

TEST REPORT

No. AR22-0077688-01

performed in accordance with

FCC Rules: Code of Federal Regulations (CFR) no. 47
Part 15 Subpart C Section 15.247

INDUSTRY CANADA

Spectrum Management and Telecommunications Radio Standards Specification

RSS-247:2017

Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and
Licence-Exempt Local Area Network (LE-LAN) Devices

PRODUCT	Dual-mode Basic Rate (BR), Enhanced Data Rate (EDR) and Low Energy (LE) Bluetooth® radio module
MODEL(s) TESTED	05010BTH
FCC ID	2A6P2-117569
IC ID	29967-117569
TRADE MARK(s)	CEIA

APPLICANT	COSTRUZIONI ELETTRONICHE INDUSTRIALI AUTOMATISMI CEIA S.p.A. Zona industriale, 54 – IT-52041 Arezzo
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Tested by	Robertino Torri <i>[Laboratory Technician]</i>	
Approved by	Roberto Colombo <i>[Laboratory manager]</i>	

Revision Sheet

Release No.	Date	Revision Description
Rev. 0	2023-04-03	First edition Digital signed - AR22-0077688-01_TR_FCC 15.247_IC RSS-247 - CEIA - BT radio module 05010BTH.doc

The results of tests and checks reported in this Test Report refer exclusively to the samples tested and described in the Report itself.

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1. GENERAL DATA

SAMPLE		
Samples received on	2022-09-19	(Item(s) sampled and sent by applicant)
IMQ reference samples	BEM	110224
Samples tested No.	1	
Object under analysis recognition	Not carried out Except where stated, characteristics of products were taken from client description and were not verified by the laboratory	
Date of acceptance of test item	2022-09-19	
TEST LOCATION		
Testing dates	2022-10-21 ÷ 2022-11-21	
Testing laboratory	IMQ S.p.A. - Via Quintiliano, 43 – IT-20138 Milano	
Testing site	Via Lombardia, 20B – IT-20021 Bollate	
ISED Canada test site registration number	8839A	
ENVIRONMENTAL CONDITIONING		
Parameter	Measured	
Ambient Temperature	20.0 ÷ 23.0 °C	
Relative Humidity	47 ÷ 55 %	
Atmospheric Pressure	989 ÷ 997 mbar	
The laboratory is monitored by a continuous environmental conditions measurements system. Temperature, humidity and pressure data are recorded on a weekly basis and stored in local archive.		
REMARKS		
Throughout this report a point (comma) is used as the decimal separator. The ability or reliability of this product to perform its intended function in a particular application has not been investigated. Unless otherwise specified, warnings, installation instruction and/or user manual provided with the sample have been checked in Italian or English version only. The test results apply to the sample as received. All information relating to the details of the equipment under test at the § 3 of this document was provided by the applicant. IMQ declines any responsibility derived from missing or wrong information provided aside by the applicant.		

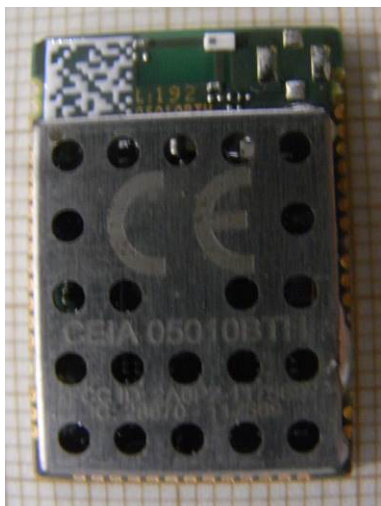
2. REFERENCE DOCUMENT

	DOCUMENT	DATE	TITLE
☒	47 CFR Part 15	2015	Radio Frequency Device
☒	ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
☒	ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
☒	RSS-GEN	2018 Is. 5	General Requirements for Compliance of Radio Apparatus
☒	RSS-247	2017 Is. 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

3. EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL DATA (According to manufacturer declaration)

MODEL (basic)	Description
05010BTH	Dual-mode Basic Rate (BR), Enhanced Data Rate (EDR) and Low Energy (LE) Bluetooth® radio module mounted on dedicated evaluation board.
VARIANTS (derived)	Description
/	/
FCC ID	2A6P2-117569
IC ID	29967-117569
Manufacturer	COSTRUZIONI ELETTRONICHE INDUSTRIALI AUTOMATISMI CEIA S.p.A. Zona industriale, 54 – IT-52041 Arezzo
Type of equipment	FHSS – Frequency hopping system
Operating frequency	2400-2483.5MHz
Max RF conducted power	FHSS : 9.58 dBm
Modulation	BR : ☒ GFSK; EDR : ☒ $\pi/4$ -DQPSK, ☒ 8DPSK
Number of channels	FHSS : 79
Antenna	CHIP antenna, gain 1.6 dBi max
Remarks	None



4. STATE OF THE EUT DURING TESTS

Channel Number	Frequency
0	2402 MHz
1	2403 MHz
:	:
38	2440 MHz
39	2441 MHz
40	2442 MHz
:	:
77	2479 MHz
78	2480 MHz

Mode	Description
See below test mode description	The EUT is mounted on evaluation board and supply by USB-TTL cable. Engineering program for management of RF parameters was used during testing to control the transmitter for staying in continuous transmission at the max RF output power. The single TX channel was fixed which was for the purpose of the measurements and included the lower, middle and higher frequency to perform the test. 3axis were chosen for radiated emission testing for each applicable mode. The choice of axis and transmission was made based on preliminary analysis measurements in order to maximize the emission characteristics of measurement performed. Only the worst result was recorded in the report, unless otherwise stated. A temporary antenna connector is provided by the manufacturer for conducted test.

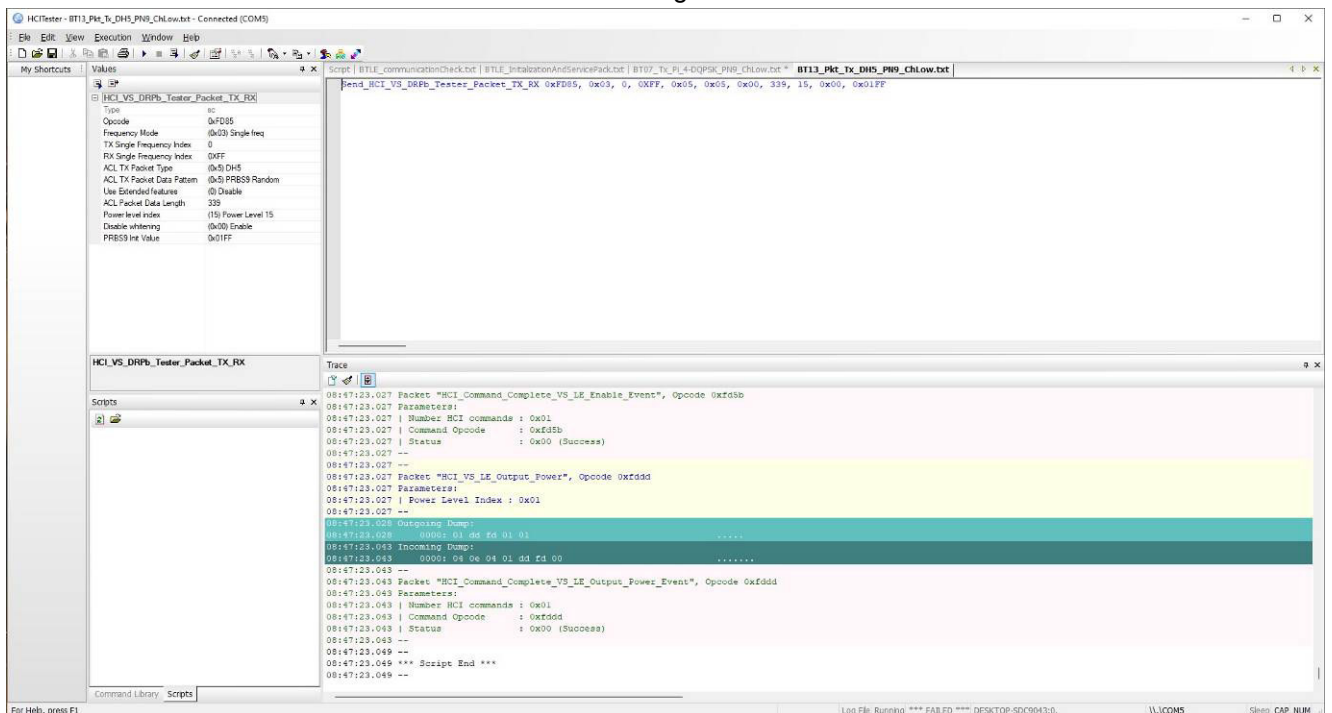
EUT OPERATING CONDITION					
NO.	MODULATION	Transmission software setting			
		PACKET	PAYLOAD	LENGTH	Power level
1	Low channel GFSK (BR)	DH5	PRBS9	339	15 (max)
2	Middle channel GFSK (BR)	DH5	PRBS9	339	15 (max)
3	High channel GFSK (BR)	DH5	PRBS9	339	15 (max)
4	Low channel $\pi/4$ -DQPSK (2-EDR)	DH5	PRBS9	339	15 (max)
5	Middle channel $\pi/4$ -DQPSK (2-EDR)	DH5	PRBS9	339	15 (max)
6	High channel $\pi/4$ -DQPSK (2-EDR)	DH5	PRBS9	339	15 (max)
7	Low channel 8DPSK (3-EDR)	DH5	PRBS9	339	15 (max)
8	Middle channel 8DPSK (3-EDR)	DH5	PRBS9	339	15 (max)
9	High channel 8DPSK (3-EDR)	DH5	PRBS9	339	15 (max)
10	Hopping mode GFSK (BR)	DH5	PRBS9	339	15 (max)
11	Hopping mode $\pi/4$ -DQPSK (2-EDR)	DH5	PRBS9	339	15 (max)
12	Hopping mode 8DPSK (3-EDR)	DH5	PRBS9	339	15 (max)

SUPPORT EQUIPMENT

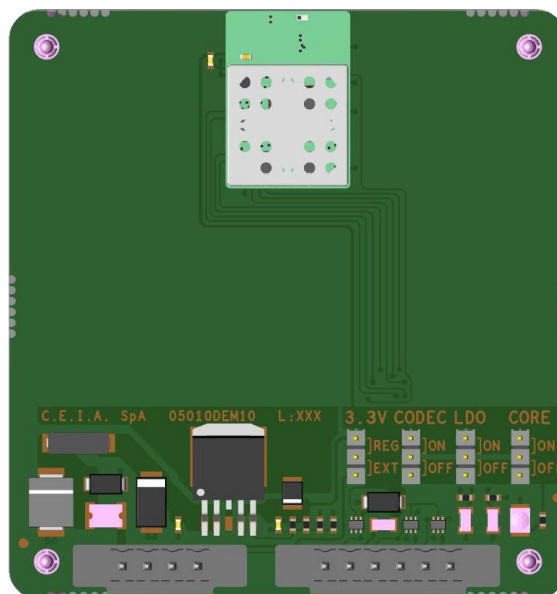
Defined as equipment needed for correct operation or loading of the EUT, but not considered as tested

Equipment	Manufacturer	Model
SW for radio parameter management	Texas Instruments	HCITester Tool
Radio parameter commands	Texas Instruments	CC256x VS HCI commands
Radio parameter testing guide	Texas Instruments	CC256x Testing Guide
Evaluation board	CEIA	05010DEM10 - L:192
AC/DC adapter for conducted emission on AC mains	Alpha elettronica	BD212 - 230VAC -12VDC

RF Management SW



Evaluation board



ELECTROMAGNETICALLY RELEVANT COMPONENTS

Component	No.	Manufacturer	Model
BT radio module	1	CEIA	05010BTH
Evaluation board	1	CEIA	05010DEM10 - L:192

RFI SUPPRESSION DEVICES

Component	No.	Manufacturer	Model
/	/	/	/

EMI PROTECTION DEVICES

Component	No.	Manufacturer	Model
/	/	/	/

EUT TECHNICAL DOCUMENTATION

Document	Reference
/	/

5. METHODS OF MEASUREMENT

All compliance measurements have been carried out using the procedures described in the standard ANSI C63.4-2014, ANSI C63.10-2013, Section 15.31 of 47CFR Part 15 – Subpart A (General), RSS-GEN and RSS-247.

Additional test requirements have been adopted according to the reference Section indicated in the § 6 of this test report.

FREQUENCY RANGE INVESTIGATED

Radiated emission tests: from 9 kHz to tenth harmonic of fundamental.

6. SUMMARY OF TEST RESULTS

POSSIBLE TEST CASE VERDICTS	
Test object meets the requirement	PASS
Test object does not meet the requirement	FAIL
Test case does not apply to the test object	N.A.
Test not performed	N.P.

47CFR Part 15C	RSS	TITLE	RESULT
15.203	RSS -Gen § 6.8	Antenna Requirements	PASS
15.207 (a)	RSS-Gen § 8.8	Conducted Emission	PASS
15.209 (a)(f)	RSS-Gen §§ 7.3/8.9	Radiated Emission	PASS
15.247 (a)	RSS -247 § 5.1	Frequency Hopping Spread Spectrum Specifications	
15.247 (a)	RSS-247 § 5.1 (a)	20 dB Bandwidth	PASS
	RSS -Gen § 6.7	99% emission bandwidth	PASS
15.247 (a)(1)	RSS -247 § 5.1 (b)	Carrier frequency (Hopping Channel) Separation	PASS
15.247(a)(1)(iii)	RSS -247 § 5.1 (c)	Number of Hopping Channels Used	PASS
15.247(a)(1)(iii)	RSS -247 § 5.1 (d)	Channel occupancy time	PASS
15.247 (a)(2)	RSS -247 § 5.2 (a)	6dB Minimum Bandwidth	N.A.
15.247 (b)	RSS -247 § 5.4	Maximum Peak Output Power	
15.247 (b)(1)	RSS -247 § 5.4 (b)	Peak Output Power	PASS
15.247 (b)(3)	RSS -247 § 5.4 (a)	Maximum conducted output power	N.A.
15.247 (b)(4)	RSS -247 § 5.4 (d)	Antenna gain	N.A.
15.247 (c)	RSS -247 § 5.4 (e)	Operation with directional antenna gains greater than 6dBi	N.A.
15.247 (d)	RSS -247 § 5.5	100 kHz Bandwidth emissions outside frequency Band	PASS
15.247 (e)	RSS -247 § 5.2 (b)	Power Spectral Density	N.A.
15.247 (f)	RSS -247 § 5.3	Hybrid systems	N.A.
15.247 (g)	RSS -247 § 5.1	FHSS Transmission characteristics	N.A.
15.247 (h)	RSS -247 § 5.1	Recognition of occupied channel & multiple transmission	N.A.
15.247 (i)	RSS -102	RF humane exposure § 47CFR 1.1307 (b)(1)	N.P.

7. TEST RESULTS

7.1 ANTENNA REQUIREMENTS

TEST REQUIREMENT	
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.	
Testing dates	2022-11-22

Antenna specifications	
N° of authorized antenna types	/
Antenna type	CHIP antenna on PCB
Maximum total gain	1.6 dBi
External power amplifiers	Not present

TEST RESULT
The EUT meets the requirements of section 15.203 and RSS -Gen § 6.8

7.2 AC MAINS POWER SUPPLY CONDUCTED EMISSION

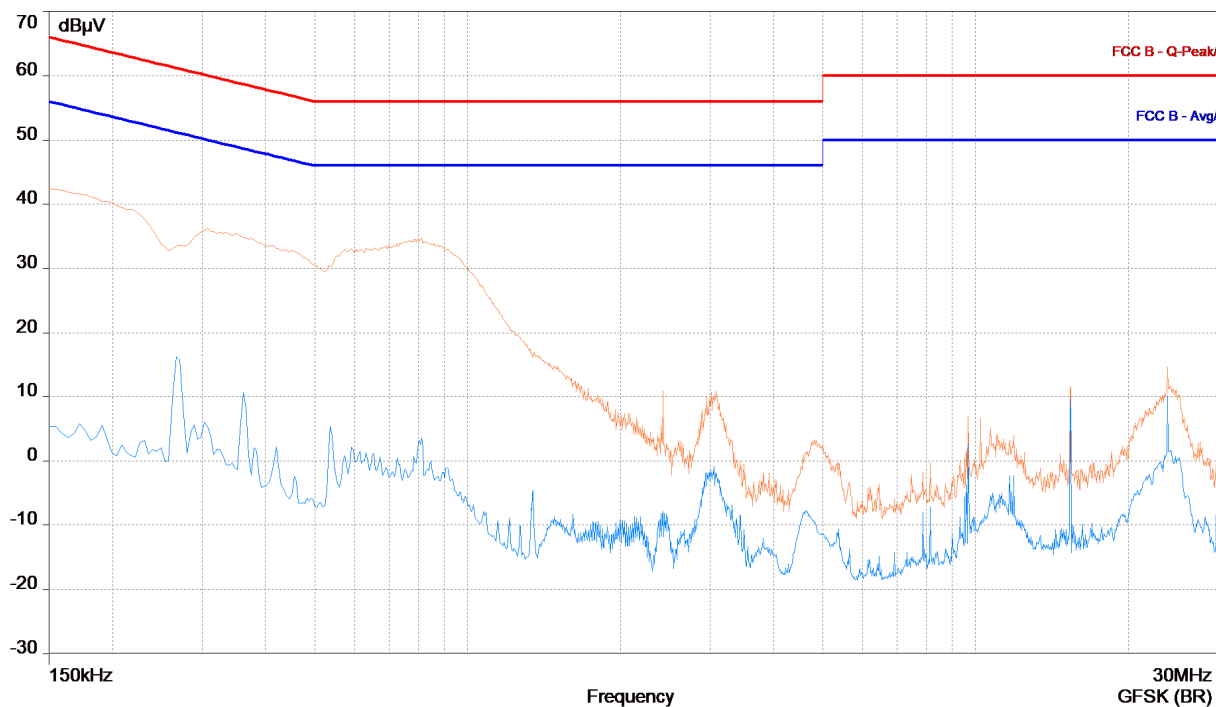
TEST REQUIREMENT	
Test setup	ANSI C63.4
Test facility	Shielded chamber
Frequency range	150 kHz – 30 MHz
IF bandwidth	9 kHz
EMC class	B
EUT operating condition	All test mode had been pre-tested. Only worst case for each mode modulation is reported
Testing dates	2022-11-15

LIMITS		
Band of operations	Quasi-Peak (dBμV)	Average Limit (dBμV)
0.15 ÷ 0.5	66 ÷ 56	56 ÷ 46
0.5 ÷ 5	56	46
5 ÷ 30	60	50

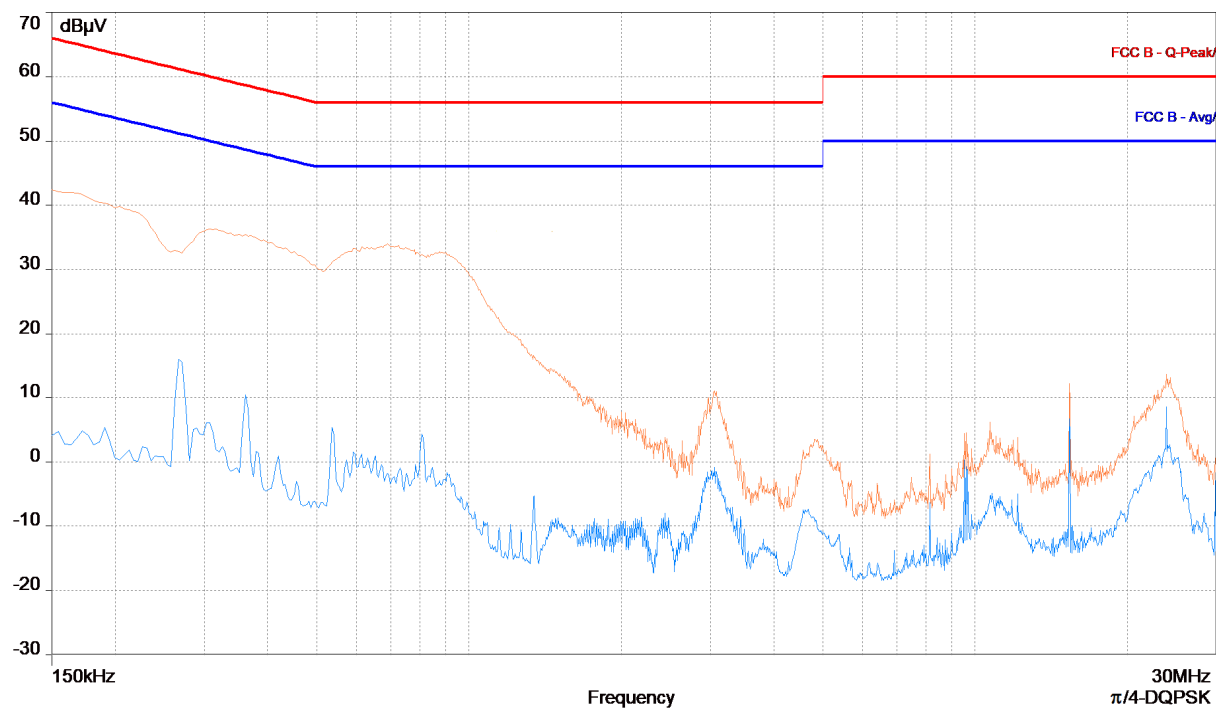
TEST RESULT
The EUT meets the requirements of sections 15.207 (a) and RSS-Gen § 8.8

TEST PROCEDURE
1) The EUT was placed on a wooden table of size, 80 cm by 80 cm, raised 80 cm. 2) The EUT received DC 12V from AC/DC power adapter which is connected to 50Ω/50μH LISN to the input power source. 3) Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement. 4) The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz. 5) The measurements were made with the detector set to PEAK and AVERAGE amplitude within a bandwidth of 9 kHz during the measurements. 6) The measurements with Quasi-Peak detector are performed only for frequencies for which the Peak values are $\geq$ (Q.P. limit - 6 dB).

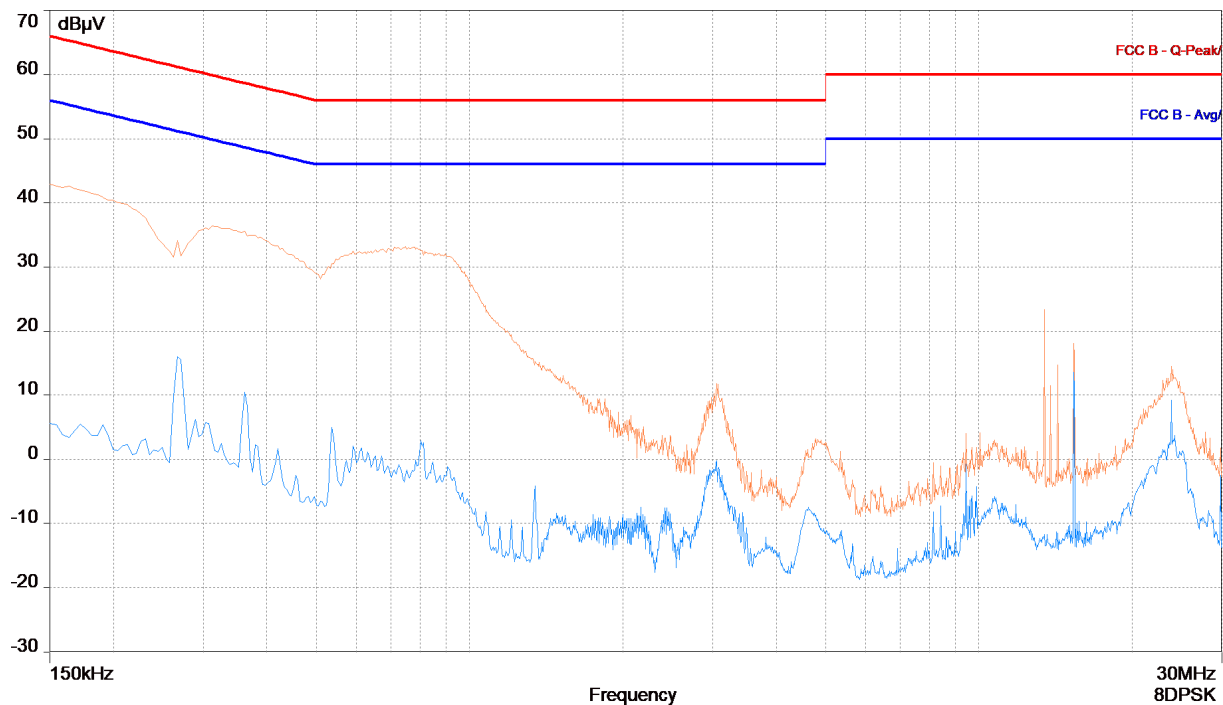
Worst case measurement result of GFSK modulation



Worst case measurement result of $\pi/4$ -DQPSK modulation



Worst case measurement result of 8DPSK modulation



7.3 RADIATED DISTURBANCES

TEST REQUIREMENT	
Test setup	ANSI C63.4
Test facility	Semi-anechoic chamber
Test distance	3 meters
Frequency range	9 kHz to tenth harmonic of fundamental
IF bandwidth (below 30 MHz)	9 kHz
IF bandwidth (below 1,000 MHz)	120 kHz
IF bandwidth (above 1,000 MHz)	1 MHz
EMC class	B
EUT operating condition	1 to 9
Remark: In accordance with part 15.31 (f) (2), where the measurement distance was specified to be 30 or 300 meters, a correction factor was applied in order to permit measurement to be performed at a separation distance. The applied formula for limits at 3 meter is: Extrapolation (dB) = $40\log(300\text{meter} / 3\text{meter}) = +80\text{db}$ Extrapolation (dB) = $40\log(30\text{meter} / 3\text{meter}) = +40\text{db}$	
Testing dates	2022-10-25 ÷ 2022-10-27

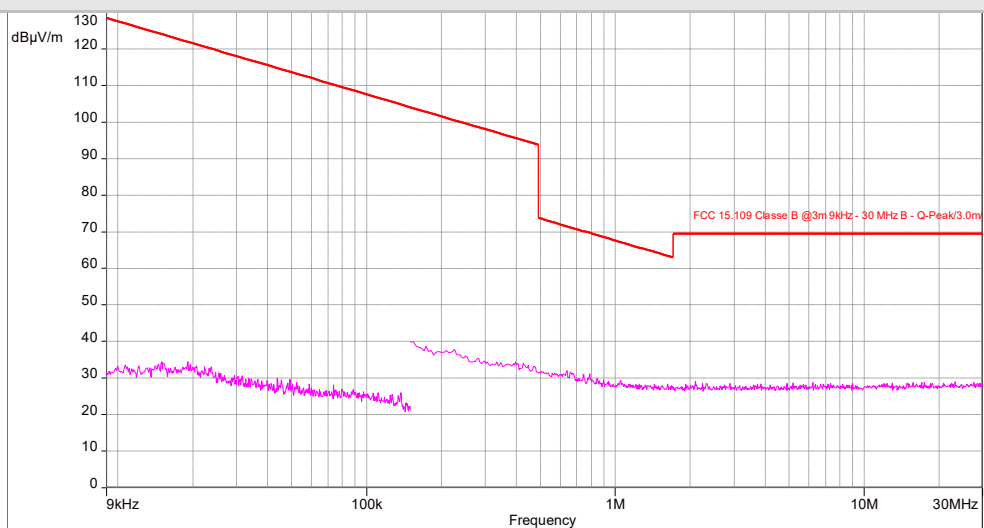
LIMITS		
Band of operations	Peak (dB μ V/m)	Average Limit (dB μ V/m)
Restricted bands	74	54
Other bands	According to emissions limits or Fundamental -20dB (which is greater)	According to emissions limits or Fundamental -20dB (which is greater)

TEST PROCEDURE
1) The EUT was placed on turntable which is 0.8 m above the ground plane 2) The turntable shall rotate from 0° to 360° degrees to determine the position of maximum emission level. 3) The EUT is positioned 3 m away from the receiving antenna, which varied from 1 to 4 m to find the highest emission. 4) The measurements were made with the detector set to PEAK and AVERAGE amplitude within a bandwidth of 100 kHz below 1000 MHz and 1 MHz above 1000 MHz. 5) The receiving antenna was positioned in both horizontal and vertical polarization. 6) The measurements with Quasi-Peak detector, below 1000 MHz are performed only for frequencies for which the Peak values are $\geq$ (Q.P. limit - 6 dB).

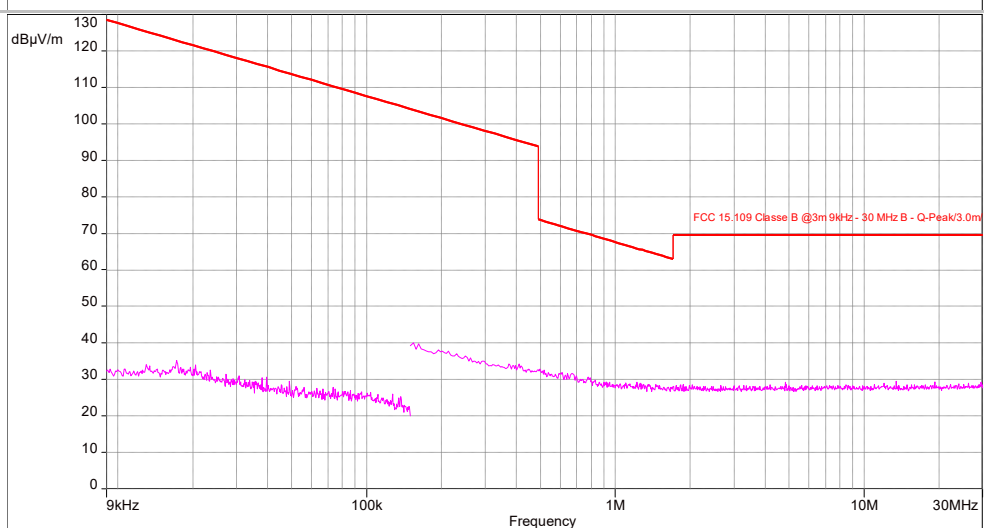
TEST RESULT
The EUT has been tested in 3 orthogonal axes at the frequencies lowest, middle and highest for each modulation. The results reported are worst case. The measurement of spurious emission of EUT in receiver mode is deemed to be fulfilled as no limits are exceeded in transmitter mode (condition considered more burdensome). The EUT meets the requirements of sections 15.205, 15.209, 15.247 and RSS-Gen §§ 7.3/8.9/8.10

9 kHz÷30 MHz - Measurement result of GFSK (BR) modulation

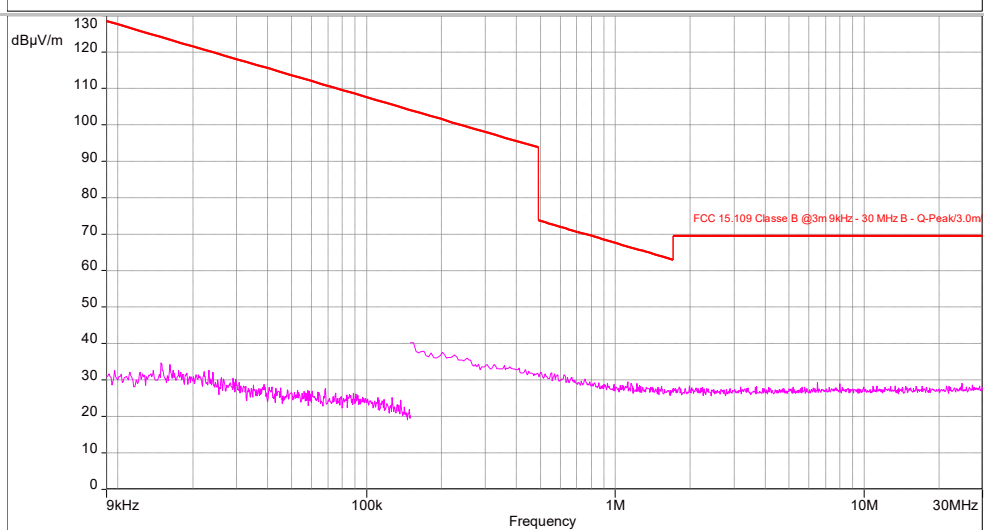
LOWER CHANNEL



MIDDLE CHANNEL

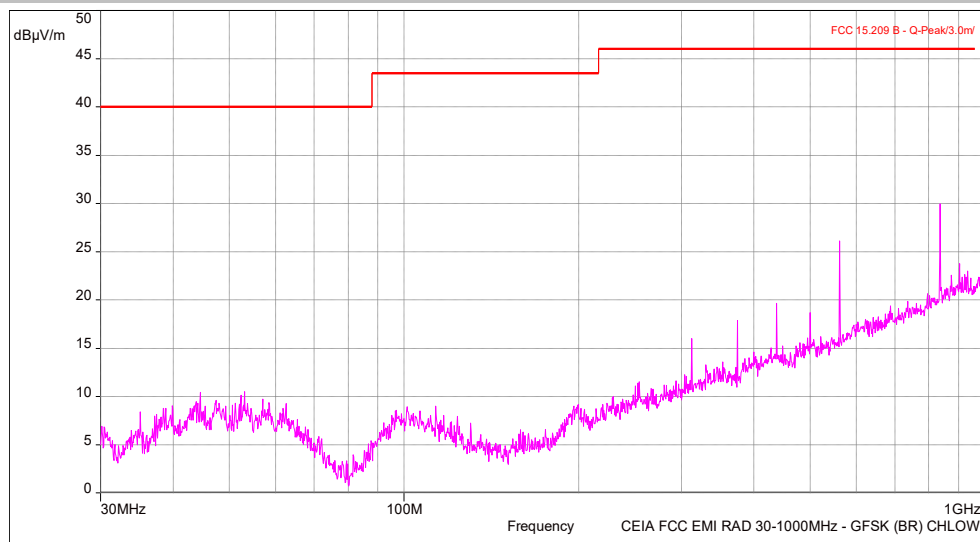


HIGHER CHANNEL

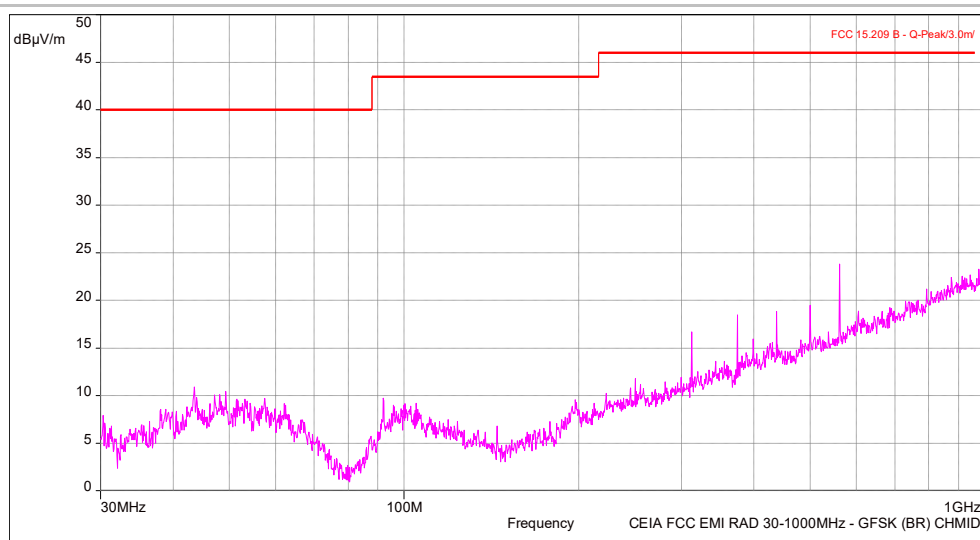


30÷1,000 MHz - Measurement result of GFSK (BR) modulation

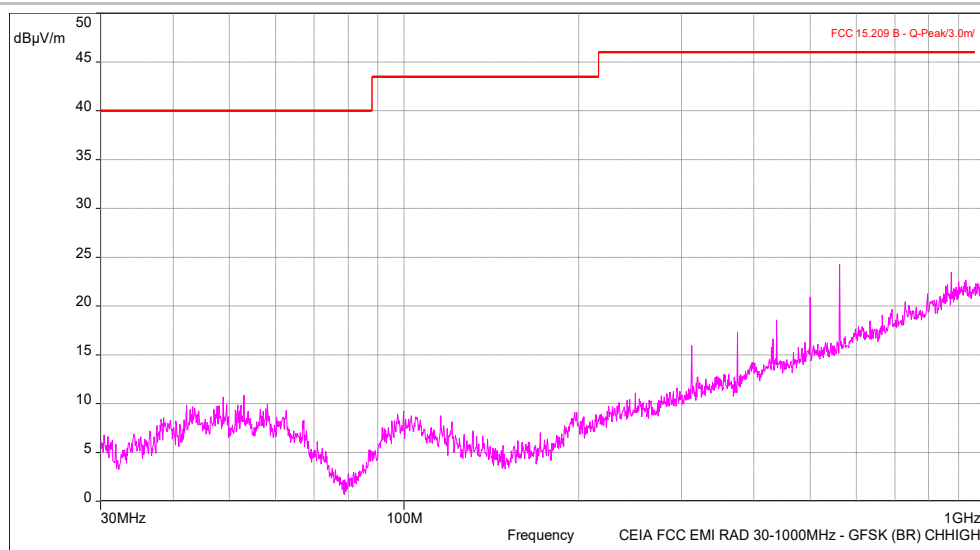
LOWER CHANNEL



MIDDLE CHANNEL

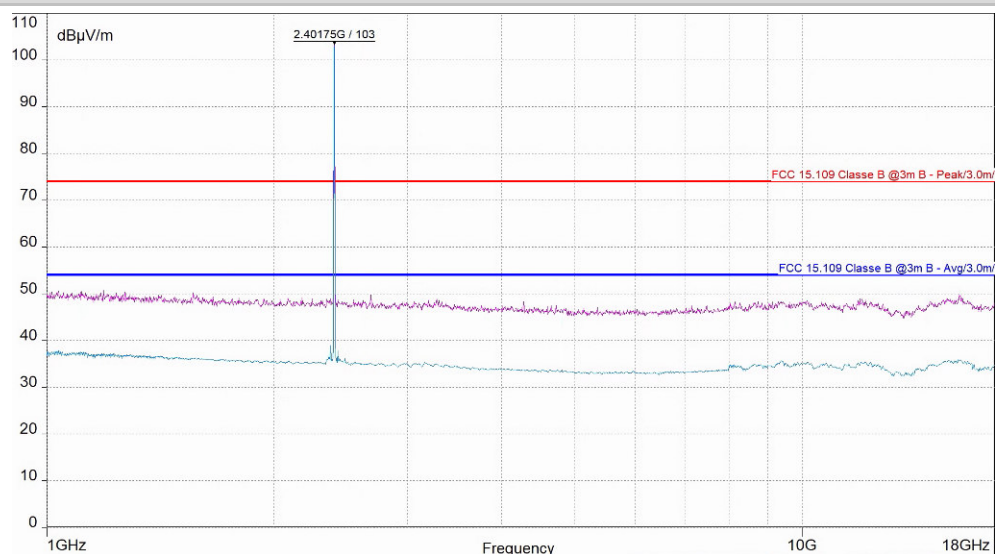


HIGHER CHANNEL

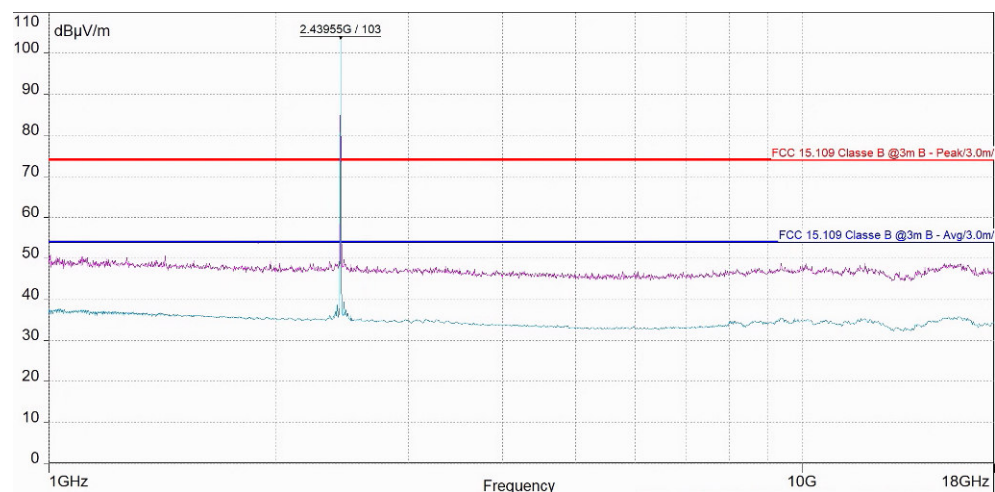


1÷18 GHz - Measurement result of GFSK (BR) modulation

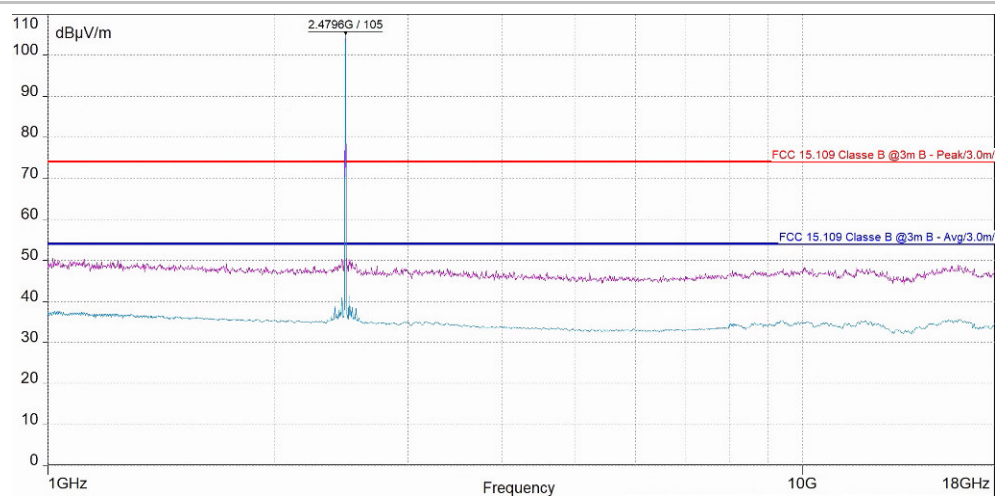
LOWER CHANNEL



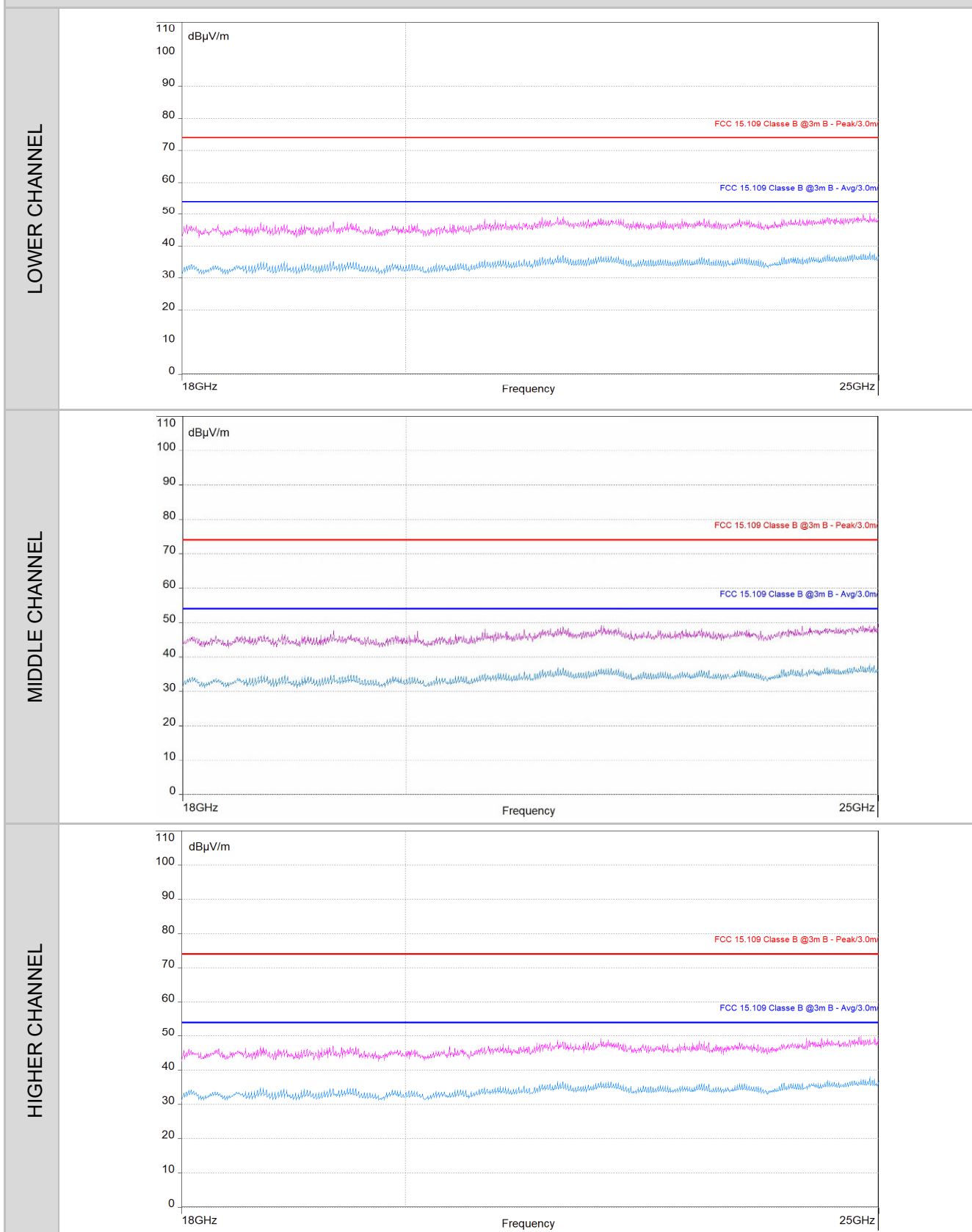
MIDDLE CHANNEL



HIGHER CHANNEL

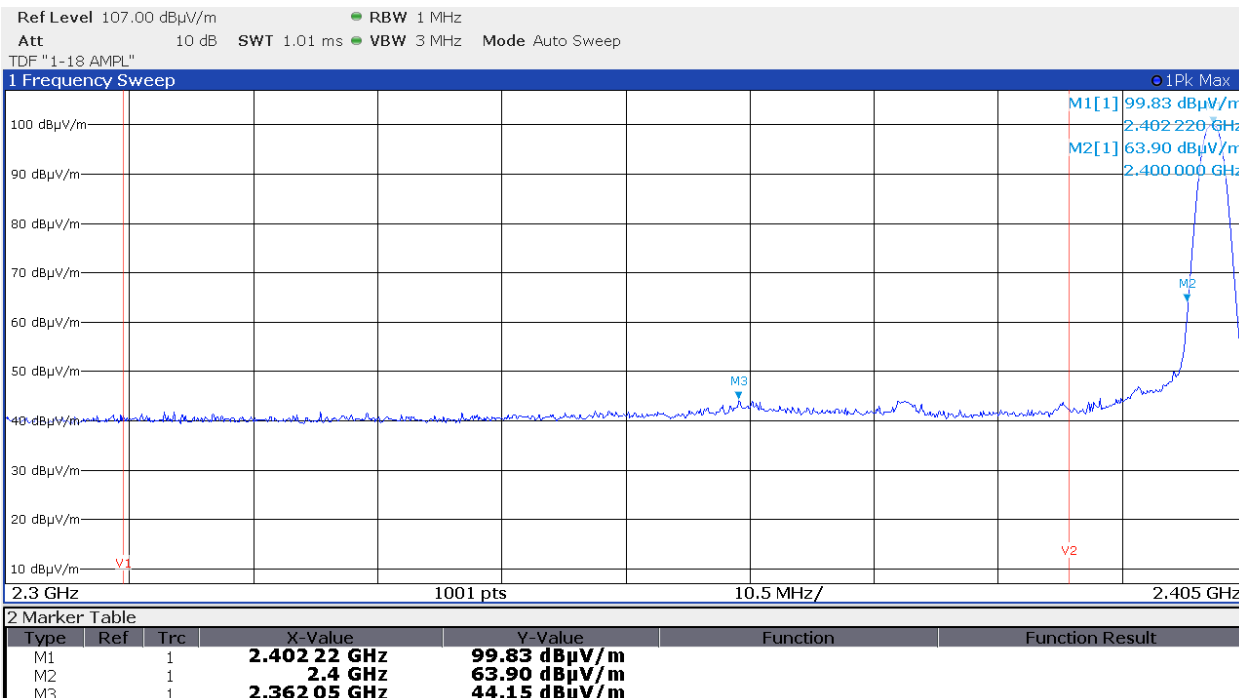


18÷25 GHz - Measurement result of GFSK (BR) modulation

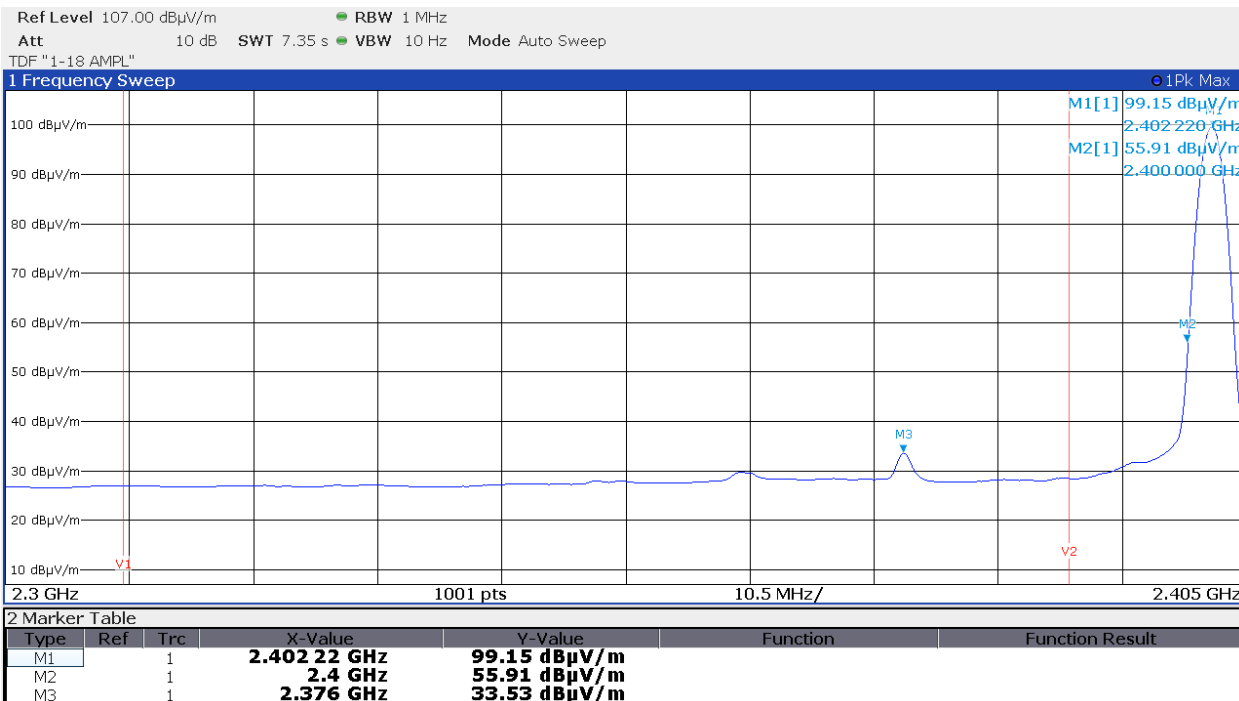


GFSK (BR) MODULATION LOWER CHANNEL - BAND-EDGE

PEAK

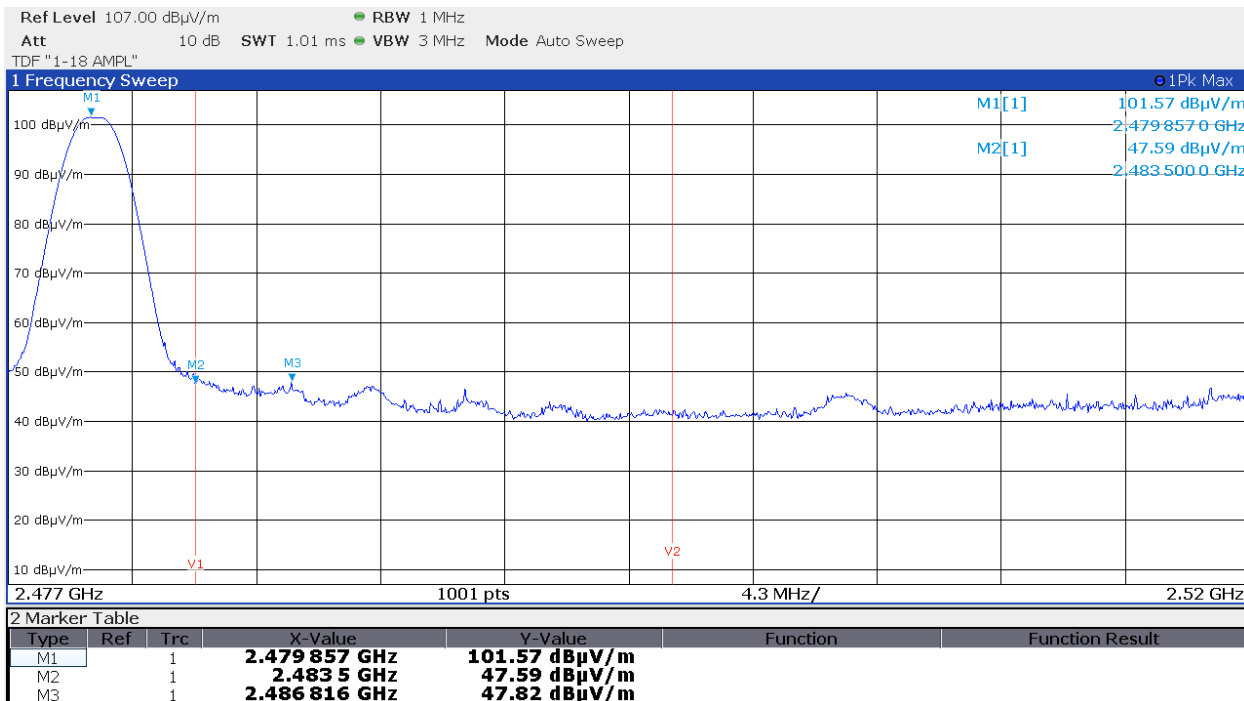


AVERAGE

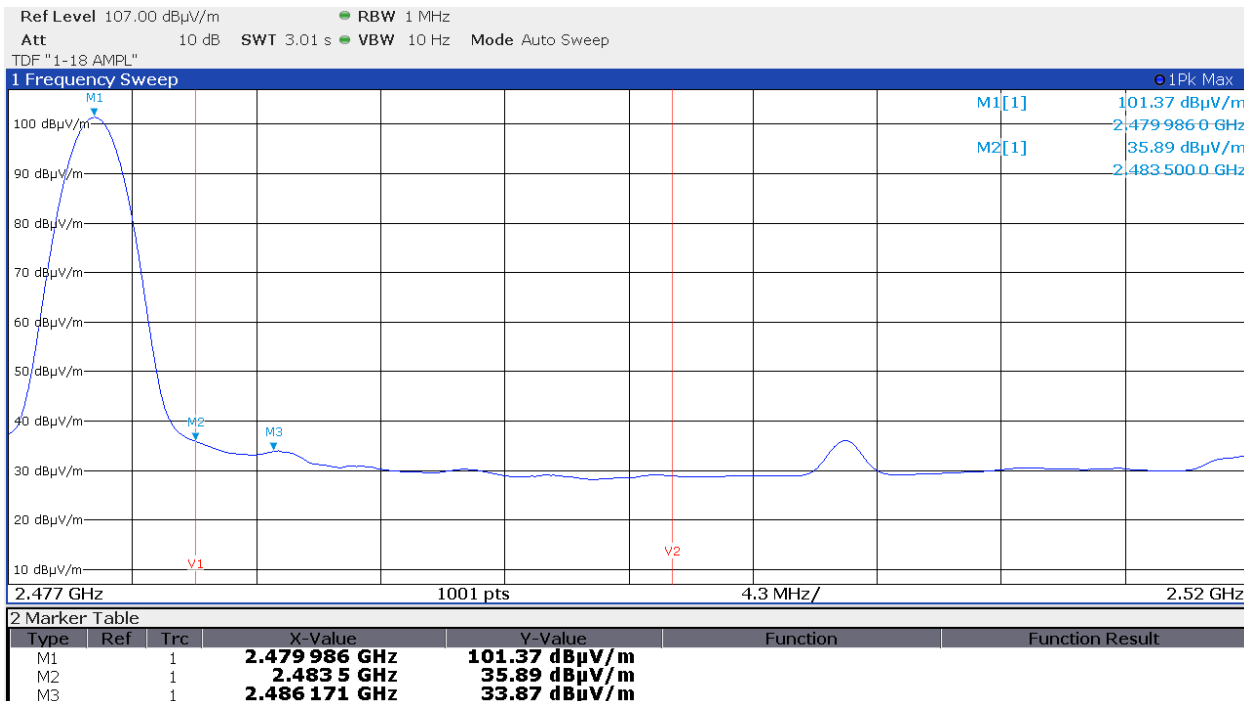


GFSK (BR) MODULATION HIGHER CHANNEL - BAND-EDGE

PEAK

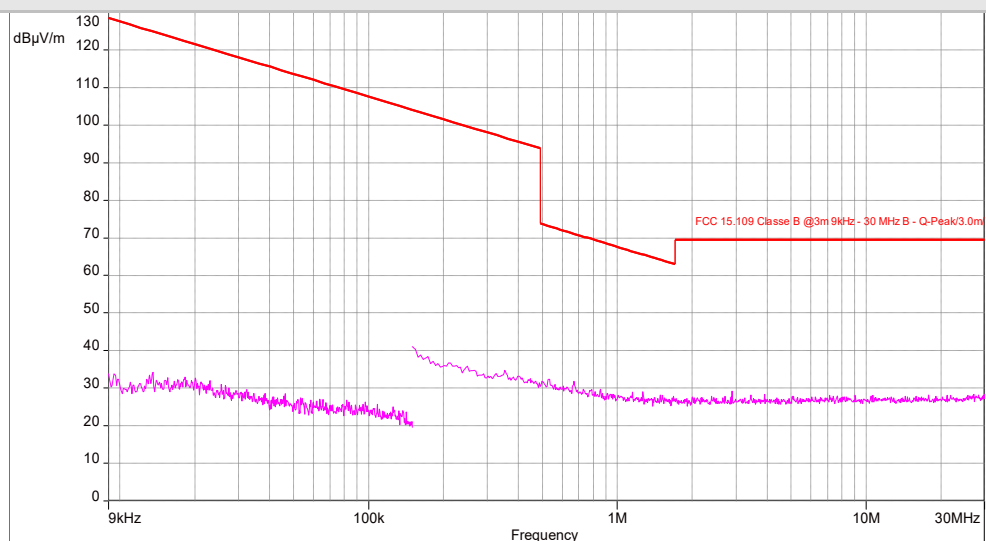


AVERAGE

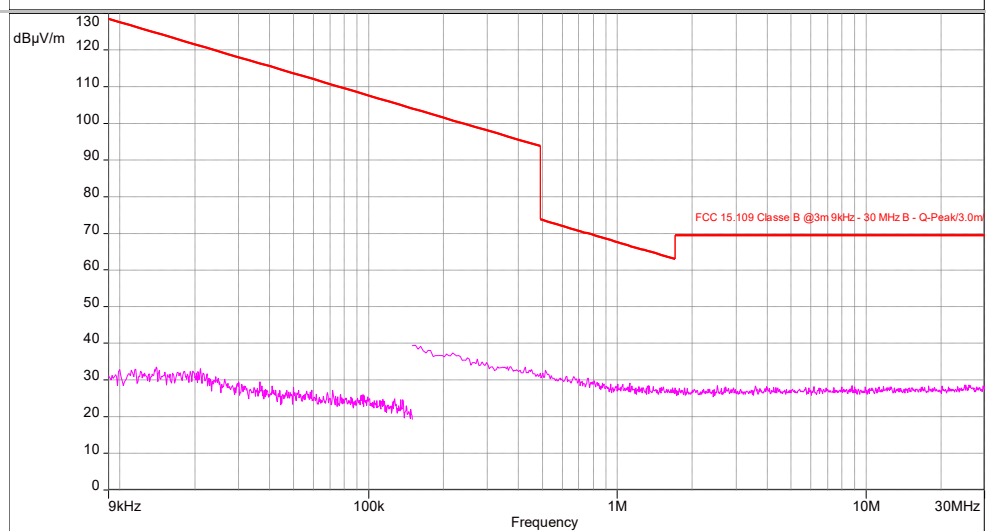


9 kHz÷30 MHz - Measurement result of $\pi/4$ -DQPSK (2-EDR) modulation

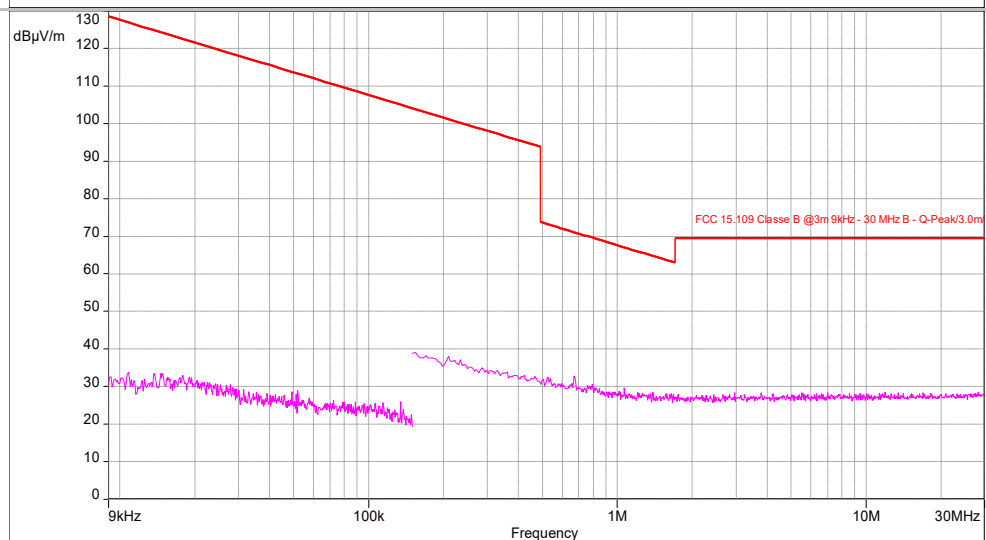
LOWER CHANNEL



MIDDLE CHANNEL

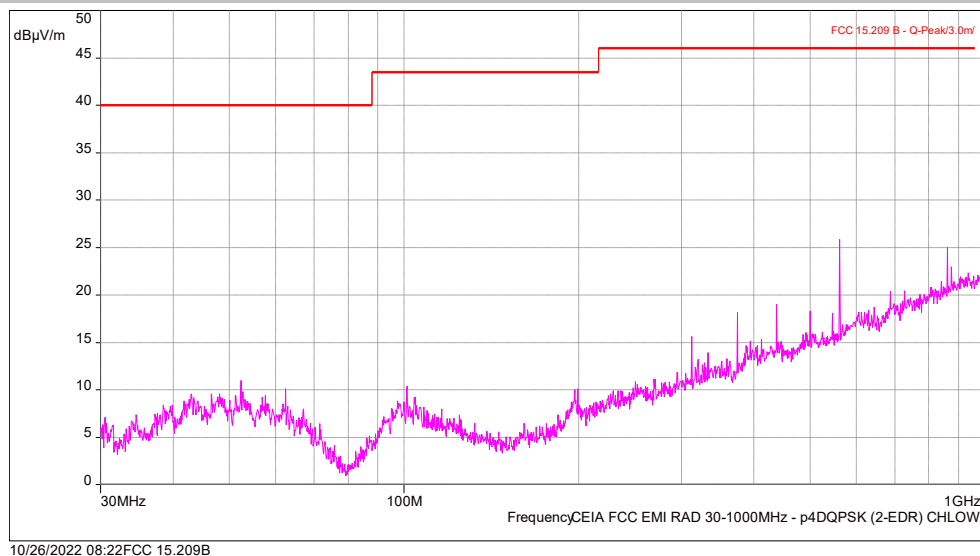


HIGHER CHANNEL

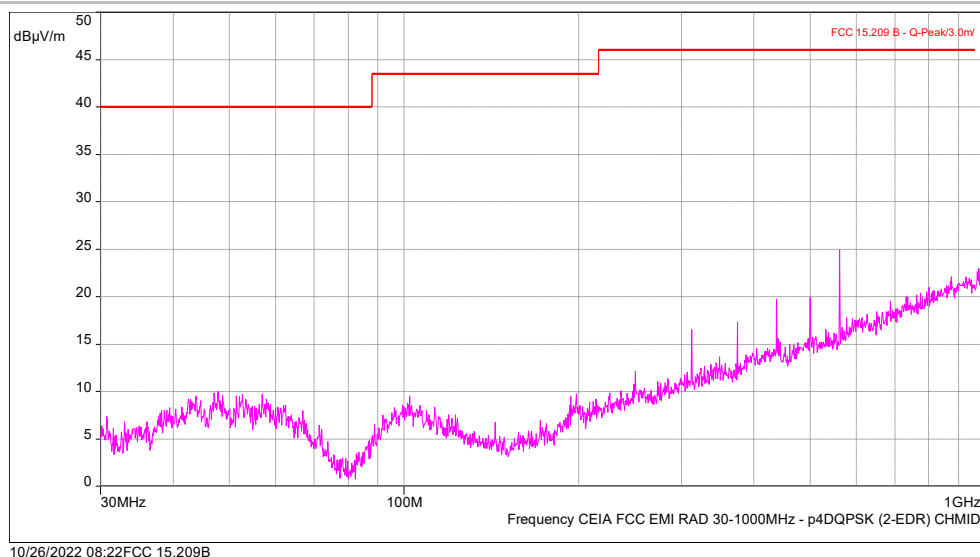


30÷1,000 MHz - Measurement result of $\pi/4$ -DQPSK (2-EDR) modulation

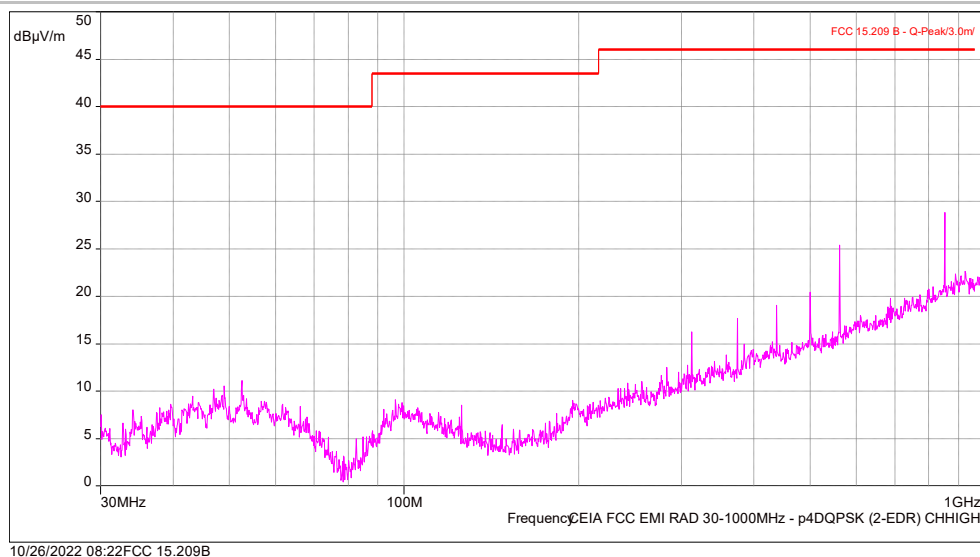
LOWER CHANNEL



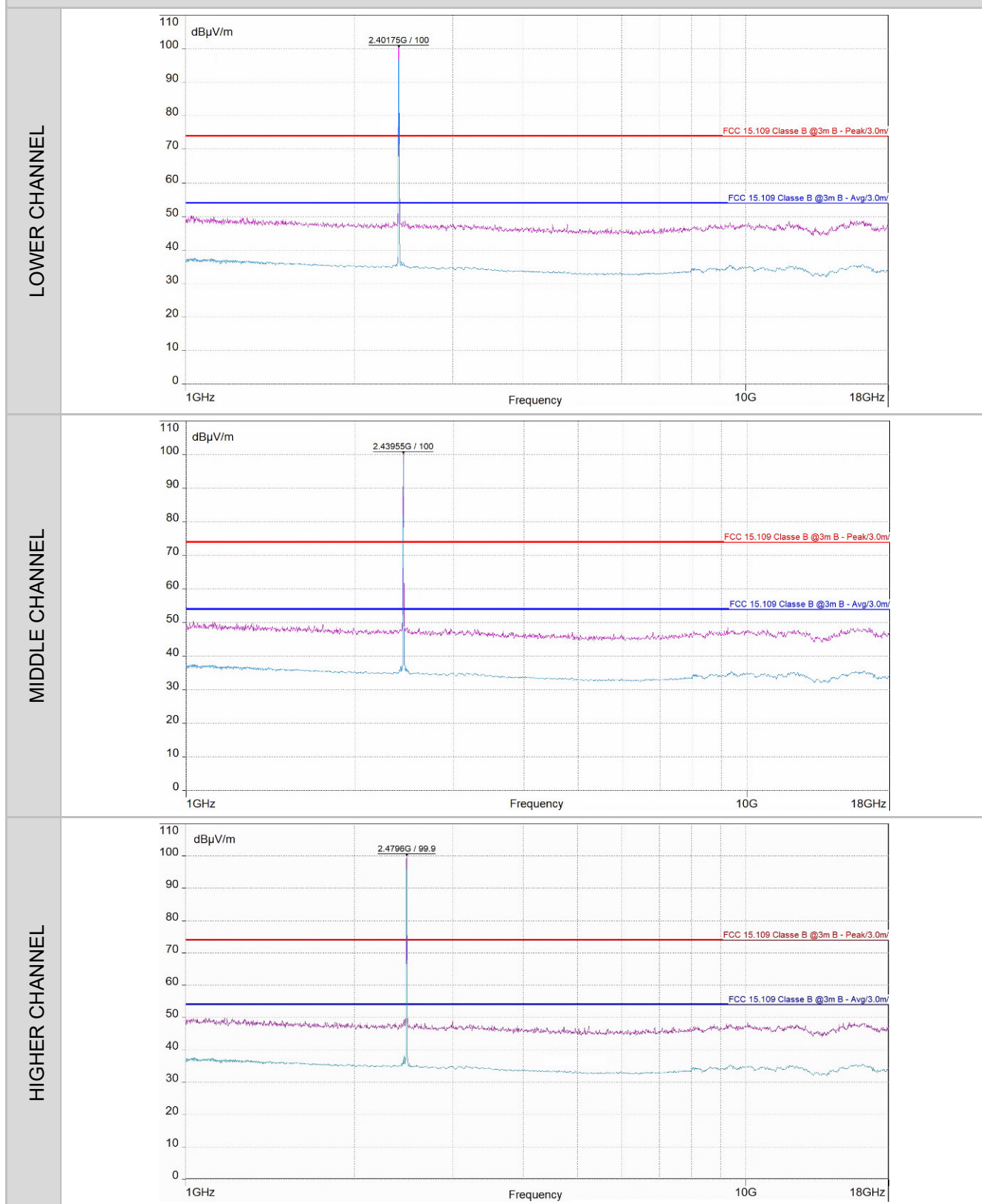
MIDDLE CHANNEL

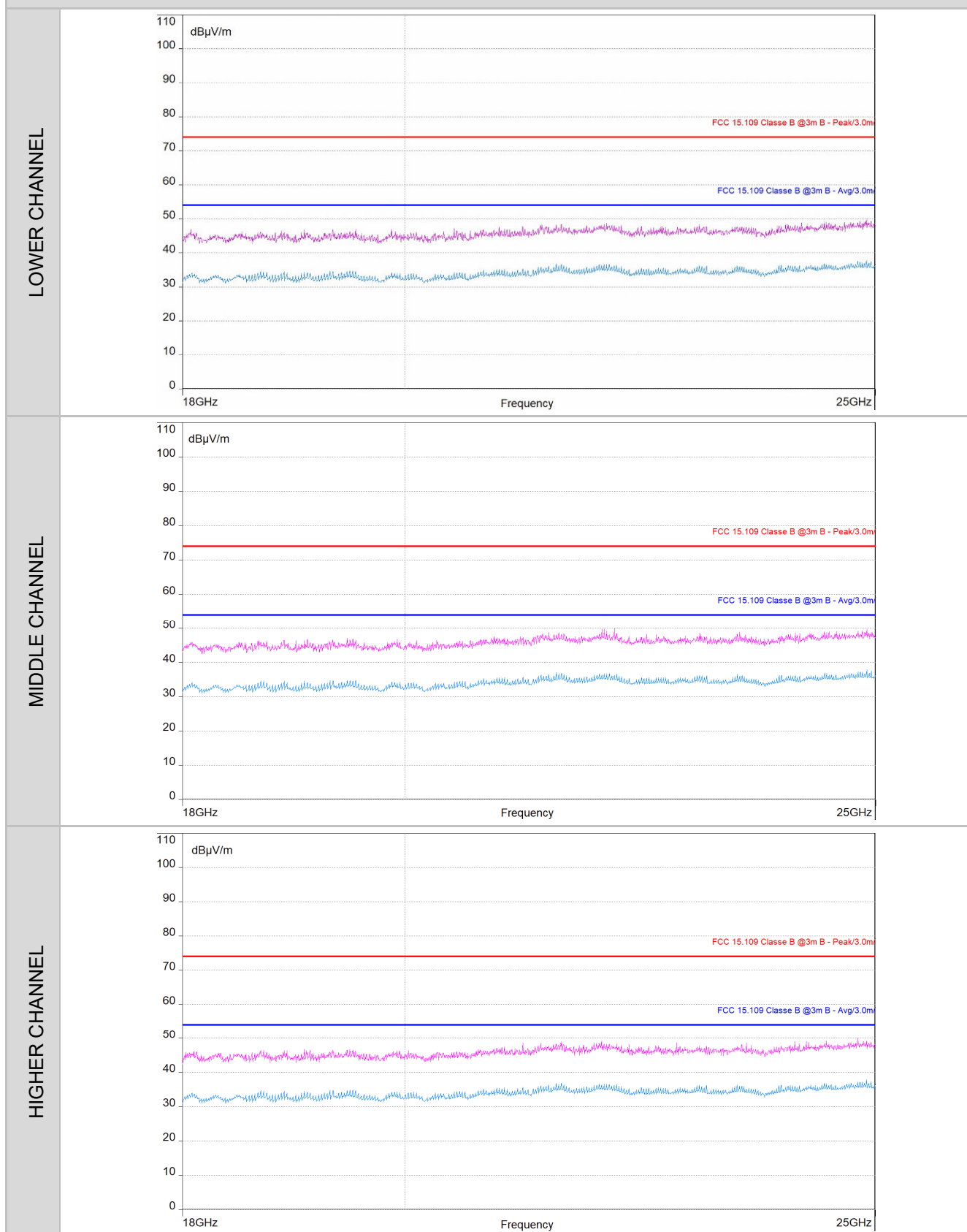


HIGHER CHANNEL



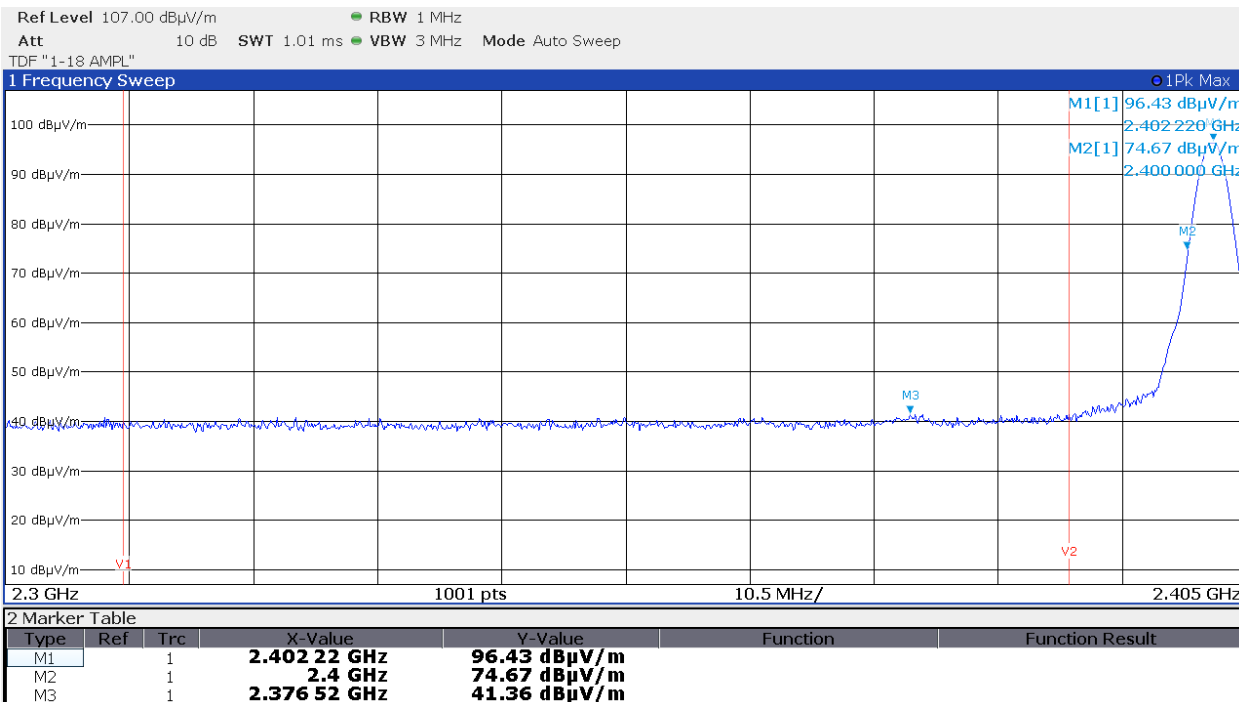
1÷18 GHz - Measurement result of $\pi/4$ -DQPSK (2-EDR) modulation



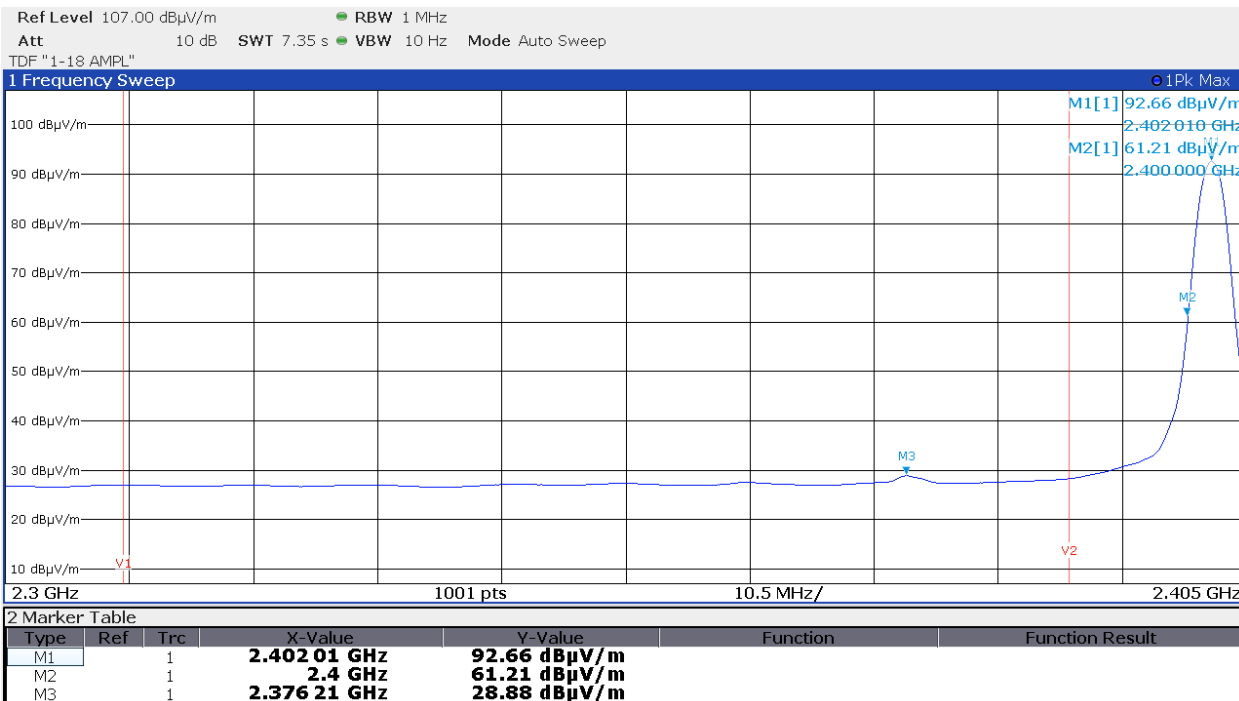
18÷25 GHz - Measurement result of $\pi/4$ -DQPSK (2-EDR) modulation

$\pi/4$ -DQPSK (2-EDR) MODULATION LOWER CHANNEL – BAND-EDGE

PEAK

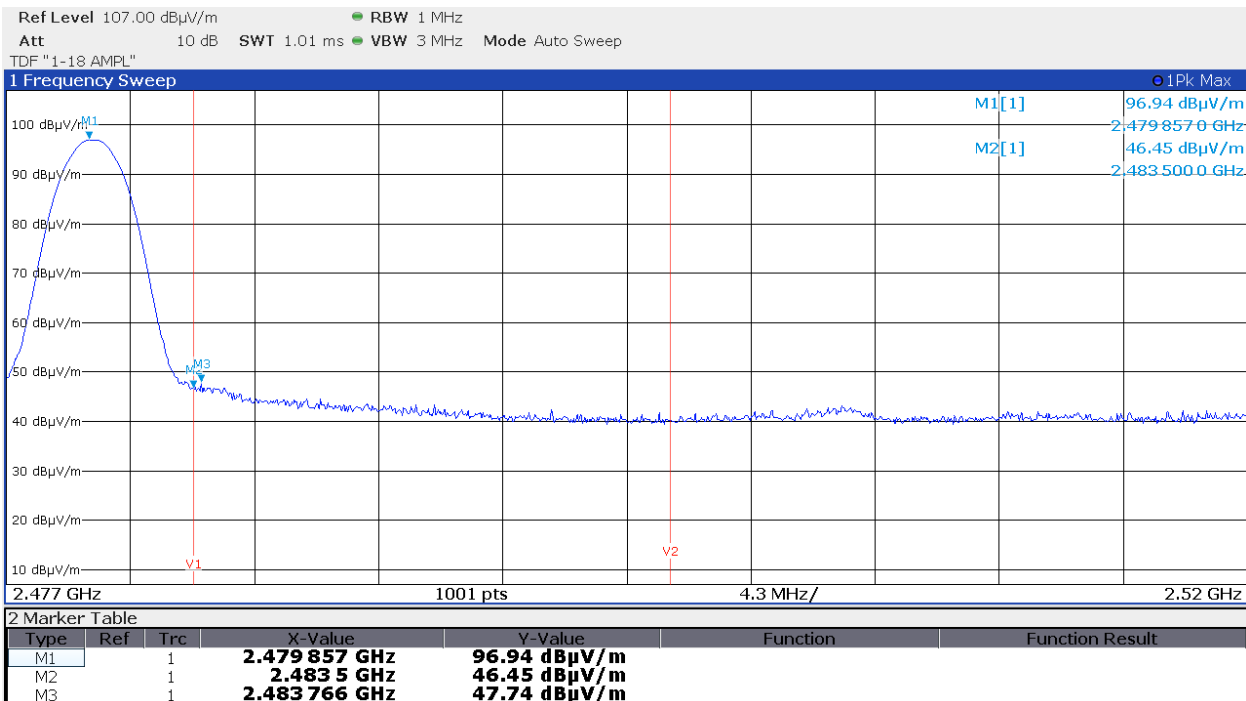


AVERAGE



$\pi/4$ -DQPSK (2-EDR) MODULATION HIGHER CHANNEL – BAND-EDGE

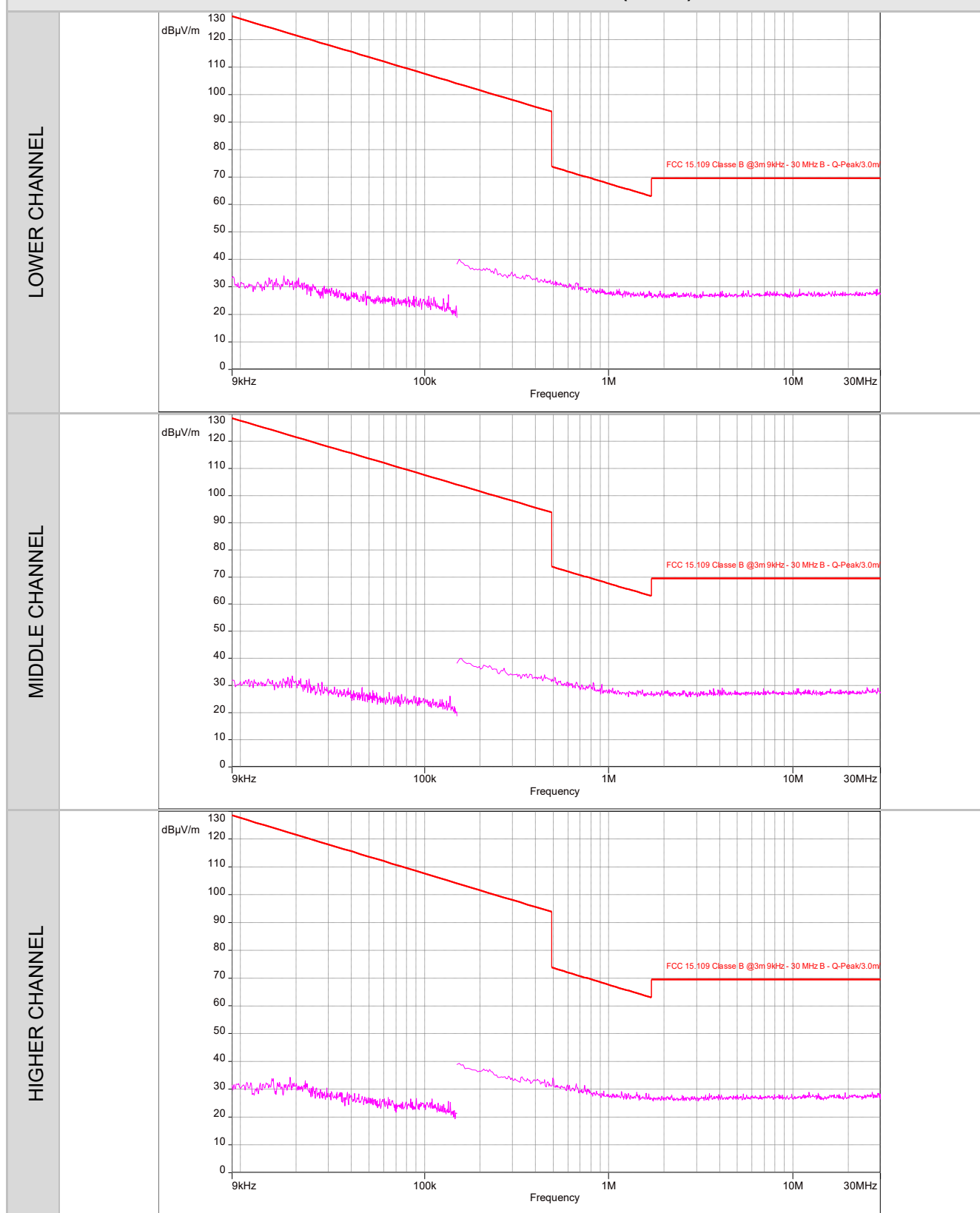
PEAK



AVERAGE

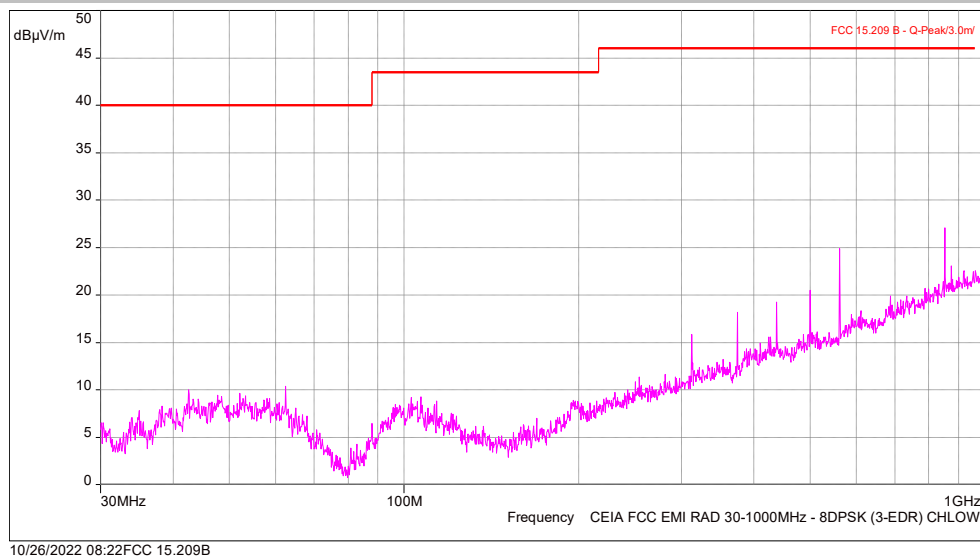


9 kHz÷30 MHz - Measurement result of 8DPSK (3-EDR) modulation

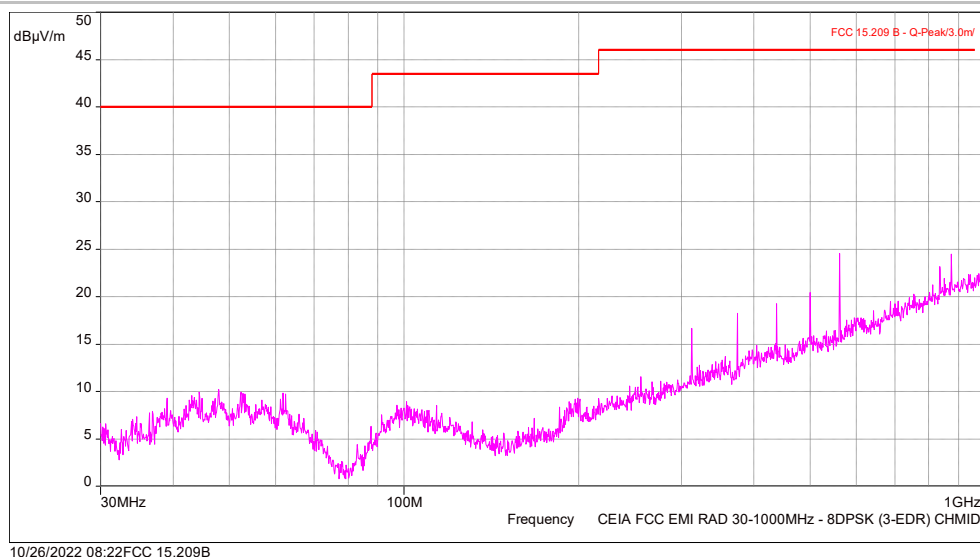


30÷1,000 MHz - Measurement result of 8DPSK (3-EDR) modulation

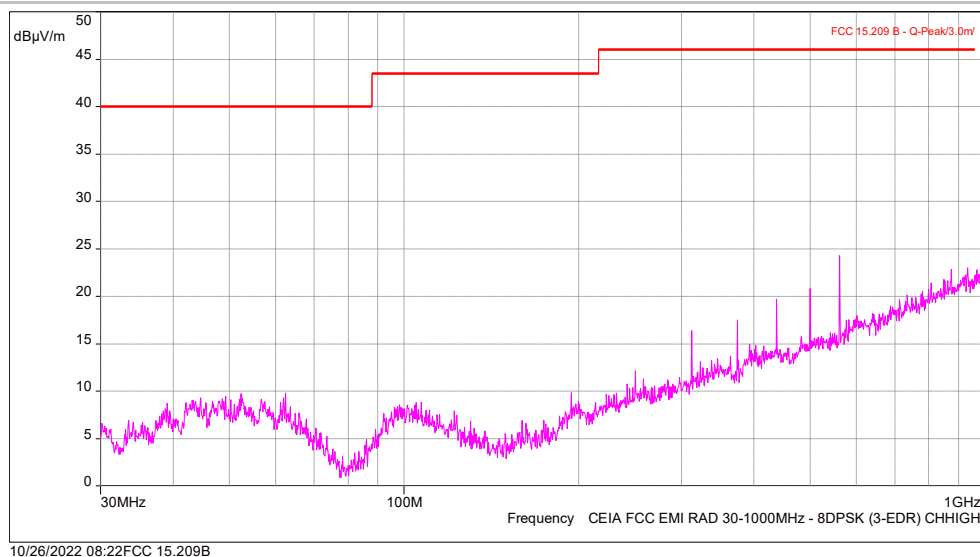
LOWER CHANNEL



MIDDLE CHANNEL

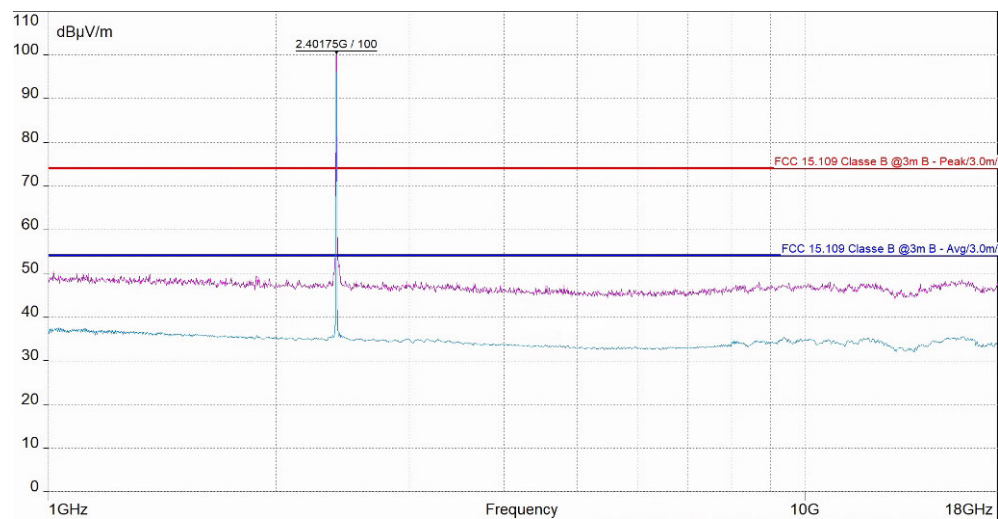


HIGHER CHANNEL

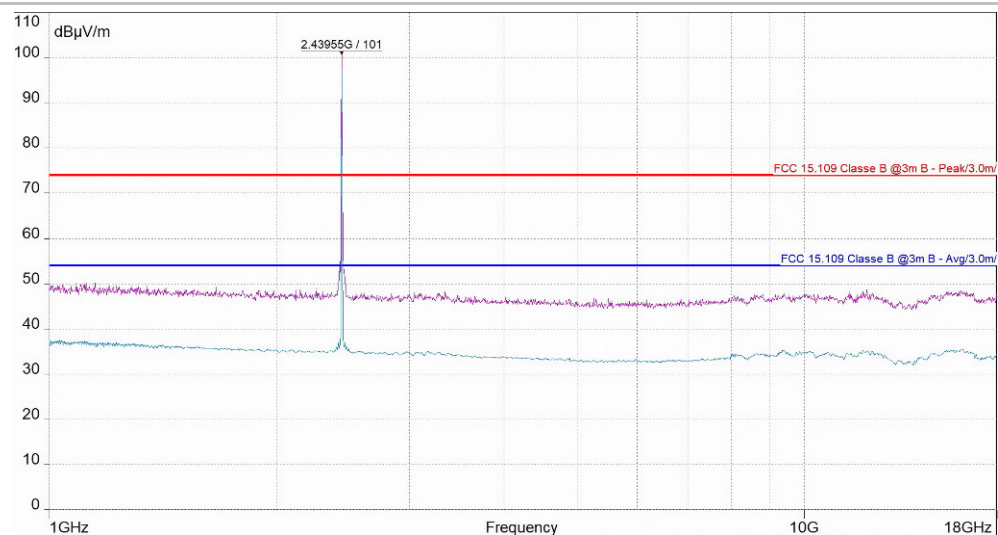


1÷18 GHz - Measurement result of 8DPSK (3-EDR) modulation

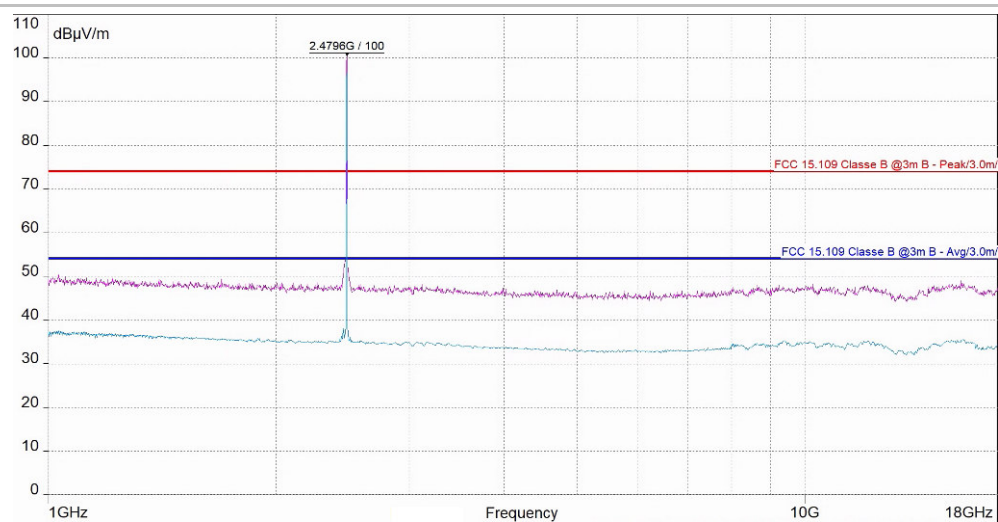
LOWER CHANNEL

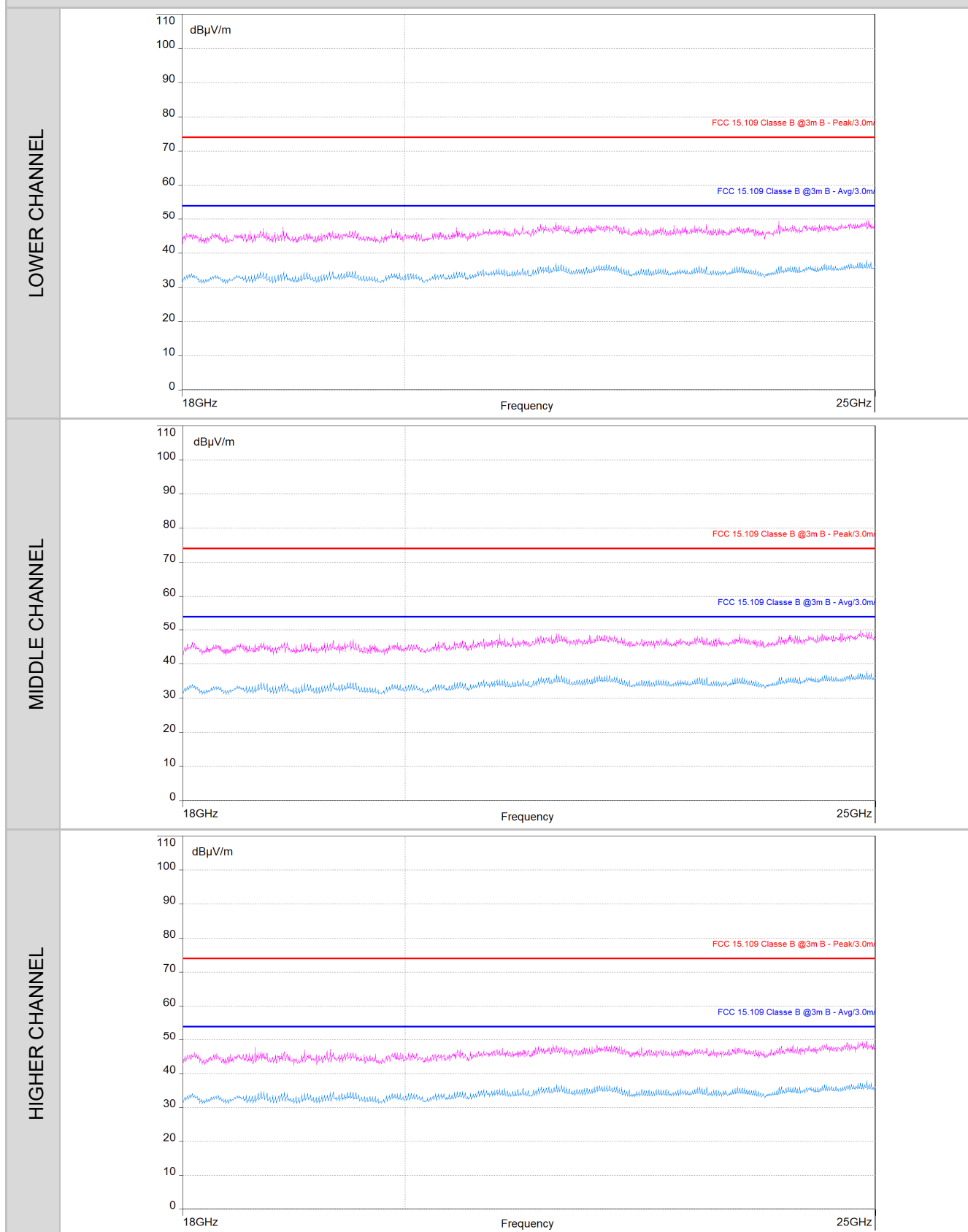


MIDDLE CHANNEL



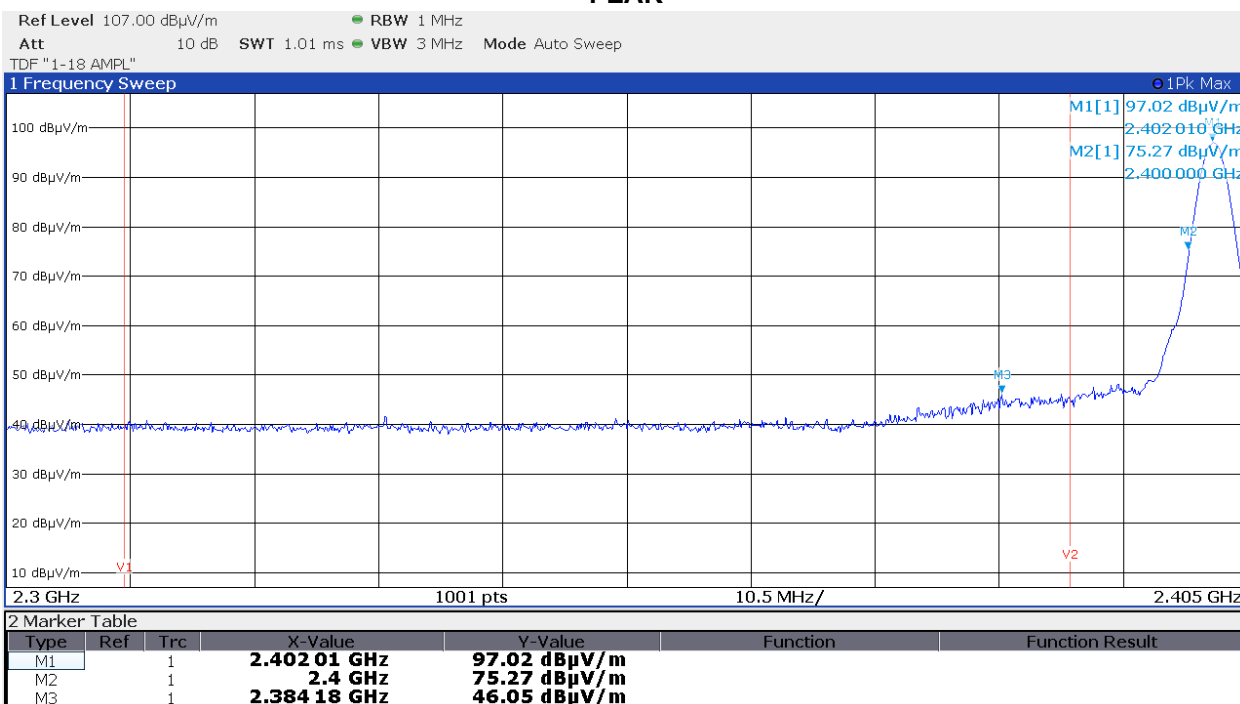
HIGHER CHANNEL



18÷25 GHz - Measurement result of 8DPSK (3-EDR) modulation

8DPSK (3-EDR) MODULATION LOWER CHANNEL – BAND-EDGE

PEAK

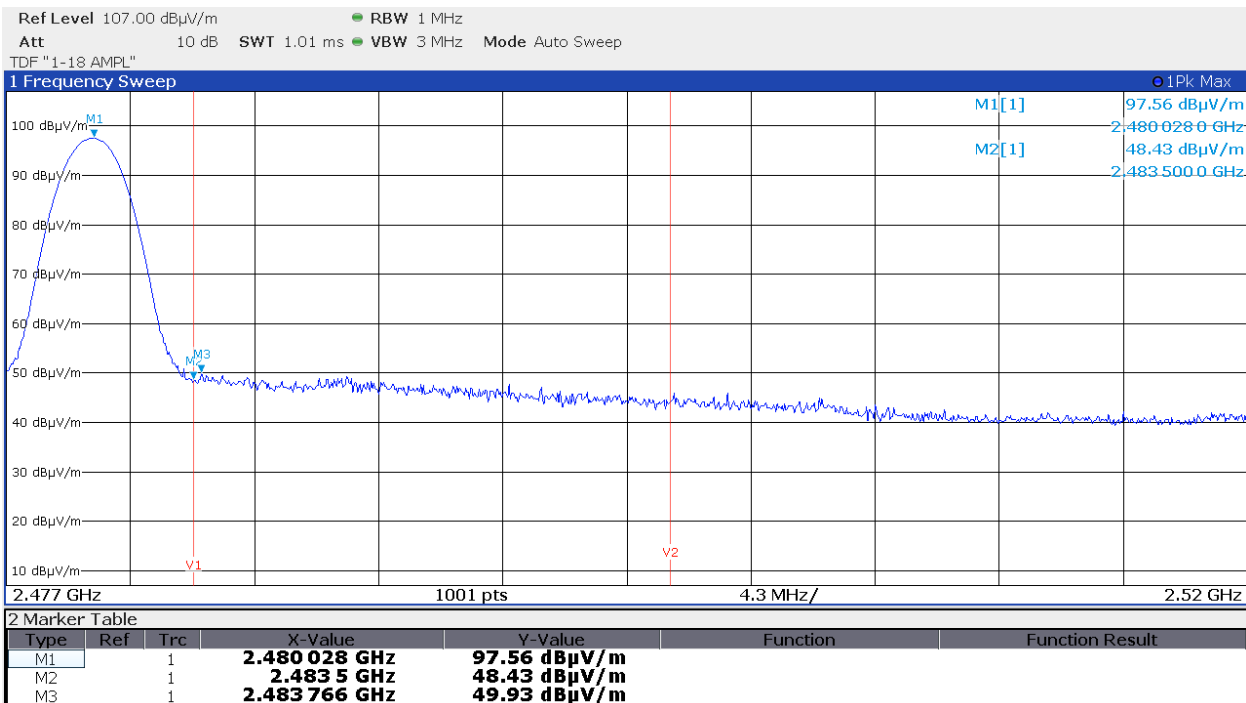


AVERAGE

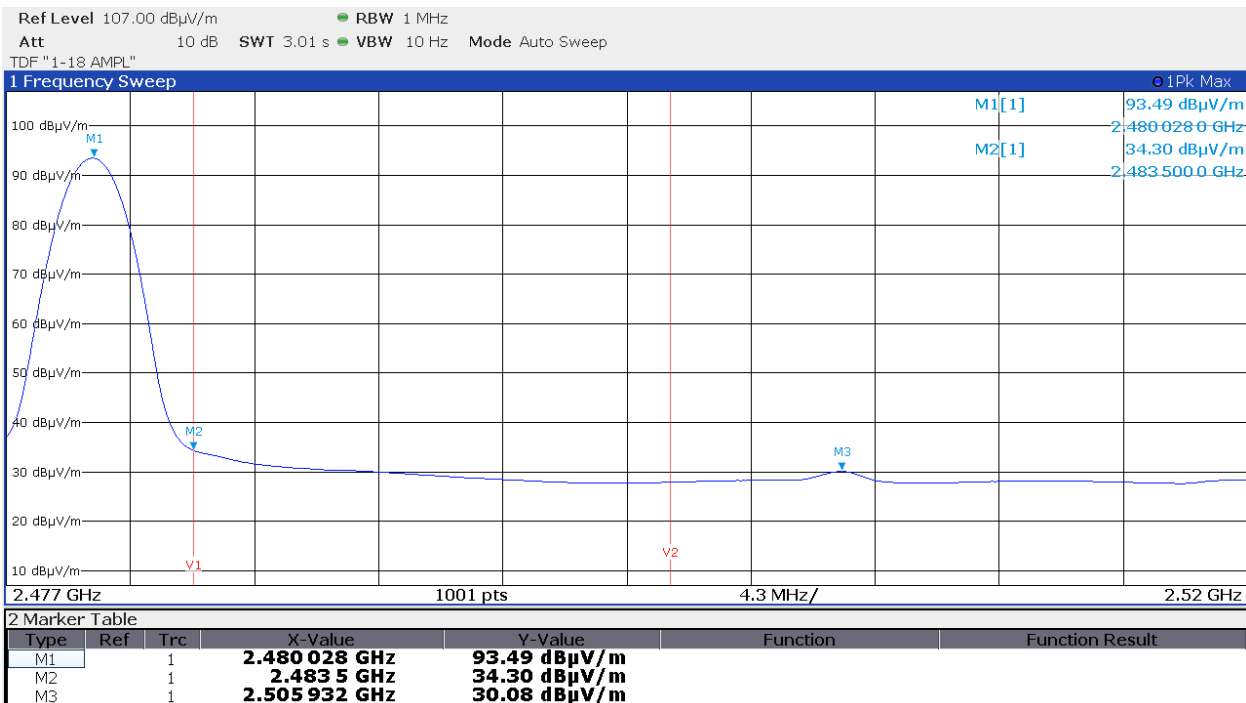


8DPSK (3-EDR) MODULATION HIGHER CHANNEL - BAND-EDGE

PEAK



AVERAGE



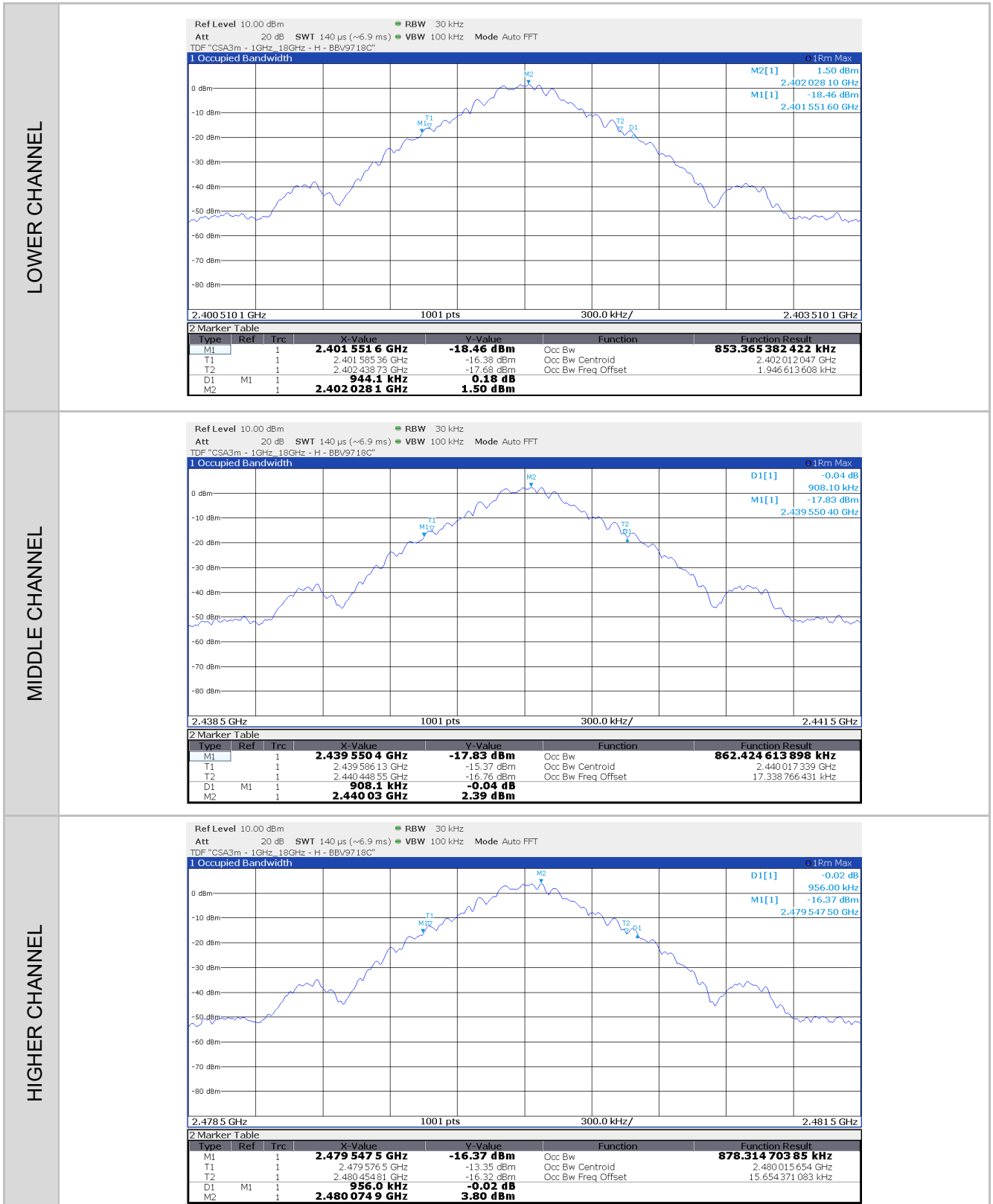
7.4 -20dB & 99% BANDWIDTH

TEST REQUIREMENT	
Spectrum analyzer settings	
Span	Wide enough for the measurement to be made
Resolution bandwidth (RBW)	30 kHz
Video bandwidth (VBW)	100 kHz
Sweep time (SWT)	AUTO
Detector function	Peak
Trace	Max hold
EUT operating condition	1 to 9
Remark	None
Testing dates	2022-10-21

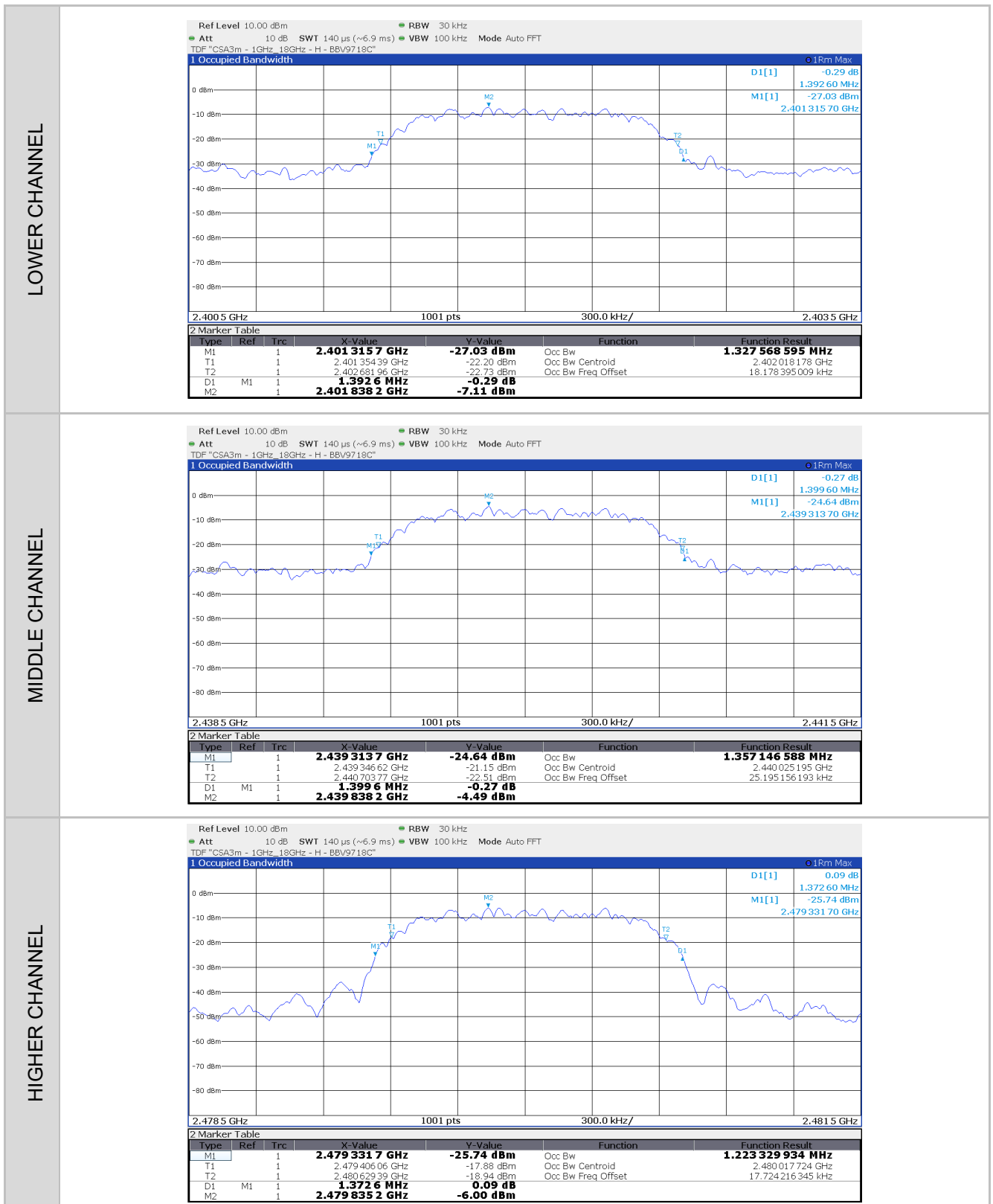
TEST RESULT
The EUT meets the requirements of sections 15.247(a) and RSS -Gen § 6.7 / RSS-247 5.1(a)

TEST PROCEDURE
The Channel bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20 dB.

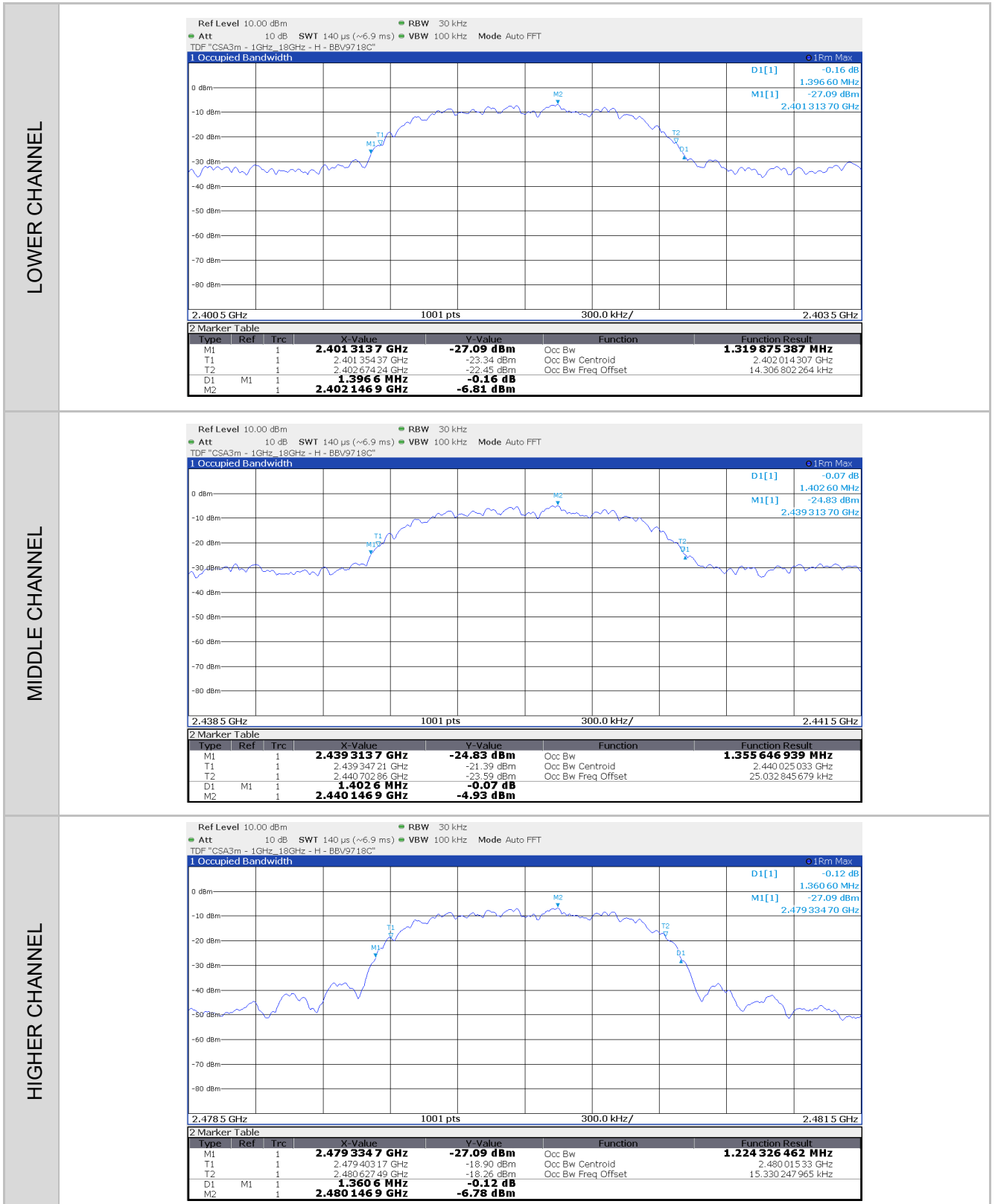
Modulation	Channel	Frequency	-20dB Bandwidth (MHz)	99% Bandwidth (MHz)
GFSK (BR)	Lower	2402	0.9441	0.8534
	Middle	2440	0.9081	0.8624
	Higher	2480	0.9560	0.8783



Modulation	Channel	Frequency	-20dB Bandwidth (MHz)	99% Bandwidth (MHz)
$\pi/4$ -DQPSK (2-EDR)	Lower	2402	1.3926	1.3276
	Middle	2440	1.3996	1.3571
	Higher	2480	1.3726	1.2233



Modulation	Channel	Frequency	-20dB Bandwidth (MHz)	99% Bandwidth (MHz)
8DPSK (3-EDR)	Lower	2402	1.3966	1.3199
	Middle	2440	1.4026	1.3556
	Higher	2480	1.3606	1.2243

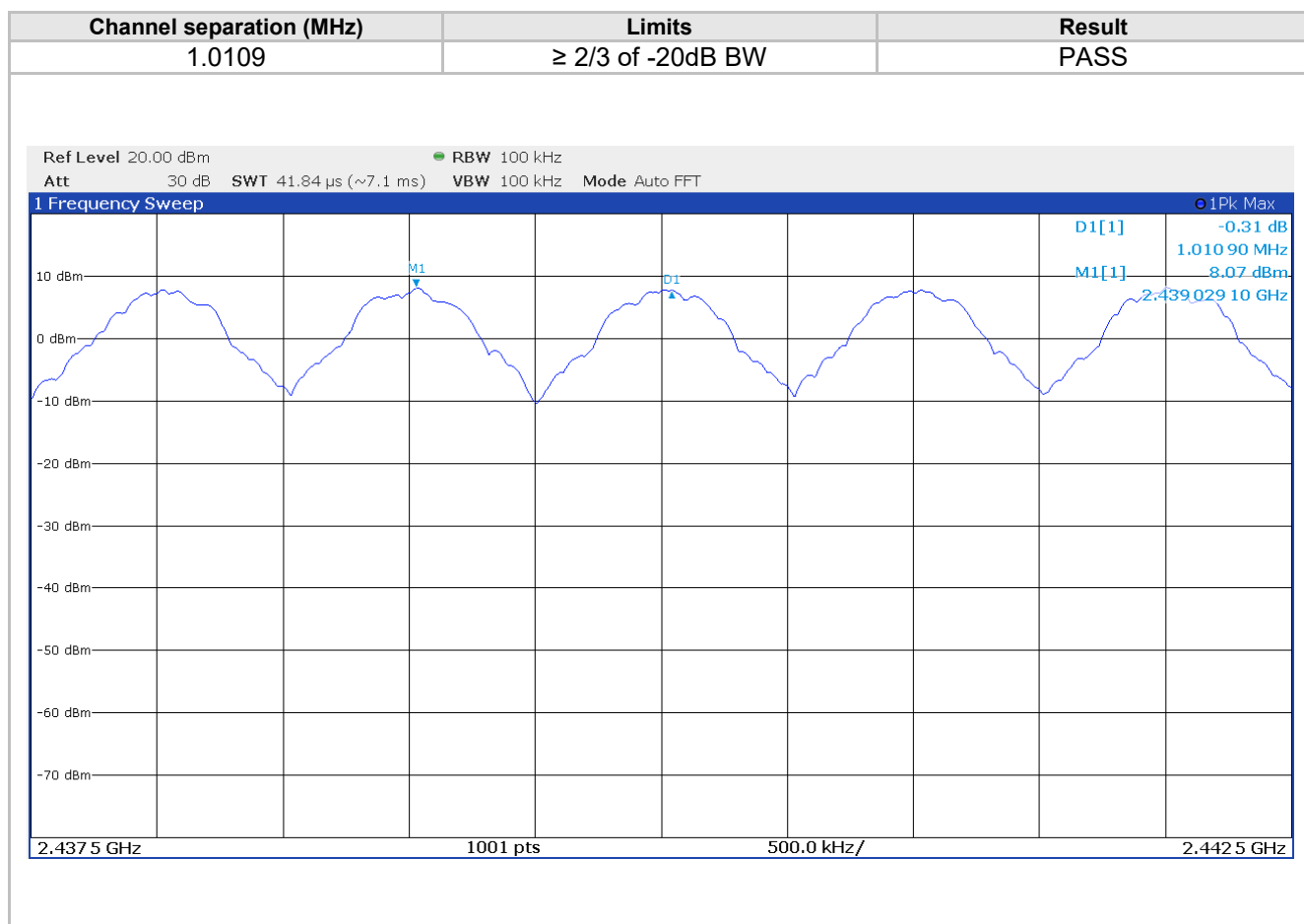


7.5 CARRIER FREQUENCY (HOPPING CHANNEL) SEPARATION

TEST REQUIREMENT	
Spectrum analyzer settings	
Resolution bandwidth (RBW)	Adjusted as necessary to best identify the center of each individual channel
Video bandwidth (VBW)	$\geq$ RBW
Sweep time (SWT)	AUTO
Detector function	Peak. Trace: Max hold
Procedure	Use of delta marker function to determine the frequency separation
EUT operating condition	10 (worst case and recorded on the report)
Testing dates	2022-11-03

TEST RESULT

The EUT meets the requirements of sections 15.247 (a) (1) and RSS -247 § 5.1 (b)



7.6 NUMBER OF HOPPING CHANNELS USED

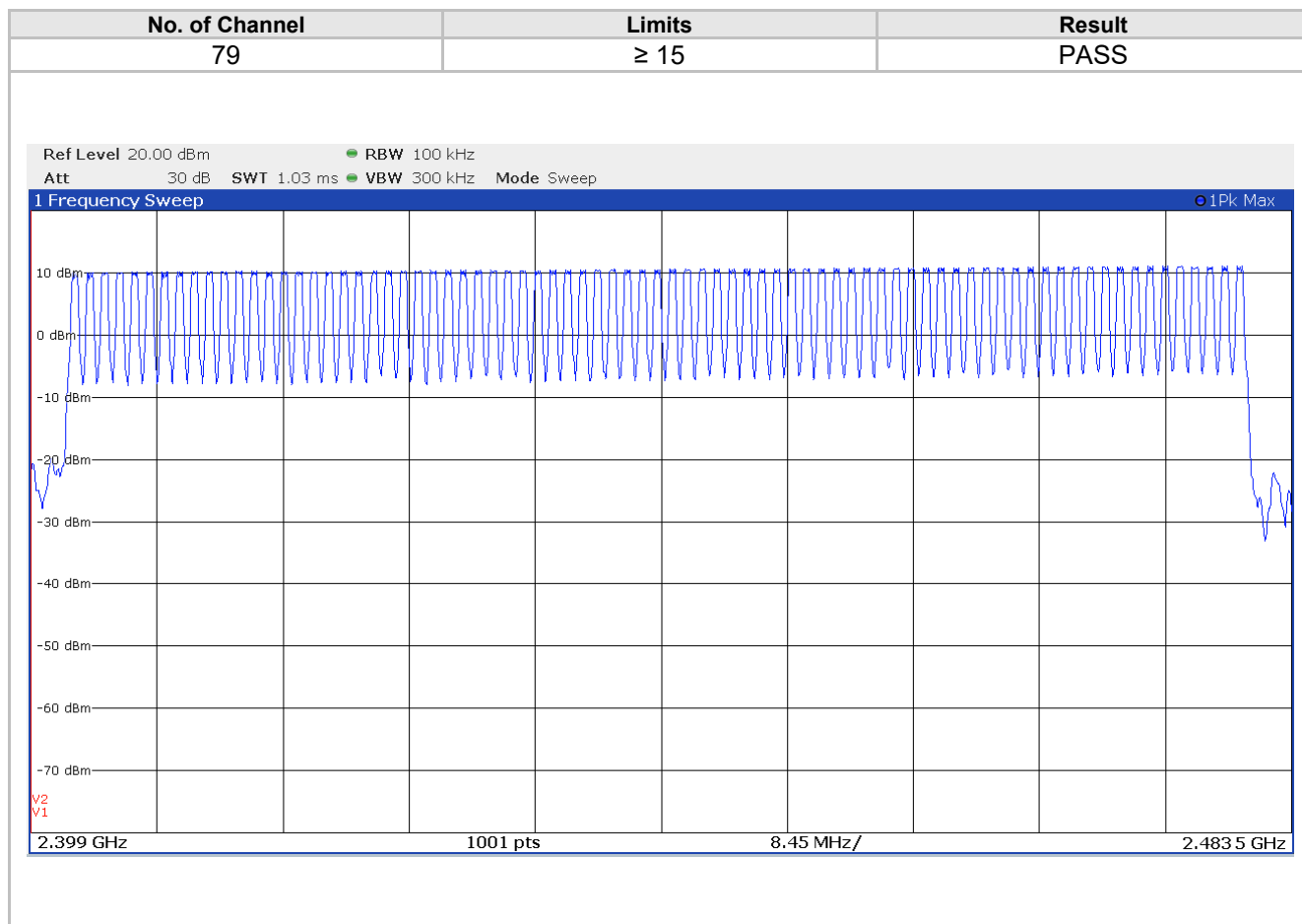
TEST REQUIREMENT

Spectrum analyzer settings

Resolution bandwidth (RBW)	Adjusted as necessary to best identify the individual channel
Video bandwidth (VBW)	$\geq$ RBW
Sweep time (SWT)	AUTO
Detector function	Peak. Trace: Max hold
Procedure	Use Span adequate to frequency band to determinate number of channels
EUT operating condition	10 (worst case and recorded on the report)
Testing dates	2022-11-02

TEST RESULT

The EUT meets the requirements of sections 15.247 (a) (1) (iii) and RSS -247 § 5.1 (c)



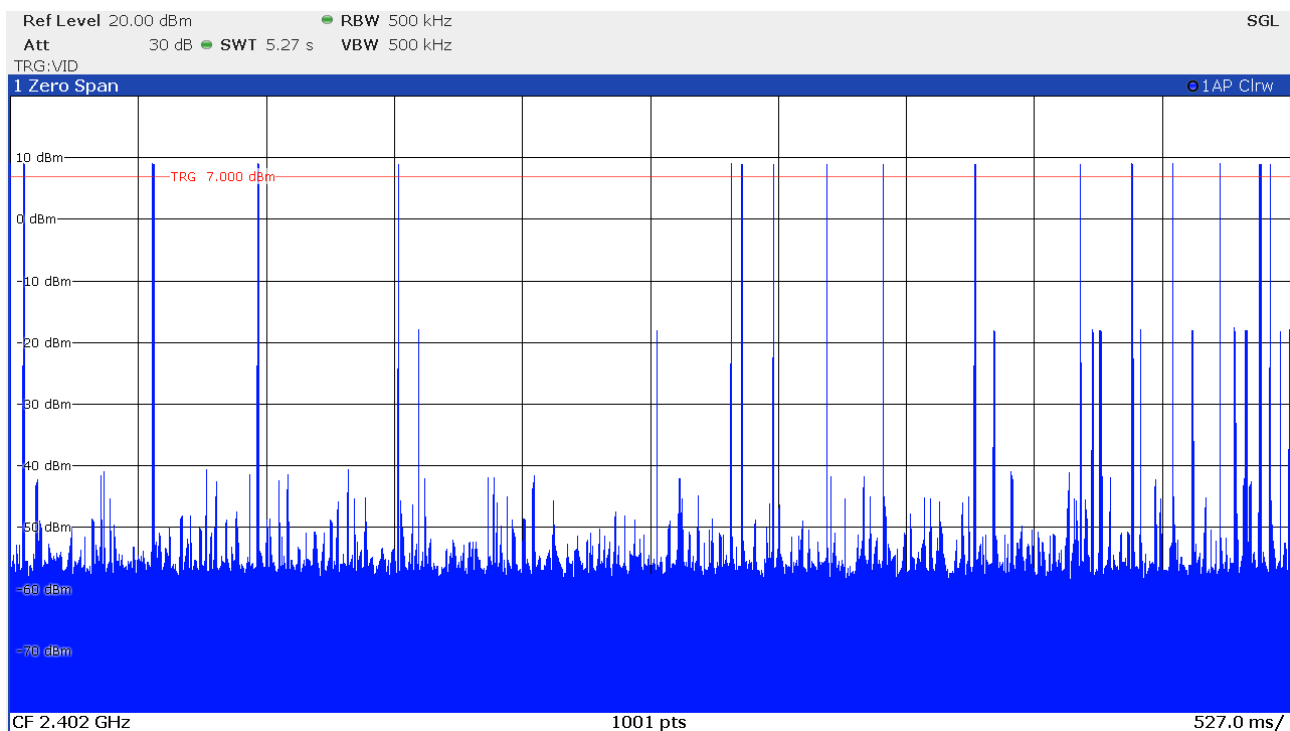
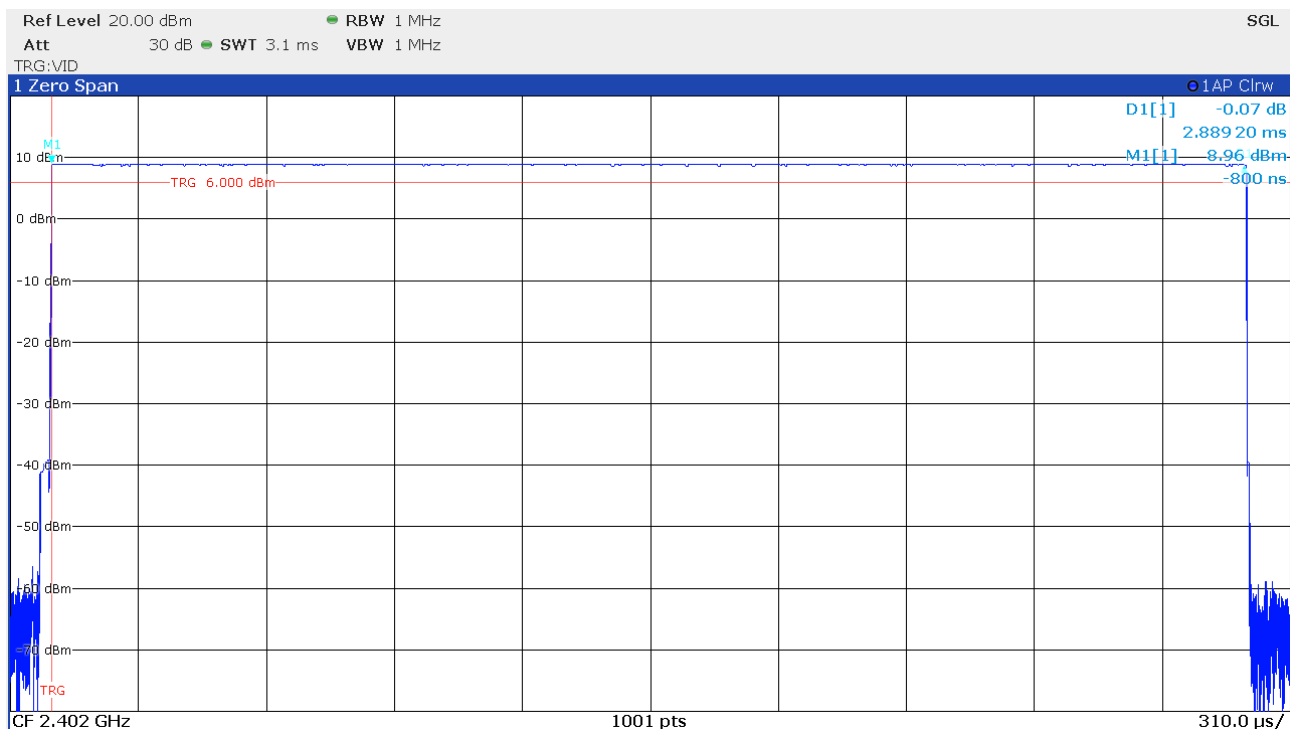
7.7 CHANNEL OCCUPANCY TIME (DWEELL TIME)

TEST REQUIREMENT	
Spectrum analyzer settings	
Resolution bandwidth (RBW)	$\leq$ channel spacing
Video bandwidth (VBW)	$\geq$ RBW
Detector function	Peak; Trace Max hold
Span	Zero span centered on a hopping channel
Sweep time (SWT)	As necessary to capture the entire dwell time per hopping channel
Procedure	Use a video trigger and trigger delay to determine the channel transmitted start. Use of delta marker function to determine the transmit time per hop. Repeat the measurement using a longer sweep time to determine the number of hops. Calculate the total number of hops in the period specified in the requirement. The occupancy time is calculated from the transmit time hop multiplied by the number of hops
EUT operating condition	10 (worst case and recorded on the report)
Testing dates	2022-11-03

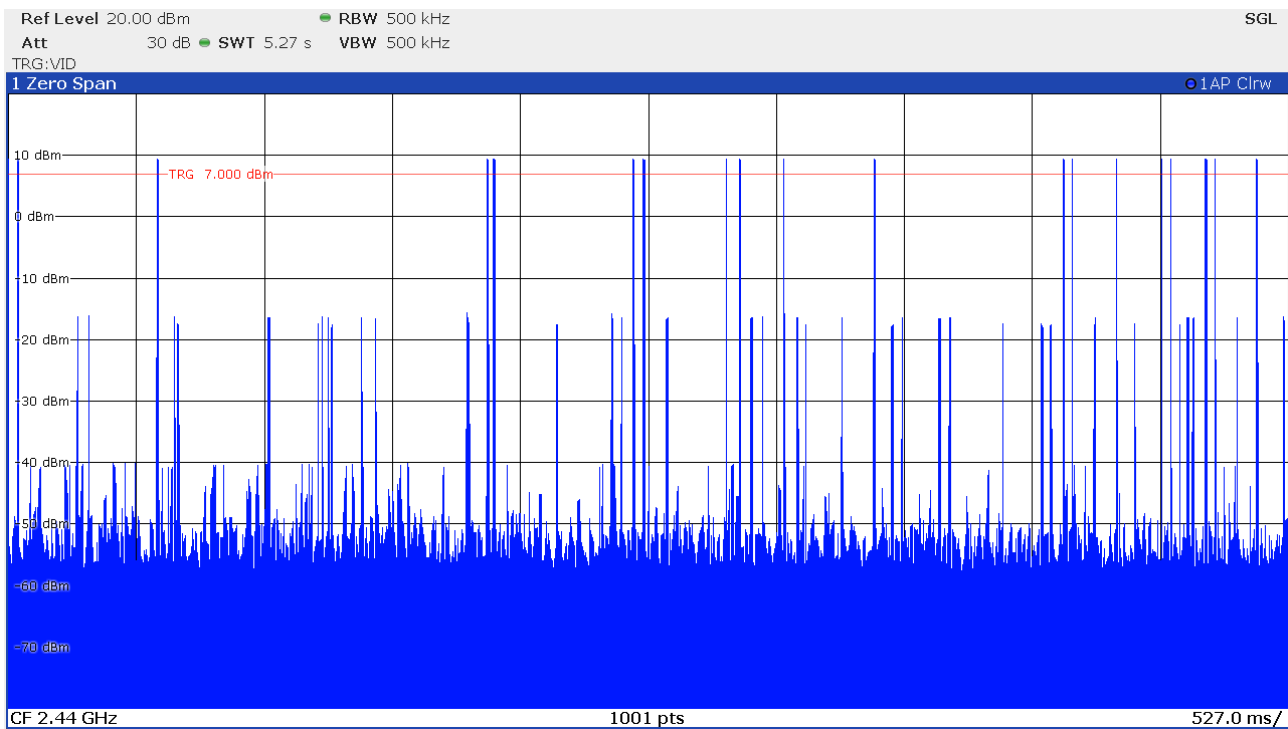
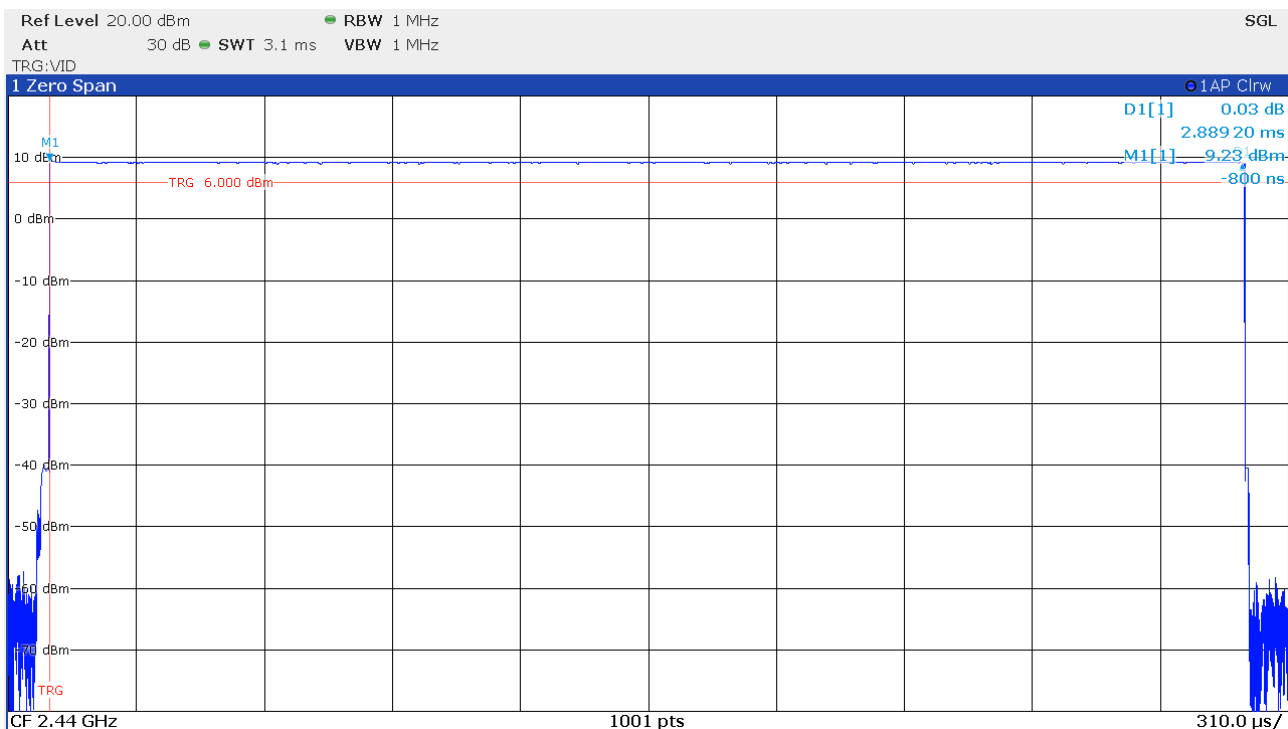
TEST RESULT
The EUT meets the requirements of sections 15.247 (a) (1) (iii) and RSS -247 § 5.1 (d)

MEASURED OCCUPANCY TIME					
Channel	Hops number	Average occupancy time (ms)			Result
		Pulse	Occupancy time	Limit	
Lower	17*6	2.8892	294.699	≤ 400	PASS
Middle	18*6	2.8892	312.034	≤ 400	PASS
Higher	19*6	2.8892	329.369	≤ 400	PASS

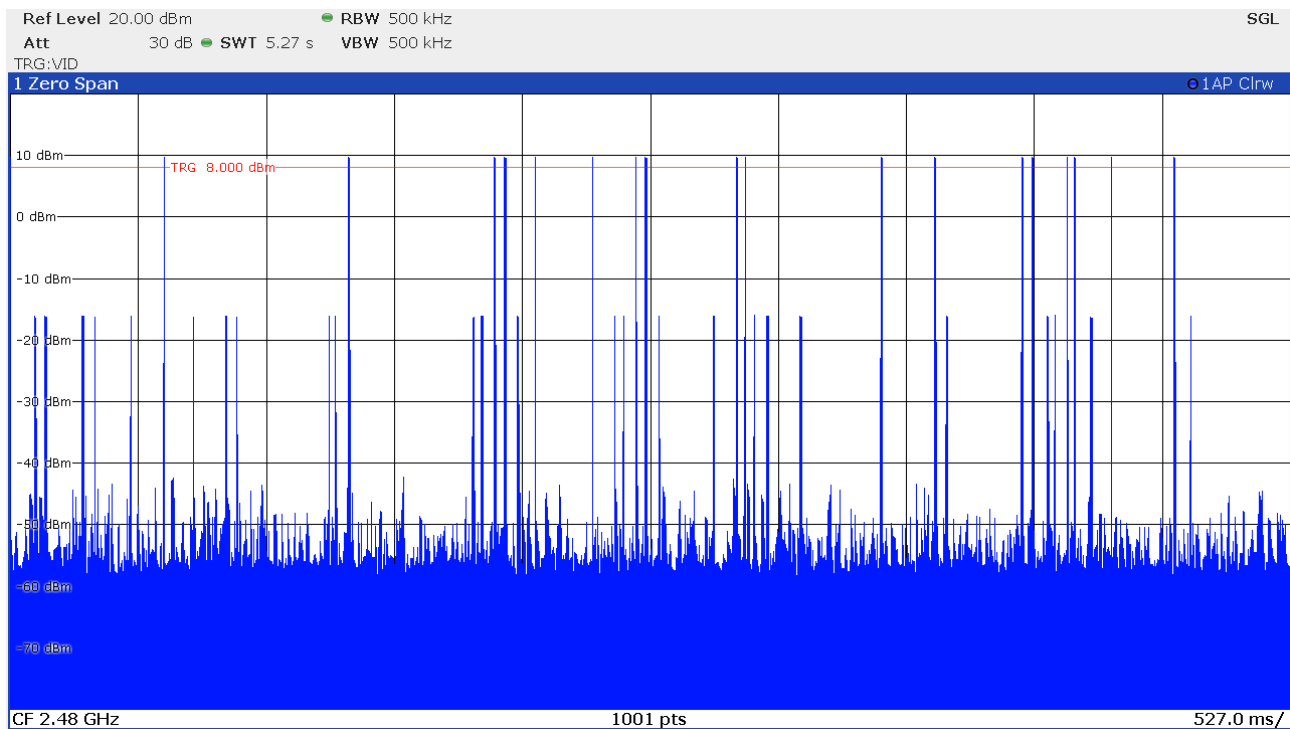
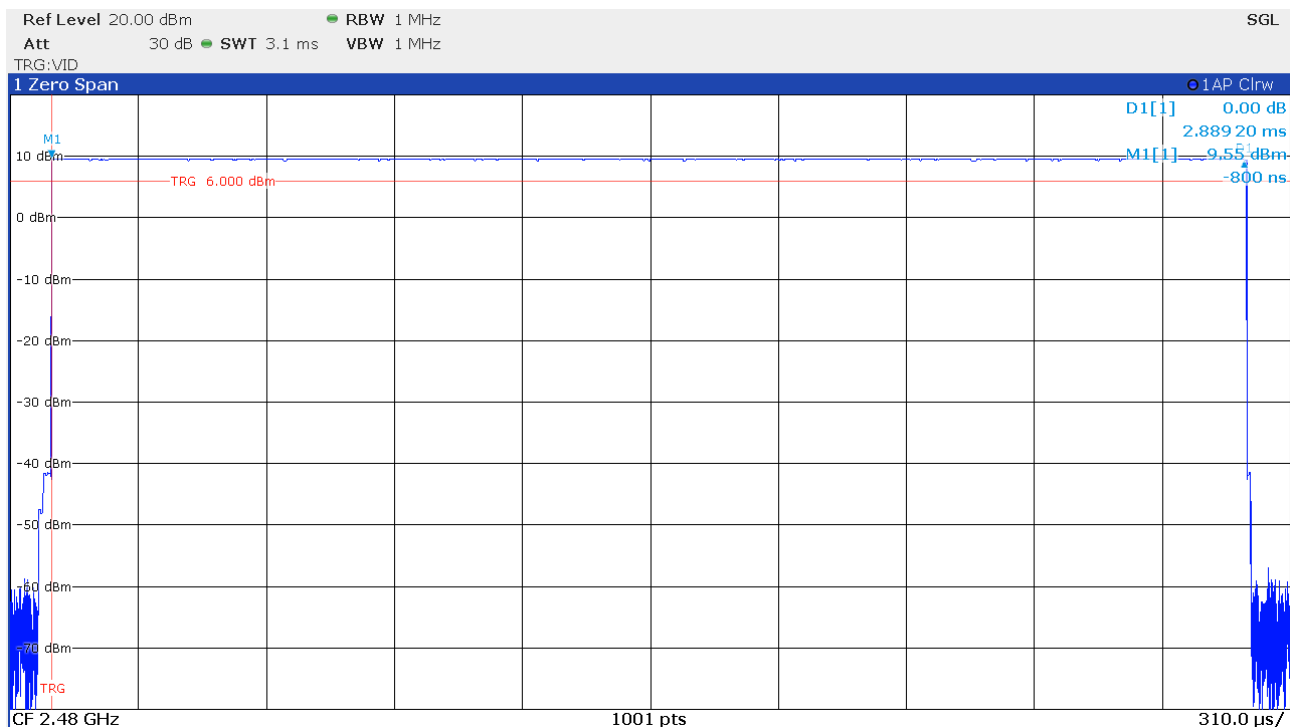
LOWER CHANNEL OCCUPANCY TIME



MIDDLE CHANNEL OCCUPANCY TIME



HIGHER CHANNEL OCCUPANCY TIME



7.8 MAXIMUM PEAK CONDUCTED OUTPUT POWER

TEST REQUIREMENT	
Spectrum analyzer settings	
Resolution bandwidth (RBW)	>20dB BW of the emission being measured
Video bandwidth (VBW)	≥ RBW
Sweep time (SWT)	AUTO
Detector function	Peak
Trace	Max hold
EUT operating condition	1 to 9
Remark	None
Testing dates	2022-10-28

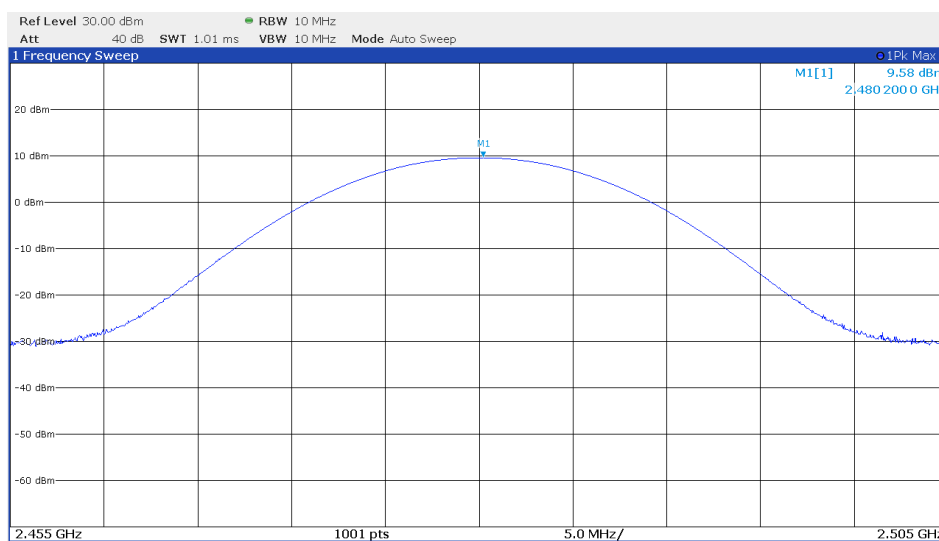
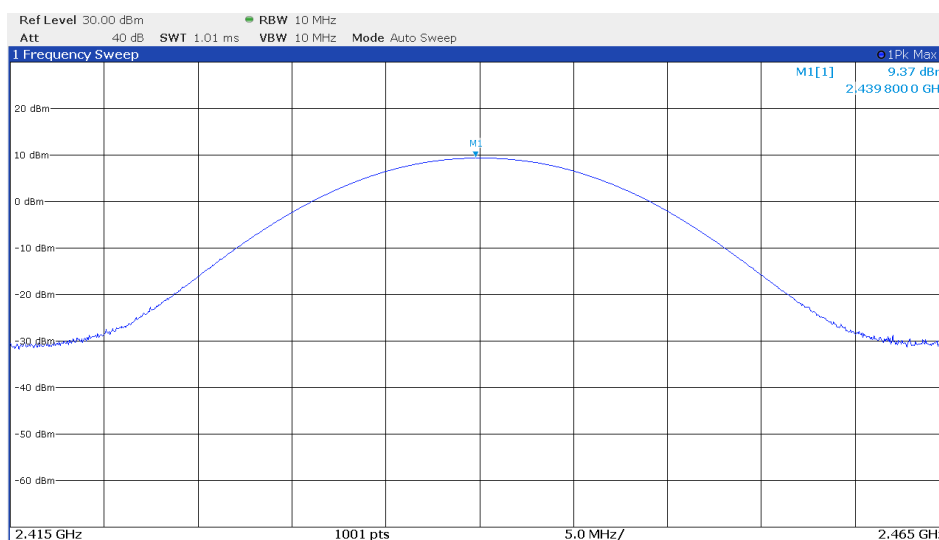
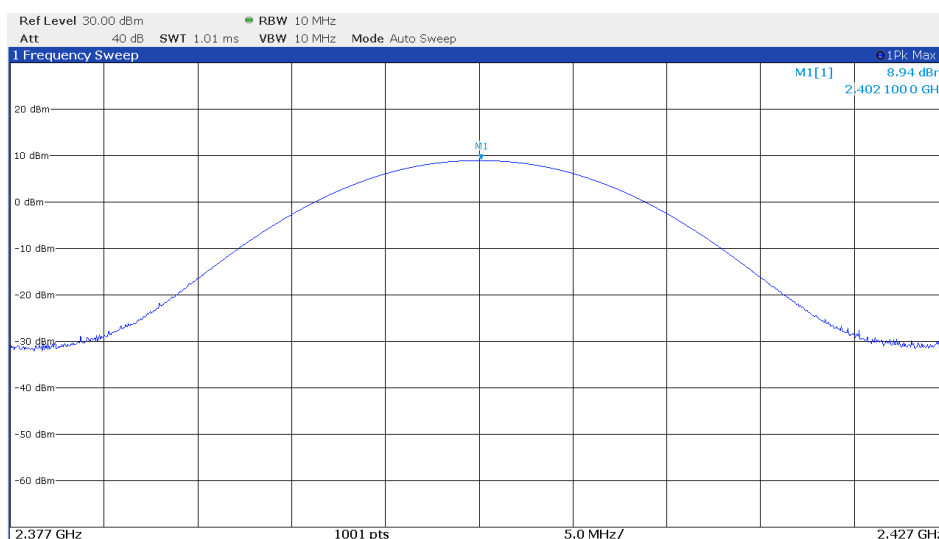
TEST RESULT
The EUT meets the requirements of sections 15.247 (b) (1) and RSS -247 § 5.4 (b)

LIMITS
0,125 Watt (21dBm)

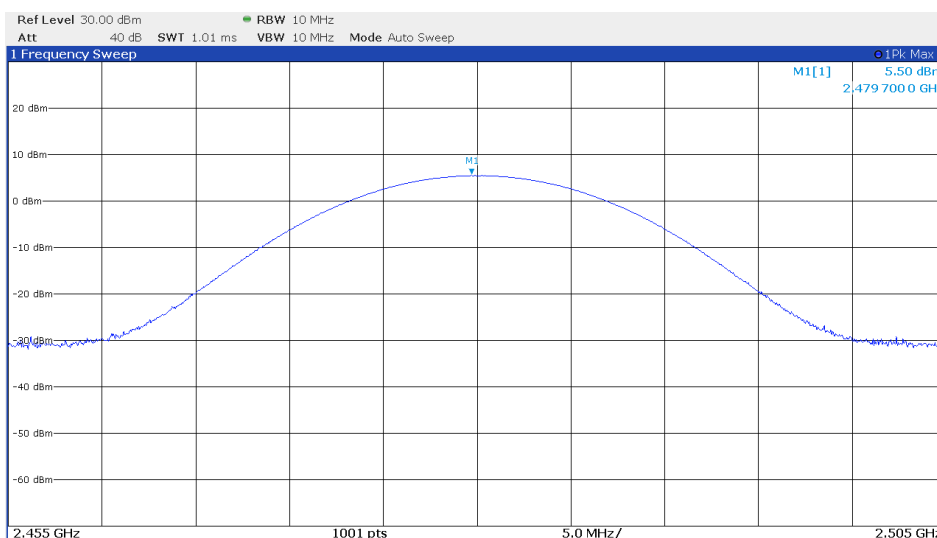
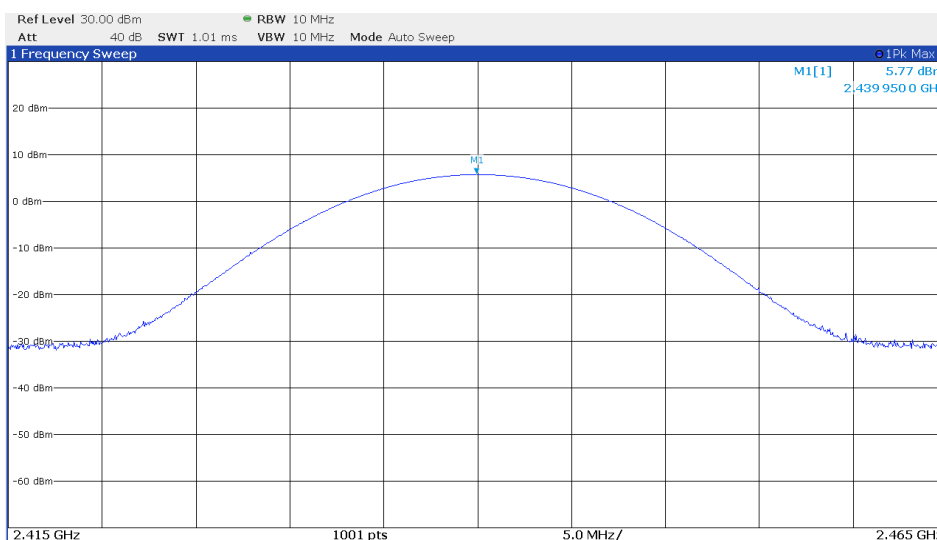
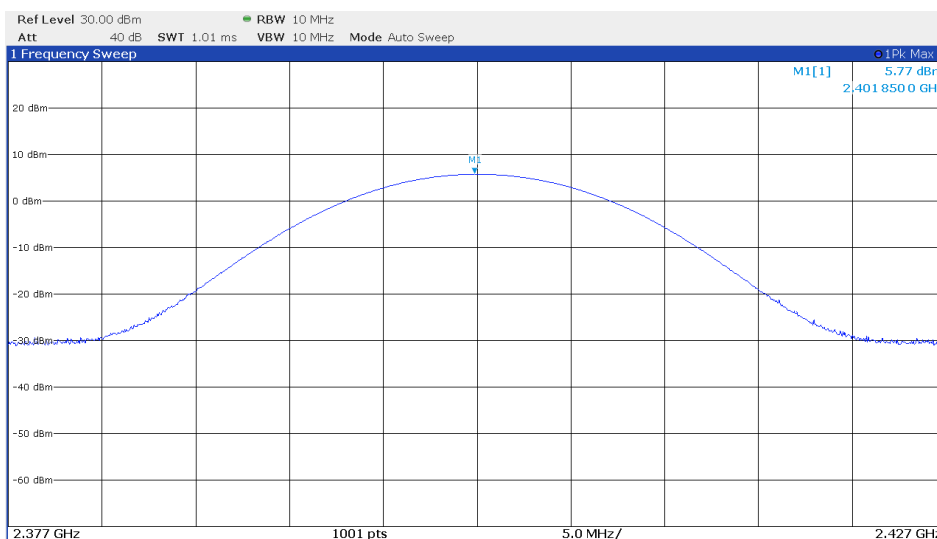
Conducted measurements test procedure
The EUT RF output port is connected directly to RF input port of spectrum analyzer. Set the EUT to work at lower, middle and higher channel. With a SPAN of about five times the measured -20dB BW and centered on a channel, wait until the trace has stabilized and set the marker to the peak of emission.

MEASURED CONDUCTED OUTPUT POWER				
Test Mode	Test Channel	Peak Power (dBm)	Limits (dBm)	Result
GFSK	Lower	8.94	≤30	Pass
	Middle	9.37	≤30	Pass
	Higher	9.58	≤30	Pass
π /4-DQPSK	Lower	5.77	≤30	Pass
	Middle	5.77	≤30	Pass
	Higher	5.50	≤30	Pass
8DPSK	Lower	6.15	≤30	Pass
	Middle	6.17	≤30	Pass
	Higher	5.97	≤30	Pass

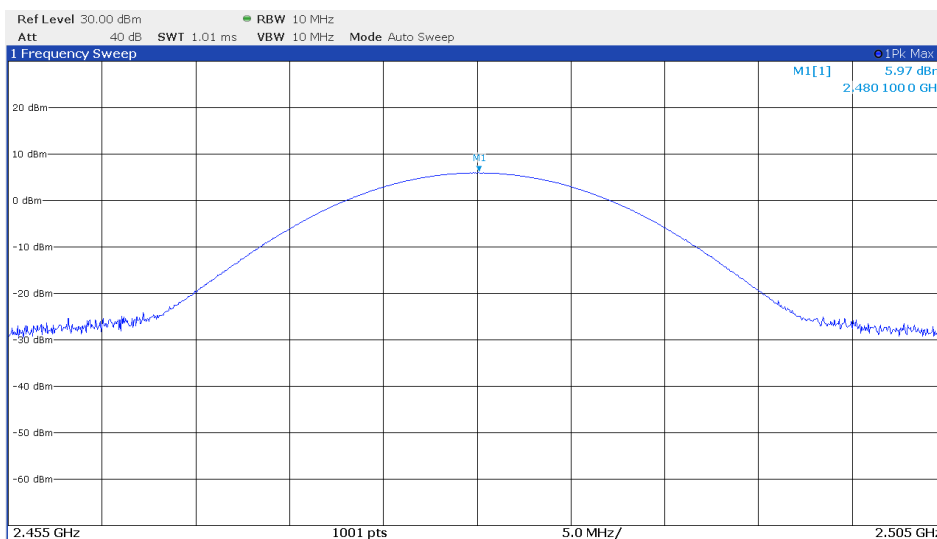
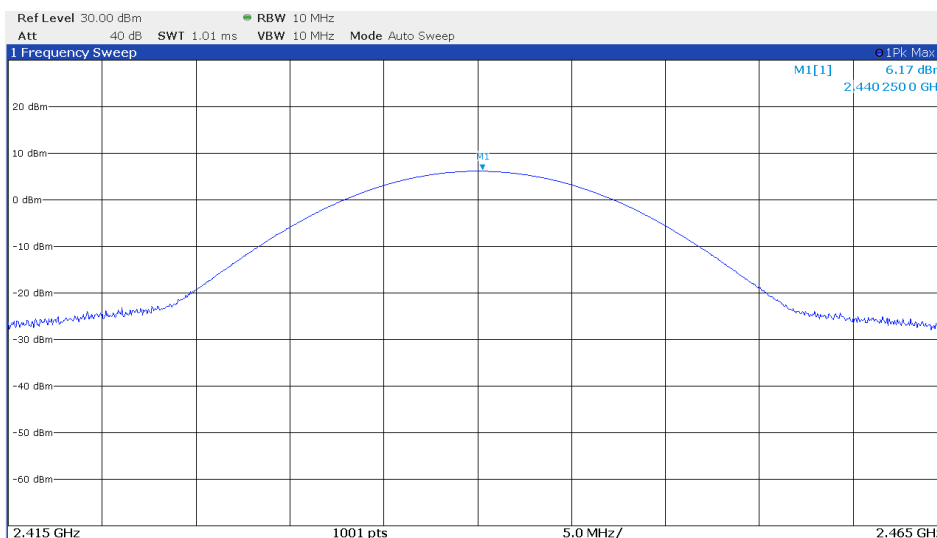
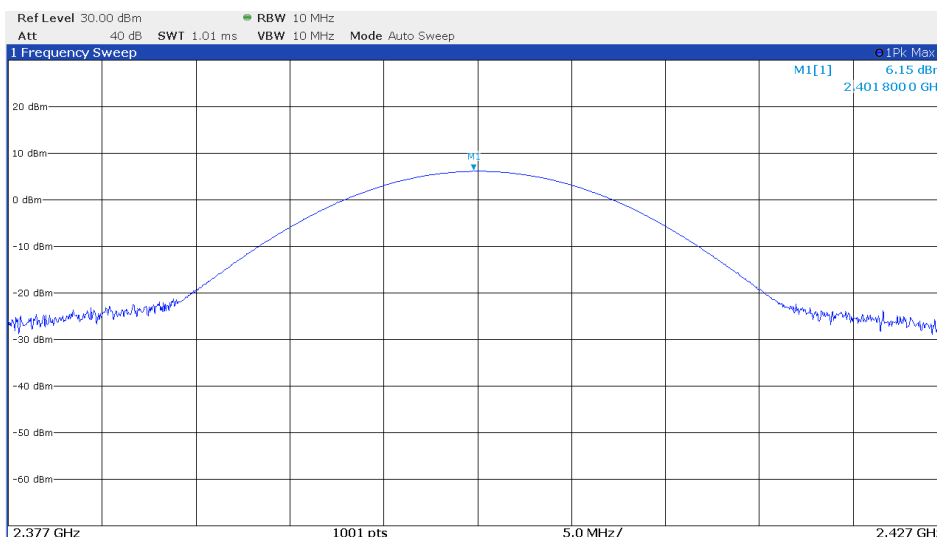
GFSK (BR) MODULATION



$\pi/4$ -DQPSK (2-EDR) MODULATION



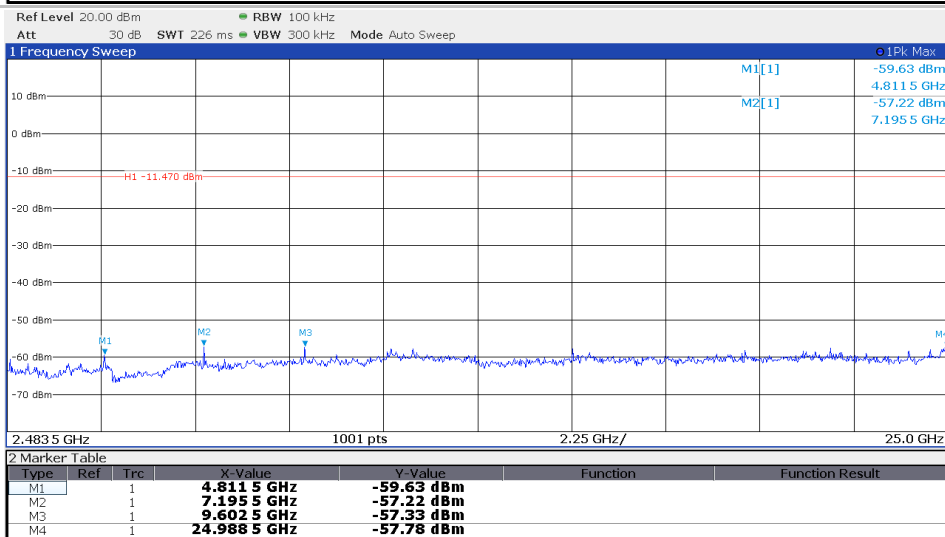
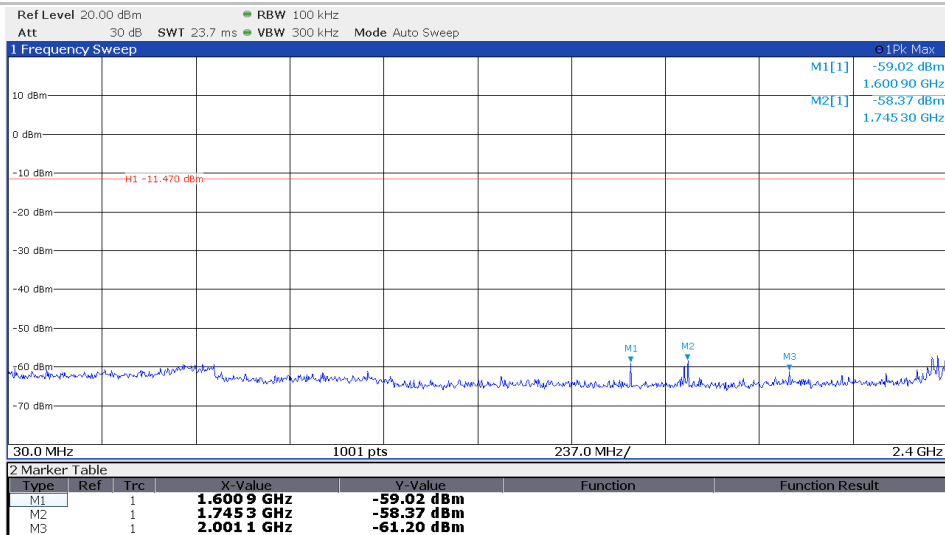
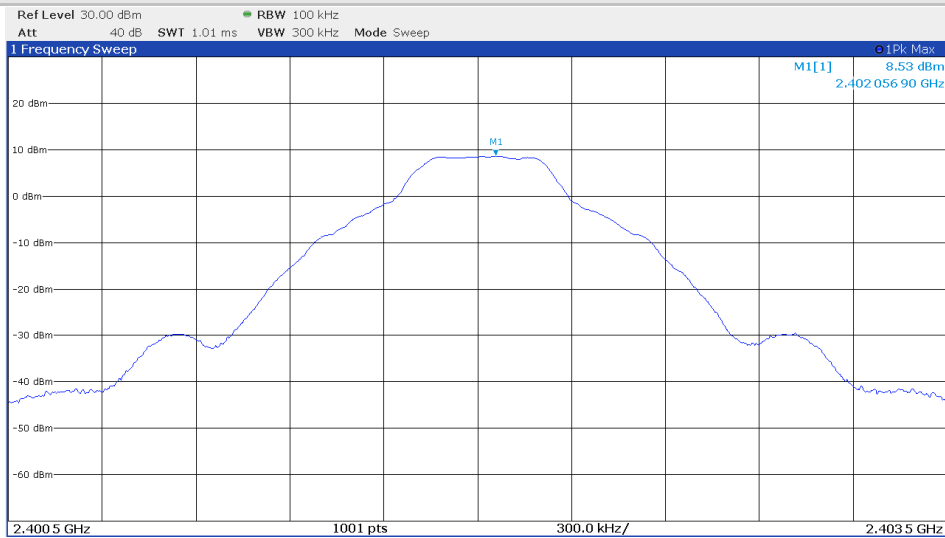
8DPSK (3-EDR) MODULATION



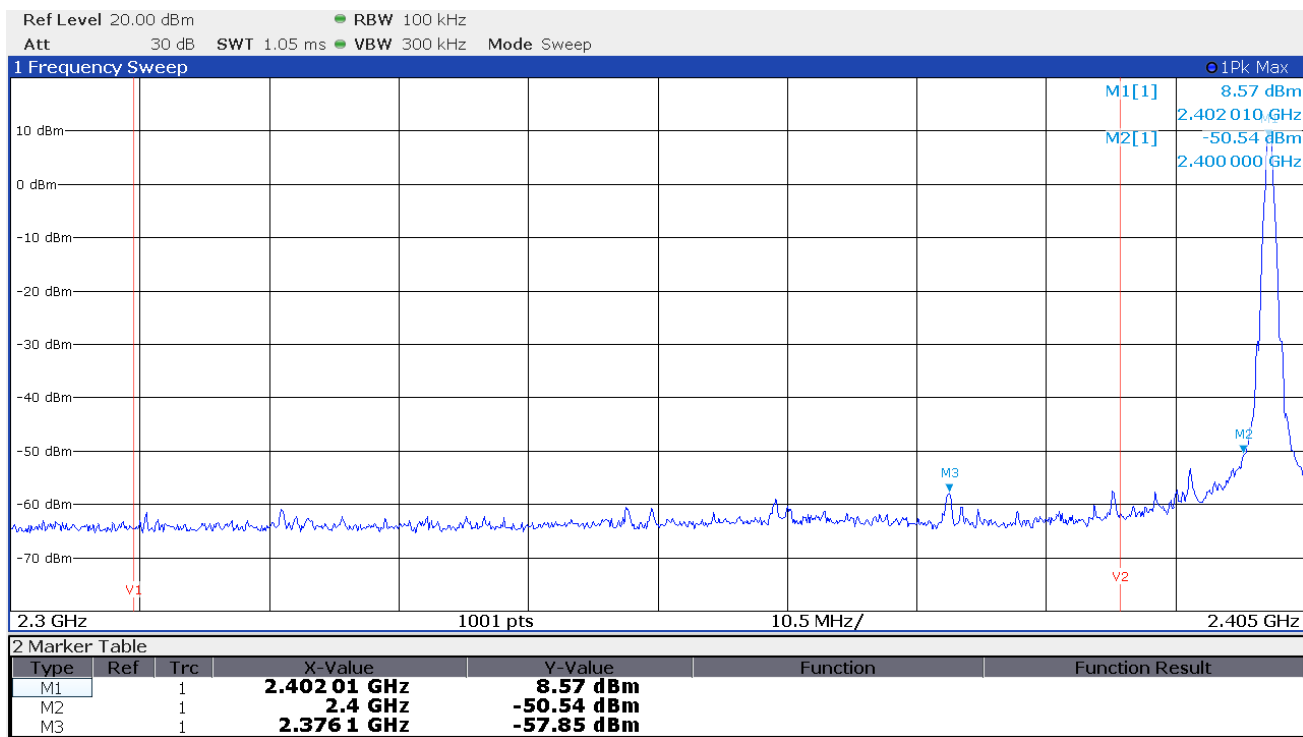
7.9 100kHz EMISSIONS OUTSIDE THE FREQUENCY BAND

TEST REQUIREMENT	
Spectrum analyzer settings	
Resolution bandwidth (RBW)	100 kHz
Video bandwidth (VBW)	300 kHz
Sweep time (SWT)	Auto
Detector function	Peak
Trace	Max hold
EUT operating condition	1 to 9
Testing dates	2022-10-28
TEST PROCEDURE	
The EUT RF output port is connected directly to RF input port of spectrum analyzer by short RF pigtail adapter. Set the EUT to work at lower, middle and higher channel. With a SPAN adjusted as necessary to best identify the center of each individual channel, wait until the trace has stabilized and set the markers to the peak of affected frequencies emission.	
LIMITS	
-20dBc below peak output power	
TEST RESULT	
All out of band spurious emissions are more -20dBc of the in-band power of the fundamental. The EUT meets the requirements of sections 15.247 (d).and RSS -247 § 5.5	

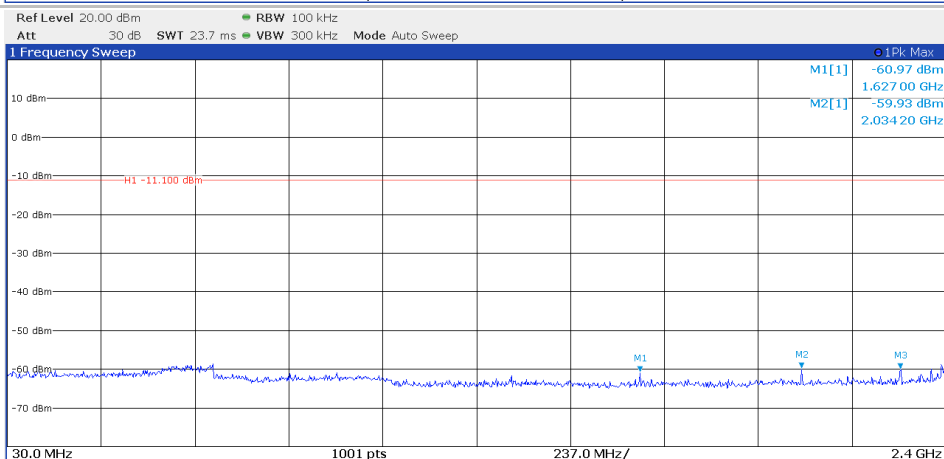
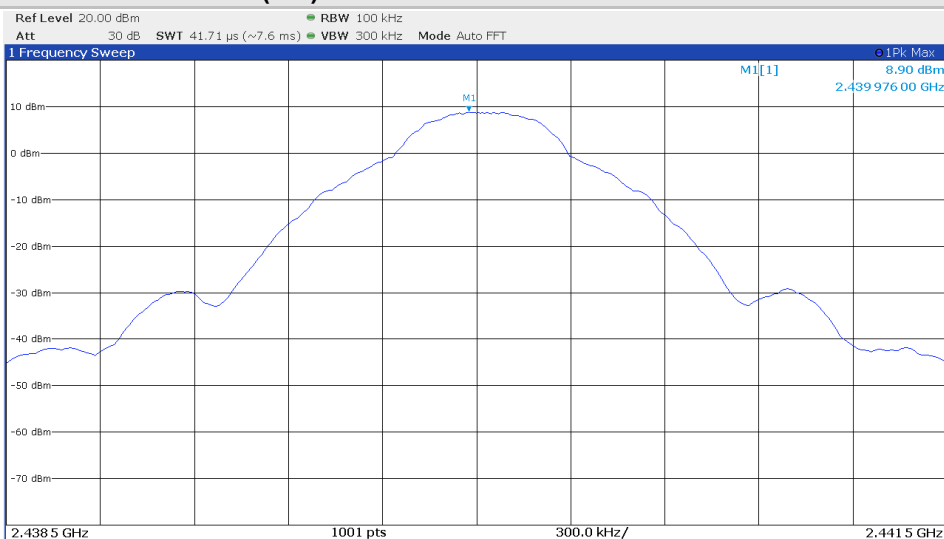
GFSK (BR) MODULATION LOWER CHANNEL



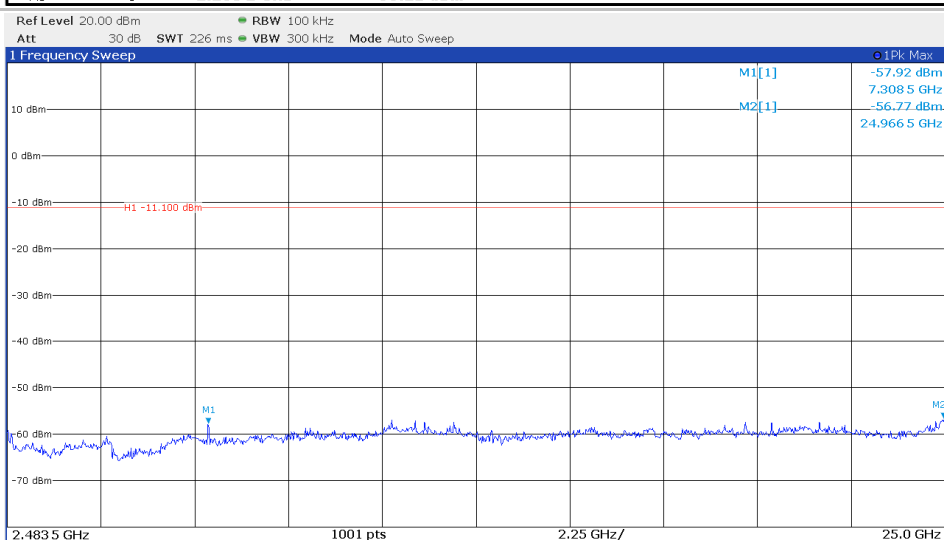
GFSK (BR) MODULATION LOWER CHANNEL - PEAK BAND-EDGE



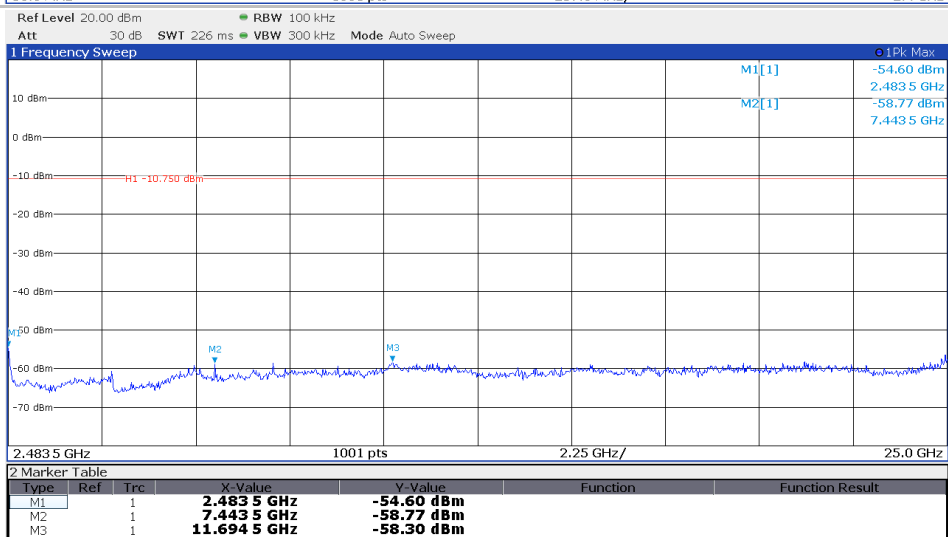
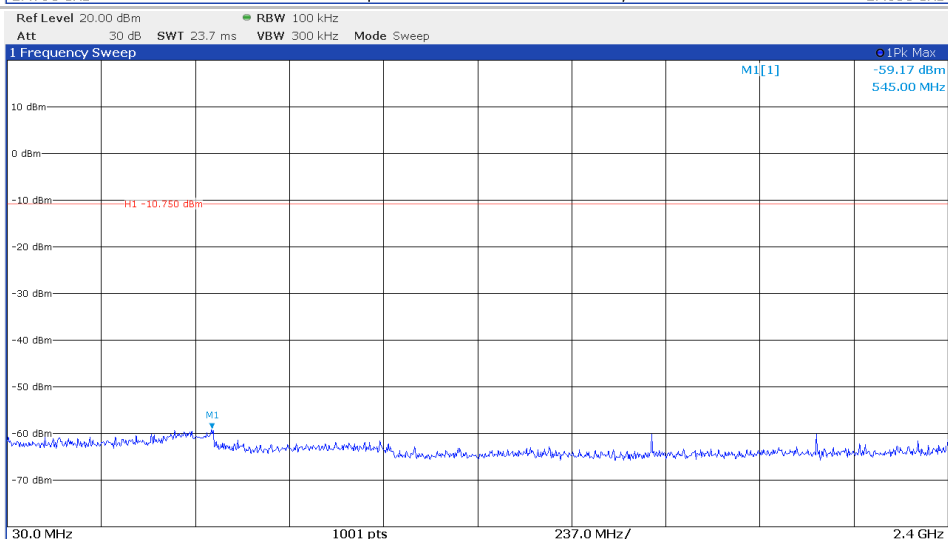
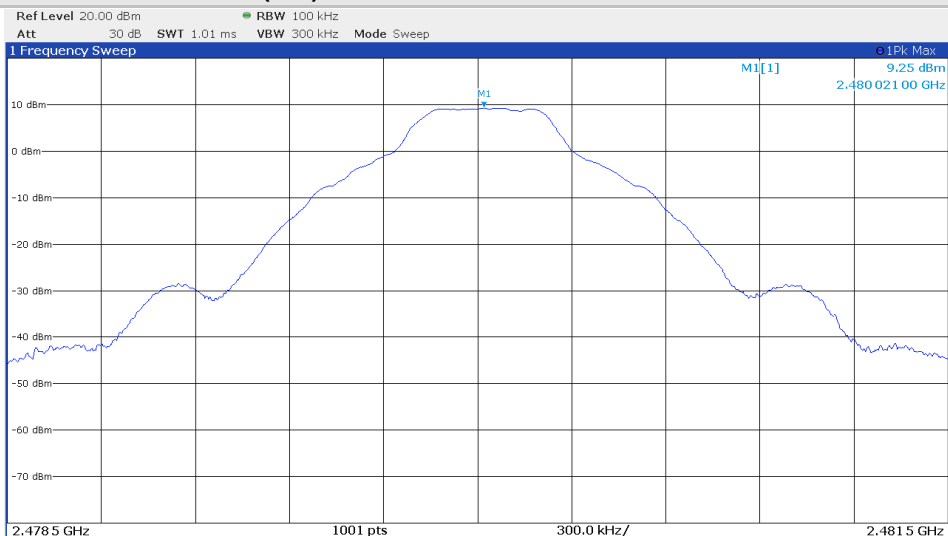
GFSK (BR) MODULATION MIDDLE CHANNEL



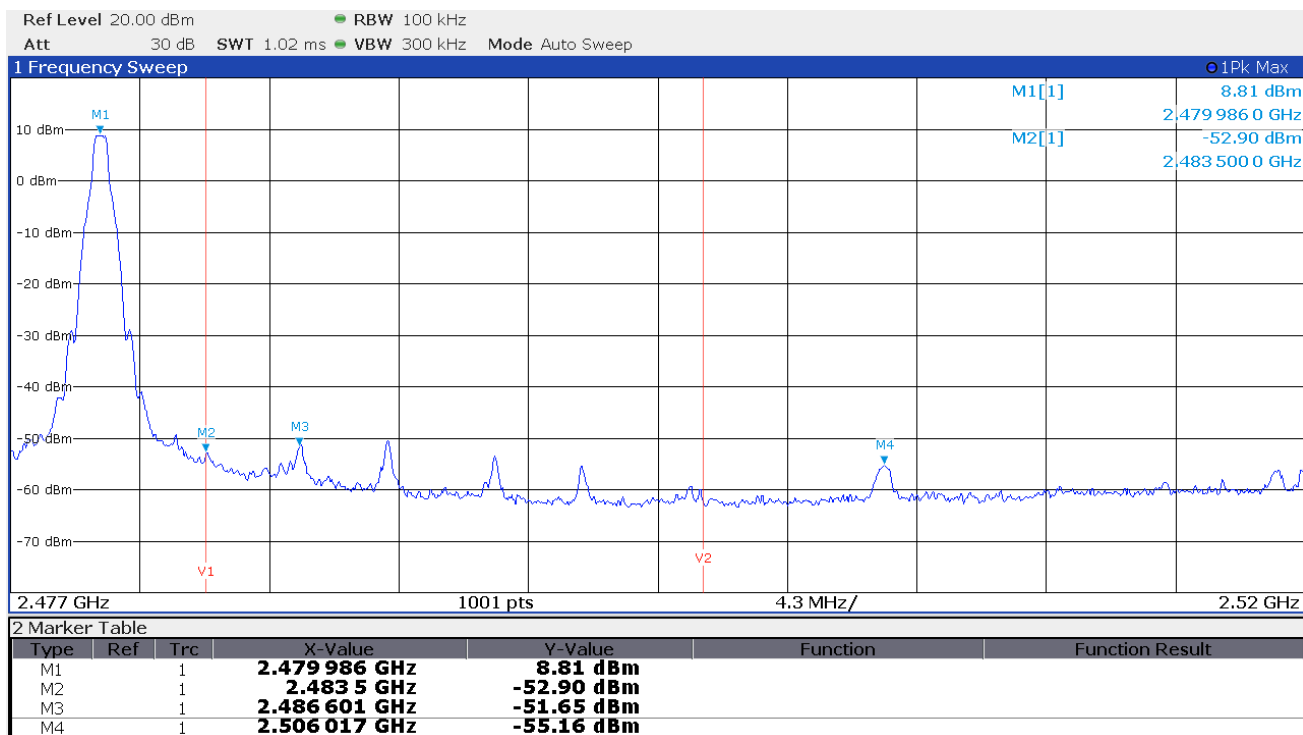
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1	1		1.627 GHz	-60.97 dBm		
M2	1		2.034 2 GHz	-59.93 dBm		
M3	1		2.285 2 GHz	-60.21 dBm		



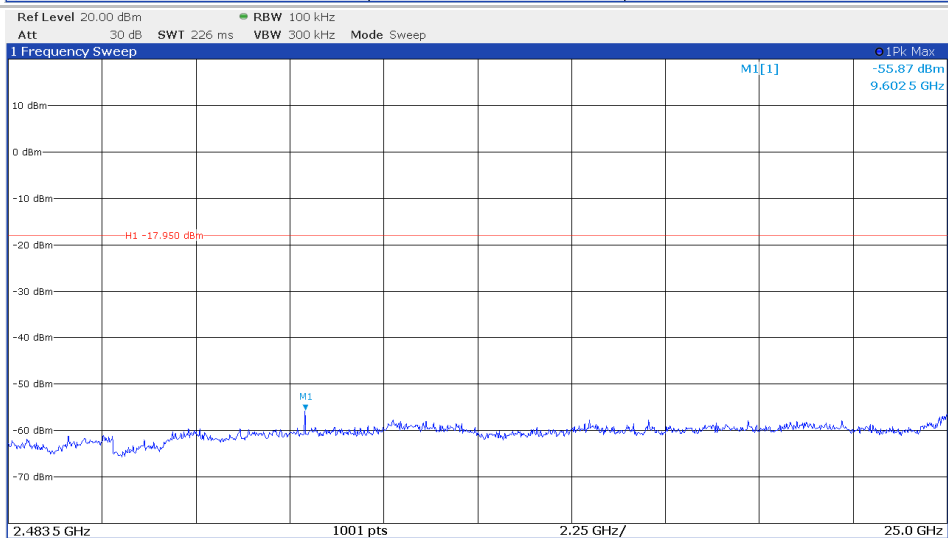
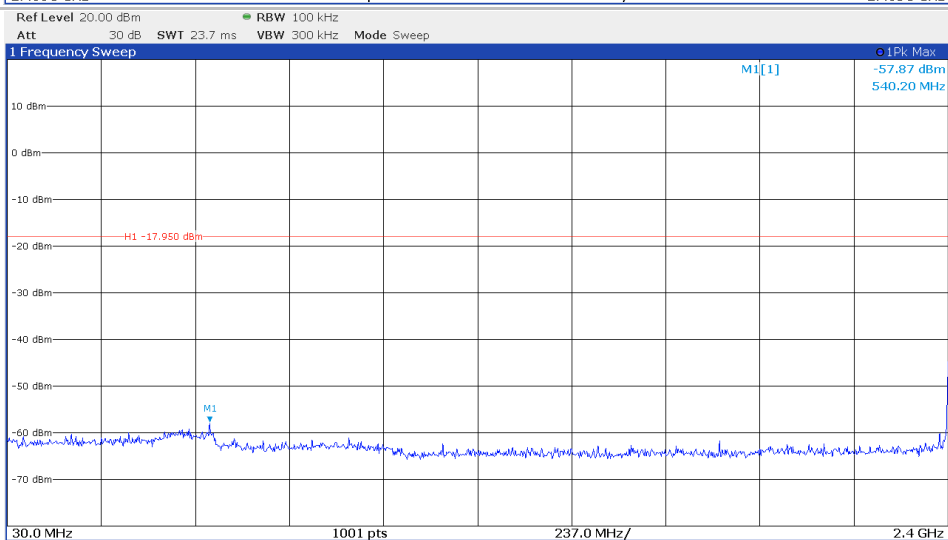
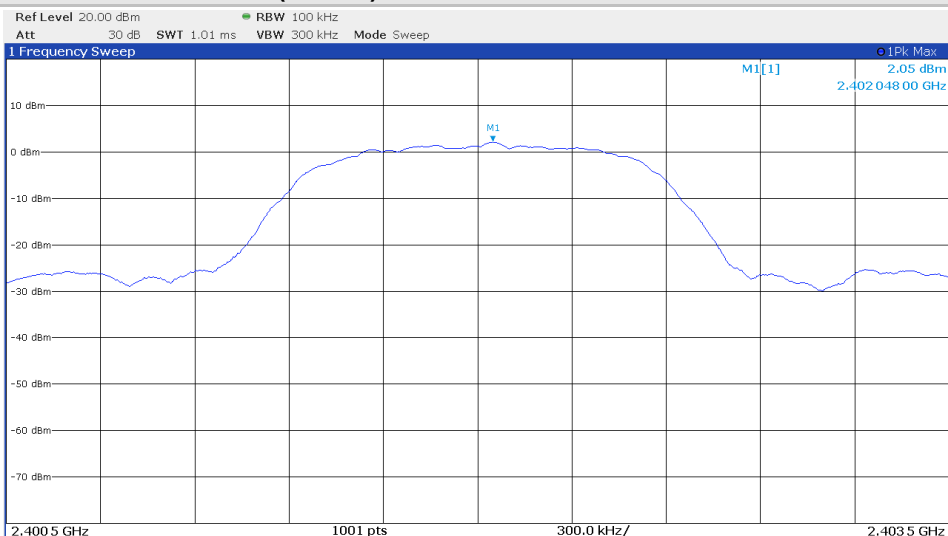
GFSK (BR) MODULATION HIGHER CHANNEL



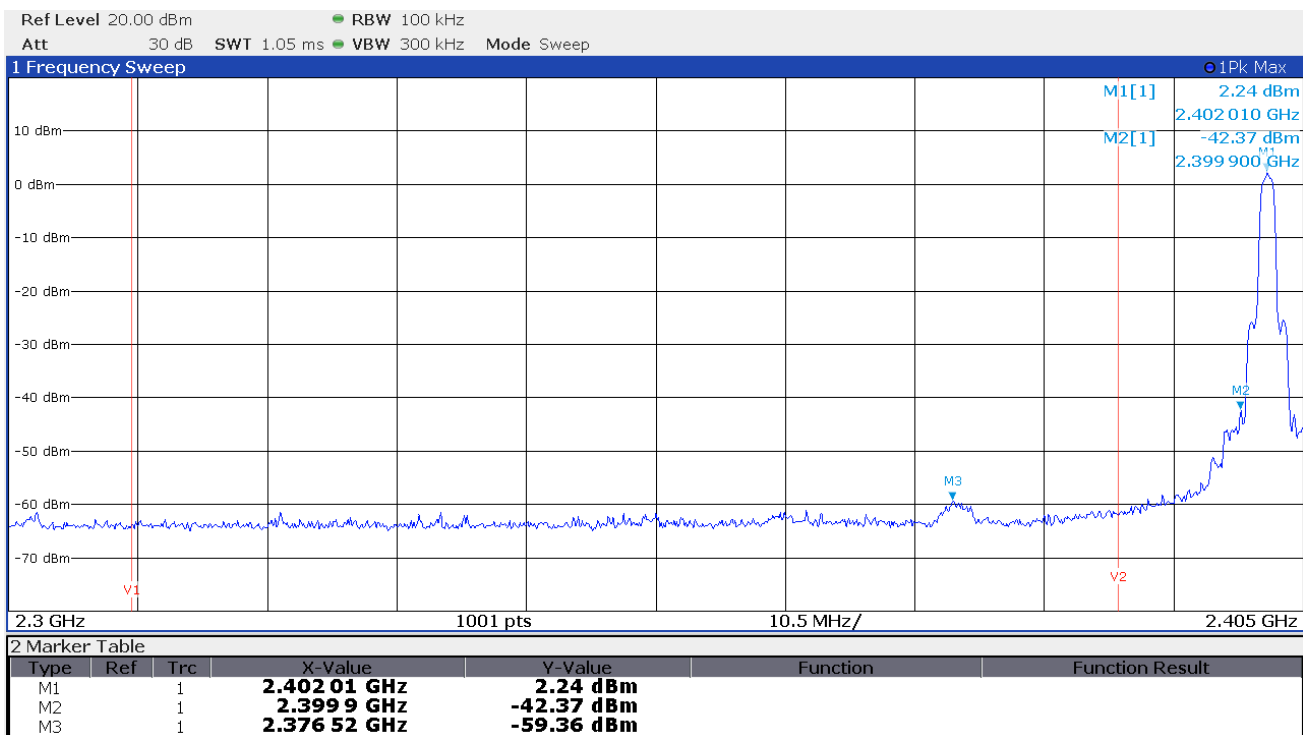
GFSK (BR) MODULATION HIGHER CHANNEL – PEAK BAND-EDGE



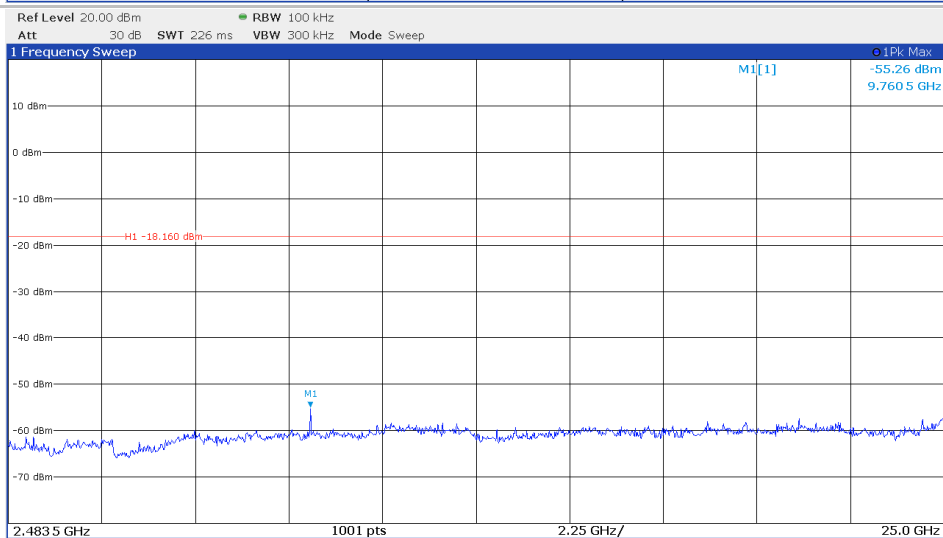
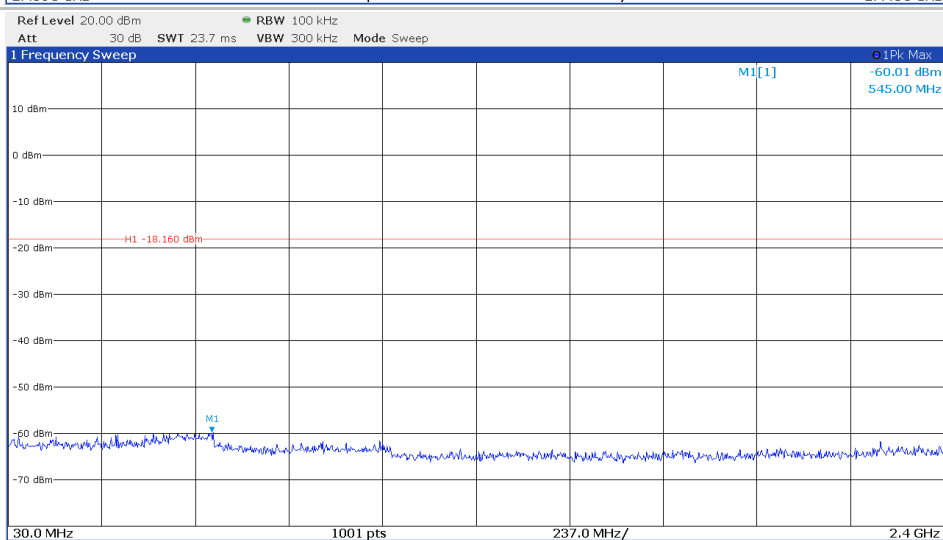
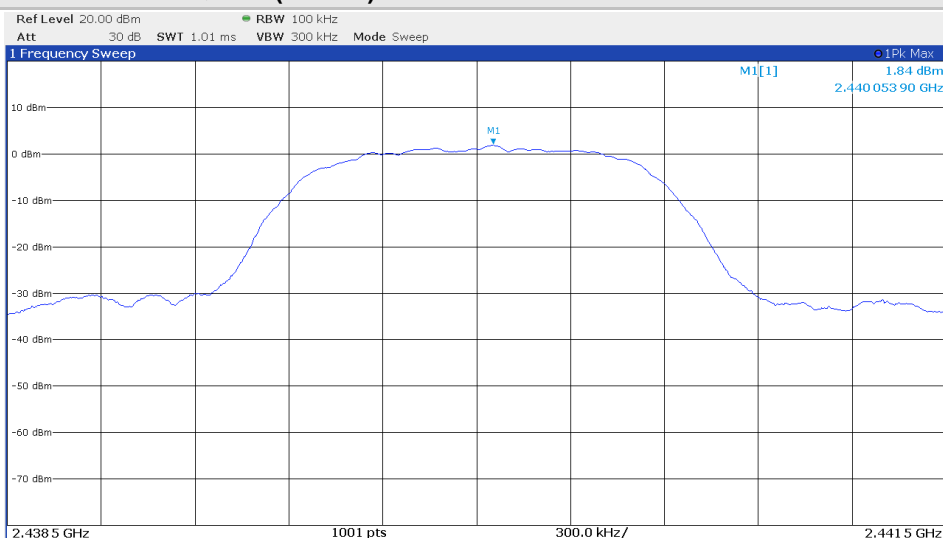
$\pi/4$ -DQPSK (2-EDR) MODULATION LOWER CHANNEL



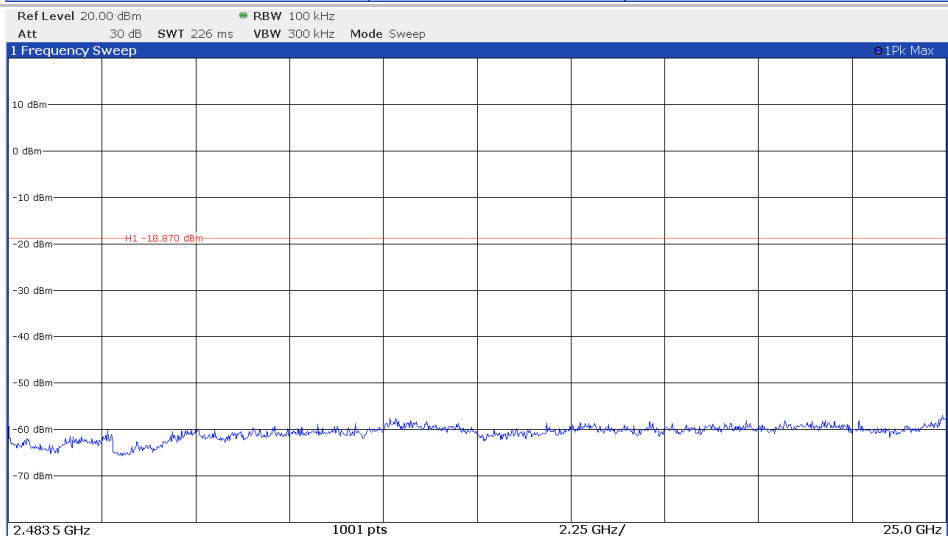
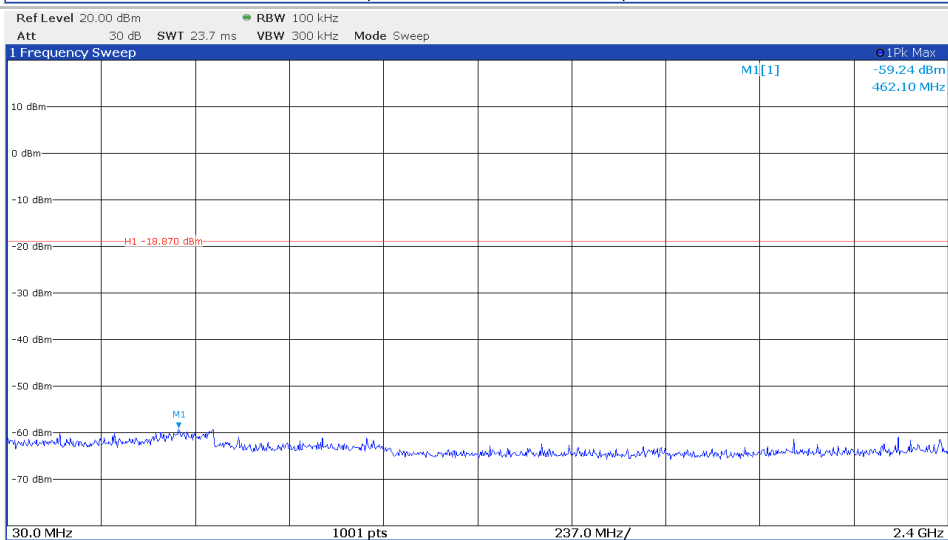
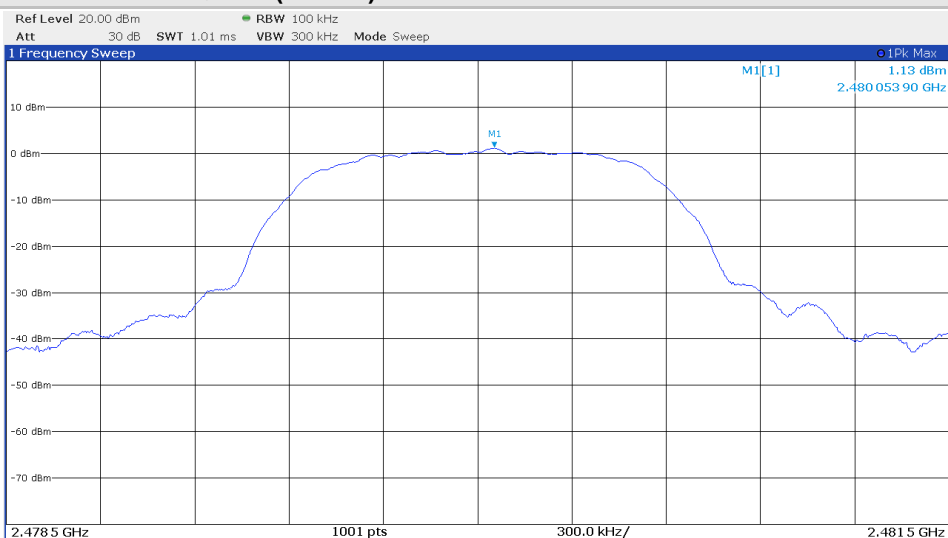
$\pi/4$ -DQPSK (2-EDR) MODULATION LOWER CHANNEL – PEAK BAND-EDGE



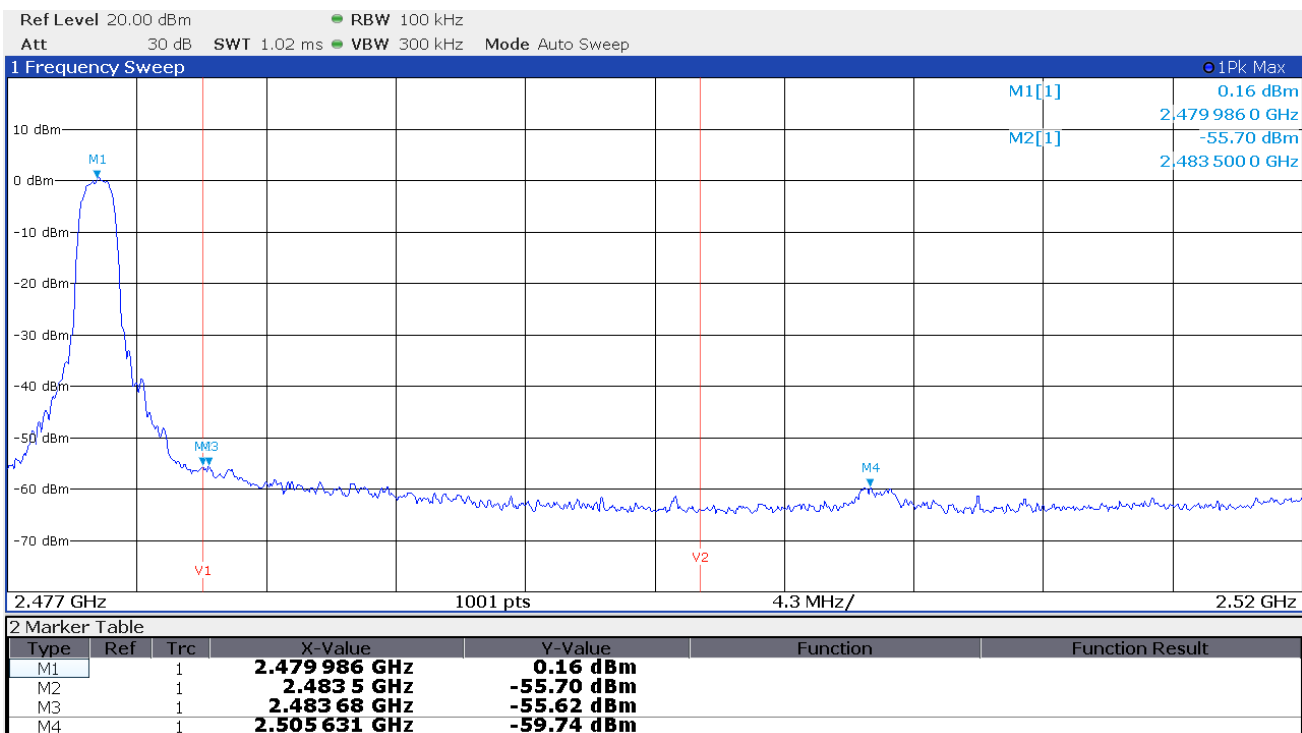
$\pi/4$ -DQPSK (2-EDR) MODULATION MIDDLE CHANNEL



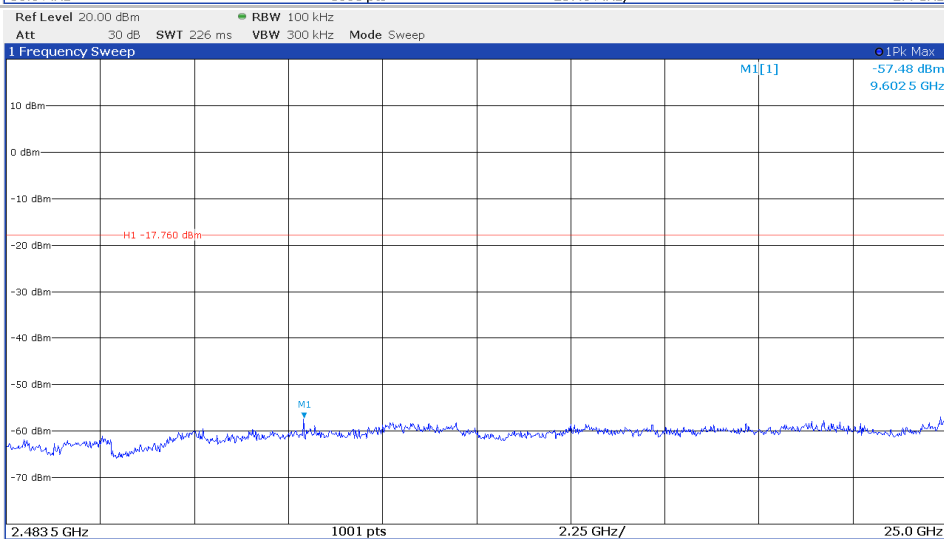
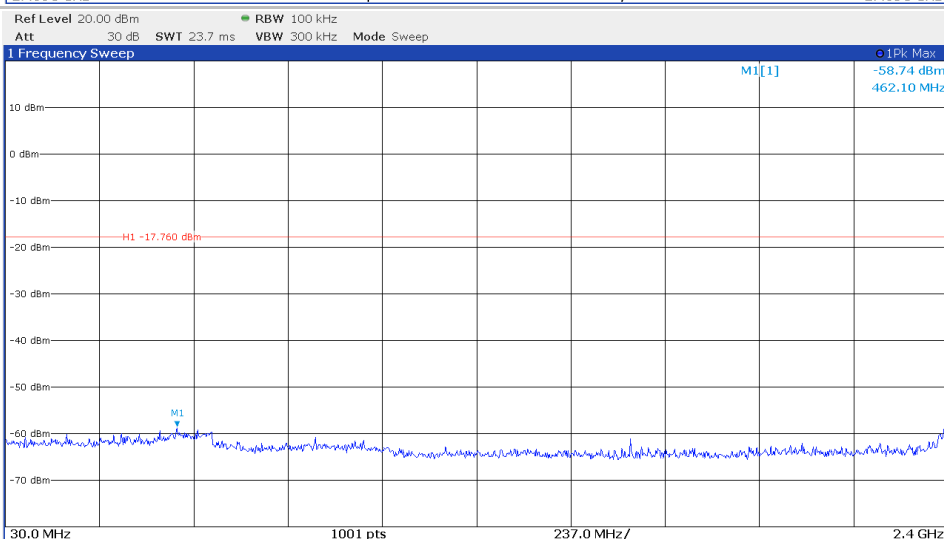
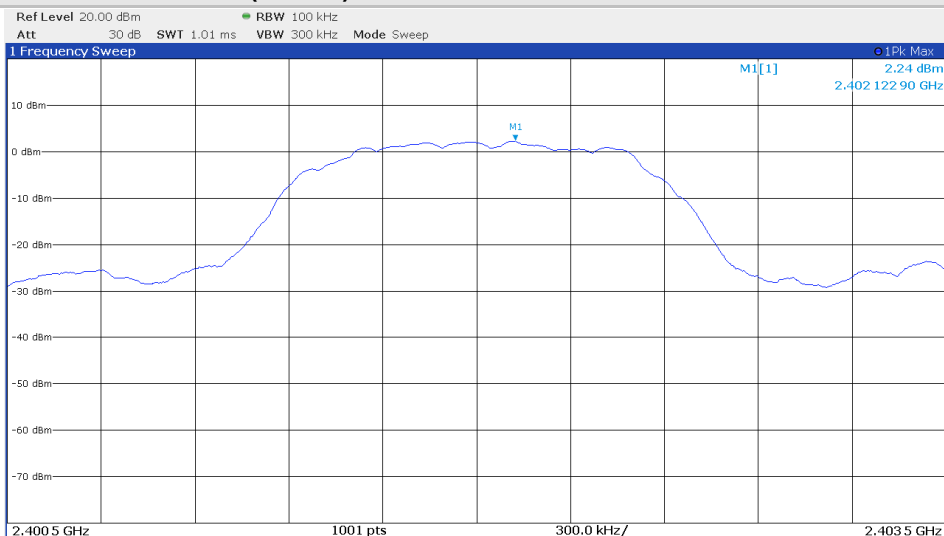
$\pi/4$ -DQPSK (2-EDR) MODULATION HIGHER CHANNEL



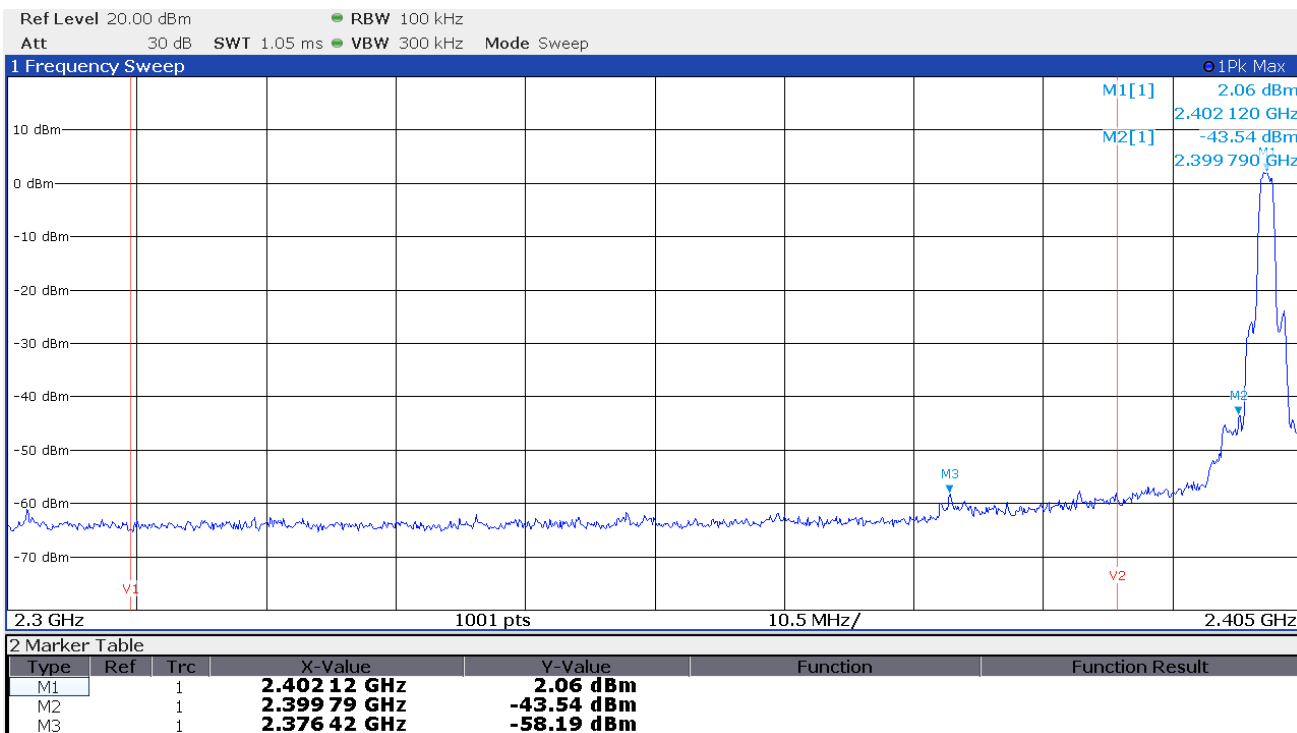
$\pi/4$ -DQPSK (2-EDR) MODULATION HIGHER CHANNEL – PEAK BAND-EDGE



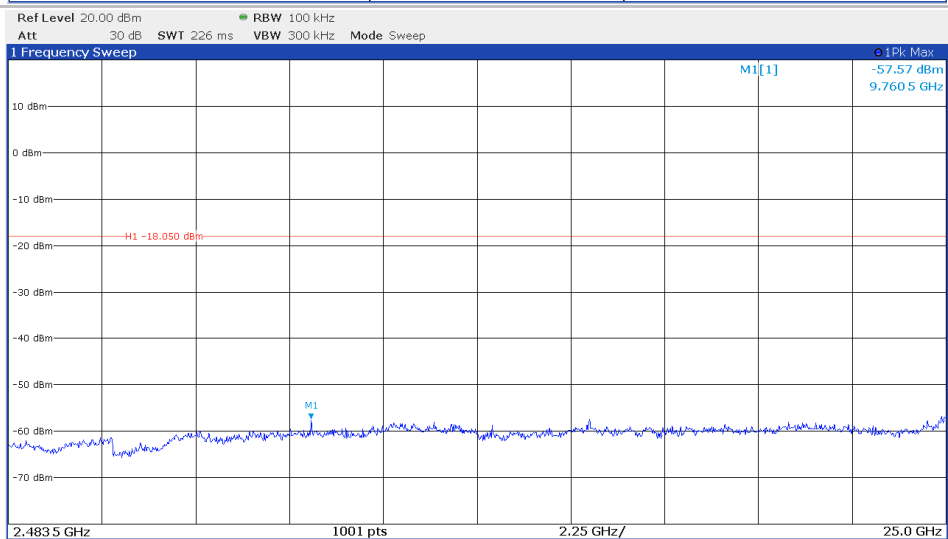
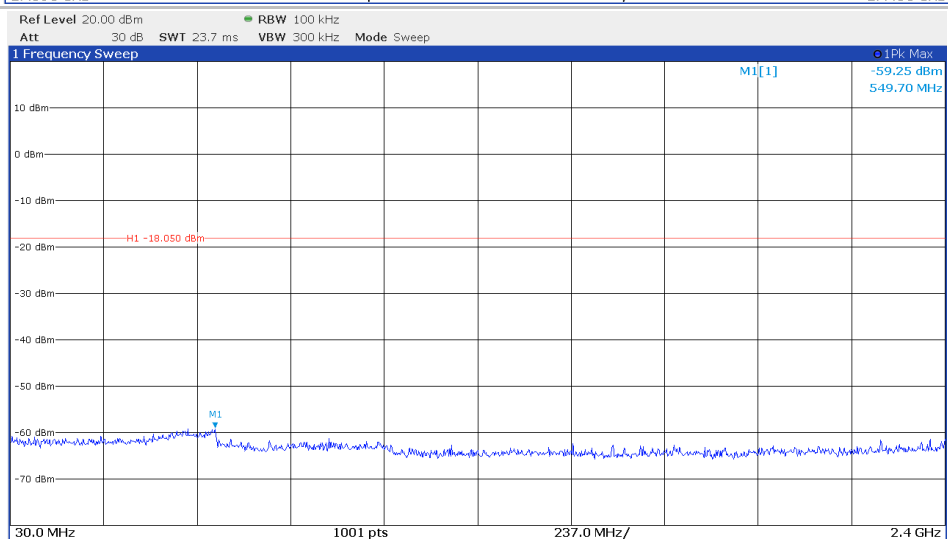
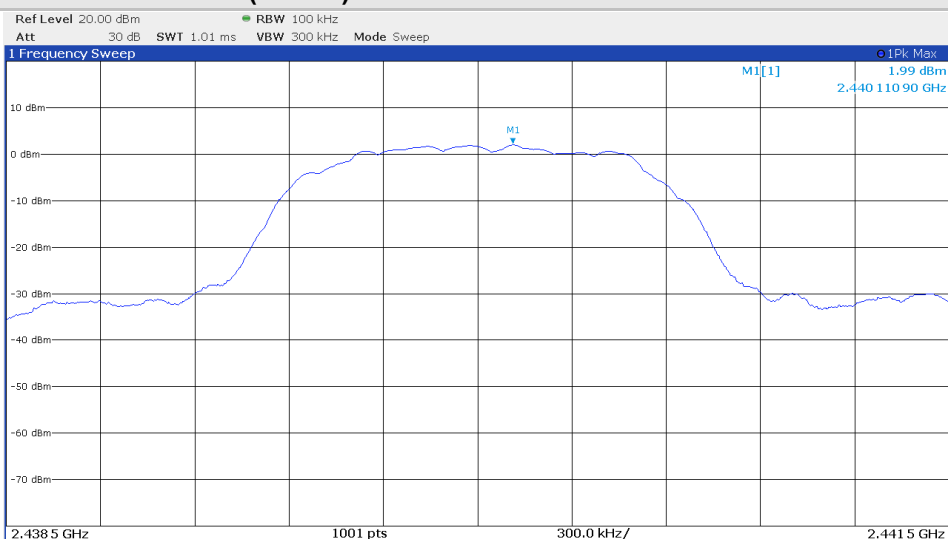
8DPSK (3-EDR) MODULATION LOWER CHANNEL



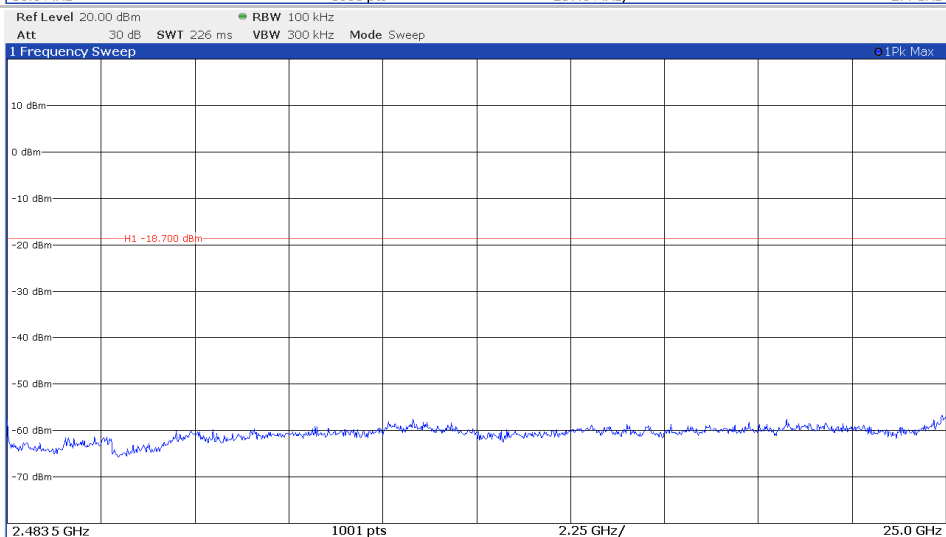
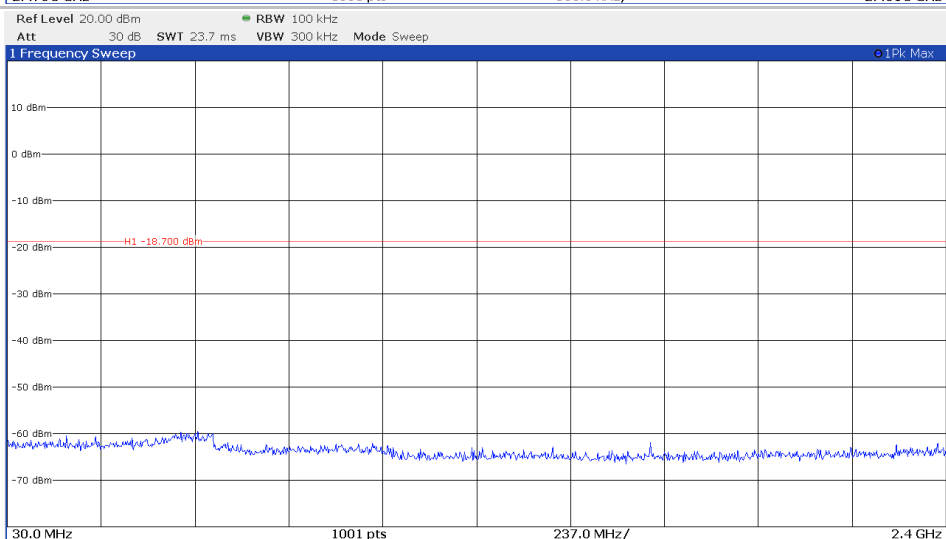
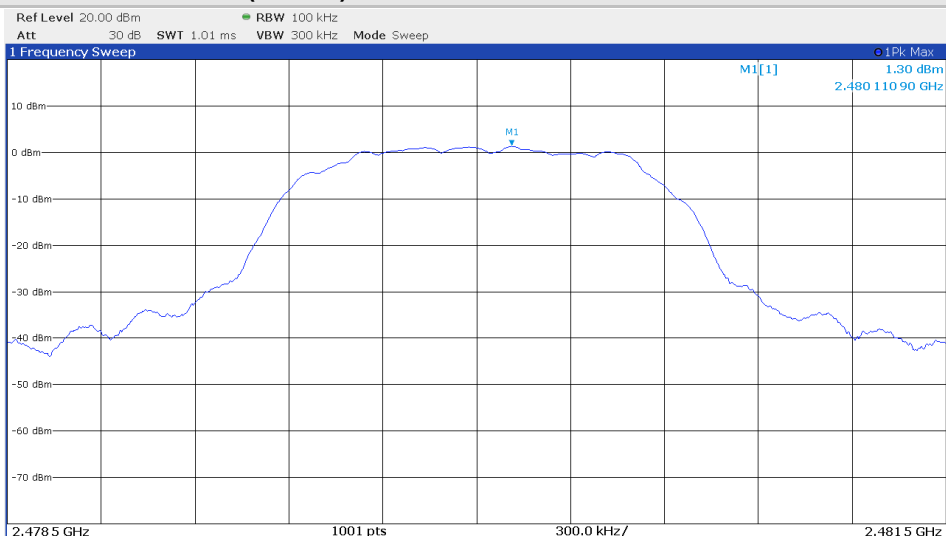
8DPSK (3-EDR) MODULATION LOWER CHANNEL – PEAK BAND-EDGE



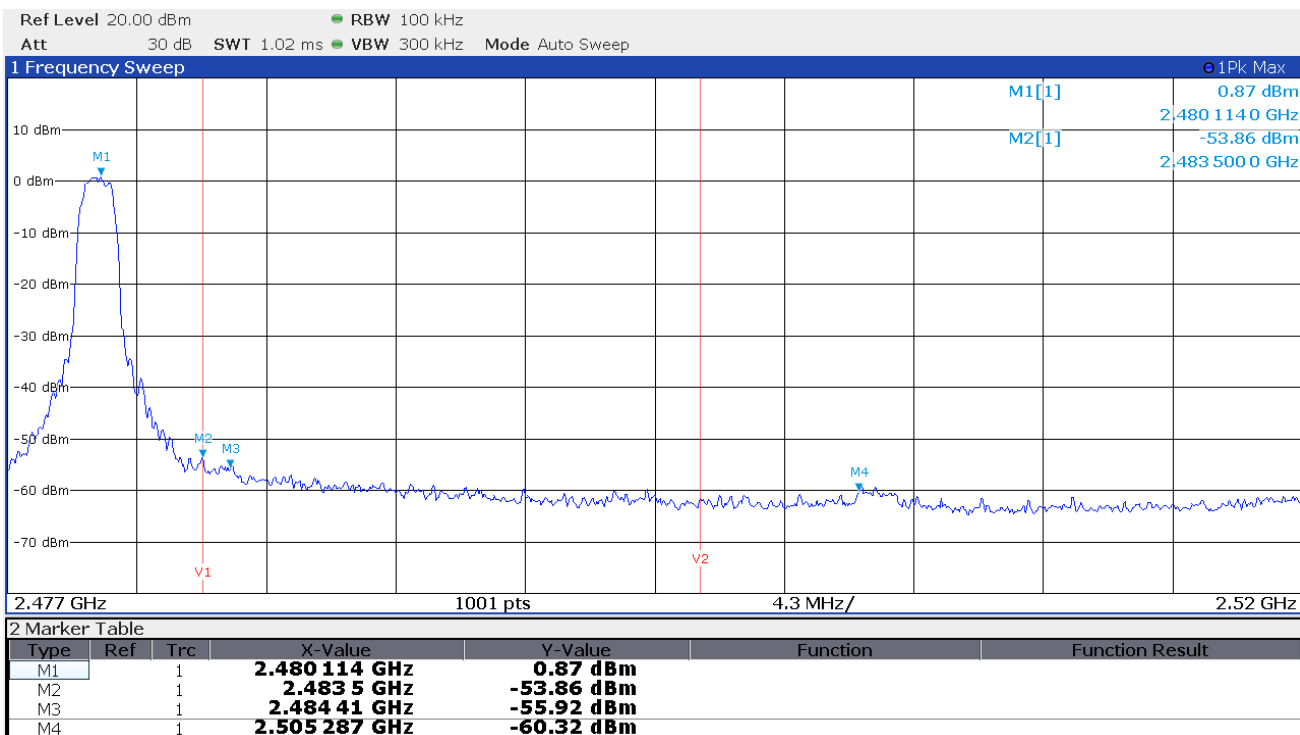
8DPSK (3-EDR) MODULATION MIDDLE CHANNEL



8DPSK (3-EDR) MODULATION HIGHER CHANNEL



8DPSK (3-EDR) MODULATION HIGHER CHANNEL – PEAK BAND-EDGE



8. MEASUREMENTS AND TESTS UNCERTAINTY

Unless otherwise stated the uncertainties for the tests and measurements are evaluated in according to IMQ Operational Instruction IO-LAB-001, IO-LAB-004 and IO-LAB-009. and requirement of NIST Technical Note 1297 and NIS 81: 1994 "The Treatment of Uncertainty in EMC Measurements"

The expanded uncertainty was calculated for all measurements and tests listed in this test report according to CISPR 16-4-2 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainty in EMC Measurements", with UKAS document LAB 34 and is documented in the quality system accordance to ISO/IEC 17025.

Internal Procedure PG-037 ensures that the requirements for traceability of calibrations, of all test equipment requiring calibration, and calibration intervals are met.

Methods Standard	Parameter	Expanded Uncertainty	Unit	Confidence level
Continuous disturbance	Terminal disturbance voltages (9 – 150 kHz)	2.4	dB	95%
	Terminal disturbance voltages (150 k – 30 MHz)	2.7	dB	95%
Radiated disturbance	Radiation disturbance (30-200 MHz – Horizontal Polariz.)	4.0	dB	95%
	Radiation disturbance (30-200 MHz – Vertical Polariz.)	4.0	dB	95%
	Radiation disturbance (200 -1000 MHz – Horizontal Polariz.)	3.5	dB	95%
	Radiation disturbance (200-1000 MHz – Vertical Polariz.)	3.4	dB	95%
	Radiation disturbance (1-6 GHz – H/V Polarization)	4.3	dB	95%
	Radiation disturbance (6-18 GHz – H/V Polarization)	4.8	dB	95%
	Radiation disturbance (18-26 GHz – H/V Polarization)	5.0	dB	95%
	Radiation disturbance (26-40 GHz – H/V Polarization)	5.2	dB	95%

9. TEST EQUIPMENT

Instrument	Manufacturer	Model	IMQ Ref.	Calibration	
				Last date	Due date
Shielded semi-anechoic chamber	ETS-LINDGREN	--	P04112	/	/
Shielded anechoic chamber	SIDT	--	P02386	/	/
EMI Receiver	Rhode & Schwarz	ESU8	S05562	2022-02-15	2022-03-15
Spectrum Analyser	Rohde & Schwarz	ESW44	S07965	2022-08-10	2023-08-10
Spectrum Analyser	Rohde & Schwarz	FSW50	S07990	2021-10-13	2022-12-13(*)
POWER SENSOR	Rohde & Schwarz	NRP-Z81	S06704	2022-06-02	2023-06-02
LISN	Rohde & Schwarz	ENV216	S03631	2022-02-07	2023-02-07
Broadband preamplifier	SCHWARZBECK	BBV 9744	S09213	2022-08-03	2023-08-03
Broadband preamplifier	SCHWARZBECK	BBV9718C	S09214	2022-07-22	2023-07-22
Broadband preamplifier	HEWLETT & PACKARD	HP8449B	S03542	2022-02-08	2023-02-08
Broadband preamplifier	SCHWARZBECK	BBV 9721	S09215	2022-08-24	2023-08-24
LOOP ANTENNA	ROHDE & SCHWARZ	HFH2-Z2E	S08326	2022-01-26	2023-01-26
LOG ANTENNA	SCHWARZBECK	VULB 9160	S03511	2022-09-20	2023-09-20
HORN ANTENNA	SCHWARZBECK	BBHA9120D	S03463	2020-07-06	2023-07-06
HORN ANTENNA	SCHWARZBECK	BBHA9170	S03724	2020-07-29	2023-07-29
SOFTWARE	Nexio	BAT-EMC V3.21.0.14	/	/	/

Note

(*) Some calibration intervals may be extended, based on sufficient calibration data and experience of use (see IEC 61010-1:2015 clause 8.3)

END OF TEST REPORT