



TEST REPORT

FCC ID: 2AEJATORO

Product: MOBILE PHONE

Model No.: TORO

Additional Model No.: N/A

Trade Mark: RAYO MOVIL

Report No.: WSCT-A2LA-R&E220900005A-BT

Issued Date: 13 October 2022

Issued for:

GSM GLOBE.COM INC

8180 NW 36 Street Suite 317 Doral FL 33166.

Issued By:

World Standardization Certification & Testing Group(Shenzhen) Co.,Ltd.
Building A-B, Baoshi Science & Technology Park, Baoshi Road,
Bao'an District, Shenzhen, Guangdong, China

TEL: +86-755-26996192

FAX: +86-755-86376605



Note: The results contained in this report pertain only to the tested sample. This report shall not be reproduced, except in full, without written approval of World Standardization Certification & Testing Group (Shenzhen) Co., Ltd. This report must not be used by the client to claim product certification, approval, or any agency of the U.S. Government.





TABLE OF CONTENTS

- 1. Test Certification 3
- 2. Test Result Summary 4
- 3. EUT Description 5
- 4. Genera Information 7
 - 4.1. TEST ENVIRONMENT AND MODE 7
 - 4.2. DESCRIPTION OF SUPPORT UNITS 7
- 5. Facilities and Accreditations 8
 - 5.1. FACILITIES 8
 - 5.2. ACCREDITATIONS 8
 - 5.3 MEASUREMENT UNCERTAINTY 9
 - 5.4 MEASUREMENT INSTRUMENTS 10
- 6. Test Results and Measurement Data 11
 - 6.1. ANTENNA REQUIREMENT 11
 - 6.2. CONDUCTED EMISSION 12
 - 6.3. CONDUCTED OUTPUT POWER 15
 - 6.4. 20dB OCCUPY BANDWIDTH 23
 - 6.5. CARRIER FREQUENCIES SEPARATION 31
 - 6.6. HOPPING CHANNEL NUMBER 38
 - 6.7. DWELL TIME 41
 - 6.8. PSEUDORANDOM FREQUENCY HOPPING SEQUENCE 49
 - 6.9. CONDUCTED BAND EDGE MEASUREMENT 50
 - 6.10. CONDUCTED SPURIOUS EMISSION MEASUREMENT 53
 - 6.11. RADIATED SPURIOUS EMISSION MEASUREMENT 60





1. Test Certification

Product: MOBILE PHONE
 Model No.: TORO
 Additional Model: N/A
 Applicant: GSM GLOBE.COM INC
 Address: 8180 NW 36 Street Suite 317 Doral FL 33166.
 Manufacturer: GSM GLOBE.COM INC
 Address: 8180 NW 36 Street Suite 317 Doral FL 33166.
 Date of Test: 23 August 2022 to 13 October 2022
 Applicable Standards: FCC CFR Title 47 Part 15 Subpart C Section 15.247

The above equipment has been tested by World Standardization Certification & Testing Group(Shenzhen) Co., Ltd. and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Tested By: Wang Xiang
 (Wang Xiang)

Checked By: Qin Shuiquan
 (Qin Shuiquan)

Approved By: Wang Fengbing
 (Wang Fengbing)

Date: 13 October 2022





2. Test Result Summary

Requirement	CFR 47 Section	Result
Antenna Requirement	§15.203/§15.247 (c)	PASS
AC Power Line Conducted Emission	§15.207	PASS
Conducted Peak Output Power	§15.247 (b)(1) §2.1046	PASS
20dB Occupied Bandwidth	§15.247 (a)(1) §2.1049	PASS
Carrier Frequencies Separation	§15.247 (a)(1)	PASS
Hopping Channel Number	§15.247 (a)(1)	PASS
Dwell Time	§15.247 (a)(1)	PASS
Radiated Emission	§15.205/§15.209 §2.1053, §2.1057	PASS
Band Edge	§15.247(d) §2.1051, §2.1057	PASS

Note:

1. PASS: Test item meets the requirement.
2. Fail: Test item does not meet the requirement.
3. N/A: Test case does not apply to the test object.
4. The test result judgment is decided by the limit of test standard.





3. EUT Description

Product Name:	MOBILE PHONE
Model :	TORO
Additional Model:	N/A
Trade Mark:	RAYO MOVIL
Operation Frequency:	2402MHz~2480MHz
Channel Separation:	1MHz
Number of Channel:	79
Modulation Type:	GFSK, $\pi/4$ -DQPSK, 8DPSK
Modulation Technology:	FHSS
Antenna Type:	Integral Antenna
Antenna Gain:	1.1 dBi
Rechargeable Polymer Battery: Li-ion	Model: TORO Type: 3.7V Rated Capacity: 1000mAh/3.7Wh Max Charge Voltage: 4.2V
Adapter:	Model: Rok2 Input: 100-240V~50/60Hz 0.15A Output: 5.0V --- 1A
Remark:	N/A.



Operation Frequency each of channel for GFSK, $\pi/4$ -DQPSK, 8DPSK

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	20	2422MHz	40	2442MHz	60	2462MHz
1	2403MHz	21	2423MHz	41	2443MHz	61	2463MHz
...
10	2412MHz	30	2432MHz	50	2452MHz	70	2472MHz
11	2413MHz	31	2433MHz	51	2453MHz	71	2473MHz
...
18	2420MHz	38	2440MHz	58	2460MHz	78	2480MHz
19	2421MHz	39	2441MHz	59	2461MHz	-	-

Remark: Channel 0, 39 & 78 have been tested for GFSK, $\pi/4$ -DQPSK, 8DPSK modulation mode.





4. Genera Information

4.1. Test environment and mode

Operating Environment:	
Temperature:	25.0 °C
Humidity:	56 % RH
Atmospheric Pressure:	1010 mbar
Test Mode:	
Engineering mode:	Keep the EUT in continuous transmitting by select channel and modulations with Fully-charged battery
<p>The sample was placed 0.8m & 1.5m for the measurement below & above 1GHz above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.</p>	

4.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Equipment	Model No.	Serial No.	FCC ID	Trade Name
Adapter	Adapter	/	/	ADAPTER

Note:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.
3. For conducted measurements (Output Power, 20dB Occupied Bandwidth, Carrier Frequencies Separation, Hopping Channel Number, Dwell Time, Spurious Emissions), the antenna of EUT is connected to the test equipment via temporary antenna connector, the antenna connector is soldered on the antenna port of EUT, and the temporary antenna connector is listed in the Test Instruments.





5. Facilities and Accreditations

5.1. Facilities

All measurement facilities used to collect the measurement data are located at **Building A-B, Baoshi Science & Technology Park, Baoshi Road, Bao'an District, Shenzhen, Guangdong, China of the World Standardization Certification & Testing Group(Shenzhen) Co., Ltd.**

The sites are constructed in conformance with the requirements of ANSI C63.4 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

5.2. ACCREDITATIONS

China National Accreditation Service for Conformity Assessment (CNAS)

Registration number NO: L3732

American Association for Laboratory Accreditation(A2LA)

Registration NO : 5768.01

Copies of granted accreditation certificates are available for downloading from our web site, <http://www.wsct-cert.com>





5.3 Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

No.	Item	MU
1	Conducted Emission Test	$\pm 3.2\text{dB}$
2	RF power, conducted	$\pm 0.16\text{dB}$
3	Spurious emissions, conducted	$\pm 0.21\text{dB}$
4	All emissions, radiated(<1GHz)	$\pm 4.7\text{dB}$
5	All emissions, radiated(>1GHz)	$\pm 4.7\text{dB}$
6	Temperature	$\pm 0.5^\circ\text{C}$
7	Humidity	$\pm 2.0\%$





5.4 MEASUREMENT INSTRUMENTS

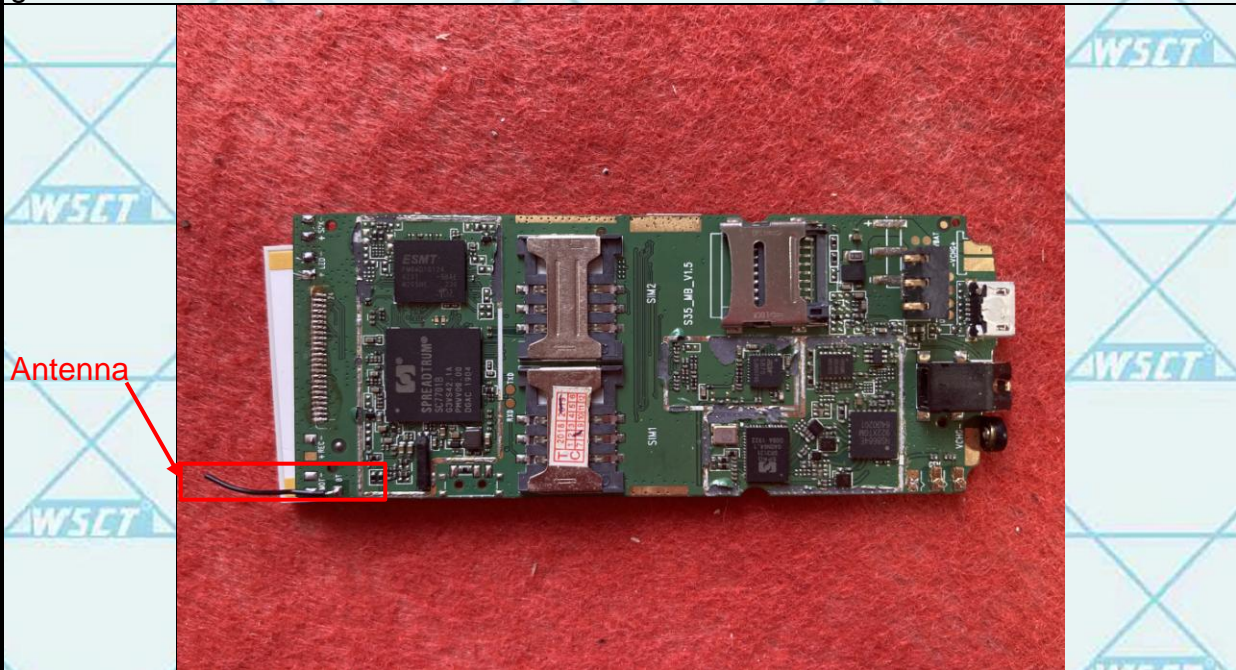
NAME OF EQUIPMENT	MANUFACTURER	MODEL	SERIAL NUMBER	Calibration Date	Calibration Due.
Test software	--	EZ-EMC	CON-03A	-	-
EMI Test Receiver	R&S	ESCI	100005	11/05/2021	11/04/2022
LISN	AFJ	LS16	16010222119	11/05/2021	11/04/2022
LISN(EUT)	Mestec	AN3016	04/10040	11/05/2021	11/04/2022
Universal Radio Communication Tester	R&S	CMU 200	1100.0008.02	11/05/2021	11/04/2022
Coaxial cable	Megalon	LMR400	N/A	11/05/2021	11/04/2022
GPIO cable	Megalon	GPIO	N/A	11/05/2021	11/04/2022
Spectrum Analyzer	R&S	FSU	100114	11/05/2021	11/04/2022
Pre Amplifier	H.P.	HP8447E	2945A02715	11/05/2021	11/04/2022
Pre-Amplifier	CDSI	PAP-1G18-38	--	11/05/2021	11/04/2022
Bi-log Antenna	SUNOL Sciences	JB3	A021907	11/05/2021	11/04/2022
9*6*6 Anechoic	--	--	--	11/05/2021	11/04/2022
Horn Antenna	COMPLIANCE ENGINEERING	CE18000	--	11/05/2021	11/04/2022
Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-631	11/05/2021	11/04/2022
Cable	TIME MICROWAVE	LMR-400	N-TYPE04	11/05/2021	11/04/2022
System-Controller	CCS	N/A	N/A	N.C.R	N.C.R
Turn Table	CCS	N/A	N/A	N.C.R	N.C.R
Antenna Tower	CCS	N/A	N/A	N.C.R	N.C.R
RF cable	Murata	MXHQ87WA3000	-	11/05/2021	11/04/2022
Loop Antenna	EMCO	6502	00042960	11/05/2021	11/04/2022
Horn Antenna	SCHWARZBECK	BBHA 9170	1123	11/05/2021	11/04/2022
Power meter	Anritsu	ML2487A	6K00003613	11/05/2021	11/04/2022
Power sensor	Anritsu	MX248XD	--	11/05/2021	11/04/2022



6. Test Results and Measurement Data

6.1. Antenna requirement

Standard requirement:	FCC Part15 C Section 15.203 /247(c)
<p>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.</p> <p>15.247(c) (1)(i) requirement: (i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.</p>	
E.U.T Antenna:	
<p>The Bluetooth antenna is a Integral Antenna. it meets the standards, and the best case gain of the antenna is 1.1dBi.</p>	





6.2. Conducted Emission

6.2.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.207														
Test Method:	ANSI C63.10:2014														
Frequency Range:	150 kHz to 30 MHz														
Receiver setup:	RBW=9 kHz, VBW=30 kHz, Sweep time=auto														
Limits:	<table border="1"> <thead> <tr> <th rowspan="2">Frequency range (MHz)</th> <th colspan="2">Limit (dBuV)</th> </tr> <tr> <th>Quasi-peak</th> <th>Average</th> </tr> </thead> <tbody> <tr> <td>0.15-0.5</td> <td>66 to 56*</td> <td>56 to 46*</td> </tr> <tr> <td>0.5-5</td> <td>56</td> <td>46</td> </tr> <tr> <td>5-30</td> <td>60</td> <td>50</td> </tr> </tbody> </table>	Frequency range (MHz)	Limit (dBuV)		Quasi-peak	Average	0.15-0.5	66 to 56*	56 to 46*	0.5-5	56	46	5-30	60	50
Frequency range (MHz)	Limit (dBuV)														
	Quasi-peak	Average													
0.15-0.5	66 to 56*	56 to 46*													
0.5-5	56	46													
5-30	60	50													
Test Setup:	<p>Reference Plane</p> <p>40cm</p> <p>80cm</p> <p>E.U.T</p> <p>AC power</p> <p>LISN</p> <p>Filter</p> <p>AC power</p> <p>EMI Receiver</p> <p>Test table/Insulation plane</p> <p><i>Remark</i> E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m</p>														
Test Mode:	Refer to item 4.1														
Test Procedure:	<ol style="list-style-type: none"> The E.U.T is connected to an adapter through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2014 on conducted measurement. 														
Test Result:	PASS														

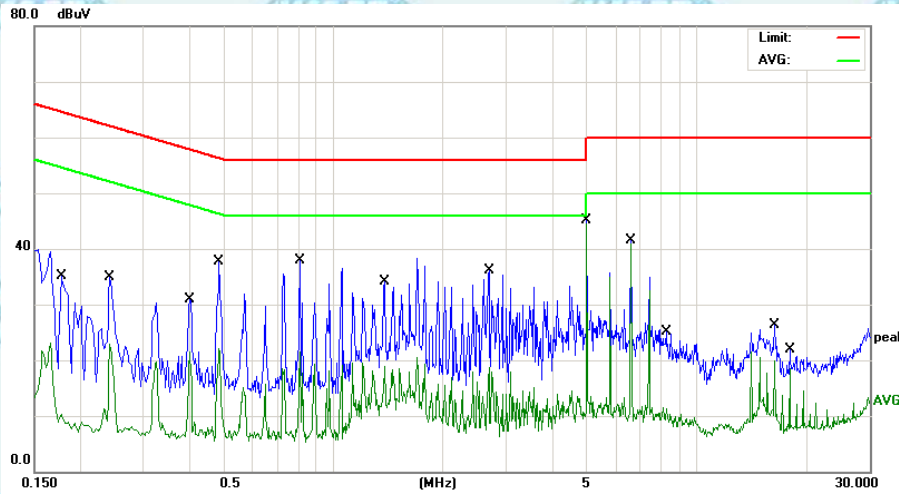




6.2.2. Test data

Please refer to following diagram for individual

Conducted Emission on Line Terminal of the power line (150 kHz to 30MHz)



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.1780	24.71	10.41	35.12	64.57	-29.45	QP
2		0.2420	12.41	10.42	22.83	52.02	-29.19	AVG
3		0.4020	11.03	10.45	21.48	47.81	-26.33	AVG
4		0.4860	27.33	10.47	37.80	56.24	-18.44	QP
5		0.8100	10.91	10.49	21.40	46.00	-24.60	AVG
6		1.3820	23.50	10.57	34.07	56.00	-21.93	QP
7		2.6820	8.10	10.67	18.77	46.00	-27.23	AVG
8	*	4.9940	34.41	10.69	45.10	56.00	-10.90	QP
9		6.6020	30.87	10.72	41.59	60.00	-18.41	QP
10		8.1180	0.78	10.75	11.53	50.00	-38.47	AVG
11		16.4660	15.16	11.06	26.22	60.00	-33.78	QP
12		18.0780	7.49	11.05	18.54	50.00	-31.46	AVG

Note:

Freq. = Emission frequency in MHz

Reading level (dBuV) = Receiver reading

Corr. Factor (dB) = Antenna factor + Cable loss

Measurement (dBuV) = Reading level (dBuV) + Corr. Factor (dB)

Limit (dBuV) = Limit stated in standard

Margin (dB) = Measurement (dBuV) – Limits (dBuV)

Q.P. = Quasi-Peak

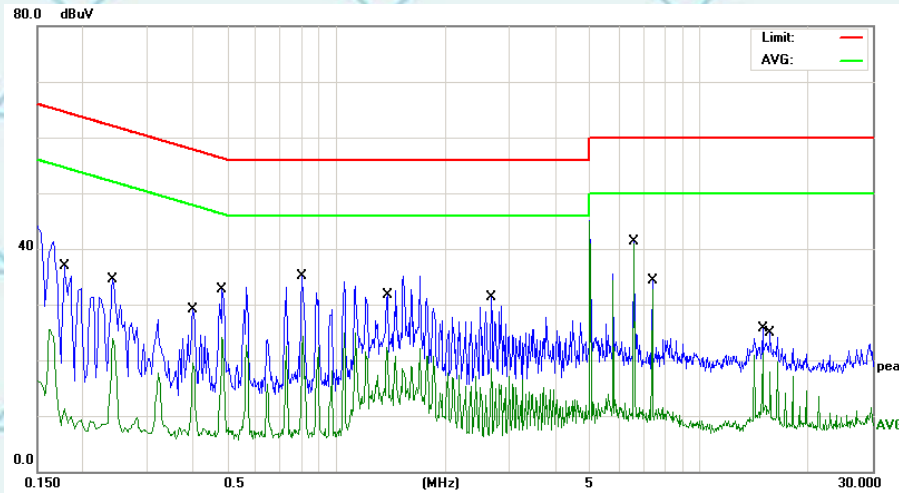
AVG = average

* is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz





Conducted Emission on Neutral Terminal of the power line (150 kHz to 30MHz)



No.	Mk.	Freq. MHz	Reading Level dBµV	Correct Factor dB	Measurement dBµV	Limit dBµV	Over dB	Detector
1		0.1780	26.58	10.41	36.99	64.57	-27.58	QP
2		0.2420	13.44	10.42	23.86	52.02	-28.16	AVG
3		0.4020	9.14	10.45	19.59	47.81	-28.22	AVG
4		0.4860	22.25	10.47	32.72	56.24	-23.52	QP
5		0.8020	24.65	10.49	35.14	56.00	-20.86	QP
6		0.8100	13.75	10.49	24.24	46.00	-21.76	AVG
7		1.3779	11.66	10.57	22.23	46.00	-23.77	AVG
8		2.6780	20.72	10.67	31.39	56.00	-24.61	QP
9	*	6.6020	30.25	10.72	40.97	50.00	-9.03	AVG
10		7.4140	23.56	10.74	34.30	60.00	-25.70	QP
11		14.9100	10.27	11.06	21.33	50.00	-28.67	AVG
12		15.6780	13.88	11.06	24.94	60.00	-35.06	QP

Note1:

- Freq. = Emission frequency in MHz
- Reading level (dBµV) = Receiver reading
- Corr. Factor (dB) = Antenna factor + Cable loss
- Measurement (dBµV) = Reading level (dBµV) + Corr. Factor (dB)
- Limit (dBµV) = Limit stated in standard
- Margin (dB) = Measurement (dBµV) – Limits (dBµV)
- Q.P. =Quasi-Peak AVG =average
- * is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.

Note2:

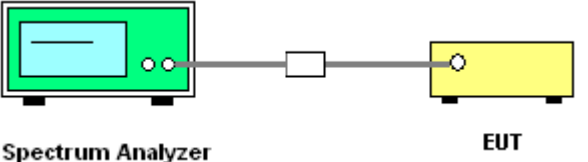
Measurements were conducted in all three channels (high, middle, low) and three modulation (GFSK, Pi/4 DQPSK, 8DPSK), and the worst case Mode (Lowest channel and GFSK) was submitted only.





6.3. Conducted Output Power

6.3.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (b)(3)
Test Method:	ANSI C63.10:2014
Limit:	Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts.
Test Setup:	 <p style="text-align: center;">Spectrum Analyzer EUT</p>
Test Mode:	Transmitting mode with modulation
Test Procedure:	Use the following spectrum analyzer settings: Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel RBW > the 20 dB bandwidth of the emission being measured VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission.
Test Result:	PASS





6.3.2. Test Data

GFSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	9.14	20.97	PASS
Middle	8.71	20.97	PASS
Highest	7.78	20.97	PASS

Pi/4DQPSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	8.61	20.97	PASS
Middle	7.82	20.97	PASS
Highest	7.23	20.97	PASS

8DPSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	8.22	20.97	PASS
Middle	7.83	20.97	PASS
Highest	7.30	20.97	PASS

Test plots as follows:



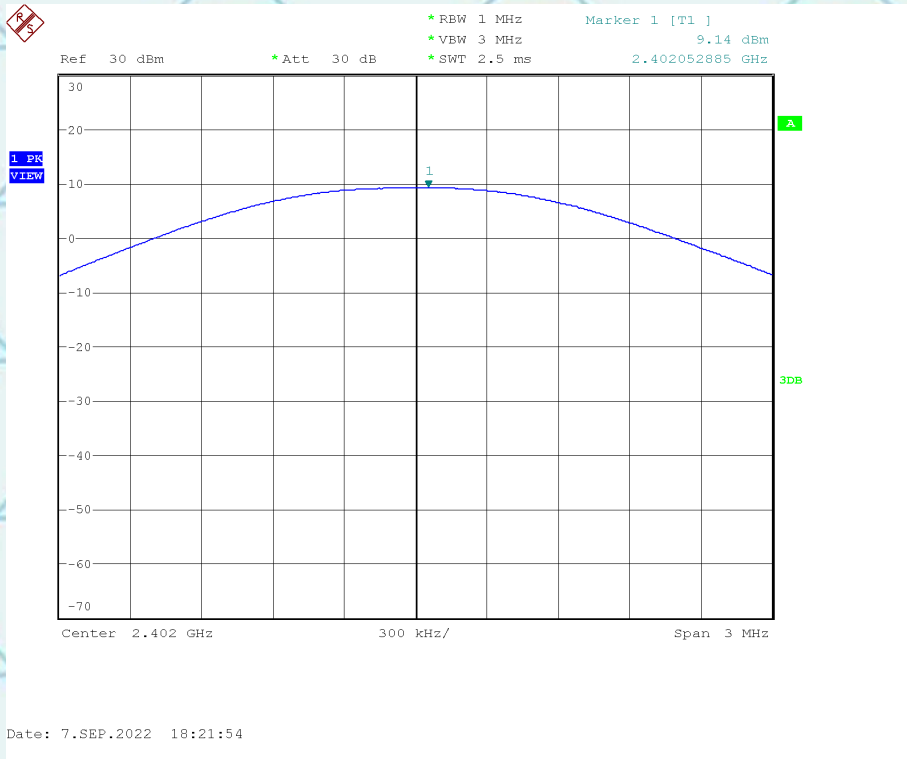


Report No.: WSCT-A2LA-R&E220900005A-BT
GFSK Modulation

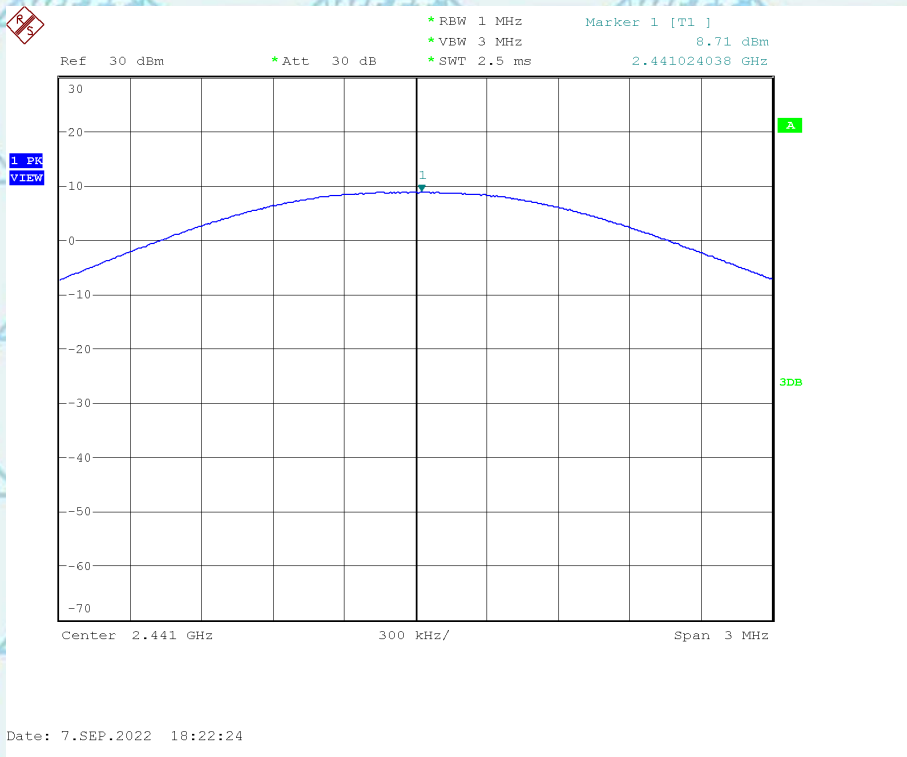
Certificate #5768.01

For Question,
Please Contact with WSCT
www.wsct-cert.com

Lowest channel

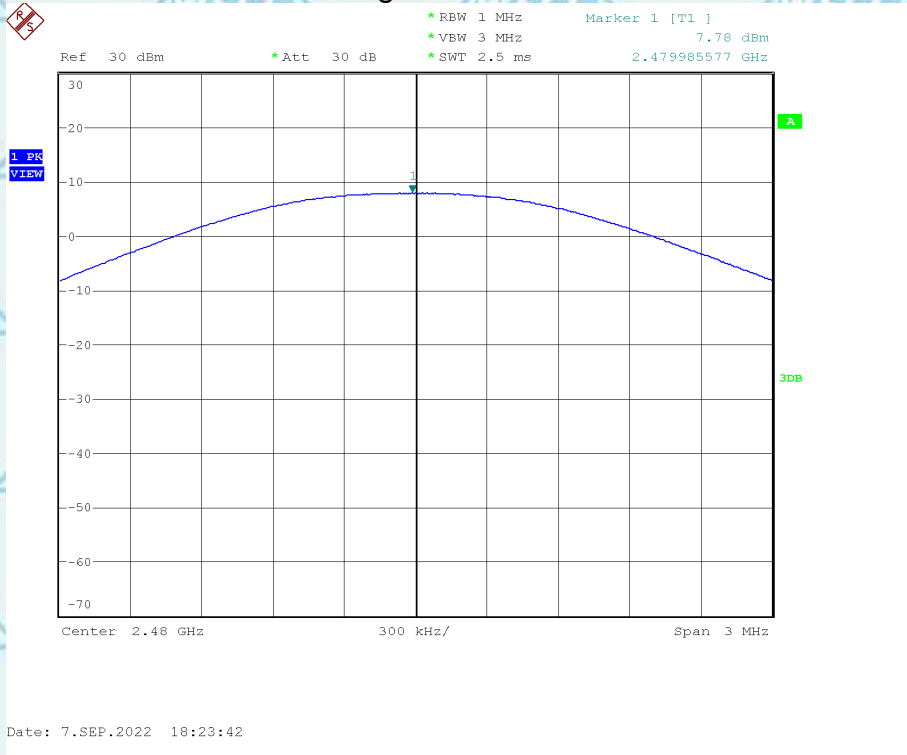


Middle channel





Highest channel



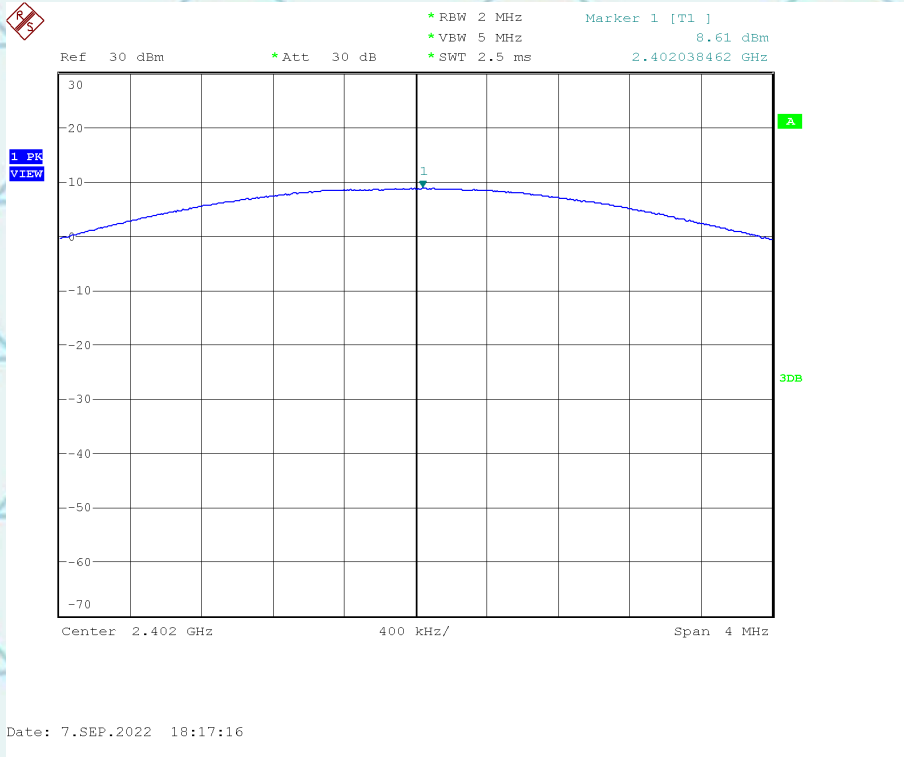


Report No.: WSCT-A2LA-R&E220900005A-BT
Pi/4DQPSK Modulation

Certificate #5768.01

For Question,
Please Contact with WSCT
www.wsct-cert.com

Lowest channel

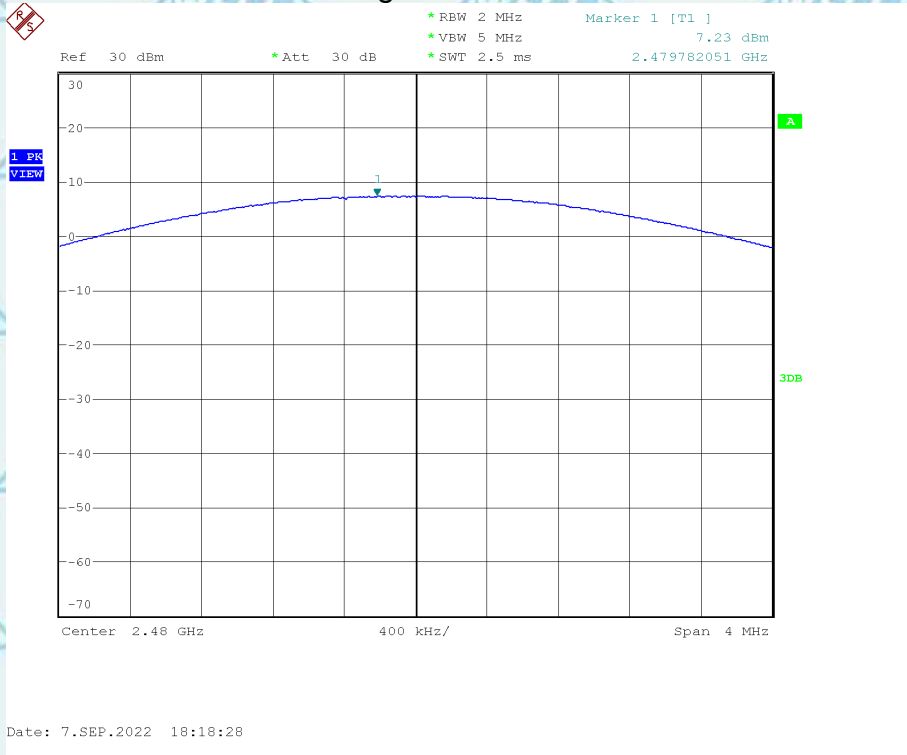


Middle channel





Highest channel



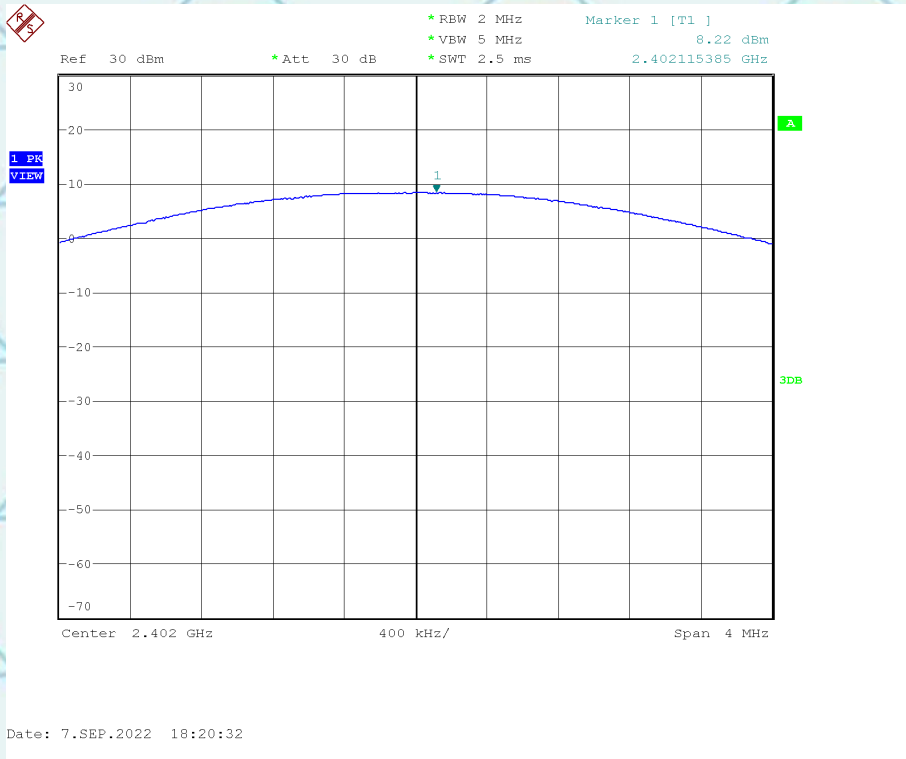


Report No.: WSCT-A2LA-R&E220900005A-BT
8DPSK Modulation

Certificate #5768.01

For Question,
Please Contact with WSCT
www.wsct-cert.com

Lowest channel

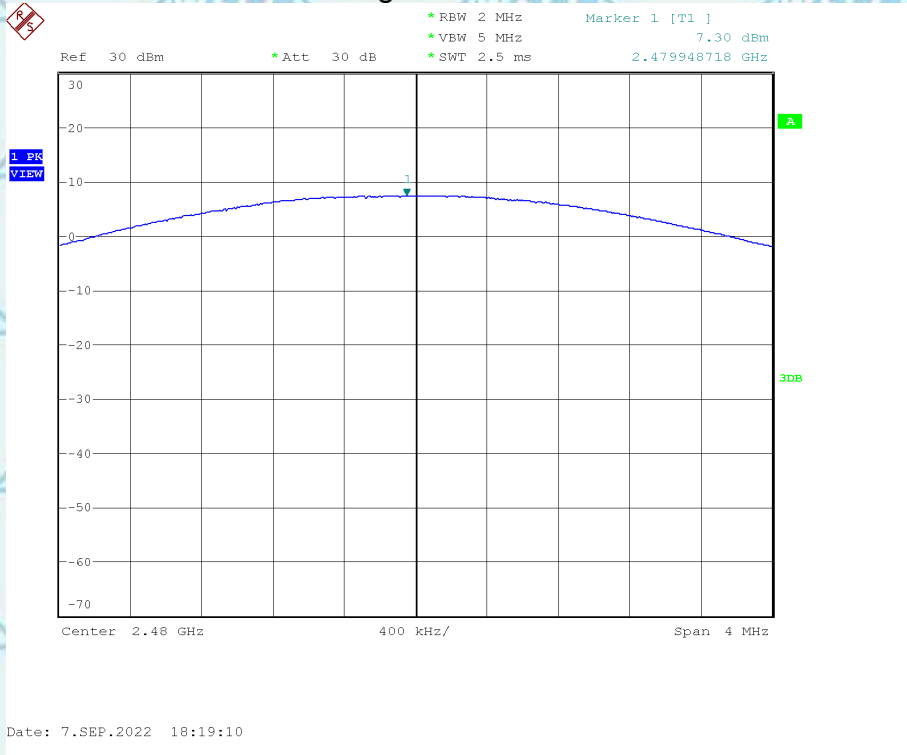


Middle channel





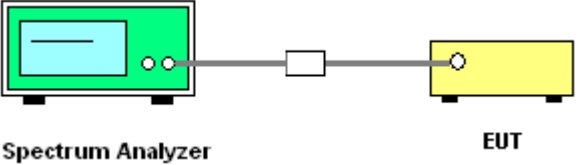
Highest channel





6.4. 20dB Occupy Bandwidth

6.4.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2014
Limit:	N/A
Test Setup:	 <p style="text-align: center;">Spectrum Analyzer EUT</p>
Test Mode:	Transmitting mode with modulation
Test Procedure:	<ol style="list-style-type: none"> 1. The testing follows ANSI C63.10:2014 Measurement Guidelines. 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Use the following spectrum analyzer settings for 20dB Bandwidth measurement. Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel; $1\% \leq RBW \leq 5\%$ of the 20 dB bandwidth; $VBW \geq 3RBW$; Sweep = auto; Detector function = peak; Trace = max hold. 5. Measure and record the results in the test report.
Test Result:	PASS



6.4.2. Test data

Test channel	20dB Occupy Bandwidth (kHz)			
	GFSK	$\pi/4$ -DQPSK	8DPSK	Conclusion
Lowest	826.92	1274.04	1274.04	PASS
Middle	822.12	1262.42	1288.46	PASS
Highest	822.12	1259.62	1269.23	PASS

Test plots as follows:



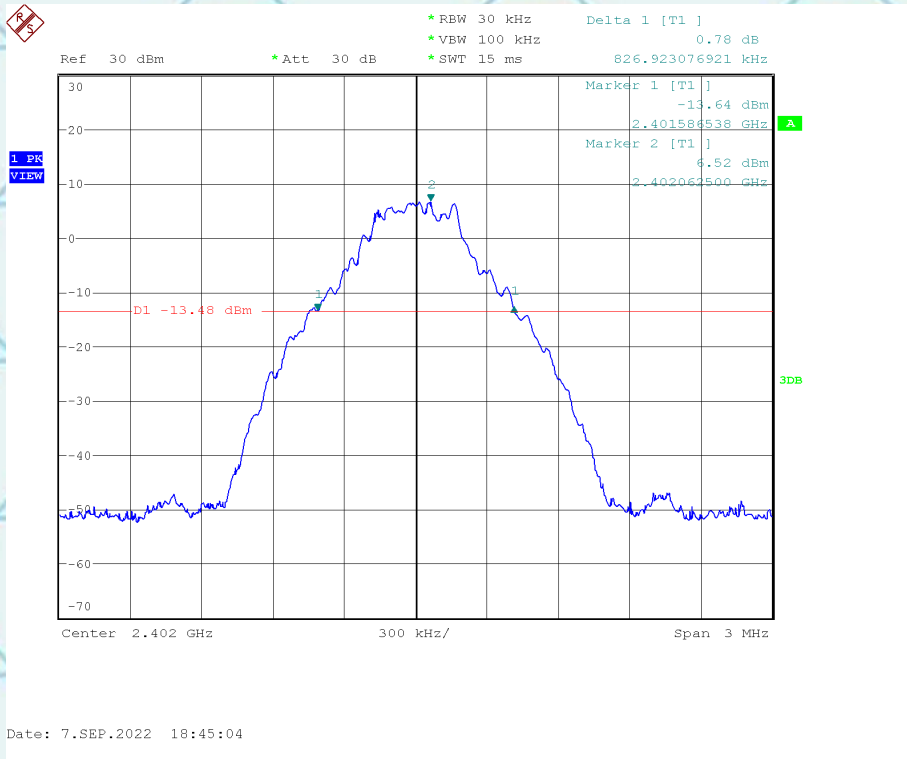


Report No.: WSCT-A2LA-R&E220900005A-BT
GFSK Modulation

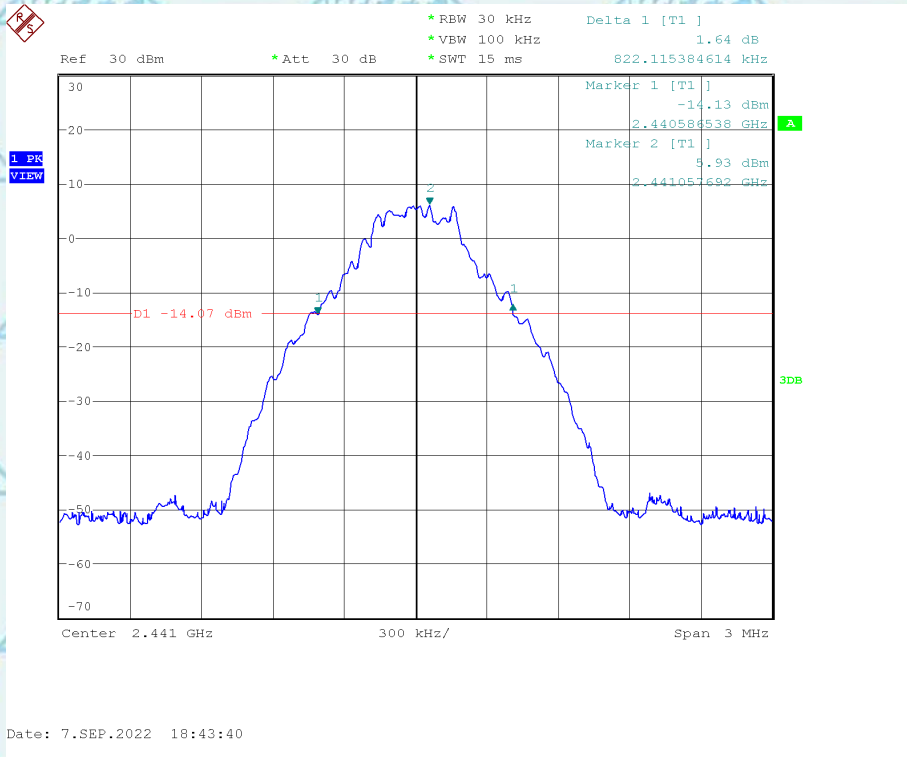
Certificate #5768.01

For Question,
Please Contact with WSCT
www.wsct-cert.com

Lowest channel

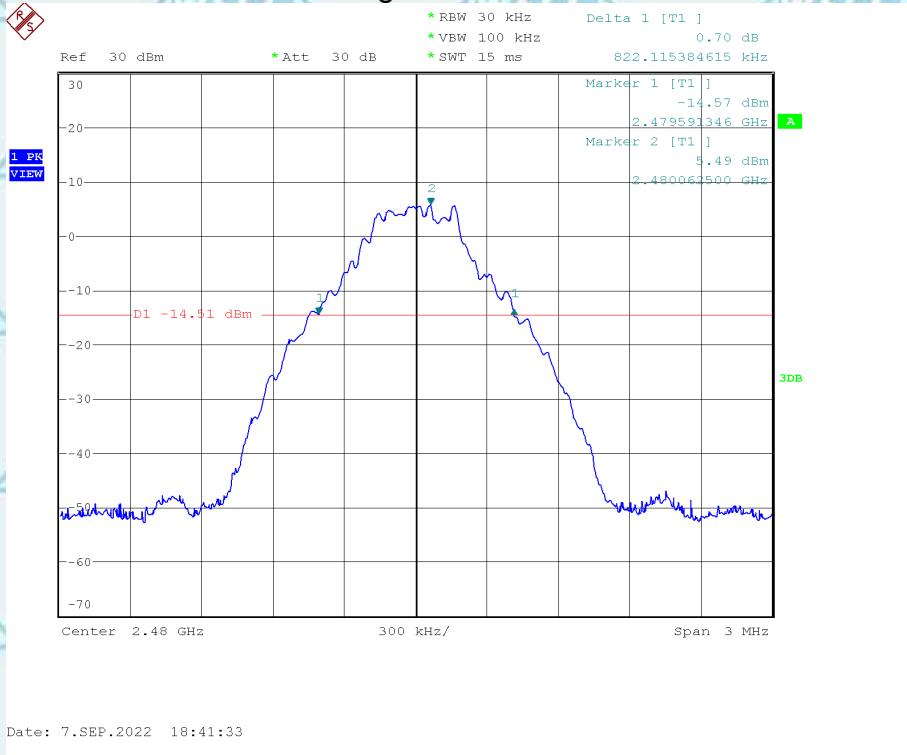


Middle channel





Highest channel



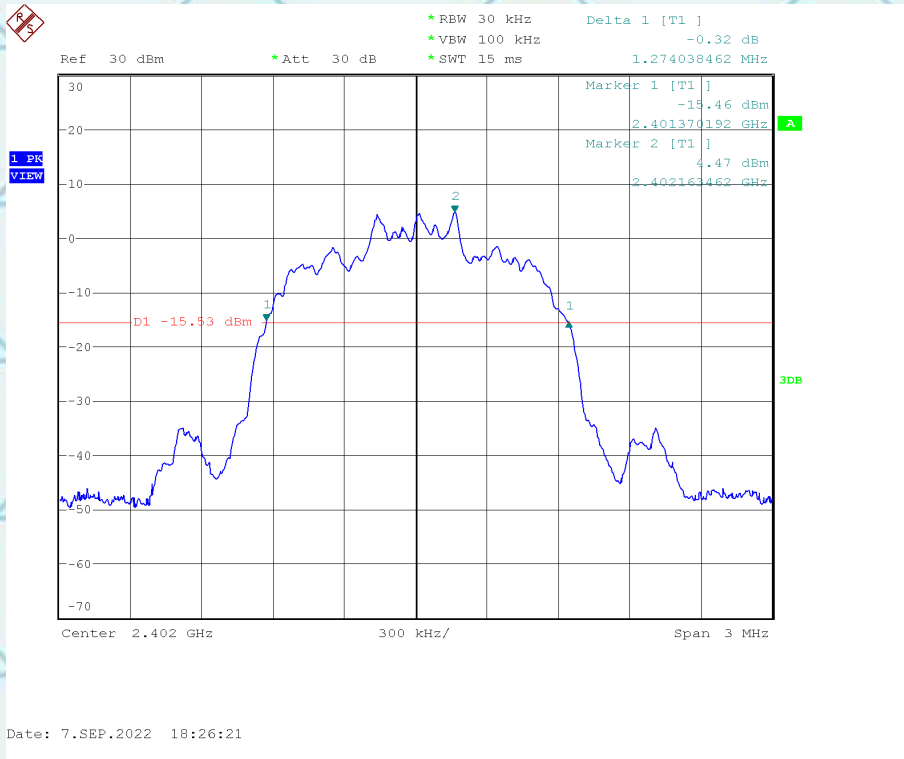


Report No.: WSCT-A2LA-R&E220900005A-BT
Pi/4DQPSK Modulation

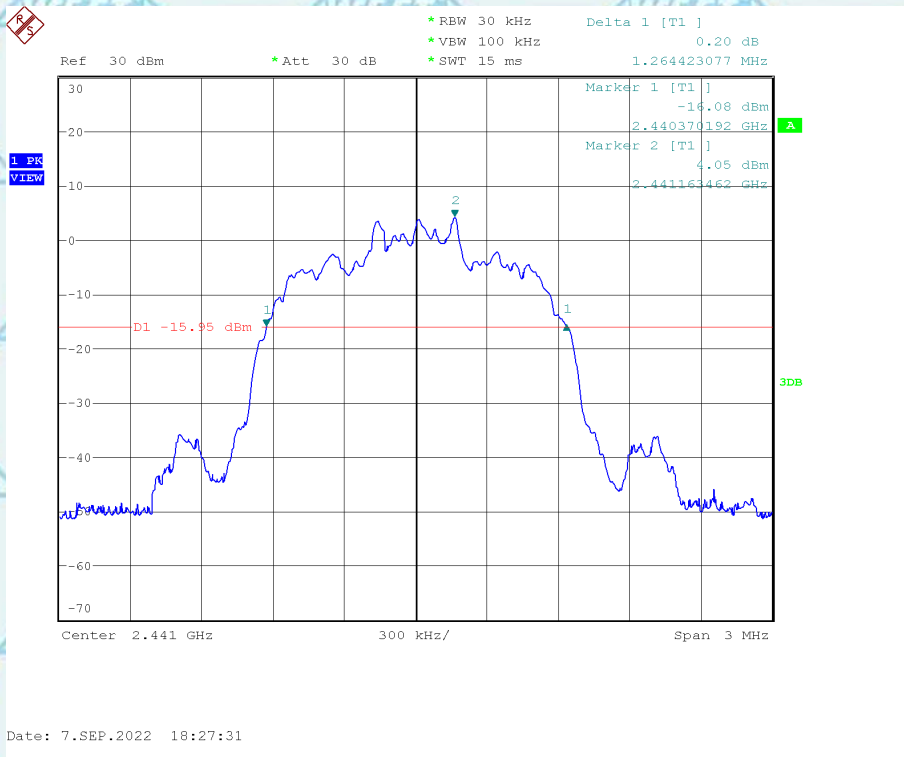
Certificate #5768.01

For Question,
Please Contact with WSCT
www.wsct-cert.com

Lowest channel



Middle channel





Highest channel



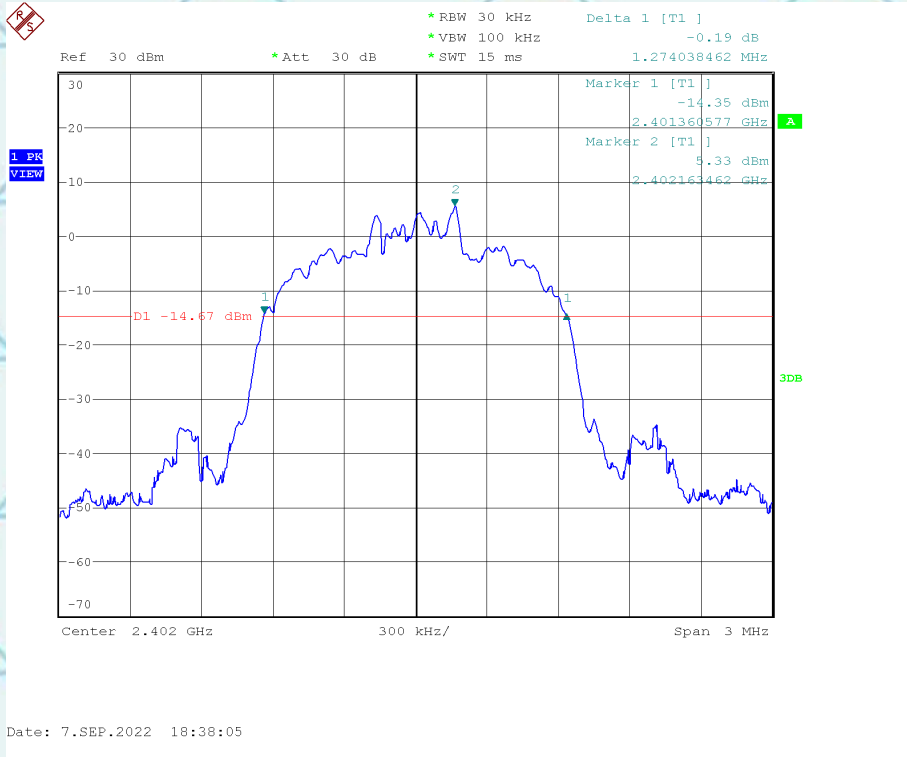


Report No.: **WSCT-A2LA-R&E220900005A-BT**
8DPSK Modulation

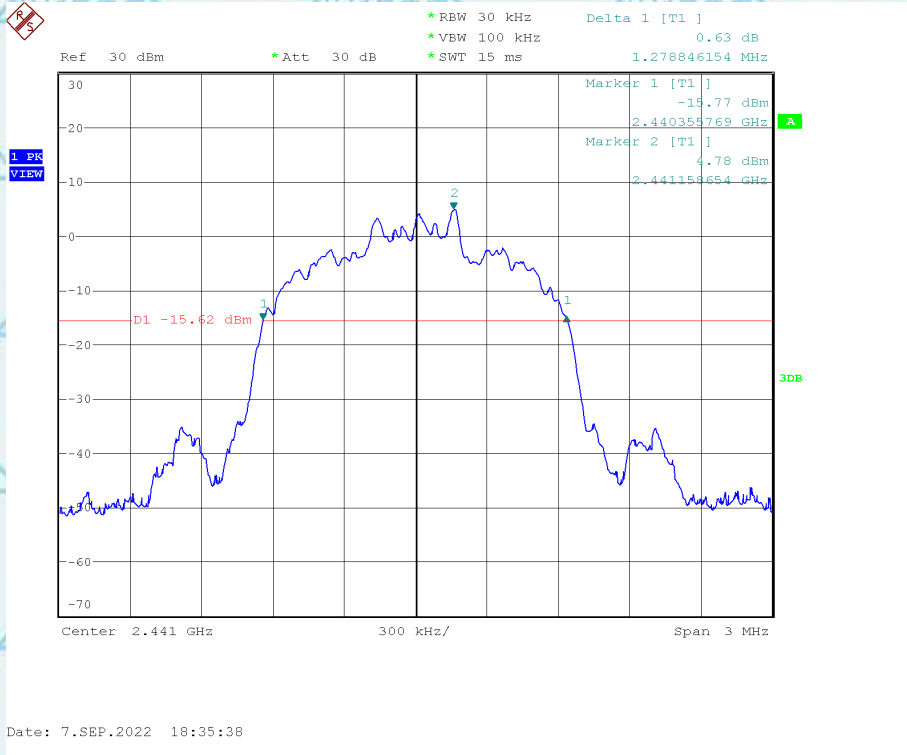
Certificate #5768.01

For Question,
 Please Contact with WSCT
www.wsct-cert.com

Lowest channel

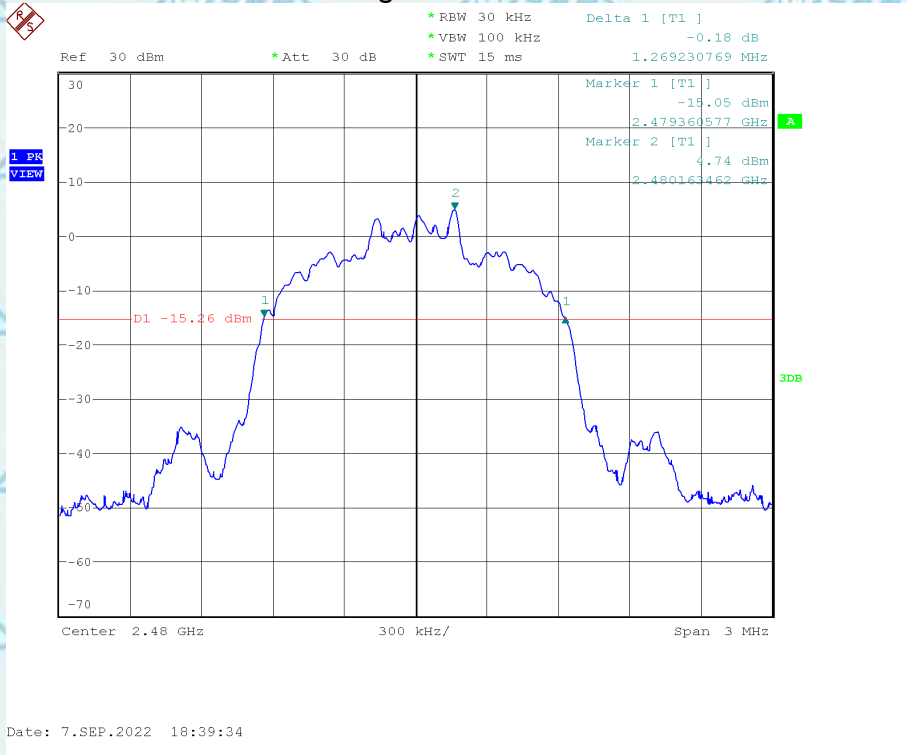


Middle channel





Highest channel





6.5.2. Test data

GFSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Lowest	1003	2/3*20dB BW	PASS
Middle	1006	2/3*20dB BW	PASS
Highest	1000	2/3*20dB BW	PASS

Pi/4 DQPSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Lowest	1000	2/3*20dB BW	PASS
Middle	1003	2/3*20dB BW	PASS
Highest	1000	2/3*20dB BW	PASS

8DPSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Lowest	997	2/3*20dB BW	PASS
Middle	997	2/3*20dB BW	PASS
Highest	1000	2/3*20dB BW	PASS



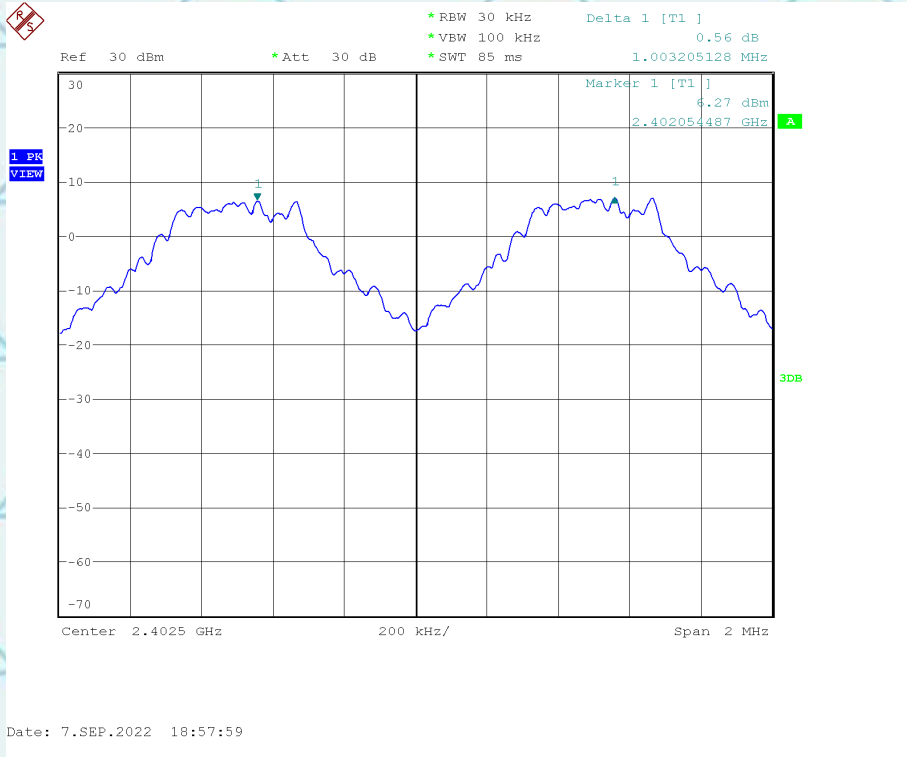


Report No.: **WSCT-A2LA-R&E220900005A-BT**
GFSK Modulation

Certificate #5768.01

For Question,
Please Contact with WSCT
www.wsct-cert.com

Lowest channel

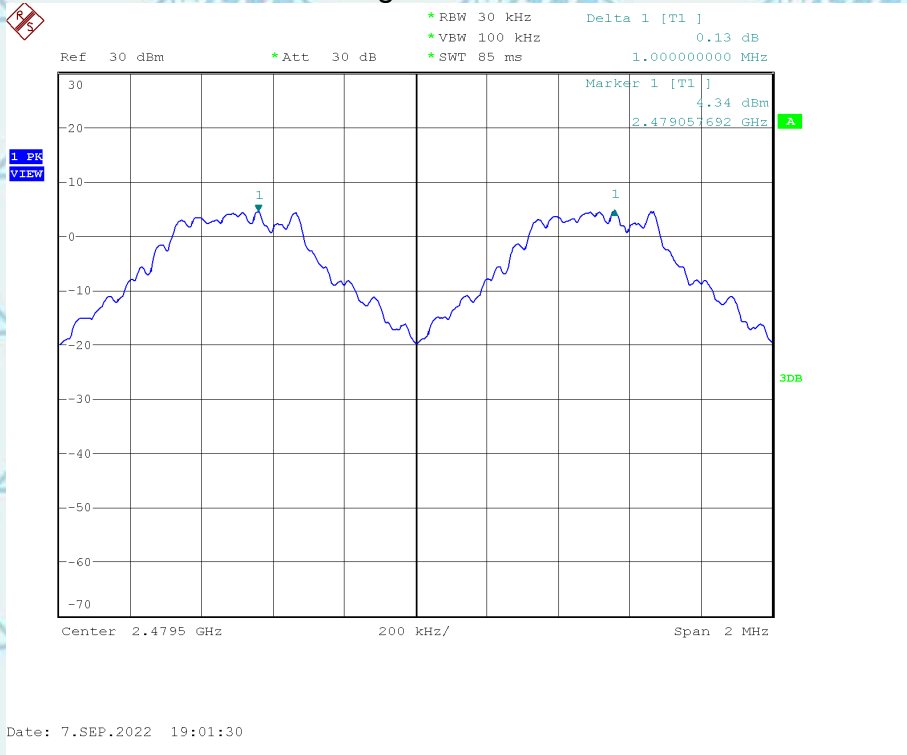


Middle channel





Highest channel



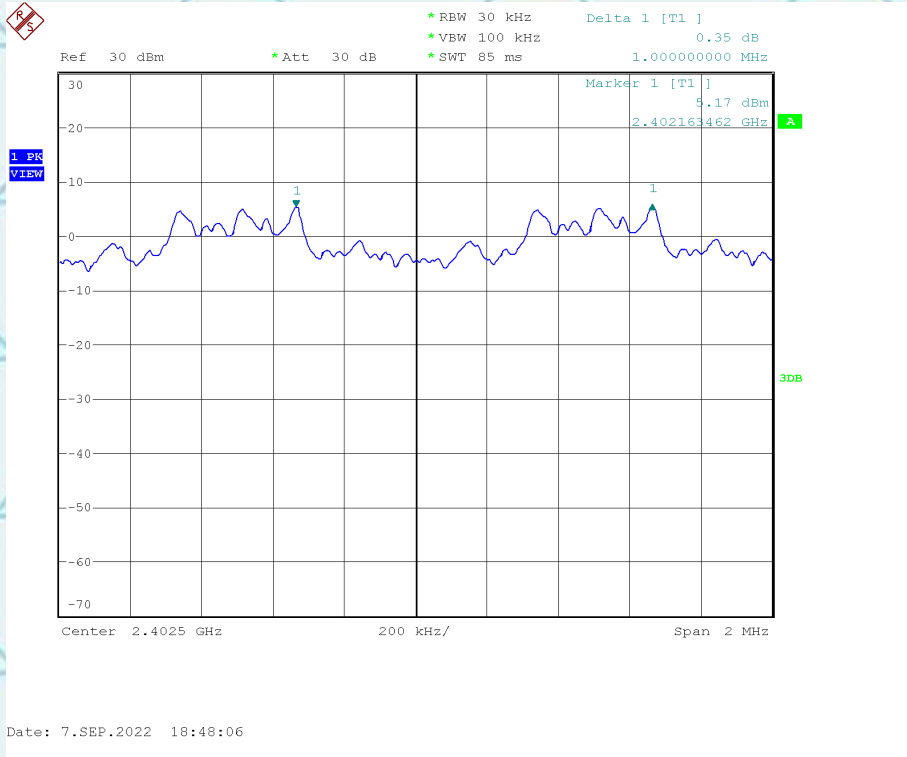


Report No.: WSCT-A2LA-R&E220900005A-BT
Pi/4DQPSK Modulation

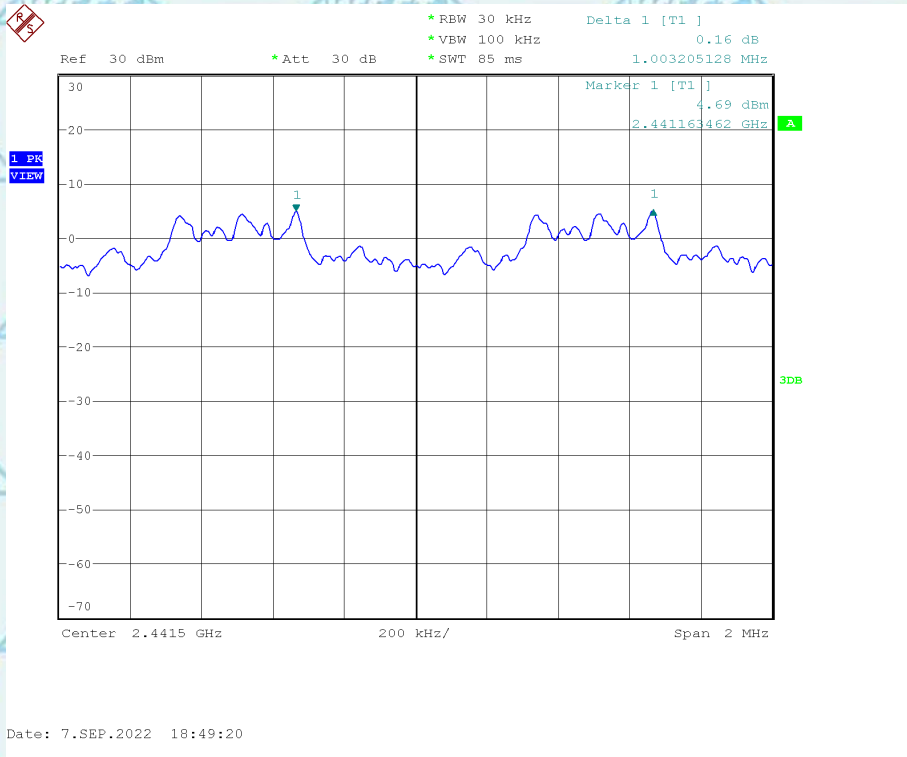
Certificate #5768.01

For Question,
Please Contact with WSCT
www.wsct-cert.com

Lowest channel

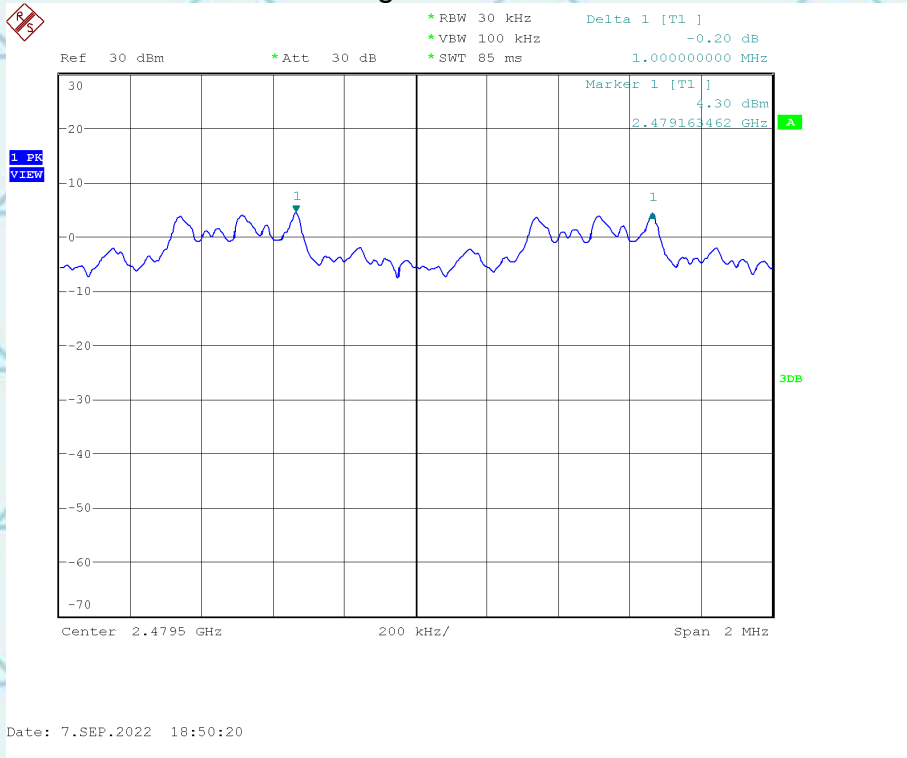


Middle channel



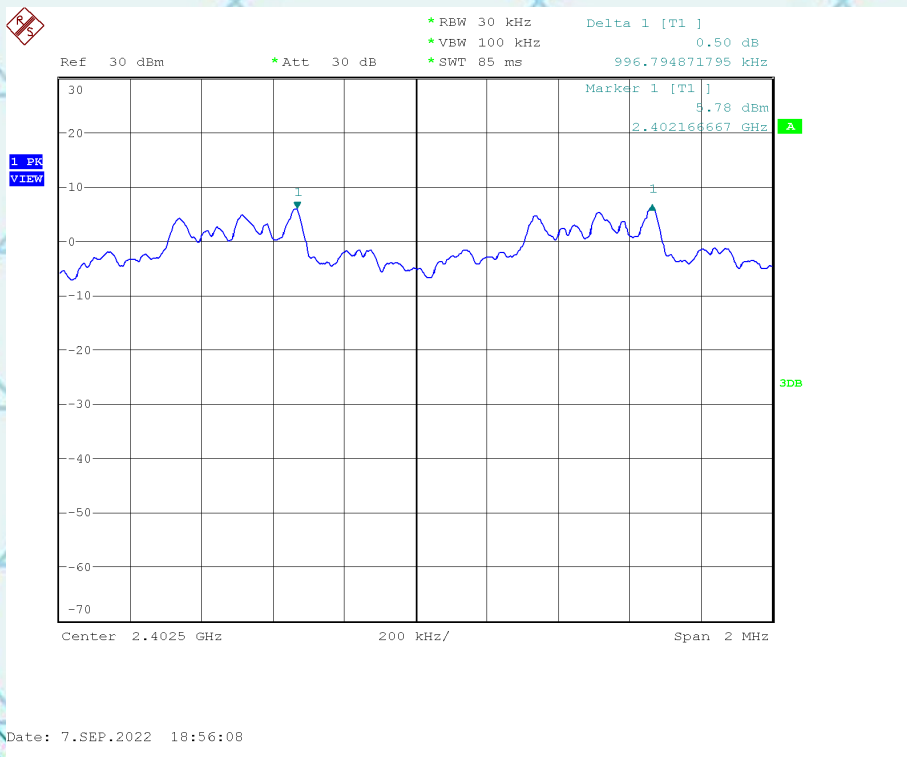


Highest channel



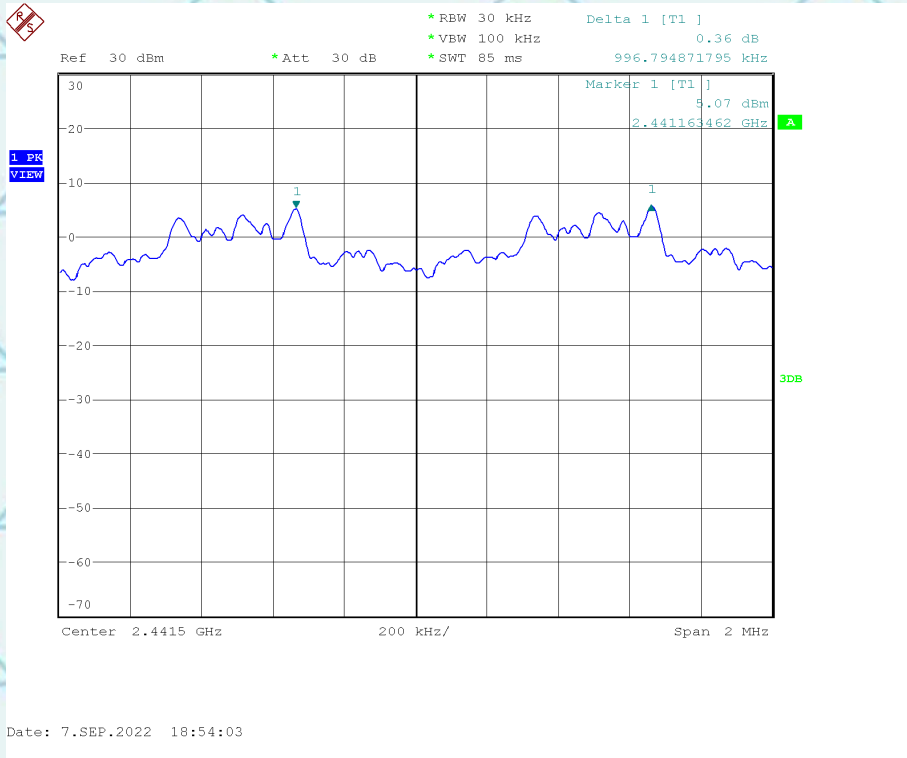
8DPSK Modulation

Lowest channel

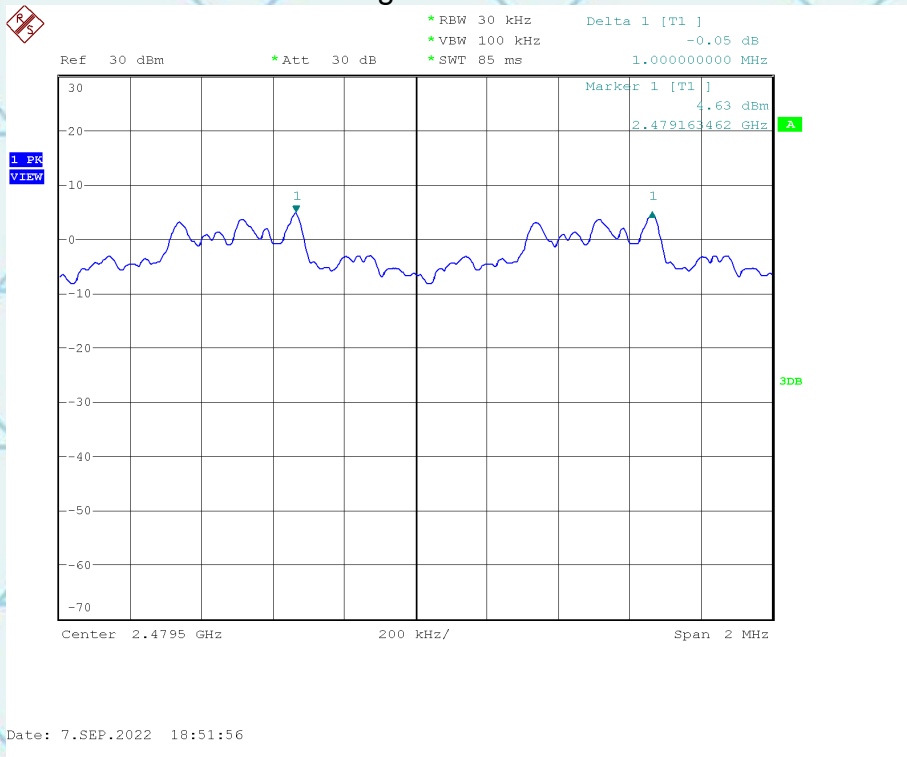




Middle channel




Highest channel





6.6. Hopping Channel Number

6.6.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2014
Limit:	Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Setup:	 <p style="text-align: center;">Spectrum Analyzer EUT</p>
Test Mode:	Hopping mode
Test Procedure:	<ol style="list-style-type: none"> 1. The testing follows ANSI C63.10:2014 Measurement Guidelines. 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Enable the EUT hopping function. 5. Use the following spectrum analyzer settings: Span = the frequency band of operation; set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold. 6. The number of hopping frequency used is defined as the number of total channel. 7. Record the measurement data in report.
Test Result:	PASS





6.6.2. Test data

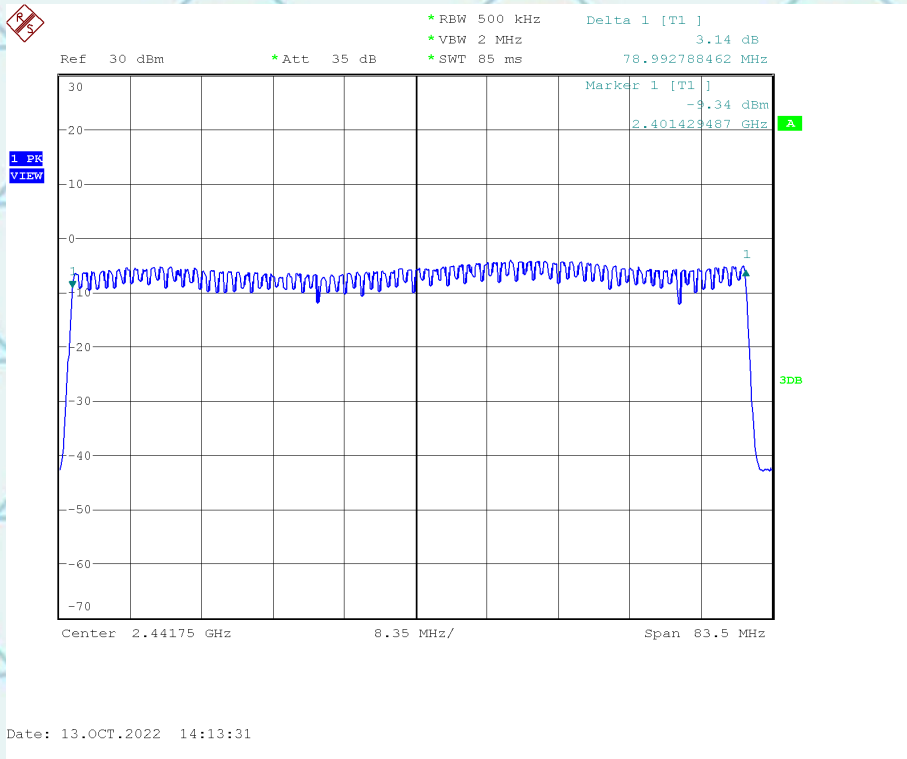
Mode	Hopping channel numbers	Limit	Result
GFSK, P/4-DQPSK, 8DPSK	79	15	PASS

Test plots as follows:






GFSK





6.7. Dwell Time

6.7.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2014
Limit:	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.
Test Setup:	 <p style="text-align: center;">Spectrum Analyzer EUT</p>
Test Mode:	Hopping mode
Test Procedure:	<ol style="list-style-type: none"> 1. The testing follows ANSI C63.10:2014 Measurement Guidelines. 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Enable the EUT hopping function. 5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW shall be \leq channel spacing and where possible RBW should be set $\gg 1/T$, where T is the expected dwell time per channel; VBW \geq RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold. 6. Measure and record the results in the test report.
Test Result:	PASS



6.7.2. Test Data

Mode	Packet	Frequency	Package Transfer Time (ms)	Dwell time (second)	Limit (second)	Result
GFSK	DH1	2402MHz	0.376	0.120	0.4	PASS
GFSK	DH1	2441MHz	0.376	0.120	0.4	PASS
GFSK	DH1	2480MHz	0.376	0.120	0.4	PASS
GFSK	DH3	2402MHz	1.632	0.261	0.4	PASS
GFSK	DH3	2441MHz	1.632	0.261	0.4	PASS
GFSK	DH3	2480MHz	1.632	0.261	0.4	PASS
GFSK	DH5	2402MHz	2.880	0.307	0.4	PASS
GFSK	DH5	2441MHz	2.880	0.307	0.4	PASS
GFSK	DH5	2480MHz	2.880	0.307	0.4	PASS

Note: 1. In normal mode, hopping rate is 1600 hops/s with 6 slots in 79 hopping channels.

For DH1, With channel hopping rate $(1600 / 2 / 79)$ in Occupancy Time Limit (0.4×79) (s), Hops Over Occupancy Time comes to $(1600 / 2 / 79) \times (0.4 \times 79) = 320$ hops

For DH3, With channel hopping rate $(1600 / 4 / 79)$ in Occupancy Time Limit (0.4×79) (s), Hops Over Occupancy Time comes to $(1600 / 4 / 79) \times (0.4 \times 79) = 160$ hops

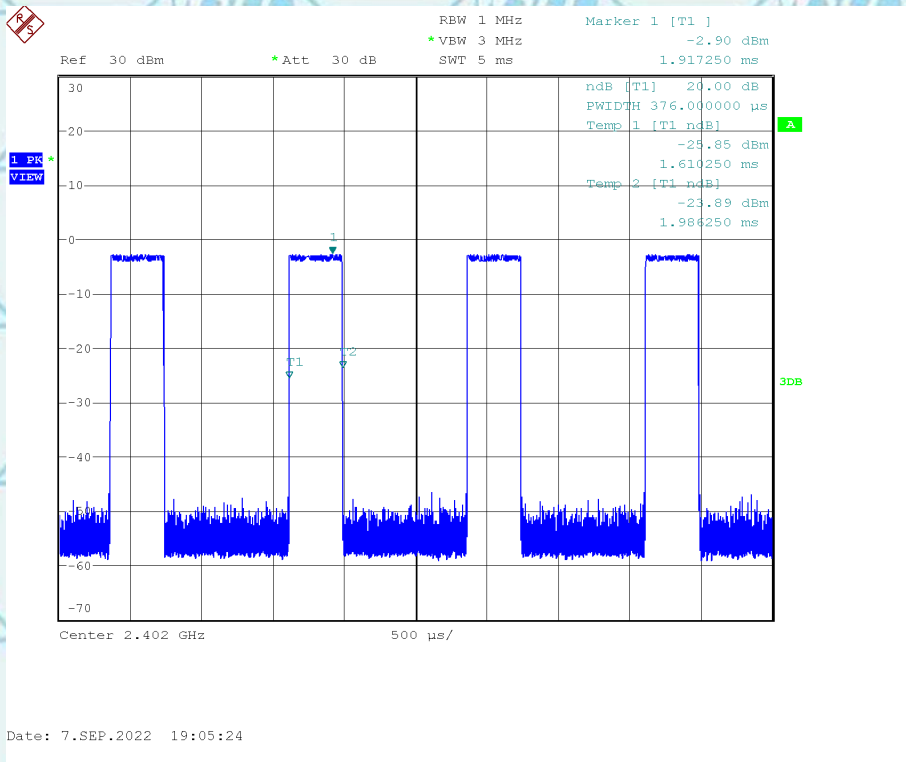
For DH5, With channel hopping rate $(1600 / 6 / 79)$ in Occupancy Time Limit (0.4×79) (s), Hops Over Occupancy Time comes to $(1600 / 6 / 79) \times (0.4 \times 79) = 106.67$ hops

2. Dwell Time(s) = Hops Over Occupancy Time (hops) x Package Transfer Time

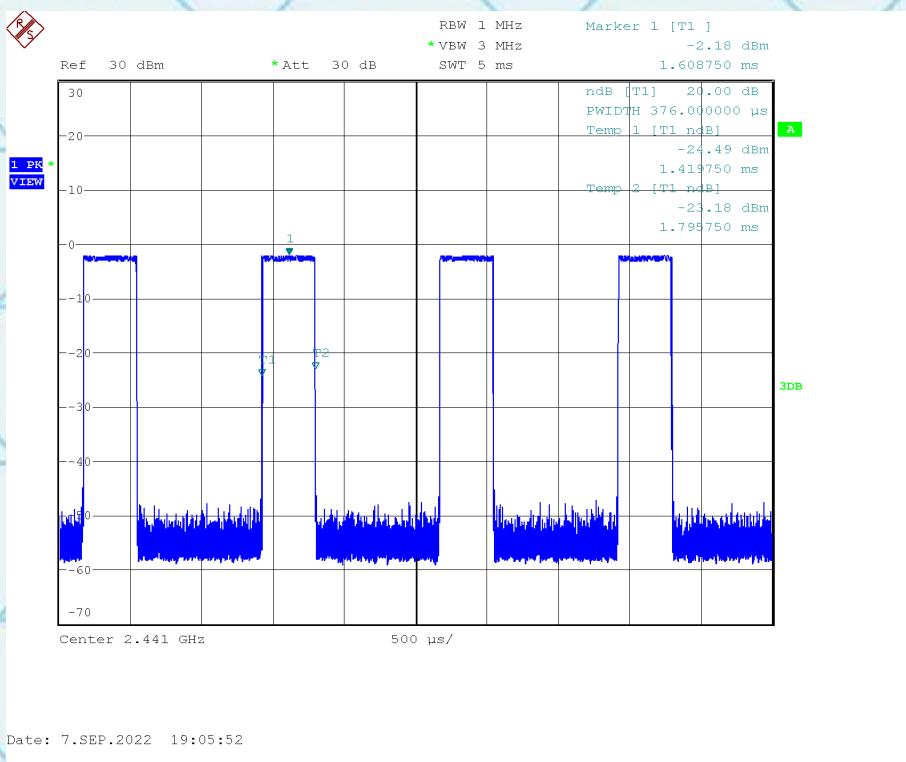
Test plots as follows:

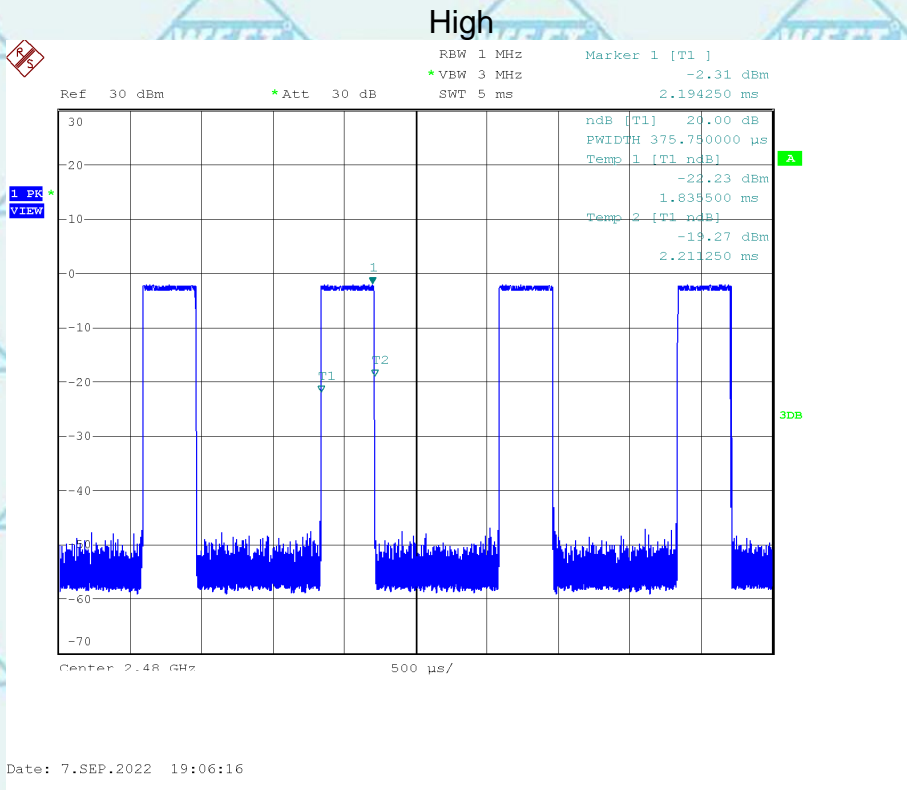


DH1 Low



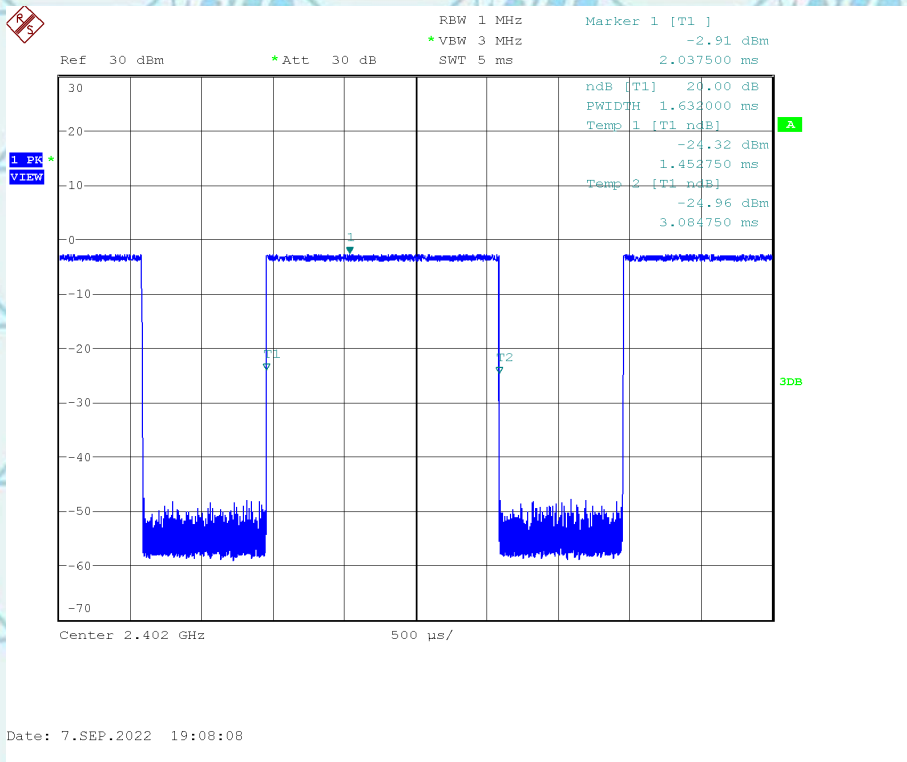
Middle



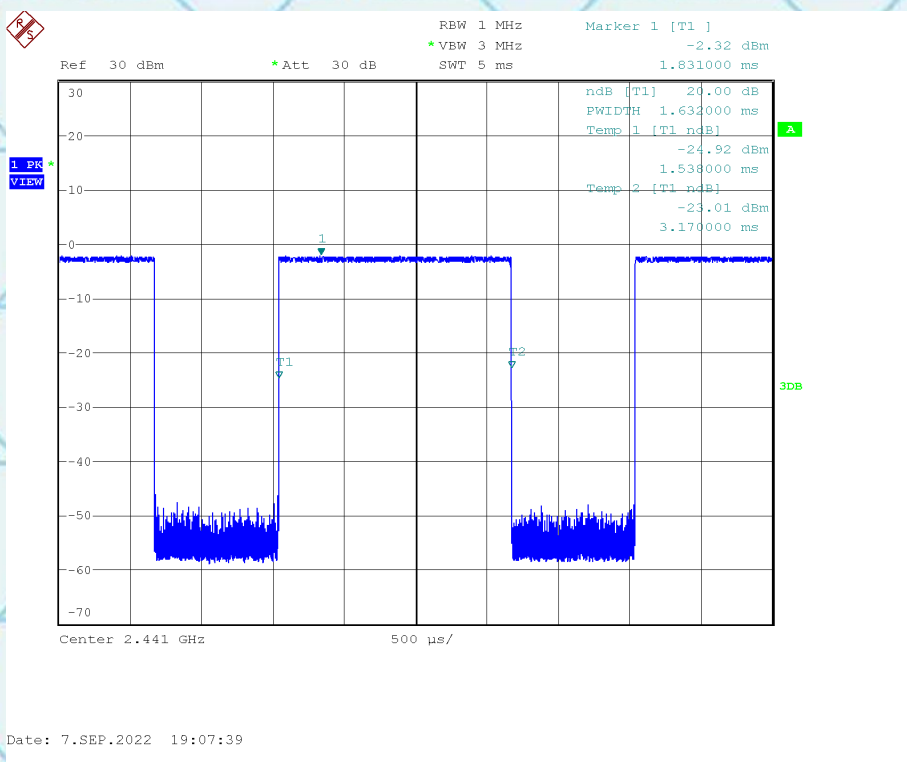




DH3 Low

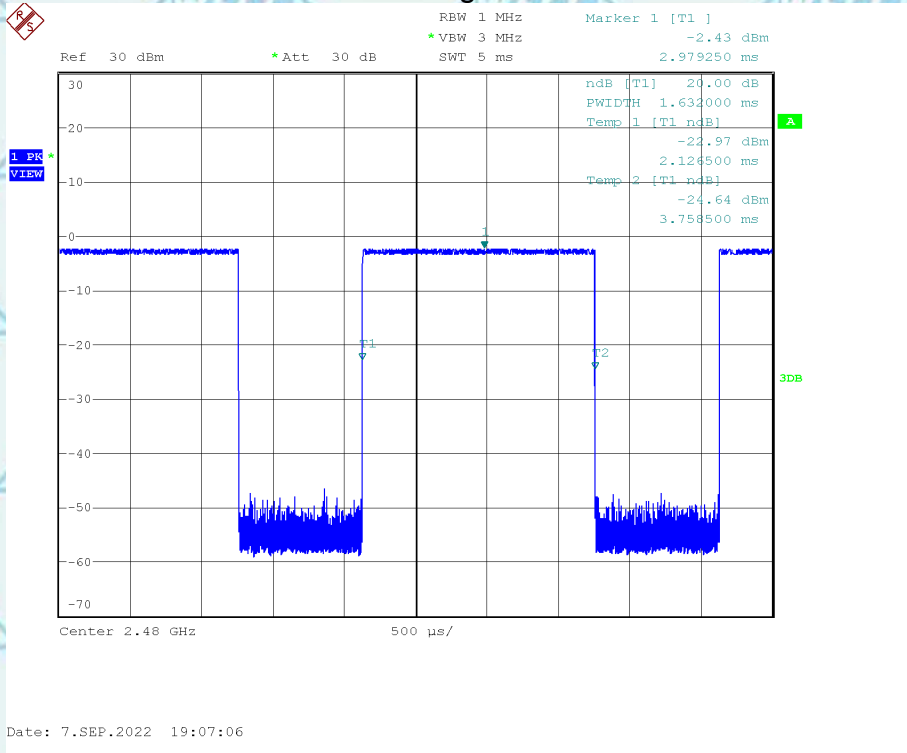


Middle



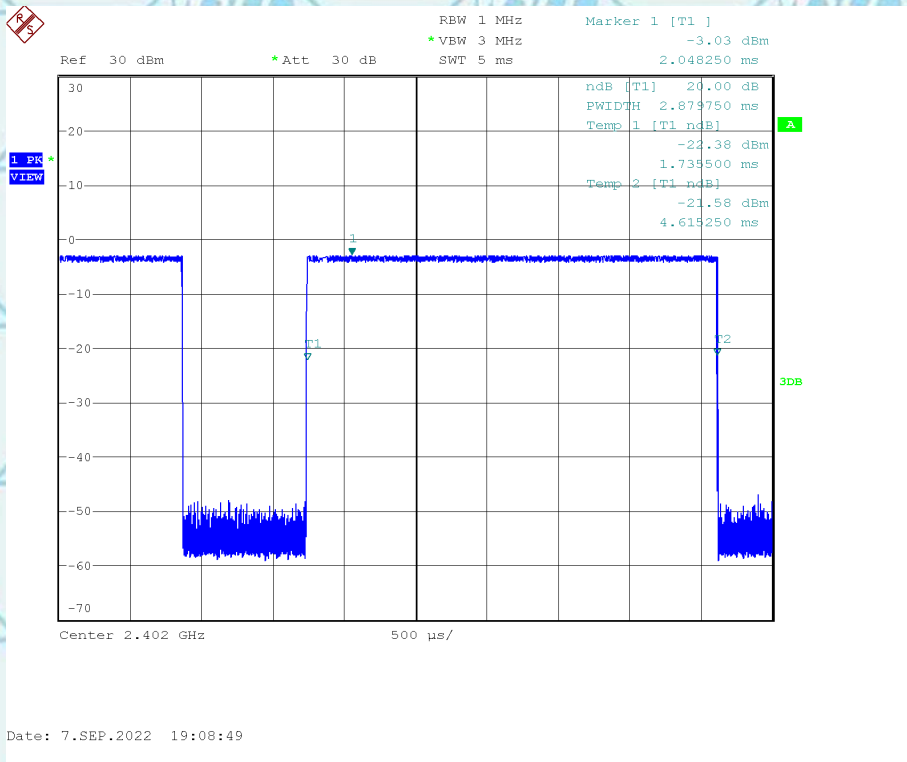


High

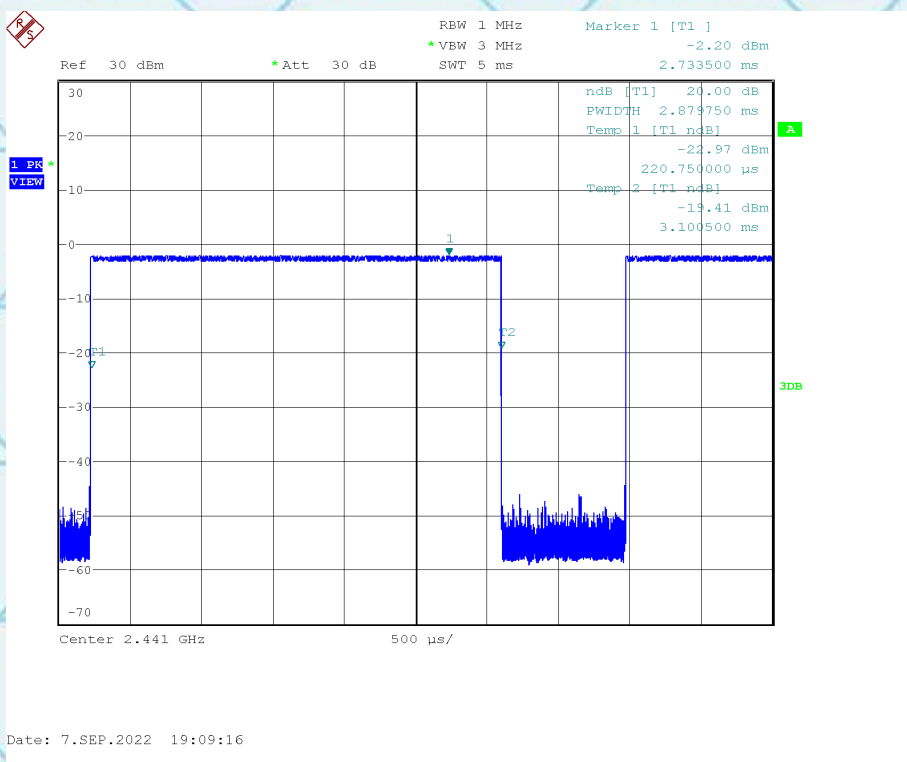




DH5 Low

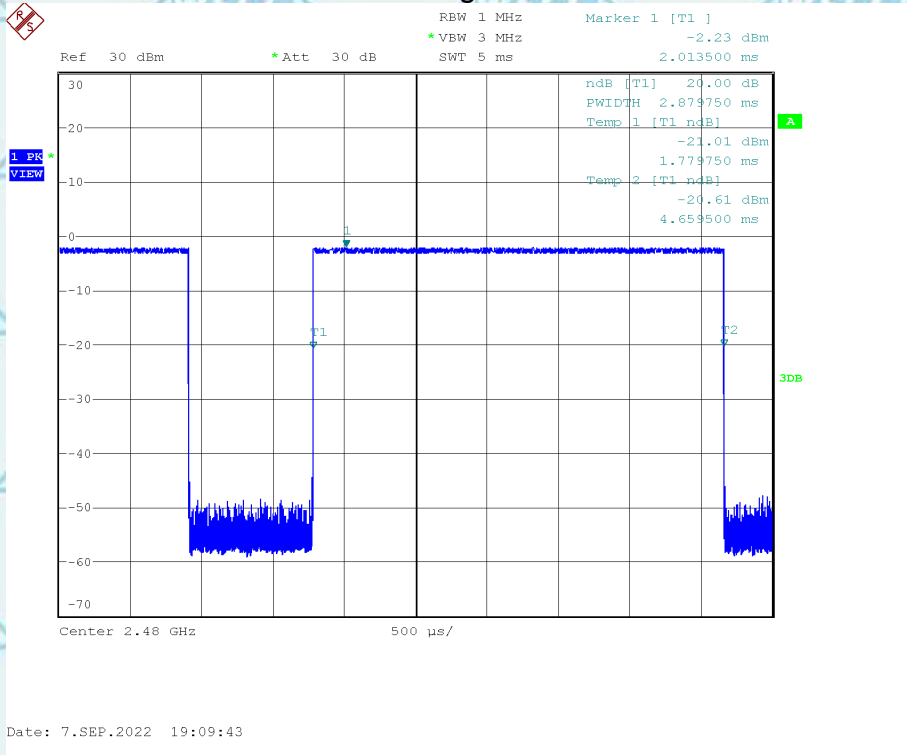


Middle





High





6.8. Pseudorandom Frequency Hopping Sequence

Test Requirement: FCC Part15 C Section 15.247 (a)(1) requirement:

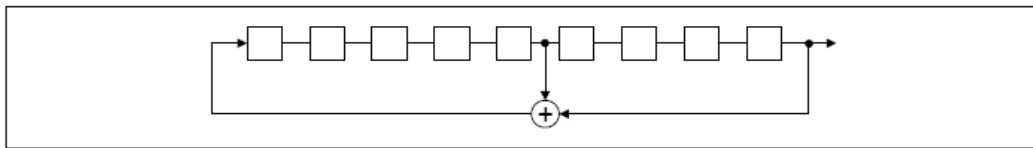
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Alternatively. Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence

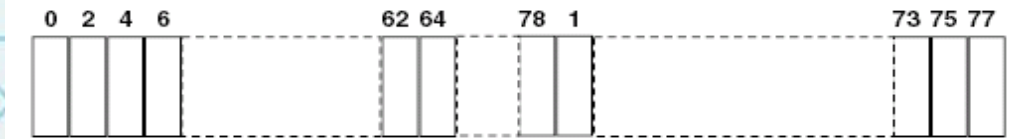
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones; i.e. the shift register is initialized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

- Number of shift register stages: 9
- Length of pseudo-random sequence: $2^9 - 1 = 511$ 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 as follow:



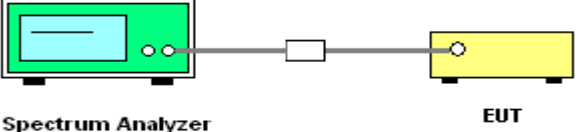
Each frequency used equally on the average by each transmitter. The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.





6.9. Conducted Band Edge Measurement

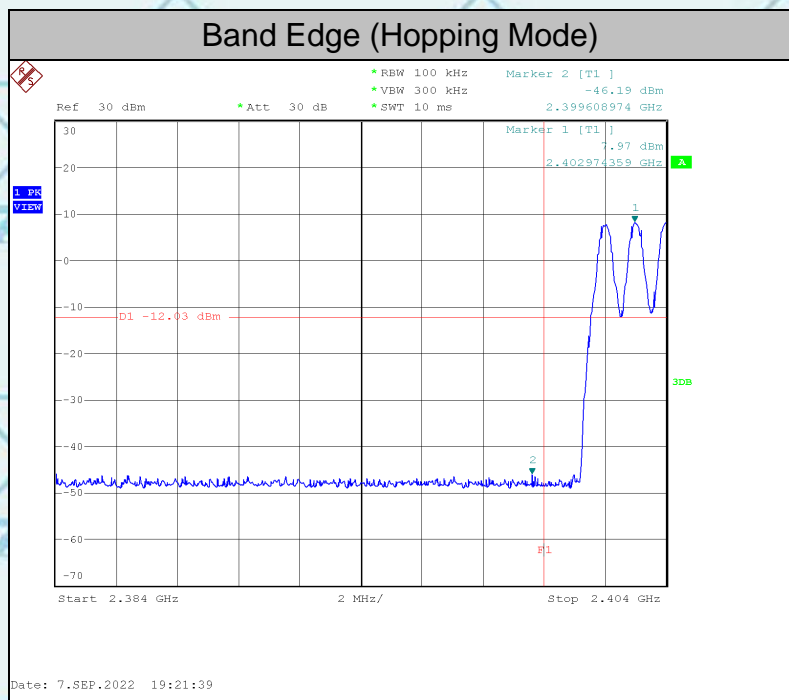
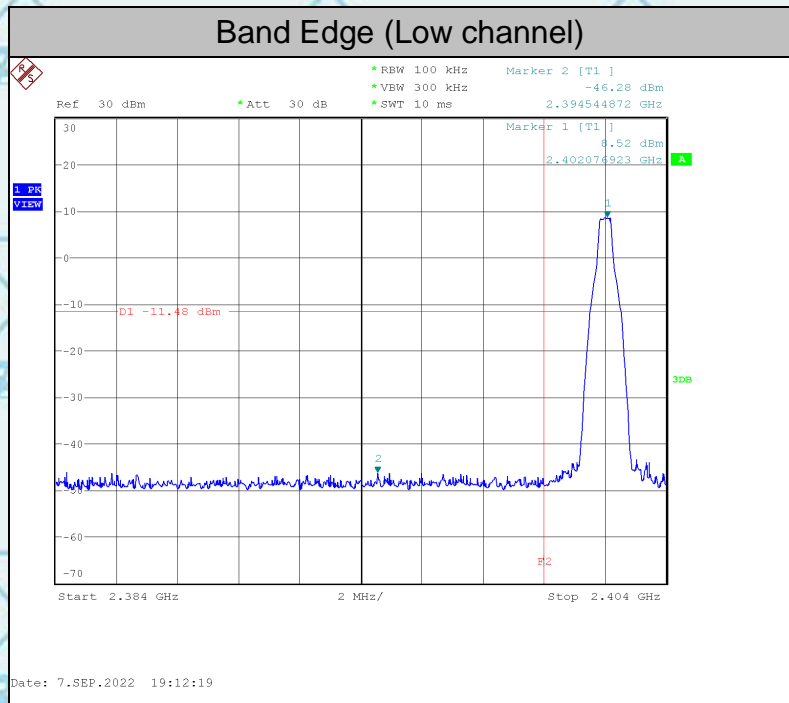
6.9.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2014
Limit:	In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.
Test Setup:	 <p style="text-align: center;">Spectrum Analyzer EUT</p>
Test Mode:	Transmitting mode with modulation
Test Procedure:	<ol style="list-style-type: none"> 1. The testing follows the guidelines in Band-edge Compliance of RF Conducted Emissions of ANSI C63.10:2014 Measurement Guidelines. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Set RBW = 100 kHz ($\geq 1\%$ span=10MHz), VBW = 300 kHz (\geqRBW). Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used. 4. Enable hopping function of the EUT and then repeat step 2 and 3. 5. Measure and record the results in the test report.
Test Result:	PASS



6.9.2. Test Data

GFSK Modulation (the worst case)

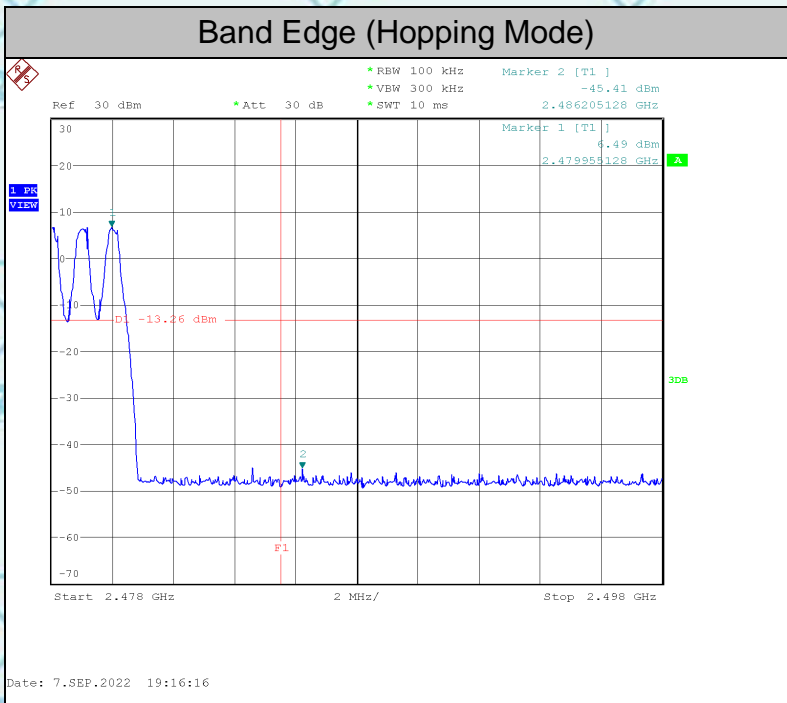
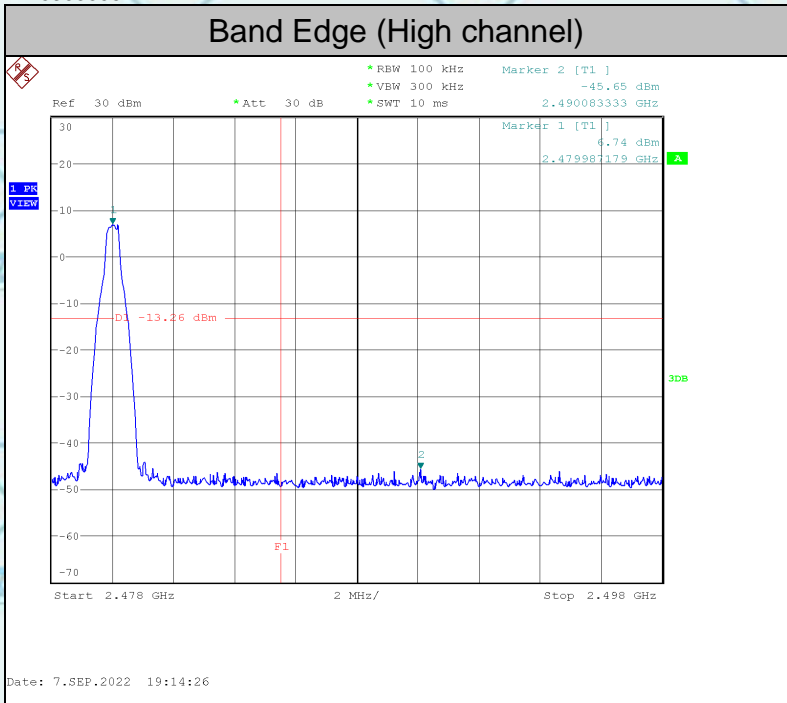




Report No.: WSCT-A2LA-R&E220900005A-BT

Certificate #5768.01

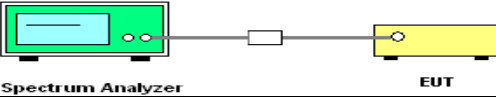
For Question,
Please Contact with WSCT
www.wsct-cert.com





6.10. Conducted Spurious Emission Measurement

6.10.1. Test Specification

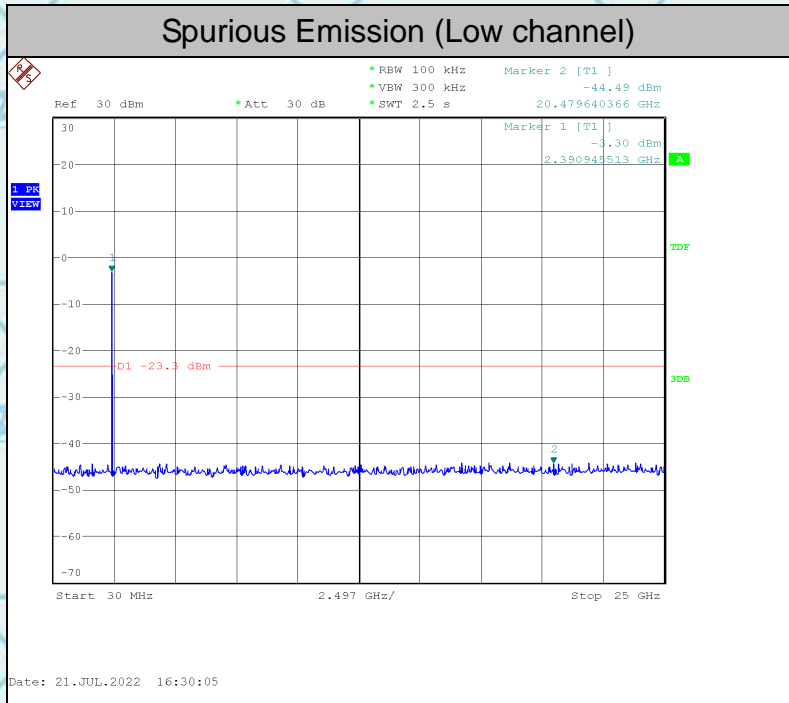
Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2014
Limit:	In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.
Test Setup:	 <p style="text-align: center;">Spectrum Analyzer EUT</p>
Test Mode:	Transmitting mode with modulation
Test Procedure:	<ol style="list-style-type: none"> 1. The testing follows the guidelines in Spurious RF Conducted Emissions of ANSI C63.10:2014 Measurement Guidelines 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW. 5. Measure and record the results in the test report. 6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
Test Result:	PASS



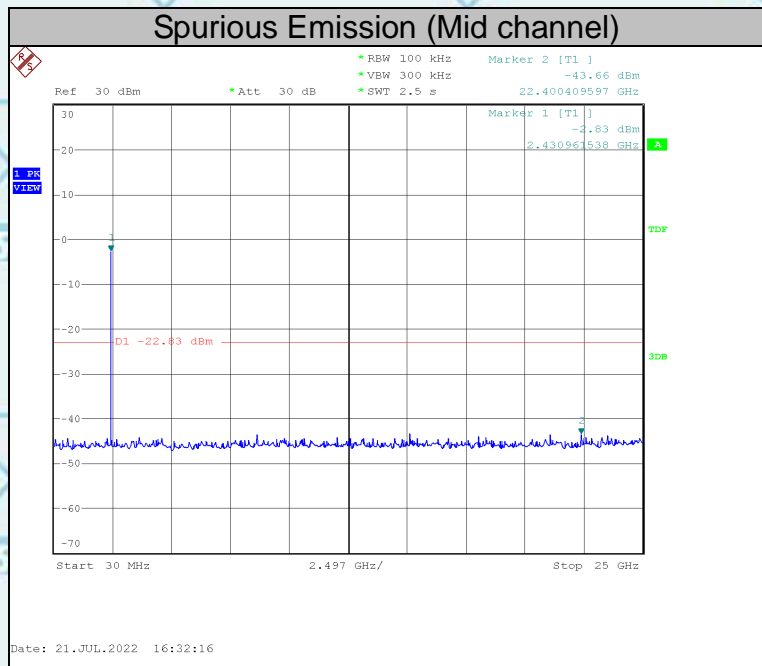


6.10.2. Test Data

GFSK mode

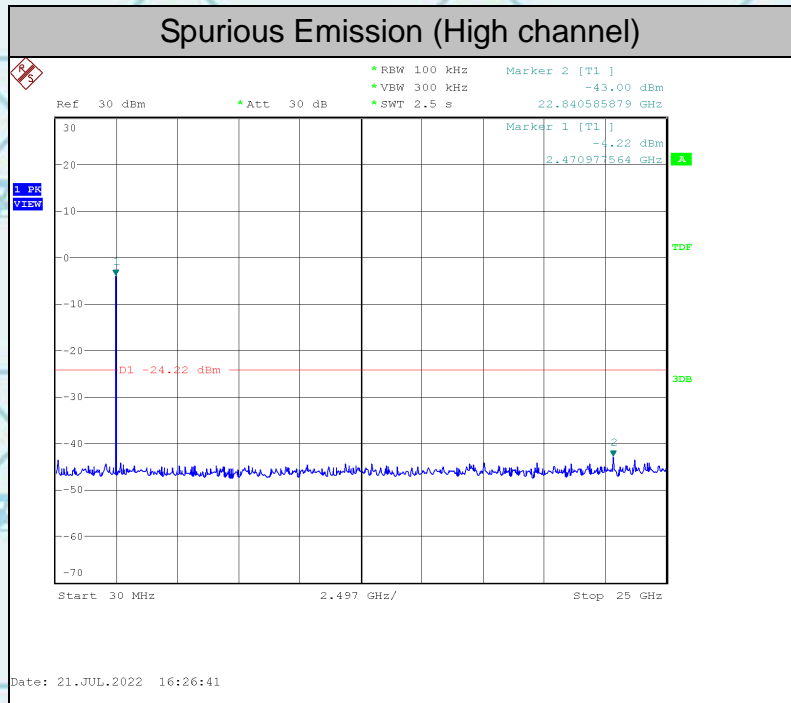


Date: 21.JUL.2022 16:30:05



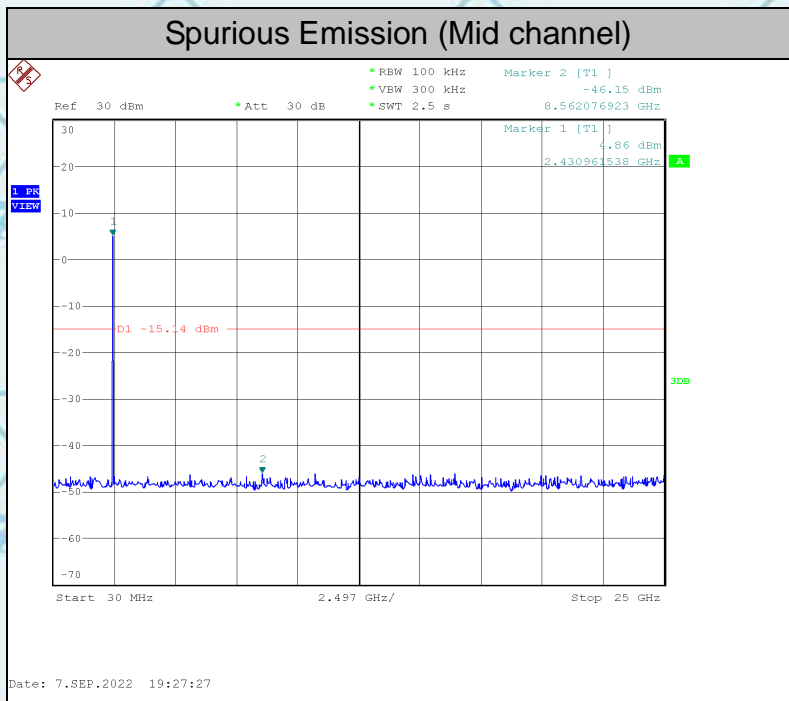
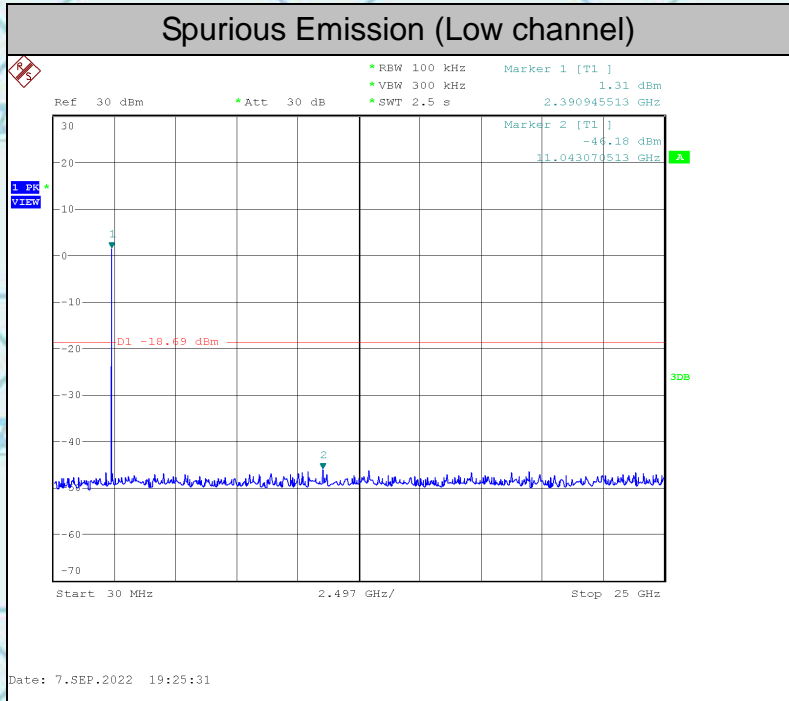
Date: 21.JUL.2022 16:32:16







Pi/4DQPSK mode

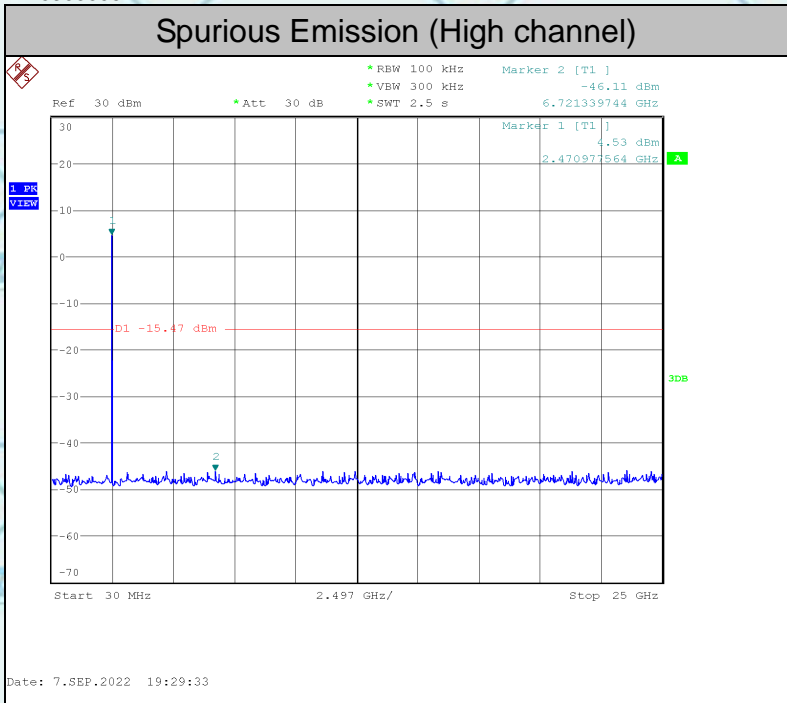




Report No.: WSCT-A2LA-R&E220900005A-BT

Certificate #5768.01

For Question, Please Contact with WSCT www.wsct-cert.com

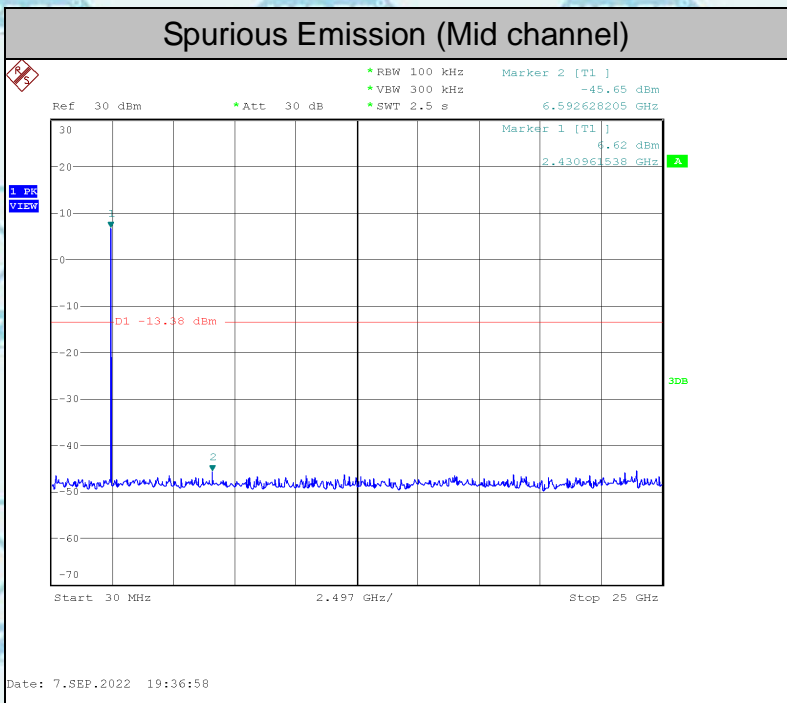
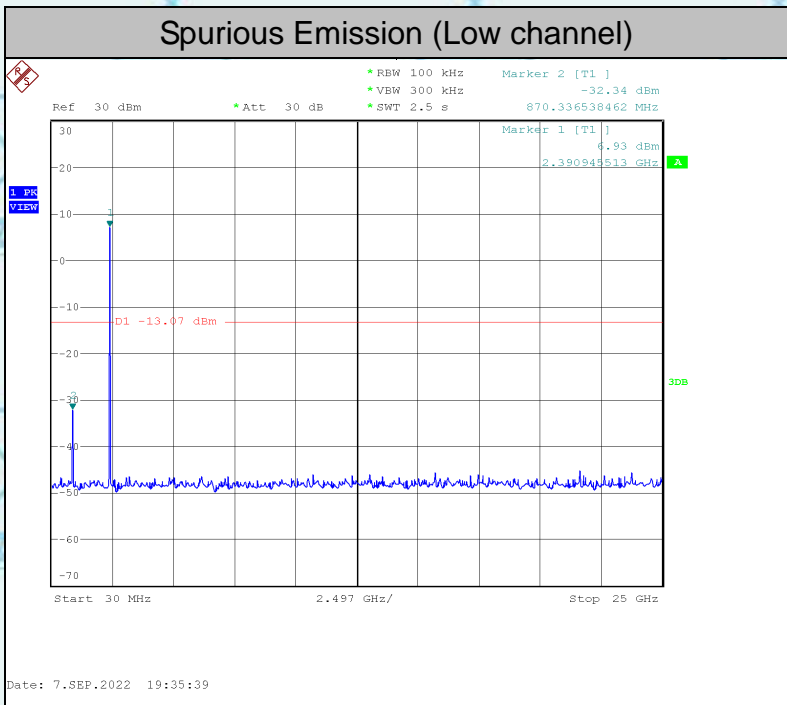


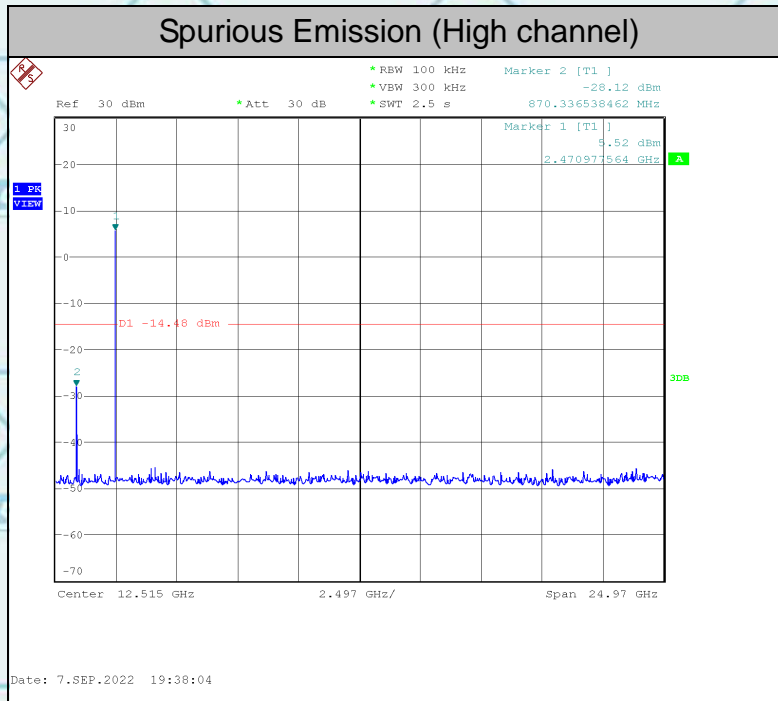


Report No.: WSCT-A2LA-R&E220900005A-BT
8DPSK mode

Certificate #5768.01

For Question,
Please Contact with WSCT
www.wsct-cert.com



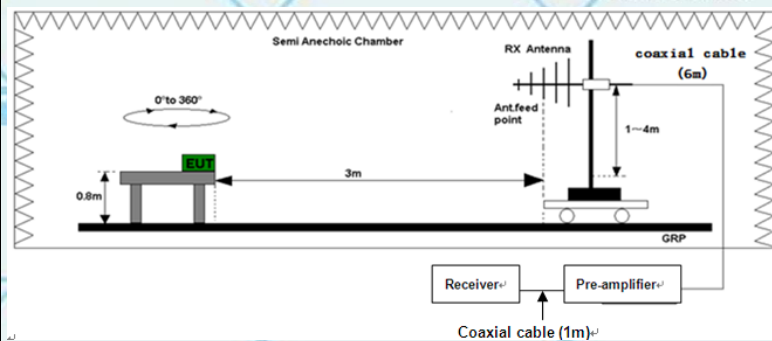




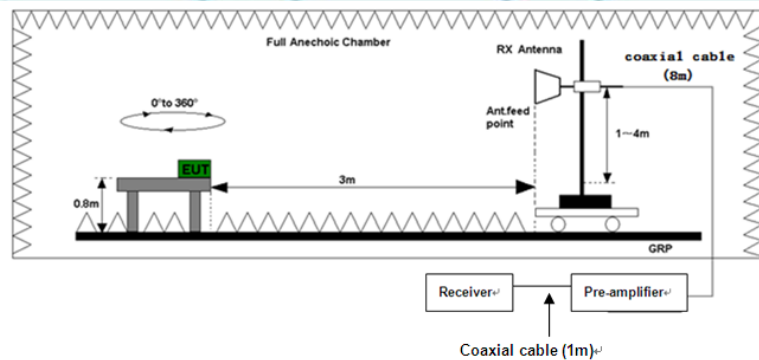
6.11. Radiated Spurious Emission Measurement

6.11.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.209				
Test Method:	ANSI C63.10:2014				
Frequency Range:	9 kHz to 25 GHz				
Measurement Distance:	3 m				
Antenna Polarization:	Horizontal & Vertical				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	9kHz- 150kHz	Quasi-peak	200Hz	1kHz	Quasi-peak Value
	150kHz- 30MHz	Quasi-peak	9kHz	30kHz	Quasi-peak Value
	30MHz-1GHz	Quasi-peak	100KHz	300KHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
		Peak	1MHz	10Hz	Average Value
Limit:	Frequency	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	30	30		
	30-88	100	3		
	88-216	150	3		
	216-960	200	3		
	Above 960	500	3		
Test setup:	Frequency	Field Strength (microvolts/meter)	Measurement Distance (meters)	Detector	
	Above 1GHz	500 5000	3 3	Average Peak	
Test setup:	For radiated emissions below 30MHz <p>Distance = 3m</p> <p>EUT</p> <p>Turn table</p> <p>Ground Plane</p> <p>Computer</p> <p>Pre -Amplifier</p> <p>Receiver</p> <p>30MHz to 1GHz</p>				



Above 1GHz



Test Mode:

Transmitting mode with modulation

Test Procedure:

1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10:2014 Measurement Guidelines.
2. For the radiated emission test below 1GHz:
The EUT was placed on a turntable with 0.8 meter above ground. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower. 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.
- For the radiated emission test above 1GHz:
Place the measurement antenna on a turntable with 1.5 meter above ground, which is away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final





	<p>measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.</p> <ol style="list-style-type: none"> 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Use the following spectrum analyzer settings: <ol style="list-style-type: none"> (1) Span shall wide enough to fully capture the emission being measured; (2) Set RBW=100 kHz for $f < 1$ GHz, RBW=1MHz for $f > 1$GHz ; VBW\geqRBW; Sweep = auto; Detector function = peak; Trace = max hold for peak (3) For average measurement: use duty cycle correction factor method per 15.35(c). Duty cycle = On time/100 milliseconds On time = $N1 * L1 + N2 * L2 + \dots + Nn-1 * Ln-1 + Nn * Ln$ Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc. Average Emission Level = Peak Emission Level + 20*log(Duty cycle) Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
<p>Test results:</p>	<p>PASS</p>



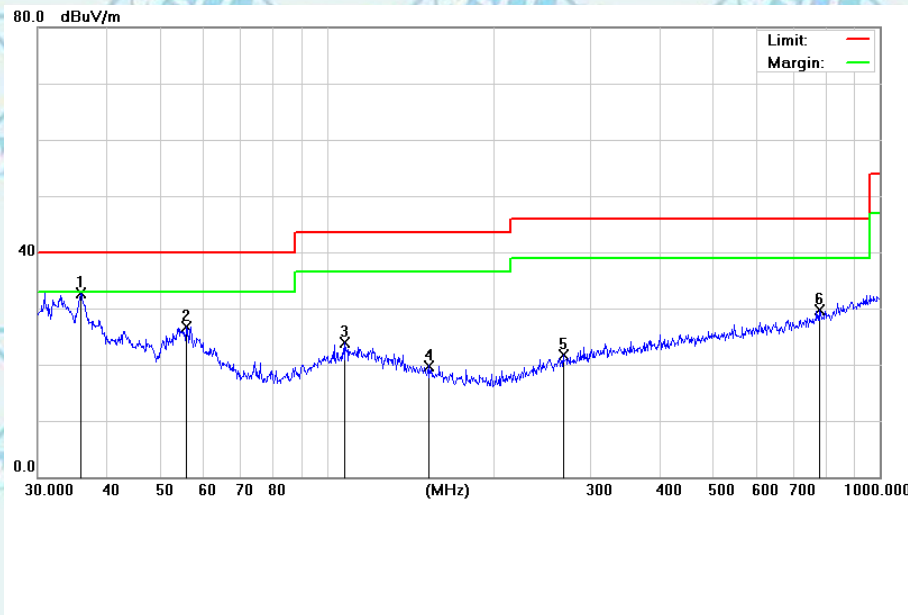


6.11.2. Test Data

Please refer to following diagram for individual

Below 1GHz

Horizontal:

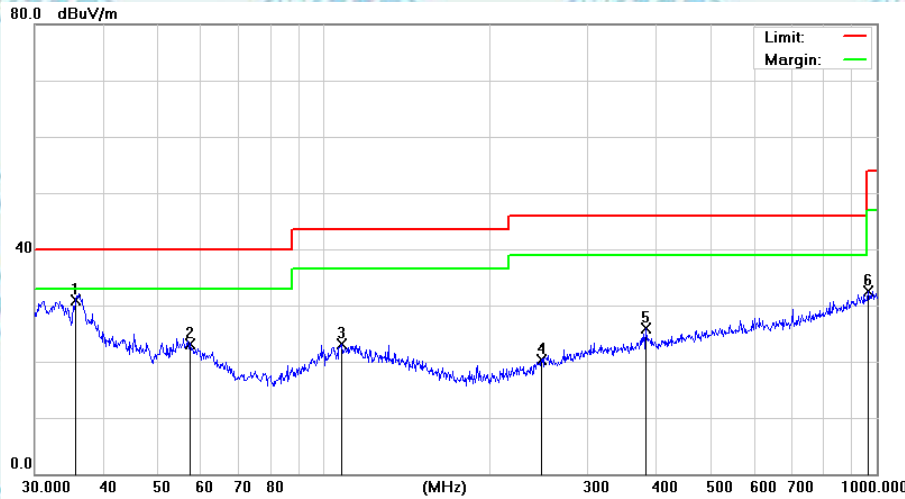


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1	*	35.8746	30.29	2.37	32.66	40.00	-7.34	QP
2		55.8047	32.40	-5.71	26.69	40.00	-13.31	QP
3		107.8877	26.26	-2.28	23.98	43.50	-19.52	QP
4		152.6641	24.96	-5.16	19.80	43.50	-23.70	QP
5		267.5455	25.58	-3.83	21.75	46.00	-24.25	QP
6		776.8778	26.06	3.58	29.64	46.00	-16.36	QP





Vertical:



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measurement dBuV/m	Limit dBuV/m	Over dB	Detector
1	*	35.6240	28.47	2.51	30.98	40.00	-9.02	QP
2		57.3923	29.10	-5.90	23.20	40.00	-16.80	QP
3		107.8877	25.30	-2.28	23.02	43.50	-20.48	QP
4		247.6819	25.13	-4.84	20.29	46.00	-25.71	QP
5		382.5879	27.02	-1.17	25.85	46.00	-20.15	QP
6		965.5421	25.86	6.70	32.56	54.00	-21.44	QP

Note: 1. The low frequency, which started from 9KHz~30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported

2. Measurements were conducted in all three channels (high, middle, low) and three modulation (GFSK, Pi/4 DQPSK, 8DPSK) and the worst case Mode (Lowest channel and GFSK) was submitted only.

3. Reading level (dBuV) = Receiver reading
 Corr. Factor (dB) = Attenuation factor + Cable loss
 Level (dBuV) = Reading level (dBuV) + Corr. Factor (dB)
 Limit (dBuV) = Limit stated in standard
 Margin (dB) = Level (dBuV) – Limits (dBuV)





Above 1GHz

GFSK

Freq. (MHz)	Low channel: 2402MHz						
	Ant.Pol	Emission Level(dBuV)		Limit 3m(dBuV/m)		Over(dB)	
	H/V	PK	AV	PK	AV	PK	AV
4804	V	60.70	40.01	74	54	-13.30	-13.99
7206	V	58.10	39.04	74	54	-15.90	-14.96
4804	H	58.34	39.26	74	54	-15.66	-14.74
7206	H	59.47	40.47	74	54	-14.53	-13.53

Freq. (MHz)	Middle channel: 2441MHz						
	Ant.Pol	Emission Level(dBuV)		Limit 3m(dBuV/m)		Over(dB)	
	H/V	PK	AV	PK	AV	PK	AV
4882	V	60.46	40.10	74	54	-13.54	-13.90
7323	V	58.57	39.65	74	54	-15.43	-14.35
4882	H	58.66	39.10	74	54	-15.34	-14.90
7323	H	58.06	39.06	74	54	-15.94	-14.94

Freq. (MHz)	High channel: 2480MHz						
	Ant.Pol	Emission Level(dBuV)		Limit 3m(dBuV/m)		Over(dB)	
	H/V	PK	AV	PK	AV	PK	AV
4960	V	60.53	41.99	74	54	-13.47	-12.01
7440	V	58.11	40.22	74	54	-15.89	-13.78
4960	H	59.49	39.24	74	54	-14.51	-14.76
7440	H	58.44	39.44	74	54	-15.56	-14.56

Note:

1. The emission levels of other frequencies are very lower than the limit and not show in test report.
2. Measurements were conducted from 1 GHz to the 10th harmonic of highest fundamental frequency.
3. Data of measurement shown "---" in the above table mean that the reading of emissions is attenuated more than 20 dB below the limits or the field strength is too small to be measured.
4. Measurements were conducted in all three modulation (GFSK, Pi/4 DQPSK, 8DPSK), and the worst case Mode (GFSK) was submitted only.





Restricted Bands Requirements

Test result for GFSK Mode(the worst case)

Frequency	Reading	Correct Factor	Emission Level	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel							
2387	62.76	-8.76	54.00	74	20.00	H	PK
2387	54.29	-8.76	45.53	54	8.47	H	AV
2387	62.48	-8.73	53.75	74	20.25	V	PK
2387	57.20	-8.73	48.47	54	5.53	V	AV
2390	60.15	-8.17	51.98	74	22.02	H	PK
2390	53.53	-8.17	45.36	54	8.64	H	AV
2390	60.15	-8.17	51.98	74	22.02	V	PK
2390	54.01	-8.17	45.84	54	8.16	V	AV
High Channel							
2483.5	63.01	-8.17	54.84	74	19.16	H	PK
2483.5	54.57	-8.17	46.40	54	7.60	H	AV
2483.5	61.82	-8.17	53.65	74	20.35	V	PK
2483.5	54.96	-8.17	46.79	54	7.21	V	AV

Note: Freq. = Emission frequency in MHz
 Reading level (dB μ V) = Receiver reading
 Corr. Factor (dB) = Attenuation factor + Cable loss
 Level (dB μ V) = Reading level (dB μ V) + Corr. Factor (dB)
 Limit (dB μ V) = Limit stated in standard
 Margin (dB) = Level (dB μ V) – Limits (dB μ V)

*******END OF REPORT*******

