N° 1-6736
Scope available
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CERTIFICATE #3478.01

TEST REPORT

EUT Description	**WLAN and BT, 2x2 PCIe M.2 1625 adapter card**
Brand Name	**Intel® Wi-Fi 6E AX411**
Model Name	**AX411E2W**
FCC/IC ID	**FCCID: PD9AX411E2 / IC ID: 1000M-AX411E2**
Date of Test Start/End	**2021-07-16 / 2021-08-17**
Features	**802.11ax, Tri Band, 2x2 Wi-Fi 6E + Bluetooth® 5.2 + CDB (Concurrent Dual Band simultaneous Wi-Fi connection) (see section 5)**

Applicant	**Intel Mobile Communications**
Address	**100 Center Point Circle, Suite 200 Columbia, South Carolina 29210 USA**
Contact Person	**Steven Hackett**
Telephone/Fax/ Email	**steven.c.hackett@intel.com**

Reference Standards	**FCC CFR Title 47 Part 15 C RSS-247 issue 2, RSS-Gen issue 5 A1 (see section 1)**

Test Report identification	**210611-03.TR05**
Revision Control	**Rev. 00 This test report revision replaces any previous test report revision** (see section 8)

The test results relate only to the samples tested.
Reference to accreditation shall be used only by full reproduction of test report.

Issued by	Reviewed by
Digitally signed by Z.OUACHICHA Date: 2021.09.10 17:58:36 +02'00'	Digitally signed by In Cheiel Date: 2021.09.10 19:42:42 +02'00'
Zayd OUACHICHA (Test Engineer Lead)	(Technical Manager Deputy) Cheiel In

Intel Corporation S.A.S – WRF Lab
425 rue de Goa – Le Cargo B6 - 06600, Antibes, France
Tel. +33493001400 / Fax +33493001401

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1. Standards, reference documents and applicable test methods

FCC	1. FCC Title 47 CFR part 15 - Subpart C – §15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz. 2019-10-01 Edition 2. FCC Title 47 CFR part 15 - Subpart C – §15.209 Radiated emission limits; general requirements. 2019-10-01 Edition 3. FCC OET KDB 558074 D01 v05r02 - Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules. 4. FCC OET KDB 662911 D01 v02r01 - Emissions Testing of Transmitters with Multiple Outputs in the Same Band. 5. ANSI C63.10-2013 - American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ISED	1. RSS-247 Issue 2 - Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices. 2. RSS-Gen Issue 5 A1- General Requirements for Compliance of Radio Apparatus. 3. FCC OET KDB 558074 D01 v05r02 - Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules. 4. FCC OET KDB 662911 D01 v02r01 - Emissions Testing of Transmitters with Multiple Outputs in the Same Band. 5. ANSI C63.10-2013 - American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

2. General conditions, competences and guarantees

- ✓ Tests performed under FCC standards identified in section 1 are covered by A2LA accreditation.
- ✓ Tests performed under ISED standards identified in section 1 are covered by Cofrac accreditation.
- ✓ Intel Corporation SAS Wireless RF Lab (Intel WRF Lab) is an ISO/IEC 17025:2017 laboratory accredited by the American Association for Laboratory Accreditation (A2LA) with the certificate number 3478.01.
- ✓ Intel Corporation SAS Wireless RF Lab (Intel WRF Lab) is an Accredited Test Firm recognized by the FCC, with Designation Number FR0011.
- ✓ Intel Corporation SAS Wireless RF Lab (Intel WRF Lab) is an ISO/IEC 17025:2017 testing laboratory accredited by the French Committee for Accreditation (Cofrac) with the certificate number 1-6736.
- ✓ Intel Corporation SAS Wireless RF Lab (Intel WRF Lab) is a Registered Test Site listed by ISED, with ISED #1000Y.
- ✓ Intel WRF Lab declines any responsibility with respect to the identified information provided by the customer and that may affect the validity of results.
- ✓ Intel WRF Lab only provides testing services and is committed to providing reliable, unbiased test results and interpretations.
- ✓ Intel WRF Lab is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.
- ✓ Intel WRF Lab has developed calibration and proficiency programs for its measurement equipment to ensure correlated and reliable results to its customers.
- ✓ This report is only referred to the item that has undergone the test.
- ✓ This report does not imply an approval of the product by the Certification Bodies or competent Authorities.

3. Environmental Conditions

- ✓ At the site where the measurements were performed the following limits were not exceeded during the tests:

Temperature	24.15 ºC ±3.45 ºC
Humidity	44.4% ±6.8%

4. Test samples

Sample	Control #	Description	Model	Serial #	Date of receipt	Note
#1	210611-03.S04	WiFi 6E Module	AX411E2W	WM:3413E8F0D1BA	2021-07-05	RF Conducted
	170000-01.S02	Laptop	Latitude E5470	21HTPF2	2017-03-28	
	191003-02.S06	Extender	PCB00651_01	6513519-009	2019-10-29	
	210611-03.S24	Socket (GfP4 SD1625)	AX411E2W	-	2021-07-22	
#2	210611-03.S01	WiFi 6E Module	AX411E2W	WM:3413E8F0D70A	2021-07-05	Used for 30MHz-1GHz and 9.5-18GHz Radiated Spurious Emissions tests
	210611-03.S25	Socket	Adaptor 1625	-	2021-07-16	
	200102-01.S03	Extender	ADEXELEC	-	2020-01-02	
	210611-02.S15	Adaptor	PowerBy SNJ A4	-	2021-07-02	
	200602-03.S06	Absorber	MCS0	-	2020-07-03	
	170801-01.S10	Laptop	Latitude E7470	7KNOXF2	2017-09-08	
	210611-02.S13	Main Antenna	SkyCross	-	2021-07-02	
	210611-02.S14	Aux Antenna	SkyCross	-	2021-07-02	
#3	210611-03.S02	WiFi 6E Module	AX411E2W	WM:3413E8F0DA75	2021-07-05	Used for 1GHz-9.5GHz Radiated Spurious Emissions tests
	210611-03.S26	Socket	Adaptor 1625	-	2021-07-16	
	200611-03.S26	Extender	ADEXELEC	-	2020-07-01	
	210611-02.S16	Adaptor	PowerBy SNJ A4	-	2021-07-02	
	200602-03.S06	Absorber	MCS0	-	2020-07-03	
	170000-01.S01	Laptop	Latitude E5470	DBPLMC2	2017-03-28	
	210611-02.S11	Main Antenna	SkyCross	-	2021-07-02	
	210611-02.S12	Aux Antenna	SkyCross	-	2021-07-02	
#4	210611-03.S01	WiFi 6E Module	AX411E2W	WM:3413E8F0D70A	2021-07-05	Used for 18GHz - 26.5GHz Radiated Spurious Emissions tests
	210611-03.S25	Socket	Adaptor 1625	-	2021-07-16	
	200611-03.S26	Extender	ADEXELEC	-	2020-07-01	
	210611-02.S15	Adaptor	PowerBy SNJ A4	-	2021-07-02	
	200602-03.S06	Absorber	MCS0	-	2020-07-03	
	170000-01.S01	Laptop	Latitude E5470	DBPLMC2	2017-03-28	
	210611-02.S11	Main Antenna	SkyCross	-	2021-07-02	
	210611-02.S12	Aux Antenna	SkyCross	-	2021-07-02	

5. EUT Features

The herein information is provided by the customer

Brand Name	Intel® Wi-Fi 6E AX411
Model Name	AX411E2W
Software Version	DRTU Version: 99.2100.64.0-OEM.DRTU.12485
Driver Version	99.0.63.5
Prototype / Production	Production
Supported Radios	802.11b/g/n/ax 2.4GHz (2400.0 – 2483.5 MHz) 802.11a/n/ac/ax 5.2GHz (5150.0 – 5350.0 MHz) 5.6GHz (5470.0 – 5725.0 MHz) 5.8GHz (5725.0 – 5895.0 MHz) 802.11ax 6.0GHz (5925.0 - 7125.0MHz) Bluetooth 5.2 2.4GHz (2400.0 – 2483.5 MHz)

Antenna Information

Transmitter	Main (chain A)	Aux (chain B)
Manufacturer	SkyCross	Skycross
Antenna type	PIFA antenna	PIFA antenna
Part number	N/A	N/A
Declared antenna gain (dBi)	+3.24	+3.24

Concurrent dual band (CDB) transmission mode

The EUT is a WiFi module supporting

Mode	Chain B	Chain A
CDB Mode		
BT Co-run – CDB SISO	WLAN 2.4GHz + WLAN 5GHz	BT
	WLAN 2.4GHz + WLAN 6GHz	BT
CDB only SISO	WLAN 2.4GHz + WLAN 5GHz	-
	WLAN 2.4GHz + WLAN 6GHz	-
CDB only SISO	-	WLAN 2.4GHz + WLAN 6GHz
	-	WLAN 2.4GHz + WLAN 5GHz
CDB only MIMO	WLAN 2.4GHz + WLAN 5GHz	WLAN 2.4GHz + WLAN 5GHz
	WLAN 2.4GHz + WLAN 6GHz	WLAN 2.4GHz + WLAN 6GHz
BT Co-run (CDB SISO)	WLAN 2.4GHz	WLAN 5GHz + BT
BT Co-run (CDB SISO)	WLAN 2.4GHz	WLAN 6GHz + BT

6. Remarks and comments

1. No deviations were made from the test methods listed in section 1 of this report
2. The CDB mode has been evaluated this report identification 210611-03.TR51

7. Test Verdicts summary

The statement of conformity to applicable standards in the table below are based on the measured values, without taking into account the measurement uncertainties.

7.1. BT Basic Rate / Enhanced Data Rate

FCC part	RSS part	Test name	Verdict
15.247 (a) (1)	RSS-247 Clause 5.1 (a) and (b)	20dB Bandwidth and Carrier frequency separation	P
15.247 (a) (1) (iii)	RSS-247 Clause 5.1 (d)	Number of hopping channels	P
15.247 (a) (1) (iii)	RSS-247 Clause 5.1 (d)	Time of Occupancy (Dwell Time)	P
15.247 (b) (1)	RSS-247 Clause 5.4 (b)	Maximum Peak Output Power and antenna gain	P
15.247 (d)	RSS-247 Clause 5.5	Out-of-band Emissions (conducted)	P
15.247 (d) 15.209	RSS-247 Clause 5.5 RSS-GEN A1 Clause 8.9	Spurious Emissions (radiated)	P

P: Pass
F: Fail
NM: Not Measured
NA: Not Applicable

8. Document Revision History

Revision #	Modified by	Revision Details
Rev. 00	N.Bui	First Issue

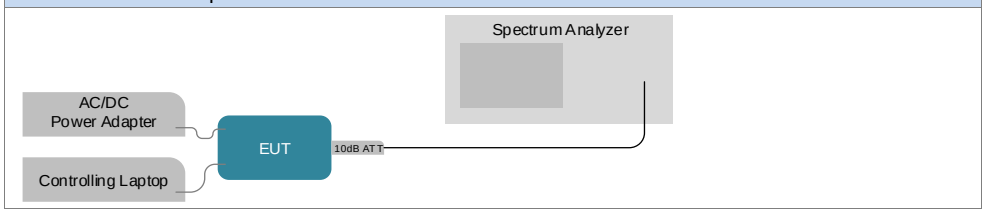
Annex A. Test & System Description

A.1 Measurement System

Measurements were performed using the following setups.

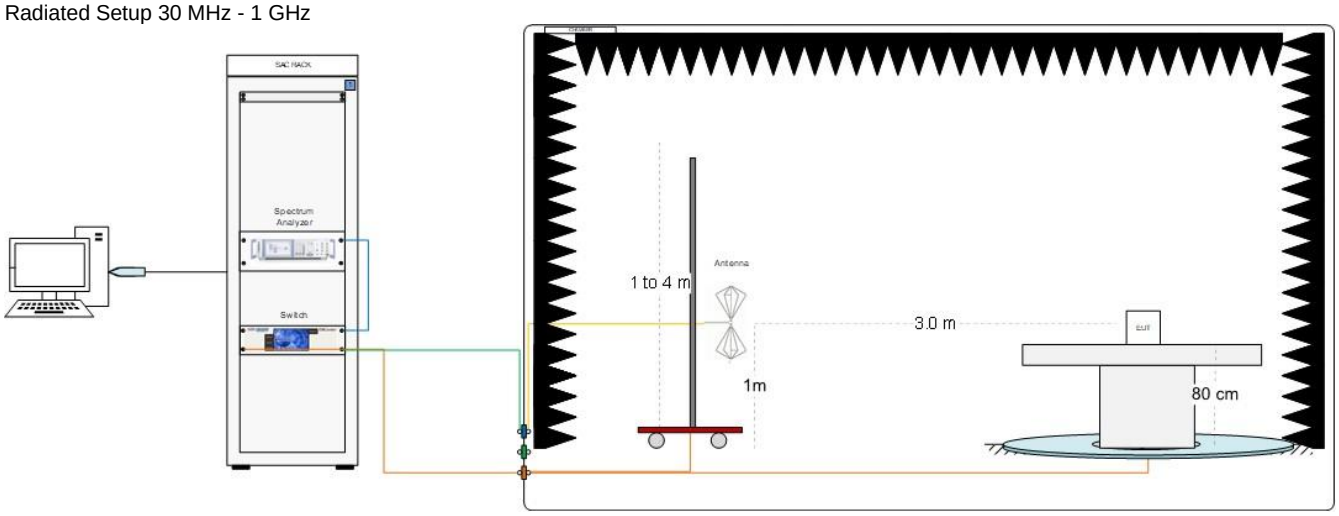
The DUT was installed in a test fixture and this test fixture is connected to a laptop computer and AC/DC power adapter. The laptop computer was used to configure the EUT to continuously transmit at a specified output power using all different modes and modulation schemes.

Conducted test setup

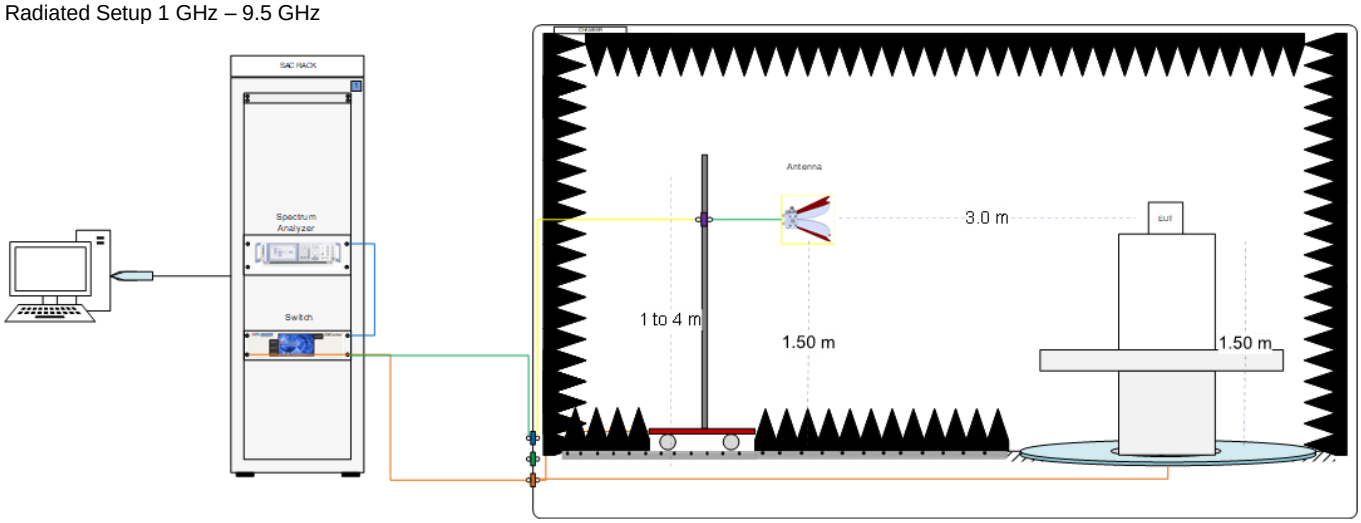


Radiated test setup

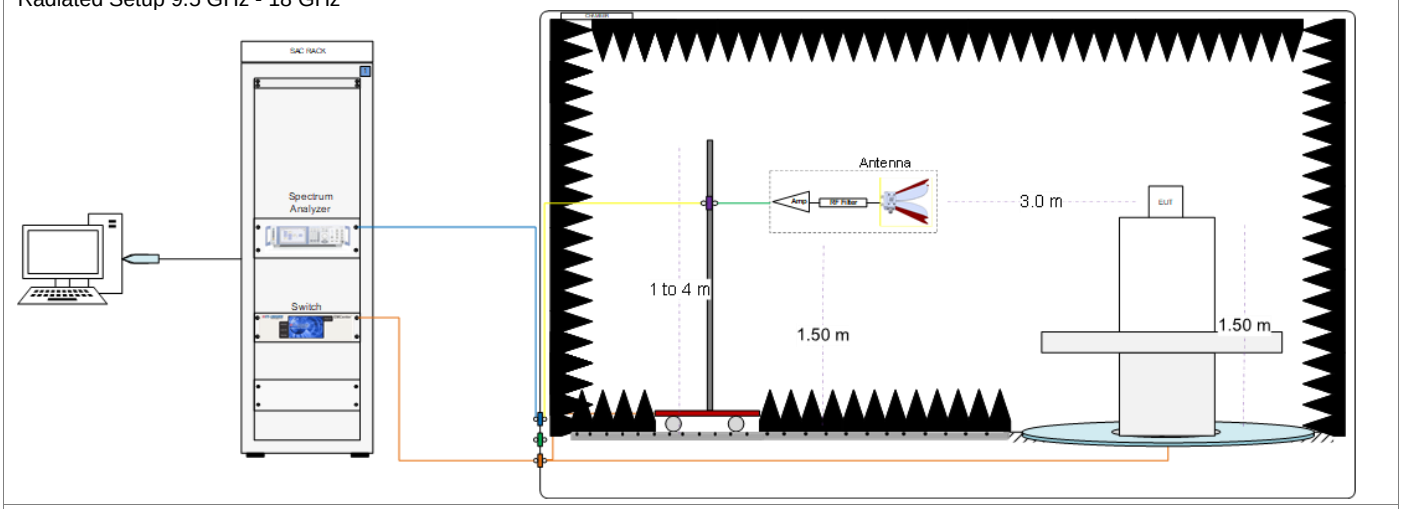
Radiated Setup 30 MHz - 1 GHz



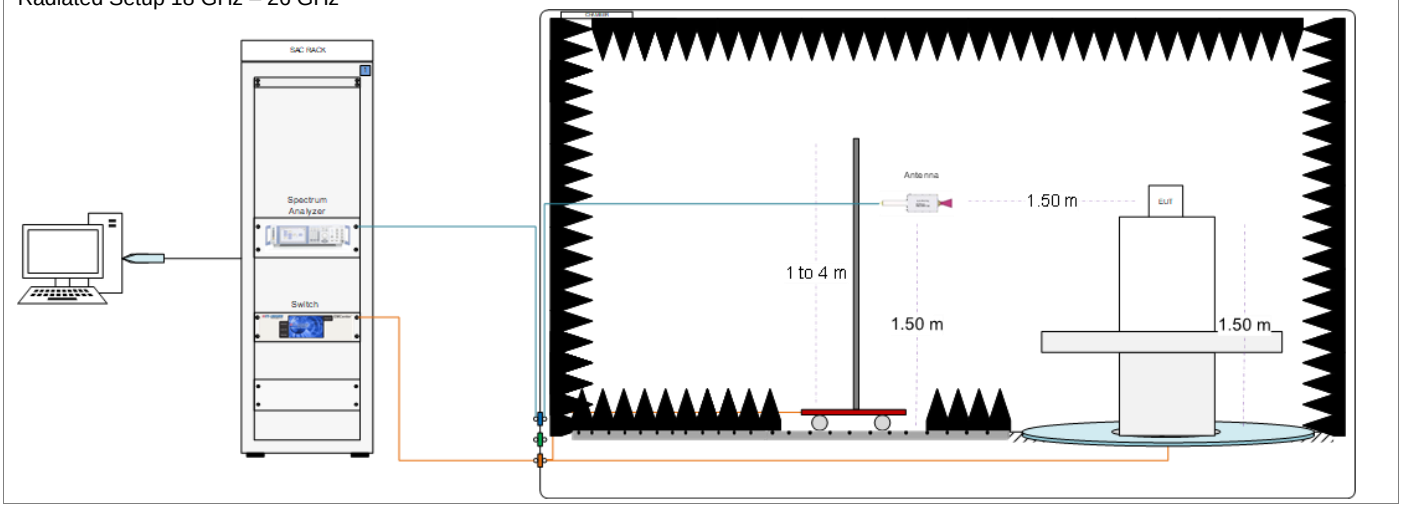
Radiated Setup 1 GHz – 9.5 GHz



Radiated Setup 9.5 GHz - 18 GHz



Radiated Setup 18 GHz – 26 GHz



Sample Calculation

The spurious received voltage V(dBuV) in the spectrum Analyzer is converted to Electric field strength using the transducer factor F corresponding to the Rx path Loss:

F (dB/m)= Rx Antenna Factor (dB/m) + Cable losses (dB) – Amplifiers Gain (dBi)
E (dBuV/m) = V(dBuV) + F (dB/m)

For field strength measurements made at other than the distance at which the applicable limit is specified, the field strength of the emission at the distance specified by the limit is deduced as follows:

$$E_{SpecLimit} = E_{Meas} + 20*\log(D_{Meas}/D_{SpecLimit})$$

where

$E_{SpecLimit}$ is the field strength of the emission at the distance specified by the limit, in dBµV/m
E_{Meas} is the field strength of the emission at the measurement distance, in dBµV/m
D_{Meas} is the measurement distance, in m
$D_{SpecLimit}$ is the distance specified by the limit, in m

A.2 Test Equipment List

Conducted setup

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
273-000	Spectrum Analyzer	FSV30	103309	Rohde & Schwarz	2019-09-02	2021-09-02
018-003	RF cable 50cm	PE360-50CM	N/A	PASTERNACK	2021-02-21	2021-08-21
018-001	10dB Attenuator + MH4	N/A	N/A	N/A	2021-03-09	2021-09-09
408-000	Temp & Humidity Logger	RA12E-TH1-RAS	RA12-E21FC8	AVTECH	2021-06-03	2023-06-03
413-000	Measurement SW v1.5.4.2	Octopi	N/A	Step AT	N/A	N/A

Radiated Setup #1

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
006-000	Anechoic Chamber	FACT3	5720	ETS-Lindgren	2020-07-06	2020-01-07
006-001	Turn Table	ETS	-	ETS-Lindgren	N/A	N/A
006-002	Switch & Positioning systems	EMC Center	00159757	ETS-Lindgren	N/A	N/A
006-008	Measurement SW	EMC32, v10.40.10	100623	Rohde & Schwarz	N/A	N/A
006-011	Boresight antenna mast	BAM 4.0-P	P/278/2890.01	Maturo	N/A	N/A
006-019	Biconical antenna 30 MHz – 1 GHz	UBAA9115 + BBVU9135 + DGA9552N	0286 + CH 9044	Schwarzbeck	2019-11-22	2021-11-22
147-000	Spectrum analyzer	FSW43	101847	Rohde & Schwarz	2020-11-02	2022-11-02
006-020	Horn antenna 3117	3117	00157734	ETS-Lindgren	2019-08-12	2021-08-12
057-000	Horn Antenna 3117 + Amplifier + HPF9.5	3117	00167062+00169546	ETS-Lindgren	2020-06-15	2022-06-15
*007-008	Double Horn Ridged antenna	3116C-PA	00169308bis + 00196308	ETS-Lindgren	2019-07-24	2021-07-24
006-039	Cable 2.5m - 30MHz to 18GHz	0500990992500KE	19.23.395	Radiall	2021-02-23	2021-08-23
006-030	Cable 1.2m – 18 to 40 GHz	UFA147A-0-0480-200200	MFR 64639223720-003	Micro-coax	2021-02-14	2021-08-14
006-034	Cable 1m - 1GHz to 18GHz	UFA147A	-	Utilflex	2021-02-18	2021-08-18
006-036	Cable 1m – 30 MHz - 18GHz	UFB311A-0-0590-50U50U	MFR 64639 223230-001	Micro-coax	2021-02-23	2021-08-23
006-052	RF Cable 7.5m	0501051057000GX	19.35.850	Radiall	2021-02-23	2021-08-23
006-038	Cable 7m - 18GHz to 40GHz	R286304009	-	Radiall	2021-02-14	2021-08-14
006-051	RF Cable 1.0m	CBL-1.5M-SMSM+	202879	Mini-Circuits	2021-02-23	2021-08-23
365-000	Temperature & Humidity logger	RA12E-TH1-RAS	00-80-A3-E1-6E-55	Avtech	2021-03-08	2023-03-08

N/A: Not Applicable
*Items not used during out of calibration period

Radiated Setup #2

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
007-000	Anechoic chamber	RFD-FA-100	5996	ETS Lindgren	2020-07-06	2022-07-06
007-002	Turntable	-	-	ETS Lindgren	N/A	N/A
007-003	Antenna Tower	2171B-3.0M	00150123	ETS Lindgren	N/A	N/A
007-006	Switch & Positioner	EMCenter	00151232	ETS Lindgren	N/A	N/A
007-005	Measurement SW	EMC32, V11.20.00	100401	Rohde & Schwarz	N/A	N/A
127-000	Spectrum Analyzer	FSV40	101358	Rohde & Schwarz	2021-01-15	2023-01-15
007-007	Double Ridge Horn (1- 18GHz)	3117	00152266	ETS Lindgren	2020-03-18	2022-03-18
057-000	Horn Antenna 3117 + Amplifier + HPF9.5	3117	00167062+00169546	ETS-Lindgren	2020-06-15	2022-06-15
*007-008	Double Horn Ridged antenna	3116C-PA	00169308bis + 00196308	ETS-Lindgren	2019-07-24	2021-07-24
007-022	RF Cable 1-18GHz, 1.5m	0501050991200GX	19.23.493	Radiall	2021-02-14	2021-08-14
007-020	RF Cable 1-18GHz, 1.2 m	2301761761200PJ	12.22.1104	Radiall	2021-02-14	2021-08-14
007-011	RF Cable 1-18GHz - 6.5m	140-8500-11-51	001	Spectrum	2021-02-14	2021-08-14
007-015	RF Cable 1GHz-18GHz 1.5m	-	-	Spirent	2021-02-15	2021-08-15
007-014	RF Cable 18-40 GHz 6m	R286304009	1747364	Radiall	2021-02-14	2021-08-14
007-023	RF Cable 1m DC-40GHz	PE360-100CM	-	Pasternack	2021-02-16	2021-08-16
007-018	RF Cable 1-9.5GHz 1.2m	0500990991200KE	-	Radiall	2021-02-15	2021-08-15
145-000	Temp & Humidity Logger	RA12E-TH1-RAS	RA12-B89BE3	Avtech	2020-01-22	2022-01-22

N/A: Not Applicable
*Items not used during out of calibration period

Shared Radiated Equipment

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
022-000	Power Sensor	NRP-Z81	104385	Rohde & Schwarz	2020-04-08	2022-04-08
061-000	Power Sensor	NRP-Z81	104386	Rohde & Schwarz	2020-04-08	2022-04-08
140-000	Power Sensor	NRP-Z81	104382	Rohde & Schwarz	2020-04-08	2022-04-08

A.3 Measurement Uncertainty Evaluation

The system uncertainty evaluation is shown in the table below with a coverage factor of k = 2 to indicate a 95% level of confidence:

Measurement type	Uncertainty	Unit
Timing	±0.12	%
Power Spectral density	±1.47	dB
Occupied bandwidth	±2.07	%
Conducted Power	±1.03	dB
Conducted Spurious Emission <26.5 GHz	±2.93	dB
Radiated tests <1GHz	±5.99	dB
Radiated tests 1GHz – 26.5 GHz	±5.73	dB

Annex B. Test Results

The herein test results were performed by:

Test case measurement	Test Personnel
20dB Bandwidth and Carrier frequency separation	Y Haddad. C Requin
Number of hopping channels	Y Haddad. C Requin
Time of Occupancy (Dwell Time)	Y Haddad. C Requin
Maximum Peak Output Power and antenna gain	Y Haddad. C Requin
Out-of-band Emissions (conducted)	Y Haddad. C Requin
Out-of-band Emissions (radiated)	A.Lounes, N.Bui
AC power-line conducted emission measurements	A.Lounes, N.Bui

B.1 20dB Bandwidth and carrier frequency separation

B.1.1 Test limits

FCC part	RSS part	Limits
15.247 (a) (1)	RSS-247 Clause 5.1 (a) and (b)	Frequency hopping systems 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, 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.

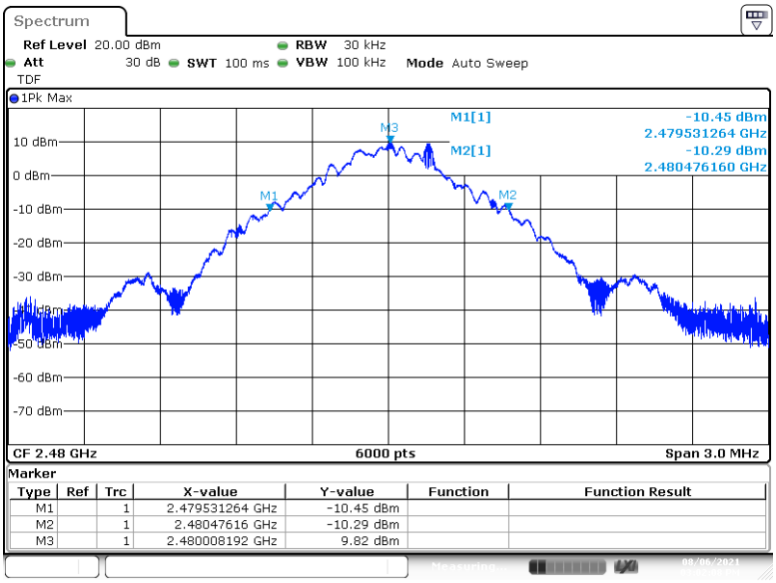
B.1.2 Results tables

Mode	Packet Type	Channel Number	Frequency [MHz]	20dB BW [MHz]	Freq. Separation [kHz]
Basic Rate GFSK	DH5	0	2402	0.943	1000
		39	2441	0.943	
		78	2480	0.945	
EDR π/4-DQPSK	2DH5	0	2402	1.423	997.50
		39	2441	1.423	
		78	2480	1.399	
EDR 8-DPSK	3DH5	0	2402	1.441	995
		39	2441	1.438	
		78	2480	1.416	

B.1.3 Results screenshot

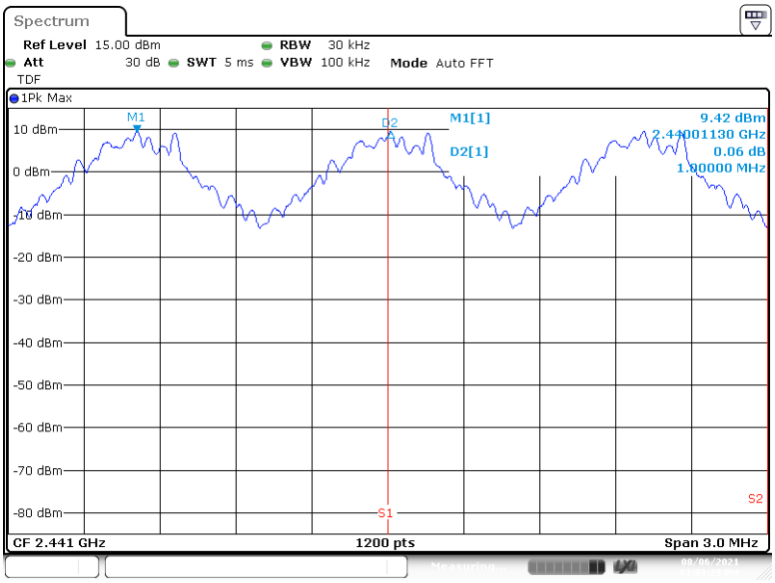
Basic Rate - GFSK

20dB BW – CH 78



Date: 6.AUG.2021 15:02:08

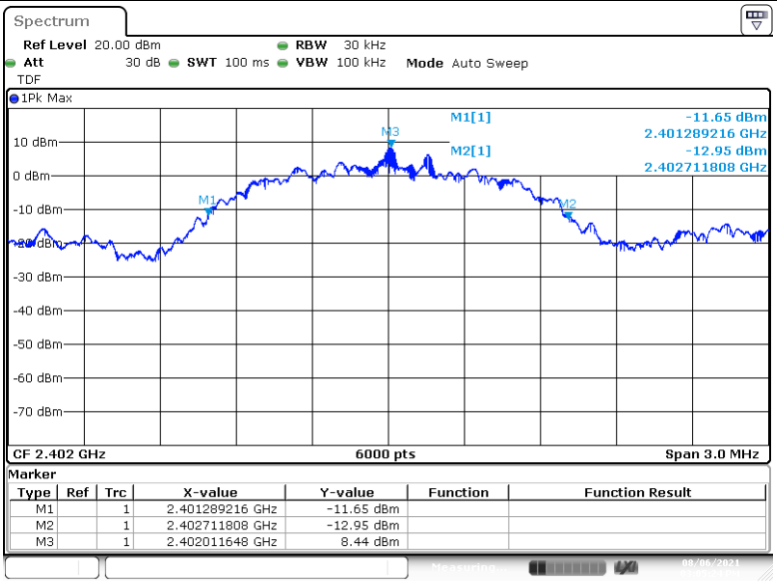
Freq. Separation



Date: 6.AUG.2021 15:03:29

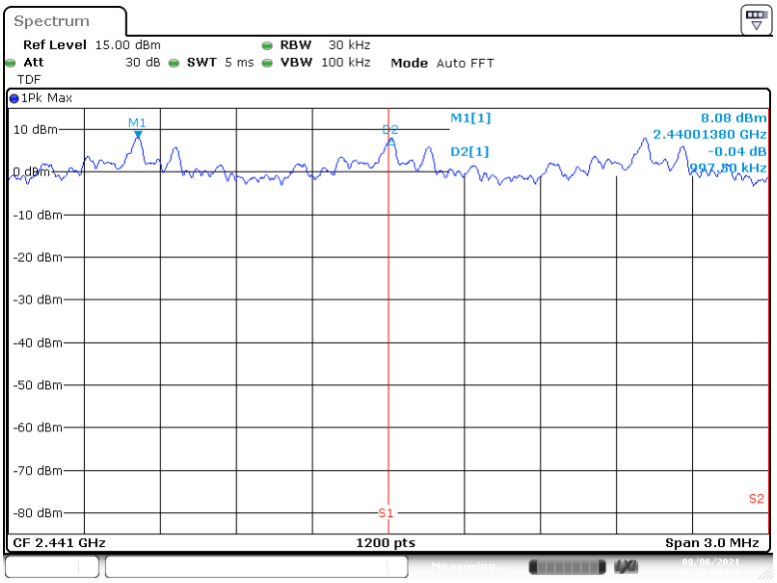
EDR – π/4-DQPSK

20dB BW – CH 0



Date: 6.AUG.2021 15:05:24

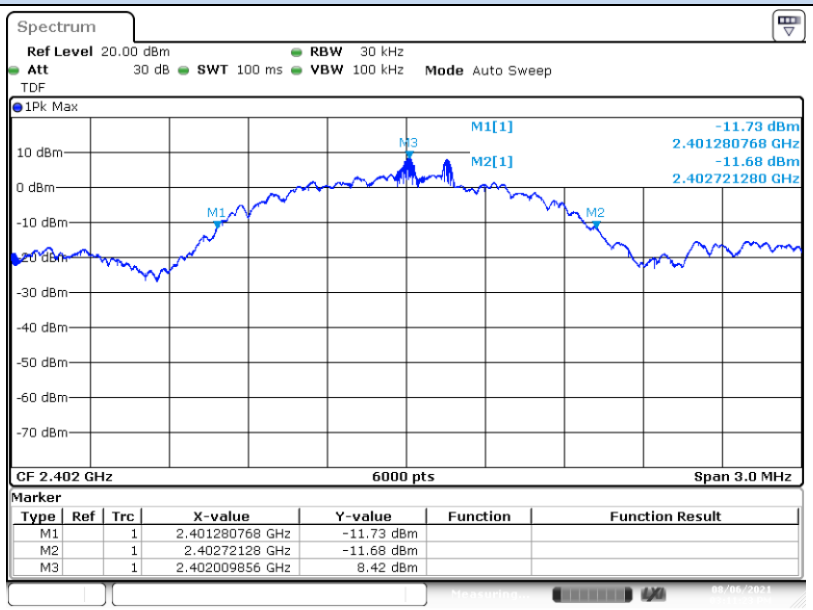
Freq. Separation



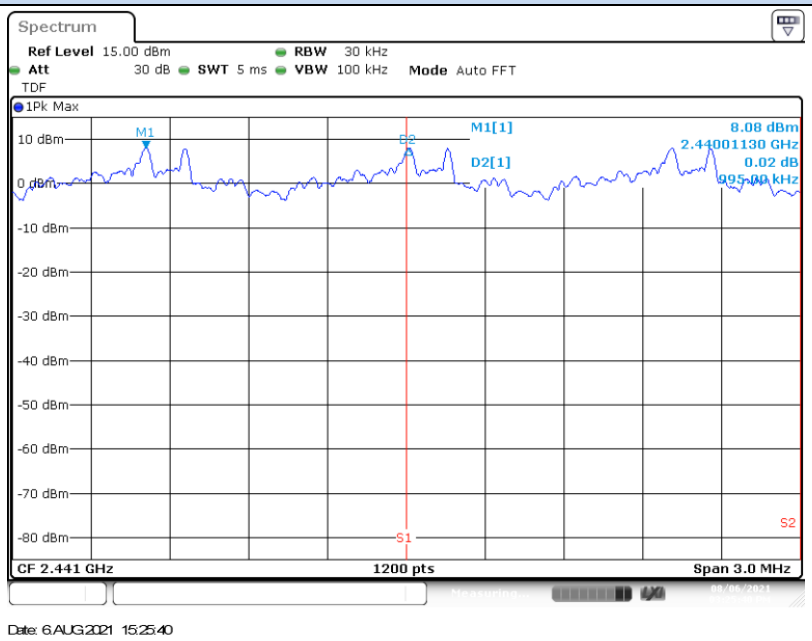
Date: 6.AUG.2021 15:20:00

EDR – 8-DPSK

20dB BW – CH 0



Freq. Separation



B.2 Number of hopping channels

B.2.1 Test limits

FCC part	RSS part	Limits
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.

B.2.2 Test procedure

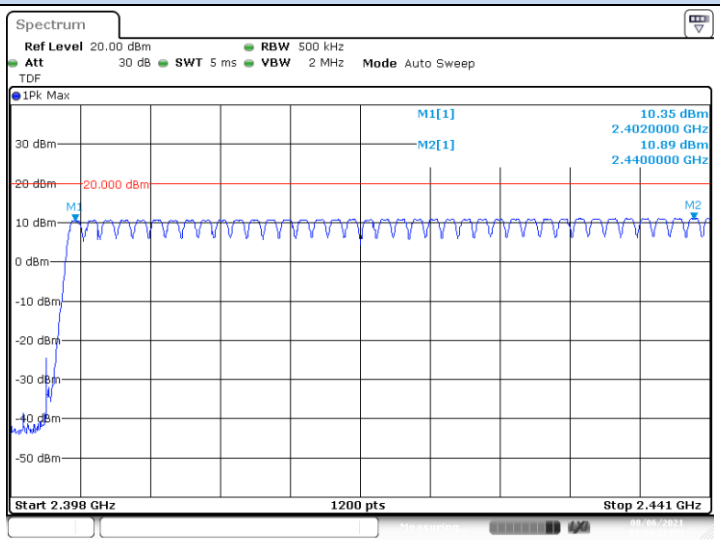
The conducted setup shown in section *Test & System Description* was used to measure the number of hopping channels. The antenna terminal of the EUT is connected to the spectrum through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

B.2.3 Results tables

Mode	Packet Type	Number of hopping channels
Basic Rate GFSK	DH5	79
EDR π/4-DQPSK	2DH5	79
EDR 8-DPSK	3DH5	79

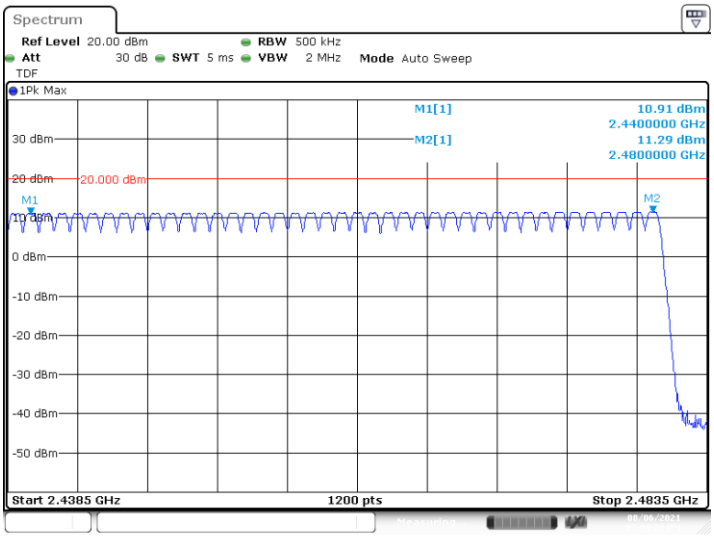
Number of hopping channels

Basic Rate – GFSK

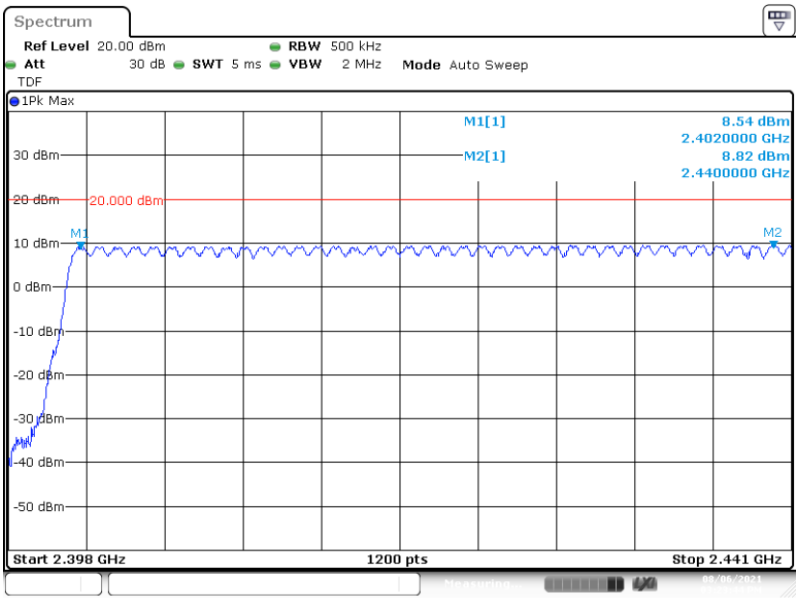


Date: 6.AUG.2021 15:04:22

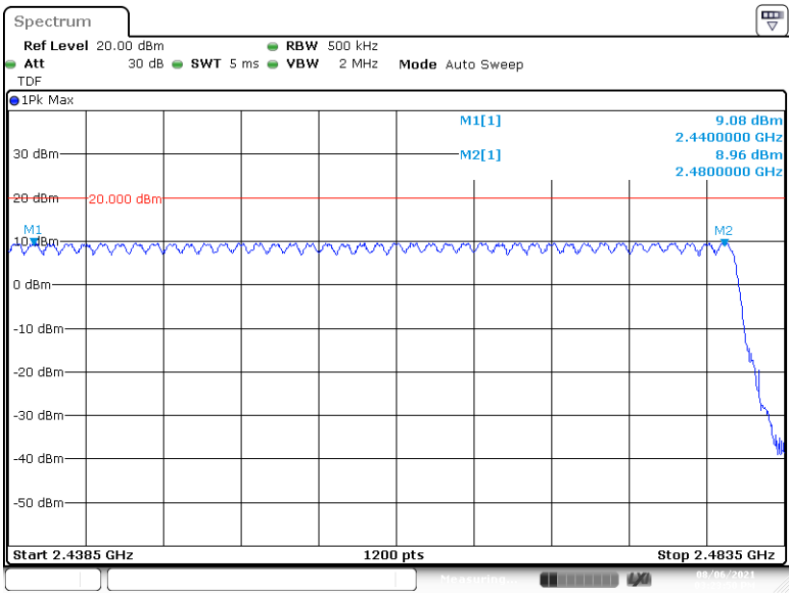
Basic Rate – GFSK



Date: 6.AUG.2021 15:04:28

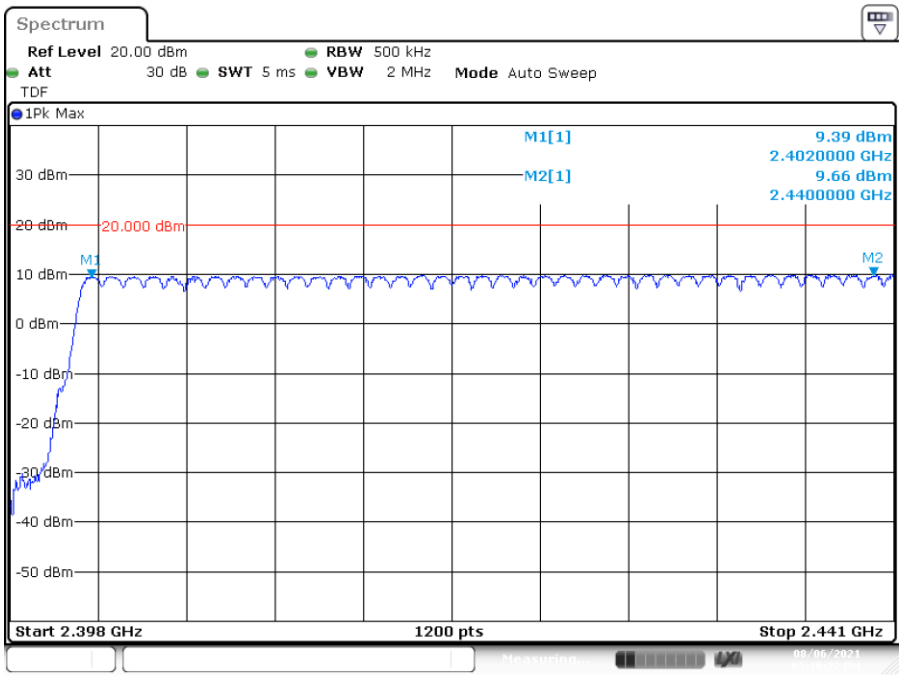
EDR – π/4-DPSK


Date: 6.AUG.2021 15:23:44

EDR – π/4-DPSK


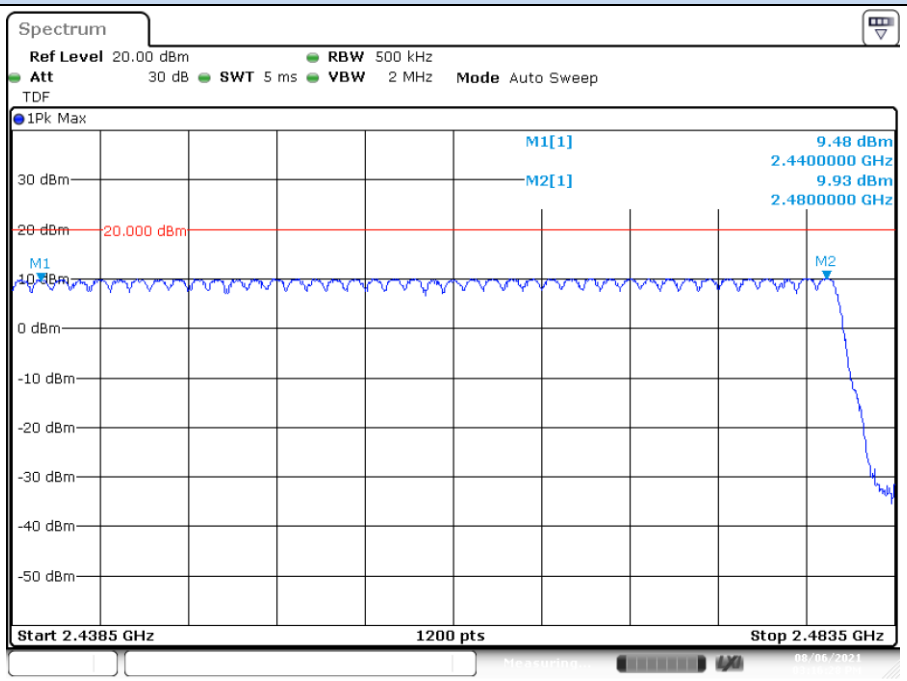
Date: 6.AUG.2021 15:23:50

EDR – 8-DPSK



Date: 6.AUG.2021 15:16:22

EDR – 8-DPSK



Date: 6.AUG.2021 15:16:28

B.3 Time of Occupancy (Dwell Time)

FCC part	RSS part	Limits
15.247 (a) (1) (iii)	RSS-247 Clause 5.1 (d)	The average time of occupancy (Dwell Time) 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.

B.3.1 Test procedure

The conducted setup shown in section *Test & System Description* was used to measure the dwell time. The antenna terminal of the EUT is connected to the spectrum through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

In the worst case, the system makes 1600 hops per second with 79 channels, providing a 1 timeslot length of 625µs.

A DH1 packet, with independence of the modulation, needs 1 time slot for transmitting and 1 time slot for receiving. Then, the system makes in the worst case 1600/2 = 800 hops per second with 79 channels. So each channel appears 800/79 = 10.13 times per second and, for a period of 0.4 x 79 = 31.6 seconds, each channel appears 10.13 x 31.6 = 320.11 times.

A DH3 packet, with independence of the modulation, needs 3 time slots for transmitting and 1 time slot for receiving. Then, the system makes in the worst case 1600/4 = 400 hops per second with 79 channels. So each channel appears 400/79 = 5.1 times per second and, for a period of 0.4 x 79 = 31.6 seconds, each channel appears 5.1 x 31.6 = 161.16 times.

A DH5 packet, with independence of the modulation, needs 5 time slots for transmitting and 1 time slot for receiving. Then, the system makes in the worst case 1600/6 = 266.67 hops per second with 79 channels. So each channel appears 166.67/79 = 3.37 times per second and, for a period of 0.4 x 79 = 31.6 seconds, each channel appears 3.37 x 31.6 = 106.49 times.

Thus, the total time of occupancy is obtained by multiplying the calculated maximum number of appearances per packet type and the measured Tx-time, as shown in the results screenshots.

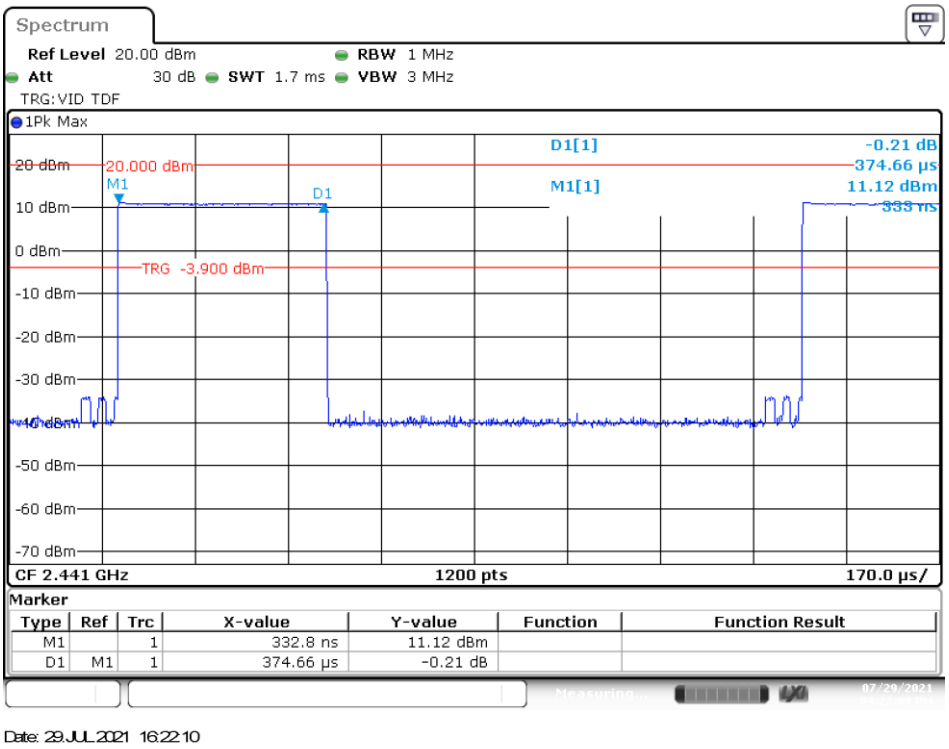
B.3.2 Results tables

Mode	Packet Type	Times of appearance	Tx-time [ms]	Dwell Time [ms]
Basic Rate GFSK	DH1	320.11	0.375	119.93
	DH3	161.16	1.633	263.19
	DH5	106.49	2.873	305.97
EDR π/4-DQPSK	2-DH1	320.11	0.388	124.22
	2-DH3	161.16	1.624	261.67
	2-DH5	106.49	2.886	307.30
EDR 8-DPSK	3-DH1	320.11	0.388	124.08
	3-DH3	161.16	1.625	261.93
	3-DH5	106.49	2.886	307.30

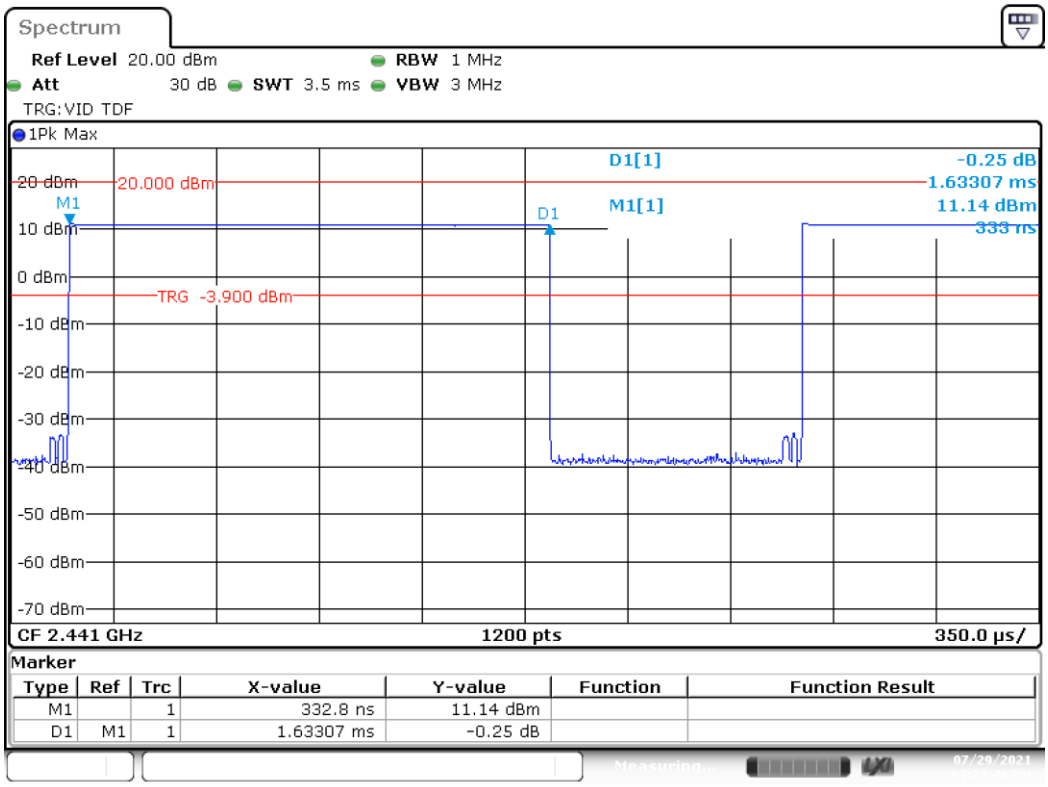
B.3.3 Results Screenshot

BDR – GFSK

DH1 Tx-Time

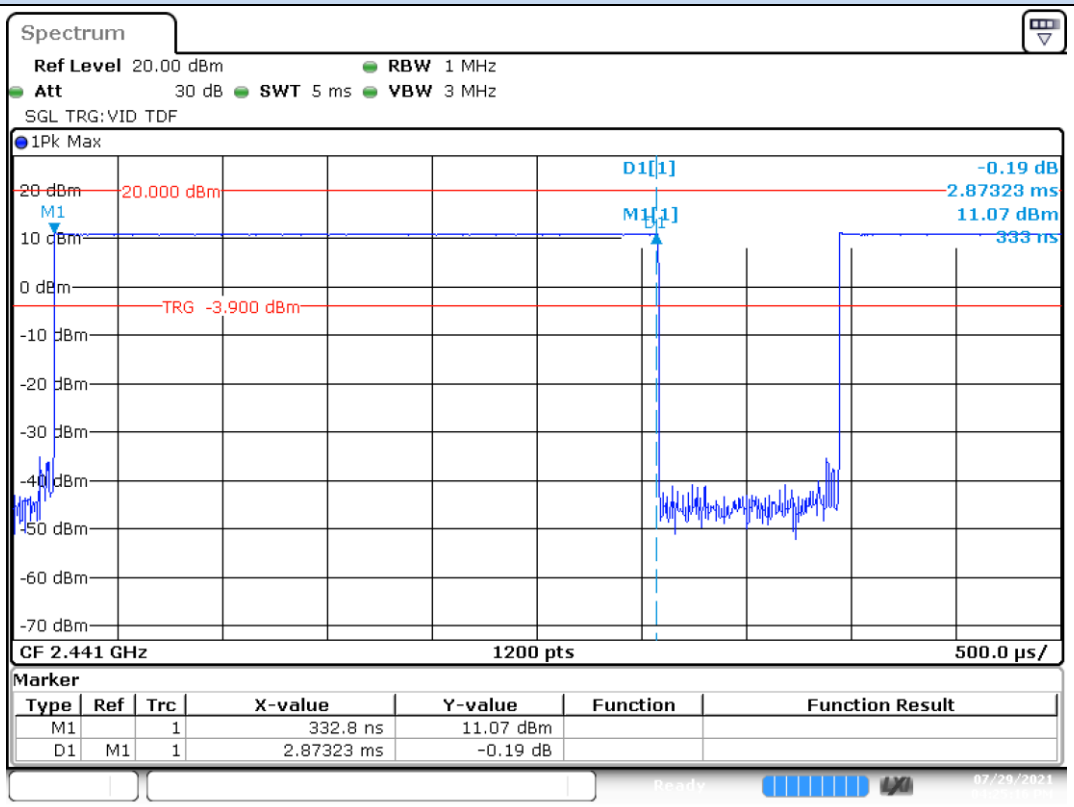


DH3 Tx-Time



Date: 29.JUL.2021 16:24:46

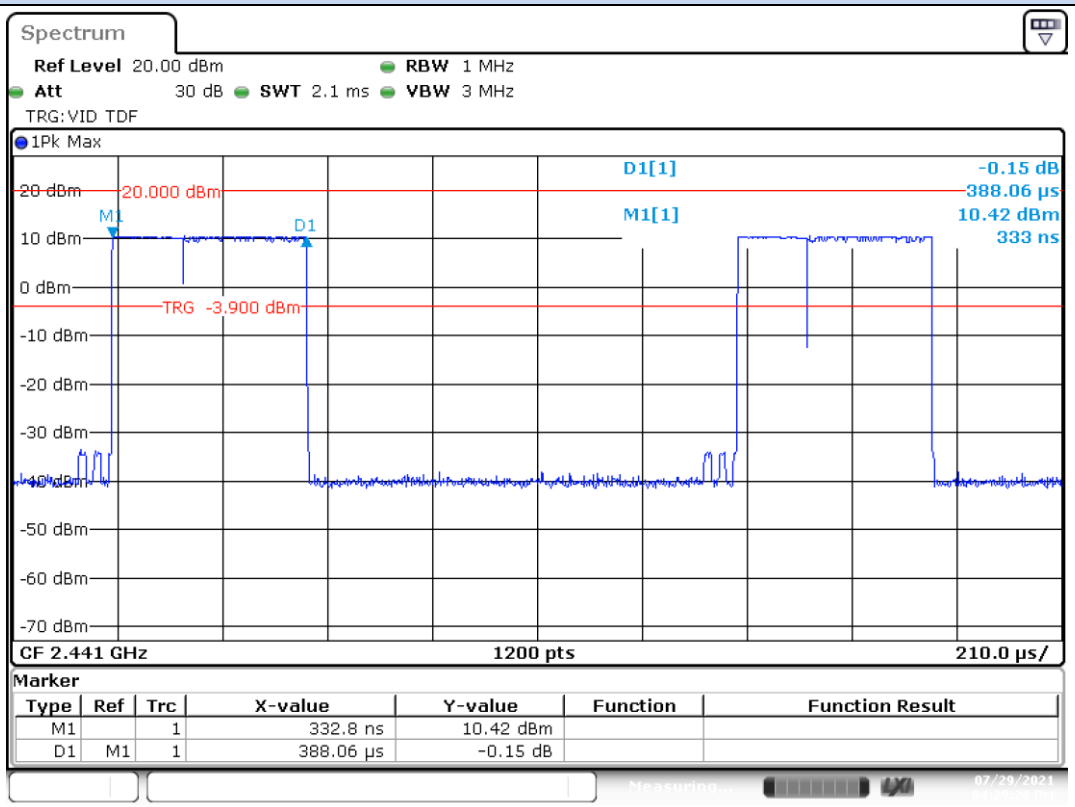
DH5 Tx-Time



Date: 29.JUL.2021 16:25:16

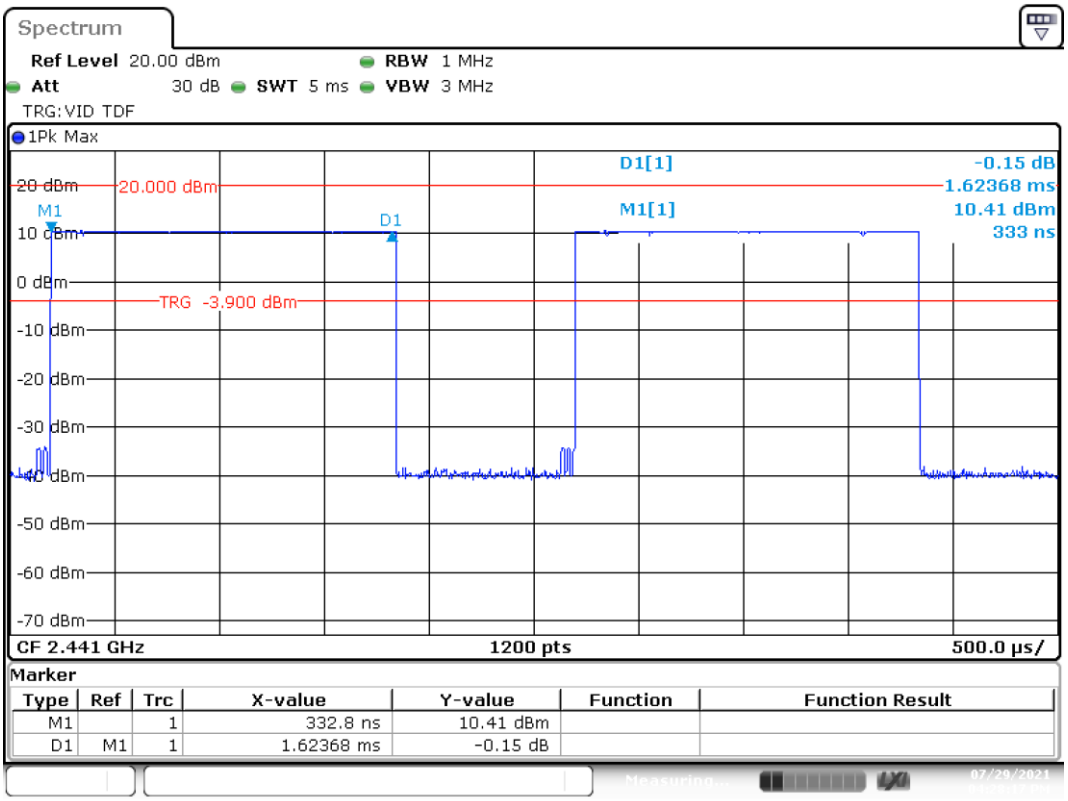
EDR – π/4-DQPSK

2-DH1 Tx-Time



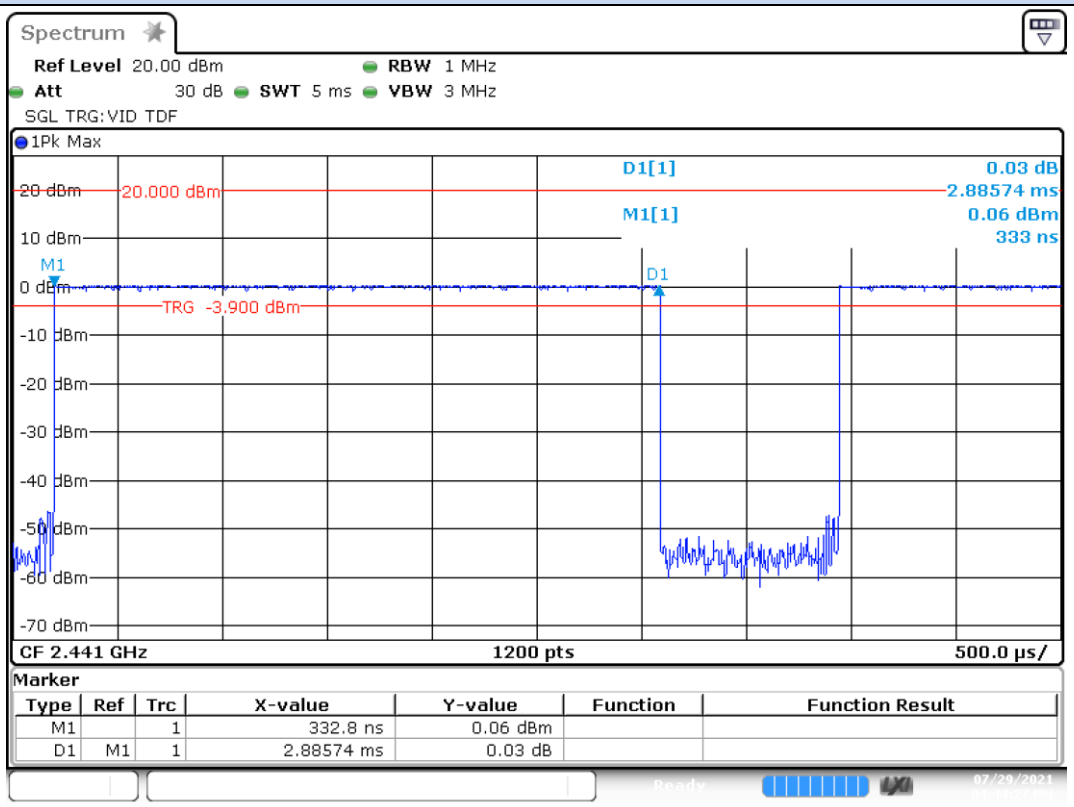
Date: 29.JUL.2021 16:29:28

2-DH3 Tx-Time



Date: 29.JUL.2021 16:28:17

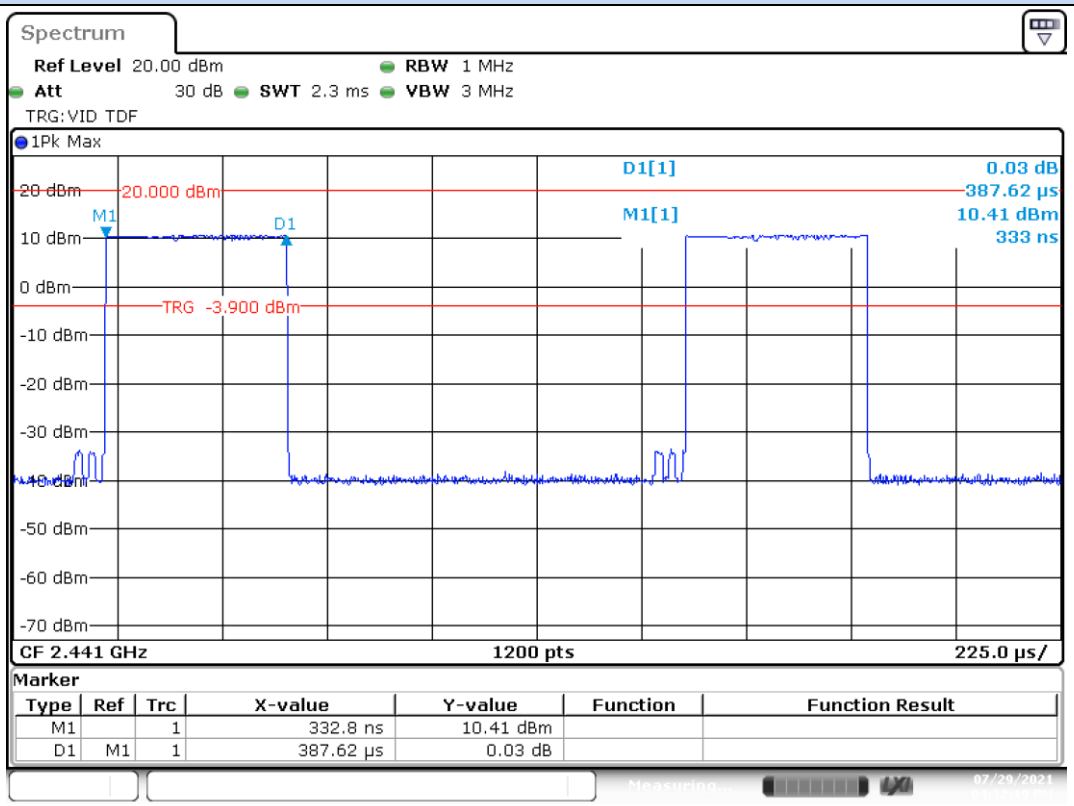
2-DH5 Tx-Time



Date: 29.JUL.2021 16:44:27

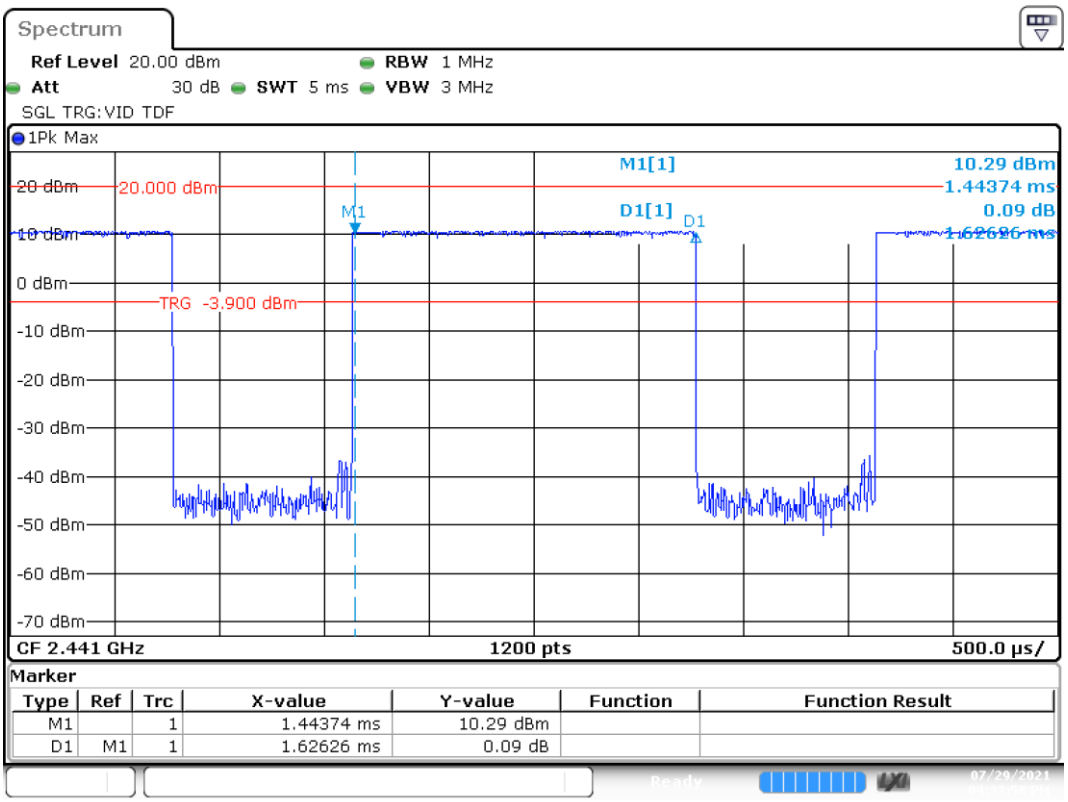
EDR – 8-DPSK

3-DH1 Tx-Time



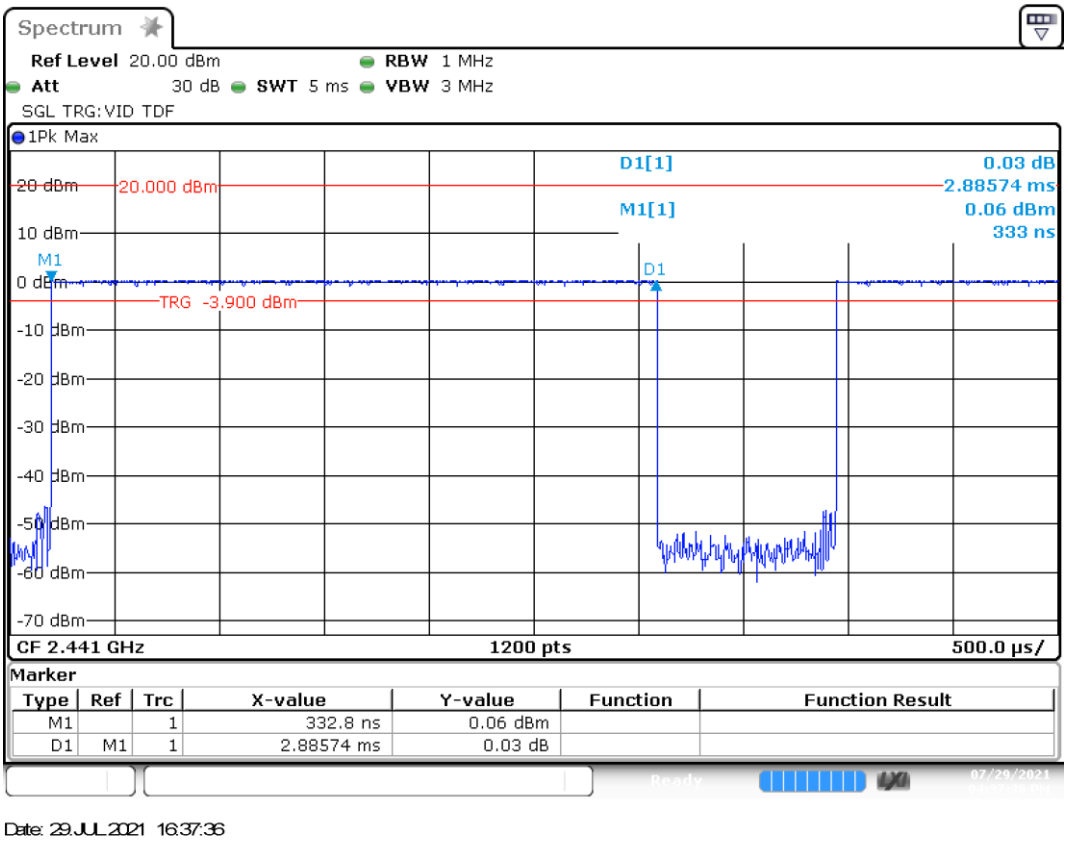
Date: 29.JUL.2021 16:32:19

3-DH3 Tx-Time



Date: 29.JUL.2021 16:33:58

3-DH5 Tx-Time


Spectrum
Ref Level 20.00 dBm
RBW 1 MHz
Att 30 dB
SWT 5 ms
VBW 3 MHz
SGL TRG:VID TDF
1Pk Max
D1[1] 0.03 dB
2.88574 ms
M1[1] 0.06 dBm
333 ns
20 dBm
20.000 dBm
10 dBm
0 dBm
TRG -3.900 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
D1
CF 2.441 GHz
1200 pts
500.0 µs/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 332.8 ns 0.06 dBm
D1 M1 1 2.88574 ms 0.03 dB
Date: 29.JUL.2021 16:37:36

B.4 Maximum Peak Output Power antenna gain

B.4.1 Test Limits

FCC part	RSS part	Limits
15.247 (b) (1)	RSS-247 Clause 5.4 (b)	(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (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. (…) (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

B.4.2 Test procedure

The conducted setup shown in section *Test & System Description* was used to measure the maximum peak output power. The antenna terminal of the EUT is connected to the spectrum through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

B.4.3 Results tables

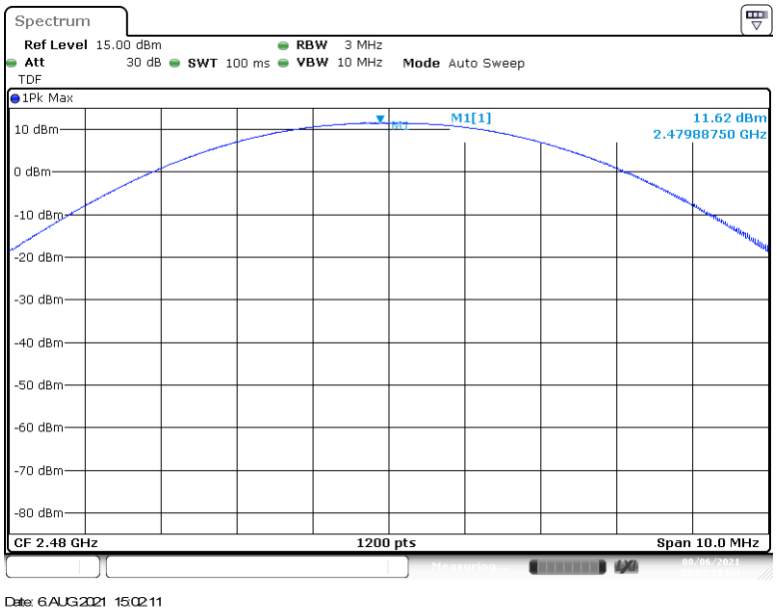
Mode	Packet Type	Channel Number	Frequency [MHz]	Peak Power [dBm]	Peak Power [mW]	Peak Power EIRP [dBm]	Peak Power EIRP [mW]
Basic Rate GFSK	DH5	0	2402	10.75	11.89	13.99	25.06
		39	2441	11.23	13.27	14.47	27.99
		78	2480	11.62	14.52	14.86	30.62
EDR π/4-DQPSK	2DH5	0	2402	10.41	10.99	13.65	23.17
		39	2441	10.83	12.11	14.07	25.53
		78	2480	10.38	10.91	13.62	23.01
EDR 8-DPSK	3DH5	0	2402	10.43	11.04	13.67	23.28
		39	2441	10.86	12.19	14.10	25.70
		78	2480	10.47	11.14	13.71	23.50

Max Value
Min Value

B.4.4 Results Screenshot

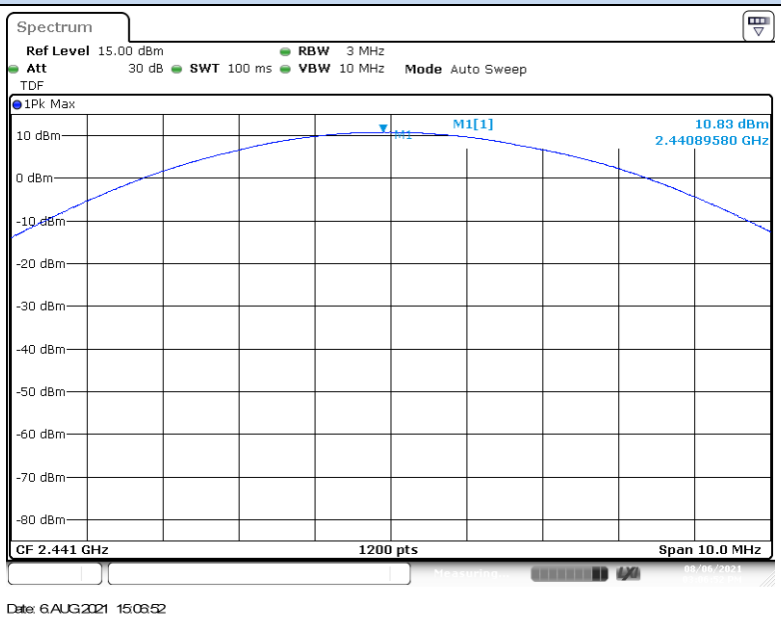
Basic Rate - GFSK

Peak Power – CH78



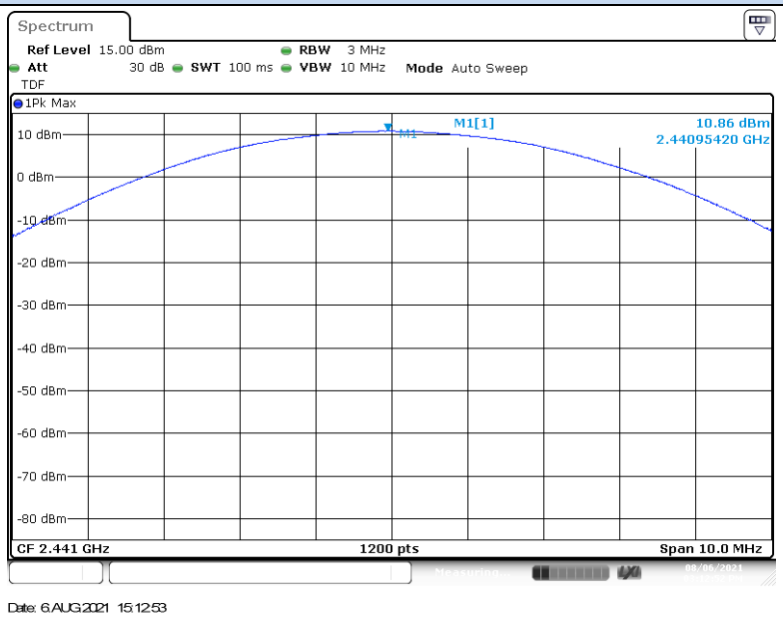
EDR – π/4-DQPSK

Peak Power – CH39



EDR – 8-DPSK

Peak Power – CH39



B.5 Out-of-band emission (conducted)

B.5.1 Test limits

FCC part	RSS part	Limits
15.247 (d)	RSS-247 Clause 5.5	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.

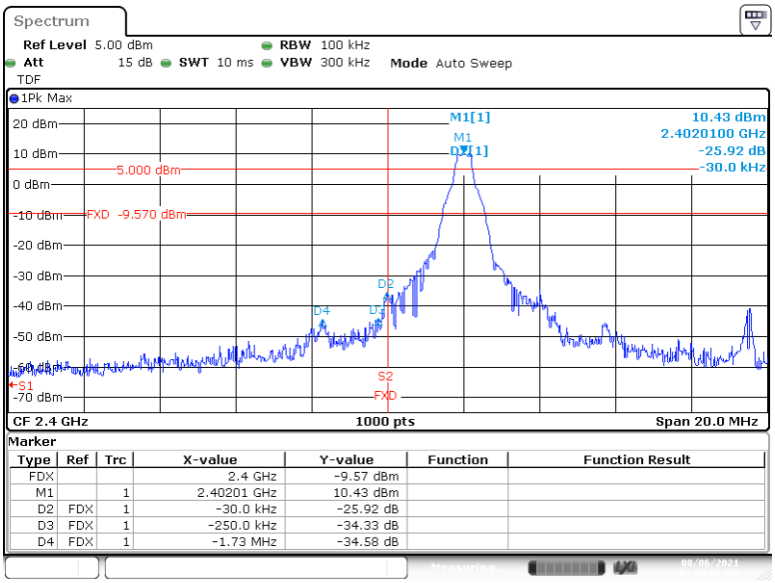
B.5.2 Test procedure

The conducted setup shown in section *Test & System Description* was used to measure the out-of-band emissions (conducted). The antenna terminal of the EUT is connected to the spectrum through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

B.5.3 Test results

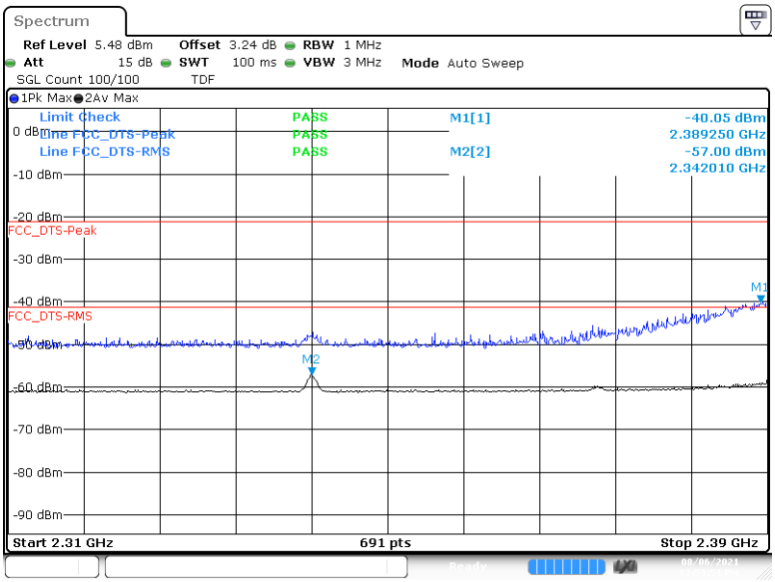
Basic Rate - GFSK

BE Low Freq Section – CH0



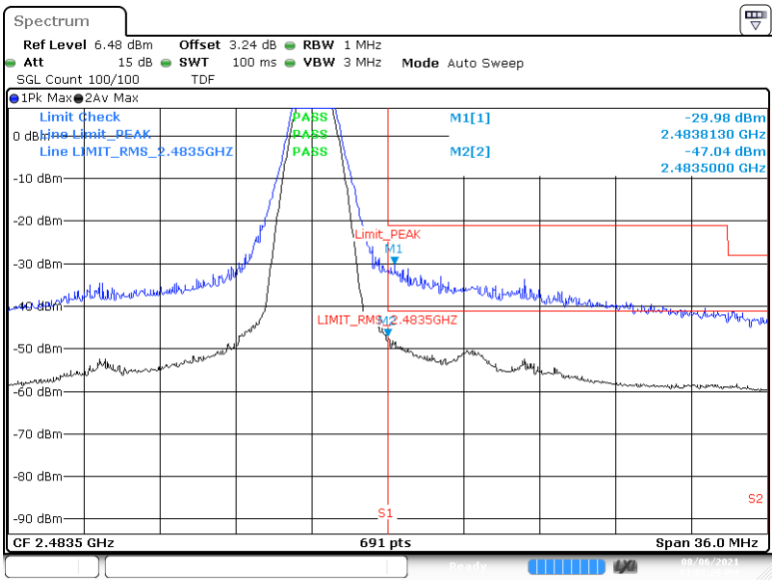
Date: 6.AUG.2021 15:00:03

BE Low Freq Section – CH0



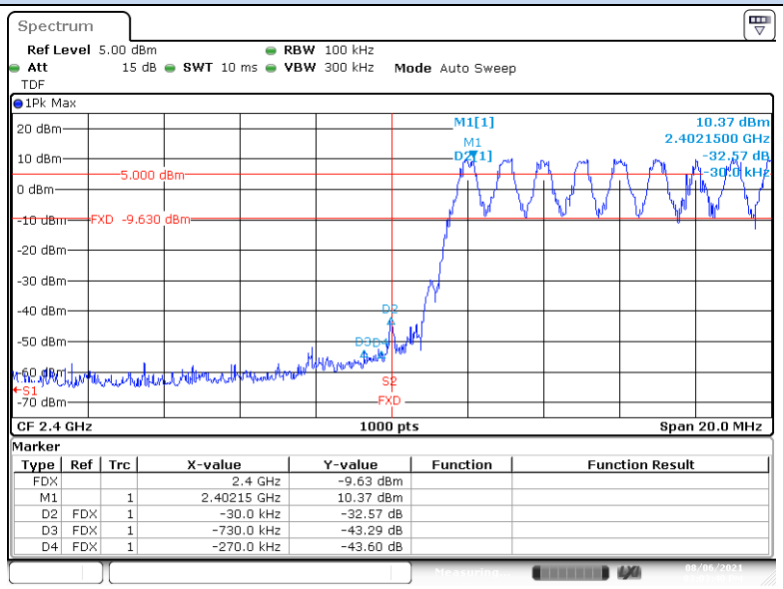
Date: 6.AUG.2021 14:59:52

BE High R Freq Section - CH78



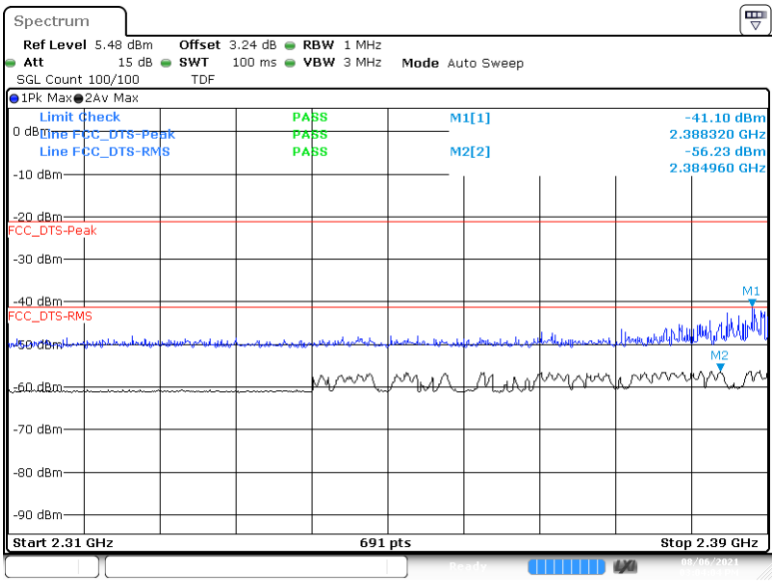
Date: 6.AUG.2021 15:02:27

BE Low NR Freq Section - Hopping



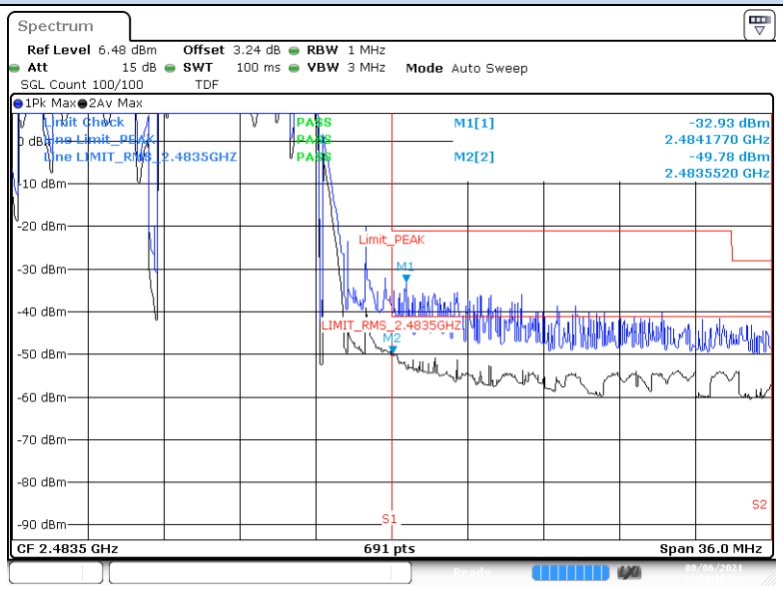
Date: 6.AUG.2021 15:03:41

BE Low R Freq Section - Hopping



Date: 6.AUG.2021 15:04:04

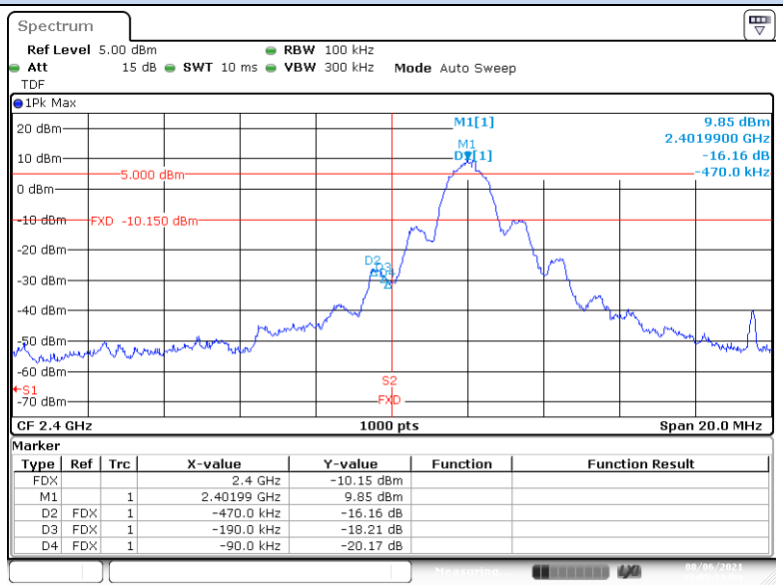
BE High R Freq Section - Hopping



Date: 6.AUG.2021 15:04:16

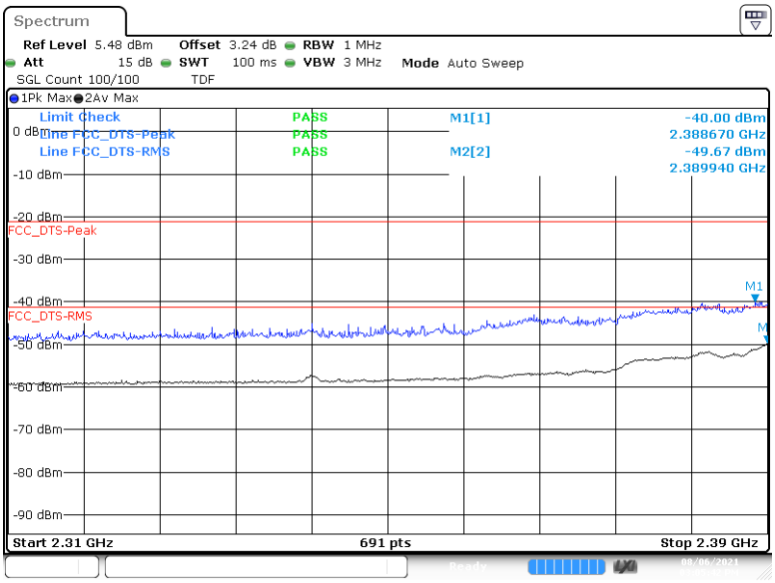
EDR – π/4-DQPSK

BE Low NR Freq Section - CH0



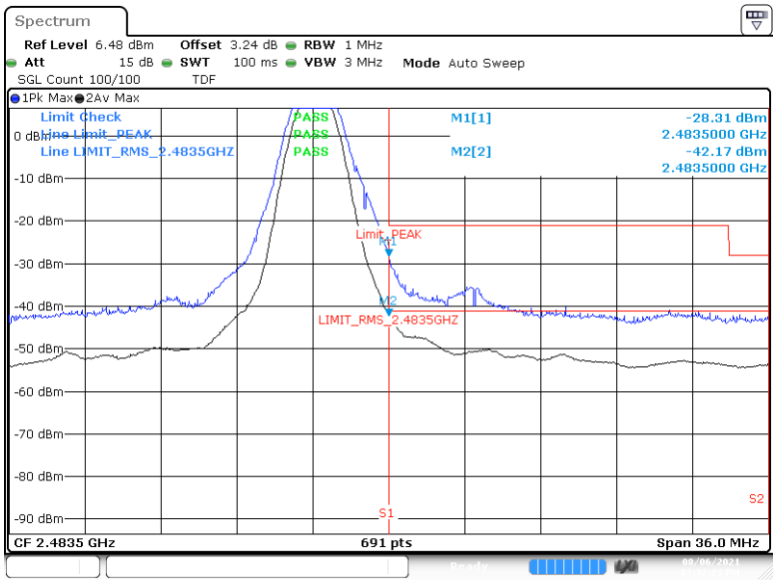
Date: 6.AUG.2021 15:05:54

BE Low R Freq Section - CH 0



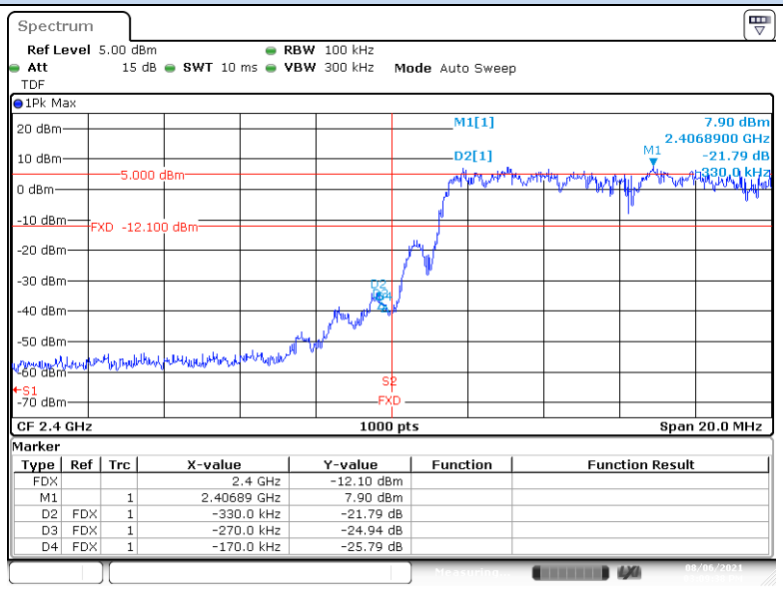
Date: 6.AUG.2021 15:05:43

BE High R Freq Section - CH 78



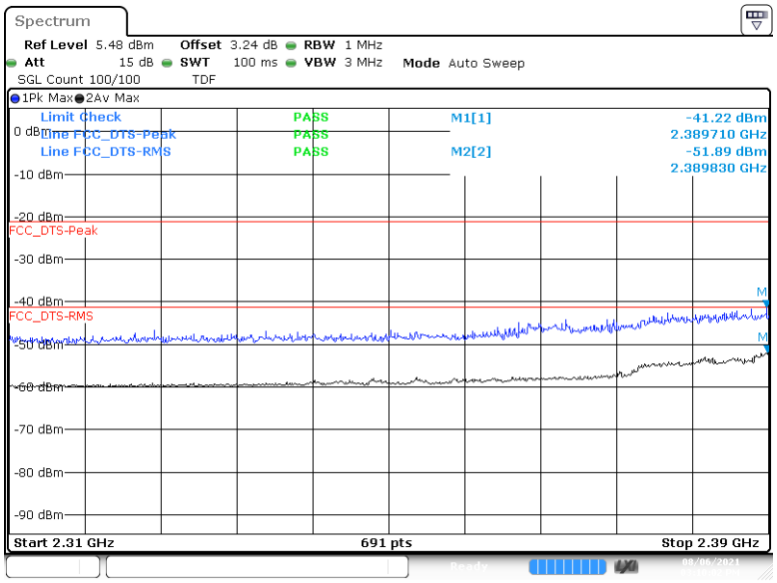
Date: 6.AUG.2021 15:32:21

BE Low NR Freq Section - Hopping



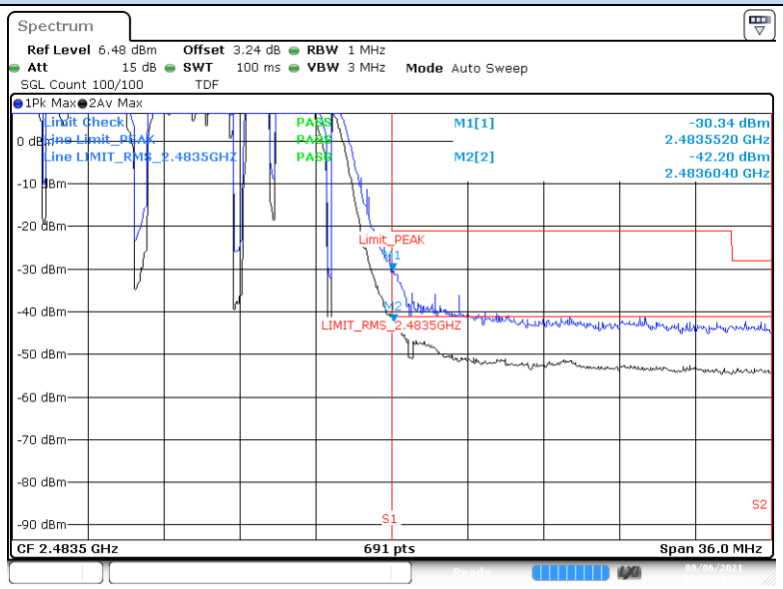
Date: 6.AUG.2021 15:09:38

BE Low R Freq Section - Hopping



Date: 6.AUG.2021 15:10:02

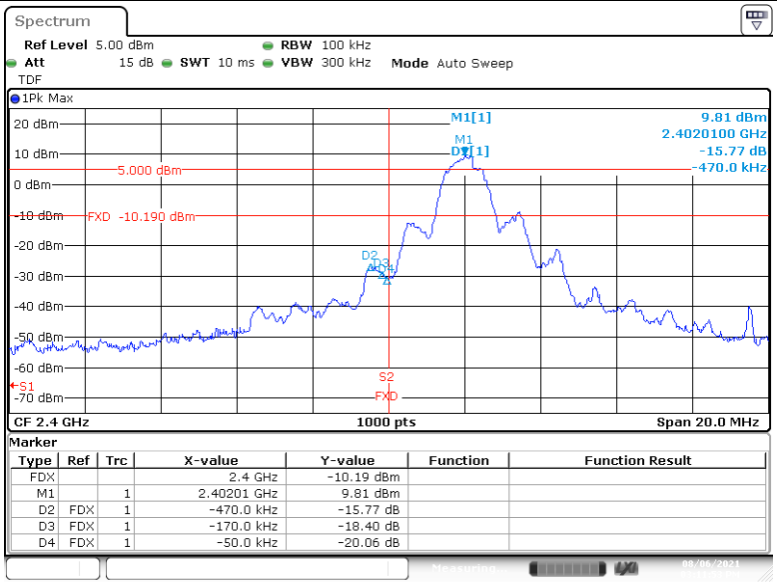
BE High R Freq Section - Hopping



Date: 6.AUG.2021 15:22:54

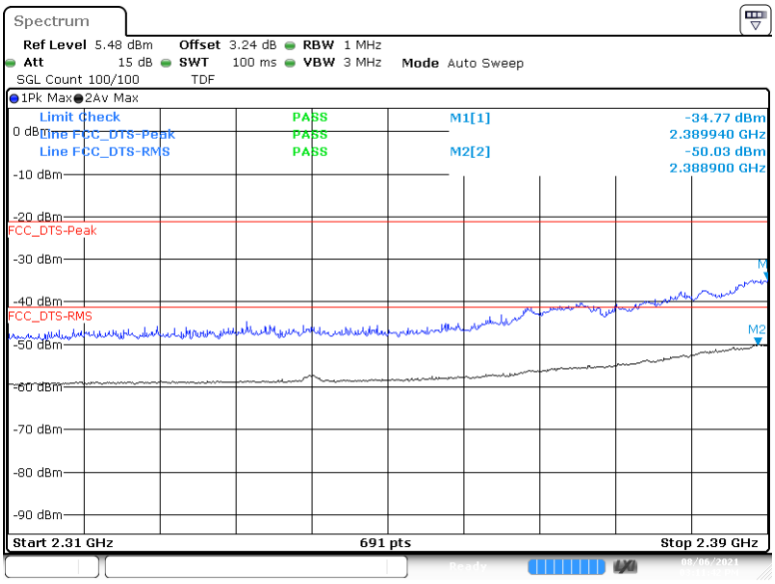
EDR – 8-DPSK

BE Low NR Freq Section - CH0



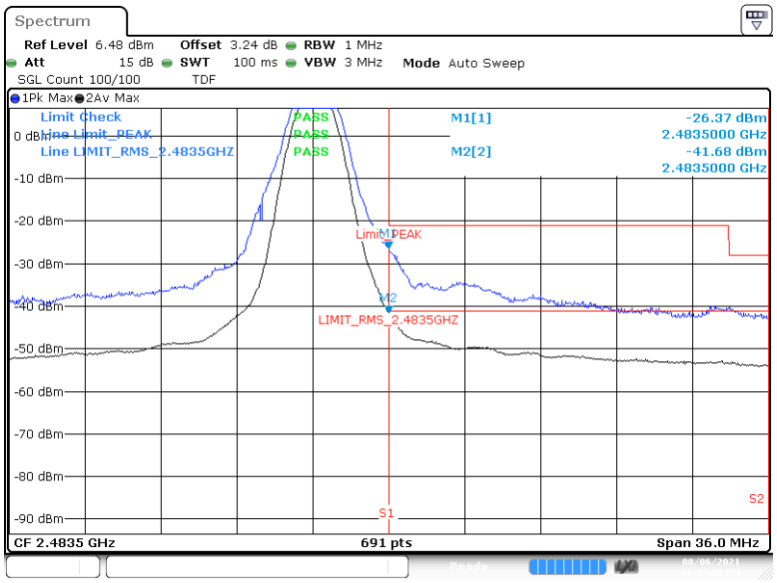
Date: 6.AUG.2021 15:11:53

BE Low R Freq Section - CH 0



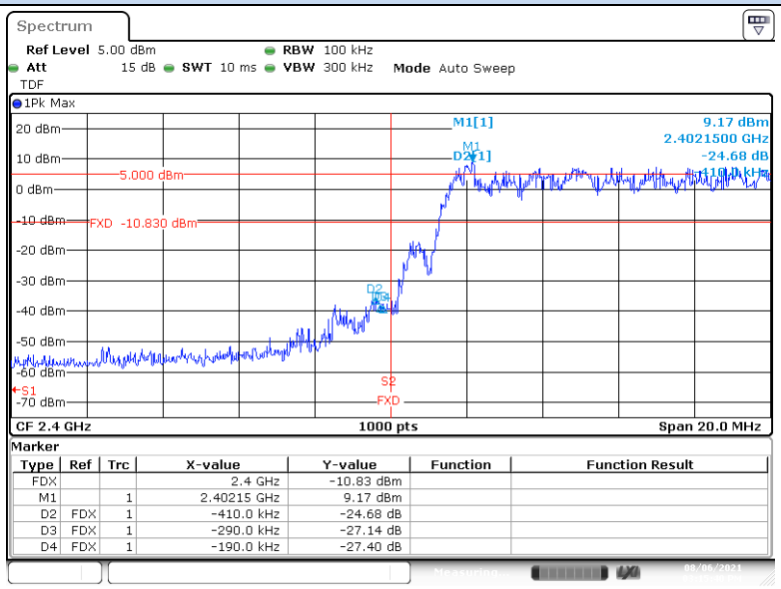
Date: 6.AUG.2021 15:11:42

BE High R Freq Section - CH 78



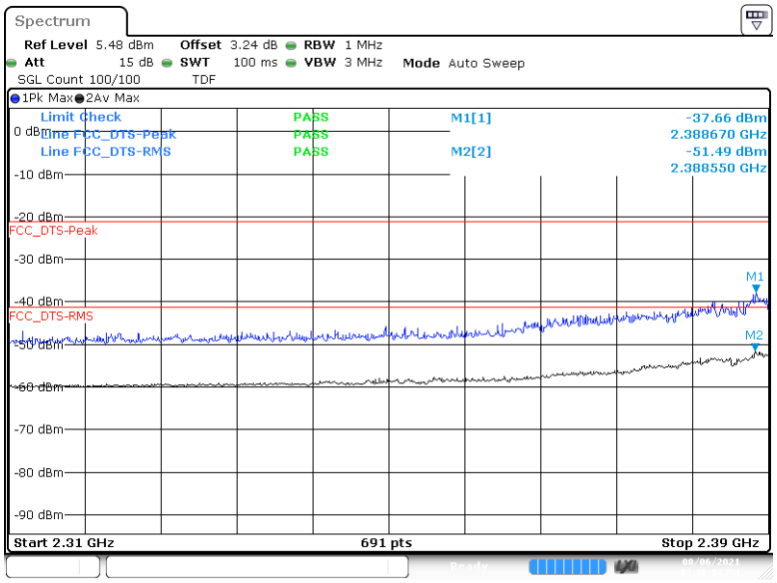
Date: 6.AUG.2021 15:37:10

BE Low NR Freq Section - Hopping



Date: 6.AUG.2021 15:15:40

BE Low R Freq Section - Hopping



Date: 6.AUG.2021 15:16:04

BE High R Freq Section – Hopping

Date: 6.AUG.2021 15:16:16

B.6 Radiated spurious emission

B.6.1 Standards references

<table>
<tr><th>FCC part</th><th>RSS part</th><th>Limits</th></tr>
<tr><td>15.247 (d)
15.209 (a)</td><td>RSS-247
Clause 5.5

RSS GEN A1
Clause 8.9</td><td>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):
<table>
<tr><th>Freq Range (MHz)</th><th>Field Stregth (µV/m)</th><th>Field Stregth (dBµV/m)</th><th>Meas. Distance (m)</th></tr>
<tr><td>30-88</td><td>100</td><td>40</td><td>3</td></tr>
<tr><td>88-216</td><td>150</td><td>43.5</td><td>3</td></tr>
<tr><td>216-960</td><td>200</td><td>46</td><td>3</td></tr>
<tr><td>Above 960</td><td>500</td><td>54</td><td>3</td></tr>
</table>
The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
For average radiated emission measurements above 1000 MHz, there is also a limit specified when measuring with peak detector function, corresponding to 20 dB above the indicated values in the table.</td></tr>
</table>

B.6.2 Test procedure

The radiated setups shown in sectionwere used to measure the radiated spurious emissions.
Depending of the frequency range and bands being tested, different antennas and filters were used.
The final measurement is done by varying the antenna height from 1 m to 4 m, the EUT azimuth over 360º and for both Vertical and Horizontal polarizations.
The radiated spurious emission was measured on the worst case configuration found.

B.6.3 Test Results

Radiated spurious - 30 MHz – 1 GHz

Radiated Spurious – All modes

Frequency	Quasi-Peak	Limit	Margin	Polar
MHz	dBµV/m	dBµV/m	dB	---
246.3	16.9	46.0	29.1	V
276.7	19.6	46.0	26.4	H
891.6	32.3	46.0	13.7	H
900.1	30.8	46.0	15.2	H
928.0	35.8	46.0	10.2	H

Note 1: The spurious signals detected do not depend on either the operating channel or the modulation mode.

1 GHz – 26.5 GHz, BR – GFSK

Radiated Spurious – CH0 DH5

Frequency	MaxPeak	Average	Limit	Margin	Polar
MHz	dBµV/m	dBµV/m	dBµV/m	dB	---
3097.5	---	40.6	54.0	**13.4**	H
3100.5	52.3	---	74.0	21.7	V
9607.0	48.6	---	74.0	25.4	V
9607.5	---	37.6	54.0	16.4	V
25755.5	47.6	---	74.0	26.4	H
25763.0	---	36.0	54.0	18.0	H

Radiated Spurious – CH39 DH5

Frequency	MaxPeak	Average	Limit	Margin	Polar
MHz	dBµV/m	dBµV/m	dBµV/m	dB	---
3156.5	52.3	---	74.0	21.7	V
3160.5	---	40.0	54.0	14.0	H
9763.5	49.1	---	74.0	24.9	V
9763.5	---	39.4	54.0	14.6	V
25601.0	48.8	---	74.0	25.2	H
25610.0	---	35.9	54.0	18.1	H

Radiated Spurious – CH78 DH5

Frequency	MaxPeak	Average	Limit	Margin	Polar
MHz	dBµV/m	dBµV/m	dBµV/m	dB	---
3149.0	52.0	---	74.0	22.0	H
3151.0	---	40.1	54.0	13.9	H
9919.0	49.1	---	74.0	24.9	V
9920.0	---	40.3	54.0	13.7	V
25878.5	48.1	---	74.0	25.9	V
25890.5	---	36.2	54.0	17.8	H

30 MHz – 26.5 GHz, EDR – π/4-DQPSK

Radiated Spurious – CH0 2DH5

Frequency	MaxPeak	Average	Limit	Margin	Polar
MHz	dBµV/m	dBµV/m	dBµV/m	dB	---
3084.0	51.8	---	74.0	22.2	V
3088.5	---	40.8	54.0	13.2	V
9604.5	48.5	---	74.0	25.5	H
9607.5	---	36.7	54.0	17.3	V
25871.0	49.8	---	74.0	24.2	V
25889.0	---	36.5	54.0	17.6	H

Radiated Spurious – CH39 2DH5

Frequency	MaxPeak	Average	Limit	Margin	Polar
MHz	dBµV/m	dBµV/m	dBµV/m	dB	---
3138.0	53.1	---	74.0	20.9	H
3138.5	---	41.2	54.0	12.8	V
9763.5	48.7	---	74.0	25.3	V
9763.5	---	38.0	54.0	16.0	V
24988.5	48.8	---	74.0	25.2	H
25012.5	---	35.4	54.0	18.6	V

Radiated Spurious – CH78 2DH5

Frequency	MaxPeak	Average	Limit	Margin	Polar
MHz	dBµV/m	dBµV/m	dBµV/m	dB	---
3189.0	53.5	---	74.0	20.5	V
3189.0	---	42.7	54.0	**11.3**	V
9919.0	48.9	---	74.0	25.1	V
9919.5	---	37.8	54.0	16.2	V
25917.0	49.0	---	74.0	25.0	V
25917.5	---	36.4	54.0	17.6	H

30 MHz – 26.5 GHz, EDR – 8-DPSK

Radiated Spurious – CH0 3DH5

Frequency	MaxPeak	Average	Limit	Margin	Polar
MHz	dBµV/m	dBµV/m	dBµV/m	dB	---
3086.5	52.0	---	74.0	22.0	V
3088.5	---	41.0	54.0	13.0	V
9607.0	47.6	---	74.0	26.4	H
9608.5	---	36.3	54.0	17.7	V
25501.0	47.6	---	74.0	26.4	H
25506.0	---	35.0	54.0	19.0	H

Radiated Spurious – CH39 3DH5

Frequency	MaxPeak	Average	Limit	Margin	Polar
MHz	dBµV/m	dBµV/m	dBµV/m	dB	---
3130.0	52.9	---	74.0	21.1	H
3138.5	---	41.3	54.0	12.7	V
9762.5	48.4	---	74.0	25.6	H
9763.5	---	38.0	54.0	16.0	V
25913.5	50.0	---	74.0	24.0	V
25929.0	---	36.7	54.0	17.3	H

Radiated Spurious – CH78 3DH5

Frequency	MaxPeak	Average	Limit	Margin	Polar
MHz	dBµV/m	dBµV/m	dBµV/m	dB	---
3188.5	52.1	---	74.0	21.9	V
3189.0	---	42.3	54.0	11.7	V
9919.5	47.9	---	74.0	26.1	V
9920.0	---	37.9	54.0	16.1	V
25907.5	49.9	---	74.0	24.1	H
25917.0	---	36.7	54.0	17.3	V

End of the report

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