TEST REPORT

Applicant Name :	The Singing Machine Company Inc.
Address :	6301 NW 5th Way, Suite 2900, Fort Lauderdale, FL, 33309, U.S.A.
Report Number :	RA230510-25327E-RF-00A
FCC ID:	2AAXO-ISM9010

Test Standard (s)
FCC PART 15.247

Sample Description

Product Type:	WiFi Touch Screen Karaoke System
Model No.:	iSM9010, iSM9012, iSM9015, iSM9020, iSM9010XX, iSM9012XX, iSM9015XX, iSM9020XX (XX means unit color, it can be A to Z or N/A)
Trade Mark:	Singing Machine
Date Received:	2023-05-10
Date of Test:	2023-05-22 to 2023-05-29
Report Date:	2023-06-04

Test Result:	Pass*

* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Roger Ling
EMC Engineer

Approved By:

Candy Li
EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★".
Shenzhen Accurate Technology Co., Ltd. is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RA230510-25327E-RF-00A	Original Report	2023-06-04

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product Type	WiFi Touch Screen Karaoke System
Tested Model	iSM9010
Multiple Model	iSM9012,iSM9015,iSM9020,iSM9010XX, iSM9012XX, iSM9015XX, iSM9020XX (XX means unit color, it can be A to Z or N/A)
Model Difference	Please refer to DOS letter
Frequency Range	Bluetooth:2402~2480MHz
Maximum conducted Peak output power	4.64dBm
Modulation Technique	BDR(GFSK)/EDR(π/4-DQPSK)/EDR(8DPSK)
Antenna Specification*	Internal Antenna: -0.68dBi(provided by the applicant)
Voltage Range	DC 15V from adapter
Sample number	RA230510-25327E-RF-S1 (CE&RE) RA230510-25327E-RF-S2(RF Conducted Test) (Assigned by ATC, Shenzhen)
Sample/EUT Status	Good condition
Adapter Information	Model No.: S-23-150-1500-US Input: 100-240~50/60Hz 1.0A Output: 15.0V ⎓ 1.5A

Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All emissions measurement was performed at Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF Frequency		$0.082*10^{-7}$
RF output power, conducted		0.71dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.74dB
Emissions, Radiated	30MHz - 1GHz	5.08dB
	1GHz - 18GHz	4.96dB
	18GHz - 26.5GHz	5.16dB
Temperature		1℃
Humidity		6%
Supply voltages		0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the Floor 1, KuMaKe Building, Dongzhou Community, Guangming Street, Guangming District, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 708358, the FCC Designation No.: CN1189.

Accredited by American Association for Laboratory Accreditation (A2LA).The Certificate Number is 4297.01.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0016. The Registration Number is 30241.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

EUT Exercise Software

"adb*" was used during testing and the power level was default*.

Special Accessories

N/A.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

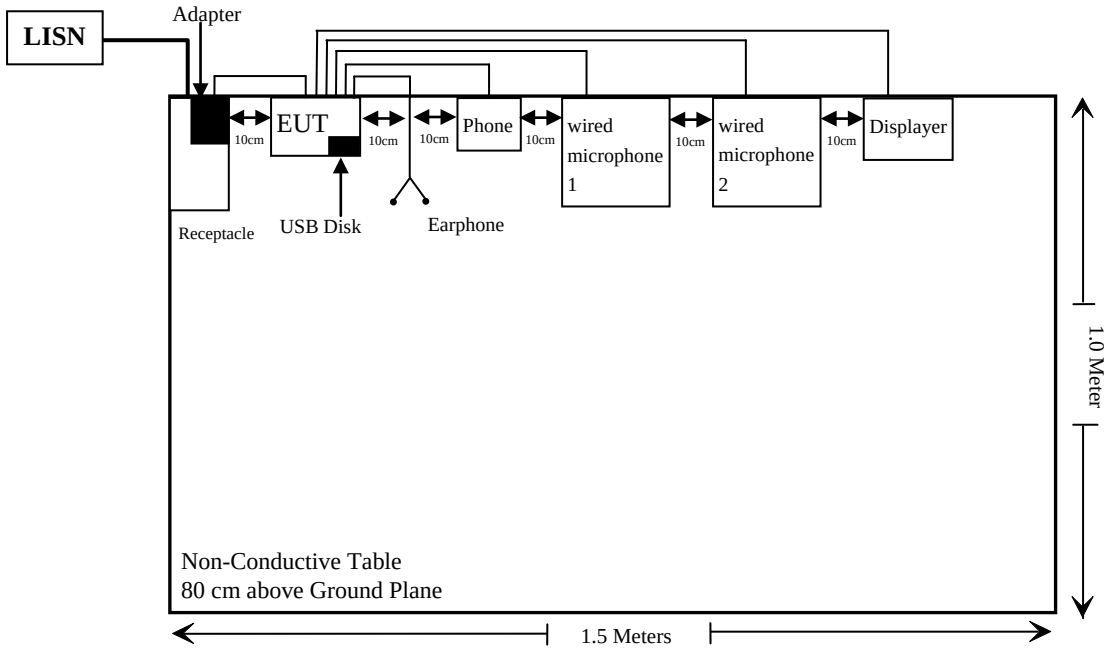
Manufacturer	Description	Model	Serial Number
PHILIPS	Displayer	275M8C	3GB035866A
Hisense	Phone	A5	860372041491400
Kingston	USB flash disk	Datatraveler G3	Unknown
SCI	Earphone	SCRC-130A	Unknown
Unknown	Microphone*2	Unknown	Unknown

External I/O Cable

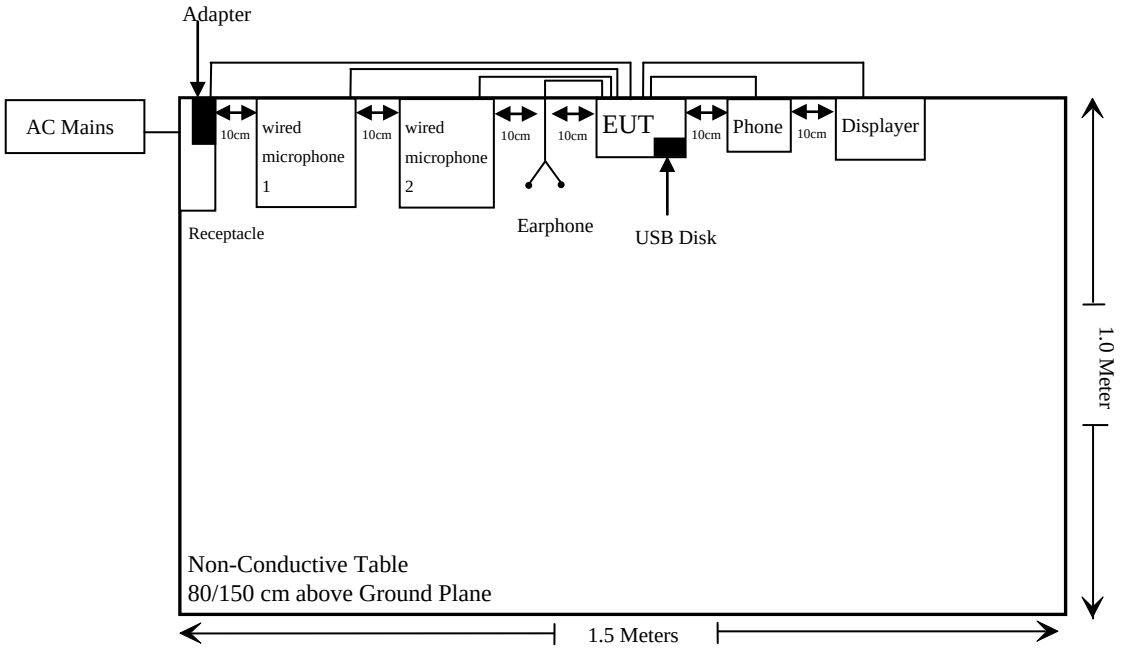
Cable Description	Length (m)	From Port	To
Shielded Detachable HDMI Cable	2.0	EUT	Displayer
Unshielded Detachable Power Cable	1.0	EUT	Adapter
Unshielded Detachable Earphone Cable	1.2	EUT	Earphone
Unshielded Detachable AUX IN Cable	1.0	EUT	Phone
Unshielded Detachable microphone Cable*2	1.4	EUT	Microphone*2

Block Diagram of Test Setup

For Conducted Emission:



For Radiated Emission:



Note: The support table edge was flush with the center of turntable.

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§1.1307 (b)	RF Exposure	Compliant
§15.207(a)	AC Line Conducted Emissions	Compliant
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliant
§15.247(a)(1)	20 dB Emission Bandwidth & 99% Occupied Bandwidth	Compliant
§15.247(a)(1)	Channel Separation Test	Compliant
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliant
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliant
§15.247(b)(1)	Peak Output Power Measurement	Compliant
§15.247(d)	Band edges	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	100784	2022/11/25	2023/11/24
Rohde & Schwarz	L.I.S.N.	ENV216	101314	2022/11/25	2023/11/24
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2022/12/07	2023/12/06
Unknown	RF Coaxial Cable	No.17	N0350	2022/11/25	2023/11/24
Conducted Emission Test Software: e3 191218 (V9)					
Radiated Emissions Test					
Rohde & Schwarz	Test Receiver	ESR	102725	2022/11/25	2023/11/24
Rohde & Schwarz	Spectrum Analyzer	FSV40	101949	2022/11/25	2023/11/24
SONOMA INSTRUMENT	Amplifier	310 N	186131	2022/11/08	2023/11/07
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2022/11/08	2023/11/07
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2022/11/08	2023/11/07
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	837	2023/02/22	2026/02/21
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2022/12/26	2025/12/25
Unknown	RF Coaxial Cable	No.10	N050	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.11	N1000	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.12	N040	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.13	N300	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.14	N800	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.15	N600	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.16	N650	2022/11/25	2023/11/24
Wainwright	High Pass Filter	WHKX3.6/18G-10SS	5	2022/11/25	2023/11/24
Wainwright	Band Reject Filter	WRCG2400/2485-2375/2510-60/11SS	10	2022/11/25	2023/11/24
Radiated Emission Test Software: e3 191218 (V9)					
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2022/11/25	2023/11/24
Rohde & Schwarz	Open Switch and Control Unit	OSP120 + OSP-B157	101244 + 100866	2022/11/25	2023/11/24
WEINSCHEL	10dB Attenuator	5324	AU 3842	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.33	RF-03	Each time	

*** Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §1.1307 (b) – RF EXPOSURE

Applicable Standard

According to KDB 447498 D04 Interim General RF Exposure Guidance v01, clause 2.1.4 –MPE-Based Exemption:

An alternative to the SAR-based exemption is provided in § 1.1307(b)(3)(i)(C), for a much wider frequency range, from 300 kHz to 100 GHz, applicable for separation distances greater or equal to $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. The MPE-based test exemption condition is in terms of ERP, defined as the product of the maximum antenna gain and the delivered maximum time-averaged power. For this case, a RF source is an RF exempt device if its ERP (watts) is no more than a frequency-dependent value, as detailed tabular form in Appendix B. These limits have been derived based on the basic specifications on Maximum Permissible Exposure (MPE) considered for the FCC rules in § 1.1310(e)(1).

Table to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

f = frequency in MHz;
R = minimum separation distance from the body of a nearby person (appropriate units, e.g., m);

Test Result

For worst case:

Mode	Frequency Range (MHz)	Tune-up Output Power		Antenna Gain		ERP		Evaluation Distance (cm)	MPE-Based Exemption Threshold (W)
		(dBm)	(mW)	(dBi)	(dBd)	(dBm)	(W)		
BT	2402-2480	5.0	3.16	-0.68	-2.83	2.17	0.002	20	0.768
2.4G Wi-Fi	2412-2462	19.0	79.43	4.57	2.42	21.42	0.139	20	0.768
5G Wi-Fi	5150-5250	13.5	22.39	-0.77	-2.92	10.58	0.011	20	0.768
5G Wi-Fi	5725-5850	14.5	28.18	2.95	0.8	15.3	0.034	20	0.768

Note 1: The tune-up power was declared by the applicant.
Note 2: 0dBd=2.15dBi.
Note 3: The BT function can transmit at the same time with the Wi-Fi function.

Simultaneous transmitting consideration:

The ratio= MPE_{BT}/limit+$MPE_{2.4G\ Wi\text{-}Fi}$/limit=0.002/0.768+0.139/0.768=0.18＜1.0

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliant.

FCC §15.203 – ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Antenna Connector Construction

The EUT has one internal antenna arrangement, which was permanently attached and the antenna gain is -0.68dBi, fulfill the requirement of this section. Please refer to the EUT photos.

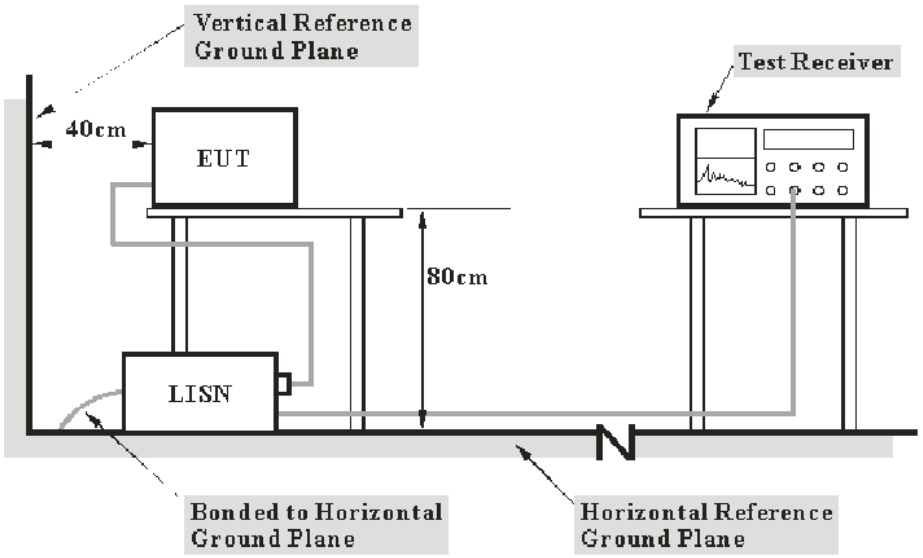
Result: Compliant.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Factor & Calculation

The factor is calculated by adding LISN VDF (Voltage Division Factor) and Cable Loss. The basic equation is as follows:

Factor = LISN VDF + Cable Loss

The "**Over limit**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over limit of -7 dB means the emission is 7 dB below the limit. The equation for calculation is as follows:

Over Limit = Level – Limit
Level = Read Level + Factor

Test Data

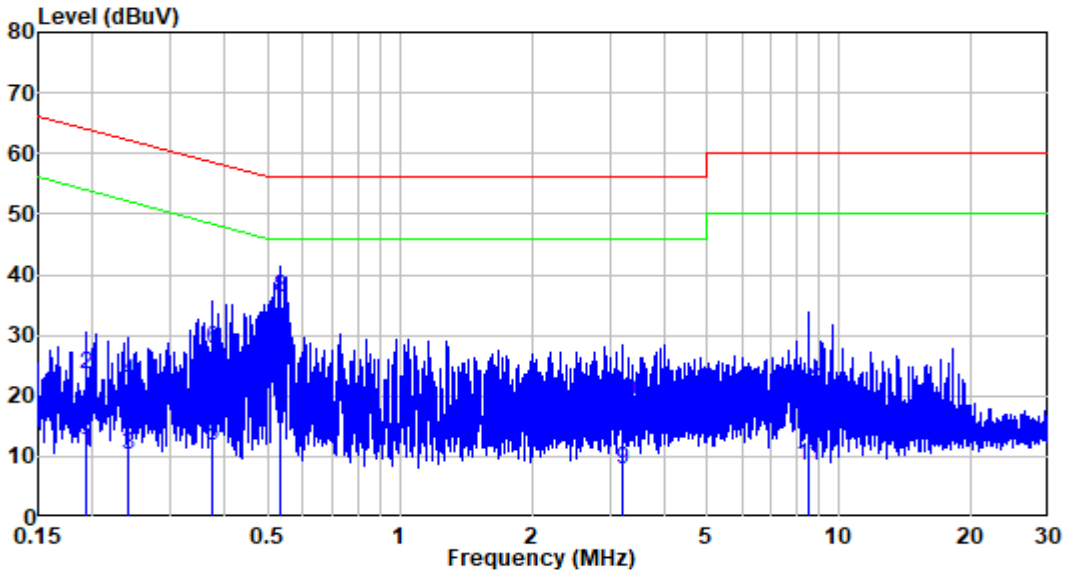
Environmental Conditions

Temperature:	23℃
Relative Humidity:	49%
ATM Pressure:	101kPa

The testing was performed by Jerry Wu on 2023-05-29.

EUT operation mode: BT Transmitting (worst case 8DPSK Middle channel)

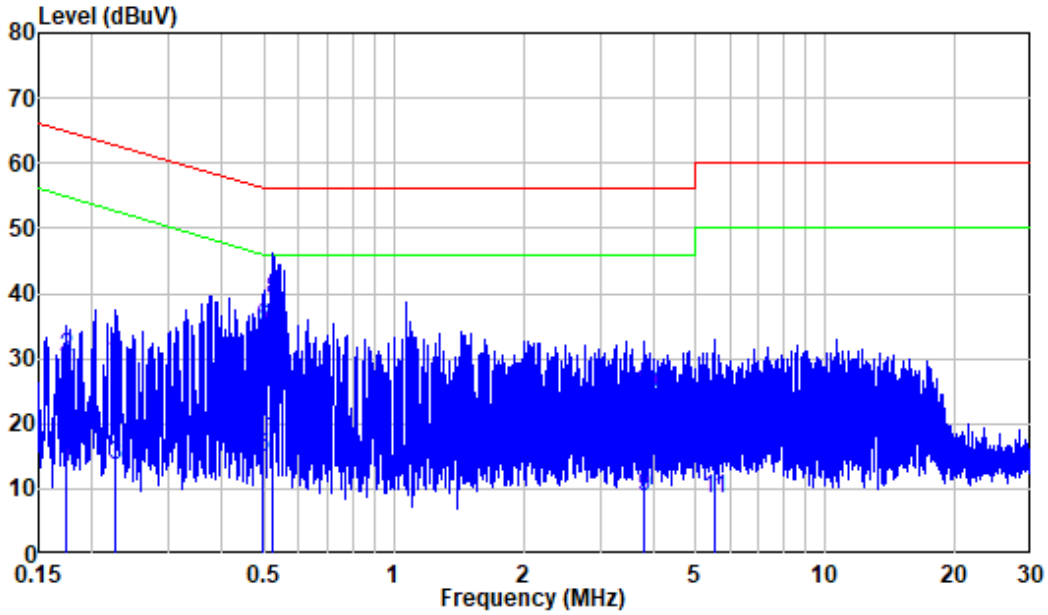
Line



Site : Shielding Room
Condition: Line
Job No. : RA230510-25327E-RF
Mode : BT Transmitting
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.193	10.30	0.69	10.99	53.89	-42.90	Average
2	0.193	10.30	13.26	23.56	63.89	-40.33	QP
3	0.241	10.34	-0.15	10.19	52.05	-41.86	Average
4	0.241	10.34	11.91	22.25	62.05	-39.80	QP
5	0.374	10.48	1.22	11.70	48.40	-36.70	Average
6	0.374	10.48	17.38	27.86	58.40	-30.54	QP
7	0.535	10.59	6.10	16.69	46.00	-29.31	Average
8	0.535	10.59	25.69	36.28	56.00	-19.72	QP
9	3.205	10.50	-2.77	7.73	46.00	-38.27	Average
10	3.205	10.50	8.47	18.97	56.00	-37.03	QP
11	8.518	10.61	-2.24	8.37	50.00	-41.63	Average
12	8.518	10.61	10.17	20.78	60.00	-39.22	QP

Neutral



Site : Shielding Room
Condition: Neutral
Job No. : RA230510-25327E-RF
Mode : BT Transmitting
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.173	10.28	2.93	13.21	54.81	-41.60	Average
2	0.173	10.28	19.76	30.04	64.81	-34.77	QP
3	0.227	10.30	3.35	13.65	52.57	-38.92	Average
4	0.227	10.30	20.20	30.50	62.57	-32.07	QP
5	0.498	10.47	4.30	14.77	46.04	-31.27	Average
6	0.498	10.47	24.36	34.83	56.04	-21.21	QP
7	0.525	10.47	6.80	17.27	46.00	-28.73	Average
8	0.525	10.47	28.53	39.00	56.00	-17.00	QP
9	3.789	10.54	-1.67	8.87	46.00	-37.13	Average
10	3.789	10.54	13.96	24.50	56.00	-31.50	QP
11	5.546	10.51	-2.05	8.46	50.00	-41.54	Average
12	5.546	10.51	12.50	23.01	60.00	-36.99	QP

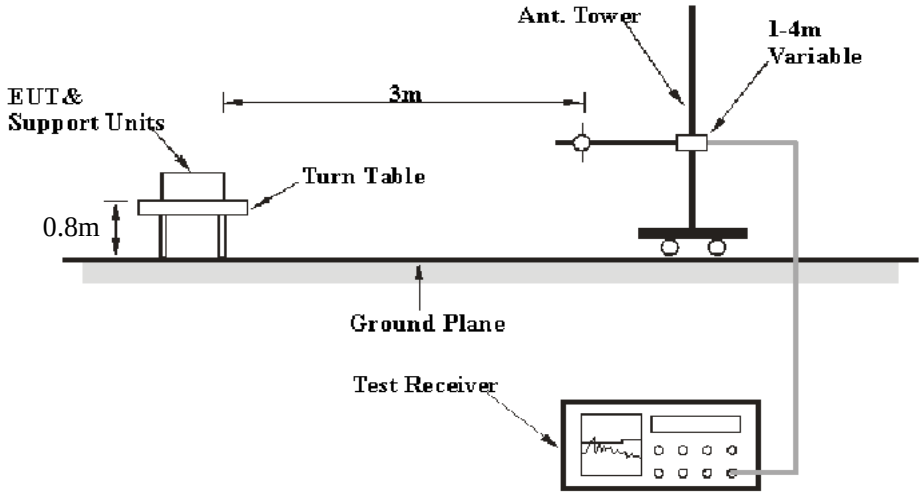
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

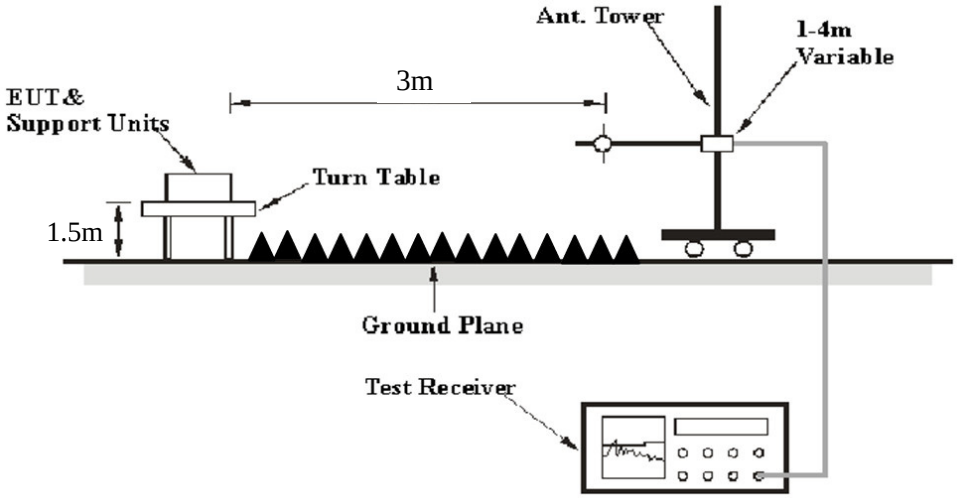
FCC §15.205; §15.209; §15.247(d)

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

The EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1 MHz	3 MHz	/	PK

For average measurement:

Use the duty cycle factor correction factor method per 15.35(c).
Duty cycle=On time/100milliseconds, On time=N1*L1+N2*L2+…Nn-1*Ln-1+Nn*Ln,
Where N1 is number of type 1 pulses, L1 is length of type 1 pulse, etc.
Average Emission Level=Peak Emission Level+20*log(Duty cycle)

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All final data was recorded in Quasi-peak detection mode for frequency range of 30 MHz -1 GHz and peak and Average detection modes for frequencies above 1 GHz.

If the maximized peak measured value complies with the limit, then it is unnecessary to perform an QP/Average measurement

Factor & Margin Calculation

The Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain. The basic equation is as follows:

Factor = Antenna Factor + Cable Loss - Amplifier Gain

The "**Over Limit/Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit/margin of -7dB means the emission is 7dB below the limit. The equation for calculation is as follows:

Over Limit/Margin = Level / Corrected Amplitude – Limit
Level / Corrected Amplitude = Read Level + Factor

Test Data

Environmental Conditions

Temperature:	23-24℃
Relative Humidity:	53-56%
ATM Pressure:	101.0kPa

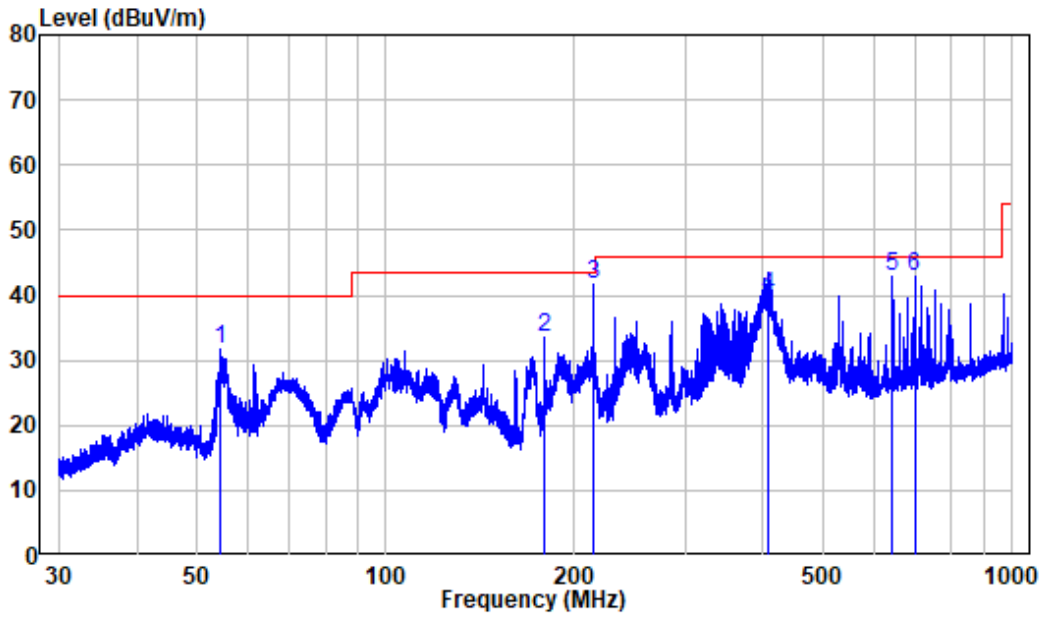
The Below 1GHz testing was performed by Jason Liu on 2023-05-27.
The Above 1GHz testing was performed by Jimmy Zheng from 2023-05-24.

EUT operation mode: BT Transmitting

Below 1GHz:

Worst case for 8DPSK, Low Channel:

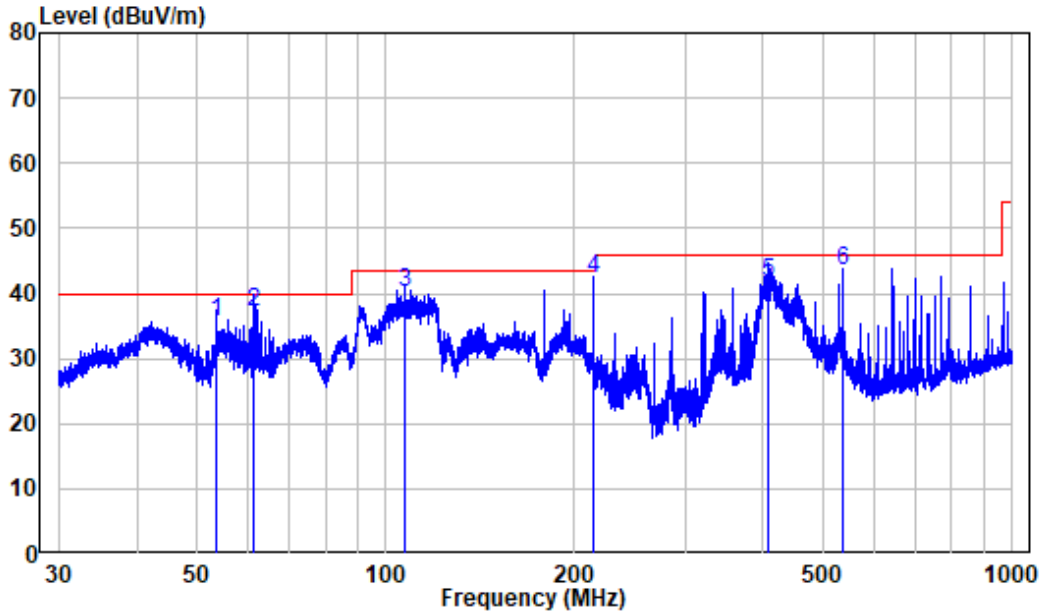
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA230510-25327E-RF
Test Mode: BT Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	54.499	-10.38	41.95	31.57	40.00	-8.43	Peak
2	179.072	-12.77	46.13	33.36	43.50	-10.14	Peak
3	214.797	-11.91	53.49	41.58	43.50	-1.92	QP
4	408.588	-6.00	45.80	39.80	46.00	-6.20	QP
5	644.554	-1.86	44.61	42.75	46.00	-3.25	QP
6	698.080	-1.54	44.30	42.76	46.00	-3.24	QP

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA230510-25327E-RF
Test Mode: BT Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	53.693	-10.34	46.00	35.66	40.00	-4.34	QP
2	61.670	-11.46	48.61	37.15	40.00	-2.85	QP
3	107.369	-11.98	52.06	40.08	43.50	-3.42	QP
4	214.891	-11.91	54.19	42.28	43.50	-1.22	QP
5	408.588	-6.00	47.80	41.80	46.00	-4.20	QP
6	537.118	-3.88	47.31	43.43	46.00	-2.57	QP

Above 1GHz (worst case for 8DPSK):

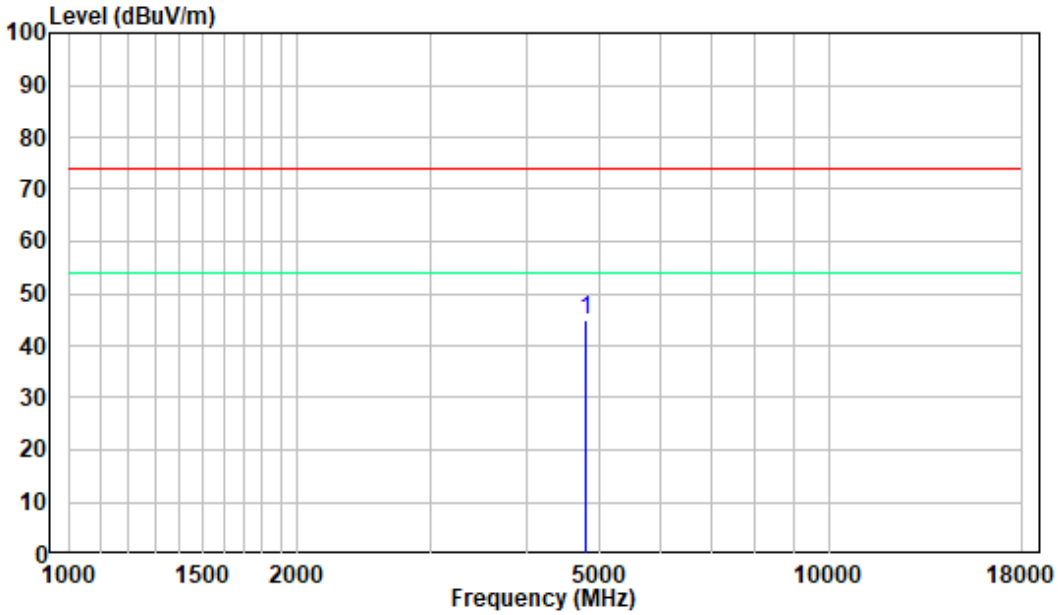
Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
	Reading (dBuV)	PK/Ave		Height (m)	Polar (H/V)				
Low Channel									
2310	51.22	PK	136	1.6	H	-10.36	40.86	74	-33.14
2310	49.12	PK	339	1.2	V	-10.36	38.76	74	-35.24
2390	51.06	PK	201	1.6	H	-10.71	40.35	74	-33.65
2390	50.56	PK	194	1.4	V	-10.71	39.85	74	-34.15
4804	50.83	PK	201	1.6	H	-6.11	44.72	74	-29.28
4804	49.94	PK	20	1.7	V	-6.11	43.83	74	-30.17
Middle Channel									
4882	49.76	PK	95	1.9	H	-5.9	43.86	74	-30.14
4882	48.43	PK	121	1.9	V	-5.9	42.53	74	-31.47
High Channel									
2483.5	54.68	PK	220	1.6	H	-10.55	44.13	74	-29.87
2483.5	54.04	PK	85	1.6	V	-10.55	43.49	74	-30.51
2500	52.87	PK	36	1.9	H	-10.42	42.45	74	-31.55
2500	51.74	PK	345	1.5	V	-10.42	41.32	74	-32.68
4960	49.85	PK	36	1.9	H	-5.47	44.38	74	-29.62
4960	47.17	PK	274	1.5	V	-5.47	41.7	74	-32.3

Note:
Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Factor + Reading
Margin = Corrected Amplitude – Limit
Average level= Peak level+ Duty Cycle Corrected Factor
The other spurious emission which is in the noise floor level was not recorded.
For above 1GHz, when the test result of peak was 20dB below to the limit of peak, which can be compliant to the average limit, just peak value was recorded.

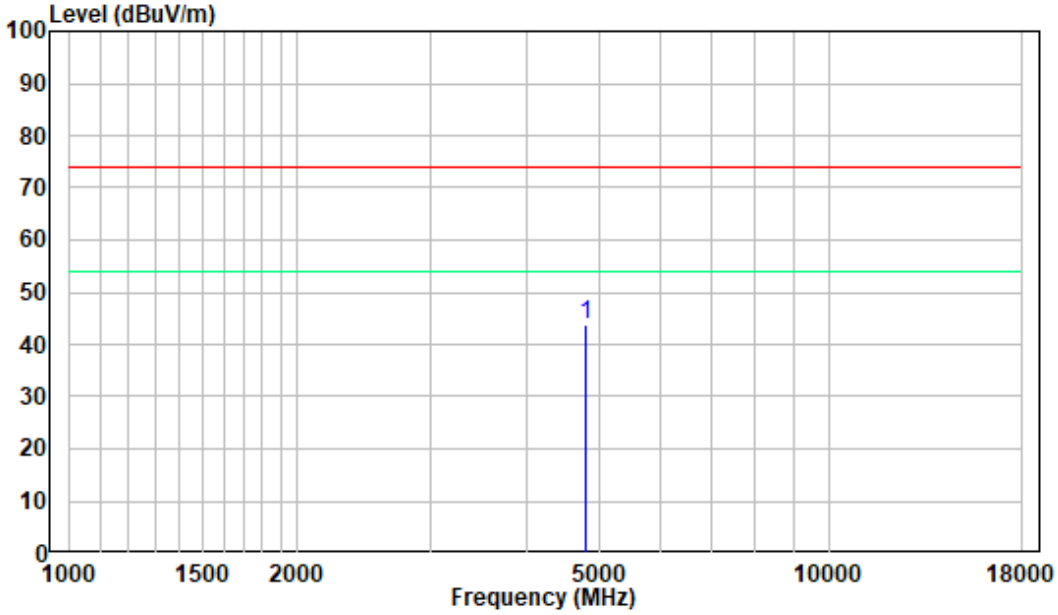
1 GHz - 18 GHz: (Pre-Scan plots)

Worst case for 8DPSK, Low Channel:

Horizontal



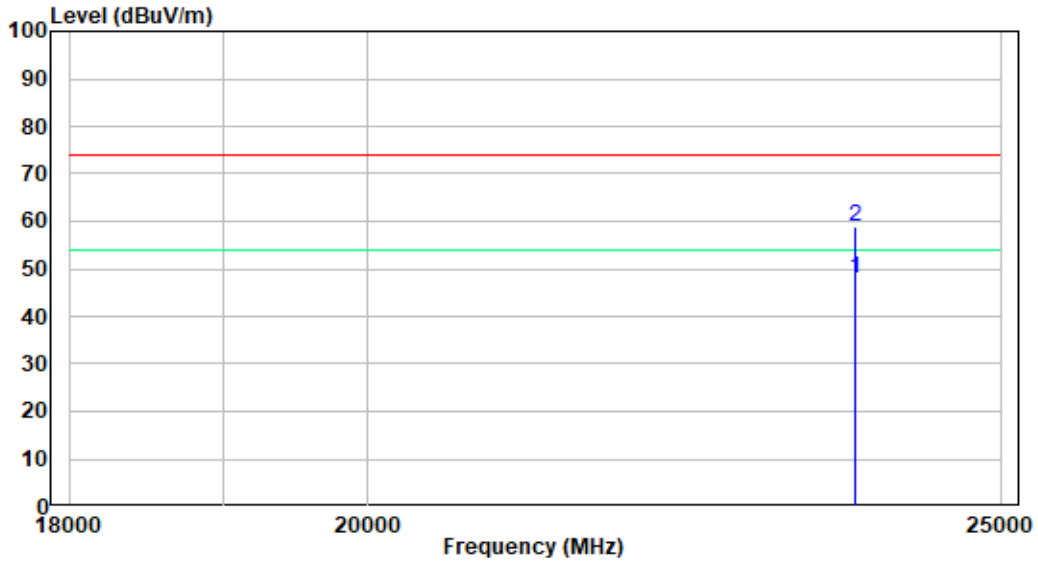
Vertical



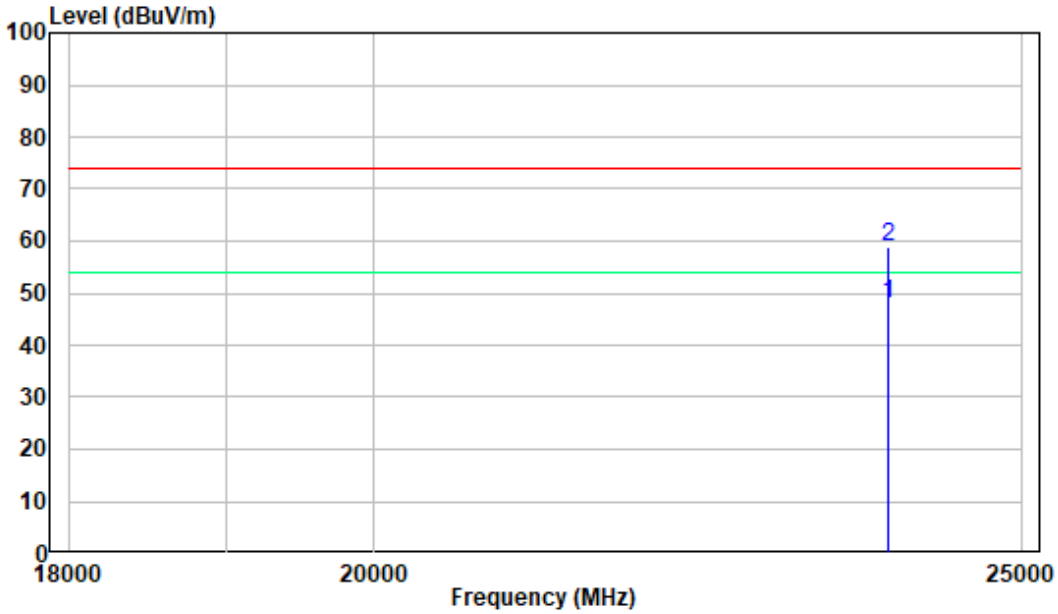
18-25GHz: (Pre-Scan plots)

Worst case for 8DPSK, Low Channel:

Horizontal



Vertical



FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

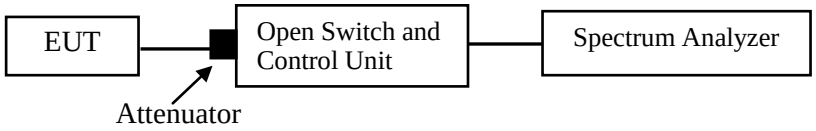
Applicable Standard

Frequency hopping systems shall have hoping 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Test Procedure

According to ANSI C63.10-2013, section 7.8.2

1. Set the EUT in TX mode, maxhold the channel.
2. Set the adjacent channel of the EUT and maxhold another trace.
3. Measure the channel separation.



Test Data

Environmental Conditions

Temperature:	25℃
Relative Humidity:	48%
ATM Pressure:	101kPa

The testing was performed by Matt Liang on 2023-05-22.

EUT operation mode: Transmitting

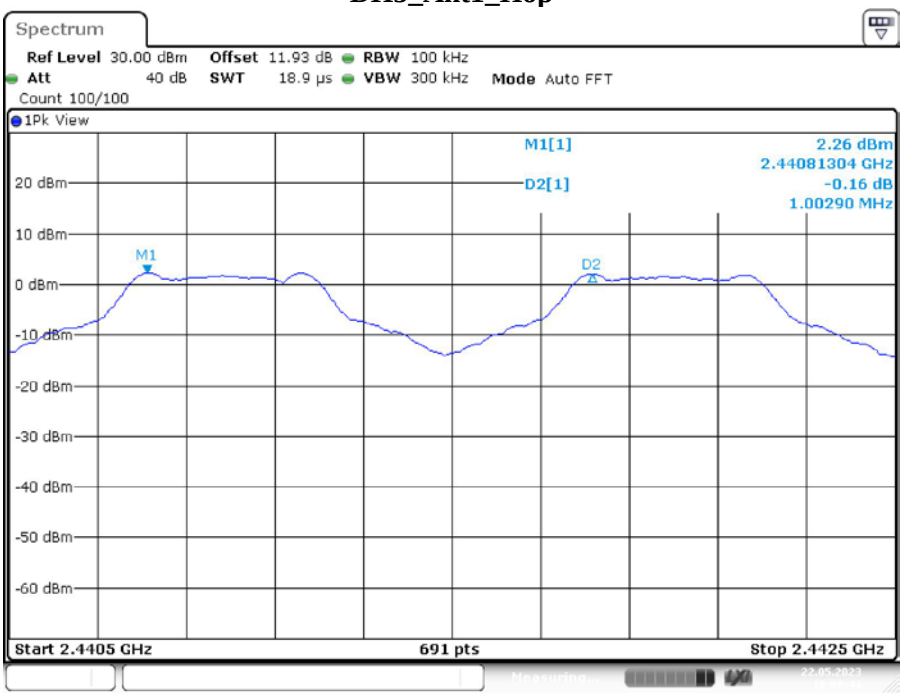
Test Result: Compliant.

Test Mode	Antenna	Channel	Result[MHz]	Limit[MHz]	Verdict
DH5	Ant1	Hop	1.003	≥0.720	PASS
2DH5	Ant1	Hop	1	≥0.880	PASS
3DH5	Ant1	Hop	1.003	≥0.880	PASS

Note: The limit = (2/3) * 20dB bandwidth

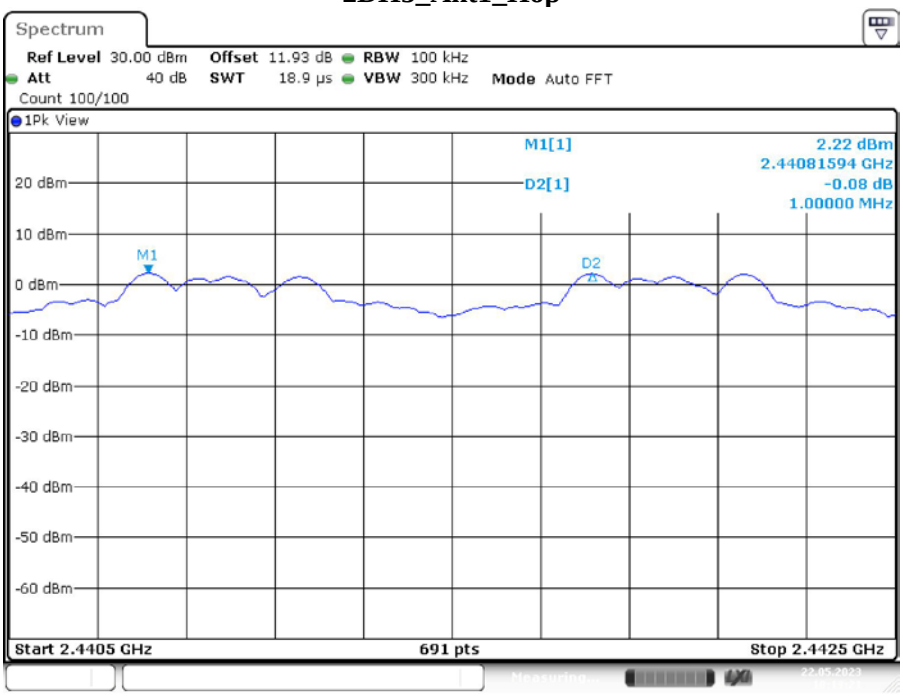
Please refer to the below plots:

DH5_Ant1_Hop



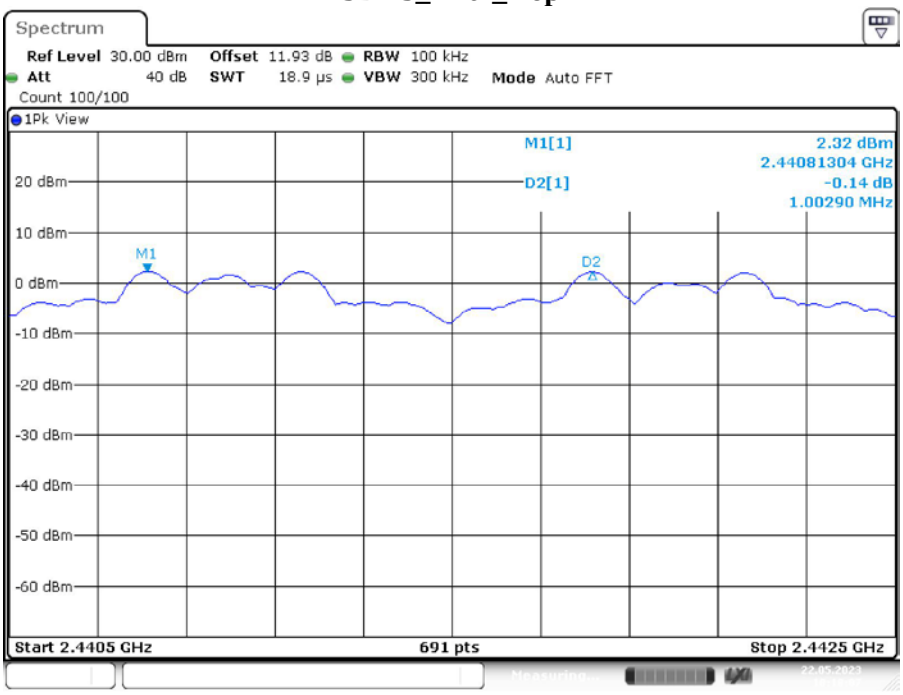
Date: 22.MAY.2023 10:08:43

2DH5_Ant1_Hop



Date: 22.MAY.2023 10:13:20

3DH5_Ant1_Hop



Date: 22.MAY.2023 10:18:07

FCC §15.247(a) (1) – 20 dB EMISSION BANDWIDTH & 99% OCCUPIED BANDWIDTH

Applicable Standard

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.

Test Procedure

According to ANSI C63.10-2013, section 7.8.7 and section 6.9.2

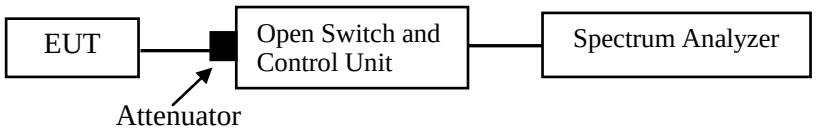
The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:
• The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

• The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.

• The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / 20 dB bandwidth if the device is not TX continuously.

• The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / 20 dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.
For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).



Test Data

Environmental Conditions

Temperature:	25℃
Relative Humidity:	48%
ATM Pressure:	101kPa

The testing was performed by Matt Liang on 2023-05-22.

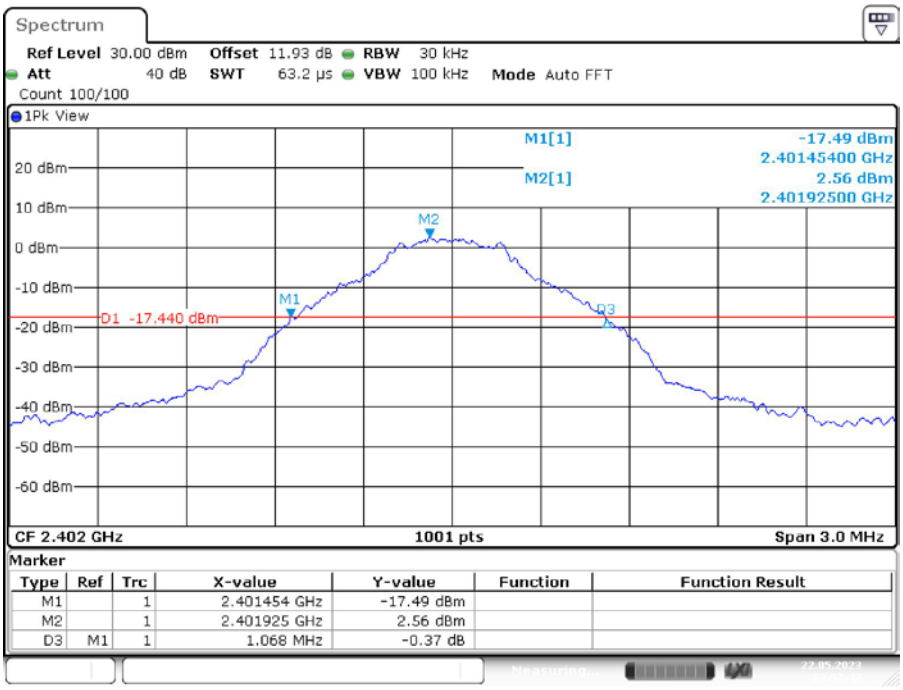
EUT operation mode: Transmitting

Test Result: Compliant.

Test Mode	Antenna	Channel	20db EBW[MHz]	OCB [MHz]	Verdict
DH5	Ant1	2402	1.07	0.923	PASS
		2441	1.05	0.929	PASS
		2480	1.08	0.926	PASS
2DH5	Ant1	2402	1.30	1.19	PASS
		2441	1.31	1.193	PASS
		2480	1.32	1.196	PASS
3DH5	Ant1	2402	1.31	1.193	PASS
		2441	1.30	1.193	PASS
		2480	1.32	1.196	PASS

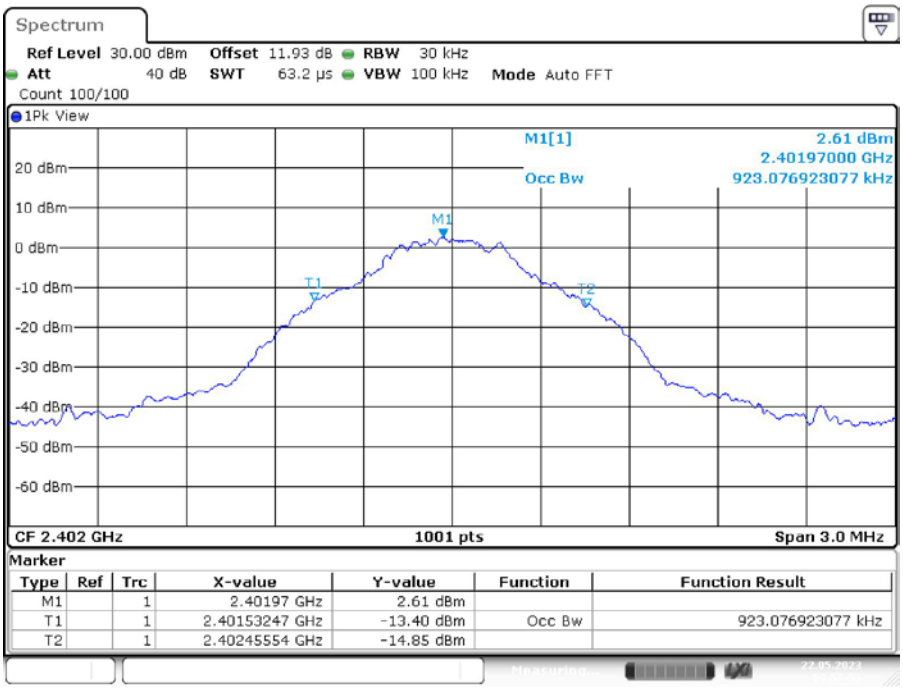
Please refer to the below plots:

20 dB EMISSION BANDWIDTH_DH5_Ant1_2402



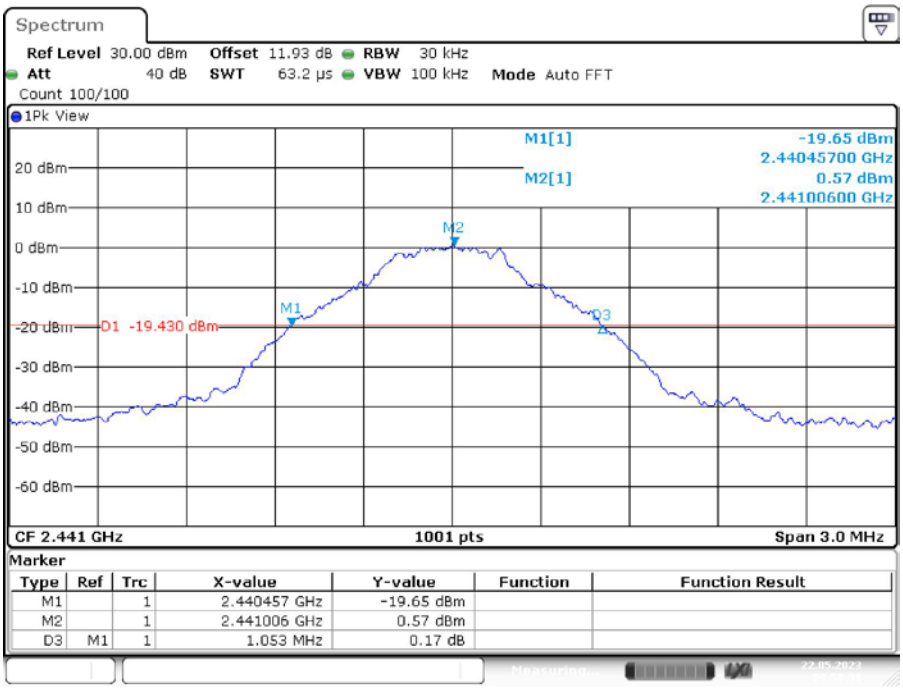
Date: 22.MAY.2023 09:57:47

99% OCCUPIED BANDWIDTH_DH5 _Ant1_2402



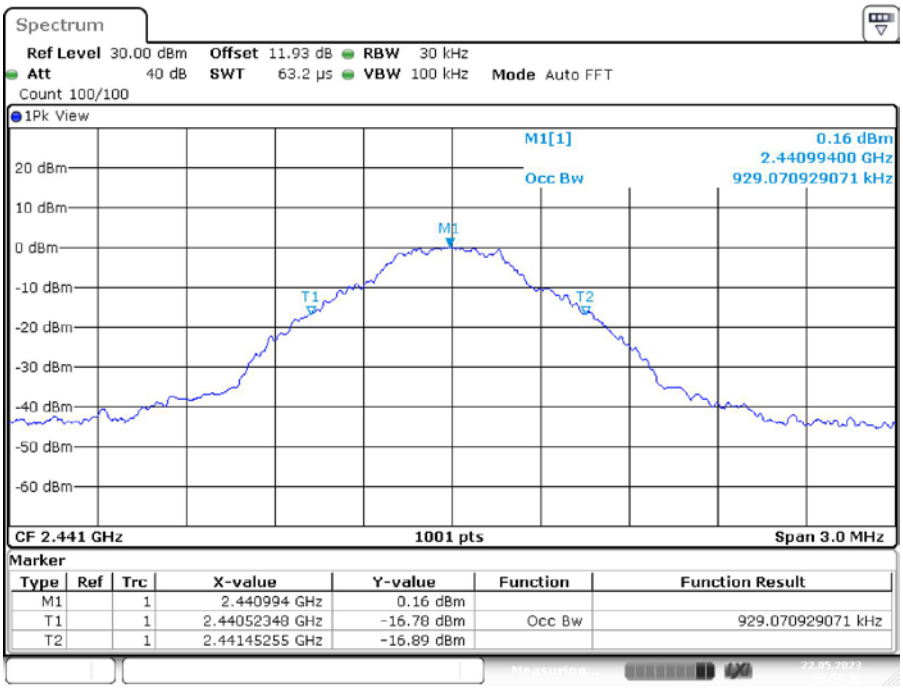
Date: 22.MAY.2023 09:57:53

20 dB EMISSION BANDWIDTH_DH5 _Ant1_2441



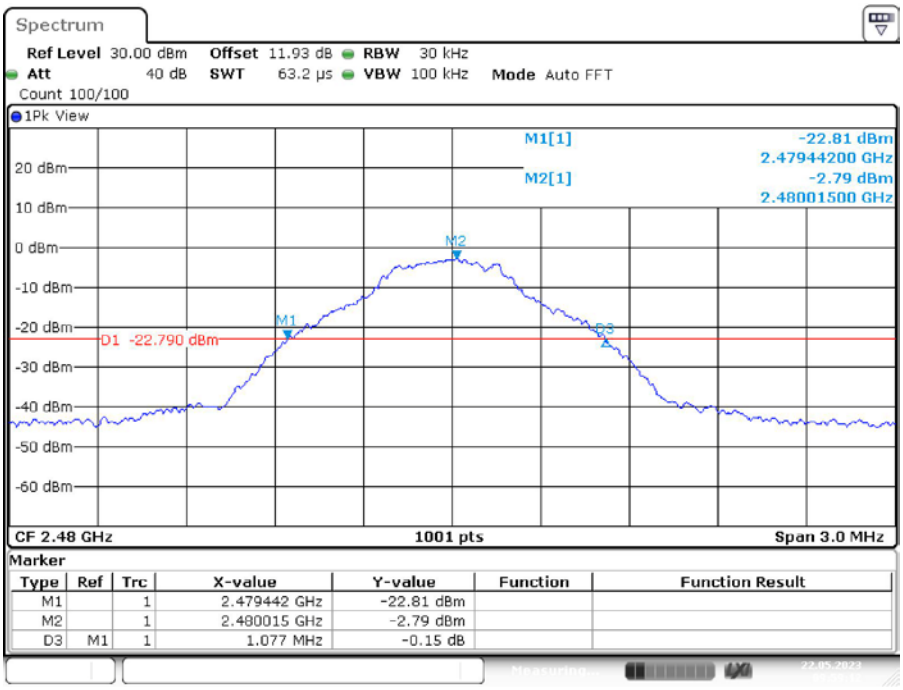
Date: 22.MAY.2023 09:58:30

99% OCCUPIED BANDWIDTH_DH5 _Ant1_2441



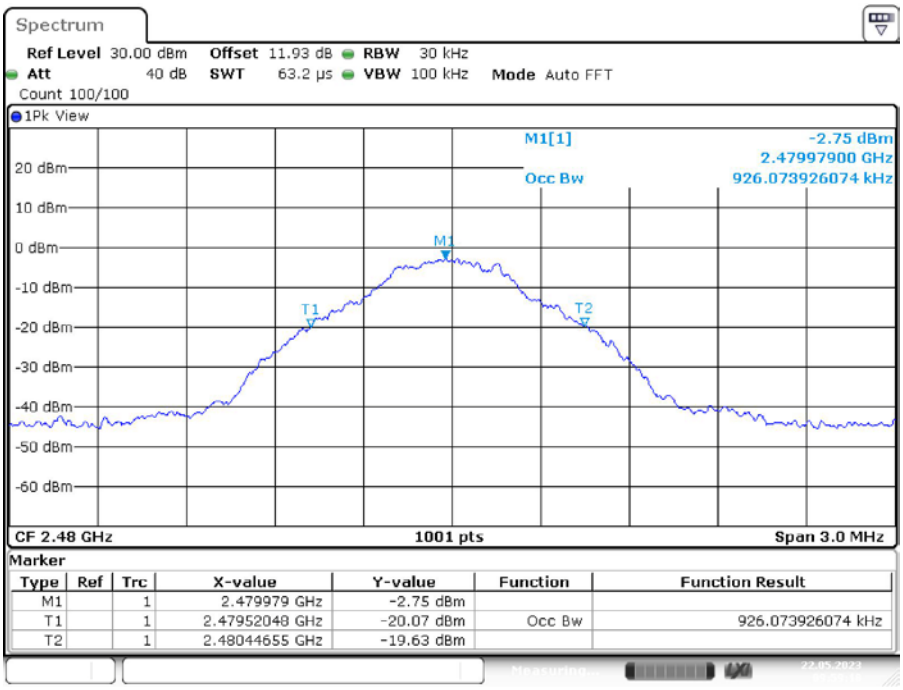
Date: 22.MAY.2023 09:58:36

20 dB EMISSION BANDWIDTH_DH5 _Ant1_2480



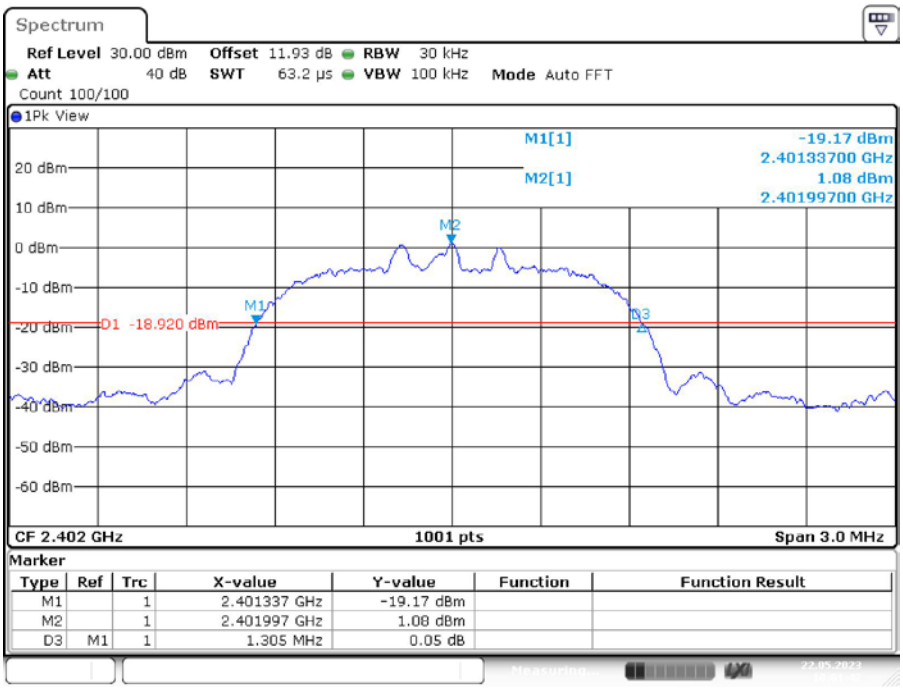
Date: 22.MAY.2023 09:59:11

99% OCCUPIED BANDWIDTH_DH5 _Ant1_2480



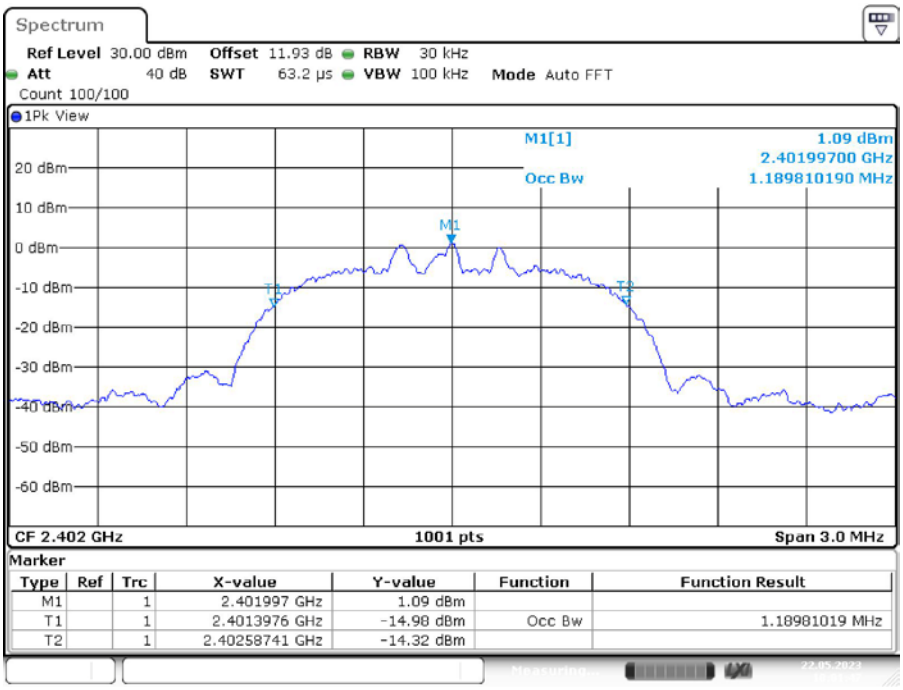
Date: 22.MAY.2023 09:59:17

20 dB EMISSION BANDWIDTH_2DH5 _Ant1_2402



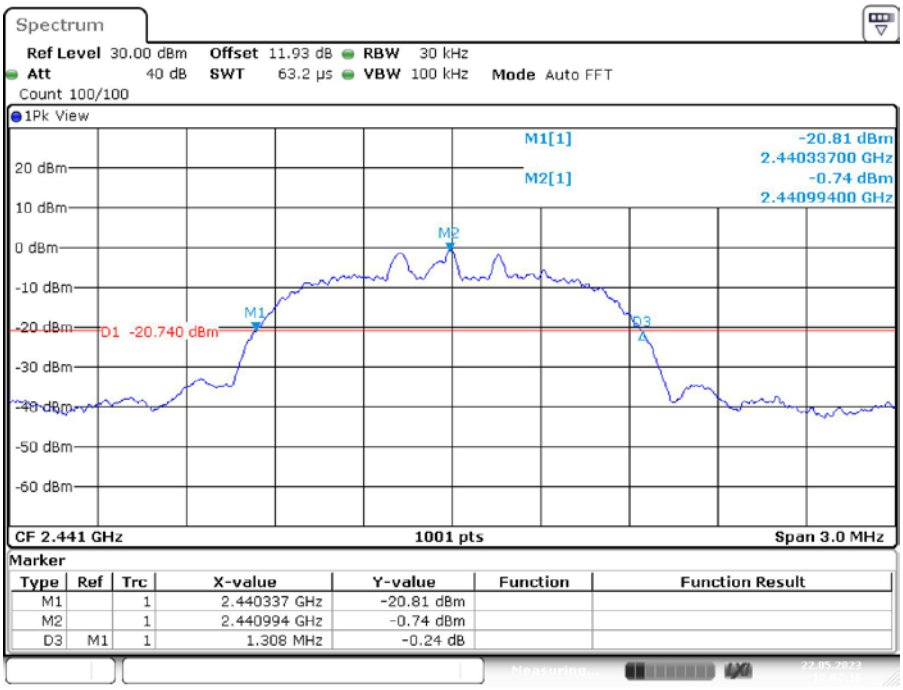
Date: 22.MAY.2023 10:01:42

99% OCCUPIED BANDWIDTH_2DH5 _Ant1_2402



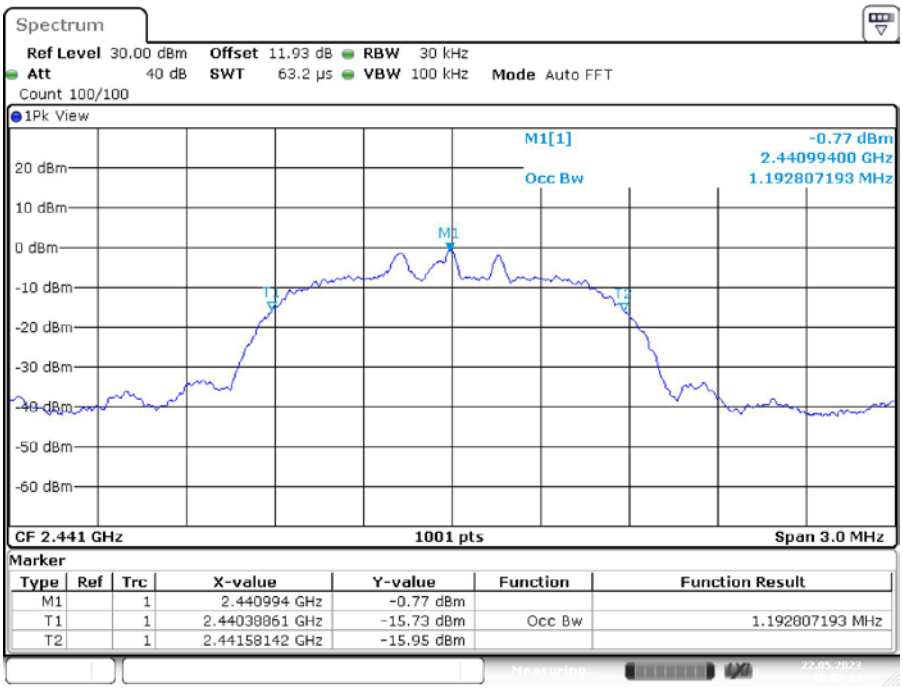
Date: 22.MAY.2023 10:01:47

20 dB EMISSION BANDWIDTH_2DH5 _Ant1_2441



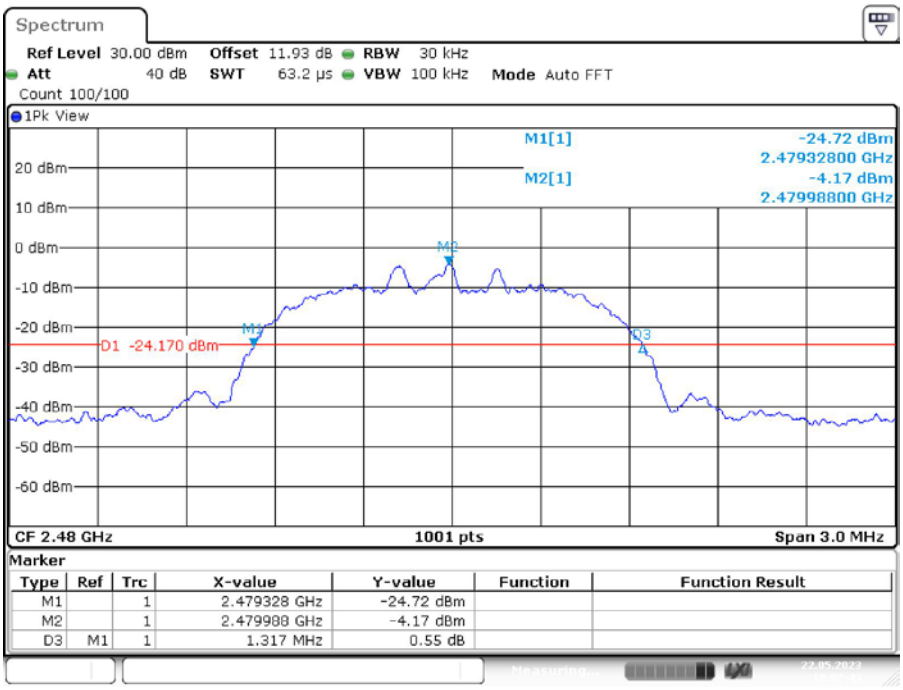
Date: 22.MAY.2023 10:02:19

99% OCCUPIED BANDWIDTH_2DH5 _Ant1_2441



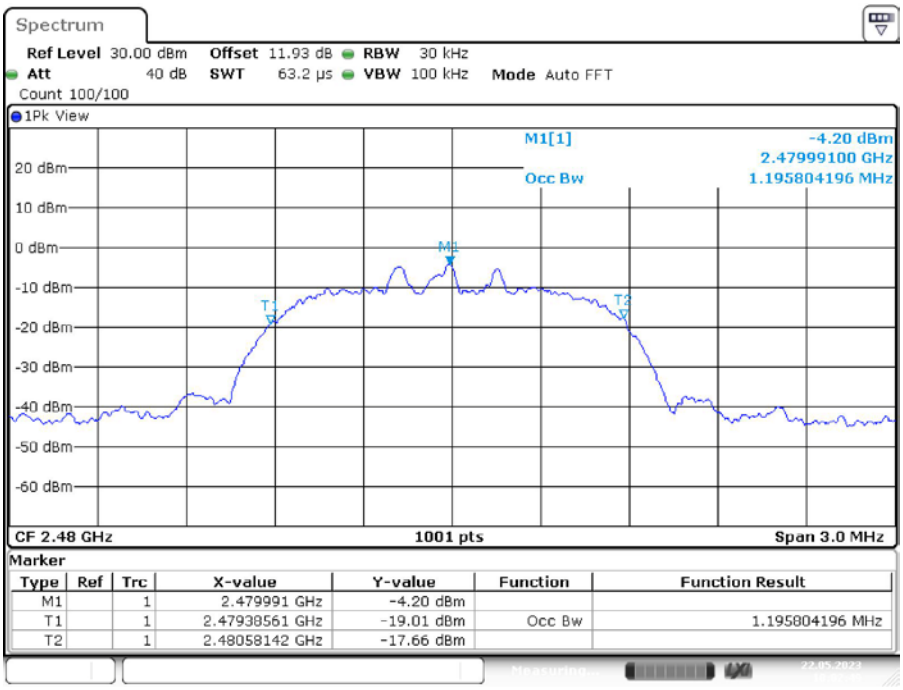
Date: 22.MAY.2023 10:02:24

20 dB EMISSION BANDWIDTH _2DH5_Ant1_2480



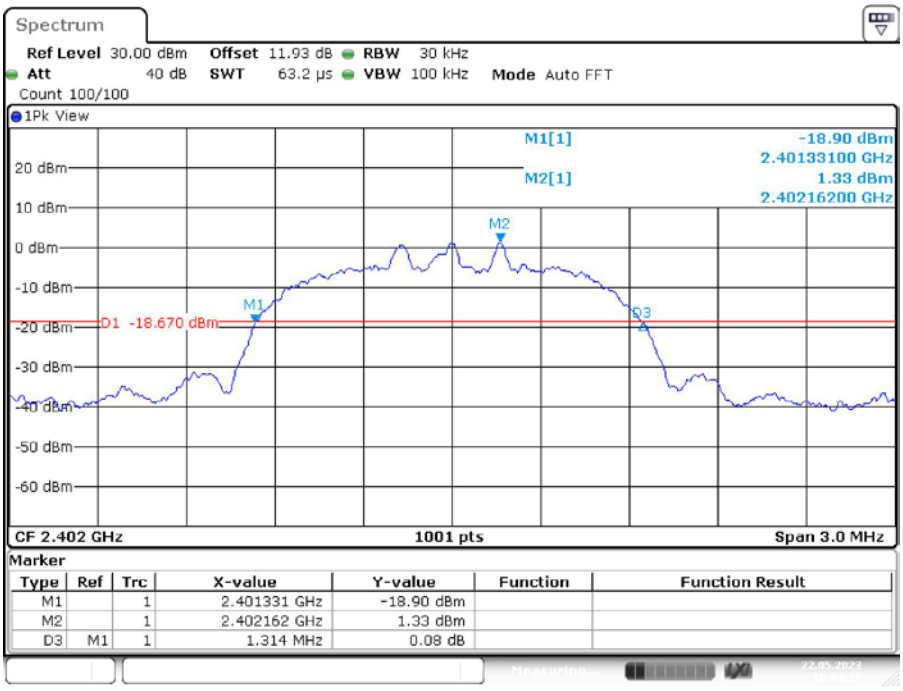
Date: 22.MAY.2023 10:02:43

99% OCCUPIED BANDWIDTH _2DH5_Ant1_2480



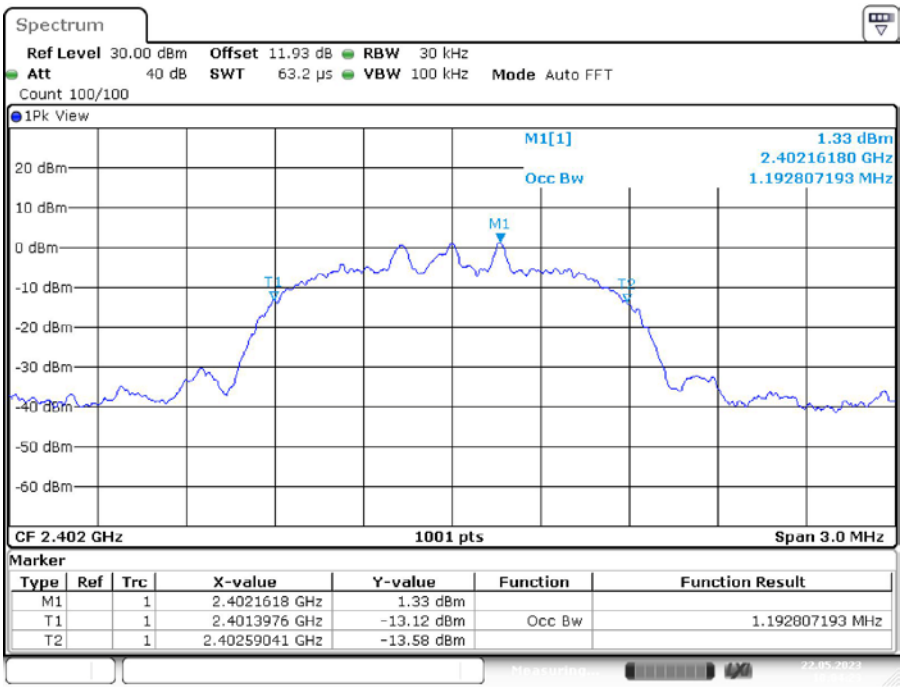
Date: 22.MAY.2023 10:02:49

20 dB EMISSION BANDWIDTH _3DH5_Ant1_2402



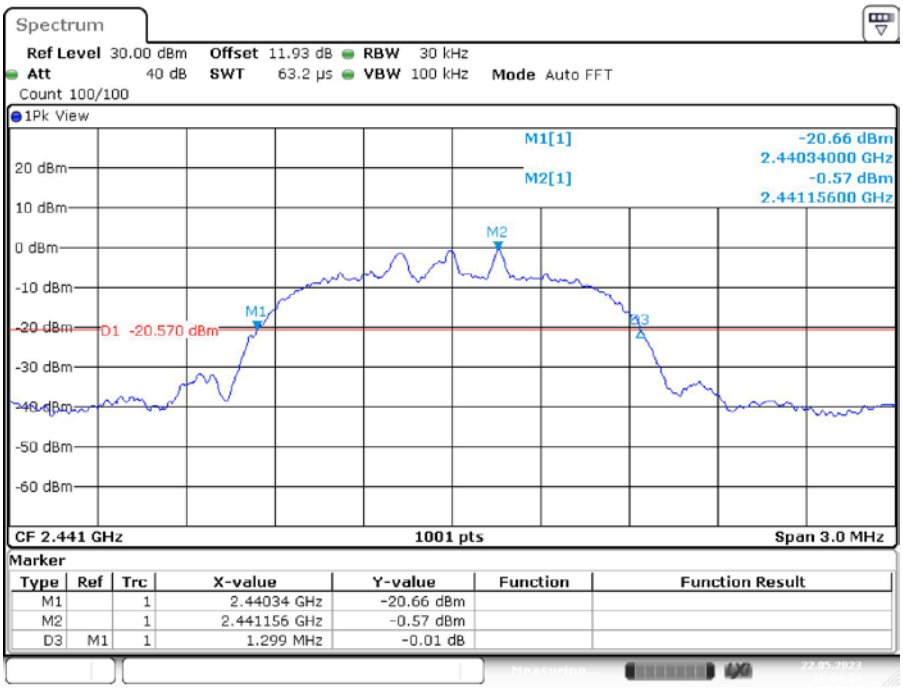
Date: 22.MAY.2023 10:04:17

99% OCCUPIED BANDWIDTH _3DH5_Ant1_2402



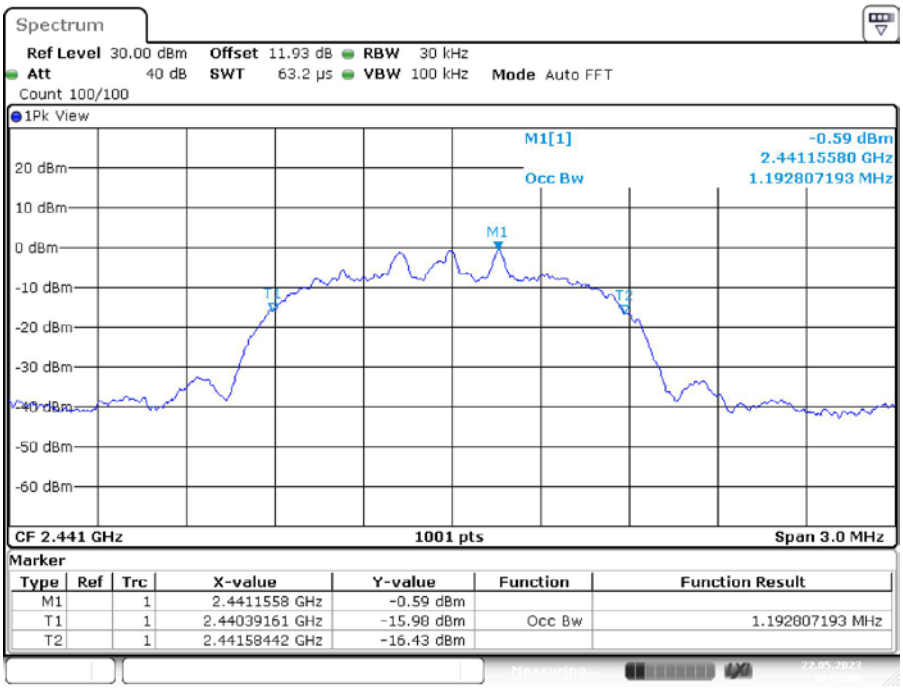
Date: 22.MAY.2023 10:04:23

20 dB EMISSION BANDWIDTH _3DH5_Ant1_2441



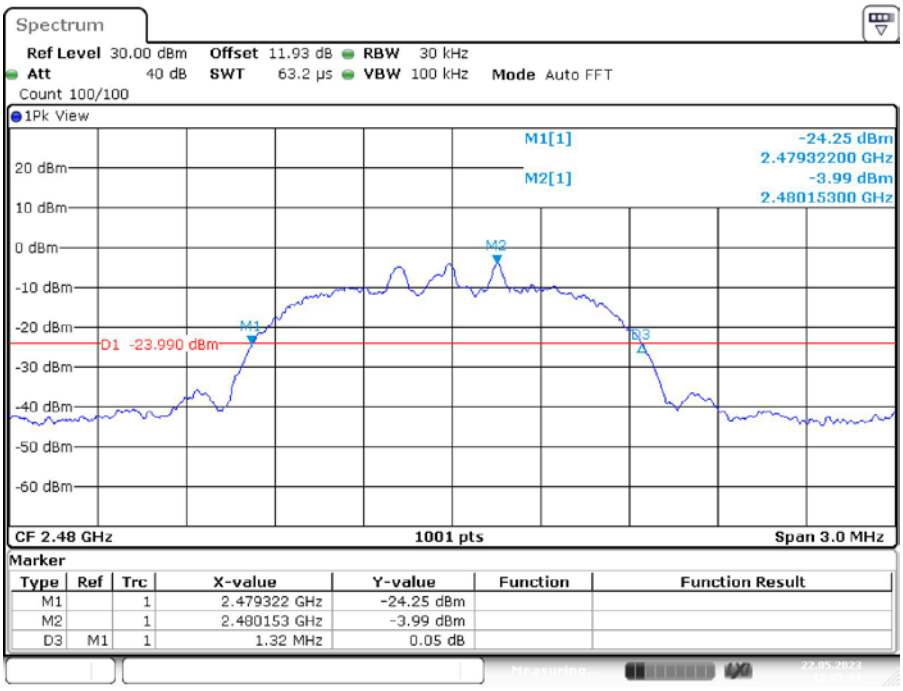
Date: 22.MAY.2023 10:04:54

99% OCCUPIED BANDWIDTH _3DH5_Ant1_2441



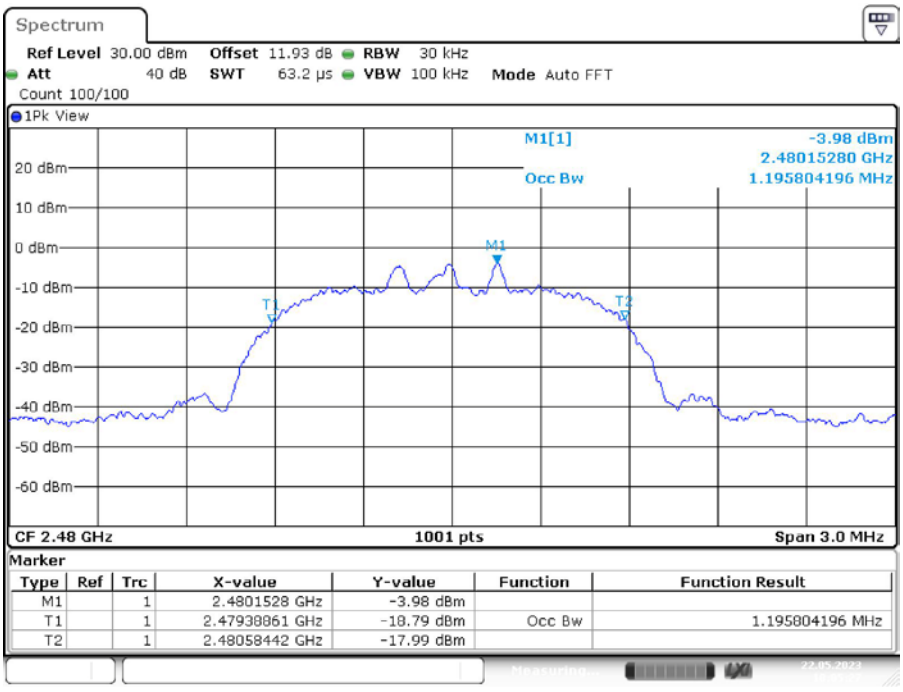
Date: 22.MAY.2023 10:05:00

20 dB EMISSION BANDWIDTH _3DH5_Ant1_2480



Date: 22.MAY.2023 10:05:21

99% OCCUPIED BANDWIDTH _3DH5_Ant1_2480



Date: 22.MAY.2023 10:05:27

FCC §15.247(a) (1) (iii)-QUANTITY OF HOPPING CHANNEL TEST

Applicable Standard

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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

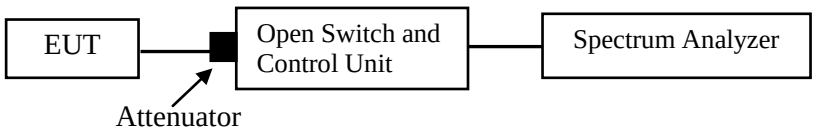
Test Procedure

According to ANSI C63.10-2013, section 7.8.3

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.

2. Set the EUT in hopping mode from first channel to last.

3. By using the max-hold function record the quantity of the channel.



Test Data

Environmental Conditions

Temperature:	25℃
Relative Humidity:	48%
ATM Pressure:	101kPa

The testing was performed by Matt Liang on 2023-05-22.

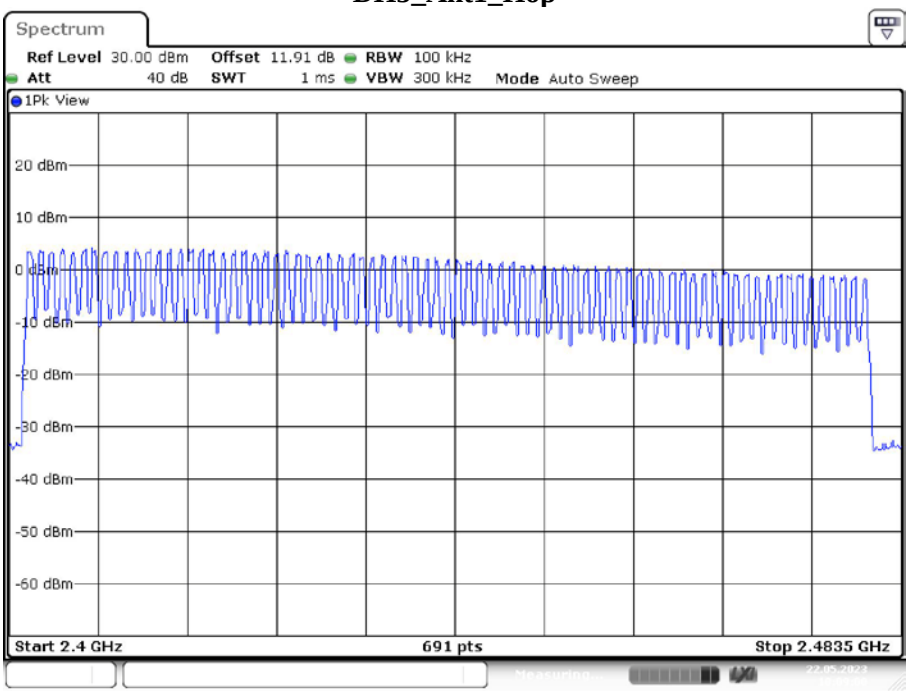
EUT operation mode: Transmitting

Test Result: Compliant.

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

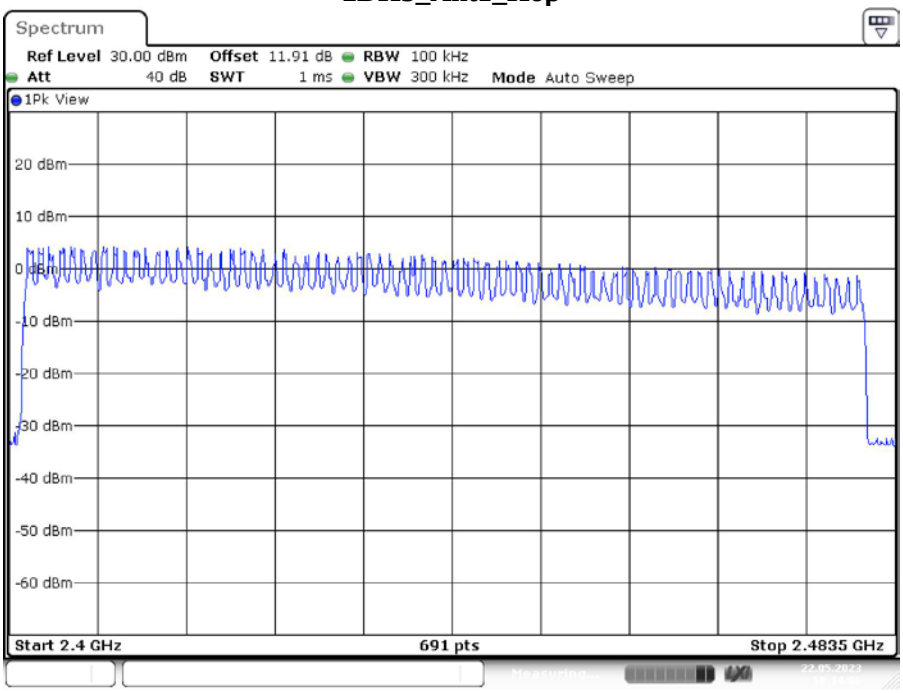
Please refer to the below plots:

DH5_Ant1_Hop



Date: 22.MAY.2023 10:09:00

2DH5_Ant1_Hop



Date: 22.MAY.2023 10:14:06

3DH5_Ant1_Hop