FCC PART 15.247

RSS-GEN, ISSUE 5,FEBRUARY 2021AMENDMENT 2

RSS-247, ISSUE 2, FEBRUARY 2017

TEST REPORT

For

Tait International Limited

245 Wooldridge Road, Harewood, Christchurch, New Zealand
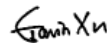
FCC ID: CASTPEHGG
IC: 737A-TPEHGG

Report Type: Original Report	Product Name: Two way radio

Report Number:	DG2210813-34322E-00B
Report Date:	2021-09-14
Reviewed By:	Gavin Xu RF Engineer
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Dongguan) No.12, Pulong East 1st Road, Tangxia Town, Dongguan, Guangdong, China Tel: +86-769-86858888 Fax: +86-769-86858891 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	Two way radio
EUT Model:	T03-00313-GCDA
Multiple Models:	T03-00313-GXXX ("XXX" please refer to the DOS)
Model Difference:	Refer to the DOS letter
Rated Input Voltage:	DC 7.4V from battery, DC 12V charging from charger base
Serial Number:	T03-00313-GCDA :DG2210813-34322E-RF-S1 T03-00313-GBEA:DG2210813-34322E-RF-S2 T03-00313-GAAA:DG2210813-34322E-RF-S3
EUT Received Date:	2021.08.13
EUT Received Status:	Good

Technical Specification

Operation Frequency Range (MHz):	2402-2480
Max. RF Output Power (Conducted)(dBm):	0.5
Antenna Gain (dBi)▲:	0
Modulation Type:	GFSK, π/4-DQPSK, 8DPSK

Objective

This report is prepared on behalf of ***Tait International Limited*** in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communications Commission's rules and RSS-247, Issue 2, February 2017, RSS-Gen, Issue 5, February 2021 Amendment 2 of the Innovation, Science and Economic Development Canada.

The tests were performed in order to determine the Bluetooth BDR and EDR mode of EUT compliance with FCC Rules Part 15, Subpart C, and section 15.203, 15.205, 15.207,15.209 and 15.247 rules and RSS-247, Issue 2, February 2017, RSS-Gen, Issue 5,February 2021 Amendment 2 of the Innovation, Science and Economic Development Canada.

Test Methodology

All measurements detailed in this test report were performed in accordance with ANSI C63.10-2013 "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices" and KDB 558074 D01 15.247 Meas Guidance v05r02. And RSS-247, Issue 2, February 2017, RSS-Gen, Issue 5, February 2021 Amendment 2 of the Innovation, Science and Economic Development Canada.

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

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.61dB
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	±1.5 dB
Temperature	±1℃
Humidity	±5%
DC and low frequency voltages	±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 for testing and the maximum power was configured as below, which was provided by the manufacturer:

Mode	Packet type	Channel	Frequency (MHz)	Packet length	Power Level▲
GFSK	DH1	Low	2402	27	52
		Middle	2441	27	3
		High	2480	27	3
	DH3	Low	2402	27	52
		Middle	2441	27	3
		High	2480	27	3
	DH5	Low	2402	27	52
		Middle	2441	27	3
		High	2480	27	3
π/4 DQPSK	2DH1	Low	2402	54	150
		Middle	2441	54	70
		High	2480	54	45
	2DH3	Low	2402	54	0
		Middle	2441	54	70
		High	2480	54	45
	2DH5	Low	2402	54	150
		Middle	2441	54	70
		High	2480	54	45
8DPSK	3DH1	Low	2402	54	150
		Middle	2441	83	70
		High	2480	83	45
	3DH3	Low	2402	83	150
		Middle	2441	83	70
		High	2480	83	45
	3DH5	Low	2402	83	150
		Middle	2441	83	70
		High	2480	83	45

Equipment Modifications

No modification was made to the EUT.

Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
/	/	/	/

Support CableList and Details

Cable Description	Shielding Type	Ferrite Core	Length(m)	From	To
/	/	/	/	/	/

Block Diagram of Test Setup

EUT

1.0 Meter

Non-Conductive Table 80/150 cm above Ground Plane

1.5 Meter
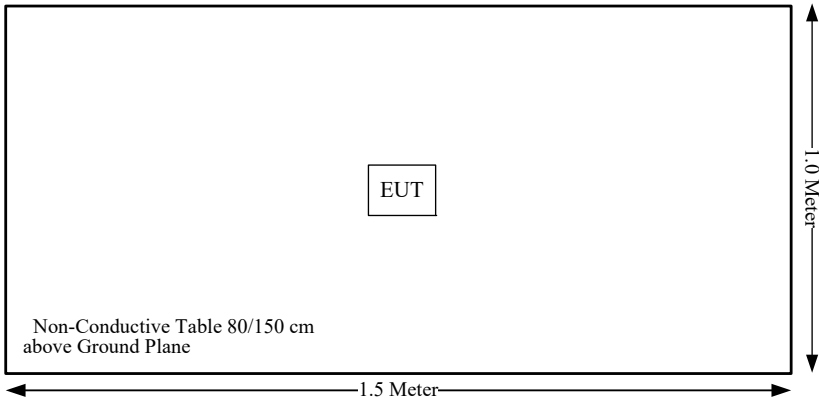
Test Equipment List

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	A060611-1	2020-11-10	2023-11-10
R&S	EMI Test Receiver	ESR3	102453	2021-09-12	2022-09-12
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2021-09-05	2022-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2021-09-05	2022-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2021-05-06	2022-05-06
HP	Amplifier	8447D	2727A05902	2021-09-05	2022-09-05
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 Technolagies	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	Spectrum Analyzer	FSV40	101591	2021-06-29	2022-06-28
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	Each time	N/A
Agilent	USB Wideband Power Sensor	U2022XA	MY5417006	2020-09-12	2021-09-12

* 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:	26.2℃	27.9°C	28.3 °C	27°C
Relative Humidity:	64%	55%	53 %	62%
ATM Pressure:	100.6kPa	100.8kPa	100.8kPa	100kPa
Tester:	Walker Chen	Joyce Qiao	Jeremy Liang	Wayne wei
Test Date:	2021-08-30	2021.09.13	2021.09.04	2021-08-23

SUMMARY OF TEST RESULTS

S/N	Rules	Description of Test	Result
1	FCC §15.247 (i) FCC §1.1310 FCC §2.1093	RF Exposure	Compliance
2	RSS-102 §2.5.1	Exemption Limits For Routine Evaluation-SAR Evaluation	Compliance
3	FCC §15.203 RSS-Gen §6.8	Antenna Requirement	Compliance
4	FCC §15.207 (a) RSS-Gen §8.8	Conducted Emissions	Compliance
5	FCC §15.205, §15.209 FCC §15.247(d) RSS-247 §5.5 RSS-Gen §8.10	Spurious Emissions	Compliance
6	FCC §15.247 (a)(1) RSS-247 §5.1 b) RSS-Gen §6.7	Emission Bandwidth	Compliance
7	FCC §15.247(a)(1) RSS-247 §5.1 b)	Channel Separation Test	Compliance
8	FCC §15.247(a)(1)(iii) RSS-247 §5.1 d)	Time of Occupancy (Dwell Time)	Compliance
9	FCC §15.247(a)(1)(iii) RSS-247 §5.1 d)	Quantity of hopping channel Test	Compliance
10	FCC §15.247(b)(1) RSS-247 §5.4 b)	Peak Output Power Measurement	Compliance
11	FCC §15.247(d) RSS-247 §5.5	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:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where
        • f(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.

Evaluate Result

The max conducted power including tune-up tolerance is 1dBm (1.26 mW).
[(max. power of channel, mW)/(min. test separation distance, mm)][√f(GHz)]
=1.26/5*(√2.480) =0.4< 3.0

So the stand-alone SAR evaluation is not necessary.

2 - EXEMPTION LIMITS FOR ROUTINE EVALUATION – SAR EVALUATION

Applicable Standard

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance[4][5]

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

Evaluate Result

The max tune-up conducted power is 1 dBm, Antenna Gain: 0 dBi, EIRP is 1 dBm(1.26 mW)

The exemption power(P) limits for routine evaluation in 2402-2480MHz is:
$(2480-2450)/(3500-2450)=(4-P)/(4-2) => P=3.94$ mW@2480 MHz>1.26 mW

So the stand-alone SAR evaluation can be exempted.

3 - 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.

According to RSS-Gen §6.8, The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.
For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).
When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.
The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.
For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

Antenna Information And Connector Construction

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

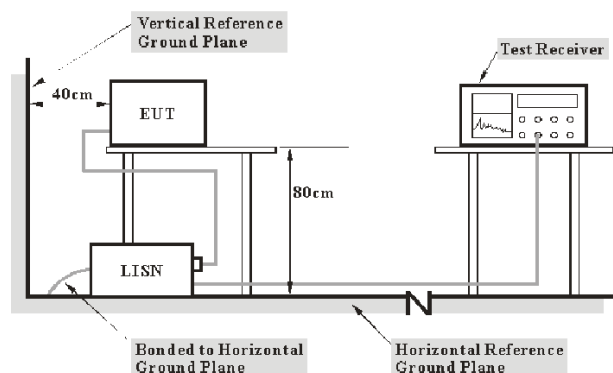| Antenna Type	Input impedance (Ohm)	Antenna Gain	Frequency Range
FPC	50	0 dBi	2.4~2.5GHz

Result: Compliance.

4 – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207(a), RSS-Gen§8.8.

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 and the RSS-Gen limits.

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: Margin = Limit – Corrected Amplitude

Test Data

Test Mode: Transmitting

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

Model: T03-00313-GCDA (worst case)

AC120V, 60 Hz, Line:
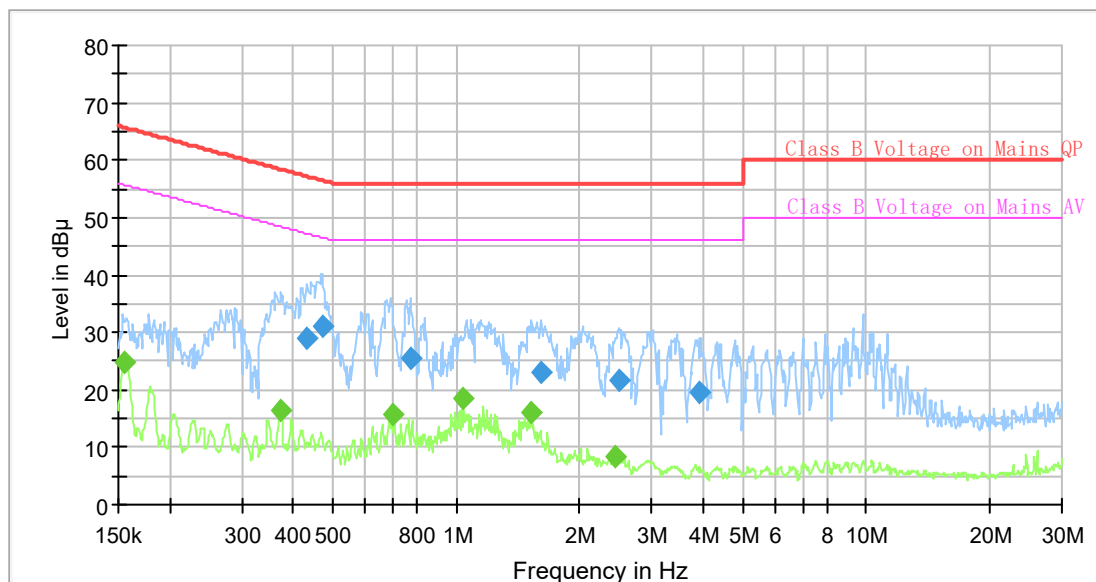
Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.155329	---	24.71	55.71	31.00	9.000	L1	9.6
0.373663	---	16.25	48.42	32.17	9.000	L1	9.6
0.431814	29.06	---	57.22	28.16	9.000	L1	9.6
0.470023	31.15	---	56.51	25.36	9.000	L1	9.6
0.697009	---	15.76	46.00	30.24	9.000	L1	9.6
0.773973	25.64	---	56.00	30.36	9.000	L1	9.7
1.043973	---	18.65	46.00	27.35	9.000	L1	9.7
1.525141	---	16.19	46.00	29.81	9.000	L1	9.7
1.603137	23.15	---	56.00	32.85	9.000	L1	9.7
2.437361	---	8.44	46.00	37.56	9.000	L1	9.7
2.486475	21.58	---	56.00	34.42	9.000	L1	9.7
3.934248	19.58	---	56.00	36.42	9.000	L1	9.7

AC120V, 60 Hz, Neutral:
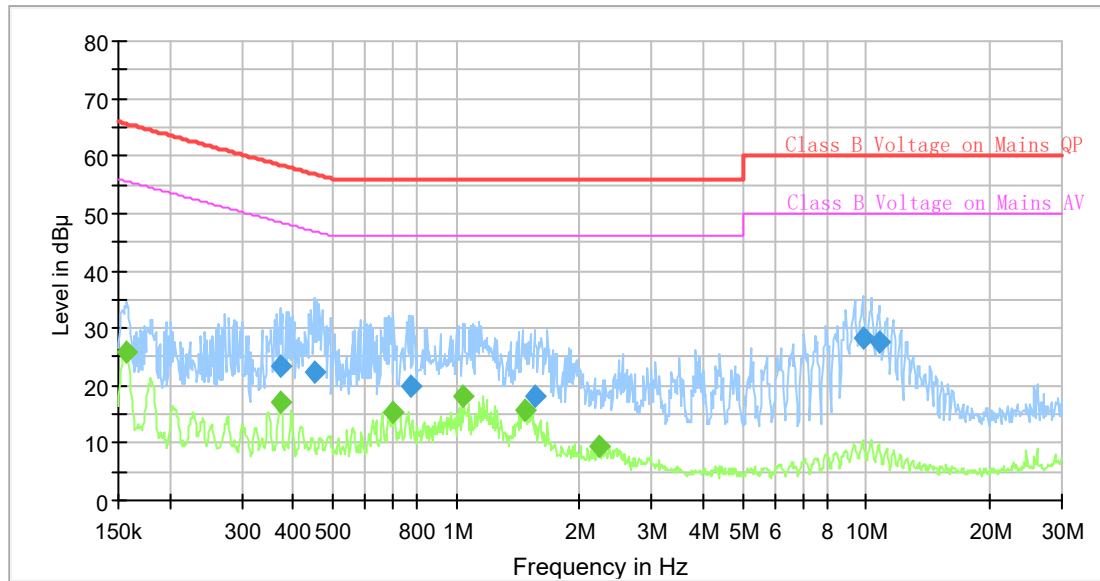
Final_Result

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.156106	---	25.77	55.67	29.90	9.000	N	9.6
0.371804	---	17.00	48.46	31.46	9.000	N	9.6
0.371804	23.27	---	58.46	35.19	9.000	N	9.6
0.449391	22.24	---	56.89	34.65	9.000	N	9.6
0.697009	---	15.35	46.00	30.65	9.000	N	9.6
0.773973	20.08	---	56.00	35.92	9.000	N	9.6
1.043973	---	18.21	46.00	27.79	9.000	N	9.6
1.465485	---	15.67	46.00	30.33	9.000	N	9.6
1.555873	18.34	---	56.00	37.66	9.000	N	9.6
2.239220	---	9.45	46.00	36.55	9.000	N	9.6
9.800563	28.47	---	60.00	31.53	9.000	N	9.7
10.774725	27.49	---	60.00	32.51	9.000	N	9.7

5 - SPURIOUS EMISSIONS

Applicable Standard

FCC §15.247 (d); §15.209; §15.205, RSS-247 §5.5, RSS-GEN §8.10.

Test System Setup

Below 1GHz:
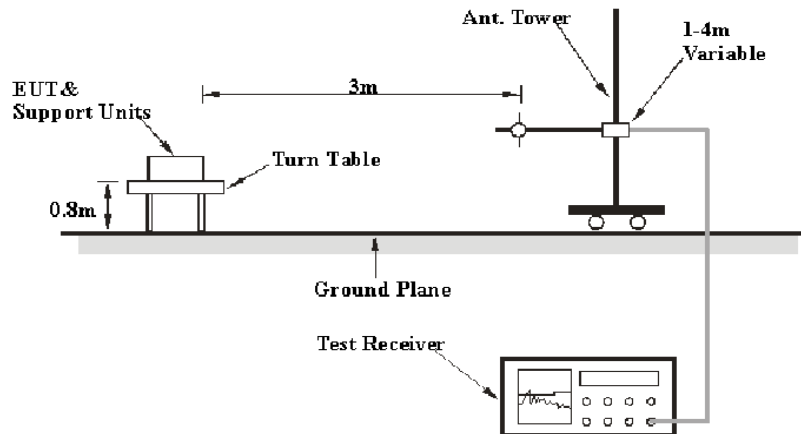
Above 1GHz:
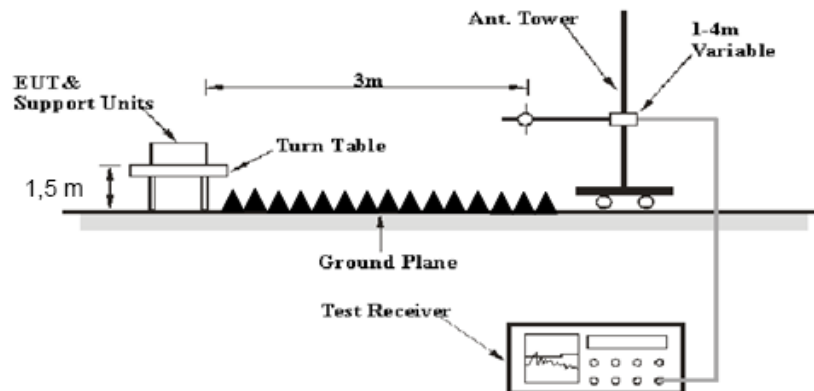
The radiated emission tests were performed in the 3 meters chamber test site for the range 30MHz to 1GHz and the 3 meters chamber B test site for above 1GHz, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247, the RSS-247 §5.5,RSS-Gen §8.10 limits..

The spacing between the peripherals was 10 cm.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

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:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - 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:

Margin = Limit – Corrected Amplitude

Test Data

Test Mode: *Transmitting*

Test Result: Compliance. *Please refer to the following table and plots.*

1) 30MHz-1GHz (*Model: T03-00313-GCDA*, with BDR mode High Channel was the worst)
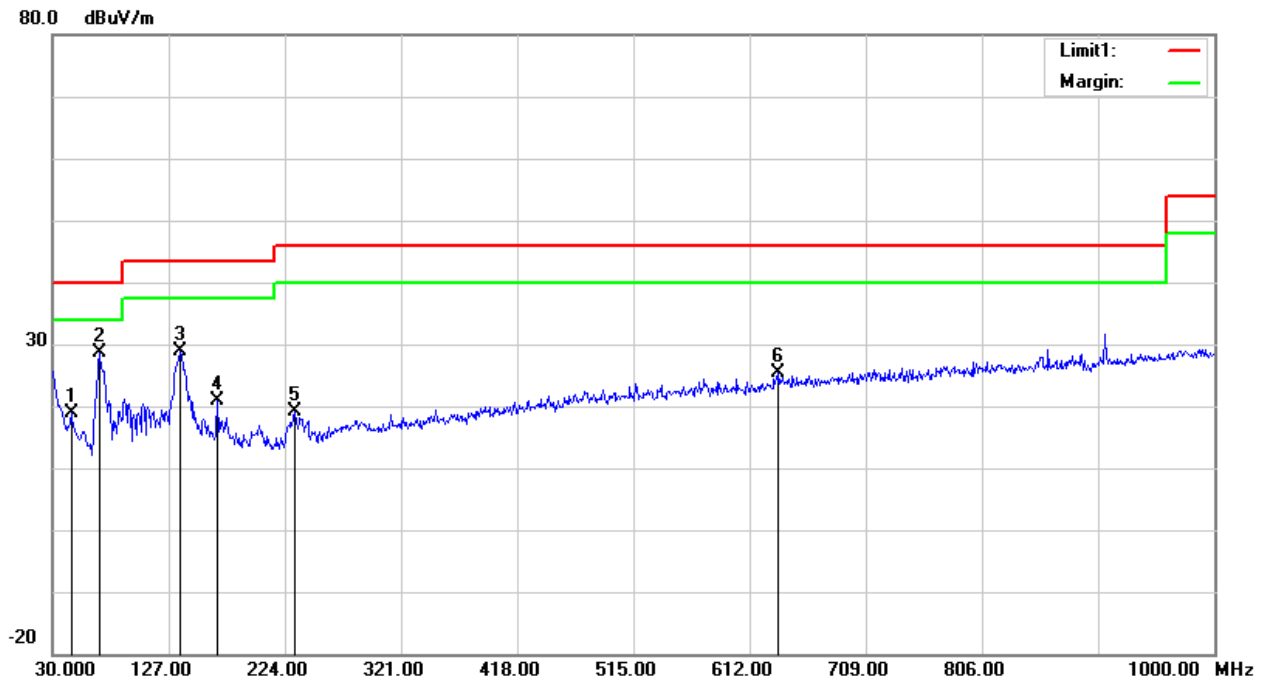
Horizontal:

Frequency (MHz)	Receiver Reading (dBμV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
45.5200	33.47	peak	-14.70	18.77	40.00	21.23
68.8000	45.44	peak	-16.72	28.72	40.00	11.28
136.7000	40.16	peak	-11.37	28.79	43.50	14.71
167.7400	33.51	peak	-12.60	20.91	43.50	22.59
231.7600	32.21	peak	-13.02	19.19	46.00	26.81
636.2500	28.62	peak	-3.16	25.46	46.00	20.54

Vertical:
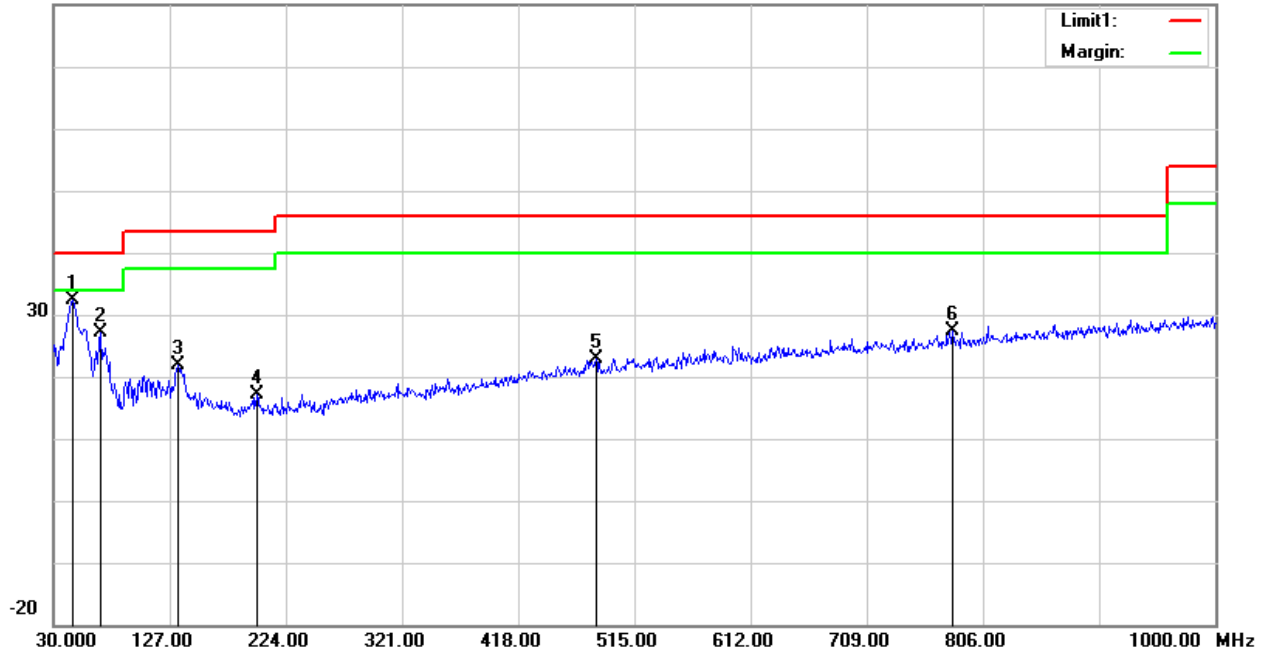
Frequency (MHz)	Receiver Reading (dBμV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
46.4900	47.52	peak	-15.18	32.34	40.00	7.66
68.8000	43.46	peak	-16.72	26.74	40.00	13.26
105.6600	33.42	peak	-12.98	20.44	43.50	23.06
136.7000	33.01	peak	-11.37	21.64	43.50	21.86
200.7200	31.53	peak	-12.27	19.26	43.50	24.24
522.7600	29.35	peak	-5.32	24.03	46.00	21.97

2) 1-25GHz:

BDR Mode 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)	Detector	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2390.00	26.89	PK	H	28.08	1.80	0.00	56.77	74.00	17.23
2390.00	14.35	AV	H	28.08	1.80	0.00	44.23	54.00	9.77
4804.00	35.29	PK	H	32.91	3.17	25.60	45.77	74.00	28.23
4804.00	23.44	AV	H	32.91	3.17	25.60	33.92	54.00	20.08
7206.00	35.78	PK	H	35.74	4.82	25.60	50.74	74.00	23.26
7206.00	23.54	AV	H	35.74	4.82	25.60	38.50	54.00	15.50
Middle Channel: 2441 MHz									
4882.00	35.62	PK	H	33.06	3.27	25.66	46.29	74.00	27.71
4882.00	23.54	AV	H	33.06	3.27	25.66	34.21	54.00	19.79
7323.00	36.92	PK	H	36.04	4.62	25.73	51.85	74.00	22.15
7323.00	23.15	AV	H	36.04	4.62	25.73	38.08	54.00	15.92
High Channel: 2480 MHz									
2483.50	26.48	PK	H	28.27	1.84	0.00	56.59	74.00	17.41
2483.50	14.37	AV	H	28.27	1.84	0.00	44.48	54.00	9.52
4960.00	36.95	PK	H	33.22	3.23	25.63	47.77	74.00	26.23
4960.00	24.82	AV	H	33.22	3.23	25.63	35.64	54.00	18.36
7440.00	36.75	PK	H	36.34	4.41	25.85	51.65	74.00	22.35
7440.00	24.58	AV	H	36.34	4.41	25.85	39.48	54.00	14.52

3) Worst Test plots (High Channel was the worst)

Horizontal

Fundamental
Test with Band
Rejection Filter
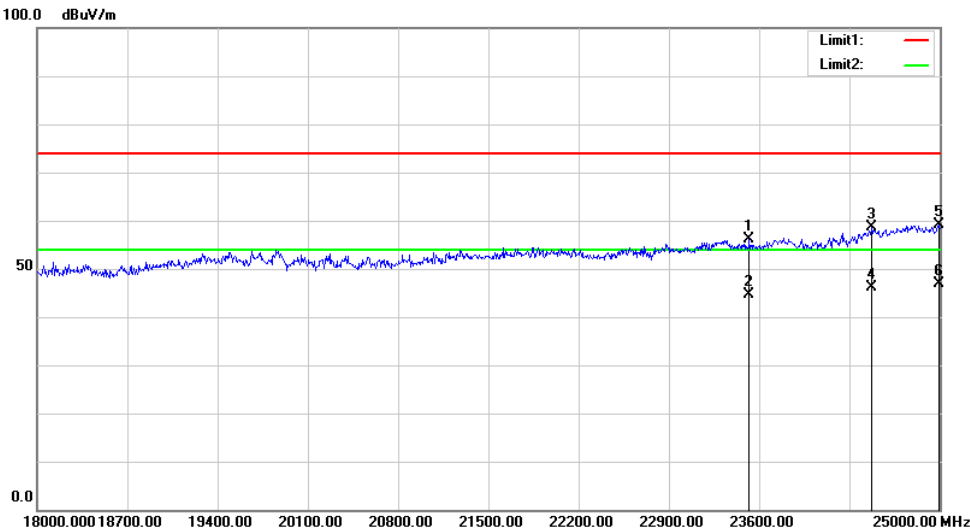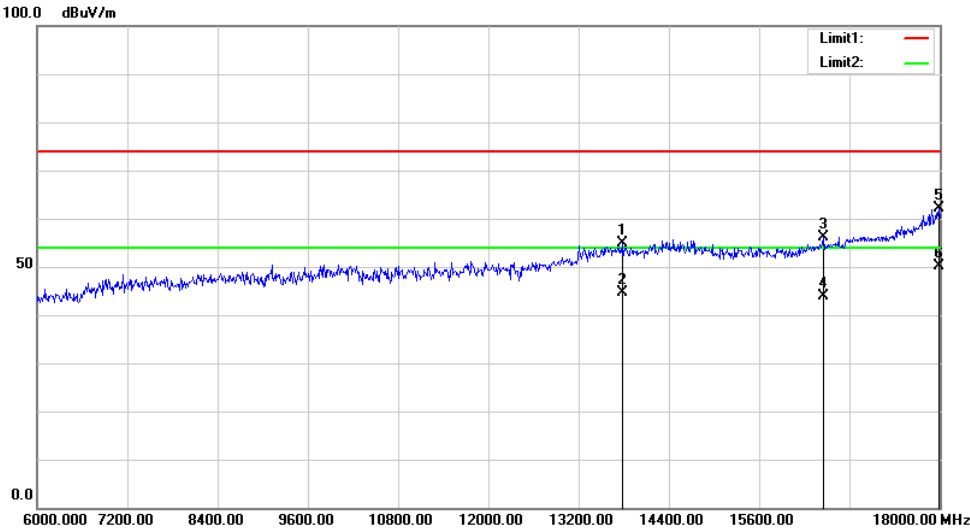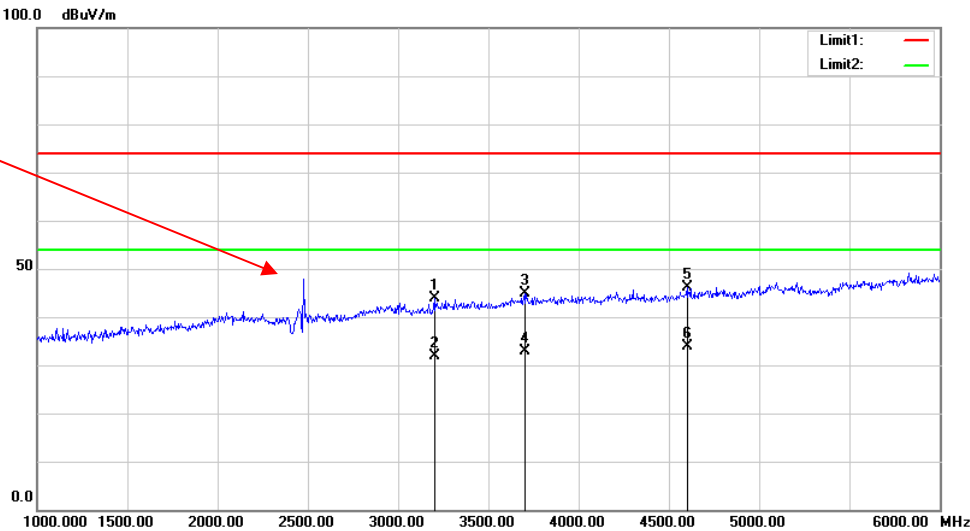
Vertical

Fundamental
Test with Band
Rejection Filter
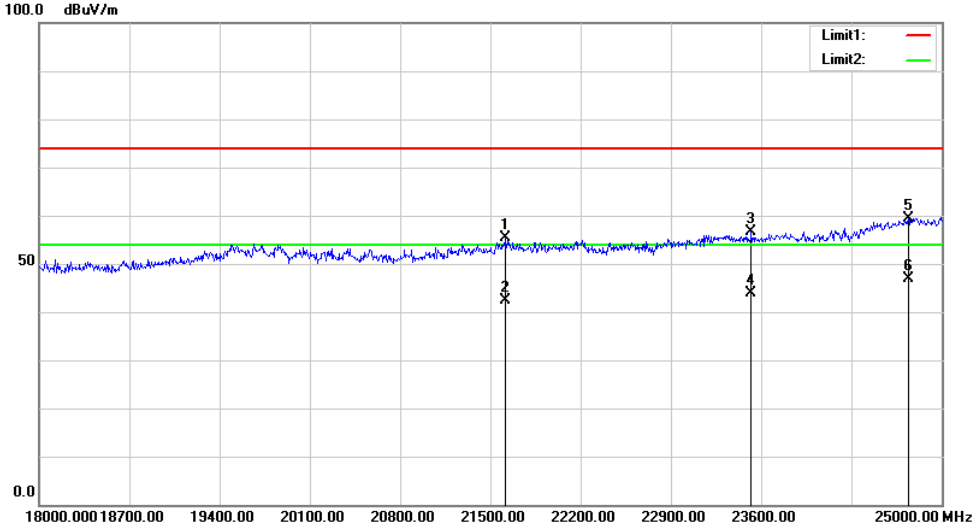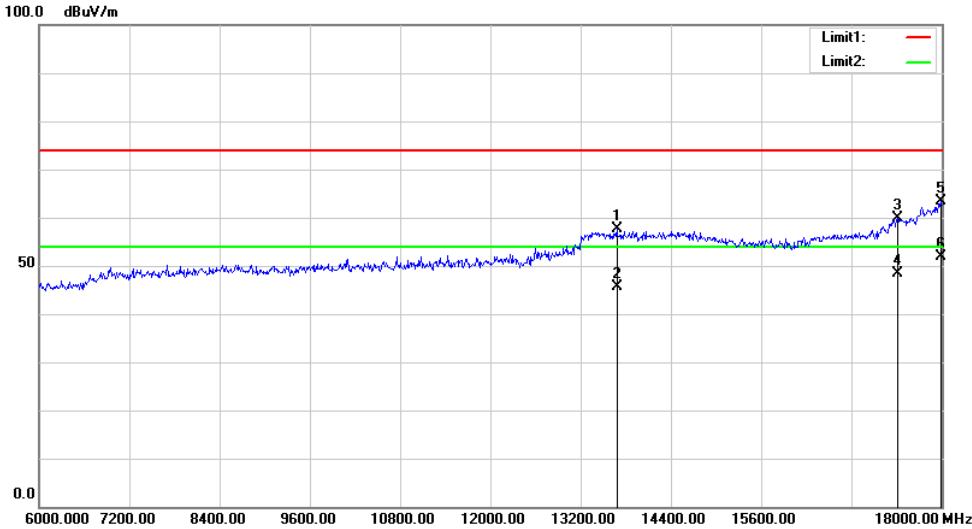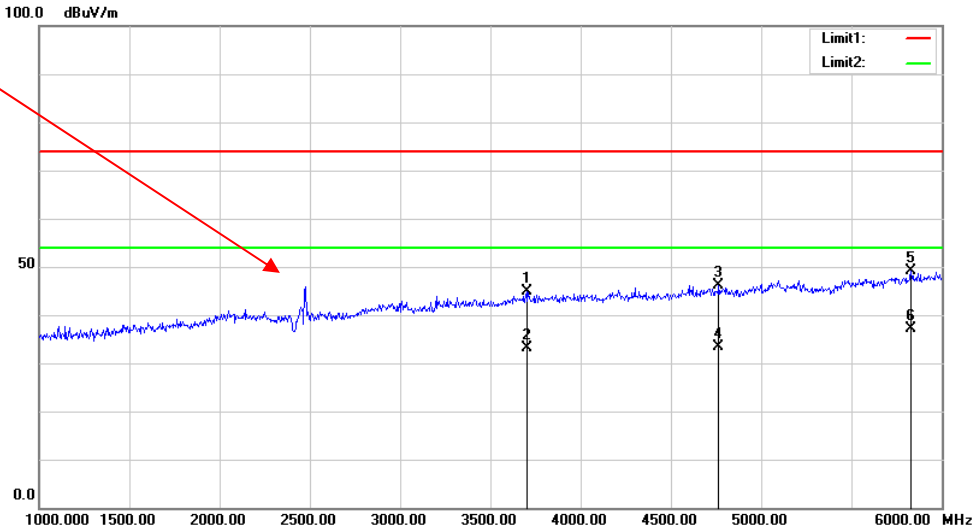
6 - CHANNEL SEPARATION TEST

Applicable Standard

According to FCC §15.247(a) (1), RSS-247 Clause 5.1 b)

Frequency hopping systems shall have hoping 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

Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
BDR (GFSK)	Low	2402	1.000	0.59
	Middle	2441	1.000	0.59
	High	2480	1.000	0.58
EDR (π/4-DQPSK)	Low	2402	1.000	0.81
	Middle	2441	1.000	0.81
	High	2480	1.000	0.81
EDR (8DPSK)	Low	2402	1.000	0.81
	Middle	2441	1.000	0.81
	High	2480	1.000	0.81

Note: Limit= (2/3) × 20dB bandwidth

BDR Mode (GFSK):
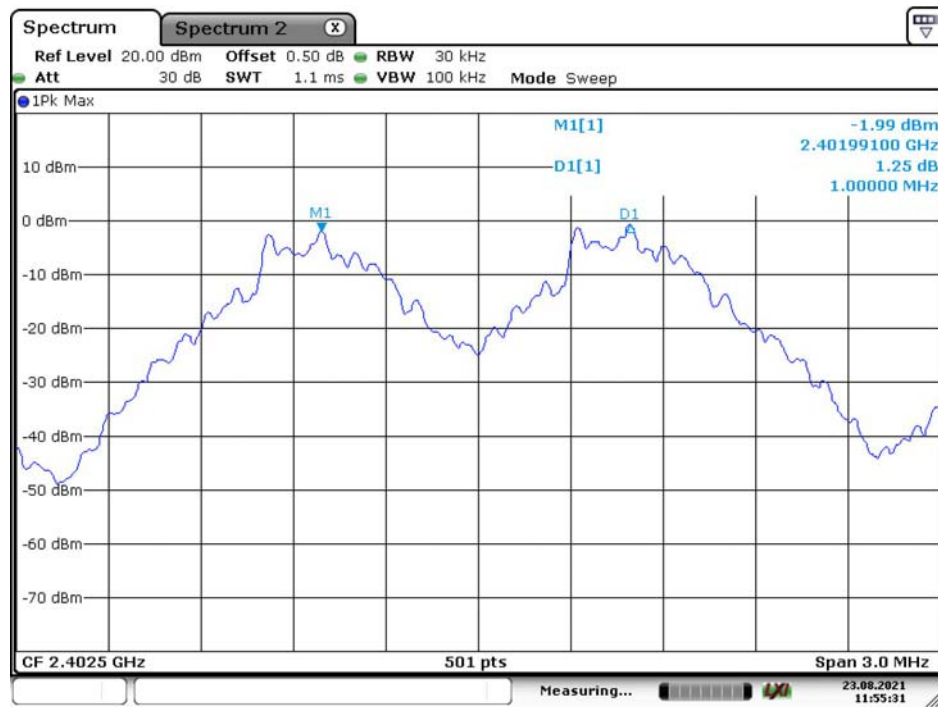
Low Channel

Date: 23.AUG.2021 11:55:31

Middle Channel

Date: 23.AUG.2021 11:56:57

High Channel

Date: 23.AUG.2021 11:59:10

EDR Mode (π/4-DQPSK):

Low Channel

Date: 23.AUG.2021 12:01:21
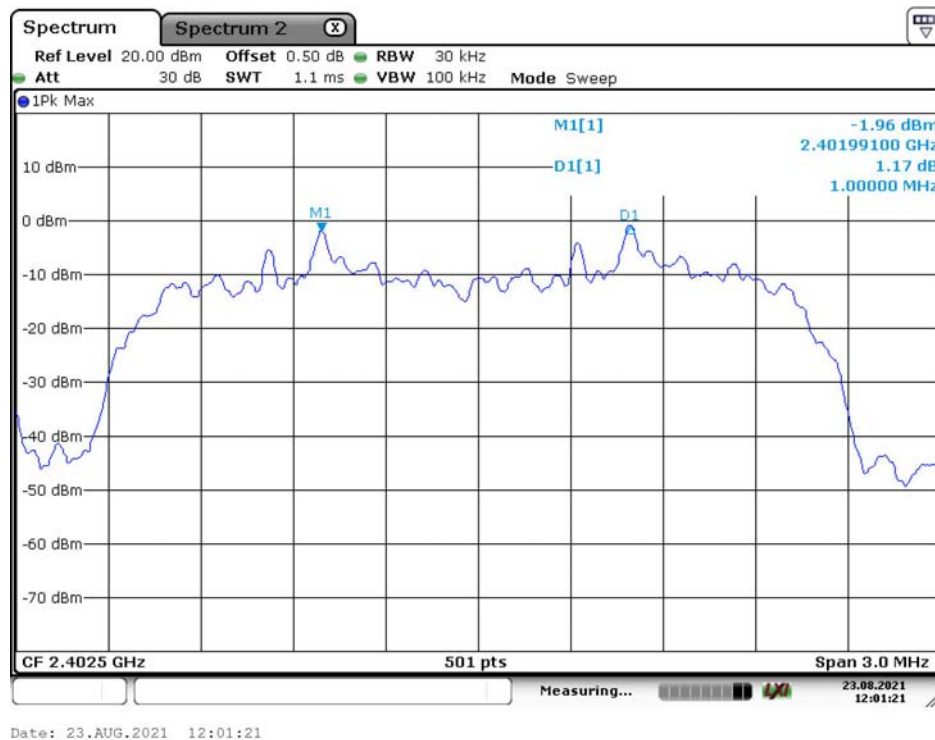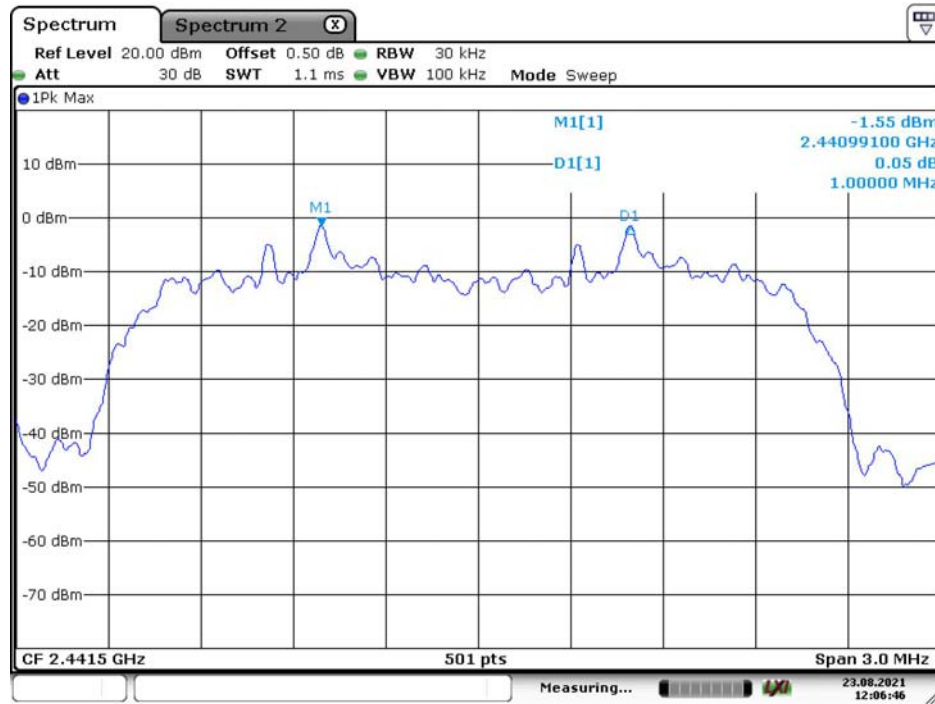
Middle Channel

Date: 23.AUG.2021 12:06:46

High Channel
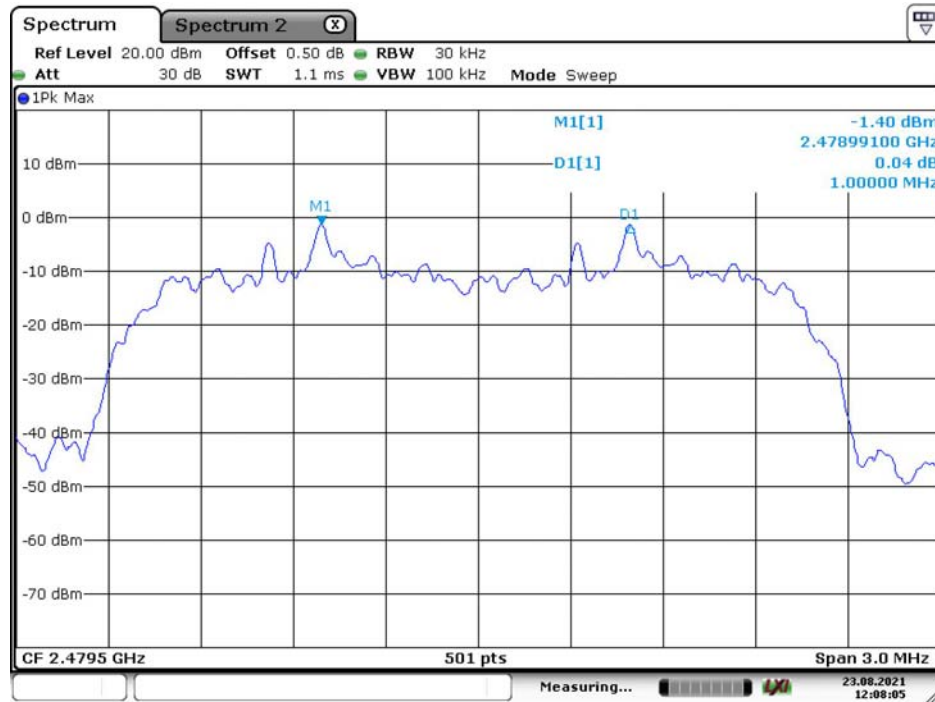
Date: 23.AUG.2021 12:08:05

EDR Mode (8DPSK):
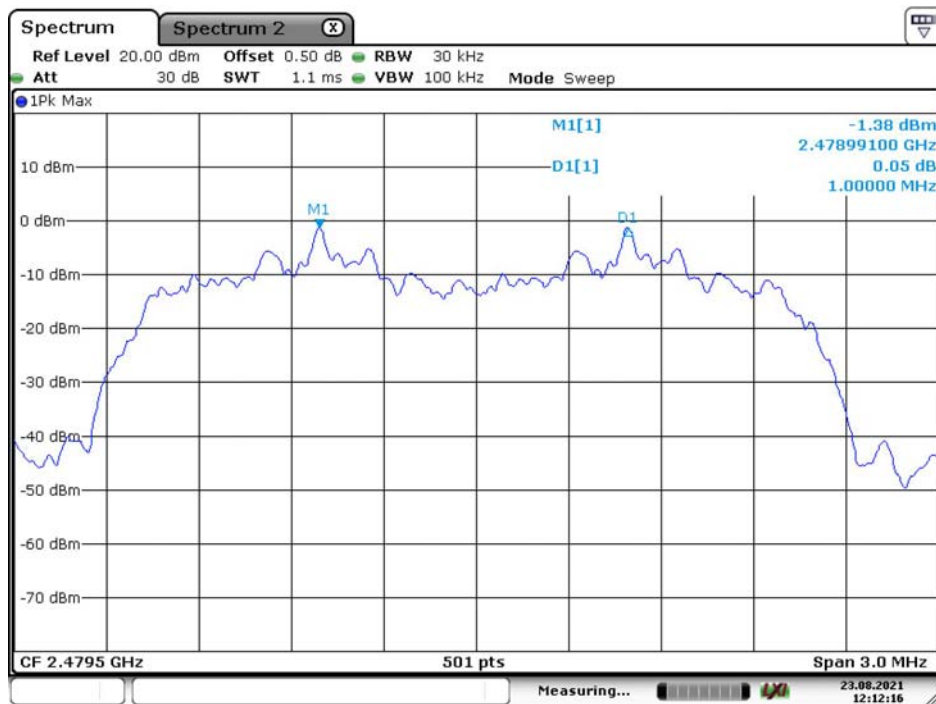
Low Channel

Date: 23.AUG.2021　12:09:41

Middle Channel

Date: 23.AUG.2021　12:10:48

High Channel

Spectrum	Spectrum 2 ⊗

Ref Level 20.00 dBm   Offset 0.50 dB ● RBW 30 kHz
Att   30 dB   SWT   1.1 ms ● VBW 100 kHz   Mode Sweep

● 1Pk Max

M1[1]   -1.38 dBm
                                2.47899100 GHz
D1[1]   0.05 dB
                                   1.00000 MHz

CF 2.4795 GHz   501 pts   Span 3.0 MHz

Measuring...   23.08.2021
                                      12:12:16
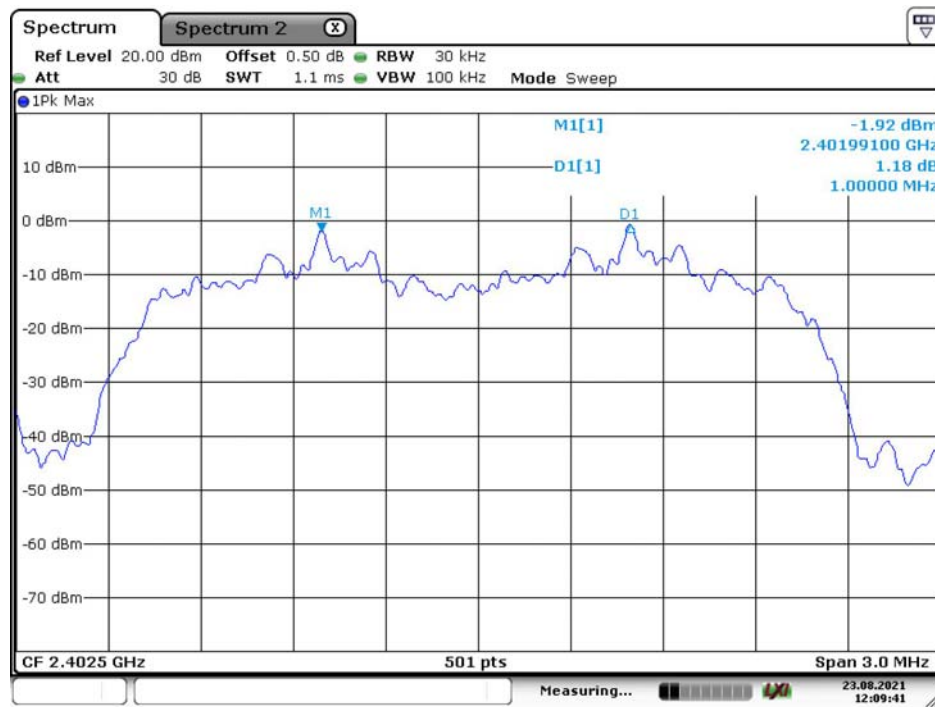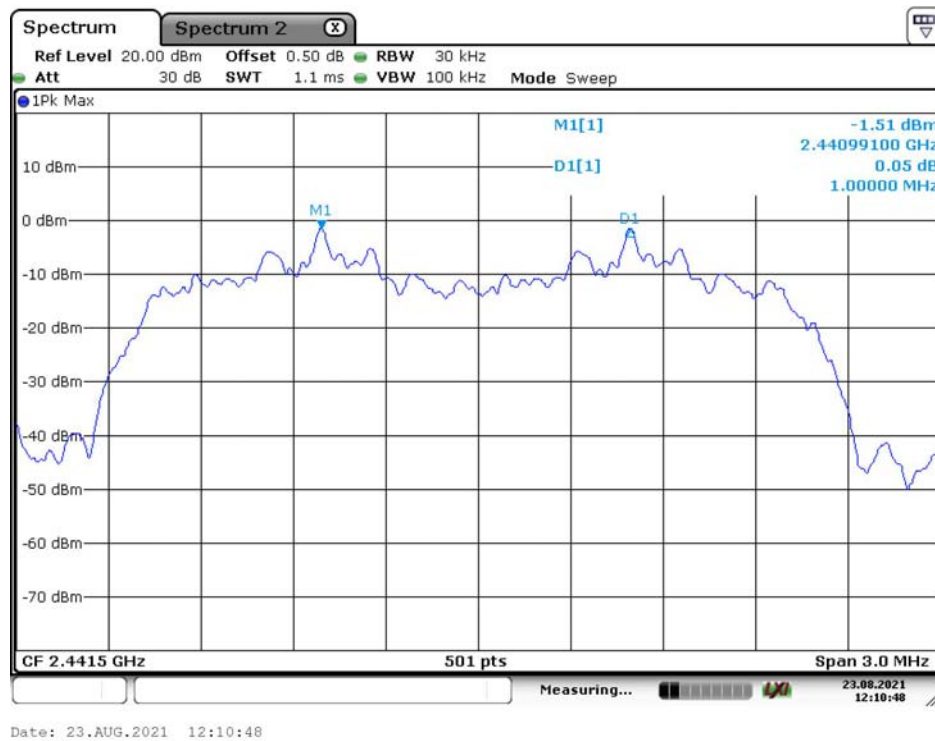
Date: 23.AUG.2021 12:12:16

7 – 20 dB BANDWIDTH AND 99% OCCUPIED BANDWIDTH TESTING

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.

According to RSS-247 Clause 5.1 b):

b)   FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz 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 that the systems operate with an output power no greater than 0.125 W.

According to RSS-Gen Clause 6.7:

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the "x dB bandwidth" is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.
The following conditions shall be observed for measuring the occupied bandwidth and x 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 / x 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 / x 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 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. Use Occupied bandwidth test function, measure the 99% Occupied bandwidth.
5. 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)	99% occupied Bandwidth (MHz)
BDR Mode (GFSK)	Low	2402	0.880	0.846
	Middle	2441	0.884	0.850
	High	2480	0.876	0.850
EDR Mode (π/4-DQPSK)	Low	2402	1.220	1.158
	Middle	2441	1.220	1.158
	High	2480	1.220	1.158
EDR Mode (8DPSK)	Low	2402	1.212	1.142
	Middle	2441	1.212	1.134
	High	2480	1.212	1.142

20dB Bandwidth:

BDR Mode (GFSK):

Low Channel

Date: 23.AUG.2021　11:54:37

Middle Channel

Date: 23.AUG.2021　11:56:20

High Channel

Date: 23.AUG.2021 11:58:13

EDR Mode (π/4-DQPSK):

Low Channel

Date: 23.AUG.2021 12:00:24
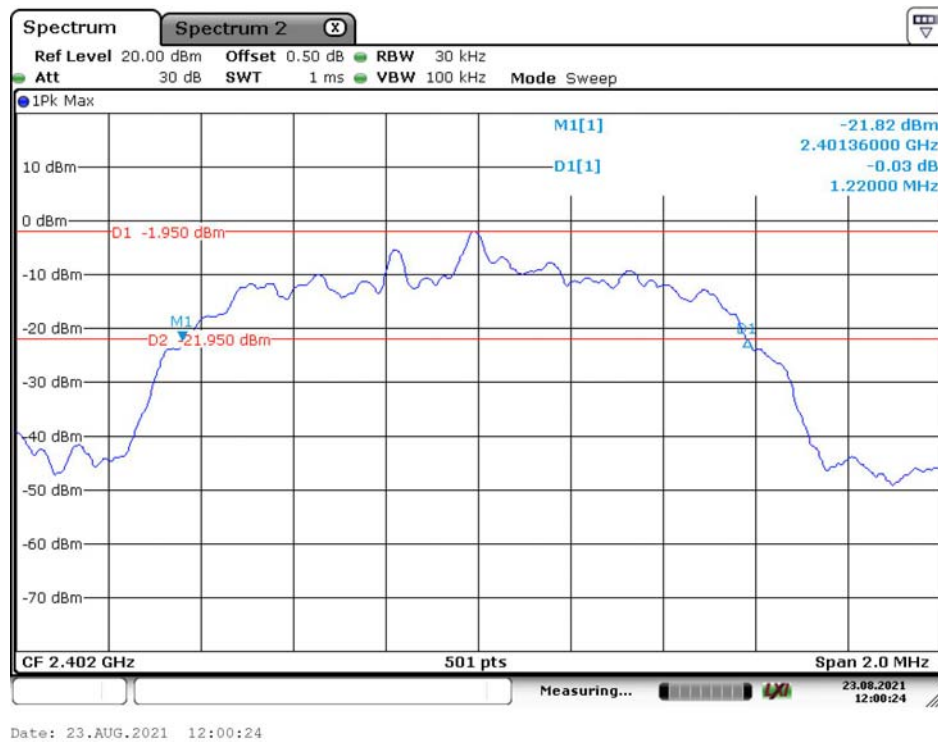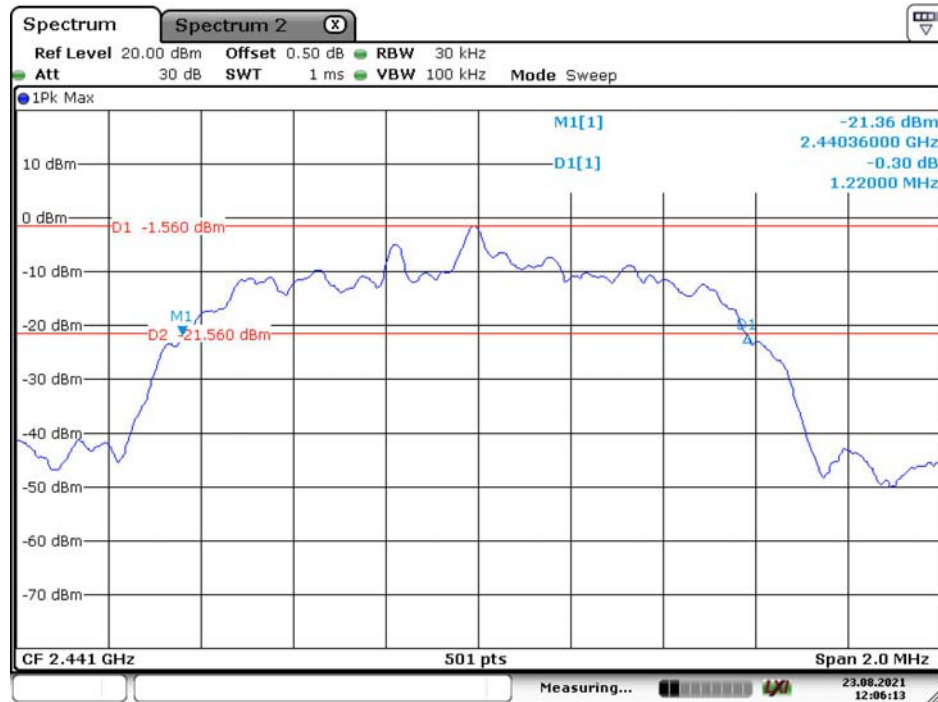
Middle Channel

Date: 23.AUG.2021   12:06:13

High Channel
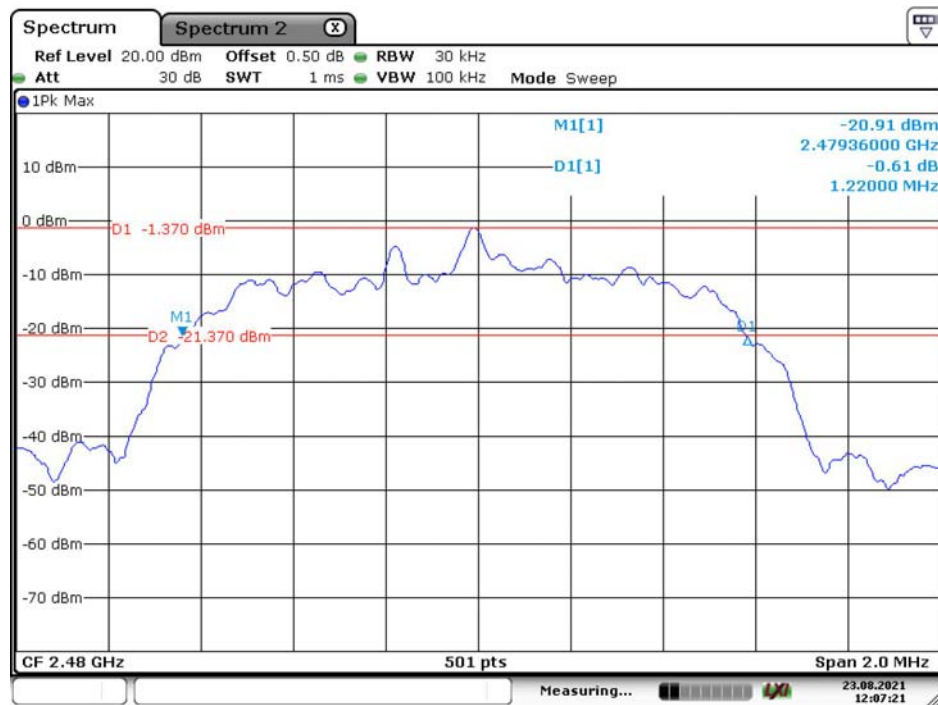
Date: 23.AUG.2021   12:07:21

EDR Mode (8DPSK):

Low Channel
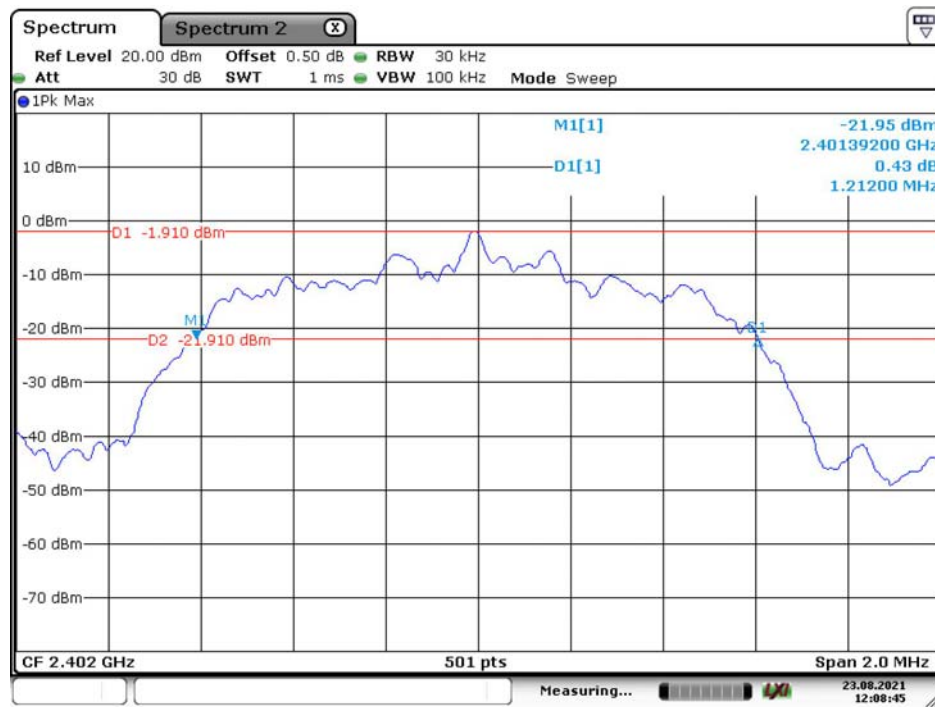
Date: 23.AUG.2021   12:08:45

Middle Channel
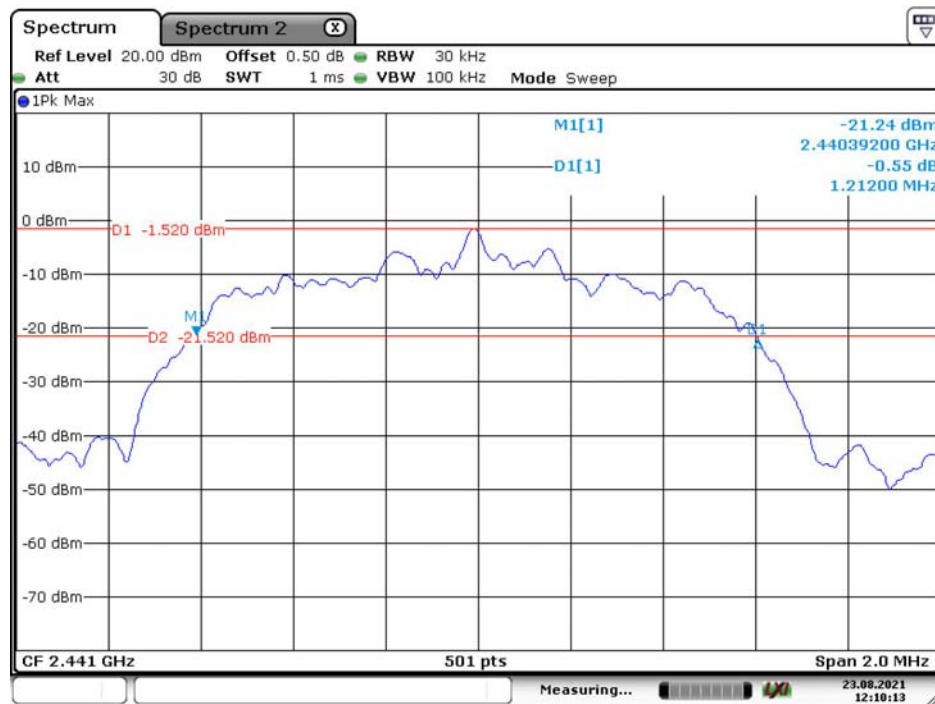
Date: 23.AUG.2021   12:10:13

High Channel

Date: 23.AUG.2021　12:11:17
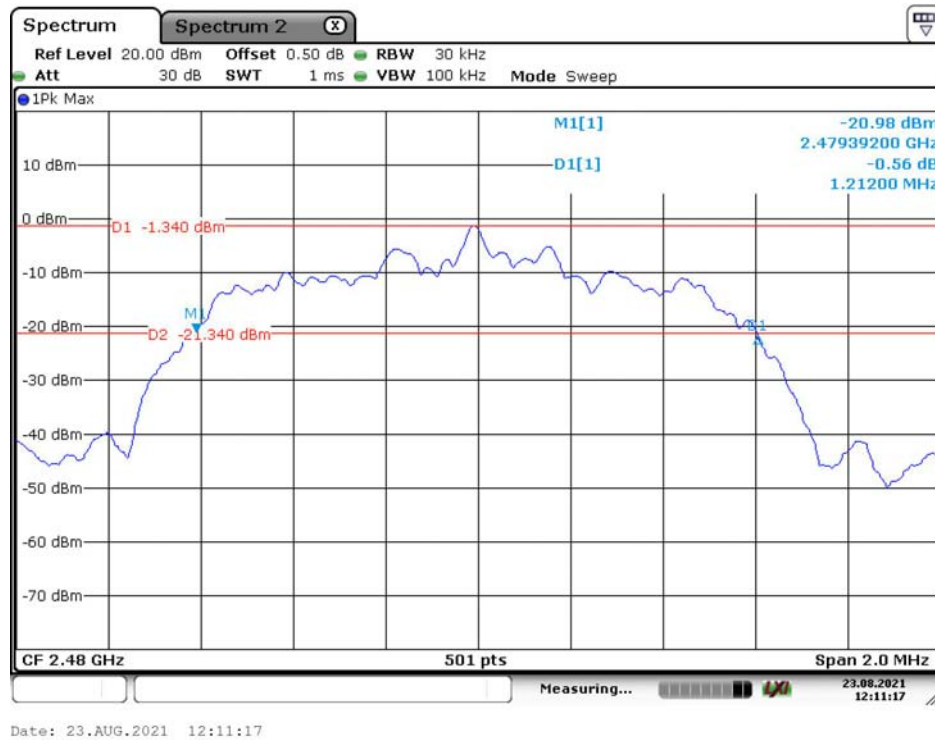
99% Occupied Bandwidth:

BDR Mode (GFSK):

Low Channel

Date: 23.AUG.2021　11:54:52

Middle Channel

Date: 23.AUG.2021 11:56:34

High Channel

Date: 23.AUG.2021 11:58:27

EDR Mode (π/4-DQPSK):

Low Channel

Date: 23.AUG.2021   12:00:38

Middle Channel

Date: 23.AUG.2021   12:06:24
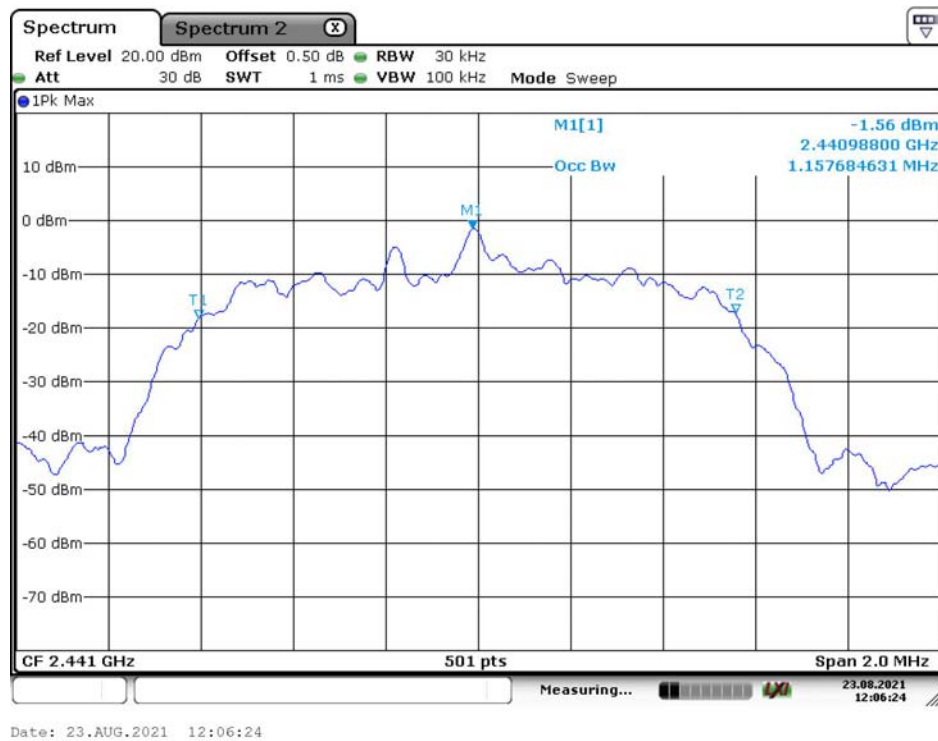
High Channel

Date: 23.AUG.2021 12:07:32

EDR Mode (8DPSK):

Low Channel
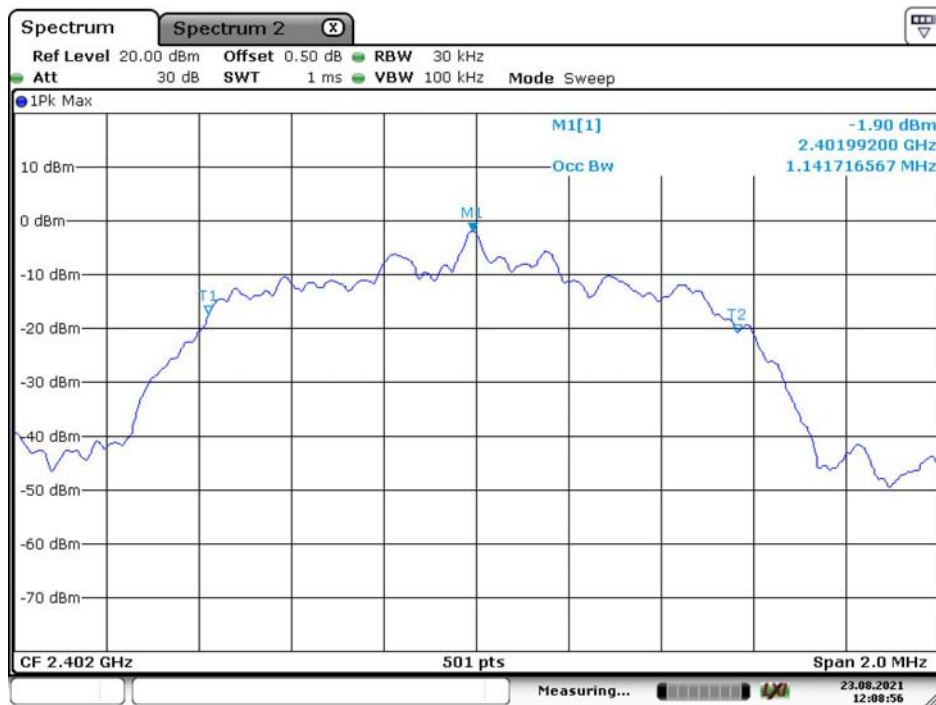
Date: 23.AUG.2021 12:08:56

Middle Channel

Date: 23.AUG.2021   12:10:24

High Channel

Date: 23.AUG.2021   12:11:28
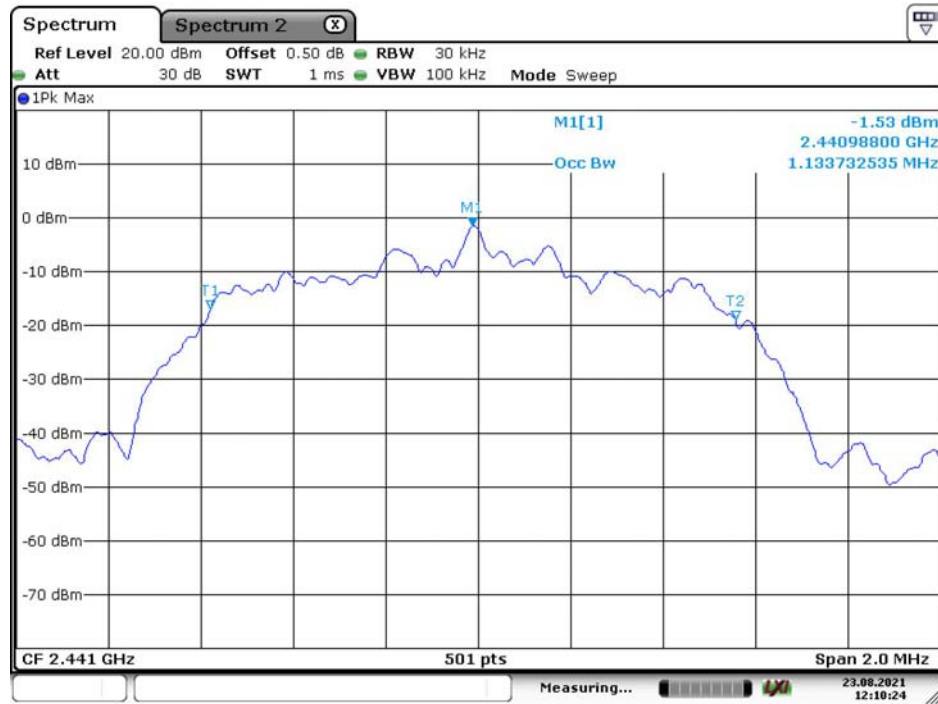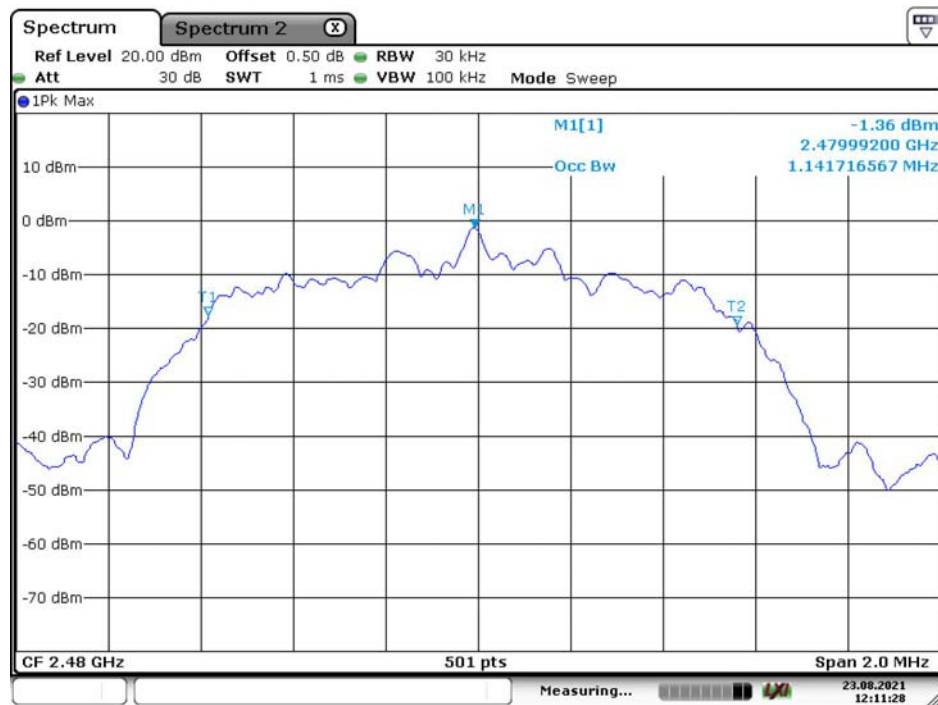
8 - QUANTITY OF HOPPING CHANNEL TEST

Applicable Standard

According to FCC §15.247(a) (1) (iii), RSS-247 Clause 5.1 d)

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
π/4-DQPSK	2400-2483.5	79	≥15
8DPSK	2400-2483.5	79	≥15

GFSK
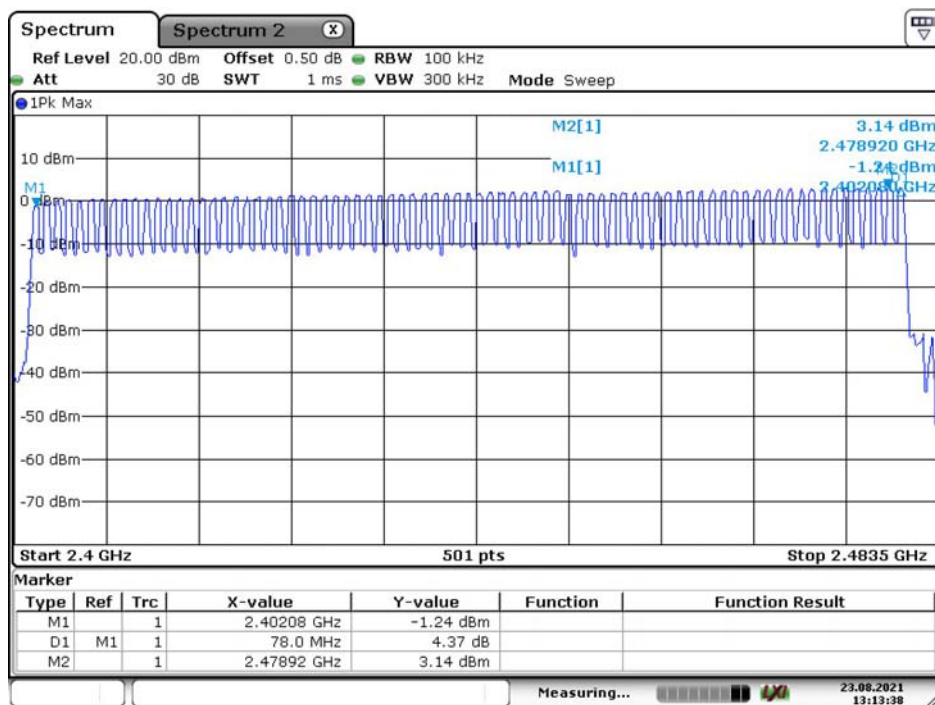
Date: 23.AUG.2021 13:13:38

π/4-DQPSK
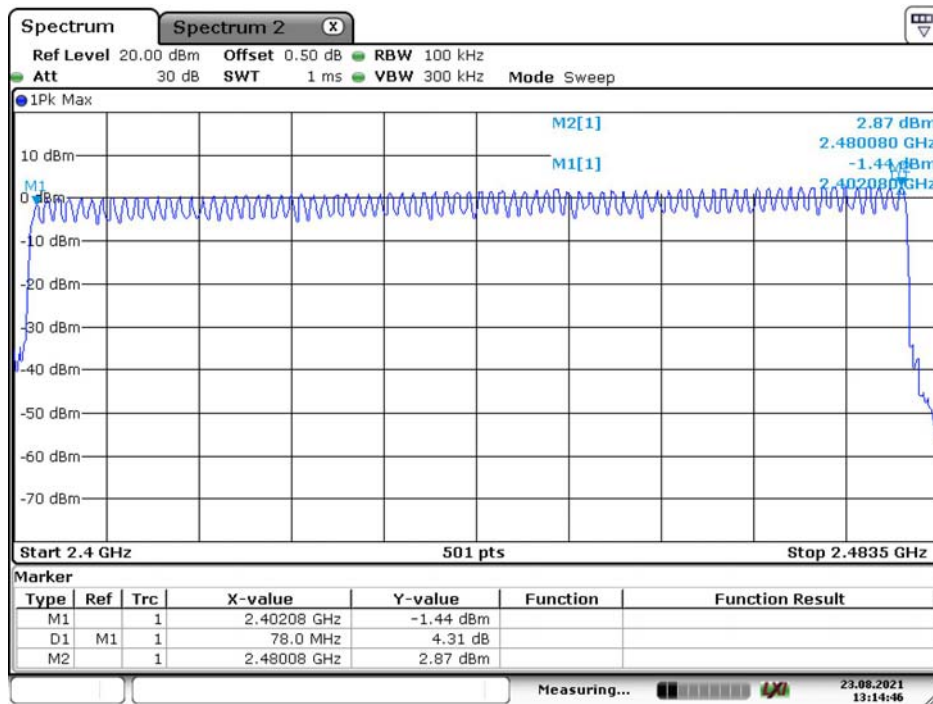
Date: 23.AUG.2021   13:14:46

8DPSK
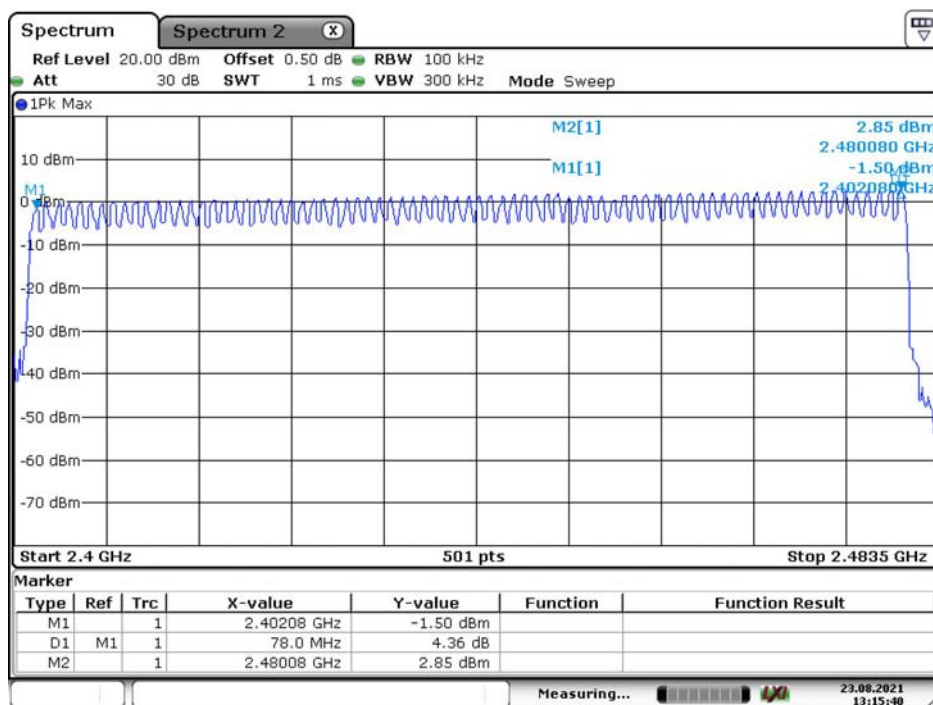
Date: 23.AUG.2021   13:15:40

9 - TIME OF OCCUPANCY (DWELL TIME)

Applicable Standard

According to FCC §15.247(a) (1) (iii), RSS-247 Clause 5.1 d)

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	0.430	0.138	
	DH3	Middle	2441	1.702	0.272	
	DH5	Middle	2441	2.958	0.316	
π/4-DQPSK	2DH1	Middle	2441	0.443	0.142	0.4
	2DH3	Middle	2441	1.721	0.275	
	2DH5	Middle	2441	2.969	0.317	
8DPSK	3DH1	Middle	2441	0.449	0.144	
	3DH3	Middle	2441	1.699	0.272	
	3DH5	Middle	2441	2.955	0.315	
Note: DH1:Dwell time=Pulse time (ms) × (1600/2/79) ×31.6 s DH3:Dwell time=Pulse time (ms) × (1600/4/79) ×31.6 s DH5:Dwell time=Pulse time (ms) × (1600/6/79) ×31.6 s						

BDR Mode (GFSK):

DH1: Middle Channel

Date: 23.AUG.2021 14:27:33

DH3: Middle Channel

Date: 23.AUG.2021 14:28:22
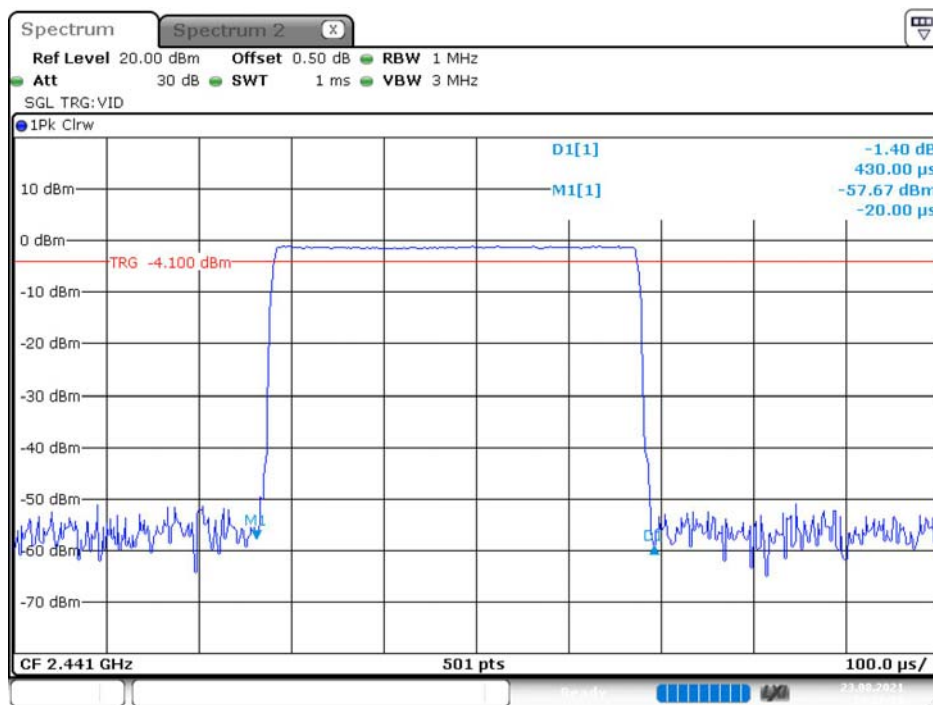
DH5: Middle Channel
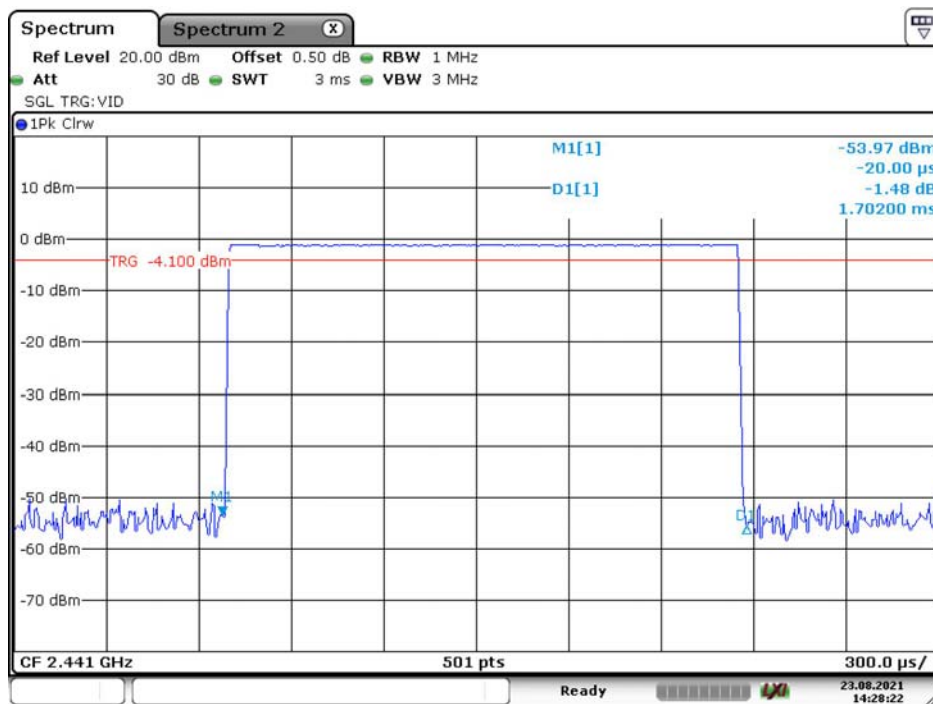
Date: 23.AUG.2021   14:28:55
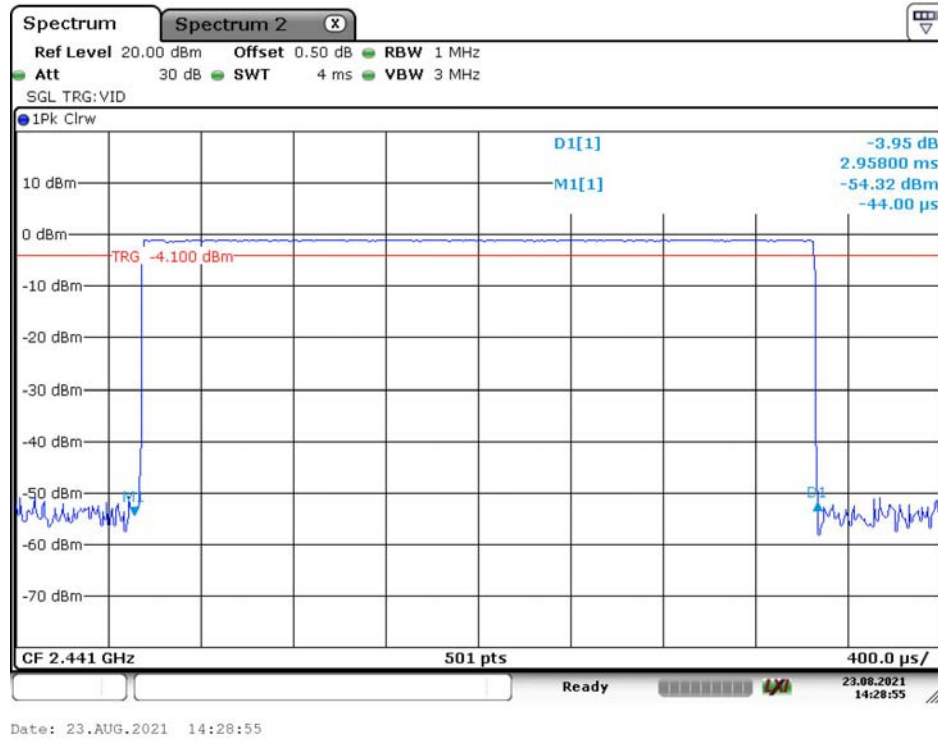
EDR Mode (π/4-DQPSK):

2DH1: Middle Channel

Date: 23.AUG.2021   14:30:12
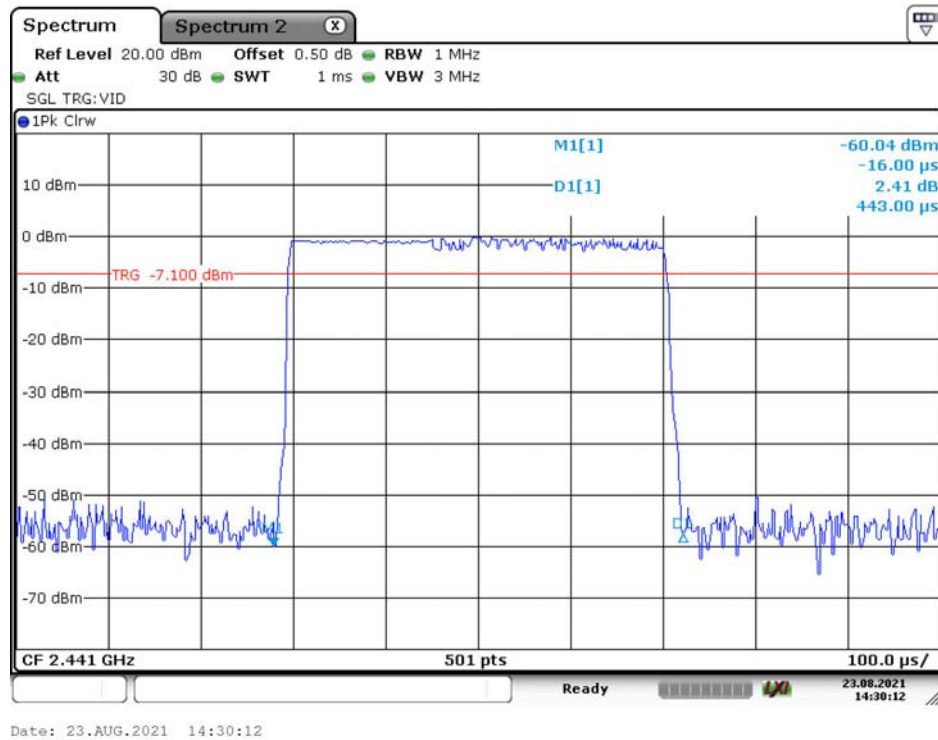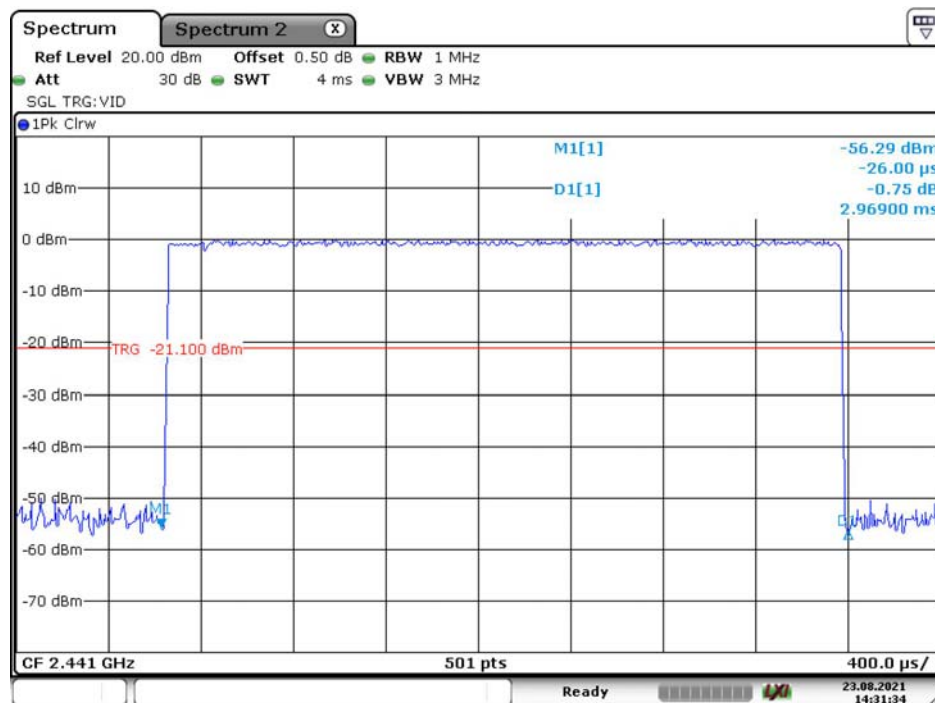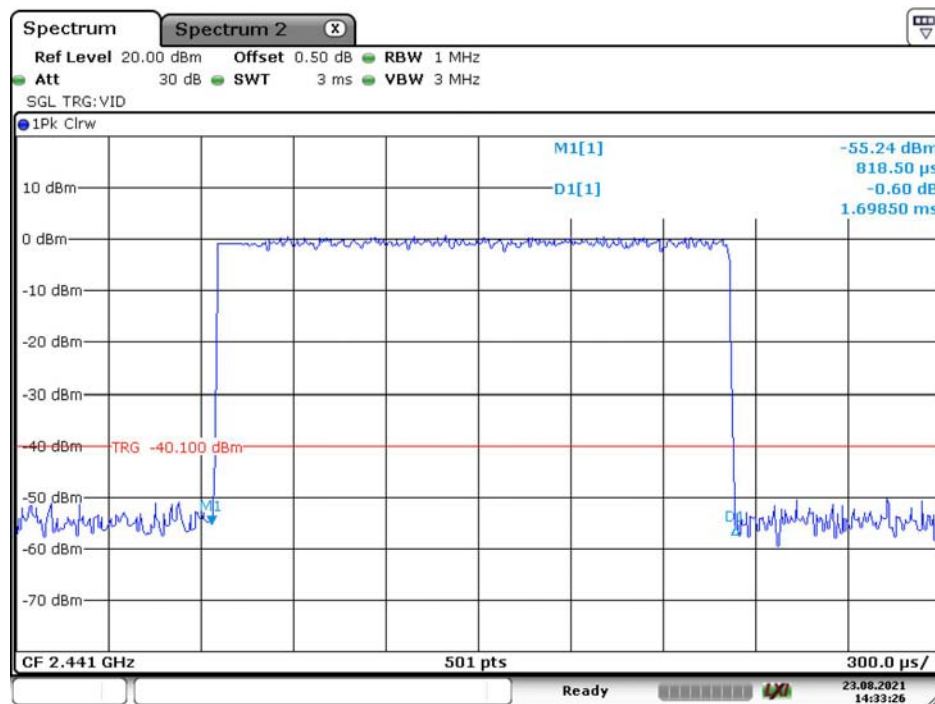
2DH3: Middle Channel
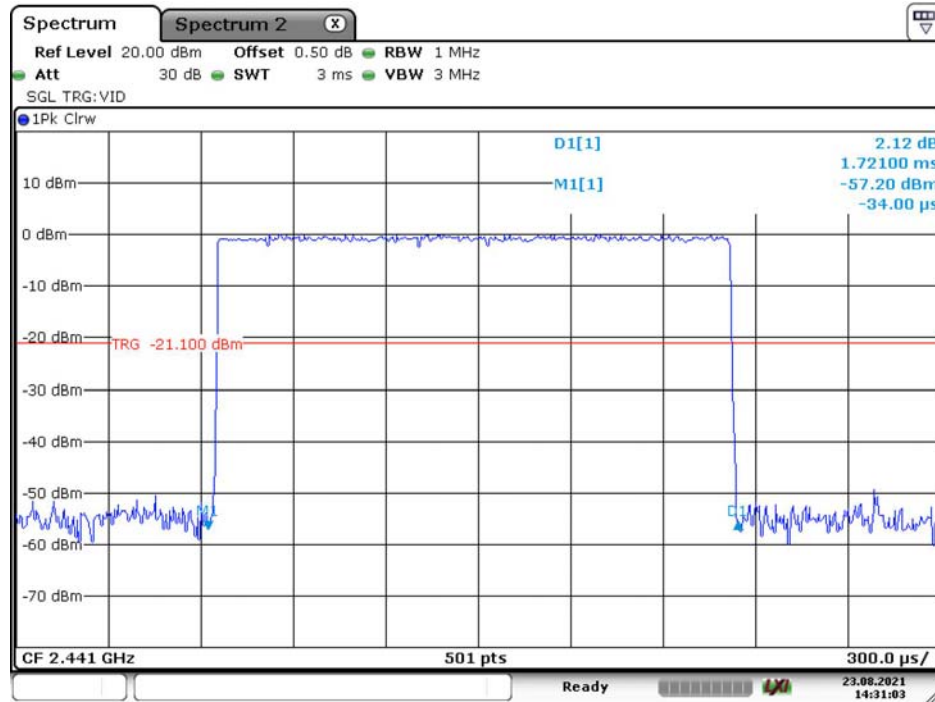
Date: 23.AUG.2021   14:31:02

2DH5: Middle Channel

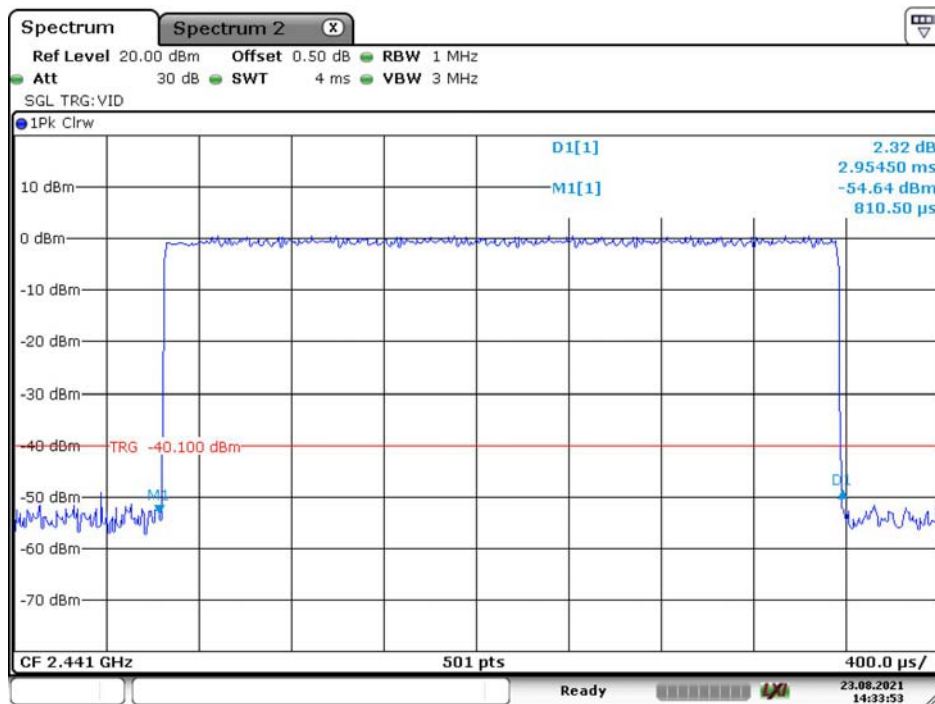Date: 23.AUG.2021   14:31:34

EDR Mode (8DPSK):

3DH1: Middle Channel
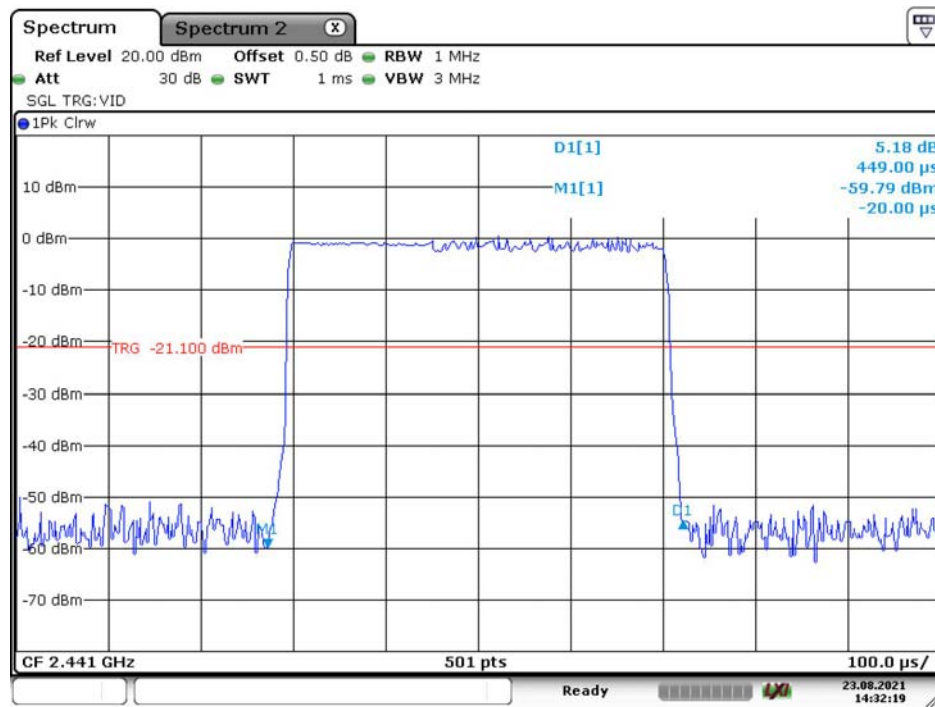
Date: 23.AUG.2021   14:32:19

3DH3: Middle Channel

Date: 23.AUG.2021   14:33:25

3DH5: Middle Channel

Date: 23.AUG.2021 14:33:53

10 - 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. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts

According to RSS-247 Clause 5.4 b)

b)　For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels.　The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

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	Frequency (MHz)	Peak Conducted Output power (dBm)	Peak Conducted Output power Limit (dBm)
BDR Mode (GFSK)	2402	0.23	21
	2441	0.08	21
	2480	-0.10	21
EDR Mode (π/4-DQPSK)	2402	-0.05	21
	2441	0.21	21
	2480	**0.50**	21
EDR Mode (8DPSK)	2402	-0.04	21
	2441	0.21	21
	2480	0.50	21

Note: The data above was tested in conducted mode, the antenna gain is 0dBi, so the test result can meet the ICED EIRP requirement.

11 - BAND EDGES TESTING

Applicable Standard

According to FCC §15.247(d)

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

According to RSS-247 Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW/ 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.
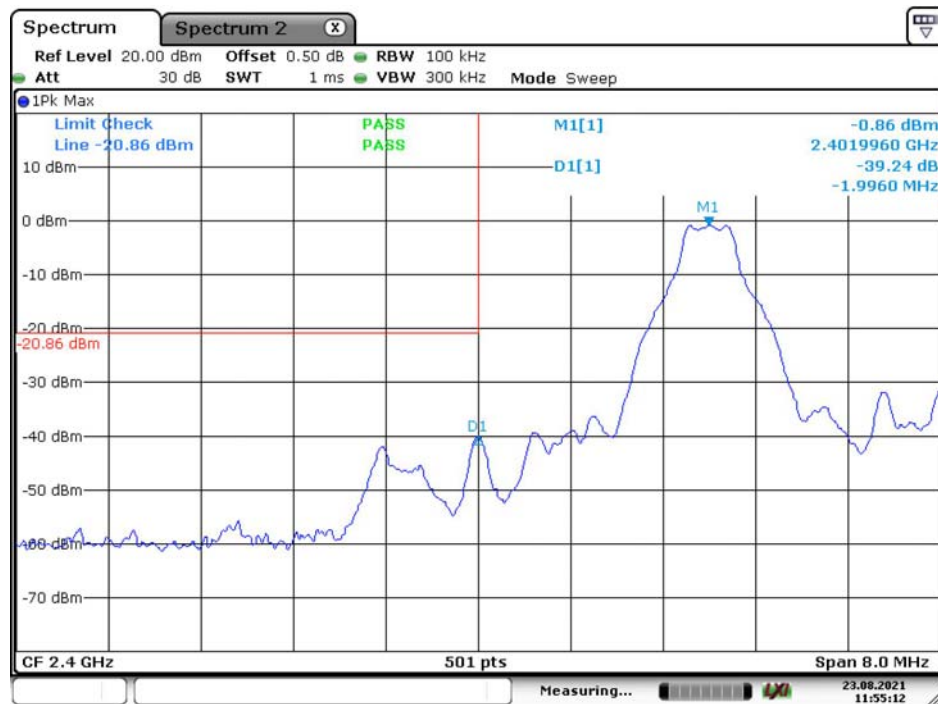5. Repeat above procedures until all measured frequencies were complete.

Test Data

Test Mode: Transmitting

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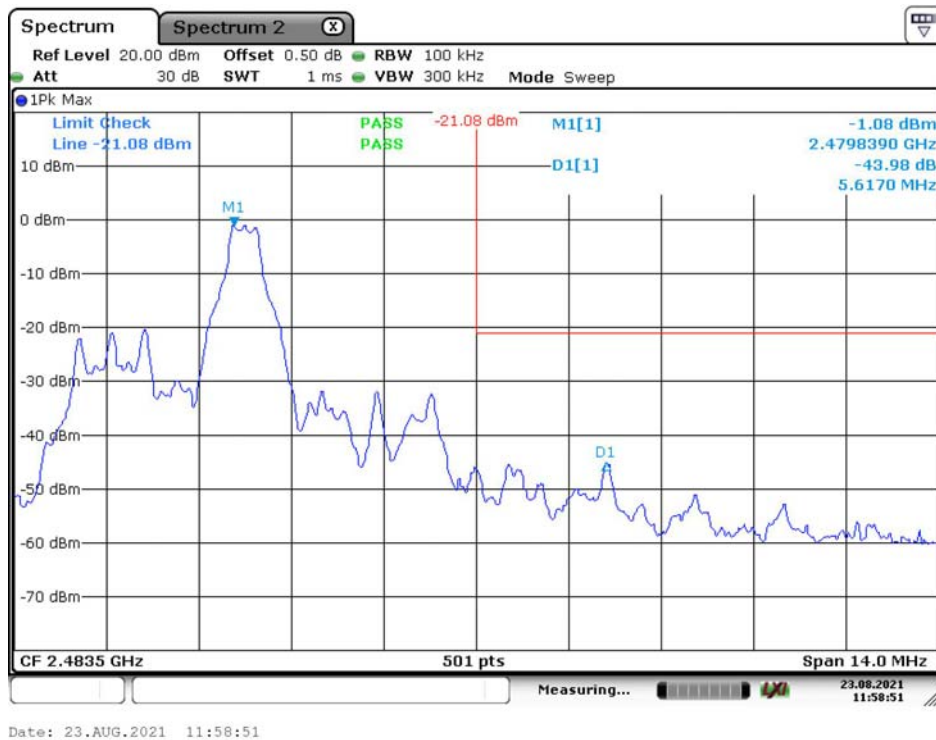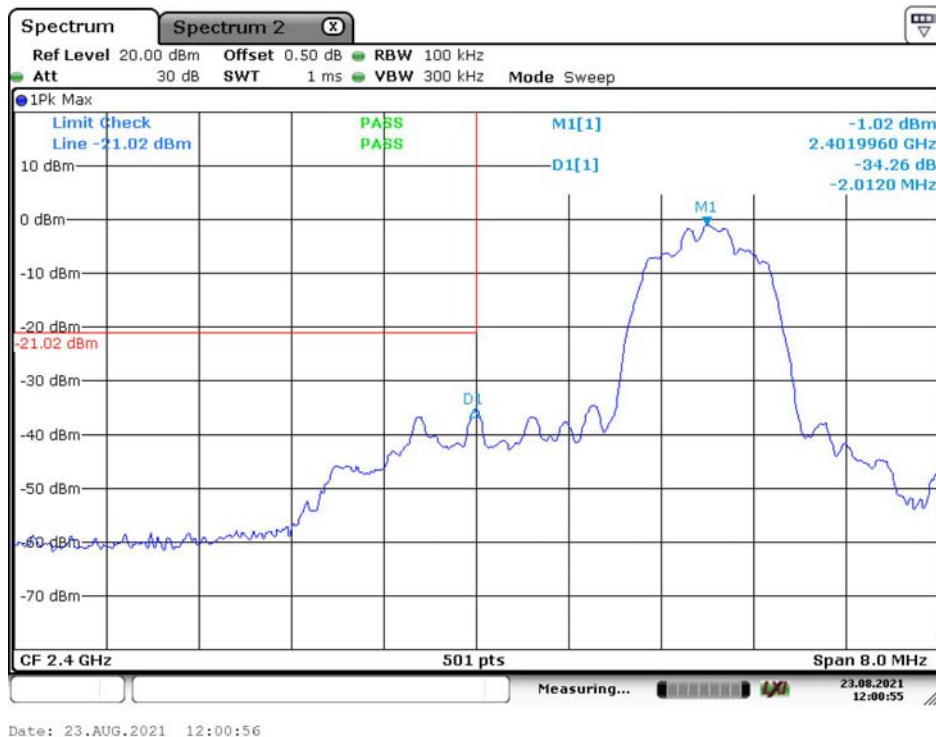
Single mode:

BDR Mode (GFSK):

Band Edge, Left Side
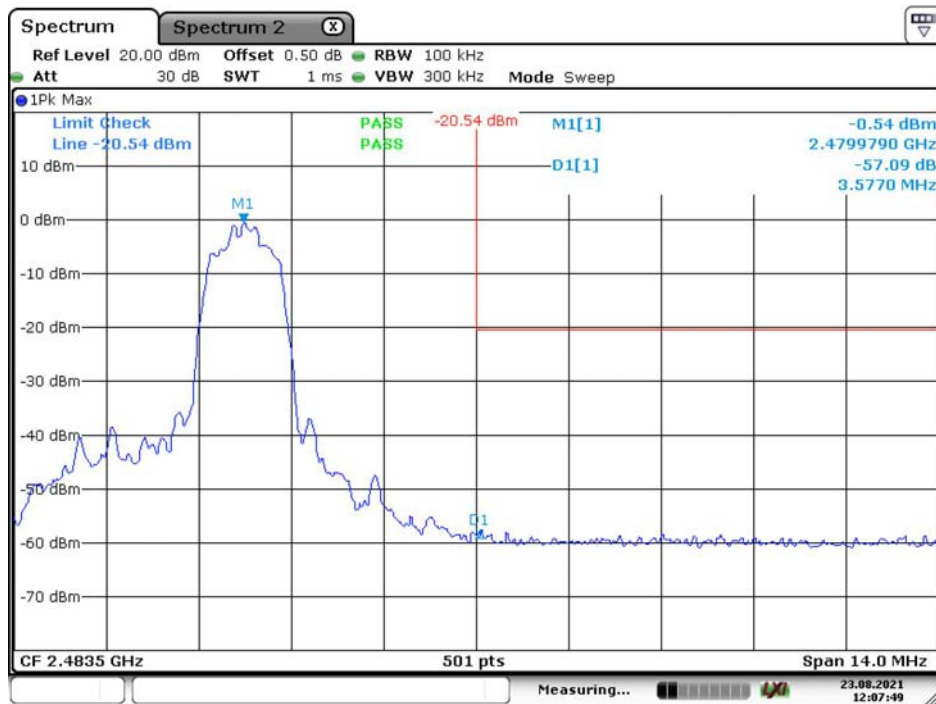

Date: 23.AUG.2021   11:55:12

Band Edge, Right Side

Date: 23.AUG.2021　11:58:51

EDR Mode (π/4-DQPSK):

Band Edge, Left Side

Date: 23.AUG.2021　12:00:56

Band Edge, Right Side

Date: 23.AUG.2021 12:07:49

EDR Mode (8DPSK):

Band Edge, Left Side
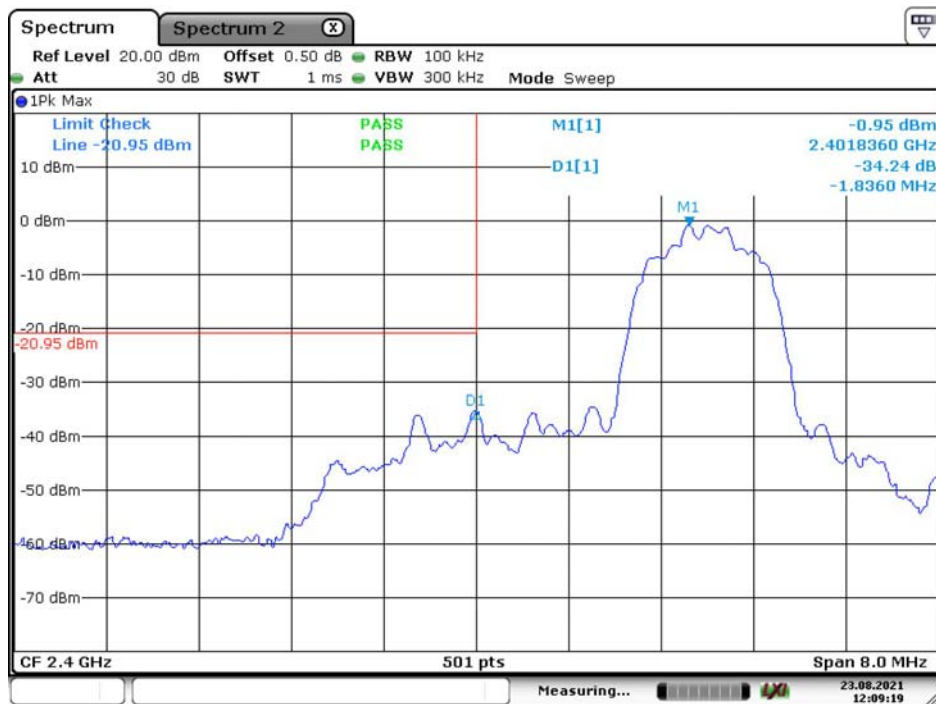
Date: 23.AUG.2021 12:09:20
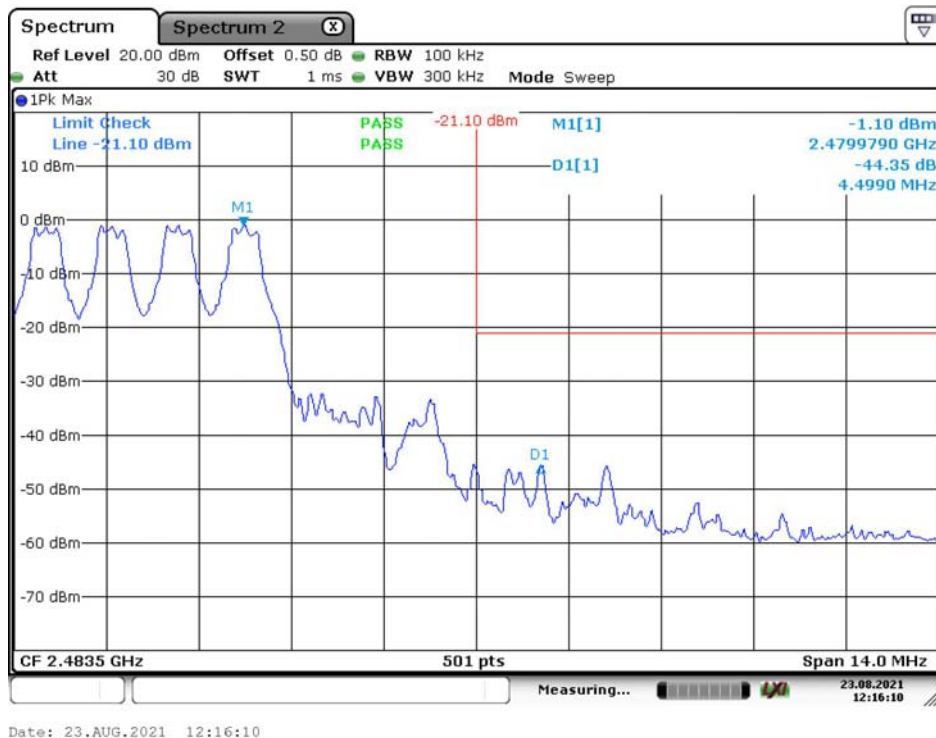
Band Edge, Right Side

Date: 23.AUG.2021   12:11:55
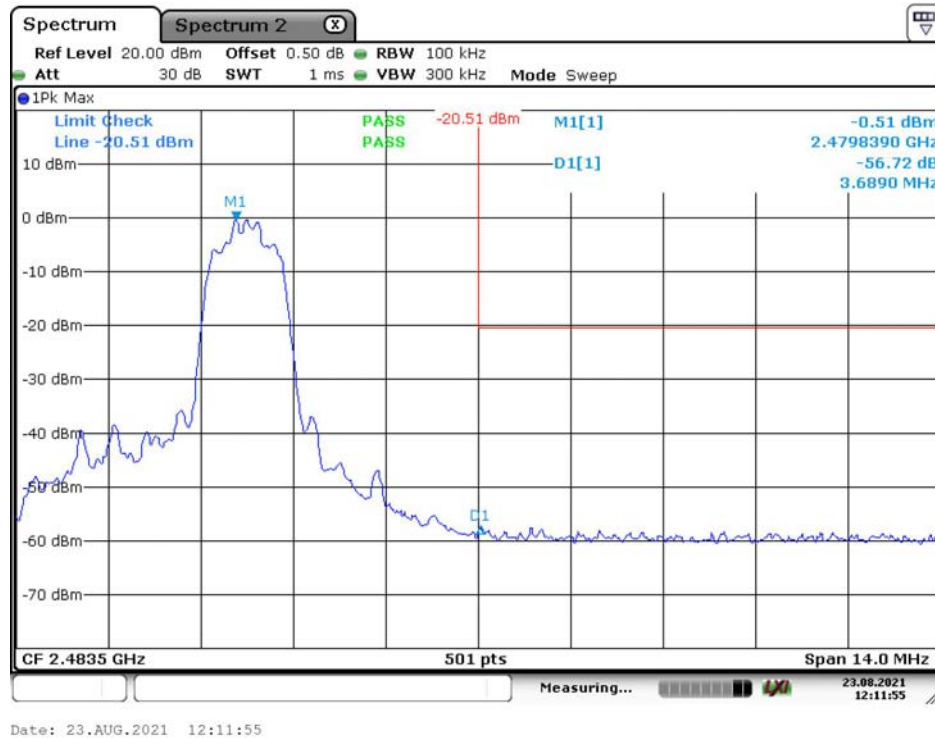
Hopping mode:

BDR Mode (GFSK):
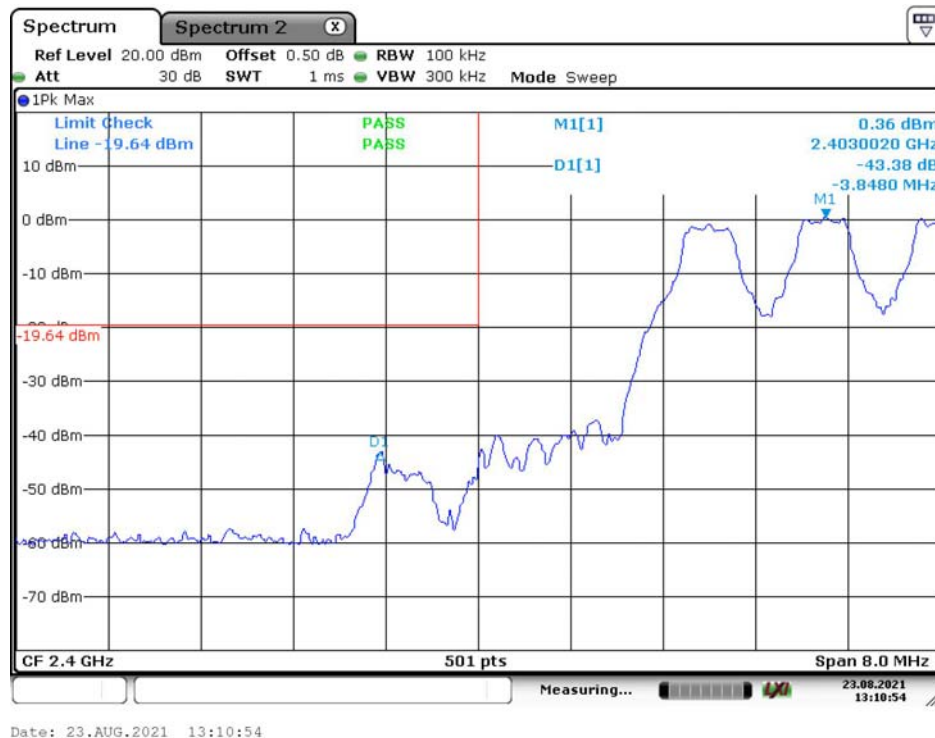
Band Edge, Left Side

Date: 23.AUG.2021   13:10:54

Band Edge, Right Side

Date: 23.AUG.2021   12:16:10

EDR Mode (π/4-DQPSK):

Band Edge, Left Side

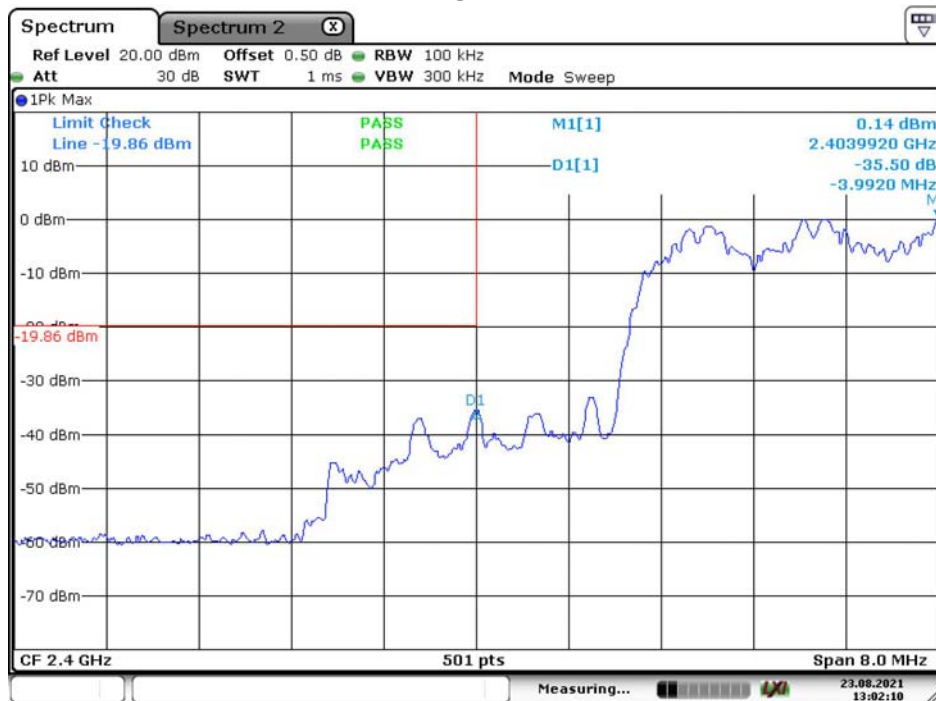
Date: 23.AUG.2021   12:18:16
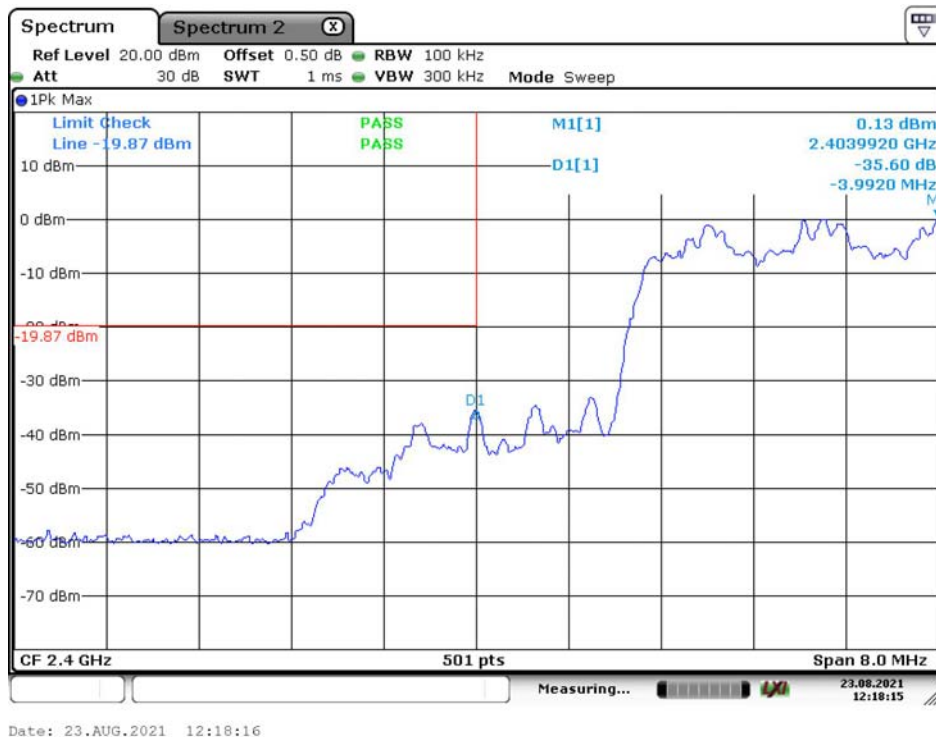
Band Edge, Right Side
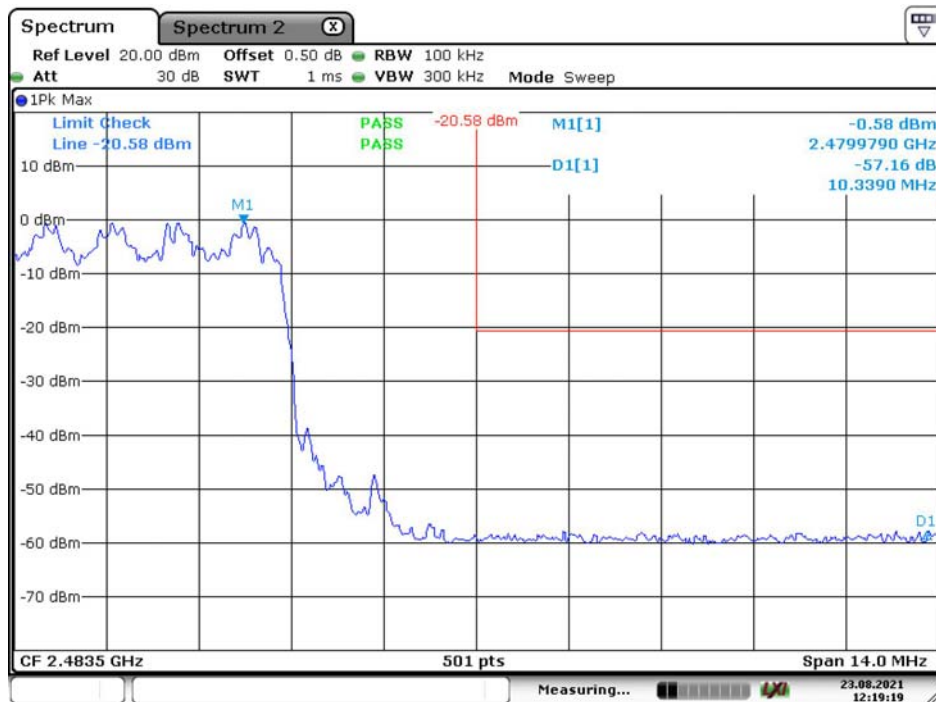
Date: 23.AUG.2021　12:19:19

EDR Mode (8DPSK):

Band Edge, Left Side

Date: 23.AUG.2021　13:02:10

Band Edge, Right Side

Date: 23.AUG.2021   13:03:32

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