

FCC PART 15.247

TEST REPORT

For

Hytera Communications Corporation Limited

Hytera Tower, Hi-Tech Industrial Park North, 9108# Beihuan Road, Nanshan District, Shenzhen, 518057 China

FCC ID: YAMHP7XXVHFS

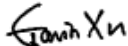
Report Type: Original Report	Product Name: Digital Portable Radio
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Report Date: <u>2021-08-18</u>	
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product Name:		Digital Portable Radio
Test Model:		HP782 VHF
Multiple Model:		HP785 VHF, HP786 VHF, HP788 VHF, HP702 VHF, HP705 VHF, HP706 VHF, HP708 VHF, HDP782 VHF, HDP785 VHF, HDP786 VHF, HDP788 VHF, HDP702 VHF, HDP705 VHF, HDP706 VHF, HDP708 VHF
Model Difference:		Refer to the DOS letter
Rated Input Voltage:		DC 7.7V from battery or DC 12V charging from charger base
Serial Number:		HP782 VHF: DG2210727-31336E-RF-S1 HP702 VHF: DG2210727-31336E-RF-S2
Adapter Information	Model:	HKA01212010-XQ
	Input:	AC 100-240V 50/60Hz 0.5A
	Output:	DC 12.0V 1.0A 12.0W
EUT Received Date:		2021.7.27
EUT Received Status:		Good

Technical Specification

Operation Frequency Range (MHz):	2402-2480
Max. RF Output Power (Conducted)(dBm):	5.71
Antenna Gain (dBi)▲:	0
Modulation Type:	GFSK, $\pi/4$ -DQPSK, 8-DPSK

Objective

This report is prepared on behalf of **Hytera Communications Corporation Limited** in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communications Commission's rules.

The tests were performed in order to determine the compliance of the EUT with FCC Rules 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 and KDB 558074 D01 DTS Meas Guidance v05r02.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	$\pm 5\%$
RF output power, conducted	$\pm 0.61\text{dB}$
Power Spectral Density, conducted	$\pm 0.61\text{ dB}$
Unwanted Emissions, radiated	30M~200MHz: 4.55 dB, 200M~1GHz: 5.92 dB, 1G~6GHz: 4.98 dB, 6G~18GHz: 5.89 dB, 18G~26.5G: 5.47 dB, 26.5G~40G: 5.63 dB
Unwanted Emissions, conducted	$\pm 1.5\text{ dB}$
Temperature	$\pm 1^\circ\text{C}$
Humidity	$\pm 5\%$
DC and low frequency voltages	$\pm 0.4\%$
Duty Cycle	1%
AC Power Lines Conducted Emission	3.12 dB (150 kHz to 30 MHz)

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

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.12, Pulong East 1st Road, Tangxia Town, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218, the FCC Designation No. : CN1220.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0022.

Declarations

BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol “▲”. Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in engineering mode, which was provided by manufacturer.

EUT Exercise Software

The software: "BLUE TEST 2.5.8.exe" was used during test, which was provided by manufacturer.
The maximum power level was configured by the software as below table:

Mode	Channel	Frequency (MHz)	Power Level Setting
GFSK	Low	2402	60
	Middle	2441	50
	High	2480	50
$\pi/4$ -DQPSK	Low	2402	60
	Middle	2441	60
	High	2480	60
8DPSK	Low	2402	60
	Middle	2441	60
	High	2480	60

Equipment Modifications

No modification was made to the EUT.

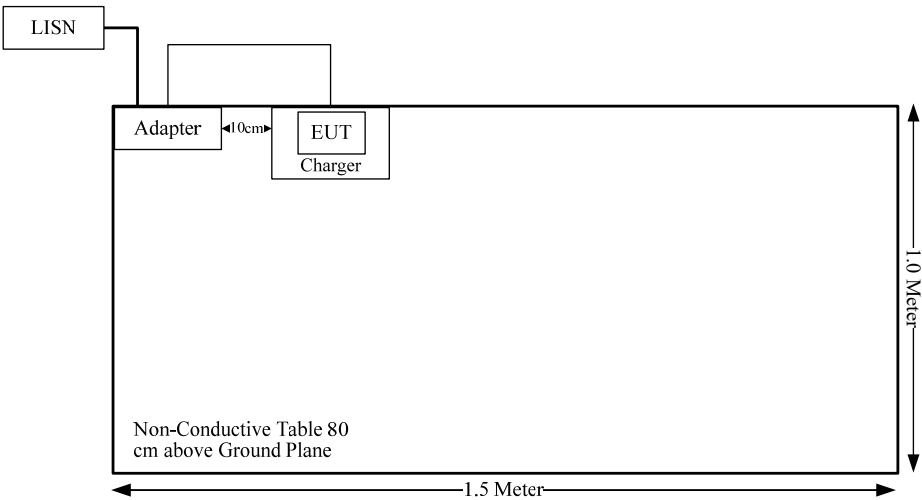
Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Apple	Mobile Phone	MGAA2CG/A	FK1R95UYG5QT

Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From	To
Adapter Cable	No	No	1.74	Adapter	EUT

Block Diagram of Test Setup



Test Equipment List

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conducted emission					
R&S	LISN	ENV 216	101614	2020-09-12	2021-09-12
R&S	EMI Test Receiver	ESCI	101121	2021-07-06	2022-07-05
MICRO-COAX	Coaxial Cable	C-NJNJ-50	C-0200-01	2020-09-05	2021-09-05
R&S	Test Software	EMC32	Version 9.10.00	N/A	N/A
Radiation Below 1GHz Test					
Sunol Sciences	Antenna	JB3	A060611-2	2020-08-25	2023-08-25
R&S	EMI Test Receiver	ESCI	100224	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-NJNJ-50	C-1000-01	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-02	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0530-01	2020-09-24	2021-09-24
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Radiation Above 1GHz Test					
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2020-12-05	2023-12-04
Agilent	Spectrum Analyzer	E4440A	SG43360054	2021-07-22	2022-07-21
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-2.4J2.4J-50	C-0700-02	2021-06-27	2022-06-26
Mini-Circuit	Amplifier	ZVA-213-S+	54201245	2020-09-05	2021-09-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2021-06-27	2022-06-26
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
E-Microwave	Band-stop Filters	OBSF-2400-2483.5-S	OE01601525	2021-06-16	2022-06-15
Mini Circuits	High Pass Filter	VHF-6010+	31118	2021-06-16	2022-06-15
RF Conducted					
R&S	EMI Test Receiver	ESR3	102453	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A
E-Microwave	Blocking Control	EMDCB-00036	0E01201047	2021-05-06	2022-05-05
E-Microwave	Coaxial Attenuators	EMCA10-5RN-6	OE01203239	2020-09-06	2021-09-06
Agilent	USB Wideband Power Sensor	U2022XA	MY5417006	2021-07-22	2022-07-21

* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Environmental Conditions

Test Items	Conducted Emissions	Radiated Emissions (Below 1GHz)	Radiated Emissions (Above 1GHz)	RF Conducted
Temperature:	26.1°C	28.1 °C	27.4 °C	26.9°C
Relative Humidity:	69%	48%	56 %	48%
ATM Pressure:	100.0kPa	99.5kPa	100.0kPa	100.7kPa
Tester:	Mia Huang	Johnson Huang	Jeremy Liang	Wayne Wei
Test Date:	2021-07-29	2021-08-02	2021-07-31	2021-08-16

SUMMARY OF TEST RESULTS

S/N	FCC Rules	Description of Test	Result
1	§15.247 (i) §1.1310 §2.1093	RF Exposure	Compliance
2	§15.203	Antenna requirement	Compliance
3	§15.207(a)	AC line conducted emissions	Compliance
4	§15.205 §15.209 §15.247(d)	Spurious emissions	Compliance
5	§15.247(a)(1)	Channel separation	Compliance
6	§15.247(a)(1)	20 dB bandwidth	Compliance
7	§15.247(a)(1)(iii)	Quantity of hopping channel test	Compliance
8	§15.247(a)(1)(iii)	Time of occupancy (dwell time)	Compliance
9	§15.247(b)(1)	Peak output power measurement	Compliance
10	§15.247(d)	Band edges	Compliance

1 - RF EXPOSURE

Applicable Standard

According to §15.247(i) and §1.1310, 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.

According to KDB447498 D01 General RF Exposure Guidance v06:

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

Measurement Result

The max conducted power including tune-up tolerance is 6 dBm (4 mW).

$[(\text{max. power of channel, mW})/(\text{min. test separation distance, mm})][\sqrt{f(\text{GHz})}]$
 $= 4/5 \cdot (\sqrt{2.480}) = 1.3 < 3.0$

So the stand-alone SAR evaluation is not necessary.

2 - ANTENNA REQUIREMENT

Applicable Standard

According to § 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 user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.
- c. Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

Antenna Information And Connector Construction

The EUT has one internal antenna arrangement for BT, fulfill the requirement of this section. Please refer to below information and the EUT photos:

Antenna Type	input impedance (Ohm)	Antenna Gain /Frequency Range
FPC	50	0dBi/2.4~2.5GHz

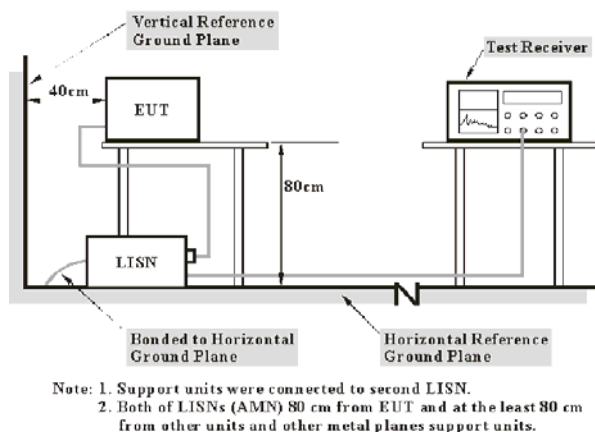
Result: Compliance.

3 – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207(a)

Test System Setup



The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207.

The spacing between the peripherals was 10 cm.

The adapter was connected to the main lisn with a 120 V/60 Hz AC power source.

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 first LISN.

The frequency and amplitude of the six highest ac power-line conducted emissions relative to the limit, measured over all the current-carrying conductors of the EUT power cords, and the operating frequency or frequency to which the EUT is tuned (if appropriate), should be reported, unless such emissions are more than 20 dB below the limit. AC power-line conducted emissions measurements are to be separately carried out only on each of the phase (“hot”) line(s) and (if used) on the neutral line(s), but not on the ground [protective earth] line(s). If less than six emission frequencies are within 20 dB of the limit, then the noise level of the measuring instrument at representative frequencies should be reported. The specific conductor of the power-line cord for each of the reported emissions should be identified. Measure the six highest emissions with respect to the limit on each current-carrying conductor of each power cord associated with the EUT (but not the power cords of associated or peripheral equipment that are part of the test configuration). Then, report the six highest emissions with respect to the limit from among all the measurements identifying the frequency and specific current-carrying conductor identified with the emission. The six highest emissions should be reported for each of the current-carrying conductors, or the six highest emissions may be reported over all the current-carrying conductors.

Corrected Amplitude & Margin Calculation

The basic equation is as follows: $V_C = V_R + A_C + VDF$; $C_f = A_C + VDF$

Herein,

V_C (cord. Reading): corrected voltage amplitude

V_R : reading voltage amplitude

A_C : attenuation caused by cable loss

VDF: voltage division factor of AMN

C_f : Correction Factor

The “**Margin**” column of the following data tables indicates the degree of compliance within the applicable limit.

For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows: $\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$

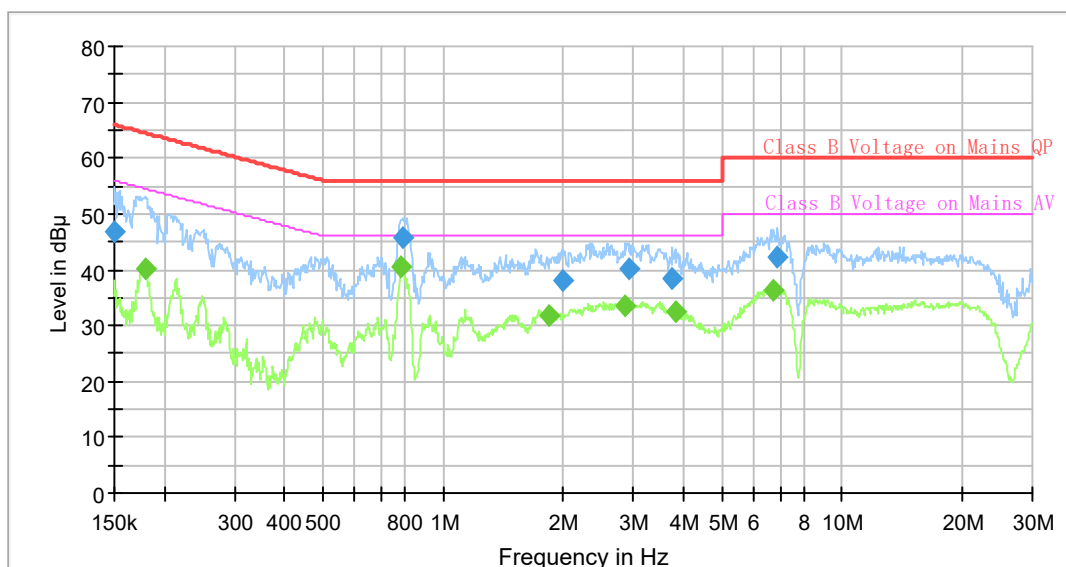
Test Data

Test Mode: Transmitting

Test Result: Compliance. Please refer to following tables and plots.

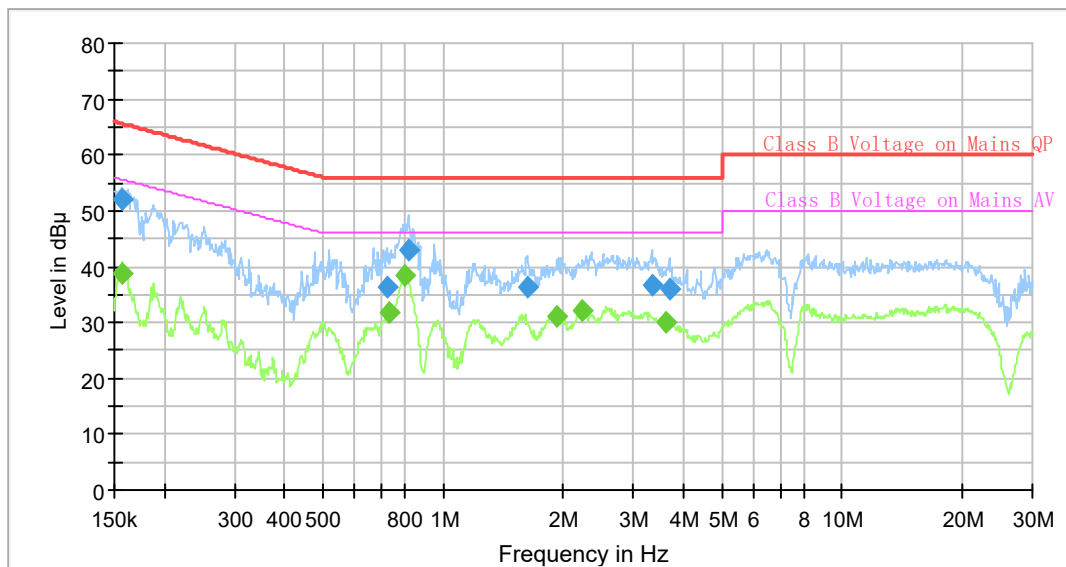
Model: HP782 VHF (worst case)

AC120V, 60 Hz, Line:



Final Result

Frequency (MHz)	QuasiPeak (dB μ V)	Average (dB μ V)	Limit (dB μ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.150000	46.64	---	66.00	19.36	9.000	L1	9.6
0.179502	---	40.19	54.51	14.32	9.000	L1	9.6
0.785640	---	40.50	46.00	5.50	9.000	L1	9.7
0.793516	45.75	---	56.00	10.25	9.000	L1	9.7
1.843403	---	31.64	46.00	14.36	9.000	L1	9.7
1.986604	38.09	---	56.00	17.91	9.000	L1	9.7
2.859129	---	33.61	46.00	12.39	9.000	L1	9.7
2.916742	40.11	---	56.00	15.89	9.000	L1	9.7
3.761553	38.45	---	56.00	17.55	9.000	L1	9.7
3.837350	---	32.37	46.00	13.63	9.000	L1	9.7
6.742118	---	36.20	50.00	13.80	9.000	L1	9.8
6.877976	42.15	---	60.00	17.85	9.000	L1	9.8

AC120V, 60 Hz, Neutral:**Final_Result**

Frequency (MHz)	QuasiPeak (dB μ V)	Average (dB μ V)	Limit (dB μ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.156106	---	38.92	55.67	16.75	9.000	N	9.6
0.156887	51.88	---	65.63	13.75	9.000	N	9.6
0.721773	36.40	---	56.00	19.60	9.000	N	9.6
0.732654	---	31.87	46.00	14.13	9.000	N	9.6
0.805479	---	38.57	46.00	7.43	9.000	N	9.6
0.817621	42.97	---	56.00	13.03	9.000	N	9.6
1.627304	36.24	---	56.00	19.76	9.000	N	9.6
1.928035	---	31.13	46.00	14.87	9.000	N	9.6
2.228079	---	32.31	46.00	13.69	9.000	N	9.6
3.337196	36.82	---	56.00	19.18	9.000	N	9.6
3.632492	---	30.20	46.00	15.80	9.000	N	9.6
3.687253	35.91	---	56.00	20.09	9.000	N	9.6

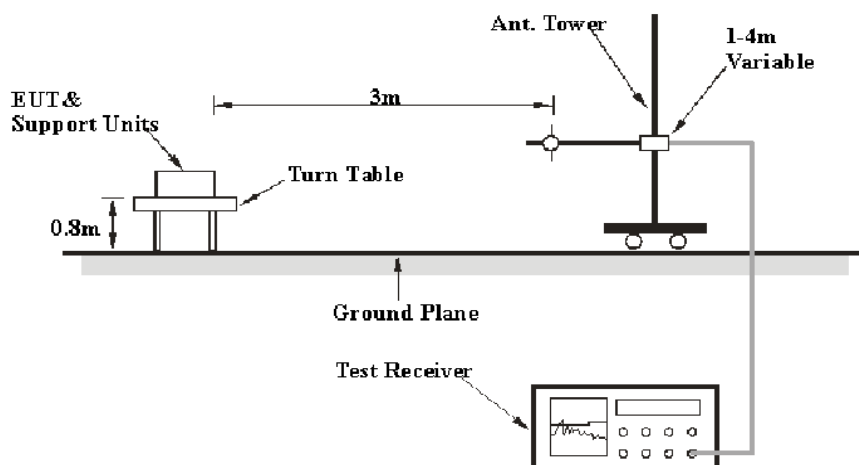
4 - SPURIOUS EMISSIONS

Applicable Standard

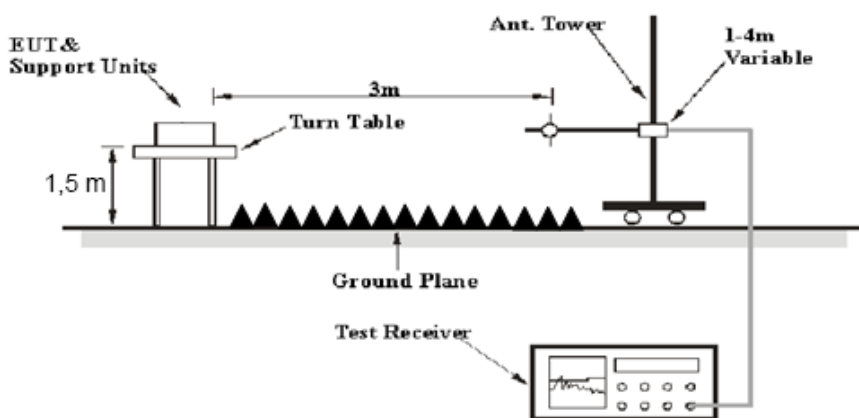
FCC §15.247 (d); §15.209; §15.205;

Test System Setup

Below 1GHz:



Above 1GHz:



The radiated emission Below 1GHz tests were performed in the 3 meters chamber, above 1GHz tests were performed in the 3 meters chamber B, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

According to ANSI C63.10-2013, during the radiated emission test, 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	120 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	AV

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

Test Procedure

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

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz - 1 GHz, peak and average detection modes for frequencies above 1 GHz.

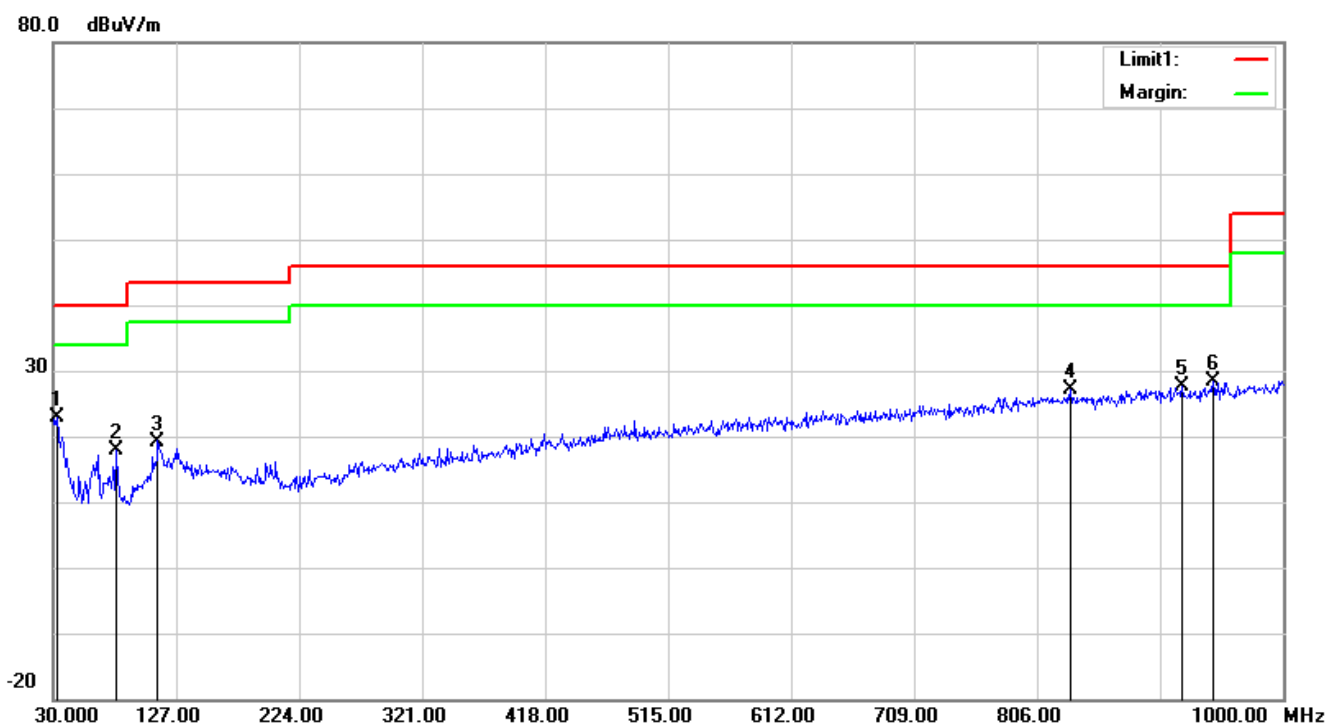
Corrected Amplitude & Margin Calculation

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

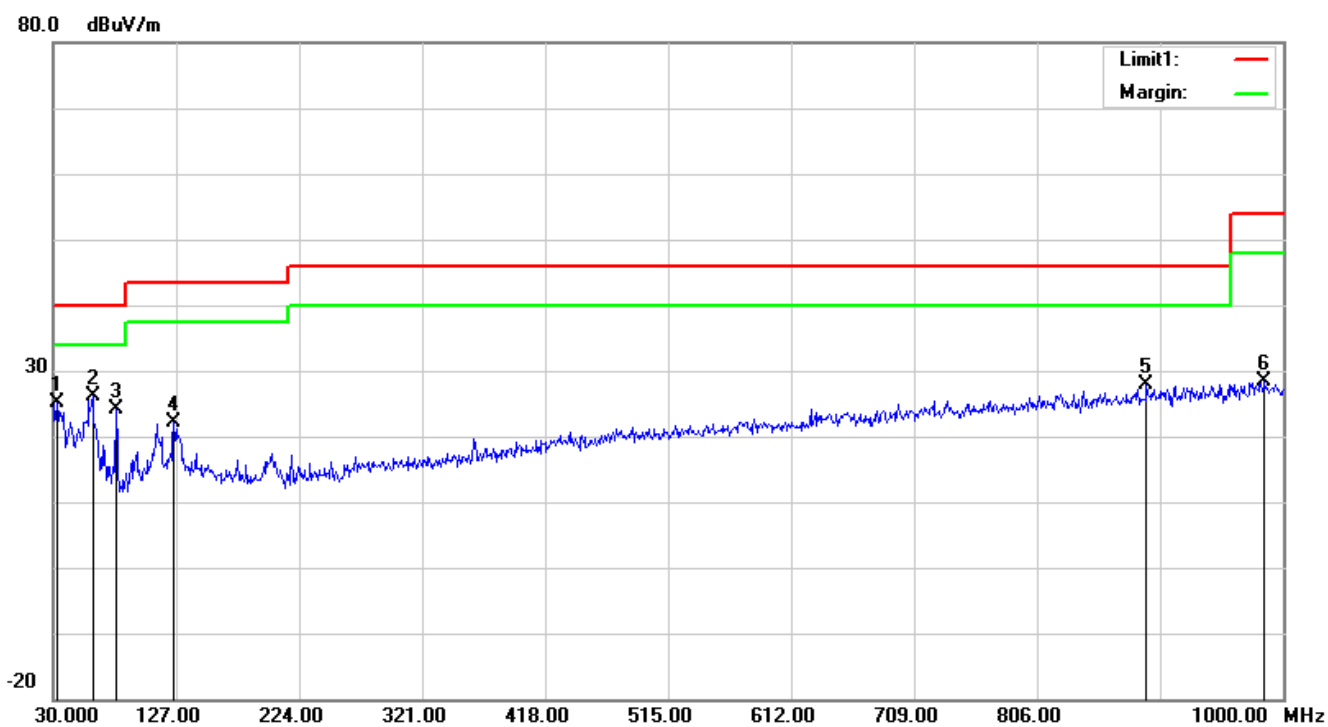
$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Data*Test Mode: Transmitting***Test Result:** Compliance*Please Refer to the following data.***1) 30MHz-1GHz (Model: HP782 VHF, BDR High channel was the worst)****Horizontal:**

Frequency (MHz)	Receiver Reading (dBμV)	Remark	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
32.9100	28.58	peak	-5.72	22.86	40.00	17.14
79.4700	34.71	peak	-16.75	17.96	40.00	22.04
112.4500	30.75	peak	-11.50	19.25	43.50	24.25
832.1900	27.51	peak	-0.49	27.02	46.00	18.98
920.4600	26.49	peak	1.04	27.53	46.00	18.47
944.7100	26.81	peak	1.62	28.43	46.00	17.57

Vertical:

Frequency (MHz)	Receiver Reading (dBμV)	Remark	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
32.9100	30.91	peak	-5.72	25.19	40.00	14.81
61.0400	43.58	peak	-17.44	26.14	40.00	13.86
79.4700	40.87	peak	-16.75	24.12	40.00	15.88
125.0600	32.69	peak	-10.52	22.17	43.50	21.33
892.3300	27.14	peak	0.77	27.91	46.00	18.09
985.4500	25.91	peak	2.40	28.31	54.00	25.69

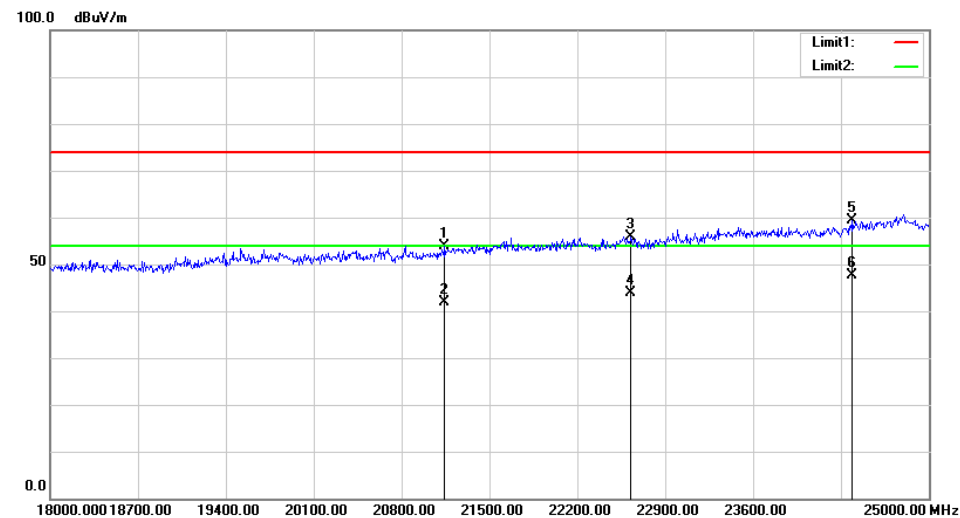
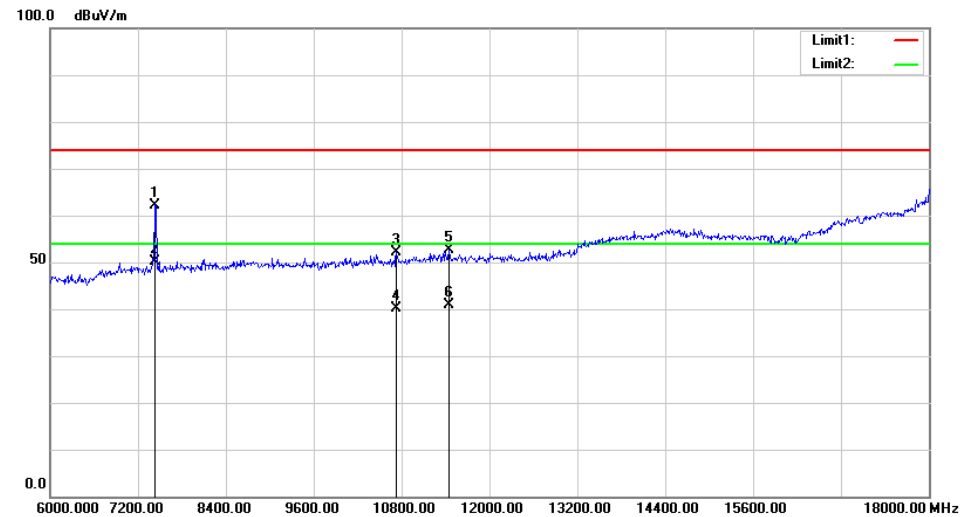
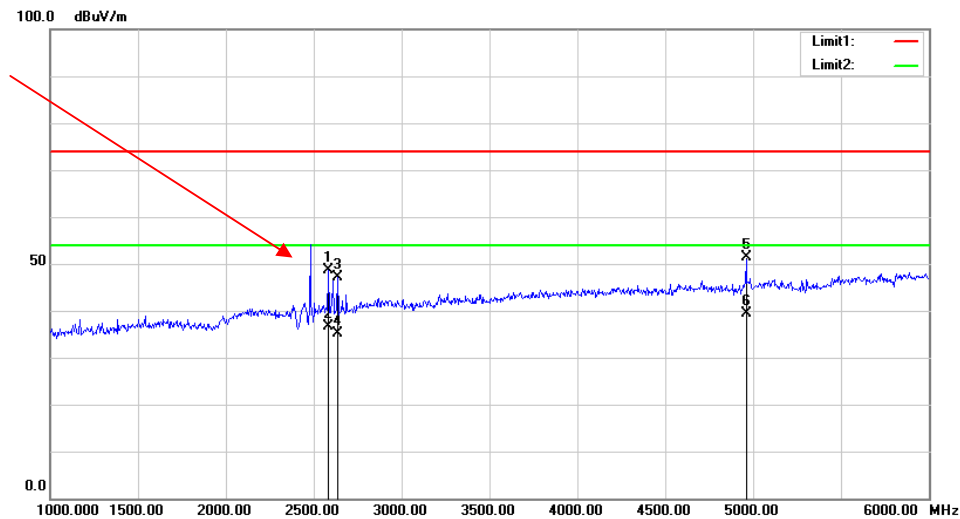
2)1GHz-25GHz:*BDR Mode (Model HP782 VHF was the worst case):*

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Remark	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2402.00	61.83	PK	H	28.10	1.80	0.00	91.73	N/A	N/A
2402.00	51.44	AV	H	28.10	1.80	0.00	81.34	N/A	N/A
2402.00	60.05	PK	V	28.10	1.80	0.00	89.95	N/A	N/A
2402.00	49.66	AV	V	28.10	1.80	0.00	79.56	N/A	N/A
2390.00	26.64	PK	H	28.08	1.80	0.00	56.52	74.00	17.48
2390.00	13.27	AV	H	28.08	1.80	0.00	43.15	54.00	10.85
4804.00	42.44	PK	H	32.91	3.17	25.60	52.92	74.00	21.08
4804.00	31.35	AV	H	32.91	3.17	25.60	41.83	54.00	12.17
7206.00	45.81	PK	H	35.74	4.82	25.60	60.77	74.00	13.23
7206.00	34.15	AV	H	35.74	4.82	25.60	49.11	54.00	4.89
2583.00	44.26	PK	H	28.60	1.87	26.20	48.53	74.00	25.47
2583.00	33.02	AV	H	28.60	1.87	26.20	37.29	54.00	16.71
Middle Channel: 2441 MHz									
2441.00	63.64	PK	H	28.18	1.82	0.00	93.64	N/A	N/A
2441.00	53.48	AV	H	28.18	1.82	0.00	83.48	N/A	N/A
2441.00	63.35	PK	V	28.18	1.82	0.00	93.35	N/A	N/A
2441.00	53.24	AV	V	28.18	1.82	0.00	83.24	N/A	N/A
4882.00	41.51	PK	H	33.06	3.27	25.66	52.18	74.00	21.82
4882.00	30.24	AV	H	33.06	3.27	25.66	40.91	54.00	13.09
7323.00	46.25	PK	H	36.04	4.62	25.73	61.18	74.00	12.82
7323.00	34.91	AV	H	36.04	4.62	25.73	49.84	54.00	4.16
2583.00	44.62	PK	H	28.60	1.87	26.20	48.89	74.00	25.11
2583.00	33.52	AV	H	28.60	1.87	26.20	37.79	54.00	16.21
High Channel: 2480 MHz									
2480.00	66.21	PK	H	28.26	1.84	0.00	96.31	N/A	N/A
2480.00	55.96	AV	H	28.26	1.84	0.00	86.06	N/A	N/A
2480.00	65.94	PK	V	28.26	1.84	0.00	96.04	N/A	N/A
2480.00	55.92	AV	V	28.26	1.84	0.00	86.02	N/A	N/A
2483.50	26.31	PK	H	28.27	1.84	0.00	56.42	74.00	17.58
2483.50	14.09	AV	H	28.27	1.84	0.00	44.20	54.00	9.80
4960.00	40.66	PK	H	33.22	3.23	25.63	51.48	74.00	22.52
4960.00	28.64	AV	H	33.22	3.23	25.63	39.46	54.00	14.54
7440.00	47.21	PK	H	36.34	4.41	25.85	62.11	74.00	11.89
7440.00	35.29	AV	H	36.34	4.41	25.85	50.19	54.00	3.81
2583.00	44.35	PK	H	28.60	1.87	26.20	48.62	74.00	25.38
2583.00	33.14	AV	H	28.60	1.87	26.20	37.41	54.00	16.59

3) Worst plots (GFSK High channel was the worst)

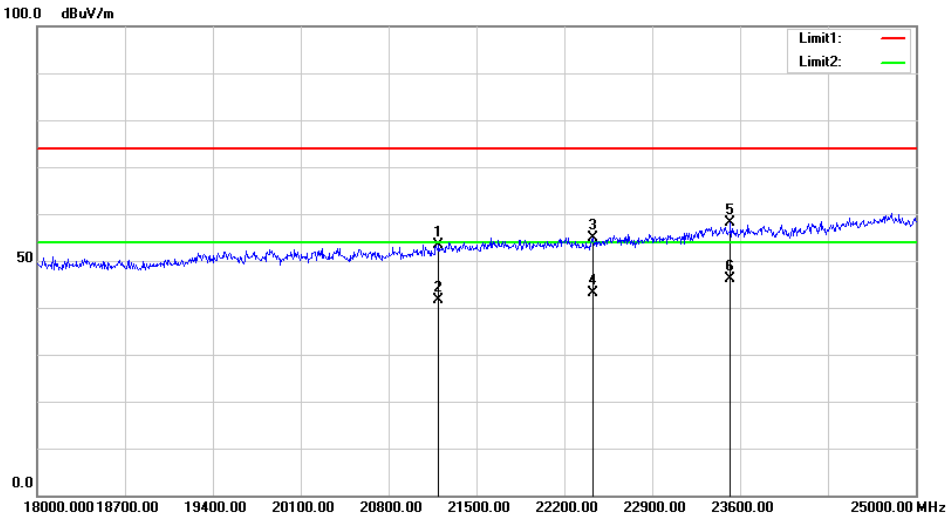
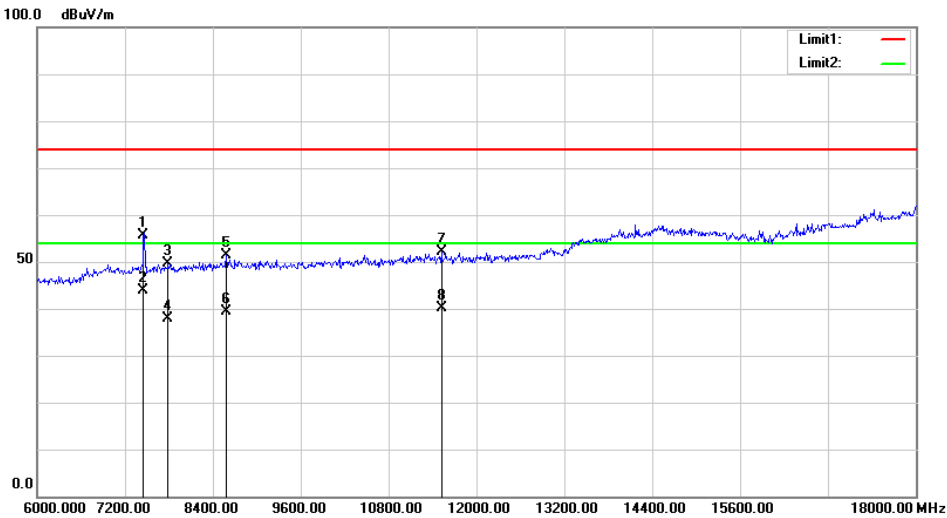
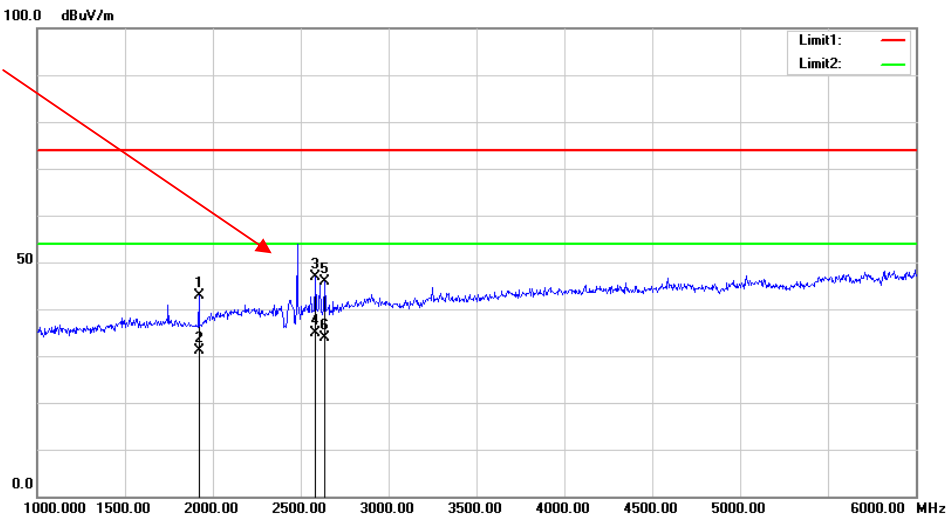
Horizontal

Fundamental
Test with Band
Rejection Filter



Vertical

Fundamental
Test with Band
Rejection Filter



5 - CHANNEL SEPARATION TEST

Applicable Standard

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.50 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW.

Test Procedure

1. Set the EUT in transmitting mode, spectrum Bandwidth was set at 30 kHz, maxhold the channel.
2. Set the adjacent channel of the EUT maxhold another trace.
3. Measure the channel separation.

Test Data

Test Mode: Transmitting

Test Result: Compliance. Please refer to following tables and plots.

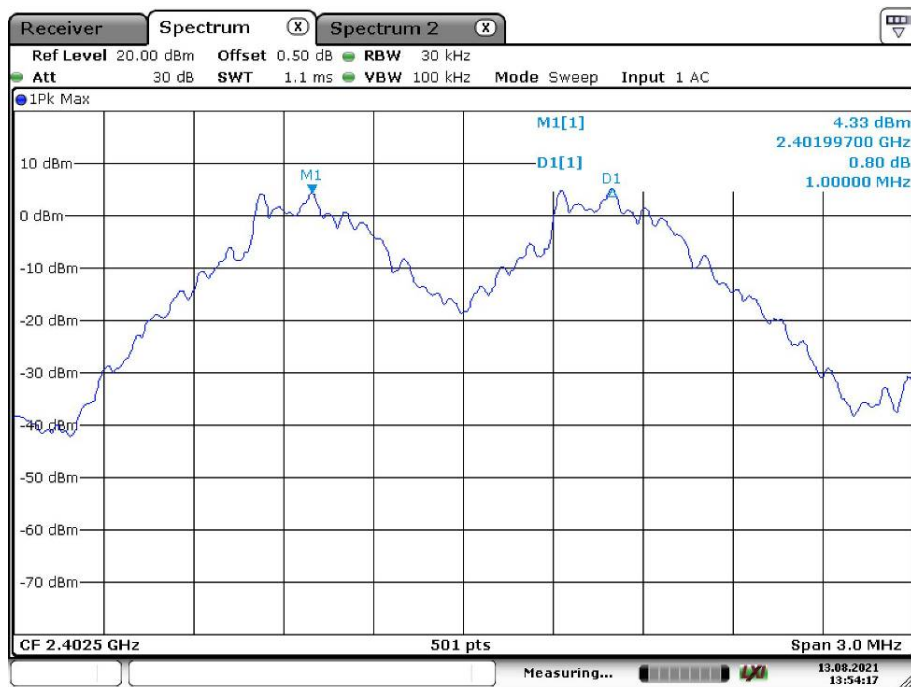
Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
BDR (GFSK)	Low	2402-2403	1.000	0.59
	Middle	2441-2442	1.000	0.60
	High	2480-2479	0.994	0.59
EDR ($\pi/4$ -DQPSK)	Low	2402-2403	1.006	0.81
	Middle	2441-2442	1.000	0.82
	High	2480-2479	1.000	0.82
EDR (8DPSK)	Low	2402-2403	1.006	0.81
	Middle	2441-2442	1.000	0.81
	High	2480-2479	1.000	0.81

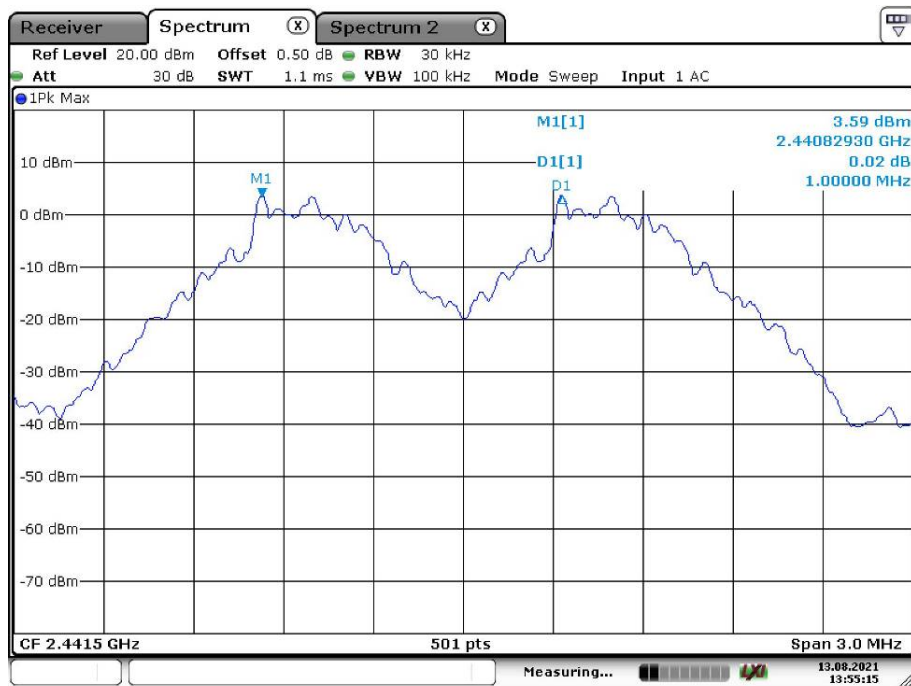
Note: Limit= $(2/3) \times 20\text{dB bandwidth}$

BDR Mode (GFSK):

Low Channel



Middle Channel



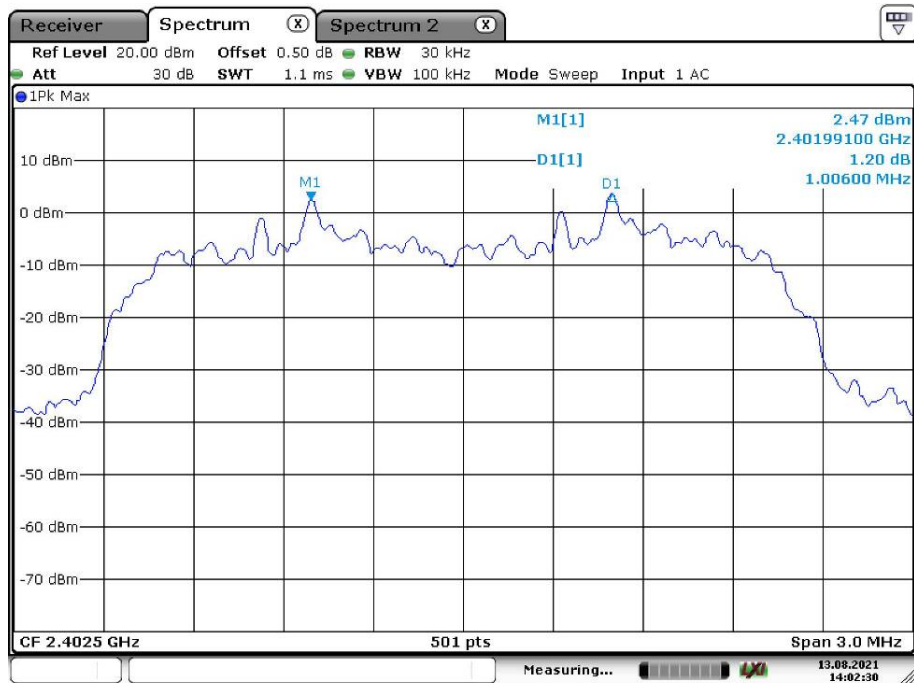
High Channel



Date: 13.AUG.2021 14:00:28

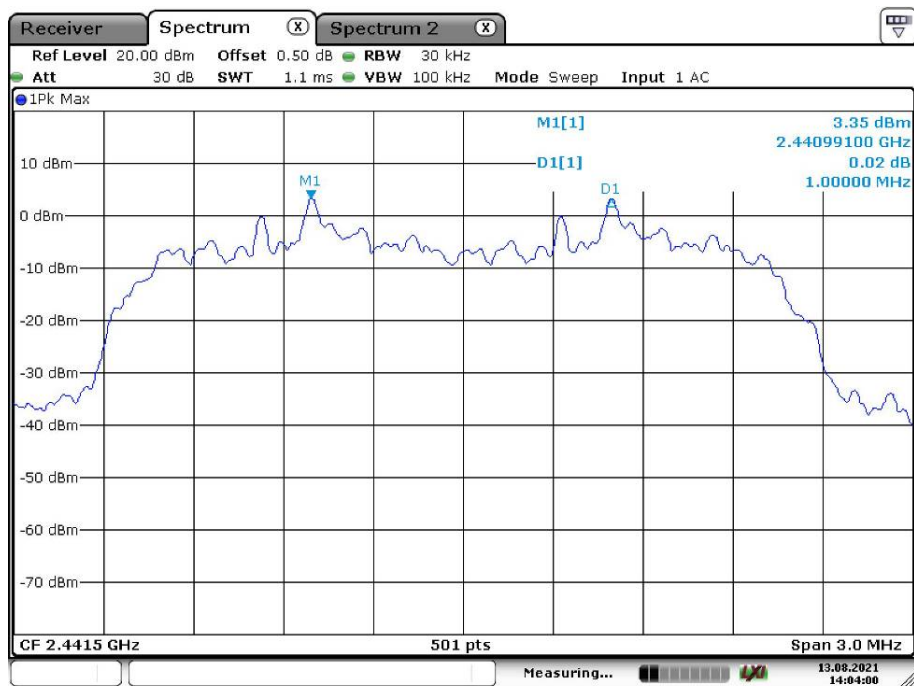
EDR Mode ($\pi/4$ -DQPSK):

Low Channel



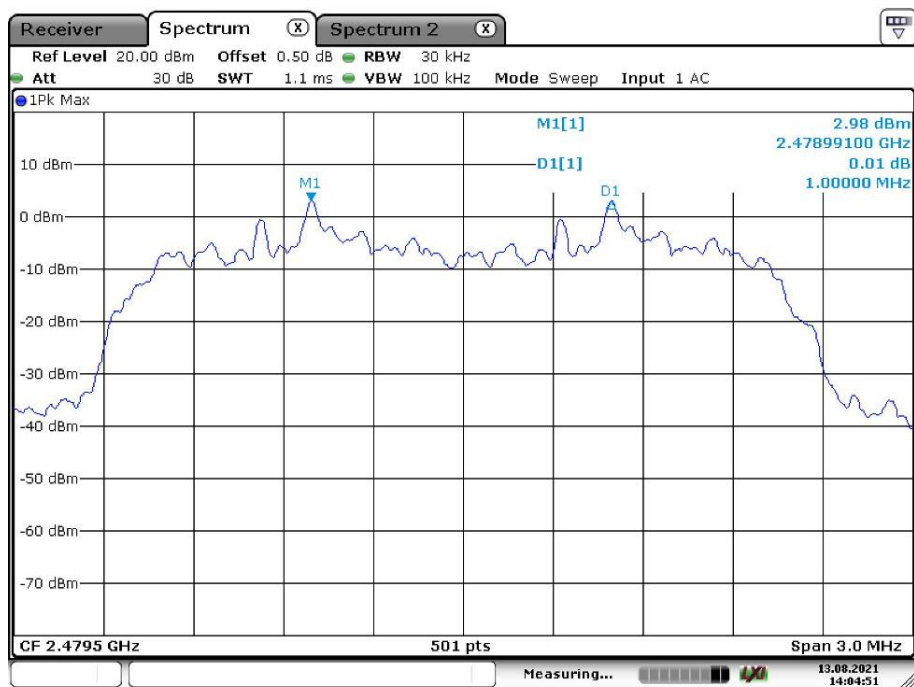
Date: 13.AUG.2021 14:02:30

Middle Channel



Date: 13.AUG.2021 14:04:00

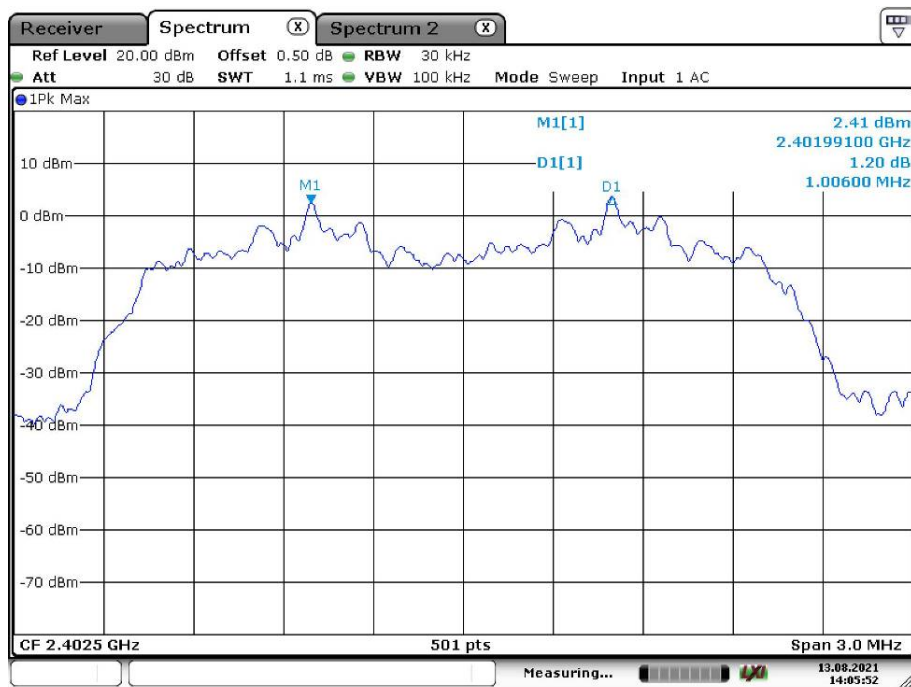
High Channel



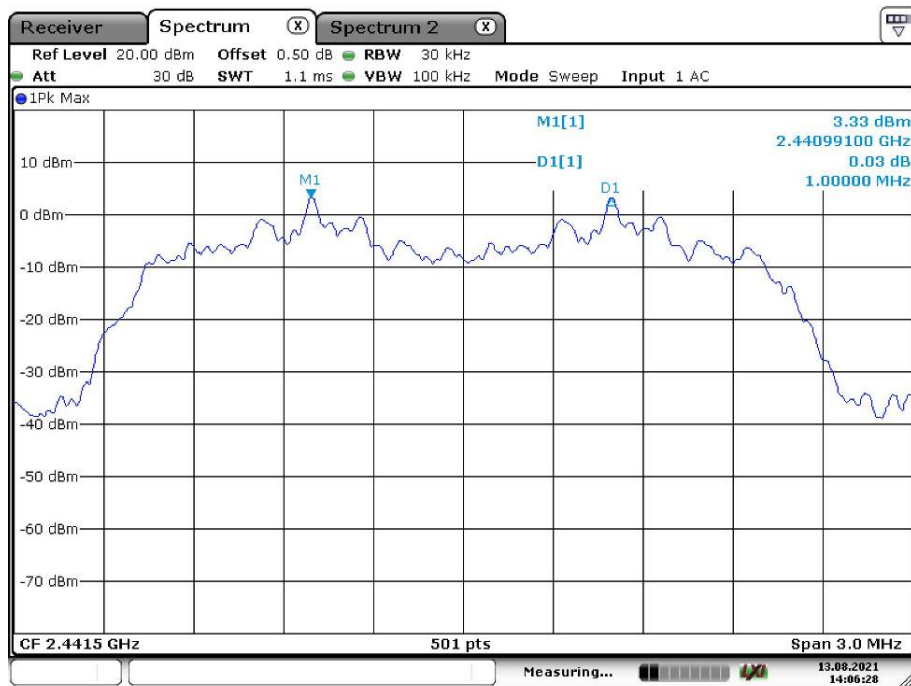
Date: 13.AUG.2021 14:04:51

EDR Mode (8DPSK):

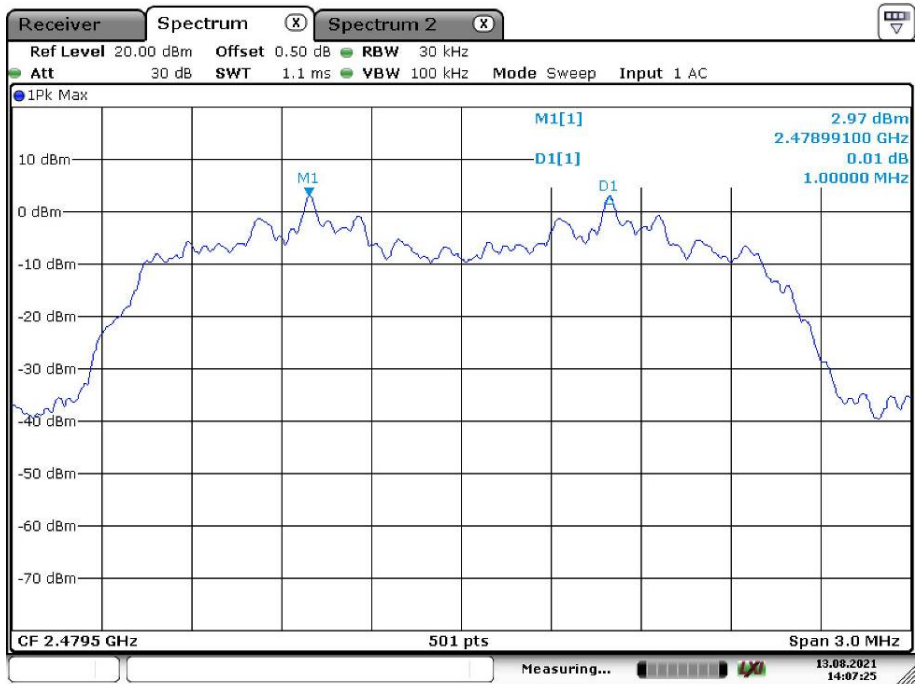
Low Channel



Middle Channel



High Channel



Date: 13.AUG.2021 14:07:25

6 – 20 dB BANDWIDTH TESTING

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

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on the test table without connection to measurement instrument. Turn on the EUT. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Data

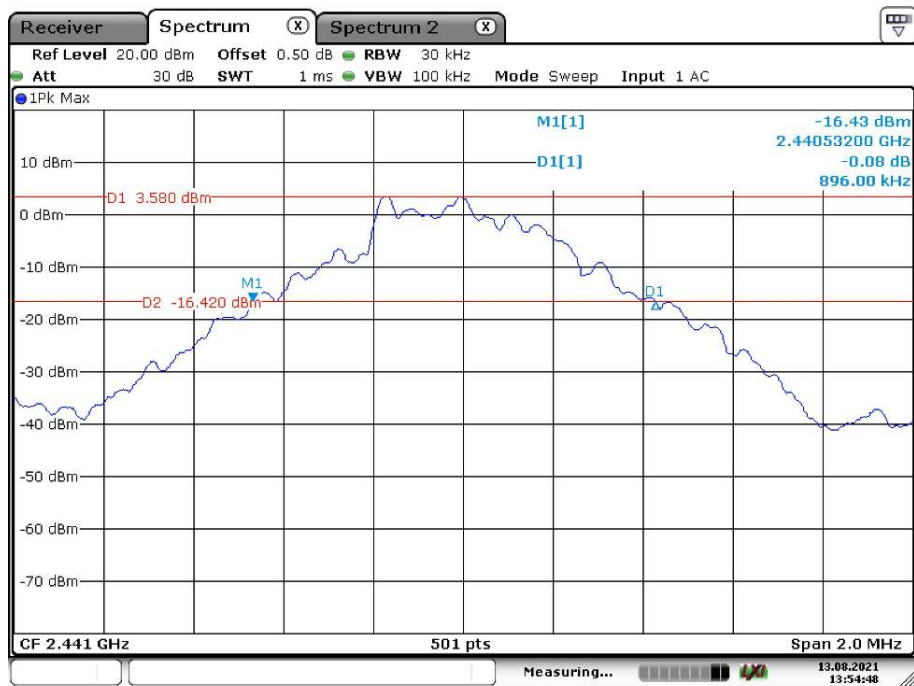
Test Mode: Transmitting

Test Result: Compliance. Please refer to following tables and plots.

Mode	Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
BDR Mode (GFSK)	Low	2402	0.884
	Middle	2441	0.896
	High	2480	0.884
EDR Mode ($\pi/4$ -DQPSK)	Low	2402	1.220
	Middle	2441	1.224
	High	2480	1.224
EDR Mode (8DPSK)	Low	2402	1.212
	Middle	2441	1.216
	High	2480	1.212

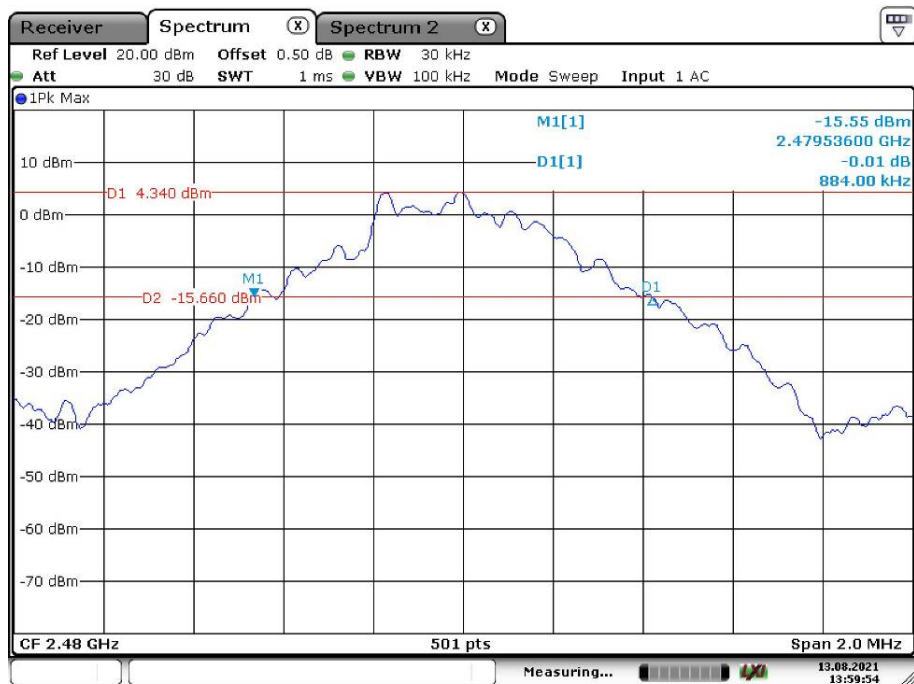
*BDR Mode (GFSK):***Low Channel**

Date: 13.AUG.2021 13:53:39

Middle Channel

Date: 13.AUG.2021 13:54:48

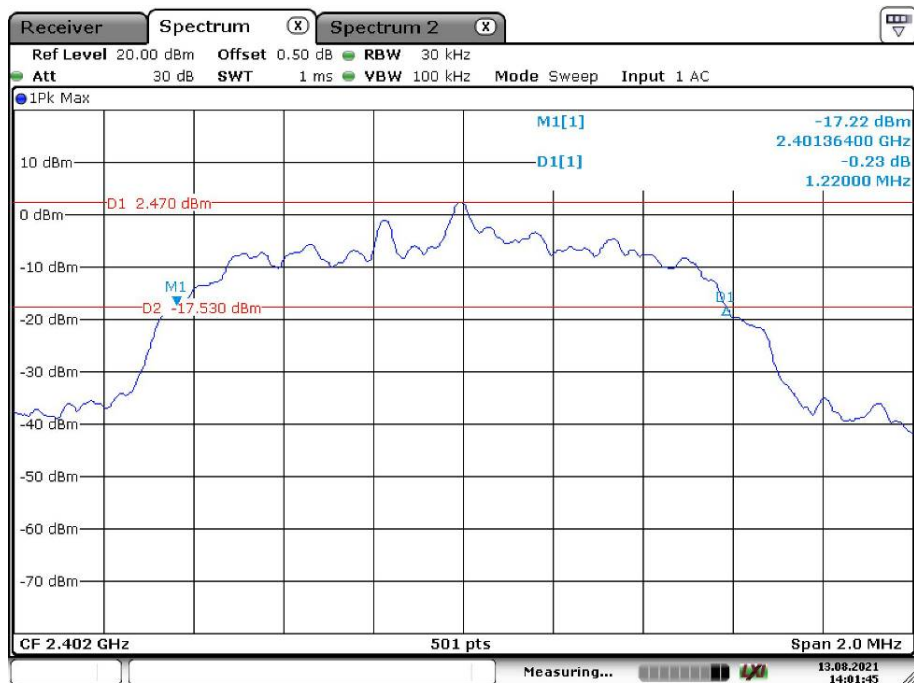
High Channel



Date: 13.AUG.2021 13:59:53

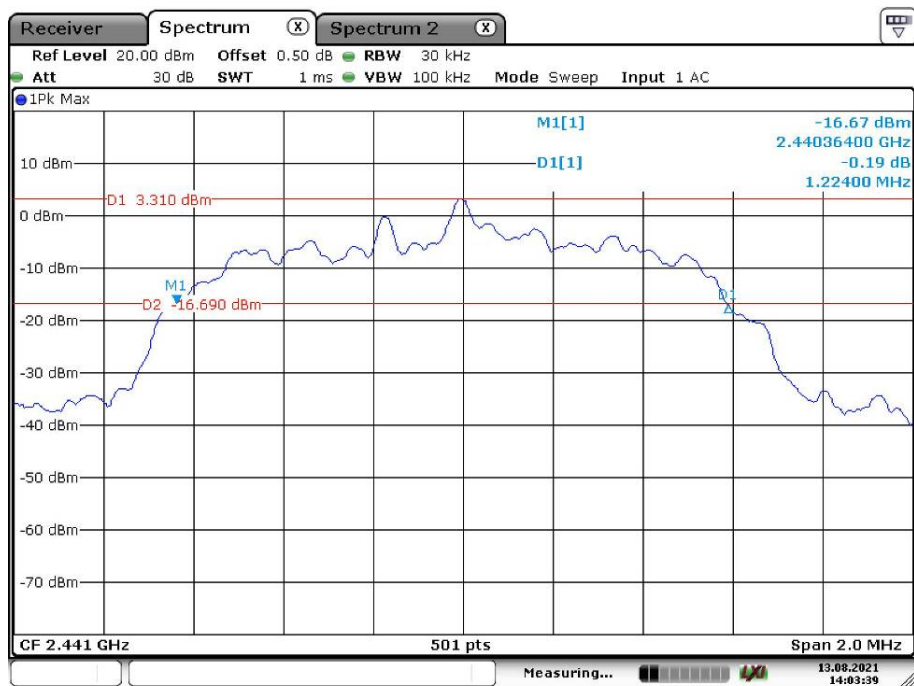
EDR Mode ($\pi/4$ -DQPSK):

Low Channel



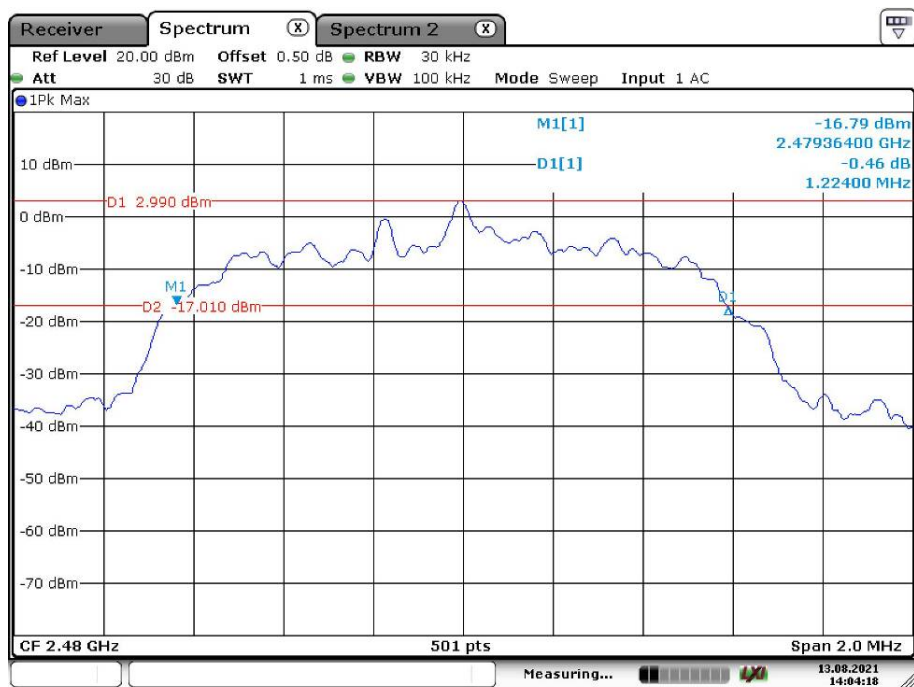
Date: 13.AUG.2021 14:01:45

Middle Channel



Date: 13.AUG.2021 14:03:38

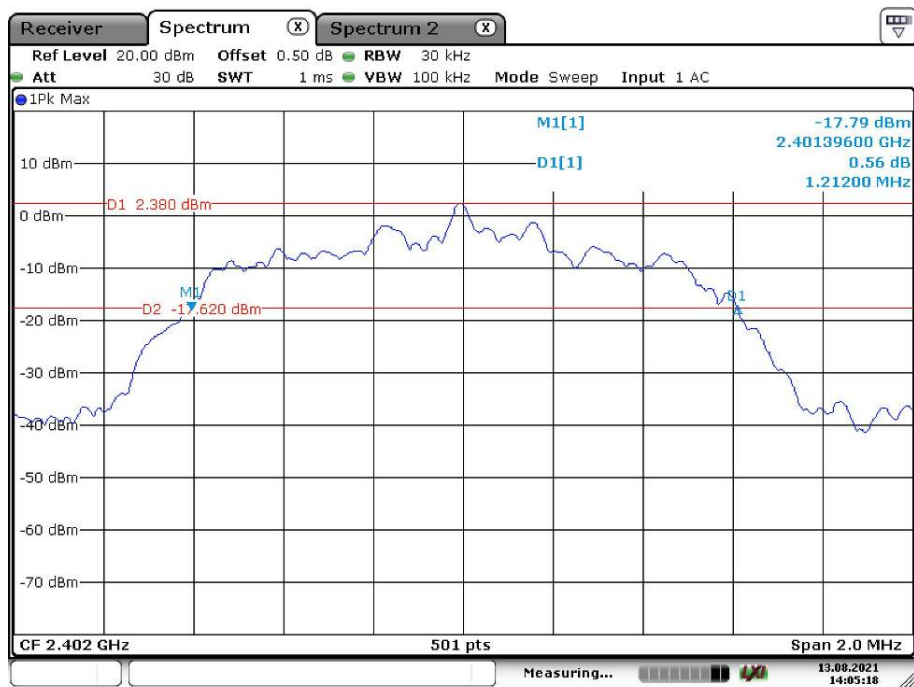
High Channel



Date: 13.AUG.2021 14:04:18

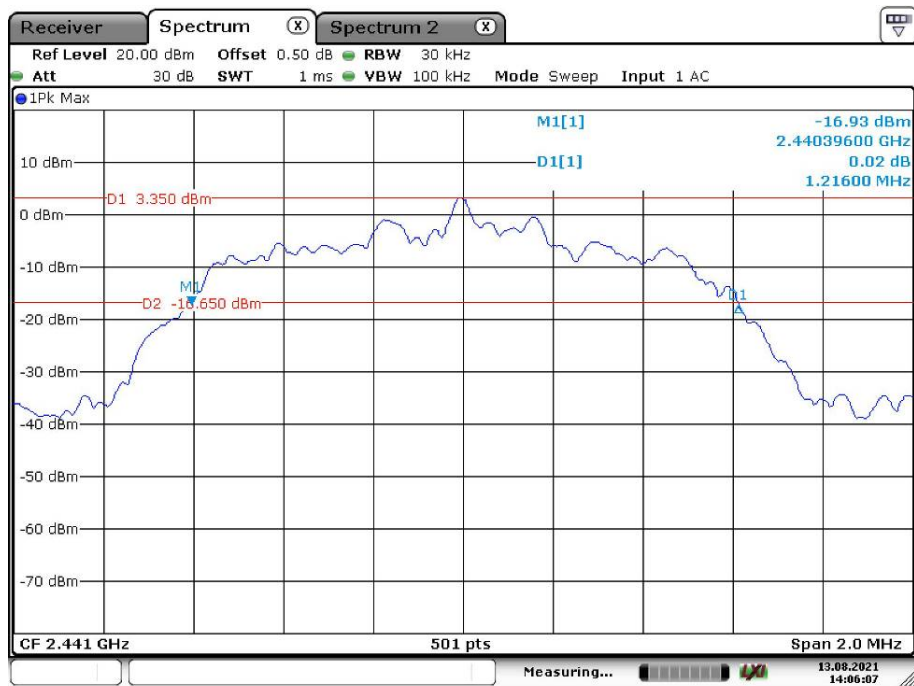
EDR Mode (8DPSK):

Low Channel



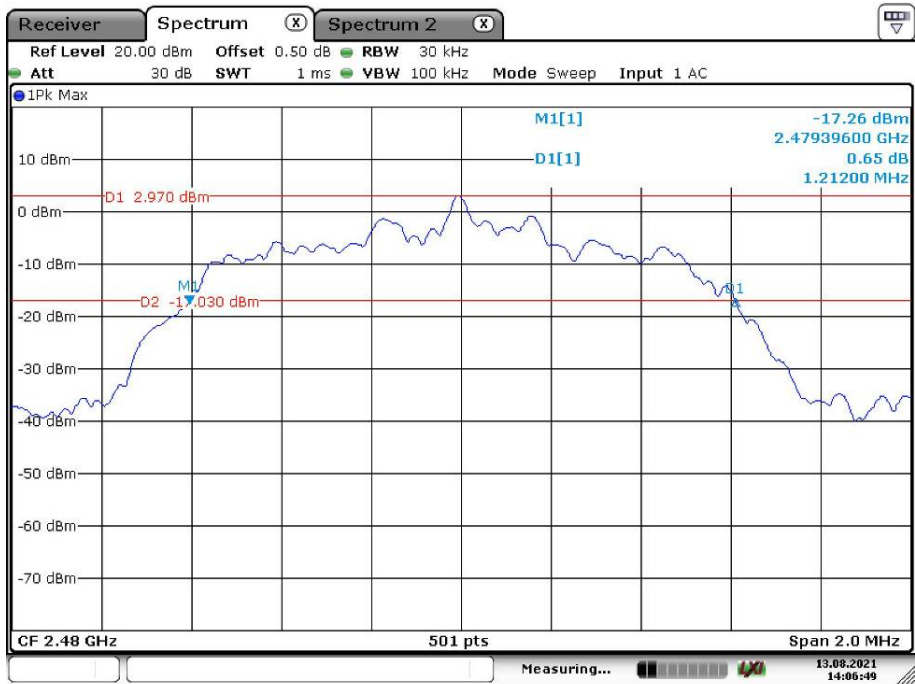
Date: 13.AUG.2021 14:05:18

Middle Channel



Date: 13.AUG.2021 14:06:07

High Channel



Date: 13.AUG.2021 14:06:49

7 - 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.

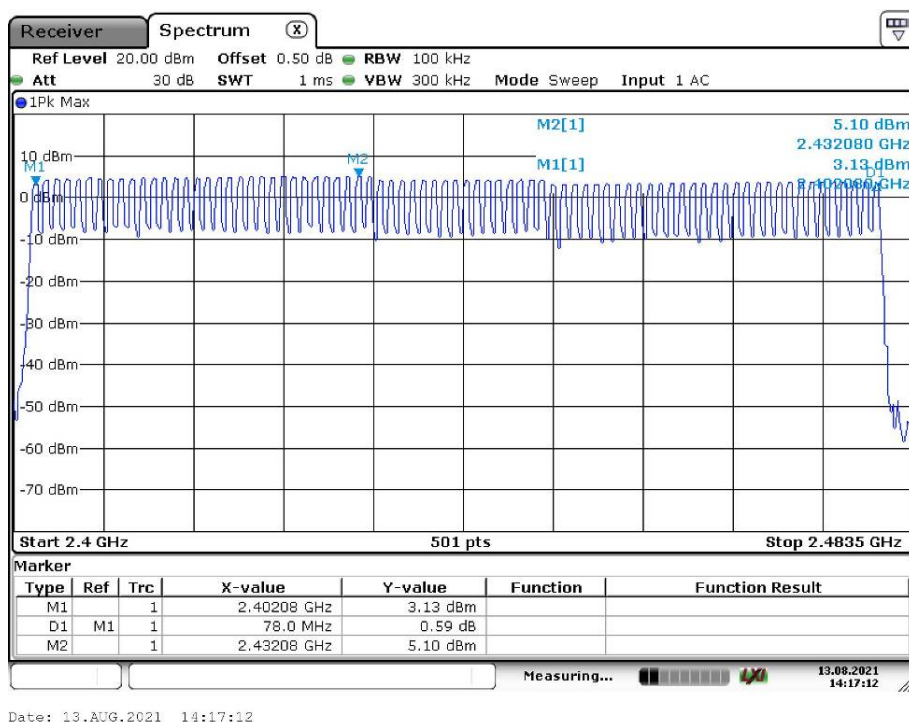
Test Data

Test Mode: Transmitting

Test Result: Compliance. Please refer to following tables and plots.

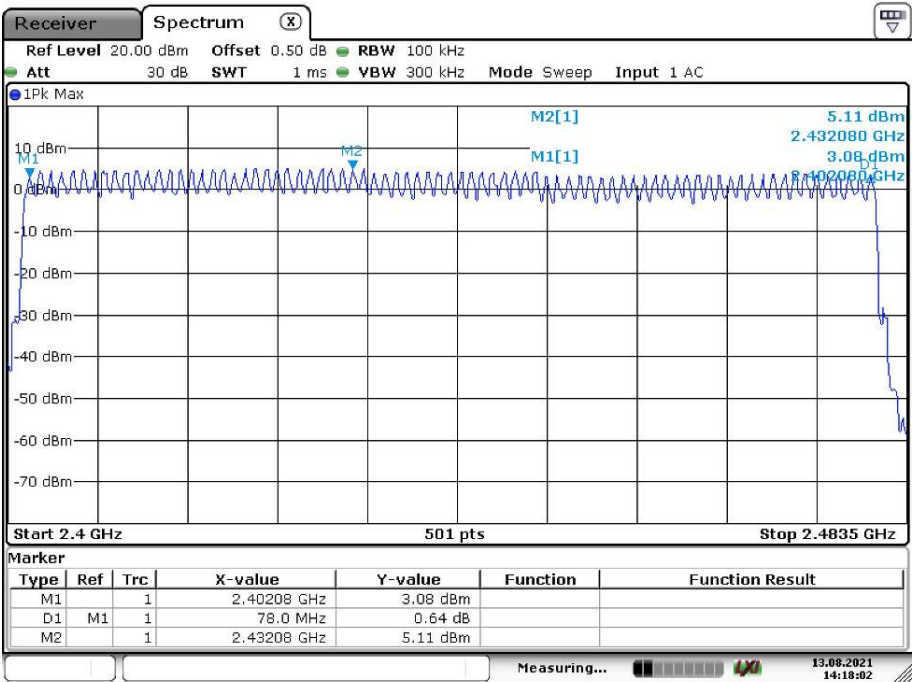
Test mode	Frequency Range (MHz)	Number of Hopping Channel	Limit
GFSK	2400-2483.5	79	≥15
$\pi/4$ -DQPSK	2400-2483.5	79	≥15
8DPSK	2400-2483.5	79	≥15

BDR Mode (GFSK)



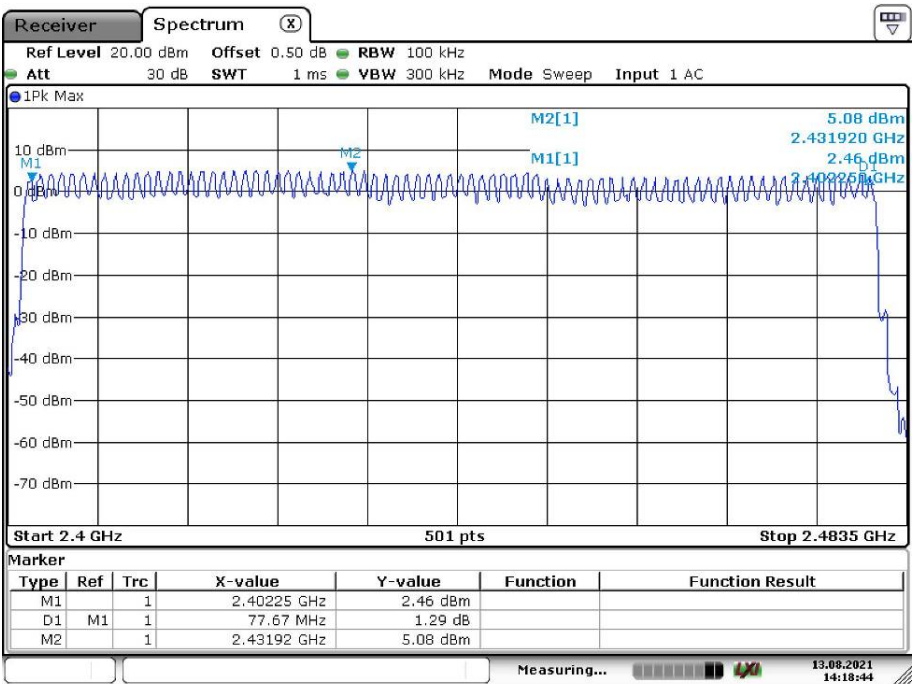
Date: 13.AUG.2021 14:17:12

EDR Mode ($\pi/4$ -DQPSK)



Date: 13.AUG.2021 14:18:02

EDR Mode (8DPSK)



Date: 13.AUG.2021 14:18:44

8 - 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

The EUT was worked in channel hopping; the time of single pulses was tested.

Test Data

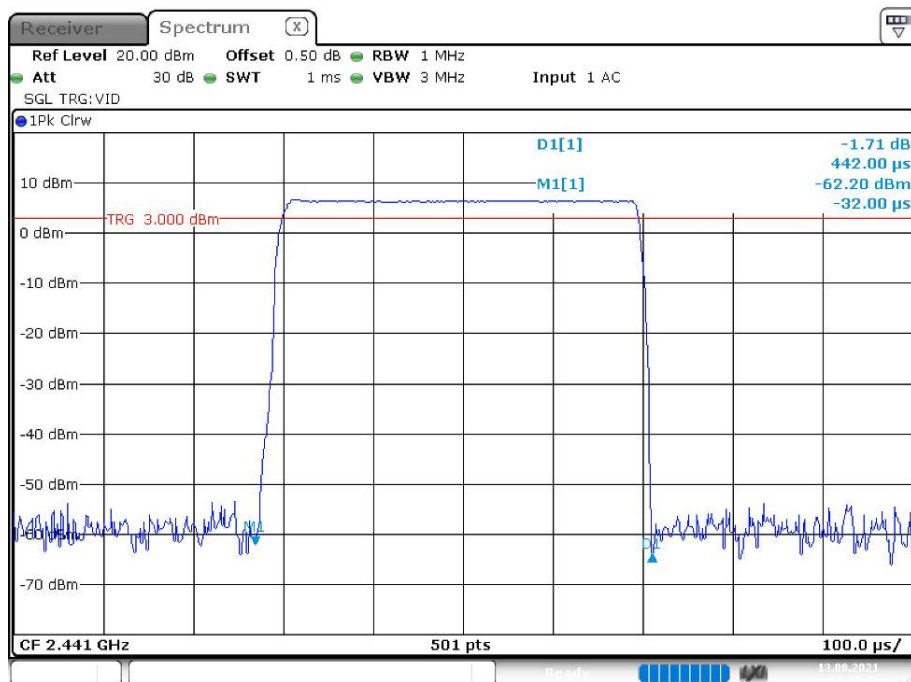
Test Mode: Transmitting

Test Result: Compliance. Please refer to following tables and plots.

Mode	Packet type	Channel	Frequency (MHz)	Puse width (ms)	Result (s)	Limit (s)
GFSK	DH1	Middle	2441	0.442	0.141	0.4
	DH3	Middle	2441	1.714	0.274	
	DH5	Middle	2441	3.010	0.321	
$\pi/4$ -DQPSK	2DH1	Middle	2441	0.455	0.146	
	2DH3	Middle	2441	1.721	0.275	
	2DH5	Middle	2441	2.977	0.318	
8DPSK	3DH1	Middle	2441	0.460	0.147	
	3DH3	Middle	2441	1.714	0.274	
	3DH5	Middle	2441	2.978	0.318	
Note: DH1:Dwell time=Pulse time (ms) \times (1600/2/79) \times 31.6 s DH3:Dwell time=Pulse time (ms) \times (1600/4/79) \times 31.6 s DH5:Dwell time=Pulse time (ms) \times (1600/6/79) \times 31.6 s						

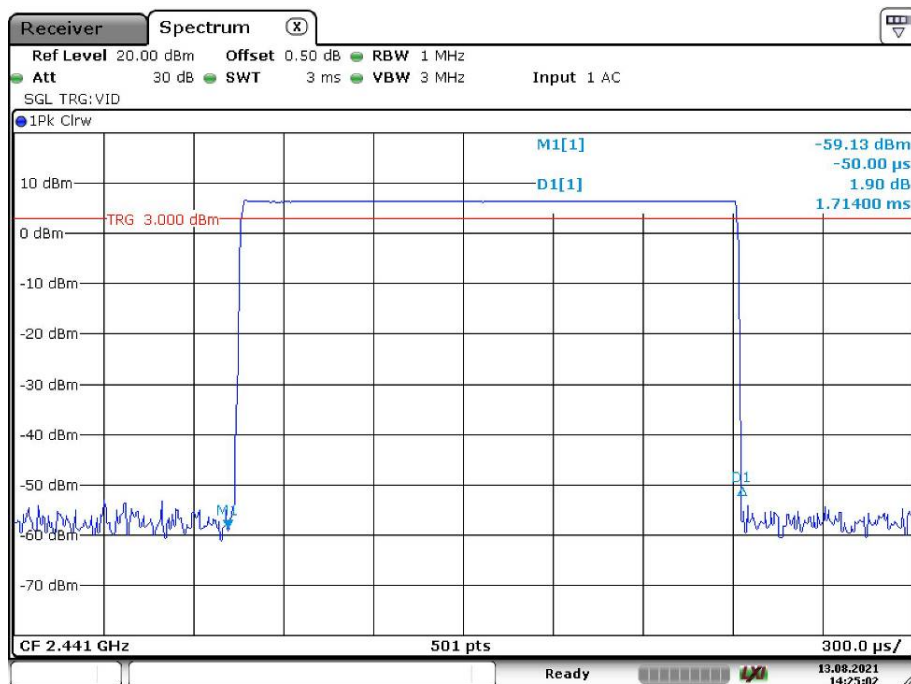
BDR Mode (GFSK):

DH1: Middle Channel



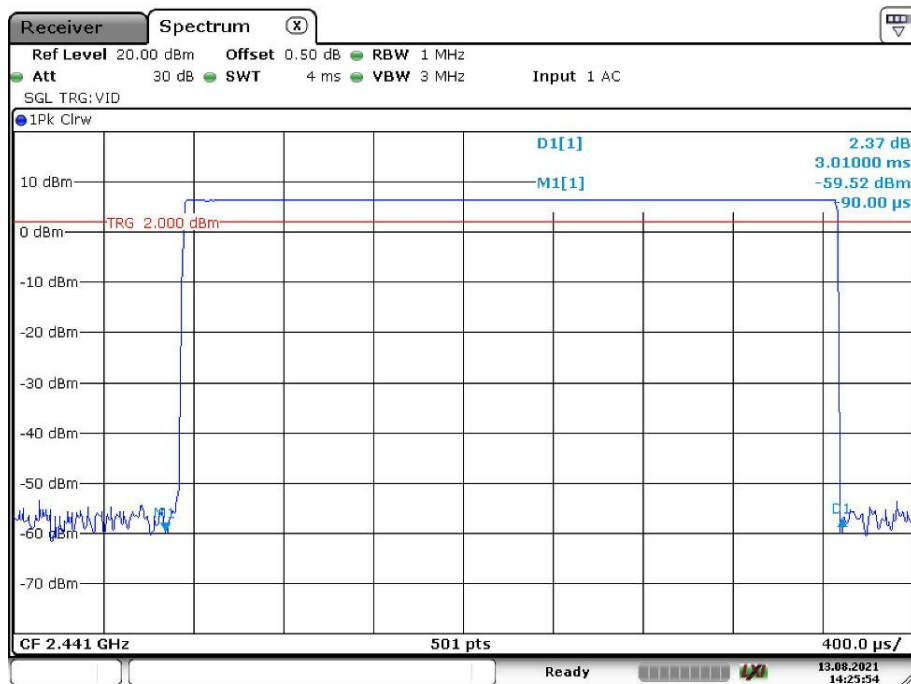
Date: 13.AUG.2021 14:23:40

DH3: Middle Channel



Date: 13.AUG.2021 14:25:02

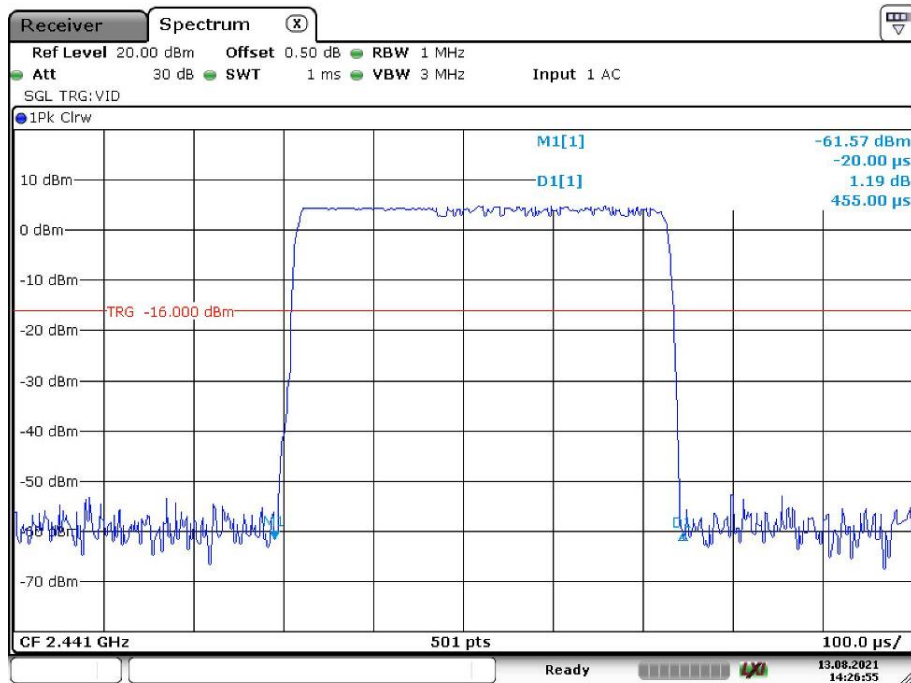
DH5: Middle Channel



Date: 13.AUG.2021 14:25:54

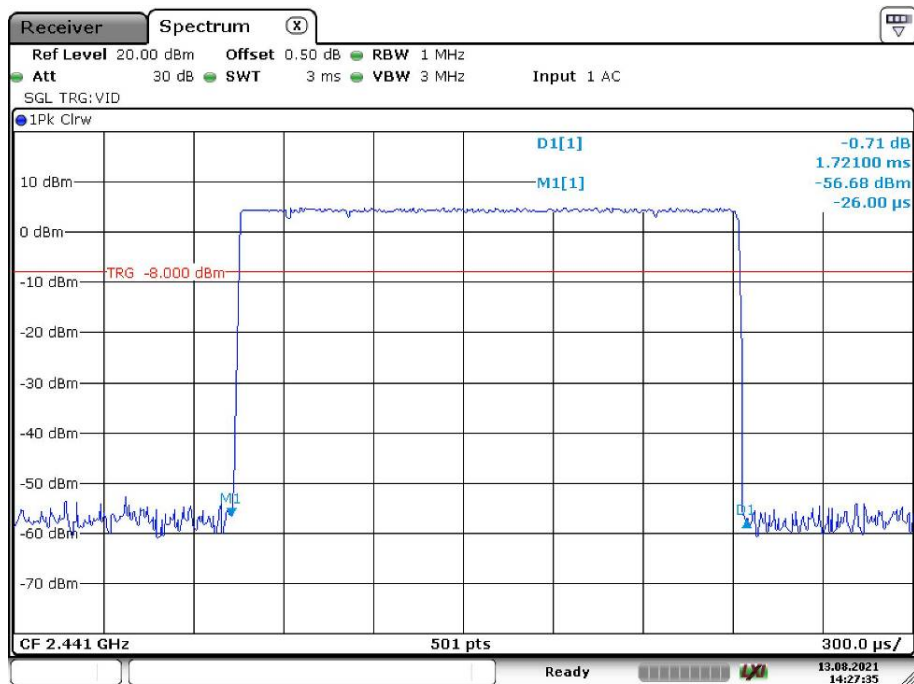
EDR Mode ($\pi/4$ -DQPSK):

2DH1: Middle Channel



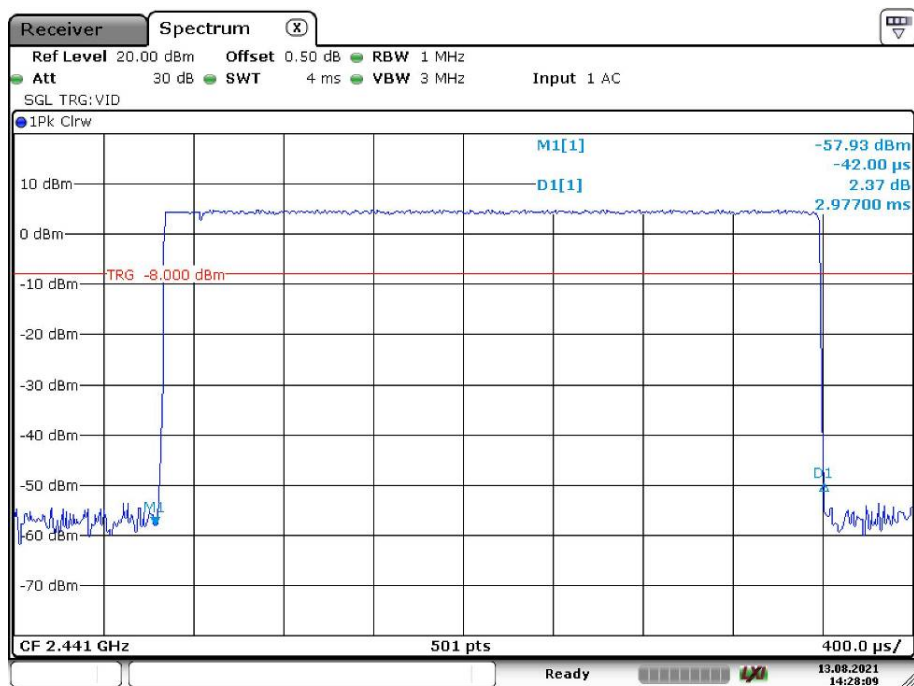
Date: 13.AUG.2021 14:26:55

2DH3: Middle Channel



Date: 13.AUG.2021 14:27:35

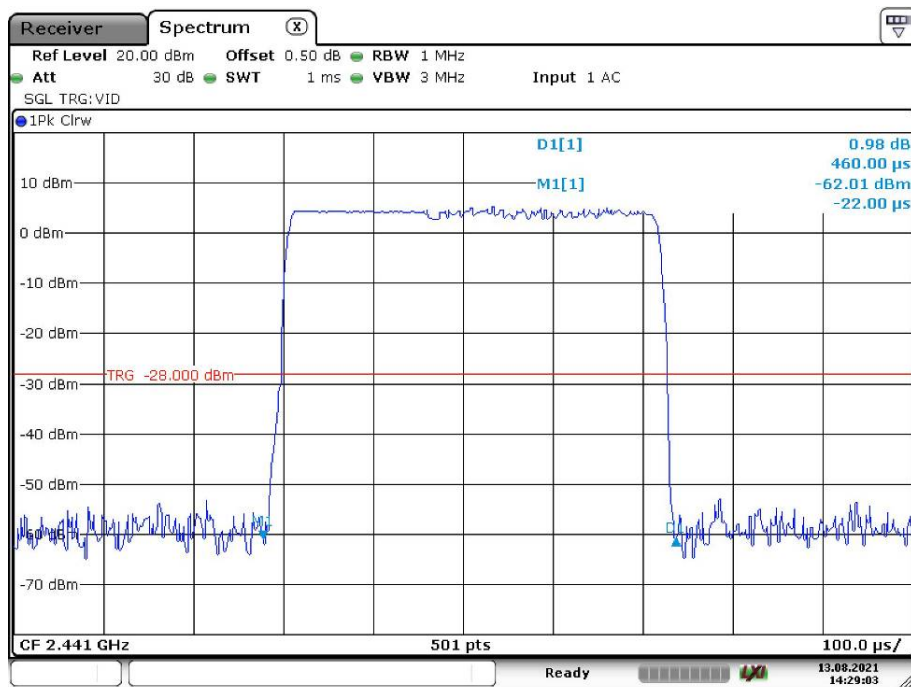
2DH5: Middle Channel



Date: 13.AUG.2021 14:28:09

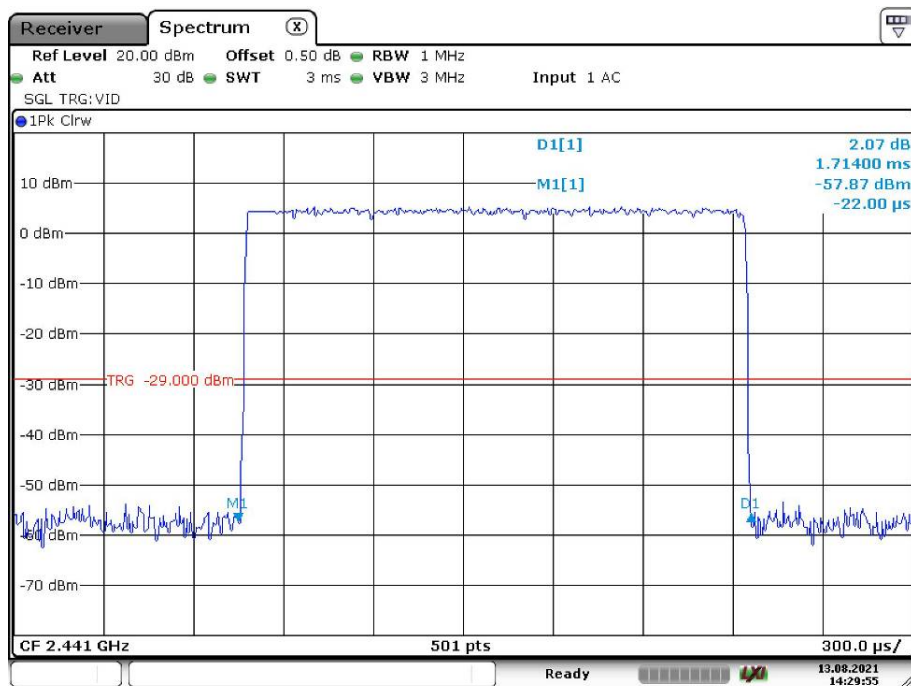
EDR Mode (8DPSK):

3DH1: Middle Channel



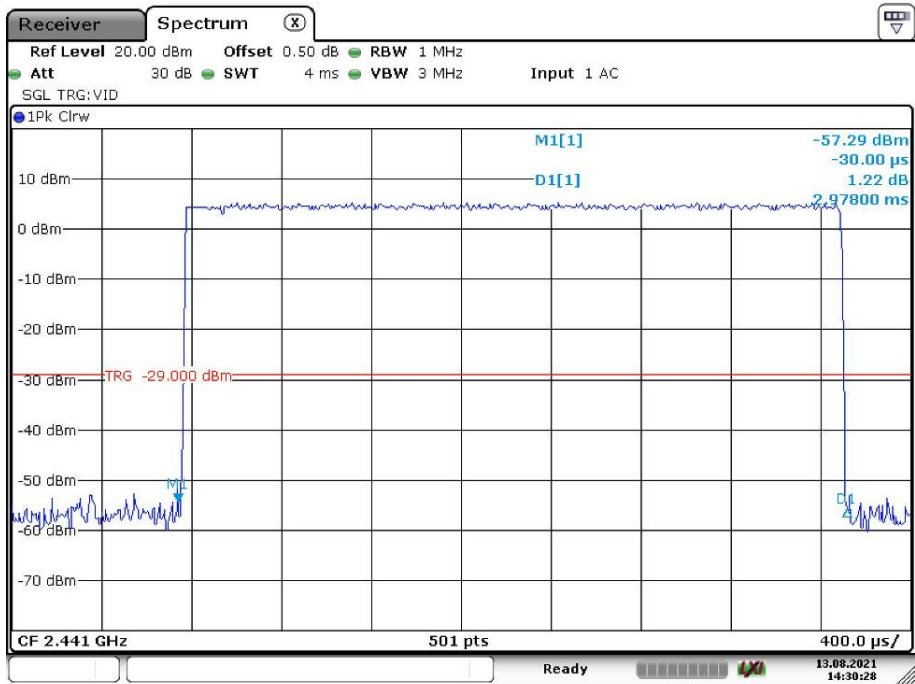
Date: 13.AUG.2021 14:29:03

3DH3: Middle Channel



Date: 13.AUG.2021 14:29:55

3DH5: Middle Channel



Date: 13.AUG.2021 14:30:28

9 - 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. 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.

Test Data

Test Mode: Transmitting

Test Result: Compliance. Please refer to following tables and plots.

Mode	Test Frequency (MHz)	Peak Conducted Output Power (dBm)	Limit (dBm)
BDR Mode (GFSK)	2402	5.39	21
	2441	4.82	21
	2480	5.71	21
EDR Mode ($\pi/4$ -DQPSK)	2402	3.06	21
	2441	4.07	21
	2480	4.05	21
EDR Mode (8DPSK)	2402	3.06	21
	2441	4.07	21
	2480	4.04	21

Note: The data above was tested in conducted mode.

10 - BAND EDGES TESTING

Applicable Standard

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)).

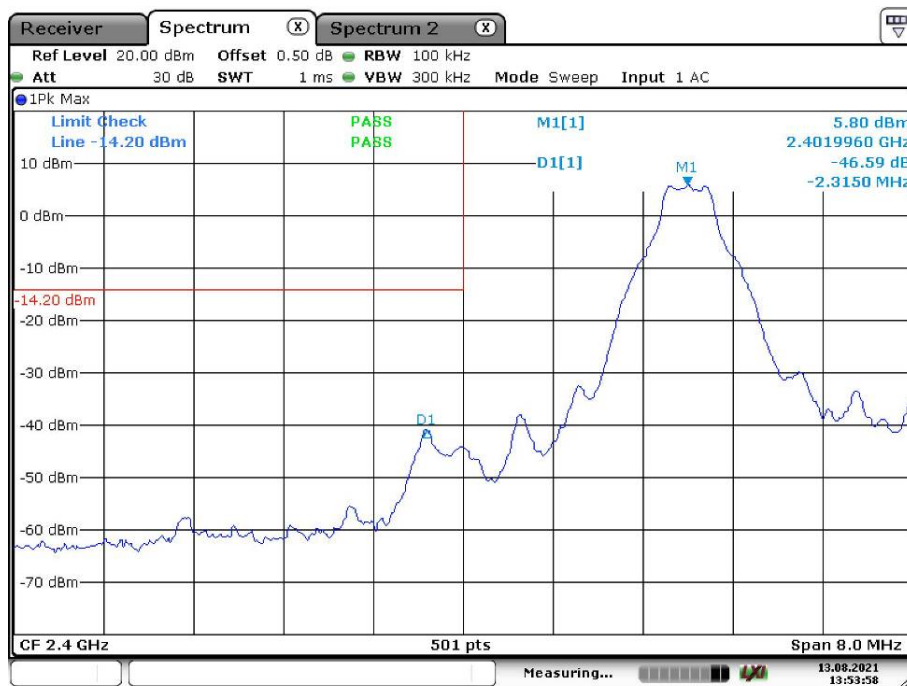
Test Procedure

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/ VBW of spectrum analyzer to 100/300 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.

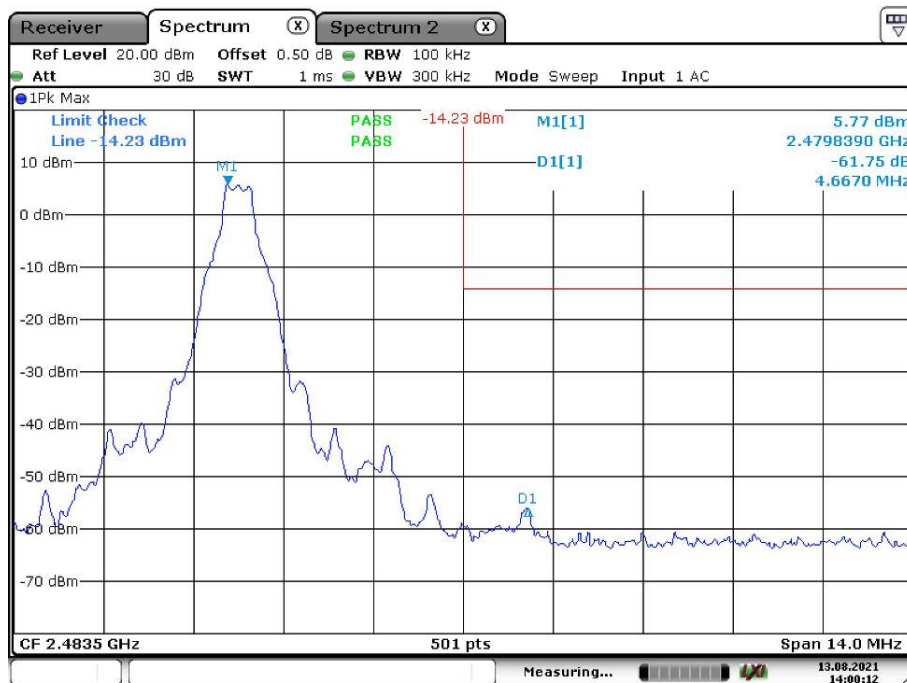
Test Data

Test Mode: Transmitting

Test Result: Compliance. Please refer to following tables and plots.

Single mode:*BDR Mode (GFSK):***Band Edge, Left Side**

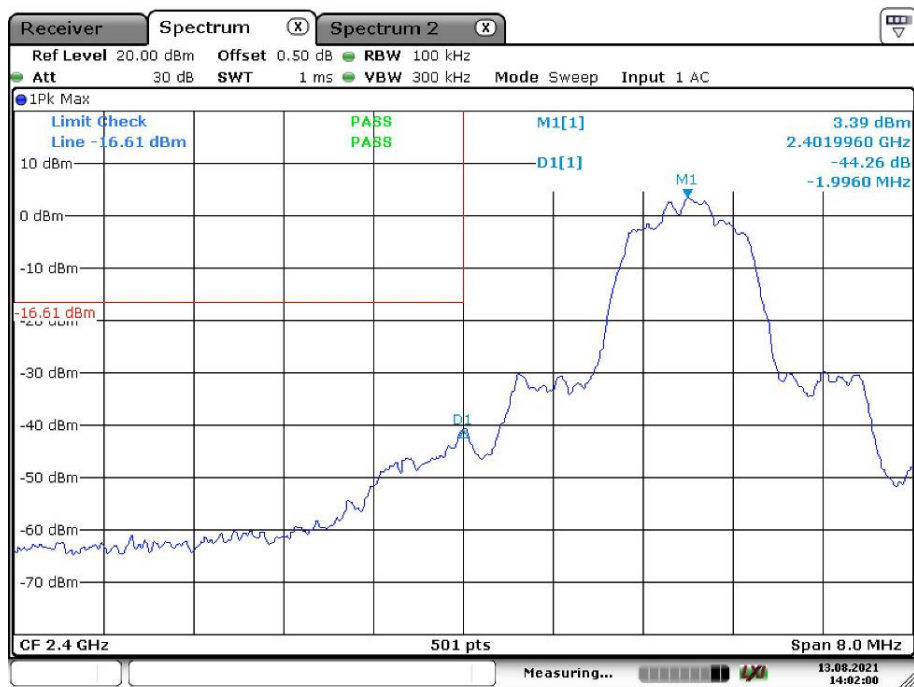
Date: 13.AUG.2021 13:53:58

Band Edge, Right Side

Date: 13.AUG.2021 14:00:12

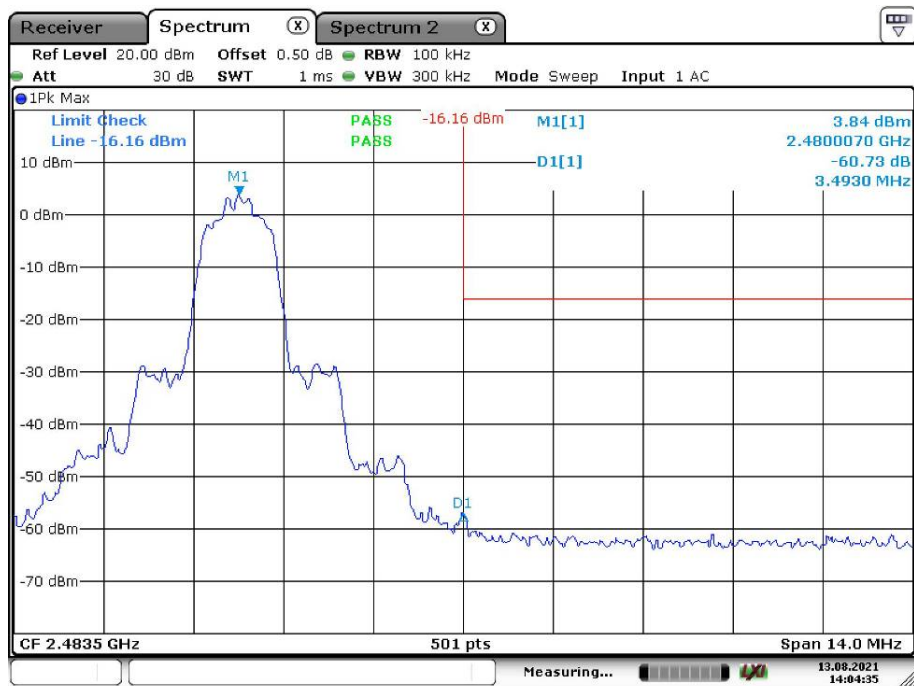
EDR Mode ($\pi/4$ -DQPSK):

Band Edge, Left Side



Date: 13.AUG.2021 14:02:00

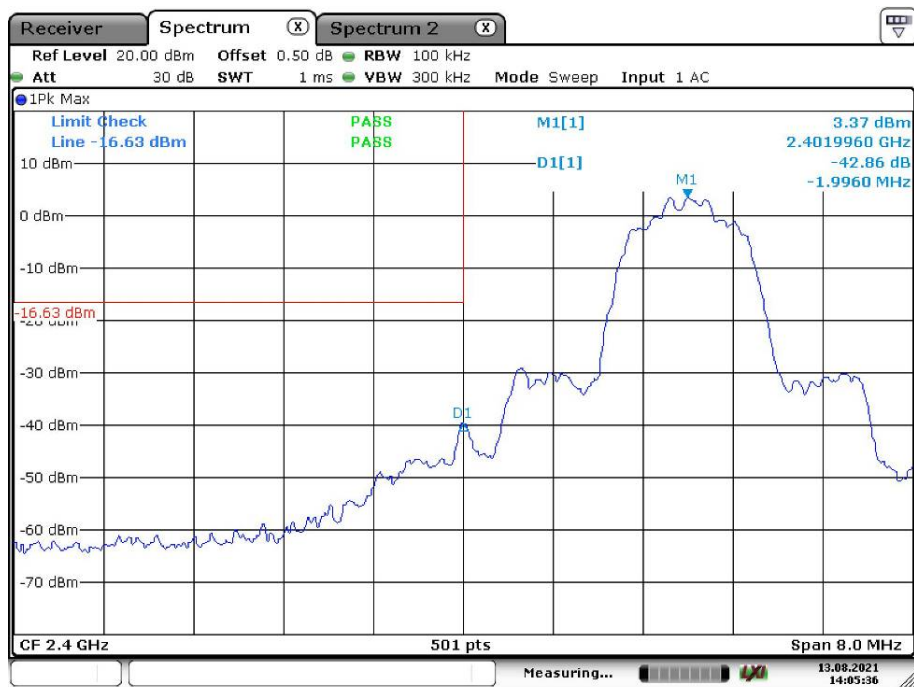
Band Edge, Right Side



Date: 13.AUG.2021 14:04:35

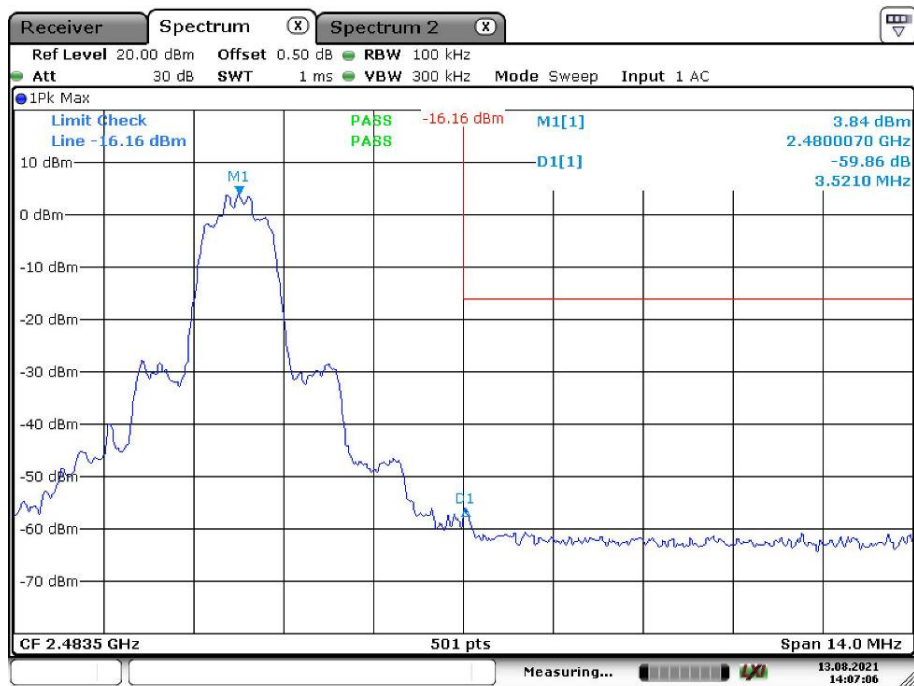
EDR Mode (8DPSK):

Band Edge, Left Side

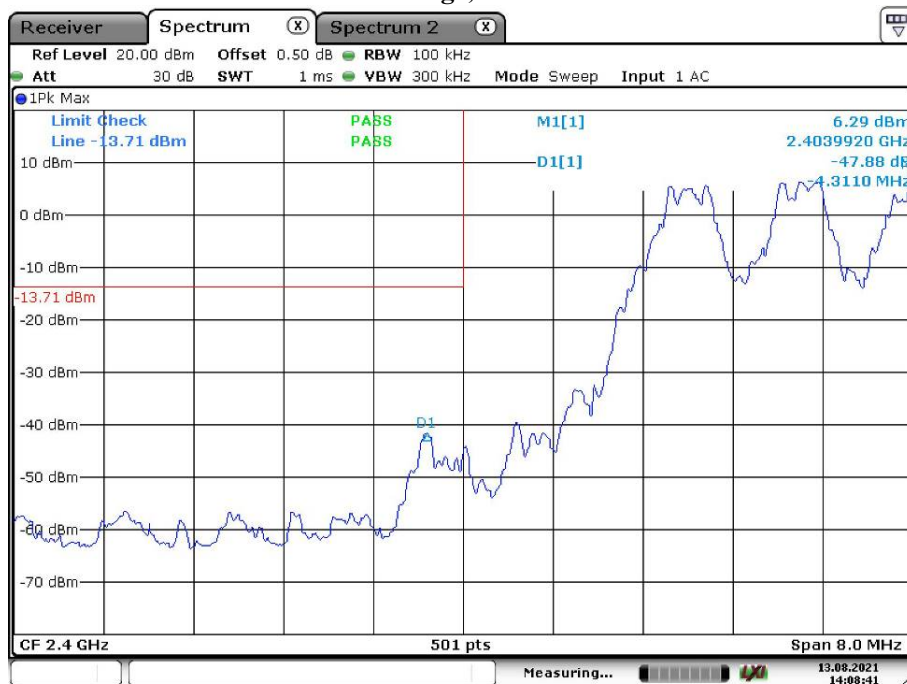


Date: 13.AUG.2021 14:05:36

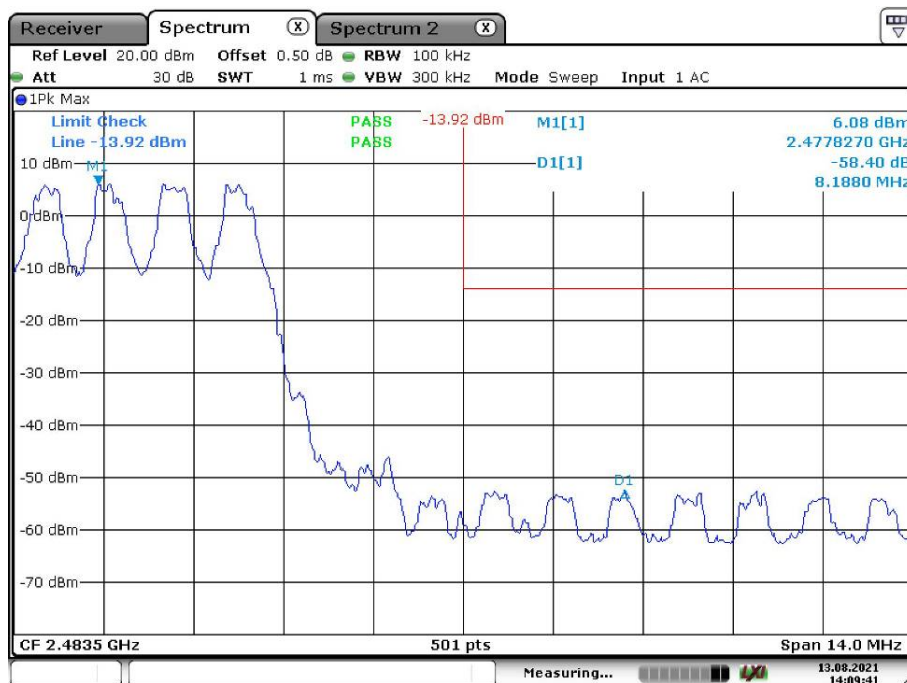
Band Edge, Right Side



Date: 13.AUG.2021 14:07:06

Hopping Mode,*BDR Mode (GFSK):***Band Edge, Left Side**

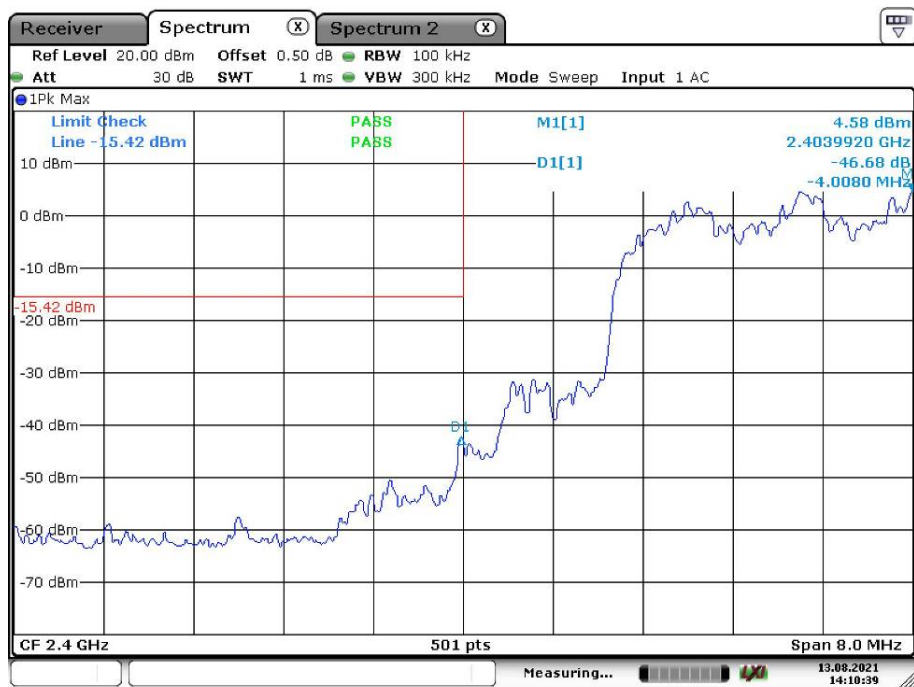
Date: 13.AUG.2021 14:08:41

Band Edge, Right Side

Date: 13.AUG.2021 14:09:41

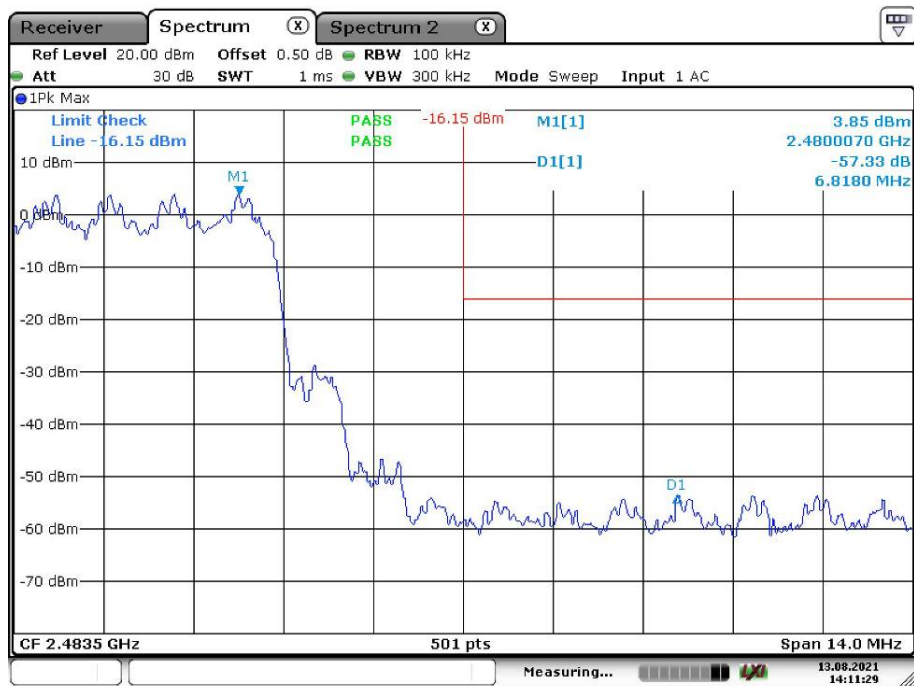
EDR Mode ($\pi/4$ -DQPSK):

Band Edge, Left Side



Date: 13.AUG.2021 14:10:39

Band Edge, Right Side



Date: 13.AUG.2021 14:11:29

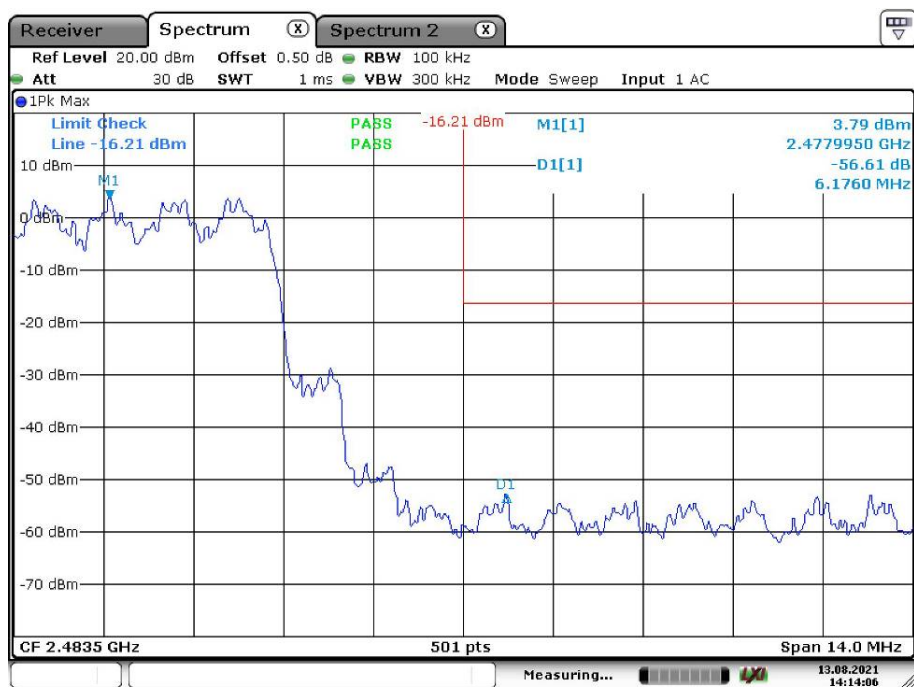
EDR Mode (8DPSK):

Band Edge, Left Side



Date: 13.AUG.2021 14:12:58

Band Edge, Right Side



Date: 13.AUG.2021 14:14:06

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