

FCC Test Report (Part 15 Subpart C)

Client Information:

Applicant: VVDN Technologies Pvt. Ltd.

Applicant add.: 398, Sector 8, Imt Manesar, Gurugram, Haryana 122051.

Manufacturer: VVDN Technologies Pvt. Ltd.

Manufacturer add.: 398, Sector 8, Imt Manesar, Gurugram, Haryana 122051.

Product Information:

Product Name: VVDN_QCS610_410_EVK

Model No.: QCS610 EVK (SOM+Carrier)

Derivative model No.: QCS410 SOM, QCS610 SOM

Brand Name: **VVDN**

Applied Standard:

FCC PART 15 Subpart C: 2013 section 15.247

Laboratory Details:

AA Electro Magnetic Test Laboratory Private Limited

PlotNo174, Udyog Vihar-Phase4, Sector18, Gurgaon, Haryana, India

Date of Receipt: Mar. 28, 2022

Date of Test: Mar. 28 ~ May. 04, 2022

Date of Issue: May. 05, 2022

Test Result: **In Compliance/Pass**

This device has been tested and found to comply with the stated standard(s), which is(are) required by the council directive of 2014/53/EU and indicated in the test report and are applicable only to the tested sample identified in the report.

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Prepared By (+ signature) Ankur Kumar:



Reviewed & Approved by: (+ signature)



Dr. Lenin Raja (Authorized Representative)

(/ lenin83/)

Contents

	Page
COVER PAGE	
1 CONTENTS.....	2
2 TEST SUMMARY	4
2.1 COMPLIANCE WITH FCC PART 15 SUBPART C.....	4
2.2 TEST LOCATION	5
2.3 MEASUREMENT UNCERTAINTY	5
3 TEST FACILITY	6
3.1 DEVIATION FROM STANDARD	6
3.2 ABNORMALITIES FROM STANDARD CONDITIONS	6
4 GENERAL INFORMATION.....	7
4.1 GENERAL DESCRIPTION OF EUT	7
4.2 DESCRIPTION OF TEST CONDITIONS.....	9
4.3 TEST PERIPHERAL LIST	10
4.4 EUT PERIPHERAL LIST.....	10
5 EQUIPMENTS LIST FOR ALL TEST ITEMS	11
6 TEST RESULT.....	13
6.1 ANTENNA REQUIREMENT	13
6.1.1 Standard requirement.....	13
6.1.2 EUT Antenna.....	13
6.2 CONDUCTION EMISSIONS MEASUREMENT.....	14
6.2.1 Applied procedures / Limit	14
6.2.2 Test procedure	14
6.2.3 Test setup.....	14
6.2.4 Test results.....	15
6.3 RADIATED EMISSIONS MEASUREMENT	17
6.3.1 Applied procedures / Limit	17
6.3.2 Test setup	17
6.3.3 Test procedure	19
6.3.4 Test Result	20
6.3.5 TEST RESULTS (Restricted Bands Requirements).....	33
6.4 BANDWIDTH TEST	34
6.4.1 Applied procedures / Limit	34
6.4.2 Test procedure	34
6.4.3 Deviation from standard	34
6.4.4 Test setup.....	34
6.4.5 Test results.....	35
6.5 CARRIER FREQUENCIES SEPARATED	41
6.5.1 Applied procedures / Limit	41

6.5.2	Test procedure	41
6.5.3	Deviation from standard	41
6.5.4	Test setup	41
6.5.5	Test results	42
6.6	HOPPING CHANNEL NUMBER	48
6.6.1	Applied procedures / Limit	48
6.6.2	Test procedure	48
6.6.3	Deviation from standard	48
6.6.4	Test setup	48
6.6.5	Test result	48
6.7	DWELL TIME	51
6.7.1	Applied procedures / Limit	51
6.7.2	Test procedure	51
6.7.3	Deviation from standard	51
6.7.4	Test setup	51
6.7.5	Test result	52
6.8	MAXIMUM PEAK OUTPUT POWER	58
6.8.1	Applied procedures / Limit	58
6.8.2	Test procedure	58
6.8.3	Deviation from standard	58
6.8.4	Test setup	58
6.8.5	Test results	59
6.9	BAND EDGE	65
6.9.1	Applied procedures / Limit	65
6.9.2	Test procedure	65
6.9.3	Deviation from standard	65
6.9.4	Test setup	65
6.9.5	Test results	66
6.10	CONDUCTED SPURIOUS EMISSIONS	69
6.10.1	Applied procedures / Limit	69
6.10.2	Test procedure	69
6.10.3	Deviation from standard	69
6.10.4	Test setup	69
6.10.5	Test results	70

2 Test Summary

2.1 Compliance with FCC Part 15 subpart C

Test	Test Requirement	Standard Paragraph	Result
Antenna Requirement	FCC Part 15 C:2013	Section 15.247(c)	PASS
Conduction Emissions	FCC Part 15 C:2013	Section 15.207(a)	PASS
Radiated Emissions	FCC Part 15 C:2013	Section 15.247(d)	PASS
Carrier Frequencies Separated	FCC Part 15 C:2013	Section 15.247(a)(1)	PASS
Hopping Channel Number	FCC Part 15 C:2013	Section 15.247(a)(1) (iii)	PASS
Dwell Time	FCC Part 15 C:2013	Section 15.247(a)(1) (iii)	PASS
Maximum Peak Output Power	FCC Part 15 C:2013	Section 15.247(b)	PASS
Band edge	FCC Part 15 C:2013	Section 15.247(d)	PASS
Conducted Spurious Emissions	FCC Part 15 C:2013	Section 15.247(d)	PASS
Note: N/A is an abbreviation for Not Applicable.			
Model description: N/A			
(1)	Reference to the FCC Public Notice DA 00-705		
(2)	Reference to ANSI C63.4:2013.		

2.2 Test Location

All tests were performed at:

AA Electro Magnetic Test Laboratory Private Limited

Plot No 174, Udyog Vihar - Phase 4, Sector 18, Gurgaon, Haryana, India

Tel.: +91-0124-4235350

2.3 Measurement Uncertainty

All measurements involve certain levels of uncertainties, The following measurements uncertainty Levels have estimated based on ANSI C63.4:2009, the maximum value of the uncertainty as below

No.	Item	Uncertainty
1	Conducted Emission Test	2.82dB
2	Radiated Emission Test	2.77dB

3 Test Facility

ILAC / NABL Accreditation No.: TC-8597

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by National Accreditation Board for Testing and Calibration Laboratories (NABL).

ILAC –A2LA Accreditation No.: 5593.01

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered American Association of Laboratory Accreditation (A2LA.)

FCC- Recognition No.: 137777

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by Federal Communications Commission (FCC).

ISED Recognition No.: 26046

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by Institute for Social and Economic Development.(ISED)

VCCI- Registration No: 4053

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by Voluntary Control Council for Interference.(VCCI)

TEC Designation No.: IND063

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by Telecommunication Engineering (TEC) Center.

BIS Recognition No: 816586

BIS recognized as per CRS scheme for IT electronics, LED control gears, Lamp, Inverter / UPS are recognized as per LRS 2020.

3.1 Deviation from standard

None

3.2 Abnormalities from standard conditions

None

4 General Information

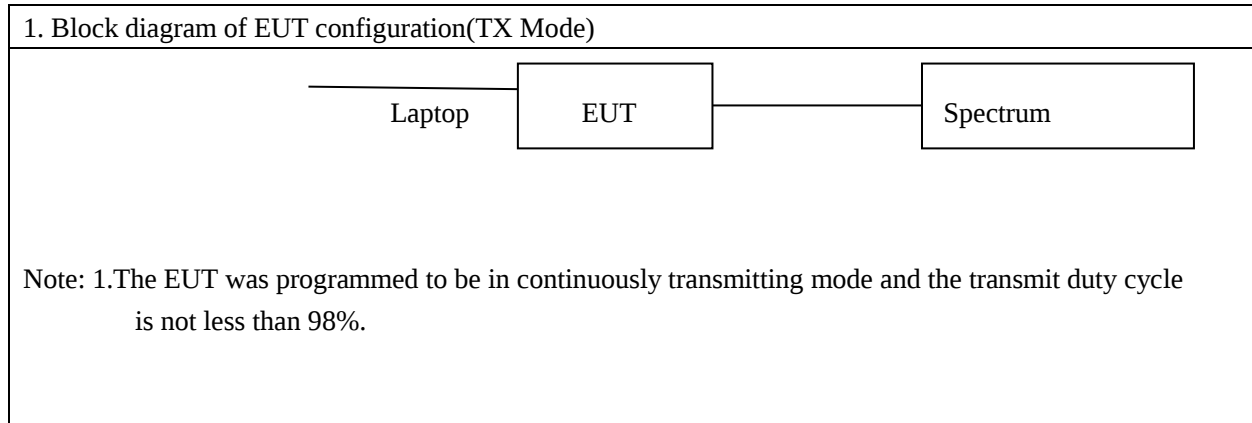
4.1 General Description of EUT

Manufacturer:	VVDN Technologies Pvt. Ltd.
Manufacturer Address:	398, Sector 8, Imt Manesar, Gurugram, Haryana 122051.
EUT Name:	VVDN_QCS610_410_EVK
Model No:	QCS610 EVK (SOM+Carrier)
Brand Name:	VVDN
Derivative model No.:	QCS410 SOM, QCS610 SOM
Serial No:	12
Operation frequency:	2402 MHz to 2480 MHz
Number Of Channel:	79
Modulation Technology:	GFSK, $\pi/4$ -DQPSK, 8DPSK(1/2/3Mbps)
Bluetooth version:	5.0
Antenna Gain:	3.2dBi
H/W No.:	QCS610 SOM Board:-701-1-01948_A1 QCS410 SOM Board:-701-1-02751_A1 Carrier Board:- 701-1-01949_A3
S/W No.:	QCS410 SOM : FW version 0.0.2 QCS610 SOM : FW version 0.0.8
Power Supply Range:	Input of EUT: Powered through Adapter Input for Meanwell adapter: 110-240VAC,50/60Hz,1.4A, Output: 12VDC,5A, 60W (max)
Condition of Sample on receipt:	Good
Note:	1 .For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual. 2. Antenna gain and antenna type provided by manufacturer.

Description of Channel:					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	27	2429	54	2456
01	2403	28	2430	55	2457
02	2404	29	2431	56	2458
03	2405	30	2432	57	2459
04	2406	31	2433	58	2460
05	2407	32	2434	59	2461
06	2408	33	2435	60	2462
07	2409	34	2436	61	2463
08	2410	35	2437	62	2464
09	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	39	2441	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471
16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	78	2480
25	2427	52	2454		
26	2428	53	2455		

4.2 Description of Test conditions

- (1) EUT was tested in normal configuration (Please See following Block diagram)



- (2) E.U.T. test conditions:

15.31(e): For intentional radiators, measurements of the variation of the input power or the adiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

- (3) Test frequencies:

According to the 15.31(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and. If required reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

- (4) Frequency range of radiated measurements:

According to the 15.33, the test range will be up to the tenth harmonic of the highest fundamental frequency.

- (5) Pre-test the EUT in all transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet and conducted to determine the worst-case mode, only the worst-case results(1Mbps/2Mbps/3Mbps) are recorded in this report.

4.3 Test Peripheral List

No.	Equipment	Manufacturer	EMC Compliance	Model No.	Serial No.	Power cord	signal cable
1	Laptop	DELL	Latitude 3490	5M2Z1W2	2m unshielded	N/A	1

4.4 EUT Peripheral List

No.	Equipment	Manufacturer	Model No.	Serial No.	Power cord	signal cable
1.	AC-DC Adapter	Meanwell	GST60A12	SC103R1080	1m Unshielded wire	N/A
2	Micro SD Card	Sandisk	32GB Class 10	-	-	-
3	HDMI Monitor	LAPCARE	-	-	--	-
4	HDMI Cable	-	-	-	N/A	1.5m shielded wire
5	Camera Module	ECON	e-CAM83_CUMI415_MOD	-	N/A	N/A
6	Camera Cable	I-PEX	81214-530B-300-1	-	N/A	30cm unshielded cable
7	USB 3.0 Pen drive	Sandisk	16GB	-	N/A	N/A
8	Ethernet Cable	-	-	-	N/A	2m UTP LAN Cable
9	RF Antenna	Molex	1461530050	-	-	-

5 Equipments List for All Test Items

No	Test Equipment	Manufacturer	Model No	Serial No	Cal. Date	Cal.Due Date
1	Spectrum Analyzer	Rohde and Schwarz	FSP40	101163	2020/12/11	2022/12/10
2	Loop antenna	DAZE Beijing	ZN30900C	18052	2021/01/29	2023/01/28
3	Hi power horn antenna	DAZE Beijing	ZN30700	18012	2021/01/30	2023/01/29
4	Horn antenna	DAZE Beijing	ZN30702	18006	2021/01/30	2023/01/29
5	Horn antenna	DAZE Beijing	ZN30703	18005	2021/01/30	2023/01/29
6	Pre amplifier	KELIANDA	LNA-0009295	-	2021/01/13	2023/01/13
7	Pre amplifier	KELIANDA	CF-00218	-	2021/01/13	2023/01/13
8	Biconical Antenna	DAZE Beijing	ZN30505C	17038	2021/01/13	2023/01/13
9	EMI-RECEIVER	Schwarzbeck	FCKL	1528194	2021/01/13	2023/01/13
10	Spectrum Analyzer	ADVANTEST	R3361	-	2021/01/13	2023/01/13
11	LISN	Kyoritsu	KNW-407	8-1789-5	2021/01/13	2023/01/13
12	Network-LISN	SCHWAR ZBECK	NNBM8125	81251314	2021/01/13	2023/01/13
13	Network-LISN	SCHWAR ZBECK	NNBM8125	81251315	2021/01/13	2023/01/13
14	PULSELIMITER	Rohde and Schwarz	ESH3-Z2	100681	2022/05/13	2023/05/12
15	50ΩCoaxialSwitch	DAIWA	1565157	-	2022/05/13	2023/05/12
16	50ΩCoaxialSwitch	-	-	-	2022/05/13	2023/05/12
17	Wireless signal power meter	DARE!!	RPR3006W	RFSW190220	2021/01/13	2023/01/13
18	Signal Generator	KEYSIGHT	N5181A	512071	2021/01/13	2023/01/13

19	RF Vector Signal Generator	Keysight	N5182B	512094	2021/01/13	2023/01/13
20	Spectrum analyzer	R&S	FSV-40N	101385	2021/01/13	2023/01/13
21	Radio Communication Tester	R&S	CMW 500	124589	2022/05/15	2023/05/14
22	Signal Generator	R&S	SMP02	837017/004 836593/005	2022/05/15	2023/05/14
23	DC Power Supply	Guanker	JK15040K	TNC/ET/C/0 01/15	2021/02/02	2023/02/01
24	Pro. Temp & Humi. Chamber	MENTEK	MHP-150-1C	MAA081125 01	2021/02/02	2023/02/01
25	Attenuators	AGILENT	8494B	-	-	-
26	Attenuators	AGILENT	8495B	-	-	-

6 Test Result

6.1 Antenna Requirement

6.1.1 Standard requirement

15.203 requirement: For intentional device, according to 15.203: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

15.247(c) (1)(i) requirement: (i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

6.1.2 EUT Antenna

The antenna is a Flexible Antenna with Cable which is connected to the board using a N-type to U.FL cable which is connected to the board via U.FL connector. Antenna gain is maximum 3.2dBi from 2.4GHz to 2.5 GHz

6.2 Conduction Emissions Measurement

6.2.1 Applied procedures / Limit

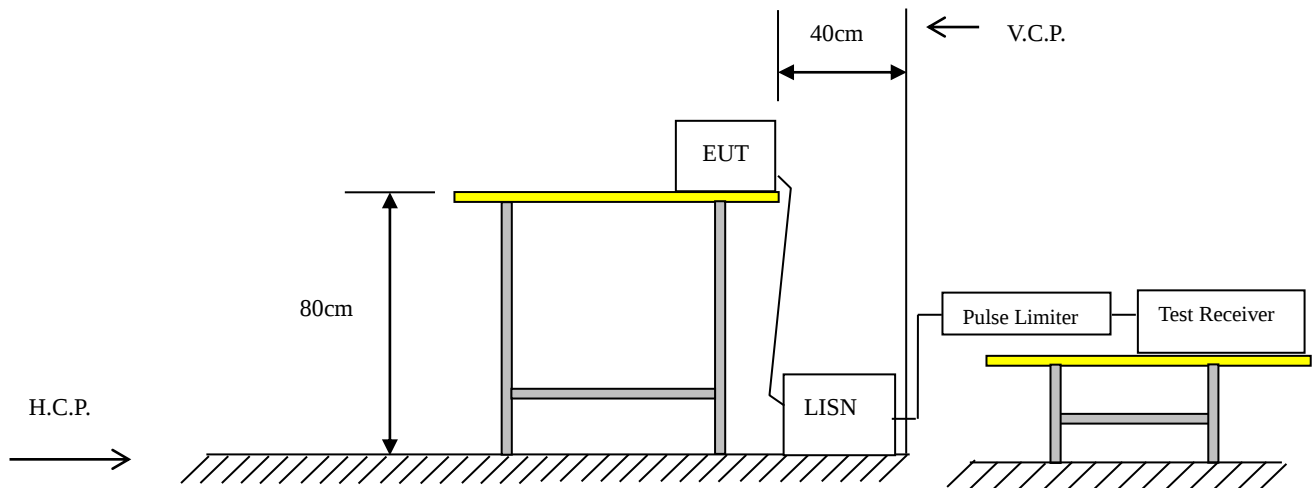
Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

Note: Decreases with the logarithm of the frequency.

6.2.2 Test procedure

EUT was placed upon a wooden test table 0.8m above the horizontal metal reference plane and 0.4m from the Vertical ground plane, and it was connected to an AMN. The closest distance between the boundary of the EUT and the surface of the AMN is 0.8m. All peripherals were connected to another AMN, and placed at a distance of 10cm from each other. A spectrum and receiver was connected to the RF output port of the AMN. Both average and quasi-peak value were detected.

6.2.3 Test setup

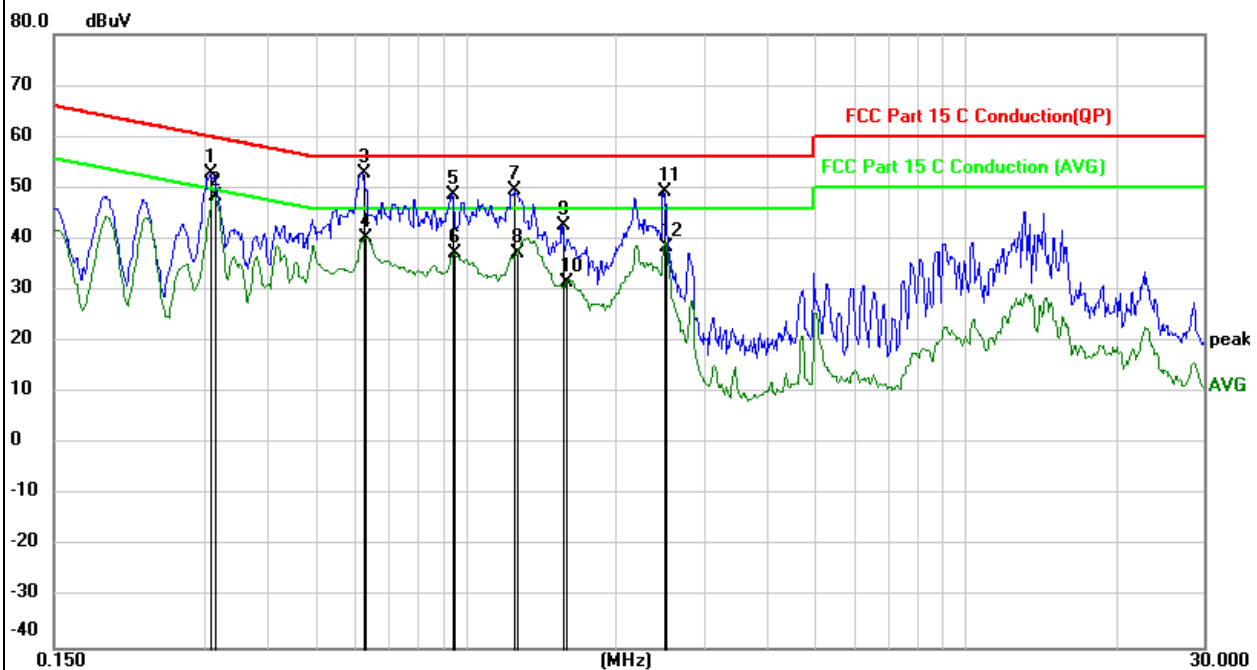


6.2.4 Test results

EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	25 °C	Relative Humidity:	51%
Pressure:	1010hPa	Test Date :	2022-03-28
Test Mode:	TX CH00 (1Mbps worst case)	Phase :	Positive
Test Voltage :	DC 12V		

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.3085	52.46	0.45	52.91	60.01	-7.10	QP
2	*	0.3134	48.03	0.45	48.48	49.88	-1.40	AVG
3		0.6260	52.39	0.41	52.80	56.00	-3.20	QP
4		0.6303	39.77	0.41	40.18	46.00	-5.82	AVG
5		0.9410	48.26	0.40	48.66	56.00	-7.34	QP
6		0.9498	36.87	0.40	37.27	46.00	-8.73	AVG
7		1.2424	49.14	0.40	49.54	56.00	-6.46	QP
8		1.2648	36.85	0.40	37.25	46.00	-8.75	AVG
9		1.5620	42.35	0.41	42.76	56.00	-13.24	QP
10		1.5933	31.13	0.41	31.54	46.00	-14.46	AVG
11		2.4890	48.85	0.41	49.26	56.00	-6.74	QP
12		2.5159	37.99	0.41	38.40	46.00	-7.60	AVG

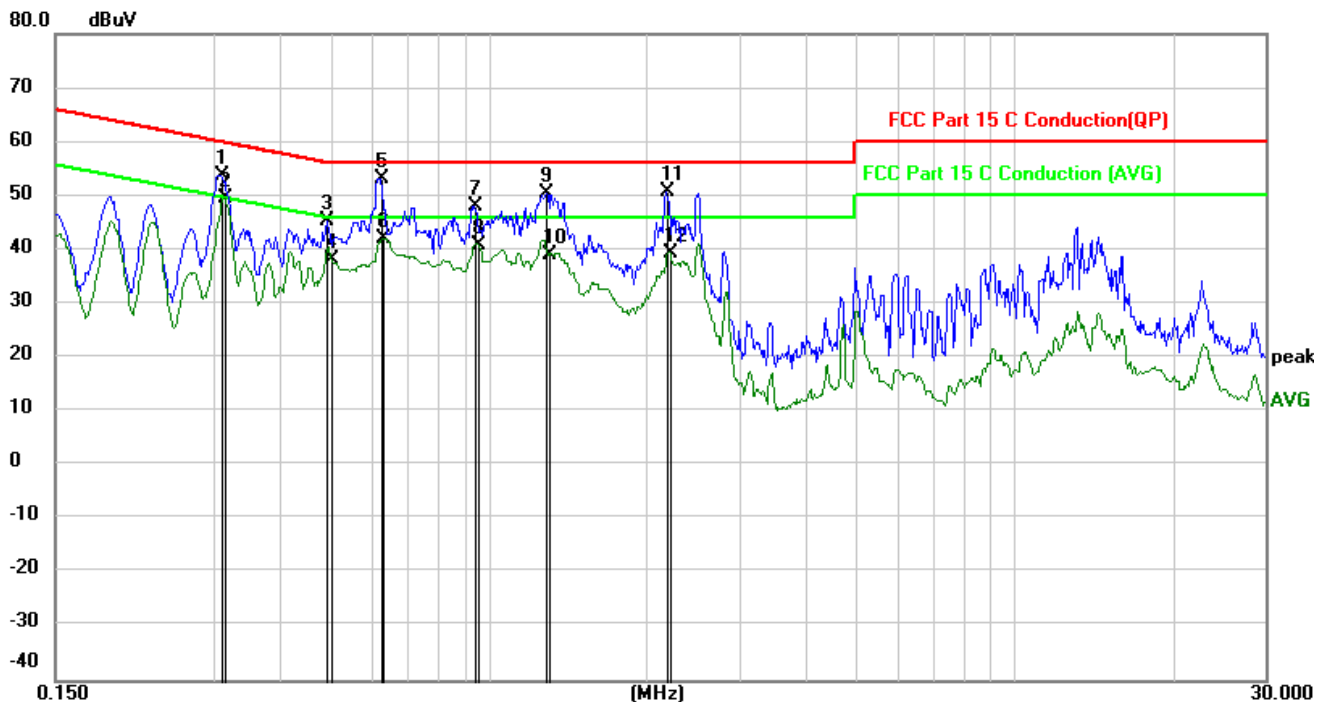
Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.



EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	25 °C	Relative Humidity:	51%
Pressure:	1010hPa	Test Date :	2022-03-28
Test Mode:	TX CH00 (1Mbps worst case)	Phase :	Negative
Test Voltage :	DC 12V		

No. Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1	0.3103	53.41	0.45	53.86	59.96	-6.10	QP
2 *	0.3140	49.14	0.45	49.59	49.86	-0.27	AVG
3	0.4916	45.06	0.41	45.47	56.14	-10.67	QP
4	0.5043	37.79	0.41	38.20	46.00	-7.80	AVG
5	0.6260	52.69	0.41	53.10	56.00	-2.90	QP
6	0.6303	41.75	0.41	42.16	46.00	-3.84	AVG
7	0.9410	47.54	0.40	47.94	56.00	-8.06	QP
8	0.9544	40.33	0.40	40.73	46.00	-5.27	AVG
9	1.2830	49.95	0.40	50.35	56.00	-5.65	QP
10	1.2963	38.77	0.40	39.17	46.00	-6.83	AVG
11	2.1785	50.39	0.41	50.80	56.00	-5.20	QP
12	2.2053	38.81	0.41	39.22	46.00	-6.78	AVG

Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.



6.3 Radiated Emissions Measurement

6.3.1 Applied procedures / Limit

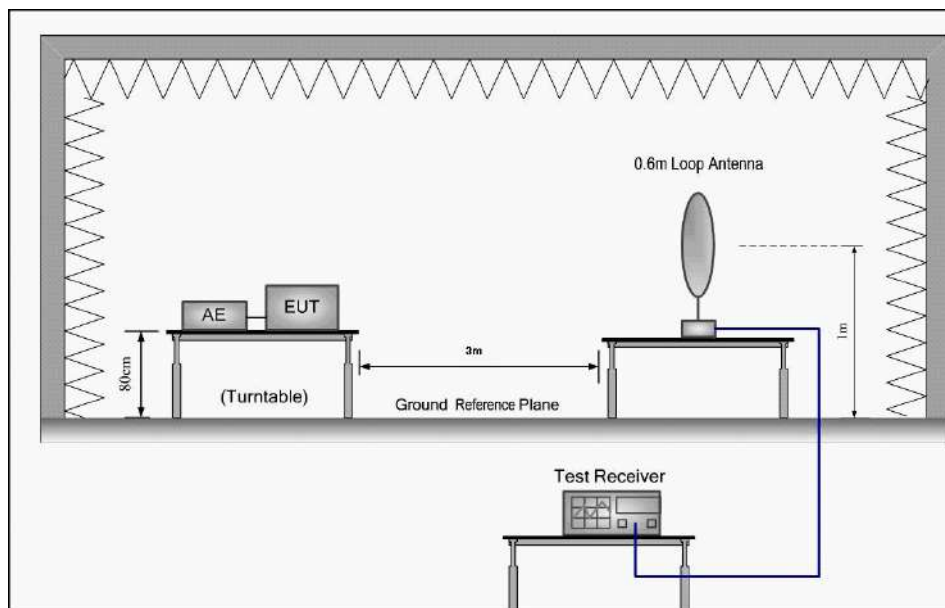
15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Frequency of Emission (MHz)	Field Strength		Measurement Distance (meters)
	$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$	
0.009-0.49	2400/F(kHz)		300
0.49-1.705	24000/F(kHz)		30
1.705-30	30		30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

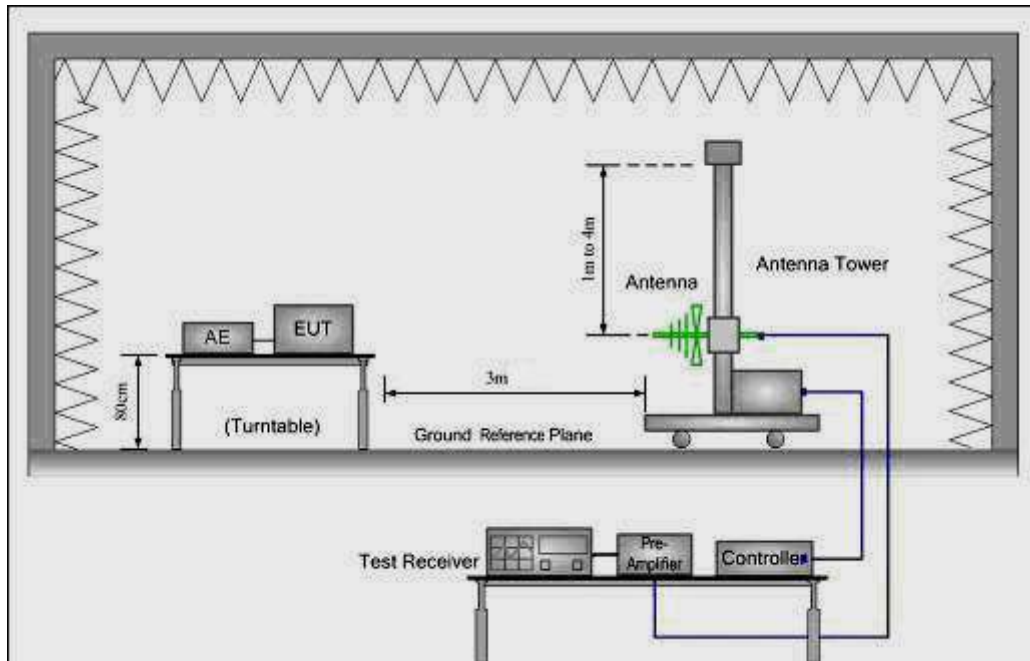
6.3.2 Test setup

Test Configuration:

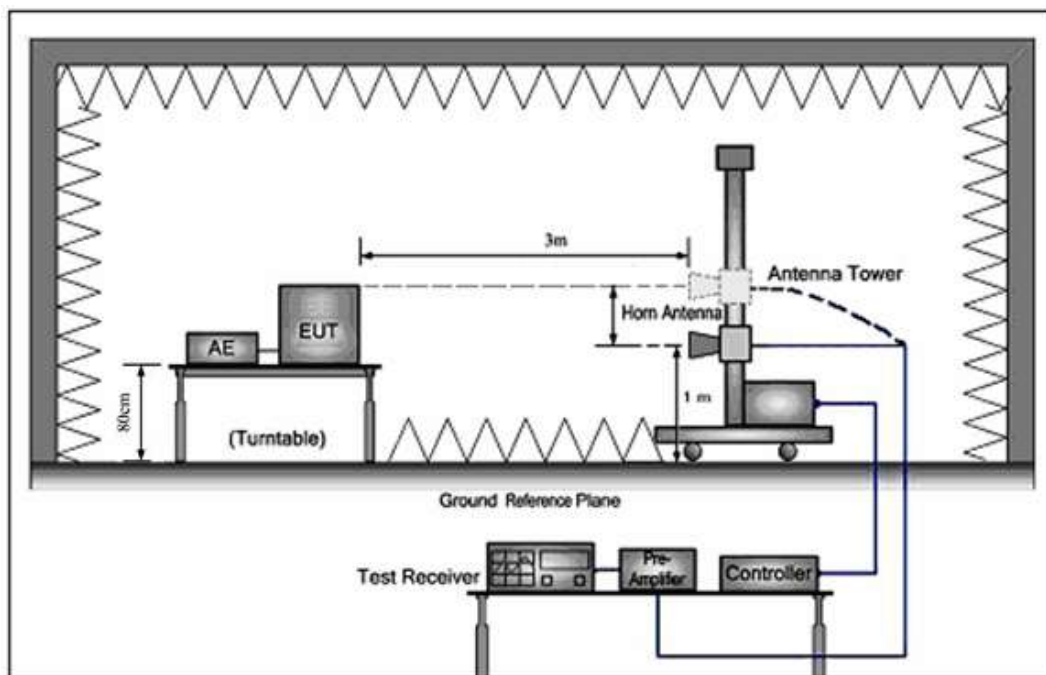
- 1) 9 kHz to 30 MHz emissions:



2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 25 GHz emissions:



6.3.3 Test procedure

EUT was placed upon a wooden test table which was placed on the turn table 0.8m above the horizontal metal ground plane, and operating in the mode as mentioned above. A receiving antenna was placed 3m away from the EUT. During testing, turn around the turn table and move the antenna from 1m to 4m to find the maximum field-strength reading. All peripherals were placed at a distance of 10cm between each other. Both horizontal and Vertical antenna polarities were tested. The worst case emissions were reported.

For measurement at frequency above 1GHz

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

6.3.4 Test Result

Radiated Emissions Test Data Below 30MHz

EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	23 °C	Test Data	2022-03-29
Pressure:	1005 hPa	Relative Humidity:	56%
Test Mode :	TX	Test Voltage :	DC 12V
Measurement Distance	3 m	Frequency Range	9KHz to 30MHz
RBW/VBW	9KHz~150KHz/RB 200Hz for QP, 150KHz~30MHz/RB 9KHz for QP		

No emission found between lowest internal used/generated frequencies to 30MHz.

Radiated Emissions Test Data Below 1GHz

EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	23 °C	Test Data	2022-03-29
Pressure:	1005 hPa	Relative Humidity:	56%
Test Mode :	TX (1Mbps) CH00 (worst case)	Test Voltage :	DC 12V
Measurement Distance	3 m	Frequency Range	30MHz to 1GHz
RBW/VBW	100KHz / 300KHz for spectrum, RBW=120KHz for receiver.		

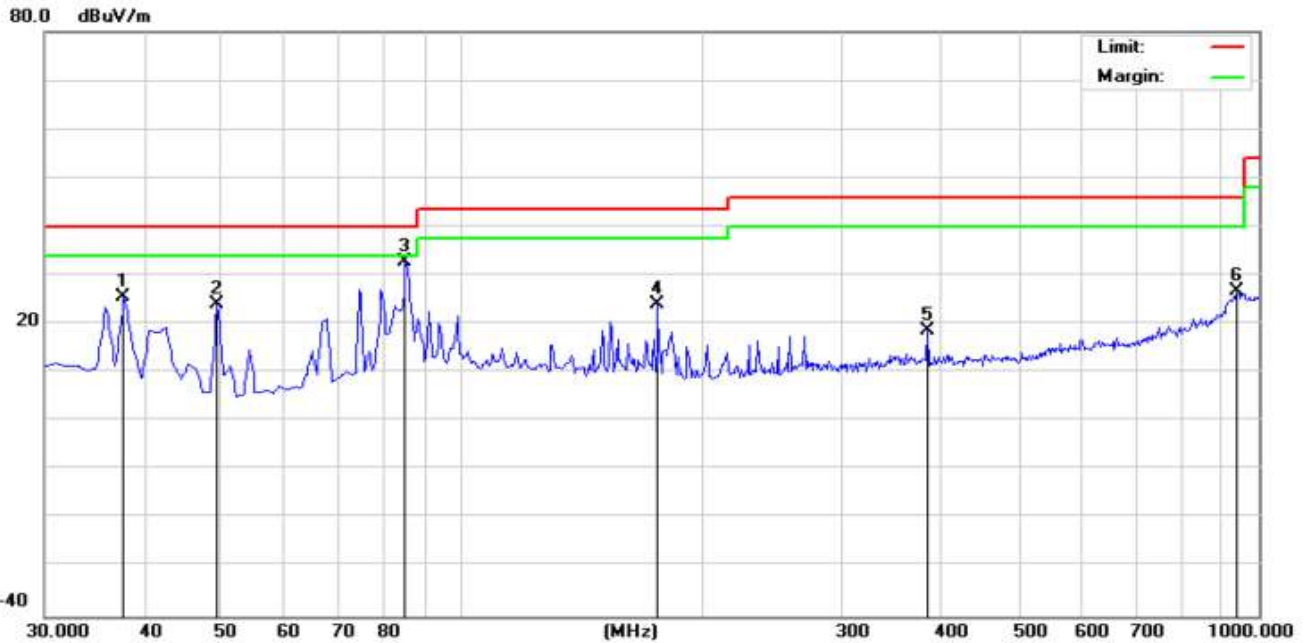
Test at Channel 00 (2.402 GHz) in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Vertical:

Peak scan

Level (dBμV/m)



Quasi-peak measurement

No.	Mk.	Freq. MHz	Reading Level dBμV	Correct Factor dB	Measure- ment dBμV/m	Limit dB/m	Over dB	Detector
1		37.7599	34.90	-9.25	25.65	40.00	-14.35	QP
2		49.4000	32.59	-8.40	24.19	40.00	-15.81	QP
3	*	85.2900	38.18	-5.35	32.83	40.00	-7.17	QP
4		176.4700	27.41	-3.46	23.95	43.50	-19.55	QP
5		384.0500	19.96	-1.34	18.62	46.00	-27.38	QP
6		938.8900	16.72	10.12	26.84	46.00	-19.16	QP

Note: ‘*’ means the worst case

Measurement Level = Reading Level + Factor

Factor= Ant Factor + Cable Loss - Pre-amplifier

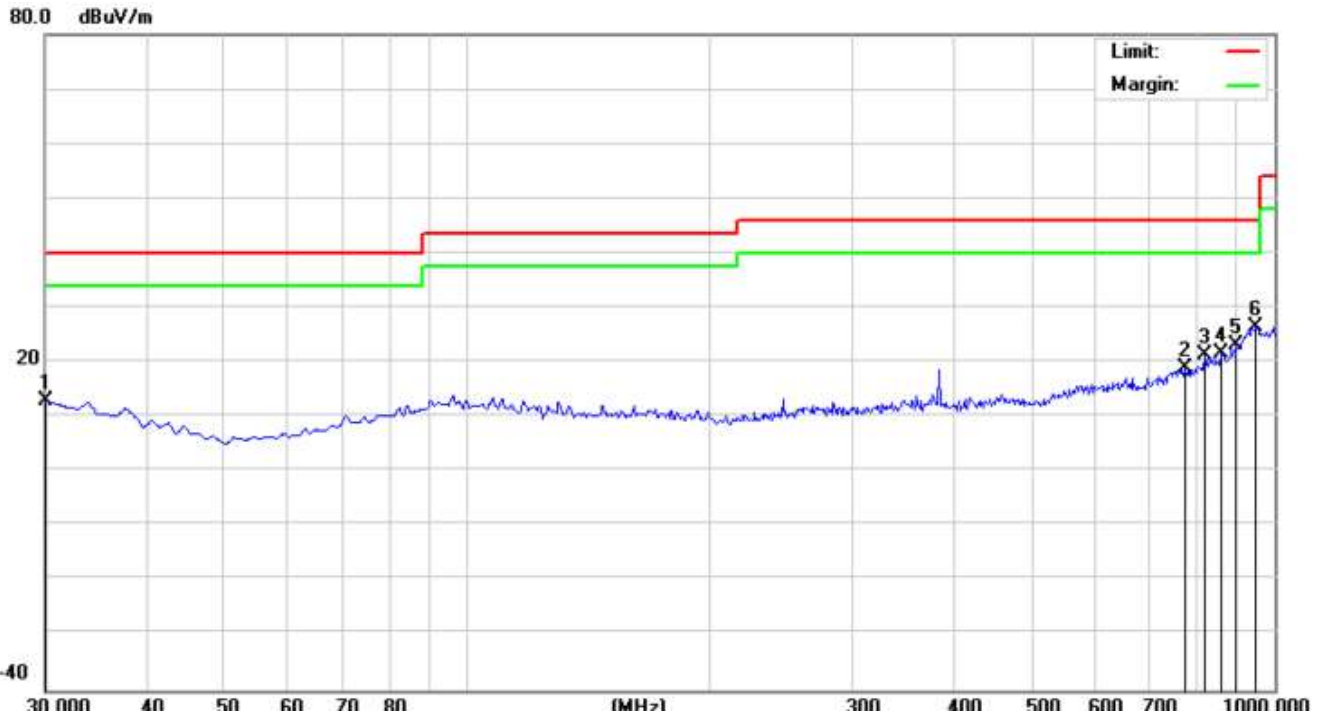
Test at Channel 00 (2.402 GHz) in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Horizontal:

Peak scan

Level (dBμV/m)



Quasi-peak measurement

No.	Mk.	Freq. MHz	Reading Level dBμV	Correct Factor dB	Measure- ment dBμV/m	Limit dB/m	Over dB	Detector
1		30.0000	15.35	-2.42	12.93	40.00	-27.07	QP
2		775.9300	15.59	3.41	19.00	46.00	-27.00	QP
3		820.5500	16.88	4.61	21.49	46.00	-24.51	QP
4		859.3500	15.70	6.05	21.75	46.00	-24.25	QP
5		899.1200	15.77	7.52	23.29	46.00	-22.71	QP
6	*	950.5300	16.29	10.25	26.54	46.00	-19.46	QP

Note: '*' means the worst case

Measurement Level = Reading Level + Factor

Factor= Ant Factor + Cable Loss - Pre-amplifier

Radiated Emissions Test Data Above 1GHz

EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	23 °C	Test Data	2022-03-29
Pressure:	1005 hPa	Relative Humidity:	56%
Test Mode :	TX 1Mbps	Test Voltage :	DC 12V
Measurement Distance	3 m	Frequency Range	1GHz to 25GHz
RBW/VBW	Spurious emission: 1MHz/1MHz for Peak, 1MHz/10Hz for Average. non-restricted band: 100KHz/300KHz for Peak.		

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804	55.04	5.06	60.10	74	-13.90	PEAK
4804	40.96	5.06	46.02	54	-7.98	AVERAGE
7206	47.04	7.03	54.07	74	-19.93	PEAK
7206	33.97	7.03	41.00	54	-13.00	AVERAGE
9608	47.13	10.63	57.76	74	-16.24	PEAK
9608	33.92	10.63	44.55	54	-9.45	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804	53.08	5.06	58.14	74	-15.86	PEAK
4804	43.03	5.06	48.09	54	-5.91	AVERAGE
7206	48.15	7.03	55.18	74	-18.82	PEAK
7206	35.54	7.03	42.57	54	-11.43	AVERAGE
9608	45.25	10.63	55.88	74	-18.12	PEAK
9608	33.09	10.63	43.72	54	-10.28	AVERAGE

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier

Lowest channel: 2402 MHz

Data rate: 1Mbps

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4882	54.80	5.06	59.86	74	-14.14	PEAK
4882	40.91	5.06	45.97	54	-8.03	AVERAGE
7323	44.97	7.03	52.00	74	-22.00	PEAK
7323	33.60	7.03	40.63	54	-13.37	AVERAGE
9764	45.35	10.63	55.98	74	-18.02	PEAK
9764	33.31	10.63	43.94	54	-10.06	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4882	54.07	5.06	59.13	74	-14.87	PEAK
4882	42.98	5.06	48.04	54	-5.96	AVERAGE
7323	45.98	7.03	53.01	74	-20.99	PEAK
7323	34.89	7.03	41.92	54	-12.08	AVERAGE
9764	45.33	10.63	55.96	74	-18.04	PEAK
9764	31.70	10.63	42.33	54	-11.67	AVERAGE

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier

Middle Channel: 2441 MHz

Data rate: 1Mbps

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4960	53.33	5.06	58.39	74	-15.61	PEAK
4960	39.86	5.06	44.92	54	-9.08	AVERAGE
7440	46.11	7.03	53.14	74	-20.86	PEAK
7440	34.83	7.03	41.86	54	-12.14	AVERAGE
9920	43.35	10.63	53.98	74	-20.02	PEAK
9920	32.96	10.63	43.59	54	-10.41	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4960	53.35	5.06	58.41	74	-15.59	PEAK
4960	38.96	5.06	44.02	54	-9.98	AVERAGE
7440	44.28	7.03	51.31	74	-22.69	PEAK
7440	32.71	7.03	39.74	54	-14.26	AVERAGE
9920	44.21	10.63	54.84	74	-19.16	PEAK
9920	32.97	10.63	43.60	54	-10.40	AVERAGE

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier

Highest Channel: 2480 MHz

Data rate: 1Mbps

EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	23 °C	Test Data	2022-03-29
Pressure:	1005 hPa	Relative Humidity:	56%
Test Mode :	TX 2Mbps	Test Voltage :	DC 12V
Measurement Distance	3 m	Frequency Range	1GHz to 25GHz
RBW/VBW	Spurious emission: 1MHz/1MHz for Peak, 1MHz/10Hz for Average. non-restricted band: 100KHz/300KHz for Peak.		

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804	53.92	5.06	58.98	74	-15.02	PEAK
4804	41.84	5.06	46.90	54	-7.10	AVERAGE
7206	46.95	7.03	53.98	74	-20.02	PEAK
7206	35.03	7.03	42.06	54	-11.94	AVERAGE
9608	44.83	10.63	55.46	74	-18.54	PEAK
9608	33.90	10.63	44.53	54	-9.47	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804	53.41	5.06	58.47	74	-15.53	PEAK
4804	41.26	5.06	46.32	54	-7.68	AVERAGE
7206	45.74	7.03	52.77	74	-21.23	PEAK
7206	33.76	7.03	40.79	54	-13.21	AVERAGE
9608	44.06	10.63	54.69	74	-19.31	PEAK
9608	32.37	10.63	43.00	54	-11.00	AVERAGE

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier

Lowest Channel: 2402 MHz

Data rate: 2Mbps

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4882	54.80	5.06	59.86	74	-14.14	PEAK
4882	42.97	5.06	48.03	54	-5.97	AVERAGE
7323	46.44	7.03	53.47	74	-20.53	PEAK
7323	33.53	7.03	40.56	54	-13.44	AVERAGE
9764	44.18	10.63	54.81	74	-19.19	PEAK
9764	32.05	10.63	42.68	54	-11.32	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4882	52.94	5.06	58.00	74	-16.00	PEAK
4882	43.60	5.06	48.66	54	-5.34	AVERAGE
7323	47.38	7.03	54.41	74	-19.59	PEAK
7323	35.76	7.03	42.79	54	-11.21	AVERAGE
9764	45.96	10.63	56.59	74	-17.41	PEAK
9764	32.10	10.63	42.73	54	-11.27	AVERAGE

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier

Middle Channel: 2441 MHz

Data rate: 2Mbps

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4960	54.89	5.06	59.95	74	-14.05	PEAK
4960	43.32	5.06	48.38	54	-5.62	AVERAGE
7440	46.04	7.03	53.07	74	-20.93	PEAK
7440	36.58	7.03	43.61	54	-10.39	AVERAGE
9920	42.15	10.63	52.78	74	-21.22	PEAK
9920	32.29	10.63	42.92	54	-11.08	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4960	54.12	5.06	59.18	74	-14.82	PEAK
4960	40.84	5.06	45.90	54	-8.10	AVERAGE
7440	45.48	7.03	52.51	74	-21.49	PEAK
7440	34.22	7.03	41.25	54	-12.75	AVERAGE
9920	44.86	10.63	55.49	74	-18.51	PEAK
9920	35.44	10.63	46.07	54	-7.93	AVERAGE

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier

Highest channel: 2480 MHz

Data rate: 2Mbps

EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	23 °C	Test Data	2022-03-29
Pressure:	1005 hPa	Relative Humidity:	56%
Test Mode :	TX 3Mbps	Test Voltage :	DC 12V
Measurement Distance	3 m	Frequency Range	1GHz to 25GHz
RBW/VBW	Spurious emission: 1MHz/1MHz for Peak, 1MHz/10Hz for Average. non-restricted band: 100KHz/300KHz for Peak.		

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804	54.24	5.06	59.30	74	-14.70	PEAK
4804	41.94	5.06	47.00	54	-7.00	AVERAGE
7206	46.19	7.03	53.22	74	-20.78	PEAK
7206	35.06	7.03	42.09	54	-11.91	AVERAGE
9608	45.15	10.63	55.78	74	-18.22	PEAK
9608	33.58	10.63	44.21	54	-9.79	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804	53.53	5.06	58.59	74	-15.41	PEAK
4804	41.18	5.06	46.24	54	-7.76	AVERAGE
7206	45.88	7.03	52.91	74	-21.09	PEAK
7206	33.44	7.03	40.47	54	-13.53	AVERAGE
9608	43.07	10.63	53.70	74	-20.30	PEAK
9608	32.57	10.63	43.20	54	-10.80	AVERAGE

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier

Lowest Channel: 2402 MHz

Data rate: 3Mbps

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4882	55.50	5.06	60.56	74	-13.44	PEAK
4882	42.53	5.06	47.59	54	-6.41	AVERAGE
7323	46.34	7.03	53.37	74	-20.63	PEAK
7323	34.32	7.03	41.35	54	-12.65	AVERAGE
9764	44.60	10.63	55.23	74	-18.77	PEAK
9764	32.52	10.63	43.15	54	-10.85	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4882	53.78	5.06	58.84	74	-15.16	PEAK
4882	43.22	5.06	48.28	54	-5.72	AVERAGE
7323	48.55	7.03	55.58	74	-18.42	PEAK
7323	36.38	7.03	43.41	54	-10.59	AVERAGE
9764	45.03	10.63	55.66	74	-18.34	PEAK
9764	31.92	10.63	42.55	54	-11.45	AVERAGE

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier

Middle Channel: 2441 MHz

Data rate: 3Mbps

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4960	55.05	5.06	60.11	74	-13.89	PEAK
4960	42.67	5.06	47.73	54	-6.27	AVERAGE
7440	46.35	7.03	53.38	74	-20.62	PEAK
7440	36.75	7.03	43.78	54	-10.22	AVERAGE
9920	41.80	10.63	52.43	74	-21.57	PEAK
9920	32.10	10.63	42.73	54	-11.27	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4960	53.63	5.06	58.69	74	-15.31	PEAK
4960	41.23	5.06	46.29	54	-7.71	AVERAGE
7440	46.27	7.03	53.30	74	-20.70	PEAK
7440	34.38	7.03	41.41	54	-12.59	AVERAGE
9920	44.88	10.63	55.51	74	-18.49	PEAK
9920	35.78	10.63	46.41	54	-7.59	AVERAGE

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier

Highest channel: 2480 MHz

Data rate: 3Mbps

6.3.5 TEST RESULTS (Restricted Bands Requirements)

EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	23 °C	Test Data	2022-03-31
Pressure:	1005 hPa	Relative Humidity:	56%
Test Mode :	TX(1Mbps,2Mbps,3Mbps)	Test Voltage :	DC 12V
Note:	1. The transmitter was setup to transmit at the lowest channel. Then the field strength was measured at 2310-2390 MHz. 2. The transmitter was setup to transmit at the highest channel. Then the field strength was measured at 2483.5-2500 MHz. 3. The data of 2390MHz and 2483.5MHz was the worst.		

Test Mode	Ant.Pol. H/V	Freq. (MHz)	Reading		Ant/CF CF(dB)	Act		Limit	
			Peak (dBuv)	AV (dBuv)		Peak (dBuv/m)	AV (dBuv/m)	Peak (dBuv/m)	AV (dBuv/m)
Data rate 1Mbps	V	2390	43.61	33.23	-5.79	37.82	27.44	74	54
	H	2390	42.27	34.11	-5.79	36.48	28.32	74	54
	V	2483.5	44.17	32.82	-4.98	39.19	27.84	74	54
	H	2483.5	44.43	34.32	-4.98	39.45	29.34	74	54
Data rate 2Mbps	V	2390	46.69	32.67	-5.79	40.90	26.88	74	54
	H	2390	45.01	34.60	-5.79	39.22	28.81	74	54
	V	2483.5	46.20	34.29	-4.98	41.22	29.31	74	54
	H	2483.5	45.86	33.15	-4.98	40.88	28.17	74	54
Data rate 3Mbps	V	2390	45.60	32.40	-5.79	39.81	26.61	74	54
	H	2390	45.03	34.32	-5.79	39.24	28.53	74	54
	V	2483.5	45.92	34.21	-4.98	40.94	29.23	74	54
	H	2483.5	45.79	33.30	-4.98	40.81	28.32	74	54

Remark:

- (1) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode.
- (2) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna
- (3) Corr.Factor = Antenna Factor + Cable Loss – Pre-amplifier.

6.4 BANDWIDTH TEST

6.4.1 Applied procedures / Limit

For frequency hopping system operating in the 2400-2483.5MHz, If the 20dB bandwidth of hopping channel is greater than 25kHz, two-thirds 20dB bandwidth of hopping channel shall be a minimum limit for the hopping channel separation.

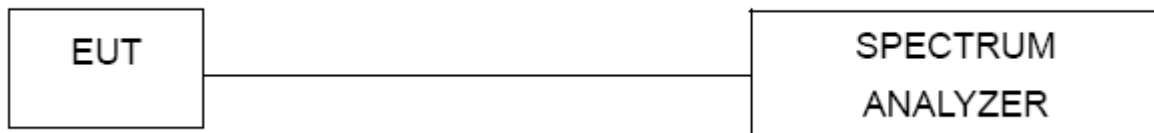
6.4.2 Test procedure

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
RBW $\geq$ 1% of the 20 dB bandwidth, VBW $\geq$ RBW, Sweep = auto, Detector function = peak
Trace = max hold

6.4.3 Deviation from standard

No deviation.

6.4.4 Test setup

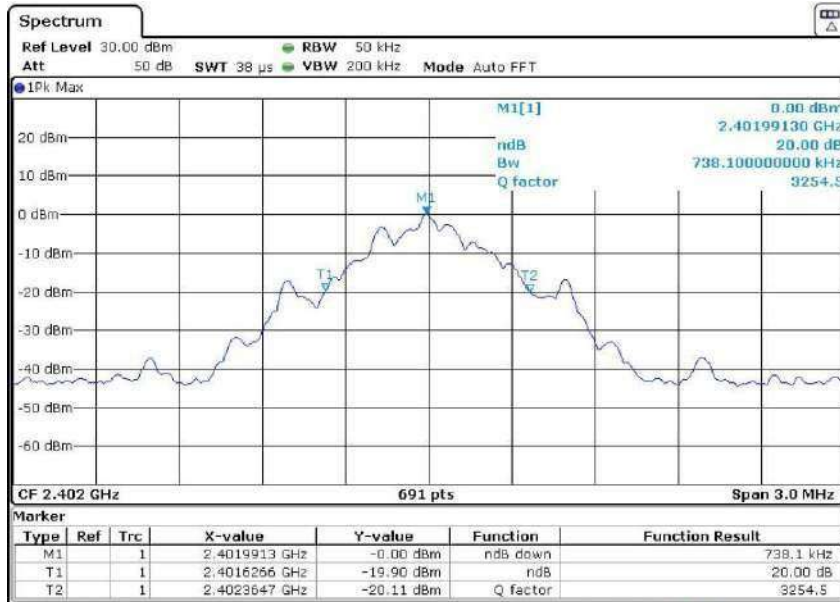


6.4.5 Test results

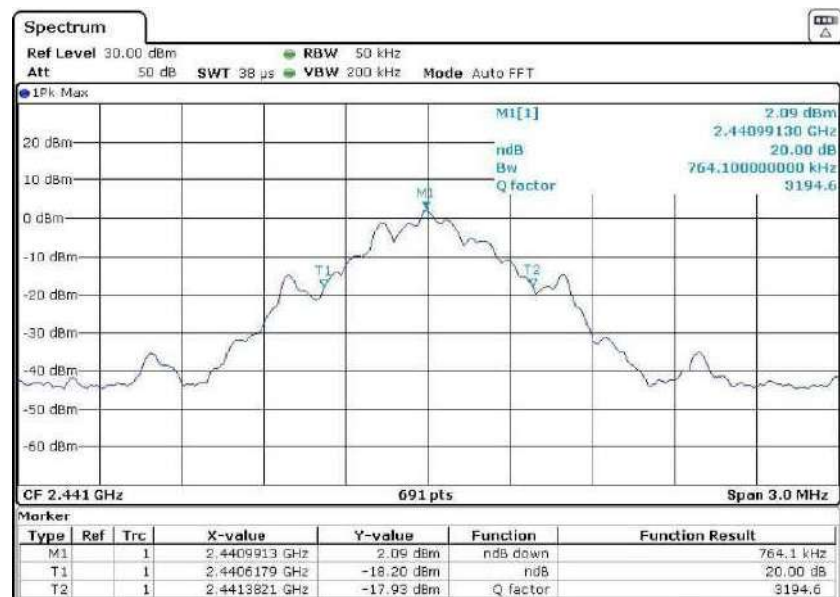
EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	26 °C	Relative Humidity:	53%
Pressure:	1010 hPa	Test Power :	DC 12V
Test Mode :	TX 1Mbps/ 2Mbps/ 3Mbps		

Channel		Channel frequency (MHz)	20dB bandwidth (KHz)	Limit (MHz)	Conclusion
1Mbps	Low	2402	738.1	N/A	Pass
	Middle	2441	764.1	N/A	Pass
	High	2480	764.1	N/A	Pass
2Mbps	Low	2402	1167.9	N/A	Pass
	Middle	2441	1167.9	N/A	Pass
	High	2480	1167.9	N/A	Pass
3Mbps	Low	2402	1263.4	N/A	Pass
	Middle	2441	1259.0	N/A	Pass
	High	2480	1263.4	N/A	Pass

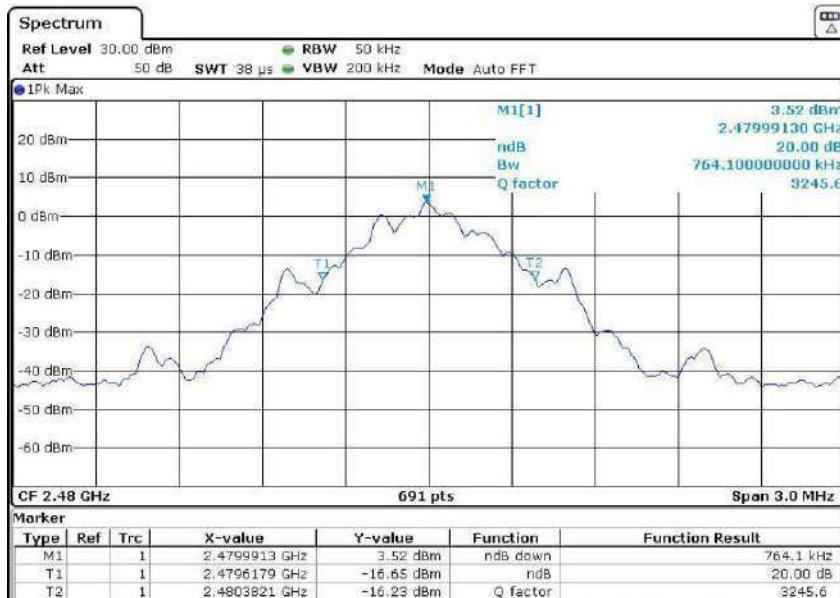
CH00-1Mbps



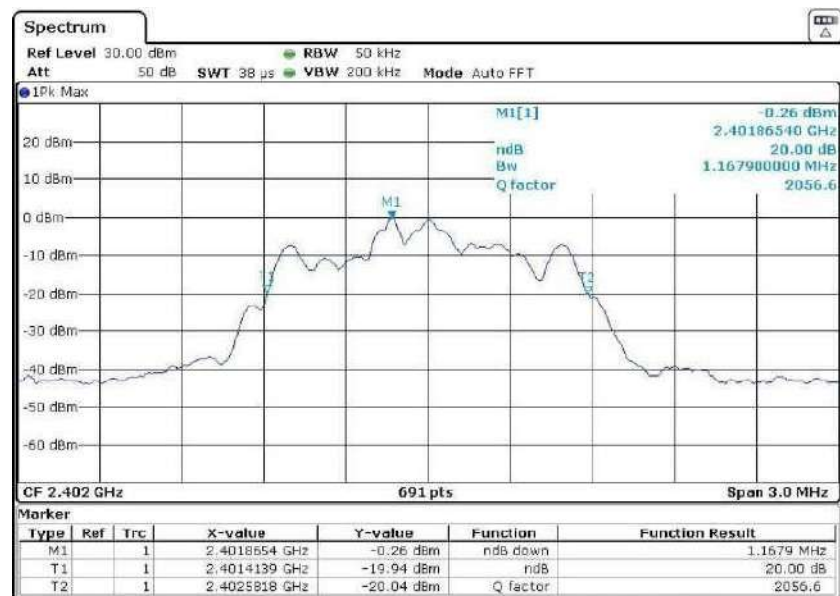
CH 39-1Mbps



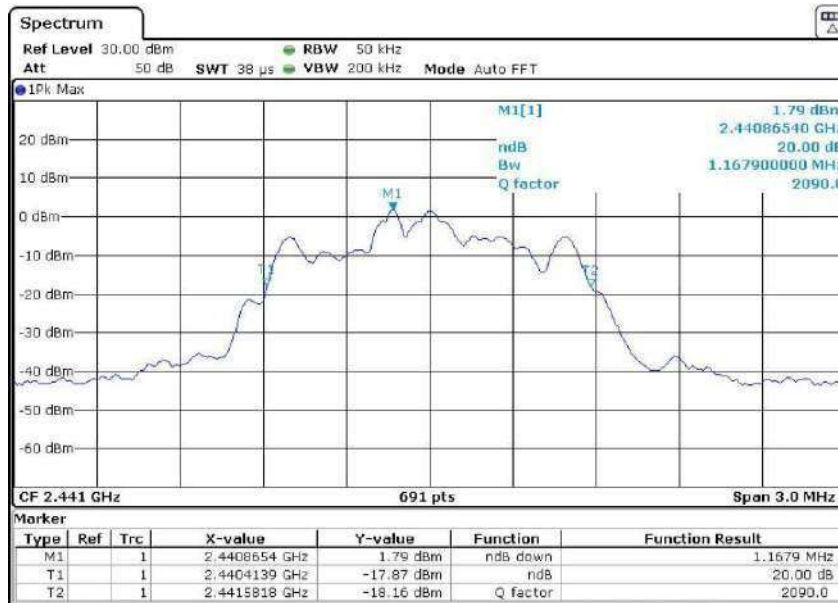
CH 78-1Mbps



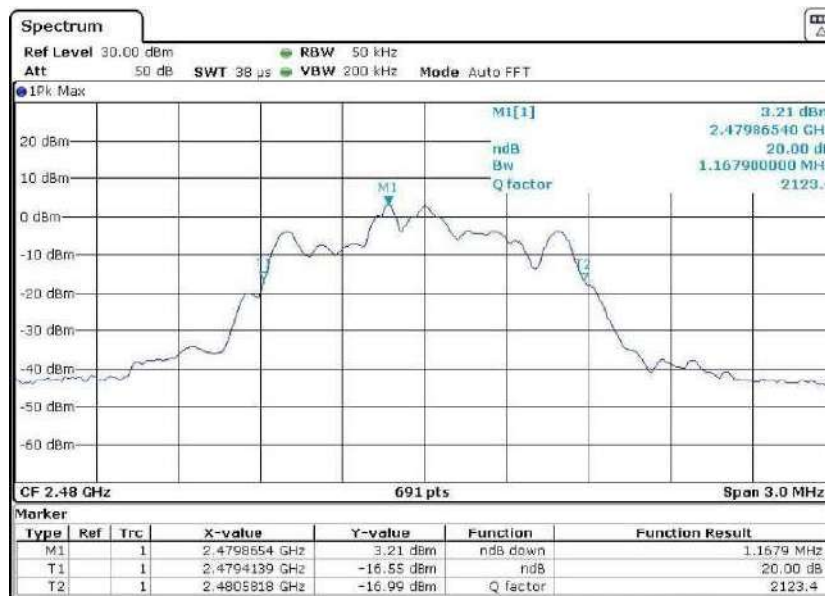
CH 00-2Mbps



CH 39-2Mbps

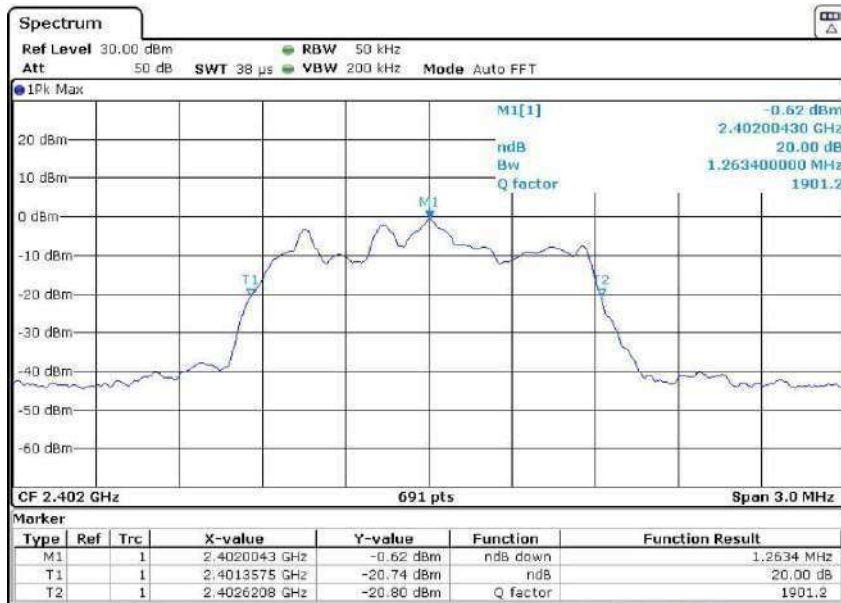


CH 78-2Mbps

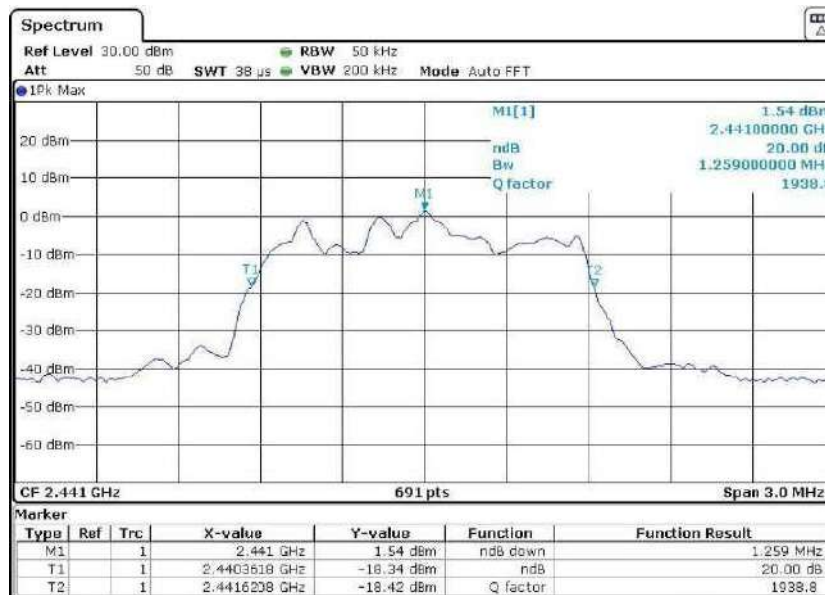


Report No.: AAEMT/EMC/210413-02-03

CH 00-3Mbps

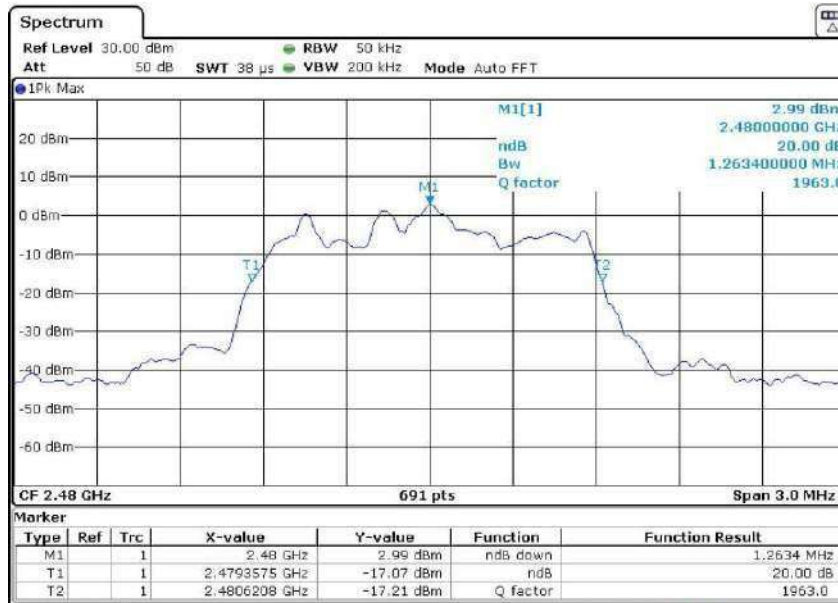


CH 39-3Mbps



Report No.: AAEMT/EMC/210413-02-03

CH 78-3Mbps



6.5 Carrier Frequencies Separated

6.5.1 Applied procedures / Limit

15.247(a) (1) 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.

6.5.2 Test procedure

- (1) Connected the antenna port to the Spectrum Analyzer, set the Spectrum Analyzer as
Span = wide enough to capture the peaks of two adjacent channels, Resolution (or IF)
Bandwidth (RBW) $\geq$ 1% of the span, Video (or Average) Bandwidth (VBW) $\geq$ RBW
Sweep = auto, Detector function = peak, Trace = max hold
- (2) The EUT should be transmitting at its maximum data rate. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.
- (3) The above procedure shall be repeated at the lowest, the middle, and the highest frequency of the stated frequency range with modulated mode. also shall be performed at different modes of operation.

6.5.3 Deviation from standard

No deviation.

6.5.4 Test setup



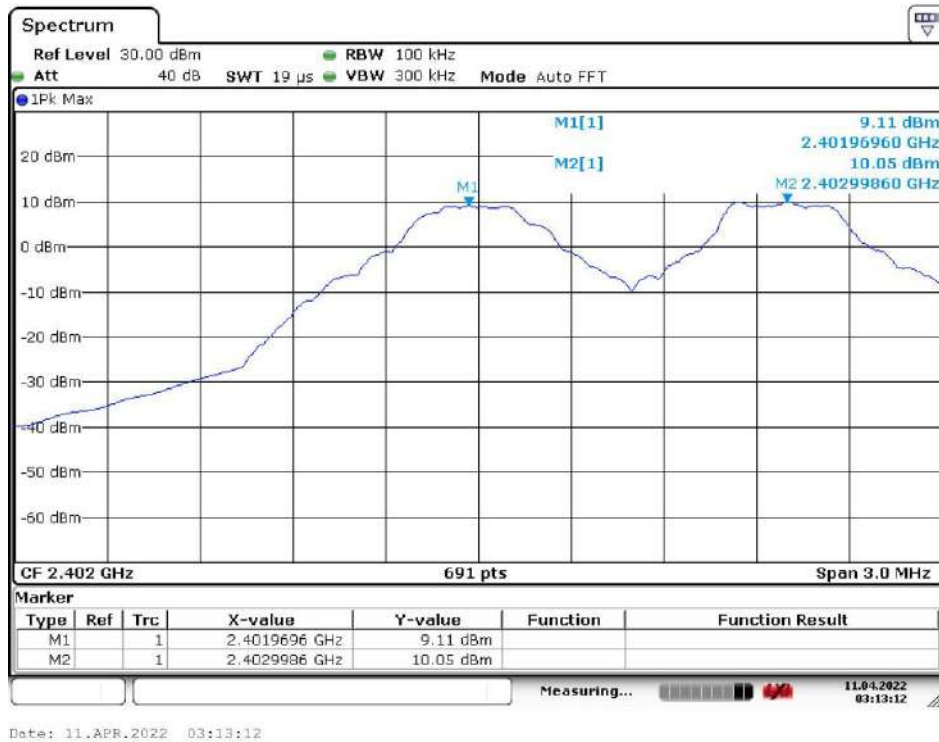
6.5.5 Test results

EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	26 °C	Relative Humidity:	53%
Pressure:	1010 hPa	Test Power :	DC 12V
Test Mode :	TX 1Mbps/ 2Mbps/ 3Mbps		

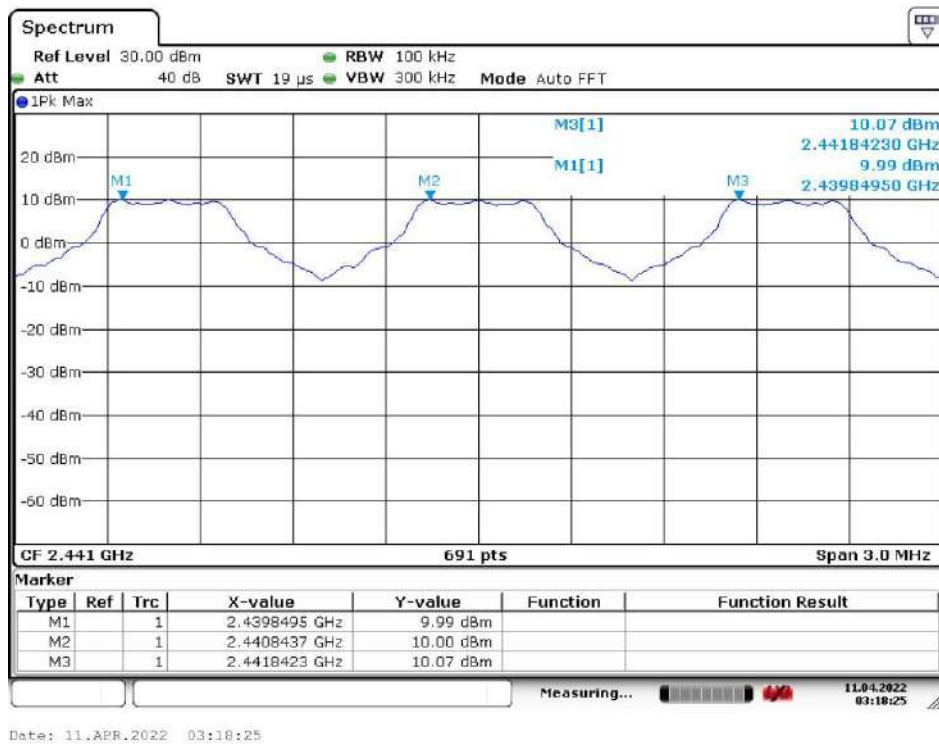
Channel		Channel frequency (MHz)	Channel Separation (MHz)	Conclusion
1Mbps	Low	2402	1.0290MHz	Pass
	Middle	2441	1.9928MHz	Pass
	Highest	2480	1.1418MHz	Pass
2Mbps	Low	2402	0.9986MHz	Pass
	Middle	2441	1.1549MHz	Pass
	Highest	2480	1.1592MHz	Pass
3Mbps	Low	2402	0.9986MHz	Pass
	Middle	2441	0.9986MHz	Pass
	Highest	2480	0.9986MHz	Pass

Ch. Separation >2/3(20dB bandwidth)

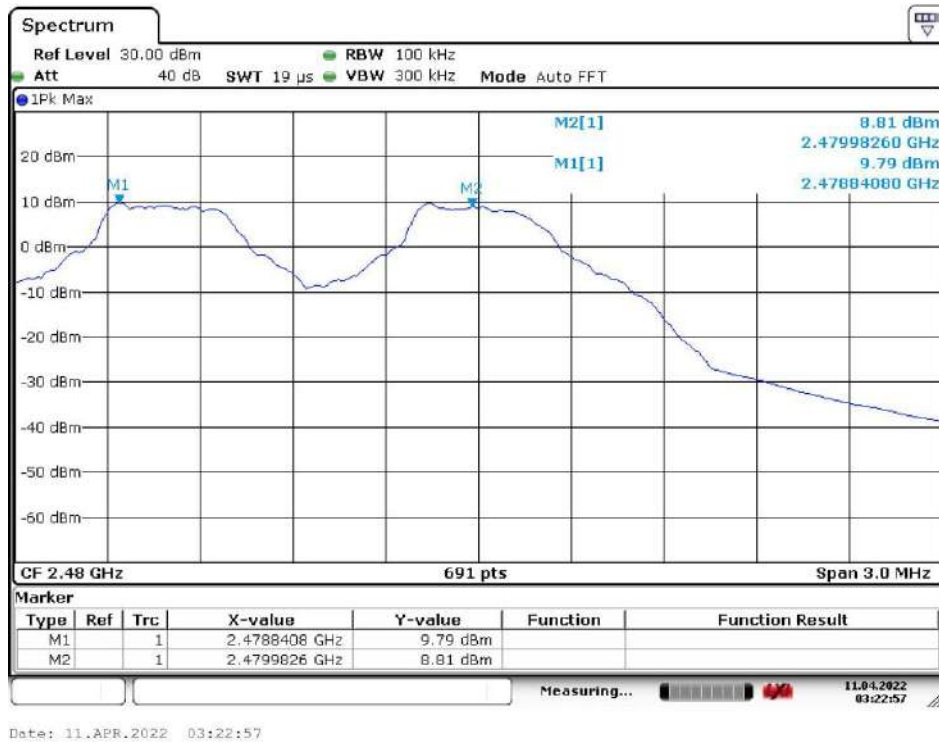
CH 00-1Mbps



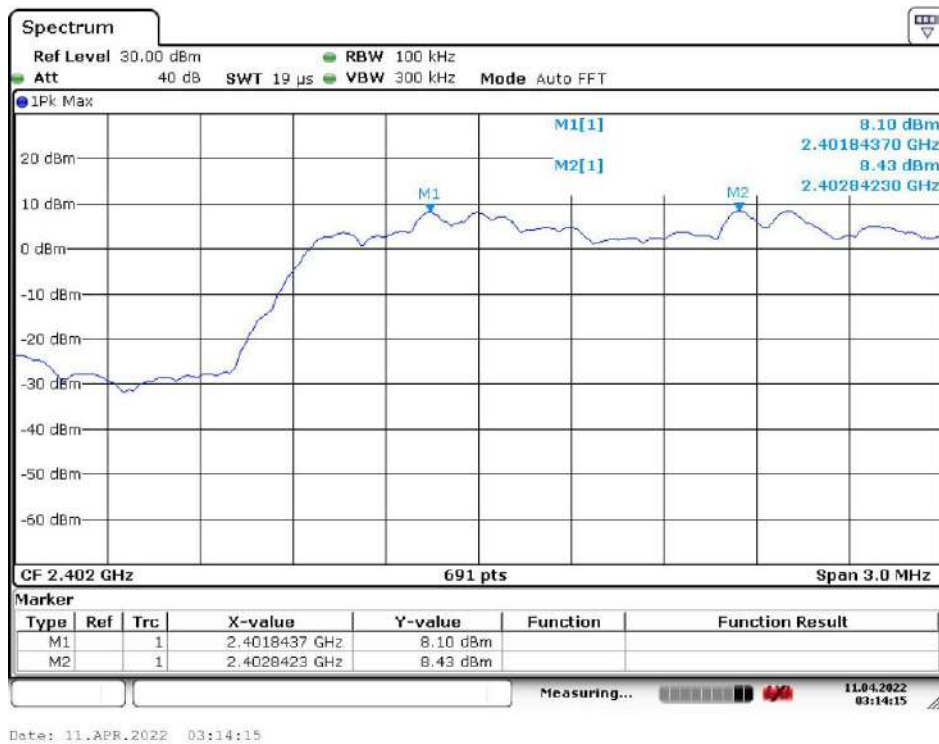
CH 39-1Mbps



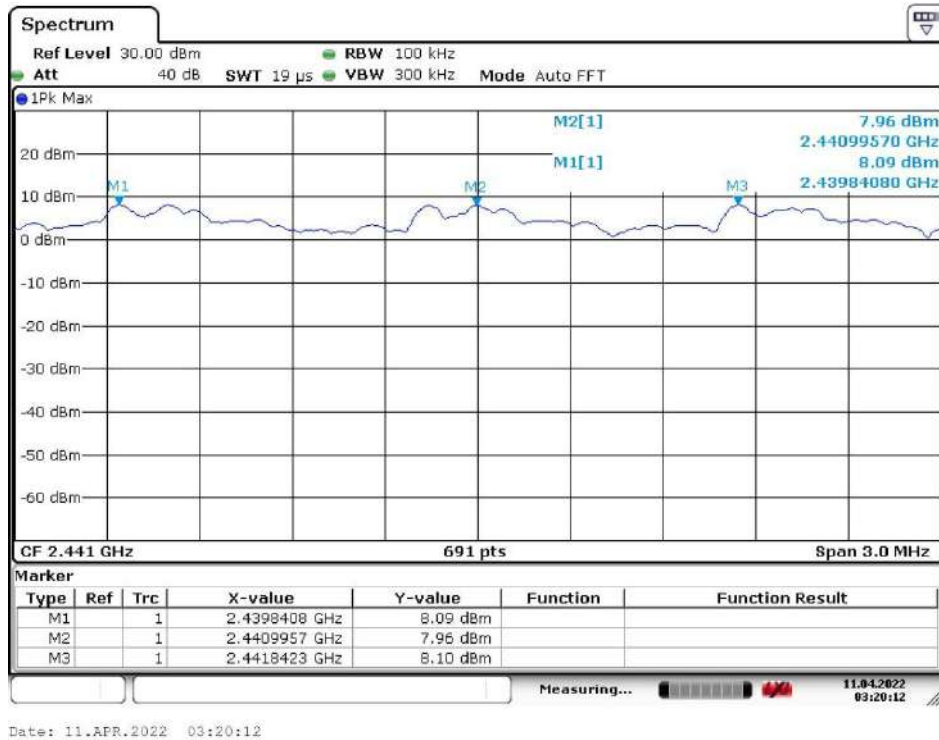
CH 78-1Mbps



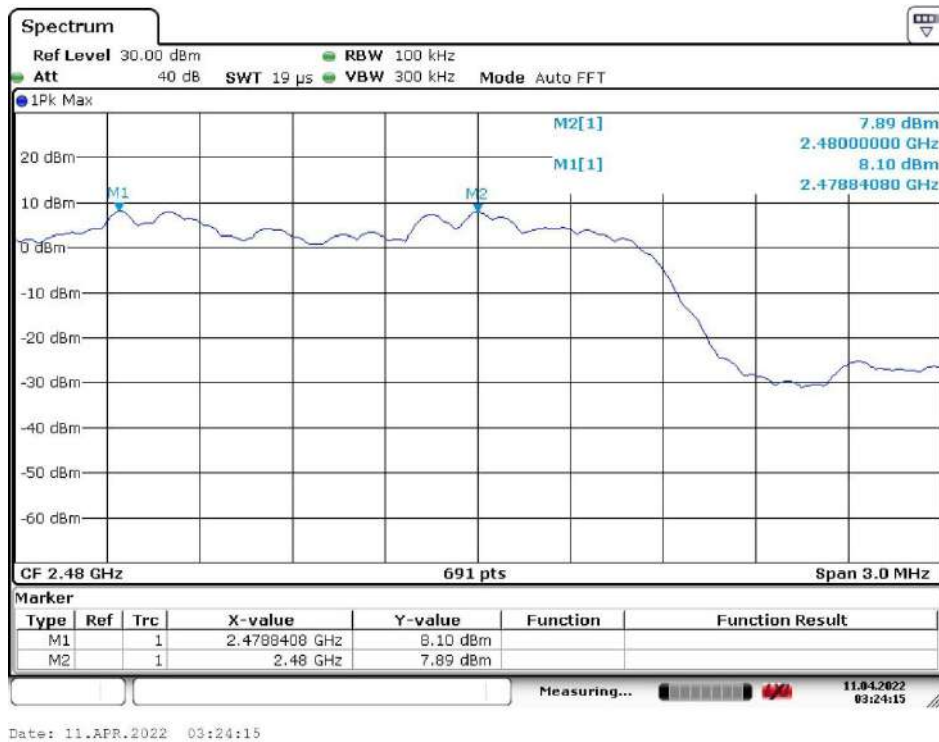
CH 00-2Mbps



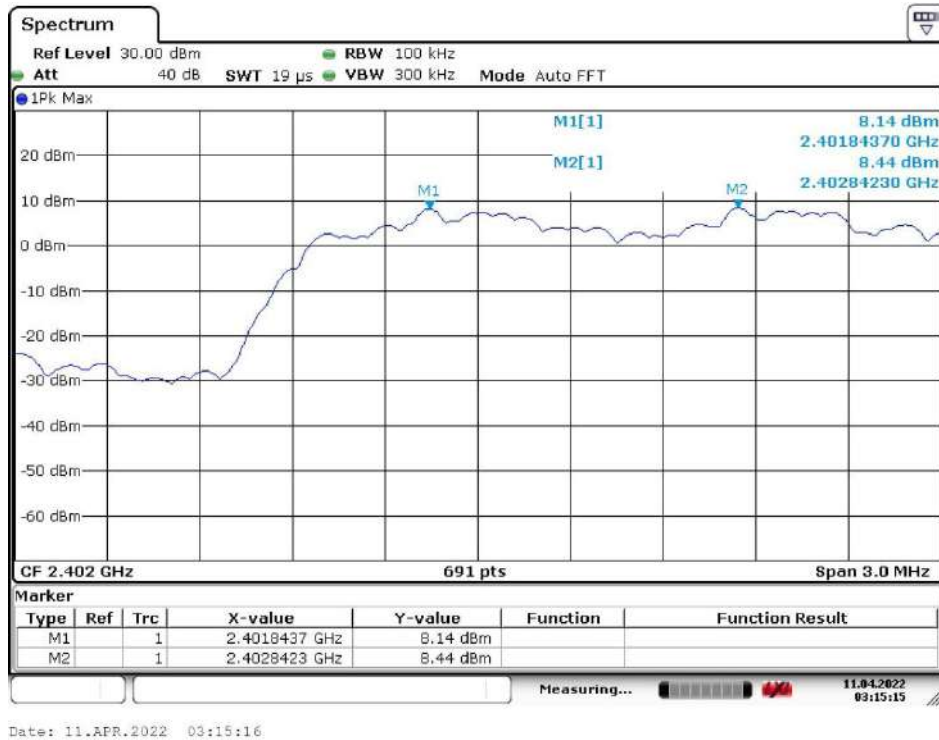
CH 39-2Mbps



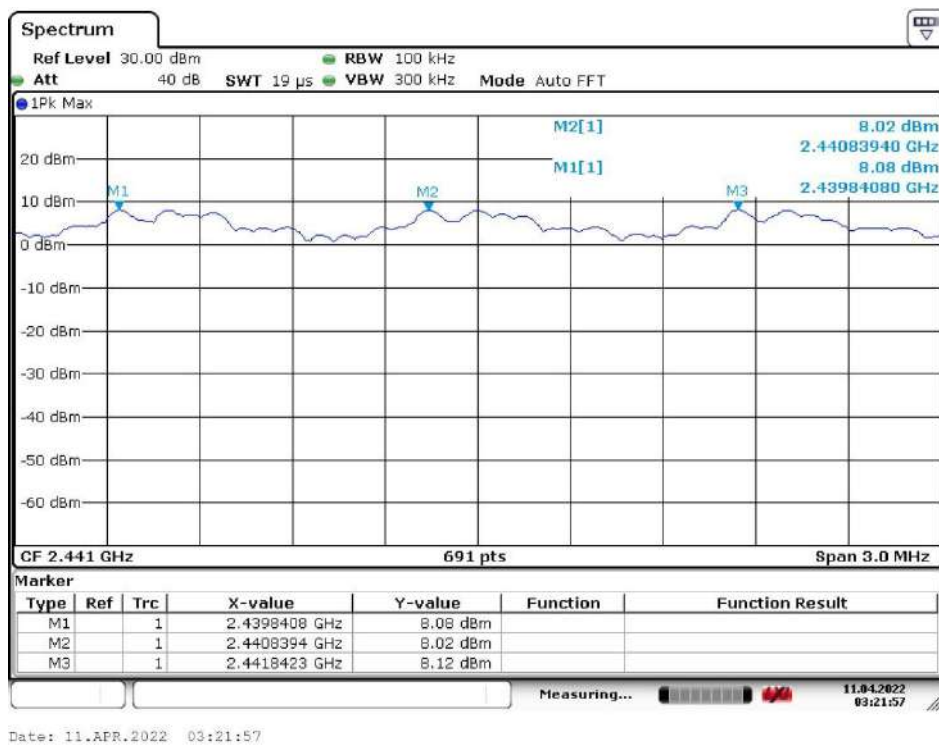
CH 78-2Mbps



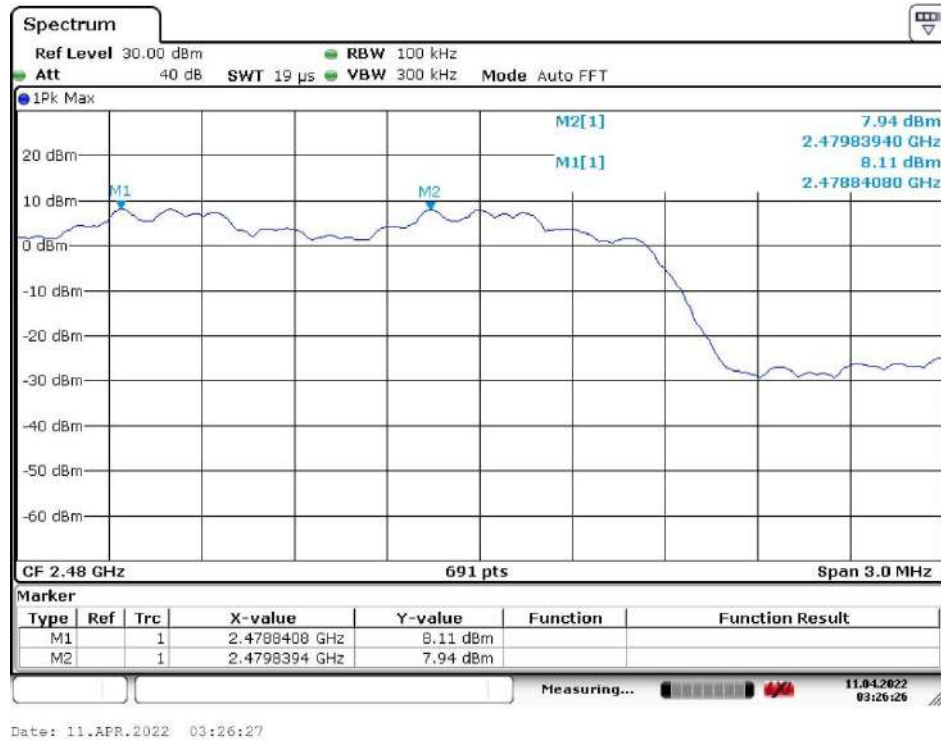
CH 00-3Mbps



CH 39-3Mbps



CH 78-3Mbps



6.6 Hopping Channel Number

6.6.1 Applied procedures / Limit

15.247(a) (1) (iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

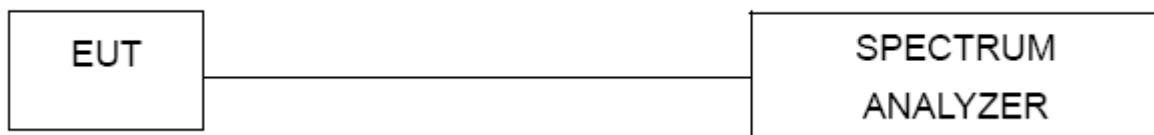
6.6.2 Test procedure

- (1) Connected the antenna port to the Spectrum Analyzer , set the Spectrum Analyzer as
Span = the frequency band of operation, RBW $\geq$ 1% of the span, VBW $\geq$ RBW Sweep = auto
Detector function = peak, Trace = max hold
- (2) The EUT should be have its hopping function enabled. Maxhold and record hopping channels It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies.

6.6.3 Deviation from standard

No deviation.

6.6.4 Test setup

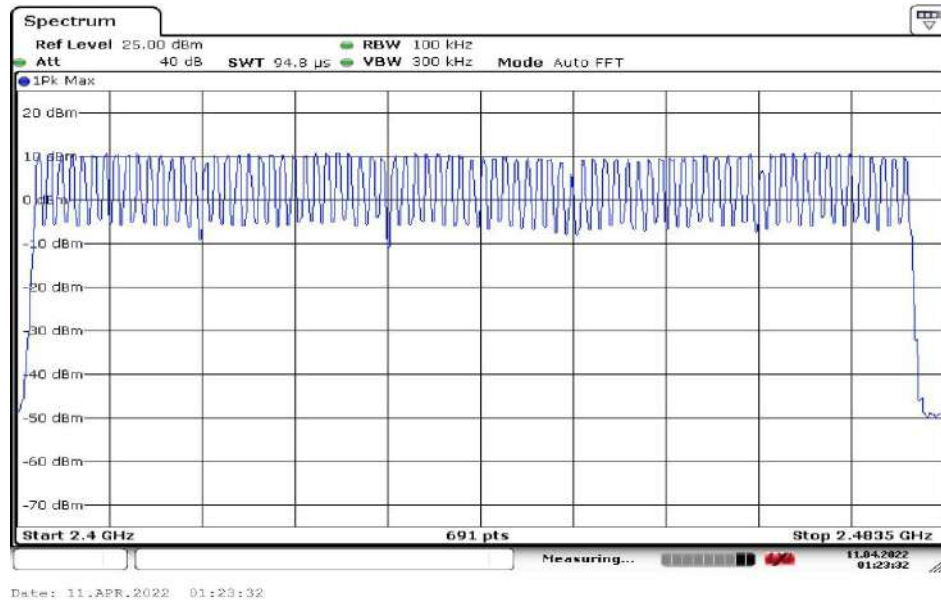


6.6.5 Test result

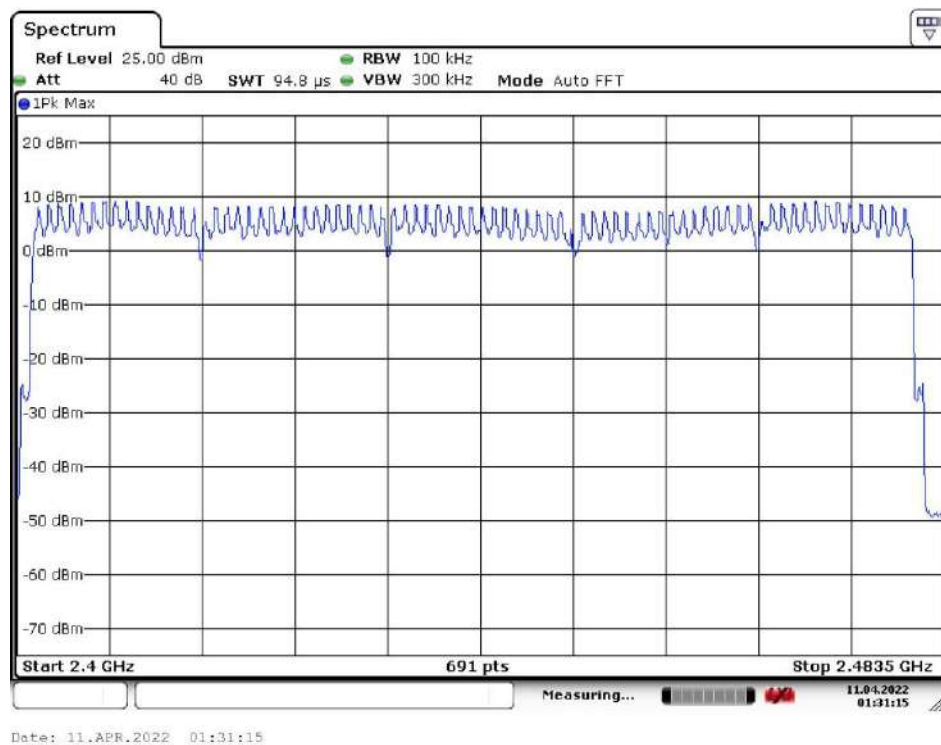
Hopping Channel Number result		
Operating Mode: 1Mbps/ 2Mbps/ 3Mbps Mode		Test date:2022-04-11
Result	Limit	Conclusion
79	>15	Pass

EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	26 °C	Relative Humidity:	53%
Pressure:	1010 hPa	Test Power :	DC 12V
Test Mode :	TX 1Mbps/ 2Mbps/ 3Mbps		

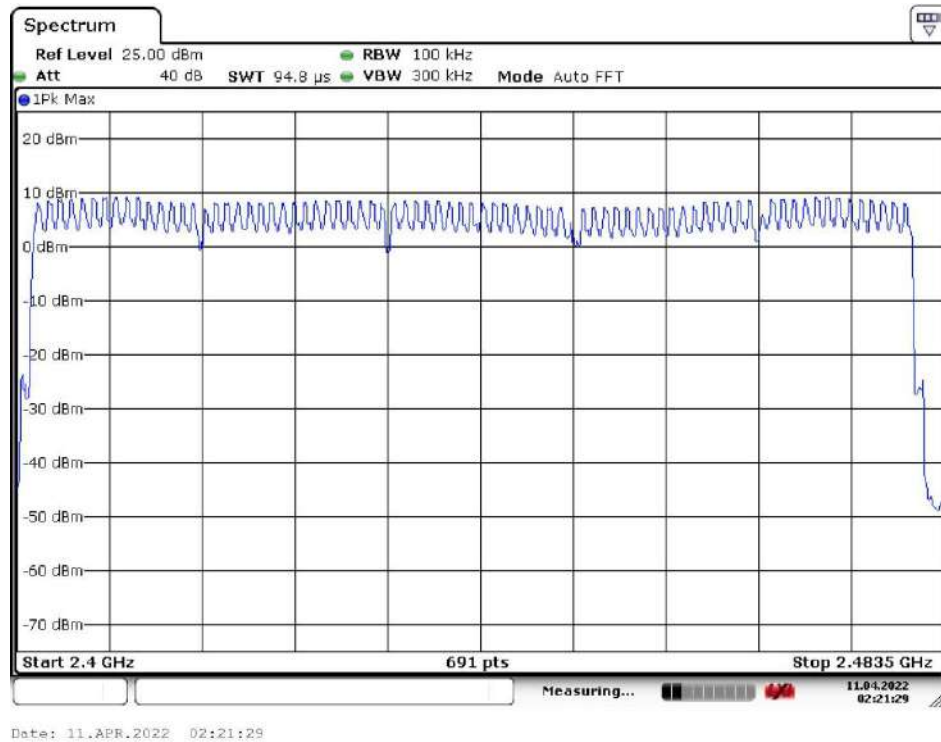
1Mbps



2Mbps



3Mbps



6.7 Dwell time

6.7.1 Applied procedures / Limit

15.247(a) (1) (iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

6.7.2 Test procedure

- (1) Place the EUT on the table in the chamber or connect the antenna port of the EUT to spectrum analyzer and set it in transmitting mode.
- (2) Set RBW of spectrum analyzer to 1MHz, VBW $\geq$ RBW
- (3) Use a video trigger with the trigger level set to enable triggering only on full pulses.
- (4) Sweep Time is more than once pulse time.
- (5) Set the center frequency on any frequency would be measure and set the frequency span to zero span.
- (6) Measure the maximum time duration of one single pulse.
- (7) Set the EUT for DH5, DH3 and DH1 packet transmitting.
- (8) Measure the maximum time duration of one single pulse.
- (9) A Period Time = $79 \times 0.4 = 31.6$ S
 - DH1 Time Slot: Reading * $(1600/2) \times 31.6/79$
 - DH3 Time Slot: Reading * $(1600/4) \times 31.6/79$
 - DH5 Time Slot: Reading * $(1600/6) \times 31.6/79$

6.7.3 Deviation from standard

No deviation.

6.7.4 Test setup

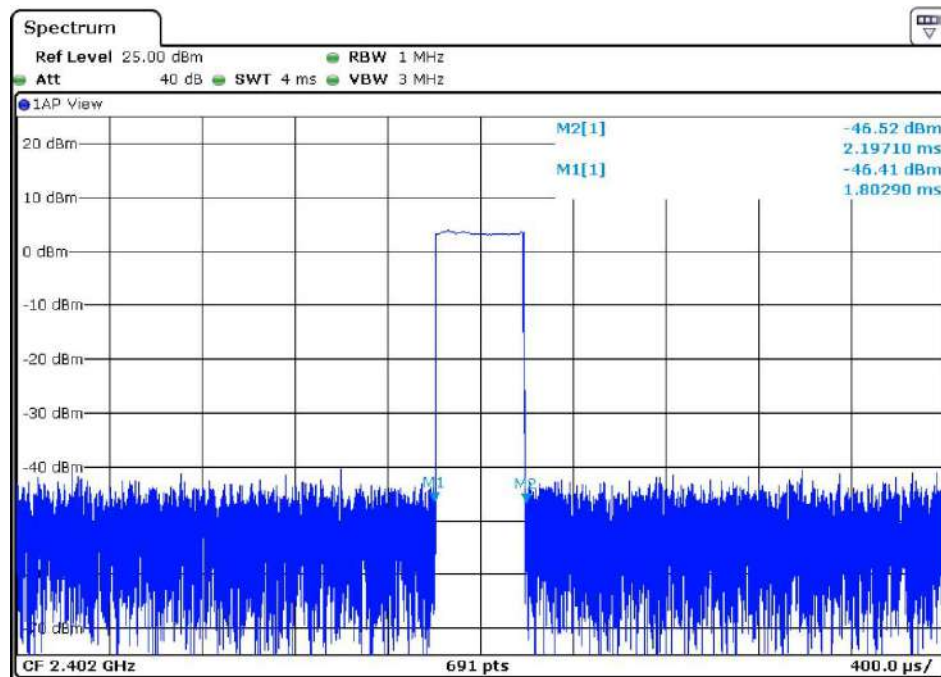


6.7.5 Test result

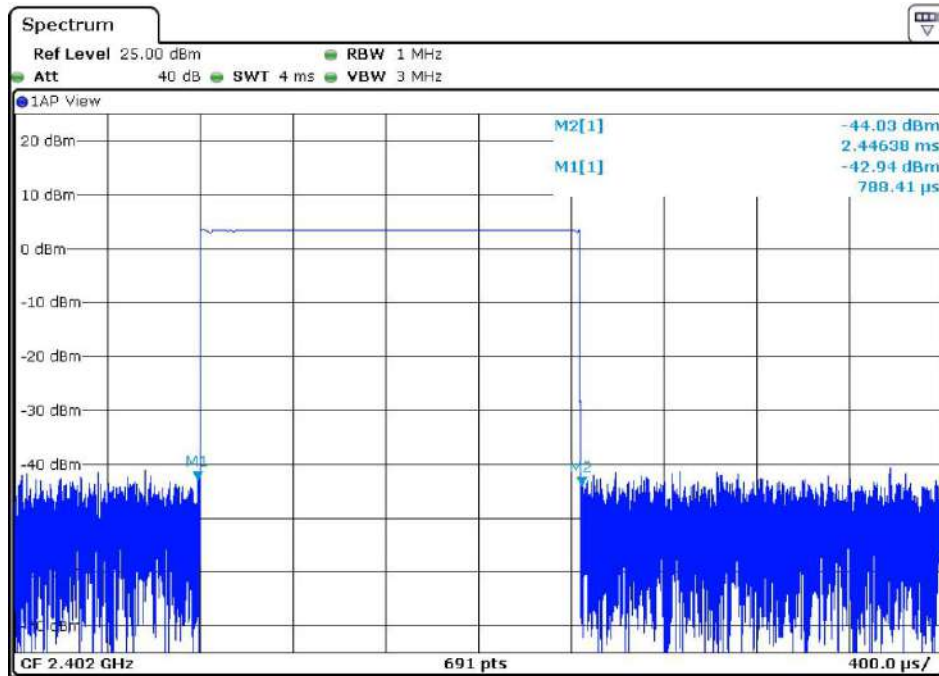
EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	26 °C	Relative Humidity:	53%
Pressure:	1010 hPa	Test Power :	DC 12V
Test Mode :	CH00-DH1/DH3/DH5 (1Mbps Mode)		

Data Packet	Frequency	Pulse Duration (ms)	Dwell Time (ms)	Limits (s)
DH1	2402 MHz	0.3942	126.144	0.4000
DH3	2402 MHz	1.65797	265.275	0.4000
DH5	2402 MHz	2.91015	310.416	0.4000

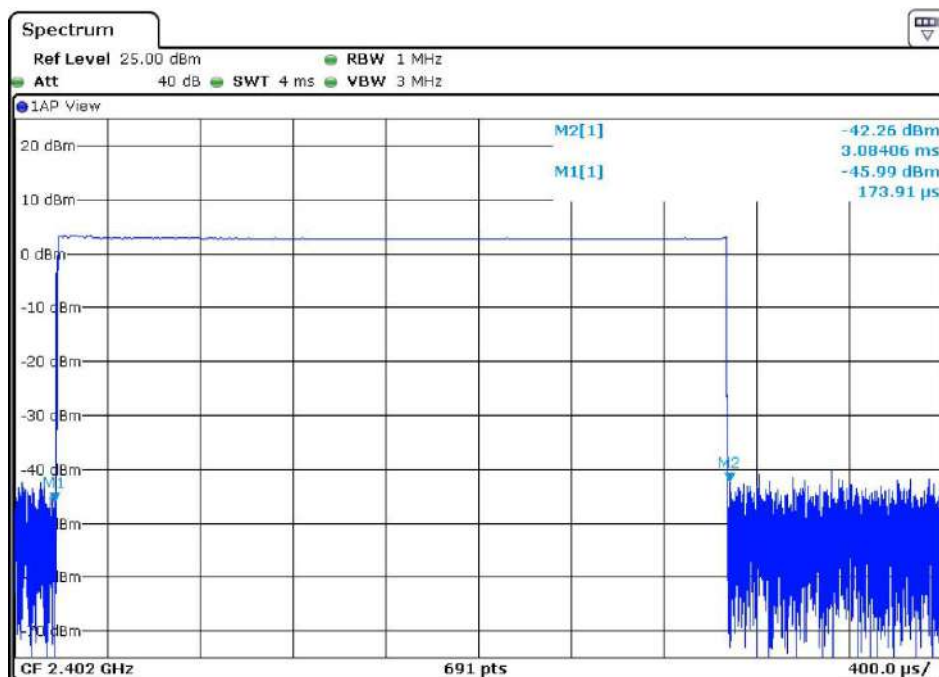
CH 00- DH1



CH 00- DH3



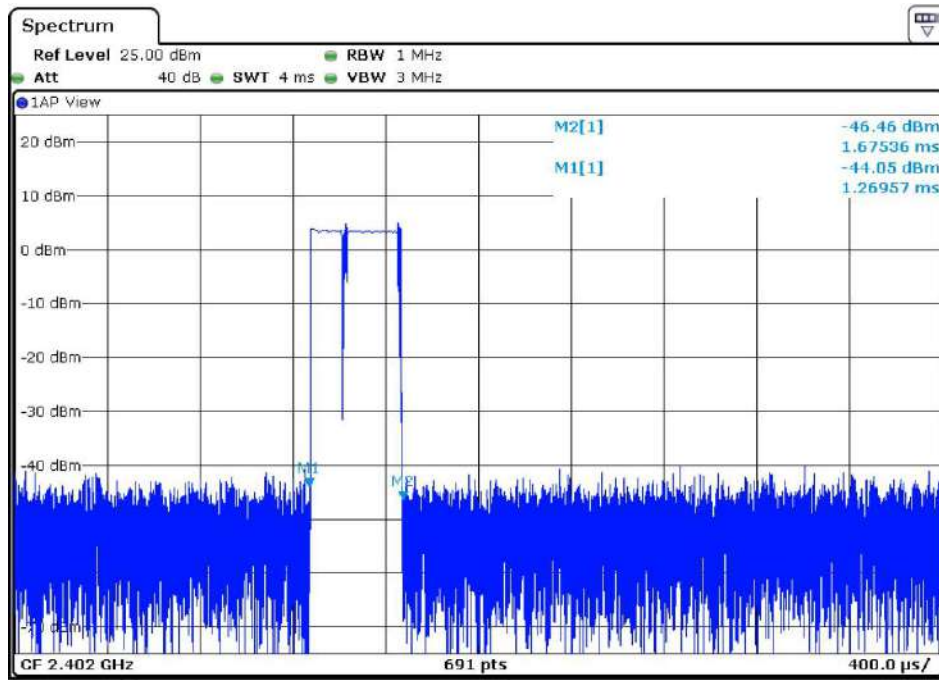
CH 00- DH5



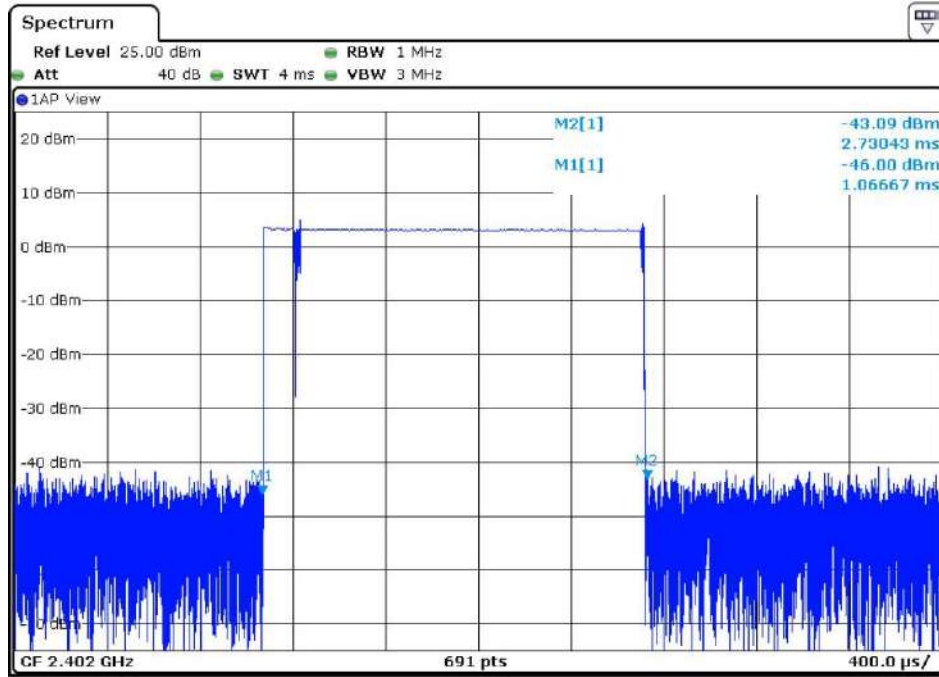
EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	26 °C	Relative Humidity:	53%
Pressure:	1010 hPa	Test Power :	DC 12V
Test Mode :	CH00-2DH1/2DH3/2DH5 (2Mbps Mode)		

Data Packet	Frequency	Pulse Duration (ms)	Dwell Time (ms)	Limits (s)
2DH1	2402 MHz	0.40579	129.852	0.4000
2DH3	2402 MHz	1.66376	266.201	0.4000
2DH5	2402 MHz	2.91015	310.416	0.4000

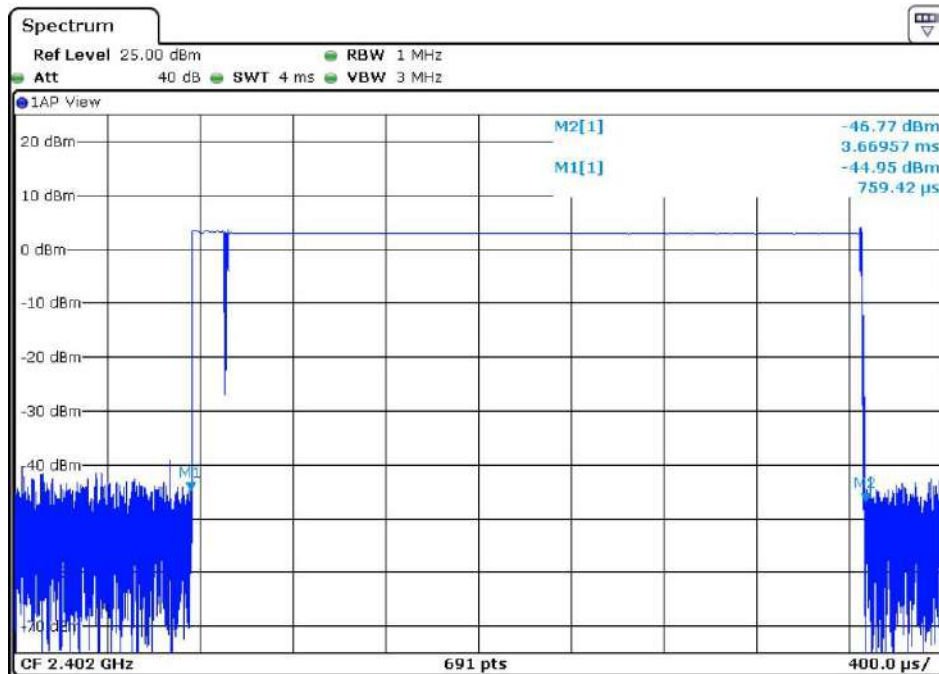
CH 00- DH1



CH 00- DH3



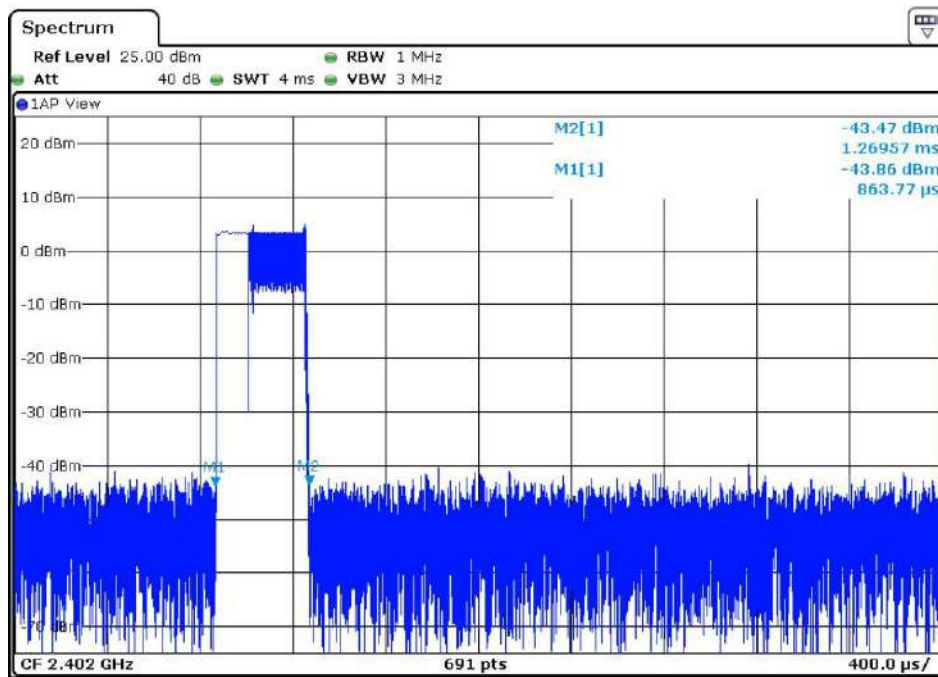
CH 00- DH5



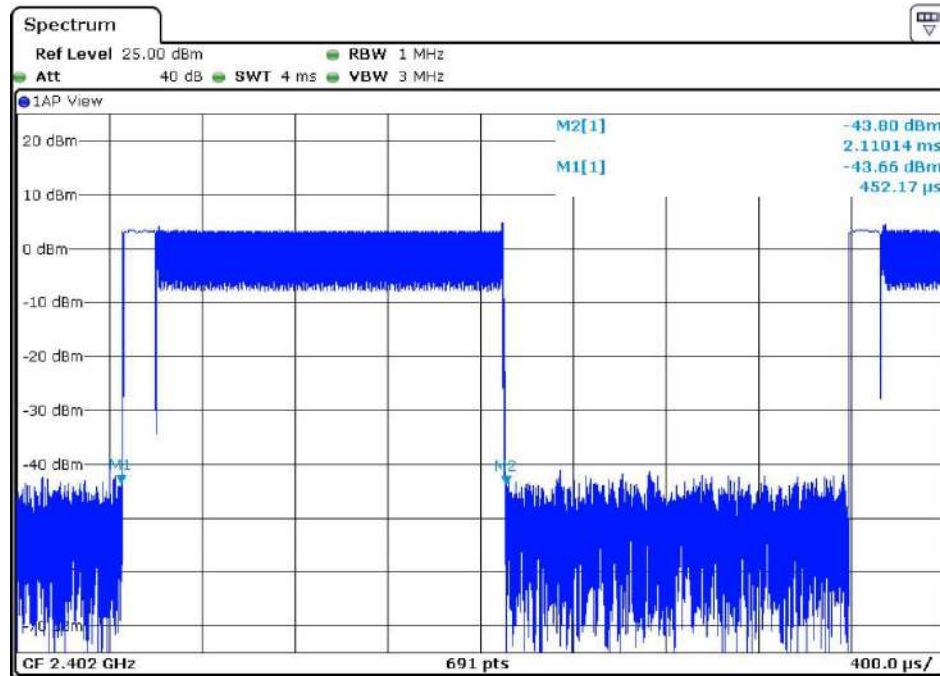
EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	26 °C	Relative Humidity:	53%
Pressure:	1010 hPa	Test Power :	DC 12V
Test Mode :	CH00-3DH1/3DH3/3DH5 (3Mbps Mode)		

Data Packet	Frequency	Pulse Duration (ms)	Dwell Time (ms)	Limits (s)
3DH1	2402 MHz	2.91014	931.244	0.4000
3DH3	2402 MHz	0.4058	64.928	0.4000
3DH5	2402 MHz	2.91014	310.414	0.4000

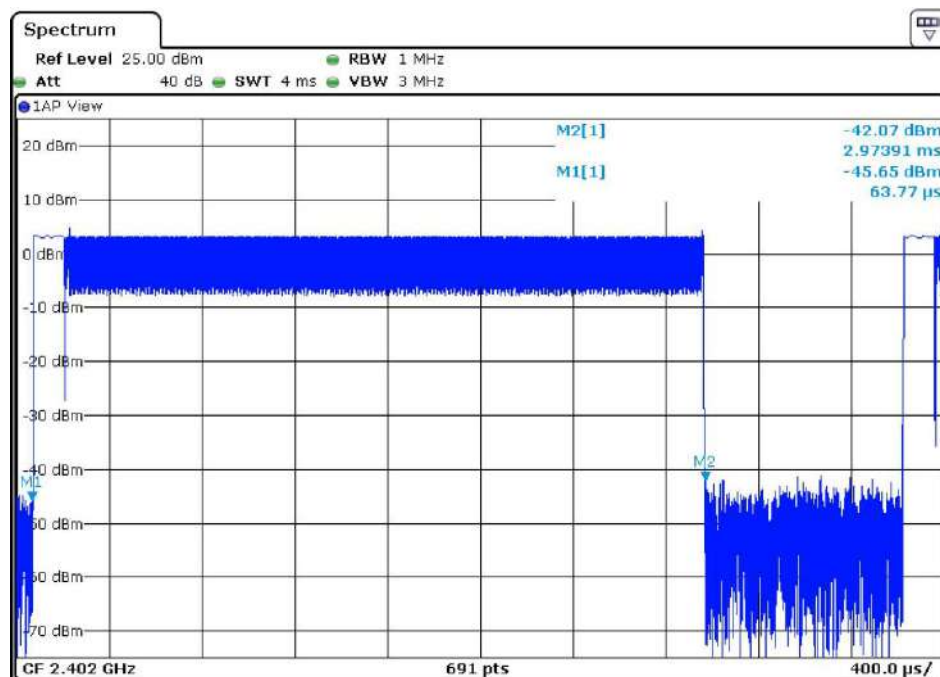
CH 00- DH1



CH 00- DH3



CH 00- DH5



6.8 Maximum Peak Output Power

6.8.1 Applied procedures / Limit

15.247(a) (1) 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.

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: 1watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

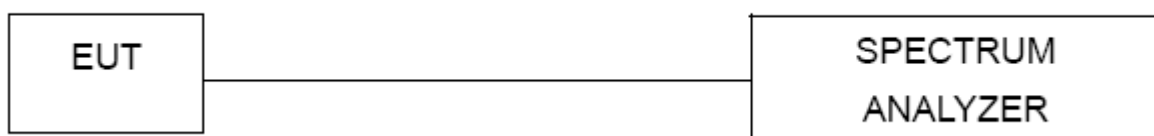
6.8.2 Test procedure

- (1) Connected the antenna port to the Spectrum Analyzer, set the Spectrum Analyzer as
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
RBW > the 20 dB bandwidth of the emission being measured, VBW ≥ RBW, Sweep = auto
Detector function = peak, Trace = max hold
- (2) The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.
- (3) The above procedure shall be repeated at the lowest, the middle, and the highest frequency of the stated frequency range with modulated mode. Also shall be performed at different modes of operation.

6.8.3 Deviation from standard

No deviation.

6.8.4 Test setup

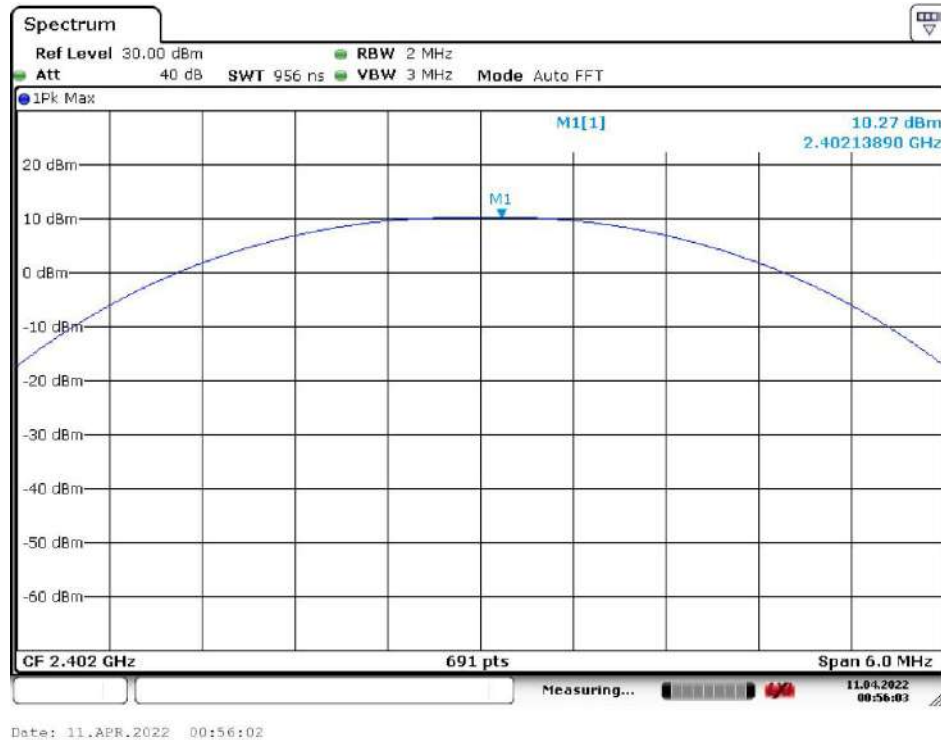


6.8.5 Test results

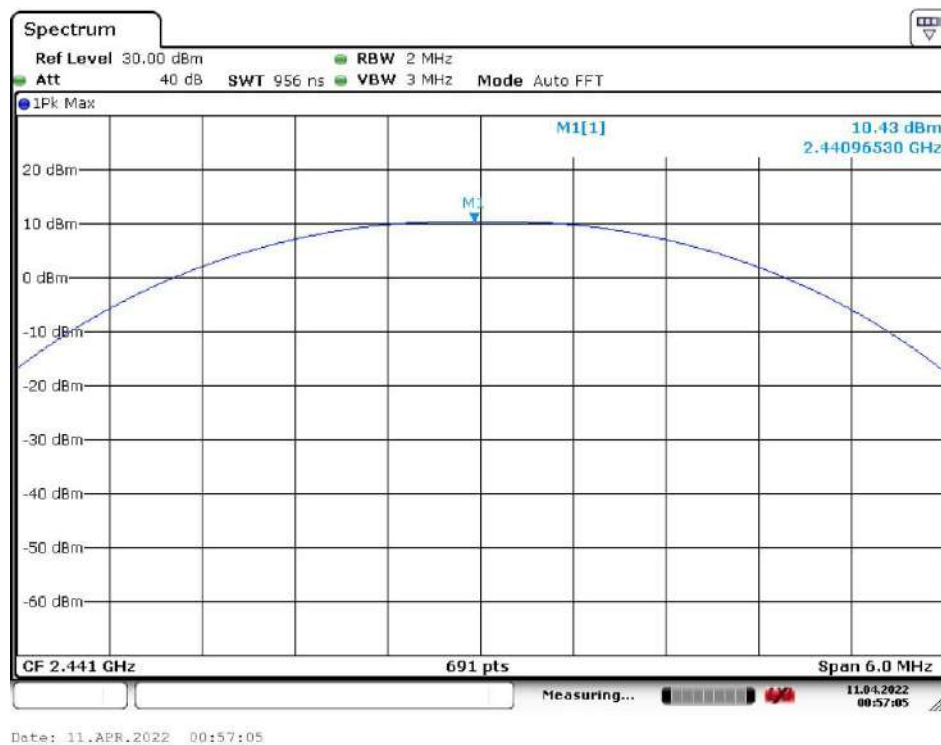
EUT:	VVDN_QCS610_410_EVK	Model Name. :	QCS610 EVK (SOM+Carrier)
Temperature:	26 °C	Relative Humidity:	53%
Pressure:	1010 hPa	Test Power :	DC 12V
Test Mode :	TX 1Mbps/ 2Mbps/ 3Mbps		
Note: All the data rates have be tested and the worst-case as the table below.			

Test Mode	Frequency	Peak Output Power (dBm)	Limit (dBm)	Result
Data rate 1Mbps	2402 MHz	10.27	21	Pass
	2441 MHz	10.43	21	Pass
	2480 MHz	10.08	21	Pass
Data rate 2Mbps	2402 MHz	9.77	21	Pass
	2441 MHz	9.56	21	Pass
	2480 MHz	9.33	21	Pass
Data rate 3Mbps	2402 MHz	9.76	21	Pass
	2441 MHz	9.97	21	Pass
	2480 MHz	9.52	21	Pass
Cable loss = 1.0 dBm				

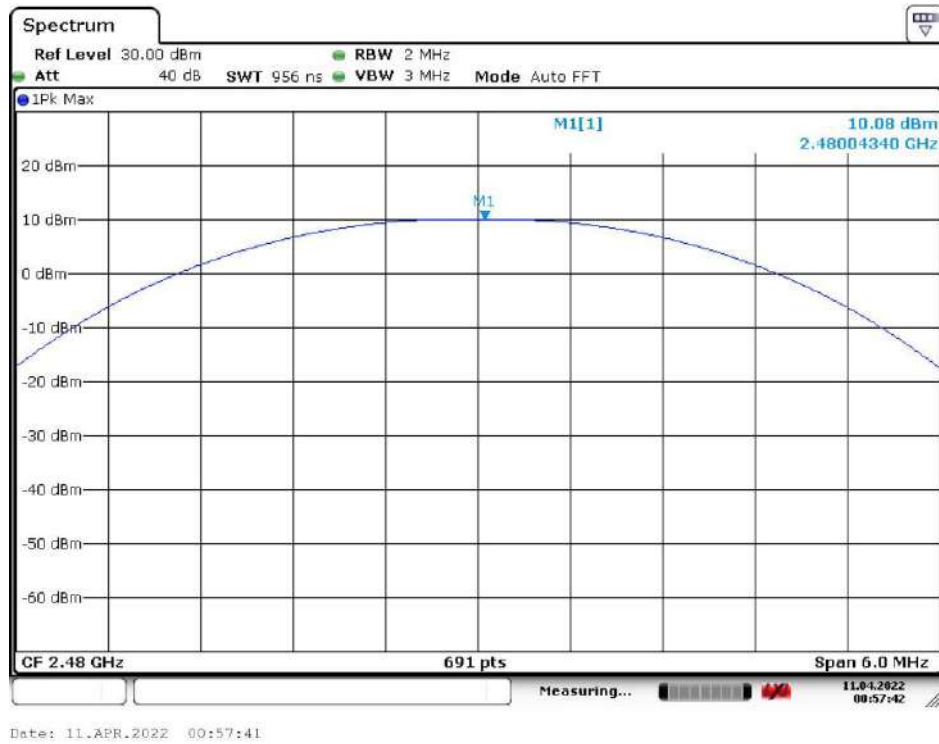
CH 00-1Mbps



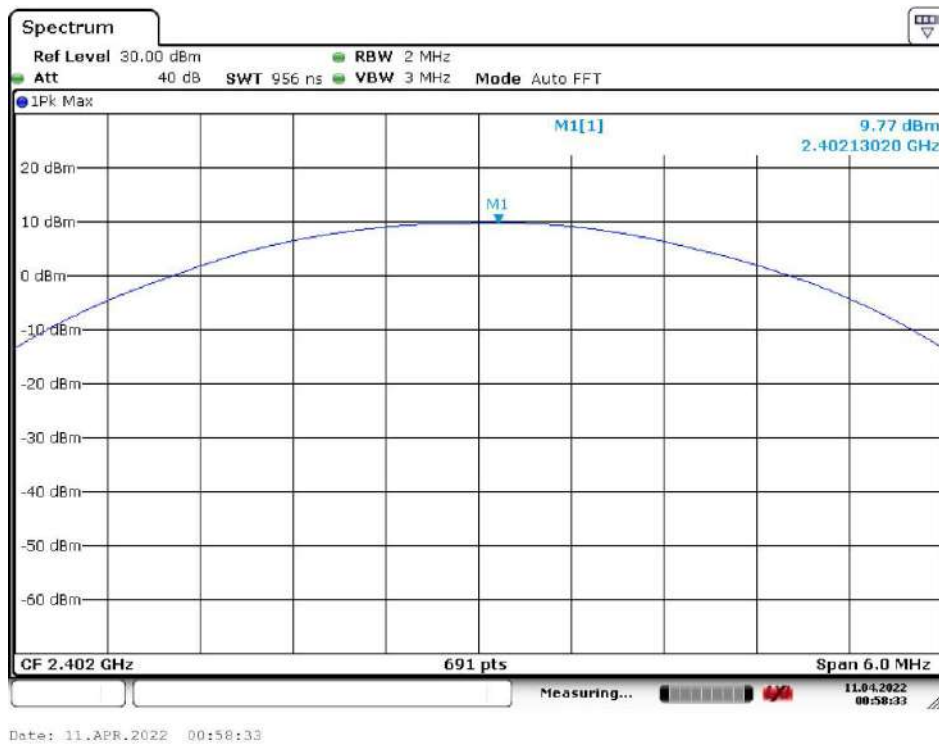
CH 39-1Mbps



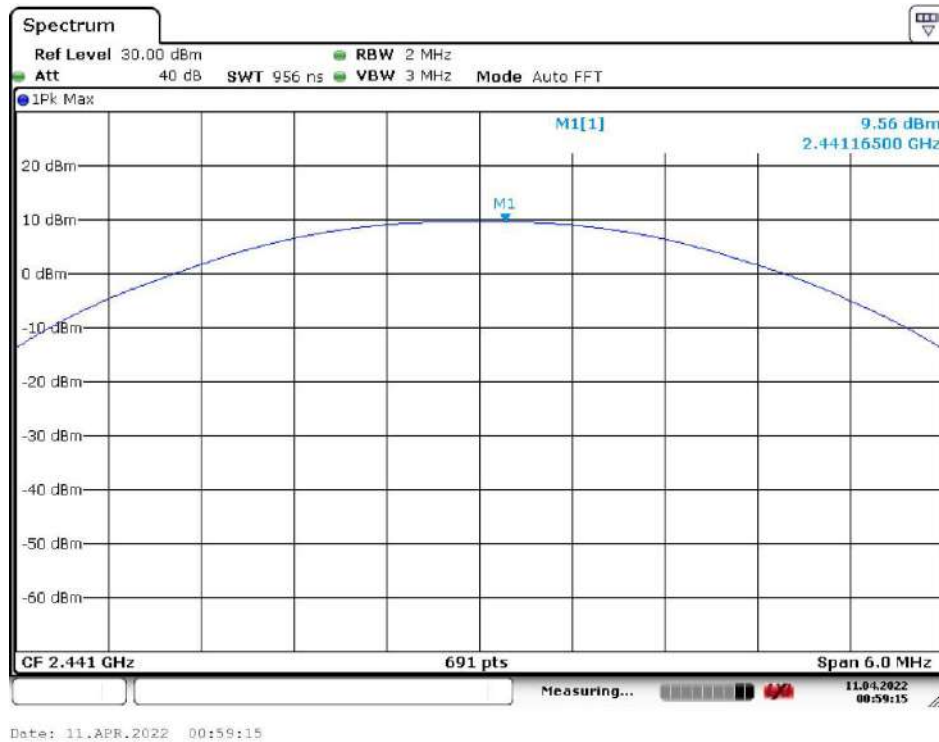
CH 78-1Mbps



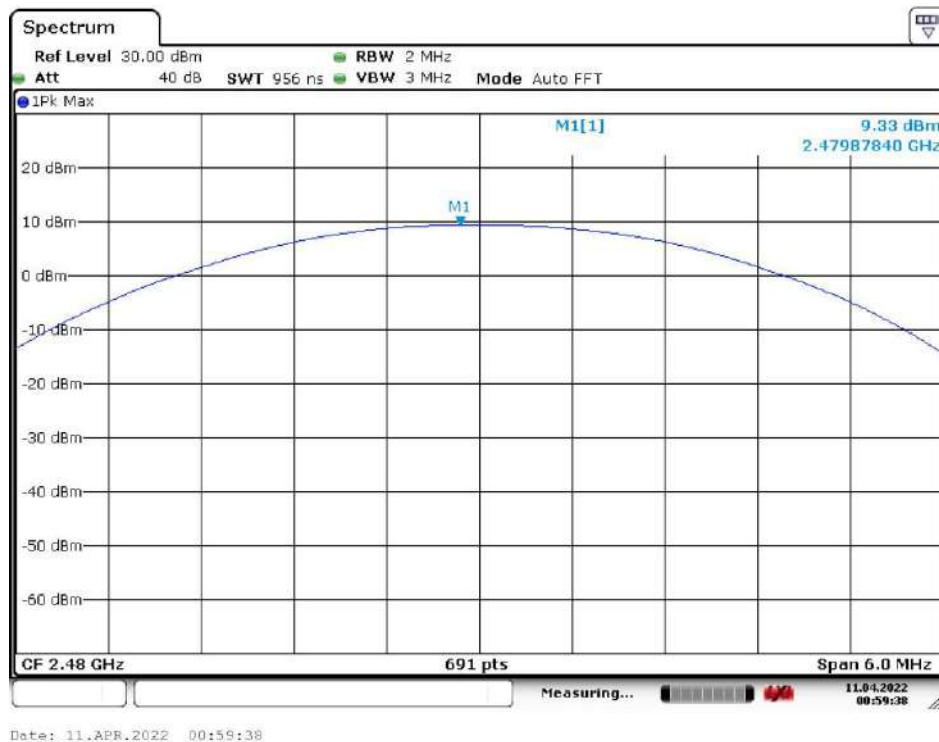
CH 00-2Mbps



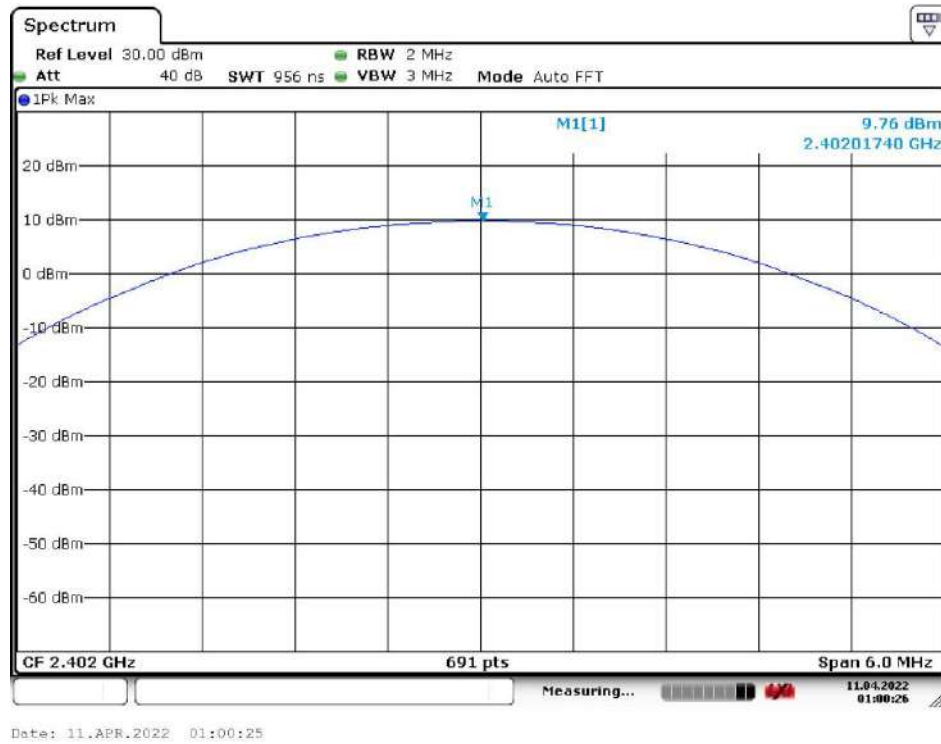
CH 39-2Mbps



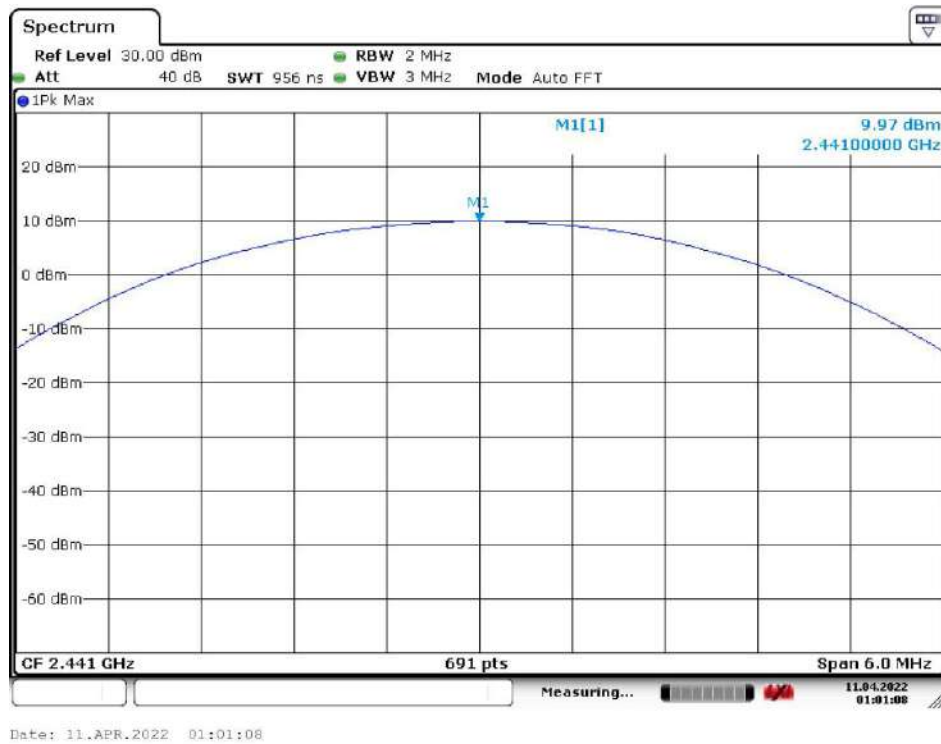
CH 78-2Mbps



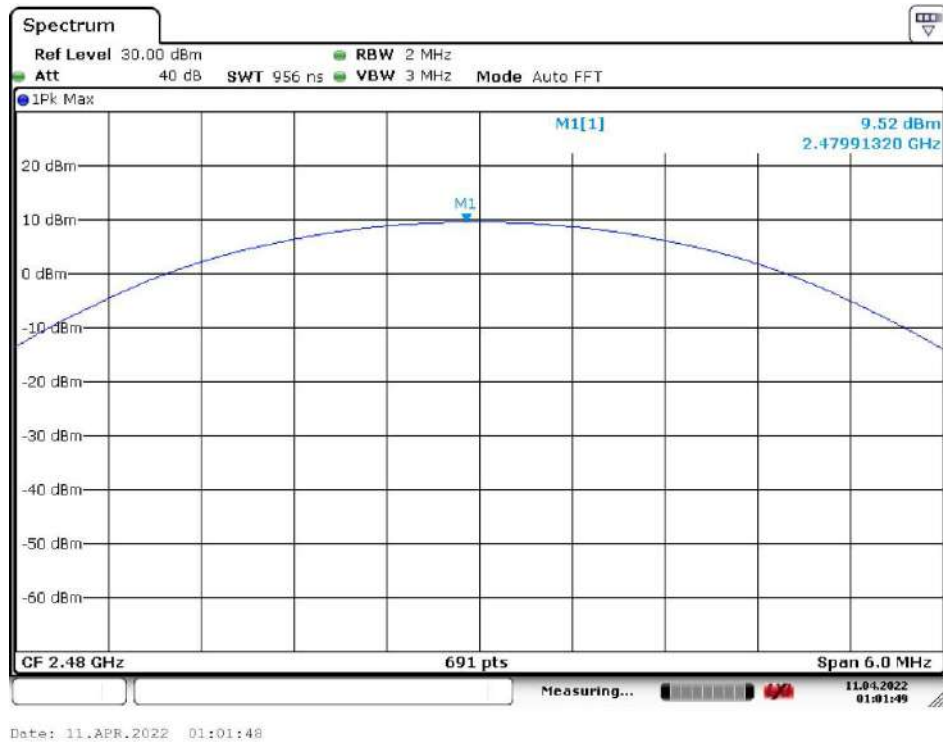
CH 00-3Mbps



CH 39-3Mbps



CH 78-3Mbps



6.9 Band edge

6.9.1 Applied procedures / Limit

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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

6.9.2 Test procedure

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation, RBW $\geq$ 1% of the span, VBW $\geq$ RBW, Sweep = auto, Detector function = peak, Trace = max hold

6.9.3 Deviation from standard

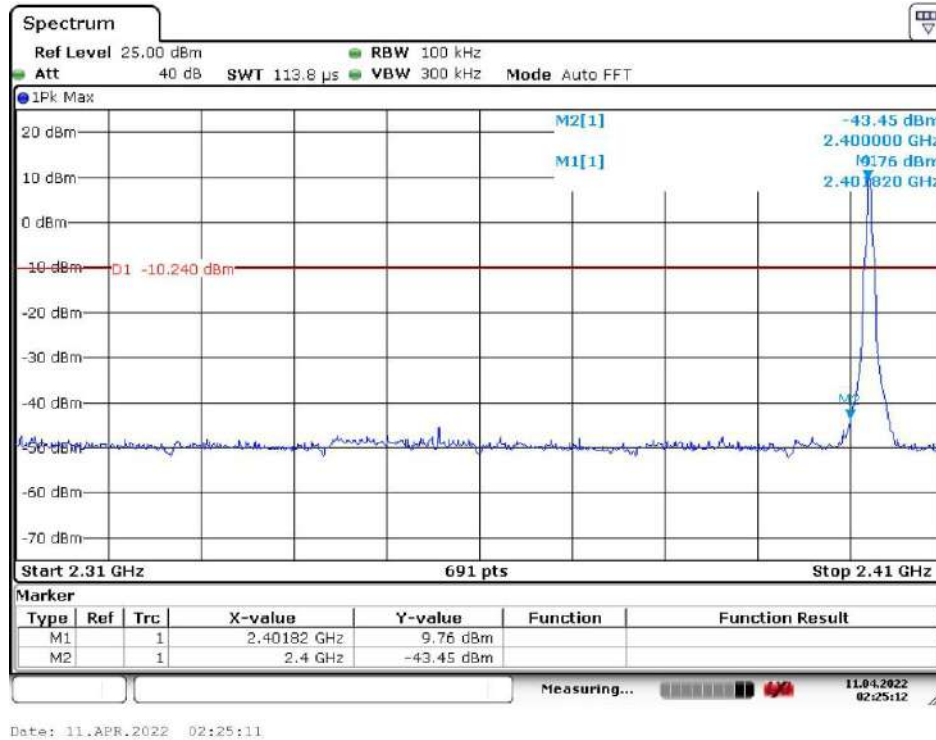
No deviation.

6.9.4 Test setup

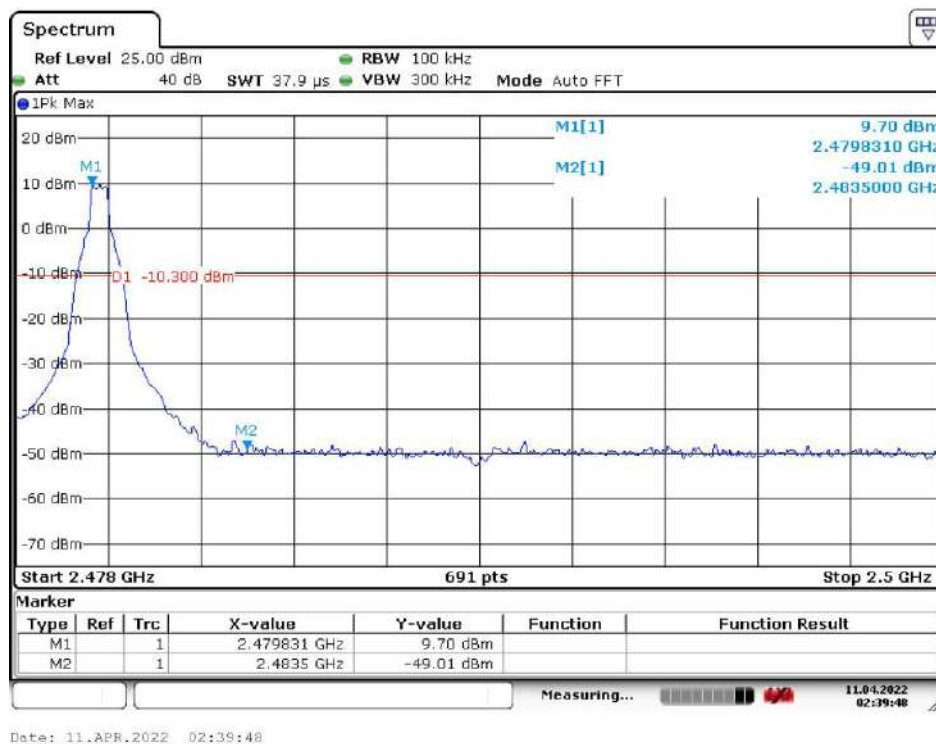


6.9.5 Test results

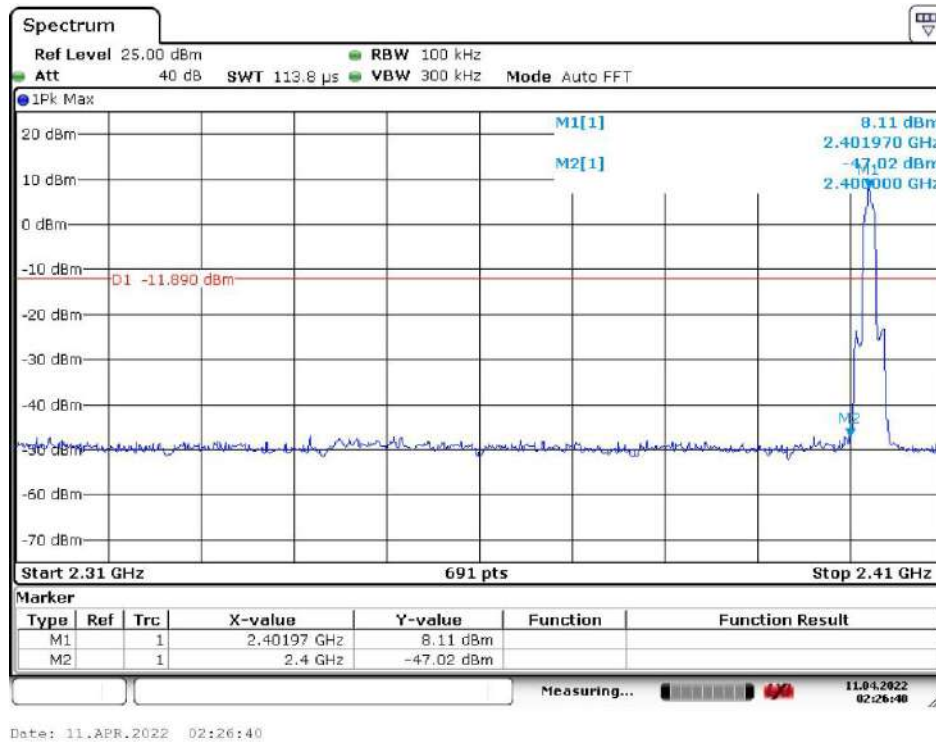
CH00 (Lower) Data rate 1Mbps



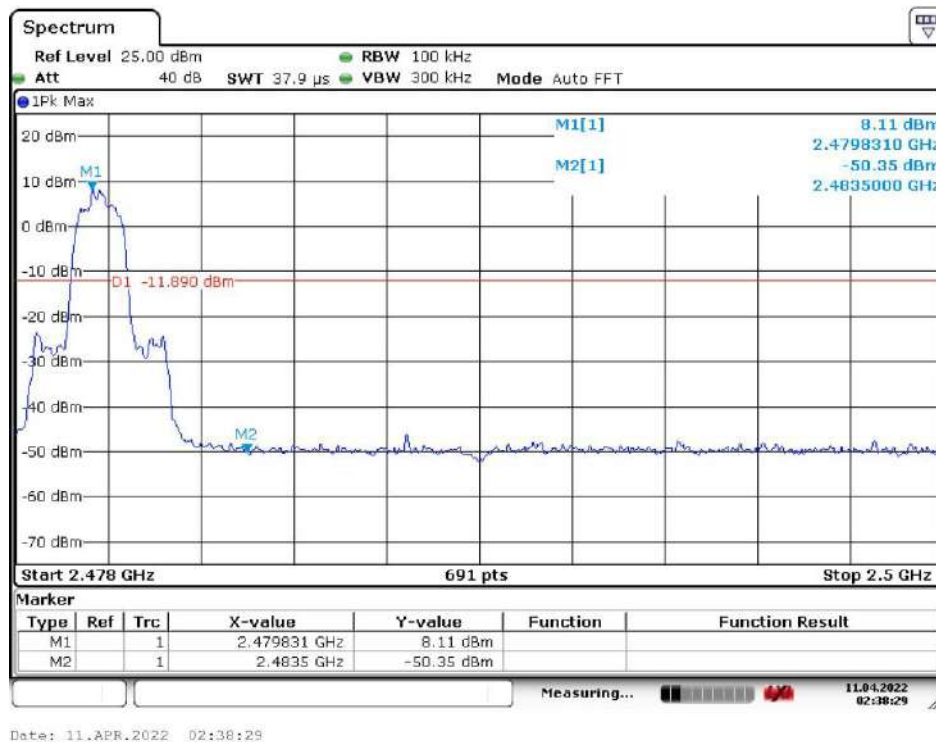
CH 78 (Upper) Data rate 1Mbps



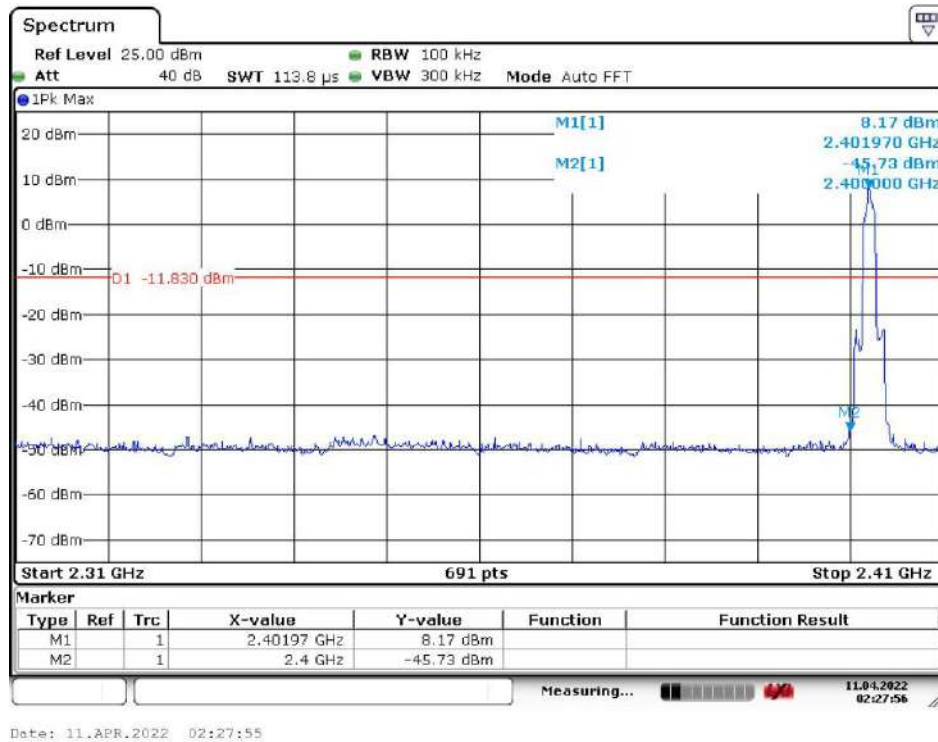
CH00 (Lower) Data rate 2Mbps



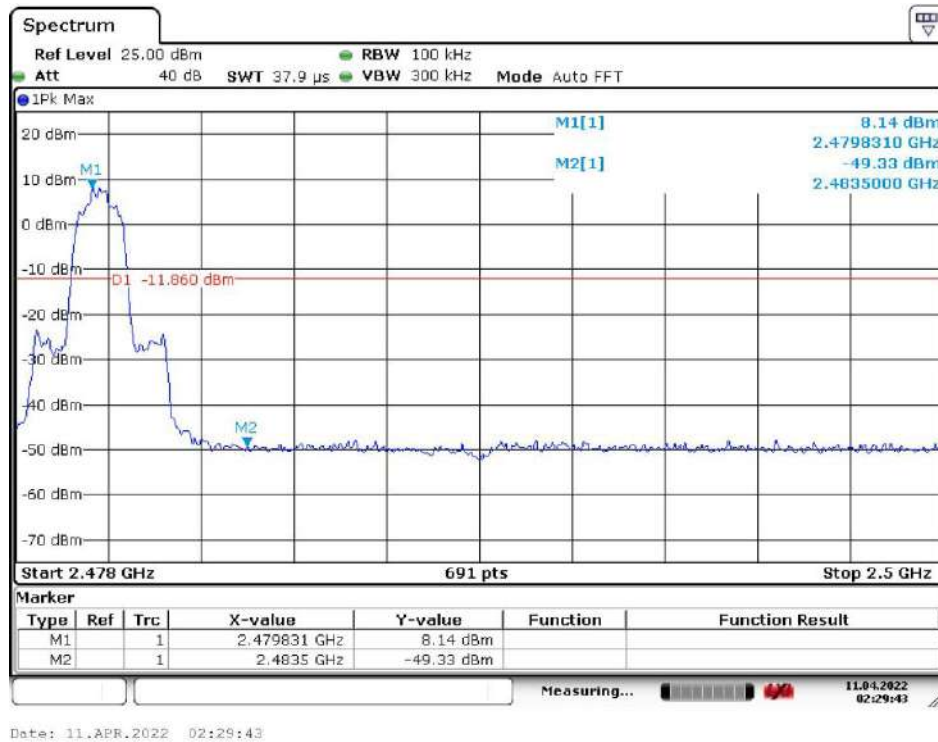
CH 78 (Upper) Data rate 2Mbps



CH00 (Lower) Data rate 3Mbps



CH 78 (Upper) Data rate 3Mbps



6.10 Conducted Spurious Emissions

6.10.1 Applied procedures / Limit

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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

6.10.2 Test procedure

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span. RBW = 100 kHz
VBW $\geq$ RBW, Sweep = auto, Detector function = peak, Trace = max hold
sweep points $\geq$ investigated frequency range/RBW.

6.10.3 Deviation from standard

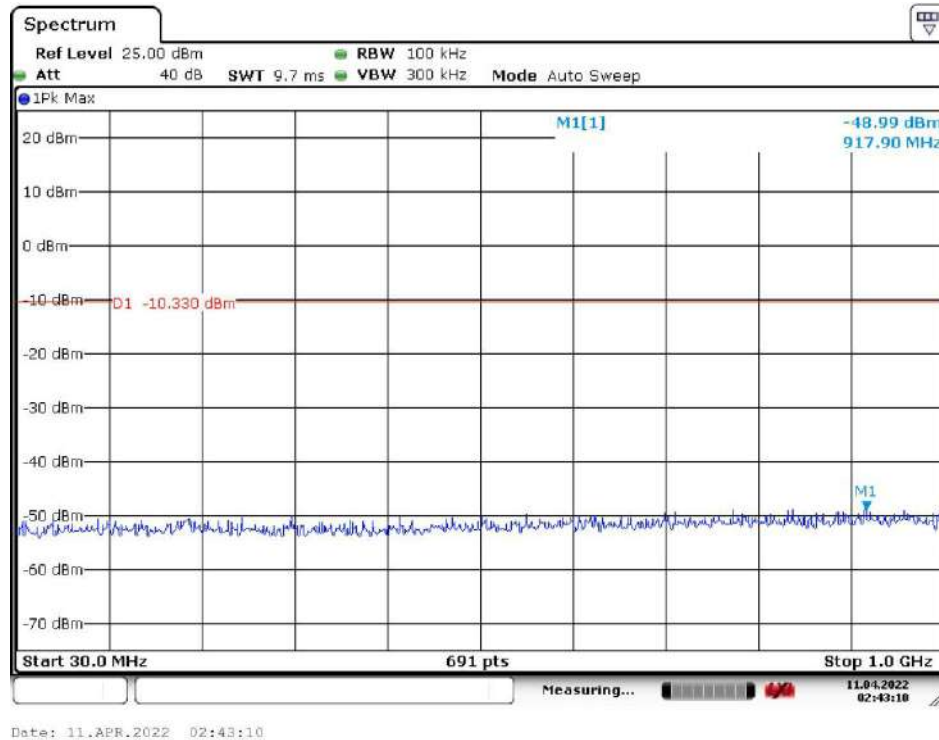
No deviation.

6.10.4 Test setup

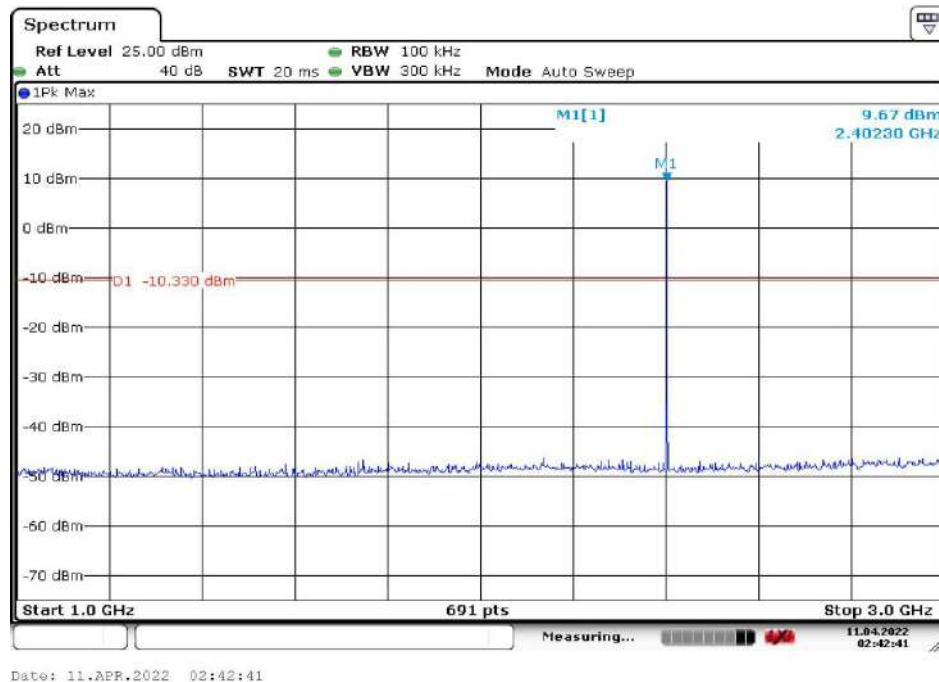


6.10.5 Test results

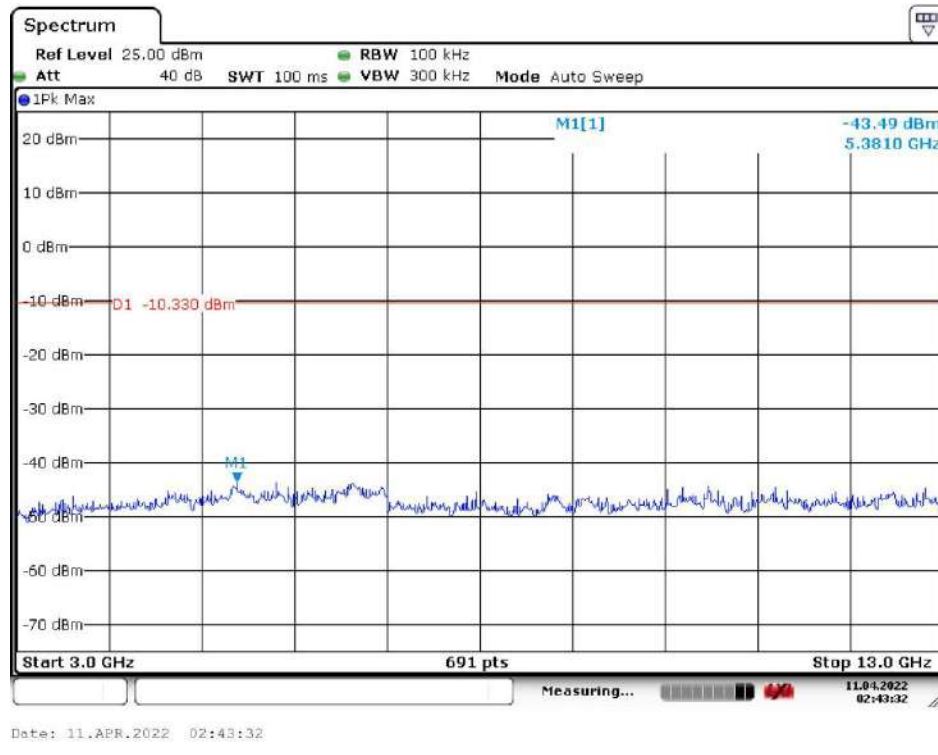
CH00 Data rate 1Mbps



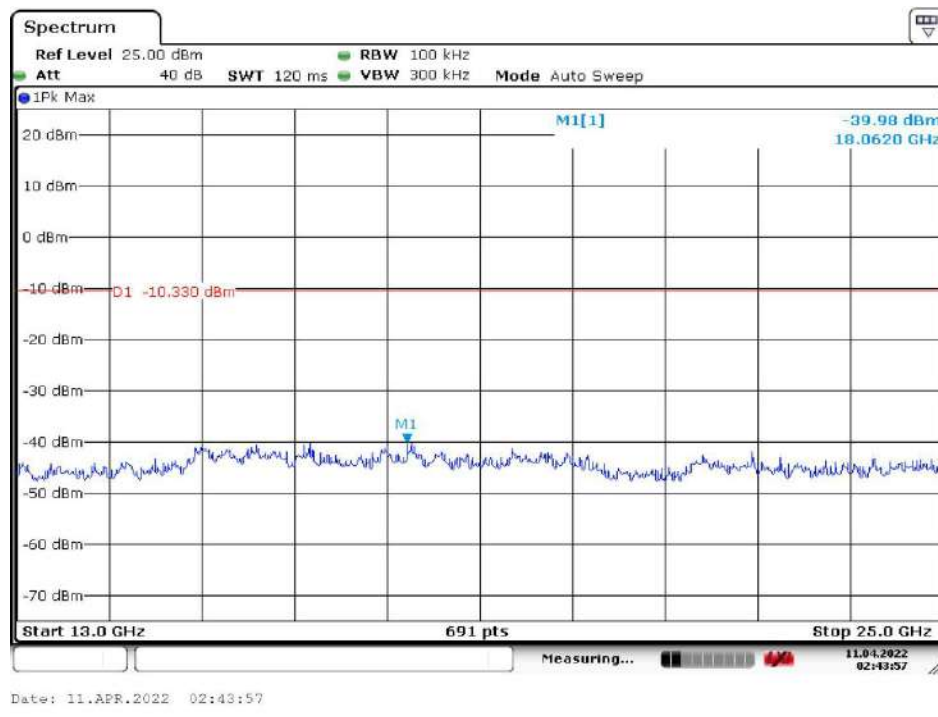
CH00 Data rate 1Mbps



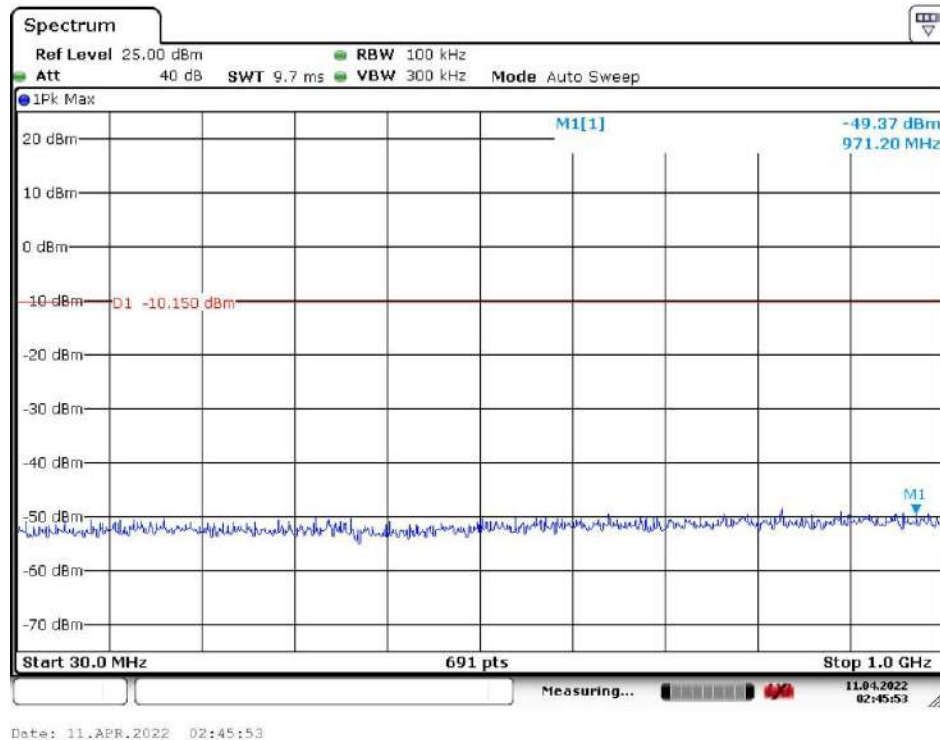
CH00 Data rate 1Mbps



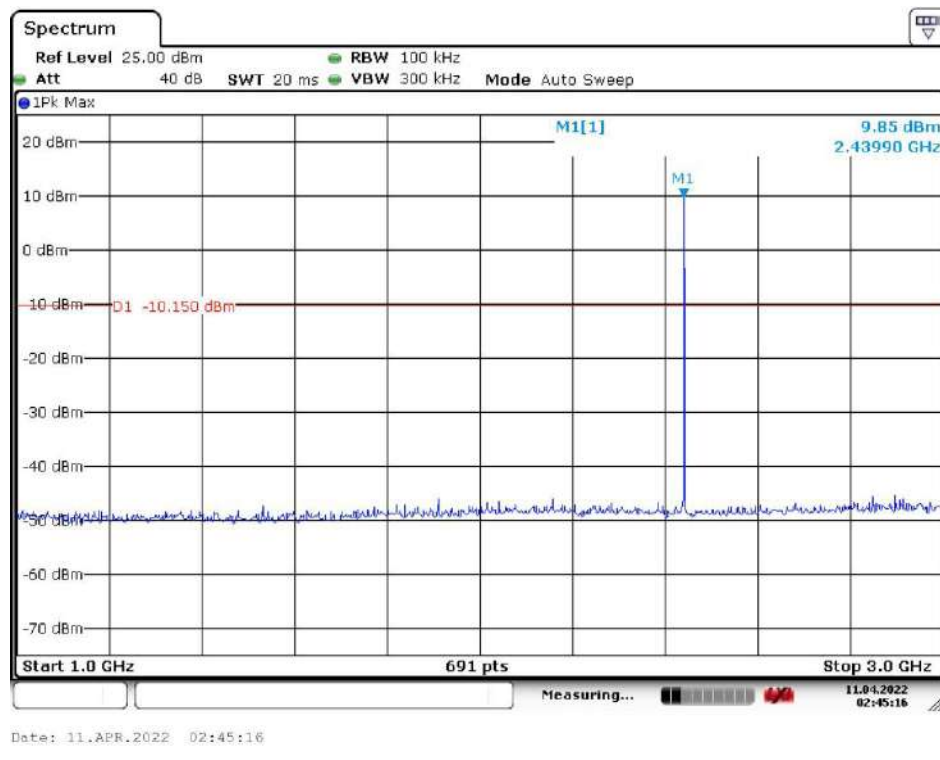
CH00 Data rate 1Mbps



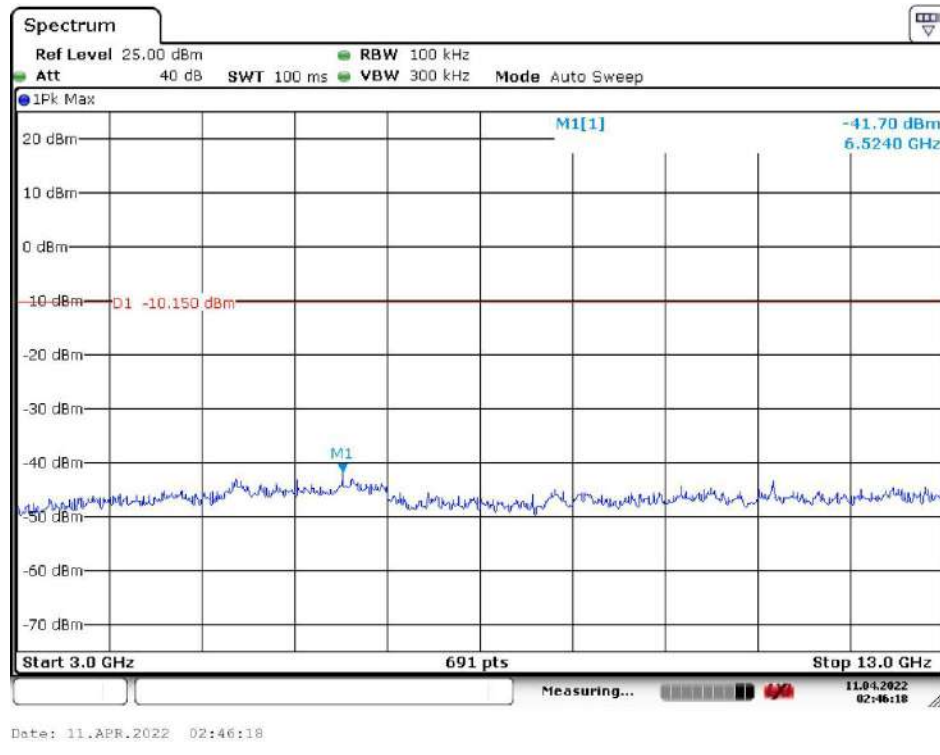
CH39 Data rate 1Mbps



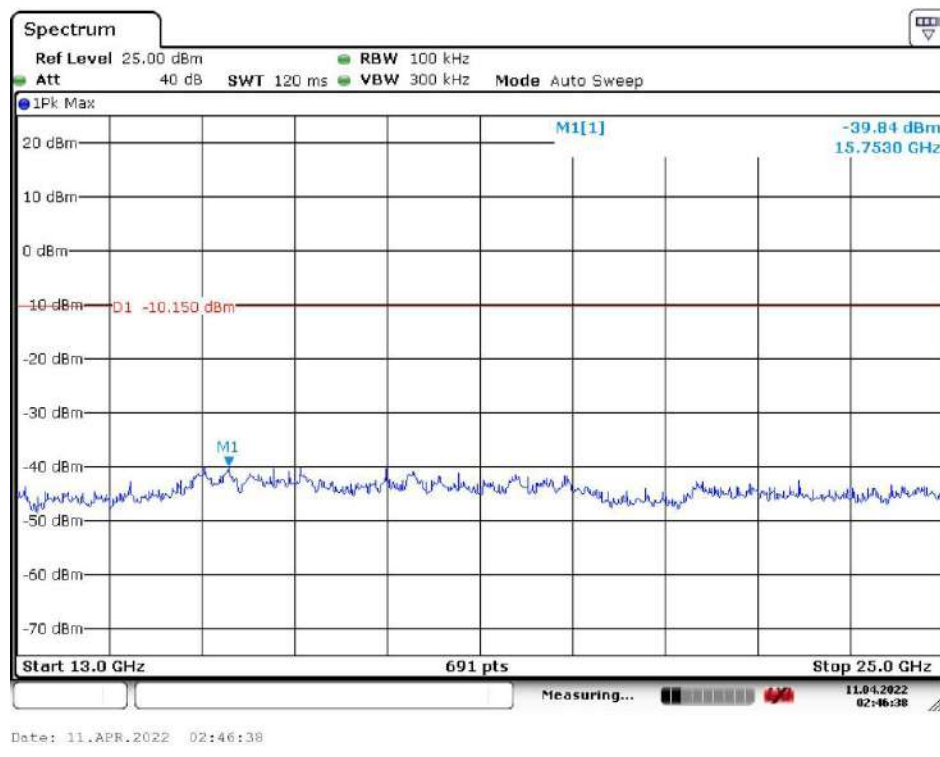
CH39 Data rate 1Mbps



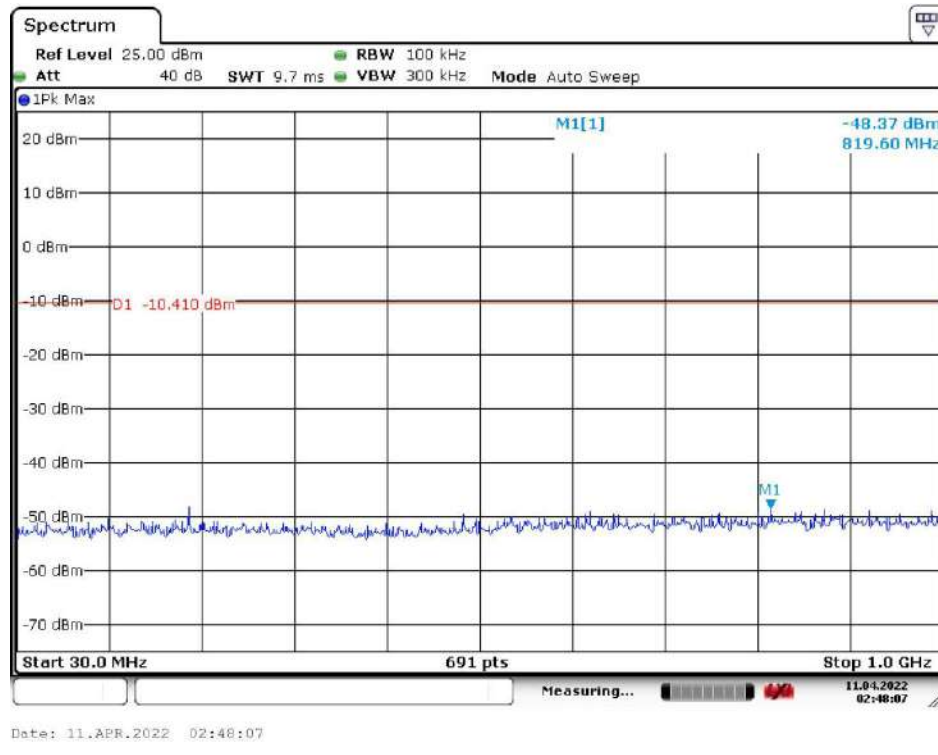
CH39 Data rate 1Mbps



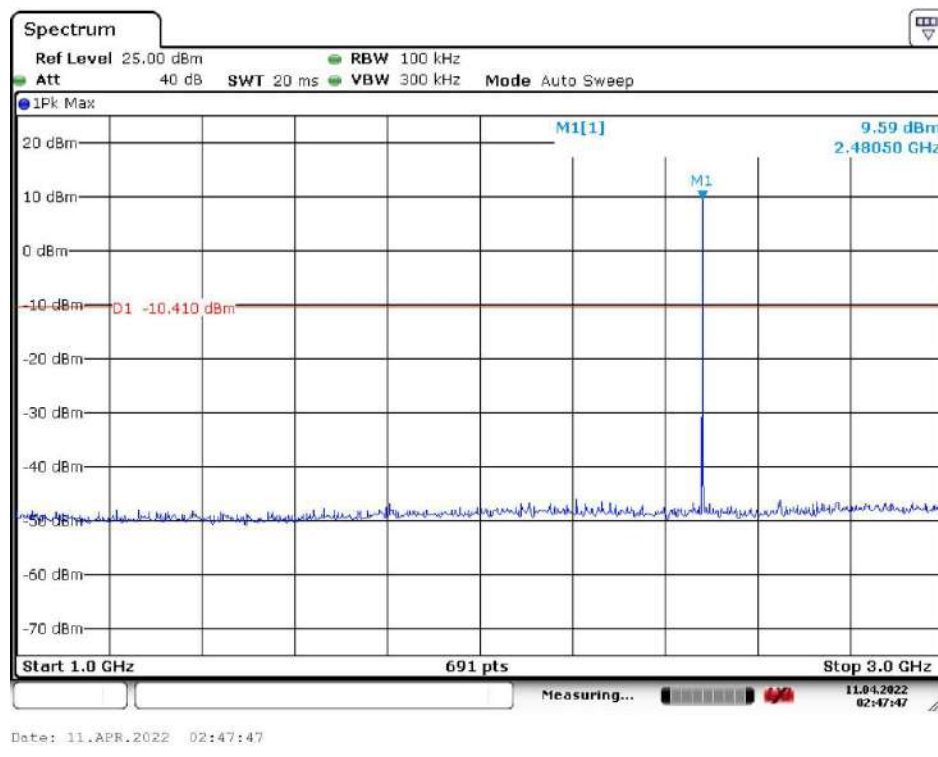
CH39 Data rate 1Mbps



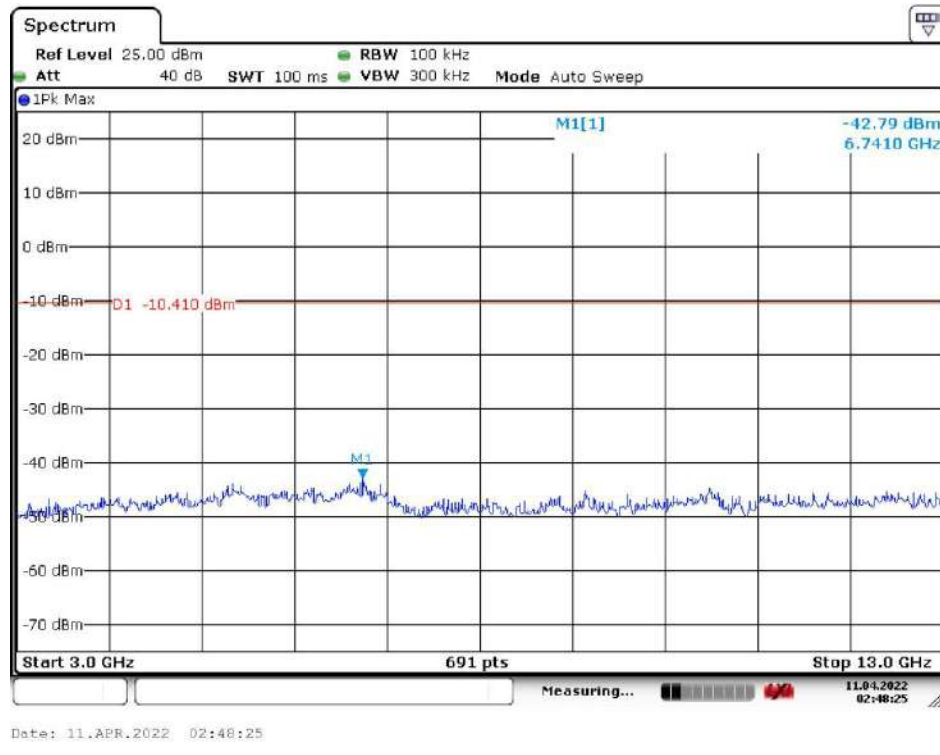
CH78 Data rate 1Mbps



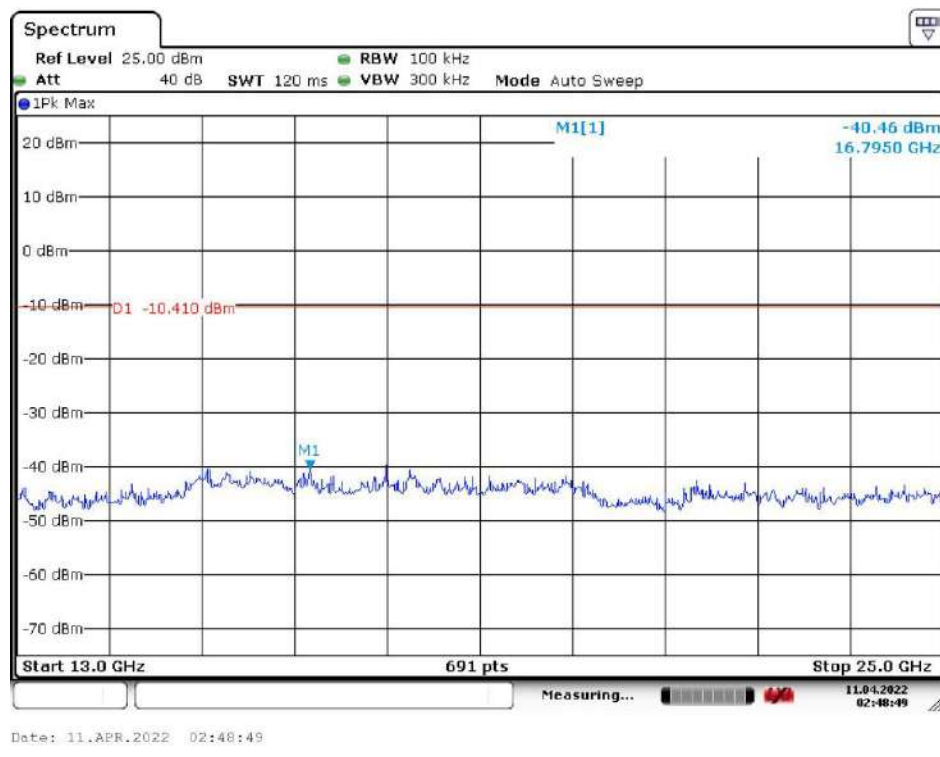
CH78 Data rate 1Mbps



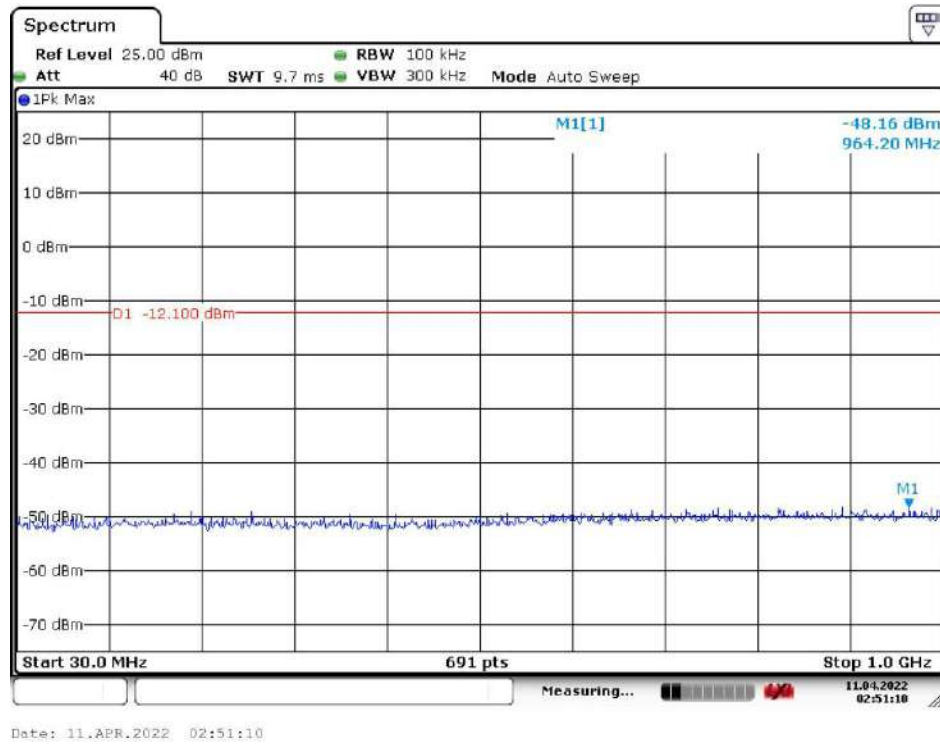
CH78 Data rate 1Mbps



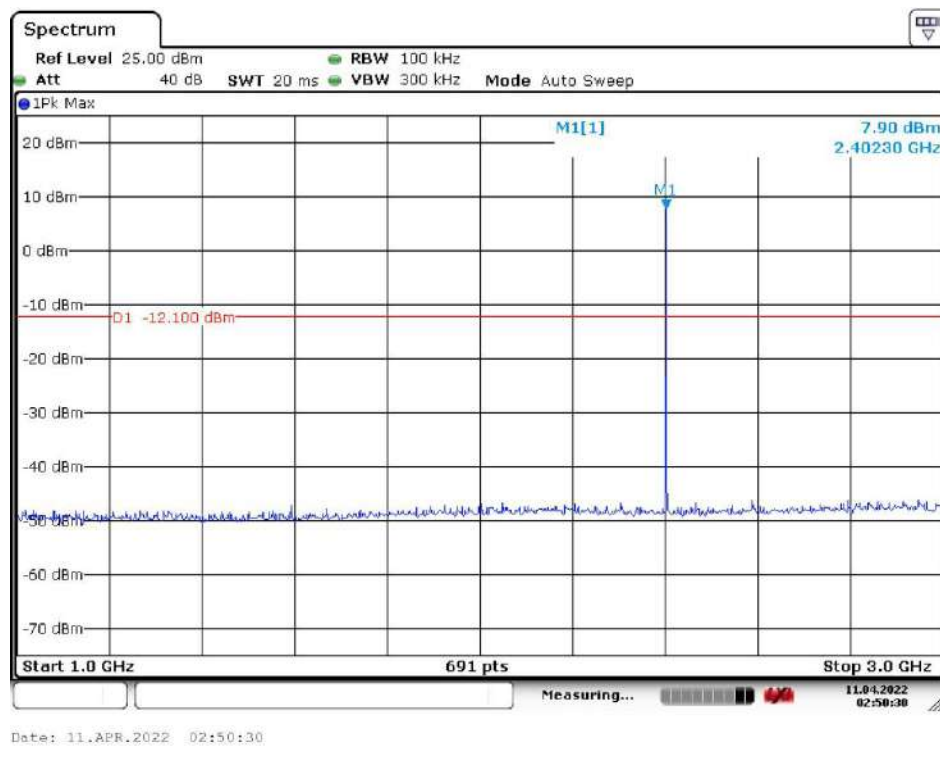
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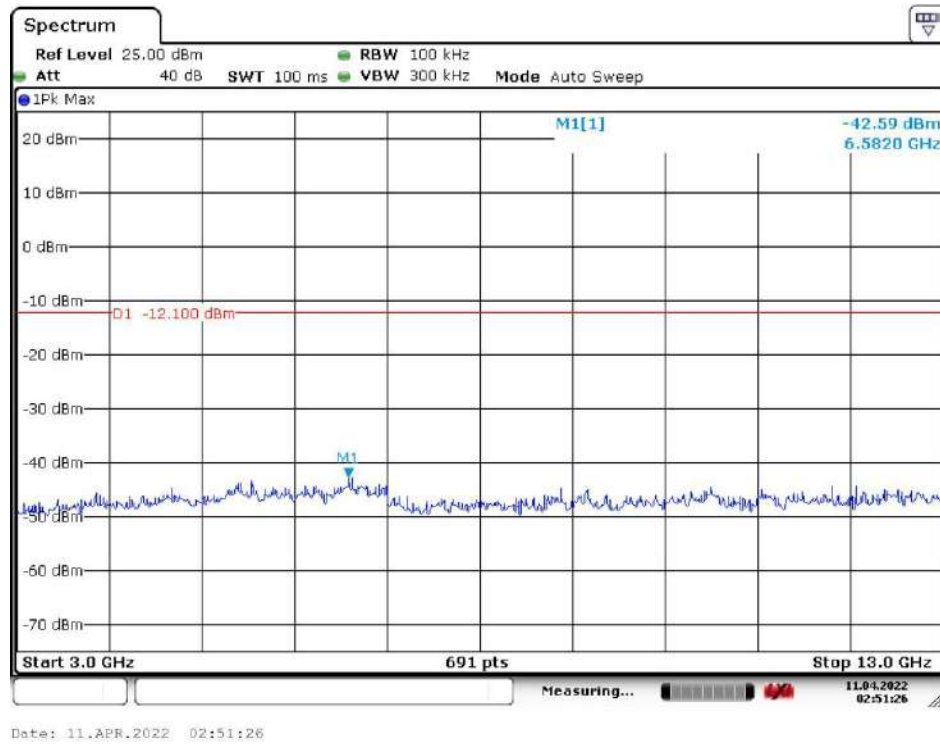
CH00 Data rate 2Mbps



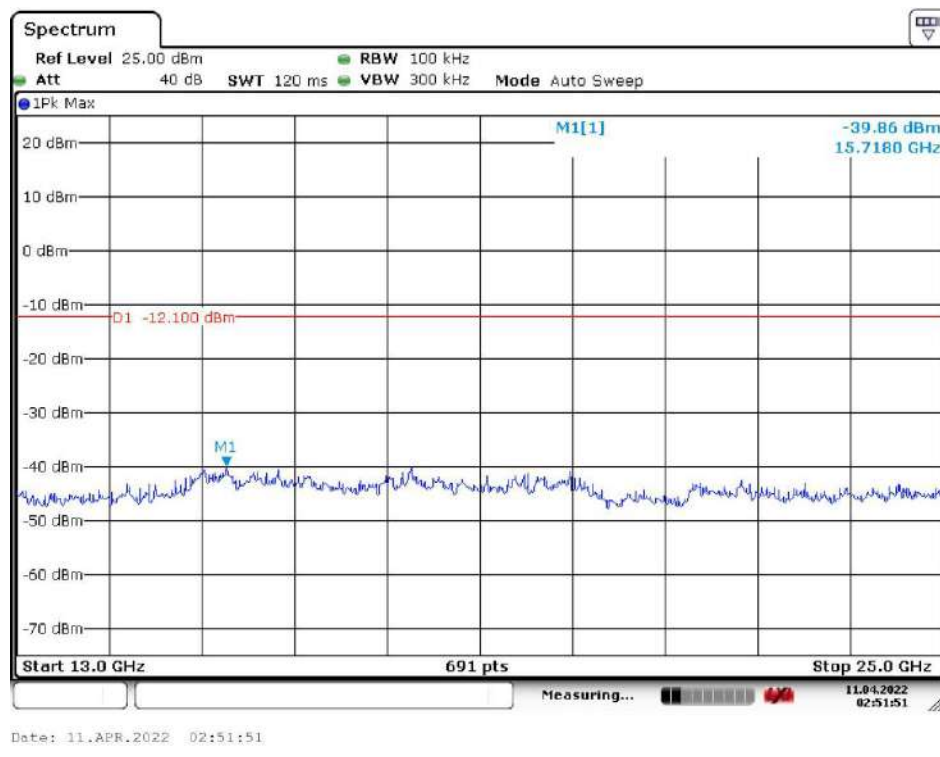
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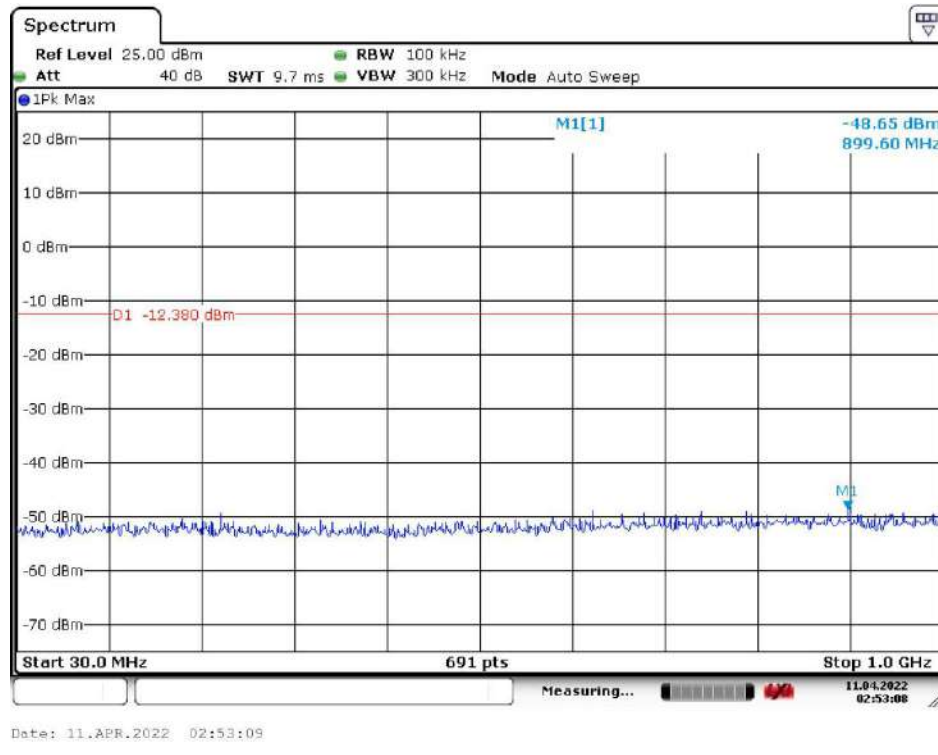
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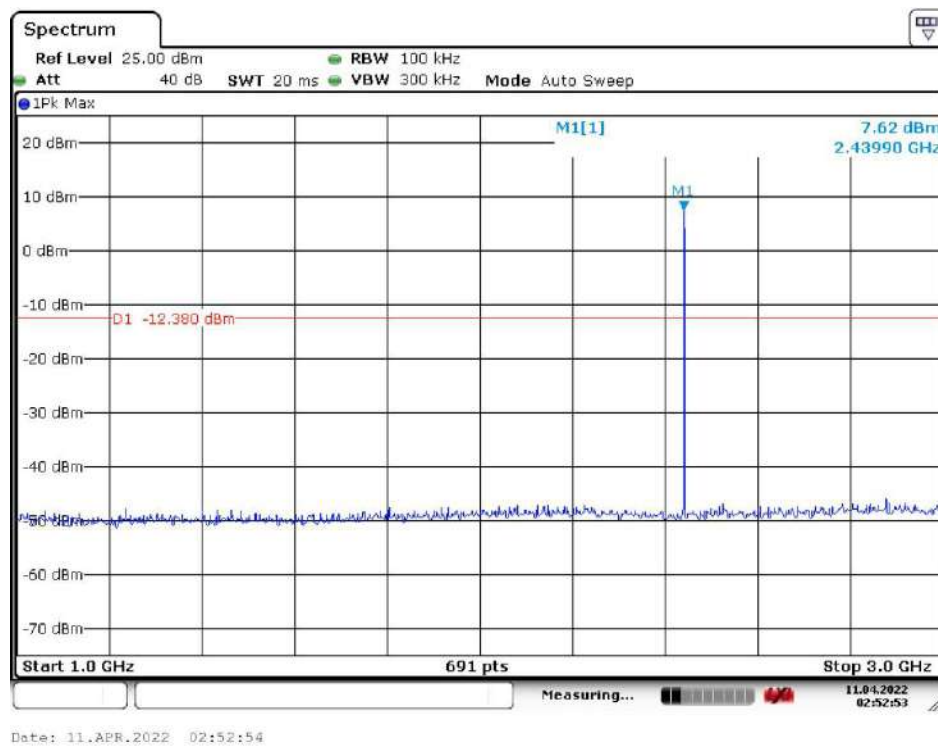
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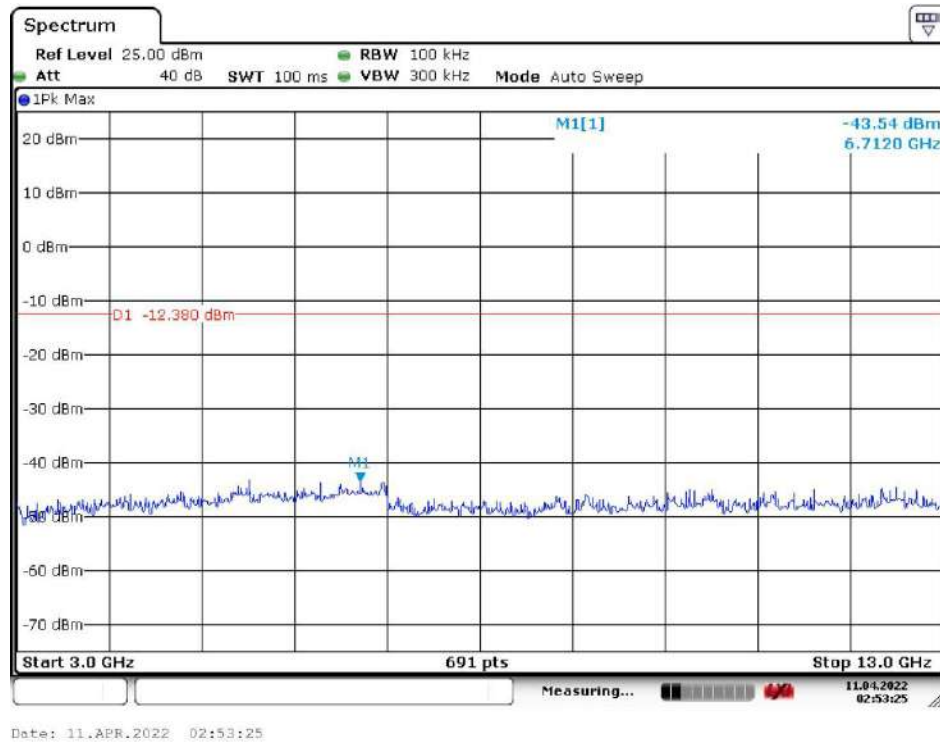
CH39 Data rate 2Mbps



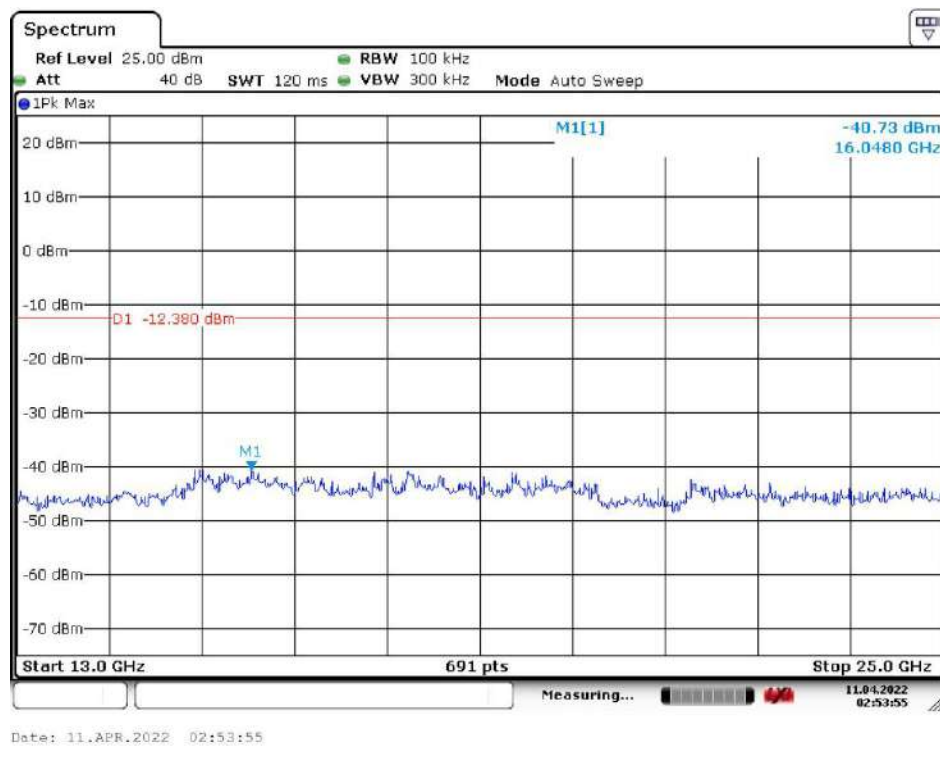
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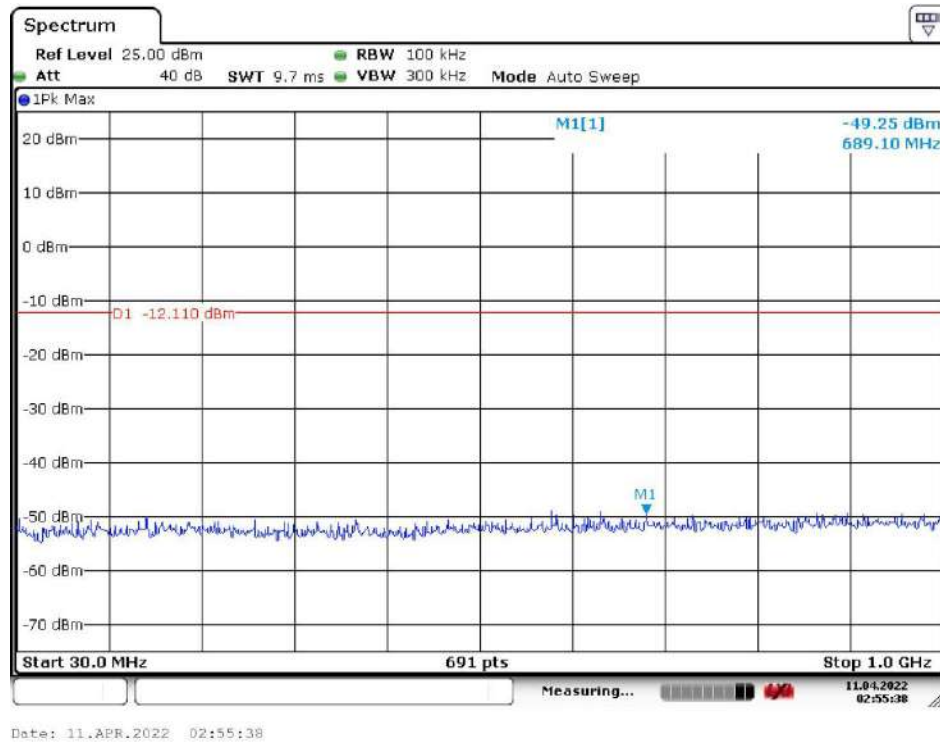
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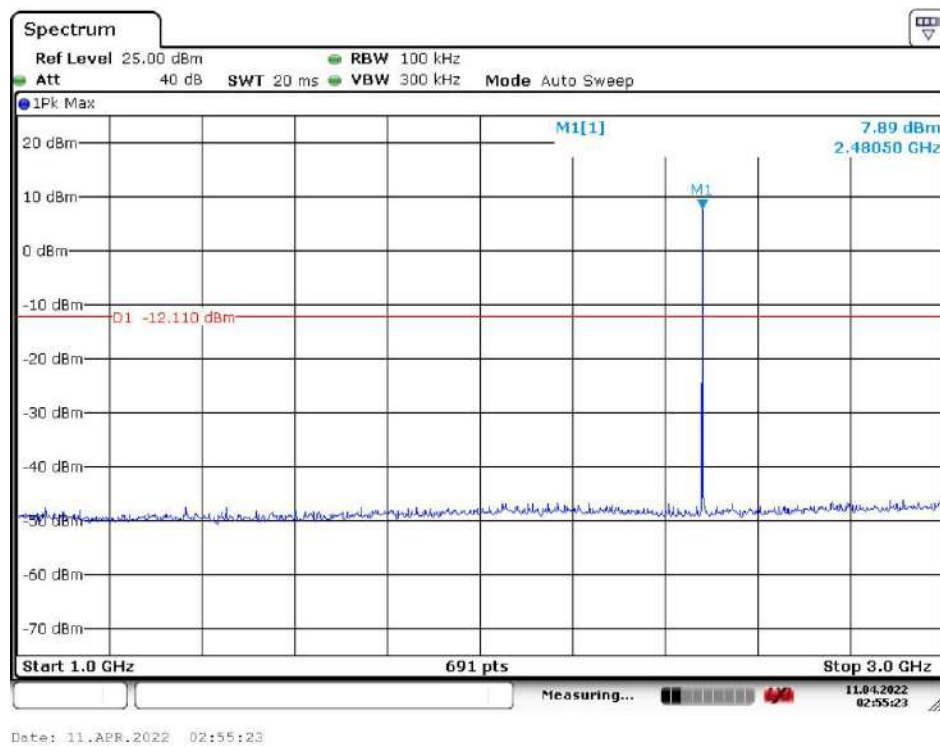
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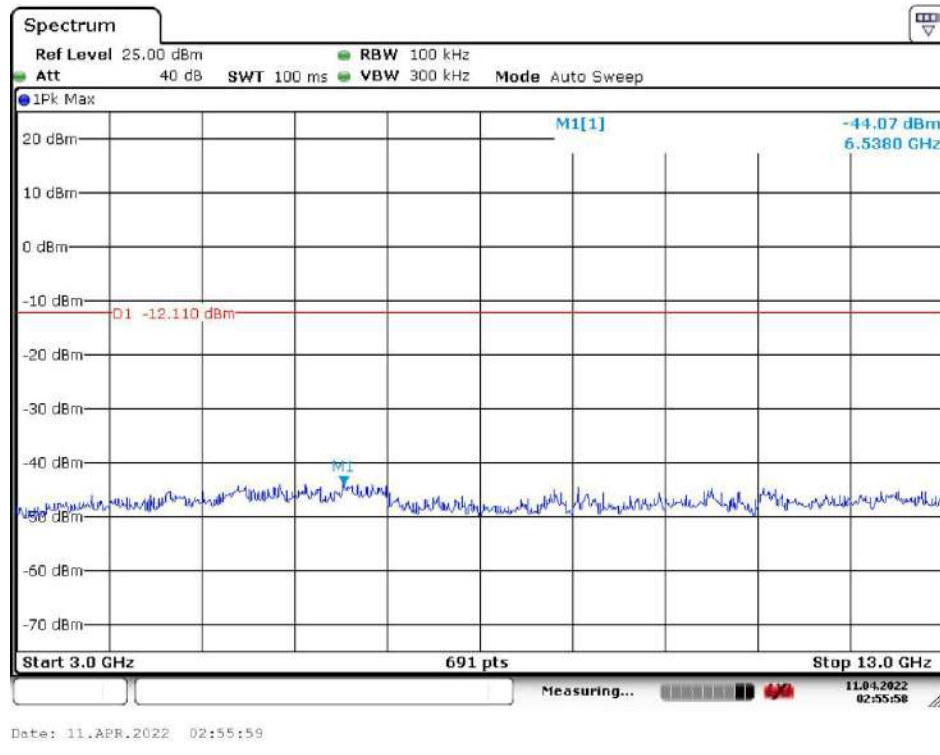
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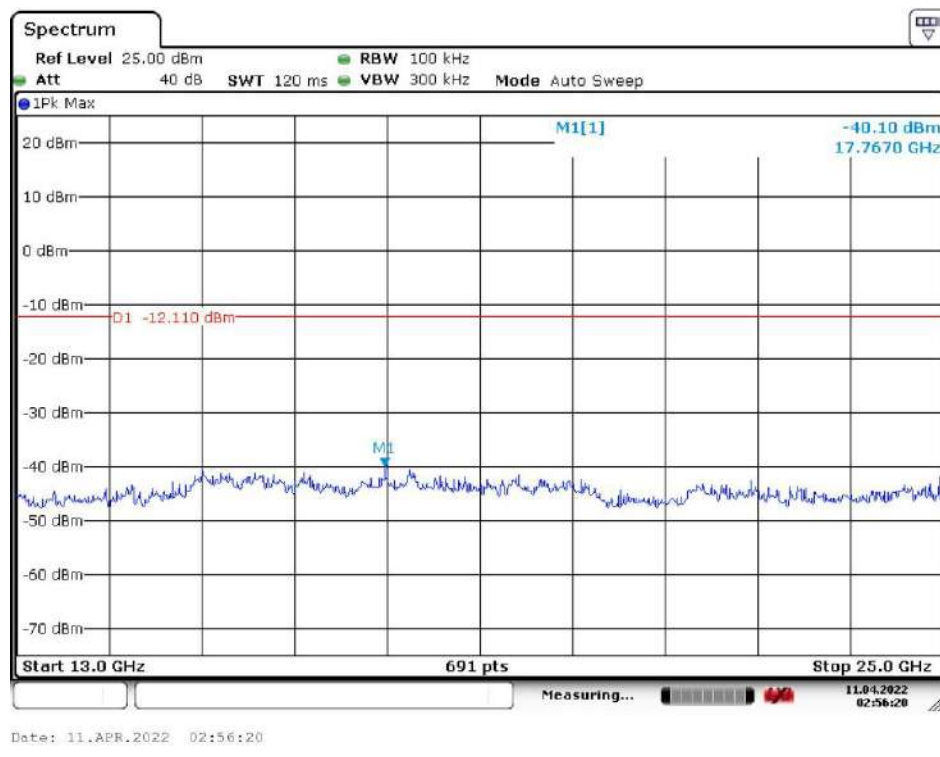
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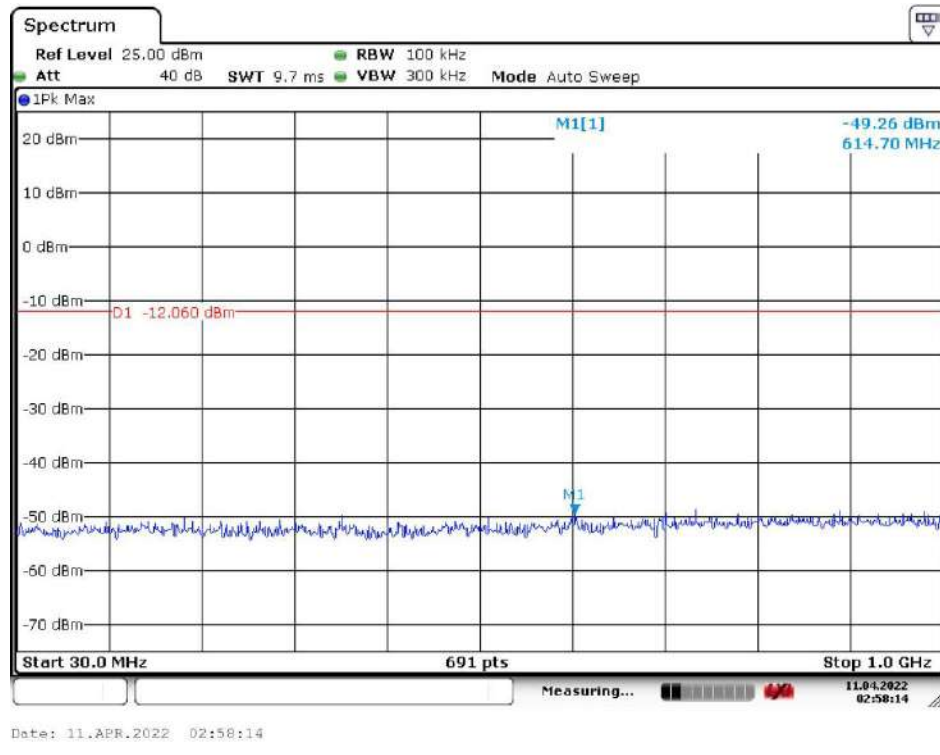
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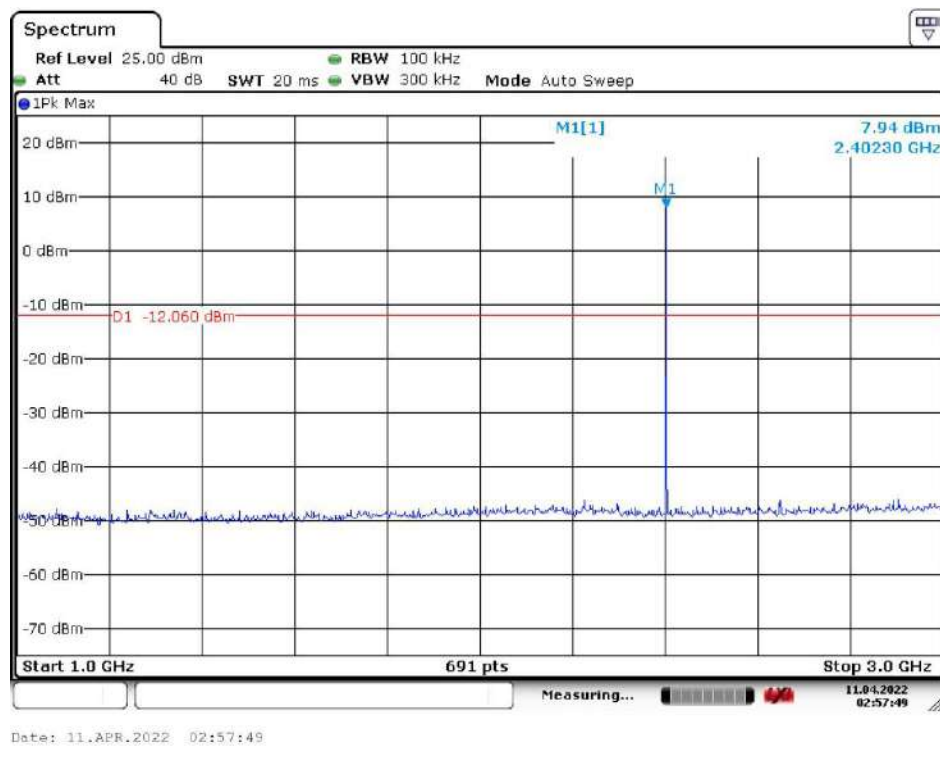
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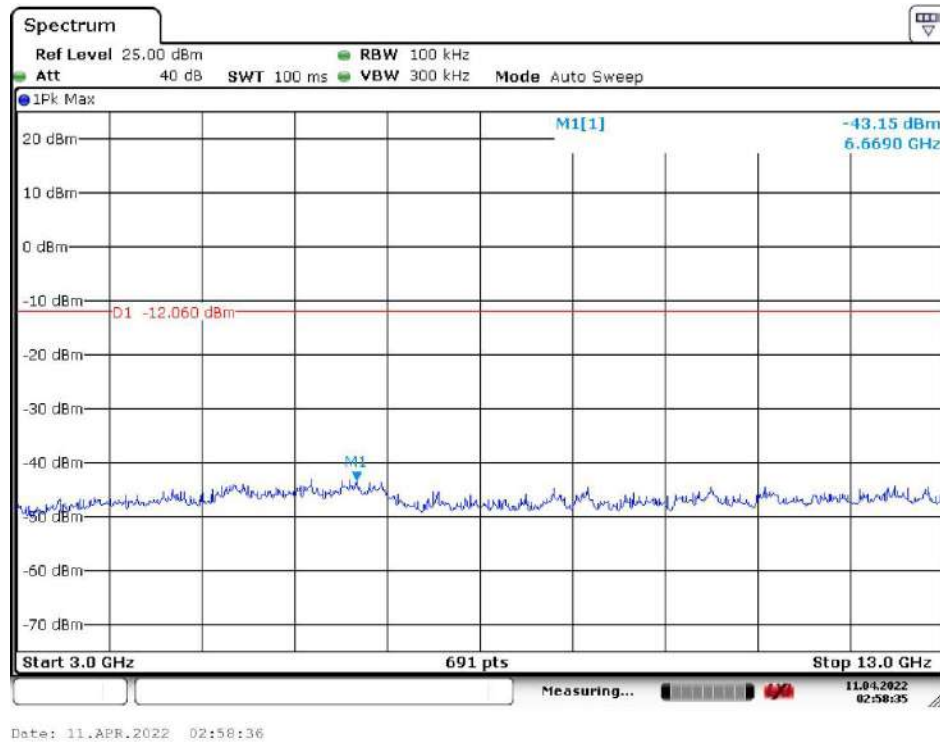
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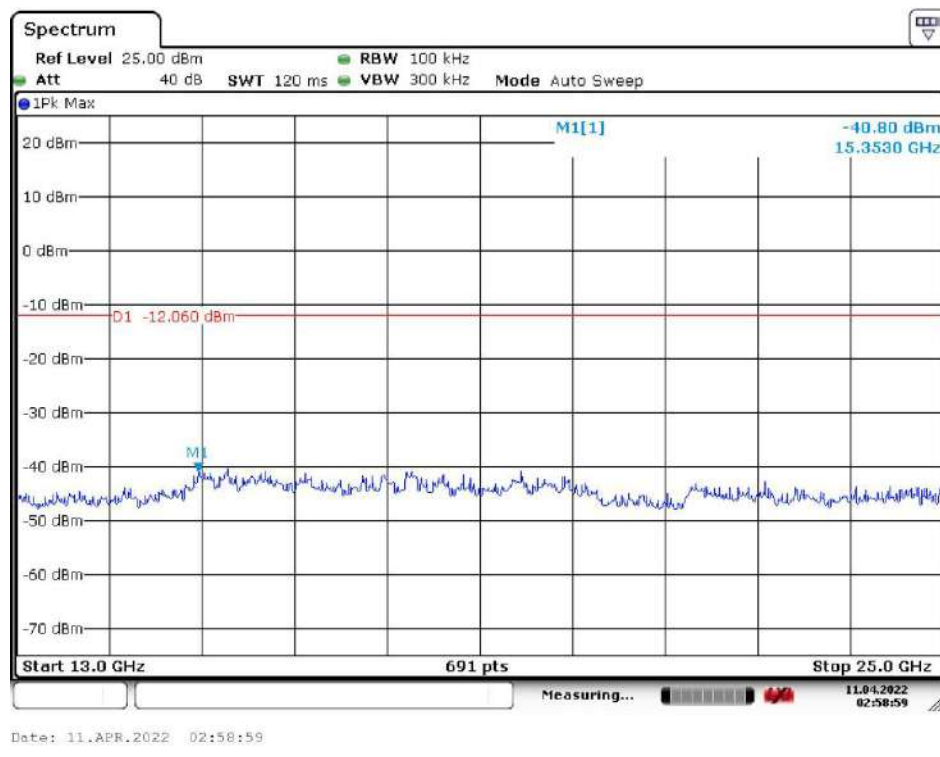
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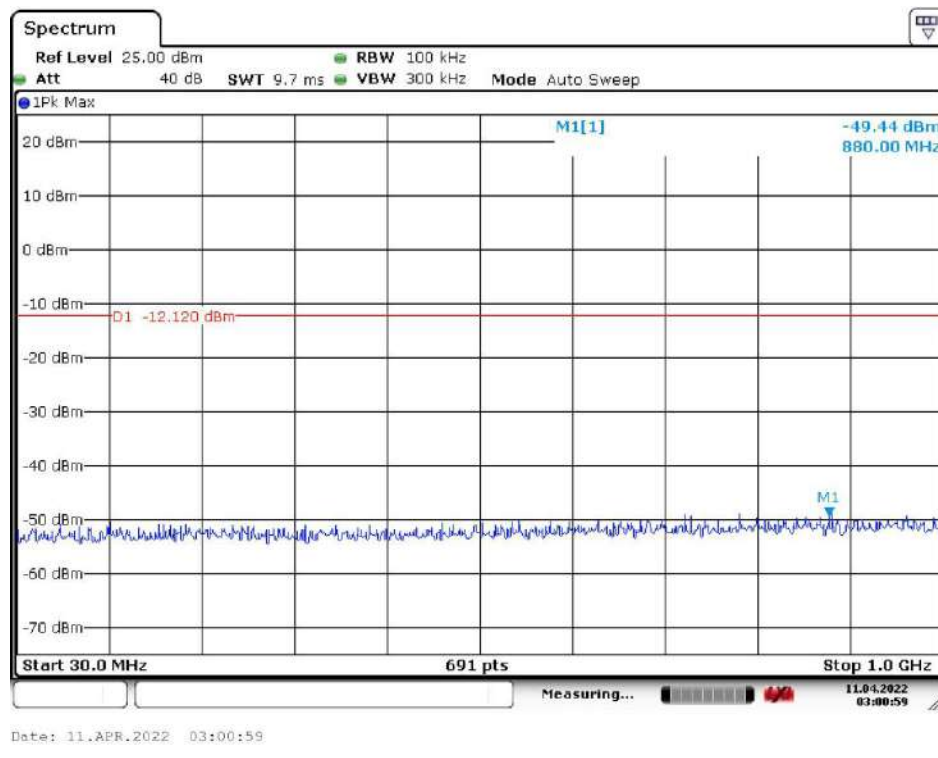
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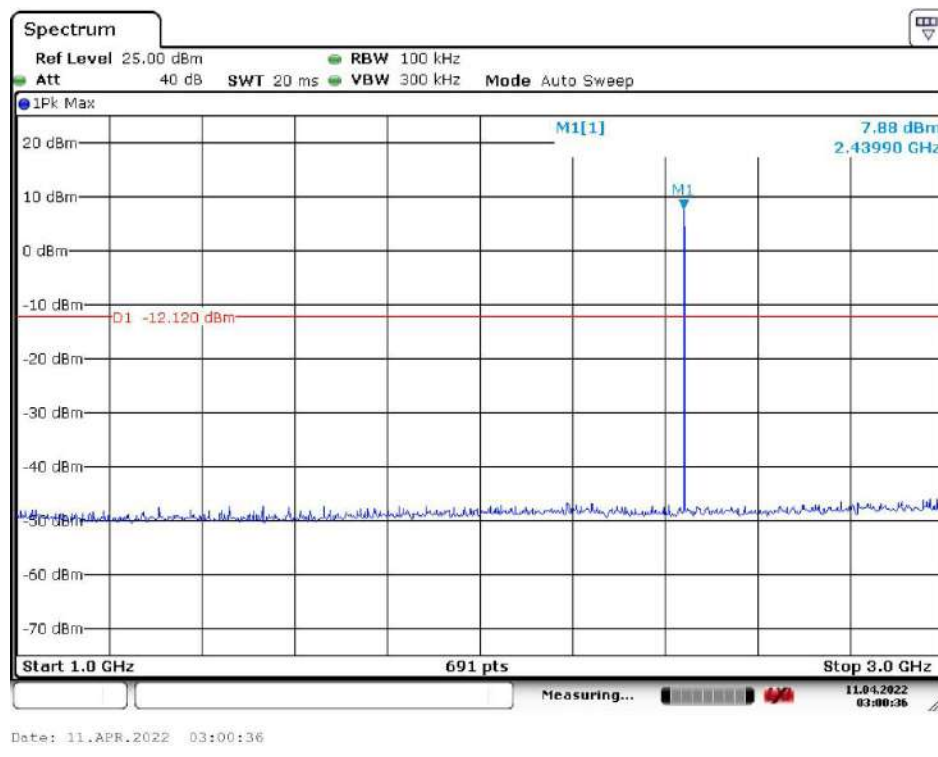
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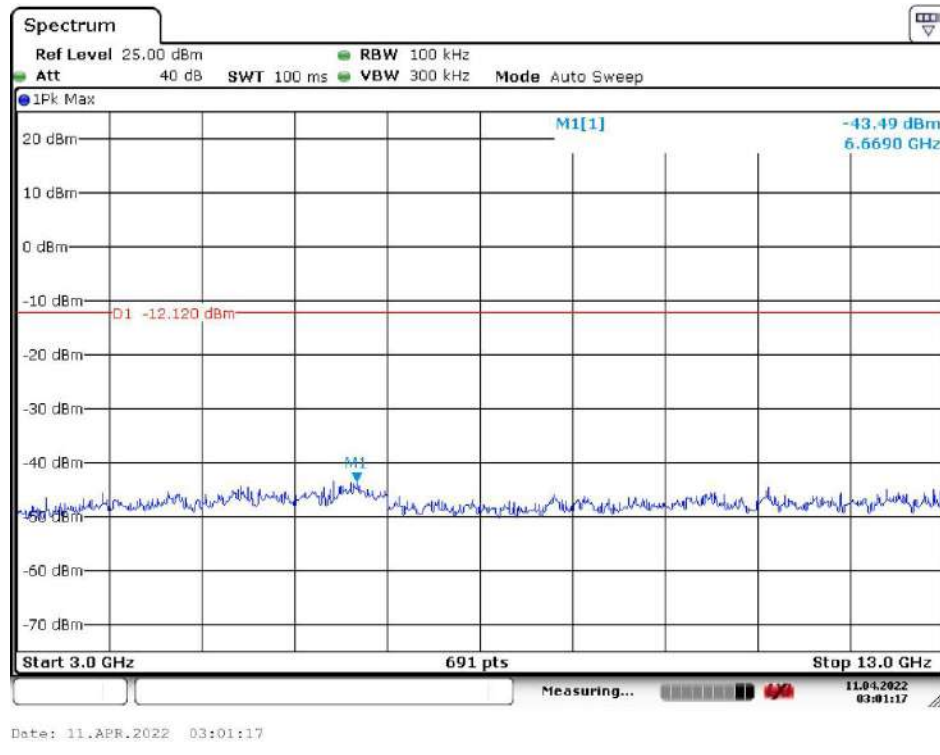
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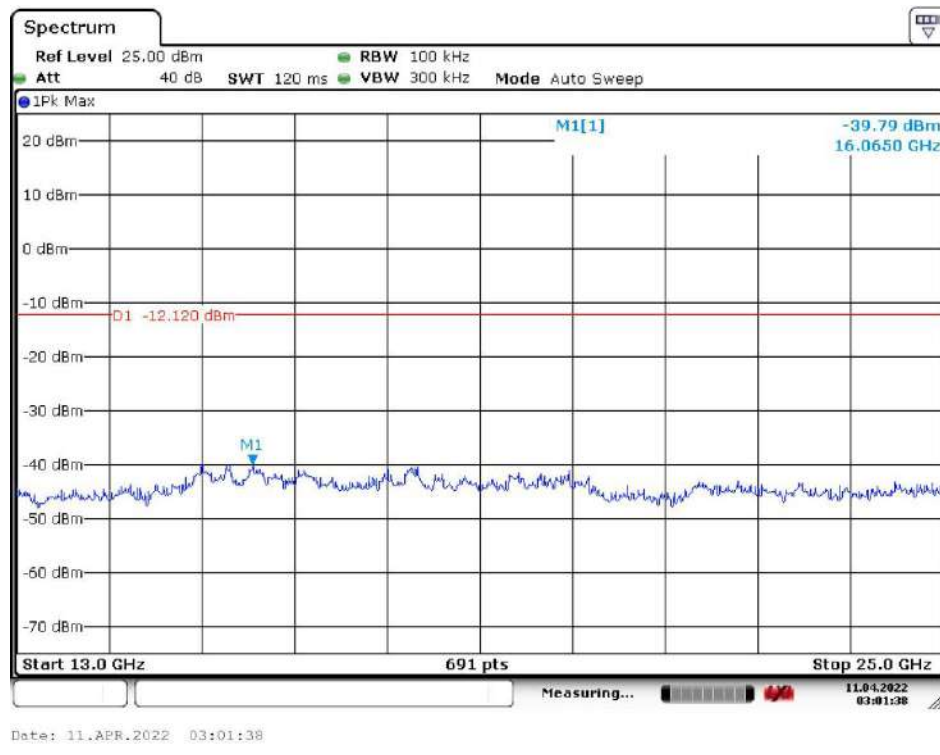
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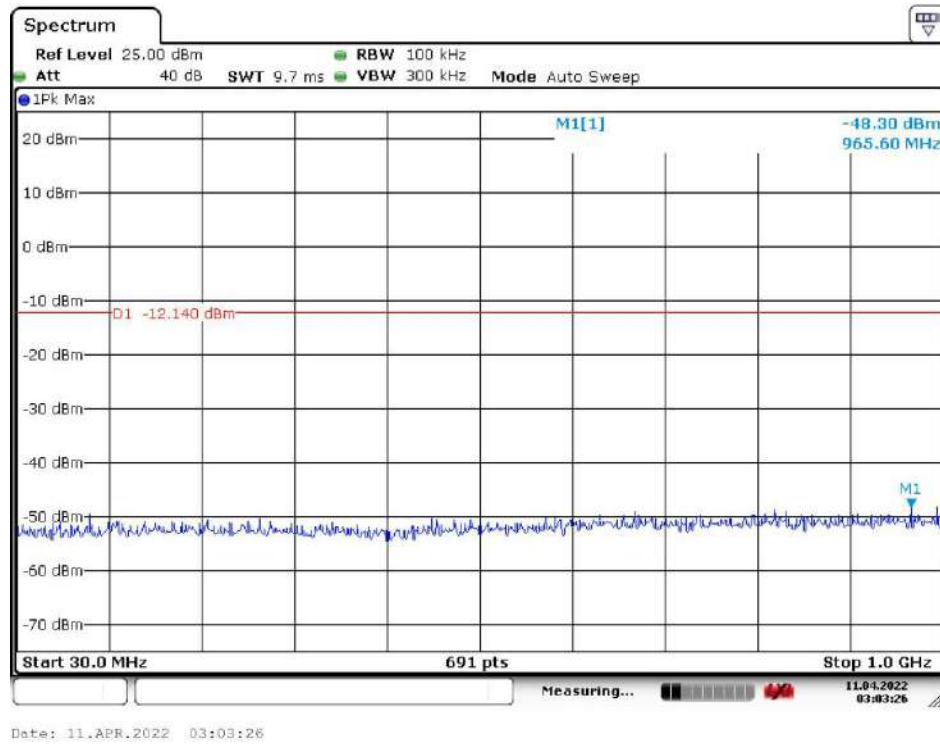
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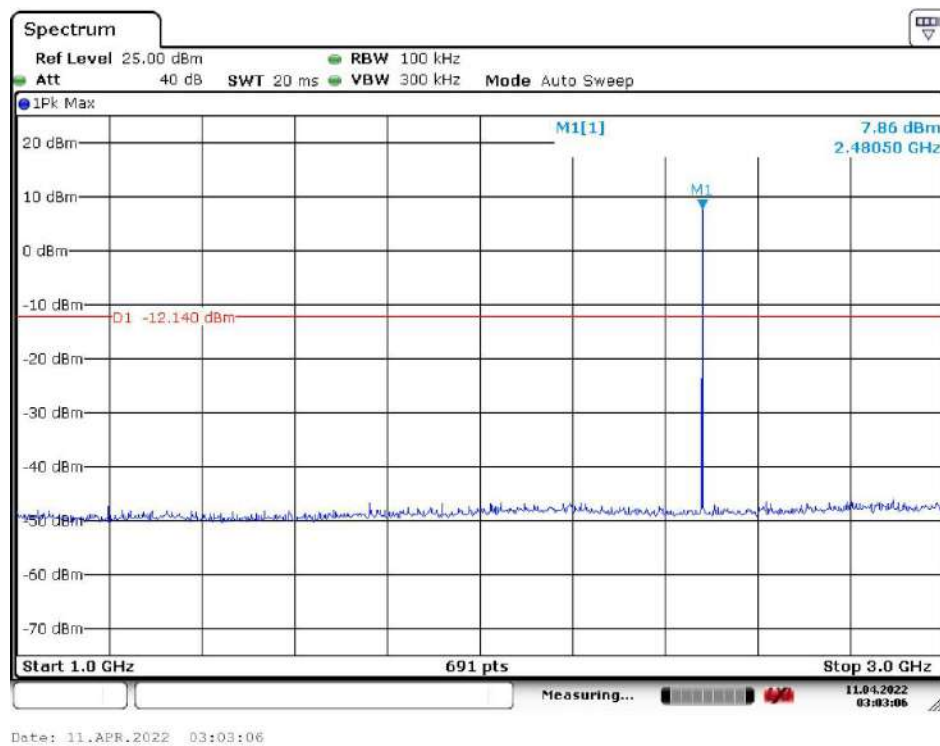
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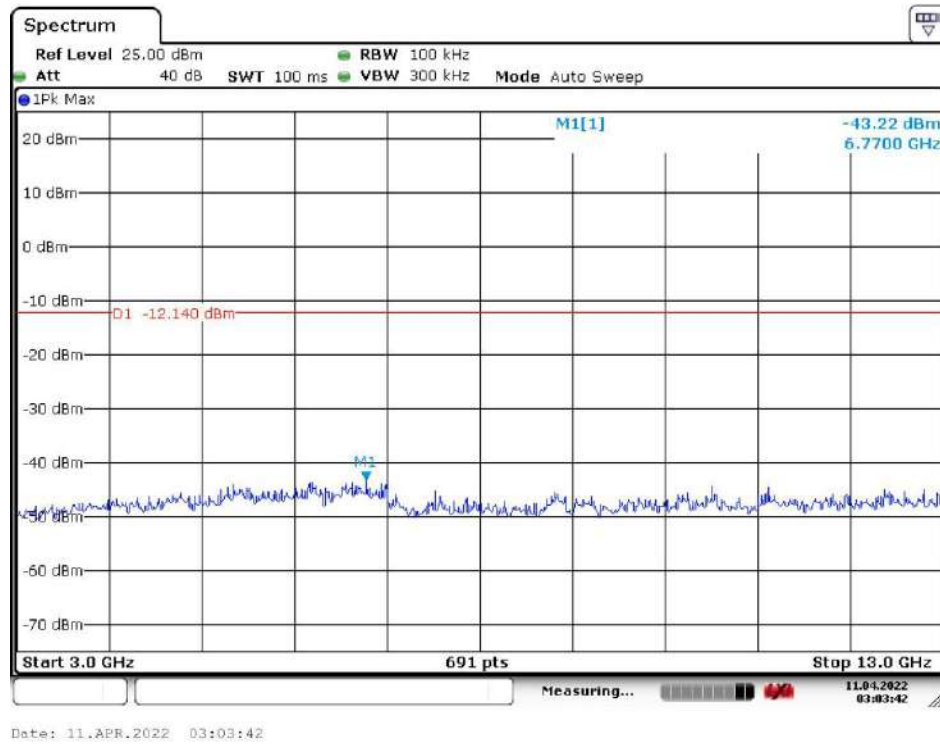
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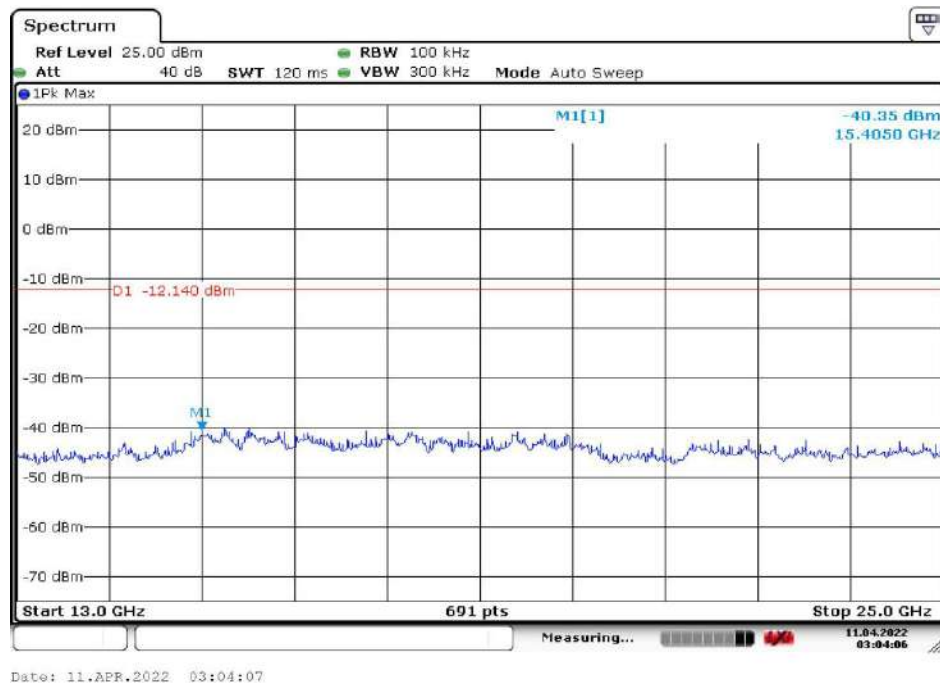
CH78 Data rate 3Mbps



CH78 Data rate 3Mbps



CH78 Data rate 3Mbps



****End of Report****

