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FCC REPORT

Application No:	SZEMO110301010RF
Applicant:	TE Group
Product Name:	Bluetooth Speakerphone
Operation Frequency:	2402MHz to 2480MHz
FCC ID:	TQGBLUESOLAR
Standards:	FCC CFR Title 47 Part 15 Subpart C
Date of Receipt:	2011-12-01
Date of Test:	2011-12-02 to 2011-12-09
Date of Issue:	2012-01-09
Test Result:	**PASS ***

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:

Jack Zhang
EMC Laboratory Manager

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3 Test Summary

Test Item	Section in CFR 47	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)	Pass
20dB Occupied Bandwidth	15.247 (a)(1)	Pass
Carrier Frequencies Separation	15.247 (a)(1)	Pass
Hopping Channel Number	15.247 (b)	Pass
Dwell Time	15.247 (a)(1)	Pass
Pseudorandom Frequency Hopping Sequence	15.247(b)(4)&TCB Exclusion List (7 July 2002)	Pass
Radiated Emission	15.205/15.209	Pass
Band Edge	15.247(d)	Pass

Remark: Pass: The EUT complies with the essential requirements in the standard.
Fail: The EUT does not comply with the essential requirements in the standard.

4 General Information

4.1 Client Information

Applicant:	TE Group
Address of Applicant:	Kapelse straar 61-2950 Kapellen-Belgium
Manufacturer:	TE Group
Address of Manufacturer	Kapelse straar 61-2950 Kapellen-Belgium
Factory:	TE Group
Address of Factory:	Kapelse straar 61-2950 Kapellen-Belgium

4.2 General Description of E.U.T.

Product Name:	Bluetooth Speakerphone
Model No.:	Blue Solar
Operation Frequency:	2402MHz~2480MHz
Test software of EUT:	CSR (manufacturer declare)
Bluetooth Version:	V2.1+EDR
Channel Spacing:	1MHz
Channel Numbers:	79
Modulation Type:	GFSK, π/4DQPSK, 8DPSK
Antenna Type:	Integral
Antenna Gain:	0dBi
EUT Power Supply:	PC: PC USB Charge
	Vehicular adapter: Model:CS0105/CU0105 Input: DC 12-24V Output: DC5.0V 500mA
USB Line:	<3m

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2402MHz	21	2422MHz	41	2442MHz	61	2462MHz
2	2403MHz	22	2423MHz	42	2443MHz	62	2463MHz
3	2404MHz	23	2424MHz	43	2444MHz	63	2464MHz
4	2405MHz	24	2425MHz	44	2445MHz	64	2465MHz
5	2406MHz	25	2426MHz	45	2446MHz	65	2466MHz
6	2407MHz	26	2427MHz	46	2447MHz	66	2467MHz
7	2408MHz	27	2428MHz	47	2448MHz	67	2468MHz
8	2409MHz	28	2429MHz	48	2449MHz	68	2469MHz
9	2410MHz	29	2430MHz	49	2450MHz	69	2470MHz
10	2411MHz	30	2431MHz	50	2451MHz	70	2471MHz
11	2412MHz	31	2432MHz	51	2452MHz	71	2472MHz
12	2413MHz	32	2433MHz	52	2453MHz	72	2473MHz
13	2414MHz	33	2434MHz	53	2454MHz	73	2474MHz
14	2415MHz	34	2435MHz	54	2455MHz	74	2475MHz
15	2416MHz	35	2436MHz	55	2456MHz	75	2476MHz
16	2417MHz	36	2437MHz	56	2457MHz	76	2477MHz
17	2418MHz	37	2438MHz	57	2458MHz	77	2478MHz
18	2419MHz	38	2439MHz	58	2459MHz	78	2479MHz
19	2420MHz	39	2440MHz	59	2460MHz	79	2480MHz
20	2421MHz	40	2441MHz	60	2461MHz		

Note:
In section 15.31(m), regards to the operating frequency range over 10 MHz, the lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel for testing see below:

Channel	Frequency
Lowest channel	2402MHz
Middle channel	2441MHz
Highest channel	2480MHz

4.3 E.U.T Operation mode

Operating Environment:	
Temperature:	25.0 °C
Humidity:	50 % RH
Atmospheric Pressure:	1015mbar
Test mode:	
Vehicular charge +transmitting:	The EUT transmitted the continuous modulation test signal at the specific channel and power charged by vehicular adapter.
PC charge + transmitting:	The EUT transmitted the continuous modulation test signal at the specific channel and PC charge to EUT.
Transmitting:	The EUT transmitted the continuous modulation test signal at the specific channel.

4.4 Description of Support Units

The EUT was tested with associated equipment as below:

Description	Manufacturer	Model No.
PC	DELL	OPTIPLEX 755
LCD-displaying	DELL	E1909WF
KEYBOARD	DELL	SK-8115
MOUSE	DELL	MOC5110
PC	DELL	OPTIDLEX 330
LCD-displaying	DELL	SP2208WFPT
KEYBOARD	DELL	SK-8115
MOUSE	DELL	MOC5110
Coder	HengTong ELECTRON	HT4000
Printer	Canon	BJC-1000SP
Mobile	Nokia	6300
DC Power	ZHAOXIN	RXN-305D

4.5 Test Facility

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

- **CNAS (No. CNAS L2929)**
  CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.
- **VCCI**
  The 3m Semi-anechoic chamber, Full-anechoic Chamber and Shielded Room (7.5m x 4.0m x 3.0m) of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-2197, G-416, T-1153 and C-2383 respectively.
- **FCC – Registration No.: 556682**
  SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen 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 No.: 556682.
- **Industry Canada (IC)**
  The 3m Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1.

4.6 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch E&E Lab
No. 1 Workshop, M-10, Middle section, Science & Technology Park, Shenzhen, Guangdong, China 518057
Telephone: +86 (0) 755 2601 2053 Fax: +86 (0) 755 2671 0594
No tests were sub-contracted.

4.7 Other Information Requested by the Customer

None.

4.8 Test Instruments list

RE in Chamber					
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Due date (yyyy-mm-dd)**
1	3m Semi-Anechoic Chamber	ETS-LINDGREN	N/A	SEL0017	2012-06-10
2	EMI Test Receiver	Rohde & Schwarz	ESIB26	SEL0023	2012-05-26
3	EMI Test software	AUDIX	E3	SEL0050	N/A
4	Coaxial cable	SGS	N/A	SEL0028	2012-05-29
5	BiConiLog Antenna (26-3000MHz)	ETS-LINDGREN	3142C	SEL0015	2012-10-29
6	Double-ridged horn (1-18GHz)	ETS-LINDGREN	3117	SEL0006	2012-10-29
7	Horn Antenna (18-26GHz)	ETS-LINDGREN	3160	SEL0076	2012-10-29
8	Pre-amplifier (0.1-1300MHz)	Agilent Technologies	8447D	SEL0053	2012-05-26
9	Pre-Amplifier (0.1-26.5GHz)	Compliance Directions Systems Inc.	PAP-0126	SEL0168	2012-10-26
11	Band filter	Amindeon	82346	SEL0094	2012-05-26

Conducted Emission					
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Due date (yyyy-mm-dd)**
1	Shielding Room	ZhongYu Electron	GB-88	SEL0042	2012-06-10
2	LISN	Rohde & Schwarz	ENV216	SEL0152	2012-10-23
3	Two-Line V-Network	ETS-LINDGREN	3816/2	SEL0021	2012-05-26
4	EMI Test Receiver	Rohde & Schwarz	ESCI	SEL0022	2012-05-26
5	Coaxial Cable	SGS	N/A	SEL0024	2012-05-29

RF conducted					
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Due date (yyyy-mm-dd)**
1	Spectrum Analyzer	Rohde & Schwarz	FSP 30	SEL0154	2012-10-23
2	Coaxial cable	SGS	N/A	SEL0028	2012-05-29

General used equipment					
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Due date (yyyy-mm-dd)**
1	Humidity/ Temperature Indicator	Shanghai	ZJ1-2B	SEL0102 to SEL0103	2012-10-27
2	Humidity/ Temperature Indicator	Shanghai	ZJ1-2B	SEL0101	2012-10-27
3	Barometer	ChangChun	DYM3	SEL0088	2012-05-18

5 Test results and Measurement Data

5.1 Antenna requirement:

Standard requirement:	FCC Part15 C Section 15.203 /247(c)

15.203 requirement:

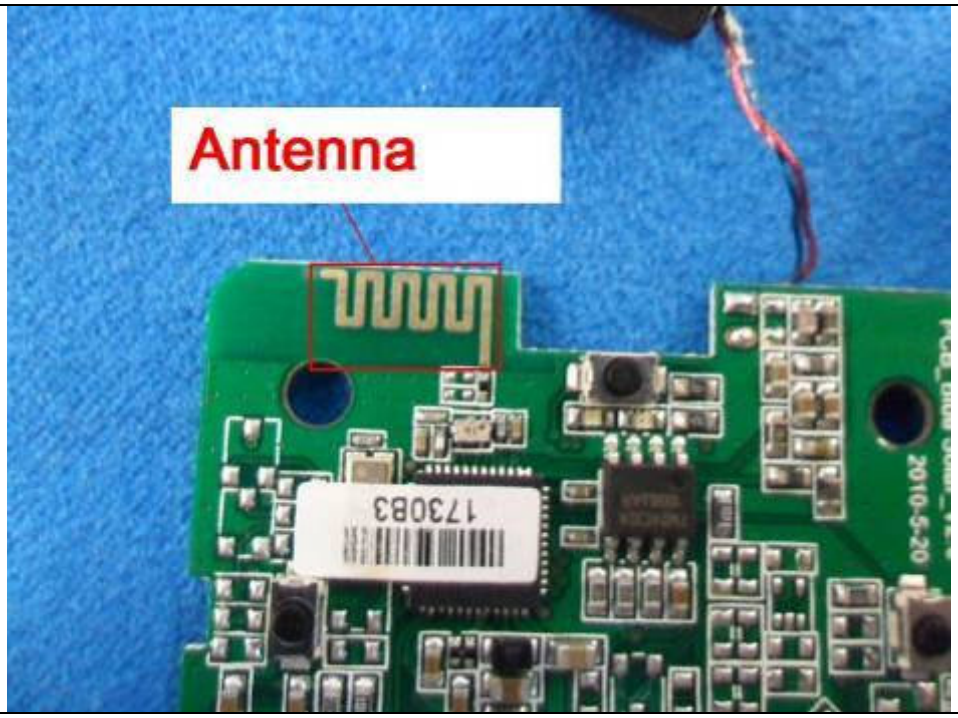
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(c) (1)(i) requirement:

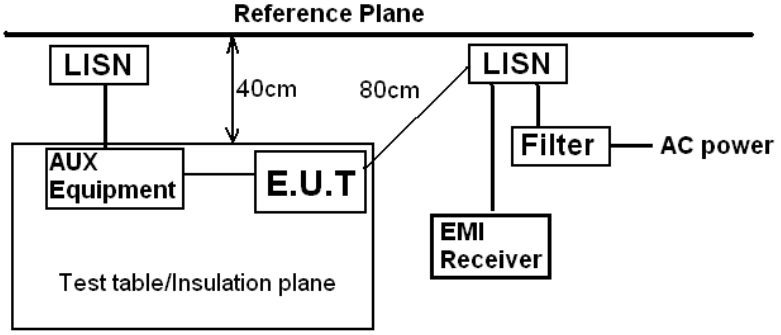
(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional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

E.U.T Antenna:	

The antenna is integrated on the main PCB and no consideration of replacement. The best gain of the antenna is 0dBi.



5.2 Conducted Emissions

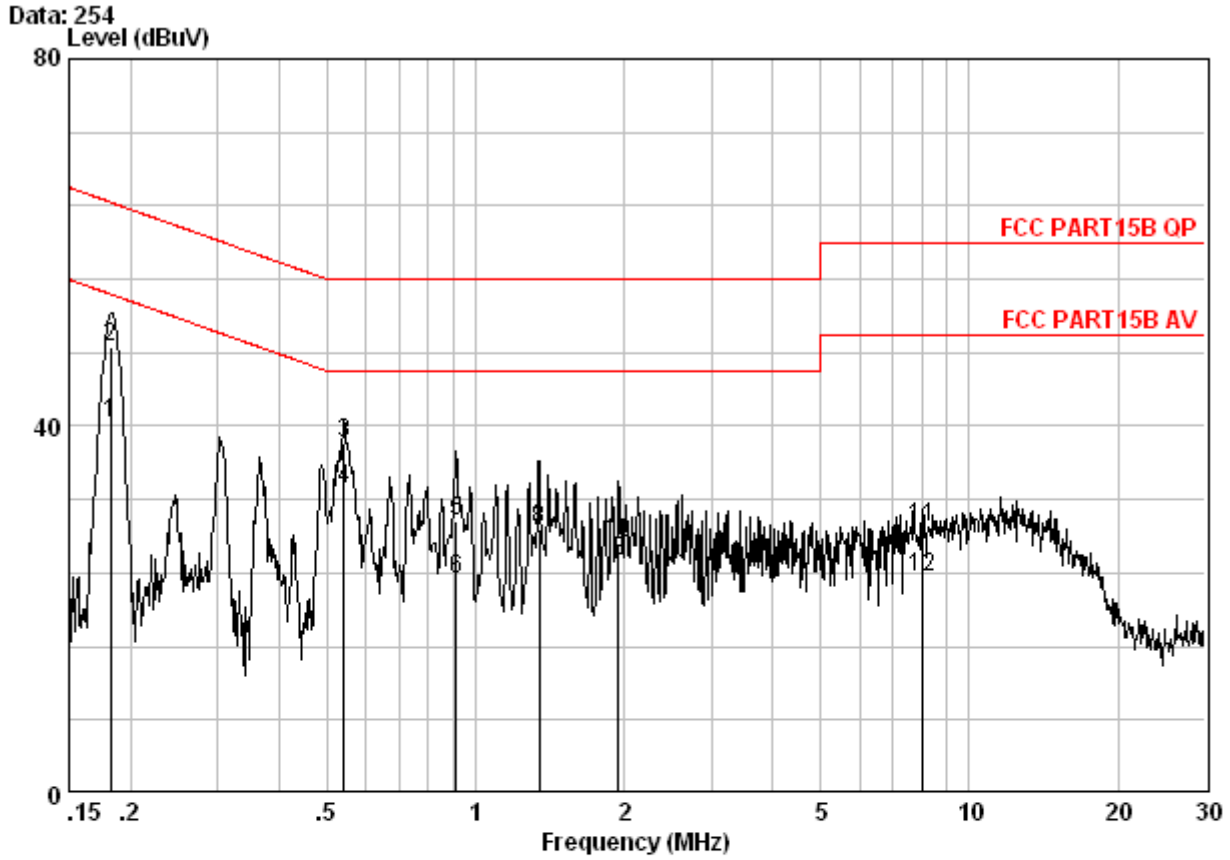
Test Requirement:	FCC Part15 C Section 15.207
Test Method:	ANSI C63.10: 2009
Test Frequency Range:	150kHz to 30MHz
Class / Severity:	Class B
Limit:	Frequency range (MHz) / Limit (dBuV): Quasi-peak / Average 0.15-0.5: 66 to 56* / 56 to 46* 0.5-5: 56 / 46 5-30: 60 / 50 * Decreases with the logarithm of the frequency.
Test procedure	The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.).The provide 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 refers 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: 2009 on conducted measurement.
Test setup:	 *Remark:* *E.U.T: Equipment Under Test* *LISN: Line Impedence Stabilization Network* *Test table height=0.8m*
Test Instruments:	Refer to section 4.8 for details.
Test mode:	PC charge +transmitting mode
Test results:	Pass

Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector.

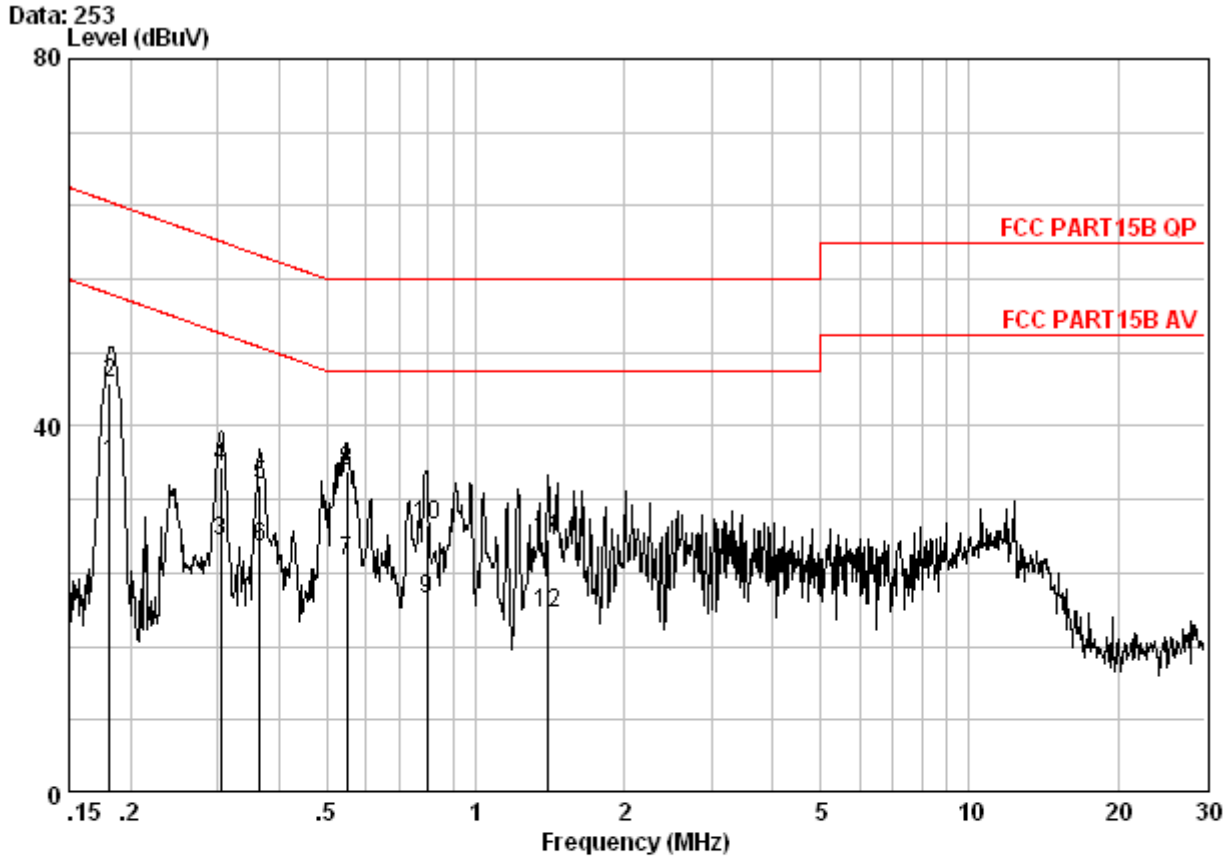
Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Live line:



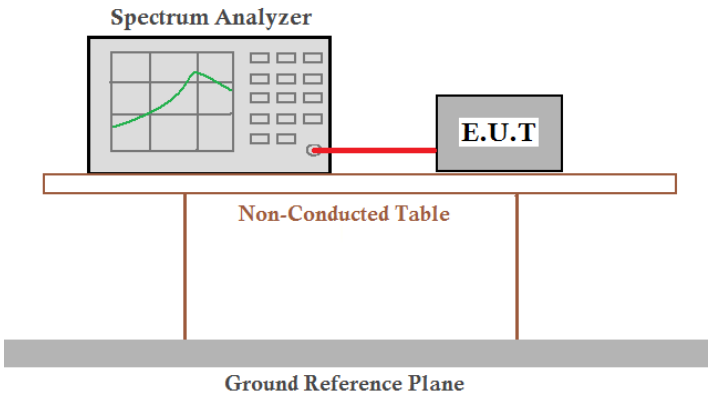
	Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1 @	0.18249	0.14	9.60	30.64	40.38	54.37	-13.99	Average
2 @	0.18249	0.14	9.60	38.98	48.72	64.37	-15.65	QP
3 @	0.54068	0.16	9.62	28.37	38.16	56.00	-17.84	QP
4 @	0.54068	0.16	9.62	23.27	33.05	46.00	-12.95	Average
5	0.91357	0.19	9.70	19.72	29.62	56.00	-26.38	QP
6	0.91357	0.19	9.70	13.53	23.42	46.00	-22.58	Average
7	1.345	0.20	9.70	18.67	28.57	56.00	-27.43	QP
8 @	1.345	0.20	9.70	18.86	28.76	46.00	-17.24	Average
9	1.949	0.20	9.70	15.41	25.31	56.00	-30.69	QP
10	1.949	0.20	9.70	17.42	27.32	46.00	-18.68	Average
11	8.062	0.25	9.86	18.96	29.07	60.00	-30.93	QP
12	8.062	0.25	9.86	13.34	23.45	50.00	-26.55	Average

Neutral line:



	Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1 @	0.18152	0.14	9.60	26.28	36.02	54.42	-18.40	Average
2	0.18152	0.14	9.60	34.94	44.68	64.42	-19.74	QP
3	0.30509	0.16	9.60	17.63	27.39	50.10	-22.71	Average
4	0.30509	0.16	9.60	25.76	35.52	60.10	-24.59	QP
5	0.36531	0.16	9.60	23.81	33.57	58.61	-25.03	QP
6	0.36531	0.16	9.60	16.95	26.71	48.61	-21.90	Average
7	0.54934	0.16	9.63	15.57	25.36	46.00	-20.64	Average
8	0.54934	0.16	9.63	25.31	35.10	56.00	-20.90	QP
9	0.79600	0.18	9.70	11.16	21.04	46.00	-24.96	Average
10	0.79600	0.18	9.70	19.29	29.17	56.00	-26.83	QP
11	1.403	0.20	9.70	17.69	27.59	56.00	-28.41	QP
12	1.403	0.20	9.70	9.64	19.54	46.00	-26.46	Average

5.3 Conducted Peak Output Power

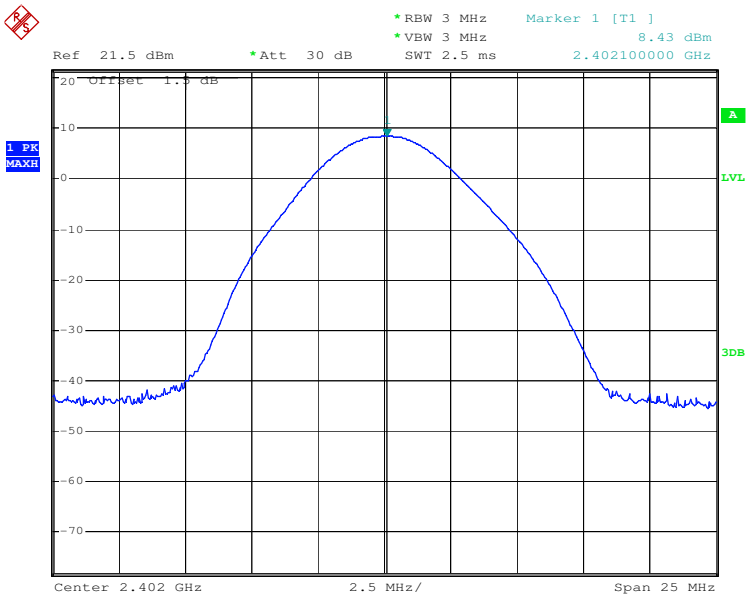
Test Requirement:	FCC Part15 C Section 15.247 (b)(1)
Test Method:	ANSI C63.10:2009
Limit:	30dBm
Test setup:	 *Remark:* *Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.*
Test Instruments:	Refer to section 4.8 for details.
Test state:	Non-hopping transmitting with all kinds of modulation.
Test results:	Pass

Measurement Data

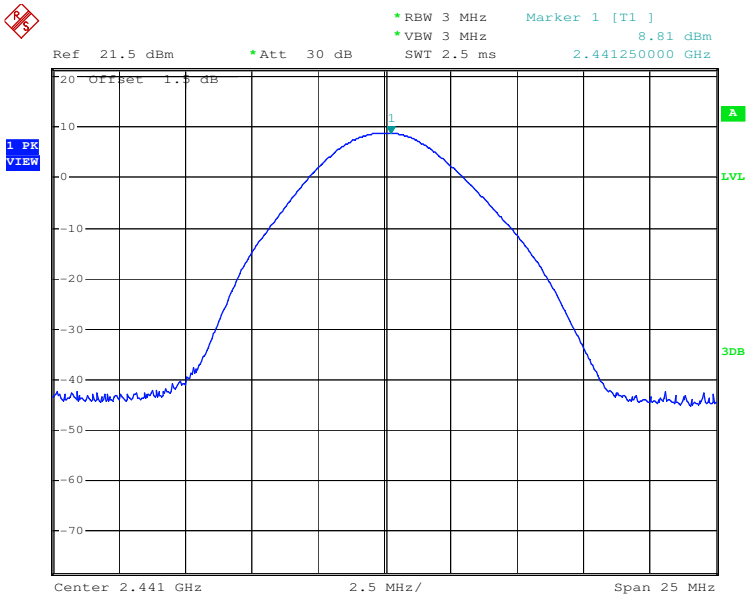
GFSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	8.43	30.00	Pass
Middle	8.81	30.00	Pass
Highest	8.68	30.00	Pass
π/4DQPSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	7.55	30.00	Pass
Middle	7.78	30.00	Pass
Highest	7.47	30.00	Pass
8DPSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	7.70	30.00	Pass
Middle	8.03	30.00	Pass
Highest	7.75	30.00	Pass

Test plot as follows:

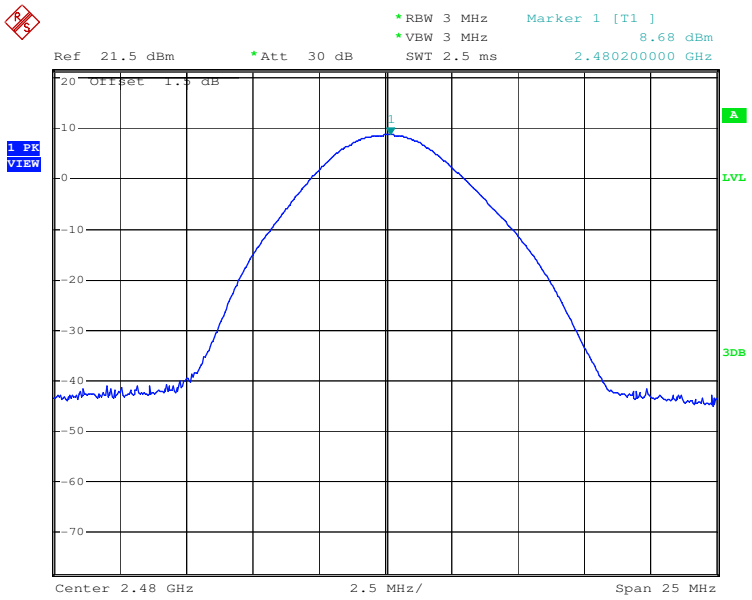
Test mode:	GFSK	Test channel:	Lowest



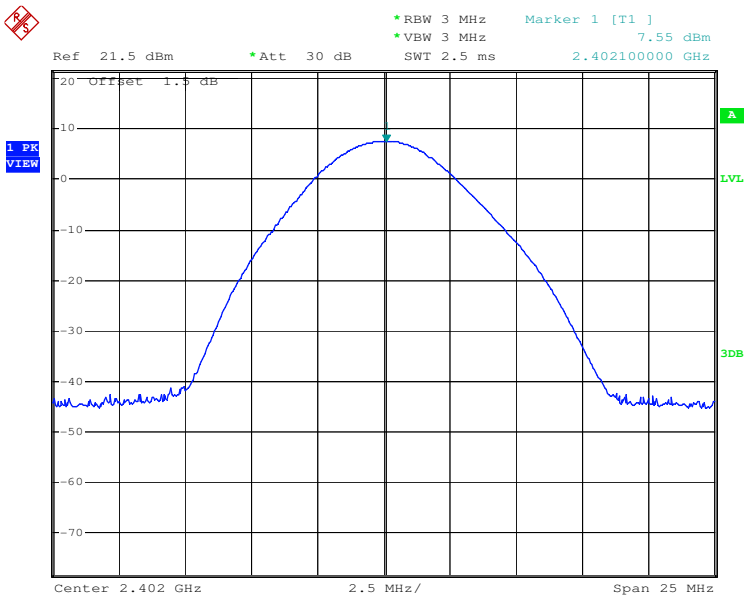
Test mode:	GFSK	Test channel:	Middle



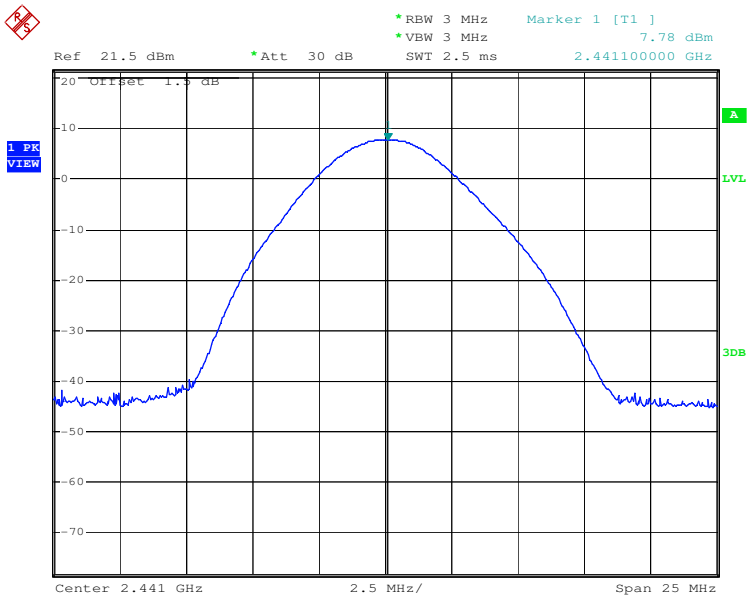
Test mode:	GFSK	Test channel:	Highest



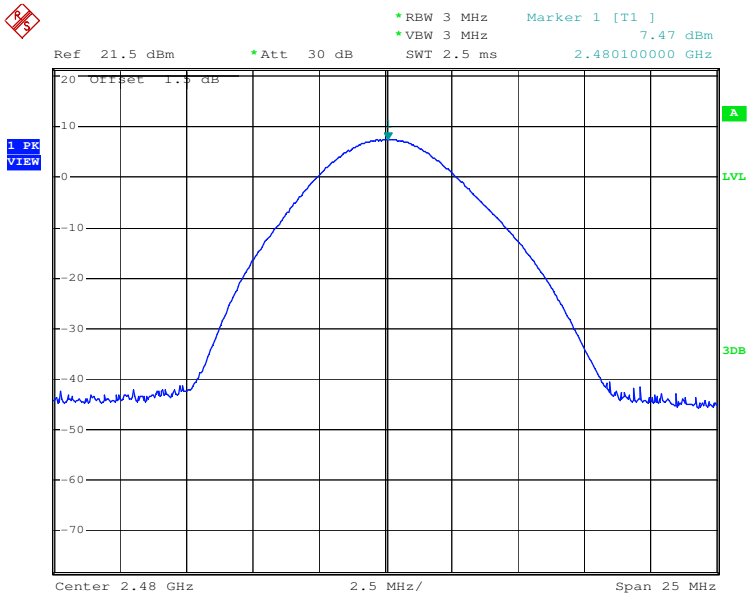
Test mode:	π/4DQPSK	Test channel:	Lowest



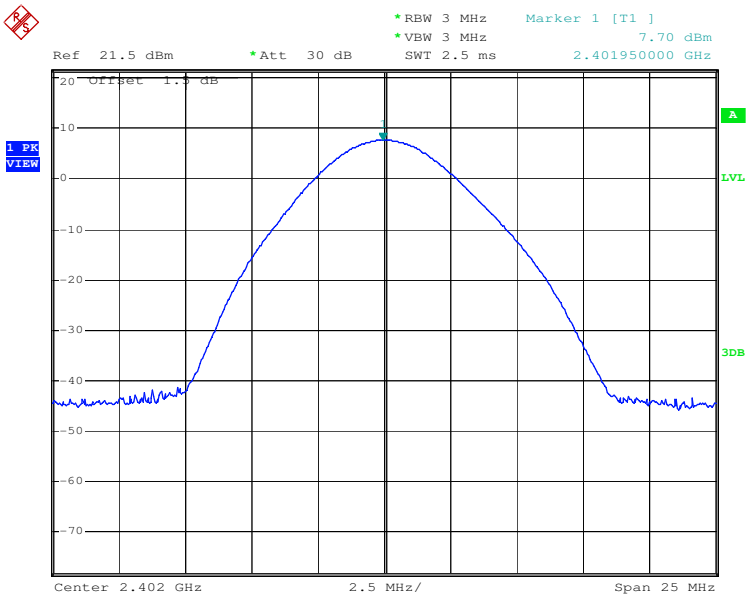
Test mode:	π/4DQPSK	Test channel:	Middle



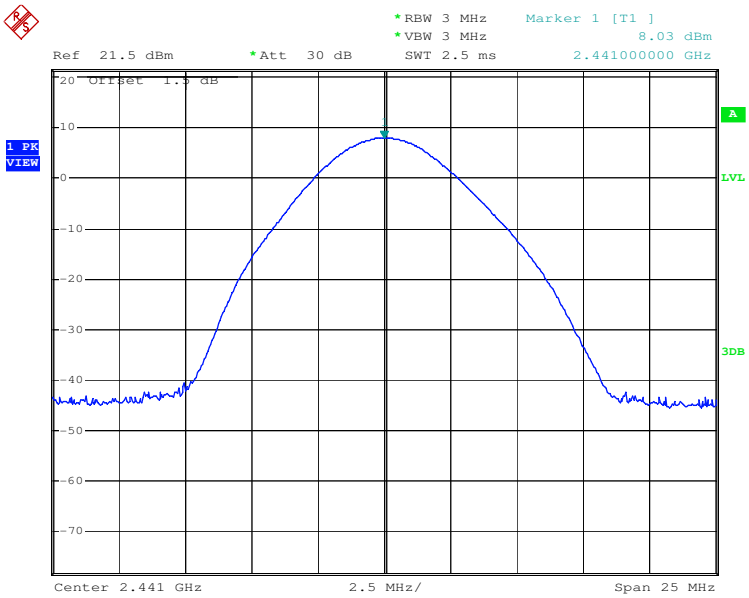
Test mode:	π/4DQPSK	Test channel:	Highest



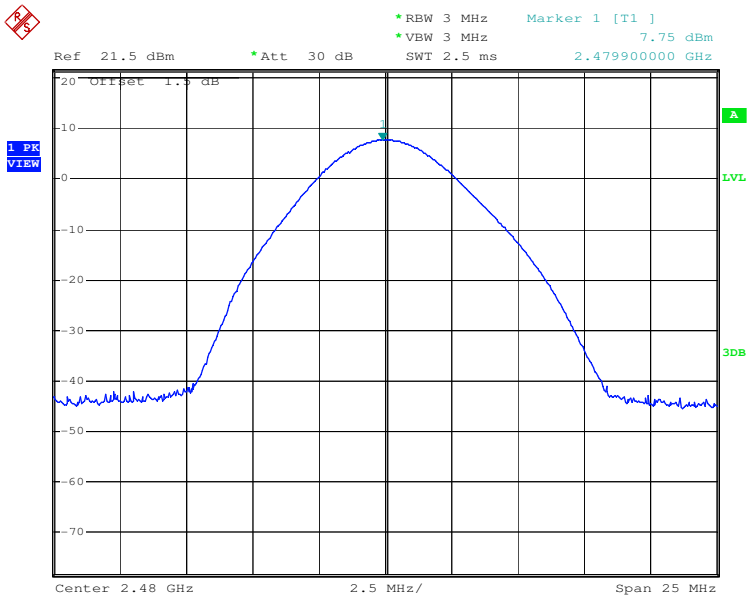
Test mode:	8DPSK	Test channel:	Lowest



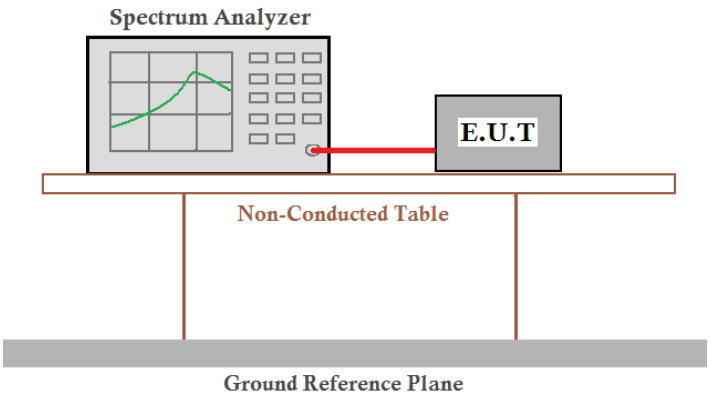
Test mode:	8DPSK	Test channel:	Middle



Test mode:	8DPSK	Test channel:	Highest



5.4 20dB Occupy Bandwidth

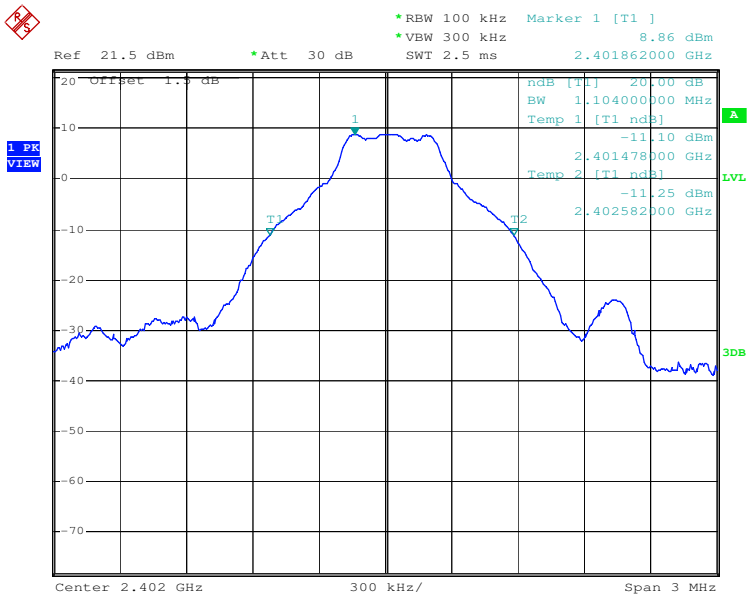
Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2009
Limit:	NA
Test setup:	
Test Instruments:	Refer to section 4.8 for details.
Test state:	Non-hopping transmitting with all kinds of modulation.

Measurement Data

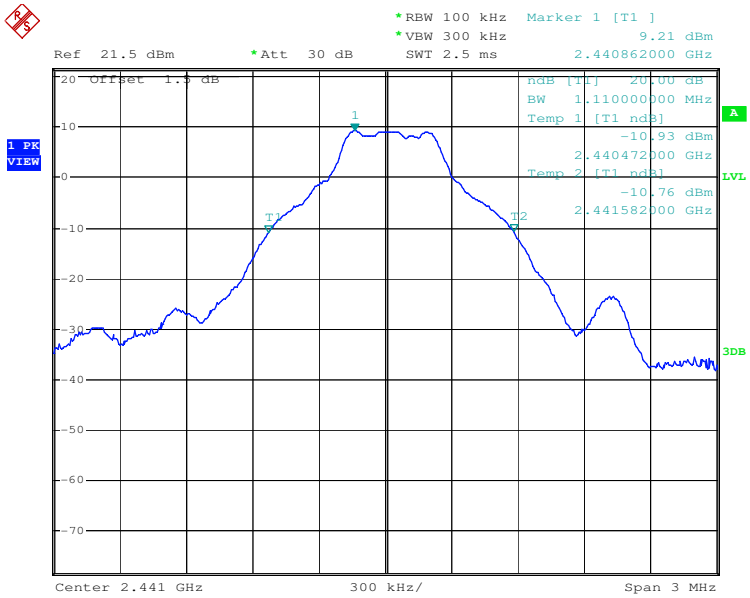
Test channel	20dB Occupy Bandwidth (kHz)		
	GFSK	π/4DQPSK	8DPSK
Lowest	1104	1404	1368
Middle	1110	1386	1350
Highest	1104	1386	1350

Test plot as follows:

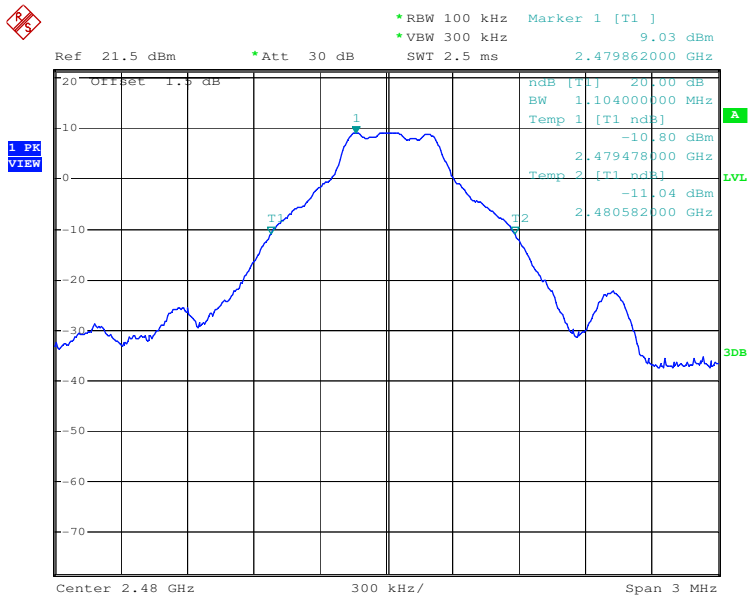
Test mode:	GFSK	Test channel:	Lowest



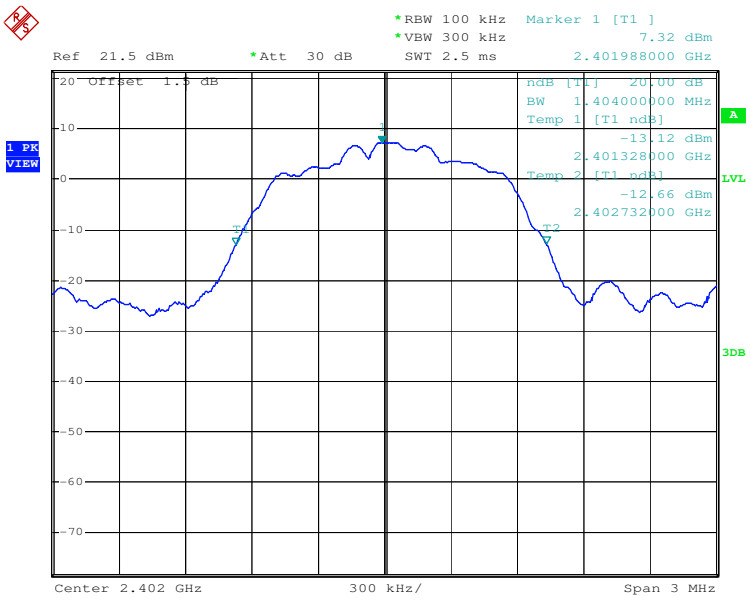
Test mode:	GFSK	Test channel:	Middle



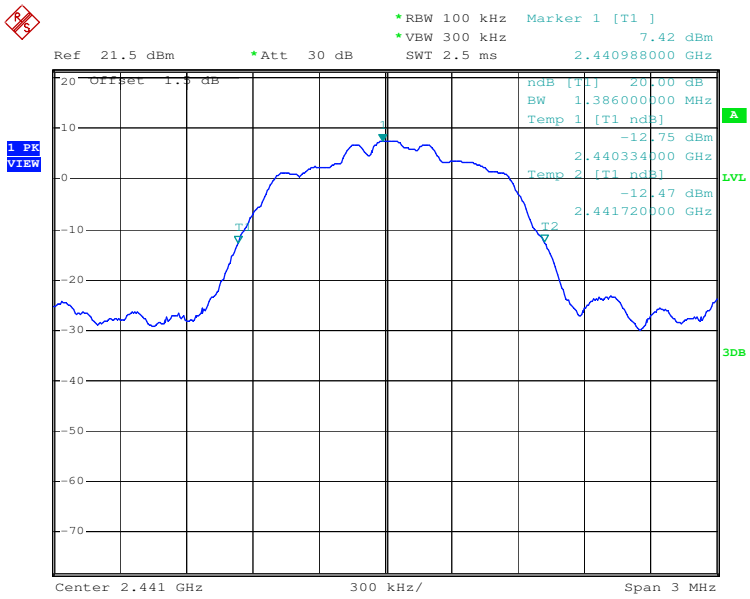
Test mode:	GFSK	Test channel:	Highest



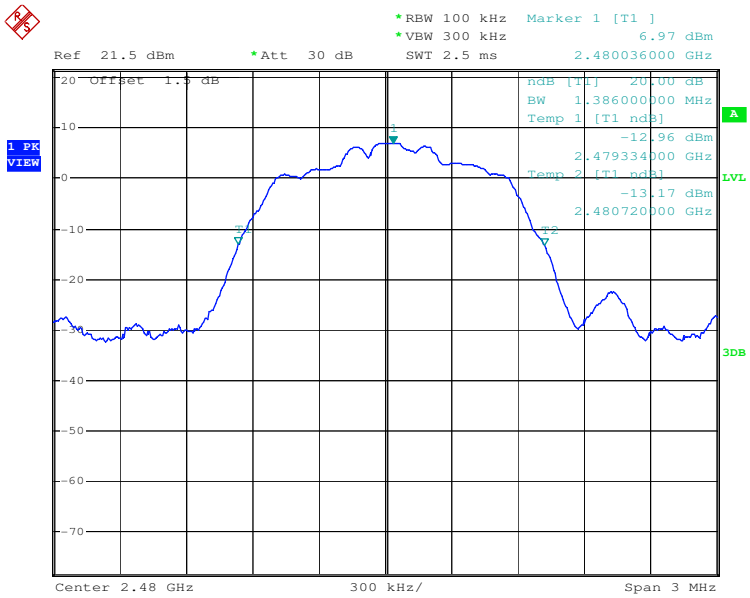
Test mode:	π/4DQPSK	Test channel:	Lowest



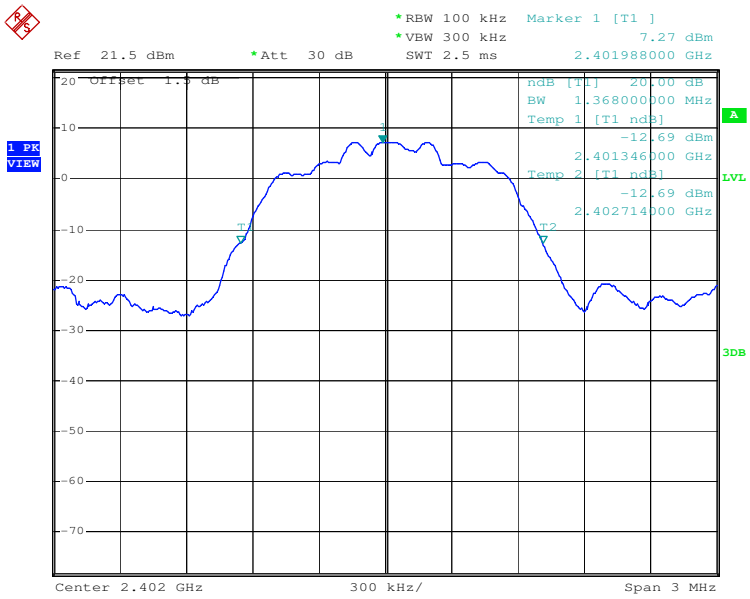
Test mode:	π/4DQPSK	Test channel:	Middle



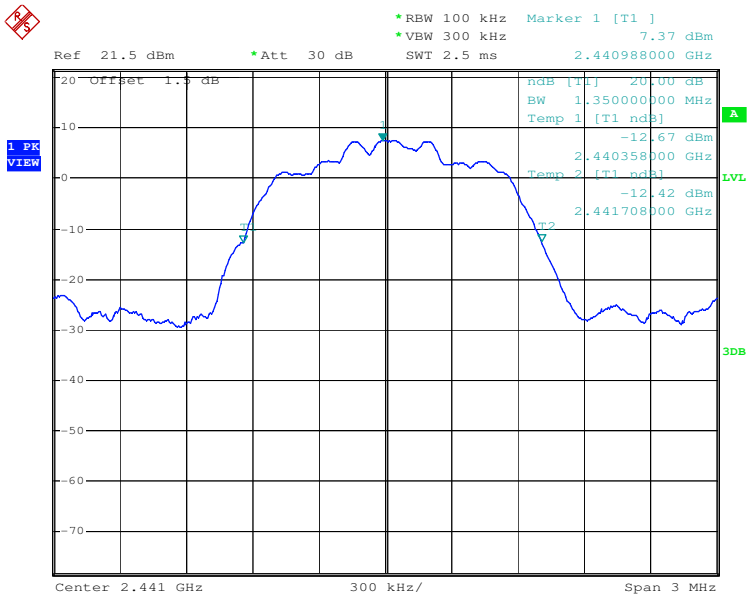
Test mode:	π/4DQPSK	Test channel:	Highest



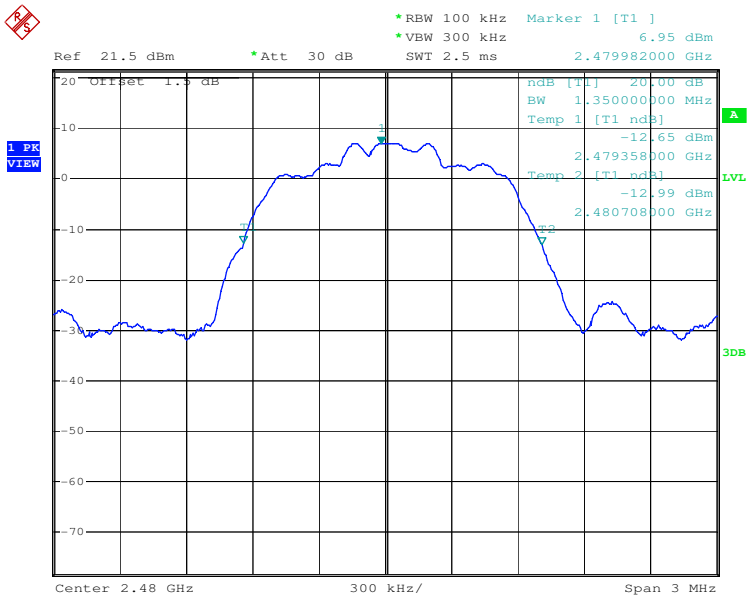
Test mode:	8DPSK	Test channel:	Lowest



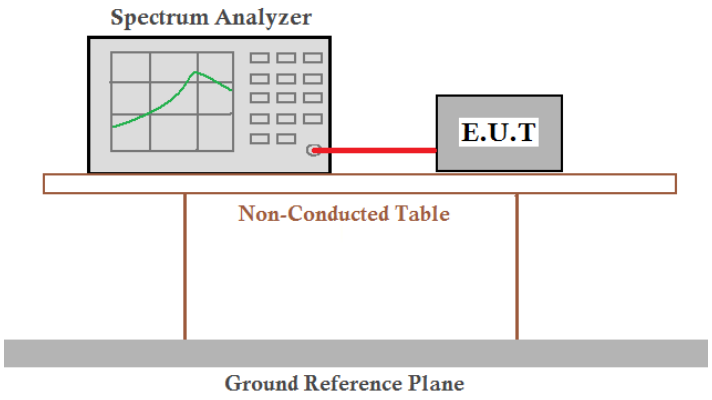
Test mode:	8DPSK	Test channel:	Middle



Test mode:	8DPSK	Test channel:	Highest



5.5 Carrier Frequencies Separation

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2009
Test state:	Hopping transmitting with all kind of modulation.
Test setup:	
Test Instruments:	Refer to section 4.8 for details.
Limit:	0.025MHz or 2/3 of the 20dB bandwidth (whichever is greater)
Test results:	Pass

Measurement Data

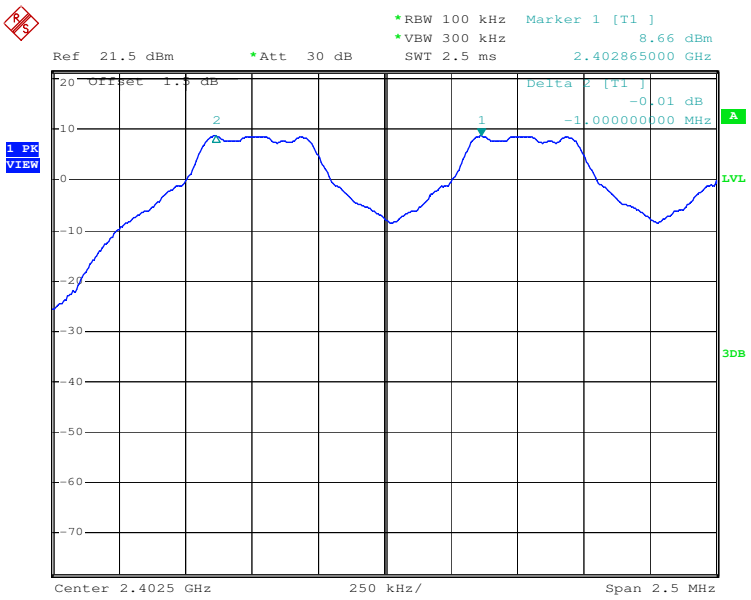
GFSK mode			
Test channel	Carrier Frequencies Separation (KHz)	Limit (KHz)	Result
Lowest	1000	≥936	Pass
Middle	1005	≥936	Pass
Highest	1000	≥936	Pass
π/4DQPSK mode			
Test channel	Carrier Frequencies Separation (KHz)	Limit (KHz)	Result
Lowest	1000	≥936	Pass
Middle	1000	≥936	Pass
Highest	1005	≥936	Pass
8DPSK mode			
Test channel	Carrier Frequencies Separation (KHz)	Limit (KHz)	Result
Lowest	1005	≥936	Pass
Middle	1005	≥936	Pass
Highest	1005	≥936	Pass

Note: According to section 5.4,

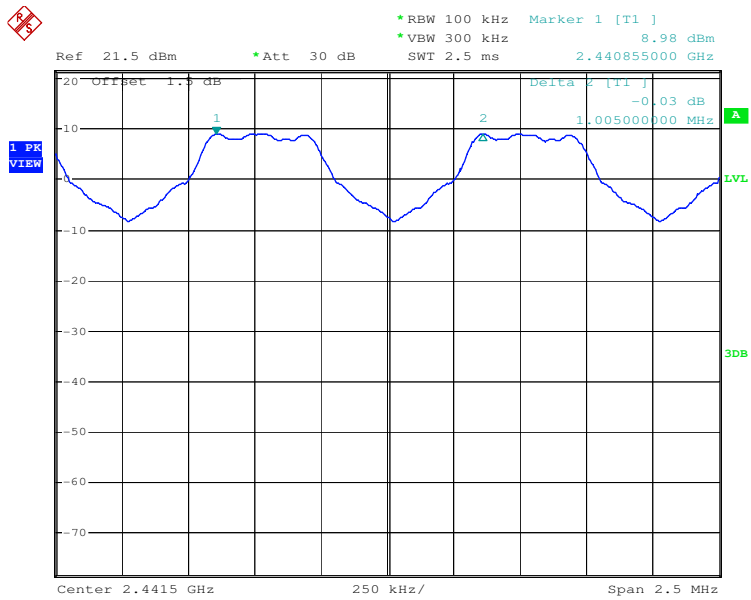
Mode	20dB bandwidth (KHz) (worse case)	Limit (KHz) (Carrier Frequencies Separation)
GFSK	1110	740
π/4DQPSK	1404	936
8DPSK	1368	912

Test plot as follows:

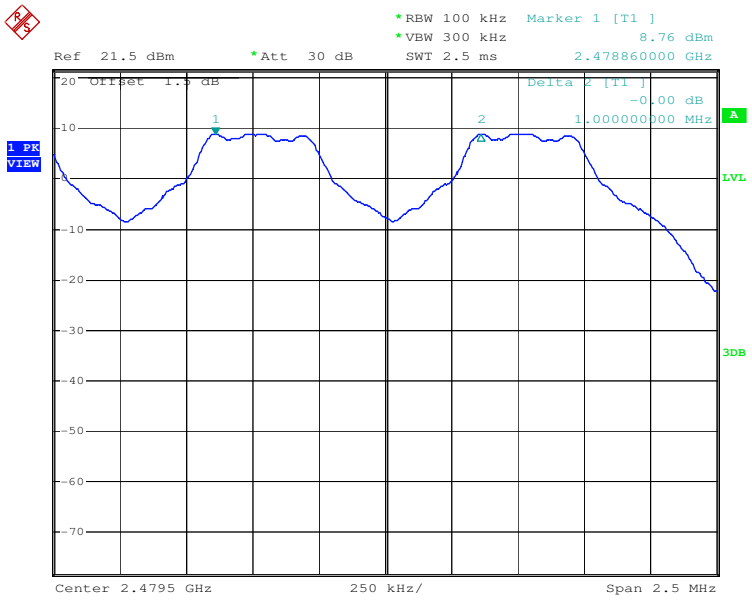
Test mode:	GFSK	Test channel:	Lowest



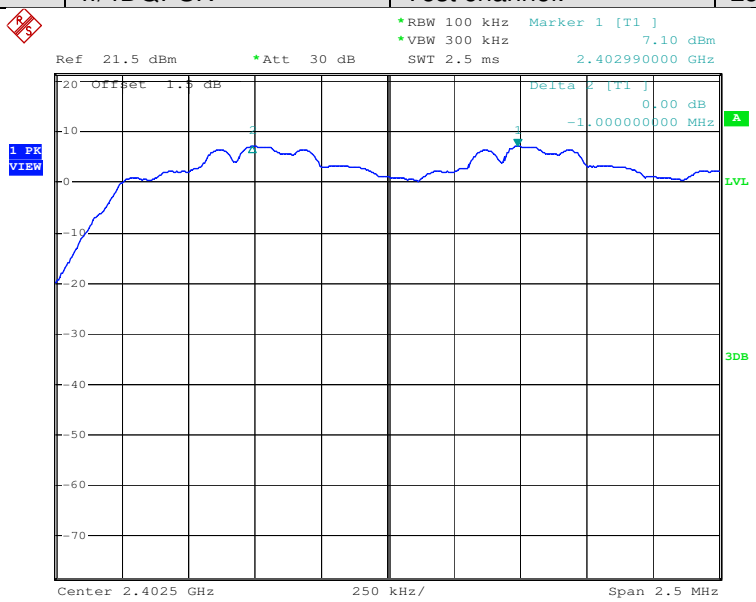
Test mode:	GFSK	Test channel:	Middle



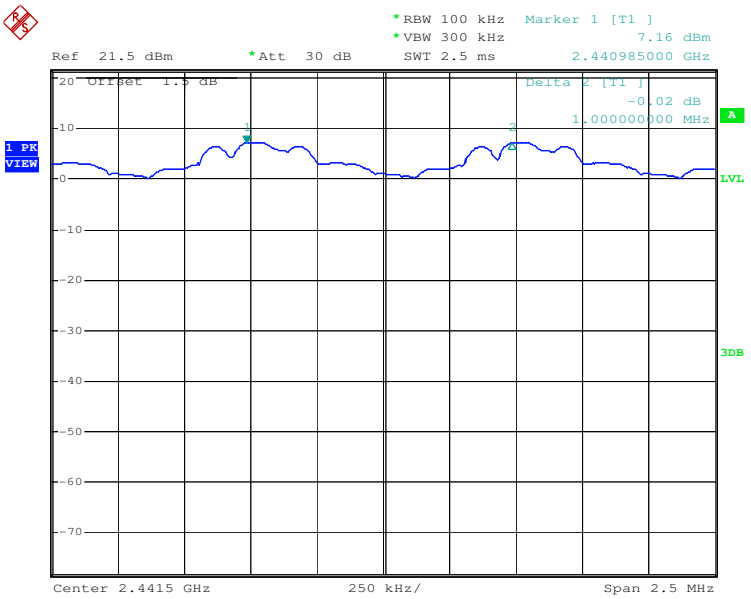
Test mode:	GFSK	Test channel:	Highest



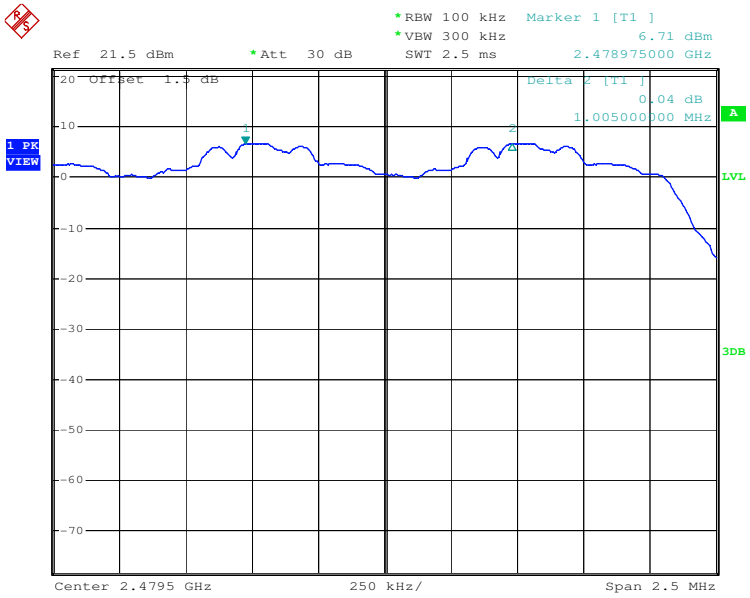
Test mode:	π/4DQPSK	Test channel:	Lowest



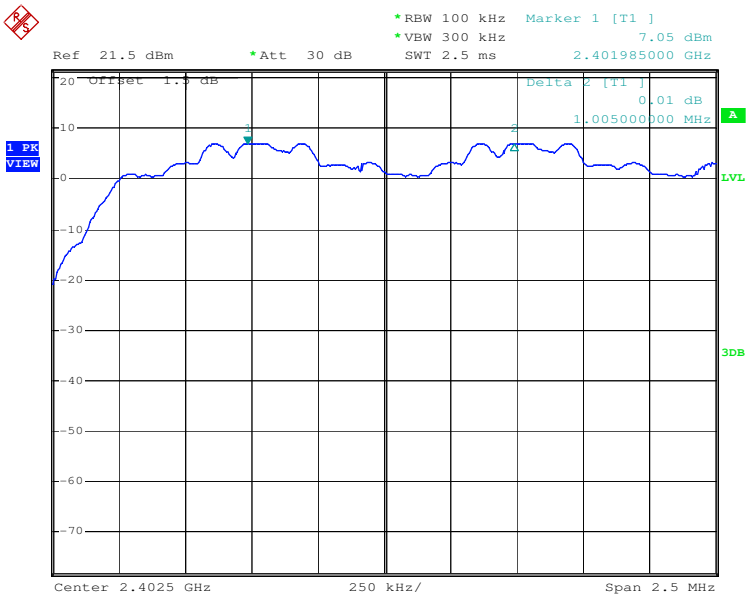
Test mode:	π/4DQPSK	Test channel:	Middle



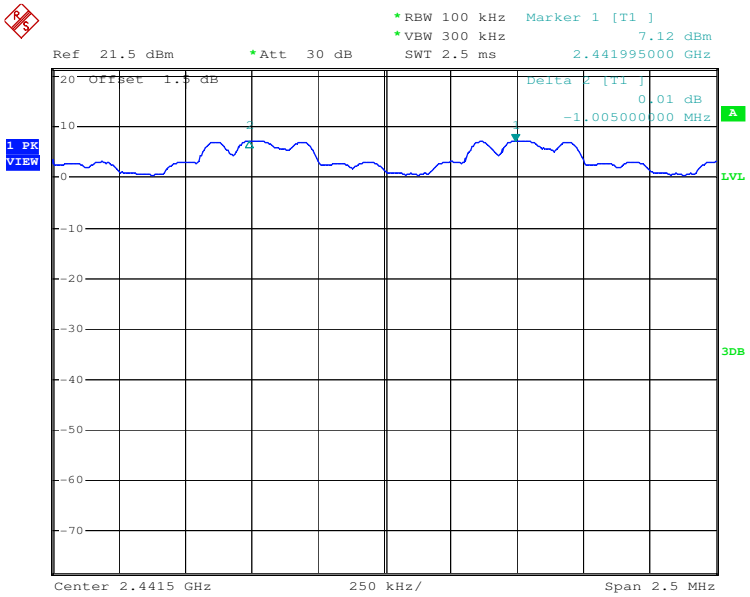
Test mode:	π/4DQPSK	Test channel:	Highest



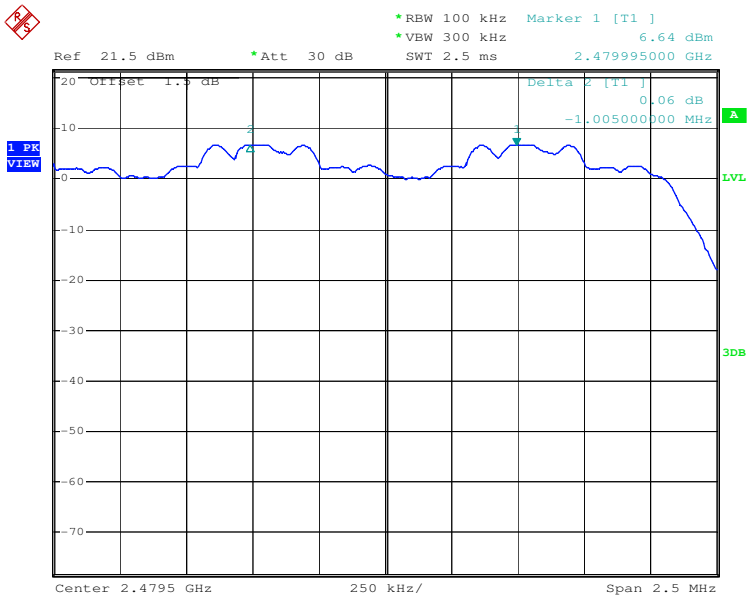
Test mode:	8DPSK	Test channel:	Lowest



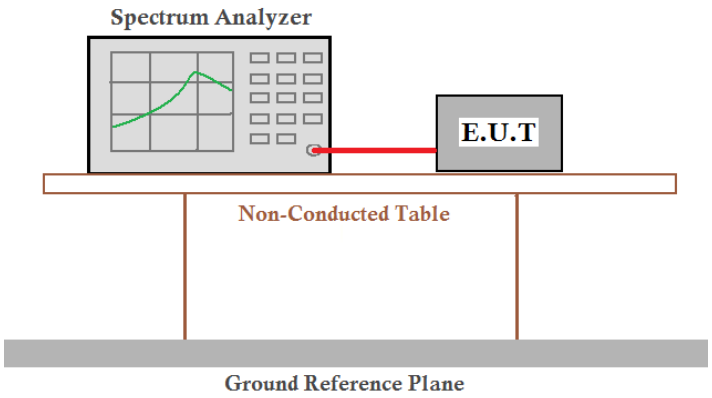
Test mode:	8DPSK	Test channel:	Middle



Test mode:	8DPSK	Test channel:	Highest



5.6 Hopping Channel Number

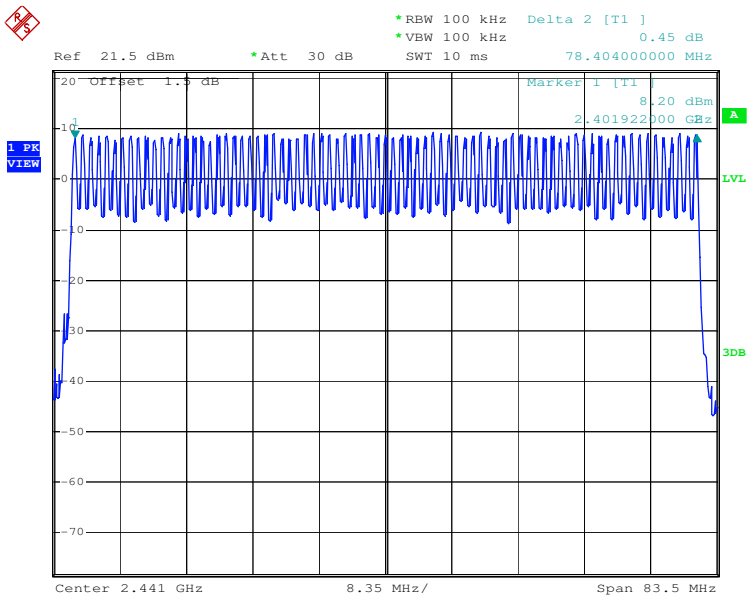
Test Requirement:	FCC Part15 C Section 15.247 (b)
Test Method:	ANSI C63.10:2009
Requirement:	⩾75 channels
Test setup:	
Test Instruments:	Refer to section 4.8 for details.
Test state:	Hopping transmitting with all kind of modulation.
Test results:	Pass

Measurement Data

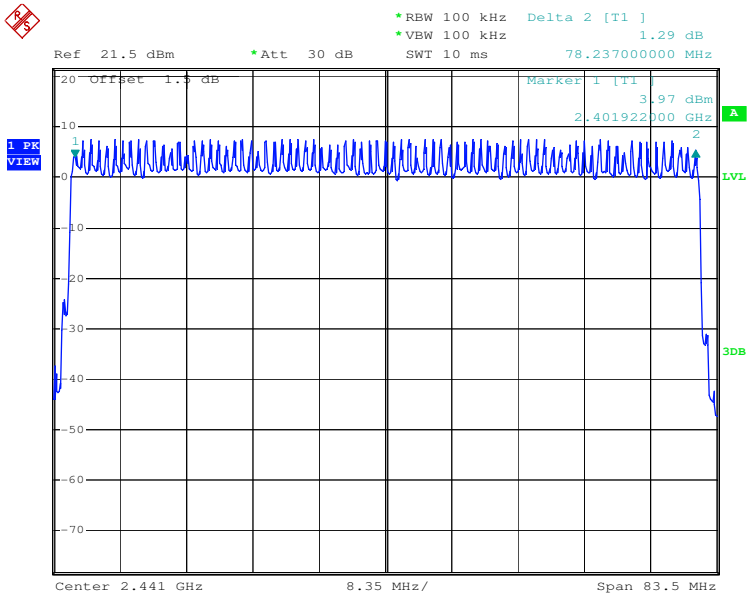
Mode	Hopping channel	Requirement
GFSK	79	⩾75
π/4DQPSK	79	⩾75
8DPSK	79	⩾75

Test plot as follows

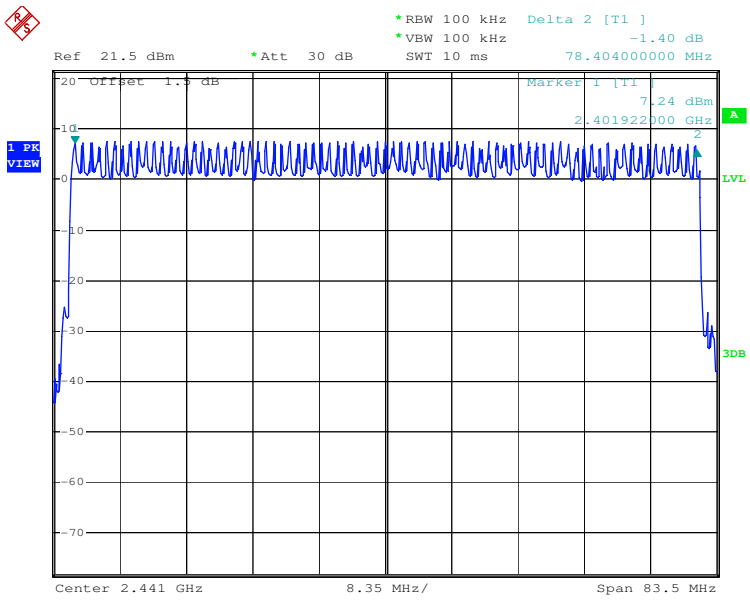
Test mode:	GFSK	



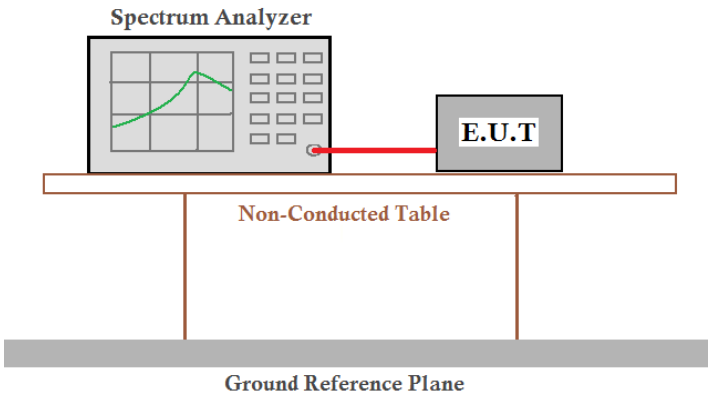
Test mode:	π/4DQPSK	



Test mode:	8DPSK	



5.7 Dwell Time

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2009
Limit:	≤ 0.4 Second
Test setup:	
Test Instruments:	Refer to section 4.8 for details.
Test state:	Hopping transmitting with all kind of modulation.
Test results:	Pass

Measurement Data

Mode	Packet	Dwell time (second)	Limit (second)
GFSK	DH1	0.1696	≤0.4
	DH3	0.2864	≤0.4
	DH5	0.3230	≤0.4
π/4DQPSK	2-DH1	0.1744	≤0.4
	2-DH3	0.2872	≤0.4
	2-DH5	0.1961	≤0.4
8DPSK	3-DH1	0.1712	≤0.4
	3-DH3	0.2872	≤0.4
	3-DH5	0.3257	≤0.4

Test Result:

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

The lowest channel (2402MHz), middle channel (2441MHz), highest channel (2480MHz) as below

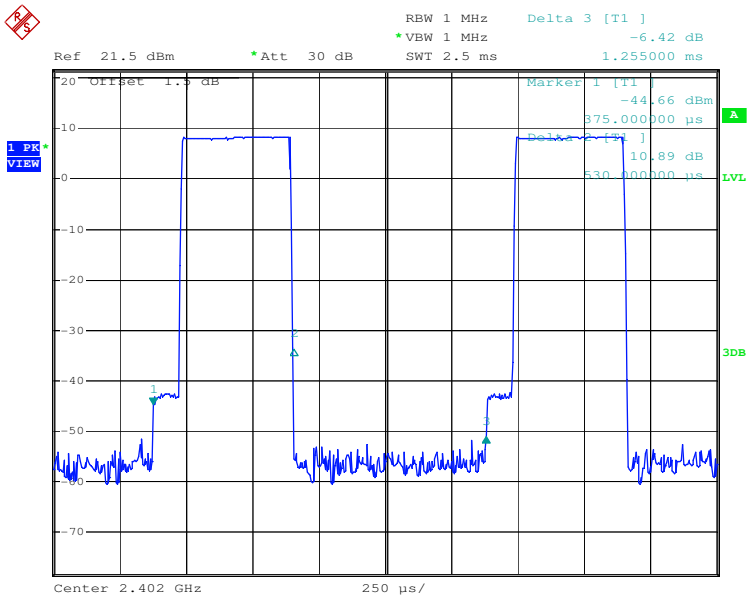
DH1 time slot=0.530(ms)*(1600/ (2*79))*31.6=169.6ms

DH3 time slot=1.79(ms)*(1600/ (4*79))*31.6=286.4ms

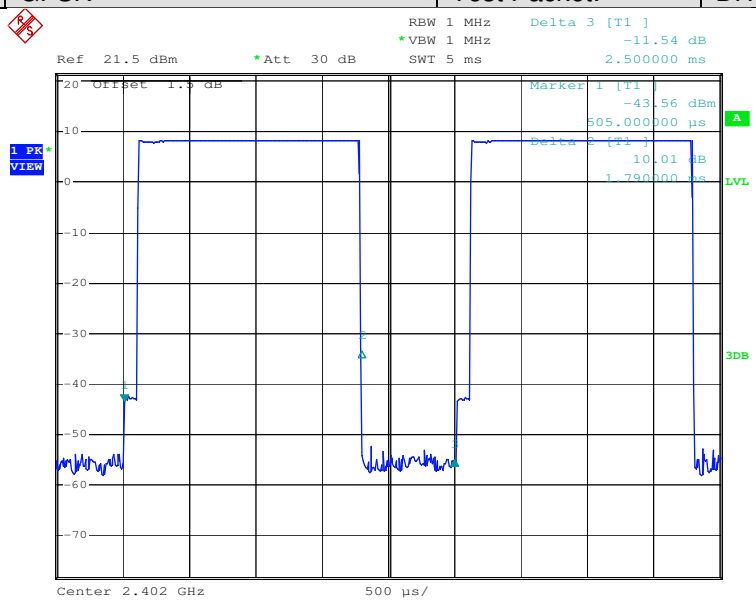
DH5 time slot=3.03(ms)*(1600/ (6*79))*31.6=323.0ms

Test plot as follows

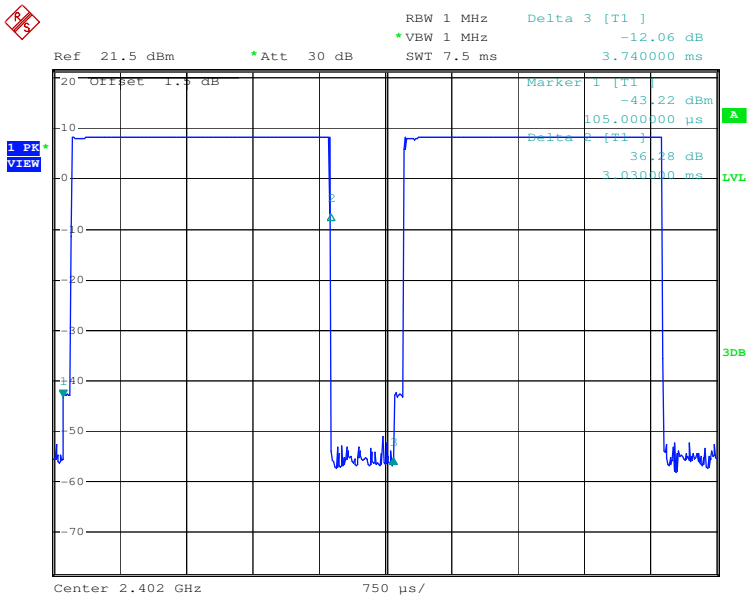
Test mode:	GFSK	Test Packet:	DH1



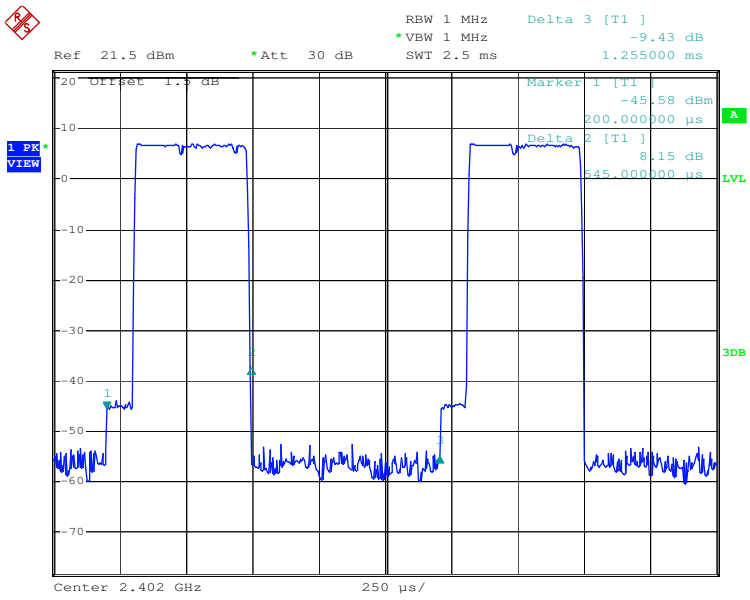
Test mode:	GFSK	Test Packet:	DH3



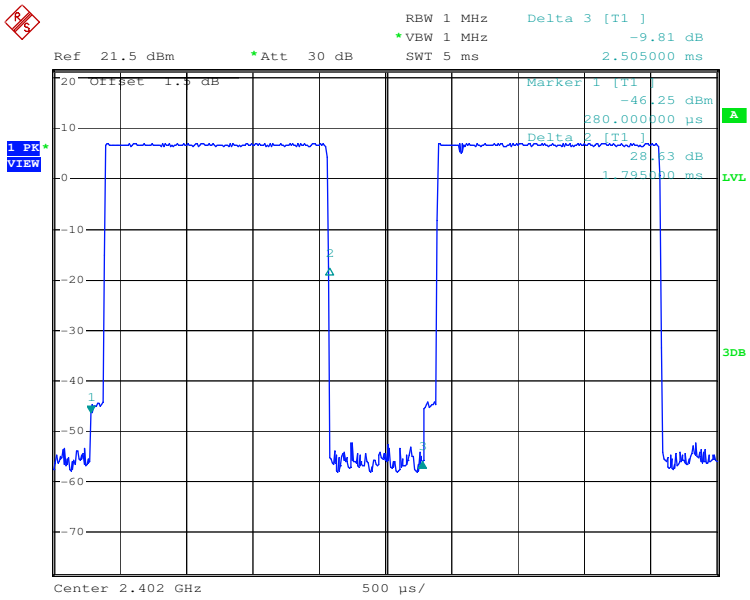
Test mode:	GFSK	Test Packet:	DH5



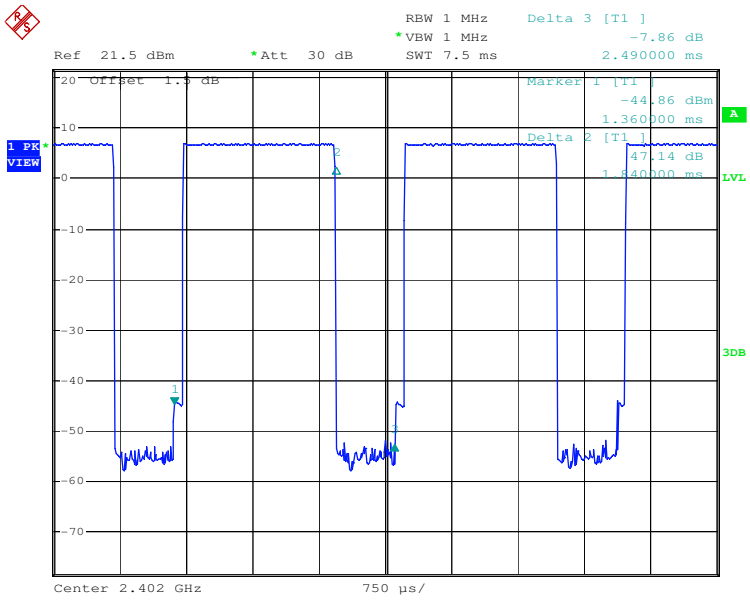
Test mode:	π/4DQPSK	Test Packet:	2-DH1



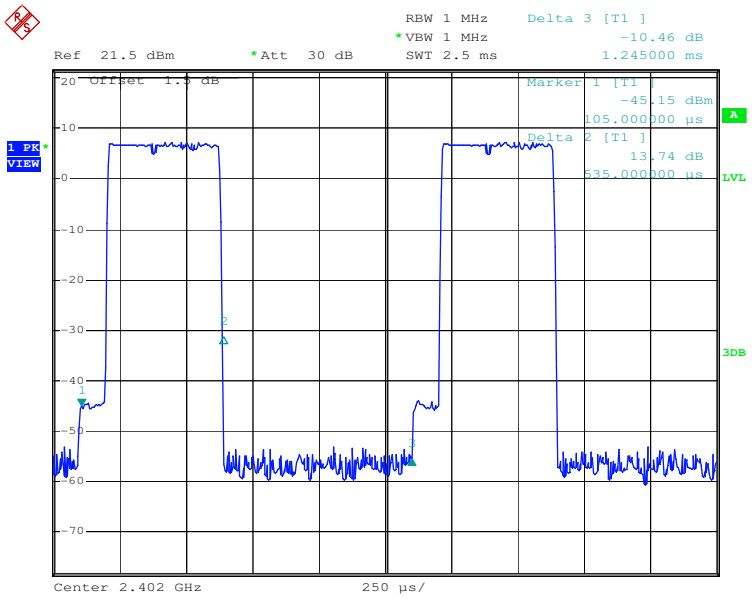
Test mode:	π/4DQPSK	Test Packet:	2-DH3



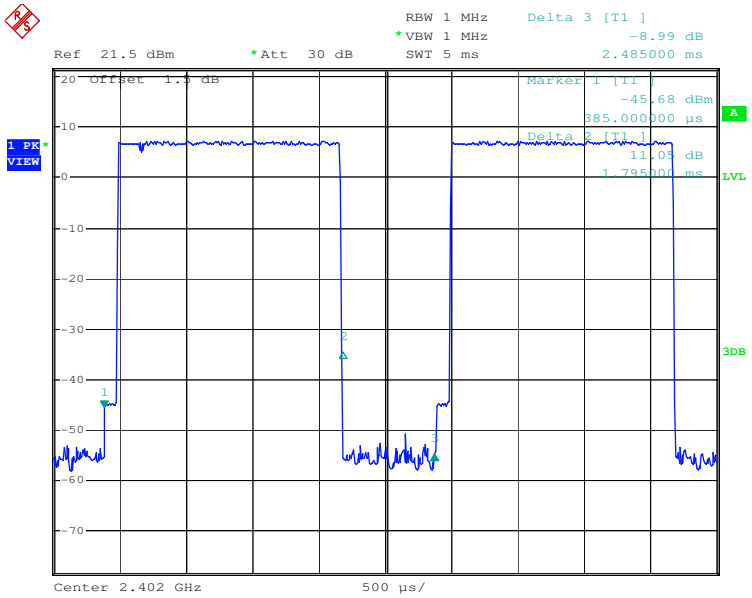
Test mode:	π/4DQPSK	Test Packet:	2-DH5



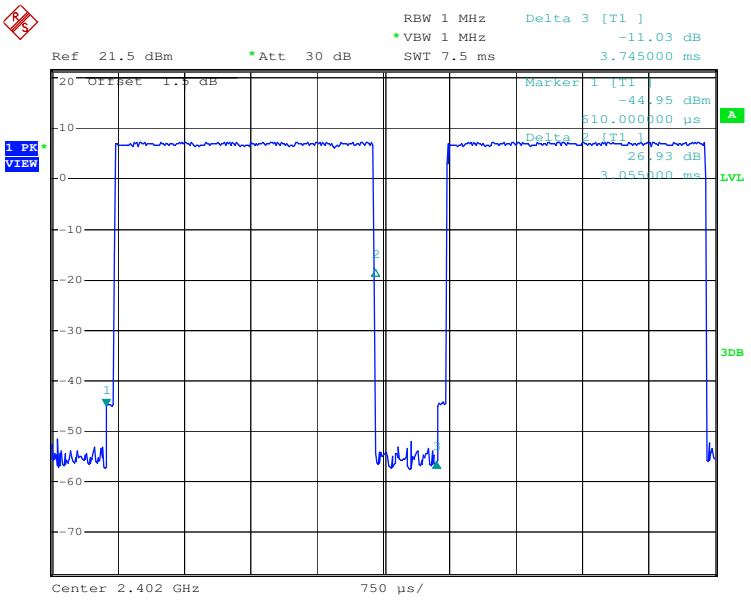
Test mode:	8DPSK	Test Packet:	3-DH1



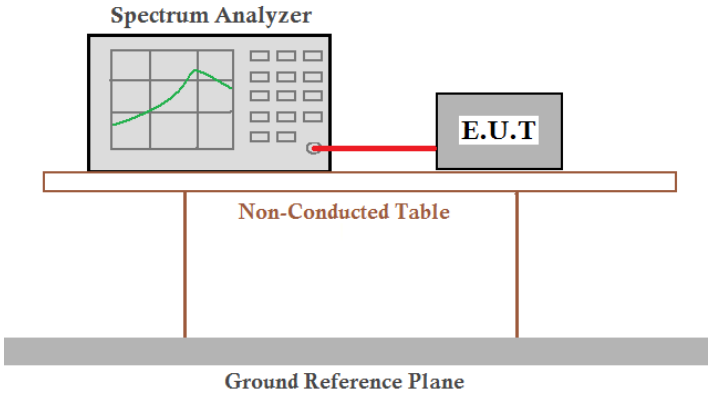
Test mode:	8DPSK	Test Packet:	3-DH3



Test mode:	8DPSK	Test Packet:	3-DH5

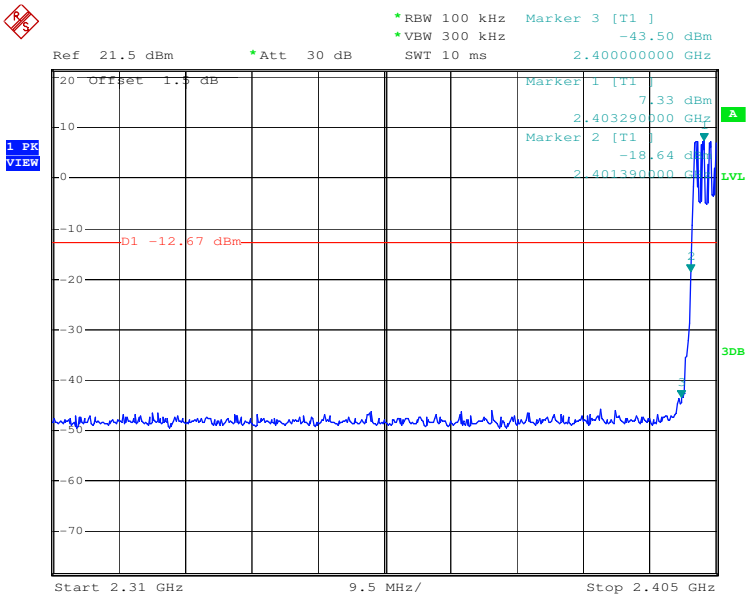


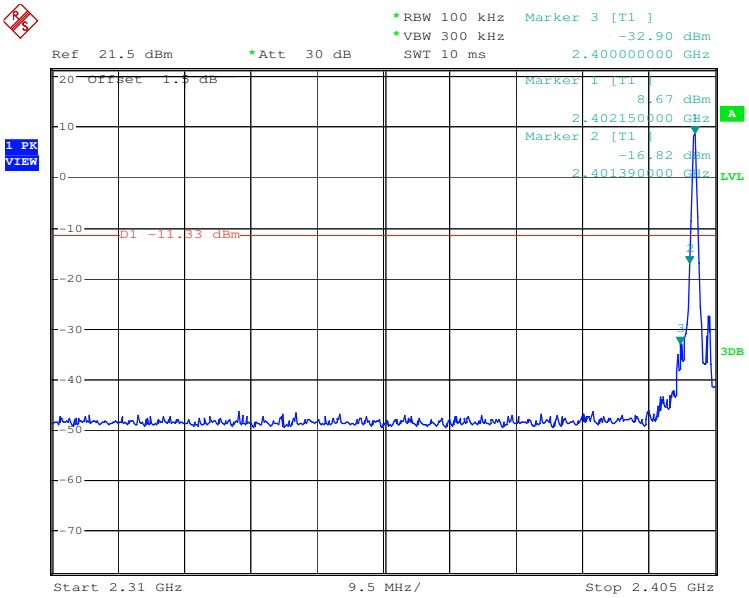
5.8 Band Edge

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2009
Limit:	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.
Test setup:	 *Remark:* *Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.*
Test Instruments:	Refer to section 4.8 for details.
Test results:	Pass

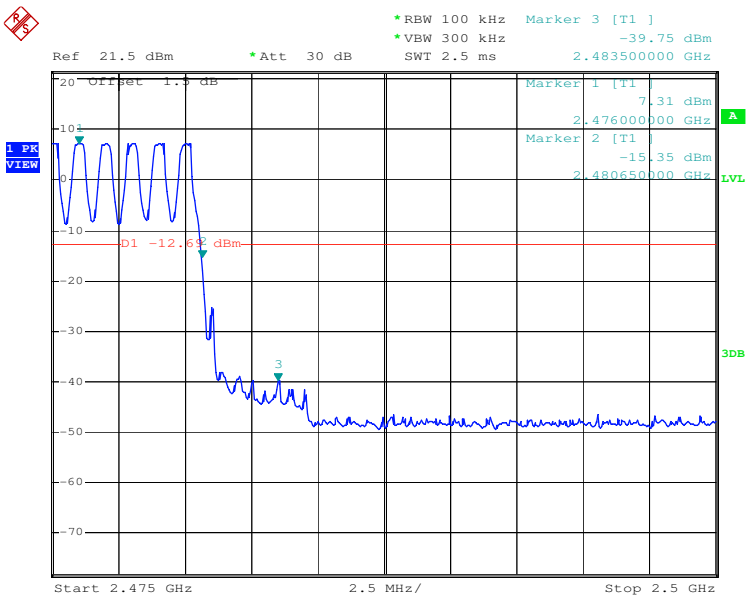
Test plot as follows:

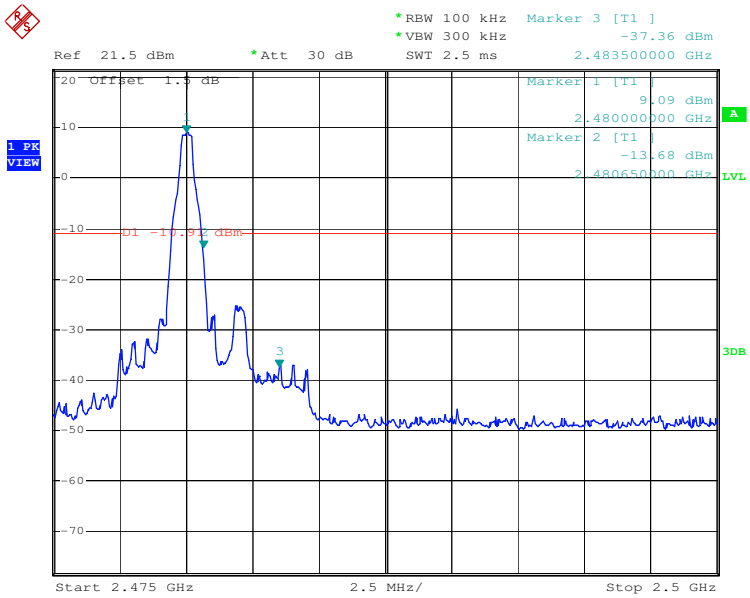
Test mode:	GFSK	Test channel:	Lowest



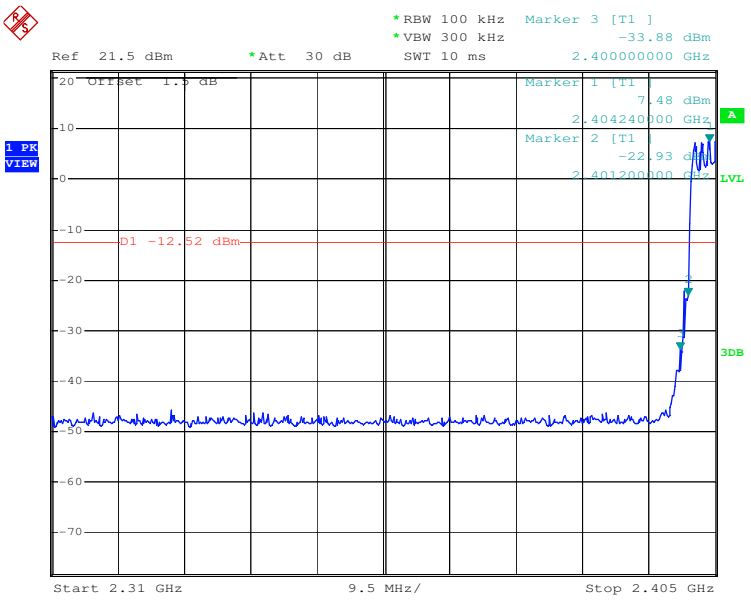


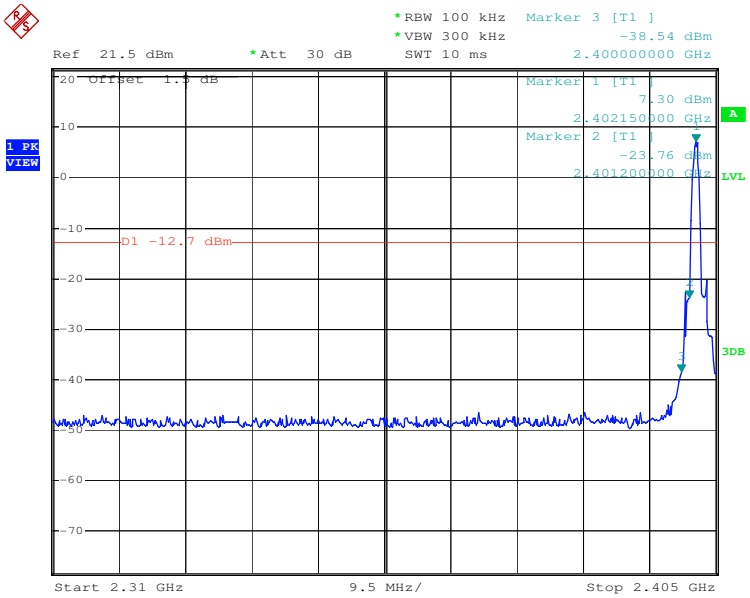
Test mode:	GFSK	Test channel:	Highest



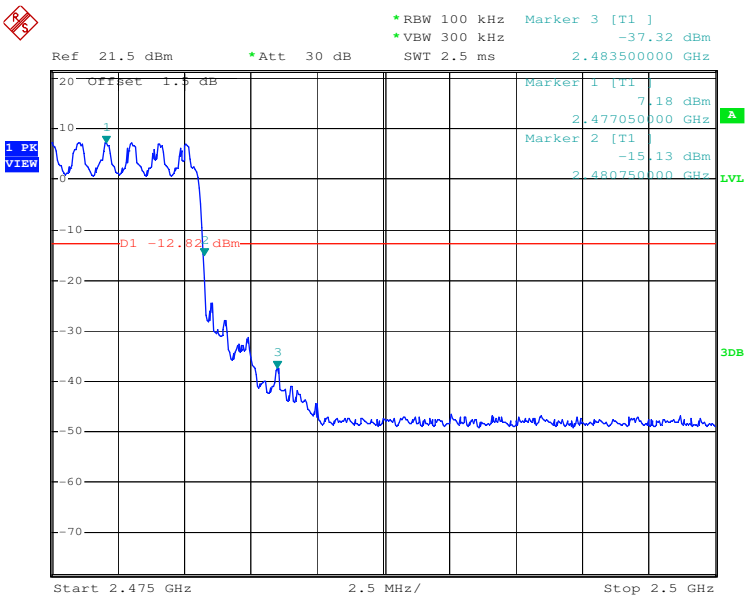


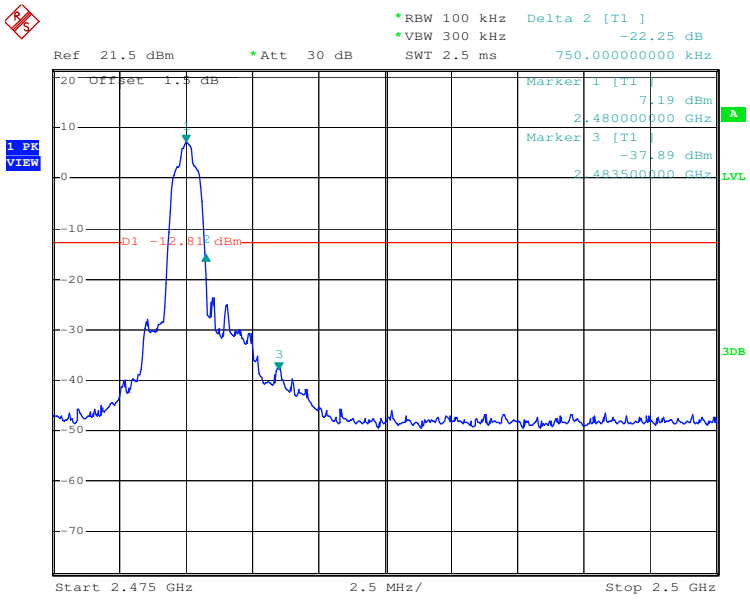
Test mode:	π/4DQPSK	Test channel:	Lowest



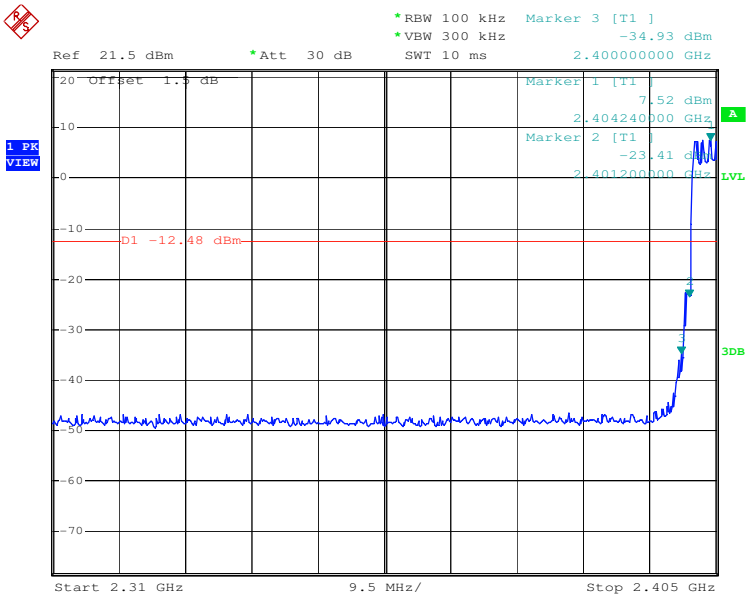


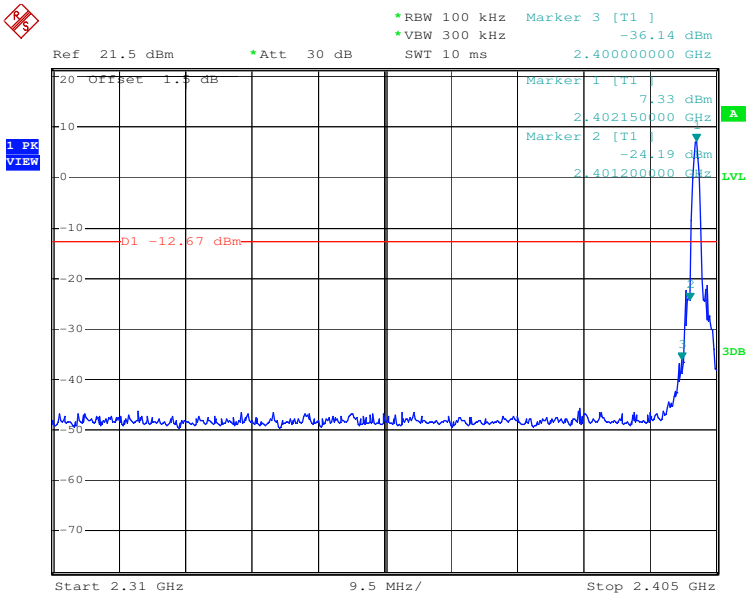
Test mode:	π/4DQPSK	Test channel:	Highest



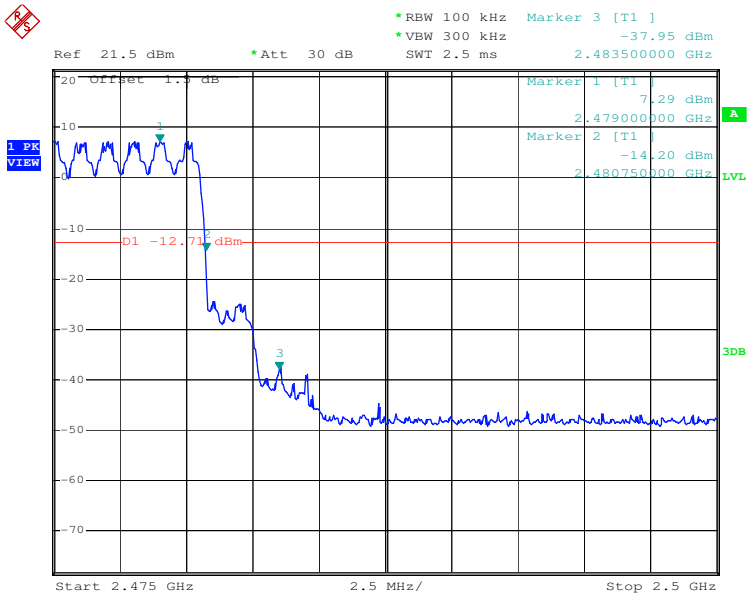


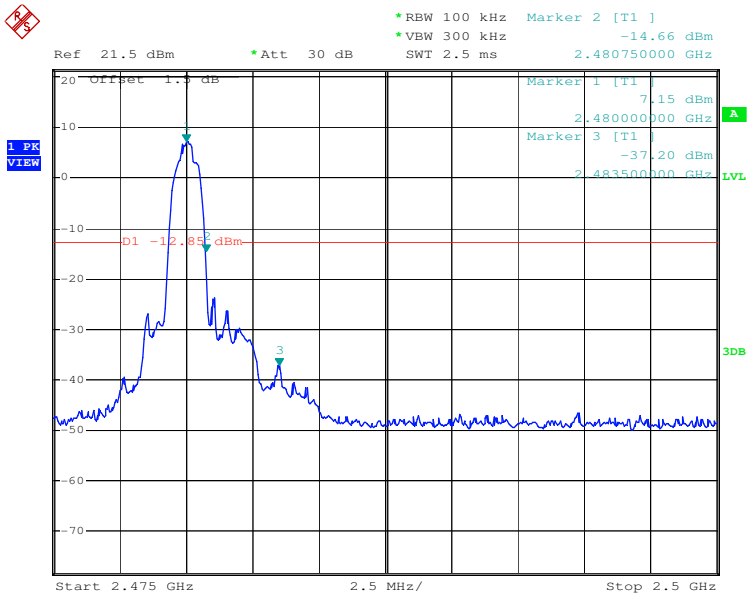
Test mode:	8DPSK	Test channel:	Lowest



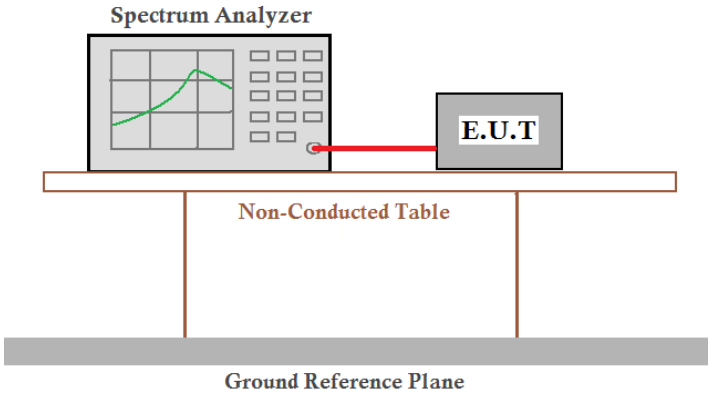


Test mode:	8DPSK	Test channel:	Highest

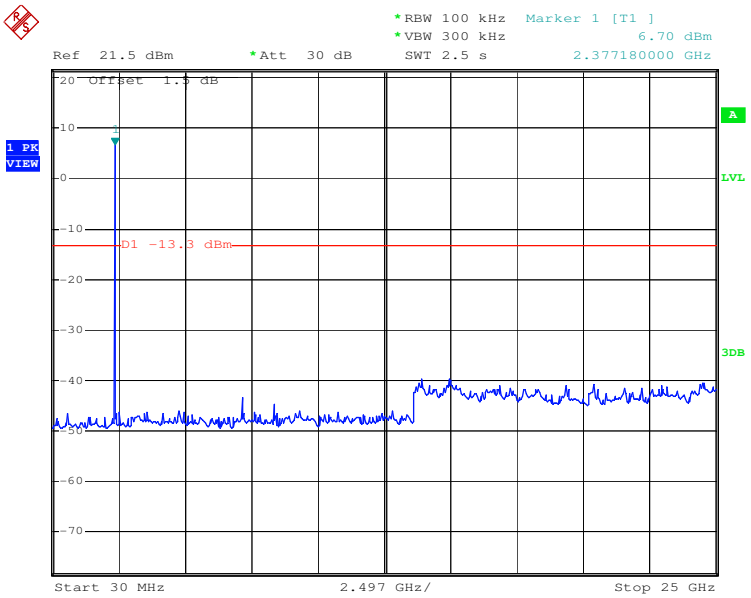




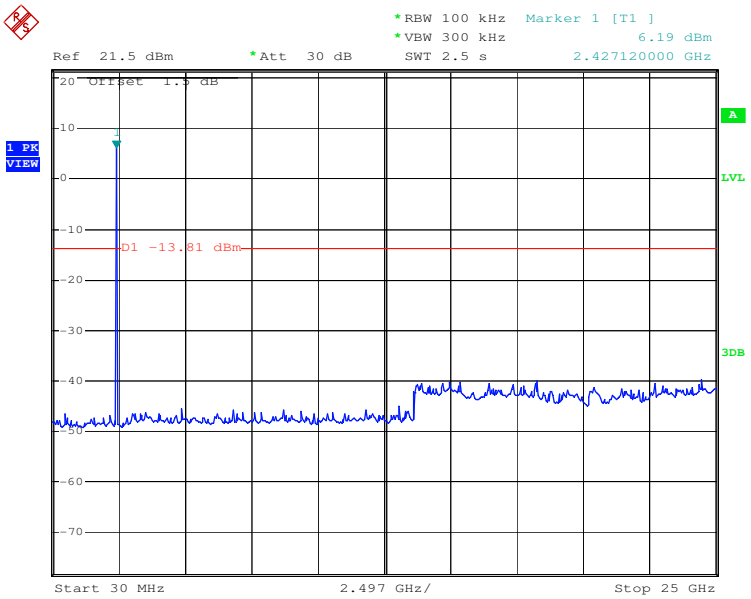
5.9 RF Antenna Conducted spurious emissions

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2009
Limit:	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.
Test setup:	 *Remark:* *Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.*
Test Instruments:	Refer to section 4.8 for details.
Test results:	Pass

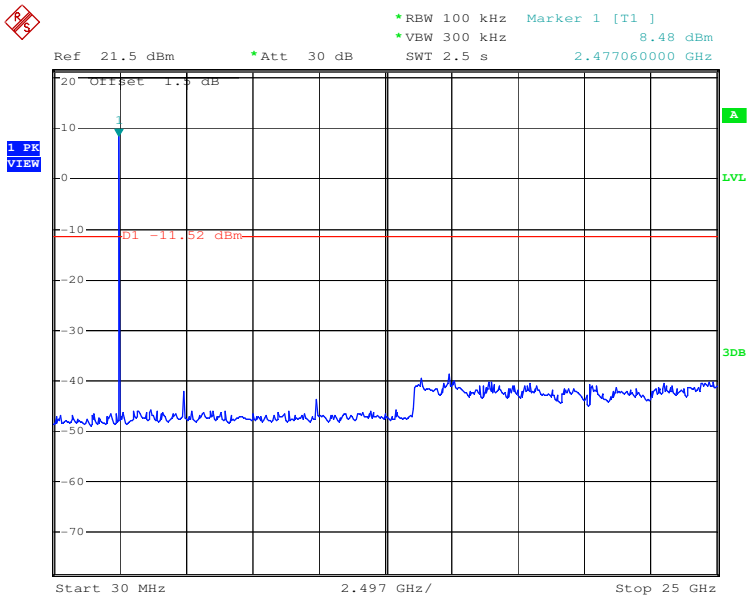
Test mode:	GFSK	Test channel:	Lowest



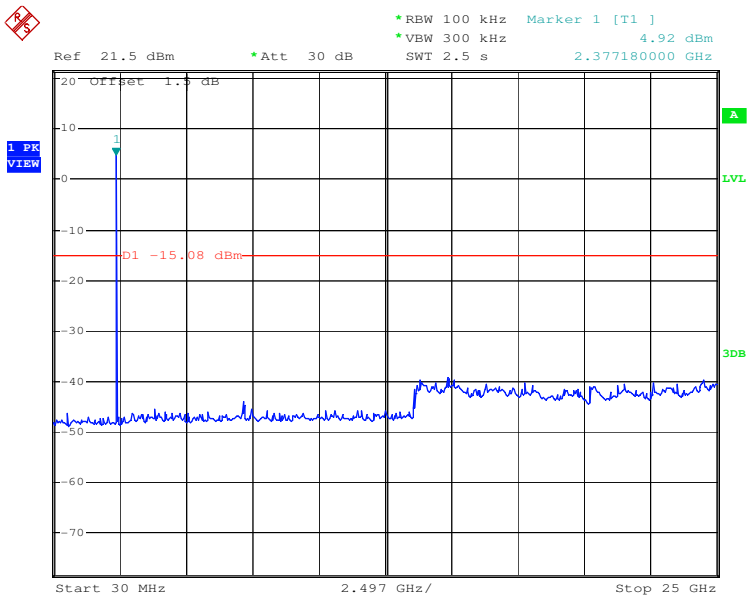
Test mode:	GFSK	Test channel:	Middle



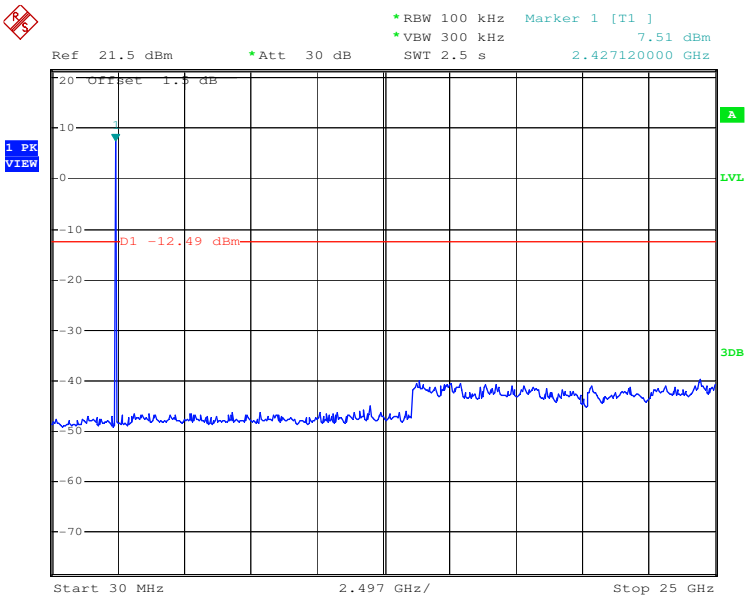
Test mode:	GFSK	Test channel:	Highest



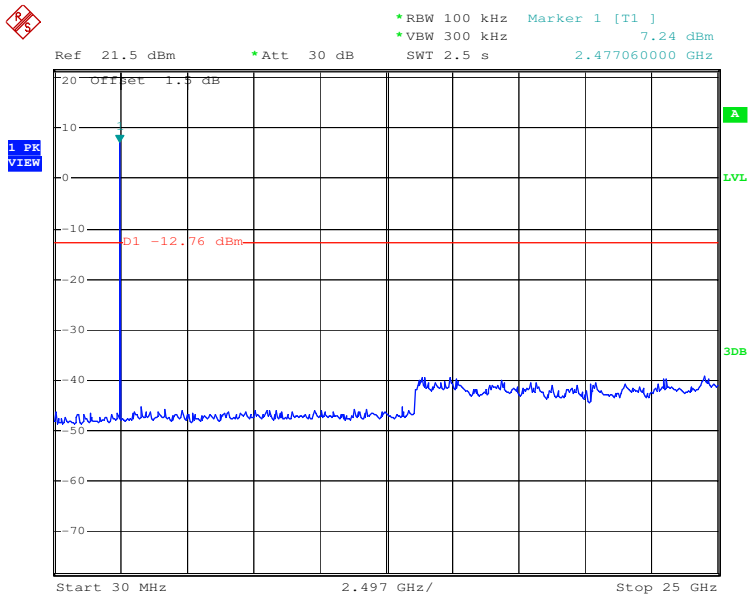
Test mode:	π/4DQPSK	Test channel:	Lowest



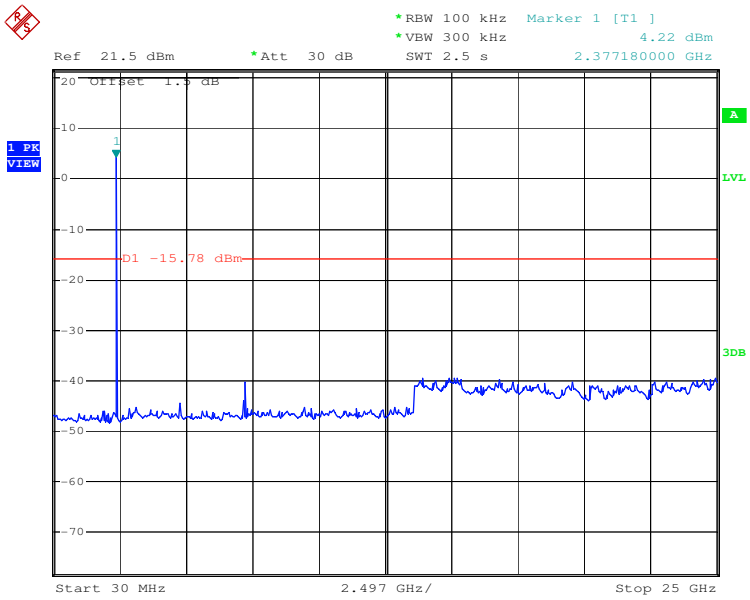
Test mode:	π/4DQPSK	Test channel:	Middle



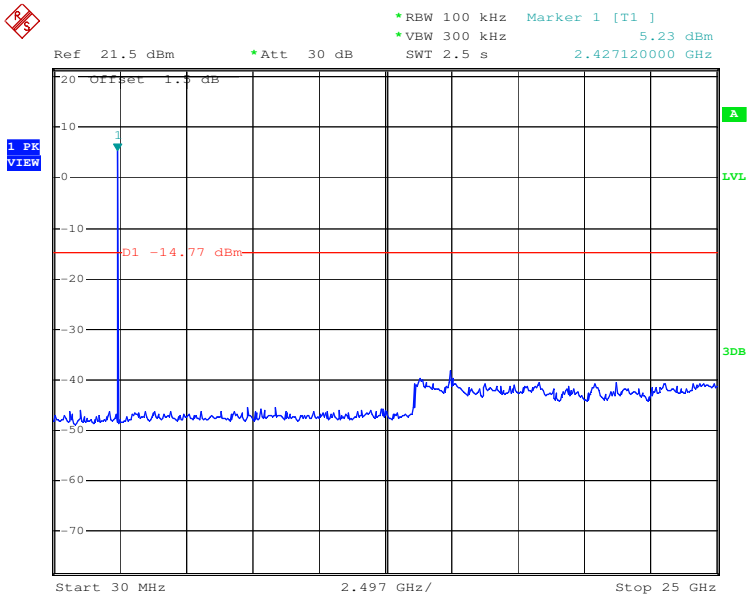
Test mode:	π/4DQPSK	Test channel:	Highest



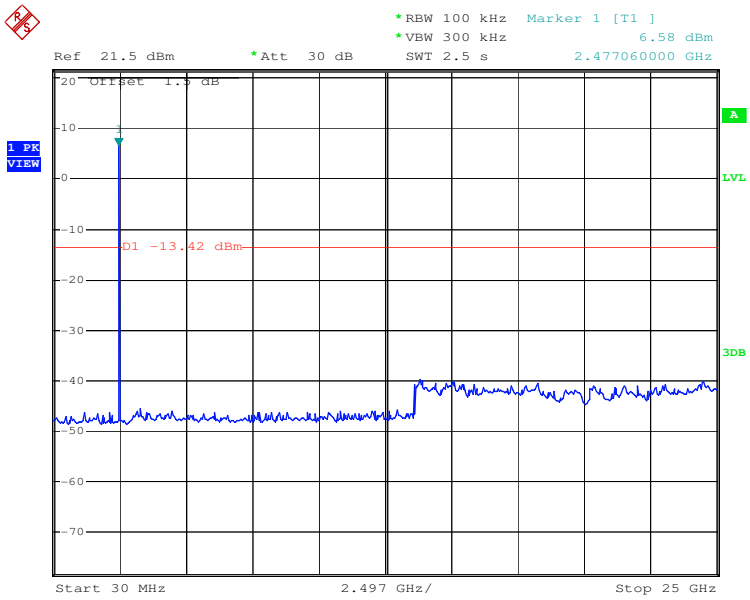
Test mode:	8DPSK	Test channel:	Lowest



Test mode:	8DPSK	Test channel:	Middle



Test mode:	8DPSK	Test channel:	Highest



5.10 Pseudorandom Frequency Hopping Sequence

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

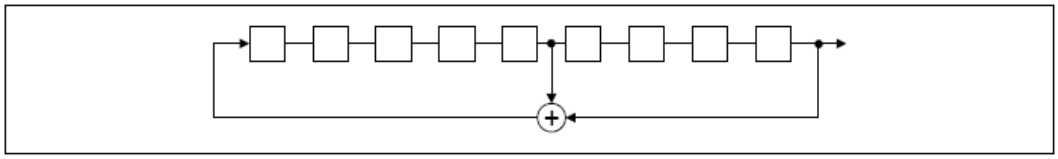
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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

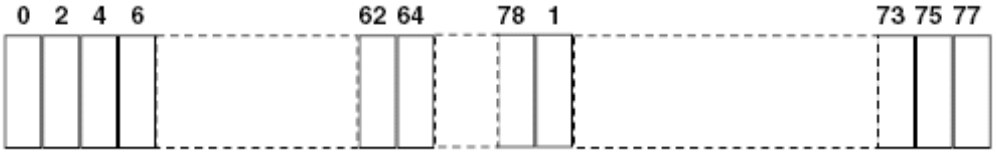
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized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

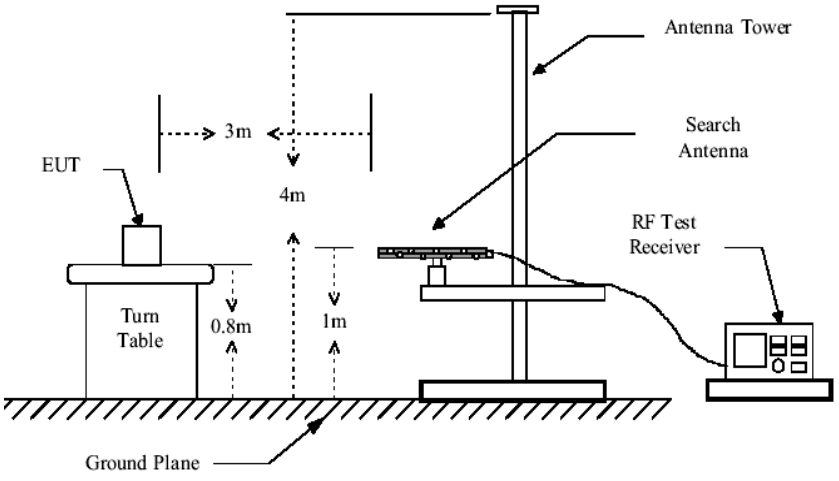
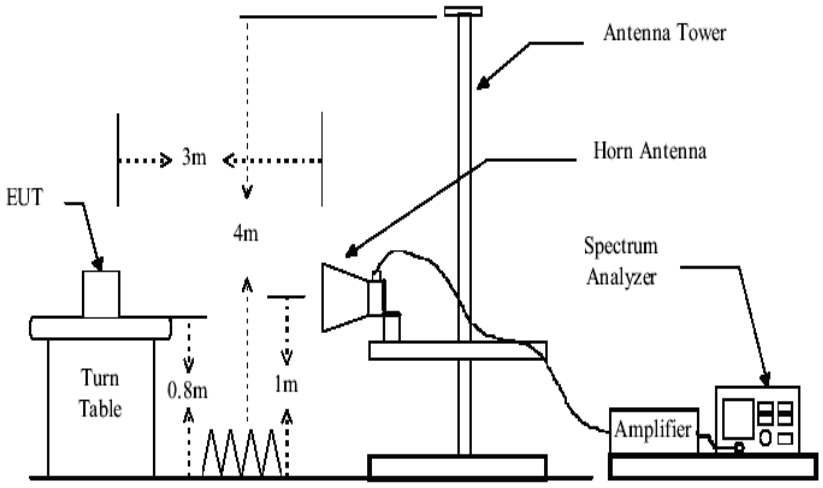
An example of Pseudorandom Frequency Hopping Sequence as follow:



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.

5.11 Radiated Emission

<table>
<tr><td>Test Requirement:</td><td>FCC Part15 C Section 15.209 and 15.205</td></tr>
<tr><td>Test Method:</td><td>ANSI C63.10: 2009 and PUBLIC NOTICE DA 00-705</td></tr>
<tr><td>Test Frequency Range:</td><td>30MHz to 25GHz</td></tr>
<tr><td>Test site:</td><td>Measurement Distance: 3m (Semi-Anechoic Chamber)</td></tr>
<tr><td>Receiver setup:</td><td>
<table>
<tr><td>Frequency</td><td>Detector</td><td>RBW</td><td>VBW</td><td>Remark</td></tr>
<tr><td>30MHz-1GHz</td><td>Quasi-peak</td><td>100KHz</td><td>300KHz</td><td>Quasi-peak Value</td></tr>
<tr><td rowspan="2">Above 1GHz</td><td>Peak</td><td>1MHz</td><td>3MHz</td><td>Peak Value</td></tr>
<tr><td>Peak</td><td>1MHz</td><td>10Hz</td><td>Average Value</td></tr>
</table>
</td></tr>
<tr><td>Limit:</td><td>
<table>
<tr><td>Frequency</td><td>Limit (dBuV/m @3m)</td><td>Remark</td></tr>
<tr><td>30MHz-88MHz</td><td>40.0</td><td>Quasi-peak Value</td></tr>
<tr><td>88MHz-216MHz</td><td>43.5</td><td>Quasi-peak Value</td></tr>
<tr><td>216MHz-960MHz</td><td>46.0</td><td>Quasi-peak Value</td></tr>
<tr><td>960MHz-1GHz</td><td>54.0</td><td>Quasi-peak Value</td></tr>
<tr><td rowspan="2">Above 1GHz</td><td>54.0</td><td>Average Value</td></tr>
<tr><td>74.0</td><td>Peak Value</td></tr>
</table>
</td></tr>
<tr><td>Test Procedure:</td><td>a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case is shown in the report.</td></tr>
<tr><td>Test Instruments:</td><td>Refer to section 4.8 for details.</td></tr>
</table>

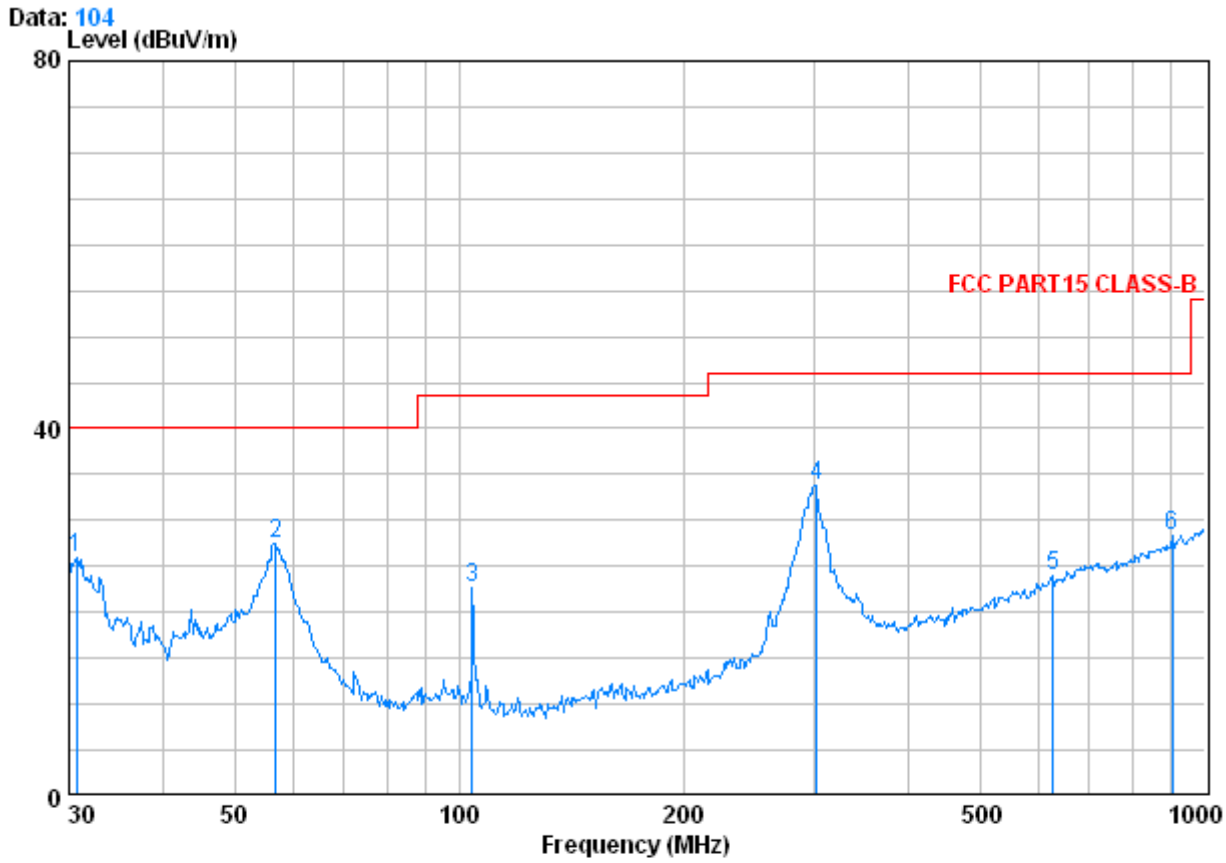
Test mode:	Non-hopping transmitting with modulation. 1. Pre-scan the EUT in GFSK, π/4DQPSK and 8DPSK modes and find out the worst case is GFSK mode. 2. Pre-scan the EUT in Vehicular charge + transmitting, PC charge + transmitting and Transmitting modes and find out the worst case is Vehicular charge + transmitting mode.
Test results:	Pass
Test setup:	Below 1GHz  Above 1GHz 

Note:
The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

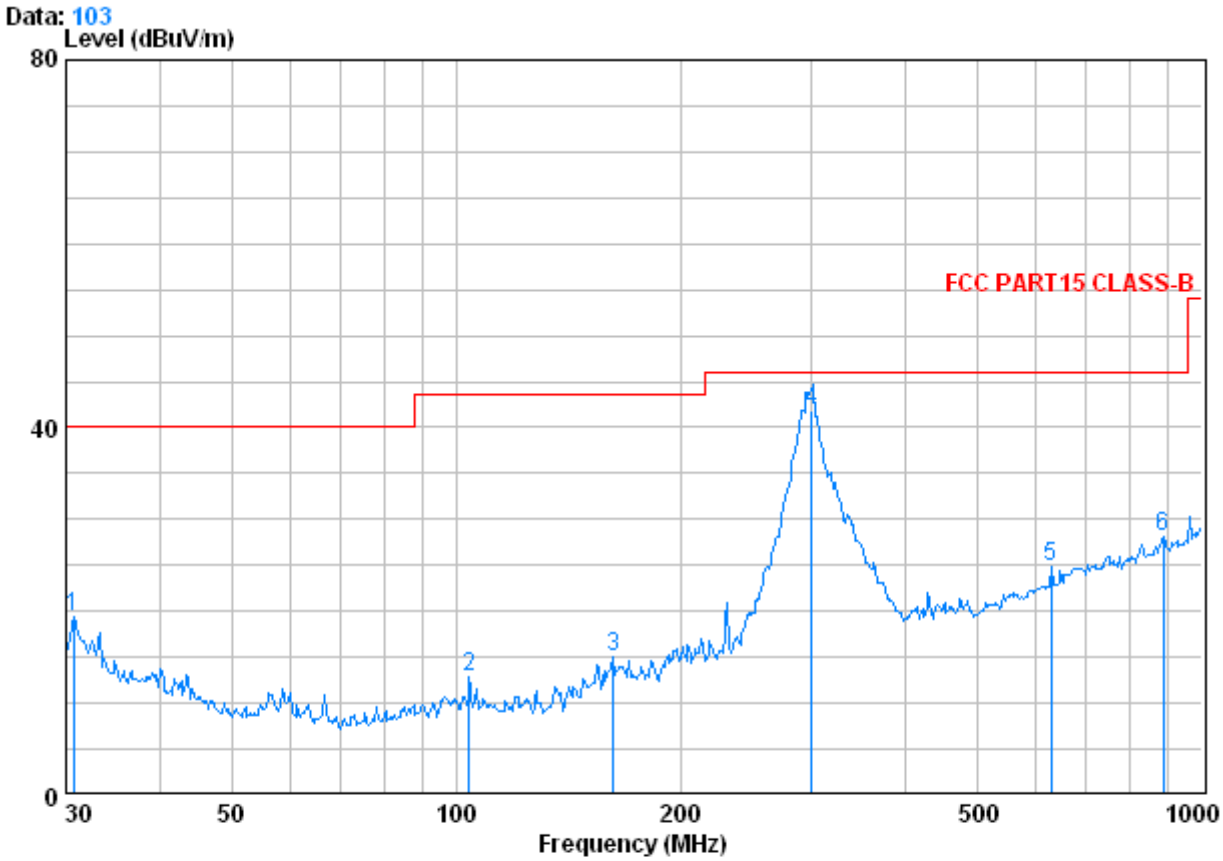
5.11.1 Radiated emission below 1GHz

Vertical



	Freq	Cable Loss	Antenna Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	30.745	0.60	15.00	27.35	37.65	25.89	40.00	-14.11
2	56.792	0.80	7.44	27.27	46.47	27.44	40.00	-12.56
3	104.170	1.21	8.89	27.17	39.65	22.58	43.50	-20.92
4	301.422	1.90	13.94	26.40	44.31	33.76	46.00	-12.24
5	625.078	2.75	20.50	27.51	28.16	23.91	46.00	-22.09
6	903.309	3.60	23.21	26.75	28.20	28.26	46.00	-17.74

Horizontal



	Freq	Cable Loss	Antenna Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	30.745	0.60	14.83	27.35	31.26	19.34	40.00	-20.66
2	104.170	1.21	8.89	27.17	29.97	12.90	43.50	-30.60
3	162.611	1.34	9.57	26.85	31.08	15.15	43.50	-28.35
4 @	299.524	1.90	13.85	26.41	52.50	41.84	46.00	-4.16
5	627.274	2.76	20.51	27.51	29.14	24.90	46.00	-21.10
6	887.610	3.55	23.11	26.85	28.26	28.07	46.00	-17.93

5.11.2 Transmitter emission above 1GHz

Worst case mode:	GFSK	Test channel:	Lowest	Remark:	Peak

Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Emission Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Antenna polarization
4783.500	4.68	34.73	41.61	61.75	59.55	74.00	-14.45	Vertical
6099.500	5.15	35.82	40.84	52.28	52.41	74.00	-21.59	Vertical
7192.250	5.77	35.88	39.89	52.19	53.95	74.00	-20.05	Vertical
8508.250	6.18	36.21	38.75	48.48	52.12	74.00	-21.88	Vertical
9718.500	5.98	37.42	37.70	46.37	52.07	74.00	-21.93	Vertical
12209.500	6.52	39.11	38.36	47.25	54.52	74.00	-19.48	Vertical
4783.500	4.68	34.73	41.61	63.19	60.99	74.00	-13.01	Horizontal
6440.250	5.24	36.22	40.55	55.43	56.34	74.00	-17.66	Horizontal
7192.250	5.77	35.88	39.89	57.78	59.54	74.00	-14.46	Horizontal
9636.250	5.99	37.34	37.76	49.93	55.50	74.00	-18.50	Horizontal
10670.250	6.14	38.37	37.73	50.73	57.51	74.00	-16.49	Horizontal
12362.250	6.56	39.26	38.43	50.89	58.28	74.00	-15.72	Horizontal

Worst case mode:	GFSK	Test channel:	Lowest	Remark:	Average

Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Emission Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Antenna polarization
4783.500	4.68	34.73	41.61	50.31	48.11	54.00	-5.89	Vertical
6099.500	5.15	35.82	40.84	43.52	43.65	54.00	-10.35	Vertical
7192.250	5.77	35.88	39.89	42.84	44.60	54.00	-9.40	Vertical
8508.250	6.18	36.21	38.75	38.79	42.43	54.00	-11.57	Vertical
9718.500	5.98	37.42	37.70	36.98	42.68	54.00	-11.32	Vertical
12209.500	6.52	39.11	38.36	37.52	44.79	54.00	-9.21	Vertical
4783.500	4.68	34.73	41.61	50.23	48.03	54.00	-5.97	Horizontal
6440.250	5.24	36.22	40.55	44.37	45.28	54.00	-8.72	Horizontal
7192.250	5.77	35.88	39.89	45.52	47.28	54.00	-6.72	Horizontal
9636.250	5.99	37.34	37.76	38.73	44.30	54.00	-9.70	Horizontal
10670.250	6.14	38.37	37.73	38.35	45.13	54.00	-8.87	Horizontal
12362.250	6.56	39.26	38.43	38.70	46.09	54.00	-7.91	Horizontal

Worst case mode:	GFSK	Test channel:	Middle	Remark:	Peak

Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Emission Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Antenna polarization
4877.500	4.72	34.59	41.68	54.34	51.97	74.00	-22.03	Vertical
6193.500	5.18	35.94	40.76	50.13	50.49	74.00	-23.51	Vertical
7239.250	5.81	35.90	39.85	49.64	51.50	74.00	-22.50	Vertical
8837.250	6.16	36.47	38.47	47.55	51.71	74.00	-22.29	Vertical
10294.250	6.05	38.06	37.57	45.57	52.11	74.00	-21.89	Vertical
11645.500	6.38	38.54	38.13	47.58	54.37	74.00	-19.63	Vertical
4877.500	4.72	34.59	41.68	56.84	54.47	74.00	-19.53	Horizontal
5970.250	5.12	35.64	40.94	51.30	51.12	74.00	-22.88	Horizontal
7321.500	5.92	35.93	39.77	54.62	56.70	74.00	-17.30	Horizontal
8649.250	6.17	36.32	38.62	48.82	52.69	74.00	-21.31	Horizontal
9577.500	5.99	37.29	37.83	46.74	52.19	74.00	-21.81	Horizontal
12538.500	6.61	39.42	38.50	46.78	54.31	74.00	-19.69	Horizontal

Worst case mode:	GFSK	Test channel:	Middle	Remark:	Average

Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Emission Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Antenna polarization
4877.500	4.72	34.59	41.68	44.56	42.19	54.00	-11.81	Vertical
6193.500	5.18	35.94	40.76	40.34	40.70	54.00	-13.30	Vertical
7239.250	5.81	35.90	39.85	39.46	41.32	54.00	-12.68	Vertical
8837.250	6.16	36.47	38.47	37.48	41.64	54.00	-12.36	Vertical
10294.250	6.05	38.06	37.57	34.72	41.26	54.00	-12.74	Vertical
11645.500	6.38	38.54	38.13	38.83	45.62	54.00	-8.38	Vertical
4877.500	4.72	34.59	41.68	46.37	44.00	54.00	-10.00	Horizontal
5970.250	5.12	35.64	40.94	41.95	41.77	54.00	-12.23	Horizontal
7321.500	5.92	35.93	39.77	44.22	46.30	54.00	-7.70	Horizontal
8649.250	6.17	36.32	38.62	38.35	42.22	54.00	-11.78	Horizontal
9577.500	5.99	37.29	37.83	38.39	43.84	54.00	-10.16	Horizontal
12538.500	6.61	39.42	38.50	37.44	44.97	54.00	-9.03	Horizontal

Worst case mode:	GFSK	Test channel:	Highest	Remark:	Peak

Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Emission Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Antenna polarization
4936.250	4.75	34.48	41.72	53.14	50.65	74.00	-23.35	Vertical
5970.250	5.12	35.64	40.94	51.41	51.23	74.00	-22.77	Vertical
7380.250	5.98	35.95	39.72	49.65	51.86	74.00	-22.14	Vertical
8931.250	6.16	36.55	38.39	47.67	51.99	74.00	-22.01	Vertical
10388.250	6.07	38.16	37.61	45.68	52.30	74.00	-21.70	Vertical
12268.250	6.54	39.18	38.39	47.66	54.99	74.00	-19.01	Vertical
4936.250	4.75	34.48	41.72	56.66	54.17	74.00	-19.83	Horizontal
5970.250	5.12	35.64	40.94	51.54	51.36	74.00	-22.64	Horizontal
7427.250	6.04	35.97	39.69	51.29	53.61	74.00	-20.39	Horizontal
9342.500	6.06	37.01	38.03	46.62	51.66	74.00	-22.34	Horizontal
10717.250	6.15	38.39	37.74	45.63	52.43	74.00	-21.57	Horizontal
12350.500	6.56	39.26	38.42	46.98	54.38	74.00	-19.62	Horizontal

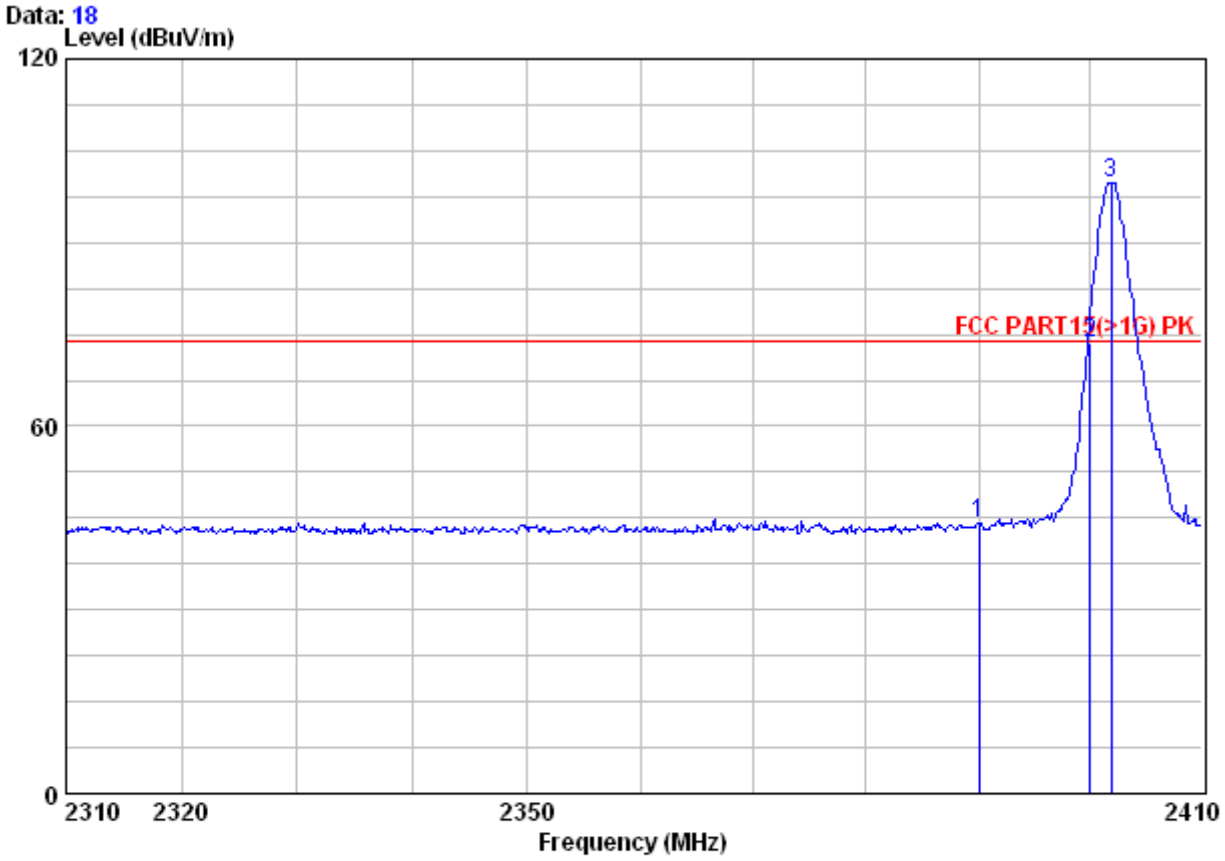
Worst case mode:	GFSK	Test channel:	Highest	Remark:	Average

Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Emission Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Antenna polarization
4936.250	4.75	34.48	41.72	43.49	41.00	54.00	-13.00	Vertical
5970.250	5.12	35.64	40.94	41.07	40.89	54.00	-13.11	Vertical
7380.250	5.98	35.95	39.72	39.43	41.64	54.00	-12.36	Vertical
8931.250	6.16	36.55	38.39	37.77	42.09	54.00	-11.91	Vertical
10388.250	6.07	38.16	37.61	35.25	41.87	54.00	-12.13	Vertical
12268.250	6.54	39.18	38.39	37.06	44.39	54.00	-9.61	Vertical
4936.250	4.75	34.48	41.72	46.48	43.99	54.00	-10.01	Horizontal
5970.250	5.12	35.64	40.94	41.33	41.15	54.00	-12.85	Horizontal
7427.250	6.04	35.97	39.69	41.86	44.18	54.00	-9.82	Horizontal
9342.500	6.06	37.01	38.03	36.03	41.07	54.00	-12.93	Horizontal
10717.250	6.15	38.39	37.74	35.31	42.11	54.00	-11.89	Horizontal
12350.500	6.56	39.26	38.42	36.46	43.86	54.00	-10.14	Horizontal

Remark: The disturbance above 13GHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed.

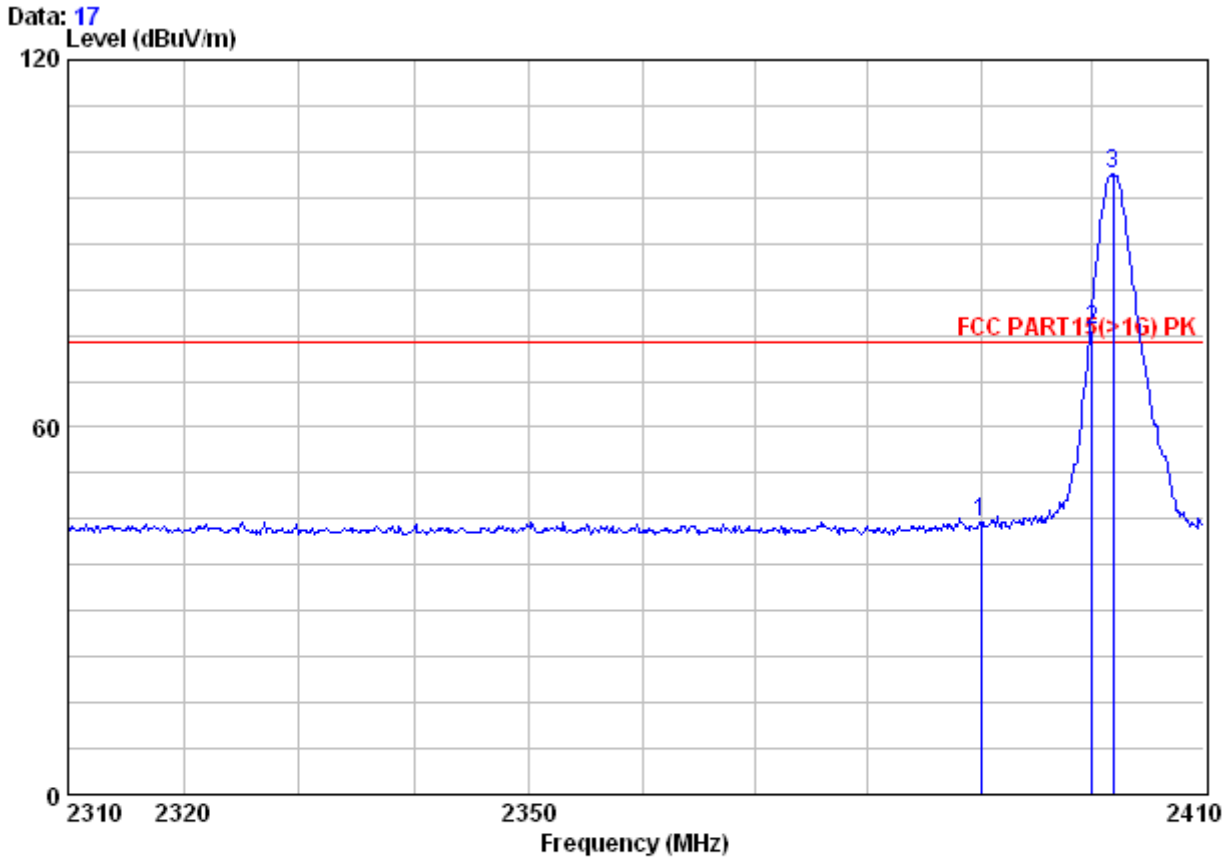
5.11.3 Band edge (Radiated Emission)

Test mode:	Transmitting	Test channel:	Lowest	Remark:	Peak	Vertical



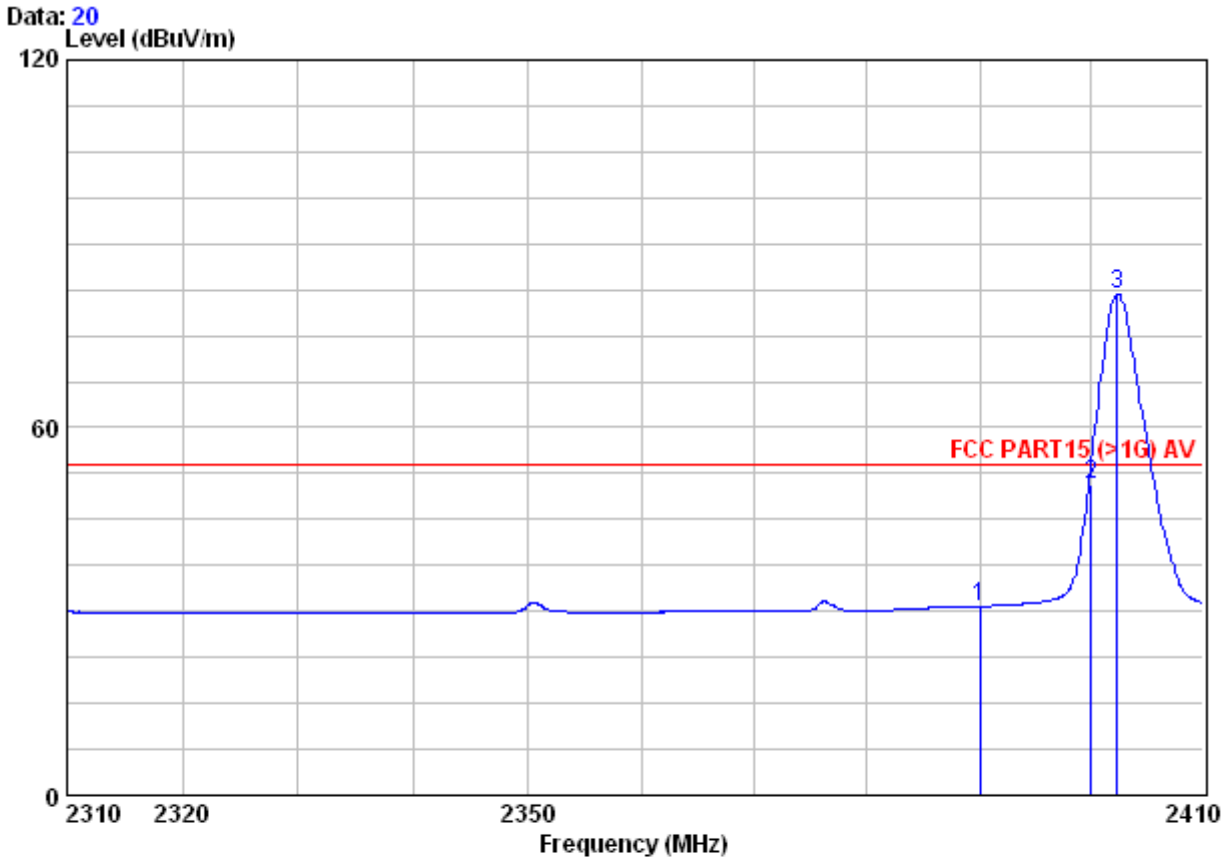
	Freq	Cable Loss	Antenna Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2390.000	2.98	32.51	39.85	48.52	44.16	74.00	-29.84
2	2400.000	2.98	32.51	39.86	77.96	73.59	74.00	-0.41
3 X	2401.900	2.98	32.51	39.86	104.12	99.76	74.00	25.76

Test mode:	Transmitting	Test channel:	Lowest	Remark:	Peak	Horizontal



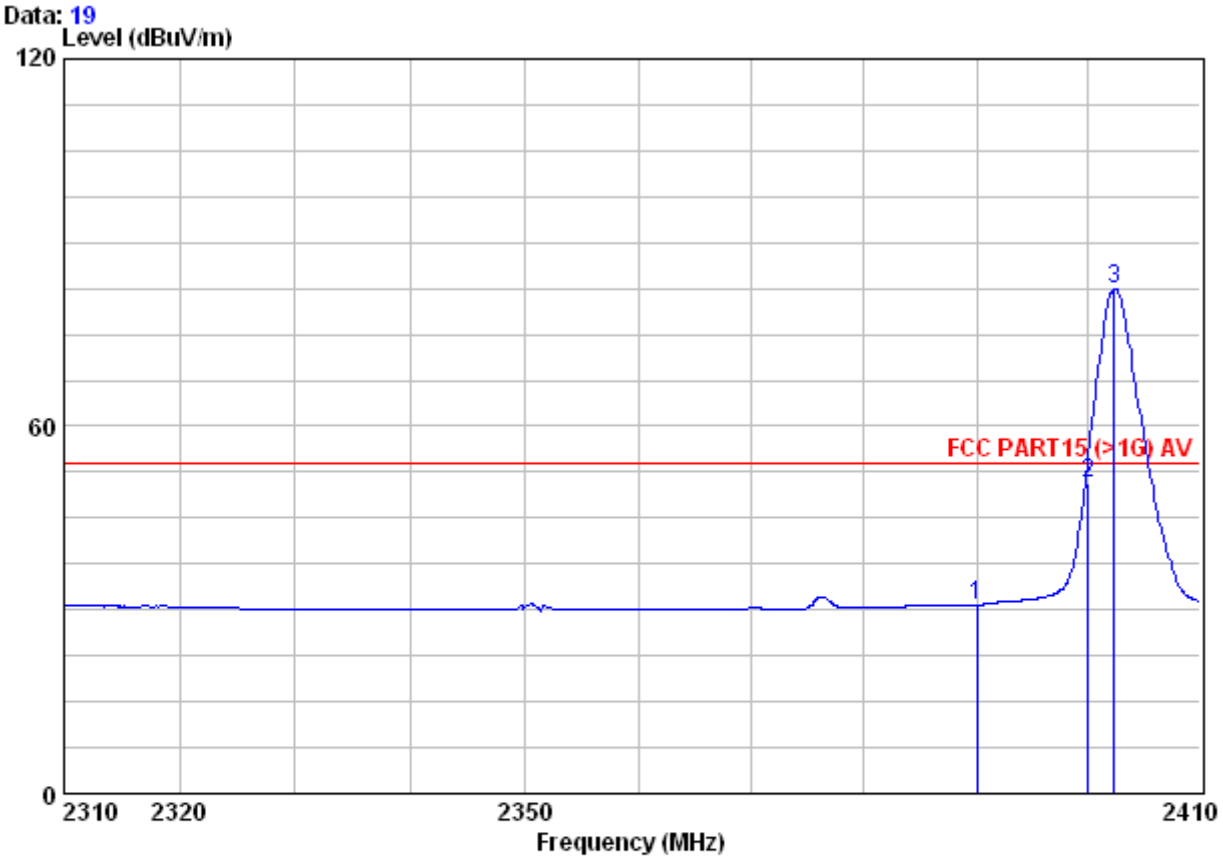
	Freq	Cable Loss	Antenna Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2390.000	2.98	32.51	39.85	48.94	44.59	74.00	-29.41
2 X	2400.000	2.98	32.51	39.86	80.28	75.91	74.00	1.91
3 X	2401.900	2.98	32.51	39.86	105.61	101.24	74.00	27.24

Test mode:	Transmitting	Test channel:	Lowest	Remark:	Average	Vertical



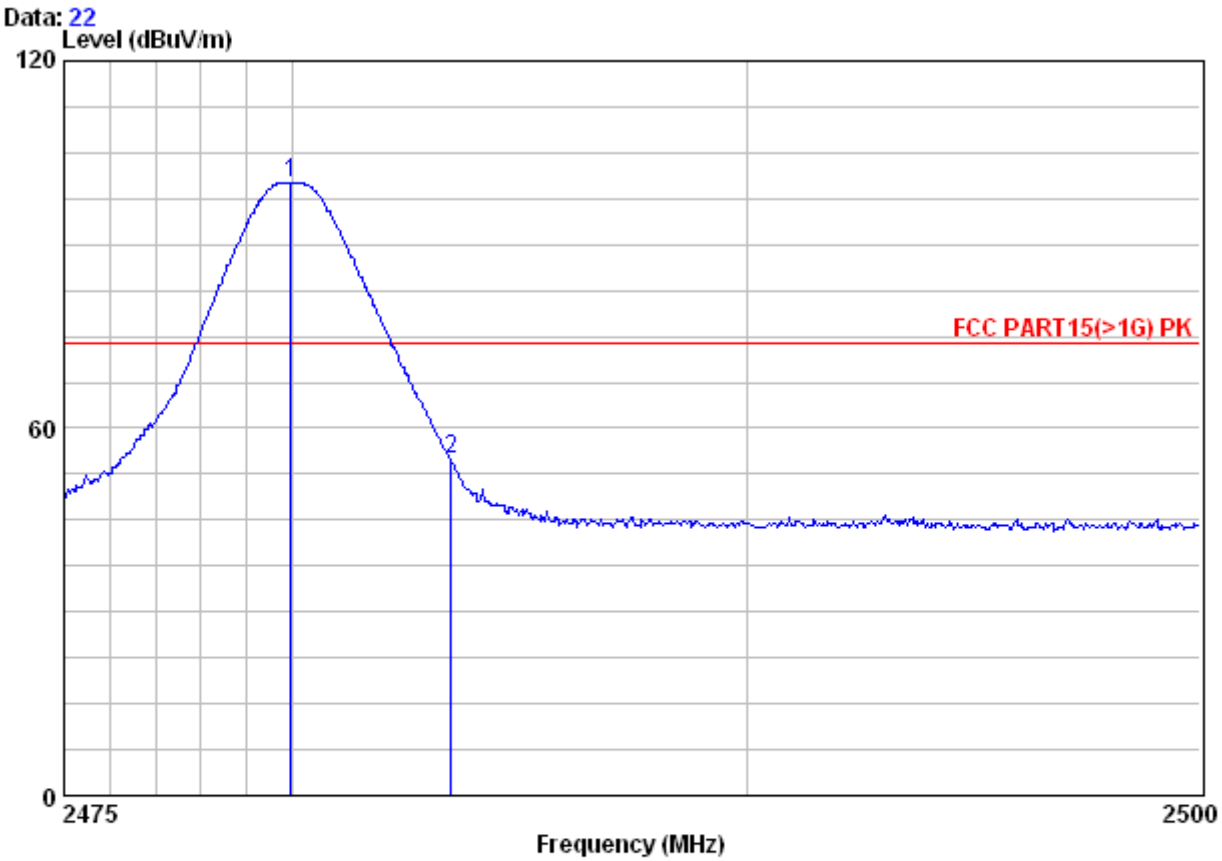
	Freq	Cable Loss	Antenna Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2390.000	2.98	32.51	39.85	35.18	30.82	54.00	-23.18
2	2400.000	2.98	32.51	39.86	55.08	50.71	54.00	-3.29
3 X	2402.300	2.98	32.51	39.86	86.15	81.79	54.00	27.79

Test mode:	Transmitting	Test channel:	Lowest	Remark:	Average	Horizontal



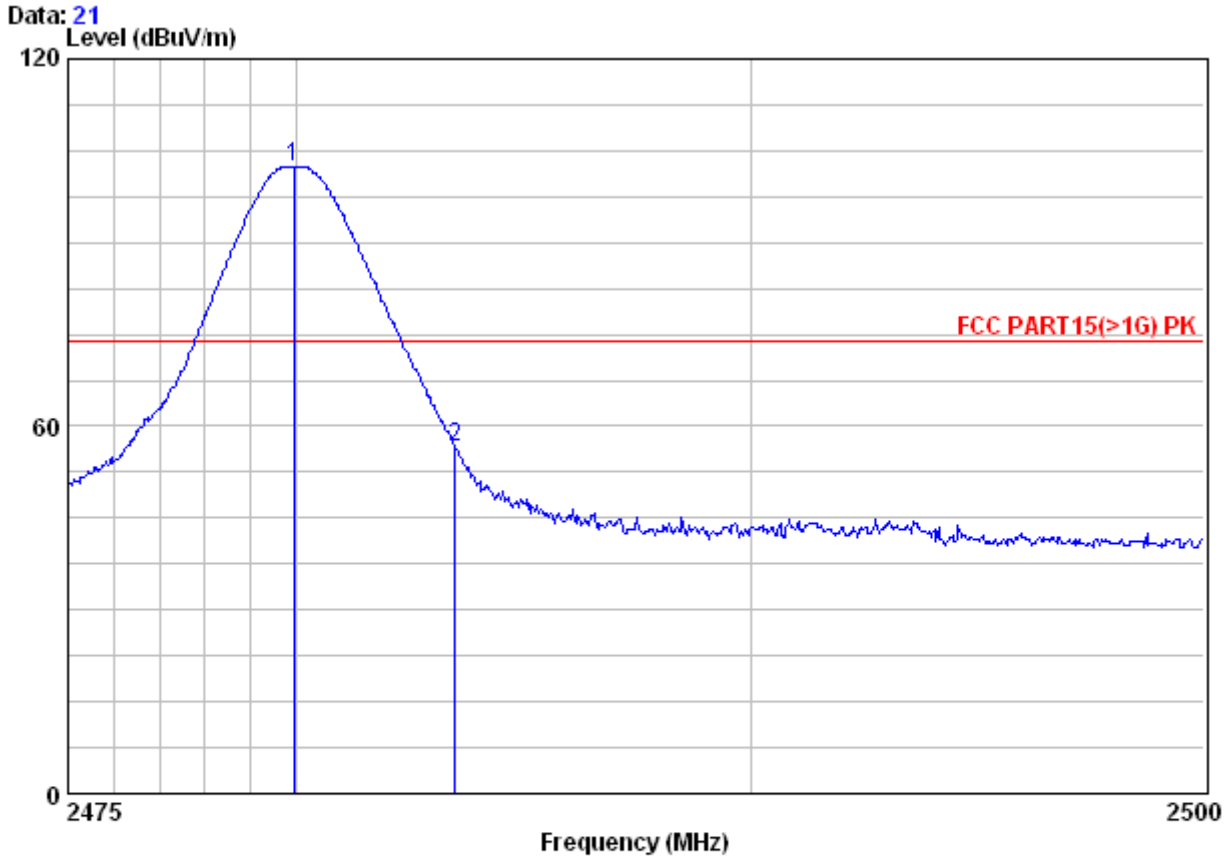
	Freq	Cable Loss	Antenna Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2390.000	2.98	32.51	39.85	35.22	30.87	54.00	-23.13
2	2400.000	2.98	32.51	39.86	55.21	50.84	54.00	-3.16
3 X	2402.300	2.98	32.51	39.86	86.85	82.49	54.00	28.49

Test mode:	Transmitting	Test channel:	Highest	Remark:	Peak	Vertical



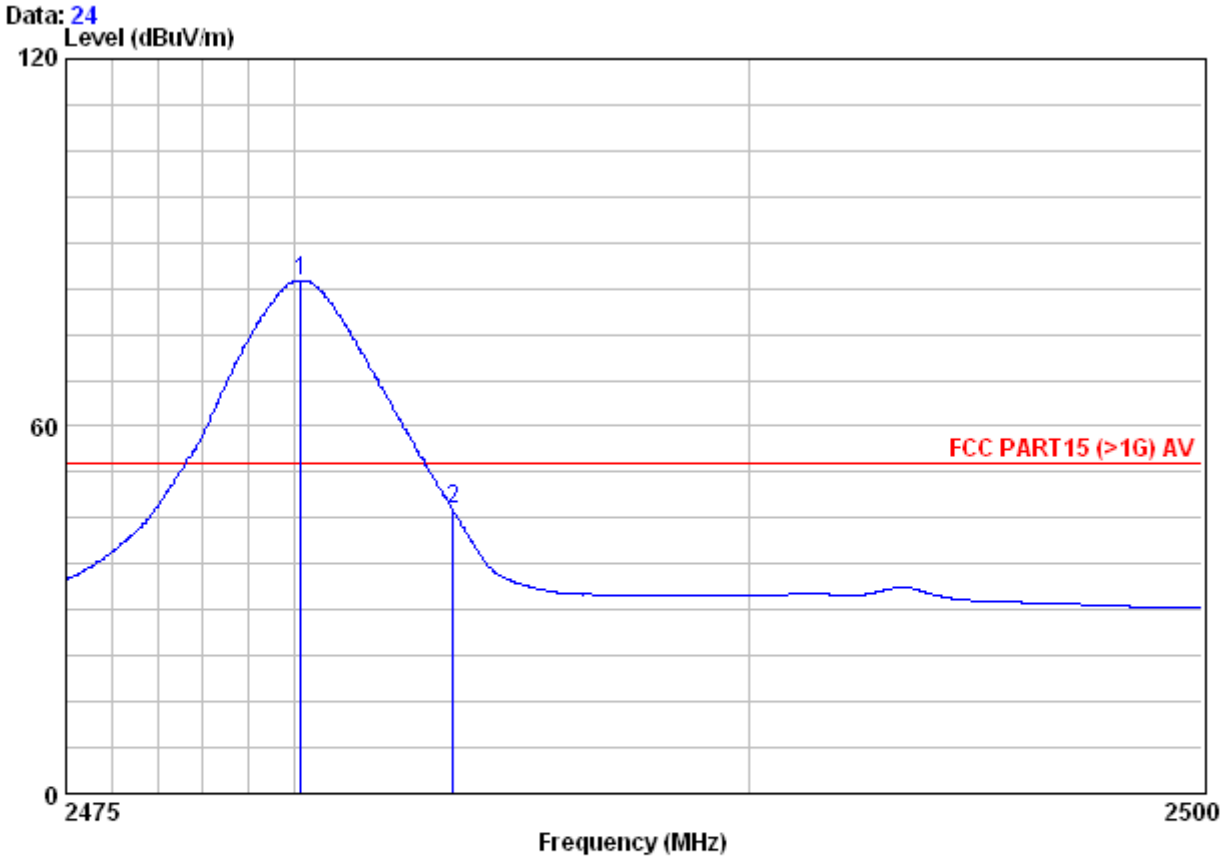
	Freq	Cable Loss	Antenna Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1 X	2479.975	3.03	32.67	39.92	104.38	100.16	74.00	26.16
2	2483.500	3.03	32.67	39.92	59.06	54.84	74.00	-19.16

Test mode:	Transmitting	Test channel:	Highest	Remark:	Peak	Horizontal



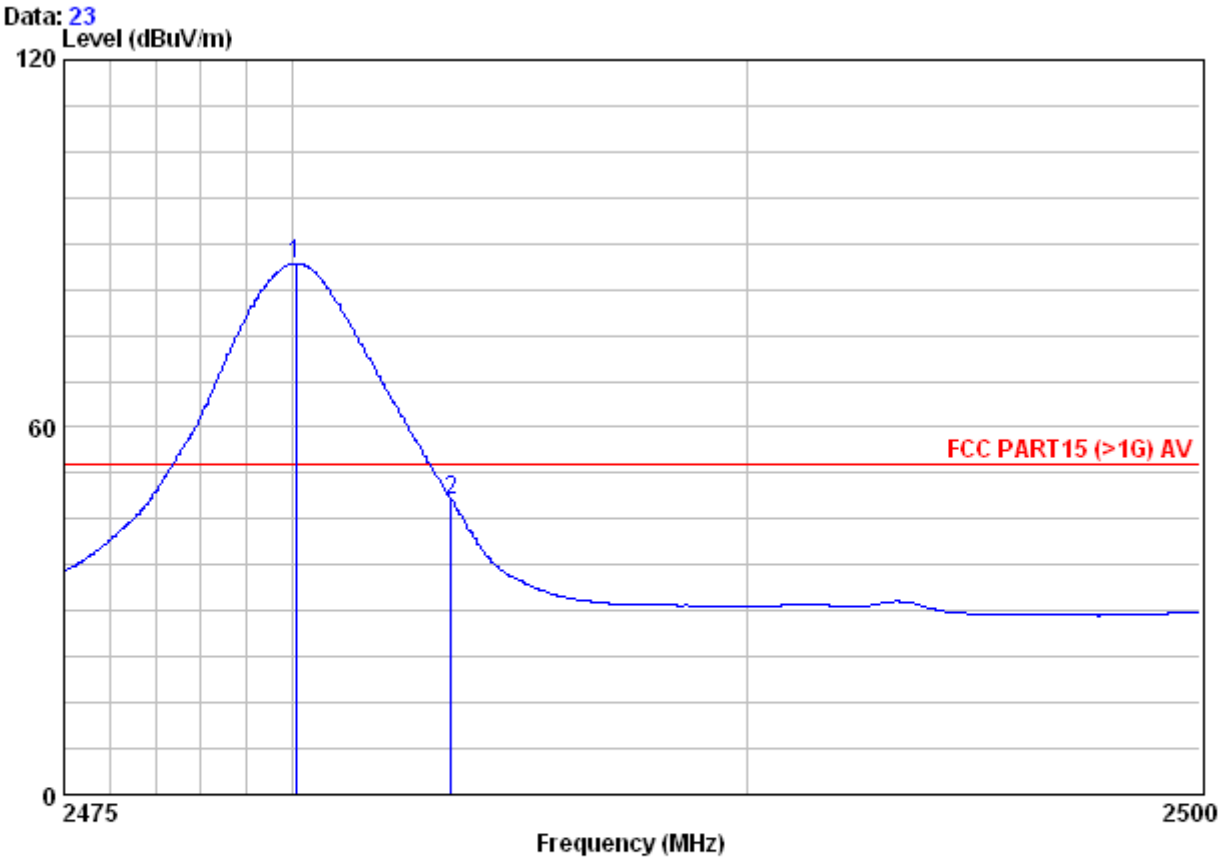
	Freq	Cable Loss	Antenna Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1 X	2479.950	3.03	32.67	39.92	106.63	102.42	74.00	28.42
2	2483.500	3.03	32.67	39.92	60.74	56.52	74.00	-17.48

Test mode:	Transmitting	Test channel:	Highest	Remark:	Average	Vertical



	Freq	Cable Loss	Antenna Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1 @	2480.150	3.03	32.67	39.92	88.08	83.86	54.00	29.86
2	2483.500	3.03	32.67	39.92	50.59	46.37	54.00	-7.63

Test mode:	Transmitting	Test channel:	Highest	Remark:	Average	Horizontal



	Freq	Cable Loss	Antenna Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1 @	2480.075	3.03	32.67	39.92	91.00	86.78	54.00	32.78
2	2483.500	3.03	32.67	39.92	52.38	48.16	54.00	-5.84