FCC - TEST REPORT

Report Number	:	**68.950.23.0879.01**	Date of Issue:	**2023-11-06**
Model	:	**NPG-001, HP52A, HP52AX, NPG01ASTB**		
Product	:	Playground		
Applicant	:	Shenzhen Skyworth Digital Technology Co., LTD.		
Address	:	14/F, Unit A, Skyworth Building, Gaoxin Ave.1.S., Nanshan District, 518063 Shenzhen, PEOPLE'S REPUBLIC OF CHINA		
Manufacturer	:	Shenzhen Skyworth Digital Technology Co., LTD.		
Address	:	14/F, Unit A, Skyworth Building, Gaoxin Ave.1.S., Nanshan District, 518063 Shenzhen, PEOPLE'S REPUBLIC OF CHINA		
Test Result	:	■ **Positive** ☐ **Negative**		
Total pages including Appendices	:	**60**		

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2 Details about the Test Laboratory

Details about the Test Laboratory
Test Site 1

Company name:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch Building 12&13, Zhiheng Wisdomland Business Park, Guankou Erlu, Nantou, Nanshan District, Shenzhen City, 518052, P. R. China
Telephone:	86 755 8828 6998
Fax:	86 755 8828 5299
FCC Registration No.:	514049
FCC Designation Number:	CN5009
IC Registration No.:	10320A

3 Description of the Equipment Under Test

Product:	Playground
Model no.:	NPG-001, HP52A, HP52AX, NPG01ASTB
Model difference:	All models have the same technical construction including circuit diagram, PCB layout, components and component layout. Only the outlook/color are different. So the main test model is NPG-001.
FCC ID:	WNA-NPG-001
Options and accessories:	Adapter, HDMI Cable, Remote
Rating:	5VDC, 3A supplied by external adapter
Adapter information:	Adapter Model: AD-0150500300US-1 Input: 100-240VAC 50/60Hz, 0.5A, Output: 5VDC,3.0A 15.0W
Remote information:	Type name: Bluetooth voice remote control Model: NPG-RCU-001 FCC ID: 2A7GQ-NPG-RCU-001
RF Transmission Frequency:	2402MHz-2480MHz
No. of Operated Channel:	79
Modulation:	GFSK, π/4-DQPSK, 8DPSK
Antenna Type:	On Board Antenna
Antenna Gain:	1.87dBi
Description of the EUT:	The EUT is a playground with Bluetooth Low Energy/Bluetooth BDR+EDR, 2.4G Wi-Fi & 5G Wi-Fi functions. Only Bluetooth BDR+EDR included in this report.

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2021 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to KDB 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.10 (2020).

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5 Summary of Test Results

Technical Requirements					
FCC Part 15 Subpart C					
Test Condition		Test Site	Test Result		
			Pass	Fail	N/A
§15.207	Conducted emission AC power port	Site 1	☒	☐	☐
§15.247 (b) (1)	Conducted peak output power	Site 1	☒	☐	☐
§15.247(a)(1)	20dB bandwidth	Site 1	☒	☐	☐
§15.247(a)(1)	Carrier frequency separation	Site 1	☒	☐	☐
§15.247(a)(1)(iii)	Number of hopping frequencies	Site 1	☒	☐	☐
§15.247(a)(1)(iii)	Dwell Time	Site 1	☒	☐	☐
§15.247(e)	Power spectral density	---	☐	☐	☒
§15.247(d)	Spurious RF conducted emissions	Site 1	☒	☐	☐
§15.247(d)	Band edge	Site 1	☒	☐	☐
§15.247(d) & §15.205 & §15.209	Spurious radiated emissions for transmitter	Site 1	☒	☐	☐
§15.203	Antenna requirement	See note 2	☒	☐	☐

Note 1: N/A=Not Applicable.
Note 2: The EUT uses on board antenna, which gain is 1.87dBi. In accordance to §15.203, it is considered sufficiently to comply with the provisions of this section.

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6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: WNA-NPG-001 complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C rules.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

☐ - **Not** Performed

The Equipment Under Test

■ - **Fulfills** the general approval requirements.

☐ - **Does not** fulfill the general approval requirements.

Sample Received Date:	2023-10-23
Testing Start Date:	2023-10-23
Testing End Date:	2023-11-04

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch –

Reviewed by:	Prepared by:	Tested by:
John Zhi	Sanvin Zheng	Carry Cai
Project Manager	Project Engineer	Test Engineer

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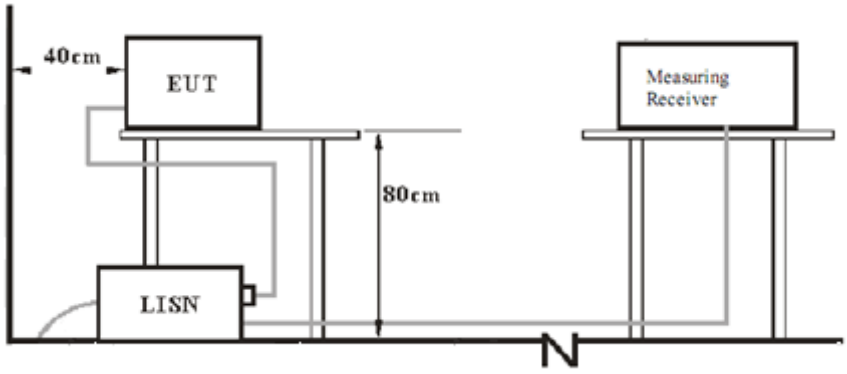
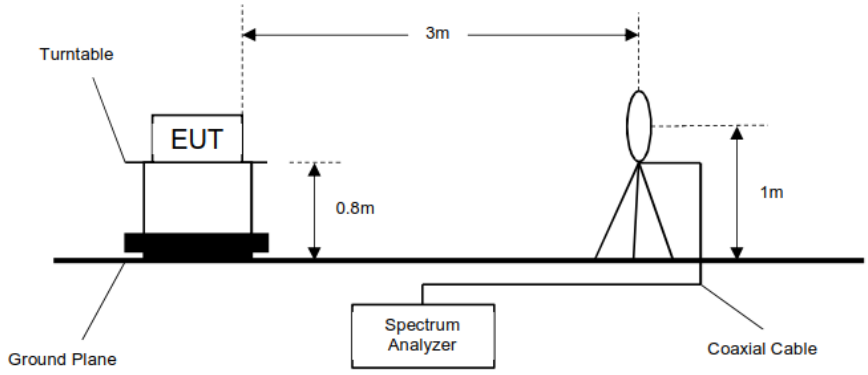
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

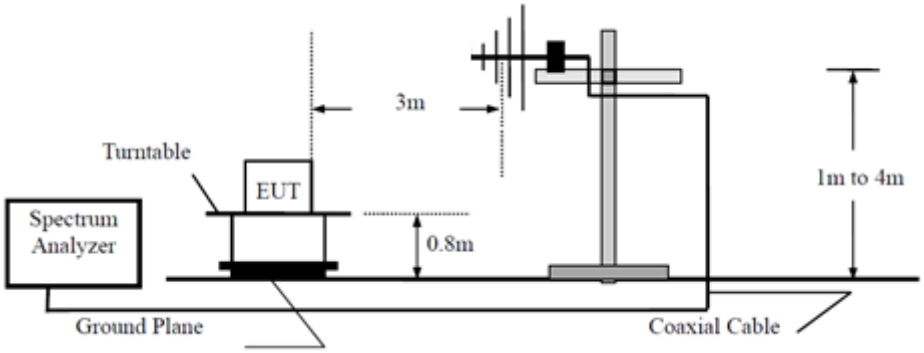


7.2 Radiated test setups

9KHz - 30MHz



30MHz - 1GHz



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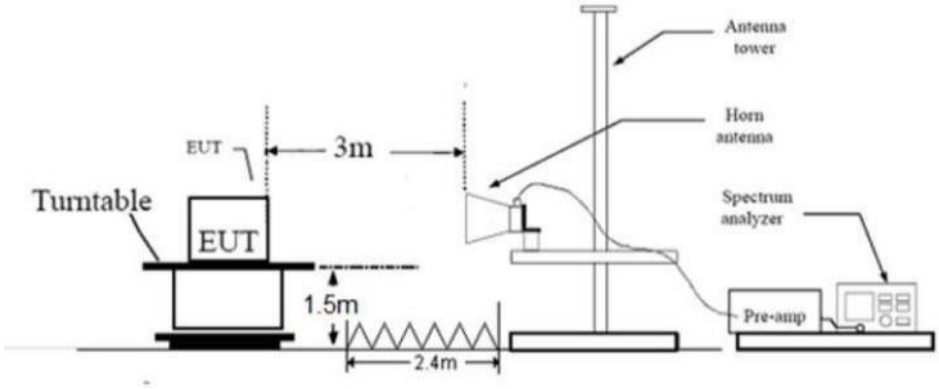
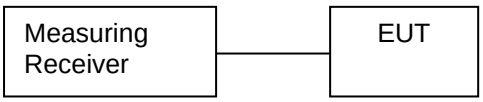
Above 1GHz



7.3 Conducted RF test setups



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8 Systems test configuration

Auxiliary Equipment Used during Test:

Description	Manufacturer	Model No.	Remark
Notebook	Lenovo	X220	---
Remote	Wuxi Weida Intelligent Electronics	NPG-RCU-001	Type name: Bluetooth voice remote control FCC ID: 2A7GQ-NPG-RCU-001

Cables Used During Test:

Cable	Length	Shielded/unshielded	With / without ferrite
HDMI Cable	150cm	Shielded	Without ferrite
Type-C Cable	100cm	Unshielded	Without ferrite

Test software information:

Test Software	adb.exe	
Modulation	Setting TX Power	Packet Type
GFSK	Default	PRBS9
π/4-DQPSK	Default	PRBS9
8DPSK	Default	PRBS9

The system was configured to hopping mode and non-hopping mode.

Hopping mode: typical working mode (normal hopping status)

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power.

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9 Technical Requirement

9.1 Conducted Emission

Test Method

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. Both sides of AC line were checked for maximum conducted interference.
6. The frequency range from 150 kHz to 30 MHz was searched.
7. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

Limit

According to §15.207, Conducted emissions limit as below:

Frequency MHz	QP Limit dBµV	AV Limit dBµV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

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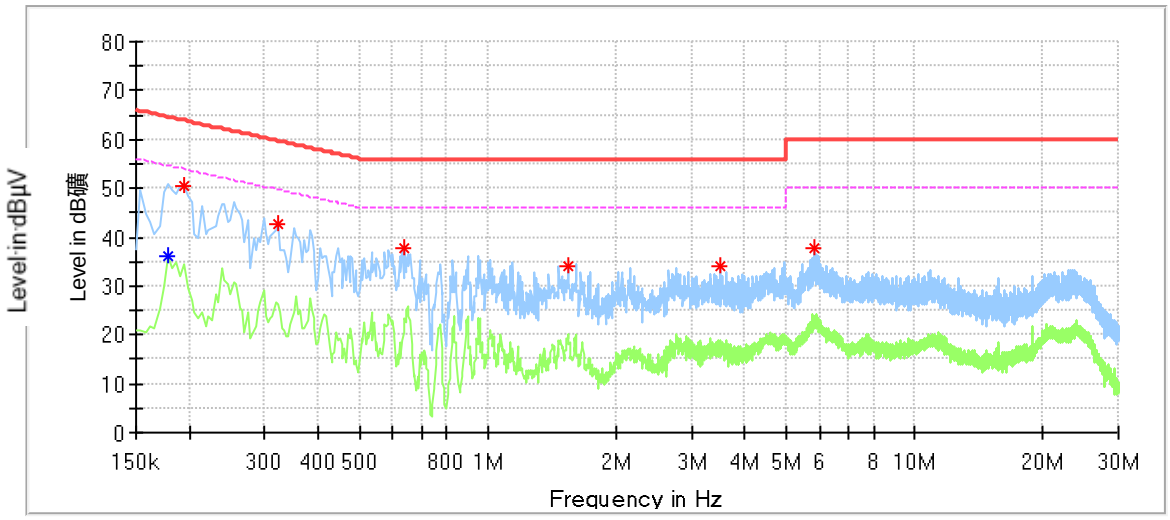
Conducted Emission

Model	:	NPG-001
Test Mode	:	Transmitting mode
Test Voltage	:	AC120V/60Hz
Remark	:	Power Line, Live



Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.178000	---	36.20	54.58	18.37	L1	9.54
0.194000	50.44	---	63.86	13.42	L1	9.54
0.322000	42.60	---	59.66	17.06	L1	9.57
0.638000	37.93	---	56.00	18.07	L1	9.60
1.546000	33.92	---	56.00	22.08	L1	9.61
3.494000	33.94	---	56.00	22.06	L1	9.68
5.802000	37.71	---	60.00	22.29	L1	9.78

Remark:
Level=Reading Level + Correction Factor
Correction Factor=LISN Factor + Cable Loss
(The Reading Level is recorded by software which is not shown in the sheet)

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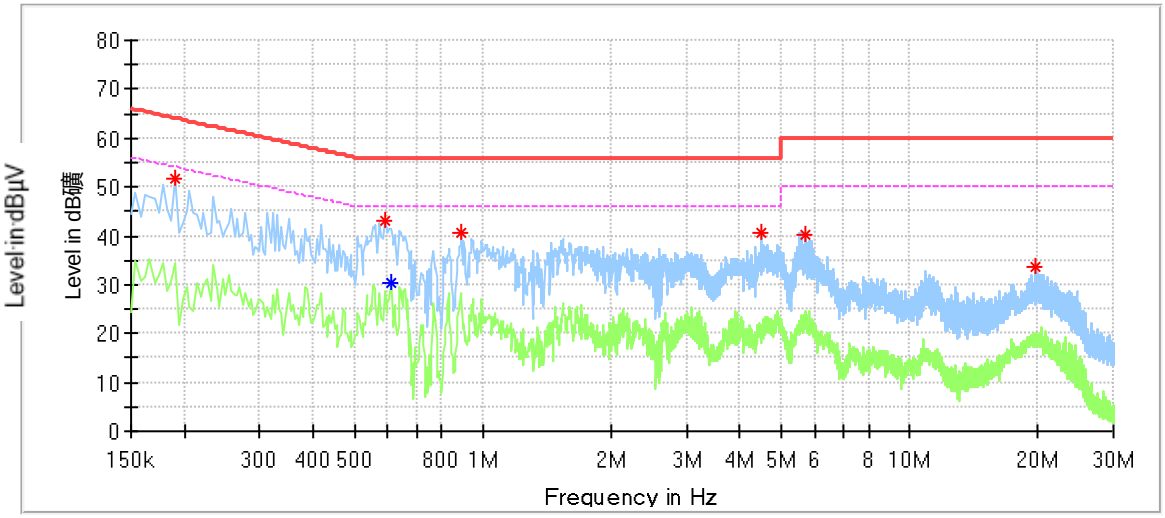
Conducted Emission

Model	:	NPG-001
Test Mode	:	Transmitting mode
Test Voltage	:	AC120V/60Hz
Remark	:	Power Line, Neutral



Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.190000	51.53	---	64.04	12.50	N	9.57
0.590000	42.90	---	56.00	13.10	N	9.63
0.610000	---	30.53	46.00	15.47	N	9.63
0.890000	40.59	---	56.00	15.41	N	9.63
4.482000	40.68	---	56.00	15.32	N	9.75
5.714000	40.15	---	60.00	19.85	N	9.81
19.694000	33.74	---	60.00	26.26	N	9.95

Remark:
Level=Reading Level + Correction Factor
Correction Factor=LISN Factor + Cable Loss
(The Reading Level is recorded by software which is not shown in the sheet)

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9.2 Conducted peak output power

Test Method

1. The RF output of EUT was connected to the test spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following test receiver settings:
   Span = approximately 5 times the 20dB bandwidth, centered on a hopping channel
   RBW > the 20dB bandwidth of the emission being measured, VBW≥RBW,
   Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power and record the results in the test report.
5. Repeat above procedures until all frequencies measured were completed.

Limits

According to §15.247 (b) (1), conducted peak output power limit as below:

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤1	≤30

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Conducted Peak Output Power

Test result as below table

Bluetooth Mode GFSK modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	6.59	Pass
Middle channel 2441MHz	6.32	Pass
High channel 2480MHz	6.21	Pass

Bluetooth Mode π/4-DQPSK modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	8.19	Pass
Middle channel 2441MHz	7.85	Pass
High channel 2480MHz	7.83	Pass

Bluetooth Mode 8DPSK modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	8.64	Pass
Middle channel 2441MHz	8.28	Pass
High channel 2480MHz	8.29	Pass

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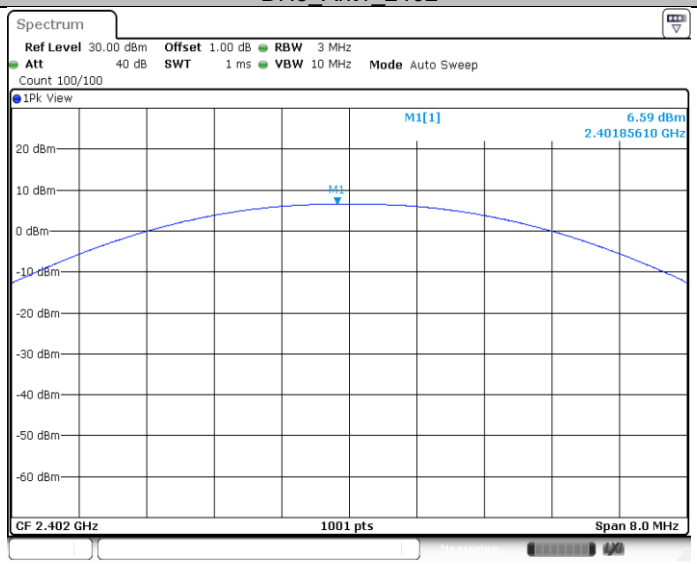
DH5_Ant1_2402



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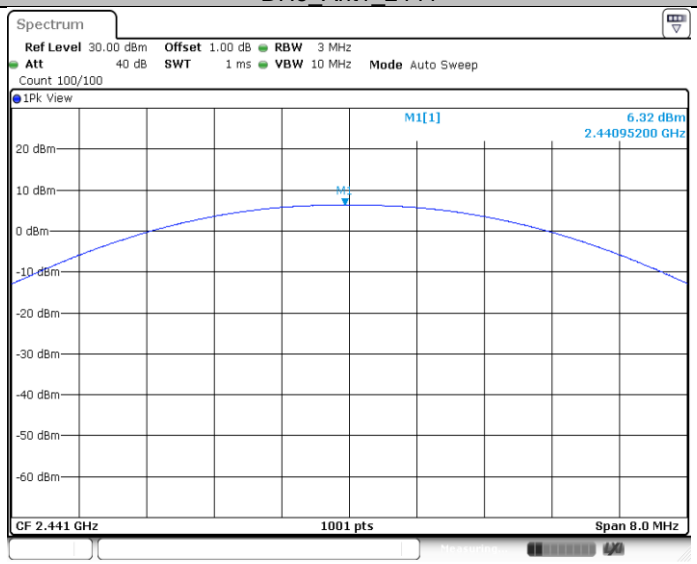

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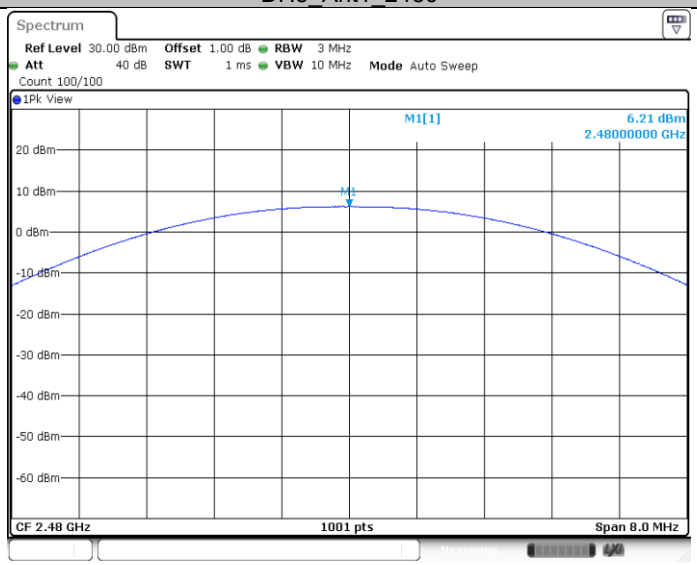

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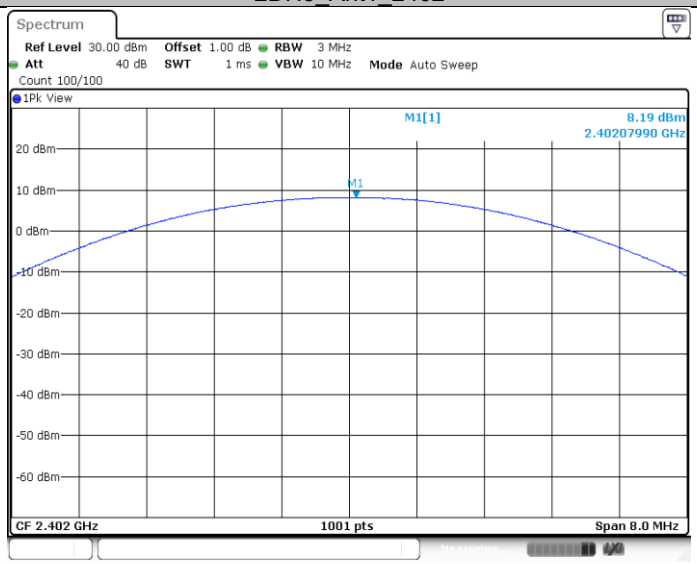
2DH5_Ant1_2402



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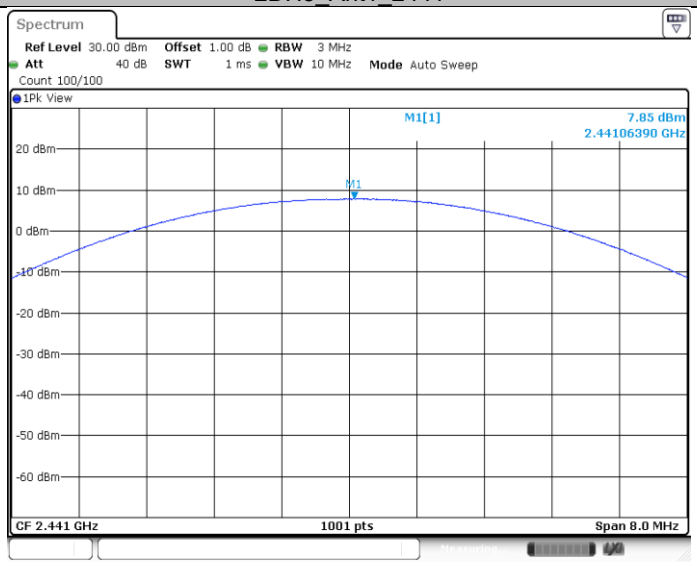

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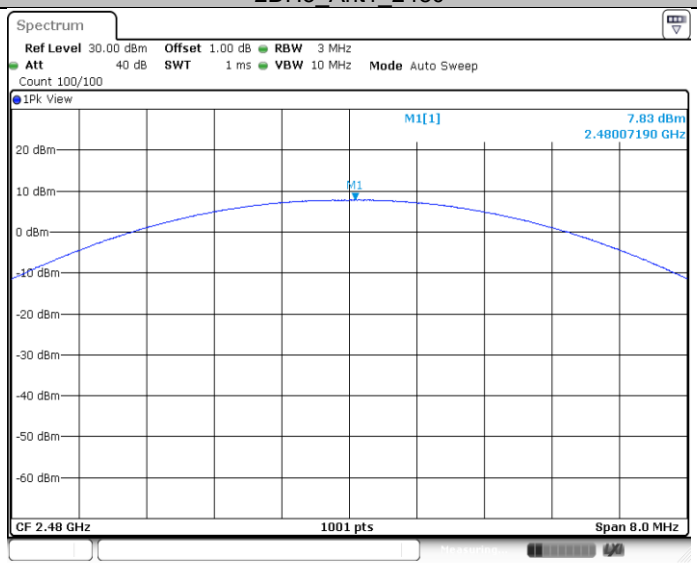

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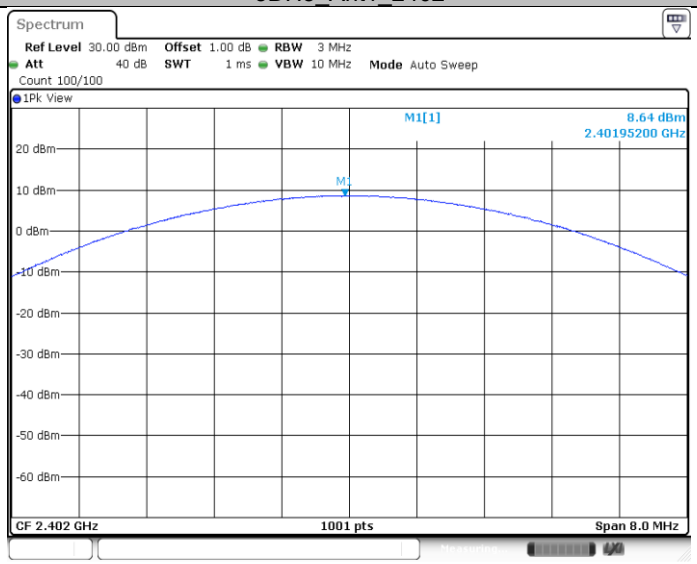
3DH5_Ant1_2402



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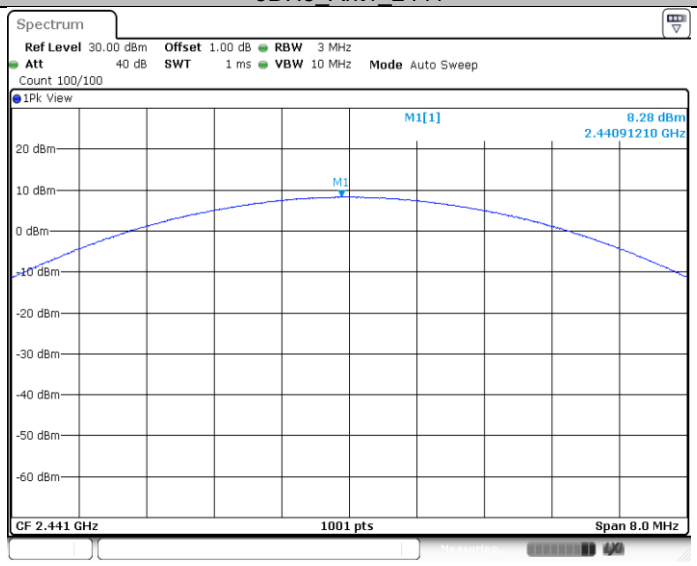

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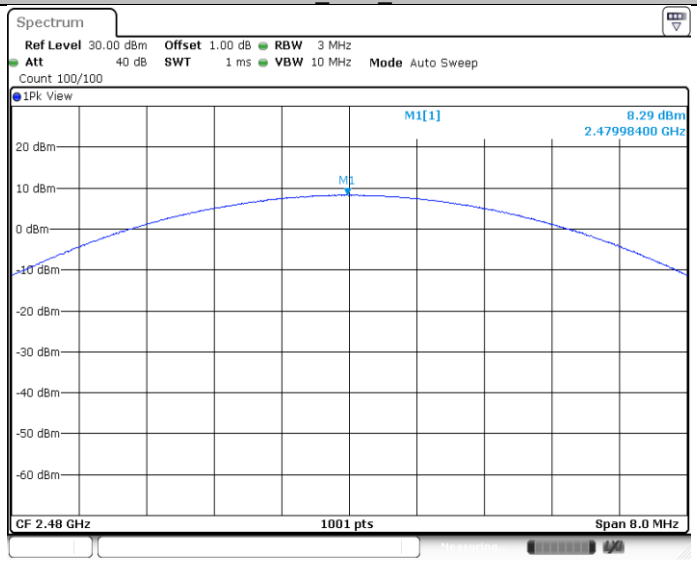

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9.3 20 dB bandwidth

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Use the following test receiver settings:
   Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
   RBW ≥ 1% to 5% of the 20 dB bandwidth/99% OBW, VBW≥3RBW,
   Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth. Record the results.
5. Repeat above procedures until all frequencies measured were complete.

Limit

According to §15.247(a)(1), 20 dB bandwidth limit as below:

Limit [kHz]
N/A

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20 dB bandwidth

Bluetooth Mode GFSK Modulation test result

Test Mode	Antenna	Channel [MHz]	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit [MHz]	Verdict
DH5	Ant1	2402	1.116	2401.445	2402.561	---	PASS
		2441	1.116	2440.445	2441.561	---	PASS
		2480	1.119	2479.442	2480.561	---	PASS
2DH5	Ant1	2402	1.383	2401.310	2402.693	---	PASS
		2441	1.383	2440.310	2441.693	---	PASS
		2480	1.383	2479.310	2480.693	---	PASS
3DH5	Ant1	2402	1.377	2401.310	2402.687	---	PASS
		2441	1.377	2440.310	2441.687	---	PASS
		2480	1.380	2479.307	2480.687	---	PASS

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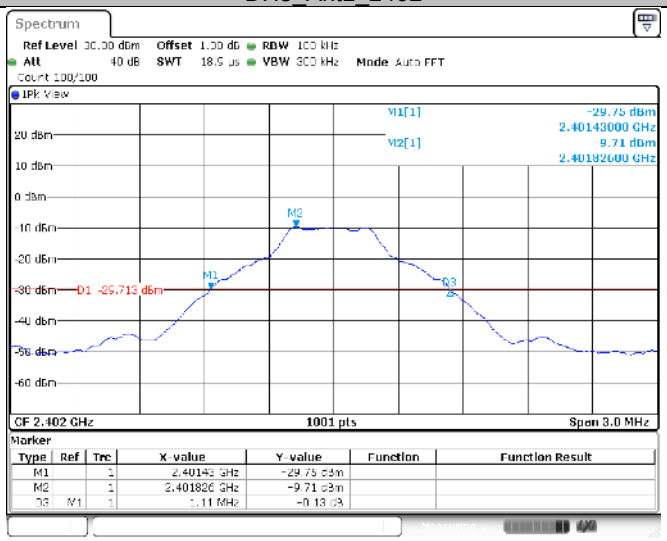

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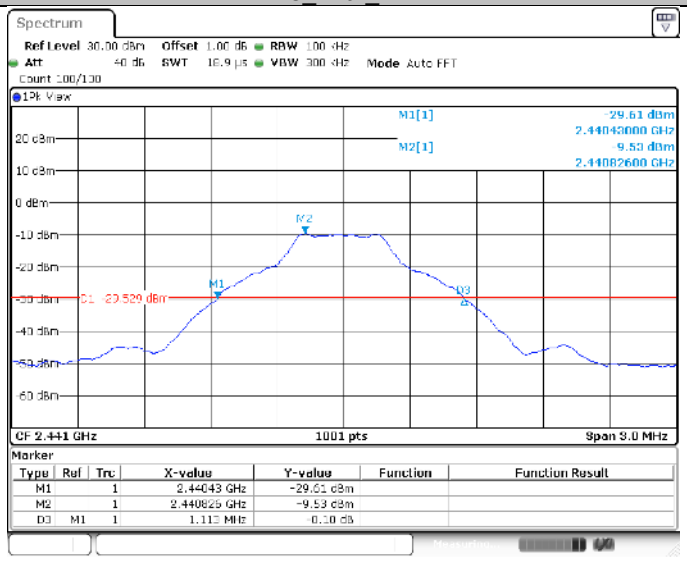
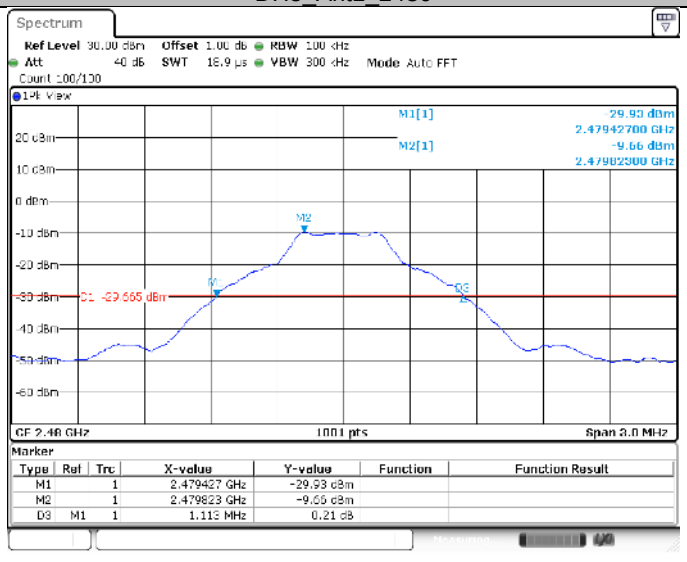
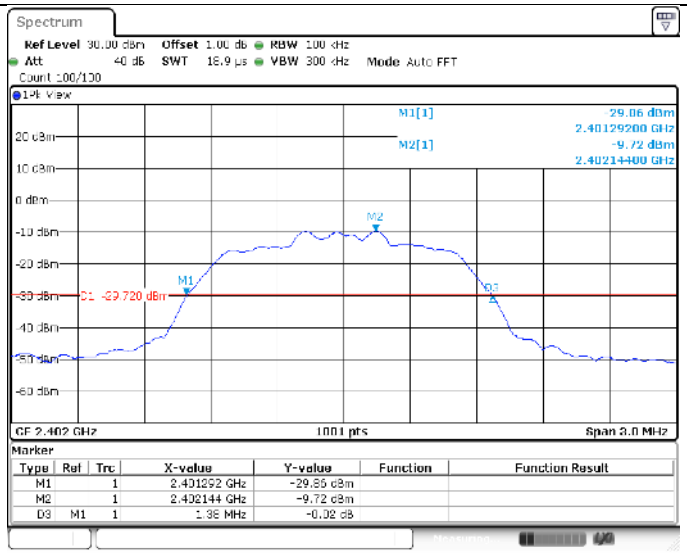


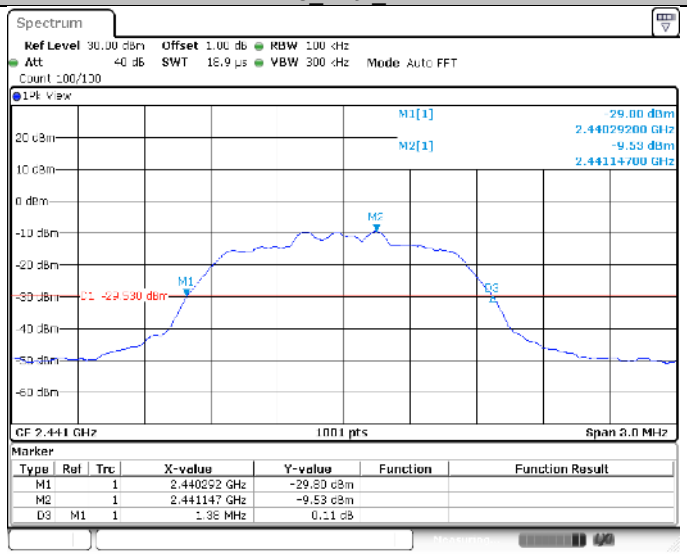
DH5_Ant1_2480



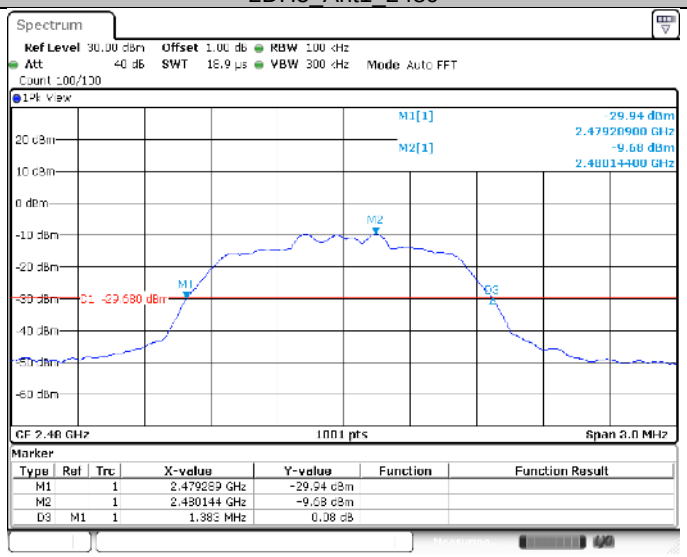
2DH5_Ant1_2402



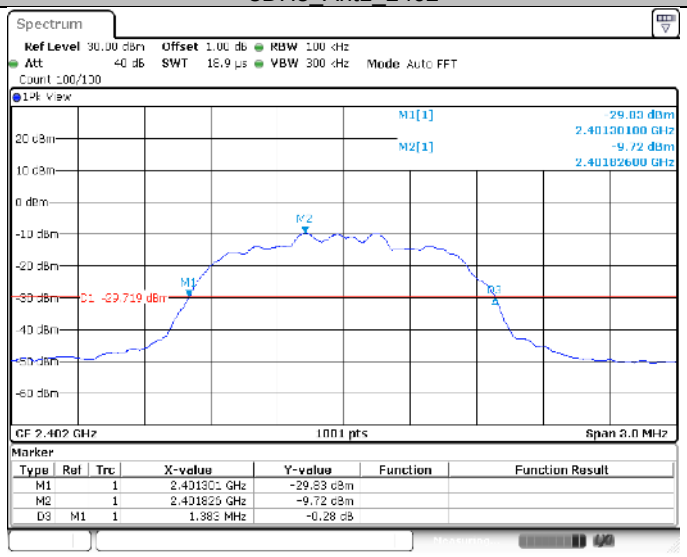
2DH5_Ant1_2441



2DH5_Ant1_2480

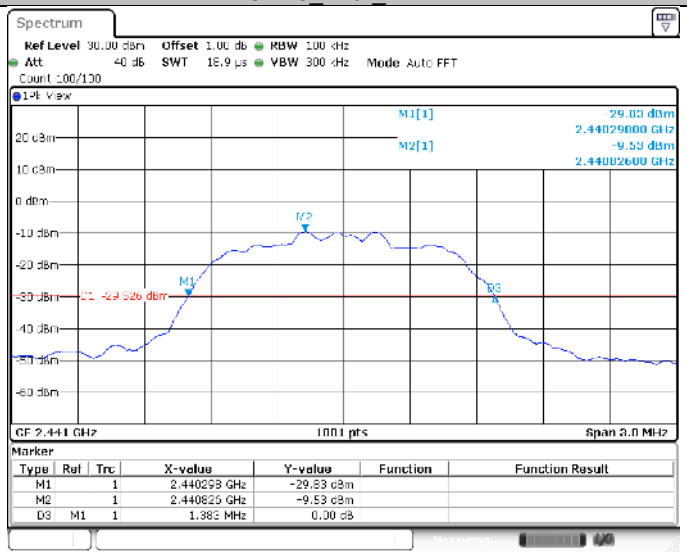


3DH5_Ant1_2402



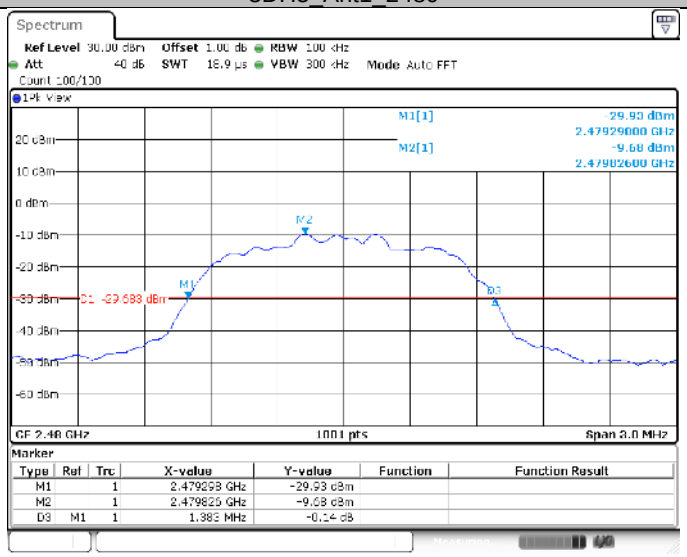
Date: 22.MAY.2023 17:17:47

3DH5_Ant1_2441



Date: 22.MAY.2023 17:19:20

3DH5_Ant1_2480



Date: 22.MAY.2023 17:20:45

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9.4 Carrier Frequency Separation

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit to hopping mode.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peaks of two adjacent channels, RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel. VBW ≥RBW, Sweep = auto, Detector function = peak.
4. By using the Max-Hold function record the separation of two adjacent channels.
5. Measure the frequency difference of these two adjacent channels by spectrum analyzer marker function. Record the results.
6. Repeat above procedures until all frequencies measured were complete.

Limit

According to §15.247(a)(1), Carrier Frequency Separation limit as below:

Limit kHz
⩾25KHz or 2/3 of the 20 dB bandwidth which is greater

Limit

Modulation	Frequency MHz	2/3 of 20 dB Bandwidth kHz
GFSK	2441	744
π/4-DQPSK	2441	922
8DPSK	2441	918

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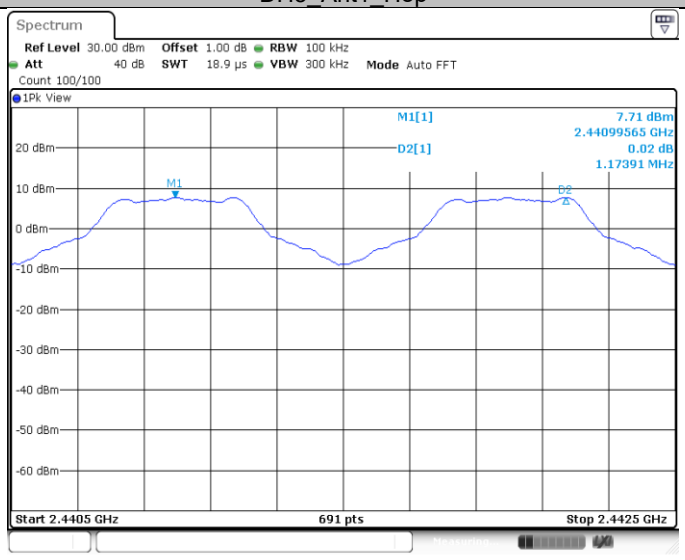
Carrier Frequency Separation

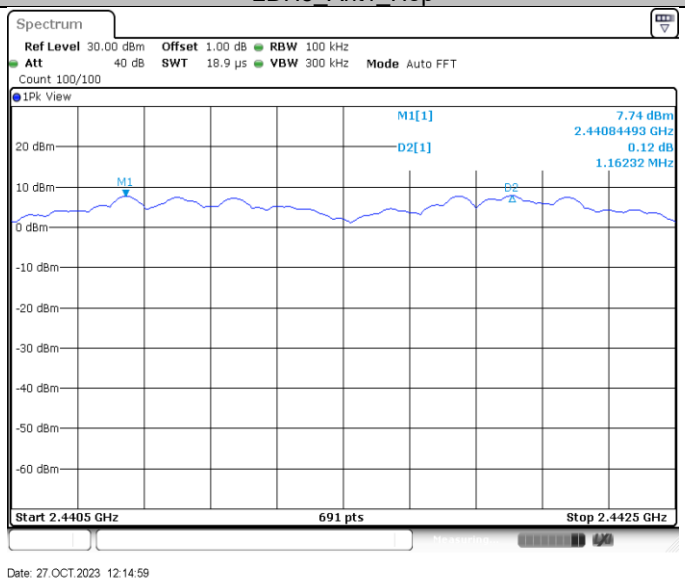
Test result: The measurement was performed with the typical configuration (normal hopping status).

Modulation	Frequency MHz	Carrier Frequency Separation kHz	Result
GFSK	2441	1.174	Pass
π/4-DQPSK	2441	1.162	Pass
8DPSK	2441	1.162	Pass

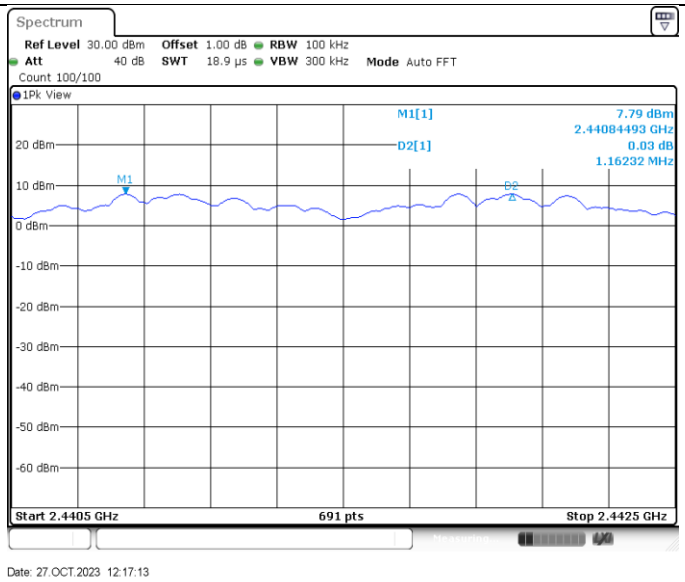
DH5_Ant1_Hop



2DH5_Ant1_Hop



3DH5_Ant1_Hop



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9.5 Number of hopping frequencies

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit to hopping mode.
3. Use the following spectrum analyzer settings:
   Span = the frequency band of operation, RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller, VBW ≥RBW, Sweep = auto, Detector function = peak, Trace=Max hold.
4. Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

Limit

According to §15.247(a)(1)(iii), Number of hopping frequencies limit as below:

Limit number
⩾ 15

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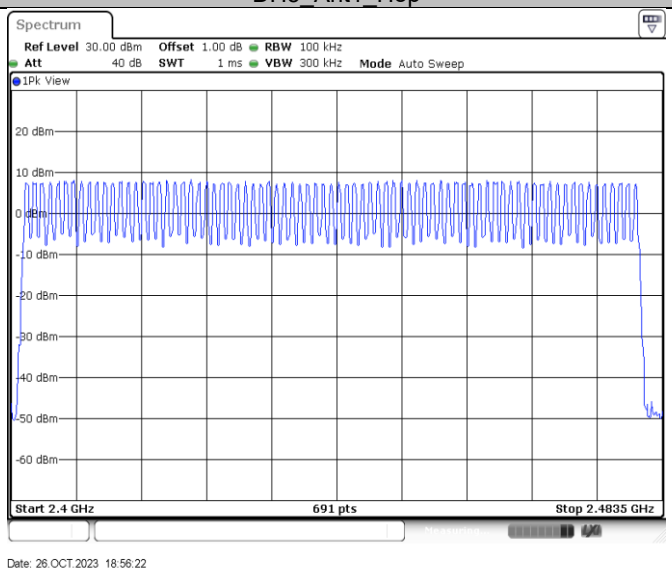
Number of hopping frequencies

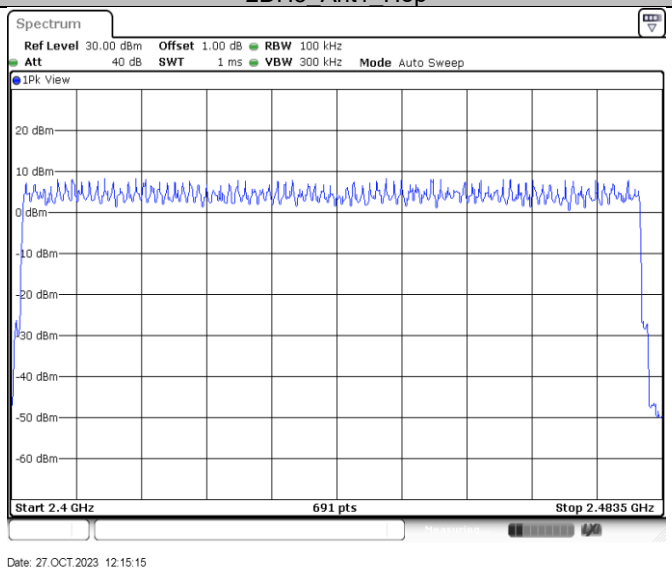
Test result: The measurement was performed with the typical configuration (normal hopping status), and the total hopping channels is constant for the all modulation mode according with the Bluetooth Core Specification.

Test Mode	Antenna	Channel	Result	Limit	Verdict
DH5	Ant1	Hop	79	>=15	PASS
2DH5	Ant1	Hop	79	>=15	PASS
3DH5	Ant1	Hop	79	>=15	PASS

DH5_Ant1_Hop



2DH5_Ant1_Hop



3DH5_Ant1_Hop

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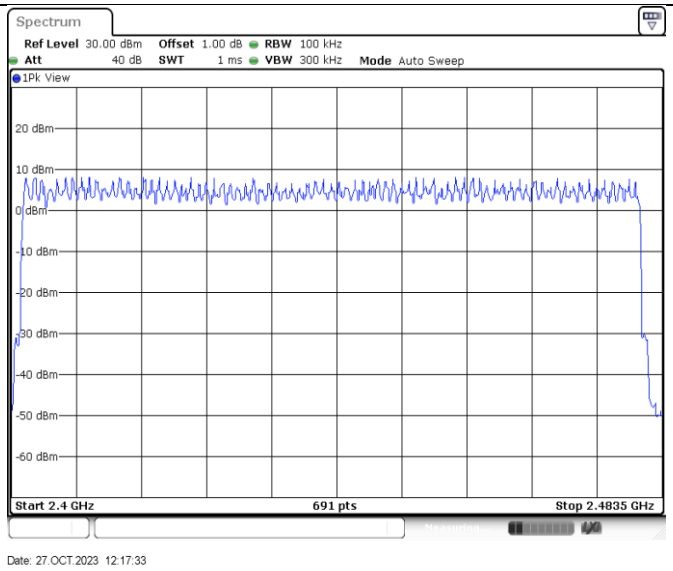

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9.6 Dwell Time

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit to hopping mode.
3. Span: Zero span, centered on a hopping channel.
4. RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
5. Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
6. Detector function: Peak.
7. Trace: Max hold. Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Limit

According to §15.247(a)(1)(iii), Dwell Time limit as below:

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

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Dwell Time

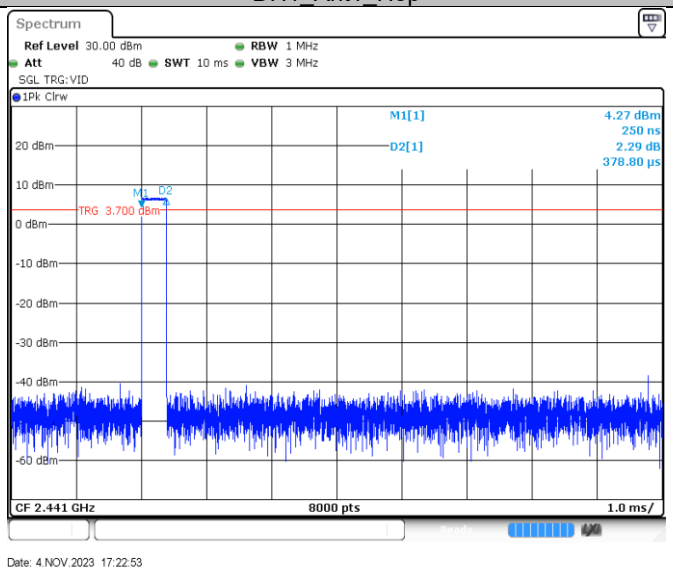
Dwell time

The maximum dwell time shall be 0.4 s.
According to the Bluetooth Core Specification,
The duration for dwell time calculation: 0.4 [s] * hopping number = 0.4 [s] * 79 [ch] = 31.6 [s]
The Dwell Time = Burst Width * Total Hops.

Test result as below:

Test Mode	Antenna	Channel	Burst Width (ms)	Total Hops	Result (s)	Limit (s)	Verdict
DH1	Ant1	Hop	0.38	320	0.121	<=0.4	PASS
DH3	Ant1	Hop	1.63	160	0.260	<=0.4	PASS
DH5	Ant1	Hop	2.87	50	0.143	<=0.4	PASS
2DH1	Ant1	Hop	0.39	330	0.128	<=0.4	PASS
2DH3	Ant1	Hop	1.63	180	0.294	<=0.4	PASS
2DH5	Ant1	Hop	2.87	110	0.316	<=0.4	PASS
3DH1	Ant1	Hop	0.39	330	0.128	<=0.4	PASS
3DH3	Ant1	Hop	1.63	200	0.326	<=0.4	PASS
3DH5	Ant1	Hop	2.88	120	0.345	<=0.4	PASS

DH1_Ant1_Hop



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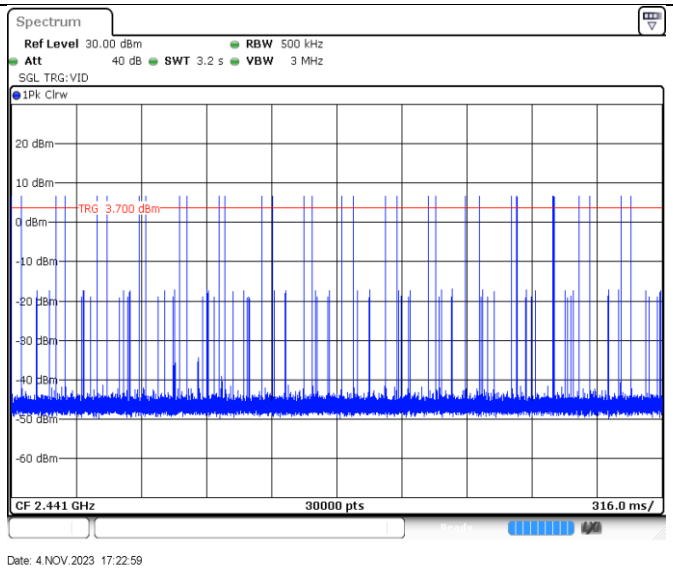
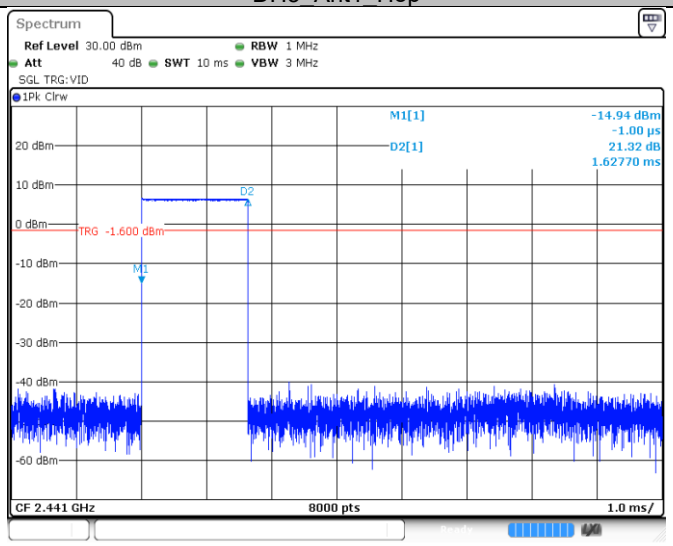
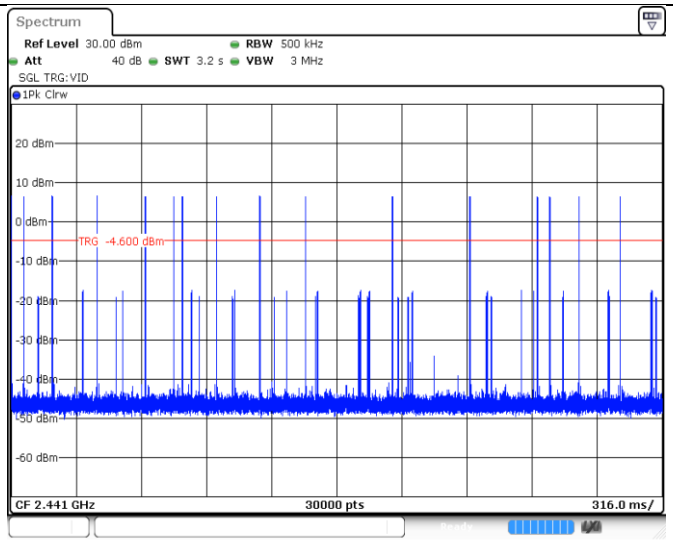
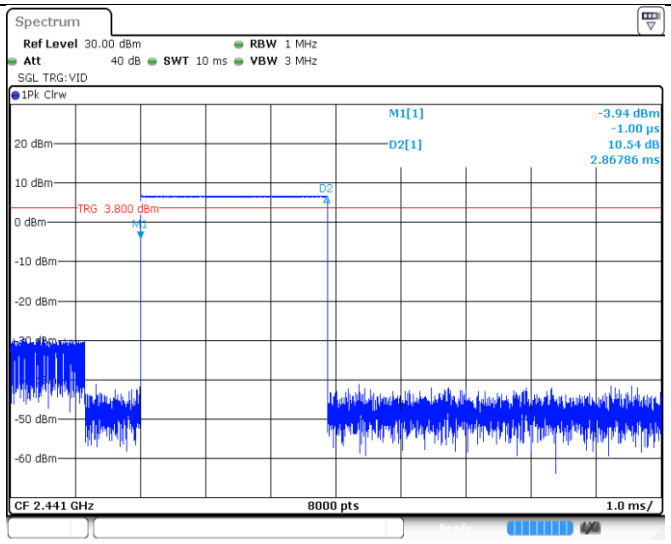


DH3_Ant1_Hop

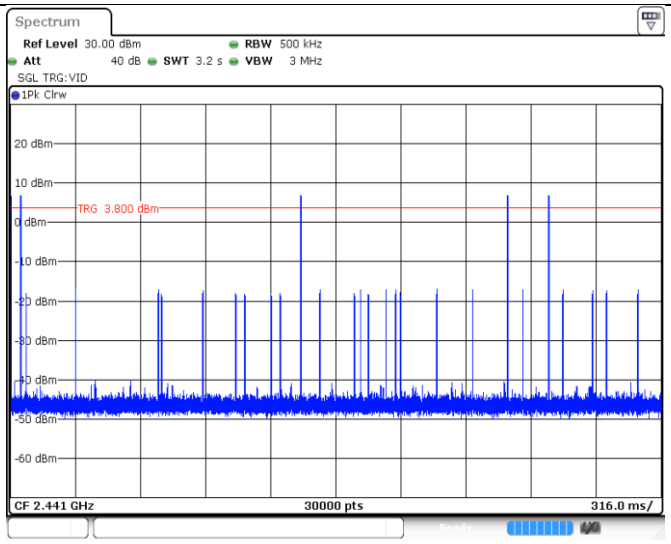




DH5_Ant1_Hop

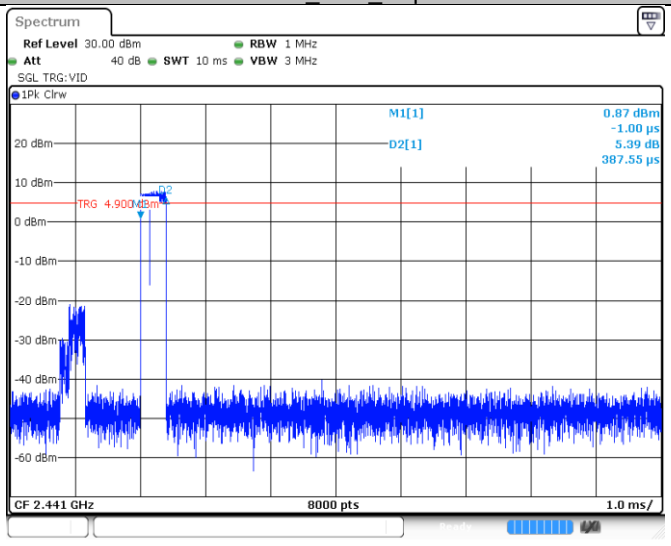


Date: 26.OCT.2023 18:56:34



Date: 26.OCT.2023 18:56:39

2DH1_Ant1_Hop



Date: 4.NOV.2023 17:28:57

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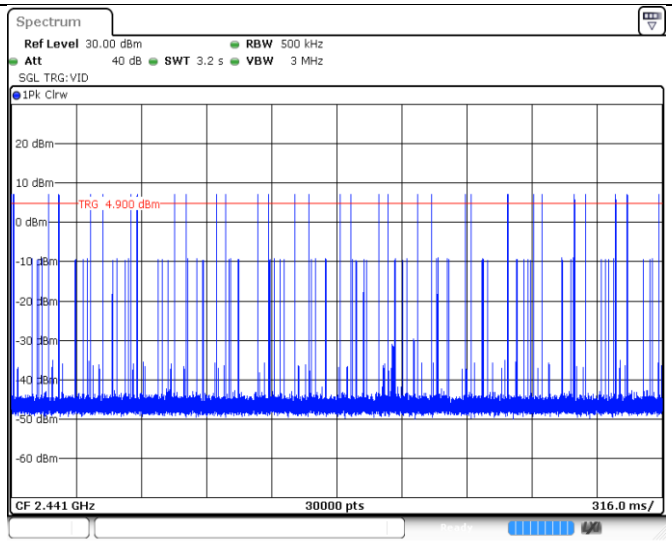
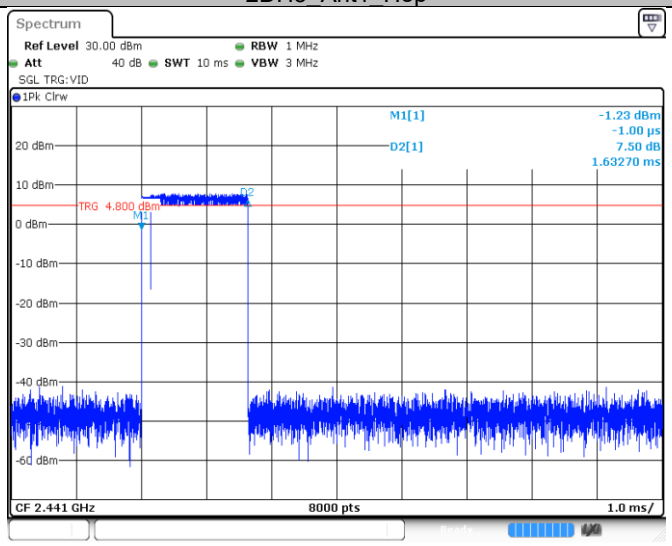
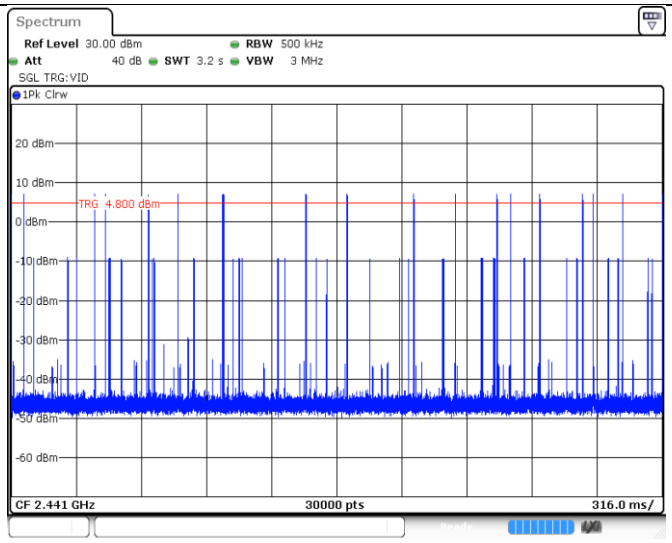


2DH3_Ant1_Hop





2DH5_Ant1_Hop

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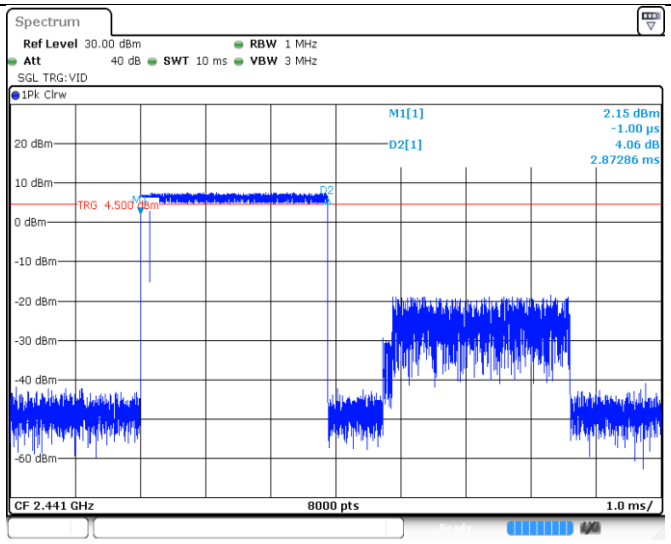
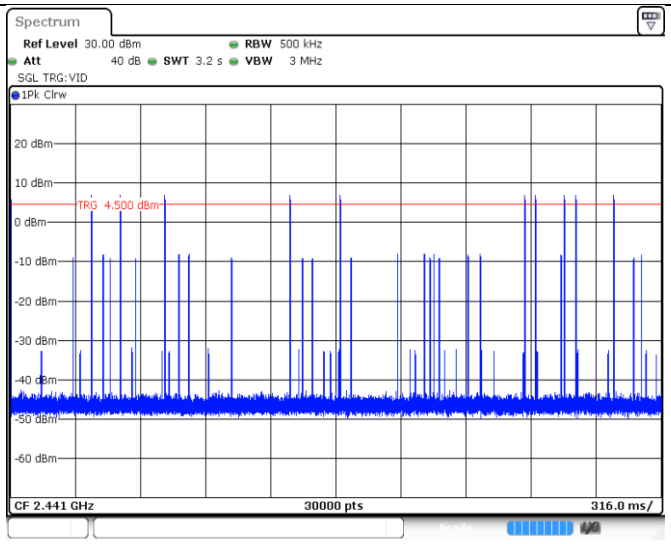
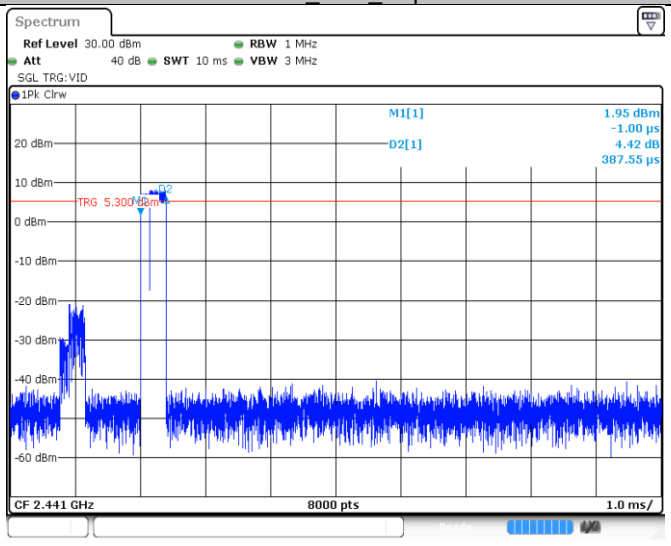


Date: 27.OCT.2023 12:15:27



Date: 27.OCT.2023 12:15:32

3DH1_Ant1_Hop



Date: 4.NOV.2023 17:32:18

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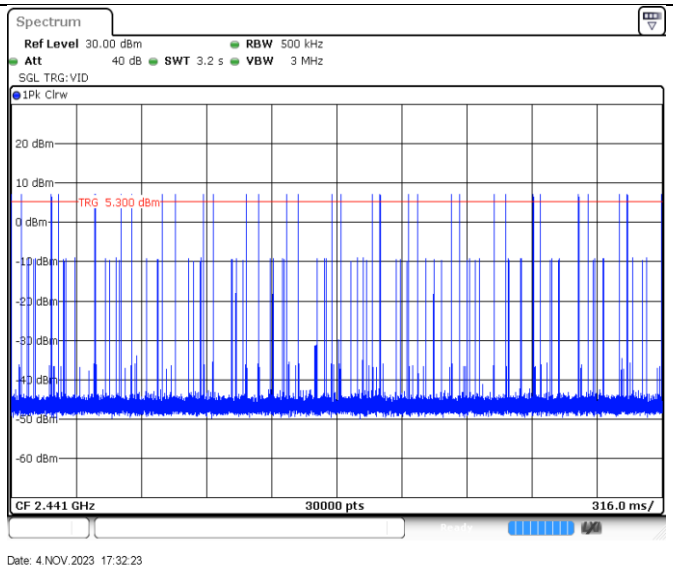
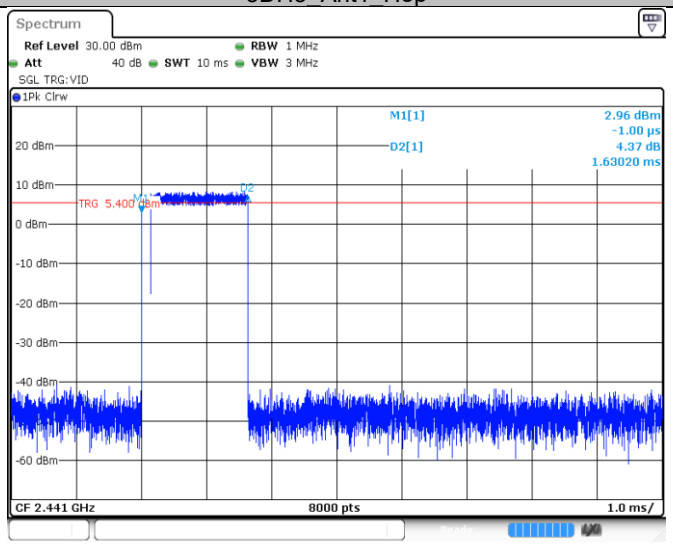
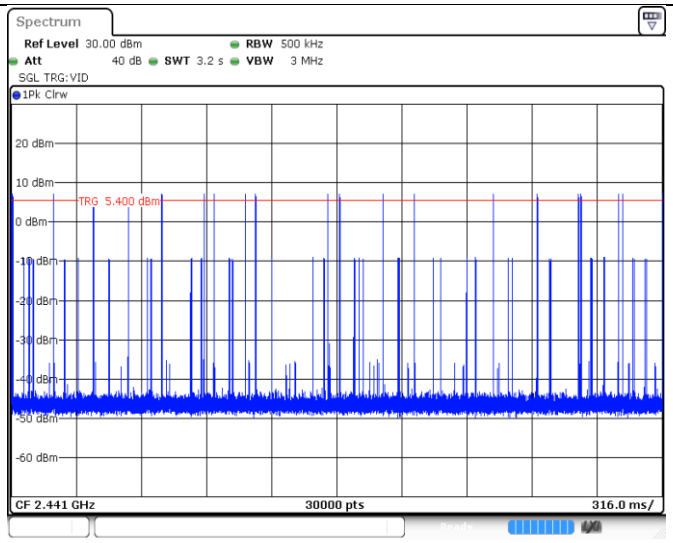


3DH3_Ant1_Hop





3DH5_Ant1_Hop

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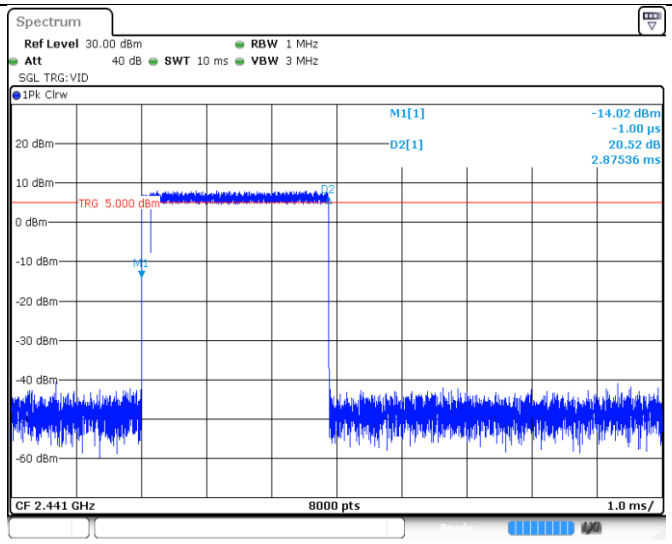

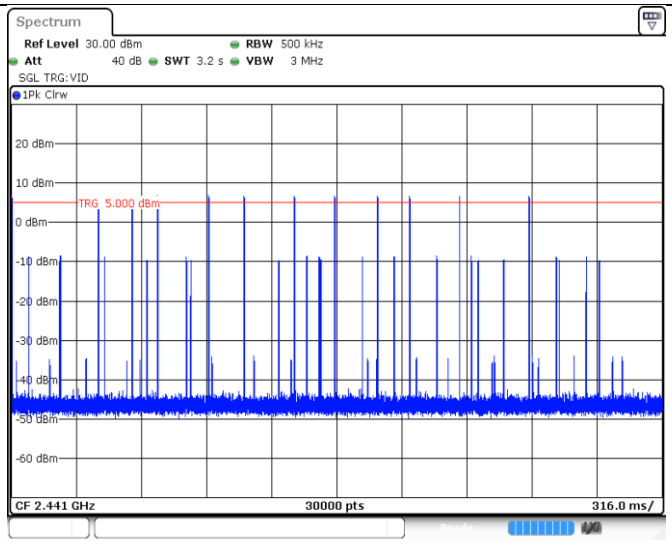

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9.7 Spurious RF conducted emissions

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector, Sweep = auto, Span = wide enough to capture the peak level of the in-band emission and all spurious emissions, Trace = max hold. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this Section.
4. Measure and record the results in the test report.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency.

Limit

According to §15.247(d), Spurious RF conducted emissions limit as below:

Frequency Range MHz	Limit (dBc)
30-25000	-20

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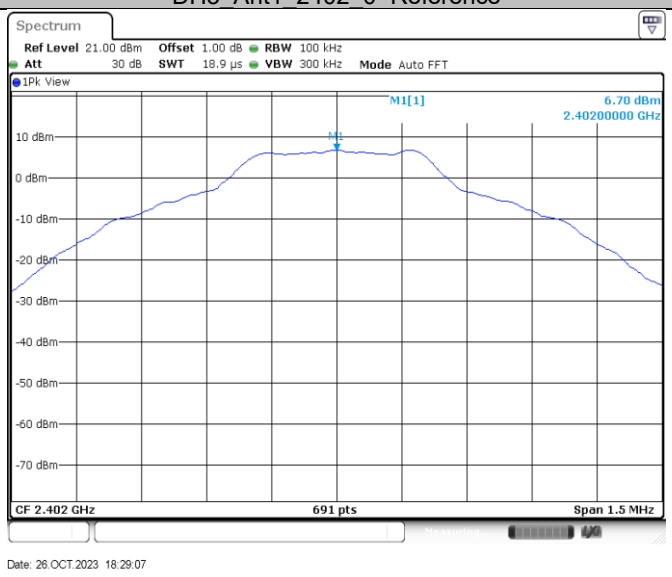
Spurious RF conducted emissions

Test Mode	Antenna	Channel (MHz)	Frequency Range (MHz)	Reference Level	Result (dBm)	Limit (dBm)	Verdict
DH5	Ant1	2402	Reference	6.70	6.70	---	PASS
			30~1000	30~1000	-62.21	<=-13.3	PASS
			1000~26500	1000~26500	-45.87	<=-13.3	PASS
		2441	Reference	6.22	6.22	---	PASS
			30~1000	30~1000	-62.01	<=-13.78	PASS
			1000~26500	1000~26500	-46.45	<=-13.78	PASS
		2480	Reference	6.17	6.17	---	PASS
			30~1000	30~1000	-62.09	<=-13.83	PASS
			1000~26500	1000~26500	-51.15	<=-13.83	PASS
2DH5	Ant1	2402	Reference	6.61	6.61	---	PASS
			30~1000	30~1000	-62.13	<=-13.39	PASS
			1000~26500	1000~26500	-38.71	<=-13.39	PASS
		2441	Reference	6.19	6.19	---	PASS
			30~1000	30~1000	-61.9	<=-13.81	PASS
			1000~26500	1000~26500	-47.56	<=-13.81	PASS
		2480	Reference	6.32	6.32	---	PASS
			30~1000	30~1000	-61.45	<=-13.68	PASS
			1000~26500	1000~26500	-51.52	<=-13.68	PASS
3DH5	Ant1	2402	Reference	6.62	6.62	---	PASS
			30~1000	30~1000	-62.03	<=-13.38	PASS
			1000~26500	1000~26500	-38.44	<=-13.38	PASS
		2441	Reference	6.19	6.19	---	PASS
			30~1000	30~1000	-62	<=-13.81	PASS
			1000~26500	1000~26500	-51.08	<=-13.81	PASS
		2480	Reference	6.31	6.31	---	PASS
			30~1000	30~1000	-62.46	<=-13.69	PASS
			1000~26500	1000~26500	-51.78	<=-13.69	PASS

DH5_Ant1_2402_0~Reference



DH5_Ant1_2402_30~1000

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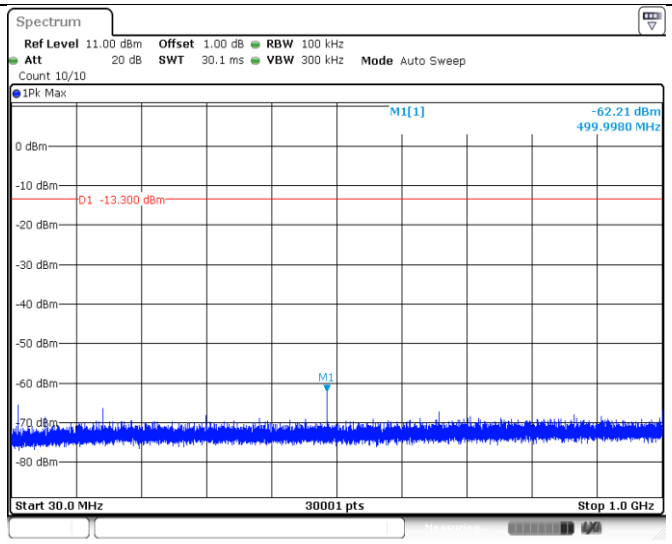

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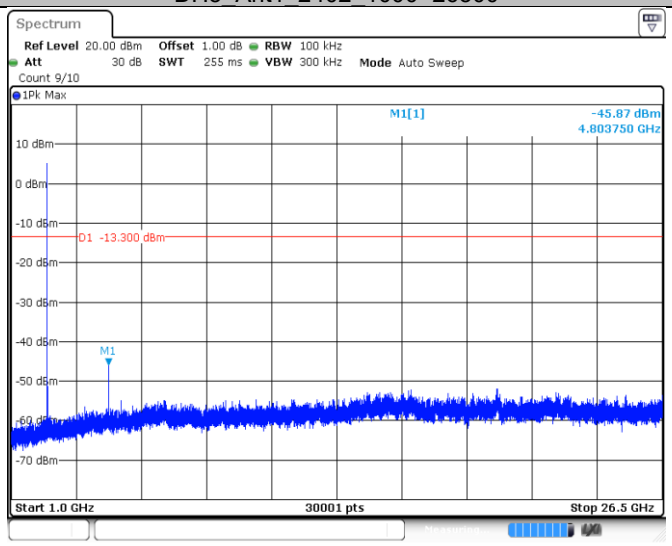

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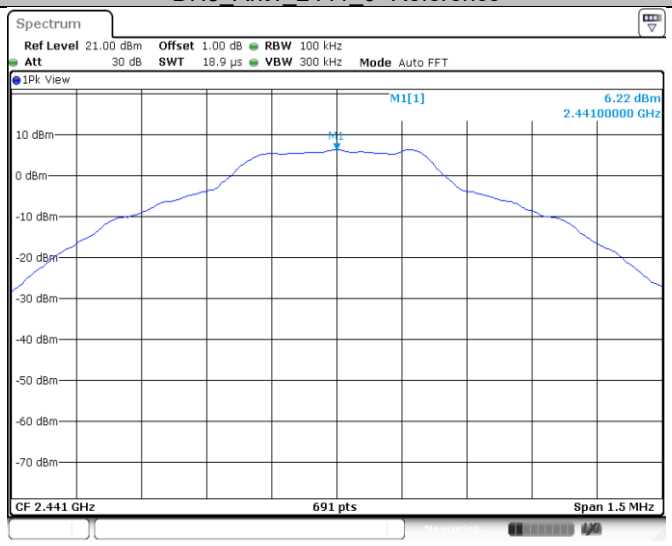

DH5_Ant1_2441_30~1000

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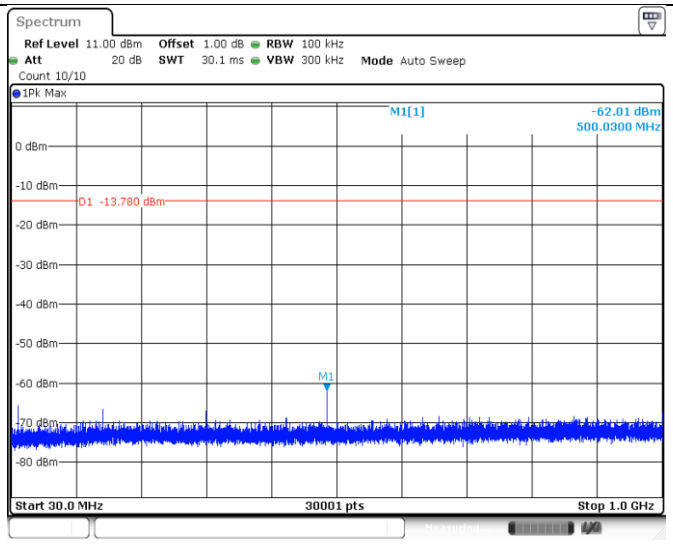

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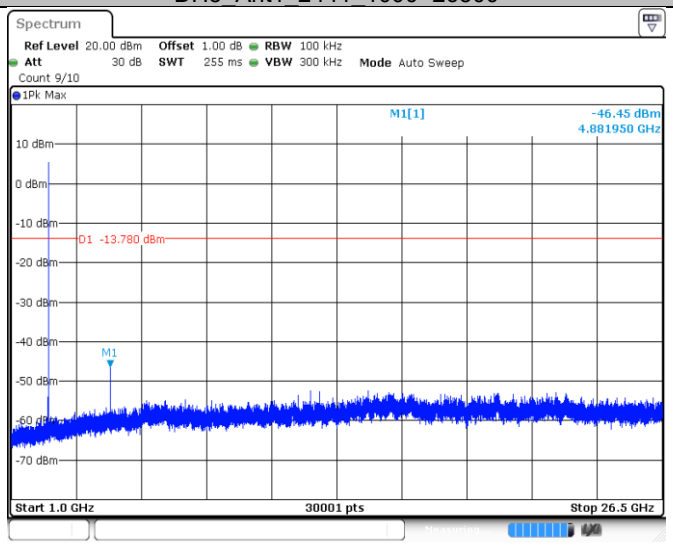
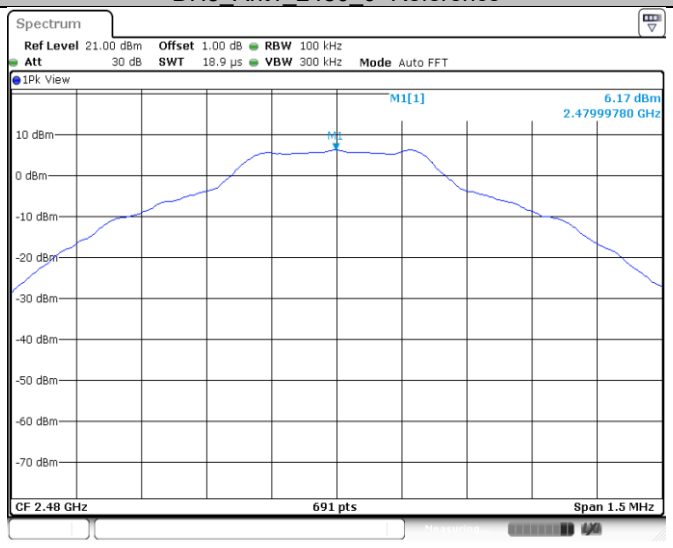


DH5_Ant1_2480_0~Reference



DH5_Ant1_2480_30~1000

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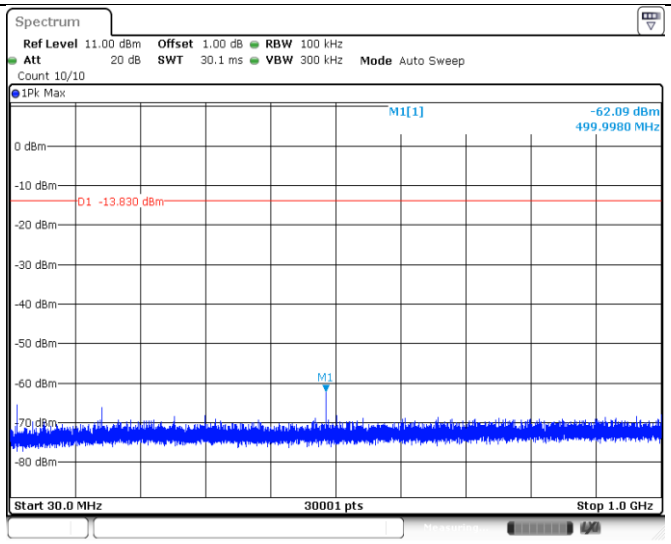

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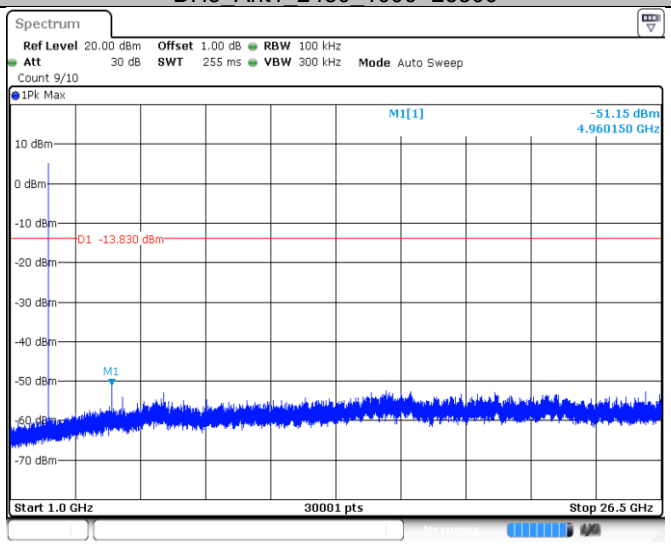

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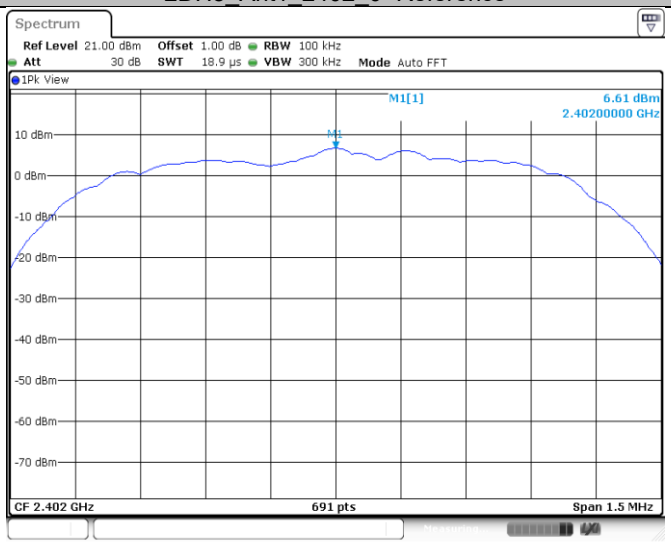

2DH5_Ant1_2402_30~1000

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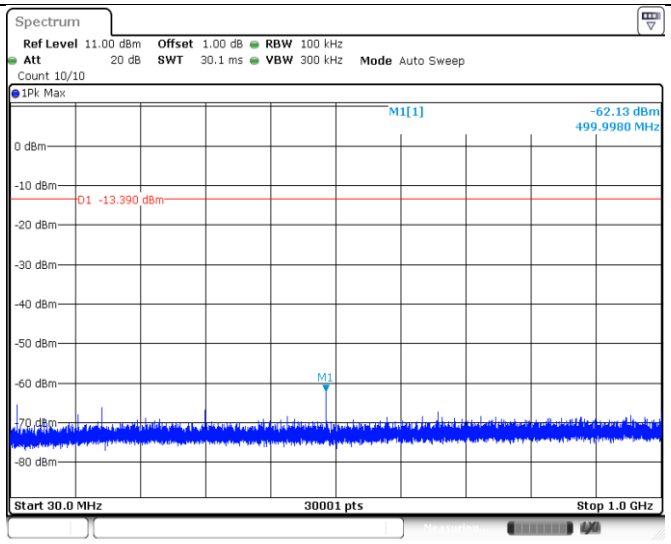

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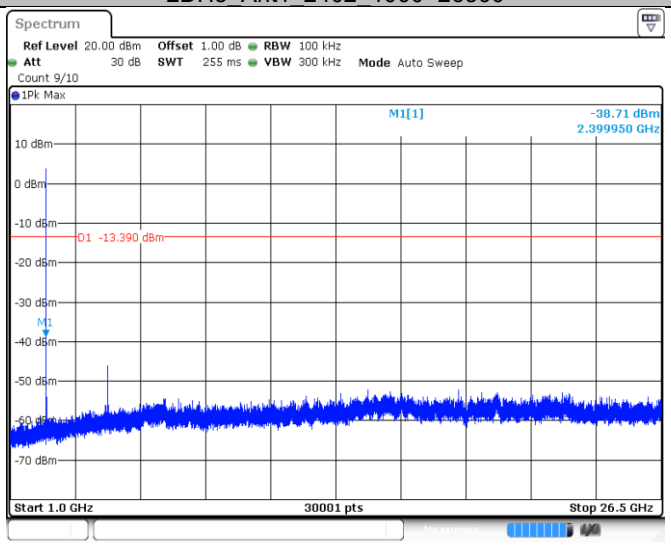

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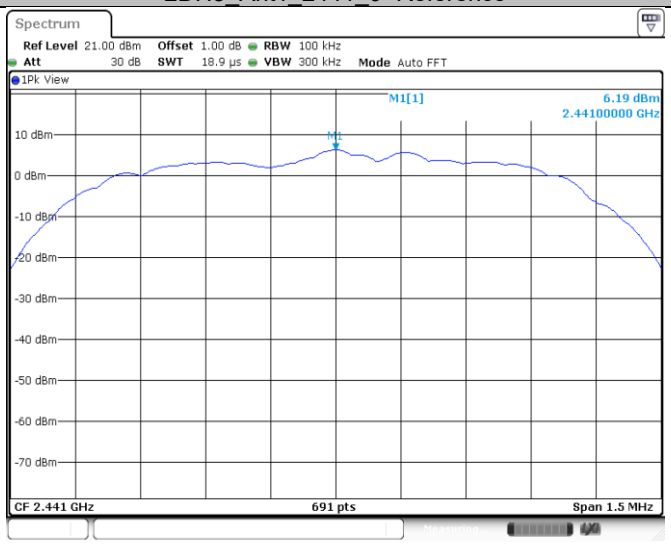

2DH5_Ant1_2441_30~1000

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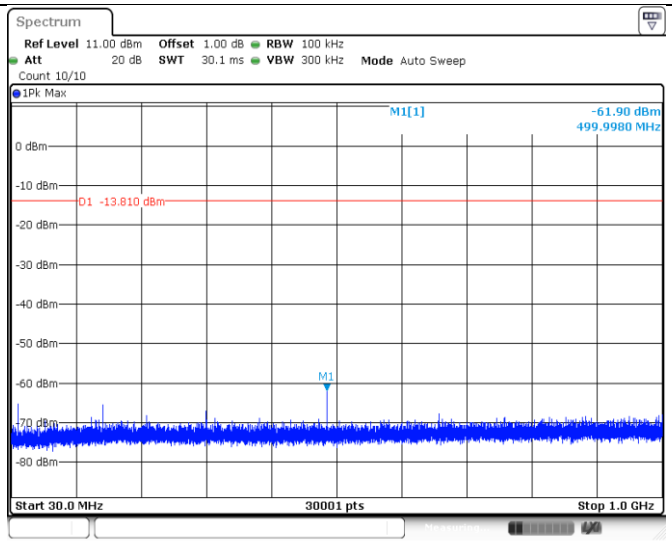

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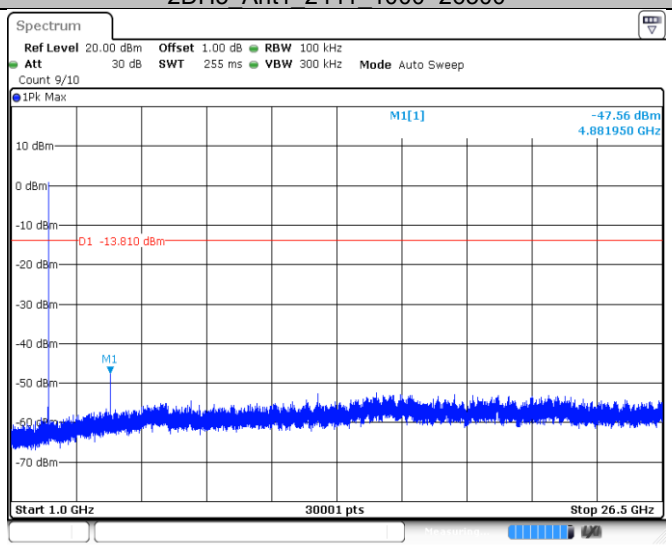

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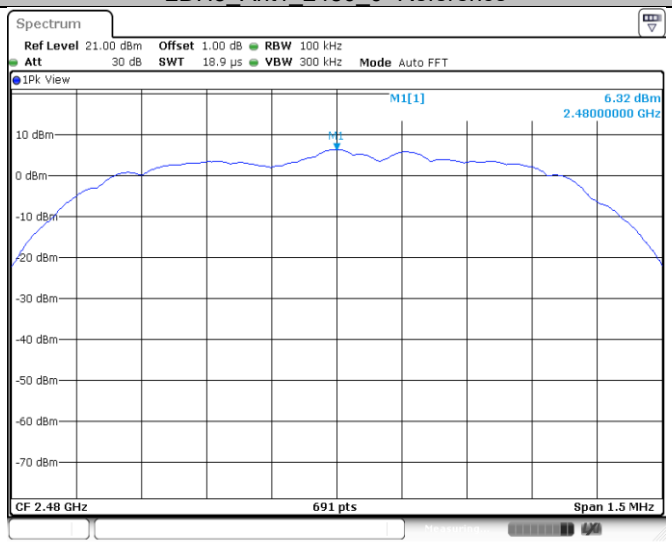

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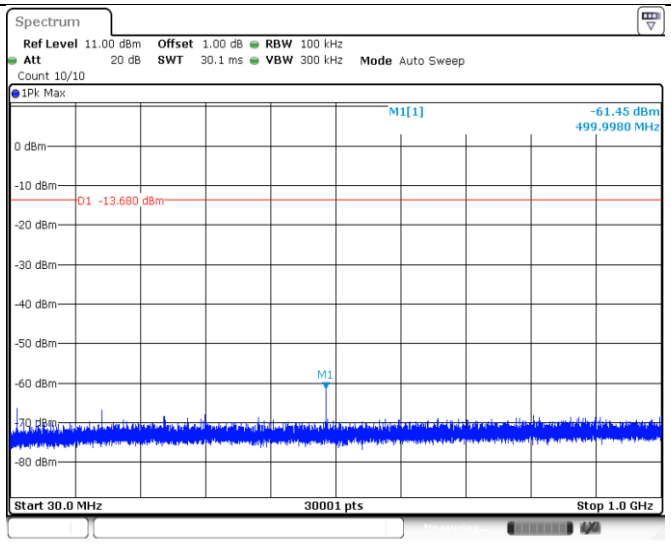

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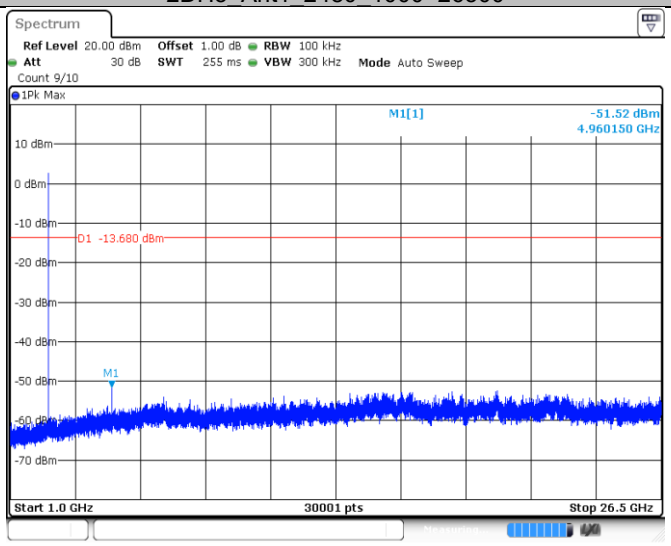

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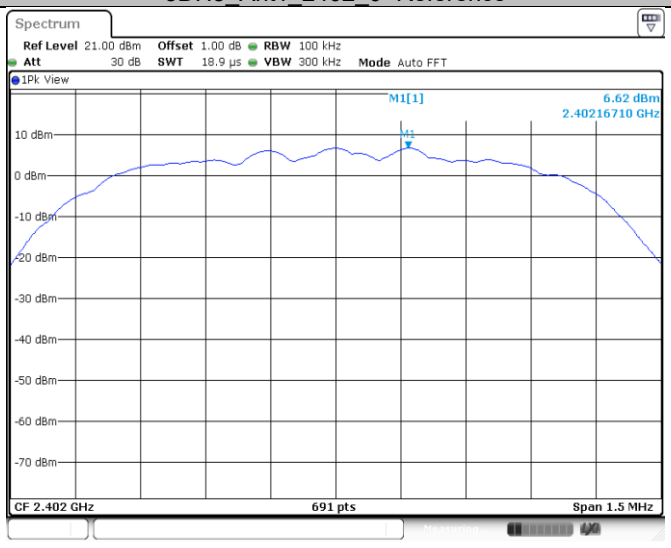

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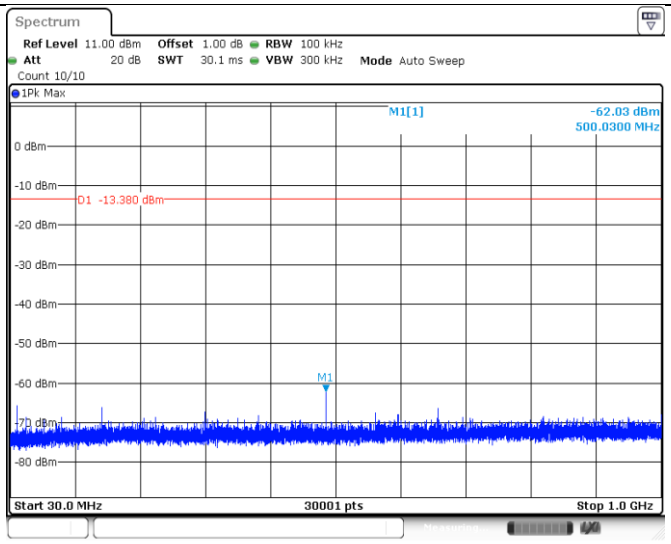

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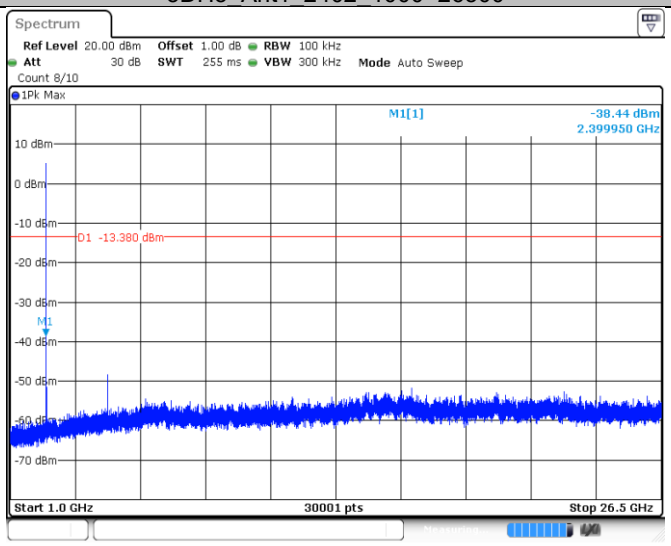

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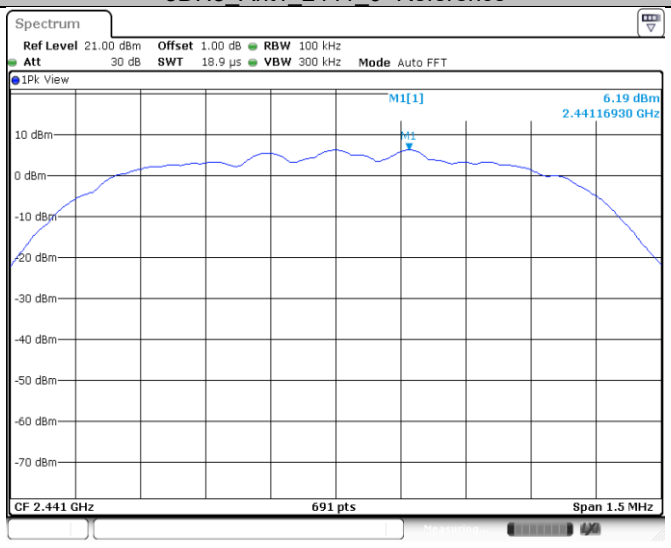

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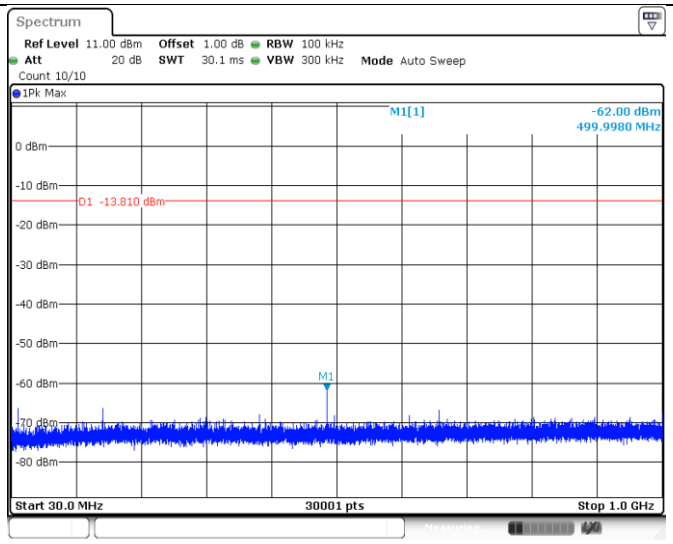

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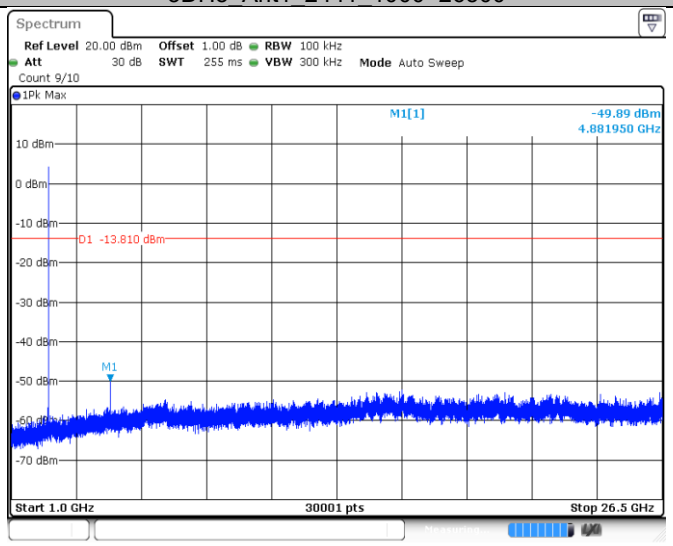
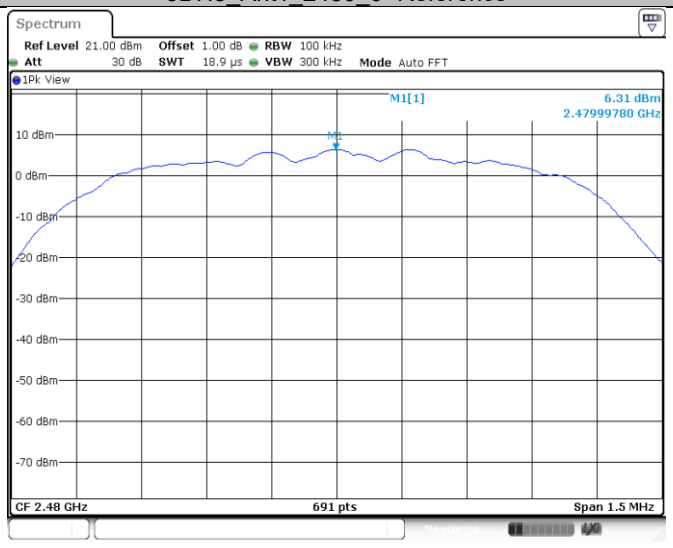


3DH5_Ant1_2480_0~Reference



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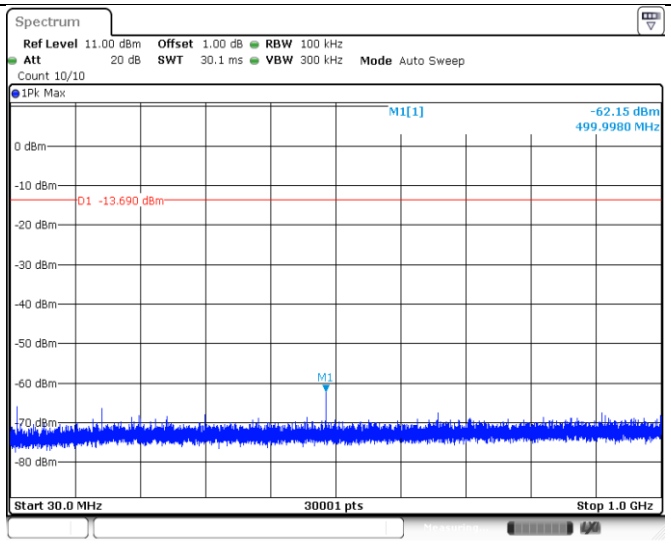
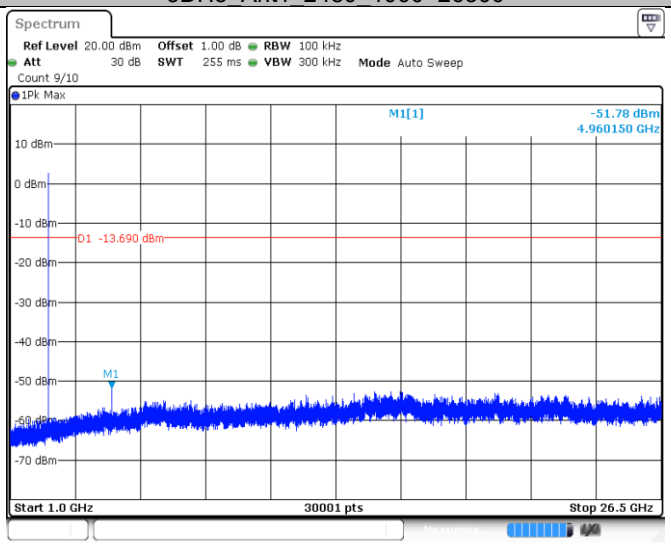


3DH5_Ant1_2480_1000~26500



9.8 Band edge testing

Test Method

1. The RF output of EUT was connected to the test receiver by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously. Set the EUT to the lowest frequency channel.
3. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector, Trace: Max hold, Sweep time: Coupled, Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation. Allow the trace to stabilize.
4. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
5. Set the EUT to the highest frequency channel and repeat step 2) to 4)
6. Enable the EUT hopping mode, repeat the test.

Limit:

According to §15.247(d), Band edge testing limit as below:

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the100 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 that the transmitter demonstrates compliance with the peak conducted power limits.

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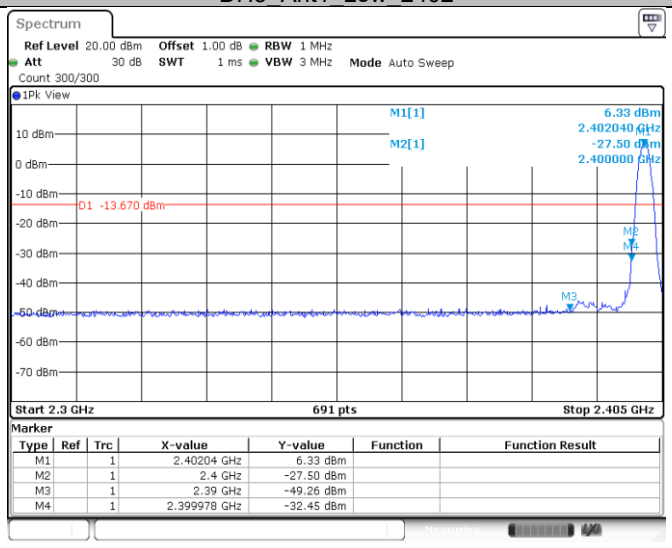
Band edge

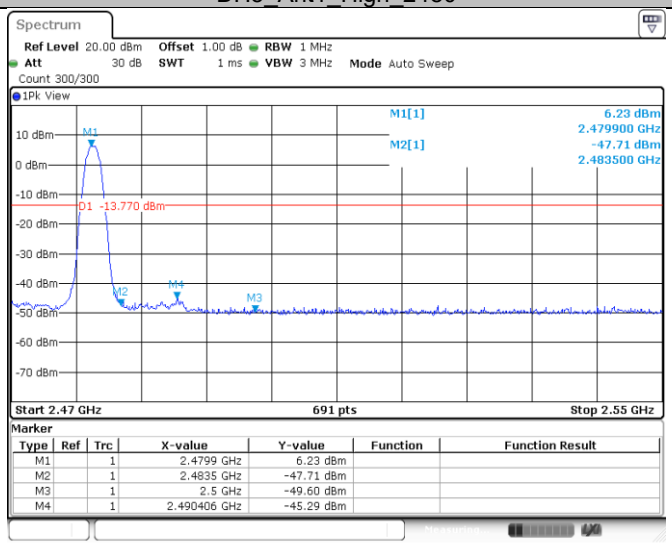
Test Result as below:

Test Mode	Antenna	Channel	Channel (MHz)	Reference Level (dBm)	Result (dBm)	Limit (dBm)	Verdict
DH5	Ant1	Low	2402	6.33	-32.45	<=-13.67	PASS
		High	2480	6.23	-45.29	<=-13.77	PASS
		Low	Hop_2402	8.10	-48.55	-11.9	PASS
		High	Hop_2480	7.89	-47.23	-12.11	PASS
2DH5	Ant1	Low	2402	7.83	-24.2	<=-12.17	PASS
		High	2480	7.45	-46.04	<=-12.55	PASS
		Low	Hop_2402	8.82	-48.5	-11.18	PASS
		High	Hop_2480	8.75	-47.54	-11.25	PASS
3DH5	Ant1	Low	2402	7.98	-24.27	<=-12.02	PASS
		High	2480	7.71	-45.86	<=-12.29	PASS
		Low	Hop_2402	9.30	-48.21	-10.7	PASS
		High	Hop_2480	9.03	-47.26	-10.97	PASS

DH5_Ant1_Low_2402



DH5_Ant1_High_2480



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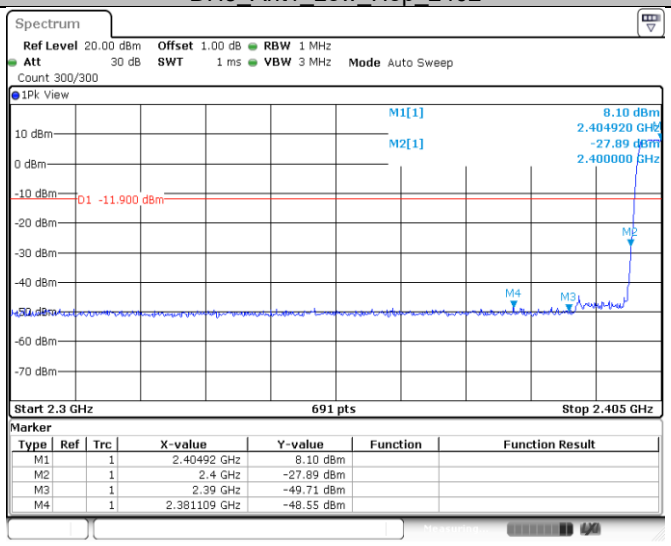
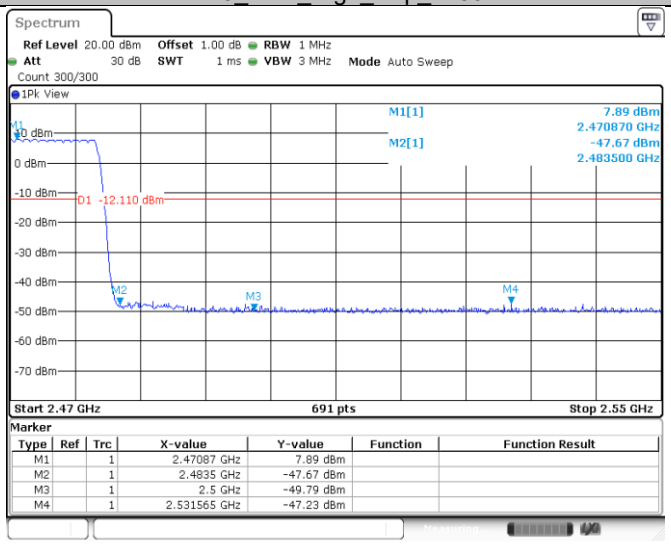
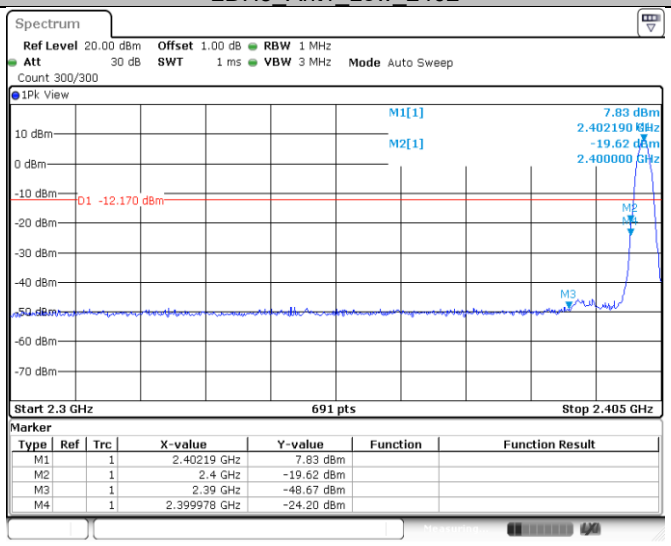
DH5_Ant1_Low_Hop_2402



DH5_Ant1_High_Hop_2480



2DH5_Ant1_Low_2402



2DH5_Ant1_High_2480

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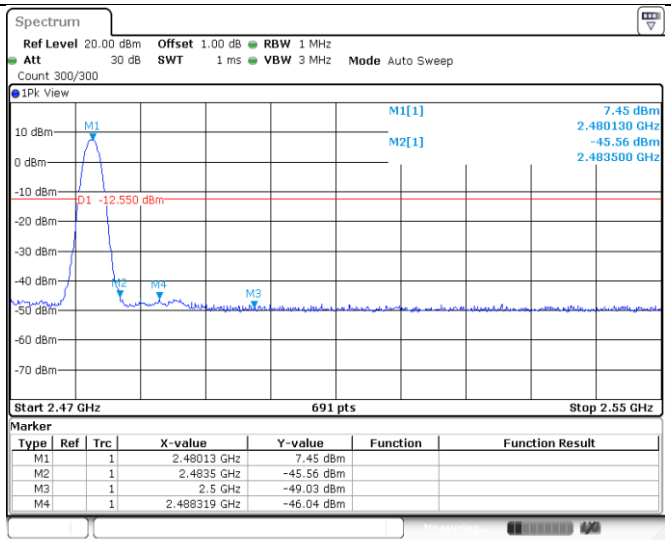
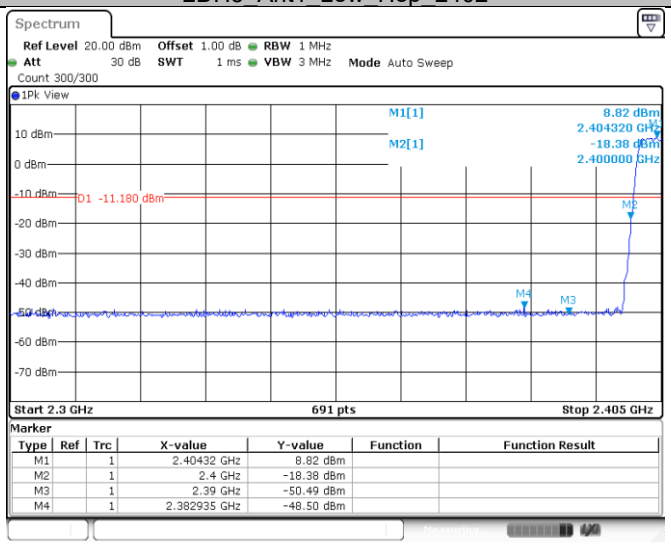
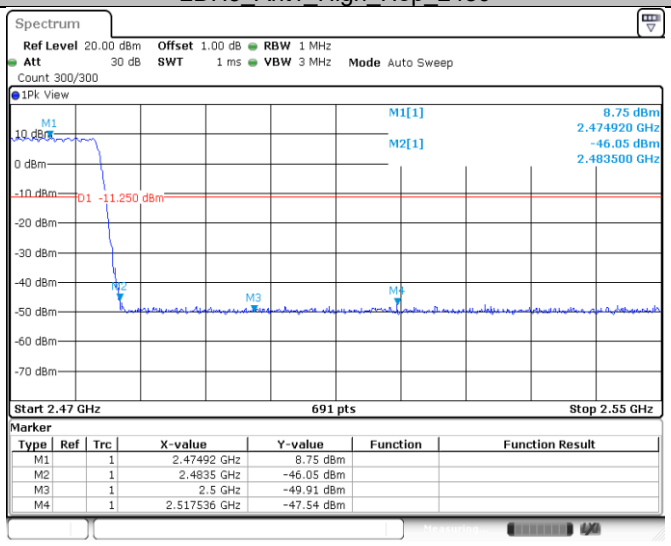


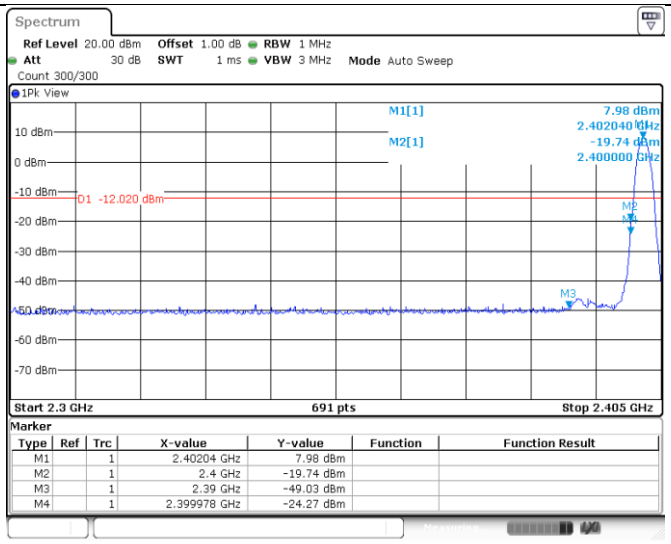
2DH5_Ant1_Low_Hop_2402



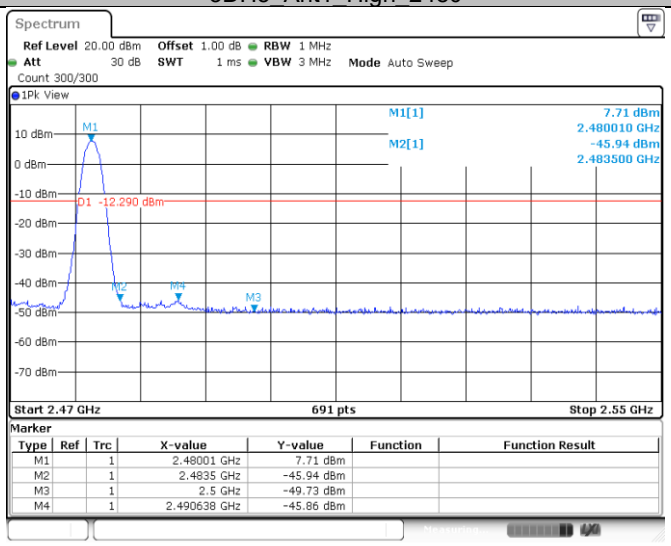
2DH5_Ant1_High_Hop_2480



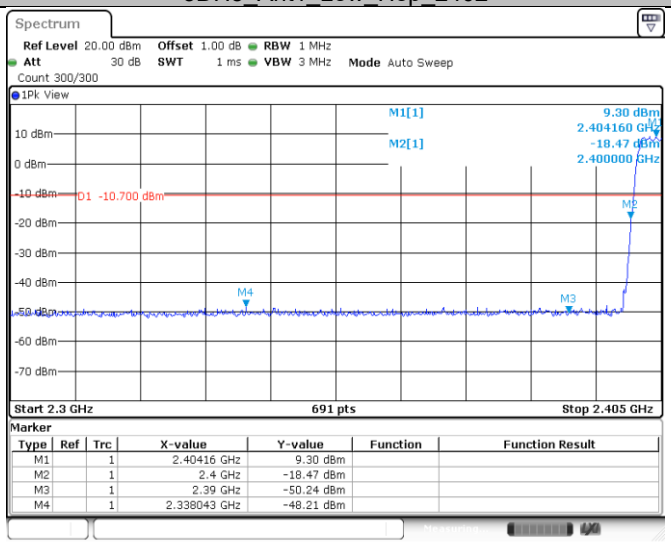
3DH5_Ant1_Low_2402



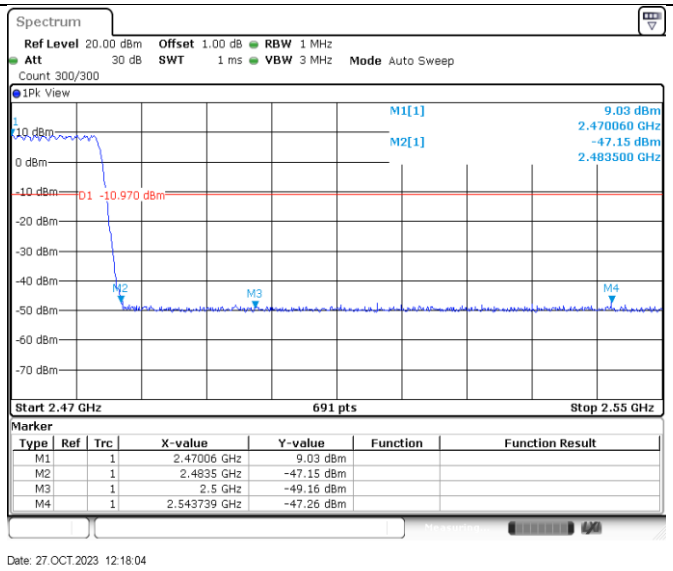
3DH5_Ant1_High_2480



3DH5_Ant1_Low_Hop_2402



3DH5_Ant1_High_Hop_2480



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9.9 Spurious radiated emissions for transmitter

Test Method

1. The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meters chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
4. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
5. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
6. Use the following test receiver settings According to C63.10:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz to 120KHz for f < 1 GHz; VBW≥ RBW; Sweep = auto; Detector function = QP; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥1 GHz for peak measurement.
   For average measurement:
   The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average ((duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor (20log(1/duty cycle)).
   The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.
7. Repeat above procedures until all frequencies measured were complete.

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Spurious radiated emissions for transmitter

Limit

The radio emission outside the operating frequency band 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. Radiated emissions which fall in the restricted bands, as defined in section15.205, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength μV/m	Field Strength dBμV/m	Detector	Measurement distance meters
0.009-0.490	2400/F(kHz)	48.5-13.8	AV	300
0.490-1.705	24000/F(kHz)	33.8-23.0	QP	30
1.705-30	30	29.5	QP	30
30-88	100	40	QP	3
88-216	150	43.5	QP	3
216-960	200	46	QP	3
960-1000	500	54	QP	3
Above 1000	500	54	AV	3
Above 1000	5000	74	PK	3

Note 1: Limit 3m(dBμV/m)=Limit 300m(dBμV/m)+40Log(300m/3m) (Below 30MHz)
Note 2: Limit 3m(dBμV/m)=Limit 30m(dBμV/m)+40Log(30m/3m) (Below 30MHz)

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Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

The only worse case (which is subject to the maximum EIRP, GFSK mode) test result is listed in the report.

Transmitting spurious emission test result as below:

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Correct factor	Result
	MHz	dBµV/m		dBµV/m		dBµV/m	(dB)	
30-1000MHz	335.981111	32.86	H	46.00	QP	13.14	20.09	Pass
	383.996111	30.77	H	46.00	QP	15.23	20.94	Pass
	521.628333	32.16	H	46.00	QP	13.84	23.51	Pass
	618.951667	34.41	H	46.00	QP	11.59	25.89	Pass
	Other Frequencies	--	H	--	QP	--	--	Pass
	197.917778	23.02	V	43.50	QP	20.48	16.77	Pass
	336.573889	26.63	V	46.00	QP	19.37	20.11	Pass
	788.755556	37.10	V	46.00	QP	8.90	27.68	Pass
	894.054444	37.89	V	46.00	QP	8.11	29.17	Pass
	Other Frequencies	--	V	--	QP	--	--	Pass

GFSK Modulation 2402MHz Test Result

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Correct factor	Result
	MHz	dBµV/m		dBµV/m		dBµV/m	(dB)	
1000-25000MHz	1854.000000	48.91	H	74.00	PK	25.09	-7.31	Pass
	2123.500000	49.61	H	74.00	PK	24.39	-5.50	Pass
	3190.500000	48.20	H	74.00	PK	25.80	-0.21	Pass
	Other Frequencies	--	H	--	PK	--	--	Pass
	1854.000000	47.17	V	74.00	PK	26.83	-7.31	Pass
	2967.500000	45.52	V	74.00	PK	28.48	-2.00	Pass
	3955.000000*	50.98	V	74.00	PK	23.02	2.73	Pass
	Other Frequencies	--	V	--	PK	--	--	Pass

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GFSK Modulation 2441MHz Test Result

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Correct factor	Result
	MHz	dBµV/m		dBµV/m		dBµV/m	(dB)	
1000-25000MHz	1854.000000	46.84	H	74.00	PK	27.16	-7.31	Pass
	2131.000000	46.90	H	74.00	PK	27.10	-5.48	Pass
	3192.000000	49.43	H	74.00	PK	24.57	-0.21	Pass
	Other Frequencies	--	H	--	PK	--	--	Pass
	3189.000000	48.58	V	74.00	PK	25.42	-0.21	Pass
	7323.500000*	43.82	V	74.00	PK	30.18	7.87	Pass
	11458.500000*	43.56	V	74.00	PK	30.44	12.31	Pass
	Other Frequencies	--	V	--	PK	--	--	Pass

GFSK Modulation 2480MHz Test Result

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Correct factor	Result
	MHz	dBµV/m		dBµV/m		dBµV/m	(dB)	
1000-25000MHz	1854.000000	48.81	H	74.00	PK	25.19	-7.31	Pass
	2374.000000*	45.36	H	74.00	PK	28.64	-4.77	Pass
	3166.500000	47.62	H	74.00	PK	26.38	-0.18	Pass
	Other Frequencies	--	H	--	PK	--	--	Pass
	1854.000000	47.57	V	74.00	PK	26.43	-7.31	Pass
	3187.000000	47.60	V	74.00	PK	26.40	-0.20	Pass
	4824.500000*	50.95	V	74.00	PK	23.05	5.25	Pass
	Other Frequencies	--	V	--	PK	--	--	Pass

Remark:
(1) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
(2) Data of measurement within frequency range 9kHz-30MHz is the noise floor or attenuated more than 20dB below the permissible limits or the field strength is too small to be measured, so test data does not present in this report.
(3) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.
(4) Level=Reading Level + Correction Factor
Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
(The Reading Level is recorded by software which is not shown in the sheet)

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10 Test Equipment List

List of Test Instruments

Conducted Emission 2# Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 3	68-4-74-19-002	102590	1	2024-5-19
LISN	Rohde & Schwarz	ENV216	68-4-87-19-001	102472	1	2024-5-20
Attenuator	Shanghai Huaxiang	TS2-26-3	68-4-81-16-003	080928189	1	2024-5-19
Test software	Rohde & Schwarz	EMC32	68-4-90-19-005-A01	Version10.35.02	N/A	N/A
Shielding Room	TDK	CSR #2	68-4-90-19-005	----	3	2025-10-15

Radiated Emission 1# Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 7	68-4-74-19-001	102176	1	2024-5-20
Loop Antenna	Rohde & Schwarz	HFH2-Z2	68-4-80-14-006	100398	1	2024-8-17
3m Semi-anechoic chamber	TDK	SAC-3 #1	68-4-90-14-001	----	3	2024-5-28
Test software	Rohde & Schwarz	EMC32	68-4-90-14-001-A10	Version10.35.02	N/A	N/A

Radiated Emission 2# Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	68-4-74-14-002	101269	1	2024-5-20
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9162	68-4-80-19-003	284	1	2024-3-5
Wave Guide Antenna	ETS	3117	68-4-80-19-001	00218954	1	2024-4-26
Pre-amplifier	Rohde & Schwarz	SCU 18F	68-4-29-19-001	100745	1	2024-5-19
Pre-amplifier	Rohde & Schwarz	SCU 18F	68-4-29-19-002	100746	1	2024-5-19
Sideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	68-4-80-14-008	12827	1	2024-7-11
Pre-amplifier	Rohde & Schwarz	SCU 40A	68-4-29-14-002	100432	1	2024-8-1
Attenuator	Mini-circuits	UNAT-6+	68-4-81-21-002	15542	1	2024-5-19
3m Semi-anechoic chamber	TDK	SAC-3 #2	68-4-90-19-006	----	2	2024-5-28
Test software	Rohde & Schwarz	EMC32	68-4-90-19-006-A01	Version10.35.02	N/A	N/A

RF conducted test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
Signal Analyzer	Rohde & Schwarz	FSV40	68-4-74-14-004	101030	1	2024-5-19
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157W	68-4-93-14-003	101226/100929	1	2024-5-20
Test software	Tonscend	System for BT/WIFI	68-4-74-14-006-A13	Version 2.6.77.0518	N/A	N/A
Shielding Room	TDK	TS8997	68-4-90-19-003	----	3	2025-10-15

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11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Conducted Emission in new shielding room (68-4-90-19-005) 150kHz-30MHz (for test using AMN ENV216)	3.15dB
Uncertainty for Radiated Emission in 3m chamber (68-4-90-14-001) 9kHz-30MHz	4.70dB
Uncertainty for Radiated Emission in 3m chamber (68-4-90-14-001) 30MHz-1000MHz	Horizontal: 4.63dB; Vertical: 4.78dB;
Uncertainty for Radiated Emission in new 3m chamber (68-4-90-19-006) 1000MHz-18000MHz	Horizontal: 5.38dB; Vertical: 5.38dB;
Uncertainty for Radiated Emission in new 3m chamber (68-4-90-19-006) 18GHz-40GHz	Horizontal: 5.29dB; Vertical: 5.29dB;
Uncertainty for Conducted RF test with TS 8997	RF Power Conducted: 1.31dB Frequency test involved: 0.6×10^{-8} or 1%

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2021, clause 4.4.3 and 4.5.1.

---The End---

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