CTC Laboratories, Inc.

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TEST REPORT

Report No. .....:	**CTC20231646E02**
FCC ID.....:	**2A6MS-T45PRO**
Applicant .....:	**Shenzhen Zhichuang All Technology Co., LTD**
Address.....:	D401, Ganghong Complex Building, Building 2, No. 7, Xiangye Road, Xialilang Community, Nanwan Street, Longgang District, Shenzhen
Manufacturer.....:	Shenzhen Zhichuang All Technology Co., LTD
Address.....:	D401, Ganghong Complex Building, Building 2, No. 7, Xiangye Road, Xialilang Community, Nanwan Street, Longgang District, Shenzhen
Product Name .....:	**Bluetooth Earbuds**
Trade Mark .....:	/
Model/Type reference.....:	sanag T45 Pro
Listed Model(s).....:	/
Standard .....:	**FCC CFR Title 47 Part 15 Subpart C Section 15.247**
Date of receipt of test sample.....:	Aug. 1, 2023
Date of testing.....:	Aug. 1, 2023 to Sept. 4, 2023
Date of issue.....:	Sept. 5, 2023
Result.....:	**PASS**

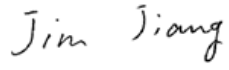
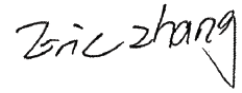
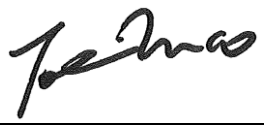
Compiled by: (Printed name+signature)	Jim Jiang	
Supervised by: (Printed name+signature)	Eric Zhang	
Approved by: (Printed name+signature)	Totti Zhao	

Table of Contents Page

1. TEST SUMMARY

1.1. Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.247: Operation within the bands 902–928MHz, 2400–2483.5MHz, and 5725–5850MHz.
RSS-247 Issue 2: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.
RSS-Gen Issue 5: General Requirements for Compliance of Radio Apparatus.
ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

1.2. Report Version

Revised No.	Date of issue	Description
01	Sept. 5, 2023	Original

1.3. Test Description

FCC Part 15 Subpart C (15.247) / RSS-247 Issue 2				
Test Item	Standard Section		Result	Test Engineer
	FCC	IC		
Antenna Requirement	15.203	RSS-Gen 6.8	Pass	Jim Jiang
Conducted Emission	15.207	RSS-Gen 8.8	Pass	Jim Jiang
Restricted Bands	15.205	RSS-Gen 8.10	Pass	Jim Jiang
Hopping Channel Separation	15.247(a)(1)	RSS-247 5.1 (b)	Pass	Jim Jiang
Dwell Time	15.247(a)(iii)	RSS-247 5.1 (d)	Pass	Jim Jiang
Peak Output Power	15.247(b)(1)	RSS-247 5.4 (b)	Pass	Jim Jiang
Number of Hopping Frequency	15.247(a)(iii)	RSS-247 5.1 (d)	Pass	Jim Jiang
Conducted Band Edge and Spurious Emissions	15.247(d)	RSS-247 5.5	Pass	Jim Jiang
Radiated Band Edge and Spurious Emissions	15.205&15.209& 15.247(d)	RSS-247 5.5	Pass	Jim Jiang
Radiated Spurious Emission	15.247(d) &15.209	RSS-247 5.5& RSS-Gen 8.9	Pass	Jim Jiang
20dB Bandwidth	15.247(a)	RSS-247 5.1 (b)	Pass	Jim Jiang

Note:
1. The measurement uncertainty is not included in the test result.
2. N/A: means this test item is not applicable for this device according to the technology characteristic of device.

1.4. Test Facility

Address of the report laboratory

CTC Laboratories, Inc.

Add: 2/F., Building 1 and 1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Longhua District, Shenzhen, Guangdong, China

Laboratory accreditation

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

A2LA-Lab Cert. No.: 4340.01

CTC Laboratories, Inc. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

Industry Canada (Registration No.: 9783A, CAB Identifier: CN0029)

CTC Laboratories, Inc. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: 9783A on Jan, 2016.

FCC (Registration No.: 951311, Designation Number CN1208)

CTC Laboratories, Inc. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 951311, Aug 26, 2017.

1.5. Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01 “Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1” and TR-100028-02 “Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2” and is documented in the CTC Laboratories, Inc. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Below is the best measurement capability for CTC Laboratories, Inc.

Test Items	Measurement Uncertainty	Notes
20dB Emission Bandwidth	±0.0196%	(1)
Carrier Frequency Separation	±1.9%	(1)
Number of Hopping Channel	±1.9%	(1)
Time of Occupancy	±0.028%	(1)
Max Peak Conducted Output Power	±0.743 dB	(1)
Band-edge Spurious Emission	±1.328 dB	(1)
Conducted RF Spurious Emission	9kHz-1GHz: ±0.746dB 1GHz-26GHz: ±1.328dB	(1)
Conducted Emissions 9kHz~30MHz	±3.08 dB	(1)
Radiated Emissions 30~1000MHz	±4.51 dB	(1)
Radiated Emissions 1~18GHz	±5.84 dB	(1)
Radiated Emissions 18~40GHz	±6.12 dB	(1)

Note (1): This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

1.6. Environmental Conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15 °C to 35 °C
Relative Humidity:	20 % to 75 %
Air Pressure:	101 kPa

2. GENERAL INFORMATION

2.1. Client Information

Applicant:	Shenzhen Zhichuang All Technology Co., LTD
Address:	D401, Ganghong Complex Building, Building 2, No. 7, Xiangye Road, Xialilang Community, Nanwan Street, Longgang District, Shenzhen
Manufacturer:	Shenzhen Zhichuang All Technology Co., LTD
Address:	D401, Ganghong Complex Building, Building 2, No. 7, Xiangye Road, Xialilang Community, Nanwan Street, Longgang District, Shenzhen
Factory:	Shenzhen Fuchang Technology Co.,Ltd.
Address:	3 rd Floor, Building F Yutong Group, No.1, shiyan Road, Shilongzai Industrial Zone, Shuitian Village Shiyan Street, Baoan District Shenzhen

2.2. General Description of EUT

Product Name:	Bluetooth Earbuds
Trade Mark:	/
Model/Type reference:	sanag T45 Pro
Listed Model(s):	/
Model Difference:	/
Power Supply:	Charging box: DC5V 1A from External adapter DC3.7V 400mAh from Battery Earphone: DC5V 70mA from Charging box DC3.7V 30mAh from Battery
Hardware Version:	/
Software Version:	/
Bluetooth 5.3 / BR+EDR	
Modulation:	GFSK, π/4-DQPSK, 8-DPSK
Operation Frequency:	2402MHz~2480MHz
Channel Number:	79
Channel Separation:	1MHz
Antenna Type:	Ceramic Antenna
Antenna Gain:	2.7dBi

2.3. Accessory Equipment Information

Equipment Information			
Name	Model	S/N	Manufacturer
Notebook	ThinkPad T460s	/	Lenovo
Cable Information			
Name	Shielded Type	Ferrite Core	Length
USB Cable	Unshielded	NO	150cm
Test Software Information			
Name	Version	/	/
FCC_assist	1.0.2.2	/	/

2.4. Operation State

Operation Frequency List: The EUT has been tested under typical operating condition. The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing. BT EDR, 79 channels are provided to the EUT. Channels 00/39/78 were selected for testing.

Operation Frequency List:

Channel	Frequency (MHz)
00	**2402**
01	2403
⋮	⋮
38	2440
39	**2441**
40	2442
⋮	⋮
77	2479
78	**2480**

Note: The display in grey were the channel selected for testing.

Test Mode:

For RF test items:
The engineering test program was provided and enabled to make EUT continuous transmit.
For AC power line conducted emissions:
The EUT was set to connect with the Bluetooth instrument under large package sizes transmission.
For Radiated spurious emissions test item:
The engineering test program was provided and enabled to make EUT continuous transmit. The EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data recorded in the report.

2.5. Measurement Instruments List

Tonscend RF Test System					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated Until
1	MXA Signal Analyzer	Keysight	N9020A	MY46471737	Dec. 16, 2023
2	Spectrum Analyzer	R&S	FSU26	100105	Dec. 16, 2023
3	Spectrum Analyzer	R&S	FSV40-N	101331	Mar. 14, 2024
4	MXG Vector Signal Generator	Agilent	N5182A	MY47420864	Dec. 16, 2023
5	PSG Analog Signal Generator	Agilent	E8257D	MY46521908	Dec. 16, 2023
6	Power Sensor	Keysight	U2021XA	MY55130004	Mar. 14, 2024
7	Power Sensor	Keysight	U2021XA	MY55130006	Mar. 14, 2024
8	Wideband Radio Communication Tester	R&S	CMW500	102414	Dec. 16, 2023
9	High and low temperature box	ESPEC	MT3035	/	Mar. 24, 2024
10	JS1120 RF Test System	TONSCEND	v2.6	/	/

Radiated Emission					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated Until
1	Trilog-Broadband Antenna	Schwarzbeck	VULB 9163	01026	Dec. 18, 2024
2	Horn Antenna	Schwarzbeck	BBHA 9120D	9120D-647	Dec. 01, 2024
3	Loop Antenna	ETS	6507	1446	Dec. 13, 2023
4	Test Receiver	Keysight	N9038A	MY56400071	Dec. 16, 2023
5	Broadband Premplifier	SCHWARZBECK	BBV9743B	259	Dec. 16, 2023
6	Mirowave Broadband Amplifier	SCHWARZBECK	BBV9718C	111	Dec. 16, 2023
7	3m chamber 3	YIHENG	EE106	/	Sep. 09, 2023

Conducted Emission					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated Until
1	LISN	R&S	ENV216	101112	Dec. 16, 2023
2	LISN	R&S	ENV216	101113	Dec. 16, 2023
3	EMI Test Receiver	R&S	ESCS30	100353	Dec. 16, 2023
4	ISN CAT6	Schwarzbeck	NTFM 8158	CAT6-8158-0046	Dec. 16, 2023
5	ISN CAT5	Schwarzbeck	NTFM 8158	CAT5-8158-0046	Dec. 16, 2023

Note: 1. The Cal. Interval was one year.

2. The Cal. Interval was three years of the antenna.

3. The cable loss has been calculated in test result which connection between each test instruments.

3. TEST ITEM AND RESULTS

3.1. Conducted Emission

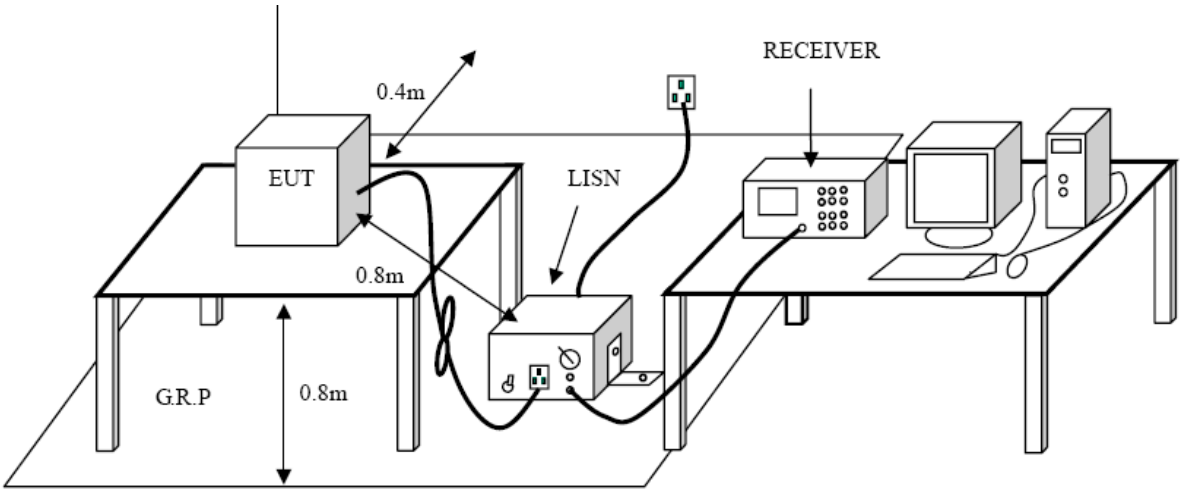
Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.207 / RSS-Gen 8.8

Frequency (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 *	56 to 46 *
0.5 - 5	56	46
5 - 30	60	50

* Decreases with the logarithm of the frequency.

Test Configuration



Test Procedure

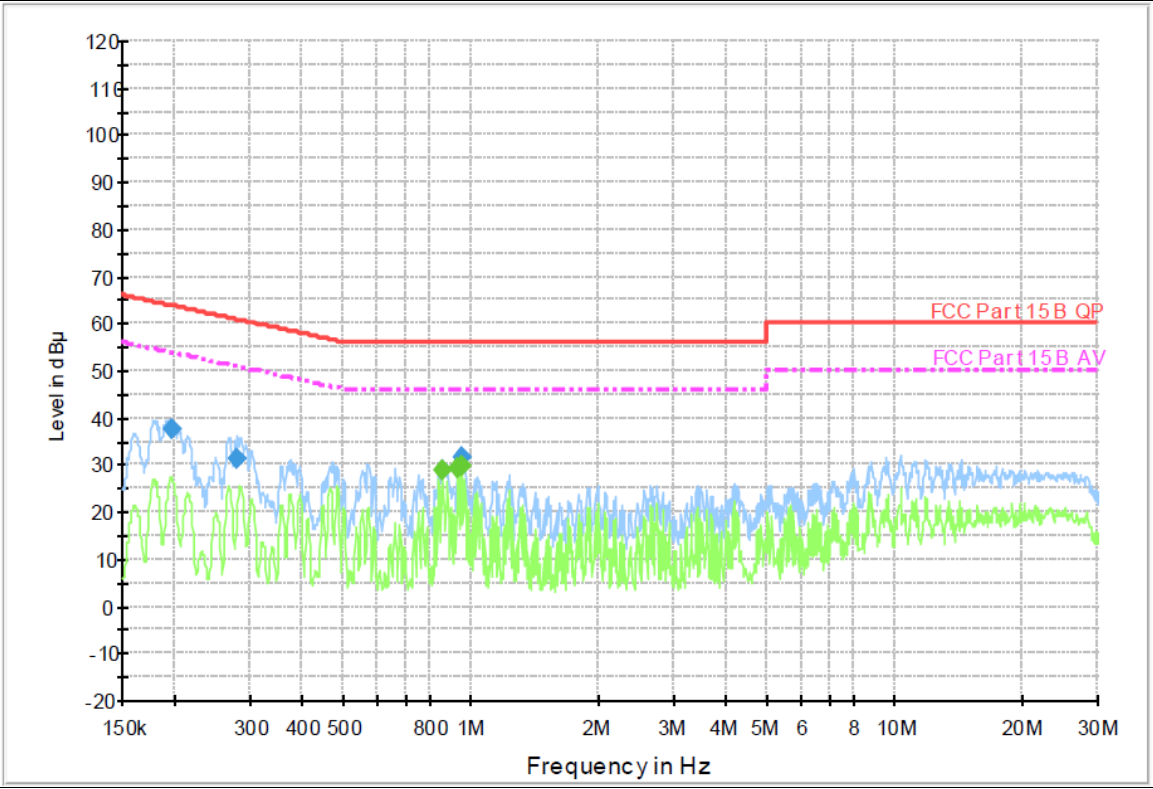
1. The EUT was setup according to ANSI C63.10:2013 requirements.
2. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface.
3. The EUT and simulators are connected to the main power through a line impedance stabilization network (LISN). The LISN provides a 50 ohm / 50 μH coupling impedance for the measuring equipment.
4. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs)
5. Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.
6. The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.
7. Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.
8. During the above scans, the emissions were maximized by cable manipulation.

Test Mode

Please refer to the clause 2.4.

Test Result

Test Voltage:	AC 120V/60Hz
Terminal:	Line
Remark:	Only worse case is reported



Final Measurement Detector 1

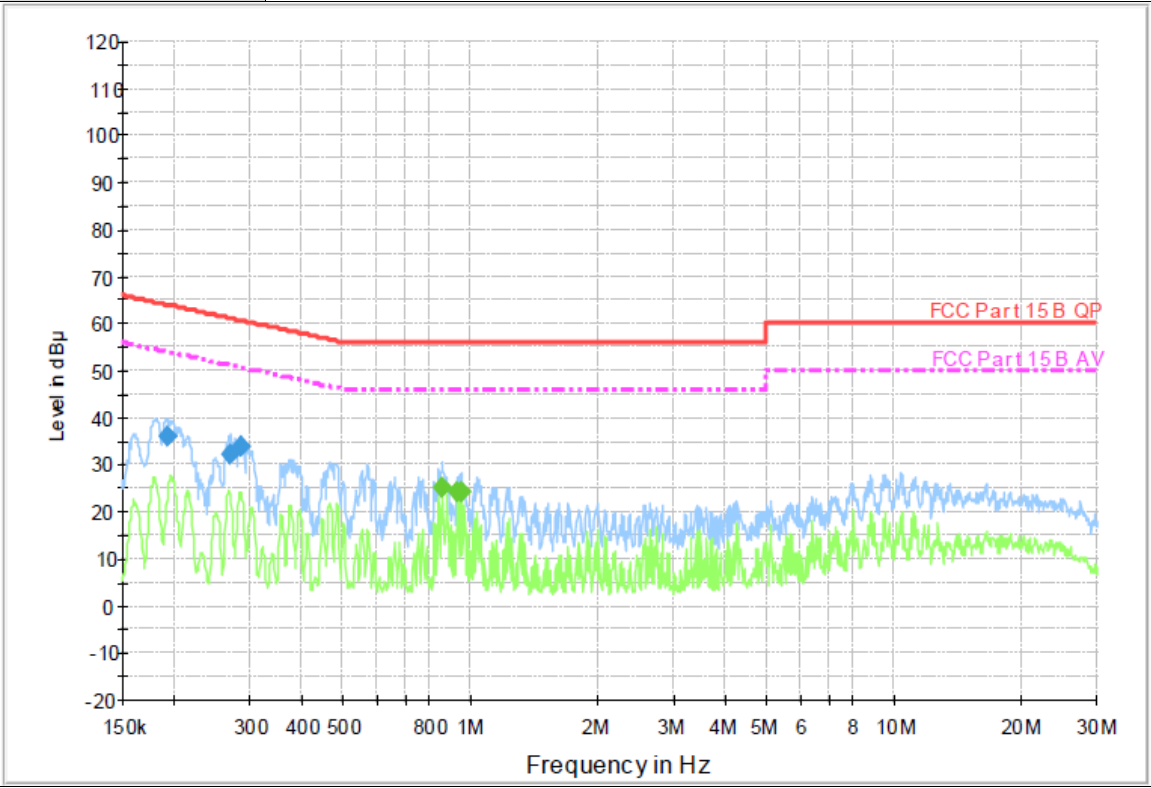
Frequency (MHz)	QuasiPeak (dBµ V)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµ V)	Comment
0.196110	37.5	1000.00	9.000	On	L1	9.4	26.3	63.8	
0.279600	30.3	1000.00	9.000	On	L1	9.4	30.5	60.8	
0.944780	31.4	1000.00	9.000	On	L1	9.5	24.6	56.0	

Final Measurement Detector 2

Frequency (MHz)	Average (dBµ V)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµ V)	Comment
0.855050	28.8	1000.00	9.000	On	L1	9.5	17.2	46.0	
0.926100	29.0	1000.00	9.000	On	L1	9.5	17.0	46.0	
0.944790	29.7	1000.00	9.000	On	L1	9.5	16.3	46.0	

Emission Level = Read Level + Correct Factor

Test Voltage:	AC 120V/60Hz
Terminal:	Neutral
Remark:	Only worse case is reported



Final Measurement Detector 1

Frequency (MHz)	QuasiPeak (dBµ V)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµ V)	Comment
0.191350	35.8	1000.00	9.000	On	N	9.3	28.2	64.0	
0.270800	32.0	1000.00	9.000	On	N	9.4	29.1	61.1	
0.285250	33.8	1000.00	9.000	On	N	9.4	26.9	60.7	

Final Measurement Detector 2

Frequency (MHz)	Average (dBµ V)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµ V)	Comment
0.855050	24.8	1000.00	9.000	On	N	9.4	21.2	46.0	
0.926100	24.1	1000.00	9.000	On	N	9.4	21.9	46.0	
0.944790	24.4	1000.00	9.000	On	N	9.4	21.6	46.0	

Emission Level = Read Level + Correct Factor

3.2. Radiated Emission

Limit

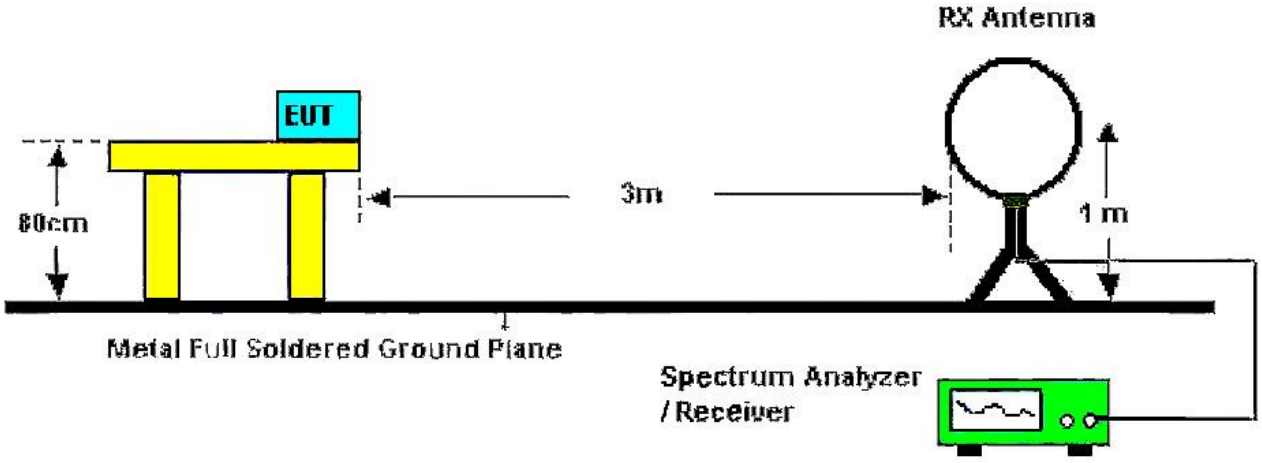
FCC CFR Title 47 Part 15 Subpart C Section 15.209 / RSS-Gen 8.9

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F (kHz)	300
0.490~1.705	24000/F (kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
960~1000	500	3

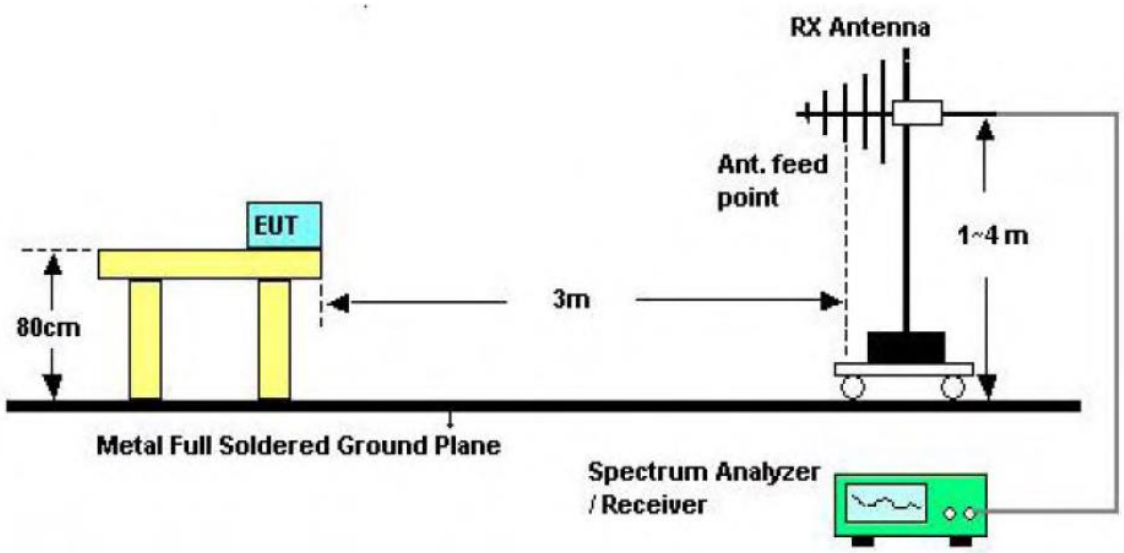
Frequency Range (MHz)	dBμV/m (at 3 meters)	
	Peak	Average
Above 1000	74	54

Note:
(1) The tighter limit applies at the band edges.
(2) Emission Level (dBμV/m)=20log Emission Level (μV/m).

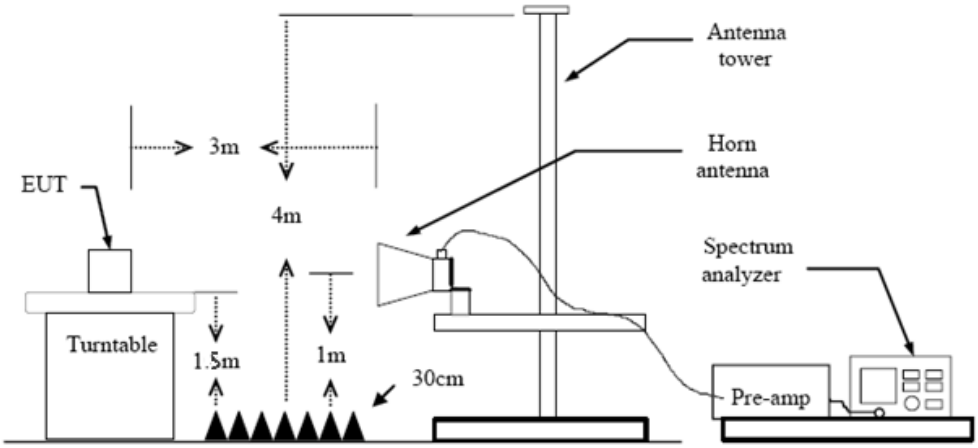
Test Configuration



Below 30MHz Test Setup



30-1000MHz Test Setup



Above 1GHz Test Setup

Test Procedure

1. The EUT was setup and tested according to ANSI C63.10:2013.
2. The EUT is placed on a turn table which is 0.8 meter above ground for below 1 GHz, and 1.5 m for above 1 GHz. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was set 3 meters from the receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Use the following spectrum analyzer settings

(1) Span shall wide enough to fully capture the emission being measured;

(2) 9k – 150kHz:
RBW=300 Hz, VBW=1 kHz, Sweep=auto, Detector function=peak, Trace=max hold
(3) 0.15M – 30MHz:
RBW=10 kHz, VBW=30 kHz, Sweep=auto, Detector function=peak, Trace=max hold
(4) 30M - 1 GHz:
RBW=120 kHz, VBW=300 kHz, Sweep=auto, Detector function=peak, Trace=max hold
If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
(5) From 1 GHz to 10^{th} harmonic:
RBW=1MHz, VBW=3MHz Peak detector for Peak value.
RBW=1MHz, VBW see note 1 with Peak Detector for Average Value.
Note 1: For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements. For the Duty Cycle please refer to clause 3.10 Duty Cycle.

Test Mode

Please refer to the clause 2.4.

Test Result

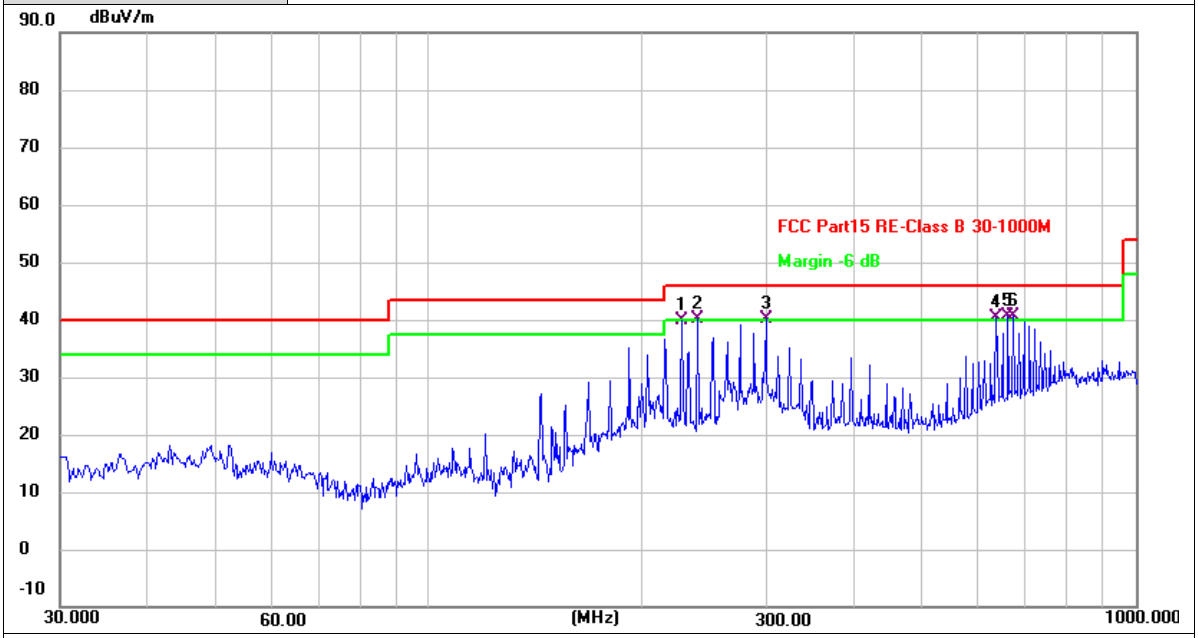
9 kHz~30 MHz

From 9 kHz to 30 MHz: The conclusion is PASS.

Note: The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

30MHz-1GHz

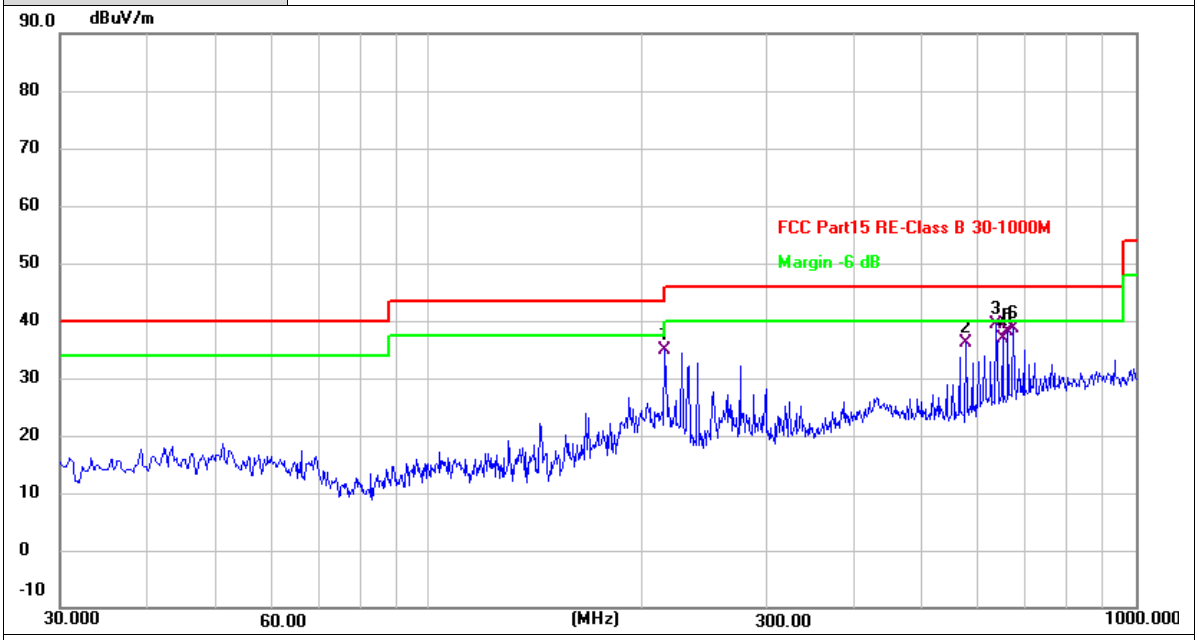
Ant. Pol.	Horizontal
Test Mode:	TX GFSK Mode 2402MHz
Remark:	Only worse case is reported.



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	227.8800	55.06	-15.16	39.90	46.00	-6.10	QP
2 !	239.8433	54.82	-14.80	40.02	46.00	-5.98	QP
3 !	299.9833	53.60	-13.47	40.13	46.00	-5.87	QP
4 !	635.9266	46.91	-6.65	40.26	46.00	-5.74	QP
5 *	660.1766	47.09	-6.34	40.75	46.00	-5.25	QP
6 !	672.1400	46.87	-6.19	40.68	46.00	-5.32	QP

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Vertical
Test Mode:	TX GFSK Mode 2402MHz
Remark:	Only worse case is reported.



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	215.9166	50.51	-15.51	35.00	43.50	-8.50	QP
2	576.1100	43.90	-7.76	36.14	46.00	-9.86	QP
3 *	635.9266	45.91	-6.65	39.26	46.00	-6.74	QP
4	647.8900	43.24	-6.48	36.76	46.00	-9.24	QP
5	659.8533	44.43	-6.34	38.09	46.00	-7.91	QP
6	672.1400	44.81	-6.19	38.62	46.00	-7.38	QP

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Above 1GHz

Ant. Pol.	Horizontal
Test Mode:	TX GFSK Mode 2402MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	4803.855	41.64	2.16	43.80	74.00	-30.20	peak
2 *	4803.880	28.97	2.16	31.13	54.00	-22.87	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Vertical
Test Mode:	TX GFSK Mode 2402MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1	4803.989	40.52	2.56	43.08	74.00	-30.92	peak
2 *	4804.022	28.49	2.56	31.05	54.00	-22.95	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Horizontal
Test Mode:	TX GFSK Mode 2441MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	4881.890	41.38	2.31	43.69	74.00	-30.31	peak
2 *	4881.924	29.11	2.31	31.42	54.00	-22.58	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Vertical
Test Mode:	TX GFSK Mode 2441MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1	4881.868	40.20	2.79	42.99	74.00	-31.01	peak
2 *	4882.011	28.09	2.79	30.88	54.00	-23.12	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Horizontal
Test Mode:	TX GFSK Mode 2480MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1 *	4959.992	28.31	2.48	30.79	54.00	-23.21	AVG
2	4960.024	40.90	2.48	43.38	74.00	-30.62	peak

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Vertical
Test Mode:	TX GFSK Mode 2480MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1 *	4959.890	27.98	3.04	31.02	54.00	-22.98	AVG
2	4960.113	40.25	3.04	43.29	74.00	-30.71	peak

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Horizontal
Test Mode:	TX π/4-DQPSK Mode 2402MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	4803.784	41.14	2.16	43.30	74.00	-30.70	peak
2 *	4803.958	28.89	2.16	31.05	54.00	-22.95	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Vertical
Test Mode:	TX π/4-DQPSK Mode 2402MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1 *	4804.001	28.82	2.56	31.38	54.00	-22.62	AVG
2	4804.012	40.98	2.56	43.54	74.00	-30.46	peak

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Horizontal
Test Mode:	TX π/4-DQPSK Mode 2441MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1 *	4881.872	28.53	2.79	31.32	54.00	-22.68	AVG
2	4881.896	40.71	2.79	43.50	74.00	-30.50	peak

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Vertical
Test Mode:	TX π/4-DQPSK Mode 2441MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1 *	4882.121	28.34	2.79	31.13	54.00	-22.87	AVG
2	4882.133	40.27	2.79	43.06	74.00	-30.94	peak

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Horizontal
Test Mode:	TX π/4-DQPSK Mode 2480MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1	4959.903	40.24	3.04	43.28	74.00	-30.72	peak
2 *	4959.919	27.80	3.04	30.84	54.00	-23.16	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Vertical
Test Mode:	TX π/4-DQPSK Mode 2480MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1	4960.102	39.85	3.04	42.89	74.00	-31.11	peak
2 *	4960.111	28.15	3.04	31.19	54.00	-22.81	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Horizontal
Test Mode:	TX 8-DPSK Mode 2402MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1 *	4803.991	29.23	2.56	31.79	54.00	-22.21	AVG
2	4804.005	40.92	2.56	43.48	74.00	-30.52	peak

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Vertical
Test Mode:	TX 8-DPSK Mode 2402MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1 *	4804.118	28.57	2.56	31.13	54.00	-22.87	AVG
2	4804.120	40.74	2.56	43.30	74.00	-30.70	peak

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Horizontal
Test Mode:	TX 8-DPSK Mode 2441MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1	4882.019	40.90	2.79	43.69	74.00	-30.31	peak
2 *	4882.110	28.84	2.79	31.63	54.00	-22.37	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Vertical
Test Mode:	TX 8-DPSK Mode 2441MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1	4882.000	40.49	2.79	43.28	74.00	-30.72	peak
2 *	4882.002	28.74	2.79	31.53	54.00	-22.47	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Horizontal
Test Mode:	TX 8-DPSK Mode 2480MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1	4959.944	40.00	3.04	43.04	74.00	-30.96	peak
2 *	4960.141	28.07	3.04	31.11	54.00	-22.89	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Vertical
Test Mode:	TX 8-DPSK Mode 2480MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1 *	4959.951	28.96	3.04	32.00	54.00	-22.00	AVG
2	4960.011	40.66	3.04	43.70	74.00	-30.30	peak

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

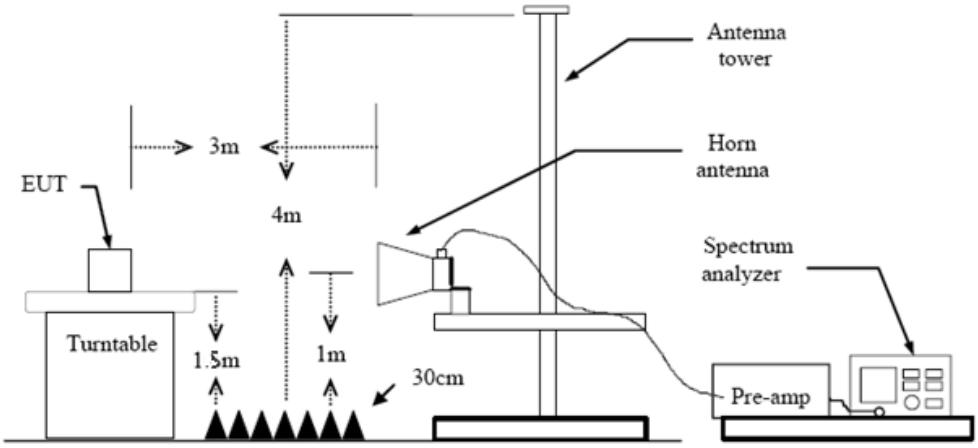
3.3. Band Edge Emissions (Radiated)

Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d) / RSS-247 5.5

Restricted Frequency Band (MHz)	(dBμV/m) (at 3m)	
	Peak	Average
2310 ~ 2390	74	54
2483.5 ~ 2500	74	54

Test Configuration



Test Procedure

1. The EUT was setup and tested according to ANSI C63.10:2013 requirements.
2. The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.
5. The receiver set as follow:

RBW=1MHz, VBW=3MHz Peak detector for Peak value.
RBW=1MHz, VBW see note 1 with Peak Detector for Average Value.

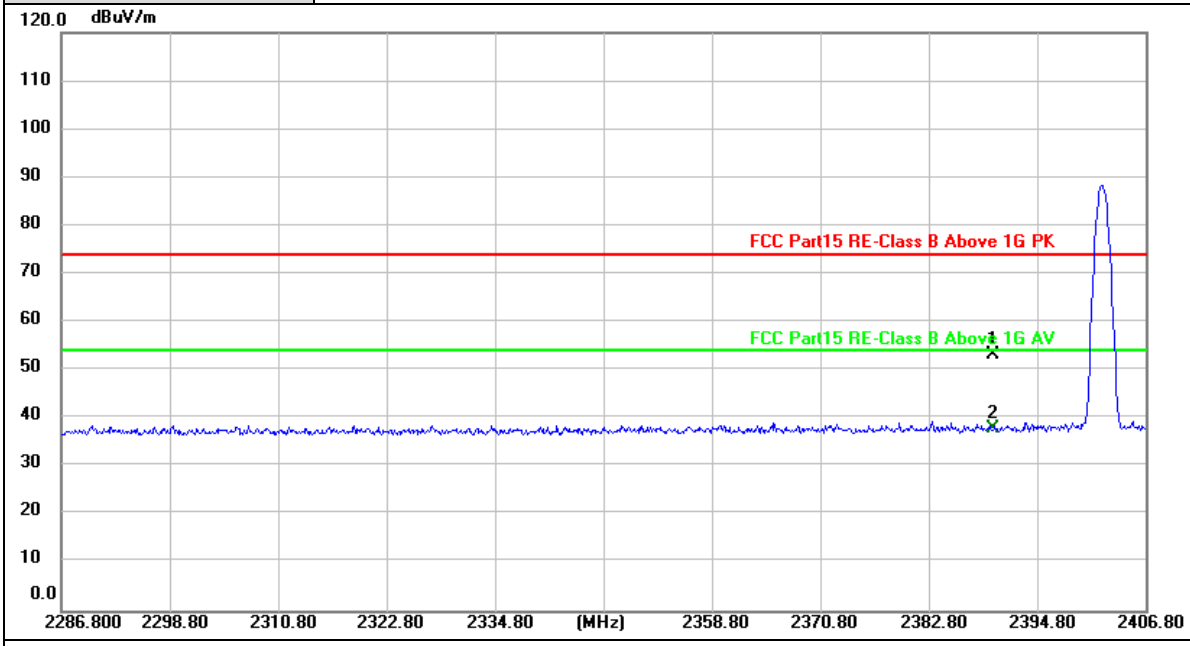
Note 1: For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements. For the Duty Cycle please refer to clause 3.10 Duty Cycle.

Test Mode

Please refer to the clause 2.4.

Test Result

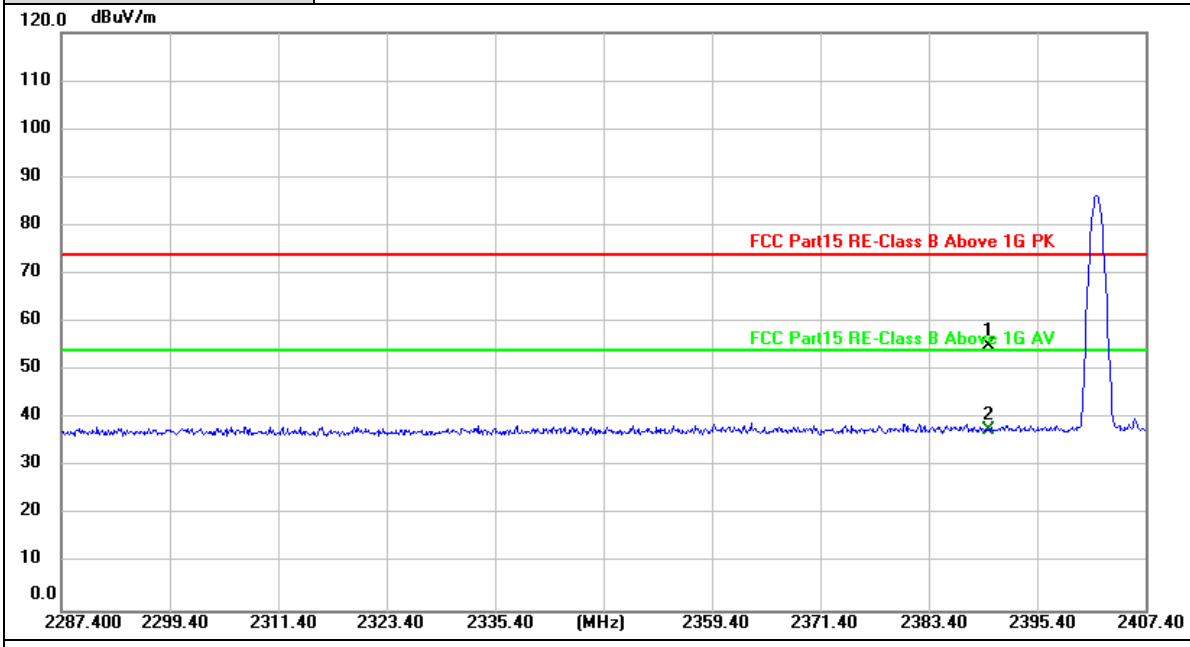
Ant. Pol.	Horizontal
Test Mode:	GFSK Mode 2402MHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2390.000	22.08	31.31	53.39	74.00	-20.61	peak
2 *	2390.000	6.74	31.31	38.05	54.00	-15.95	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

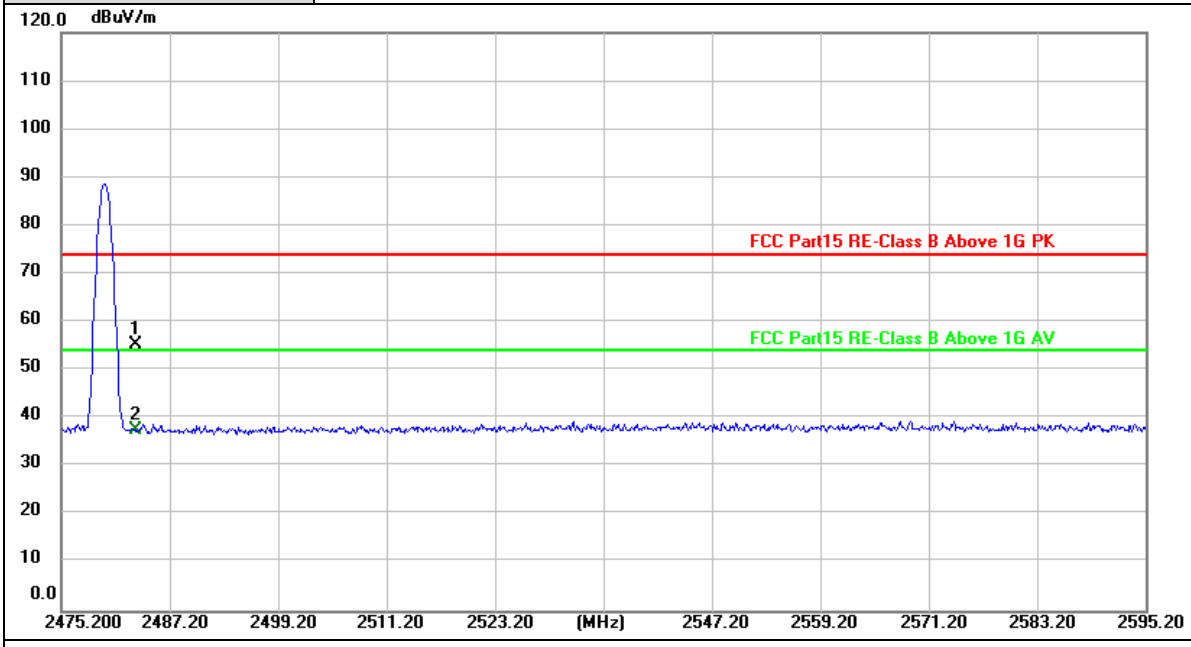
Ant. Pol.	Vertical
Test Mode:	GFSK Mode 2402MHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2390.000	23.81	31.31	55.12	74.00	-18.88	peak
2 *	2390.000	6.30	31.31	37.61	54.00	-16.39	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

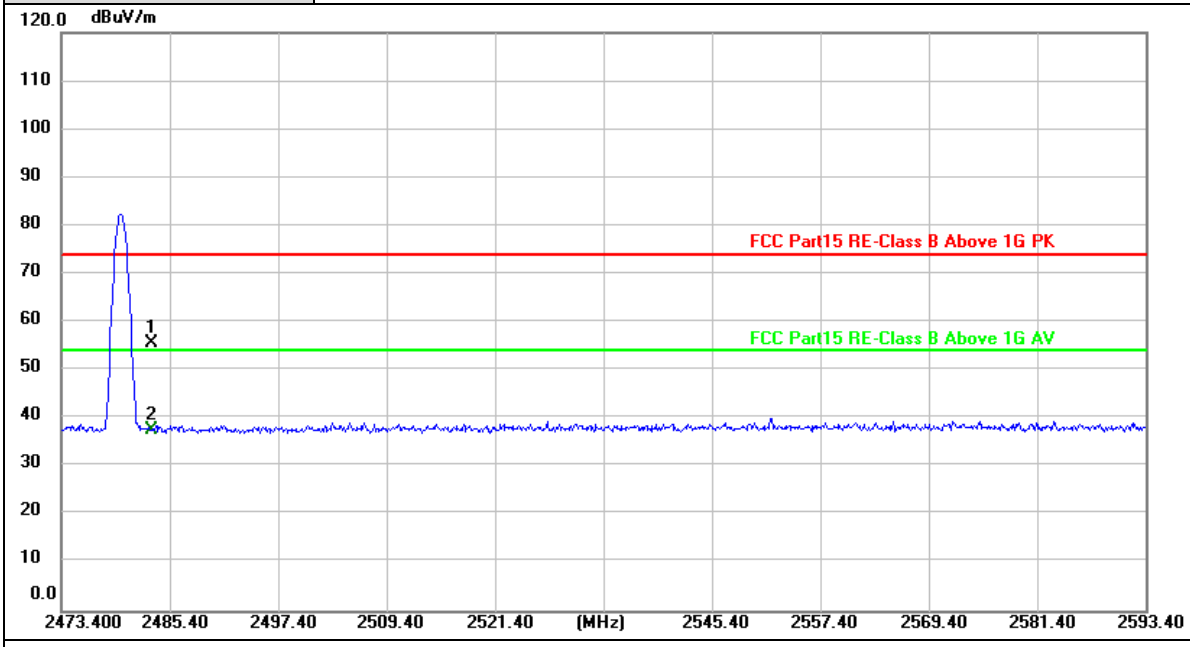
Ant. Pol.	Horizontal
Test Mode:	GFSK Mode 2480MHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2483.500	23.77	31.48	55.25	74.00	-18.75	peak
2 *	2483.500	6.13	31.48	37.61	54.00	-16.39	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

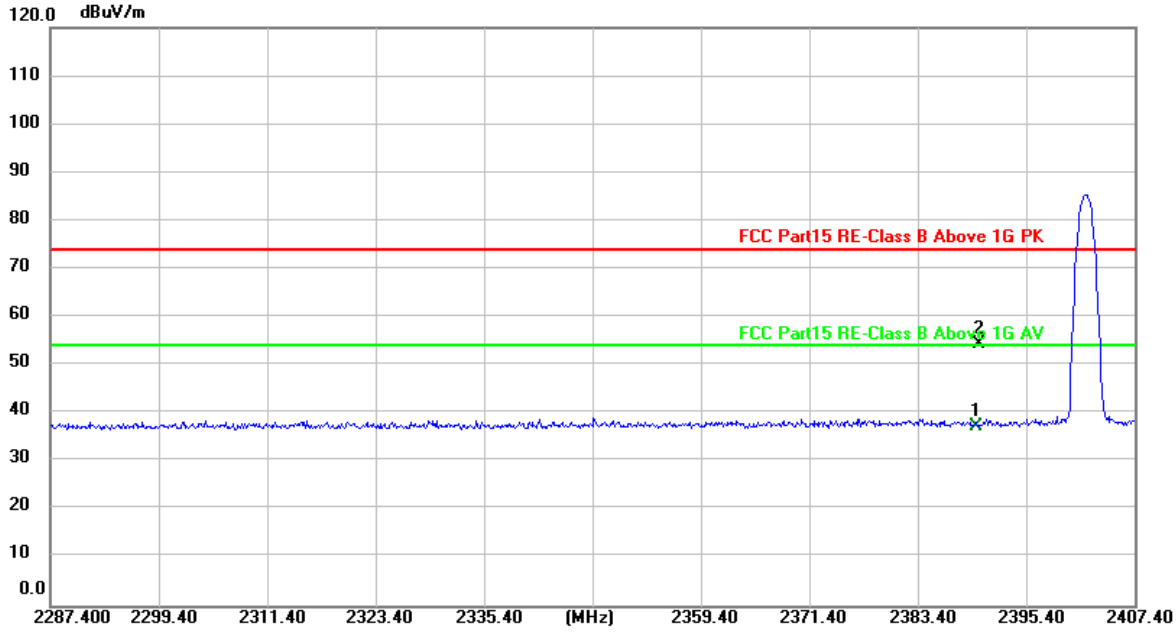
Ant. Pol.	Vertical
Test Mode:	GFSK Mode 2480MHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2483.500	24.20	31.48	55.68	74.00	-18.32	peak
2 *	2483.500	6.28	31.48	37.76	54.00	-16.24	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

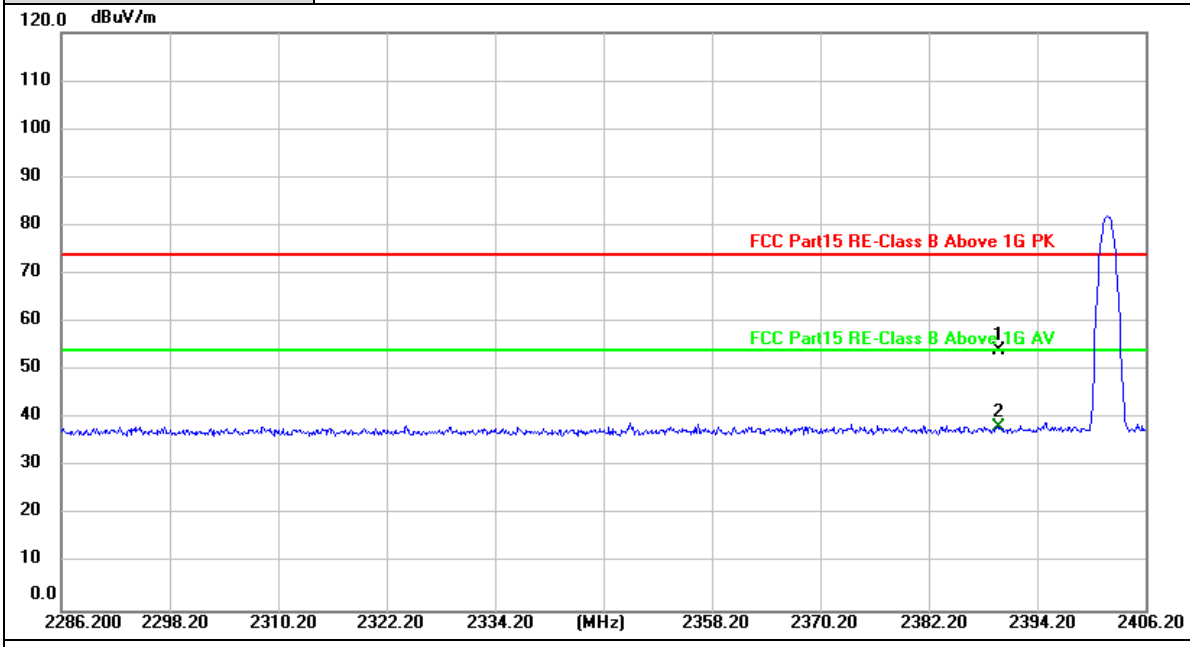
Ant. Pol.	Horizontal
Test Mode:	π/4-DQPSK Mode 2402MHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1 *	2390.000	6.13	31.31	37.44	54.00	-16.56	AVG
2	2390.200	23.04	31.31	54.35	74.00	-19.65	peak

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

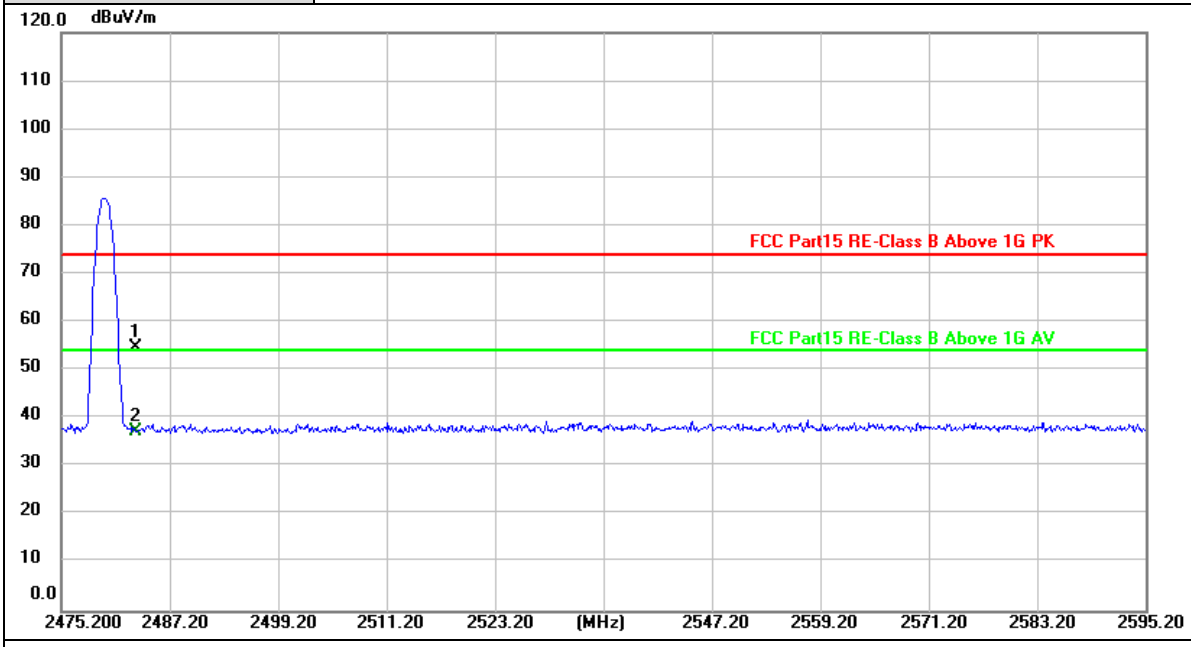
Ant. Pol.	Vertical
Test Mode:	π/4-DQPSK Mode 2402MHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2390.000	22.96	31.31	54.27	74.00	-19.73	peak
2 *	2390.000	6.93	31.31	38.24	54.00	-15.76	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

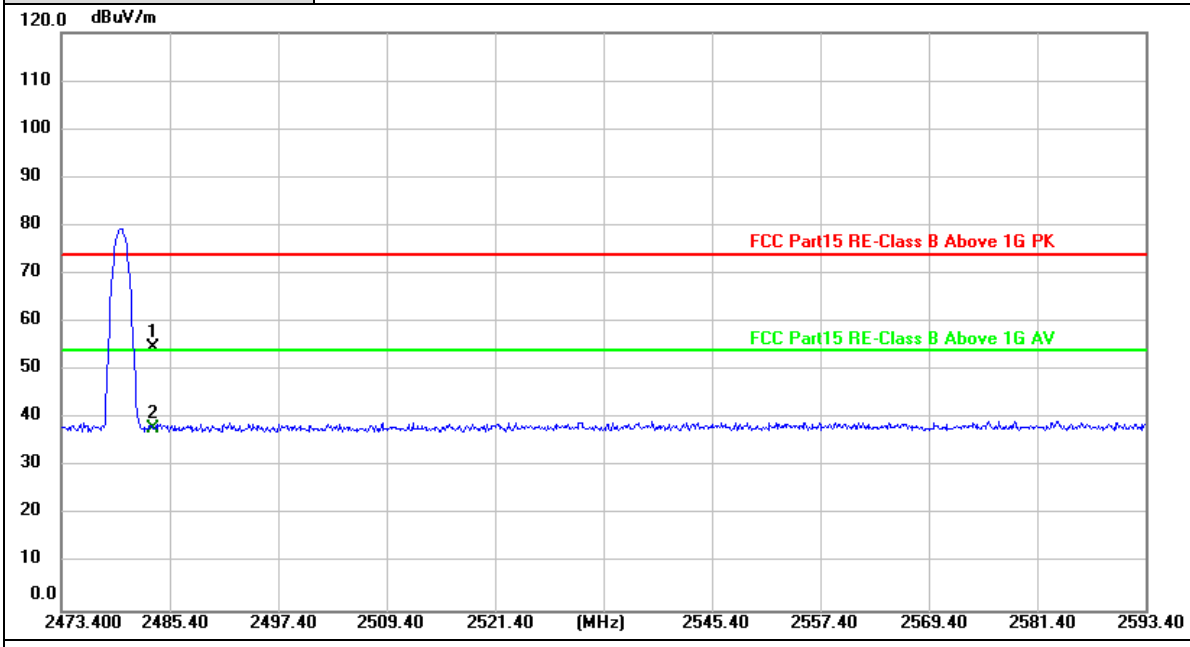
Ant. Pol.	Horizontal
Test Mode:	π/4-DQPSK Mode 2480MHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2483.500	23.28	31.48	54.76	74.00	-19.24	peak
2 *	2483.500	5.75	31.48	37.23	54.00	-16.77	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

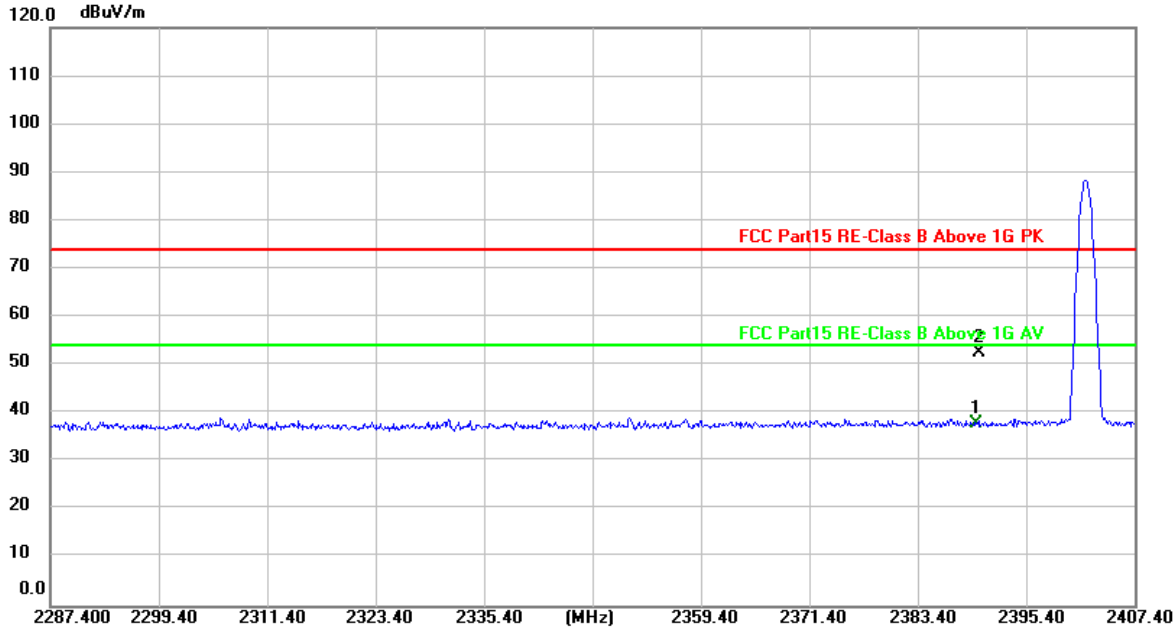
Ant. Pol.	Vertical
Test Mode:	π/4-DQPSK Mode 2480MHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2483.500	23.38	31.48	54.86	74.00	-19.14	peak
2 *	2483.500	6.47	31.48	37.95	54.00	-16.05	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

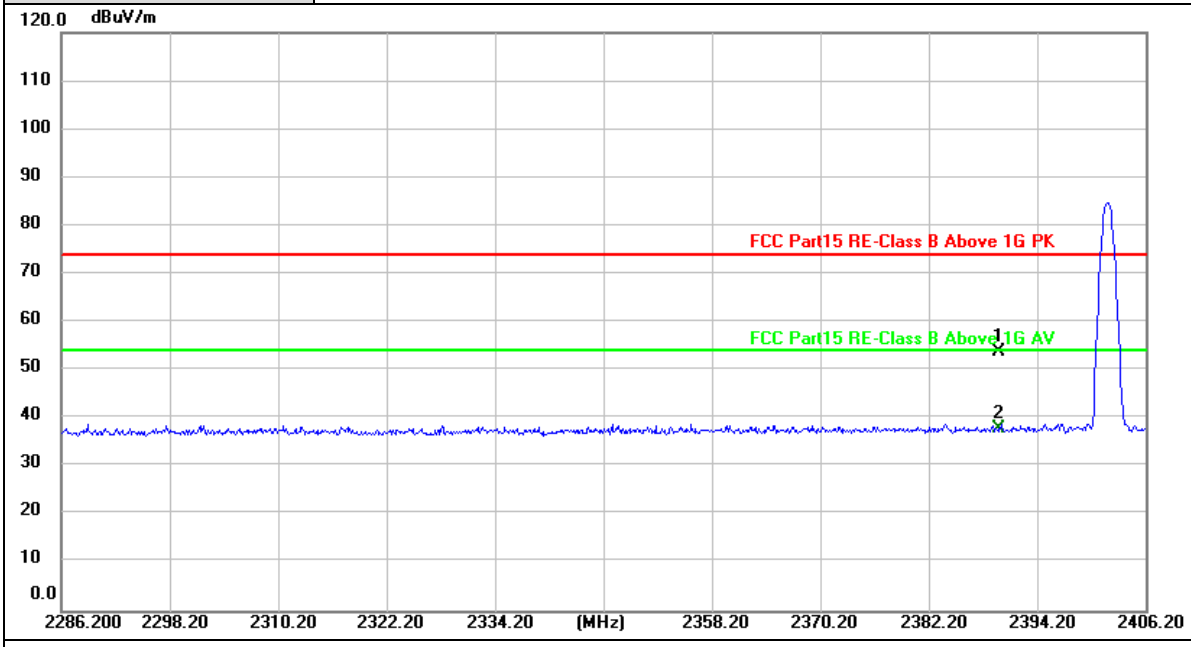
Ant. Pol.	Horizontal
Test Mode:	8-DPSK Mode 2402MHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1 *	2390.000	6.64	31.31	37.95	54.00	-16.05	AVG
2	2390.200	21.47	31.31	52.78	74.00	-21.22	peak

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

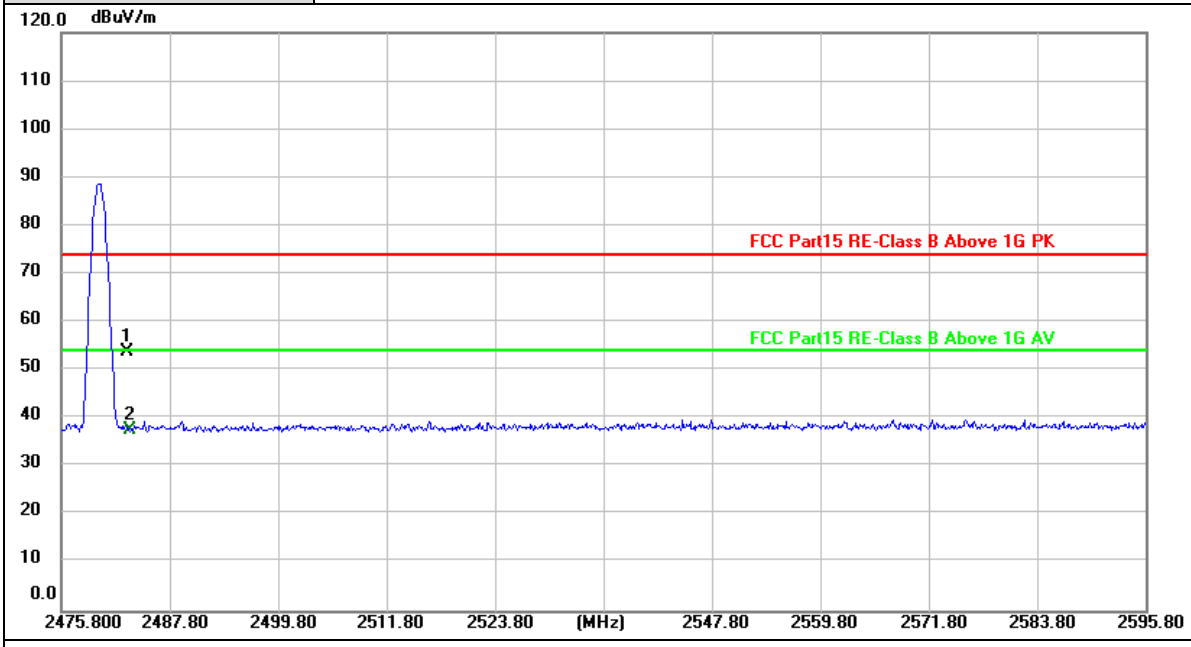
Ant. Pol.	Vertical
Test Mode:	8-DPSK Mode 2402MHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2390.000	22.59	31.31	53.90	74.00	-20.10	peak
2 *	2390.000	6.64	31.31	37.95	54.00	-16.05	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

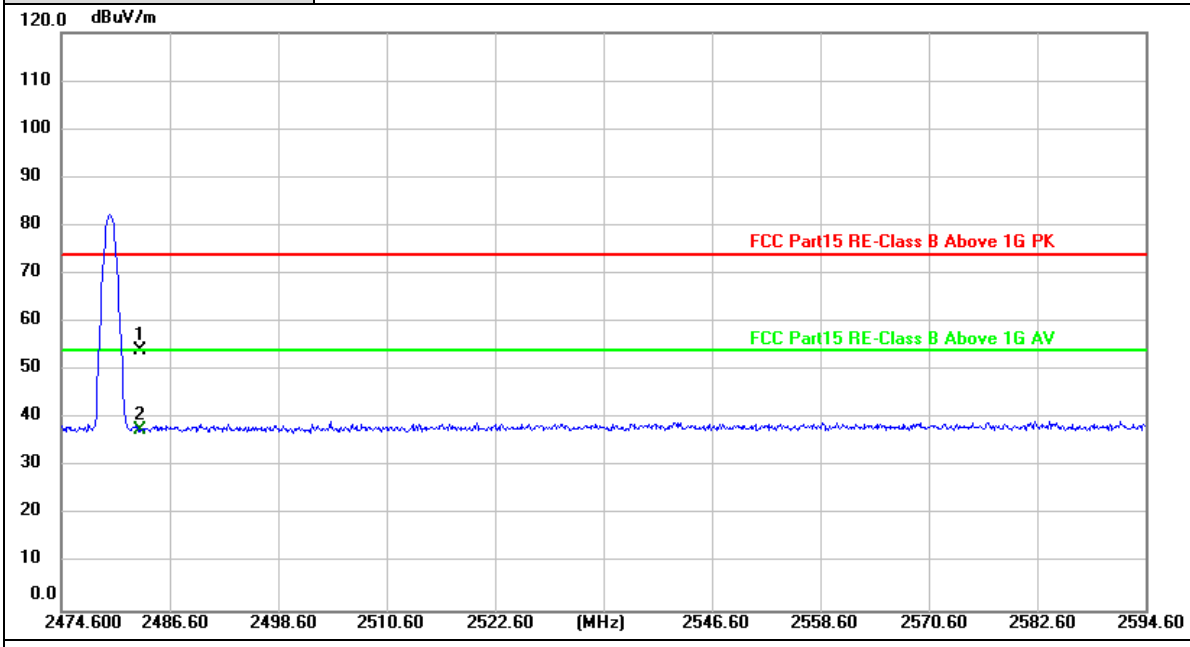
Ant. Pol.	Horizontal
Test Mode:	8-DPSK Mode 2480MHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2483.220	22.38	31.47	53.85	74.00	-20.15	peak
2 *	2483.500	6.26	31.48	37.74	54.00	-16.26	AVG

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

Ant. Pol.	Vertical
Test Mode:	8-DPSK Mode 2480MHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2483.500	22.61	31.48	54.09	74.00	-19.91	peak
2 *	2483.500	6.18	31.48	37.66	54.00	-16.34	AVG

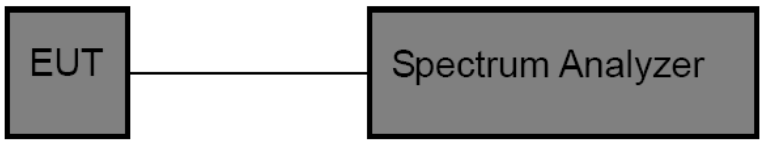
Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

3.4. Band Edge and Spurious Emissions (Conducted)

Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d) / RSS-247 5.5
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Test Configuration



Test Procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   RBW = 100 kHz, VBW ≥ RBW, scan up through 10th harmonic.
   Sweep = auto, Detector function = peak, Trace = max hold.
4. Measure and record the results in the test report.

Test Mode

Please refer to the clause 2.4.

Test Result

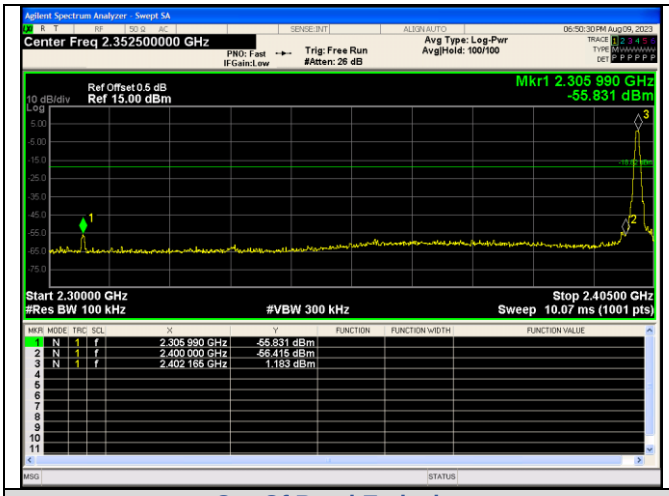
Non-Hopping

Modulation	Packet	Channel	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result
GFSK	DH5	0	2400.00	-56.415	-18.82	-37.595	PASS
			2305.99	-55.831	-18.82	-37.011	PASS
			9608.10	-42.258	-18.82	-23.438	PASS
		39	9764.17	-45.595	-19.04	-26.555	PASS
		78	2483.50	-62.145	-19.89	-42	PASS
			5775.12	-40.484	-19.89	-20.594	PASS
π/4DQPSK	2-DH5	0	2400.00	-51.903	-18.77	-33	PASS
			9608.11	-42.285	-18.77	-23.515	PASS
		39	9764.17	-45.983	-19.46	-26.523	PASS
		78	2483.50	-60.992	-19.98	-41	PASS
			9920.24	-47.787	-19.98	-27.807	PASS
8DPSK	3-DH5	0	2400.00	-52.109	-18.69	-33	PASS
			9608.11	-42.454	-18.69	-23.764	PASS
		39	9764.17	-46.480	-18.8	-27.680	PASS
		78	2483.50	-61.698	-19.8	-42	PASS
			9920.24	-48.480	-19.8	-28.680	PASS

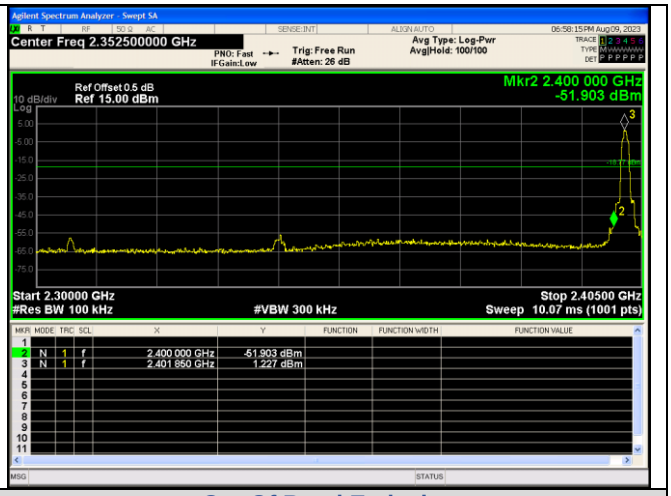
Hopping

Modulation	Packet	Channel	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result
GFSK	DH5	Hopping	2398.91	-52.339	-18.7	-33.639	PASS
			2400.00	-55.671	-18.7	-36.971	PASS
			2483.50	-57.450	-19.62	-37.830	PASS
			2400.00	-54.521	-18.9	-35.621	PASS
			2483.50	-59.505	-19.54	-39.965	PASS
			2382.01	-53.461	-18.51	-34.951	PASS
			2400.00	-58.030	-18.51	-39.520	PASS
			2483.50	-61.514	-19.46	-42.054	PASS
π/4DQPSK	2-DH5		2400.00	-52.989	-18.62	-34.369	PASS
			2483.50	-61.033	-19.49	-41.543	PASS
			2400.00	-53.710	-18.9	-34.810	PASS
			2483.50	-59.877	-19.36	-40.517	PASS
			2400.00	-49.691	-18.52	-31.171	PASS
			2483.50	-60.139	-19.39	-40.749	PASS
8DPSK	3-DH5		2400.00	-50.478	-18.83	-31.648	PASS
			2483.50	-60.148	-19.53	-40.618	PASS
			2400.00	-49.107	-18.68	-30.427	PASS
			2483.50	-61.378	-19.43	-41.948	PASS
			2372.87	-55.144	-18.53	-36.614	PASS
			2400.00	-56.819	-18.53	-38.289	PASS
			2483.50	-60.957	-19.37	-41.587	PASS

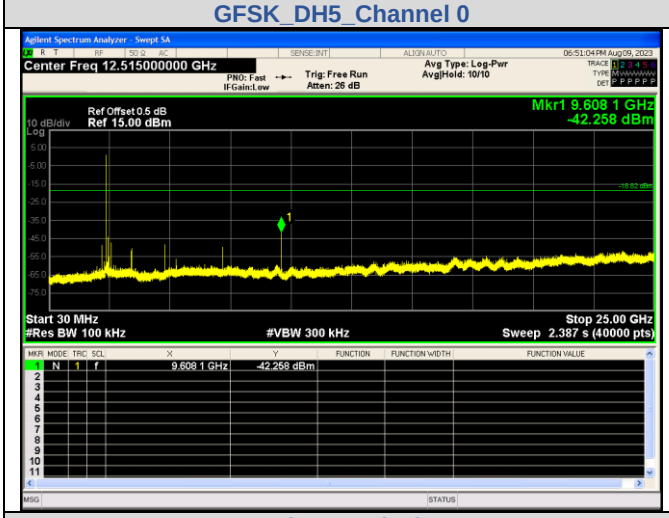
Test plot as follows:



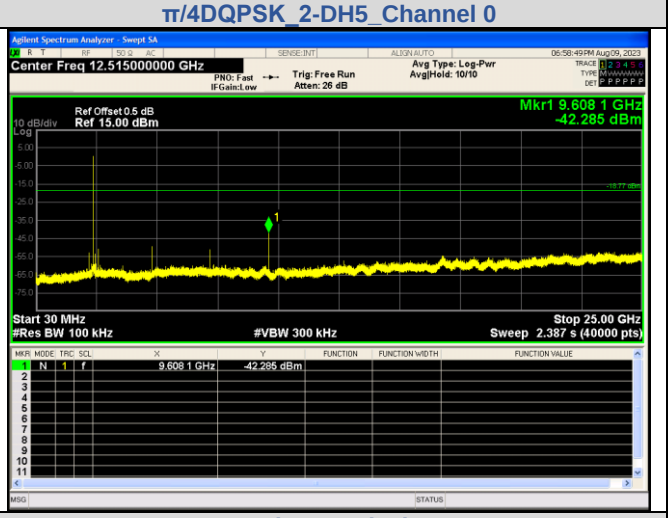
Out Of Band Emission
GFSK_DH5_Channel 0



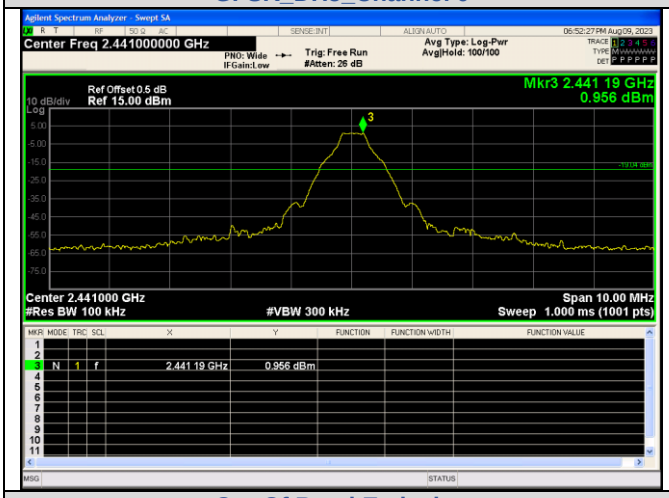
Out Of Band Emission
π/4DQPSK_2-DH5_Channel 0



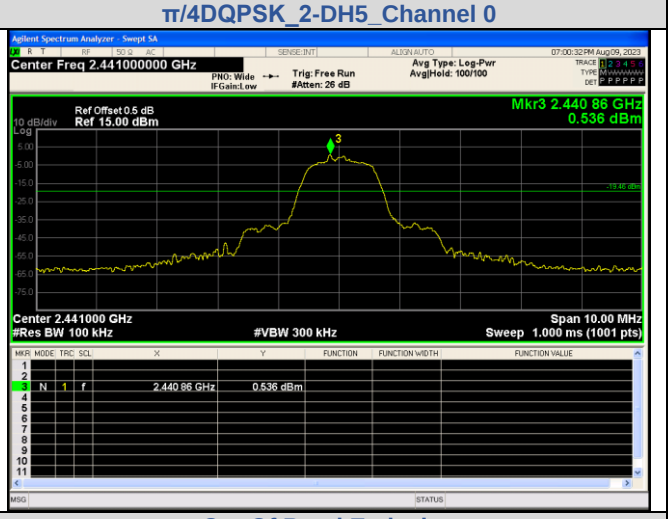
Spurious Emission
GFSK_DH5_Channel 0



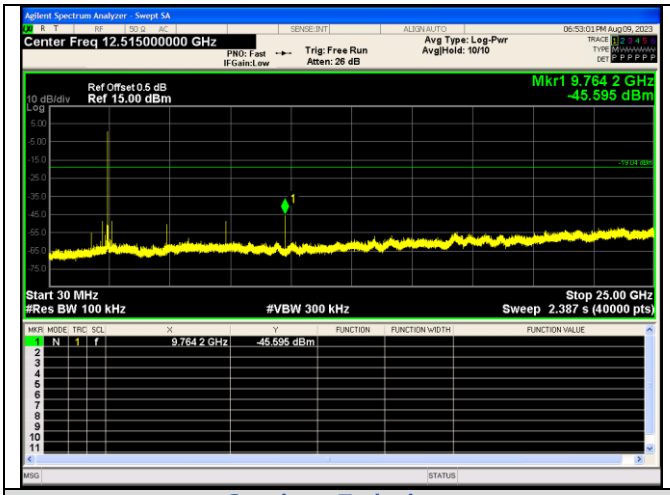
Spurious Emission
π/4DQPSK_2-DH5_Channel 0



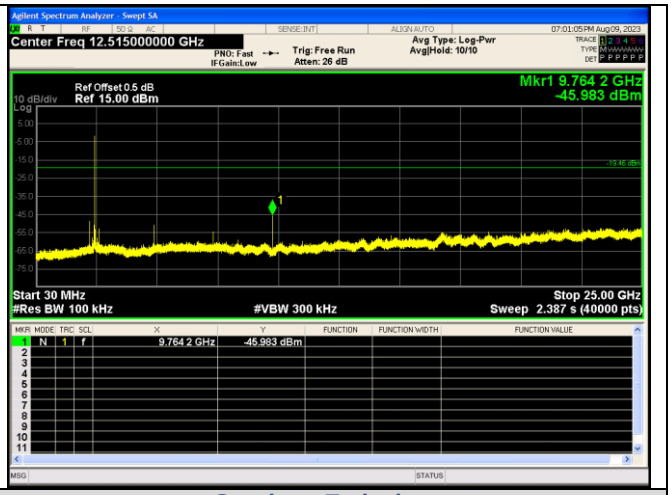
Out Of Band Emission
GFSK_DH5_Channel 39



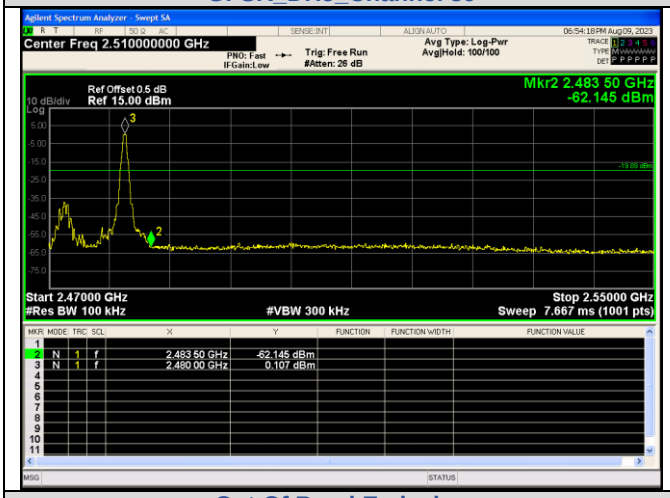
Out Of Band Emission
π/4DQPSK_2-DH5_Channel 39



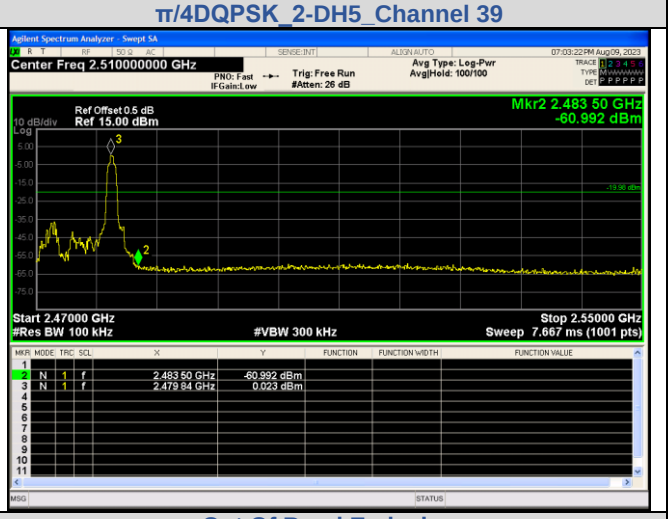
Spurious Emissions
GFSK_DH5_Channel 39



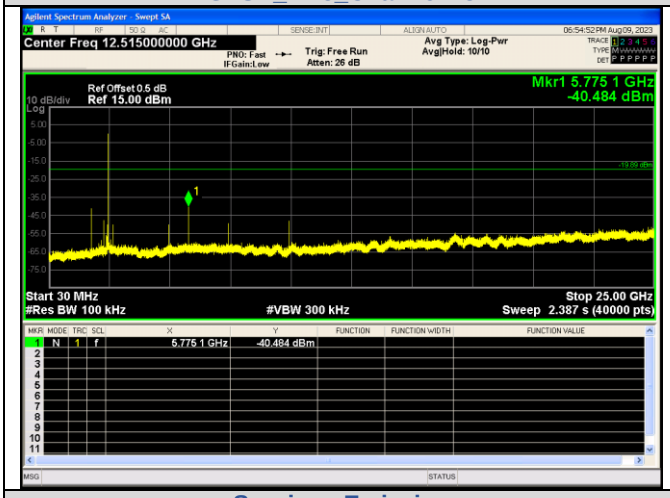
Spurious Emissions
π/4DQPSK_2-DH5_Channel 39



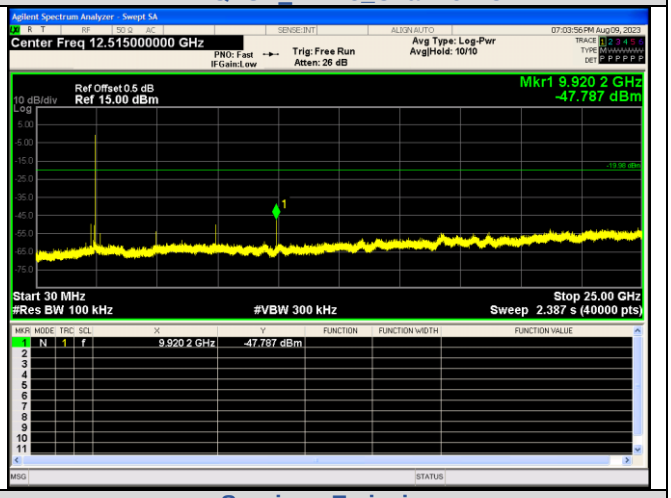
Out Of Band Emission
GFSK_DH5_Channel 78



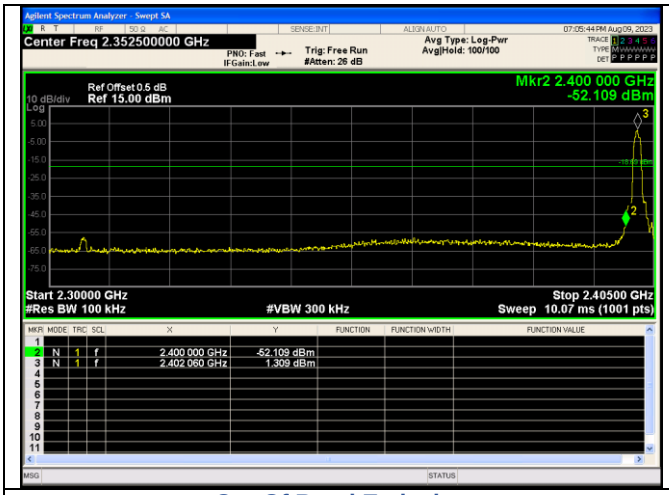
Out Of Band Emission
π/4DQPSK_2-DH5_Channel 78



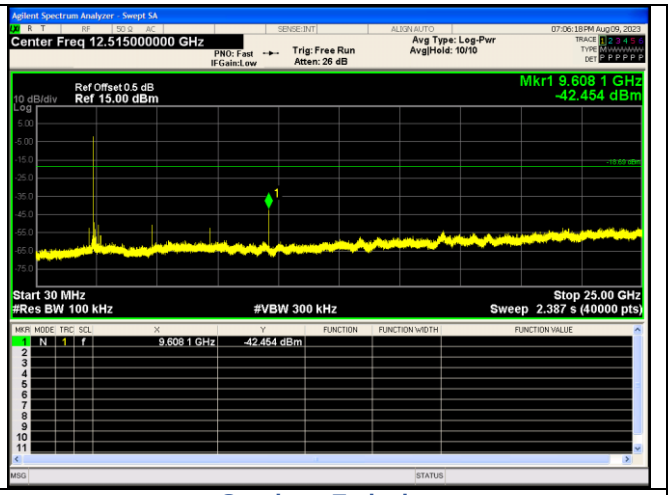
Spurious Emission
GFSK_DH5_Channel 78



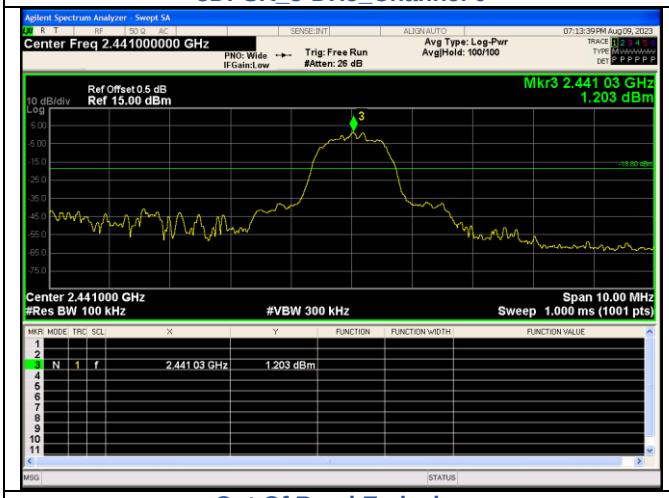
Spurious Emission
π/4DQPSK_2-DH5_Channel 78



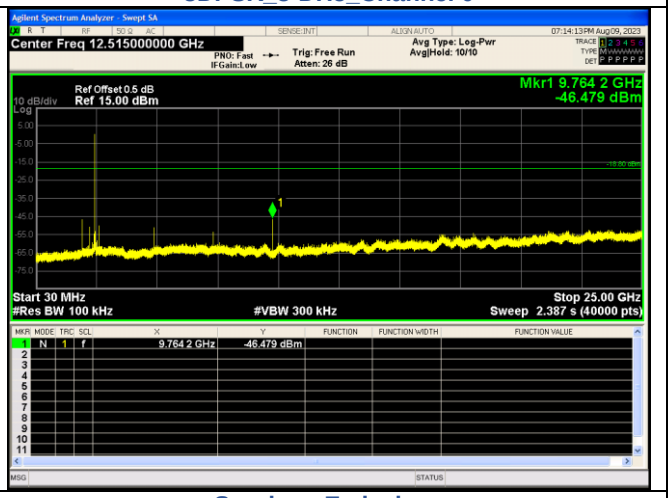
Out Of Band Emission
8DPSK_3-DH5_Channel 0



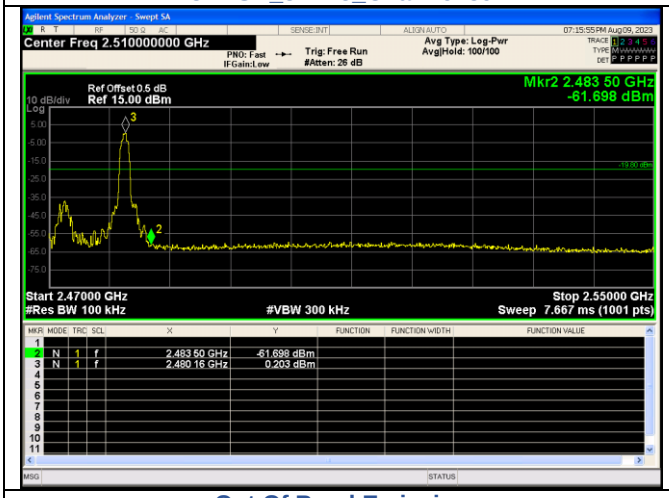
Spurious Emission
8DPSK_3-DH5_Channel 0



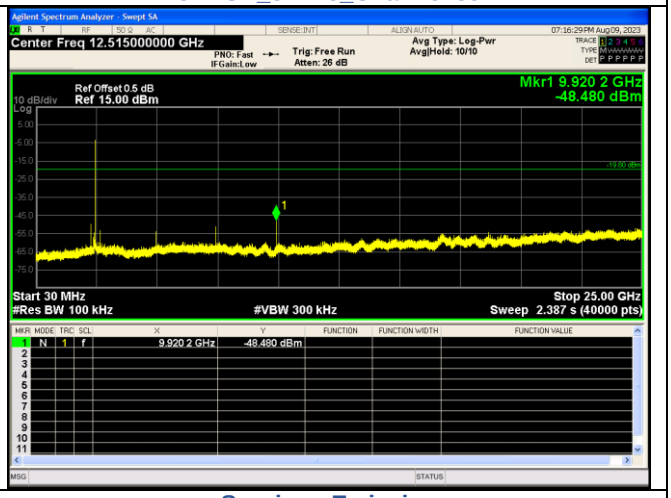
Out Of Band Emission
8DPSK_3-DH5_Channel 39



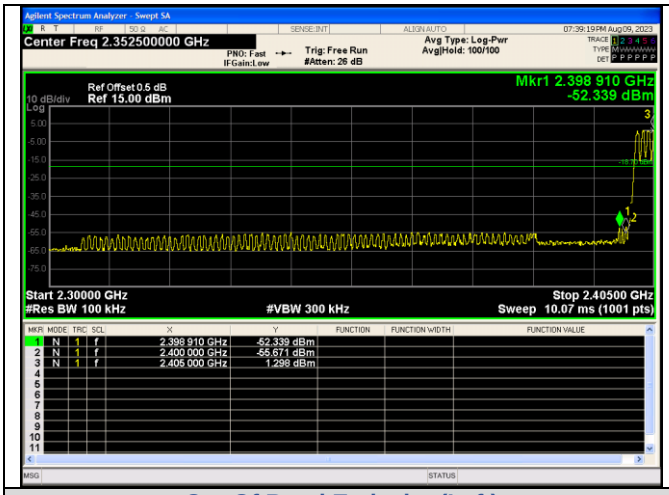
Spurious Emissions
8DPSK_3-DH5_Channel 39



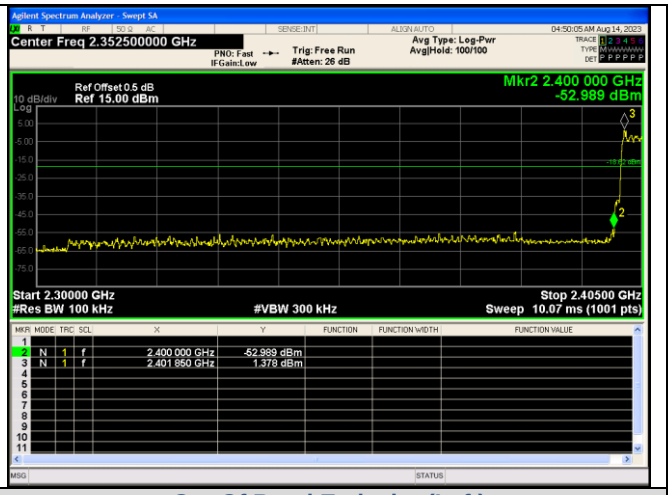
Out Of Band Emission
8DPSK_3-DH5_Channel 78



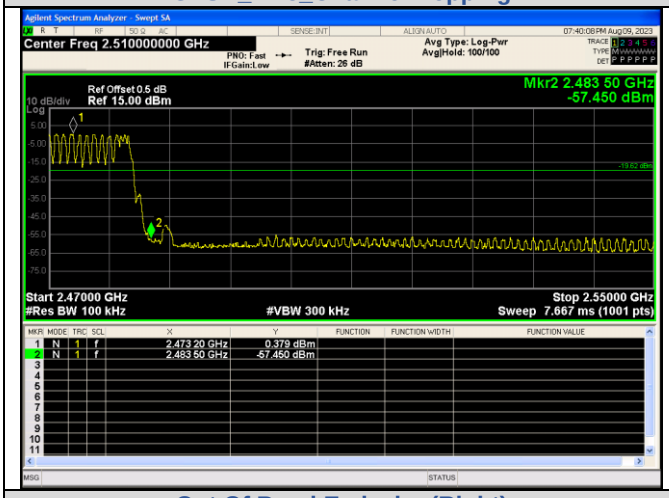
Spurious Emission
8DPSK_3-DH5_Channel 78



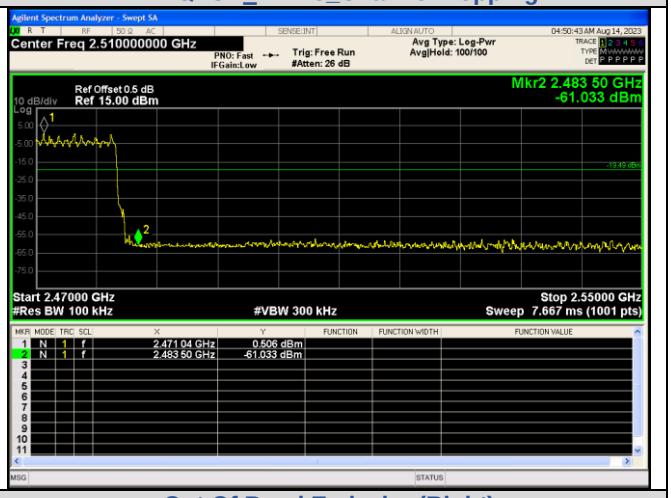
Out Of Band Emission(Left)
GFSK_DH5_Channel Hopping



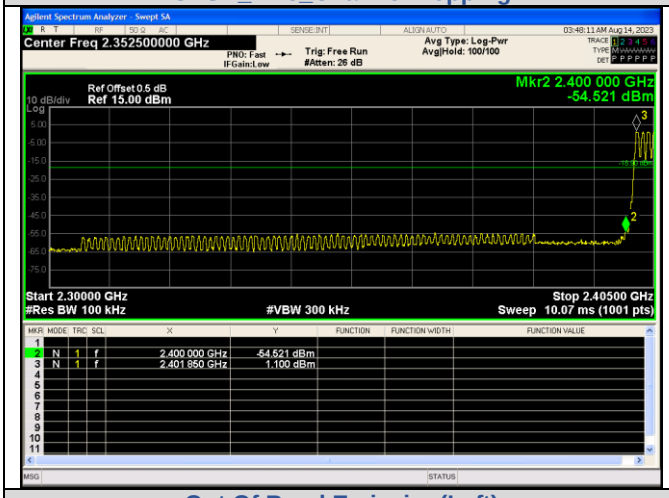
Out Of Band Emission(Left)
π/4DQPSK_2-DH5_Channel Hopping



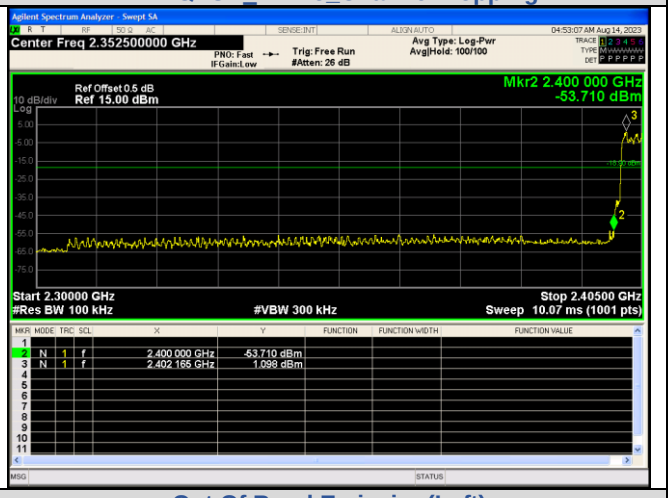
Out Of Band Emission(Right)
GFSK_DH5_Channel Hopping



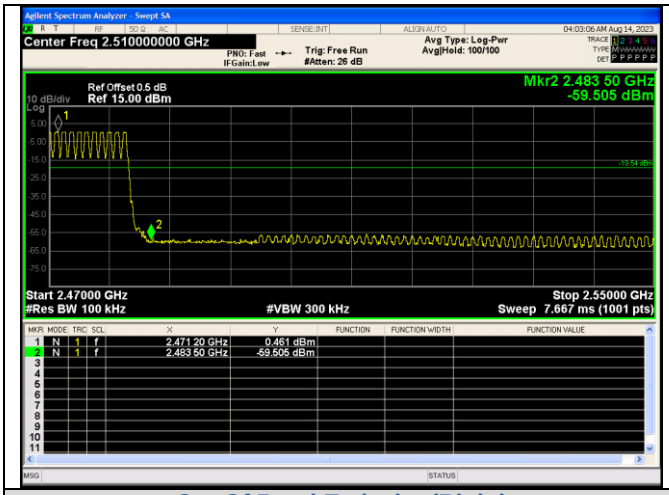
Out Of Band Emission(Right)
π/4DQPSK_2-DH5_Channel Hopping



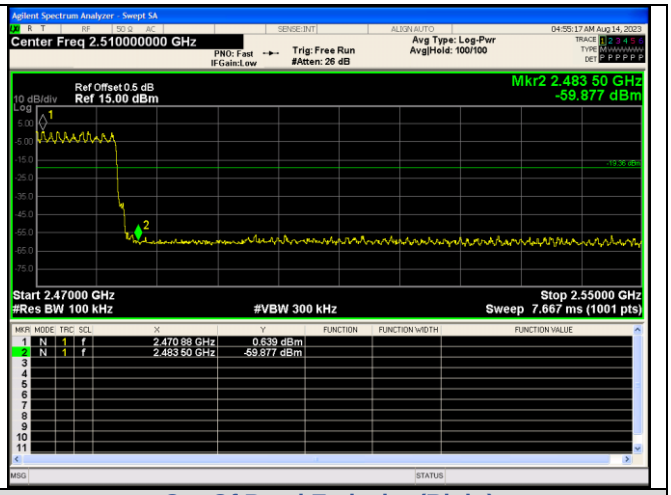
Out Of Band Emission(Left)
GFSK_DH5_Channel Hopping



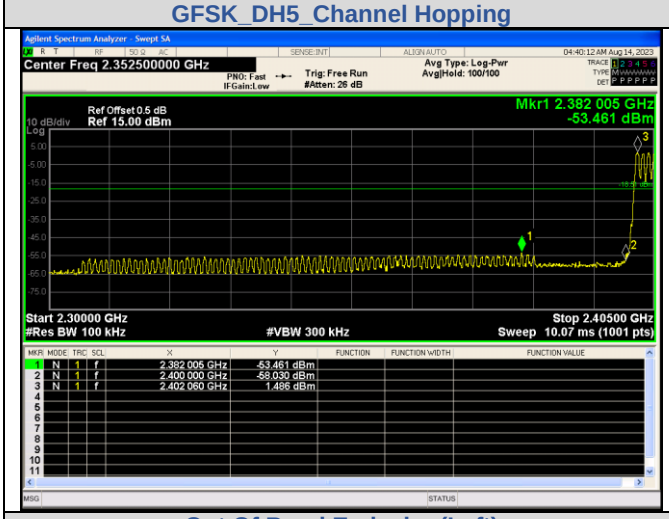
Out Of Band Emission(Left)
π/4DQPSK_2-DH5_Channel Hopping



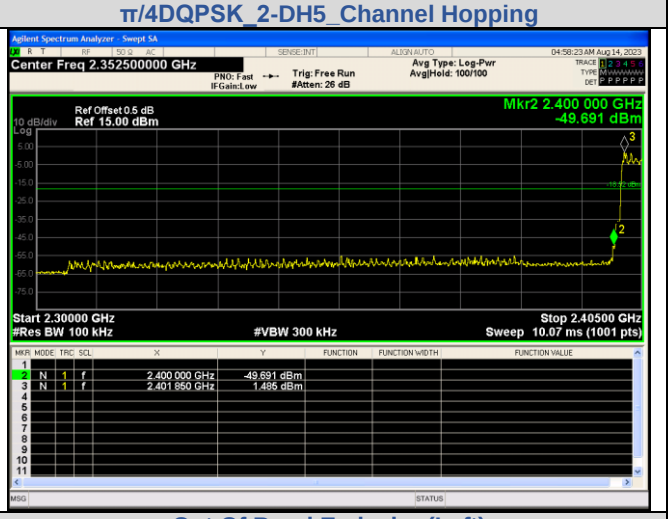
Out Of Band Emission(Right)
GFSK_DH5_Channel Hopping



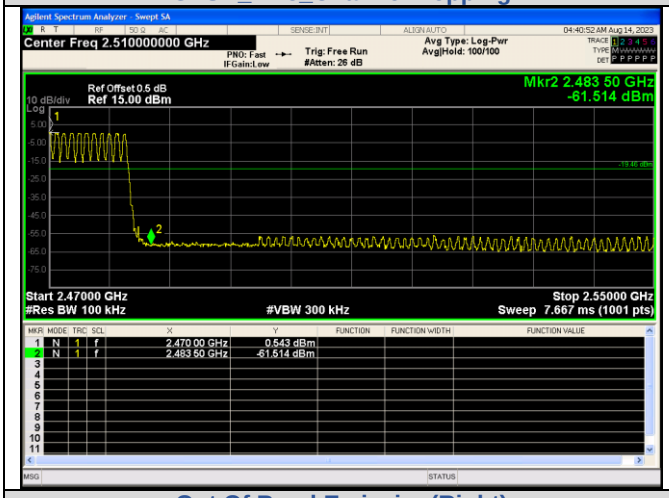
Out Of Band Emission(Right)
π/4DQPSK_2-DH5_Channel Hopping



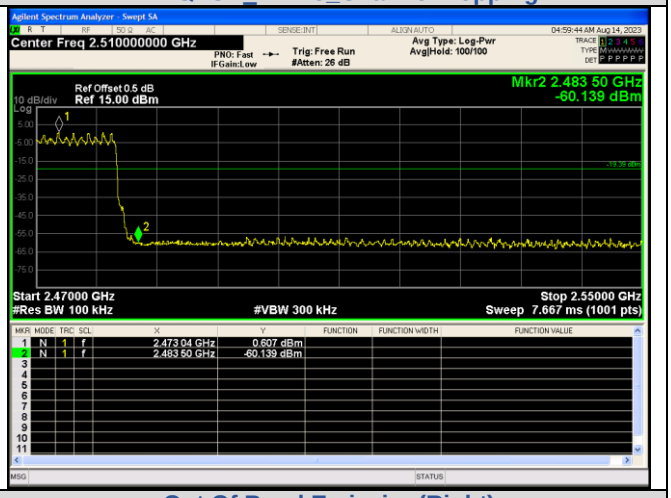
Out Of Band Emission(Left)
GFSK_DH5_Channel Hopping



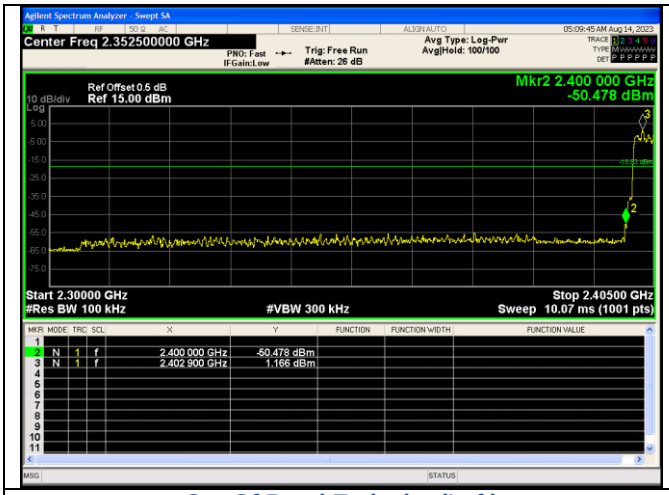
Out Of Band Emission(Left)
π/4DQPSK_2-DH5_Channel Hopping



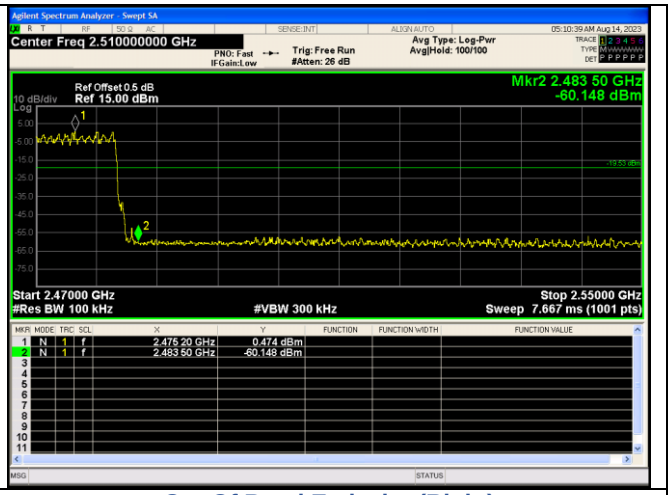
Out Of Band Emission(Right)
GFSK_DH5_Channel Hopping



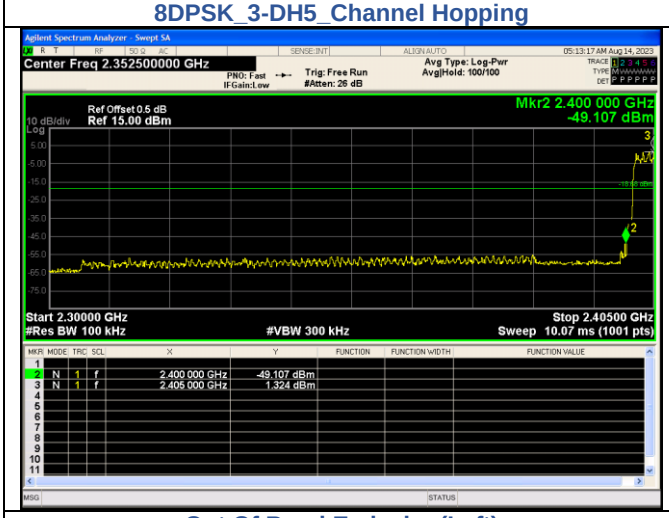
Out Of Band Emission(Right)
π/4DQPSK_2-DH5_Channel Hopping



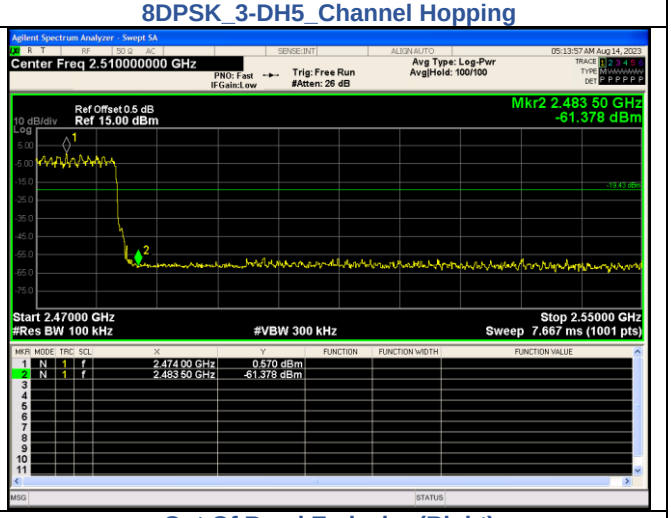
Out Of Band Emission(Left)
8DPSK_3-DH5_Channel Hopping



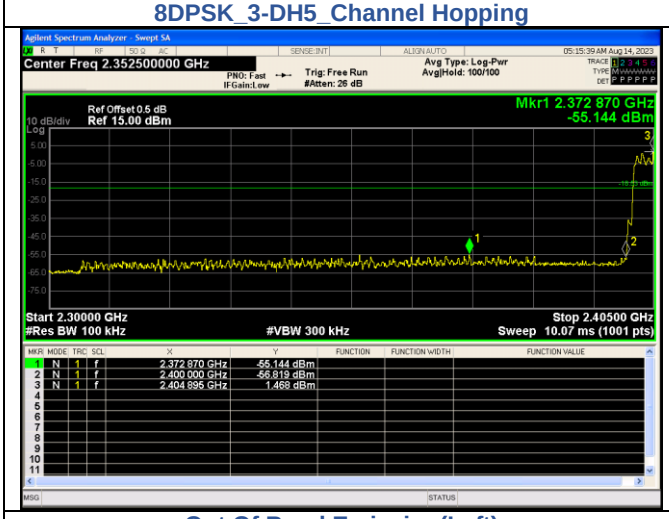
Out Of Band Emission(Right)
8DPSK_3-DH5_Channel Hopping



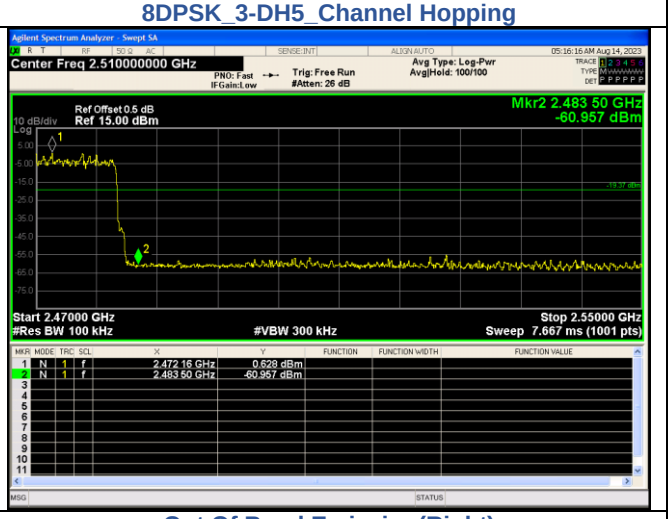
Out Of Band Emission(Left)
8DPSK_3-DH5_Channel Hopping



Out Of Band Emission(Right)
8DPSK_3-DH5_Channel Hopping



Out Of Band Emission(Left)
8DPSK_3-DH5_Channel Hopping



Out Of Band Emission(Right)
8DPSK_3-DH5_Channel Hopping