SGS-CSTC Standards Technical Services
(Shanghai) Co., Ltd.

588 West Jindu Road,Songjiang District,Shanghai,China
Telephone: +86 (0) 21 6191 5666
Fax: +86 (0) 21 6191 5678
ee.shanghai@sgs.com

1 Cover Page

FCC Part 15C TEST REPORT

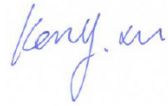
Application No.:	SHEM1311002229RF
Applicant:	KOKKIA, INC
Manufacturer:	KOKKIA, INC
FCC ID:	XWA- IADAPTER-X
Equipment Under Test (EUT): **NOTE:** The following sample(s) submitted was/were identified on behalf of the client as	
Product Name:	Bluetooth Universal Adapter
Model No.(EUT):	iAdapter
Add Model No.:	iAdapter_black, iAdapter_white
Standards:	FCC PART 15 Subpart C: 2012
Date of Receipt:	November 12, 2013
Date of Test:	November 19, 2013 to November 21, 2013
Date of Issue:	December 02, 2013
Test Result:	**Pass***

*In the configuration tested, the EUT detailed in this report complied with the standards specified above.

Tony Wu
E&E Section Manager
SGS-CSTC (Shanghai) Co., Ltd.

2 Version

Revision Record				
Version	**Chapter**	**Date**	**Modifier**	**Remark**
00	/	December 02, 2013	/	Original

Authorized for issue by:				
Engineer		Eddy Zong **Print Name**		
Clerk		Susie Liu **Print Name**		
Reviewer		Keny Xu **Print Name**		

3 Test Summary

Test Item	Test Requirement	Test method	Result
Antenna Requirement	FCC Part 15, Subpart C Section 15.203/15.247 (c)	---	PASS
AC Power Line Conducted Emission	FCC Part 15, Subpart C Section 15.207	ANSI C63.10 (2009) Section 6.2	PASS
20dB Occupied Bandwidth	FCC Part 15, Subpart C Section 15.247 (a)(1)	ANSI C63.10 (2009) Section 6.9.1	PASS
Conducted Peak Output Power	FCC Part 15, Subpart C Section 15.247 (b)(1)	ANSI C63.10 (2009) Section 6.10.1	PASS
Carrier Frequencies Separation	FCC Part 15, Subpart C Section 15.247 (a)(1)	ANSI C63.10 (2009) Section 7.7.2	PASS
Hopping Channel Number	FCC Part 15, Subpart C Section 15.247 (b)	ANSI C63.10 (2009) Section 7.7.3	PASS
Dwell Time	FCC Part 15, Subpart C Section 15.247 (a)(1)	ANSI C63.10 (2009) Section 7.7.4	PASS
RF Conducted Spurious Emissions and Band-edge	FCC Part 15, Subpart C Section 15.247(d)	ANSI C63.10 (2009) Section 7.7.9&7.7.10	PASS
Radiated Spurious Emissions and Band-edge	FCC Part 15, Subpart C Section 15.209 and Section 15.205	ANSI C63.10 (2009) Section 6.4&6.5&6.6	PASS

Remark:

Note: There are 3 models mentioned in this report, and they are the similar in electrical and electronic characters. Only the model iAdapter was tested since their difference was the colour.

4 Contents

5 General Information

5.1 Client Information

Applicant:	KOKKIA, INC
Address of Applicant:	43575 Mission Blvd #302, Fremont, CA 94539. USA
Manufacturer:	KOKKIA, INC
Address of Manufacturer:	43575 Mission Blvd #302, Fremont, CA 94539. USA
Factory:	DONGGUAN CITY GREENTECH ELECTRONIC TECHNOLOGY CO., LTD.
Address of Factory:	2-3 Floor, 68 Wen Zeng Road, Wentang, Dongguan city, Guangdong, China.

5.2 General Description of E.U.T.

Product Name:	Bluetooth Universal Adapter
Model No.(EUT):	iAdapter
Add Model No.:	iAdapter_black, iAdapter_white
Brand Name:	KOKKIA
Product Description:	Portable product

5.3 Technical Specifications:

Operation Frequency:	2402MHz~2480MHz
Bluetooth Version:	2.1+EDR
Modulation Technique:	FHSS (GFSK, π/4DQPSK, 8DPSK)
Number of Channel:	79
Power Supply:	Charging voltage: DC 5.0V by USB port Rechargeable battery: DC4.2V
Antenna Type	Integral Chip Antenna
Antenna Gain	0.5dBi
Engineering mode:	Using test software to control EUT working in continuous transmitting, and select channel and modulation type.

5.4 Description of Support Units

The EUT has been tested with associated equipment below.

Description	Manufacturer	Model No.	Supplied by
Laptop	Lenovo	L430	SGS
BT test board	/	/	Client

Software name	Manufacturer	Supplied By
Blue Test3 (For CSR)		Client/SGS

5.5 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. E&E Lab

No.588 West Jindu Road, Songjiang District, Shanghai, China. 201612.

Tel: +86 21 6191 5666

Fax: +86 21 6191 5678

No tests were sub-contracted.

5.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **CNAS (No. CNAS L0599)**

  CNAS has accredited SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing. Date of expiry: 2014-07-26.

- **FCC – Registration No.: 402683**

  SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered and fully described in a report filed with the Federal Communications Commission (FCC). The acceptance letter from the FCC is maintained in our files. Registration No.: 402683, Expiry Date: 2015-02-22.

- **Industry Canada (IC) – IC Assigned Code: 8617A**

  The 3m Semi-anechoic chamber of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 8617A. Expiry Date: 2014-09-20.

- **VCCI (Member No.: 3061)**

  The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-3868 and C-4336 respectively. Date of Registration: 2012-05-29. Date of Expiry: 2015-05-28.

6 Equipments List

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due date
1	Spectrum Analyzer	Rohde & Schwarz	FSP-30	2705121009	2013-02-23	2014-02-22
2	EMI test receiver	Rohde & Schwarz	ESU40	100109	2013-02-23	2014-02-22
3	Horn Antenna (1GHz to 18GHz)	SCHWARZBECK	BBHA9120D	9120D-679	2013-03-07	2014-03-06
4	Horn Antenna (14GHz to 40GHz)	SCHWARZBECK	BBHA 9170	BBHA9170373	2013-03-07	2014-03-06
5	ANTENNA (25MHz to 2GHz)	SCHWARZBECK	VULB9168	9168-313	2013-03-07	2014-03-06
6	Ultra broadband antenna (30MHz to3GHz)	Rohde & Schwarz	HL562	100227	2013-10-09	2014-10-08
7	Horn Antenna (1GHz to 18GHz)	Rohde & Schwarz	HF906	100284	2013-06-02	2014-06-01
8	Active Loop Antenna (9kHz to 30MHz)	Rohde & Schwarz	FMZB 1519	1519-034	2013-07-28	2014-07-27
9	High-low temperature cabinet	Suzhou Zhihe	TL-40	50110050	2013-04-13	2014-04-12
10	Tunable Notch Filter	Wainwright instruments Gmbh	WRCT800.0/880.0-0.2/40-5SSK	9	2013-06-02	2014-06-01
11	High pass Filter	FSCW	HP 12/2800-5AA2	19A45-02	2013-06-02	2014-06-01
12	Low noise amplifier	TESEQ	LNA6900	70133	2013-02-23	2014-02-22
13	Attenuator	HUAXIANG	TS2-6dB	11051002	/	/
14	Attenuator	HUAXIANG	TS2-6dB	11051001	/	/
15	AC power stabilizer	WOCEN	6100	51122	2013-06-02	2014-06-01
16	DC power	QJE	QJ30003SII	611145	2013-06-02	2014-06-01

7 Test Results

7.1 E.U.T. test conditions

Test Power: DC 5V

Requirements: 15.31(e) For intentional radiators, measurements of the variation of the input power or the radiated 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.

Operating Environment:

Temperature: 20.0 -25.0 °C

Humidity: 35-75 % RH

Atmospheric Pressure: 99.2 -102.0 kPa

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

Pursuant to Part 15.31(c) For swept frequency equipment, measurements shall be made with the frequency sweep stopped at those frequencies chosen for the measurements to be reported.

Test frequency is the lowest channel: 0 channel (2402MHz), middle channel: 39 channel (2441MHz) and highest channel: 78 channel (2480MHz) with fixed at channel.

7.2 Frequency Hopping System Requirement

This transmitter device is frequency hopping device, and complies with Part 15.247 (g) and (h)

This device uses Bluetooth radio which operates in 2400~2483.5MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands(1MHz each; centred from 2402~2480MHz) in the range 2400~2483.5MHz. The transmitter switches hop frequencies 1600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share detail of any identified band channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

This device was tested with an Bluetooth system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements

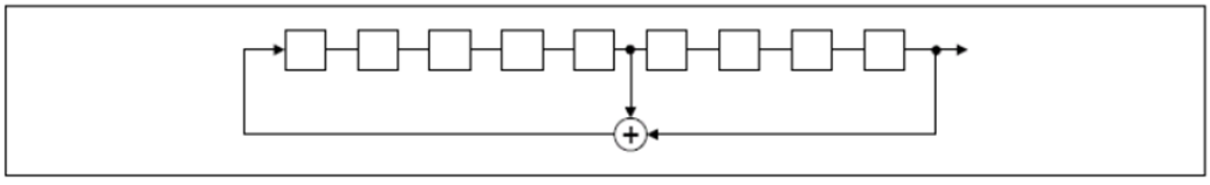
EUT Pseudorandom Frequency Hopping Sequence

The Pseudorandom sequence may be generated in a nine-shift register whose 5^{th} and 9^{th} stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones.

Number of shift register stages: 9

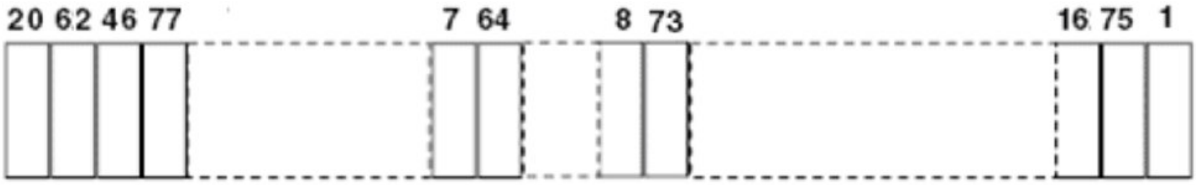
Length of pseudo-random sequence:29-1=511 bits

Longest sequence of zeros: 8(non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence



Each frequency used equally on the average by each transmitter.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

7.3 Antenna Requirement

Standard requirement

15.203 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, 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.

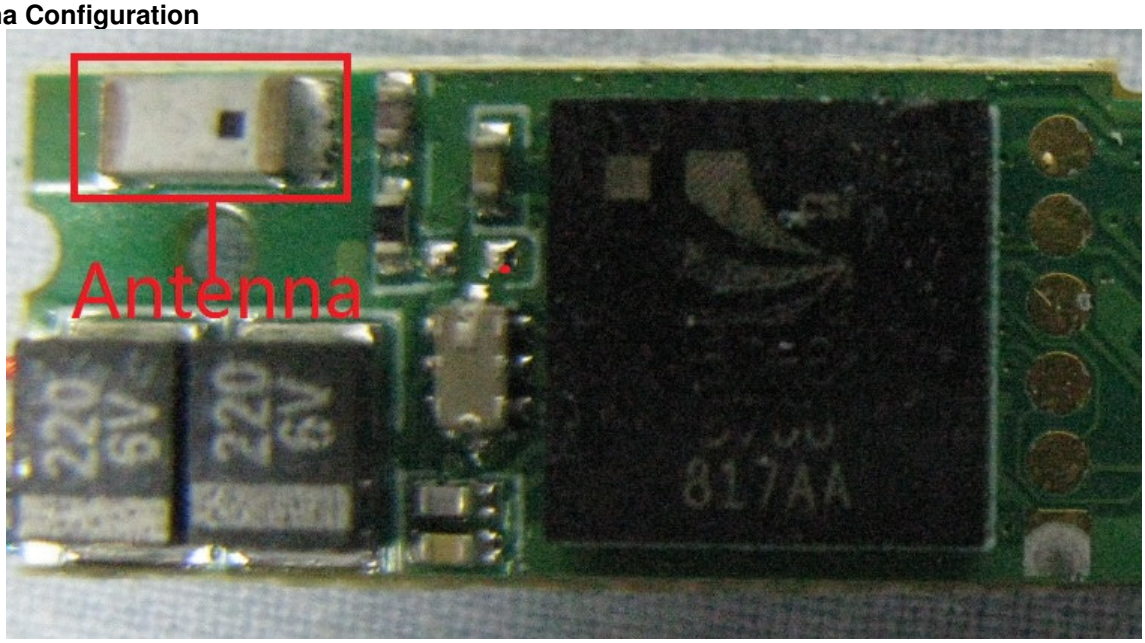
15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna

The antenna is integrated Chip Antenna and no consideration of replacement. The gain of the antenna is less than 0.5 dBi.

Antenna Configuration



7.4 Conducted Emissions on Mains Terminals

Test Requirement: FCC Part 15C, Section 15.207

Test Method: ANSI C63.10:2009 Section 6.2

Test Result: Pass

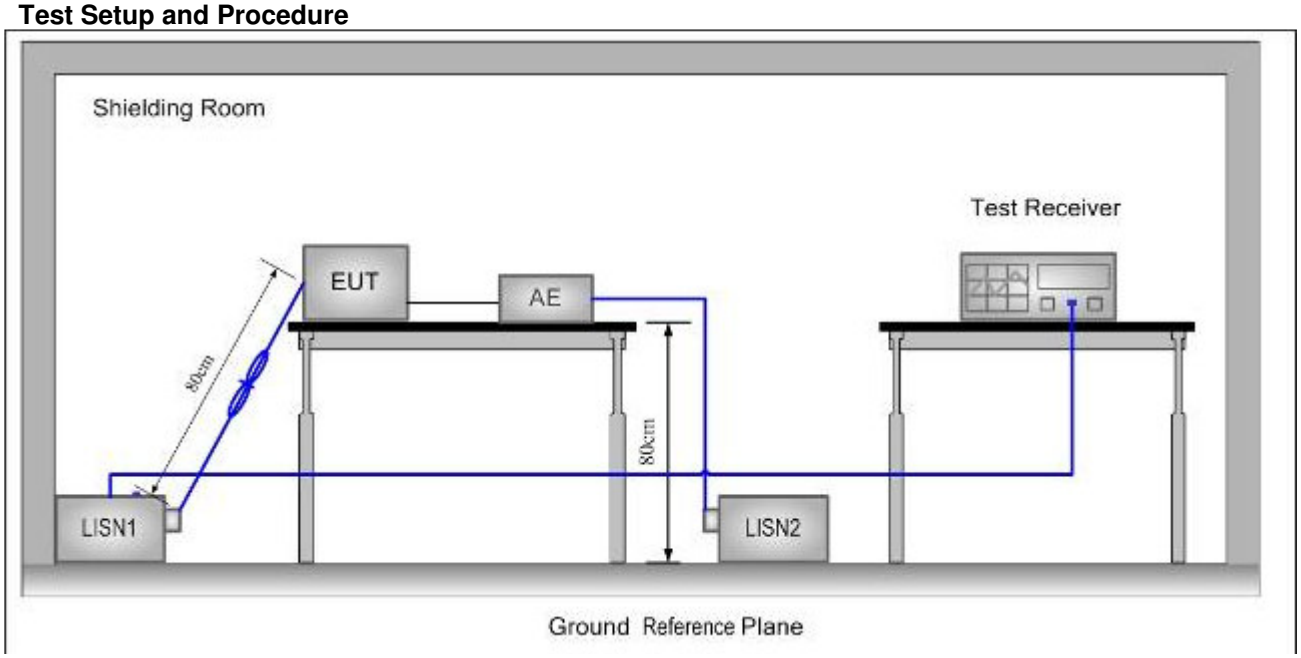
Frequency Range: 150 KHz to 30 MHz

Class/Severity: Class B

Limit:

Frequency range MHz	Class B Limits dB (μV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note1: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50MHz. Note2: The lower limit is applicable at the transition frequency.		

Test Setup and Procedure



1. The mains terminal disturbance voltage was measured with the EUT in a shielded room.
2. The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN, which was bonded to the ground reference plane in the same way as the

LISN for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded

3. The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, but separated from metallic contact with the ground reference plane by 0.1m of insulation.

4. The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISN mounted on top of the ground reference plane. This distance was between the closest points of the LISN and the EUT. The mains lead of EUT excess 0.8m was folded back and forth parallel to the lead so as to form a horizontal bundle with a length between 0.3m and 0.4m. All other units of the EUT and associated equipment was at least 0,8 m from the LISN.

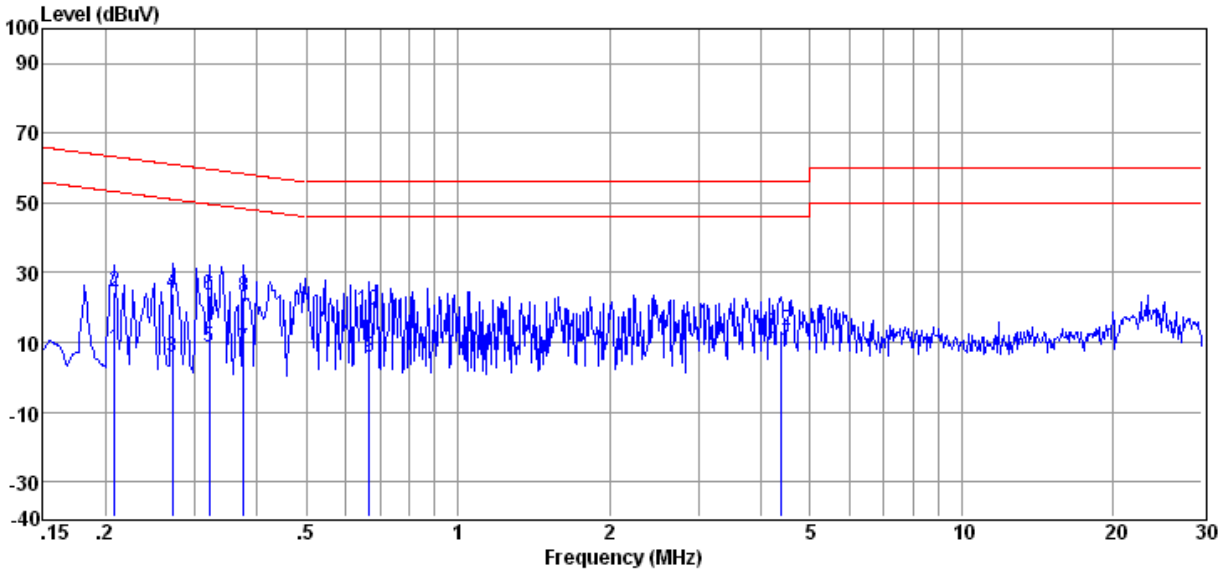
Measurement Data

Pre-scan was performed with peak detected on all ports, Quasi-peak & average measurements were performed at the frequencies at which maximum peak emission level were detected.

Please see the attached Quasi-peak and Average test results.

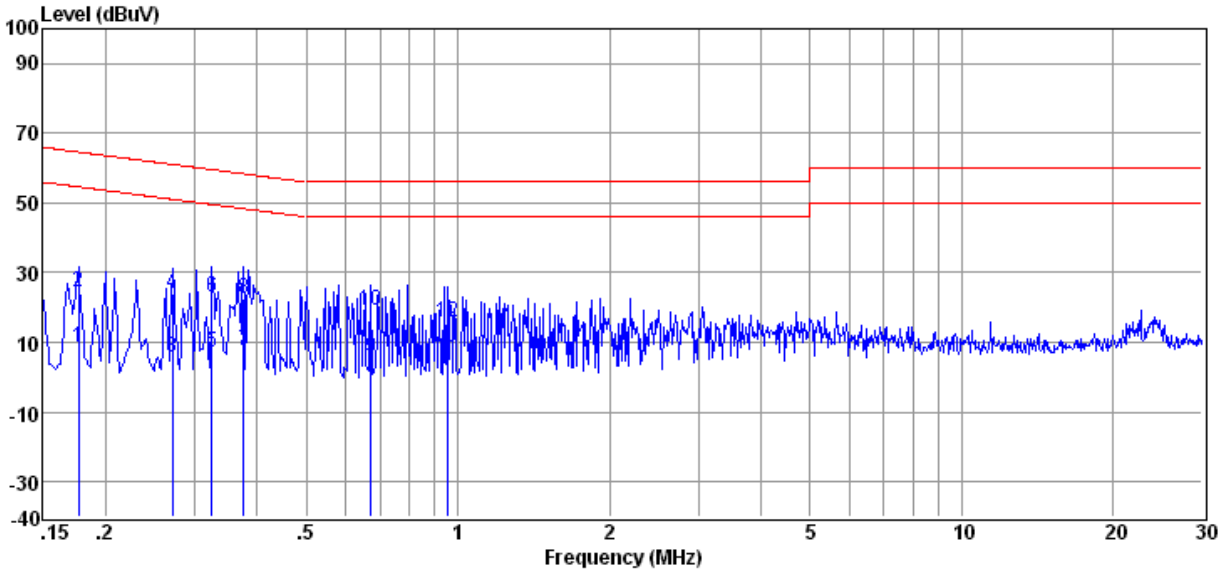
Level = Read Level + LISN/ISN Factor + Cable Loss.

Test Mode: Engineering mode **Test Port:** L Line



Item	Freq.	Read Level	LISN Factor	Cable Loss	Level	Limit Line	Over Limit	Detector
(Mark)	(MHz)	(dBµV)	(dB)	(dB)	(dBµV)	(dBµV)	(dB)	
1	0.208	7.87	0.10	0.10	8.07	53.27	-45.20	Average
2	0.208	24.08	0.10	0.10	24.28	63.27	-38.99	QP
3	0.272	5.55	0.12	0.10	5.77	51.07	-45.30	Average
4	0.272	23.85	0.12	0.10	24.07	61.07	-37.00	QP
5	0.322	8.31	0.14	0.10	8.55	49.66	-41.11	Average
6	0.322	23.20	0.14	0.10	23.44	59.66	-36.22	QP
7	0.375	7.86	0.16	0.10	8.12	48.39	-40.27	Average
8	0.375	22.70	0.16	0.10	22.96	58.39	-35.43	QP
9	0.668	5.34	0.20	0.10	5.64	46.00	-40.36	Average
10	0.668	18.79	0.20	0.10	19.09	56.00	-36.91	QP
11	4.384	7.05	0.30	0.18	7.53	46.00	-38.47	Average
12	4.384	12.90	0.30	0.18	13.38	56.00	-42.62	QP

Test Mode: Engineering mode **Test Port:** N Line



Item	Freq.	Read Level	LISN Factor	Cable Loss	Level	Limit Line	Over Limit	Detector
(Mark)	(MHz)	(dBµV)	(dB)	(dB)	(dBµV)	(dBµV)	(dB)	
1	0.177	8.13	0.14	0.10	8.37	54.64	-46.27	Average
2	0.177	24.24	0.14	0.10	24.48	64.64	-40.16	QP
3	0.272	5.62	0.10	0.10	5.82	51.07	-45.25	Average
4	0.272	23.57	0.10	0.10	23.77	61.07	-37.30	QP
5	0.325	6.72	0.10	0.10	6.92	49.57	-42.65	Average
6	0.325	23.02	0.10	0.10	23.22	59.57	-36.35	QP
7	0.375	7.33	0.10	0.10	7.53	48.39	-40.86	Average
8	0.375	22.35	0.10	0.10	22.55	58.39	-35.84	QP
9	0.672	5.47	0.19	0.10	5.76	46.00	-40.24	Average
10	0.672	18.67	0.19	0.10	18.96	56.00	-37.04	QP
11	0.953	4.71	0.20	0.10	5.01	46.00	-40.99	Average
12	0.953	15.57	0.20	0.10	15.87	56.00	-40.13	QP

7.5 20dB Occupied Bandwidth

Test Requirement: FCC Part 15 C Section 15.247 (a)(1)

Test Method: ANSI C63.10:2009 Clause 6.9.1

Test Procedure:

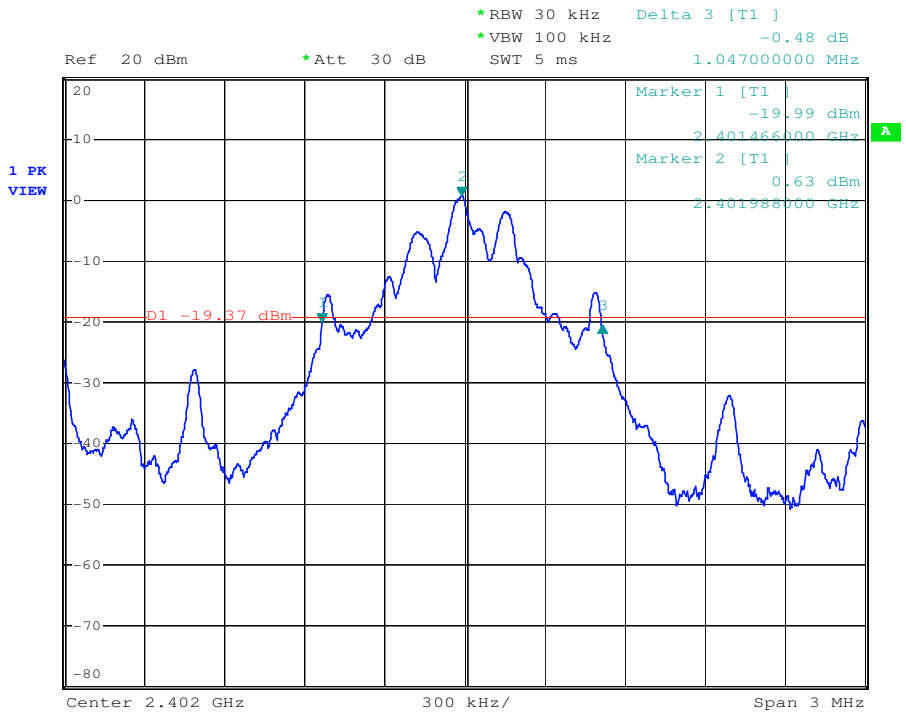
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: Span = approximately 2 to 3 times the 20dB bandwidth, centred on the hopping channel;
3. Set the spectrum analyzer: RBW 100kHz; VBW ≥ RBW. Sweep = auto; Detector Function = Peak. Trace = Max Hold.
4. Mark the peak frequency and -20dB points.

Test date

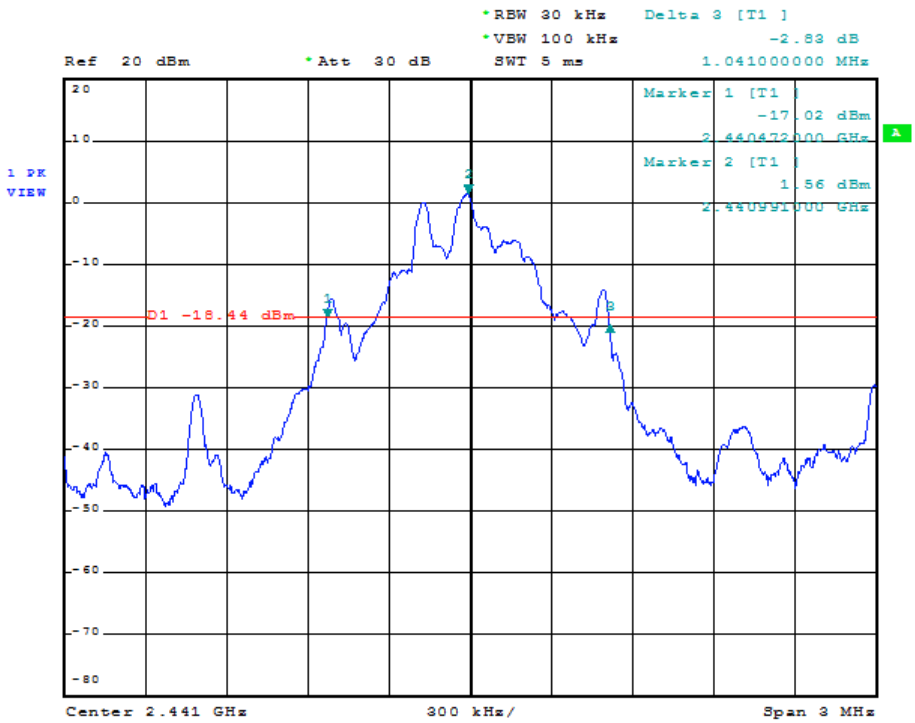
Test Channel	Channel Frequency (MHz)	Modulation	Bandwidth(MHz)
Low	2402	GFSK	1.047
Middle	2441	GFSK	1.041
High	2480	GFSK	1.056
Low	2402	π/4DQPSK	1.173
Middle	2441	π/4DQPSK	1.161
High	2480	π/4DQPSK	1.173
Low	2402	8DPSK	1.179
Middle	2441	8DPSK	1.173
High	2480	8DPSK	1.179

Test plot as follows:

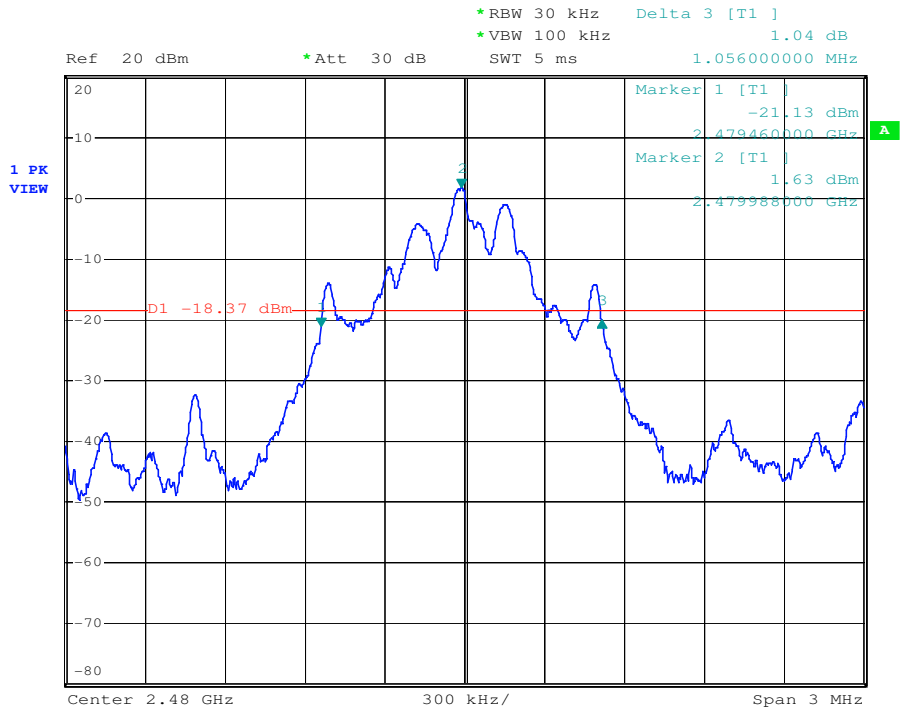
Test mode:	GFSK	Test channel:	Lowest



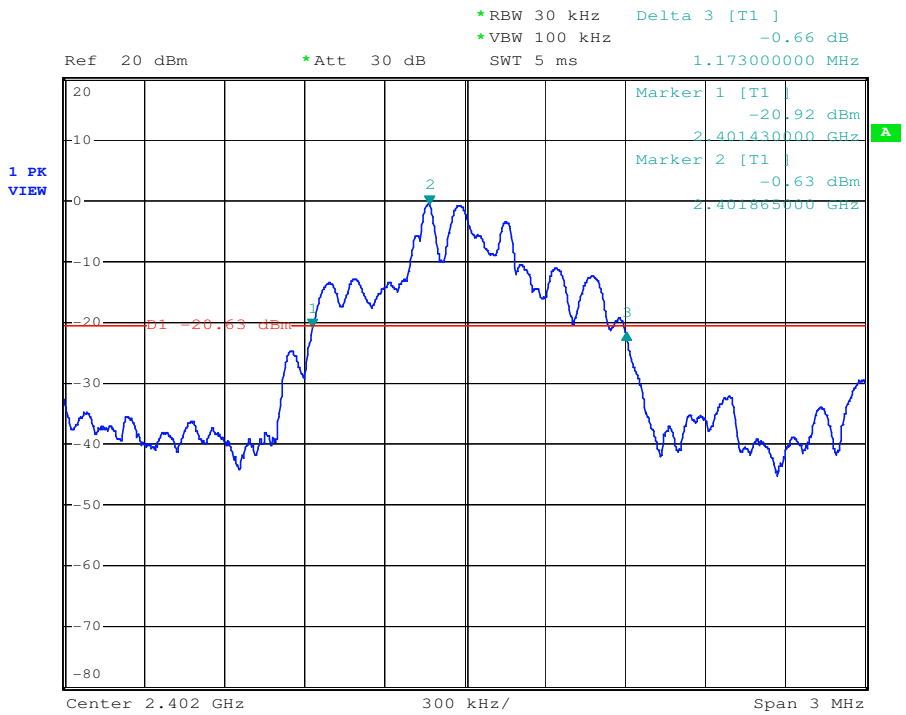
Test mode:	GFSK	Test channel:	Middle



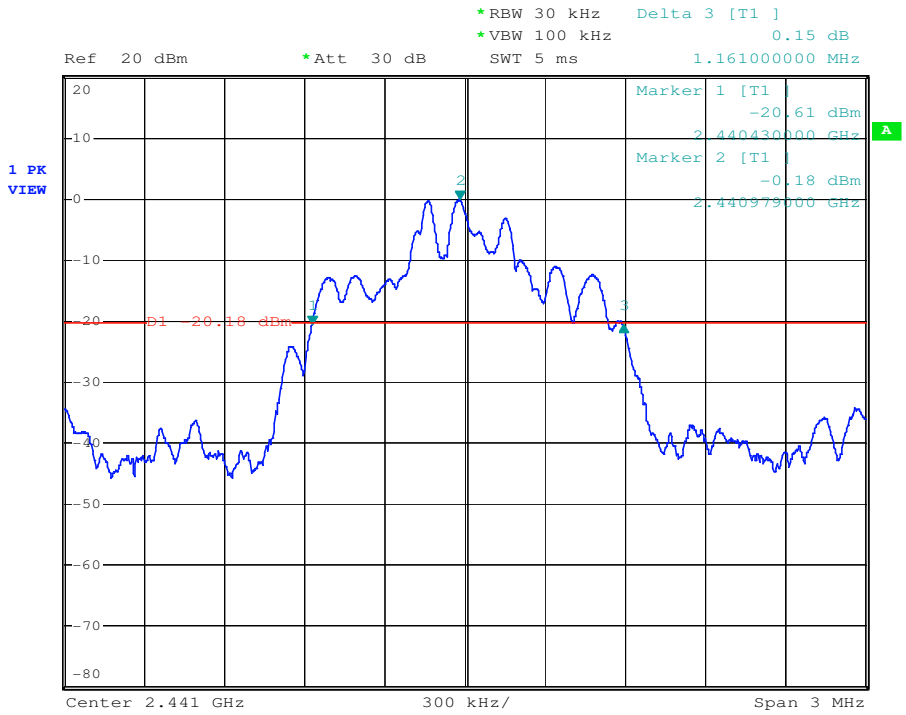
Test mode:	GFSK	Test channel:	Highest



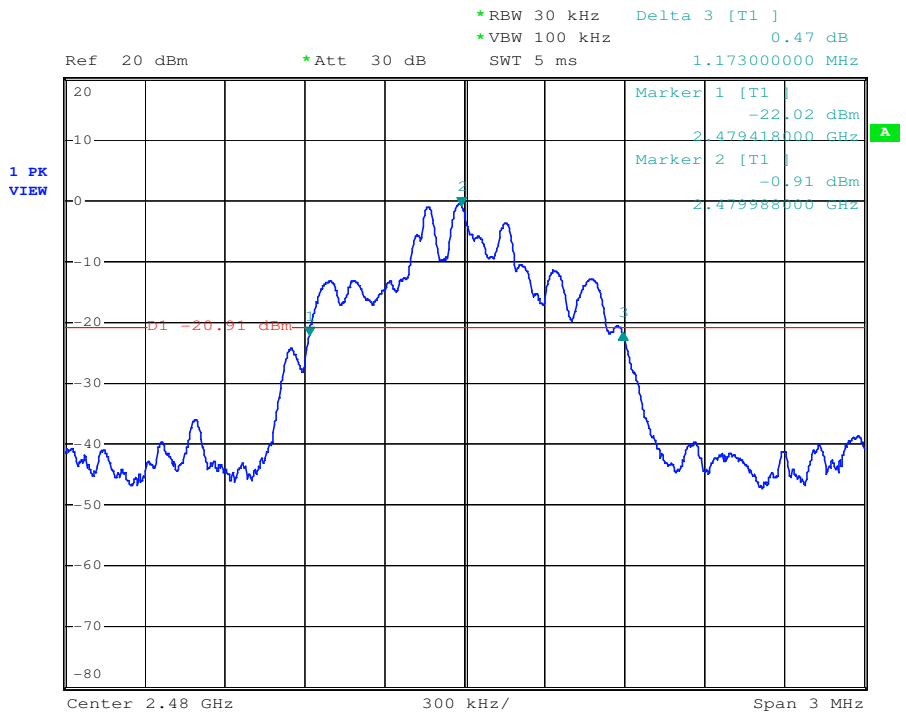
Test mode:	π/4DQPSK	Test channel:	Lowest



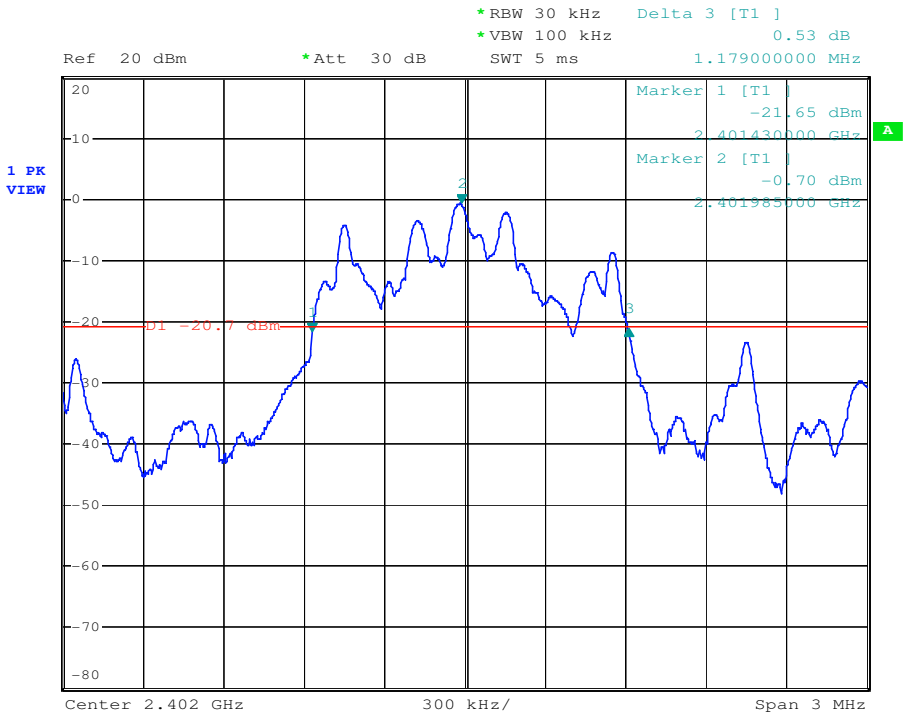
Test mode:	π/4DQPSK	Test channel:	Middle



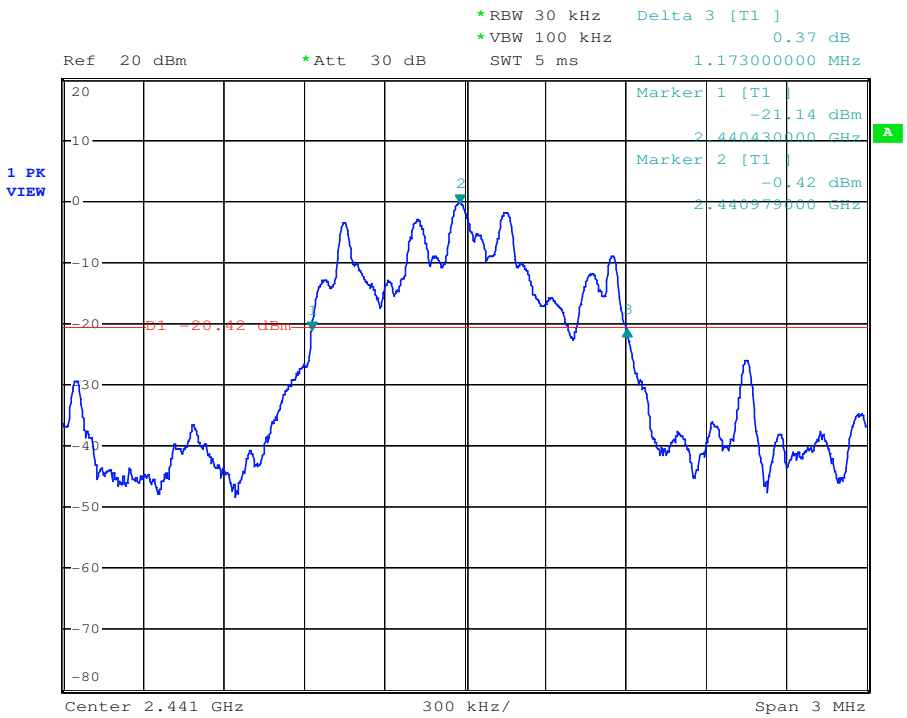
Test mode:	π/4DQPSK	Test channel:	Highest



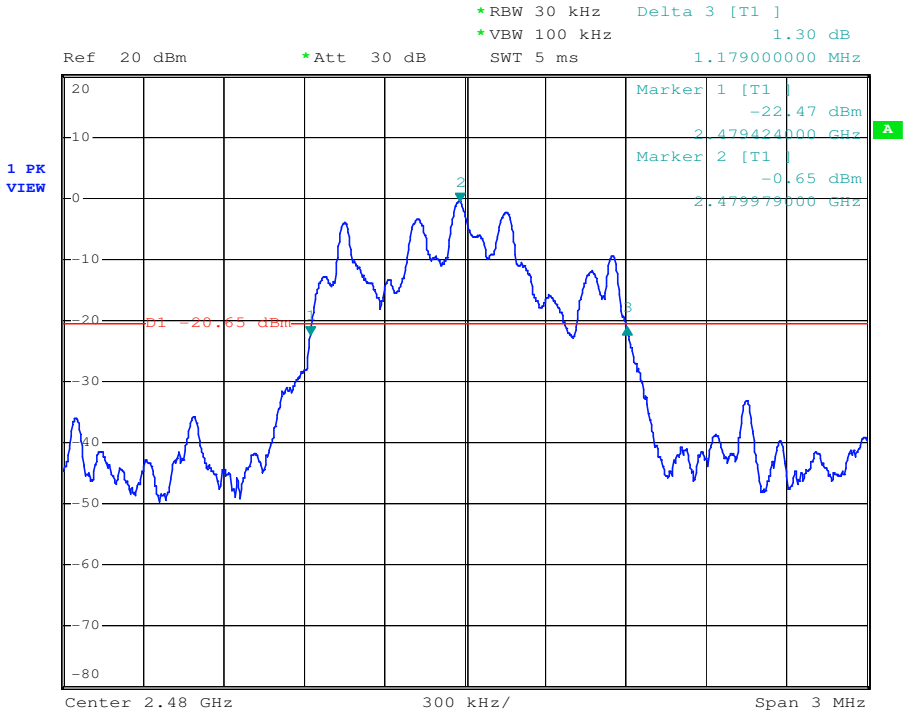
Test mode:	8DPSK	Test channel:	Lowest



Test mode:	8DPSK	Test channel:	Middle



Test mode:	8DPSK	Test channel:	Highest



7.6 Conducted Peak Output Power

Test Requirement: FCC Part 15.247 Section 15.247(b)(1)

Test Method: ANSI C64.10:2009 Section 6.10.1

Test Result: Pass

Test Limit: Regulation 15.247 (b)(1)For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.
Refer to the result "Hopping channel number" of this document. The 0.125 watt (20.0dBm) limit applies.

Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3 MHz. VBW = 3 MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, middle and highest channel individually. Record the max value.

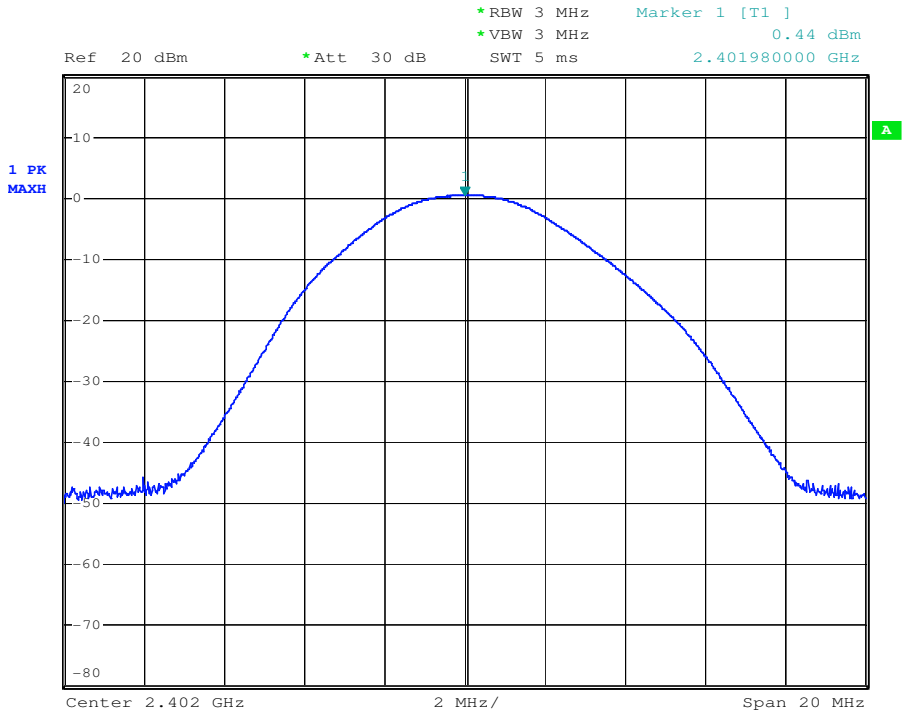
Test Results record:

Test Channel	Modulation	Fundamental Frequency (MHz)	Reading Power (dBm)	Cable Loss (dB)	Output Power (dBm)	Limit (dBm)	Result
Lowest	GFSK	2402	0.44	0.5	0.94	30	Pass
Middle	GFSK	2441	1.02	0.5	1.52	30	Pass
Highest	GFSK	2480	1.28	0.5	1.78	30	Pass
Lowest	π/4DQPSK	2402	-0.43	0.5	0.07	30	Pass
Middle	π/4DQPSK	2441	1.05	0.5	1.55	30	Pass
Highest	π/4DQPSK	2480	-0.24	0.5	0.26	30	Pass
Lowest	8DPSK	2402	-0.01	0.5	0.49	30	Pass
Middle	8DPSK	2441	-0.02	0.5	0.48	30	Pass
Highest	8DPSK	2480	-0.10	0.5	0.40	30	Pass

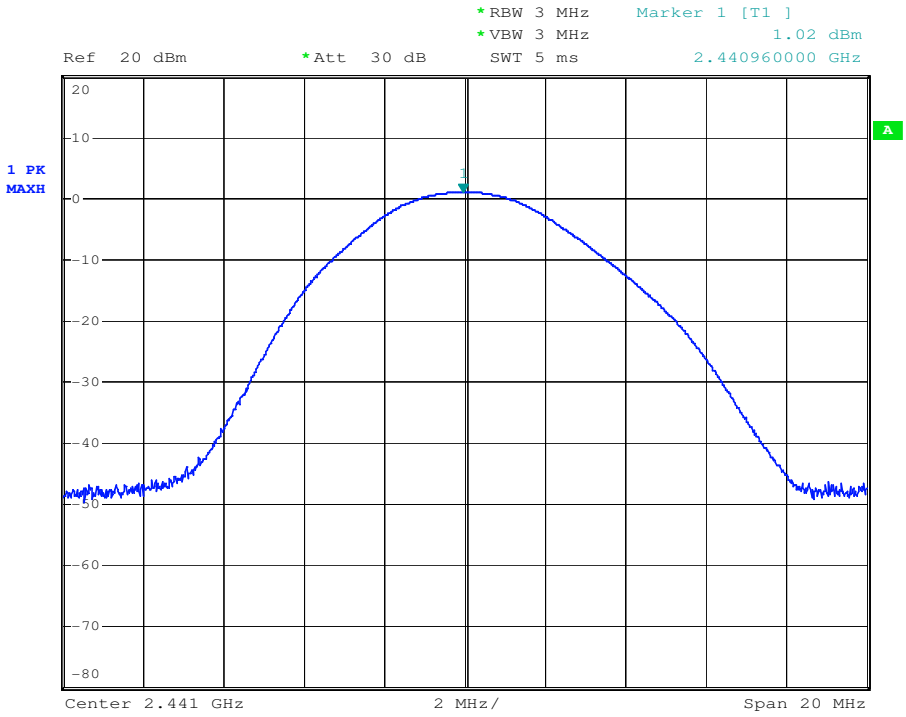
Remark: Output Power= Reading Power + Cable Loss

Test result plot as follows:

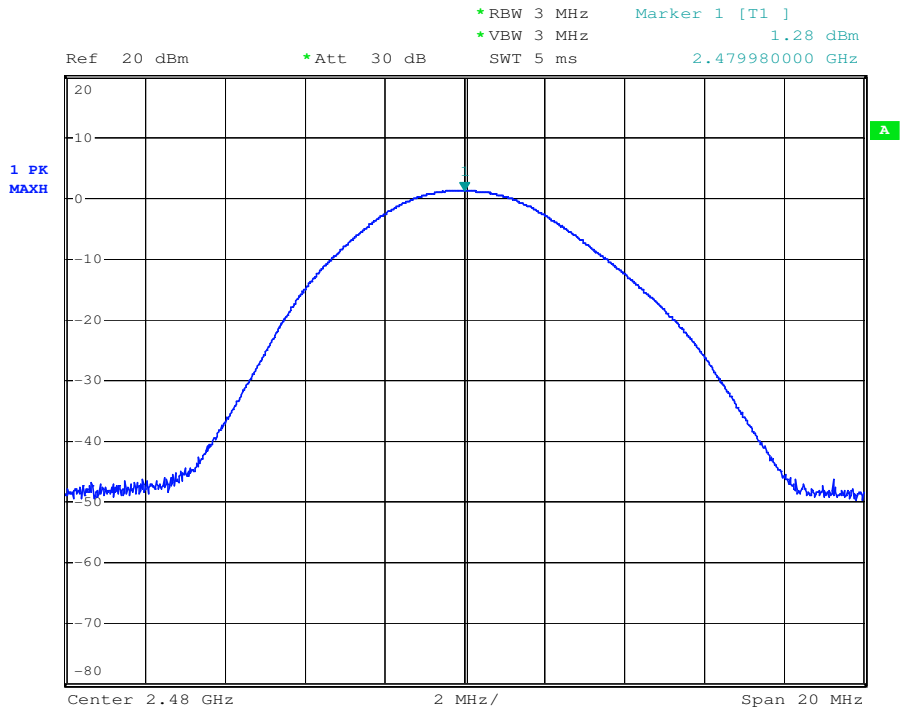
Test mode:	GFSK	Test channel:	Lowest



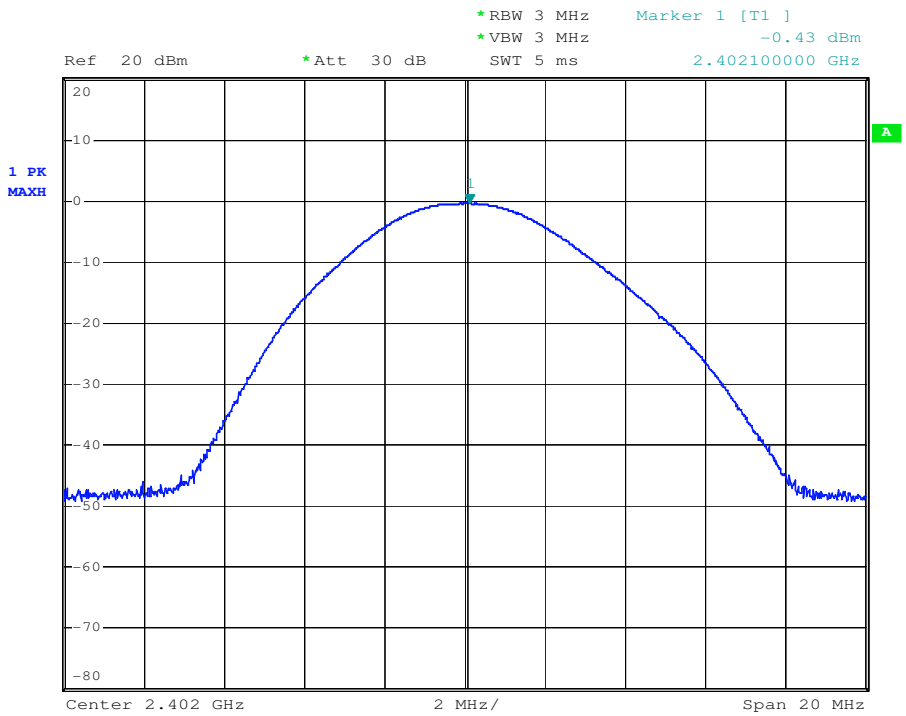
Test mode:	GFSK	Test channel:	Middle



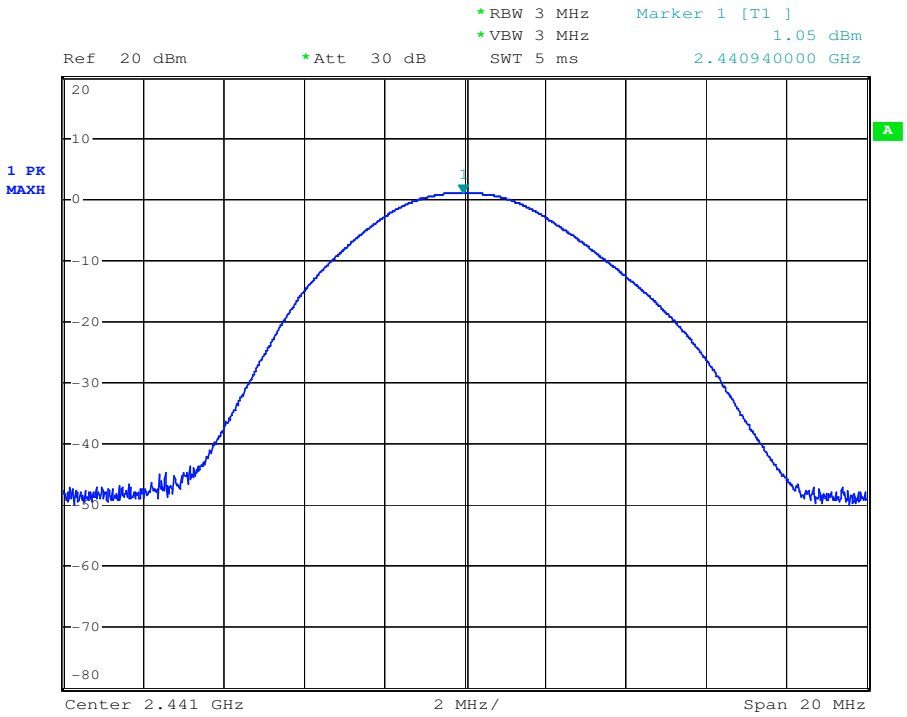
Test mode:	GFSK	Test channel:	Highest



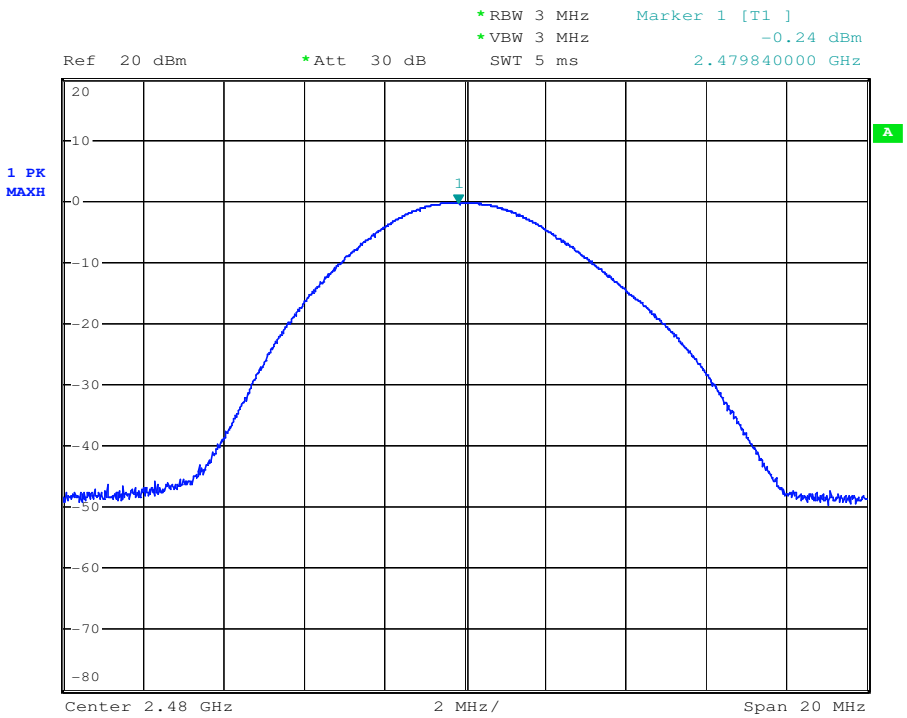
Test mode:	π/4DQPSK	Test channel:	Lowest



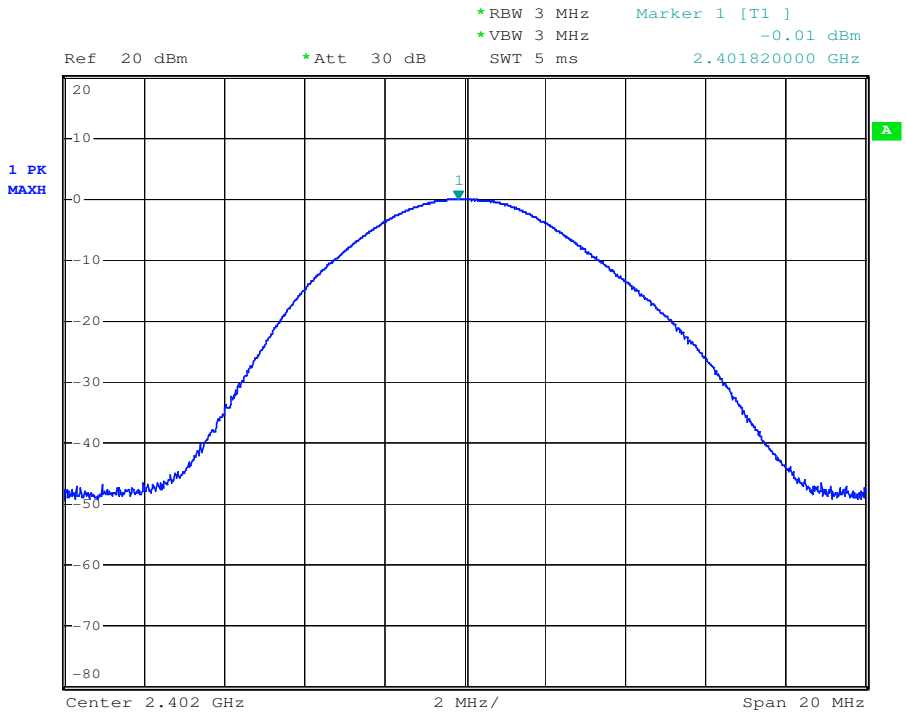
Test mode:	π/4DQPSK	Test channel:	Middle



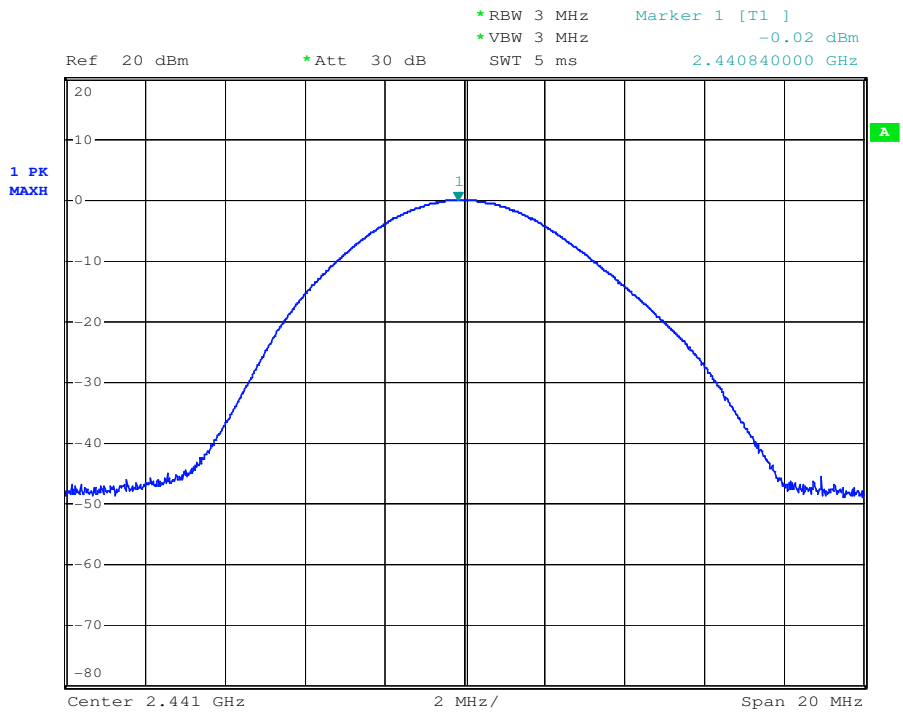
Test mode:	π/4DQPSK	Test channel:	Highest



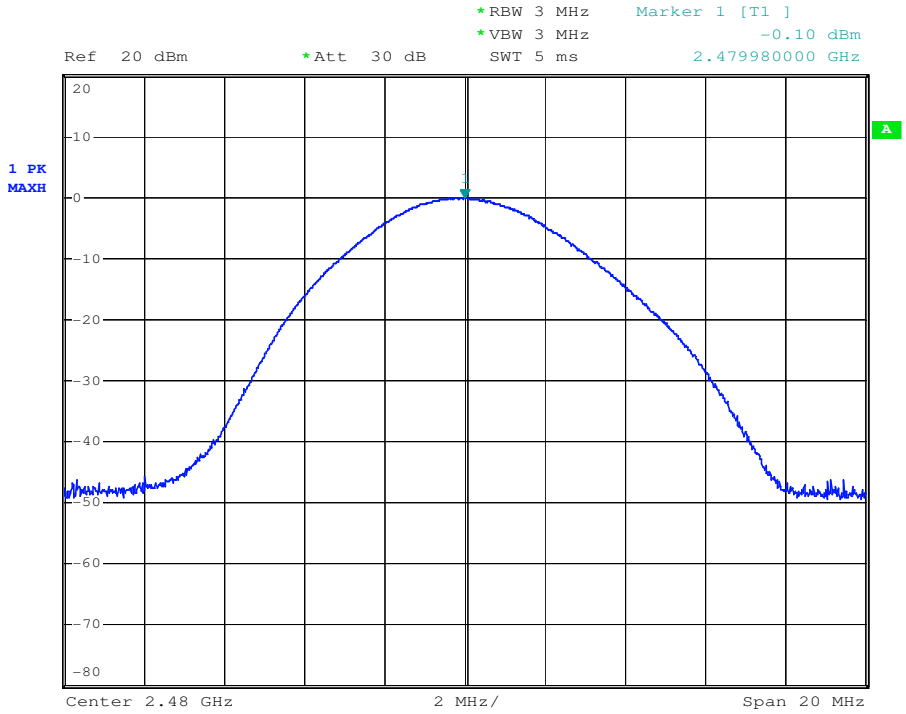
Test mode:	8DPSK	Test channel:	Lowest



Test mode:	8DPSK	Test channel:	Middle



Test mode:	8DPSK	Test channel:	Highest



7.7 Carrier Frequencies Separated

Test Requirement: FCC Part 15 C Section 15.247 (a)(1)

Test Method: ANSI C63.10:2009 Clause 7.7.2

Limit: 0.025MHz or 2/3 of the 20dB bandwidth (whichever is greater)

Test result: Pass

Test Procedure:

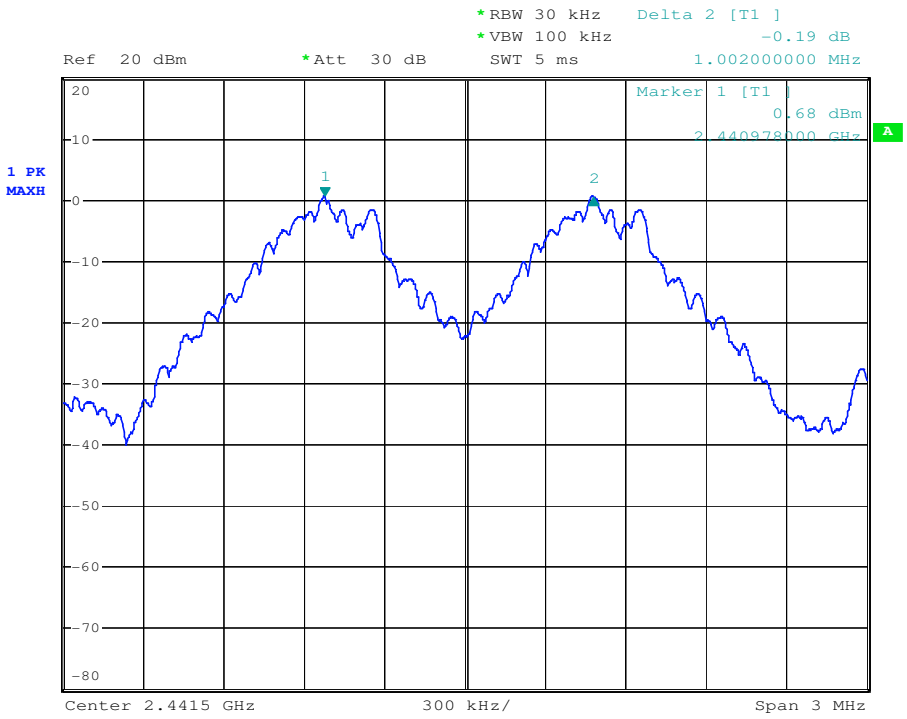
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW =100 kHz). VBW≥RBW , Span = 3MHz. Sweep = auto; Detector Function = Peak. Trace = Maxhold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

Test Channel	Modulation	Carrier Frequencies Separated (MHz)	Limit (MHz) (25kHz or two-thirds of the 20 dB bandwidth)	Results
Middle Channels (channel 39 and channel 40)	GFSK	1.002	0.025/0.703kHz	PASS
Middle Channels (channel 39 and channel 40)	π/4DQPSK	1.005	0.025/0.782kHz	PASS
Middle Channels (channel 39 and channel 40)	8DPSK	1.005	0.025/0.786kHz	PASS

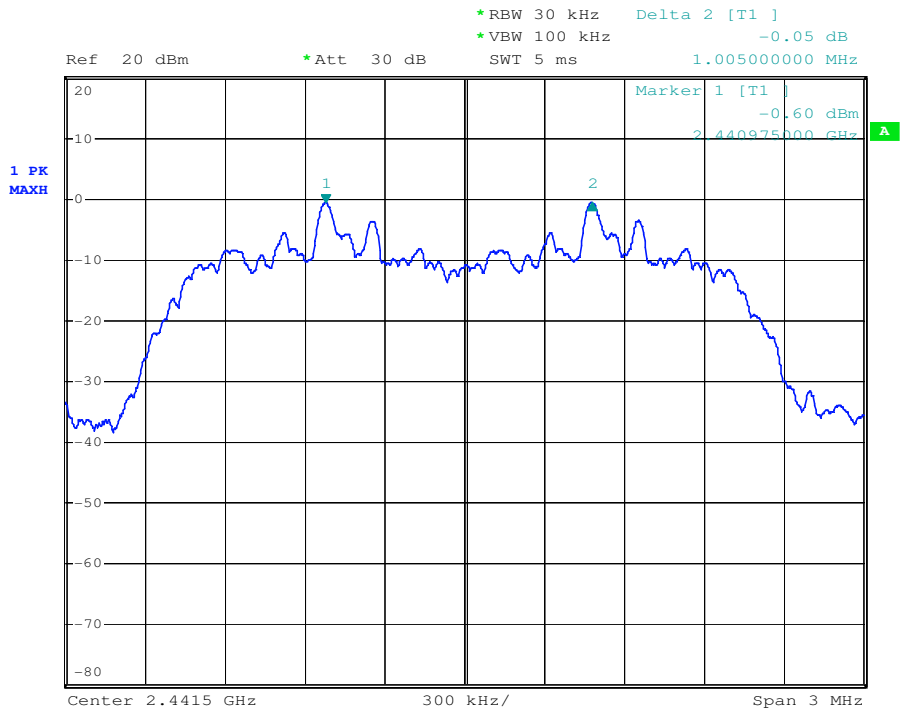
Note: 20dB bandwidth reference Section 7.4

Test plot as follows:

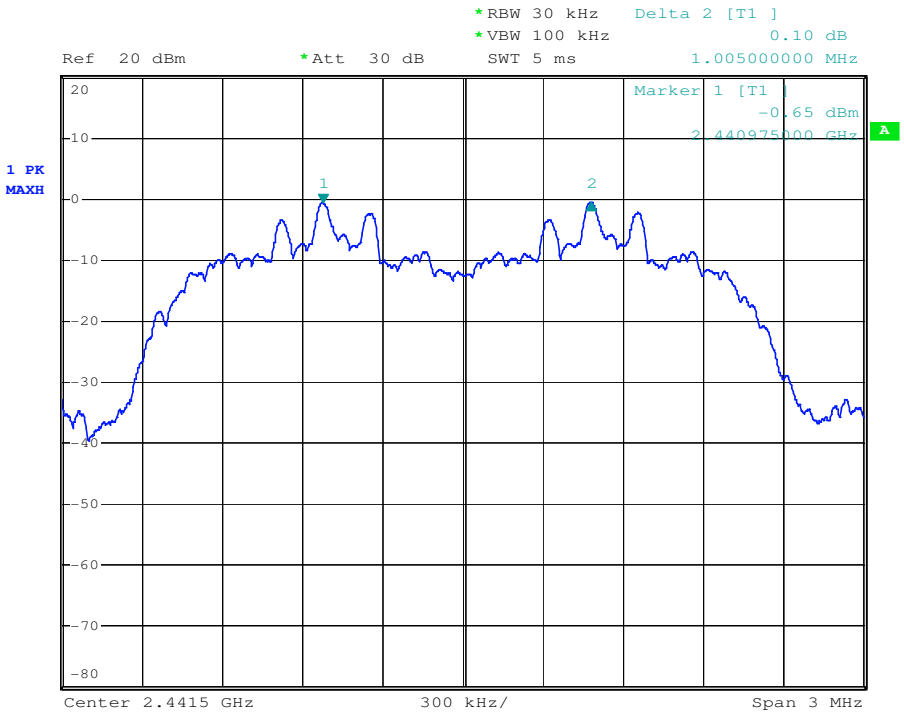
Test mode:	GFSK	Test channel:	Middle



Test mode:	π/4DQPSK	Test channel:	Middle



Test mode:	8DPSK	Test channel:	Middle



7.8 Hopping Channel Number

Test Requirement: FCC Part15 C Section 15.247(b)

Test Method: ANSI C63.10:2009 Clause 7.7.3

Limit: At least 15 channels

Test Result: Pass

Test Mode: Hopping transmitting with all kind of modulation

Test Procedure:

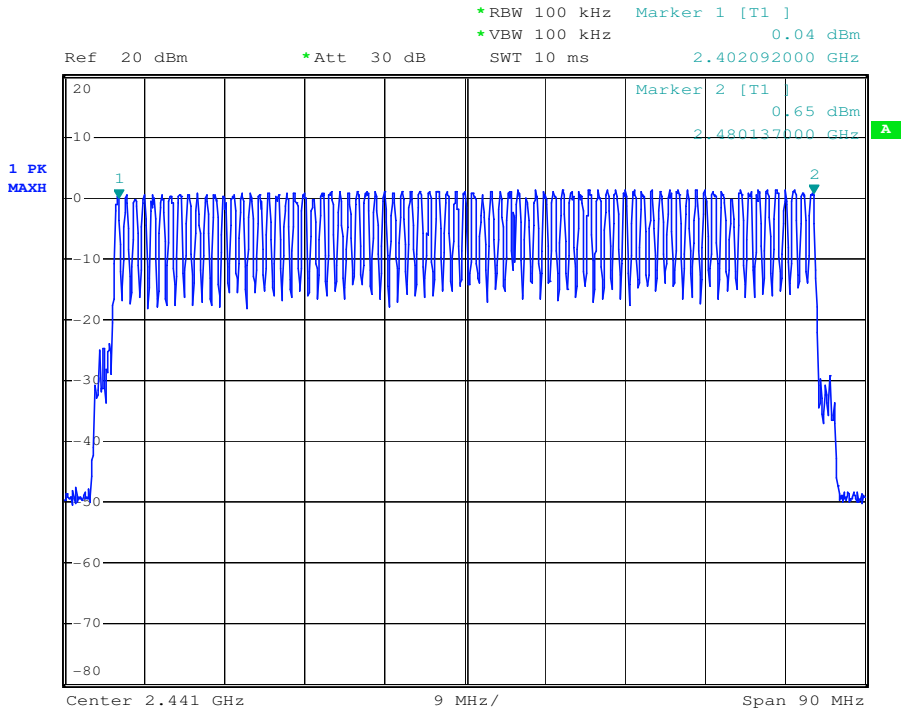
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100 kHz. VBW ⩾300 kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: start frequency = 2400MHz. stop frequency = 2483.5MHz. Submit the test result graph.

Measurement Data

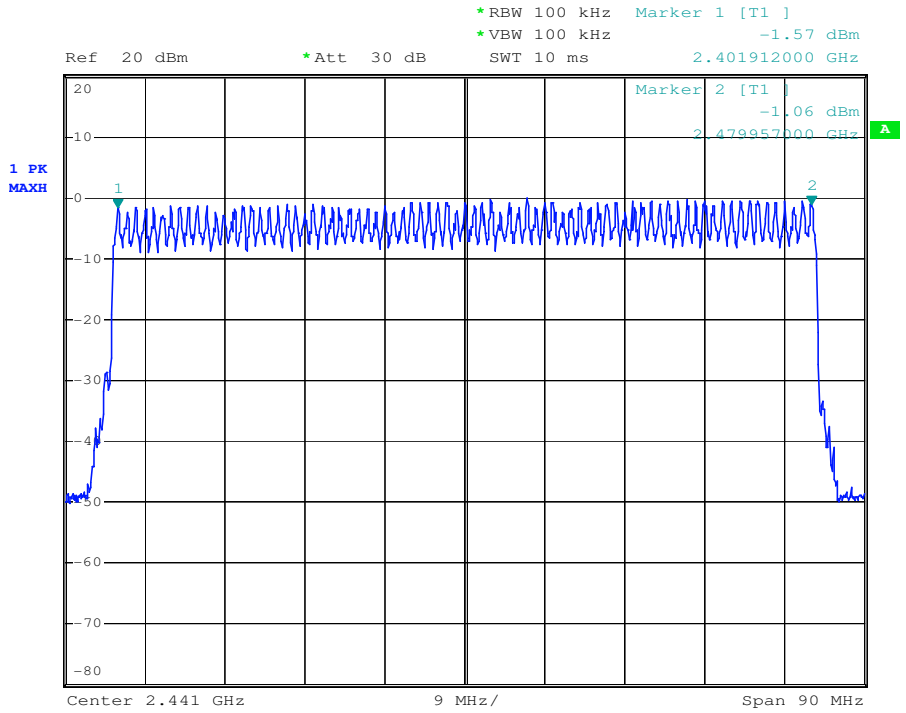
Mode	Hopping channel numbers	Limit	Results
GFSK	79	≥15	Pass
π/4DQPSK	79	≥15	Pass
8DPSK	79	≥15	Pass

Test plot as follows:

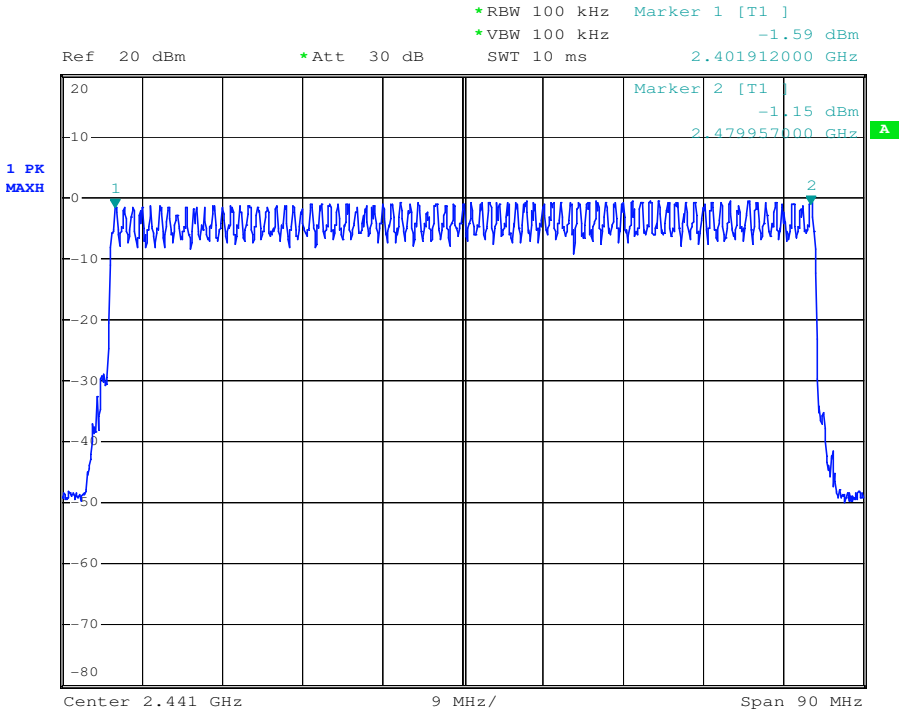
Test mode:	GFSK



Test mode:	π/4DQPSK



Test mode:	8DPSK



7.9 Dwell Time

Test Requirement: FCC Part 15 C Section 15.247(a)(1)

Test Method: ANSI C63.10:2009 Clause 7.7.4

Limit: Regulation 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.

Test Status: Hopping transmitting with all kind of modulation.

Test Result: Pass

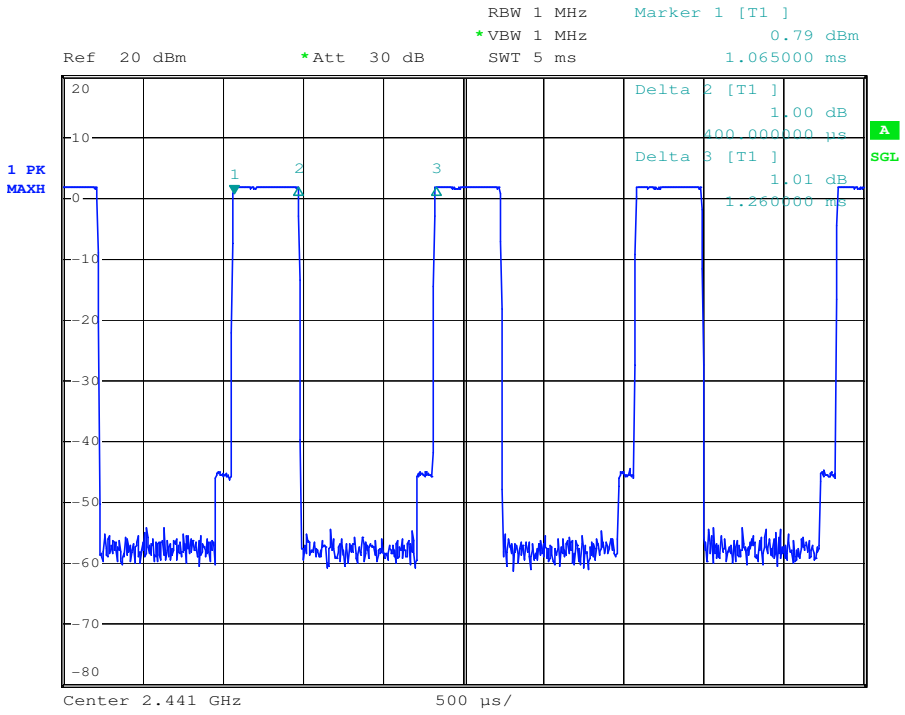
Test Procedure:

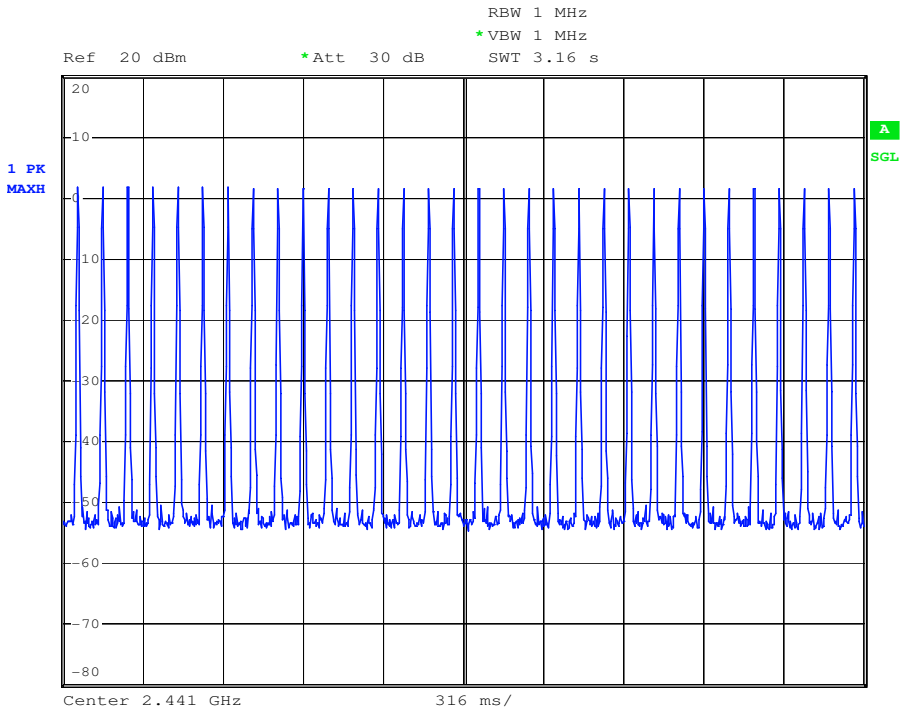
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0. centered on a hopping channel;
3. Use Emission width * No. of Hopping Channels in 31.6s to determine the dwell time.

Frequency (MHz)	Modulation	Packet	Emission Width (ms)	Number of Hopping Channel in 31.6s	Average Time of Occupancy(s)	Limit(s)	Result
2441	GFSK	DH1	0.40	320	0.13	0.4	Pass
		DH3	1.66	160	0.27	0.4	Pass
		DH5	2.88	110	0.32	0.4	Pass
2441	π/4DQPSK	2DH1	0.42	320	0.13	0.4	Pass
		2DH3	1.64	160	0.26	0.4	Pass
		2DH5	1.71	110	0.19	0.4	Pass
2441	8DPSK	3DH1	0.42	320	0.13	0.4	Pass
		3DH3	1.66	160	0.27	0.4	Pass
		3DH5	2.91	110	0.32	0.4	Pass

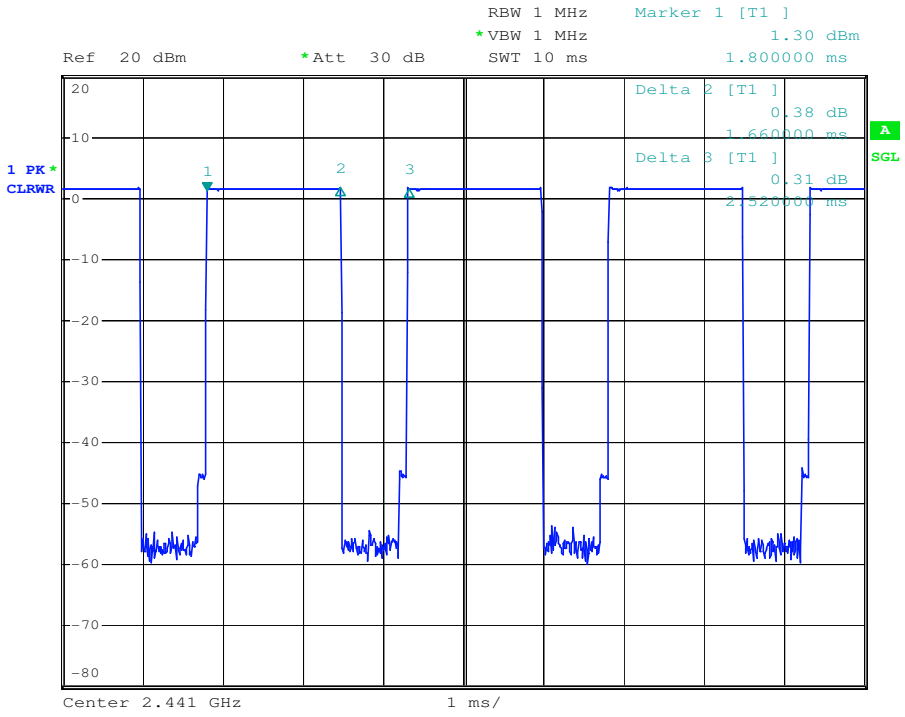
Test plot as follows::

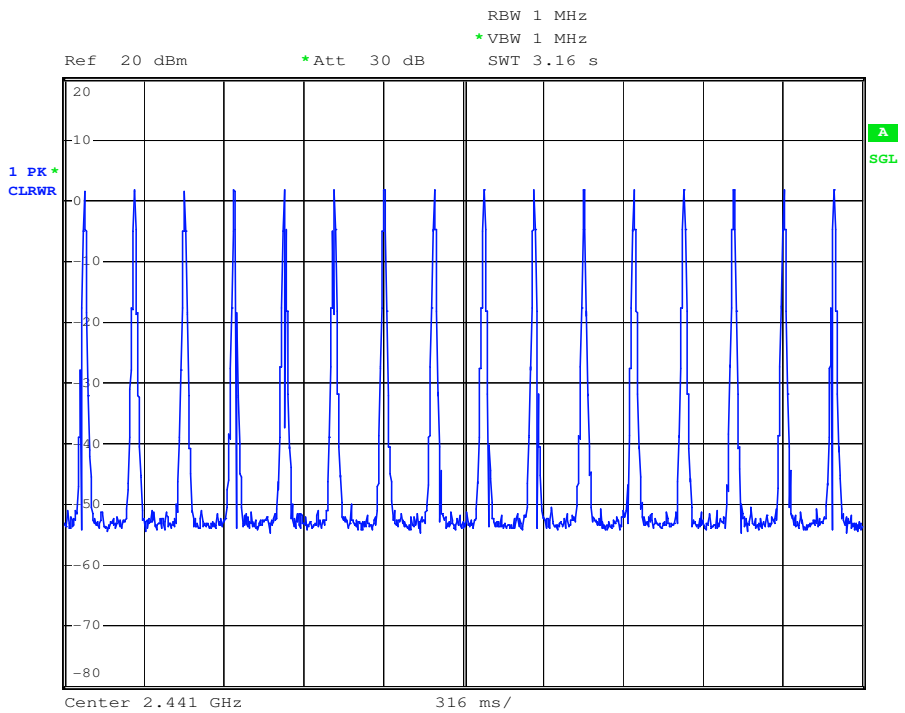
Frequency 2441MHz: Modulation: GFSK-DH1



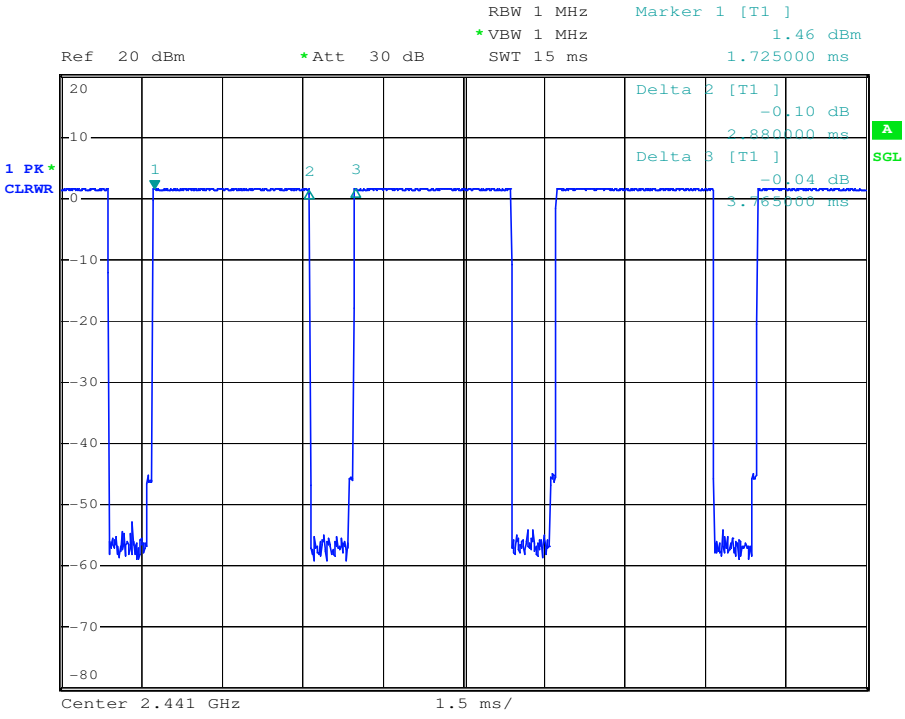


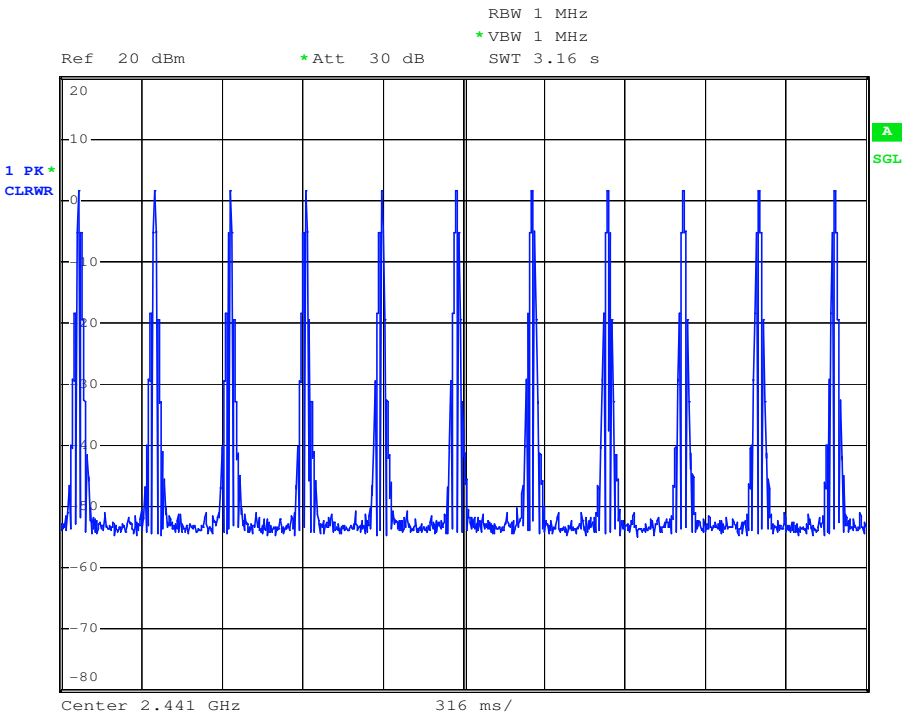
Frequency 2441MHz: Modulation: GFSK- DH3



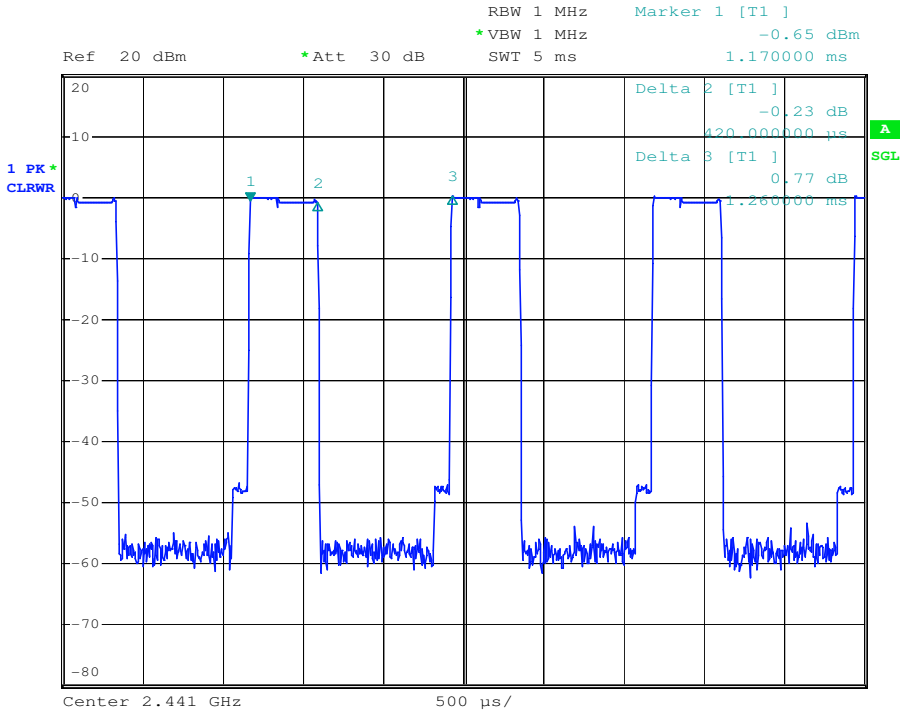


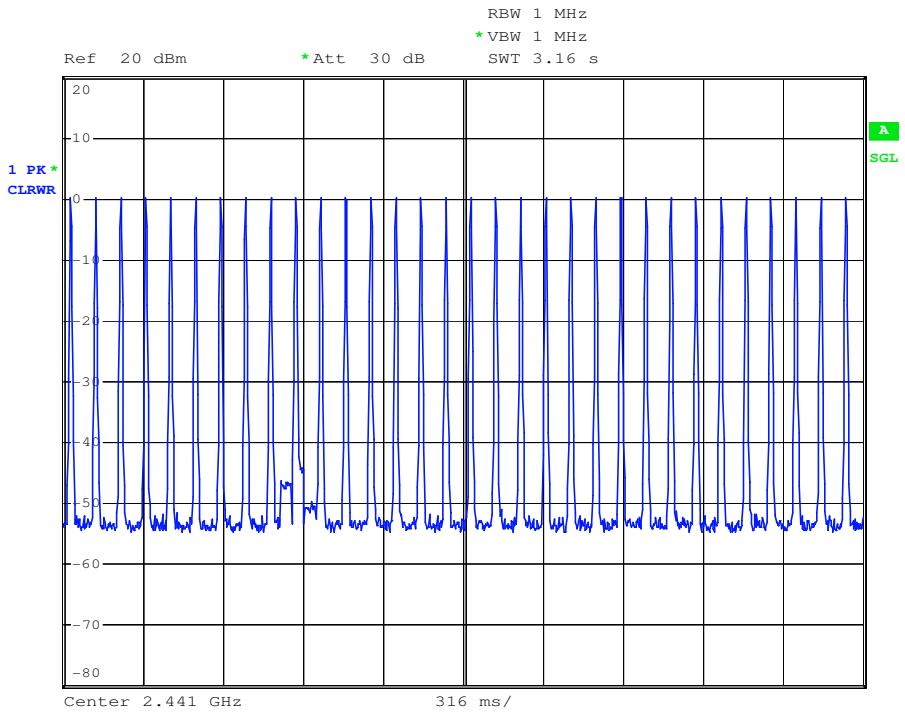
Frequency 2441MHz: Modulation: GFSK- DH5



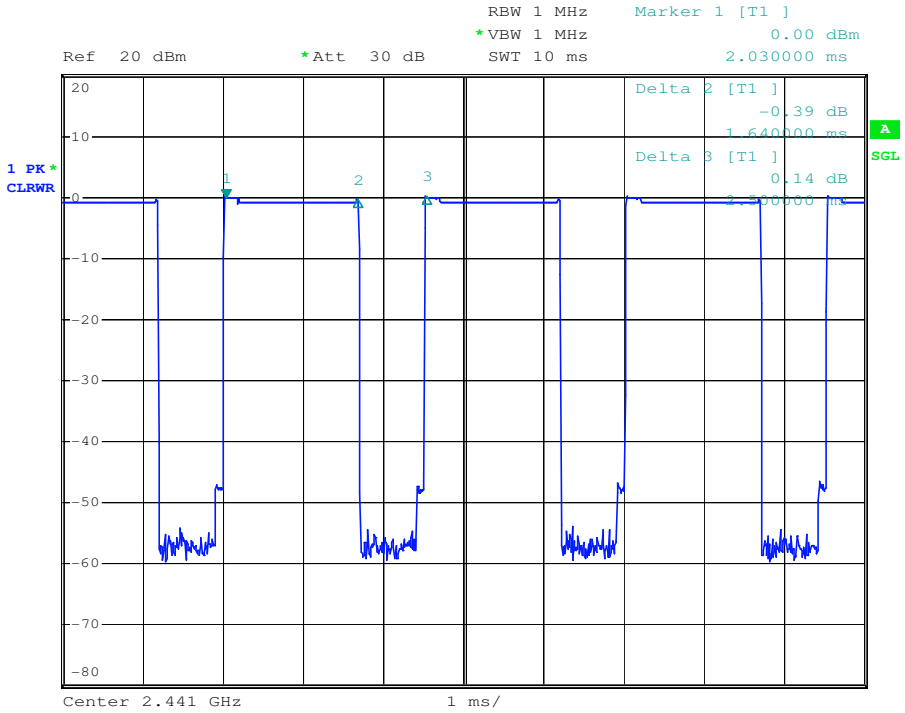


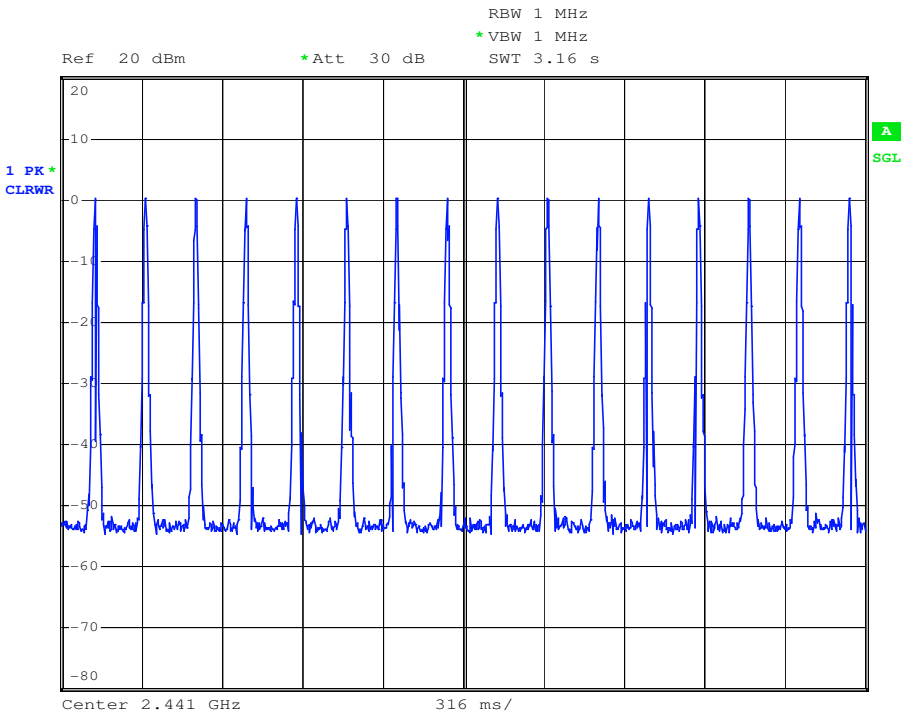
Frequency 2441MHz: Modulation: π/4DQPSK-2DH1



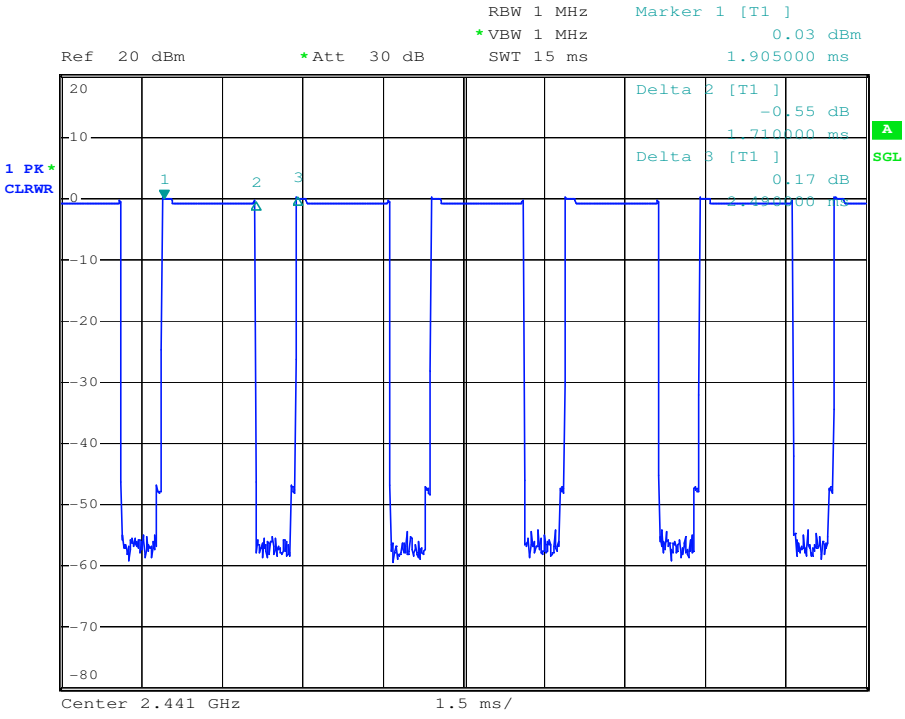


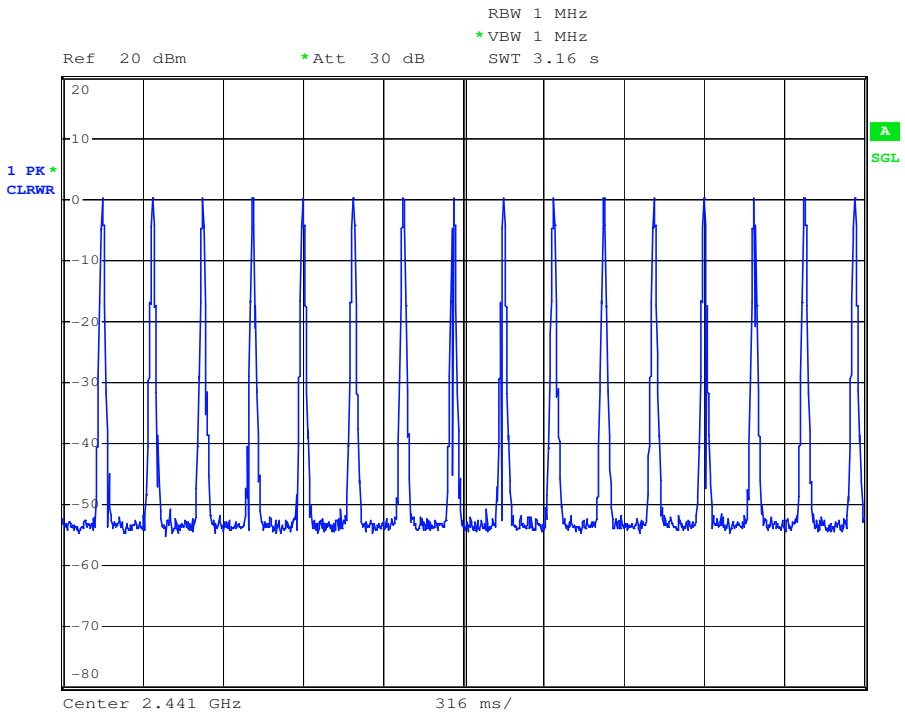
Frequency 2441MHz: Modulation: π/4DQPSK-2DH3



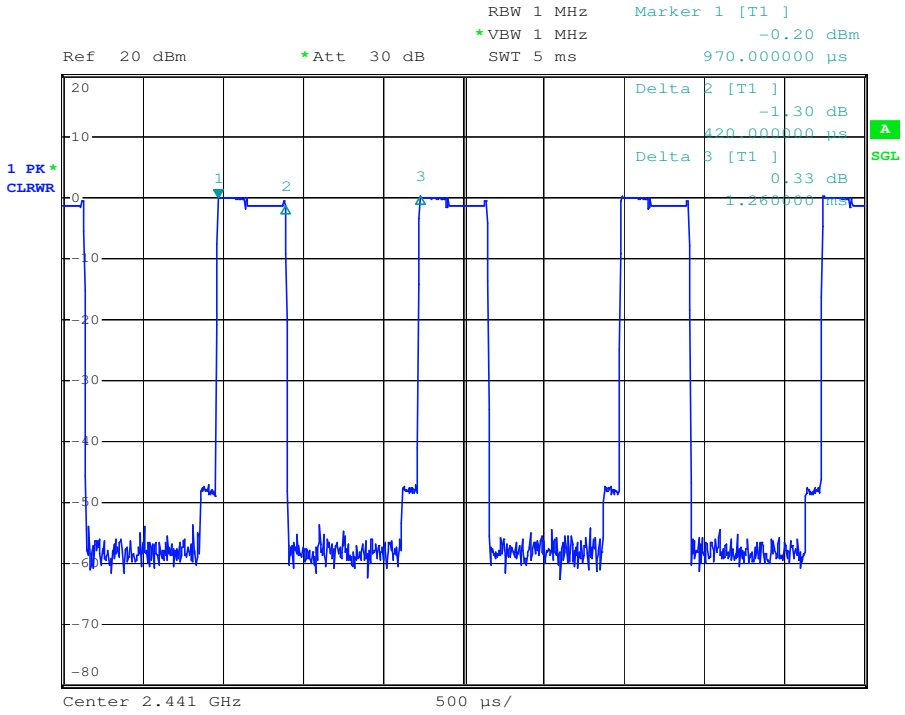


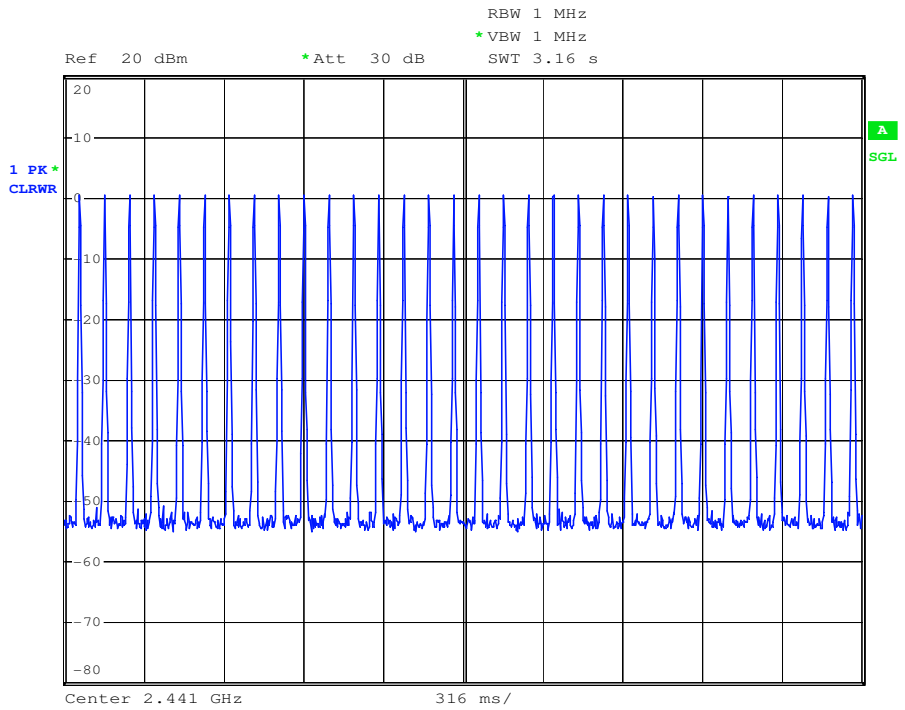
Frequency 2441MHz: Modulation: π/4DQPSK-2DH5



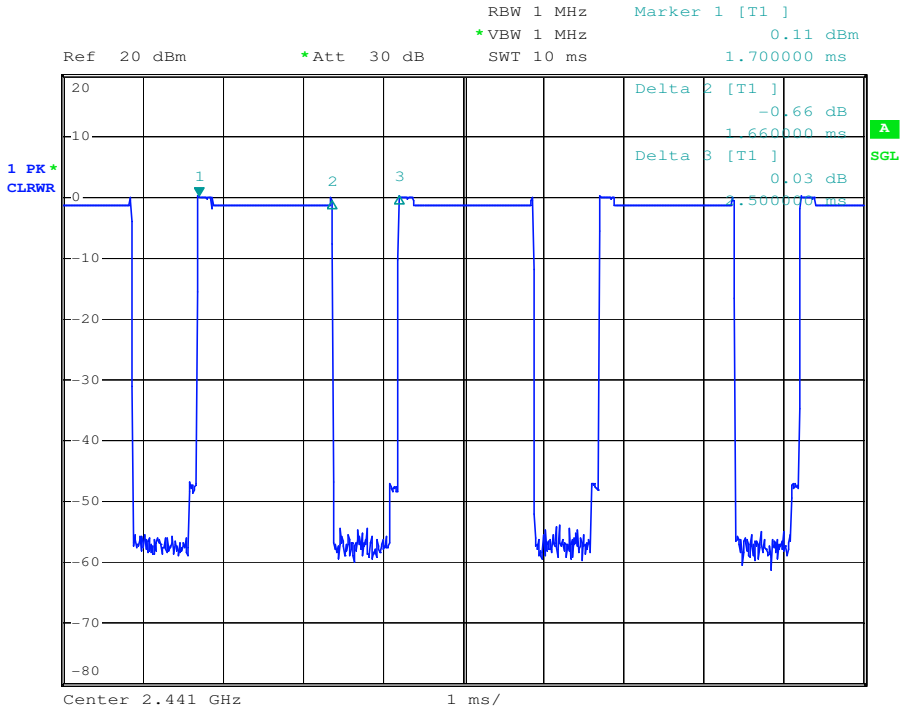


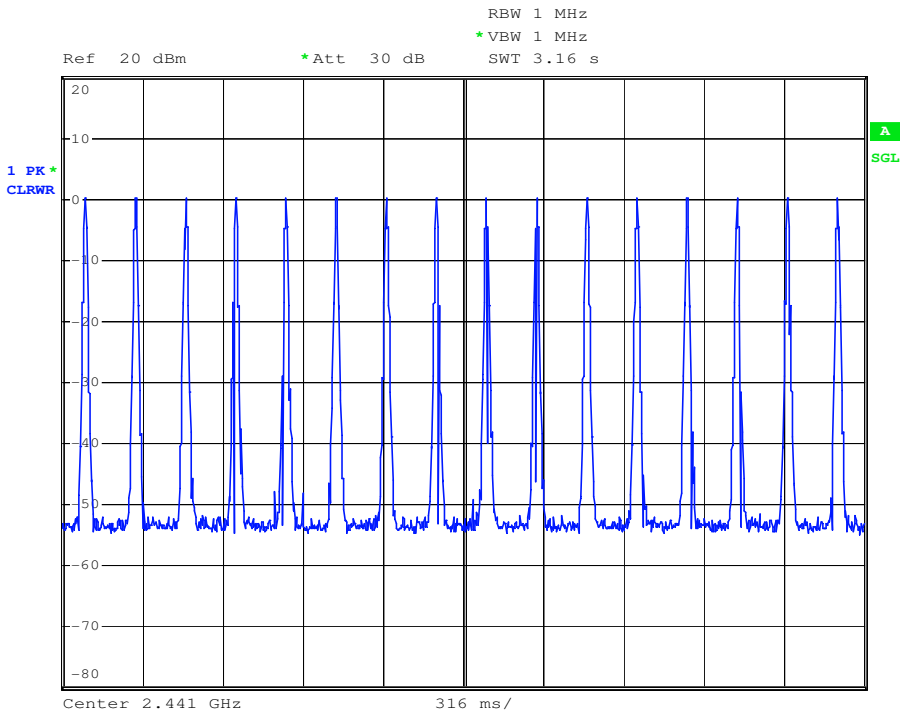
Frequency 2441MHz: Modulation: 8DPSK-3DH1



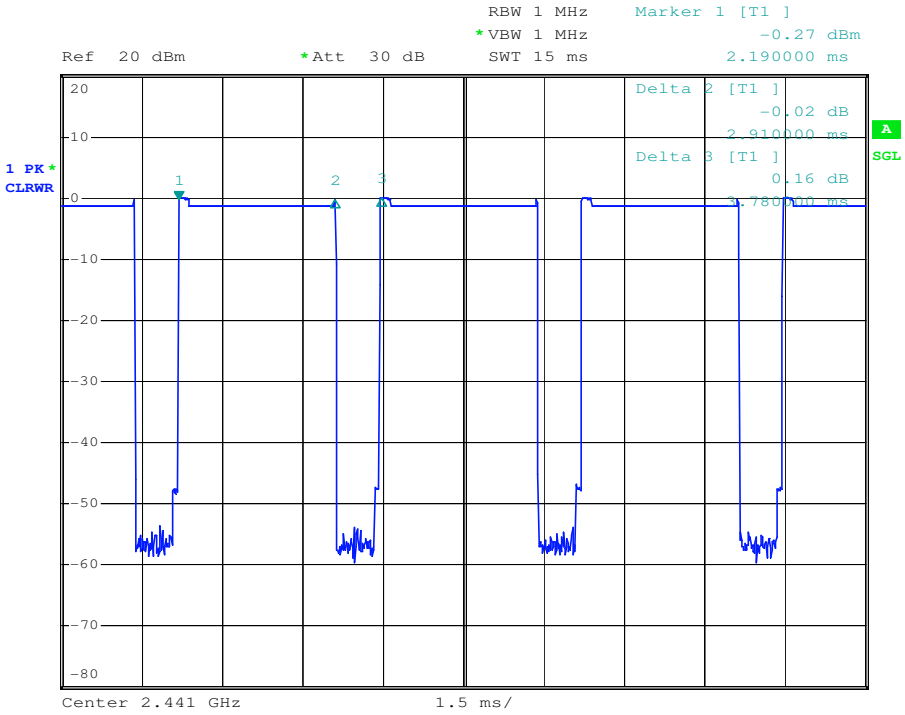


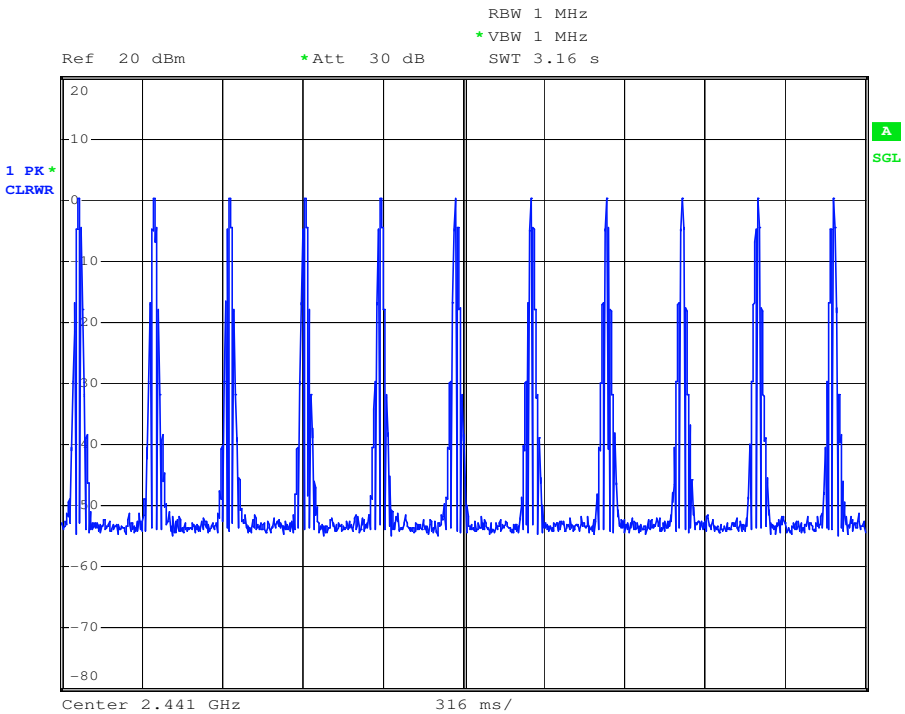
Frequency 2441MHz: Modulation: 8DPSK-3DH3





Frequency 2441MHz: Modulation: 8DPSK-3DH5





7.10 Conducted Spurious Emissions and Band-edge

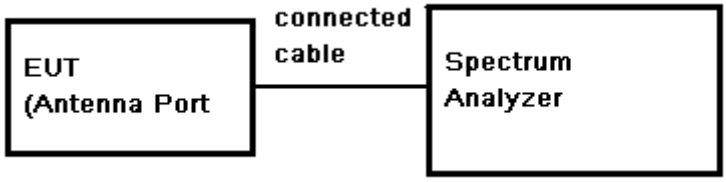
Test Requirement: FCC Part 15 Section 15.247(d)

Test Method: ANSI C63.10:2009 Clause 7.7.9&7.7.10

Limit: (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.

Test Result: Pass

Test Configuration:



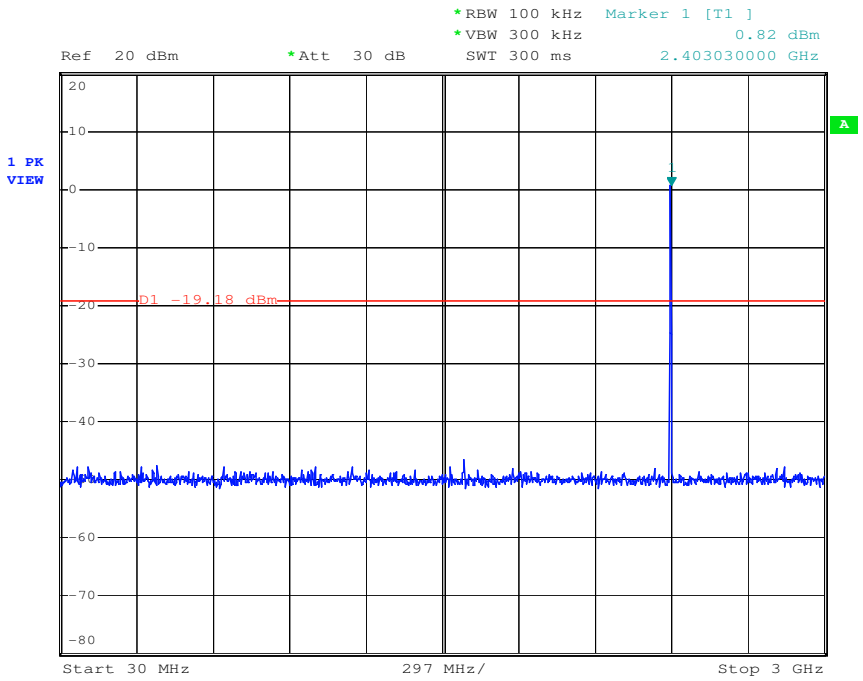
Test Procedure: 1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 100KHz. VBW >= RBW. Sweep = auto; Detector Function = Peak (Max. hold).

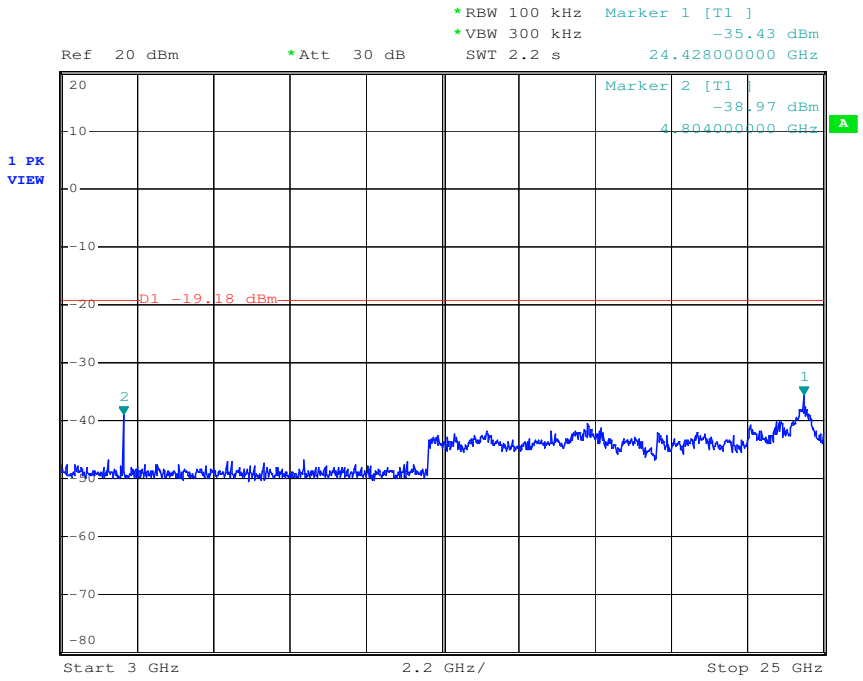
Conducted Spurious Emissions Test plot as follows:

Test mode:	GFSK	Test channel:	Lowest

30MHz to 3GHz

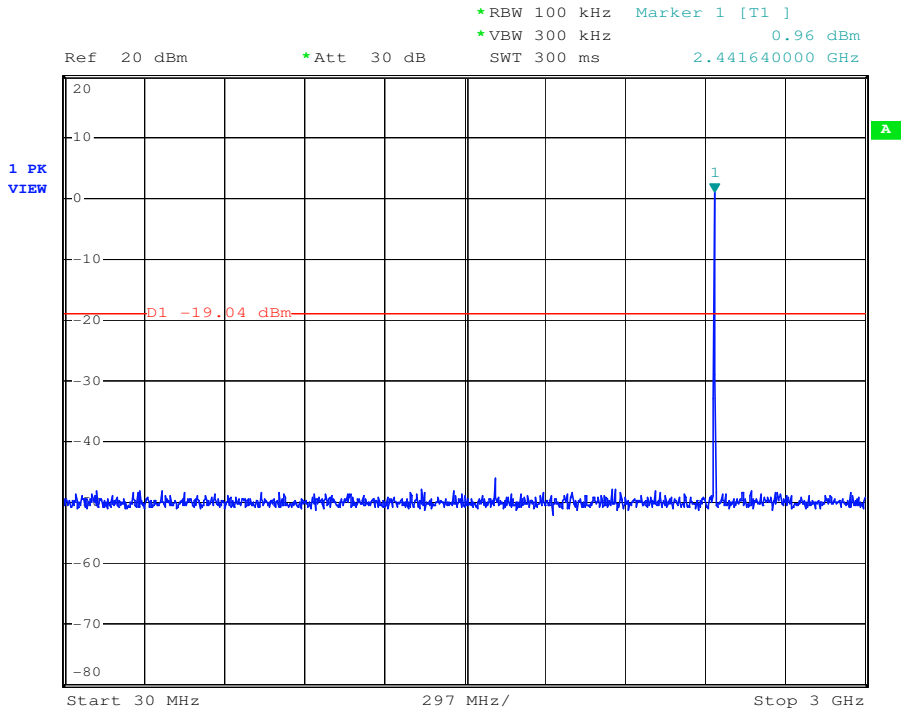


3GHz to 25GHz

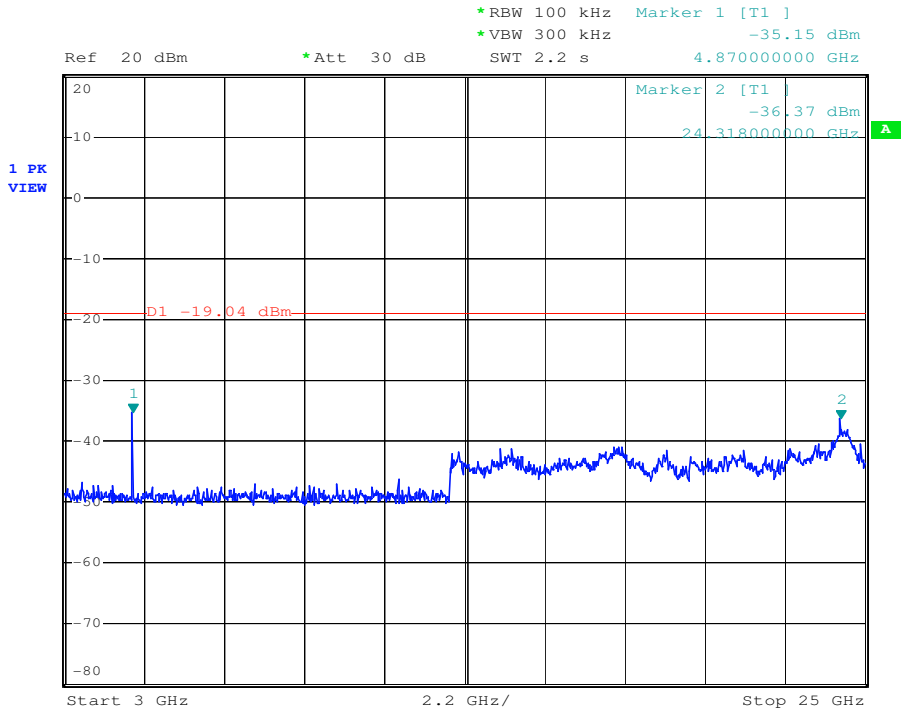


Test mode:	GFSK	Test channel:	Middle

30MHz to 3GHz

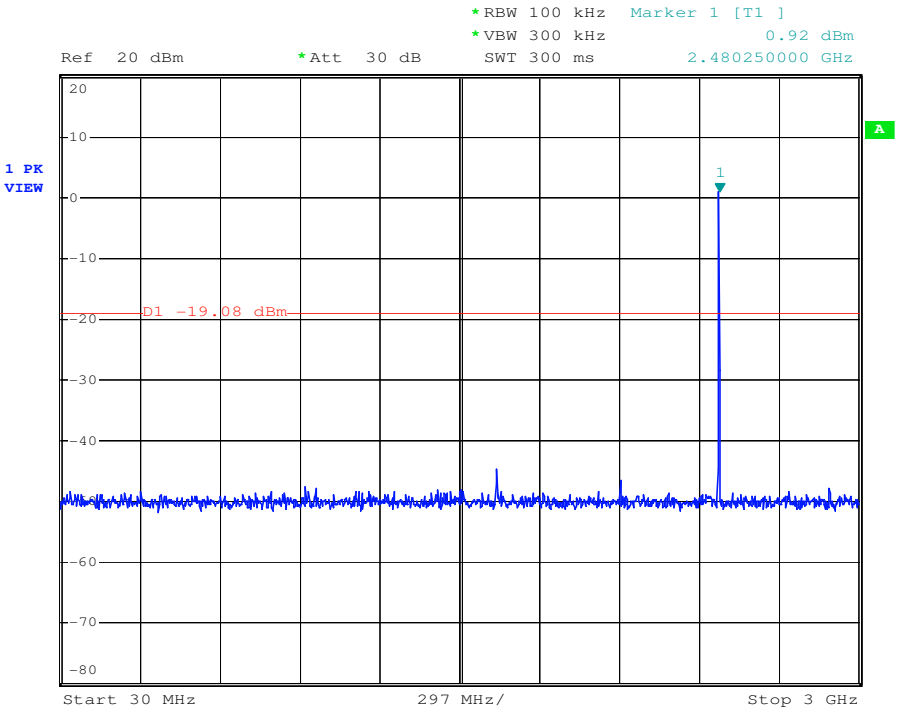


3GHz to 25GHz

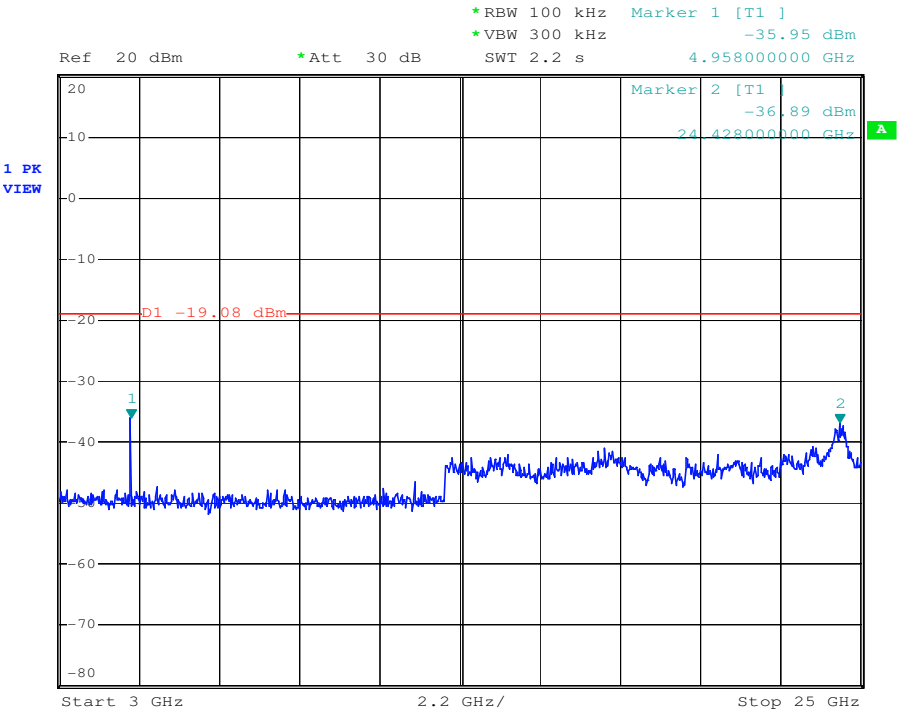


Test mode:	GFSK	Test channel:	Highest

30MHz to 3GHz

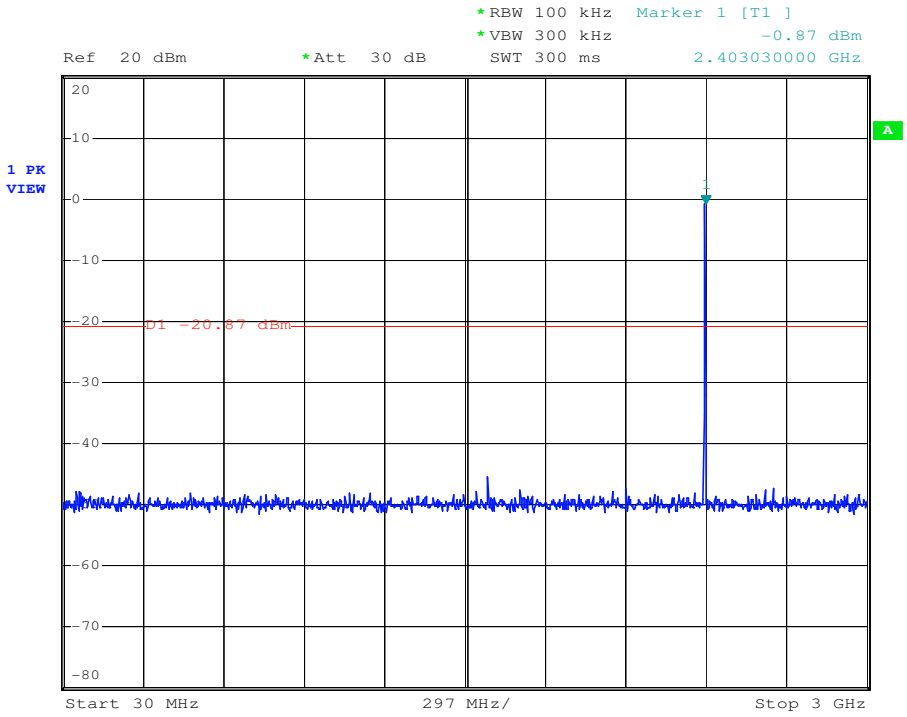


3GHz to 25GHz

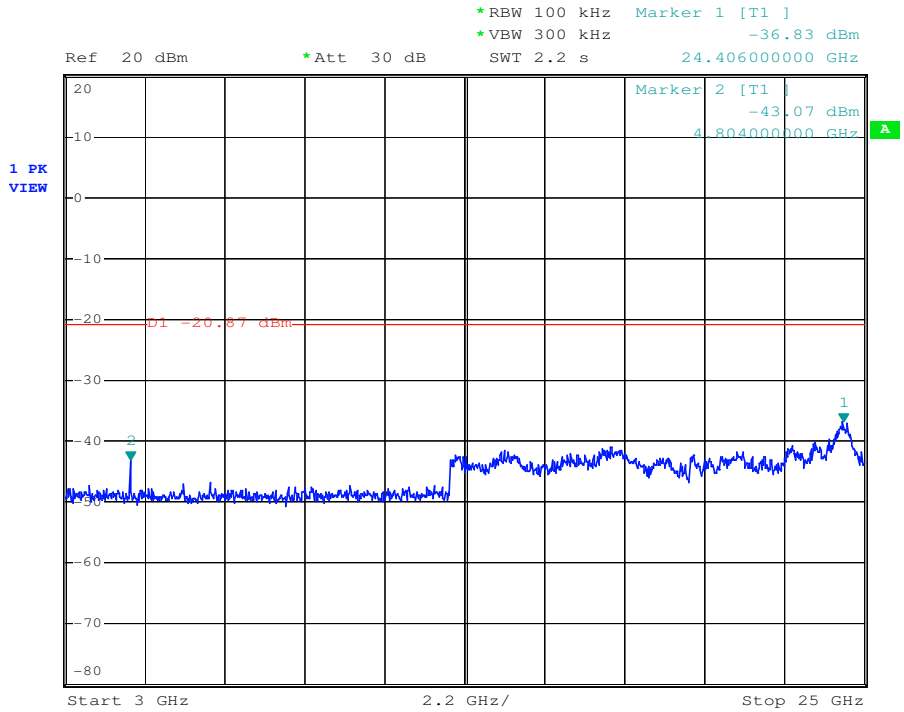


Test mode:	π/4DQPSK	Test channel:	Lowest

30MHz to 3GHz

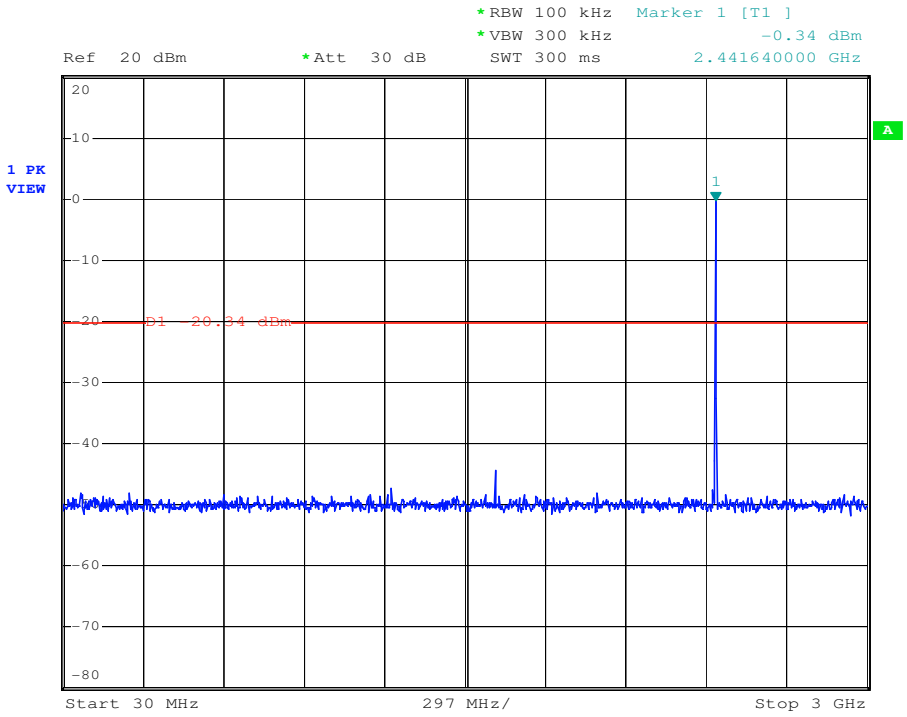


3GHz to 25GHz

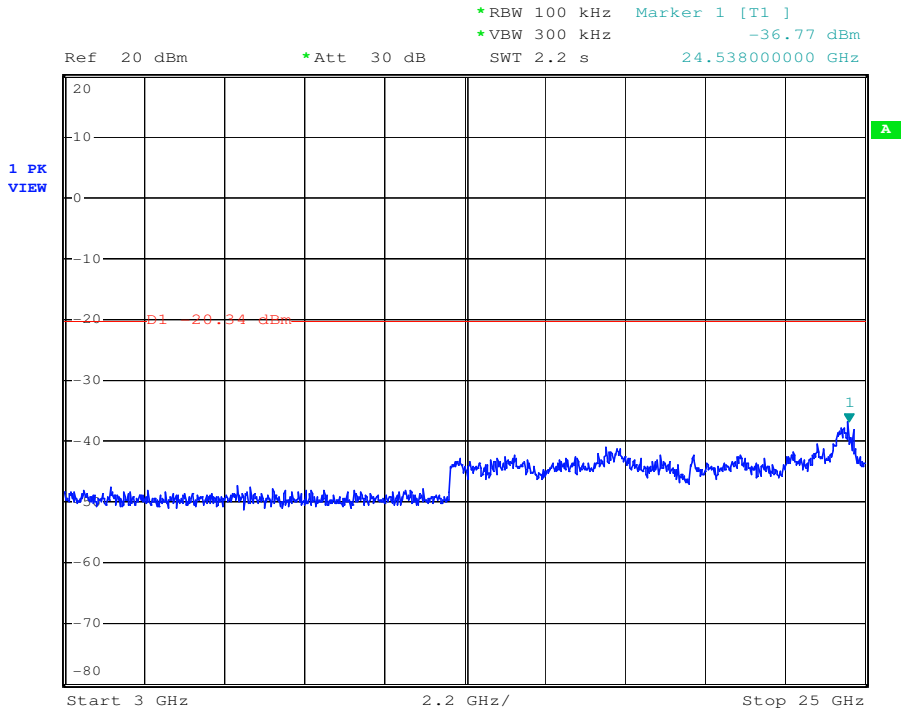


Test mode:	π/4DQPSK	Test channel:	Middle

30MHz to 3GHz

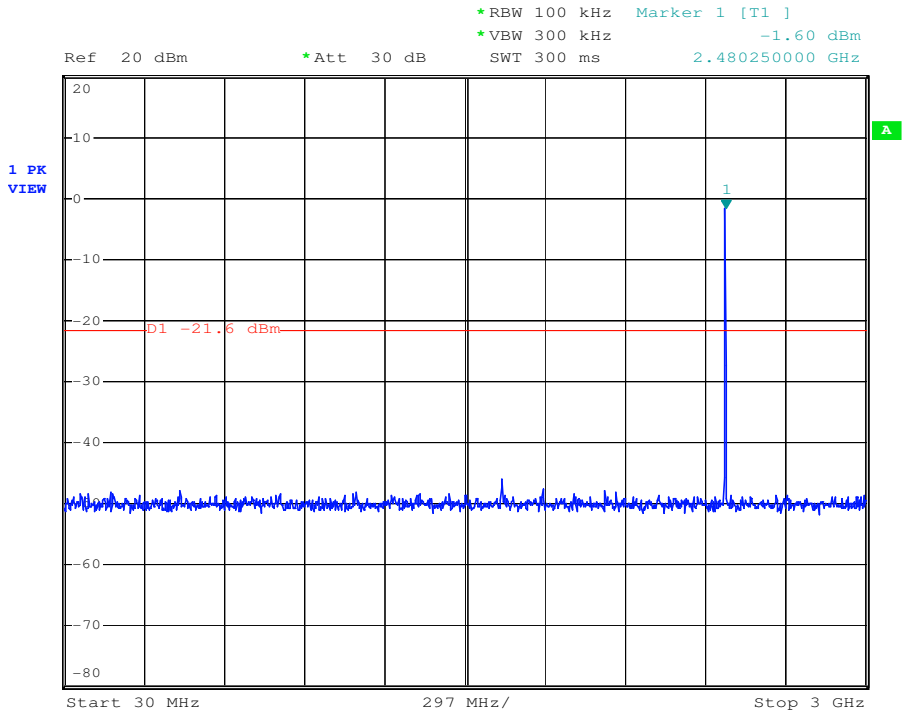


3GHz to 25GHz

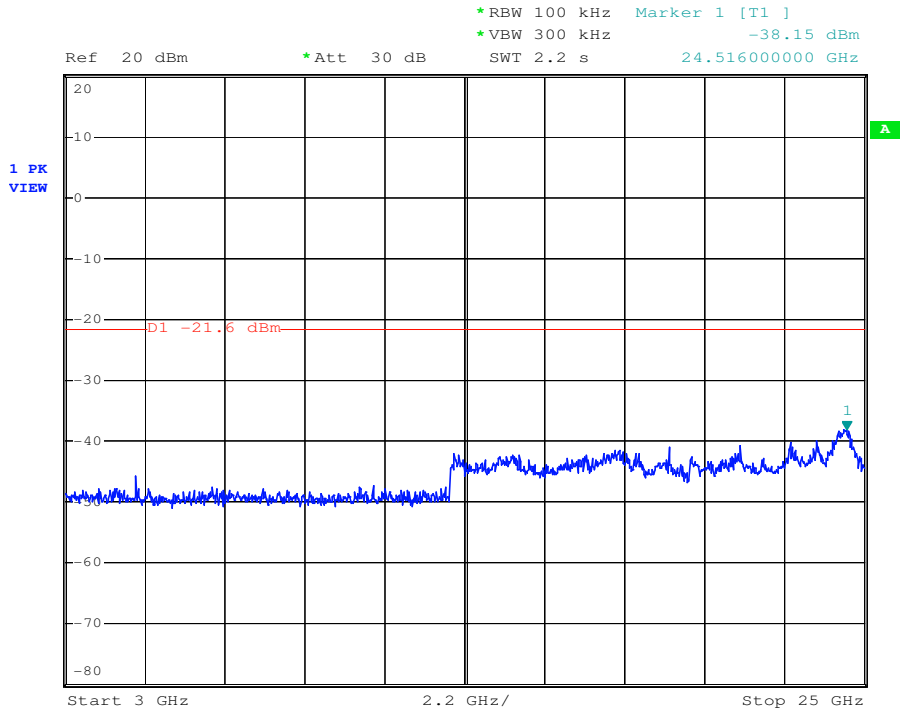


Test mode:	π/4DQPSK	Test channel:	Highest

30MHz to 3GHz

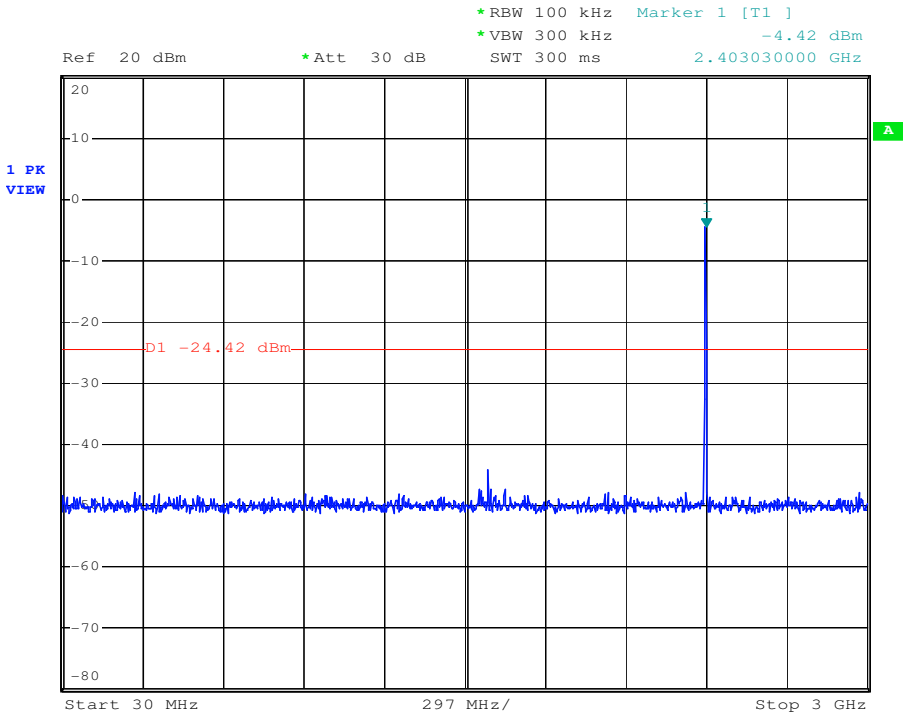


3GHz to 25GHz

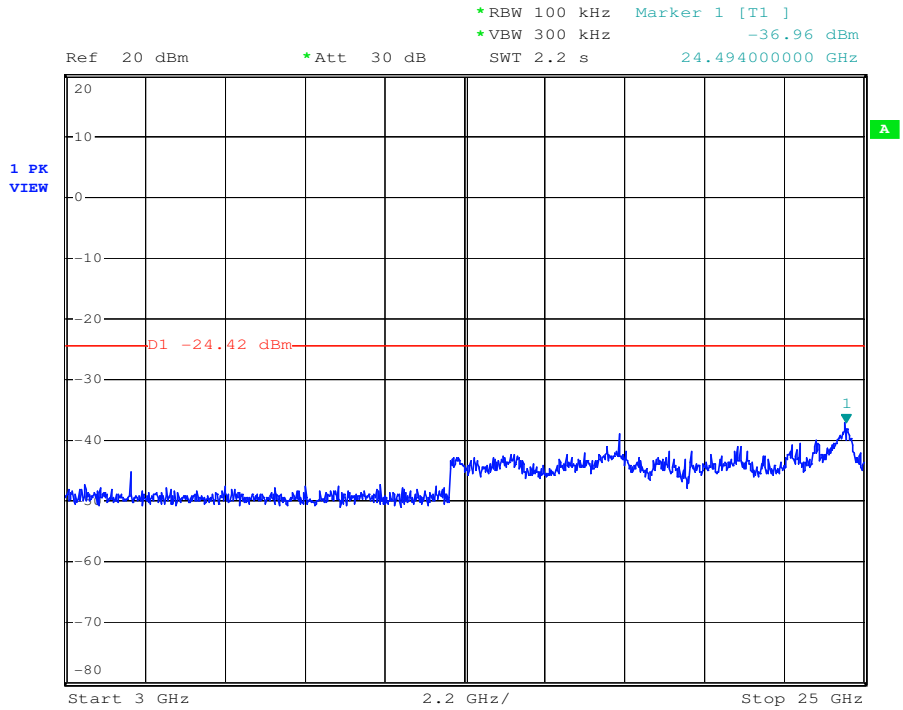


Test mode:	8DPSK	Test channel:	Lowest

30MHz to 3GHz

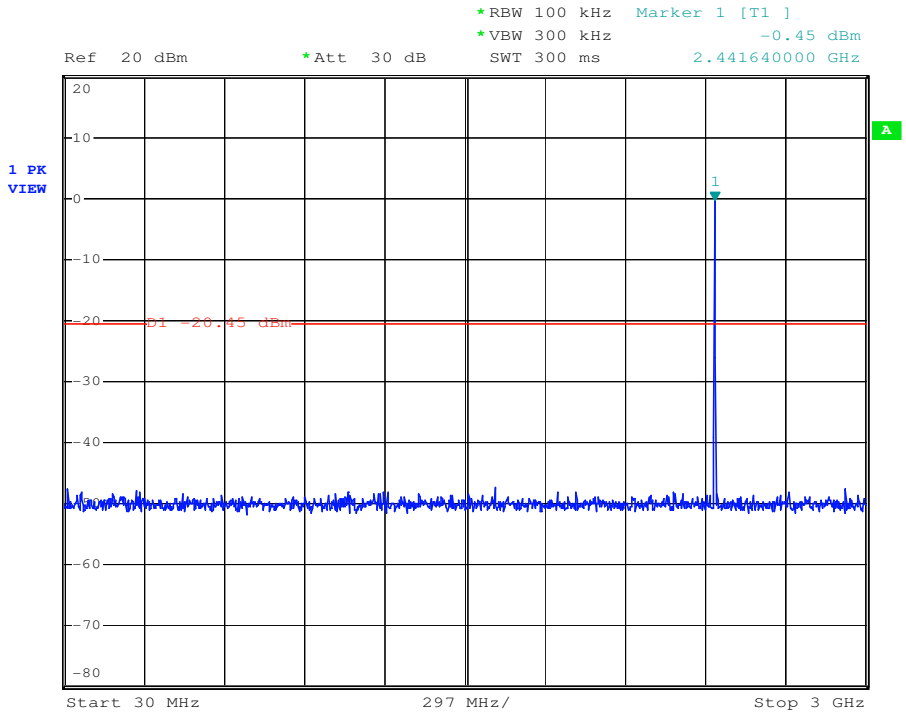


3GHz to 25GHz

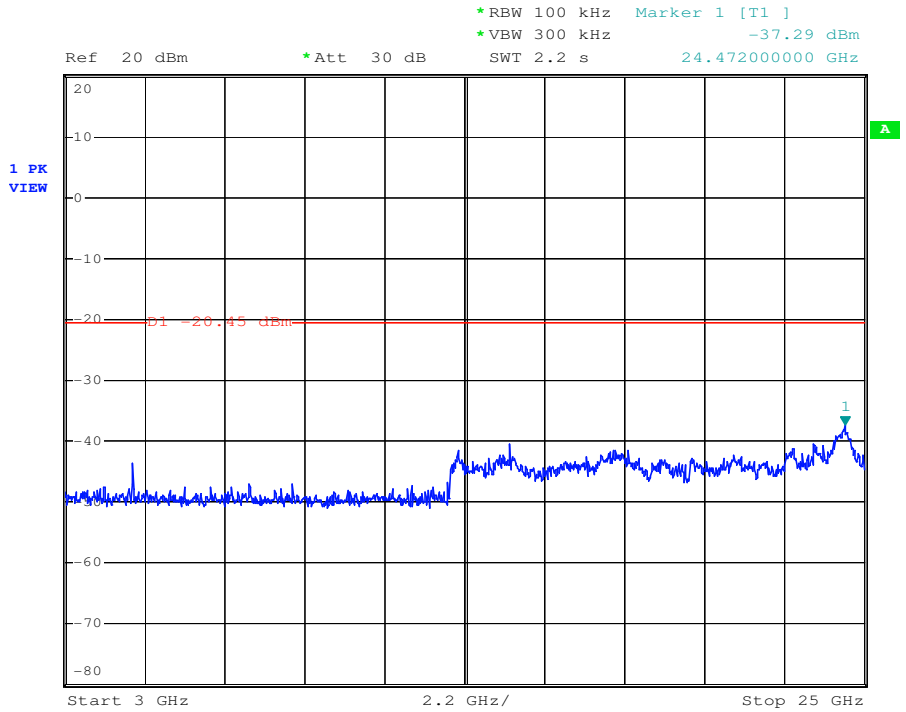


Test mode:	8DPSK	Test channel:	Middle

30MHz to 3GHz

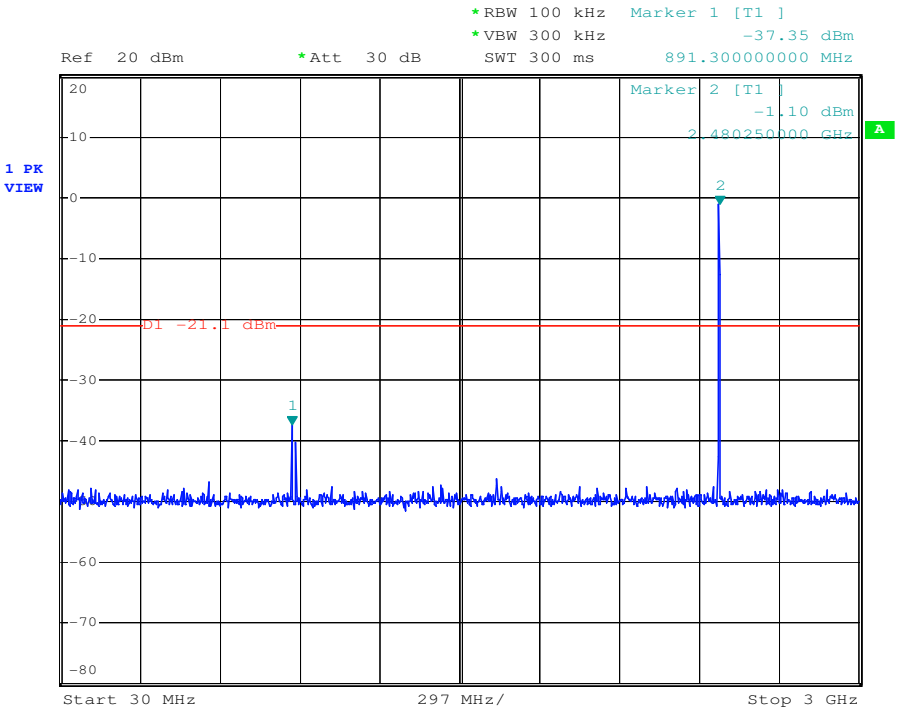


3GHz to 25GHz

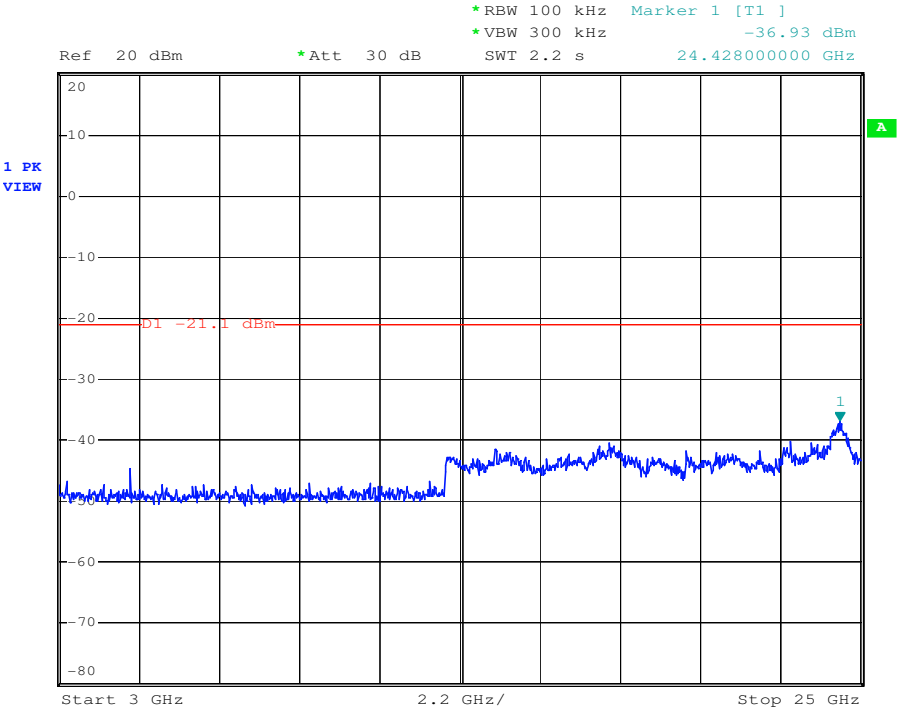


Test mode:	8DPSK	Test channel:	Highest

30MHz to 3GHz

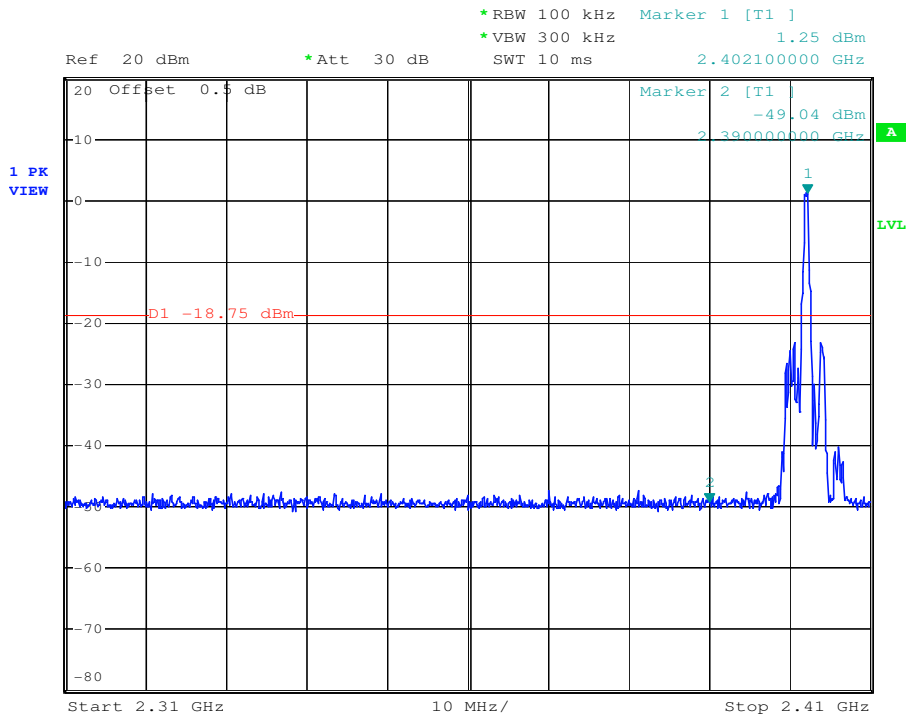


3GHz to 25GHz

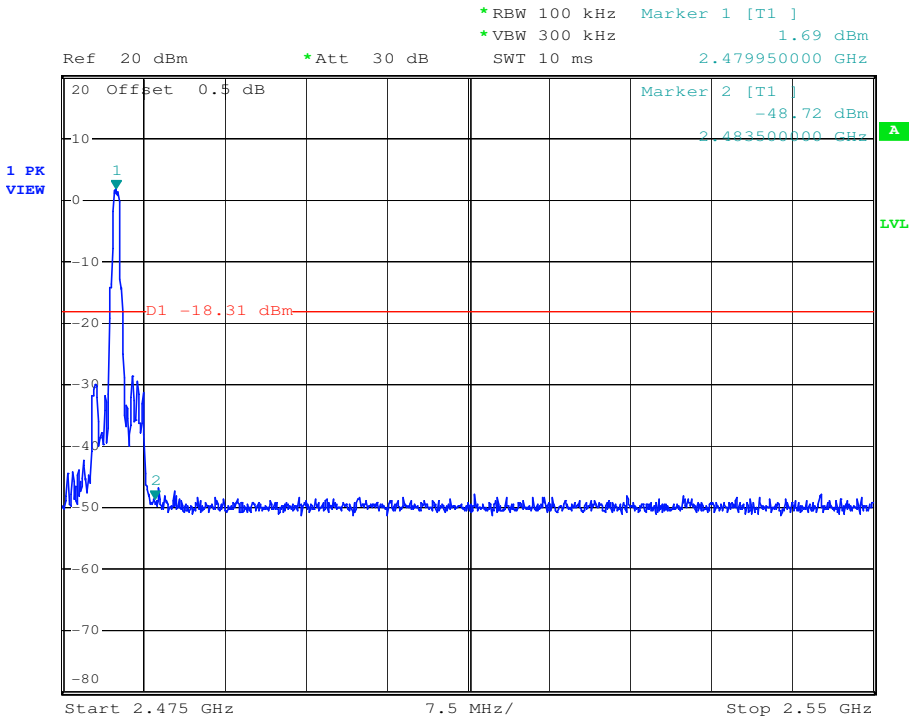


Conducted Band-edge test plot as follows:

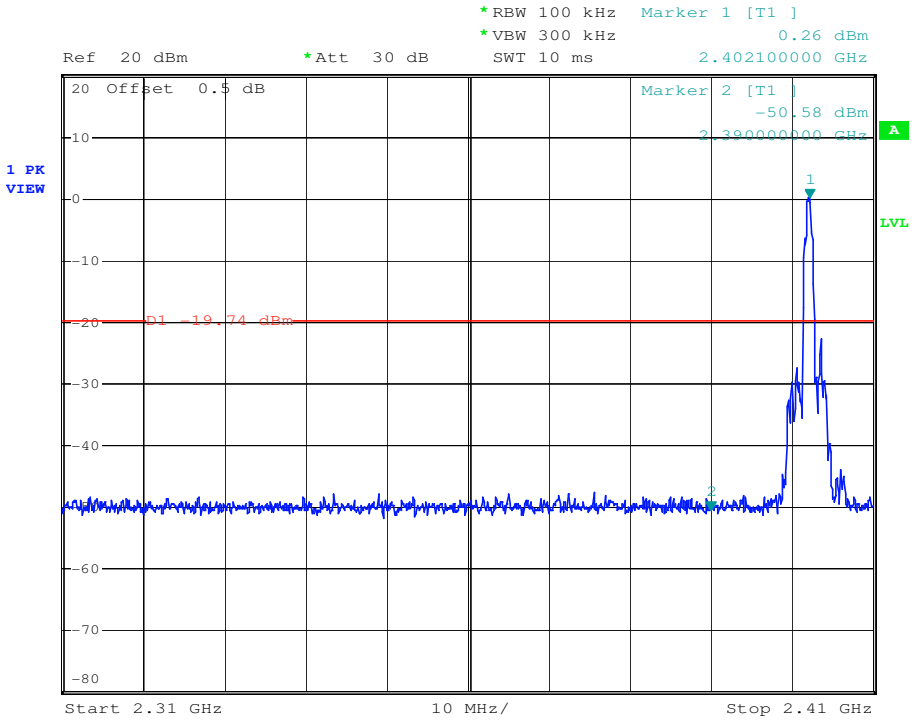
Test mode:	GFSK	Test channel:	Lowest



Test mode:	GFSK	Test channel:	Highest

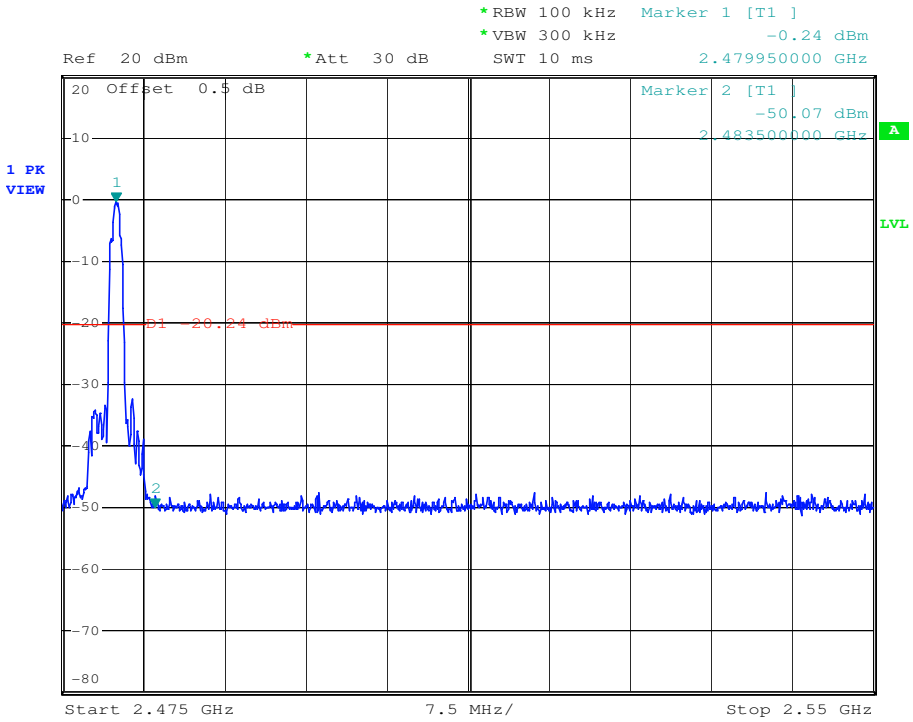


Test mode:	π/4DQPSK	Test channel:	Lowest

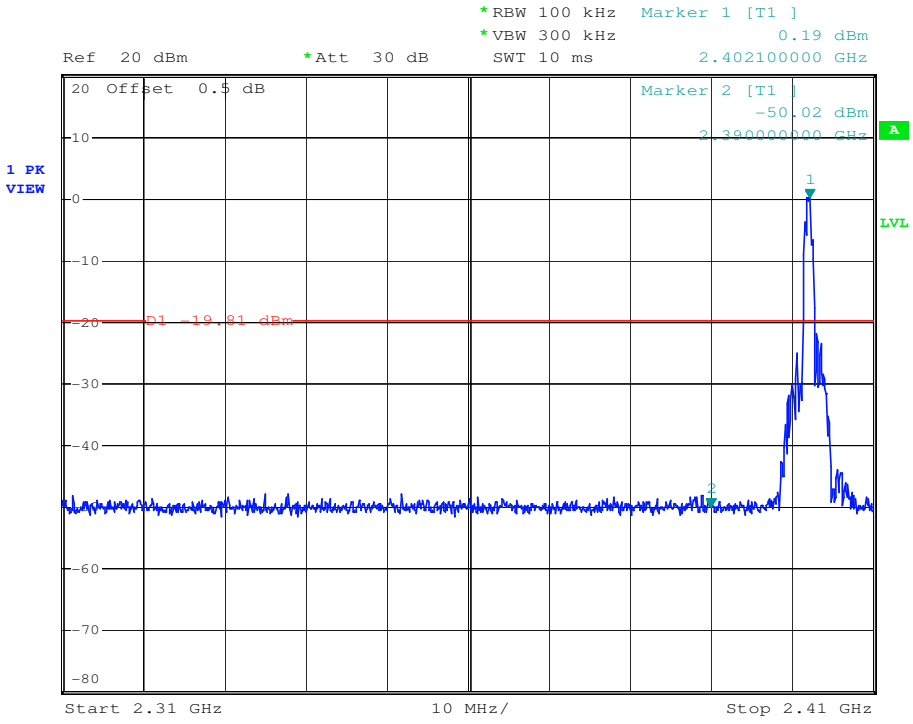


Test mode:	π/4DQPSK	Test channel:	Highest

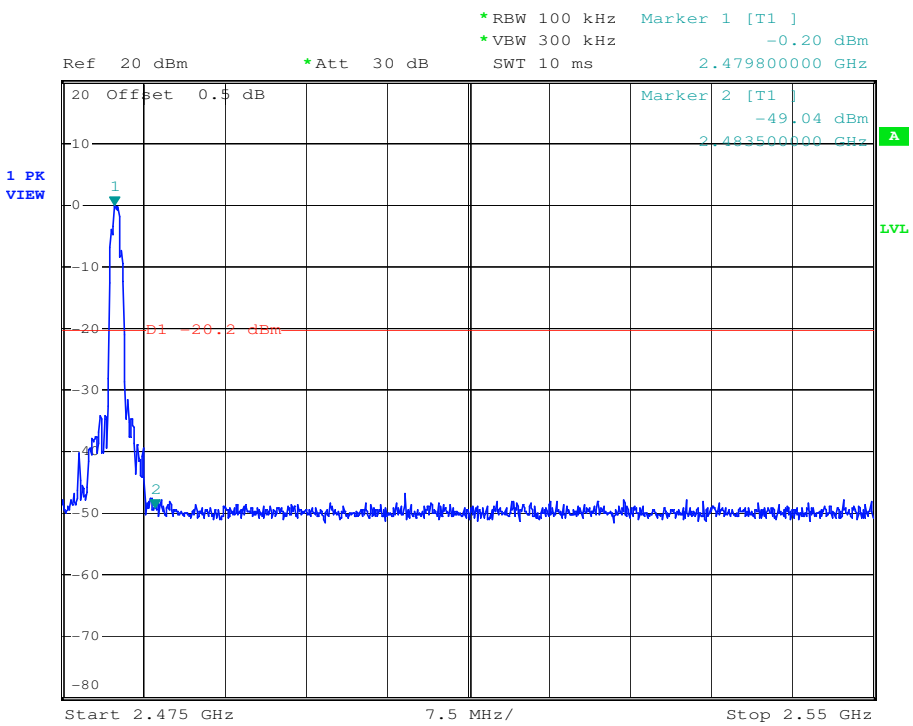
30MHz to 3GHz



Test mode:	8DPSK	Test channel:	Lowest



Test mode:	8DPSK	Test channel:	Highest



7.11 Radiated Spurious Emissions and Band edge

Test Requirement: FCC Part 15 Section 15.209 and Section 15.205

Test Method: ANSI C63.10:2009 Clause 6.5&6.6&6.7

Test site/setup: Measurement Distance: 3m (Semi-Anechoic Chamber)

Test instrumentation set-up:

Frequency Range	Detector	RBW	VBW
9KHz to 150KHz	Quasi-Peak	=200KHz	≥RBW
150KHz to 30MHz	Quasi-Peak	RBW=9KHz	VBW≥RBW
30MHz to 1GHz	Quasi-Peak	RBW=120KHz	VBW≥RBW
Above 1GHz	Peak	RBW=1MHz	VBW≥RBW
	Average		VBW=10Hz
Sweep=Auto			

Receive antenna scan height 1 m - 4 m. polarization Vertical / Horizontal

15.209 Limit:

Frequency Range (MHz)	Field strength limit (dBμV/m)	Measurement distance (m)
0.009 ~ 0.49	128.5 ~ 93.8	3
0.49 ~1.705	73.8 ~63.0	
1.705 ~30	69.5	
30 ~ 88	40.0	
88 ~ 216	43.5	
216 ~ 960	46.0	
Above 960	54.0	

Test Configuration:

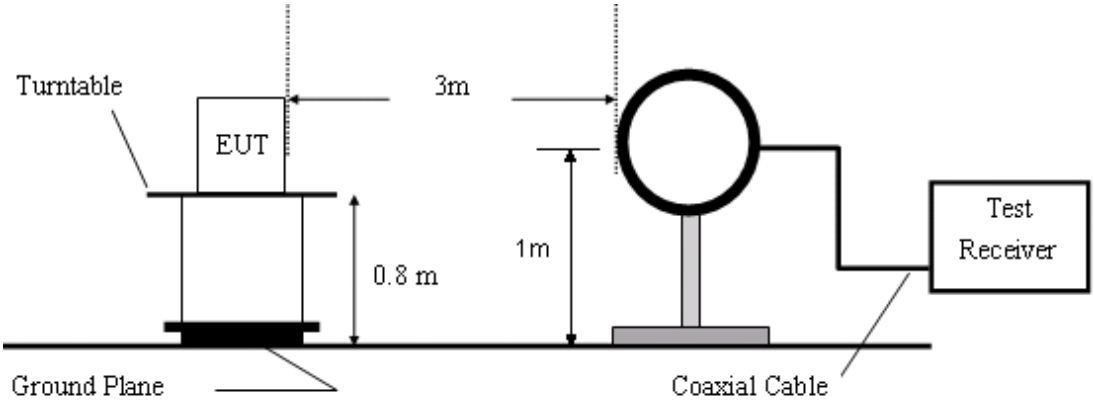


Figure1. Below 30MHz radiated emissions test configuration

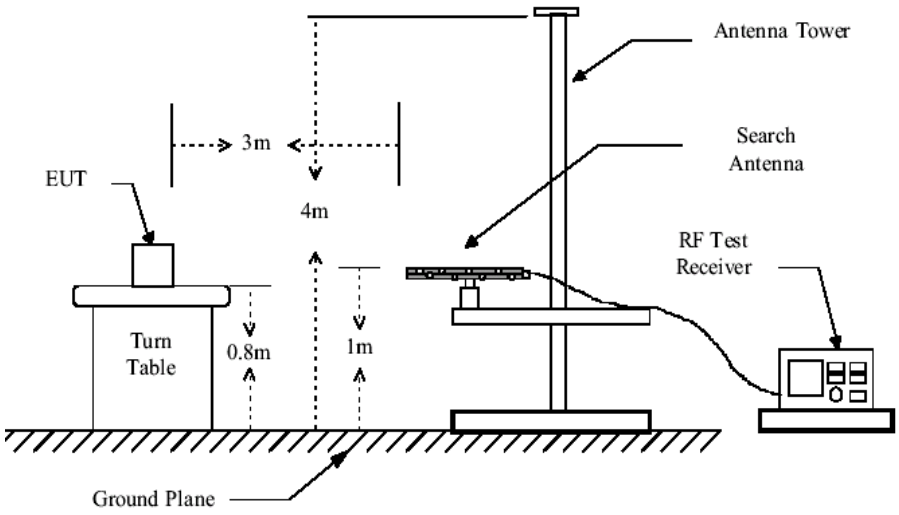


Figure2. 30MHz to 1GHz radiated emissions test configuration

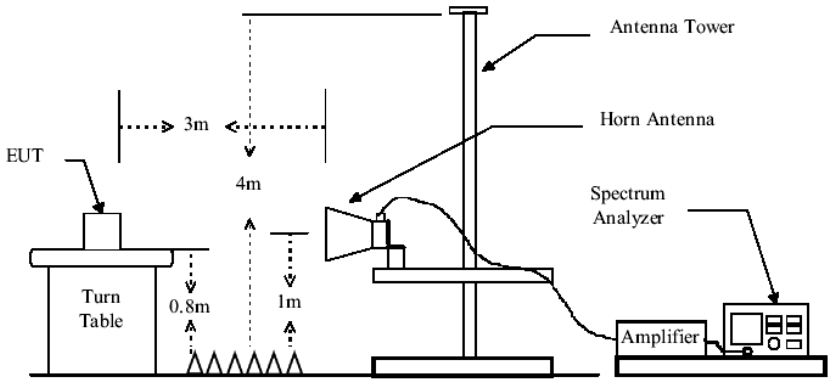


Figure3. Above 1GHz radiated emissions test configuration

Test Procedure:

The procedure used was ANSI Standard C63.10:2009. The receiver was scanned from 9KHz to 25GHz.When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated 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. The worst case emissions were reported.

Low noise amplifier was used below 1GHz, High pass Filter was used above 3GHz.

Between 1G and 3GHz, we did not use any amplifier or filter.

Pre-test was performed on normal operation and charging mode and only normal operation mode, Compliance test was performed on worse case (GFSK mode).

Test were performed for their spatial orthogonal(X, Y, Z), the worst test data (X orthogonal) was submitted.

1) For this intentional radiator operates below 25 GHz. the spectrum shall be investigated to the tenth harmonic of the highest fundamental frequency. And above the third harmonic of this intentional radiator, the disturbance is very low. So the test result only displays to 5rd harmonic.

As shown in Section, for frequencies above 1000 MHz. the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

The test only perform the EUT in transmitting status since the test frequencies were over 1GHz only required transmitting status.

Radiated Spurious Emissions:

Test Result: The EUT does meet the FCC requirements

Test in **Channel Low**

Mark	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Detector	polarization
1	4818.75	38.59	8.46	47.05	74	-26.95	peak	Horizontal
2	7218.75	38.89	10.66	49.55	74	-24.45	peak	Horizontal
3	9597.5	34.95	14.23	49.18	74	-24.82	peak	Horizontal
4	4818.75	37.22	8.46	45.68	74	-28.32	peak	Vertical
5	7218.75	39.3	10.66	49.96	74	-24.04	peak	Vertical
6	9597.5	35.48	14.23	49.71	74	-24.29	peak	Vertical

Test in **Channel Middle**

Mark	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Detector	polarization
1	4877.5	37.46	8.83	46.29	74	-27.71	peak	Horizontal
2	7309.75	39.43	10.88	50.31	74	-23.69	peak	Horizontal
3	9777.25	36.92	14.45	51.37	74	-22.63	peak	Horizontal
4	4887.5	36.37	8.89	45.26	74	-28.74	peak	Vertical
5	7309.75	38.88	10.88	49.76	74	-24.24	peak	Vertical
6	9777.25	35.72	14.45	50.17	74	-23.83	peak	Vertical

Test in **Channel High**

Mark	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Detector	polarization
1	4971.5	37.86	8.94	46.80	74	-27.20	peak	Horizontal
2	7450.75	38.93	11.19	50.12	74	-23.88	peak	Horizontal
3	9906.5	35.66	14.67	50.33	74	-23.67	peak	Horizontal
4	4971.5	38.47	8.94	47.41	74	-26.59	peak	Vertical
5	7450.75	38.26	11.19	49.45	74	-24.55	peak	Vertical
6	9906.5	35.76	14.67	50.43	74	-23.57	peak	Vertical

Remark: 1. Test Level =Receiver Reading + Antenna Factor + Cable Loss –Preamplifier Factor.

2. No any other emissions level which are attenuated less than 20dB below the limit.
According to 15.31(o), the amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this Part. Hence there no other emissions have been reported.

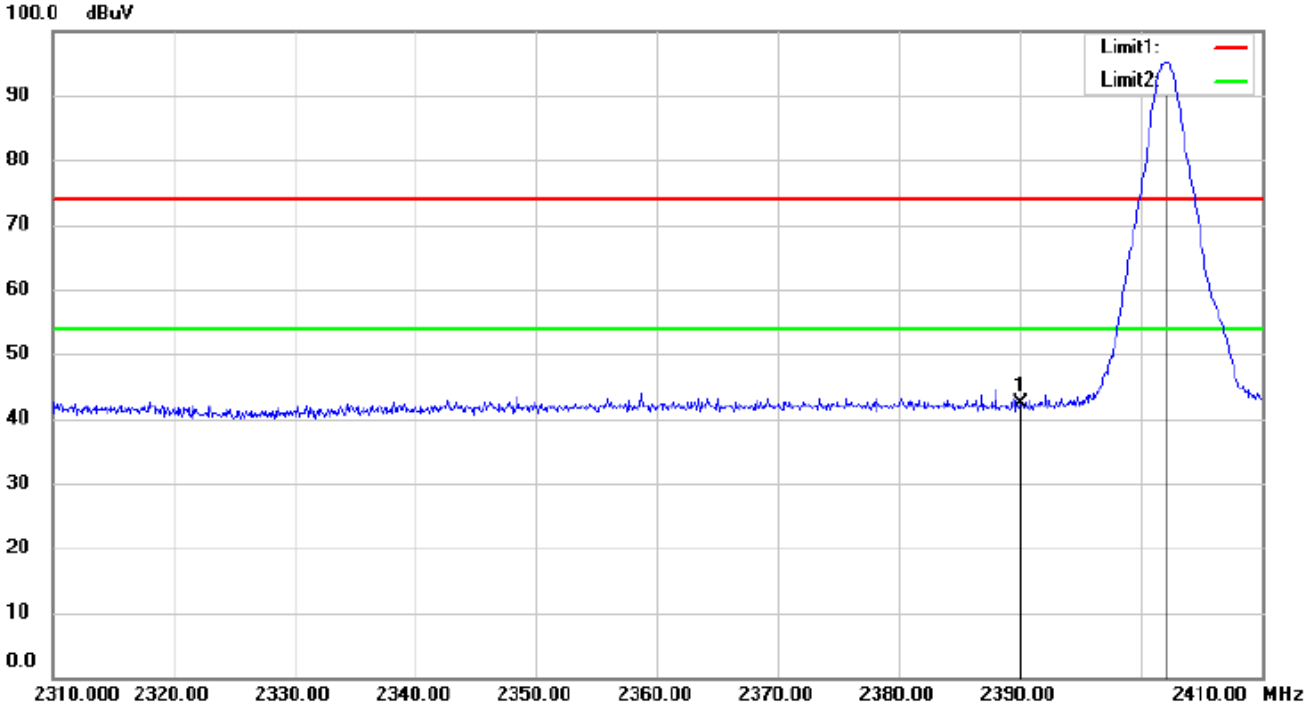
3. If the Peak value below the AV Limit, the AV test doesn't perform for this submission.

Radiated Band-edge:

Test Result: The EUT does meet the FCC requirements.

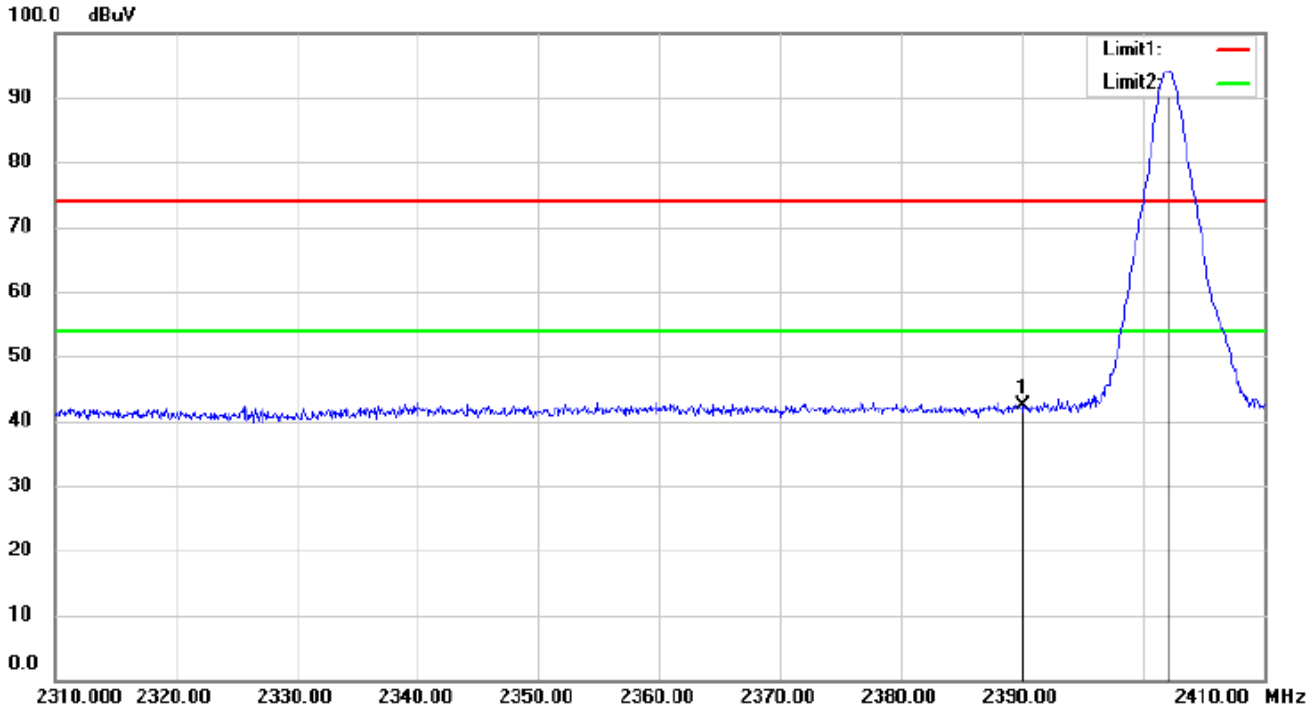
CH Low 2402MHz **Modulation: GFSK**

Horizontal, Peak Detector:



Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2390.000	42.95	peak	-0.56	42.39	74.00	-31.61
2	2402.200	95.82	peak	-0.63	95.19	74.00	21.19

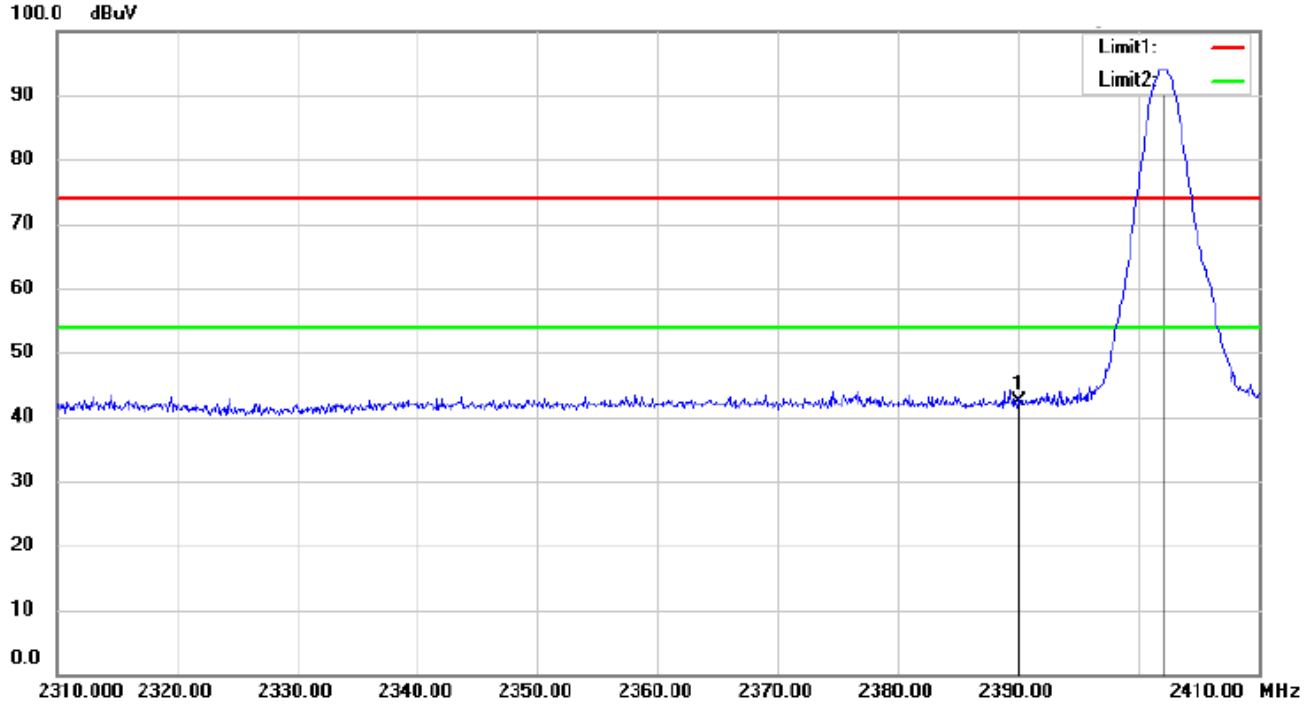
Vertical, Peak Detector:



Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2390.000	42.90	peak	-0.56	42.34	74.00	-31.66
2	2402.100	94.69	peak	-0.63	94.06	74.00	20.06

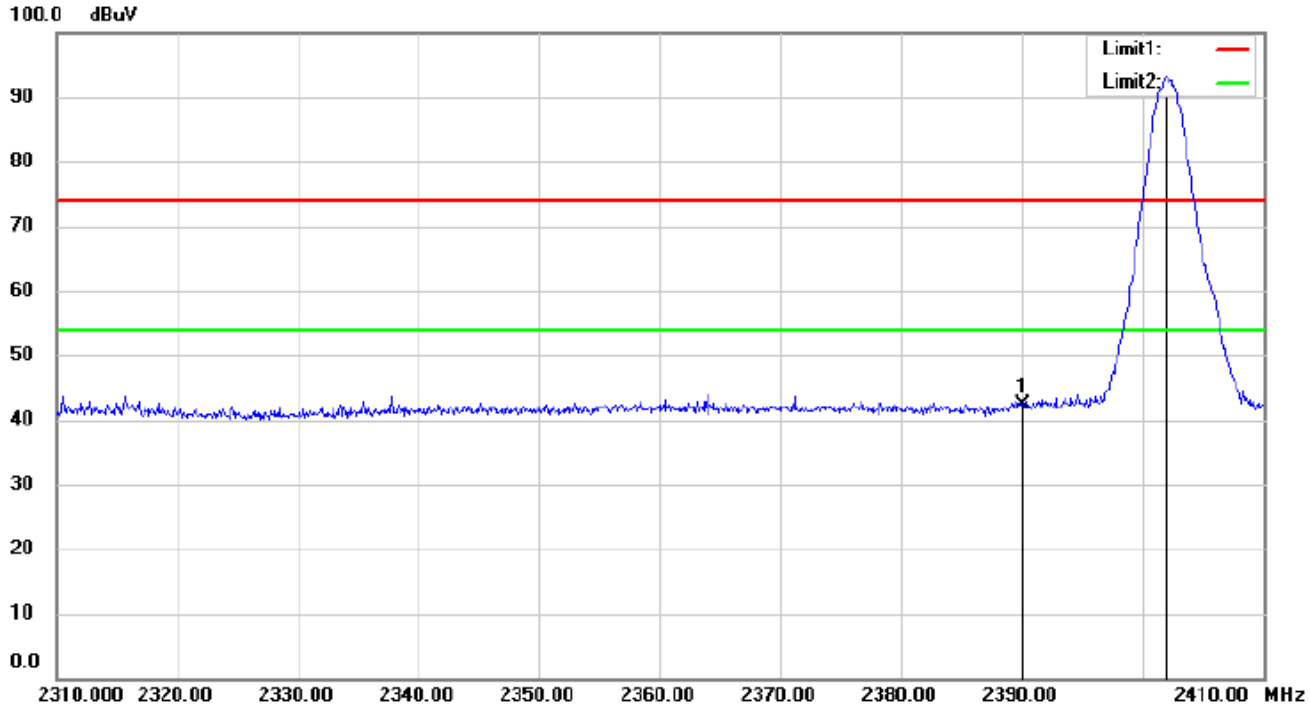
CH Low 2402MHz **Modulation: π/4DQPSK**

Horizontal, Peak Detector:



Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2390.000	43.00	peak	-0.56	42.44	74.00	-31.56
2	2402.000	94.71	peak	-0.62	94.09	74.00	20.09

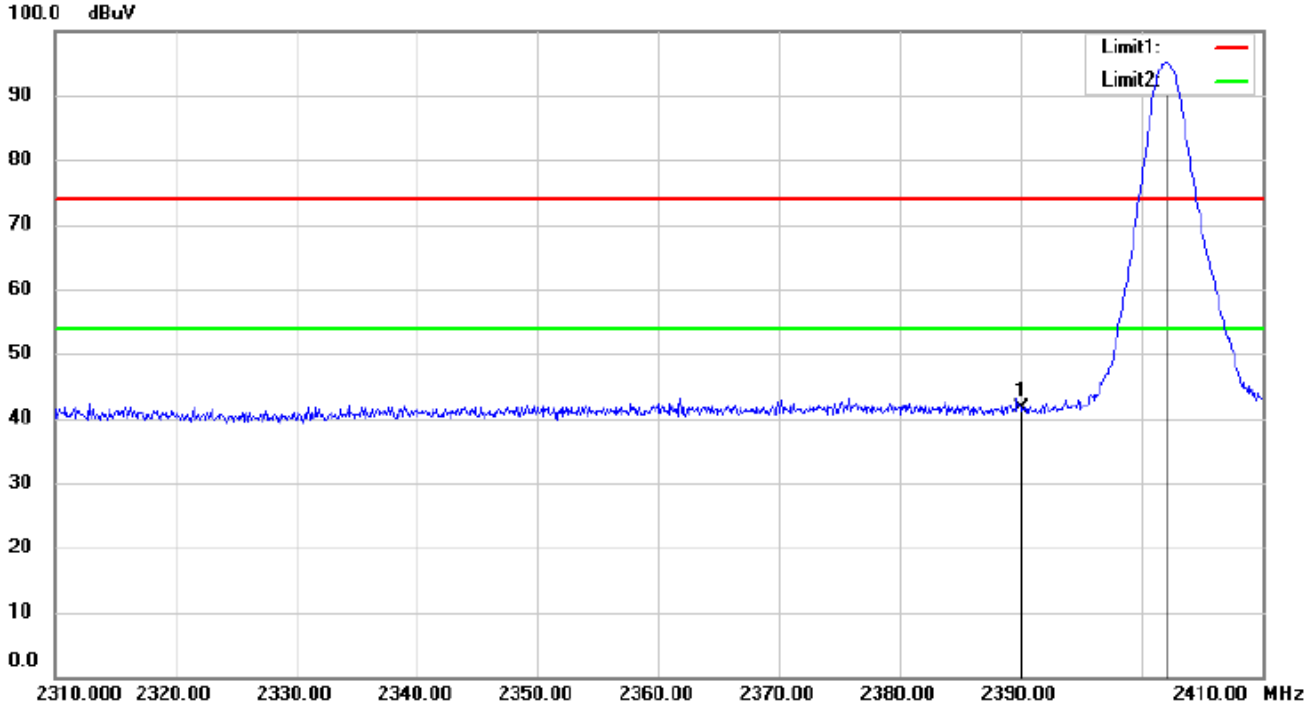
Vertical, Peak Detector:



Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2390.000	42.82	peak	-0.56	42.26	74.00	-31.74
2	2401.900	93.71	peak	-0.62	93.09	74.00	19.09

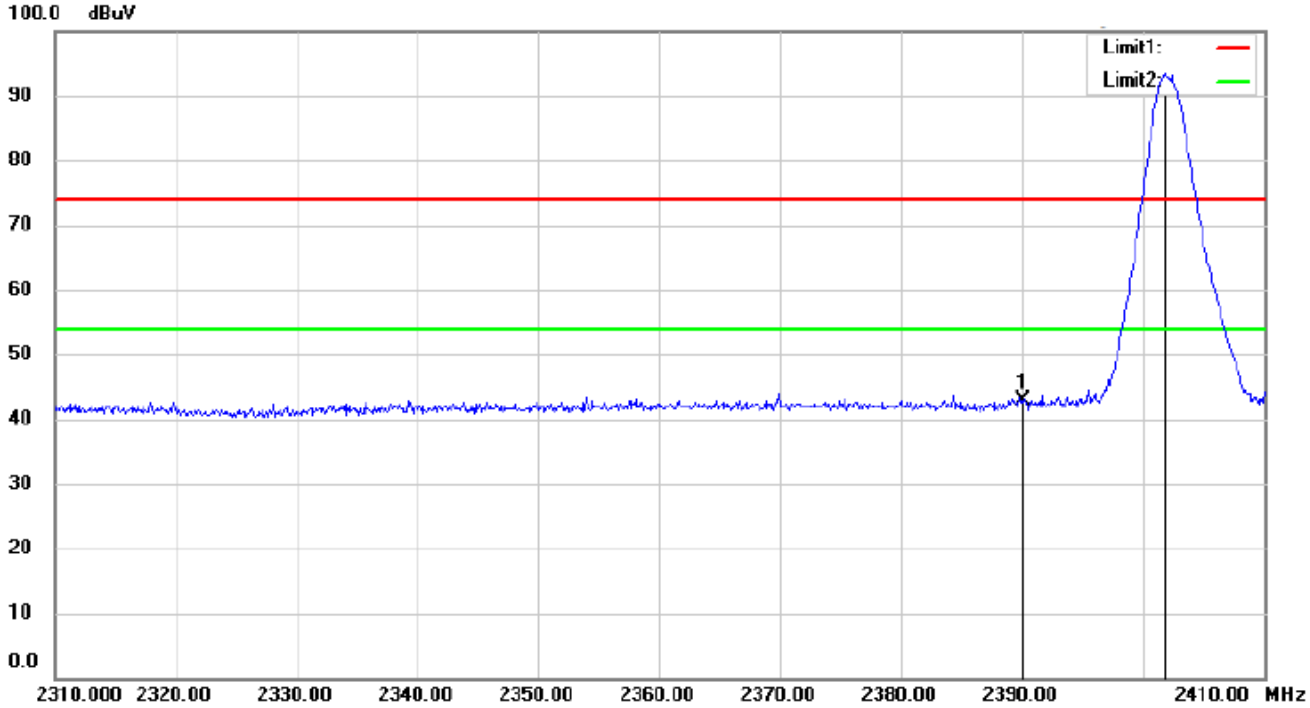
CH Low 2402MHz **Modulation: DPSK**

Horizontal, Peak Detector:



Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2390.000	42.27	peak	-0.56	41.71	74.00	-32.29
2	2402.000	95.82	peak	-0.62	95.20	74.00	21.20

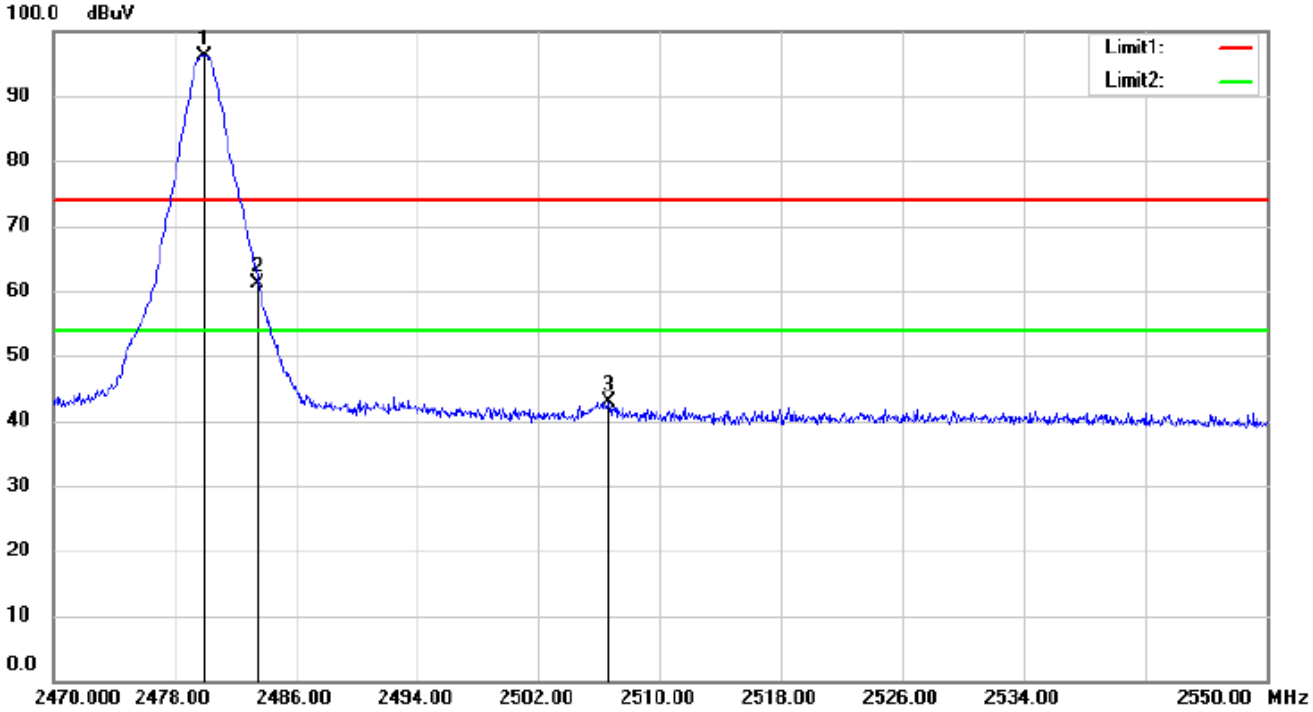
Vertical, Peak Detector:



Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2390.000	43.39	peak	-0.56	42.83	74.00	-31.17
2	2401.800	93.97	peak	-0.62	93.35	74.00	19.35

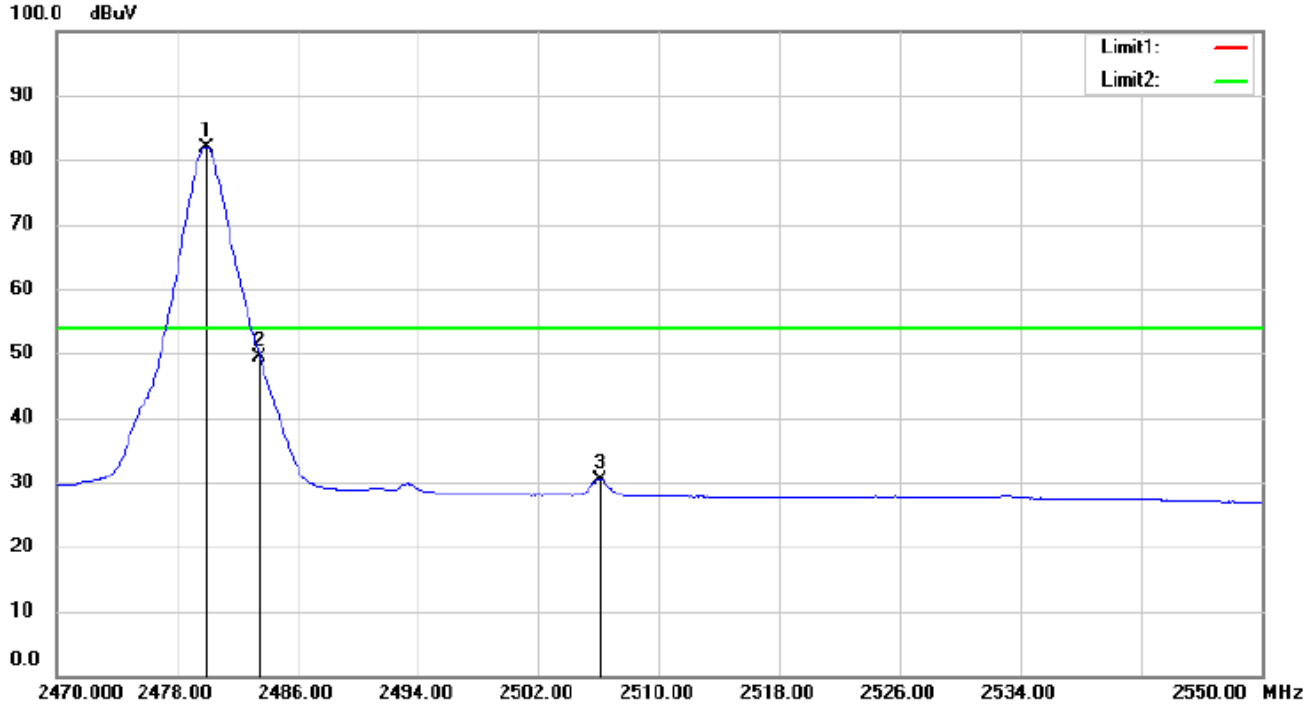
CH Low 2480MHz **Modulation: GFSK**

Horizontal, Peak Detector:



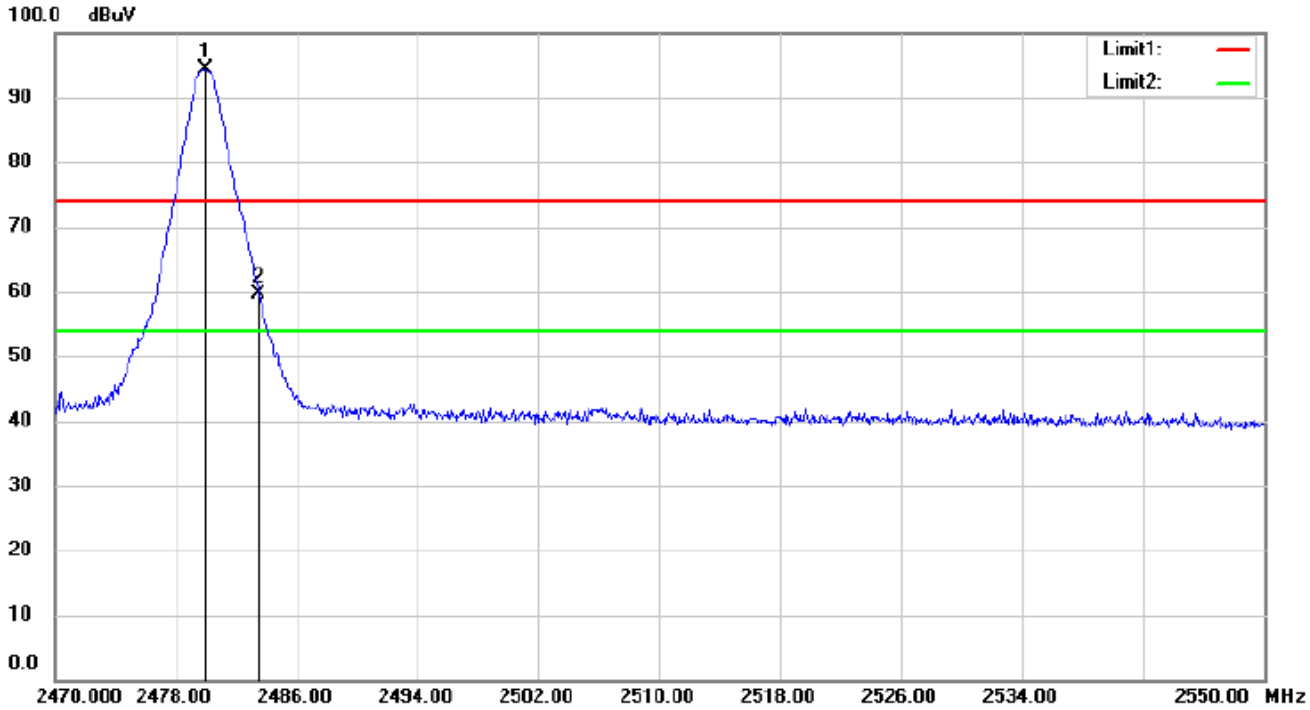
Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2479.920	97.18	peak	-0.99	96.19	74.00	22.19
2	2483.500	62.11	peak	-1.01	61.10	74.00	-12.90
3	2506.640	43.94	peak	-1.02	42.92	74.00	-31.08

Horizontal, Average Detector:



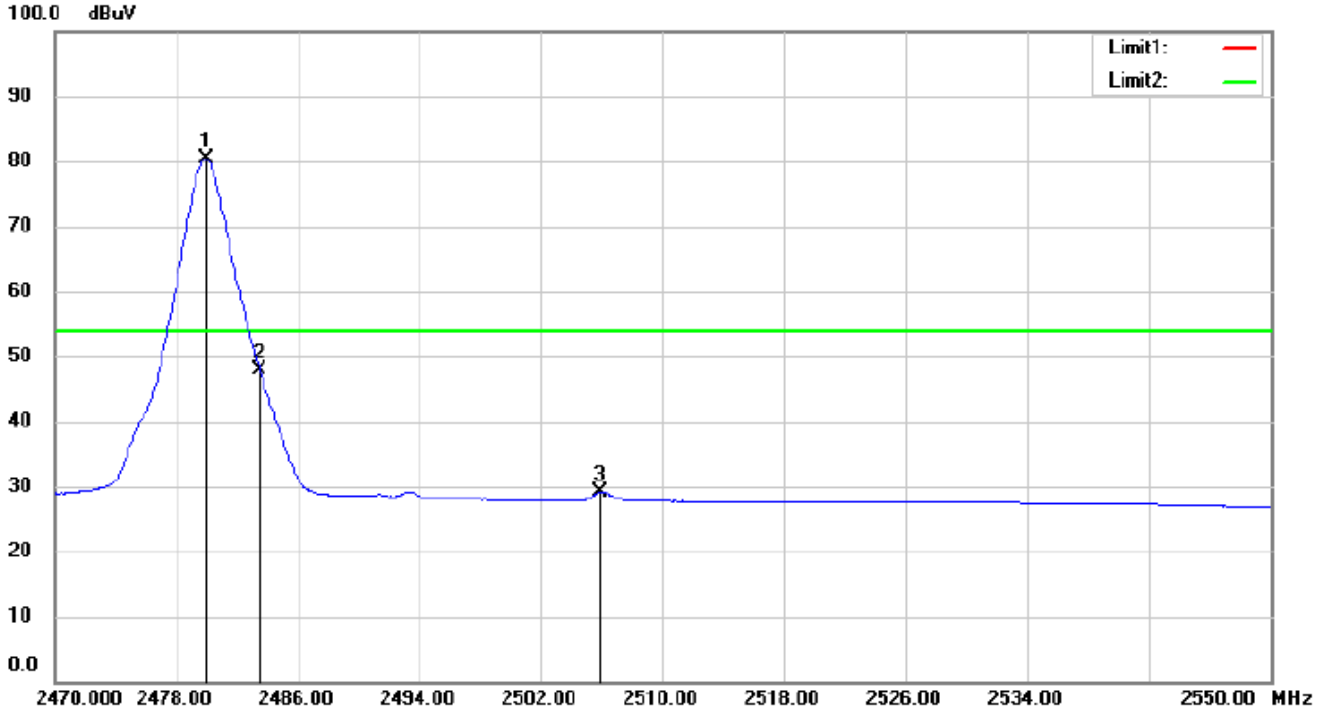
Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2479.920	82.92	peak	-0.99	81.93	54.00	27.93
2	2483.500	50.33	peak	-1.01	49.32	54.00	-4.68
3	2506.080	31.45	peak	-1.02	30.43	54.00	-23.57

Vertical, Peak Detector:



Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2480.000	95.34	peak	-0.99	94.35	74.00	20.35
2	2483.500	60.74	peak	-1.01	59.73	74.00	-14.27

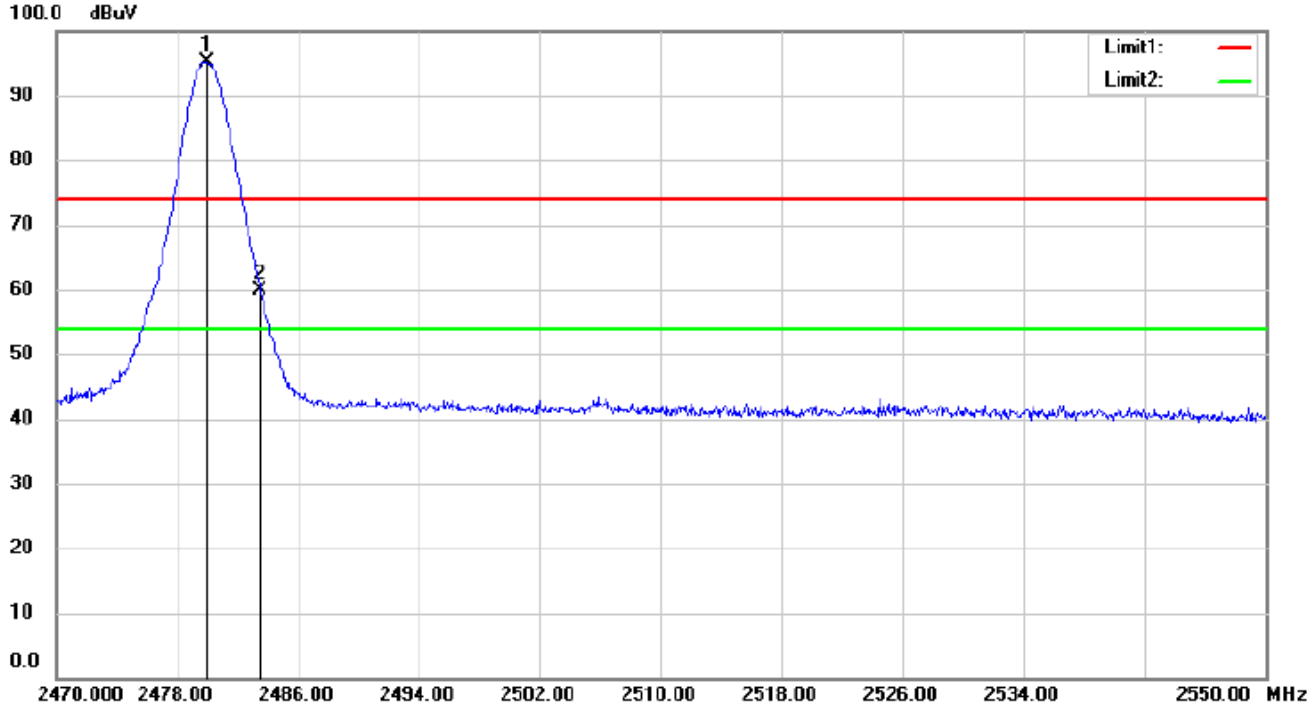
Vertical, Average Detector:



Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2479.920	81.26	peak	-0.99	80.27	54.00	26.27
2	2483.500	48.86	peak	-1.01	47.85	54.00	-6.15
3	2505.920	30.19	peak	-1.02	29.17	54.00	-24.83

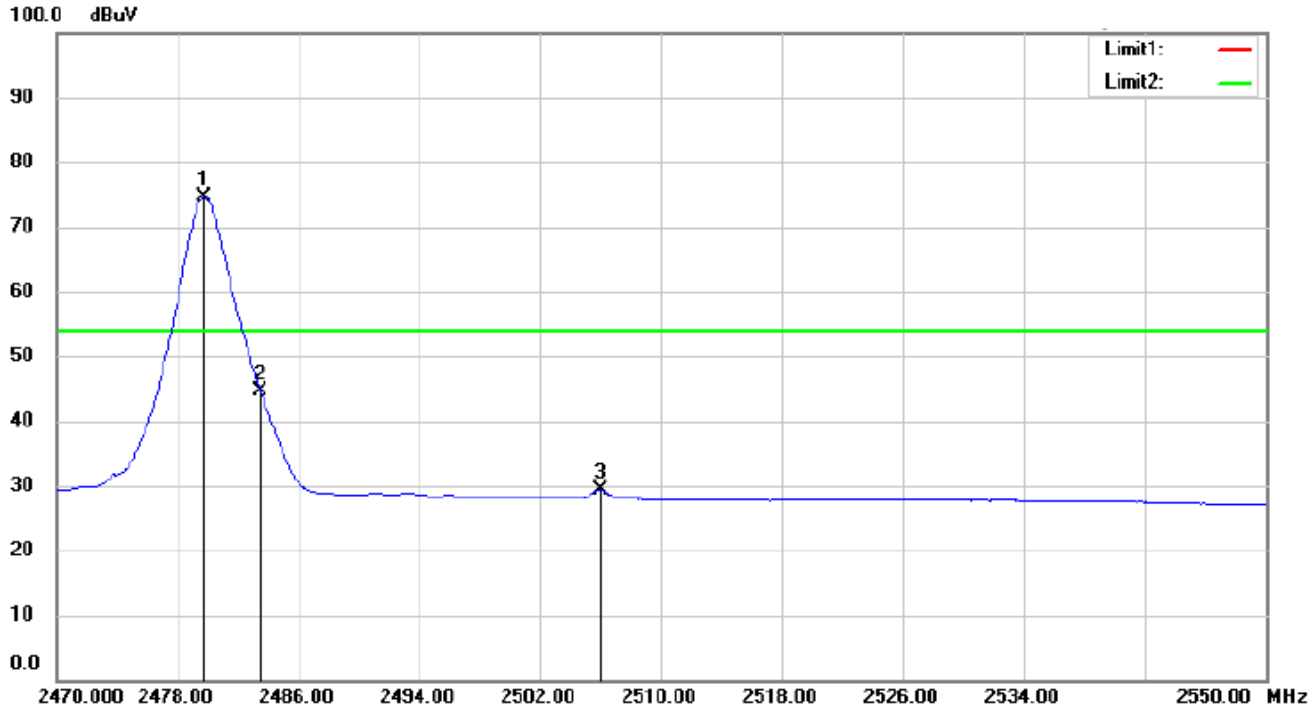
CH Low 2480MHz **Modulation: π/4DQPSK**

Horizontal, Peak Detector:



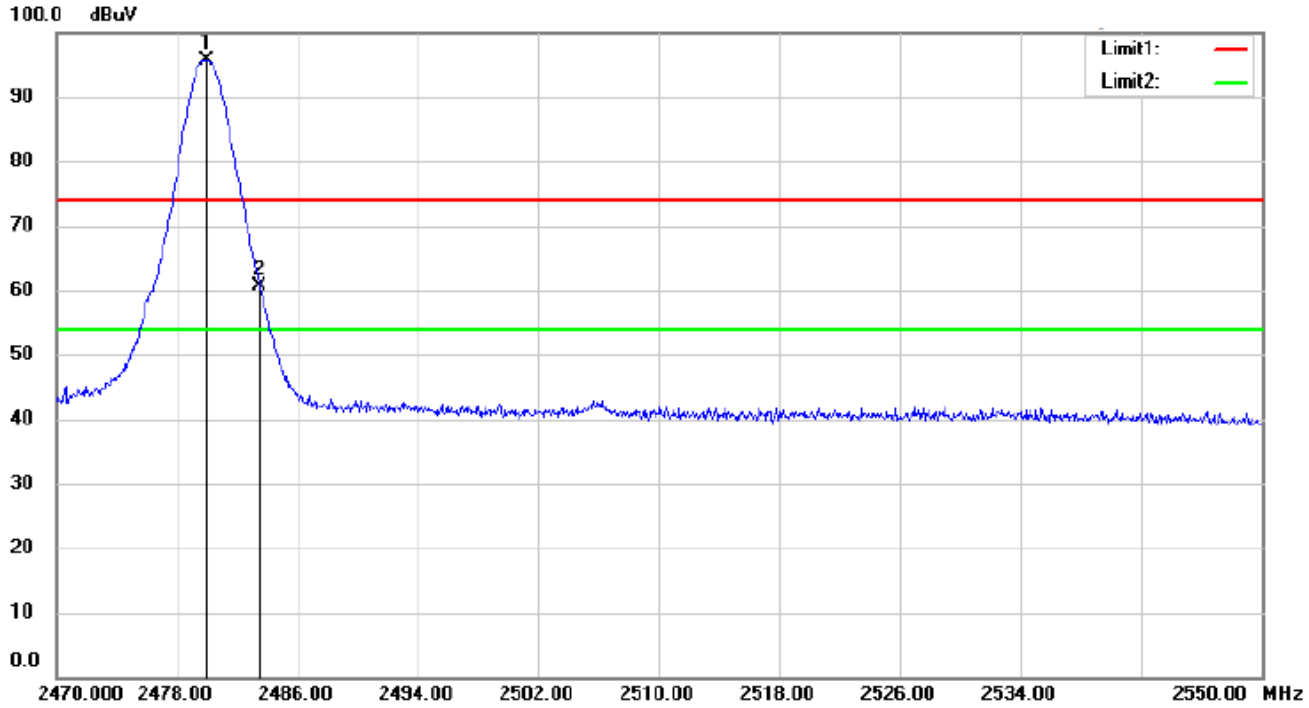
Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2479.920	96.15	peak	-0.99	95.16	74.00	21.16
2	2483.500	60.83	peak	-1.01	59.82	74.00	-14.18

Horizontal, Average Detector:



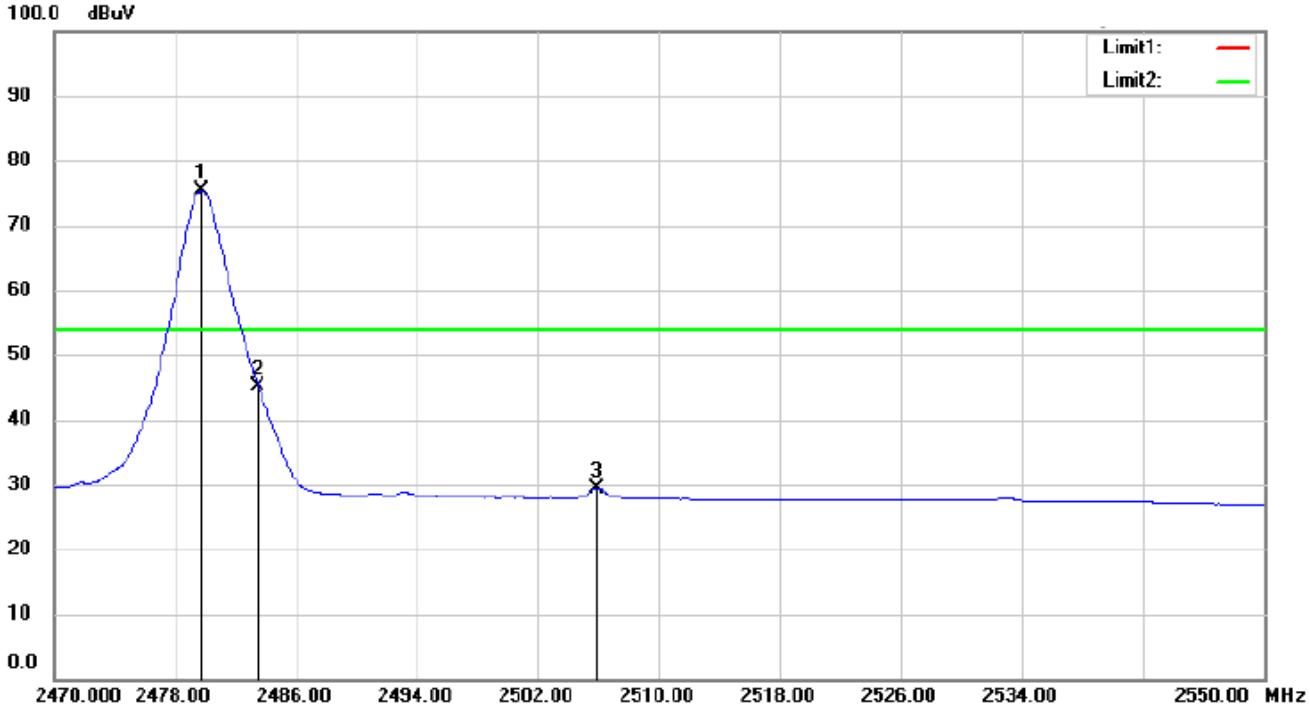
Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2479.760	75.50	peak	-0.99	74.51	54.00	20.51
2	2483.500	45.63	peak	-1.01	44.62	54.00	-9.38
3	2506.000	30.38	peak	-1.02	29.36	54.00	-24.64

Vertical, Peak Detector:



Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2479.920	96.74	peak	-0.99	95.75	74.00	21.75
2	2483.500	61.63	peak	-1.01	60.62	74.00	-13.38

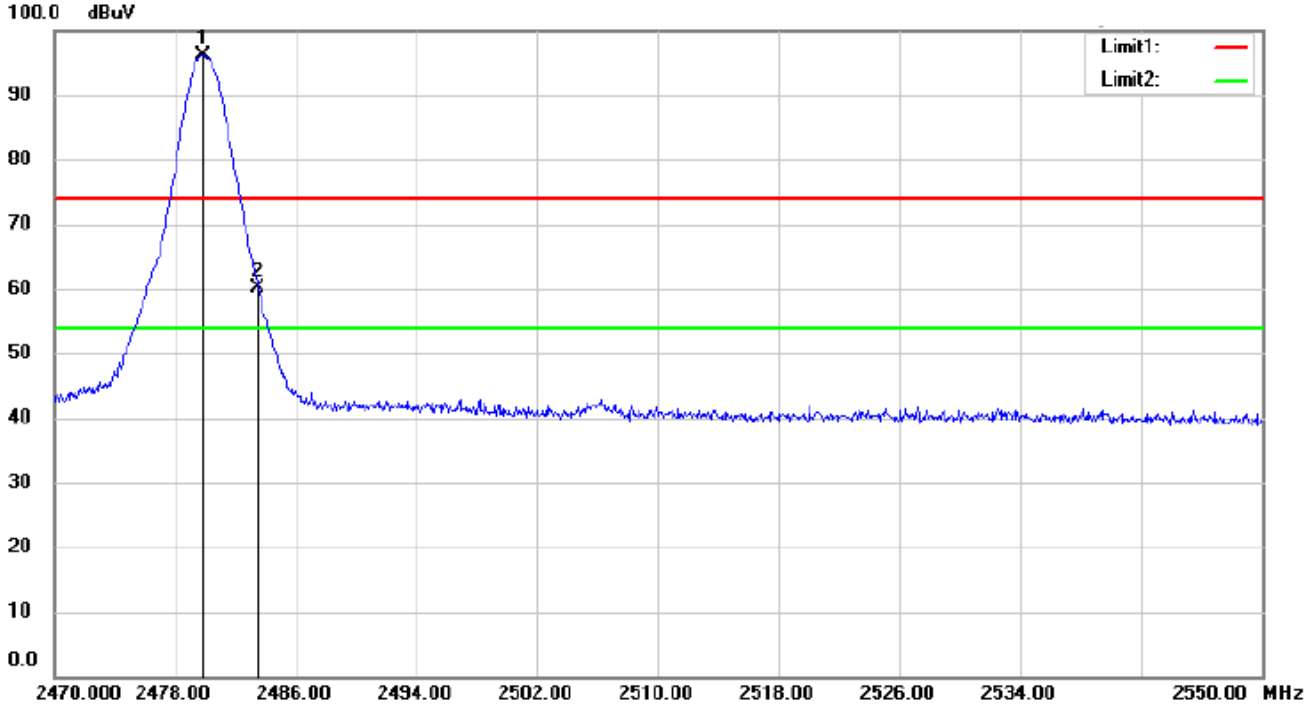
Vertical, Average Detector:



Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2479.760	76.34	peak	-0.99	75.35	54.00	21.35
2	2483.500	46.23	peak	-1.01	45.22	54.00	-8.78
3	2505.920	30.45	peak	-1.02	29.43	54.00	-24.57

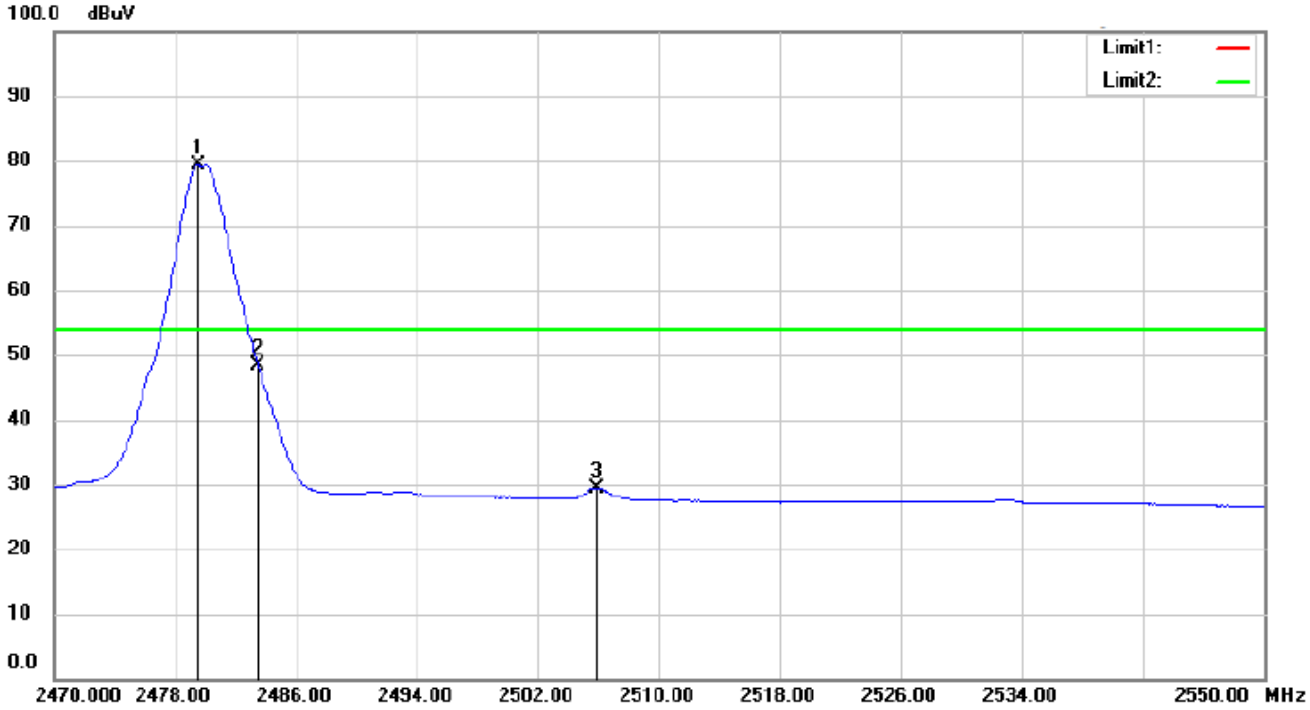
CH Low 2480MHz **Modulation: DPSK**

Horizontal, Peak Detector:



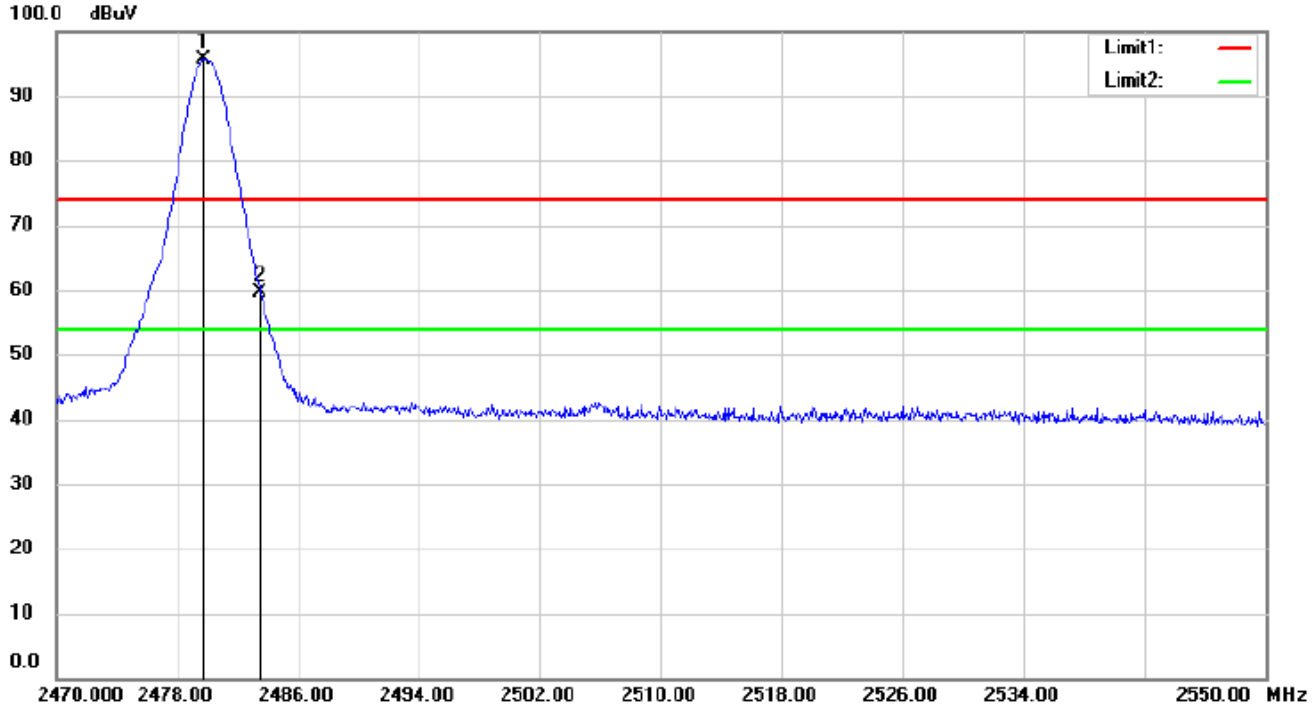
Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2479.840	97.11	peak	-0.99	96.12	74.00	22.12
2	2483.500	61.16	peak	-1.01	60.15	74.00	-13.85

Horizontal, Average Detector:



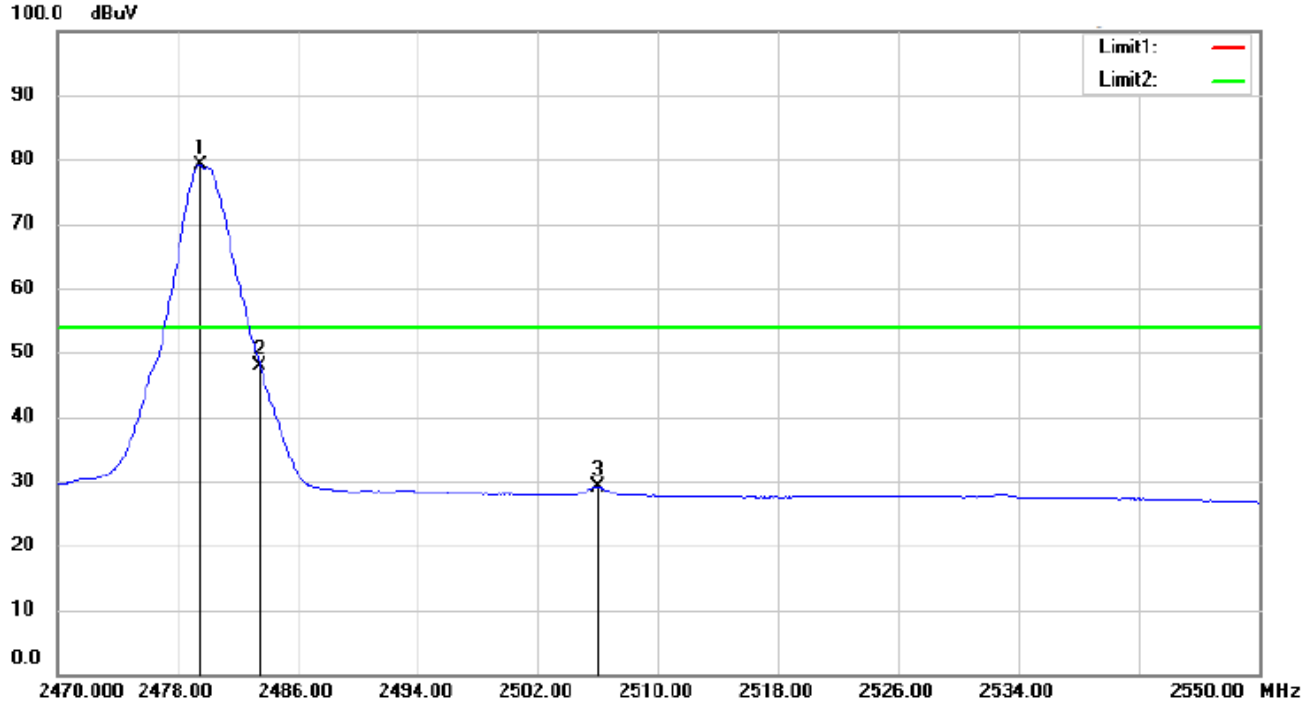
Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2479.520	80.32	peak	-0.99	79.33	54.00	25.33
2	2483.500	49.27	peak	-1.01	48.26	54.00	-5.74
3	2505.840	30.52	peak	-1.02	29.50	54.00	-24.50

Vertical, Peak Detector:



Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2479.760	96.74	peak	-0.99	95.75	74.00	21.75
2	2483.500	60.72	peak	-1.01	59.71	74.00	-14.29

Vertical, Average Detector:



Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	2479.520	80.17	peak	-0.99	79.18	54.00	25.18
2	2483.500	48.87	peak	-1.01	47.86	54.00	-6.14
3	2506.000	30.10	peak	-1.02	29.08	54.00	-24.92

Remark: 1. Test Level = Receiver Reading + Antenna Factor + Cable Loss- Preamplifier Factor

2. No any other emissions level which are attenuated less than 20dB below the limit.

   According to 15.31(o), The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this Part. Hence there no other emissions have been reported.

3. If the Peak value below the AV Limit, the AV test doesn't perform for this submission.

All frequencies within the "Restricted bands" have been evaluated to compliance. Section 15.205 Restricted bands of operation.

Except as shown in paragraph of this section. Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	
13.36 - 13.41	322 - 335.4		

8 Test Setup Photographs

Refer to the < iAdapter _Test Setup photos-FCC>.

9 EUT Constructional Details

Refer to the < iAdapter _External Photos-FCC > & < iAdapter _Internal Photos-FCC >.

--End of the Report--