHz]	Verdict
DH5	Ant1	Hop	0.991	≥0.960	PASS
2DH5	Ant1	Hop	0.928	≥0.880	PASS

Test Graphs



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5.7 Time of Occupancy (Dwell Time)

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement:

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. RBW is set to 1MHz and VBW is set to 3MHz on spectrum analyzer. The dwell time is calculated by:

Dwell time = time slot length * hop rate * 0.4s with:

The selected EUT Packet type uses a slot type of 5-Tx&1-Rx and a hopping rate of 1600(ch*hop/s) for all channels. So the final hopping rate for all channel is $1600/6=266.67(\text{ch*hop/s})$

Limits:

Rule Part15.247(a) specifies that " Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. 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."

Dwell time	$\leq 400\text{ms}$
------------	---------------------

Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$.

Requirements	Uncertainty					
Dwell Time	DH5	U=0.70ms	2DH5	U=0.70ms	3DH5	U=0.70ms

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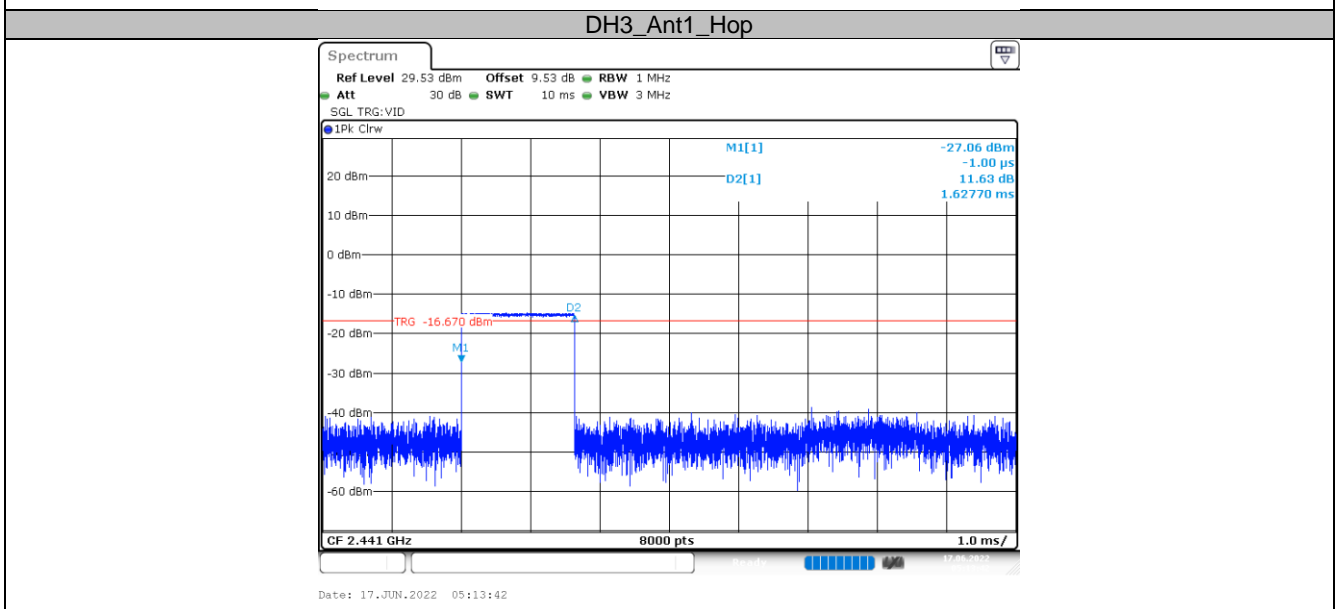
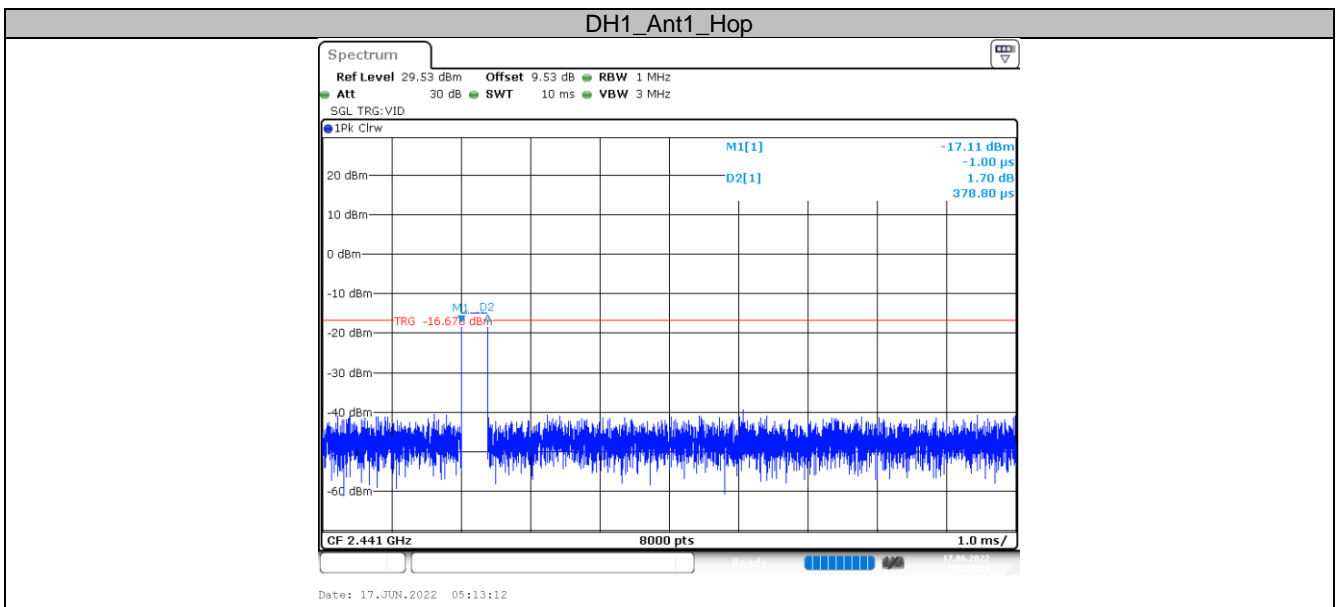
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Test Results:

TestMode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.38	320	0.121	≤0.4	PASS
DH3	Ant1	Hop	1.63	160	0.26	≤0.4	PASS
DH5	Ant1	Hop	2.87	106.67	0.306	≤0.4	PASS
2DH1	Ant1	Hop	0.39	320	0.124	≤0.4	PASS
2DH3	Ant1	Hop	1.63	160	0.261	≤0.4	PASS
2DH5	Ant1	Hop	-1.86	106.67	-0.198	≤0.4	PASS

Test Graphs:

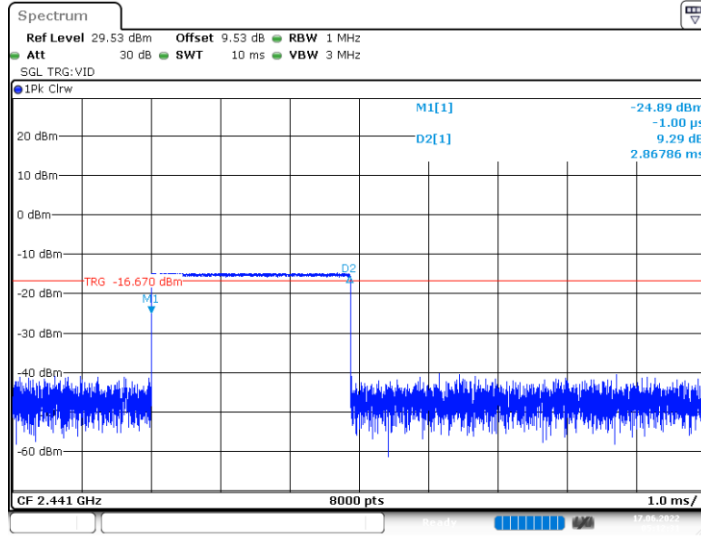


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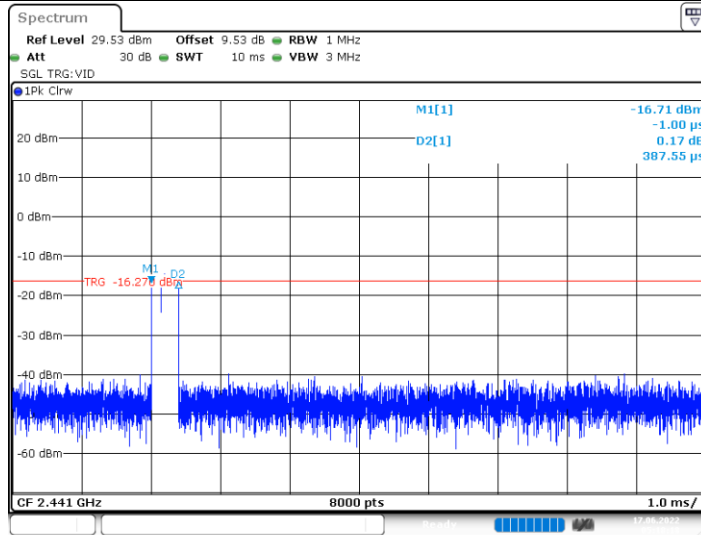
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DH5_Ant1_Hop



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2DH1_Ant1_Hop



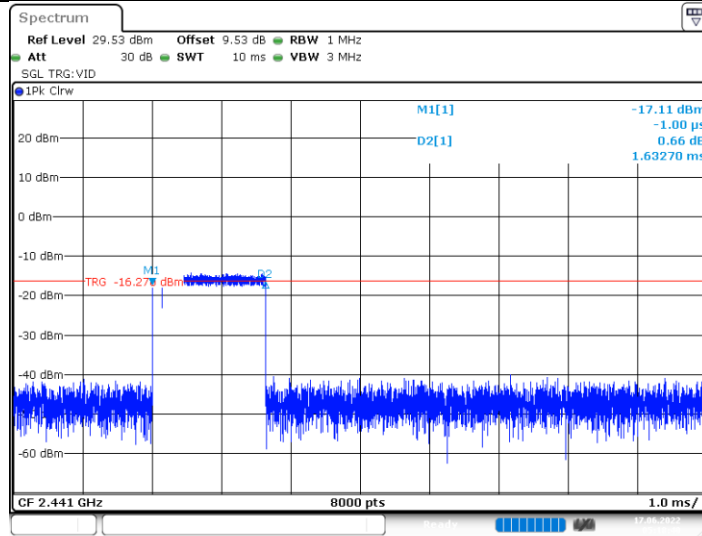
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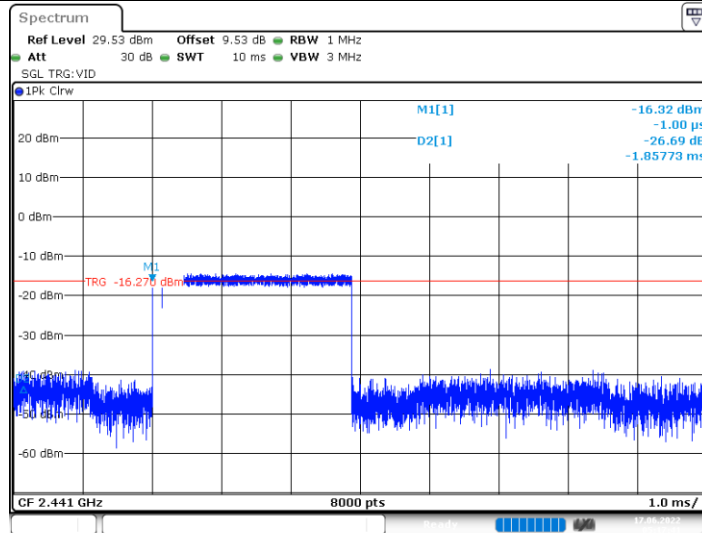
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2DH3_Ant1_Hop



Date: 17.JUN.2022 05:18:40

2DH5_Ant1_Hop



Date: 17.JUN.2022 05:17:42

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5.8 Band Edge Measurement

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement:

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable the band edge of the lowest and highest channels were measured. The peak detector is used and RBW is set to 100 kHz and VBW is set to 300 kHz on spectrum analyzer.

Limits:

Rule Part 15.247(d) specifies that "In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$, $U = 936 \text{ Hz}$, $2 \text{ GHz} - 3 \text{ GHz} = 1.407 \text{ dB}$.

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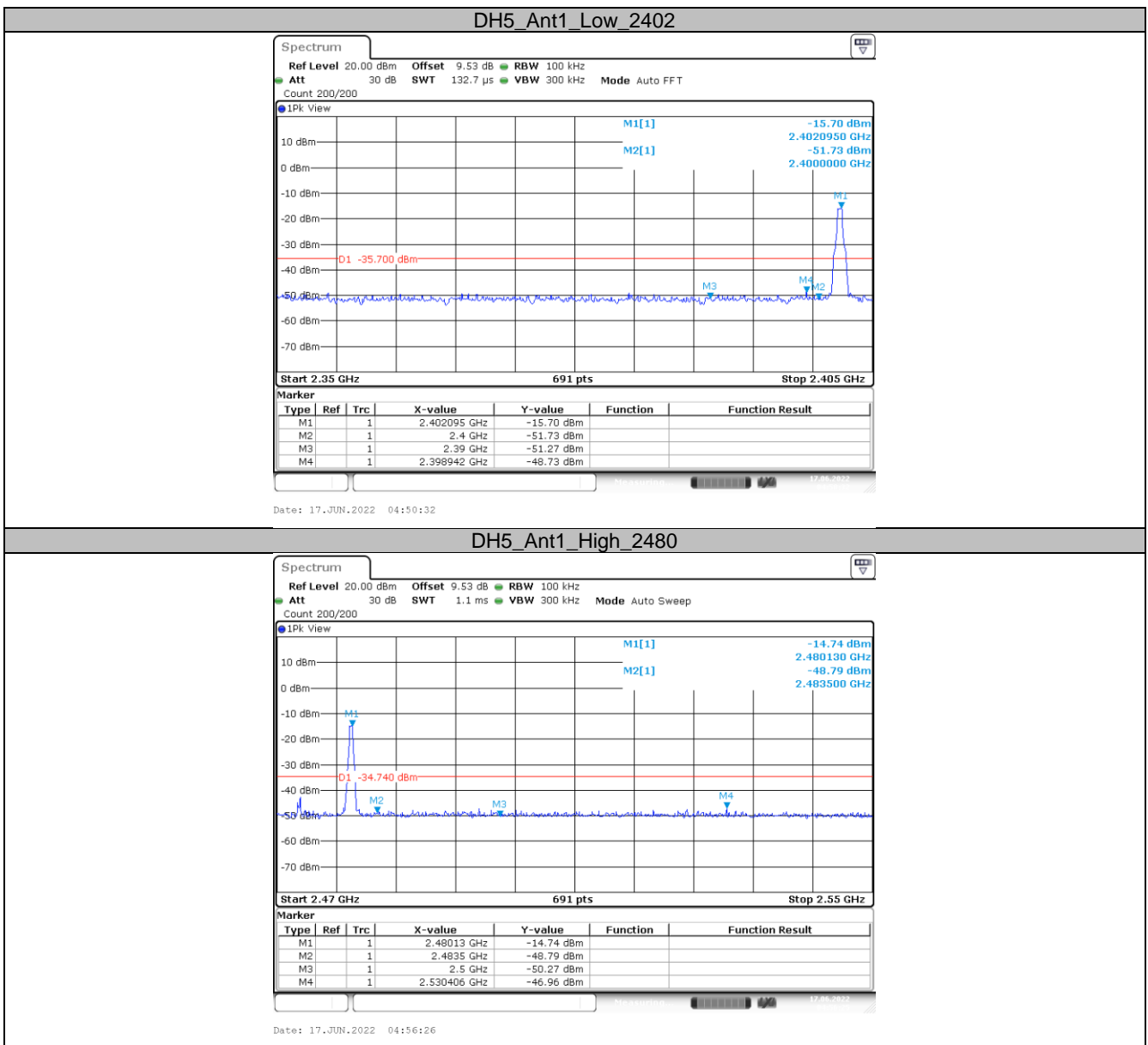
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Test Result:

TestMode	Antenna	ChName	Channel	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	Low	2402	-15.70	-48.73	≤-35.7	PASS
	Ant1	High	2480	-14.74	-46.96	≤-34.74	PASS
	Ant1	Low	Hop_2402	-16.28	-48.58	≤-36.28	PASS
	Ant1	High	Hop_2480	-14.75	-46.96	≤-34.75	PASS
2DH5	Ant1	Low	2402	-15.53	-48.17	≤-35.53	PASS
	Ant1	High	2480	-14.65	-47.48	≤-34.65	PASS
	Ant1	Low	Hop_2402	-19.54	-49.24	≤-39.54	PASS
	Ant1	High	Hop_2480	-15.25	-47.39	≤-35.25	PASS

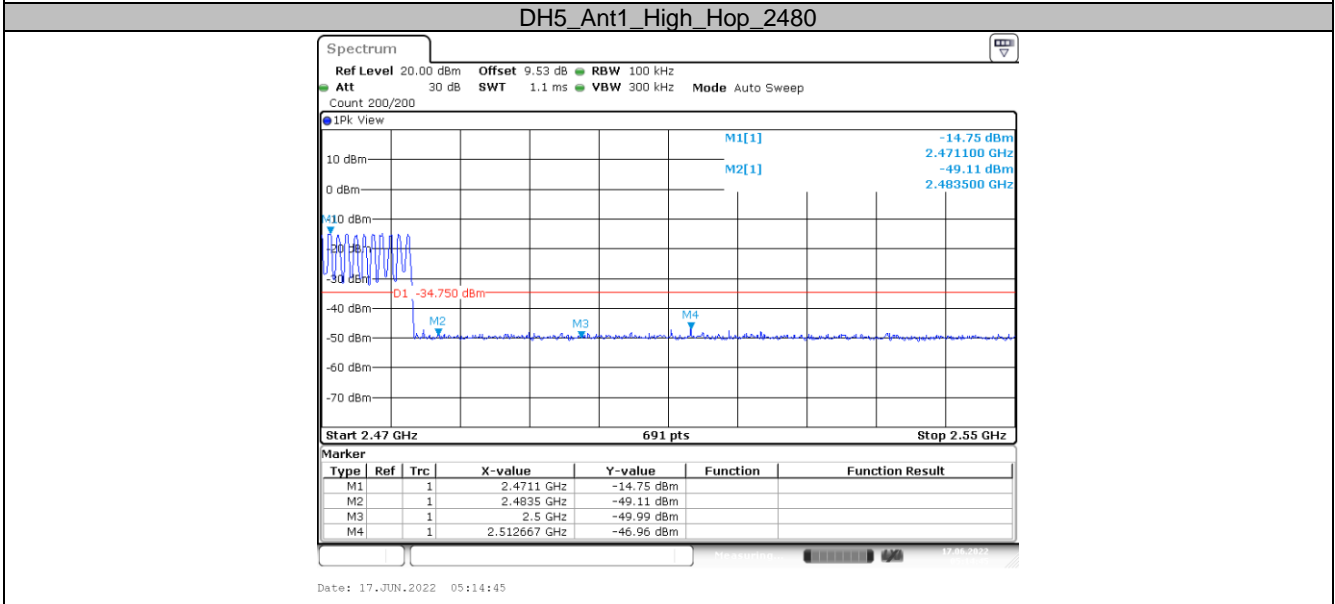
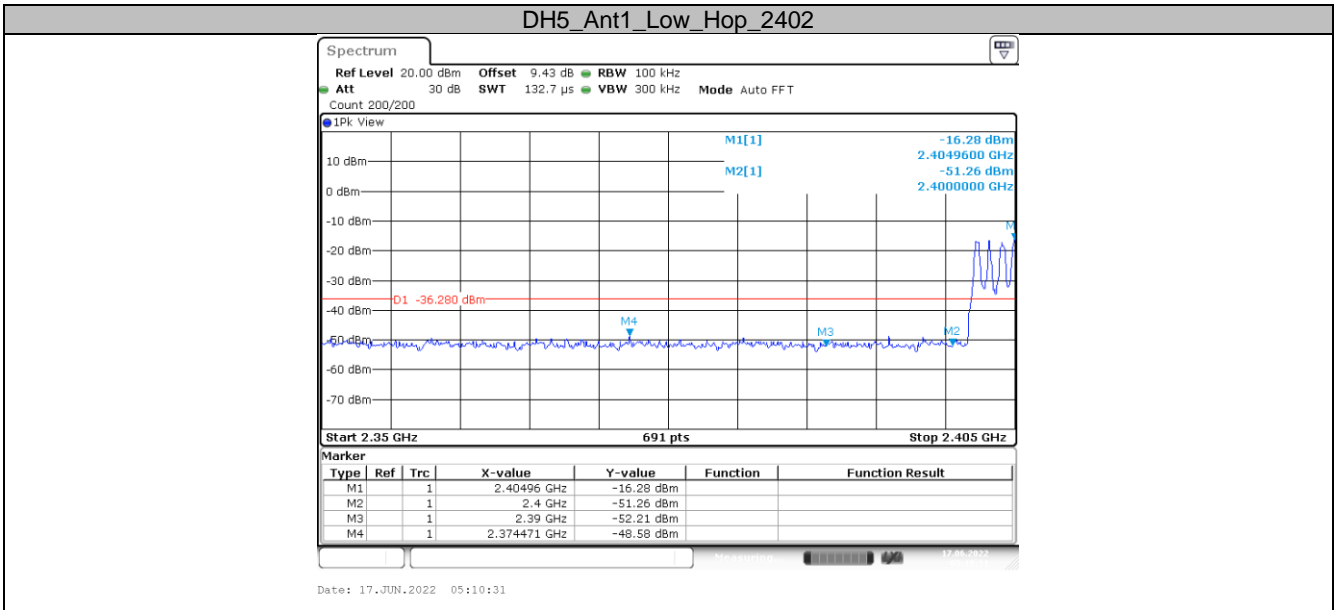
Test Graphs:



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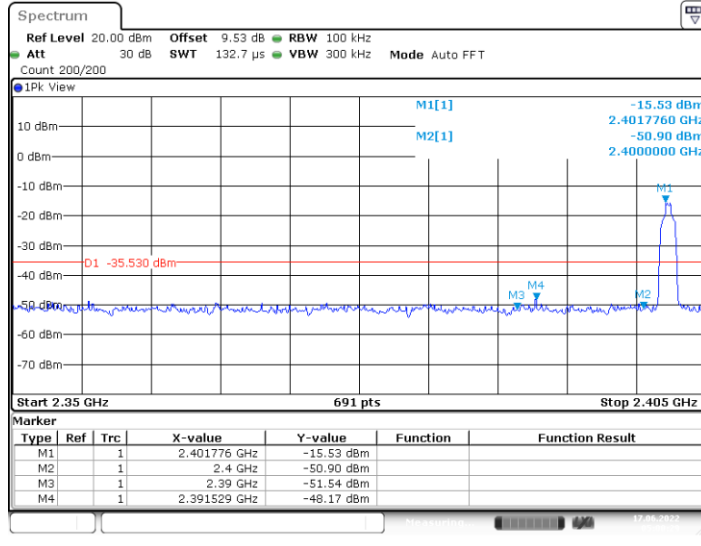


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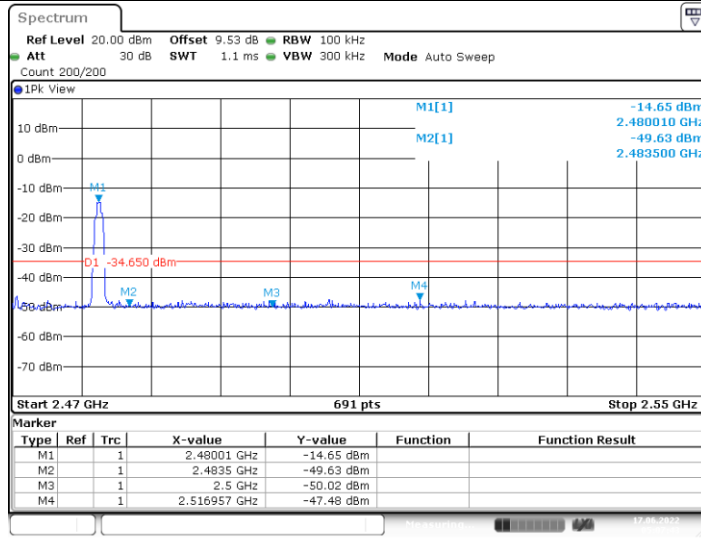
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2DH5_Ant1_Low_2402



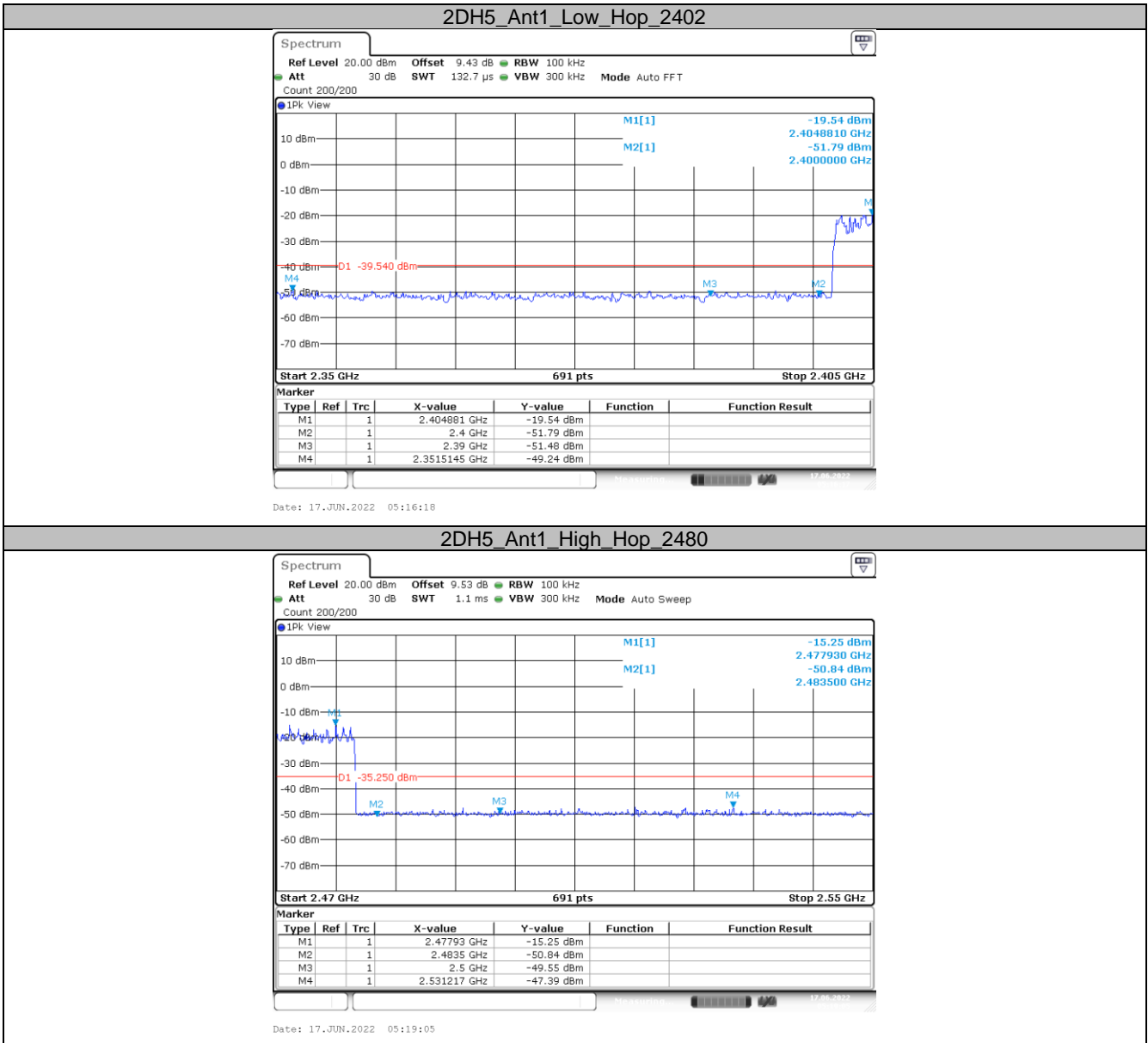
2DH5_Ant1_High_2480



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5.9 Number of hopping Frequency

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement:

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. RBW is set to 100KHz and VBW is set to 300KHz on spectrum analyzer. Set EUT on Hopping on mode.

Limits:

Rule Part 15.247(a) (1) (iii) specifies that” Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.”

Limits	≥ 15 channels
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Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 0.75\text{dB}$.

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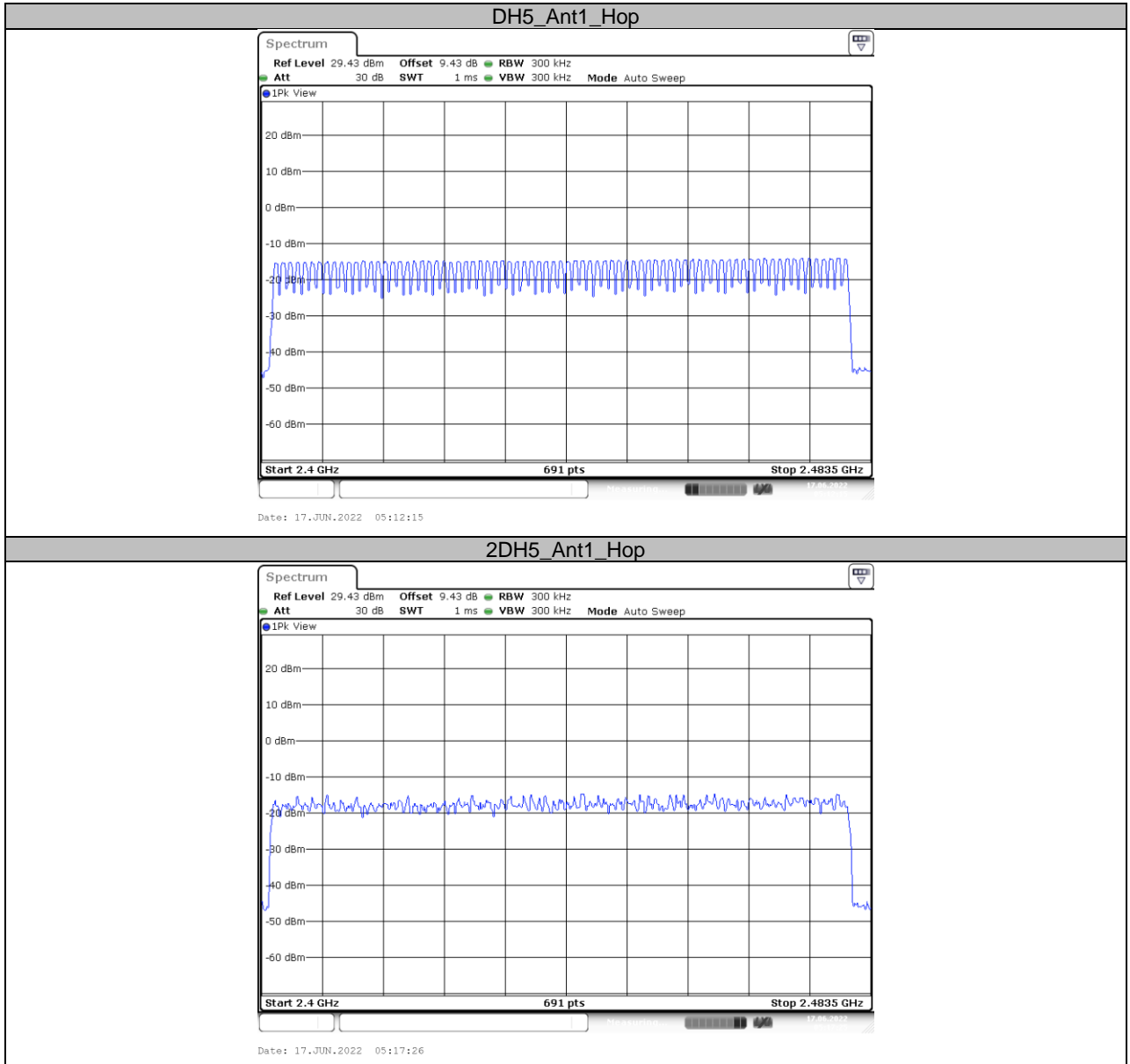
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Test Results:

TestMode	Antenna	Channel	Result[Num]	Limit[Num]	Verdict
DH5	Ant1	Hop	79	>=15	PASS
2DH5	Ant1	Hop	79	>=15	PASS

Test Graphs:



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5.10 Spurious RF Conducted Emissions

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement:

The EUT was connected to the spectrum analyzer with a known loss. The spectrum analyzer scans from 30MHz to the 10th harmonic of the carrier. The peak detector is used. Set RBW to 100kHz and VBW to 300 kHz, Sweep is set to AUTO .The test is in transmitting mode.

Limits:

Rule Part 15.247(d) specifies that "In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$.

Frequency	Uncertainty
100kHz-2GHz	0.684 dB
2GHz-26GHz	1.407 dB

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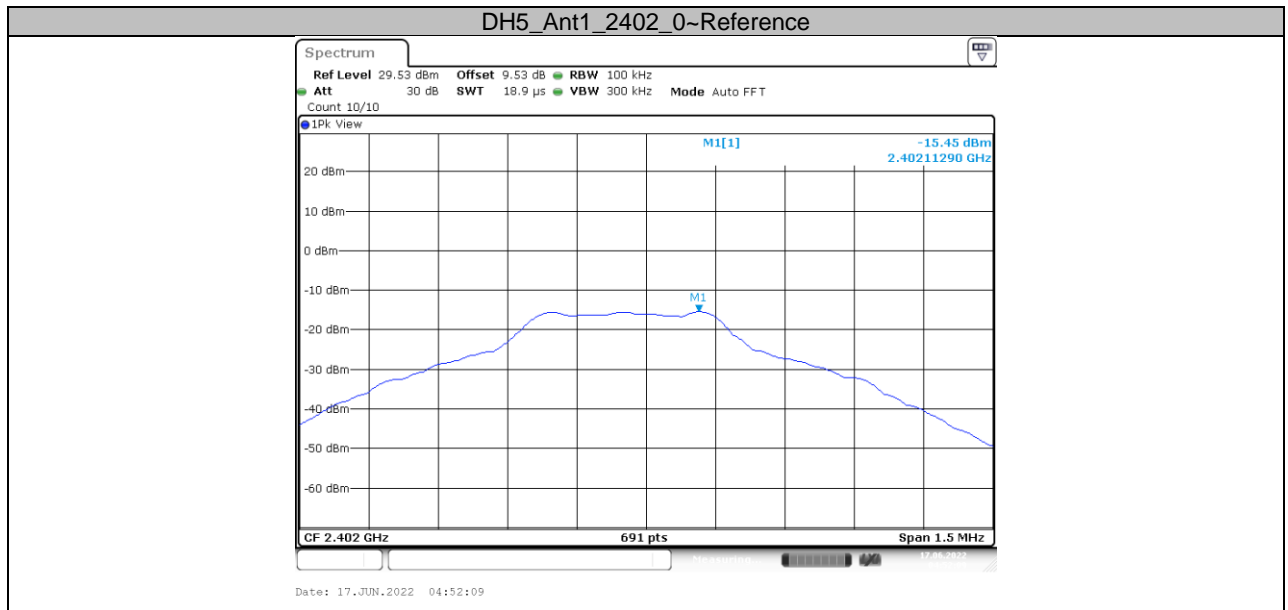
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Test Results:

TestMode	Antenna	Channel	FreqRange [MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	Reference	-15.45	-15.45	---	PASS
			30~1000	-15.45	-52.13	≤-35.45	PASS
			1000~26500	-15.45	-48.86	≤-35.45	PASS
	Ant1	2441	Reference	-15.13	-15.13	---	PASS
			30~1000	-15.13	-59.78	≤-35.13	PASS
			1000~26500	-15.13	-48.53	≤-35.13	PASS
	Ant1	2480	Reference	-14.71	-14.71	---	PASS
			30~1000	-14.71	-59.16	≤-34.71	PASS
			1000~26500	-14.71	-48.35	≤-34.71	PASS
2DH5	Ant1	2402	Reference	-15.50	-15.50	---	PASS
			30~1000	-15.50	-42.47	≤-35.5	PASS
			1000~26500	-15.50	-46.22	≤-35.5	PASS
	Ant1	2441	Reference	-15.08	-15.08	---	PASS
			30~1000	-15.08	-51.38	≤-35.08	PASS
			1000~26500	-15.08	-47.89	≤-35.08	PASS
	Ant1	2480	Reference	-14.62	-14.62	---	PASS
			30~1000	-14.62	-59.41	≤-34.62	PASS
			1000~26500	-14.62	-48.54	≤-34.62	PASS

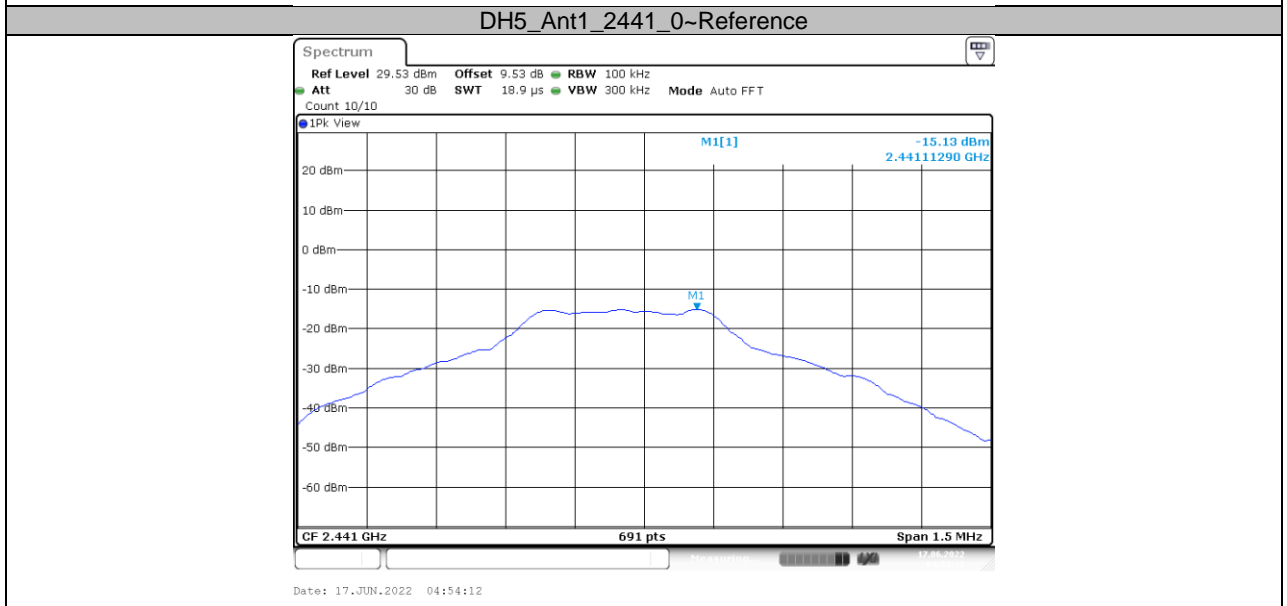
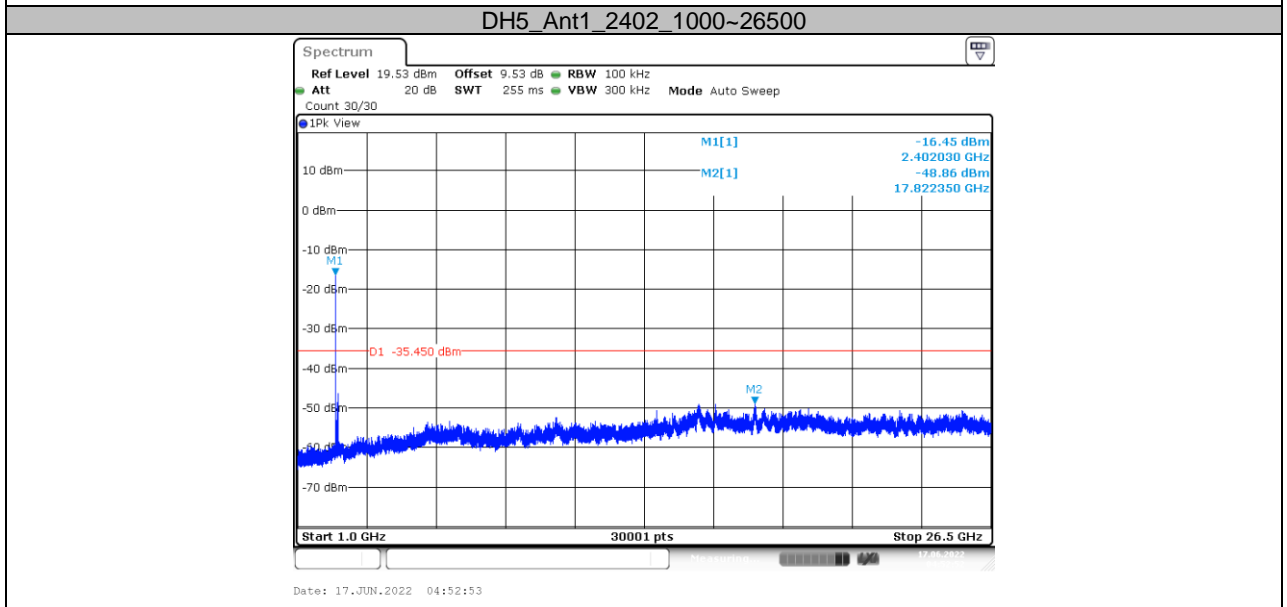
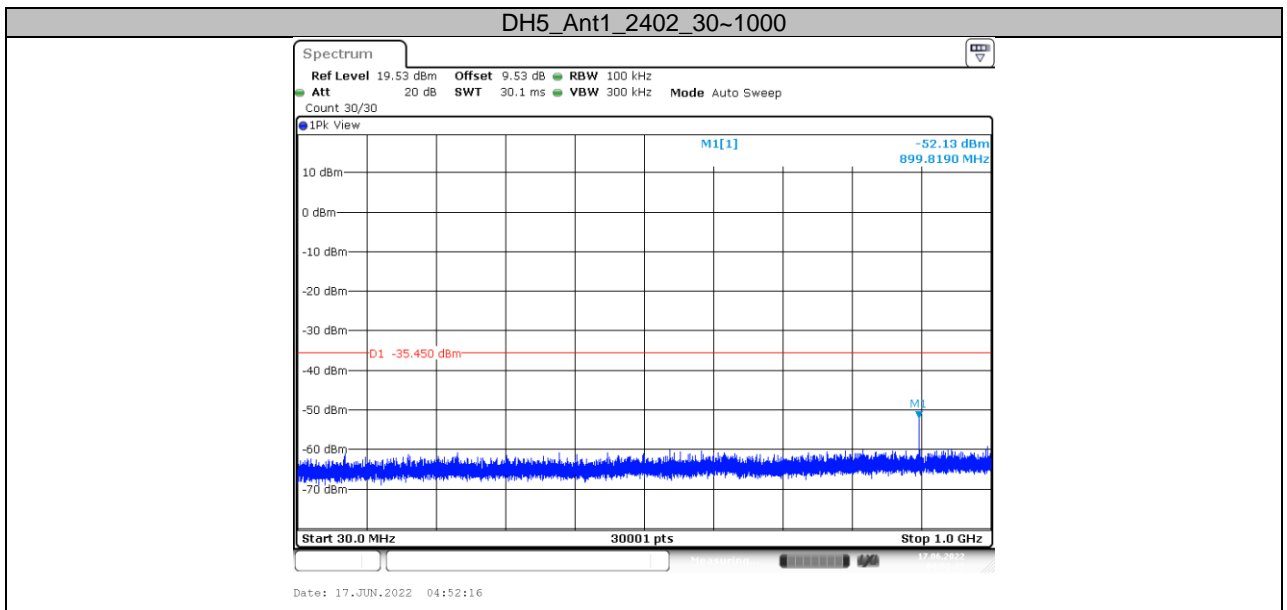
Test Graphs:



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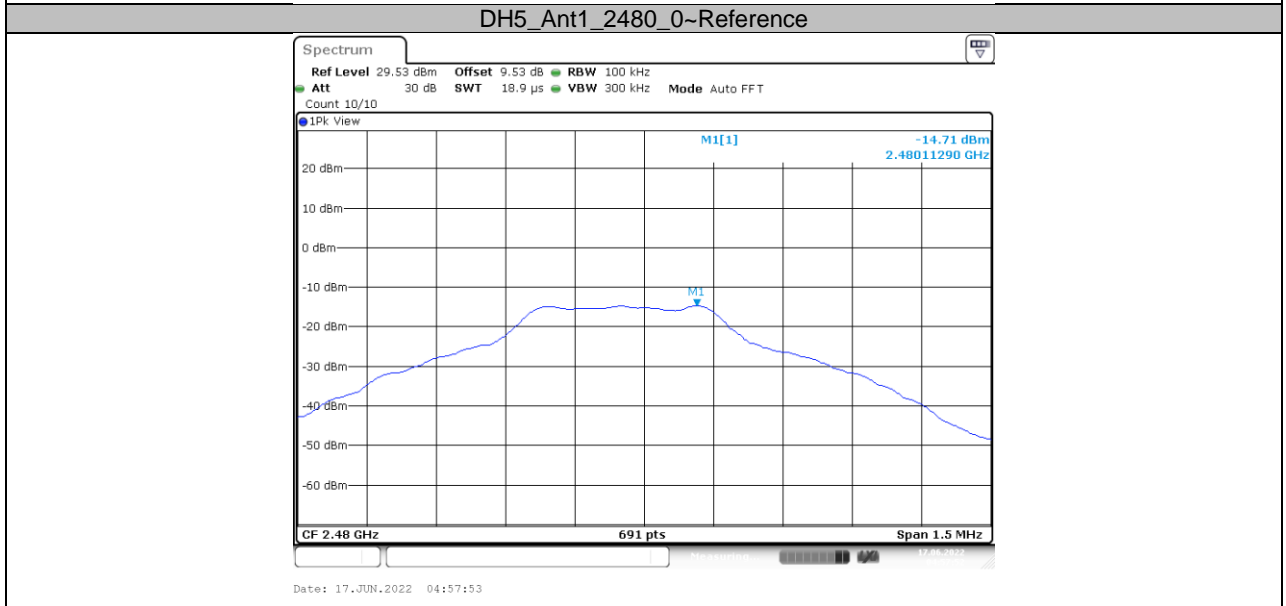
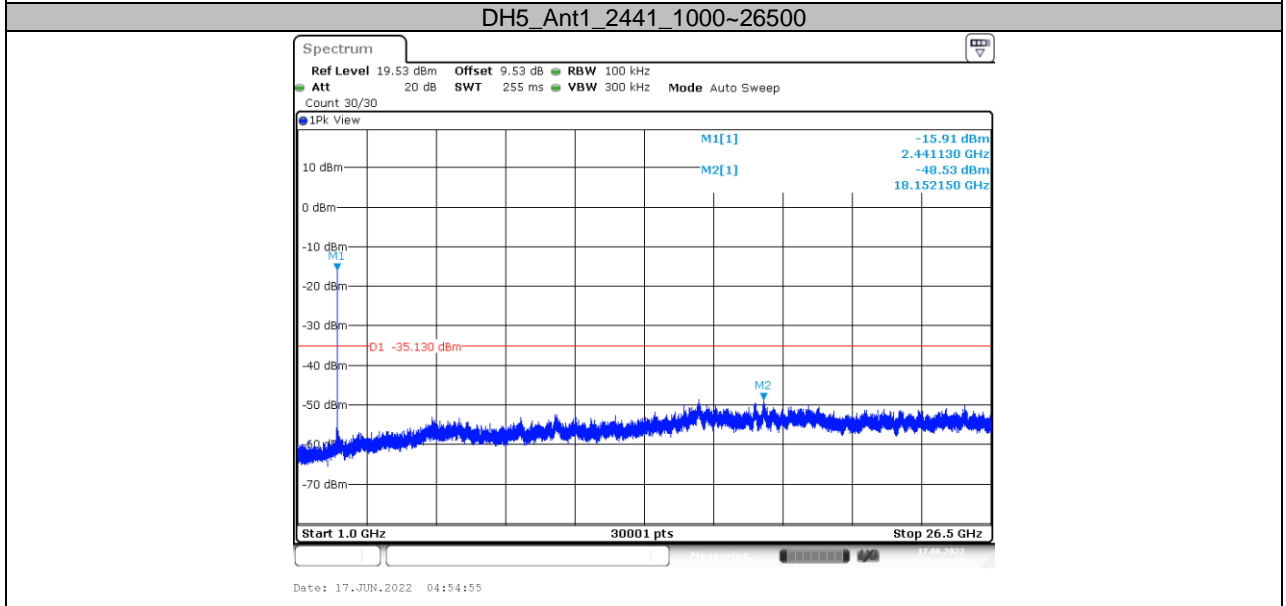
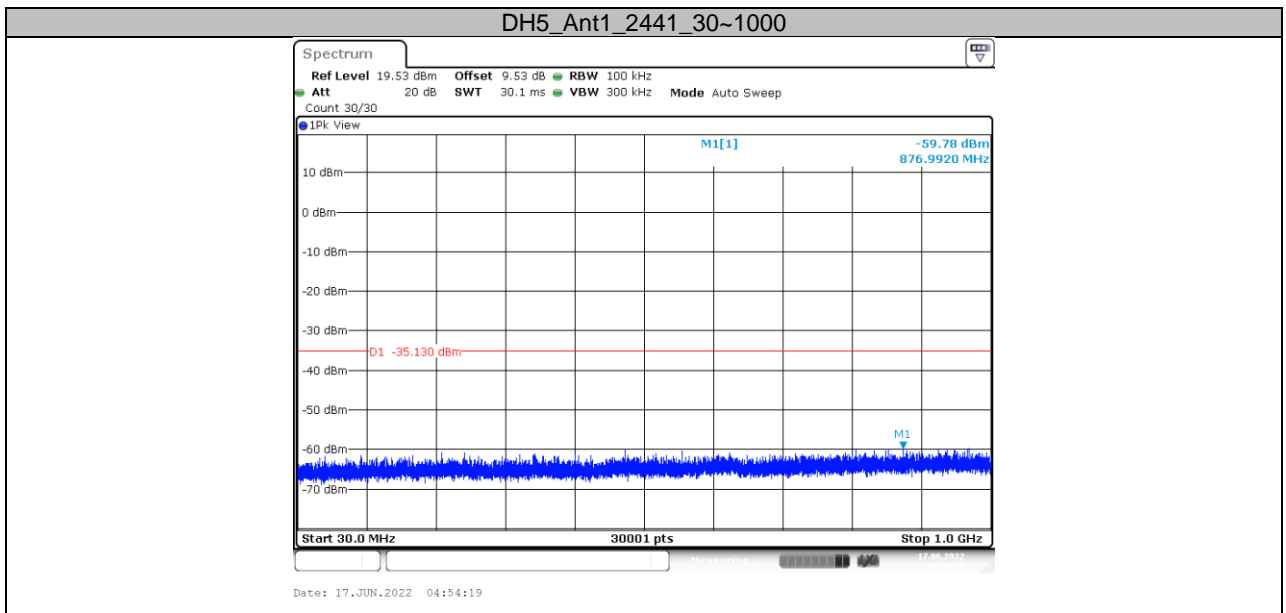
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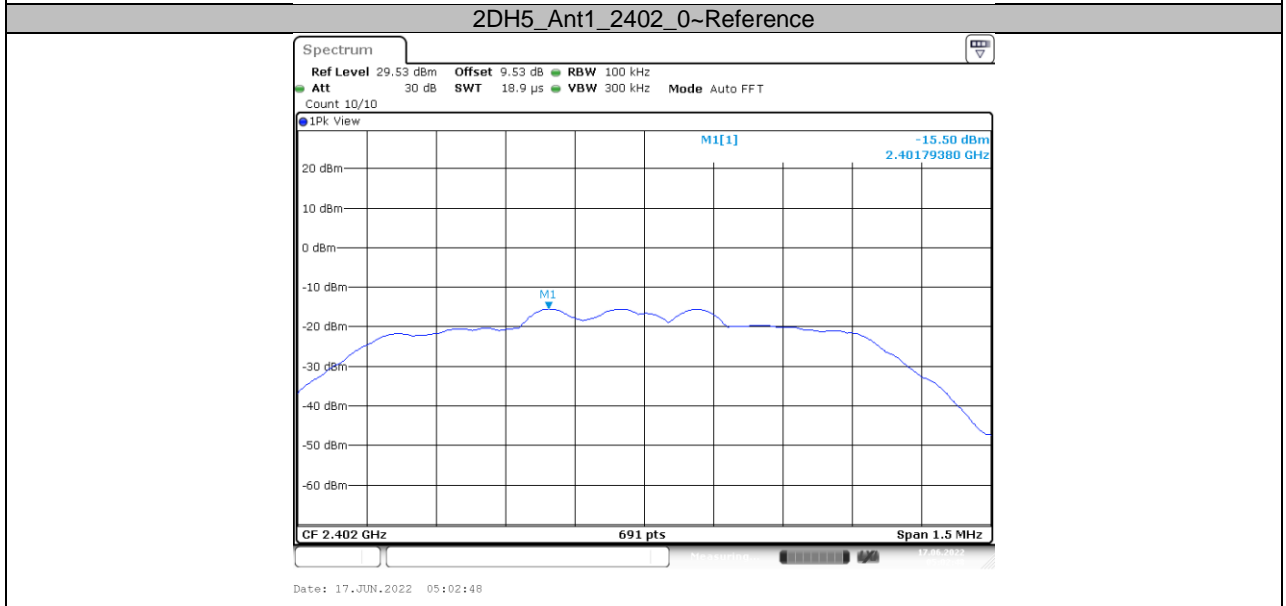
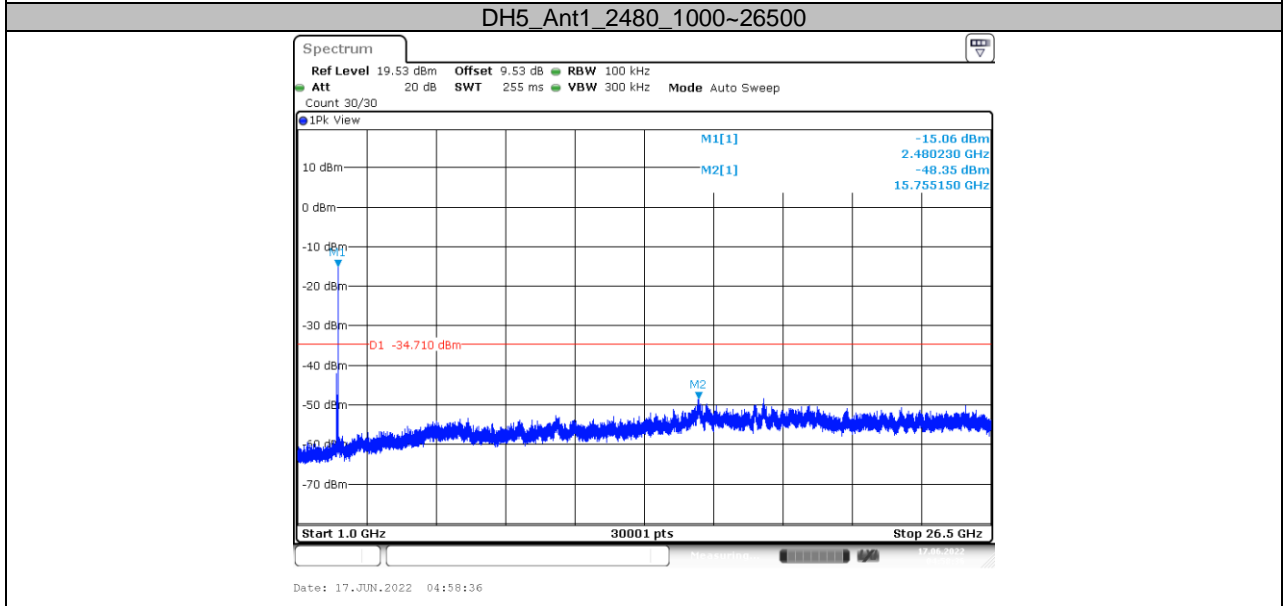
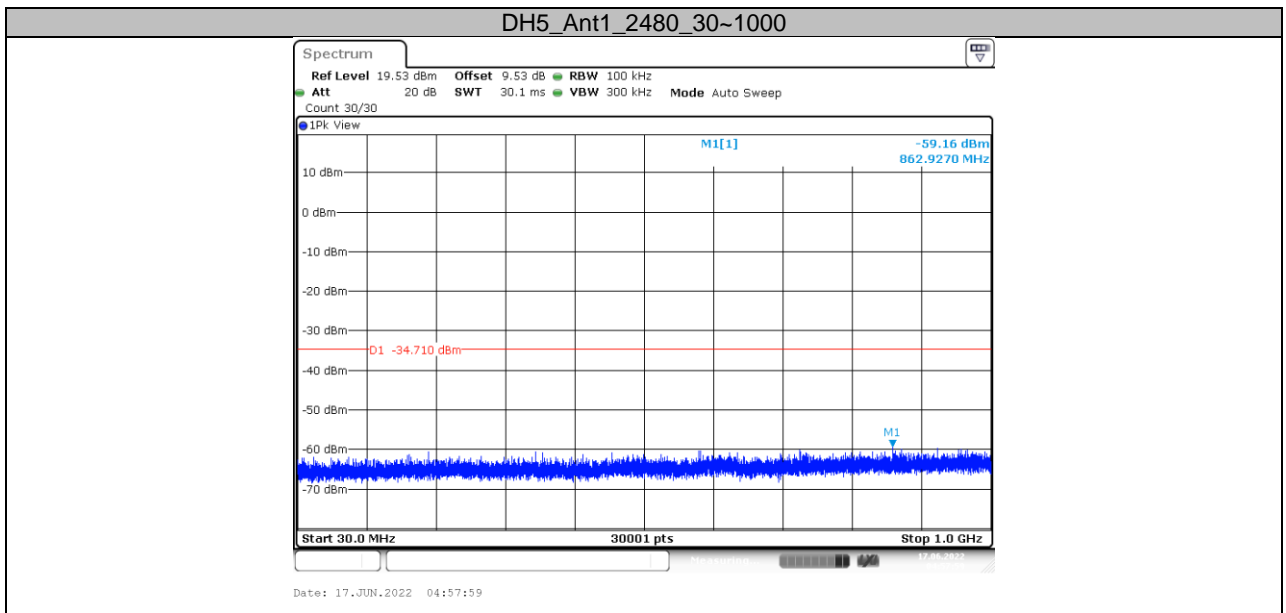
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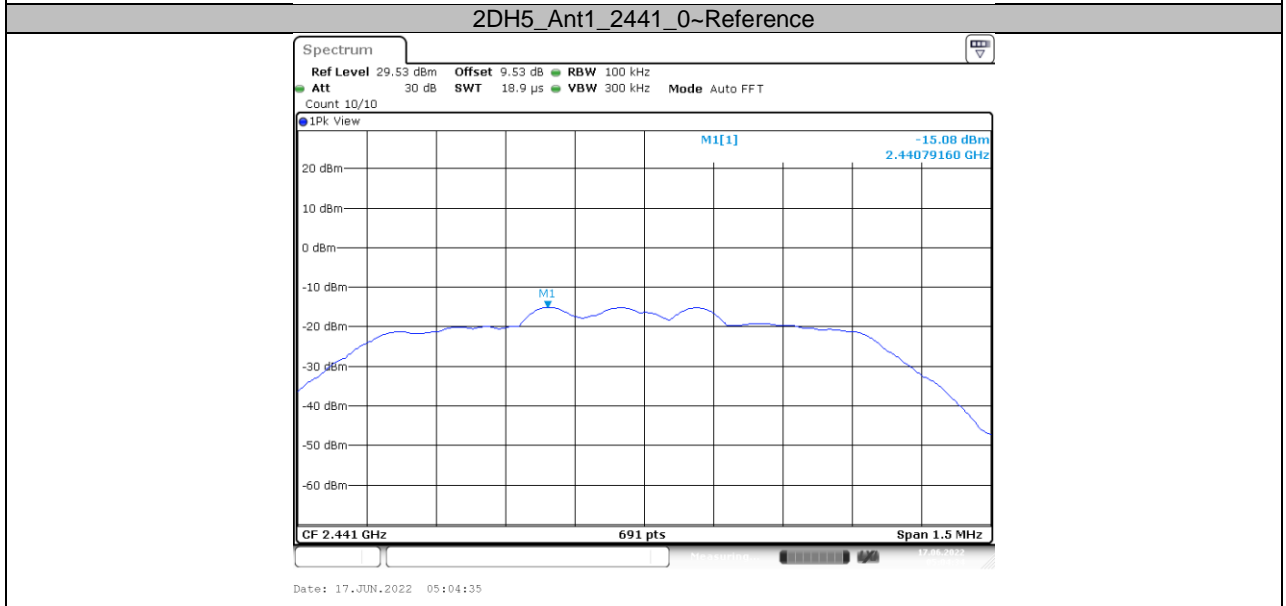
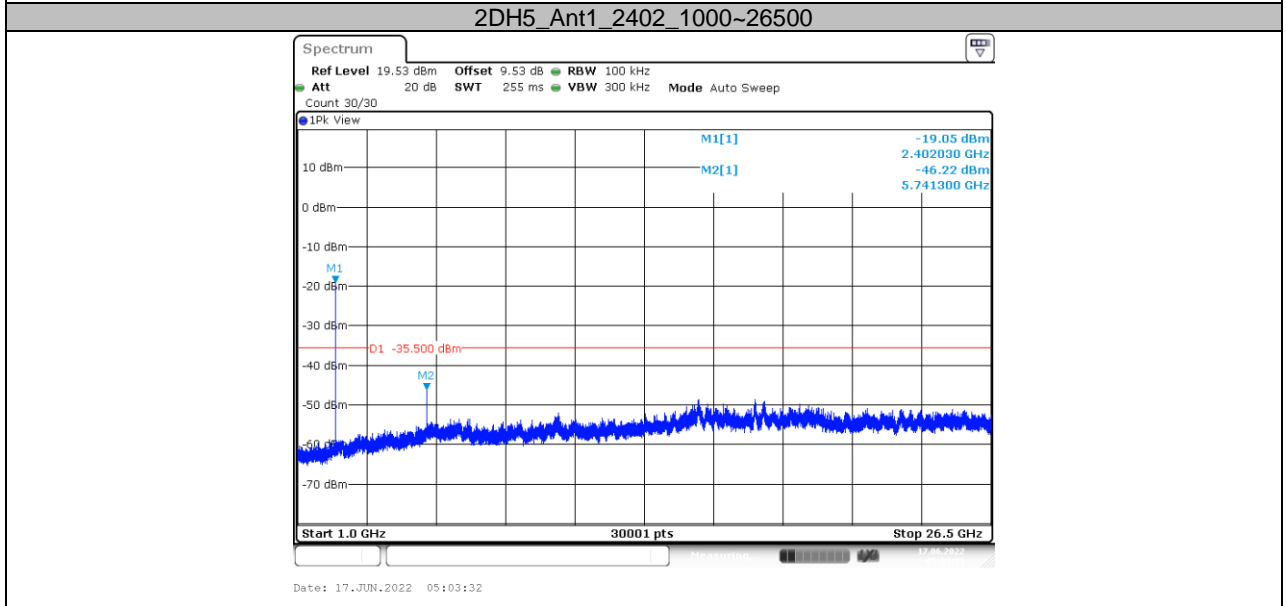
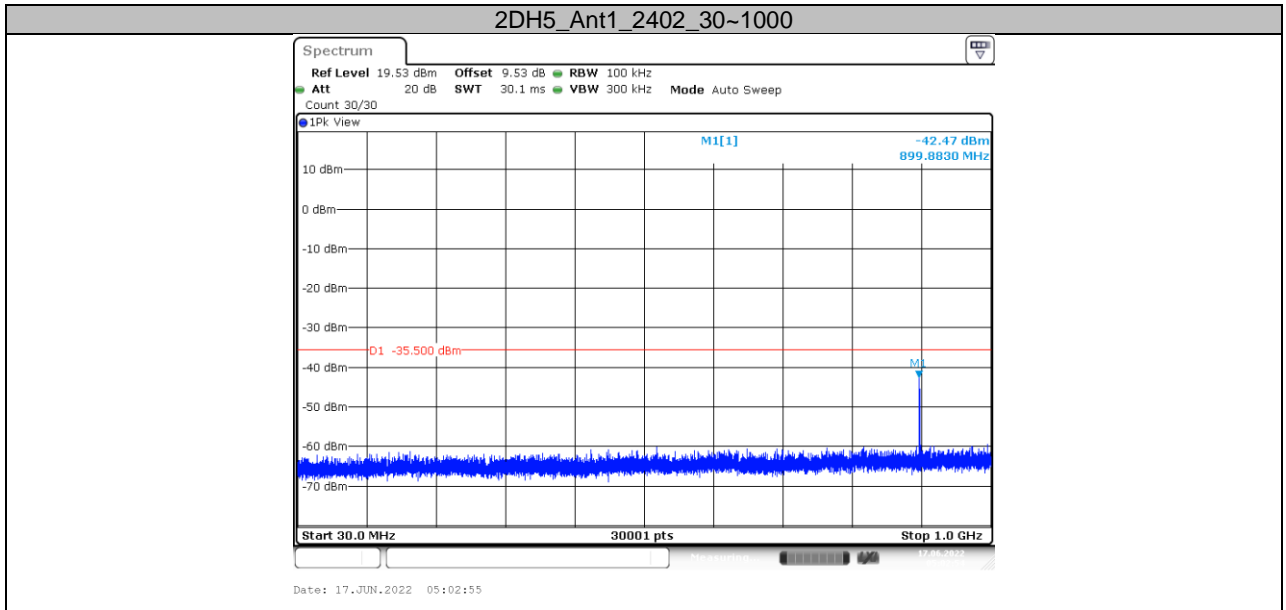
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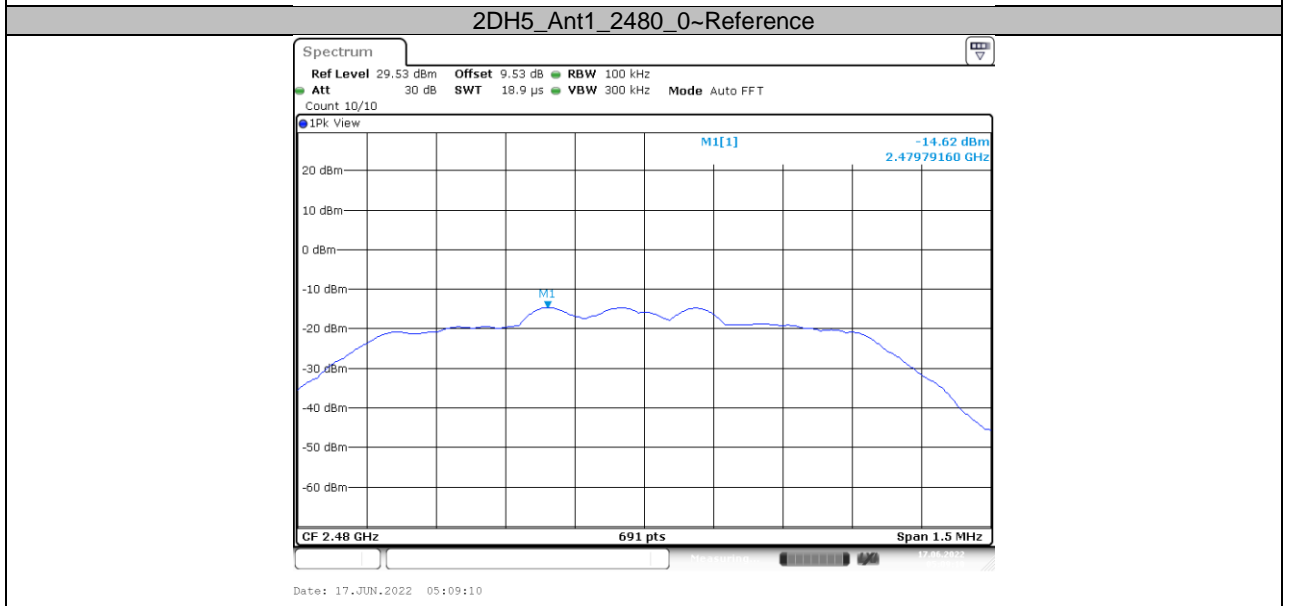
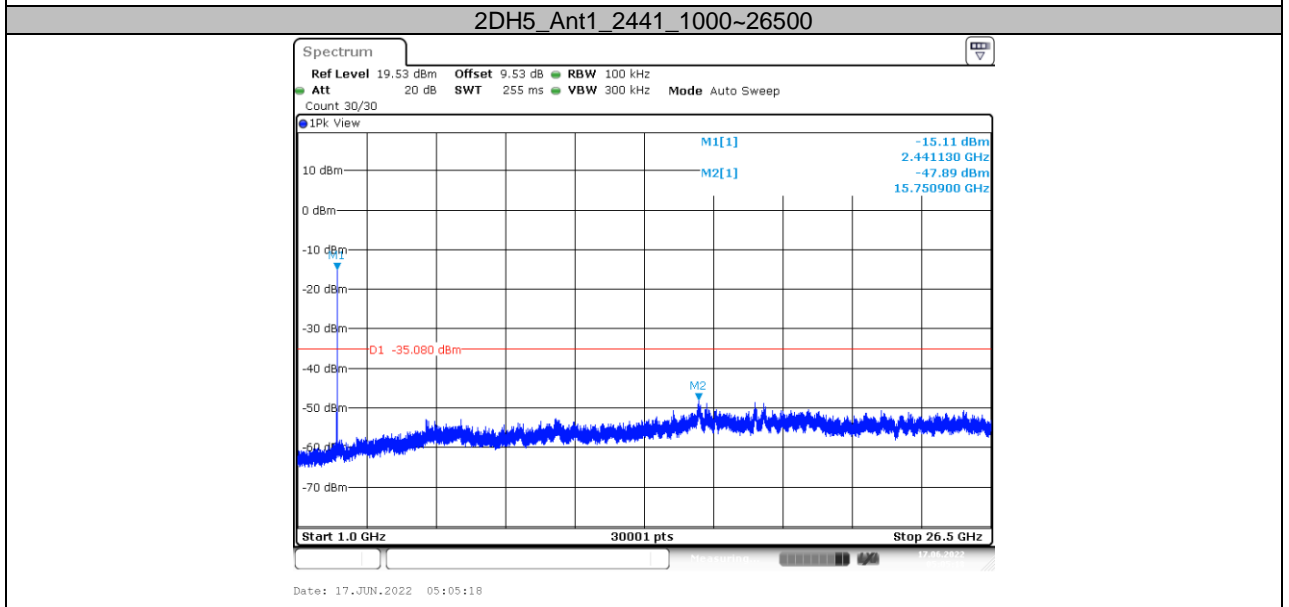
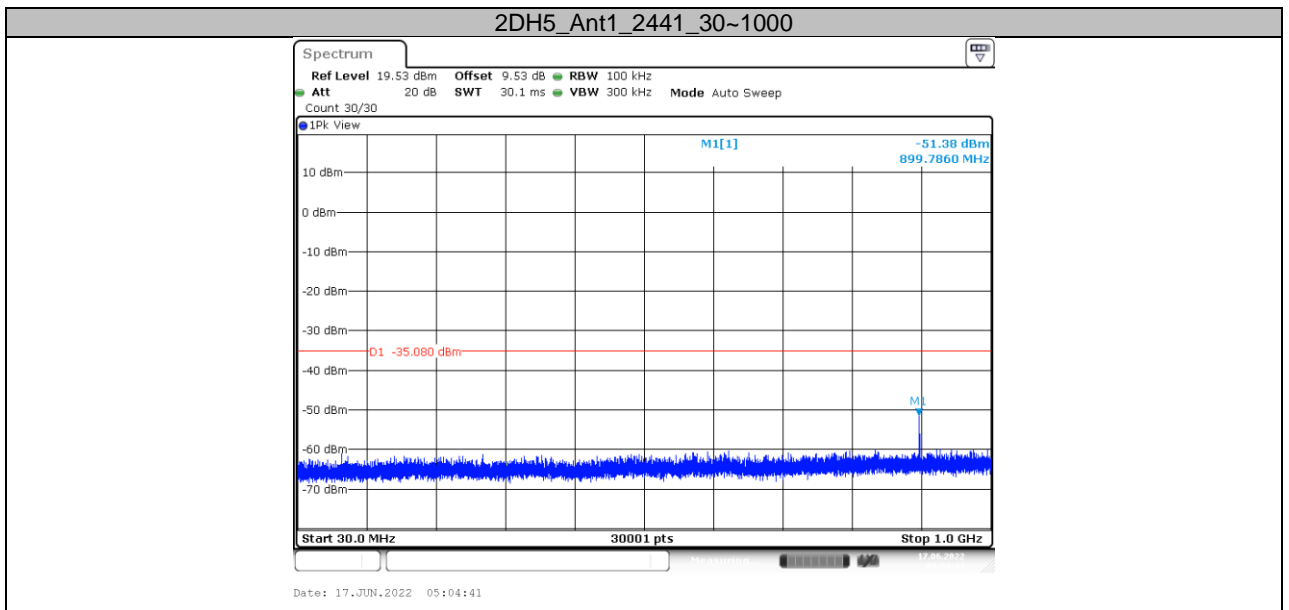
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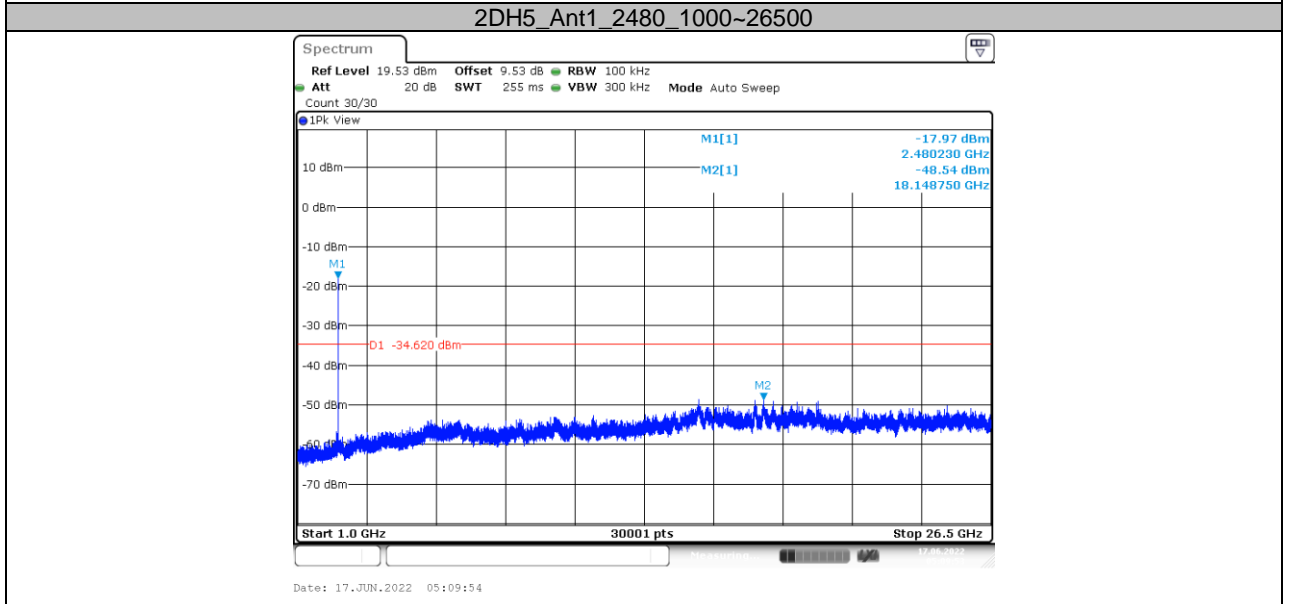
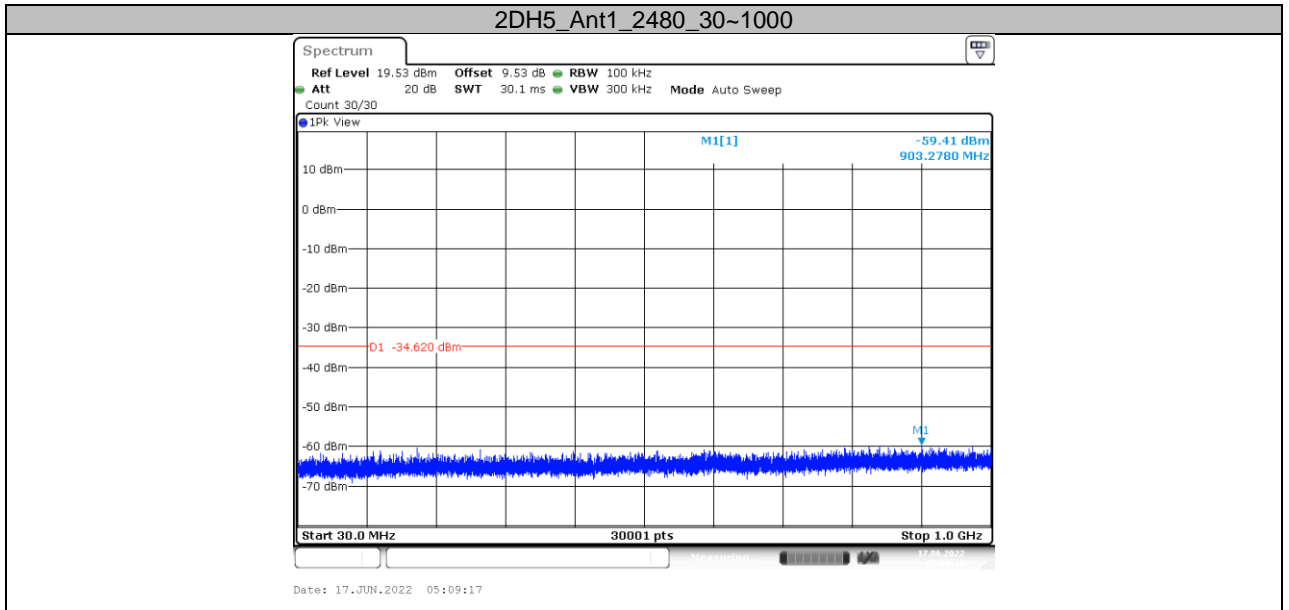
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6. Appendix E

Test Equipment	Type/Mode	SERIAL NO.	Equipment No.	Manufacturer	Cal. Due
3m Semi-Anechoic Chamber	FACT-4	ST08035	WKNA-0024	ETS	2024-12-12
Semi-Anechoic Chamber(5m)	SAC-5	SAC-5-2.0	EM-000557	COMTEST	2024-11-02
Spectrum Analyzer	N9010B	MY57470323	DZ-000174	KEYSIGHT	2023-03-02
EMI Test Receiver	N9038A-508	MY532290079	EM-000397	Agilent	2023-03-02
EMI Test Receiver	ESR7	102235	VGDY-0956	R&S	2023-03-03
Broadband Antenna	VULB 9163	9163-530	EM-000342	SCHWARZBECK	2023-06-26
Waveguide Horn Antenna	HF906	360306/008	WKNA-0024-8	R&S	2023-03-04
Waveguide Horn Antenna	BBHA9170	00949	EM-000383	SCHWARZBECK	2022-08-27
Loop Antenna	HLA 6121	540046	EM-000546	TESEQ	2023-06-07
Loop Antenna	FMZB1513	1513-170	EM-000384	SCHWARZBECK	2023-03-04
Broadband Antenna(5m)	VULB 9163	9163-676	EM-000382	SCHWARZBECK	2023-05-06
Bandstop Filters	SW-BSF-2400-100 -7-A1	/	EM-000495	/	2022-08-31
5G Bandstop Filters	WRCJV12-4900-5 100-5900-6100-5 OEE	1	DZ-000186	WI	2022-12-20

The End