TEST REPORT

Applicant Name :	HONG KONG YO YOUNG INTELLIGENT CO.,LIMITED
Address :	19H MAXGRAND PLAZA NO.3 TAI YAU STREET SAN PO KONG, KOWLOON, HONGKONG
Report Number :	SZNS221017-47499E-RF-00A
FCC ID:	2A8X4-AIR1ULTRA

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	Smart phone
Model No.:	Air1 Ultra
Multiple Model(s) No.:	Air1 Ultra+, Air2 Ultra, B1 Ultra
Trade Mark:	IIIF150
Date Received:	2022/10/17
Report Date:	2022/12/09

Test Result:	Pass*

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

Prepared and Checked By:

Nick Fang

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 "★ ".
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Smart phone
Tested Model	Air1 Ultra
Multiple Models	Air1 Ultra+, Air2 Ultra, B1 Ultra (model difference see product declaration letter of similarity)
Frequency Range	Bluetooth: 2402~2480MHz
Maximum conducted Peak output power	Bluetooth: 13.92dBm
Modulation Technique	Bluetooth: GFSK, π/4-DQPSK, 8DPSK
Antenna Specification*	Antenna: 3.63dBi (provided by the applicant)
Voltage Range	DC 3.85V from battery or DC 5V/9V/12V/15V/3.3-11V from adapter
Test Sample serial number	1MLU (Assigned by ATC)
Sample/EUT Status	Good condition
Adapter information	Model: FC69U Input: AC 100-240V, 50/60Hz, 0.8A Max Output: QC: DC 5V, 3A/9V, 3A/12V, 2.5A PD: DC 5V, 3A/9V, 3A/12V, 2.5A/15V, 2A PPS: DC 3.3-11V, 2.72A

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		0.73dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.72dB
Emissions, Radiated	9kHz - 30MHz	2.66dB
	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
	26.5GHz - 40GHz	4.72dB
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 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. 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 429 7.01.

Listed by Innovation, Science and Economic Development Canada (ISEDC), the Registration Number is 5077A.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

EUT Exercise Software

EUT was test in the engineering mode and the power level is Default*. The power level was provided by the manufacturer.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

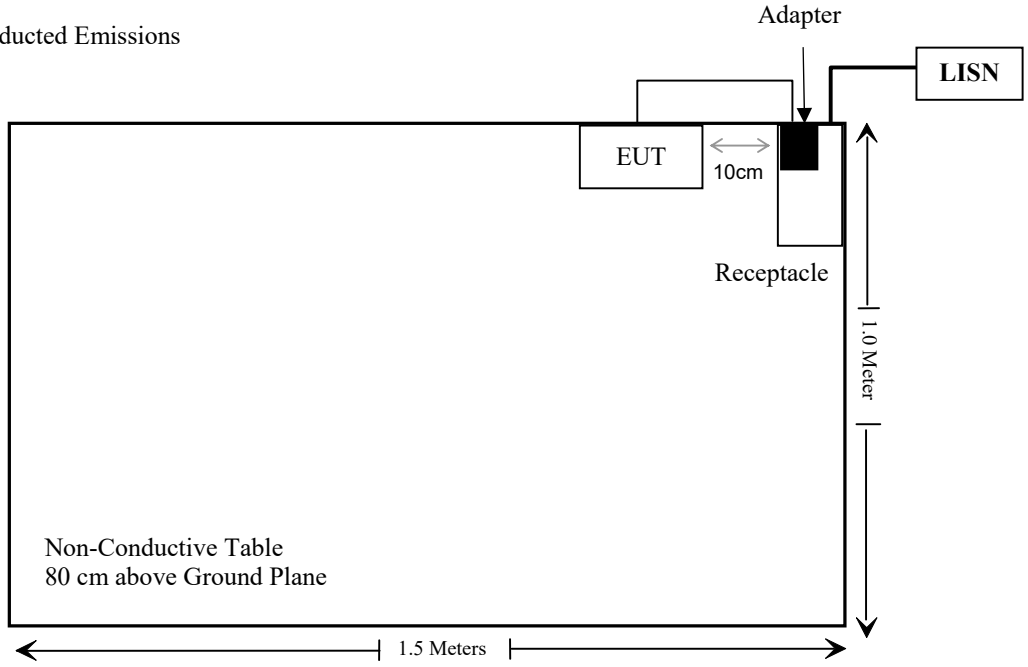
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

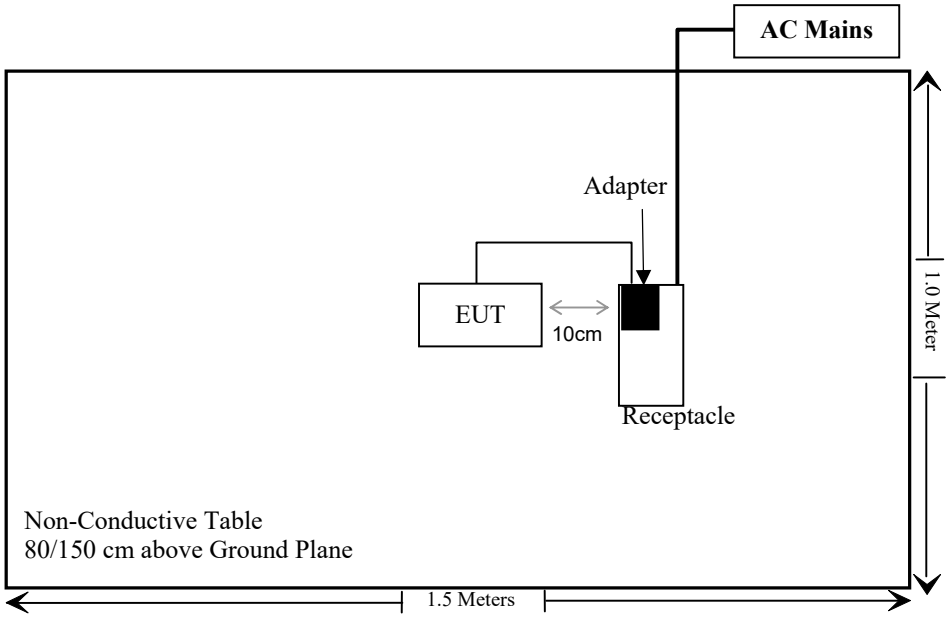
Cable Description	Length (m)	From Port	To
Un-shielding Detachable USB Cable	1.0	EUT	Adapter

Block Diagram of Test Setup

For Conducted Emissions



For Radiated Emissions:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §15.247 (i), §1.1307 (b) & §2.1093	RF EXPOSURE	Compliant
§15.203	Antenna Requirement	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 Emissions Test					
Rohde& Schwarz	EMI Test Receiver	ESCI	100784	2021/12/13	2022/12/12
Rohde & Schwarz	L.I.S.N.	ENV216	101314	2021/12/13	2022/12/12
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2021/12/13	2022/12/12
Unknown	RF Coaxial Cable	No.17	N0350	2021/12/14	2022/12/13
Conducted Emission Test Software: e3 19821b (V9)					
Radiated Emissions Test (30MHz-1GHz)					
Rohde& Schwarz	Test Receiver	ESR	102725	2021/12/13	2022/12/12
SONOMA INSTRUMENT	Amplifier	310 N	186131	2021/11/09	2022/11/08
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Unknown	RF Coaxial Cable	No.12	N040	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.13	N300	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.14	N800	2021/12/14	2022/12/13
Radiated Emission Test Software: e3 19821b (V9)					
Radiated Emissions Test (Above 1GHz)					
Rohde&Schwarz	Spectrum Analyzer	FSV40	101949	2021/12/13	2022/12/12
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2021/11/09	2022/11/08
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2022/11/08	2023/11/07
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2021/11/11	2022/11/10
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2022/11/08	2023/11/07
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2020/01/05	2023/01/04
Wainwright	High Pass Filter	WHKX3.6/18G-10SS	5	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.10	N050	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.11	N1000	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.15	N600	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.16	N650	2021/12/14	2022/12/13
Radiated Emission Test Software: e3 19821b (V9)					

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
SPECTRUM ANALYZER	Rohde & Schwarz	FSU26	200982	2022/07/04	2023/07/03
Rohde & Schwarz	Open Switch and ControlUnit	OSP120 + OSP-B157	101244 + 100866	2021/12/13	2022/12/12
WEINSCHEL	10dB Attenuator	5324	AU 3842	2021/12/14	2022/12/13

*** 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§15.247 (i), §1.1307 (b) & §2.1093 – RF EXPOSURE

Applicable Standard

According to FCC §2.1093 and §1.1307(b), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

Measurement Result

Please refer to SAR test report: CR221047499-20.

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 3.63 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

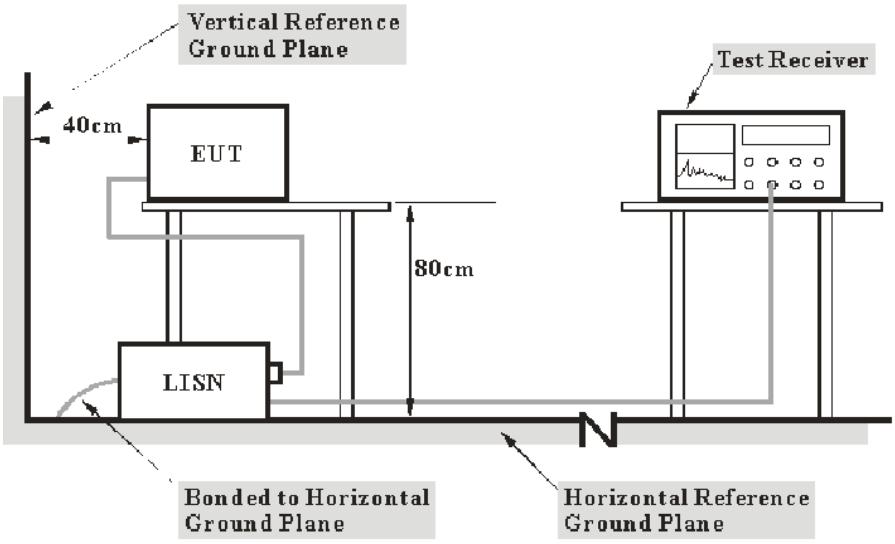
Result: Compliance.

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.

Transd Factor & Margin Calculation

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

Transd 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, a over limit of -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Over Limit = level – Limit
Level= reading level+ Transd Factor

Test Data

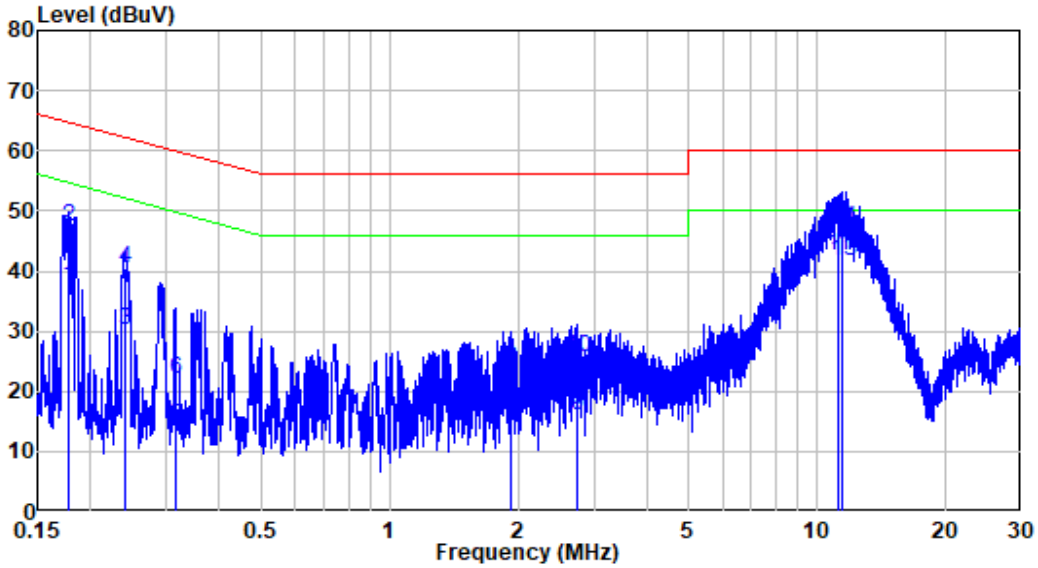
Environmental Conditions

Temperature:	24℃
Relative Humidity:	54%
ATM Pressure:	101.2 kPa

The testing was performed by Jason Liu on 2022-11-07.

EUT operation mode: Transmitting (the worst case for 8DPSK Mode, High channel)

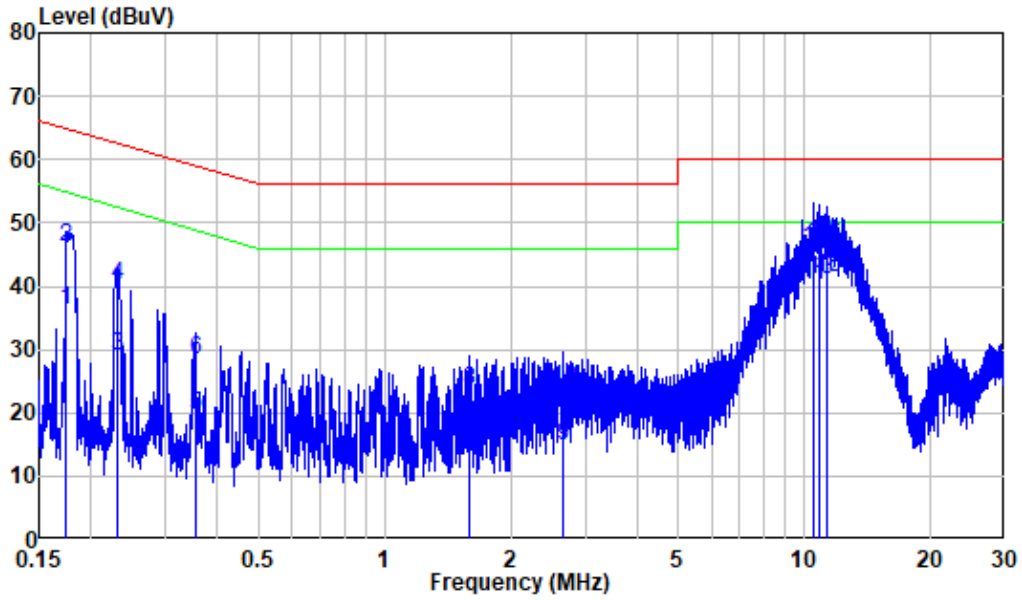
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Job No. : SZNS221017-47499E-RF
Mode : BT
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.177	9.80	27.63	37.43	54.62	-17.19	Average
2	0.177	9.80	37.45	47.25	64.62	-17.37	QP
3	0.240	9.80	20.49	30.29	52.08	-21.79	Average
4	0.240	9.80	30.66	40.46	62.08	-21.62	QP
5	0.315	9.80	4.35	14.15	49.85	-35.70	Average
6	0.315	9.80	12.36	22.16	59.85	-37.69	QP
7	1.922	9.82	4.45	14.27	46.00	-31.73	Average
8	1.922	9.82	13.94	23.76	56.00	-32.24	QP
9	2.737	9.83	6.10	15.93	46.00	-30.07	Average
10	2.737	9.83	15.72	25.55	56.00	-30.45	QP
11	11.161	9.91	32.77	42.68	50.00	-7.32	Average
12	11.161	9.91	37.17	47.08	60.00	-12.92	QP
13	11.476	9.91	31.69	41.60	50.00	-8.40	Average
14	11.476	9.91	37.28	47.19	60.00	-12.81	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Job No. : SZNS221017-47499E-RF
Mode : BT
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.175	9.80	26.36	36.16	54.74	-18.58	Average
2	0.175	9.80	36.43	46.23	64.74	-18.51	QP
3	0.232	9.80	19.17	28.97	52.39	-23.42	Average
4	0.232	9.80	30.40	40.20	62.39	-22.19	QP
5	0.354	9.80	9.91	19.71	48.86	-29.15	Average
6	0.354	9.80	18.57	28.37	58.86	-30.49	QP
7	1.585	9.82	4.71	14.53	46.00	-31.47	Average
8	1.585	9.82	13.70	23.52	56.00	-32.48	QP
9	2.654	9.83	4.89	14.72	46.00	-31.28	Average
10	2.654	9.83	14.05	23.88	56.00	-32.12	QP
11	10.515	10.01	30.04	40.05	50.00	-9.95	Average
12	10.515	10.01	35.75	45.76	60.00	-14.24	QP
13	10.811	10.01	31.10	41.11	50.00	-8.89	Average
14	10.811	10.01	36.85	46.86	60.00	-13.14	QP
15	11.362	10.01	31.21	41.22	50.00	-8.78	Average
16	11.362	10.01	36.52	46.53	60.00	-13.47	QP

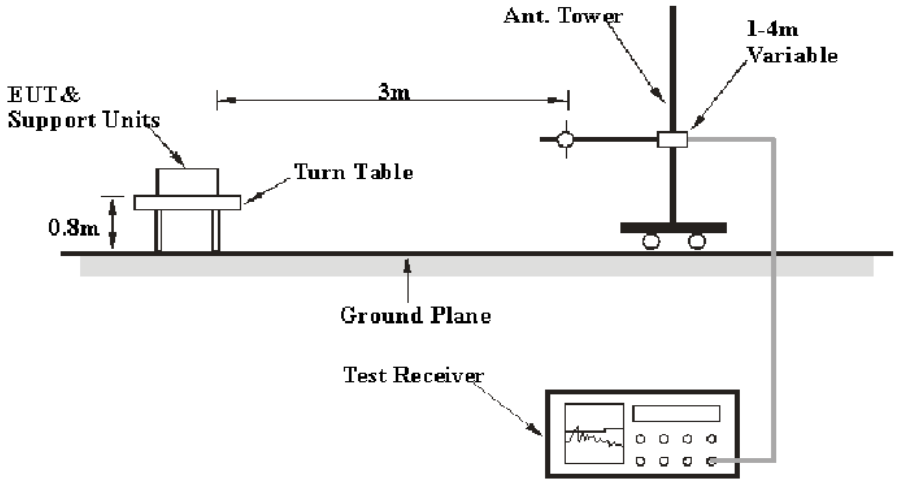
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

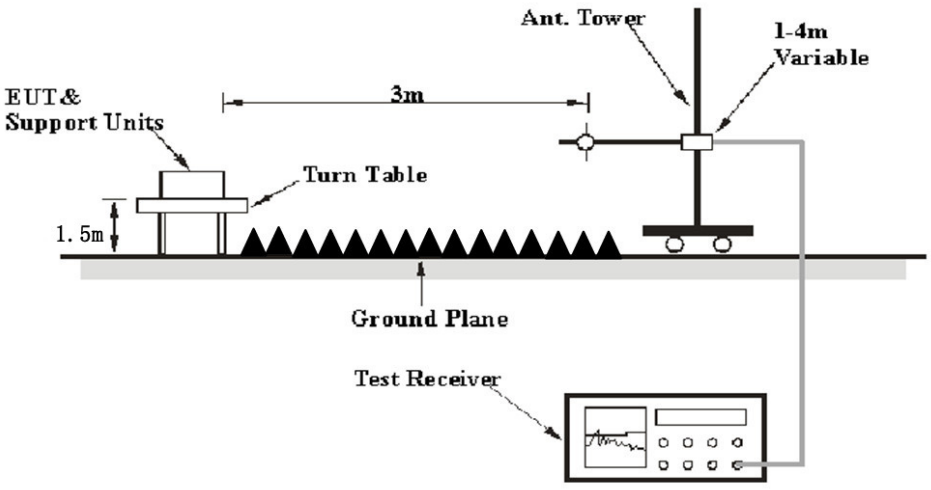
FCC §15.205; §15.209; §15.247(d)

EUT Setup

Below 1 GHz:



Above 1GHz:



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

Corrected Factor & Margin Calculation

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

Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain

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

Margin/Over Limit = Corrected Amplitude/Level-Limit
Corrected Amplitude/Level = Reading + Corrected Factor

Test Data

Environmental Conditions

Temperature:	22~25.5℃
Relative Humidity:	52~62%
ATM Pressure:	101~10.1.3kPa

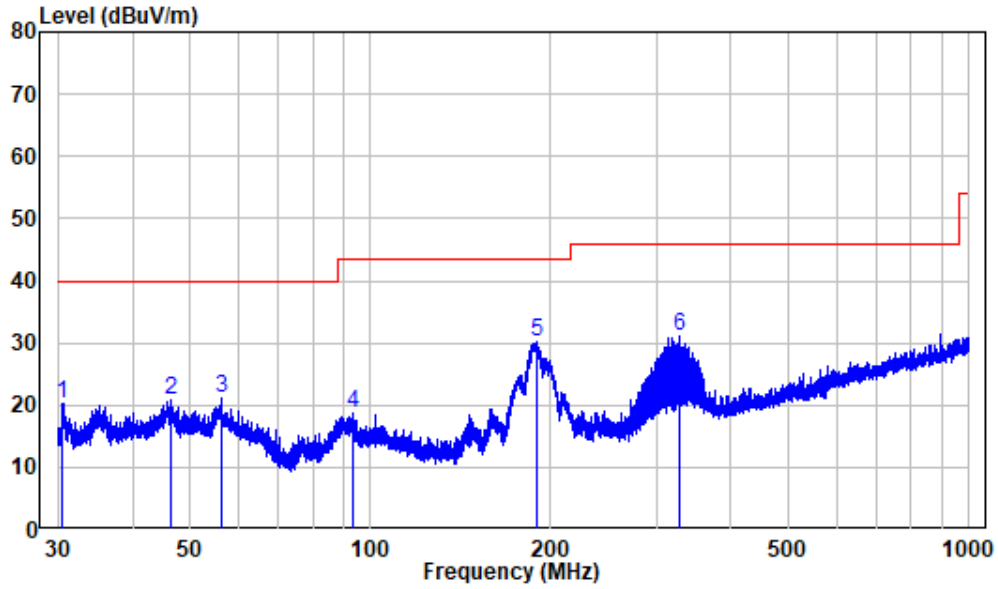
The testing was performed by Jimi on 2022-11-07 for below 1GHz and Level Li from 2022-10-24 to 2022-12-09 for above 1GHz.

EUT operation mode: Transmitting (Pre-scan in the X,Y and Z axes of orientation, the worst case orientation was recorded)

30MHz-1GHz: *(worst case is 8DPSK Mode, High channel)*

Note: When the test result of Peak was more than 6dB below the limit of QP, just the Peak value was recorded.

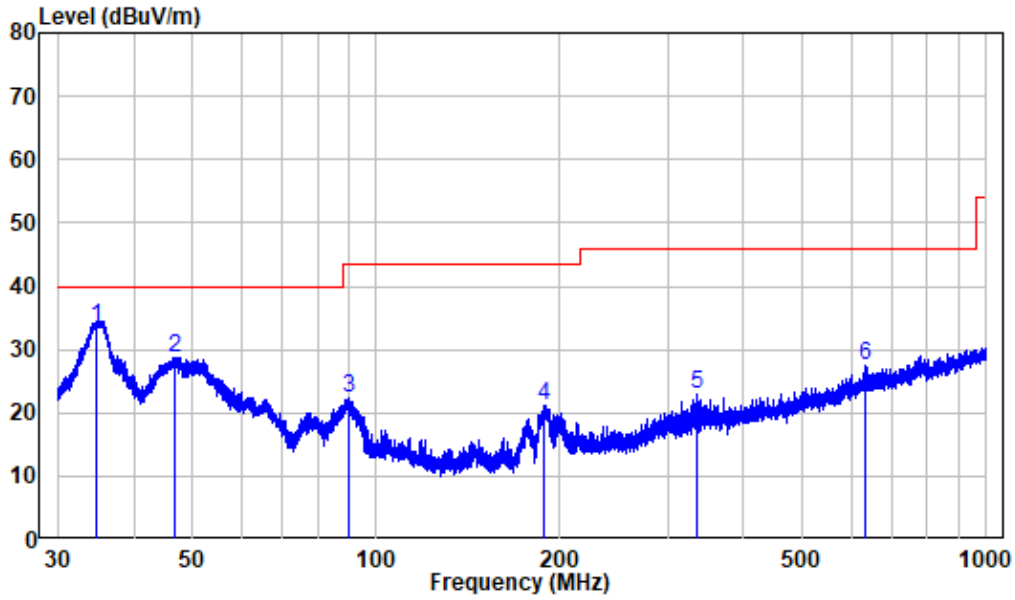
Horizontal:



Site : chamber
Condition: 3m Horizontal
Job No. : SZNS221017-47499E-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	30.584	-12.33	32.68	20.35	40.00	-19.65	Peak
2	46.279	-10.00	30.76	20.76	40.00	-19.24	Peak
3	56.370	-10.13	31.14	21.01	40.00	-18.99	Peak
4	93.358	-12.89	31.47	18.58	43.50	-24.92	Peak
5	189.572	-11.64	41.76	30.12	43.50	-13.38	Peak
6	328.751	-8.05	39.17	31.12	46.00	-14.88	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : SZNS221017-47499E-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	34.791	-11.60	45.09	33.49	40.00	-6.51	QP
2	46.564	-10.00	38.81	28.81	40.00	-11.19	Peak
3	90.379	-13.89	36.20	22.31	43.50	-21.19	Peak
4	188.660	-11.74	32.93	21.19	43.50	-22.31	Peak
5	334.859	-7.62	30.59	22.97	46.00	-23.03	Peak
6	635.020	-1.99	29.34	27.35	46.00	-18.65	Peak

Above 1GHz: *(the worst case is GFSK Mode, DH5)*

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
Low Channel 2402MHz									
2310	60.24	PK	359	2.1	H	-7.24	53.00	74	-21.00
2310	60.05	PK	81	1.2	V	-7.24	52.81	74	-21.19
2390	62.73	PK	51	2	H	-7.22	55.51	74	-18.49
2390	62.49	PK	110	1.8	V	-7.22	55.27	74	-18.73
4804	57.43	PK	290	1.7	H	-3.51	53.92	74	-20.08
4804	59.12	PK	269	1.6	V	-3.51	55.61	74	-18.39
Middle Channel 2441MHz									
4882	57.18	PK	248	1.3	H	-3.37	53.81	74	-20.19
4882	58.75	PK	286	1.9	V	-3.37	55.38	74	-18.62
High Channel 2480MHz									
2483.5	64.18	PK	2	2.1	H	-7.20	56.98	74	-17.02
2483.5	63.89	PK	187	1.9	V	-7.20	56.69	74	-17.31
2500	61.81	PK	167	1.7	H	-7.18	54.63	74	-19.37
2500	61.68	PK	7	1.2	V	-7.18	54.5	74	-19.50
4960	56.13	PK	241	2.5	H	-3.01	53.12	74	-20.88
4960	56.92	PK	330	1.8	V	-3.01	53.91	74	-20.09

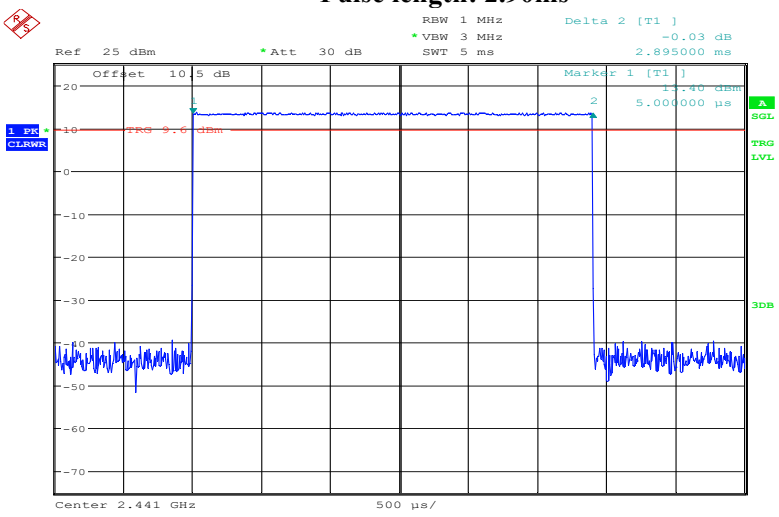
Field Strength of Average						
Frequency (MHz)	Peak Measurement @3m (dBμV/m)	Polar (H/V)	Duty Cycle Correction Factor (dB)	Corrected Ampitude (dBμV/m)	FCC Part 15.247	
					Limit (dBμV/m)	Margin (dB)
Low Channel(2402MHz)						
2310	53.00	H	-24.73	28.27	54	-25.73
2310	52.81	V	-24.73	28.08	54	-25.92
2390	55.51	H	-24.73	30.78	54	-23.22
2390	55.27	V	-24.73	30.54	54	-23.46
4804	53.92	H	-24.73	29.19	54	-24.81
4804	55.61	V	-24.73	30.88	54	-23.12
Middle Channel(2441MHz)						
4882	53.81	H	-24.73	29.08	54	-24.92
4882	55.38	V	-24.73	30.65	54	-23.35
High Channel(2480MHz)						
2483.5	56.98	H	-24.73	32.25	54	-21.75
2483.5	56.69	V	-24.73	31.96	54	-22.04
2500	54.63	H	-24.73	29.90	54	-24.10
2500	54.50	V	-24.73	29.77	54	-24.23
4960	53.12	H	-24.73	28.39	54	-25.61
4960	53.91	V	-24.73	29.18	54	-24.82

Note:

Absolute Level = Corrected Factor + Reading
Margin = Corrected. Amplitude - Limit
Average level= Peak level+ Duty Cycle Corrected Factor

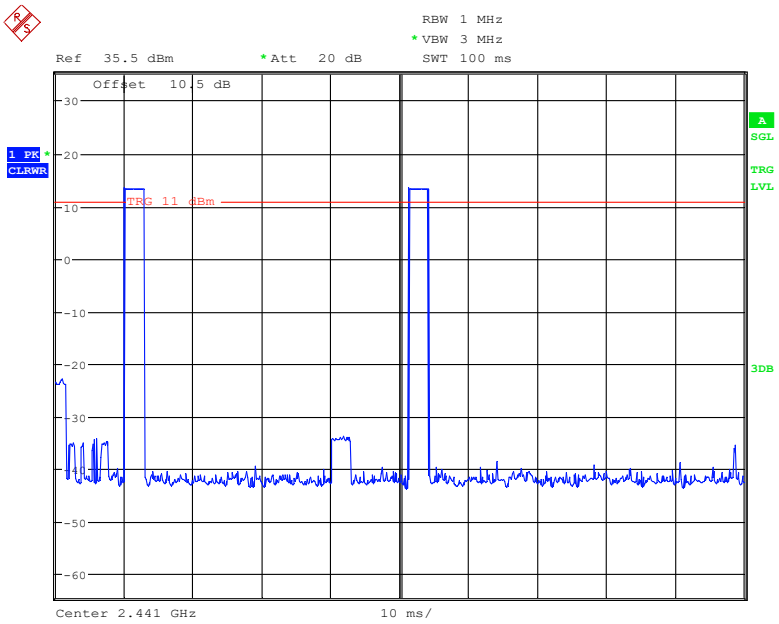
The worst case duty cycle as below:
Duty cycle = Ton/100ms = 2.90*2/100=0.058
Duty Cycle Corrected Factor = 20lg (Duty cycle) = 20lg0.058 = -24.73

Pulse length: 2.90ms



Date: 24.OCT.2022 18:52:55

Maximum Pulse number in 100ms: 2

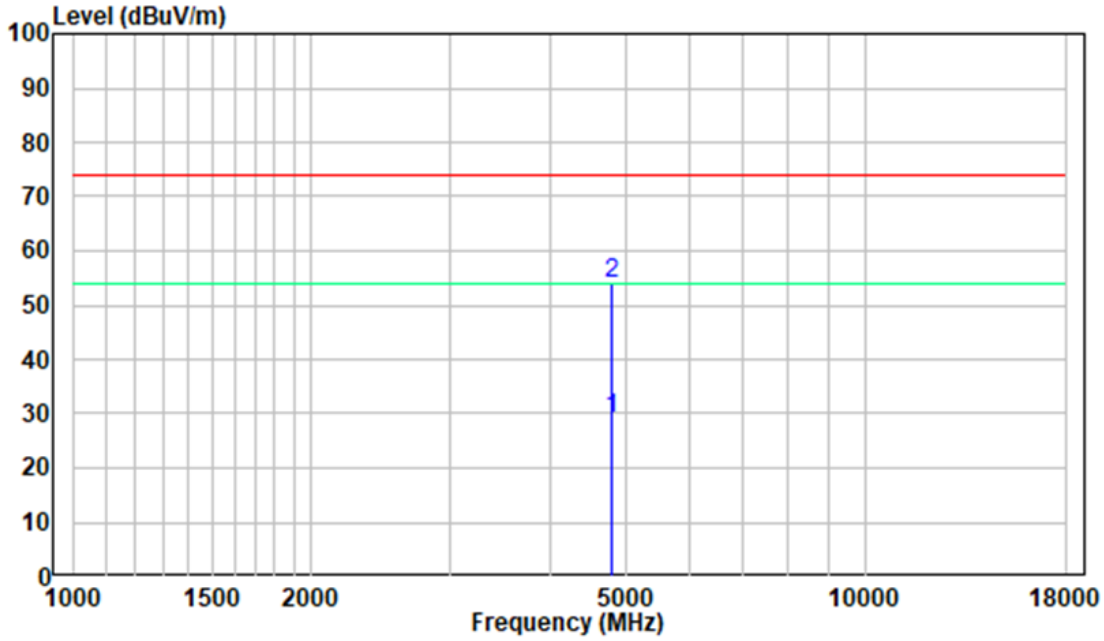


Date: 9.DEC.2022 18:53:56

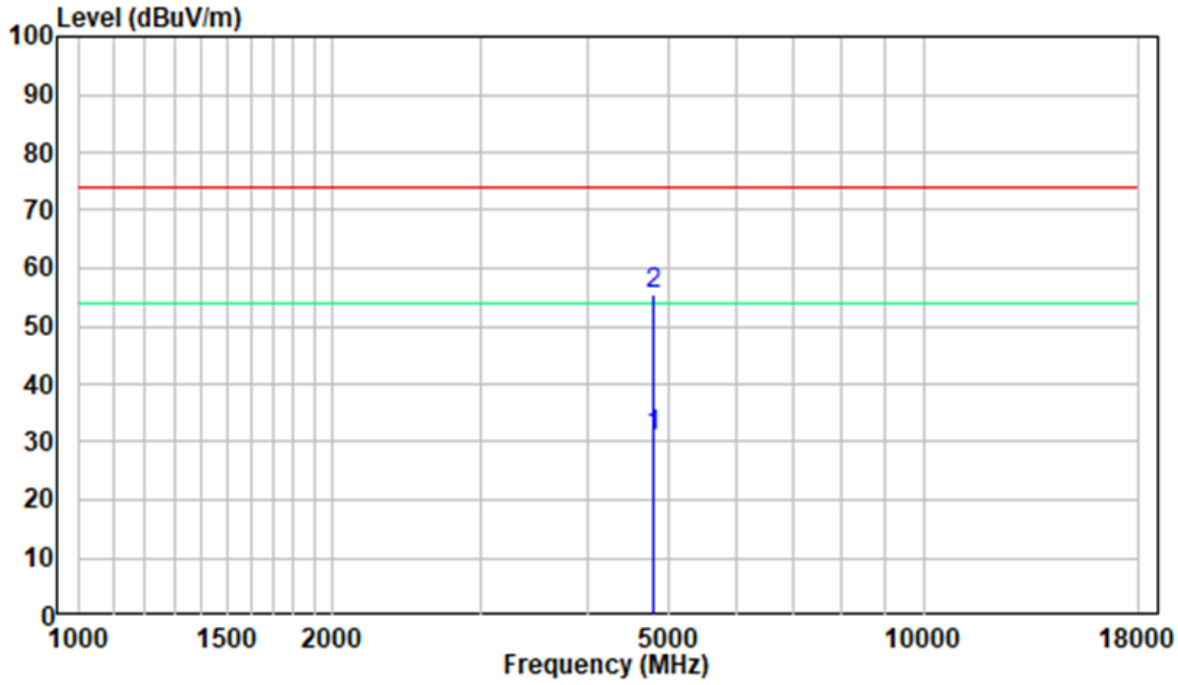
1-18GHz

Pre-scan for Low Channel

Horizontal:



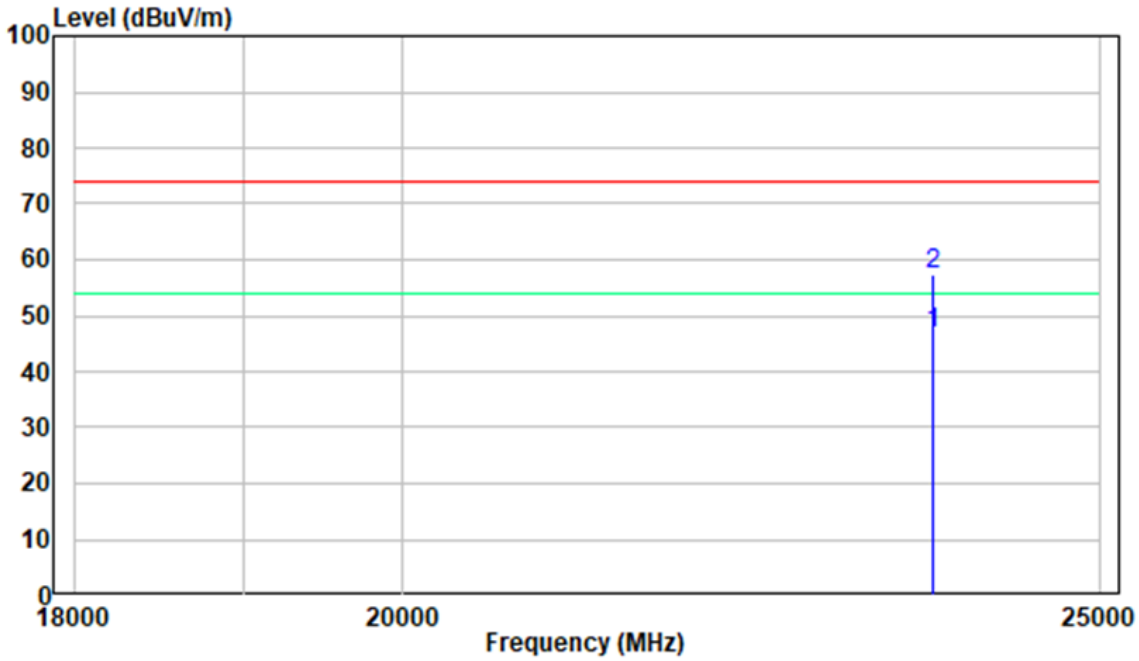
Vertical:



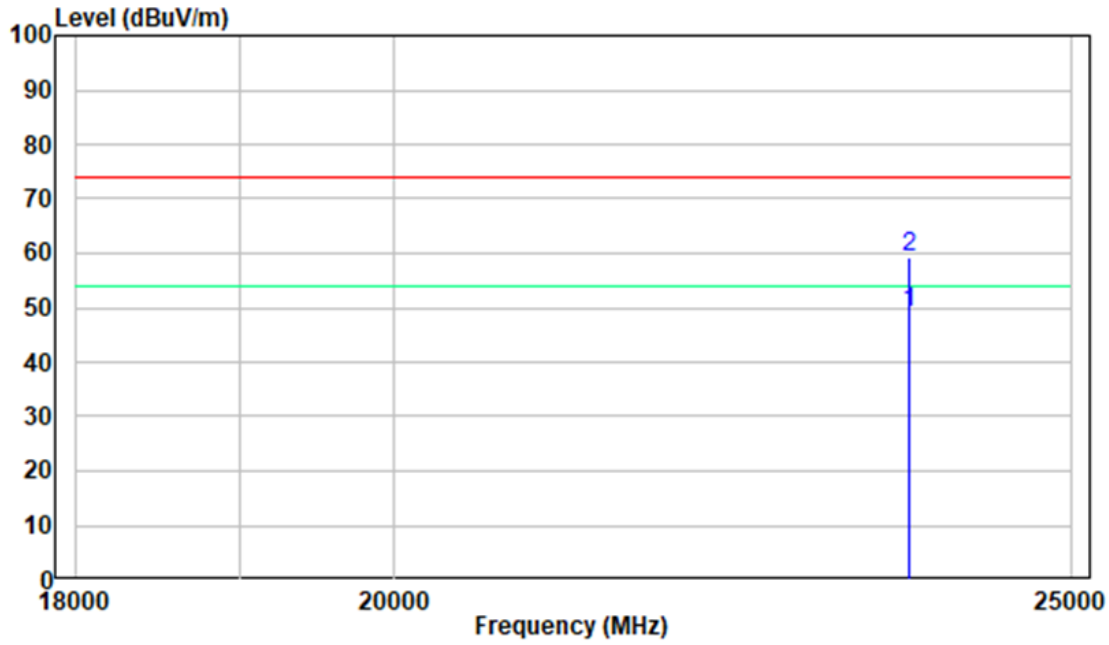
18-25GHz

Pre-scan for Low Channel

Horizontal:



Vertical:



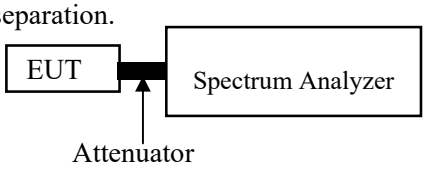
FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

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

1. Set the EUT in transmitting 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:	28℃
Relative Humidity:	56%
ATM Pressure:	101.0 kPa

The testing was performed by Cat Kang on 2022-10-24.

EUT operation mode: Transmitting

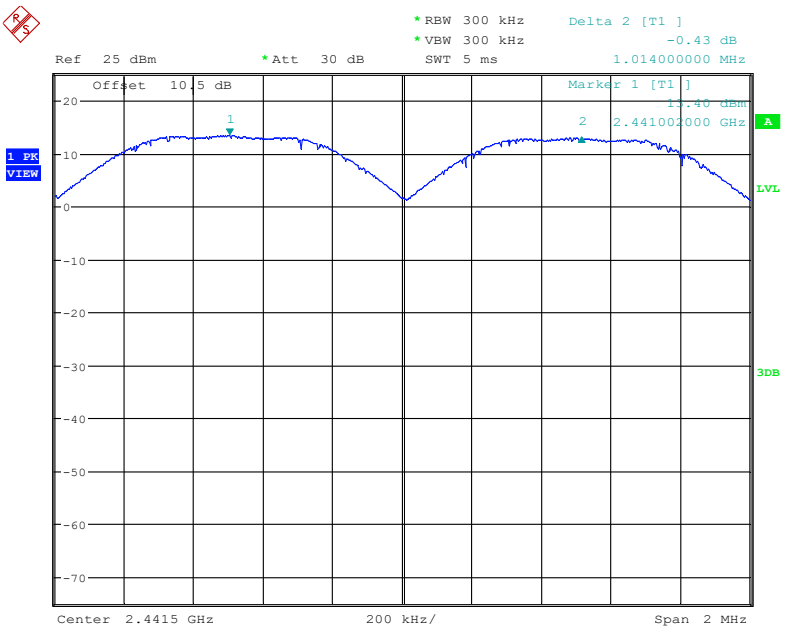
Test Result: Compliant.

Test Mode	Channel Separation (MHz)	20 dBc BW (MHz)	Two-thirds of the 20 dB bandwidth (MHz)	Channel Separation Limit	Result
BDR(GFSK)					
Hopping	1.014	0.876	0.584	> two-thirds of the 20 dB bandwidth	Compliance
EDR(π/4-DQPSK)					
Hopping	1.008	1.275	0.850	> two-thirds of the 20 dB bandwidth	Compliance
EDR(8DPSK)					
Hopping	0.994	1.284	0.856	> two-thirds of the 20 dB bandwidth	Compliance

Note: The limit > two-thirds of the 20 dB bandwidth

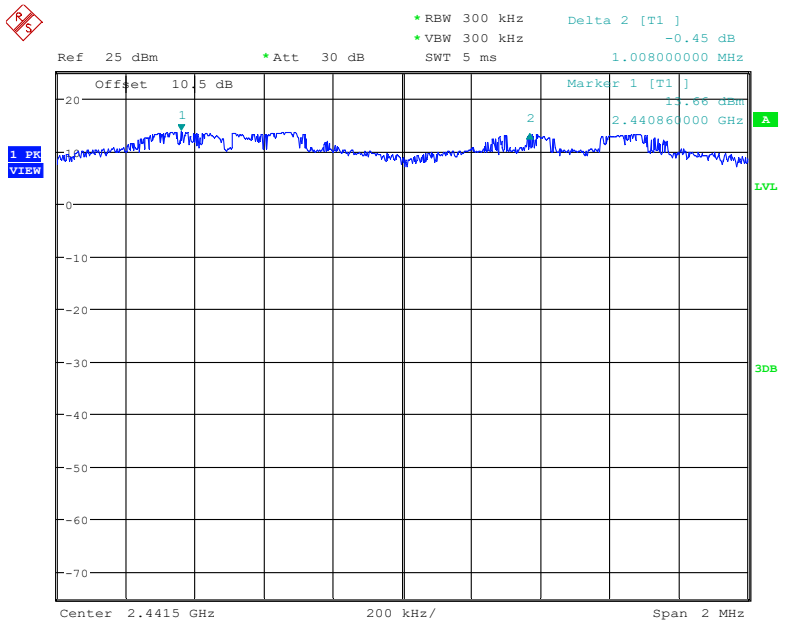
Please refer to the below plots:

BDR (GFSK)



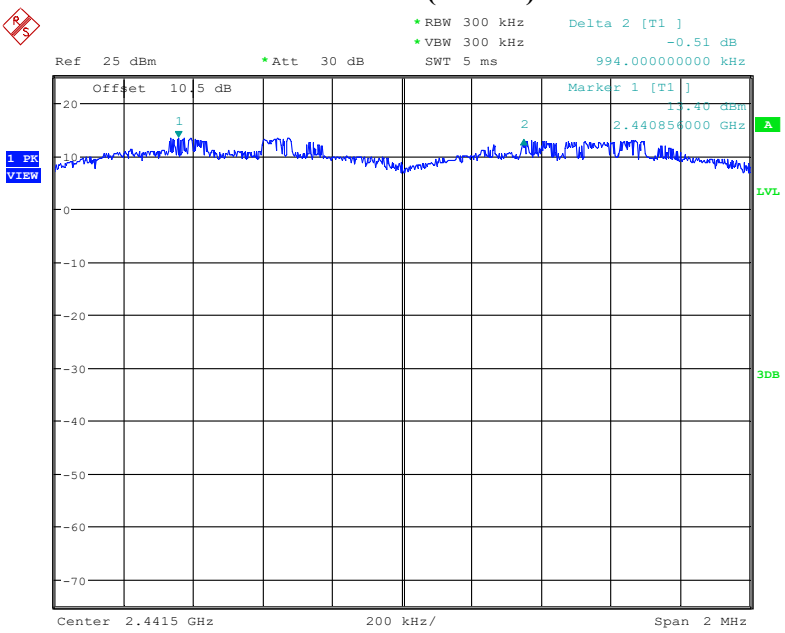
Date: 24.OCT.2022 18:52:21

EDR (π/4-DQPSK)



Date: 24.OCT.2022 19:05:06

EDR (8DPSK)



Date: 24.OCT.2022 19:13:20

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

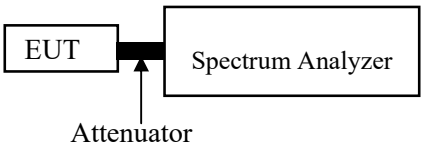
The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:
• The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

• 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 transmitting 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:	28℃
Relative Humidity:	56%
ATM Pressure:	101.0 kPa

The testing was performed by Cat Kang on 2022-10-24 and 2022-11-29.

EUT operation mode: Transmitting

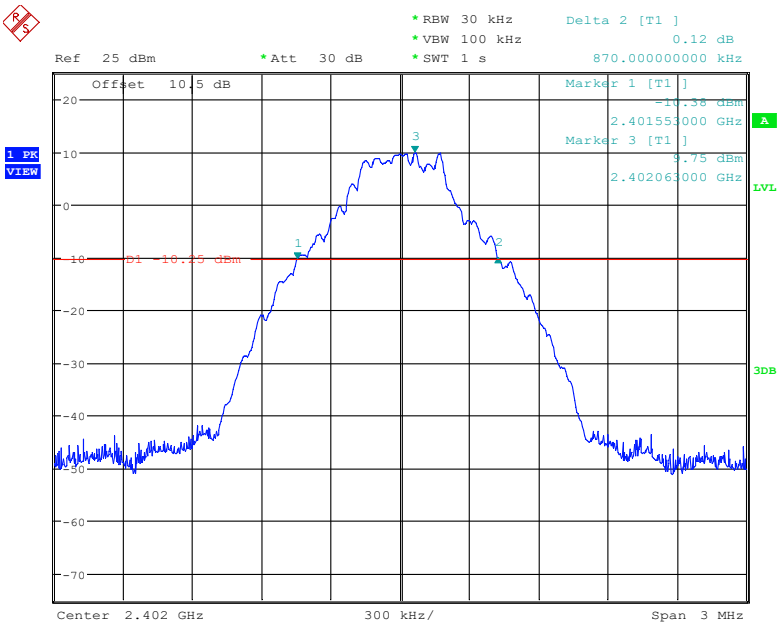
Test Result: Compliant.

Mode	Channel	Frequency (MHz)	99% Emission Bandwidth (MHz)	20 dB Emission Bandwidth (MHz)
BDR (GFSK)	Low	2402	0.759	0.870
	Middle	2441	0.762	0.876
	High	2480	0.731	0.870
EDR (π/4-DQPSK)	Low	2402	1.135	1.269
	Middle	2441	1.149	1.269
	High	2480	1.146	1.275
EDR (8DPSK)	Low	2402	1.146	1.275
	Middle	2441	1.152	1.274
	High	2480	1.149	1.284

Please refer to the below plots:

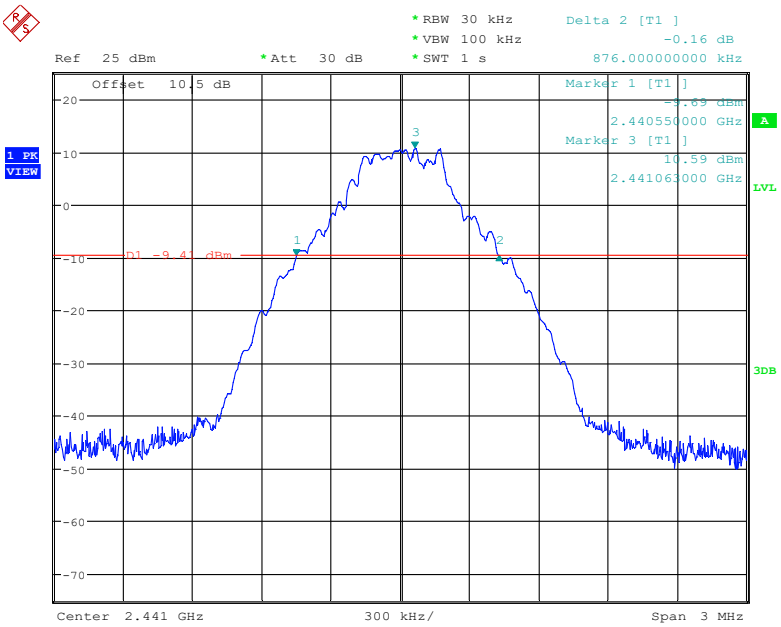
20 dB Emission Bandwidth

BDR (GFSK): Low Channel



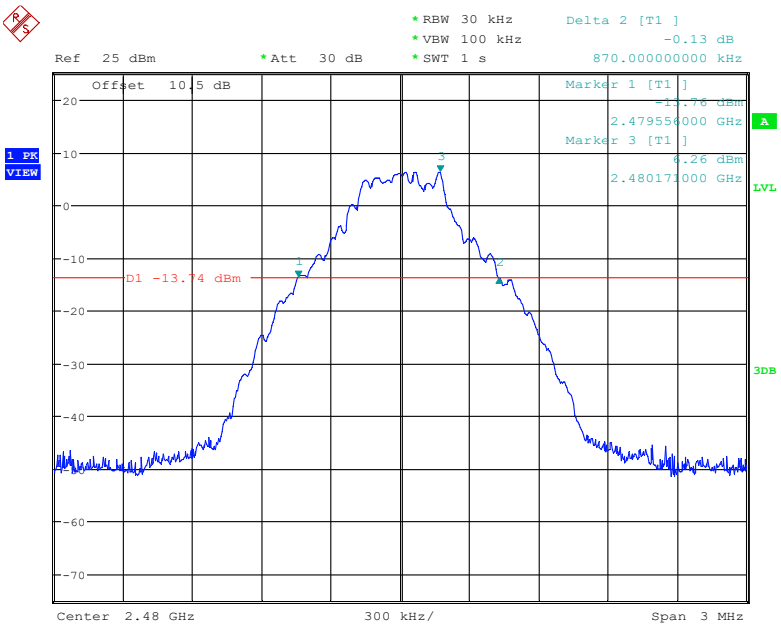
Date: 24.OCT.2022 18:18:16

BDR (GFSK): Middle Channel



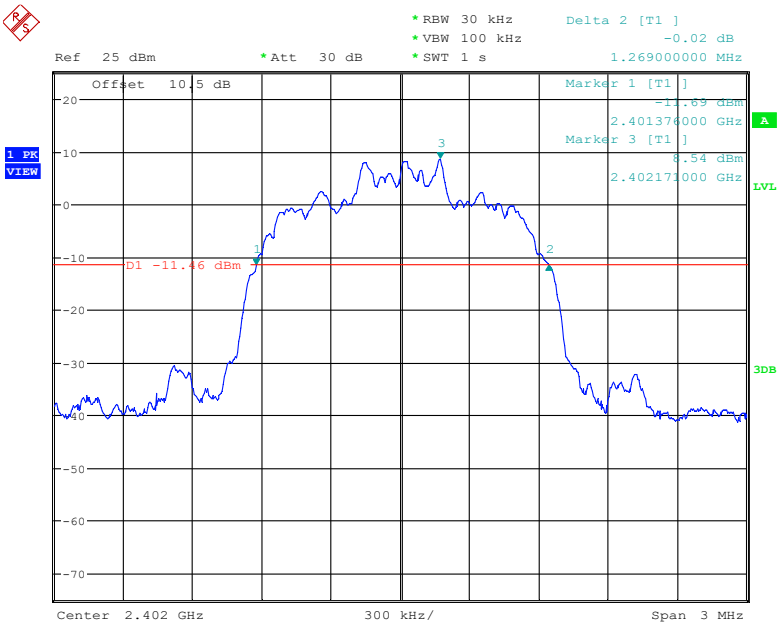
Date: 24.OCT.2022 19:24:39

BDR (GFSK): High Channel



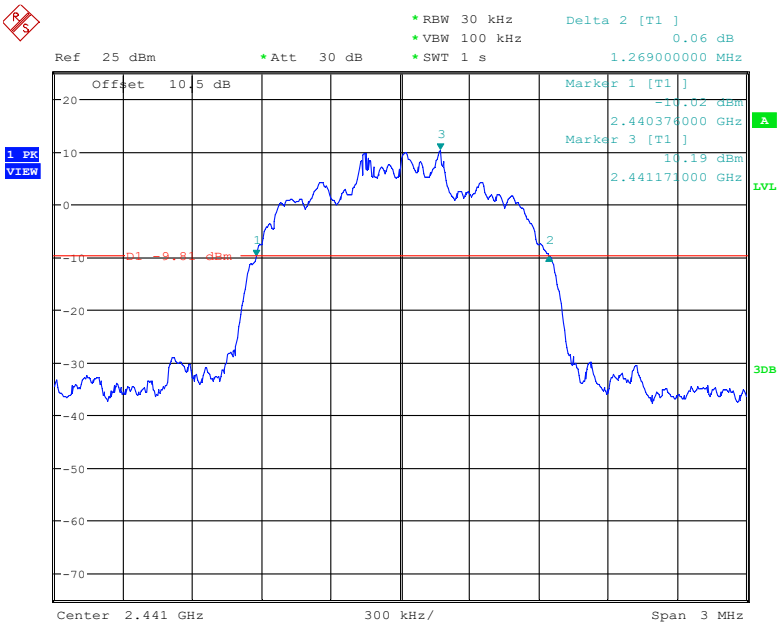
Date: 24.OCT.2022 18:40:03

EDR (π/4-DQPSK): Low Channel



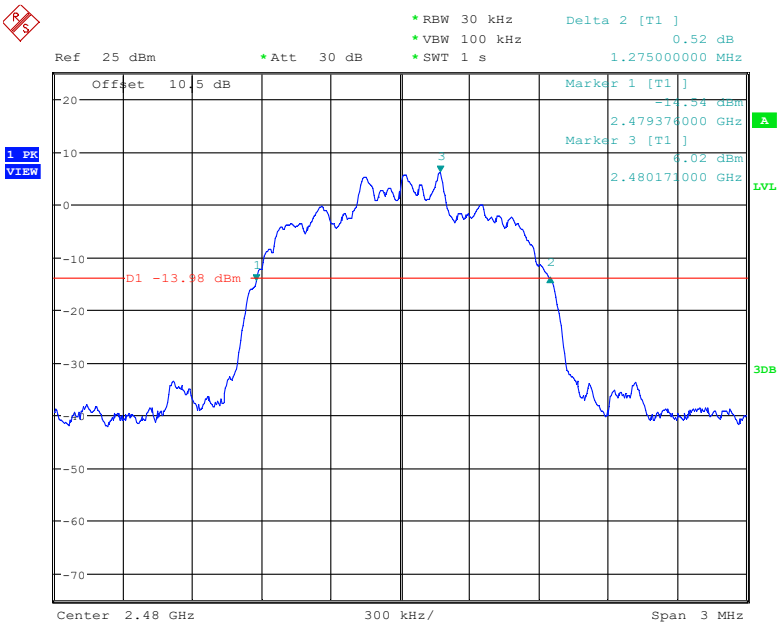
Date: 24.OCT.2022 18:21:31

EDR (π/4-DQPSK): Middle Channel



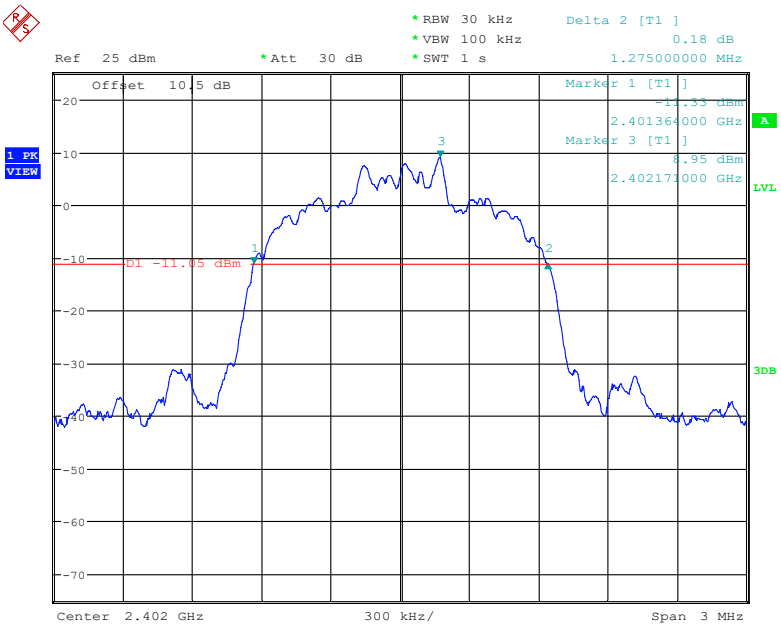
Date: 24.OCT.2022 19:21:32

EDR (π/4-DQPSK): High Channel



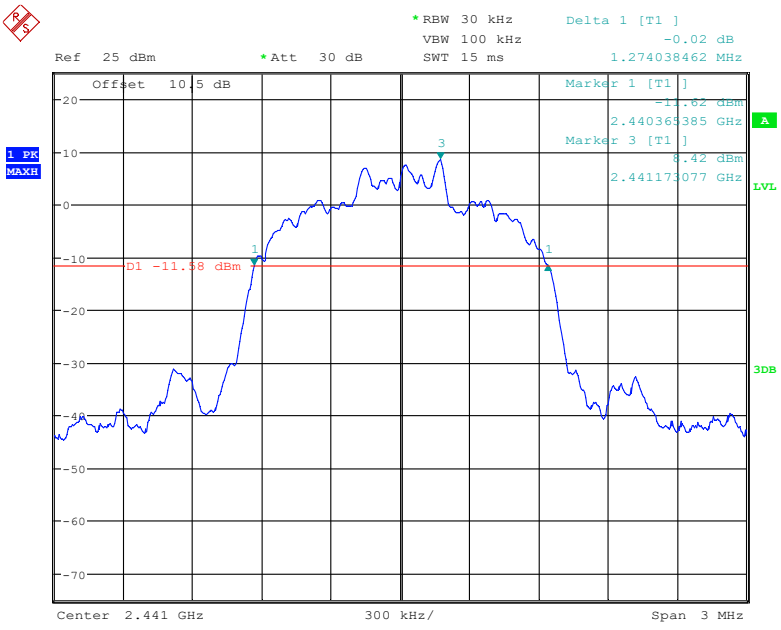
Date: 24.OCT.2022 18:42:46

EDR (8DPSK): Low Channel



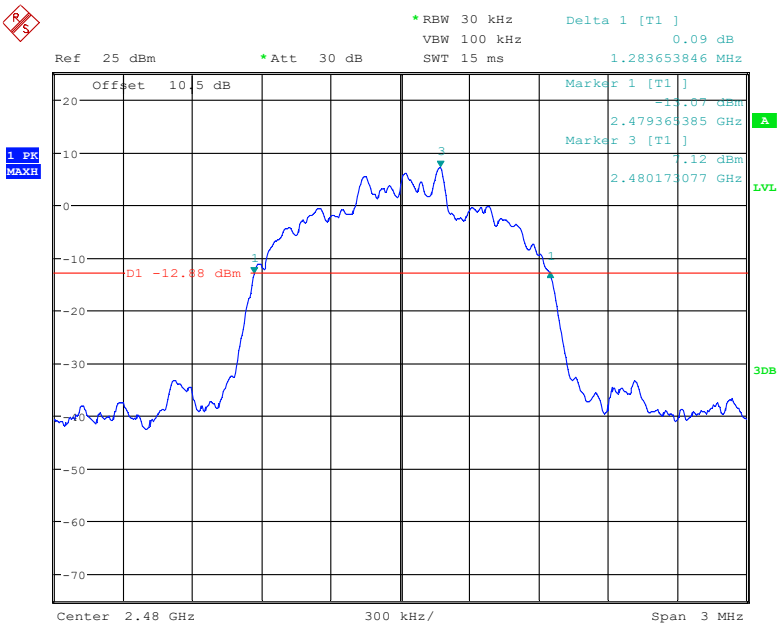
Date: 24.OCT.2022 18:24:25

EDR (8DPSK): Middle Channel



Date: 29.NOV.2022 16:26:11

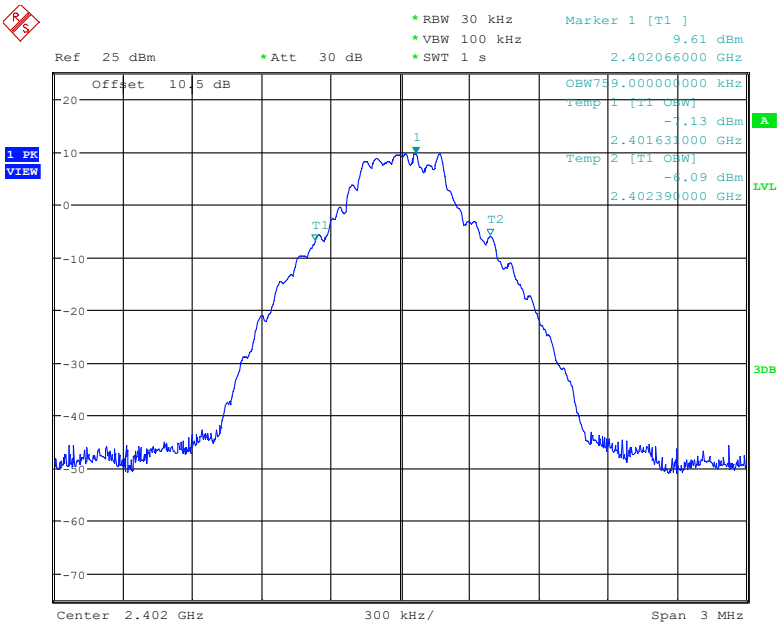
EDR (8DPSK): High Channel



Date: 29.NOV.2022 16:30:01

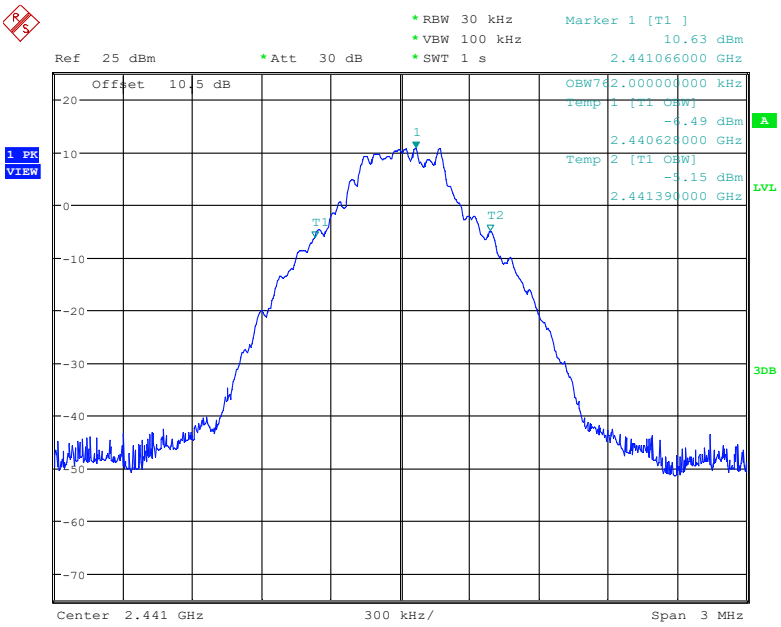
99% Emission Bandwidth

BDR (GFSK): Low Channel



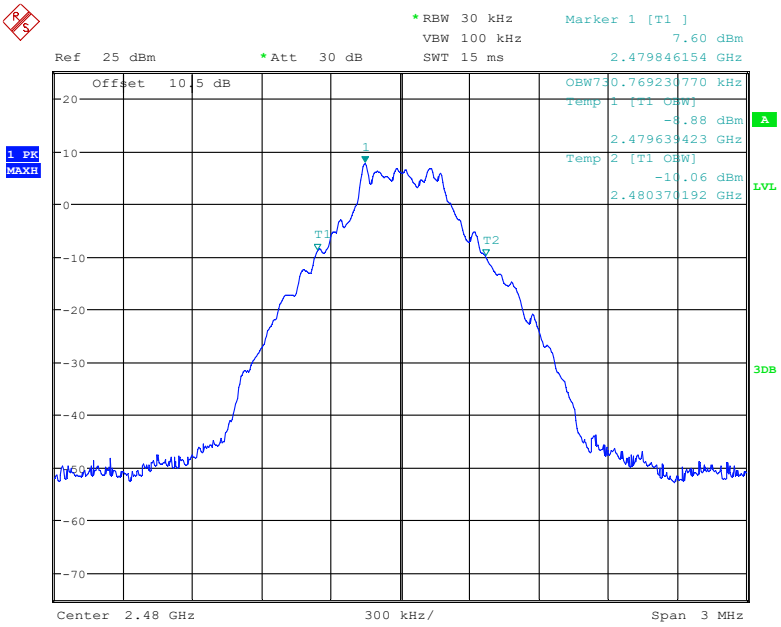
Date: 24.OCT.2022 18:17:08

BDR (GFSK): Middle Channel



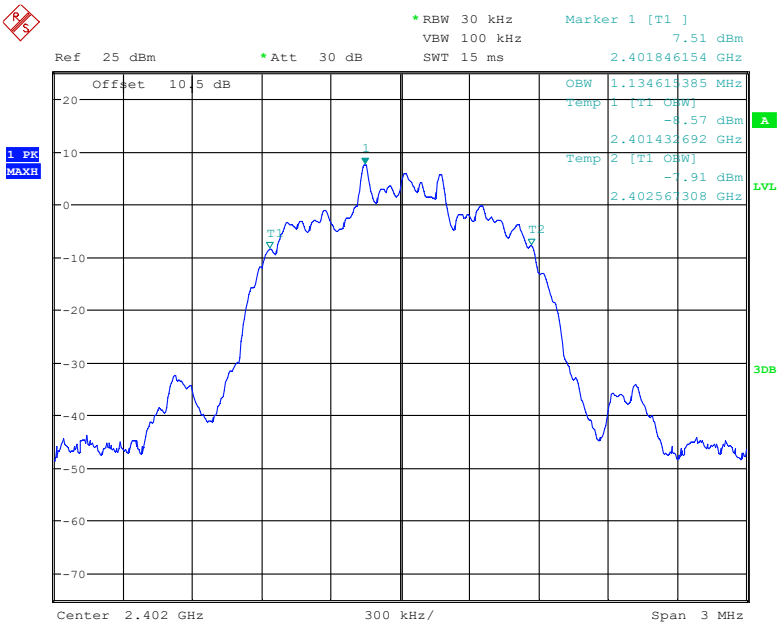
Date: 24.OCT.2022 19:22:50

BDR (GFSK): High Channel



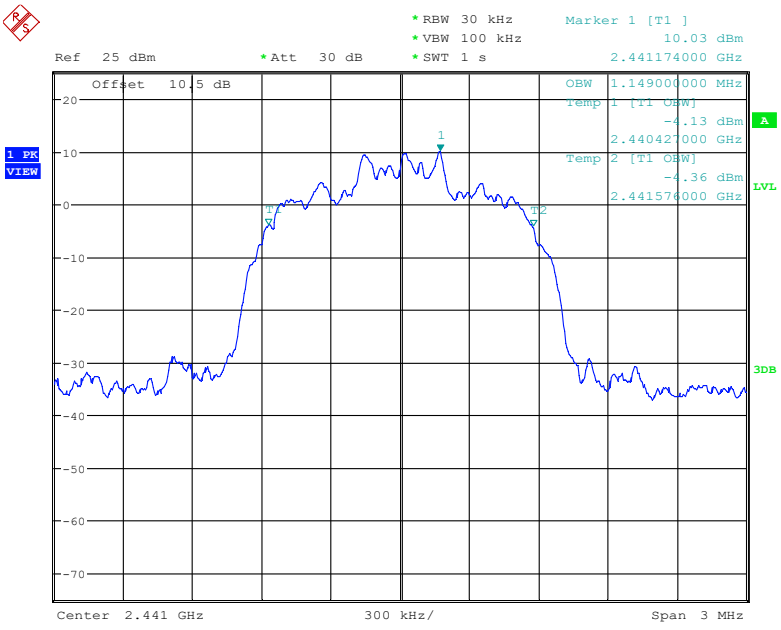
Date: 29.NOV.2022 16:33:50

EDR (π/4-DQPSK): Low Channel



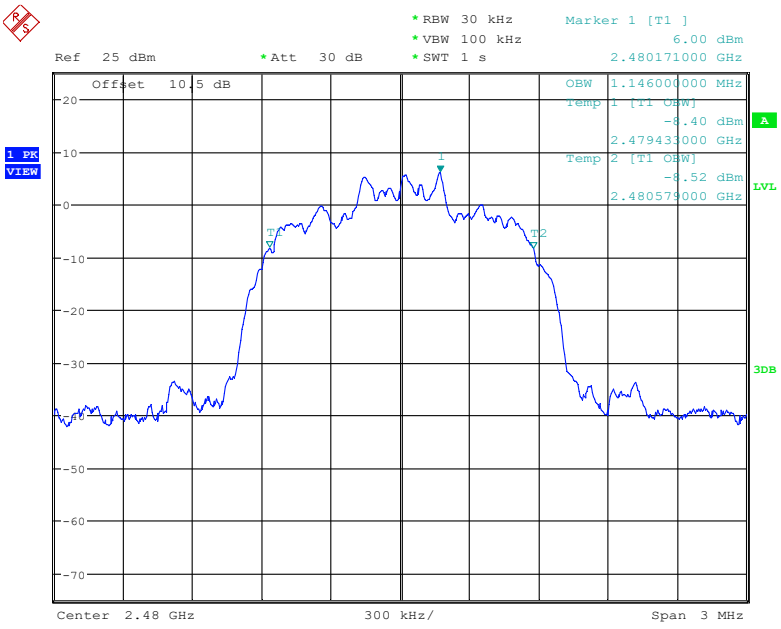
Date: 29.NOV.2022 16:32:42

EDR (π/4-DQPSK): Middle Channel



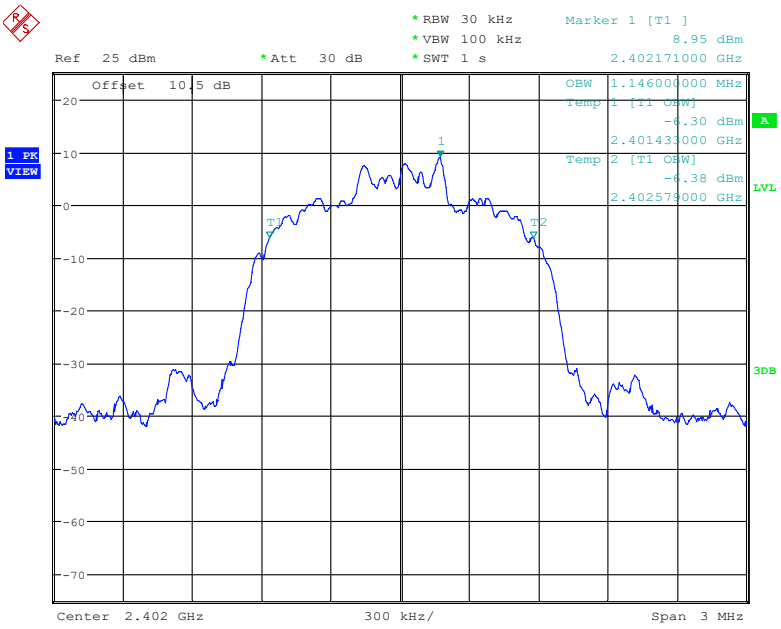
Date: 24.OCT.2022 18:32:41

EDR (π/4-DQPSK): High Channel



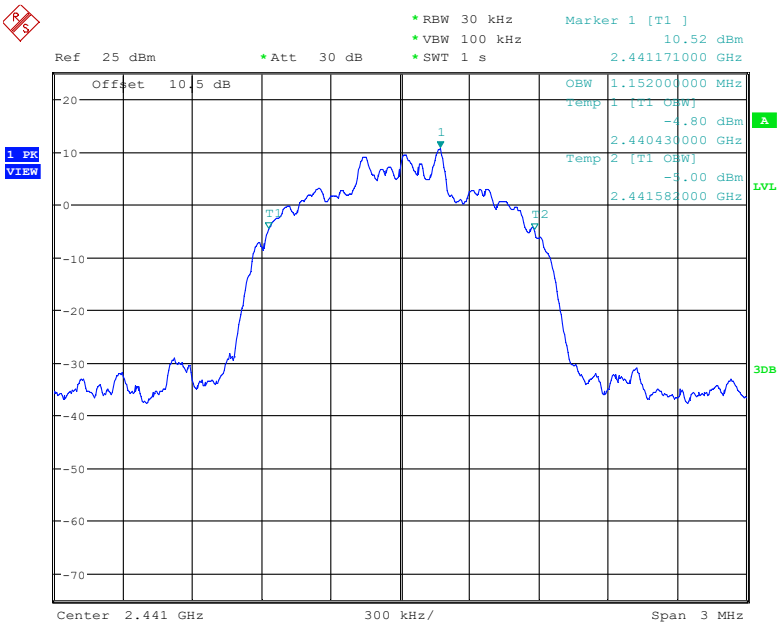
Date: 24.OCT.2022 18:42:09

EDR (8DPSK): Low Channel



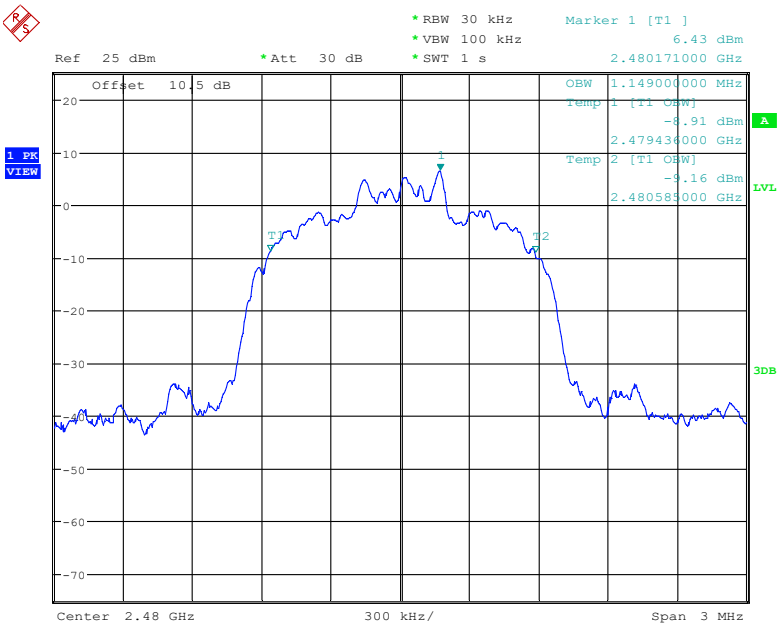
Date: 24.OCT.2022 18:23:47

EDR (8DPSK): Middle Channel



Date: 24.OCT.2022 18:34:47

EDR (8DPSK): High Channel



Date: 24.OCT.2022 18:45:23

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

Applicable Standard

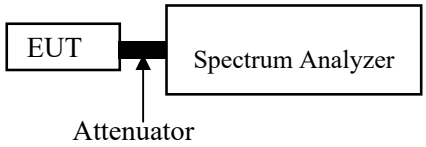
Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Procedure

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:	28℃
Relative Humidity:	56%
ATM Pressure:	101.0 kPa

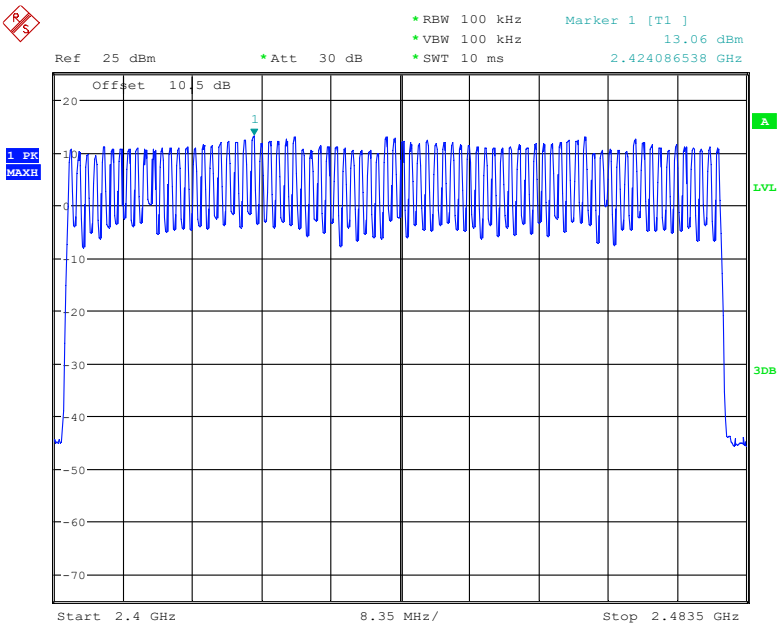
The testing was performed by Cat Kang on 2022-11-29.

EUT operation mode: Transmitting

Test Result: Compliant.

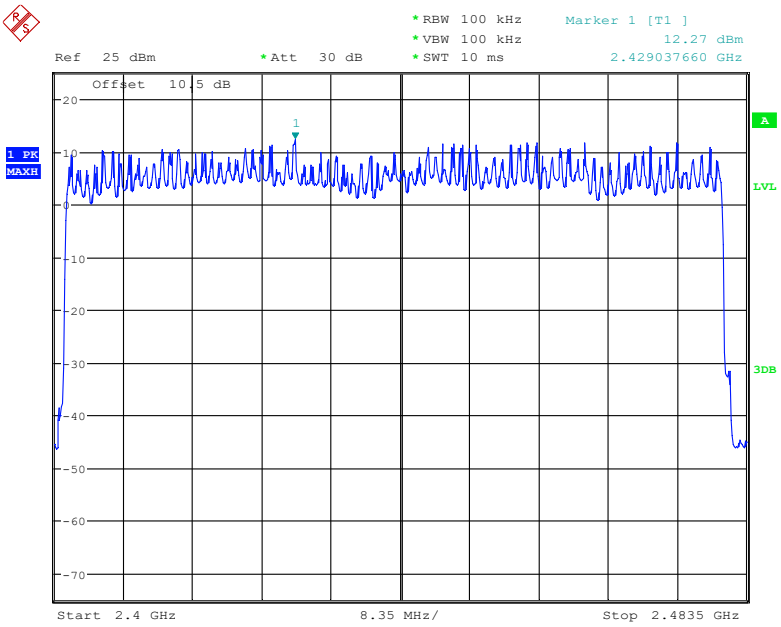
Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
BDR(GFSK)	2400-2483.5	79	≥15
EDR(π/4-DQPSK)	2400-2483.5	79	≥15
EDR(8DPSK)	2400-2483.5	79	≥15

BDR (GFSK): Number of Hopping Channels



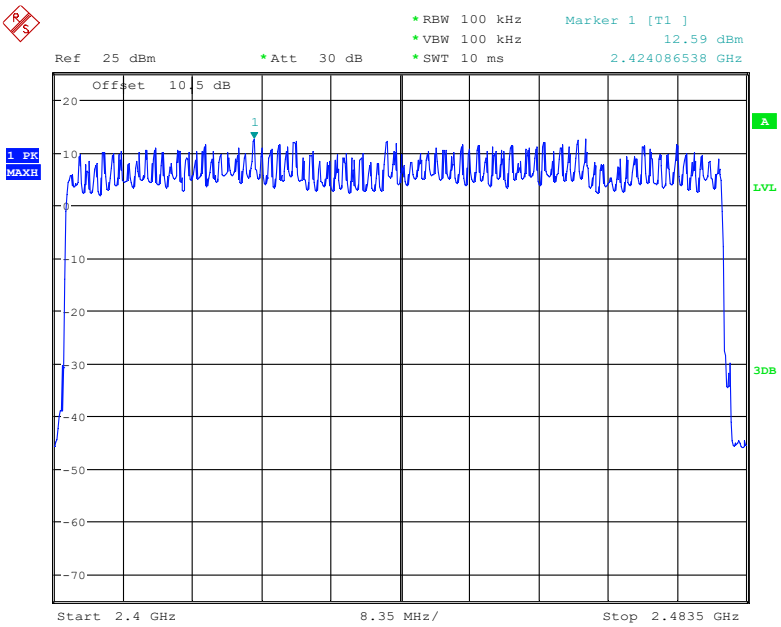
Date: 29.NOV.2022 12:58:49

EDR (π/4-DQPSK): Number of Hopping Channels



Date: 29.NOV.2022 13:02:46

EDR (8DPSK): Number of Hopping Channels



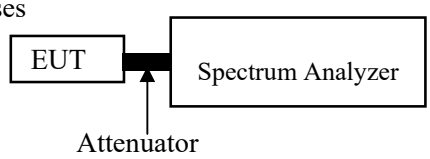
FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)

Applicable Standard

Frequency hopping systems in the 2400-2483.5 MHz 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

1. The EUT was worked in channel hopping.
2. Set the RBW to: 1MHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 0Hz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Recorded the time of single pulses



Test Data

Environmental Conditions

Temperature:	28℃
Relative Humidity:	56%
ATM Pressure:	101.0 kPa

The testing was performed by Cat Kang on 2022-10-24 and 2022-11-26.

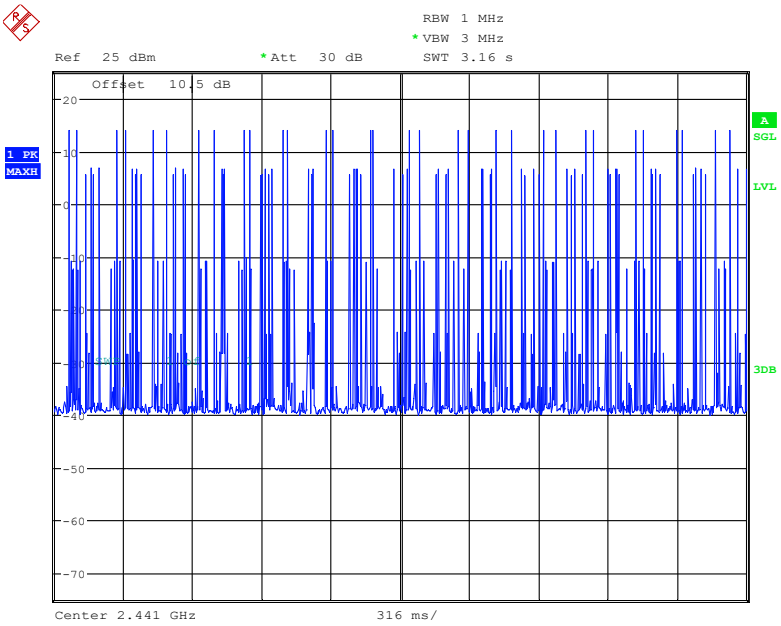
EUT operation mode: Transmitting

Test Result: Compliant.

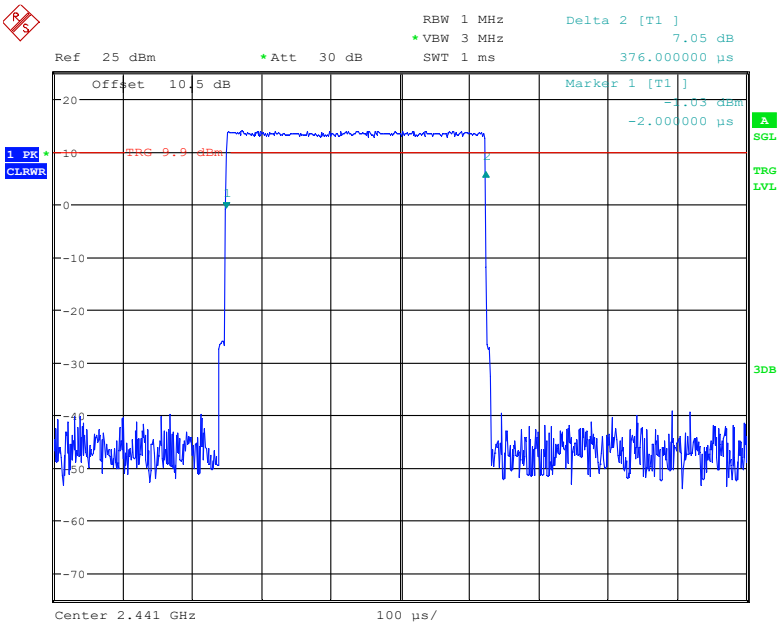
Test Mode	Channel	Pulse Time [ms]	Total Hops [Num]	Result[s]	Limit[s]	Verdict
DH1	Hop	0.38	320	0.122	<=0.4	PASS
DH3	Hop	1.64	180	0.295	<=0.4	PASS
DH5	Hop	2.90	110	0.319	<=0.4	PASS
2DH1	Hop	0.38	310	0.118	<=0.4	PASS
2DH3	Hop	1.64	170	0.279	<=0.4	PASS
2DH5	Hop	2.91	110	0.320	<=0.4	PASS
3DH1	Hop	0.38	320	0.122	<=0.4	PASS
3DH3	Hop	1.64	180	0.295	<=0.4	PASS
3DH5	Hop	2.91	130	0.378	<=0.4	PASS

Note 1: A period time=0.4*79=31.6(S), Result= Pulse Time *Total hops
Note 2: Total hops=Hopping Number in 3.16s*10
Note 3: Hopping Number in 3.16s=Total of highest signals in 3.16s (Second high signals were other channel)

BDR (GFSK):
DH1

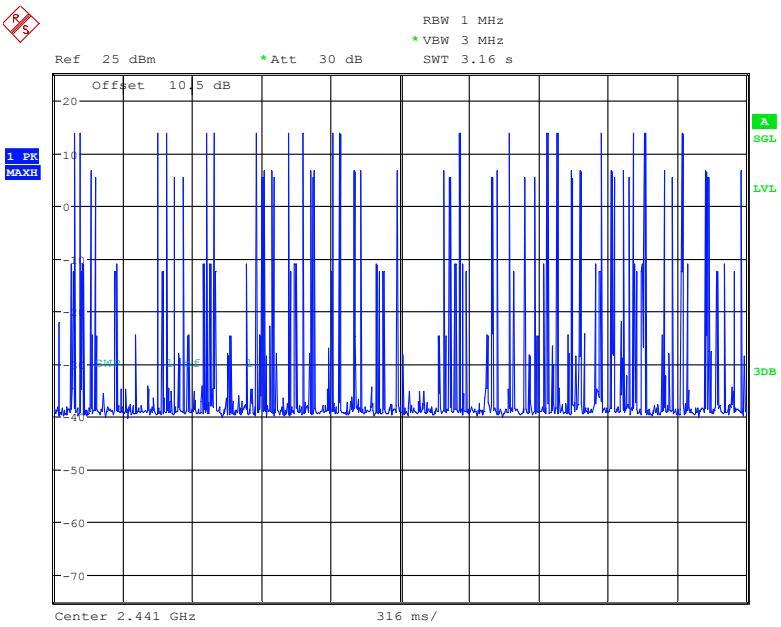


Date: 24.OCT.2022 18:48:06

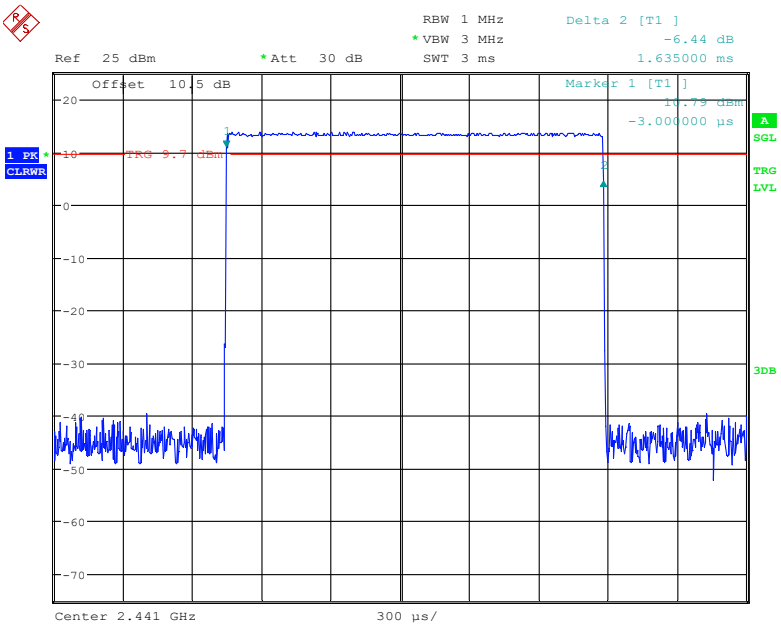


Date: 24.OCT.2022 18:48:24

DH3

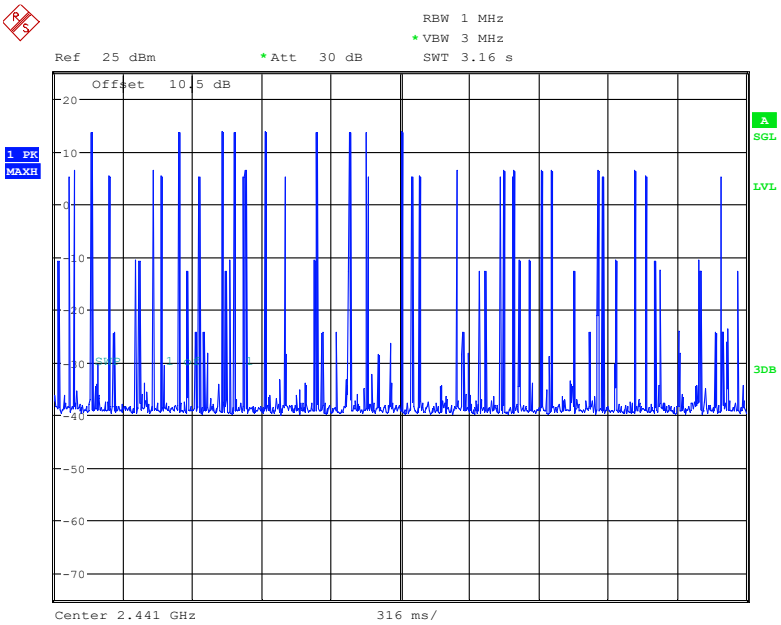


Date: 24.OCT.2022 18:48:52

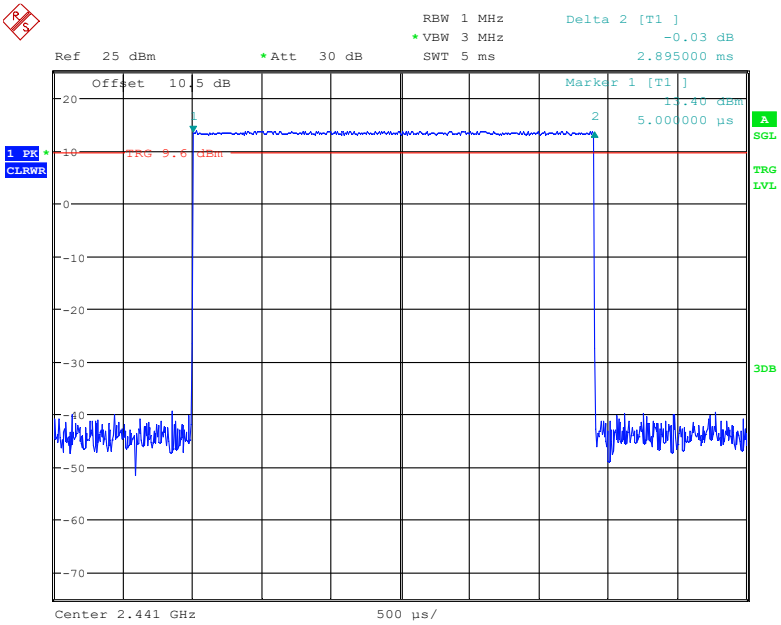


Date: 24.OCT.2022 18:49:10

DH5



Date: 24.OCT.2022 18:52:37



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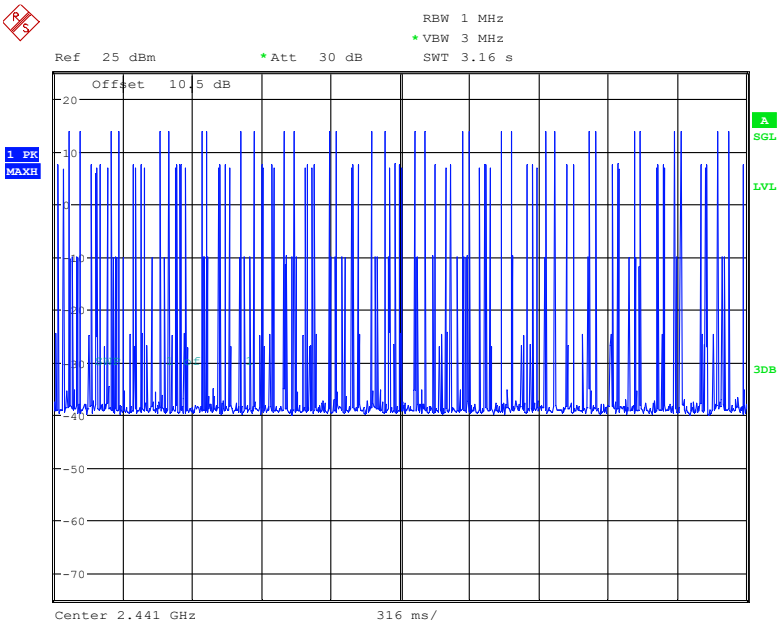
EDR(π/4-DQPSK):
2DH1



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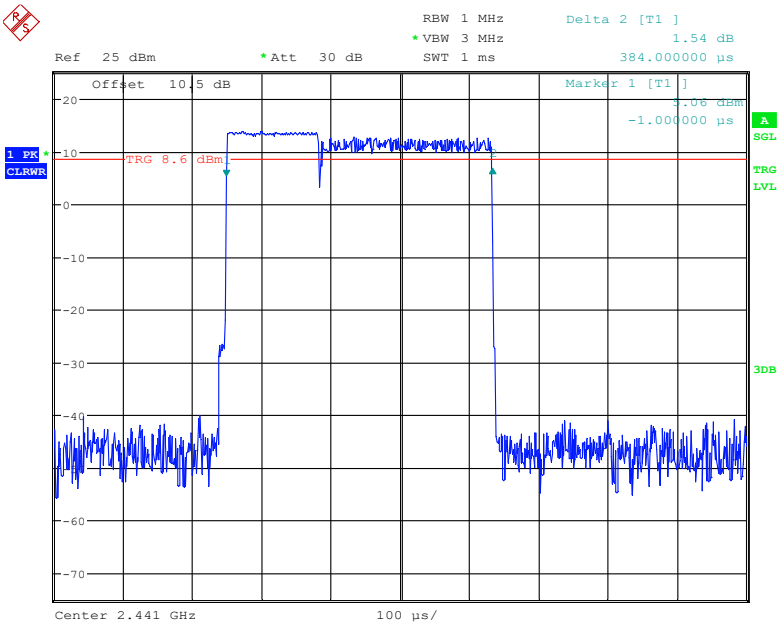

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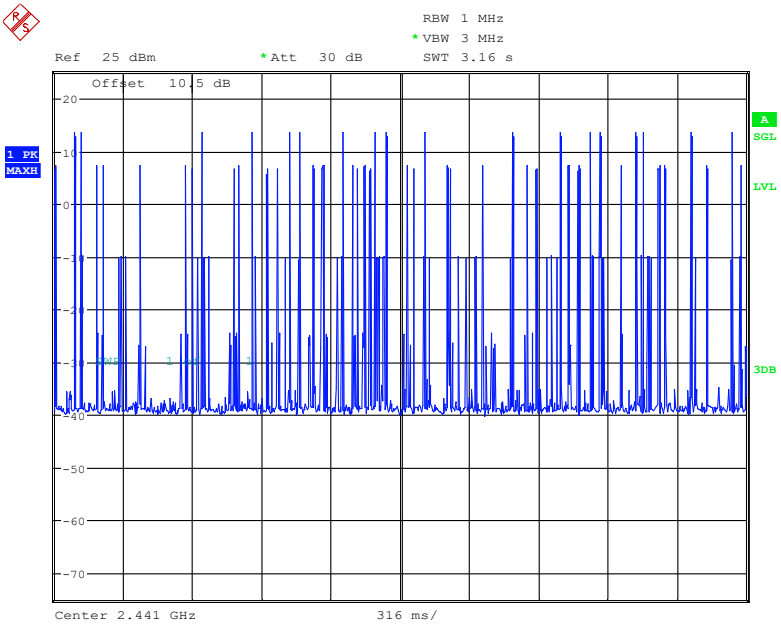
2DH3



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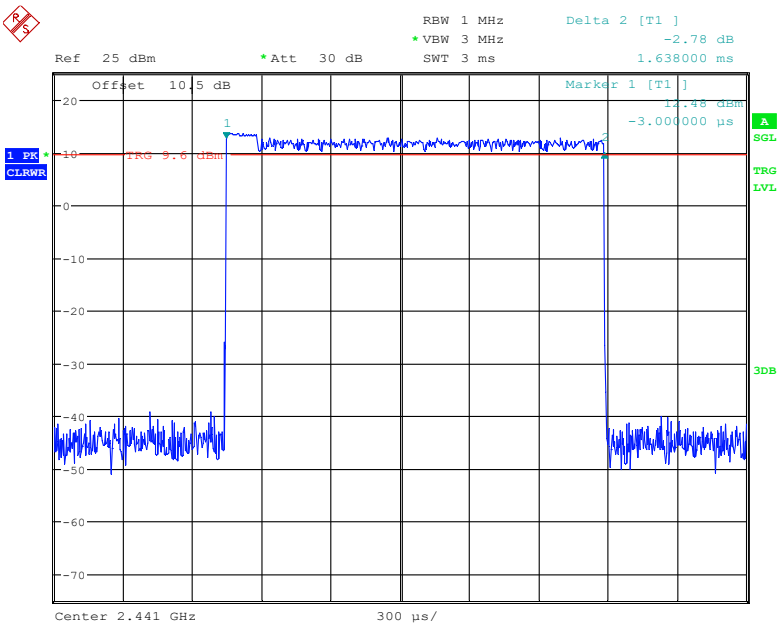
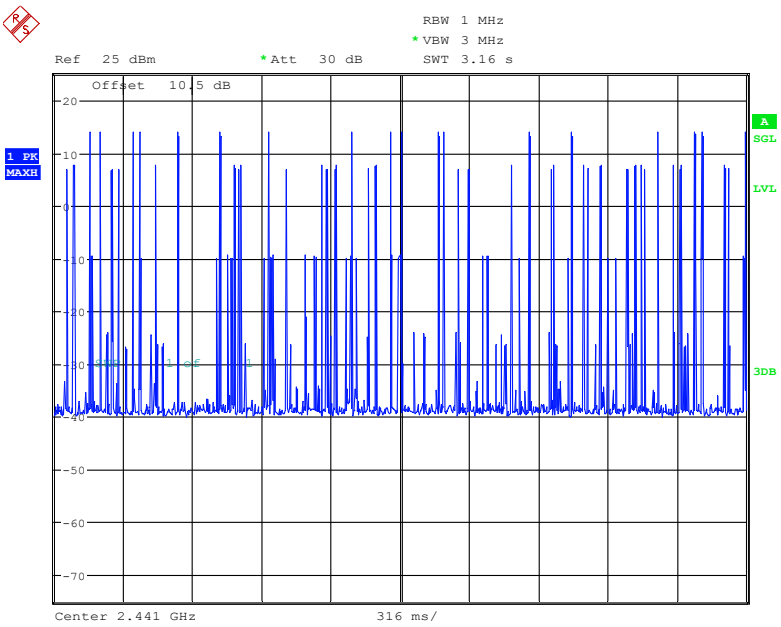


Date: 24.OCT.2022 19:00:03

2DH5



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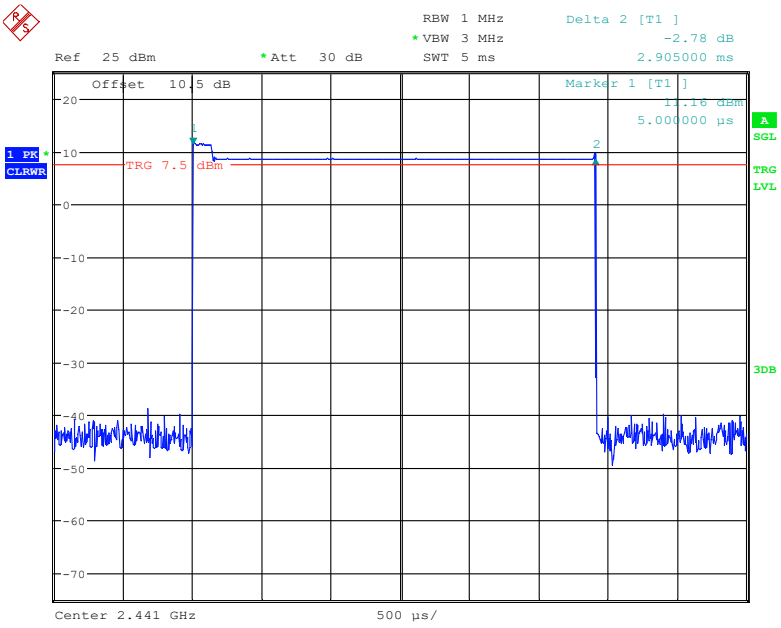
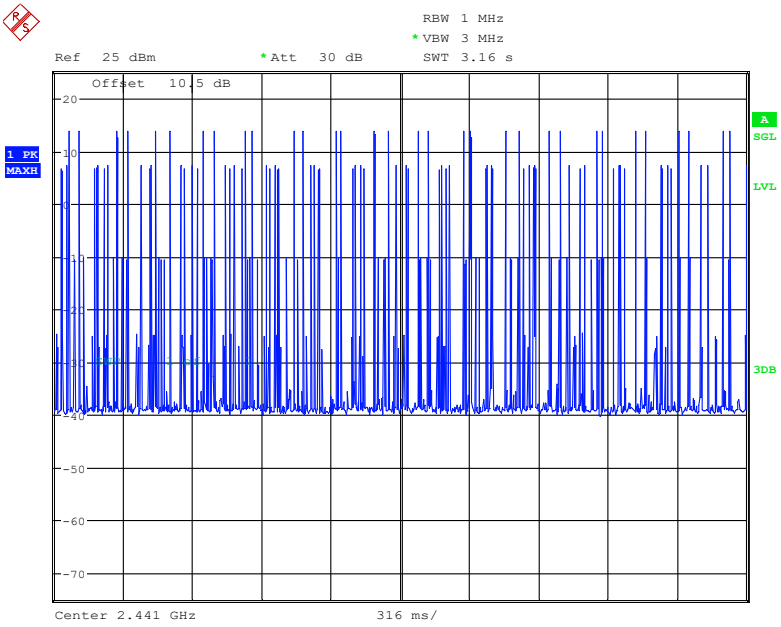


Date: 26.NOV.2022 18:20:20

EDR (8DPSK):
3DH1



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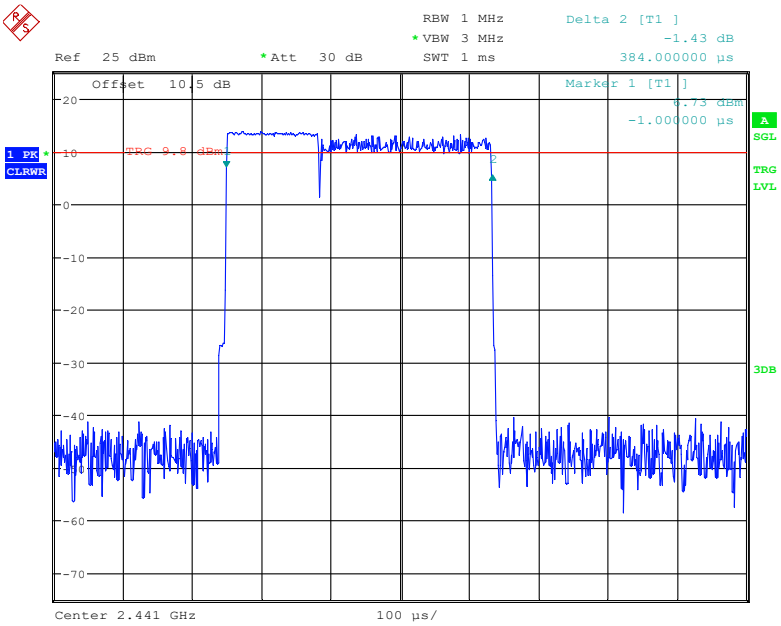
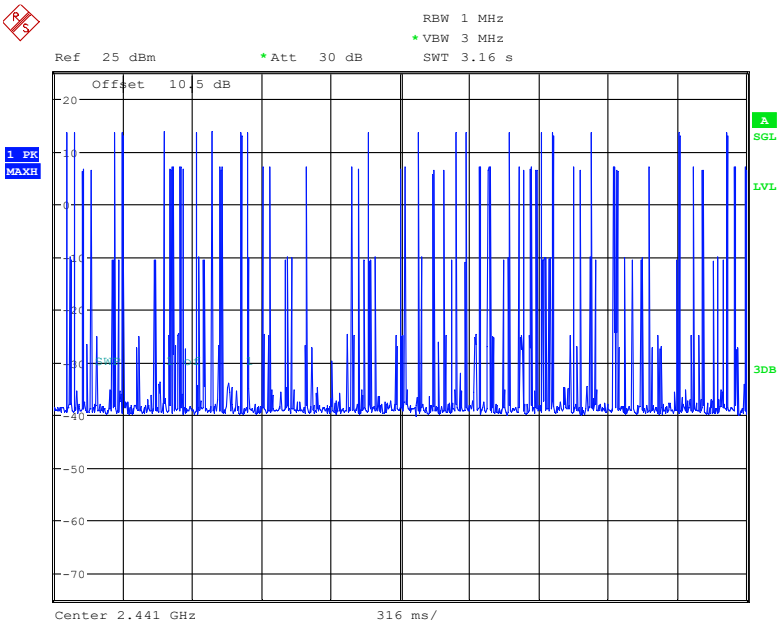


Date: 24.OCT.2022 19:09:16

3DH3



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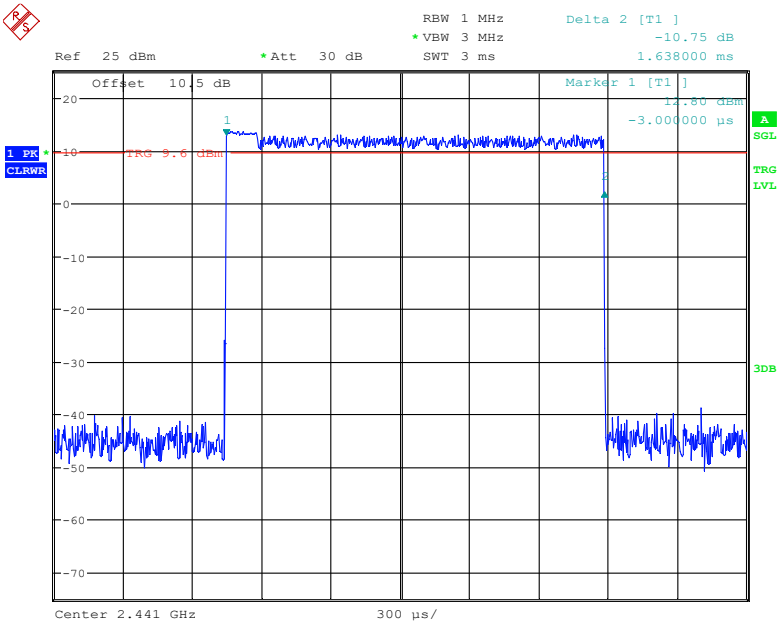

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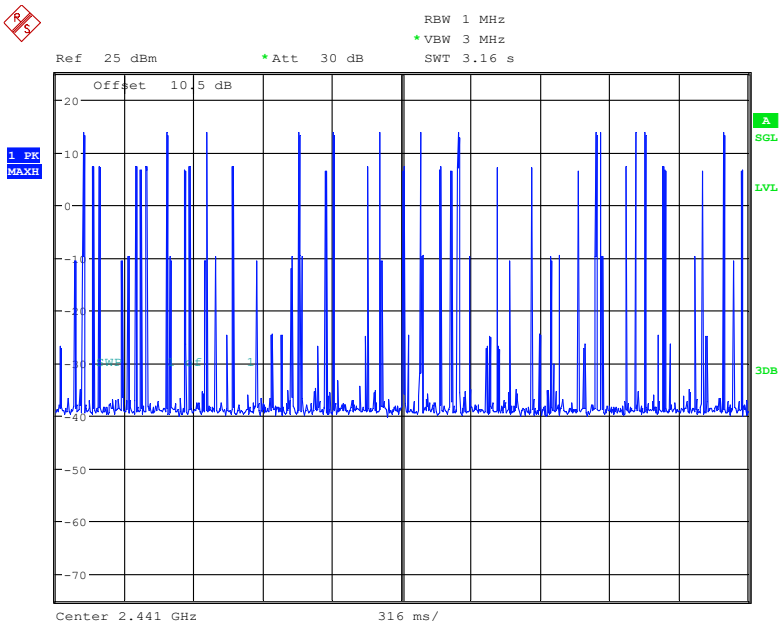
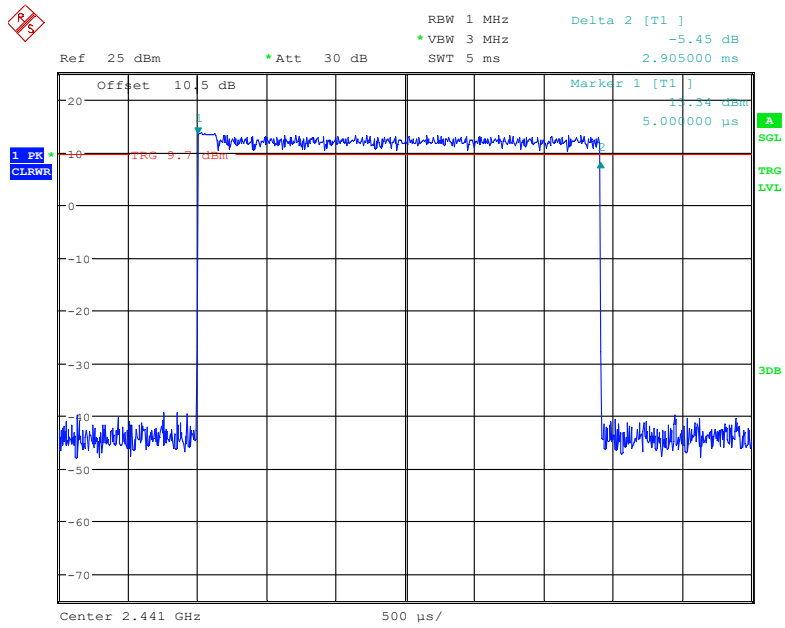
3DH5



Date: 24.OCT.2022 19:13:35



Date: 24.OCT.2022 19:13:54

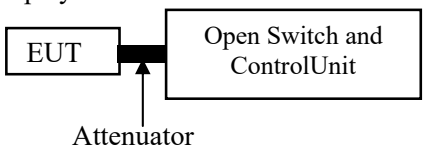
FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

Applicable Standard

According to §15.247(b) (1), 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. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

Test Procedure

1. Place the EUT on a bench and set in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



Note: the Open Switch and ControlUnit has a built-in power sensor.

Test Data

Environmental Conditions

Temperature:	28℃
Relative Humidity:	56%
ATM Pressure:	101.0 kPa

The testing was performed by Cat Kang on 2022-11-09.

EUT operation mode: Transmitting

Test Result: Compliant.

Mode	Channel	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)
BDR (GFSK)	Low	2402	12.83	21
	Max. Channel	2424	13.81	21
	Middle	2441	13.75	21
	High	2480	9.66	21
EDR (π/4-DQPSK)	Low	2402	12.19	21
	Max. Channel	2429	13.92	21
	Middle	2441	13.71	21
	High	2480	9.72	21
EDR (8DPSK)	Low	2402	11.95	21
	Max. Channel	2424	13.63	21
	Middle	2441	13.55	21
	High	2480	9.60	21

FCC §15.247(d) & RSS-247 § 5.5 - BAND EDGES TESTING

Applicable Standard

According to FCC §15.247(d).

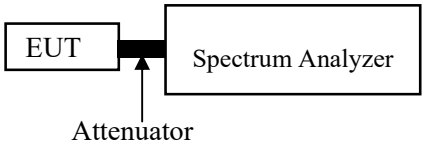
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

According to RSS-247 § 5.5.

In any 100 kHz 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 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(e), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.



Test Data

Environmental Conditions

Temperature:	25~27.1 ℃
Relative Humidity:	57~58 %
ATM Pressure:	101.0 kPa

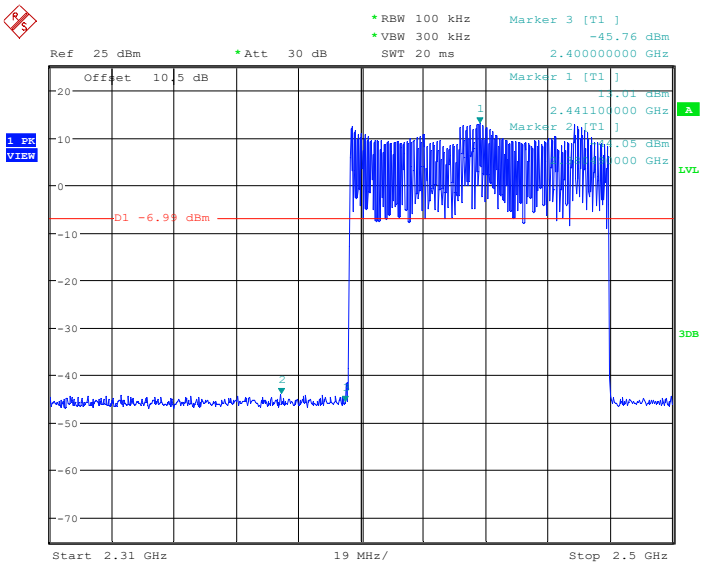
The testing was performed by Cat Kang on 2022-10-24.

EUT operation mode: Transmitting

Test Result: Pass

Please refer to following plots

BDR (GFSK): Band Edge-Left Side Hopping



Date: 24.OCT.2022 18:54:56

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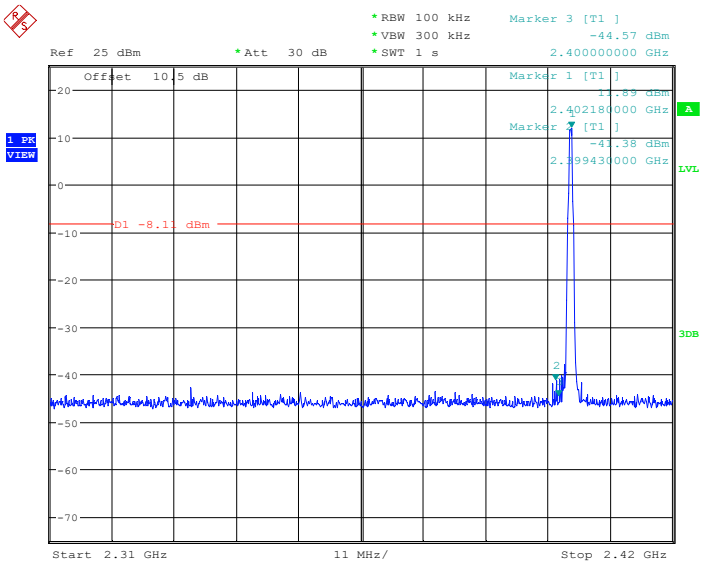
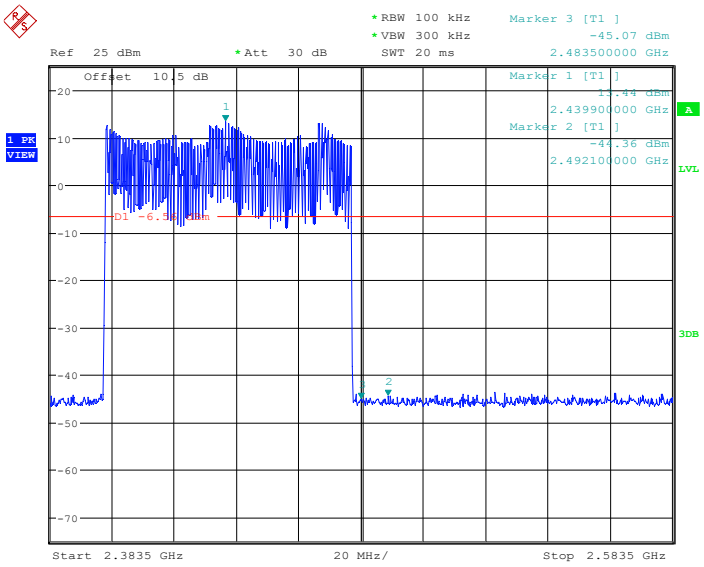


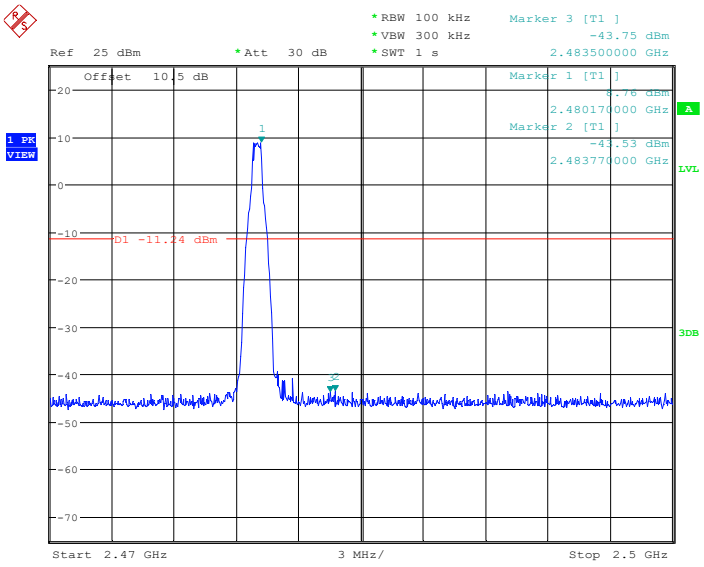
Date: 24.OCT.2022 18:18:54

BDR (GFSK): Band Edge-Right Side Hopping



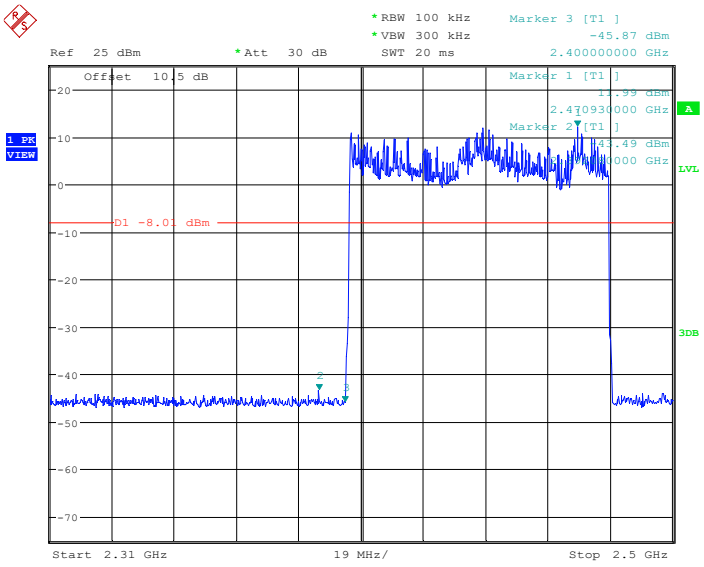
Date: 24.OCT.2022 18:57:08

Single



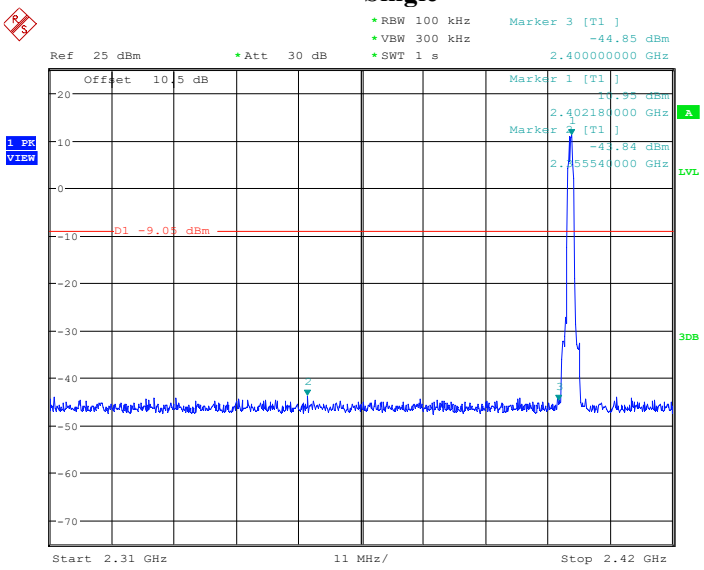
Date: 24.OCT.2022 18:40:29

EDR (π/4-DQPSK): Band Edge-Left Side Hopping



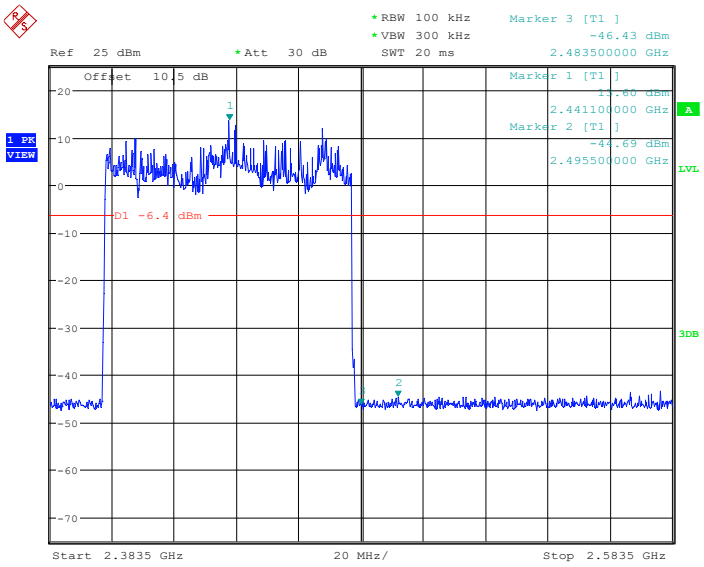
Date: 24.OCT.2022 19:07:25

Single



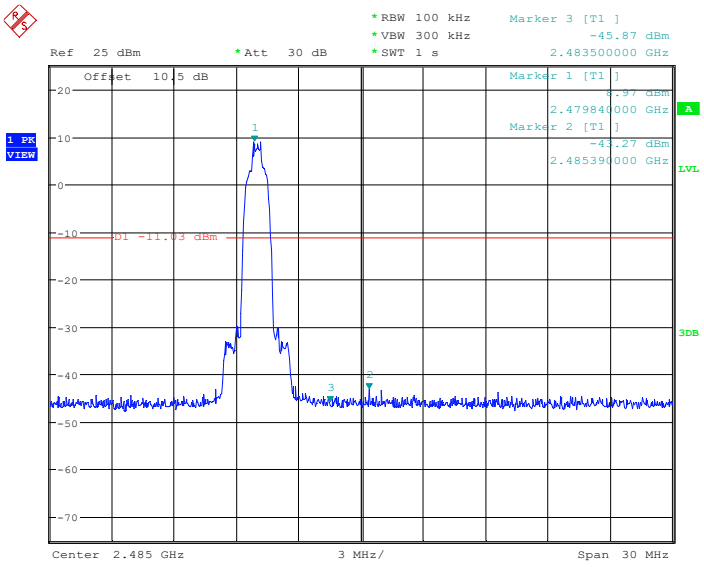
Date: 24.OCT.2022 18:21:56

EDR (π/4-DQPSK): Band Edge-Right Side Hopping



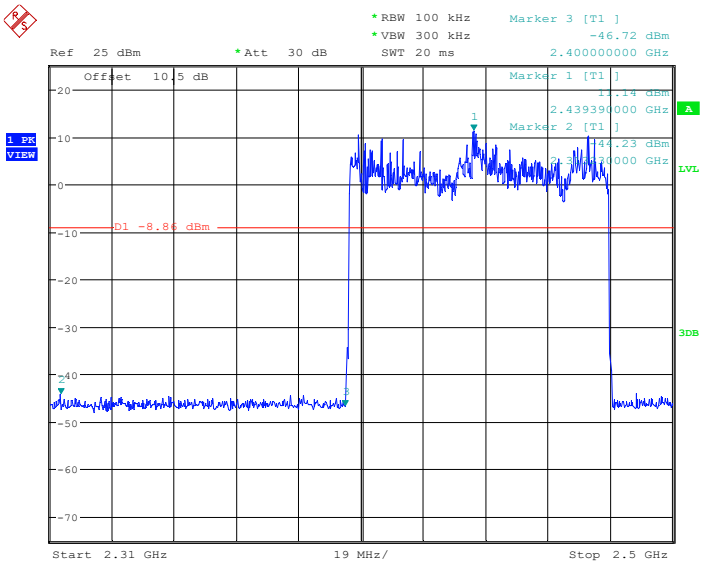
Date: 24.OCT.2022 19:08:24

Single



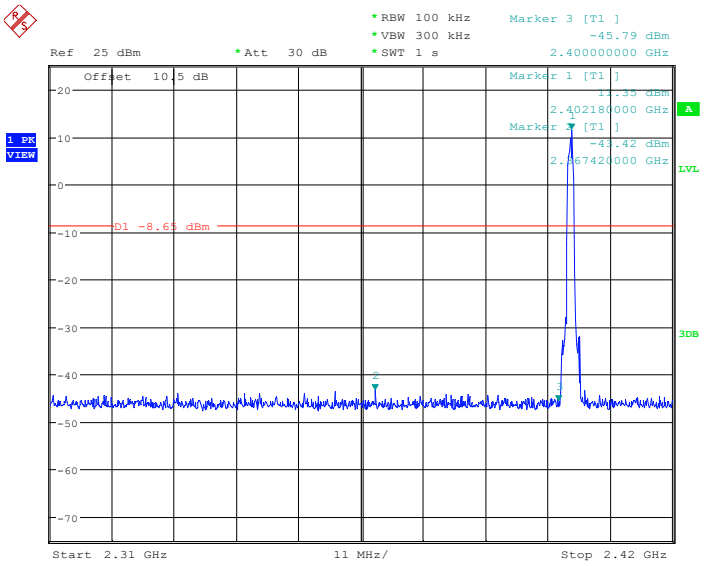
Date: 24.OCT.2022 18:43:40

EDR (8DPSK): Band Edge-Left Side Hopping



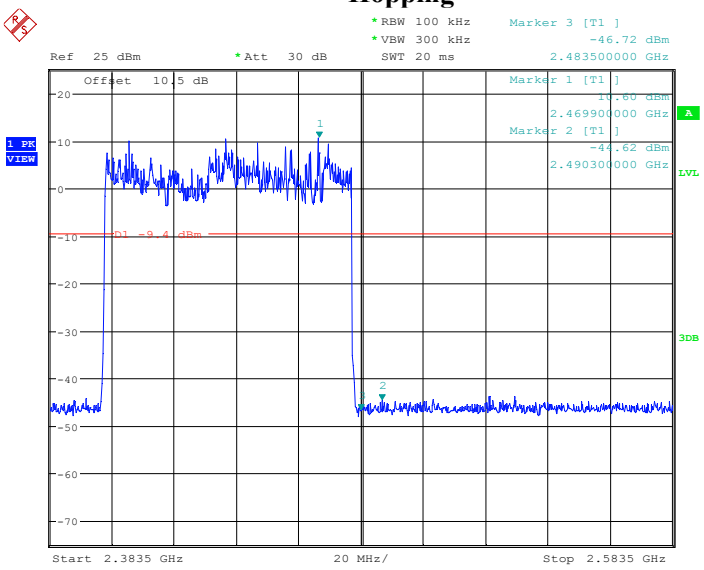
Date: 24.OCT.2022 19:14:52

Single



Date: 24.OCT.2022 18:24:49

EDR (8DPSK): Band Edge-Right Side Hopping



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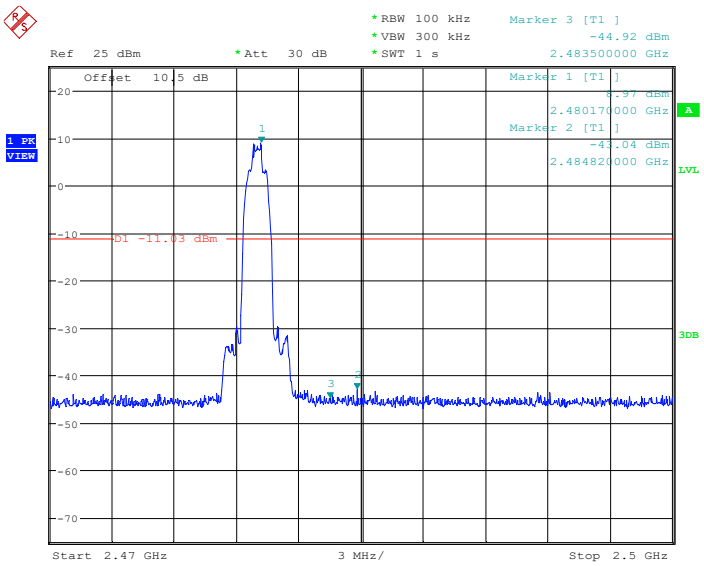
Single



Date: 24.OCT.2022 18:46:41

******* END OF REPORT *******