TEST REPORT

Applicant Name :	Shenzhen Huion Trend Technology Co., Ltd.
Address :	Huion Science and Technology Park, Keji 1st Road, Bao'an District, Shenzhen China
Report Number :	RA230103-00156E-RF-00A
FCC ID:	2A8IG-D227

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	Creative Pen Computer
Model No.:	KS2401
Multiple Model(s) No.:	KS2201,KT2201,KS2402,KS2701
Trade Mark:	HUION
Date Received:	2023/01/03
Report Date:	2023/04/12

Test Result:	Pass*

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

Prepared and Checked By:

Andy Yu
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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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RA230103-00156E-RF-00A	Original Report	2023/04/12

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Creative Pen Computer
Tested Model	KS2401
Multiple Models	KS2201,KT2201,KS2402,KS2701(model difference see product declaration letter of similarity)
Frequency Range	Bluetooth: 2402~2480MHz
Transmit Peak Power	11.90dBm
Modulation Technique	Bluetooth: GFSK, π/4-DQPSK, 8DPSK
Antenna Specification*	4.88dBi (provided by the applicant)
Voltage Range	DC 19V from adapter
Sample serial number	1X74-1 for Conducted and Radiated Emissions Test 1X79-1 for RF Conducted Test (Assigned by ATC)
Sample/EUT Status	Good condition
Adapter Information	Model: FSP270-RBAN3 Input: AC 100-240V,50/60Hz,3.5A Output: DC 19.0V,14.21A,270.0W

Objective

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

Each test item follows test standards and with no deviation.

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
Audio Frequency Response		0.1dB
Low Pass Filter Response		1.2dB
Modulation Limiting		1%
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 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 5077A.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

EUT Exercise Software

"WCN_Comb_Tool"* exercise software was used to the EUT tested and the power level is Default*. The software and power level was provided by the applicant.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

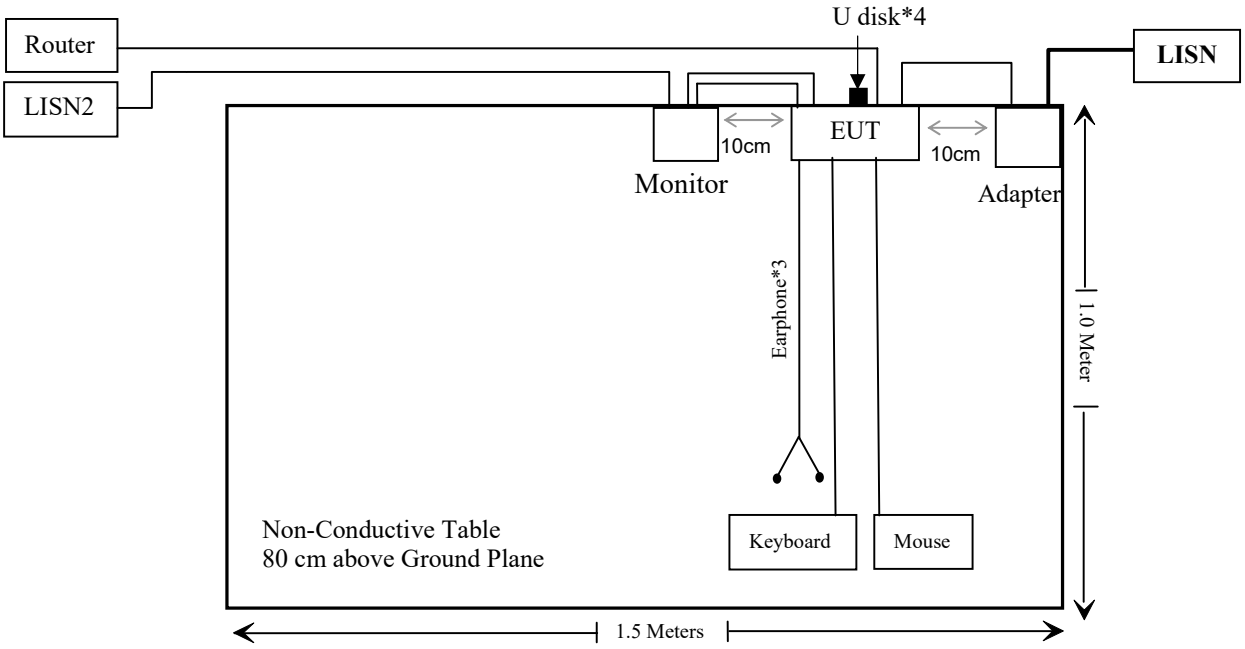
Manufacturer	Description	Model	Serial Number
Teda	Router	WS5100	A4933FEF1D01
Unknown	Earphone*3	Unknown	Unknown
Unknown	U disk *4	Unknown	Unknown
DELL	Monitor	RVE A00	506250042400R
DELL	Keyboard	Unknown	Unknown
DELL	Mouse	Unknown	Unknown

External I/O Cable

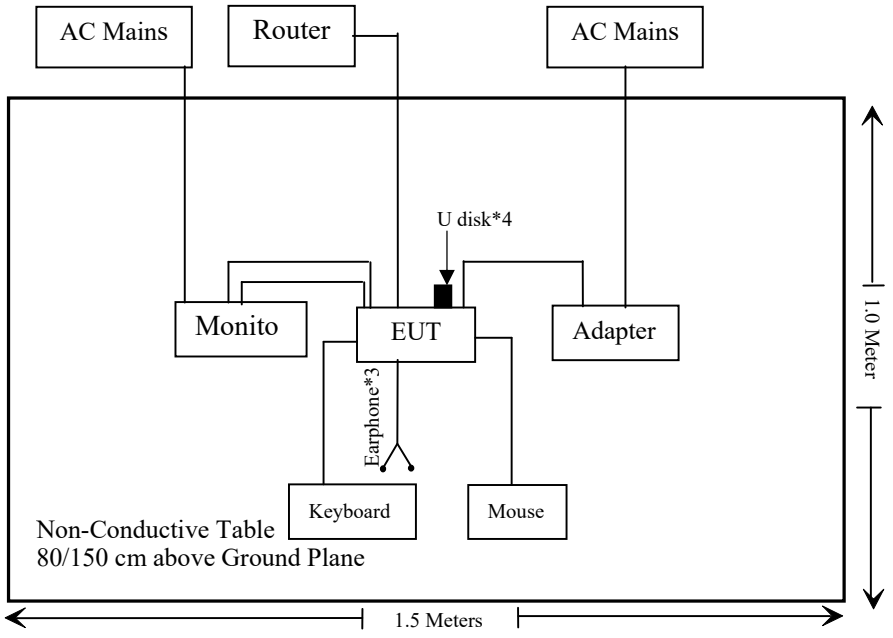
Cable Description	Length (m)	From/Port	To
Un-shielded detachable RJ45 cable	8.0	EUT	Router
Unshielded Detachable DC cable	1.5	Adapter	EUT
Shielded detachable HDMI cable	2.0	EUT	Monitor
Shielded detachable DVI cable	2.0	EUT	Monitor
Unshielded Detachable AC cable	1.0	Adapter	AC Mains/ LISN
Unshielded Detachable USB cable	1.2	EUT	Keyboard
Unshielded Detachable USB cable	1.2	EUT	Mouse
Unshielded Detachable AC cable	1.5	Monitor	LISN2

Block Diagram of Test Setup

For conducted emission



For Radiation emission



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §2.1091	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 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 19821b (V9)					
Radiated emission 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	9120D-1067	2022/11/30	2025/11/29
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2022/12/26	2025/12/25
Radiated Emission Test Software: e3 19821b (V9)					
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
RF Conducted Test					
Rohde&Schwarz	Spectrum Analyzer	FSV-40	101495	2022/11/25	2023/11/24
Agilent	USB wideband power sensor	U2021XA	MY54250003	2022/06/27	2023/06/26
WEINSCHEL	10dB Attenuator	5324	AU 3842	2022/11/25	2023/11/24

*** 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) &§2.1091- RF EXPOSURE

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

General frequency and separation-distance dependent MPE-based effective radiated power(ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemptionfrom further evaluation from 300 kHz through 100 GHz.

Table 1 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.

Ris the minimum separation distance in meters
f = frequency in MHz

For multiple RF sources: Multiple RF sources are exempt if:

in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation:

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c} \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

Result

Mode	Frequency (MHz)	Antenna Gain		Tune up conducted power		ERP		Evaluation Distance (m)	ERP Limit (W)
		(dBi)	(dBd)	(dBm)	(W)	(dBm)	(W)		
Bluetooth	2402-2480	4.88	2.73	12.0	0.016	14.73	0.030	0.2	0.768
BLE	2402-2480	4.88	2.73	10.5	0.011	13.23	0.021	0.2	0.768
Wi-Fi	2412-2462	4.88	2.73	18.0	0.063	20.73	0.118	0.2	0.768
	5180-5240	4.98	2.83	16.0	0.040	18.83	0.076	0.2	0.768
	5260-5320	4.98	2.83	17.5	0.056	20.33	0.108	0.2	0.768
	5500-5700	4.98	2.83	16.5	0.045	19.33	0.086	0.2	0.768
	5745-5825	4.98	2.83	16.0	0.040	18.83	0.076	0.2	0.768

Note:
1. The tune up conducted power and antenna gain was declared by the applicant.
2: 0dBd=2.15dBi.
3: The Bluetooth/BLE can transmit at same time with 2.4G Wi-Fi or 5G Wi-Fi

Simultaneous transmitting consideration (worst case):

The ratio=ERP_{BT}/ERP+ ERP_{Wi-Fi}/ ERP =0.030/0.768+0.118/0.768=0.193＜1.0, so simultaneous exposure is compliant.

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

Result: Compliance

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 for Bluetooth and the maximum antenna gain is 4.88dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Antenna Type	Antenna Gain	Impedance	Frequency Range
PCB	4.88dBi	50 Ω	2.4~2.5GHz

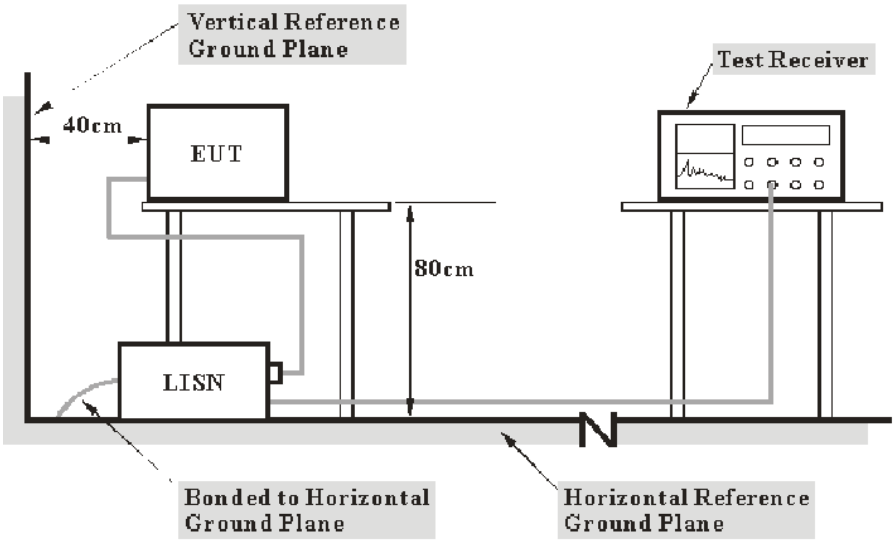
Result: Compliance

FCC §15.207 (a) § 8.8 – 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

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) and Cable Loss. 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, 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

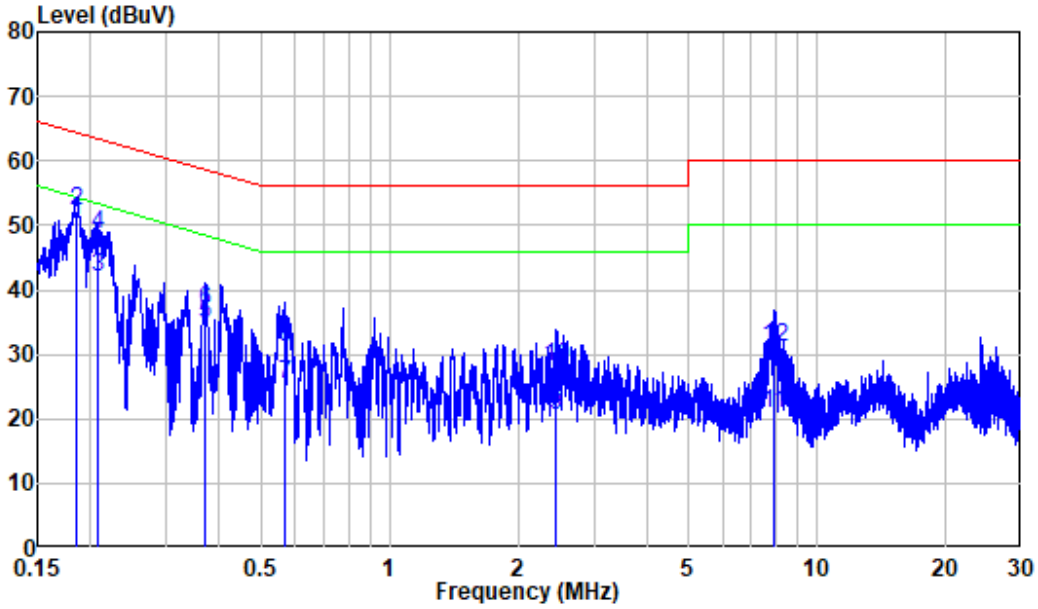
Environmental Conditions

Temperature:	23℃
Relative Humidity:	52%
ATM Pressure:	101.0 kPa

The testing was performed by lipa on 2023-02-01.

EUT operation mode: Transmitting(worst case is 8DPSK high channel)

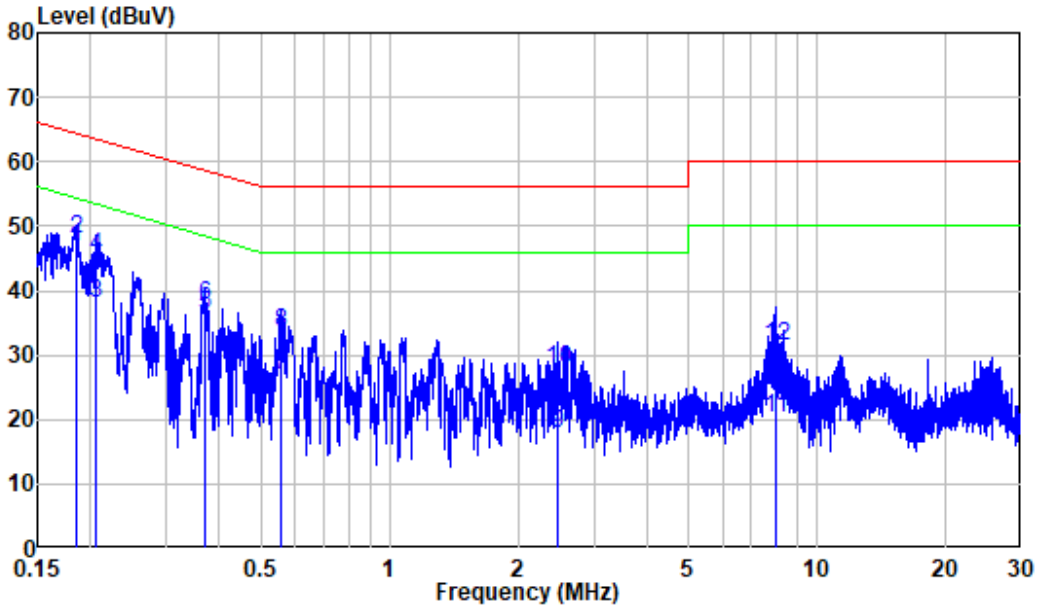
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Job No. : RA230103-00156E-RF
Mode : BT
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.185	9.90	40.92	50.82	54.26	-3.44	Average
2	0.185	9.90	42.24	52.14	64.26	-12.12	QP
3	0.208	9.90	31.94	41.84	53.27	-11.43	Average
4	0.208	9.90	38.61	48.51	63.27	-14.76	QP
5	0.372	9.83	24.88	34.71	48.46	-13.75	Average
6	0.372	9.83	27.13	36.96	58.46	-21.50	QP
7	0.569	9.85	15.60	25.45	46.00	-20.55	Average
8	0.569	9.85	21.15	31.00	56.00	-25.00	QP
9	2.446	9.92	10.66	20.58	46.00	-25.42	Average
10	2.446	9.92	18.05	27.97	56.00	-28.03	QP
11	7.893	9.98	10.72	20.70	50.00	-29.30	Average
12	7.893	9.98	20.98	30.96	60.00	-29.04	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Job No. : RA230103-00156E-RF
Mode : BT
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.185	9.80	36.89	46.69	54.25	-7.56	Average
2	0.185	9.80	38.32	48.12	64.25	-16.13	QP
3	0.205	9.80	28.09	37.89	53.41	-15.52	Average
4	0.205	9.80	35.57	45.37	63.41	-18.04	QP
5	0.370	9.87	26.34	36.21	48.50	-12.29	Average
6	0.370	9.87	27.82	37.69	58.50	-20.81	QP
7	0.558	9.88	17.12	27.00	46.00	-19.00	Average
8	0.558	9.88	23.59	33.47	56.00	-22.53	QP
9	2.472	9.82	8.01	17.83	46.00	-28.17	Average
10	2.472	9.82	18.04	27.86	56.00	-28.14	QP
11	7.983	10.04	10.24	20.28	50.00	-29.72	Average
12	7.983	10.04	21.32	31.36	60.00	-28.64	QP

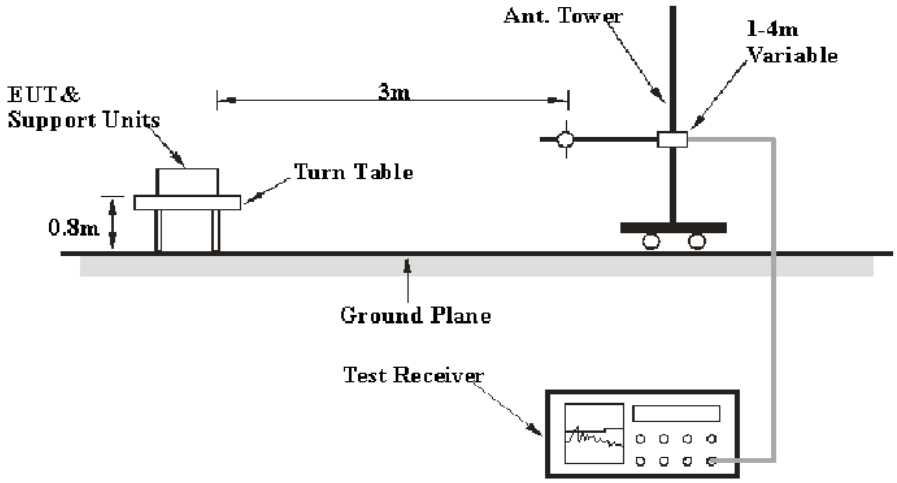
FCC §15.209, §15.205 & §15.247(d)- Spurious Emissions

Applicable Standard

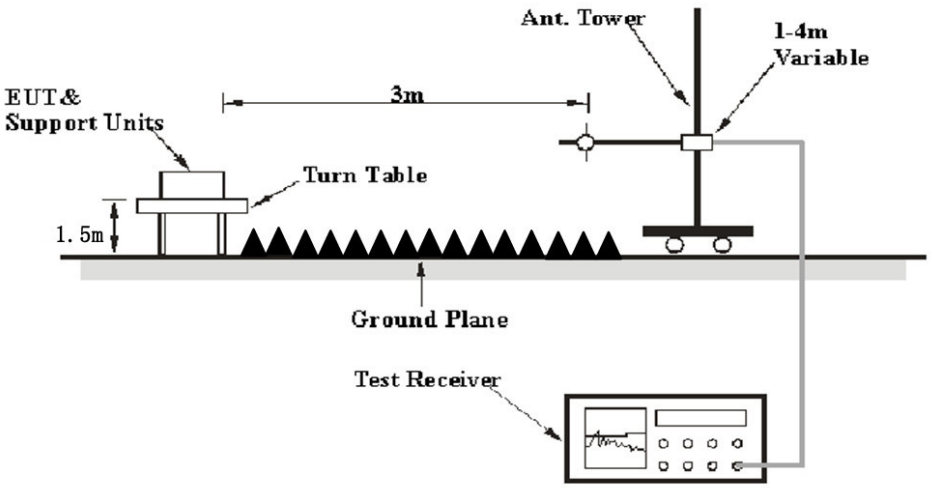
FCC §15.205; §15.209; §15.247(d);

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.

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:	25~25.5℃
Relative Humidity:	52~55%
ATM Pressure:	101.0 kPa

The testing was performed by Jimi Zheng on 2023-02-15 for below 1GHz,and on 2023-02-08 for above 1GHz

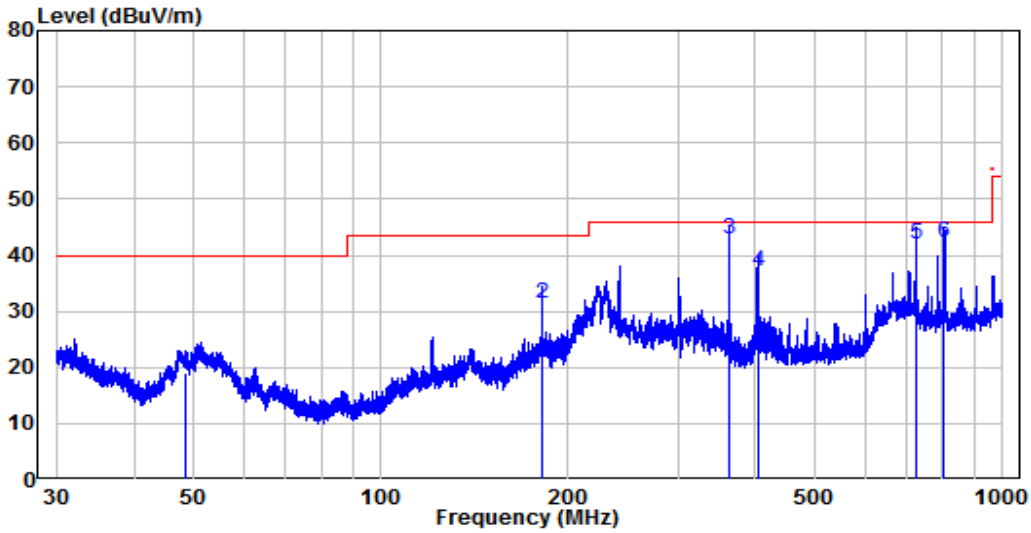
EUT operation mode: Transmitting

Note: Pre-scan in the X,Y and Z axes of orientation, the worst case X-axes of orientation was recorded

Below 1GHz: *(worst case is 8DPSK high channel)*

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

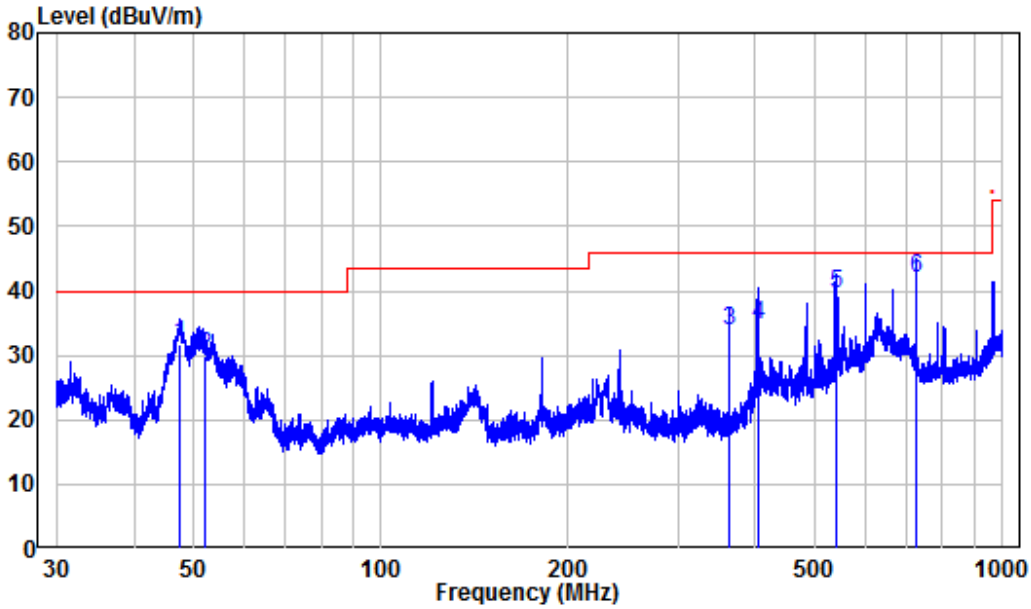
Horizontal



Site : chamber
Condition: 3m Horizontal
Job No. : RA230103-00156E-RF
Test Mode: BT

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	48.46	-15.72	34.65	18.93	40.00	-21.07	QP
2	181.12	-12.20	43.50	31.30	43.50	-12.20	QP
3	362.35	-9.24	52.15	42.91	46.00	-3.09	QP
4	404.84	-7.19	44.30	37.11	46.00	-8.89	QP
5	724.58	-1.59	43.50	41.91	46.00	-4.09	QP
6	806.37	-0.45	42.59	42.14	46.00	-3.86	QP

Vertical



Site : chamber
Condition: 3m Vertical
Job No. : RA230103-00156E-RF
Test Mode: BT

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	47.37	-15.04	46.68	31.64	40.00	-8.36	QP
2	52.03	-16.63	46.56	29.93	40.00	-10.07	QP
3	362.35	-9.24	43.17	33.93	46.00	-12.07	QP
4	404.84	-7.19	42.00	34.81	46.00	-11.19	QP
5	539.95	-4.67	44.26	39.59	46.00	-6.41	QP
6	724.58	-1.59	43.46	41.87	46.00	-4.13	QP

Above 1GHz: (worst case for 8DPSK)

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Factor (dB/m)	Corrected Ampitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
Low Channel 2402MHz									
2310	61.75	PK	310	1.9	H	-7.24	54.51	74	-19.49
2310	62.00	PK	174	1.8	V	-7.24	54.76	74	-19.24
2390	63.45	PK	51	1.9	H	-7.22	56.23	74	-17.77
2390	63.34	PK	270	1.2	V	-7.22	56.12	74	-17.88
4804	60.94	PK	109	1.4	H	-3.51	57.43	74	-16.57
4804	60.19	PK	158	1.4	V	-3.51	56.68	74	-17.32
Middle Channel 2441MHz									
4882	59.12	PK	130	1.8	H	-3.37	55.75	74	-18.25
4882	58.30	PK	93	1.8	V	-3.37	54.93	74	-19.07
High Channel 2480MHz									
2483.5	64.88	PK	10	1.6	H	-7.20	57.68	74	-16.32
2483.5	64.42	PK	335	2.3	V	-7.20	57.22	74	-16.78
2500	63.83	PK	257	1.9	H	-7.18	56.65	74	-17.35
2500	63.72	PK	157	2.4	V	-7.18	56.54	74	-17.46
4960	57.70	PK	64	1.9	H	-3.01	54.69	74	-19.31
4960	58.31	PK	218	1.9	V	-3.01	55.30	74	-18.70

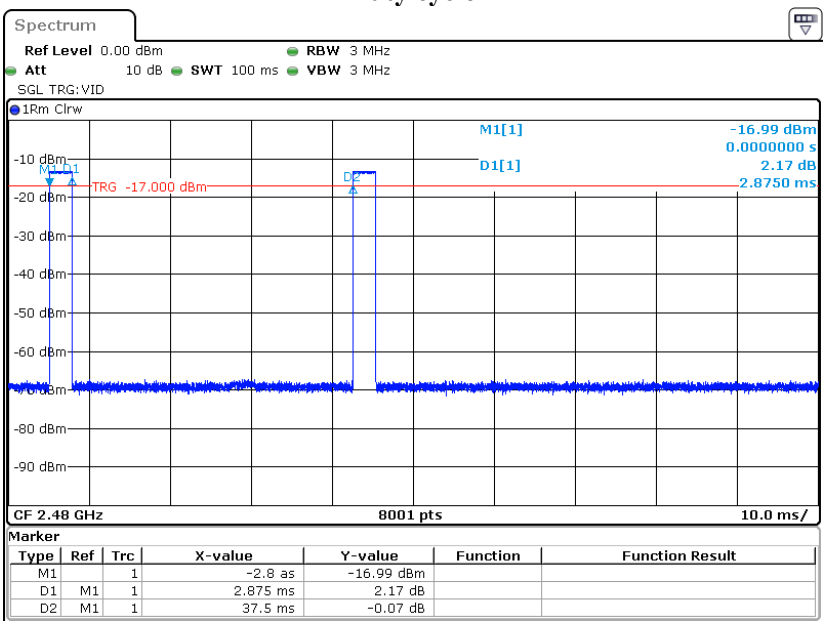
Field Strength of Average							
Frequency (MHz)	Peak Measurement @3m (dBμV/m)	Polar (H/V)	Duty Cycle Correction Factor (dB)	Corrected Ampitude (dBμV/m)	FCC Part 15.247		
					Limit (dBμV/m)	Margin (dB)	Comment
Low Channel 2402MHz							
2310	54.51	H	-24.81	29.70	54	-24.30	Bandedge
2310	54.76	V	-24.81	29.95	54	-24.05	Bandedge
2390	56.23	H	-24.81	31.42	54	-22.58	Bandedge
2390	56.12	V	-24.81	31.31	54	-22.69	Bandedge
4804	57.43	H	-24.81	32.62	54	-21.38	Harmonic
4804	56.68	V	-24.81	31.87	54	-22.13	Harmonic
Middle Channel 2441MHz							
4882	55.75	H	-24.81	30.94	54	-23.06	Harmonic
4882	54.93	V	-24.81	30.12	54	-23.88	Harmonic
High Channel 2480MHz							
2483.5	57.68	H	-24.81	32.87	54	-21.13	Bandedge
2483.5	57.22	V	-24.81	32.41	54	-21.59	Bandedge
2500	56.65	H	-24.81	31.84	54	-22.16	Bandedge
2500	56.54	V	-24.81	31.73	54	-22.27	Bandedge
4960	54.69	H	-24.81	29.88	54	-24.12	Harmonic
4960	55.30	V	-24.81	30.49	54	-23.51	Harmonic

Note:

Absolute Level = Corrected Factor + Reading
Margin = Corrected. Amplitude - Limit
Average level= Peak level+ Duty Cycle Corrected Factor
Other emissions which was 20dB below limit or in noise floor was not recorded.

Worst case duty cycle:
Duty cycle = Ton/100ms = 2.875*2/100=0.0575
Duty Cycle Corrected Factor = 20lg (Duty cycle) = 20lg0.0575 = -24.81

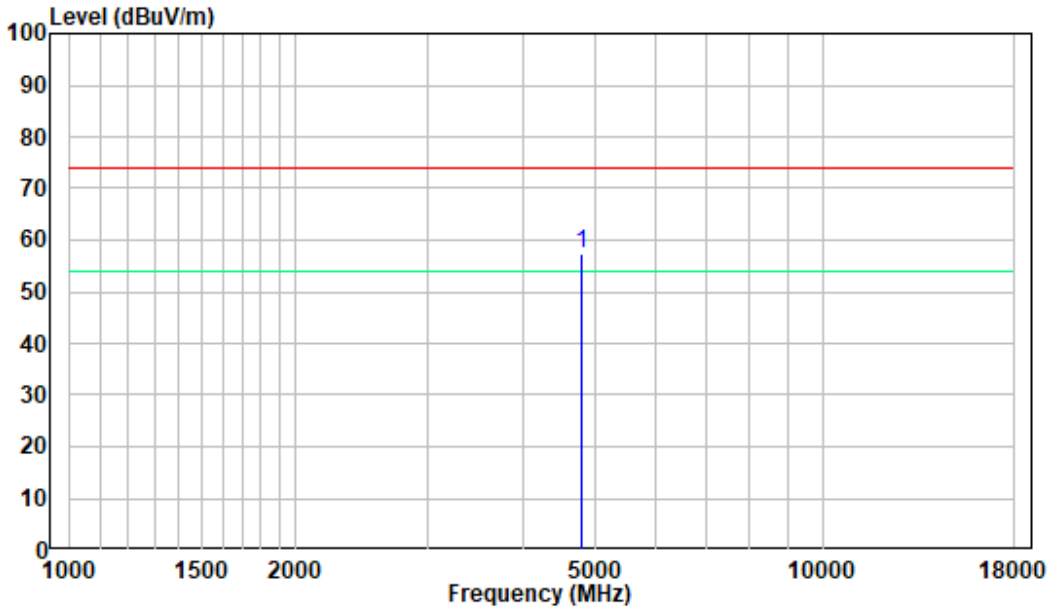
Duty cycle



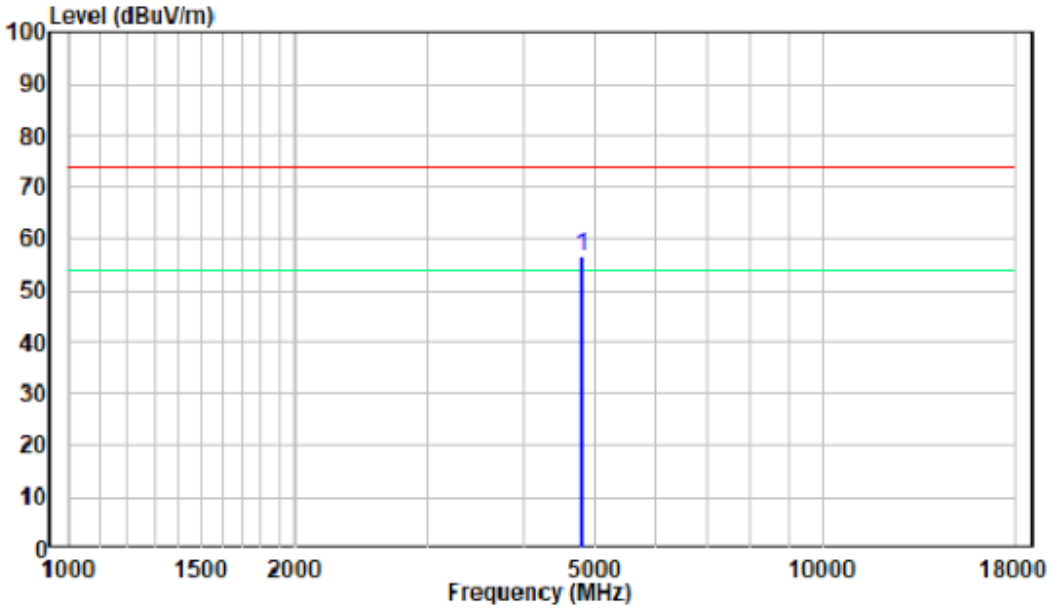
1 GHz - 18 GHz: (Pre-Scan plots)

Low channel

Horizontal



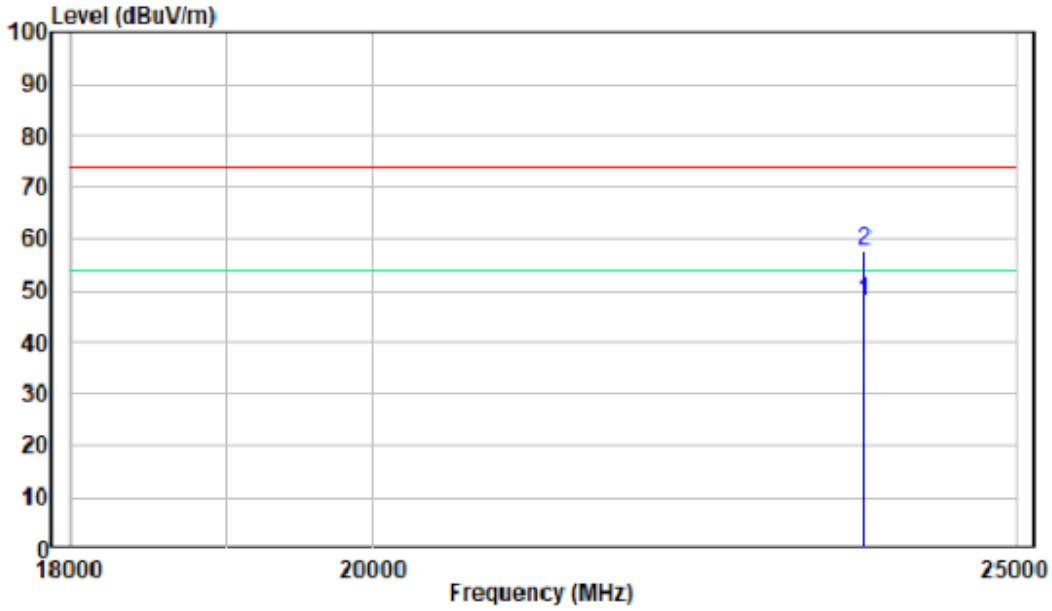
Vertical



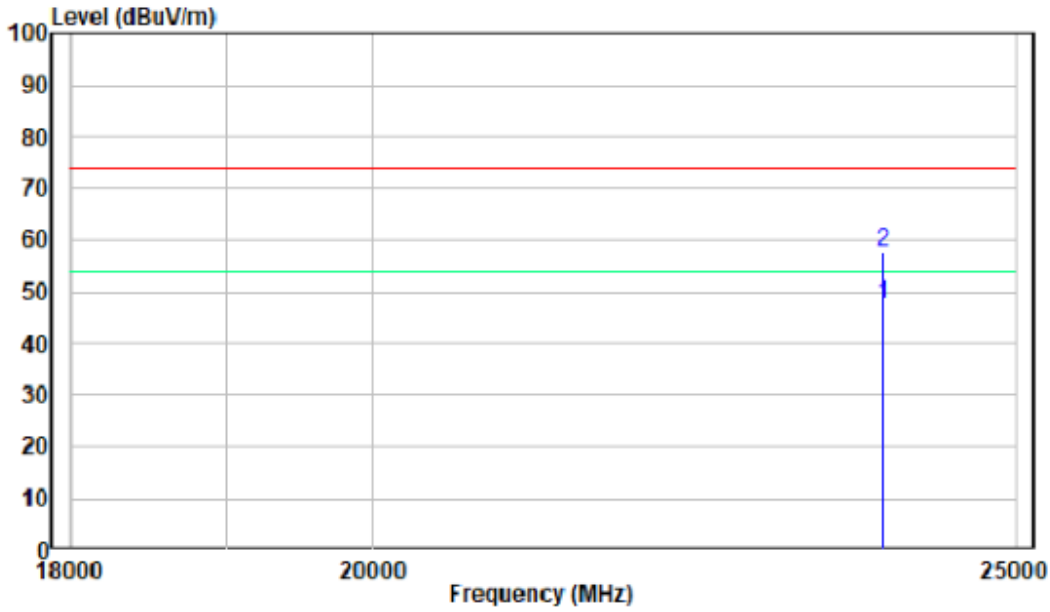
18-25GHz: (Pre-Scan plots)

Low channel

Horizontal



Vertical



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

Applicable Standard

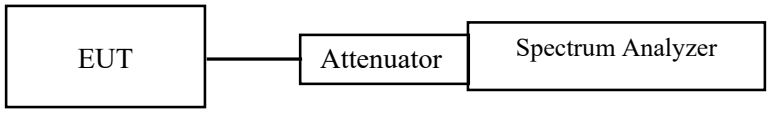
According to FCC §15.247(a) (1):

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

Test Method: ANSI C63.10-2013 Clause 7.8.2

1. Set the EUT in transmitting mode, max hold the channel.
2. Set the adjacent channel of the EUT and max hold another trace.
3. Measure the channel separation.



Test Data

Environmental Conditions

Temperature:	26 ℃
Relative Humidity:	34 %
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2023-02-25.

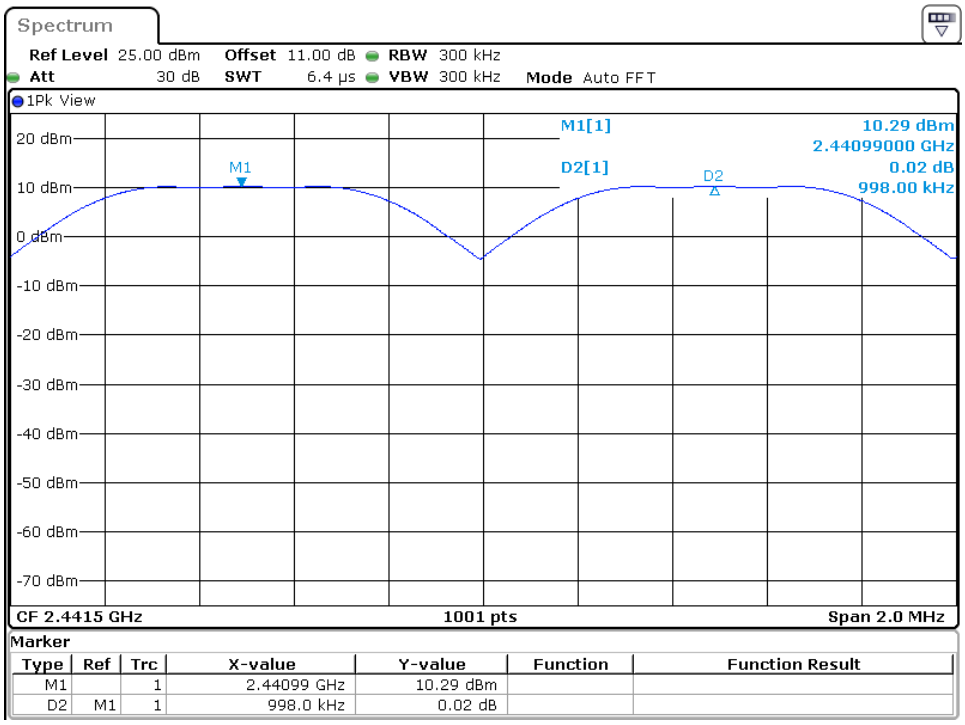
EUT operation mode: Transmitting

Test Result: Pass

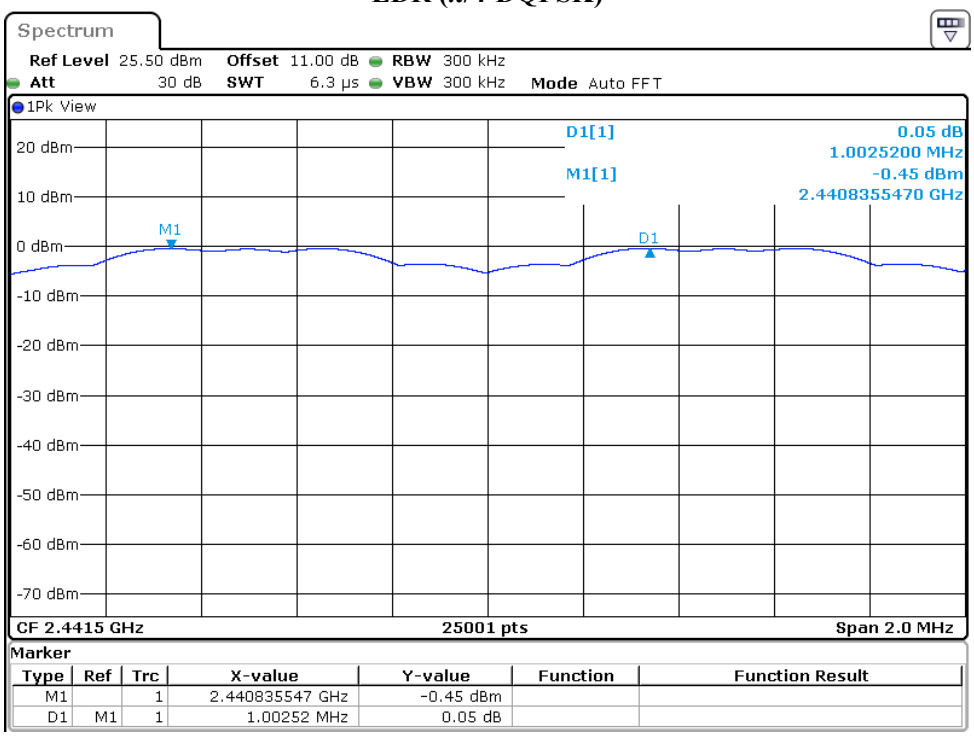
Please refer to following table and plots.

Test Mode	Channel Separation (MHz)	20 dB BW (MHz)	Two-thirds of the 20 dB bandwidth (MHz)	Channel Separation Limit	Result
BDR(GFSK)					
Hopping	0.998	0.864	0.576	> two-thirds of the 20 dB bandwidth	Compliance
EDR(π/4-DQPSK)					
Hopping	1.002	1.263	0.842	> two-thirds of the 20 dB bandwidth	Compliance
EDR(8DPSK)					
Hopping	1.012	1.260	0.840	> two-thirds of the 20 dB bandwidth	Compliance

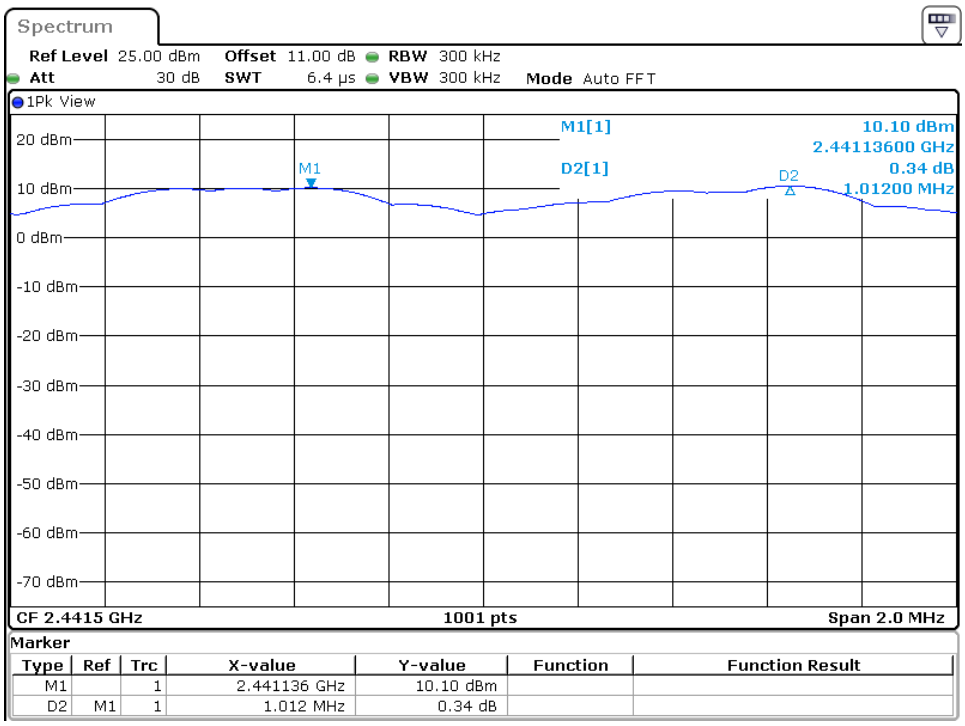
BDR (GFSK)



EDR (π/4-DQPSK)



EDR (8DPSK)



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

Applicable Standard

According to FCC §15.247(a) (1):

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

Test Method: ANSI C63.10-2013 Clause 7.8.7 & Clause 6.9.2

The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:

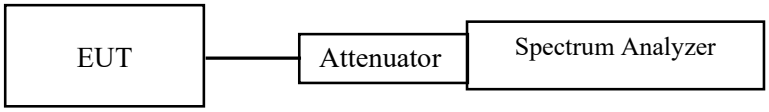
• The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

• 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 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:	26 ℃
Relative Humidity:	34 %
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2023-02-25.

EUT operation mode: Transmitting

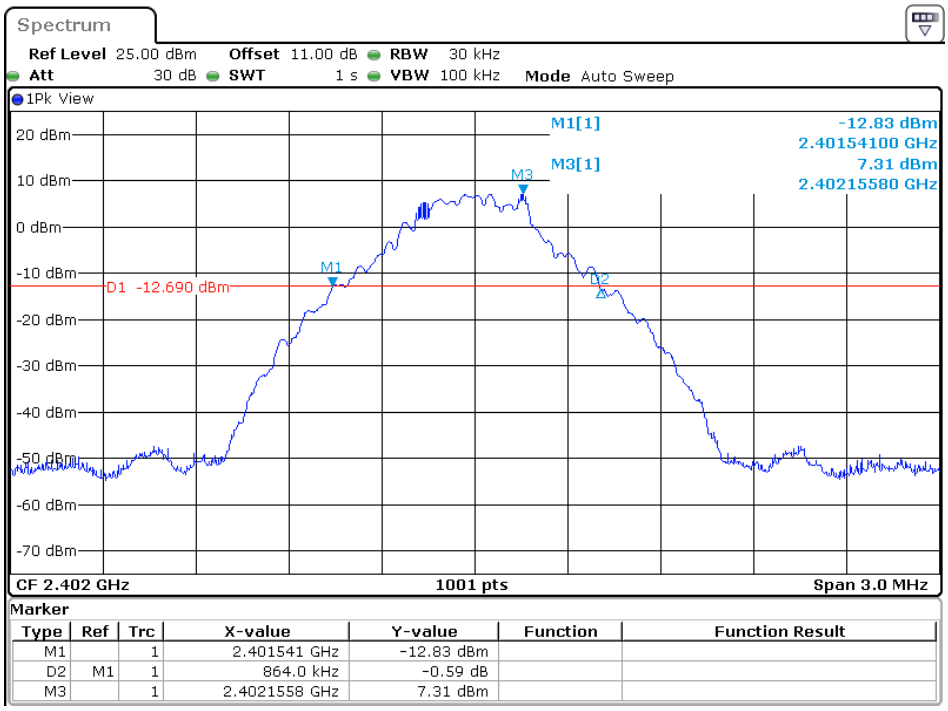
Test Result: Pass

Please refer to following table and plots.

Mode	Channel	Frequency (MHz)	99% Emission Bandwidth (MHz)	20 dB Emission Bandwidth (MHz)
BDR (GFSK)	Low	2402	0.752	0.864
	Middle	2441	0.755	0.864
	High	2480	0.749	0.861
EDR (π/4-DQPSK)	Low	2402	1.142	1.260
	Middle	2441	1.145	1.260
	High	2480	1.139	1.263
EDR (8DPSK)	Low	2402	1.142	1.260
	Middle	2441	1.148	1.257
	High	2480	1.145	1.257

BDR (GFSK):

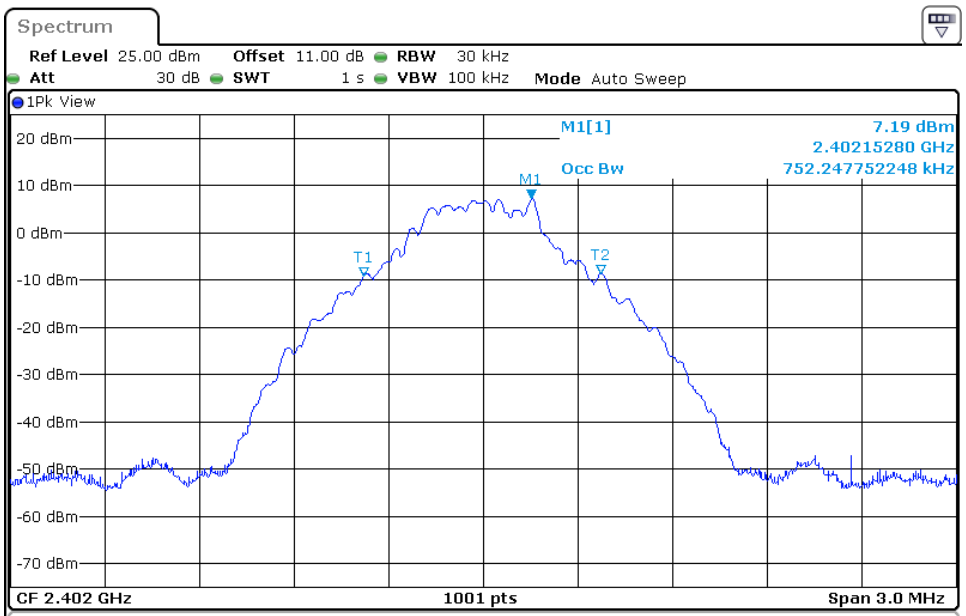
20dB Emission Bandwidth, Low Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.401541 GHz	-12.83 dBm		
D2	M1	1	864.0 kHz	-0.59 dB		
M3		1	2.4021558 GHz	7.31 dBm		

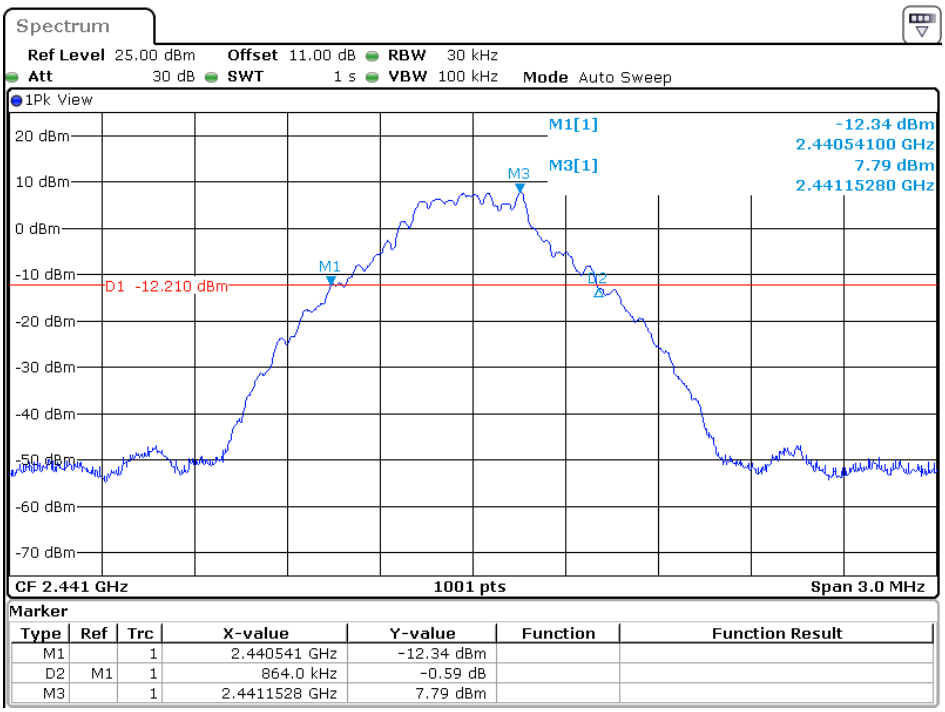
99% Occupied Bandwidth, Low Channel



Marker

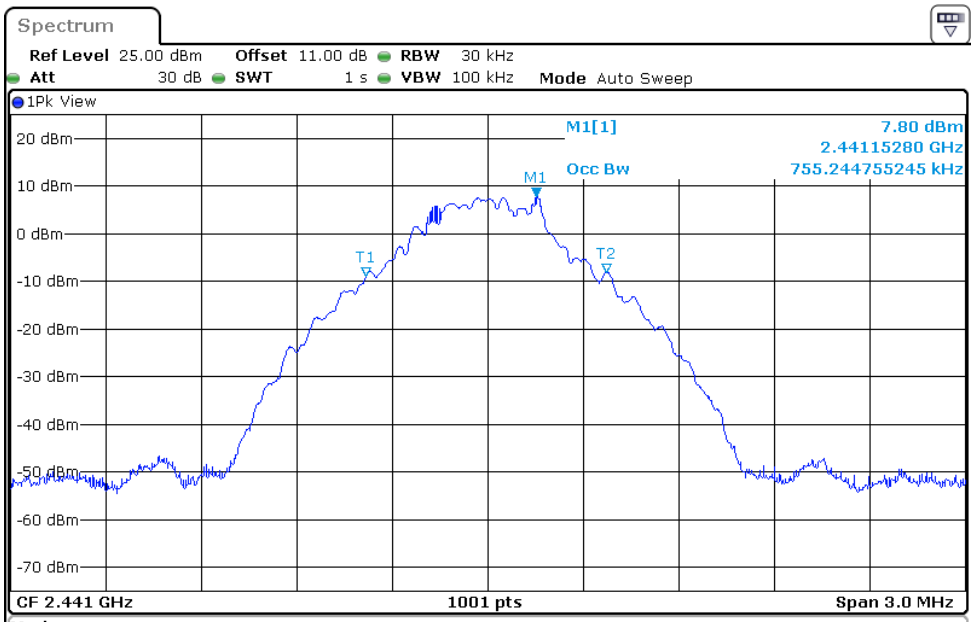
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4021528 GHz	7.19 dBm		
T1		1	2.40161938 GHz	-9.07 dBm	Occ Bw	752.247752248 kHz
T2		1	2.40237163 GHz	-8.70 dBm		

20dB Emission Bandwidth, Middle Channel



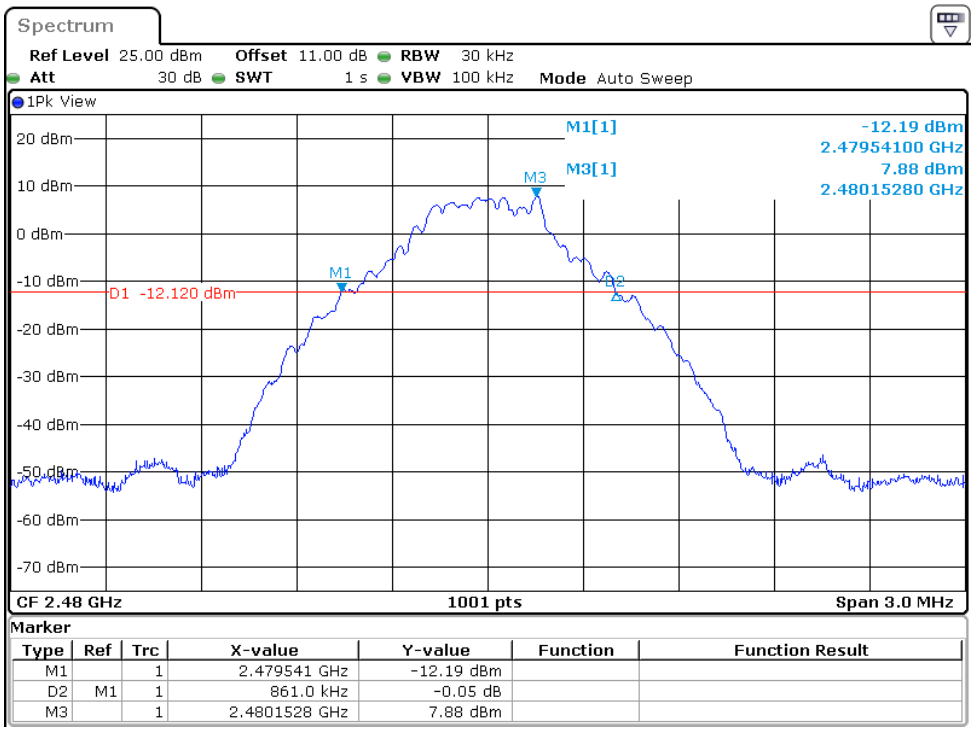
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.440541 GHz	-12.34 dBm		
D2	M1	1	864.0 kHz	-0.59 dB		
M3		1	2.4411528 GHz	7.79 dBm		

99% Occupied Bandwidth, Middle Channel



Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4411528 GHz	7.80 dBm		
T1		1	2.44061638 GHz	-8.91 dBm	Occ Bw	755.244755245 kHz
T2		1	2.44137163 GHz	-8.18 dBm		

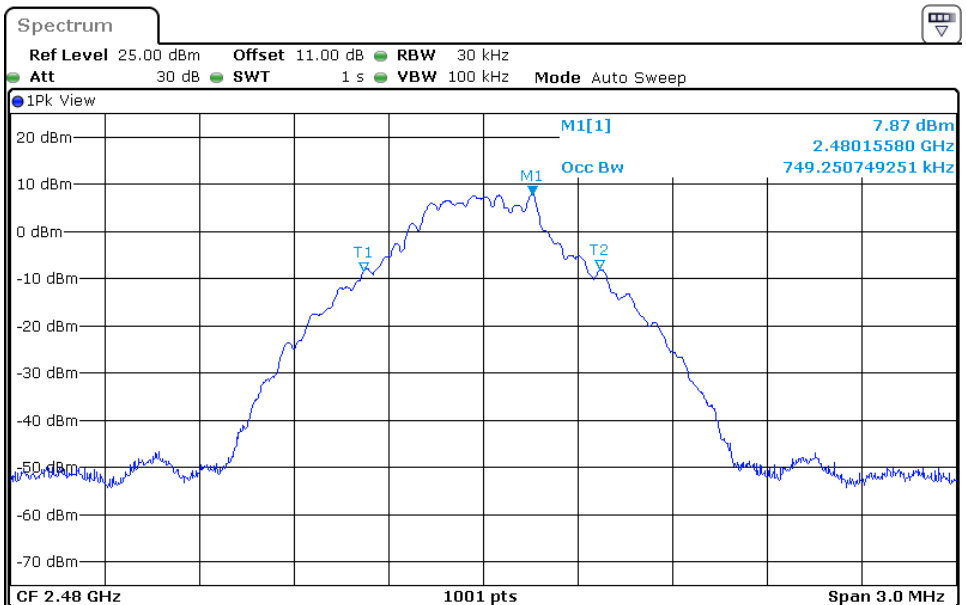
20dB Emission Bandwidth, High Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479541 GHz	-12.19 dBm		
D2	M1	1	861.0 kHz	-0.05 dB		
M3		1	2.4801528 GHz	7.88 dBm		

99% Occupied Bandwidth, High Channel

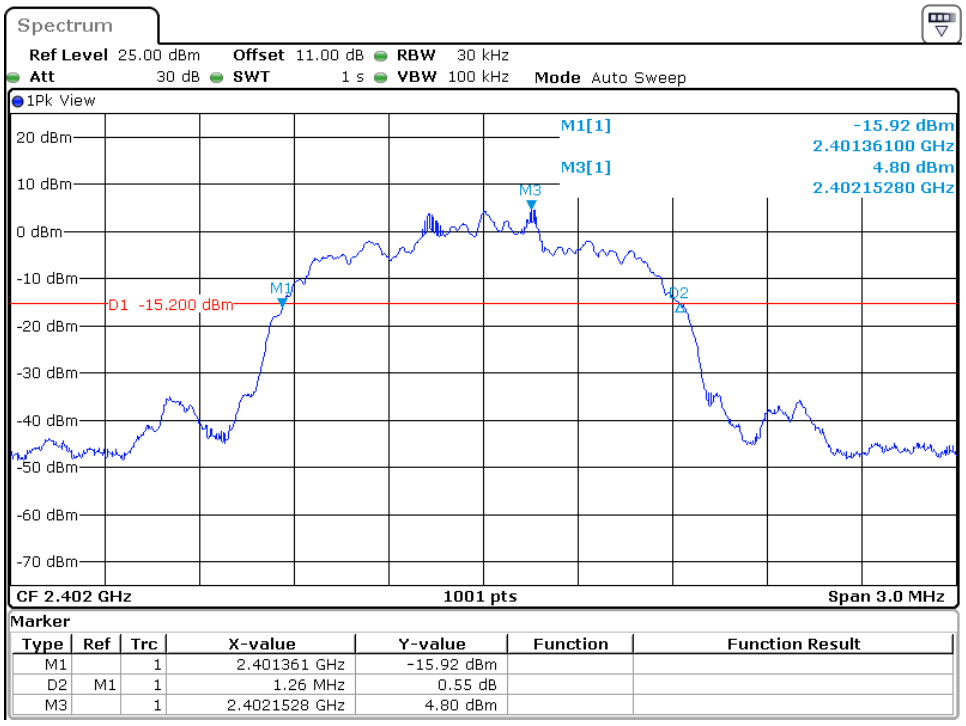


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4801558 GHz	7.87 dBm		
T1		1	2.47961938 GHz	-8.42 dBm	Occ Bw	749.250749251 kHz
T2		1	2.48036863 GHz	-7.99 dBm		

EDR (π/4-DQPSK):

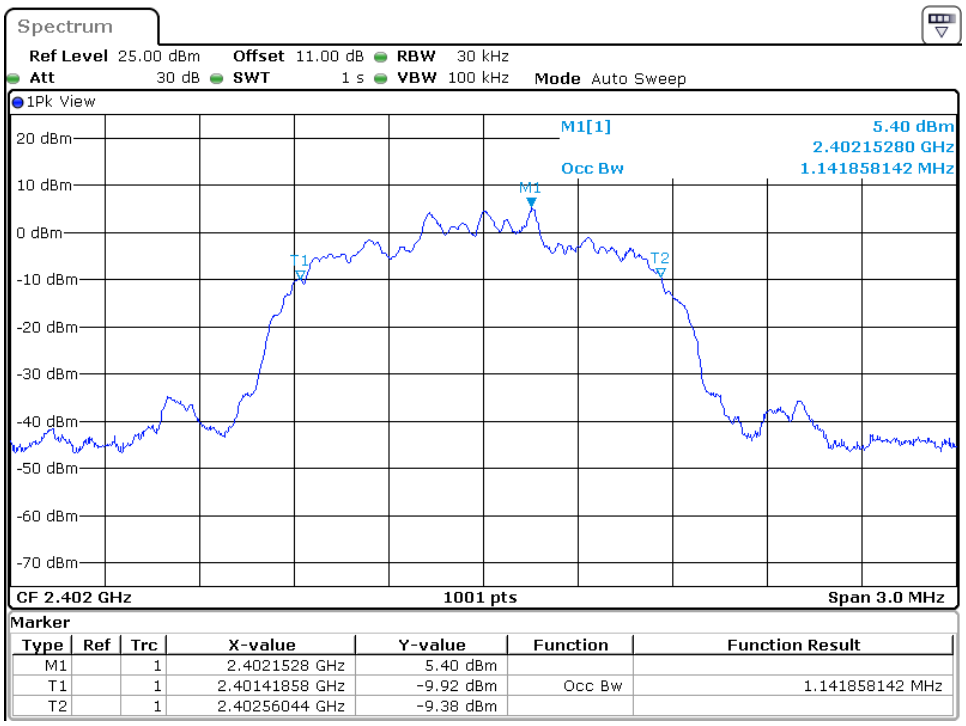
20dB Emission Bandwidth, Low Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.401361 GHz	-15.92 dBm		
D2	M1	1	1.26 MHz	0.55 dB		
M3		1	2.4021528 GHz	4.80 dBm		

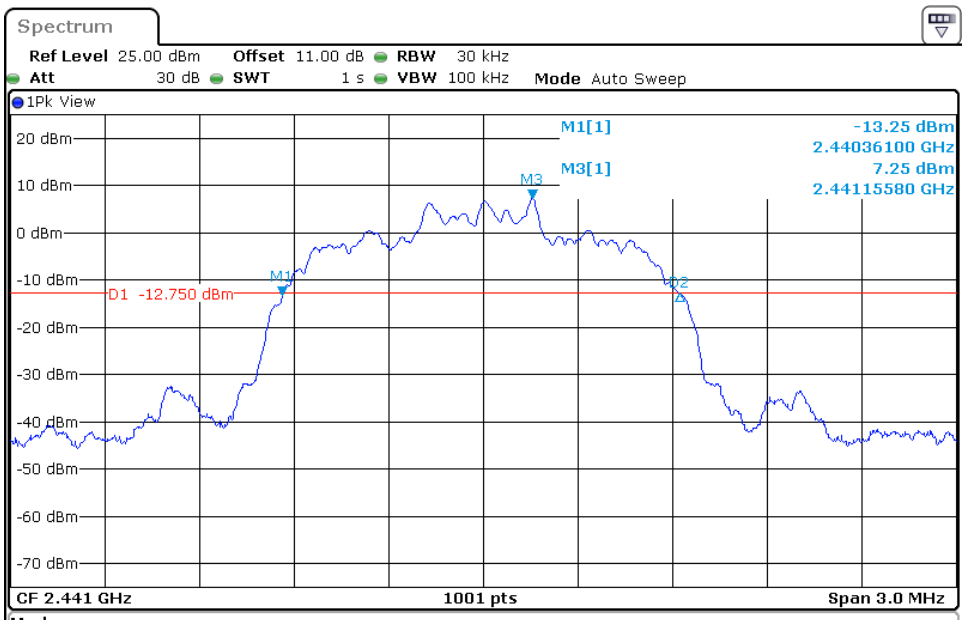
99% Occupied Bandwidth, Low Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4021528 GHz	5.40 dBm		
T1		1	2.40141858 GHz	-9.92 dBm	Occ Bw	1.141858142 MHz
T2		1	2.40256044 GHz	-9.38 dBm		

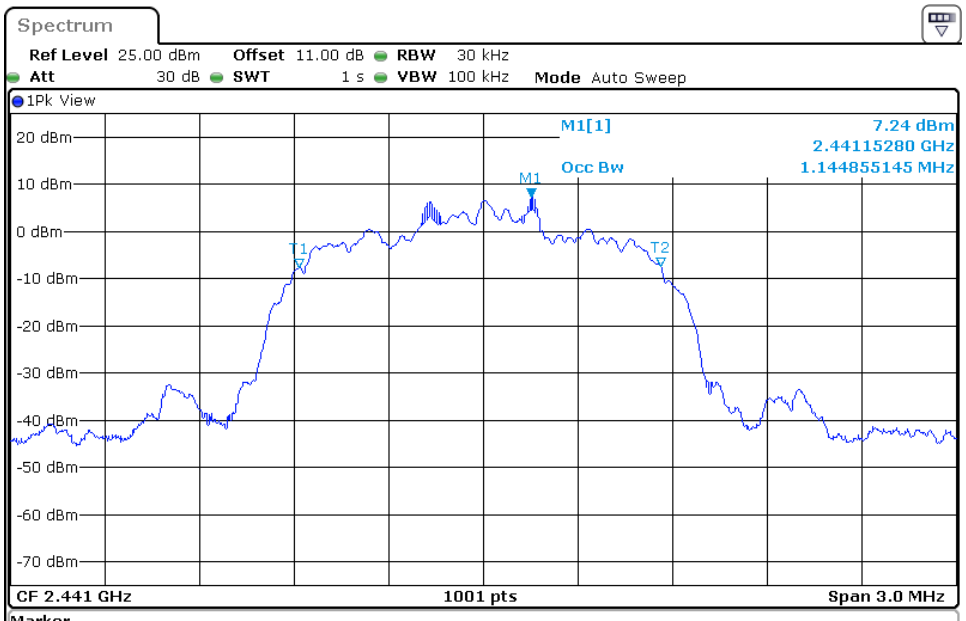
20dB Emission Bandwidth, Middle Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.440361 GHz	-13.25 dBm		
D2	M1	1	1.26 MHz	0.41 dB		
M3		1	2.4411558 GHz	7.25 dBm		

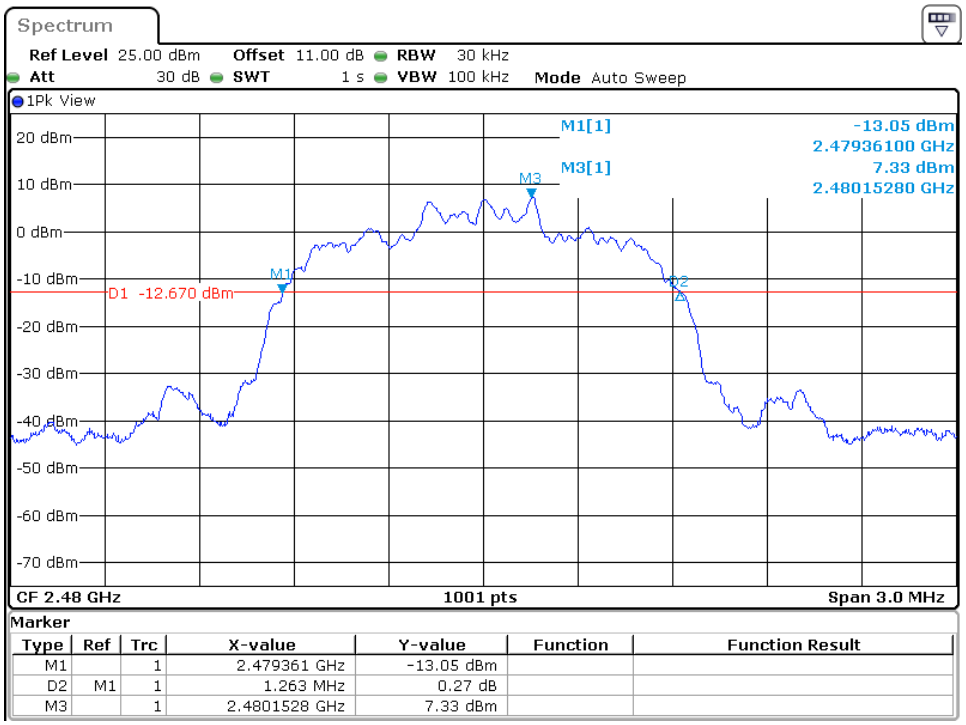
99% Occupied Bandwidth, Middle Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4411528 GHz	7.24 dBm		
T1		1	2.44041558 GHz	-7.73 dBm	Occ Bw	1.144855145 MHz
T2		1	2.44156044 GHz	-7.33 dBm		

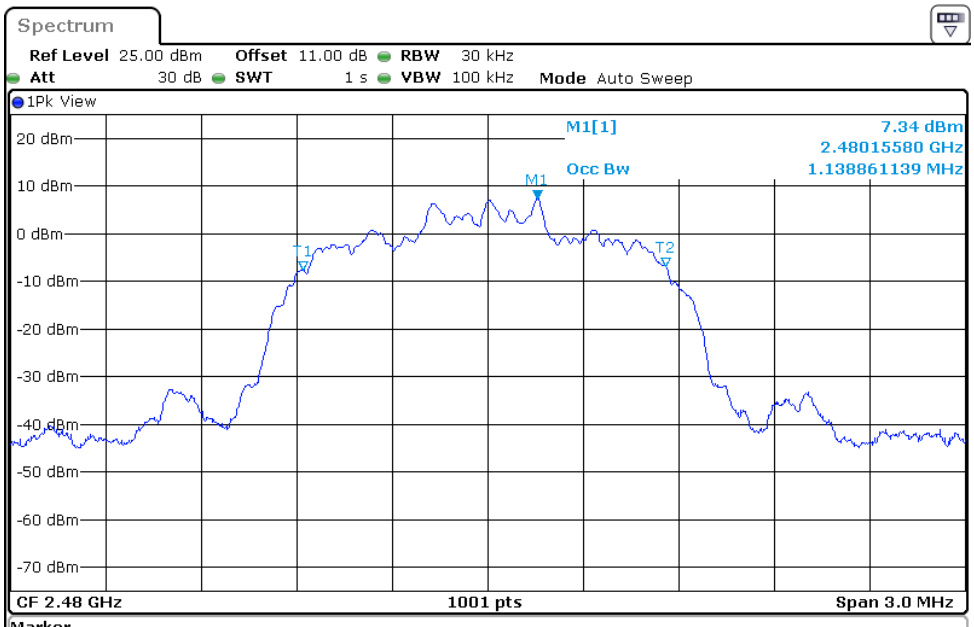
20dB Emission Bandwidth, High Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479361 GHz	-13.05 dBm		
D2	M1	1	1.263 MHz	0.27 dB		
M3		1	2.4801528 GHz	7.33 dBm		

99% Occupied Bandwidth, High Channel

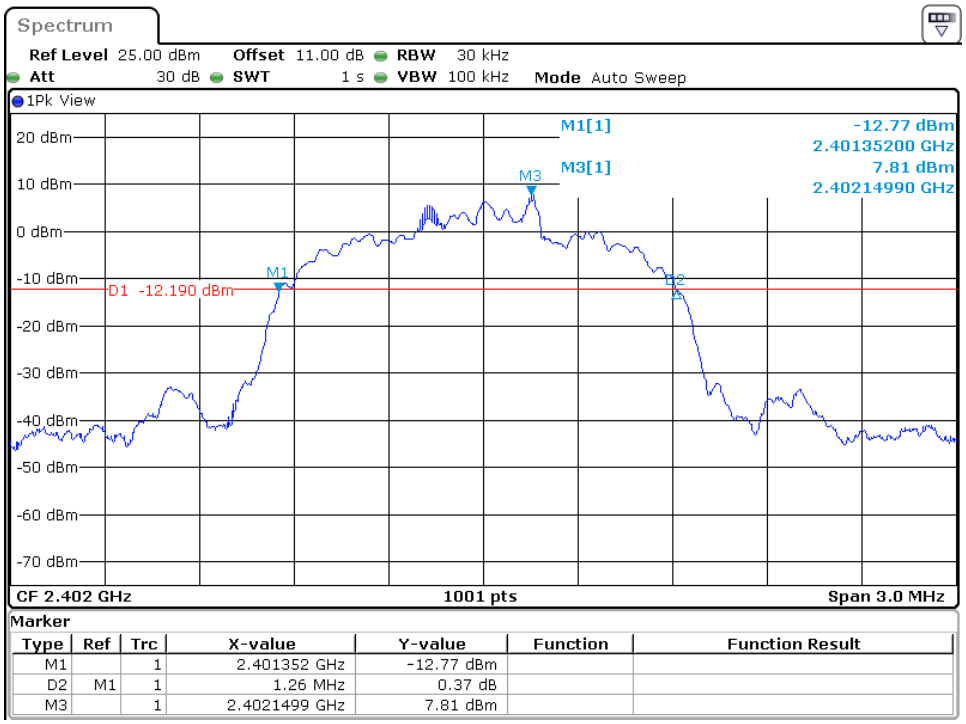


Marker

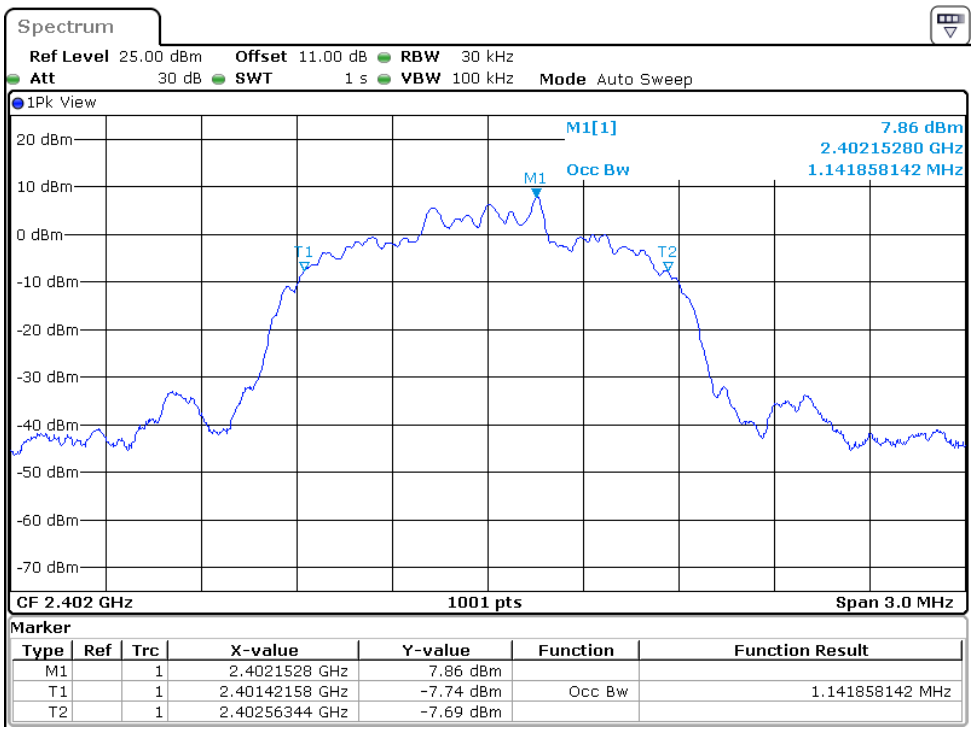
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4801558 GHz	7.34 dBm		
T1		1	2.47941858 GHz	-7.54 dBm	Occ Bw	1.138861139 MHz
T2		1	2.48055744 GHz	-6.90 dBm		

EDR (8DPSK):

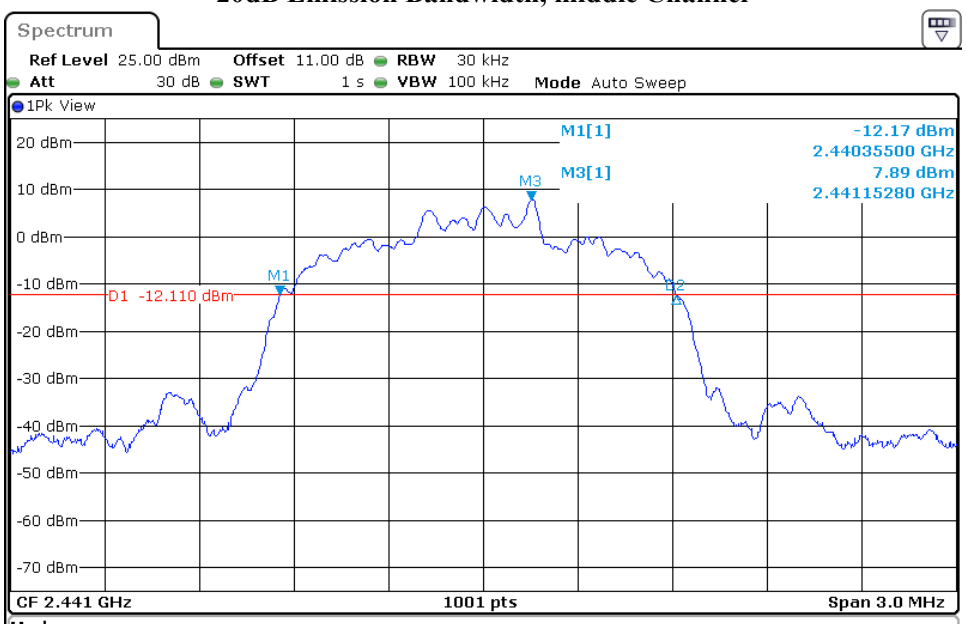
20dB Emission Bandwidth, Low Channel



99% Occupied Bandwidth, Low Channel



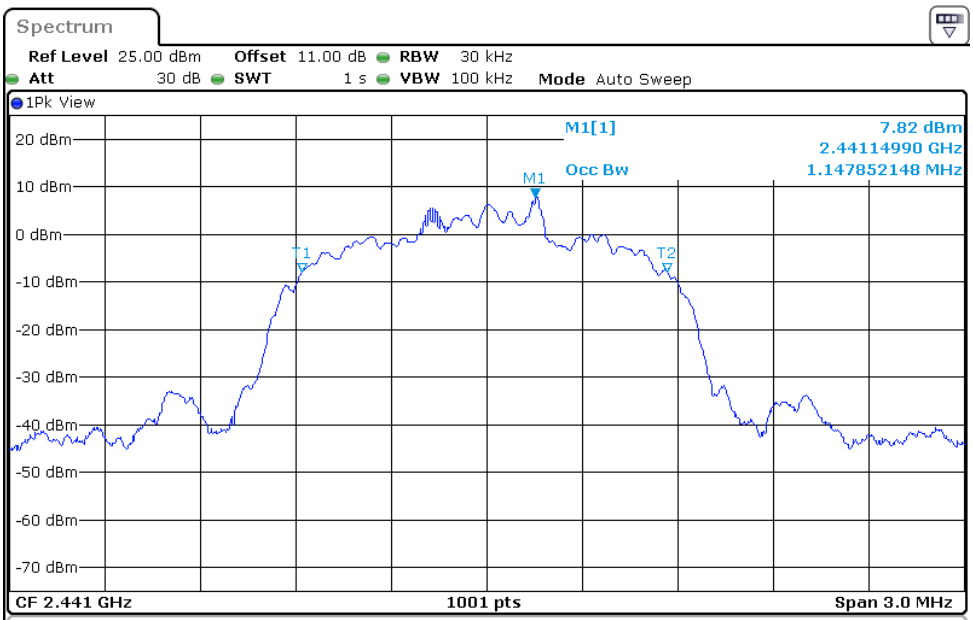
20dB Emission Bandwidth, middle Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.440355 GHz	-12.17 dBm		
D2	M1	1	1.257 MHz	-0.23 dB		
M3		1	2.4411528 GHz	7.89 dBm		

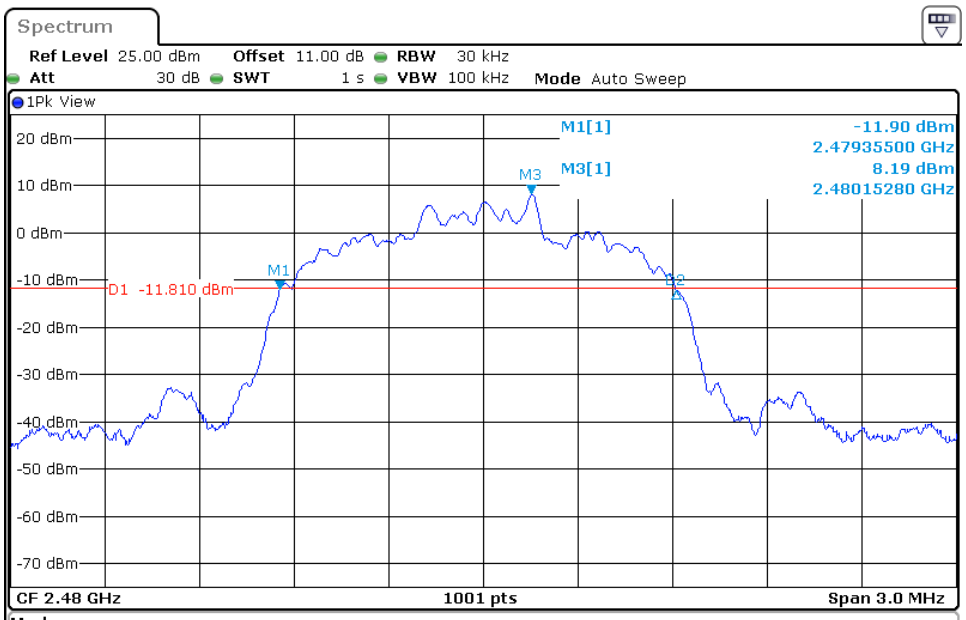
99% Occupied Bandwidth, Middle Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4411499 GHz	7.82 dBm		
T1		1	2.44041858 GHz	-7.93 dBm	Occ Bw	1.147852148 MHz
T2		1	2.44156643 GHz	-7.88 dBm		

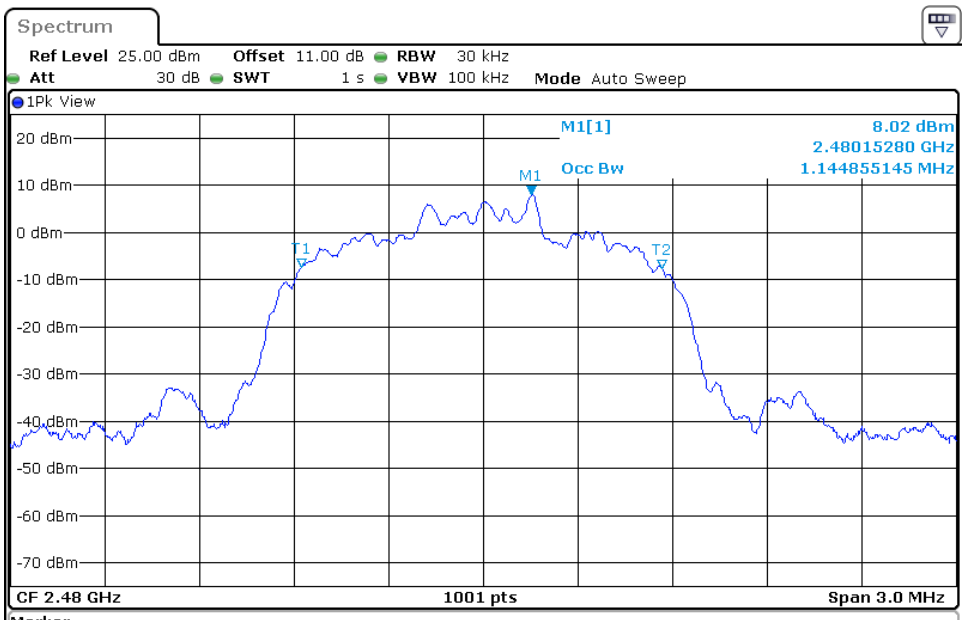
20dB Emission Bandwidth, High Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479355 GHz	-11.90 dBm		
D2	M1	1	1.257 MHz	-0.27 dB		
M3		1	2.4801528 GHz	8.19 dBm		

99% Occupied Bandwidth, High Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4801528 GHz	8.02 dBm		
T1		1	2.47942158 GHz	-7.41 dBm	Occ Bw	1.144855145 MHz
T2		1	2.48056643 GHz	-7.63 dBm		

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

Applicable Standard

According to FCC §15.247(a) (1) (iii):

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.

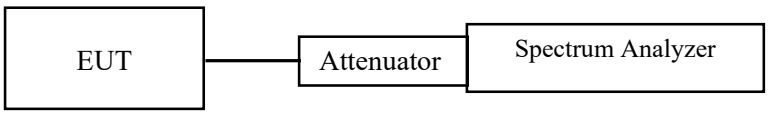
Test Procedure

Test Method: ANSI C63.10-2013 Clause 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:	26 ℃
Relative Humidity:	34 %
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2023-02-25.

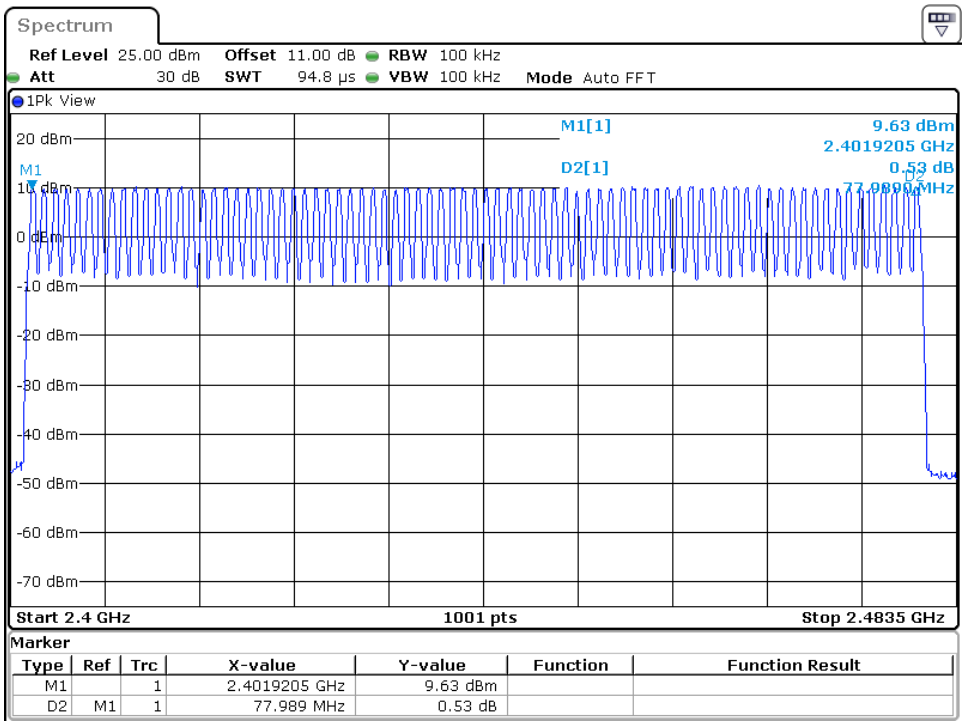
EUT operation mode: Transmitting

Test Result: Pass

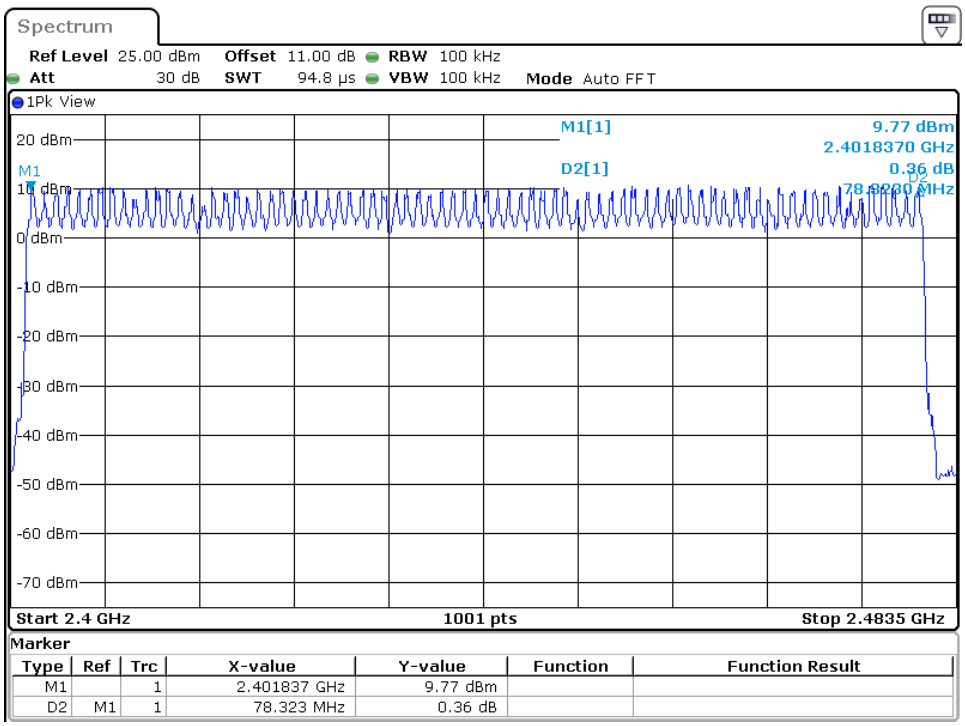
Please refer to following table and plots.

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

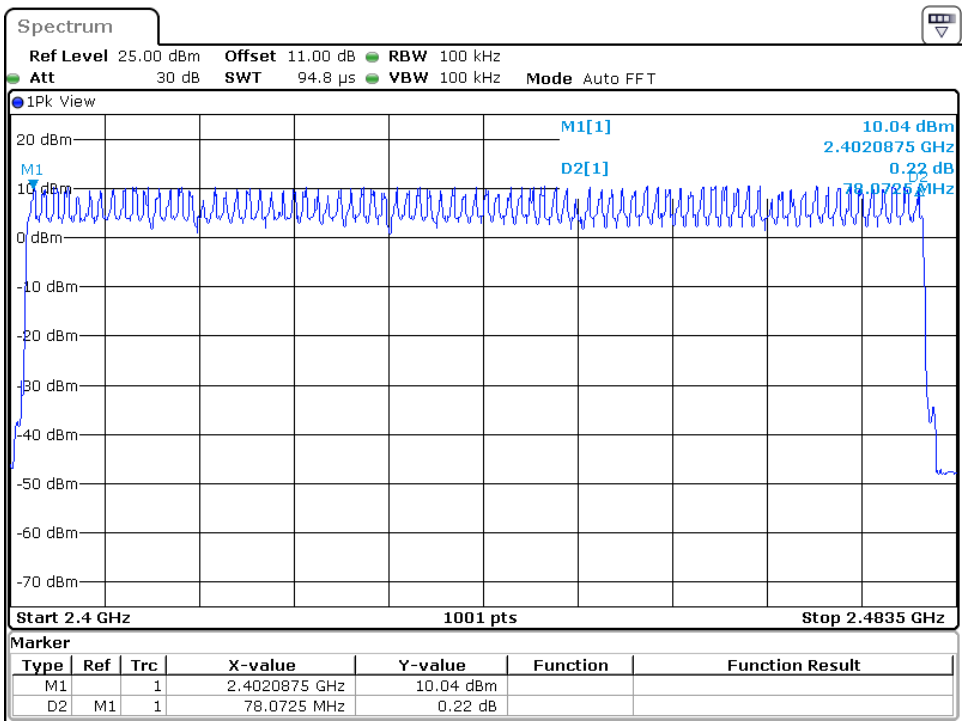
BDR (GFSK): Number of Hopping Channels



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



EDR (8DPSK): Number of Hopping Channels



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

Applicable Standard

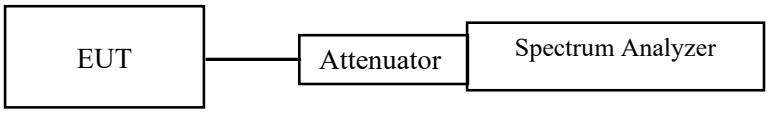
According to FCC §15.247(a) (1) (iii):

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

Test Method: ANSI C63.10-2013 Clause 7.8.4

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:	26 ℃
Relative Humidity:	34 %
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2023-02-25.

EUT operation mode: Transmitting

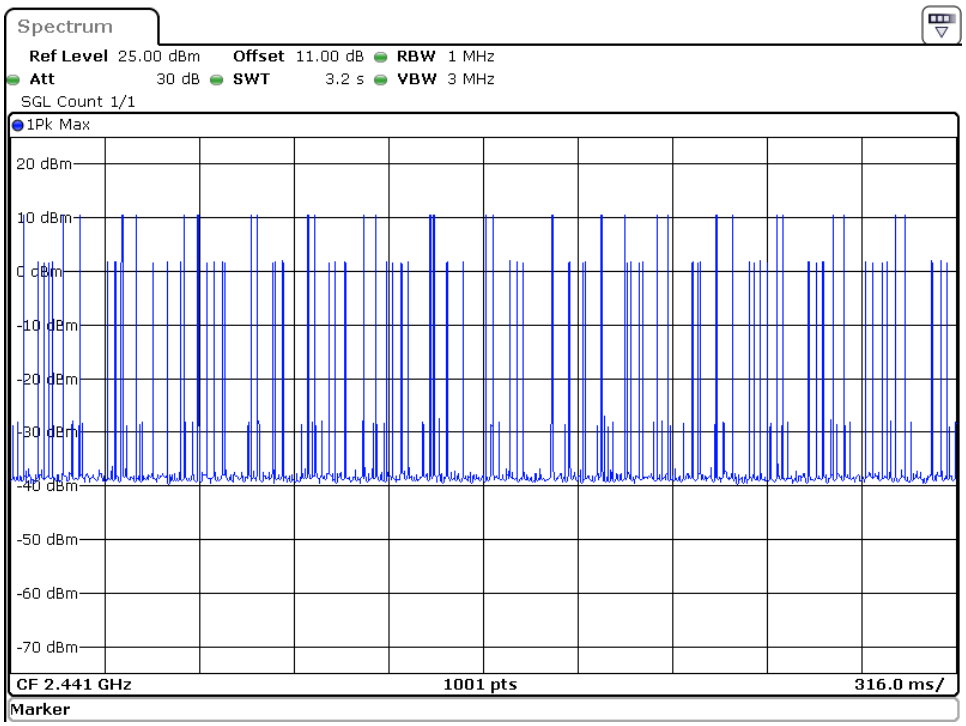
Test Result: Pass

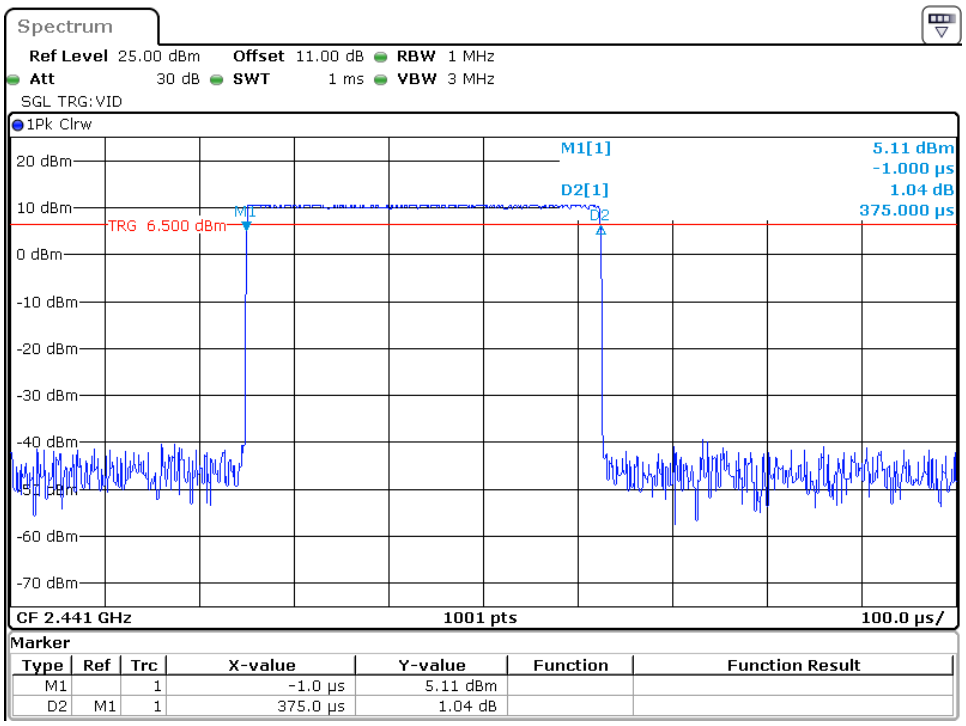
Please refer to following table and plots

Test Mode	Channel	Pulse Time [ms]	Total Hops [Num]	Result[s]	Limit[s]	Verdict
DH1	Hop	0.375	300	0.113	<=0.4	PASS
DH3	Hop	1.635	150	0.245	<=0.4	PASS
DH5	Hop	2.88	90	0.259	<=0.4	PASS
2DH1	Hop	0.384	300	0.115	<=0.4	PASS
2DH3	Hop	1.638	150	0.246	<=0.4	PASS
2DH5	Hop	2.89	100	0.289	<=0.4	PASS
3DH1	Hop	0.384	300	0.115	<=0.4	PASS
3DH3	Hop	1.638	130	0.213	<=0.4	PASS
3DH5	Hop	2.89	100	0.289	<=0.4	PASS

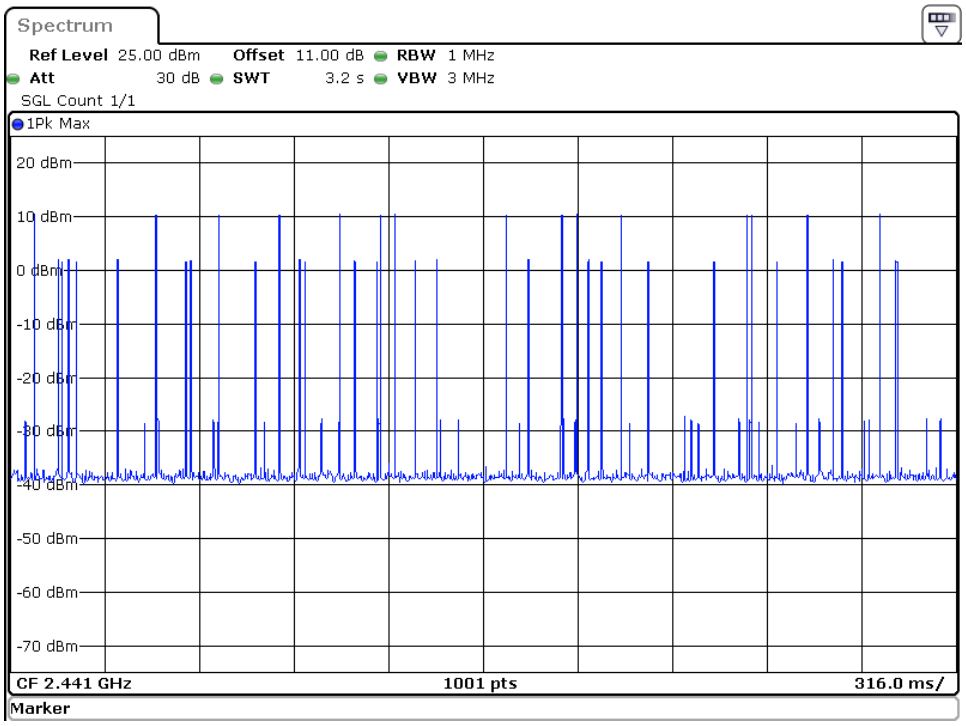
Note 1: A period time=0.4*79=31.6(S), Result= Pulse Time *Total hops
Note 2: Total hops=Hopping Number in 3.16s*10
Note 3: Hopping Number in 3.16s=Total of highest signals in 3.16s (Second high signals were other channel)

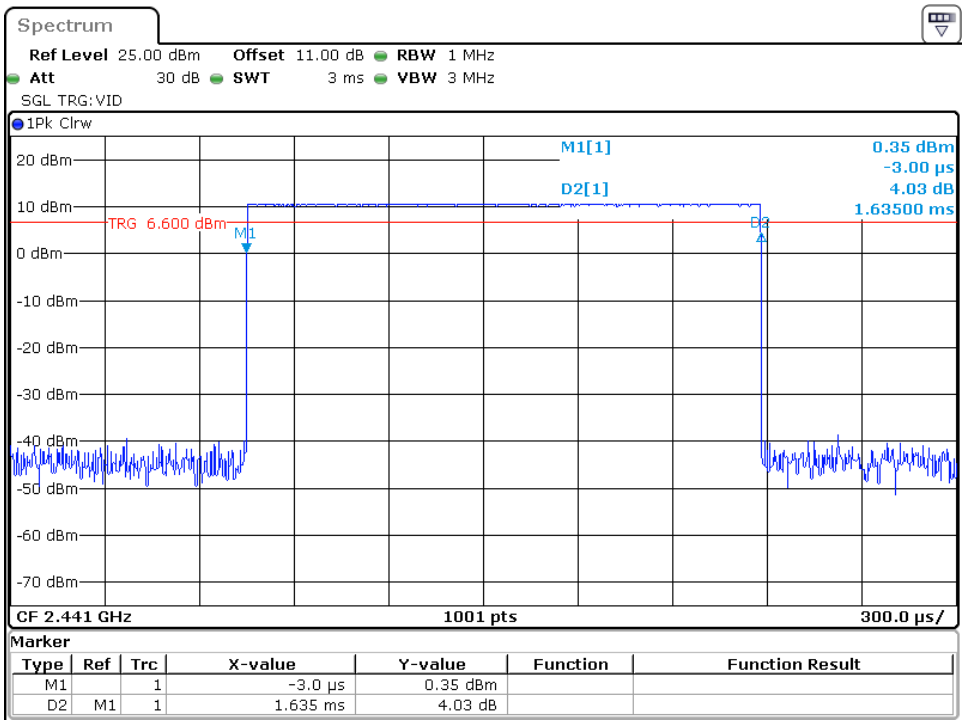
BDR (GFSK):
DH1


Spectrum
Ref Level 25.00 dBm Offset 11.00 dB RBW 1 MHz
Att 30 dB SWT 3.2 s VBW 3 MHz
SGL Count 1/1
1Pk Max
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
1001 pts
316.0 ms/
Marker

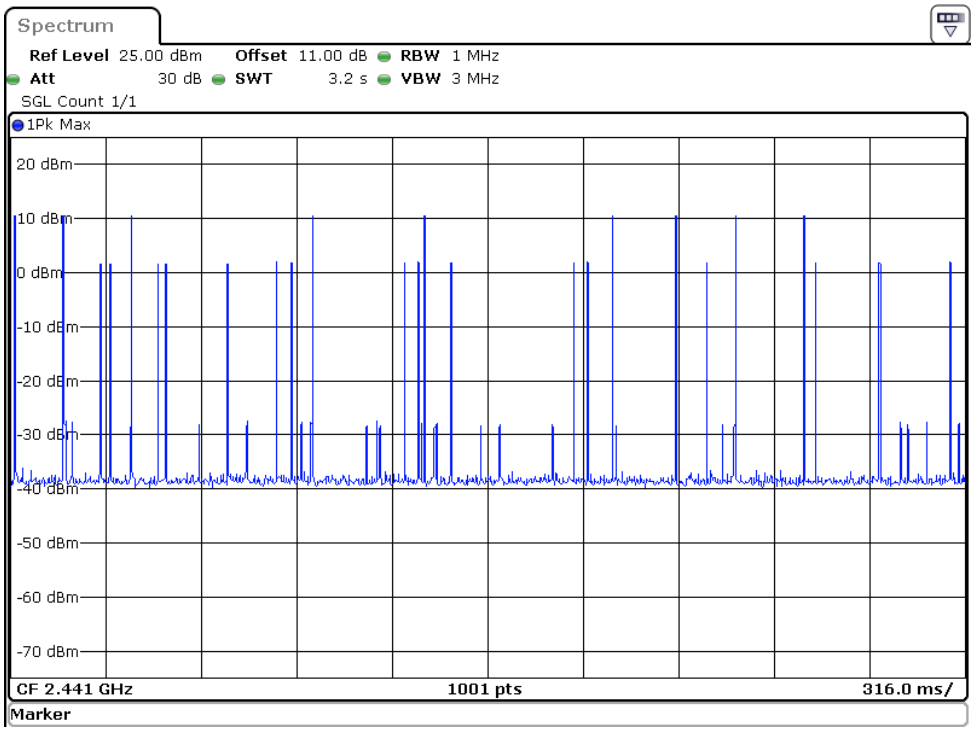

Spectrum
Ref Level 25.00 dBm Offset 11.00 dB RBW 1 MHz
Att 30 dB SWT 1 ms VBW 3 MHz
SGL TRG:VID
1Pk Clrw
M1[1] 5.11 dBm
-1.000 µs
D2[1] 1.04 dB
375.000 µs
TRG 6.500 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
1001 pts
100.0 µs/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 -1.0 µs 5.11 dBm
D2 M1 1 375.0 µs 1.04 dB

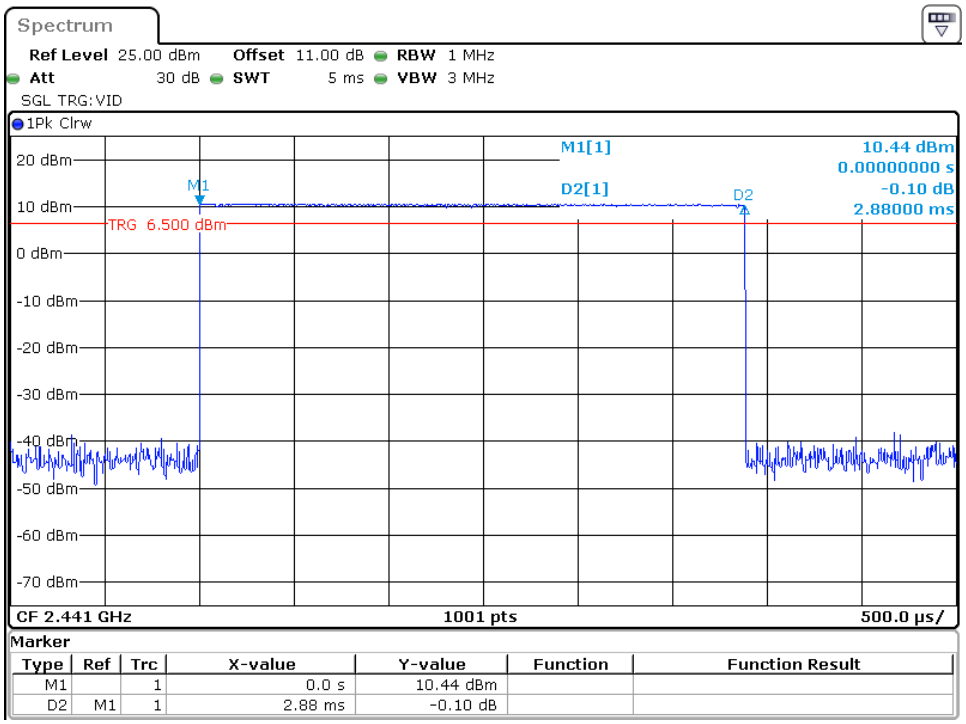
DH3


Spectrum
Ref Level 25.00 dBm Offset 11.00 dB RBW 1 MHz
Att 30 dB SWT 3.2 s VBW 3 MHz
SGL Count 1/1
1Pk Max
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
1001 pts
316.0 ms/
Marker

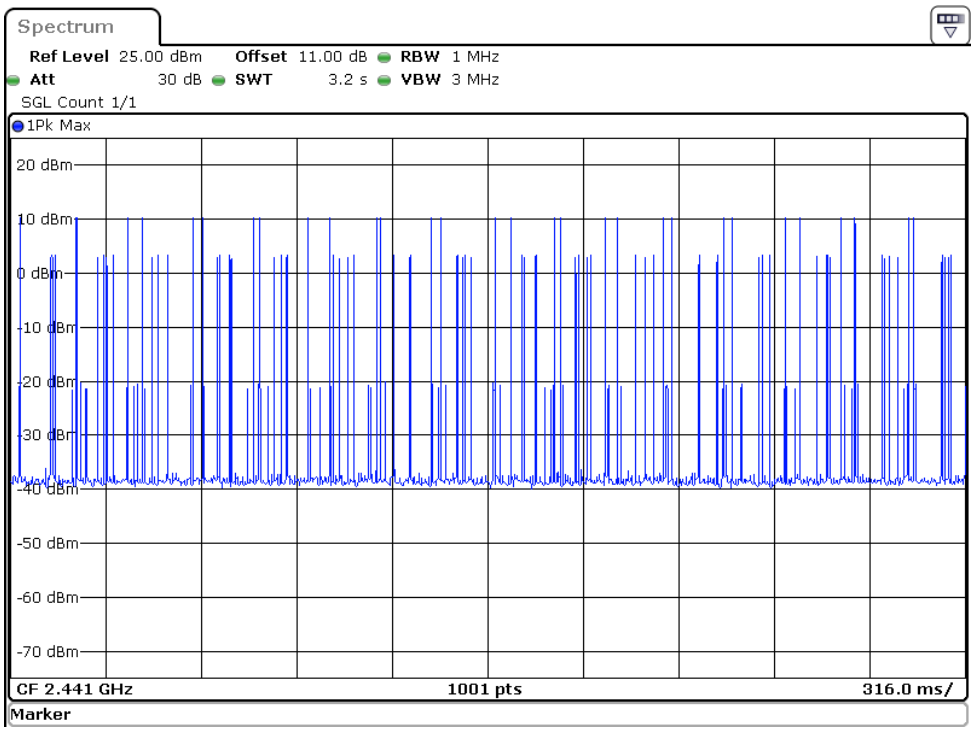

Spectrum
Ref Level 25.00 dBm Offset 11.00 dB RBW 1 MHz
Att 30 dB SWT 3 ms VBW 3 MHz
SGL TRG:VID
1Pk Clrw
M1[1] 0.35 dBm
-3.00 µs
D2[1] 4.03 dB
1.63500 ms
TRG 6.600 dBm
M1
D2
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
1001 pts
300.0 µs/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 -3.0 µs 0.35 dBm
D2 M1 1 1.635 ms 4.03 dB

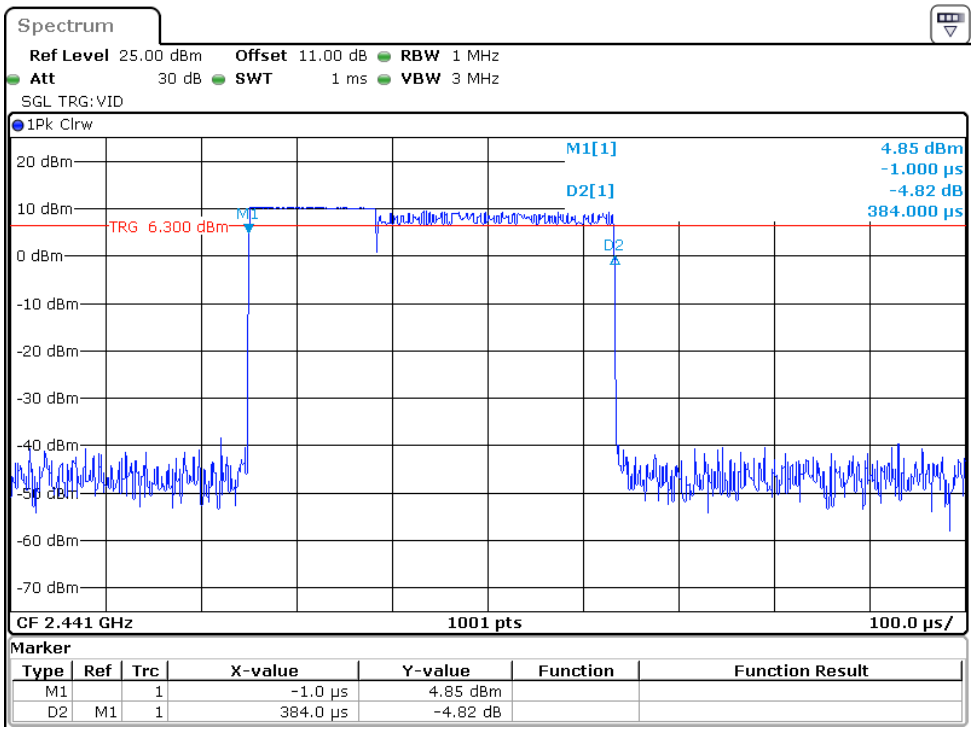
DH5


Spectrum
Ref Level 25.00 dBm Offset 11.00 dB RBW 1 MHz
Att 30 dB SWT 3.2 s VBW 3 MHz
SGL Count 1/1
1Pk Max
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
1001 pts
316.0 ms/
Marker

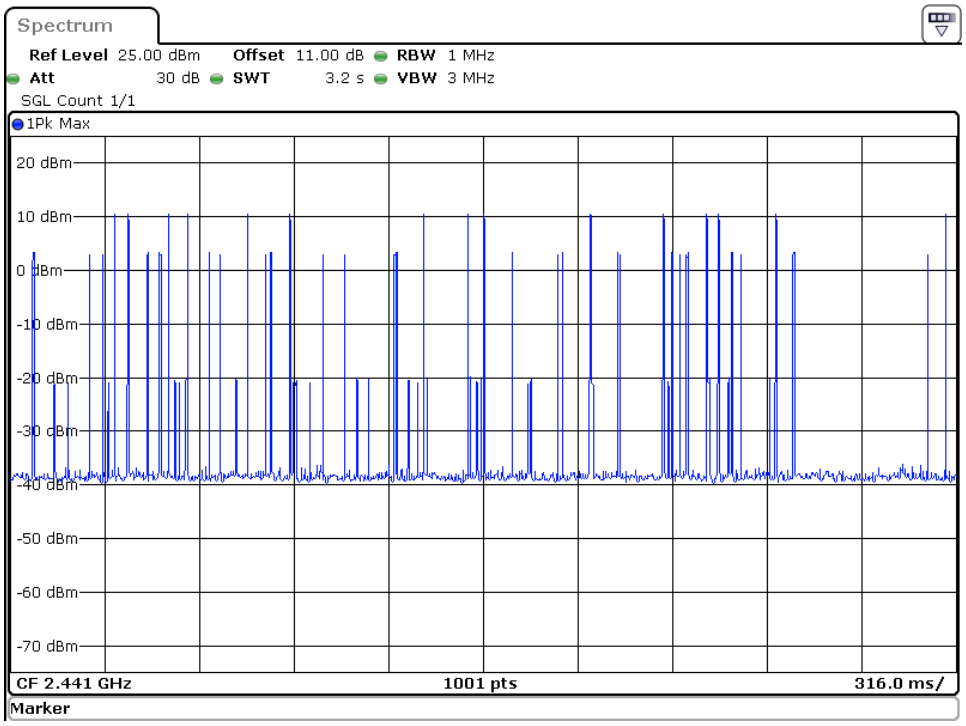

Spectrum
Ref Level 25.00 dBm Offset 11.00 dB RBW 1 MHz
Att 30 dB SWT 5 ms VBW 3 MHz
SGL TRG:VID
1Pk Clrw
M1[1] 10.44 dBm
0.00000000 s
D2[1] -0.10 dB
2.88000 ms
M1
D2
TRG 6.500 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
1001 pts
500.0 µs/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 0.0 s 10.44 dBm
D2 M1 1 2.88 ms -0.10 dB

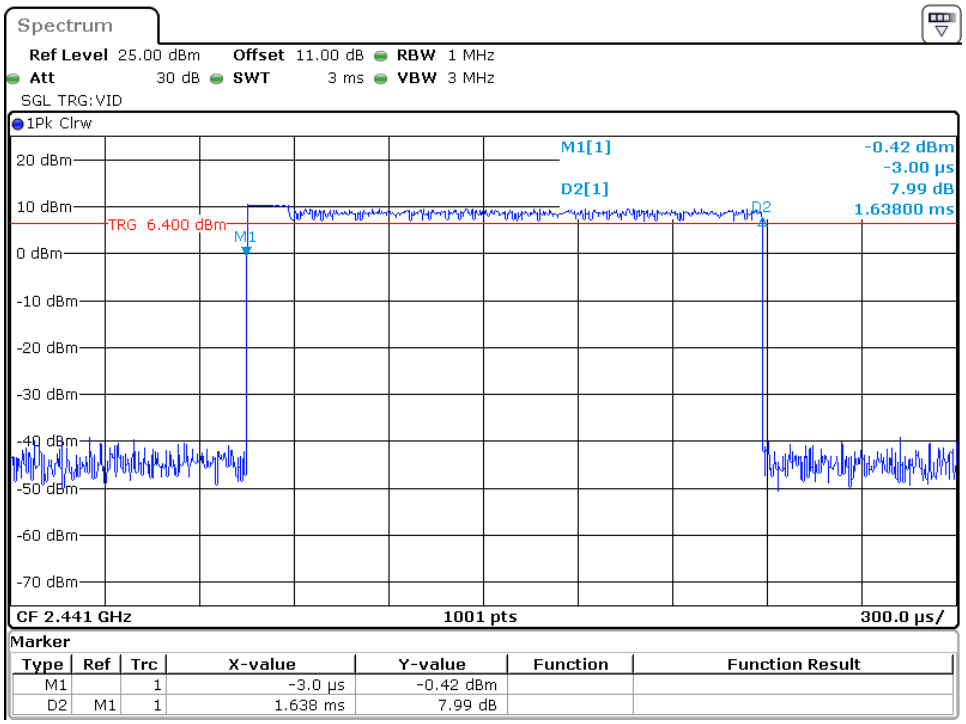
EDR(π/4-DQPSK):
2DH1



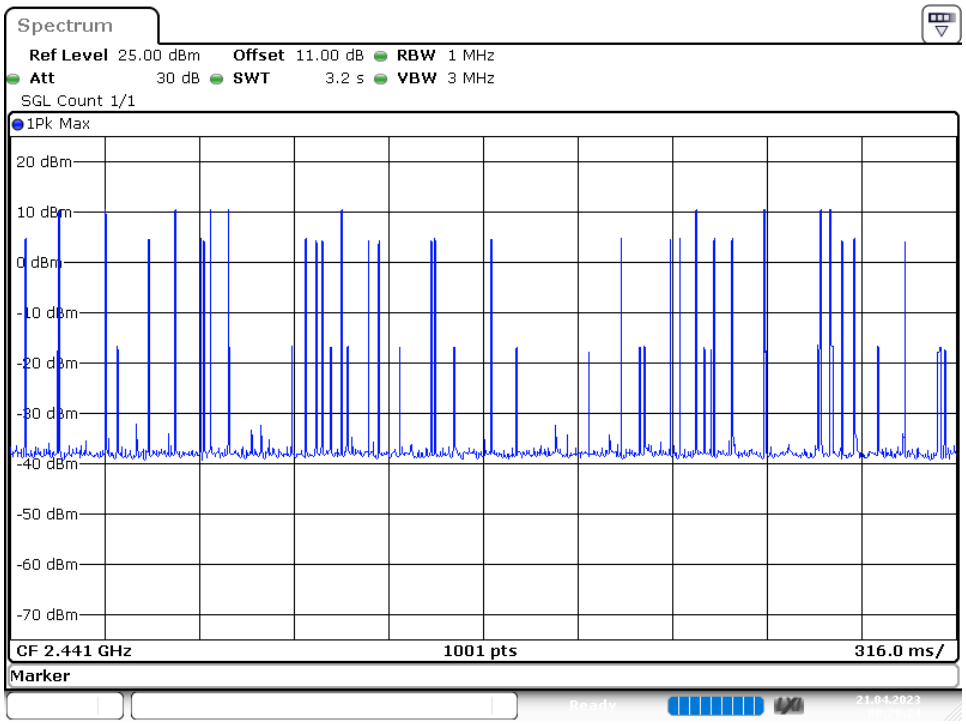


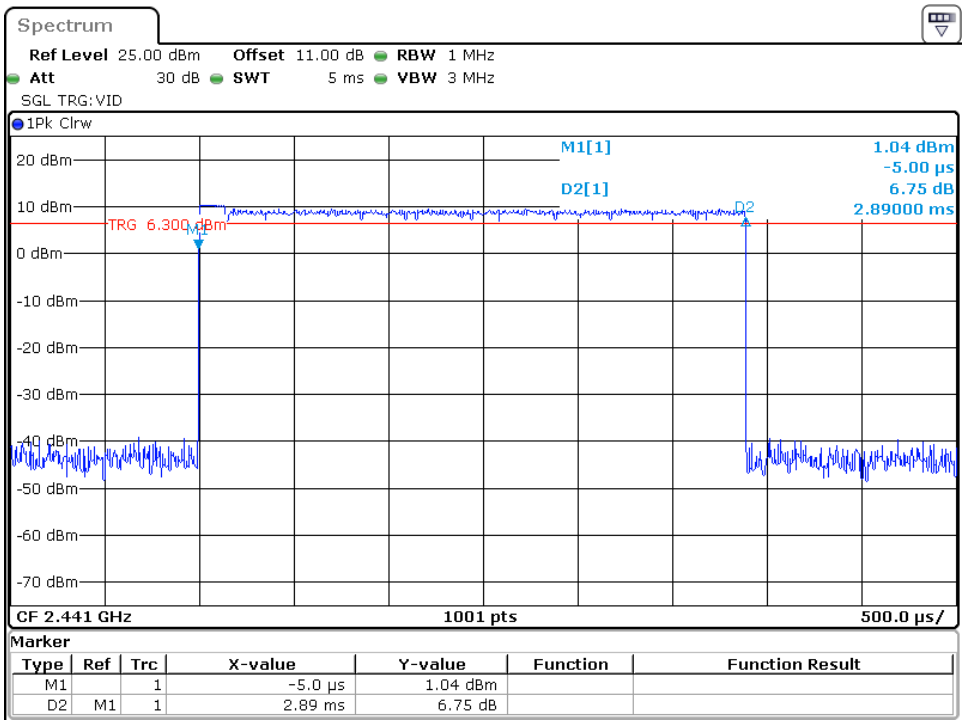
2DH3


Spectrum
Ref Level 25.00 dBm Offset 11.00 dB RBW 1 MHz
Att 30 dB SWT 3.2 s VBW 3 MHz
SGL Count 1/1
1Pk Max
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
1001 pts
316.0 ms/
Marker

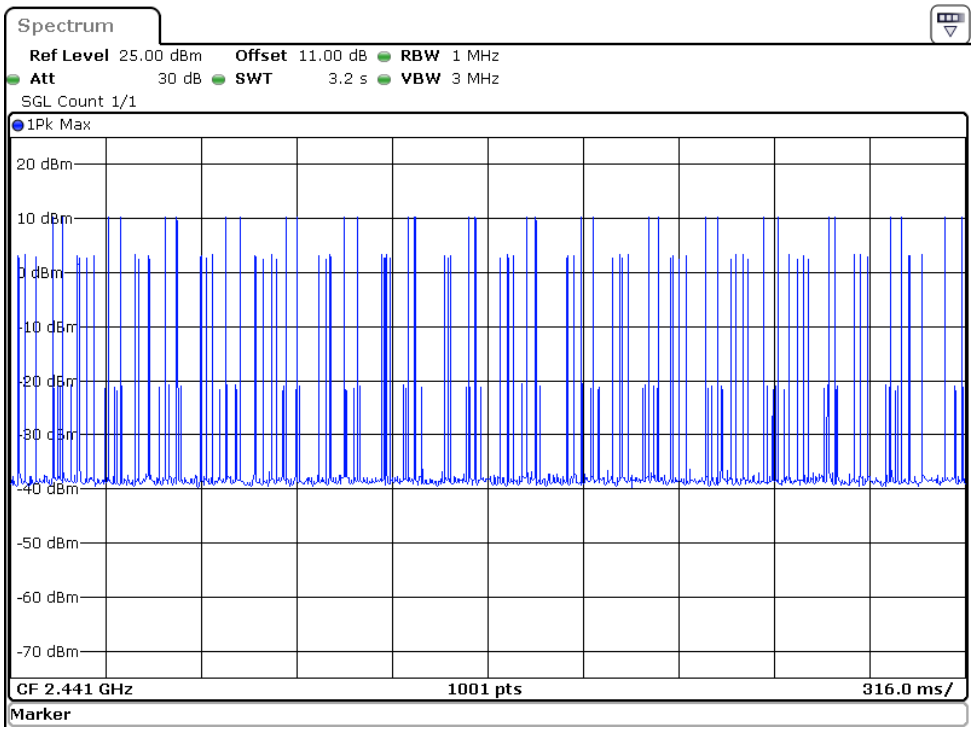

Spectrum
Ref Level 25.00 dBm Offset 11.00 dB RBW 1 MHz
Att 30 dB SWT 3 ms VBW 3 MHz
SGL TRG:VID
1Pk Clrw
M1[1] -0.42 dBm
-3.00 µs
D2[1] 7.99 dB
1.63800 ms
TRG 6.400 dBm
M1
D2
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
1001 pts
300.0 µs/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 -3.0 µs -0.42 dBm
D2 M1 1 1.638 ms 7.99 dB

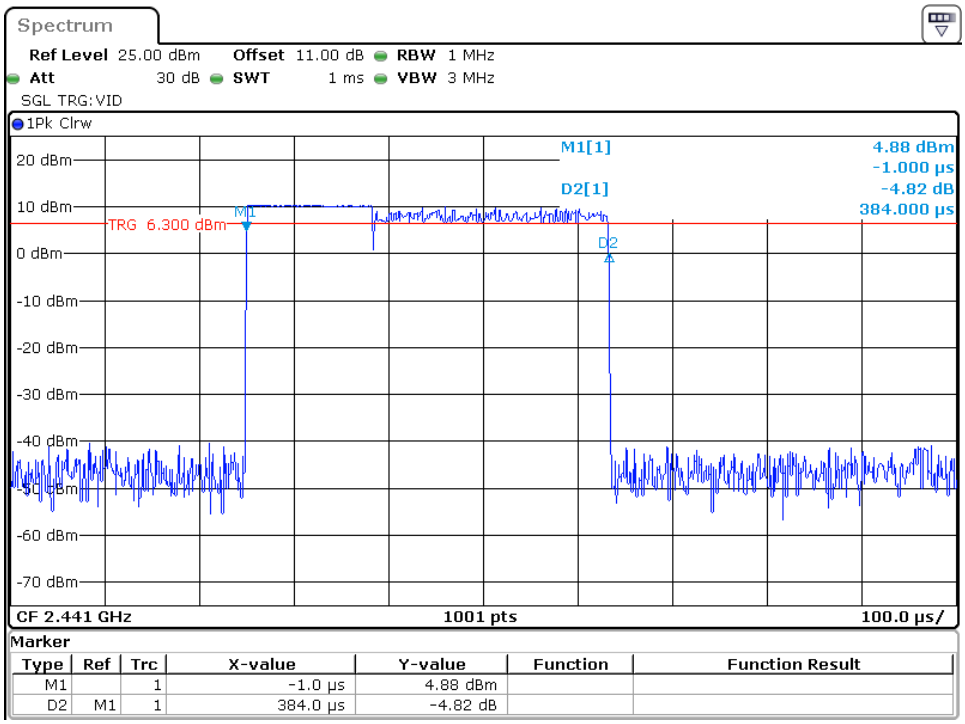
2DH5


Spectrum
Ref Level 25.00 dBm Offset 11.00 dB RBW 1 MHz
Att 30 dB SWT 3.2 s VBW 3 MHz
SGL Count 1/1
1Pk Max
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
1001 pts
316.0 ms/
Marker

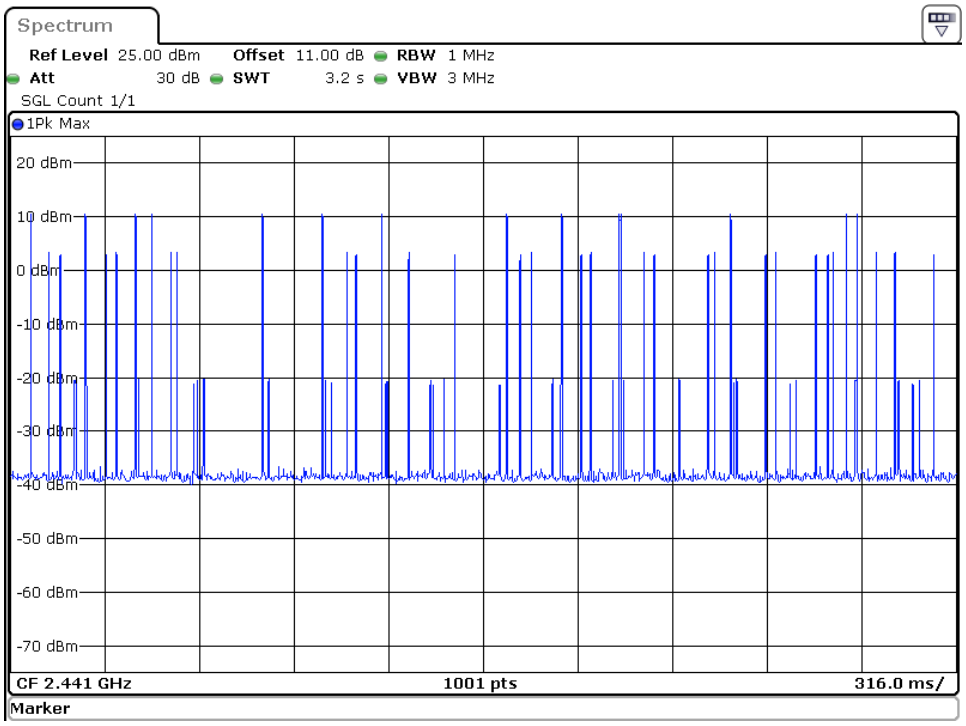

Spectrum
Ref Level 25.00 dBm Offset 11.00 dB RBW 1 MHz
Att 30 dB SWT 5 ms VBW 3 MHz
SGL TRG:VID
1Pk Clrw
M1[1] 1.04 dBm
-5.00 µs
D2[1] 6.75 dB
2.89000 ms
TRG 6.300 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
1001 pts
500.0 µs/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 -5.0 µs 1.04 dBm
D2 M1 1 2.89 ms 6.75 dB

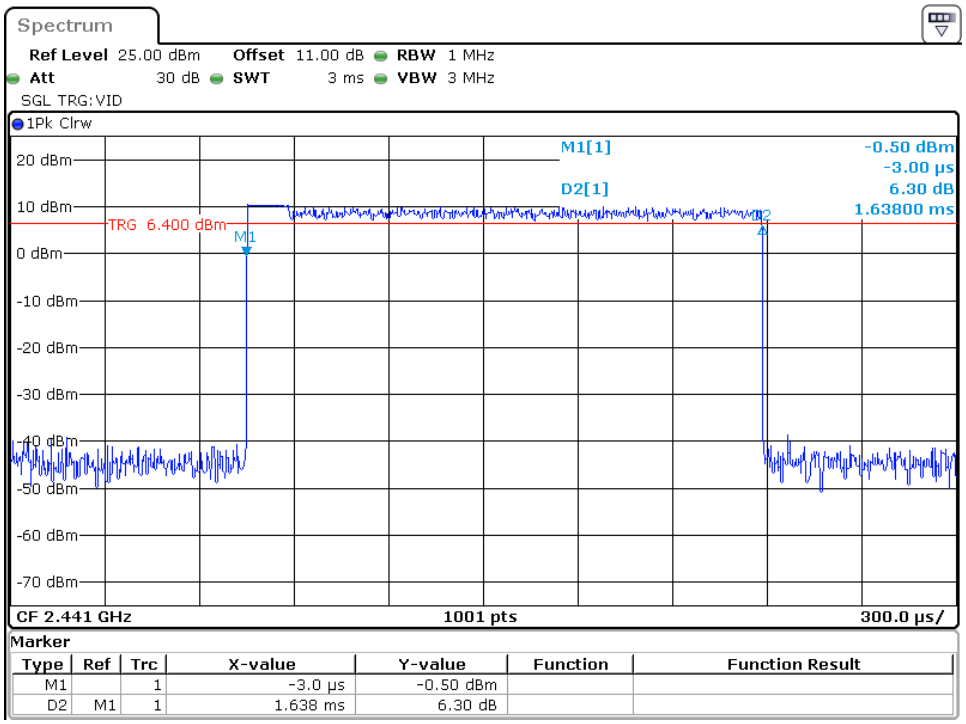
EDR (8DPSK):
3DH1



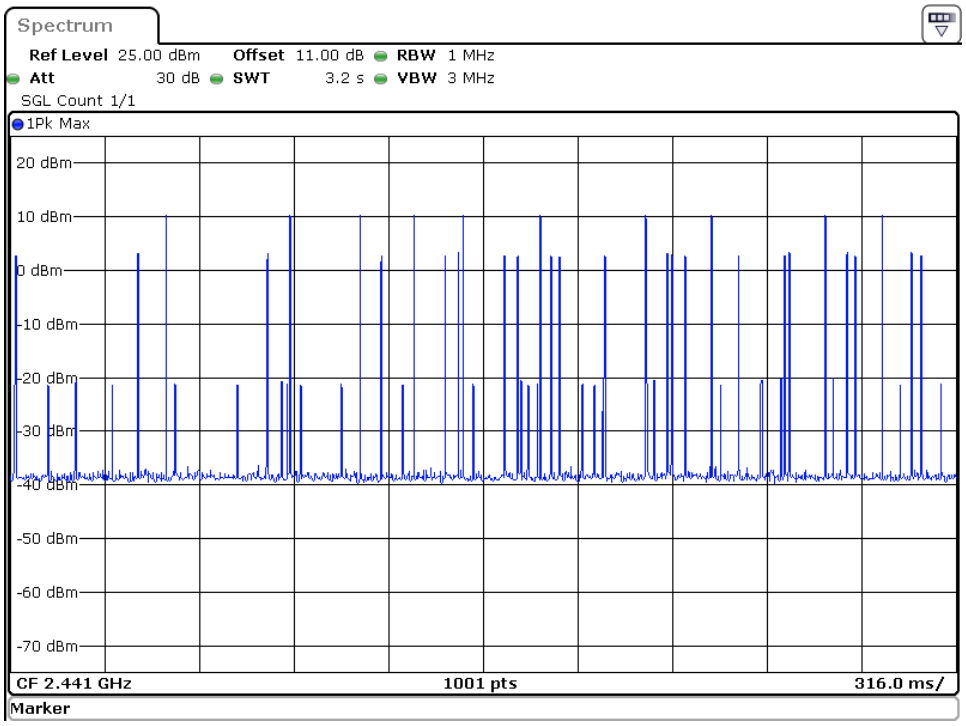


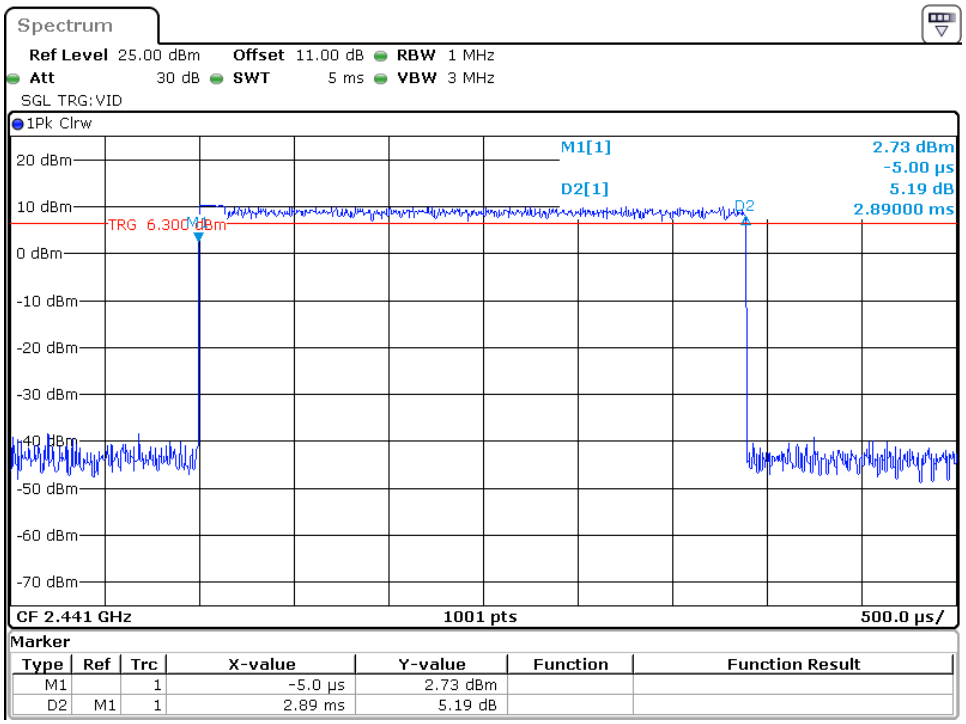
3DH3


Spectrum
Ref Level 25.00 dBm Offset 11.00 dB RBW 1 MHz
Att 30 dB SWT 3.2 s VBW 3 MHz
SGL Count 1/1
1Pk Max
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
1001 pts
316.0 ms/
Marker


Spectrum
Ref Level 25.00 dBm Offset 11.00 dB RBW 1 MHz
Att 30 dB SWT 3 ms VBW 3 MHz
SGL TRG:VID
1Pk Clrw
M1[1] -0.50 dBm
-3.00 µs
D2[1] 6.30 dB
1.63800 ms
TRG 6.400 dBm
M1
D2
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
1001 pts
300.0 µs/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 -3.0 µs -0.50 dBm
D2 M1 1 1.638 ms 6.30 dB

3DH5


Spectrum
Ref Level 25.00 dBm Offset 11.00 dB RBW 1 MHz
Att 30 dB SWT 3.2 s VBW 3 MHz
SGL Count 1/1
1Pk Max
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
1001 pts
316.0 ms/
Marker


Spectrum
Ref Level 25.00 dBm Offset 11.00 dB RBW 1 MHz
Att 30 dB SWT 5 ms VBW 3 MHz
SGL TRG:VID
1Pk Clrw
M1[1] 2.73 dBm
-5.00 µs
D2[1] 5.19 dB
2.89000 ms
TRG 6.300 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
1001 pts
500.0 µs/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 -5.0 µs 2.73 dBm
D2 M1 1 2.89 ms 5.19 dB

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

Applicable Standard

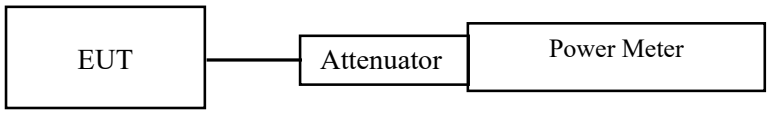
According to FCC §15.247(b) (1):

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

Test Method: ANSI C63.10-2013 Clause 7.8.5

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.



Test Data

Environmental Conditions

Temperature:	26 ℃
Relative Humidity:	34 %
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2023-02-25.

EUT operation mode: Transmitting

Test Result: Pass

Please refer to following table and plots.

Mode	Channel	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)
BDR (GFSK)	Low	2402	9.87	21
	Middle	2441	10.44	21
	High	2480	10.59	21
EDR (π/4-DQPSK)	Low	2402	10.09	21
	Middle	2441	10.22	21
	High	2480	10.44	21
EDR (8DPSK)	Low	2402	11.90	21
	Middle	2441	10.27	21
	High	2480	10.39	21

FCC §15.247(d) - BAND EDGES TESTING

Applicable Standard

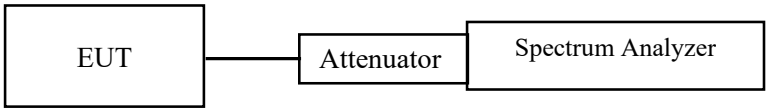
According to FCC §15.247(d).

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)).

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.6 & Clause 6.10

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:	26 ℃
Relative Humidity:	34 %
ATM Pressure:	101.0 kPa

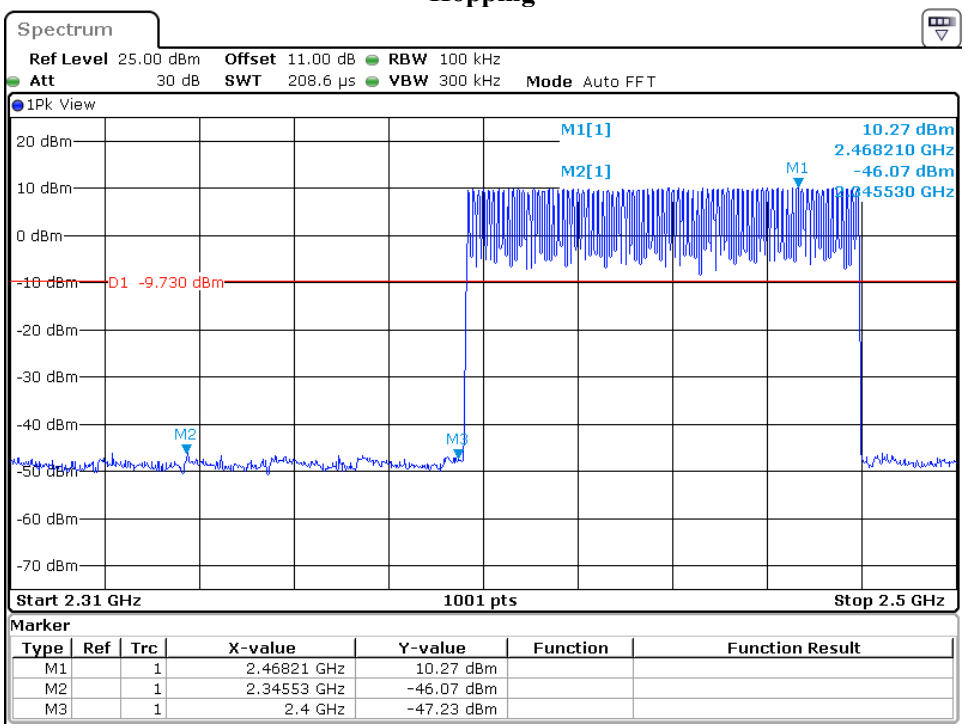
The testing was performed by Roger Ling on 2023-02-25.

EUT operation mode: Transmitting

Test Result: Pass

Please refer to following plots

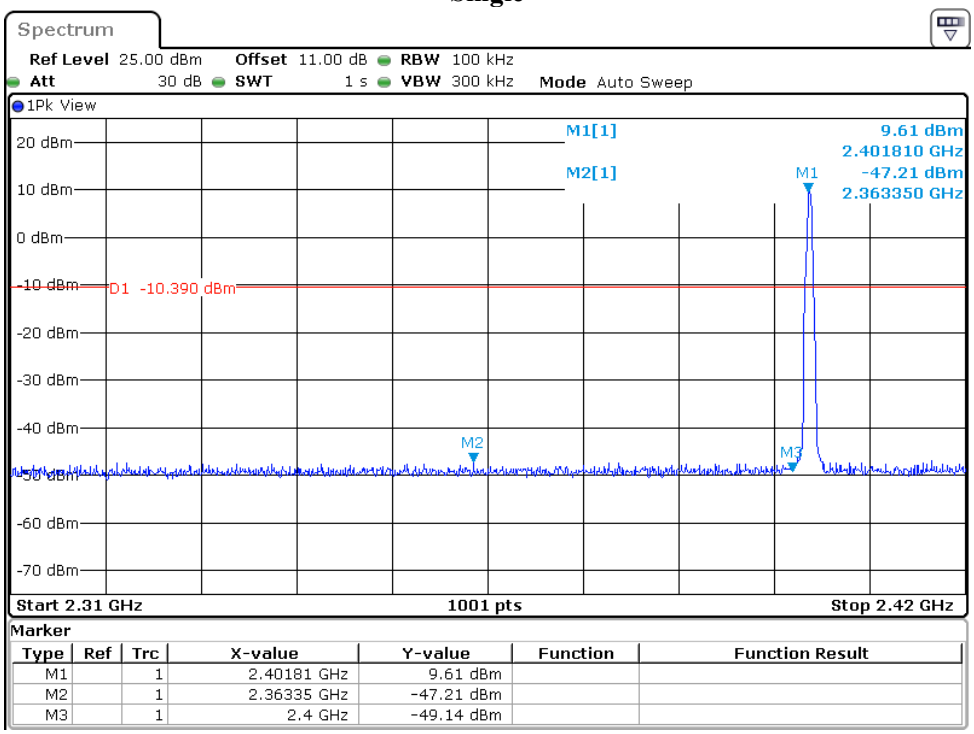
BDR (GFSK): Band Edge-Left Side
Hopping



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.46821 GHz	10.27 dBm		
M2		1	2.34553 GHz	-46.07 dBm		
M3		1	2.4 GHz	-47.23 dBm		

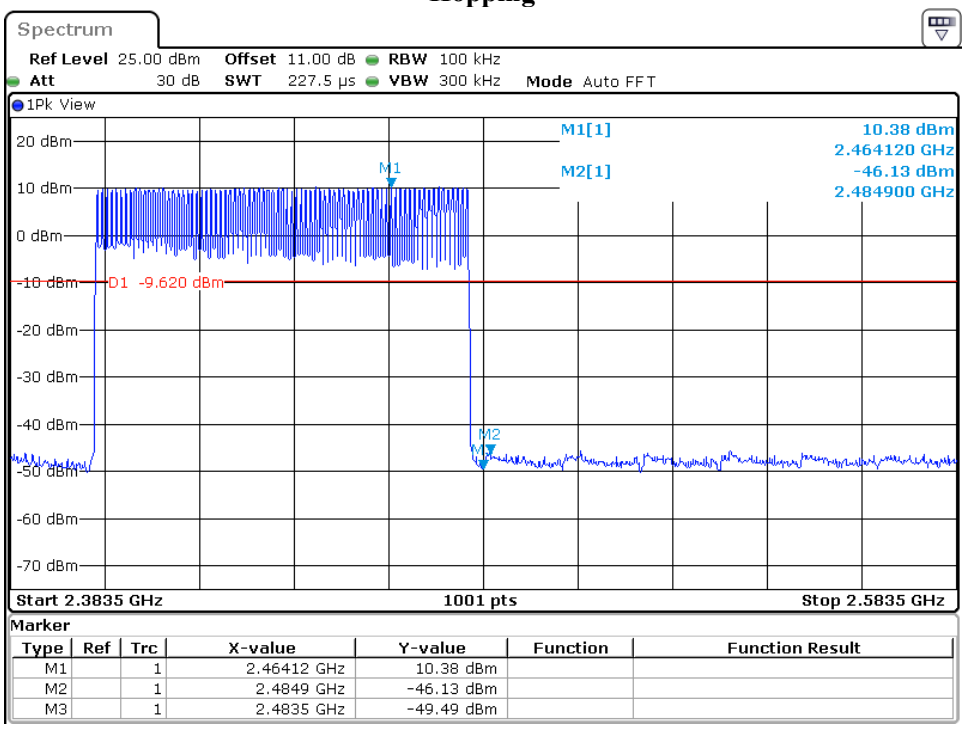
Single



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40181 GHz	9.61 dBm		
M2		1	2.36335 GHz	-47.21 dBm		
M3		1	2.4 GHz	-49.14 dBm		

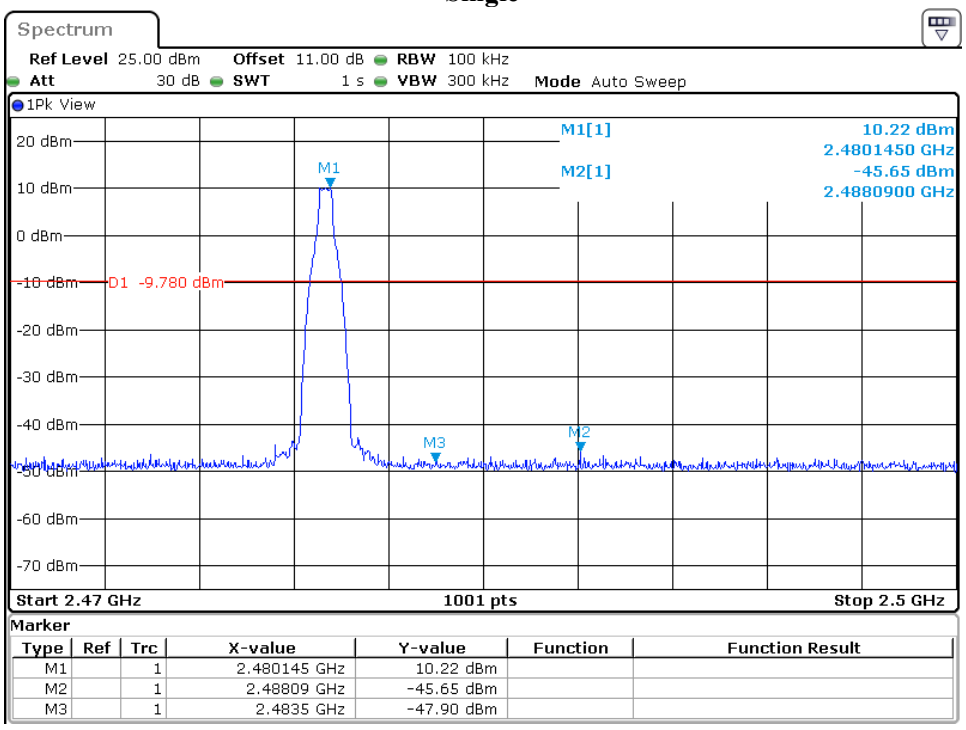
BDR (GFSK): Band Edge-Right Side Hopping



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.46412 GHz	10.38 dBm		
M2		1	2.4849 GHz	-46.13 dBm		
M3		1	2.4835 GHz	-49.49 dBm		

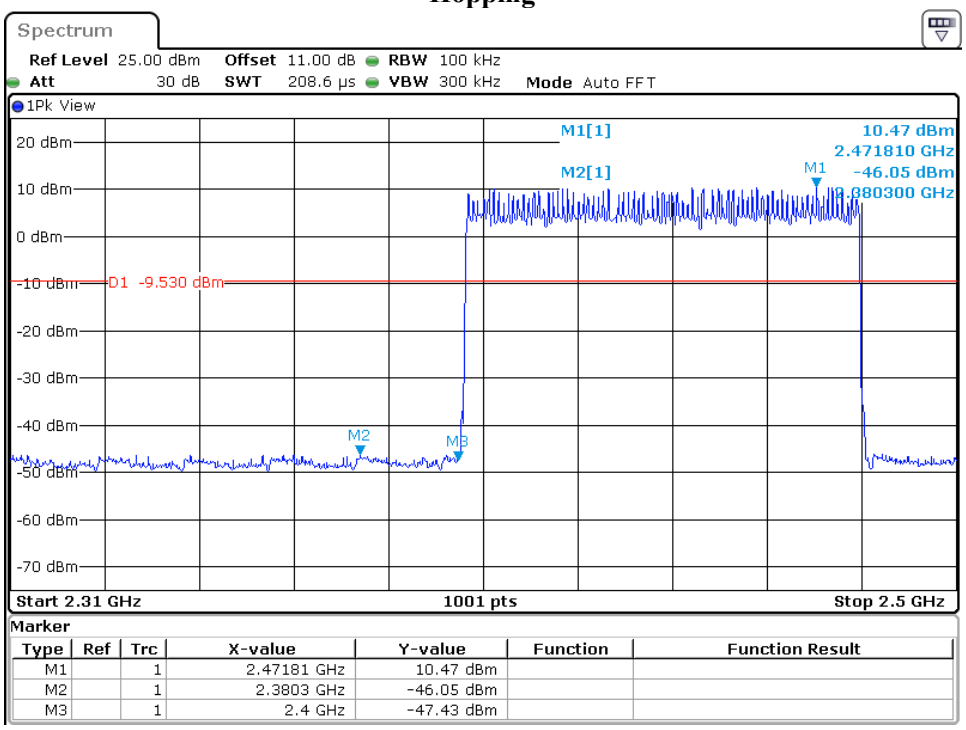
Single



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.480145 GHz	10.22 dBm		
M2		1	2.48809 GHz	-45.65 dBm		
M3		1	2.4835 GHz	-47.90 dBm		

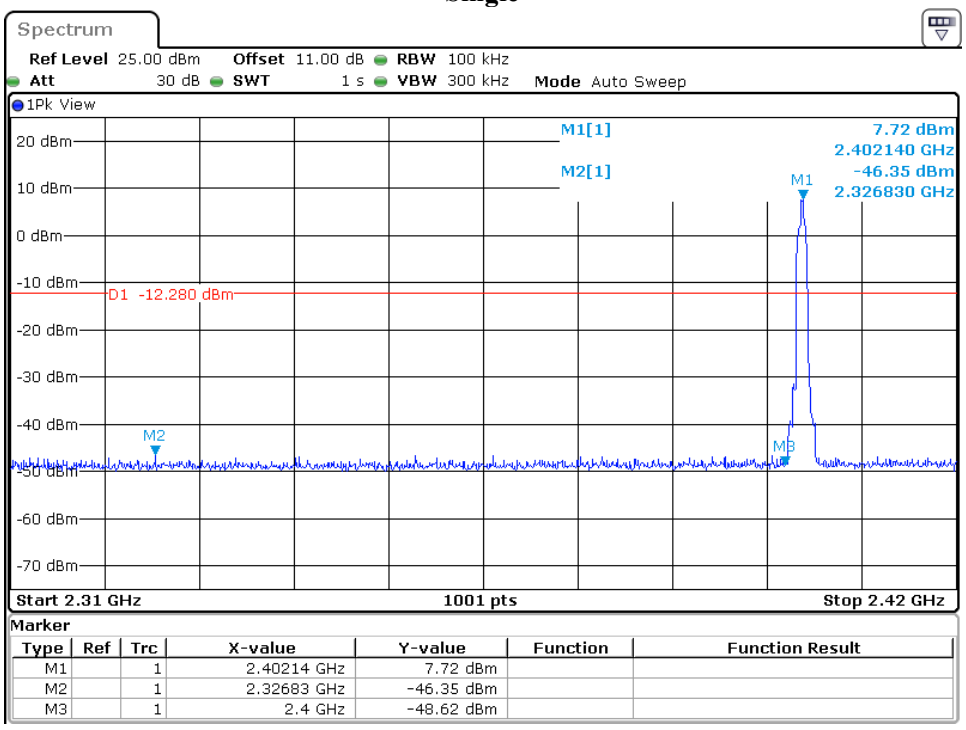
EDR (π/4-DQPSK): Band Edge-Left Side
Hopping



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47181 GHz	10.47 dBm		
M2		1	2.3803 GHz	-46.05 dBm		
M3		1	2.4 GHz	-47.43 dBm		

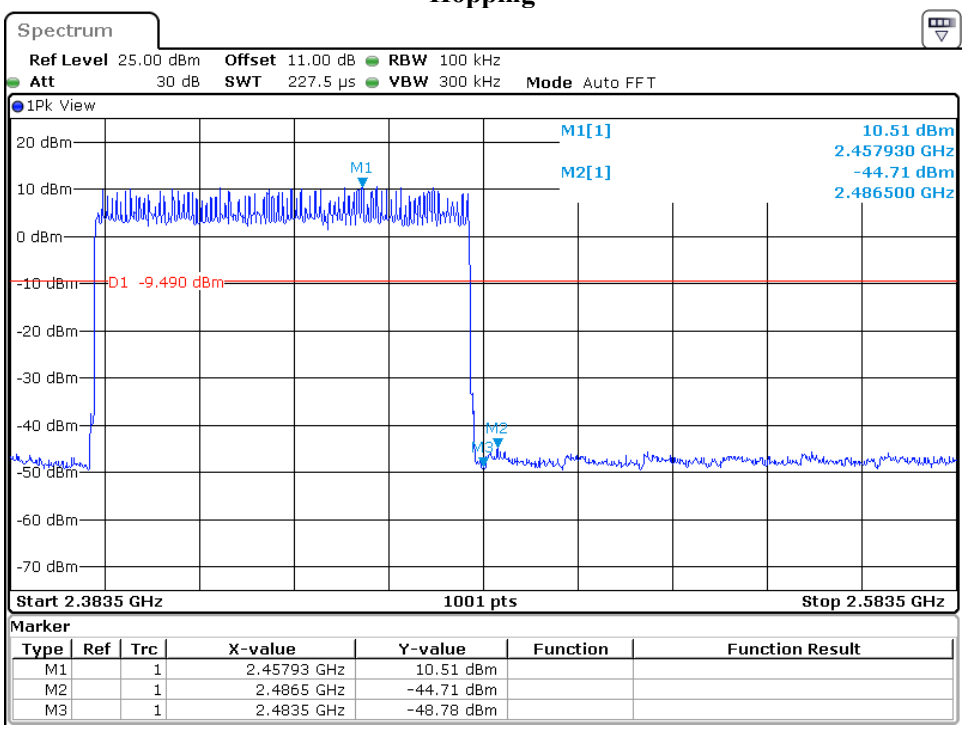
Single



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40214 GHz	7.72 dBm		
M2		1	2.32683 GHz	-46.35 dBm		
M3		1	2.4 GHz	-48.62 dBm		

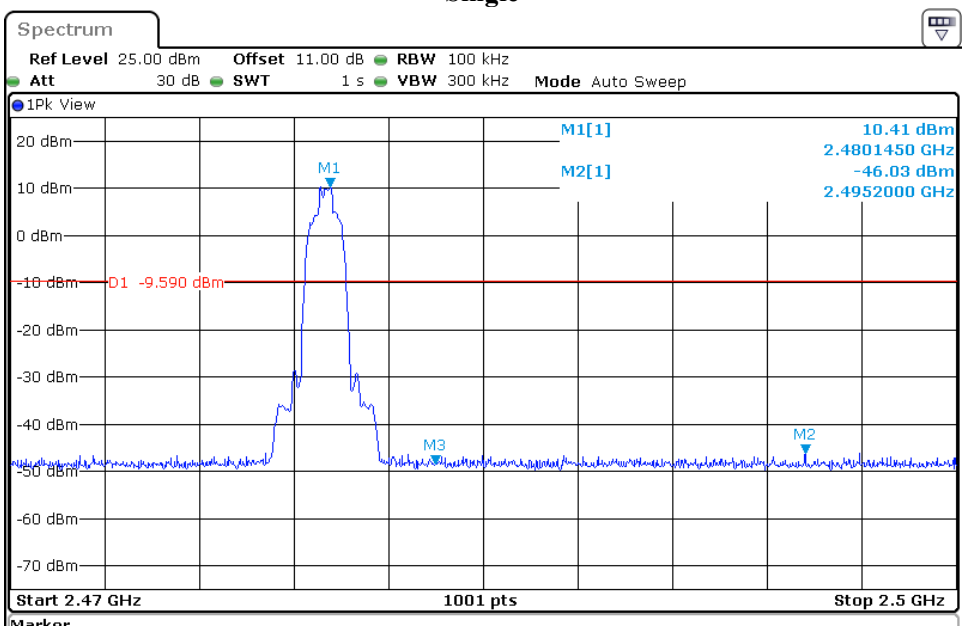
EDR (π/4-DQPSK): Band Edge-Right Side Hopping



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.45793 GHz	10.51 dBm		
M2		1	2.4865 GHz	-44.71 dBm		
M3		1	2.4835 GHz	-48.78 dBm		

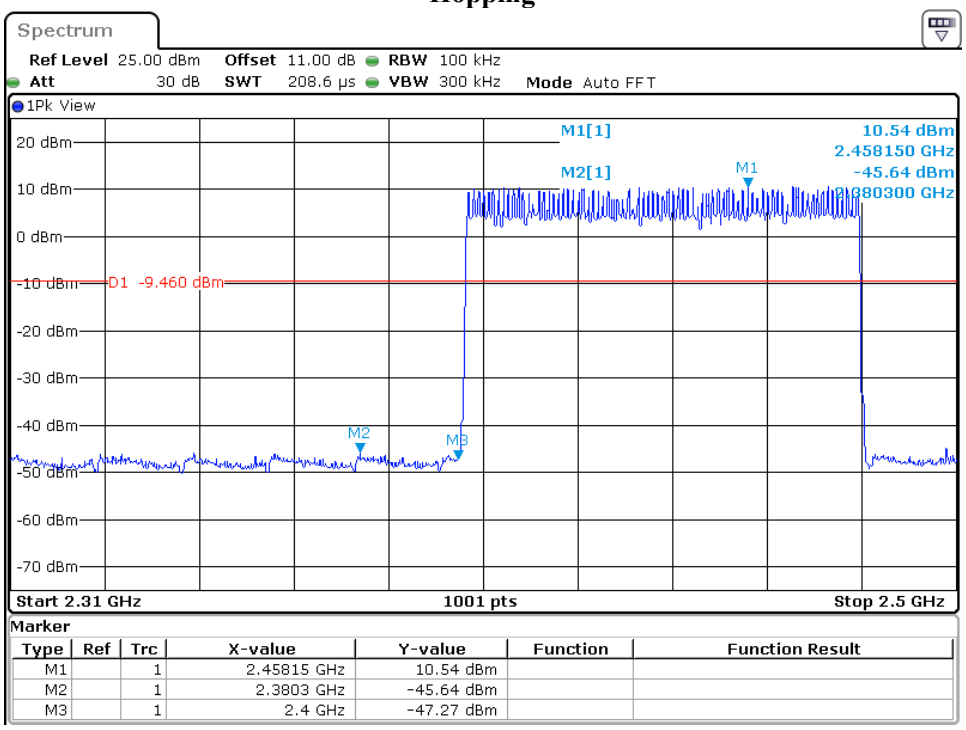
Single



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.480145 GHz	10.41 dBm		
M2		1	2.4952 GHz	-46.03 dBm		
M3		1	2.4835 GHz	-48.41 dBm		

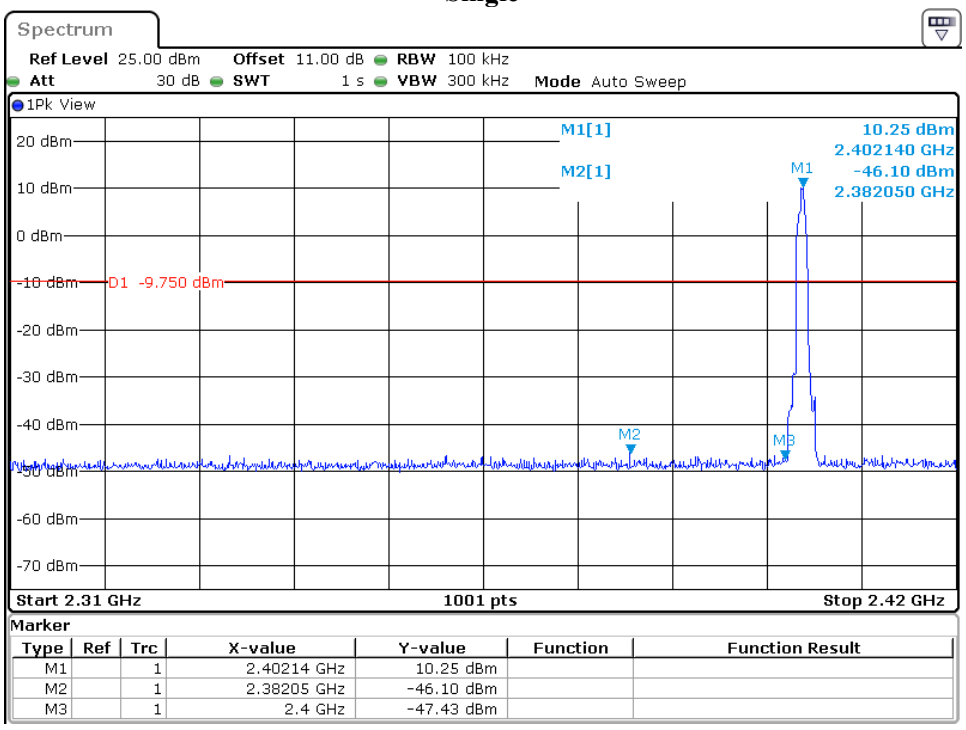
EDR (8DPSK): Band Edge-Left Side
Hopping



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.45815 GHz	10.54 dBm		
M2		1	2.3803 GHz	-45.64 dBm		
M3		1	2.4 GHz	-47.27 dBm		

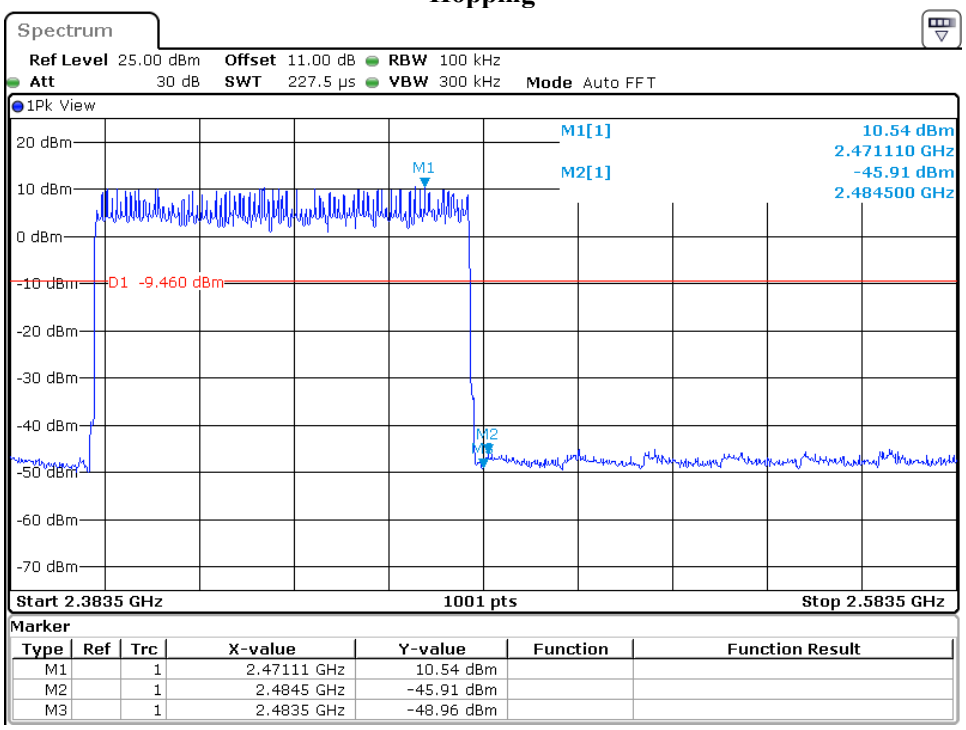
Single



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40214 GHz	10.25 dBm		
M2		1	2.38205 GHz	-46.10 dBm		
M3		1	2.4 GHz	-47.43 dBm		

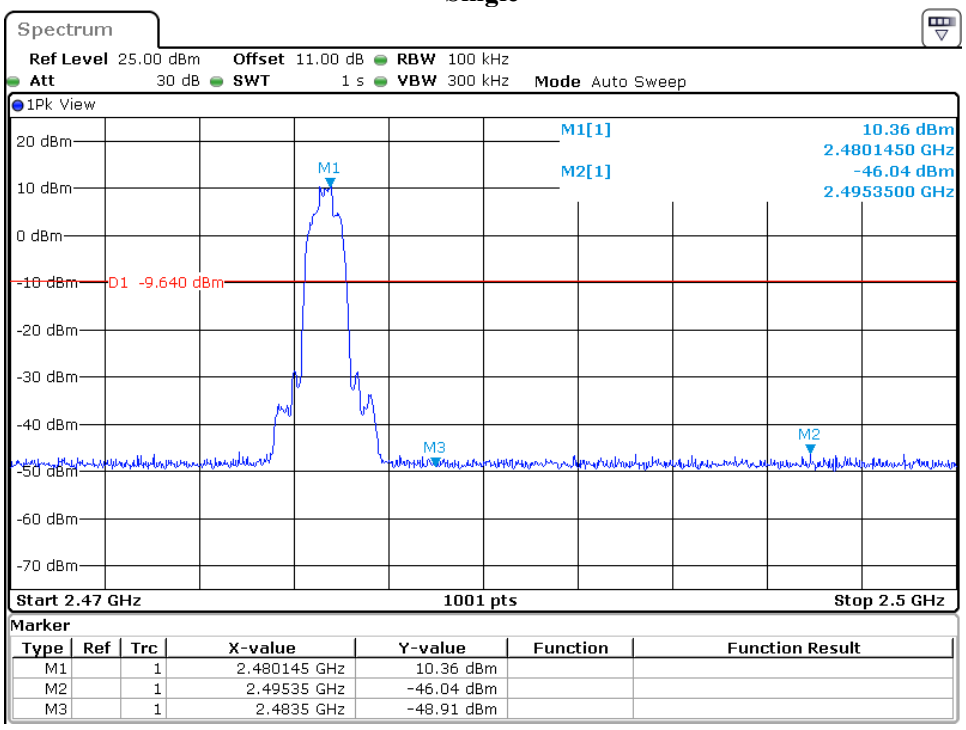
EDR (8DPSK): Band Edge-Right Side Hopping



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47111 GHz	10.54 dBm		
M2		1	2.4845 GHz	-45.91 dBm		
M3		1	2.4835 GHz	-48.96 dBm		

Single



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.480145 GHz	10.36 dBm		
M2		1	2.49535 GHz	-46.04 dBm		
M3		1	2.4835 GHz	-48.91 dBm		

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