CERTIFICATE #3478.01

TEST REPORT

EUT Description	**WLAN and BT, 2x2 PCIe M.2 2230 adapter card,**
Brand Name	**Intel® Wi-Fi 6 AX201**
Model Name	**AX201NGW**
FCC ID ISED ID	**PD9AX201NG** **1000M-AX201NG**
Date of Test Start/End	**2018-09-13 / 2018-11-22**
Features	**802.11ax, Dual Band, 2x2 Wi-Fi + Bluetooth® 5** (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** (see section 1)

Test Report identification	**180717-02.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.
The test report shall not be reproduced in full, without written approval of the laboratory.

Issued by

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1. Standards, reference documents and applicable test methods

1. FCC 47 CFR part 15 - Subpart C – §15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
2. FCC 47 CFR part 15 - Subpart C – §15.209 Radiated emission limits; general requirements.
3. ANSI C63.10-2013 - American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
4. DA 00-705 Released March 30, 2000 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
5. RSS-247 Issue 2 - Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
6. RSS-Gen Issue 5 - General Requirements for Compliance of Radio Apparatus.

2. General conditions, competences and guarantees

- ✓ Intel Corporation SAS Wireless RF Lab (Intel WRF Lab) is an ISO/IEC 17025:2005 testing 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 a Registered Test Site listed by ISED, with ISED Assigned Code 1000Y.
- ✓ 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	22 ºC ±2 ºC
Humidity	50 % ± 30 %

4. Test samples

Sample	Control #	Description	Model	Serial #	Date of receipt	Note
#1	180717-02.S05	RF MODULE	AX201NGW	WFM : 3413E8CA86BD	2018-09-06	Used for conducted tests
	180522-02.S03	EXTENDER	PCB00651_01	6510818-190	2018-05-31	
	170000-01.S04	LAPTOP	LATITUDE E5470	DMRKMC2	2017-05-10	
#2	180717-02.S07	RF MODULE	AX201NGW	WFM : 3413E8CA866D	2018-09-06	Radiated Spurious emission from 30MHz to 1 GHz
	180326-01.S03	EXTENDER	PCB00651_01	6510818-198	2018-03-27	
	170209-01.S16	LAPTOP	LATITUDE E7470	C1HTPF2	2017-02-09	
#3	180717-02.S08	RF MODULE	AX201NGW	WFM:3413E8CA8681	2018-09-06	Radiated Spurious emission from 1 GHz to 26.5 GHz
	180717-03.S18	EXTENDER	PCB00651_01	6510817-133	2018-08-21	
	170801-01.S10	LAPTOP	LATITUDE E7470	7KNOXF2	2017-09-07	

5. EUT Features

Brand Name	Intel® Wi-Fi 6 AX201
Model Name	AX201NGW
FCC ID	PD9AX201NG
ISED ID	1000M-AX201NG
Software Version	OEM DRTU_08048_11_1832_0G
Driver Version	99.0.39.1 (V010.16.t64)
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 – 5850.0 MHz) Bluetooth 5 2.4GHz (2400.0 – 2483.5 MHz)
Antenna Information	CHAIN A: PIFA antenna. WiFi 2.4GHz & 5GHz and BT CHAIN B: PIFA antenna. WiFi 2.4GHz & 5GHz
Additional Information	

6. Remarks and comments

N/A

7. Test Verdicts summary

7.1. BT Basic Data 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 Clause 8.9	Out-of-band Emissions (radiated)	P

8. Document Revision History

Revision #	Date	Modified by	Revision Details
Rev. 00	2018-11-30	G. Roustan I. Kharrat	First Issue

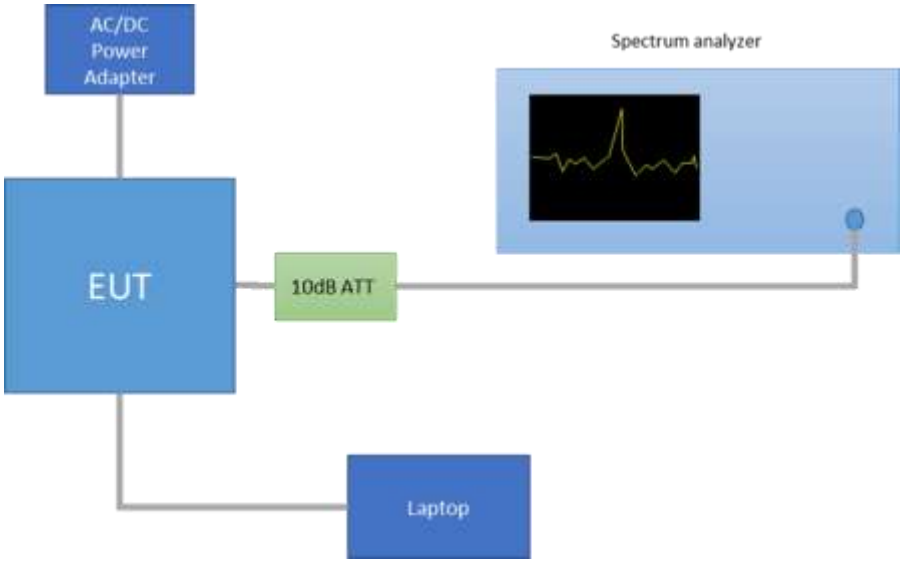
Annex A. Test & System Description

A.1 Measurement System

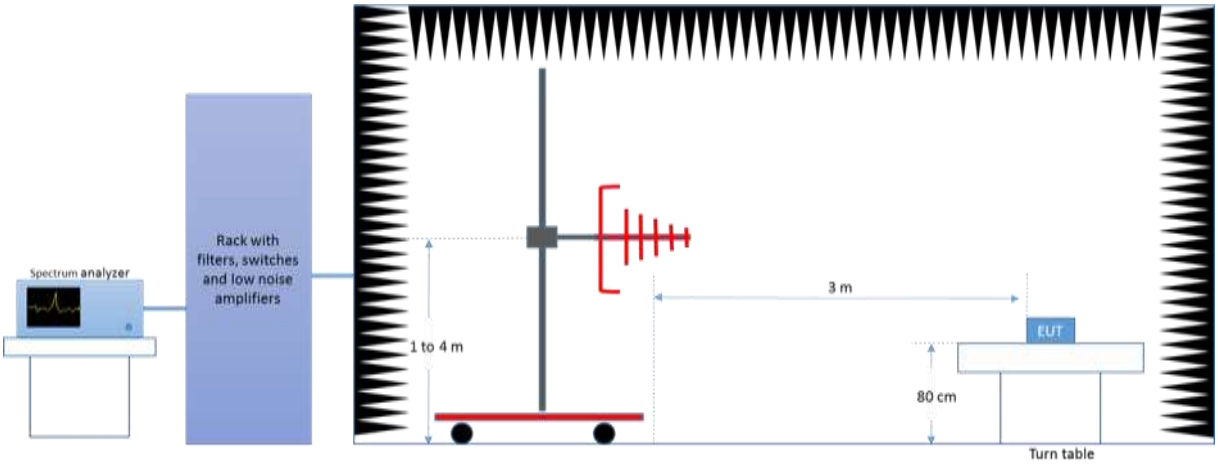
Measurements were performed using the following setups.

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.

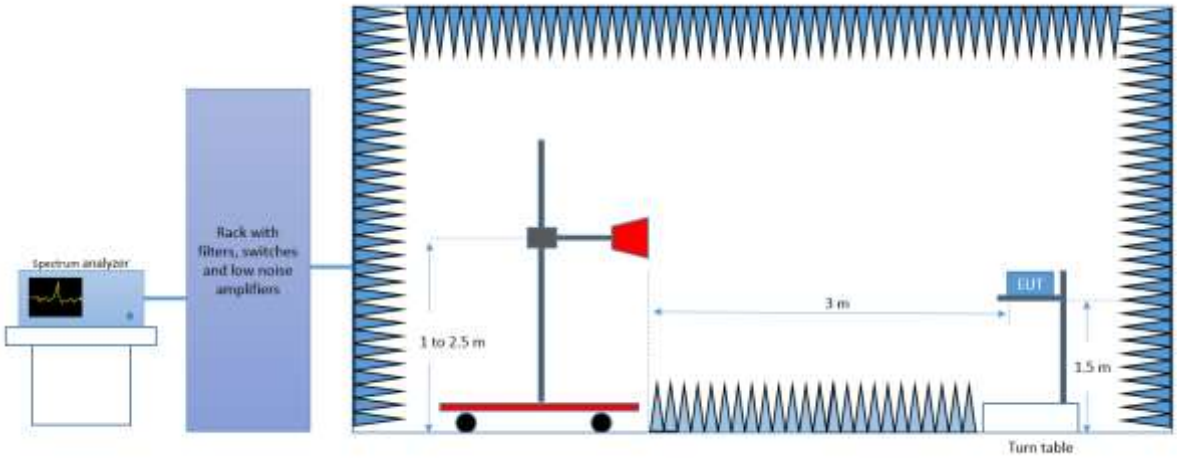
Conducted Setup



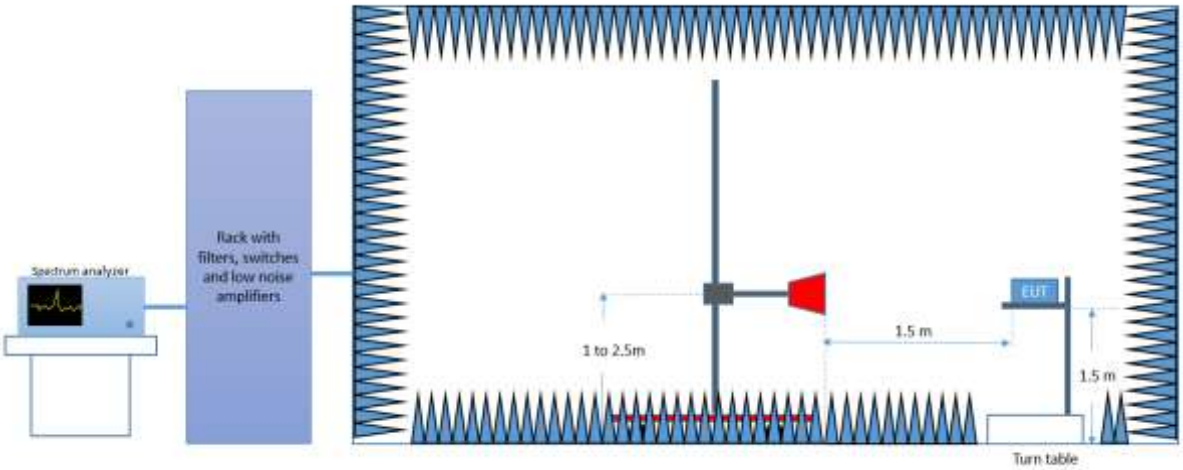
Radiated Setup 30 MHz- 1 GHz



Radiated Setup 1 GHz – 18 GHz



Radiated Setup 18 GHz – 26.5 GHz



A.2 Test Equipment List

Conducted Setup

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0316	Spectrum analyzer	FSV30	103309	Rohde & Schwarz	2017-09-22	2019-09-22

Radiated Setup-1

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0420	Spectrum analyzer	FSV40	101556	Rohde & Schwarz	2018-05-17	2020-05-17
0137	Log antenna 30 MHz – 1 GHz	3142E	00156946	ETS Lindgren	2017-12-19	2019-12-19
0135	Semi Anechoic chamber	FACT 3	5720	ETS Lindgren	2018-04-18	2020-04-18
0530	Measurement Software	EMC32	100623	Rohde & Schwarz	N/A	N/A

N/A: Not Applicable

Radiated Setup-2

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0133	Spectrum analyzer	FSV40	101358	Rohde & Schwarz	2018-04-11	2020-04-11
0138	Double Ridged Horn Antenna 1 GHz – 18 GHz	3117	00152266	ETS Lindgren	2018-03-29	2020-03-29
0141	Double Ridged Horn Antenna 1 GHz – 18 GHz	3117	00157736	ETS Lindgren	2018-05-11	2020-05-11
0334	Double Ridged Horn Antenna 18 GHz – 40 GHz	3116C-PA	00196308	ETS Lindgren	2017-08-22	2019-08-22
0337	Full Anechoic chamber	RFD_FA_100	5996	ETS Lindgren	2018-04-17	2020-04-17
0329	Measurement Software	EMC32	100401	Rohde & Schwarz	N/A	N/A

N/A: Not Applicable

Radiated Setup - shared equipment

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0617	Power Sensor 50MHz-18GHz	NRP-Z81	104386	Rohde & Schwarz	2018-04-16	2020-04-16
0618	Power Sensor 50MHz-18GHz	NRP-Z81	104382	Rohde & Schwarz	2018-04-16	2020-04-16

A.3 Measurement Uncertainty Evaluation

The system uncertainty evaluation is shown in the below table:

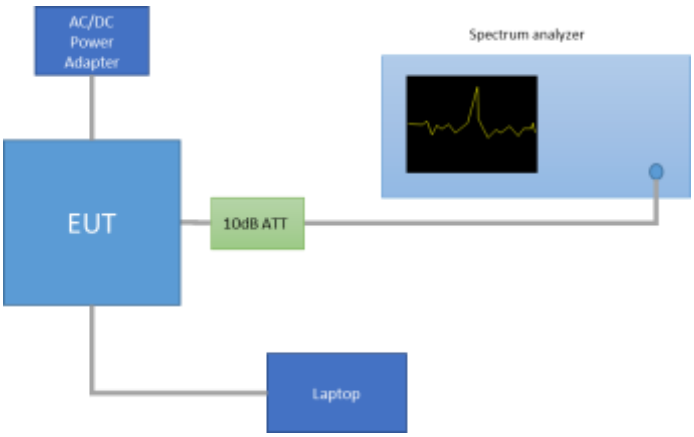
Measurement type	Uncertainty [±dB]
Conducted Power	±1.0
Conducted Spurious Emission	±2.9
Radiated tests <1GHz	±3.8
Radiated tests 1GHz - 40 GHz	±4.7

Annex B. Test Results

B.1 20dB Bandwidth and carrier frequency separation

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.



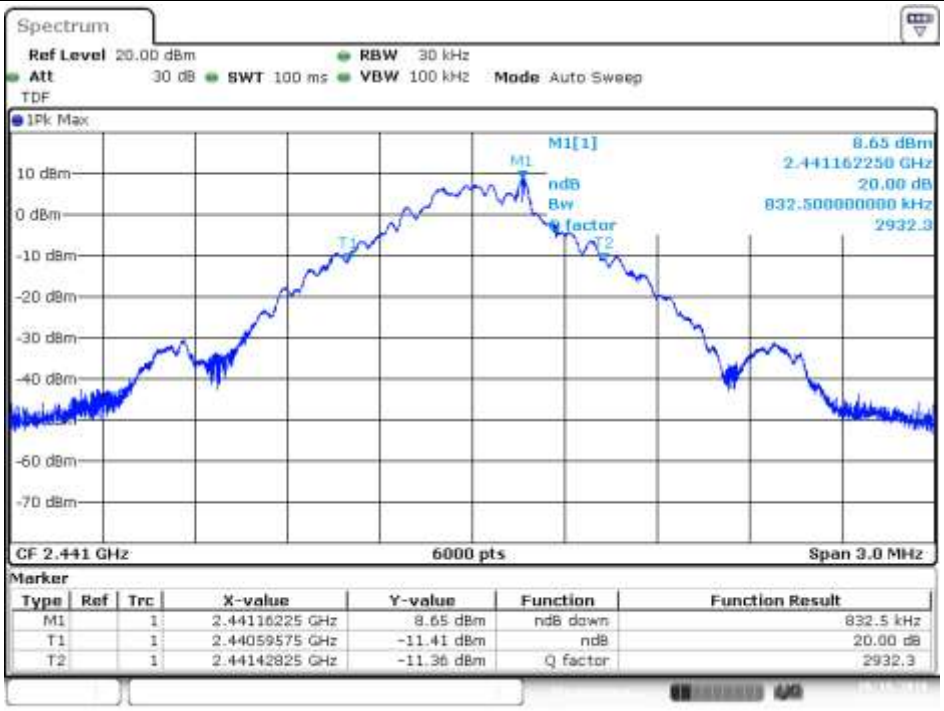
Results tables:

Mode	Packet Type	Channel Number	Frequency [MHz]	20dB BW [MHz]	Freq. Separation [kHz]
Basic Rate GFSK	DH5	0	2402	0.822	1000
		39	2441	**0.833**	
		78	2480	0.832	
EDR π/4-DQPSK	2DH5	0	2402	1.424	1000
		39	2441	**1.442**	
		78	2480	1.429	
EDR 8-DPSK	3DH5	0	2402	1.421	1000
		39	2441	1.421	
		78	2480	**1.426**	

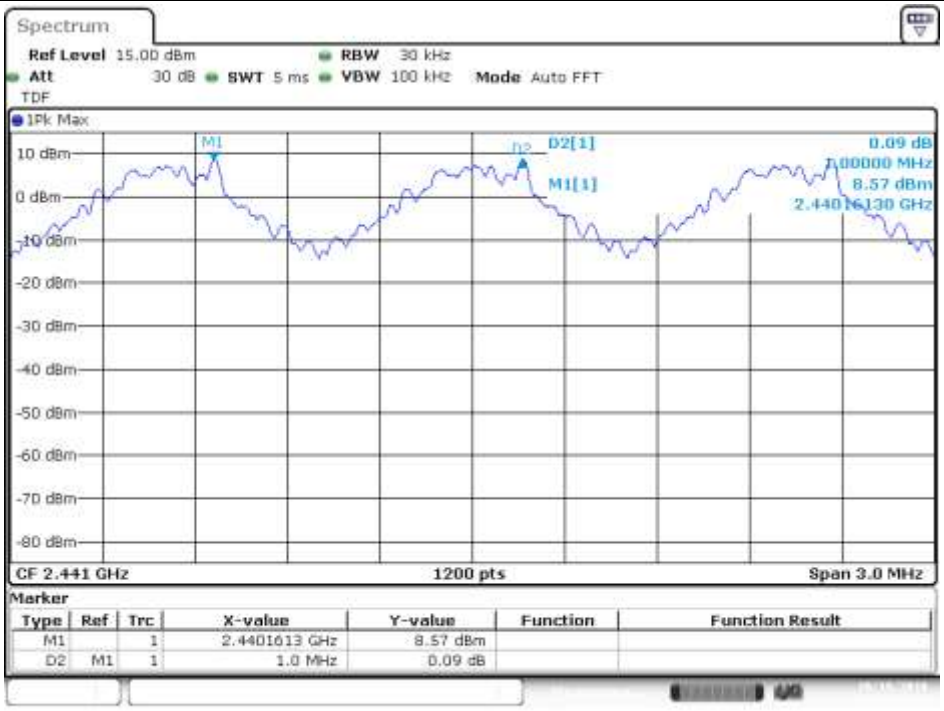
Results screenshot

Basic Rate - GFSK

20dB BW – CH39

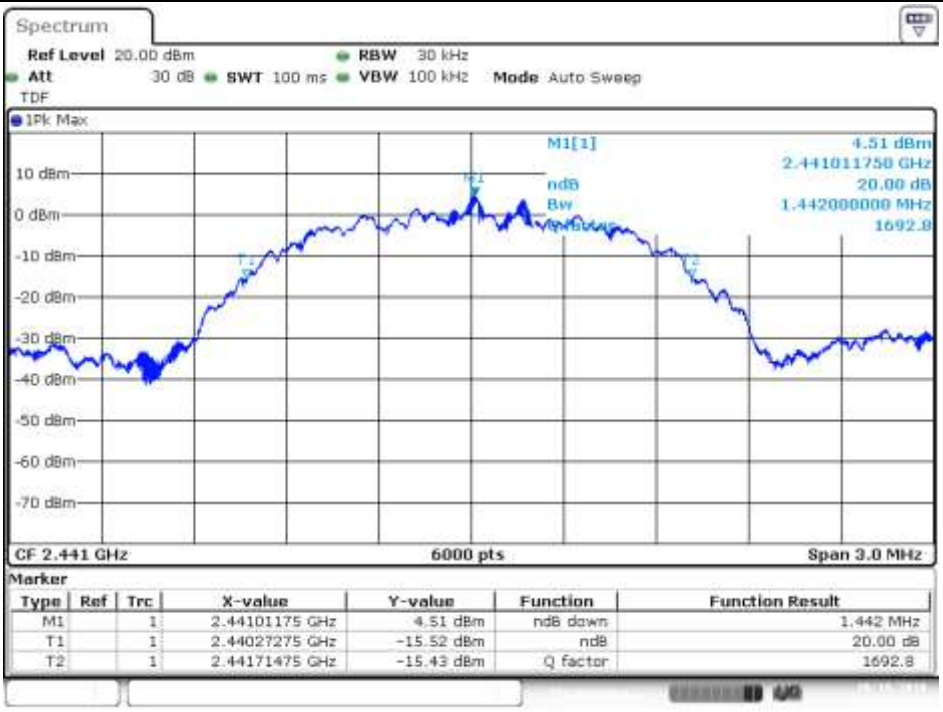


Freq. Separation

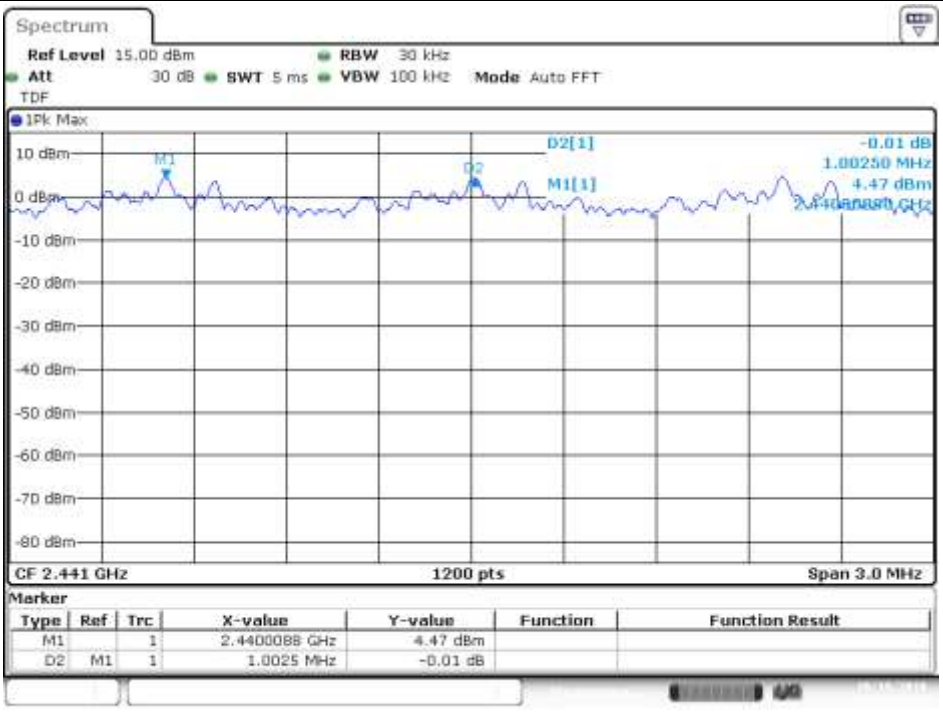


EDR – π/4-DQPSK

20dB BW – CH39

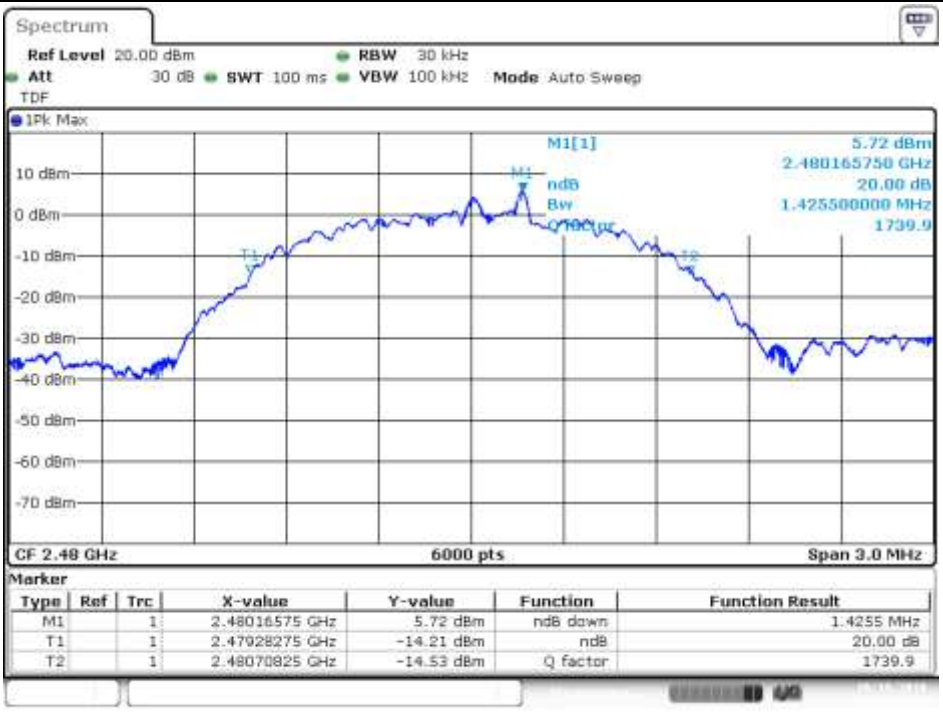


Freq. Separation

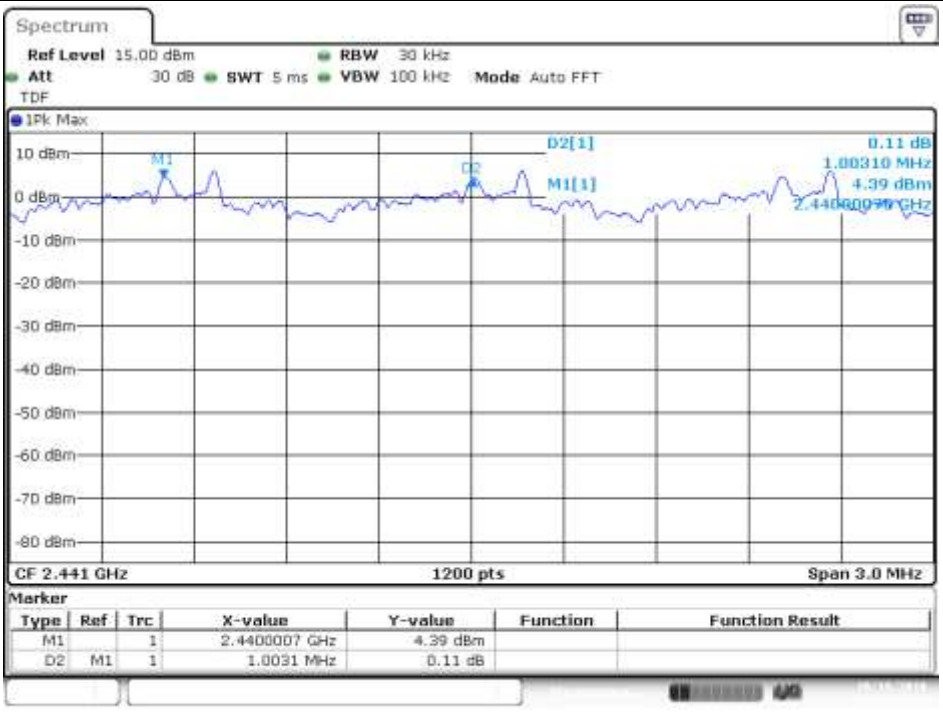


EDR – 8-DPSK

20dB BW – CH78



Freq. Separation



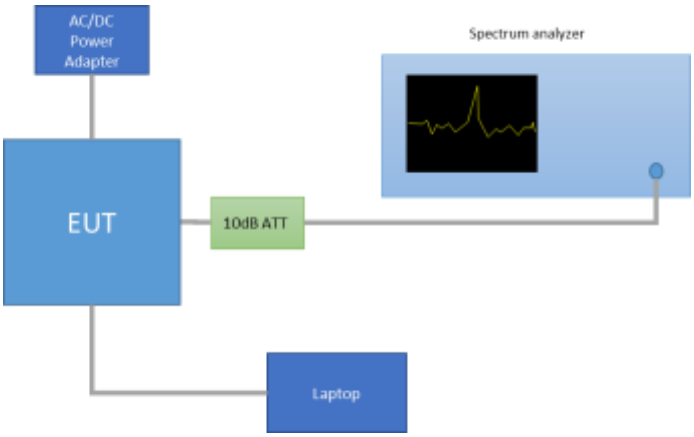
B.2 Number of hopping channels

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.

Test procedure

The setup below 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.

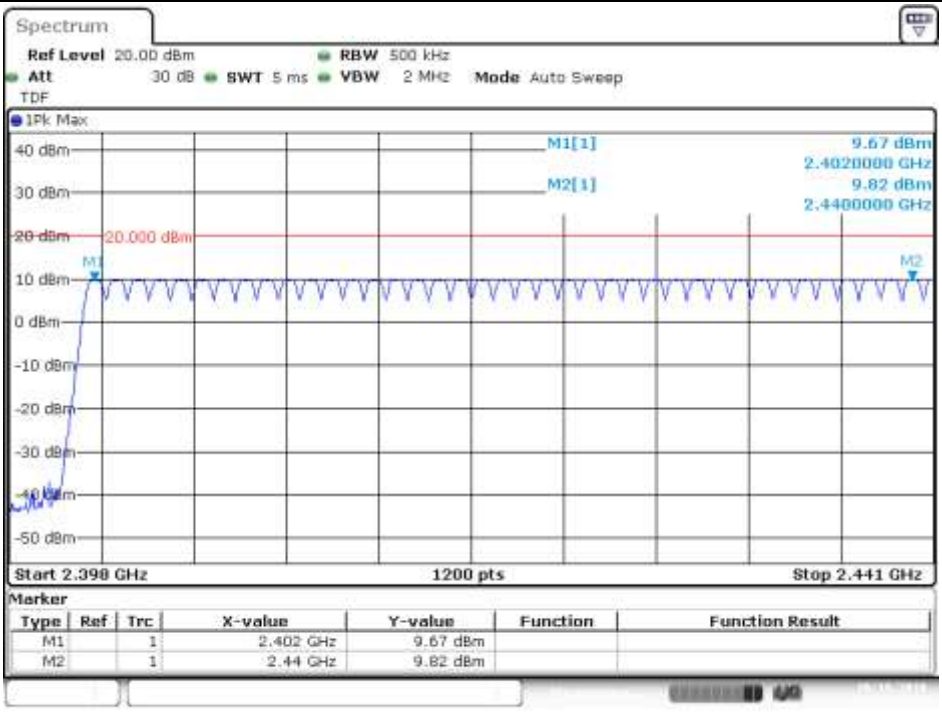


Results tables

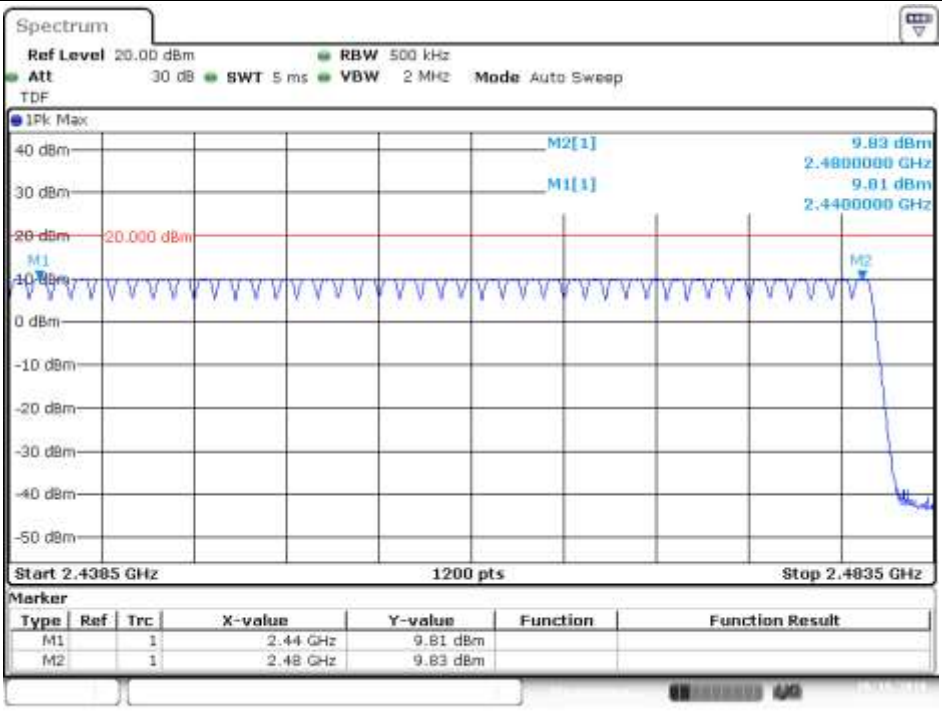
Mode	Packet Type	Number of hopping channels
Basic Rate GFSK	DH5	79
EDR π/4-DQPSK	2DH5	79
EDR 8-DPSK	3DH5	79

Number of hopping channels

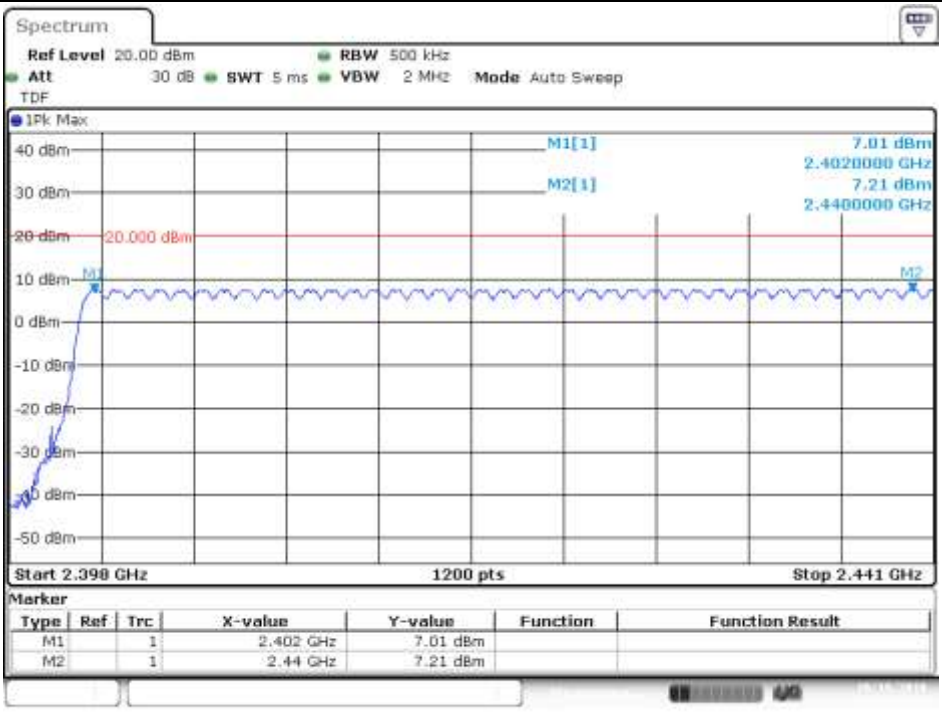
Basic Rate – GFSK



Basic Rate – GFSK

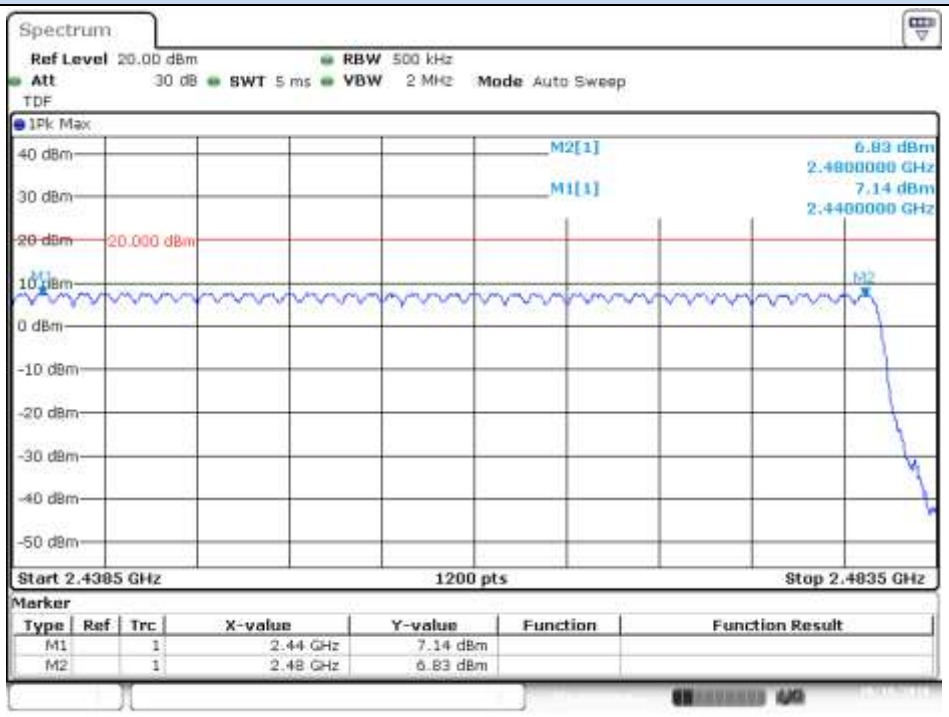


EDR – π/4-DPSK



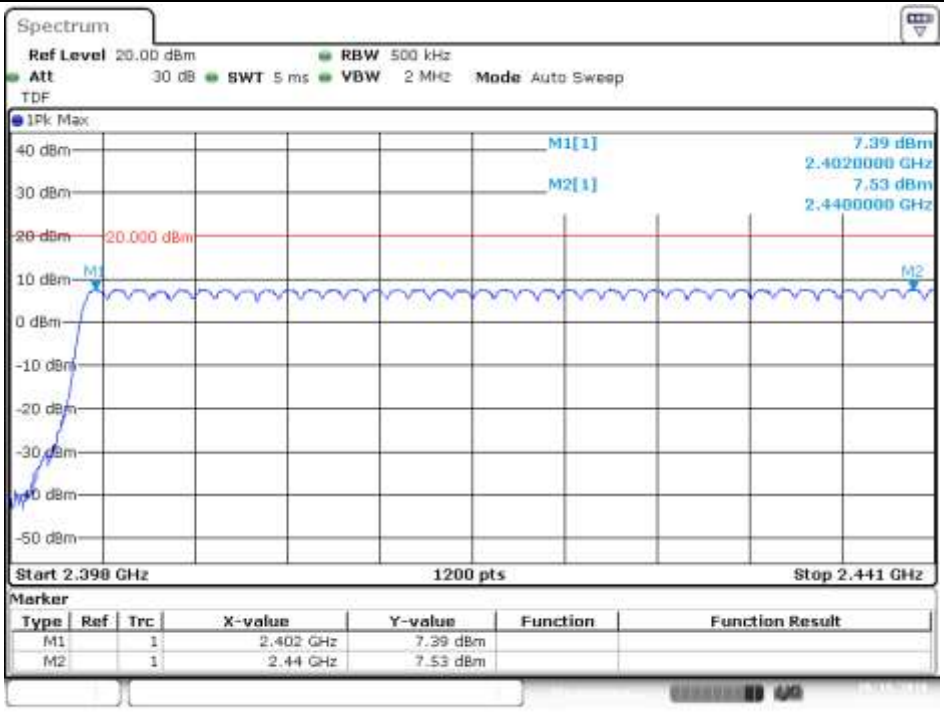
Date: 18.OCT.2018 10:48:47

EDR – π/4-DPSK

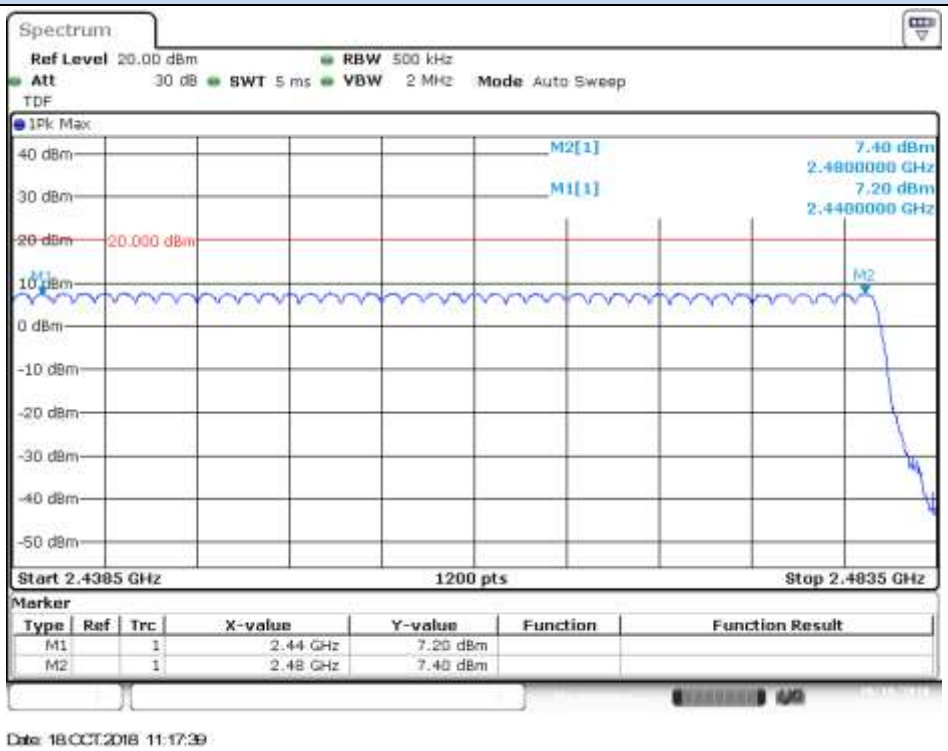


Date: 18.OCT.2018 10:50:43

EDR – 8-DPSK



EDR – 8-DPSK

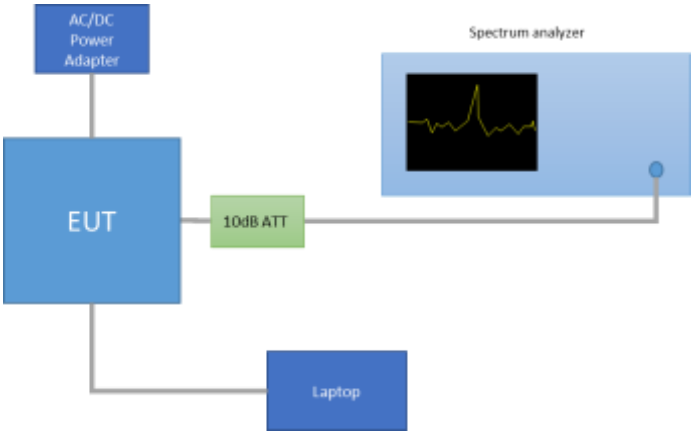


B.3 Time of Occupancy (Dwell Time)

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.

Test procedure

The setup below 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.

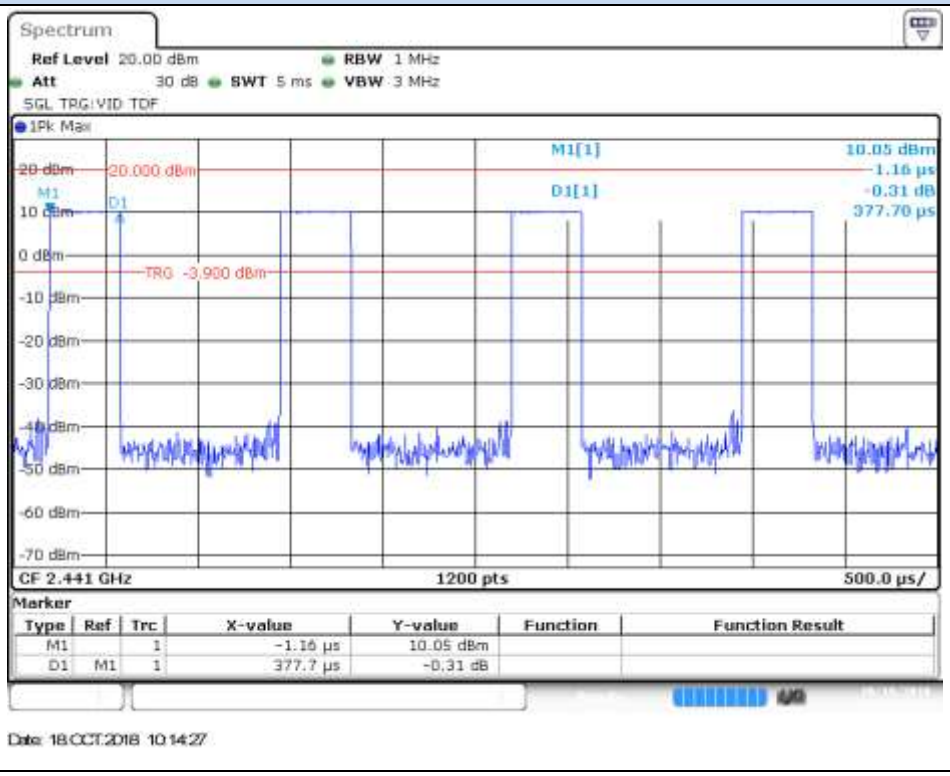
Results tables

Mode	Packet Type	Times of appearance	Tx-time [ms]	Dwell Time [ms]
Basic Rate GFSK	DH1	320.11	0.377	120.681
	DH3	161.16	1.637	263.819
	DH5	106.49	2.884	307.117
EDR π/4-DQPSK	2-DH1	320.11	0.389	124.523
	2-DH3	161.16	1.638	263.980
	2-DH5	106.49	2.891	307.863
EDR 8-DPSK	3-DH1	320.11	0.385	123.242
	3-DH3	161.16	1.626	262.046
	3-DH5	106.49	2.890	307.756

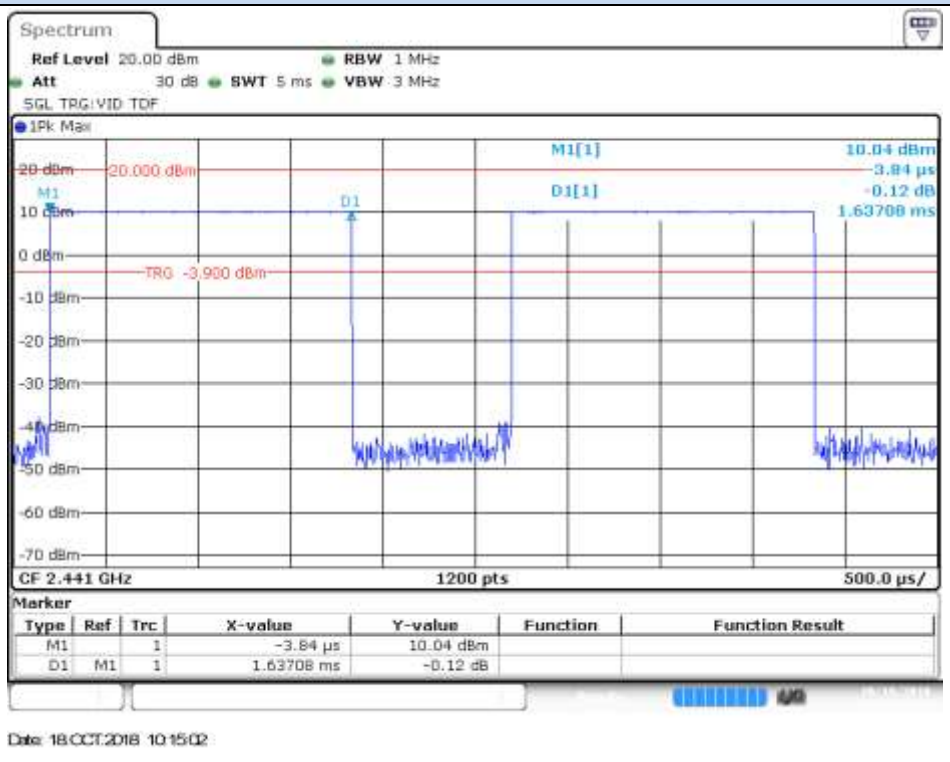
Results Screenshot:

BDR – GFSK

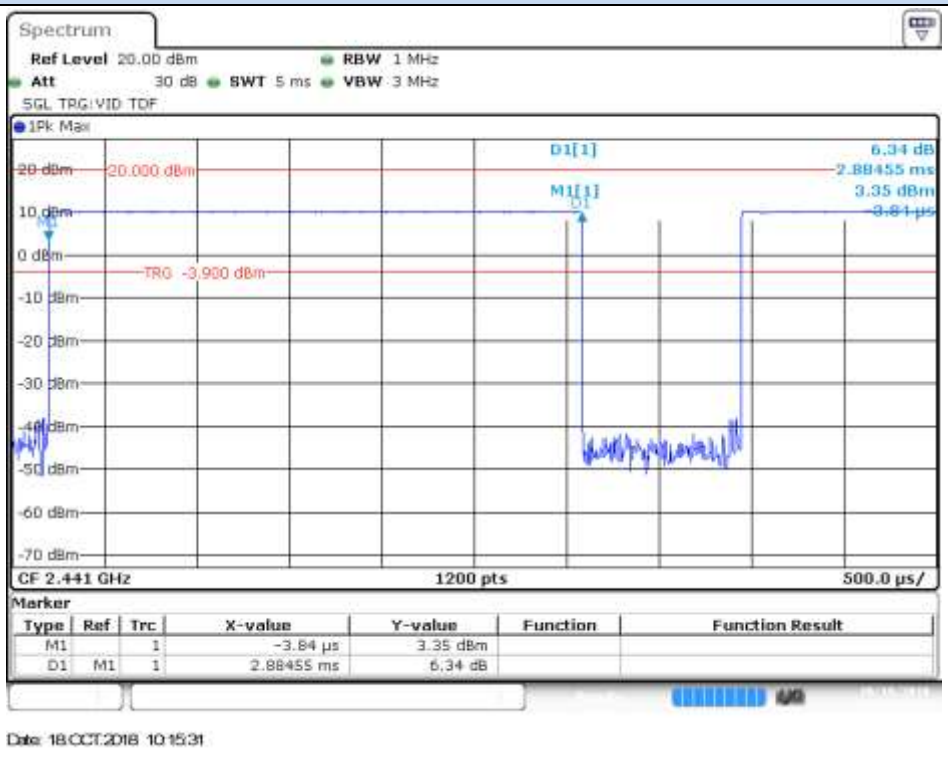
DH1 Tx-Time



DH3 Tx-Time

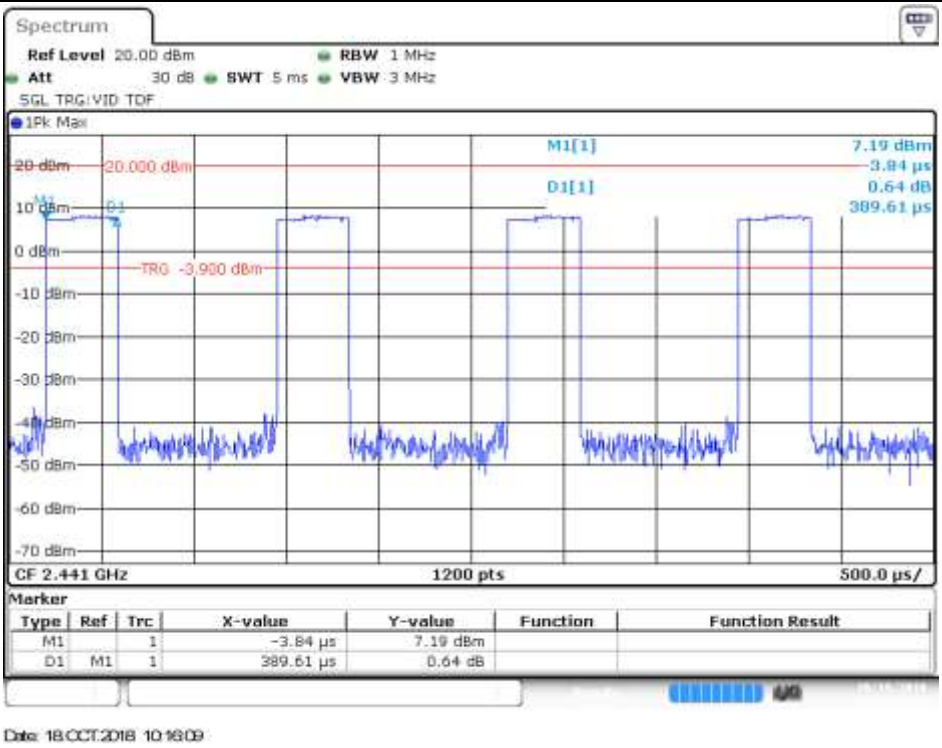


DH5 Tx-Time

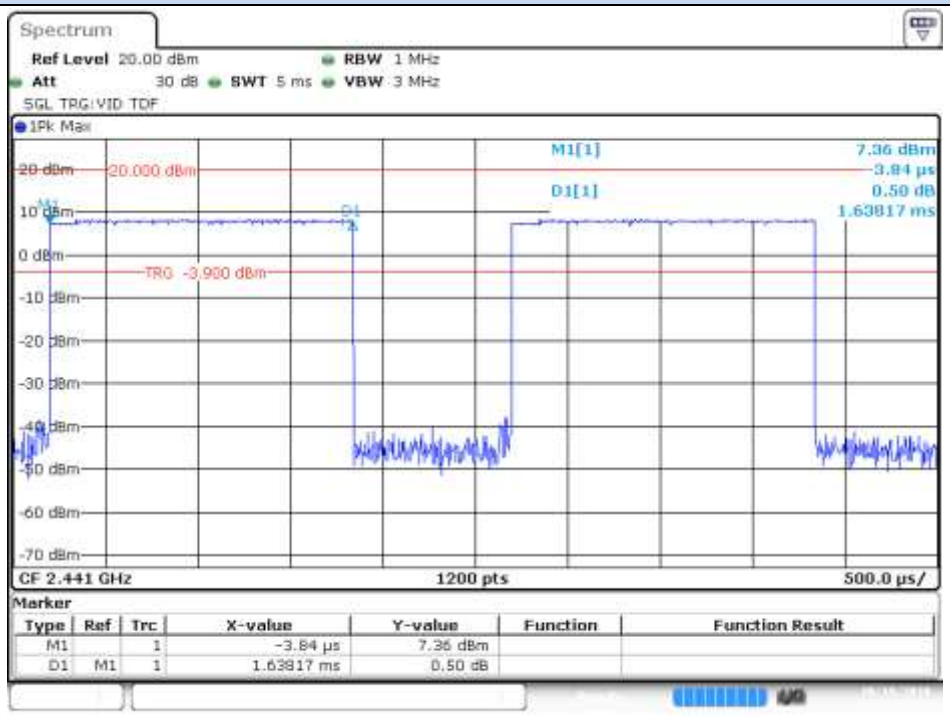


EDR – π/4-DQPSK

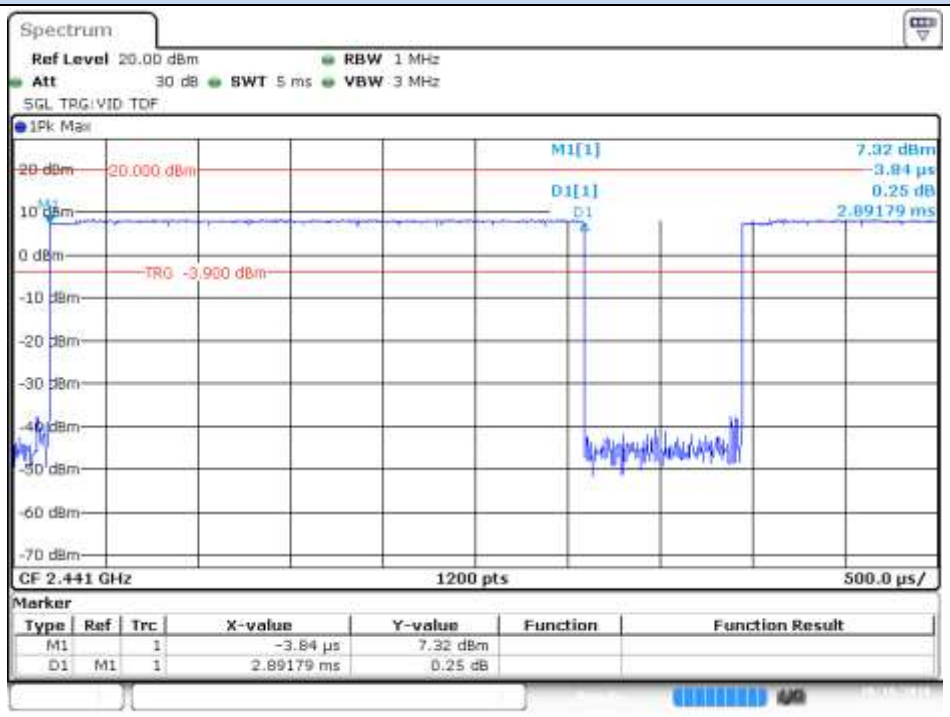
2-DH1 Tx-Time



2-DH3 Tx-Time

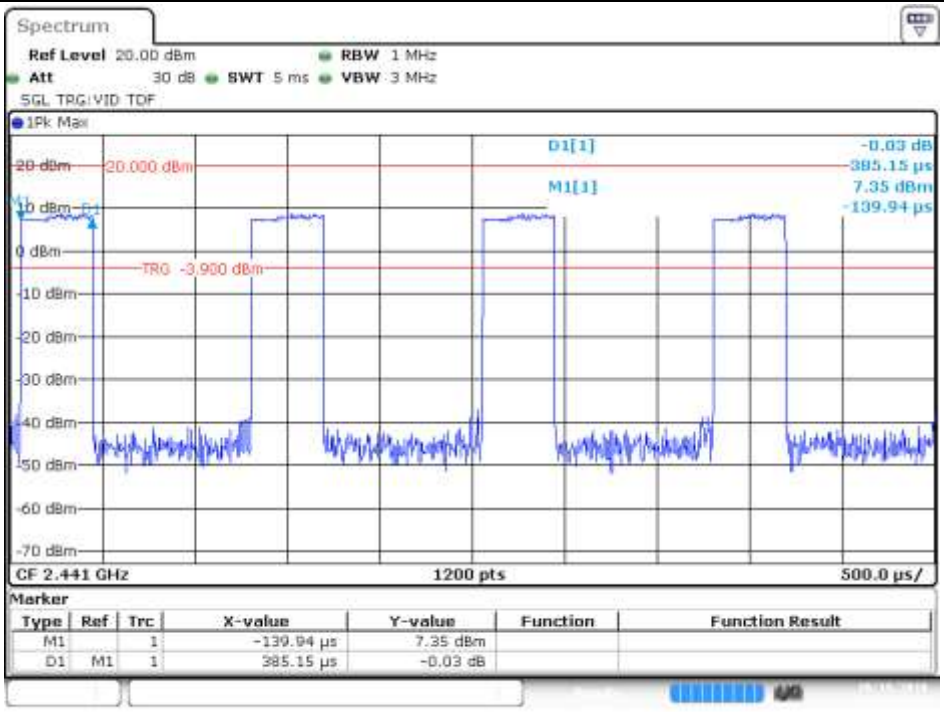


2-DH5 Tx-Time



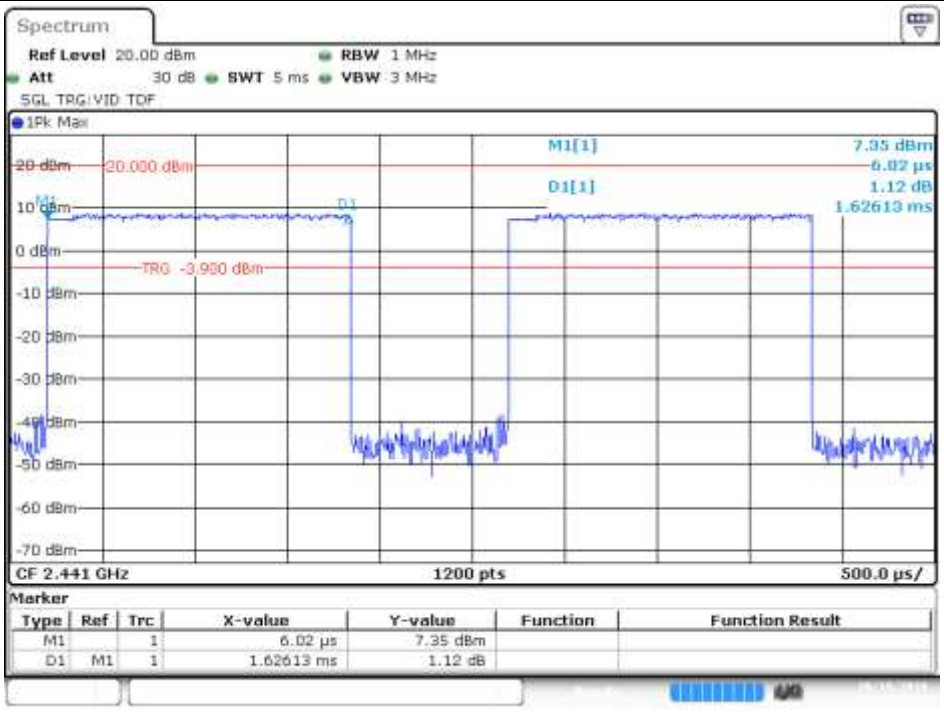
EDR – 8-DPSK

3-DH1 Tx-Time

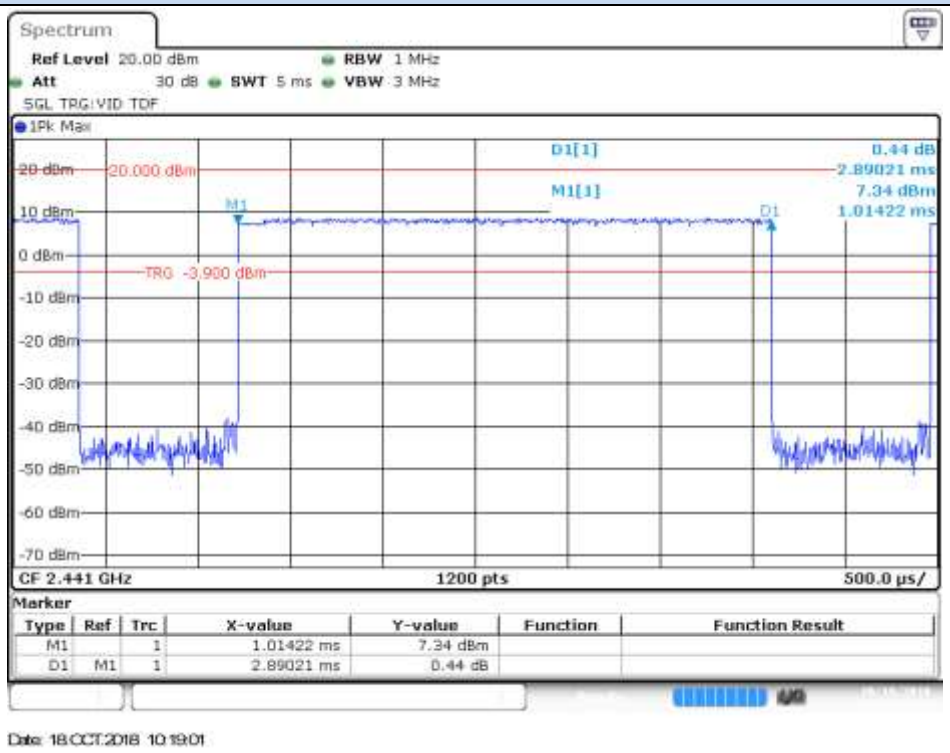


Date: 18.OCT.2018 10:17:51

3-DH3 Tx-Time



Date: 18.OCT.2018 10:18:26

3-DH5 Tx-Time


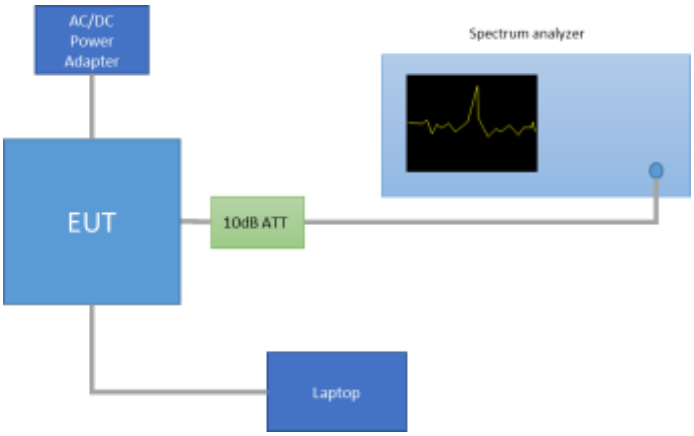
B.4 Maximum Peak Output Power antenna gain

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.

Test procedure

The setup below 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.



The declared maximum antenna gain is 3.24dBi.

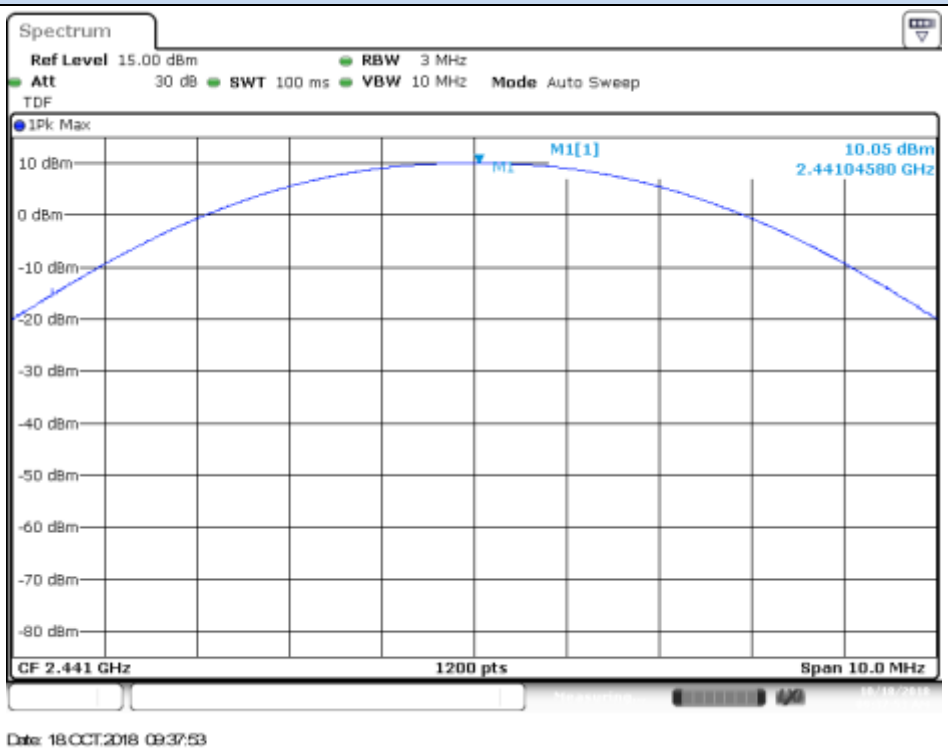
Results tables

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	9.88	9.73	13.12	20.51
		39	2441	**10.05**	10.12	13.29	21.33
		78	2480	9.85	9.66	13.09	20.37
EDR π/4-DQPSK	2DH5	0	2402	8.83	7.64	12.07	16.11
		39	2441	**9.02**	7.98	12.26	16.83
		78	2480	8.83	7.64	12.07	16.11
EDR 8-DPSK	3DH5	0	2402	8.94	7.83	12.18	16.52
		39	2441	**9.17**	8.26	12.41	17.42
		78	2480	8.96	7.87	12.20	16.60

Results Screenshot

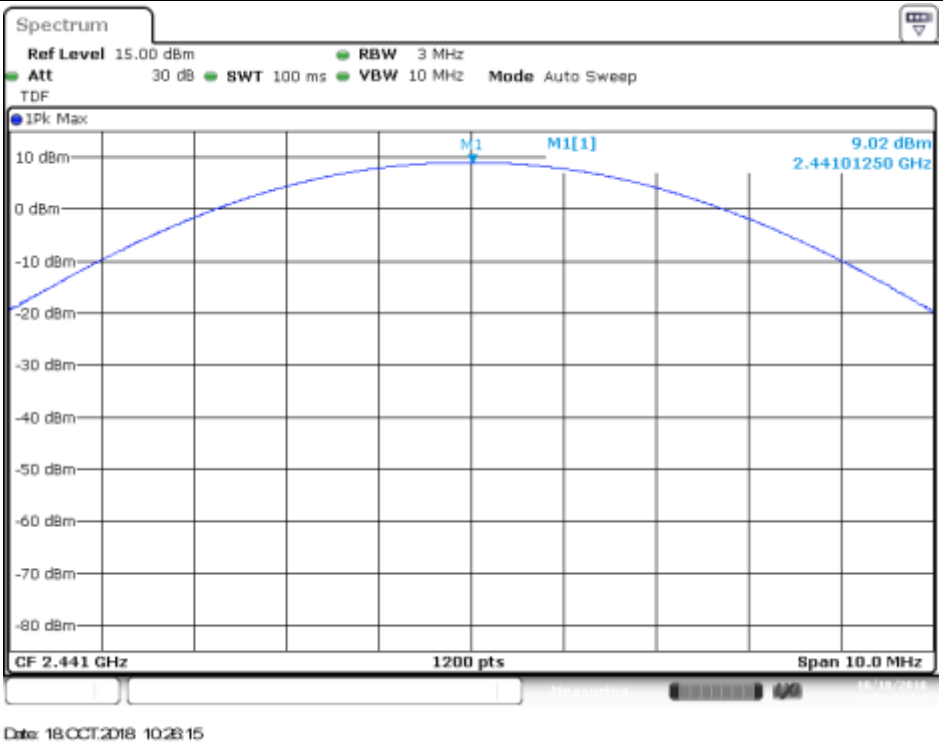
Basic Rate - GFSK

Peak Power – CH39



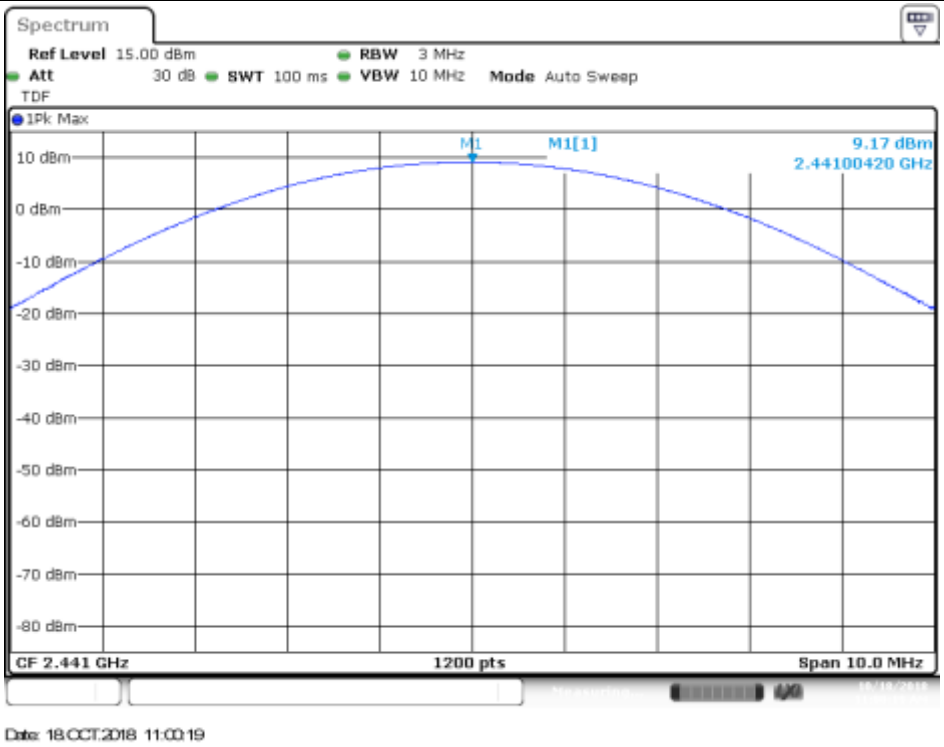
EDR – π/4-DQPSK

Peak Power – CH39



EDR – 8-DPSK

Peak Power – CH39



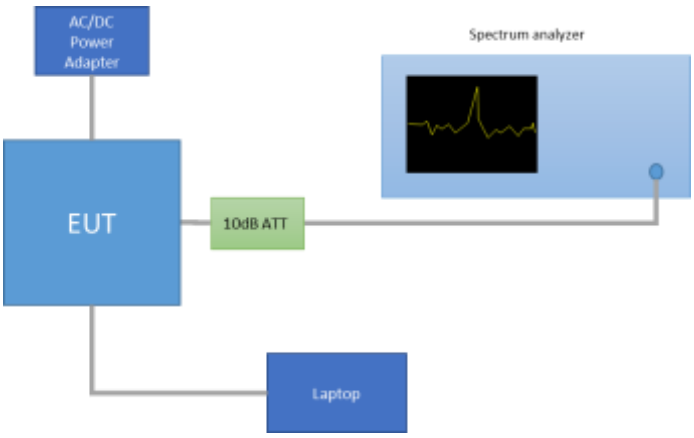
B.5 Out-of-band emission (conducted)

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.

Test procedure

The setup below 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.

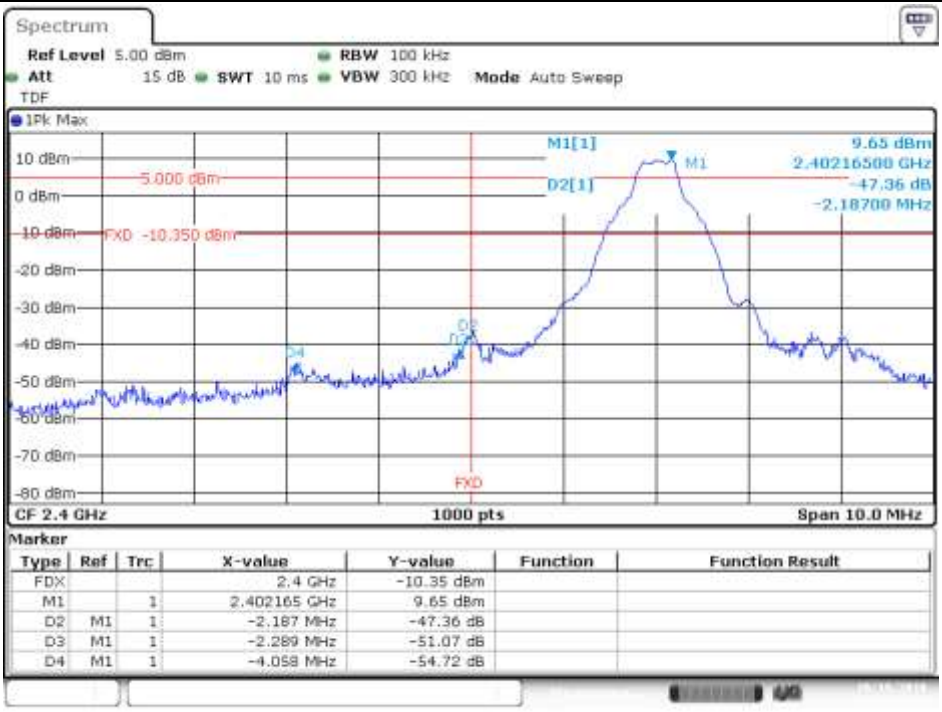


Note: these PSD_{Peak} values are shown just as a reference for the compliance of the Out-of-band Measurements. Thus the RBW used for these measurements was 100 kHz.

Mode	**Packet Type**	**CH**	**Frequency [MHz]**	**PSD Peak [dBm/100kHz]**
Basic Rate - GFSK	DH5	0	2402	9.65
		39	2441	9.84
		78	2480	9.73
EDR – π/4-DQPSK	2DH5	0	2402	6.86
		39	2441	7.17
		78	2480	6.89
EDR – 8-DPSK	3DH5	0	2402	6.93
		39	2441	7.26
		78	2480	6.98

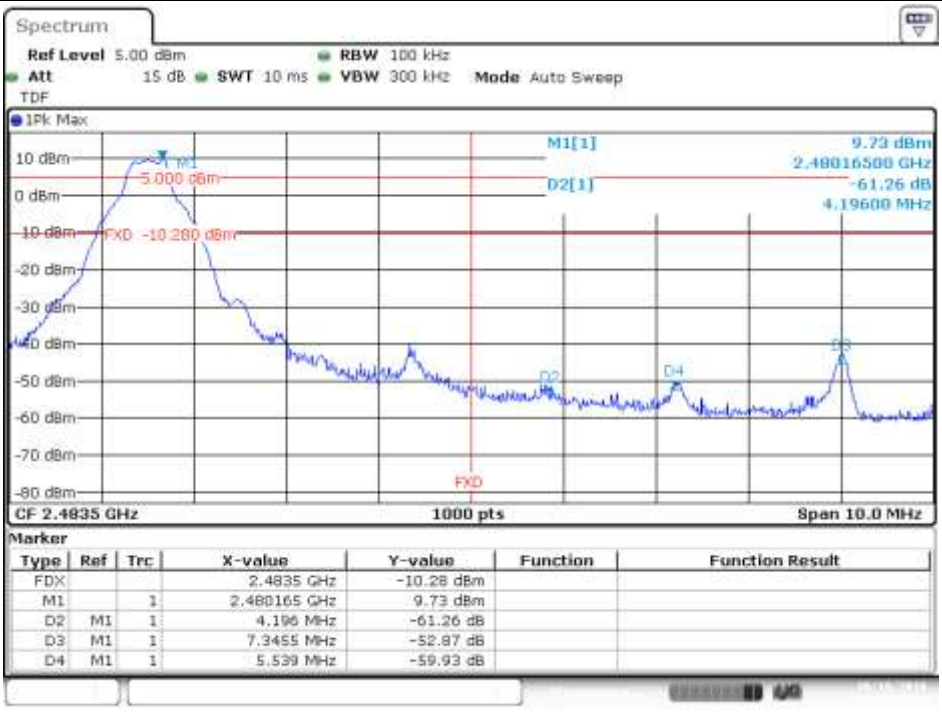
Basic Rate - GFSK

BE Low Freq Section – CH0



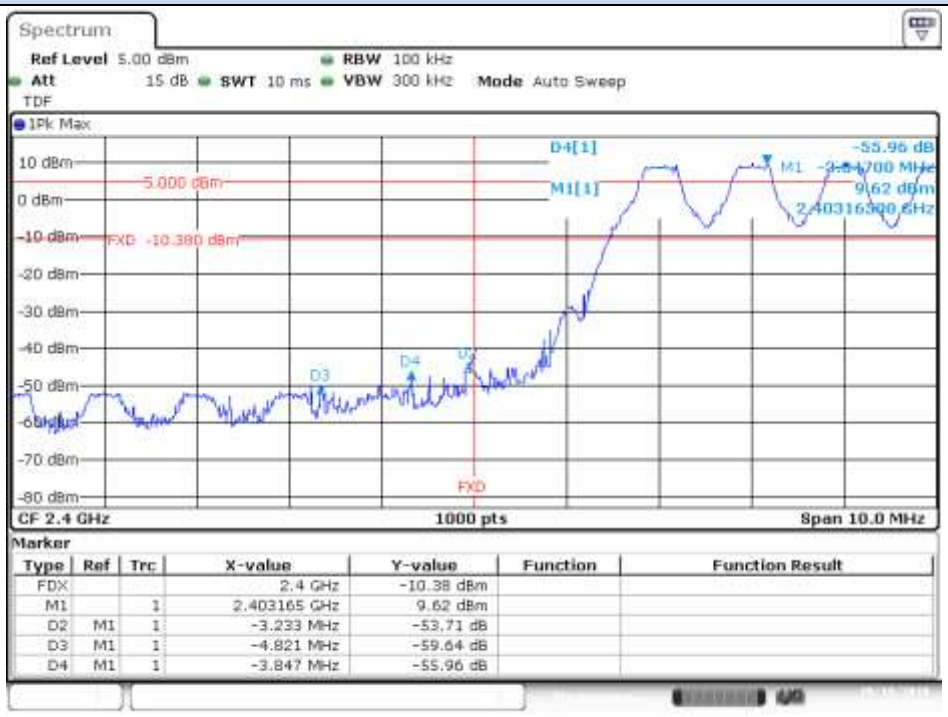
Date: 18.OCT.2018 09:28:44

BE High Freq Section – CH78

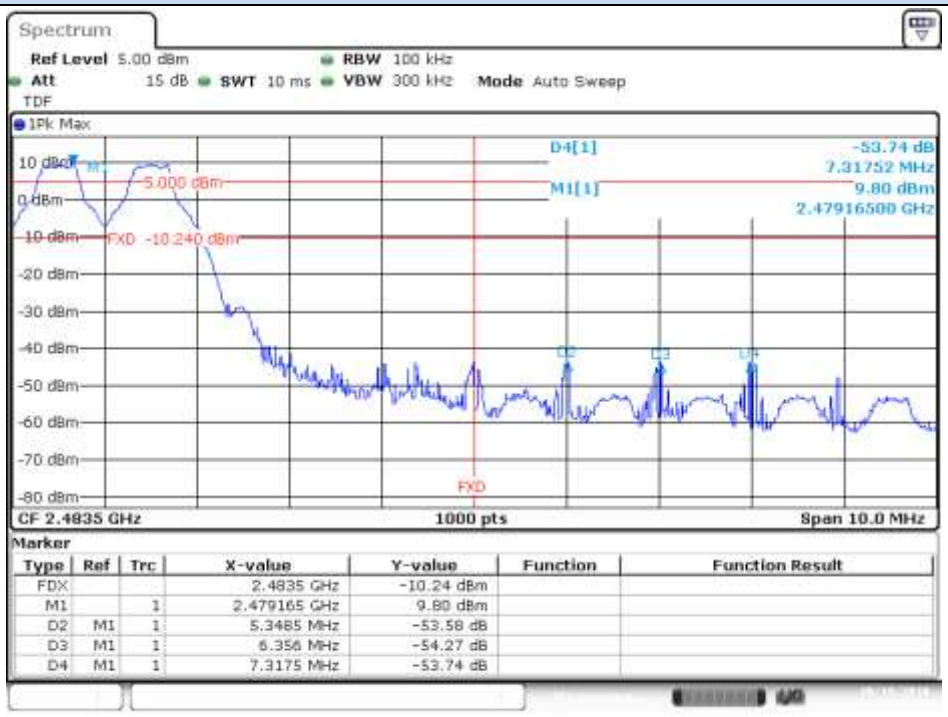


Date: 18.OCT.2018 09:48:24

BE Low Freq Section – Hopping

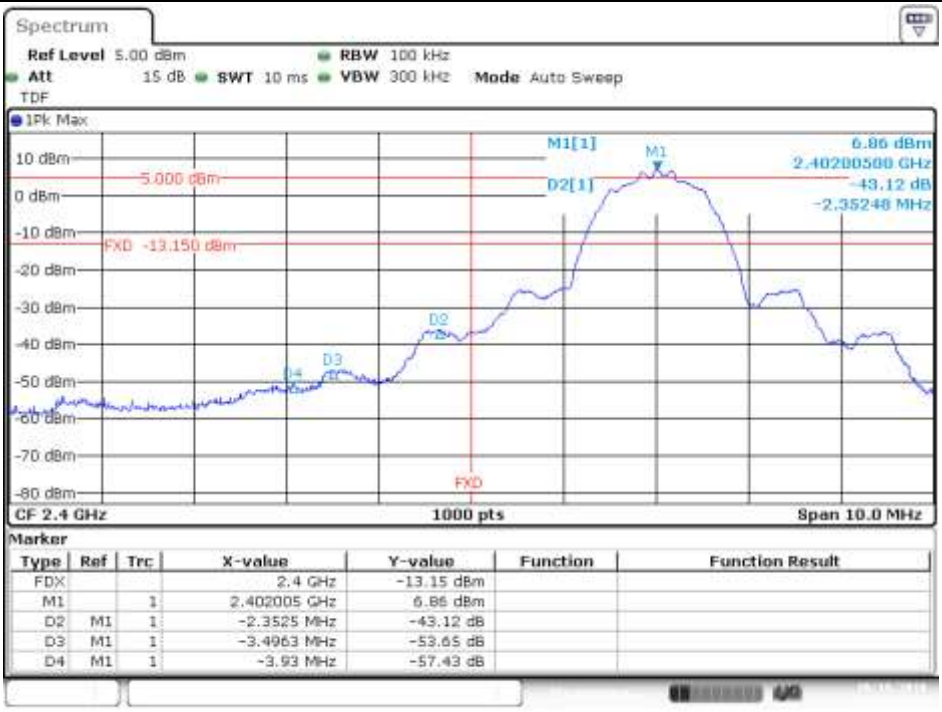


BE High Freq Section – Hopping

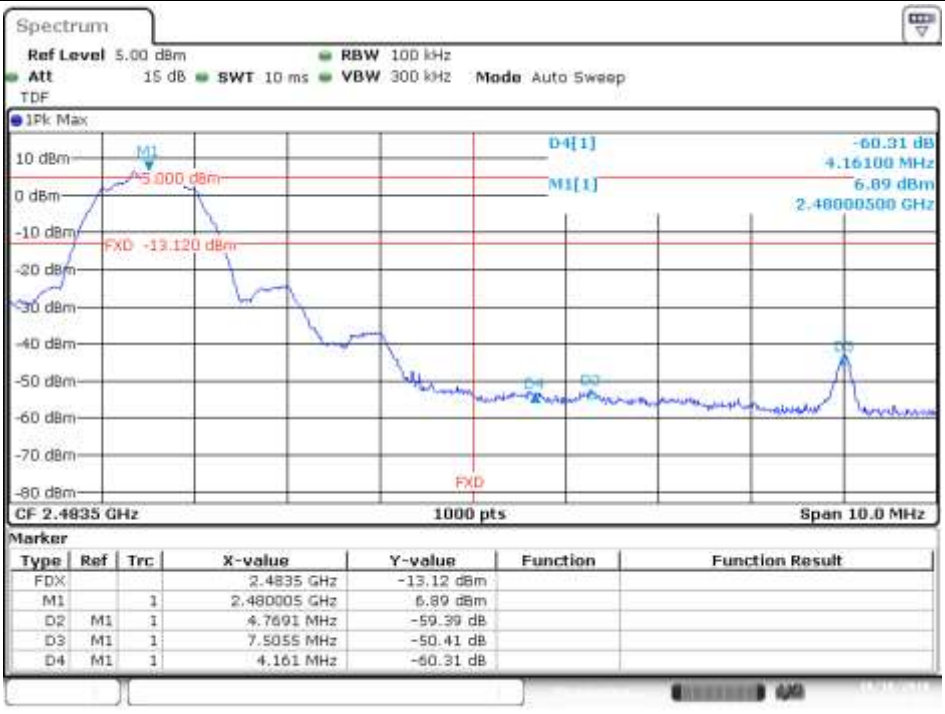


EDR – π/4-DQPSK

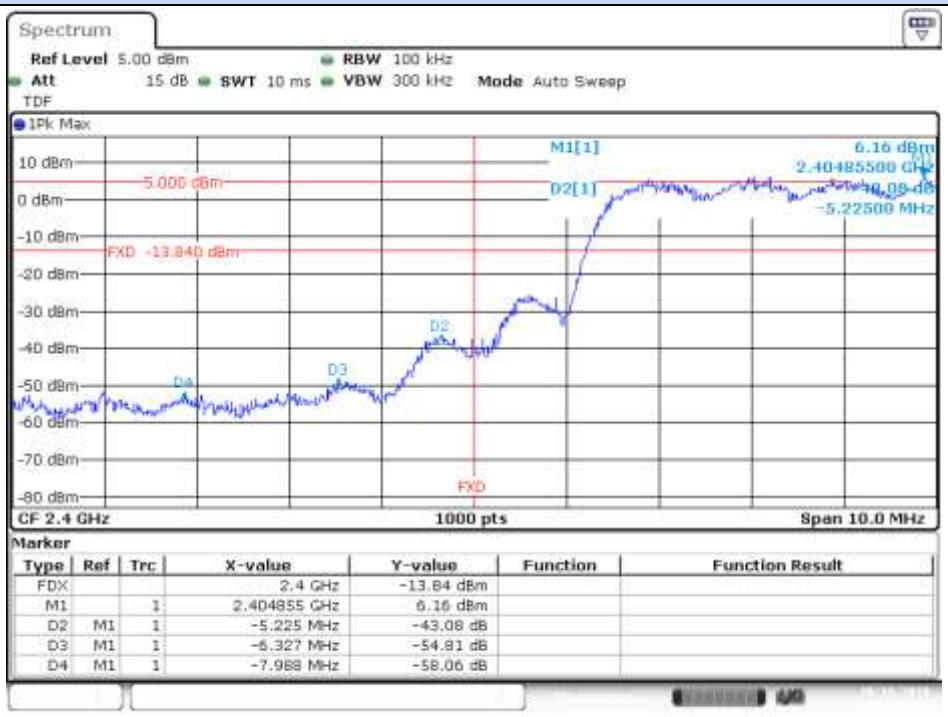
BE Low Freq Section – CH0



BE High Freq Section – CH78

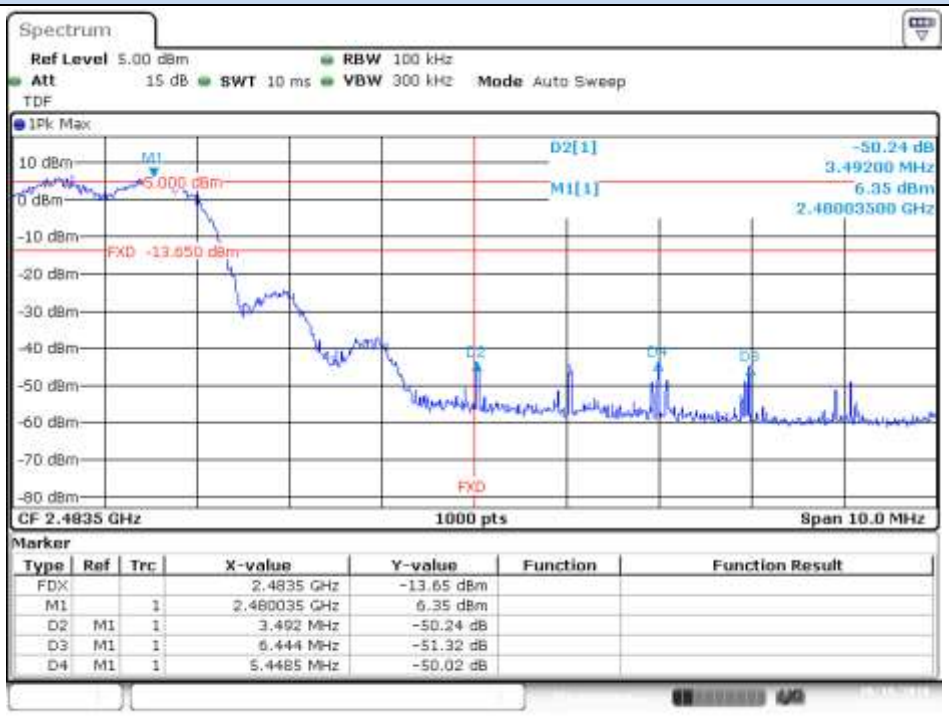


BE Low Freq Section – Hopping



Date: 18.OCT.2018 10:44:51

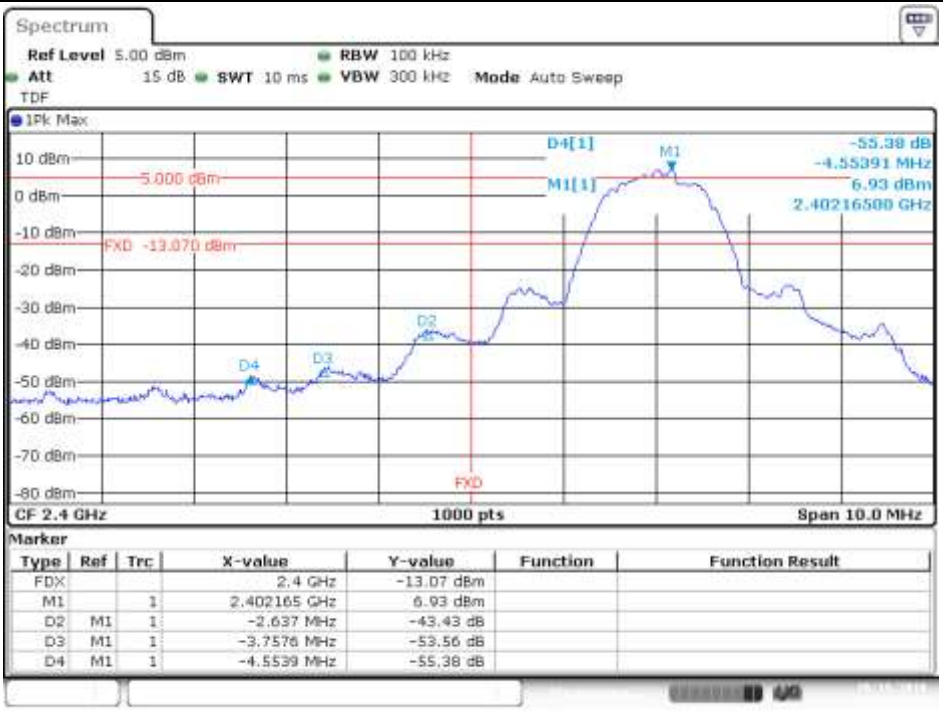
BE High Freq Section – Hopping



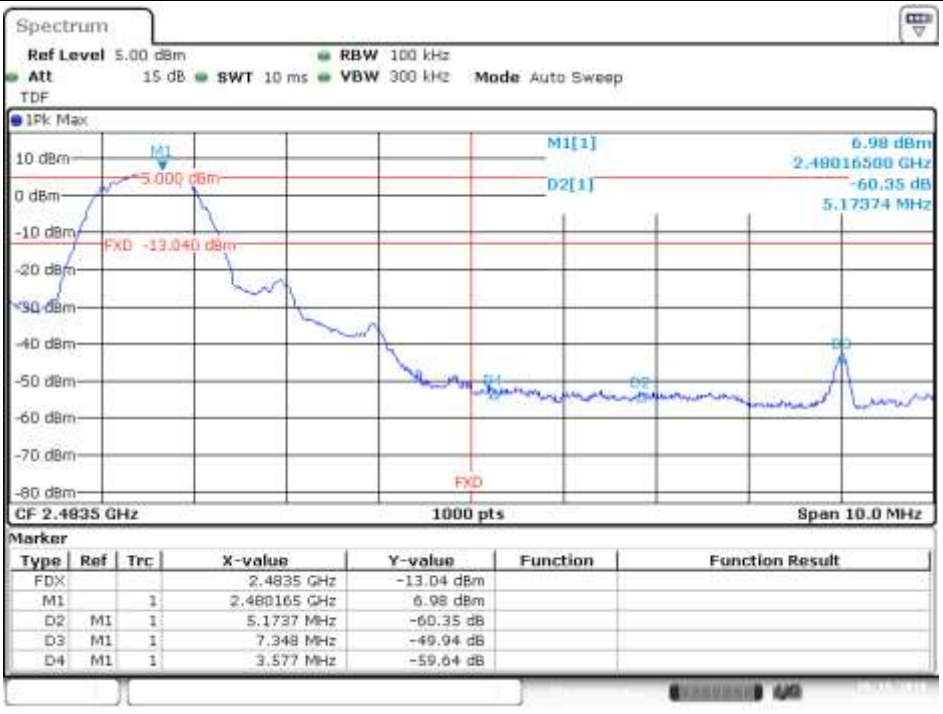
Date: 18.OCT.2018 10:45:58

EDR – 8-DPSK

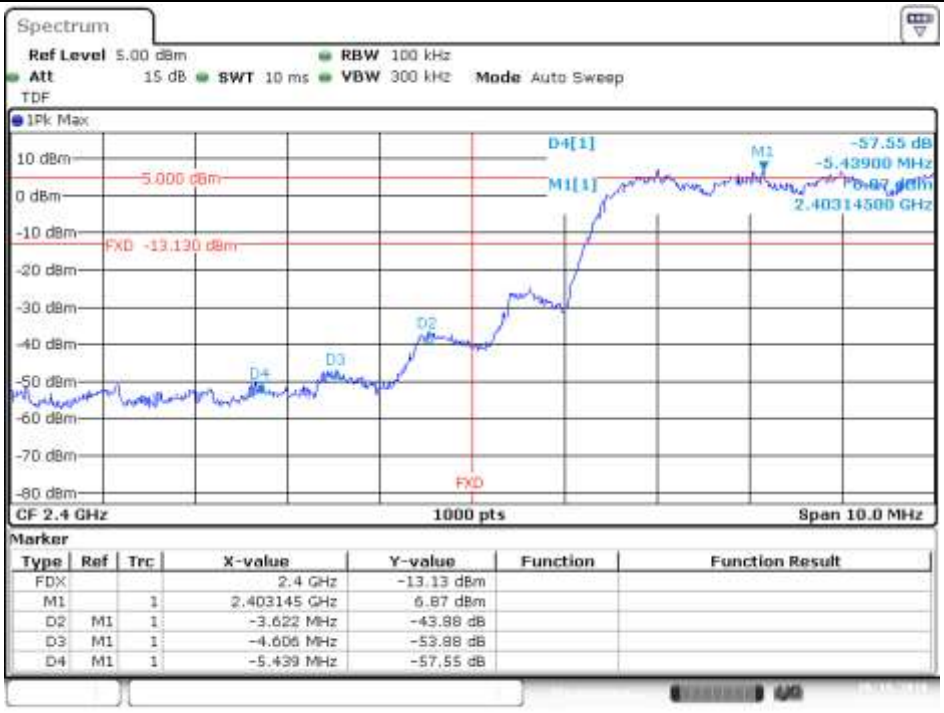
BE Low Freq Section – CH0



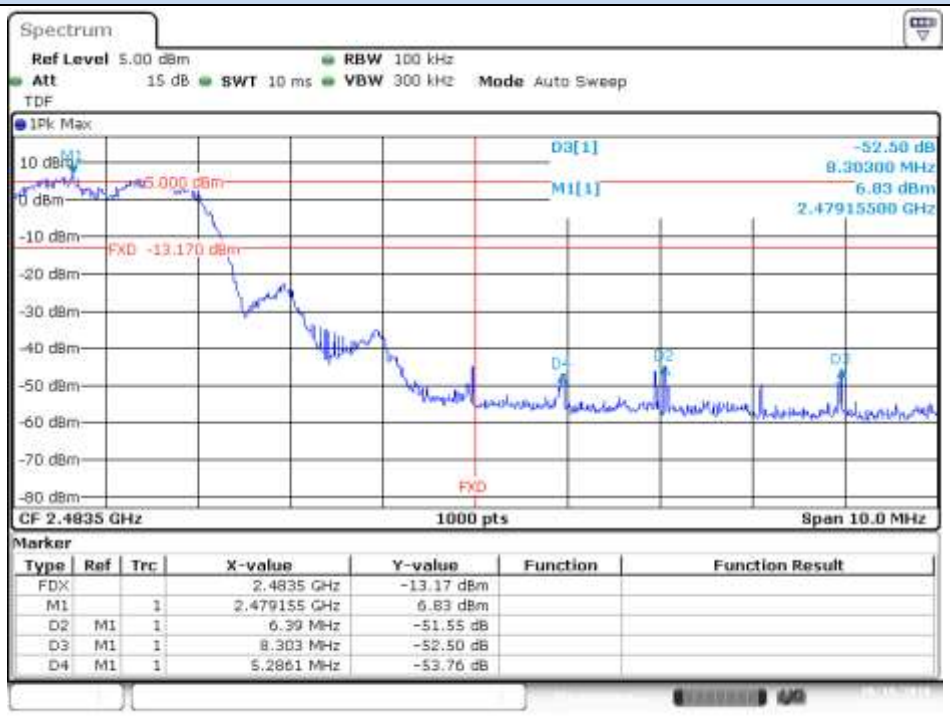
BE High Freq Section – CH78



BE Low Freq Section – Hopping



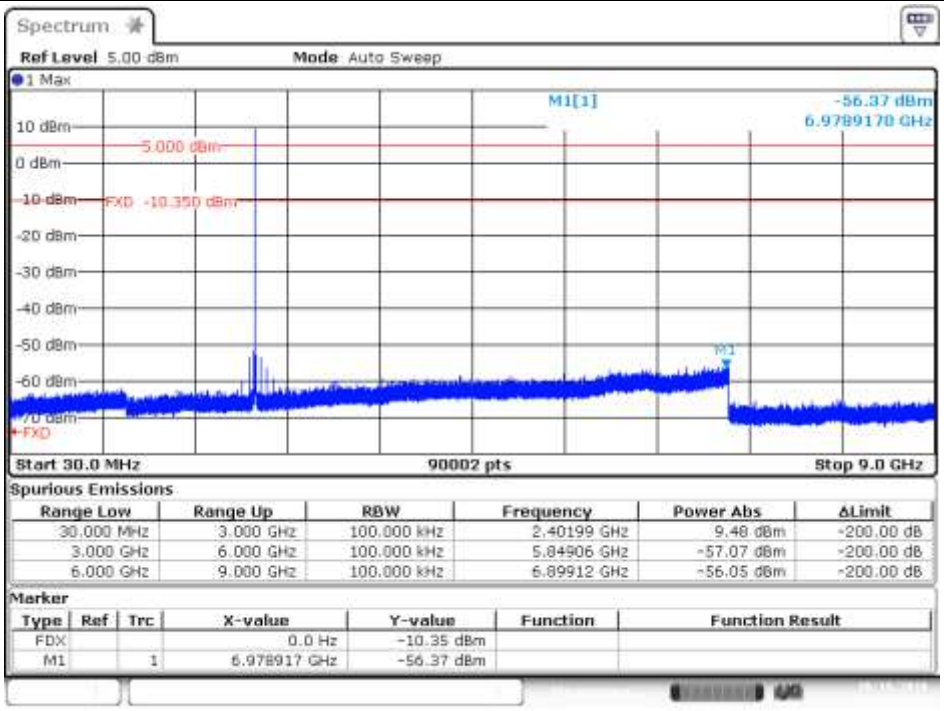
BE High Freq Section – Hopping



Conducted Spurious results Screenshot

Basic Rate - GFSK

Cond Spur – CH0 (30MHz - 9GHz)



Spurious Emissions

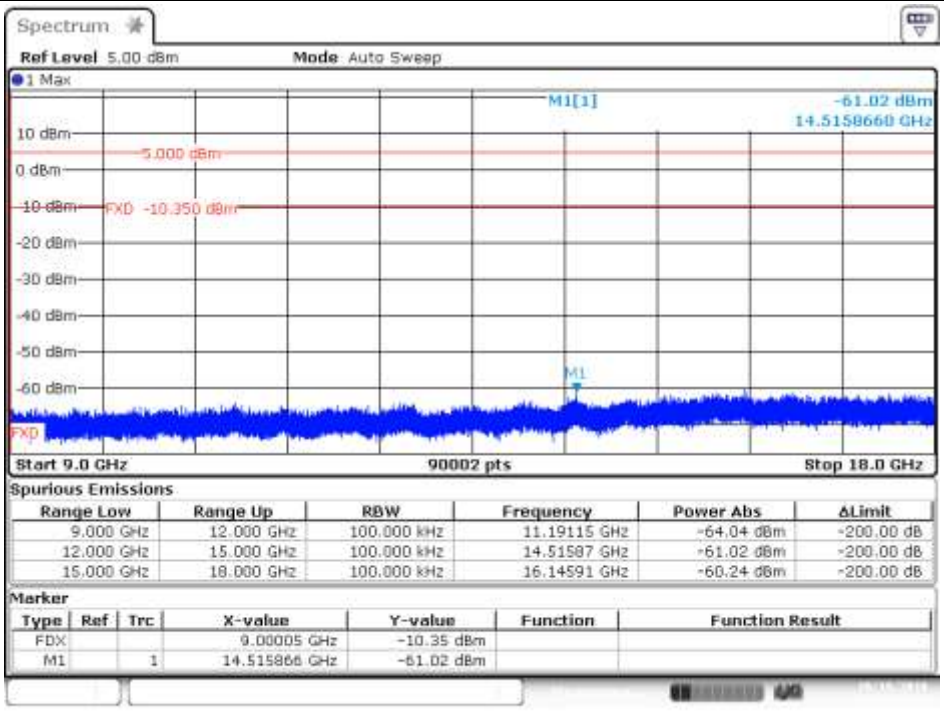
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
30.000 MHz	3.000 GHz	100.000 kHz	2.40199 GHz	9.48 dBm	-200.00 dB
3.000 GHz	6.000 GHz	100.000 kHz	5.84906 GHz	-57.07 dBm	-200.00 dB
6.000 GHz	9.000 GHz	100.000 kHz	6.89912 GHz	-56.05 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-10.35 dBm		
M1		1	6.978917 GHz	-56.37 dBm		

Date: 18.OCT.2018 09:32:28

Cond Spur – CH0 (9GHz - 18GHz)



Spurious Emissions

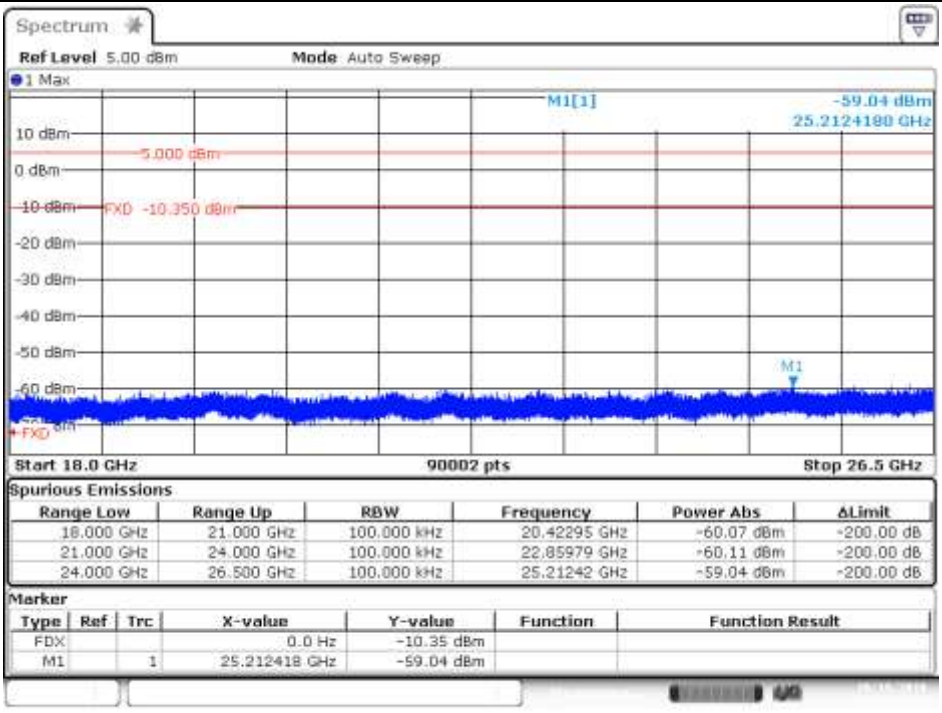
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
9.000 GHz	12.000 GHz	100.000 kHz	11.19115 GHz	-64.04 dBm	-200.00 dB
12.000 GHz	15.000 GHz	100.000 kHz	14.51587 GHz	-61.02 dBm	-200.00 dB
15.000 GHz	18.000 GHz	100.000 kHz	16.14591 GHz	-60.24 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			9.00005 GHz	-10.35 dBm		
M1		1	14.515866 GHz	-61.02 dBm		

Date: 18.OCT.2018 09:33:35

Cond Spur – CH0 (18GHz – 26.5GHz)



Spurious Emissions

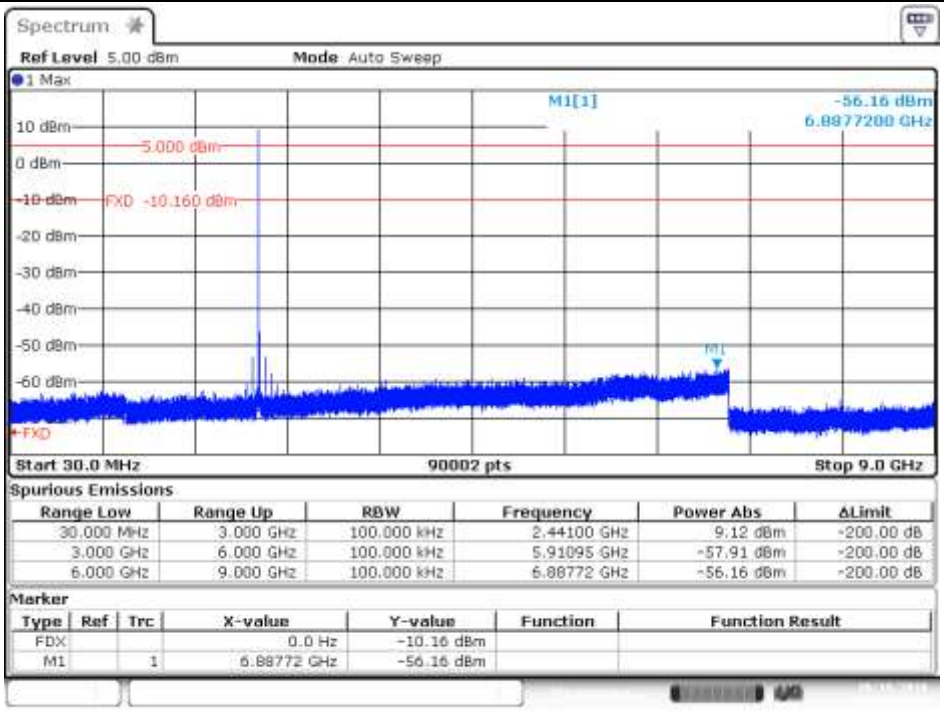
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
18.000 GHz	21.000 GHz	100.000 kHz	20.42295 GHz	-60.07 dBm	-200.00 dB
21.000 GHz	24.000 GHz	100.000 kHz	22.85979 GHz	-60.11 dBm	-200.00 dB
24.000 GHz	26.500 GHz	100.000 kHz	25.21242 GHz	-59.04 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-10.35 dBm		
M1		1	25.212418 GHz	-59.04 dBm		

Date: 18.OCT.2018 09:34:05

Cond Spur – CH39 (30MHz - 9GHz)



Spurious Emissions

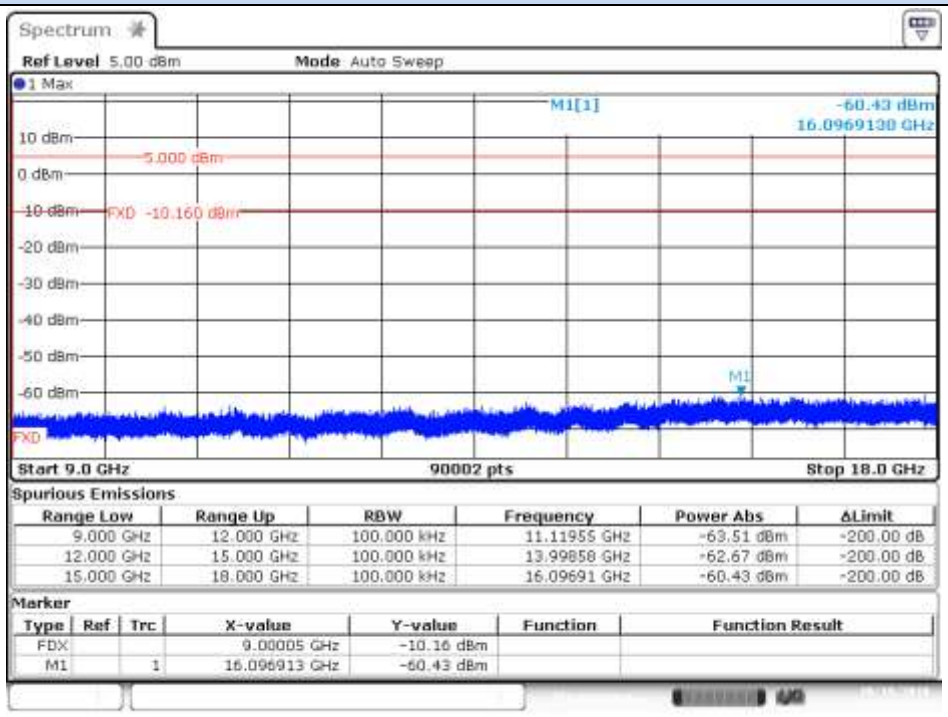
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
30.000 MHz	3.000 GHz	100.000 kHz	2.44100 GHz	9.12 dBm	-200.00 dB
3.000 GHz	6.000 GHz	100.000 kHz	5.91095 GHz	-57.91 dBm	-200.00 dB
6.000 GHz	9.000 GHz	100.000 kHz	6.88772 GHz	-56.16 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-10.16 dBm		
M1		1	6.88772 GHz	-56.16 dBm		

Date: 18.OCT.2018 09:40:52

Cond Spur – CH39 (9GHz - 18GHz)



Spurious Emissions

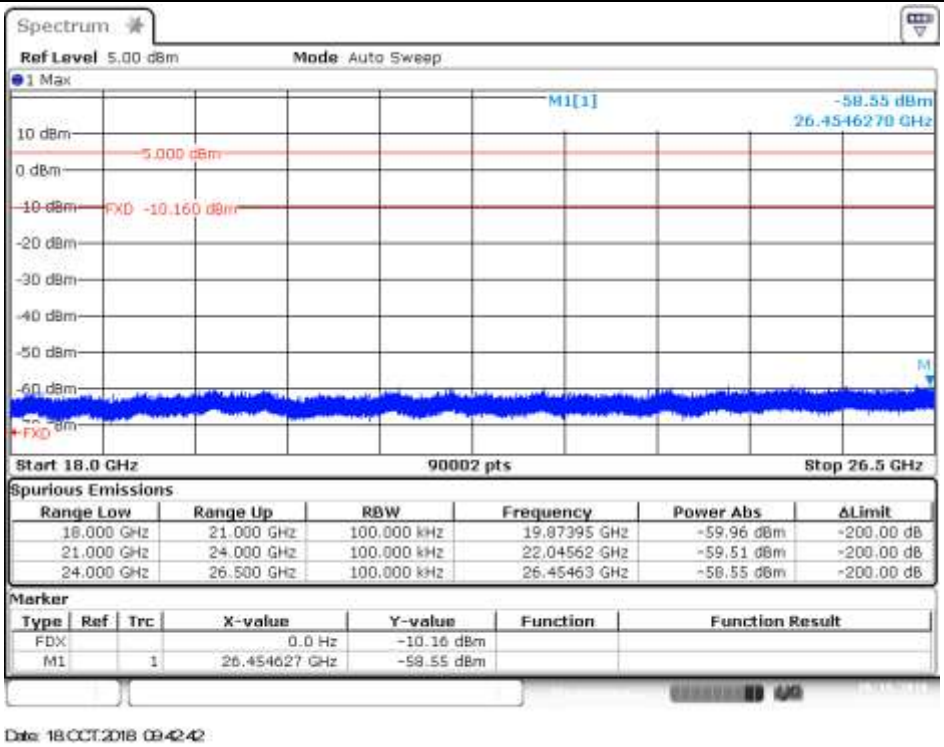
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
9.000 GHz	12.000 GHz	100.000 kHz	11.11955 GHz	-63.51 dBm	-200.00 dB
12.000 GHz	15.000 GHz	100.000 kHz	13.99858 GHz	-62.67 dBm	-200.00 dB
15.000 GHz	18.000 GHz	100.000 kHz	16.09691 GHz	-60.43 dBm	-200.00 dB

Marker

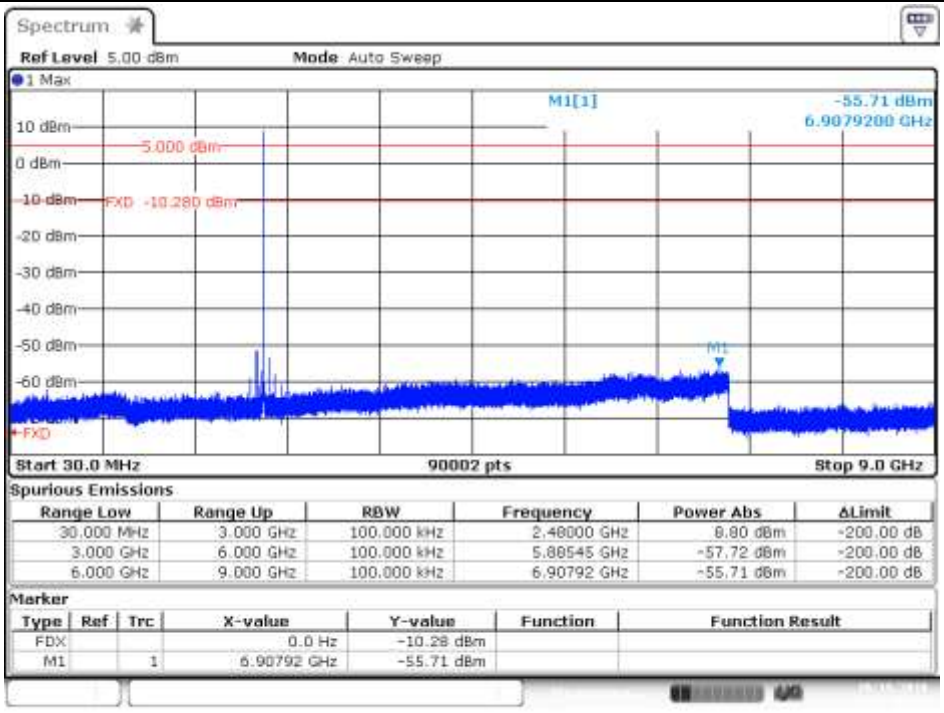
Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			9.00005 GHz	-10.16 dBm		
M1		1	16.096913 GHz	-60.43 dBm		

Date: 18.OCT.2018 09:41:51

Cond Spur – CH39 (18GHz – 26.5GHz)



Cond Spur – CH78 (30MHz - 9GHz)



Spurious Emissions

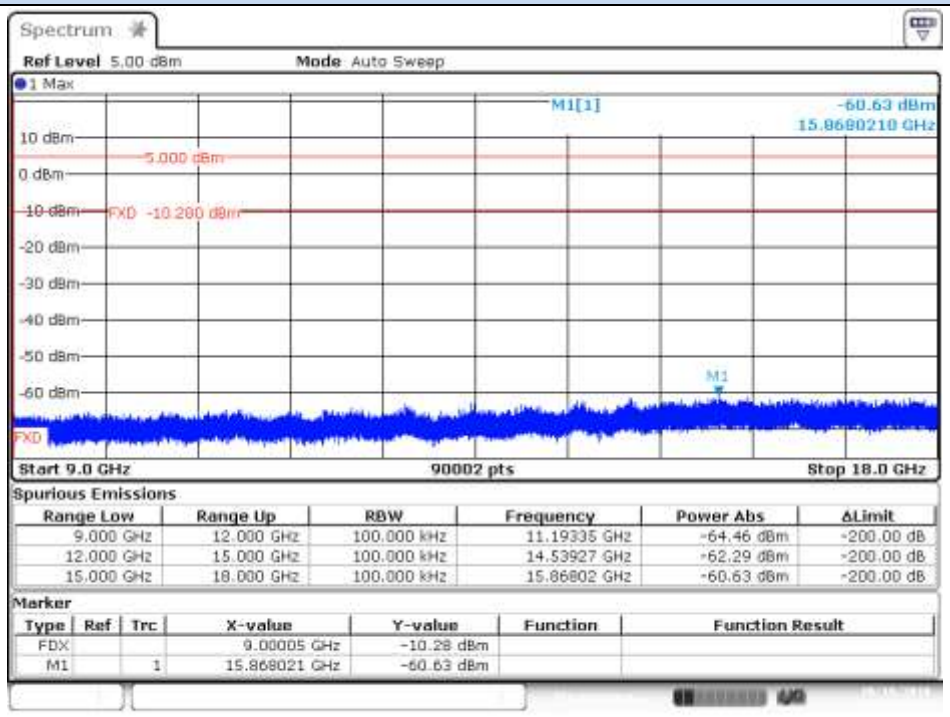
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
30.000 MHz	3.000 GHz	100.000 kHz	2.48000 GHz	8.80 dBm	-200.00 dB
3.000 GHz	6.000 GHz	100.000 kHz	5.80545 GHz	-57.72 dBm	-200.00 dB
6.000 GHz	9.000 GHz	100.000 kHz	6.90792 GHz	-55.71 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-10.28 dBm		
M1		1	6.90792 GHz	-55.71 dBm		

Date: 18.OCT.2018 09:50:47

Cond Spur – CH78 (9GHz - 18GHz)



Spurious Emissions

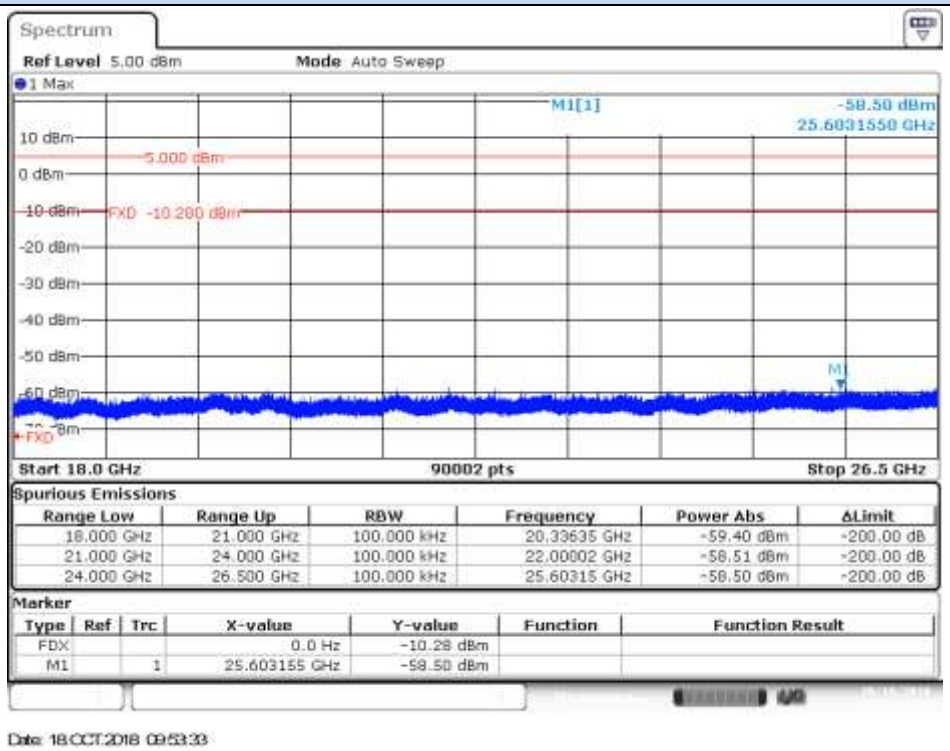
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
9.000 GHz	12.000 GHz	100.000 kHz	11.19335 GHz	-64.46 dBm	-200.00 dB
12.000 GHz	15.000 GHz	100.000 kHz	14.53927 GHz	-62.29 dBm	-200.00 dB
15.000 GHz	18.000 GHz	100.000 kHz	15.86802 GHz	-60.63 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			9.00005 GHz	-10.28 dBm		
M1		1	15.868021 GHz	-60.63 dBm		

Date: 18.OCT.2018 09:51:18

Cond Spur – CH78 (18GHz – 26.5GHz)



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
18.000 GHz	21.000 GHz	100.000 kHz	20.33635 GHz	-59.40 dBm	-200.00 dB
21.000 GHz	24.000 GHz	100.000 kHz	22.00002 GHz	-58.51 dBm	-200.00 dB
24.000 GHz	26.500 GHz	100.000 kHz	25.60315 GHz	-58.50 dBm	-200.00 dB

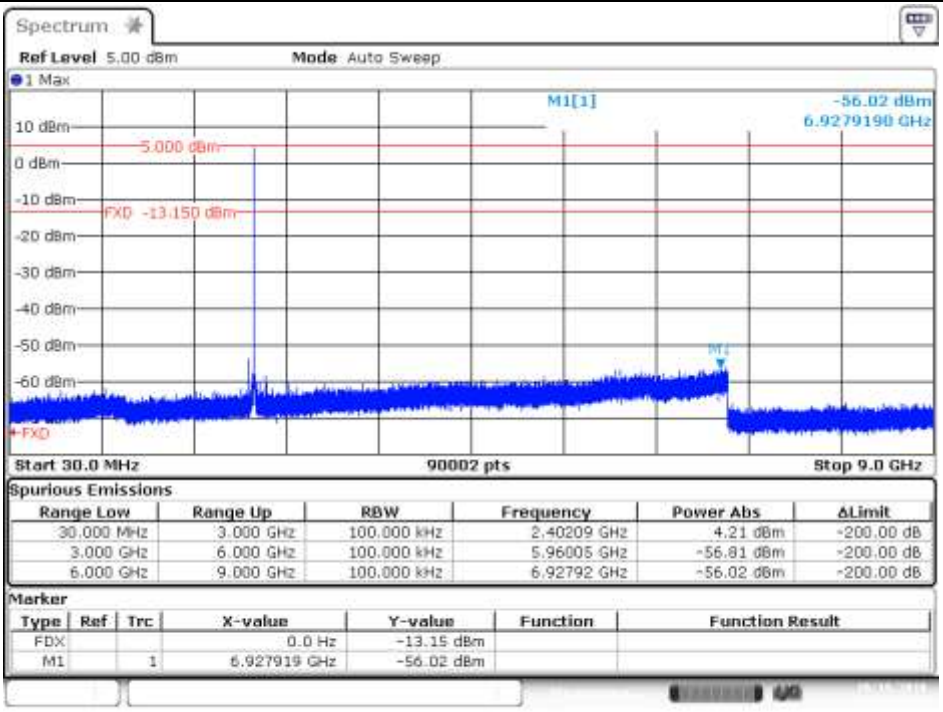
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-10.28 dBm		
M1		1	25.603155 GHz	-58.50 dBm		

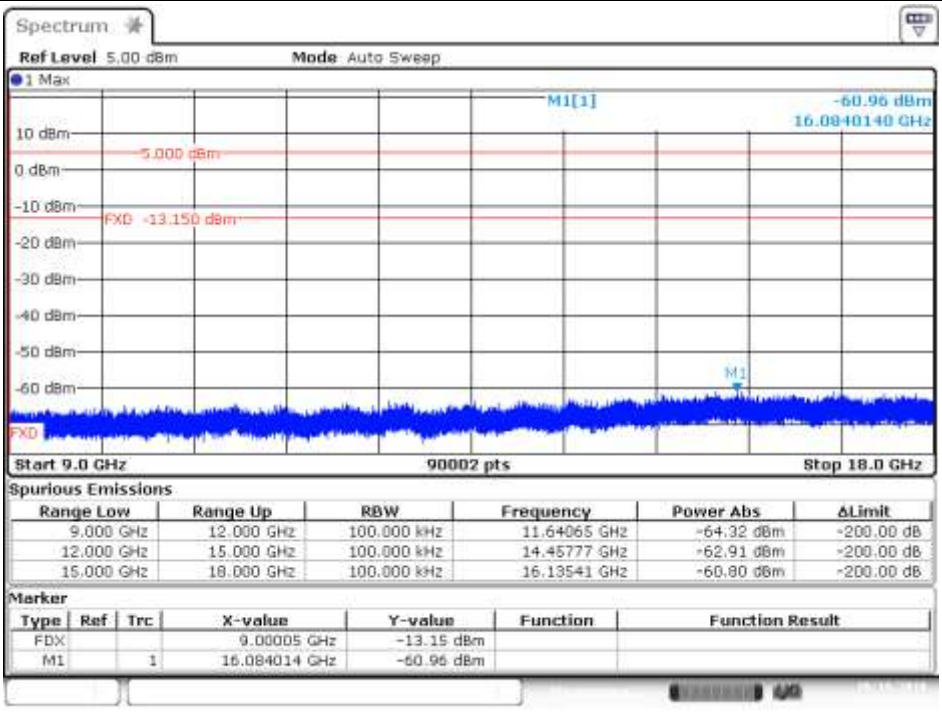
Date: 18.OCT.2018 09:53:33

EDR – π/4-DQPSK

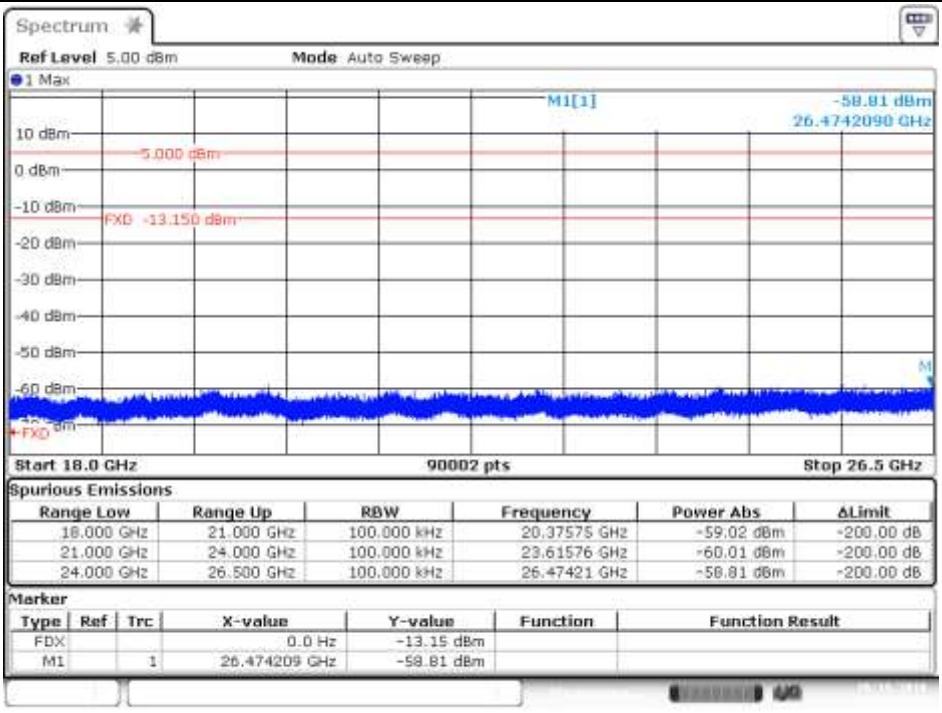
Cond Spur – CH0 (30MHz - 9GHz)



Cond Spur – CH0 (9GHz - 18GHz)



Cond Spur – CH0 (18GHz – 26.5GHz)



Spurious Emissions

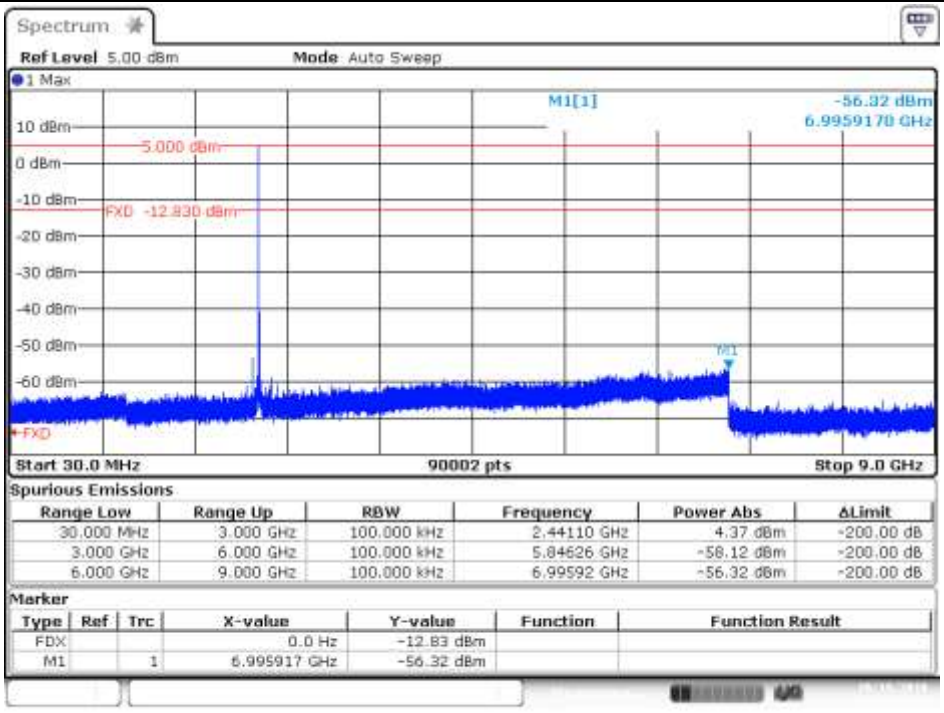
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
18.000 GHz	21.000 GHz	100.000 kHz	20.37575 GHz	-59.02 dBm	-200.00 dB
21.000 GHz	24.000 GHz	100.000 kHz	23.61576 GHz	-60.01 dBm	-200.00 dB
24.000 GHz	26.500 GHz	100.000 kHz	26.47421 GHz	-58.81 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-13.15 dBm		
M1		1	26.474209 GHz	-58.81 dBm		

Date: 18.OCT.2018 10:24:56

Cond Spur – CH39 (30MHz - 9GHz)



Spurious Emissions

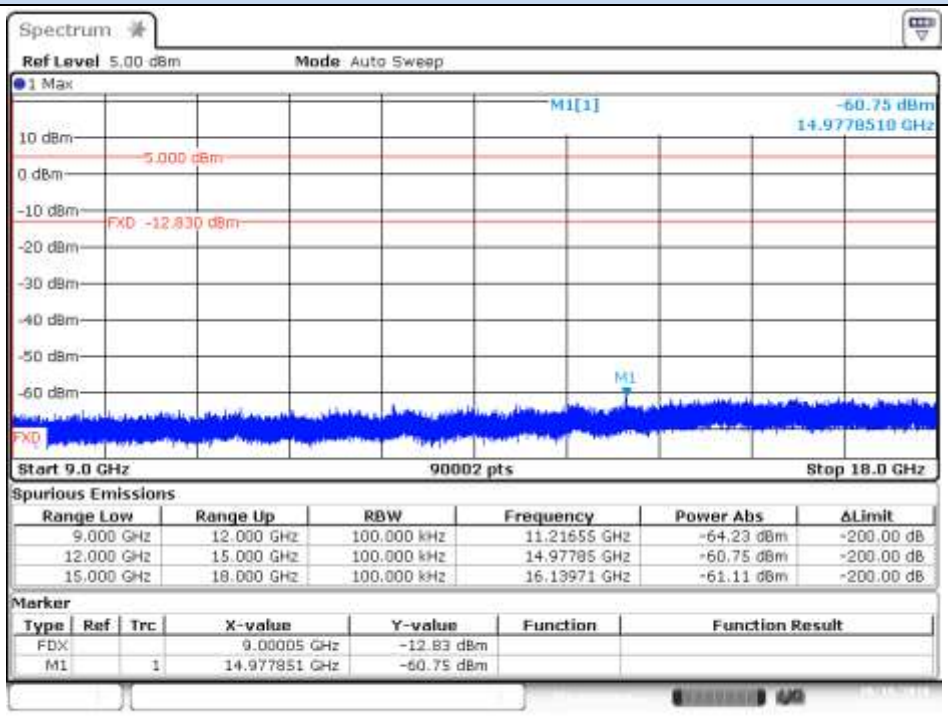
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
30.000 MHz	3.000 GHz	100.000 kHz	2.44110 GHz	4.37 dBm	-200.00 dB
3.000 GHz	6.000 GHz	100.000 kHz	5.84626 GHz	-58.12 dBm	-200.00 dB
6.000 GHz	9.000 GHz	100.000 kHz	6.99592 GHz	-56.32 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-12.83 dBm		
M1		1	6.995917 GHz	-56.32 dBm		

Date: 18.OCT.2018 10:37:13

Cond Spur – CH39 (9GHz - 18GHz)



Spurious Emissions

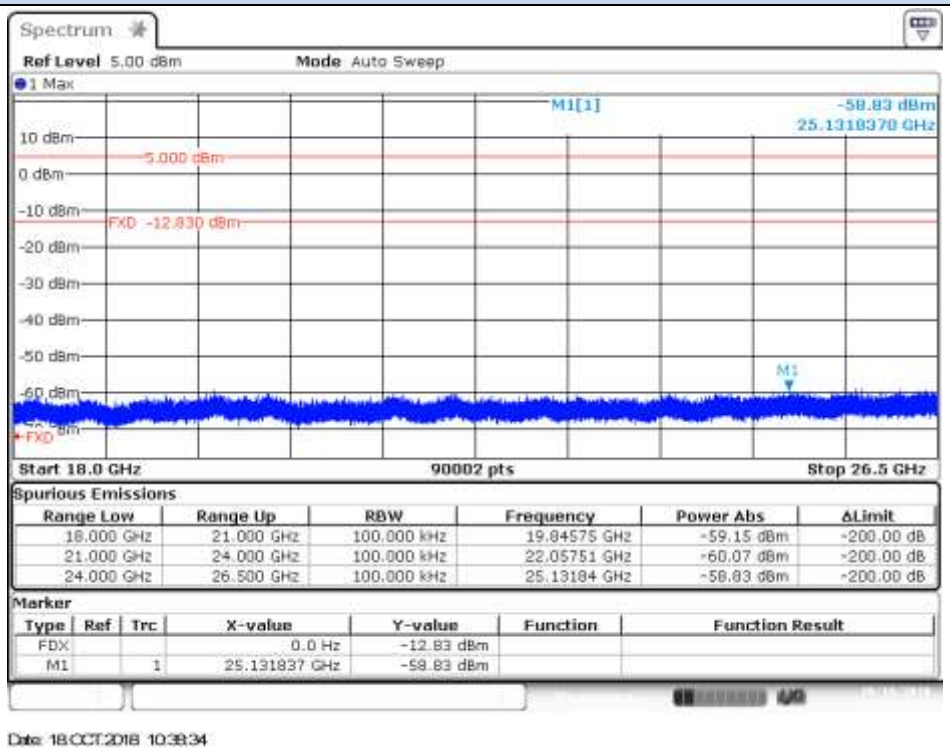
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
9.000 GHz	12.000 GHz	100.000 kHz	11.21655 GHz	-64.23 dBm	-200.00 dB
12.000 GHz	15.000 GHz	100.000 kHz	14.97785 GHz	-60.75 dBm	-200.00 dB
15.000 GHz	18.000 GHz	100.000 kHz	16.13971 GHz	-61.11 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			9.00005 GHz	-12.83 dBm		
M1		1	14.977851 GHz	-60.75 dBm		

Date: 18.OCT.2018 10:37:54

Cond Spur – CH39 (18GHz – 26.5GHz)



Spurious Emissions

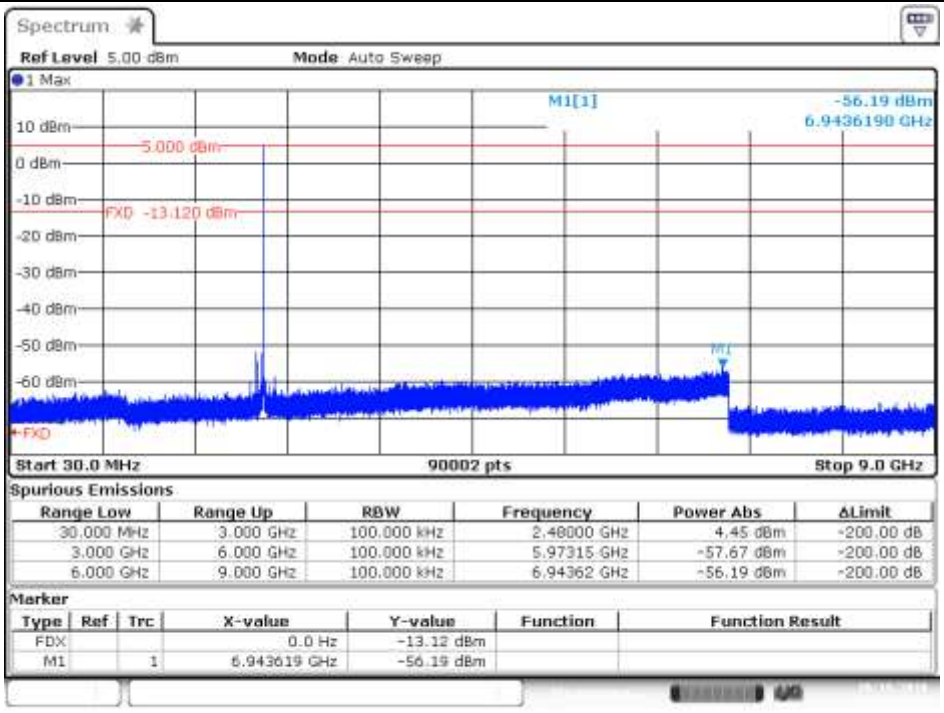
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
18.000 GHz	21.000 GHz	100.000 kHz	19.84575 GHz	-59.15 dBm	-200.00 dB
21.000 GHz	24.000 GHz	100.000 kHz	22.05751 GHz	-60.07 dBm	-200.00 dB
24.000 GHz	26.500 GHz	100.000 kHz	25.13184 GHz	-58.83 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-12.83 dBm		
M1		1	25.131837 GHz	-58.83 dBm		

Date: 18.OCT.2018 10:38:34

Cond Spur – CH78 (30MHz - 9GHz)



Spurious Emissions

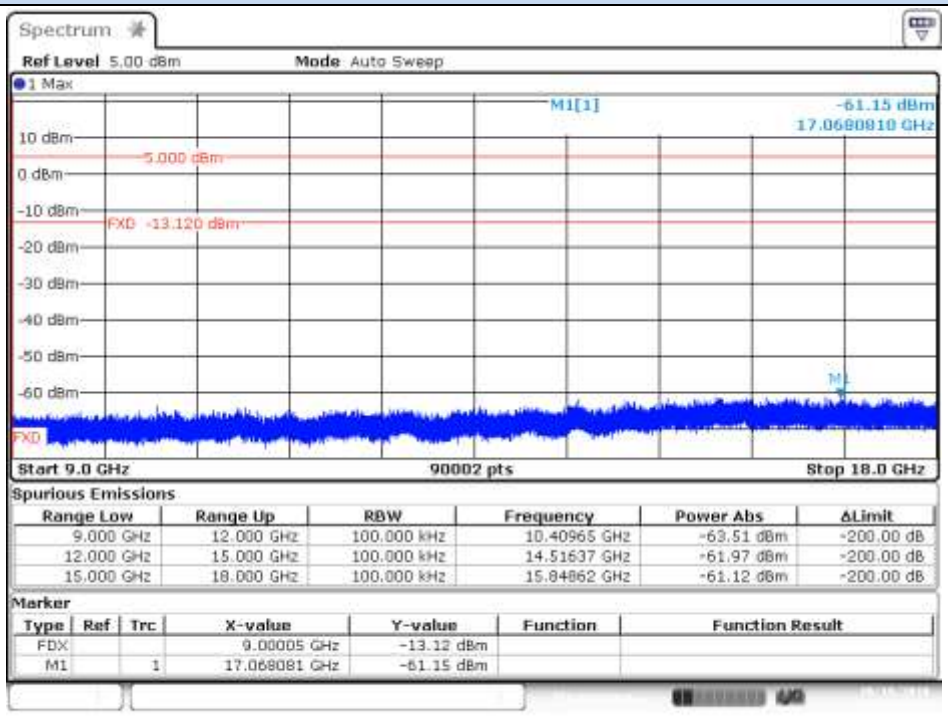
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
30.000 MHz	3.000 GHz	100.000 kHz	2.48000 GHz	4.45 dBm	-200.00 dB
3.000 GHz	6.000 GHz	100.000 kHz	5.97315 GHz	-57.67 dBm	-200.00 dB
6.000 GHz	9.000 GHz	100.000 kHz	6.94362 GHz	-56.19 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-13.12 dBm		
M1		1	6.943619 GHz	-56.19 dBm		

Date: 18.OCT.2018 10:42:55

Cond Spur – CH78 (9GHz - 18GHz)



Spurious Emissions

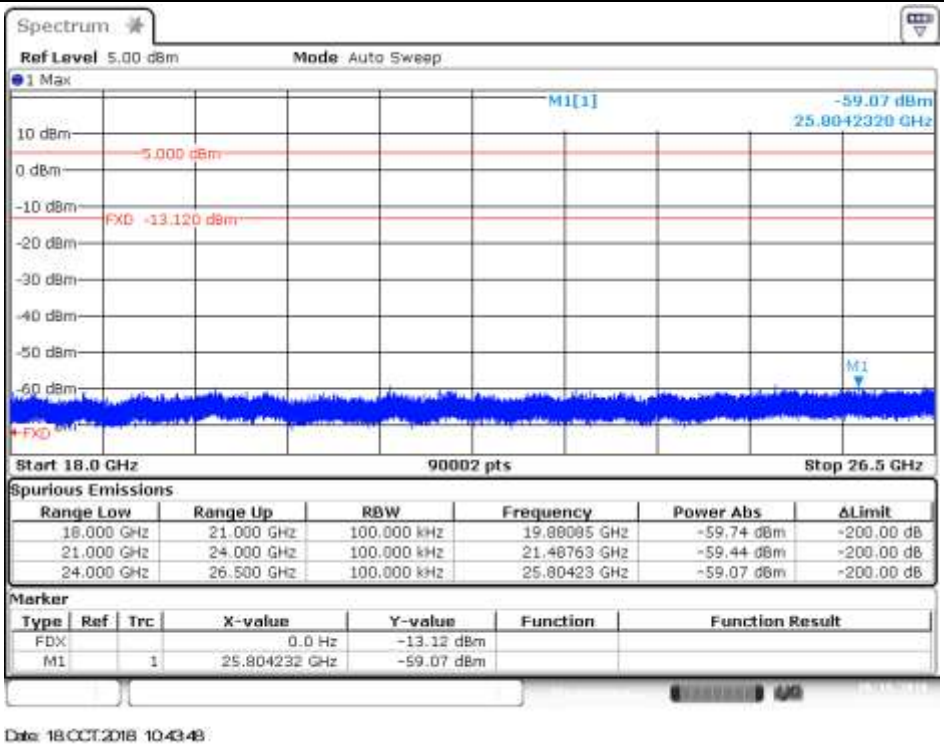
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
9.000 GHz	12.000 GHz	100.000 kHz	10.40965 GHz	-63.51 dBm	-200.00 dB
12.000 GHz	15.000 GHz	100.000 kHz	14.51637 GHz	-61.97 dBm	-200.00 dB
15.000 GHz	18.000 GHz	100.000 kHz	15.84862 GHz	-61.12 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			9.00005 GHz	-13.12 dBm		
M1		1	17.068081 GHz	-61.15 dBm		

Date: 18.OCT.2018 10:43:28

Cond Spur – CH78 (18GHz – 26.5GHz)



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
18.000 GHz	21.000 GHz	100.000 kHz	19.88085 GHz	-59.74 dBm	-200.00 dB
21.000 GHz	24.000 GHz	100.000 kHz	21.48763 GHz	-59.44 dBm	-200.00 dB
24.000 GHz	26.500 GHz	100.000 kHz	25.80423 GHz	-59.07 dBm	-200.00 dB

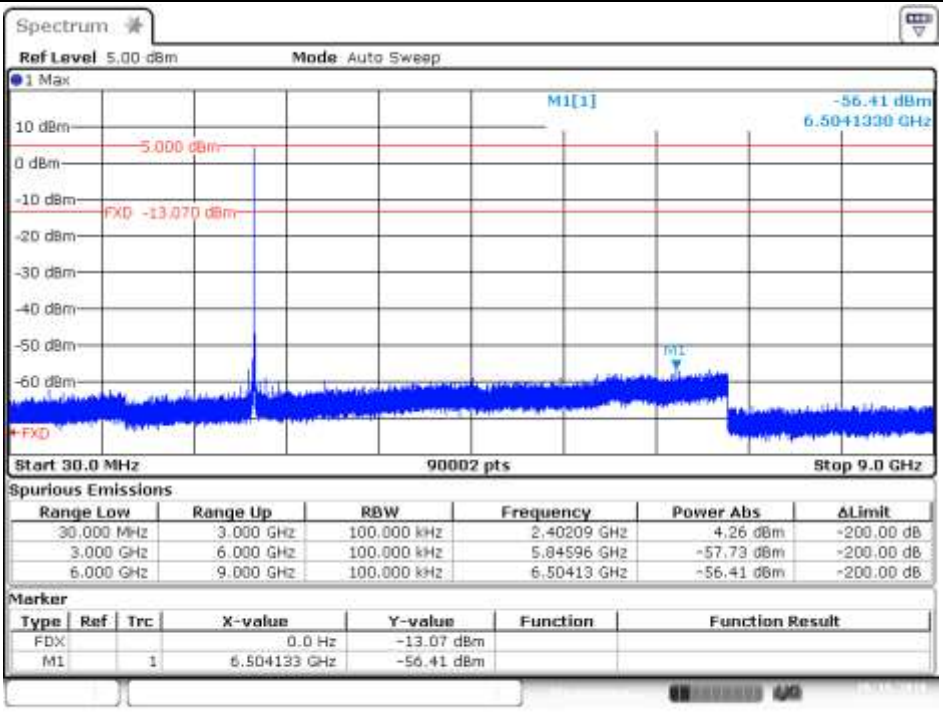
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-13.12 dBm		
M1		1	25.804232 GHz	-59.07 dBm		

Date: 18.OCT.2018 10:43:48

EDR – 8-DPSK

Cond Spur – CH0 (30MHz - 9GHz)



Spurious Emissions

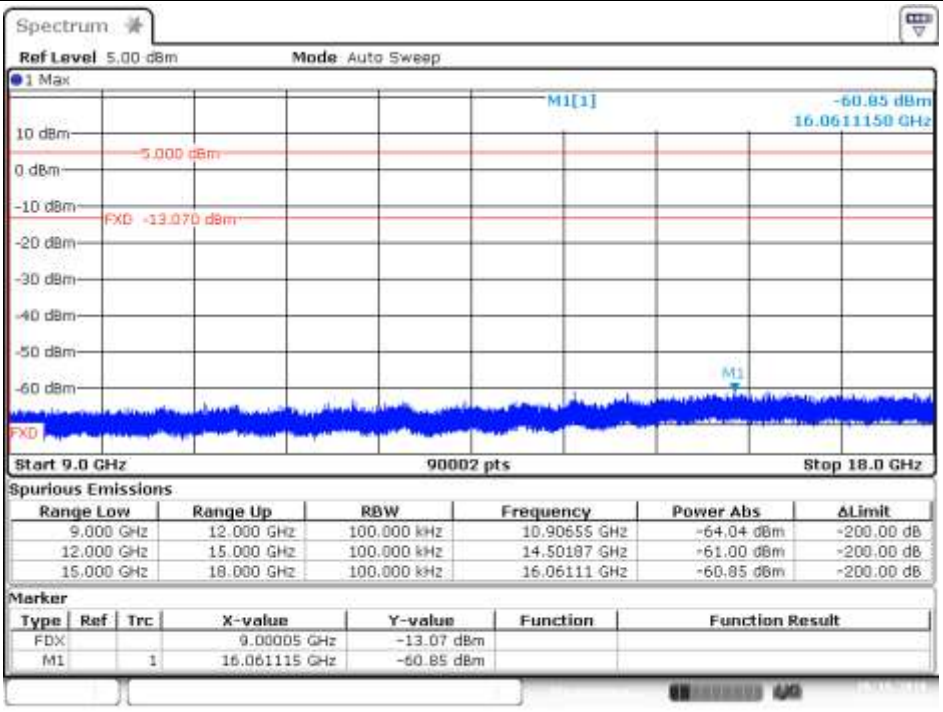
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
30.000 MHz	3.000 GHz	100.000 kHz	2.40209 GHz	4.26 dBm	-200.00 dB
3.000 GHz	6.000 GHz	100.000 kHz	5.84596 GHz	-57.73 dBm	-200.00 dB
6.000 GHz	9.000 GHz	100.000 kHz	6.50413 GHz	-56.41 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-13.07 dBm		
M1		1	6.504133 GHz	-56.41 dBm		

Date: 18.OCT.2018 10:55:32

Cond Spur – CH0 (9GHz - 18GHz)



Spurious Emissions

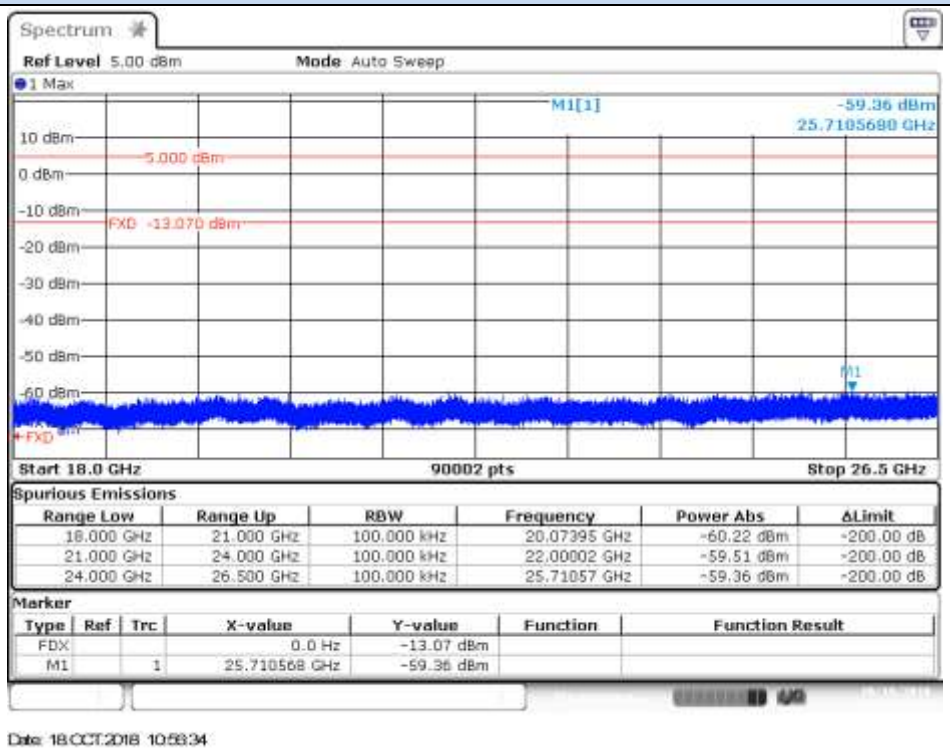
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
9.000 GHz	12.000 GHz	100.000 kHz	10.90655 GHz	-64.04 dBm	-200.00 dB
12.000 GHz	15.000 GHz	100.000 kHz	14.50187 GHz	-61.00 dBm	-200.00 dB
15.000 GHz	18.000 GHz	100.000 kHz	16.06111 GHz	-60.85 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			9.00005 GHz	-13.07 dBm		
M1		1	16.061115 GHz	-60.85 dBm		

Date: 18.OCT.2018 10:59:09

Cond Spur – CH0 (18GHz – 26.5GHz)



Spurious Emissions

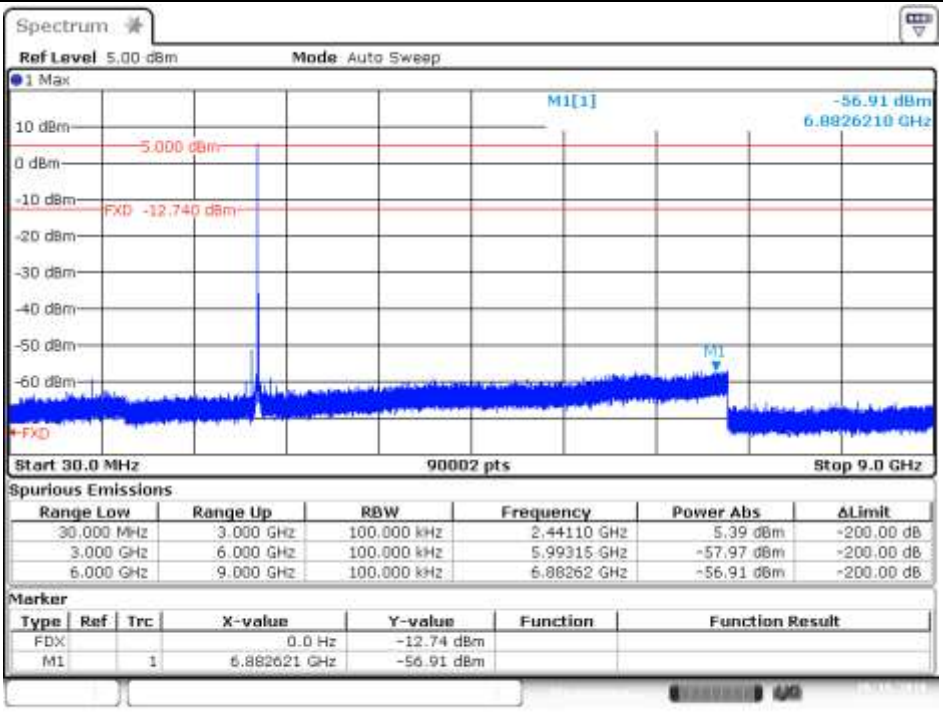
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
18.000 GHz	21.000 GHz	100.000 kHz	20.07395 GHz	-60.22 dBm	-200.00 dB
21.000 GHz	24.000 GHz	100.000 kHz	22.00002 GHz	-59.51 dBm	-200.00 dB
24.000 GHz	26.500 GHz	100.000 kHz	25.71057 GHz	-59.36 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-13.07 dBm		
M1		1	25.710568 GHz	-59.36 dBm		

Date: 18.OCT.2018 10:59:34

Cond Spur – CH39 (30MHz - 9GHz)



Spurious Emissions

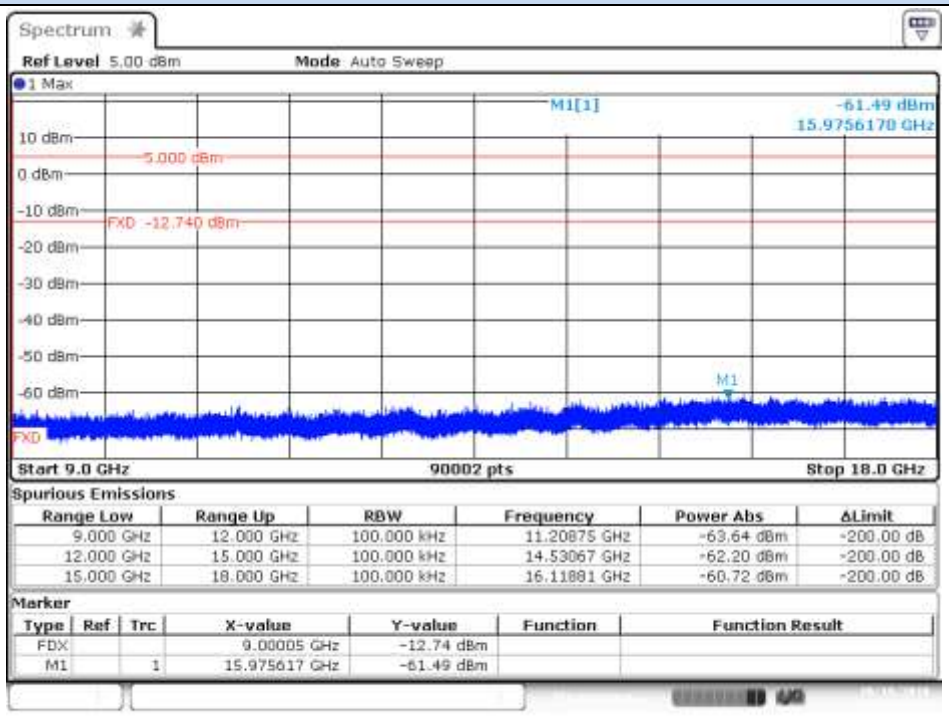
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
30.000 MHz	3.000 GHz	100.000 kHz	2.44110 GHz	5.39 dBm	-200.00 dB
3.000 GHz	6.000 GHz	100.000 kHz	5.99315 GHz	-57.97 dBm	-200.00 dB
6.000 GHz	9.000 GHz	100.000 kHz	6.88262 GHz	-56.91 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-12.74 dBm		
M1		1	6.882621 GHz	-56.91 dBm		

Date: 18.OCT.2018 11:03:10

Cond Spur – CH39 (9GHz - 18GHz)



Spurious Emissions

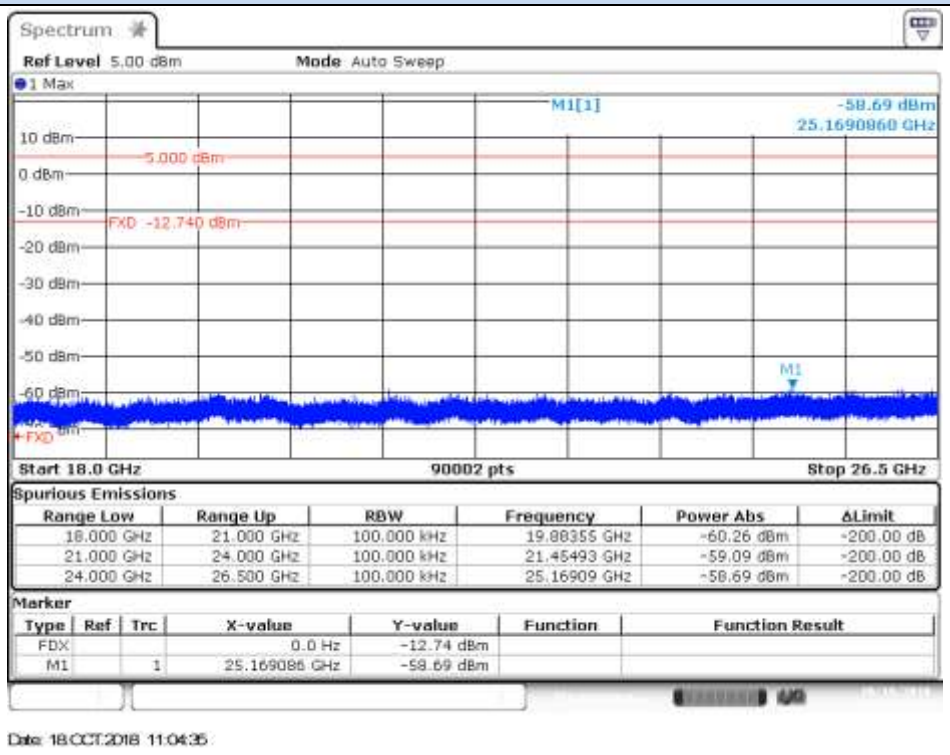
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
9.000 GHz	12.000 GHz	100.000 kHz	11.20875 GHz	-63.64 dBm	-200.00 dB
12.000 GHz	15.000 GHz	100.000 kHz	14.53067 GHz	-62.20 dBm	-200.00 dB
15.000 GHz	18.000 GHz	100.000 kHz	16.11881 GHz	-60.72 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			9.00005 GHz	-12.74 dBm		
M1		1	15.975617 GHz	-61.49 dBm		

Date: 18.OCT.2018 11:04:05

Cond Spur – CH39 (18GHz – 26.5GHz)



Spurious Emissions

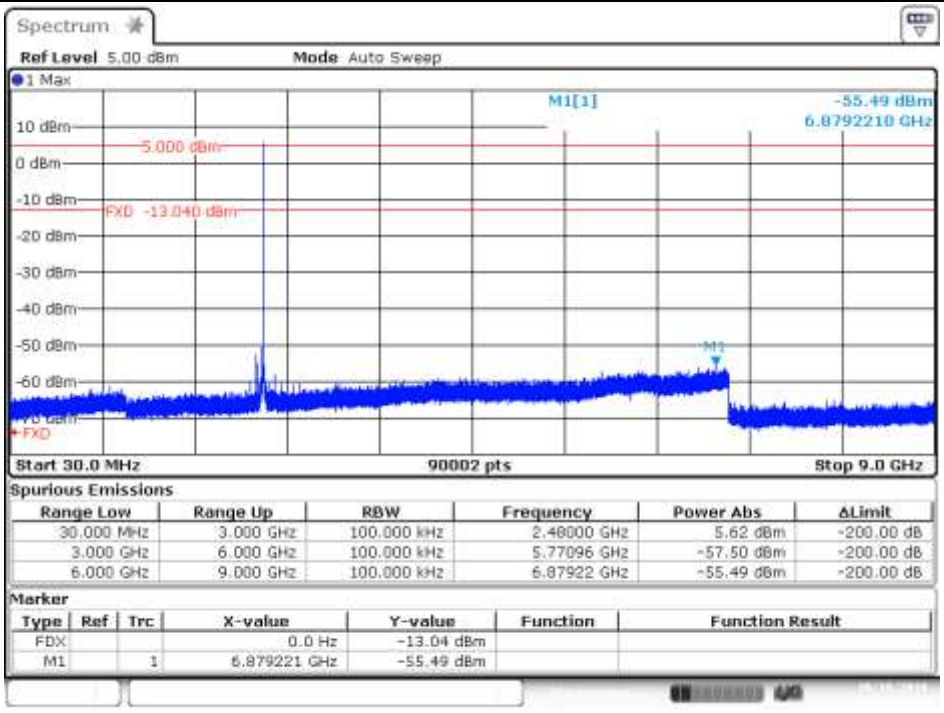
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
18.000 GHz	21.000 GHz	100.000 kHz	19.88355 GHz	-60.26 dBm	-200.00 dB
21.000 GHz	24.000 GHz	100.000 kHz	21.45493 GHz	-59.09 dBm	-200.00 dB
24.000 GHz	26.500 GHz	100.000 kHz	25.16909 GHz	-58.69 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-12.74 dBm		
M1		1	25.169086 GHz	-58.69 dBm		

Date: 18.OCT.2018 11:04:35

Cond Spur – CH78 (30MHz - 9GHz)



Spurious Emissions

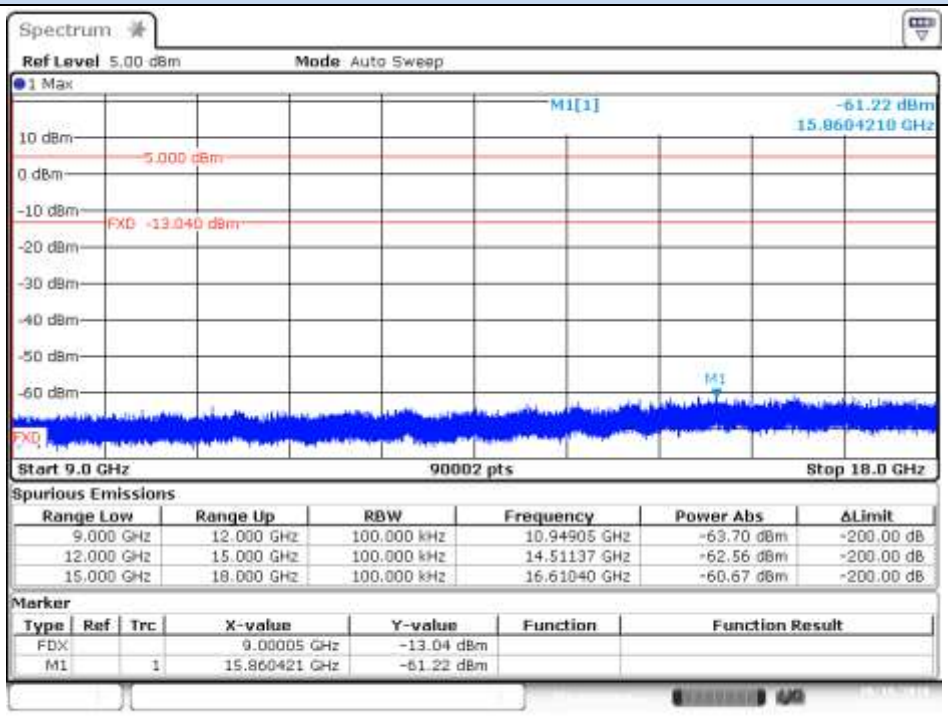
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
30.000 MHz	3.000 GHz	100.000 kHz	2.48000 GHz	5.62 dBm	-200.00 dB
3.000 GHz	6.000 GHz	100.000 kHz	5.77096 GHz	-57.50 dBm	-200.00 dB
6.000 GHz	9.000 GHz	100.000 kHz	6.87922 GHz	-55.49 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-13.04 dBm		
M1		1	6.879221 GHz	-55.49 dBm		

Date: 18.OCT.2018 11:10:06

Cond Spur – CH78 (9GHz - 18GHz)



Spurious Emissions

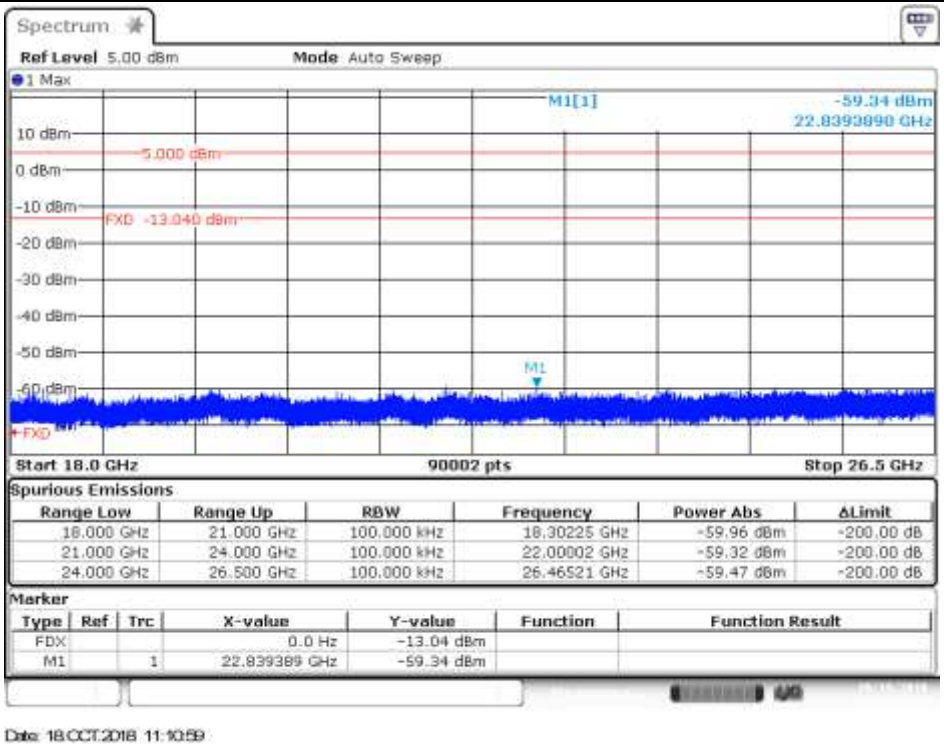
Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
9.000 GHz	12.000 GHz	100.000 kHz	10.94905 GHz	-63.70 dBm	-200.00 dB
12.000 GHz	15.000 GHz	100.000 kHz	14.51137 GHz	-62.56 dBm	-200.00 dB
15.000 GHz	18.000 GHz	100.000 kHz	16.61040 GHz	-60.67 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			9.00005 GHz	-13.04 dBm		
M1		1	15.860421 GHz	-61.22 dBm		

Date: 18.OCT.2018 11:10:39

Cond Spur – CH78 (18GHz – 26.5GHz)



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
18.000 GHz	21.000 GHz	100.000 kHz	18.30225 GHz	-59.96 dBm	-200.00 dB
21.000 GHz	24.000 GHz	100.000 kHz	22.00002 GHz	-59.32 dBm	-200.00 dB
24.000 GHz	26.500 GHz	100.000 kHz	26.46521 GHz	-59.47 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
FDX			0.0 Hz	-13.04 dBm		
M1		1	22.839389 GHz	-59.34 dBm		

Date: 18.OCT.2018 11:10:59

B.6 Radiated spurious emission

Standards references

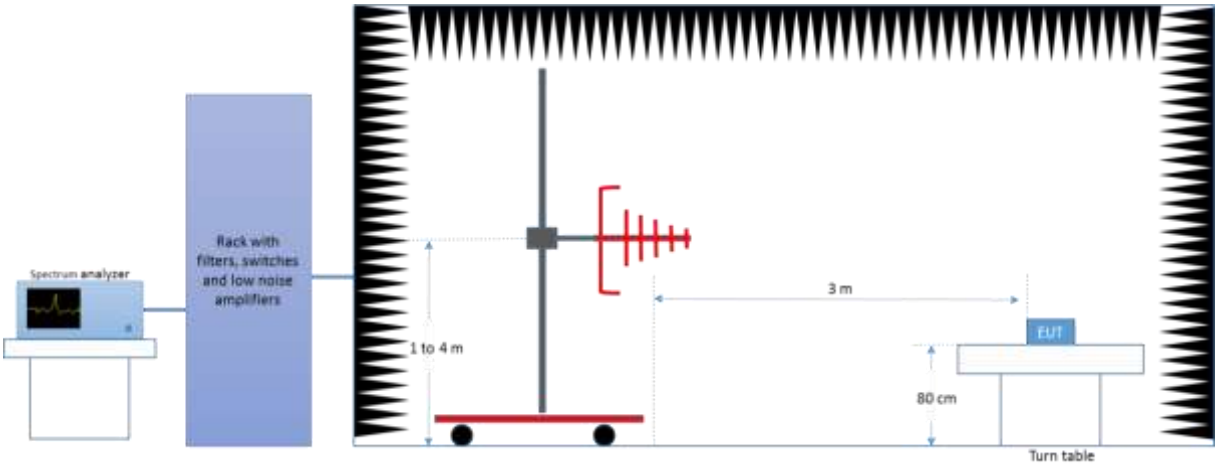
<table>
<tr><th>FCC part</th><th>RSS part</th><th>Limits</th></tr>
<tr><td>15.247 (d)
15.209 (a)</td><td>RSS-247
Clause 5.5

RSS GEN
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>

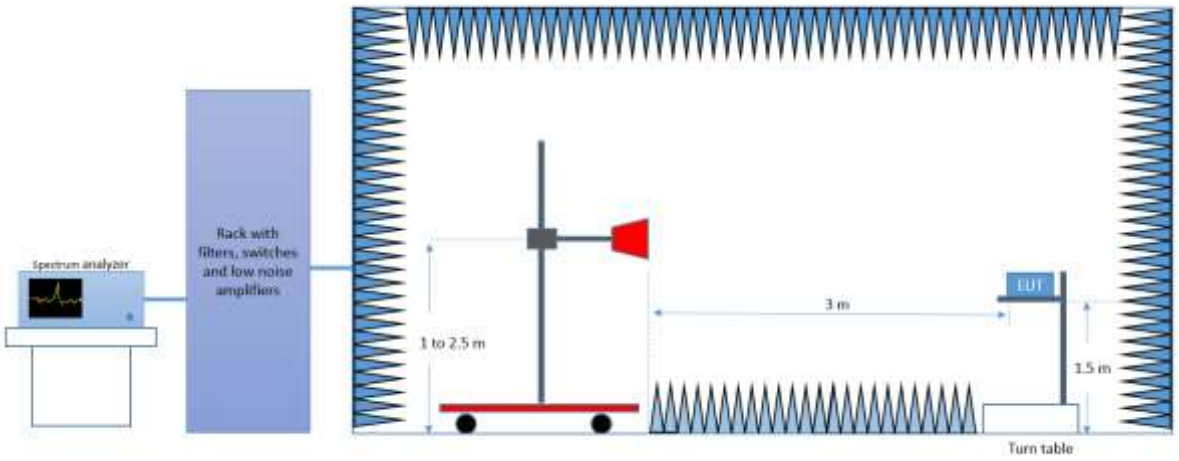
Test procedure:

The setups below were 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 as indicated in the setups below for each band, the EUT azimuth over 360º and for both Vertical and Horizontal polarizations.
The radiated spurious emission was measured on the worst case configuration found.

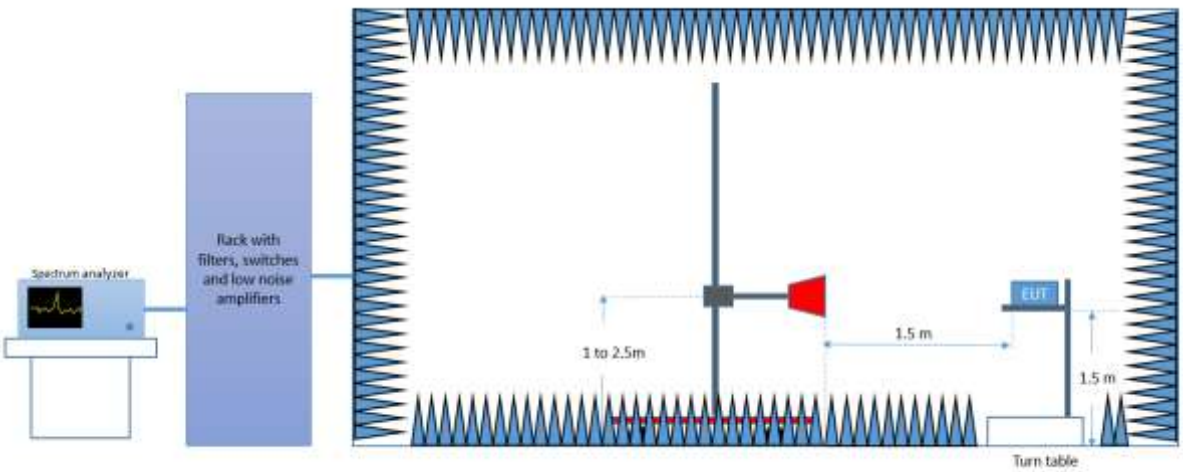
Radiated Setup 30 MHz - 1GHz



Radiated Setup 1 GHz – 18 GHz



Radiated Setup 18 GHz – 26.5 GHz



Sample Calculation

The field strength is deduced from the radiated measurement using the following equation:

$$E = 126.8 - 20\log(\lambda) + P - G$$

where

E is the field strength of the emission at the measurement distance, in dBµV/m

P is the power measured at the output of the test antenna, in dBm

λ is the wavelength of the emission under investigation [300/f_{MHz}], in m

G is the gain of the test antenna, in dBi

NOTE – The measured power P includes all applicable instrument correction factors up to the connection to the test

Antenna e.g. cable losses, amplifier gains.

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*

Test Results

30 MHz – 26.5 GHz, BR – GFSK

Radiated Spurious – CH0 DH5

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
128.7	31.3	---	43.6	12.2
624.0	38.2	---	46.0	7.8
3369.0	58.0	---	74.0	16.0
3369.0	---	46.7	54.0	7.3
16716.3	---	47.6	54.0	6.4
16777.2	58.8	---	74.0	15.2
25929.7	49.4	---	74.0	24.6
25949.6	---	37.4	54.0	16.6

Radiated Spurious – CH39 DH5

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
128.1	30.4	---	43.6	13.2
256.2	32.6	---	46.0	13.4
3370.0	---	46.1	54.0	7.9
3381.0	59.2	---	74.0	14.8
16726.9	59.8	---	74.0	14.2
16754.0	---	47.6	54.0	6.4
19458.2	47.2	---	74.0	26.8
19527.0	---	36.2	54.0	17.8

Radiated Spurious – CH78 DH5

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
127.5	28.5	---	43.6	15.1
541.3	34.7	---	46.0	11.3
3192.5	57.0	---	74.0	17.0
3192.5	---	46.7	54.0	7.3
16748.7	58.4	---	74.0	15.6
16751.6	---	47.7	54.0	**6.3**
19488.8	47.6	---	74.0	26.4
19529.2	---	36.0	54.0	18.0

30 MHz – 26.5 GHz, EDR – π/4-DQPSK

Radiated Spurious – CH0 2DH5

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
128.7	31.0	---	43.6	12.6
730.3	38.9	---	46.0	7.1
3375.5	58.0	---	74.0	16.0
3376.5	---	46.5	54.0	7.5
16682.0	59.9	---	74.0	14.1
16744.3	---	47.8	54.0	6.2
19856.0	---	36.4	54.0	17.6
19860.7	48.1	---	74.0	25.9

Radiated Spurious – CH39 2DH5

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
128.2	30.7	---	43.6	12.9
298.8	31.7	---	46.0	14.3
3101.5	57.6	---	74.0	16.4
3101.5	---	46.6	54.0	7.4
16747.2	58.9	---	74.0	15.1
16754.0	---	47.9	54.0	6.1
19932.9	---	35.8	54.0	18.2
19944.4	48.4	---	74.0	25.6

Radiated Spurious – CH78 2DH5

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
128.1	31.0	---	43.6	12.5
298.9	31.9	---	46.0	14.1
3380.5	58.9	---	74.0	15.1
3380.5	---	46.6	54.0	7.4
16693.1	58.8	---	74.0	15.2
16704.7	---	47.9	54.0	**6.1**
21484.6	---	36.7	54.0	17.3
21492.7	48.6	---	74.0	25.4

30 MHz – 26.5 GHz. EDR – 8-DPSK

Radiated Spurious – CH0 3DH5

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
128.1	31.3	---	43.6	12.3
672.0	36.7	---	46.0	9.3
3360.5	---	46.3	54.0	7.7
3384.5	58.8	---	74.0	15.2
16777.2	58.4	---	74.0	15.6
16779.1	---	47.2	54.0	6.8
19496.0	---	35.7	54.0	18.3
19497.3	47.2	---	74.0	26.8

Radiated Spurious – CH39 3DH5

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
127.5	29.4	---	43.6	14.1
311.3	30.4	---	46.0	15.6
3380.5	58.9	---	74.0	15.1
3380.5	---	46.6	54.0	7.4
16723.5	58.4	---	74.0	15.6
16726.4	---	47.6	54.0	**6.4**
19455.6	46.7	---	74.0	27.3
19496.0	---	35.7	54.0	18.3

Radiated Spurious – CH78 3DH5

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
128.7	31.2	---	43.6	12.3
311.9	31.7	---	46.0	14.3
3374.0	---	46.5	54.0	7.5
3374.5	59.1	---	74.0	15.0
16732.7	59.1	---	74.0	14.9
16741.9	---	47.6	54.0	6.4
19471.4	---	34.7	54.0	19.3
19472.2	46.9	---	74.0	27.1