FCC Radio Test Report

FCC ID: 2AA5V-F4056591

Original Grant

Report No.	:	TB-FCC147478
Applicant	:	Krischerco World-Wide Co.
Equipment Under Test (EUT)		
EUT Name	:	WIRELESS SHOWER SPEAKER
Model No.	:	F4056591
Series Model No.	:	PP#5268143
Brand Name	:	N/A
Receipt Date	:	2016-03-30
Test Date	:	2016-03-31 to 2016-04-08
Issue Date	:	2016-04-09
Standards	:	FCC Part 15: 2015, Subpart C(15.247)
Test Method	:	ANSI C63.10: 2013
Conclusions	:	**PASS**

In the configuration tested, the EUT complied with the standards specified above,
The EUT technically complies with the FCC requirements

Test/Witness Engineer : Ivan Su

Approved& Authorized :

This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in the report.

1A/F., Bldg.6, Yusheng Industrial Zone, The National Road No.107 Xixiang Section 467, Xixiang, Bao'an, Shenzhen, China
Tel: +86 75526509301 Fax: +86 75526509195

Contents

1. General Information about EUT

1.1 Client Information

Applicant	:	Krischerco World-Wide Co.
Address	:	13/F-8, 155 Keelung Rd. Sec.1, Taipei, Taiwan
Manufacturer	:	SHENZHEN Moccer Industrial Co., Ltd
Address	:	3F, 1st Building CaiFa Industrial Park, RenMing Rd., Guan Lan, Shenzhen, China

1.2 General Description of EUT (Equipment Under Test)

EUT Name	:	WIRELESS SHOWER SPEAKER	
Models No.	:	F4056591, PP#5268143	
Model Difference	:	All these models are identical in the same PCB, layout and electrical circuit, the only difference is model name for commercial.	
Product Description	:	Operation Frequency: Bluetooth 3.0: 2402~2480MHz	
		Number of Channel:	Bluetooth:79 Channels **See Note 3**
		Max Peak Output Power:	Bluetooth: 4.543 dBm(8-DPSK)
		Antenna Gain:	1.2 dBi PCB Antenna
		Modulation Type:	GFSK 1Mbps(1 Mbps) π/4-DQPSK(2 Mbps) 8-DPSK(3 Mbps)
Power Supply	:	DC Voltage supplied from Host System by USB cable. DC power by Li-ion Battery.	
Power Rating	:	DC 5.0V by USB cable. DC 3.7V by 800mAh Li-ion Battery.	
Connecting I/O Port(S)	:	Please refer to the User's Manual	

Note:

(1) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

(2) Channel List:

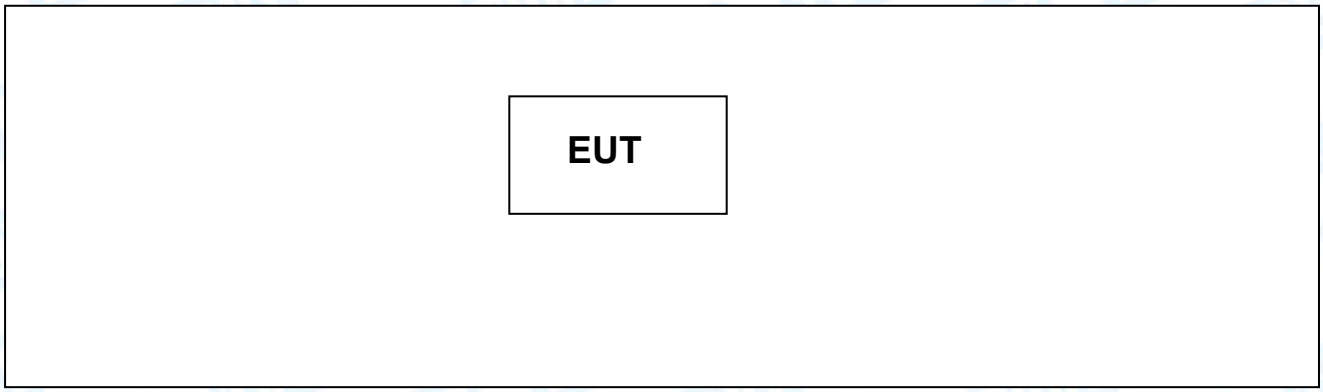
Bluetooth Channel List					
Channel	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**
00	**2402**	27	2429	54	2456
01	2403	28	2430	55	2457
02	2404	29	2431	56	2458
03	2405	30	2432	57	2459

04	2406	31	2433	58	2460
05	2407	32	2434	59	2461
06	2408	33	2435	60	2462
07	2409	34	2436	61	2463
08	2410	35	2437	62	2464
09	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	**39**	**2441**	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471
16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	**78**	**2480**
25	2427	52	2454		
26	2428	53	2455		

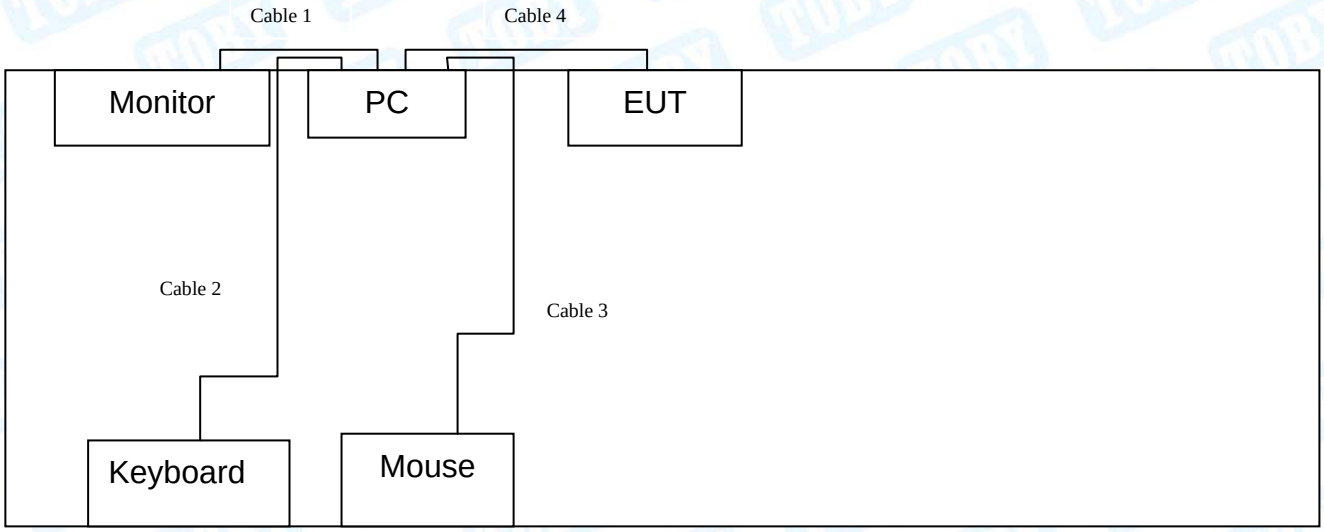
(3) The Antenna information about the equipment is provided by the applicant.

1.3 Block Diagram Showing the Configuration of System Tested

TX Mode



USB Charging with TX Mode



1.4 Description of Support Units

Equipment Information				
Name	**Model**	**FCC ID/DOC**	**Manufacturer**	**Used "√"**
LCD Monitor	E170Sc	DOC	DELL	√
PC	OPTIPLEX380	DOC	DELL	√
Keyboard	L100	DOC	DELL	√
Mouse	M-UARDEL7	DOC	DELL	√
Cable Information				
Number	**Shielded Type**	**Ferrite Core**	**Length**	**Note**
Cable 1	YES	YES	1.5M	
Cable 2	YES	YES	1.5M	
Cable 2	YES	NO	1.5M	
Cable 3	NO	YES	0.8M	

1.5 Description of Test Mode

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned follow was evaluated respectively.

For Conducted Test	
Final Test Mode	**Description**
Mode 1	USB Charging with TX GFSK Mode

For Radiated Test	
Final Test Mode	**Description**
Mode 1	USB Charging with TX GFSK Mode
Mode 2	TX Mode(GFSK) Channel 00/39/78
Mode 3	TX Mode(π/4-DQPSK) Channel 00/39/78
Mode 4	TX Mode(8-DPSK) Channel 00/39/78
Mode 5	Hopping Mode(GFSK)
Mode 6	Hopping Mode(π/4-DQPSK)
Mode 7	Hopping Mode(8-DPSK)

Note:

(1) For all test, we have verified the construction and function in typical operation. And all the test modes were carried out with the EUT in transmitting operation in maximum power with all kinds of data rate. We have pretested all the test mode above.

According to ANSI C63.10 standards, the measurements are performed at the highest, middle, lowest available channels, and the worst case data rate as follows:

TX Mode: GFSK (1 Mbps)

TX Mode: π/4-DQPSK (2 Mbps)

TX Mode: 8-DPSK (3Mbps)

(2) The EUT is considered a portable unit; it was pre-tested on the positioned of each 3 axis, X-plane, Y-plane and Z-plane. The worst case was found positioned on X-plane as the normal use. Therefore only the test data of this X-plane was used for radiated emission measurement test.

1.6 Description of Test Software Setting

During testing channel& Power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of Bluetooth mode.

Test Software Version	Appo Tech RF Control Kit V4.0		
Frequency	2402 MHz	2441MHz	2480 MHz
GFSK	DEF	DEF	DEF
π/4-DQPSK	DEF	DEF	DEF
8-DPSK	DEF	DEF	DEF

1.7 Measurement Uncertainty

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

Test Item	Parameters	Expanded Uncertainty (U_{Lab})
Conducted Emission	Level Accuracy: 9kHz~150kHz 150kHz to 30MHz	 ±3.42 dB ±3.42 dB
Radiated Emission	Level Accuracy: 9kHz to 30 MHz	±4.60 dB
Radiated Emission	Level Accuracy: 30MHz to 1000 MHz	±4.40 dB
Radiated Emission	Level Accuracy: Above 1000MHz	±4.20 dB

1.8 Test Facility

The testing report were performed by the Shenzhen Toby Technology Co., Ltd., in their facilities located at 1A/F., Bldg.6, Yusheng Industrial Zone, The National Road No.107 Xixiang Section 467, Xixiang, Bao'an, Shenzhen, Guangdong, China. At the time of testing, the following bodies accredited the Laboratory:

CNAS (L5813)

The Laboratory has been accredited by CNAS to ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories for the competence in the field of testing. And the Registration No.: CNAS L5813.

FCC List No.: (811562)

The Laboratory is listed in the United States of American Federal Communications Commission (FCC), and the registration number is 811562.

IC Registration No.: (11950A-1)

The Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing. The site registration: Site# 11950A-1.

2. Test Summary

FCC Part 15 Subpart C(15.247)/ RSS 247 Issue 1				
Standard Section		Test Item	Judgment	Remark
FCC	IC			
15.203		Antenna Requirement	PASS	N/A
15.207	RSS-GEN 7.2.2	Conducted Emission	PASS	N/A
15.205	RSS-Gen 7.2.3	Restricted Bands	PASS	N/A
15.247(a)(1)	RSS 247 5.1 (2)	Hopping Channel Separation	PASS	N/A
15.247(a)(1)	RSS 247 5.1 (4)	Dwell Time	PASS	N/A
15.247(b)(1)	RSS 247 5.4 (2)	Peak Output Power	PASS	N/A
15.247(b)(1)	RSS 247 5.1 (4)	Number of Hopping Frequency	PASS	N/A
15.247(c)	RSS 247 5.5	Radiated Spurious Emission	PASS	N/A
15.247(a)	RSS 247 5.1 (1)	99% Occupied Bandwidth & 20dB Bandwidth	PASS	99%OBW GFSK:820.4154kHz π/4-DQPSK: 1166.00kHz 8-DPSK: 1150.70KHz
Note: N/A is an abbreviation for Not Applicable.				

3. Test Equipment

Conducted Emission Test					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Cal. Due Date**
EMI Test Receiver	Rohde & Schwarz	ESCI	100321	Aug. 07, 2015	Aug. 06, 2016
RF Switching Unit	Compliance Direction Systems Inc	RSU-A4	34403	Aug. 07, 2015	Aug. 06, 2016
AMN	SCHWARZBECK	NNBL 8226-2	8226-2/164	Aug. 07, 2015	Aug. 06, 2016
LISN	Rohde & Schwarz	ENV216	101131	Aug. 07, 2015	Aug. 06, 2016
Radiation Emission Test					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Cal. Due Date**
Spectrum Analyzer	Agilent	E4407B	MY45106456	Aug. 29, 2015	Aug. 28, 2016
EMI Test Receiver	Rohde & Schwarz	ESCI	100010/007	Aug. 07, 2015	Aug. 06, 2016
Bilog Antenna	ETS-LINDGREN	3142E	00117537	Mar. 26, 2016	Mar. 25, 2017
Bilog Antenna	ETS-LINDGREN	3142E	00117542	Mar. 26, 2016	Mar. 25, 2017
Horn Antenna	ETS-LINDGREN	3117	00143207	Mar. 26, 2016	Mar. 25, 2017
Horn Antenna	ETS-LINDGREN	3117	00143209	Mar. 26, 2016	Mar. 25, 2017
Pre-amplifier	Sonoma	310N	185903	Mar. 26, 2016	Mar. 25, 2017
Pre-amplifier	HP	8447B	3008A00849	Mar. 26, 2016	Mar. 25, 2017
Cable	HUBER+SUHNER	100	SUCOFLEX	Mar. 26, 2016	Mar. 25, 2017
Positioning Controller	ETS-LINDGREN	2090	N/A	N/A	N/A

4. Conducted Emission Test

4.1 Test Standard and Limit

4.1.1Test Standard

FCC Part 15.207

4.1.2 Test Limit

Conducted Emission Test Limit

Frequency	Maximum RF Line Voltage (dBμV)	
	Quasi-peak Level	Average Level
150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
500kHz~5MHz	56	46
5MHz~30MHz	60	50

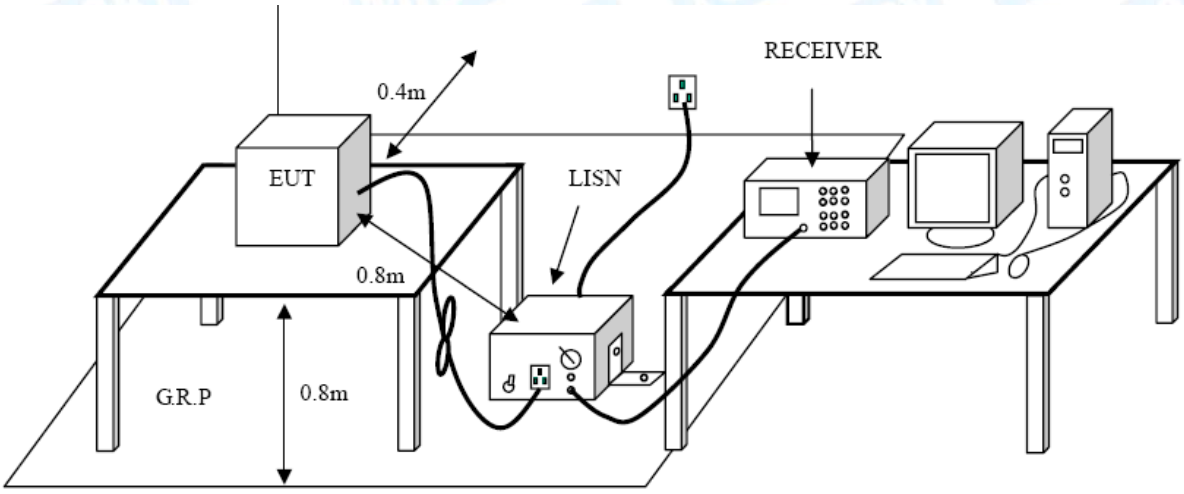
Notes:

(1) *Decreasing linearly with logarithm of the frequency.

(2) The lower limit shall apply at the transition frequencies.

(3) The limit decrease in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.2 Test Setup



4.3 Test Procedure

The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

LISN at least 80 cm from nearest part of EUT chassis

The bandwidth of EMI test receiver is set at 9kHz, and the test frequency band is from 0.15MHz to 30MHz.

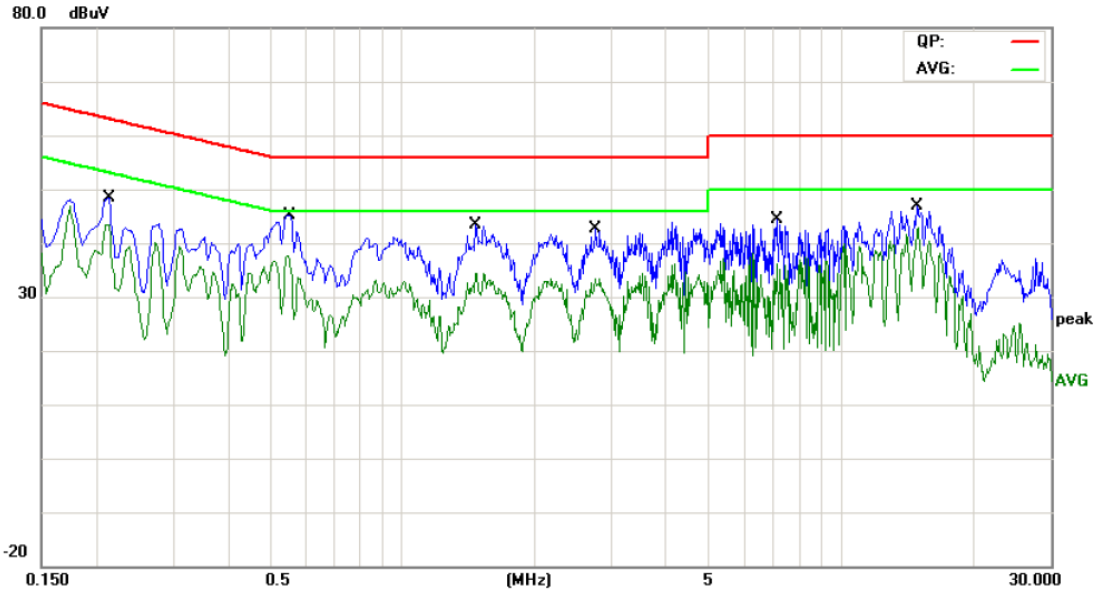
4.4 EUT Operating Mode

Please refer to the description of test mode.

4.5 Test Data

Test data please refer the following pages.

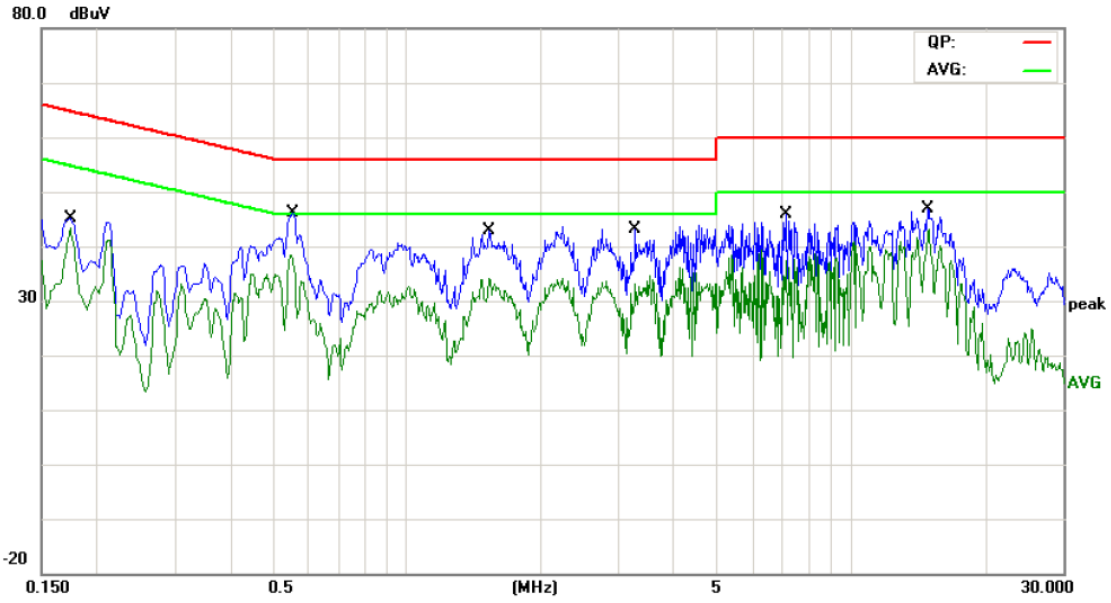
EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	AC 120V/60 Hz		
Terminal:	Line		
Test Mode:	USB Charging with TX GFSK Mode 2402 MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.2140	36.23	10.02	46.25	63.04	-16.79	QP
2		0.2140	32.63	10.02	42.65	53.04	-10.39	AVG
3		0.5540	34.56	10.05	44.61	56.00	-11.39	QP
4		0.5540	26.78	10.05	36.83	46.00	-9.17	AVG
5		1.4700	29.91	10.06	39.97	56.00	-16.03	QP
6		1.4700	24.42	10.06	34.48	46.00	-11.52	AVG
7		2.7540	27.70	10.03	37.73	56.00	-18.27	QP
8		2.7540	22.55	10.03	32.58	46.00	-13.42	AVG
9		7.1020	31.94	10.06	42.00	60.00	-18.00	QP
10		7.1020	26.70	10.06	36.76	50.00	-13.24	AVG
11		14.9060	33.48	10.26	43.74	60.00	-16.26	QP
12	*	14.9060	32.42	10.26	42.68	50.00	-7.32	AVG

Emission Level= Read Level+ Correct Factor

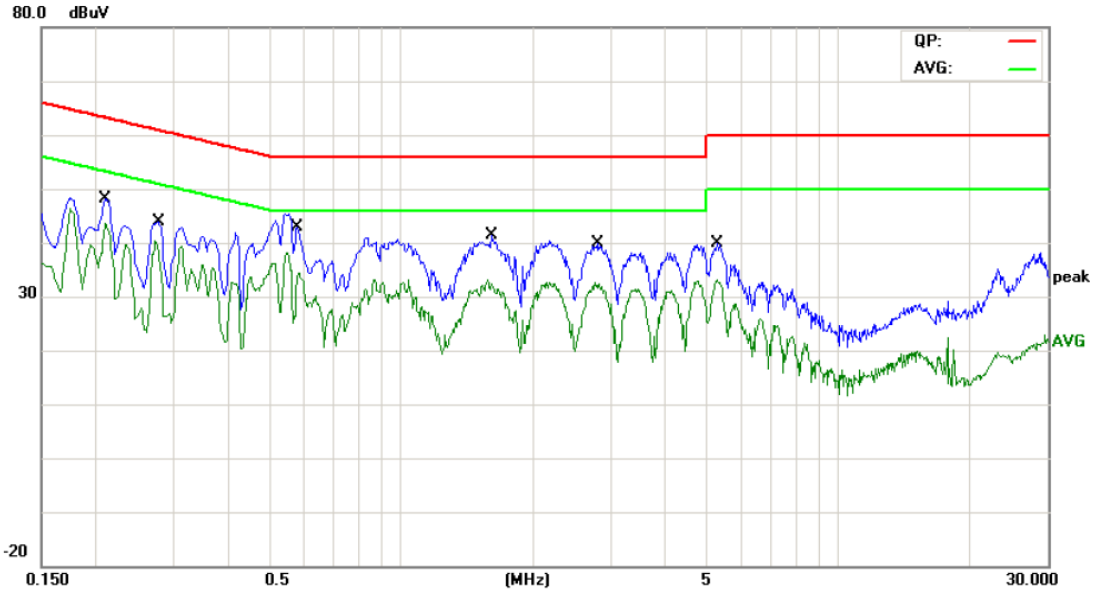
EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	AC 120V/60 Hz		
Terminal:	Neutral		
Test Mode:	USB Charging with TX GFSK Mode 2402 MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.1740	33.87	10.12	43.99	64.76	-20.77	QP
2		0.1740	33.24	10.12	43.36	54.76	-11.40	AVG
3		0.5540	35.55	10.02	45.57	56.00	-10.43	QP
4		0.5540	27.79	10.02	37.81	46.00	-8.19	AVG
5		1.5339	29.83	10.11	39.94	56.00	-16.06	QP
6		1.5339	23.60	10.11	33.71	46.00	-12.29	AVG
7		3.2620	28.40	10.06	38.46	56.00	-17.54	QP
8		3.2620	23.46	10.06	33.52	46.00	-12.48	AVG
9		7.1020	32.02	10.06	42.08	60.00	-17.92	QP
10		7.1020	26.90	10.06	36.96	50.00	-13.04	AVG
11		14.9060	33.54	10.06	43.60	60.00	-16.40	QP
12	*	14.9060	32.47	10.06	42.53	50.00	-7.47	AVG

Emission Level= Read Level+ Correct Factor

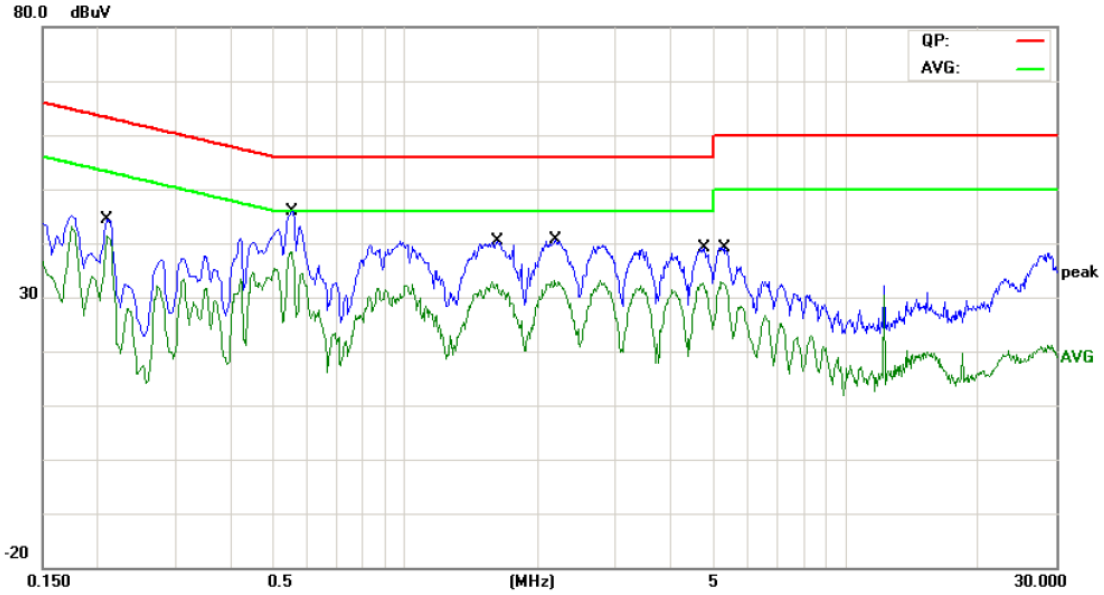
EUT:	WIRELESS SHOWER SPEAKER	**Model Name :**	F4056591
Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	AC 240V/60 Hz		
Terminal:	Line		
Test Mode:	USB Charging with TX GFSK Mode 2402 MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.2100	36.69	10.02	46.71	63.20	-16.49	QP
2	*	0.2100	33.17	10.02	43.19	53.20	-10.01	AVG
3		0.2779	33.42	10.02	43.44	60.88	-17.44	QP
4		0.2779	27.85	10.02	37.87	50.88	-13.01	AVG
5		0.5780	31.81	10.06	41.87	56.00	-14.13	QP
6		0.5780	23.36	10.06	33.42	46.00	-12.58	AVG
7		1.6100	28.39	10.06	38.45	56.00	-17.55	QP
8		1.6100	22.05	10.06	32.11	46.00	-13.89	AVG
9		2.7980	25.19	10.03	35.22	56.00	-20.78	QP
10		2.7980	21.74	10.03	31.77	46.00	-14.23	AVG
11		5.2540	25.93	9.97	35.90	60.00	-24.10	QP
12		5.2540	22.66	9.97	32.63	50.00	-17.37	AVG

Emission Level= Read Level+ Correct Factor

EUT:	WIRELESS SHOWER SPEAKER	**Model Name :**	F4056591
Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	AC 240V/60 Hz		
Terminal:	Neutral		
Test Mode:	USB Charging with TX GFSK Mode 2402 MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.2100	33.01	10.12	43.13	63.20	-20.07	QP
2		0.2100	31.33	10.12	41.45	53.20	-11.75	AVG
3		0.5540	35.44	10.02	45.46	56.00	-10.54	QP
4	*	0.5540	28.06	10.02	38.08	46.00	-7.92	AVG
5		1.6220	28.33	10.10	38.43	56.00	-17.57	QP
6		1.6220	21.73	10.10	31.83	46.00	-14.17	AVG
7		2.1900	28.71	10.06	38.77	56.00	-17.23	QP
8		2.1900	22.88	10.06	32.94	46.00	-13.06	AVG
9		4.7900	25.65	10.06	35.71	56.00	-20.29	QP
10		4.7900	21.89	10.06	31.95	46.00	-14.05	AVG
11		5.3340	25.25	10.06	35.31	60.00	-24.69	QP
12		5.3340	21.60	10.06	31.66	50.00	-18.34	AVG

Emission Level= Read Level+ Correct Factor

5. Radiated Emission Test

5.1 Test Standard and Limit

5.1.1 Test Standard

FCC Part 15.209

5.1.2 Test Limit

Radiated Emission Limit (9 kHz~1000MHz)

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

Radiated Emission Limit (Above 1000MHz)

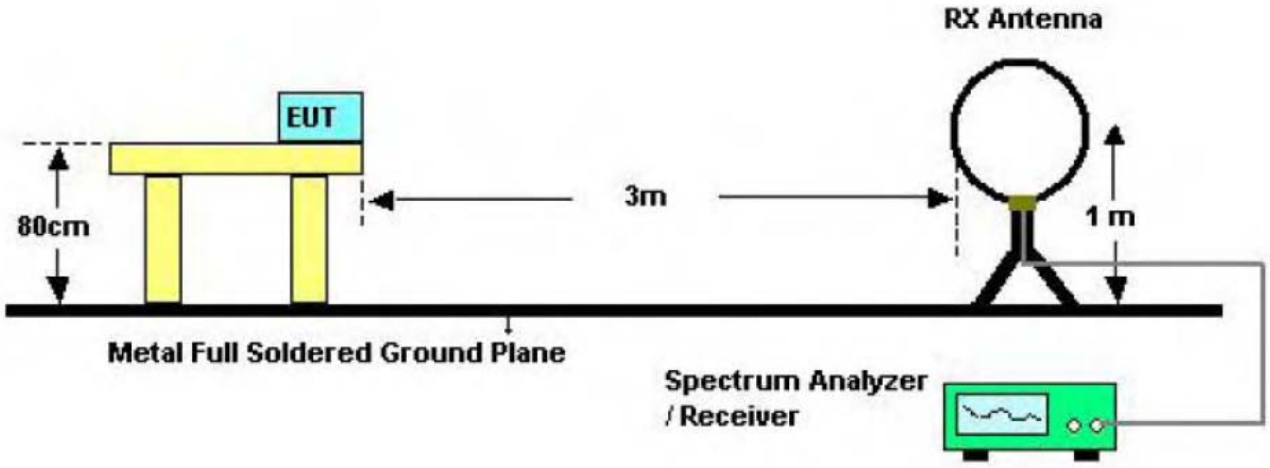
Frequency (MHz)	Class B (dBuV/m)(at 3m)	
	Peak	Average
Above 1000	74	54

Note:

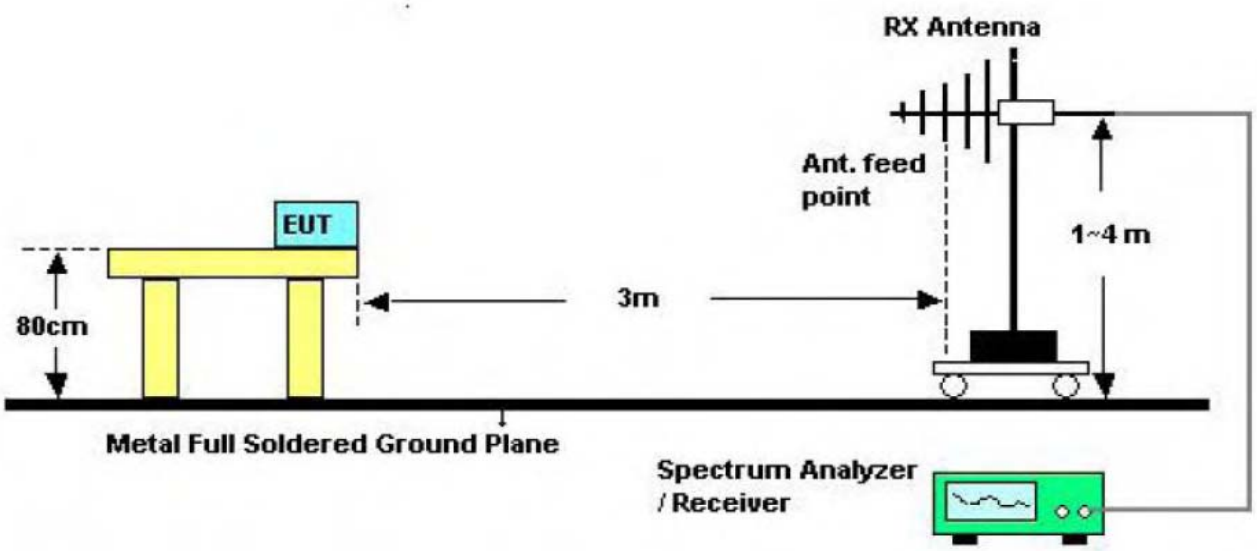
(1) The tighter limit applies at the band edges.

(2) Emission Level (dBuV/m)=20log Emission Level (uV/m)

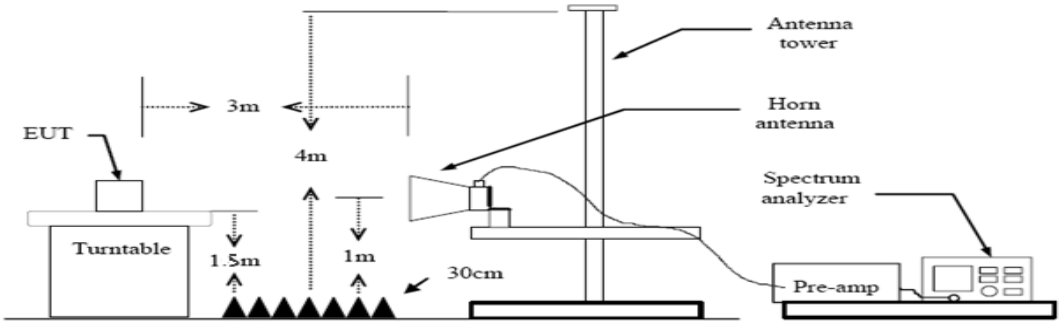
5.2 Test Setup



Bellow 30MHz Test Setup



Bellow 1000MHz Test Setup



Above 1GHz Test Setup

5.3 Test Procedure

(1) The measuring distance of 3m shall be used for measurements at frequency up to 1GHz and above 1 GHz. The EUT was placed on a rotating 0.8m high above ground, the table was rotated 360 degrees to determine the position of the highest radiation.

(2) Measurements at frequency above 1GHz. The EUT was placed on a rotating 1.5m high above the ground. RF absorbers covered the ground plane with a minimum area of 3.0m by 3.0m between the EUT and measurement receiver antenna. The RF absorber shall not exceed 30cm in high above the conducting floor. The table was rotated 360 degrees to determine the position of the highest radiation.

(3) The Test antenna shall vary between 1m and 4m, Both Horizontal and Vertical antenna are set to make measurement.

(4) The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.

(5) If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit Bellow 1 GHz, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed. But the Peak Value and average value both need to comply with applicable limit above 1 GHz.

(6) Testing frequency range below 1GHz the measuring instrument use VBW=120 kHz with Quasi-peak detection.

(7) Testing frequency range above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=10 Hz with Peak Detector for Average Values.

(8) For the actual test configuration, please see the test setup photo.

5.4 EUT Operating Condition

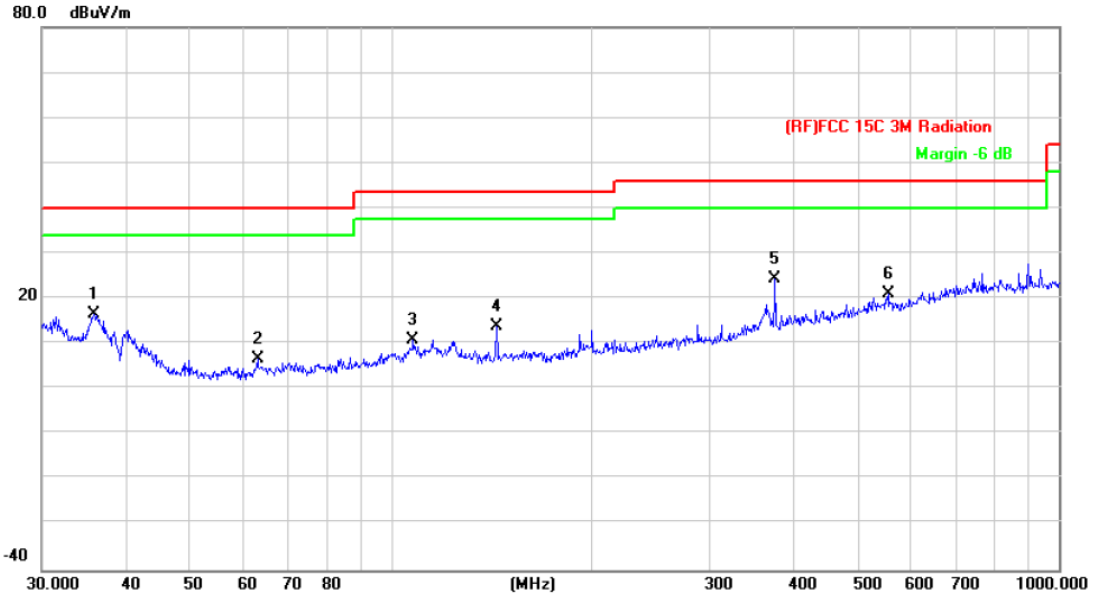
The Equipment Under Test was set to Continual Transmitting in maximum power in TX mode.

5.5 Test Data

Remark: During testing above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=1 kHz with Peak Detector for Average Values.

Test data please refer the following pages.

EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2402MHz		
Remark:	Only worse case is reported		

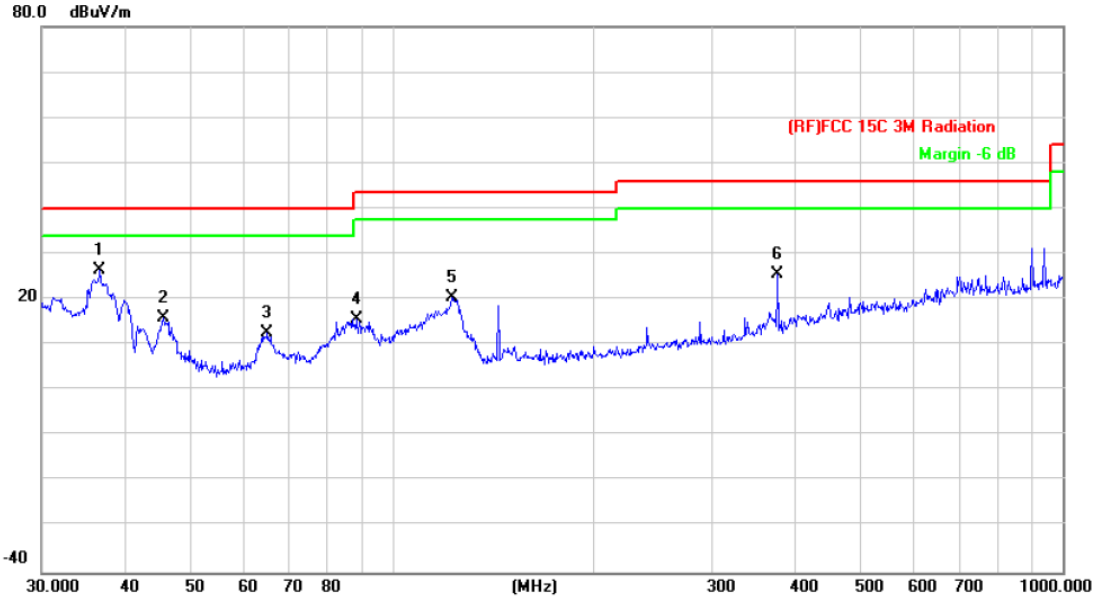


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		35.8746	34.20	-17.60	16.60	40.00	-23.40	peak
2		63.0916	30.88	-24.25	6.63	40.00	-33.37	peak
3		107.8877	32.60	-21.86	10.74	43.50	-32.76	peak
4		143.8295	35.55	-21.67	13.88	43.50	-29.62	peak
5	*	375.9385	38.78	-14.40	24.38	46.00	-21.62	peak
6		554.8254	31.19	-10.13	21.06	46.00	-24.94	peak

*:Maximum data x:Over limit !:over margin

Emission Level= Read Level+ Correct Factor

EUT:	WIRELESS SHOWER SPEAKER	**Model Name :**	F4056591
Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	DC 5V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2402MHz		
Remark:	Only worse case is reported		

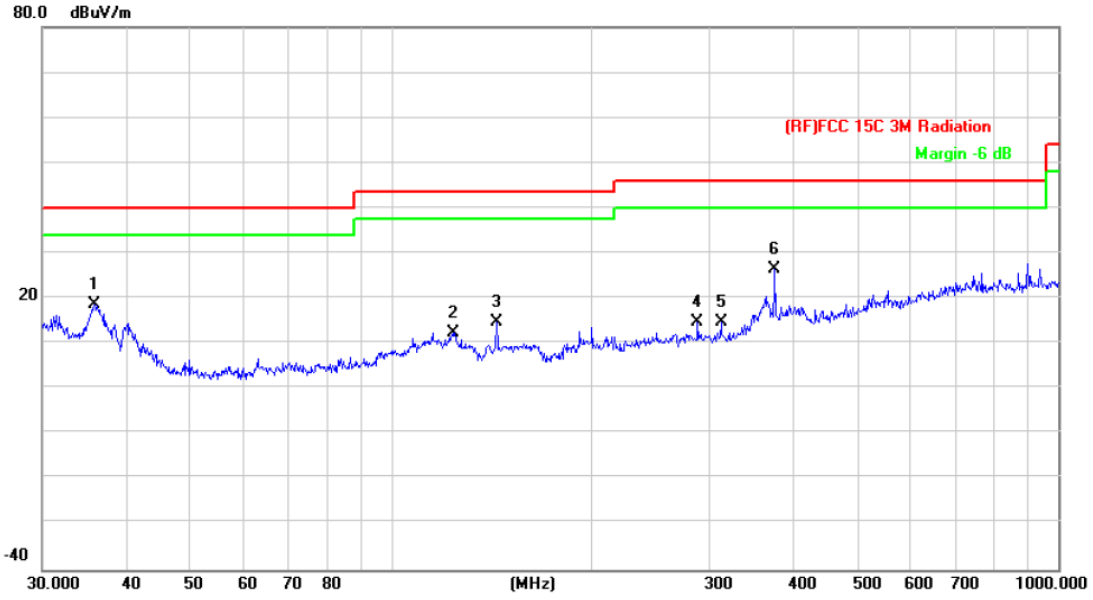


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	36.6375	44.46	-18.07	26.39	40.00	-13.61	peak
2		45.5348	38.40	-22.51	15.89	40.00	-24.11	peak
3		65.1145	36.75	-24.06	12.69	40.00	-27.31	peak
4		88.3421	38.44	-22.79	15.65	43.50	-27.85	peak
5		122.8340	42.94	-22.41	20.53	43.50	-22.97	peak
6		375.9385	39.95	-14.40	25.55	46.00	-20.45	peak

*:Maximum data x:Over limit !:over margin

Emission Level= Read Level+ Correct Factor

EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Horizontal		
Test Mode:	TX π/4-DQPSK Mode 2402MHz		
Remark:	Only worse case is reported		

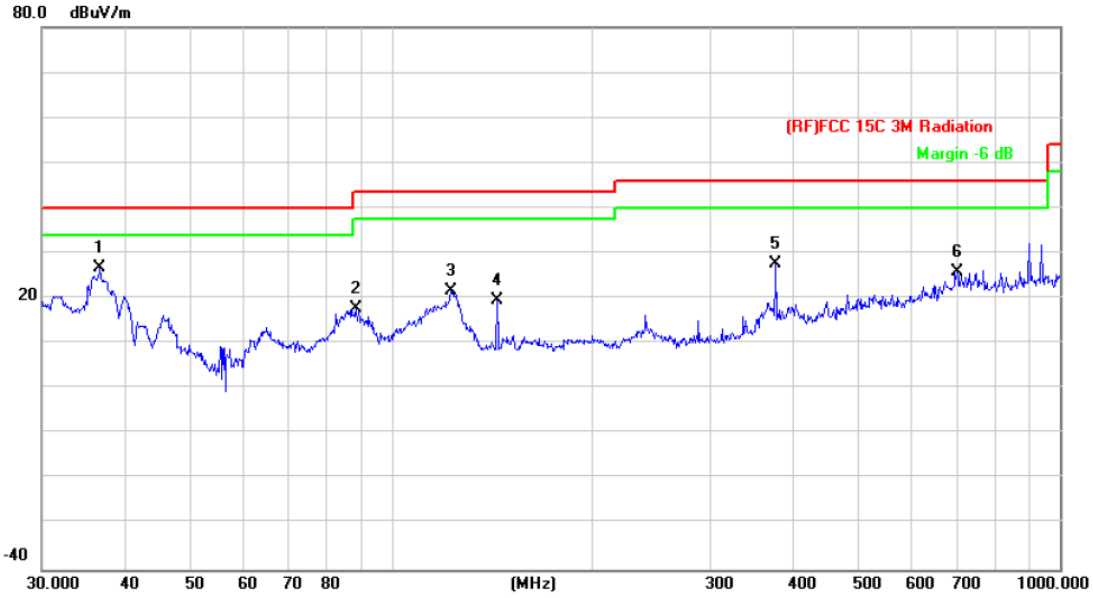


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		35.8746	36.20	-17.60	18.60	40.00	-21.40	peak
2		123.6984	34.88	-22.39	12.49	43.50	-31.01	peak
3		143.8291	36.55	-21.67	14.88	43.50	-28.62	peak
4		287.9904	32.09	-17.32	14.77	46.00	-31.23	peak
5		312.1792	31.38	-16.63	14.75	46.00	-31.25	peak
6	*	375.9384	40.78	-14.40	26.38	46.00	-19.62	peak

*:Maximum data x:Over limit !:over margin

Emission Level= Read Level+ Correct Factor

EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Vertical		
Test Mode:	TX π/4-DQPSK Mode 2402MHz		
Remark:	Only worse case is reported		

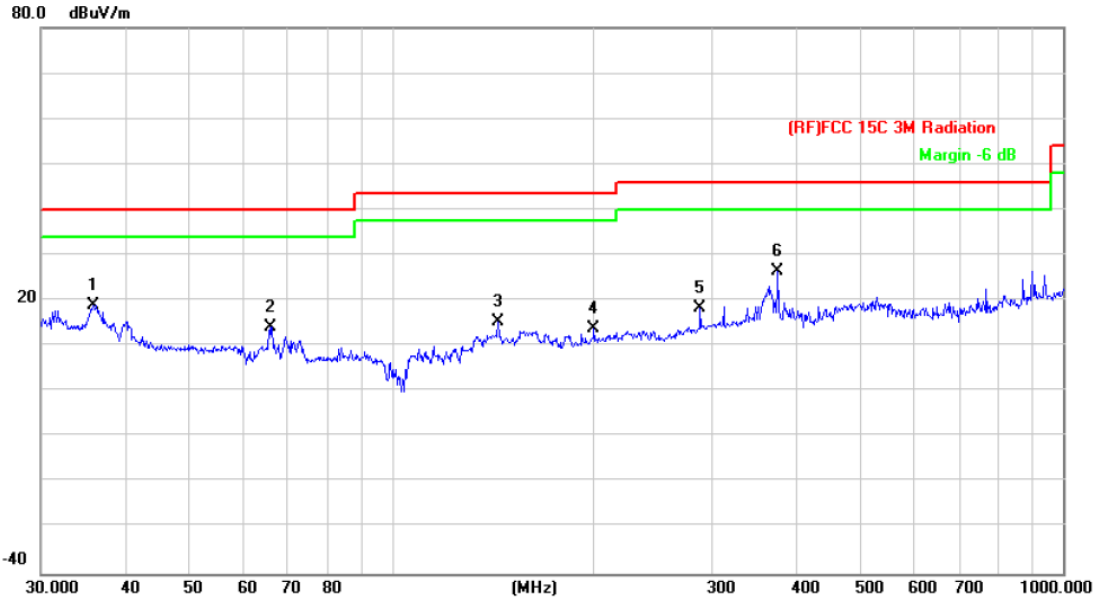


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	36.6375	44.96	-18.07	26.89	40.00	-13.11	peak
2		88.3421	40.44	-22.79	17.65	43.50	-25.85	peak
3		122.8340	43.94	-22.41	21.53	43.50	-21.97	peak
4		143.8291	41.31	-21.67	19.64	43.50	-23.86	peak
5		375.9384	41.95	-14.40	27.55	46.00	-18.45	peak
6		701.7607	32.87	-6.88	25.99	46.00	-20.01	peak

*:Maximum data x:Over limit !:over margin

Emission Level= Read Level+ Correct Factor

EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Horizontal		
Test Mode:	TX 8-DPSK Mode 2402MHz		
Remark:	Only worse case is reported		

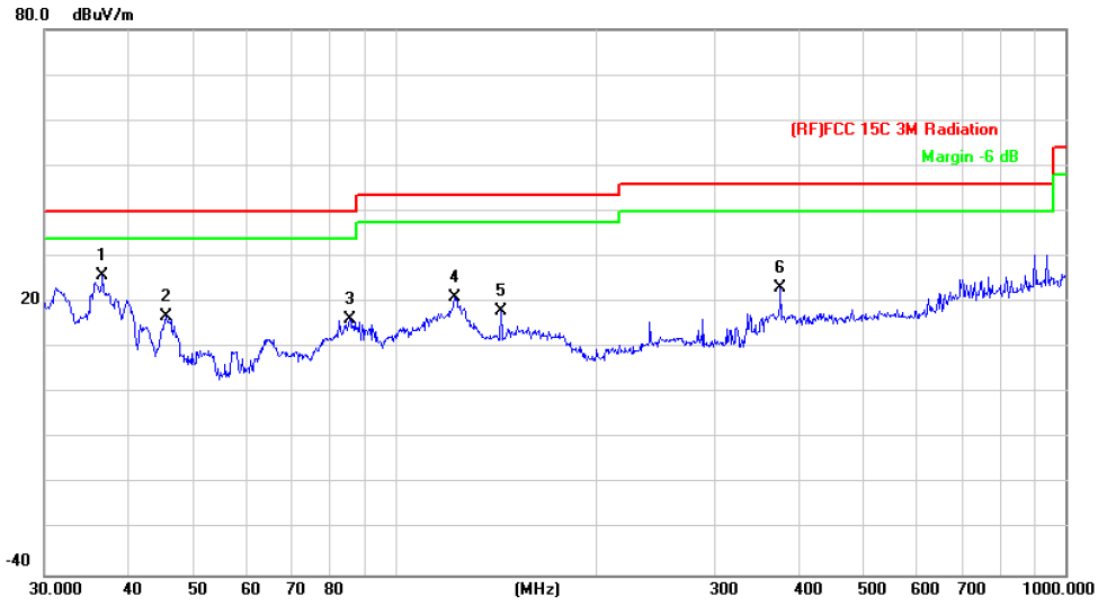


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		35.8746	36.70	-17.60	19.10	40.00	-20.90	peak
2		66.0340	38.25	-23.98	14.27	40.00	-25.73	peak
3		143.8291	37.05	-21.67	15.38	43.50	-28.12	peak
4		199.9856	34.31	-20.39	13.92	43.50	-29.58	peak
5		287.9904	35.59	-17.32	18.27	46.00	-27.73	peak
6	*	375.9384	40.78	-14.40	26.38	46.00	-19.62	peak

*:Maximum data x:Over limit !:over margin

Emission Level= Read Level+ Correct Factor

EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Vertical		
Test Mode:	TX 8-DPSK Mode 2402MHz		
Remark:	Only worse case is reported		

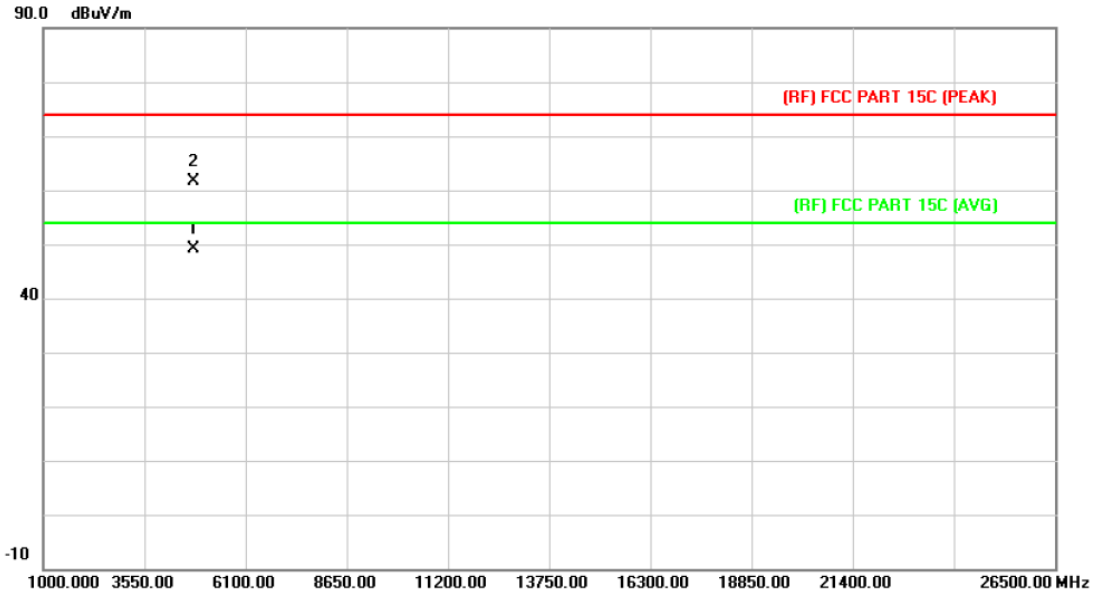


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	36.6375	43.96	-18.07	25.89	40.00	-14.11	peak
2		45.5347	39.40	-22.51	16.89	40.00	-23.11	peak
3		85.5977	39.11	-22.95	16.16	40.00	-23.84	peak
4		122.8340	43.44	-22.41	21.03	43.50	-22.47	peak
5		143.8291	39.81	-21.67	18.14	43.50	-25.36	peak
6		375.9384	37.45	-14.40	23.05	46.00	-22.95	peak

*:Maximum data x:Over limit !:over margin

Emission Level= Read Level+ Correct Factor

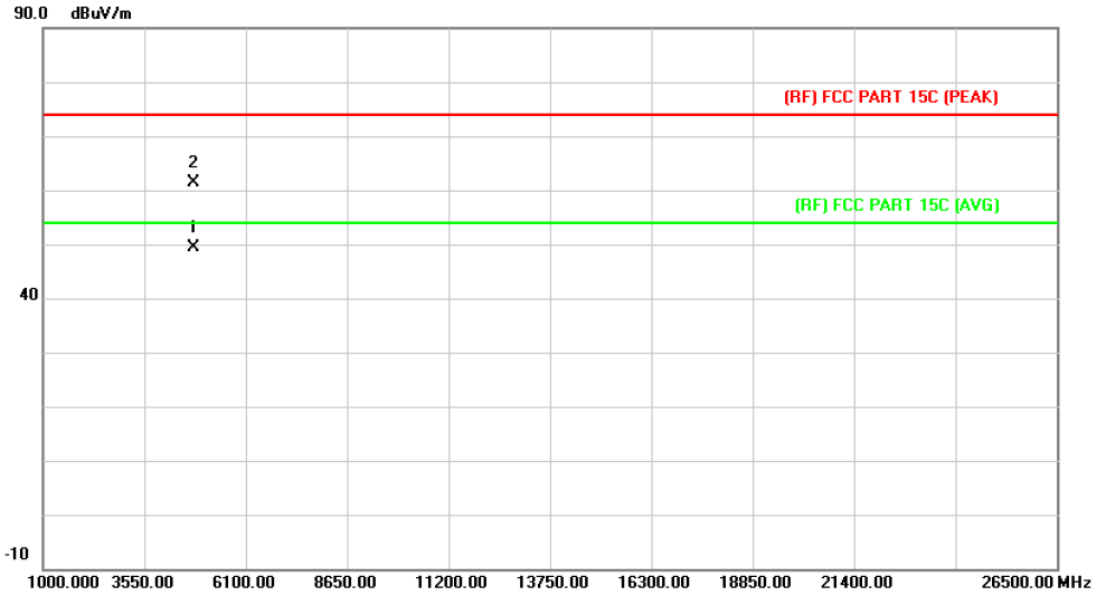
EUT:	WIRELESS SHOWER SPEAKER	**Model Name :**	F4056591
Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	DC 5V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2402MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4803.943	35.63	13.44	49.07	54.00	-4.93	AVG
2		4804.027	48.18	13.44	61.62	74.00	-12.38	peak

Emission Level= Read Level+ Correct Factor

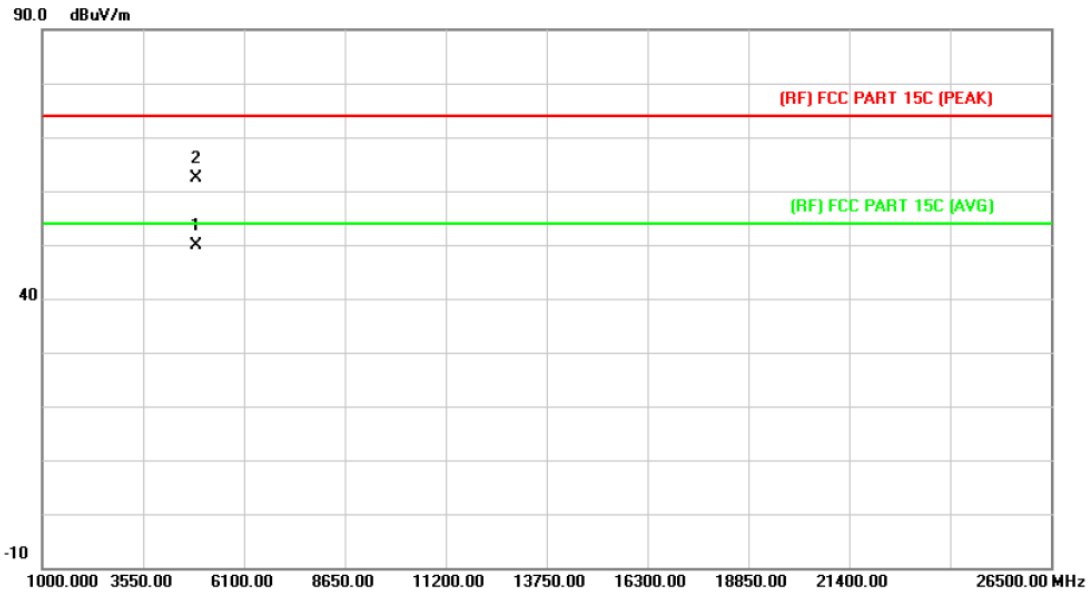
EUT:	WIRELESS SHOWER SPEAKER	**Model Name :**	F4056591
Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	DC 5V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2402MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4804.066	35.95	13.44	49.39	54.00	-4.61	AVG
2		4804.102	48.04	13.44	61.48	74.00	-12.52	peak

Emission Level= Read Level+ Correct Factor

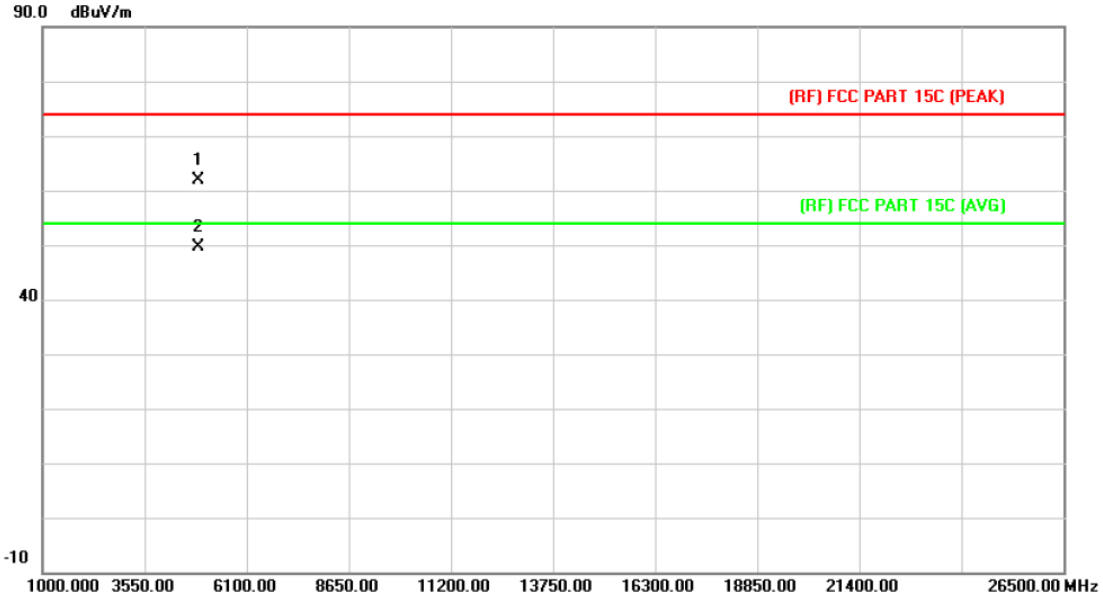
EUT:	WIRELESS SHOWER SPEAKER	**Model Name :**	F4056591
Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	DC 5V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2441MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4881.832	35.86	13.90	49.76	54.00	-4.24	AVG
2		4882.750	48.59	13.90	62.49	74.00	-11.51	peak

Emission Level= Read Level+ Correct Factor

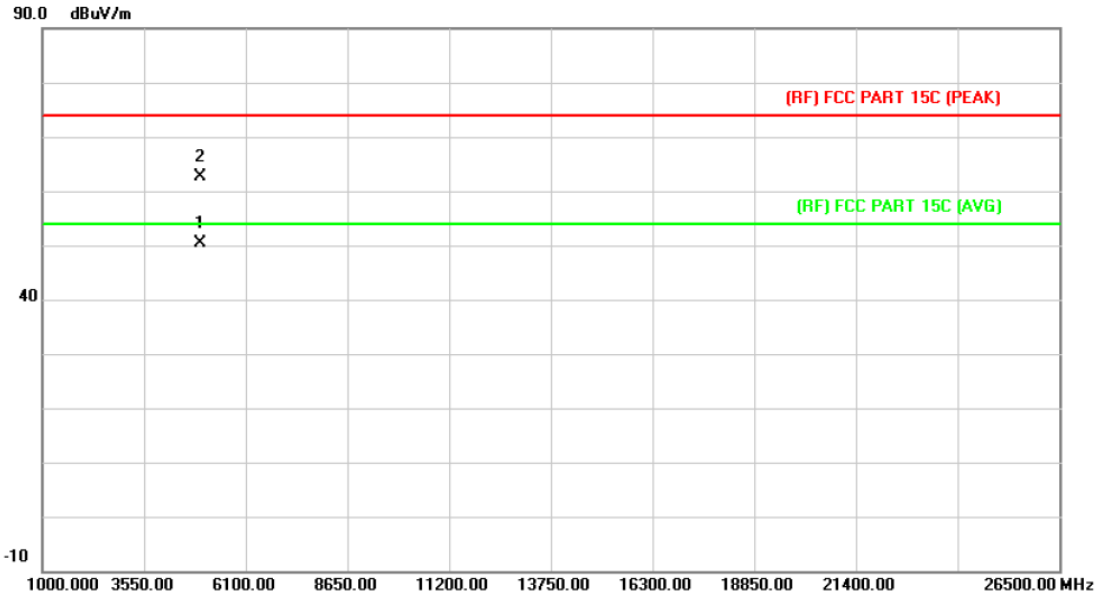
EUT:	WIRELESS SHOWER SPEAKER	**Model Name :**	F4056591
Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	DC 5V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2441MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4881.772	48.07	13.90	61.97	74.00	-12.03	peak
2	*	4881.844	35.72	13.90	49.62	54.00	-4.38	AVG

Emission Level= Read Level+ Correct Factor

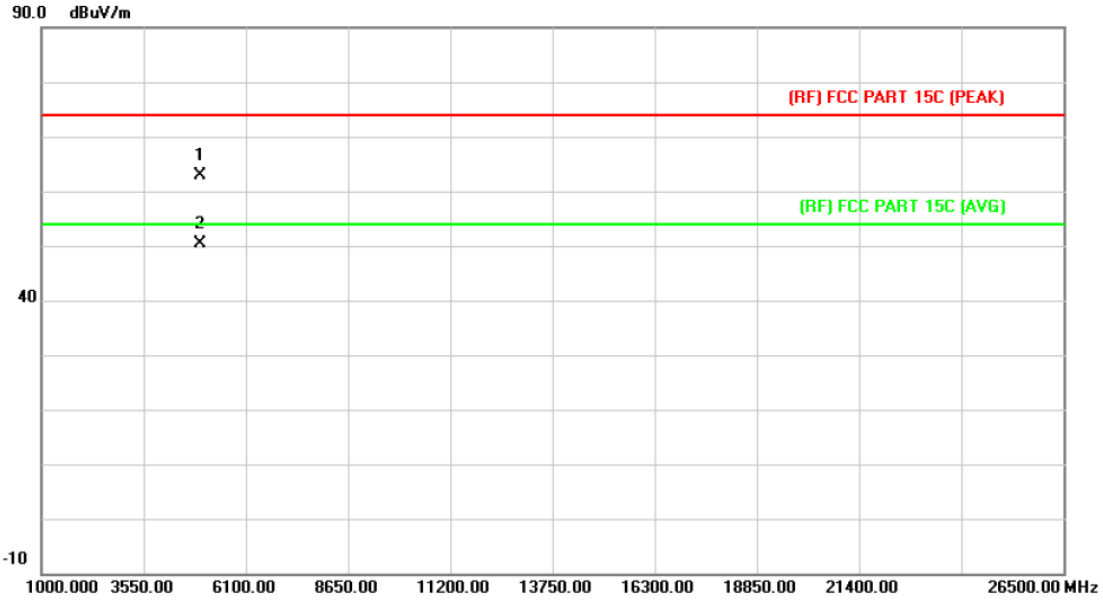
EUT:	WIRELESS SHOWER SPEAKER	**Model Name :**	F4056591
Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	DC 5V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2480MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4959.952	36.14	14.36	50.50	54.00	-3.50	AVG
2		4960.309	48.27	14.36	62.63	74.00	-11.37	peak

Emission Level= Read Level+ Correct Factor

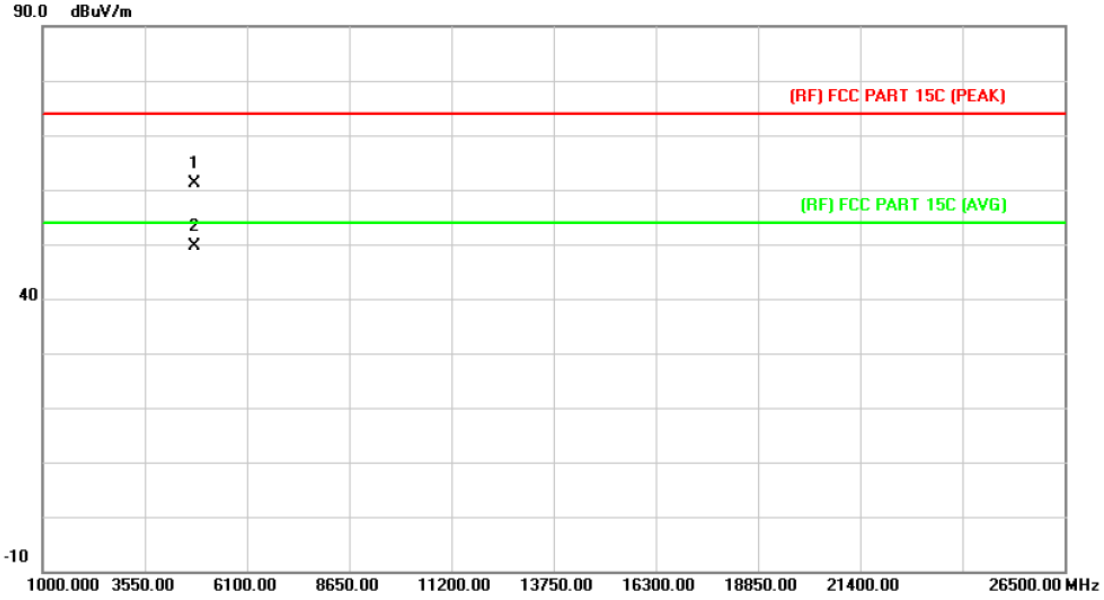
EUT:	WIRELESS SHOWER SPEAKER	**Model Name :**	F4056591
Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	DC 5V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2480MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4959.649	48.57	14.36	62.93	74.00	-11.07	peak
2	*	4960.063	35.99	14.36	50.35	54.00	-3.65	AVG

Emission Level= Read Level+ Correct Factor

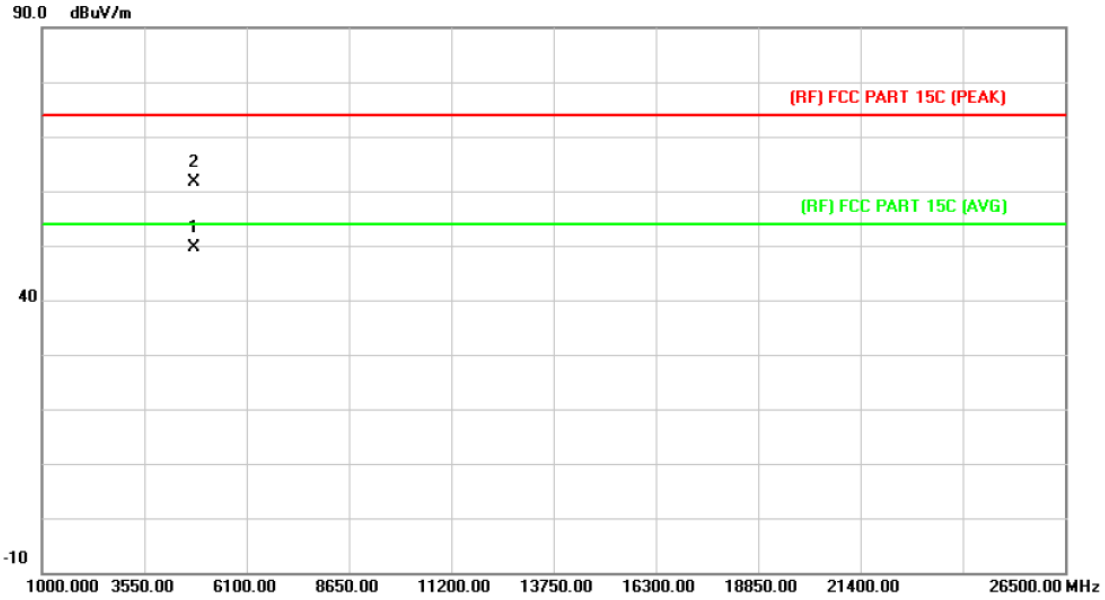
EUT:	WIRELESS SHOWER SPEAKER	**Model Name :**	F4056591
Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	DC 5V		
Ant. Pol.	Horizontal		
Test Mode:	TX 8-DPSK Mode 2402MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4803.889	47.61	13.44	61.05	74.00	-12.95	peak
2	*	4804.102	36.31	13.44	49.75	54.00	-4.25	AVG

Emission Level= Read Level+ Correct Factor

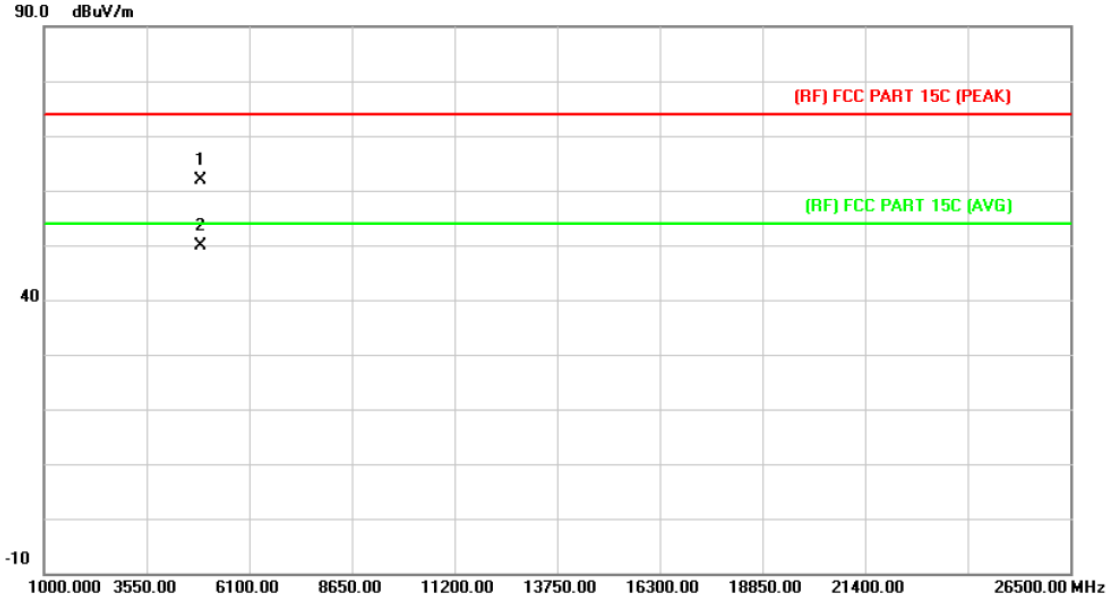
EUT:	WIRELESS SHOWER SPEAKER	**Model Name :**	F4056591
Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	DC 5V		
Ant. Pol.	Vertical		
Test Mode:	TX 8-DPSK Mode 2402MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4803.958	36.07	13.44	49.51	54.00	-4.49	AVG
2		4804.207	48.29	13.44	61.73	74.00	-12.27	peak

Emission Level= Read Level+ Correct Factor

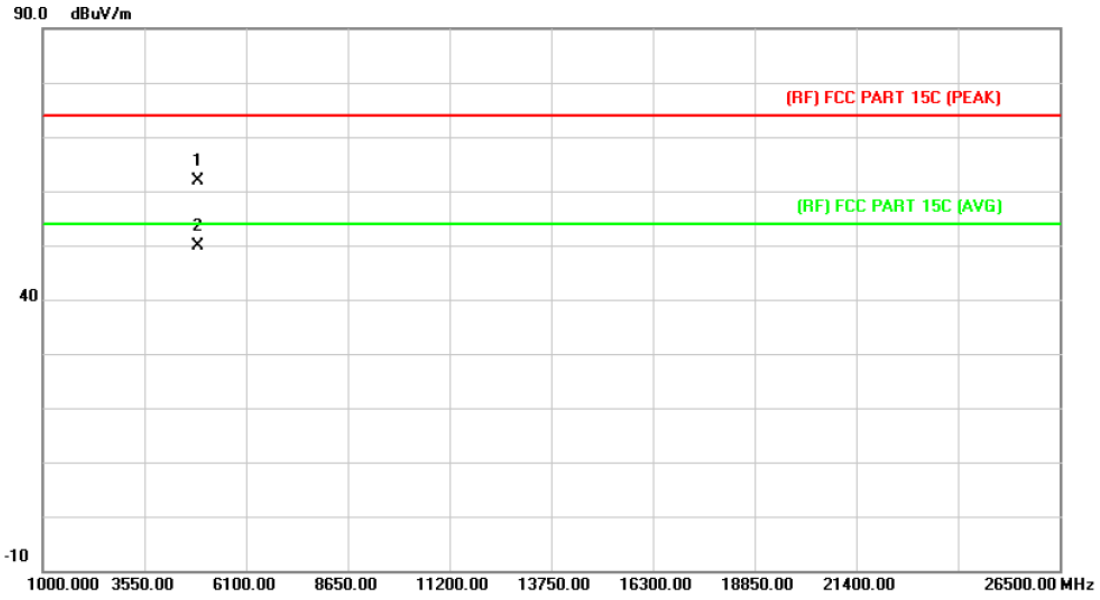
EUT:	WIRELESS SHOWER SPEAKER	**Model Name :**	F4056591
Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	DC 5V		
Ant. Pol.	Horizontal		
Test Mode:	TX 8-DPSK Mode 2441MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4881.838	48.10	13.90	62.00	74.00	-12.00	peak
2	*	4882.009	35.97	13.90	49.87	54.00	-4.13	AVG

Emission Level= Read Level+ Correct Factor

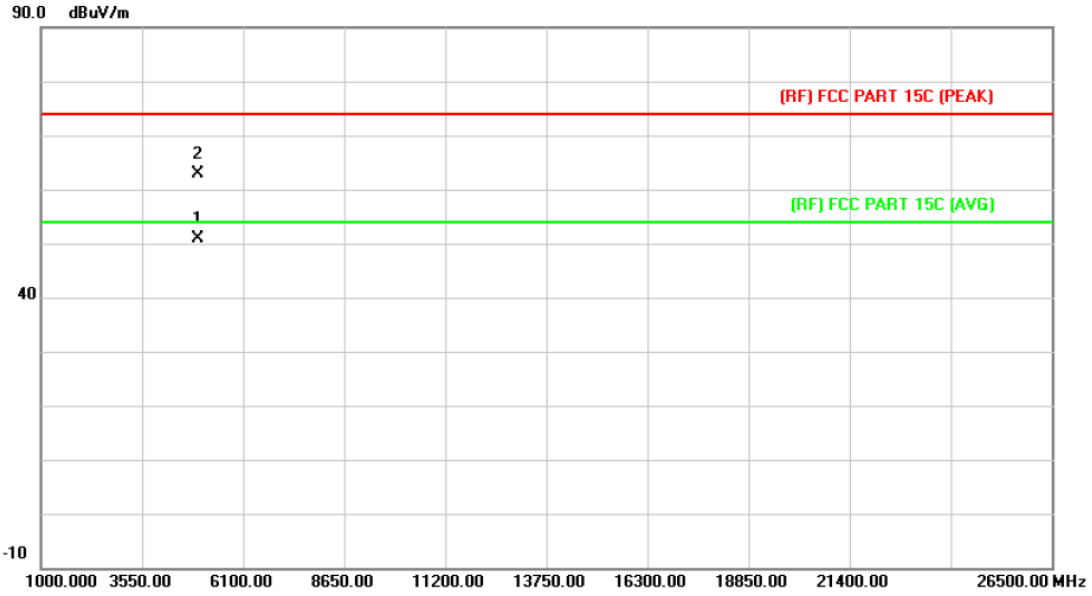
EUT:	WIRELESS SHOWER SPEAKER	**Model Name :**	F4056591
Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	DC 5V		
Ant. Pol.	Vertical		
Test Mode:	TX 8-DPSK Mode 2441MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4881.649	47.90	13.90	61.80	74.00	-12.20	peak
2	*	4882.126	36.02	13.90	49.92	54.00	-4.08	AVG

Emission Level= Read Level+ Correct Factor

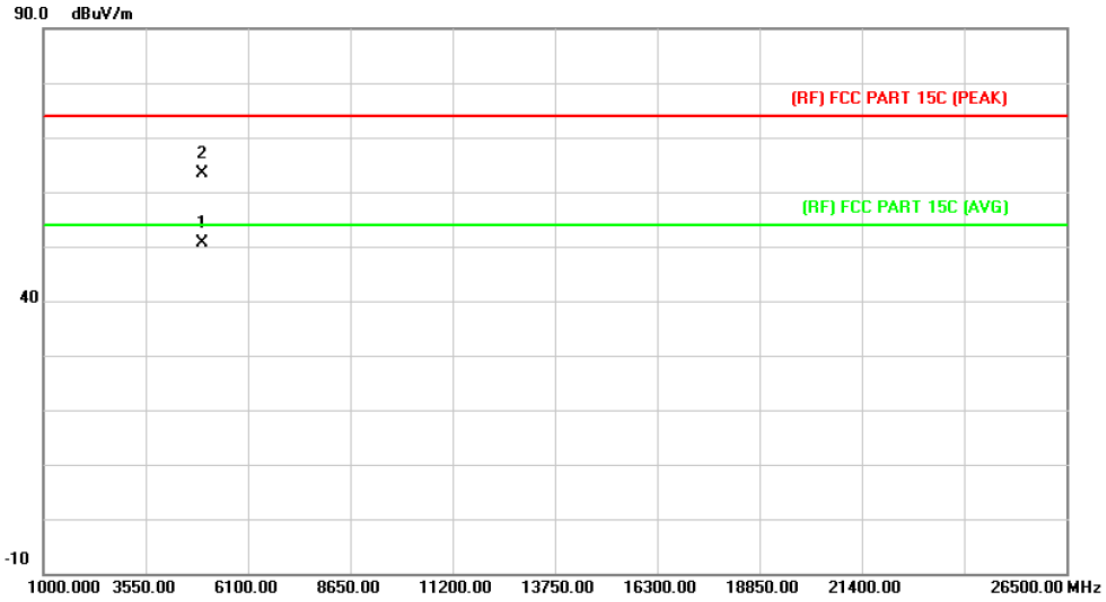
EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Horizontal		
Test Mode:	TX 8-DPSK Mode 2480MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4960.057	36.46	14.36	50.82	54.00	-3.18	AVG
2		4960.270	48.54	14.36	62.90	74.00	-11.10	peak

Emission Level= Read Level+ Correct Factor

EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Vertical		
Test Mode:	TX 8-DPSK Mode 2480MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4960.006	36.28	14.36	50.64	54.00	-3.36	AVG
2		4960.069	48.94	14.36	63.30	74.00	-10.70	peak

Emission Level= Read Level+ Correct Factor

6. Restricted Bands Requirement

6.1 Test Standard and Limit

6.1.1 Test Standard

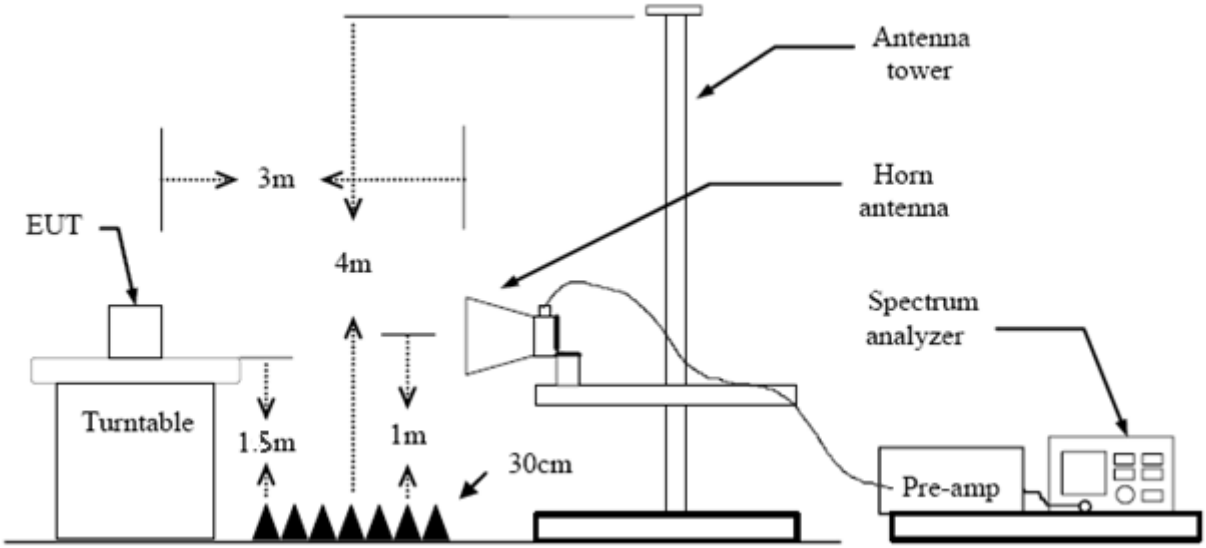
FCC Part 15.209

FCC Part 15.205

6.1.2 Test Limit

Restricted Frequency Band (MHz)	Class B (dBuV/m)(at 3m)	
	Peak	Average
2310 ~2390	74	54
2483.5 ~2500	74	54
Note: All restriction bands have been tested, only the worst case is reported.		

6.2 Test Setup



6.3 Test Procedure

(1) The measuring distance of 3m shall be used for measurements at frequency up to 1GHz and above 1 GHz. The EUT was placed on a rotating 0.8m high above ground, the table was rotated 360 degrees to determine the position of the highest radiation.

(2) Measurements at frequency above 1GHz. The EUT was placed on a rotating 1.5m high above the ground. RF absorbers covered the ground plane with a minimum area of 3.0m by 3.0m between the EUT and measurement receiver antenna. The RF absorber shall not exceed 30cm in high above the conducting floor. The table was rotated 360 degrees to determine the position of the highest radiation.

(3) The Test antenna shall vary between 1m and 4m, Both Horizontal and Vertical antenna are set to make measurement.
(4) The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
(5) If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit Bellow 1 GHz, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed. But the Peak Value and average value both need to comply with applicable limit above 1 GHz.
(6) Testing frequency range below 1GHz the measuring instrument use VBW=120 kHz with Quasi-peak detection.
(7) Testing frequency range above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=10 Hz with Peak Detector for Average Values.
(8) For the actual test configuration, please see the test setup photo.

6.4 EUT Operating Condition

The Equipment Under Test was set to Continual Transmitting in maximum power.

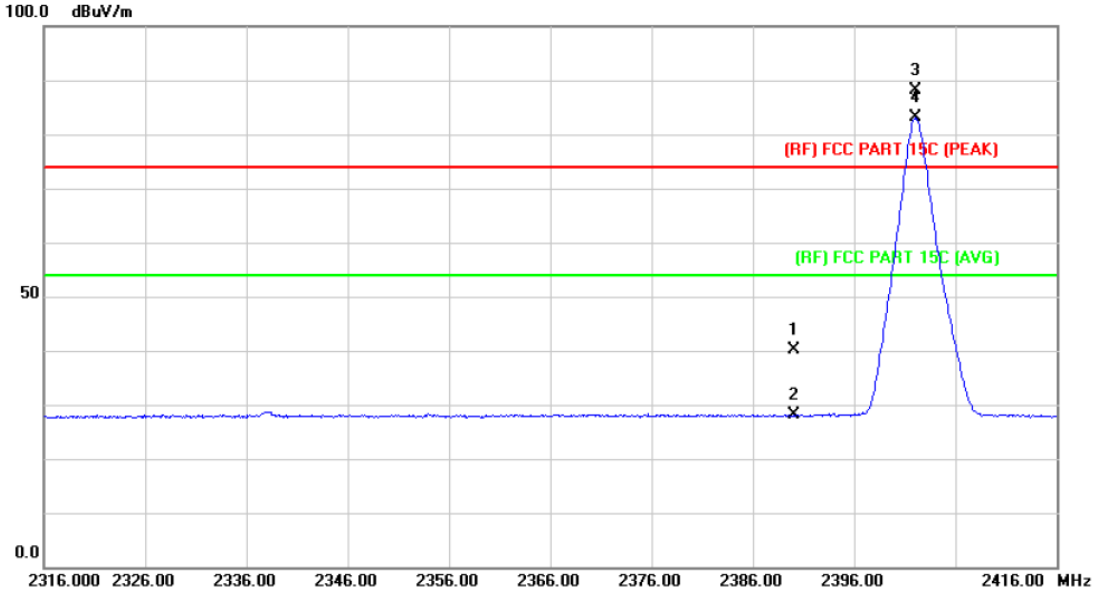
6.4 Test Data

Remark: During testing above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=1 KHz with Peak Detector for Average Values.

All restriction bands have been tested, only the worst case is reported.

(1) Radiation Test

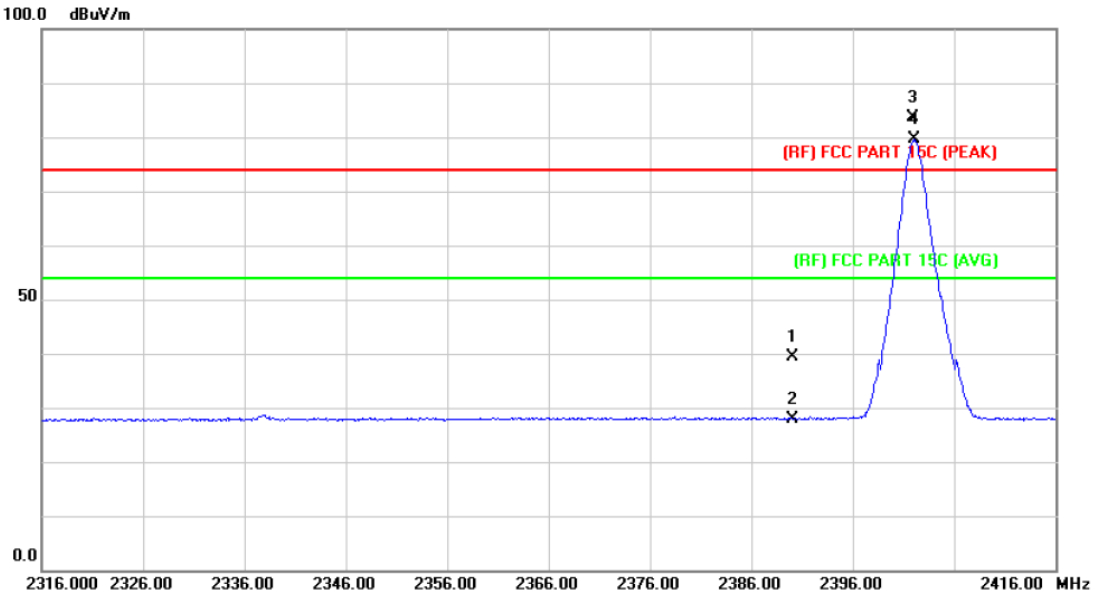
EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2402MHz		
Remark:	N/A		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	39.41	0.77	40.18	74.00	-33.82	peak
2		2390.000	27.26	0.77	28.03	54.00	-25.97	AVG
3	X	2402.000	87.39	0.82	88.21	Fundamental Frequency		peak
4	*	2402.100	82.20	0.82	83.02	Fundamental Frequency		AVG

Emission Level= Read Level+ Correct Factor

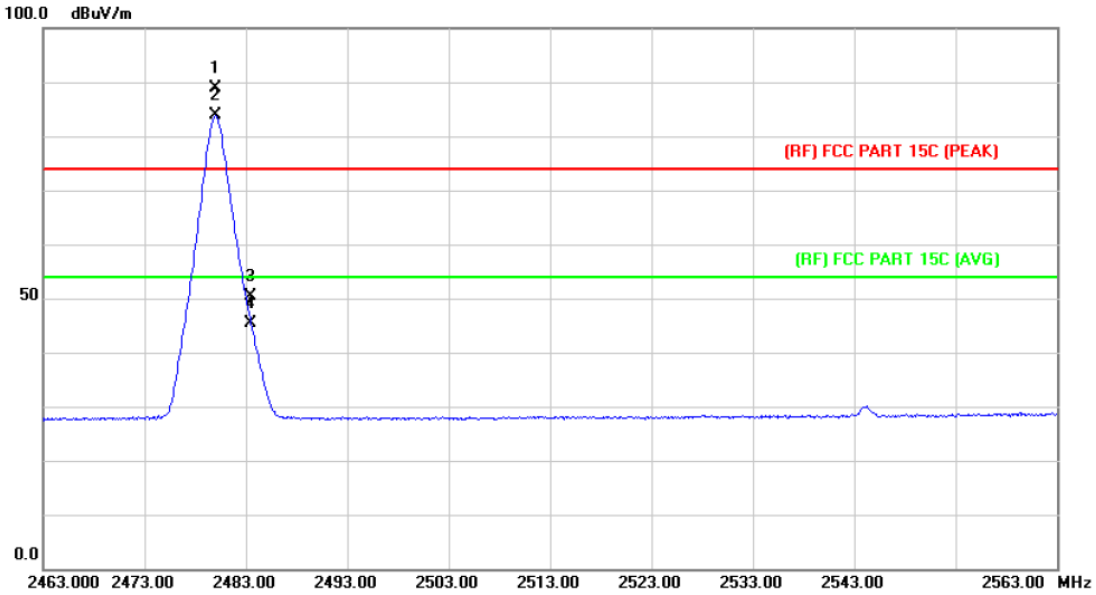
EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2402MHz		
Remark:	N/A		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	38.54	0.77	39.31	74.00	-34.69	peak
2		2390.000	27.13	0.77	27.90	54.00	-26.10	AVG
3	X	2401.900	82.87	0.82	83.69	Fundamental Frequency		peak
4	*	2402.000	78.78	0.82	79.60	Fundamental Frequency		AVG

Emission Level= Read Level+ Correct Factor

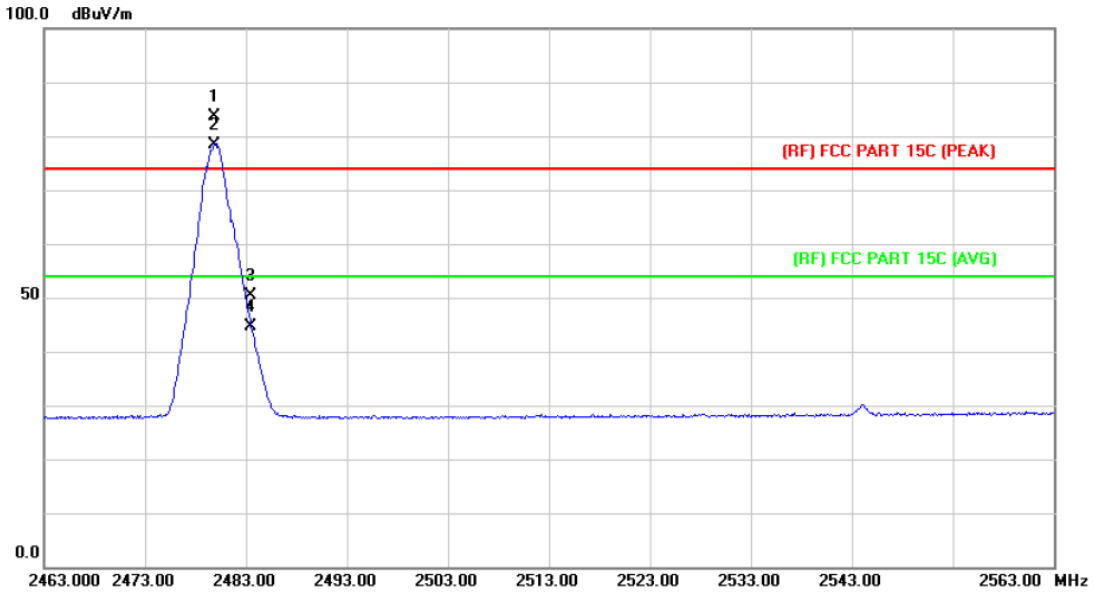
EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2480 MHz		
Remark:	N/A		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	X	2480.000	87.79	1.15	88.94	Fundamental Frequency		peak
2	*	2480.000	82.66	1.15	83.81	Fundamental Frequency		AVG
3		2483.500	49.24	1.17	50.41	74.00	-23.59	peak
4		2483.500	44.27	1.17	45.44	54.00	-8.56	AVG

Emission Level= Read Level+ Correct Factor

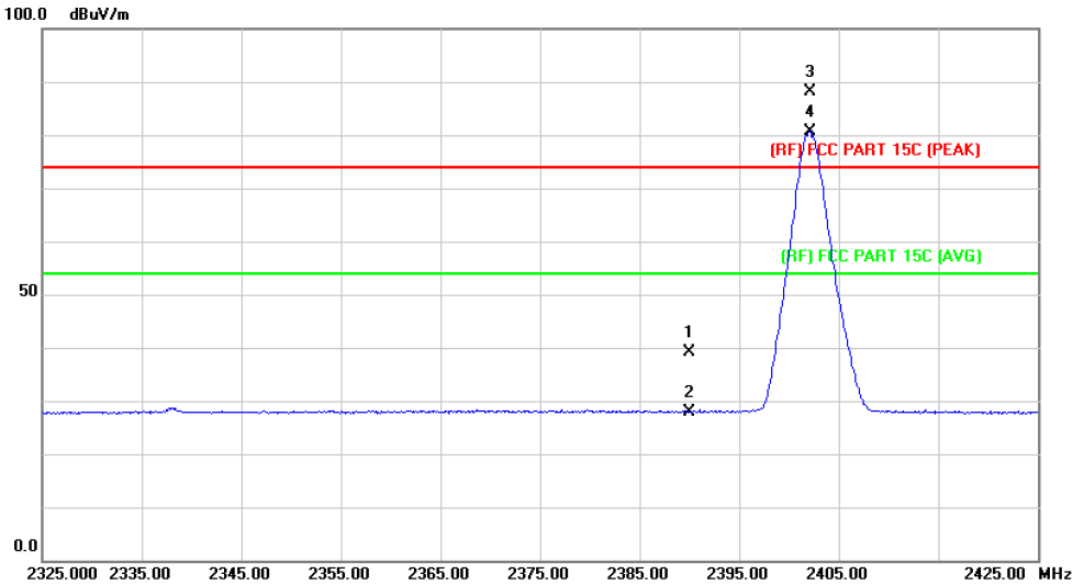
EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2480 MHz		
Remark:	N/A		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	X	2479.900	82.59	1.15	83.74	Fundamental Frequency		peak
2	*	2479.900	77.20	1.15	78.35	Fundamental Frequency		AVG
3		2483.500	49.23	1.17	50.40	74.00	-23.60	peak
4		2483.500	43.51	1.17	44.68	54.00	-9.32	AVG

Emission Level= Read Level+ Correct Factor

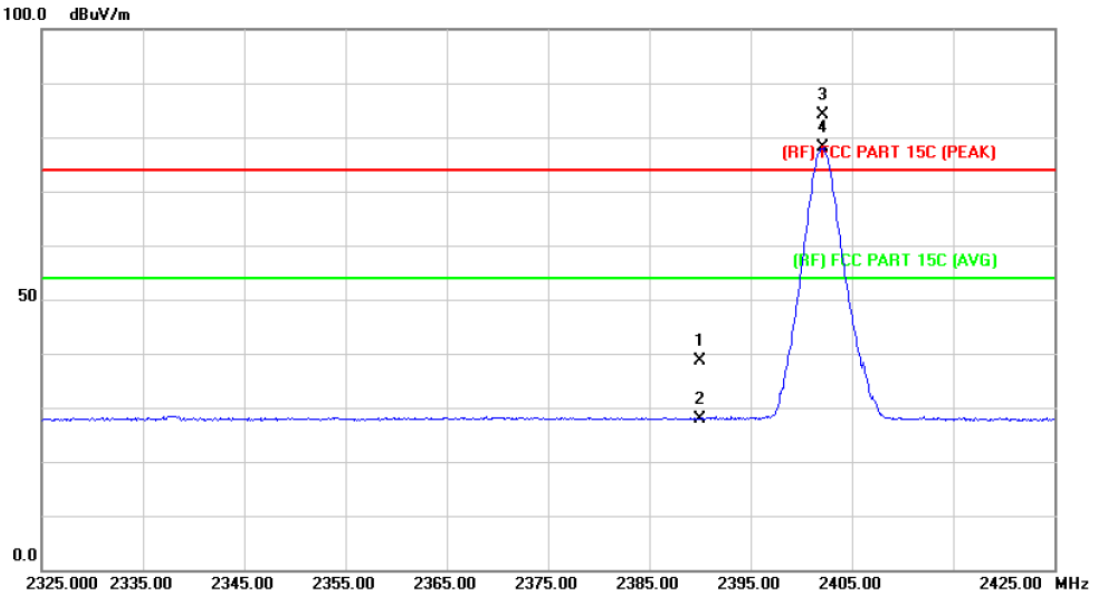
EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Horizontal		
Test Mode:	TX 8-DPSK Mode 2402MHz		
Remark:	N/A		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	38.31	0.77	39.08	74.00	-34.92	peak
2		2390.000	27.15	0.77	27.92	54.00	-26.08	AVG
3	X	2402.100	87.39	0.82	88.21	Fundamental Frequency		peak
4	*	2402.100	79.89	0.82	80.71	Fundamental Frequency		AVG

Emission Level= Read Level+ Correct Factor

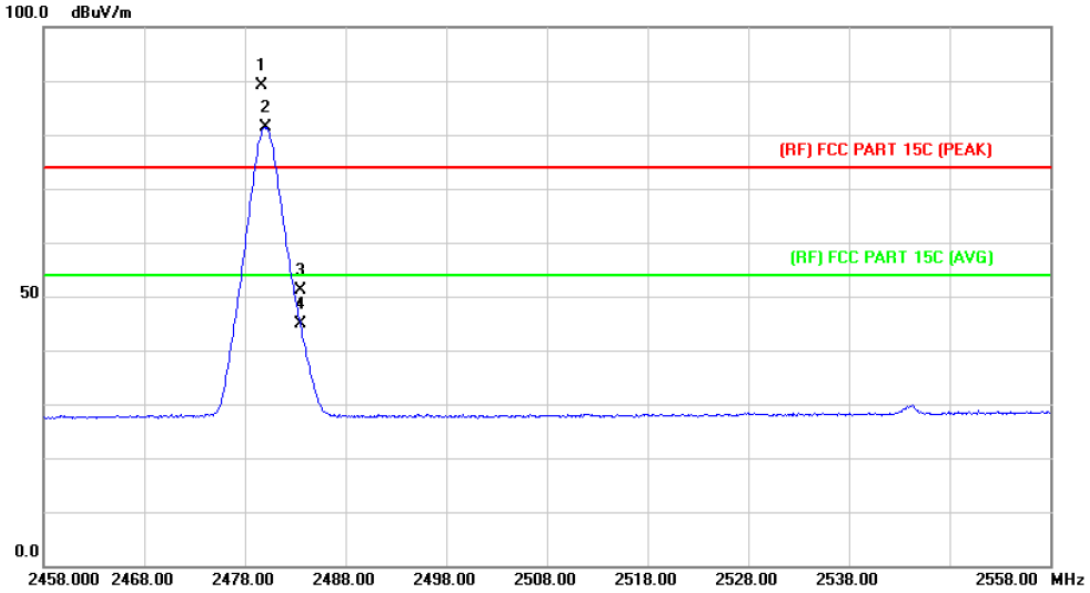
EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Vertical		
Test Mode:	TX 8-DPSK Mode 2402MHz		
Remark:	N/A		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	37.78	0.77	38.55	74.00	-35.45	peak
2		2390.000	27.23	0.77	28.00	54.00	-26.00	AVG
3	X	2402.100	83.43	0.82	84.25	Fundamental Frequency		peak
4	*	2402.200	77.24	0.82	78.06	Fundamental Frequency		AVG

Emission Level= Read Level+ Correct Factor

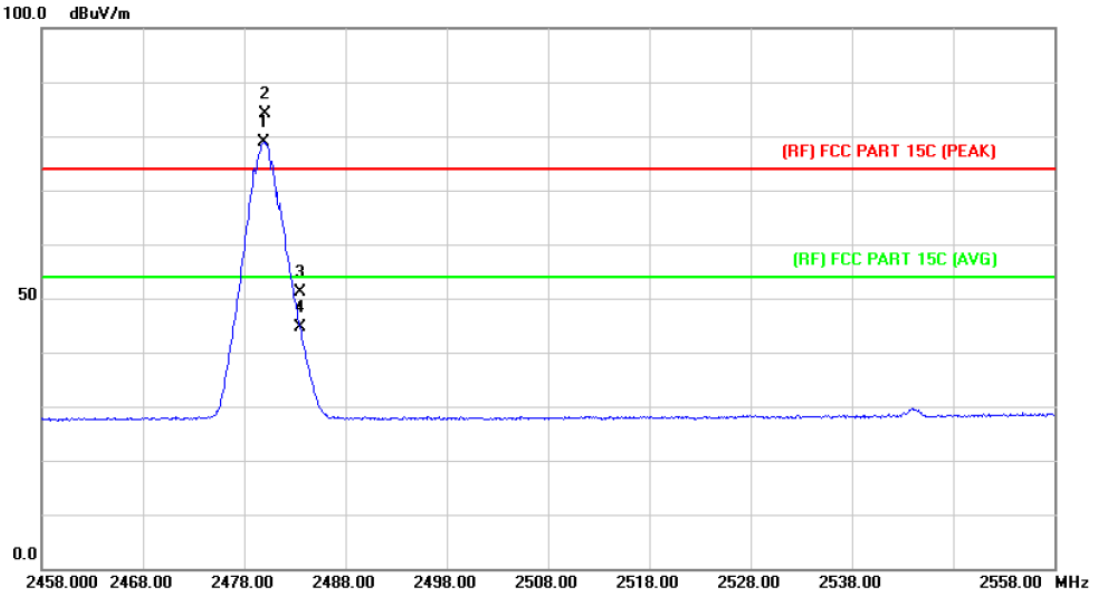
EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Horizontal		
Test Mode:	TX 8-DPSK Mode 2480MHz		
Remark:	N/A		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	X	2479.700	88.02	1.15	89.17	Fundamental Frequency		peak
2	*	2480.000	80.24	1.15	81.39	Fundamental Frequency		AVG
3		2483.500	49.90	1.17	51.07	74.00	-22.93	peak
4		2483.500	43.64	1.17	44.81	54.00	-9.19	AVG

Emission Level= Read Level+ Correct Factor

EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 5V		
Ant. Pol.	Vertical		
Test Mode:	TX 8-DPSK Mode 2480MHz		
Remark:	N/A		

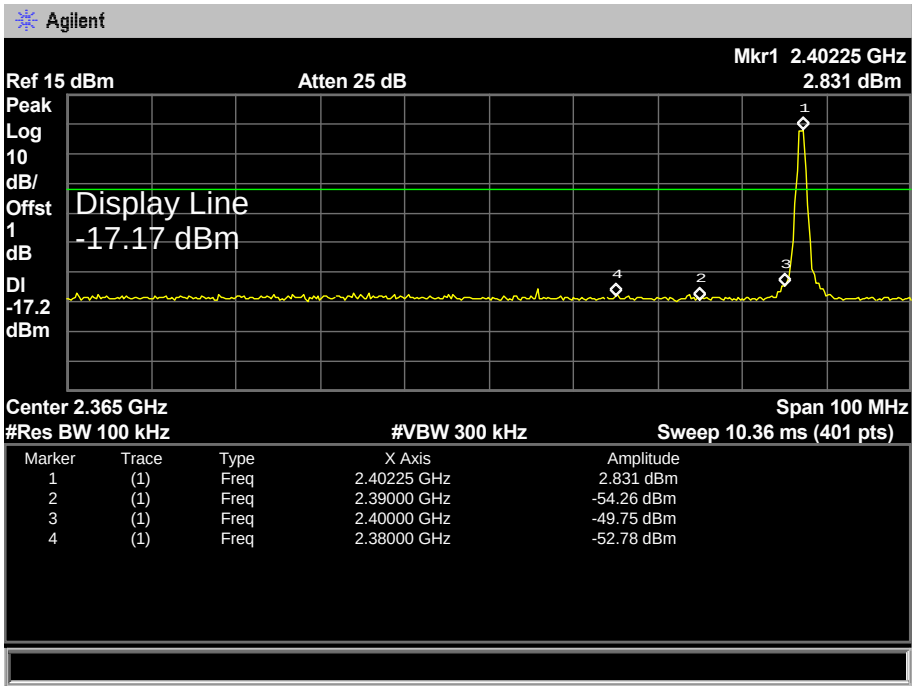


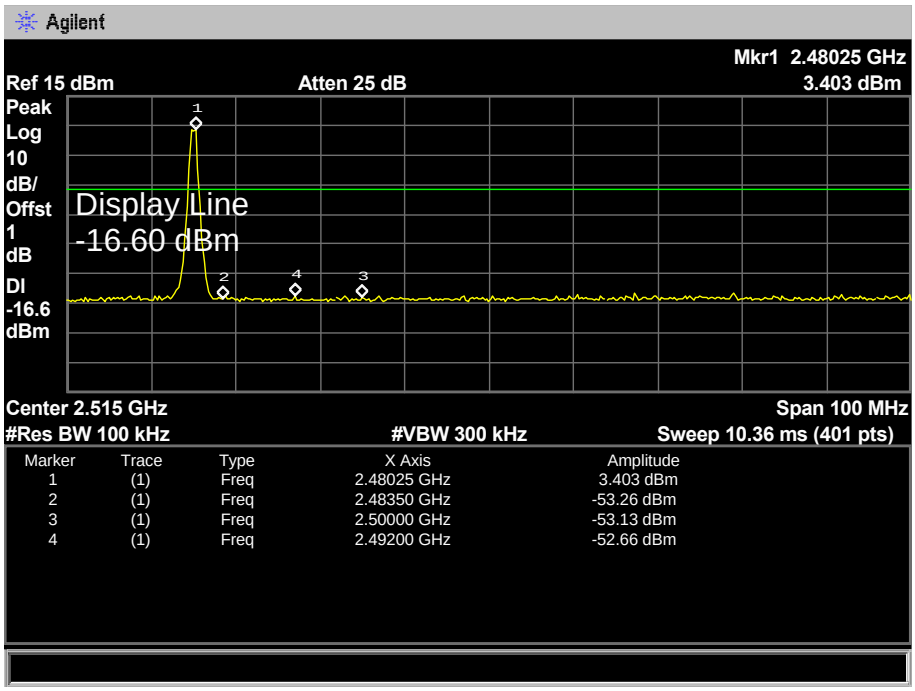
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	2479.900	77.74	1.15	78.89	Fundamental Frequency		AVG
2	X	2480.100	83.09	1.15	84.24	Fundamental Frequency		peak
3		2483.500	49.87	1.17	51.04	74.00	-22.96	peak
4		2483.500	43.42	1.17	44.59	54.00	-9.41	AVG

Emission Level= Read Level+ Correct Factor

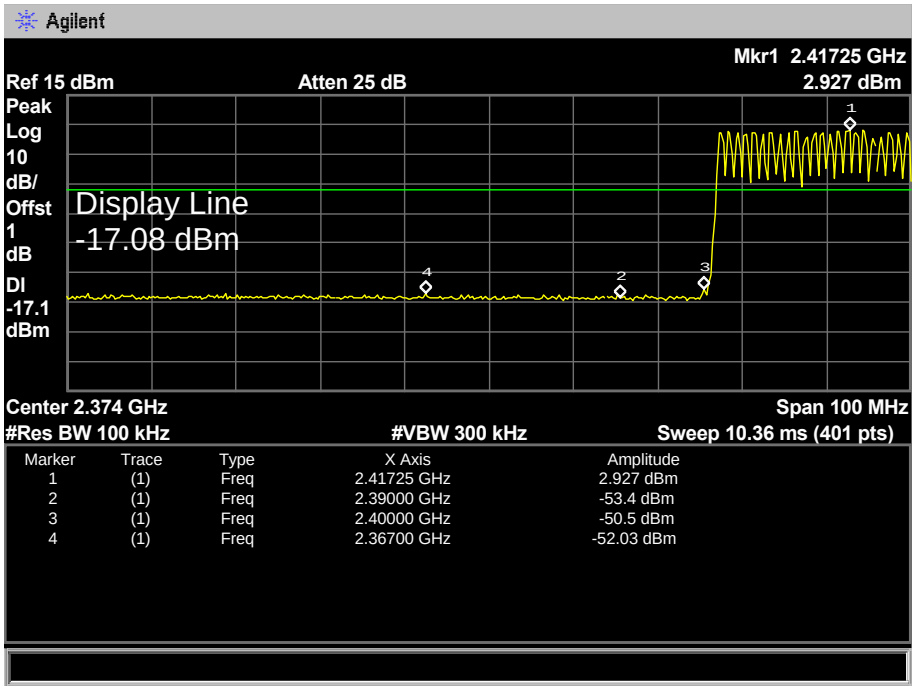
(2) Conducted Test

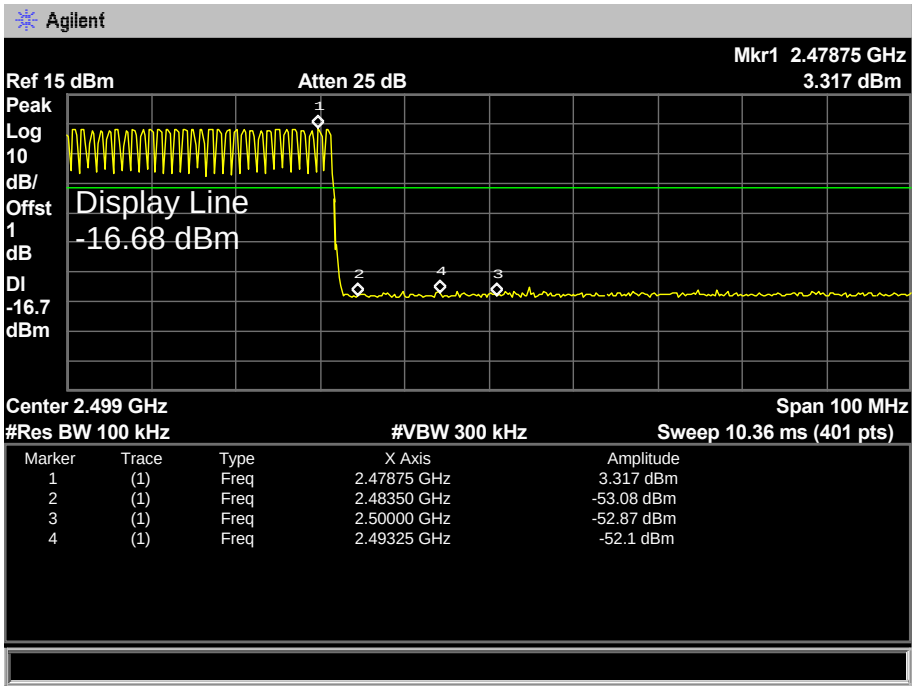
EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX GFSK Mode 2402MHz / 2480 MHz		
Remark:	N/A		



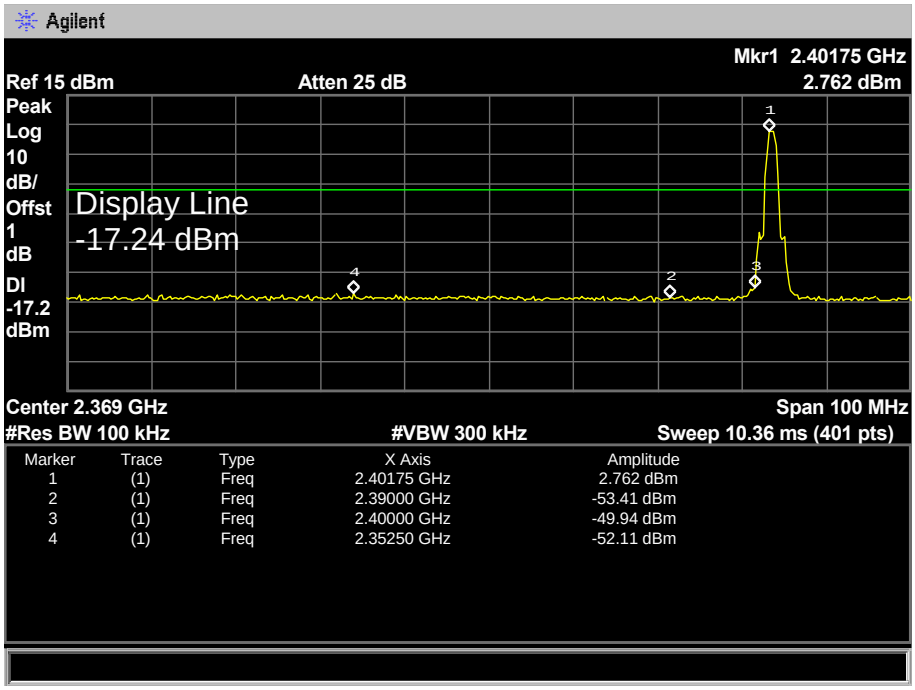


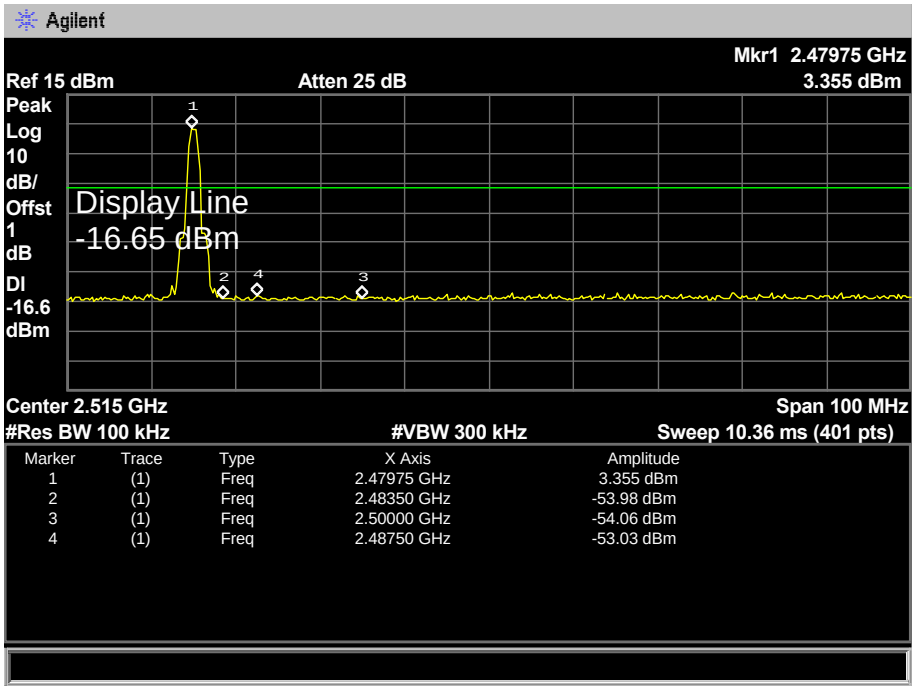
EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	GFSK Hopping Mode		
Remark:	N/A		



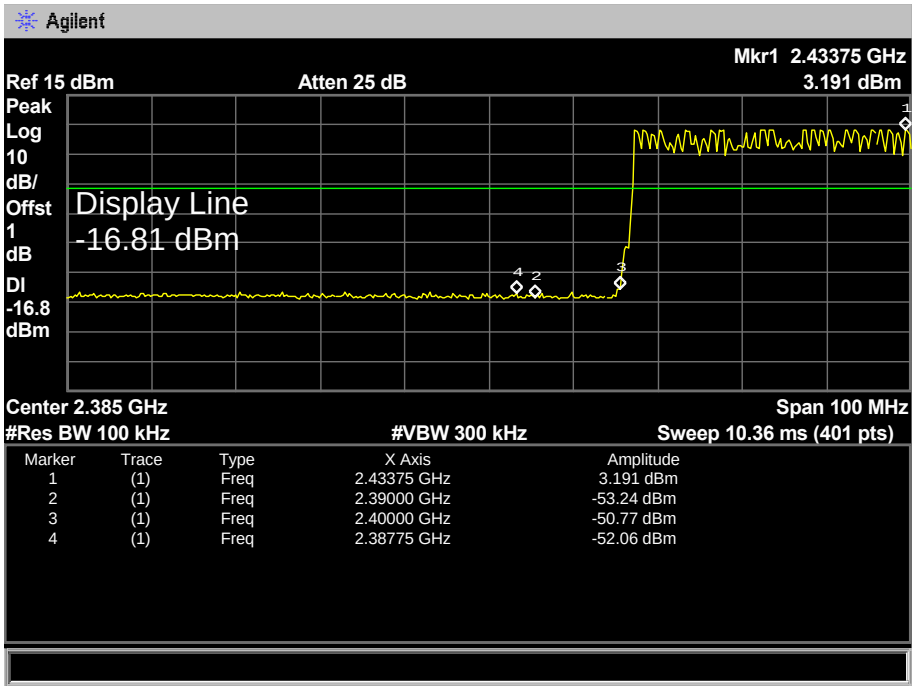


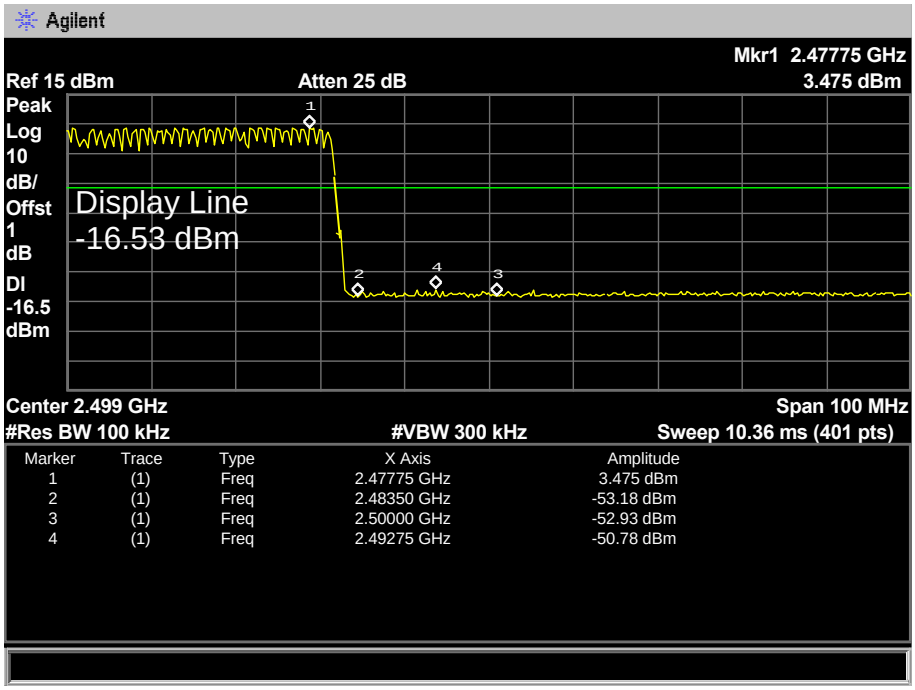
EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX 8-DPSK Mode 2402MHz / 2480 MHz		
Remark:	N/A		





EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	8-DPSK Hopping Mode		
Remark:	N/A		





7. Number of Hopping Channel

7.1 Test Standard and Limit

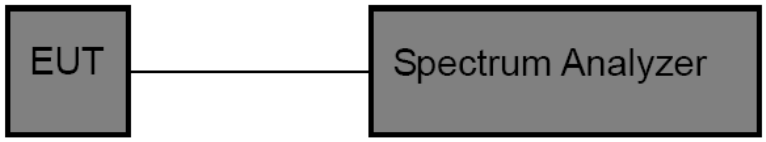
6.1.1 Test Standard

FCC Part 15.247 (a)(1)

6.1.2 Test Limit

Section	Test Item	Limit
15.247	Number of Hopping Channel	>15

7.2 Test Setup



7.3 Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

(2) Spectrum Setting: RBW=100 KHz, VBW=100 KHz, Sweep time= Auto.

7.4 EUT Operating Condition

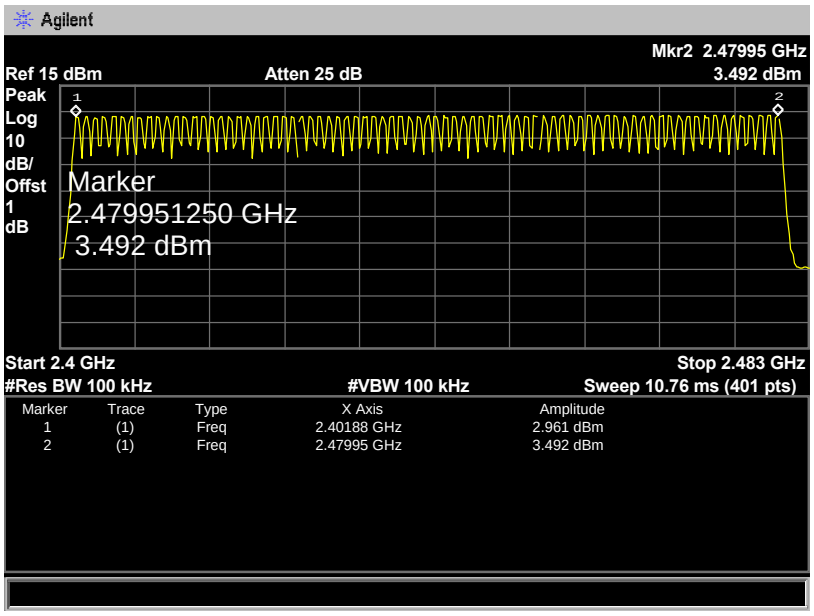
The EUT was set to the Hopping Mode by the Customer.

7.5 Test Data

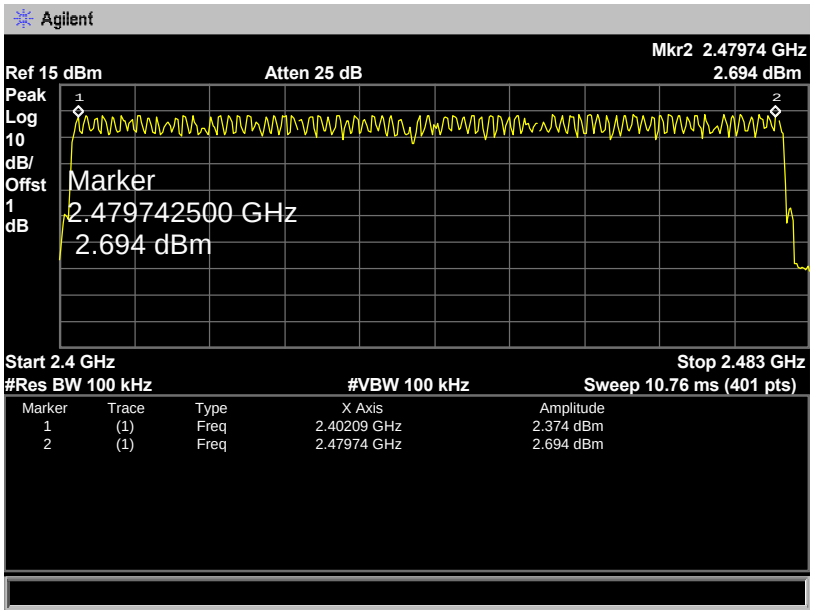
EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (GFSK/8-DPSK)		

Frequency Range	Quantity of Hopping Channel	Limit
2402MHz~2480MHz	79	>15
	79	

GFSK Mode



8-DPSK Mode



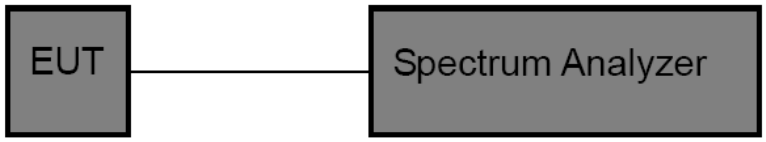
8. Average Time of Occupancy

8.1 Test Standard and Limit

8.1.1 Test Standard
FCC Part 15.247 (a)(1)
8.1.2 Test Limit

Section	Test Item	Limit
15.247(a)(1)/ RSS-210 Annex 8(A8.1d)	Average Time of Occupancy	0.4 sec

8.2 Test Setup



8.3 Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
(2) Spectrum Setting: RBW=1MHz, VBW=1MHz.
(3) Use video trigger with the trigger level set to enable triggering only on full pulses.
(4) Sweep Time is more than once pulse time.
(5) Set the center frequency on any frequency would be measure and set the frequency span to zero.
(6) Measure the maximum time duration of one single pulse.
(7) Set the EUT for packet transmitting.
(8) Measure the maximum time duration of one single pulse.

8.4 EUT Operating Condition

The EUT was set to the Hopping Mode by the Customer.

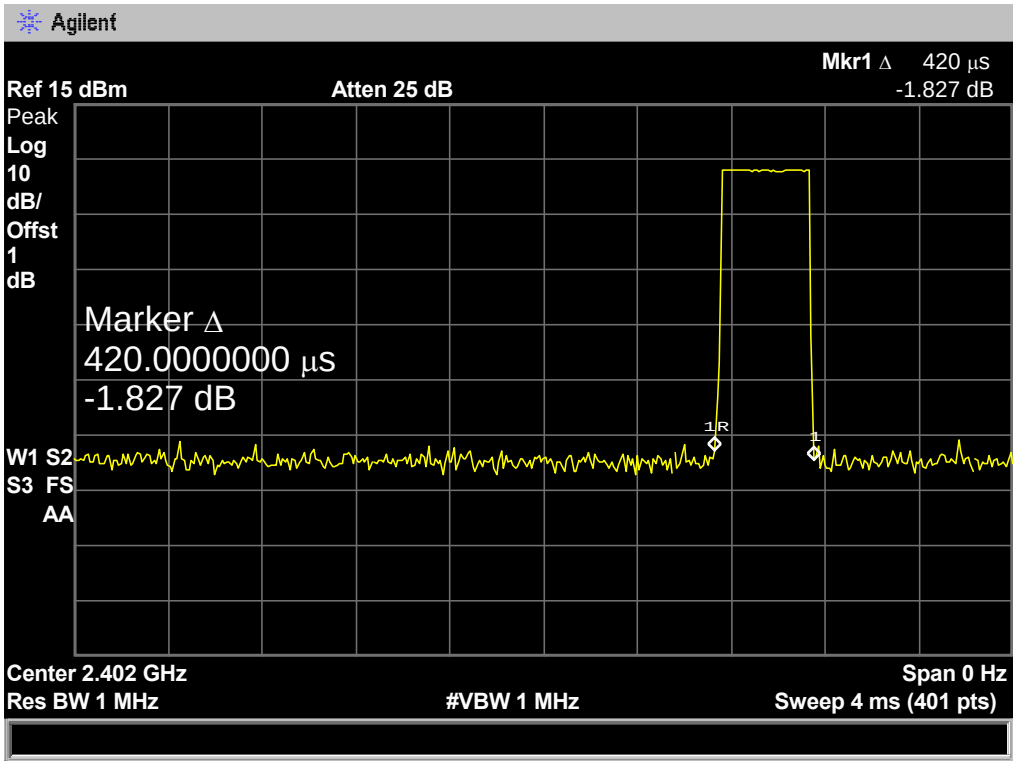
8.5 Test Data

EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (GFSK DH1)		

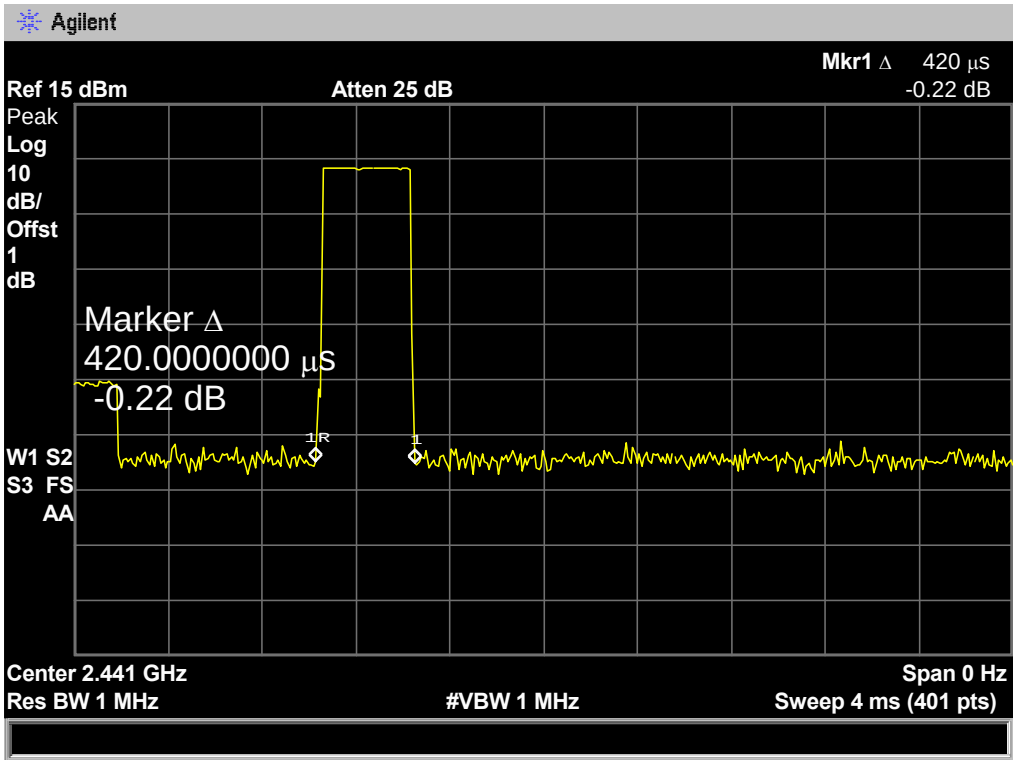
Channel (MHz)	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
2402	0.420	134.40	31.60	400	PASS
2441	0.420	134.40			
2480	0.430	137.60			

GFSK Hopping Mode DH1

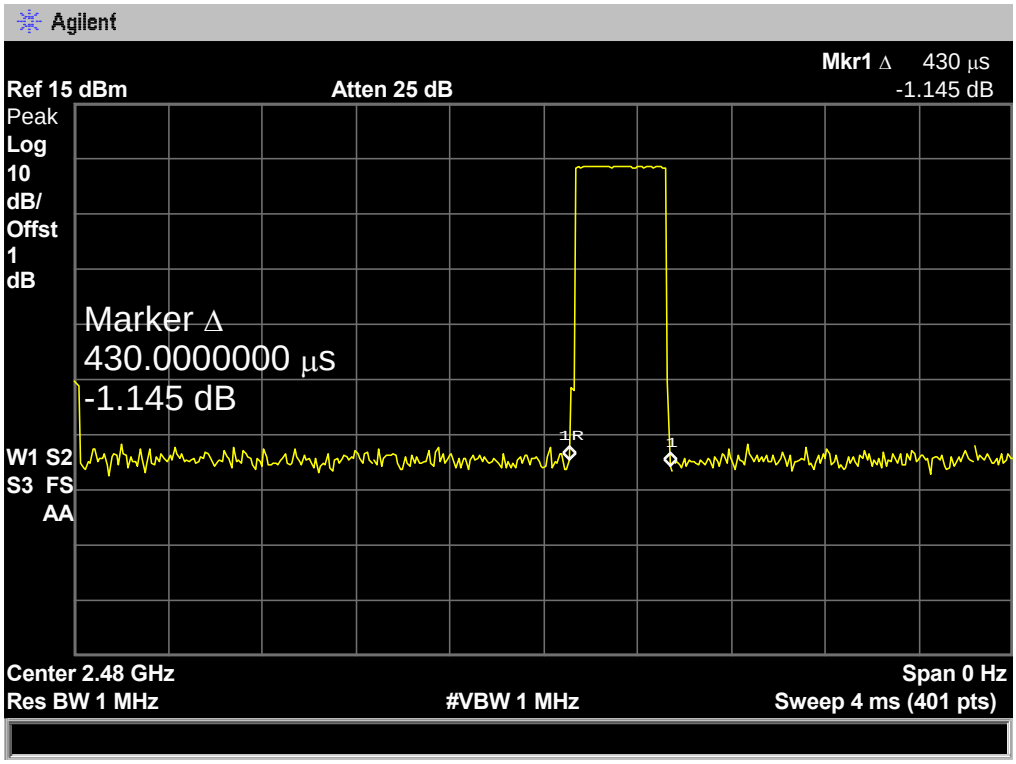
2402 MHz



GFSK Hopping Mode DH1
2441 MHz



GFSK Hopping Mode DH1
2480 MHz

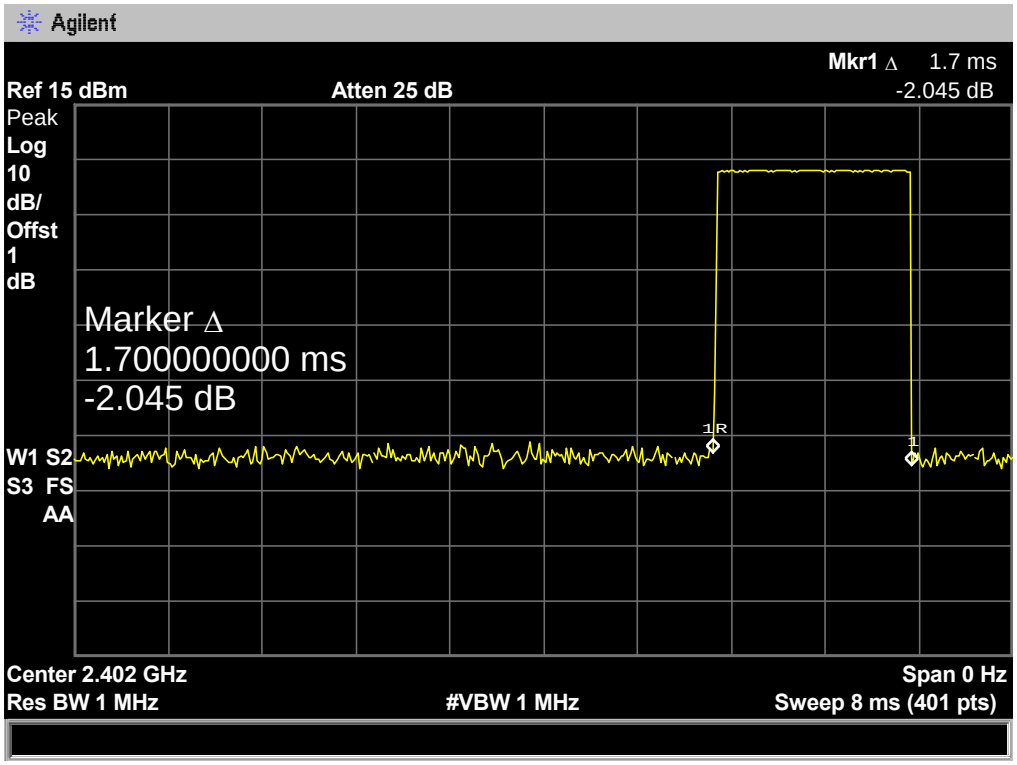


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (GFSK DH3)		

Channel (MHz)	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
2402	1.700	272.00	31.60	400	PASS
2441	1.700	272.00			
2480	1.700	272.00			

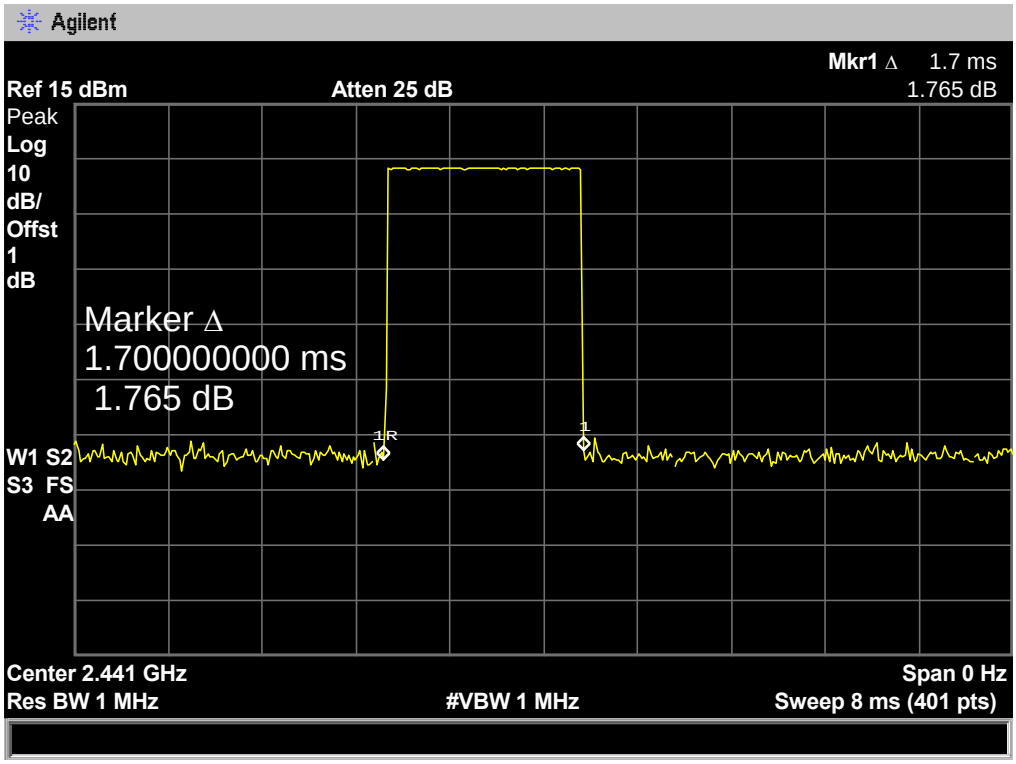
GFSK Hopping Mode DH3

2402 MHz



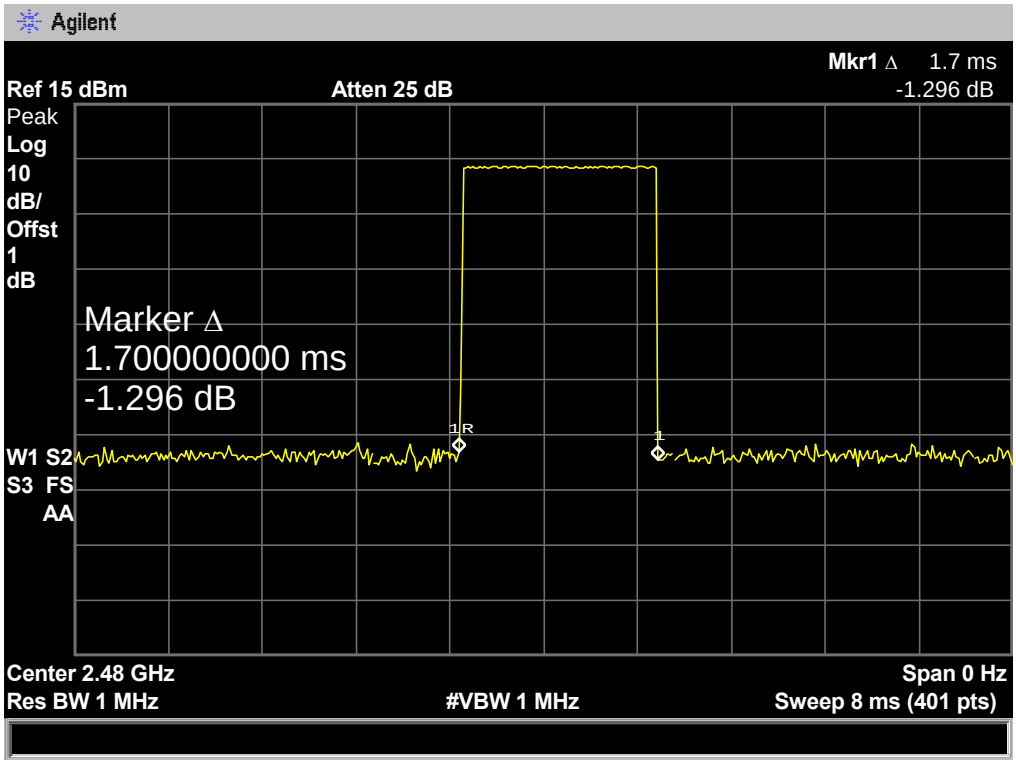
GFSK Hopping Mode DH3

2441 MHz



GFSK Hopping Mode DH3

2480 MHz

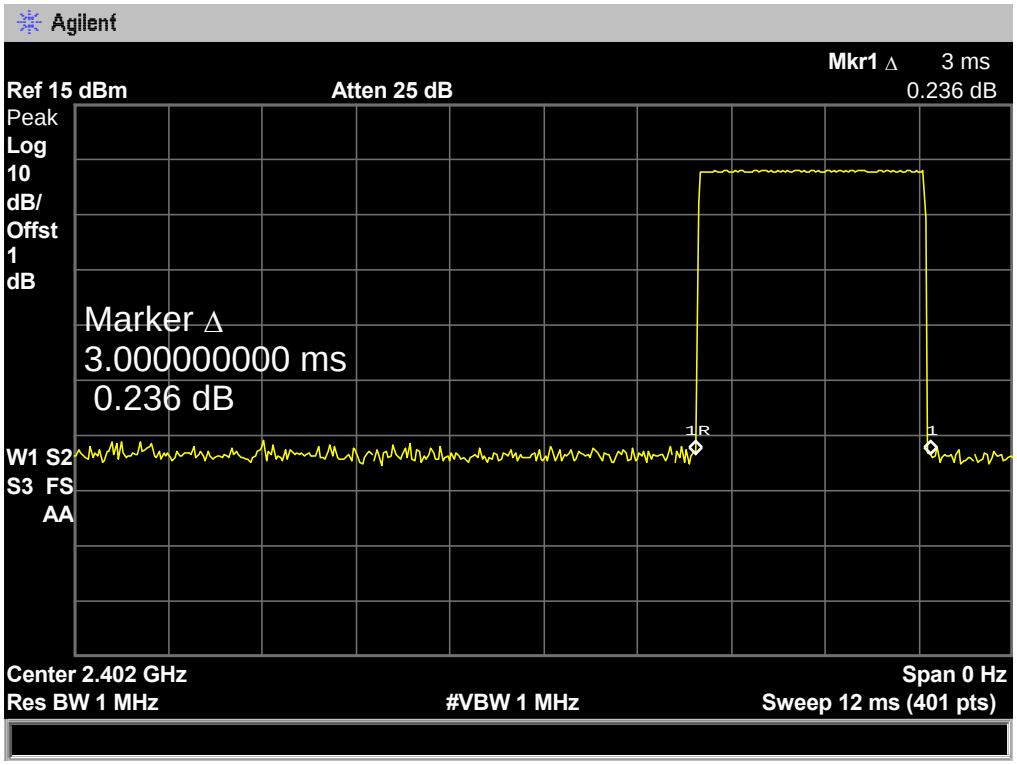


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (GFSK DH5)		

Channel (MHz)	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
2402	3.000	320.00	31.60	400	PASS
2441	3.000	320.00			
2480	3.000	320.00			

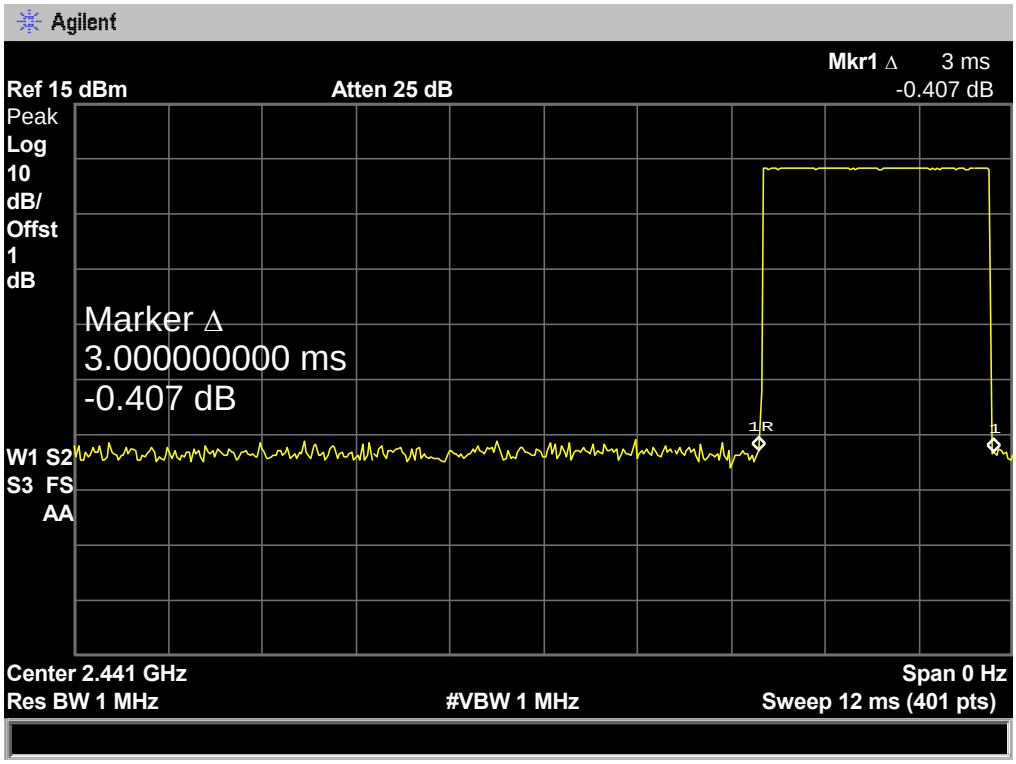
GFSK Hopping Mode DH5

2402 MHz



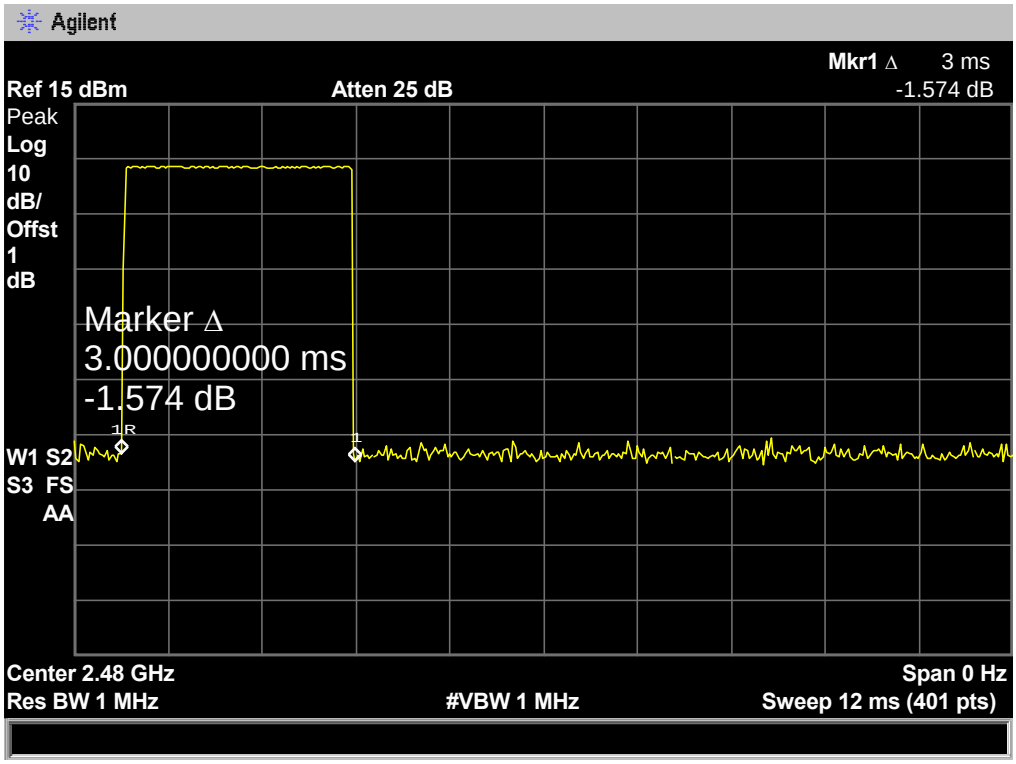
GFSK Hopping Mode DH5

2441 MHz



GFSK Hopping Mode DH5

2480 MHz

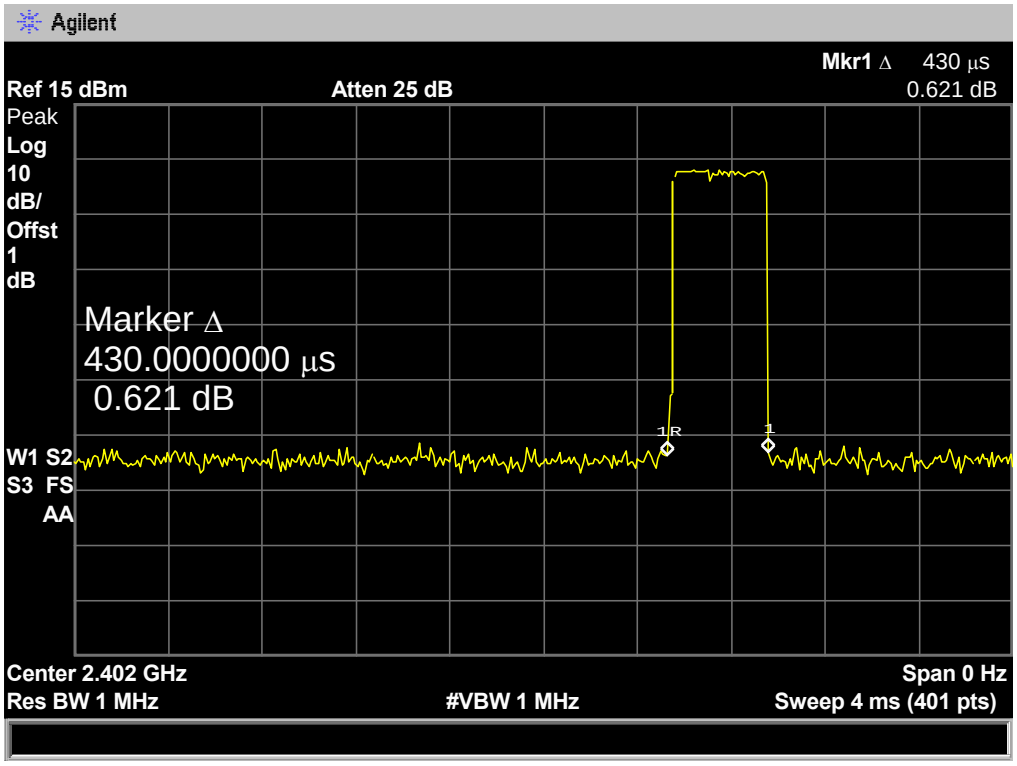


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (π/4-DQPSK DH1)		

Channel (MHz)	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
2402	0.430	137.60	31.60	400	PASS
2441	0.440	140.80			
2480	0.440	140.80			

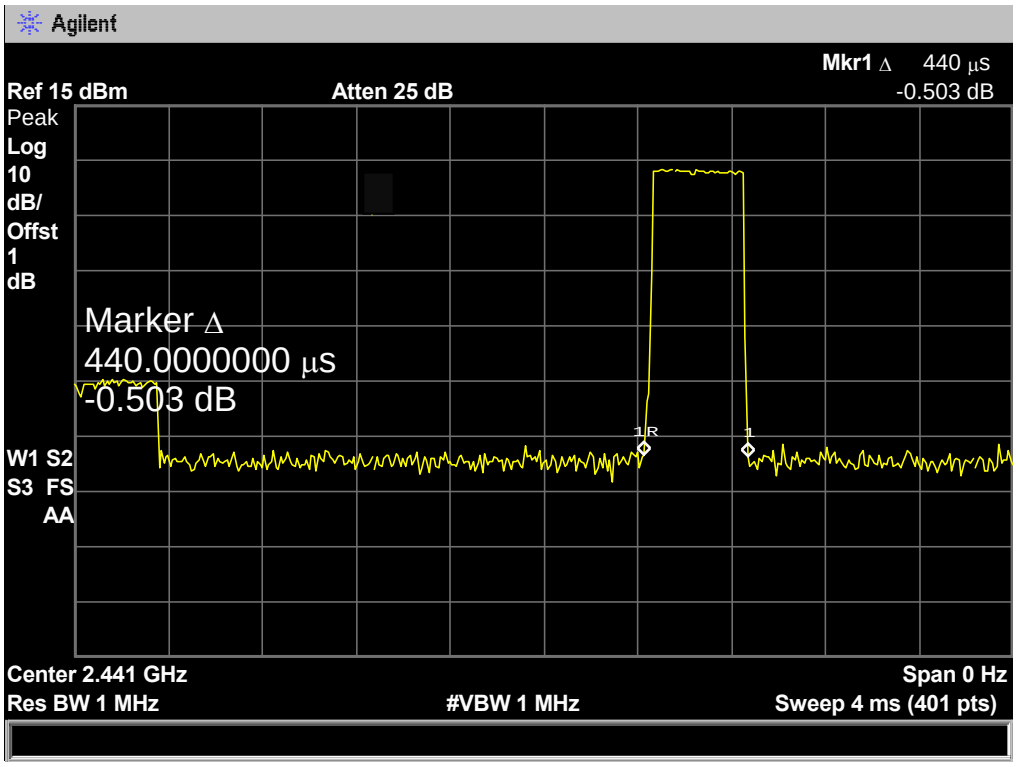
π/4-DQPSK Hopping Mode DH1

2402 MHz



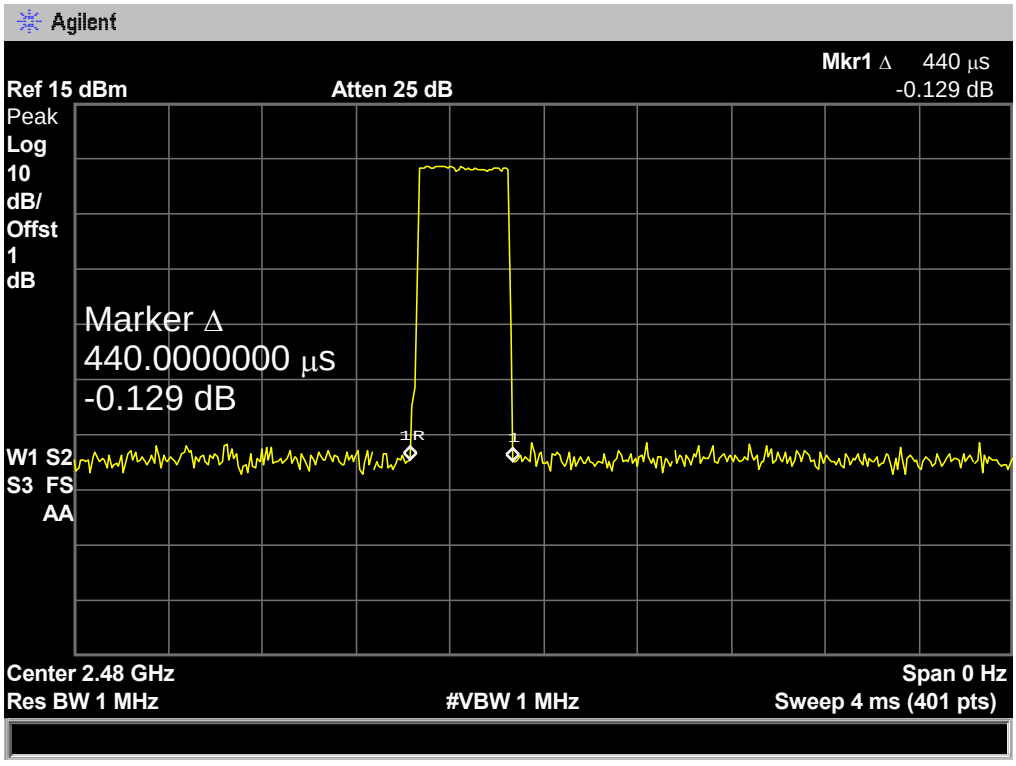
π /4-DQPSK Hopping Mode DH1

2441 MHz



π /4-DQPSK Hopping Mode DH1

2480 MHz

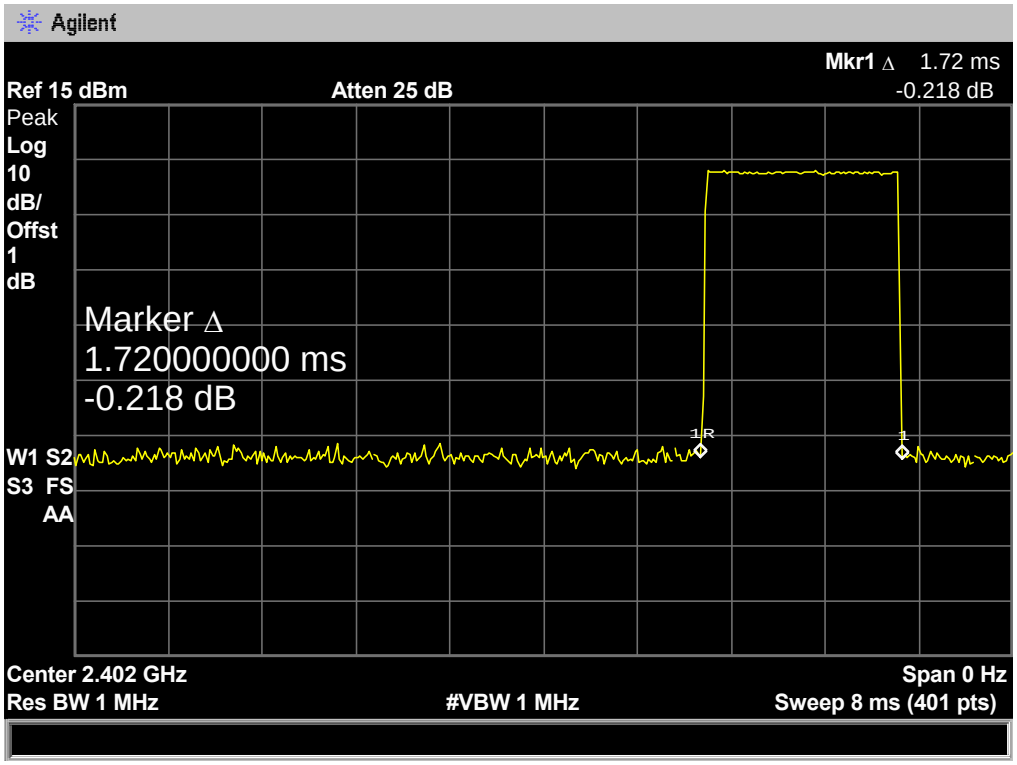


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (π/4-DQPSK DH3)		

Channel (MHz)	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
2402	1.720	275.20	31.60	400	PASS
2441	1.700	272.00			
2480	1.720	275.20			

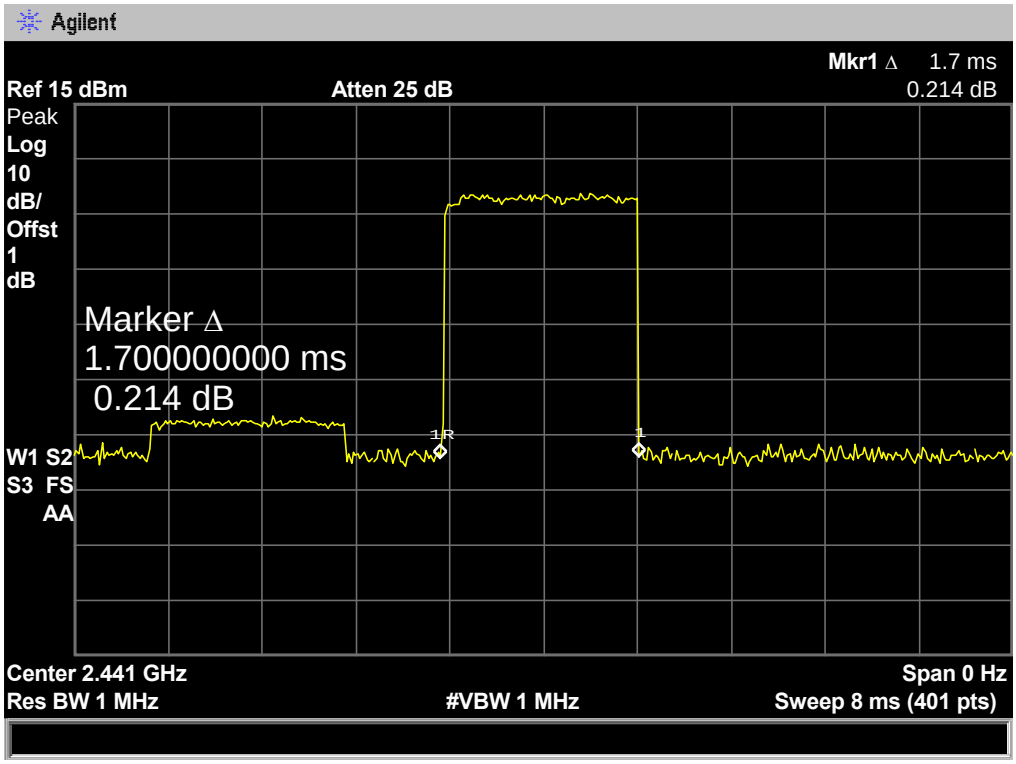
π/4-DQPSK Hopping Mode DH3

2402 MHz



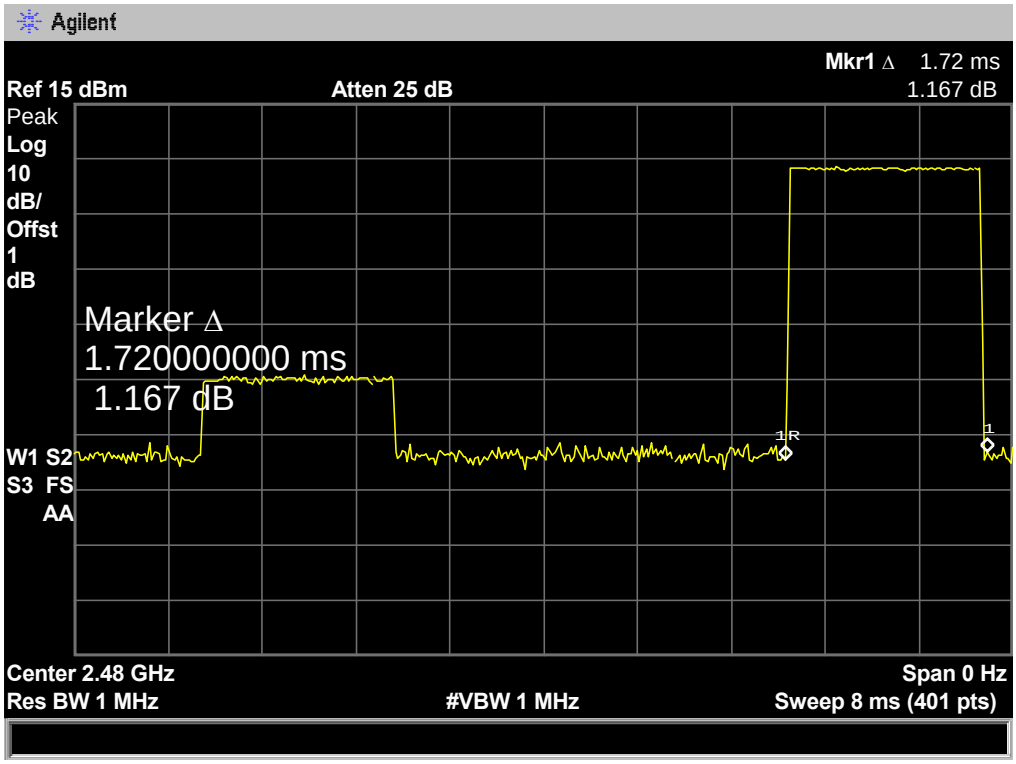
π /4-DQPSK Hopping Mode DH3

2441 MHz



π /4-DQPSK Hopping Mode DH3

2480 MHz

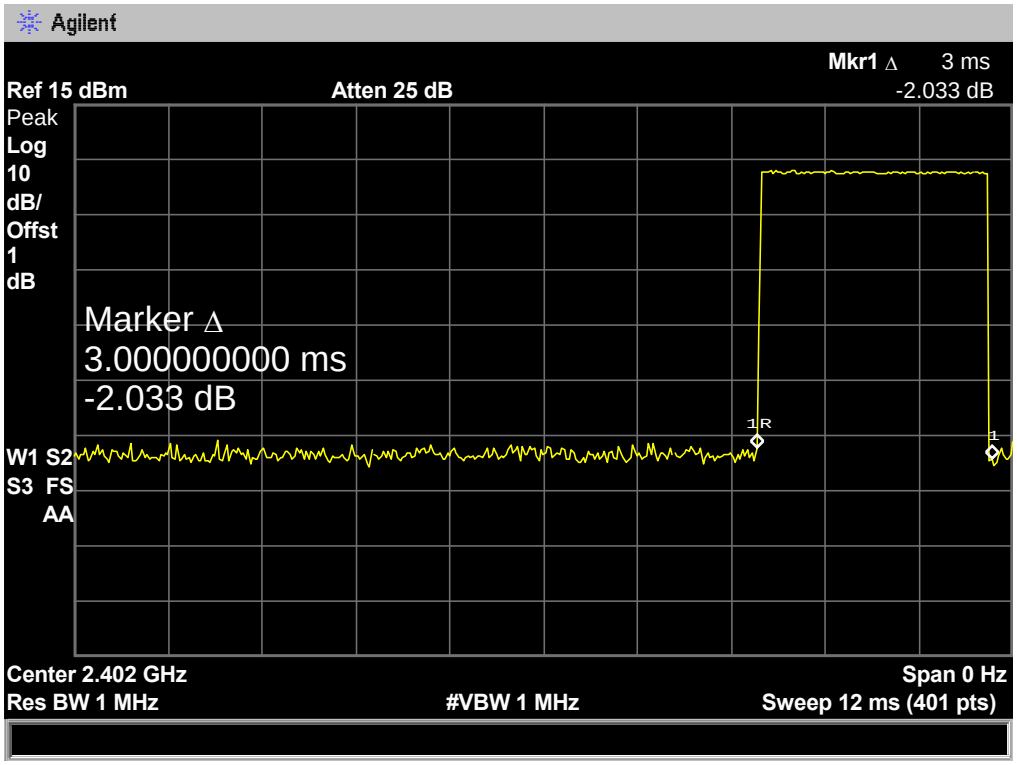


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (π/4-DQPSK DH5)		

Channel (MHz)	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
2402	3.000	320.00	31.60	400	PASS
2441	3.000	320.00			
2480	3.000	320.00			

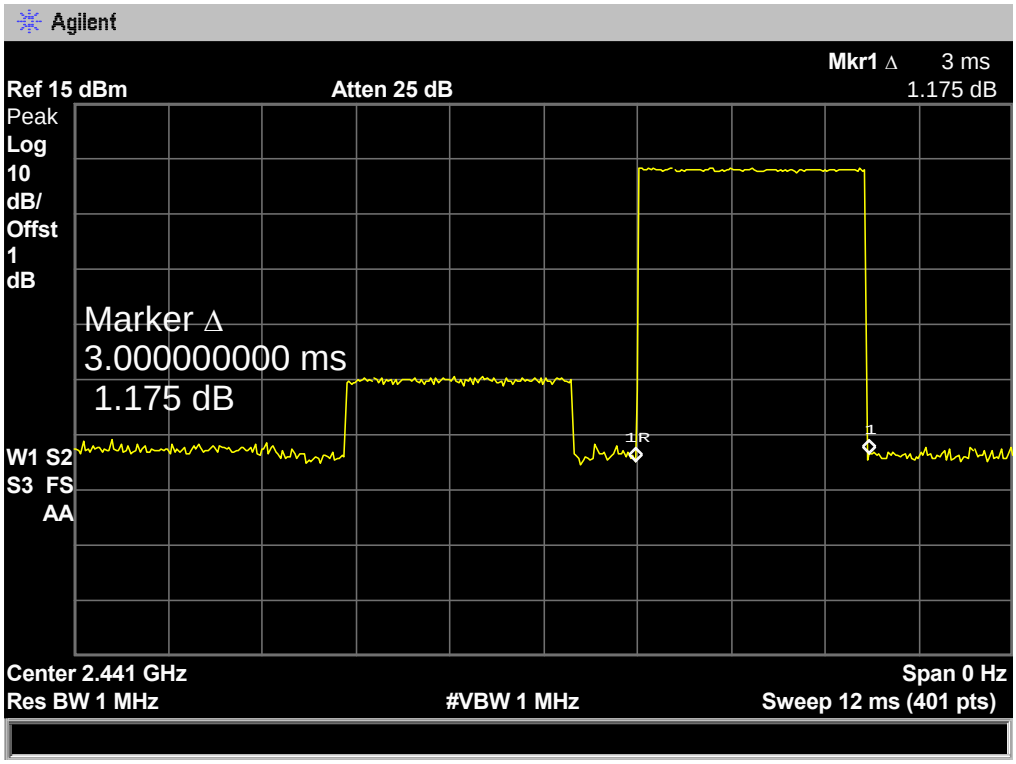
π/4-DQPSK Hopping Mode DH5

2402 MHz



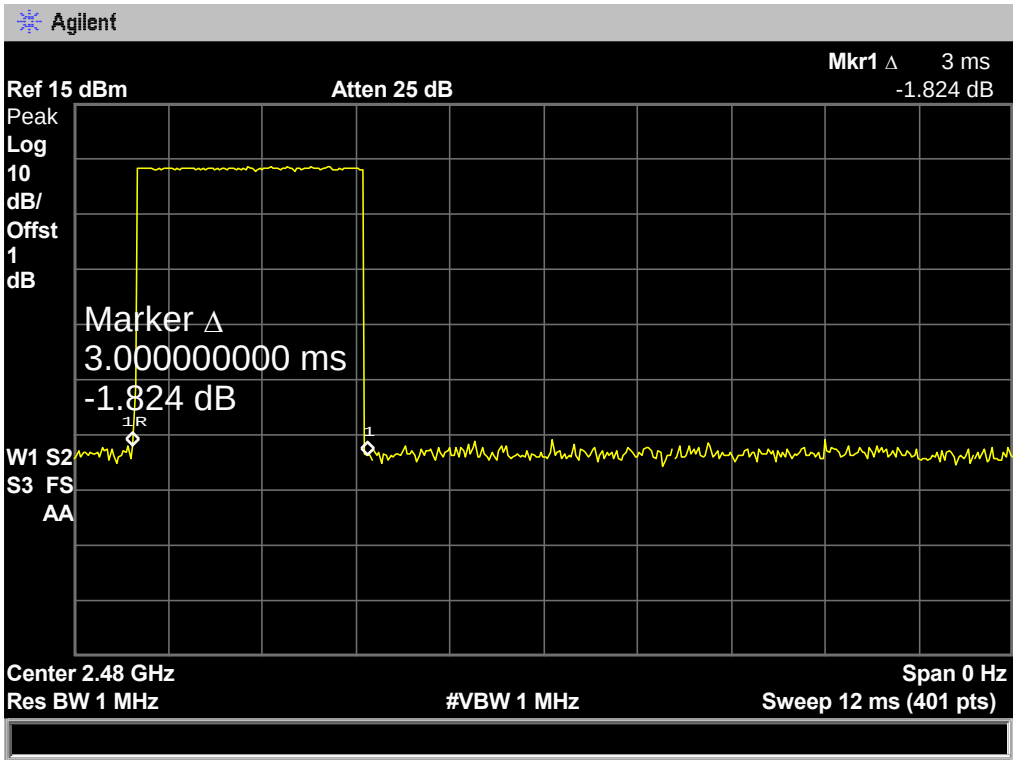
π /4-DQPSK Hopping Mode DH5

2441 MHz



π /4-DQPSK Hopping Mode DH5

2480 MHz

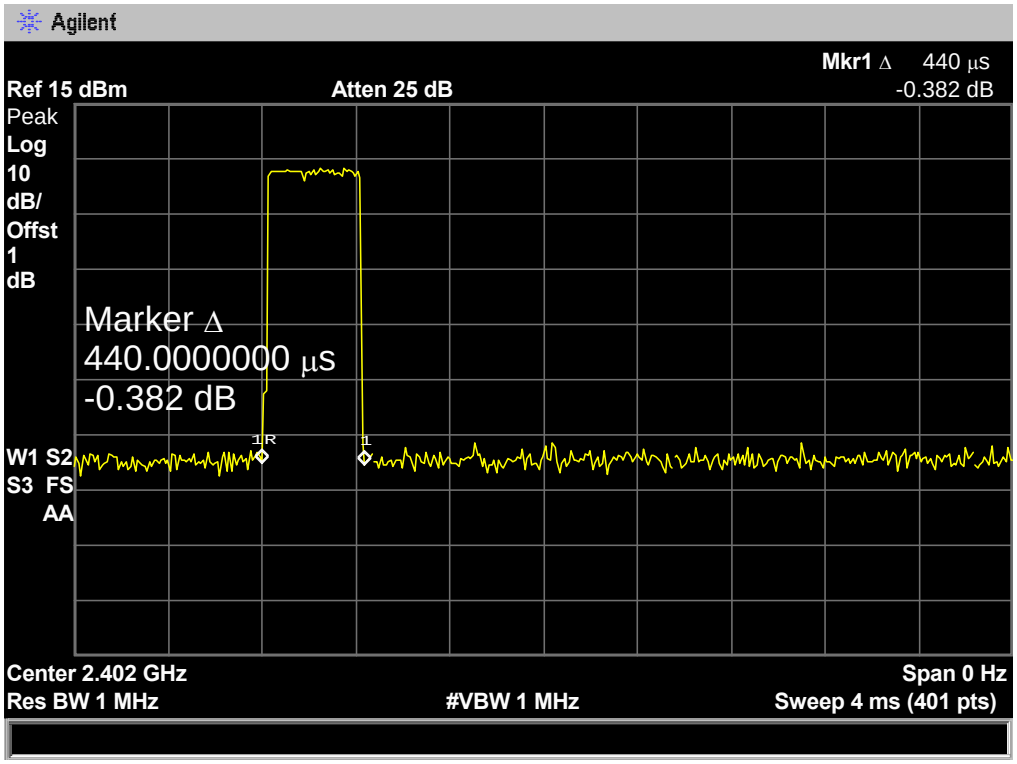


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (8-DPSK DH1)		

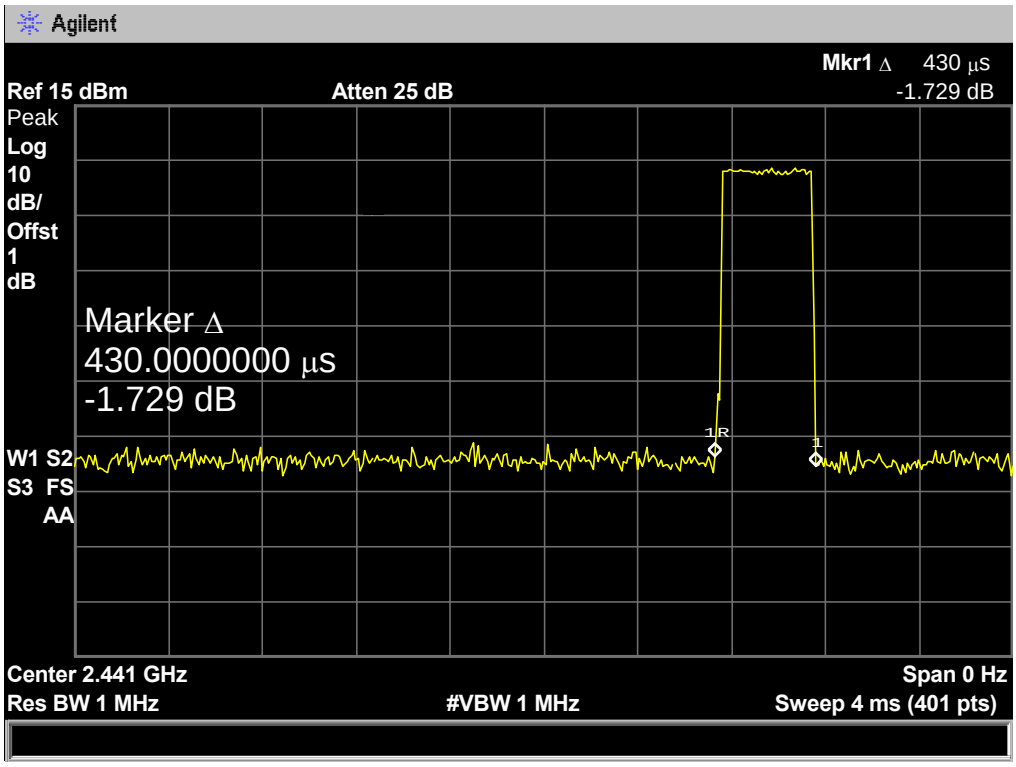
Channel (MHz)	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
2402	0.440	140.80	31.60	400	PASS
2441	0.430	137.60			
2480	0.430	137.60			

8-DPSK Hopping Mode DH1

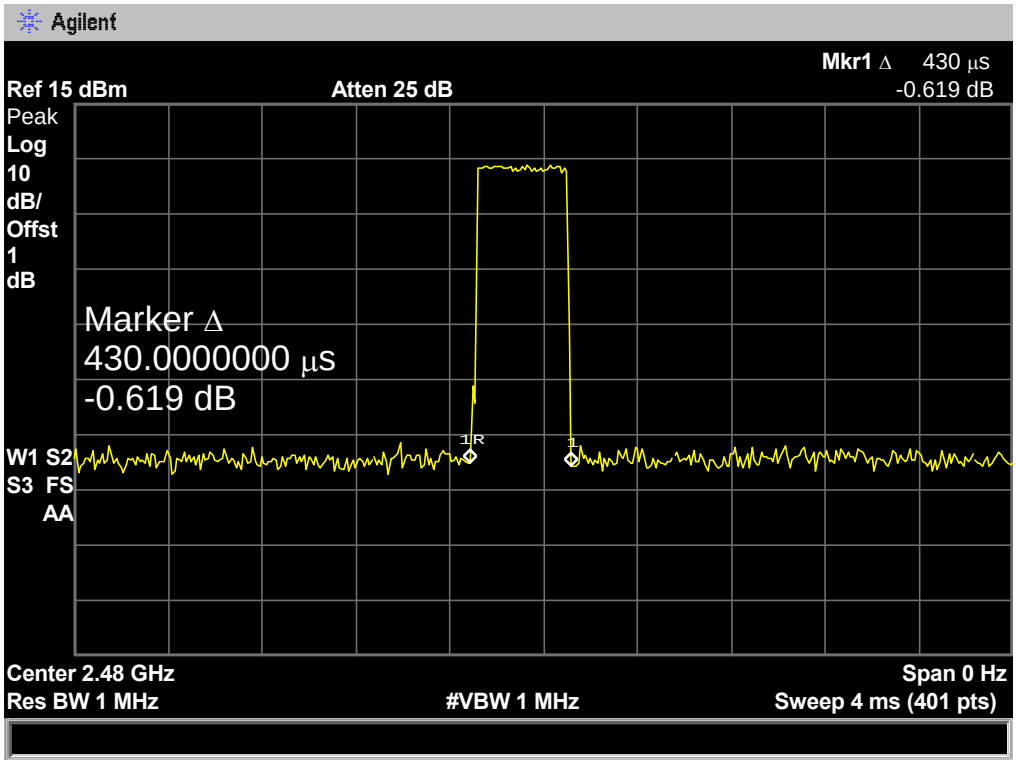
2402 MHz



8-DPSK Hopping Mode DH1
2441 MHz



8-DPSK Hopping Mode DH1
2480 MHz

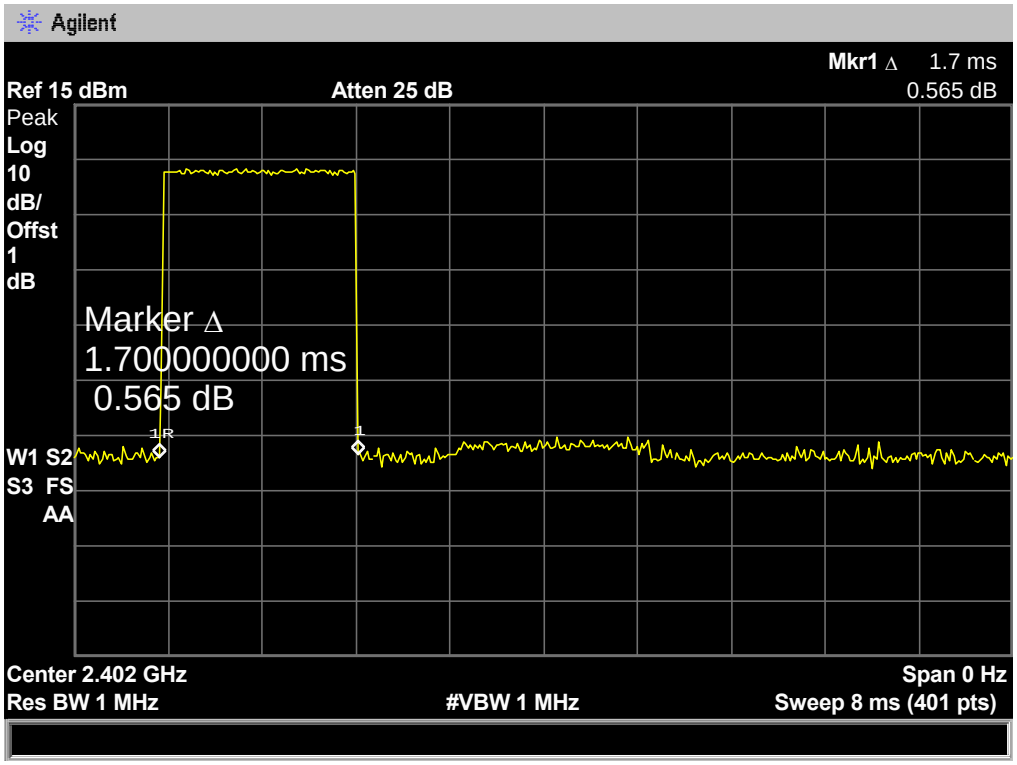


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (8-DPSK DH3)		

Channel (MHz)	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
2402	1.700	272.00	31.60	400	PASS
2441	1.700	272.00			
2480	1.700	272.00			

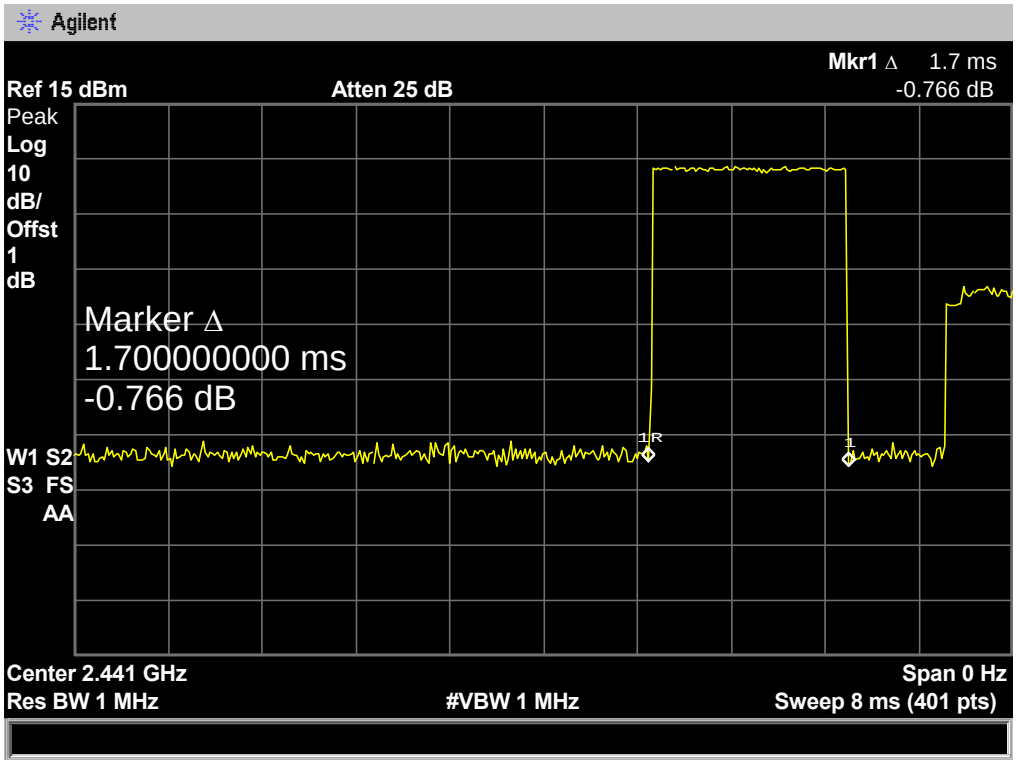
8-DPSK Hopping Mode DH3

2402 MHz



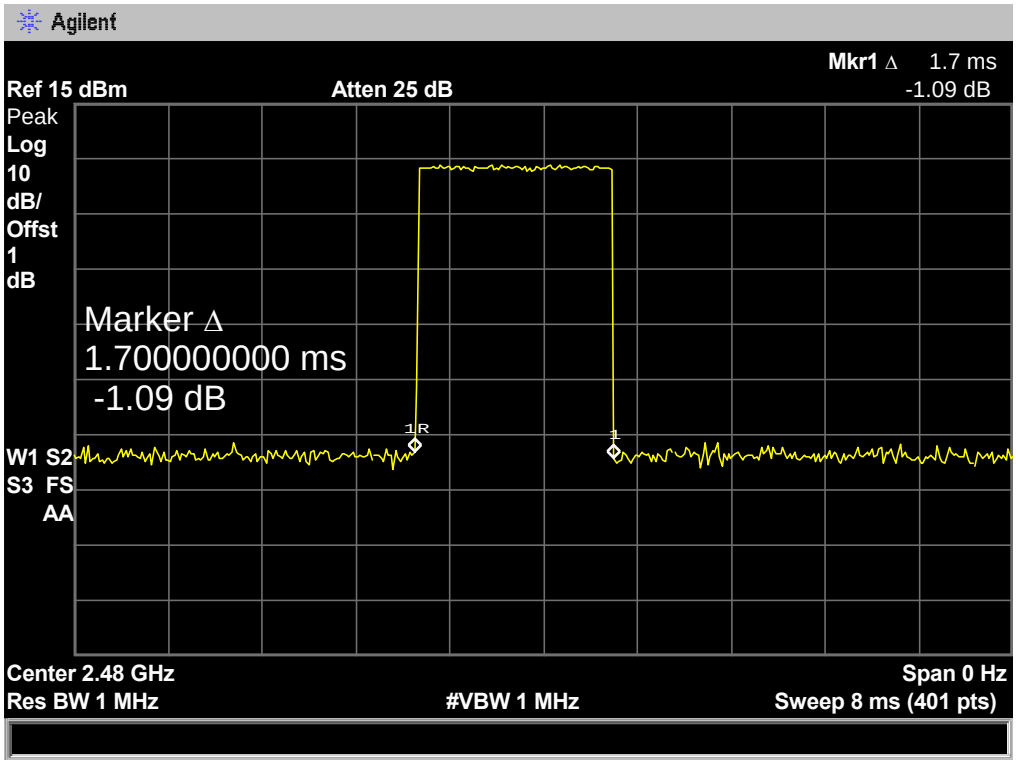
8-DPSK Hopping Mode DH3

2441 MHz



8-DPSK Hopping Mode DH3

2480 MHz

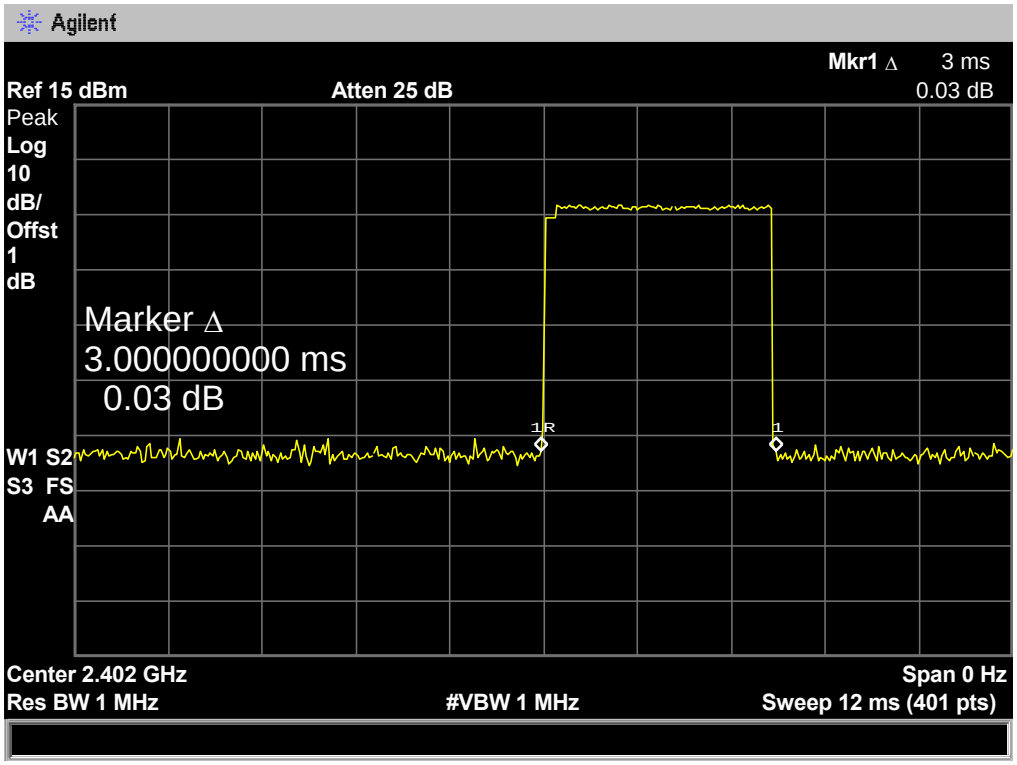


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (8-DPSK DH5)		

Channel (MHz)	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
2402	3.000	320.00	31.60	400	PASS
2441	3.000	320.00			
2480	3.000	320.00			

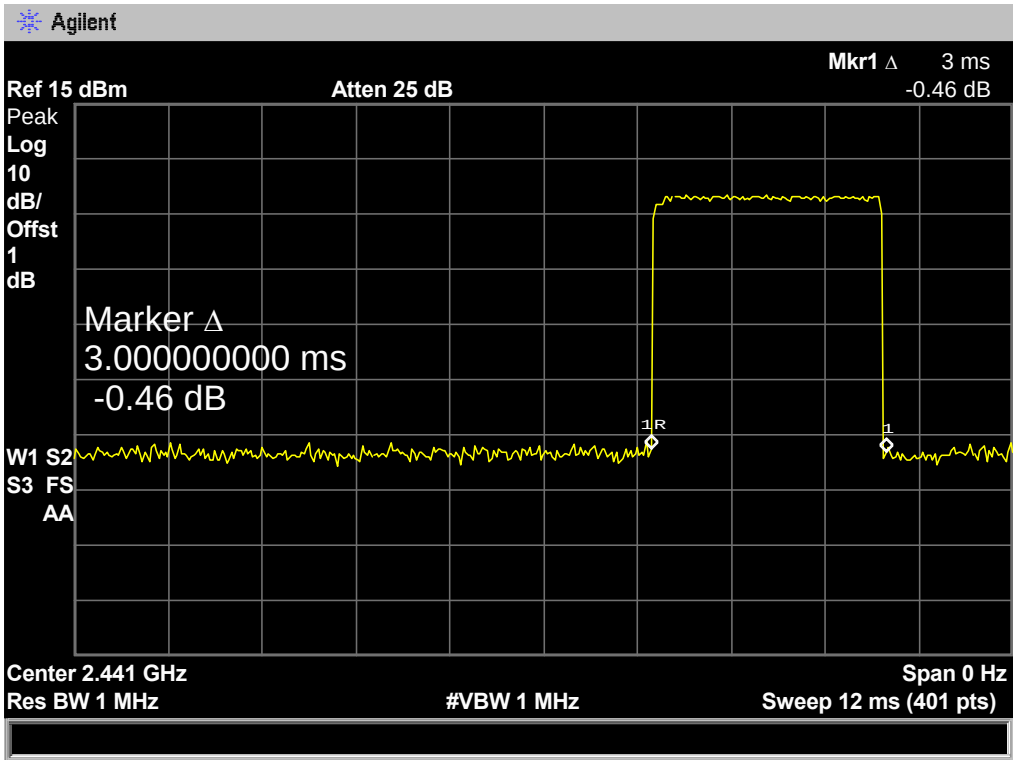
8-DPSK Hopping Mode DH5

2402 MHz



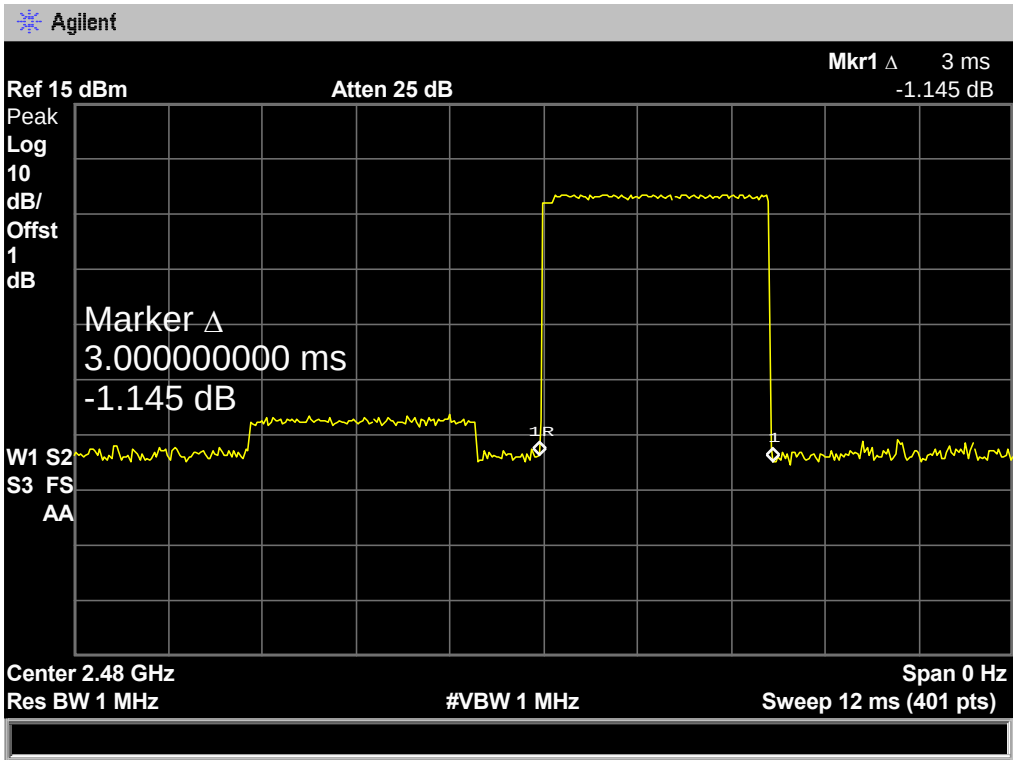
8-DPSK Hopping Mode DH5

2441 MHz



8-DPSK Hopping Mode DH5

2480 MHz



9. Channel Separation and Bandwidth Test

9.1 Test Standard and Limit

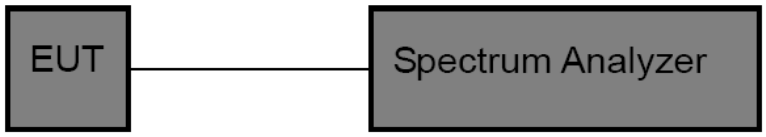
9.1.1 Test Standard

FCC Part 15.247

9.1.2 Test Limit

Test Item	Limit	Frequency Range(MHz)
Bandwidth	<=1 MHz (20dB bandwidth)	2400~2483.5
Channel Separation	>25KHz or >two-thirds of the 20 dB bandwidth Which is greater	2400~2483.5

9.2 Test Setup



9.3 Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

(2) Spectrum Setting:
Channel Separation: RBW=30 kHz, VBW=100 kHz.
Bandwidth: RBW=30 kHz, VBW=100 kHz.

(3) The bandwidth is measured at an amplitude level reduced 20dB from the reference level. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst –case (i.e the widest) bandwidth.

(4) Measure the channel separation the spectrum analyzer was set to Resolution Bandwidth:30 kHz, and Video Bandwidth:100 kHz. Sweep Time set auto.

9.4 EUT Operating Condition

The EUT was set to the Hopping Mode for Channel Separation Test and continuously transmitting for the Bandwidth Test.

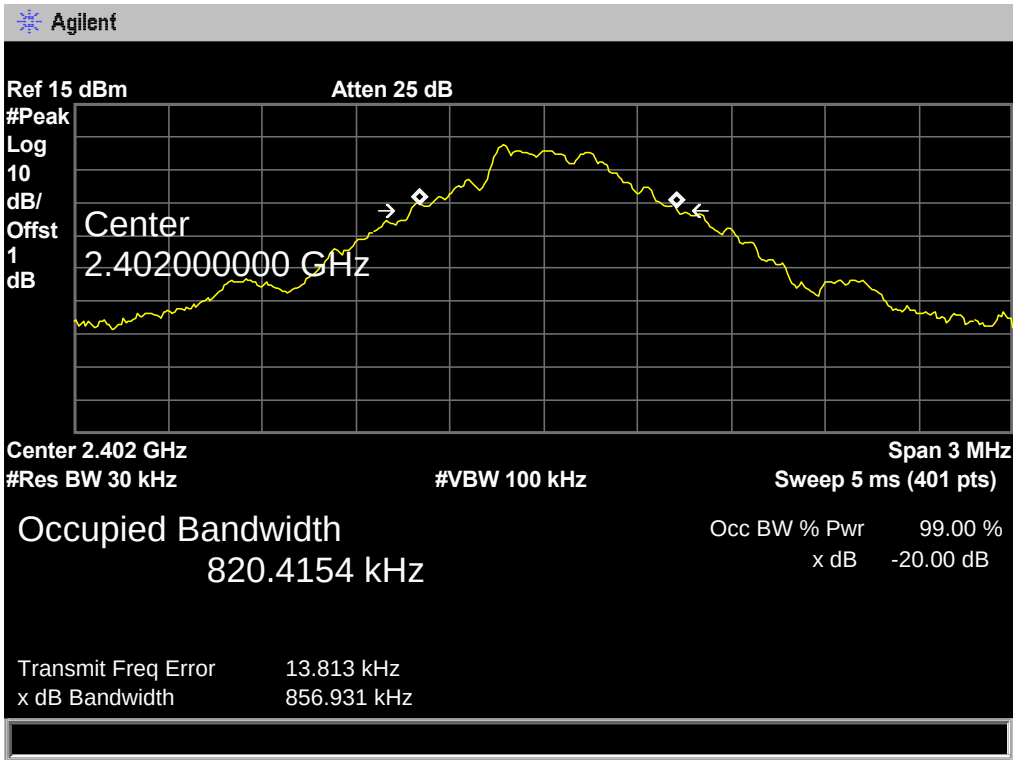
9.5 Test Data

EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX Mode (GFSK)		

Channel frequency (MHz)	99% OBW (kHz)	20dB Bandwidth (kHz)	20dB Bandwidth *2/3 (kHz)
2402	820.4154	856.931	
2441	817.2926	854.060	
2480	818.6371	855.380	

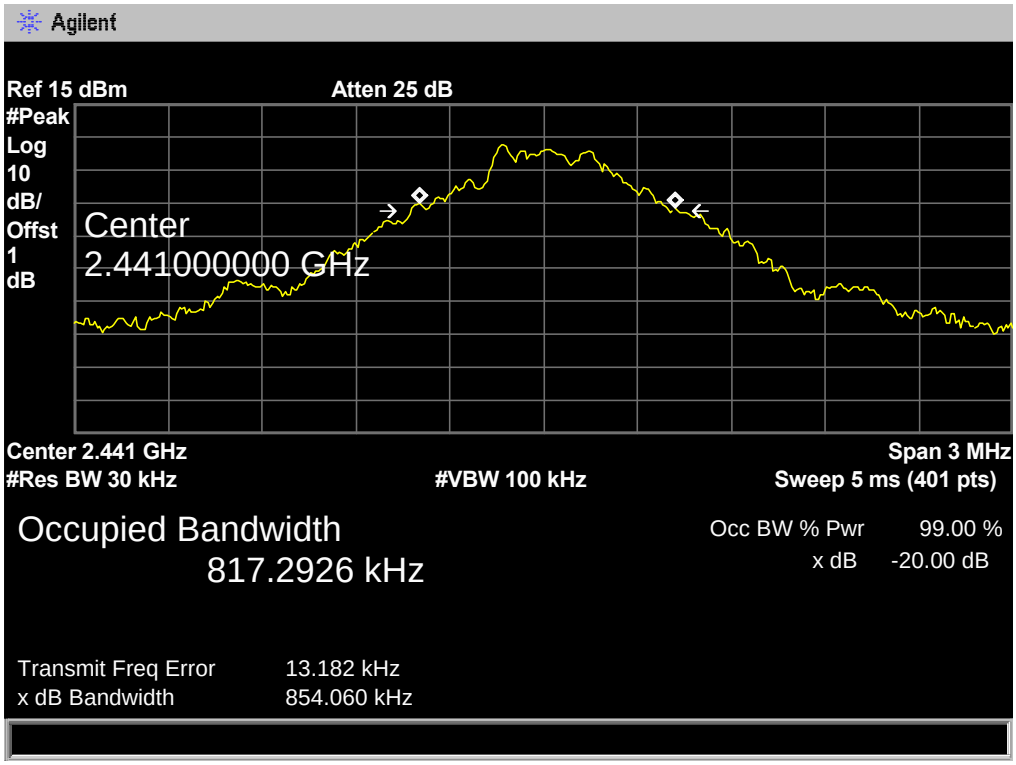
GFSK TX Mode

2402 MHz



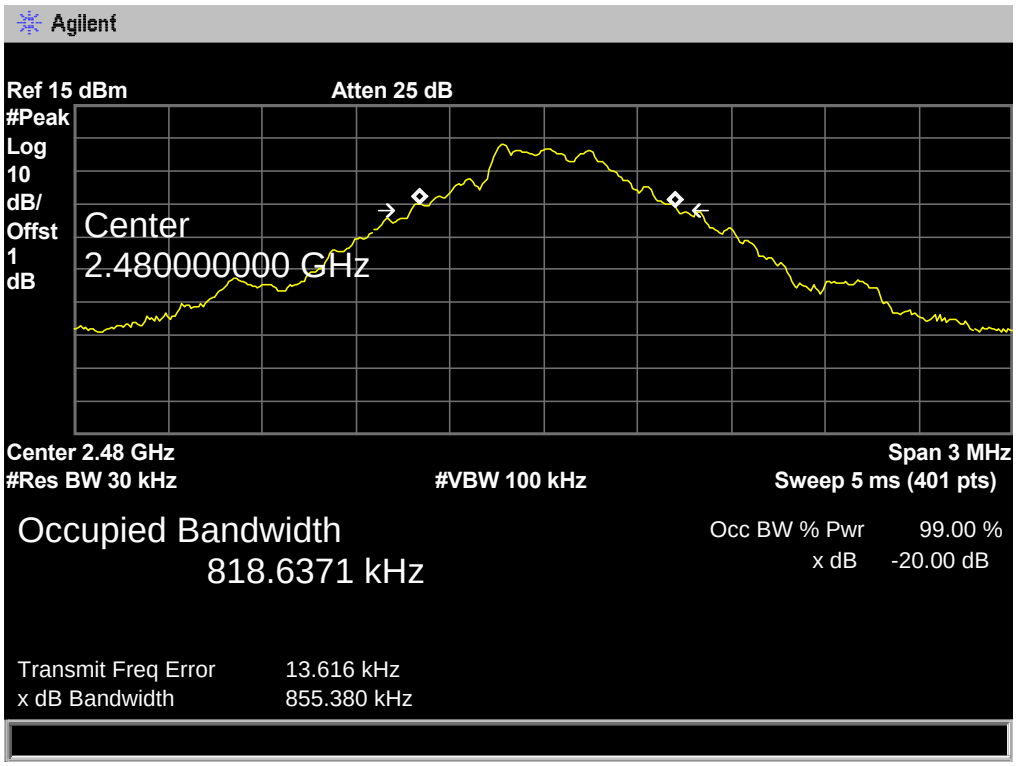
GFSK TX Mode

2441 MHz



GFSK TX Mode

2480 MHz

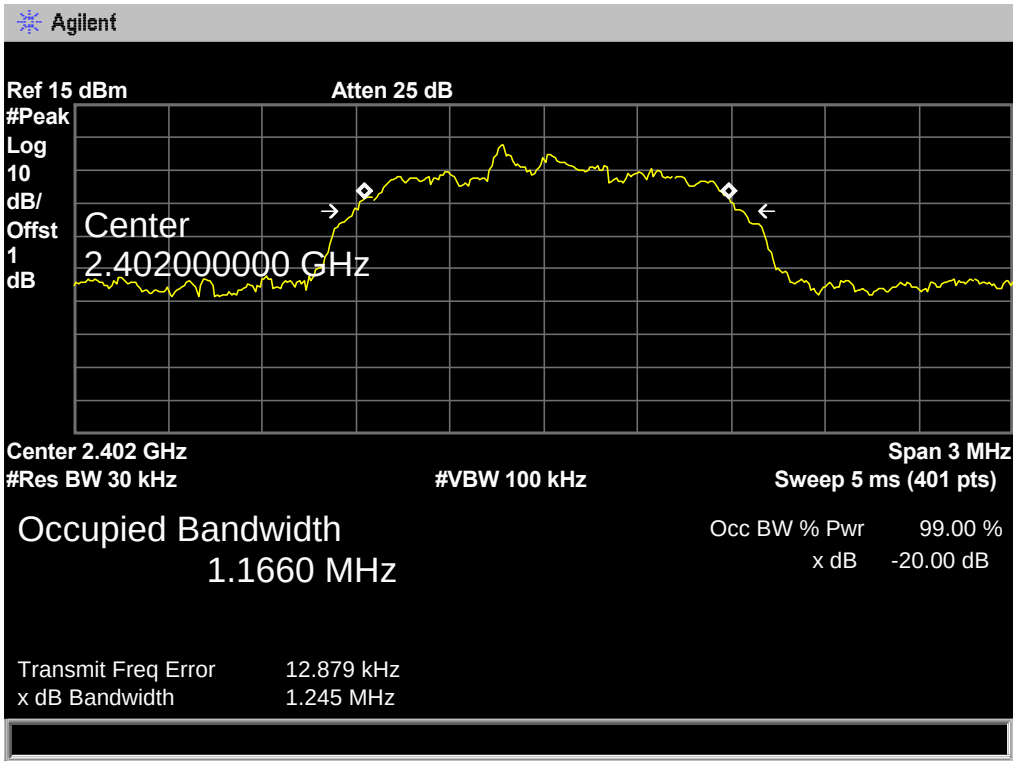


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX Mode (π /4-DQPSK)		

Channel frequency (MHz)	99% OBW (kHz)	20dB Bandwidth (kHz)	20dB Bandwidth *2/3 (kHz)
2402	1166.00	1245.00	830.00
2441	1160.80	1254.00	836.00
2480	1163.20	1253.00	835.33

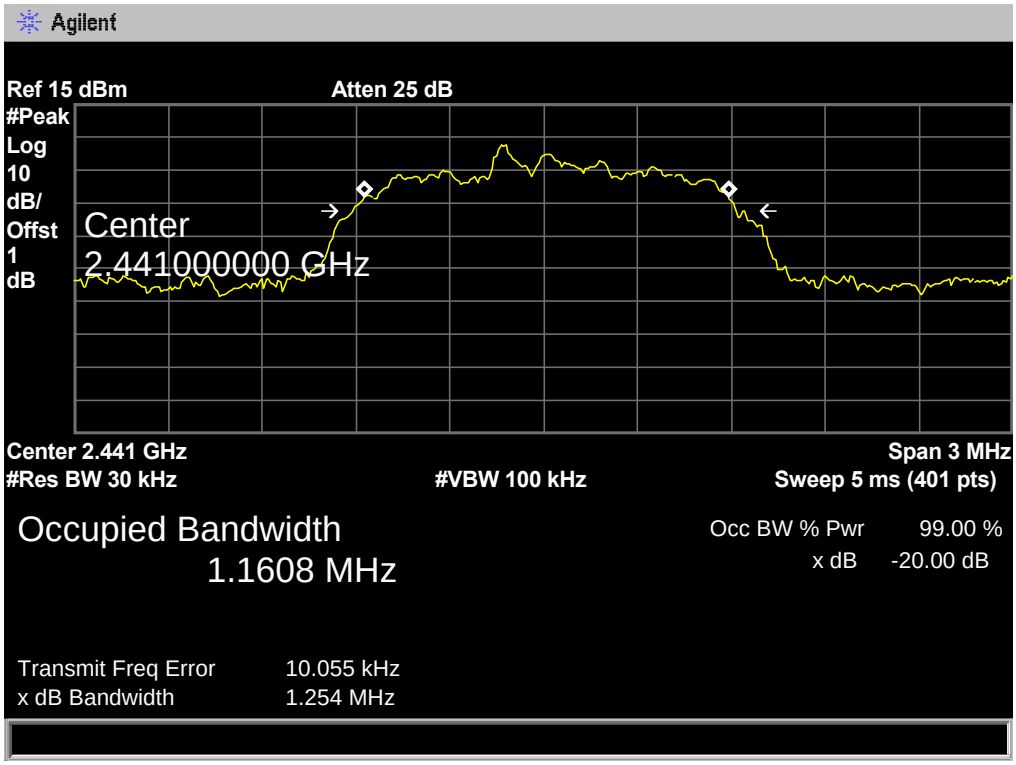
π /4-DQPSK TX Mode

2402 MHz



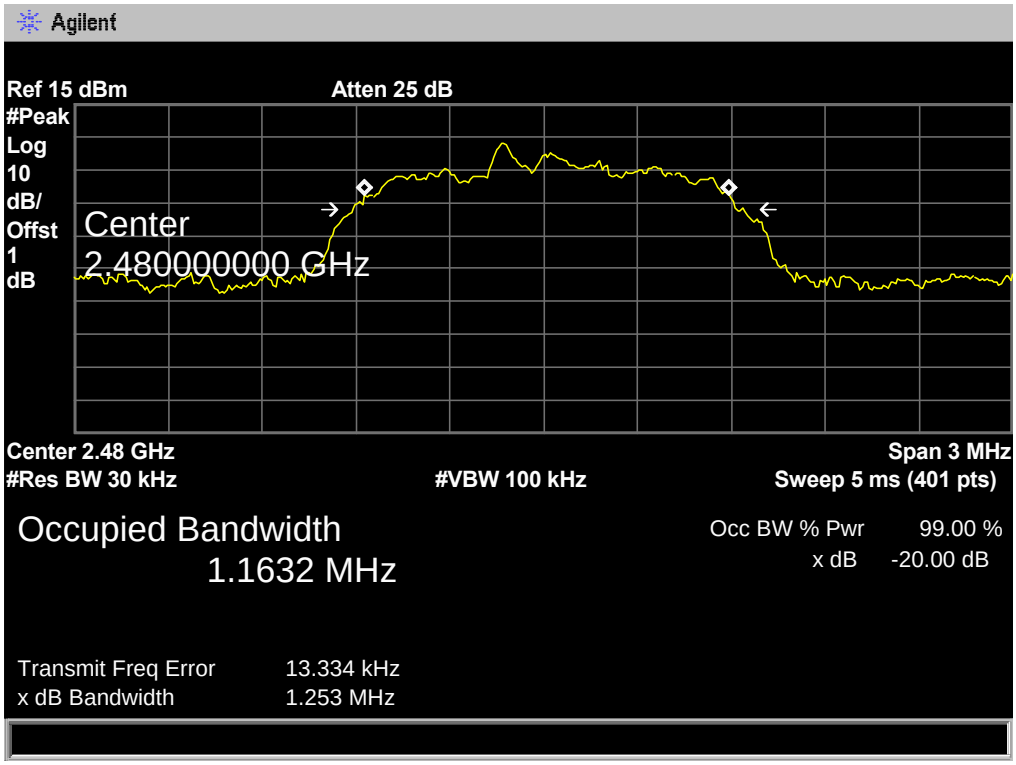
π /4-DQPSK TX Mode

2441 MHz



π /4-DQPSK TX Mode

2480 MHz

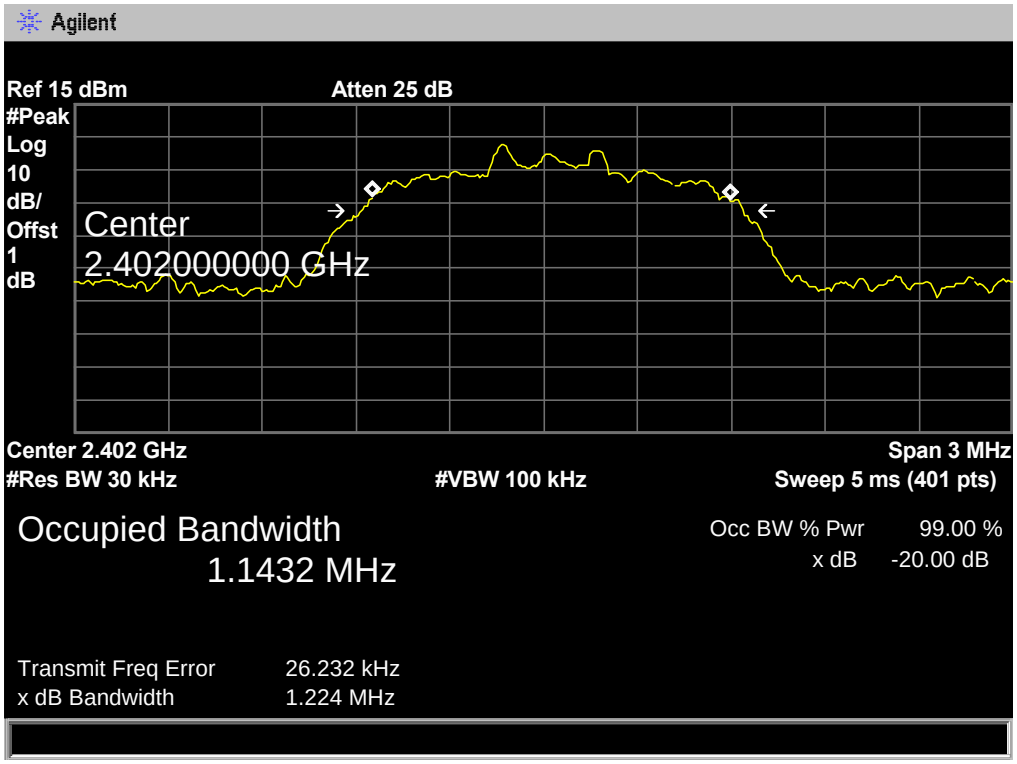


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX Mode (8-DPSK)		

Channel frequency (MHz)	99% OBW (kHz)	20dB Bandwidth (kHz)	20dB Bandwidth *2/3 (kHz)
2402	1143.00	1224.00	816.00
2441	1149.10	1226.00	817.33
2480	1150.70	1224.00	816.00

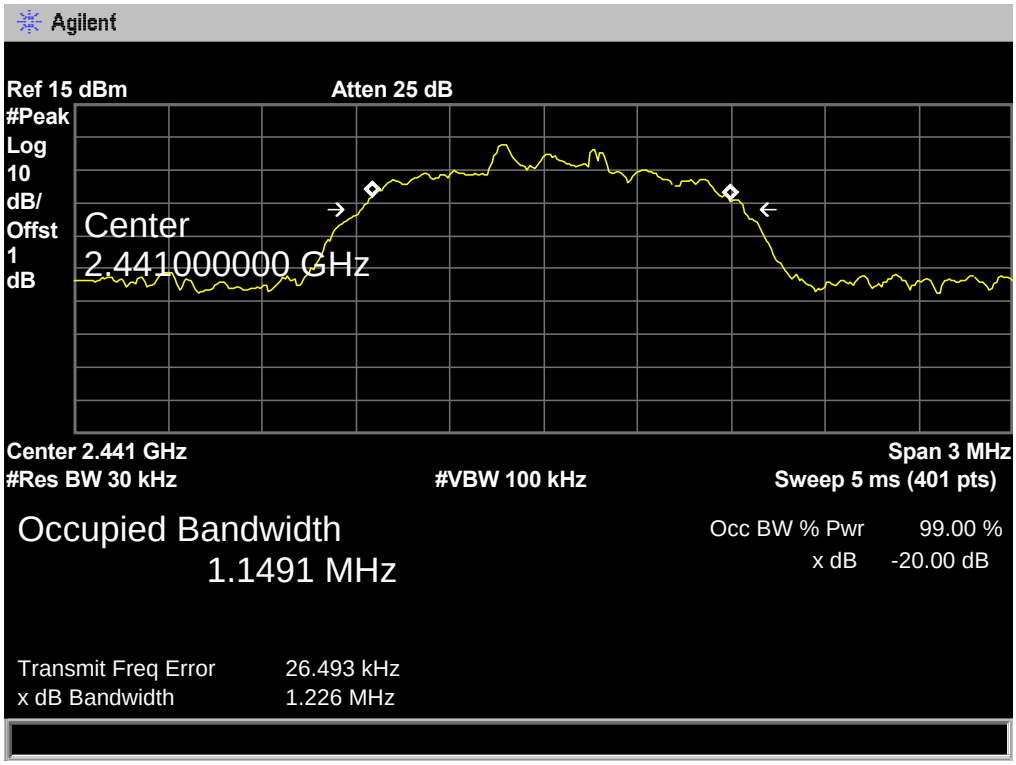
8-DPSK TX Mode

2402 MHz



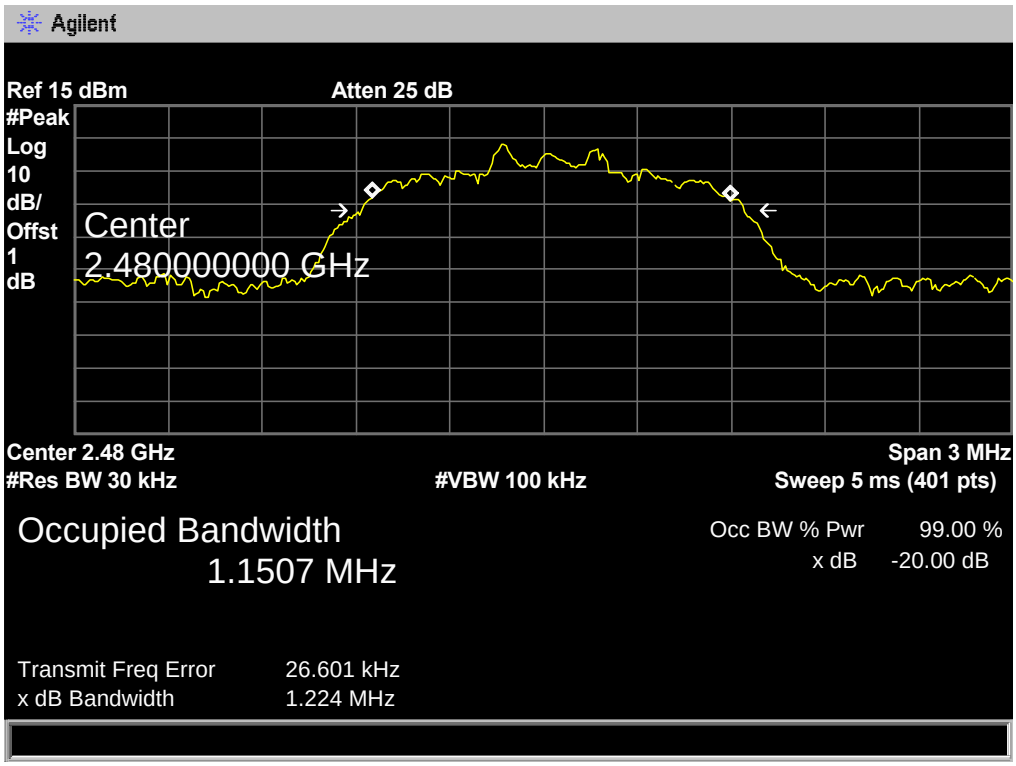
8-DPSK TX Mode

2441 MHz



8-DPSK TX Mode

2480 MHz

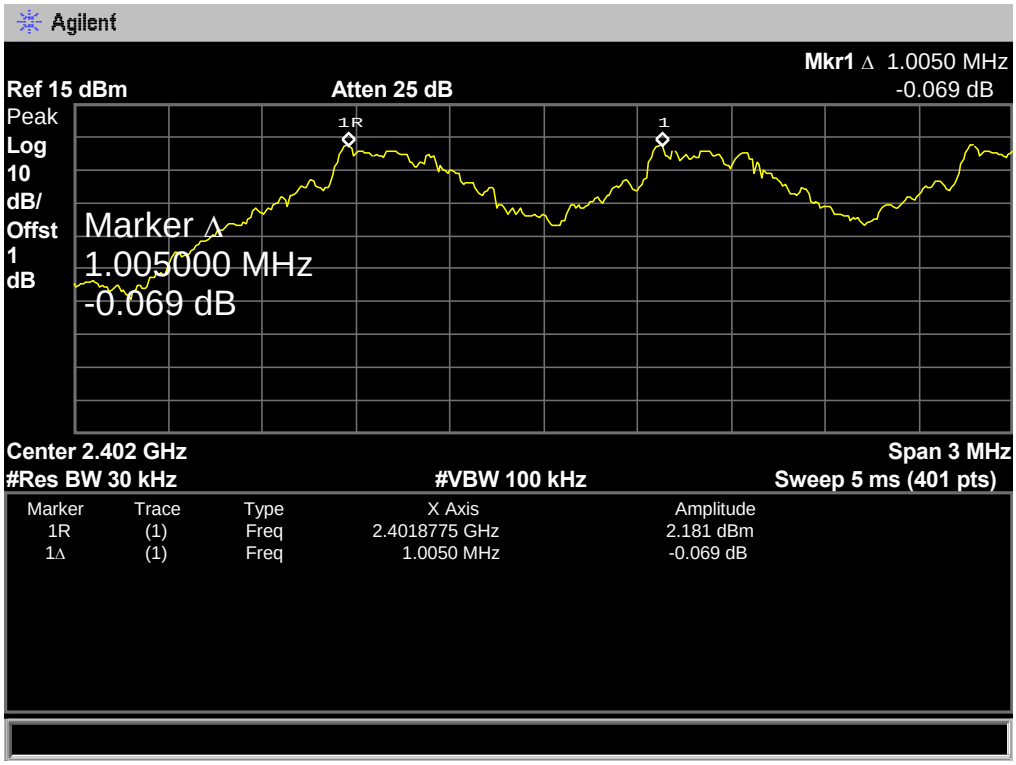


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (GFSK)		

Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit (kHz)
2402	1005.00	856.931
2441	1005.00	854.060
2480	1005.00	855.380

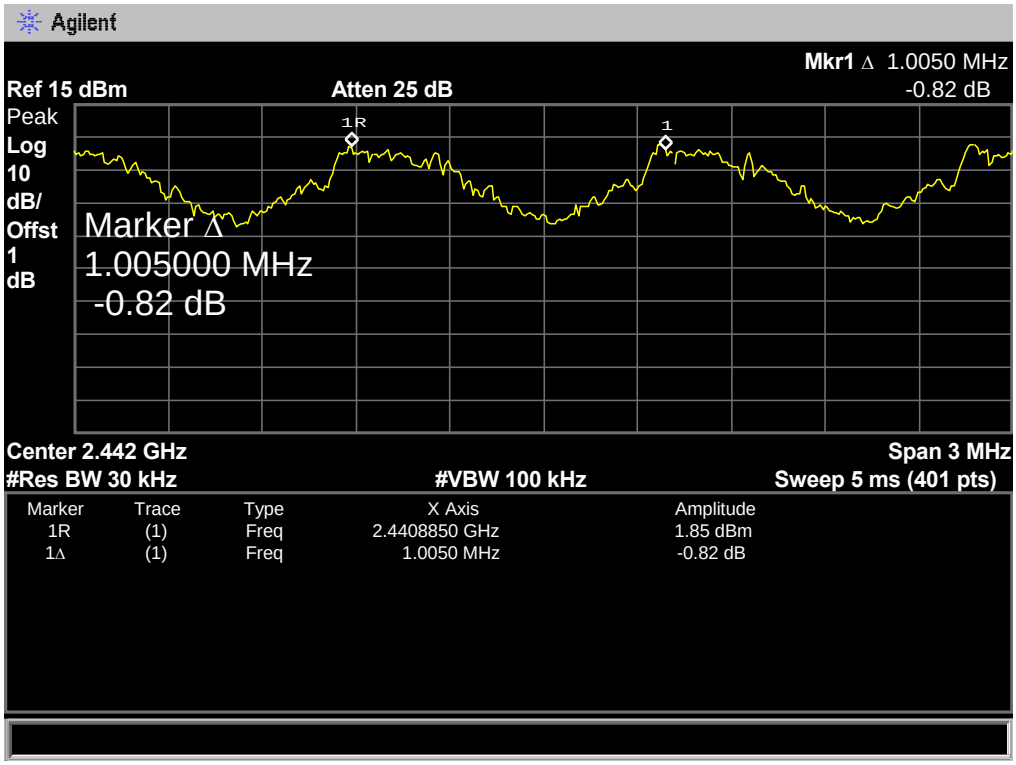
GFSK Hopping Mode

2402 MHz



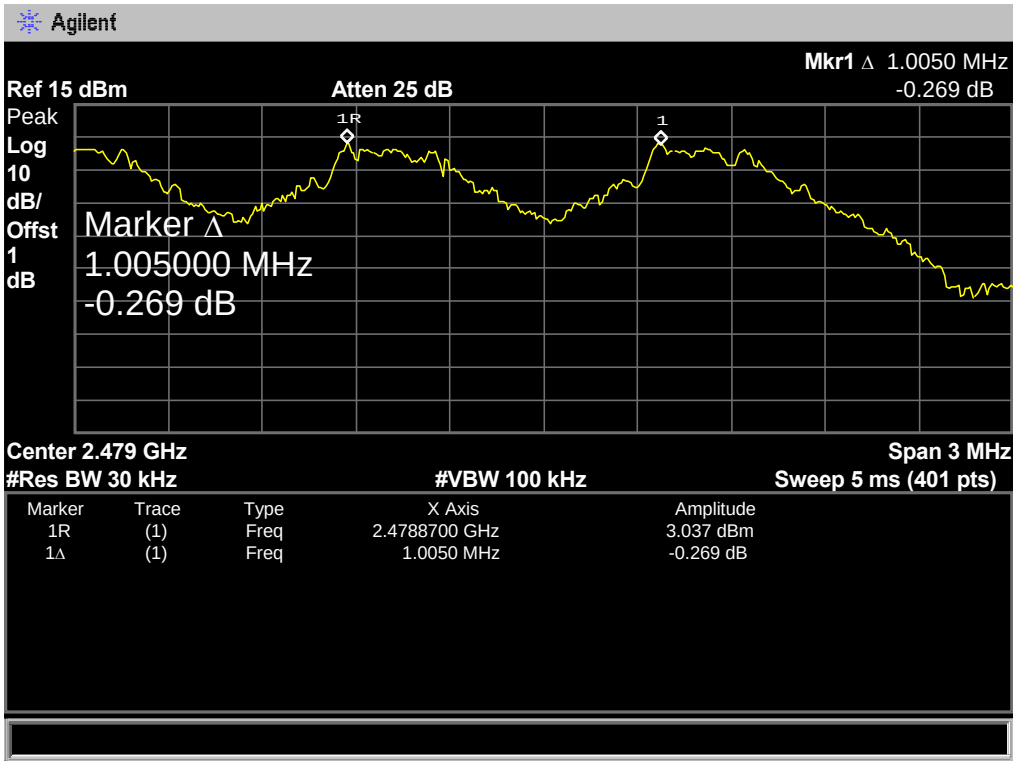
GFSK Hopping Mode

2441 MHz



GFSK Hopping Mode

2480 MHz

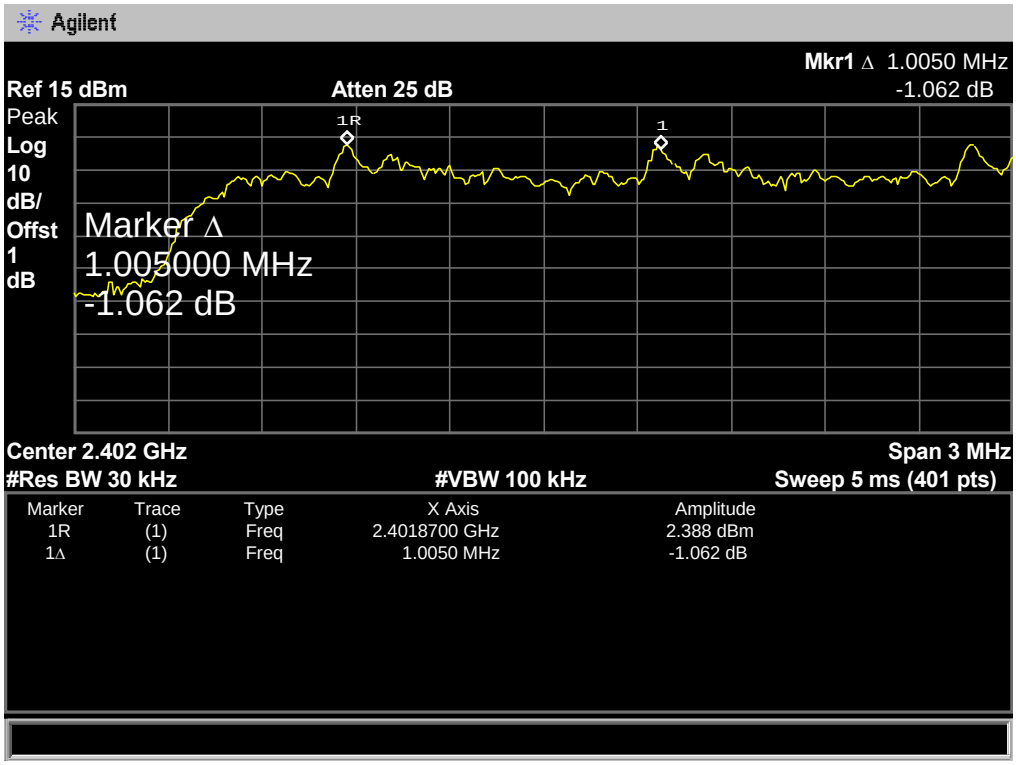


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (π/4-DQPSK)		

Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit (kHz)
2402	1005.00	830.00
2441	1005.00	836.00
2480	1005.00	835.33

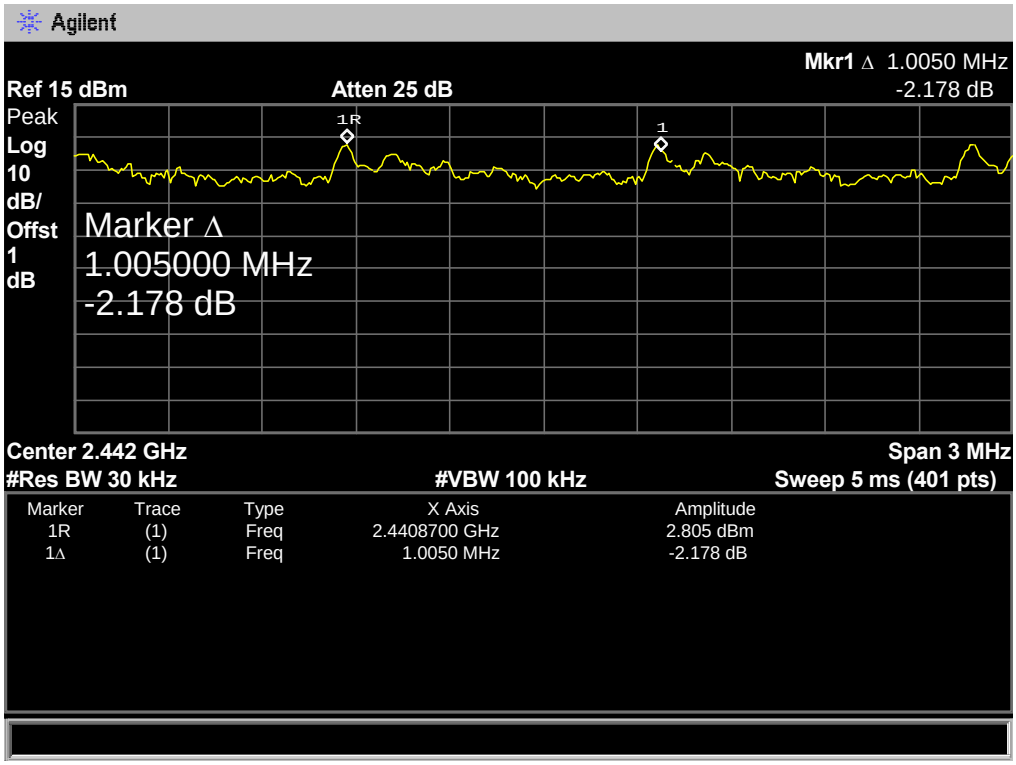
π/4-DQPSK Hopping Mode

2402 MHz



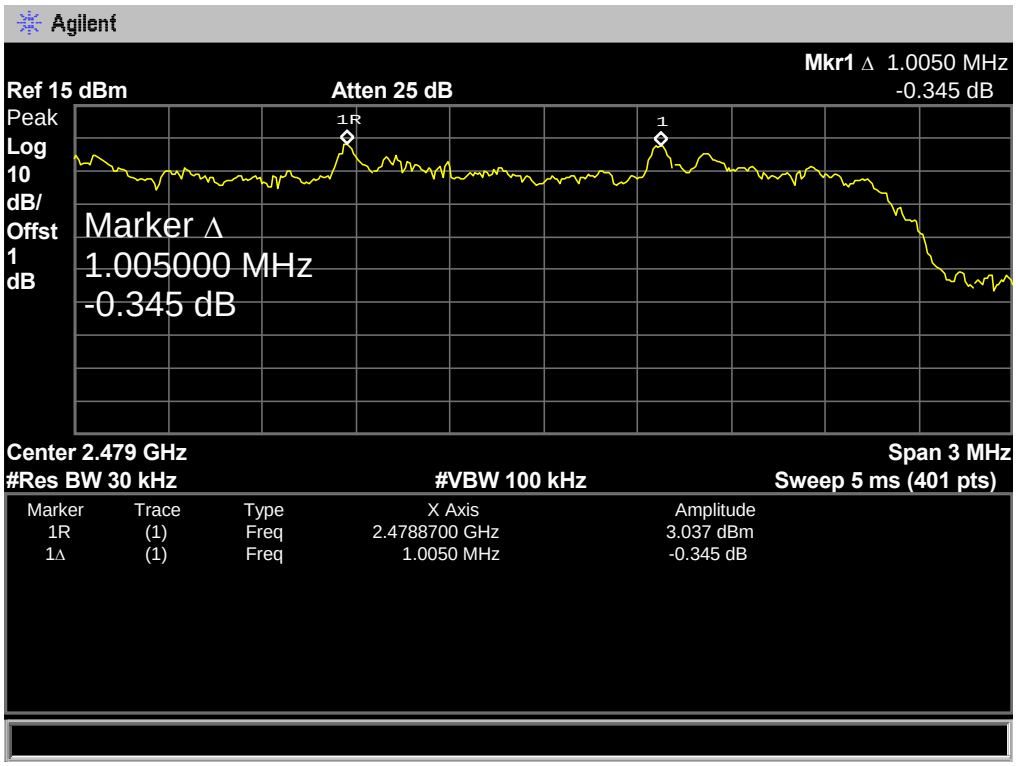
π /4-DQPSK Hopping Mode

2441 MHz



π /4-DQPSK Hopping Mode

2480 MHz

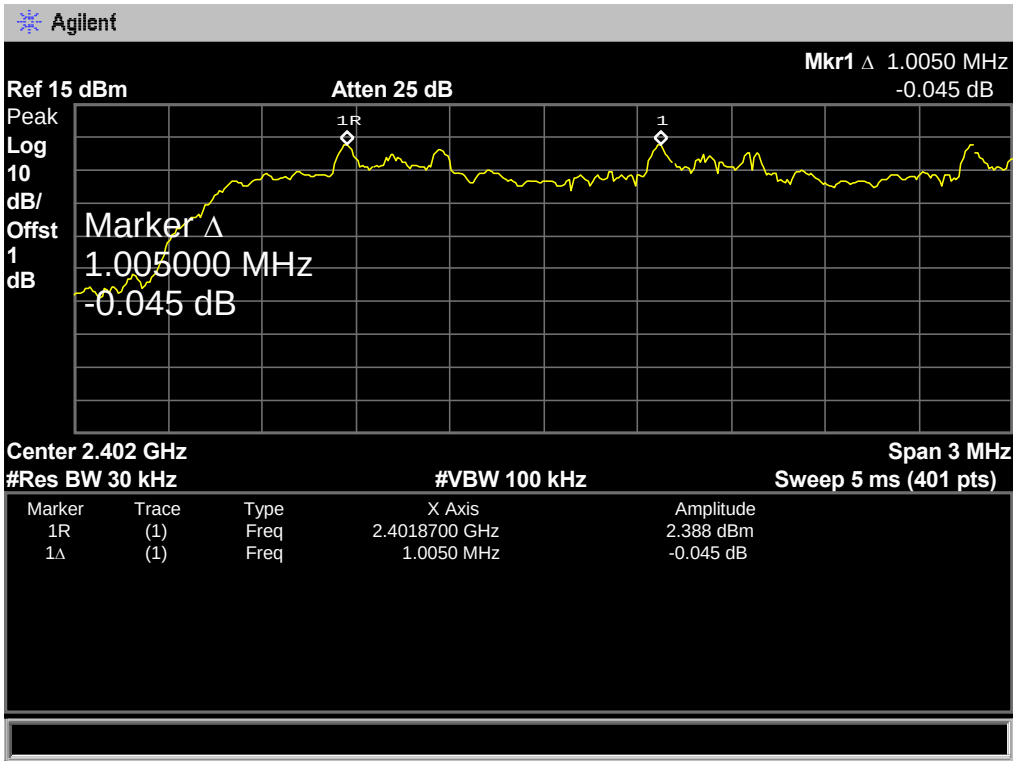


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (8-DPSK)		

Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit (kHz)
2402	1005.00	816.00
2441	1005.00	817.33
2480	1005.00	816.00

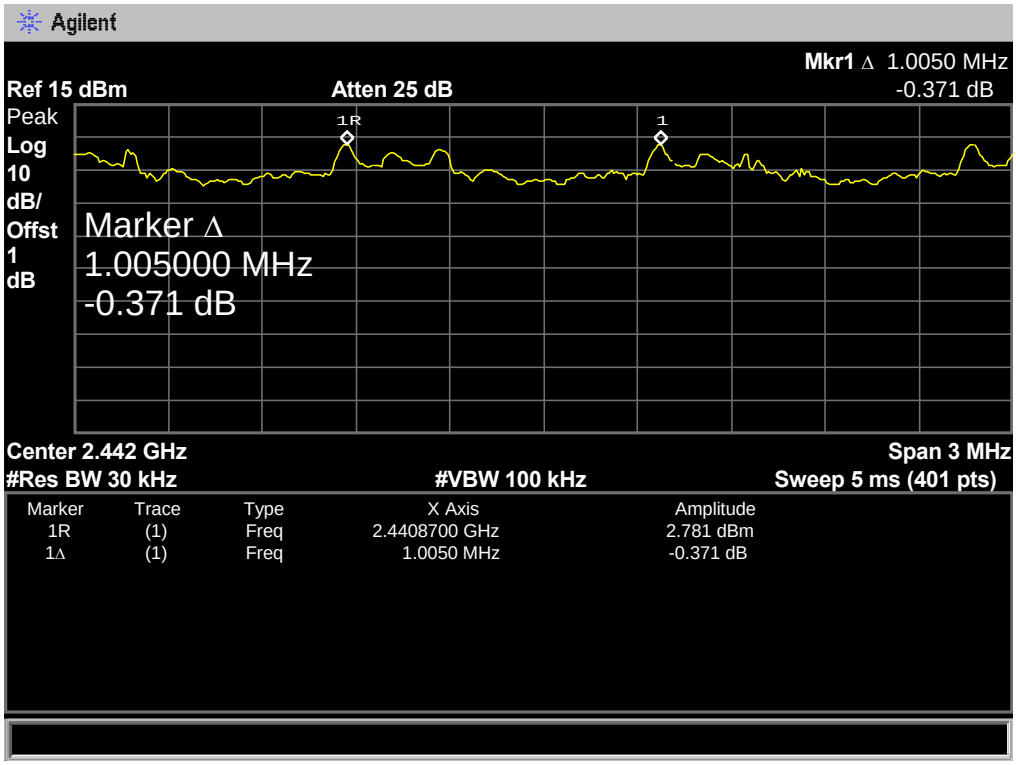
8-DPSK Hopping Mode

2402 MHz



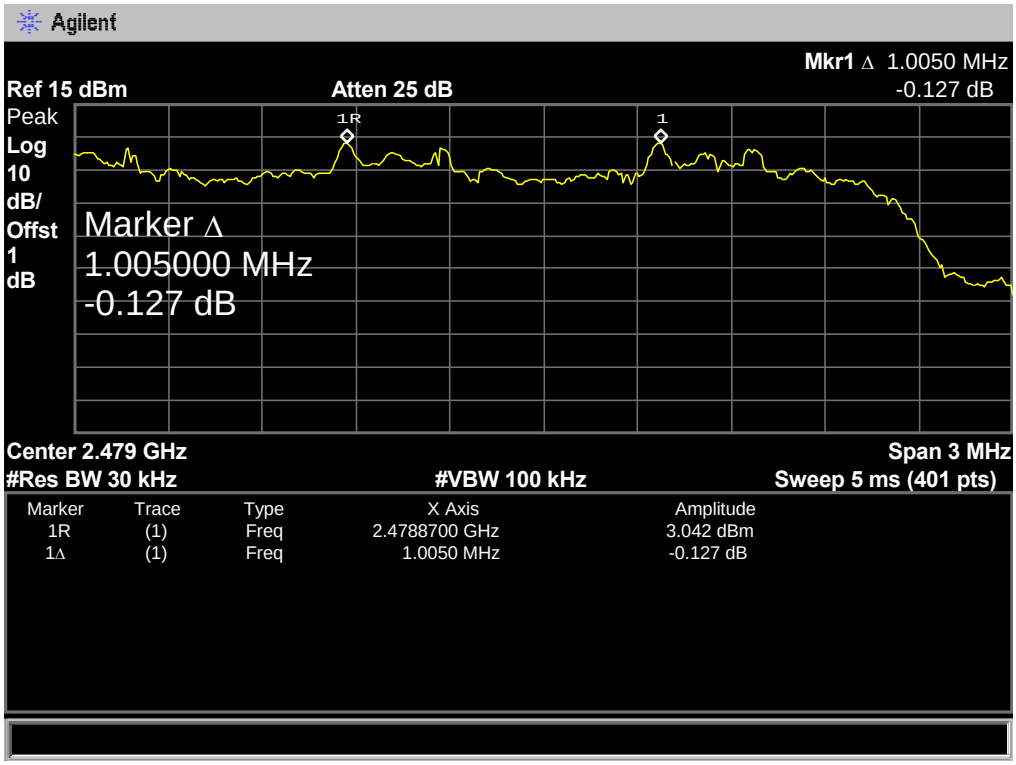
8-DPSK Hopping Mode

2441 MHz



8-DPSK Hopping Mode

2480 MHz



10. Peak Output Power Test

10.1 Test Standard and Limit

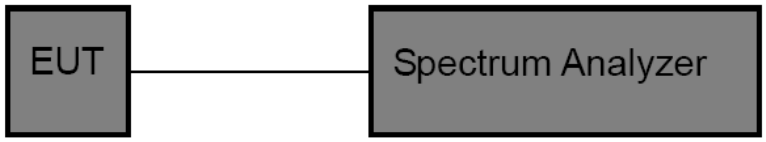
10.1.1 Test Standard

FCC Part 15.247 (b) (1)

10.1.2 Test Limit

Test Item	Limit	Frequency Range(MHz)
Peak Output Power	Hopping Channels>75 Power<1W(30dBm) Other <125 mW(21dBm)	2400~2483.5

10.2 Test Setup



10.3 Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

(2) Spectrum Setting:

Peak Detector: RBW=1 MHz, VBW=3 MHz for bandwidth less than 1MHz.

RBW=3 MHz, VBW=3 MHz for bandwidth more than 1MHz.

10.4 EUT Operating Condition

The EUT was set to continuously transmitting in the max power during the test.

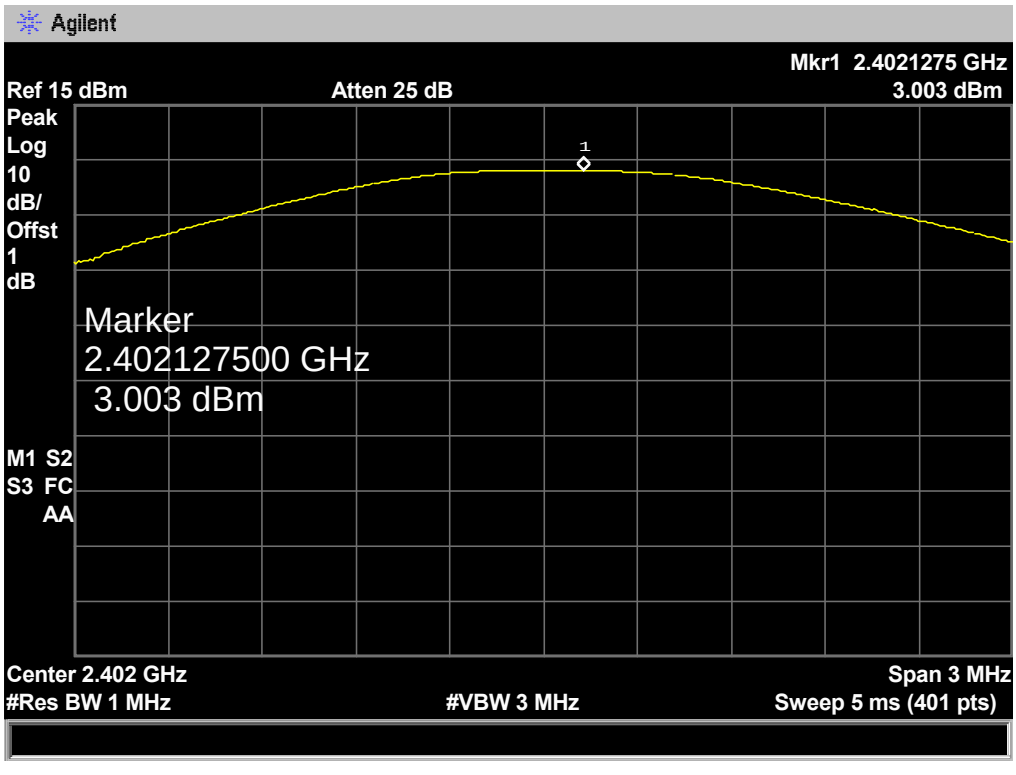
10.5 Test Data

EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX Mode (GFSK)		

Channel frequency (MHz)	Test Result (dBm)	Limit (dBm)
2402	3.003	30
2441	3.281	
2480	3.519	

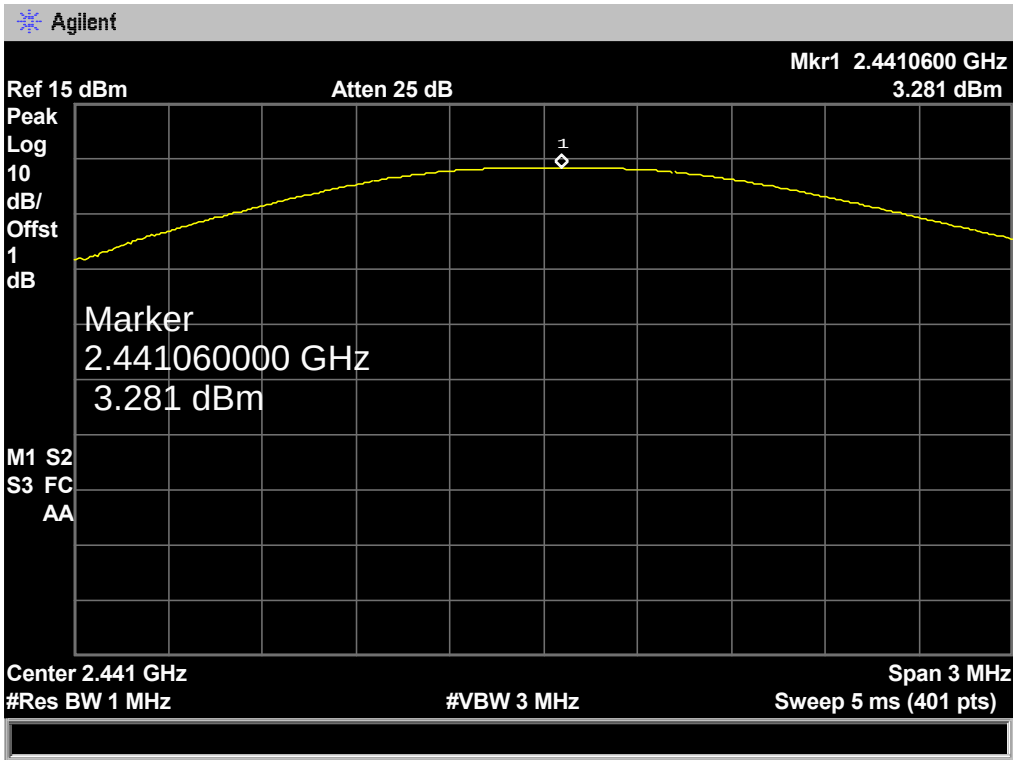
GFSK TX Mode

2402 MHz



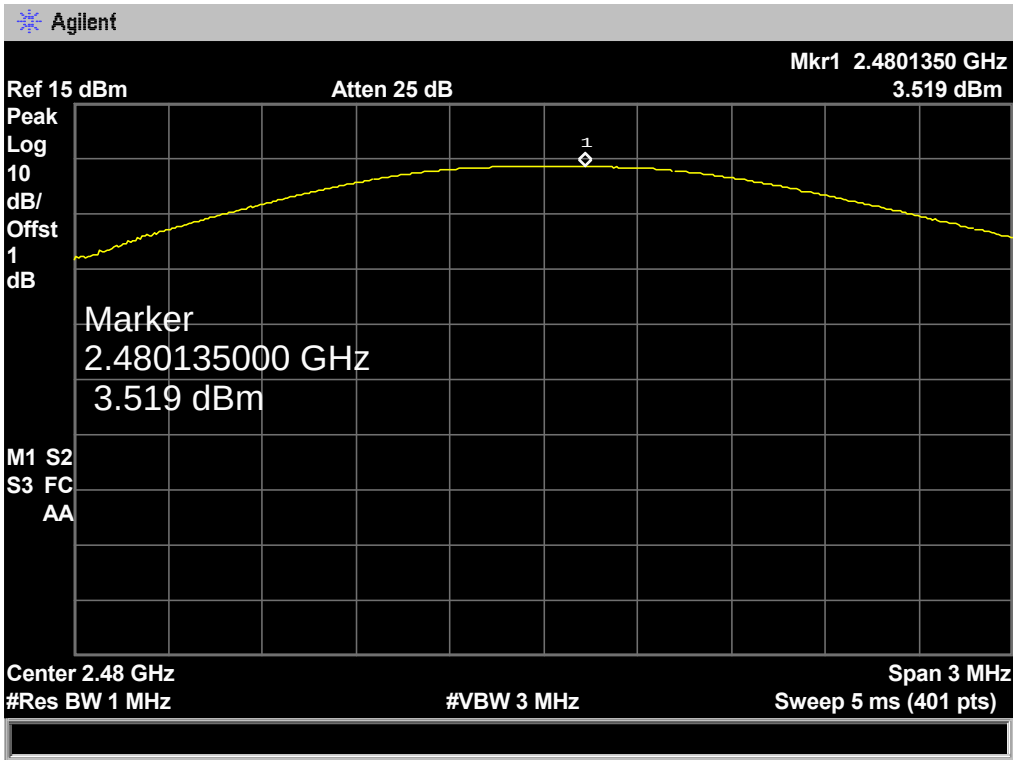
GFSK TX Mode

2441 MHz



GFSK TX Mode

2480 MHz

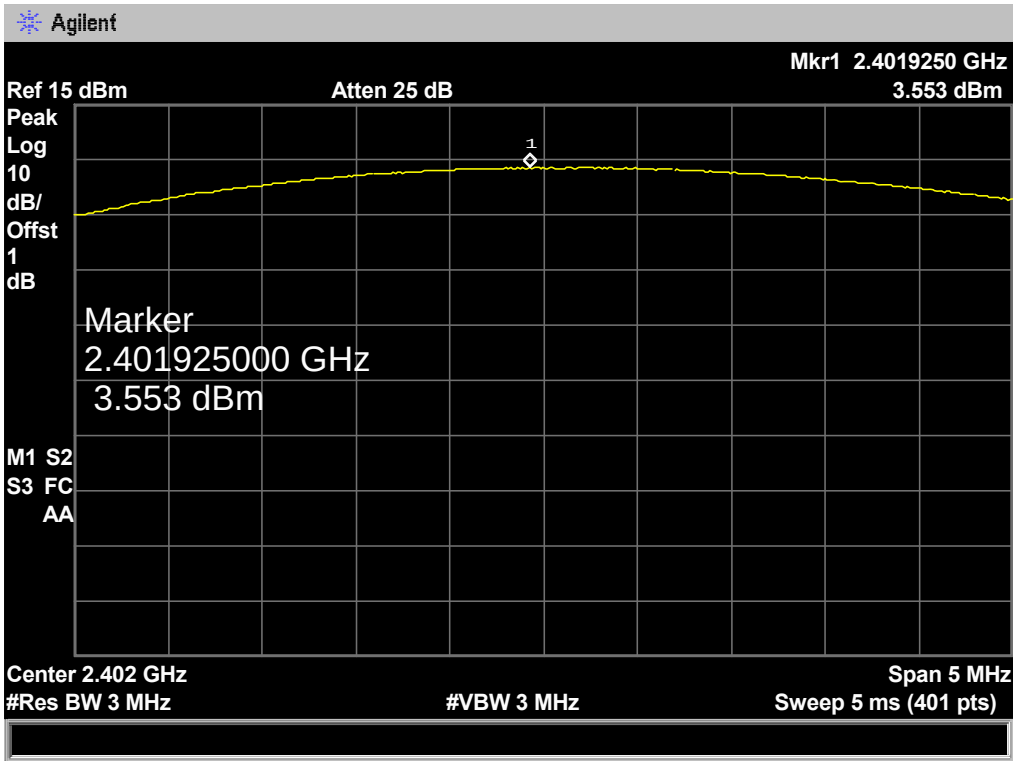


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX Mode (π /4-DQPSK)		

Channel frequency (MHz)	Test Result (dBm)	Limit (dBm)
2402	3.553	21
2441	3.844	
2480	4.083	

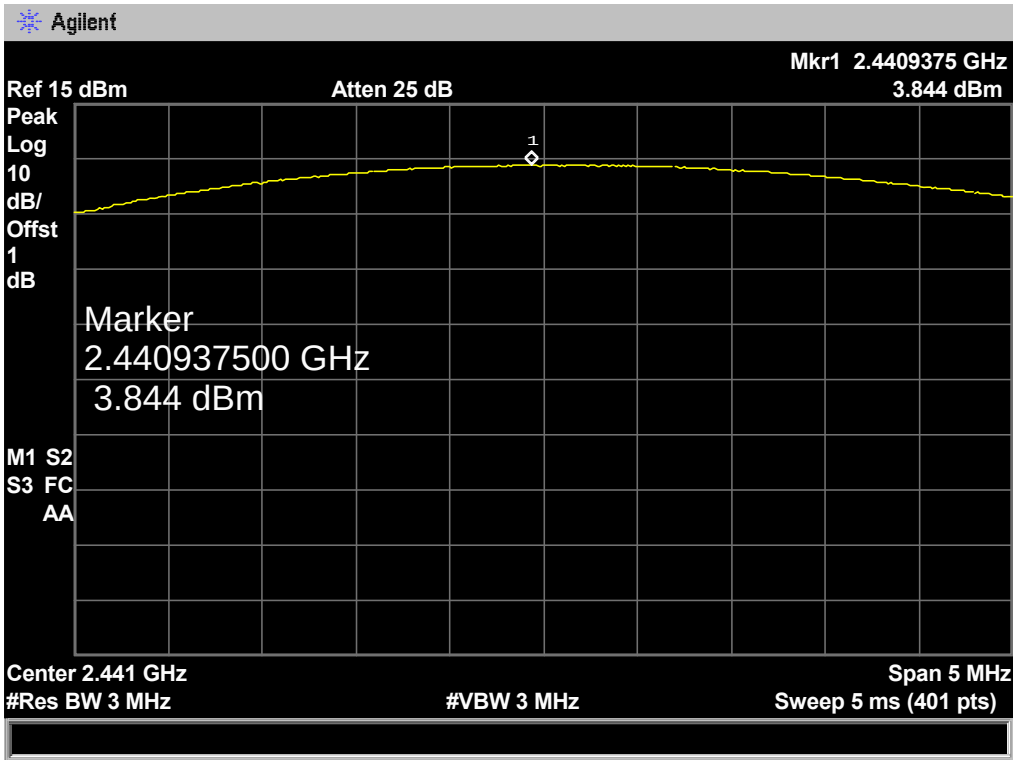
π /4-DQPSK TX Mode

2402 MHz



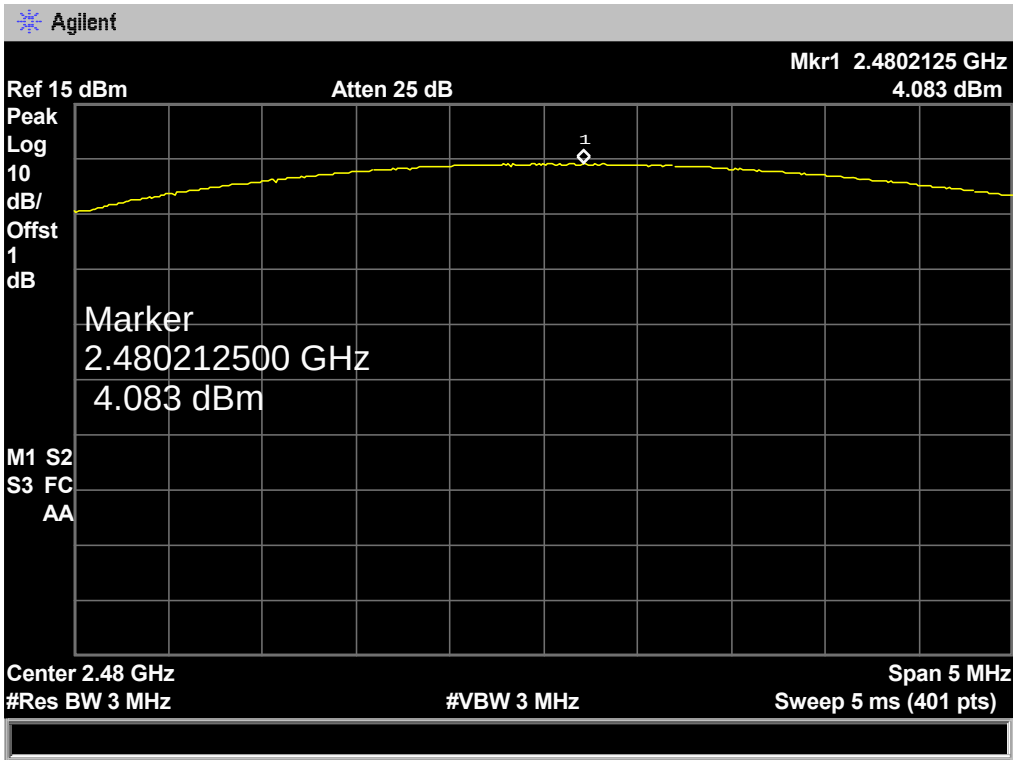
π /4-DQPSK TX Mode

2441 MHz



π /4-DQPSK TX Mode

2480 MHz

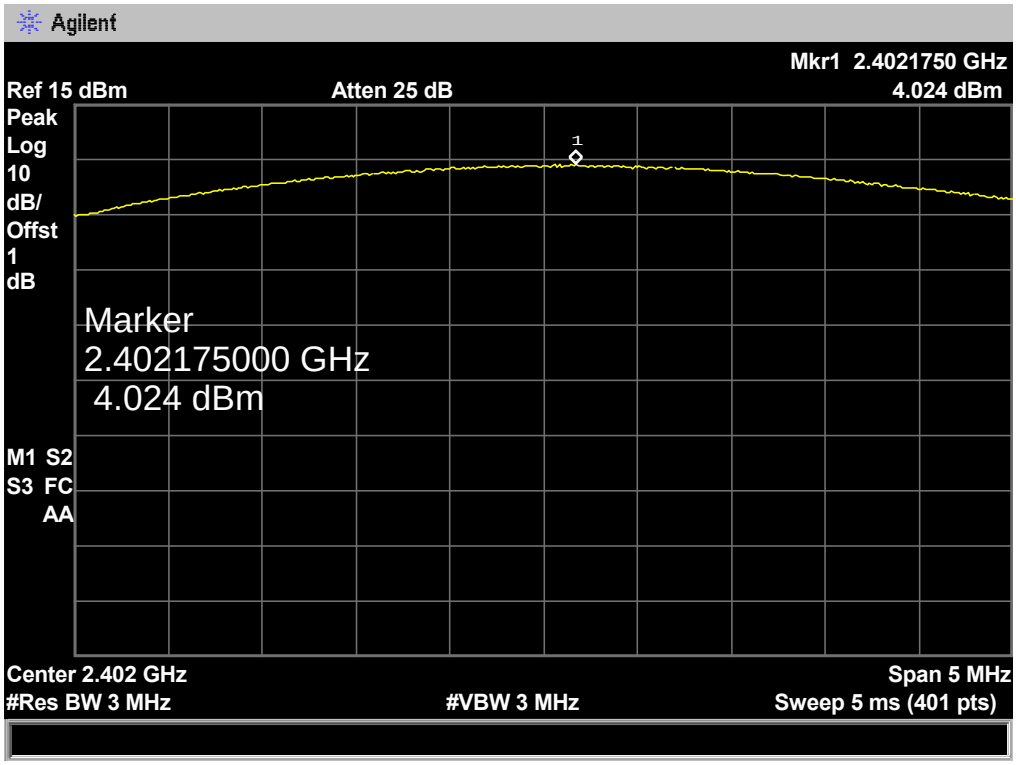


EUT:	WIRELESS SHOWER SPEAKER	Model Name :	F4056591
Temperature:	25 ℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX Mode (8-DPSK)		

Channel frequency (MHz)	Test Result (dBm)	Limit (dBm)
2402	4.024	21
2441	4.340	
2480	4.543	

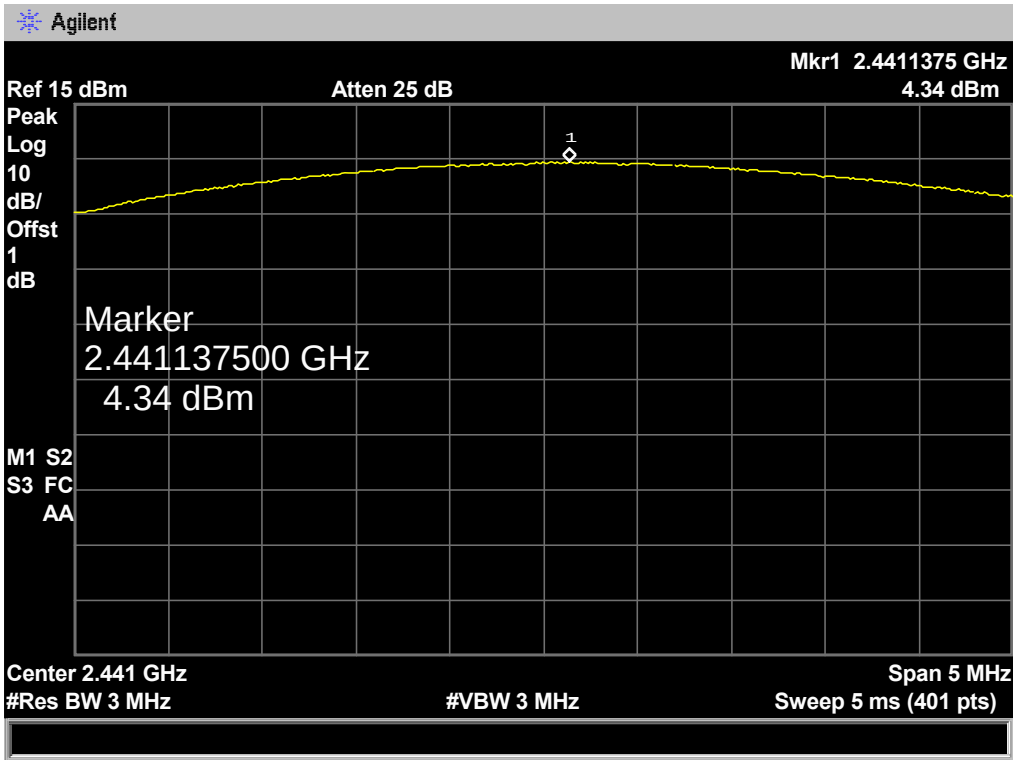
8-DPSK TX Mode

2402 MHz



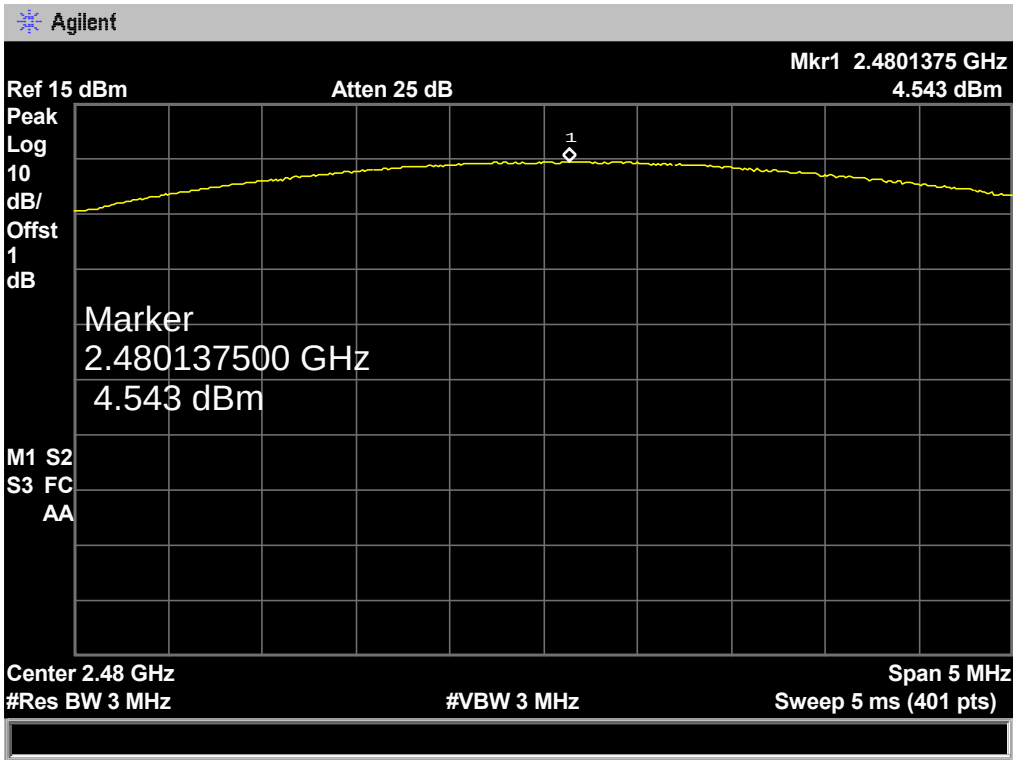
8-DPSK TX Mode

2441 MHz



8-DPSK TX Mode

2480 MHz



11. Antenna Requirement

11.1 Standard Requirement

11.1.1 Standard

FCC Part 15.203

11.1.2 Requirement

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

11.2 Antenna Connected Construction

The directional gains of the antenna used for transmitting is 1.2 dBi, and the antenna connector is de-signed with permanent attachment and no consideration of replacement. Please see the EUT photo for details.

The EUT antenna is a PCB antenna. It complies with the standard requirement.

Antenna Type
☑ Permanent attached antenna
☐ Unique connector antenna
☐ Professional installation antenna